TECHNIQUE FOR PREPARING GRIDDED WIND FIELDS TO ENHANCE AMBIENT AND TROPICAL CYCLONE WAVE HINDCASTING CAPABILITIES

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MOTIVATION

- Previously used coarse resolution ambient gridded winds from NCEP and high resolution tropical cyclone winds from the parametric Holland vortex model forced using ‘best track’ data from the Australian Bureau of Meteorology (BoM)

- Model hundreds of tropical cyclones for each study

- Modelling conducted in regions where measured data for model calibration is sparse

- This study investigated ways to:

    - develop a robust and elegant methodology for blending wind fields that can be automated

    - improve the reliability of model calibration in regions where measured data is sparse by more accurately modelling seastates at the periphery of storms

    - improve the simulation of 'lead up swell' prior to the onset of a storm and of the subsequent decay of the storm peak seastate

SUMMARY OF METHODOLOGY

	Misplaced Vortex Treatment	**Blending Method**
Trial #1 **Distance Method**	Threshold applied to ambient winds outside the vortex	Distance
Trial #2 **Modified Kurihara et al. Method**	Vortex removed	Radius to maximum winds
Trial #3 **Vortex Relocation Method**	Vortex relocated by distorting grid	Eye

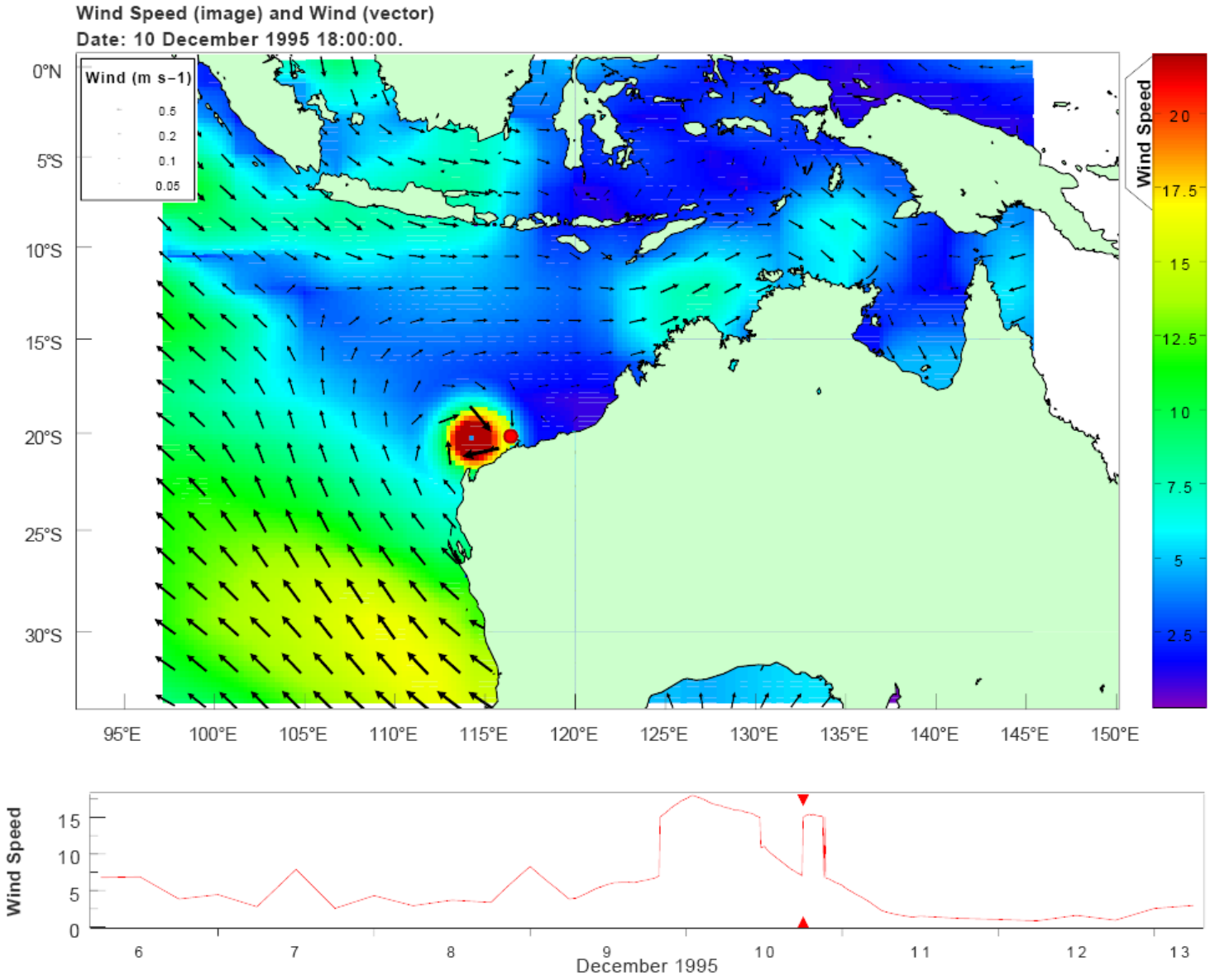
CONCLUSIONS

– We have successfully developed a robust, flexible wind field blending process which provides for much-improved tropical cyclone wind field representation in data sparse regions. This in turn allows:

- improved simulation and calibration of tropical cyclone wave fields
- more accurate long term continuous wind and wave simulation
- more accurate determination of storm peaks (and consequent estimates of extremes)
- improved simulation of storm lead-up and decay, resulting in more reliable assessments of floating facility operability

Trial #2 - Modified Kurihara et al. method

- Kurihara et al. (1993) investigated a scheme to replace a crudely resolved vortex in large scale analysis winds with a vortex that is properly specified for use in a prediction model to improve initial conditions
- poorly resolved tropical cyclone vortices from the NCEP ambient gridded winds removed
- radius to maximum winds blending method implemented
- typically resulted in a depression in the wind field where the NCEP vortex had been
- the Holland vortex is generally smaller than the NCEP vortex
- left a ‘moat’ in the blended wind field between the ambient and cyclonic signatures.



Blended wind field for Tropical Cyclone Frank (1995) when the NCEP vortex was removed using the modified Kurihara et al. method

Trial #2 - Modified Kurihara et al. method

- improved automation of the wind field preparation process
- resulted in unrealistic wind signatures

Trial #3 - Vortex Relocation method

- While implementing Trial #1 and #2 noticed that the NCEP vortex and the high resolution vortex were often misaligned
- To avoid ‘moats’ and vortex misalignment we chose to relocate the NCEP vortex
- **Step1** - identify and record the deviation of the the NCEP vortex from the BoM ‘best track’ vortex
- **Step 2** - NCEP vortex relocated to BoM vortex position by applying a grid transformation within an elliptical area where the source and destination of the NCEP vortex coincides with the ellipse focii
- **Step 3** - the distorted grid is then re-interpolated onto the original regular grid
- **Step 4** - Holland vortex wind speeds and directions blended into the distorted synoptic wind field (Eye Method)
- qualitatively most realistic looking blended wind field from the methods trialed

