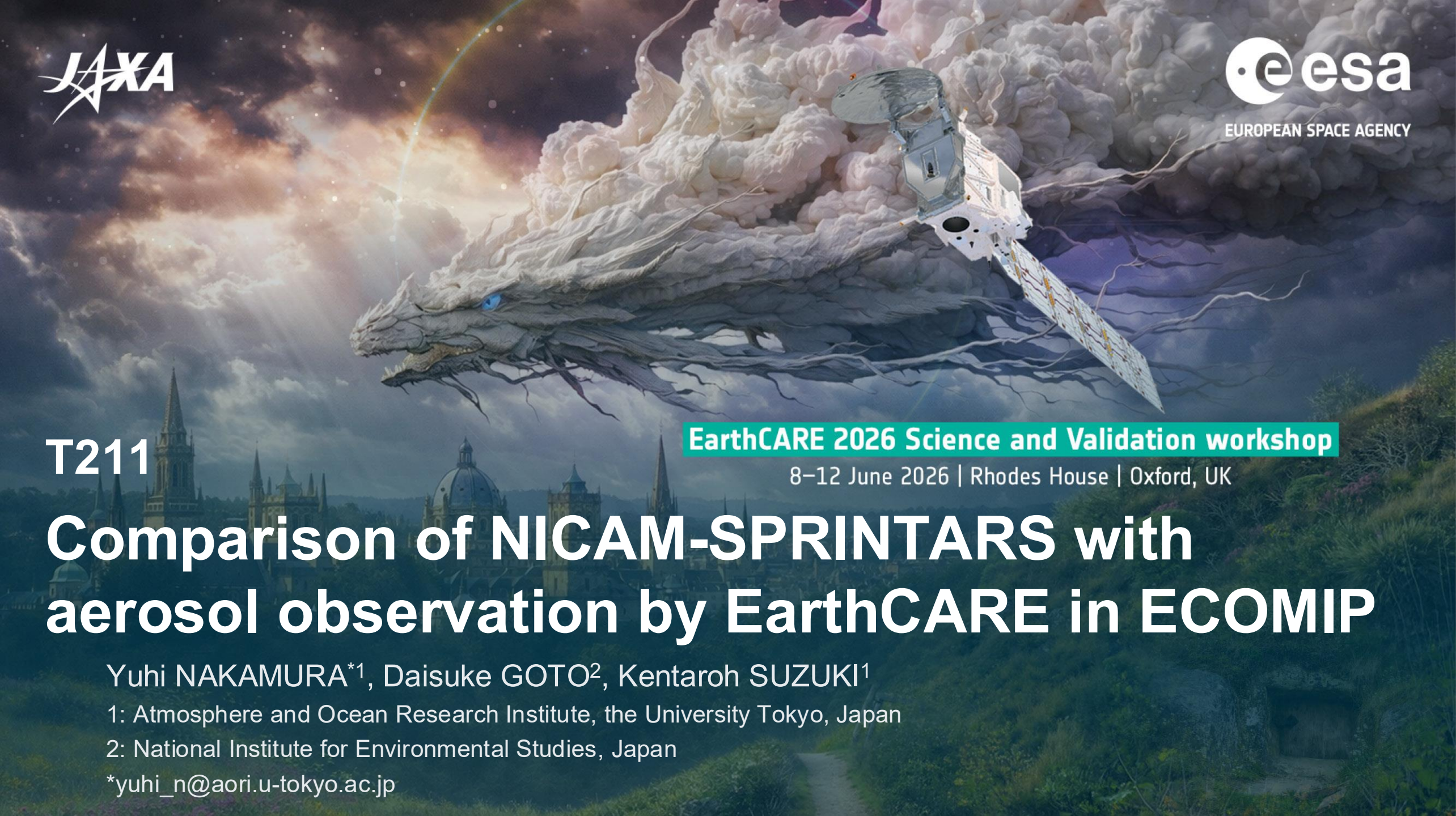

T211

Comparison of NICAM-SPRINTARS with aerosol observation by EarthCARE in ECOMIP

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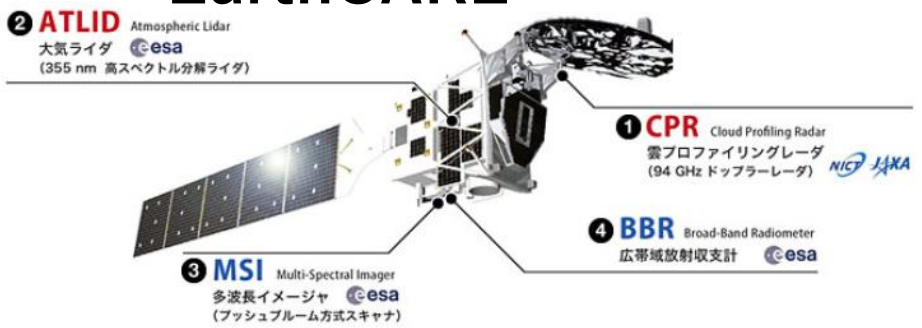
ECOMIP: Comparison of EarthCARE with models

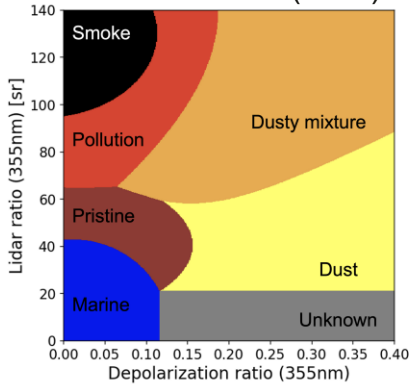
EarthCARE

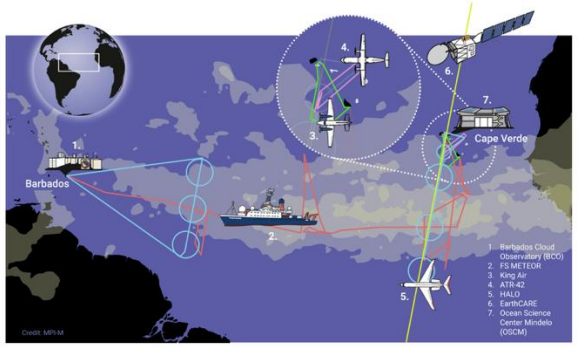


1. **"Lidar ratio", new observable by ATLID**
   → For better classification of aerosol type
2. **High sensitivity and Doppler capability by CPR**
   → New insights on in-cloud dynamics

