METEOR: Legacy Evaluation Report
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METEOR: Modelling Exposure Through Earth Observation Routines

UK SPACE AGENCY

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British Geological Survey
Expert | Impartial | Innovative

FATHOM

GEM
GLOBAL EARTHQUAKE MODEL
working together to assess risk

Oxford Policy Management

HOT

ImageCat

NSET
Earthquake Safe Communities in Nepal

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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
BMZ	German Ministry of the Environment
CAT	Catastrophe
CBO	Community-Based Organisations
CBS	Central Bureau of Statistics, Nepal
CCG	Climate Compatible Growth programme
CEA	Cost-Effectiveness Analysis
COP26	26th Conference of Parties of the UNFCCC
DAC	Development Assistance Committee
DFID	UK Department for International Development (now part of FCDO)
DHM	Department of Hydrology and Meteorology, Nepal
DLK	Germany Aerospace Centre
DMA	Disaster Management Agency, Tanzania
DMD	Disaster Management Department: Prime Minister's Office of Tanzania focused on disaster risk
DP	Development Partner
DRFIP	Disaster Risk Financing and Insurance Programme
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DRRM	Disaster Risk Reduction and Management
DUDBC	Department of Urban Development and Building Construction, Nepal
EO	Earth Observation
EP&R	Emergency Preparedness and Response
EQ	Evaluation Question
ESG	Environmental, Social, and Governance
Fathom	Provides innovative flood modelling and analytics, based on extensive flood risk research
FCDO	Foreign, Commonwealth and Development Office, UK
FGD	Focus Group Discussion
FNCCI	Federation of Nepalese Chambers of Commerce & Industry
GBP	Great British Pounds (£)

GDP	Gross Domestic Product
GED4ALL	Global Exposure Database for Multi-Hazard Risk Analysis
GEM	Global Earthquake Model: Non-profit organisation focused on the pursuit of earthquake resilience worldwide
GFDRR	Global Facility for Disaster Reduction and Recovery
GLOF	Glacial Lake Outburst Flood
GoN	Government of Nepal
GoT	Government of Tanzania
GRMA	Global Risk Modelling Alliance, IDF
GST	Geological Survey of Tanzania
HDX	Humanitarian Data Exchange
HOT	Humanitarian OpenStreetMap Team: A global non-profit organisation the uses collaborative technology to create OSM maps for areas affected by disasters
IBF	Impact Based Weather Forecasting
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
IPP	International Partnership Programme
IT	Information Technology
JBA	Flood risk management company
KII	Key Informant Interview
KP	Knowledge Products
KPI	Key Performance Indicator
KTH	Royal Institute of Technology, Sweden
L&D	Loss and Damage
LDC	Least Developed Country
LDCRP	Local Disaster and Climate Resilience Planning, Nepal
LEOC	Local Emergency Operations Centre, Nepal
LGA	Local Government Authority
M&E	Monitoring & Evaluation
METEOR	Modelling Exposure Through Earth Observation Routines
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
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
ODA	Official Development Aid
OECD	Organisation for Economic Co-operation and Development
OED	Open Exposure Data format of the Oasis Loss Modelling Framework
OPM	Oxford Policy Management Limited: Organisation focused on sustainable project design and implementation for reducing social and economic disadvantage in low-income countries
PDNA	Post Disaster Needs Assessment
PEA	Political Economic Analysis
PIF	Policy and institutions Facility, Nepal
PMO	Prime Minister's Office, Tanzania
QA	Quality Assurance
RAG	Red-Amber-Green
SDGs	Sustainable Development Goals
SITREP	Situation Reports
SoP	Standard Operation Procedure
SUPER	Strengthen Urban Preparedness, Earthquake preparedness and Response
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	United Kingdom Research and Innovation
UKSA	United Kingdom Space Agency
UN	United Nations
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNICEF	United Nations Children's Emergency Fund
UNISDR	United Nations International Strategy for Disaster Reduction
UNFCCC	United Nations Framework Convention on Climate Change
UN RCO	United Nations Resident Coordinator's Office
UNWOMEN	United Nations Entity for Gender Equality and the Empowerment of Women
URBE Latam	Understanding Risks & Building Enhanced Capabilities in Latin American cities
USAID	United States Agency for International Development
V20	Vulnerable 20 Group of Countries
WB	World Bank
YILabs	Youth Innovation Labs, Nepal

Executive Summary

Introduction

This report gives the methodology, findings and conclusions from the legacy evaluation of the METEOR project (Modelling Exposure Through Earth Observation Routines) just under one year from the closure of the project in March 2021. The project's purpose was to generate robust data to help reduce the human and financial cost of disasters such as earthquakes, landslides, volcanic eruptions and floods. Policies, plans and actions relating to Disaster Risk Reduction and Management (DRRM) need to be based on a good understanding of the distribution and character of exposure. METEOR applied innovative techniques in Earth Observation (EO), developing and delivering accurate information on the level of buildings' exposure to natural hazards. Hazard footprints were created, together with open protocols and capacity development of local decision-makers to apply the data and assess hazard exposure. The project ran for three years and was managed by a consortium led by the British Geological Survey[1] together with ImageCat[2], the Humanitarian OpenStreetMap Team[3], Oxford Policy Management[4], the Global Earthquake Model (GEM) Foundation[5] and Fathom[6]. The project delivered detailed data for two countries, Nepal and Tanzania, and less detailed data for the 47 least developed ODA countries[7]. The lead partner in Nepal was the National Society for Earthquake Technology[8] (NSET) with the Disaster Management Department of the Prime Minister's Office[9] (DMD) in Tanzania. The project was co-funded through the UK Space Agency's (UKSA) International Partnership Programme[10] (IPP).

There are two objectives of this legacy evaluation: to assess the evidence of projects outcomes and impact, and investigate causality between the project and the outcomes; and to provide insights on how to strengthen the design and implementation of future interventions based on the experience and reflection of the METEOR project.

Methodology

This evaluation focused on four key questions around relevance (was there a real need for national exposure and multi-hazard data and protocols?), effectiveness (to what extent did the outputs lead to improvements in the capacity of stakeholders to use the data in DRRM policy and practice?), impact (is there evidence to suggest that the project has improved DRRM policy and planning?) and sustainability (is there evidence of sustained interest by DRRM stakeholders and utilising METEOR data and protocols?). This evaluation used a range of techniques to gather data, including desk research, participatory workshops, and key informant interviews. Findings and conclusions were shared and validated at a learning event, where lessons and recommendations were discussed. In line with the previous evaluations, the evidence was analysed around 3 case studies. For the Global Case Study, interviews were held with development partners, insurance industry representatives, and DRRM professionals from ODA countries. Data collection was based on a workshop with METEOR partners and information on data downloads from the hosting online platforms. For the Nepal Case Study, the political economy analysis was updated to refresh the national political, institutional, and economic

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[1] https://www.bgs.ac.uk/

[2] imagecatinc.com

[3] https://www.hotosm.org/

[4] https://www.opml.co.uk/

[5] https://www.globalquakemodel.org/

[6] https://www.fathom.global/

[7] https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/daclist.htm

[8] https://www.nset.org.np/

[9] https://www.tanzania.go.tz/

[10] https://www.gov.uk/government/collections/international-partnership-programme

context related to DRRM. Interviews were carried out with a range of government, NGO, academic and donor organisations. A similar process was undertaken in the Tanzania Case Study.

There were some challenges experienced in carrying out this evaluation. The time available for implementation was short: from contracting in January 2022 to completion in mid-March 2022. The national case studies interviews were held in person, while those for the global case study took place over zoom. COVID-19 meant that few international conferences took place. It had been planned that such conferences would be used to gather data from key stakeholders in ODA countries on their use of the datasets. In Tanzania, there were difficulties confirming meetings and accessing individuals with experience of using the data. This issue was mirrored in Nepal, where the turnover of critical government staff is high.

Results against legacy targets

The table below lists the targets for the legacy at the Impact and outcome levels, colour coded. All targets were achieved or exceeded.

	Legacy target	**Achievement**
Impact	There is evidence that 3 priority end-users in Nepal and Tanzania (at least 1 for each country) have used METEOR outputs to inform 3 DRRM activities.	**Exceeded**
Outcome 1	METEOR datasets are still hosted by the official/government-led platforms currently in use.	**Achieved**
Outcome 3	There is evidence 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).	**Exceeded**
	There is evidence METEOR outputs have been used by at least **1** insurance company, CAT modeller, or similar.	**Achieved**
	METEOR datasets are still hosted by the credible **6** nodes and still being accessed.	**Achieved**

Table ES-1. Summary of results against logframe indicators' legacy targets

Global Case Study

In terms of **relevance**, the question being addressed related to the need for data and protocols. Most of the stakeholders interviewed confirmed that the METEOR products address a clear knowledge gap. The lack of data was cited as one of the main reasons insurance companies have difficulty working in ODA countries. The Level 1 Exposure data for the 47 ODA countries were particularly relevant to governments and development partners. The Level 1 data sets are of limited use for the insurance industry because they do not cover the countries of primary interest to these profit-making bodies, and they do not include the most relevant buildings such as productive, commercial and infrastructure assets.

In assessing **effectiveness,** we looked at whether global users were satisfied with the outputs and whether they provided the right level of information. Interviewees, particularly those who work on disaster risk modelling, greatly appreciated the availability and usability of the Level 3 data (i.e. the ones developed for Tanzania and Nepal). These data were seen to be robust, comprehensive and in an appropriate format.

In looking at **impact,** we assessed whether METEOR outputs have improved decision-making. The data sets and the training materials have been viewed and downloaded thousands of times. However, given the nature of open data, there is limited information on who is using the data and how the data are being used. There is more evidence of the use of the outputs by project partners and their close networks. For those involved in risk modelling, this has saved them considerable time and resources.

Sustainability assessed concrete plans to use the METEOR outputs, of which there were numerous examples. This included planned use by the Insurance Development Forum and development partners such as the World Bank.

Nepal Case Study

The country continues to face loss and damage from disasters such as floods and landslides. Institutional changes prompted by the update of legislation in 2019 continue with the National Disaster Risk Reduction and Management Authority now regularly convening meetings and drafting policies. The localisation of DRRM continues.

In terms of **relevance**, in Nepal, a national portal provides public access to exposure data and protocols in one place. The project has been **effective**, improving understanding of the use of hazard, exposure and vulnerability data to contribute to national DRRM policy and practice. However, capacity limitations limit the better use and development of the information and tools.

It is too early to measure the final **impact** of reducing disaster-related deaths and losses. However, there is evidence of the data sets improving response capacity. Additionally, there is raised, **sustained** interest in using the data sets by a wide range of national stakeholders.

Tanzania Case Study

The increasing vulnerability to weather-related disasters is disrupting lives, destroying infrastructure and leading to health problems and food insecurity. In April 2021, thousands of households were affected, and tens of people died following a tropical cyclone. Three months previously, flooding left hundreds of homes damaged or destroyed and one person dead.

Regarding the national management of DRRM, the policy review process is ongoing, and it is expected that the policy will be tabled in parliament in the next few months. The updated Disaster Management Act is awaiting final approval, and a risk reduction strategy is ready for implementation. Not all structures envisaged are in place: DMD will remain a department within the Prime Minister's Office instead of becoming an independent authority.

There is clear **relevance** of the METEOR data in Tanzania for use at the national level. Confidence in the usefulness of the data sets was shown in requests for further data at a sub-national level and covering additional hazards such as drought. **Effectiveness** is evidenced through the use of the data by DMD, the national coordinating body for DRRM. However, there was little evidence of using the data by other stakeholders in Tanzania, with many reporting a lack of involvement in developing the data sets hampering ownership. In-person capacity building was also limited because of COVID-19 restrictions. Other factors limiting effectiveness in Tanzania include disaster data being scattered across different institutions and the limitations of capacity and resources of the national coordinating body. At the higher level of **impact**, the METEOR data informed DRRM at a policy level, and there are cases of use for national planning. However, more time is needed to see if this translates to improved response and reduced disaster-related deaths, loss and damage. There were no unintended impacts reported.

In terms of **sustainability**, the data is available on open-access platforms, but there is limited awareness of the existence of the data across Tanzanian stakeholders. Most interviews started with information on the location of the data sets: once the interviewees had checked the data, there was more understanding of the potential for their use.

Conclusions

The section below brings together the findings from the three case studies and the data from the legacy indicators shown in the logframe, using the four broad areas of evaluation.

Relevance assesses if an intervention is doing the right things, if the objectives and design respond to beneficiaries' needs, and if these are sensitive to the context and capacity conditions in which the project takes place. The programme's relevance against international frameworks (e.g. SDGs[11], Sendai[12], COP26[13]) is clear. It is also very relevant to particular groups of stakeholders such as national-level bodies, researchers, and project and development partners. Given the increasing emphasis on planning for DRRM at the sub-national level, the utility of the data sets is more limited at the regional and county levels. Similarly, these data sets only partially meet the insurance industry's needs. Concerning the relevance of the programme's design, a clear results framework and theory of change were updated during implementation, sustaining relevance. And finally, the data sets and protocols are clear knowledge gaps in DRRM, evidenced by thousands of downloads.

Effectiveness assesses whether or not the intervention is achieving its objectives, including results across different groups. The logframe shows the targets were all achieved or exceeded. The data have been well received by global and national stakeholders, with the ground-truthing and open access over the data particularly appreciated. The high level of effectiveness is particularly noteworthy given the COVID-19 restrictions, showing the team members were adequately flexible and creative in responding to them.

Impact assesses whether the project is expected to generate significant positive or negative, unintended or intended higher-level effects. The target at this level was met and exceeded, although the evaluation did not assess explicit contribution or attribution. However, it is evident the project went in the right direction, building capabilities that will support the mainstreaming of more robust data into DRRM planning and practice. The objective of Tanzania and Nepal acting as DRRM 'lighthouses' in their regions is not currently happening.

Sustainability assesses the extent to which the project's benefits are likely to continue, given the capacities of the systems needed to sustain those benefits over time. Given the mandates of METEOR partners, many are still providing some input and advice, and the open data are still available and used by national-level bodies. There is less evidence of sustainability in non-government bodies and sub-national governments, particularly in Tanzania. The pandemic did constrain an effective exit.

Lessons

What worked well: a particular strength of the project is robust and active project management. There was excellent leadership, regular communications, and a good mix of in-person and remote meetings supported by shared data. The partnership was strong with world-leading organisations in their specialisms, bringing strong credibility and networks to the consortium. The team hit the ground running, strengthened by prior relationships within the consortium. The advisory boards for the project, the insurance industry, and in Nepal built buy-in and provided inputs and feedback. The choice of skilled and strategic members enabled them to act as champions. The focus on transparency and traceability of the data in user-appropriate formats with the "badge" of the consortium promoted trust and, therefore, uptake.

What to do differently in the future: with the benefit of hindsight, a few areas could have been stronger. The balance between the provision of data and building capacity leaned substantially towards the former, hampering greater ownership by ODA countries' beneficiaries. A time extension dedicated to the outputs' uptake and capacity building would have helped. A better understanding of

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[11] https://sdgs.un.org/
[12] https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030
[13] https://ukcop26.org/wp-content/uploads/2021/11/COP26-Presidency-Outcomes-The-Climate-Pact.pdf

the national partners' capacity from the outset would have assisted in replacing too-optimistic assumptions. Similarly, a more explicit understanding of the advantages and disadvantages of working with government and non-government partners should underpin partner choices in future projects. There is also more work to be done to think through publicity campaigns to create demand for the projects and improve understanding of how the data are being used without compromising open-data principles.

Further feedback on what went well and lessons for future projects are available in Section 7, which documents the learning event.

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 - ended 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/SSBN Limited 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 the 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. In addition to the detailed exposure data, METEOR also generated a series of national hazard footprints for Nepal (flood, seismic and landslide) and Tanzania (flood, seismic and volcanic) and modelled the impact of the hazards on the exposure. Providing new consistent data to governments, Development Partners (DPs), and insurance providers will promote the 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 iterations of the UK Space Agency's (UKSA) International Partnership Programme (IPP), which uses space expertise to develop and deliver innovative solutions to real-world problems across the globe. The funding helps 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 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 the specific countries; 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. About the legacy evaluation

The overall purpose of the evaluation is to assess the broad outcomes and long-term impact of the project one year after funding was completed. This is of particular importance as the project was designed to produce many of the deliverables in the last six months of implementation. This evaluation is taking place just under one year from the end of the project.

The legacy evaluation has two objectives: to assess the evidence of project outcomes and impact, and investigate causality between the project and the observed effects; and provide insights for the UKSA and consortium partners on how to best design and implement future interventions based on learning.

The legacy evaluation assesses results against the Organisation for Economic Cooperation and Development's (OECD) Criteria for evaluation[14], in particular assessing relevance, effectiveness, impact and sustainability.

The evaluation has three main components: a global case study that targets representatives of the insurance industry and the global development community; two country case studies covering Nepal and Tanzania; and the completion of the logframe, including an update of the achievements against the relevant targets.

The findings and conclusions will be discussed at a learning event in late March 2022. The minutes of that event are appended to this document.

1.5. Structure of this document

Following this introduction, a description of the methodology used in the evaluation is given. The analysis of the project results against the logframe follows in section three. Sections four and five give the global and national case studies findings, respectively. The final sections draw out the conclusions of the legacy evaluation and lessons for future programming.

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[14] See https://www.oecd-ilibrary.org/sites/543e84ed-en/1/2/1/index.html?itemId=/content/publication/543e84ed-en&_csp_=535d2f2a848b7727d35502d7f36e4885&itemIGO=oecd&itemContentType=book

2. Methodology

2.1. Overview

Progress towards the achievement of the objectives of this programme has been measured in the baseline[15], midline[16] and endline[17] evaluations. These evaluations noted the uneven delivery of milestones over the project life: the release of the final products is in the last months of the project implementation. The importance of this legacy evaluation is therefore particularly acute, allowing more time for progress towards outcome and impact to be seen.

The purpose and scope of the evaluation are given in Section 1.4 above.

The evaluation questions and sub-questions are given in more detail in the table below.

	Evaluation Question	Indicative supporting questions
Relevance	In other ODA countries, was there a real need and/or demand for national exposure and multi-hazard and vulnerability data and protocols that validate the uncertainty process?	• Have other ODA countries expressed interest in these data? • Have there been requests for these data by other ODA countries? • Do we see broader uptake and use of the protocols, including outside Nepal and Tanzania?
Effectiveness	To what extent did the METEOR outputs lead to improvements in the capacity and ability of national and international stakeholders to knowledgeably utilise EO-based hazard, exposure and vulnerability data in DRRM policy and practice?	• How are Nepal and Tanzania using METEOR outputs in any DRRM activities? • Are users (national and international) satisfied with the tools? Are they providing the right level of information? • Have national experts improved their capacity to use and update EO data to generate information relevant for DRRM? • Because of the project, how are national technical experts in Nepal and Tanzania serving as regional experts or 'lighthouses' in the DRRM space?
Impact	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? Have there been any unintended / additional outcomes from the delivery	• How are the senior decision-makers of relevant Ministries (e.g. PMO in Tanzania and MoHA in Nepal) and other end-users (e.g. NSET, ICIMOD, FCDO in Nepal, and Red Cross, World Bank in Tanzania) using METEOR products consistently to inform their DRRM activities and decision-making? • How are the 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) using and updating the METEOR products? • In what ways have the METEOR outputs led to improved national DRRM policy and planning?

