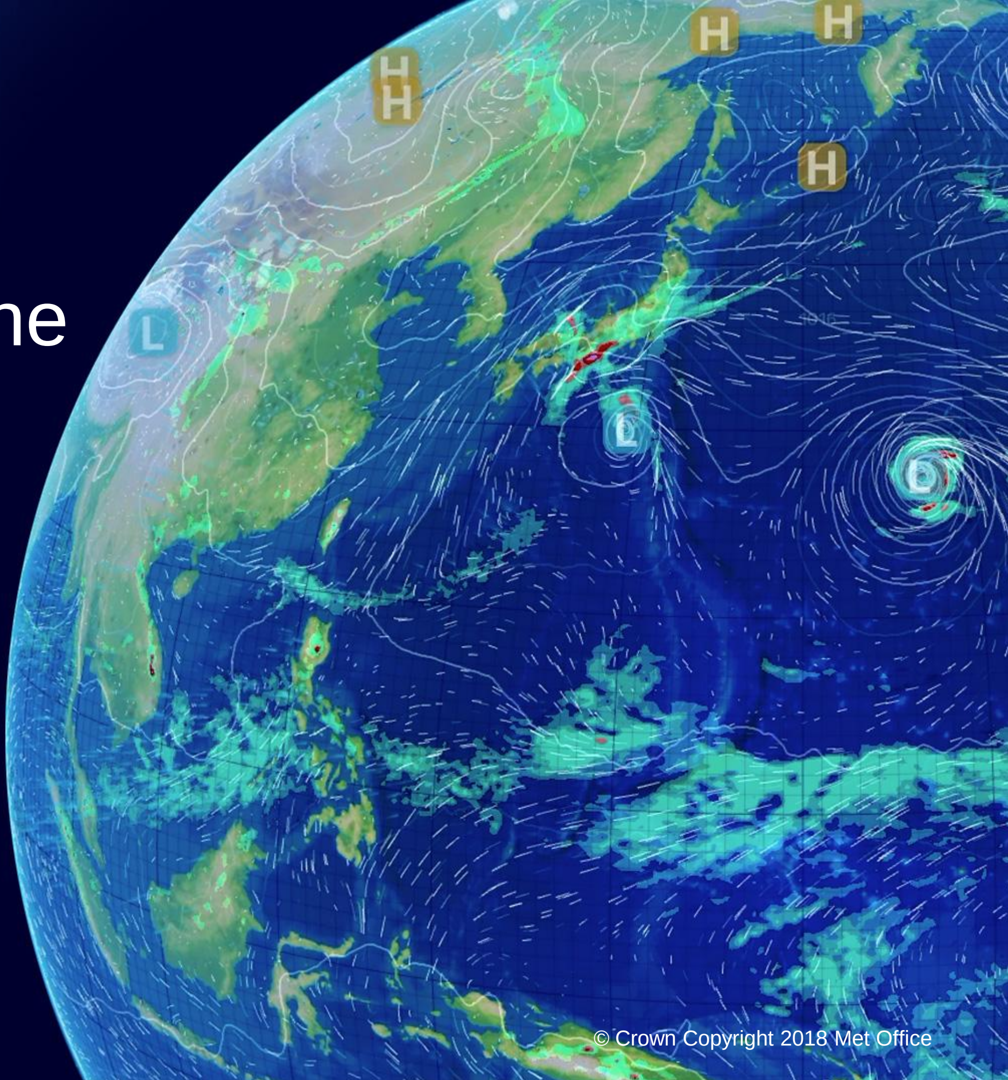
UK: In Partnership with the Philippines to improve forecasting of Tropical Cyclones



