

## Limitation of MODIS Precipitable Water Data Product in the Sea of Okhotsk

*Kon Joon Bhang and Jin-Duk Lee  
Kumoh National Institute of Technology*

### Summary

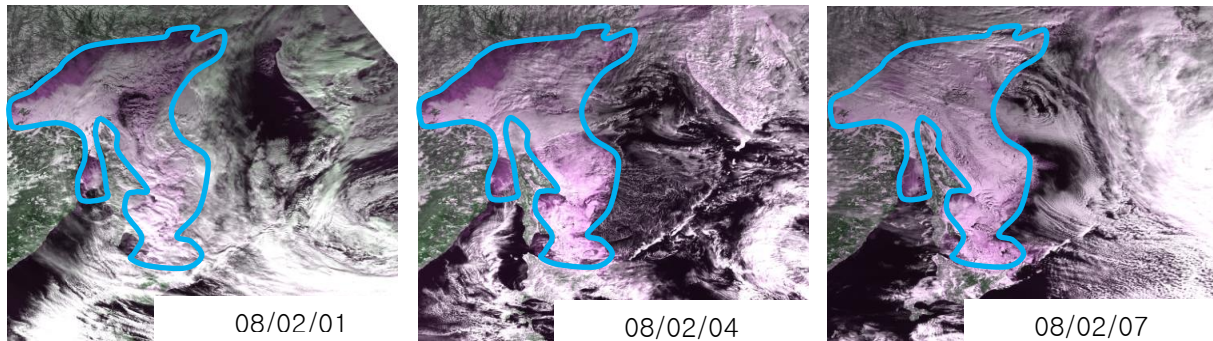
Accurate measurement of water vapor amount in the air is very important in estimating precipitation, energy balance, etc. in the climate change monitoring. We observed the precipitable water data product from MODIS to identify the data feature with the AVHRR and Landsat imagery. In most cases, the precipitable water in the East Asia is properly portrayed based on the procedure of the MODIS data processing algorithm but identifiable data gaps were found over a sea ice area such as the Sea of Okhotsk. By observation and comparison with other satellite datasets, two precipitable water data products (monthly average with and without clear sky) had precipitable water over the Sea of Okhotsk. We suspected the water vapor, cloud, and sea ice were not effectively segregated over the sea ice area. For example, the precipitable water over the Sea of Okhotsk was essentially the same as the sea ice especially during the season of the presence of abundant floating sea ice came from Alaska on February. Therefore, the precipitable water should be carefully considered in application or use of the data.

### Method

The precipitable water or column water vapor amount products from MODIS are provided through (Level 1 and Atmosphere Archive and Distribution System (LAADS) by NASA. Level 3 Monthly Joint Aerosol Water Vapor/Cloud Product of MOD08\_M3 and Level 3 Daily Joint Aerosol Water Vapor/Cloud Product of MOD08\_D3 in the Terra Atmosphere Level 3 database was retrieved using the data search tool. These data were compared with the AVHRR and Landsat satellite imagery and measured data (i.e. wind field and air temperature) to verify the status of the sea ice and cloud covers over the Sea of Okhotsk.

### Results

Figure 1 shows the natural colored satellite images from AVHRR on Feb. 1<sup>st</sup>, 4<sup>th</sup>, and 7<sup>th</sup> in 2008. The blue-line polygons are the areas covered with floating sea ice measured by Japan. The area includes cloud covers as well in the southern part (08/02/01), in the northeastern part (08/02/04 and 18/02/07) of the area. The black “C” shape in 08/02/01 almost disappeared in 08/02/07, indicating the sea ice gradually moved and some is covered by cloud. Note that the cloud pattern in each image, cloud covers in half of the bottom of the area in the 08/02/01 image, upper right part in 08/02/04 and upper part in 08/02/07. The precipitable water vapor amount should follow the density of cloud in general but it does not. Comparing to Figure 2, the MODIS daily datasets does not well matched to the cloud covers which is a part of precipitable water vapor amount. There was a small cloud cover at the bottom of the blue-lined area of 08/02/01 in



**Figure 1 Images from AVHRR**

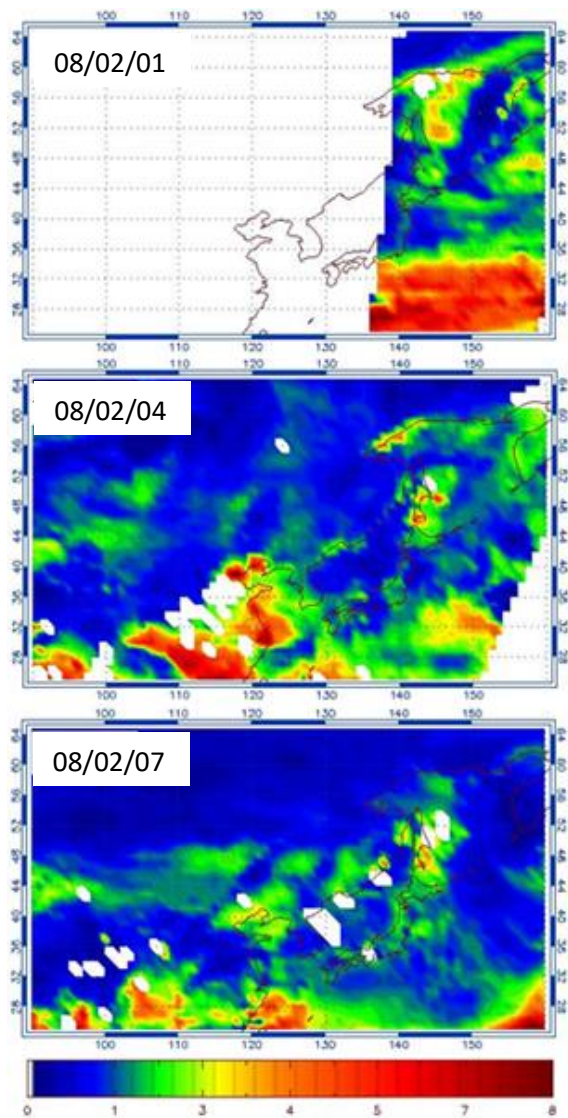
Figure 1 but dense water vapors were present in Figure 2. Also, the water vapor cover was rather more like the sea ice cover. The water vapor amount was high near the bottom of the blue-lined area in 08/02/04 and 08/02/07 in Figure 2, which is actually sea ice with the clear sky in Figure 1. Especially for 08/02/07, the cloudy area right of the blue-outlined region was fully covered with cloud but the precipitable water vapors were almost zero in Figure 2.

### Conclusion

Based on the observation, the precipitable water amount data from MODIS have a high possibility of contamination by sea ice typically over the ocean with sea ice like the sea of Okhotsk. This may cause issues in scientific analyses and applications and users should consider the drawback of the data in terms of the importance of the application accuracy. The precipitable water data product covering between 60°N and 60°S do not include the case.

### References

Lu, N., Qin, J., Yang, K., Gao, Y., Koike, T. (2011) On the use of GPS measurement for Moderate Resolution Imaging Spectrometer precipitable water vapor evaluation over southern Tibet. *Journal of Geophysical Research, Atmosphere*. Vol. 116, D23.



**Figure 2 MODIS Precipitable Water Data Product**