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DNV GL – ENERGY – RENEWABLES ADVISORY

Assessment of Extreme Wind Speed in cyclone Regions

Christian Peake

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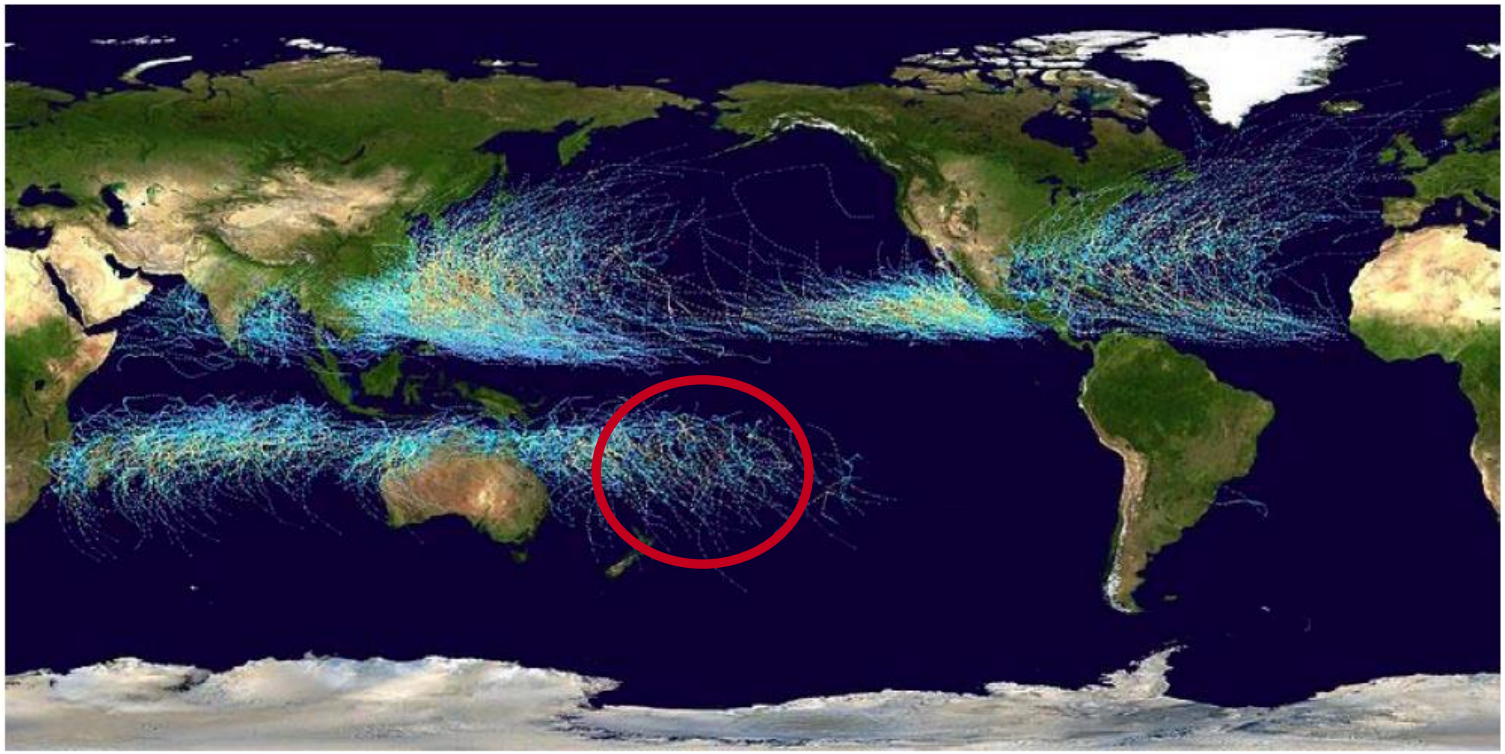
Introduction

- **DNV GL** – formerly know as – **Garrad Hassan**
  - The world's largest dedicated renewable energy consultancy.
  - Independent technical and engineering services, software products and training in onshore and offshore wind, wave and tidal and solar PV and CSP.
  - Now a part of DNV GL after a recent merger, bringing together over 3,000 energy experts world wide

- Christian Peake
  - Manages the Energy Team in the Pacific Region – Pre-construction and Operational Energy Assessments.
  - Joined Garrad Hassan in 2001 in Melbourne, Australia.

Tropical Cyclones

Also know as Cyclones, Typhoons and Hurricanes



It’s just a storm…

Chinese typhoon knocks out 17 wind turbines

CHINA: Eight wind turbines have blown down by typhoon-strength winds in south China's Guangdong Province.

Typhoon Usagi, the most powerful this year, also broke off blades of another nine wind turbines when it hit the Honghaiwan Wind Farm in coastal Shanwei City, Guangdong.

