ESA Radiation Algorithms

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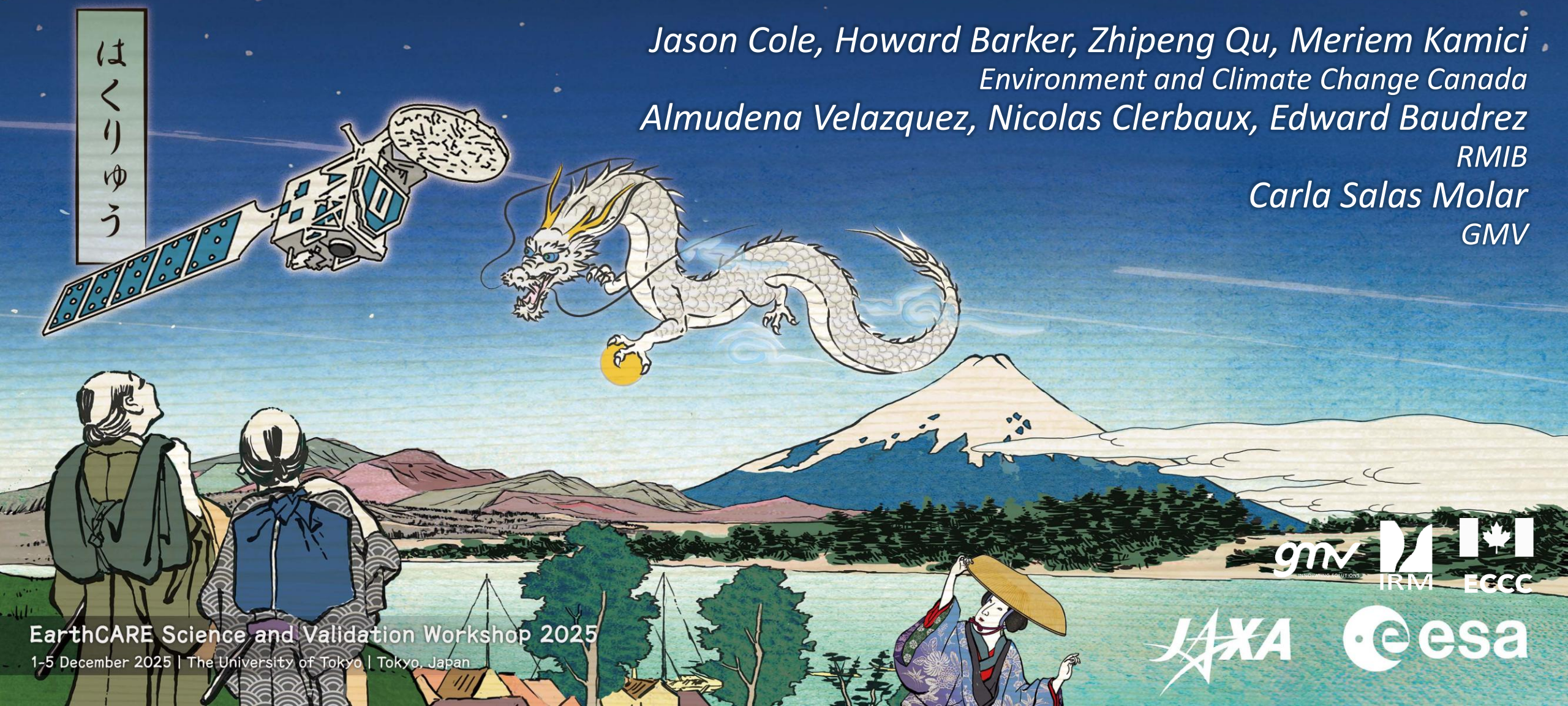

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Preparing for radiative transfer: ACM-COM and ACMB-3D

ACMB-3D (ALL-3D)

- Create 3D domain around active sensor track
- Maps information from active sensor to across track points