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[15] https://meteor-project.org/storage/METEOR_M2.4P_Baseline_Evaluation_Report.pdf.
[16] https://meteor-project.org/storage/METEOR_M2.6P_Midline_Evaluation_Report.pdf.
[17] https://meteor-project.org/storage/METEOR_M2.9P_Endline_Evaluation_Report.pdf.

	Evaluation Question	Indicative supporting questions
	of METEOR products, including outside of DRRM?	• Has access to the METEOR outputs improved national planning and decision-making in other sectors, outside DRRM? • Has the project led to improved, rapid access to relevant information on exposure? • In what ways have the METEOR outputs led to improvements in the decision-making process of other ODA governments, NGOs, policy makers and insurers? How have Nepal and Tanzania acted as 'lighthouses'? • Are there any unintended consequences of the METEOR products – positive or negative? How did these occur?
Sustainability	Is there evidence of sustained interest by DRRM stakeholders (e.g. other LDC governments, NGOs, the insurance industry and the humanitarian community) in utilising METEOR data and protocols?	• Is there evidence that humanitarian and development actors such as UNICEF, the World Bank or UK FCDO have used available METEOR data or protocols when evaluating disaster risk in ODA or developing countries? • Is there evidence that the protocols and datasets improved and supported the development of insurance products for use in developing countries? • Have there been follow-on opportunities for the METEOR consortium to work (together or separately) with or build on the METEOR products? • Are other governments using the METEOR products as part of their decision-making? What are some of the barriers/ facilitators of wider use?

Table 2: Evaluation Questions

2.2. Data collection

The instruments and methodology for the evaluation were set up to be flexible and practical. They include:

- **Desk research**: As part of the country case studies, the team updated the information gathered during the previous project evaluations related to the DRRM processes in Nepal and Tanzania's pilot countries. Documents include national plans and policies pertaining to DRRM, sector strategies/policies, and national statistics. In addition, the team gathered information on the number and geographical location of METEOR outputs' views and downloads.

- **Participatory workshop with METEOR partners**: On 19th January 2022, an online workshop was held and attended by 15 members of the METEOR consortium. The workshop was highly participatory, using polls and a virtual whiteboard to collect impressions from the participants about the project's relevance, effectiveness, impact and sustainability.

- **Key Informant Interviews:** Semi-structured Key Informant Interviews (KIIs) were conducted with national (in Nepal and Tanzania) and international (from the insurance industry and humanitarian community) stakeholders. KIIs with selected METEOR partners and representatives from other ODA stakeholders were also carried out. The instruments that guided the KIIs are contained in Annex 8.1.

- **Legacy Learning Event:** On 17th March 2022, a final learning event with the METEOR partners, Caribou Digital and the UKSA, was held virtually on Zoom to review the key findings of the legacy evaluation and discuss its key lessons and recommendations for future projects. The

results from the Legacy Learning Event were used to fine-tune the content of the legacy evaluation Report. The slides and minutes of the learning event are included in Annexes 8.2 and 8.3, respectively.

The table below links the methods used with the evaluation questions.

Evaluation Question	OECD DAC Criteria	Methods & Tools			
		Desk Research	Participatory workshop	KIIs	Legacy Learning Event
EQ1: In Tanzania and Nepal, and other ODA countries, was 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
EQ2: To what extent did the METEOR outputs lead to improvements in the capacity and ability of national and international stakeholders to knowledgeably utilise EO-based hazard, exposure and vulnerability data in DRRM policy and practice?	Effectiveness	X	X	X	X
EQ3: 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	X
EQ4: Have there been any unintended/additional outcomes from the delivery of METEOR products, including outside of DRRM?	Impact	X	X	X	X
EQ5: Is there evidence of sustained interest by DRRM stakeholders (e.g. other LDC governments, NGOs, the insurance industry and the humanitarian community) in utilising METEOR data and protocols?	Sustainability		X	X	X

Table 3. Data collection methods map

Some data collection methods initially included in the evaluation's Terms of Reference were not used. These are:

- **Focus Group Discussions** (FGDs) were planned to be used with key international stakeholders, such as the members of the METEOR Insurance Industry Advisory Group (IIAG) and members of the METEOR Advisory Board, formed by development partners operating in the DRRM realm. However, after discussing this approach with a key project advisor and with the project manager, it was considered a better option to interview the more active members of these groups individually. In total, four KIIs with project advisors were carried out.

- **Online survey:** An online METEOR data user survey was developed during the endline evaluation and included in the download packages on the METEOR website. During the endline, only two users had filled in the online survey, and, unfortunately, that number had not changed by the time of the legacy evaluation. As the number of respondents was too small to be significant, we decided not to use the survey data.

- **Participatory evaluation workshops in Nepal and Tanzania:** We explored the possibility of having participatory evaluation workshops in Nepal and Tanzania to review with key stakeholders the contribution of METEOR towards change. However, we decided to limit the

in-country data collection to KIIs, mainly because of delays in the contracting process of the evaluators that led to a very brief planning period. Nevertheless, the number and insights gathered through the KIIs seem to be sufficient.

2.2.1. Global Case Study

The Legacy Global Case Study looked at the relevance, effectiveness, impact and sustainability outside Nepal and Tanzania. The data collection methods used were: the participatory workshop with METEOR partners; data on the METEOR outputs' views and downloads provided by GEM (METEOR partner responsible for IT and knowledge management); and KIIs with members with the Development Partners (DPs), insurance industry and ODA countries. The KIIs were conducted between 8th February and 4th March 2022. Table 4 provides a list of the stakeholders interviewed.

Institution/Organisation	Stakeholder Type
BGS	Project Partners
ImageCat	Project Partners
UK FCDO	Development Partners
World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR) and Insurance Development Forum (IDF)	Development Partners, Insurance Industry
Impact Forecasting, Aon	Insurance Industry
Hannover Re	Insurance Industry
Verisk	Insurance Industry
Uganda's Directorate of Geological Survey and Mines	ODA countries
International researcher working in the Democratic Republic of Congo	ODA countries
Open University, PhD student researching on UKSA IPP	Other

Table 4. Stakeholders interviewed for the Global Case Study

2.2.2. Nepal Case Study

The legacy evaluation findings for Nepal are primarily based on the in-country KII interviews. The KIIs were conducted between 14th February and 3rd March 2022.

A quick Political Economy Analysis (PEA) has been carried out to update Nepal's context from the endline. OPM Nepal refreshed this to ensure its continuing relevance. This involved an update on the national political, institutional, and economic context related to DRRM.

In addition to the PEA update, the OPM team worked closely with NSET and interviewed other key national DRRM stakeholders in Nepal to assess the relevance, effectiveness, impact, and sustainability aspects of the METEOR project in Nepal. Table 5 lists the institutions covered by the interviews.

Organisation	Stakeholder Type
National Society for Earthquake Technology (NSET)	NGO, Project Partner
National Disaster Risk Reduction and Management Authority	Government
National Emergency Operation Centre, Ministry of Home Affairs	Government
Central Bureau of Statistics (CBS)	Government
Nepal Academy of Science and Technology	Government
Ministry of Federal Affairs and General administration	Government
National Planning Commission	Government
Department of Hydrology and Meteorology	Government
Youth Innovation Lab	NGO
UN Resident Coordinator Office	Inter-Governmental

Practical Action	INGO
Institute of Engineering, Tribhuvan University (TU)	Academia
USAID – TAYAR programme	Donor
Foreign Commonwealth and Development Office	Donor
United Nations Development Programme	Intergovernmental
OPM DRRM team	Project Partner

Table 5. Stakeholders interviewed for the Nepal Case Study

2.2.3. Tanzania Case Study

As for Nepal, the PEA for Tanzania was refreshed to fill in the country context update in the case study. This involved an update on the national political, institutional, and economic context related to DRRM.

To assess the METEOR project's relevance, effectiveness, impact, and sustainability in Tanzania, KIIs were held with relevant in-country stakeholders between 10th February and 3rd March 2022. Table 6 below shows the institutions/stakeholders interviewed.

Institution/Organisation	Stakeholder Type
PMO-DMD	Government / project partner
Ministry of Water	Government
Geological Survey of Tanzania (GST)	Government
Foreign, Commonwealth & Development Office (FCDO)	Donor
World Bank	Donor
Ardhi University	Academia
Tanzania Red Cross Society (TRCS)	Humanitarian organisation
Humanitarian Open Street Map Team (HOT)	Humanitarian organisation

Table 6. Stakeholders interviewed for the Tanzania Case Study

2.3. Key challenges and limitations of the legacy evaluation

This legacy evaluation was conducted during the COVID-19 pandemic, although this has not affected its regular implementation as interviews for the national case studies were held in person, and those for the Global Case Study occurred via Zoom. The primary general constraint to the legacy evaluation was the short time available to plan and execute the evaluation, which was only contracted in January 2022 and imperatively had to end by mid-March 2022 for administrative constraints of the donor.

In terms of the challenges and limitations of the Global Case Study, the main one was identifying and interviewing stakeholders from other ODA countries. Since COVID-19 did not allow for the planned attendance of project partners to international events such as the Understanding Risk conference in 2020 and 2021, the network of key stakeholders in ODA countries was not built during the project as intended. Consequently, the evaluators asked BGS to leverage their international network to introduce ODA stakeholders. Only two responded out of the nine contacted, and they were finally interviewed. The other constraint was not being able to use the online feedback survey data because of the very low response (see Section 2.2).

In Tanzania, methodological limitations or challenges during the legacy evaluation included difficulties confirming meetings with stakeholders for several reasons. Most stakeholders did not remember the project, having been engaged a while back on METEOR. Others could recall the METEOR project and being engaged on the general aspects of the project but have not used or even viewed the final METEOR datasets and protocols. Therefore, they were not keen to be interviewed as the questions centred around the uptake of METEOR datasets and protocols. In some cases, those previously engaged by the project had moved on and were no longer at the institutions consulted, and there was no proper hand-over, leaving a gap in the institutional memory.

Some stakeholders in Dodoma accepted the meetings as they were facilitated by the national project partner (PMO-DMD) and national disaster coordinator but could not engage well with the interview questions as they said they were not aware of where METEOR datasets and outputs. Of these, some acknowledged potential uses for the datasets and protocols once the interviewer elaborated, but again, because they did not engage with the actual datasets and protocols, the interviews lacked depth.

In Nepal, the general limitations and challenges observed were confirming meetings with the individuals who attended the METEOR training events. There has been turnover and transfer of critical governments staffs who were part of training resulting in a lack of continuity for the uptake of the METEOR outputs. Consequently, the technical teams of key government agencies such as the National Emergency Operations Centre (NEOC) and the National Disaster Risk Reduction and Management Authority (NDRRMA) were unaware of the use of METEOR outputs for DRRM decision making and planning.

2.4. Result monitoring and logframe completion

The data collection from Nepal, Tanzania, and international stakeholders was used to update all the logframe relevant indicators to show the longer-term results achieved. A summary of data sources for each logframe indicator relevant to the legacy evaluations is presented below.

##	Indicator	Data source
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 whereby METEOR outputs inform the improvement of the building codes in Nepal and Tanzania. The model is included in METEOR's Cost-Effectiveness Analysis (CEA).
IM 2	Total modelled direct avoided economic loss attributed to disasters in Nepal and Tanzania (in GBP £)	Internal model based on a hypothetical scenario whereby METEOR outputs inform the improvement of the building codes in Nepal and Tanzania. The model is included in METEOR's CEA.
IM 3	Qualitative indicator: progress towards mainstreaming the use of robust DRR data to systematically inform policy changes across the public and private sector, and civil society	KIIs in Nepal and Tanzania
OC 1.1	Qualitative indicator: progress towards the use of project outputs by the governments of Nepal and Tanzania	Assessed 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 DRRM (KPI 1)	Project monitoring data
OC 2.1	Qualitative indicator: progress towards the use of project outputs by the other end-users in Nepal and Tanzania to inform their DRRM decision-making and practice	Assessed by Impact Indicator 3
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 partners and Advisory Board members
OC 3.2	Qualitative indicator: Progress towards creating insurance products informed by METEOR data and/or protocols	KIIs with METEOR partners and KIIs with METEOR IIAG members
OC 3.3	Number of dissemination nodes where METEOR KPs and datasets are available to be accessed	KIIs with METEOR partners and desk research

Table 7. Logframe update at legacy

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 4th March 2022, which is about a year after the project ended (27th March 2021). The logframe was prepared by the M&E team, but co-developed with all consortium members. Particularly, many of the legacy 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).
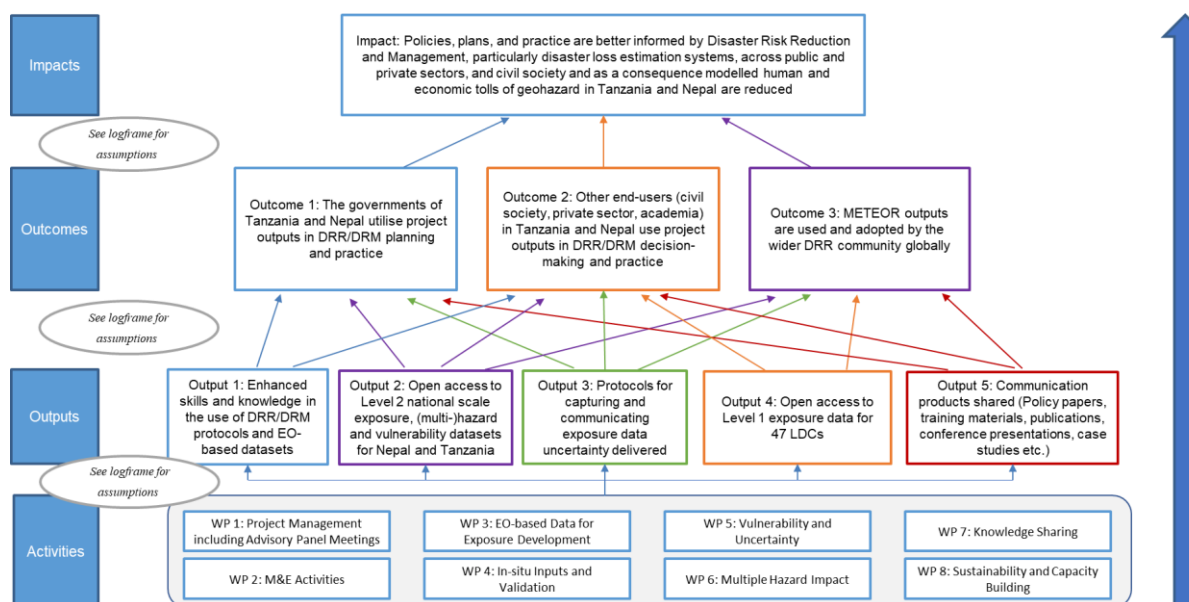

Figure 1. METEOR Theory of Change

Table 8 summarises the results achieved by the project against the logframe targets for the elements of the ToC relevant to the legacy evaluation: impact and outcomes. There are no output indicators to be monitored by the legacy evaluation because all the outputs have been delivered during the project implementation. 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.

##	Indicator	Data source	Legacy target	Target achievement
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	Legacy target	Target achievement
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 that 3 priority end-users* (governmental and non-) in Nepal and Tanzania (at least 1 for each country) have used METEOR outputs to inform 3 DRRM activities (e.g. risk assessments, technical studies, policies or strategies). *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	**Exceeded** **Nepal** • FCDO Nepal • Tribhuvan University • Department for Hydrology and Meteorology **Tanzania** • DMD/PMO
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	At legacy, this indicator is assessed by Impact Indicator 3.	**N/A**
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 still hosted by the official/government-led platforms currently in use.	**Nepal – Achieved** BIPAD portal, owned by the government. **Tanzania – Achieved** The data are on the Resilience Academy Geonode Platform, which is participated by the government.
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	At legacy, this indicator is assessed by Impact Indicator 3.	**N/A**

##	Indicator	Data source	Legacy target	Target achievement
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 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).	**Exceeded** • Use of METEOR protocols in Nigeria, Tunisia, Colombia and Brazil • Use of METEOR data in Nepal in at least six ODA-funded projects • Multiple concrete plans of using the METEOR data by the IDF
OC 3.2	**Qualitative indicator: Progress towards creating insurance products informed by METEOR data and/or protocols**	KIIs with METEOR Insurance Industry Advisory Group members	There is evidence METEOR outputs have been used by at least **1** insurance company, CAT modeler, or similar	**Achieved** • Earthquake parametric insurance model developed in Nepal (and flood model planned) by Aon's Impact Forecasting team (World Bank-funded) • Multiple insurance-related interviewees expressed concrete plans of using the METEOR data if the right opportunity occurs
OC 3.3	**Number of dissemination nodes where METEOR KPs and datasets are available to be accessed**	KIIs with METEOR partners, Monitoring data	METEOR datasets are still hosted by the credible **6** nodes and still being accessed. List of credible nodes: 1. METEOR platform 2. GEM OpenQuake 3. World Bank GeoNode 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 GeoNode Library 4. Humanitarian Data Exchange 5. Nepal: Building Information Platform Against Disaster (BIPAD) 6. Tanzania: Resilience Academy Geonode Platform

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

Table 8. Summary of results against logframe indicators' endline targets

3.1. Impact

The long-term goal of the METEOR project is to help LDCs 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 in the two countries, which, luckily, we hope will never happen again. However, through the Cost-Effectiveness Analysis (CEA) undertaken before the end of the project, it was possible to give an indication of the partial forecasted impact of METEOR (see Endline Evaluation Report[18] for more detail). The result showed that **during the period 2018-2024, the estimated contribution of METEOR would reduce direct economic loss by £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 that 3 priority end-users[19] (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)". The legacy evaluation uncovered numerous instances where the METEOR outputs have been used by priority and non-priority end-users in Tanzania, Nepal, and beyond. **Error! Reference source not found.** provides a list of the reported METEOR output uses. **The evidence gathered shows that the METEOR outputs were used so far by 4 priority end-users in Nepal and Tanzania to support 7 DRRM activities, as well as by numerous other non-priority end-users. The impact indicator has therefore been exceeded.**

Name of end-user	Priority end-user (Y/N)	METEOR output used	Brief description of the use
Nepal			
FCDO Nepal	Y	All METEOR outputs	The datasets were used by the FCDO in planning the various programmes.
Institute of Engineering, Tribhuvan University (TU)	Y	All METEOR Outputs	Students are using METEOR data and protocols in their research.
Tribhuvan University, Department for Hydrology and Meteorology (DHM)	Y	Landslide Hazard, Flood Hazard, Multi-Hazard, Level 3 Exposure	The NERC SHEAR-funded Landslide-EVO project, which includes Tribhuvan University, Nepal's Department for Hydrology and Meteorology and the METEOR partner Kathmandu Living Lab, is using the METEOR data to develop an existing flood early warning system in Nepal into a multi-hazard early warning

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[18] https://meteor-project.org/storage/METEOR_M2.9P_Endline_Evaluation_Report.pdf.

[19] **Priority end-users list established by the project partners: Nepal:** Ministry of Home Affairs / Nepal Disaster Risk Reduction and Management Authority (NDRRMA), Department of Hydrology and Meteorology (DHM), NSET, ICIMOD, UK Foreign, Commonwealth and Development Office (FCDO) Nepal, Tribhuvan University (TU); **Tanzania:** Disaster Management Department (DMD) / Prime Minister Office (PMO), Geological Survey of Tanzania (GST), Tanzania Meteorological Agency (TMA), University of Dar Es Salaam, Tanzania Urban Resilience Programme (TURP) / Resilience Academy, Red Cross, World Bank.

