Introduction of confidence flag to the Himawari-8 precipitation estimation algorithm

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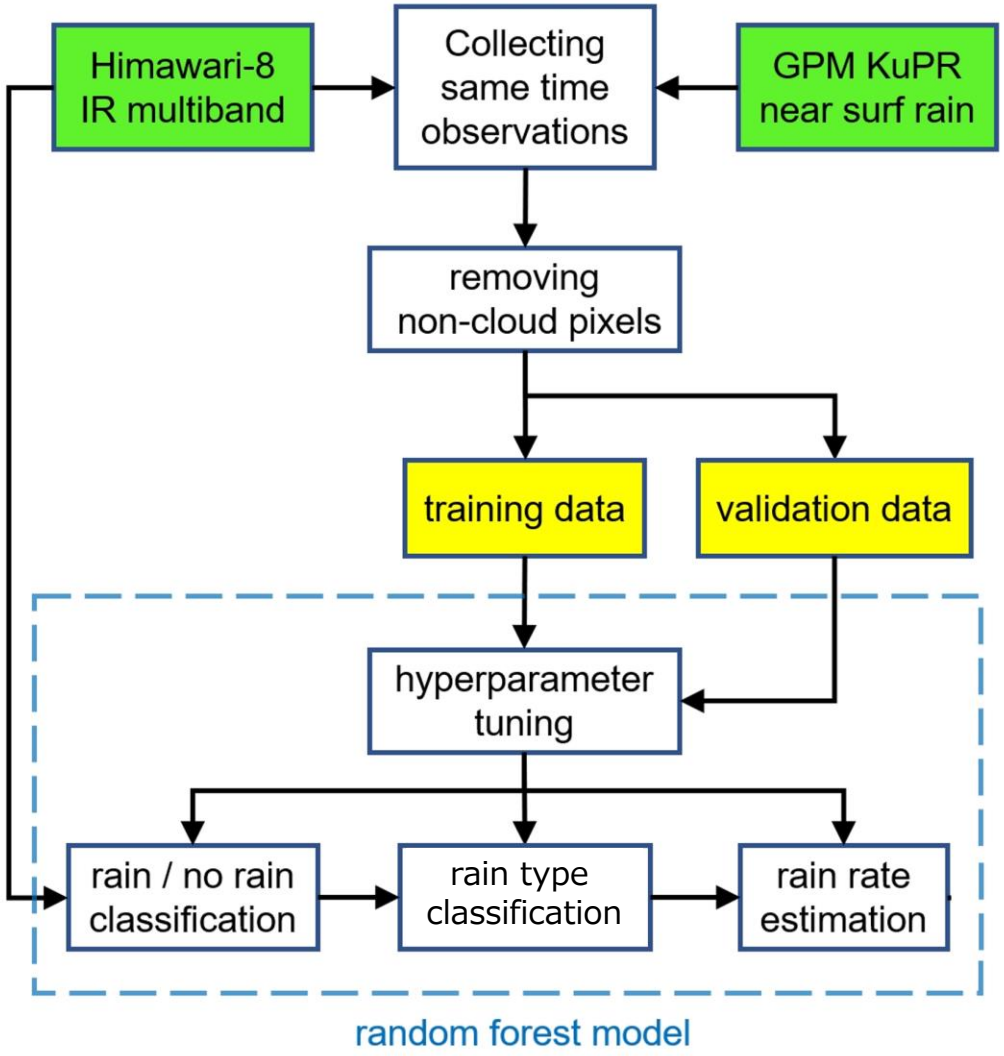
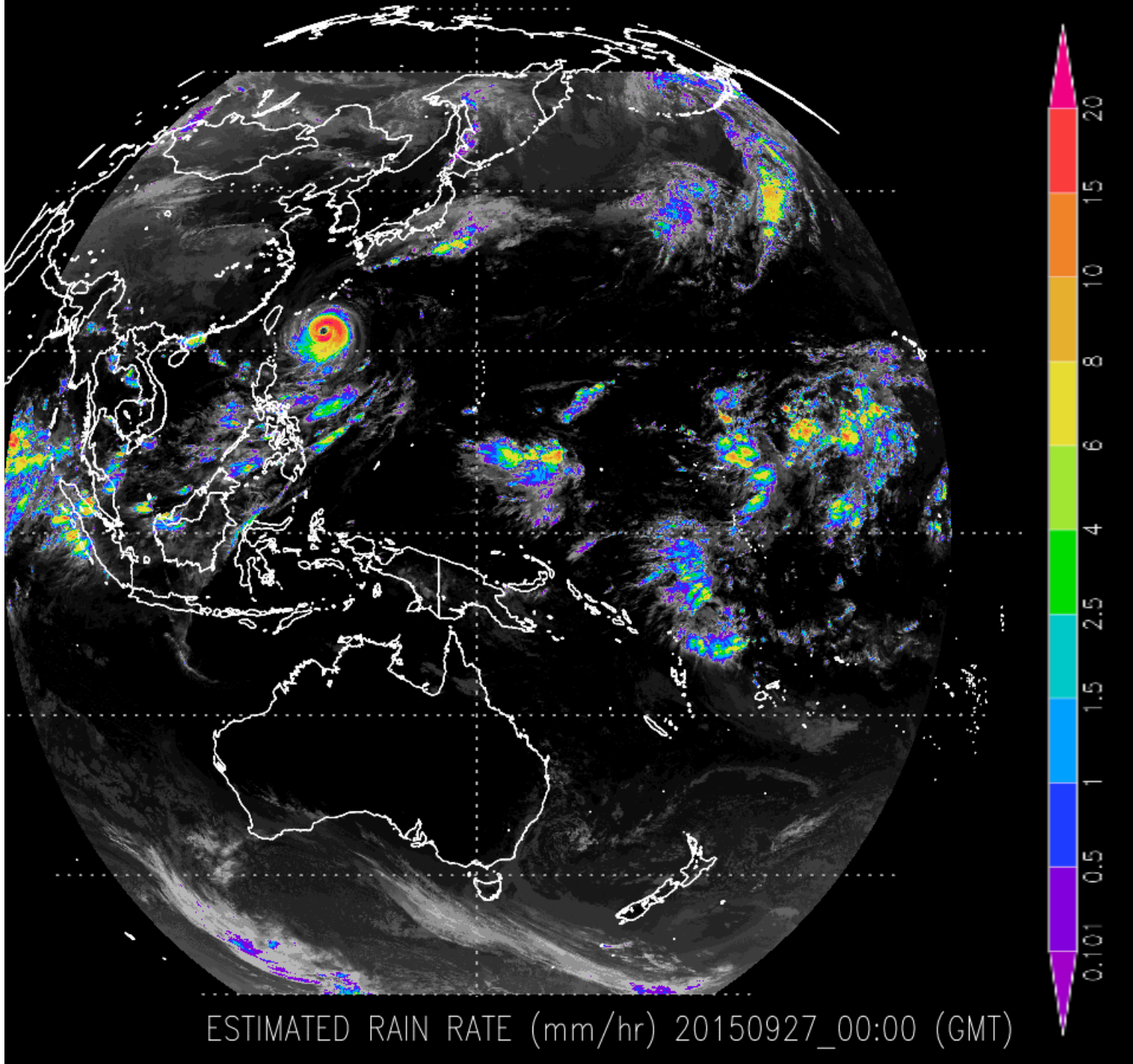
Himwari-8 precipitation estimation algorithm (HPA global)





