



# Engineering the sigma-IASI radiative transfer code



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## Introduction

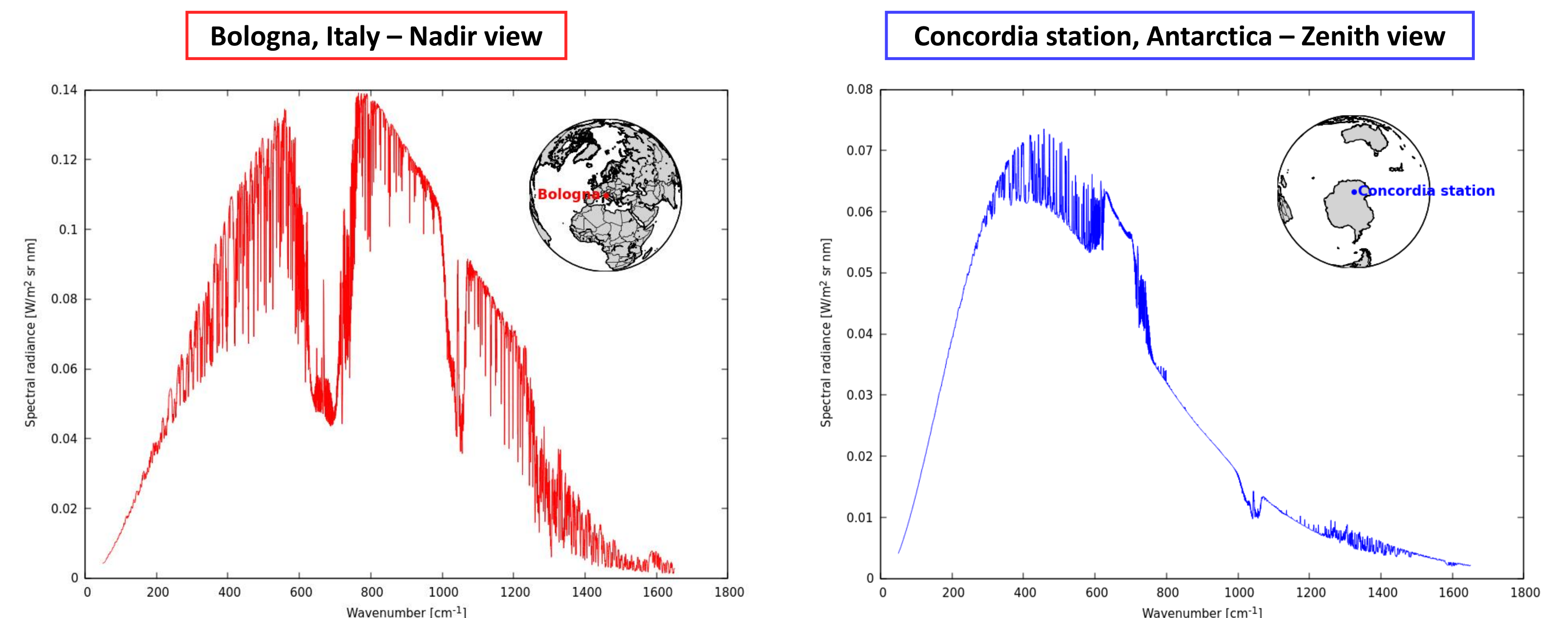
The **Sigma-IASI** is a fast radiative transfer code designed to calculate the Earth's spectrum radiance in the infrared range and the associated Jacobian matrices. Primarily developed by the University of Basilicata for the IASI (Infrared Atmospheric Sounder Interferometer) instrument, it has recently been extended, with support from ASI, to deal with clouds and aerosol presence and cover a wider spectral interval that includes the FIR band observed by FORUM (Far-Infrared Outgoing Radiation Understanding and Monitoring).

The code parameterizes optical depths as a low-order polynomial of temperature. For water vapor, it uses a different approach to account for gas concentration effects like self-broadening of spectral lines. The radiance calculations in cloudy sky conditions are based on an implementation of the scaling method that allows for multiple scattering effects. The code uses an update of the Chou method for the parametrization of the backscatter parameter. Liquid and ice clouds are accounted via the particle content and particle size.