Name of end-user	Priority end-user (Y/N)	METEOR output used	Brief description of the use
			system that also supports resilience to landslides.
UNDP	N	Flood Hazard, Landslide Hazard	Used during various monsoon seasons to understand potential risks of landslides while formulating plans.
Practical Action	N	All METEOR outputs	Used in the Tomorrow's Cities programme. Data of hazard and vulnerability METEOR project used in a presentation to share information and increase the capacity of the other stakeholders.
Central Bureau of Statistics (CBS)	N	All METEOR outputs	CBS has used the METEOR data and other data from primary and secondary sources to generate reports on disasters.
USAID TAYAR (Improved Disaster Risk Management) Programme	N	All METEOR outputs	Based on the multi-hazards and vulnerability identified by the METEOR project, Tayar Nepal supported 10 municipalities of Nepal in designing their DRRM policies and planning.
Aon, World Bank	N	All METEOR outputs	Impact Forecasting, the CAT model development team of Aon, used the Level 3 Exposure and the seismic hazard data to develop an earthquake risk model for Nepal funded by the World Bank's Finance for Growth Development Policy Financing programme to support the development of an earthquake parametric insurance for the Government of Nepal.
GeoAdaptive LLC	N	Flood Hazard, Landslide Hazard, Seismic Hazard	Part of a team working in Nepal to assess municipal disaster risk preparedness, understand disaster risk profiles and provide recommendations for development planning and emergency preparedness and response (EP&R) purposes.
Tanzania			
DMD / PMO	Y	Flood Hazard	In the preparation of early warning information sent to local government authorities (LGAs).
DMD / PMO	Y	Flood Hazard data, Dar Es Salaam Building Survey by HOT	In the generation of situation reports (SITREP) during disasters.
DMD / PMO	Y	Flood Hazard	In preparation of Post Disaster Needs Assessments (PDNAs) that determine

Name of end-user	Priority end-user (Y/N)	METEOR output used	Brief description of the use
			resource allocation and prioritisation. Example: PDNA prepared for 2020 Tanga Floods during the long rainy season (March-May).
DMD / PMO	Y	Seismic Hazard Map from GEM	METEOR outputs informed the preparation of 5-year Disaster Risk Reduction Strategy (2021-2026) as part of its national commitments under the Sendai Framework for Disaster Risk Reduction 2015-2030.
Globally			
BGS	N	METEOR protocols	In the UK Research and Innovation (UKRI) funded URBE Latam project in Colombia and Brazil to integrate landslide, flood, and volcanic hazards in the project outputs.
BGS	N	METEOR Protocols, Level 1 Exposure	To develop a Python-based toolbox for multi-hazard assessment.
ImageCat	N	METEOR Protocols	To support the project "Do-It-Yourself Adaptation: New Pathways for Community Flood Risk Communication" in Nigeria with the creation of an exposure database.
ImageCat	N	METEOR Protocols	To develop a multi-hazard study (floods and earthquakes) in Tunisia funded by the World Bank's Disaster Risk Financing and Insurance Programme (DRFIP).

Table 9. Reported uses of the METEOR outputs identified by the legacy evaluation

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 by governmental and non-governmental end-users, respectively. In particular, Outcome Indicators 1.1 and 2.1 aimed to monitor the uptake of the METEOR outputs in Nepal and Tanzania, which is already covered by Impact Indicator 3 at legacy.

Concerning Outcome Indicator 1.2, its legacy target was "**METEOR data and protocols are still hosted on official government or government-led platforms** in Nepal and Tanzania, in demonstration of their approval by the key national DRRM stakeholders". **The M&E Team has considered Outcome Indicator 1.2 as formally achieved** because key METEOR data are still hosted on the "BIPAD: Building Information Platform Against Disaster" in Nepal[20] and the "Resilience Academy geonode platform" in Tanzania[21]. A check on the two platforms shows that the data are still online. The BIPAD portal is

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[20] https://bipadportal.gov.np/risk-info/#/hazard
[21] https://geonode.resilienceacademy.ac.tz/

government-owned, which implies a high degree of data ownership. 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 used the Resilience Academy geonode platform, which is participated but not owned by the government. The Resilience Academy is a partnership between four academic institutions in Tanzania, which spurred from the Tanzania Urban Resilience Programme (TURP), of which the 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 chose 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.

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 that METEOR outputs have been used by at least 3 development partners in supporting 3 DRRM activities in developing countries (Outcome Indicator 3.1)
- Evidence that METEOR outputs have been used by at least 1 insurance company, CAT modeller, or similar (Outcome Indicator 3.2)
- Evidence that METEOR outputs are still widely accessible through credible online platforms (Outcome Indicator 3.3).

Outcome Indicator 3.1 was assessed as exceeded. As pointed out in the Global Case Study, both the METEOR protocols and data have been used in multiple DP-funded DRRM activities (see **Error! Reference source not found.**), for example:

- The METEOR protocols were used by ImageCat in projects in Nigeria (funded by the US National Aeronautics and Space Administration (NASA)) and Tunisia (World Bank GFDRR-funded)
- The METEOR protocols were used by BGS in Colombia and Brazil in the UKRI-funded URBE Latam project
- The Landslide-EVO project funded by the NERC SHEAR, which includes the METEOR partner Kathmandu Living Lab, have used the METEOR data in Nepal
- The METEOR data were used by Aon in a World Bank-funded project in Nepal
- The METEOR data were used by GeoAdaptive consultants in Nepal
- The METEOR data were used by Practical Action in the Tomorrow's Cities programme in Nepal
- The METEOR data were used in the USAID TAYAR (Improved Disaster Risk Management) Programme in Nepal
- The Insurance Development Forum have several concrete plans of using the METEOR data in different DRRM activities.

Outcome Indicator 3.2 was fully achieved. There is evidence that Aon has used the METEOR data in a World Bank-funded project to develop an earthquake risk model for Nepal to design a parametric insurance product. In addition, although no evidence of additional insurance products supported was received by the evaluators, there is evidence of concrete plans from insurance-related actors to use the project data when suitable opportunities arise (see Section 4.3).

Finally, **Outcome Indicator 3.3 was fully achieved** as METEOR outputs are still present[22] on all 6 credible nodes initially identified by the project partners.

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[22] As of 3rd March 2022.

4. Global Case Study

The Global Case Study of the legacy evaluation investigates key elements of the project's relevance, effectiveness, impact and sustainability outside Nepal and Tanzania. METEOR targeted three international audiences: national stakeholders in other ODA countries, the DPs, and insurance industry stakeholders. The case study presents the findings from 10 interviewees and a workshop attended by over 10 people from the METEOR consortium. The interviews included a government official from Uganda, an international researcher working on volcanic risk and DRM in the Democratic Republic of Congo, four risk modellers working at or for insurance companies, and two development partners.

4.1. Relevance

The evaluation question investigating the project's relevance internationally is the following: was there a real need and/or demand for national exposure and multi-hazard and vulnerability data and protocols that validate the uncertainty process in other ODA countries?

The great majority of the interviews confirmed that the METEOR products address a clear knowledge gap in developing countries. Although the project partners did not receive direct requests to access the data from other ODA governments, this statement appears to be confirmed by the many downloads of the 47 METEOR Level 1 Building Exposure datasets of ODA countries recorded from the METEOR portal (3,900 since October 2021[23]) and the Humanitarian Data Exchange (722 as of 16th December 2021)[24].

Three interviewees from the insurance industry and the DPs identified the lack of data as one of the main reasons for the lack of disaster insurance companies working in ODA countries. Specifically, the **METEOR Level 1 Exposure data appear to be particularly relevant for uses in DRRM and humanitarian activities and to raise awareness of the needs of disaster risk insurance.** The respondents pointed out how ODA governments can use these data to have an idea of the national-scale exposure of their countries, and DPs can use them, as they are or after their inclusion in bespoke risk models, to initiate talks with LDC governments on disaster risk insurance and better DRR. The term used several times to refer to the importance of the Level 1 Exposure data was "a starting point", like if they were a springboard for something more.

Indeed, evidence from the insurance-related interviews confirms that **the Level 1 Building Exposure datasets are not detailed enough to be very relevant for the insurance players** because:

- **They do not cover the most relevant countries**: insurance companies are profit-driven commercial enterprises that need to see a strong business case to start operating in a particular country. More than one insurance-related interviewee said that the Least Developed Countries where they operate, and including middle-income countries would have made the data more relevant to private insurance.
- **They do not cover the most relevant assets:** the METEOR exposure data cover only residential buildings. These are definitely important for humanitarian purposes or public insurance, but private insurance is especially interested in the assets with the highest replacing cost value, such as productive, commercial and infrastructural assets.

Another aspect stressed by multiple interviewees, including those from ODA countries, is that lack of data is only one of the problems affecting adequate DRRM in ODA and developing countries. **Political**

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[23] Statistics before 15/10/2021 are not available.
[24] For detailed statistics of the access to the METEOR data publicly available, please see Appendix 1.1.

will and limited capacity are other crucial barriers, perhaps even more important than the lack of data.

4.2. Effectiveness

The primary "effectiveness" aspect studied by this Global Case Study is whether users outside of Nepal and Tanzania have been satisfied with the METEOR outputs and whether they provide the right level of information.

The evidence shows the METEOR products have been well received by those who have looked at them. Particularly, those who work on disaster risk modelling have appreciated the Nepal and Tanzania data (Multi-hazards and Level 3 Exposure), which concretely represent a step-change in the available data in the developing world. One risk modeller said: "*I have worked on a Vietnam study and, compared to that, METEOR is a well-handled product. METEOR is easily in the top 3 remote sensing data projects I have seen [the other two are from Facebook and the Global Urban Footprint from the Germany Aerospace Centre (DLK)]. In terms of usability and availability, METEOR is the top 1*".

The added values of METEOR data on Nepal and Tanzania are high in terms of both robustness and comprehensiveness of the data. The most critical feature was reported to be the **ground validation of the exposure data** undertaken by HOT's local partners. The data ground-truthing considerably reduces the uncertainty, which is one of the most significant barriers to using exposure data in DRRM.

The METEOR Level 1 Building Exposure data's main advantage is their broad geographical coverage compared to the depth and comprehensiveness of the other METEOR data. Several interviewees confirmed that, for the included countries, these data could be valuable for high-level risk analysis and as a starting point to develop bottom-up models. In addition, two interviewees expressed appreciation of the **"insurance-friendly" format** of the Level 1 Exposure data, as they come in the OED format from the Oasis Loss Modelling Framework, an open-source catastrophe modelling platform widely used by the insurance and DRM sectors.

However, the level 1 data also have some significant limitations to be used by the insurance industry. Two limitations presented in the relevance section above are the lack of coverage of other low- and middle-income countries outside of the ODA list and the productive, commercial and infrastructure assets. In addition, a risk modeller interviewed pointed out how the METEOR **methodology for Level 1 Building Exposure data is very similar to the one used by modellers within the insurance industry**, thus, according to him, not adding much value to their internal models. On the other hand, the high methodological alignment of the METEOR data with the ones used by the insurance industry can also be seen as an advantage in the usability of these data by insurance players when data are not available. This benefit was confirmed by several insurance-related sources who remarked their concrete intention of using the project data if opportunities in ODA countries arise.

4.3. Impact

METEOR aimed at improving the way DRRM is carried out in Nepal, Tanzania, and, to a lesser extent, in other ODA countries. The Global Case Study looked at whether and how the METEOR outputs have improved the data access and the decision-making by ODA stakeholders, the insurance industry and DPs.

Despite knowing that the METEOR data and training outputs have been viewed and downloaded thousands of times, including by users in ODA countries (see Annex 8.4.1), we have no way of knowing the profile of these users. Unfortunately, the website statistics do not capture detailed

information about the users as no registration is required, and only two individuals who have downloaded the data from the METEOR portal have filled in the feedback survey included[25].

The interviews and the consortium workshop have not surfaced any evidence of ODA governments directly requesting access to the METEOR data from the project partners, besides Nepal and Tanzania. Multiple interviewees pointed out the low awareness of the data by key international stakeholders among DPs, insurance actors and ODA countries. This requires some reflections. Firstly, the project was never designed to be a hub for international requests for data access. Instead, it aimed to provide international data in an open and publicly accessible way so that anyone could download them. The download figures in the past year show that this assumption was sound. Furthermore, the project had planned the participation in several international events in the last year of implementation and after it, which had to be cancelled because of the COVID-19 pandemic. The dissemination efforts were therefore redirected to develop online knowledge products, which have rescinded that direct communication with the potential users.

Consequently, **while the METEOR data and protocols are publicly accessible on multiple online platforms, they are not and have not been systematically disseminated to the broad international community.** As a result, the METEOR outputs appear to be primarily used by:

- Users who have been directly involved in the project, e.g. project partners, members of the Advisory Board or the IIAG
- Users who work with the project stakeholders in the previous category
- Technical online users of the platforms hosting the METEOR datasets, such as HDX or the GEM portal.

Although, as said, we do not have information about the impact of the METEOR outputs on technical online users, there is robust evidence of their use by multiple users from the other categories. The METEOR partners have used the METEOR protocols and/or data in at least four research and ODA-funded actions. BGS reported having used the protocols in the UK Research and Innovation (UKRI) funded URBE Latam project[26] in Colombia and Brazil to integrate landslide, flood, and volcanic hazards in the project outputs. ImageCat used the METEOR protocols to support the project "Do-It-Yourself Adaptation: New Pathways for Community Flood Risk Communication" in Nigeria[27] with the creation of an exposure database, which was funded through by NASA's "Human Planet" initiative. ImageCat also used the protocols to develop a multi-hazard study (floods and earthquakes) in Tunisia funded by the World Bank's Disaster Risk Financing and Insurance Programme (DRFIP). The NERC SHEAR-funded Landslide-EVO project[28], which includes the METEOR partner Kathmandu Living Lab, is using the METEOR data to develop an existing flood early warning system in Nepal into a multi-hazard early warning system that also supports resilience to landslides.

Other users directly in touch with the METEOR partners or advisers have used the project outputs in DRRM activities. BGS reported that the METEOR data were used by GeoAdaptive consultants in Nepal working on assessing municipal disaster risk preparedness, understanding disaster risk profiles and providing recommendations for development planning and emergency preparedness and response (EP&R) purposes. Impact Forecasting, the CAT model development team of Aon, used the Level 3 Exposure and the seismic hazard data to develop an earthquake risk model for Nepal funded by the World Bank's Finance for Growth Development Policy Financing[29] programme to support the development of an earthquake parametric insurance for the Government of Nepal.

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[25] Information about the survey results were given in the METEOR Endline Evaluation Report, and no additional responses were received as of 6th March 2021.

[26] https://warwick.ac.uk/fac/arts/schoolforcross-facultystudies/igsd/research/urbelatam/

[27] https://www.rsif-paset.org/project/do-it-yourself-adaptation-new-pathways-for-community-flood-risk-communication/

[28] https://paramo.cc.ic.ac.uk/landslide/

[29] https://projects.worldbank.org/en/projects-operations/project-detail/P173044

A critical positive impact of the METEOR data is saving a considerable amount of time and resources from disaster risk modelling operations. For example, a risk modeller interviewed pointed out that "*having METEOR data simplified the job of exposure modelling so that we could concentrate on the rest. Having the ready data from METEOR saved easily three to four months of modelling work*". Another CAT modeller working for an insurance group claimed: "*When we develop our CAT commercial models, we build our exposure dataset (industry loss dataset) internally, and we have a team working on it. An effort of months of that team goes into it. In the case of a country with no exposure data, we would need to use any publicly available data. We could use satellite census data or remote sensing, but that takes a lot of time. We would probably not have the time and budget to build the dataset ourselves. So, METEOR is a great head start and would save a lot of time and effort*".

The Global Case Study identified instances of positive impact of METEOR that was mainly unexpected. For example, ImageCat reported having provided the NASA Disaster Programme with METEOR data for building exposure in conjunction with critical infrastructure in disaster-impacted countries, although they have not kept detailed track of these exchanges with NASA. Additionally, the METEOR team member Dr Annie Winson from BGS won an internal grant that allowed their team to develop a Python-based toolbox for multi-hazard assessments using the project protocols. The purpose was to turn the METEOR model into a toolbox to save time in future BGS DRRM activities, hence representing good Value for Money for the organisation. The tool is operational, and it is running with the METEOR ODA countries' data, though BGS is considering whether to expand it to use data in countries not covered by METEOR. Because of the development of the toolbox, BGS was approached by a UK insurance company to provide multi-hazard risk data for British homes, which is a very positive but unexpected result of the project. Also, Luca Petrarulo, part of the METEOR M&E team, mentioned the existence of the Level 1 Exposure datasets to modellers from the University of Oxford and the Swedish Royal Institute of Technology (KTH) working on the FCDO-funded Climate Compatible Growth (CCG) programme. They said they would use the data for Laos to estimate the energy demand in different parts of the country as input in the national energy system model they are developing for the government. This is a good example of the applicability of METEOR data for international development purposes in sectors other than DRRM.

4.4. Sustainability

The Legacy Global Case Study looked at sustainability in terms of prospective opportunities for international stakeholders to use the METEOR outputs.

The evaluation identified numerous examples of concrete plans to use the METEOR outputs in DP-funded DRRM efforts. The Insurance Development Forum (IDF) have several concrete plans of using the METEOR data in different activities, including: i) the use of METEOR Level 1 Exposure data to support the disaster risk analysis within the IDF's Global Risk Modelling Alliance (GRMA)[30] in partnership with the Vulnerable 20 (V20) Group of Ministers of Finance and funded by the German government; ii) the use of the project data in DRRM activities under triparty agreements[31] between the IDF, the United Nations Development Programme (UNDP) and the German Ministry of the Environment (BMZ) to increase insurance protection in climate-exposed countries; iii) the recommendation of the METEOR data to the Global Resilience Index Initiative[32], which was launched at the United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties 2021 (COP26) to provide an update of the United Nations Office for Disaster Risk Reduction's (UNDRR) Global Assessment Report; iv) the inclusion of the METEOR data as a case study in IDF's forthcoming

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[30] https://www.reinsurancene.ws/idf-sets-up-global-risk-modelling-alliance-with-v20-group/
[31] https://www.insdevforum.org/projects/the-idf-undp-bmz-tripartite-programme-increasing-insurance-protection-in-climate-exposed-countries/
[32] https://www.cgfi.ac.uk/global-resilience-index-initiative/

educational toolkit for people at the entry-level to pull together hazard, exposure and vulnerability data to perform risk assessments; v) the use of METEOR exposure data in IDF's efforts for making the use of exposure data more interoperable and test their transformation between the GED4ALL (format of the Global exposure database for all created by the HOT) and the OED formats. In addition, the World Bank has expressed interest in expanding the Nepal's earthquake risk model developed under the Finance or Growth Development Policy Financing programme to include the flooding risk as well.