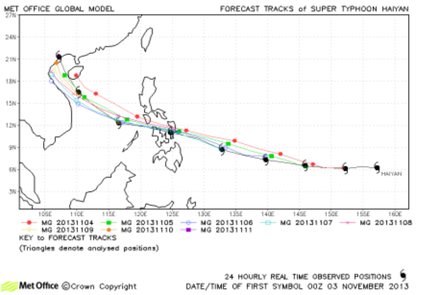
Andy Hartley

Tropical Cyclones: From Science to Mitigation

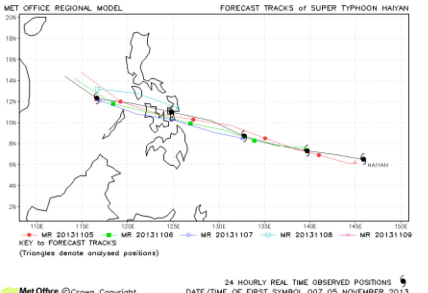
16th January 2019

Nov 2013: Super Typhoon Haiyan









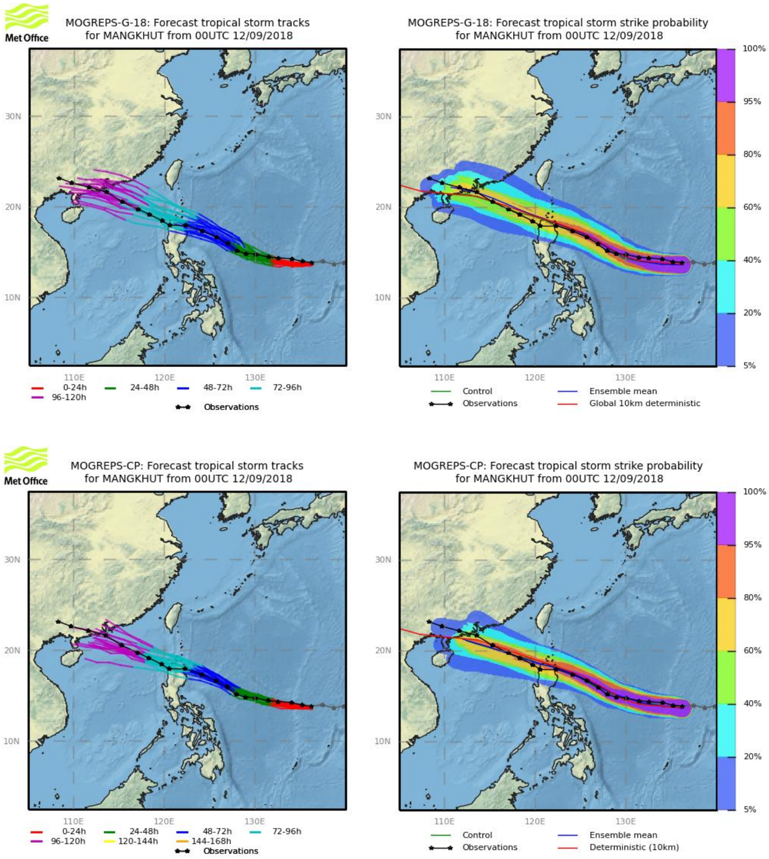
Tropical Cyclone Ompong, September 2018

"Honestly, that was a very stressful weekend. The sad thing is, after all the preparations that we have, several warnings that we issued, the press conferences that we conducted regarding TC Ompong, still there's a lot of casualties.

I do not know where we lacked. "

Jun Galang

Chief Meteorologist, PAGASA



In partnership with The Philippines Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)

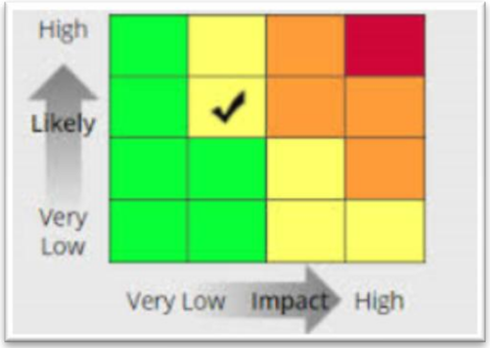
Modernisation Programme

- Purchase new Super Computer
- Use the Met Office Unified Model for TC forecasting
- Become UM associate partners:
    - Technical support to supply modelling infrastructure
    - Model evaluation infrastructure
    - Technical training
    - Engagement with UM partnership community

In partnership with The Philippines Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)

