Impact Study of the Assimilation of Surface Sensitive Microwave Radiances in the GEOS

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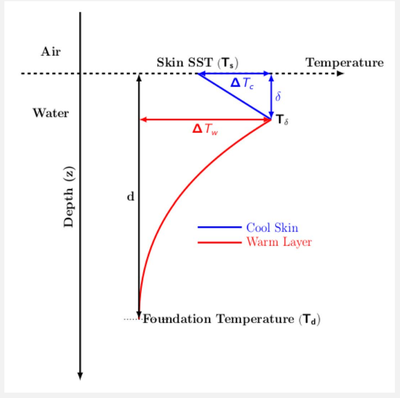
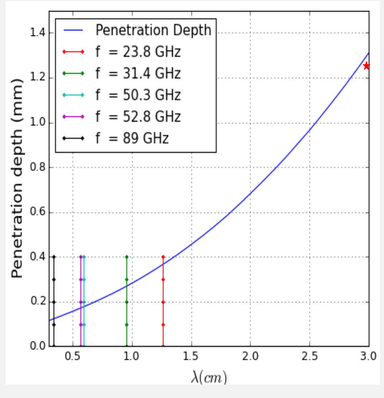
Motivation

The aim of this study is to investigate the feasibility of assimilating low frequency microwave observations from different satellite Microwave radiometers such as the Advanced Microwave Sounding Unit-A (AMSU-A). These observations are relevant to the description of air temperature, humidity, and surface parameters such as ocean surface temperature. Their assimilation into Goddard Earth Observing System (GEOS) modeling and assimilation system helps better constrain models in regions where very few observations are assimilated. In recent years, Channels 1–4 and 15 have not been assimilated in GEOS because of their large sensitivities to uncertain surface parameters such as emissivity and skin temperature.

Variation of temperature with depth & Penetration depth

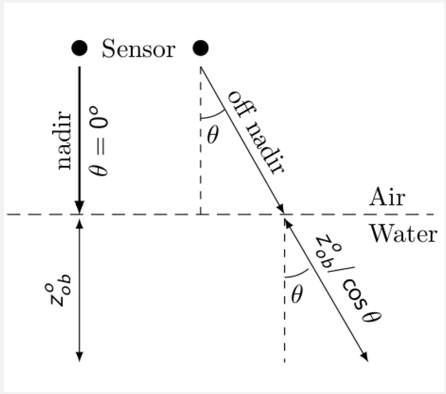


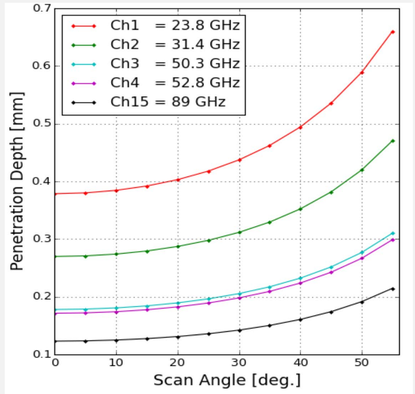


$$\frac{\partial T}{\partial z} = \begin{cases} \Delta T_c/\delta & \text{if } 0 \le z \le \delta \text{ (Cool Layer)}, \\ -\mu \frac{\Delta T_w}{z-\delta} \left(\frac{z-\delta}{d-\delta}\right)^{\mu} & \text{if } \delta < z \le d \text{ (Warm Layer)}. \end{cases}$$

$$\mathcal{C}_{T_B} = T_B^{new} - T_B = H[T(z_0 + \delta z)] - H[T(z_0)] = \frac{\partial T_B}{\partial T(z)} \frac{\partial T(z)}{\partial z} \delta z + O(\delta z^2).$$

