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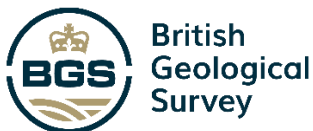
METEOR: MODELLING EXPOSURE
THROUGH EARTH OBSERVATION ROUTINES

UK SPACE AGENCY

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Glossary

BGS	British Geological Survey: The UK national geoscience organisation focusing on public-good geoscience for government, and research to understand earth and environmental processes in the UK and internationally
BIPAD	Building Information Platform Against Disaster, Nepal
CAT	Catastrophe
CBO	Community Based Organisations
CBS	Central Bureau of Statistics, Nepal
CDO	Chief District Officer
CEA	Cost-Effectiveness Analysis
COSTECH	Commission for Science and Technology, Tanzania
CP	Communication Product
CSO	Civil Society Organisation
DAC	Development Assistance Committee
DDMC	District Disaster Management Committee
DFID	Department for International Development
DHM	Department of Hydrology and Metrology, Nepal
DMA	Disaster Management Agency, Tanzania
DMD	Disaster Management Department: Prime Minister's Office of Tanzania focused on disaster risk
DMG	Department of Mines and Geology, Nepal
DP	Development Partners
DPNet	Disaster Preparedness Network - Nepal
DRFIP	Disaster Risk Financing and Insurance Programme of World Bank
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DRRM	Disaster Risk Reduction and Management
DUDBC	Department of Urban Development and Building Construction, Nepal
eGA	e-Government Agency in (Tanzania)
EQ	Evaluation Question
FAO	Food and Agriculture Organization of the United Nations
FCDO	Foreign, Commonwealth and Development Office (UK)
FGD	Focus Group Discussion
Fathom	Provides innovative flood modelling and analytics, based on extensive flood risk research

GBP	Great British Pounds (£)
GDP	Gross Domestic Product
GEM	Global Earthquake Model: Non-profit organisation focused on the pursuit of earthquake resilience worldwide
GFDRR	Global Facility for Disaster Reduction and Recovery
GoN	Government of Nepal
GoT	Government of Tanzania
GST	Geological Survey of Tanzania
HOT	Humanitarian OpenStreetMap Team: A global non-profit organisation the uses collaborative technology to create OSM maps for areas affected by disasters
ICIMOD	International Centre for Integrated Mountain Development
IDF	Insurance Development Forum
IIAG	Insurance Industry Advisory Group
ImageCat	International risk management innovation company supporting the global risk and catastrophe management needs of the insurance industry, governments and NGOs
IoE	Institute of Engineering
IM	Impact indicator in Logframe
IPP	International Partnership Programme
KII	Key Informant Interview
KP	Knowledge Product
KPI	Key Performance Indicator
LDC	Least Developed Country
LDCRP	Local Disaster and Climate Resilience Planning framework, Nepal
LDMC	Local Disaster Risk Reduction and Management Committee
M&E	Monitoring & Evaluation
METEOR	Modelling Exposure Through Earth Observation Routines
MEWRI	Ministry of Energy, Water Resources and Irrigation, Nepal
MoFAGA	Ministry of Federal Affairs and General Administration, Nepal
MoHA	Ministry of Home Affairs, Nepal
NASA	National Aeronautics and Space Administration (USA)
NAST	National Academy of Science and Technology, Nepal
NBS	National Bureau of Statistics, Tanzania
NCDRRM	National Council for Disaster Risk Reduction and Management, Nepal
NDRRMA	National Disaster Risk Reduction and Management Authority, Nepal
NEOC	National Emergency Operation Centre, Nepal

NGO	Non-Governmental Organisation	
NPC	National Planning Commission, Nepal	
NPR	Nepalese Rupee	
NRA	National Reconstruction Authority, Nepal	
NSET	National Society for Earthquake Technology: Non-governmental organisation working on reducing earthquake risk in Nepal and abroad	
OC	Outcome indicator in Logframe	
ODA	Official Development Assistance	
OED	Open Exposure Data format	
OECD	Organisation for Economic Co-operation and Development	
OP	Output indicator in Logframe	
OPM	Oxford Policy Management Limited: Organisation focused on sustainable project design and implementation for reducing social and economic disadvantage in low-income countries	
PDMC	Provincial Disaster Risk Reduction and Management Committee	
PEA	Political Economic Analysis	
PM	Project Manager	
PMO	Prime Minister's Office of Tanzania	
QA	Quality Assurance	
QM	Quarterly Meeting	
RAG	Red-Amber-Green assessment	
SDGs	Sustainable Development Goals	
SFDRR	Sendai Framework on Disaster Risk Reduction	
SOP	Standard Operation Procedure	
TADMAC	Tanzania Disaster Management Committee	
TMA	Tanzania Meteorological Academy	
ToC	Theory of Change	
ToR	Terms of Reference	
TRCS	Tanzania Red Cross Society	
TU	Tribhuvan University, Nepal	
TURP	Tanzania Urban Resilience Project	
UDOM	University of Dodoma	
UDSM	University of Dar es Salaam	
UKRI	UK Research and innovation	
UKSA	United Kingdom Space Agency	

UN	United Nations
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNHCR	United Nations Humanitarian High Commissioner for Refugees
UNICEF	United Nations Children's Emergency Fund
UNRCO	United Nations Resident Coordinator's Office
USAID	United States Agency for International Development
USD	U.S. Dollar ($)
WB	World Bank
WFP	World Food Programme
WHO	World Health Organisation
WP	Work Package (of the METEOR project)
WP2	Work Package 2 - M&E Activities
YILabs	Youth Innovation Labs, Nepal

Executive Summary

At present, there is a poor understanding of population exposure in some Official Development Assistance (ODA) countries, which causes major challenges when making Disaster Risk Management (DRM) decisions. **Modelling Exposure Through Earth Observation Routines (METEOR) creates a step-change in the application of Earth Observation (EO) exposure data by developing and delivering more accurate levels of population exposure to natural hazards.** The project delivered detailed building exposure data to the governments of Tanzania and Nepal, together with national hazard footprints for specific geohazards, vulnerability data models that map the interaction of multiple hazards, and open protocols describing the steps used to produce the datasets. These products can be used by governments and other end-users to inform policies, plans and practice relating to Disaster Risk Reduction and Management (DRRM). Less detailed exposure data were made available for all other ODA countries, often also referred to as Least Developed Countries (LDCs). Providing new consistent data to governments, town planners, and insurance providers will promote welfare and economic development in these countries and better enable them to respond to the hazards when they do occur.

METEOR was funded through the second iteration of the UK Space Agency's (UKSA) International Partnership Programme (IPP), funded through the Global Challenges Research Fund (GCRF), which uses space expertise to deliver innovative solutions to real world problems across the globe. **The project ran from 7th February 2018 to 31st March 2021.**

This document gives the results of the **endline evaluation** of the project carried out by Oxford Policy Management (OPM). It has been prepared with input from all consortium partners and support from Caribou Space (the provider of monitoring and evaluation (M&E) services to the funder).

The endline evaluation was undertaken with the following general objectives:

- Assess **evidence of the project results and evidence of longer-term impact**.
- Assess **the degree to which the project achieved its outcomes and impacts** – and understand how project activities contributed to these.
- **Provide insights for the consortium and stakeholders** on how to best design and implement future interventions, based on the insights gained from the experience of implementation.

Methodology

The endline evaluation assessed the progress the project has made at the end point of implementation using the standard Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC)'s evaluation criteria[1]:

- **Relevance:** Evaluation Question (EQ) 1 - In developing countries, is there a real need and/or demand for national exposure and multi-hazard and vulnerability data and protocols that validate the uncertainty process?

- **Coherence:** EQ2 - To what extent was the project coherent with other DRRM interventions in Tanzania and Nepal, and possibly in other ODA recipient countries?

- **Efficiency:** EQ3 - Did the project design and deliver level-one exposure data and protocols for all ODA countries and level-two exposure, hazard and vulnerability data and protocols for Nepal and Tanzania? Was the delivery cost-efficient? What worked well and not so well?

- **Effectiveness:** EQ4 - To what extent did the design and delivery of the METEOR outputs lead to improvements in the capacity and ability of national and international stakeholders to

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[1] https://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm

knowledgably utilise EO-based hazard, exposure and vulnerability data in DRRM policy and practice?

- **Impact**: EQ5 - Is there evidence to suggest that the project has improved in-country DRRM policy and planning? And, if so, is there a reasonable expectation that, in the event of a disaster, countries will experience an improved response, reducing disaster-related deaths, loss and damage?

- **Sustainability**: EQ6 - Is there sustained interest by DRRM stakeholders (e.g. other LDC governments, NGOs, the insurance industry and the humanitarian community) in these data and protocols?

More details on the endline evaluation's methodology, including about challenges and limitations, are provided in Section 2.

Logframe indicators results

In terms of the results achieved by the project against its logframe indicators, Table ES-1 presents a brief assessment of the results using a Red, Amber, Green (RAG) codification: green = objective fully achieved or exceeded; amber = objective partially achieved; red = objective not achieved. The full assessment is included in Table 7 and in Section 3.

Table ES-1. Brief summary of results against logframe indicators' endline targets

##	Indicator
IM 1	Modelled reduction of deaths, missing persons and directly affected persons attributed to disasters (of similar magnitude and impact) per 100,000 population (disaggregating males and females) in Nepal and Tanzania (aligned with SDG indicators 11.5.1 and 13.1.1)
IM 2	Total modelled direct avoided economic loss attributed to disasters in Nepal and Tanzania (in GBP £)
IM 3	Qualitative indicator: progress towards mainstreaming the use of robust DRR data to systematically inform policy changes across public and private sector, and civil society
OC 1.1	Qualitative indicator: progress towards use of project outputs by the governments of Nepal and Tanzania
OC 1.2	Feedback from relevant Ministry (or decision-maker) on the usefulness of the project outputs for improving their national DRRM (KPI 1)
OC 2.1	Qualitative indicator: progress towards use of project outputs by the other end-users in Nepal and Tanzania to inform their DRRM decision-making and practice
OC 3.1	Qualitative indicator: Feedback from the global community (e.g. UNICEF, UNISDR, WB, GFDRR) in respect of usefulness of project outputs (KPI 4)
OC 3.2	Qualitative indicator: Progress towards creating insurance products informed by METEOR data and/or protocols
OC 3.3	Number of dissemination nodes where METEOR KPs and datasets are available to be accessed
OP 1.1	Percentage of professionals trained in Nepal and Tanzania reporting increased knowledge on the training topic (disaggregating males and females)
OP 1.2	Number of professionals trained in Nepal and Tanzania (disaggregating males and females)
OP 1.3	Number of organisations that had representatives trained in Nepal and Tanzania
OP 1.4	Percentage of targeted institutions and organisations in Nepal and Tanzania that had at least two people trained
OP 2.1a	Percentage of Nepalese and Tanzanian territory covered by Level 2 exposure data (aligned with SFDRR Global Target g and Priority Area 1) (KPI 2a.1)
OP 2.1b	Percentage of Nepalese and Tanzanian territory covered by Level 2 multi-hazard data (aligned with SFDRR Global Target g and Priority Area 1) (KPI 2a.2)
OP 2.2	Percentage of approached users reporting satisfaction with METEOR exposure datasets (disaggregating males and females)
OP 3.1	Protocols for capturing and communicating exposure data uncertainty delivered - Workplan on track to achieve completion within deadline
OP 3.2	Percentage of approached users reporting satisfaction with METEOR protocols (disaggregating males and females)

##	Indicator
OP 4.1	Number of Level-1 datasets for LDCs uploaded on online platforms (aligned with SFDRR Global Target g and Priority Area 1) (KPI 2b)
OP 5.1	Policy paper on the use of national-scale exposure data for insurance and other risk-transfer mechanisms published and shared
OP 5.2	Number of communication products shared
OP 5.3	Number of conferences or workshops hosted or attended by consortium members at which METEOR's findings are shared or discussed

Legend: IM = Impact indicator; OC = Outcome indicator; OP = Output indicator.

Global Case Study

The Global Case Study of this endline evaluation provides some indications of the relevance, effectiveness and sustainability potential of the METEOR outputs for the target stakeholders outside Tanzania and Nepal.

Insurance Industry

The endline evaluation confirms that the project successfully engaged with the insurance industry in multiple occasions during its last year of implementation, in addition to the ones in the previous years. This was facilitated by a 'METEOR champion' from the Insurance Development Forum who was able to help promote and showcase METEOR products within the insurance industry. Based on the focus group discussions (FGDs) and general discussions at last year's project events involving insurance representatives, the evaluation can conclude **there is clear indication that the METEOR outputs are useful to them**. In particular, there is evidence that the **Level 1 Exposure data and protocols represent a step-change in providing national scale exposure estimations in LDCs**, something that was not available anywhere else before.

However, the discussions with insurance stakeholders highlighted how the provision of data in only the first step of a longer process. Indeed, as the risk transfer culture in LDCs is far from being mainstream, **the development of insurance markets in those countries will require substantial political engagement, something that the project was never meant to provide.** Therefore, it appears that **the project long-term target of contributing to the creation to new insurance products is too ambitious** and the M&E team in Section 4.1.2 suggests changes to the target for the legacy evaluation, which is due to take place at the end of 2021.

Development Partners

The evaluation found consistent evidence across the Development Partners (DPs) involved in the endline activities that METEOR outputs are highly relevant to their needs. What makes METEOR particularly interesting and useful are: i) the strength of the METEOR data and their breadth covering both large global regions through the Level 1 Exposure data as well as Tanzania and Nepal in depth; ii) the positive example given by co-developing the processes, protocols and data outputs with national stakeholders; and iii) the publishing of high-quality training videos and other resources. Additional evidence of the credibility and usefulness of the METEOR outputs is the fact that some of the engaged **DPs (e.g. World Bank and UNICEF) have offered to host the data on their official portals**.

There is also evidence of **coherence and synergies of METEOR with other DP-funded initiatives in the DRRM realm**, such as the "Tomorrow's Cities" project covering Kathmandu and the Tanzania Urban Resilience Programme (TURP), both of which involve some METEOR partners.

At the same time, DPs part of the METEOR Advisory Board have also highlighted some of the **weaknesses or limitations of the METEOR project.** These were related to: i) the limitation of METEOR data in stopping short of generating multi-hazard risk outputs, although the project delivered all the elements needed to assess risk levels; ii) weaknesses in the external communication of the otherwise outstanding results, pointing out that a dedicated communication expert would have helped; iii) some

deficiencies in properly communicate the benefits of DRRM in the two target countries, particularly in monetary and lives saved terms; iv) the unbalance in national stakeholder engagement, leaning heavily towards disaster management agencies and technical experts, compared to statistical offices and higher government levels (e.g. Ministry of Finance, Planning Commission, Prime Minister Office), which ultimately hold budgets and political capital.

The endline evaluation found that there have been **two instances where the METEOR protocols** and the experience accumulated during the project **have been used by some METEOR partners to generate additional data or analysis.** This was the case in **Nigeria**, where ImageCat prepared an exposure database for the project "Do-It-Yourself Adaptation: New Pathways for Community Flood Risk Communication", and in **Tunisia**, where the World Bank's Disaster Risk Financing and Insurance Programme (DRFIP), after receiving an online presentation of METEOR outputs, approached ImageCat and funded a quick multi-hazard risk study, which could likely lead to a larger project. **It is reasonable to expect that if the METEOR data had been released earlier, then we would have likely seen more examples of DPs' funding.**

Nepal is a mountainous, landlocked country that sits in a seismically active zone and experiences frequent extreme events due to a variety of natural and man-made hazards. The country continued to observe loss and damage from disasters during 2020. In terms of DRRM governance, **the national coordinating body is the Disaster Risk Reduction and Management Authority (NDRRMA)**, the organization and management of which was approved in September 2020. **NDRRMA has been experiences some challenges, particularly in coordinating with several agencies that still act under unclear and overlapping legal provisions.** This is especially true for the Ministry of Home Affairs (MoHA), the former DRRM coordinating institution, which continues to hold decision-making power in the sector. Additional challenges in the DRRM sector in Nepal are in terms of: i) disaster risk governance, ii) capacity building, iii) data management, and iv) availability of financial resources. For further details on DRRM governance and political economy dynamics please see Section 5.1.1.

The evaluation found that **the availability of open-source and open access exposure, multi-hazard, and vulnerability data and protocols generated by METEOR has been regarded as a great success by all the organisations interviewed in Nepal. METEOR outputs are hosted by NDRRMA official data platform (BIPAD) and they ready to be used** by the Government of Nepal as well as by a wider based of non-governmental end-users such as civil society, private sector and academia. A series of potential uses for METEOR outputs in DRRM activities in Nepal have been identified and included in Table 8.

Two are the main gaps to the successful use of the METEOR products in Nepal that still remain. The first one is the need for in-depth training. During the endline evaluation, wider training to different stakeholders was being planned, but has still to be delivered, which means that it is expected to take place after the end of the project. Building sufficient capacity in national stakeholders through this training will be crucial to ensure the independent applicability and update of METEOR data in-country. In addition, training design will have to consider how to maximise the dissemination of knowledge so that it can be further trickled down to the provincial and local levels. **The second gap** mentioned by several organisations interviewed is the provision of **Standard Operating Procedures (SOPs) to use the open-source data.** SOPs would go beyond METEOR protocols in that they would provide detailed procedures and technical advice on how to use METEOR data to prepare appropriate responses and recovery action plans.

Tanzania is becoming increasingly vulnerable to tropical storms, droughts and floods with the national costs of climate-related hazards estimated to be around 1% of GDP in recent years. The country context update carried out by the endline evaluation team found that **the Disaster Management Department (DMD), METEOR's national partner in Tanzania, will likely remain the national DRRM coordinating body**, contrarily to what stated by the Disaster Management Act (2015), which foresaw

its replacement with a new Disaster Management Agency. Efforts **are underway by DMD to establish a National Disaster Risk Reduction Strategy**, which will be followed by an aligned Disaster Policy and the revision of the 2015 Act.

The interviews conducted showed that the existing relationship between Government, civil society and academia in Tanzania as influenced by the existing political economy is creating an **overall disincentive to act or making decisions amongst bureaucrats and an overall anti-risk-taking approach**. The situation is also complicated by the fact that **DRRM is not a sector that is given as much priority and there is overall poor political will to invest in the sector**. The context may change as Tanzania is currently undergoing a change in national political leadership.

In addition to the above overall DRRM challenges in Tanzania, there are specific challenges that will influence uptake of METEOR outputs. The findings from the endline evaluation show the following as key challenges: **i) low visibility of METEOR outputs amongst stakeholders, ii) high staff turnover at the respective institutions engaged, iii) Lack of formal Government accreditation and engagement of e-Government Agency, and iv) low capacity to engage with METEOR outputs.** More details are provided in Section 5.2.2.

The endline evaluation can confirm that METEOR outputs were well received by all stakeholders. Interviews show that there is **continued interest in the METEOR outputs in Tanzania**. Most stakeholders thought at the very least the outputs would support dialogue in-country and enable evidence-backed communication with government on DRRM issues. The outputs could also have potential benefits for disaster policy, response, and planning in the future. Specifically, the outputs will inform DMD on preparedness and would be very useful in developing the DRR Strategy and policy. Other organisations identified as likely to use the data/protocols in-country include the World Bank, HOT and the Resilience Academy established under TURP.

Unfortunately, there are existing sensitivities surrounding commitment to using METEOR outputs in-country that might affect the ultimate uptake of METEOR outputs. The concerns or sensitivities are driven by the Statistics Act and its stipulations for data to have formal Government approval before stakeholders, particularly Government stakeholders, can comfortably engage with it. This approval has yet to be received (or even requested) by METEOR. In addition, the e-Government Agency will also have to approve the data before they can be hosted on any official government-owned platform. While it is reasonable to assume the lack of accreditation by a formal local institution may not affect the ability of DMD to mobilise national stakeholders, the possible inability by stakeholders to officially use METEOR data is a concrete concern as a new law in Tanzania forbids the use of statistics and data that has not been approved by the government for official use. Currently, the alternative found by the project is to use the Resilience Academy geonode platform to reach national end-users, but this might be not enough to achieve the project's goal of mainstreaming the use of evidence-based DRRM in national decision-making.

In addition, **low capacity is a general DRRM challenge that is particularly likely to affect METEOR outputs' uptake**, as staff in the engaged institutions, even those that have been trained, do not have enough knowledge and skills to properly use the outputs and be able to revise and update the outputs without additional support.

Process evaluation
Interviews with METEOR partners confirm very effective internal dynamics in the consortium. The consortium brought together the right expertise, assembling an array of global experts across a range of perils. Partners in the consortium had clear roles and they were capably coordinated by BGS's project manager. The consortium invested in building the team, with regular meetings and updates in place, including face to face in the countries of implementation as well as the UK. In most cases the difference in perspectives, views and opinions were resolved into an agreed approach or action.

The project adapted well to changing circumstances, including adapting to the travel restrictions imposed by **COVID-19**. However, this **was a major issue given the planned training and capacity development in the last year of the project**. It is fair to say that more and earlier capacity development using METEOR products would have led to a more solid foundation for local ownership. For this reason, local officers and partners in both Tanzania and Nepal were vital in ensuring continuation of project activities.

Conclusions

Based on the findings that emerged during the interviews and other activities, Table ES-2 summarises the key conclusions of the endline in line with the OECD DAC evaluation criteria. More details are provided in Section 7.

Table ES-2. Summary of endline conclusions

Evaluation criteria	Key conclusions
Relevance	**There is consistent and strong evidence that the METEOR products are needed and useful.** At the global level, representatives of the insurance industry and development partners expressed interest in the applicability of the data to their work in addressing gaps in disaster risk financing and DRRM. At the national level, there is clear need of robust and transparent disaster risk data to inform national as well as local DRRM policies, plans and activities. Many counterparts and stakeholders wanted more datasets and protocols from the project, which is a sign of confidence in and usefulness of METEOR outputs.
Coherence	**The project is well aligned with other interventions in DRRM** in both Tanzania and Nepal, as well as international drivers of good practice in DRRM, including this Sustainable Development Goals and the Sendai framework.
Efficiency and cost-effectiveness	**The project outputs were delivered on time, and to a high standard**. This was confirmed in interviews with the consortium members and national stakeholders. METEOR's Cost-Effectiveness Analysis (CEA) confirmed that: i) **METEOR's return on investment is positive**, that is, in time, it produces more economic benefits than its cost; ii) **METEOR methodology using EO-based data is much more cost-effective than the analysed project alternatives not utilising EO-based data.**
Effectiveness	**The project delivered well against targets, and all METEOR key performance indicators were met, with the exception of one**. In terms of training people to use the data, satisfaction with the training that has been completed is high. **Outside Tanzania and Nepal, the project successfully engaged with relevant Development Partners and members of the insurance industry**, who have confirmed they are keen to use METEOR outputs in their work in developing countries. Unfortunately, the cancellation of international DRRM conferences and events **affected the ability of the project to reach government officials from LDCs**, although several members of the METEOR consortium regularly work in those countries.
Impact	**All evidence points to the success of METEOR in producing useful, scientifically sound, accessible, and cost-efficient DRRM-relevant data.** However, there is still **no evidence of institutional change and mainstreaming** of improved data and analysis in DRRM policies, plans, and practice supported by METEOR. In hindsight, **the inclusion of strong elements of behavioral change and mainstreaming in the impact statement has been too ambitious.** That said, the problem was more about target setting than about project underperformance. **Without additional time and resources from METEOR, there seem to be more likelihood for Nepal to independently use METEOR's products than Tanzania.** This is because the more technical nature of the national partner, NSET, aligned its interest and capacity to the technical nature of the project, compared to the more political and less technical nature of DMD in Tanzania.
Sustainability	**Generally speaking, the data produced by the project is available on multiple open access platforms and is open source.** Moreover, a plethora of online training products have been developed and are now publicly accessible (see Appendix 9.5.1 for a list). In addition, **at the national as well as global level, there is sustained interest from a range of key stakeholders**, including national governmental and non-governmental end-users, development partners, and representatives from the insurance industry.