Positive perspectives for additional uses in supporting insurance product development in ODA countries have been reported. Besides the World Bank-funded project in Nepal run by Aon, multiple insurance-related interviewees claimed to be very interested in using the data in future opportunities, particularly as a starting point to develop bespoke models. For example, one interview mentioned: "*If we are going to develop something bottom-up, we will probably start with using the METEOR data, but, at the moment, there aren't concrete opportunities to use them*". Another modeller reported to have planned to submit a project proposal for a Nepal-based project using the METEOR Level 3 Exposure data as part of the methodology, but unfortunately, in the end, his company decided not to bid for it. He remarked that his team "*is very interested in the METEOR data. We work in developing countries where data are lacking, and the METEOR data can be a very good starting point. We are a CAT model development company, and we try to be sponsored to create data in these countries*". He added that, in addition to the World Bank, the [InsuResilience Solutions Fund](https://www.insuresilience-solutions-fund.org/)[33] is another donor that could be interested in funding projects using the METEOR data to develop CAT models as well as actual insurance products for developing countries. Finally, the flood risk management company JBA has expressed an interest in using the Level 1 Exposure data in country-level flood studies in multiple countries.

4.5. Global Case Study's Conclusions

In conclusion, one year after the end of the project, the Legacy Global Case Study found that:

- **Relevance:** METEOR addressed a clear lack of data and knowledge to support evidence-based DRRM in ODA countries. The Level 1 Exposure datasets, which are the ones available outside Nepal and Tanzania, appear to be a solid starting point to high-level national risk analysis and further build on them. However, the development of the Level 1 Exposure data in the 47 ODA countries can hardly significantly improve DRRM and close the insurance gap in these countries without additional efforts similar to those undertaken by METEOR in Nepal and Tanzania to address national political commitment and capacity constraints. Obviously, the project did not have the resources to work on the ground in 47 countries, and therefore it was not designed to do so. However, the evidence shows that the need for future METEOR-like projects in these countries is high.

- **Effectiveness:** The METEOR products are adequately robust and comprehensive to effectively inform DRRM activities in ODA countries. Compared to previously available data, their key added value appears to be the ground validation of the Level 3 Exposure data and their public availability in the formats used by the insurance and humanitarian sectors alike. Nevertheless, some key limitations in the scope of the Level 1 Exposure data were reported by insurance-related interviewees, which can hamper their usability by this industry.

- **Impact:** METEOR data and training products have been downloaded thousands of times, although the users' profiles are unknown. The evidence available shows that the METEOR data have been used extensively by the project partners and advisors or those professionally close to them, achieving important improvements in both the humanitarian and insurance sectors. There is, however, no evidence of ODA stakeholders outside Nepal and Tanzania requesting access to the METEOR data, likely due to their limited international dissemination targeting

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[33] https://www.insuresilience-solutions-fund.org/

ODA audiences because of COVID-19 and the low capacity to absorb the technical complexity of the project products without targeted capacity-building support.

- **Sustainability:** The evaluation identified numerous examples of concrete opportunities for which the METEOR products are likely to be used in DRRM and disaster risk insurance. Based on the information obtained from the people interviewed, some conclusions on the main barriers and enablers of the sustainable use of the METEOR products outside its target countries can be drawn. In terms of **enablers**, **having influential METEOR's "champions"**, such as Dr Stuart Fraser from the World Bank GFDRR and involved in the IDF, and advisors (e.g. the IIAG members) has proven pivotal in letting the right international stakeholders know about the project outputs that led to their use. In addition, **the wide network and reputation of the METEOR partners** in the international DRRM community have facilitated the integration of the project data and protocols in additional studies and projects. In terms of **barriers**, the **lack of awareness of METEOR by international stakeholders** have only been partially addressed by the enablers above. Making the data publicly accessible does not directly translate into the international community to know about them, particularly for those users who do not independently frequent online data platforms. Subsequently, **capacity gaps in ODA countries** may prevent users from those countries to approach the METEOR data. Finally, evidence showed that **more clarity on the licensing rules and process applying to the use of the Level 1 Exposure Data** in different situations is needed, particularly in cases where the funding are part of the ODA budget, but the data users are commercial entities (e.g. consultancies).

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 human-induced hazards. These include road accidents, landslides, floods, fire, heat, and cold waves factored by various phenomena like damaging windstorms, intense rainfall, thunderstorms (lightning), rapid, unplanned infrastructure and urbanisation, and lack of awareness at different levels. The country is 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 face loss and damage from various disasters. Nepal experienced severe socio-economic impact as well as raised health concerns due to the global COVID-19 pandemic. Weather-induced disasters such as floods and landslides continue to affect lives and livelihoods. In 2020, the landslide events took 303 lives and affected 771 families in different parts of Nepal. The flood events took 42 lives and affected 512 households. Similarly, in 2021, the monsoon and post-monsoon rains damaged houses, settlements, and infrastructures when the country was ready to harvest rice crops. The flood alone took the lives of 63 individuals, and 279 households were affected, in addition to the 178 deaths and 604 families affected by landslides.

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 Ministry of Home Affairs and whose members include line ministry secretaries (civil servants as opposed to elected officials), Security agencies (chiefs of Nepal Police, Armed Police Force, National Investigation Department, Lieutenant General of Nepal Army), private sectors (FNCCI, Chamber of Commerce), Deputy Governor of Central Bank, Chairperson of Telecommunication Authority, Member secretary of Social Council Welfare, Chairperson of Nepal Red Cross Society 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 Chief Executive of the NDRRMA in December 2019, the institution continues 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, i.e., i) policy, planning, and monitoring division, and ii) risk reduction and operation. By December 2021, the NDRRMA has organised 12 executive committee meetings and 8 National Council for DRRM meetings. Along with this, the NDRRMA issued three policies, i.e. Operational Guidelines for National Platform for DRR 2020, Operational Guidelines for the rehabilitation of flood and landslide victims, 2020, and National Strategy Management for Disaster Risk Financing, 2021 and Disaster Management Volunteer Bureau Formation and Volunteer Mobilization Procedure, 2022. The NDRRMA has drafted a few policies for approval, i.e., DRRM Fund Operationalization Procedures, Guidelines for Simulation Operations, NGO Mobilization Guidelines for Rehabilitation Procedures, 5 years NDRRMA Work Plan, and NDRRMA Standard Operation Procedure (SoP). This is expected to further enhance the process of DRRM in Nepal.

The NDRRMA is a designated institution established under Article 10 of the Disaster Risk Management Act, 2017. It must work together with several agencies, but 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 and, therefore, the power delegation received by the NDRRMA is still being settled with MoHA.

The Nepal Reconstruction Authority (NRA) was established to rapidly reconstruct the physical damages caused by the massive earthquakes of April 25 and May 12, 2015, and aftershocks. Formally on 23rd December 2021, the NRA has been closed, as 92 per cent of private housing, 85 per cent of archaeological sites, and 92 per cent of government buildings have been reconstructed. NRA handed over the remaining responsibilities and capital to the Department of Urban Development and Building Construction (DUDBC) and the NDRRMA. The NDRRMA is in line to adopt NRA's issued policy and directive documents in regards to housing construction and other relevant policy response measures. The NDRRMA-led BIPAD (Building Information Platform Against Disaster) portal[34] is the central repository and single data source for informing DRRM decision-making at all levels of government in Nepal. BIPAD is developed by pooling all credible digital and spatial data available within different government bodies, non-governmental organisations, academic institutions, and research organisations on a single platform. All the METEOR data outputs are hosted by the NDRRMA in the BIPAD portal[35] and are ready to be used by the Government of Nepal and a wider range of non-governmental end-users such as civil society, private sector, and academia.

The Ministry of Federal Affairs and General Administration (MoFAGA) is mandated for coordination, facilitation, and institutional development support to local governments. It also fosters inclusive development by promoting peoples' participation in local governance. MoFAGA has endorsed the Guidelines on Strategic Action Plan of DRR for Localization, 2021. MoFAGA is initiating the localisation of disaster concerns through the local disaster and climate resilience planning (LDCRP) framework (draft). The development organisation is found to be already adopting[36] the draft LDCRP in the local-level assessment and planning process. MoFAGA expects the LDCRP framework to be officially approved soon as it is in the final endorsement process. Furthermore, MoFAGA is working with the National Planning Commission (NPC) to integrate disaster concerns into the mid-term evaluation framework, periodic plans, and seven-step 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 process.

The Department of Hydrology and Meteorology (DHM) continues to strengthen and upgrade the hydro-meteorological station. 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 systems are automated, and more real-time stations are about to be established. The flood forecasting in the mountain and hilly regions is planned. Together with the NDRRMA, the DHM initiated piloting of Impact Based Weather Forecasting (IBF) in 12 local governments of 4 mountain districts since this (2021) year with technical support from UK Met and Oxford Policy Management, Policy and institutions Facility (PIF).

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[34] https://bipadportal.gov.np/

[35] https://bipadportal.gov.np/risk-info/#/hazard

[36] 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

The cabinet has approved the National Framework for climate-induced loss and damage framework in October 2021, which is a commonly agreed-upon standard methodological framework for loss and damage (L&D) assessment, building on successful and replicable national and international concepts and practices as well as limitations. This has been considered one of Nepal's contributions to the Santiago Network on Loss and Damage under the UNFCCC.

Besides government agencies, the UN Agencies, civil society, and academia continue to support Government efforts in Nepal's disaster management cycle (preparedness, response, recovery, mitigation). After the midline, the NDRRMA led the advisory committee of METEOR and the other government institutions. The NDRRMA has provided guidance to the project partners about its usefulness and further enhancing the efforts in the future.

5.1.2. Country case study findings

Relevance
The METEOR project in Nepal has achieved its intended outputs by addressing the real needs and demand for national-level exposure, multi-hazard and vulnerability data**.** With the METEOR dataset and protocols archived in the national BIPAD portal hosted by the lead DRRM agency in Nepal, **it supplies and provides public access to national-level exposure data in one place** for its use, analysis, and decision-making for all users. The METEOR outputs provide composite information on exposure, multi-hazard, and vulnerability data, on floods, landslides and earthquakes at the national level, which can be openly accessed and available for public use for all organisations, researchers, academia, students, and private sectors working on disaster sector and have benefited from this initiative.

Effectiveness
METEOR projects in Nepal **improved understanding to make use of earth observation hazard**, exposure, and vulnerability data to positively contribute to national DRRM policy and practice. It has fostered information exchange among various agencies working in DRRM in Nepal to readily make use of available information for necessary decision making. Even though the METEOR output is effective in terms of data access publicly, the focus should be on building further capacity and disseminating information on using the project datasets and protocols to wider users. The stakeholder advises making an effort to **ensure technical capacity and knowledge are built across wider end-users** for the application of METEOR data and protocol for DRRM activities.

Other stakeholders who have accessed the data for technical use and capacity building purposes suggest further ground-truthing of the METEOR outputs regarding data consistency and accuracy. For example, YILabs and Practical Action found that when they visited communities that according to the METEOR data were highly vulnerable to floods, they were actually less vulnerable. For this reason, data received from the METEOR datasets needed to be triangulated or verified from other means. In the future, the vulnerable location identified through METEOR outputs systemically needs to be assessed and verified on the ground for better decision making and planning. The improvement in the dataset will improve response, fewer disaster-related deaths, less loss and damage, and create resilient communities and societies. It is further advised to make use of universal/international colour codes like traffic light rather than single colour coding from light to dark for hazard zoning/mapping.

Impact
The availability of publicly accessible open-source METEOR national-level exposure, multi-hazard, and vulnerability data and protocols 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 on seismic, flood, and landslide risk** adding significant value to the data-based/risk-informed policy development process in Nepal. The outputs of METEOR are ready for

the Government of Nepal to use in DRRM as well as for wider end-users such as civil society, private sector and academics for decision making and use in practice.

Indeed, the interviews surfaced several concrete examples where Nepal's stakeholders have used the METEOR outputs in their DRRM activities, ranging from international aid planning to developing early warning systems, from disaster risk assessments to urban resilience (see **Error! Reference source not found.**). These users include all the spectrum of targeted actors, including DPs (UNDP, FCDO, World Bank, USAID), the government (DHM, CBS), NGOs (Practical Action), consultancies (GeoAdaptive) and academia (TU).

Despite the concrete set of impacts of METEOR outputs in DRRM policy, planning and activities in Nepal are yet to be observed, it seems to be only a matter of time. In fact, additional key national DRRM stakeholders have shown concrete plans to integrate the METEOR datasets in their regular DRRM activities (see Table 10).

Stakeholders	DRRM activity
NDRRMA	Disaster preparedness and planning across all 753 Local Governments.
NAST	Useful for pre-disaster re-construction planning and Conventional Technology for Housing Construction. Inform the prioritisation of the deployment areas of an earthquake and landslide Early Warning System in Nepal.
UN RCO	Useful to institutions and researchers working on multiple risk assessments at different levels. Also, to build synergies with an existing project to take forward data and information from METEOR outputs. Development of an evidence-based emergency response plan.
YILabs	Visualise risk scenarios further in the BIPAD portal and build capacity to replicate the process from the national level to use at local levels.
UNDP/ UNICEF/ UNWOMEN	Potential use in ongoing initiatives supported by EU to Strengthen Urban Preparedness, Earthquake Preparedness and Response in Western parts of Nepal (SUPER).
NPC	Use of dataset in evidence-based planning and inform the NPC's assessment of the financial resource requirement for DRR in Nepal.

Table 10. Plans of using METEOR outputs in DRRM activities in Nepal, identified by stakeholders

Sustainability

With the national-level exposure, multi-hazard, and vulnerability data and protocol generated from METEOR, there has been increasing **demand to improve the spatial resolution of the exposure data to the building-level to cover all 753 local governments** in Nepal. The METEOR data are currently embedded in the BIPAD portal hosted by the NDRRMA. Still, there has been a general realisation that more work is needed on multi-hazard exposure and its data chain. The data can play a significant role in risk visualisation and reducing the magnitude of the risk at all levels. **The NDRRMA confirms its readiness to lead the data update process** in the future, but collaboration with development partners is needed.

The stakeholders consulted provided several key recommendations to further improve national DRRM planning and decision-making using the METEOR project outputs listed below.

1. **Building capacity and orientation to the relevant DRRM stakeholders to make use of available METEOR datasets**: Even though the METEOR outputs are archived in the BIPAD portal, making the best use of available information for DRRM planning has been constrained by adequate capacity building and training to users at all levels. Many stakeholders suggested organising orientation and dissemination training programmes engaging all relevant stakeholders, including students, academic faculties, professors, civil society organisations, the private sector, and government officers at all levels of the government. The capacity building process should foster better involvement and collaboration between these stakeholders in using the data and

protocols in research, new knowledge generation and practical advice to local governments, including vulnerable communities. It is also advised to ensure knowledge and capacity are transferred to the local levels, such as administrative officers from the Local Emergency Operations Centre (LEOC), mayors, and local leaders, to make them aware of local disaster risk profiles for better DRRM planning and investment allocation prior to any disasters. The training and orientation should provide information on the range of possible uses of the METEOR datasets and their interpretability, and better communicate the probabilistic nature of such data. For broader use, it has been recommended to define the technical terminologies both in English and Nepali languages.

2. **Analyse exposure data for local administrative boundaries:** Many stakeholders suggest improving the spatial resolution of the current information down to the household-level. Moreover, further work is required to match the top-down METEOR exposure data with additional bottom-up data from the local communities. The following steps could be identifying the hotspots of risk and vulnerability based on available information to further improve the spatial resolution and update the information at the local level. It is also advised to make use of the protocols to prepare new datasets or separate maps at the local level in urban and rural municipalities by showing the different categories of exposure, vulnerability, and hazards.

3. **Prepare and implement a METEOR dataset communication and dissemination strategy**: Many of the stakeholders and agencies are still not aware of the full use potential of the METEOR datasets in DRRM planning and decision making. The METEOR project limited communication and dissemination of its work during the project period. Therefore, it is advised for the NDRRMA to prepare a communication and dissemination strategy to reach out to relevant actors on availability and making use of the METEOR products in their day-to-day work and decision-making process. The strategy should target to benefits end-users in the following ways: i) orientation on how to access and make use of the project data and protocols; ii) expand collaboration and engagement with federal, provincial and local level government units, students, academia, researchers, civil society and the private sector for using the outputs; iii) fostering advise to the local level to make use of information for better decision-making and planning; iv) ensuring relevant DRRM stakeholders (local governments, academicians, civil societies, and private sectors) collaborate and participate in the decision-making process for disaster preparedness and response; and v) preparing simplified communication products for reaching out to the most vulnerable communities and targeted DRRM stakeholders.

4. **Update the current datasets and integrate climate change aspects in the hazard and vulnerability information**: Many of the stakeholders advised that there have been no further updates after the upload of the dataset. It has been advised to continuously improve the information as new disasters occur in Nepal to validate and triangulate the data produced. Also, as Nepal is a highly-vulnerable country to climate change, it is recommended to generate national-level hazard and vulnerability information on additional elements such as glacial lake outburst floods (GLOFs)[37], hailstorms, droughts, forest fires, cold waves, heatwaves etc. This will make the current METEOR datasets more comprehensive on climate-induced disasters in Nepal.

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[37] BGS reported having submitted an internal proposal for a research project to assess GLOF hazard in Nepal, the decision about which is still pending.

Nepal Case Study's Conclusions

Relevance: Nepal's METEOR dataset and protocols **addressed the real needs and demand of earth observation information by supplying and providing public access** to national exposure multi-hazard and vulnerability data and protocols in one place.

Effectiveness: The METEOR project in Nepal **improved understanding of using earth observation** hazard, exposure, and vulnerability data to positively contribute to national DRRM policy and practice. However, **additional capacity of relevant stakeholders needs to be enhanced** to make better use of information and further translate the protocol to generate local-level information.

Impact: The project has met the expectation of the national DRRM stakeholders interviewed to provide information for improving disaster response, and reducing disaster-related death and loss and damage. It is **too early to measure the actual impact from the METEOR project in improved in-country DRRM policy and planning**. However, it has met the expectation of the wider DRRM stakeholders in providing information to be used in improved response, reducing disaster-related death, and loss and damage.

Sustainability: METEOR datasets and protocols have **raised sustained interest within the DRRM stakeholders and agencies** in Nepal to use the existing dataset, improve information and deploy the protocol at the local levels to address the disaster management challenges observed in Nepal through continuous capacity building, dissemination, and knowledge sharing.

5.2. Tanzania findings

5.2.1. Country context update

An update to the Tanzania endline contextual analysis was conducted by conducting a quick PEA.

Evolving risk context

Tanzania is becoming increasingly vulnerable to tropical storms, droughts and floods. These disasters result in disruption to daily lives, destruction of infrastructure, health problems and food insecurity.

In April 2021, 22 people died, and at least 6,000 households were affected following heavy rains and strong winds associated with tropical cyclone Jobo that formed over the south-western Indian Ocean and moved west-northwest towards the eastern coast of Tanzania[38.] In January 2021, severe flooding in the Mtwara Region left one person dead in Mtwara-Mikindani municipality and approximately 400 homes were reported as damaged or destroyed.[39] 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.[40]

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 seismic events include the August 2020 magnitude 5.9 earthquake, 88 km off southeast of Dar es Salaam,[41] and the March 2021 4.0 earthquake near Musoma, North Mara.[42] For both these events, no casualties were reported.

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[38] https://www.ifrc.org/appeals?date_from=&date_to=&appeal_code=&text=&page=5
[39] http://floodlist.com/africa/tanzania-flood-mtwara-january-2021
[40] https://www.thecitizen.co.tz/tanzania/news/heavy-rains-leave-12-dead-in-dar-es-salaam-2718074
[41] https://www.thecitizen.co.tz/tanzania/news/earthquake-of-5-9-magnitude-strikes-off-tanzania-coast-2714408
[42] https://www.thecitizen.co.tz/tanzania/news/earthquake-of-4-7-magnitude-hits-mara-tanzania-3319036

Policy and Legal Framework

Progress has been made in measures taken to review and establish a new legal and policy framework to guide DRRM activities in Tanzania since the endline interviews conducted in 2021.

