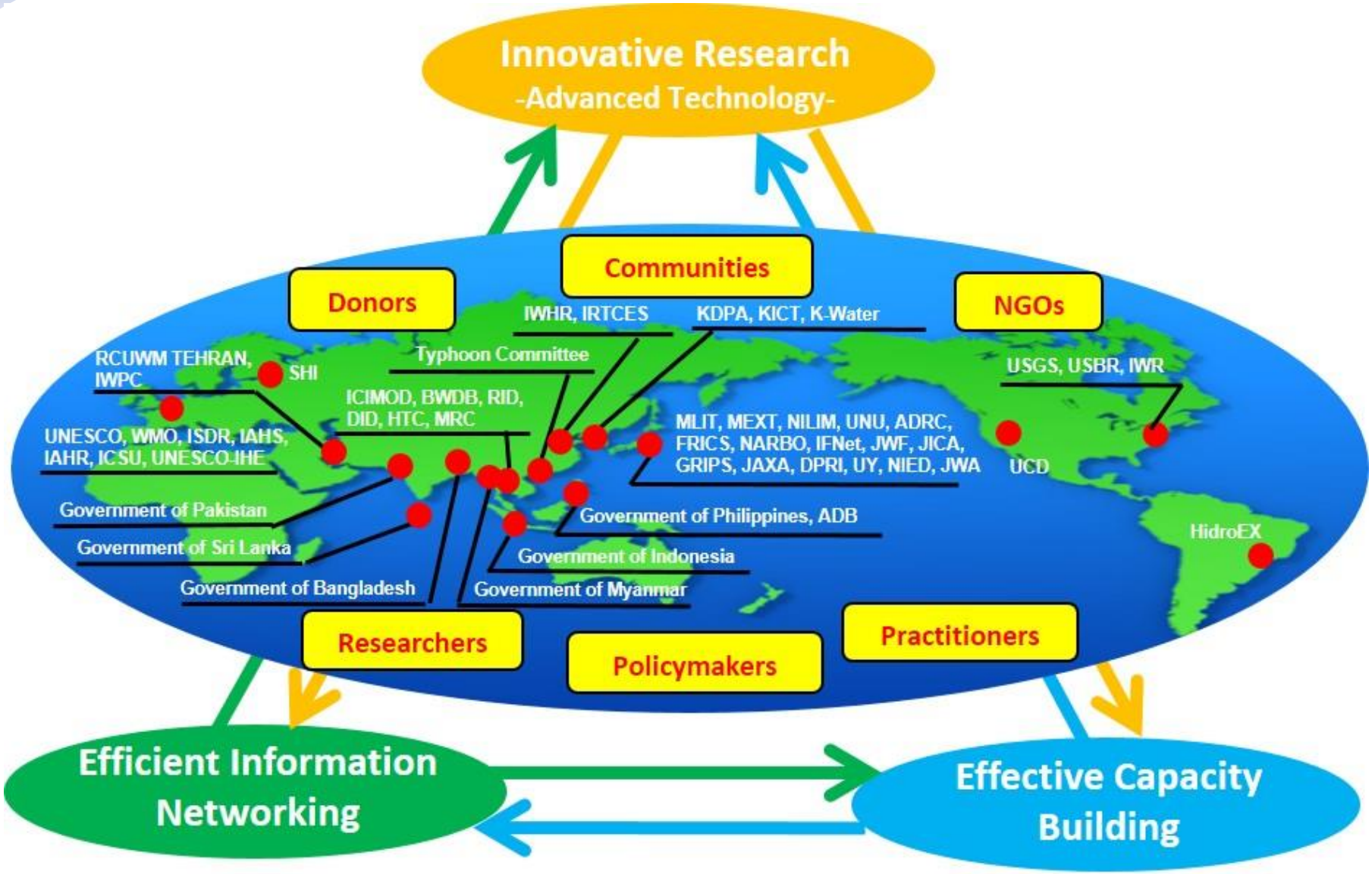
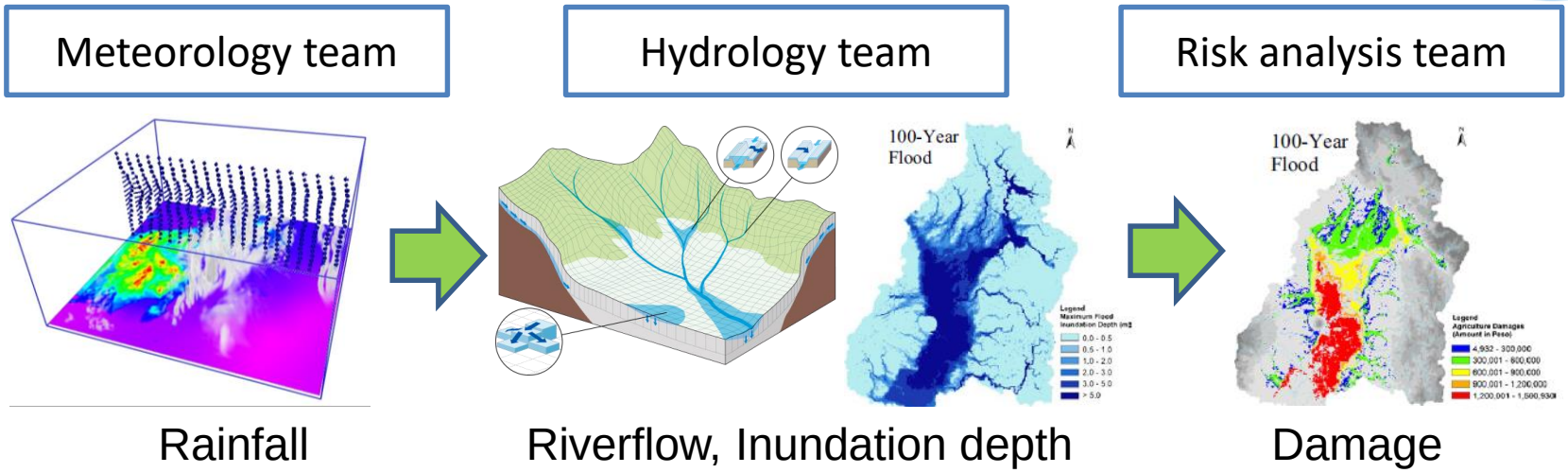
Three Pillars of ICHARM Activities





