AMSR/AMSR-E Sea Surface Temperature Algorithm

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1. Abstract

Sea Surface Temperature (SST) is retrieved mainly from AMSR/AMSR-E 6GHz and 10 GHz vertical polarization (V) data, by using 37 GHz V and H (horizontal), 23 V, 6H, and 10H data as supplements. The current SST algorithm includes following nine procedures.
(a) Incident angle correction
(b) Atmospheric (water vapor, cloud liquid water) correction
(c) Surface wind correction
(d) Land contamination correction
(e) Removal of sunglitter area
(f) Salinity correction
(g) Removal of sea ice area
(h) Conversion to SST
(i) Spatial running mean
A target of retrieved SST accuracy is within 0.5 - 0.7℃ when compared with buoy SST.

2. Detailed data processing procedures

(a) Incident angle correction

Correction of the brightness temperature, dA, due to incident angle variation is given by the following equations;

dA= - 2.9*(A - 55.0) 6 GHz V
dA= - 2.7*(A - 55.0) 10 GHz V,

where A is the incident angle. The horizontal polarization data are also corrected by similar equations.

(b) Atmospheric correction

Correction for atmospheric opaque is obtained from a pair of two temperatures of 23 GHz V and 37 GHz V. Fig. 1 shows an example of getting the correction value for TMI 10 GHz which reads 37V and 21V to give the correction value for 10V. Because brightness temperatures of 23V and 37V are changed with SST, the table is made with 5℃ interval of SST from 0 to 35 ℃. It is necessary to omit data contaminated by rain, since SST accuracy becomes worse in rainy areas. Its judge is made by counting the number of pixels within 6 GHz or 10 GHz spatial resolution, in which the correction value shown in Fig. 1 is out of specified range. If the number of pixels with out of range is larger than a threshold, SST is missing.

(c) Surface wind correction

Correction for sea surface wind is made independently from two frequencies ;6V and 6H, and 10V and 10H, which are already corrected for atmospheric opaque. Fig. 2 shows a thematic map to make the wind correction. Brightness temperature of V polarization is almost constant under a condition of sea surface wind speed less than 7 - 8 m/s. But, the one of H polarization increases uniformly. Above 7 - 8 m/s, both brightness temperature of V and H polarization increase with wind speed, whose ratio is about 1 /1.7. This ratio may depend on a relative angle between the wind direction and antenna direction, and also on a difference between SST and air temperature.

