The Bureau of Meteorology

Satellite Earth Observations for early warnings of weather hazards in the Asia-Pacific

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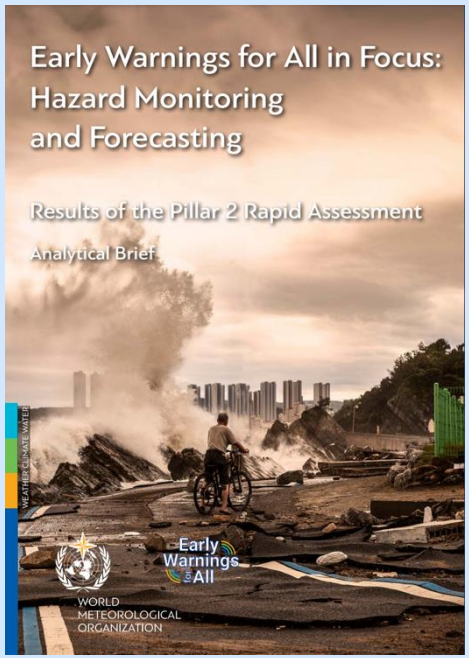
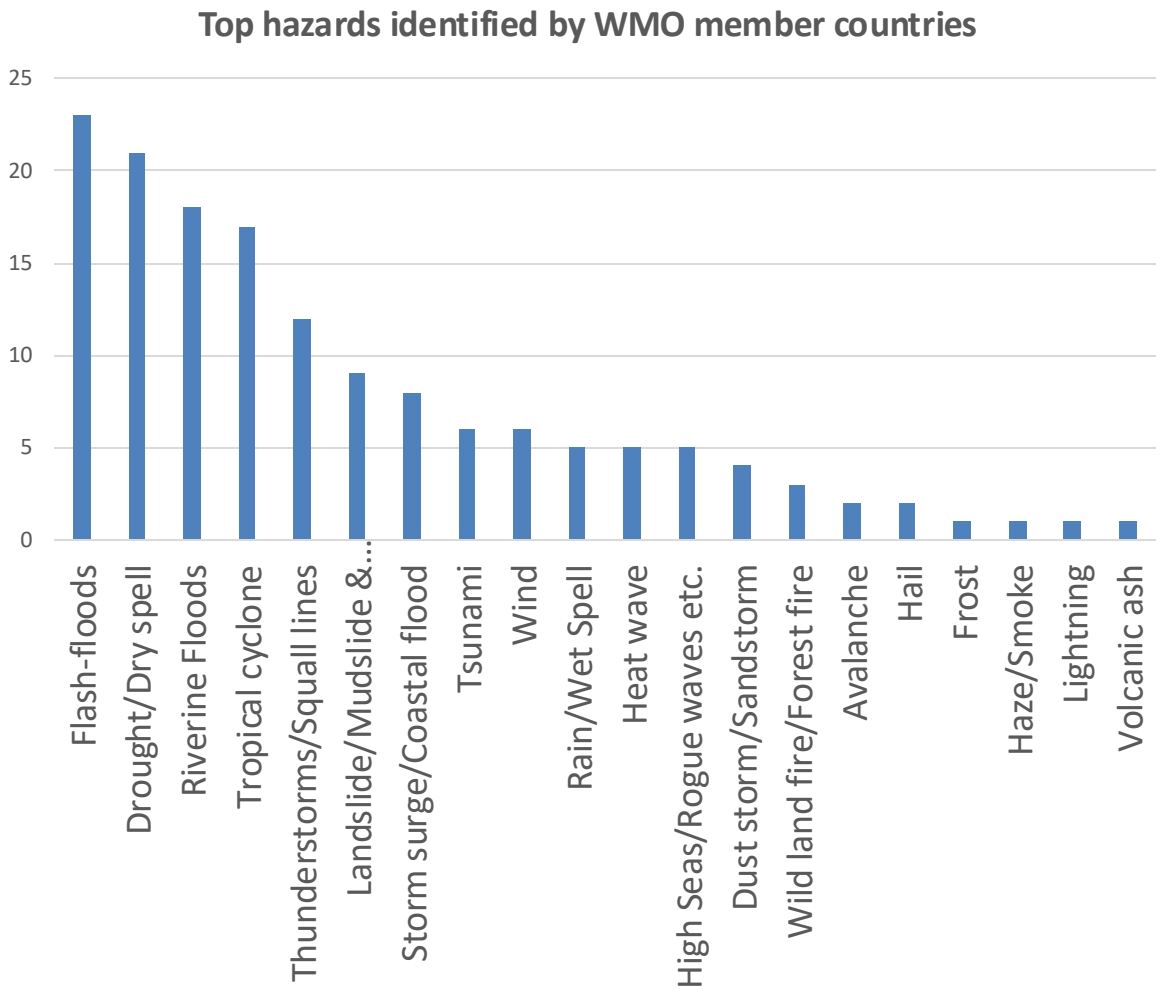
Weather hazards in the Asia Pacific region

Flood, **Drought**, **Tropical cyclones**,and **Thunderstorms** are the top hazards.