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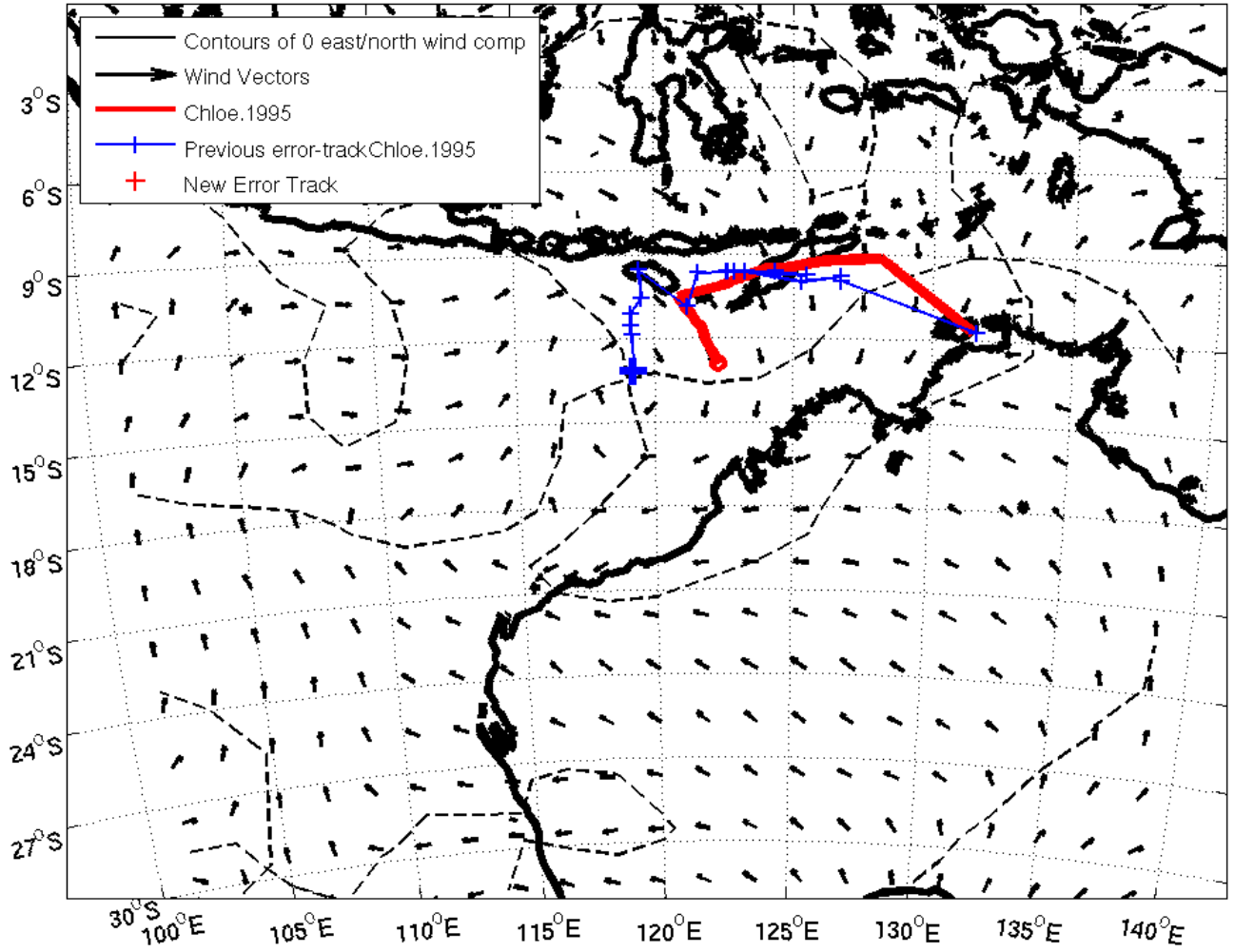

