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Normalization of microwave time series observations (1979 – 2005) : application to surface melting analysis over Antarctica and surface temperature over Canada/Alaska.

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Polar regions are anticipated to evolve significantly in response to the expected increase in temperature over the next decades. To bypass the lack of meteorological stations in boreal and austral high latitudes, remote sensing observations are the only alternative for characterizing past trends and monitoring the actual evolution. This project deals with the development of two new databases of climatic indicators (melting duration over Antarctica and summer surface temperature over Canada/Alaska) derived from satellite microwave measurements as this type of data presents the strong advantage of being slightly influenced by the atmosphere. Starting with SMMR data, observations are available since 1979 (EASE-Grid NSIDC database). However, the 1979–2005 period includes observations from 4 different sensors (SMMR and SSM/I on board DMSP F8, F11 and F13) whose characteristics vary (mainly calibration and time of acquisition). As a consequence, sensor replacement induces significant artifacts in the derived surface geophysical parameters which, in turn, bias the climatic analysis of the series. We present here two different methods to normalize temperature to overcome calibration variations and changes in data acquisition time (variable overpass time, differences between satellites and satellite drift), as well as to interpolate missing data.

Over Canada, the normalization method uses a diurnal cycle model derived from ERA40 re-analysis (ECMWF 2.5°) dataset which is fitted to the two satellite measurements available per day. The derived parameter is thus a consistent hourly series of temperatures during the summer (without snow). This approach shows that SMM/I F8 data are biased by -2.03°C over the whole Canada/Alaska area, when compared to the ERA40 – SSM/I F11 and F13 differences.

Over Antarctica, we use observations from a constellation of similar sensors observing the surface at various hours of the day since 2002 (SSM/I-F13, -F14, and -F15 and AMSR-E). We combine all these data, first to model the diurnal variations of surface melting and second to correct the time series of melting duration and extent. Results show that the unbiased time series gives a cooling trend over the 1979-199 period with a decreasing rate weaker than previously published uncorrected time series.

Both normalization approaches are discussed and analyzed.