Using Convection Permitting Models to Improve the Forecasting of High Impact Weather in Southeast Asia

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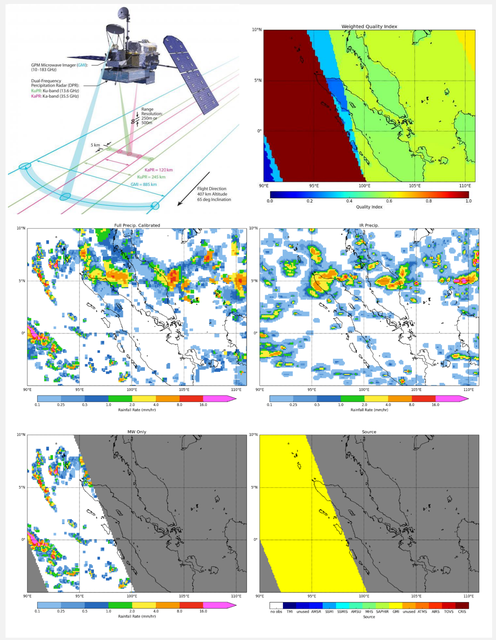
Motivation

1. To realise the benefits of advancements in the science of global and high resolution regional models for forecasting high impact weather in the Philippines, Malaysia and Indonesia.
2. To influence future model development through a combination of enhanced understanding of how models perform and closer collaboration between forecasters and scientists

Observations Research

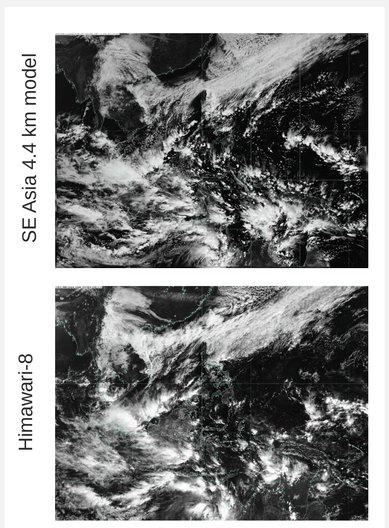
Through deeper understanding of observations used in model evaluation, we are ensuring that forecasters are able to make like-for-like comparisons between models and satellite observations



GPM IMERG

- 30 minute global precipitation estimates at 0.1° resolution
- Based on microwave imagers, dual frequency precipitation radar and geostationary satellites
- Infra-red Kalman filter weight and quality flag used to derive a quality index defined as:

IR kalman filter weight > 0 then
*QI = (100-IR%)/100 * QI*



Simulated Imagery

- Radiative transfer model (RTTOV) uses T, Q, P and Liquid/Ice Cloud fields
- Himawari-8 IR window (10.4 μm), WV (6.2 μm) and vis (0.64 μm) channels.
- Operational Global UM and SE Asia 4.4 km model fields.
- Displayed alongside corresponding 'real' satellite images.
- Allows forecasters to judge the position of features in the model compared to near-real time observations

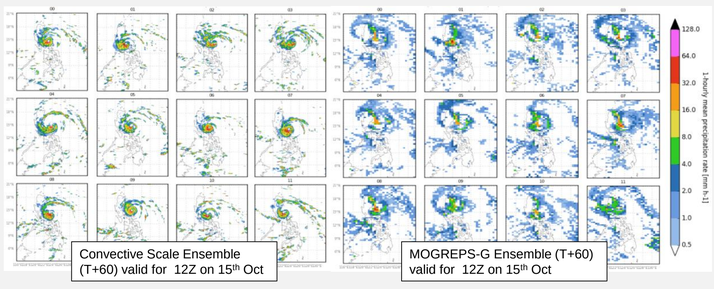
Detailed Evaluation of High Impact Weather Events

Detailed reviews of high impact weather case studies allows in-country forecasters to improve their interpretation of model performance, review action taken, and identify best practice

Philippines (Tropical Cyclone Sarika – locally "Karen")

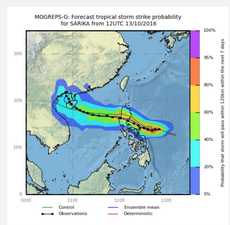
- Rapid intensification on 14th – 15th Oct 2016
- >400mm recorded on 15th Oct in Catanduanes, Luzon
- Ensemble forecast gave useful information of strike probability at T+60

GPM IMERG precipitation hourly rate at 12Z on 15th Oct



Convective Scale Ensemble (T+60) valid for 12Z on 15th Oct

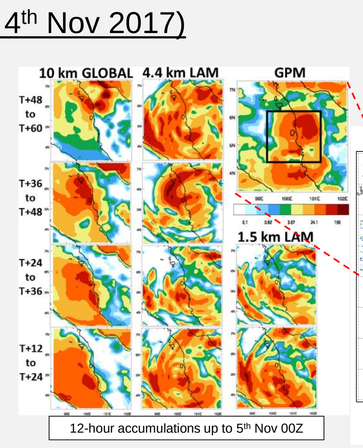
MOGREPS-G Ensemble (T+60) valid for 12Z on 15th Oct