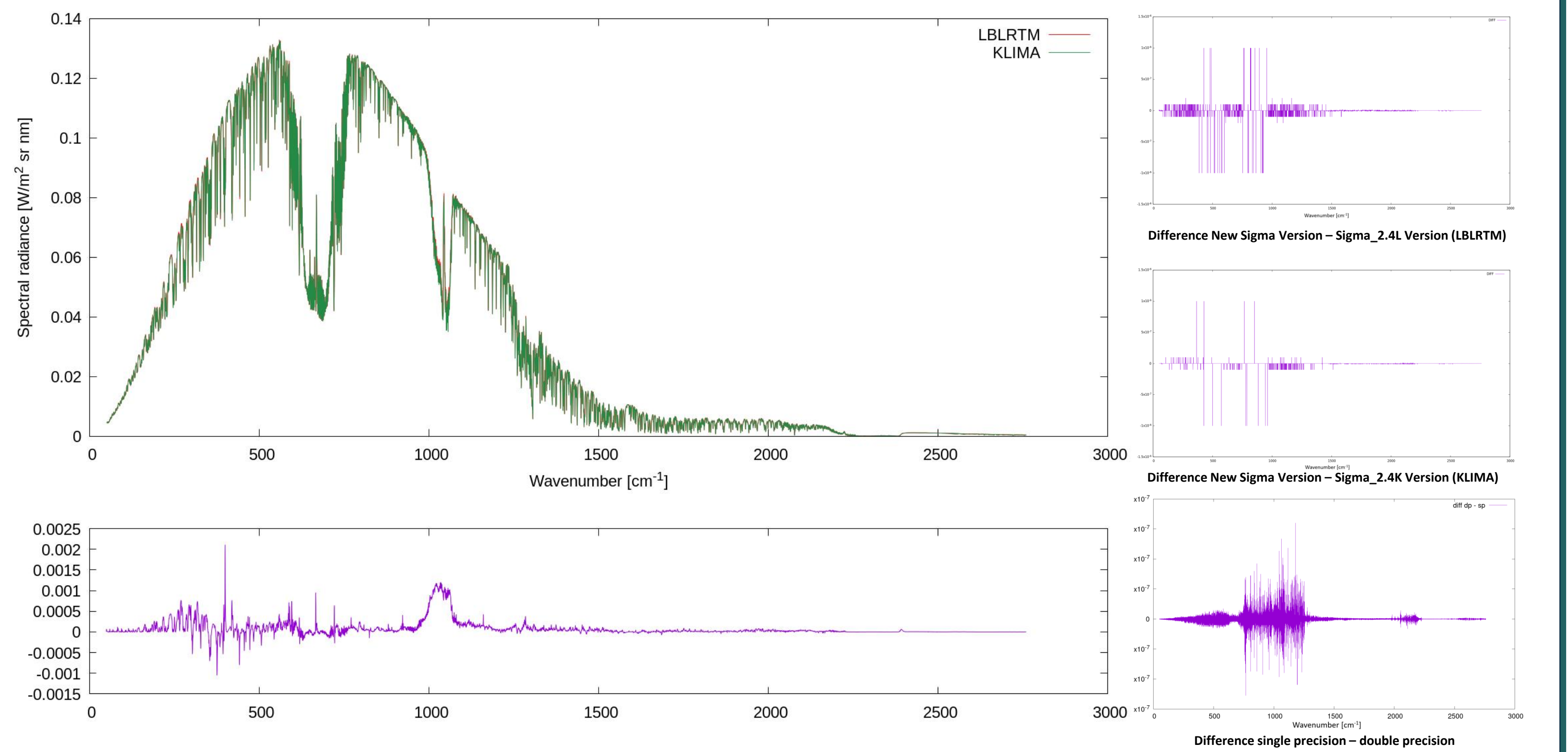
As part of the FIT-FORUM project, the code has been completely reengineering. The new version of the code has been converted to modern Fortran language. A new variable handling system has been introduced, with variables grouped using derived types (structures). The code subdivision have been rearranged, using a modular structure, where various subroutines have been reorganized and new ones added to manage specific functionalities. The interface has been modified, and error handling, absent in the original version, has been implemented. Several new user-selectable features have been introduced in the code.