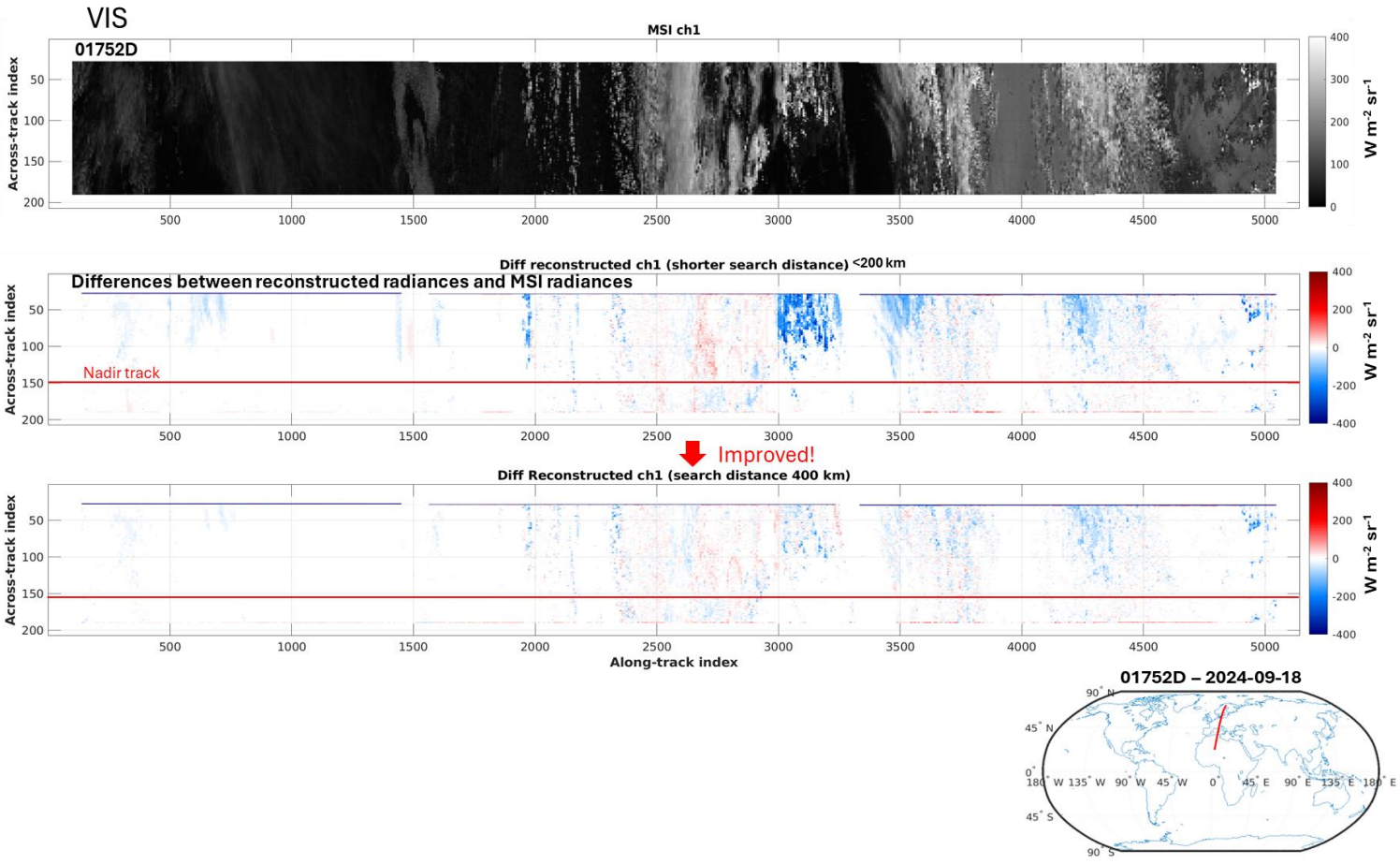
Barker et al, QJRMS, 2011
Qu et al, AMT, 2025

ACM-COM

- Prepares inputs for radiative transfer
- State variables (temperature, gases)
- Surface optics (albedo, emissivity)
- Two versions of cloud, aerosol and precipitation
  - *ACM-CAP* (synergistic retrieval, used for RT)
  - *Composite* (combine single sensor retrievals)

Cole et al, AMT, 2025

BA to BC baseline change in ACMB-3D increased searching distance up to 400 km



See *H112, H117, Lobby13*

Performing radiative transfer: ACM-RT

See *Annex35, Lobby13*

ACM-RT

- **1D broadband radiative outputs**

- Radiative fluxes and heating rates profiles (LW, SW)
  - All-sky, clear-sky and pristine
  - Only on the retrieval “curtain”
- Direct and diffuse downwelling SW surface fluxes

