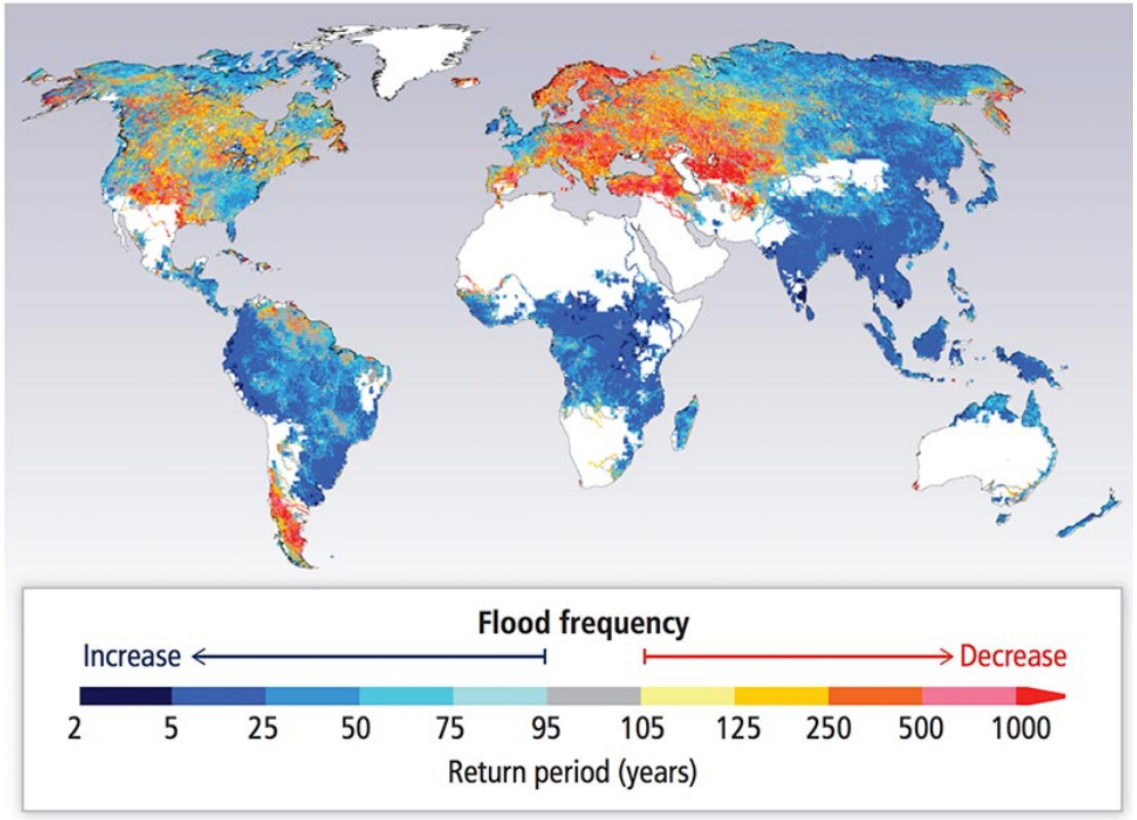
Asia Water Forum 2022
8–11 August 2022 • Online

Focus Area: Climate change and water-related risks

Session Title: Real-time radar rainfall estimation and nowcasting system in urban areas

Schedule: [11 August 2022 | 9:00 a.m. – 10:30 a.m. (GMT+08)]

Climate change & urbanization affect the flood frequency and its magnitude



The map above presents the global flood risk from rivers at the end of the 21st century. The research team used eleven climate models to calculate how floods with a discharge magnitude of a 20th century 100-year flood may occur in the 2080s. Areas of darker blue have a higher probability (lower return period) of a 20th century 100-year flood occurring within a given year. So, instead of these century floods occurring 'once every 100 years' (with a 1% chance of annual occurrence), they may turn into 'decade' or 'half-century' floods (every 10-50 years; with a 10%-2% chance of annual occurrence).

