Met Office

Case Study

Enhancing preparedness and response in the Philippines

Support for the Philippines Department of Science and Technology, and its National Meteorological Service; the Philippine Atmospheric, Geophysical and Astronomical Service Administration

Challenge

The location of the Philippines means that it is subject to a range of natural hazards, including earthquakes and volcanoes. It is also situated on the typhoon belt in the north-west Pacific. This results in most of its islands experiencing periods of torrential rain, flooding, landslides, high winds, thunderstorms and related storm surges, between June and November.

Typhoons are one of the most dangerous natural hazards. They cause considerable loss of life and immense damage to property. They are also notoriously difficult to predict. The effect of these hazards was witnessed in 2011's Typhoon Pedring (internationally known as Nesat), 2012's Typhoon Pablo (Bopha), and the most disastrous storm of the century, Typhoon Yolanda (Haiyan) in 2013.

The country is usually affected by around 21 cyclonic storms each year and directly struck by five to six. To make sure society is sufficiently resilient and prepared requires the development and delivery of effective weather and climate services.

Background

In 2012 the President of the Philippines gave instructions to put in place a responsive programme for disaster prevention and mitigation in relation to natural hazards for the Philippines. His aim was to provide weather warnings to the Philippine population at least six hours ahead of a potential weather event.

In response, project NOAH (Nationwide Operational Assessment of Hazards) was launched by the Philippine Department of Science and Technology (DOST). The focus of the project was to undertake scientific research into disasters and related hazards, develop cutting edge technologies and recommend innovative information services as part of the government's disaster risk reduction efforts.

Working in partnership with the University of the Philippines, the Philippine Atmospheric Geophysical and Astronomic Service Administration (PAGASA) and other stakeholders, DOST took a multi-disciplinary approach in developing systems, tools, and other technologies to help prevent and mitigate disasters.

One of the component projects of NOAH focussed on Weather Information Integration for System Enhancement (WISE). DOST contacted the Met Office as part of this project to assist and advise on applying scientific skill and expertise in weather and climate, to enhance service delivery and ultimately ensure that people take action.

Focus of partnership

Over the last few years we have established a close partnership with DOST, which incorporates the national meteorological service, PAGASA. The partnership is built on three pillars:

1. Development and delivery of Met Office Unified Model (MetUM)[1] numerical weather prediction (NWP) products - delivering a suite of forecast products based on both the high-resolution Philippines model and operational global model forecasts for early warning systems and longer range climate predictions for climate resilience.
2. Development of MetUM seasonal forecast products – using our world leading seasonal forecasting complexity, resolution and skills to explore integration into the Philippines operational processes and research activities.
3. Human resource development – training covering short range forecasting through to long range climate prediction.

As our partnership with PAGASA evolved, we produced an innovative service, transforming what was originally a science-based proposal into the delivery of a complete modelling, forecasting, guidance and impacts service for the Philippines.

[1] The MetUM is the numerical modelling system developed and used at the Met Office for all weather and climate applications.

"Typhoons are one of the most dangerous natural hazards to people. They can cause considerable loss of life and damage to property, as we saw with Typhoon Haiyan in 2013.

Following Haiyan we have been working closely with PAGASA to help enhance its scientific and technological capabilities. Together we have created an improved modelling, forecast, guidance and impacts service for the Philippines.

When Typhoon Hagupit reached land in December 2014, many lives were saved as a result of such improved weather warnings and forecast information as well as consistent communication of the weather event to the Philippine Government. It is testament to the value of 'partnership', that PAGASA is now seeking to become a MetUM Associate, and we look forward to many years of collaboration."

Julian Menadue
Senior International Development Manager, Met Office

PROJECT CASE STUDY -
HEAVY RAINFALL PILOT PROJECT

High resolution forecasting for Greater Metro Manila Area (GMMA)

Manila is the capital of the Philippines, with a population of 12 million. The Manila metropolitan area can be directly affected by tropical cyclones and also experiences a South West monsoon that can focus thunderstorm activity over the metropolitan area, triggering widespread floods and increased risk of landslides.

Sometimes tropical storms missing Manila to the north can enhance the South West monsoon and increase its intensity. This happened in August 2014 with tropical cyclone Halong, and twice in September 2014 with tropical cyclone Kalmaegi and an unnamed tropical depression in the West Philippine Sea (South China Sea).

In all three instances we provided PAGASA with high resolution NWP outputs which meant they could be used for early warning of severe weather within the Manila metropolitan area. In each case PAGASA issued a yellow 'take action' weather warning which alerted people to the risk of flooding.

Impact based forecasts, as opposed to a general weather forecast that people have to interpret themselves, help to improve preparedness for adverse weather and protect the homes, lives and livelihoods of the Philippine population.