3D broadband radiative outputs

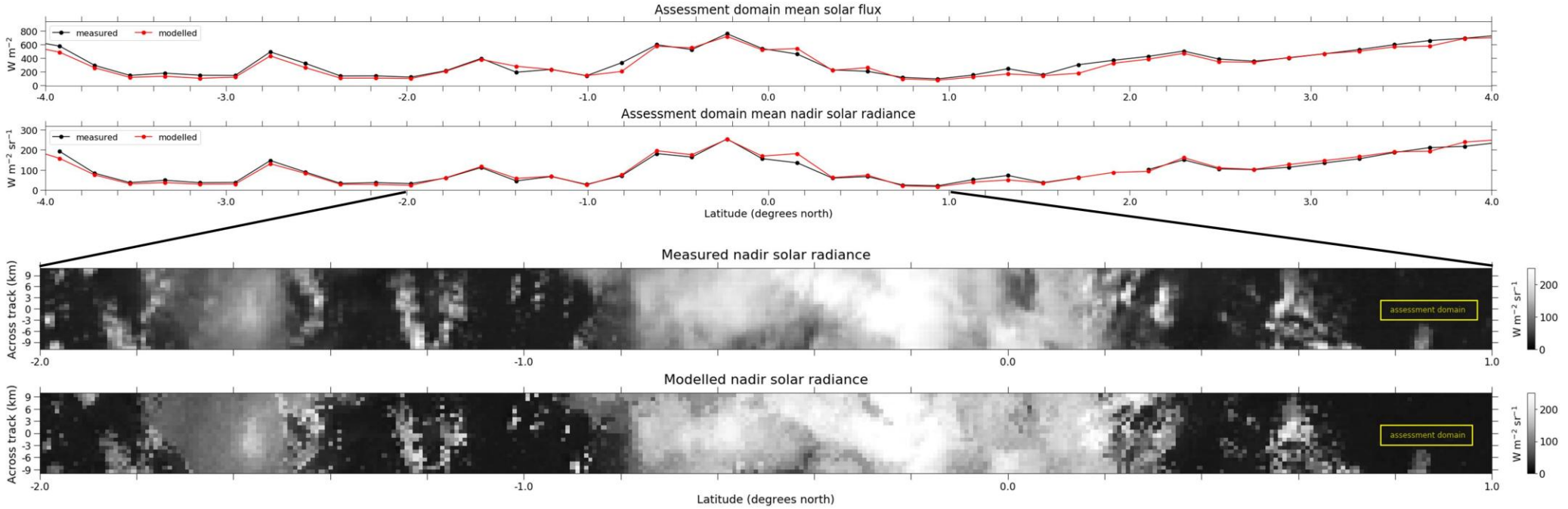
- LW and SW radiances for each BBR view
- SW radiative profiles and heating rate profiles
- Direct and diffuse downwelling SW surface fluxes
- Upwelling LW fluxes at co-registration height
- Quantities averaged to 21x5 km “assessment domains”