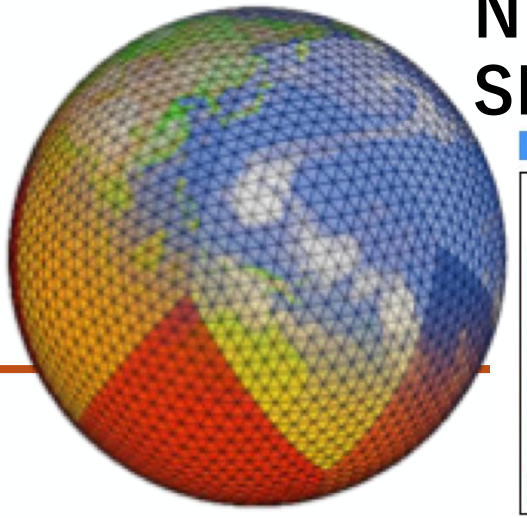
➢ **New perspective on aerosol-cloud interaction**

Nishizawa et al. (2026)

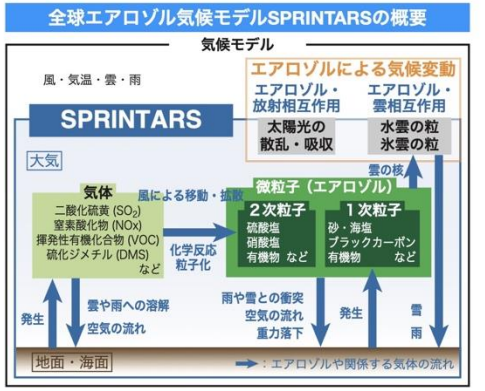




https://orcestra-campaign.org/intro.html



NICAM-SPRINTARS



1. **NICAM:** Global storm-resolving model
2. **SPRINTARS:** aerosol module

➢ **Evaluation of aerosol model with new observation in ECOMIP**

observation data and model setup

EarthCARE
- **13th AUG 2024, ECOMIP**
- **event-to-orbit comparison**

1. ATLID: ATL-CLA vCb
- High Spectral Resolution Lidar
- ✓ aerosol mass extinction coef.

2. CPR: AC-CLP vBb
- Cloud Profiling radar
- radar reflectivity and Doppler velocity
- Retrieval product on microphysics

3. MSI: MSI-CLP vCa
- multi spectral imager
- ✓ optical thickness, effective radius

MODIS
– MOD08_M3
- 1° grid AOT

GCOM-C
– SGLI L3.ATMOS
- 0.083° grid COTW/COTI

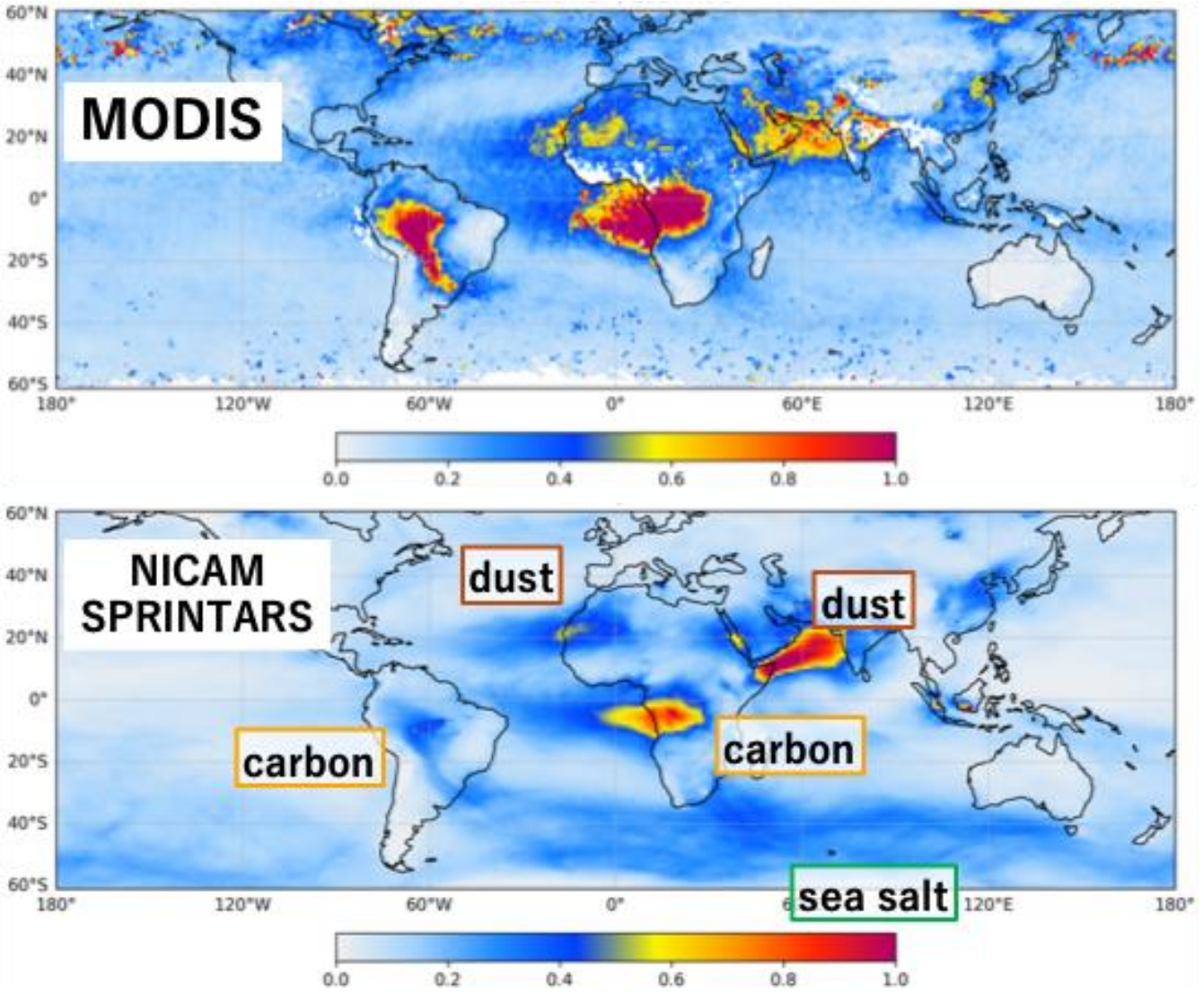
NICAM v21.0 (Satoh et al. 2008, 2014)
- **14km resolution** (glevel9)
- **NDW6** (Seiki et al. 2022, Goto et al. 2024)
  - 2-moment bulk cloud microphysics

1. **2-day experiment: 13th AUG 2024**
   target case for aerosol event
2. **monthly experiment: AUG 2024**
   Nudging to ERA 6hourly ERA ($\boldsymbol{u}_h, T$)

SPRINTARS (Takemura et al. 2005 JGR)
- based on Goto et al. (2024 GMD)
- **interaction with NDW6 nucleation**
- emission as boundary condition