	However, development of capacity in Nepal and Tanzania for users to be able to use and model the data has not been completed as planned. While capacity development has been a priority from the start, the timeline was - in retrospect - always optimistic, with the training planned for the last months of the programme, once the METEOR products were available. But the onset of COVID-19 a year before the project completion provided a huge obstacle.

Lessons

In retrospect, METEOR was a largely successful project, able to deliver datasets and protocols covering all ODA countries, with more detailed analyses for Tanzania and Nepal published and available on open access portals. The key factors that helped in the project success are:

- **A good mix of organisations** who are key experts in their areas
- The resources invested in **building joint ownership** across the consortium with **active, strong project management**
- The ability of the project team to **be flexible and adapt** to changing circumstances
- **A logical and clear division of labour** which allowed the consortium working together efficiently and effectively.

Key improvements identified for future projects are:

- **Better consider the balance of skills across the consortium**, which, for a project like METEOR, should include a partner with more experience of capacity development in ODA countries, and with expertise in behavioural change.
- Better build into the project design and implementation experience of **working with government and non-government institutions and the advantages and disadvantages of each.** This could mean including both science and policy partners in countries where the project is active.
- **Allow more time for post-production sharing and capacity development** around the products. Ideally this would be accompanied by **greater publicity and more political momentum.** This may imply brining in dedicated resources result communication and developing bespoke communication products to **showcase the potential impact of data-driven DRRM in non-technical terms** (e.g. monetary savings, life loss reduction).
- In terms of setting targets, there is a fine **balance to be maintained between ambition and over-optimism**.

Legacy Evaluation

In order to assess the broad outcomes and long-term impact of the METEOR project, a legacy evaluation is planned to be conducted after about 1 year from project end. A Grant Change Notice request was recently put in for providing budget for a METEOR Legacy Evaluation, currently under assessment by the UKSA. If approved, the legacy evaluation will have the following objectives:

- **Assess evidence of the project outcomes and longer-term impact,** and investigate the causality between the project and the observed effects
- **Provide insights for the UKSA and the consortium partners** on how to best design and implement future interventions, based on learning gained from the assessment of the project's contribution to the observed outcomes and impact.

1. Introduction

1.1. METEOR Project Summary

Title	Modelling Exposure Through Earth Observation Routines (METEOR): EO-based Exposure, Nepal and Tanzania
Starting Date	08/02/2018
Duration	36 months (extended to end on 31 March 2021)
Partners	Consortium: The British Geological Survey (BGS) (Lead), ImageCat, The Humanitarian OpenStreetMap Team (HOT), Oxford Policy Management Limited (OPM), The Global Earthquake Model (GEM) Foundation, Fathom International Partners: National Society for Earthquake Technology (NSET) - Nepal, The Disaster Management Department (DMD) – Tanzania
Target Countries	Nepal and Tanzania for "Level 2" results and all 47 Least Developed ODA countries for "Level 1" data
IPP Project	IPPC2_07_BGS_METEOR
Project Lead	British Geological Survey (BGS)
M&E Lead	Oxford Policy Management Limited (OPM)

Table 1. METEOR Project Summary

1.2. Project Overview

METEOR sought to contribute to a reduction in the cost, in human and financial terms, of disasters such as earthquakes, landslides, volcanic eruptions and floods. A major challenge, when making Disaster Risk Reduction and Management (DRRM) decisions, is poor understanding of the distribution and character of exposure in Least Developed Countries (LDCs) or Official Development Assistance (ODA) countries. Exposure needs to be mapped, monitored, modelled and fed into sectoral policies and plans (e.g. urban, infrastructure, energy) to build resilience and foster growth. This requires that governments, companies, Non-Governmental Organisations (NGOs), the United Nations and humanitarian organisations have strategies and practices that minimise the chance of a disaster occurring and mitigate the consequences if such an event happens. METEOR took a step-change in the application of Earth Observation (EO) exposure data by developing and delivering more accurate levels of buildings' exposure to natural hazards. Providing new consistent data to governments, Development Partners (DPs) and insurance providers will promote welfare and economic development in these countries and better enable them to respond to the hazards when they do occur.

METEOR was co-funded through the second iteration of the UK Space Agency's (UKSA) International Partnership Programme (IPP), which uses space expertise to deliver innovative solutions to real world problems across the globe. The funding helps to build sustainable development while building effective partnerships that can lead to growth opportunities for British companies.

1.3. Project Objectives

METEOR aimed to formulate an innovative methodology of creating exposure and multi-hazard data through the use of EO-based imagery to identify development patterns throughout a country. Stratified sampling technique harnessing traditional land use interpretation methods, modified to

characterise building patterns, can be combined with EO and in-field building characteristics to capture the distribution of building types. The associated protocols and standards were developed for broad application to ODA countries and were tested and validated for both Nepal and Tanzania to assure they are fit-for-purpose.

Detailed building data collected on the ground for the cities of Kathmandu (Nepal) and Dar es Salaam (Tanzania) were used to compare and validate the EO generated exposure datasets. Objectives of the project looked to: deliver exposure data for 47 of the least developed ODA countries, including Nepal and Tanzania; create hazard footprints for Nepal and Tanzania; create open protocols; develop critical exposure information from EO data; and provide capacity-building of local decision makers to apply data and assess hazard exposure.

1.4. Work Packages

Outlined below are the eight work packages (WPs) that made up the METEOR project (Table 2). These were led by various partners, with a brief description of what each of the work packages covered provided in Table 2.

Work Package	Title	Lead	Overview
WP.1	Project Management	BGS	Project management, meetings with UKSA, quarterly reporting and the provision of feedback on project deliverables and direction across primary stakeholders.
WP.2	Monitoring and Evaluation	OPM	Monitoring and evaluation of the project and its impact, using a theory of change approach to assess whether the associated activities are leading to the desired outcome.
WP.3	EO Data for Exposure Development	ImageCat	EO-based data for exposure development, methods and protocols of segmenting/classifying building patterns for stratified sampling of building characteristics.
WP.4	Inputs and Validation	HOT	Collect exposure data in Kathmandu and Dar es Salaam to help validate and calibrate the data derived from the classification of building patterns from EO-based imagery.
WP.5	Vulnerability and Uncertainty	GEM	Investigate how assumptions, limitations, scale and accuracy of exposure data, as well as decisions in data development process lead to modelled uncertainty.
WP.6	Multiple Hazard Impact	BGS	Multiple hazard impacts on exposure and how they may be addressed in disaster risk management by a range of stakeholders.
WP.7	Knowledge Sharing	GEM	Disseminate to the wider space and development sectors through dedicated web-portals and use of open databases.
WP.8	Sustainability and Capacity-Building	ImageCat	Sustainability and capacity-building, with the launch of the databases for Nepal and Tanzania while working with in-country experts.

Table 2. Overview of METEOR Work Packages

1.5. About this document

This report has been prepared by Oxford Policy Management as Lead Partner for the Monitoring and Evaluation (M&E) work package. It has been prepared following a process of data collection that took place between November 2020 and March 2021. The Endline report provides a formal assessment of final progress towards targets and it assesses to what extent the project contributed to its intended outcomes and impacts. It also provides useful lessons that can be taken on by future projects. The report has been prepared with the collaboration and input from all the consortium partners, and with support from Caribou Space (UKSA IPP M&E provider). It builds on the work done on the baseline and midline reports and it follows the general provisions included in the M&E Plan.

1.6. Endline objectives

The endline evaluation was undertaken with the following general objectives:

- Assess **evidence of the project results and evidence of longer-term impact**.
- Assess **the degree to which the project achieved its outcomes and impacts** – and understand how project activities contributed to these.
- **Provide insights for the consortium and stakeholders** on how to best design and implement future interventions, based on the insights gained from the experience of implementation.

1.7. Structure of this document

The sections below are structured as follows: Section 2 describes the key components and methodology of the endline evaluation; Section 3 provides a summary of the project results against its logical framework (also called logframe); Section 4 and 5 present updates and findings of the Summative Evaluation component, respectively from the Global Study and the National Case Studies of Nepal and Tanzania; Section 6 illustrates the findings of the Process Evaluation component; Section 7 draws some conclusions derived from the endline findings around the key endline evaluation criteria; and finally, Section 8 lays out some of the lessons learnt from METEOR's design and implementation.

2. Methodology of the endline

2.1. Overview

The overall evaluation approach for METEOR is laid out in the M&E Plan, contained in a separate document (METEOR Report M2.8/P). The endline evaluation assessed the progress the project has made at the end point of implementation using the standard Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC)'s evaluation criteria[2]:

- **Relevance:** Evaluation Question (EQ) 1 - In developing countries, is there a real need and/or demand for national exposure and multi-hazard and vulnerability data and protocols that validate the uncertainty process?

- **Coherence:** EQ2 - To what extent was the project coherent with other DRRM interventions in Tanzania and Nepal, and possibly in other ODA recipient countries?

- **Efficiency:** EQ3 - Did the project design and deliver level-one exposure data and protocols for all ODA countries and level-two exposure, hazard and vulnerability data and protocols for Nepal and Tanzania? Was the delivery cost-efficient? What worked well and not so well?

- **Effectiveness:** EQ4 - To what extent did the design and delivery of the METEOR outputs lead to improvements in the capacity and ability of national and international stakeholders to knowledgably utilise EO-based hazard, exposure and vulnerability data in DRRM policy and practice?

- **Impact**: EQ5 - Is there evidence to suggest that the project has improved in-country DRRM policy and planning? And, if so, is there a reasonable expectation that, in the event of a disaster, countries will experience an improved response, reducing disaster-related deaths, loss and damage?

- **Sustainability**: EQ6 - Is there sustained interest by DRRM stakeholders (e.g. other LDC governments, NGOs, the insurance industry and the humanitarian community) in these data and protocols?

For each of the main criteria, specific evaluation questions were prepared. The full list is provided in Appendix 9.1.

The endline evaluation was formed by three main components:

i. **Result monitoring and logframe completion:** Compilation of the endline achievements of METEOR within the project logframe (see Section 3).

ii. **Summative evaluation:** The project has an unusual timeline, with key outputs being completed towards the end of the project life. Therefore, the focus of the endline was on questions around relevance, effectiveness and sustainability, while the questions around impact reverted around the solidity of the causal assumptions behind the Theory of Change to understand the likelihood of longer-term impact, which will be directly more visible during the legacy evaluation. The summative component of the endline evaluation will be comprised of a Global Case Study (Section 4) and two National Case Studies focusing on Tanzania and Nepal (Section 5).

iii. **Process evaluation:** In order to understand how the project has been managed, what has accelerated or impeded progress, and what has contributed to the results that have been achieved, interviews with the METEOR project partners were held (see Section 6).

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[2] https://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm

The methodology used for each of these components is described in more details in the following sections.

2.2. Data collection

Given the situation and resulting constraints linked to COVID-19, the instruments and methodology for the evaluation had to be flexible and practical. The final list of different data sources included:

- **Desk research:** As part of the endline national case studies, the team updated the information gathered in the baseline and midline related to the DRRM processes that currently exist in the pilot countries of Nepal and Tanzania. Documents included national laws, plans and policies related to DRRM, sector strategies, literature on risk exposure representation and modelling, literature on disaster risk insurance in developing countries, and national and international statistics.

- **Key Informant Interviews (KIIs):** Online and in person semi-structured KIIs were conducted with individuals or groups from national stakeholders in Nepal and Tanzania. The KII guiding questionnaire is provided in Appendix 9.2. KIIs were also conducted with the METEOR consortium partners as part of the Process Evaluation component.

- **Focus Group Discussions (FGDs):** FGDs were conducted during the Global Study with during Insurance Industry Advisory Group (IIAG) meetings and other meetings with representatives from the Development Partners and the insurance industry.

- **Online survey:** The team developed an online user survey to receive feedback from those who download the METEOR products.

- **Final Learning Event online workshop:** On 23 March 2021, an online workshop titled "METEOR Final Learning Event" was facilitated by the M&E team. In attendance were representatives from all project partners, Caribou Digital and the UKSA. The M&E team presented the preliminary findings of and key lessons from the endline evaluations and the fruitful discussions at the workshop provided additional relevant information that was integrated in this evaluation report.

- **Cost-Effectiveness Analysis:** All IPP projects are required to produce a CEA to contribute to the UKSA's understanding of the impact of the projects. A CEA is a "type of value-for-money analysis that compares the costs of alternatives that achieve different amounts of the same impact"[3]. METEOR's CEA was mainly undertaken during 2020, finalised in early 2021, and submitted separately (METEOR Report M2.7/C). The CEA compared the cost-effectiveness of METEOR and two alternatives: an "Airborne sensing" alternative and a "Ground data" alternative. The findings of the CEA delivered on the side of the endline evaluation will be used to answer questions about the efficiency of the project. More information is provided in Section 7.3.

Table 3 presents an overview of the application of the different data collection methods to address the general evaluation questions.

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[3] *The Green Book, Appraisal and Evaluation in Central Government*

Evaluation Question	OECD DAC Criteria	Methods & Tools					
		Desk Research	Cost-effectiveness analysis	Final Learning Event	Focus Group Discussions	KIIs	Online survey
EQ1: In developing countries, is there a real need and/or demand for national exposure and multi-hazard and vulnerability data and protocols that validate the uncertainty process?	Relevance	X		X	X	X	X
EQ2: To what extent was the project coherent with other DRRM interventions in Tanzania and Nepal, and possibly in other ODA recipient countries?	Coherence			X		X	
EQ3: Did the project design and deliver level-one exposure data and protocols for all ODA countries and level-two exposure, hazard and vulnerability data and protocols for Nepal and Tanzania? Was the delivery cost-efficient? What worked well and not so well?	Efficiency		X	X		X	
EQ4: To what extent did the design and delivery of the METEOR outputs lead to improvements in the capacity and ability of national and international stakeholders to knowledgably utilise EO-based hazard, exposure and vulnerability data in DRRM policy and practice?	Effectiveness	X		X	X	X	X
EQ5: Is there evidence to suggest that the project has improved in-country DRRM policy and planning? And, if so, is there a reasonable expectation that, in the event of a disaster, countries will experience an improved response, reducing disaster-related deaths, loss and damage?	Impact		X	X		X	
EQ6: Is there sustained interest by DRRM stakeholders (e.g. other LDC governments, NGOs, the insurance industry and the humanitarian community) in these data and protocols?	Sustainability			X	X	X	X

Table 3. Data collection methods map

2.3. Key challenges and limitations of the endline evaluation

This evaluation was conducted in a challenging context for two main reasons:

- The **COVID-19 epidemic** which affected the project, and the evaluation team's options and choices of tools with which to carry out the evaluation
- **The UK Government's spending review**, which brought uncertainty in the project on the possibility of receiving a time extension to make up for the delays caused by the pandemic.

The main impact of COVID-19 on the evaluation design was in the tools used for data collection and the quantity of data available. For obvious reasons, **international evaluators were not able to travel to Tanzania and Nepal.** Therefore, local M&E team members had to carry out KIIs on their own. Moreover, **the ability to have personal interactions with international stakeholder groups was limited.** Particularly, our original plans of attending international conferences and events where to meet several potential informants for the Global Case Study in one place had to be dropped in lieu of the use of virtual interactions through an online survey and meetings.

A specific challenge in Nepal was the unavailability of the OPM evaluator who had conducted the previous METEOR evaluations. Another senior consultant from OPM Nepal, Apar Paudyal, with experience on DRRM was included in the project and was responsible for the whole endline Nepal Case Study. Despite Apar's initial lack of knowledge about the project and the impossibility of being joined by an international evaluator from the team because of COVID-19 travel restrictions, the M&E team believes the impact of this change in staff on the evaluation has not been substantial. In fact, Apar was widely briefed on the project implementation status in December 2020; he participated in the Nepal METEOR Advisory Committee meetings, and the case study's progress was followed weekly in M&E team meetings.

Some words also have to be spent on the tight timeframe of the endline evaluation. In its Terms of Reference (ToR), the M&E team had proposed three timeframe scenarios based on the possibilities of receiving different ranges of time extension to the project by the UKSA. Unfortunately, in the end, **no time extension was granted to the project**, which implied a few limitations to the evaluation, such as:

- **The data collection and analysis of the evaluation had to be carried out in the last month or even weeks before the project end**, which in turn meant challenges, such as: a) low availability of key informants, who were busy with other project activities; b) less time to arrange interviews and other data collection activities; c) high volume of interviews in a short period; and d) short timeframe for the data analysis.
- **Some of the key project activities to be evaluated could not be included in the evaluation analysis because they had yet to happen**. The most notable case is the final training events in Nepal, which have yet to be scheduled.
- **Some of the planned data collection activities could not happen** because of the delay in the project activities. For example, because of the delay in training in Nepal, the evaluation could only use training feedback forms from the training in Tanzania.

Despite these limitations, the evaluation findings and conclusions are in line with what was observed during the midline and, to some extent, baseline evaluations. This was confirmed by the participants at the Final Learning Event, who did not find anything very surprising in the preliminary evaluation findings and conclusions.

2.4. Result monitoring and logframe completion

Since its inception, the METEOR project has monitored its progress along its Theory of Change (ToC) through a logframe, a framework expressing annual progress in terms of indicators and targets at the impact, outcome and output levels. During the endline evaluation, the M&E team prepared an excel tracker to report the evidence behind the results achieved by the end of the project and compared them with the target set for the endline. The findings of the result monitoring process are presented in Section 3, while relevant extracts of the logframe are included in Appendix 9.3. The full logframe in Excel, including the log of changes in indicators and targets occurred throughout the project, has been submitted separately to Caribou Digital and the UKSA.

2.5. Summative evaluation

2.5.1. Global Case Study

The Global Case Study aims at identifying evidence of the METEOR outputs' contribution to outcomes and impact outside Tanzania and Nepal. The main informants for the study were representatives from key international stakeholder groups targeted by the project, namely DPs and the international humanitarian community, the insurance and re-insurance industry, and governments of the LDCs. As mentioned, the evaluation activities were limited by the travel and social interaction restrictions imposed by the COVID-19 pandemic and by the tight timeframe for conducting data collection activities. Consequently, the Global Case Study is relatively "light touch" compared to what was envisaged in the M&E Plan, prepared at the beginning of the project. The main contribution of the endline Global Case Study to the evaluation was to gather **evidence on the interest in (relevance), usefulness (effectiveness, coherence), and future prospect (impact, sustainability) of the METEOR outputs for the three main project target stakeholders outside of Tanzania and Nepal, namely:**

- **Insurance Industry**

- **Global Humanitarian and Development Community**

- **Governments of other ODA-listed countries.**

Concerning the insurance industry, the evaluation was based on one Focus Group Discussion on 23rd February 2021 during the final Insurance Industry Advisory Group (IIAG) meeting – a group of insurance stakeholders kept regularly appraised by the project – as well as specific questions asked at the IIAG meeting on 24th September 2020 and an event with the Lloyd's of London. All these events were held online.

In a similar fashion, **concerning the global humanitarian and development community**, the evaluators were able to ask specific questions in a Focus Group Discussion setting at two virtual METEOR events with the World Bank's Global Facility for Disaster Reduction and Recovery (11th November 2020) and the United Nations Children's Emergency Fund (UNICEF) Data Use Unit (28th January 2021).

The key questions asked at these events were the following:

- Do you think the METEOR products can strengthen the discipline around the development of exposure and risk data? Why / In what way?

- How likely do you think your organisation would use the open source/access METEOR products in the future? For what?

- How likely do you think your organisation would pay to use or expand the METEOR products in the future? For what? Have you got concrete plans to use or expand the METEOR products?

- [For members of the insurance industry or Disaster Risk Financing community] Do you think any METEOR product (and if so which ones) have high potential to lead to the creation of insurance products in LDC or other developing countries? Why / In what way? Have you got concrete plans to use the METEOR products to support your organisation in developing insurance products?

The endline evaluation ToR had also foreseen to run an FGD at a meeting of the METEOR Advisory Board. Unfortunately, because of the tight timeframe of the final months of the project implementation, the Advisory Board meeting was not opened to the members of the M&E team. However, the meeting's notes were shared with the evaluators and used as source of information in the study.

In terms of gathering data from other LDCs, the practical solution identified by the M&E team was to develop an online user survey to be shared with the METEOR products. The team asked contacts close to the project at the United Nations Office for Disaster Risk Reduction (UNDRR) to kindly share the data and the link to the survey with their national focal points in LDCs. Unfortunately, because of the tight timeframe and the multiple correspondence needed for the communications to be distributed, the data and survey were shared only in March 2021, too close to the end of the project to receive enough responses to be relevant in the endline evaluation analysis. To date, only two responses were received, a sample too small to be used. It is possible that the responses to the survey will be used in the legacy evaluation, if enough of them will be available.

2.5.2. National Case Studies

Nepal

A quick **Political Economy Analysis** (PEA) has been carried out to update the context in Nepal from the midline. OPM Nepal **refreshed** this to ensure its continuing relevance. This involved an update on the national political, institutional, and economic context related to DRRM (Nepal finding below). In addition to the PEA update, the team worked closely with NSET and interviewed other key national DRRM stakeholders in Nepal to **assess the relevance, efficiency, and effectiveness of the co-development aspects of the METEOR project in Nepal.** Discussions were held with the key institutions shown in Table 4.

Organisation	Organisation Type	Interview type
National Society for Earthquake Technology (NSET)	NGO / project partner	KII
National Disaster Risk Reduction and Management Authority	Government	KII
Central Bureau of Statistics (CBS)	Government	KII
Department of Hydrology and Metrology (DHM)	Government	KII
Practical Action	iNGO	KII
Institute of Engineering, Tribhuvan University (TU)	Academia	KII
UN Resident Coordinator Office	Inter-Governmental	KII
Youth Innovation Lab	NGO	KII
Department of Mines and Geology	Government	KII
Nepal Academy of Science and Technology	Government	KII
OPM DRRM team	Project Partner	KII

Table 4. Stakeholders interviewed for the endline Nepal case study

Tanzania

For the endline evaluation online semi-structured KIIs were conduct in March 2021 with 9 stakeholders from Government, Donors and Humanitarian organisation in-country as per Table 5.

Institution/Organisation	Organisation Type	Interview type
PMO-DMD	Government / project partner	KII
Geological Survey of Tanzania (GST)	Government	
Foreign, Commonwealth & Development Office (FCDO)	Donor	KII
World Bank	Donor	KII
Ardhi University	Academia	KII
Tanzania Red Cross Society (TRCS)	Humanitarian organisation	KII

Table 5. Stakeholders interviewed for the endline Tanzania case study

For the KIIs with other government stakeholders, donors and humanitarian community, the team prepared some guiding questions informed by previous interviews with the stakeholders conducted during the midline evaluation. The questionnaire for the different KIIs had the following common themes aiming at assessing the level of Tanzanian government and national DRRM stakeholders' buy-in of the project and its outcomes, assessing the level of Tanzanian key DRRM stakeholders' ownership of the project outputs and identifying key lessons from the project implementation to the benefit of other projects. The core questions were structured along the following themes (see Appendix 9.2 for the specific questions):

- Existing DRRM challenges

- Use and potential relevance of the METEOR data and/or protocols

- Potential and existing application of METEOR datasets and protocols

- Whether staff in the specific organisations have been trained on the use of METEOR data

- If there are any overlaps between the METEOR datasets and protocols and other projects or organisations working in the area that use or will use the data/protocols.