Fluxes

Radiances

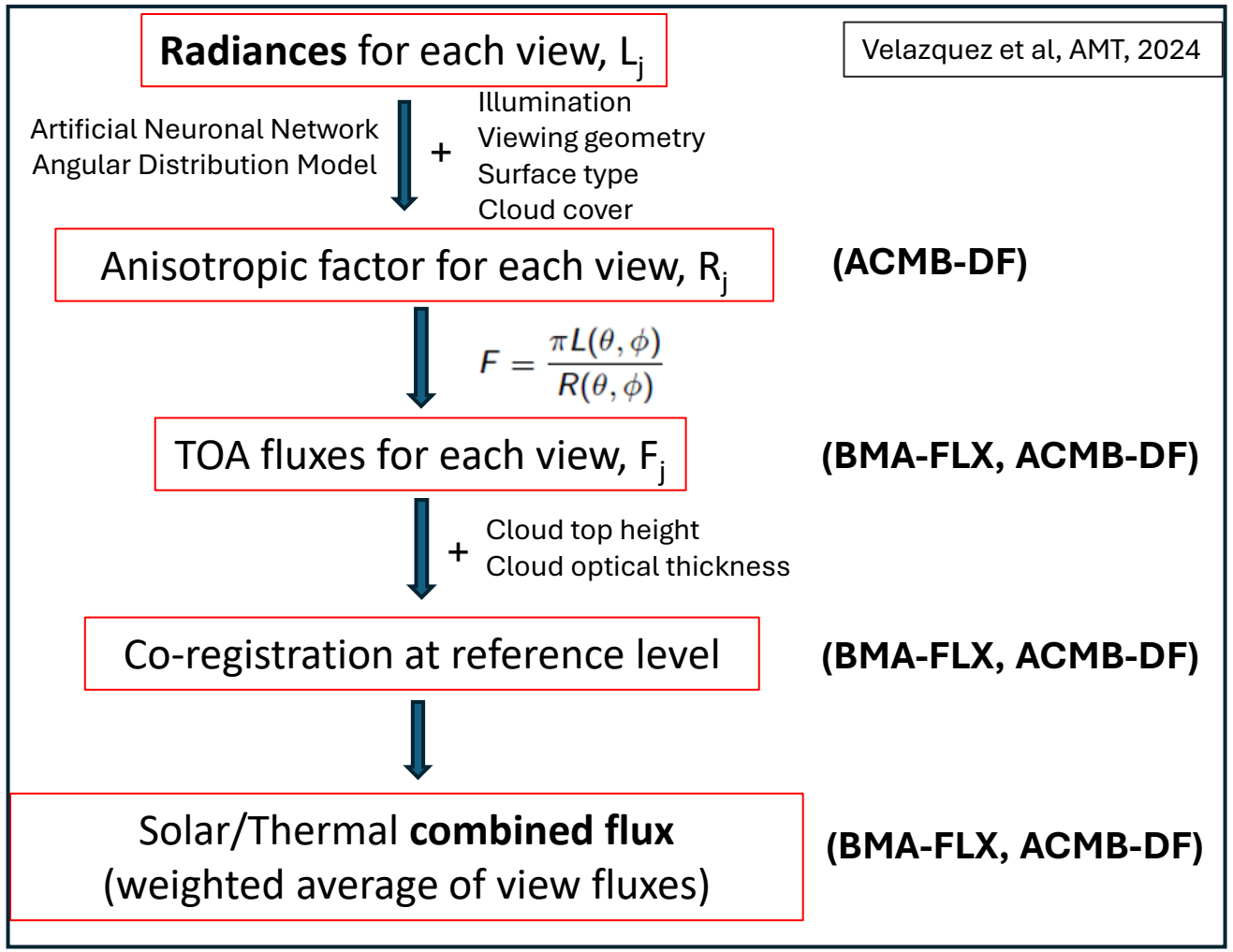
Measured radiance

Modelled radiance



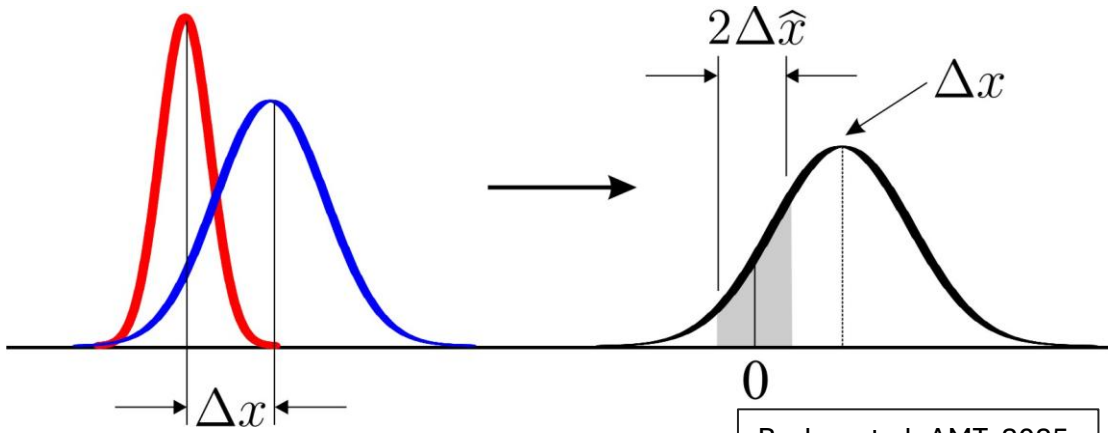
Radiative transfer closure assessment: BMA-FLX and ACMB-DF