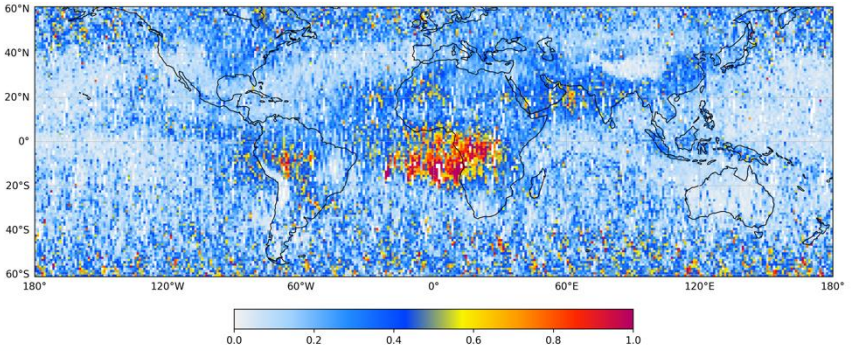
Joint-Simulator (Masunaga et al. 2010)
- for radar parameters (Z_e and v_d)

monthly mean AOT



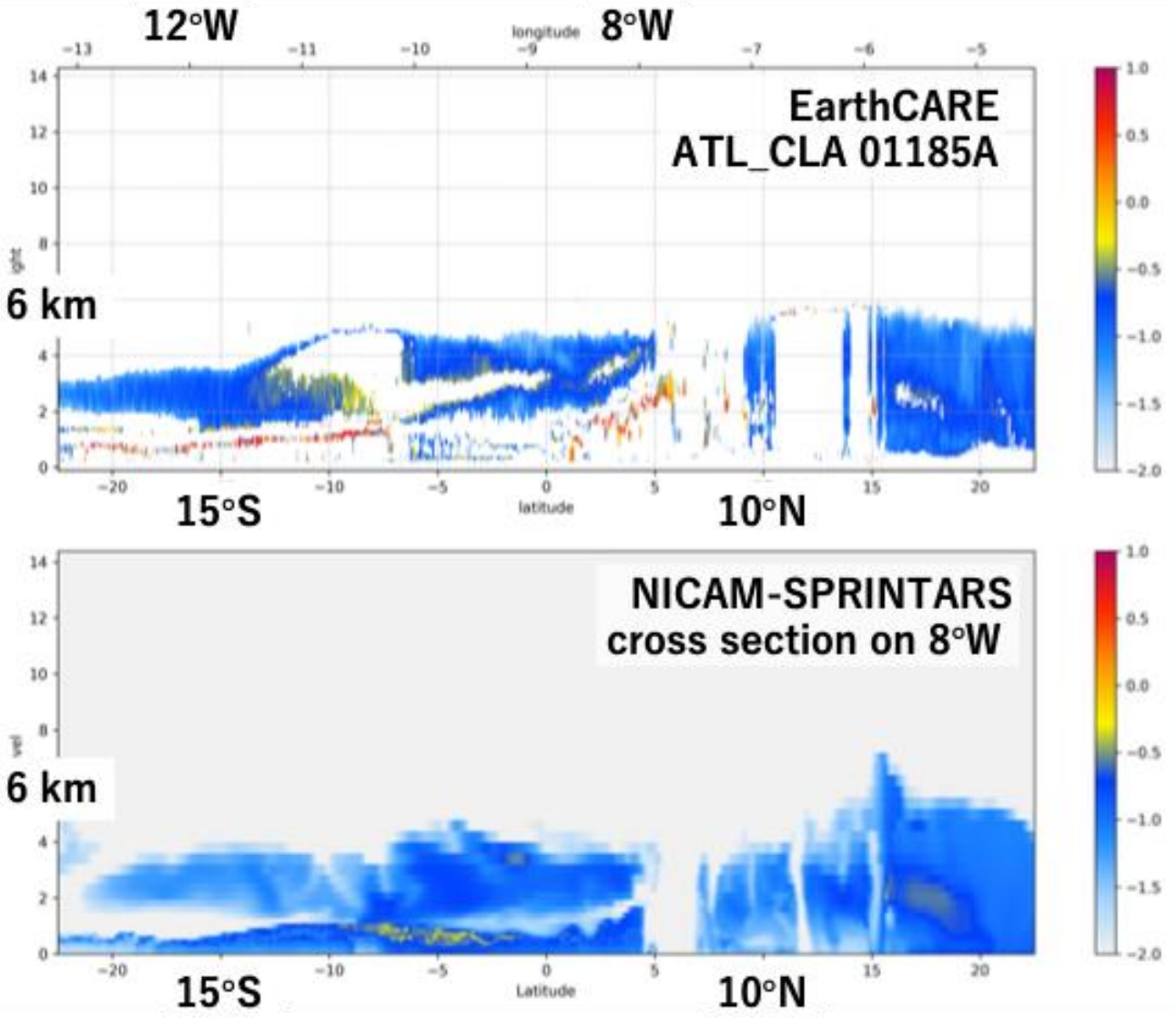
- **good regional distribution corresponding to aerosol components**
- underestimation over lands
  → The emission dataset should be updated.
- overestimation over southern ocean

EarthCARE



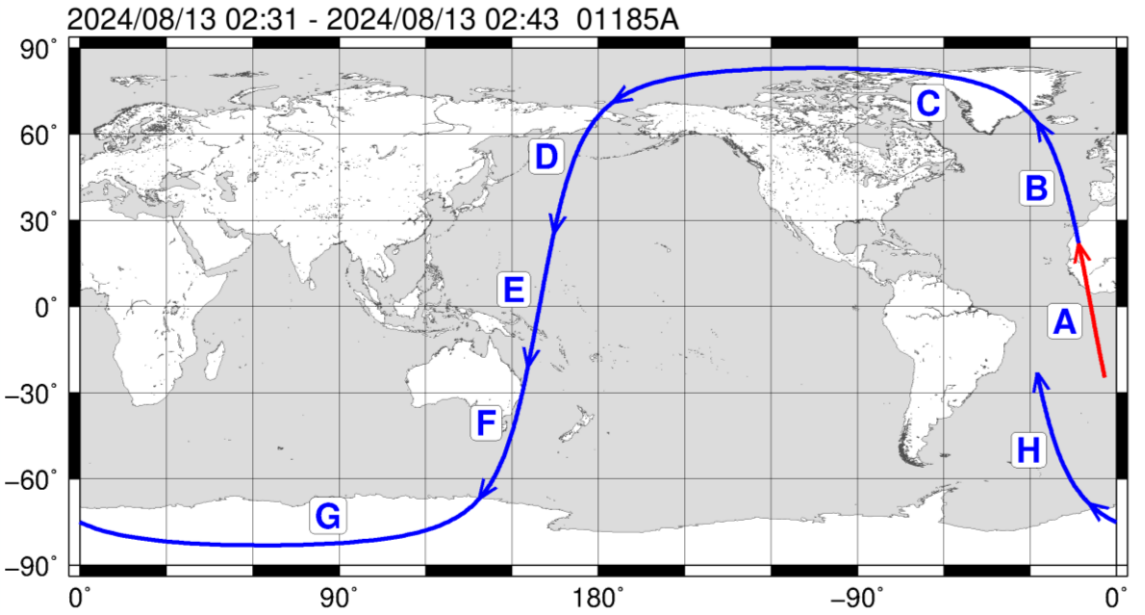
AOT Estimation by EarthCARE ATLID as vertical integration of extinction