The interview the PMO-DMD looked at both the above thematic areas as with other stakeholders plus a light-touch process evaluation focused on project partner engagement with other consortium partners.

A key challenge during the interviews was finding the continuity between midline and endline interviews because of staff turnover as in some of the institutions (such as TRCS, UDSM and the GST) staff interviewed and engaged during the baseline and/or midline activities no longer worked in these institutions. As a result, some of the interviews had to introduce METEOR again before getting the key focus of the endline evaluation.

In addition to the primary data collection, the Case Study updated the DRRM context assessment carried on at midline, through a desk research.

2.6. Process Evaluation

The data for the light-touch endline process evaluation were collected through online interviews of twelve people from the 7 partners of the METEOR consortium (see Table 6). The views of OPM staff were integrated into the analysis below as it was compiled.

Organisation	Person interviewed	Interview type
NSET	Sharad Wagle	KII
DMD	John Kiriwai	KII
BGS	Kay Smith Colm Jordan Annie Winson	KII
GEM	Paul Henshaw Vitor Silva Nicole Paul	KII
HOT	William Evans	KII
IMAGECAT	Charlie Huyck Shubharoop Ghosh	KII
FATHOM	Chris Sampson	KII

Table 6. Stakeholders interviewed for the endline process evaluation

All interviews followed the same questions which focused on three main aspects of METEOR's implementation:

- Consortium management, communication, and ways of working
- Fostering ownership of METEOR outputs
- The sustainability of project outputs and impact after the project end.

The summary of the findings and common themes from the interviews is presented Section 6.

3. Results against logframe indicators

This section presents the results achieved by the project against its logframe indicators. The period covered is from the beginning of the project (7th February 2018) to the end of it (27th March 2021). The logframe was prepared by the M&E team, but co-developed with all consortium members. Particularly, many of the endline targets were agreed in consultation with all the partners to define ambitious, but realistic objectives to provide evidence of the achievement of METEOR Theory of Change (ToC) (Figure 1).
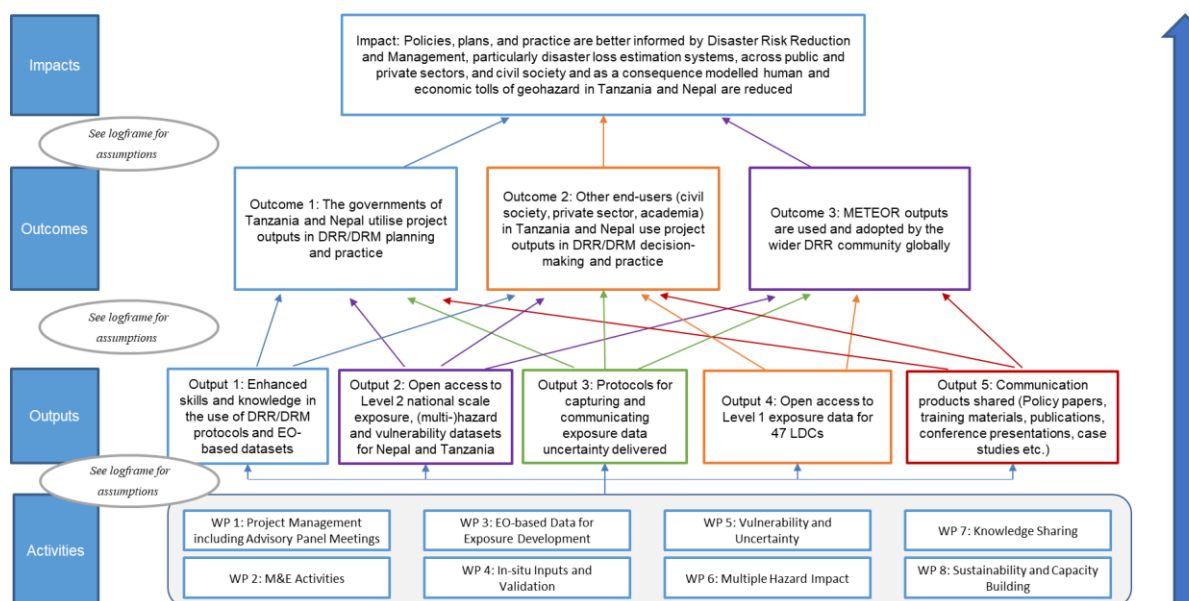
Figure 1. METEOR Theory of Change

Table 7 summarises the results achieved by the project against the endline logframe targets for the different elements of the ToC: impact, outcomes, and outputs. In the last column, the M&E Team gives a Red-Amber-Green (RAG) assessment of the target achievements and a brief summary of the evidence underpinning the ratings. The RAG legend is: green = objective fully achieved or exceeded; amber = objective partially achieved; red = objective not achieved.

After the table, the section continues by providing some narrative explanations of the results.

Table 7. Summary of results against logframe indicators' endline targets

##	Indicator	Data source	Endline target	Achieved (Yes/No/Partially)
IM 1	**Modelled reduction of deaths, missing persons and directly affected persons attributed to disasters (of similar magnitude and impact) per 100,000 population (disaggregating males and females) in Nepal and Tanzania (aligned with SDG indicators 11.5.1 and 13.1.1)**	Internal model based on a hypothetical scenario	No target was set because the impact would only manifest in the longer-term and only if disasters occur.	N/A

##	Indicator	Data source	Endline target	Achieved (Yes/No/Partially)
IM 2	**Total modelled direct avoided economic loss attributed to disasters in Nepal and Tanzania (in GBP £)**	Cost-Effectiveness Analysis	No target was set because the impact would only manifest in the longer-term and only if disasters occur.	Internal model projection (2018-24): £6,769,232
IM 3	**Qualitative indicator: progress towards mainstreaming the use of robust DRR data to systematically inform policy changes across public and private sector, and civil society**	KIIs in Nepal and Tanzania, Monitoring data	There is evidence of concrete plans to use METEOR outputs to inform specific DRRM activities (e.g. risk assessments, technical studies, policies or strategies) by **4** priority end-users* (governmental and non-) in Tanzania and Nepal (at least 1 for each country). *Priority end-users list: Nepal: MoHA / NDRRMA, DHM, NSET, ICIMOD, FCDO Nepal, TU; Tanzania: DMD / PMO, GST, TMA, University of Dar Es Salaam, TURP / Resilience Academy, Red Cross, World Bank	**Partially achieved** Multiple governmental and non-governmental stakeholders are interested to use METEOR outputs in DRRM activities, but no concrete plans (i.e. with allocated resources) are in place yet
OC 1.1	**Qualitative indicator: progress towards use of project outputs by the governments of Nepal and Tanzania**	KIIs in Nepal and Tanzania, Monitoring data	1. Relevant government stakeholders in Tanzania and Nepal confirm their intention to use METEOR outputs to support specific DRR/DRM assessments, technical studies, policies or strategies. 2. Between Outcome Indicator 1.1 and Outcome Indicator 2.1, end-users in Tanzania and Nepal have used the METEOR outputs in at least 1 DRRM activity per country.	**Partially achieved** Governments in both Tanzania and Nepal have confirmed their intention to use the METEOR outputs, but no actual use in DRRM activities has happened yet
OC 1.2	**Feedback from relevant Ministry (or decision-maker) on the usefulness of the project outputs for improving their national DRRM (KPI 1)**	Monitoring data	METEOR datasets are hosted on official/government-led platforms in Tanzania and Nepal.	**Nepal - Achieved** • BIPAD **Tanzania –Achieved** The data are on the Resilience Academy Geonode Platform, which is participated by the government. Formal approval of the data has not been sought by the project as have followed Workb.
OC 2.1	**Qualitative indicator: progress towards use of project outputs by the other end-users in Nepal and Tanzania to inform their DRRM decision-making and practice**	KIIs in Nepal and Tanzania, Monitoring data	1. "Other end-users" in Tanzania and Nepal confirm their intention to use METEOR outputs to support specific DRR/DRM assessments, technical and/or scientific studies, strategies or inform their support to the	**Partially achieved** Other end-users confirmed their intention to use the METEOR outputs, but no actual use in DRRM activities has happened yet

##	Indicator	Data source	Endline target	Achieved (Yes/No/Partially)
			government's DRR/DRM efforts. 2. Between Outcome Indicator 1.1 and Outcome Indicator 2.1, end-users in Tanzania and Nepal have used the METEOR outputs in at least 1 DRRM activity per country.	
OC 3.1	**Qualitative indicator: Feedback from the global community (e.g. UNICEF, UNISDR, WB, GFDRR) in respect of usefulness of project outputs (KPI 4)**	KIIs with METEOR Advisory Board members	There is evidence of concrete plans that the organisations on the METEOR Advisory Board are going to use the METEOR outputs in supporting **1** DRRM activity in developing countries	**Achieved** • Advisory Board members confirm strong intentions of using METEOR data in their activities • Strong evidence of usefulness by WB GFDRR and UNICEF • Use of METEOR protocols in Nigeria and Tunisia
OC 3.2	**Qualitative indicator: Progress towards creating insurance products informed by METEOR data and/or protocols**	FGD with METEOR Insurance Industry Advisory Group (IIAG) members	There is evidence of concrete plans that the organisations in the Insurance Industry Advisory Group are going to use the METEOR outputs in supporting the creation of **1** CAT model, risk modelling / assessment study, or insurance product	**Partially achieved** There is clear appreciation for METEOR products and high likelihood of use, but no specific concrete plans yet
OC 3.3	**Number of dissemination nodes where METEOR KPs and datasets are available to be accessed**	KIIs with METEOR partners, Monitoring data	6 nodes of which at least 1 global, 1 Tanzanian and 1 Nepalese. List of credible nodes: 1. METEOR platform 2. GEM OpenQuake 3. World Bank Data Risk Library 4. Humanitarian Data Exchange 5. Nepal: Building Information Platform Against Disaster (BIPAD) 6. Tanzania: Resilience Academy Geonode Platform	**Achieved** 1. METEOR platform 2. GEM OpenQuake 3. World Bank Data Risk Library 4. Humanitarian Data Exchange 5. Nepal: Building Information Platform Against Disaster (BIPAD) 6. Tanzania: Resilience Academy Geonode Platform (uploaded pending approval)
OP 1.1	**Percentage of professionals trained in Nepal and Tanzania reporting increased knowledge on the training topic (disaggregating males and females)**	Training questionnaires	75%	**Achieved** 97% (Partial data: only training in Tanzania included. No training in Nepal has been conducted yet)
OP 1.2	**Number of professionals trained in Nepal and Tanzania (disaggregating males and females)**	Training lists of attendees	50	**Partially achieved** 27 males + 16 females = 43 (Partial data: only training in Tanzania included. No training in Nepal has been conducted yet)

##	Indicator	Data source	Endline target	Achieved (Yes/No/Partially)
OP 1.3	**Number of organisations that had representatives trained in Nepal and Tanzania**	Training lists of attendees	10	**Achieved** 21 (Partial data: only training in Tanzania included. No training in Nepal has been conducted yet)
OP 1.4	**Percentage of targeted institutions and organisations in Nepal and Tanzania that had at least two people trained**	Training lists of attendees	75%	**Not achieved** 10% (Partial data: only training in Tanzania included. No training in Nepal has been conducted yet)
OP 2.1a	**Percentage of Nepalese and Tanzanian territory covered by Level 2 exposure data (aligned with SFDRR Global Target g and Priority Area 1) (KPI 2a.1)**	Project data	Nepal: 100% Tanzania: 100%	**Achieved** Nepal: 100% Tanzania: 100%
OP 2.1b	**Percentage of Nepalese and Tanzanian territory covered by Level 2 multi-hazard data (aligned with SFDRR Global Target g and Priority Area 1) (KPI 2a.2)**	Project data	Nepal: 100% Tanzania: 100%	**Achieved** Nepal: 100% Tanzania: 100%
OP 2.2	**Percentage of approached users reporting satisfaction with METEOR exposure datasets (disaggregating males and females)**	Online survey and training questionnaires	Males: 75% Females: 75%	**Achieved** Males: 100% Females 100% Total: 100%
OP 3.1	**Protocols for capturing and communicating exposure data uncertainty delivered - Workplan on track to achieve completion within deadline**	Project data	Knowledge of the protocols has been transferred to the right stakeholders in Tanzania and Nepal	**Partially achieved** Protocols produced and published. Knowledge transferred in Tanzania, but not in Nepal yet
OP 3.2	**Percentage of approached users reporting satisfaction with METEOR protocols (disaggregating males and females)**	Online survey and training questionnaires	Males: 75% Females: 75%	**Achieved** Males: 100% Females 100% Total: 100%
OP 4.1	**Number of Level-1 datasets for LDCs uploaded on online platforms (aligned with SFDRR Global Target g and Priority Area 1) (KPI 2b)**	Data on online platforms	47 (including Nepal and Tanzania)	**Achieved**
OP 5.1	**Policy paper on the use of national-scale exposure data for insurance and other risk-transfer mechanisms published and shared**	Data on online platforms	1	**Not achieved** 0 No policy paper has been published. However, there are a number of smaller concept notes for donors developed by ImageCat
OP 5.2	**Number of communication products shared**	Data on online platforms	19	47
OP 5.3	**Number of conferences or workshops hosted or attended by consortium members at which**	Monthly Reporting to UKSA	10	28

##	Indicator	Data source	Endline target	Achieved (Yes/No/Partially)
	METEOR's findings are shared or discussed			

Legend: IM = Impact indicator; OC = Outcome indicator; OP = Output indicator.

3.1. Impact

The long-term goal of the METEOR project is to help LDCs to have better evidence to inform their DRRM plans, policies, and practice so that there will ultimately be less loss of life and resources. The logframe projected this impact in three indicators:

- Impact Indicator 1: Modelled reduction of deaths, missing persons and directly affected persons attributed to disasters (of similar magnitude and impact) per 100,000 population (disaggregating males and females) in Nepal and Tanzania (aligned with SDG indicators 11.5.1 and 13.1.1)
- Impact Indicator 2: Total modelled direct avoided economic loss attributed to disasters in Nepal and Tanzania (in GBP £)
- Impact Indicator 3: Qualitative indicator: progress towards mainstreaming the use of robust DRR data to systematically inform policy changes across public and private sector, and civil society

To concretely assess the project results against the **first two indicators**, we would need to have large disasters to occur in the two countries, which, luckily, we hope it will never happen again. However, through the Cost-Effectiveness Analysis undertaken, it was possible to give an indication of the partial forecasted impact of METEOR (see Section 7.3 for more details). The result showed that **during the period 2018-2023, the estimated contribution of METEOR would produce a reduction of direct economic loss of £6,769,232 in Nepal. A similar estimation of the potential reduction in lives lost has not been undertaken because it was not asked by the CEA.**

Impact Indicator 3 had the following endline target: "There is evidence of concrete plans to use METEOR outputs to inform specific DRRM activities (e.g. risk assessments, technical studies, policies or strategies) by 4 priority end-users (governmental and non-) in Tanzania and Nepal (at least 1 for each country)". The definition of "concrete plans" was to have set up a specific activity, with a title and ideally a budget. **We have considered the objective as only partially achieved**. This is because, although it is true that multiple governmental and non-governmental stakeholders have shown clear interest in using METEOR outputs in DRRM activities, no concrete plans (i.e. with allocated resources) are in place yet. The reasons of this are multiple (see Section 7.5), but the key one appears to be the lack of time for supporting the uptake of METEOR outputs in the two target countries due to COVID restrictions.

3.2. Outcome indicators

3.2.1. Outcome 1 and 2

Outcomes 1 and 2 are about the use of METEOR outputs in Tanzania and Nepal respectively by governmental and non-governmental end-users. In particular, the objectives of the three logframe indicators related to these outcomes aimed at two main targets by the end of the project:

- **METEOR data and protocols are hosted on official government platforms** in Tanzania and Nepal, in demonstration to their approval by the key national DRRM stakeholders (Outcome Indicator 1.2)

- **National end-users generally confirm their intention to use METEOR outputs** in their future DRRM activities **and, at the same time, they have used METEOR outputs** in their DRRM activities at least **once per country by the end of the project** (Outcome Indicators 1.1 and 2.1).

The M&E Team has considered Outcome Indicator 1.2 as formally achieved in both countries, although with some important differences. In fact, in Nepal, METEOR data are hosted on the "BIPAD: Building Information Platform Against Disaster", which is government-owned, which implies a high degree of ownership of the data. In Tanzania, where there seems to be too limited capability at the central government level to have a comprehensive online platform with national disaster risk data, the consortium identified the "Resilience Academy geonode platform", which is participated in but not owned by the government, as a viable option to have the data directly accessed by academia, practitioners, and potentially the government. The web platform is a partnership between four academic institutions in Tanzania, which was an initiative of the Tanzania Urban Resilience Programme (TURP), of which Government of Tanzania is a partner. This means that no government approval of the METEOR outputs was required to upload them on the platform. In fact, the project team purposely chosen not to follow the route of seeking formal approval of the data and protocols by the government as the approval process was deemed too opaque and potentially counterproductive for the project. Nevertheless, as reported in the Tanzania case study (Section 5.2), at the moment there are clear formal barriers for government officials to be able to use METEOR data for official use as the Statistics Act 2015 (amended in 2018 and 2019) prohibits such uses for data that have not been formally approved by the government. More engagement of the e-Government Agency is needed before the data and protocols can be uploaded on government-owned websites.

Concerning Outcome Indicators 1.1 and 2.1, we assessed them as partially achieved. While there is consistent evidence that national stakeholders find METEOR outputs useful, so far there were no instances in which they were used in informing national DRRM activities. Whilst DMD approached METEOR for seismic data for the draft Tanzania DRM plan, the data supplied consisted of pre-existing data with new supporting text produced with METEOR resources. It is likely to be only a matter of time before METEOR outputs may be used in informing national DRRM activities and the legacy evaluation will be the right place to re-assess these indicators.

3.2.2. Outcome 3

Outcome 3 looks at the adoption and use of METEOR outputs by the wider DRR community globally. The indicators of this outcome aimed to see by the project endline:

- Evidence of concrete plans by DPs of using METEOR outputs in supporting at least 1 DRRM activity (Outcome Indicator 3.1)
- Evidence of concrete plans by the insurance industry of using METEOR outputs in supporting the creation of at least 1 CAT model, risk assessment, or insurance product (Outcome Indicator 3.2)
- Evidence that METEOR outputs are widely accessible through credible online platforms (Outcome Indicator 3.3).

Outcome Indicator 3.1 was assessed as fully achieved because Global Case Study has found strong evidence that METEOR outputs are useful to the global DP community and they are likely to use them directly or fund projects to use them. Moreover, there are two examples of DRRM activities that have used METEOR protocols in Nigeria and Tunisia. For more details refer to Section 4.2.

Outcome Indicator 3.2 was only partially achieved. This is because, despite the IIAG members were highly impressed by METEOR outputs, they have not shown "concrete plans" of using them yet. It is to be noted that for commercial sensitivities, it was agreed that IIAG members could have kept their plans to use the project data confidential.

Finally, **Outcome Indicator 3.3 was fully achieved** as METEOR outputs have been uploaded on all 6 credible nodes initially identified by the project partners.

3.3. Output indicators

3.3.1. Output 1

Output 1 focused on achieving enhanced capacity by national stakeholders in Tanzania and Nepal to understand and use METEOR data and protocols. The project was ready to run a series of capacity building activities in both countries before the end of the project to properly explain and showcase the data and the potential of the methodology in DRRM. Because of COVID-19, the consortium asked for a no-cost extension to UKSA to have more time to deliver in-country training activities, which unfortunately was not ultimately granted. The consequence of this was a very limited timescale for delivering the training activities before the end of the project. The result is that, while a 2-day workshop was held in Tanzania, to date it has only been possible to hold a pre-training event has been held in Nepal. The main issue in Nepal was that national authorities requested a more in-depth and hands-on training than what was originally foreseen and its organisation has taken longer than expected. Therefore, **the data used to assess Output 1 indicators can be considered partial, as they only cover capacity building in Tanzania, but not in Nepal.**

In summary, current evidence shows that the project has **exceeded the targets for number of organisations trained** (21 compared to 10 expected) **and "usefulness" of the training** (Output Indicator 1.1) with 97% of respondents confirming their knowledge increased or substantially increased because of the training received. **The project also performed well in terms of size of the training** (Output Indicator 1.2). In fact, even though the endline target has been partially met (43 people trained Vs. 50 expected), the objective is likely to be met by the training in Nepal.

The target that is very unlikely to be met is the one of Output Indicator 1.4, which foresaw 75% of the organisations present at the training events to have at least 2 staff trained, in order to increase the chances that the knowledge would be retained in the organisations. However, **in Tanzania, only 2 out of 21 organisations (10%) had more than one person trained, which cannot be considered a good result.** It should be noted that the intended number of invitees to the training had to be cut due to the risks of COVID-19. Nonetheless, **this is an aspect the METEOR Team will have to pay much more attention to in the organisation of the training in Nepal.**

3.3.2. Output 2

Output 2 is about delivering the in-country data in Tanzania and Nepal and ensuring they are deemed useful by their end-users. **All the target indicators for Output 2 have been achieved.** Both Level 2 exposure data (Output Indicator 2.1a) and multi-hazard data (Indicator 2.1b) for Tanzania and Nepal were produced. In addition, when asked to what extent they were satisfied with the exposure datasets, 100% of approached users answered "satisfied" or "very satisfied". The sample of 40 people included participants to the Tanzania training, the Nepal pre-training workshop, and two respondents to the online user survey.

3.3.3. Output 3

Output 3 aimed at producing and transferring the knowledge of protocols for capturing and communicating exposure data uncertainty. The protocols were indeed developed and published on the METEOR website. Those users who were approached (same sample of 40 as for Output 2) were either "satisfied" or "very satisfied" with the protocols (Output Indicator 3.2). However, while the protocols were explained in Tanzania, their knowledge will only be transferred to Nepalese stakeholders when the training is held. Hence, **Output Indicator 3.1 was only fully achieved in Tanzania and partially achieved in Nepal.**

3.3.4. Output 4

Output 4 is about delivering Level 1 exposure datasets for all 47 LDCs, including Tanzania and Nepal. **The endline target has been achieved** as national datasets have been published on the METEOR website and other platforms (e.g. UN OHCA Human Data Exchange, GFDRR Risk Data Library, GEM OpenQuake platform).

3.3.5. Output 5

Output 5 included the appropriate dissemination of the knowledge and results produced by the project. **In terms of both knowledge and communication products** (e.g. policy papers, training materials, publications, conference presentations, case studies etc.) shared (Output Indicator 5.2) **and conferences or workshops** at which METEOR team presented (Output Indicator 5.3), the project team was very prolific and **exceeded the endline goals** in both cases. The full list of communication products and events attended is provided in Appendix 9.5).

Output Indicator 5.1 indicated that the project would have delivered a "Policy paper on the use of national-scale exposure data for insurance and other risk-transfer mechanisms". **Formally, the objective has not been achieved** because the policy paper was not developed. However, ImageCat prepared a number of smaller concept notes for donors covering that specific topic.

4. Global Case Study

The Global Case Study of this endline evaluation provides some indications of the relevance, effectiveness and sustainability potential of the METEOR outputs for the target stakeholders outside Tanzania and Nepal. Below the evaluation findings are presented following the relevant target groups they refer to, namely the insurance industry and the international development partners. As explained in Section 2.5.1, to this day, the responses to the online user survey were only two and they were not considered in the endline conclusions. Nevertheless, for transparency reasons, their summary is included in this section.