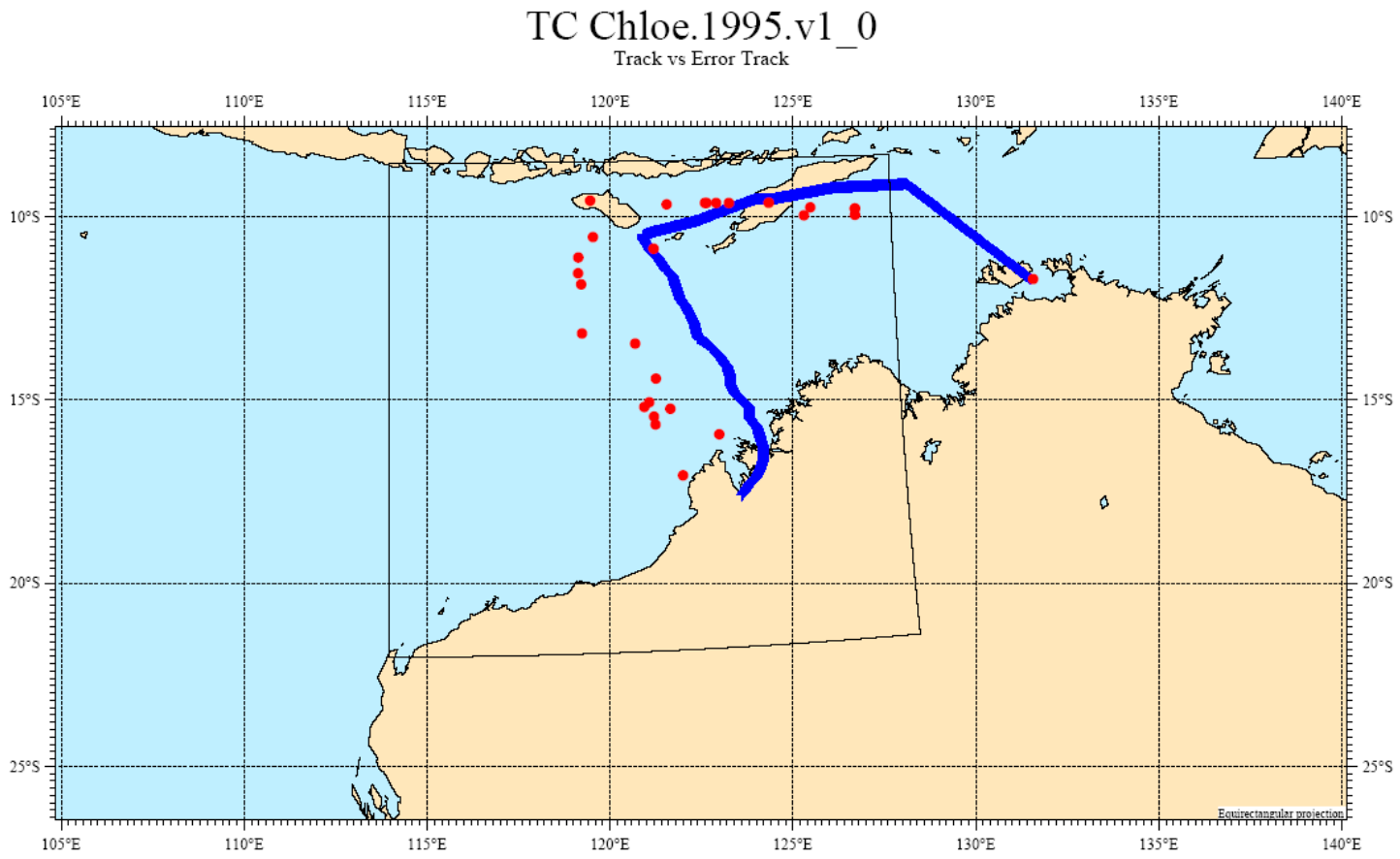

Overlay plot of an ‘error track’ (red) and a ‘best track’ (blue)

