Consensus Forecasts of Modelled Wave Parameters

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Motivation/Application

- Consensus techniques have been found to be very useful in operational forecasts of a range of atmospheric parameters at the Bureau
- Investigate applicability of consensus forecasting techniques to wave forecasts

Method

- Generated consensus forecasts at 14 buoy locations from 10 numerical wave models
- Past performance used to bias correct and combine numerical forecasts
- Examined applicability to H_s, U_{10} and T_p out to five day forecasts

Conclusions

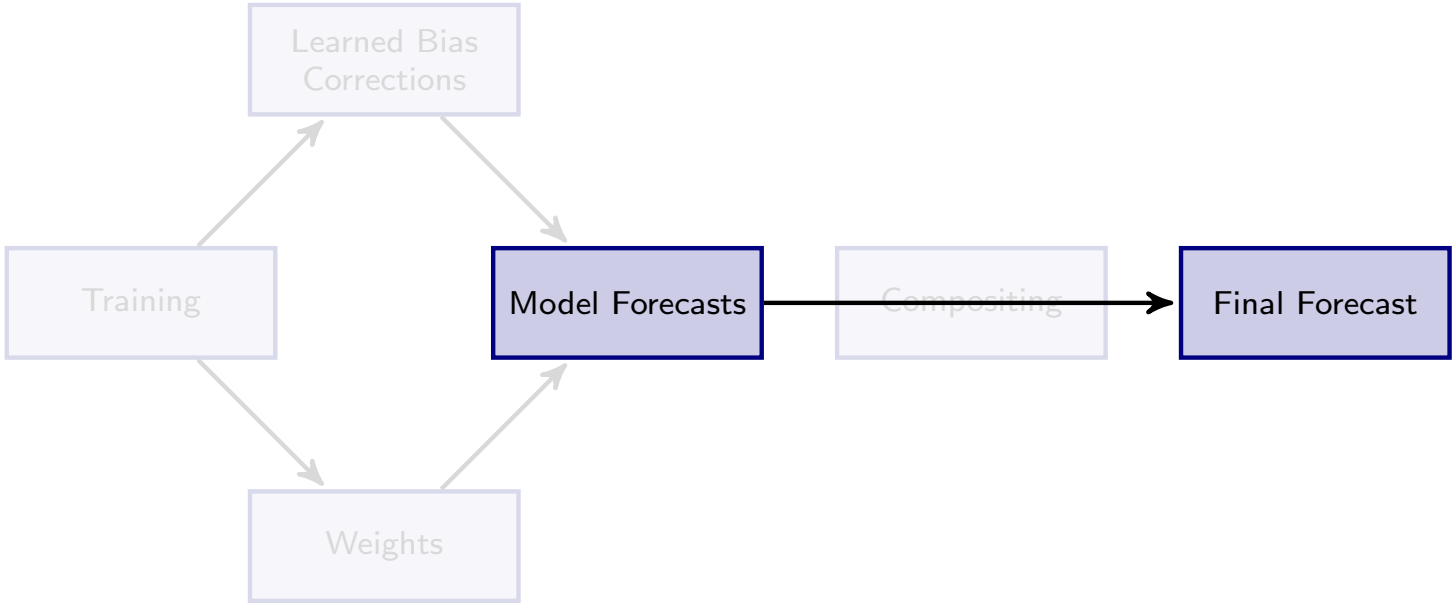
- Composites of corrected component forecasts provide significant improvements over raw models
- Gains generally persist out to five day forecast periods
- Little gained by using more than 5 or 6 models
- Independence of components, as well as quality are important considerations

Background

- Operational Consensus Forecast (OCF) is an objective weather forecasting system based on combining forecasts from several numerical models
- Operational for T_{max} , T_{min}, rainfall etc. at Bureau since March 9, 2005
- Generally outperforms other forms of objective weather guidance
- MAE of 24 hour forecast T_{max} , T_{min} is approx. 10% lower than official forecasts

Background

What is OCF?