Objective

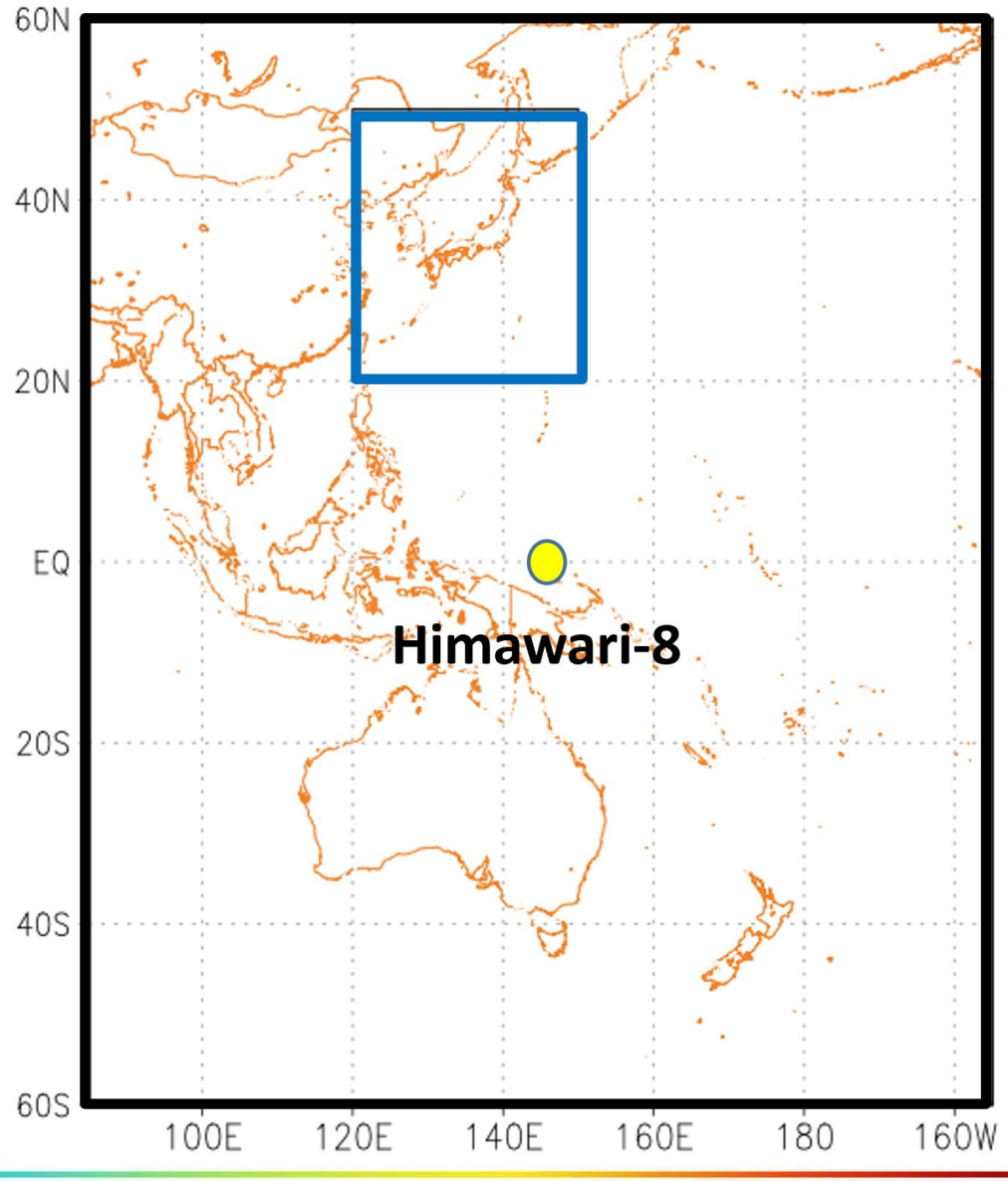
- To make HPA Japan for improvement in fit rate to extreme rain

Data

- Period: JJA from 2015 to 2020 (5 years)
- IR brightness temperature (BT) of Himawari-8

  HPA global: **black** squared area, HPA Japan: **blue** squared area
- Truth of precipitation: GPM KuPR (13.6GHz) near surf rain
- Ground truth: radar-AMeDAS

explanatory variables	applications
ΔT7.3−13.3	cloud top height
ΔT8.6−10.4 Δ10.4−12.4	cloud optical thickness
ΔT6.2−6.9 ΔT6.9−7.3	vertical distribution of WV
BT6.2, BT6.9, BT7.3, BT8.6, BT10.4, BT12.4, BT13.3	