- Flood forecasting system
  - Regional ensemble prediction system (Event base study, Power generation dam operation)
  - Realtime rainfall/flood forecasting (SriLanka, Iran)
- Water resource management system
  - Seasonal forecast + water and energy budget hydrological model (Brazil, Tonegawa, Srilanka)
- Climate change effect
  - Flood/drought risk change by global warming. Dynamic downscaling of climate model projections (Philippines, Indonesia)

Frequency of flood/drought is increasing

2017 Northern Kyushu

Wikipedia

2018 July Western Japan

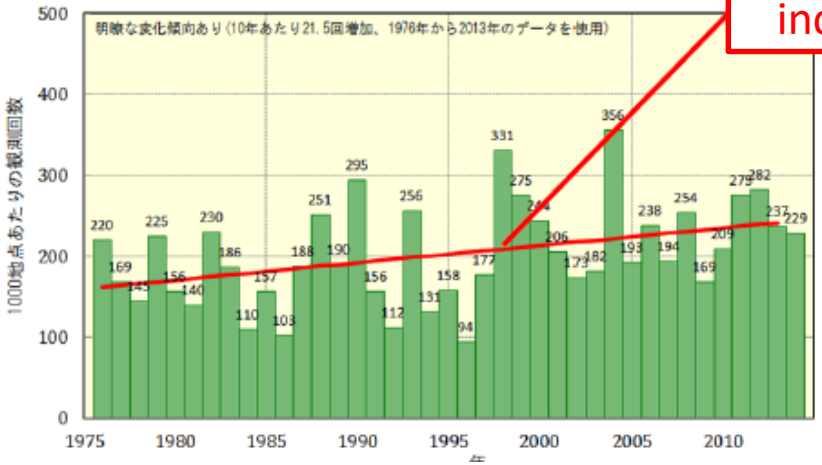
Asahi News Paper

2019 Typhoon Hagibis

Reuter

Number of rainfall>50mm/h

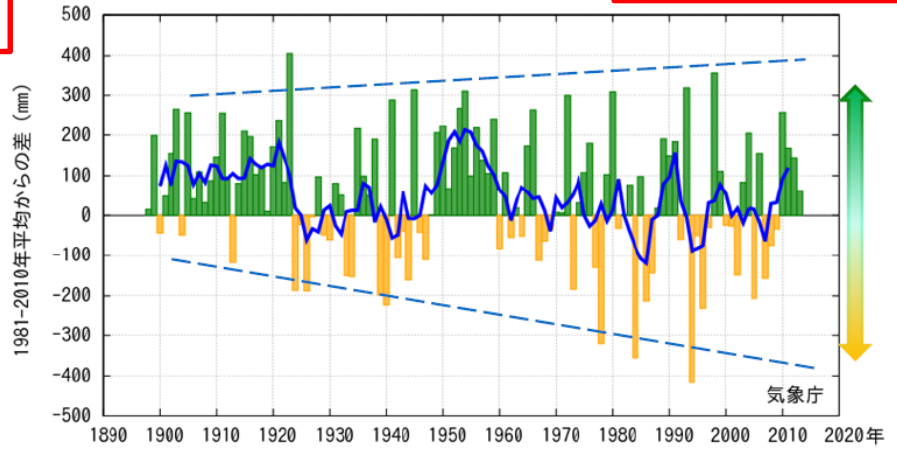
Flood risk increase



(JMA)

Annual rainfall

Drought risk increase



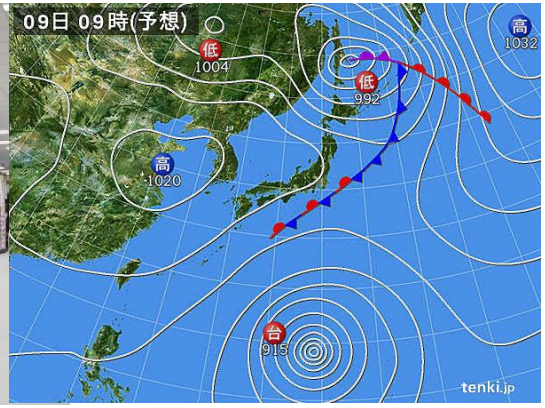
(JMA)

Global warming causes flood/drought risk increase by increasing of strength and frequency of heavy rainfall or unbalanced rainfall distribution.

