



ESA-JAXA Pre-Launch EarthCARE Science and Validation Workshop

13 – 17 November 2023 | ESA-ESRIN, Frascati (Rome), Italy

L1 simulator tool for EarthCARE's Multi-Spectral Imager (MSI)

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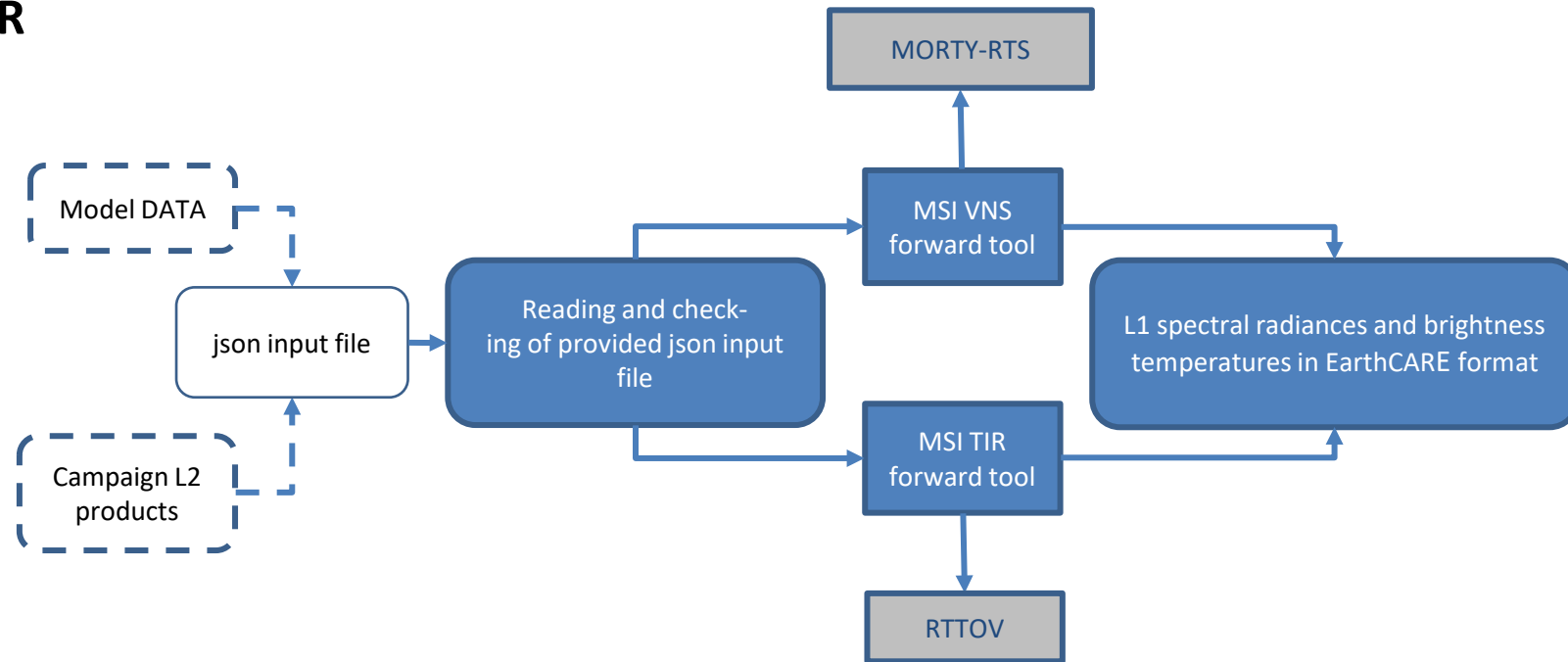
¹Freie Universität Berlin, ²TROPOS



- **Python** tool for realistic **simulations** of **EarthCARE MSI radiances and BTs**
- Input data can be from **models** or/and **measurements (e.g. campaigns)**
- Consisting of **two modules**:
 - **MSI VNS** (FUB): VIS (0.67 μ m), NIR (0.865), SWIR1 (1.65), SWIR2 (2.21)
 - **MSI TIR** (TROPOS): TIR1 (8.8), TIR2 (10.8), TIR3 (12.0)
- **Flexible** with respect to **input data** (e.g. scattering functions, number of layers etc.)
- **Tailored** for **MSI spectral channels** (accounting for smile in VNS)