4.1. Insurance Industry

### 4.1.1. Relevance and effectiveness

Figure 2. Global reported disaster by type, 1970 to 2019
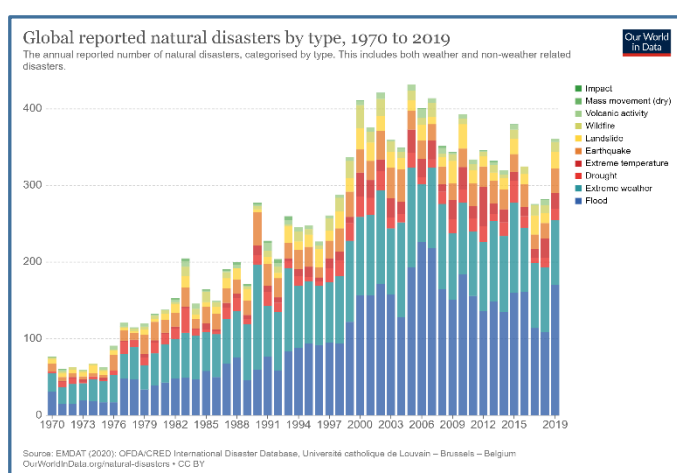
With the worsening of climate change, disasters are becoming more frequent, severe and deadlier. In the last five decades, the average number of annual reported disasters have grown from about 80 to 360 (Figure 2). With it, the economic loss and damage caused by disasters has steadily risen, passing in the same period from USD 3 billion to over USD 105 billion (Figure 3). In spite of this dramatic trend, important risk transfer mechanisms such as disaster risk insurance are still underused, particularly in developing countries. According to the Lloyd's second underinsurance report, the global insurance gap was USD 162 billion in 2018, with 96% of it located in developing countries[4]. One of the main reasons for this gap in LDCs is the unavailability of data allowing reliable disaster risk assessments.

Figure 3. Economic damage by disaster type, 1970 to 2019
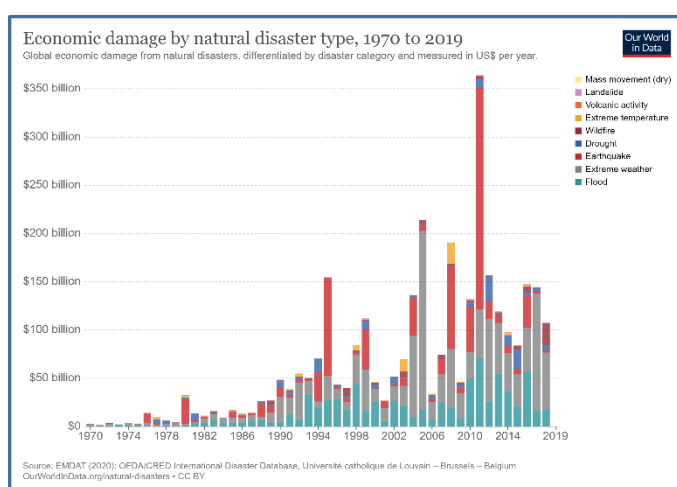
This introduction highlights the relevance of robust, open source, national scale exposure data such as those produced by METEOR for the insurance and reinsurance industry. This is why the project created the IIAG in the first place, that is to establish a direct engagement with representatives of the global insurance. **The endline evaluation confirms that the project successfully engaged with the insurance industry** in multiple occasions during its last year of implementation, in addition to the ones in the previous years. Such interactions

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[4] Lloyd's (2018), A world at risk. Closing the insurance gap, https://www.lloyds.com/~/media/files/news-and-insight/risk-insight/2018/underinsurance/lloyds_underinsurance-report_final.pdf.

were facilitated by the presence of a **"METEOR champion"** within the IIAG, namely Dr. Stuart Fraser working at the same time for the World Bank GFDRR and the IDF Risk Modelling and Mapping Group. The close engagement by the METEOR team with and inclusion of Dr. Fraser in both its Advisory Board composed of Development Partners and in the IIAG was proven to be a successful move. Indeed, once he was convinced of the validity of the METEOR products, Dr. Fraser was able to promote their showcase to his network of DPs and insurers. He actively supported the creation of the IIAG and he participated in the organisation of online presentations to GFDRR and Lloyds.

Although it is true that Dr. Fraser helped in opening some doors to the right audiences, it is also true that **the project team and the relevance and usefulness of the METEOR outputs kept those doors open.** Based on the FGDs and general discussions at last year's project events involving insurance representatives, the evaluation can conclude there is clear indication that the METEOR outputs are useful to them. In particular, there is evidence that the **Level 1 Exposure data and protocols represent a step-change in providing national scale exposure estimations in LDCs**, something that was not available anywhere else before. In addition, what makes the Level 1 Exposure data and protocols from METEOR even more useful to the insurance industry is:

- **Credibility:** the scientific reputation of the international partners in the METEOR consortium is globally renowned

- **Transparency:** the open access of the protocols behind the data allows to verify the robustness of the data

- **Flexibility:** the data were provided in multiple formats, including the Open Exposure Data (OED) format, which is used by the open source catastrophe modelling platform "Oasis Loss Modelling Framework".

4.1.2. Sustainability

In terms of project outcomes, the one in the METEOR logframe related the insurance industry is "Outcome 3.2: Qualitative indicator: Progress towards supporting the creation of CAT models, risk modelling/assessment studies or insurance products informed by METEOR data and/or protocols". The target set for the end of the project was "There is evidence of concrete plans that the organisations in the Insurance Industry Advisory Group are going to use the METEOR outputs in creating 1 new insurance product".

However, despite evidence that the METEOR products are useful to support the risk modelling necessary to develop new disaster risk insurance products in LDCs, the discussions with insurance stakeholders highlighted how the provision of data is only the first step of a longer process. Indeed, as the risk transfer culture in LDCs is far from being mainstream, **the development of insurance markets in those countries will require substantial political engagement, something that the project was never meant to provide.**

What the project has successfully delivered is some part of the evidence in support of the political process. In particular, some of the stakeholders we spoke to confirmed the usefulness of the data for developing CAT models that can then be used in two main ways: a) provide the basis for initial discussions with LDC governments and donors, which can then progress to future signature of disaster insurance agreements; and b) inform the development of specific insurance products when the need arise.

The FGD and discussions brought up suggestions for the METEOR consortium to **proactively engage the insurance market through deals with some of the leading CAT model vendors and consultancies.** In fact, only a portion of insurance companies have internal capacity to develop their own CAT models,

and they rely on external providers. Therefore, ensuring the key CAT modellers know about the METEOR data could allow them to promptly respond to the market needs in LDCs when they arise.

The insurance stakeholders also pointed out that there are still important data gaps to be able to properly assess disaster risk in LDCs. In particular, besides exposure, a **global risk map including multi-hazard and vulnerability data are key analytical elements that at the moment are not available to the insurance and humanitarian sectors.**

Based on what was discussed above, it appears that **the project long-term target of contributing to the creation to new insurance products is too ambitious.** Therefore, the M&E team suggests to change it into: "There is evidence of concrete plans that the organisations in the Insurance Industry Advisory Group are going to use the METEOR outputs in supporting the creation of 1 CAT model, risk modelling/assessment study, or insurance product". **Although, there have not been concrete examples of the use of METEOR outputs in any of these products, there is evidence that, under the right conditions, insurance stakeholders will use METEOR data.** For example, Dr. Fraser said that "Almost certainly, IDF would use the data in the countries they are working on". Similar positive remarks were made by representatives of Hanover Re. (Reinsurance company) and AIR Worldwide (CAT modelling consultancy). For all these reasons, the evaluation team judges the achievement of Outcome 3.2 as Amber in the RAG scale.

4.2. Development Partners

4.2.1. Relevance and effectiveness

The evaluation found consistent evidence across the Development Partners involved in the endline activities that METEOR outputs are highly relevant to their needs. The **key strengths of METEOR** can be summarised as follows:

- **Usefulness of METEOR data:** DPs confirmed they find the data produced by METEOR very useful and consistent with their efforts in closing the disaster risk financing gap and supporting DRRM in developing countries. This is particularly true for the Level 1 Exposure data because of broad geographical coverage. At the same time, they pointed out how having worked in-depth in two LDCs, Tanzania and Nepal, was a really good choice too. In fact, DPs can now use the two national case studies to show other ODA countries the type of data that can be developed to assist in disaster risk assessments. In addition, METEOR protocols can be used as a springboard to develop more specific data in other LDCs. However, for this purpose, it would have been useful for METEOR to also have produced data at a higher resolution, for example at the regional/provincial and local levels, to facilitate the discussion with governments about specific project risks (e.g. infrastructure, building).

- **Great example of co-development**: DP stakeholders appreciated the solid efforts by METEOR in involving national stakeholders in the development of the processes, protocols and data outputs, and remarked they will definitely use METEOR as a positive example in that sense.

- **High-quality training material:** At the final Advisory Board meeting, the participants highly praised ("fantastic resource" (World Bank member)) the training videos and other resources produces by the project, now available on the project website. They see them as providing a good legacy of the project and they will likely point others to them in the future.

Additional evidence of the credibility and usefulness of the METEOR outputs is the fact that engaged DPs have offered to host the data on their official portals, such as World Bank Risk Data Library and UNICEF MagicBox for Disaster Risk, and the METEOR partners were invited to join the WHO-UNICEF GIS Working Group for digital microplanning. **There is also evidence of coherence and synergies of**

METEOR with other DP-funded initiatives in the DRRM realm. For instance, the UK Research and Innovation (UKRI) funded "Tomorrow's Cities" project will likely use data from the World Bank Risk Data Library. In addition, as Kathmandu is one of the target cities of this project, and some of METEOR partners are also involved in the project, it is evident that national METEOR data will be used to investigate disaster risks at city level.

The Advisory Board highlighted also some **weaknesses or limitations of the METEOR project** that can be used to draw lessons for future efforts:

- **METEOR data limitations:** Although METEOR produced robust and transparent exposure, hazard/multi-hazard, and vulnerability data for Tanzania and Nepal, the project stopped short of generating risk outputs. Having multi-hazard risk products is considered by the DPs very useful to clearly communicate with LDC governments about the need of strong DRRM policies. The METEOR team acknowledged that generating risk data is very important for the future; now that the foundation work is complete, a future project will be able to develop risk outputs.

- **External communication:** At the Advisory Board meeting, communication was assessed as a weakness of the project. DPs remarked that the project should have been much better in showcasing the outstanding results of the project. Indeed, their impression was that, while all data must be on the project website, it should be supplemented by a sustained social media campaign.

- **In-country strategic engagement:** The Advisory Board DPs agreed that, in Tanzania and Nepal, the project linked up very heavily with disaster management agencies and technical experts, but not enough with statistical offices and higher government levels (e.g. Ministry of Finance, Planning Commission, Prime Minister Office), which ultimately hold budgets and political capital that can improve the sustainability of the project and push for data sharing. The project should have enhanced efforts in finding "champions" within influential government institutions to foster the traction of METEOR in-country, which is a wider issue facing development projects.

- **In-country communication:** The Advisory Board acknowledged the sensitivity associated with the complexity in communication of the benefits of METEOR in DRRM in the two target countries, both in terms of costs and number of lives saved as a result of METEOR, but were pleased with the impact from METEOR text being included in the Tanzania Disaster Risk Plan, a key indicator of impact. Producing a case study and communication products was raised as important in previous learning events and project meetings, but the delivery of the final data close to the project end did not allow them to be generated

4.2.2. Sustainability

Despite the high appreciation for the METEOR data, there have not yet been instances that we know of where the Level 1 Exposure data have been used in other LDCs either through sovereign or DP-funded projects. However, there have been **two instances where the METEOR protocols** and the experience accumulated during the project **have been used by some METEOR partners to generate additional data or analysis.** ImageCat reported that, off the back of the METEOR protocols, they were able to support the project "Do-It-Yourself Adaptation: New Pathways for Community Flood Risk Communication" in **Nigeria** with the creation of an exposure database, which was funded through by the US National Aeronautics and Space Administration's (NASA) "Human Planet" initiative. Furthermore, as a direct outcome of METEOR's presentation to the GFDRR in November 2020, one of the participants from the World Bank's Disaster Risk Financing and Insurance Programme (DRFIP)

approached ImageCat and funded a quick multi-hazard risk study for **Tunisia**. The project started out as an exposure development study, but ended up being expanded to include a very brief risk study using GEM and Fathom data. This was in the prospect of accessing in the near future a more consistent amount of funds from GFDRR to deliver disaster exposure and risk studies in many developing countries. It is possible that some of these opportunities will be seen during the legacy evaluation, although there is high uncertainty on the timeframe.

It is reasonable to expect that had the METEOR data been released earlier then we would have likely seen more examples of DPs funding studies like these ones or other types of international projects. Nonetheless, there is evidence that DPs such as the World Bank and UK Foreign, Commonwealth and Development Office (FCDO) are interested in commissioning new work to the METEOR partners. However, at the Advisory Board meeting, they pointed out that **currently the procedures for future engagement and the long-term public facing nature of the METEOR consortium are unclear**. While

DPs have directly approached single organisations such as ImageCat, GEM or BGS with opportunities, they do not know whether they should continue to do so after the METEOR project ends. Colm Jordan, METEOR Principal Investigator, explained that there will not be a formal entity called "METEOR consortium", but that there is the will to continue to work

> "METEOR organisations bonded well as a partnership during the project"
>
> Colm Jordan, BGS

together, like several of the partners had been doing before the project. He pointed out that for DPs approaching one of the consortium partners will be fine because they will bring others in as needed.

5. National Case Studies

5.1. Nepal Case Study

5.1.1. Country context update

Evolving risk Context

Nepal is a mountainous, landlocked country that sits in a seismically active zone and experiences frequent extreme events due to a variety of natural and man-made hazards. These include fire, heat, and cold waves factored by various phenomena like damaging windstorms, intense rainfall, thunderstorms (lightning), and rapid, unplanned infrastructure and urbanisation, and lack of awareness at different levels. The country is also exposed to a broad range of natural hazards, including many of those of interest to METEOR, such as earthquakes, landslides, and floods.

Nepal continues to observe loss and damage from disasters. In 2020, Nepal experienced severe socio-economic impact as well as raised health concerns due to the global COVID-19 pandemic. Disasters such as floods and landslides continue to affect lives and livelihoods. Last year, landslide events took 303 lives and affected 771 families in different parts of Nepal, while flood events took 42 lives and affected 512 households.

Governance of disaster risk management update

The DRRM Act 2017 was revised in 2019. The DRRM Act 2017 (amended in 2019) puts at the top of the DRRM governance a multi-stakeholder *National Council for Disaster Risk Reduction and Management (NCDRRM)* chaired by the Prime Minister. Reporting to this head council is the *Executive Committee,* which is chaired by the Minister of Home Affairs and whose members include line ministry secretaries (civil servants as opposed to elected officials), Development Partners, NGOs, Community Based Organisations (CBOs), and other organisations that work in DRRM. Finally, sitting underneath the Executive Committee, the DRRM Act creates a *Disaster Risk Reduction and Management Authority (NDRRMA)* to coordinate DRRM activities across Nepal.

After the appointment of the CEO of NDRRMA in December 2019, the NDRRMA continued to strengthen governance and policy reform on DRRM in Nepal. **The Government of Nepal approved the organisation and management of the NDRRMA on 24th Sep 2020** with 38 staff at the federal level led by the chief executive and supported by two divisions, the policy, planning, and monitoring division, and the risk reduction and operation division. As of date, by March 2021, NDRRMA has organised 6 executive committee meetings and 2 National Council for DRRM meetings. Along with this, NDRRMA issued two policies, i.e. Operational guidelines for the National DRR Platform 2020 and Operational guidelines for the rehabilitation of flood and landslide victims, 2020. NDRRMA also drafted few policies for approval i.e.: Volunteer Bureau Formation and Operationalization Procedures, Disaster Risk Financing Strategy, Guidelines for Simulation Operations, NGO Mobilisation Guidelines for Rehabilitation Procedures, 5 years NDRRMA Work Plan, and NDRRMA Standard Operation Procedure (SoP). These are expected to further enhance the process of DRRM in Nepal.

NDRRMA is a designated institution established under Article 10 of the Disaster Risk Management Act, 2017. **NDRRMA must work together with several agencies, however, it is observed that there is still an unclear and overlapping legal provision threatening the overall performance of this institution.** Likewise, the decision-making power is still with the Ministry of Home Affairs (MoHA), and to initiate anything, it must go through the tedious government process for approval and ultimate implementation of any plans. As a result, the current institutional mechanism of the NDRRMA is another major concern in the DRRM sector as some of the legal provisions are found to be overlapped, therefore **the delegation of power that NDRRMA has received is still being settled with MoHA**.

The Ministry of Federal Affairs and General Administration (MoFAGA) has a mandate for the coordination, facilitation, and institutional development support to local governments. It also fosters inclusive development by promoting peoples' participation in local governance. **MoFAGA is initiating localisation of disaster concerns through a local disaster and climate resilience planning (LDCRP) framework**[5], which has already been adopted in the local-level assessment and planning process even though the framework is still a draft. MoFAGA expects that the LDCRP framework will be officially approved soon, as it is in the final endorsement process. Furthermore, MoFAGA is working with the National Planning Commission (NPC) to ensure that disaster concerns are integrated into the mid-term evaluation framework, periodic plans, and seven steps planning process. In Feb 2021, NPC launched the SDG localisation resource book for all local governments to integrate social, economic, and environmental aspects in their planning and budgeting processes.

The Department of Hydrology and Meteorology (DHM) continues to strengthen and upgrade the hydro-meteorological stations. The new weather radar has been installed in Surkhet, whereas Udayapur and Palpa are in the pipeline. Initially, the hydro and meteorological data were manually entered, but now most of the systems are automated, and more real-time stations are about to be established. The flood forecasting in the mountain and hilly regions is planned.

Besides government agencies, the UN Agencies, Civil Society Organisations (CSOs), and academia continue to support government efforts to strengthen the disaster management cycle (preparedness, response, recovery, mitigation) in Nepal.

After the midline evaluation, **NDRRMA has been leading the Nepal advisory committee of METEOR along with the other government institutions.** The NDRRMA has been observing the project very closely and advising the project partners about its usefulness.

5.1.2. Country case study findings

The endline evaluation findings for Nepal are largely based on the in-country KIIs, project advisory committee meetings led by NDRRMA, and discussion with participants who attended a pre-training session on 9th March 2021. The KIIs were conducted in the first three weeks of March 2021. During the endline evaluation, wider training to different stakeholders was being planned. While writing the endline report, the full-scale training has yet to be organised, which means that it is expected to take place after the end of the project.

Common DRRM challenges in Nepal
The Government of Nepal has devised appropriate policies, acts, programmes, and institutional arrangements to systematically deal with disaster risk reduction and management. Despite several initiatives, legal regimes, and institutional mechanisms, **effective implementation of DRRM has remained a key concern in Nepal**. The key challenges observed are in terms of how: **i) disaster risk governance; ii) capacity building; iii) data management; and iv) availability of financial resources** to effectively and efficiently reduce loss and damage resulting from climatic and non-climatic disasters. It is observed that **local government in Nepal still relies on perception-based decision-making** without an appropriate understanding of the science-based, data-driven, or risk-informed decision-making process in DRRM.

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[5] A Guidebook for preparation of Local disaster and climate resilient plan, Oct 2020. https://narmin.org.np/wp-content/uploads/2020/11/LDCRP_Handbook-for-LGs.pdf

Disaster management has been further challenged by **widespread poverty and the wrong approach to the socio-economic development.** For instance, haphazard development, road construction without appropriate engineering measures, encroachment of riverbanks to establish settlements, etc. are further aggravating loss and damage during disasters. Local government in Nepal, since it is relatively new, has limited human resources, knowledge, and capacity to mobilise appropriate resources in early preparedness, response, and recovery efforts.

The DRRM effort has been further constrained by a **lack of systematic coordination between agencies** involved in the generation, processing, archiving, and management of data and information. Although there is a central data portal in Nepal, it faced several challenges, particularly because data management responsibilities between various agencies involved in DRRM have not been defined. There is also no protocol and mechanism developed to share information and data between the agencies.

For this reason, there is **lack of a comprehensive set of risk data in one place** to support decision-making at all levels of the government. For example, there is no accurate information on physical infrastructure that is vulnerable to disasters in Nepal, which would facilitate risk zoning. The composite information on exposure, multi-hazard, and vulnerability data has been a major obstacle in the DRR sector. Even though the data are available within the agencies, the public has limited access to them and the available data are not communicated effectively for public use.

METEOR uptake related challenges

Since different agencies in Nepal often work in siloes, there is a **lack of inter-agencies coordination as well as capacity for continuous research and modelling.** This would ensure that different data sources are collated to prepare a comprehensive picture to generate national-level exposure, multi-hazard, and vulnerability data and information in one single portal accessible for use in decision-making. Similarly, although Nepal made progress in the use of technology for forecasting disaster events, a technical workforce is needed to ensure coverage of information for real-time communication and dissemination to all three levels of governments. It is expected that the NDRRMA-led BIPAD portal will ultimately become the central repository and single data source for informing DRRM decision-making at all levels of government in Nepal. It is comforting to know that some of METEOR datasets are already hosted on that portal. Within its executive rights, NDRRMA should be able to enhance its capacity and framework for disaster-related data-keeping, processing, and management of the information.

Applicability of METEOR outputs

The availability of open-source and open access exposure, multi-hazard, and vulnerability data and protocols generated by METEOR has been regarded as a great success by all the organisations interviewed. Since access to reliable data has always been a great concern, **METEOR has offered an opportunity for high-quality data to assess seismic, flood, and landslide risk** adding more value to the data-based/risk-informed policy development process in Nepal. METEOR outputs are ready to be used by the Government of Nepal (GoN) as well as by a wider based of non-governmental end-users such as civil society, private sector and academia.

The concrete set of applicability of METEOR outputs in DRRM activities in Nepal is summarised in Table 8, which also shows the national stakeholders/potential users involved and the specific METEOR outputs likely to be useful.

Applicability of METEOR outputs	METEOR outputs involved	Stakeholders
Disaster preparedness across all 753 Local Governments.	All METEOR outputs	NDRRMA
Complete set of data which can be used for multiple purposes and influence the national policies and action plans to reduce the number and losses of the disaster. Useful to current work on documentation of Conventional Technology for Housing Construction and pre-disaster re-construction planning.	All METEOR outputs	National Academy of Science and Technology (NAST)
Generating more knowledge at a different level and integrate into weekly weather bulletin, agro-bulletin of DHM.	All METEOR outputs	Department of Hydrology and Metrology (DHM)
Integrate METEOR data in the National Data Profile.	All METEOR outputs	Central Bureau of Statistics (CBS)
Baseline data for future research programmes and students' thesis and research. Offer pre- and post-disasters assessment to GoN. Make better use of information in Tomorrow's City programme.	METEOR protocols	Institute of Engineering (IoE)
Comprehensive multi-hazard data sets useful to integrate with flood resilience portal and connecting with actual users for decision making to generate evidence-based results.	Multi-hazard data	Practical Action
Strengthen further work on understanding seismic risk and vulnerability.	All METEOR outputs	Department of Mines and Geology (DMG)
Useful to institutions and researchers working on multiple risk assessments at different levels. Also, build synergies with an existing project to take forward data and information use from METEOR outputs. Development of an evidence-based emergency response plan.	All METEOR outputs	United Nations Resident Coordinator's Office (UNRCO)
Visualise further risk scenarios in BIPAD portal and build capacity to replicate the process from the national level to use at local levels.	All METEOR outputs	Youth Innovation Labs (YILabs)

Table 8. Concrete applicability of METEOR outputs in DRRM activities in Nepal, identified by stakeholders

There were observations from several organisations interviewed requesting METEOR to **provide Standard Operating Procedures (SOPs) to use the open-source data** and enhance its applicability and use at all levels. In fact, although the METEOR outputs are now hosted by the BIPAD portal, many official users are required to follow detailed procedures to make use of available data. For example, IoE runs about 28 to 30 master's programmes which offer a wide range of research and studies, incorporating disaster and the building of resilient cities. For engineering students, collecting disaster data was always difficult, but METEOR openly available data has provided opportunities to use that information for analysis in future research. In this regard and for other wider end-users, it is expected that detailed procedures could facilitate the use of METEOR data to better apply seismic, landslides, and flood risk information. The SOPs can further help to offer technical advice during post-disaster assessment and prepare appropriate response and recovery action plans. The data use procedures can further add value to the formulation of a more concrete plan for disaster risk preparedness, coordinating the agencies involved in DRRM in Nepal.