Mitigate rainfall/flood disaster by Numerical Weather Predictions (NWP)

Early warning

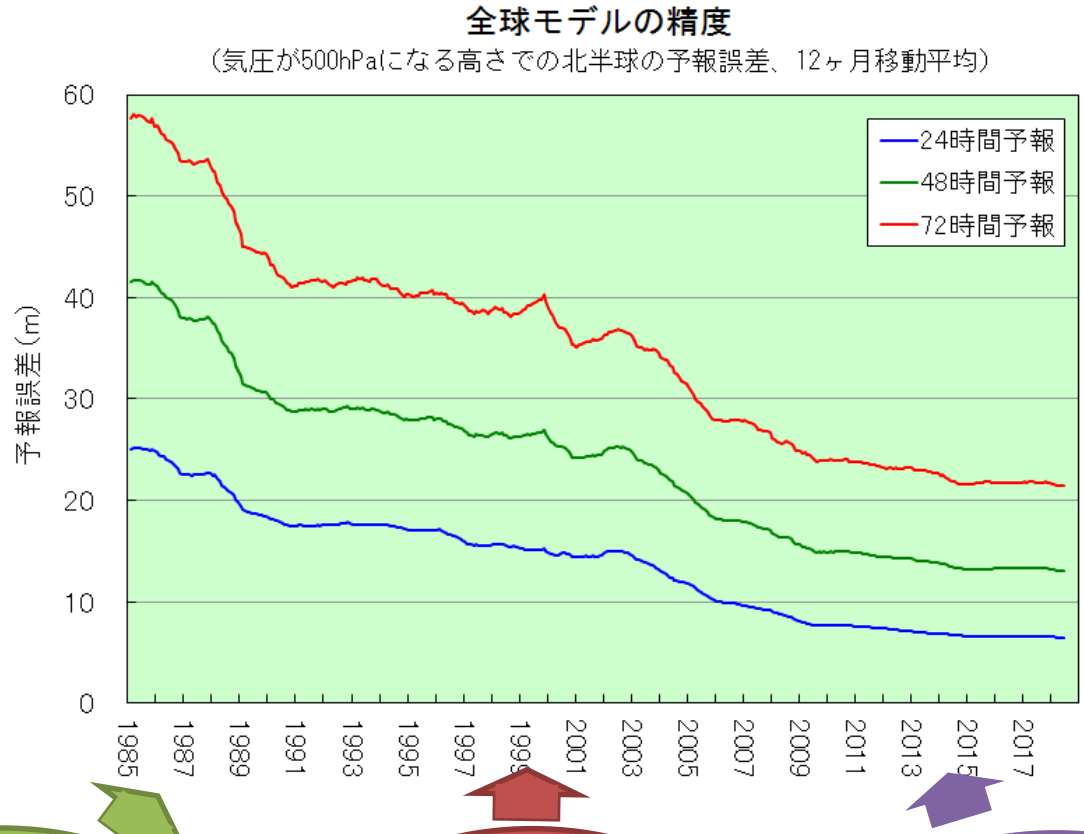
Mitigate damage



Utilizing NWP for Flood forecasting

- Earlier distribution of evacuation recommendation
  - Save lives, effective evacuation movement
  - Mitigate disaster damage（Economic, Agriculture)
  - Early preparation of disaster counter measures（Works of municipality offices, etc.）
- Effective dam operation
  - Flood water reduction by early water release from flood control dams
  - Reduction of the loss of water amount for power generation & disaster mitigation of downstream area（power generation dams）
- There are lot of advantages if we can realize quantitative precipitation forecast (QPF)