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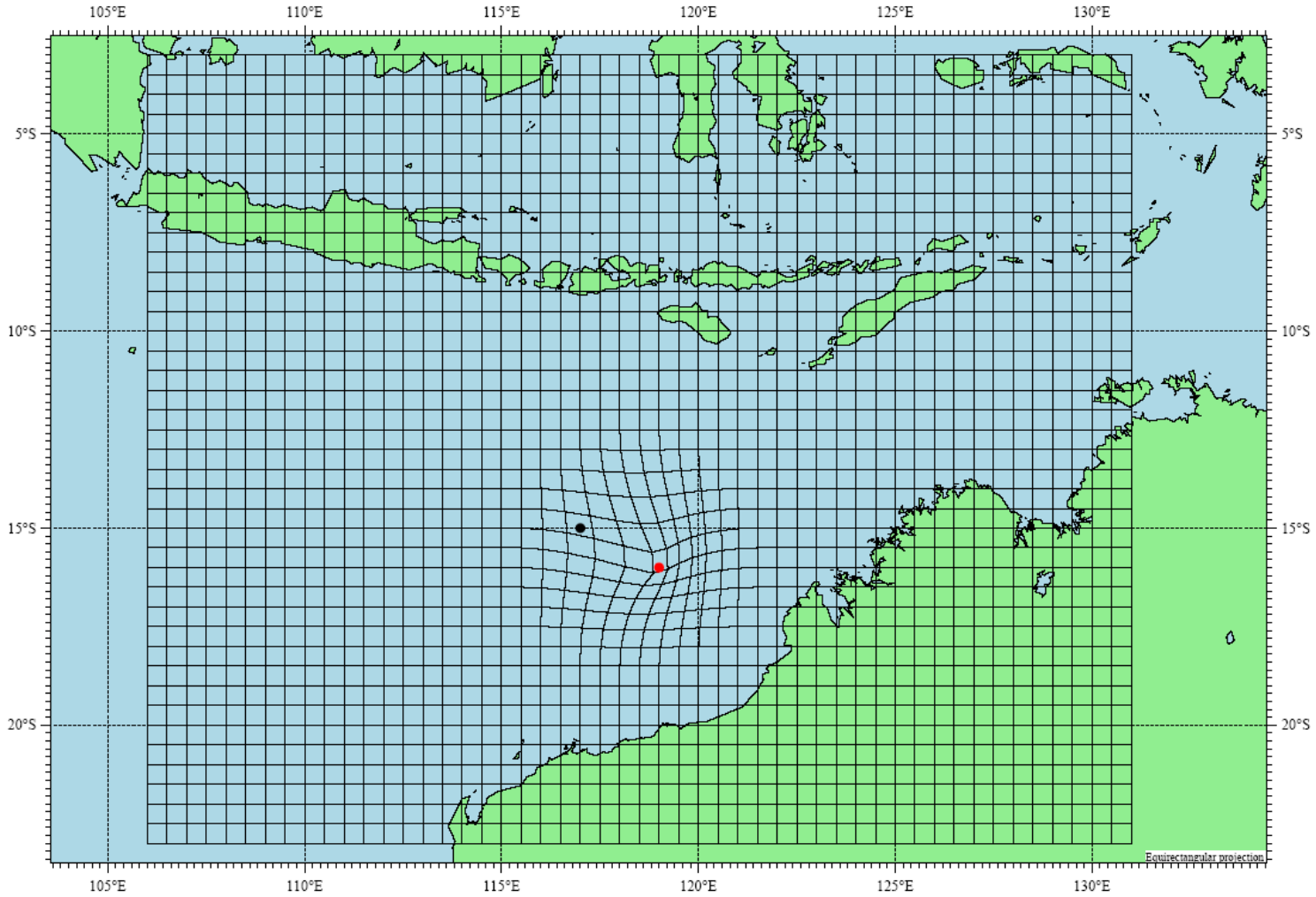