ADB

https://www.publichealthpost.org/databyte/global-flood-risk-under-climate-change/

Climate change & urbanization affect the flood frequency and its magnitude

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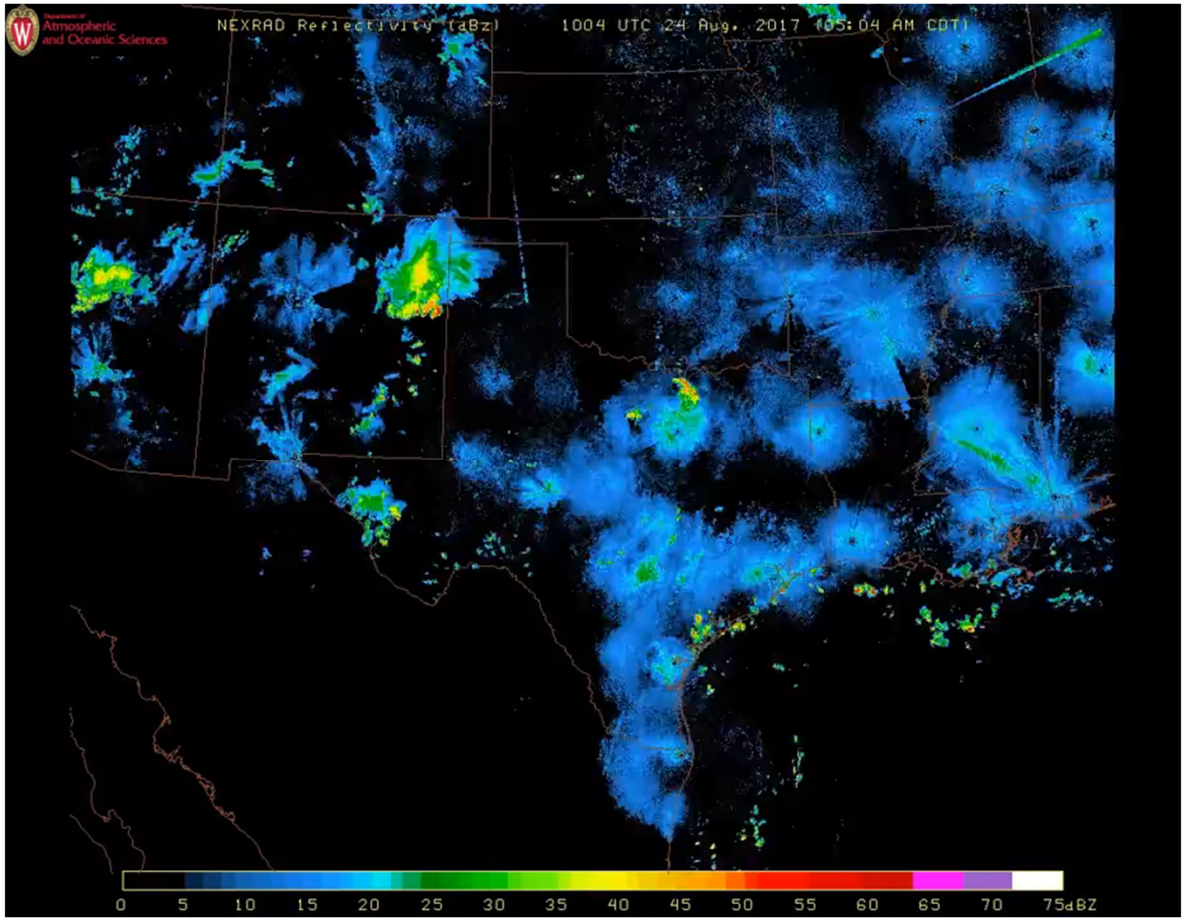
Rainfall events in the tropics are highly localized