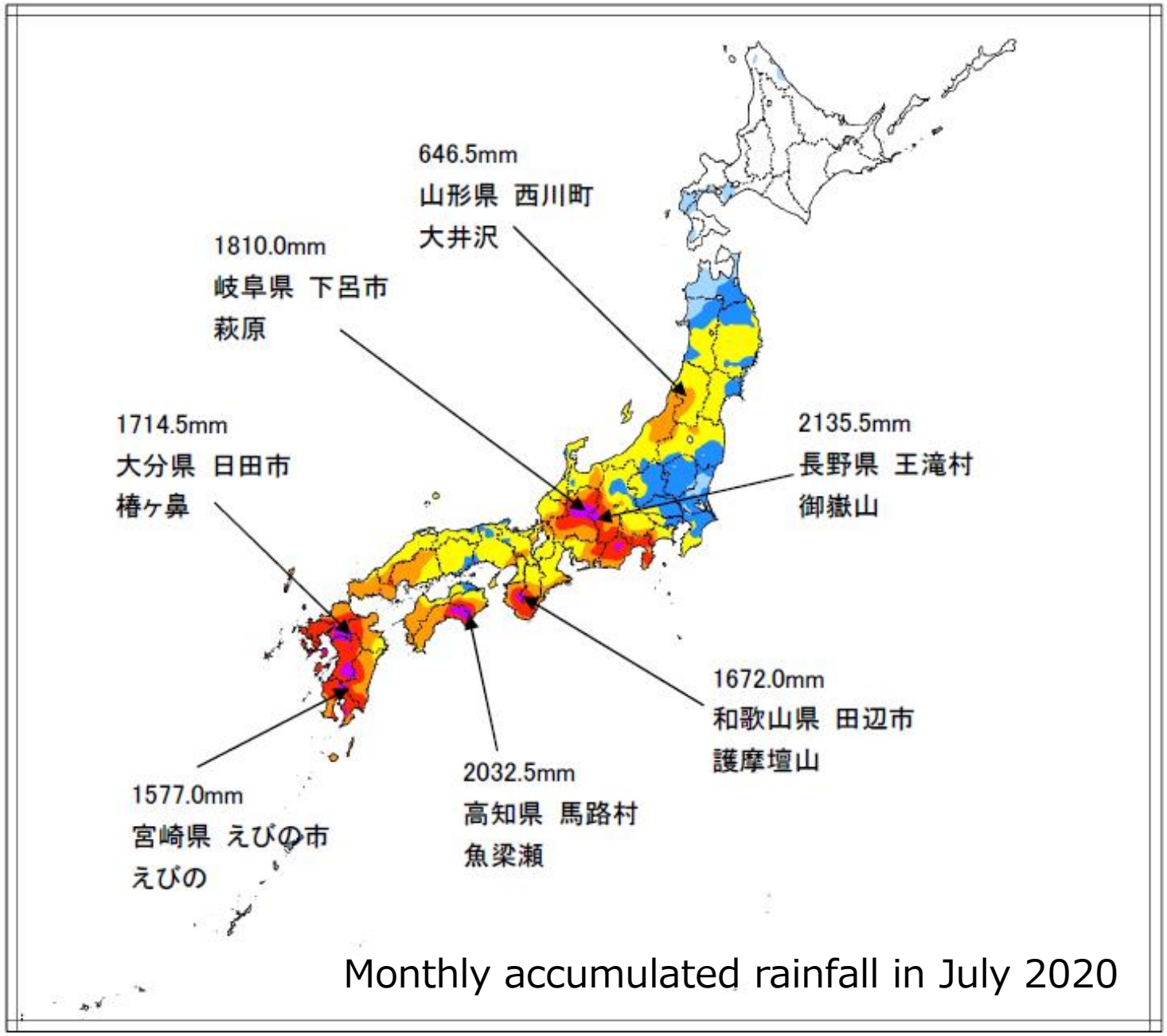
Case study in July 2020

・Rainy front caused heavy rainfall in western Japan

・Linear rainbands occurred over the Kyushu region

・Precipitation was more than four times higher than ususal

・A case of linear rainband in the Kyushu region and a case of frontal rainfall in the Chubu region are shown



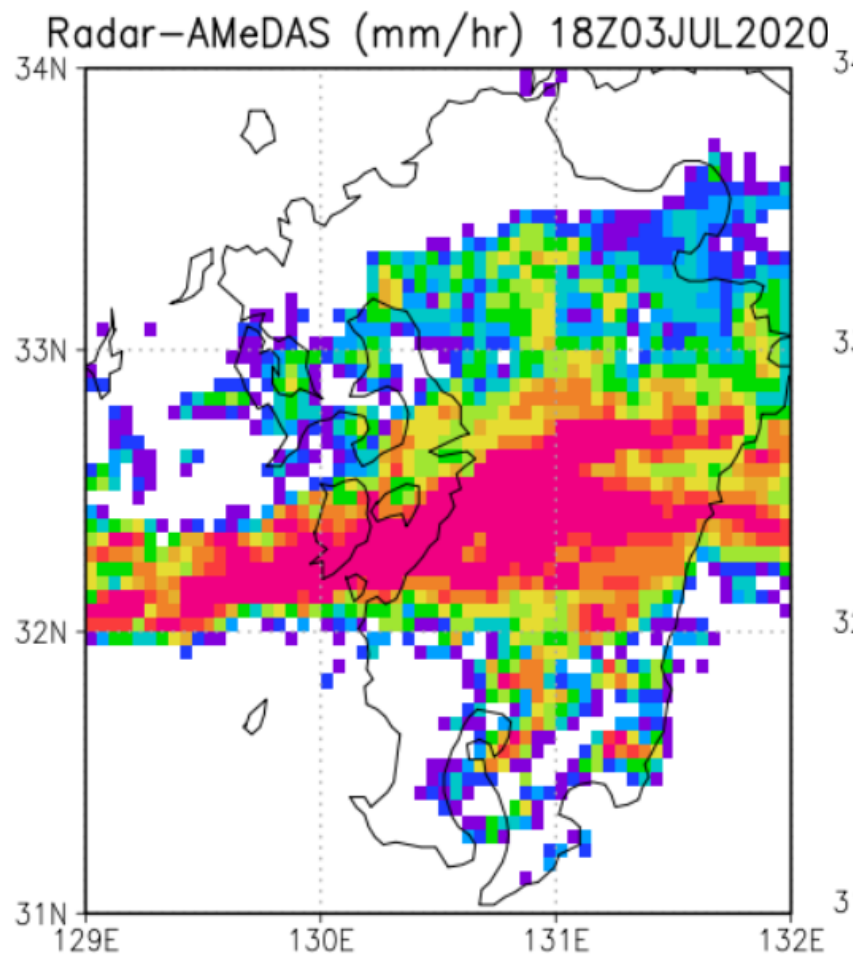
Monthly accumulated rainfall in July 2020

