Microwave Land Surface Emissivity over Tibetan Plateau Retrieved from FY-3D Microwave Radiation Imager——Case Study

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ABSTRACT

Land surface emissivity is an important parameter used in satellite remote sensing and NWP data assimilation. Its physical properties are affected by surface type, surface roughness, surface temperature, dielectric constant, and water content, as well as frequency and zenith angle. This study presents the land surface emissivity characteristics over the third pole——the Tibetan Plateau(TP), where the current emissivity products from various sources show some significant discrepancies. The results show that the spatial distribution of the land surface emissivity was associated with the type of land surface，with a smaller difference in the southeast of the Qinghai-Tibetan Plateau. The inversion error of surface emissivity in this study mainly comes from the surface temperature of ERA-5 reanalysis data and the precipitation pixel discrimination. In order to improve the accuracy of result, and then establish a long time series of land surface emissivity database，which provides data support for the remote sensing of the geophysical parameters of the TP, further studies of quantitative error are needed.

INTRODUCTION

In recent years, there have been numerous studies to explore the uses of satellite data to construct global emissivity atlas and to use the retrieved emissivity for data assimilation (Prigent et al, 1997,2008; Shi et al., 2013; Weng and Grody, 2001; Yang and Weng, 2011; Yang and Weng, 2011). But variability of land surface emissivity are not simulated well over many surfaces types. This uncertainty is continuing to be a major problem that affects satellite data assimilation over land and remote sensing of land surface properties, such as soil moisture, vegetation water content, surface temperature and so on.

As the unique topography, variety of land cover and its important influence on weather and climate change, the TP has become a special area for scholars. The time and spatial coverage of satellite observation makes up for the limitations of conventional observations. However, there are still few studies on the surface emissivity of microwave over the TP by using the observations of space-borne microwave radiation imager.

Based on the FY-3D MWRI observation data and ERA-5 reanalysis data, the surface emissivity of the TP was investigate by using the simplified microwave radiation transfer equation in this study. Combined with the IGBP (International Geosphere Biosphere Program) land cover classification data. The spatial distribution characteristics of surface emissivity over the TP are obtained, which provides a more abundant theoretical basis for the study of the influence of this region on weather and climate change.

METHOD AND RESULT

Method

1. Microwave radiation transfer equation

- $TB = \epsilon . T_s . \gamma + T_{atm\uparrow} + T_{atm\downarrow} . (1-\epsilon) . \gamma$
- $\epsilon = \frac{TB - T_{atm\uparrow} - T_{atm\downarrow} . \gamma}{(T_s - T_{atm\downarrow}) . \gamma}$
- $T_{atm\uparrow} = \int_0^h T(z) . \tau(z) . e^{-\tau(z,h)/\mu} dz;$
- $T_{atm\downarrow} = \int_h^0 T(z) . \tau(z) . e^{-\tau(z,0)/\mu} dz;$
- $\gamma = e^{-\tau/\mu}$