Weather and Climate Science for Services Partnership

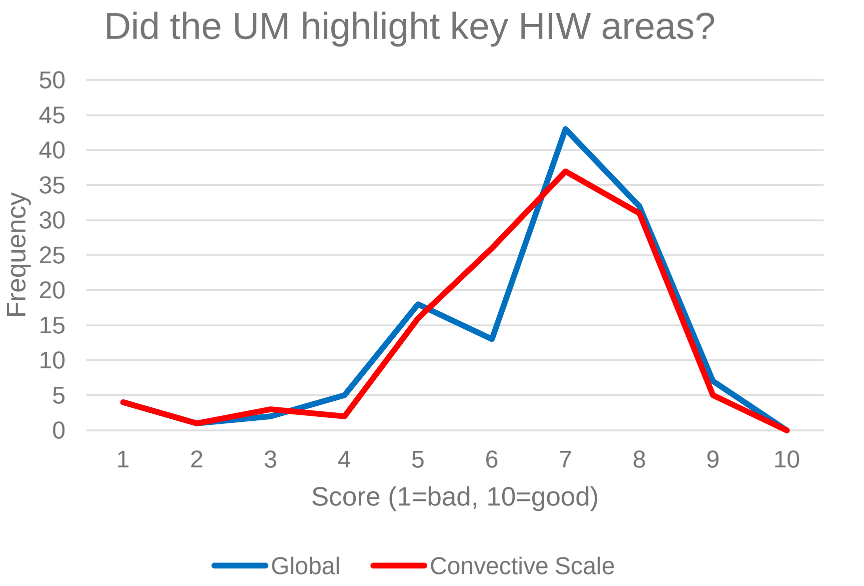
- Science for services partnership
- Collaborative research on:
    1. Global scale science
    2. Regional scale science
    3. Translation of science into improved services
- Realise benefits of modelling improvements
- Improve understanding of models
- Develop impact based forecasting approaches



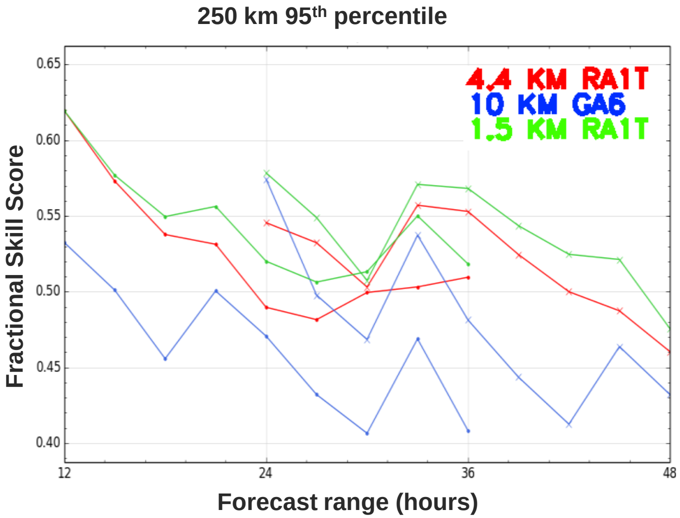
Why “science for services”?

1. To realise the benefits of advancements in the science of global and high resolution regional models for forecasting high impact weather in South East Asia.
2. To influence future model development through a combination of enhanced understanding of how models are used and closer working between forecasters and scientists

Baseline Assessment



Based on 104 surveys compiled by PAGASA forecasters between May and October 2017



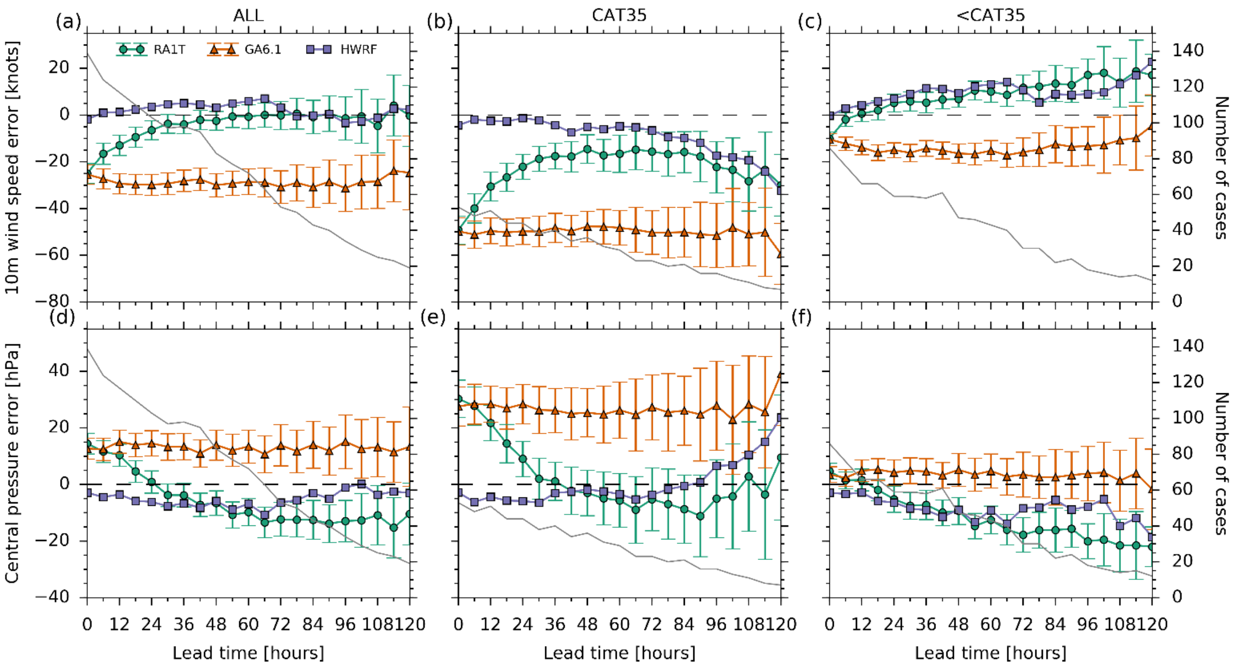
Timeseries of the 95th percentile fractional skill score (FSS) for a 250 km length-scale

