



Radiation and Synergy Sessions Summary

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2nd ESA-JAXA EarthCARE In-Orbit Validation Workshop

17 – 20 March 2025 | ESA-ESRIN | Frascati (Rome), Italy

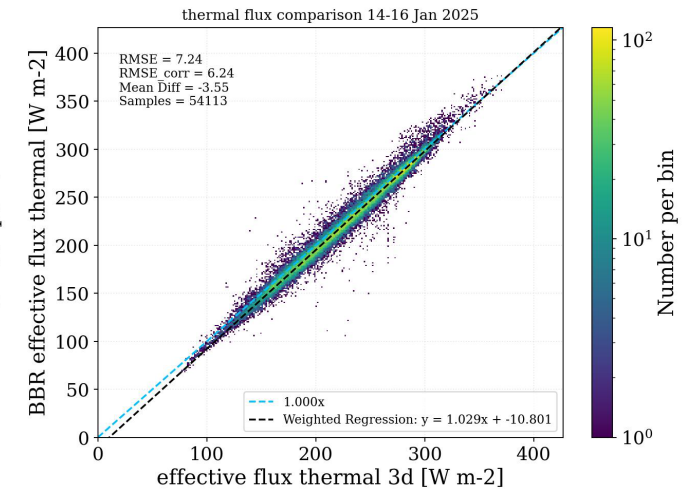
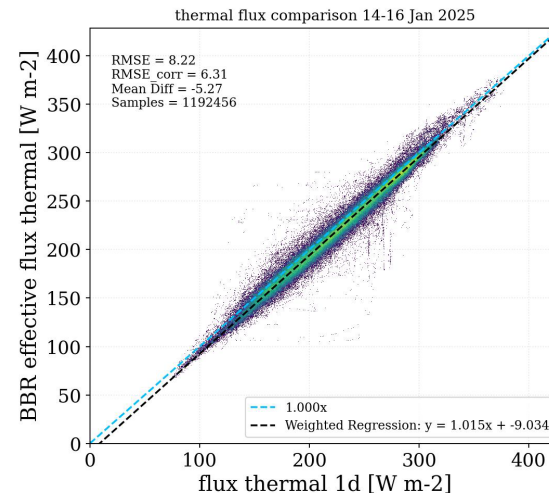
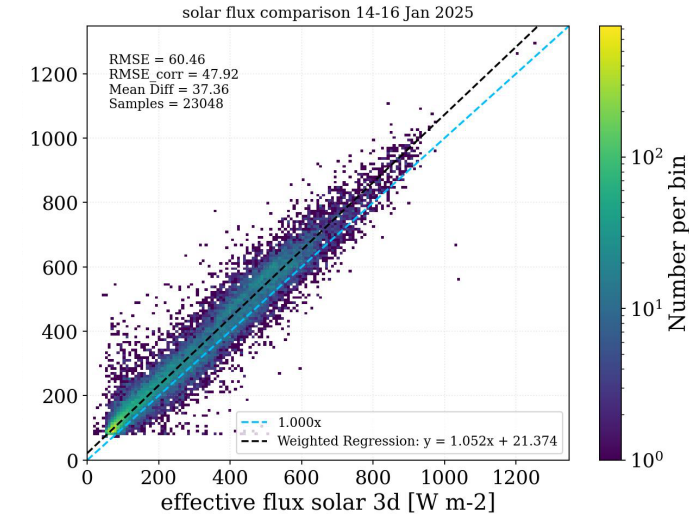
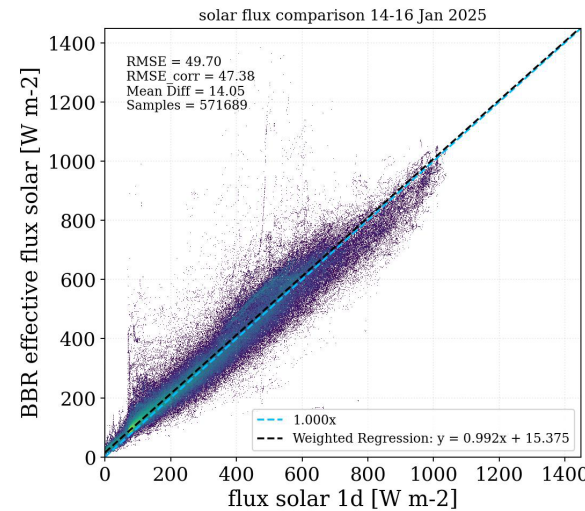
- Kentaroh Suzuki and Jason Cole : Overview and early intercomparison of ESA/JAXA radiation products
- Almudena Velazquez Blazquez : L2 BM-RAD and BMA-FLX products verification
- Carla Salas Molar : Radiative Closure Verification with EarthCARE BBR Solar and Thermal Fluxes
- Takashi M. Nagao : Initial Validation of JAXA's Four-Sensor Synergy Radiation Budget Product: ALL_RAD
- Lei Liu : Validation of EarthCARE cloud & aerosol retrievals using surface spectral infrared radiances from ECALOT campaign