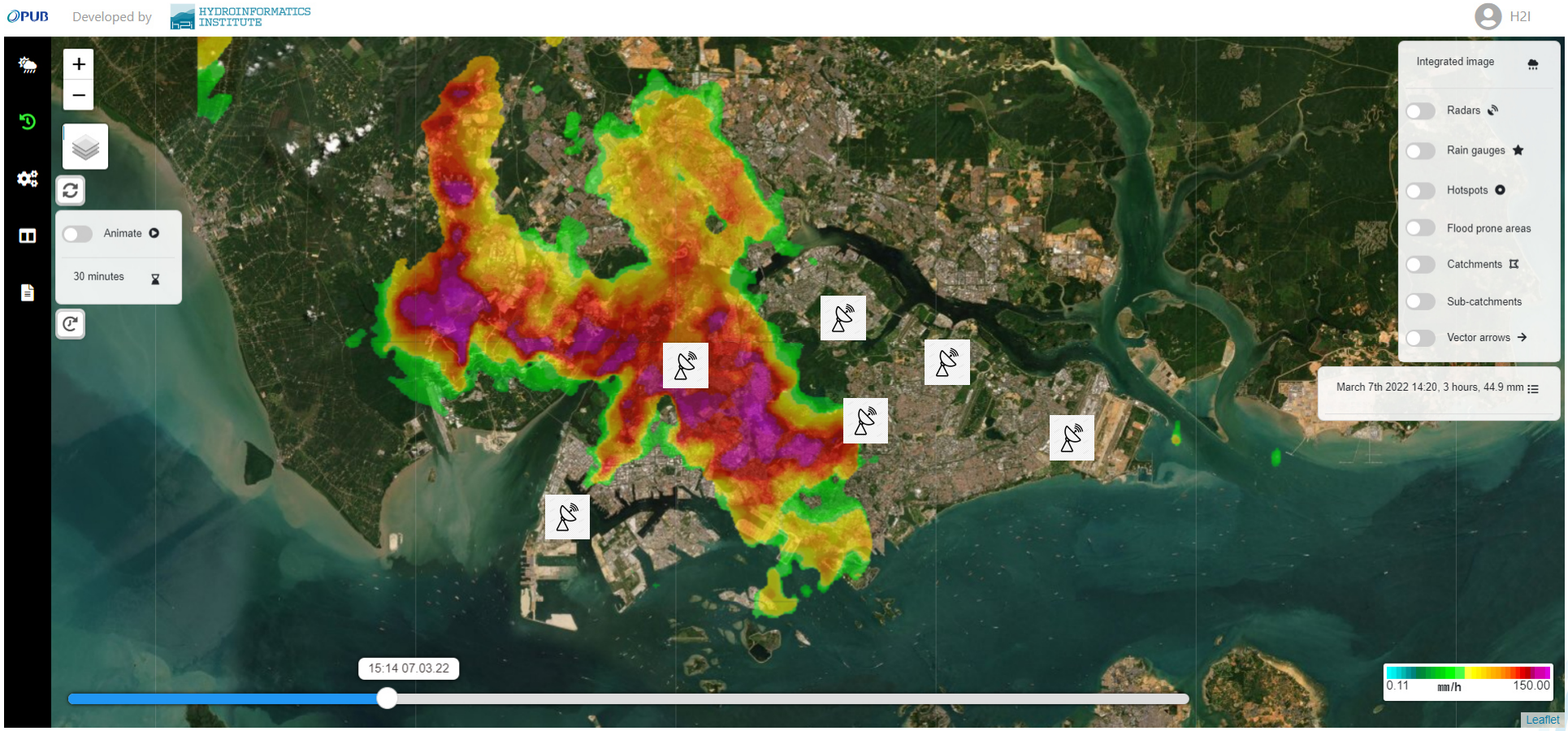
Urbanization pictures: https://justsomething.co/before-and-after-world/