Tropical Cyclone science highlights

Regional scale (convection permitting) compared to global scale models

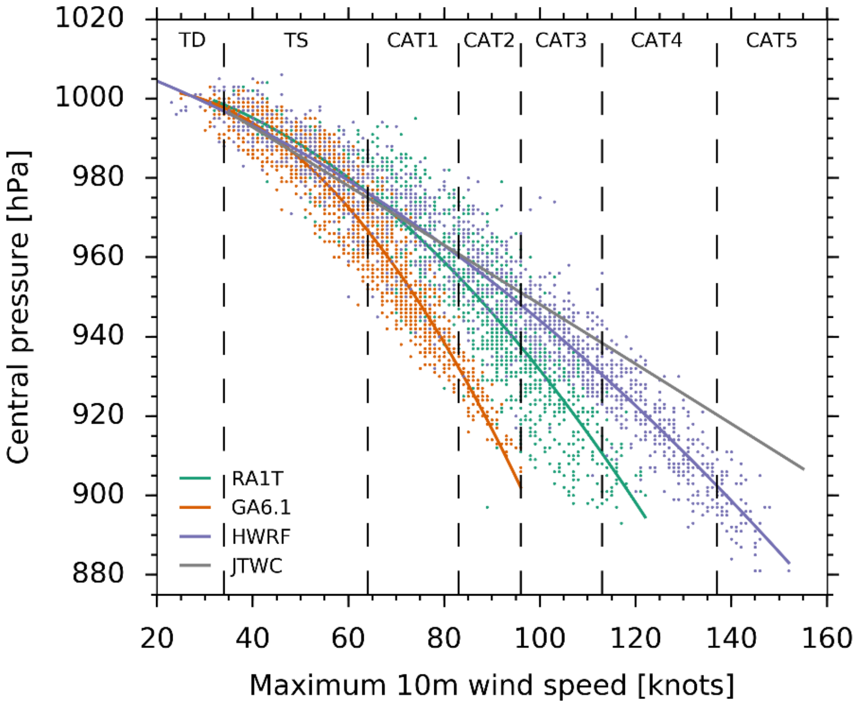
Intensity forecast biases

- Overall, RA1T has a wind speed bias close to zero once spun-up:
  - Wind speeds under-estimated in intense TCs
  - Opposite bias in weaker storms
- RA1T has a tendency to over-deepen storms
- Systematic weak bias in GA6.1
- Biggest difference compared to HWRF is in first 36 hours - vortex initialisation a priority