- $f_i = o + b_i + e_i$
- Systematic error removed through learned bias correction
- Random error minimised through compositing

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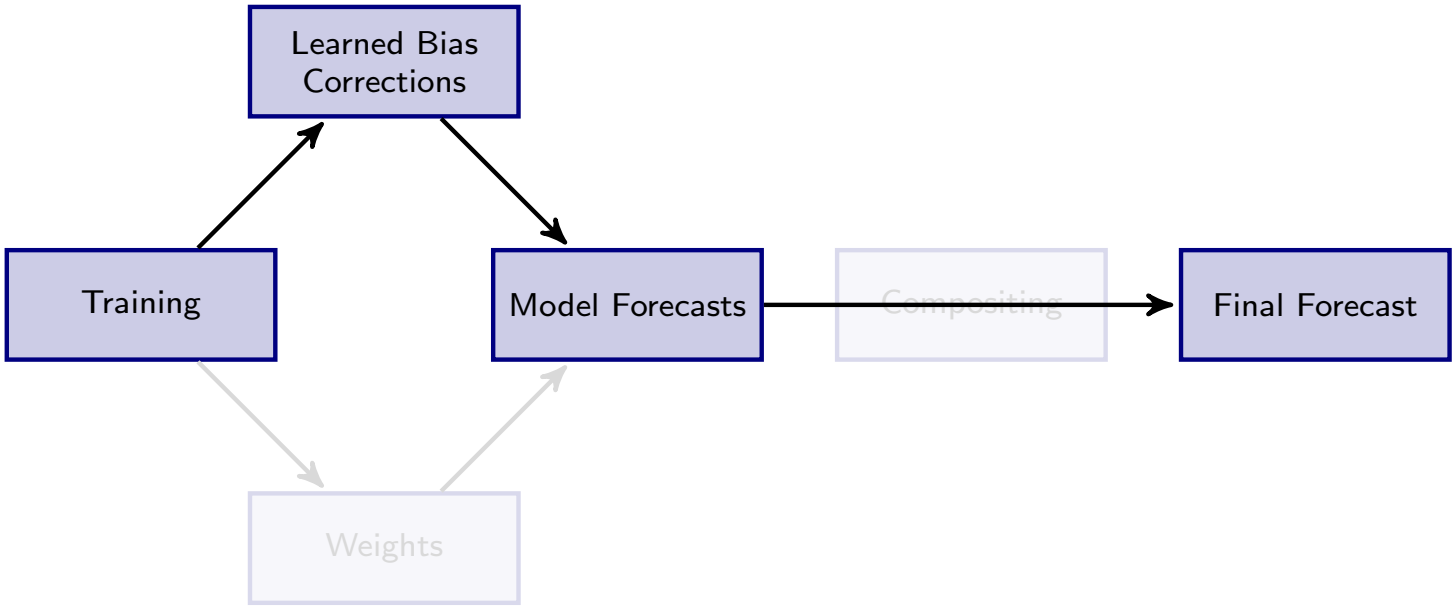

