

A Global Wave Hindcast Focused on the South Pacific

13th International Workshop on Wave Hindcasting and
4th Coastal Hazards Symposium

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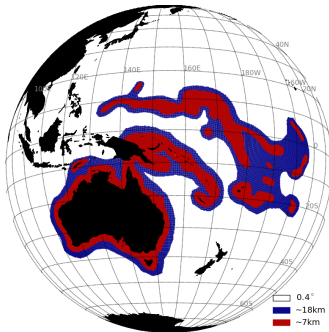


Motivation

- South Pacific
 - Part of a larger climate AusAID program in the South Pacific (PACCSAP)
 - Wave important for many reason in the South Pacific
 - Very little data in the region
- Australia
 - Consistent hindcast dataset around the Australian coast.

Method

Hindcast



- Covers 34.5 years, from start of 1979 to mid 2013
- CFSR wind and ice forcing
- WAVEWATCH III version 4.08
- Validation against all available altimeters and select buoys

Projections



Suite of CMIP5 forced runs

Summary

- 34.5 year hindcast has been completed and validated
 - 1979 - mid 2013
 - 0.4 degree global, high resolution in the South Pacific and around Australia
 - Validation against altimeters and buoys indicates quality is very good.
 - Some issues with step changes in the CFSR winds
 - Wave biases sensitive to changes in the high wind speeds
- Wave climate and projections
 - Description of current wave climate provide by hindcast
 - Likely change in wave climate 30 and 90 years from now provided by projection runs

Outline

- 1 Overview
 - Waves in the Pacific
 - Project Objectives
- 2 Wave Hindcast
 - Model Setup
 - Validation
- 3 Climate Projections
 - Summary of Work
- 4 Conclusions

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- Model Setup
- Validation

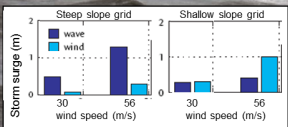
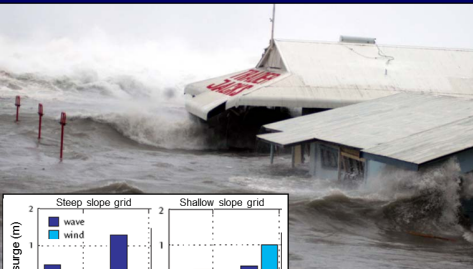
3 Climate Projections

- Summary of Work

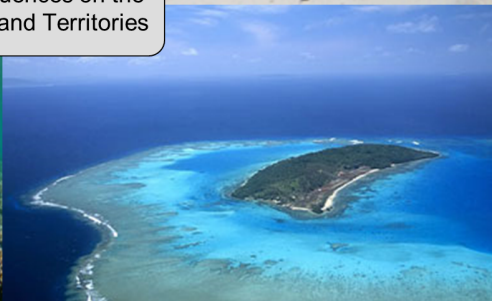
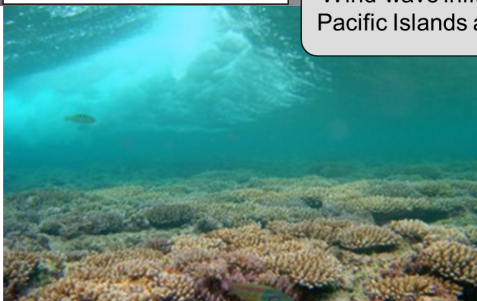
4 Conclusions

INUNDATION: wind-wave setup is the dominant contributor to coastal flooding events

EROSION: wind-waves drive coastal sediment budgets. A shift in direction may lead to erosion.



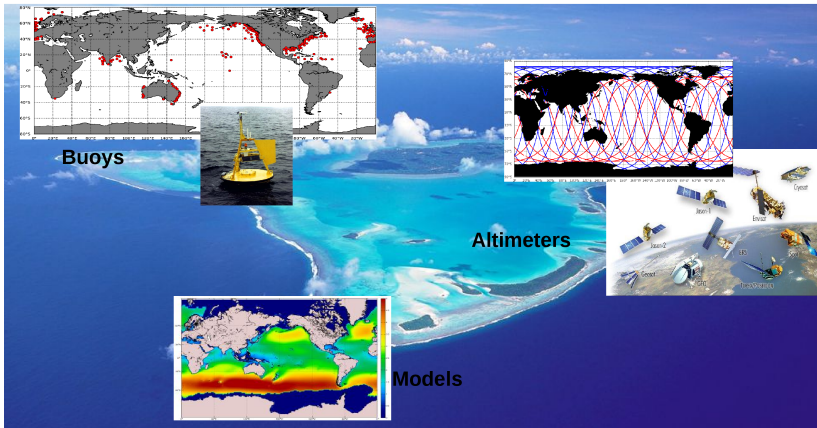
Wind-wave influences on the Pacific Islands and Territories



DISTURBANCE: Marine habitats are characterised by the wave climate (energy) at that site.