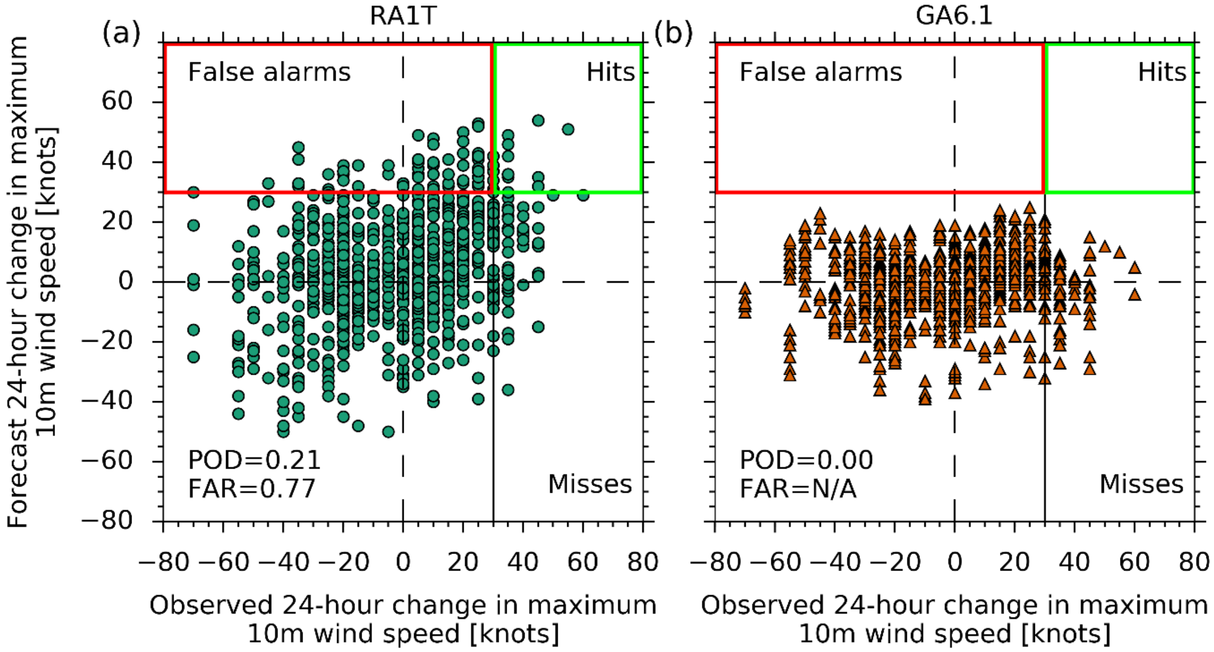
Wind-pressure relation

- RA1T yields a much improved WPR compared to GA6.1…
- …but wind speeds are under-estimated for a given central pressure
- HWRF provides a better match to obs in the high-intensity limit. Two possible factors:
  - Higher resolution of HWRF (2 km inner nest vs 4.4 km)
  - Smaller drag coefficient at high wind speeds in HWRF – **see later**

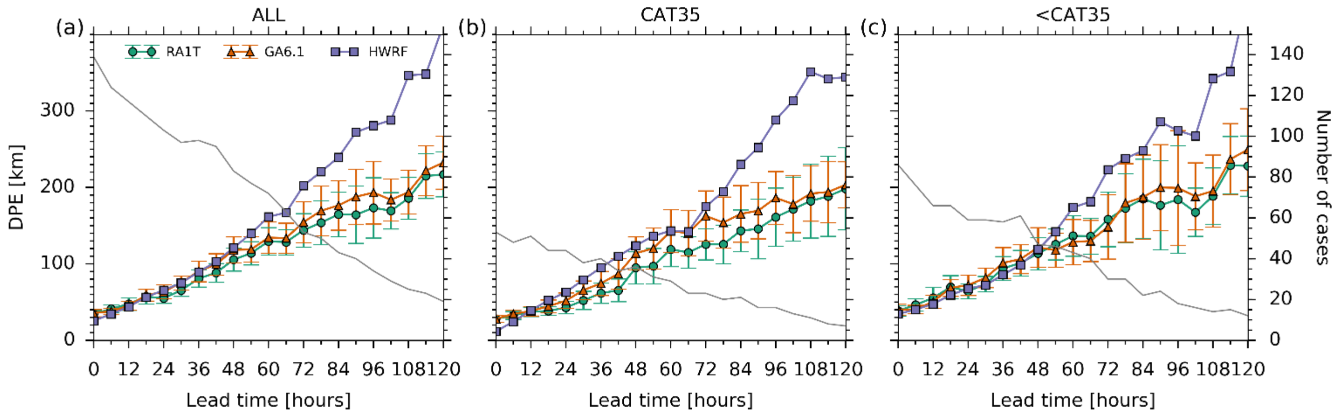


Rate of intensification

- RA1T captures some genuine RI cases…
- …but tends to produce too many false alarms
- GA6.1 cannot predict RI at all
- Many false alarms occur when a weak analysis is followed by a rapid spin-up towards obs – vortex initialisation