- Arnoud Apituley : Validation of EarthCARE ATLID and CPR products using Cabauw measurements: preliminary results (EVID14)
- Jean-Baptiste Renard: BAIVÉC project - Validation of Atlid products using the in-situ aerosol and cloud measurements performed with the LOAC2 instrument under weather balloons
- Tim Carlsen : Validating from within: early Level 2 product intercomparison from CELLO-ORCESTRA
- Zen Mariani : Surface Validation During the EarthCARE Commissioning Cal/Val Campaign in Ottawa (ECALOT)
- Konstantin Krüger: Validation of EarthCARE's ATLID L2a cloud and aerosol products using co-located independent airborne lidar profile data observed during the PERCUSION field campaign
- Nathan Feuillard: Comparison between EarthCARE and ATR42 measurements and products during the MAESTRO field campaign

Seed question Q1 : *what are the positive findings about the data quality that can be highlighted?*



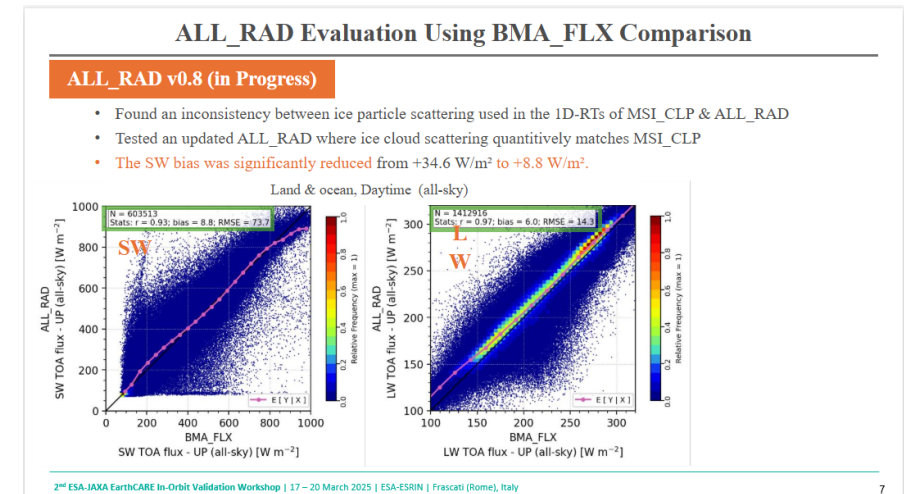
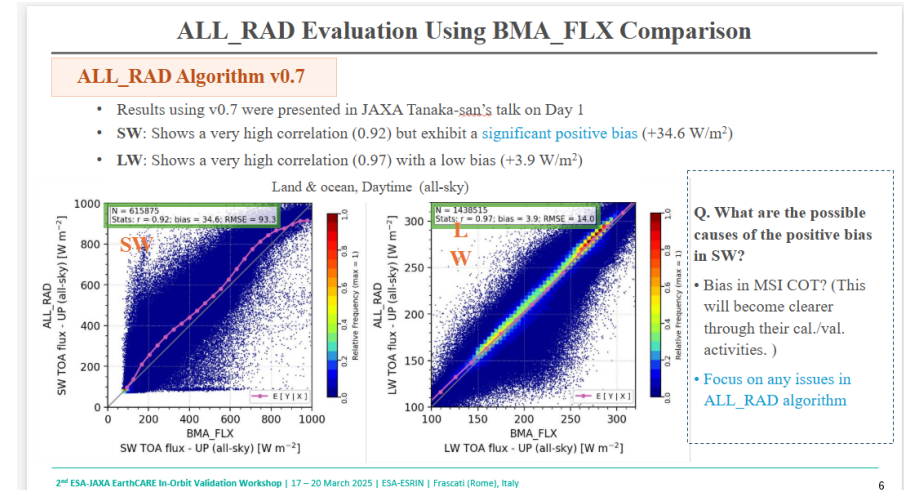
- EarthCARE instruments and algorithms work already sufficiently well to say that the mission objective will be met.
- **Solar : Good agreement with both 1d and 3d modelled fluxes but still needs improvement**
- Thermal : Very good agreement with $RMSE < 10 \text{ W m}^{-2}$ (within EarthCARE's accuracy requirement)
- Still lot of validation work before public release of the 3- and 4-sensor products (Dec. 2025)



Seed question Q2 : what aspects have been identified for improvements and are there clear/proposed ways to address that?