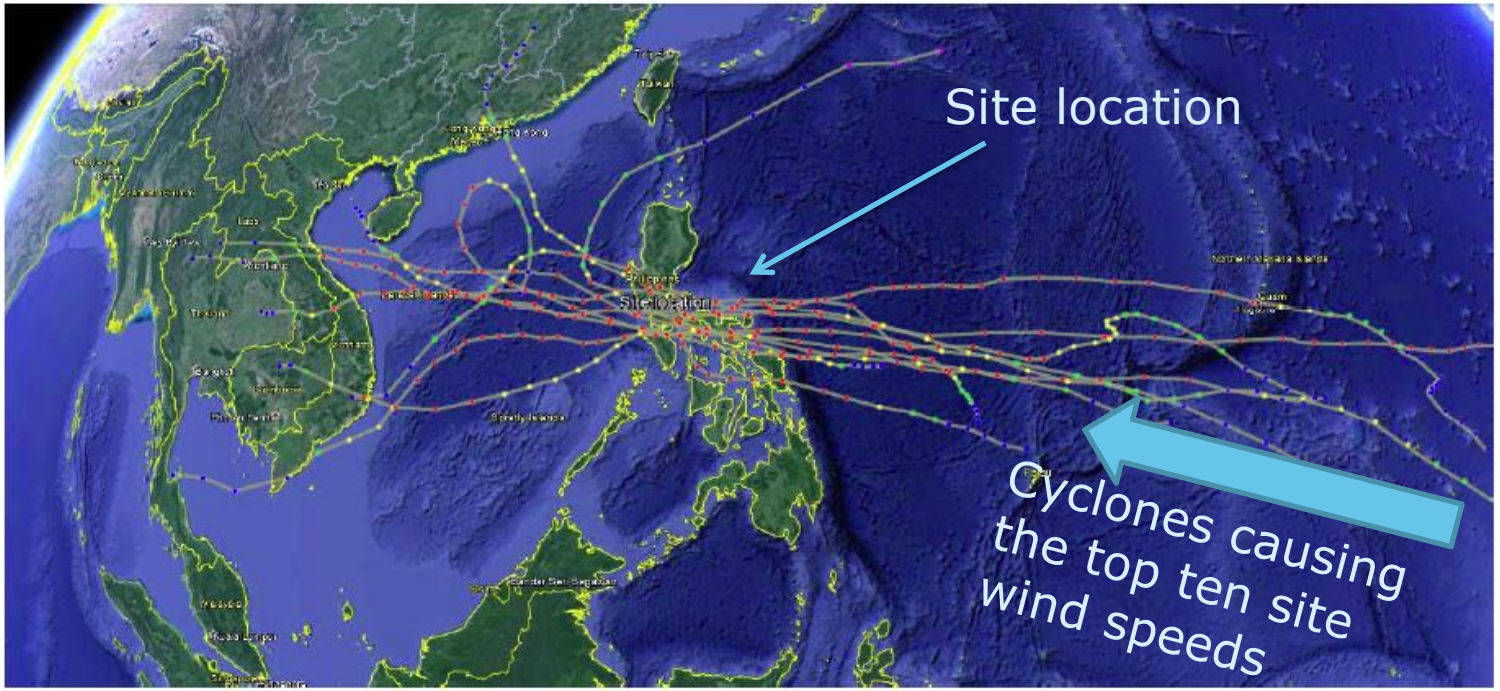
According to Windpower Intelligence, Honghaiwan consist of 25 imported Vestas V47 600kW turbines. The remaining wind turbines need maintenance to see whether they can operate normally.

According to the manager of the wind farm, the typhoon has led to nearly CNY 100 million ($16 million) loss to the wind farm. The wind farm was hit by a similar typhoon in 2003, with 13 out of 25 turbines damaged causing 10 million yuan loss.