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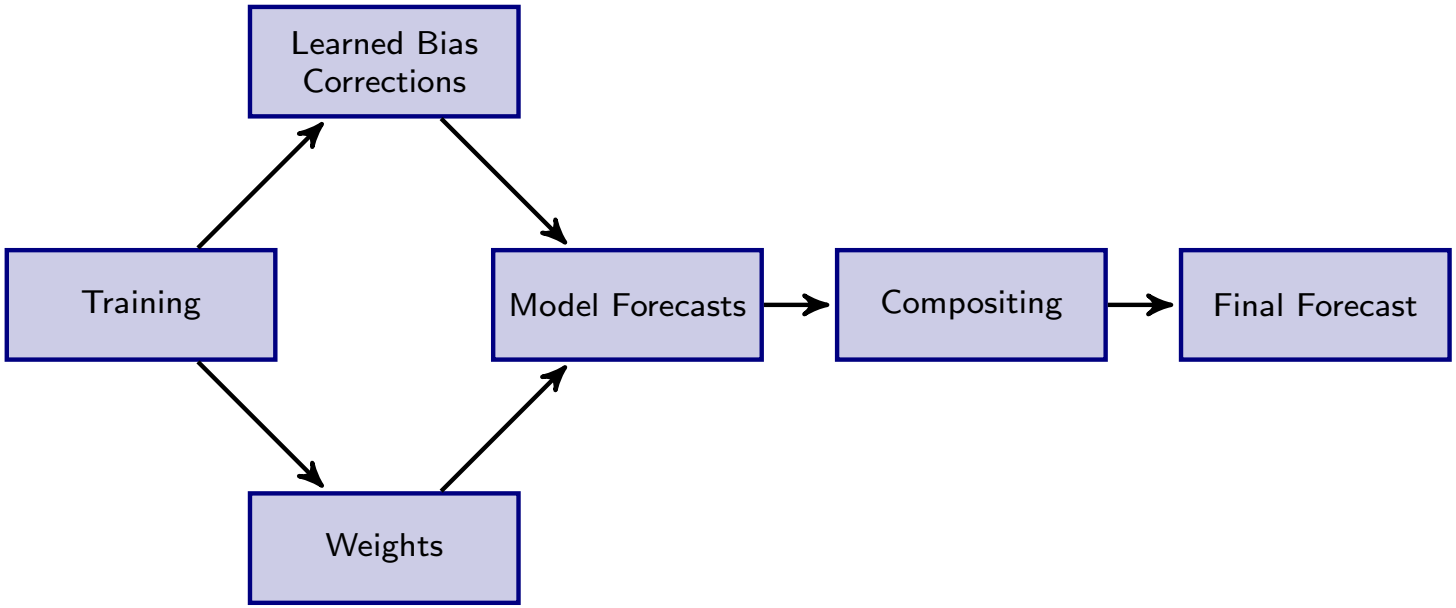

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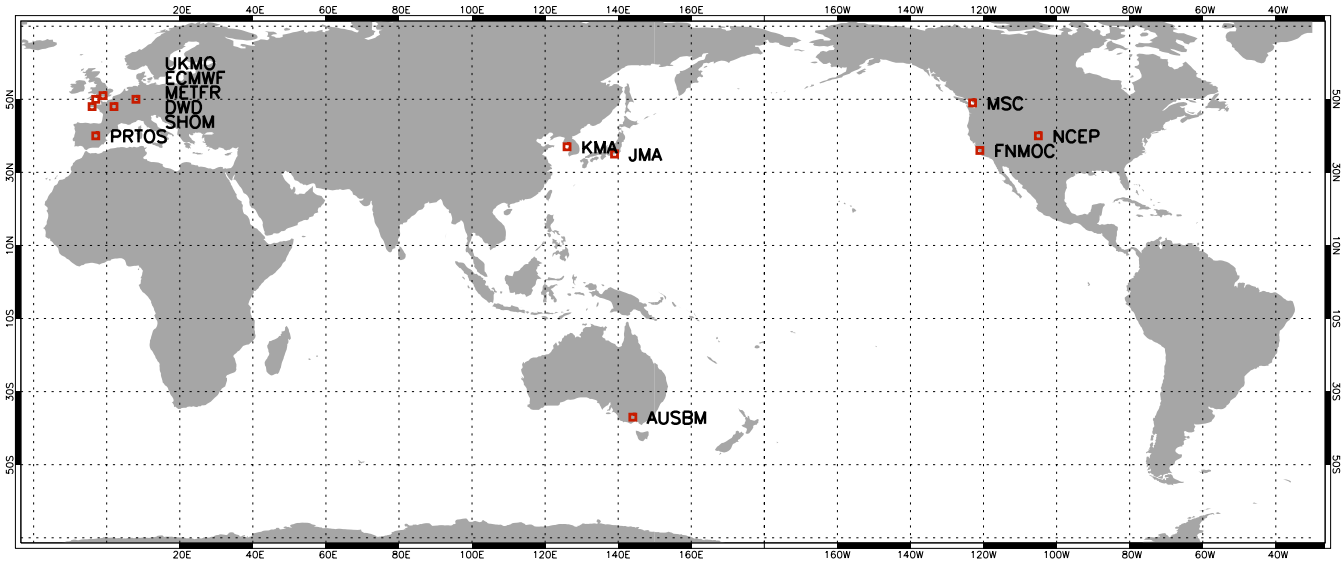
Background

