WP 8b: The Tropical Pacific Observing System and the Pacific Islands

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Summary

- Pacific islands communities are end-users of products that depend on TPOS. Raw data itself is used only by weather forecasters and researchers.
- These products include:
  - Seasonal forecasts of rainfall, temperature, sea level extremes, ocean temperature extremes
  - Weather forecasts, particularly of extreme events (tropical cyclones)
  - Monitoring and projections of climate change
- Observations of some quantities are already lacking
  - Maintaining and improving the skill of model forecasts is critical for protecting lives in the Pacific.
Vulnerability of Pacific islands to climate extremes and change

- Tropical cyclones, storm surges and tsunamis
  ⇒ Monitoring and NWP
- Droughts and high rainfall periods
- Extreme sea level and coral bleaching events
  ⇒ Seasonal prediction (statistical and dynamic models)
- Climate change – sea level rise, rising heat extremes and rainfall extremes
  ⇒ Climate monitoring and projections
  ⇒ Process studies to improve understanding of past changes, models and projections
The impacts of severe wave inundation - lives, livelihoods and infrastructure can be saved through warnings, disaster planning and adaption.

- **Wake Atoll (US)**
- **Roi-Namur, Kwajalein Atoll (MI)**
- **Chuuk, (FSM)**
- **Kosrae State, (FSM)**
- **Takuu Atoll (PNG)**
- **Delap, Majuro Atoll (MI)**
  - Emergency shoreline remediation

**Crop damage**: Takuu Atoll (PNG)

**Buildings destroyed**: Delap, Majuro Atoll (MI)
La Niña: Tuvalu Drought 2011

- Dynamical prediction models provided valuable guidance of rainfall deficiencies in Tuvalu throughout 2011.
- Similarly for drought in the Marshall Islands in 2013
Contributions to Extreme Sea Levels

Global Warming

Variability

Sea Level (seasonal and regional variations)

Tropical Cyclones

Tides

Storm Surge

El Niño

La Niña

Source: Chand and Walsh (2009)
NWP forecasts of:

• Wave conditions (storm surge)
• Aviation forecasting
• Tropical cyclone warnings
  • Rely on global initial analyses, but extreme events in the Pacific require data coverage over traditionally data-sparse region

Tsunami warnings
Most skill comes from ENSO predictability and impacts. Dynamic and statistical models, rely mostly on ocean temperature and salinity (surface and sub-). TAO-Triton provides equatorial data, Argo array beyond. Data required for model initialization, but also calibration, model development and verification.

• Rainfall and temperature
  => Benefit water management, agriculture planning, and predicting health risks

• Sea level extremes and Tropical cyclones
  => Benefit disaster risk management (resources, warnings, preparedness)
• Extreme ocean temperatures, affecting coral (bleaching) and fish stocks
  => Benefit fisheries, tourism, reef management and monitoring
• Sea level anomalies, especially dangerous when concurrent with king tides and/or storm surges
  ⇒ Seasonal predictability due to ENSO
  ⇒ Benefits in planning coastal development and safeguarding agricultural, marine and water resources
Pacific seasonal climate prediction centers

• NIWA (New Zealand)
  • Island Climate Update (monthly)
  • Includes teleconference with Pacific National Met Services
  • Summary of conditions (including the ocean, based on TAO/Triton data)
  • 3 month forecasts of temperature and rainfall

• Pacific ENSO Applications Center (Hawaii)
  • Comprehensive summary of ENSO conditions
  • Forecasts of SST, rainfall and temp for US Pacific Is. countries

• Bureau of Meteorology (Australia)
  • Online Climate Outlook Forum
  • Statistical seasonal forecasts of T and rainfall produced by PICs
  • Dynamic forecasts from POAMA (PASAP and COSSPac program)
Sea Surface Temperature Seasonal Prediction

- Coral risk metrics
- Probabilistic forecasts
- Time-series of SST anomalies
- Skill scores
Sea Level Seasonal Prediction

Sea level anomaly forecasts

Timeseries for Exclusive Economic Zones of Partner Countries

Tercile predictions

Skill scores for all forecasts
Data available in netCDF and text format
Tropical Cyclone Seasonal Prediction

- Regional probabilistic tropical cyclone predictions.
- Geographic distribution of tropical cyclone activity.

**Australian region**
Average of 11 TCs
Chances of more: 37%

**South Pacific**
Average of 11 TCs
Chances of more: 55%
Products – climate change monitoring and projections

Data requirements for developing better models, verifying historical climate simulations and understanding

• Projections inform adaptation planning, and confidence in projections increases with better understanding of climate processes
  • Data requirements cover atmospheric and oceanic analyses, tide gauges, wave buoys, remote sensing…
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Perspectives for future TPOS

• Ocean acidification will have drastic consequences in the Pacific but observations are sparse
• Wave inundation will become more problematic
  • Few in-situ observations are available for model calibration and verification
• New components and technologies would provide major benefits
  • Biological monitoring to understand fish behavior
  • More cost effective observations, e.g. wave powered gliders and sensors on submarine cables
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Thank you

The Centre for Australian Weather and Climate Research
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