- check consistency of optical properties between retrievals and RT computations (talk of Takashi). Way forward : keep meeting regularly between retrieval and flux people, document the processings on both side (ATBDs? journal papers,...), run RTM to also simulate MSI NB radiances, ...
- Similarly, the ancillary data (e.g. surface albedo, temperature, ...) should be consistent. Use X-MET as far as possible, document clearly if deviation. Valuable to validate meteorological quantities that are used by retrieval algorithms as well as the retrieval products themselves



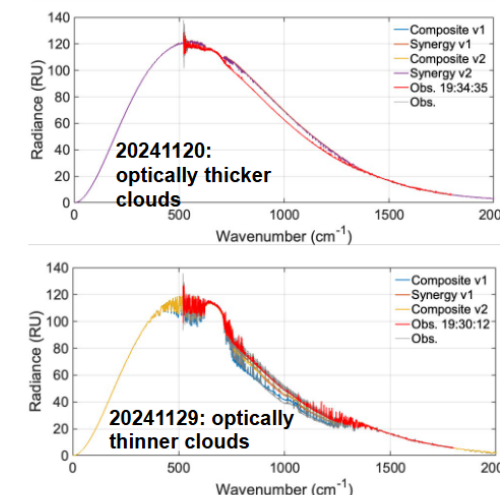
Seed question Q3 : Which L1 and L2 products or aspects are not yet (optimally) validated ? (e.g. due to late release to Cal/Val users)

- Fluxes must be validated at surface as well. First contribution from Lei is important. BSRN later (Takashi).
- Validation of target classifications mostly limited to ATLID or CPR; synergistic target classifications are now also available
- Need continued ground-based and aircraft validation of cloud-base height to validate assumptions in synergistic target classifications and retrievals, with strong impacts on surface radiation & radiative closure (Lei Liu's talk)

EarthCARE AERI Validation Conclusion

Collocated spectrally resolved infrared measurements provide a unique approach for validating and refining EarthCARE cloud retrieval products:

- Multiple versions of the retrieval products were compared.
- Radiative closure is relatively good for both optically thin and thick cloud conditions with DLR biases remain within 10 RU in the window band.
- Certain spectral shape biases persist, necessitating further analysis to identify their root causes and explore potential solutions for improving the retrieval products.



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Seed question Q4 :What are the recommendations / suggestions for future L1 / L2 validation activities (e.g. validation needs, gaps) and for mission planning?



- swapping of Japanese/European RTM and aerosol/cloud retrievals
- surface validation
- consolidate intercomparison with CERES / reduce biases
- keep trying to have CERES instrument operated in "EarthCARE" mode to get reference fluxes for BMA-FLX validation.
- validation of cloud-base height & surface radiation from ground-based stations (e.g. CloudNet/ACTRIS)



Q1 : what are the positive findings about the data quality that can be highlighted?

- the instruments and algorithms work already sufficiently well to say that the mission objective will be met.
- still lot of work for public release of 3/4 sensor products (Dec. 2025), but have already made significant progress on radiative closure

Q2 : what aspects have been identified for improvements and are there clear/proposed ways to address that?

- check consistency of optical properties between retrievals and RT computations (talk of Takashi). Way forward : keep meeting regularly between retrieval and flux people, document the processings on both side (ATBDs? journal papers,...), run RTM to also simulate MSI NB radiances, ...
- Similarly, the ancillary data (e.g. surface albedo, temperature, ...) should be consistent. Use X-MET as far as possible, document clearly if deviation. Valuable to validate meteorological quantities that are used by retrieval algorithms as well as the retrieval products themselves.

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Q4 : What are the recommendations / suggestions for future L1 / L2 validation activities (e.g. validation needs, gaps) and for mission planning?

- swapping of Japanese/European RTM and aerosol/cloud retrievals
- surface validation (L2 developers have identified)
- consolidate intercomparison with CERES / reduce biases
- keep trying to have CERES instrument operated in "EarthCARE" mode to get reference fluxes for BMA-FLX validation.
- Validation of cloud-base height & surface radiation in different regimes from long record of ground-based stations (e.g. CloudNet/ACTRIS)