- Woodcock and Greenslade recently applied OCF to 24 hour H_s forecasts
- Work limited by a lack of quality models
- Extended here to include:
  - 10 international models
  - Peak Period and 10 m wind speeds
  - Extended forecast periods

Method

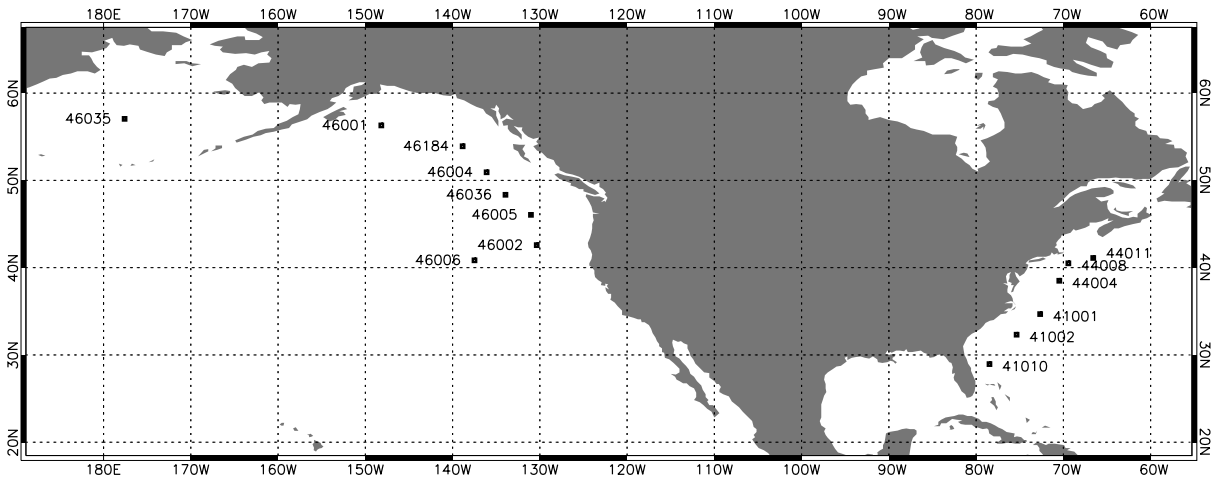
Model Data



- Based on JCOMM intercomparison data set
- 12 models, ∼245 sites

Method

Observational Data



- Subset of sites chosen where all models present
- KMA, PRTOS not included
- 10 models, 14 sites
- October 2006 - July 2007