Example of a grid distorted using the vortex relocation method

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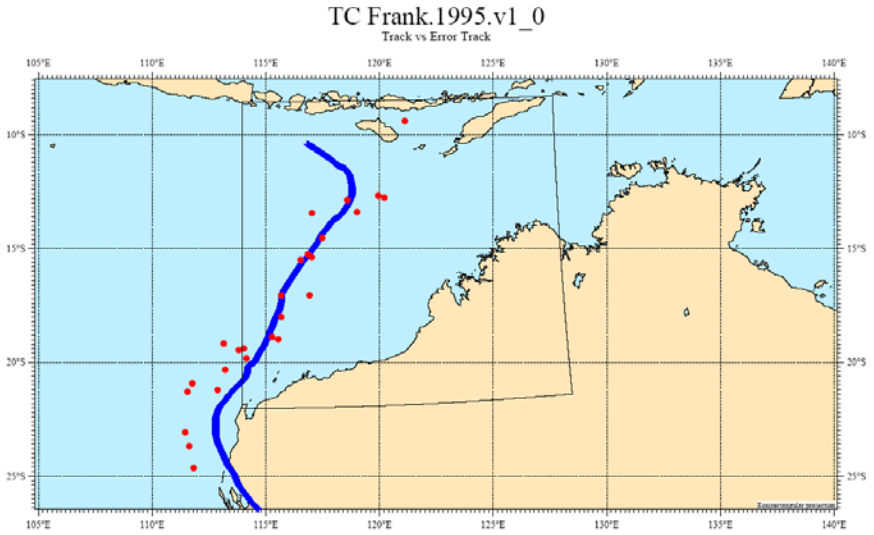
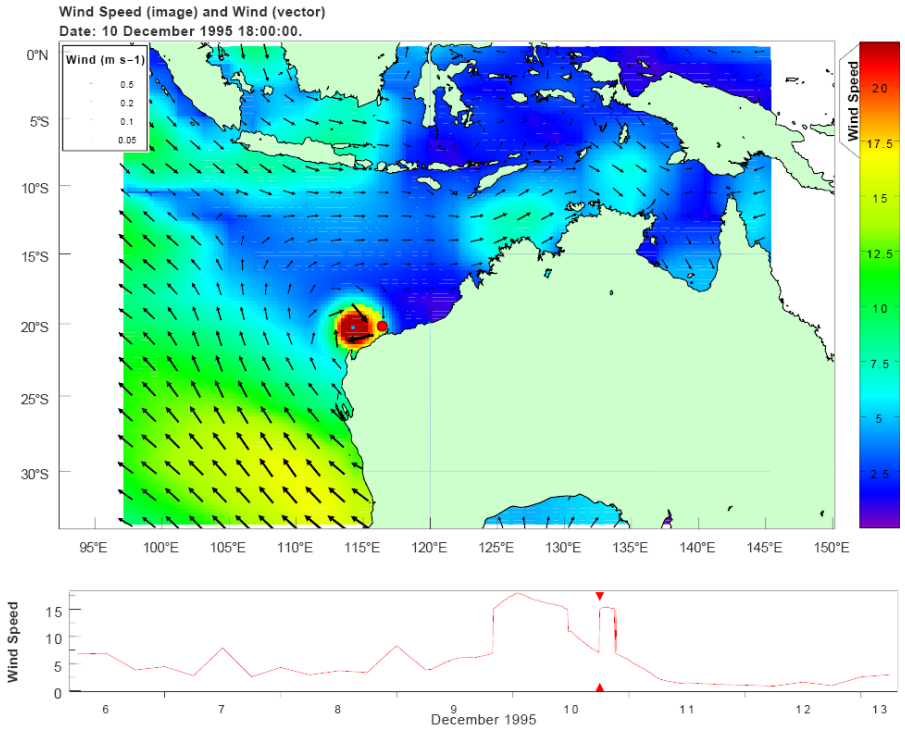
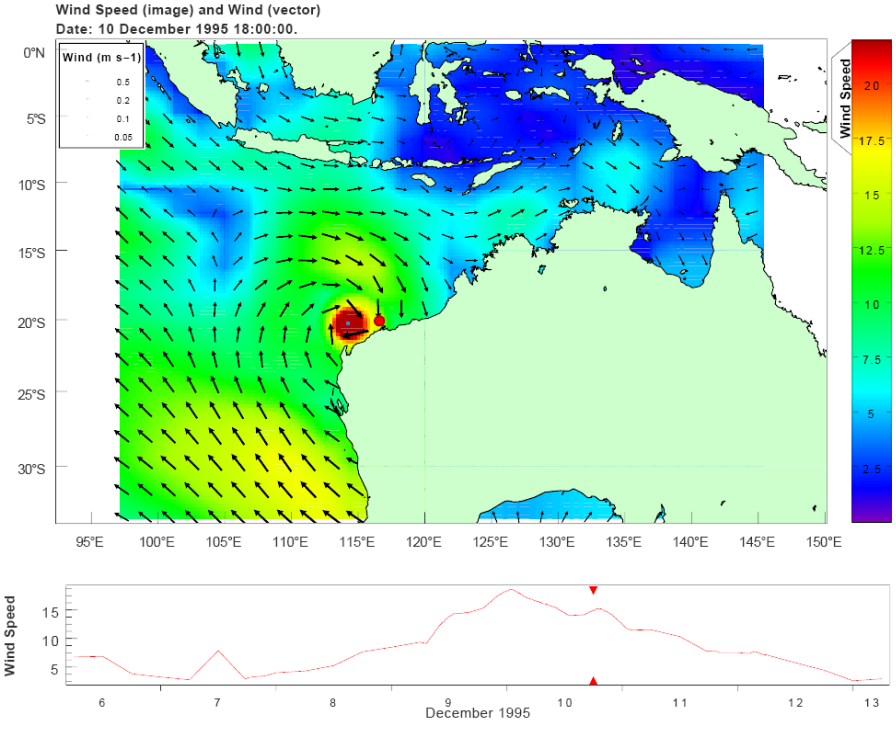
RESULTS

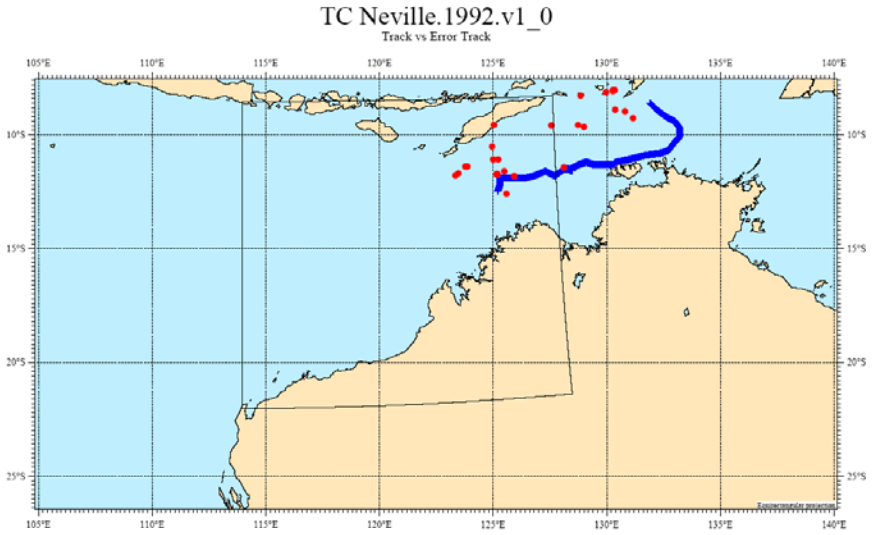
- vortex relocation method used to hindcast wind and wave fields for a select database of tropical cyclones affecting the northwest of Australia
- test the robustness of the blending algorithm and automation of the wind preparation process
- cyclones selected to represent a cross-section of intensities and varying distances between the NCEP vortex and the BoM track
    - weak NCEP vortex and/or short relocation distance
    - long relocation distance
- results compared against measured data