Stakeholders further advised trying to **ensure technical capacity and knowledge are built across wider end-users** for the application of METEOR data and protocol for DRRM activities. For example, the pre-training raised the expectation of NDRRMA to hold comprehensive training enabling their staff to work on data management, visualisation, and communication using METEOR data and protocols. Similarly, other stakeholders stressed that, as the information generated from METEOR is useful at all levels of government, it is advisable to build capacity of a broad group of end-users so that process can be replicated to transfer knowledge at all levels. Indeed, it was observed that by combining centralised data on BIPAD with the necessary capacity of a broad end-user base, METEOR can provide concrete improvements to the DRRM sector in Nepal.

There has been increasing **demand to increase the resolution of the exposure data from METEOR to cover all 753 local governments in Nepal.** At present, METEOR data are embedded in the BIPAD portal hosted by NDRRMA, but there has been a general realisation that more work has to be done on multi-hazard exposure and its data chain. METEOR data can play a significant role in data visualisation and reducing the magnitude of the risk at all levels. Similarly, it is found necessary to map and predict potential loss and damage and assist all local governments in formulating disaster preparedness to avoid future losses through the comprehensive data repository. It is also critical to map potential damage to physical infrastructure, buildings, and assets that are prone to disasters, so that NDRRMA and other relevant government agencies can decide about future investment in such assets. Therefore, there is increasing interest in accessing exposure data covering all local governments in combination with the necessary capacity building activities.

NDRRMA confirms it is ready to lead the METEOR data update process in the future, but collaboration with Development Partners is needed. The DRR act has mandated NDRRMA on data management and sharing with different audiences. NDRRMA is already collecting the scattered data related to disaster risk and will share it for wider use through the BIPAD portal. NDRRMA is also currently finalising its work plan and SOPs for the next five years. In them, multi-hazard risk assessment has been a key priority and they have been integrating in the portal information about flood, weather, and seismic hazards. Lightning events have also significantly increased in Nepal, and further modelling is required to reduce potential losses. METEOR datasets have been seen as an opportunity to prepare a more comprehensive disaster preparedness action plan enhanced with quantitative information. Likewise, NDRRMA is keen to integrate METEOR data in existing plans such as the monsoon preparedness plan, the mobilisation of volunteers, and the NGO mobilisation plan.

5.2. Tanzania findings

5.2.1. Country context update

Evolving risk context
Tanzania is becoming increasingly vulnerable to tropical storms, droughts and floods with the national costs of climate-related hazards estimated to be around 1% of GDP in recent years. These disasters result in disruption of daily lives, destruction of infrastructure, health problems and food insecurity.

In October 2020, 12 people died and there was disruption of transport in Dar es Salaam due to heavy rains. Victims were swept away by flood waters from the overflowing Msimbazi River.[6] In January 2021, severe flooding in Mtwara Region left 1-person dead in Mtwara-Mikindani municipality and approximately 400 homes were reported as damaged or destroyed.[7]

Tanzania lies on an active fault line stretching from the north of the country to the south, and tremors occur from time to time. The last significant earthquake (magnitude 5.7) happened in September 2016 in the Kagera region of northwest Tanzania. That earthquake killed at least 17 people, injured several hundred, and caused significant damage to local infrastructure. More recent earthquake events include the August 2020 magnitude 5.9 earthquake, 88 km off southeast of Dar es Salaam,[8] and the

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[6] https://www.thecitizen.co.tz/tanzania/news/heavy-rains-leave-12-dead-in-dar-es-salaam-2718074
[7] http://floodlist.com/africa/tanzania-flood-mtwara-january-2021
[8] https://www.thecitizen.co.tz/tanzania/news/earthquake-of-5-9-magnitude-strikes-off-tanzania-coast-2714408

March 2021 4.0 earthquake near Musoma, North Mara.[9] For both these events no casualties were reported.

Governance of disaster risk management update

While the 2015 Disaster Management Act calls for new structures at both the national and sub-national levels, the situation is still dynamic and some of these had yet to be fully operationalised. The Disaster Management Act (2015) provides the overarching legal framework for disaster preparedness and response in Tanzania and stipulates that DMD is to be replaced with a Disaster Management Agency (DMA) to allow for easier division of resources, and the Tanzania Disaster Management Council (TADMAC), which is meant to oversee the management of the affairs of the DMA. Based on what DMD told the endline evaluation team in an interview conducted in March 2021, we understand that, ultimately, **the DMA will not be formed and DMD will remain as is under the Prime Minister's Office,** with the Permanent Secretary as the overall Accountable Officer/Manager. Under DMD, the Director General currently has three Deputy Directors that report to him. Under each Deputy Director, there are two principal disaster coordinators followed by three senior disaster coordinators. **TADMAC remains as the body that oversees the operations of DMD**.

The reason behind the decision not to form the DMA is the lack of final parliamentary approval for the formation of the Agency. The perspective of the Parliament was that the activities that DMD conducts can be done within the existing structure under the Prime Minister's Office, without the need for a separate corporate body. The effort is instead directed to strengthening the existing DMD. The budgetary implications of an independent agency were also among the factors for deciding not to pursue the DMA. The reasons for the initial push for a DMA was mostly related to better allocation of resources.

DMD is the central government body responsible for formulation of policies and plans related to disaster risk management in the country, and for optimising collaborations between the Government of Tanzania (GoT) and international organisations supporting DRRM activities in the country (e.g. World Bank, UNDP, WHO, UNICEF, WFP), civil society and the private sector. The Disaster Management Act 2015 calls for the formation of a National Disaster Management Platform chaired by the Director General of DMD, which is required to convene at least twice annually to provide a platform for relevant stakeholders from line Ministries, the private sector, development partners and academia to meet and discuss strategic issues related to disaster management and advise the Government accordingly. Some of these stakeholders are as per Figure 4 which provides an updated list of the main DRRM stakeholders in Tanzania. The key change from the midline evaluation, is that the Tanzania Meteorological Agency is now the Tanzania Meteorological Authority and the formation of FCDO to replace DFID.

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[9] https://www.thecitizen.co.tz/tanzania/news/earthquake-of-4-7-magnitude-hits-mara-tanzania-3319036
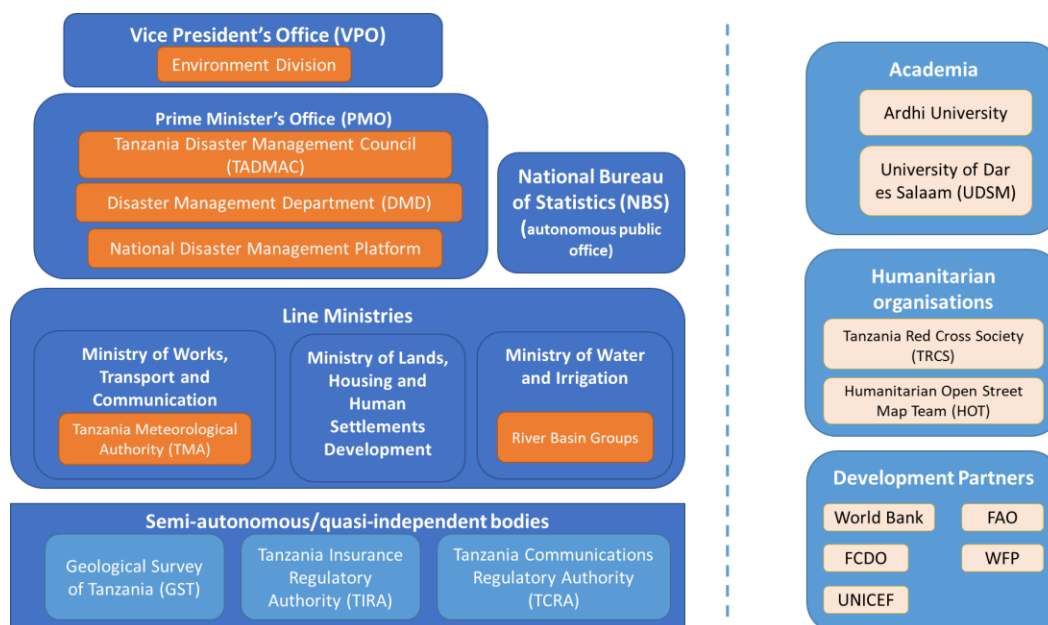
*Figure 4. Key DRRM stakeholders in Tanzania (*Source: Authors)

Policy and Legal Framework

The legal and policy framework guiding DRRM activities in Tanzania include several key pieces of legislation, the most important of which is the **Disaster Management Act 2015,** which replaced the Disaster Relief Coordination Act 1990**.** A finding from the endline evaluation is that **efforts are underway to table the review of the 2015 Act to the Parliament before end of the current financial year**.

During METEOR's baseline and midline evaluations there was mention of a possible assessment or review of the 2004 Disaster Policy for purposes of determining its relevance, or if it might need an update. This is yet to happen. Based on recent endline interviews, the plan for this is to include the review of the policy in the next financial year budget.

It was also mentioned that as part of its national commitments under the Sendai Framework for Disaster Risk Reduction 2015-2030, **efforts are underway by DMD to establish a National Disaster Risk Reduction Strategy** to guide national DRR efforts as informed by current government strategies and in line with the current DRM regulations. The status of this during the endline interviews is that the DRR Strategy establishment was put on hold with DMD keen to bring in more stakeholders in the process. After establishment of the DRR Strategy the plan is to develop a Disaster Policy and ensure it is aligned with the strategy.

The endline interviews recently conducted show that the existing relationship between Government, civil society and academia in Tanzania as influenced by the existing political economy is creating an **overall disincentive to act or making decisions amongst bureaucrats and an overall anti-risk-taking approach**. This in turn is delaying some of the decisions and steps that need to be taken to make progress in DRRM governance and policy in the country. Going forward, in light of newly appointed leadership in Tanzania, new opportunities may present themselves and perhaps this might potentially result in more concrete decision making amongst high-level bureaucrats along existing solidified policies.

5.2.2. Country case study findings

Common DRM challenges

The endline interviews recently conducted show some continuity of general challenges of the DRRM sector with those identified at midline. These include the fact that, while policies and plans seem to be in place, **DRRM is not a sector that is given as much priority and there is overall poor political will to invest in the sector**. Some mention that while a lot of effort has been put to strengthening the institutional and legal framework for DRRM over the last 20 years, most of the programmes/projects are not being effectively implemented partly due to lack of political will. There is still a sentiment from stakeholders that **the approach to disasters is still reactive in nature and needs to be more proactive**. Less is invested in proactive planning, with the existing disaster emergency funds at national and local government level allocated only to emergency response.

The focus on more reactive event-centric planning aimed mostly at civil protection management is partly linked to **limited resources**. The endline interviews show that limited financial resources remain a challenge in the sector. In addition to that, staffing shortages present another key challenge. For example, DMD itself is currently rather stretched with at least one Senior Disaster Coordinator previously engaged in METEOR having left. The other associated challenge on staffing is the **capacity** within the existing DRRM institutions, and lack of sufficient professional disaster expertise within the specific institutions. A particular example shared by DMD, was related to the fact that most staff hired are trained on the job and then move on to other jobs or roles, creating a gap within the Department.

Lack of sufficient data is another key general DRRM challenge that is closely intertwined with finance and capacity challenges. Aligned with inadequate data is the fact that the existing data are hosted or developed by different institutions or stakeholders, presenting a key institutional challenge for DMD as the national disaster coordinator, and ultimately for the uptake of the METEOR outputs. Capacity building is still needed on data collection, disaggregation, and analysis.

These were all key issues identified at the time of the midline evaluation, which saw little or no improvement since then, except for the efforts of planning more proactively for disasters, which will possibly be improved once the DRR Strategy is developed, and other policies and legislation are aligned to it.

METEOR uptake related challenges

In addition to the above overall DRRM challenges in Tanzania, there are specific challenges that will influence uptake of METEOR outputs. The findings from the endline evaluation show the following as key challenges: **i) low visibility of METEOR outputs amongst stakeholders; ii) high staff turnover at the respective institutions engaged; iii) Lack of formal Government accreditation and engagement of e-Government Agency; and iv) low capacity to engage with METEOR outputs.**

Lack of timely or sufficient engagement with the final METEOR outputs throughout the project implementation phase resulted in low visibility of the projects to the different stakeholders. The consequence being more needs to be done by DMD as the local project partner post project completion to ensure more reach, understanding and use of the METEOR outputs is achieved. This is further reinforced by the findings of interviews with DMD, that indicated that more pro-active engagement of other technical stakeholders was necessary even as co-developers early on to ensure better understanding and engagement with the outputs. This would also reduce the dependency by other technical stakeholders on DMD for future updating, revisions and clarifications of the METEOR data and protocols. The technical stakeholders at different institutions such as GST and the Ministry of Water need to be given training and more training is needed for institutions like DMD and GST that received some training. It was further suggested that more needed to be done to summarise 3 years of METEOR work and ultimately increase visibility of METEOR outputs. Some suggestions provided

include dissemination of advocacy products such as policy briefs to decision making bodies as part of the project, using different forums and platforms. It was indicated that the project website alone might not suffice.

Inconsistent engagement with the METEOR project by stakeholders in Tanzania over the 3 years of the project is partly due to **staff turnover in some of the institutions engaged, inhibiting institutional memory and hence making hand-over and ownership of METEOR data difficult.** This presented a challenge during the endline interviews as personnel engaged during the early and mid-stages of the project no longer worked in said institutions and existing personnel did not have previous knowledge of METEOR or its outputs due to poor internal communication. Specific to the endline interviews, the COVID-19 pandemic and associated risks meant that face to face interviews were not feasible and instead stakeholders were engaged virtually in-country. While it was feasible to engage stakeholders virtually, it required a lot more follow up to confirm interviews, and virtual interviews are generally not as effective as face to face interviews for some stakeholders due to lack of personal interaction.

It was observed that there are existing sensitivities surrounding commitment to using METEOR outputs in-country that might affect the ultimate uptake of METEOR outputs. The concerns or sensitivities are driven by the Statistics Act and its stipulations for data to have formal Government approval before stakeholders, particularly Government stakeholders, can comfortably engage with it. Secondly, for hosting of the METEOR outputs on a Government platform, the project needs to engage the e-Government Agency (eGA) before data can be uploaded. While it is reasonable to assume the lack of accreditation by a formal local institution may not affect the ability of DMD to mobilise national stakeholders, the possible inability by stakeholders to officially use METEOR data is a concrete concern as a new law in Tanzania forbids the use of statistics and data that has not been approved by the government for official use. As an alternative it was suggested that perhaps Ardhi University (Disaster Management Training Center), as academia might be another option for hosting METEOR data, as they are not bound by all the protocols and are more independent. However, the risk remains that while the university might be able to host the METEOR outputs, it might be that Government stakeholders remain reserved about official use of the data and do not perceive it as legitimate enough for official use.

Low capacity is a general DRRM challenge that is particularly likely to affect METEOR outputs' uptake, as staff in the engaged institutions do not have enough knowledge and skills to properly use the outputs and be able to revise and update the outputs without additional support. Indeed, if stakeholders must reach out to the local project partner (DMD) to better engage with the outputs or seek further clarifications or to update the outputs, this might undermine METEOR's sustainability. While, DMD has received training and would be able to engage relatively better with the METEOR outputs, further training was still requested as per endline interview, which confirmed how the recent training provided in-country was not sufficient to summarise 3 years of work and subsequent outputs.

Applicability of METEOR outputs
The METEOR outputs were well received by all stakeholders. Interviews show that there is **continued interest in the METEOR outputs in Tanzania**. **The key issues are the pathways that need to be taken to ensure uptake and sustainability.** Most stakeholders thought at the very least the outputs would support dialogue in-country and enable evidence-backed communication with government on DRRM issues.

The outputs could also have potential benefits for disaster policy, response, and planning in the future. Specifically, the outputs will inform DMD on preparedness and would be very useful in developing policy. This is timely, as DMD is yet to establish the DRR strategy and review and potentially update both the 2004 Disaster Policy and the 2015 Act. It was stated that while national level

assessments exist in Tanzania, most are not as useful because they do not include flood data. That said, METEOR geohazard data on flooding would be of added value.

Other organisations identified as likely to use the data/protocols in-country include the World Bank, HOT and the Resilience Academy established under Tanzania Urban Resilience Programme (TURP), which is specifically focused on DRRM in urban areas, principally Dar es Salaam, with the aim to increase Tanzanian resilience to climate and disaster risk. The Resilience Academy is an initiative established to ensure the sustainability of knowledge and systems that are developed under this partnership programme between the GoT, World Bank and FCDO. The Resilience Academy "aims to curate and transfer data, tools, and models of the program into a local academic and technical platform". It is an initiative that involves a dedicated faculty in five academic institutions in Mainland Tanzania, Zanzibar and Finland[10]. These institutions include the University of Dar es Salaam, Ardhi University, Sokoine University of Agriculture, State University of Zanzibar, and University of Turku in Finland.

Future data requests
While the provision of national exposure, multi-hazard and vulnerability data and protocols by METEOR project does fill an existing data gap in-country, the endline interviews indicate that **there is still appetite for more data outputs at different scales focusing on similar or other hazards.**

It was stated that it would be of added value to have drought data in the future. Plus, weather maps that are layered with exposure and vulnerability data as weather maps alone are useful but not sufficient without exposure and vulnerability. Other requests from the project partner DMD were for climate resilience data and flood modelling.

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[10] World Bank. 2019. *Tanzania Urban Resilience Program: Annual Report 2019 (English)*. Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/132061570739508217/Tanzania-Urban-Resilience-Program-Annual-Report-2019.

6. Process evaluation

The endline Process Evaluation provides views from the consortium partners on key aspects such as project management, communication, project sustainability and the ability by METEOR of building ownership of outputs and outcomes by target stakeholders.

6.1. Internal management, communication, and functioning

The consortium brought together the right expertise, **assembling an array of global experts across a range of perils. Partners in the consortium had clear roles**, bringing their experience and networks to contribute to the impact of the METEOR project.

The project worked with very different partners in Tanzania and Nepal. In Tanzania, DMD is responsible for the coordination at the national level of disaster management and response. They also have a key role in ensuring good practice in disaster preparedness across government, and this role is underpinned by their organisational location in the Prime Minister's Office. This contrasts with NSET in Nepal. NSET is an NGO, a community of Nepalese professionals with technical and social expertise in earthquake disaster management. Its objective is to foster the advancement of earthquake engineering and technology to mitigate earthquake risk. It sits outside government and uses its networks, knowledge and expertise to influence government and citizens. The two bodies have different rules, incentives and procedures. Several partners reflected that these **differences between the partners were not sufficiently articulated in the design, and built into the implementation of the project.** It was suggested in discussions that the consortium partners now have a clearer understanding of the advantages and disadvantages of working directly with a government partner given their mandate, reach and ways of working, and with a body outside government, respected for its expertise and linked into global networks around that expertise. This more nuanced recognition of the roles of the different bodies within their national contexts can be used in future projects to ensure effective relationships with those partners. In the case of Tanzania specifically, complex government procedures were not clearly communicated in the early stages of implementation. This resulted in the lack of a mechanism to enable payments to be made to DMD. This took a significant amount of management time and effort to resolve.

With the benefit of hindsight, some partners were of the view that other expertise in different areas, of different perils should have been brought in to widen the project impact. A request for additional funding to do this was made during implementation, but without success.

The consortium invested in building the team, with regular meetings and updates in place, including face to face in the countries of implementation as well as the UK. Given the different time zones that the partners operate in, this was not straightforward. In most cases **the difference in perspectives, views and opinions were resolved into an agreed approach or action.** However, this was not always possible. The meetings to bring partners together were initiated from the start of the project, and included joint working on the Theory of Change - which several partners noted as an important starting point.

The project manager continued the ethos of collaboration and good communication: her inputs were widely commended. The sharing of the filing system and updating of the project website were also useful tools. Although one partner noted the time that it took to understand the dependencies between different project activities. Such a diverse range of expertise, organisational cultures and personalities inevitably led to differences of opinion.

The project adapted well to changing circumstances, including adapting to the travel restrictions imposed by COVID-19. This was a major issue given the planned meetings, stakeholder events, training and capacity development in the last year of the project. **The relationships that had been built in the**

early days of implementation provided a solid foundation for continuing team effectiveness. Several consortium partners noted the importance of conversations that take place at in-person events, the discussions in coffee breaks, and conversations over drinks in the evening in building understanding and goodwill between colleagues in different countries and organisations. **Local officers and partners in both Tanzania and Nepal were vital in ensuring continuation of project activities**. As well as the OPM officers in Tanzania and Nepal, the HOT local partner office in Tanzania played a major role in the success of the training that took place in Dar es Salaam. The NSET team played a similar role in Nepal, particularly working in the last months of implementation to understand and meet the needs of the NDRRMA.

6.2. Building ownership of the project outputs and outcomes

In the last two months of implementation, training was conducted in Tanzania and a pre-training workshop completed in Nepal using METEOR databases and protocols. The METEOR products are also publicly available on local portals in both countries. This output built on a continuous focus on understanding the potential uses and needs of different stakeholders across and outside government in both countries. **This building of relationships, mutual understanding and trust over time was a vital component of engendering ownership**. It was not a linear progression however. The training that had been planned in February in Nepal was not able to take place as anticipated as the national coordinating body, the NDRRMA, communicated in discussions that there was a process of approval required before national level training could roll out. This 'pre-training' workshop was held with key stakeholders on the 9th March 2021 and it is hoped that the full training can take place soon.

Several partners felt that more and earlier capacity development using METEOR products would have led to a more solid foundation for local ownership. Showcasing the project products and a formal launch event with wide publicity were mentioned. A different work plan would also have allowed more time for these activities, starting earlier in the project timeline. However, given the onset of COVID-19 and lockdown restrictions over a year before the project end, the planned approach was not able to be implemented and so alternative suggestions are conjecture. A firmer rooting of the project in Tanzania and Nepal through project offices or officers, and more translation of materials into Kiswahili and Nepali were other suggestions made to increase ownership.

It was also noted that a better understanding of the political economy of both Tanzania and Nepal would have informed a more targeted approach to building ownership, supporting the differentiated approach to working with national partners mentioned in 1.1 above.

6.3. Sustainability perspectives

In terms of sustainability, the restrictions covered and the impossibility of delivering the training in person means that **there is now a range of materials online, available for broader use outside Nepal and Tanzania, that can build further capacity**. The data and protocols are openly available, allowing access by a wide range of users. They are also accessible on multiple platforms. A full list with internet links is provided in Appendix 9.5.