## Software test and samples

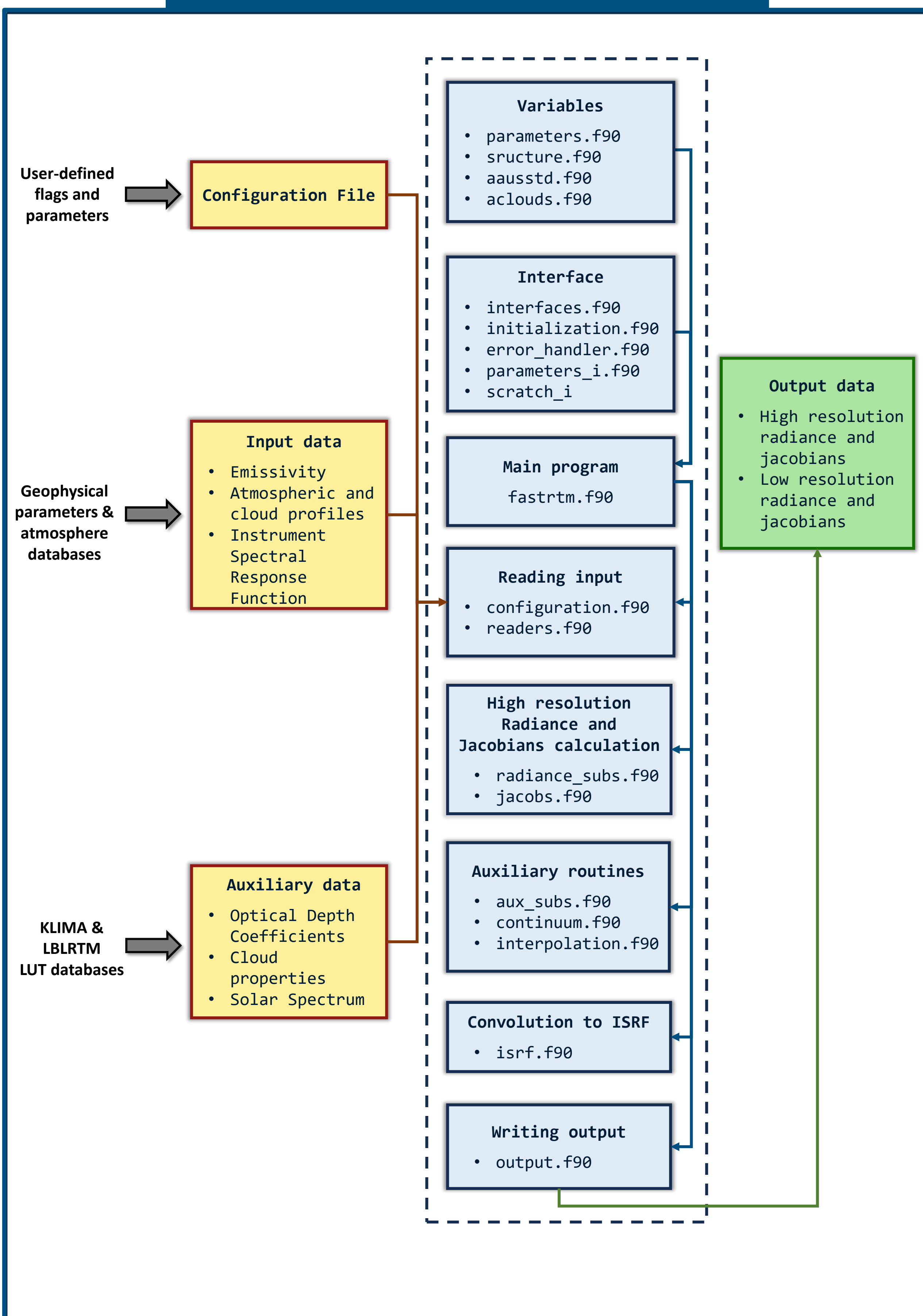
In this section we show some examples of spectral radiance computation at the resolution of FORUM instrument.



More specifically, we show the differences between the computation of radiances from LBLRTM and KLIMA databases with the new version, the comparison with the old version of the code and the comparison between single and double precision calculations. In this case, we have used a larger spectral range that the code allows to simulate.



## New SIGMA-Code structure



## Features and perspective

- The **LUT database** is now selectable via a switch in the configuration file. The available databases in this version are LBLRTM and KLIMA, each based on their respective codes. Note that the continuum model is also consistent with the selected database.
- The code can operate in either single or double precision. The single precision version of the code also preserves the distinction of variables' precision that was originally defined in version 2.4, whereas the double precision version exclusively uses double precision for all variables.
- The configuration has a switch to allow user-defined **emissivity**. In this case the emissivity is read from a file, and then adapted to the retrieval range requested in the configuration file.
- The **convolution** of the high-resolution spectrum is now more flexible. The user can directly select an ASCII file containing the user-defined ISRF function instead of using the hardwired ISRF function which was suitable for the IASI instrument.
- It is now possible to adjust the altitude profile using the hydrostatic equilibrium, instead of a preset altitude profile. This is only relevant for cloudy sky condition.

The code is currently structured as a standalone executable. A version that can be used as a subroutine to be integrated in a retrieval code is under development.

## References

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