# COMPARISON OF IASI LEVEL 2 TEMPERATURE PROFILE RETRIEVALS AND IN-SITU SOUNDINGS

Tuuli Perttula, Janne Kotro, and Pirkko Pylkkö

Finnish Meteorological Institute, Erik Palménin aukio 1, 00560 Helsinki, Finland

Tel.: +358505918218, E-mail: tuuli.perttula@fmi.fi

## ABSTRACT

The Infrared Atmospheric Sounding Interferometer (IASI) is part of the payload of EUMETSAT polar orbiting meteorological satellite Metop-A, launched in 2006. IASI measures radiances in 8461 channels (spectral range 3.62 to 15.50 micrometers). Such novel instrument has a lot of potential in different meteorological, climatological and air chemistry applications. IASI level 2 products include temperature and humidity profiles, cloud top temperature and pressure, surface temperature, and concentrations of several trace gases. Since IASI operates in infrared region only values from above clouds can be retrieved. In cloudless situations IASI level 2 temperature profile retrievals can contain values from 90 pressure levels maximum.

In this work we compared IASI level 2 temperature profile retrievals and operational in-situ soundings in Jyväskylä, Finland. The study includes quality of IASI retrievals in cases of varying vertical temperature distributions and on different altitudes. It is seen that IASI temperature profile retrievals are of good quality when temperature changes evenly but have problems observing temperature inversions. That amongst other reasons leads to IASI retrievals being of the best quality in middle troposphere and the worst near surface.

# Text

## 1. Introduction

Satellites have an important role in observing atmospheric vertical profiles. Satellites reach places like oceans where in-situ measurements are hard or impossible to make. Also, satellite measurements are done in much better spatial resolutions.

IASI is a Michelson interferometer flying on EUMETSAT polar orbiting meteorological satellite Metop-A. Metop was launched in 2006 and first IASI products were available in spring 2007. IASI measures radiances in the spectral region 3.62 - 15.50 μm (IR). IASI measurements are made every 25 km. The total swath width is 2200 km. Metop overpasses Finland 3 to 4 times a day. IASI temperature profiles are level 2 products that are processed by the EUMETSAT from the raw radiance measurements. Besides temperature profiles, level 2 products also include humidity

profiles, cloud top temperature and pressure, surface temperature, and concentrations of several trace gases (e.g. ozone, carbon dioxide and methane). The IASI temperature profile retrievals can contain values from 90 pressure levels maximum. Observations can only be done above clouds or in cloudless situations (Phulpin et al., 2007).

The goal of this work was to find out whether the IASI level 2 temperature profile retrievals can be used in the weather service in addition to the operational in-situ soundings.

## 2. Temperature profile comparison

We compared IASI temperature profile retrievals with FMI operational in-situ soundings made in Jyväskylä, Finland between 15 October and 14 November 2009 (Fig. 1). In-situ soundings were made at 18 UTC. The closest IASI soundings to the in-situ soundings in time and distance were chosen for the comparisons. Compared sounding pairs were 28 in total. The average distance between soundings was 16 km (shortest 6 km, longest 27 km). The average time difference was 30 minutes (shortest 5 min, longest 58 min).

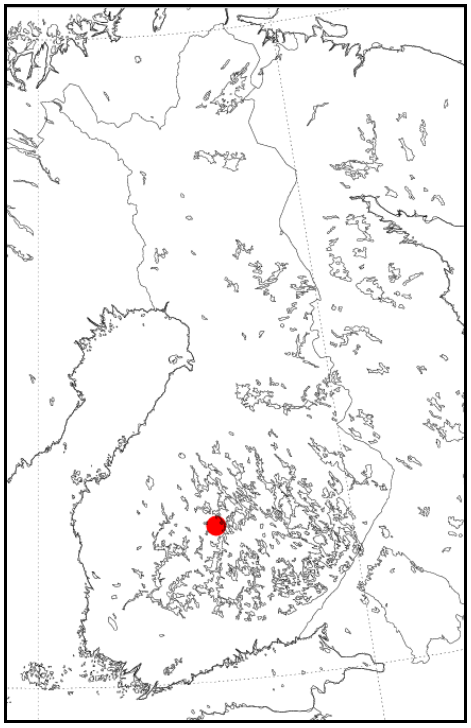

*Fig. 1: In-situ soundings were made in Jyväskylä, Finland (marked with red dot). Closest IASI soundings were compared with the in-situ soundings.*

Figure 2 shows four examples of the compared sounding pairs. These soundings were made in 15 Oct (Fig. 2(a)), 18 Oct (Fig. 2(b)), 23 Oct (Fig. 2(c)) and 13 Noc (Fig. 2(d)). Figures show that the compared soundings have values close to each other on most altitudes. However, IASI soundings have clear problems with observing inversions. This is probably due to the averaging that is made during the level 2 processing.

