Developments in the context of the Concordiasi project over Antarctica

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Antarctica is operationally and climatologically data sparse, due to highly limited surface observing facilities in the high southern latitudes. Satellite measurements have the potential to fill these data gaps, but they present their own unique challenges and difficulties. This is true in particular of the data provided by hyperspectral infra-red sounders such as IASI. These challenges must be overcome and errors need to be reduced to produce accurate reanalyses for climate studies that are based primarily on observed conditions.

To improve our understanding of these challenges, a field experiment was organised over Antarctica (Concordiasi, Rabier et al, 2010), and in particular over the Concordia station. It must be noted that the atmospheric temperature profiles over the area exhibit a very strong inversion at the surface, with surface temperatures colder by up to 20K than the lower troposphere, which is indeed both difficult to model and to observe. The humidity is also quite low over inland Antarctica. During the Concordiasi field campaign, special measurements were obtained measuring the atmospheric profiles together with surface parameters, synchronised with the track of the European MetOp platform with the hyperspectral IASI sensor onboard. They were then compared to IASI measurements and to the outputs of the meteorological model of Meteo-France, especially adjusted for this area (Bouchard et al, 2010). The available in-situ observations obtained at Concordia were also compared to the results of IASI data retrievals using the Met Office 1D-VAR, part of the EUMETSAT NWP SAF. It was found that the problem of correct estimation of the surface temperature was the main limiting factor in the quality of IASI retrievals. A good prior estimation of skin temperature can be estimated using the radiative transfer equation together with IASI observations. In this study, the 943.25 cm^{-1} channel has been chosen for the estimation. This window channel has a very high transmittance. The skin temperature is calculated assuming a fixed surface emissivity of 0.99. Results are presented in Figure 1. In this figure, the skin temperature retrieved from the IASI window channel (blue line) is closer to the radiosounding surface temperature (black line) than the model skin temperature (red line), in terms of magnitude and time evolution. Based on this new estimation of the skin temperature, retrievals have been performed over 44 cases during Austral spring 2008. The root mean square (rms) between analysis and radiosounding, averaged on a layer of the troposphere between 250hPa and 650hPa, has been calculated for the temperature profile. The rms has decreased of about 10% from the case with skin temperature from model (rms about 1.18K) to the one with skin temperature from IASI window channel (rms of about 1.06K). To conclude, these additional data at the Concordia station have been used to improve our use of IASI data over the region. Results have shown that special attention has to be paid to the surface temperature estimation prior to the retrieval. Other sensitivity studies are under way to understand the impact of other parameters such as bias correction and error statistics. This study has highlighted the potential of IASI observations to contribute to a monitoring of weather and climate over the polar areas.

The second part of the project is a long-duration balloon campaign that will take place above Antarctica from September 2010 to early 2011. During this campaign, 18 12-m diameter superpressure balloons will be released in the stratospheric polar vortex from McMurdo station by the French space agency (CNES) in September and October. The balloons will fly around 20 km and will carry up to 60 kg of instrumentation and flight devices. It is expected that most of the balloons will be flying simultaneously for a few months in the austral spring and early summer and provide continuous observations of the polar atmosphere during that period.All balloons will carry a small in-situ meteorological package that will measure temperature and pressure. The horizontal wind at the flight level will be monitored from the successive GPS positions of the balloons. These observations will be sent in near real time to the GTS, so as to be assimilated in the NWP systems operated by the various meteorological services around the world, and thus contribute to the improvement of meteorological forecasts. 12 balloons will furthermore carry the driftsonde gondolas developed at NCAR. Each driftsonde gondola contains about 50 miniaturized dropsondes, which can be released individually on demand during the stratospheric balloon flight to provide high-resolution profiles of thermo-dynamic variables below the balloon. During the campaign, the dropsoundings will be mainly phased with the METOP passage above the balloons, in order to provide an in-situ measurement that can be compared with the temperature profile retrieved from IASI observations. Some will also be deployed in the so-called "sensitive regions" of numerical forecasts, where small improvements in the description of the atmospheric flow can lead to large improvements in the simulation.

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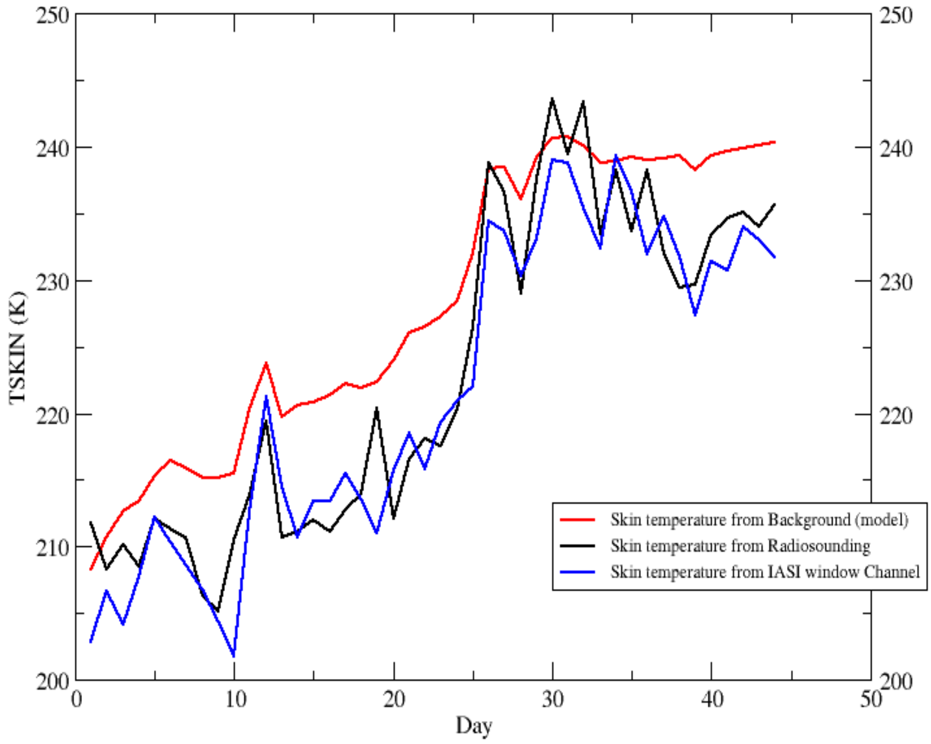

Figure 1: Skin temperature (K) from data in austral spring 2008 (44 cases between the 1st October to 29 November 2008 at 0hUTC) from Model (red line), radiosounding (black line), IASI window channel (blue line).