JMA disaster report

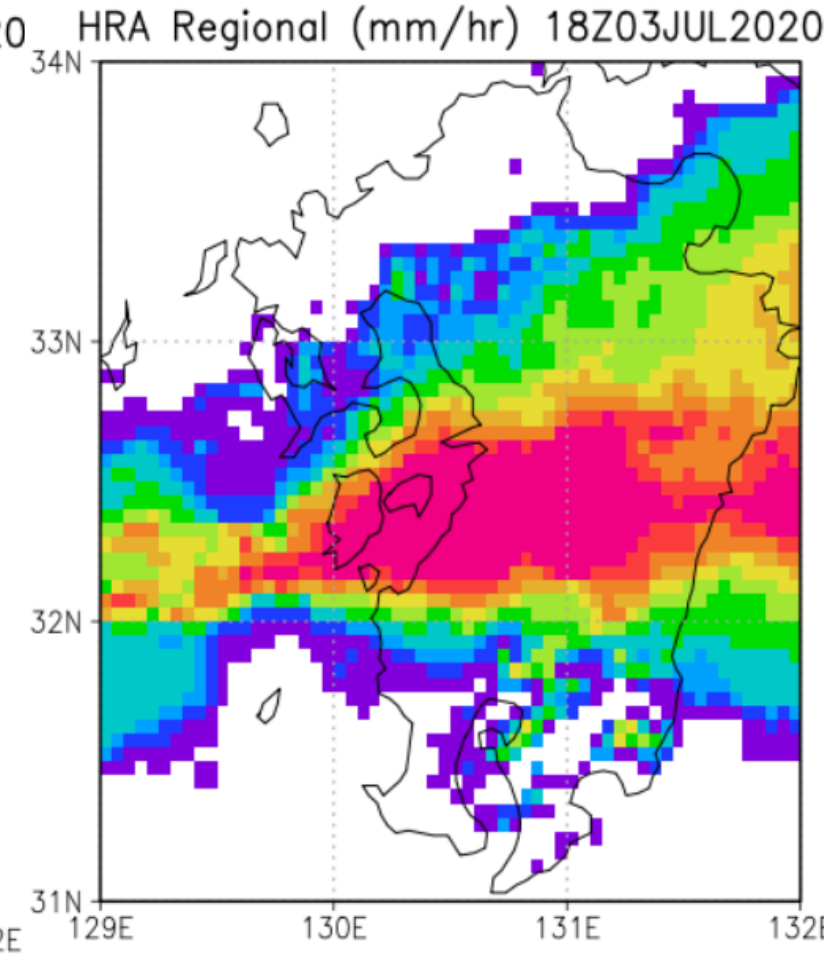
A linear rainband case 1 over the Kyushu area

(b) The HPA global underestimates rainfall on the windward side of linear rainband
(c) The HPA Japan is in good agreement with the radar-AMeDAS observation