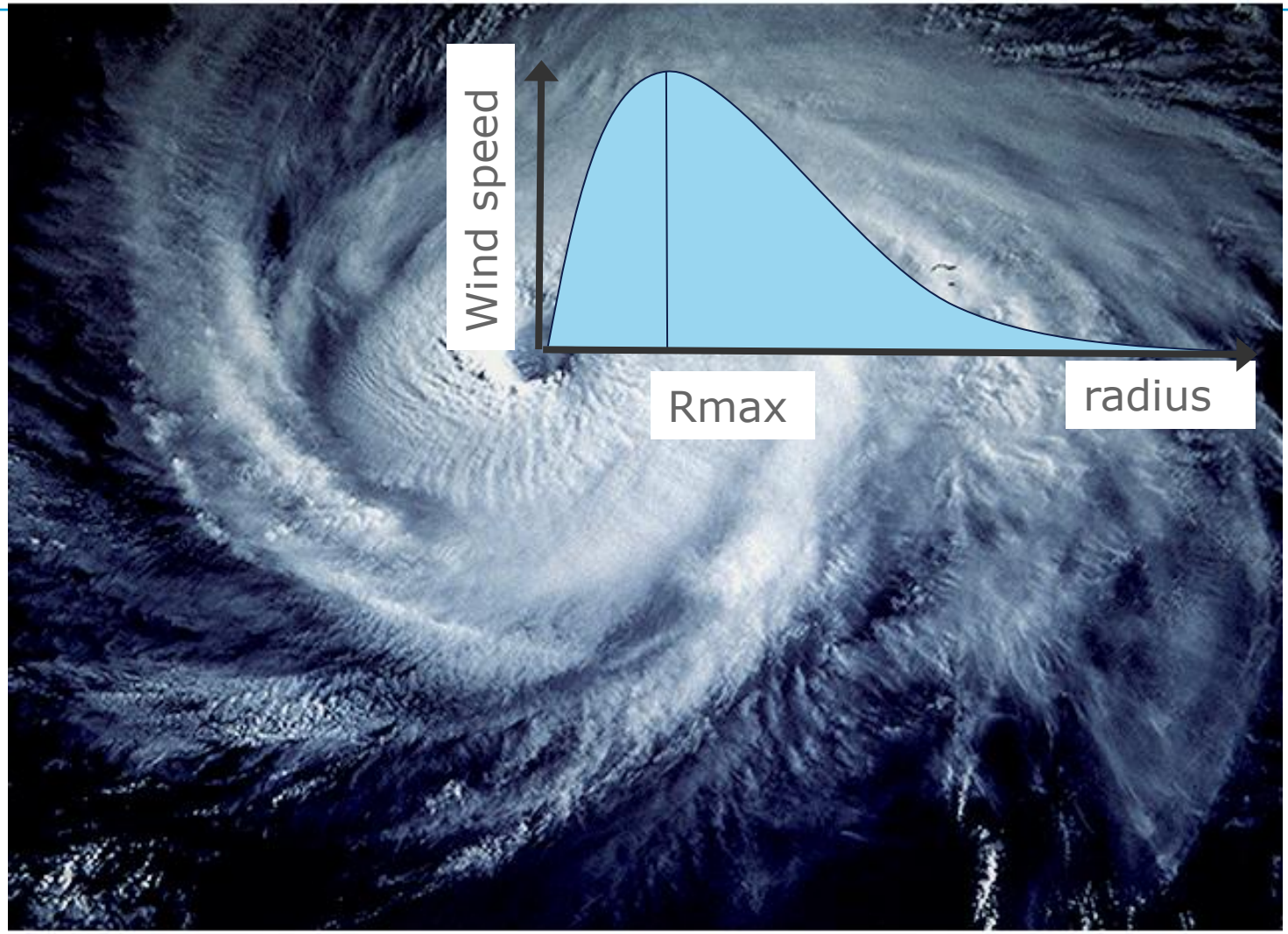
The wind farm was developed by Guangdong Jihua Wind Energy Company in 2000 in Honghaiwan (Honghai Bay). The first stage project went into operation in 2003, totaling 16.5MW. It