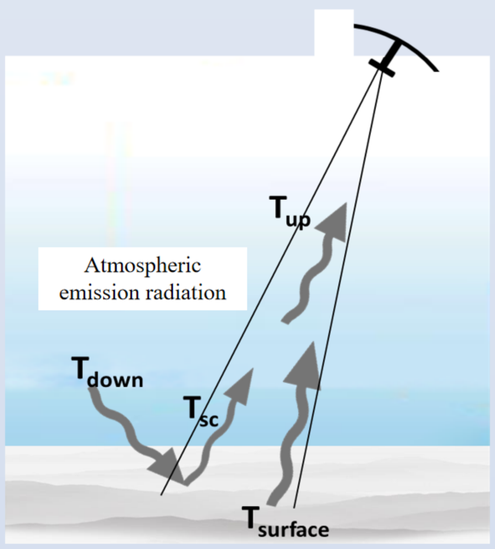

Figure 1. Microwave radiation transfer equation schematic diagram

2. Match the reanalysis data

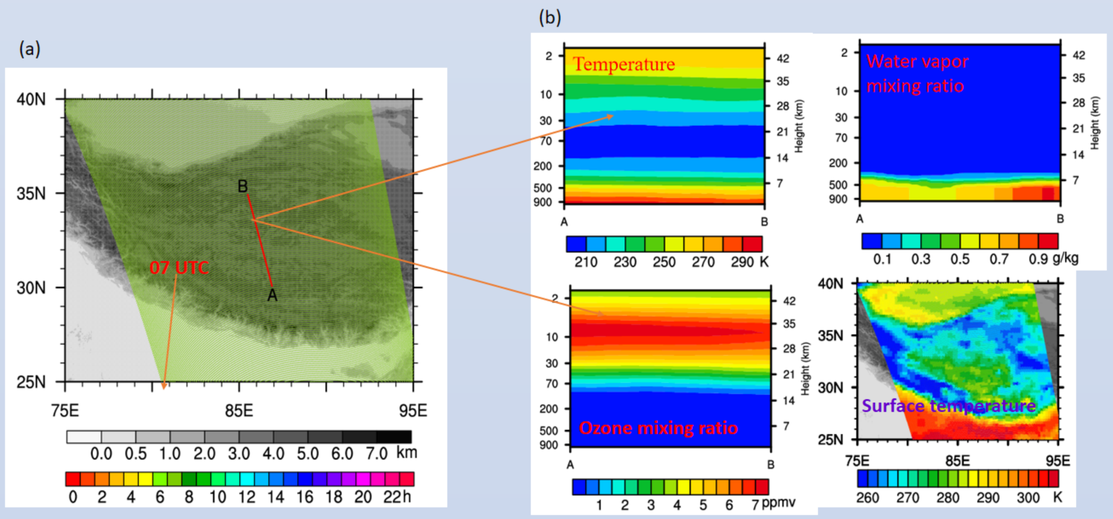

Figure 2. (a) The part of the 20190206.0648 orbit and (b) the matched reanalysis data

3. IGBP land cover classification

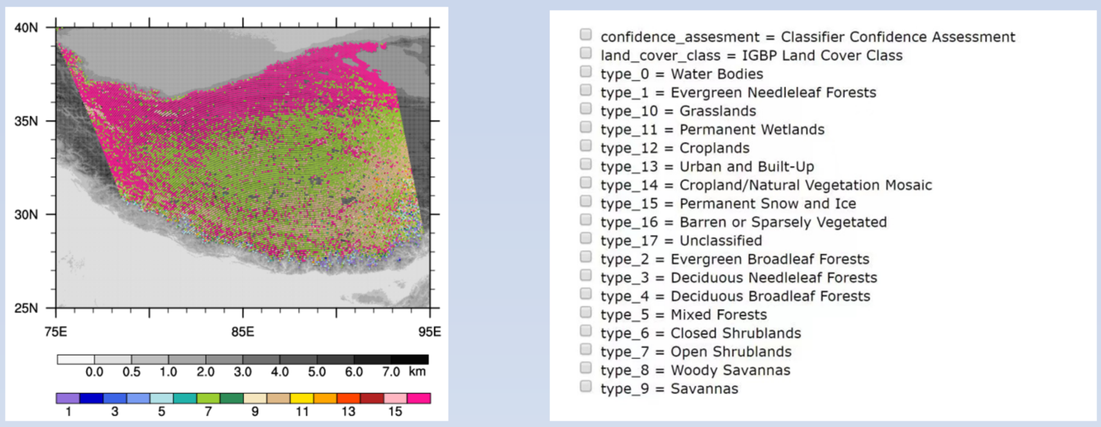

Figure 3. IGBP land cover classification of the part 20190206.0648 orbit

4. Clear sky classification

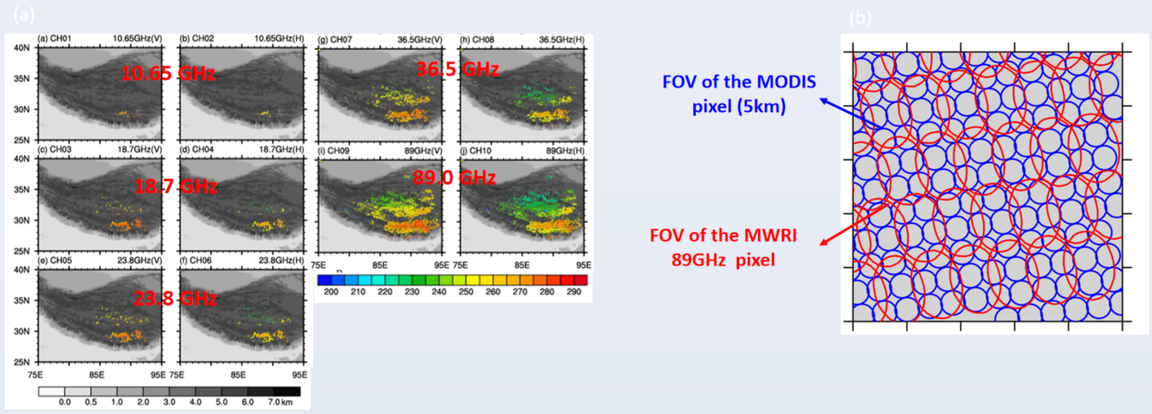

Figure 4. (a) Clear sky pixel of the different channel, (b) the FOV of the MODIS pixel (5km) and the MWRI 89 GHz channel pixel