13th AUG event comparison: lidar

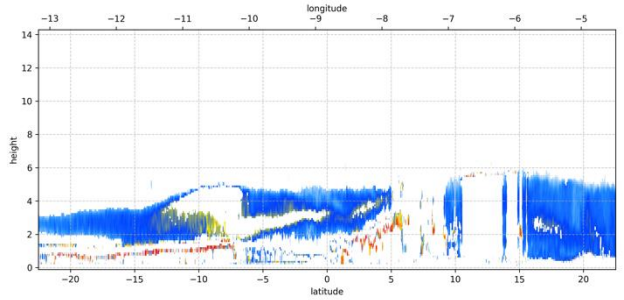


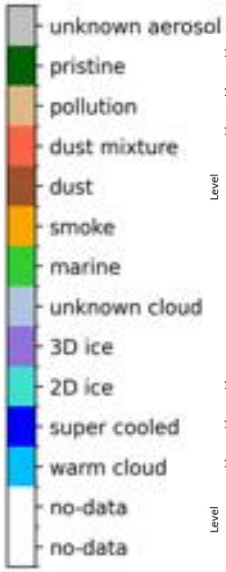
aerosol mass extinction coef. $\log_{10}[\mathrm{km}^{-1}]$

- NICAM-SPRINTARS has good agreements with EarthCARE ATLID.
- Quantitatively good, too
- Missing is due to clouds.

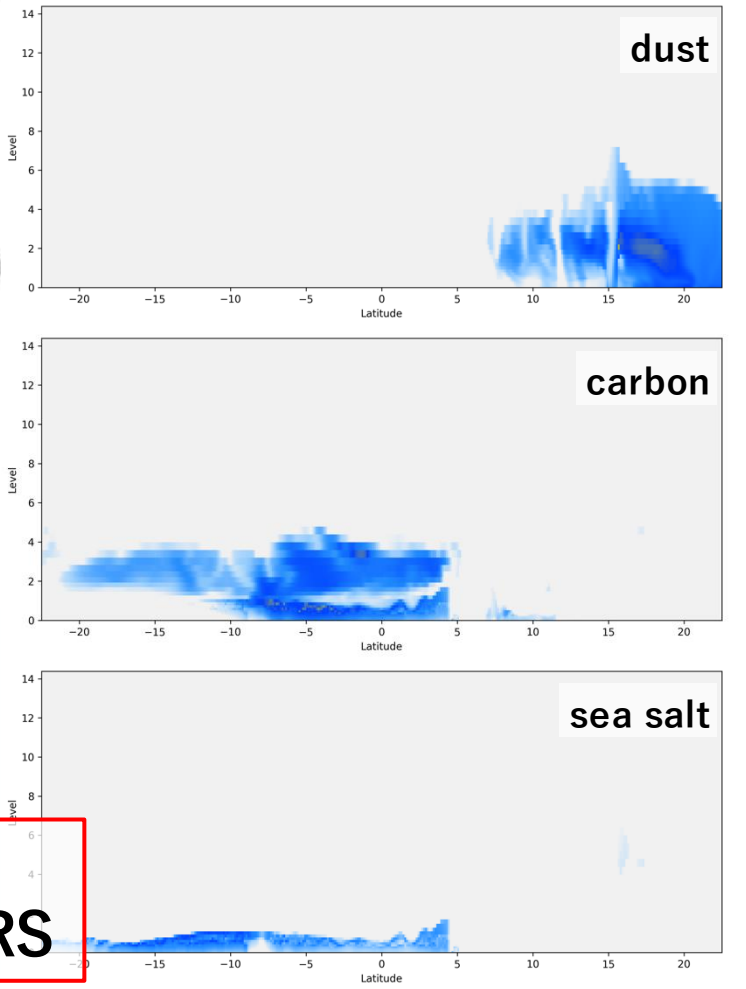


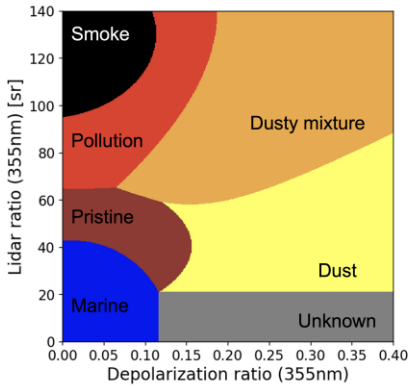
13th AUG event comparison: particle type