was expanded with another 20.4MW in 2004.

DNVGL Assessment of extreme wind speed

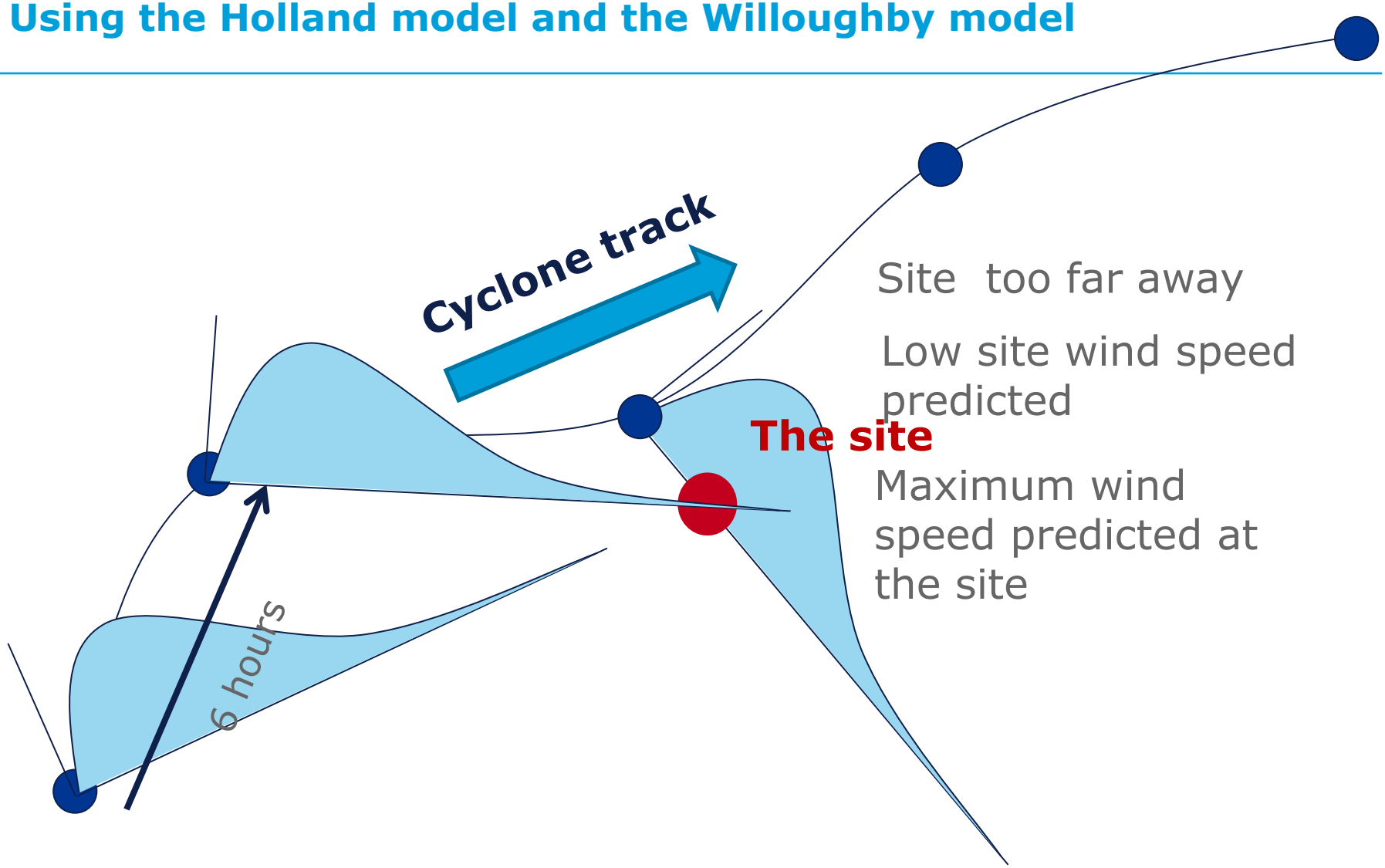
Based on Cyclone track data recorded by the Japanese Meteorological Agency (JMA)