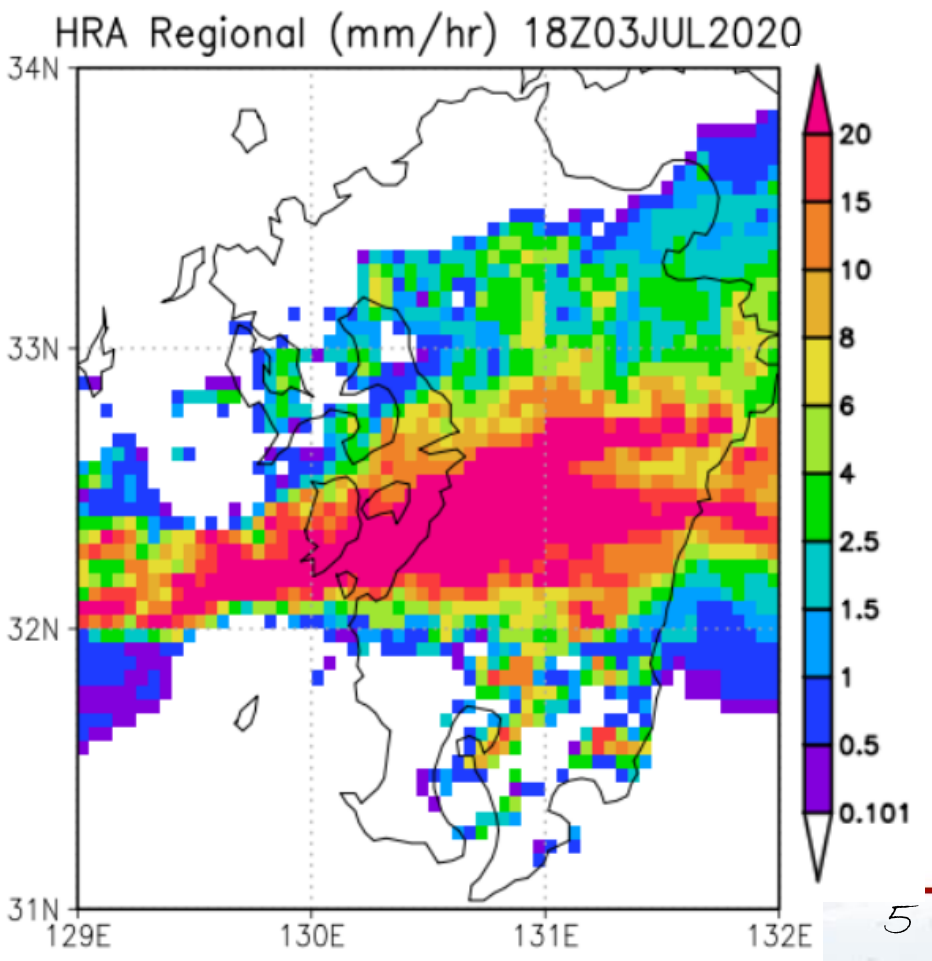
(a) Radar-AMeDAS



(b) HPA global



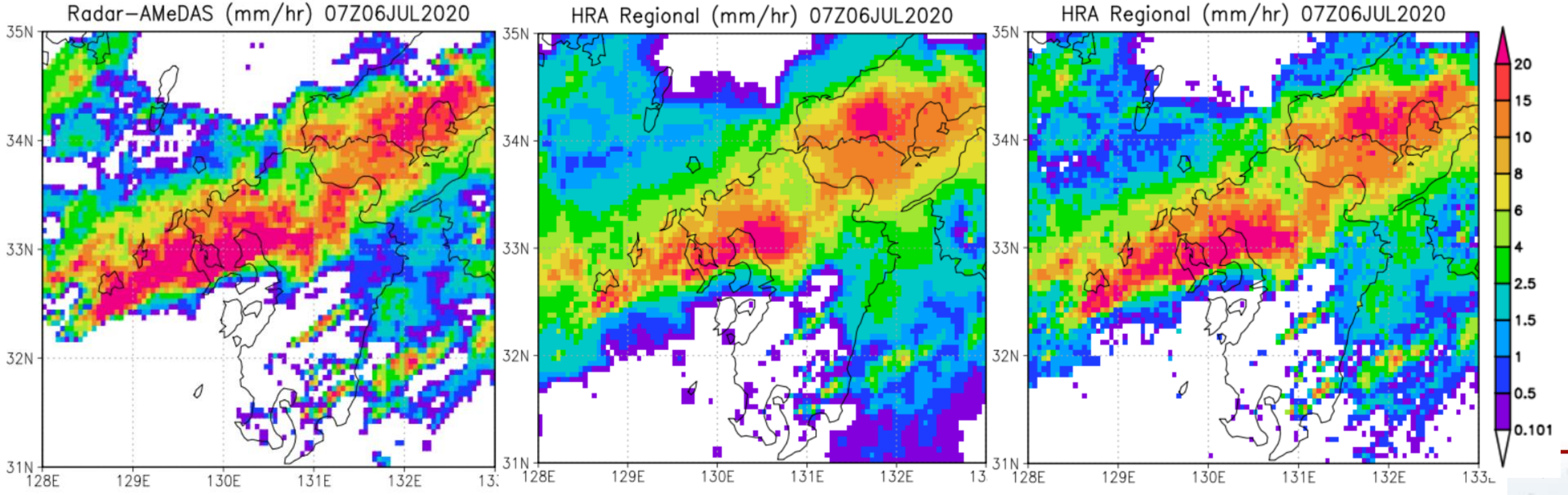
(c) HPA Japan



A linear rainband case 2 over the Kyushu area

(a) The radar-AMeDAS observed a linear rainband
(b) The HPA global underestimates the extent of heavy rain
(c) The HPA Japan has improved for the underestimation
・Note that the over-detection of rainfall has also been improved by HPA Japan