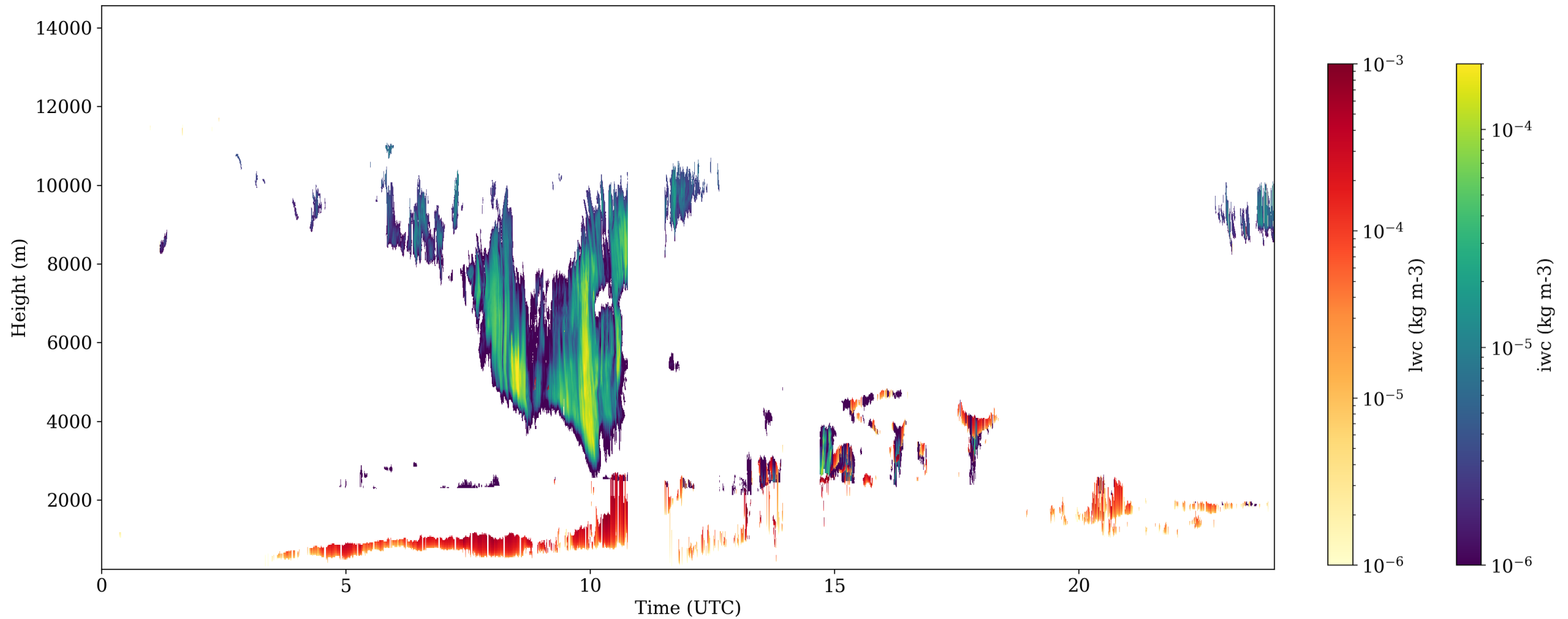


- **JSON input file** containing all relevant **information** for **VNS** and **TIR**
- **One JSON file** per column/pixel
- Reading and validation of input file
- **Radiative transfer** simulations using
 - VNS: **MORTY-RTS***
 - TIR: **RTTOV**
- Write **spectral radiances** and **BT** in **EarthCARE MSI RGR format**