Benefits so far

The NWP outputs were produced to be used by PAGASA meteorologists specifically in relation to severe weather events such as the tracking of tropical cyclones.

Notable successes derived from the pilot program across 2014/15 included:

Forecasting improvements:

- Production of visualised forecasts for use by PAGASA forecasters.
- Improved forecast representation of the low pressure associated with tropical storms – assisting with forecasting storm intensity.
- Improved initialisation resulting in about a 10% increase in forecast accuracy of tropical cyclone tracks at landfall. This has pushed the timeline of forecasting tracks within a 100 km envelope out from ~24 hours to ~36 hours.
- Production of convective scale forecasting at 2 km resolution initially for use across the GMMA (see 'project case study' on page 3).
- Development of a prototype forecast model for the Angat Dam (the associated reservoir supplies the Manila metropolitan area).

Operational enhancements:

- Heightened activity during significant events, e.g. Haiyan (Yolanda) and Hagupit (Ruby), when more detailed forecast runs were produced by the Met Office including ensembles with the focus on cyclone track, landfall location/time and intensity.
- Sharing of our operational practices, including working practices and systems for forecasting and warning of severe weather, through hosting PAGASA forecasters at the Met Office head office in the UK.

A Convective Scale Modelling joint conference hosted by PAGASA at their head office in Manila. Attended by representatives from PAGASA, the Korea Met Administration, Japan Meteorological Agency, the Metro Manila Development Agency and the Met Office

Training and workshops:

- Training and workshops on the MetUM held at the Met Office in the UK for PAGASA and University of Philippines staff.
- Training on impact forecasting resulting in clearer messaging to the public and other stakeholders.
- Training on engaging with stakeholders to develop sector-specific impact forecasts.
- A joint workshop on convective scale modelling hosted by PAGASA.

Strength in partnership

The strength of our partnership with PAGASA was demonstrated when Typhoon Hagupit (locally named Ruby) hit in December 2014. It was the second most intense tropical cyclone of the year and brought high winds and heavy rain.

As the storm formed over the Pacific, we worked closely with PAGASA to predict its track and assess its intensity. The Met Office global weather forecasting model, along with other leading global modelling systems, identified the development of Typhoon Hagupit four days ahead of it making landfall. However the storm's track proved difficult to predict as different global models gave different forecasts of the typhoon's track.

"We would like to extend our sincerest gratitude for the valuable assistance that the Met Office officials and staff have given PAGASA – DOST during the passage of Typhoon Hagupit in the Philippines. The guidance documents and invaluable insights that you have provided were really very helpful and guided us to better understand Typhoon Hagupit's behaviour and validate our forecast. This heightened our capacity to assess the different models and provided the opportunity to enhance our capability in weather forecasting."

