# Enhancing GSMaP precipitation tracking algorithm through combined use of high-resolution cloud moving vectors and ForTraCC

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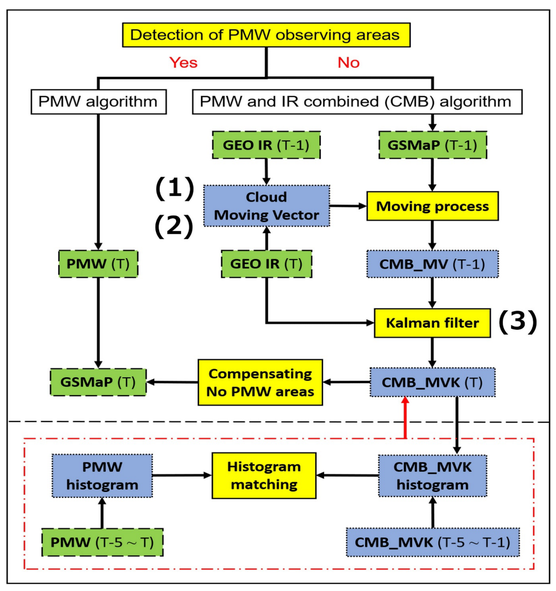
## Algorithm improvement process

・Several ongoing efforts to improve the GSMaP_MVK algorithm using frequent observations from latest geostationary meteorological satellite, Himawari-8.

・Improvements are being made in four locations within the GSMaP_MVK algorithm shown in Figure 1.




(1)Higher resolution of cloud moving vectors (CMV)

(2)Attempting to implement Forecast and Tracking the Evolution of Cloud Clusters (ForTraCC; Vila et al. 2008)

(3)Higher resolution precipitation intensity output

**Fig. 1: flowchart of GSMaP_MVK algorithm**

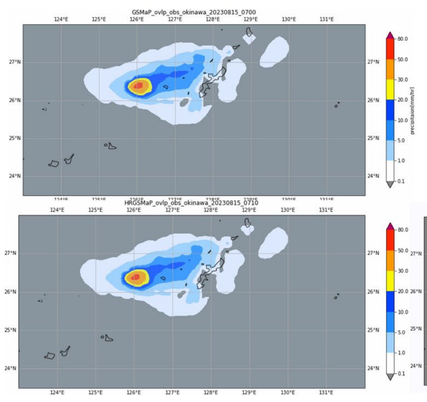
## High-resolution GSMaP

・Using the high-frequency IR observations of Himawari-8, we attempted to improve the resolution of GSMaP_MVK output by distributing the rainfall amount within a 0.1° grid to a 0.02° grid.

・The upper panel of Figure 4 shows the conventional hourly GSMaP output, and the lower panel shows the output with a higher resolution of 0.02° every 10 minutes.

・The accuracy of the rainfall area estimation of the high-resolution GSMaP was verified using the radar-AMeDAS observations as truth.

・Conventional GSMaP scores decreased over time, resulting in discontinuities, but the high-resolution GSMaP improved the discontinuities.



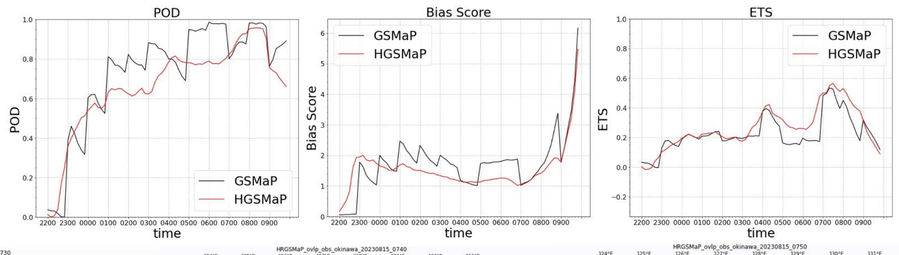




**Fig. 4: Continuous snapshot of GSMaP rain rate**

## A high-resolution cloud moving vector

・We attempted to improve the spatio-temporal resolution of cloud moving vectors (CMVs) using high-frequency observations of the Himawari-8.