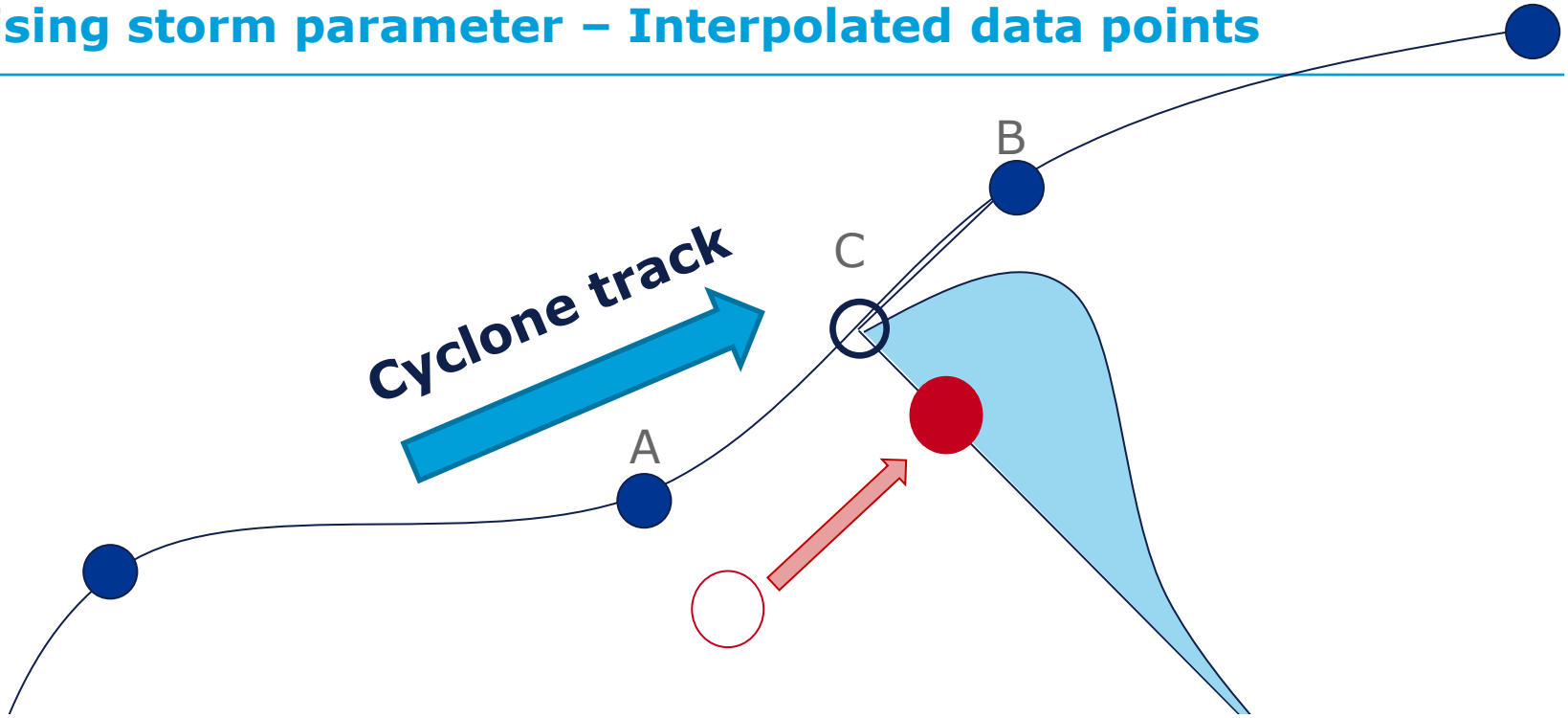
Radial velocity profile



Using the Holland model and the Willoughby model



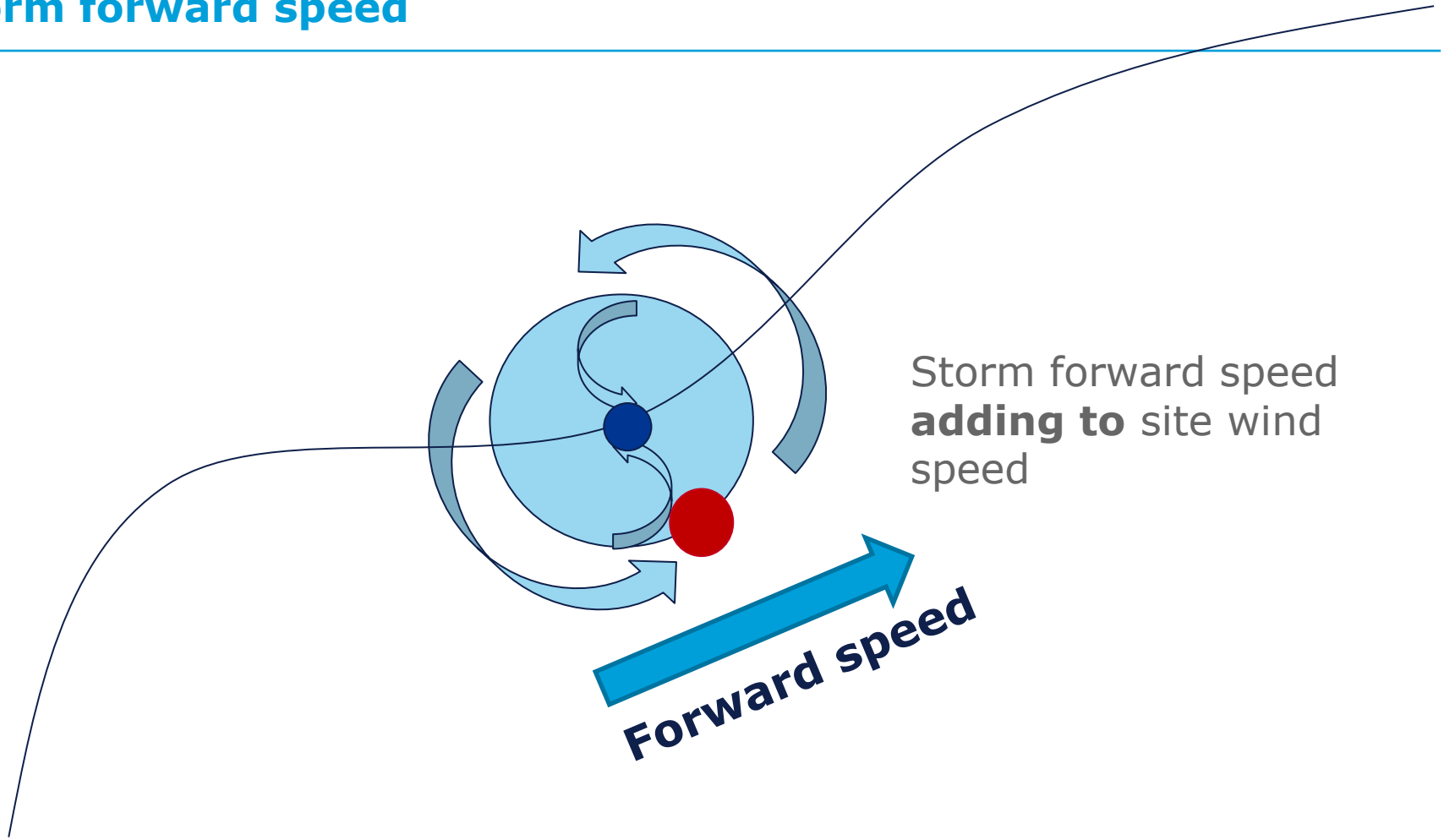
Optimising storm parameter – Interpolated data points



Interpolated data points optimised to get maximum site wind speed considering:

- Location;
- Change in storm maximum wind speed;
- Change in pressure;
- Change in temperature; and
- Change in storm size.