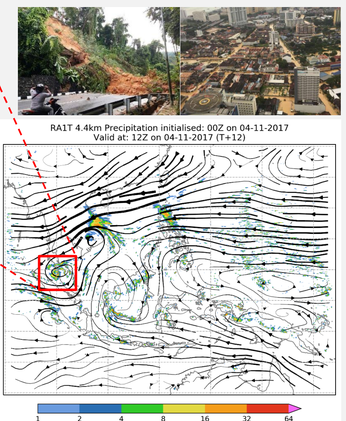
MOGREPS-G Ensemble (T+60) strike probability

Malaysia (Penang Island Flooding – 4th Nov 2017)

- Borneo vortex enhanced by interactions with equatorial westerly winds and TC Damrey
- Strong localised convergence over NW Peninsula Malaysia
- 4.4km and 1.5km convective scale models provided useful information on precipitation intensity, location and local wind circulation at T+48



12-hour accumulations up to 5th Nov 00Z

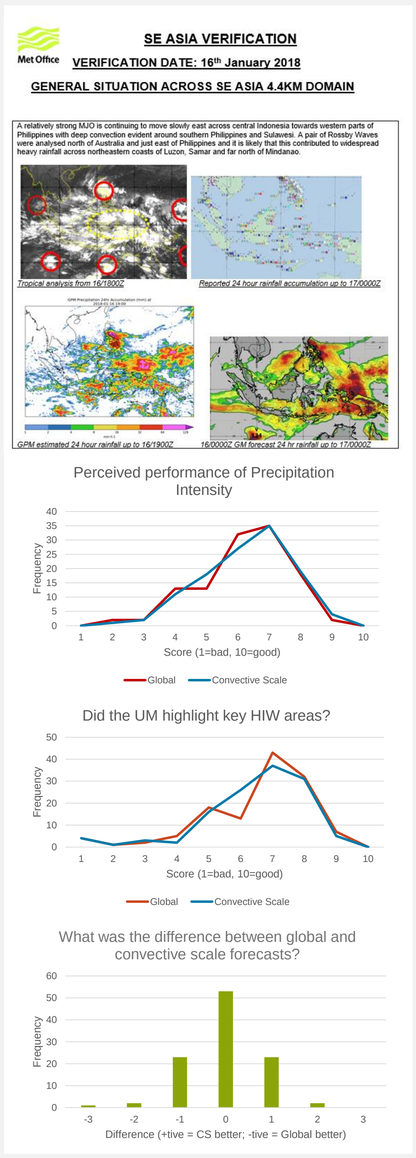


Improved Visualisation & Feedback

Interaction between forecasters and scientists is leading to improved visualisation techniques and plots of model diagnostics. Robust and quantifiable feedback from forecasters leads to forecaster-led priorities for model development

Forecaster Evaluation Survey

- Questions on previous day's forecast
- Forecasters evaluate key features such as precipitation intensity, location, propagation speed, wind speed and direction
- >150 response since May 2017
- Indicates that forecasters perceive very little advantage from convective scale models compared to global



FOREST: Forecast, Observation, and Research Evaluation and Survey Toolkit

- Runs on Amazon Web Service
- Interactive plots run server-side, allowing function over slow bandwidth
- Compares forecasts from different models
- Compares recent observations to model forecasts
- Allows forecasters to complete survey to feedback quantitative information to scientists developing the model
- Allows forecasters to easily create case studies of post-event analysis

Impact Based Forecasting

Though a series of workshops where the UK experience is shared with forecasters in SE Asia, roadmaps are being created to help each country develop their own system of delivering warnings that consider the likelihood and potential impact of a weather event

Involves:

- Workshop to introduce IBF, identify primary hazards and develop impacts tables
- Identify stakeholders and existing datasets on vulnerability and exposure
- Work with disaster mitigation sector to develop pilot studies to trial new system

Weather system	Primary	Secondary	Tertiary
Tropical Cyclone	Strong Wind, heavy rain, tornado, lightning	Storm surge, surface flooding, coastal flooding, river flooding, flash flood, fire	Landslide, water-borne diseases, infrastructure,
NE Monsoon	Cold temperatures, gale force winds	Frost, big waves	Cold weather-related illnesses, Agricultural damage (frost)

Example of Primary, Secondary and Tertiary Hazards

	Minimal	Minor	Significant	Severe
Lives & livelihoods	Minor injuries due to standing water	Non-life threatening injuries & minor accidents	Life-threatening injuries, few deaths (from water-borne diseases, vehicle & other major accident)	Large number of deaths (e.g. due to drowning, landslides, electrocution)
	Some local businesses disrupted	Major impact to local economy	Major impact to regional economy	Major impact to national economy
Residential	Discomfort	Disruption of daily activities	Danger of drowning	House completely submerged
	Furniture & some appliances wet	Furniture & appliances submerged	Partial damage due to landslide	House at risk of being swept away by running water
		Restrict access to house	Temporarily in-habitable for a prolonged period	

Example of an Impact Table for Heavy Rainfall

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