Improvement of NWP accuracy



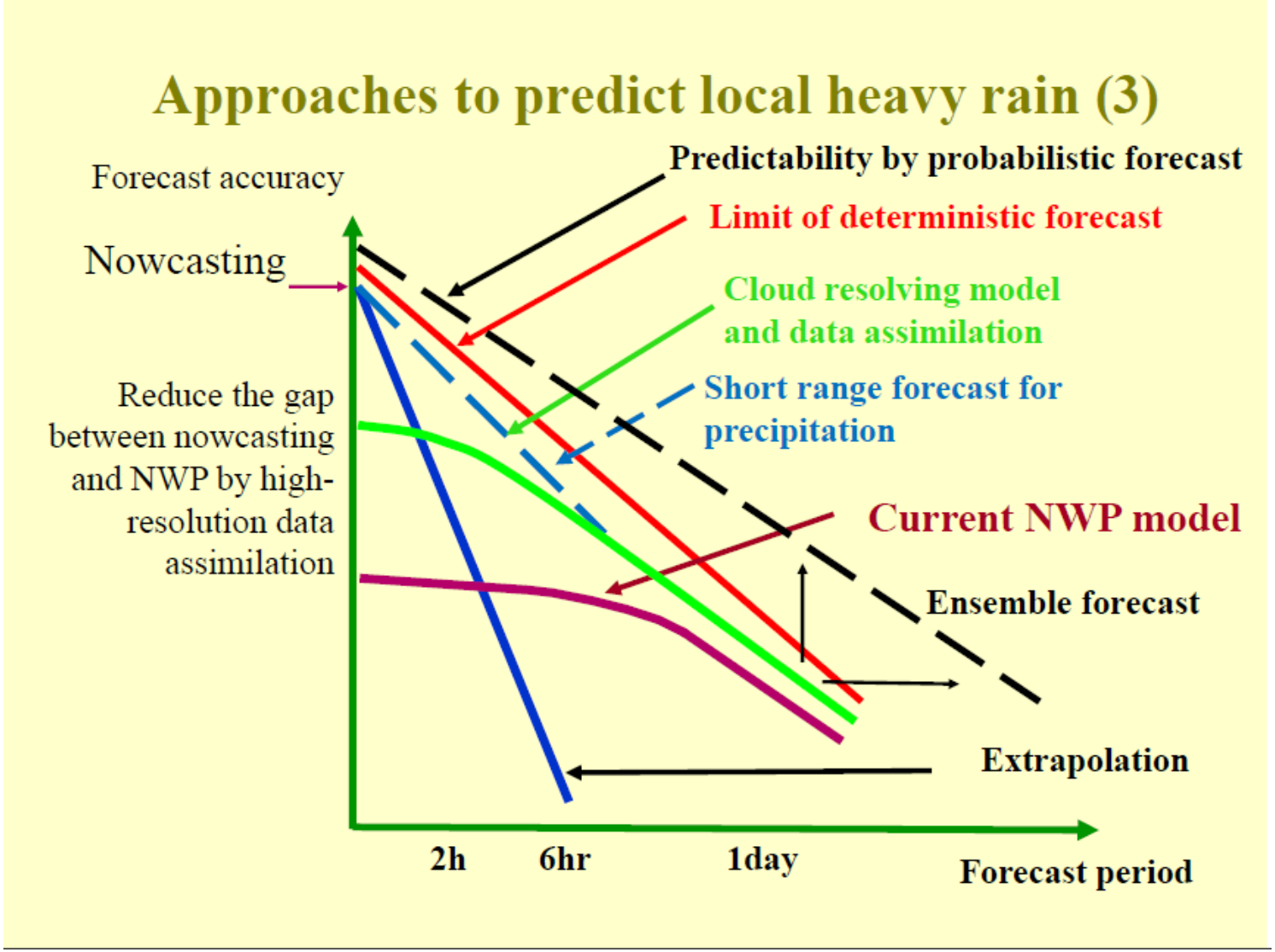
（JMA 2018）

Model improvement, higher resolution

New observation technology

Data assimilation technique

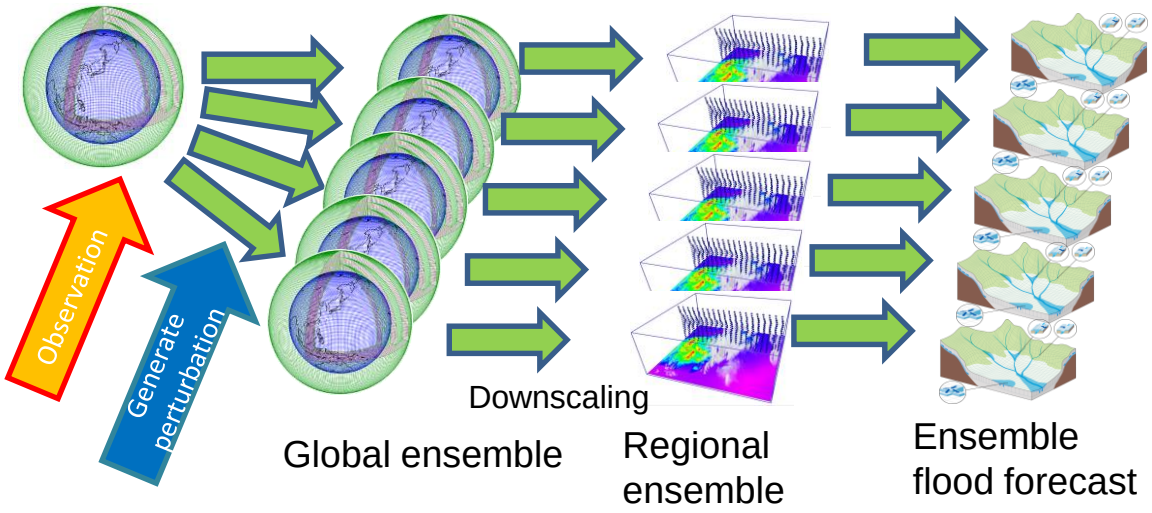
Improve the limit of NWP



After Saito (2012)