Based on the results of the Rapid Assessment conducted by the WMO (Nov, 2023)





The need for early warnings

- In the South Pacific in 2020, economic losses from **cyclones** and **flooding** were around $1 billion with at least 71 lives lost
- In Asia in 2021, there were a total of more than 100 natural hazard events, of which 80 percent were **flood** and **storm** events. These resulted in almost 4,000 fatalities, about 80 percent caused by flooding. Weather and water-related hazards caused total damage of US$35.6 billion, affecting nearly 50 million people
- Individual events can cause very significant losses:
  - TC Harold (2020). Tragically, people in Solomon Islands, Vanuatu and Fiji lost their lives, while many more were injured
  - Twin Tropical Cyclones Judy and Kevin (2023) affected 197,388 people in Fiji representing approximately 66% of the total population. The impact of the disaster was 40% of the gross domestic product with recovery costs estimated at $50 million

Given that severe weather events cause high economic losses and social impacts, there needs to be a priority on early warnings.

Weather agencies deliver forecasts and warnings that are essential to the safety and well-being of Asia-Pacific people and communities.

Floods in Cambodia, August 2024, captured by MODIS. Image credit: NASA Worldview application (https://worldview.earthdata.nasa.gov/), part of the NASA Earth Observing System Data and Information System (EOSDIS).

WMO and EW4All

- The World Meteorological Organization (WMO) provides world leadership and expertise in international cooperation in the delivery and use of high-quality, authoritative weather, climate, hydrological and related environmental services by its Members, to improve the well-being of all.
- **Early Warnings for All (EW4All)** is a high priority initiative for WMO. The aim is to ensure that everyone on Earth is protected from hazardous weather, water, or climate events through life-saving early warning systems by the end of 2027.

How are satellite Earth observations contributing to EW4All?

- There are limited in-situ observations in southern hemisphere, so satellite observations are essential for weather and warning services in the Asia-Oceania region
- WMO members in the Asia-Pacific region are working together to ***strengthen national multi-hazard early warning/alert service systems and support, including the EW4All initiative*** starting with mapping the satellite related gaps and developing a regional implementation plan for EW4All by ~mid 2025

Importance of satellite observations for early warnings

- Global weather model data from international agencies are critical, but often not fine enough resolution for Pacific Islands. In-situ and **satellite data** are used together to cross-check for consistency and refine their own meteorological understanding. This is required in the moist tropics where subtle influences can be missed in model output.
- **Visible imagery** have a large positive impact. Used for monitoring Tropical Cyclones, fires, volcanic eruption, etc
- **Rainfall** products such as GSMaP for floods, thunderstorms and warnings of the key hazards
- **2.5 min "rapidscan" observations from geostationary satellites** for localized convective thunderstorms and tropical cyclones that have a rapid development cycle. Also for forest fires

- For ocean applications: **sea surface winds** and **significant wave height**
- **Multi-sensor microwave** imagery for tropical cyclones

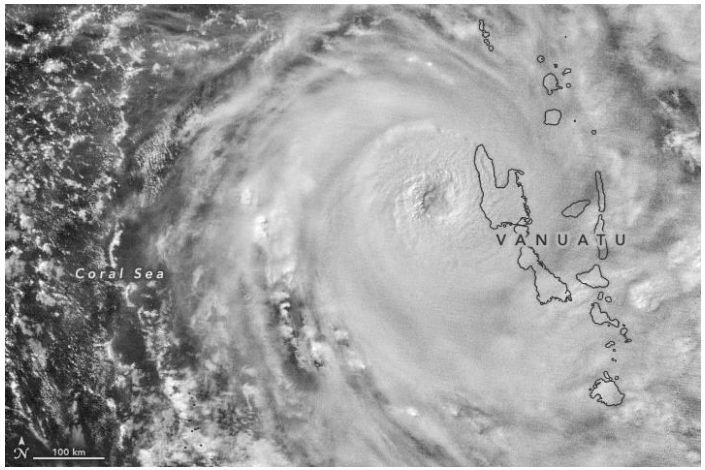


Image of TC Harold in 2020 using VIIRS day-night band data.
Image credit: NASA Earth Observatory.

Main challenges and obstacles

1. **Training**.
   - Ongoing training needed on interpretation of different satellite product types, where to find the products, which ones to use in different situations, etc.
   - WMO VLab program delivers training – mostly online.
   - Lack of capability to develop satellite applications or tune products to local conditions.
   - IT training and documentation required for maintenance of hardware and software.
2. **Fast and reliable comms infrastructure.** Internet is most common method of data access, but it's expensive and at times unreliable. Many countries can't receive 10 min geostationary data.
3. **Visualisation tools.** Many users report that data is displayed in web browsers with no local data manipulation capability. Users need a common platform for visualisation and analysis of different data.

".. the whole value cycle of multi-hazard early warning systems is built on collaborative efforts of various national and international stakeholders inclusive of multilateral and bilateral development partners, in the public, private, and academic sectors, and their collective and collaborative efforts at global, regional, and national levels are fundamentally needed."

(WMO Resolution 4, United Nations Early Warning for All initiative)