CSQ-11 Summary

Question	Knowledge Advancement Objectives	Geophysical Observables	Measurement Requirements	Tools & Models	Policies / Benefits
How can we improve early warning of extreme events and climate hazards?	• Characterize the vulnerability of societies to various types of climate extremes s.	• N/A		AI methods could be considered.	Disaster risk reduction, climate adaptation, loss and damage, insurance and socioeconomic risk reduction.
	• Improve long-range (e.g. seasonal) weather forecasting systems to identify potential high risk extreme events and develop automatic early warning systems.	• temperature, pressure, humidity and wind observations. • Extend the vertical coverage to stratosphere to enable better long-term predictability.	High spatial, vertical and horizontal resolution	AI techniques could be considered.	
	• Improve understanding of weather and climate phenomena that lead to extreme events. Utilize this information for early warnings of high risk for climate extremes.	• Long time series of weather and climate related parameters. • Continuous monitoring of weather and climate anomalies/patterns. • Temperature, precipitation, circulation	High spatial, vertical and horizontal resolution	Data mining and time series analysis of historical data. Application of AI techniques.	

CSQ-11 Narrative

Timely and reliable early warnings are acknowledged as efficient ways for minimizing risks related to disasters by saving lives and economic losses. This is recognised by the new WMO flagship early warnings for all initiative endorsed at the recent WMO Congress (https://beta.wmo.int/site/early-warnings-all-initiative) which recognises a key role for EO science. Such, early warnings can be seen as concrete solutions for climate adaptation, emphasized, e.g. by IPCC 2021. Observations together with forecasting form the heart of early warning systems (see Figure 1 as an example). Therefore it is important to ensure that the observational data supporting early warning systems is of the highest possible quality (https://beta.wmo.int/site/early-warnings-all-initiative/observation-and-forecasting-early-warnings).

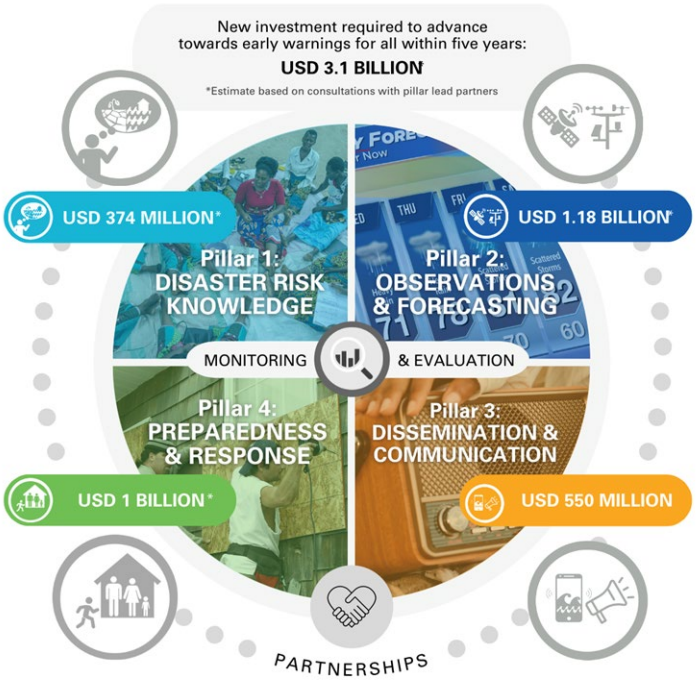

Figure 1: Key pillars and budget overview of the Early Warnings for All initiative – an initiative with the goal to improve early warning systems especially in the developing countries. Figure taken from Early Warnings for All Initiative Executive Action Plan 2023-2027, WMO 2022.

Vulnerability is also a key concept in risk assessment of extreme events. It depends, in addition to environmental factors, on various socioeconomic, demographic, biophysical, cultural, and institutional factors. Various spatial and temporal scales are also important to consider when characterizing vulnerability and risks.

To develop early warning alerts for extreme events, accurate forecasting of extreme events (or increased probability for such events) is important. In this respect, improved long-range (e.g. seasonal) weather forecasts could allow identification of dangerous weather conditions in advance and allow improved preparedness for climate extremes. Alternative data-driven approaches for early warning systems could be developed by extensively analysing historical data to identify conditions that lead to extreme events. In all cases such activities are underpinned by high quality observations both the initialise forecasts and verify model performance.

References

AR6, IPCC 2021 (WG-I: Climate Change 2021, The Physical Science Basis)

WMO, 2022 (Early Warnings for All Initiative Executive Action Plan 2023-2027)