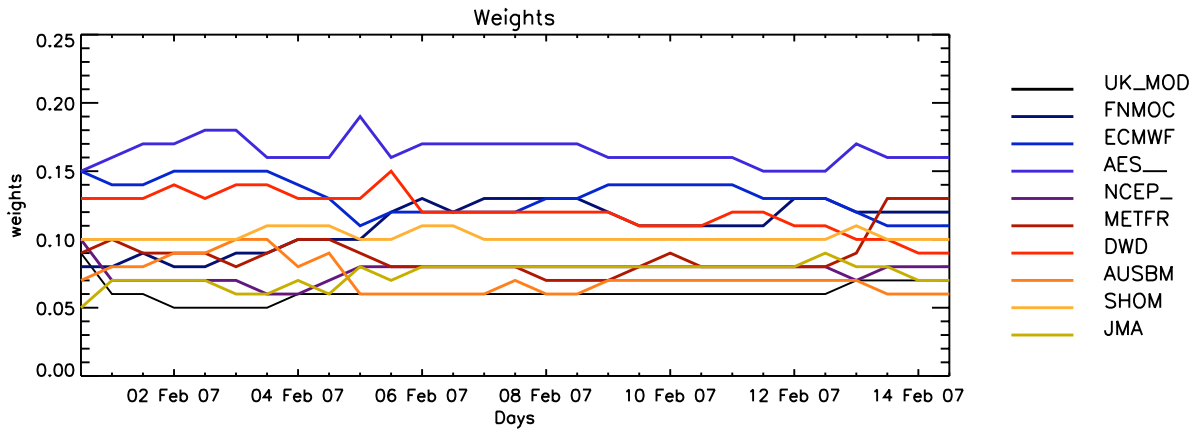
Method

- Generate consensus forecasts of H_s, U_{10} and T_p at all sites
- Forecasts out to 5 days, 12-hourly intervals
- $\sim$ 2500 forecasts
- Several methods of combining forecasts explored:
  - Individual linear regression
  - Individual bias-correction
  - Equal-weighted composites
  - Performance-weighted composites
  - Fixed training period of 29 events used

24 Hour Forecasts

Composites

- Performance weighted composites outperformed equal weighted composites
- $\hat{w}_i = (MAE)_i^{-1} \left(\sum_{i=1}^{n} (MAE)_i^{-1} \right)$



24 Hour Forecasts

Composites Results

Variable	Best Scheme	Imp. Ave	Imp. Best
H_s	PWBC	36%	14%
U_{10}	PWLC	31%	18%
T_p	PWBC	47%	22%

24 Hour Forecast RMS Improvements

24 Hour Forecasts

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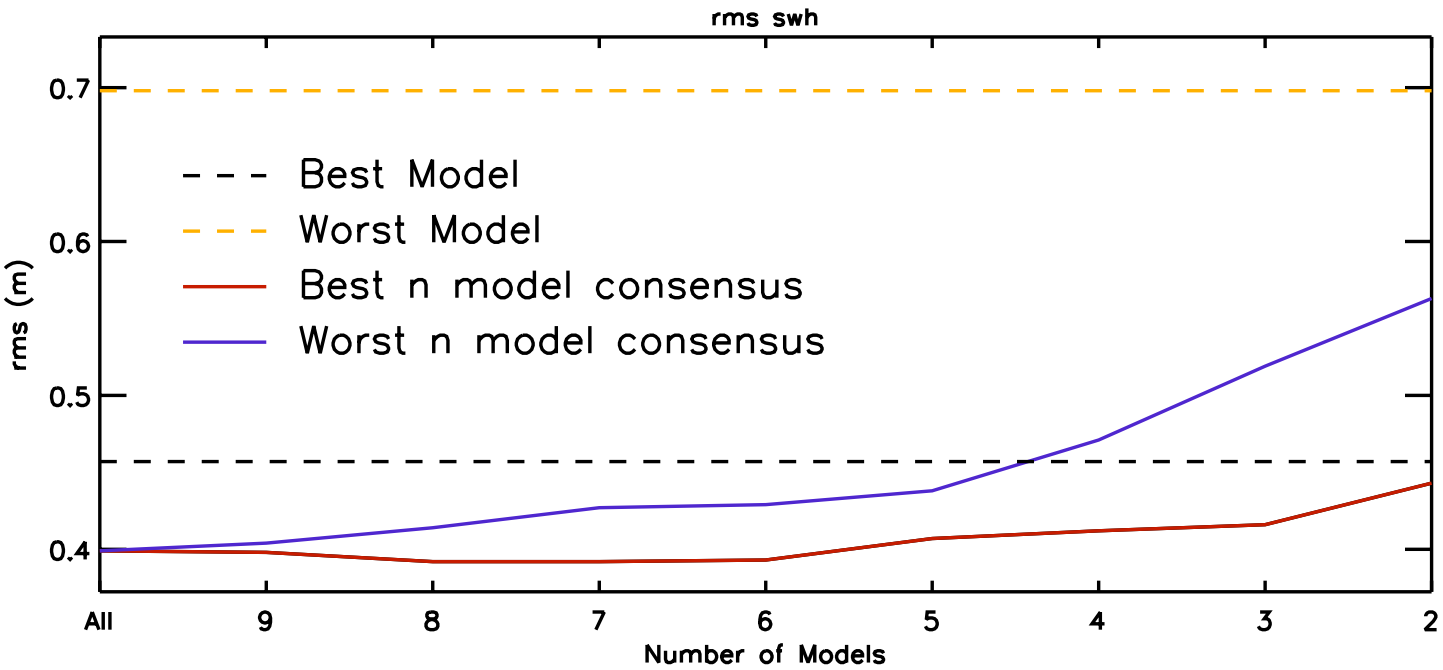
24 Hour Forecast RMS Improvements

