METROLOGY FOR CLIMATE ACTION

26–30 SEPTEMBER 2022

Bureau International des Poids et Mesures

WORLD METEOROLOGICAL ORGANIZATION

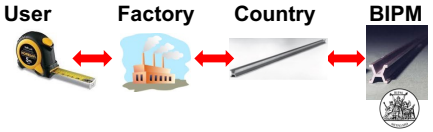
ERADIATE

supporting metrology for Earth observation with highly accurate radiative transfer simulation

V. Leroy, *Y. Nollet, S. Schunke, N. Misk, Y. Govaerts*

1 | Radiative transfer models are essential to cal/val

Calibration: unbroken chain of comparison of measurement devices traceable to SI



This cannot be done with radiometers onboard satellites.

Solution: vicarious calibration using simulated reference over well-characterised target

2 | RTMs can be improved

Modern radiometers require **simulated references with 1% accuracy**, but RTMs generally don't meet this requirement. Likely causes:

- Insufficiently accurate **absorption modelling** (may be the method or the input data)
- **1D plane-parallel** assumption (no planetary curvature, no relief, no adjacency)

Other issues:

- Difficult to use and fine-tune highly accurate models
- Compartmentalised community: subcommunities address issues but have no platform to share their advances
- Little benefit from modern technology

3 | Towards 1% accuracy with Eradiate

Highly accurate

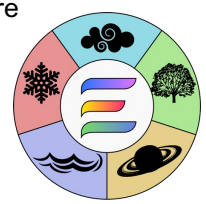
- Monte Carlo ray tracing (Mitsuba renderer)
- 3D geometry
- State-of-the-art molecular absorption modelling

Built to integrate models more easily

- Flexible platform
- Free and open-source software
- High-quality documentation

Modern software technology

- Modular design (extensible)
- Robust testing process
- Intuitive Python interface



Main features

- Hyperspectral simulation of TOA signal
- 1D plane-parallel and spherical-shell atmosphere
- AFGL (1986) standard atmospheric profiles
- 3D surface (vegetation)

5 | Outlook

Better reliability

- Compare vs other models, benchmarking (RAMI-V, RAMI4ATM)
- Compare vs observations, eventually TRUTHS

Better accuracy

- Better gaseous absorption modelling
- More scattering models

Better traceability

- Ship and handle SI-traceable data
- Use for uncertainty propagation

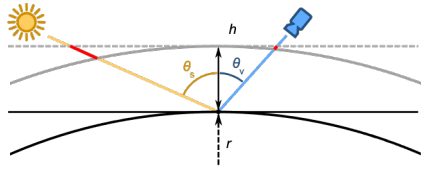
4 | Example: influence of planetary curvature

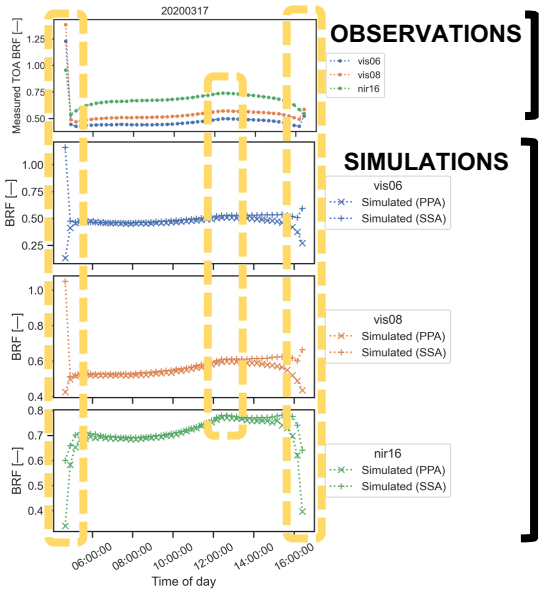
First example of SEVIRI time series (Libya 4 PICS)

- Grazing illumination in the morning and evening
- Atmospheric and aerosol data from ERA5 and CAMS
- RPV surface
- Plane-parallel (PPA) vs spherical-shell (SSA)
- WIP (simulations being improved, don't match observations very well)

Qualitative observations

- Hot spot correctly captured
- Morning and evening peaks **only visible with SSA**, yet to explain
- Important impact of SSA vs PPA at SZA > 60°





The development of Eradiate was supported by

Copernicus Europe's eyes on Earth · esa · Metrology for Earth Observation and Climate