NEW ZEALAND WAVE CLIMATE VARIABILITY BASED ON WEATHER PATTERNS

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Would it be possible to perform a robust statistical relationship between waves and storm surge with atmospheric variables at a national scale?

*Ministry of Business, Innovation and Employment
PREVIOUS WORKS

Pickrill and Mitchell (1979) – 17 years obs.
Laing (1993) – 5 months wave hindcast
Laing (2000) – 13 y. from radar altimeter
Gorman et al. (2003a,b) – 20 y. wave hindcast
Godoi et al. (2015) – 45y. Wave hindcast
Coggins et al. (2016) – 29y. Wave hindcast

GOALS:

• To find a regional atmospheric predictor of waves and storm surges reaching NZ coasts.
• To analyze wave climate variability at daily, weekly, seasonal and interannual scales.
• To develop a framework for climate change projections.

NEW ZEALAND WAVE CLIMATE ANALYSIS

Correlations with Climate Modes
**ESTELA**: a method for evaluating the source and travel time of the wave energy reaching a local area. (Perez et al. 2014a)

Following (Hegermiller et al. 2016)
With CFSR SLP fields of 2º resolution from 1993 to 2012
TAILOR-MADE INDICES

PCA correlation

WAVE DATA

- GlobWave database
- Ifremer wave reanalysis

EOF1 - var=9.93 %

EOF2 - var=5.72 %

EOF3 - var=5.02 %

$p_{HS}$
LINEAR REGRESSION: VALIDATION PERIOD

Validation 2006-2012 estela PCs-13days+1day Fe NZ cent estela 0 NW Mean

Validation 2006-2012 estela PCs-13days+1day Fe NZ NW estela 0 NW Mean

Validation 2006-2012 estela PCs-13days+1day Fe NZ SW estela 0 NW Mean

Validation 2006-2012 estela PCs-13days+1day Fe NZ North estela 0 NW Mean

Validation 2006-2012 estela PCs-13days+1day Fe NZ South estela 0 NW Mean

Validation 2006-2012 estela PCs-13days+1day Fe NZ SE estela 0 NW Mean
WEATHER PATTERNS

MEAN SLP

CFSR reanalysis 1993-2012

K-MEANS
WEATHER PATTERNS - WAVES

WAVE DATA
- GlobWave database
- Ifremer wave reanalysis

WT1  WT5  WT9  WT13

WT2  WT6  WT10  WT14

WT3  WT7  WT11  WT15

Hssea/Hstotal
Tm Swell (s)
WEATHER PATTERNS – STORM SURGE

SURGE DATA: DAC Reanalysis

ANOMALY 99%
TIME-SCALES OF VARIABILITY

• SEASONALITY

AUSTRAL SUMMER CONDITIONS

AUSTRAL WINTER CONDITIONS
TIME-SCALES OF VARIABILITY

- **Madden Julian Oscillation (MJO)**
TIME-SCALES OF VARIABILITY

- INTERANNUAL VARIABILITY
TIME-SCALES OF VARIABILITY

CFSR

20CR
TIME-SCALES OF VARIABILITY

20CR

Compo et al. 2011
GCMs’ skills (on-going work)

Sorted out by performance to model synoptic situations based on Perez et al. (2014b)
SUMMARY

• We have defined a regional daily atmospheric predictor for waves and storm surges along NZ coasts.

• This regional predictor is able to explain wave climate variability at daily, intramonthly, seasonal and interannual time-scales.

• The use of clustering techniques simplifies the analysis of multivariate problems such as coastal flooding and erosion.

• The statistical-relationship established between waves and storm surge with slp fields, allows its application for climate change projections.

• The skill of GCMs should be analyzed carefully!!
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THANK YOU FOR YOUR ATTENDANCE!

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HISTORICAL PROBABILITIES  1979-2009