(a) Radar-AMeDAS **(b) HPA global** **(c) HPA Japan**

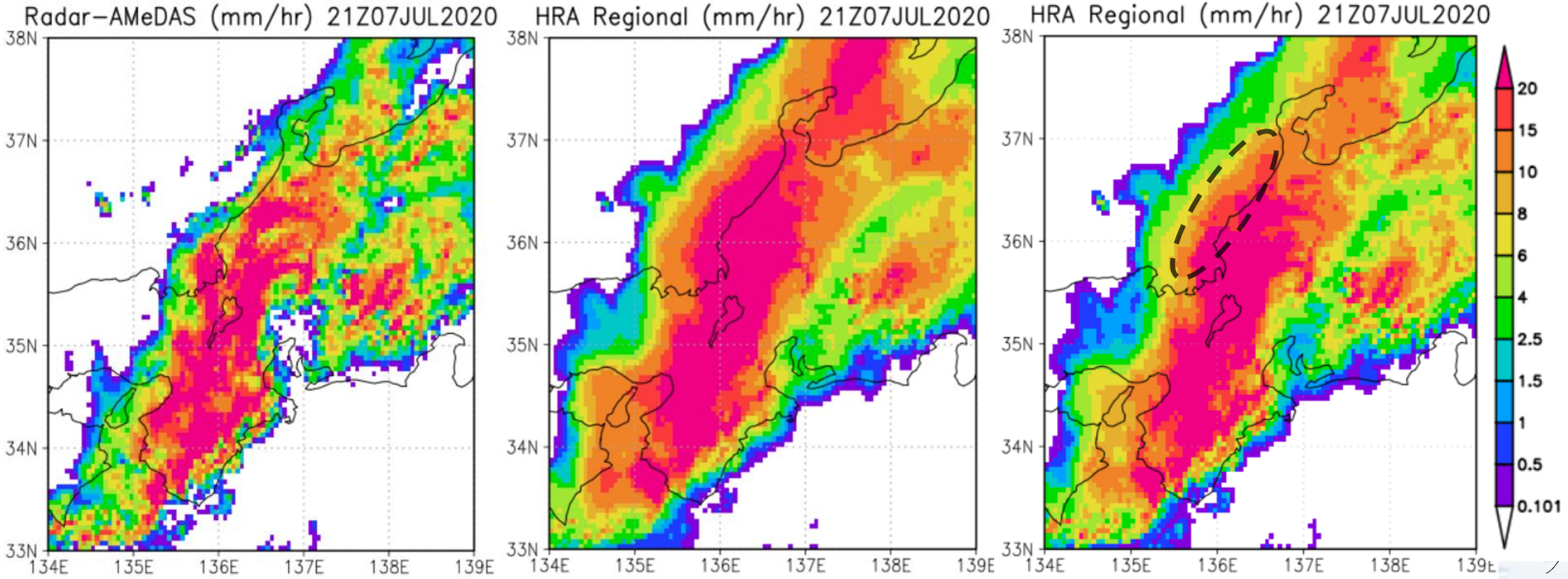


A frontal rain case over the Chubu area

(b) The HPA global over-detected heavy rain area compared to the previous case

(c) Much of overestimation occurred within the optically thick upper clouds

(a) Radar-AMeDAS **(b) HPA global** **(c) HPA Japan**



A frontal rain case over the Chubu area

(b) The HPA global over-detected heavy rain area compared to the previous case

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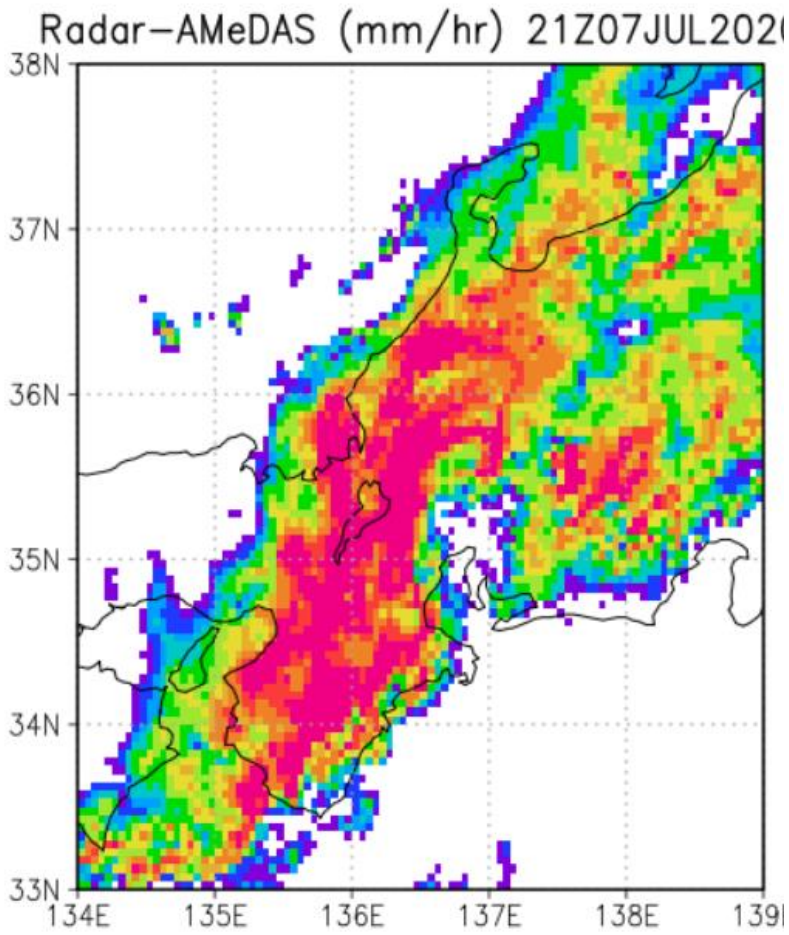
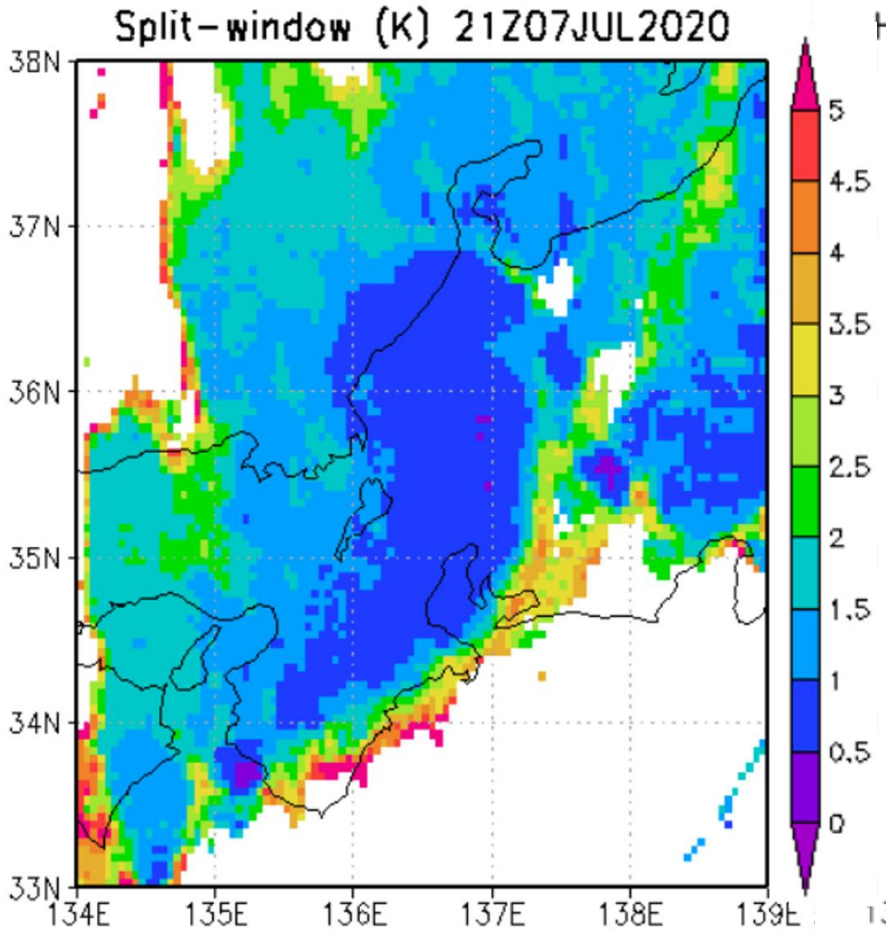
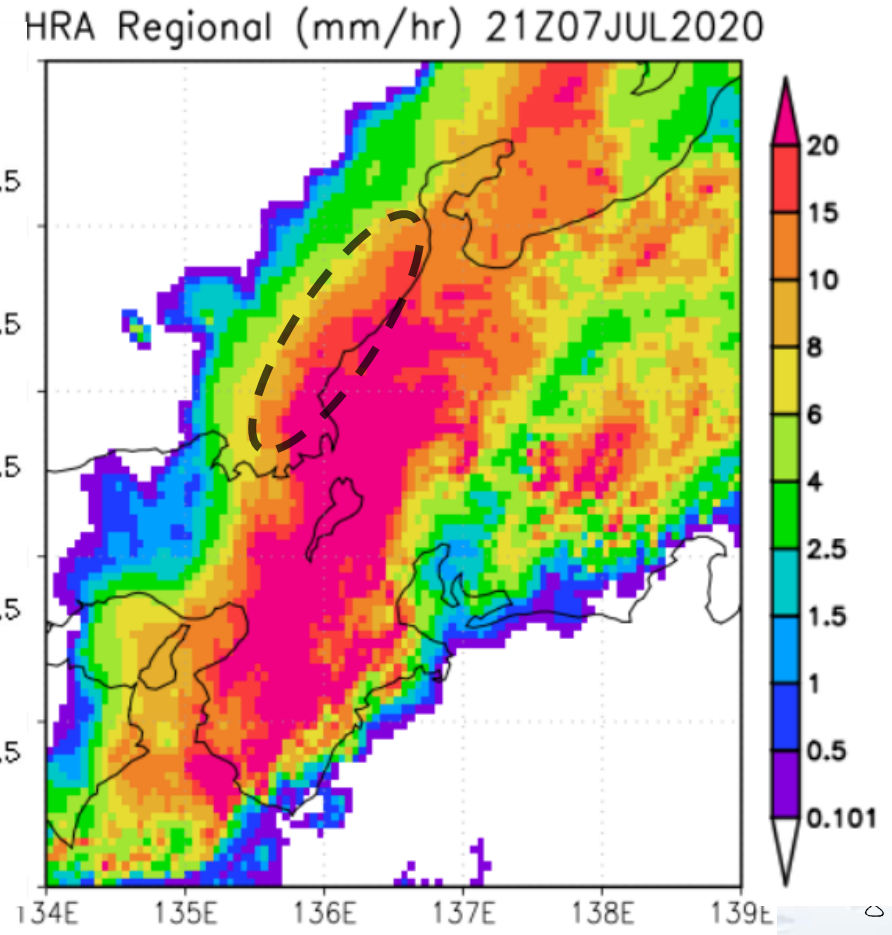
(a) Radar-AMeDAS