Dr Vicente Malano
PAGASA Acting Administrator
10 December 2014

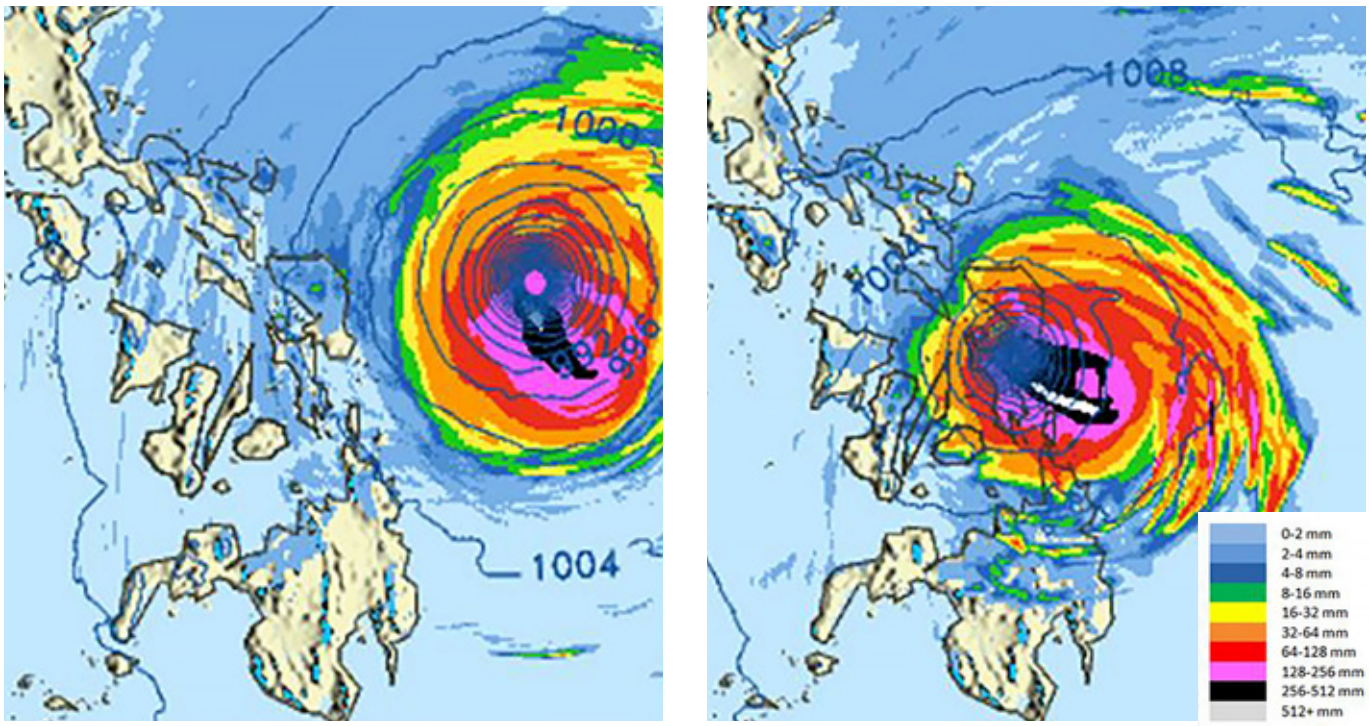

Figure 1: T+72 hour forecast of 12 hour precipitation accumulations of a more northerly slow moving track (left) and a more southerly fast moving track (right) from 15Z 07 December 2014.

As it became increasingly clear that Typhoon Hagupit was a significant threat, we undertook additional, more detailed model runs. These included high-resolution ensemble outputs which enabled some level of confidence to be applied to the expected landfall time and location. Attention was focussed on the variance between a slow moving and a fast moving track of the typhoon towards the Philippines (figure 1), and the related impacts of each.

These more optimised forecast outputs were made available to PAGASA and were used to complement other data sources in the delivery of early warnings and advice from PAGASA to the Philippines Government and the wider population.

On December 6, Hagupit made landfall in the Philippines, then tracked across the country passing south of the capital Manila. Throughout the development and passage of the storm we also provided relevant and timely advice to decision makers within the UK's Department for International Development and Foreign and Commonwealth Office. This advice was used by UK Government to support decision making on the early deployment of humanitarian assistance.

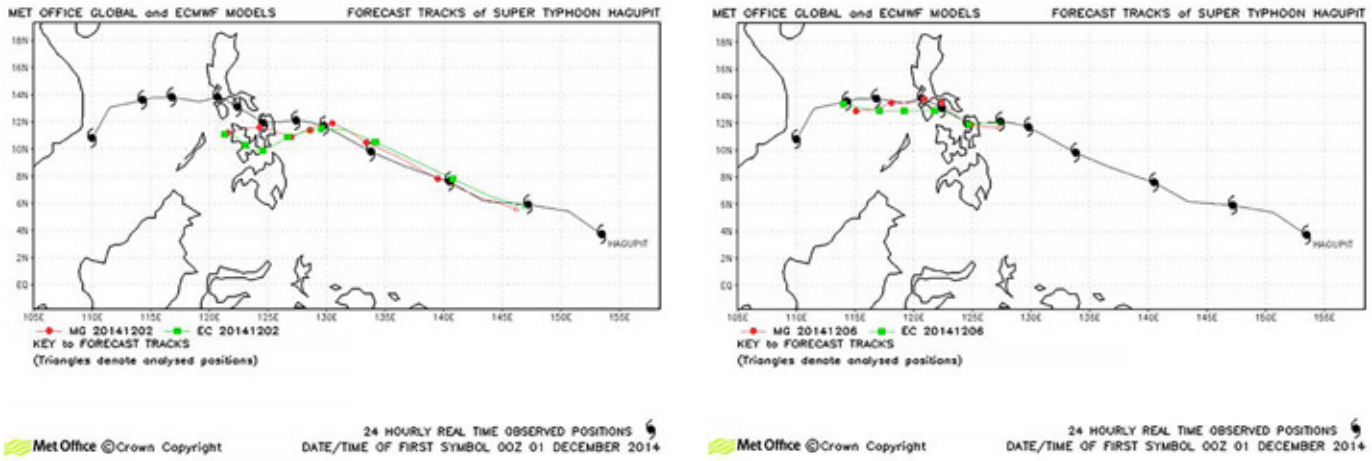

Figure 2: Actual (black) and forecast storm tracks from the Met Office (red) and European Centre for Medium Range Weather Forecasts (ECMWF) (green) from 00Z 02 December 2014 (left) and 00Z 06 December 2014 (right).

Recent model improvements

Tropical cyclones are notoriously difficult to predict. But recent improvements to the Met Office forecasting model and our partnership with the Philippines are helping improve forecast accuracy and mitigate what can be devastating impacts.