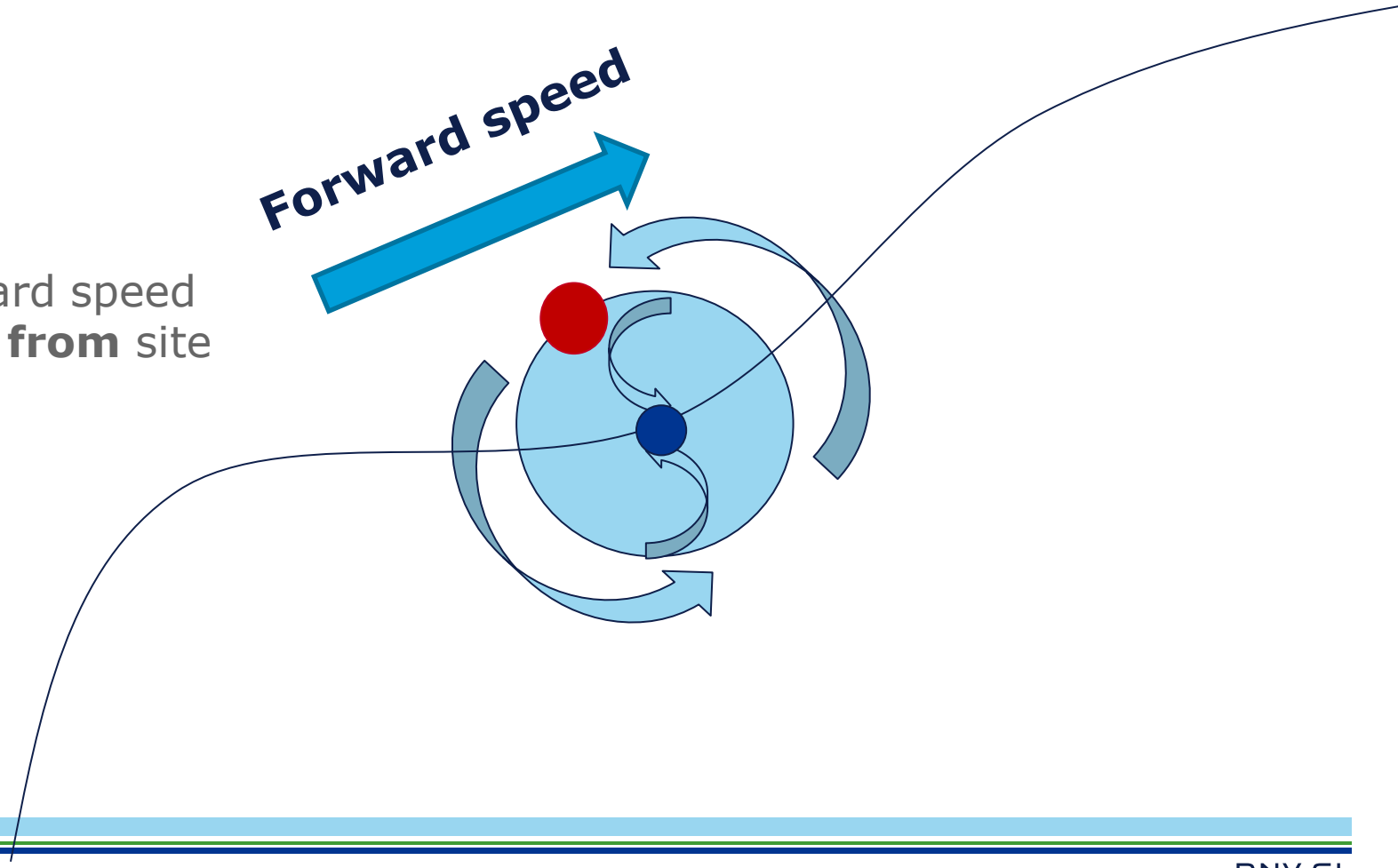
Storm forward speed



Storm forward speed **adding to** site wind speed

Storm forward speed

Storm forward speed **detracting from** site wind speed



Assessment of the 50 year extreme wind speed

Summary of methodology

- Obtain cyclone track data over the region where the site is located.
- Interpolation of data between the 6 hour data points to optimise all storm parameters, not just distance to the site.
- Application of a cyclone velocity profile to predict site wind speed.
- Take account of the forward speed of the cyclone.
- Gumbel assessment to estimate the 50 year wind speed.