Two ways of regional ensemble prediction system

Simple Downscaling



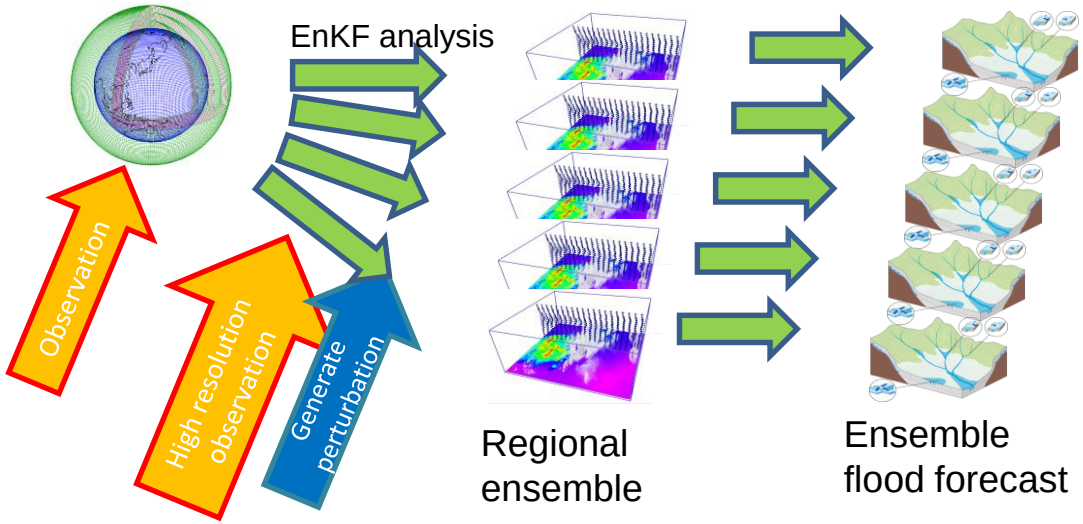
UK Met office

33 km global ensemble 12 member→2.2 km regional ensemble, 12 member

Météo France

15 km global ensemble 35 member→2.5 km regional ensemble, 12 member

Regional data assimilation



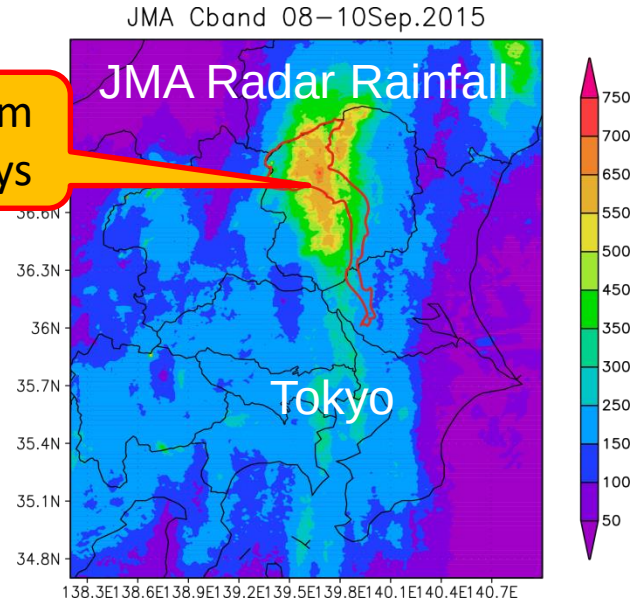
JMA

20 km GCM→5 km regional ensemble, 21 member

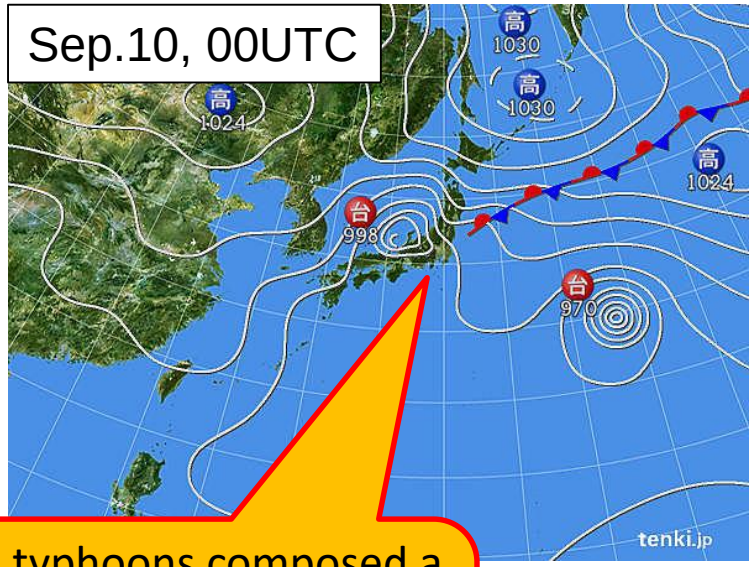
ICHARM

20 km GCM→3 km regional ensemble, 33 member

2015 Kinugawa River flood



700 mm in 3days



Two typhoons composed a convergence line to support long lasting rainband

Killed: 2
Evacuated people: 7032
Totally/Partially destroyed houses: 5277
Inundated above the floor houses: 166
Inundated area: 40 km^2