Efforts were on the way to review the **2004 Disaster Policy** in Tanzania and update the most important piece of legislation, the Disaster Management Act 2015, during the endline interviews. Currently, the Disaster Policy review process is ongoing and at a stage where PMO-DMD gathers suggestions and recommendations from different stakeholders. The expectation is that the **updated Disaster Policy will be tabled to the parliament within this financial year.**

The updating of the **Disaster Management Act 2015** has made further progress, having been tabled to the parliament at this stage and pending approval in May 2022.

During the endline evaluation, there was also mention that efforts were underway to establish a **National Five-Year Disaster Risk Reduction Strategy (2021-2026)** as part of the national commitments under the Sendai Framework for Disaster Risk Reduction 2015-2030. This process is complete, and the Strategy designed to guide national DRR efforts is ready for implementation.

Update on the governance of disaster risk management update

Key findings from the endline evaluation included the fact that while the 2015 Disaster Management Act calls for new structures at both the national and sub-national levels, not all the new structures will be operationalised, specifically the Disaster Management Agency (DMA), which will not be established and DMD will remain as is under the Prime Minister's Office. In addition, the Tanzania Disaster Management Council (TADMAC) remains the body that oversees the operations of DMD. This has further been reconfirmed as part of the legacy evaluation. However, while the governance of disaster risk management has not changed since the endline evaluation, there is potential for changes following the ongoing efforts to update the 2015 Disaster Management Act pending approval in May 2022.

5.2.2. Country case study findings

Relevance

The need for robust and transparent disaster risk data to inform national as well as local DRRM policies, plans and activities is evident. There is still relevance for METEOR data in Tanzania for use in country-level analysis, country risk profiling or similar national-level assessments.

Demand for more datasets such as drought, loss of vegetation cover due to wildfires by the national project partner indicated a sign of confidence and usefulness of METEOR data by the national disaster coordinator. Some evidence from other government stakeholders consulted indicates that the data are valuable. They could see complementarities to existing datasets they already have, even though they had not directly engaged with the METEOR datasets. In academia, potential use cases were identified for research and teaching purposes, such as natural hazard modelling courses provided conditional upon access to the raw data.

While the demand is there for more datasets and protocols from METEOR, the limitations for some user demands lie with the scale and granularity of the data. The majority of stakeholders that engaged or had viewed the data with concrete use cases in mind thought they were useful for analysing risk at the national level, but they could not use it for city or district level analysis, where they had potential interventions.

Two potential use cases that came out of the interviews partly did not materialise as both initiatives were aiming at determining hazard profiles of either a city or district, whereas the donors were considering implementing improvement of urban services in cities and social protection interventions, i.e. safety net programmes. In both cases, stakeholders saw a potential use case for the Level 3 Exposure data.

Effectiveness

Evidence shows that METEOR contributed to some improvements in the capacity of PMO-DMD as the national coordinator, in knowledgeably using the EO-based data in DRRM practice and to some extent in policy-making. Error! Reference source not found. lists four instances in which DMD used the METEOR data in the DRRM activities, spanning from technical risk assessments to strategic document preparation. **However, no evidence is seen of significant improvement in the capacity and ability of other national and international stakeholders beyond the national project partner.** The project managed to deliver data and protocols that meet a demand identified for national-level data, but it appears that more effort was needed to foster ownership of these outputs by broader national stakeholders. This lack of evidence of active or prior engagement with METEOR by DRRM stakeholders in Tanzania is not due to a lack of demand or practical applications for such data. **This is primarily driven by their reported lack of sufficient involvement of these stakeholders during project implementation, which hampered the ownership of the outputs.**

According to some interviewees, **insufficient capacity building influenced the use of EO-based data for DRRM policy and practice.** While workshops were held in-country, they were generally felt insufficient, as requests for further training were made during the legacy KIIs. Secondly, some interviewees pointed out how **these workshops did not always include the right people** able to interpret and analyse the data, but rather at times included more senior officials who lacked the interest and technical capacity to significantly benefit from the training received.

As **Tanzania disaster data are scattered across different institutions**, the positive impact seen in DMD's use of EO-based data did not translate to broader use by other national and international stakeholders in the country. This was also influenced by Tanzania's poor data-sharing culture and the unnecessary bureaucracies created around data sharing, limiting their widespread use amongst DRRM stakeholders.

Lastly, **the low capability and lack of resources by PMO-DMD means it may be too stretched to pass on the knowledge** of using EO-based data to the many relevant stakeholders that need to be capacitated. It appears that the project design made too optimistic assumptions around the national project partner's capability to further train other national stakeholders after the end of the project.

Impact

The legacy evaluation showed **that the METEOR data were used to inform DRRM at a policy level** by providing input into the preparation of the 5-year Disaster Risk Reduction Strategy (2021-2026) and encouraging review of instruments such as the National Operational Guidelines for Disaster Management.

Evidence also exists of use cases for national planning. Some examples include serving as inputs for the development of early warning information. This early warning information is sent to the local government authorities (LGAs) prior to events, such as flooding. Other uses include preparing **Situation Reports (SITREP)** on disasters. METEOR outputs have also been used in **Post Disaster Needs Assessments (PDNAs)** to inform decisions on resource allocation in response activities.

While recognising the above contributions of METEOR to DRRM policy and planning, these use cases all sit with the national project partner and, to a large extent, entail consultative use of the data and not extensive technical analysis. The ownership of the outputs by other stakeholders is crucial, considering the capacity limitations within PMO-DMD.

The technical nature of the project means its outputs are aligned with the more technical national stakeholders, and their deeper engagement in METEOR might have resulted in a more widespread impact. The project's design assumptions on the capabilities of the political national partner to trickle down the project outputs to other DRRM stakeholders seem to have been faulty. Key barriers to the indirect engagement of national technical stakeholders through DMD were the administrative issues

that precluded the payment of DMD for the majority of the project implementation (see previous evaluations) and COVID-19, but also the low capacity and capability of the political partner. In hindsight, perhaps having a political and a technical local partner would have been more effective.

While evidence shows improved awareness of likely loss and damage following a disaster such as flooding or earthquakes by PMO-DMD, there is no concrete evidence suggesting that this has translated to improved response and reduced disaster-related deaths or loss and damage. It might be that more time is needed to capture this impact, but improved awareness and mentioned use cases above are a starting point.

No evidence was provided by stakeholders of unintended or additional outcomes from the delivery of METEOR outputs.

Sustainability
METEOR data is available on the project website and other open access platforms. However, most stakeholders contacted have insufficient awareness of where to find the METEOR data. This could be due to poor dissemination and feedback provision to stakeholders following the completion of final METEOR products, despite the location of the data was provided during the final in-country training workshop. For example, one stakeholder was keen on using the Tanzania seismic hazard map, but could not find the downloadable layers on the METEOR website and therefore ended up not using the data. This is because the downloadable file was hosted on the Resilience Academy platform, which the stakeholder was unaware of, and the project website does not have links to the other platforms where the outputs are hosted. The above case further emphasises the lack of awareness of the existence of METEOR outputs by stakeholders.

Upon being informed of where to find the datasets and the types of available datasets during the legacy evaluation, one donor indicated potential concrete plans for use of the METEOR outputs. However, the fact that for most stakeholders, the conversation began with first informing them of the outputs and where to find them is an indication of the poor dissemination of METEOR outputs and the lack of ownership by Tanzanian stakeholders, which casts doubt on the project sustainability.

The sustained interest by DRRM stakeholders in using METEOR data and protocols is also significantly minimised by **the lack of sufficient and well-targeted capacity development in-country and awareness creation**. Stakeholders indicated that more capacity building was needed beyond the workshops and training provided during project implementation to ensure ownership and eventually enable the mainstreaming of METEOR data and protocols in national DRRM.

Tanzania Case Study's Conclusions
Relevance: METEOR outputs in Tanzania address an existing demand for national-level exposure and multi-hazard and vulnerability data and protocols for national-level assessment and similar country-level risk profiling.

Effectiveness: The design and delivery of METEOR outputs have led to improvements in the capacity and ability of the national project partner to use EO-based hazard, exposure and vulnerability data in DRRM policy and practice. Little evidence exists of improved capacity outside of the national project partner. More capacity building is needed for other national and international stakeholders.

Impact: Evidence exists in Tanzania of METEOR outputs being used in DRRM policy and planning by the national project partner. The Tanzania METEOR datasets have been used to prepare the National Disaster Risk Reduction Strategy (2021-2026) and inform the development of disaster SITREPs and PDNAs. However, it might be premature to determine if this will translate into improved response, fewer disaster-related deaths and loss and damage.

Sustainability: METEOR data is available on the project website and other open access platforms. However, sustained interest by DRRM stakeholders in utilising METEOR data and protocols is not

significant due to the lack of awareness by most stakeholders of the METEOR outputs and the lack of sufficient and well-targeted capacity development in-country. More was needed in terms of in-country awareness raising and fostering a sense of ownership by national stakeholders of the METEOR outputs.

6. Conclusions

6.1. Relevance

According to the OECD definition, relevance assesses if an intervention is doing the right things. More specifically, the extent to which the intervention's objectives and design respond to the beneficiaries' needs and priorities. Are the objectives and the design sensitive to the economic, environmental, equity, social, political economy and capacity conditions in which the project takes place? In other words, do relevant stakeholders view the intervention as useful and valuable?

The broader relevance of the programme against international frameworks and goals such as the SDGs and the Sendai Framework has been confirmed in previous evaluations.

In terms of relevance to stakeholder needs, it is essential to consider who the stakeholders are in this case. **As discussed in the Global Case Study above, the most relevant stakeholders for this project were the development partners, researchers, project partners, and national level bodies.** The Level 1 Exposure datasets were less relevant for the insurance industry, although they were considered a good starting point for further elaborations. **At the level of the Country Case Studies,** given that a significant amount of planning in both countries takes place at devolved levels (regions and districts), **the datasets and protocols as they stand are of limited relevance at the sub-national level for the government. Given the project's limited resources, this trade-off appears logical, especially if future support becomes available to develop more granular datasets.**

Regarding the relevance of the programme's quality of design, the results or objectives statements in the design were clearly phrased, there was a measurement framework in place, and the theory of change was updated to remain relevant over time. The impact level objectives were set high, but clear and smart supporting objectives and indicators were set such that progress towards impact could be measured. The design was in accordance with the organisational capacity and capability of METEOR partners in terms of producing the datasets and protocols at the output level. But a combination of COVID-19, institutional restructuring in Nepal and capacity constraints in both Nepal and Tanzania meant that the move from training to capacity was not fully realised.

The datasets and protocols address a clear knowledge gap in DRRM. This was consistent across the three case studies. In Nepal, the datasets and protocols are integrated into the national systems, and in Tanzania, the primary user so far is the national partner, DMD. At the global level, the datasets were perceived to be very useful by the development partners in discussion with governments, and METEOR partners are using the datasets in other projects. And although there was no evidence of country governments outside Nepal and Tanzania requesting or accessing the datasets or protocols, the publicly available data and training tools were viewed and downloaded thousands of times.

Besides data gaps, there are other factors inhibiting effective DRRM in ODA countries that are more political such as capacity limitations, political prioritisation and incentives, which result in the allocation of resources to disaster recovery rather than prevention.

6.2. Effectiveness

The OECD defines effectiveness as the assessment of whether or not the intervention is achieving its objectives, including any differential results across groups. Effectiveness is concerned with the most closely attributable results along the causal pathway (as opposed to impact, which examines higher-level effects and broader changes).

Looking at the logframe analysis given above, the targets set at the outcome level were all achieved or exceeded: METEOR products have been used by at least three development partners in more than

the three DRRM activities; METEOR products have been used by at least one insurance company; and METEOR datasets are still hosted by 6 credible nodes and are still being accessed.

The data have been well received by users in both lighthouse countries and by global stakeholders. According to multiple sources, the ground-truthing of the exposure data was a particular strength of this dataset compared to others available for ODA countries. The open-access aspect nature of the project outputs was also commended. The data and protocols are perceived to be of good quality, with only some limitations on level 1 data for the insurance industry.

The high achievement in terms of effectiveness of the project is particularly remarkable given the constraints that COVID-19 placed upon the project. The programme partners were very responsive: plans were changed and flexed to be as effective as possible within the context of the global pandemic.

6.3. Impact

The impact that this intervention was seeking to contribute towards is that modelled human and economic costs of geohazard in Nepal and Tanzania are reduced as a consequence of policy, plans and practice being better informed by DRRM. Assessing impact should illustrate the difference the intervention makes: has it generated or is it expected to generate significant positive or negative, intended or unintended, higher-level effect? It addresses the ultimate significance of the effects of the intervention and how it will contribute to changing society for the better.

In terms of impact indicators, one qualitative indicator had a target relevant to the legacy evaluation. The indicator sought to measure progress towards mainstreaming the use of robust DRRM data to systematically inform policy changes across the public and private sectors, and civil society. The specific indicator target related to finding evidence that three prioritised end-users in Nepal and Tanzania have used METEOR outputs to inform at least three DRRM activities, such as risk assessments, technical studies, policies or strategies and that **target was met and exceeded**. Understanding more broadly who is downloading and using the data is not possible as that information is not routinely gathered.

The resources allocated to this legacy evaluation were not sufficient to enable the mapping of pathways of explicit contribution or attribution, and so it is not possible to identify the degree to which the METEOR project caused the impact specified in the Theory of Change, that is, loss of life and economic loss. However, it is clear that **the project is going in the right direction and building capabilities that can reasonably be assumed to support the mainstreaming of more robust data into national and international DRRM planning and the closure of the insurance gap. More time appears to be needed to make the project's full impact explicit.**

The project design considered Nepal and Tanzania acting as 'lighthouses', demonstrating and sharing experience with other nations. **Given the constraints in the two countries' ability to take on full ownership of the METEOR products, using them nationally, it is unsurprising that there was no evidence of the 'lighthouse effect' taking place.** It is plausible that COVID-19 also played a constraining role in allowing for sufficient international knowledge sharing occasions in the past year.

In terms of unintended impacts, there were none reported in either Nepal or Tanzania. At the global level, BGS created a Python toolbox that has been internally discussed in relation to BGS insurance industry-facing products for the UK.

6.4. Sustainability

This section considers the extent to which the benefits of the METEOR project are continuing or are likely to continue, given the capacities of the systems needed to sustain those benefits over time.

Considering sustainability at each point in the results chain: **at the input level, the funding provided for the project has stopped.** There is still some technical input and advice being provided by METEOR partners in line with their different mandates. **At the level of outputs, outputs 2, 3, and 4 relate to the open access to data and protocols and, as such, will continue.** Output one relates to enhanced skills and knowledge in the use of the datasets and protocols. **Further training and work to enhance the skills and knowledge are limited by the funding available to the in-country partners, in particular, the governments of Nepal and Tanzania, and NSET.** For outcome 1 - where governments in Nepal and Tanzania use the project outputs - this will continue to some degree but will also be limited by the resources available and national priorities as discussed above. For outcome 2 - where other end-users in Nepal and Tanzania use the project outputs - there is little evidence that this is currently happening in Tanzania. There are more examples in Nepal of other government bodies and programmes using the data and protocols (see **Error! Reference source not found.**). In relation to outcome 3 - where METEOR outputs are used by the wider, global DRR community - there is evidence of sustainability, especially where they were involved in the project (i.e. partners and advisors).

Considering the exit strategy, a significant constraint in ensuring an effective withdrawal was the COVID pandemic. This was particularly important as the programme design was always skewed towards a significant increase in capacity development activities towards the end of the project life. While some in-person training did take place, this was limited in terms of the location, the timing and the extent of training that was possible.

7. Lessons

This section gathers some conclusive thoughts on what worked well and what should have been done differently in hindsight to provide insights for future programmes. The target audiences for these lessons are the UK Space Agency, other DPs, and prospective DRRM projects' implementing organisations.

The project has been broadly successful, and the evaluators acknowledge that. However, it is always easier to spot elements that are not perfectly working than those working well. Hence the list of insights on potential improvements is longer, without implying any negative judgement on the project performance.

7.1. What worked well

The following are project design and implementation elements that worked particularly well for METEOR and should be considered in future programming:

- **Project management:** One constant finding across all the project evaluations was that the project management provided by BGS was particularly effective, especially considering the dispersed location of the consortium globally. Besides the personal ability of the METEOR project manager, Dr Kay Smith, other successful practices that can be replicated are: i) having a monthly progress call with all project partners and updates from all project work packages; ii) having annual in-person meetings, potentially of several days and held in the target countries, which can be linked to additional in-country stakeholder meetings and events; and iii) having a shared project folder clearly organised and available to all project partners.

- **Partnership:** The METEOR consortium brought together world-class technical organisations with an excellent reputation and international networks with influential local partners. This added convening power to the project and credibility to its outputs in Tanzania, Nepal, and beyond. Another added value of the METEOR partnership was having organisations and individuals with prior joint work experience, which smoothened the internal communication and work practices.

- **Use of targeted advisory groups:** The project was aided by three advisory groups targeting its primary beneficiaries, namely the METEOR Advisory Board bringing together representatives of important DPs, the Insurance Industry Advisory Group that gathered executives and technical staff of prominent insurance-related organisations, and the Nepal METEOR Advisory Committee, which included the main political and technical DRRM stakeholders in the country. These advisory groups worked bidirectionally to keep key stakeholders appraised and build their buy-in of the project outputs, on the one hand, and receive precious feedback and requests by the intended beneficiaries for tailoring the final products, on the other hand. Unsurprisingly, the level of METEOR outputs' ownership by these groups' members has been high, particularly compared to Tanzania, where a similar advisory group was not formed (see Sections 4 and 5). The advisors' selection was also important, especially in choosing people with the appropriate technical capacity to appreciate the potential of the products and, at the same time, strategically positioned to convincingly disseminate them to the right potential users.

- **Focus on transparency and accessibility:** One of the main added values of METEOR was the transparency of their data and protocols. The project delivered open data that are not only in the public domain and free for use in DRRM in ODA countries and non-profit uses, but also fully transparent and potentially replicable because of the published protocols used. Such transparency allowed for peer review by national and international experts and increased the level of trust in the data. Furthermore, METEOR focused on the broad accessibility of the outputs by posting them on globally-known knowledge platforms and in government-

participated platforms in Tanzania and Nepal. Thousands of people have been already viewing and downloading the METEOR data and training materials. Finally, the project team considered the interoperability of the METEOR data by publishing them in both humanitarian- and insurance-friendly formats and dividing the Level 1 global data into regional and national data to facilitate their download.

Additional lessons from the METEOR Legacy Learning Event – What worked well / I am most proud of

- Collaborative effort from all involved.

- Documentation of taxonomy and metadata associated with integration of EO data.

- Trusted partners.

- Project reports to be made openly available indefinitely through the NERC Open Report Archive.

- I am proud about the final project outputs (open data, training, documents and methodology).

- The Sustainability Plan helped understand the various user needs. Also the project carried out interviews with key people to establish the needs and use cases for using the EO-based products.

- Now we have a better understanding of the level of effort involved in generating the desired data.

- The METEOR products are in use, many downloads from all over the world.

- Project management and cooperation.

- Developed new skills internally.

- Online training material as a hugely effective and useful output.

- Training materials and data can be shared/useful for a variety of purposes in the future.

- Support for M&E (new aspect to many partners) from external and grant funder.