Weather radars provide spatio-temporal distribution of rainfall in real time

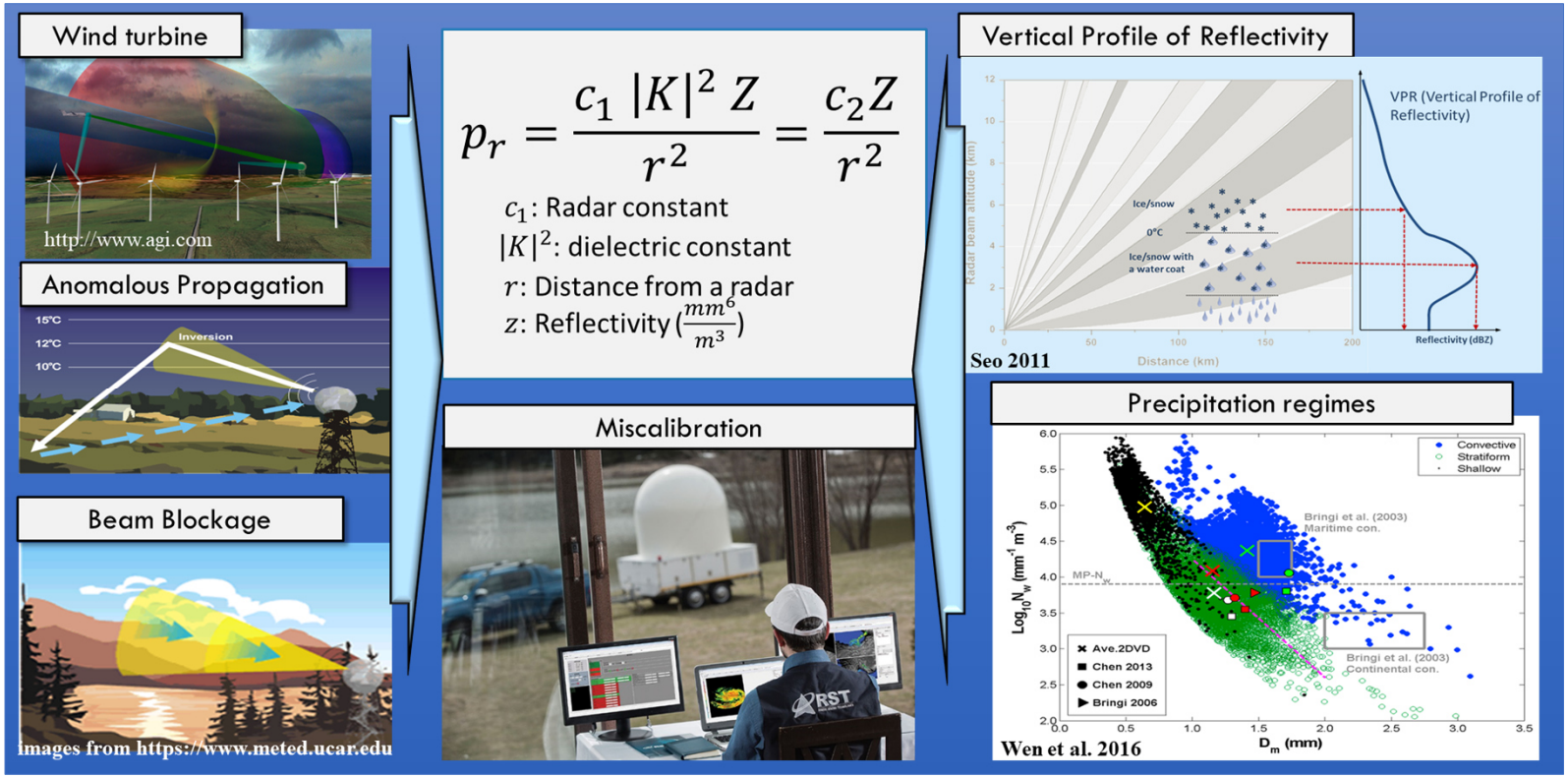


Real-time rainfall monitoring system in urban areas based on X-band radar network

