Surface temperature retrievals from IASI and SEVIRI channels in the convective scale numerical prediction AROME-France model

Naima Boukachaba, Vincent Guiraud, Nadia Forrrient
CNRM, Météo-France and CNRS, 42 Avenue Gaspard Coriolis, 31057 Toulouse Cedex, France
naima.boukachaba@meteo.fr

Introduction

Land surface temperature (LST) is one of the key surface parameters which indicates the energy balance at the Earth’s surface and is particularly relevant for domains such as agriculture, climatology, hydrology and weather forecasts [Kerr et al., 2004]. The retrieval of LST from remote sensing is still a big challenge basically because of cloud cover and variation of land surface emissivity. By using the approach developed by Vincenmanni [2013] to find the LST from a combination of IASI channels, a new selection of channels over land was tested to better analyse the lowest layers of the atmosphere in particular in terms of temperature. This work shows the results of the best surface-sensitive IASI channel selection for LST retrieval. For that, we first compared LST from IASI MetOp A & MetOp B. Then, we compared background (which is a short-range forecast of AROME model) LST with retrieved IASI channels LST. We also performed inter-channels IASI LST comparisons. Finally, we validated IASI surface-sensitive channel by comparing retrieved LST from IASI with retrieved LST from SEVIRI.

IASI and SEVIRI channel selection

To retrieve LST, we should have the best surface-sensitive channel. For that, we chose five IASI channels and three SEVIRI channels. The five IASI channels selected for retrieving LST are: 1027 (901.5 cm-1), 1191 (942.5 cm-1), 1194 (943.25 cm-1), 1271 (962.5 cm-1) and 1884 (1115.75 cm-1). For SEVIRI, we selected channel 01 [IR 19 (2564.10 cm-1), channel 04 [IR 8.7 (1149.43 cm-1)] and channel 07 [IR 12.0 (833.33 cm-1)]. All these channels are sensitive to surface and clouds.

Results

Background LST

Retrieved LST

The same approach used in the Guedj et al. [2011] study was chosen for the computation of LST using radiative transfer equation inversion (Equation 1):

$$LST = \frac{\Gamma}{\Delta LST} \cdot \left( \Gamma_r - \Gamma \right)$$

(Eq.1) [Karbox et al., 2006]

Where \(\Gamma_r\), \(\Gamma\), and \(\Delta LST\) represent the surface emissivity, the atmospheric transmission, and the atmospheric upwelling and downwelling radiances, respectively. The \(\Gamma\) and \(\Delta LST\) can be computed using the RTTOV model v11 [Saunders et al., 2012] given a priori knowledge of the atmosphere (short range forecasts of air temperature and humidity) [Borbas et al., Rastor, 2010]. For IASI LST retrievals, we compared two types of emissivity: constant emissivity (0.98) and emissivity atlas developed by the Space Science and Engineering Center at University of Wisconsin [Borbas et al., 2007]. In operational, retrieved LST from SEVIRI uses variable emissivity derived from EUMETSAT.

In this poster, we present only the results using emissivity atlas of 2013 (for IASI) for a study period from the 15th January 2015 till the 26th February 2015. All experiments was operated in the new configuration of AROME model with 1.5 km spatial resolution and 90 vertical levels. For the assimilation, AROME uses 3DVar data assimilation with long-range 56 forecasts every 3h.

Conclusions and future work

In order to prepare the assimilation of the new hyperspectral sensors such as IRS (which will be onboard Meteosat Third Generation and will supply for the first time measures in thousands of channels, at high-diffuse frequency “every 30 minutes” over Europe) and IASI-MB (IASI-New Generation observations embedded in AROME model, we performed a comparison between current sensors. For that, we chose to work with IASI and SEVIRI. We first compared LST retrieved from IASI MetOp A & MetOp B. Then, we compared background LST with retrieved IASI channels LST. We also performed inter-channels IASI LST comparisons. After that, we compared IASI LST vs SEVIRI LST. The results of this study has shown that IASI from MetOp A & MetOp B produces similar LST retrievals. The use of an emissivity atlas has allowed to obtain a more realistic LST compared to the results using constant emissivity (not shown). The comparison between channels in regional AROME model has enabled to select one IASI channel for LST retrieval: channel number 1191, because it provided the best results in terms of lower difference between background and retrieved LST, correlation with other retrieved LST from IASI and SEVIRI channels (we found similar results in the global ARPEGE model, not shown). The comparison between IASI and SEVIRI retrievals presented good results allowing to study the complementarity between polar and geostationary satellites. The next step is to study the impact of this retrieved LST on the simulation and assimilation of IASI surface-sensitive infrared observations in the AROME model.

References