Looking to the future, it is important to build in a **mechanism for tracking the use of the data**, to understand in practical terms how the analysis and understanding from data modelling is influencing policy and practice. More information on the source data, how to use and analyse the data sets - the exposure data in particular - were also requested.

7. Conclusions

Based on the findings that emerged during the interviews and other activities, in this section we summarise the key conclusions and common themes of the endline in line with the OECD DAC evaluation criteria.

7.1. Relevance

Relevance addresses the question 'is the project doing the right things', that is the extent to which the intervention objectives and design respond to beneficiaries' needs and priorities.

There is consistent and strong evidence that the METEOR products are needed and useful. At the global level representatives of the insurance industry and development partners expressed interest in the applicability of the data to their work in addressing gaps in disaster risk financing and

> "Almost certainly, IDF would use the data in the countries they are working on."
>
> Stuart Fraser

DRRM. This has been evidenced also by their **availability to host METEOR data** on their websites and portals.

At the national level, previous METEOR evaluations highlighted the **need for robust and transparent disaster risk data to inform national as well as local DRRM policies, plans and activities.** The endline evaluation confirmed such need, demonstrated by the strong interested shown by key political (e.g. NDRRMA, DMD) and technical (e.g. NSET, Ardhi University, Dar es Salaam University) stakeholders in the training and local engagement events.

Many counterparts and stakeholders wanted more datasets and protocols from the project. In both Tanzania and Nepal data at the sub-national level has been requested. This is in line with the delegation of responsibility for some elements of DRRM from the national to more local levels. Similarly, representatives from the insurance industry and development partners expressed an interest in more comprehensive data (i.e. including multi-hazard, vulnerability and risk elements) at the global level. While both these sets of data are outside the terms of reference of METEOR, such requests reflect the confidence of the stakeholders in the usefulness and quality of METEOR products.

7.2. Coherence

Coherence addresses the question 'how well does the project fit' with other interventions in a country, sector or institution.

The project is well aligned with other interventions in DRRM in both Tanzania and Nepal. In fact, several project partners are involved in those interventions. For example, OPM in Tanzania is part of the Tanzania Urban Resilience Programme and, in Nepal, BGS and NSET are a part of the Tomorrow's Cities programme. Obviously, the local partners - DMD in Tanzania and NSET in Nepal - are actively involved in DRRM initiatives in their respective countries. Their knowledge and networks have been integrated into METEOR throughout the design and implementation phases. As a result, the project is aligned with national priorities, policies and the government machinery.

At the international level METEOR is fully aligned with drivers of good practice in DRRM, including this Sustainable Development Goals and the Sendai framework. At the more technical level, the data sets and protocols are integrated with international standards as proven by the use of METEOR protocols in international initiatives in Nigeria and Tunisia, plus a number of additional proposals currently under evaluation.

7.3. Efficiency and cost-effectiveness

Efficiency

Efficiency addresses the question of how well resources are being used, the extent to which the intervention delivers, or is likely to deliver, results in an economic and timely way.

The project outputs were delivered on time, and to a high standard. This was confirmed in interviews with the consortium members and national stakeholders. There was a consensus among the consortium members that the investment in building the team and relationships between its members, including through regular face to face meetings, paid dividends in terms of the smooth and timely implementation. The high quality of project management built on pre-existing relationships between consortium members. Initially there were challenges in engaging with the government bureaucracy in Tanzania in particular, but these were eventually resolved. However, it did have an impact on the ability of DMD to fully engage with the operations of the project.

Cost effectiveness

Cost-effectiveness was the focus of the METEOR CEA. The analysis compared the costs involved in contributing to the same "impact" generated by METEOR by two alternative methodologies not using EO-based data. The two project alternatives considered were:

1. **Airborne sensing alternative:** The main concept behind the first project alternative is that it would maintain everything the same as the METEOR methodology, except for the source of remote data for the Level 2 exposure data. While METEOR uses satellite EO data, this project alternative uses airborne sensing data taken by aircraft.

2. **On-the-ground observation alternative:** The key difference of this alternative with the METEOR methodology is that instead of using a combination of EO- and ground-based observation to develop Level 2 exposure data for Tanzania and Nepal, it only uses on-the-ground data of a much more extended area (1,000 times bigger than in METEOR). The on-the-ground observation data would then be elaborated by ImageCat in the same way as for METEOR, i.e. using stratified sampling to obtain the nationwide data.

As mentioned, in order to better compare the cost-effectiveness of the alternatives, the level of project-generated impact was maintained constant among alternatives. To do so, ImageCat and GEM modelled the direct economic loss that Nepal would incur if an earthquake as strong as the 2015 Gorkha one would strike in two scenarios: one in which the building codes stay the same (without project scenario); and one in which certain improvements to the building codes are made because they were informed by the METEOR data (with project scenario). This is just a very partial benefit of the METEOR project, but it is always difficult to quantify the impact of a DRRM project, unless a disaster strikes.

The CEA confirmed two main hypotheses:

- **METEOR's return on investment (ROI) is positive**, that is, in time, it produces more economic benefits than its cost (see Figure 6).
- **METEOR methodology is much more cost-effective than the options** (see Figure 5).

Figure 5. Cost of delivering METEOR and its alternatives (2018-23)

Figure 5. Cost of delivering METEOR and its alternatives (2018-23)

METEOR £3.10M
Air £8.66M
Ground £131.19M

Figure 6. Present value of total costs and impacts by year for the METEOR project (2018-23)
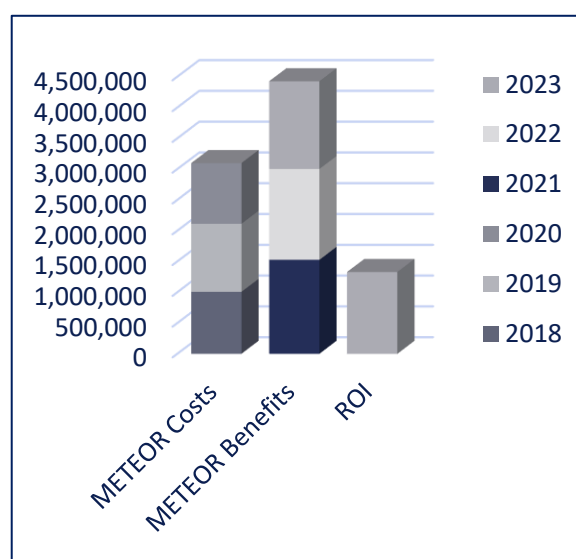
7.4. Effectiveness

Effectiveness addresses the question of whether the project met its objectives.

The project delivered well against targets, and all METEOR key performance indicators were met, with the exception of one. More specifically, 100% of Tanzania and Nepal's territories are now covered by Level 2 exposure and multi-hazard data. In addition, the other 47 LDCs are now covered by Level 1 exposure data. Those data sets and protocols are also shared on credible open access platforms. In the target countries, while in Nepal METEOR data sets and protocols are hosted on an official platform, in Tanzania they are on an academic platform, rather than a government-owned one. This could create some barriers for the use of METEOR data by government officials, but potentially also other national end-users. More engagement with the Tanzanian e-Government Agency is needed.

In terms of training people to use the data, satisfaction with the training that has been completed is high. 94% of the people who attended the training in Tanzania reported increased knowledge on the training topics against a target of 75%, and satisfaction with the METEOR data was 100%. The full training was not completed in Nepal, but at the pre-training workshop all attendees reported satisfaction with the METEOR protocols and data.

Outside Tanzania and Nepal, the project successfully engaged with relevant Development Partners and members of the insurance industry, who have confirmed they are keen to use METEOR outputs in their work in developing countries. Unfortunately, the cancellation of international DRRM conferences and events **affected the ability of the project to reach government officials from LDCs**, although several members of the METEOR consortium regularly work in those countries.

Indeed, COVID-19 had a strong impact on effectiveness. Restrictions on international and national travel severely impacted the team's ability to deliver training. Furthermore, the national level institutions had their capacity stretched to varying degrees in dealing with the impact of the global pandemic.

7.5. Impact

Impact addresses the question of the difference the intervention makes, particularly in contributing to longer-term and higher-level effects.

METEOR Theory of Change has the following impact statement: "Policies, plans, and practice are better informed by Disaster Risk Reduction and Management, particularly disaster loss estimation systems, across public and private sectors, and civil society and as a consequence modelled human and economic tolls of geohazard in Tanzania and Nepal are reduced". There are two main elements underpinning this statement: 1) designing and developing robust DRRM-relevant data; and 2) mainstreaming their use in policies, plans and practice (in Tanzania and Nepal and to some extent beyond them).

All evidence points to the success of METEOR in producing useful, scientifically sound, accessible, and cost-efficient DRRM-relevant data. All stakeholders approached during the endline evaluation and throughout previous evaluations confirm this.

However, there is limited evidence of institutional change and mainstreaming of improved data and analysis in DRRM policies, plans, and practice supported by METEOR. In the Midline Evaluation Report, we had presented a figure showing the correspondence between METEOR ToC, the "continuum of change" going from beneficiaries being unaware of the problem to practicing sustained change, and what we had called the "METEOR Pathway" with the steps needed to sustain the intended change in the ToC. Figure 7 provides an update of that figure with an assessment of the change from project midline to endline. What is shown is that while the key project outputs have been produced and to some extent their knowledge transferred, more work and local engagement is needed to achieve the expected level of behavioural change.
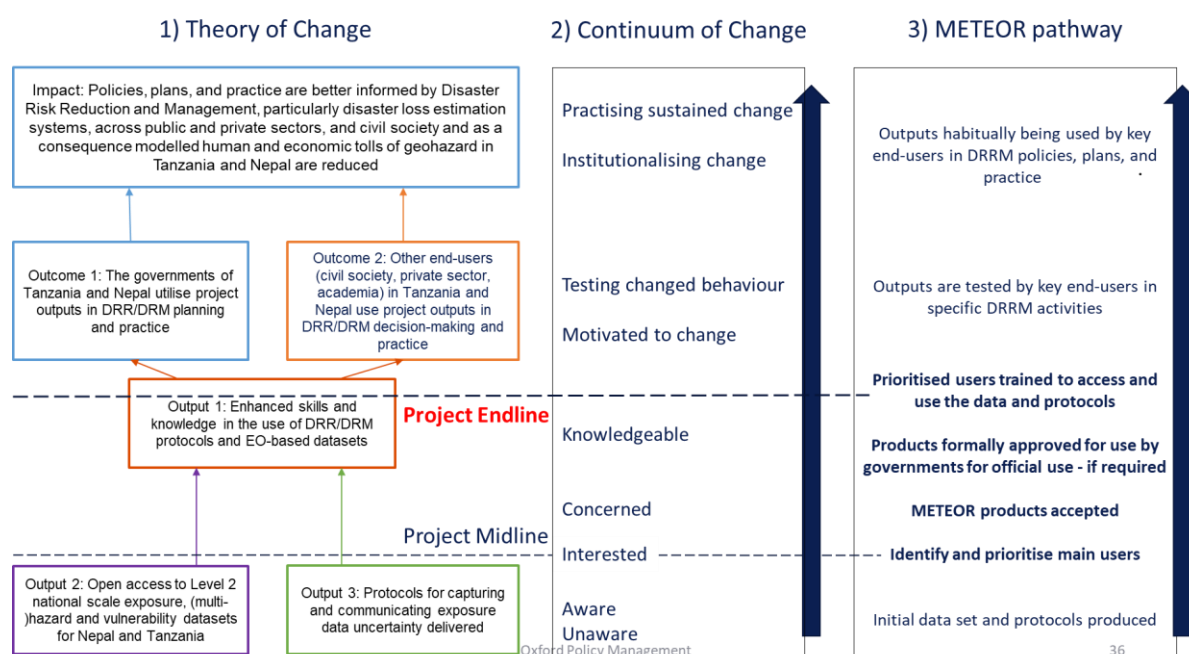
Figure 7. Endline assessment of the METEOR's pathway from outputs to impact

In hindsight, while the METEOR project has been properly designed, resourced, and managed to attain the first impact element, i.e. the relevant and robust data, **the inclusion of strong elements of behavioural change and mainstreaming in the impact statement has been too ambitious.** Despite strong efforts in the co-creation of the products with local stakeholders (particularly in Nepal), the

ability to see concrete behavioural change during the lifespan of the project has been hampered mainly by:

a) A project timeline, budget, and consortium experience greatly skewed towards the scientific efforts behind the data development compared to the institutional change and stakeholder uptake efforts; and
b) Clear differences in the technical capabilities of the national project partners in Nepal and Tanzania and the political economy context they had to operate in.

In other words, considering the very low baseline of the Least Developed Country context in terms of available DRRM-related data, capacity, finance, and general attitude to risk transfer, what METEOR was set to achieve (i.e. scientific data and behavioural change) went beyond its capability. Therefore, **the problem was more about target setting than about project underperformance.**

Ideally, now that the robust data have been published, a subsequent project focused on the behavioural change aspects, such as use and mainstreaming of the data in policies, plans and practice could have good chances of success. Positively, there are some perspectives such as Tomorrow's Cities in Nepal, and the Resilience Academy and TURP in Tanzania that are well placed to apply METEOR data and protocols after the end of the project.

Without additional time and resources from METEOR, there seem to be more likelihood for Nepal to independently use METEOR's products than Tanzania. This is because the more technical nature of the national partner, NSET, aligned its interest and capacity to the technical nature of the project, compared to the more political and less technical nature of DMD in Tanzania. This, together with other contextual factors, resulted in NSET's ownership (i.e. ability to independently use) of the METEOR data and methodology being solid enough to likely take them up in their DRRM technical assessments, capacity building and advisory work to the government of Nepal. On the contrary, it will take more technical training and support in building political appetite in Tanzania for mainstreaming the METEOR products into national DRRM.

7.6. Sustainability

Sustainability deals with the issue of whether the benefits will last, how likely are they to continue beyond the end of the project.

The data produced by the project is freely available on multiple open access platforms. Moreover, a plethora of online training products have been developed and are now publicly accessible (see Appendix 9.5.1 for a list).

At the global level, there is sustained interest from a range of development partners as well as representatives from the insurance industry. This has been shown also in practical terms with the funding of activities using METEOR protocols in Nigeria and Tunisia, and a few others likely to be funded (pending proposal evaluations).

However, development of capacity in Nepal and Tanzania for users to be able to use and model the data has not been completed as planned. While capacity development has been a priority from the start, the timeline was - in retrospect - always optimistic, with the training planned for the last months of the programme, once the METEOR products were available. But the onset of COVID-19 a year before the project completion provided a huge obstacle. Despite this, some training has gone ahead, and has been well reviewed by participants, but development of deeper capacity across a range of partners involved in both the technical and policy aspects of DRRM has not been possible.

That said, there is clearly sustained interest at the national level to work with the METEOR products. In Nepal there has been a request for Standard Operating Procedures to further embed the use of the protocols in policy and practice. In Tanzania there is interest in further work to continue engagement with the partners of DMD, including building awareness from the level of senior leaders right through to citizens. In addition, a request was made for follow up to deliver training to technical officers from a range of ministries and other institutions to enable them to use the data to establish mechanisms to integrate the products from METEOR in their everyday tasks.

In conclusion, lots of different sustainability seeds have been planted, and it is unlikely that METEOR outputs will be completely discontinued. These seeds need watering by METEOR partners, particularly in an ongoing promotion of the need for EO-based data in disaster risk financing and DRRM at national, sub-national and local level. Although the METEOR consortium will not present itself as a formal entity to the world, the partnership of its organisations has been well consolidated and it is likely more joint funded opportunities to expand and use METEOR data and protocols will arise. In brief, the idea is that after the end of METEOR, as DRRM is the core business of all technical organisations in the consortium, they will independently pursue more international opportunities, which could lead to use METEOR protocols in other countries. Partnerships for such opportunities will be ad hoc in nature, and specific sub-sets of the METEOR consortium may bid together according to the technical requirements to be used. Possible sources of funding are the World Bank and its GFDRR, UK FCDO, other branches of the British Government such as the UKSA and UK Research and Innovation, other space agencies (e.g. NASA, ESA), the IDF, the UN Development Programme, the Green Climate Fund, and, possibly, developing country governments directly.

7.7. Focus of the Legacy Evaluation

Originally, the M&E plan did not foresee a legacy evaluation, i.e. an evaluation to assess the broad outcomes and long-term impact of the METEOR project after about 1 year from its end. However, during the implementation, it became abundantly clear that for a project like METEOR in which most of the key deliverables happen in the last weeks of the project, the endline evaluation would not be able to capture enough evidence of the put into use of the project's outputs to definitely answer questions about impact.

Therefore, a Grant Change Notice request was recently put in for providing budget for a METEOR Legacy Evaluation, currently under assessment by the UKSA. If approved, the legacy evaluation will have the following objectives:

- **Assess evidence of the project outcomes and longer-term impact,** and investigate the causality between the project and the observed effects
- **Provide insights for the UKSA and the consortium partners** on how to best design and implement future interventions, based on learning gained from the assessment of the project's contribution to the observed outcomes and impact.

During the Annual Learning Event 2020, a participatory approach with METEOR partners agreed on indicative legacy logframe targets in light of a legacy evaluation to be conducted in January 2023. However, as currently designed, the legacy evaluation data collection would run in December 2021. Therefore, in Table 9 we suggest changes to the original logframe indicator targets for the legacy to account for the reduction in time for the results to concretise. Changes are highlighted in red font.

Table 9. Current and suggested logframe indicator legacy targets

Ref.	Indicator	Current Legacy Target (Cumulative Feb 2018-Mar 2023)	Suggested Legacy Target (Cumulative Feb 2018-Dec 2021)
Impact Indicator 3	Progress towards <u>mainstreaming</u> the use of robust DRR data to systematically inform policy changes across public and private sector, and civil society	There is evidence that 6 priority end-users (governmental and non-) in Tanzania and Nepal (at least 2 for each country) have used METEOR outputs to inform 3 DRRM activities (e.g. risk assessments, technical studies, policies or strategies).	There is evidence that 3 priority end-users (governmental and non-) in Tanzania and Nepal (at least 1 for each country) have used METEOR outputs to inform 3 DRRM activities (e.g. risk assessments, technical studies, policies or strategies).
Outcome Indicator 1.1 and 2.1	Progress towards <u>use</u> of project outputs by the governments and other end-users in Nepal and Tanzania to inform their DRRM decision-making and practice	N/A – Measured by Impact Indicator 3	N/A – Measured by Impact Indicator 3
Outcome Indicator 1.2	Feedback from relevant Ministry (or decision-maker) on the usefulness of the project outputs for improving their national DRRM	METEOR datasets are <u>still</u> hosted by the official/government-led platforms <u>currently in use</u>	METEOR datasets are <u>still</u> hosted by the official/government-led platforms <u>currently in use</u>
Outcome Indicator 3.1	Feedback from the global community (e.g. UNICEF, UNISDR, WB, GFDRR) in respect of usefulness of project outputs	There is evidence that METEOR outputs <u>have been used</u> by at least 3 development partners in supporting 3 DRRM activities in developing countries	There is evidence that METEOR outputs <u>have been used</u> by at least 3 development partners in supporting 3 DRRM activities in developing countries (including the uses in Nigeria and Tunisia already undertaken)
Outcome Indicator 3.2	Progress towards creating insurance products informed by METEOR data and/or protocols	There is evidence that METEOR outputs <u>have been used</u> by at least 3 insurance companies	There is evidence that METEOR outputs <u>have been used</u> by at least 1 insurance company, CAT modeler, or similar
Outcome Indicator 3.3	Number of dissemination nodes where METEOR KPs and datasets are available to be accessed	METEOR datasets are hosted by the 6 credible nodes. List of credible nodes: METEOR platform GEM OpenQuake World Bank GeoNode Humanitarian Data Exchange Nepal: Building Information Platform Against Disaster (BIPAD) Tanzania: Resilience Academy Geonode platform	METEOR datasets are <u>still</u> hosted by the credible 6 nodes and still <u>being accessed</u> List of credible nodes: METEOR platform GEM OpenQuake World Bank GeoNode Humanitarian Data Exchange Nepal: Building Information Platform Against Disaster (BIPAD) Tanzania: Resilience Academy Geonode platform

8. Lessons learnt

8.1. What worked well

METEOR achieved its main objectives of delivering datasets and protocols covering all ODA countries, with more detailed analyses for Tanzania and Nepal published and available on open access portals. The consortium consisted of a **good mix of organisations who are key experts in their areas** of science, they know their subject well and have a realistic idea of what they can deliver. To work on delivering the project objectives, the METEOR team invested in **building joint ownership** across the consortium with **active, strong project management** and continuous focus on delivering high quality products on time. **The project team has flexed and adapted** to changing circumstances, including new institutions such as the NDRRMA. The division of labour between the different partners was clear and logical and each of those partners brought their skills and experience to bear on **working together efficiently and effectively**. The result is a high quality, credible set of products that have the potential to inform policy and practice in DRM.

8.2. What to do differently

In future projects, it would be useful to **consider the balance of skills across the consortium**. With METEOR, the focus was on organisations with credibility in delivering good quality science-based products. However, the ultimate aim of METEOR was to change the behaviour of policy makers and implementors. **A partner with more experience of capacity development in ODA countries, and with expertise in behavioural change should be considered**. Such a partner could bring knowledge and the experience of conducting political economy analyses, could advise on building local political support and successful advocacy.

Similarly, the lessons from experience of **working with government and non-government institutions and the advantages and disadvantages of each can be better built into project design and implementation** in future. This experience has taught us that in future projects it would be good to have both science and policy partners in countries where the project is active. In fairness, the project team had identified the need for more technical partners, particularly in Tanzania, earlier in the implementation, but the request for expanding the consortium was not successful.

In order to be able to track the actual use of these data sets in policy making and practice, the project timeline would need to **allow more time for post-production sharing and capacity development** around the products. Ideally this would be accompanied by **greater publicity and more political momentum**, supported by a capacity development partner, as outlined above, and dedicated resources to result communication to policy-makers and the broader public, both nationally and internationally. In this regard, developing bespoke communication products to **showcase the potential impact of data-driven DRRM in non-technical terms** (e.g. monetary savings, life loss reduction) could help generate broader political buy-in in developing country governments.

In terms of setting targets, there is a fine balance to be maintained between ambition and over-optimism. **The process of setting targets should be participatory, strongly linked to the ToC and based on a solid understanding of how change happens**. It is also important to keep the pace of change in mind particularly given the constraint of the limited project life. In particular, **co-development requires significant amounts of time**, but increases the ownership of the final product by the people who are most likely to use it.