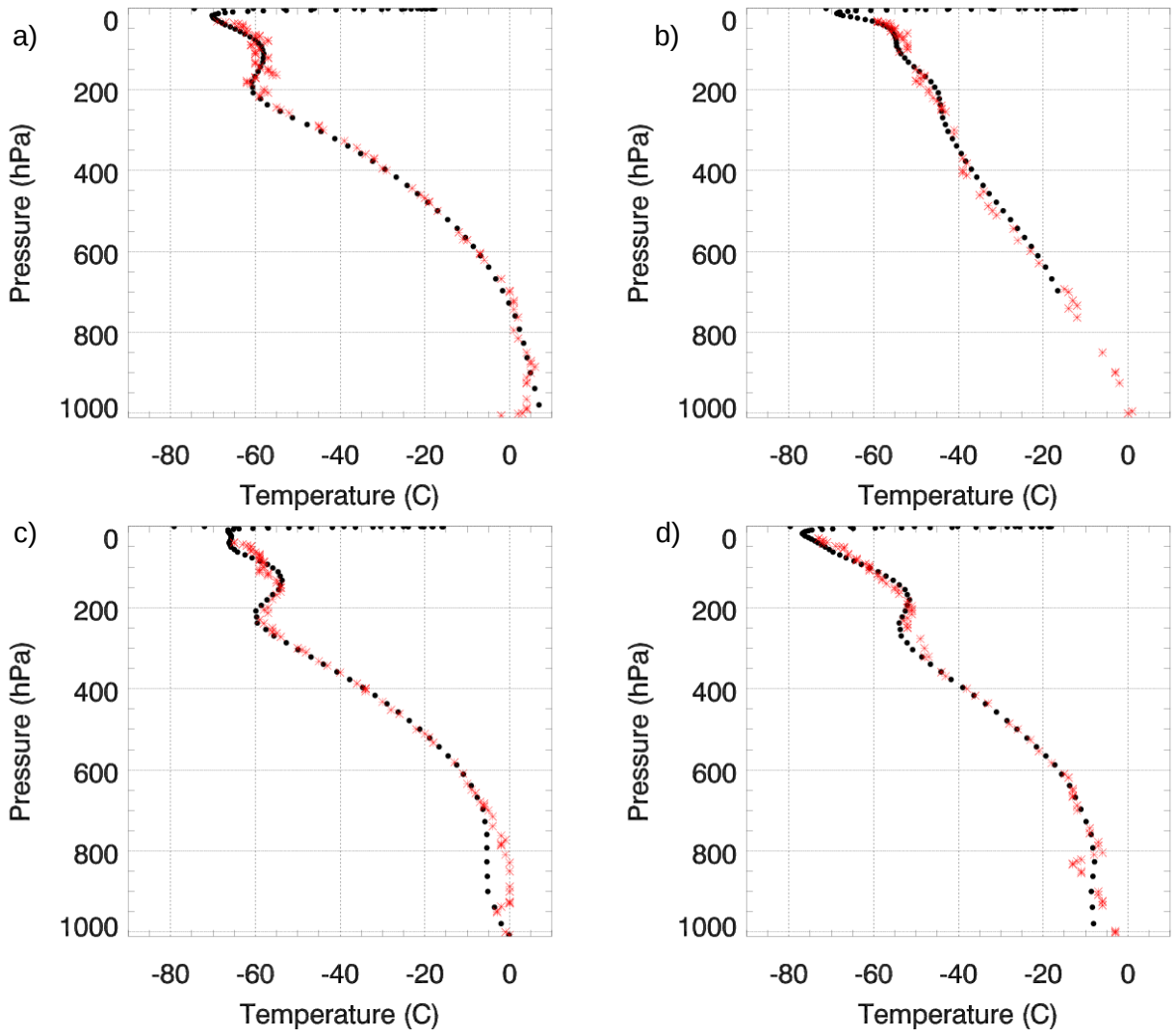


*Fig. 2: Four examples of the compared soundings. IASI soundings are marked with black dots and in-situ soundings with red stars. a) 15 Oct 2009, b) 18 Oct 2009, c) 23 Oct 2009, d) 13 Nov 2009.*