- **BMA-FLX** transforms unfiltered solar and thermal radiances to upwelling fluxes



- **ACMB-DF** reports differences in radiances and fluxes from BMA-FLX and those computed in ACM-RT
  - Fluxes from 1D and 3D radiative transfer
  - Radiances are transformed to fluxes using same ADMs and view weights in BMA-FLX

- In addition to reporting differences, the probably of agreement is reported
  - Accounts for radiance and flux uncertainties
  - Reported for range of flux differences Δx

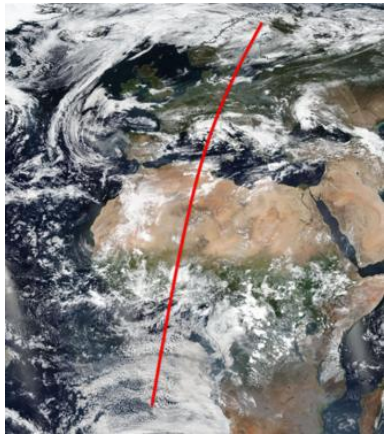


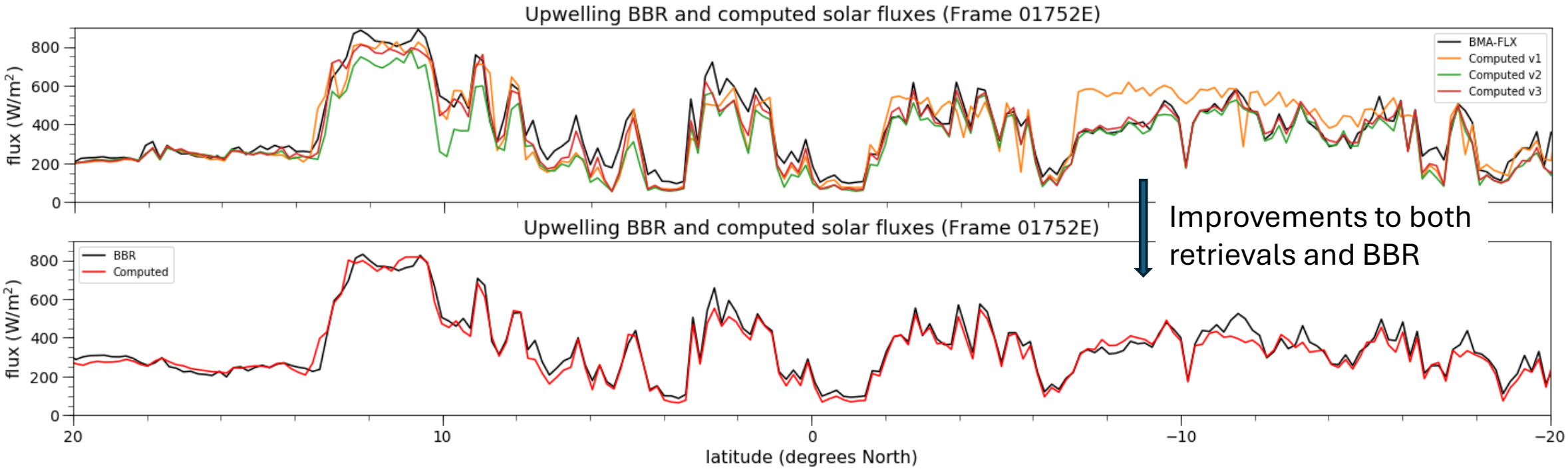
Barker et al, AMT, 2025

See *H229, Annex38, Lobby13*

Radiative closure assessment

- Radiative closure assessment has been used during the early stages of the mission to highlight areas of concern for retrieval algorithms
- Targeted both specific individual and large numbers of cases using observations over many orbits and months