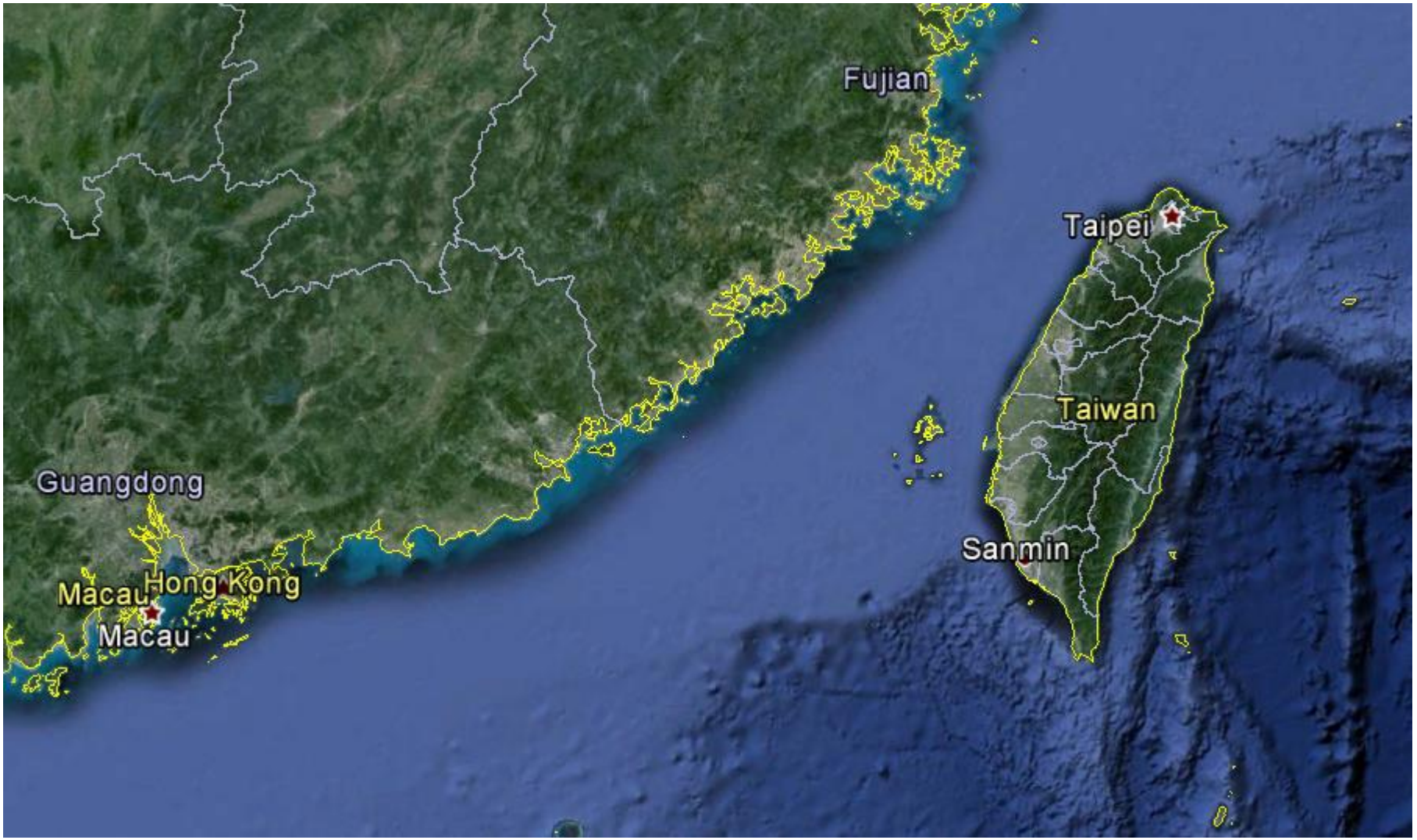
Further site specific analysis required – 10m, 10min, over ocean

- Gust factor – convert from 10min to 3 sec gust,
- Wind shear – assessment of hub height extreme wind speeds?; and
- Terrain multiplier – is the site on a steep slope? – Possibly CFD analysis can add value.