Box 1. What worked well - Additional lessons from the METEOR Legacy Learning Event

7.2. What to do differently

While METEOR has been generally successful, there are things that, in hindsight, could have been done differently or insights that could improve future DRRM programmes. These range from strategic design elements to practical considerations.

- **Design projects with a change-driven approach:** METEOR was a perfect data-driven machine. It had a highly-skilled group of technical organisations that brought about their cutting edge methodologies and resources to produce data representing a real step-change in the available DRRM information in ODA countries. The consortium excellently interpreted the mandate of the UKSA IPP programme of delivering innovative and readily-applicable products to showcase British knowledge and the potential of Earth Observation in international development. However, the project design was clearly unbalanced in terms of internal capacities and allocated time towards producing the data and protocols rather than having them taken up and owned by the national stakeholders. For instance, the delivery of the final products was planned for the last quarter of the project, leaving very limited time for the design and delivery of in-country training, which was further affected by the COVID-19 pandemic. This also left

little space for utilising longer-term and deeper forms of capacity-building activities, such as secondments, study visits, and joint "North-South" working groups that would have fostered the local ownership of the METEOR protocols and, with it, the project sustainability.

- **Plan and set up the exit strategy early on:** Further, the general assumptions on the capacity and capability of the national partners to work as "DRRM lighthouses" inside Tanzania and Nepal and in their respective regions were too optimistic. Based on the legacy evaluation evidence, there is little expectation that the local METEOR partners (or others) in Tanzania and Nepal will autonomously train others to develop and use the METEOR outputs in DRRM. A clear exit strategy could have been devised from the project's onset to establish the local partners' post-project roles and responsibilities and work throughout the project towards those goals. This would have likely implied additional capacity assessment of the national partners in the project design and inception phases.

- **Identify national champions:** A way to enhance the uptake of the project outputs by local stakeholders is by identifying the right national partners and individual champions. While the Global Case Study showed how the presence of champions and advisors was crucial in having the project data disseminated and used by others, the same was not evidenced in the National Case Studies. In terms of the choice of the national partners, METEOR took different approaches by choosing a technical NGO in Nepal and a political government department in Tanzania. Both options come with pros, cons, and trade-offs concerning the levels of technical capacity, political influence, resource availability, and ultimate impact of the project. The evaluations' evidence showed there is no perfect option, so perhaps future projects could consider having both a political and a technical partner in each of the target countries. At the same time, more effort could be put into identifying pivotal individuals that can help champion the dissemination and uptake of the project outputs by the broader DRRM system.

- **Move from co-creation to co-ownership:** It is fair to say that METEOR went beyond the norm in international development, which is having the international partners transfer their technology and knowledge to the local beneficiaries. Instead, METEOR took some positive steps in co-creating the data by having the local partners submit user requirements documents, validating the exposure data through in-country activities delivered by HOT's local partners, and eliciting local expert knowledge for tailoring the outputs. This allowed for the METEOR outputs being more aligned with the local needs, thus increasing their effectiveness. Nevertheless, a step even forward would have been moving from co-creation to co-ownership, whereby the project is designed to empower local technical leadership of work packages and their involvement as peers in the protocols' structuring, development and integration in the national DRRM system. As a result, the national partners would own the protocols as well as the data and be ready to keep them up-to-date and alive after the project end.

- **Strengthen project communication:** One of the legacy evaluation's cross-cutting findings is the need to foster awareness of the technically-robust data and protocols. While COVID played a detrimental role in the project dissemination activities, the other part of the problem seems to be the lack of communication products to accompany the release of the technical outputs. For instance, besides two in-country training workshops, no national awareness-raising campaigns about the release of the METEOR outputs were planned. In addition, while the METEOR website contains a comprehensive list of technical documents and data, it does not contain knowledge products for a non-technical audience such as infographics, and more accessible products like the training videos have low visibility as they are not referenced on the home page.

- **Expand the data coverage:** The need for DRRM-supporting data has been demonstrated by all the project evaluations. These evaluations show how METEOR has done an excellent job in

addressing the need for national-level DRRM data in Tanzania and Nepal, given the resources available to the project. That said, additional data needs that future projects could address remain. In particular, the different stakeholders interviewed during the legacy evaluation have expressed the need for data covering all developing countries (not just the ODA ones), additional hazards, and the local level.

- **Have a better understanding of local administrative constraints:** METEOR suffered from administrative issues in paying the national partner in Tanzania for a good part of its implementation. As reported in the endline evaluations, these issues resulted in the local partner's low engagement in the project and a significant amount of management time and effort to resolve. Other general issues (not encountered by METEOR) could be related to local taxes, social security and VAT. A lesson for future projects is to have an administrative checklist to ensure the smooth management of the project at the local level from the beginning.

- **Consider how to monitor data usage:** METEOR has chosen to promote the broad accessibility of its data, and this is absolutely positive. However, this came at the cost of a reduced capability of knowing in detail who is downloading the data and how they are using them. Unfortunately, the authors do not have the necessary technical knowledge to offer a solution for future project developers. Yet, it is an aspect that we wanted to flag which should be considered in future planning.

Additional lessons from the METEOR Legacy Learning Event – What to do differently / General lessons for future projects

- Allow for an additional period to IPP projects dedicated exclusively to capacity building and the uptake of the project outputs.
- Ensure that at least two people of each organisation attend the training activities to foster the institutional knowledge retention.
- Set up a full and clear licensing agreement within the consortium covering the use of the project outputs after the end of the project.
- Need to address problems of awareness of available products and possible use cases, particularly with local partners. I suspect this requires more in-country partners with a specific role for engagement and marketing.
- More consistent communication and more effective outreach planning.
- Do not skew expectations of capacity building or training to end of project.
- Release products early for testing and evaluation. There is a need for better engagement with end-users and receive their meaningful feedback.
- More regular in person interaction with DMD.
- Longer engagement to build relationships.
- Unravel contextual complexity, and understand needs of end-users.
- Prioritise capacity building.
- Find partners who can really have an impact.
- Develop a commercialisation plan.
- Involve the national partners in the actual technical development for truer capacity building.
- Better outreach to modellers in Tanzania.

What more can we do: me and my organisation

- Find funding streams to translate material into local languages (and potentially more).
- Apply products to new projects.

- Develop detailed datasets with in-country input, when feasible under projects or initiatives.
- Build partnership to enhance uptake in the insurance sector (possibly starting in middle-income countries).
- Think more carefully/creatively about where to find data, e.g. on open data users.
- Develop project proposals using the methodologies developed in METEOR.
- Expand the data to additional countries, potentially developing global data.
- Develop further tools (Python) to make the METEOR multi-hazard methodology useful for further work.
- Develop ties of the METEOR data to economic and Environmental, Social, and Governance (ESG) modelling for disruption, climate change.

Box 2. What to do differently - Additional lessons from the METEOR Legacy Learning Event

8. Annexes

8.1. Interview guides

8.1.1. Nepal and Tanzania Case Studies - Key Informant Interviews

Preparation
- Ensure you know the mandate of the organisation
- Read past interview notes of interviews with this person or others in the organisation (endline if applicable)
- Make sure you pace the interview so that you have time to ask questions 5 and 6 for key partners and close stakeholders – it's important but at the end, and so in danger of being rushed.

Interviewee:		Title/Role:	
Organisation:		Date of interview:	
Country:		Interviewer:	

Introduction

Introduce yourself and inform the respondents about the background of the project, and the purpose of the legacy evaluation - and why you are interested in their view. Ensure you have **their consent** to proceed with the interview. Let them know that the interview **will take about 1hour** and that their responses will be anonymous. They can stop anytime if they are not comfortable with a question. Here is some suggested text – you can summarise if they know METEOR:

Good morning/afternoon/evening. My name is [………………] from Oxford Policy Management. OPM worked with a consortium of organisations led by the British Geological Society on a project called Modelling Exposure Through Earth Observation Routines or METEOR. METEOR was a three-year project which ended a year ago. It developed new datasets and protocols to improve understanding of exposure. Exposure in this context means the location and key characteristics infrastructure such as housing, factories, hospitals, and roads in an area that could be impacted or destroyed by a hazard such as an earthquake or a flood. The open-source standards and protocols allow for the quantitative assessment of exposure in a multi-hazard setting. The goal is the use of exposure data by national stakeholders in disaster risk management and response activities.

We interviewed you previously because you are actively engaged in this area. We would like to ask you a few questions about your activities and views around exposure, disaster risk management and response. The interview will take about one hour. The information you give us is confidential and will only be used for reporting purposes. Your name will not be revealed to anyone and your responses will be combined with others to show combined views and opinions. There are no right or wrong answers. It is your true opinion that is important to us.

Core questions

1) Is your organisation using the datasets and protocols? If not, can you explain why not? (e.g., not in the mandate of the organisation, data is not of right quality/ format, no training) – then go to Q2

    If you are using the datasets/ protocols:

    a) Can you tell me more about how they are being used?

    b) Are you satisfied with them? Are they providing the right level of information? Do they meet your expectations?

    c) Have you updated the datasets or developed apps or other tools for using them? Please give details.

    d) How does the use of the dataset's/ protocols 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)

    e) Do you see other benefits of this information for Tanzania/ Nepal?

    f) In the event of a disaster, do you think Tanzania/ Nepal would have an improved response, fewer disaster-related deaths, less loss and damage? Please give details

    g) Has access to the METEOR outputs improved national planning and decision-making in other sectors, outside DRRM?

2) Do you know of other organisations or projects within Tanzania/ Nepal that are using (or will use) the data/ protocols? Please give details

    a) What makes it easy for different organisations to use the datasets and protocols? What are some of the challenges in using them?

3) Have you improved your capacity to use and update the datasets/ protocols to generate information relevant for DRRM? Please give details, including what helped to improve your capacity and what the challenges are.

    a) Will that capacity enable you to serve as a regional DRRM expert? Please give details, including what helps improve capacity to serve as a regional expert, and what the challenges are.

    b) Have you seen evidence of any uptake by organisations or bodies outside Tanzania/ Nepal using the data/ protocols? Please give details

    c) Have you been approached by anybody to give information or advice? Please give details

4) Have you seen or are you aware of any unexpected or unintended consequences of the METEOR products – positive or negative? How did these occur?

Q5 and 6 may have been answered in previous responses but can be used to probe for more details.

5) What did the METEOR project do well in improving national DRRM planning and decision-making? What were the key factors in achieving impact?

6) What could have been done better by the METEOR project to improve national DRRM planning and decision-making?

Preparation

- Ensure you know the mandate of the organisation
- Read past interview notes of interviews with this person or others in the organisation (endline if applicable)

Interviewee:		Title/Role:	
Organisation:		Date of interview:	
Country:		Interviewer:	

Introduction

Introduce yourself and inform the respondents about the background of the project, and the purpose of the legacy evaluation - and why you are interested in their view. Ensure you have **their consent** to proceed with the interview. Let them know that the interview **will take about 30-45 minutes** and that their responses will be anonymous.

Questions

Core questions
Advisory Board and IIAG members
1) Do you think the METEOR products have strengthened the discipline around the development of exposure and risk data? Why / In what way?   2) Has your organisation used (or is likely to use) the open source/access METEOR products in the future? Why / Why not? For what?   3) Has your organisation paid (or is likely to pay) to use or expand the METEOR products? Why / Why not? For what?   4) [For members of the insurance industry or Disaster Risk Financing community] Do you know of any contribution by any METEOR product (and if so which ones) to the creation of insurance products in LDC or other developing countries? Have you got concrete plans to use the METEOR products to support your organisation in developing insurance products?
ODA countries' stakeholders
1) Can you briefly describe the in-country procedures/ processes/ policies the government and other stakeholders undertake around disaster risk assessment? Is your organisation involved? What other organisations are involved?   2) In your opinion, what are the major challenges faced by your country when it comes to assessing and planning against the risks of a disaster? What about other LDC/developing countries based on your knowledge/experience?   3) [After explaining the METEOR products that are available for their country] Do you know whether your country has used these products to improve the disaster risk assessment

effectiveness? If yes, in what way? If not, do you think these products could be used to improve the disaster risk assessment effectiveness in your country? Why / In what way?

4) Has access to the METEOR outputs improved national planning and decision-making in other sectors, outside DRRM?

METEOR Legacy Learning Event

Luca, aileen, Shamim, Apar

17 March 2022

Oxford Policy Management

UK SPACE AGENCY

METEOR: Modelling Exposure Through Earth Observation Routines

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1. Legacy Evaluation Overview

Purpose

1. **Assess evidence of the project outcomes and longer-term impact** and investigate the causality between the project and the observed effects.

2. **Provide insights for the UK Space Agency (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.

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Agenda

1. Legacy Evaluation Overview
2. Summary of findings
   i. Logframe
   ii. Global Study
   iii. National Study – Nepal
   iv. National Study – Tanzania
3. Q&A

Coffee break

4. Conclusions
   i. Relevance
   ii. Effectiveness
   iii. Impact
   iv. Sustainability
5. Lessons
6. Reflections on lessons
7. Closing remarks

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2.1 Logframe results

Slide 1

Findings – Logframe results

Indicator	Legacy target	Assessment
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 that **3** priority end-users* (governmental and non-) in Nepal and Tanzania (at least 1 for each country) have used METEOR outputs to inform **3** DRRM activities (e.g. risk assessments, technical studies, policies or strategies).	**Exceeded – 7 DRRM activities** **Nepal** • FCDO Nepal • Tribhuvan University • Department for Hydrology and Meteorology **Tanzania** • DMD/PMO
OC 1.2. Feedback from relevant Ministry (or decision-maker) on the usefulness of the project outputs for improving their national DRRM (KPI 1)	METEOR datasets are still hosted by the official/government-led platforms currently in use.	**Achieved** • **Nepal**: BIPAD portal, owned by the government. • **Tanzania**: The data are on the Resilience Academy Geonode Platform, which is participated by the government.

*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

Slide 2

Findings – Logframe results

Indicator	Legacy target	Assessment
OC 3.1. Number of dissemination nodes where METEOR KPs and datasets are available to be accessed	METEOR datasets are still hosted by the credible **6** nodes and still being accessed.	**Achieved** 1. METEOR platform 2. GEM OpenQuake 3. World Bank GeoNode Library 4. Humanitarian Data Exchange 5. Nepal: Building Information Platform Against Disaster (BIPAD) 6. Tanzania: Resilience Academy Geonode Platform

Slide 3

# Findings – Logframe results

Indicator	Legacy target	Assessment
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 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).	**Exceeded** • Use of METEOR protocols in Nigeria, Tunisia, Colombia and Brazil • Use of METEOR data in Nepal in at least six ODA-funded projects • Multiple concrete plans of using the METEOR data by the IDF
OC 3.2. Qualitative indicator: Progress towards creating insurance products informed by METEOR data and/or protocols	There is evidence METEOR outputs have been used by at least **1** insurance company, CAT modeler, or similar	**Achieved** • Earthquake parametric insurance model developed in Nepal (and flood model planned) by Aon's Impact Forecasting team (World Bank-funded) • Multiple insurance-related interviewees expressed concrete plans of using the METEOR data if the right opportunity occurs

Slide 4

2.2 Global Case Study
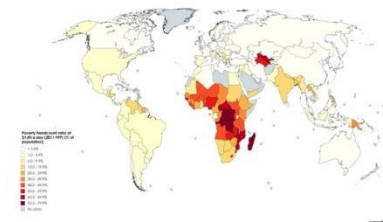
Methodology – Global case study

- Participatory evaluation workshop on 19th January

- Interviews with 10 organisations

	Stakeholder Type
BGS	Project Partners
ImageCat	Project Partners
UK FCDO	Development Partners
World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR) and Insurance Development Forum (IDF)	Development Partners, Insurance Industry
Impact Forecasting, Aon	Insurance Industry
Hannover Re	Insurance Industry
Verisk	Insurance Industry
Uganda's Directorate of Geological Survey and Mines	ODA countries
International researcher working in the Democratic Republic of Congo	ODA countries
Open University, PhD student researching on UKSA IPP	Other

Findings - Global Case Study

Impact

- Thousands of views and downloads of METEOR products

- METEOR products used extensively by project partners, advisors or those close to them

- No evidence of ODA countries directly requesting access to data

Sustainability

- Numerous concrete plans of using METEOR products identified

- **Enablers**: influential METEOR champions, partners' wide network and reputation

- **Barriers**: lack of awareness of METEOR, capacity gaps in ODA countries, need for clarity on licensing

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Findings – Global Case Study

Relevance

- METEOR addressed a clear lack of data and knowledge

- Level 1 Exposure datasets are a solid starting point for DRRM

- Alone, they are not enough and in-country support is required

- Clear need for more METEOR-like projects

Effectiveness

- METEOR products effective to inform DRRM activities in LDCs

- Key added values: ground-truthing, open access, insurance-friendly formats

- Important limitations in scope of Level 1 data for insurance purposes (countries, assets)

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2.3 Nepal Case Study

Methodology – Nepal

16 organisations interviewed

Organisation	Stakeholder Type
National Society for Earthquake Technology (NSET)	NGO, Project Partner
National Disaster Risk Reduction and Management Authority	Government
National Emergency Operation Centre, Ministry of Home Affairs	Government
Central Bureau of Statistics (CBS)	Government
Nepal Academy of Science and Technology	Government
Ministry of Federal Affairs and General administration	Government
National Planning Commission	Government
Department of Hydrology and Meteorology	Government
Youth Innovation Lab	NGO
UN Resident Coordinator Office	Inter-Governmental
Practical Action	INGO
Institute of Engineering, Tribhuvan University (TU)	Academia
USAID – TYAR program	Donor
Foreign Commonwealth and Development Office	Donor
United Nations Development Programme	Intergovernmental
OPM DRRM team	Project Partner

PEA update - Nepal

- Nepal disasters 2021: landslides 178 lives lost (604 HHs), flooding 63 lives lost (279 HHs)
- NDRRMA focal institution to strengthen governance and policy reform in DRRM
  - Held 12 executive committee meetings and 8 National Councils
  - Approved Several polices and guidelines to effectively respond to DRRM
  - Delegation of power to NDDRMA being settled with Ministry of Home Affairs
  - Nepal reconstruction authority formally closed and handover to NDRRMA
- MoFAGA and NPC: localisation of disaster concerns through local disaster and climate-resilient planning framework (draft), SDG localisation framework, harmonization of LAPA, LCDRP and DPRP etc.