Algorithm changes beyond BA baseline

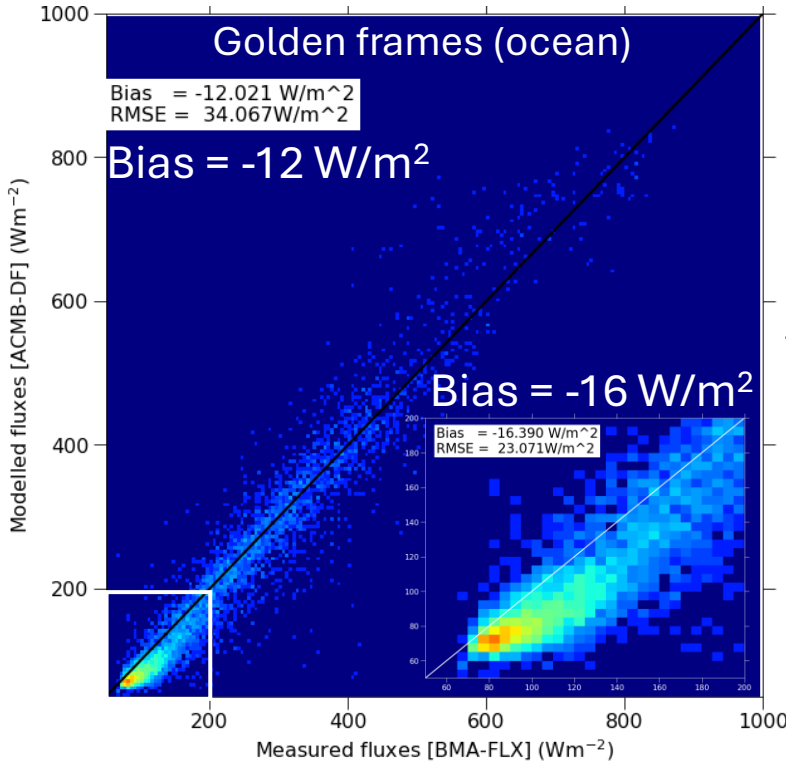
Baseline BA to BC

- Bug fixes in specification of aerosol types and solar Monte Carlo radiative transfer code
- Switch aerosol inputs from ACM-CAP to ATL-EDB (extinction) and A-TC (classification), clouds and precipitation

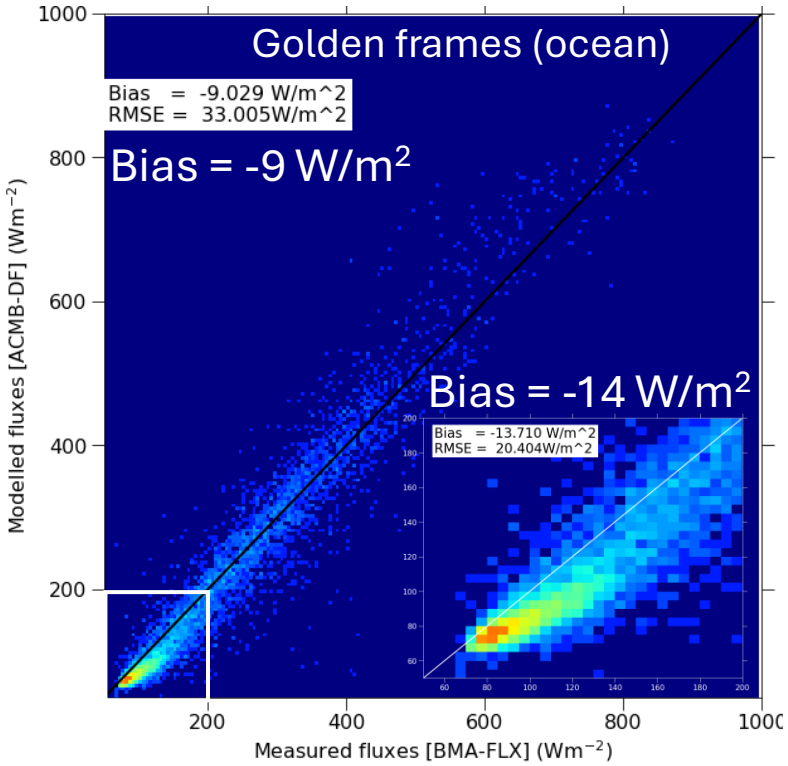
Baseline BC to BD

- Improve land specification (BRDF instead of Lambertian), add stratospheric aerosols to radiative transfer, bugfixes

BA baseline (38%)



BA + aerosol fix + RT fix (41%)



ATLID aerosol + ACM-CAP cloud (48%)