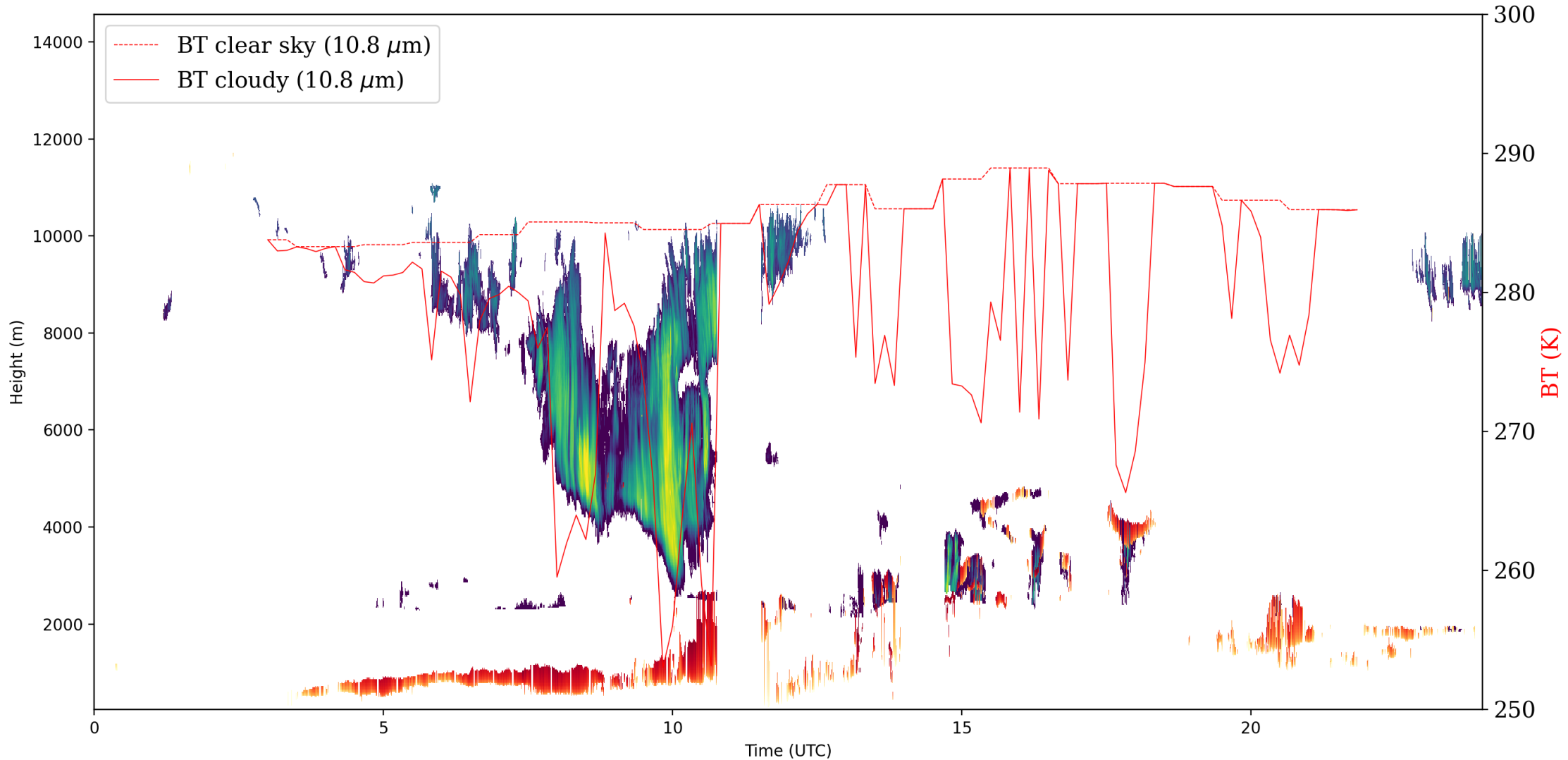


***MORTY-RTS: Matrix Operator Radiative Transfer in pYthon – Radiative