9. Appendices

9.1. Evaluation Questions

Table 10. Evaluation Questions

Criteria	Evaluation Question	Indicative supporting questions
Efficiency	Did the project design and deliver level-one exposure data and protocols for most ODA countries and level-two data and protocols for Nepal and Tanzania? Was the delivery cost-efficient? What worked well and not so well?	- Do the protocols/data sets provide more representative exposure data (not skewed to known urban areas)? - How has the consistency and quality of the exposure data in pilot countries (Nepal and Tanzania) improved overtime? - Has the project delivered open-source exposure data? - Is the provision of protocols and level two data cost-efficient to make it feasible and practical to replicate efforts in Tanzania and Nepal across other ODA countries?
Effectiveness	To what extent did the design and delivery of exposure data, protocols, and training lead to improvements in the capacity and ability of national stakeholders to knowledgably utilize exposure data, improving their work products related to DRR and DRM?	- Are Nepal and Tanzania using the data in their planning processes? - Are users satisfied with the tools? Are they providing the right level of information? - Have national experts improved their capacity to use EO data to generate information relevant for risk reduction? - Are national technical experts better positioned to serve as regional experts or "lighthouses" in the space?
Impact	Is there evidence to suggest that the project has improved in-country DRR/DRM policy and planning? And, if so, is there a reasonable expectation that, in the event of a disaster, countries will experience an improved response, reducing disaster-related deaths, loss and damage?	- How and in what ways have the protocols and project activities led to improved national DRR/DRM policy and planning? - Has the project led to improved, rapid access to relevant information on exposure? - Has the information lead to improvements in decision-making process of NGOs, policy makers and insurers? - Is there evidence to suggest that the project has led to improved mitigation strategies and the regional distribution of resources? - Do we see changes/improvements in DRR resource allocation?
Sustainability	Is there sustained interest by DRR/DRM stakeholders (e.g. other LDC governments, NGOs, the insurance industry and the humanitarian community) in these data and protocols?	- Is there evidence to suggest that humanitarian actors such as UNICEF are or plan to use these tools when evaluating loss and damage related to a disaster? - Do the protocols and datasets improve and support the development of insurance products for use in developing countries?
Relevance	In developing countries, is there a real need and/or demand for exposure data protocols that validate the uncertainty process?	- Has the project strengthened the discipline around the development of exposure data? - Is there evidence that the project has improved the lineage and characterization of uncertainty? - Have other ODA countries expressed interest in these data? - Has there been uptake of level one data by other ODA countries? - Do we see broader uptake and use of the protocols? - Assuming the lack of data is the issue that governments face.

9.2. Interview Questions

Table 11. Interview Questions

Interview group	Type of evaluation	Questions

Consortium partners	Process evaluation	• *How did you feel the consortium worked together to achieve the agreed results? What worked well? Any suggestions to improve collaboration on future projects?*
		• *When there were significant delays on key milestones, what do you feel were the main factors causing this? Any suggestions on minimising risks of delay on other projects in future?*
		• *What steps do you feel have been taken to ensure ownership of the project process and outcomes within government counterparts? Do you feel enough was done? Any reflections, suggestions?*
		• *Knowing what you know now, what would you do differently next time in terms of:*
		   o *The consortium*
		   o *Ways of working*
		   o *The division of labour*
		   o *The pace of progress*
		   o *Collaboration with other initiatives*
		   o *Ensuring sustainability*

LDC Government representatives	Global Case Study	*Online survey. See Appendix 9.4.*
Insurance Industry Advisory Group	Global Case Study	• *Do you think the METEOR products can strengthen the discipline around the development of exposure and risk data? Why / In what way?* • *How likely do you think your organisation would use the open source/access METEOR products in the future? For what?* • *How likely do you think your organisation would pay to use or expand the METEOR products in the future? For what? Have you got concrete plans to use or expand the METEOR products?* • *[For members of the insurance industry or Disaster Risk Financing community] Do you think any METEOR product (and if so which ones) have high potential to lead to the creation of insurance products in LDC or other developing countries? Why / In what way? Have you got concrete plans to use the METEOR products to support your organisation in developing insurance products?*
Advisory Board	Global Case Study	• *Do you think the METEOR products can strengthen the discipline around the development of exposure and risk data? Why / In what way?* • *How likely do you think your organisation would use the open source/access METEOR products in the future? For what?* • *How likely do you think your organisation would pay to use or expand the METEOR products in the future? For what? Have you got concrete plans to use or expand the METEOR products?*

Nepal Key Informant Interviews	National Case Study	1) What do you think are the key challenges for Nepal in disaster risk management and reduction?
		
		  a) Has the lack of national exposure and multi-hazard and vulnerability data and protocols been a problem for Nepal?
		
		2) Have you seen the METEOR data and/ or protocols? How/ when? (if not, give a brief explanation of their content, and potential uses).
		
		3) How do you think your organisation could use the datasets and protocols? Or are you using them already? Please give details
		
		  a) If you are using them, are you satisfied with them? Are they providing the right level of information? Do they meet your expectations?
		
		  b) Do you have plans to start using them, or increase your use of the datasets and protocols?

Interview group	Type of evaluation	Questions
		c) How does/ will that lead to improved decision-making for your organisation? (Note: this may be national DRRM policy and planning; decision-making of NGOs; or the development of insurance products)
		d) Do you see other benefits of this information for Nepal? (e.g. in policy, planning, insurance)
		e) In the event of a disaster, do you think Nepal would have an improved response, fewer disaster-related deaths, less loss and damage? Please give details
		4) Have any of the staff of your organisation had any training on use of the datasets and protocols? Please give details
		a) If not, do you think you could use them without training? Please give details
		b) Do you feel your organisation has the capacity to use, improve and replicate the METEOR data? Please give details
		5) Would you feel comfortable sharing your knowledge and expertise internationally with other countries? Please give details
		6) Does the production of the datasets and protocols by METEOR overlap with any other projects or organisations working in this area? Is that consistent with their work? Please give details
		7) Do you know of other organisations or projects within Nepal that use (or will use) the data/ protocols? Please give details
Tanzania Key Informant Interviews	National Case Study	1) What do you think are the key challenges for Tanzania in disaster risk management and reduction?
		a) Has the lack of national exposure and multi-hazard and vulnerability data and protocols been a problem for Tanzania/ Nepal?
		2) Have you seen the METEOR data and/ or protocols? How/ when? (if not, give a brief explanation of their content, and potential uses).
		3) How do you think your organisation could use the datasets and protocols? Or are you using them already? Please give details
		a) If you are using them, are you satisfied with them? Are they providing the right level of information? Do they meet your expectations?
		b) Do you have plans to start using them, or increase your use of the datasets and protocols?
		c) How does/ will that lead to improved decision-making for your organisation? (Note: this may be national DRRM policy and planning; decision-making of NGOs; or the development of insurance products)
		d) Do you see other benefits of this information for Tanzania? (e.g. in policy, planning, insurance)
		e) In the event of a disaster, do you think Tanzania would have an improved response, fewer disaster-related deaths, less loss and damage? Please give details
		4) Have any of the staff of your organisation had any training on use of the datasets and protocols? Please give details

Interview group	Type of evaluation	Questions
		a) If not, do you think you could use them without training? Please give details
		b) Do you feel your organisation has the capacity to use, improve and replicate the METEOR data? Please give details
		5) Would you feel comfortable sharing your knowledge and expertise internationally with other countries? Please give details
		6) Does the production of the datasets and protocols by METEOR overlap with any other projects or organisations working in this area? Is that consistent with their work? Please give details
		7) Do you know of other organisations or projects within Tanzania that use (or will use) the data/ protocols? Please give details

9.3. Updated METEOR Logframe at endline

IMPACT 1	Impact Indicator 1		2018*	2019*	2020*	2021*	TOT	2021-24*	TOT	Assumptions
Policies, plans, and practice are better informed by Disaster Risk Reduction and Management, particularly disaster loss estimation systems, across public and private sectors, and civil society and, as a consequence, modelled human and economic tolls of geohazard in Tanzania and Nepal are reduced	Modelled reduction of deaths, missing persons and directly affected persons attributed to disasters (of similar magnitude and impact) per 100,000 population (disaggregating males and females) in Nepal and Tanzania **(aligned with SDG indicators 11.5.1 and 13.1.1)**	Planned	0.00							
		Achieved								
	Source									
	Official national statistics									
	Impact Indicator 2		2018*	2019*	2020*	2021*	TOT	2021-24*	TOT	
	Total modelled direct avoided economic loss attributed to disasters in Nepal and Tanzania (in GBP £)	Planned	0.00							
		Achieved					£1,692,308		£6,769,232	
	Source									
	Official loss and damage estimation by national partners									
	Impact Indicator 3		2018*	2019*	2020*	2021*	TOT	2022*	TOT	
	Qualitative indicator: progress towards mainstreaming the use of robust DRR data to systematically inform policy changes across public and private sector, and civil society	Planned				Qual		Qual		
		Achieved				Partially				
	Source									
	Key Informant Interviews and workshops in baseline and endline evaluations									

##	Indicator	Endline target	Legacy target
IM 3	**Qualitative indicator: progress towards mainstreaming the use of robust DRR data to systematically inform policy changes across public and private sector, and civil society**	There is evidence of: 1) Buy-in of METEOR outputs by the senior decision-makers of relevant Ministries (e.g. PMO in Tanzania and MoHA in Nepal) and of other end-users (e.g. NSET, ICIMOD, DFID in Nepal, and Red Cross, World Bank in Tanzania); 2) Ownership of METEOR outputs by key technical users in relevant governmental and other end-users (e.g. DMD, GST, TMA, UDSM, Resilience Academy in Tanzania, and NSET, ICIMOD, MoHA, DHM in Nepal).	There is evidence that 3 priority end-users (governmental and non-) in Tanzania and Nepal (at least 1 for each country) have used METEOR outputs to inform 3 DRRM activities (e.g. risk assessments, technical studies, policies or strategies).

OUTCOME 1	Outcome Indicator 1.1		2018*	2019*	2020*	2021*	TOT	2022*	TOT	Assumptions
The governments of Tanzania and Nepal utilise project outputs in DRR/DRM planning and practice	Qualitative indicator: progress towards use of project outputs by the governments of Nepal and Tanzania to inform their DRR/DRM decision-making and practice	Planned			Qual	Qual		N/A		• Natural disasters occur up to one year after the project and are of similar magnitude and location of those before the project.
		Nepal			Achieved	Partially achieved				• Relevant stakeholders are constrained to improve their DRR/DRM policy and planning by a lack of knowledge and awareness of the proper protocols, tools and data.
		Tanzania			Partially achieved	Partially achieved				• Political will is in place
	Source									
	Key Informant Interviews and workshops in baseline and endline evaluations									
	Outcome Indicator 1.2		2018*	2019*	2020*	2021*	TOT	2022*	TOT	
	Feedback from relevant Ministry (or decision-maker) on the usefulness of the project outputs for improving their national DRR/DRM **(KPI 1)**	Planned			Qual	Qual		Qual		
		Nepal			Achieved	Achieved				
		Tanzania			Partially achieved	Achieved				
	Source									
	Feedback from the Ministries through KII at baseline, midline, endline									

##	Indicator	Endline target	Legacy target
OC 1.1	**Qualitative indicator: progress towards use of project outputs by the governments of Nepal and Tanzania to inform their DRR/DRM decision-making and practice**	1. Relevant government stakeholders in Tanzania and Nepal confirm their intention to use METEOR outputs to support specific DRR/DRM assessments, technical studies, policies or strategies. 2. Between Outcome Indicator 1.1 and Outcome Indicator 2.1, end-users in Tanzania and Nepal have used the METEOR outputs in at least 1 DRRM activity per country.	N/A – Measured by Impact Indicator 3
OC 1.2	**Feedback from relevant Ministry (or decision-maker) on the usefulness of the project outputs for improving their national DRR/DRM (KPI 1)**	METEOR datasets are hosted on official/government-led platforms in Tanzania and Nepal.	METEOR datasets are <u>still</u> hosted by the official/government-led platforms <u>currently in use</u>

OUTCOME 2	Outcome Indicator 2.1		2018*	2019*	2020*	2021*	TOT	2022*	TOT	Assumptions
Other end-users (civil society, development partners, private sector, academia) in Tanzania and Nepal use project outputs in DRR/DRM decision-making and practice	Qualitative indicator: progress towards use of project outputs by the other end-users in Nepal and Tanzania to inform their DRR/DRM decision-making and practice	Planned			Qual	Qual		N/A		• Relevant stakeholders are constrained to improve their DRR/DRM policy and planning by a lack of knowledge and awareness of the proper protocols, tools and data.
		Nepal			Achieved	Partially achieved				• Resources are allocated • End users have willingness to change • Capacity levels of emergency plan implementers are adequate
		Tanzania			Partially achieved	Partially achieved				
		Source								
		Key Informant Interviews and workshops in baseline, midline, and endline								

##	Indicator	Endline target	Legacy target
OC 2.1	**Qualitative indicator: progress towards use of project outputs by "other end-users" (civil society, development partners, private sector, academia) in Nepal and Tanzania to inform their DRR/DRM decision-making and practice**	1. "Other end-users" in Tanzania and Nepal confirm their intention to use METEOR outputs to support specific DRR/DRM assessments, technical and/or scientific studies, strategies or inform their support to the government's DRR/DRM efforts. 2. Between Outcome Indicator 1.1 and Outcome Indicator 2.1, end-users in Tanzania and Nepal have used the METEOR outputs in at least 1 DRRM activity per country.	N/A – Measured by Impact Indicator 3

OUTCOME 3	Outcome Indicator 3.1			2018*	2019*	2020*	2021*	TOT	2022*	TOT	Assumptions
METEOR ouputs are used and adopted by the wider DRR community globally	Qualitative indicator: Feedback from the global community (e.g. UNICEF, UNISDR, WB, GFDRR) in respect of usefulness of project outputs **(KPI 4)**	Planned				Qual	Qual		Qual		• Resources are allocated • End users have willingness to change • Capacity levels of emergency plan implementers are adequate
		Achieved				Achieved	Achieved				
	Source										
	Key Informant Interviews in baseline and endline evaluations										
	Outcome Indicator 3.2			2018	2019	2020	2021	TOT	2022*	TOT	
	Qualitative indicator: Progress towards supporting the creation of CAT models, risk modelling / assessment studies or insurance products informed by METEOR data and/or protocols	Planned				Qual	Qual		Qual		
		Achieved				Achieved	Partially achieved				
	Source										
	Key Informant Interviews in baseline, midline, and endline evaluations										
	Outcome Indicator 3.3			2018*	2019*	2020*	2021*	TOT	2022*	TOT	
	Number of dissemination nodes where METEOR KPs and datasets are available to be accessed	Planned				0	6	6	0	6	
		Achieved				1	5	6			
	Source										
	KIIs at endline and legacy and internet search										

##	Indicator	Endline target	Legacy target
OC 3.1	**Qualitative indicator: Feedback from the global community (e.g. UNICEF, UNISDR, WB, GFDRR) in respect of usefulness of project outputs (KPI 4)**	There is evidence that the organisations on the METEOR Advisory Board are going to use the METEOR outputs in supporting DRRM activities in developing countries	There is evidence that METEOR outputs have been used by at least 3 development partners in supporting 3 DRRM activities in developing countries (including the uses in Nigeria and Tunisia already undertaken)
OC 3.2	**Qualitative indicator: Progress towards creating insurance products informed by METEOR data and/or protocols**	Insurance companies are engaged in creating new insurance products	There is evidence that METEOR outputs have been used by at least 1 insurance company, CAT modeler, or similar
OC 3.3	**Number of dissemination nodes where METEOR KPs and datasets are available to be accessed**	METEOR datasets are hosted by the 6 credible nodes. List of credible nodes: METEOR platform GEM OpenQuake World Bank GeoNode Humanitarian Data Exchange Nepal: Building Information Platform Against Disaster (BIPAD) Tanzania: Resilience Academy Geonode platform	METEOR datasets are still hosted by the 6 credible nodes and still being accessed

OUTPUT 1	Output Indicator 1.1		2018*	2019*	2020*	2021*	TOT	2022*	TOT	Assumption
Enhanced skills and knowledge in the use of DRR/DRM protocols and EO-based datasets	Percentage of professionals trained in Nepal and Tanzania reporting increased knowledge on the training topic (disaggregating males and females) **(KPI 3)**	Planned				75%	75%			• Decision-makers are willing to use the datasets they approve and find useful
		Males				95%	95%			• Trained stakeholders are able to use the knowledge gained during training to increase the overall capacity of their organisation
		Females				100%	100%			
		TOT				97%	97%			• Trained organisations in Tanzania and Nepal and end users downloading project outputs elsewhere are willing to use them and share their knowledge
		Source								
		Training feedback surveys and KIIs in baseline, midline, and endline								
	Output Indicator 1.2		2018*	2019*	2020*	2021*	TOT	2022*	TOT	
	Number of professionals trained in Nepal and Tanzania (disaggregating males and females)	Planned	0	0	0	50	50			
		Males	0	0	0	27	27			
		Females	0	0	0	16	16			
		TOT	0	0	0	43	43			
		Source								
		Training logs								
	Output Indicator 1.3		2018*	2019*	2020*	2021*	TOT	2022*	TOT	
	Number of organisations that had representatives trained in Nepal and Tanzania	Planned	0	0	0	10	10			
		Achieved		0	0	21	21			
		Source								
		Training logs								
	Output Indicator 1.4		2018*	2019*	2020*	2021*	TOT	2022*	TOT	
	Percentage of targeted institutions and organisations in Nepal and Tanzania that had at least two people trained	Planned				75%	75%			
		Achieved				10%	10%			
		Source								
		Training logs								

OUTPUT 4	Output Indicator 4.1		2018*	2019*	2020*	2021*	TOT	2022*	TOT	Assumption
Open access to Level 1 exposure data for 47 LDCs	Number of Level-1 datasets for LDCs uploaded on online platforms (aligned with SFDRR Global Target g and Priority Area 1) **(KPI 2b)**	Planned	0	0	0	47	47			• Decision-makers are willing to use the datasets they approve and find useful • Trained stakeholders are able to use the knowledge gained during training to increase the overall capacity of their organisation • Trained organisations in Tanzania and Nepal and end users downloading project outputs elsewhere are willing to use them and share their knowledge
		Achieved		0	0	47	47			
		Source								
		Data on online platforms								

OUTPUT 5	Output Indicator 5.1		2018*	2019*	2020*	2021*	TOT	2022*	TOT	Assumption
Communication products shared (CPs - Policy papers, training materials, publications, conference presentations, case studies etc.)	Policy paper on the use of national-scale exposure data for insurance and other risk-transfer mechanisms published and shared	Planned	0	0	0	1	1			• Decision-makers are willing to use the datasets they approve and find useful
		Achieved		0	0	0	0			• Trained stakeholders are able to use the knowledge gained during training to increase the overall capacity of their organisation
		Source								
		Data on online platforms								• Trained organisations in Tanzania and Nepal and end users downloading project outputs elsewhere are willing to use them and share their knowledge
	Output Indicator 5.2		2018*	2019*	2020*	2021*	TOT	2022*	TOT	
	Number of communication products shared	Planned	0	7	7	5	19			
		Achieved	9	13	4	21	47			
		Source								
		Data on online platforms								
	Output Indicator 5.3		2018*	2019*	2020*	2021*	TOT	2022*	TOT	
	Number of conferences or workshops hosted or attended by consortium members at which METEOR's findings are shared or discussed	Planned	0	2	3	5	10			
		Achieved	4	10	7	7	28			
		Source								
		Monthly Reporting to UKSA								

* The milestone dates all refer to the 7 February of each year

9.4. Online user survey

[Available here: https://forms.gle/DQjhE89CRegNKB3X8]

Online questionnaire on the METEOR data sets and protocols

This survey is conducted for assessing the quality and usefulness of the METEOR data sets and protocols that you have either downloaded or were sent to. It takes about **5 minutes** to complete and the information you will provide will be used in the final evaluation of the METEOR project as well as for understanding potential improvements needed. We thank you in advance for your support!

If you are okay to be contacted again in 1 year time for another 5-minute questionnaire to review whether and how you have used the METEOR products, that would be extremely helpful. In that case, please include your email address below.

Email: [Free text field]

Important: Your email address will be stored by the British Geological Survey and will not be used for any other purposes. In compliance with the EU GDPR laws, you can request the removal of your email address from the database in any moment, by emailing Kay Smith at xxx@bgs.ac.uk.

Question 1. Which METEOR product(s) have you viewed? (Tick all applicable answers) [Multiple answers allowed]

a. Exposure Data Set

- Which countries or regions were covered? [Field comes out if option is ticked. Free text answer]

b. Hazard Data Set

- Please select the applicable characteristics [Field comes out if option is ticked. Multiple answers allowed]

  o Nepal

  o Tanzania

  o Earthquakes

  o Flooding

  o Landslides

  o Volcanic Eruptions

  o Multi-hazard

c. Vulnerability Data Set

- Please select the applicable characteristics [Field comes out if option is ticked. Multiple answers allowed]

  o Nepal

  o Tanzania

d. Detailed Protocols (Methodology)

- Which data do they refer to? [Field comes out if option is ticked. Multiple answers allowed]

     o Exposure

     o Hazard

     o Vulnerability

Question 2. How did you hear about METEOR? (A few words will do, thanks!)

[Free text answer]

Question 3. How did you receive the METEOR product(s)? [One response only]

 a. Received link by email by the METEOR project team

   • From which organisation? [Field comes out if option is ticked. Free text answer]

 b. Received link by email by a third party (i.e. not by the METEOR project team)

   • From which organisation? [Field comes out if option is ticked. Free text answer]

 c. No link received by email. I downloaded it/them from the METEOR portal

 d. No link received by email. I downloaded it/them from a third party portal

   • Please paste here the URL of the portal? [Field comes out if option is ticked. Free text answer]

Question 4. Why are you interested in METEOR products? How do you plan to use them? (This is very important to us!)

[Free text answer]

[For each of the products ticked in Question 1, this section will appear]

Question 5a. How would you rate the quality and completeness of the Exposure Data Sets you reviewed? [One response only]

 a. Excellent

 b. Good

 c. Neither good nor bad

 d. Not very good

 e. Bad

   • Please let us know what we could improve [Free text answer]

Question 5b. How would you rate the quality and completeness of the Hazard Data Sets you reviewed? [One response only]

 a. Excellent

 b. Good

 c. Neither good nor bad

 d. Not very good

 e. Bad

- Please let us know what we could improve [Free text answer]

Question 5c. How would you rate the quality and completeness of the Vulnerability Data Sets you reviewed? [One response only]

a. Excellent

b. Good

c. Neither good nor bad

d. Not very good

e. Bad

- Please let us know what we could improve [Free text answer]

Question 5d. How would you rate the quality and completeness of the Protocols you reviewed? [One response only]

a. Excellent

b. Good

c. Neither good nor bad

d. Not very good

e. Bad

- Please let us know what we could improve [Free text answer]

That is it! Thank you so much for taking the time to give us your feedback! If you wish to get in touch, feel free to email Kay Smith at xxx@bgs.ac.uk.

9.5. List of knowledge and communication products, and outreach events

9.5.1. Knowledge and communication products published

1. DOCUMENT (31 May 2018): Monitoring & Evaluation Plan. METEOR Report Number: M2.2/P (https://meteor-project.org/storage/METEOR_M2.2P_Monitoring_Evaluation_Plan.pdf)

2. DOCUMENT (31 August 2018): Import Existing Data into OSM. METEOR Report Number: M4.1/P (https://meteor-project.org/documents/METEOR_M4.1P_Import_Existing_Data_into_OSM.pdf)

3. CONFERENCE PRESENTATION (3-6 September 2018): METEOR: Modelling Exposure through Earth Observation Routines. Proceedings of the National EO Conference, Birmingham.

4. CONFERENCE PRESENTATION (4 September 2018): UKNEOC 2018: Jordan, et al. (2018) METEOR: Modelling Exposure Through Earth Observation Routines

5. DOCUMENT (14 September 2018): Baseline Design Document. METEOR Report Number: M2.3/P (https://meteor-project.org/storage/METEOR_M2.3P_Baseline_Design_Document.pdf)

6. DOCUMENT (25 October 2018): Definition of taxonomy for multi-peril vulnerability. METEOR Report Number: M5.1/P (https://meteor-project.org/storage/METEOR_M5.1P_Definition_of_taxonomy_for_multi-peril_vulnerability.pdf)

7. BLOG (28 November 2018): Turning UK aid into sustainable space projects (https://www.devex.com/news/sponsored/turning-uk-aid-into-sustainable-space-projects-93895)

8. DOCUMENT (1 December 2018): Mapping of Exposure. METEOR Report Number: M4.2/P (https://meteor-project.org/documents/METEOR_M4.2P_EO_Mapping_of_Exposure.pdf)

9. EVENT PRESENTATION (5 December 2018): GEM2018 Global Earthquake Model Working together to assess risk: Jordan, et al. (2018) METEOR: Modelling Exposure Through Earth Observation Routines

10. CONFERENCE PRESENTATION (10-14 December 2018): Addressing the disaster risk reduction needs of end users in emerging countries using Earth Observation (EO) data and innovative risk products as part of the "Modelling Exposure through Earth Observation Routines (METEOR)" project. AGU Fall Meeting. San Francisco. (https://agu.confex.com/agu/fm19/meetingapp.cgi/Paper/608342)

11. CONFERENCE PRESENTATION (10-14 December 2018): Modelling Exposure Through Earth Observation Routines (METEOR) for Developing Countries: Increasing availability and access to more robust risk information. AGU Fall Meeting. Abstract #NH52B-03.