2015 Sep.Kinugawa River flood event

Basin Rainfall

River discharge

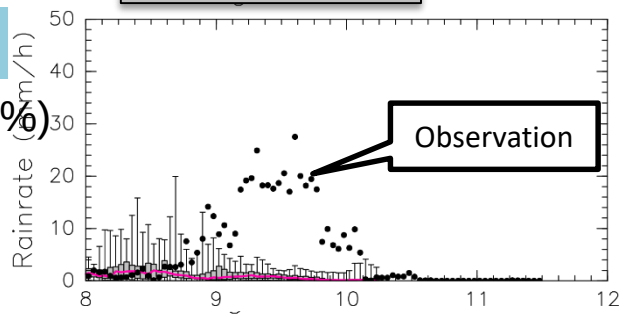
54h before

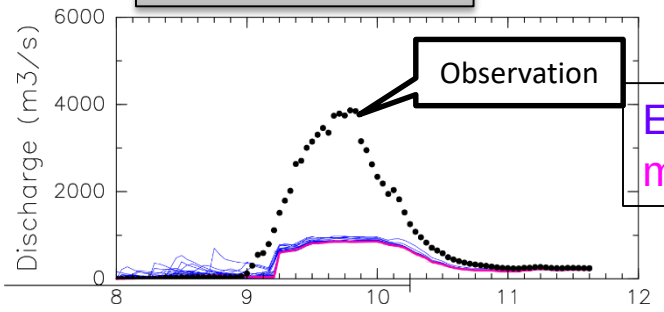
42h before

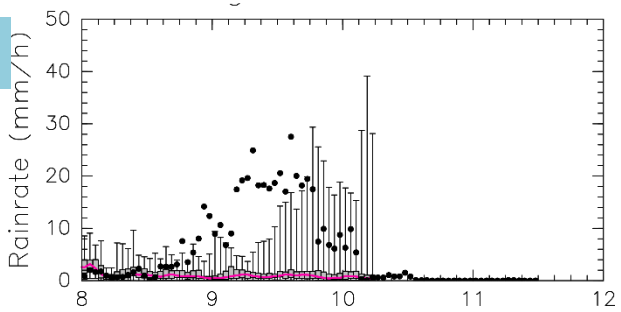
30h before

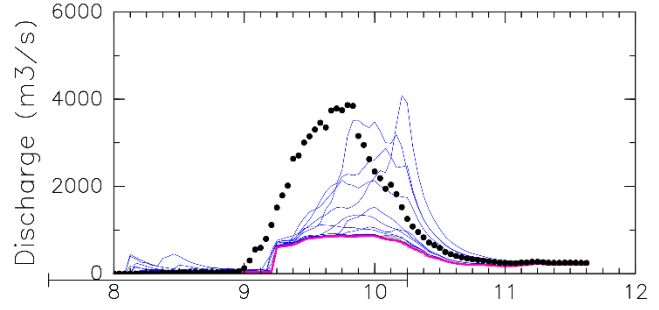
18h before

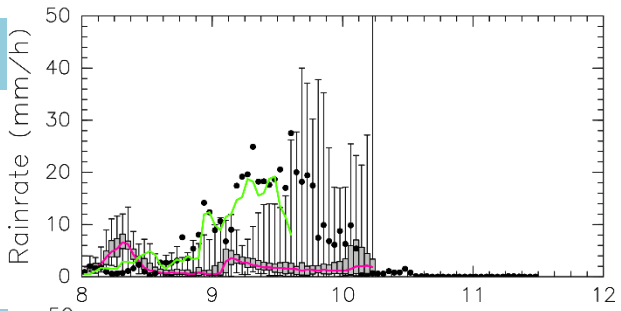
Ensemble (25-75%)
Median
JMA MSM
Observation