Findings - Nepal

Relevance

- Achieved its intended outputs by addressing the needs and demand for national-level exposure, multi-hazard and vulnerability data
- National BIPAD portal hosts the data and protocol – public access

Effectiveness

- Improved understanding to make use of earth observation hazard
- Additional effort needed to ensure technical capacity and knowledge are built across wider end-users for its wider application

Findings - Nepal

Impact

- Concrete set of impact in DRRM policy, planning and activities are yet to be observed
- Many DRRM stakeholders are using the information in research, decision making and raising awareness

Sustainability

- NDRRMA hosts the portal
- Increasing demand to scale down the resolution of the exposure data to cover all 753 local governments
- Further capacity building required for continued use by wider DRRM agencies and stakeholders
- See report for detailed recommendations

2.4 Tanzania Case Study

PEA update - Tanzania

- Tanzania: increasingly vulnerable to tropical storms, droughts and floods
- April 2021, 22 people died, and at least 6,000 households were affected - heavy rains and strong winds associated with tropical cyclone Jobo that formed over the south-western Indian Ocean
- January 2021, severe flooding in the Mtwara Region – 1 dead, approximately 400 homes reported as damaged or destroyed

Policy and Legal Framework

- 2004 Disaster Management Policy update at stakeholder consultation stage. To parliament this FY
- Updated 2015 DM Act already tabled in Parliament pending approval May 2022
- National DRR strategy (2021-2026) under Sendai Framework established, ready for implementation

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Methodology – Tanzania

8 organisations interviewed

Institution/Organisation	Stakeholder Type
PMO-DMD	Government / project partner
Ministry of Water	Government
Geological Survey of Tanzania (GST)	Government
Foreign, Commonwealth & Development Office (FCDO)	Donor
World Bank	Donor
Ardhi University	Academia
Tanzania Red Cross Society (TRCS)	Humanitarian organisation
Humanitarian Open Street Map Team (HOT)	Humanitarian organisation

---

Findings - Tanzania

Relevance

- Country-level risk profiling or similar national level assessments
- Demand for more hazard scope (e.g. drought) –signifies confidence
- Limitation for some user demands- scale and granularity

Effectiveness

- Effective in improving capacity of national project partner in using EO-based data in DRRM policy and practice
- Little evidence is seen of use by other stakeholders
- Scattered data
- National partner too stretched
- More needed to foster ownership

Findings – Tanzania

Impact

Evidence of by project partner in DRRM policy and planning

- Policy to inform National DRR Strategy
- In practice in preparation of early warning prep to LGA, disaster Situation Reports and Post Disaster Needs Assessments (PDNAs).

Sustainability

- METEOR outputs available on open access platforms
- Lack of awareness of availability of outputs by most stakeholders
- Insufficient capacity building
- No sense of ownership by stakeholders outside of project partner

Clarifications? Questions?

Was there anything that feels not valid?

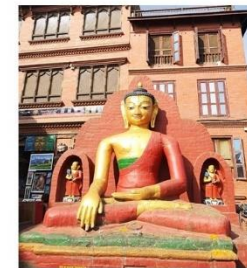Is there anything important missing?

Was there anything surprising?

3. Questions

5 minutes of Zen

4. Conclusions

Conclusions – Effectiveness

- Targets were met, and exceeded at outcome level
- Data sets have been well-received by users
- Quality, ground-truthing and open access commended
- Project responded flexibly and creatively to COVID: this limited impact on effectiveness
- There is further demand for capacity building – beyond DMD in Tanzania, across more users in both countries

Conclusions – Relevance

- Overwhelming evidence the METEOR products are needed and useful
- Relevance against SDGs, global frameworks already established
- Relevance to stakeholder needs varies
  - High for national-level bodies, researchers, project and development partners
  - Less so for insurance industry ("starting point") and sub-national government
- All want more: evidence of relevance and confidence
  - Insurance and DPs wanted global-level
  - Tanzania and Nepal wanted local-level, and more hazards
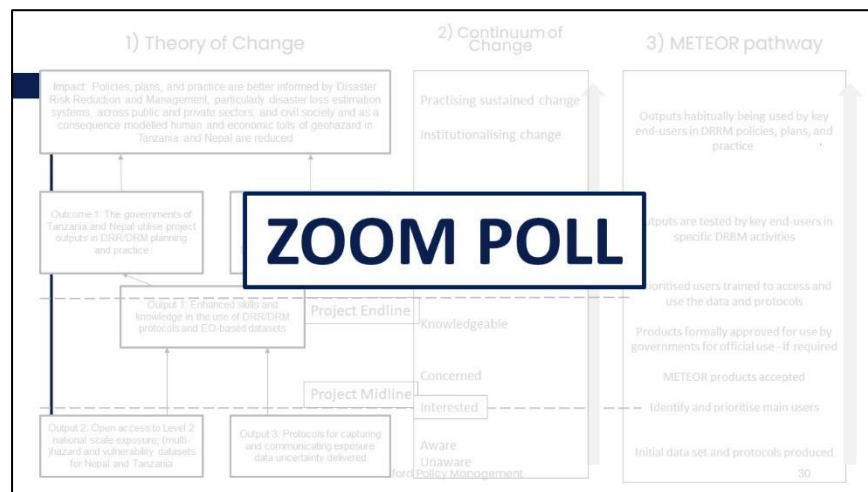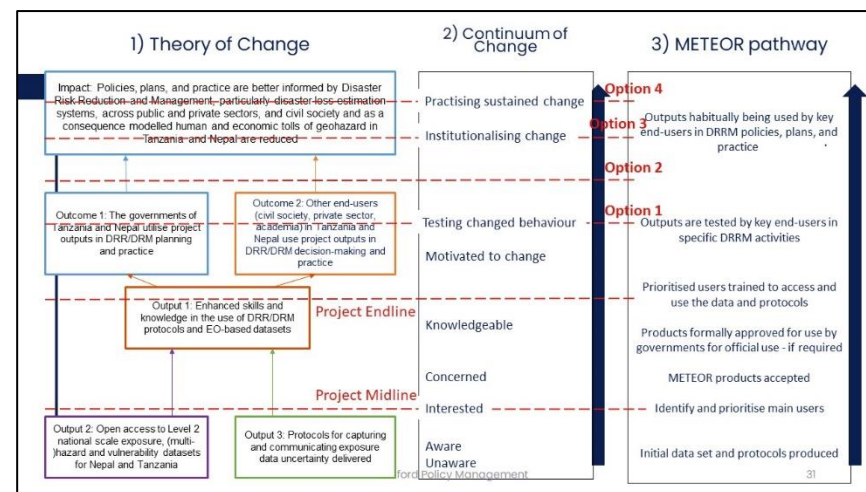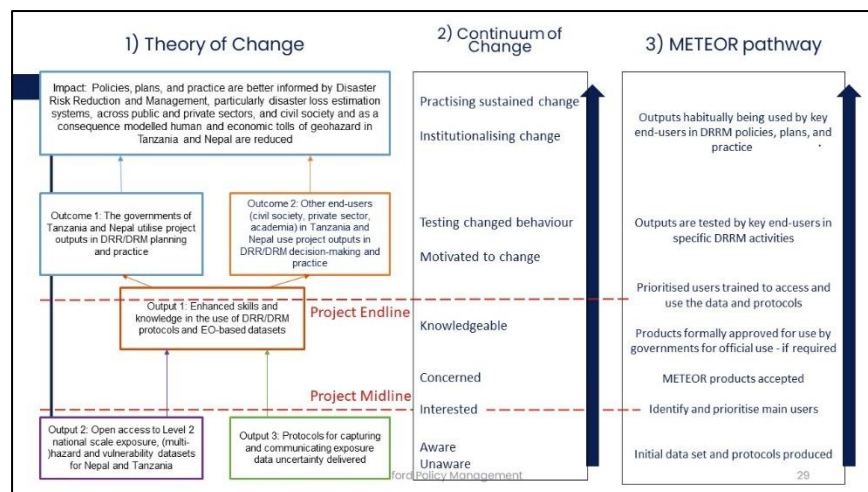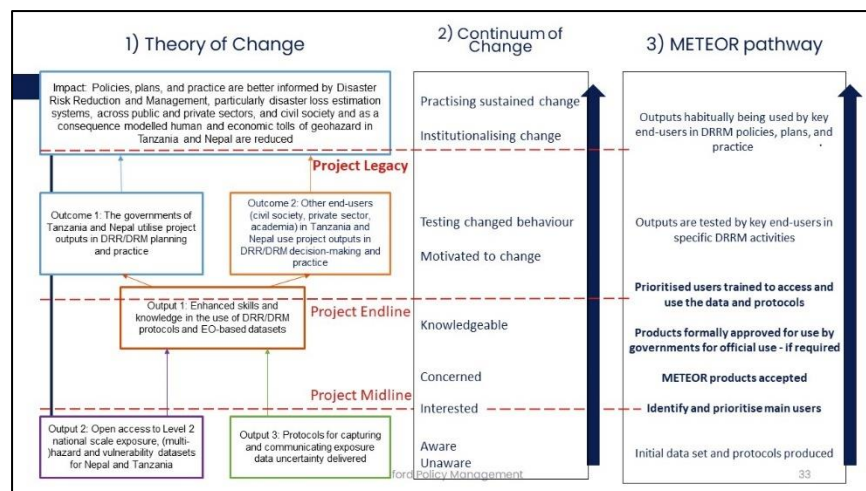
Conclusions – Impact

- It is clear the project results are building capabilities that can reasonably be assumed to support the mainstreaming of more robust data into national and international DRRM planning
- More than three prioritised end-users in Nepal and Tanzania have used METEOR outputs to inform at least three DRRM activities: target exceeded
- Limited understanding of who is downloading the data, and how they are using it. No evidence of other ODA countries using them.
- One positive, unintended outcome observed

Slide 1 (Theory of Change diagram)

1) Theory of Change

Impact: 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

Project Legacy

Outcome 1: The governments of Tanzania and Nepal utilise project outputs in DRR/DRM planning and practice

Outcome 2: Other end-users (civil society, private sector, academia) in Tanzania and Nepal use project outputs in DRR/DRM decision-making and practice

Output 1: Enhanced skills and knowledge in the use of DRR/DRM protocols and EO-based datasets

Project Endline

Output 2: Open access to Level 2 national scale exposure, (multi-)hazard and vulnerability datasets for Nepal and Tanzania

Output 3: Protocols for capturing and communicating exposure data uncertainty delivered

Project Midline

2) Continuum of Change

Practising sustained change

Institutionalising change

Testing changed behaviour

Motivated to change

Knowledgeable

Concerned

Interested

Aware

Unaware

3) METEOR pathway

Outputs habitually being used by key end-users in DRRM policies, plans, and practice

Outputs are tested by key end-users in specific DRRM activities

Prioritised users trained to access and use the data and protocols

Products formally approved for use by governments for official use - if required

METEOR products accepted

Identify and prioritise main users

Initial data set and protocols produced

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Slide 2

Conclusions – Sustainability

- Data is open-source, open access, accessible on multiple platforms
- Ability of government bodies to fully embed use, to deliver further training is limited by resources available to them
- End users outside government using the data: little evidence in Tanzania, more happening in Nepal
- In the wider, global community, there is evidence of sustainability, especially where they were involved in the project
- Effective withdrawal and closure was constrained by COVID, compounded by skewing of capacity outputs towards the end of project life

Outcome 1: The governments of Tanzania and Nepal utilise project outputs in DRR/DRM planning and practice

Outcome 2: Other end-users in Tanzania and Nepal use project outputs in DRR/DRM decision-making and practice

Outcome 3: METEOR outputs are used by the wider, global DRR community

Slide 3

Clarifications? Questions?

Does the analysis resonate with you?

Are there aspects where you disagree?

Is there nuance missing?

Slide 4

5. Lessons

Lessons – Exercise

- Go to Miro board – Link in the chat
- Write down your personal lessons on:
  - Things in METEOR that worked particularly well / I am mostly proud of
  - Things to be done differently / suggestions for future projects
  - Personal (or own organisation's) follow-ups to improve METEOR sustainability

Lessons – Do differently

- Rebalance the data/ capacity. Different timing and resourcing could have increased sustainability
- A better understanding of capacity from the outset would have replaced assumptions. E.g. Tanzania and Nepal acting as 'lighthouses'
- Use understanding of pros and cons of different partners (e.g. government and non-government) to inform partner choices
- Deepen co-creation to co-ownership, building on understanding of capacity and partner choices
- Consider publicity campaigns to widen/ deepen demand
- Improve documentation/ understanding of data usage

Lessons – What worked well

- Strong, active project management (leadership, calls, meetings in-person, shared data store)
- Partnership: 'top-notch' organisations with strong credibility and networks - and with prior relationships
- Advisory Boards (project, insurance and Nepal): built buy-in and provided inputs/ feedback. Skilled and strategic members acting as 'champions'
- Focus on transparency, traceability

6. Reflections on the lessons

8.3. Legacy Learning Event – Minutes

On 18th March 2022, a 2-hour online Legacy Learning Event was organised by the METEOR M&E Team on Zoom. The meeting was attended by 15 people from the METEOR consortium, Caribou Space (the M&E partner of the UKSA), and a PhD student from the Open University researching on METEOR and other EO-based projects (see Figure 2).

Figure 2. Screenshot of the participants to the METEOR Legacy Learning Event

The purpose of the meeting was to present the findings, conclusions, and lessons from the METEOR legacy evaluation, gather the consortium's feedback and possibly identify additional lessons. The slides presented at the learning event are provided in Annex 8.2. This annex provides the highlights from the discussions that occurred during the event.

Figure 3. Agenda of the METEOR Legacy Learning Event

Figure 3 shows the agenda of the event. Sessions 1 and 2 were structured as presentations of the purpose of the legacy evaluation and its key findings, respectively. The findings covered an overview of the project's performance against its logframe indicators and targets, and the evidence and conclusions of the global and national case studies.

In Session 3, the participants were asked if in the findings they heard there was anything that felt not valid, anything important that was missing, or anything surprising. The findings about the need for additional capacity building and dissemination caught the participants' attention. In particular, it was pointed out how it was known that COVID-19 had affected the impact of the dissemination and capacity-building activities delivered by the project because remote training is not a perfect substitute for in-person one. A lesson for the UKSA identified would be to allow for an additional period to IPP projects dedicated exclusively to capacity building and the uptake of the project outputs.

An attendee asked whether the finding of the lack of knowledge of the availability of the METEOR data in Tanzania was due to the fact that the interviewees did not attend the training workshops offered by the project. Shamim Zakaria, from OPM, explained that this only partially affected the finding. She pointed out how staff turnover had affected the retention of the awareness of the data and the capacity to use them, but also that sometimes the decision-makers sent the wrong individuals to the training, especially people who were senior management and not technical officials who would actually use the data. The lesson identified was to always ensure that at least two people from each organisation would attend the training.

Another participant asked whether there were some specific use cases of the Level 3 Exposure data in Tanzania. Shamim expressed the satisfaction with the data by DMD, shown by the several occasions in which they used them. Outside DMD, she spoke about how the World Food Programme and Ardhi University are planning to use the METEOR data in risk analyses linked to safety net programmes, and the World Bank would like to use them to understand disaster risks before implementing urban service interventions within the TURP.

After a brief break, the workshop resumed with a presentation of the evaluation's conclusions about the project's relevance, effectiveness, impact and sustainability. To introduce the conclusions about impact, Aileen Lyon used the diagram in Figure 4 to provide options of the level of impact achieved by the project at that point in time that were voted by the participants in a Zoom poll. Eight out of 12 voters selected option 2, which places the project's impact between the testing of changed behaviour and institutionalising change on the continuum of change used. Two voted for option 1 and the remaining two voted for option 3. Option 3 was the actual level at which the evaluation team assessed the project.
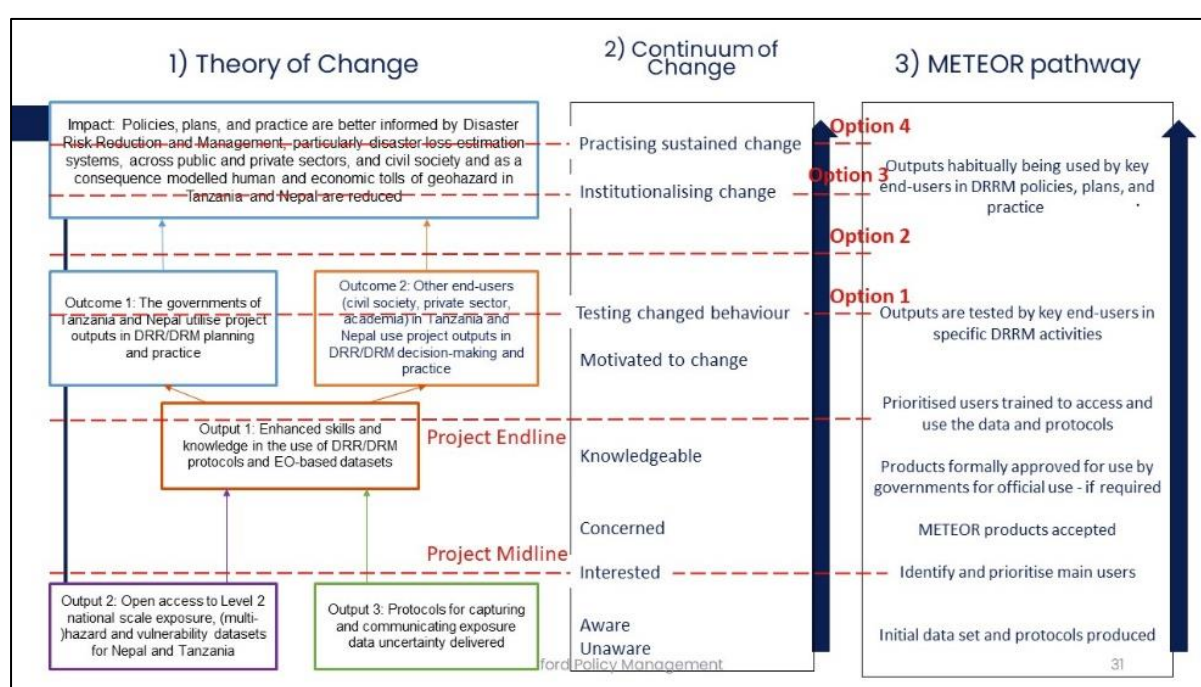

Figure 4. Options of METEOR's level of impact for participatory survey during the learning event

After the presentation of the conclusions, the audience was asked for any feedback or need of clarification. One point raised was the recognition that because the project focused on making its outputs open-access, this would imply not restricting the access to the data to the provision of personal information, which is the reason for not having information about who is using the data and for what. One project advisor felt slightly disappointed with the low relevance of the Level 1 data for the insurance industry and asked whether the project explored the market for the use of Level 3 data. The answer from the project team was that the barriers for the insurance industry to working in ODA countries were known and that, in their view, the outcome was not disappointing. They pointed out that, because of those barriers identified by the evaluation, the goal was never for the Level 1 data to suffice as they are, but rather to raise interest in insurance players for further developments. The fact that they "*paid attention, looked at the quality of the data, looked at the protocols, and are thinking how they would use them*" was satisfactory to the team.

One unaddressed need that was highlighted was for the consortium to agree on how to deal with licensing the use of the current data to commercial end-users. Currently, the setting and management of royalties are unclear, and the project partners decided to discuss this further on a separate occasion.

Figure 5. Participatory identification of lessons using Miro during the learning event

The next session looked at the lessons from the project's legacy. It started with a brainstorming exercise using the online whiteboard Miro[43] (see Figure 5). The complete Miro board with the identified lessons is given in Figure 6 below. The lessons were summarised and transcribed in Box 1 and Box 2.