Component Variations

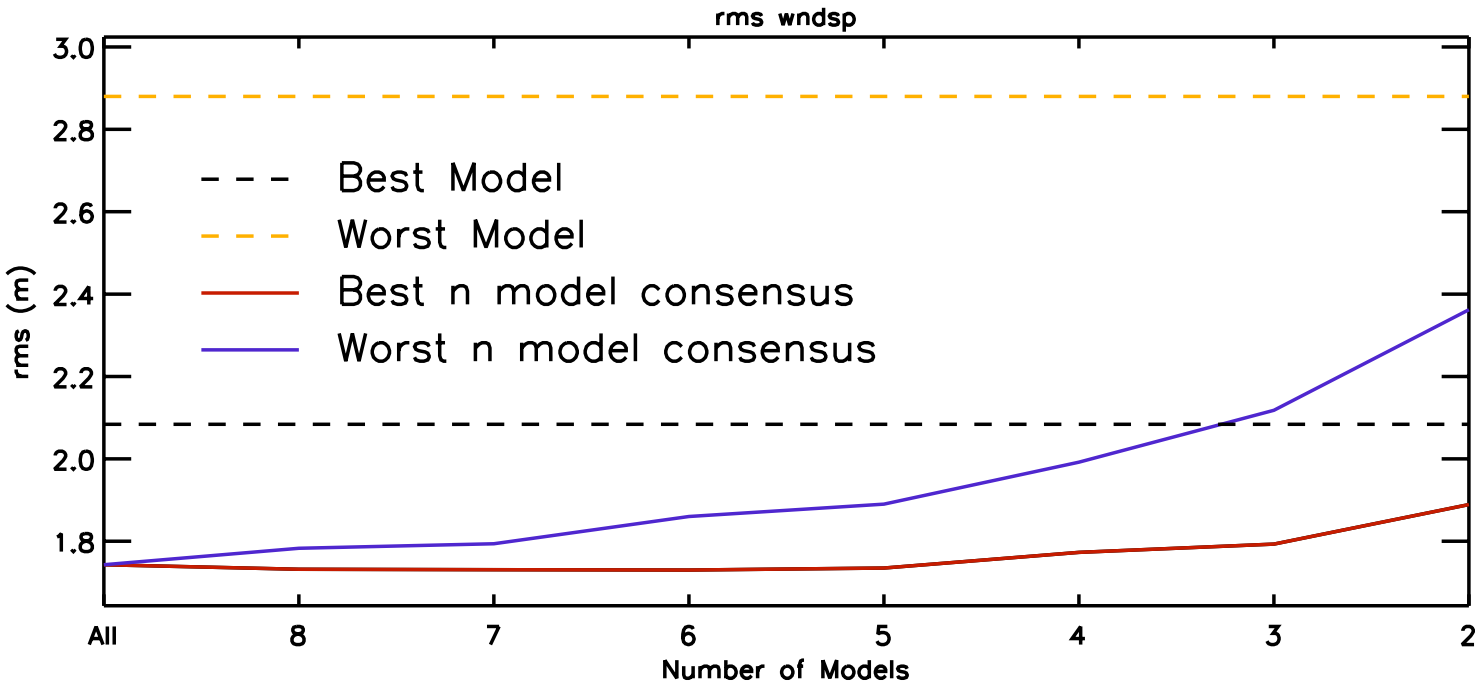
Significant Wave Height



H_s results for varying components

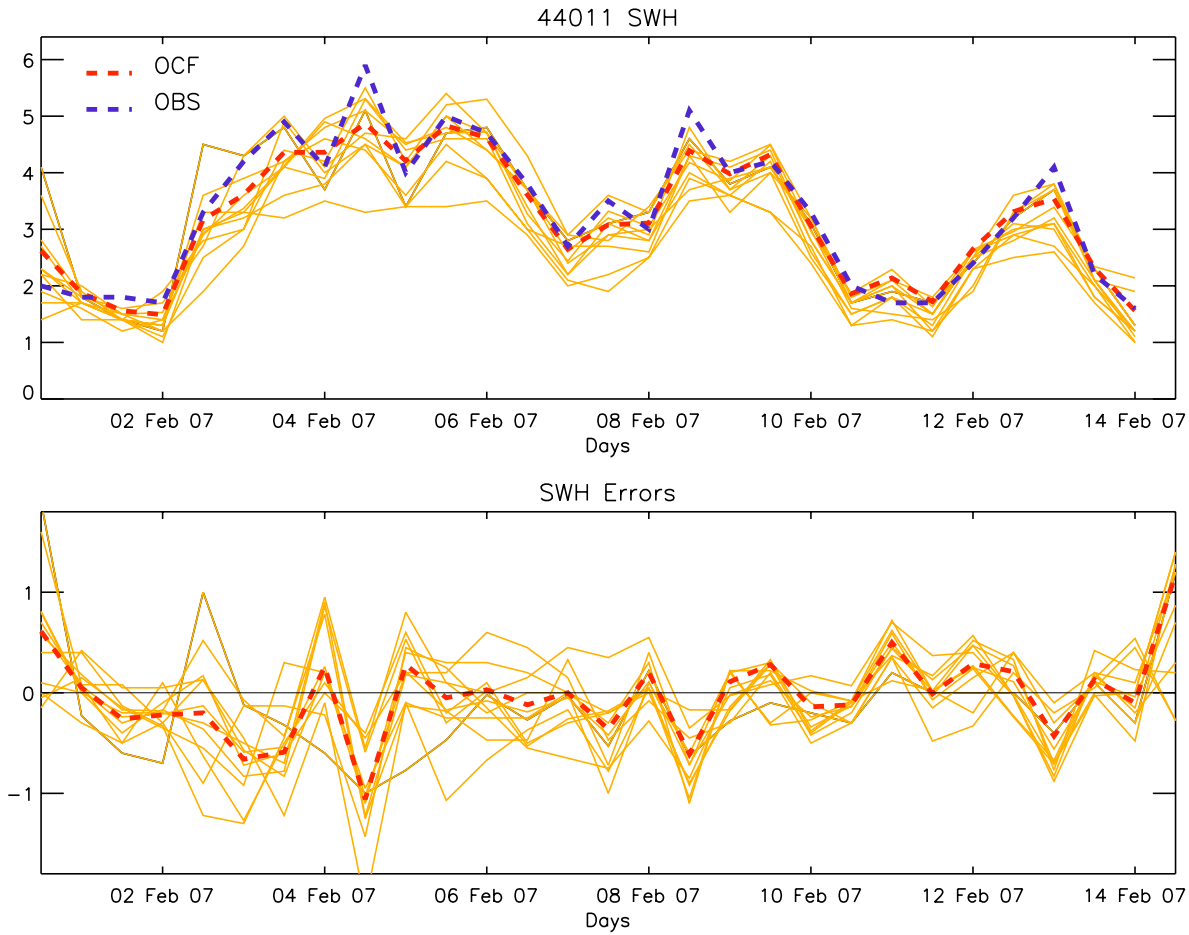
Component Variations

Wind Speed



U_{10} results for varying components

Component Variations



Component Variations

Model	RMSE
ECMWF	0.45
UKMO	0.55
SHOM	0.47

PWBC using specified components

Components	R	RMSE
ECMWF and UKMO	0.43	0.41
ECMWF and SHOM	0.85	0.44

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PWBC using specified components