SPRINTARS aerosol component

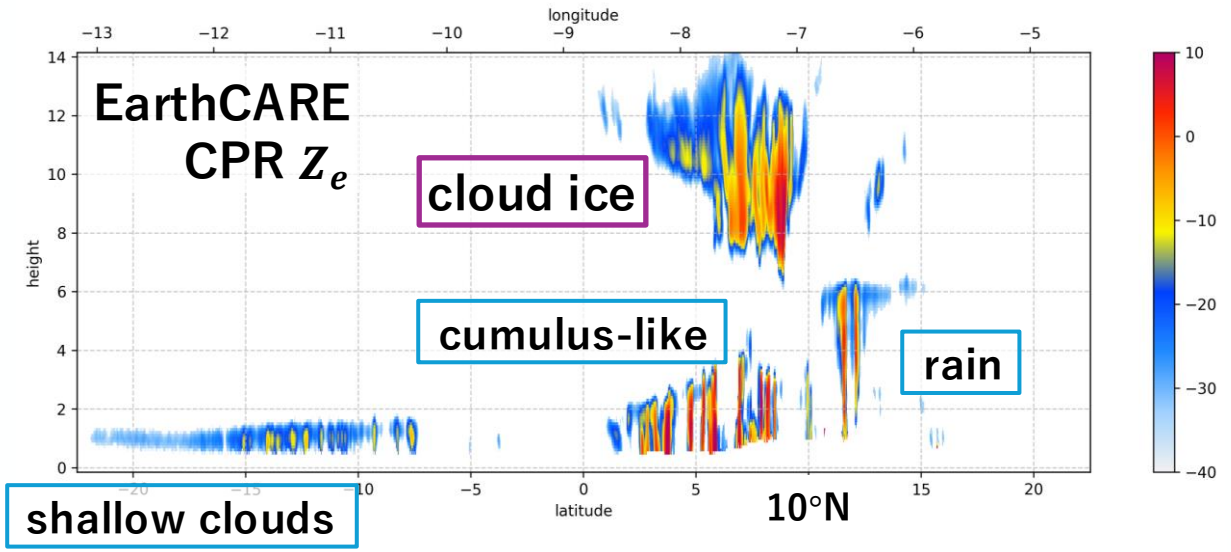


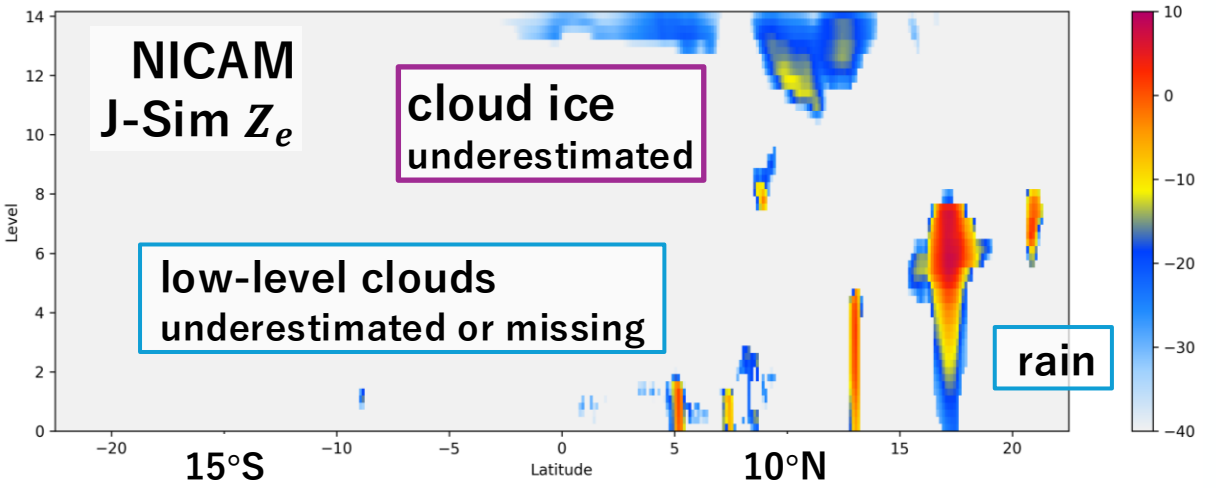


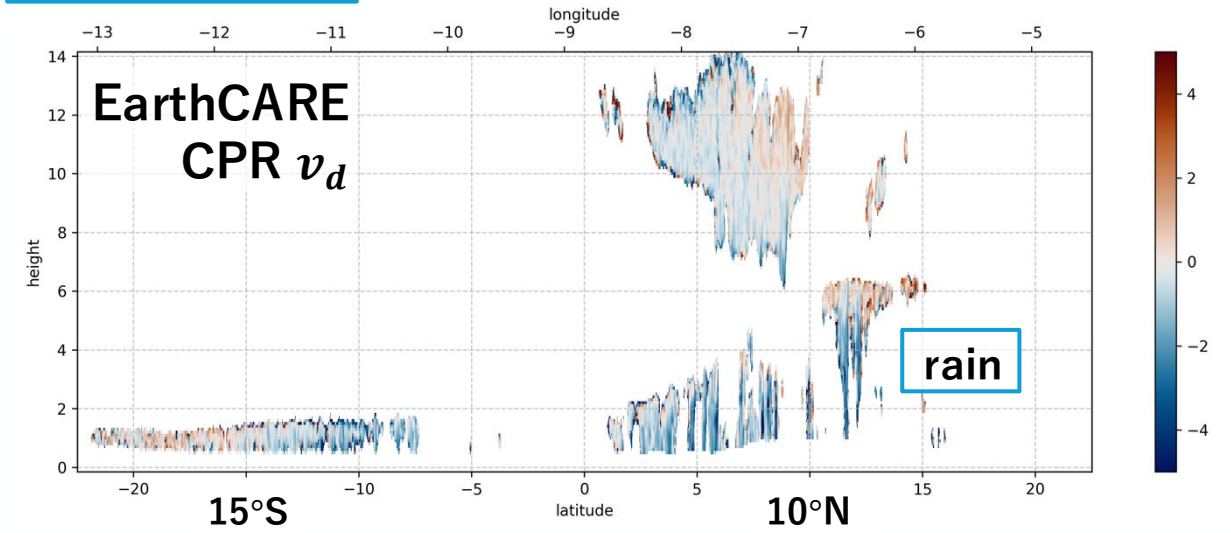
- dust in northern part
- carbon in southern part
- sea salt near surface

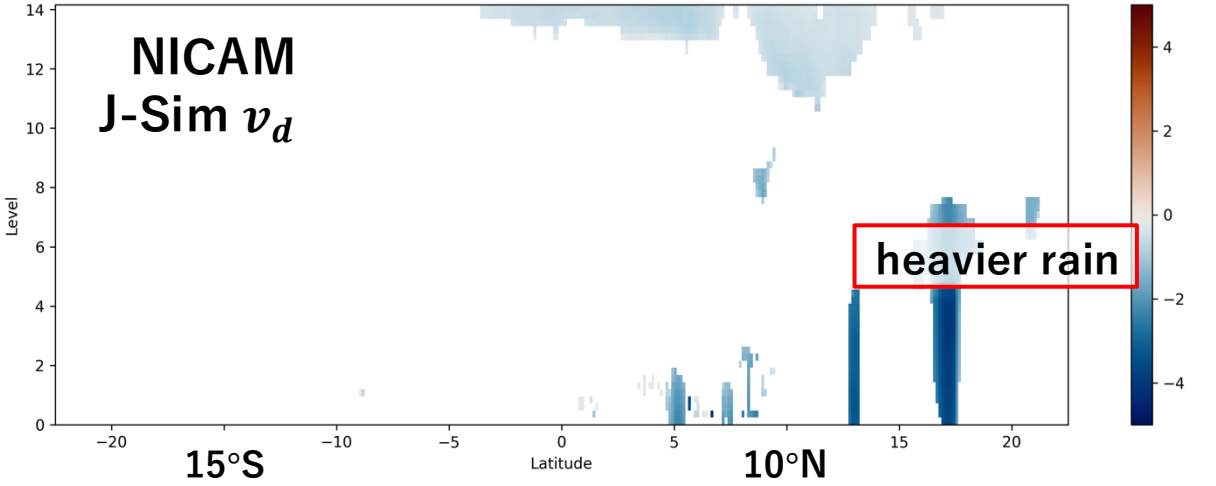
The aerosol distribution is consistent between EarthCARE and NICAM-SPRINTARS