Transfer Solver**

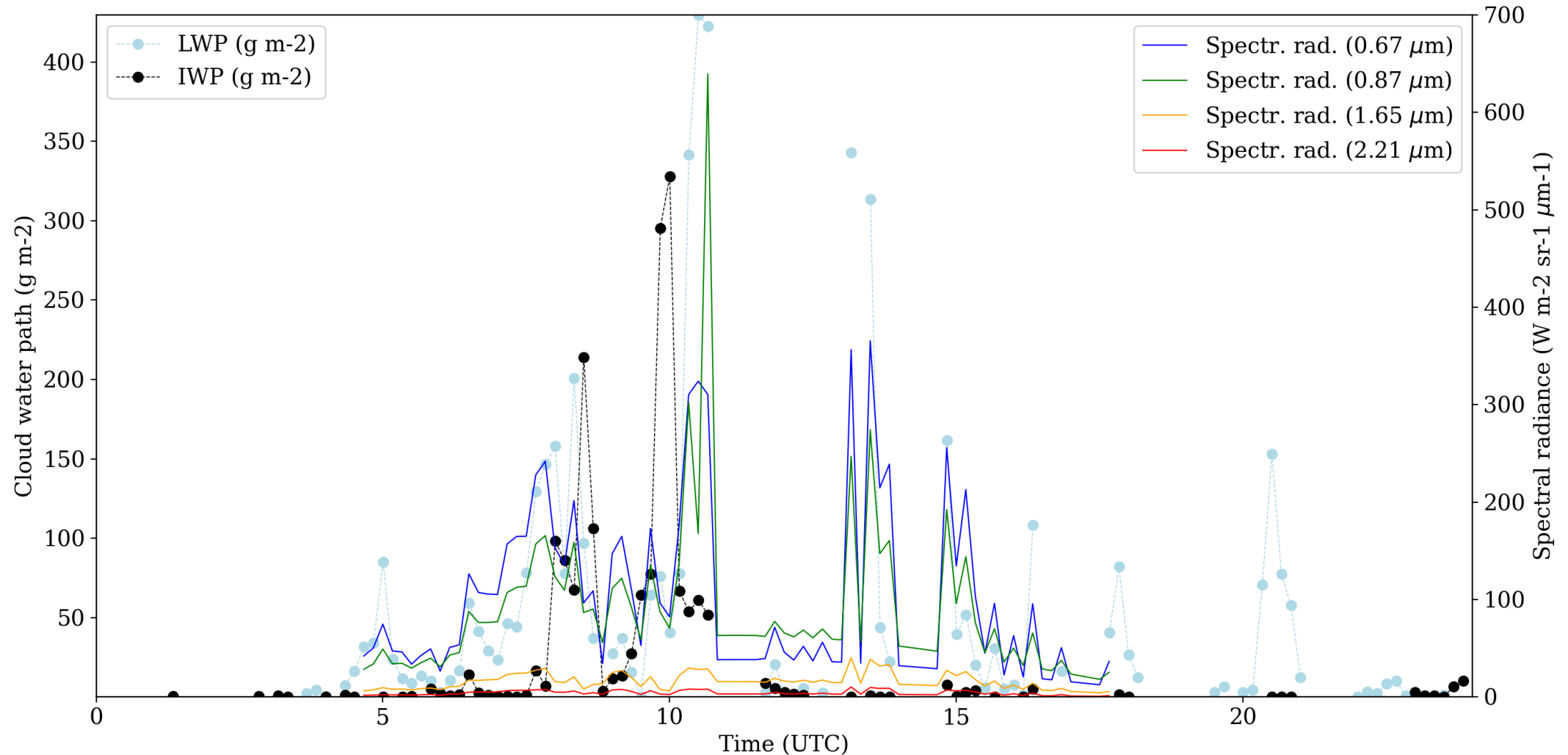
MSI forward tool: Example – Lindenberg 9 July 2022