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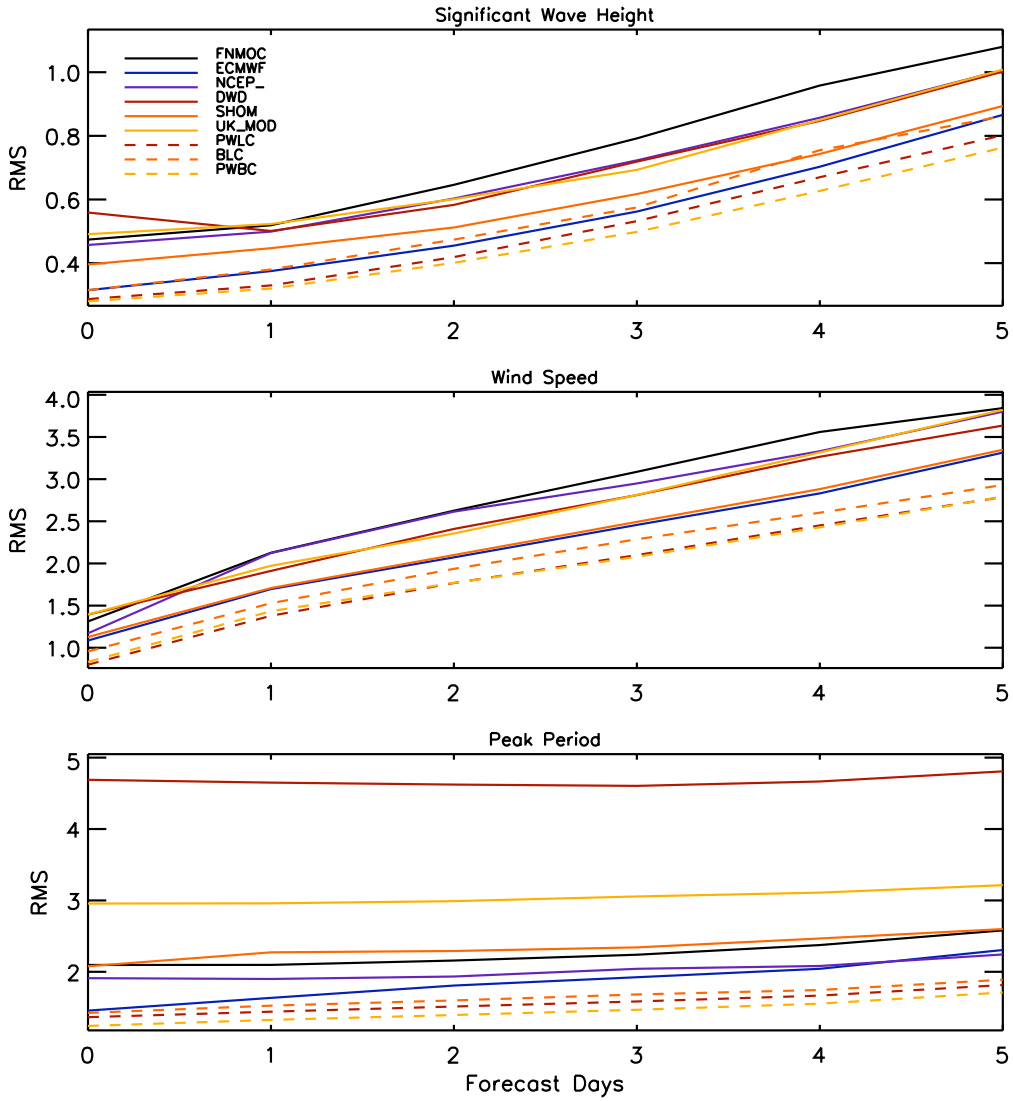
Extended Forecast Periods



Conclusions

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- Gains generally persist out to five day forecast periods
- 10 models used here excessive, little gained beyond 5 or 6
- Independence of components, as well as quality are important considerations

Further Work

- Perform similar analysis for Australian sites
- Assess best combination of models for our region
- Extend to a grid based scheme using altimeter observations for training