- Spatial and temporal resolution: 100 meter, 2 minute

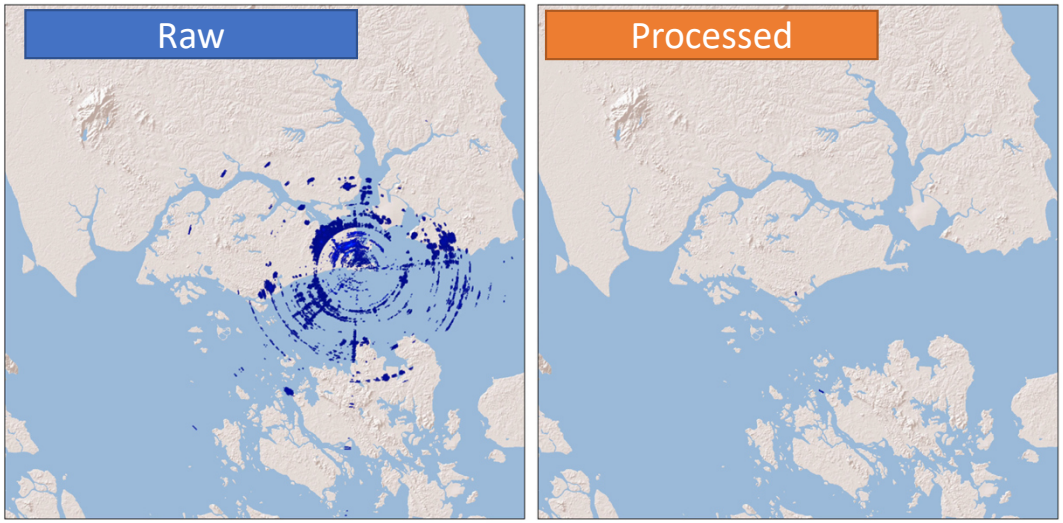


Various uncertainty sources affect radar rainfall estimation accuracy

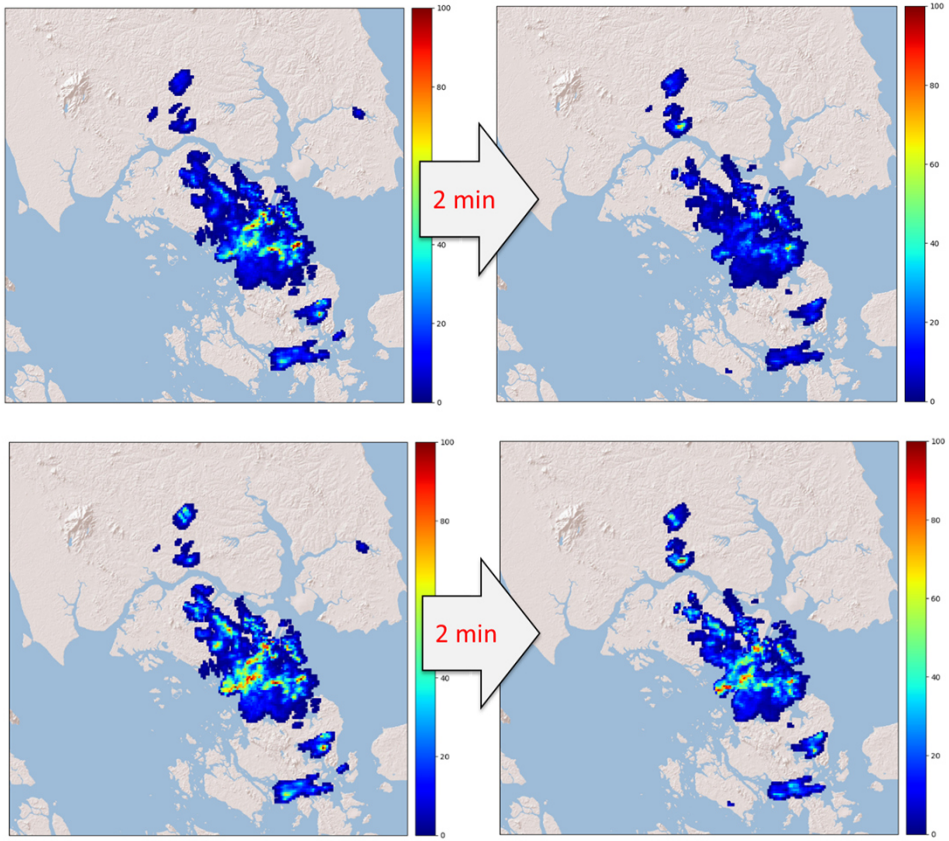


Weather radars provide spatio-temporal distribution of rainfall in real time

- Removal of non-precipitation echoes with more than 99 % accuracy



- Estimation error reduction by 35 % on average



Radar-based rainfall prediction outperforms Numerical Weather Prediction (NWP) model

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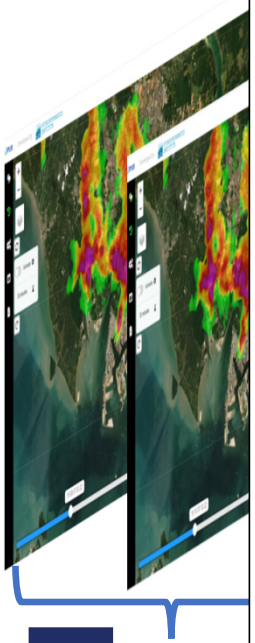