(d) Split-window



(c) HPA Japan

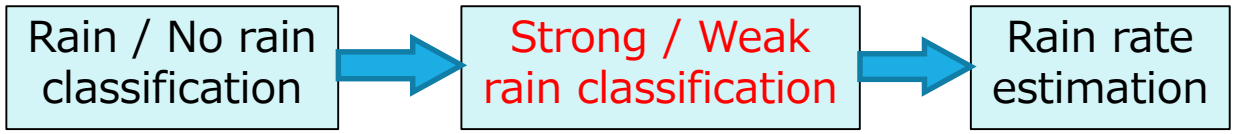


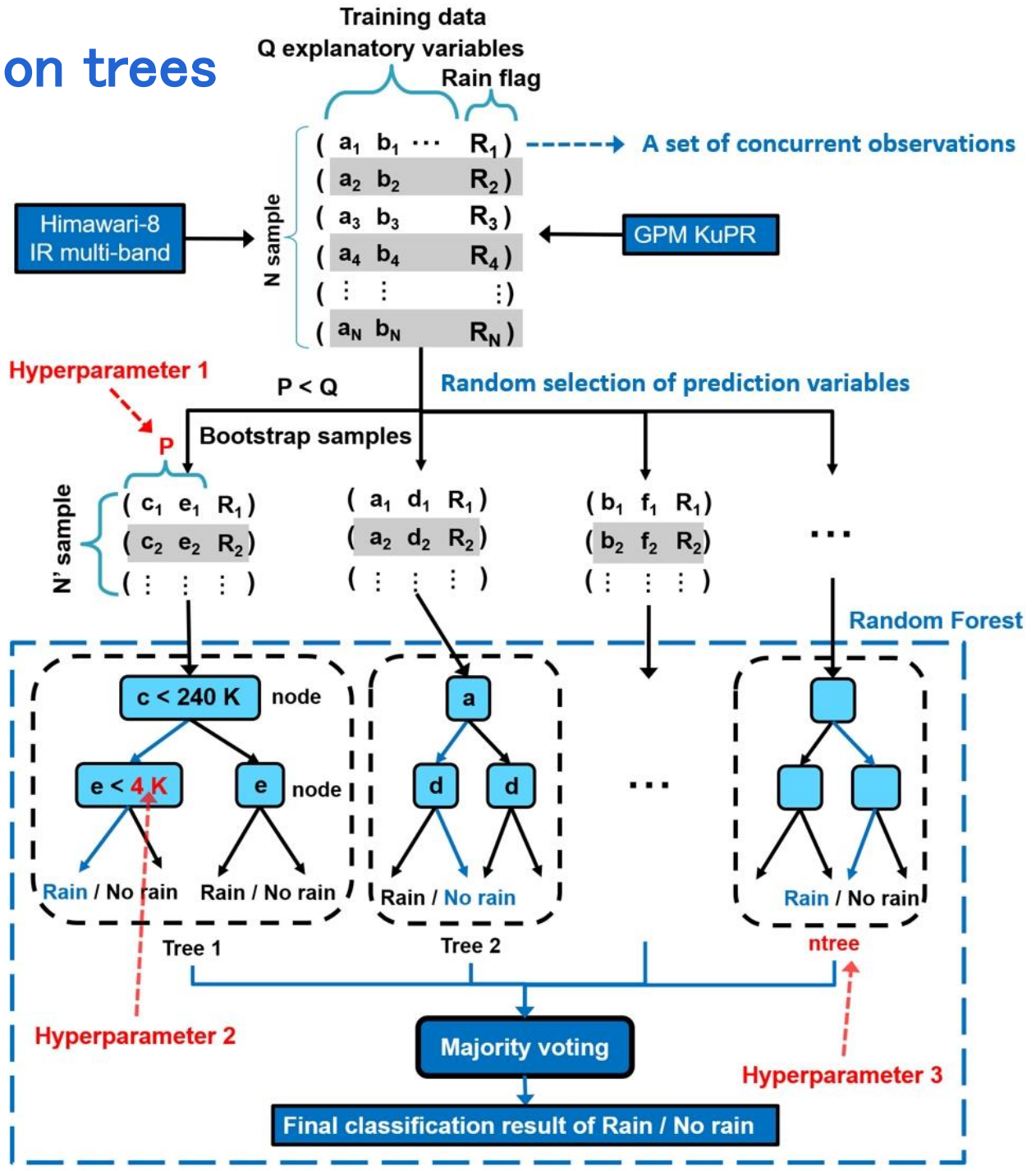
Confidence based on ratio of classification trees

- Bootstrap samples by random sampling
  - Creating classification (regression) tree with each bootstrap sample
- Probabilistic estimation by majority vote for each classification tree
  - If 251 out of 500 classification trees are diagnosed as rainy, the results is rainy
    However, the reliability is very low

- To detect overestimation of the heavy rain area, the confidence level was determined based on the ratio of the classification tree in the strong or weak rain classification process