MSI forward tool: Example – Lindenberg 9 July 2022

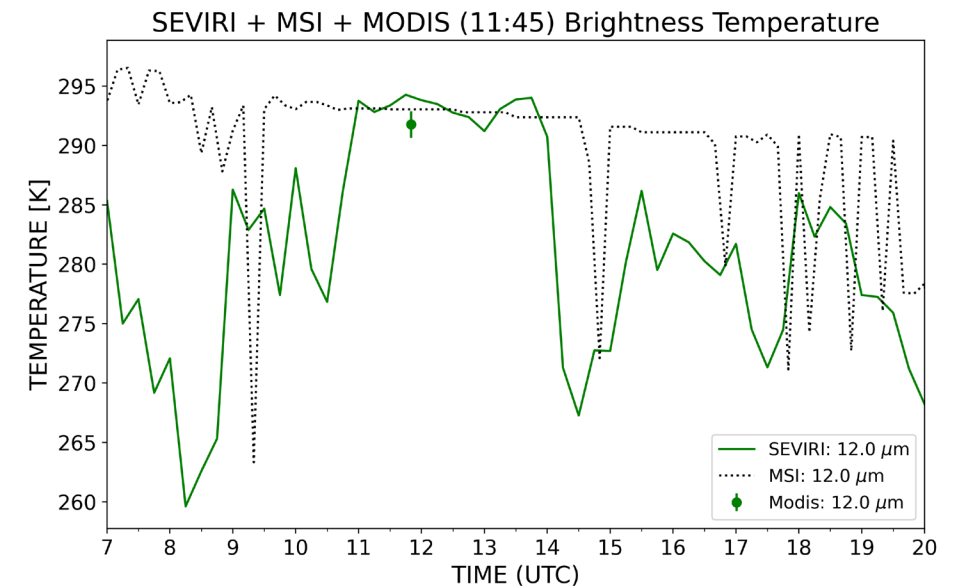


MSI forward tool: Example – Lindenberg 9 July 2022





- MSI tool **freely available** for download
- Integrated in the ESA data validation center (**EVDC**) (talk and demo by Jarek Dobrzanski on EVDC Cal/Val tools)
- Successfully tested using input from **Cloudnet and PollyXT lidars**
- First **validations** against observations from **MSG SEVIRI and MODIS** look promising



G. Walter, TROPOS

- **When?**
 - Today 17:30 during Demos/Poster Session
- **Where?**
 - Cook Room
- **Download:**
 - https://gitlab.com/wew_fub/msi-tool

Thanks!

Demonstration on how to use MultiSpectral Imager on EarthCARE forward tool (MSI-Tool)

```
[4]: from IPython.display import JSON, Image
```

```
[5]: from netCDF4 import Dataset
import plot_functions as pfun
import importlib

The path to your rttov directory is: /home/earthcare/rttov13//lib
```

Installation

- Installation of MORTY (RTS for VNS-bands), RTTOV13 (RTS for TIR-bands) and MSI-Tool following README.md
- Activate virtual environment

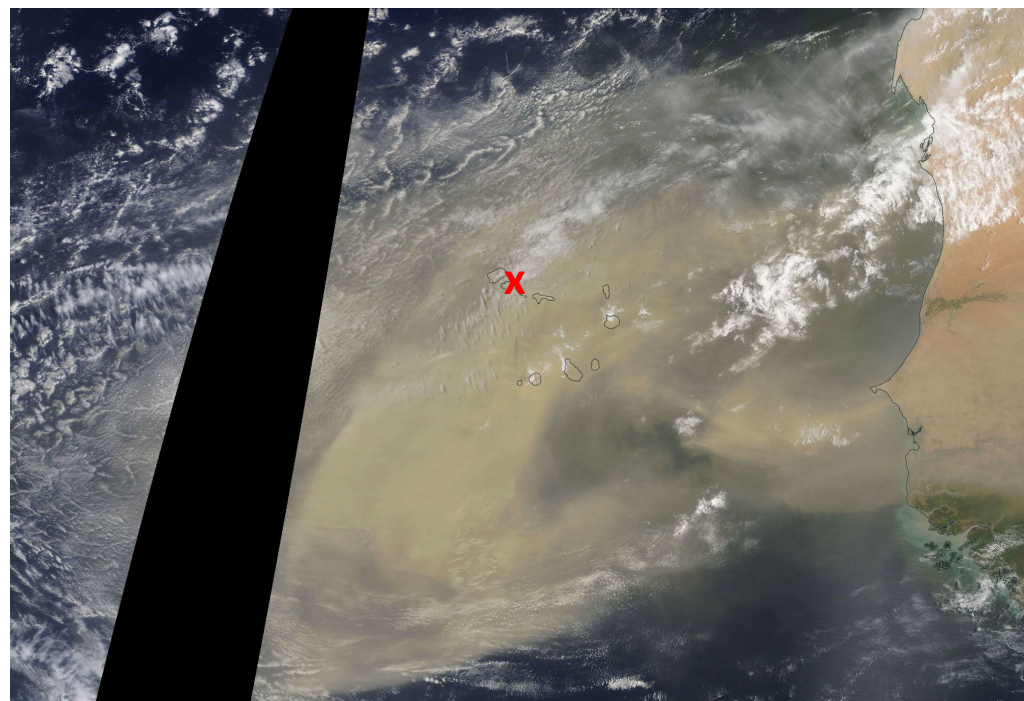
Example 1:
Liquid cloud ($\tau=3.5$) above Lindenberg

```
[6]: # Define paths for input and output files
path = './Data/'
```

```
[7]: json_input_file = 'Lindenberg_2023_02_10_15_00.json'
output_file = json_input_file[:-4] + '.hs'
Image(path + json_input_file[:-4] + '.png', width=400)
```