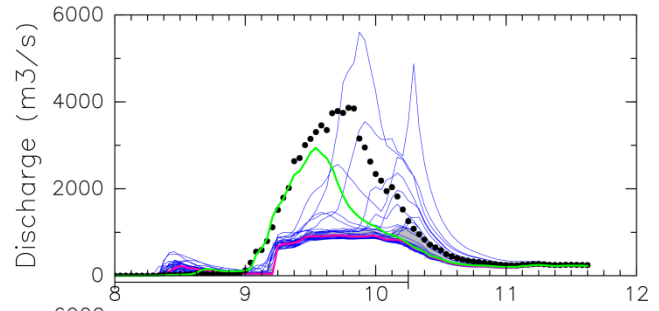


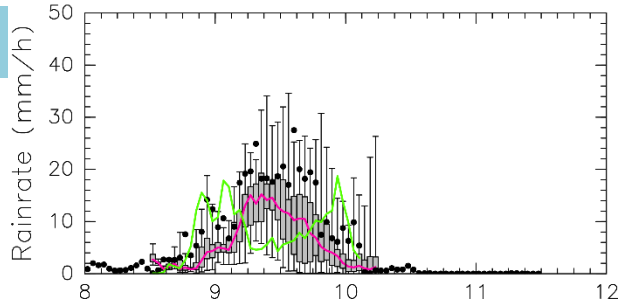


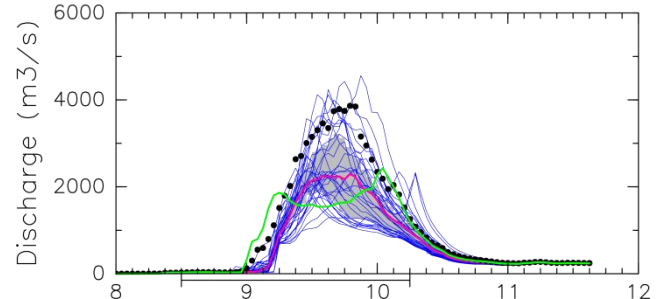












2019 Oct.Typhoon Hagibis, Nagano city

Basin Rainfall

River discharge

48h before

36h before

24h before

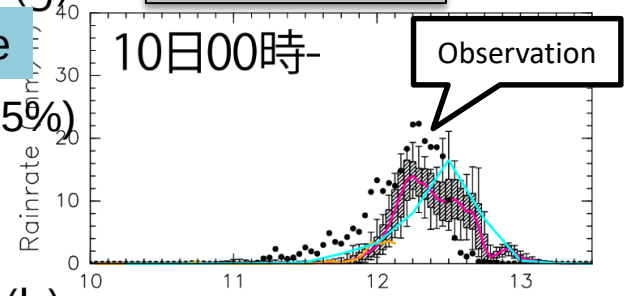
12h before

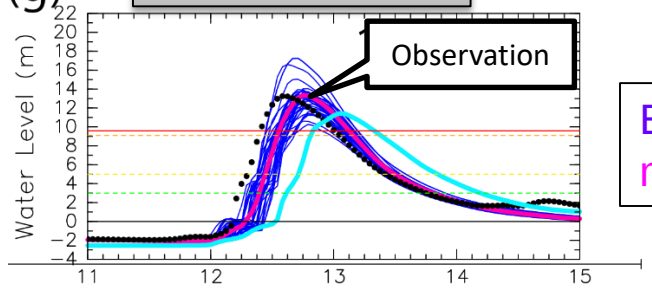
Ensemble (25-75%)