LAGOON CIRCULATION: wind-wave setup drives lagoon circulation. Changing wave conditions may influence flushing.

Available Data in the Region



Project Objectives



Historical variability and change

- Identify data sets
- Produce a 30 year modelled wave data set at high spatial and temporal resolution

Future wave climate

- Perform an ensemble of wave model runs under climate model wind forcing
- Assess the ability to capture current wave climate
- Examine changes in future climate

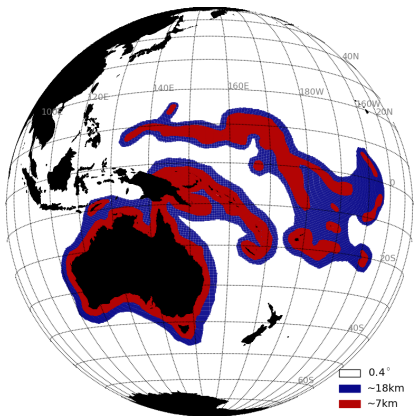
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CFSR Winds

- Excellent resource for wave hindcast work
- Not the only ones...
 - Cox et al 2011
 - Chawla et al 2013
 - Rascle and Ardhuin 2013
 - et al ...

34.5 Year Wave Hindcast

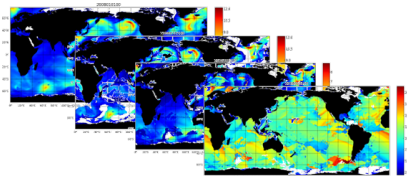


- Covers 34.5 years, from start of 1979 to mid 2013
- CFSR wind and ice forcing
- WAVEWATCH III version 4.08
- Ardhuin et al 2010 Source terms (Rascle and Ardhuin 2013 modifications, Test 451, with very slight tuning)
- Two way nested 10' and 4' grids in the South Pacific and around the Australian coast.

Hindcast Outputs

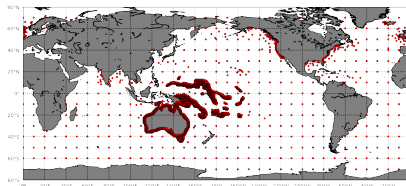
Gridded Outputs

- Hourly outputs at native grid resolution
- 30 integrated variables for each grid



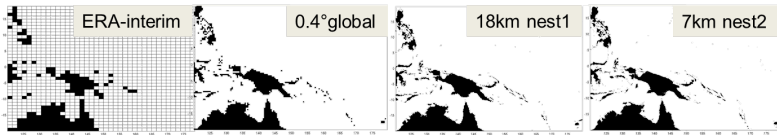
Spectral Outputs

- 3600 Spectral output points buoy locations
 - 10 degree intervals over the globe
 - 0.5 degree intervals within the 4arcmin grids

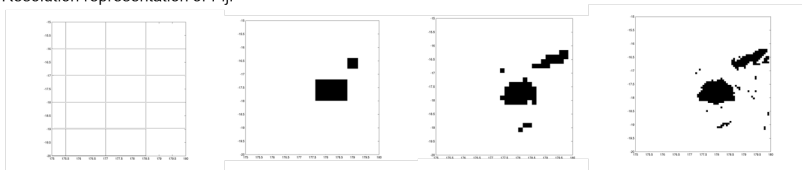


Value of Resolution

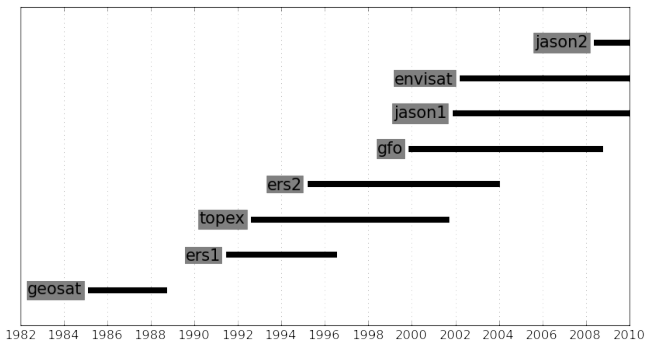
Resolution representation of the South Pacific



