Importance of Radiative Transfer Models in Atmospheric Remote Sensing

Isaac Moradi[1,2], Derek Posselt[3], Ian Adams[2], Patricia Castellanos[2], John Yorks[2]
1- ESSIC/CISESS University of Maryland, College Park, MD
2- NASA Goddard Space Flight Center, Greenbelt, MD
3- Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA

NASA

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Global Modeling & Assimilation Office

Summary

Radiative transfer models (RTMs) are crucial for satellite instrument development and remote sensing applications. RTMs play a significant role in Observing System Simulation Experiments (OSSE) for evaluating future satellite missions and optimizing instrument designs, leading to improved weather forecasting, climate monitoring, and Earth science applications. Additionally, they facilitate data assimilation, combining satellite observations with numerical models to enhance atmospheric predictions. However, current RT models mainly focus on operational data assimilation, limiting their application in satellite instrument development, OSSE, and studying the Planetary Boundary Layer (PBL).

Current Status

Differences between simulations conducted by different RTMs for the ATMS instrument. The differences are generally higher for the surface sensitive channels due to inaccuracy in the emissivity and lower for the temperature and water vapour sounding channels (Moradi 2020).
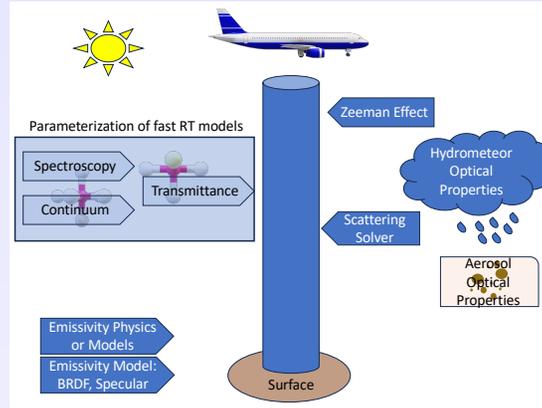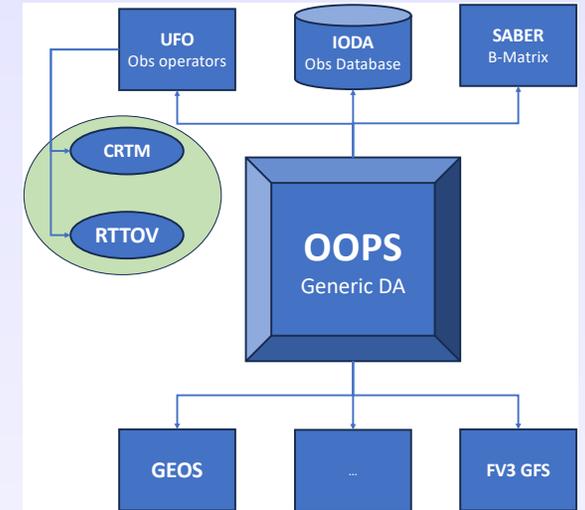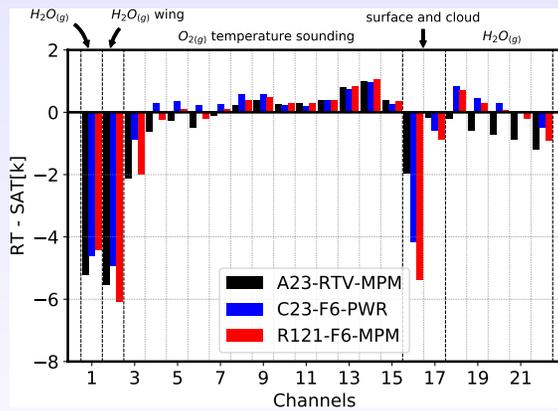
The Concept

Diagram illustrating the transfer of energy through the atmosphere, indicating surface, atmospheric, cloud, and aerosol contributions to radiative transfer.
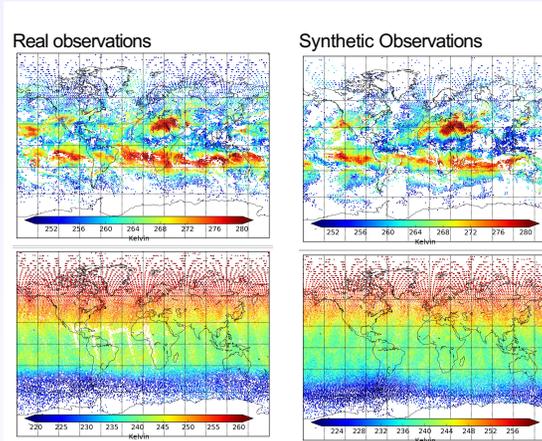

Measured infrared brightness temperatures from two channels, sensitive to water vapor (top) and stratospheric temperature (bottom), compared against simulations by a radiative transfer model. The input profiles for the RT computations were provided by the NASA GEOS model.

Applications

Schematic illustration of the Joint Effort for Data assimilation Integration (JEDI) framework, including its current operational RTMs.
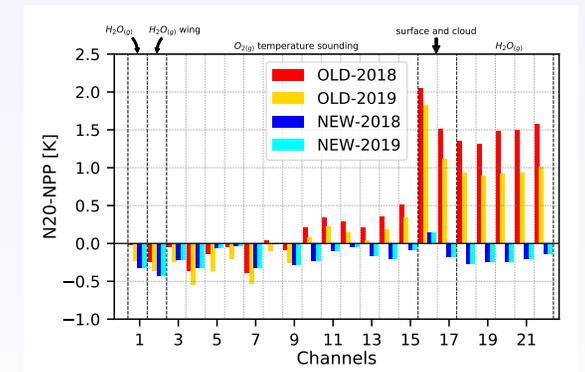
Leveraging RTMs to assess biases in observations from the ATMS onboard Soumi NPP and NOAA-20 (Moradi 2020).

Moradi, JGR 2020 DOI: 10.1029/2019JD031831

Moradi TGRS 2023 DOI: 10.1109/TGRS.2023.3330067