Photo: Uganda landscape by Denis Onyodi/URCS-DRK-Climate Centre

Improved forecasting helps people prepare for the weather and the seasons

SHEAR research outcome

This brief outlines SHEAR's advances made in developing new or improved forecast products for various natural hazards and their impacts in Asia and Africa. SHEAR projects have worked to advance the quality of the forecast information to support preparedness, by increasing the confidence, credibility and usability of forecasting science.

Summary

The ability to forecast weather conditions and anticipate potential impacts is crucial for achieving improved resilience and responses to disasters.

SHEAR research projects have made enormous advances in forecasting science and connecting science to practice.

These advances include increasing the forecast lead time, improving the accuracy of models, and extending the coverage of systems to new areas. Some projects now also include impact-based forecasting.

Through the co-development of forecasting science with a wide range of stakeholders, the advances in forecasting within SHEAR are relevant for decision-makers and easy to understand.

Introduction

Weather forecasting science helps us to understand where, when and how severe weather-induced hazard events and associated impacts are likely to occur. Too often we respond during and after events, rather than acting in advance. Forecasts can help us to act in anticipation of weather-induced hazards, to protect lives, livelihoods and assets. Recent advances in the fields of the atmospheric sciences provide an opportunity to forecast weather-related hazards across a range of decision-relevant timescales from hours to months.

Projects in the Science for Humanitarian Emergencies and Resilience (SHEAR) programme have developed both new forecast information as well as more decision-relevant models, such as impact-based forecasting, through co-development with diverse stakeholders. The co-creation, verification and integration of science in existing procedures ensured longevity and the continued use of these forecast products beyond SHEAR.

Improved forecasting products

Acting in advance of imminent weather-related events is highly dependent on the warning time (lead time) of a forecast and the confidence decision-makers have in the accuracy of the forecast information available to them. Overall, SHEAR has both improved existing forecasting models and expanded the coverage to new geographical areas.

Increasing lead times

Increasing how far in advance hazards can be forecast has benefits for disaster preparedness and response, as it gives decision-makers more time to issue warnings and act early. In Kenya, Mozambique, Senegal and Uganda flooding is a major hazard which leads to severe human, social and economic losses. The Forecasts for Anticipatory Humanitarian Action (FATHUM) project worked to increase forecast lead times and understand how flood risk and resilience has changed in Mozambique and Uganda. The project used the Global Flood Awareness System (GloFAS) that monitors and forecasts floods around the world and can help to provide longer lead times for extreme events in such contexts where local flood forecasting capacity is limited.

About SHEAR

The SHEAR programme (Science for Humanitarian Emergencies and Resilience) carried out innovative research, in some of the most hazard-prone parts of the world, to better understand and forecast disasters, and minimize the risk they pose to vulnerable communities.

SHEAR cutting-edge research aimed to enhance the quality, availability and use of risk information and early warning systems.

SHEAR research brought together the unique knowledge and skills of stakeholders in physical and social sciences, disaster risk management practice, and policymaking. Effectively managing this range of expertise enabled SHEAR to deliver holistic cross-disciplinary, high-impact work on disaster risk and resilience.

For further information please see the SHEAR Knowledge Product Directory.

Improved skill and coverage

Swift decision-making requires confidence in accurate forecasting models with appropriate geographical coverage. This enables action ahead of disasters, by identifying where weather-related impacts will be the most severe. Several projects in SHEAR have contributed to expanding the areas where forecasting information is available. For example, the FATHUM project has installed a total of 51 new reporting points to the GloFAS interface across Uganda, located in flood-prone areas, providing information for institutional decision-makers where it is needed the most.

In Kenya, the Forecast-based Preparedness and Action (ForPAc) project worked with the Kenya Meteorological Department (KMD), the IGAD Climate Prediction and Application Centre (ICPAC), the National Drought Management Authority and other partners to provide long-lead seasonal and sub-seasonal forecasts with improved skill and coverage. The forecast skill information was shared with stakeholders in flood and drought contexts to inform decision-making. County Offices of the National Drought Management Authority (NDMA) piloting ForPAc-initiated products have assessed these as having sufficient skill to support use across the country.

Across various SHEAR projects, the sharing of verification and transparent skill information about forecasting products supported rational, objective risk-based decision-making, which led to the greater credibility of forecasts. In Mozambique and Madagascar, tropical cyclone landfalls have severe impacts, leading to loss of life and mass displacement, yet little is known about the paths these hazards follow, their intensities and the weather conditions they will cause. The Predicting Impacts of Cyclones in South-East Africa (PICSEA) project provided this much-needed information through the most comprehensive assessment of tropical cyclone forecast systems to date to determine which forecast systems provide accurate and reliable information, and in which conditions.

Adding an impact focus

While normal weather forecasts indicate where a weather-related event may occur, impact-based forecasting merges such hazard forecasts with knowledge of vulnerability and exposure information to identify what, where and how impacts may materialize. Impact-based forecasting has been used to anticipate, for example, flood damage, landslides and agricultural impacts. The addition of this impact layer to forecasting information has helped inform early action plans for particular hazards.

The Nowcasting Flood Impacts of Convective Storms (NFLICS) project sought to enhance the preparedness for flood risk in Dakar, Senegal and has strengthened ANACIM (Agence Nationale de l'Aviation Civile et de la Météorologie – Senegal's national agency of civil aviation and meteorology) capacities for forecasting imminent high-impact weather events, or nowcasting. Combined with institutional knowledge of flood-prone areas, this contributed to ANACIM advising the at-risk populations in Dakar of heavy rainfall in September 2021, with consideration for scale-up within the institution's regional remit for forecasting severe weather.

