PCRAFI PROGRAM

Parametric Indices for Excess Rainfall and Drought

Pacific Rapid-Respose Financing

Flash flood event at the Mataniko river in the Solomon Islands, April 2014. Credit: Toby Branbury

Pacific Community
Communauté du Pacifique
PACIFIC ISLANDS FORUM SECRETARIAT
Disaster Risk Financing & Insurance Program
SUPPORTED BY WORLD BANK GROUP
GFDRR
Global Facility for Disaster Reduction and Recovery

Background

In 2017, Pacific Island Countries (PICs) made a request to the World Bank to investigate the potential development of a rainfall product that would provide governments insurance against both excess rainfall and drought. PICs are exposed to significant damage and disruption from these perils, which is expected to increase with the impacts of climate change.

Table 1: Recent rainfall and drought events across Pacific Island Countries

Year	Impact / Description of the Event
2015-2016	A regional El-Nino driven drought impacted multiple countries, causing critical shortages of drinking water and food security issues from disruptions to agriculture; national emergencies were declared in the Marshall Islands and Palau, and Fiji reported tens of thousands affected
2014	Flash flooding in Honiara, Solomon Islands, displaced tens of thousands of people, washed houses away and damaged infrastructure
2012	Thousands were displaced in Fiji by severe flooding in both January and March, caused by torrential rain from tropical disturbances; tens of millions in economic losses were also reported
2011	A widespread Pacific drought led to a declaration of emergency and fresh-water rationing in Tuvalu following a critical shortage of water

Source: World Bank, 2018

Catastrophic rainfall and drought events represent a coverage gap within the financial protection instruments that are available to PICs . The Pacific Catastrophe Risk Insurance Company (PCIRC) offers governments coverage against earthquakes, tsunamis and tropical cyclones, but currently does not provide insurance policies for drought, or excess rainfall, arising from weather systems such as tropical depressions or convective storms.

To investigate the viability of expanding PCRICs insurance coverage the World Bank commissioned a technical consortium[1] led by DHI to conduct a pre-feasibility study outlining options for a rainfall insurance product that can provide parametric insurance for both excess rainfall and drought impacts. Five countries were chosen for the study given recent experiences with excess rainfall and drought, namely: Fiji, the Marshall Islands, Palau, the Solomon Islands and Tuvalu. The study focused on the development of 'parametric' indices that use rainfall data to indicate the severity of a hazard event, and thereby defining a trigger or set indicator for a potential payout to the policyholder, or government.

What is Parametric Insurance?

Parametric insurance products f or natural disasters are designed to pay out based on a specific measure of the physical hazard, rather than an assessment of loss. These products can be simple, (for example, triggering from the magnitude of an earthquake occurring within a predefined area), or they can be complex (for example, using hazard parameters such as rainfall accumulations as inputs into a model that builds an event footprint and estimates losses).

Parametric insurance products are able to estimate damage and losses more quickly, and therefore calculate payouts faster than traditional indemnity insurance, which requires on-the-ground damage and loss assessments. Parametric insurance is also more feasible to implement in economies where historic damage and loss data from natural hazards is limited – whereas these data would be required to develop traditional indemnity insurance products.One disadvantage of parametric insurance is basis risk, which is the potential for a payout amount to differ from the actual losses observed on the ground.

[1] The consortium was led by water specialists DHI, and comprised the Tropical Marine Science Institute, Singapore, and SFR Consulting.

Methodology

Drought and excess rainfall indices have been developed that capture the occurrence of extreme events at Province level[2], using satellite data from NASA. The drought index identifies drought events based on a number of 'dry' days occurring, while the excess rainfall index identifies events based on 24-hour rainfall accumulations.

The Index Methodology

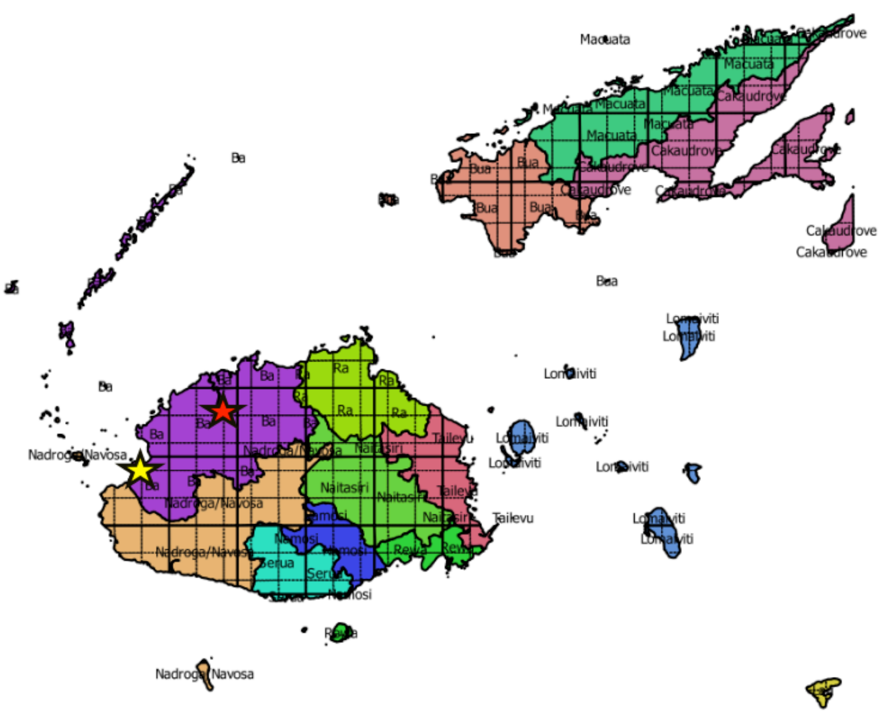
The indices are based on remote-sensing data from the NASA precipitation satellite missions. Multiple data sources, including ground-based station data, were assessed for use, and the NASA data was identified as the most suitable option for reasons including:

- 17 years of consistent historical record of measurements;
- Consistent methodology and resolution of data across the whole region;
- Resolution allows feasible capture of severe events;
- Near real-time, frequent reporting (every 0.5 hours for the Global Precipitation Mission).

The data covering the entire Pacific available from the year 2000 to the present was analysed to understand the frequency and extent of excess rainfall and drought:

- 24-hour rainfall accumulations[3] were selected as the optimal basis for the indices;
    - Excess rainfall is then captured using a maximum accumulation in 7-days;
    - The drought index is a 'number of dry days' measure.
- Population data was overlaid onto the index to create a view of number of people affected by extreme rainfall events.

Figure 1: Fiji administrative boundaries overlaid with NASA Tropical Rainfall Monitoring Mission grids



Source: DHI

[2] The indices are at first administrative unit level; i.e. either Province, State or Atoll depending on the country.

[3] The maximum of 24-hour accumulations considering a rolling window that overlaps with a UTC day is the measure taken. For more details, please refer to the full technical report.

Results

The triggers were tested against historic events that had been compiled into a historical catalogue, and also with rain gauge data provided by national meteorological agencies. A strong match was found between events in the historical record, and events identified by the defined index triggers. This is particularly true of drought events, where all the identified events in the historical catalogue were captured by the index. For excess rainfall, the match was strong, but some significant events were not captured. Following consultations with national meteorological agencies this could be due to (i) the incidence of high tide during the periods of sustained high levels of rainfall; and (ii) prior waterlogging of soil for certain historical events, which are not captured in the current methodology.

The download and processing of NASA data has been automated and implemented into a prototype of a web-based monitoring system, to demonstrate how real-time monitoring could be established. The rainfall data can be assessed and presented for administrative units to enable easy overview of number of people affected and to provide the specific location of an extreme weather trigger.

Next steps

The feasibility of excess rainfall, and drought indices for the region has been confirmed. The next stage of development will be taken forwards by the PCRIC- established in 2017 as the successor to the Pacific Catastrophe Risk Insurance Pilot, owned and directed by its subscribing member countries.

PCRIC will build on the existing methodology, to undertake work to strengthen the relationship between the rainfall indices and impacts experienced to develop the final product. Opportunities have been identified to improve the index, including;

» Incorporation of NASA's highest resolution (0.1 degree, 0.5 hourly interval) precipitation data system (GPM) in the latter half of 2018, due to new data releases. The current system relies on the NASA TRMM data at 0.25 degree resolution and 3-hourly intervals.

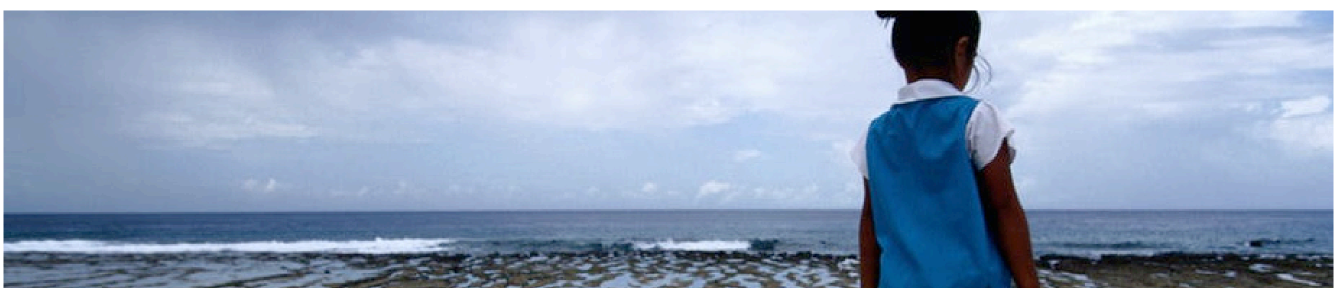
» Ability to overlay data from local rain gauges to supplement the remote sensing measure;

» Integration of work currently underway in the region to identify drought triggers based on the vulnerabilities of different communities arising from their principal source of water; specifically, the determination of 'number of days' at which cover should begin for different sub-regions based on this work;

» Inclusion of tidal data and prior waterlogging of soil into the excess rainfall index, for which the necessary data is readily available;

» Further engagement in the region to identify the effectiveness of the product with respect to the specific impacts client countries are looking to cover.

The feasibility of hosting the index as a real-time monitoring tool within an agency, and potentially a pre-existing web platform in the region will also be examined.



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