12. DOCUMENT (6 February 2019): Exposure Data Classification, Metadata Population and Confidence Assessment. METEOR Report Number: M3.2/P (https://meteor-project.org/documents/METEOR_M3.2P_Exposure_Data_Classification_Metadata_Population_and_Confidence_Assessment.pdf)

13. DOCUMENT (11 February 2019): Protocols for Crowd-Sourcing Regional Exposure Data. METEOR Report Number: M4.3/P (https://meteor-project.org/documents/METEOR_M4.3P_Protocols_for_Crowd-Sourcing_Regional_Exposure_Data.pdf)

14. DOCUMENT (15 February 2019): Baseline Evaluation Report. METEOR Report Number: M2.4/P (https://meteor-project.org/storage/METEOR_M2.4P_Baseline_Evaluation_Report.pdf)

15. DOCUMENT (19 March 2019): Hazard Footprint for Nepal and Tanzania. METEOR Report Number: M6.1/P (https://meteor-project.org/storage/METEOR_M6.1P_Hazard_Footprints_for_Nepal_and_Tanzania.pdf)

16. BLOG (3 April 2019): An approach to field data collection in Kathmandu (https://www.hotosm.org/updates/an-approach-to-field-data-collection-in-kathmandu/)

17. CONFERENCE PRESENTATION (April 2019): METEOR: Modelling Exposure through Earth Observation Routines to aid sustainable development. Geophysical Research Abstract, Vol 21, EGU 2019-17990

18. BLOG (27 June 2019): Collecting building data sets for exposure data in Tanzania (https://www.hotosm.org/updates/collecting-building-data-sets-for-exposure-data-in-tanzania/)

19. DOCUMENT (August 2019): Midline Design Document. METEOR Report Number: M2.5/P (https://meteor-project.org/storage/METEOR_M2.5P_Midline_Design_Document.pdf)

20. DOCUMENT (1 August 2019): Ground Data Collection Using Protocols Kathmandu, Nepal. METEOR Report Number: M4.4/P (https://meteor-project.org/documents/METEOR_M4.4P_Ground_Data_Collection_Using_Protocols_I_Kathmandu.pdf)

21. CONFERENCE PRESENTATION (13 May 2019): ESA Living Planet Symposium 2019: Jordan, et al. (2019) METEOR: Modelling Exposure Through Earth Observation Routines, a step towards Disaster Risk Reduction for ODA countries

22. CONFERENCE PRESENTATION (19 September 2019): HOT Summit and State of The Map 2019: O'Hara, et a. (2019) How can we use remote sensing technology to assess exposure to natural hazards? The METEOR Project

23. CONFERENCE PRESENTATION (9-13 December 2019): METEOR: Constructing methodologies for multi-hazard impacts on exposure in developing nations. AGU Fall Meeting. San Francisco. https://agu.confex.com/agu/fm19/meetingapp.cgi/Paper/583006

24. CONFERENCE PAPER (December 2019): AGU 2019: Winson, et al, (2019) METEOR: Constructing methodologies for multi-hazard impacts on exposure in developing nations. American Geophysical Union, Fall Meeting 2019, abstract IN51C-01

25. CONFERENCE PAPER (December 2019): AGU 2019: Ghosh, et al. (2019) Addressing the disaster risk reduction needs of end users in emerging countries using Earth Observation (EO) data and innovative risk products as a part of the "Modelling Exposure through Earth Observation Routines (METEOR)" project. American Geophysical Union, Fall Meeting 2019, abstract IN43B-05

26. DOCUMENT: Jordan, C. (2019) METEOR: Modelling Exposure Through Earth Observation Routines to Aid Sustainable Development. Geophysical Research Abstracts . 2019, Vol. 21, p1-1. 1p

27. CONFERENCE PRESENTATION (7 April 2019) EGU 2019: Jordan, et al. (2019) METEOR: Modelling Exposure Through Earth Observation Routines to Aid Sustainable Development

28. DOCUMENT (16 January 2020): Methods for Analysing Multi-Hazards with Exposure. METEOR Report Number: M6.2/P (https://meteor-project.org/storage/METEOR_M6.2P_Methods_for_Analysing_Multi-Hazards_with_Exposure.pdf)

29. BLOG (February 2020): METEOR: modelling Exposure Through Earth Observation Routines (https://www.spacefordevelopment.org/blog/2020/02/meteor-modelling-exposure-through-earth-observation-routines/)

30. DOCUMENT (March 2020): Midline Evaluation Report. METEOR Report Number: M2.6/P (https://meteor-project.org/storage/METEOR_M2.6P_Midline_Evaluation_Report.pdf)

31. DOCUMENT (8 April 2020): Assessment of Vulnerability Uncertainty. METEOR Report Number: M5.3/P (https://meteor-project.org/storage/METEOR_M5.3P_Assessment_of_Vulnerability_Uncertainty.pdf)

32. DOCUMENT (22 April 2020): Collection of Loss Data and Development of Vulnerability Models. METEOR Report Number: M5.2/P (https://meteor-project.org/storage/METEOR_M5.2P_Collection_of_Loss_Data_and_Development_of_Vulnerability_Models.pdf)

33. DOCUMENT (22 April 2020): Landslide Methodology Report. METEOR Report Number: M6.2b/P (https://meteor-project.org/storage/METEOR_M6.2bP_Landslide_Methodology_Report.pdf)

34. DOCUMENT (24 September 2020): Ground Data Collection Using Protocols II. Dar es Salaam, Tanzania. METEOR Report Number: M4.5/P (https://meteor-project.org/storage/METEOR_M4.5P_Ground_Data_Collection_Using_Protocols_II_DarEsSalaam_v4.pdf)

35. DOCUMENT (30 November 2020): Draft Protocols on Hazard and Exposure Modelling. METEOR Report Number: M6.3/P (https://meteor-project.org/storage/METEOR_M6.3P_Draft_Protocols_on_Hazard_and_Exposure_Modelling.pdf)

36. DOCUMENT (15 December 2020): Endline Design Document. METEOR Report Number: M2.8/P (https://meteor-project.org/storage/METEOR_M2.8P_Endline_Design_Document.pdf)

37. CONFERENCE PAPER: AGU 2020: Ghosh, et al (2020) UK Space Agency's METEOR project: Making the case for Earth Observation (EO) data for insurance in developing countries. AMERICAN Geophysical Union, Fall Meeting 2020, abstract NH036-08

38. DOCUMENT: Huyck, C (IN REVIEW) Characterizing Uncertainty of General Building Stock Exposure Data. Earthquake Spectra. (manuscript ID: EQS-20-0097)

39. DOCUMENT (10 February 2021): Propagation of uncertainty on disaster risk analyses. METEOR Report Number: M5.4/P (https://meteor-project.org/storage/METEOR_M5.4P_Propagation_of_uncertainty_on_disaster_risk_analyses.pdf)

40. BLOG (25 March 2021): "Exposure Data and Models Shared with Disaster Management Stakeholders in Tanzania" on HOT's website (https://www.hotosm.org/updates/exposure-data-and-models-shared-with-disaster-management-stakeholders-in-tanzania/CONFERENCE PAPER (April 2021): EGU 2021: Winson, et al. (2021) METEOR: A methodology for assessing the potential for multi-hazard impacts on building exposure in developing nations. EGU General Assembly 2021, online, 19–30 Apr 2021, EGU21-10983 (https://doi.org/10.5194/egusphere-egu21-10983, 2021)

41. DOCUMENT (19 March 2021): Open source taxonomy, data model and documentation. METEOR Report Number: M3.5/P (PENDING UPLOAD TO WEBSITE)

Exposure

1. **Introduction to exposure data**

   - VIDEO:
     https://www.youtube.com/watch?list=PL08aqbvcszvR8VSy2znTarUsmzpIrCXsF&v=AFuHJzfRbuk

   - NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/presentations/1.%20Introduction%20to%20exposure.pdf

   - NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/transcripts/1-4.%20Exposure%20transcript.pdf

   - TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/presentations/1.%20Introduction%20to%20exposure.pdf

   - TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/transcripts/1-4.%20Exposure%20transcript.pdf

2. **Basic process of exposure development**

   - VIDEO:
     https://www.youtube.com/watch?list=PL08aqbvcszvR8VSy2znTarUsmzpIrCXsF&v=sGp4bHLPkjw

   - NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/presentations/2.%20Basic%20process%20of%20developing%20exposure%20data.pdf

   - NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/transcripts/1-4.%20Exposure%20transcript.pdf

   - TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/presentations/2.%20Basic%20process%20of%20developing%20exposure%20data.pdf

   - TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/transcripts/1-4.%20Exposure%20transcript.pdf

3. **Value of EO data in exposure development**

   - VIDEO:
     https://www.youtube.com/watch?list=PL08aqbvcszvR8VSy2znTarUsmzpIrCXsF&v=NVS48vXa-Bg

   - NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/presentations/3.%20Value%20of%20EO%20data%20in%20exposure%20development.pdf

   - NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/transcripts/1-4.%20Exposure%20transcript.pdf

   - TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/presentations/3.%20Value%20of%20EO%20data%20in%20exposure%20development.pdf

   - TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/transcripts/1-4.%20Exposure%20transcript.pdf

4. **Understanding exposure data**

- VIDEO:
  https://www.youtube.com/watch?list=PL08aqbvcszvR8VSy2znTarUsmzpIrCXsF&v=d1RDFq TZ-u8

- NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/presentations/4.%20Understanding%20exposure%20data.pdf

- NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/transcripts/1-4.%20Exposure%20transcript.pdf

- TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/presentations/4.%20Understanding%20exposure%20data.pdf

- TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/transcripts/1-4.%20Exposure%20transcript.pdf

5. **Overview of exposure development for METEOR**

- VIDEO:
  https://www.youtube.com/watch?list=PL08aqbvcszvR8VSy2znTarUsmzpIrCXsF&v=u8JLDZX tFj4

- NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/presentations/METEOR%20Exposure%20Overview.pptx.pdf

- NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/transcripts/METEOR%20Exposure%20Overview%20Transcript.docx.pdf

- TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/presentations/METEOR%20Exposure%20Overview.pptx.pdf

- TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/transcripts/METEOR%20Exposure%20Overview%20Transcript.docx.pdf

6. **Overview of exposure metadata for METEOR**

- VIDEO:
  https://www.youtube.com/watch?list=PL08aqbvcszvR8VSy2znTarUsmzpIrCXsF&v=2SJKeMl rSZk

- NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/presentations/METEOR%20Metadata%20Overview.pptx.pdf

- NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/transcripts/METEOR%20Metadata%20Overview%20Transcript.docx.pdf

- TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/presentations/METEOR%20Metadata%20Overview.pptx.pdf

- TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/transcripts/METEOR%20Metadata%20Overview%20Transcript.docx.pdf

7. **Demonstration of exposure flowchart for METEOR in Nepal**

- NEPAL VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvSB-fRKzWgg9yZteLSxprTB&v=a-ano3uZ5mw

- NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/presentations/METEOR_Nepal_Flowchart_Demonstration.pdf

- NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/exposure/transcripts/METEOR_Nepal_Flowchart_Demonstration_Transcript.pdf

- TANZANIA VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvR8VSy2znTarUsmzpIrCXsF&v=bc1ckh8j5As

- TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/presentations/METEOR_Tanzania_Flowchart_Demonstration.pptx.pdf

- TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/exposure/transcripts/METEOR_Tanzania_Flowchart_Demonstration_Transcript.docx.pdf

Flooding

1. **Introduction to flood modelling**

- VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvRCG4blOhhOXSpT4VZM9HuY&v=LyRcfxIVsb8

- NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/floods/presentations/Introduction%20to%20Flood%20Modelling.pdf

- NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/floods/transcripts/Introduction%20to%20Flood%20Modelling%20Transcript.pdf

- TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/floods/presentations/Introduction%20to%20Flood%20Modelling.pdf

- TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/floods/transcripts/Introduction%20to%20Flood%20Modelling%20Transcript.pdf

2. **METEOR flood modelling**

- VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvRCG4blOhhOXSpT4VZM9HuY&v=2coVGE6ZInI

- NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/floods/presentations/METEOR%20Flood%20Modelling.pdf

- NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/floods/transcripts/METEOR%20Flood%20Modelling%20Transcript.pdf

- TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/floods/presentations/METEOR%20Flood%20Modelling.pdf

- TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/floods/transcripts/METEOR%20Flood%20Modelling%20Transcript.pdf

Seismic

1. **Introduction to disaster risk assessment for earthquakes**

   - NEPAL VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvRCG4blOhhOXSpT4VZM9HuY&v=LyRcfxIVsb8

   - NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/seismic/presentations/Earthquake%20Scenario%20Methodology%20-%20Nepal.pdf

   - NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/seismic/transcripts/Earthquake%20Scenario%20Methodology%20-%20Nepal%20(Transcript).pdf

   - TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/seismic/presentations/1.%20Disaster%20Risk%20Assessment%20for%20Earthquakes%20-%20Tanzania.pdf

   - TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/seismic/transcripts/Earthquake%20Scenario%20Methodology%20-%20Tanzania%20(Transcript).pdf

2. **Demonstration of scenario risk assessment for earthquakes**

   - NEPAL VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvQ_1giOFNSxo6T7nwoqjGSg&v=2JI0v_gEk0U

   - NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/seismic/presentations/Earthquake%20Scenario%20Demonstration%20-%20Nepal.pdf

   - TANZANIA VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvQbYHmvRHanx7bGxXZ-IOfj&v=GzzSmMNoi-k

   - TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/seismic/presentations/Tanzania%20-%20Scenario%20Walkthough.pdf

Landslide

1. **Introduction to landslides**

   - NEPAL VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvRKGRnmKsL1u73eHno-m0SM&v=EOSqVWMPvFw

   - NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/landslide/presentations/1.%20Introduction%20to%20Landslides.pdf

   - NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/landslide/transcripts/1.%20%20Introduction%20to%20Landslides.pdf

- **Creation of hazard susceptibility maps**

   - NEPAL VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvRKGRnmKsL1u73eHno-m0SM&v=45Z1aCgT3wQ

- NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/landslide/presentations/2.%20Creation%20of%20hazard%20susceptibility%20maps.pdf

- NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/landslide/transcripts/2.%20Creation%20of%20hazard%20susceptibility%20maps.pdf

- **GIS landslide implementation**

  - NEPAL VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvRKGRnmKsL1u73eHno-m0SM&v=l1wPUaCaAl8

  - NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/landslide/presentations/3.%20GIS%20Landslide%20Implementation.pdf

  - NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/landslide/transcripts/3.%20GIS%20Landslide%20implementation.pdf

Volcanic

1. **Introduction to volcanic hazard assessment**

   - TANZANIA VIDEO: https://www.youtube.com/watch?v=wkvYjXwh84I

   - TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/volcanoes/presentations/Introduction%20to%20volcanoes_METEOR%20volcanic%20hazard%20assessment.pptx.pdf

   - TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/volcanoes/transcripts/Introduction%20to%20volcanoes_METEOR%20volcanic%20hazard%20assessment.docx.pdf

Multi-hazard Impact

1. **Introduction to multi-hazards**

   - VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvRmWJRjg5AMGAWFkhIuJdwq&v=PNr2aLnU2GI

   - NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/multi-hazard-risk/presentations/1.%20Introduction%20to%20Multihazards.pdf

   - NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/multi-hazard-risk/transcripts/1.%20Introduction%20to%20Multihazards.pdf

   - TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/multi-hazard-risk/presentations/1.%20Introduction%20to%20Multihazards.pdf

   - TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/multi-hazard-risk/transcripts/1.%20Introduction%20to%20Multihazards.pdf

2. **Modelling multi-hazards**

   - NEPAL VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvSL5pbqiec-CrL9M1nYJdh8&v=lMw1XijshPs

   - NEPAL PDF: https://downloads.openquake.org/meteor/training-materials/nepal-training/multi-hazard-risk/presentations/2a.%20Modelling%20Multihazards%20Nepal.pdf

- NEPAL TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/nepal-training/multi-hazard-risk/transcripts/2a.%20Modelling%20Multihazards%20Nepal.pdf

- TANZANIA VIDEO: https://www.youtube.com/watch?list=PL08aqbvcszvRmWJRjg5AMGAWFkhIuJdwq&v=5b5XY0q5Nww

- TANZANIA PDF: https://downloads.openquake.org/meteor/training-materials/tanzania-training/multi-hazard-risk/presentations/2b.%20Modelling%20Multihazards%20Tanzania.pdf

- TANZANIA TRANSCRIPT: https://downloads.openquake.org/meteor/training-materials/tanzania-training/multi-hazard-risk/transcripts/2b.%20Modelling%20Multihazards%20Tanzania.pdf

Social Media

1. 12/03/2021: Building Disaster Resilient Countries/Cities Through Open Spatial Data and Exposure Analysis (https://www.hotosm.org/updates/building-disaster-resilient-countries-slash-cities-through-open-spatial-data-and-exposure-analysis/)
2. 26/02/2021: OMDTZ Level 1 exposure map of Tanzania (https://twitter.com/OMDTZ/status/1365189649359069187)
3. 26/02/2021: BGS Stakeholder Workshop in Tanzania: Day 2 (https://twitter.com/ColmJordan/status/1365210765939113984)
4. 25/02/2021: BGS Stakeholder Workshop in Tanzania: Day 1 (https://twitter.com/ColmJordan/status/1364918155060146182)
5. 14/10/2020: ImageCat on UN Disaster Risk Reduction Day – L1 LDC Exposure release (https://twitter.com/ImageCatInc/status/1316152674299998208)
6. 13/10/2020: GEM on UN Disaster Risk Reduction Day – L1 LDC Exposure release (https://twitter.com/nicopurr/status/1316050382519513088)
7. 29/07/2020: ImageCat using METEOR data to address impacts of flooding in Africa (https://twitter.com/ImageCatInc/status/1288554952659329024)
8. 08/03/2020: BGS DMD training in Tanzania with HOT and OMDTZ (https://twitter.com/winsonannie/status/1236714300074536961)
9. 02/03/2020: BGS DMD training on exposure in Tanzania with HOT and OMDTZ (https://twitter.com/winsonannie/status/1234463832271138817)
10. 13/11/2019: BGS Stakeholder Engagement Workshop in Nepal (https://twitter.com/winsonannie/status/1194488078372491265)
11. 13/10/2019: BGS UN Disaster Risk Reduction Day co-design of METEOR products (https://twitter.com/britgeosurvey/status/1183306539286827008)
12. 13/10/2019: BGS UN Disaster Risk Reduction Day the METEOR project (https://twitter.com/BritGeoSurvey/status/1183303881113194497)
13. 13/10/2019: HOT UN Disaster Risk Reduction Day (https://twitter.com/hotosm/status/1316060645209649152)
14. 27/06/2019: Collecting building data sets for exposure data in Tanzania (https://www.hotosm.org/updates/collecting-building-data-sets-for-exposure-data-in-tanzania/)
15. 03/04/2019: An approach to field data collection in Kathmandu (https://www.hotosm.org/updates/an-approach-to-field-data-collection-in-kathmandu/)
16. 28/11/2018: Turning UK aid into sustainable space projects (https://www.devex.com/news/sponsored/turning-uk-aid-into-sustainable-space-projects-93895)

9.5.2. Workshops, conferences and events attended

1. EVENT (10-14 December 2018): American Geophysical Union 2018 (https://meteor-project.org/documents/AGU_METEOR_GHOSH_121218.pdf)

2. EVENT (5 December 2018): GEM2018 Global Earthquake Model: Working together to assess risk (https://meteor-project.org/documents/METEOR_poster_Pavia_November_2018.pdf and https://meteor-project.org/documents/poster_GEM_meeting_v7.pdf)

3. EVENT (4-7 September 2018): UK National Earth Observation Conference 2018 (https://meteor-project.org/documents/METEOR_poster_UKNEOC_2018.pdf)

4. PRESENTATION: 20/09/2018: DfID, Use of science for informing DRR in Nepal and beyond

5. EVENT (December 2019): American Geophysical Union 2019 (https://meteor-project.org/documents/AGU_iPosterSessions.pdf)

6. WORKSHOP (November 2019): Stakeholder workshop for technical officials in Nepal

7. WORKSHOP (November 2019): Stakeholder workshop for policy-makers in Nepal

8. EVENT (19-23 September 2019): HOT Summit and State of the Map 2019 (https://meteor-project.org/documents/2019-09%20_%20HOT%20Summit%20%20__%20METEOR%20Project.pdf)

9. EVENT (12-17 May 2019): ESA Living Planet Symposium 2019 (https://meteor-project.org/documents/METEOR_poster_LPS_May_2019.pdf)

10. EVENT (7-12 April 2019): EGU General Assembly 2019 (https://meteor-project.org/documents/METEOR_EGU19_ColmJordan.pdf)

11. WORKSHOP (13/03/2019): Stakeholder Engagement Workshop, ground data collection, Tanzania

12. WORKSHOP (14/03/2019): South-South learning workshop, Tanzania

13. PRESENTATION (26/06/2019): Humanitarian Data Exchange

14. PRESENTATION (23/05/2019): Insurance Industry Advisory Group Meeting 1

15. EVENT (14/01/2020): UK Space2Connect – networking event

16. PRESENTATION (23/12/2020): Nepal National Advisory Meeting

17. PRESENTATION (19/11/2020): Lloyds DRF Meeting

18. PRESENTATION (11/11/2020): GFDRR

19. CONFERENCE: AGU 2020: Ghosh, et al (2020) UK Space Agency's METEOR project: Making the case for Earth Observation (EO) data for insurance in developing countries. AMERICAN Geophysical Union, Fall Meeting 2020, abstract NH036-08

20. PRESENTATION (03/03/2020): Insurance Industry Advisory Group Meeting 2

21. PRESENTATION (24/09/2020): Insurance Industry Advisory Group Meeting 3

22. WORKSHOP (09/03/2021): NDRRMA, Nepal – Stakeholder pre-training workshop

23. WORKSHOP (25-26/02/2021): Stakeholder Training Workshop, Tanzania

24. PRESENTATION (22/02/2021): NDRRMA pre-training discussion, Nepal

25. PRESENTATION (28/01/2021): UNICEF – DUU open house series

26. CONFERENCE (20/01/2021): 23rd Nepal Symposium: Multi-hazard Risk Assessment Initiatives in Nepal: Challenges and Opportunities

27. PRESENTATION (23/02/2021): Insurance Industry Advisory Group Meeting 4

28. CONFERENCE: EGU 2021: Winson, et al. (2021) METEOR: A methodology for assessing the potential for multi-hazard impacts on building exposure in developing nations. EGU General Assembly 2021, online, 19–30 Apr 2021, EGU21-10983 (https://doi.org/10.5194/egusphere-egu21-10983, 2021)