MC-FORUM: exploiting FORUM observations in meteorological and climate models

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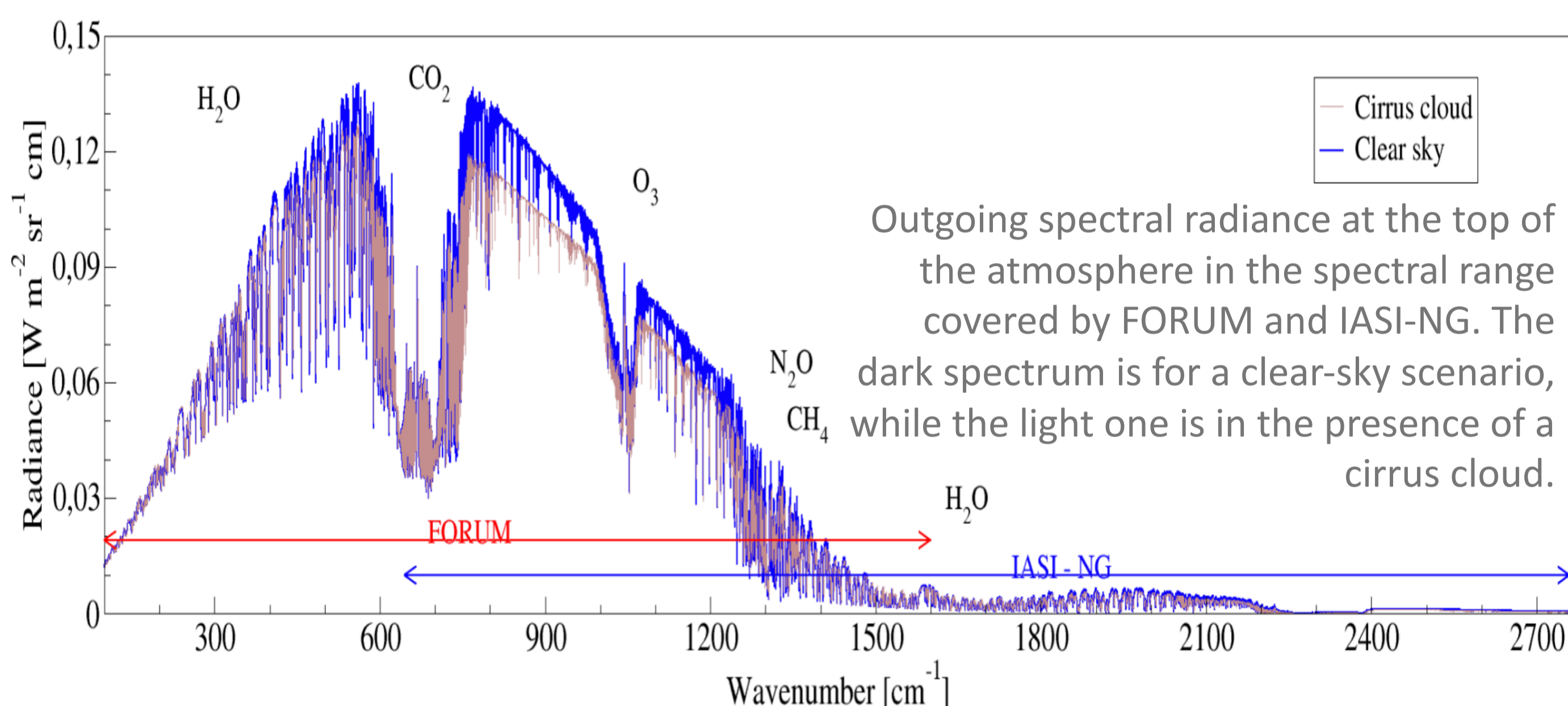
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Rationale

In meteorology and climatology, satellite observations have a crucial importance, because they offer consistent and comprehensive measurements of the Earth's atmosphere and surface on a global scale. These observations are used through Data Assimilation (DA) techniques to produce reliable estimates of the Earth system state, merging irregularly distributed atmospheric observations with short-range model runs, essentially performing an optimal space-time interpolation onto a regular grid. These gridded atmospheric states are the initial conditions for the numerical integration of weather models, for operational forecasts, diagnostic studies and the analysis of the atmospheric climate system behaviour over time.   The forthcoming ESA 9th Earth Explorer (EE9) FORUM (Far-infrared-Outgoing-Radiation Understanding and Monitoring) mission will gather spectrally resolved radiance fields in the Far and Mid InfraRed regions, covering spectral band from 100 to 1600 cm-1, with 0.5 cm-1 un-apodised resolution. Here the largest portion of the planet's outgoing longwave radiation (OLR) happens, and there are the signatures of various climate forcing mechanisms and related feedback ones, with high sensitivity to upper tropospheric water vapor and cirrus clouds.   MC-FORUM (Meteo and Climate exploitation of FORUM) is a two year project co-funded by the Italian Space Agency (ASI), started in Jan. 2024, with the primary objective of developing tools and skills to exploit FORUM in meteorology and climate.   The impact of FORUM data will be analysed on different spatio-temporal scales and with different DA techniques (variational and based on ensemble Kalman filter). Furthermore, tools will be developed to exploit FORUM measurements within diagnostic and validation activities of global climate models, to allow the study of new parameterisations and the potential of FORUM in the evaluation of radiative forcings and climate feedbacks.

Activities and connections

Outgoing spectral radiance at the top of the atmosphere in the spectral range covered by FORUM and IASI-NG. The dark spectrum is for a clear-sky scenario, while the light one is in the presence of a cirrus cloud.

Coordination (CNR-IBE)

Exploitation and Dissemination (CNR-INO)

Analysis of the radiative transfer model σ-IASI/FORUM (UniBAS-SI)

Integration of σ-IASI/FORUM in the data assimilation (CNR-IFAC)

Connection with the ASI project **FIT-FORUM** (Forward and Inverse Tools for FORUM)

Analysis of the measurement products of the FORUM mission (CNR-INO)

Study of new parameterisations, and of the potential of FORUM in the **evaluation of radiative forcings and climatic feedbacks**.
Reference model: EC-Earth3

Sensitivity of FORUM measurements in a global climate model (PoliTO-DIATI).
Use of spectrally resolved data to separate model biases in different spectral regions.
Development of tools for model diagnostics and new parameterisations.
Study of radiative forcings and climate feedbacks.

Simulation of FORUM measurements in a global climate model (CNR-ISAC). Generation of synthetic data to evaluate the sensitivity of the measurement to the model tuning parameters and to the future evolution of the climate system.

Performance evaluation of a global climate model through comparison with IASI measurements (CNR-IFAC)

Impact of FORUM data on different spatio-temporal scales, using different **Data Assimilation** (DA) techniques, variational and ensemble-based Kalman filter-like. Main reference numerical models: WRF, SPEEDY-NEMO

DA in model runs for **short/medium range** weather forecasts (CNR-IBE).
Use of variational and Monte Carlo methods based on the Kalman filter. Impact tests, using OSSEs (Observing System Simulation Experiments).

DA in coupled model runs at **medium/long range** (UniBO-DIFA).
Potential of FORUM measurements for the control and initialization of forecasts at seasonal and interannual scales.

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