1. Introduction & motivation

The Japan meteorological agency/Meteorological research institute (JMA/MRI) is working on applying a dynamic emissivity (DE, Karbou et al. 2005, 2006) method over land to the global numerical weather prediction (NWP) system of JMA. The DE is known as a good estimate method of land surface emissivity which depends on surface conditions. Therefore, we expect to improve analysis and forecast skills over land and downstream in the JMA system.


• The surface emissivity is used for the background brightness temperature.

\[ T_b(v, \theta) = T_a↓(v, \theta) + \left(1 - \varepsilon(v, \theta)\right) T_a↑(v, \theta) + T_s(v, \theta) \]  

(1)

• We estimate such a dynamically varying emissivity from observation and background.

\[ \varepsilon(v, \theta) = \frac{T - T_a↓(v, \theta) - T_a↑(v, \theta)}{T - T_s(v, \theta)} \]  

(2)

The emissivity is retrieved from eq. (1) as follows,

\[ T_b(v, \theta) \text{: brightness temperature (BT) of observation} \]
\[ T_a↓(v, \theta) \text{: surface temperature of background} \]
\[ T_a↑(v, \theta) \text{: atmospheric upwelling BT of background} \]
\[ T_s(v, \theta) \text{: emissivity from observation and background} \]
\[ \varepsilon(v, \theta) \text{: net atmospheric transmissivity of background} \]

3. Experimental settings

3.1 Configuration of global NWP system of JMA

The 4DVar system with JMA global spectral model (GSM) is used. The inner model is TL399L100 (horizontal reso. 20 km, top 0.01 hPa). The outer model is TL399L00 (horizontal reso. 55 km, top 0.01 hPa). The 6-hr assimilation window, incremental 4D-Var, and 6-hr assimilation window are applied. Radiative transfer model: RTTOV10.2. Used channels of AMSU-A and ATMS are assimilated in the global NWP system of JMA.

3.2 DE settings

The DE method is applied to surface-sensitive channels for the microwave sounders (AMSU-A and ATMS) over land.

The dynamic emissivity is estimated at 50.30 GHz (ch.3 of AMSU-A and ATMS).

The emissivity is used at 54.00 GHz and 54.94 GHz (chs. 6, 7 of AMSU-A and chs. 7, 8 of ATMS).

4. Results

4.1 Spatial distributions of emissivity and O-B statistics

The emissivity slightly decreases over the eastern Siberia and north America (Fig. 3c) due to the DE method, which improves the brightness temperature of the first guess (Fig. 3a).• On the coast lines, the emissivity in the TEST is smaller because \( T_s \) in eq. 2 may include influence from sea. We cannot clearly find the negative influence from the low emissivity on the coast lines.

4.2 Contamination of DE

Thick clouds/precipitations would contaminate the emissivity. • Over the dense vegetation such as tropical rain forests, the emissivity is generally about 0.95. • Most emissivities in the TEST are consistently estimated as 0.95 (red dots in Fig.5a). In the case A, the emissivity is estimated under almost clear-sky condition (Fig. 5b).

In the case B, the emissivity is estimated as 0.85, and there are thick clouds and precipitations (Fig. 5b).

(a) Estimated DEs at ch.3 of METOP-2/AMSU-A
(b) 1200-1259 UTC, 28 Apr.
(c) 0100-0159 UTC, 23 May

5. Summary

The DE method was investigated by using the global NWP system of JMA, and we obtained some positive impacts.

• The estimated emissivity was different from the TerraS and the test emissivity, which improves the brightness temperature observations was increased mainly over NH, which would improve the forecast.
• The thick clouds/precipitations would contaminate the emissivity.

6. Future works

• Assimilating more surface-sensitive channels (ch. 5 of AMSU-A, and ch. 6 of ATMS) over land.

• Investigating a method detecting of the thick clouds/precipitations over land to avoid their negative influence.

References


THICK CLOUDS/PRECIPITATIONS WOULD CONTAMINATE THE EMISSIVITY.