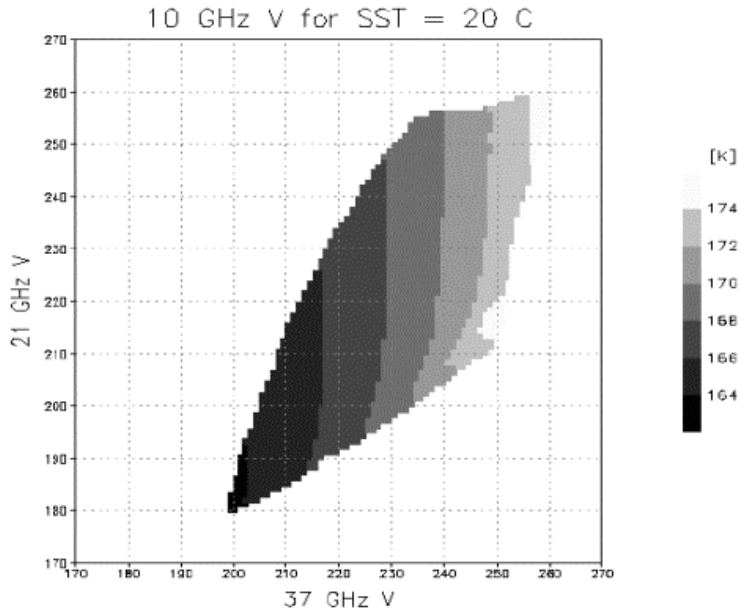

Fig. 1 Effect of atmospheric opaque for 10 GHz V

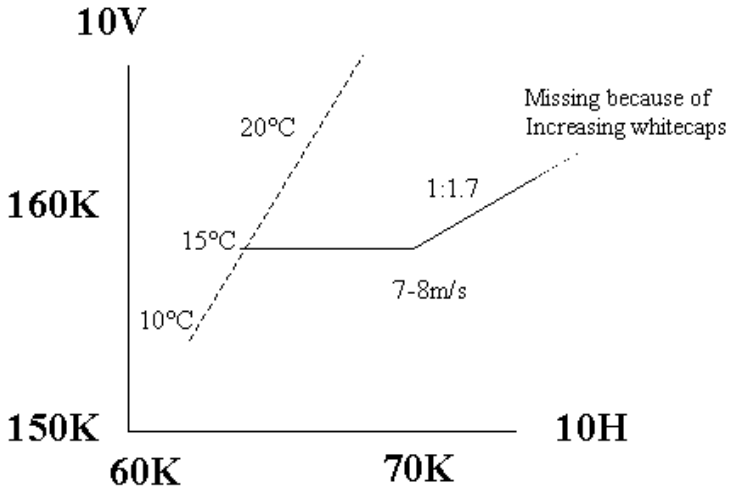

Fig. 2 Effects of surface wind for 10 GHz V and H

(d) Land contamination correction

Contamination by land emission increases drastically when the pixel approaches a shoreline, or the pixel includes an island. Here, land contamination is corrected for pixels that the increment is less than 2 K. For pixels of contamination larger than 2 K, SST is missing.

(e) Removal of sunglitter area

Sunglitter is checked by using a relative angle between the antenna beam direction and sun direction, which is given by L1B. SST is missing for pixels of the relative angle larger than 30°.

(f) Salinity correction

Salinity effect can not be neglected when SST is high as 30 °C, and the correction value is an order of 0.1 or 0.3 K. Its effect is calculated in advance by using the climate salinity, and a data set of correcting salinity effect is prepared with spatial resolution of 1 degree. This data set is not modified even after the launch.

(g) Removal of sea ice area

Sea ice will be detected by checking the value obtained from the atmospheric correction. If its value exceeds 5.5 K in the latitude larger than 65°, it is judged that the pixel is contaminated by sea ice. SST is missing when the number of pixels with sea ice contamination exceeds a specified value.

(h) Conversion to SST

The relationship between 6V (or 10V) and SST is calculated by using the complex relative dielectric constant given by Klein and Swift (1977). Fig. 3 shows its the relationship.

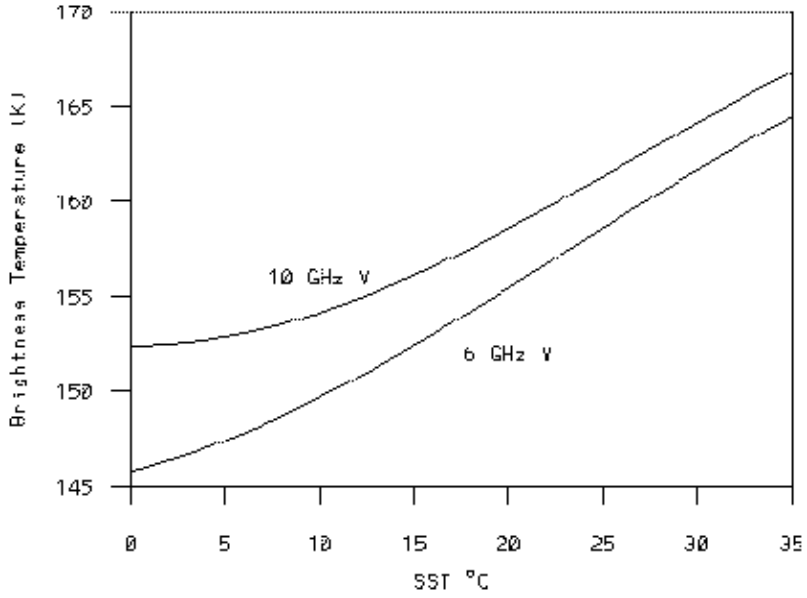

Fig. 3 Relation between SST and 6 V (or 10V)

(i) Spatial running mean

The temperature resolution at 6 GHz is about 0.3 K for one pixel, which is corresponding to about 0.6℃ of SST. It is necessary to reduce its noise. A current method is a spatial running mean with 5 pixels by 5 pixels (50 km by 50 km area). The simulation indicates the reduced noise becomes less than 0.1 K after applying 5 by 5 running mean.

3. References

Shibata A., K. Imaoka, M. Kachi, and H. Murakami (1999) :SST Observation by TRMM Microwave Imager aboard Tropical Rainfall Measuring Mission, Umi no Kenkyu, vol.8, no.2, pp. 135 to 139 (in Japanese)