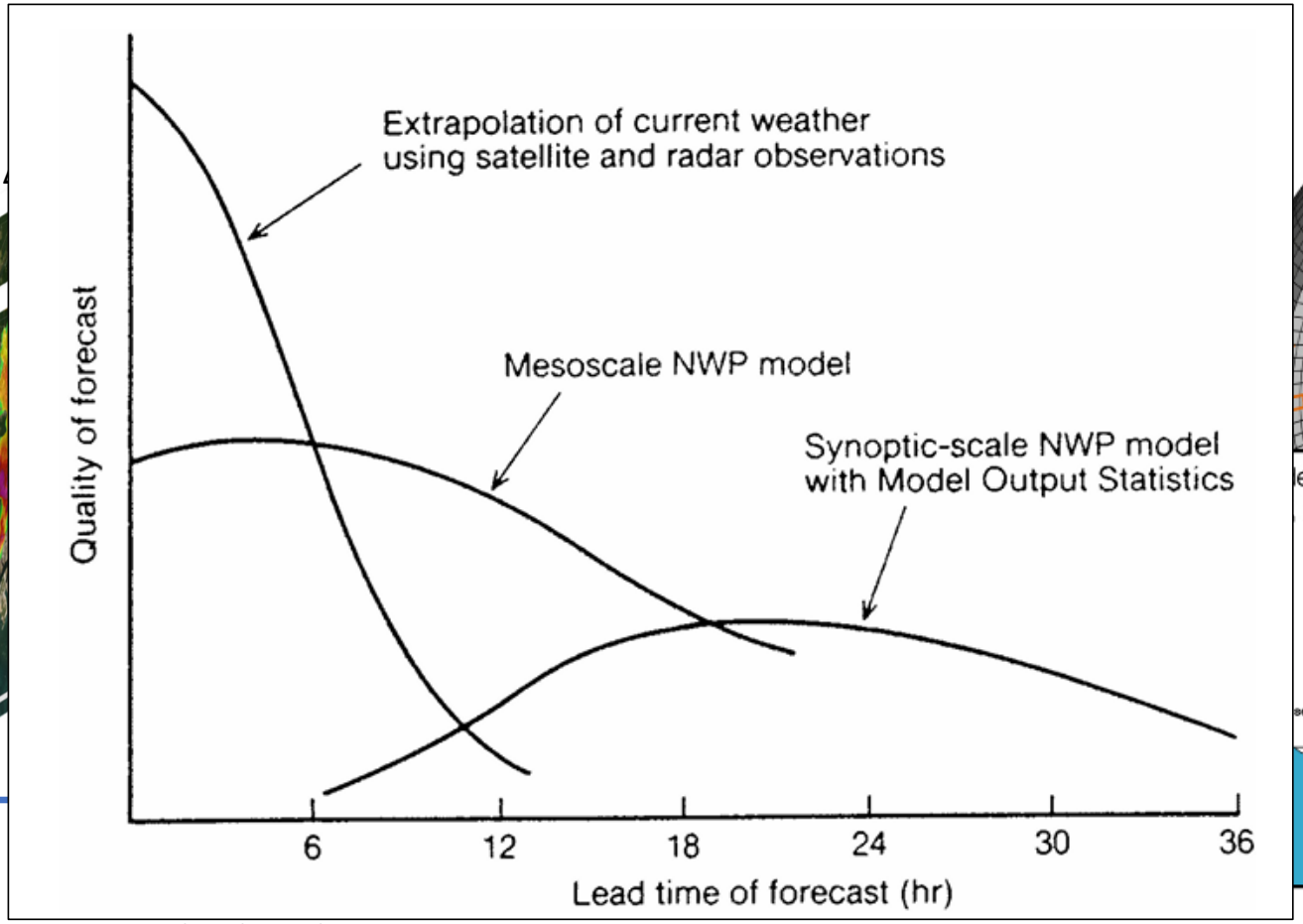

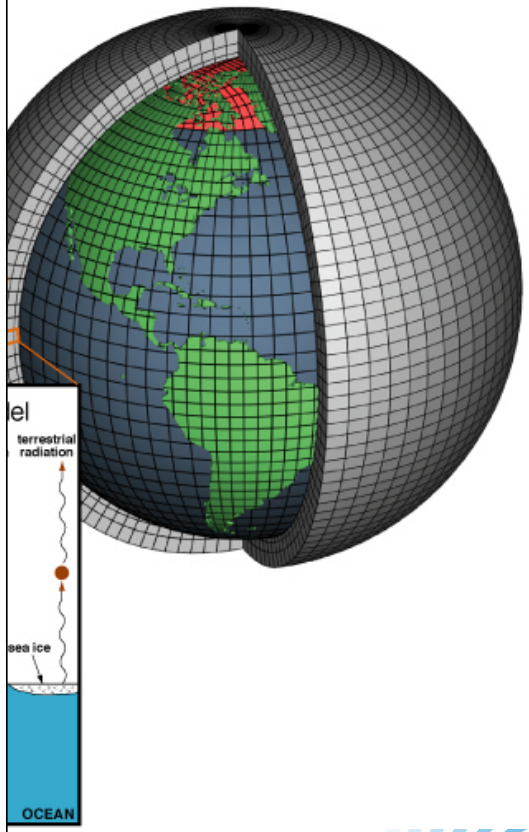

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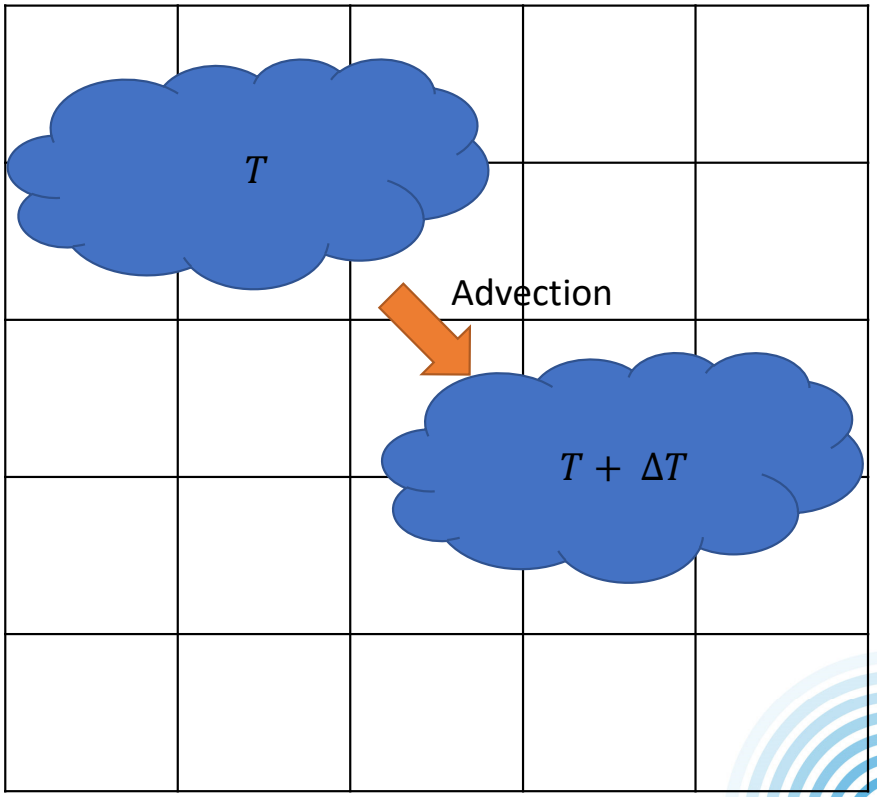
http://cdn.intechopen.com/pdfs/35109/InTech-Nowcasting.pdf

General radar-based nowcasting model structure