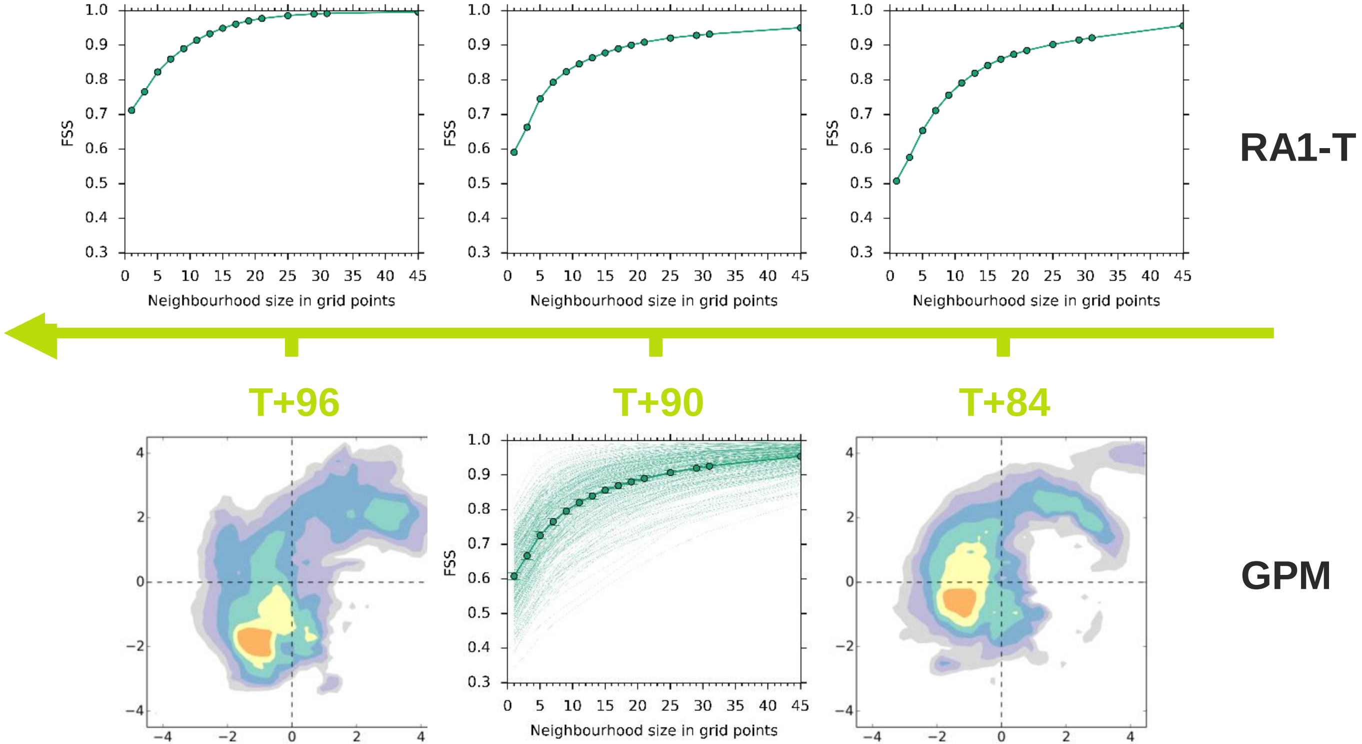
Track errors



- No statistically significant differences in DPE relative to obs between RA1T and GA6.1
- Storm positions are generally different though, i.e. convective-scale model modifies the steering flow inherited from the driving global model
- Error growth rate increases beyond T+48 in HWRF leading to larger errors at long lead times

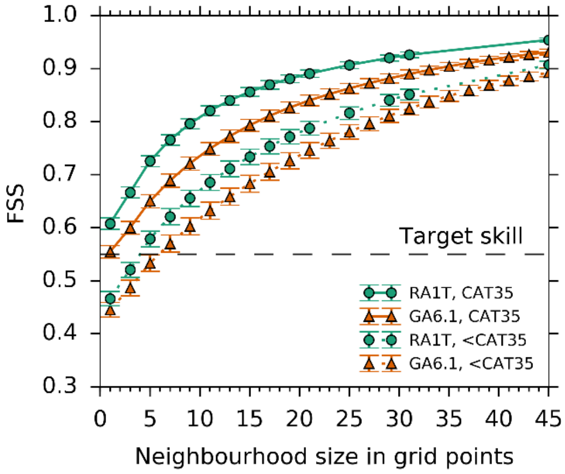
Precipitation forecast skill

- At each lead time, extract storm-centred precip field from model output and matching GPM obs…
- Apply a (percentile) threshold…
- Compute the FSS statistic…
- Average over multiple cases