Stepwise scheme of RF rain estimation process

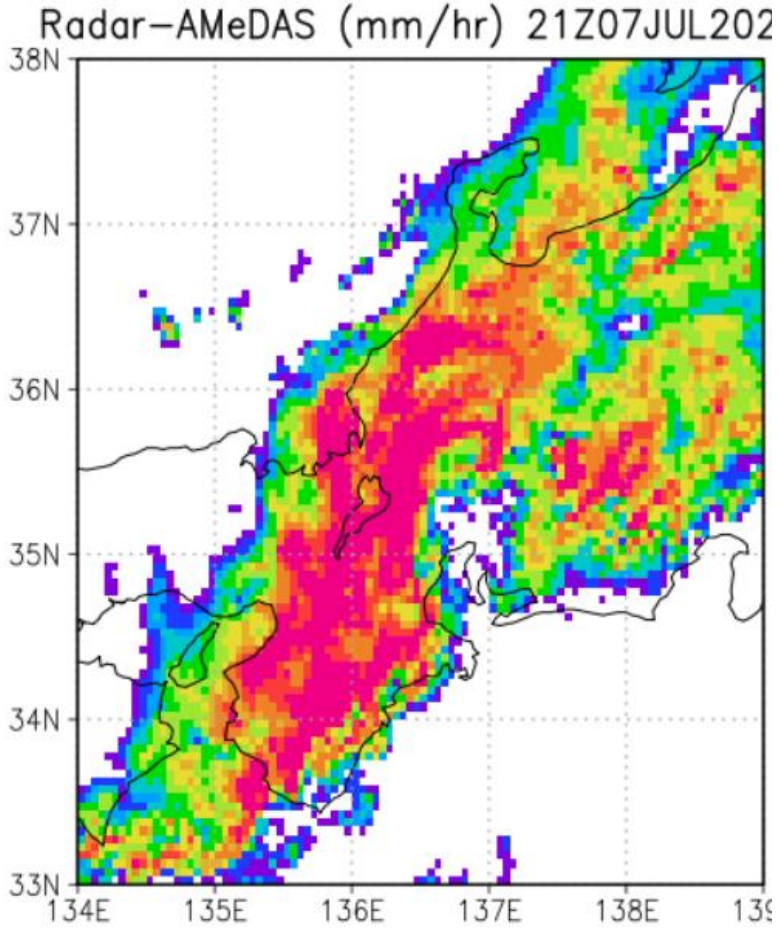




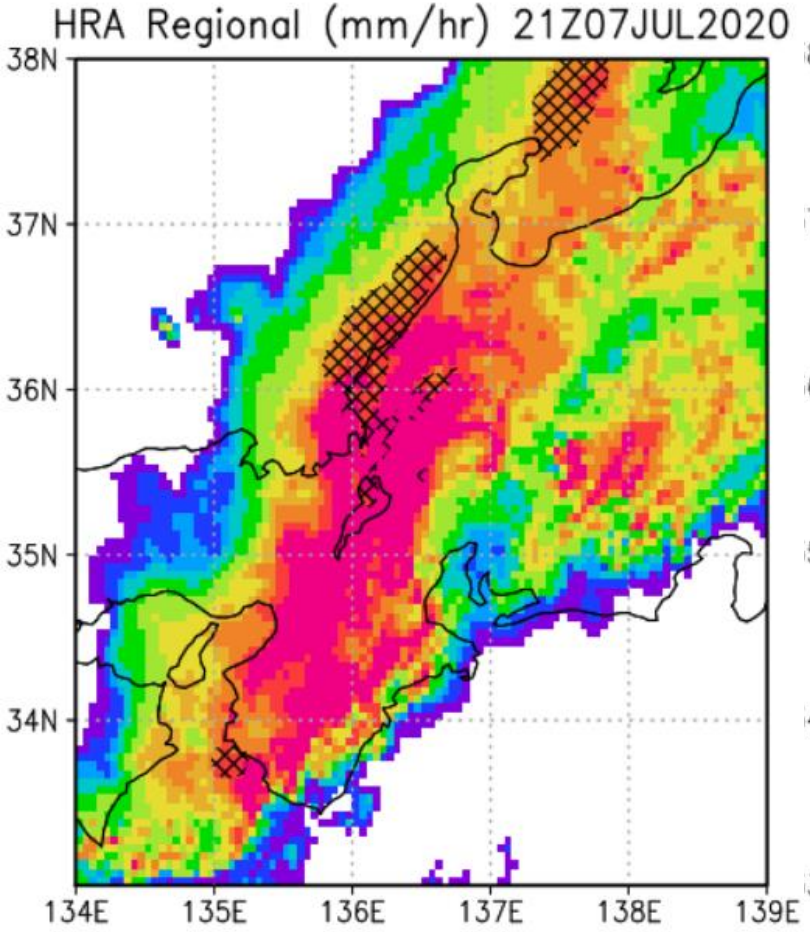
Case analysis using RF confidence level

・If the ratio of majority trees to minority trees is less than about 1.3, the confidence level is considered low.

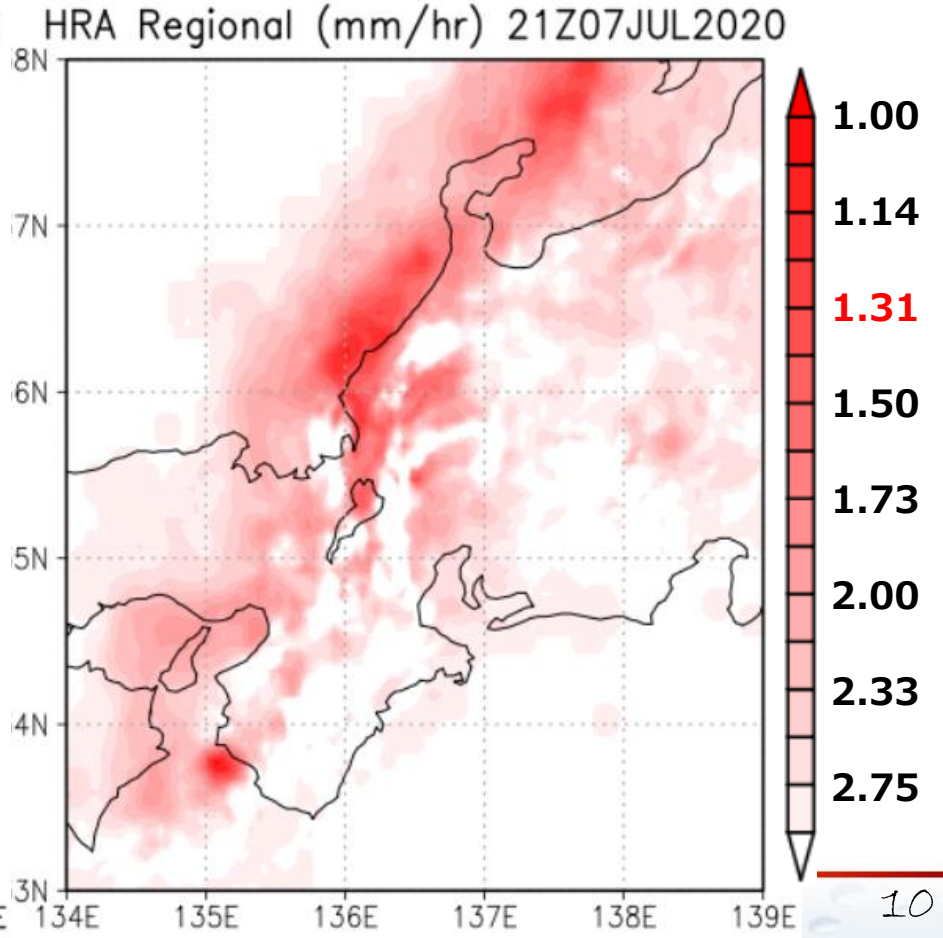
(a) Radar-AMeDAS



(b) HPA Japan



(c) Classification ratio



Summary

- The HPA Japan was improved compared to the HPA global
  - HPA Japan over-detected strong rainfall in the optically thick upper clouds due to reduction in effectiveness of IR multi-band

- A confidence flag was introduced based on the confidence of strong or weak rain classification results
  - It depends on the ratio of majority trees to the minority trees
  - The closer ratio of majority to minority is to 1:1, the confidence is lower
  - The confidence flag enables us to identify some of over-detected strong rainfall