Advection vector computation

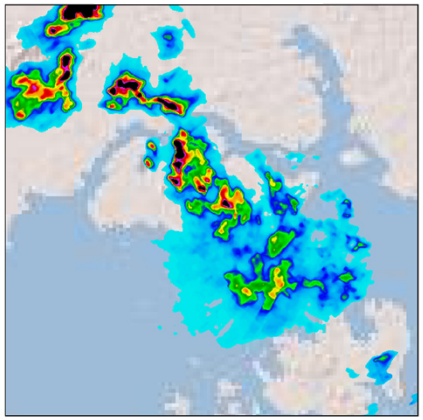
https://nanonets.com/blog/optical-flow/

Lagrangian persistence

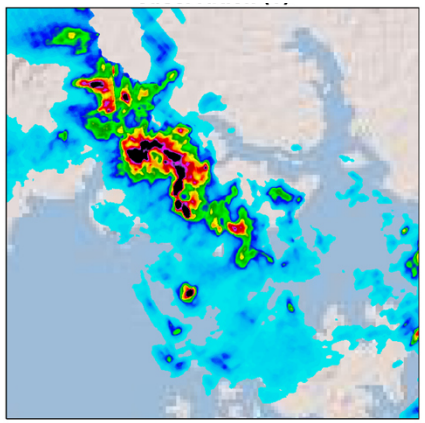


Nowcasting performance at 30 min lead time (500 meter resolution)