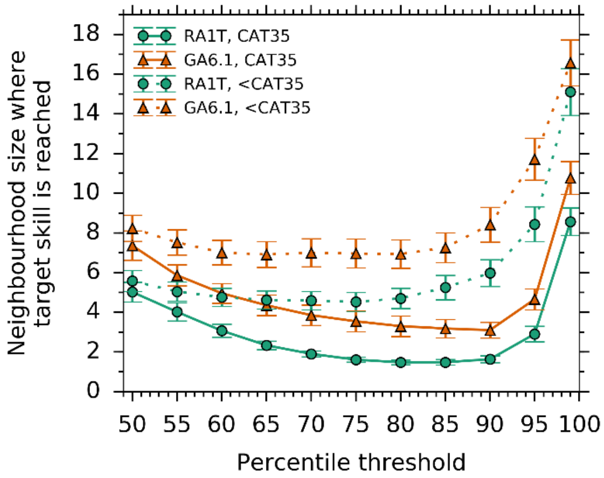


Precipitation forecast skill

- Storm-centred approach probes how well a model can predict the location of precip structures *within* TCs
- At a 90th percentile threshold, RA1T has greater skill than GA6.1 at all spatial scales, in both weak and strong storms
- This result holds at other percentile thresholds
- Both models are better able to predict the location of rainfall in intense TCs than weak ones



FSS at 90th percentile threshold



Skill as a function of threshold

Translating improved science into improved forecasts

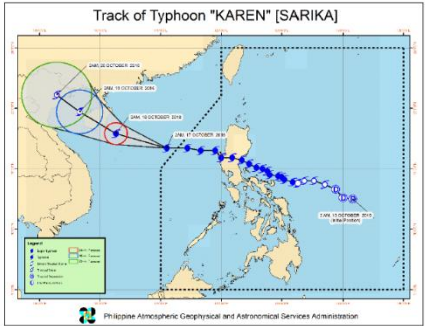
Learning from past events

Impact-Based Forecasting

Post-event case studies

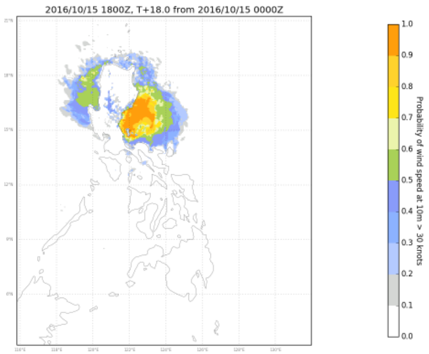
- Deeper understanding of model performance
- Opportunity to review action taken, and identify best practice
- Cases chosen based on daily forecaster evaluation
- Mix of weather types, forecast hits / misses / false alarms
- Done in collaboration with in-country partners
- 3 cases each run for Malaysia and Philippines

TC Karen 15/10/2016

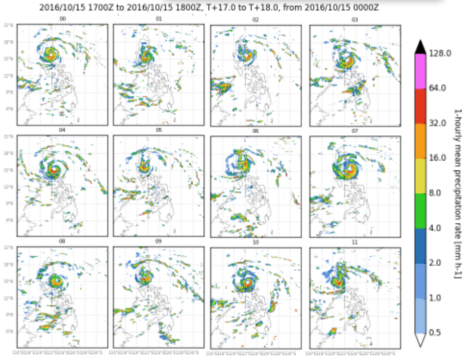


Observed track provided by PAGASA

Right: GPM IMERG (late) observations for 15/10/2016 @ 18Z



4.4KM Ensemble: Probability of wind speed at 10m >30Knots at T+18.



4.4km Ensemble @ T+18 (from 00Z 15/10/2016 run) for 1 hourly mean precipitation rate.

Charlie Pilling, Becky Beckett, Andy Hartley & WP1&2

Impact Based Forecasting training

Participants. WCSSP Project Partners that are involved in issuing impact-based warnings

