Background

- 1992 Mid NSW Tide- Storm Surge Analysis by MHL, based on 3-5 years of data for 8 sites.
- 2008 analysis commissioned by DECC, can now incorporate up to 20 years of data for 18 sites.
- Early stage of the study, now presenting some preliminary results.

Purpose

- Improved Accuracy and Confidence in the guideline values
- Guideline values for many more sites across the state
- Improve the presentation of results
- Assess the measurable changes in tidal climate
- Determine drivers of storm surge and relative impact on the NSW coast

Project Drivers

- Support DECC Estuary, Coastal and Floodplain management programs
- Design Water Level (planning & coastal structures)
- Shoreline stability
- Navigation and Port Operations
- Event-based Environmental and Aquaculture impacts

Data:
- DECC Network maintained by MHL
- 4 Offshore tide gauges (pressure transducer)
- 14 Near-shore tide gauges
- 7 Waverider buoys
- 250+ Estuary Flood gauges
- 100+ Rainfall gauges
- Sydney Ports Authority – Fort Denison data from 1914
- Bureau of Meteorology - BLUElink and wind data

1992 & 2008 results compared

- A change in tidal residual over time would be an indicator of climate change
- Similar results for short return periods, but variation in return period for extreme events
- Important to provide an analysis of the uncertainty of the design levels

Known Anomaly Drivers

- Barometric Setup
- Coastally Trapped (Shelf) Waves
- Ocean Currents and Eddies
- Temperature and Salinity gradients
- Southern Oscillation Index (ENSO)
- Wind Setup
- Wave Setup
- Transient Response to drivers
- Bathymetric Effects
- Tsunami
- Others?

Fort Denison Residual Return Period

- Very similar results to the original analysis, as we would expect for long datasets

11/20/2008
**Tidal Residual Return Period**

- Good correlation between all sites along the coast.
- Events are more common at north and south extents.
- Joint probability analysis will provide design levels at many locations along the coast.

**Harmonic Analysis**

- Harmonic components:
  - 24.8 hr (lunar day)
  - 27 day (longitude of the moon)
  - 1yr (longitude of the Sun)
  - 8.8 yr (lunar perigee)
  - 18.6 yr (moons ascending node)
  - 21000 yr (solar perigee)
- Gives us constituents: M2, S2, K1, O1, etc
- Tidal planes derived from constituents, eg MHWS = Z0 + M2 + S2
- Forecast tides based on constituents
- Residual (Anomaly) WL = Measured WL - Predicted WL
- Tide climate varies on very long cycles

**MSL trends**

- No consistent trend in MSL for various sites across the state.
- Highlights the importance of local effects within global trends.

**Long Term Fort Denison**

- Trend for monthly mean: 0.93 mm/yr
- Trend for last 20 years: 0.42 mm/yr
- Global rise: 3.3 mm/yr for 15 years
- IPCC forecast SLR: up to 0.91 m for 100 years

**BLUELink**

- Developed by BoM, CSIRO & RAN
- 10 km grid with twice per week forecasts
- Inputs:
  - Satellite, Drifters (surface and sub-surface), buoys, tide gauges, ship data, weather stations
- It models:
  - Currents, SST, MSL, Salinity
- More information:

**BoM BLUElink**

- Includes the effects of wind & wave setup, barometric effects, rainfall, ocean currents, temp & salinity, shelf waves, etc
- Understanding of drivers
- Prediction of anomaly events
- Improve extrapolation between locations
- But is a model, and strongly reliant on actual measurements. Future design levels reliant on data and models of long term changes.
**SOI vs. MSL**

SOI:

\[ \text{Paihiti} - \text{Darwin} \]

\[
\frac{\text{SOI}}{\text{AVE}}
\]

- Good correlation: 0.59 for 2yr average & 9mth delay
- 3rd Order polynomial trend removed on both signals

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**Wind Setup**

- Generally considered to be one of the more important drivers of storm surge.
- Wind Setup is generated by wind stress against the surface of the water causing a surface gradient. Forcing water downwind. Depth dependent

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**Wave Setup - Correlation**

- Good correlation for SE waves
- What about NE? – not much wave action from that direction. Bathymetry effects?

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**Wind - Anomaly Correlation**

- Excellent correlation between W-S winds for Pt Macquarie offshore and near-shore.
- But why SW & offshore???
Wave Setup - Correlation

- Poor correlation for Batemans offshore tide gauge. We would not expect wave setup at a station outside the breaker zone.
- But, Middle Head also shows a correlation, even though it's not expected to have wave setup... some cross correlation?

Preliminary Results

Conclusions

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