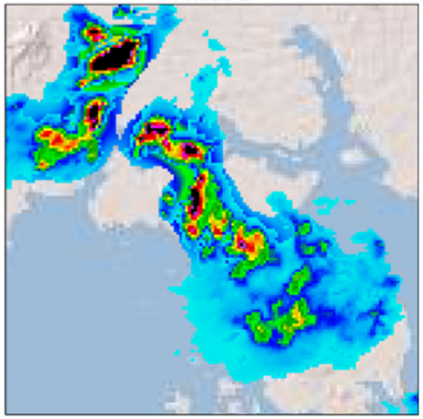
Observation (T)

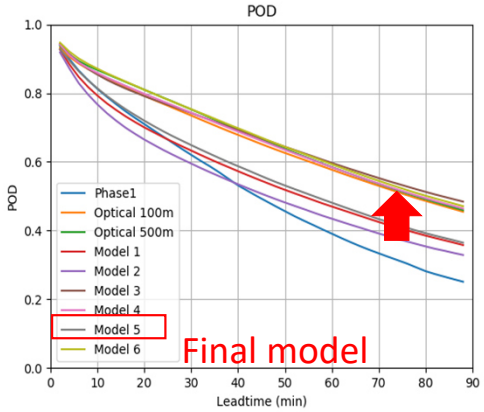


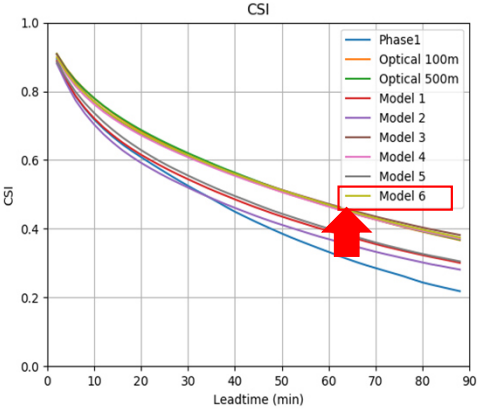
Observation (T+30min)

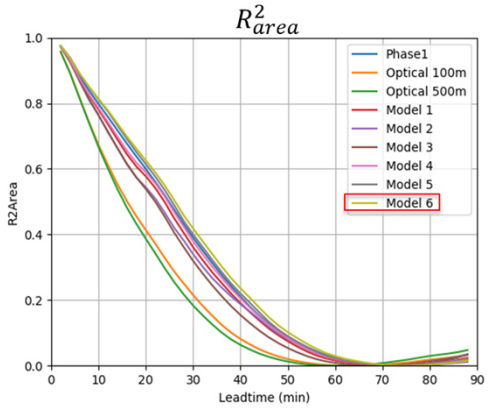


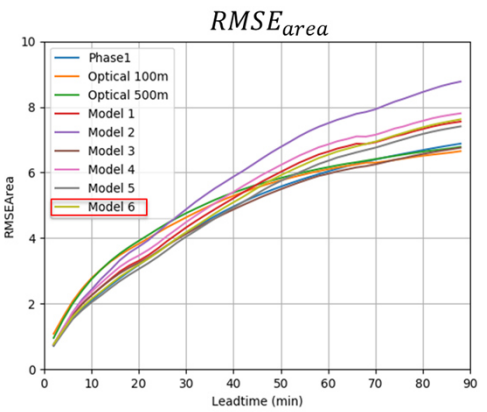
Forecast (T+30min)











Conclusions

- Weather radar can capture high spatio-temporal variability of rainfall
- In urban areas, X-band radars could be a better solution than C-band and S-band radars due to their smaller size and therefore easier cite selection for the installation
- Beam blockage and attenuation effects can be mitigated by using dual-polarimetric radar rainfall estimation algorithms and using a radar network
- Ideally, multiple radar observations at a location can reduce uncertainty in radar rainfall estimation

- Radar-based nowcasting provides a good accuracy for rainy area forecast
- Accurate quantitative rainfall forecast is still challenging, especially in the tropics where convective storms are dominant of which variability in space and time is significant
- The detection of convective storm initiation is also challenging