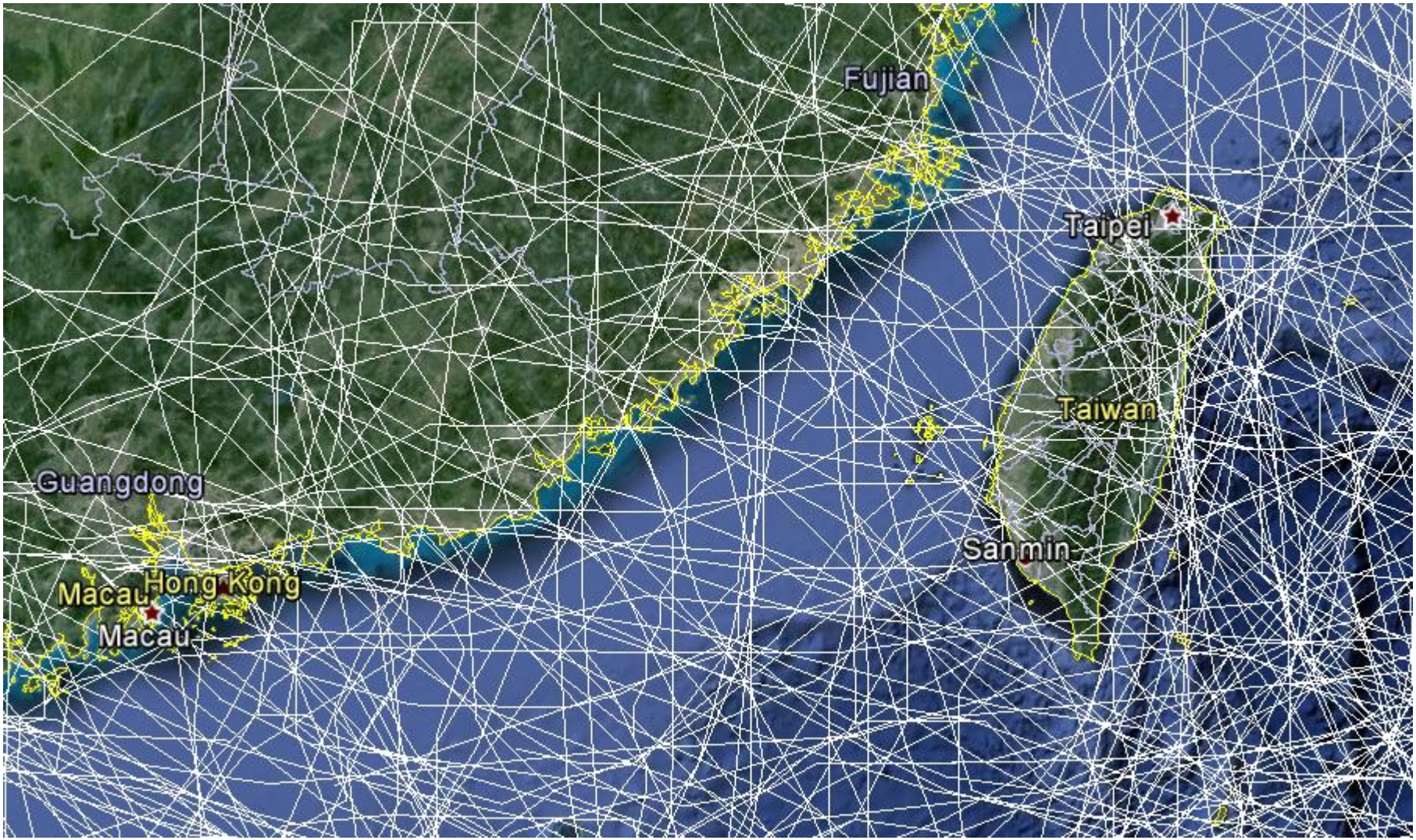
Site data and building codes

- Finally, don't forget the assessment of site wind data and local building codes – these should still be considered.

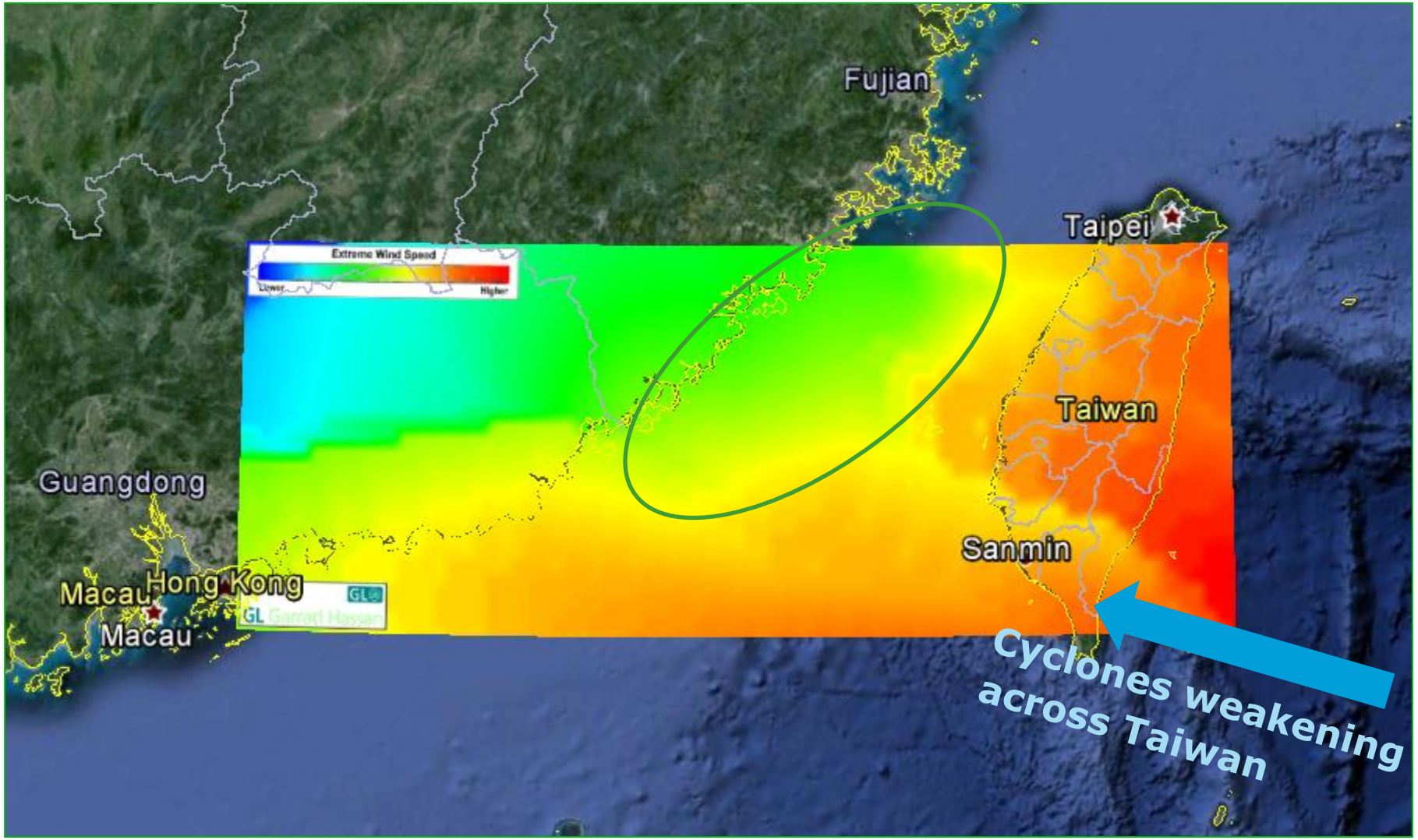
A recent development - Extreme wind maps



Extreme wind maps - 36 years of storm tracks from the JMA



Extreme wind maps



Concluding remarks

Cyclone risk should be considered when;

- Developing;
- Buying; and
- Investing in Wind Farms.

Site specific assessments should be conducted for turbine design and site suitability

Extreme wind maps are a new area of development

Questions?

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