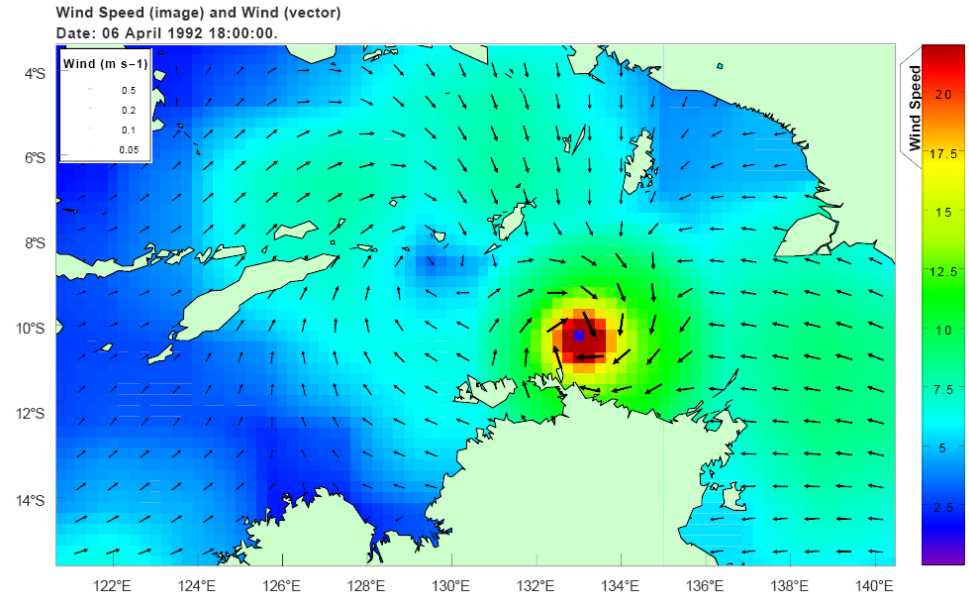


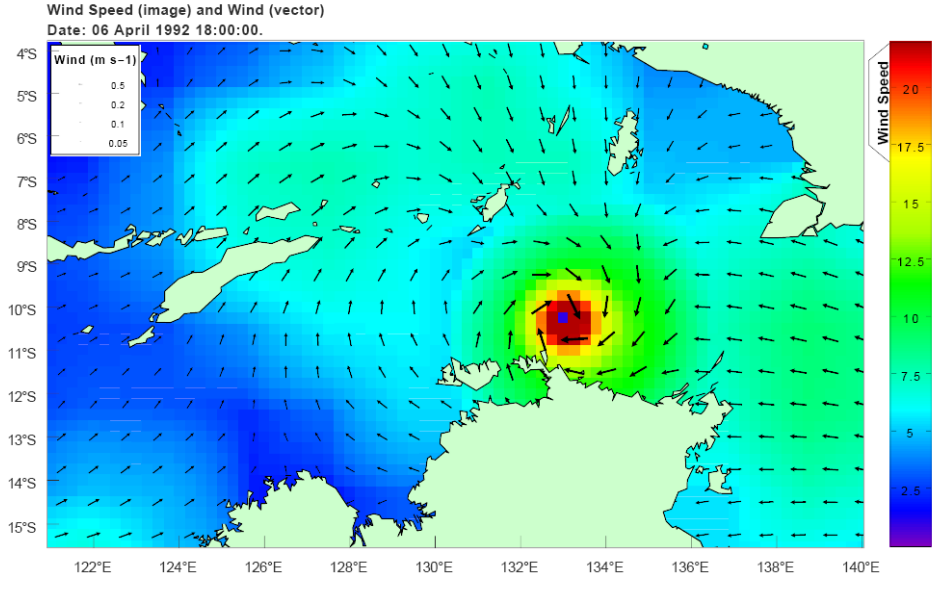




Weak NCEP Vortex and Short Relocation Distance



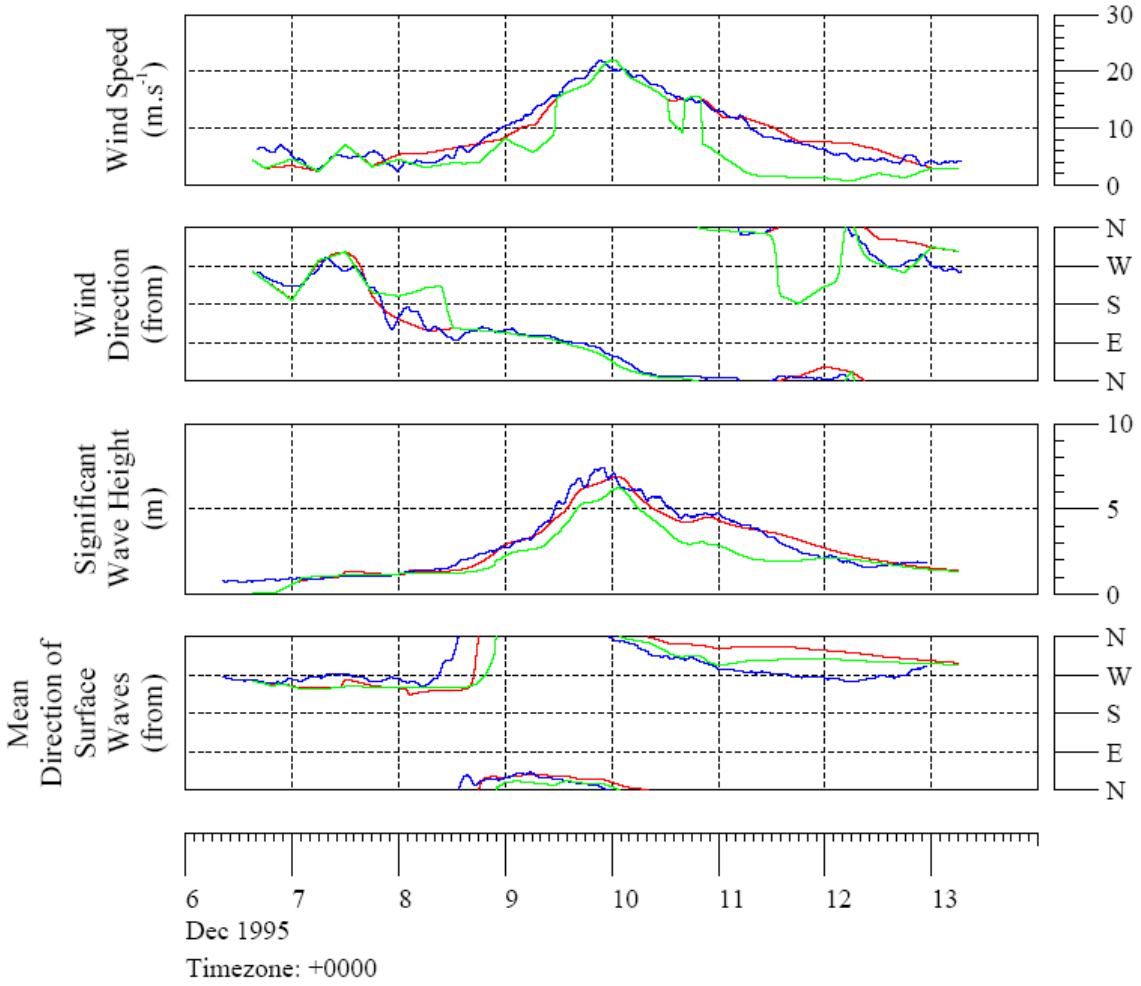




Long Relocation Distance

Tropical Cyclone Frank

Red - Vortex Relocation modelled data
Green - Vortex Removal modelled data.
Blue - measured data.



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ACKNOWLEDGEMENTS

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