Result

1. The microwave land surface emissivity of the 20190206.0648 case

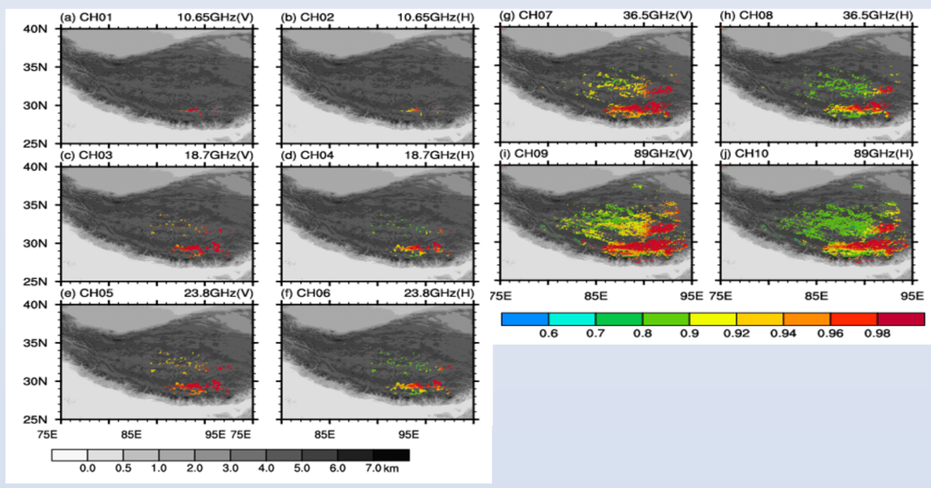

Figure 5. The spatial distribution of the microwave land surface emissivity with different channels for the 20190206.0648 case

2. Microwave surface emissivity of different land cover

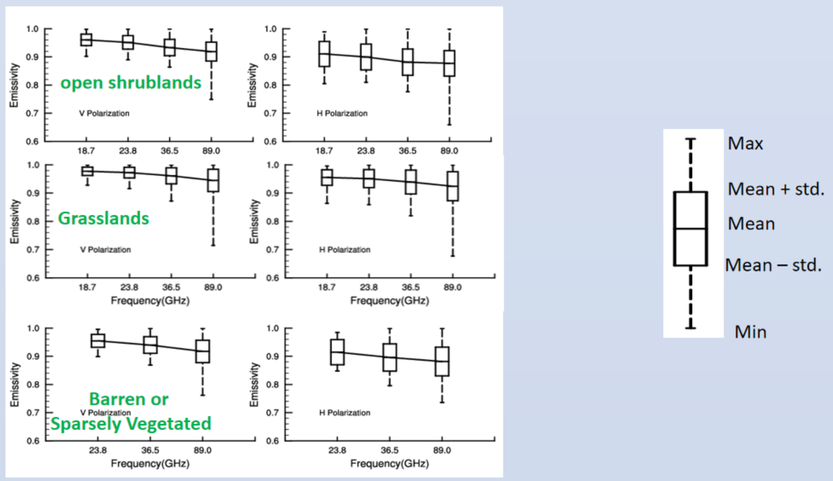

Figure 6. The microwave land surface emissivity of the different land cover

SUMMARY AND FUTURE WORK

In this case, the result show that microwave land surface emissivity of microwave in the clear sky over the TP is basically above 0.7, and the spatial distribution of the microwave land surface emissivity was associated with the type of land surface，with a smaller difference in the southeast of the TP.

The microwave surface emissivity of grasslands is higher than that of the open shrublands and the barren sparsely vegetated.

Our next studies will include 1) using 1D-Var algorithm to retrieved the microwave land emissivity over the TP，(2) The emissivity from different databases is then compared, (3) a long-time series of microwave land emissivity dataset over the TP based will be established in connecting FY-3D MWRI data with other emissivity datasets.

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