13th AUG event comparison: radar



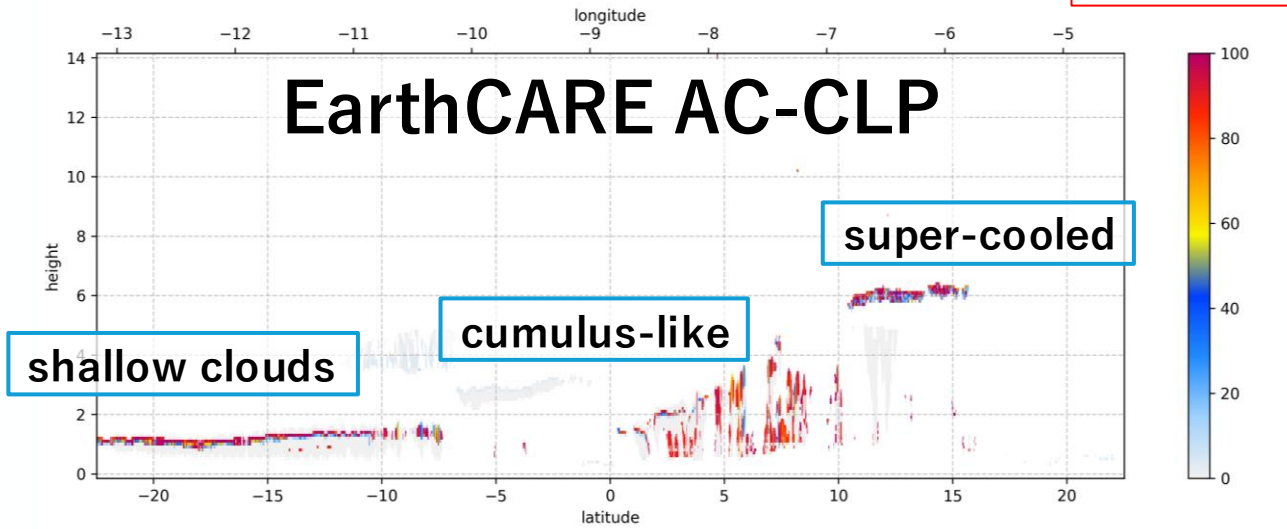


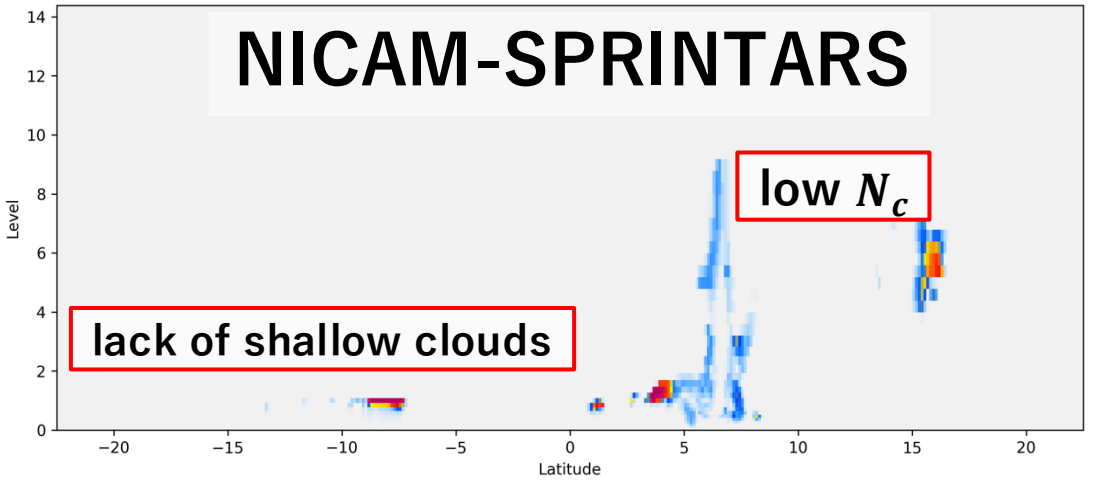


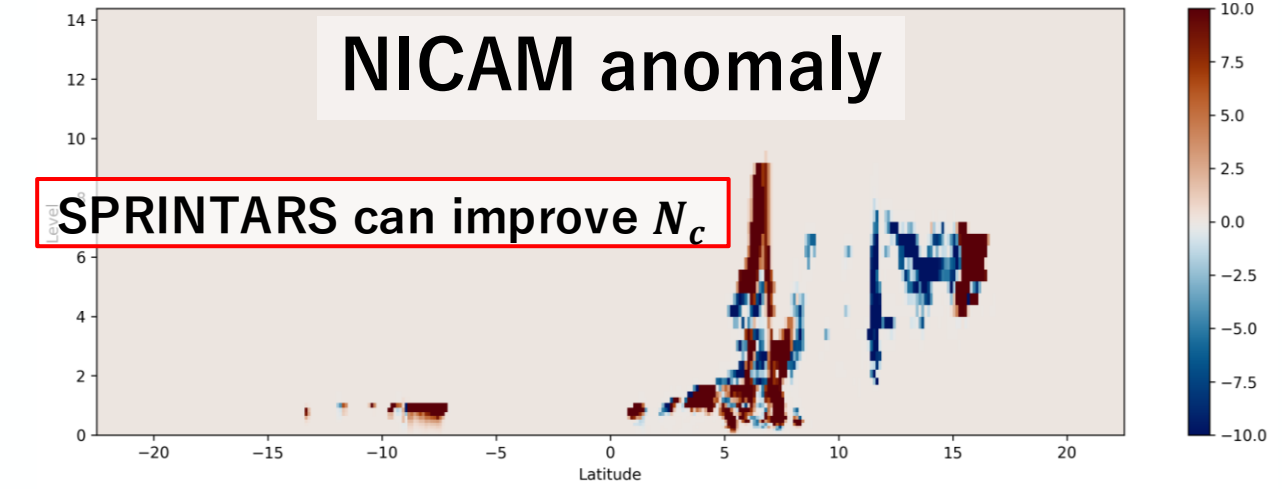


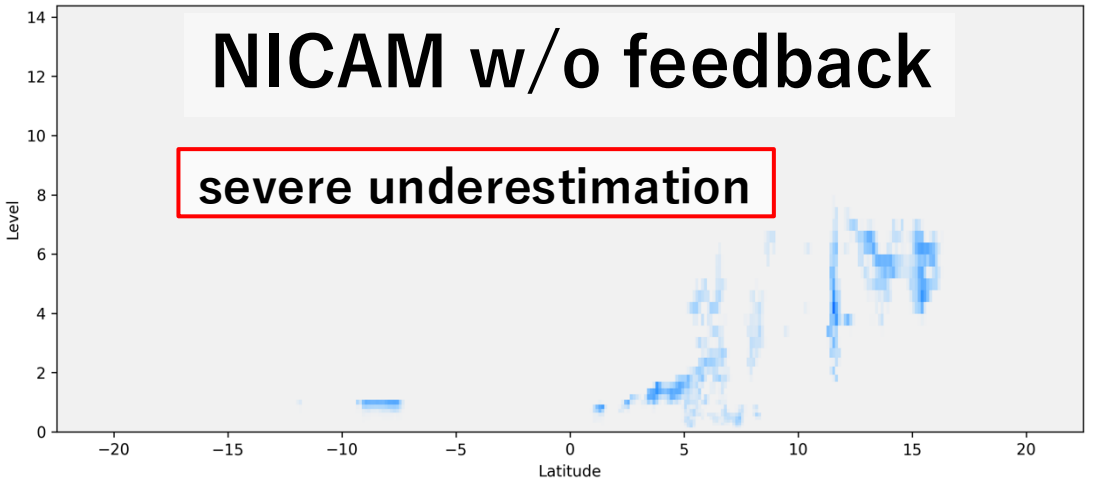
13th AUG event comparison: retrieval product

number concentration of cloud liquid [10^6 #/m^3]









Summary

1. Comparison of NICAM-SPRINTARS with EarthCARE

- Monthly mean AOT shows good overall agreement, but quantitative differences.
- The target case is **13th AUG 2024**, within ECOMIP

2. Good consistent results by NICAM-SPRINTARS

- Each aerosol component, dust, carbon, and sea salt, is reproduced separately.
- From view of radar signals, shallow clouds are missing in NICAM-SPRINTARS.
- N_c is underestimated by NICAM, but SPRINTARS can mitigate it.