In December 2013, Typhoon Yolanda (Haiyan) wreaked havoc across the Philippines, leaving over 6,000 people dead and millions displaced. It was one of the most powerful tropical cyclones ever recorded.

While the storm's track was predicted accurately using a global forecasting model, its intensity was underestimated. This is an issue for any global model; while their resolution is improving as increased computer power becomes available, it's still not enough to replicate the conditions at a tropical cyclone's typically compact centre, where winds can reach 190 mph and pressure as low as 900 millibars.

In July 2014, we implemented major improvements to our global model. As well as improving tropical cyclone intensity predictions, tracking predictions also improved by almost nine percent.

An even more recent change has taken advantage of the observational estimates made by tropical cyclone warning centres around the world. Assimilating this data into the global model has improved tracking predictions by another six percent. We are also testing a high-resolution regional model using a fixed domain over the Philippines. With increased supercomputing power in the near future, this regional model will be implemented in real-time over every tropical cyclone that's occurring at any one time.

Met Office and PAGASA partnership - key dates

SEPT 2011
Typhoon Pedring (Nesat)

PRE 2012
Met Office contact with PAGASA via WMO and PRECIS*

JULY 2012
Launch of project NOAH

DEC 2012
Typhoon Pablo (Bopha)

NOV 2013
Typhoon Yolanda (Haiyan)

NOV 2013
UK Aid humanitarian assistance

UKaid
from the British people

*PRECIS - Providing REgional Climates for Impacts Studies
- regional climate modelling system from the Met Office Hadley Centre

Building climate resilience

The partnership between PAGASA and the Met Office was still in its formative stage in 2013 when Typhoon Yolanda (Haiyan) hit the Philippines with such devastating consequences. The UK government immediately provided humanitarian support funded by UK aid, followed up with a technical assistance programme to help recovery and reconstruction in the Philippines. One component of this programme is 'building resilience to climate extremes', which is being managed by the Met Office in partnership with PAGASA.

The project running across 2015/16 involves:

- stress-testing reconstruction plans against current and future weather and climate risks;
- capacity building within PAGASA for weather forecasting and disaster resilience; and
- support to run new high-resolution climate models and translate weather information into hazard warnings for contingency planning.

A central component of this project is the generation and analysis of high-resolution future climate simulations, using a regional climate model developed by the Met Office Hadley Centre. The simulations will provide insights into the variable and changing nature of typhoons and other significant climate extremes in the Philippines.

The new climate data will be shared with stakeholders, industry and partner agencies involved in hazard and risk mapping. The project will feed risk information into new and existing risk mapping platforms. This will inform decision makers and provide a comprehensive understanding of future climate-related risks. The model simulations and analysis will also contribute to broader regional climate modelling programmes in the Philippines as well as South East Asia more widely.

Next steps

Working closely with PAGASA has and will continue to produce further developments in the messaging of both weather impacts and climate projections to the Philippines stakeholder community and its population at large.

Following on from the WISE project, the Met Office and PAGASA have continued to collaborate, and, in early 2016, PAGASA announced its plans for an integrated High Performance Computer (iHPC) project. This will see the installation of a Cray XC40 supercomputer within a newly furbished data centre at PAGASA's Head Office in Manila.

Following on from the success of the initial NWP project, the Met Office's role within the iHPC project is to supply, install, support and provide research and development services on the Met Office's Unified Model (MetUM), which will lead to PAGASA becoming a MetUM associate.

DEC 2014
Typhoon Ruby (Hagupit)

JUNE 2014
Start of MetUM NWP Project: development phase for introduction of MetUM

JAN 2015
UK Aid technical assistance on climate resilience

UKaid
from the British people

JULY 2015
Start of transition phase for introduction of MetUM

FEB 2016
Start of integrated iHPC project and installation of the MetUM at PAGASA

Who we are

The Met Office is a global centre of excellence in weather and climate science, and the UK's national weather service. Founded in 1854, the Met Office pioneered weather forecasting. Ever since then we have been at the forefront of developments in weather and climate science.

Our international development work

We draw on our scientific and operational strengths to offer practical advice and specialist consultancies. Our wide range of skills and expertise enables us to support countries around the globe in developing and enhancing their weather and climate services.

What makes us different?

As an international organisation, we are exposed to many challenges and have a reputation of meeting and exceeding expectations. Our strong track record includes:

- experience of working in over 150 countries;
- a pool of internationally-experienced specialist staff;
- World Meteorological Organization (WMO) accredited training;
- a thorough understanding of how weather and climate are linked to development goals and policies;
- design of impact-based forecasting for WMO policy;
- supercomputing capacity for sophisticated modelling;
- developing one of the most accurate regional meteorological models in the world, now adopted by Australia, South Africa and South Korea.

To find out more:

+44 1392 885 680

internationaldevelopment@metoffice.gov.uk

@metofficeww

Find us on LinkedIn