[7]:

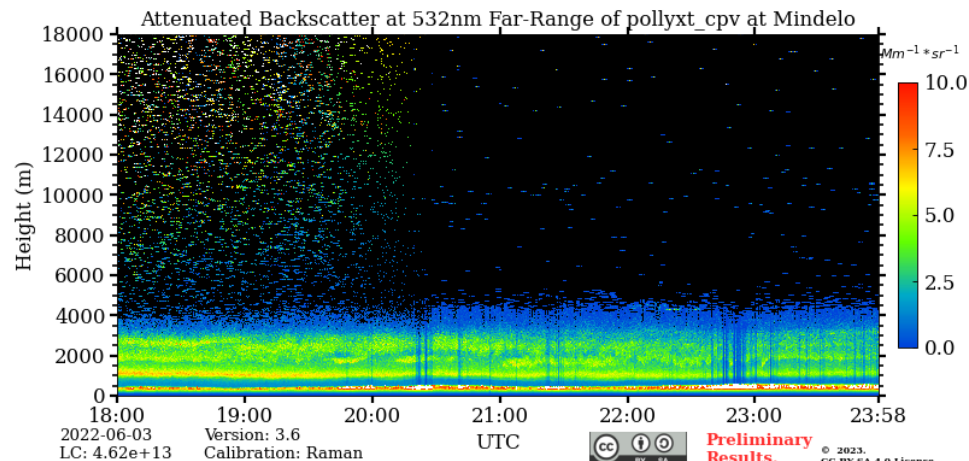
Intense dust outbreak on 3 June 2022



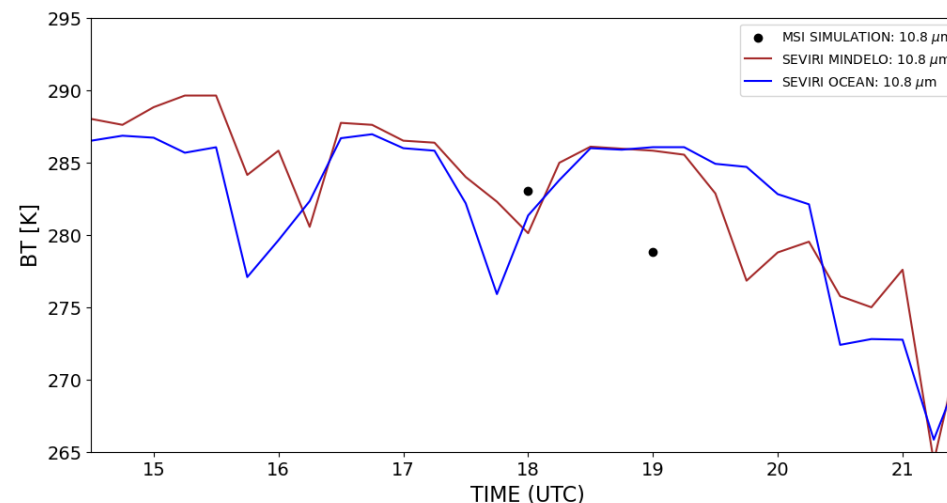
Modis Aqua 3 June 2022, 14:45 UTC

Source: <https://www.earthdata.nasa.gov/worldview>

- Simulation of strong dust events can help to improve the discrimination between clouds and aerosol in MSI scenes
- Synergy between MSI and ATLID provides a better picture



<https://polly.tropos.de/>



Simulated MSI
10.8 micron
channel and
collocated
MSG SEVIRI
pixel, courtesy
by G. Walter