➢ **future work..**

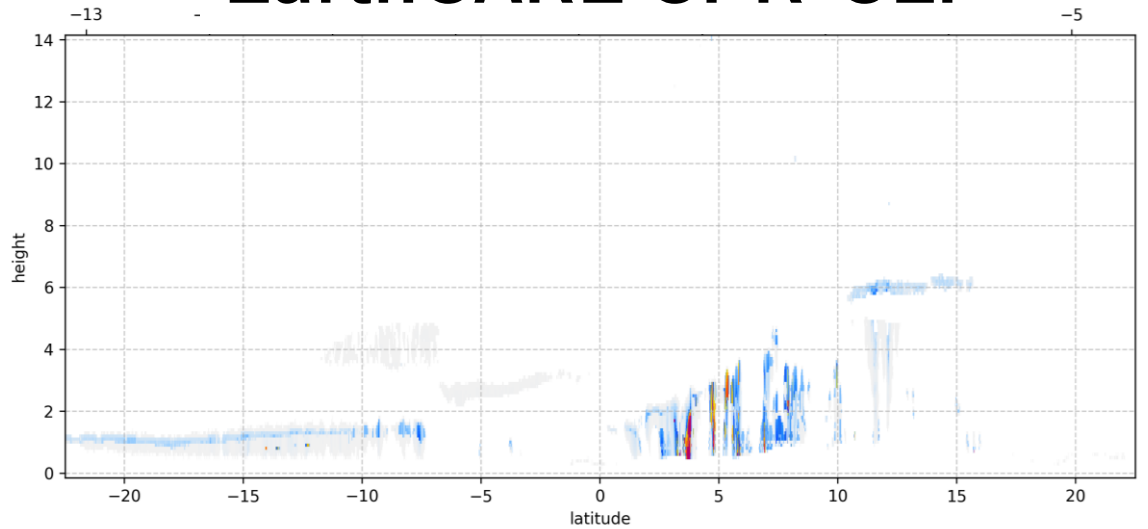
1. higher horizontal resolution to avoid resolution-dependent biases
2. detailed process analysis on aerosol-cloud interaction
3. cloud radiative effect

supplement…

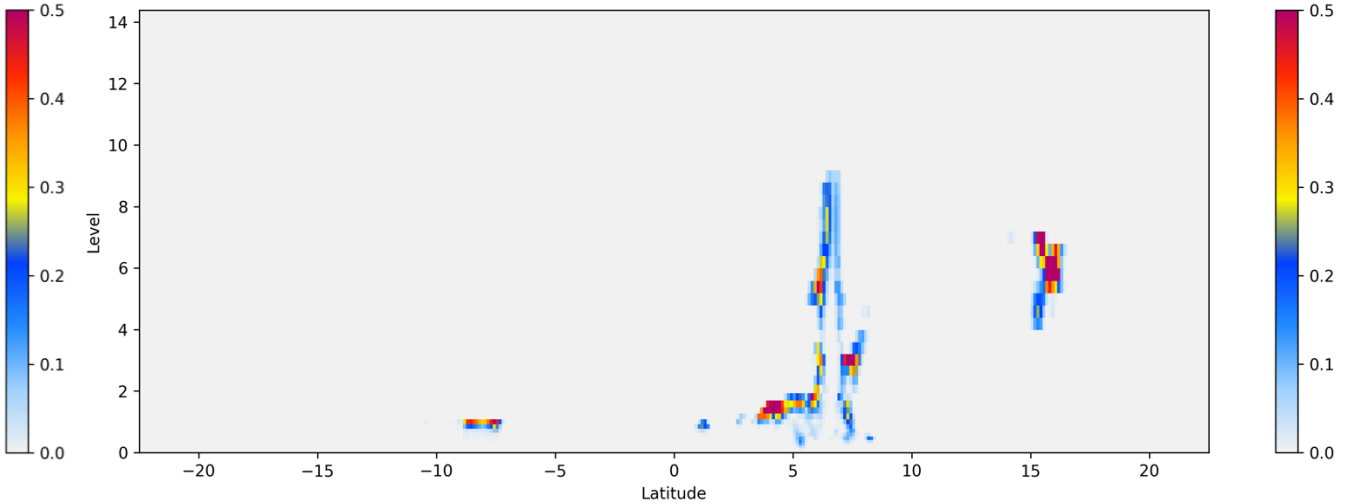
13rd AUG event comparison: retrieval

mixing ratio of cloud liquid [g/kg]