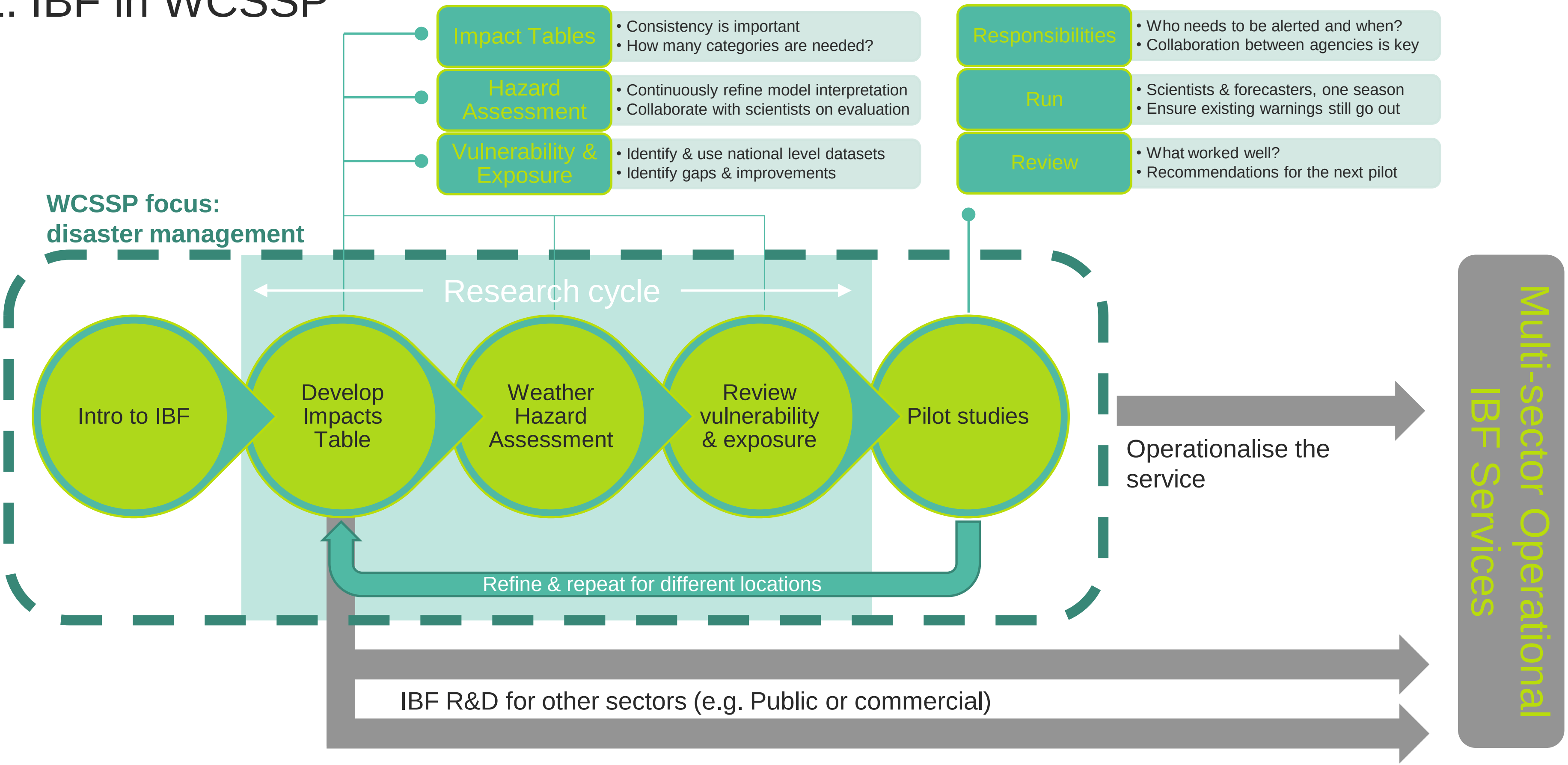
Aims. To give an introduction to impact based forecasting, and therefore ensure that all WCSSP project delivery partners involved in issuing an impact-based forecast have a consistent understanding of their responsibilities in a pilot IBF system.

Objectives. The workshop will address 3 main objectives:

1. Ensure that each institution or department has a consistent understanding of IBF, and what their responsibilities are within that
2. Creation of 'impacts tables' that describe, for a given impact, what the impacts are for different levels of warnings for different sectors
3. Create a road map for the development and trialling of an IBF system during WCSSP pilot studies

Charlie Pilling, Becky Beckett & Andy Hartley

1. IBF in WCSSP



Summary

- Realising the benefits of past and future improvements in the modelling into improved HIW forecasts
- Building stronger links between science and forecasting
- Benefits to scientific model evaluation via more systematic feedback
- Benefits to forecasting through a deeper understanding of model behaviour
- Collaboration with in-country partners through joint work & knowledge sharing

Met Office

Questions & Answers

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