Meam

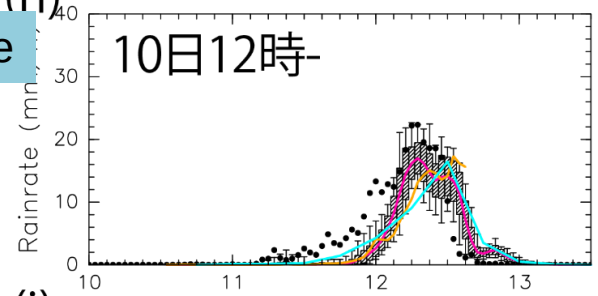
JMA MSM

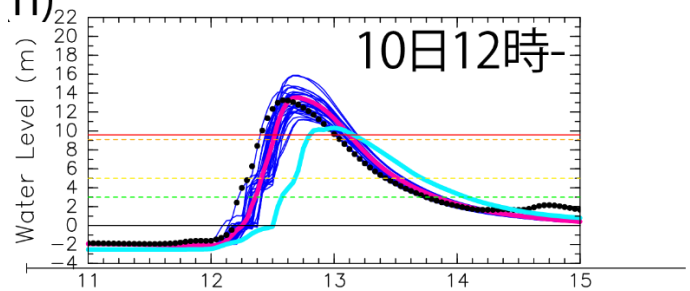
JMA GSM

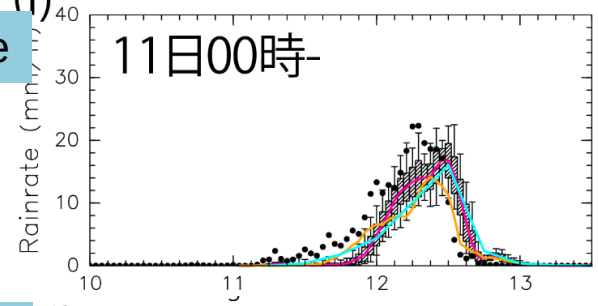


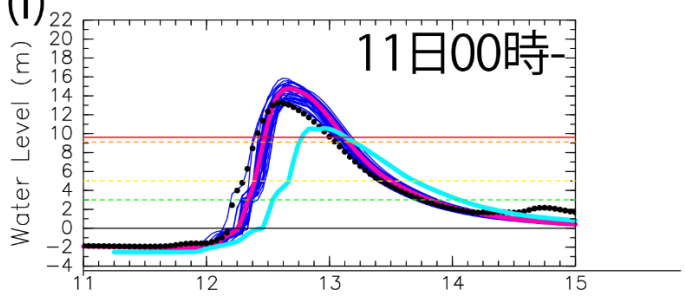


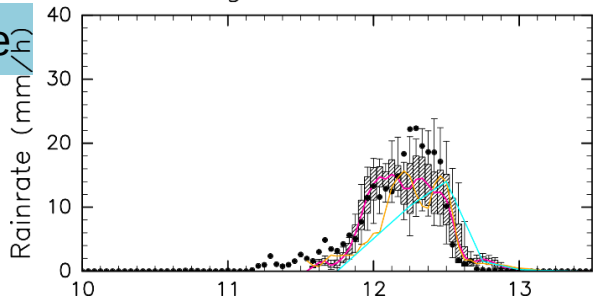
Ensemble meam

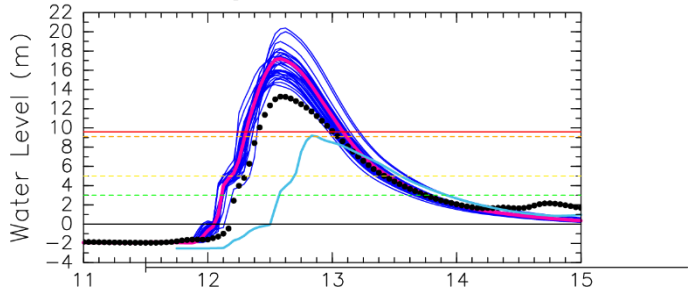




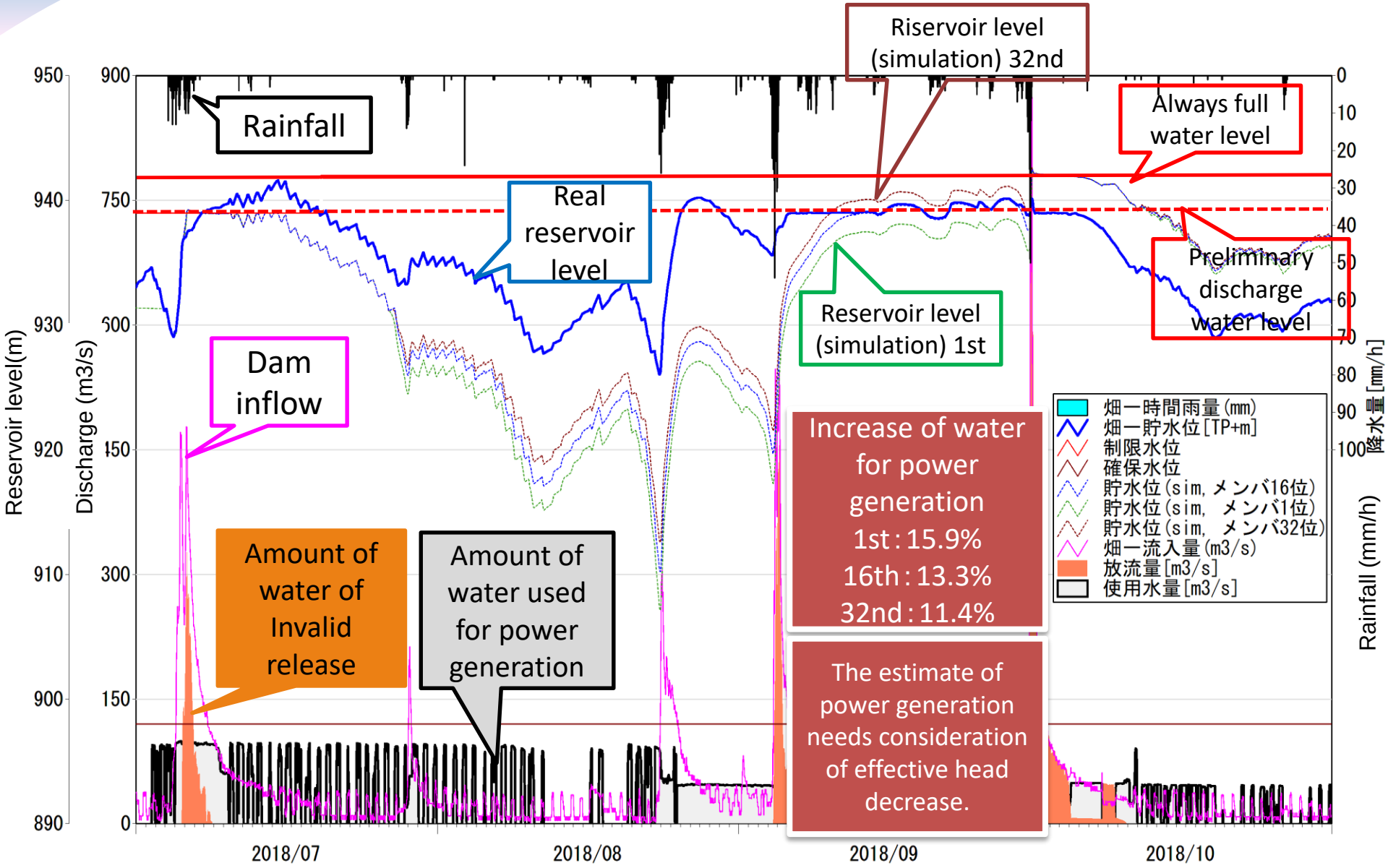








Dam water level operation simulation by using inflow forecast (Hatanagi first dam) Jul.-Oct. 2018



(Mr. Nakamura, Nippon Koei)

Thank you for your attention!