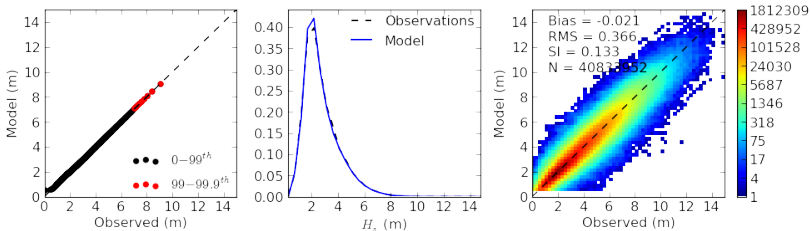
Resolution representation of Fiji



Altimeters Used for Validation



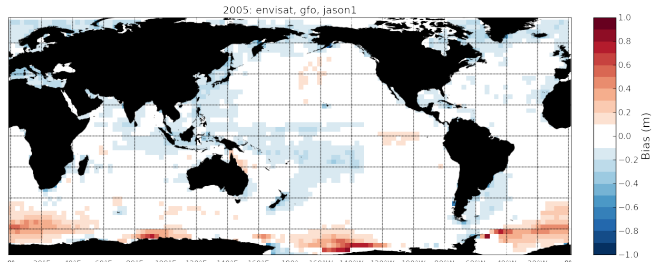
Altimeter Validation



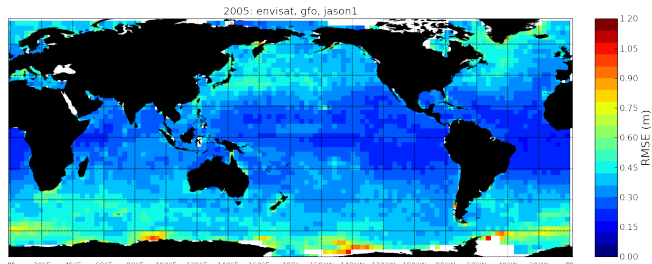
Example full year of 2005

Altimeter Validation

Bias



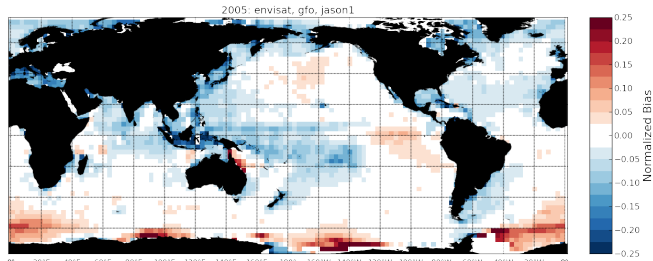
RMSE



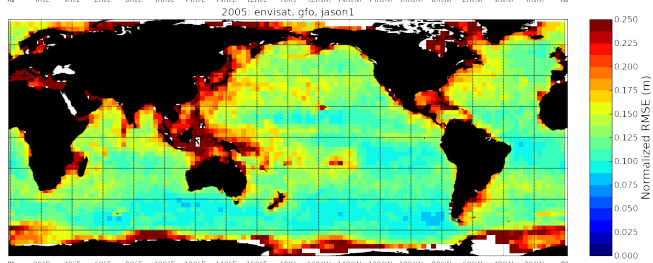
Example full year of 2005

Altimeter Validation

Normalised
Bias



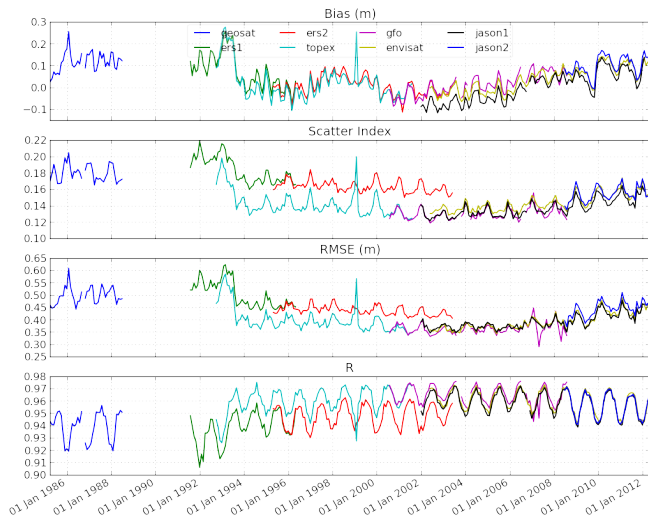
Normalised
RMSE



Example full year of 2005

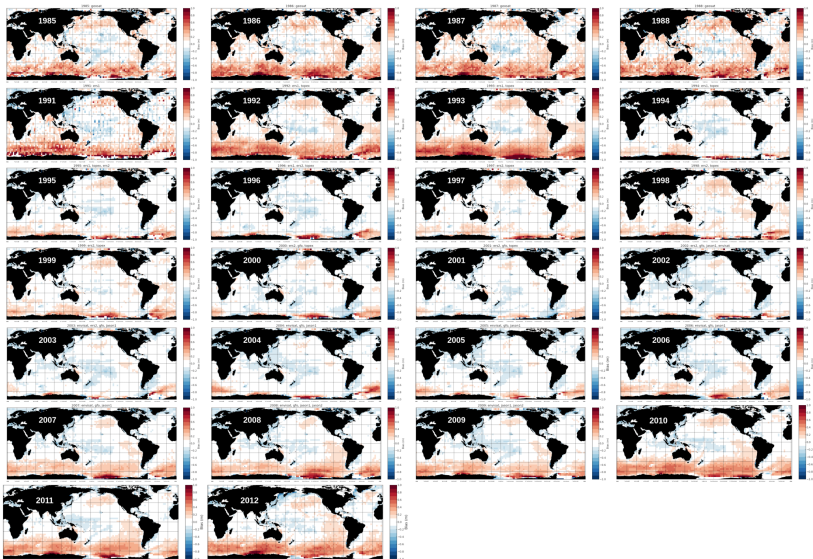
