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Interpreting timeseries of microwave brightness temperature in Antarctica using dynamic modeling.

G. Picard (1), L. Brucker (1), M. Fily (1), H. Gallée (1), G. Krinner (1)

(1) Laboratoire Glaciologie et Geophysique de l'Environnement CNRS / Université Joseph Fourier - Grenoble 54 rue Moliere 38400 St Martin d'Heres, France phone : +33 476 82 42 53 fax : +33 476 82 42 01

Evolution of microwave brightness temperatures as measured by SSM/I or AMSR passive radiometer is strongly related to surface temperature in Antarctica. This motivates research for retrieving surface temperature from these quasi-daily observations available for nearly 3 decades. However, the relationship is complicated by two problems: the microwave emissivity and the wave penetration. This paper focuses on the latter issue and uses a simple physically-based dynamical model to interpret the temporal variations of microwave brightness temperatures in Antarctica. The model takes surface meteorological variables from ERA-40 reanalysis as input and predicts top-of-atmosphere brightness temperature. It includes a surface scheme, the thermal diffusion within the snowpack, the snowpack microwave emission, and the atmospheric emission and transmission. Each component is relatively simple and requires estimation of several unknown parameters. Once optimized, the model shows surprisingly good performances in the dry zone (where snow never melts): daily brightness temperature is predicted for 1993-2002 with a RMSE ranging from 2 K to 4 K (mean RMSE over 4 channels, 37/19 Ghz and H/V polarisations) depending on the location. The error mostly comes from the model and meteorological data and little from microwave observation noise ($\approx$ 0.5 K). Separating the model and meteorological data contributions to the error is in general difficult but using the Automatic Weather Station at Dome C (75^{o}S, 123^{o}E), we were able to identify significant errors in ERA-40 surface temperature, both at the seasonal and inter-annual scales. The spatial variations of RMSE in Antarctica seem related to the wind strength. Indeed, larger errors are found in windy

regions but the profound causes (e.g. micro-meteo, erosional surface features, snow ventilation, etc) are still unclear. The parameters estimated by optimization are analysed, especially their spatial variation. We also assess how well they are constrained by the observations. An important conclusion is that the surface scheme, while significantly contributing to the model performances, needs further improvement. Modeling the microwave emission can also be improved by adding physical processes and thus reducing the number of lump parameters.