Co-production of forecasts

Key to the contribution of the various SHEAR projects to disaster preparedness has been an emphasis on the co-development of science with decision-makers to produce relevant information, ensure users understand the forecasting information and that they can use it confidently. Working together with decision-makers has enabled scientific advancements in forecasting as well as translation into practice. Trust and relationship-building over a long period of time, in some cases even building on preceding projects, ensures that the learning and advances we have collaborated to achieve are effectively and sustainably incorporated into working practice in the long-term.

Designing forecasting systems

Research groups in SHEAR have collaborated with various government and humanitarian actors to support local disaster preparedness and anticipation capacity. For example, FATHUM has been working closely with the Uganda Red Cross Society and the Government of Uganda's Ministry of Water and Environment to advise on the suitability of using GloFAS in the country's Early Action Protocol – a formal plan to guide the implementation of actions taken in response to a forecast of a hazard event. This work has included an assessment of suitable forecast triggers and thresholds to support these anticipatory actions as well as facilitated dialogue to build understanding among stakeholders of key concepts underpinning flood forecasting, such as false alarms.

The IPACE-Malawi project (Improving Preparedness to Agro-Climatic Extremes in Malawi) improved the forecasting and delivery of agriculture-specific weather information to improve the preparedness of farmers and humanitarian organizations. The project is based on a participatory approach of identifying how weather conditions affect crop production, based on recent experiences of drought and floods in Malawi. Providing forecasts with information about likely conditions over the course of a season supports farmers to make longer term decisions about what types of crops to plant and when, protecting them from losses caused by extreme weather. This approach also simultaneously analyses the accuracy and reliability of seasonal forecast models, improving knowledge and understanding of likely weather conditions at seasonal timescales.

Humanitarian-specific dissemination

Co-development by multiple scientific agencies in dialogue with the humanitarian users of forecasting information has contributed to more effective and coordinated humanitarian responses. For example, the FATHUM team has worked alongside the European Centre for Medium-Range Weather Forecasts, the University of Bristol's HYFlood project and HR Wallingford to produce real-time flood bulletins for, and in close dialogue with, humanitarian agencies responding to Cyclones Idai and Kenneth in Mozambique in 2019, Hurricane Iota in Central America in 2020, and Cyclone Eloise in Mozambique in 2021. Speaking after Cyclones Idai and Kenneth, Professor Charlotte Watts, Chief Scientific Advisor for the UK's Foreign, Commonwealth and Development Office reported, "This is the first time we have been able to use science so early in both planning for and responding to the devastating impact of cyclones."

Further example: Co-designed improved drought forecasting in Kenya

The ForPAc project has developed long-lead forecasts for drought in Kenya, enabling forecasting in June of the October–December season – the principal growing season for arid and semi-arid lands. Previously only available in September, the extended forecast lead time enhances preparedness planning.

The forecasting information from the ForPAc project in Kenya strengthens the national Drought Early Warning System (DEWS). While the project-initiated products were co-developed and piloted with decision-makers in seven counties, they have now been integrated within the NDMA's DEWS county bulletins – an important development in drought risk management and early warning in Kenya.

Further example: Humanitarian-specific forecasting in Pakistan

Through deliberation with national government and NGOs, several SHEAR projects have produced forecasting models that directly support seasonal planning. In Pakistan, the SatWIN-ALERT project (Satellite data for Weather Index Insurance-Agricultural Early Warning System) is using data from satellite observations of vegetation cover to forecast agricultural yields. These forecasts are forming the basis of planning for winter wheat shortages for the Start Network – a network of humanitarian organizations working to deliver effective early action and response to crises.

Conclusion

SHEAR has made enormous advances in forecasting information and its applications. New forecasting information was developed for remote areas where, at the same time, the skills and the lead time of forecasts to act in advance was increased. This led to a leap in the ability to better anticipate anomaly seasons and extreme events. The success of this work was achieved by collaborating with different stakeholders and building on existing information. This way, national and local-level application for in-country stakeholders was enhanced, which resulted in better decision-making processes in the country to avoid losses and damages in extreme events. For example, in Uganda this was achieved through the collaboration between FATHUM and the Ugandan Red Cross Society on anticipatory action. Embedding forecasting information into existing in-country procedures and systems ensures its longevity and the continued production and use of these forecast products well beyond SHEAR.

In the SHEAR examples from Kenya, Malawi, Mozambique, Pakistan and Uganda, the improvement and use of forecast information supported decision-makers to act more effectively and with more confidence to mitigate the impacts of hazards before they occurred. For multiple different sectors (such as agriculture, disasters and emergencies, and Water, Sanitation and Hygiene) it has become increasingly important to work with climate and forecast information. The time to act well in advance of anomaly weather is crucial to addressing systemic risks in a changing climate and we consider the work of SHEAR as a crucial step to establishing and optimizing concepts, like impact-based forecasting or anticipatory action. This strand of work helps to save lives and livelihoods and will need to be massively scaled up in the future.

Photo: The FATHUM team has worked alongside the European Centre for Medium-Range Weather Forecasts, the University of Bristol's HYFlood project and HR Wallingford to produce real-time flood bulletins for, and in close dialogue with, humanitarian agencies responding to Cyclones Idai and Kenneth in Mozambique in 2019. This image shows the Mozambique Red Cross Society's response after Cyclone Idai, Mozambique, 18–20 March 2019 by Denis Onyodi/IFRC-DRK-Climate Centre.