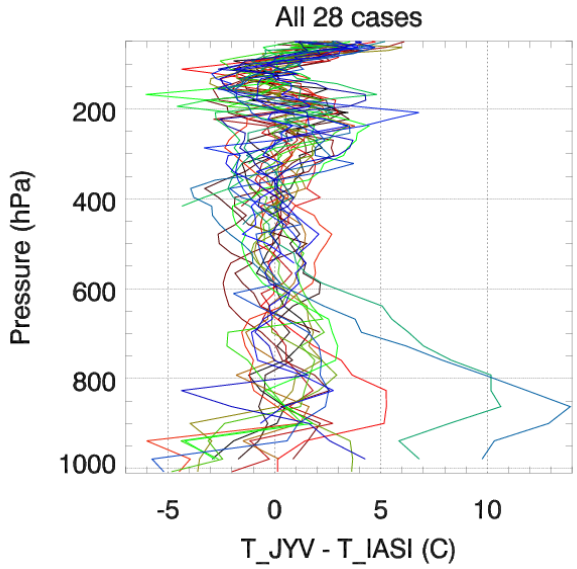


*Fig. 3: Subtraction between in-situ soundings and IASI soundings. Different comparison pairs are marked with different colours.*

Figure 3 shows subtracted values between in-situ soundings and IASI soundings. In-situ soundings were interpolated to the same pressure levels with IASI soundings to perform the calculations. Between 100 hPa and 800 hPa the subtractions are +-2 ˚C for most of the sounding pairs. Two sounding pair out of 28 have clearly larger values, the subtraction being at most +10 ˚C. Below 800 hPa the differences are from -6 to + 15 ˚C.

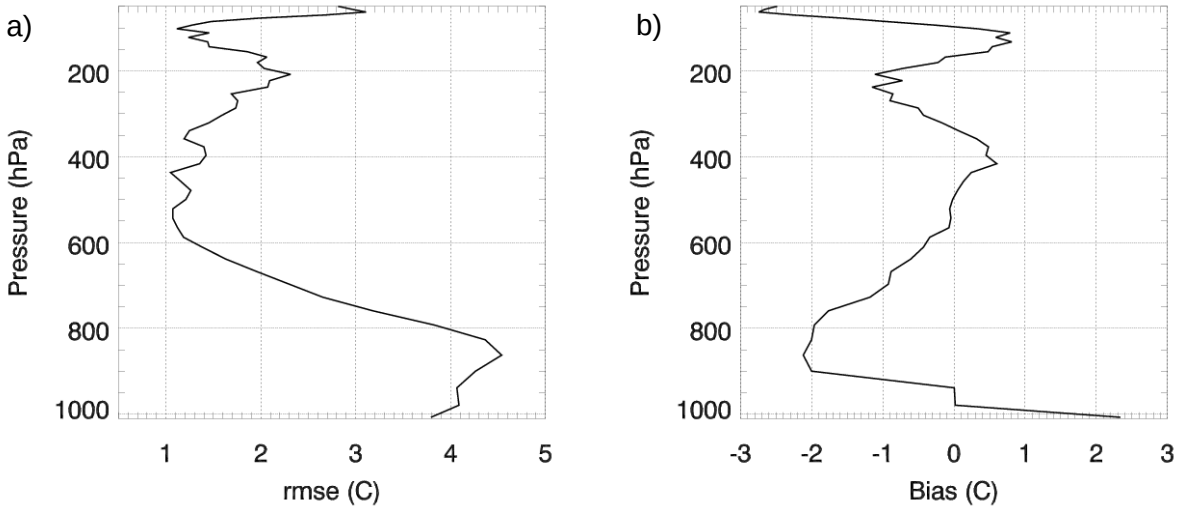


*Fig. 4: a) Rms-error of all the compared sounding pairs b) Bias of all the compared sounding pairs. In-situ soundings were interpolated to the same pressure levels with IASI soundings.*

We calculated the root mean square error (rmse) and bias for all the sounding pairs (Fig. 4). Root mean square error is about +-1 ˚C between 350 hPa and 600 hPa and grows up to +-4.5 ˚C towards the surface. There is also a peak of rmse at 200 hPa due to the tropopause at that height. The bias is negative on most altitudes and positive only at 250 hPa, 400 hpa and 100 hPa.

**3. Conclusions**

In chosen cases the IASI level 2 temperature profile retrievals seem to be of good quality above 600 hPa. However, they have some problems with the tropopause temperature inversion. Below 600 hPa the quality of the IASI soundings varies a lot and especially the surface inversions are hard to observe.

**References**

Phulpin, T., D. Blumstein, F. Prel, B. Tournier, P. Prunet, and P. Schussel, 2007: Applications of IASI on Metop-A: First Results and Illustration of Potential Use for Meteorology, Climate Monitoring, and Atmospheric Chemistry. SPIE Conference, Vol 6684, San Diego.