Radiative Transfer and Surface Properties working group action items from ITSC-21

Marco Matricardi

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Action RTSP-1 on Benjamin Johnson: to identify specific field campaigns in support of validating fast RT models (specifically RTTOV and CRTM at first).

No field experiments have been conducted specifically for validation of fast RT models. The best option is to utilize existing field experiment data with satellite overpasses to validate individual satellite observations in cases where the surface and atmospheric column are well characterized.

General field experiment list:
https://www.eol.ucar.edu/all-field-projects-and-deployments

Microwave:
https://pmm.nasa.gov/science/ground-validation/field-campaigns
The ground and aircraft data has all been processed and validated, and incorporates several other microwave imagers and sounders. Combined datasets exist from various NASA PIs and other researchers in the GPM Project.

Infrared:
Individual sensors sometimes have their own field experiments, but there's often overlapping observations from other sensors.
IASI: JAIVEx, EAQUATE
Some sensors did not have specific field experiments for validation, so we'd have to identify experiments with overlapping observations.

Follow-on action: maintain and update list of "golden" field experiments (variety of observations, high data quality, good sensor overlap/coverage), need input from instrument scientists and other key users/developers.

Action RTSP-2 on Raymond Armante : to give feedback to the RTSP-WG co-chairs on the COMET campaign.

Note that the campaign name has changed to MAGIC. There is a web site https://magic.aeris-data.fr where information on the campaign and the related datasets is available.

Available in-situ data include Temperature, Humidity, CO_2, CH_4, CO and N_2O profiles, as well as wind and surface information. Aircraft and balloon measurements are also included in the dataset.

A “raw” dataset is currently available. A “calibrated” dataset should be available by the end of November. The use of the dataset is currently restricted but it should became openly available after the first half of next year.

Action RTSP-3 on Jerome Vidot: to provide feedback on cloud scattering validation datasets.

1) The CALIPSO and CLOUDSAT satellites on the A-Train (now called C-Train) could be exploited for cloud scattering validation:

- The combination lidar CALIOP - radar CPR provides state-of-the art retrievals of ice/liquid water content profiles and also a high quality cloud/aerosol mask.

- The IR radiometer onboard CALIPSO has collocated observations in three window channels (8.7, 11, and 12 microns) at 1 km spatial resolution. Radiances in these channels could be compared to RT simulations using ice/liquid water profiles from CALIPSO/CLOUDSAT as inputs to the calculations.

2) More recently Jerome has tried to co-locate C-Train with CrIS and he found a considerable number of near overpasses that could be used to validate scattering calculations over the wide range of frequencies offered by CrIS. There is, however, the problem of how to handle cloud heterogeneity in the CrIS FOV. For that purpose one could exploit VIIRS.

Action RTSP-4 on Benjamin Johnson: to create SRF repository and coordinate inputs from RTWG and other contributors.

The CRTM SRF repository is available to CRTM contributors, but currently not publicly available pending permissions from various data source providers. Individuals may be approved on a per-case basis.
Contact Benjamin.T.Johnson@noaa.gov

There's a public page that has a limited set of SRFs in support of GSICs requirements:
https://www.star.nesdis.noaa.gov/smcd/GCC/instrInfo-srf.php

NWPSAF SRFs
https://www.nwpsaf.eu/site/software/rttov/download/coefficients/spectral-response-functions/

Action RTSP-5 on Marco Matricardi: to contact RFM group regarding approaches to map uncertainties in spectroscopy into radiance uncertainties.

A collaboration has been initiated with Sergio deSouza-Machado at UMBC. Results on spectroscopy error mapping have been presented by

Matricardi (2018) at the ECMWF radiation workshop https://www.ecmwf.int/sites/default/files/elibrary/2018/18242-infrared-radiance-modelling-and-assimilation.pdf

DeSouza-Machado et al. (2019) in the discussion paper https://www.atmos-meas-tech-discuss.net/amt-2019-282/

Note that CO_2 spectroscopy error perturbations have not been carried out yet, because it would involve coupling to the line-by-line model line mixing code.

Action RTSP-6 on Vivienne Payne: to establish and communicate approaches to encourage/enable recommendation RTSP-8 (Characterization of LBL model biases, especially in well characterized regions of the spectrum. Attempt to map uncertainties in spectroscopy into radiance uncertainties, starting from major lines of a given region).

This action has not been completed but we had like to carry it over (pending a discussion during the current working group)

Action RTSP-7 on Claude Camy-Peret: to provide comprehensive communication to the conference co-chairs and to the RTSP-WG regarding a unified model for describing the shape of the relevant atmospheric water vapour lines from the MW to the visible including the very important TIR and SWIR regions.

Claude Camy-Peret

A unified model for the H2O lines and continuum

A unified model for describing the shape of the relevant atmospheric water vapour lines from the microwave (MW) to the visible including the very important thermal (TIR) and shortwave infrared (SWIR) regions should be promoted/supported by the agencies operating and designing satellite instruments based on spectroscopic remote sensing……

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The outcome of this coordinated effort would be a new unified parameterization of all the water vapour lines and of the H2O continuum, with a clearer and more rigorous process to separate the LBL and continuum contribution in the RTM on which would be based the fast RTM models. The corresponding parameters (and the new ones needed) should be provided in a centralized institution for testing and validation and then made available (and disseminated) to the wider community of users of spectroscopic parameters for computing atmospheric absorption/emission by the ubiquitous H2O molecule

Action RTSP-8 to the RTSP-WG Co-Chairs (Marco Matricardi and Ben Johnson): share recommendation with other relevant working groups (e.g., IPWG, Land Surface subgroup, other relevant surface research communities).

B. Johnson attended IPWG and ICWG, and presented the relevant ITSC-21 actions and recommendations at these workshops

Action RTSP-9 on Ben Johnson: to report on current developments of physical and scattering properties of aerosols, clouds, and precipitation to the RTSP working group.

***Ice Clouds and Precipitation**:*

Scattering/Absortion properties:
UV - Far IR: http://stc-se.com/data/bbaum/Ice_Models/UV-FarIR_SpectralModels.html

Microwave and Submillimeter:
State of the art for Microwave: ICE DB includes ADDA, DDSCAT: https://rhoneyager.github.io/libicedb/notes.html
Characteristic Basis Function Method (CBFM): https://www.e-fermat.org/files/communication/1536a937390006.pdf
Individual snowflake and ice crystals (SNOWFAKE): https://journals.ametsoc.org/doi/pdf/10.1175/JAMC-D-15-0130.1

***Aerosols**:*
Scattering / Absorption properties:
MOPSMAP: https://mopsmap.net/
CMAQ Specifications: https://www.epa.gov/cmaq/cmaq-models-0
NAAPS: https://www.nrlmry.navy.mil/aerosol/

Index of Refraction of dust:
Stegmann et al.: https://www.sciencedirect.com/science/article/pii/S002185021730071X

Missing: updated indices of refraction across range of relevant sensor frequencies for other aerosol types, particularly lacking in the community is Far-IR support.