As the learning workshop was the last event of the project, it was closed by some final remarks and farewells of the different team members.
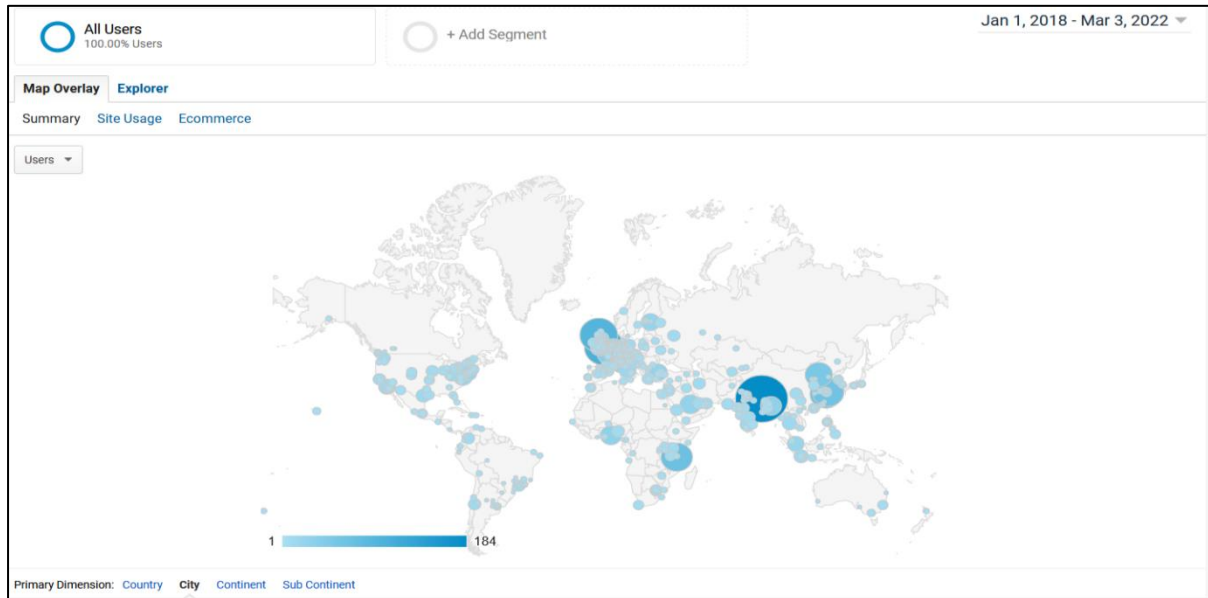
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[43] https://miro.com/

Figure 6. Lessons identified at the METEOR Legacy Learning Event

8.4. Use of METEOR datasets since project end

8.4.1. METEOR websites

METEOR website

Geographic distribution of usage of METEOR website (2018-01-01 - 2022-03-03)

All page accesses since analytics enabled mid 2020: Over 11,000 page accesses by > 3,600 distinct users from over 1,000 different cities around the world.
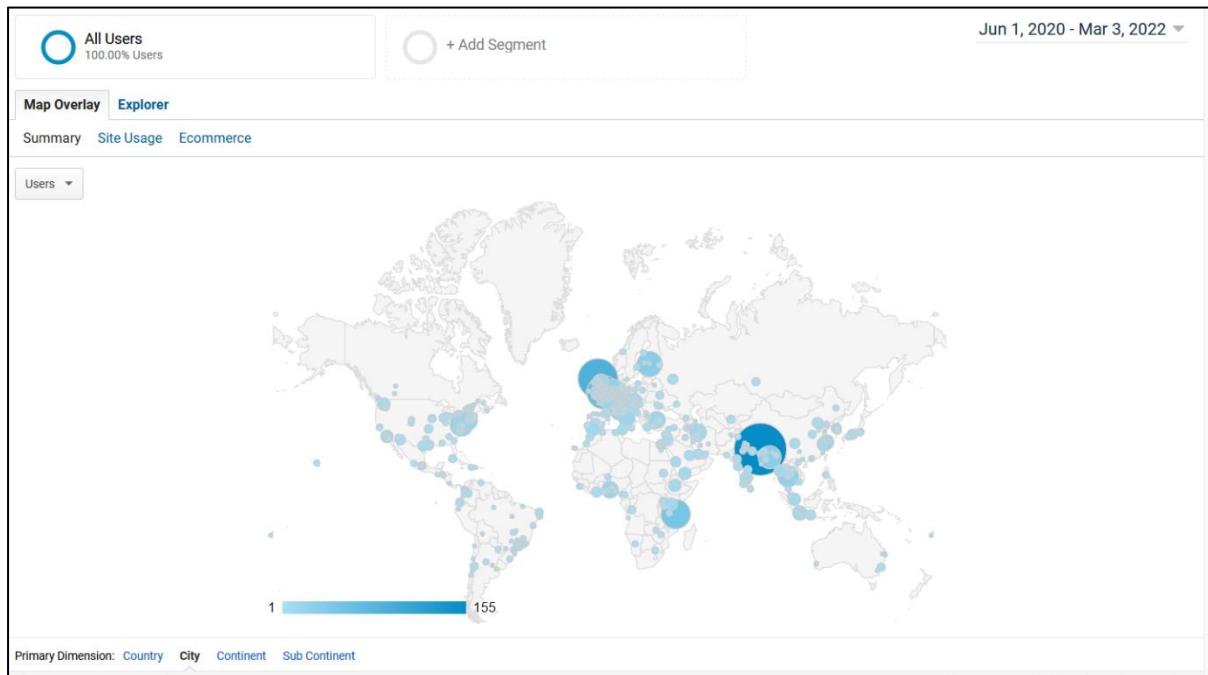
Note the large dark blue dots over Kathmandu and Dar es Salaam, almost certainly due to the training sessions and related activity by local partners.
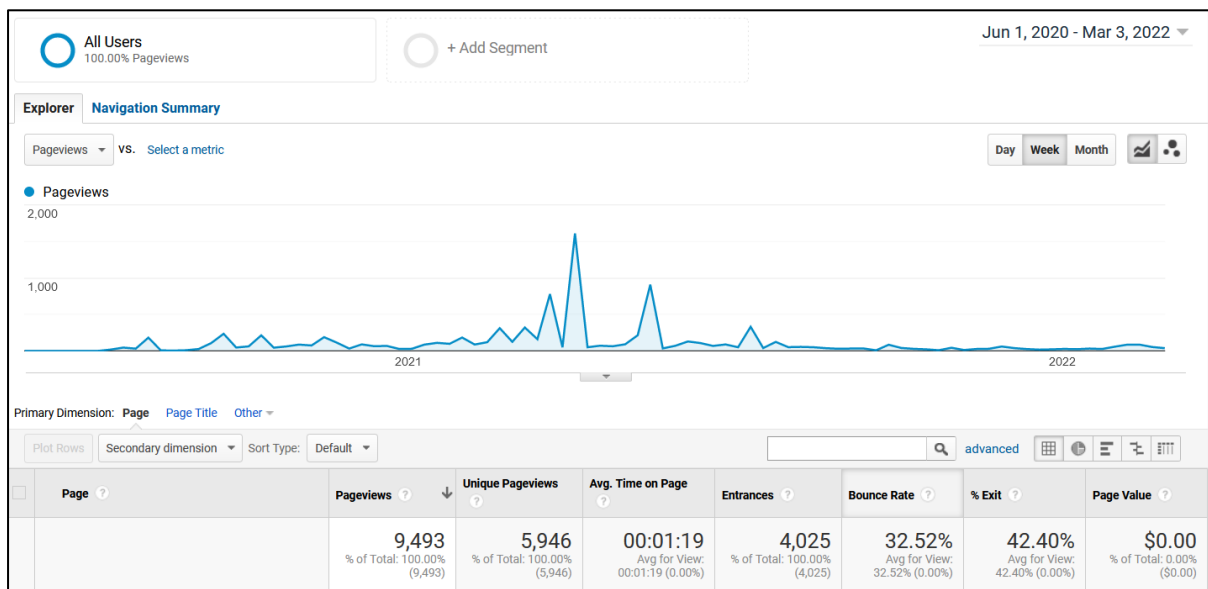
Page accesses (website)
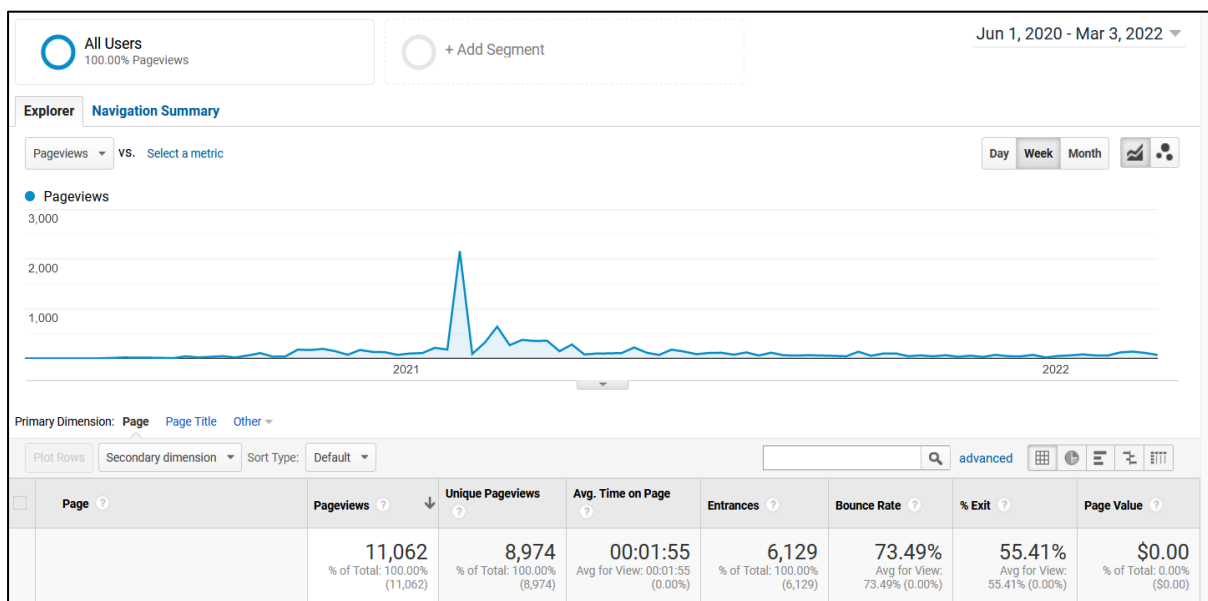
METEOR Map Portal

Geographic distribution of usage of METEOR map portal (2018-01-01 - 2022-03-03)
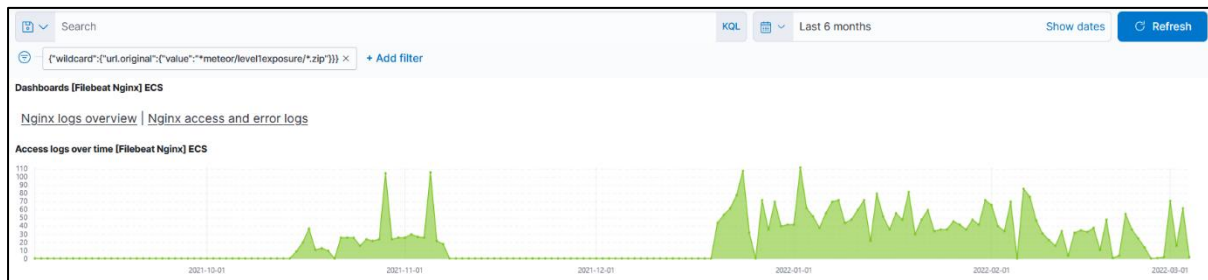

Over 9400 page access from > 2400 distinct users in > 900 different cities around the world.
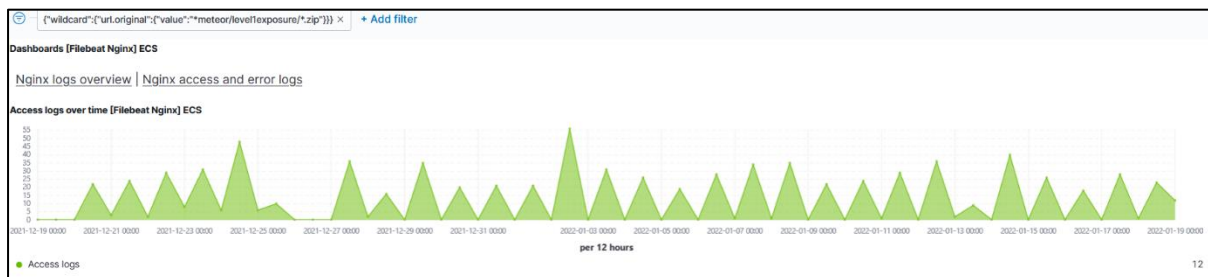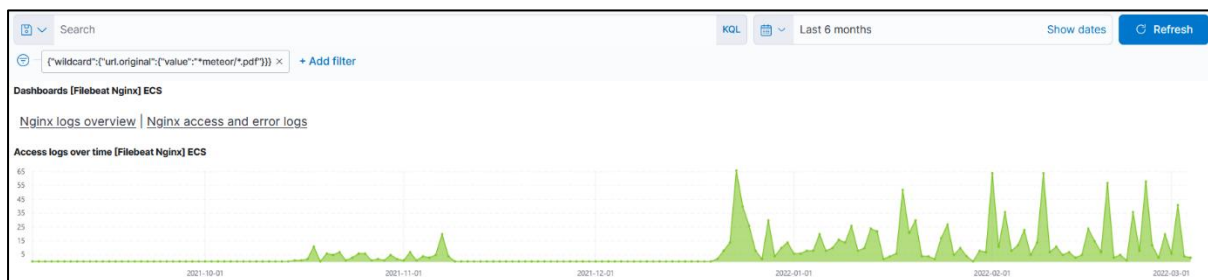
Page accesses (portal)

Over 3900 exposure zip downloads in the last 6 months (no data available before 2021-10-15)

842 Exposure ZIP downloads in the last month (802 excluding obvious bot accesses)

Over 1200 training documents (in PDF) (no data available before 2021-10-15)

243 Training documents downloaded in the last month (~90 excluding obvious bot accesses!)
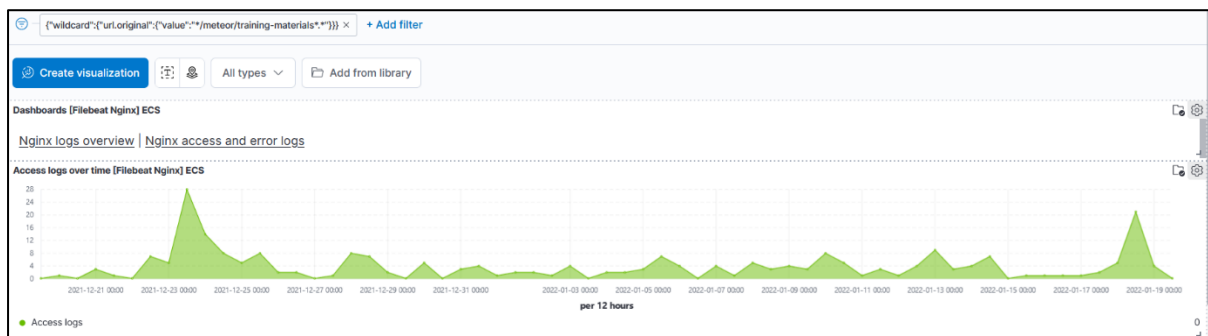
8.4.2. Humanitarian Data Exchange Platform

As of 2021-12-16, HDX reports that we had a total of 1610 downloads by 437 distinct users
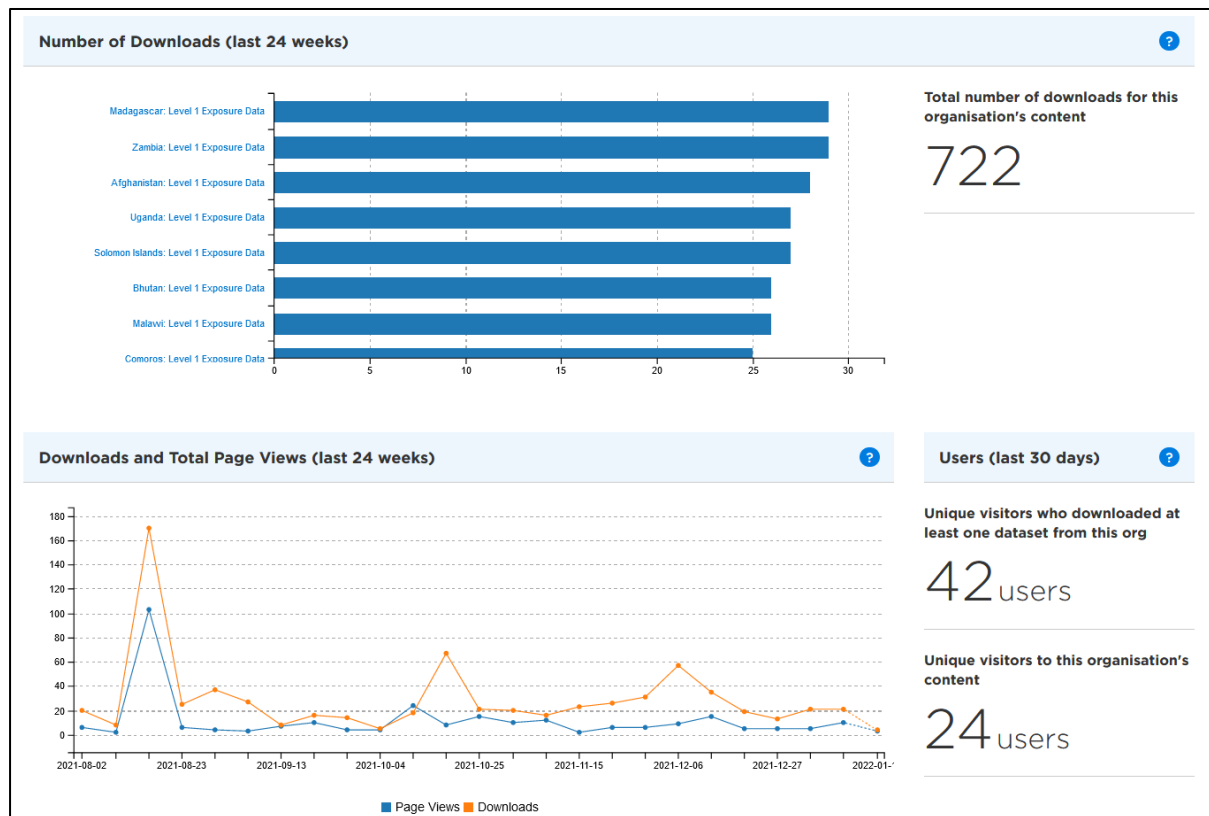
8.4.3. Resilience Academy Geonode (Tanzania)

Very limited data available from https://geonode.resilienceacademy.ac.tz - two TZ maps available, 52 views for flood, 14 views for seismic.

https://geonode.resilienceacademy.ac.tz/layers/?limit=10&offset=0&title__icontains=METEOR&abstract__icontains=METEOR&purpose__icontains=METEOR&f_method=or

8.5. Updated logframe at legacy

Please see Table 8 for details on the legacy results.

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		Exceeded		
		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). *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

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		Achieved		
		Tanzania			Partially achieved	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 still hosted by the official/government-led platforms currently in use.

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
		Tanzania			Partially achieved	Partially achieved				• End users have willingness to change • Capacity levels of emergency plan implementers are adequate
		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		Exceeded		
	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		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	0	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 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 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: 1. METEOR platform 2. GEM OpenQuake 3. World Bank GeoNode 4. Humanitarian Data Exchange 5. Nepal: Building Information Platform Against Disaster (BIPAD) 6. Tanzania: Resilience Academy Geonode Platform	METEOR datasets are still hosted by the credible **6** nodes and still being accessed. List of credible nodes: 1. METEOR platform 2. GEM OpenQuake 3. World Bank GeoNode 4. Humanitarian Data Exchange 5. Nepal: Building Information Platform Against Disaster (BIPAD) 6. Tanzania: Resilience Academy Geonode Platform