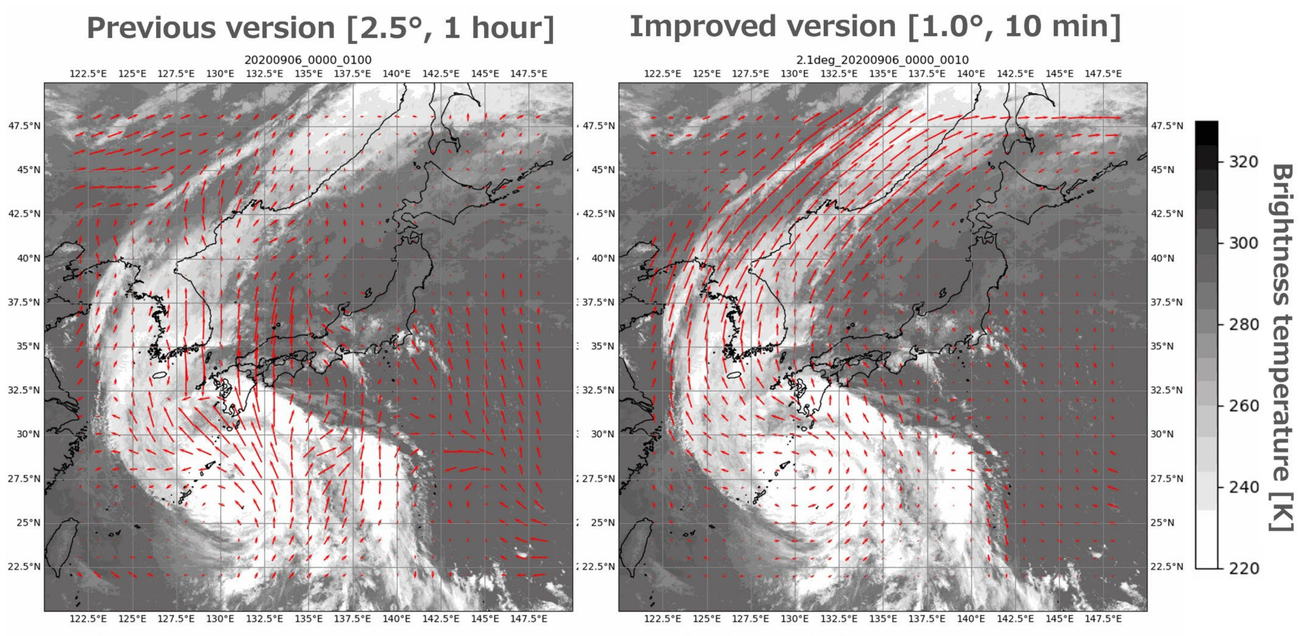



**Fig. 2: Improved spatio-temporal resolution of cloud moving vectors**

・The zonal wind speed near cloud top height obtained from the local forecast model (LFM) is compared to the high-resolution CMV as shown in Fig. 3.

・High-resolution CMV are highly correlated with the model result and the underestimation is greatly reduced.

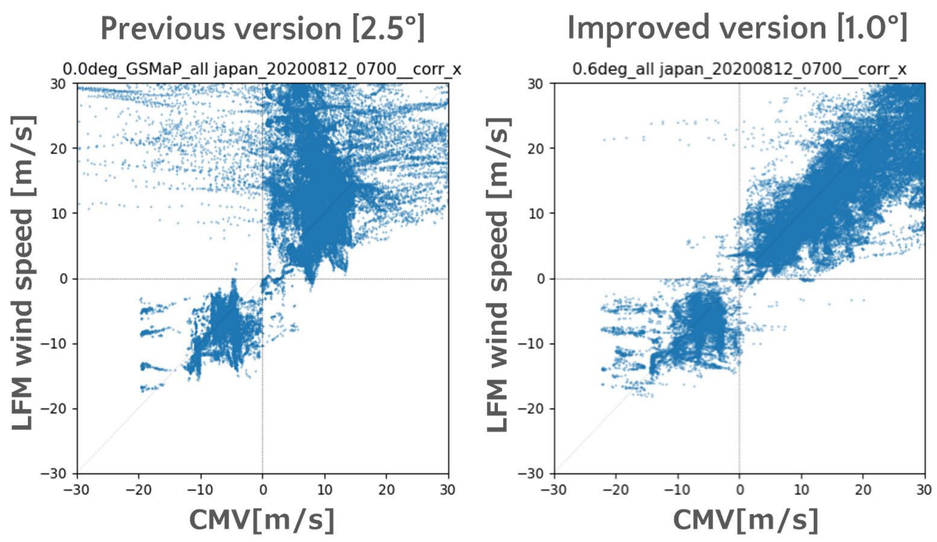



**Fig. 3: Comparison of model zonal wind speeds and GSMaP CMV**

## Introduction of Forecast and Tracking the Evolution of Cloud Clusters (ForTraCC)

・It has been reported that precipitation tracking methods using the cloud moving vector may misidentify the movement direction of heavy rainfall areas when the movement direction of upper clouds and heavy rainfall areas is different under strong vertical wind shear.