Penetration depth scan angle dependence



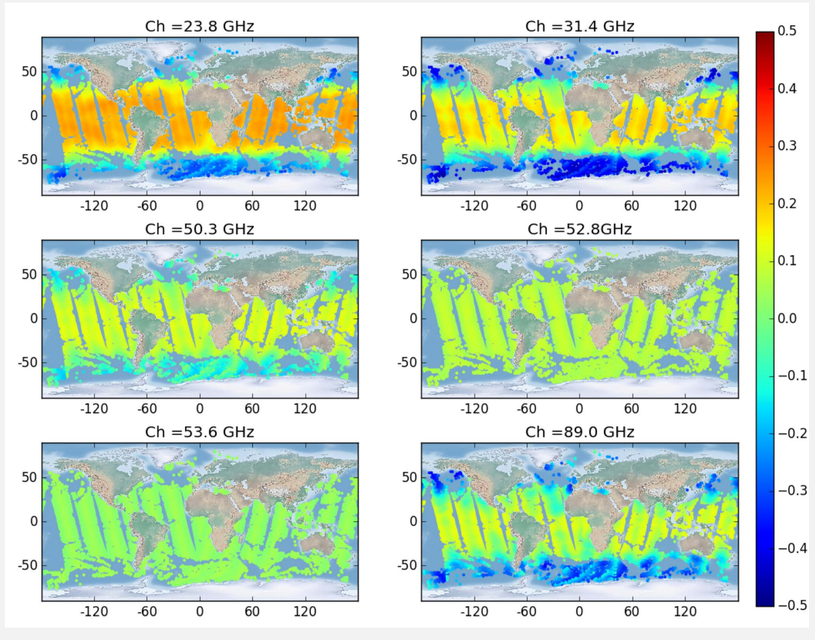


$$z_{ob} = z_{ob}(\theta = 0)/\cos\theta, \text{ where } z^o_{ob} = z_{ob}(\theta = 0)$$

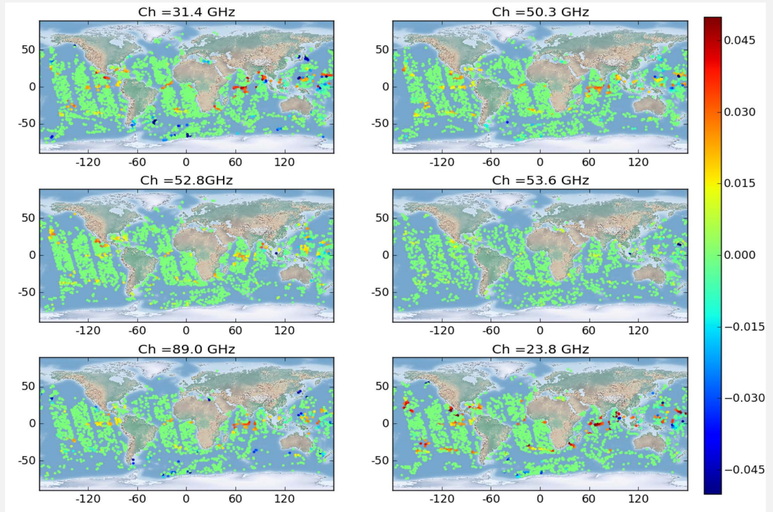
Results

All 15 Channels of AMSU-A has been assimilated, but just Channels 1-5 & 15 have been presented

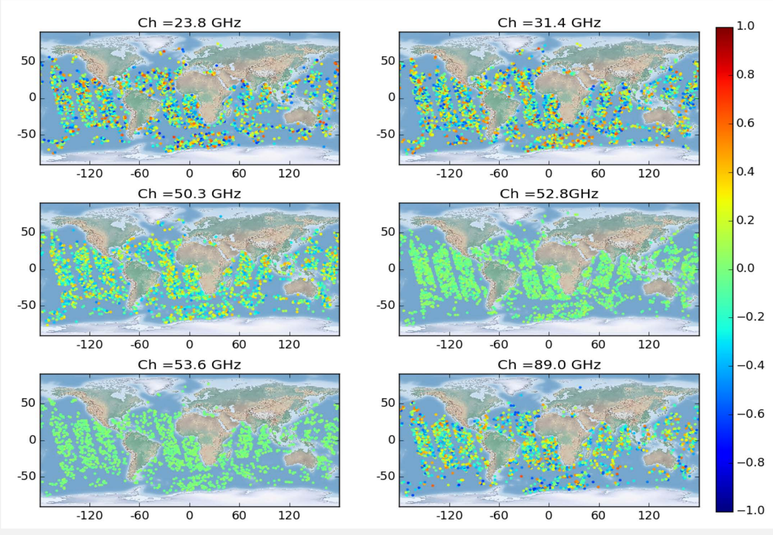
dTb / dT(z) for AMSU-A on MetOp-A on 20170209



C_{Tb} for AMSU-A on MetOp-A



Observation - Forecast for AMSU-A on MetOp-A



Conclusions

Initial attempt to assimilate surface sensitive channels have been performed in GEOS system. Penetration depth changes vs frequency and scan angle changes and it's effect on measured Tbs has been investigated which is negligible. A further investigation is needed, and we are going to extend this study to lower frequencies.

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