Temporal Discontinuity

Waves - Bias



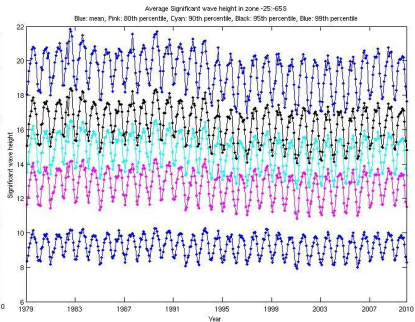
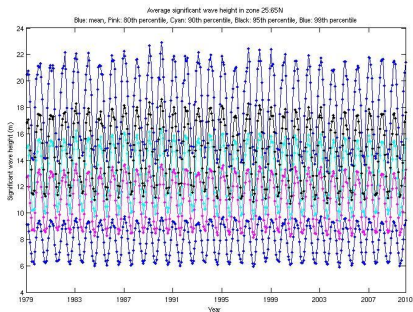
Temporal Discontinuity

Waves



Temporal Discontinuity

Winds

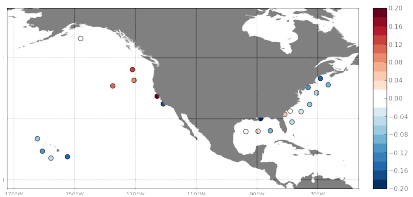


NDBC

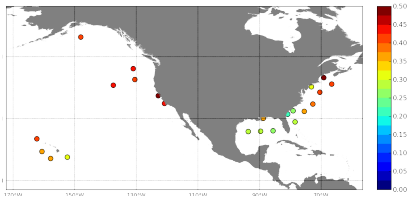
Full Period

Global Grid - Full Period

Bias

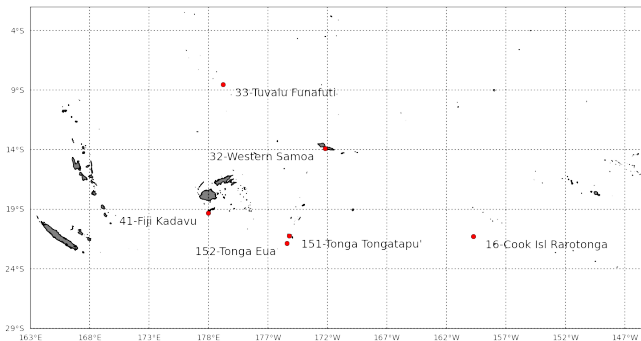


RMSE



SOPAC Buoy data for Validation

7km grids



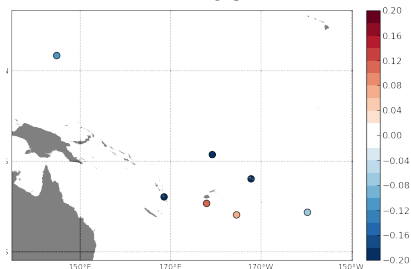
Only Available of the a few years in the late 80's
and early 90's