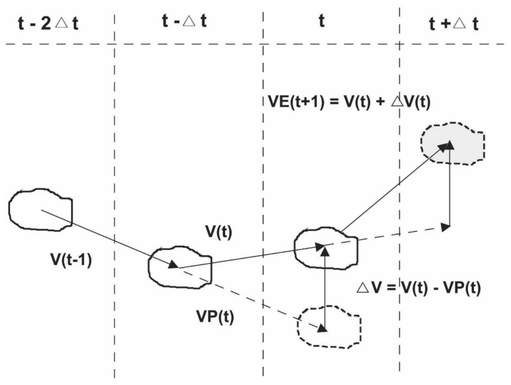



TABLE 3. ACU, BIAS, POD, and FAR for 30-, 60-, 90-, and 120-min forecast lead times for the period 6–11 Jan 2003.

| | 30 min | 60 min | 90 min | 120 min |
|---|---|---|---|---|
| ACU | 0.98 | 0.98 | 0.97 | 0.96 |
| BIAS | 0.96 | 0.95 | 0.91 | 0.87 |
| POD | 0.77 | 0.64 | 0.54 | 0.44 |
| FAR | 0.20 | 0.32 | 0.41 | 0.49 |

(1)At first, detect precipitation clusters

(2)Calculate the pseudo center of gravity position for each cluster

(3)If clusters overlap in two consecutive images, they are considered to be the same cluster

(4)Predicting the position at time T+1 based on the trajectory for two time-steps from T-2 to T=0

**Fig. 5: Conceptual algorithm diagram of ForTraCC (Vila et al. 2008)**

・Figure 6 shows rain clusters moving eastward despite easterly winds in the tropics, and the center of gravity position of ForTraCC captures the eastward movement of the rain clusters.

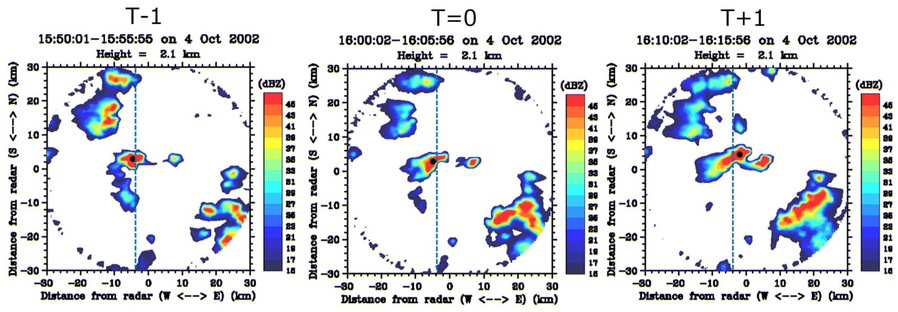



**Fig. 6: Ground-based radar snapshot of Sumatra, Indonesia**

・Figure 7 shows that the tracking accuracy of GSMaP_MVK can be improved by using ForTraCC to correct the higher-resolution cloud moving vectors.

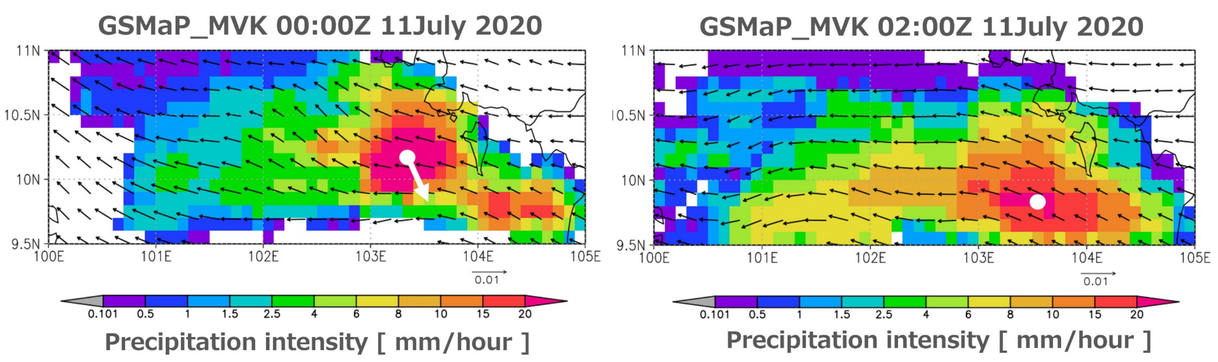



**Fig. 7: An example of comparison between ForTraCC and cloud moving vectors**

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