SOPAC Validation

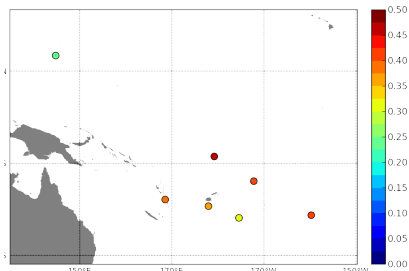
High Resolution Grids

7km Grids - short period

Bias



RMSE

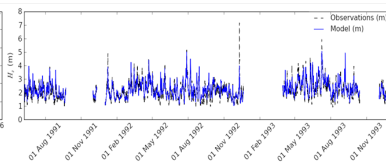
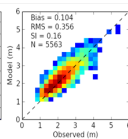
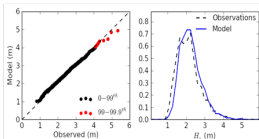
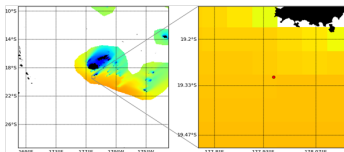
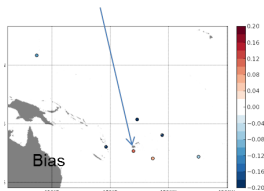


SOPAC Validation

High Resolution Grids

Fiji

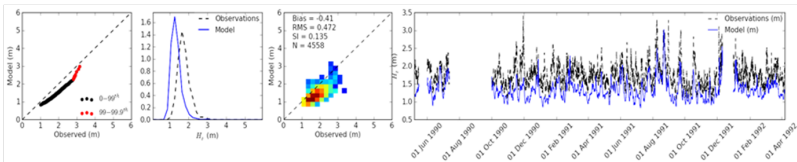
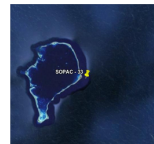
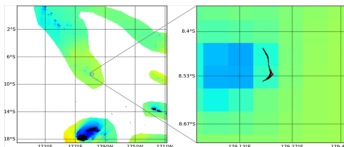
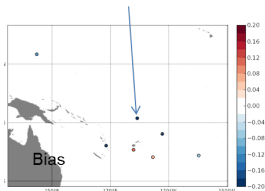
Aug 1991 – end 1993



SOPAC Validation

High Resolution Grids

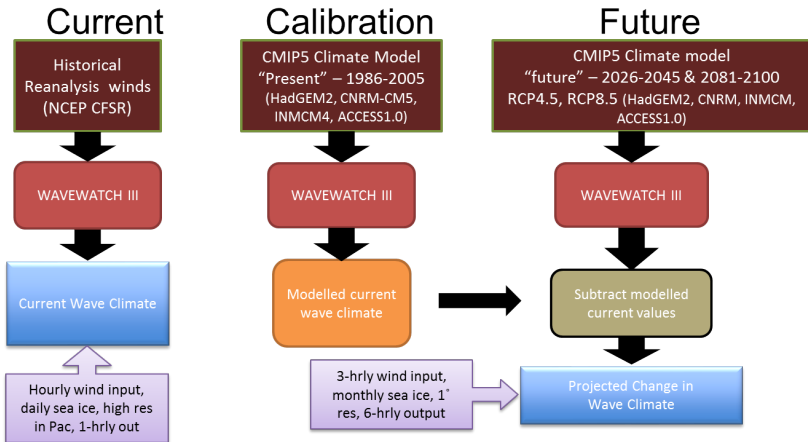
Tuvalu
Jun 1990 – Apr 1992



Outline

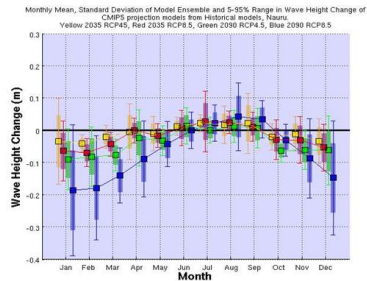
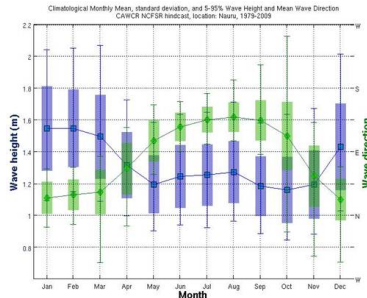
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Projections



Country Reports

- Historical wave climate:
 - Description of what drives waves at each location
 - Seasonal height and direction variation
 - Description of what storm waves are (height, period, direction, what causes them)
 - Any interannual variability
 - Eg. ENSO correlation?
- Projected wave climate:
 - Likely changes in wave climate for 2026-2045 and 2081-2100



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Thank You

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The Pacific-Australia Climate Change Science and
Adaptation Planning