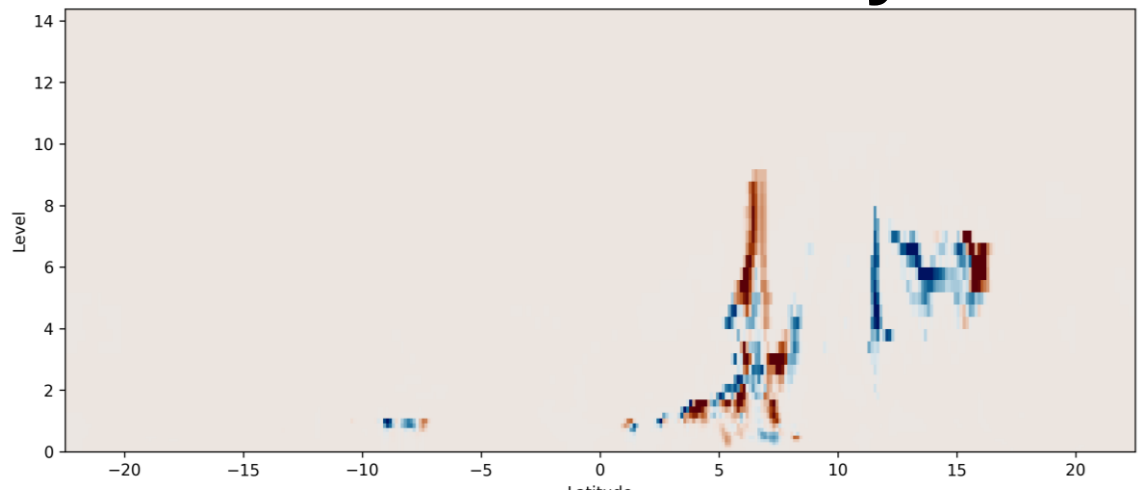
EarthCARE CPR-CLP



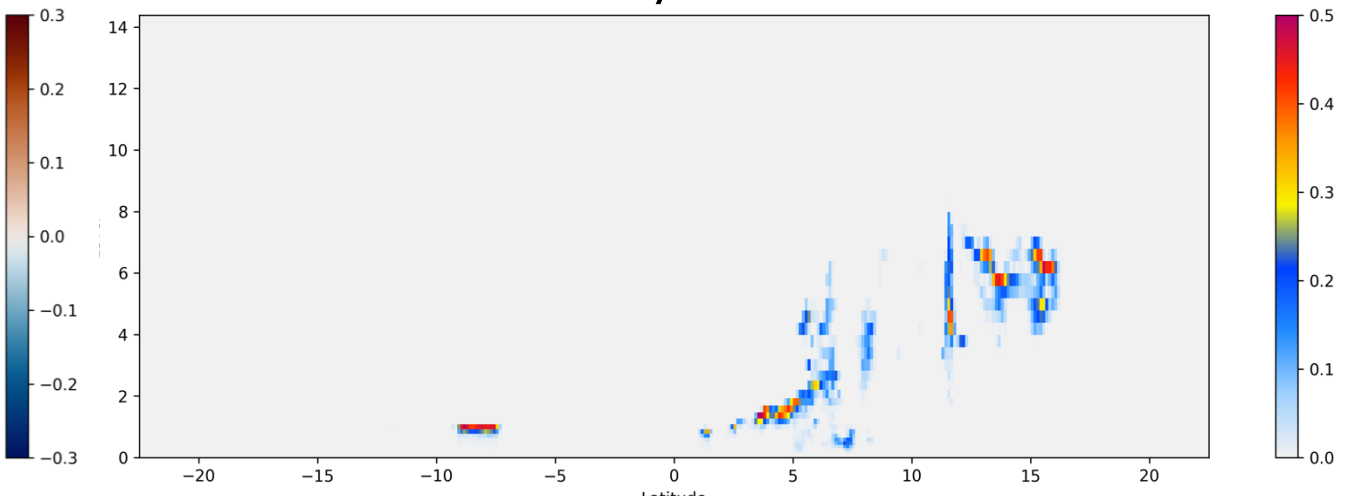
NICAM-SPRINTARS



NICAM anomaly



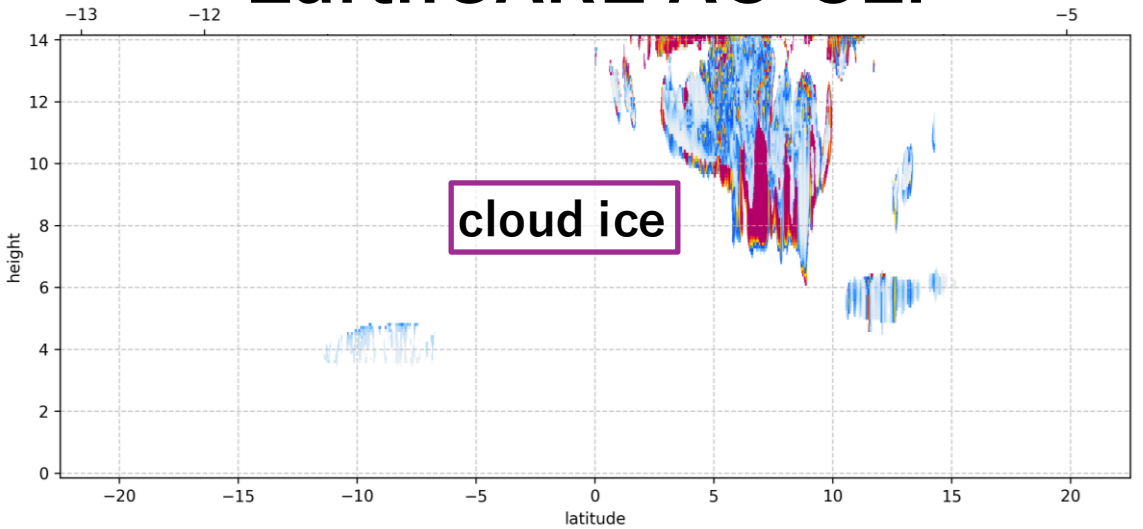
NICAM w/o feedback



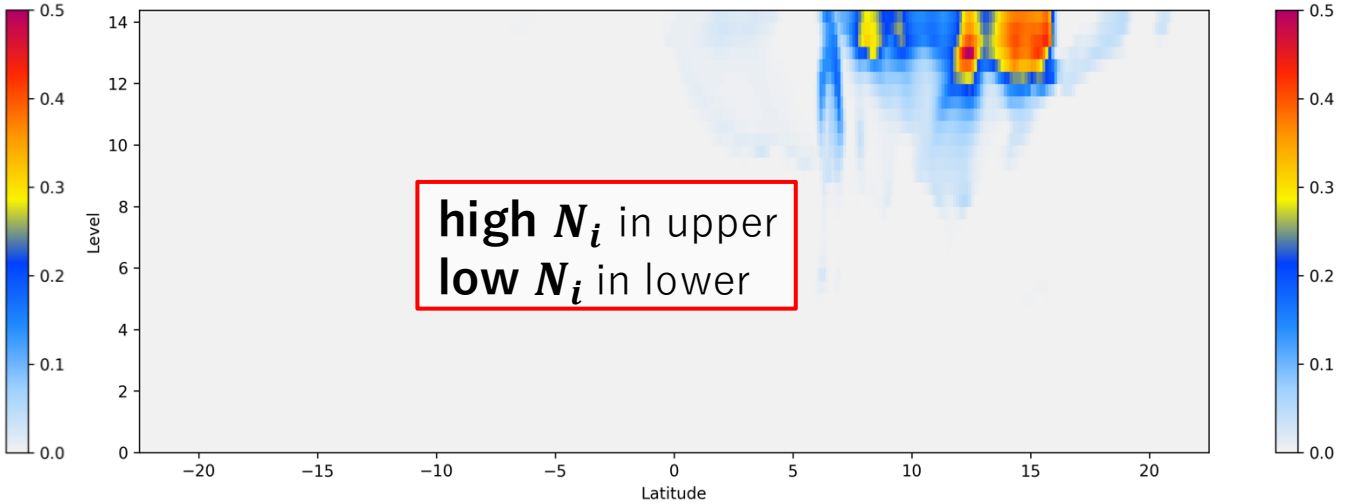
13rd AUG event comparison: retrieval

number concentration of cloud ice [10^6 #/m^3]

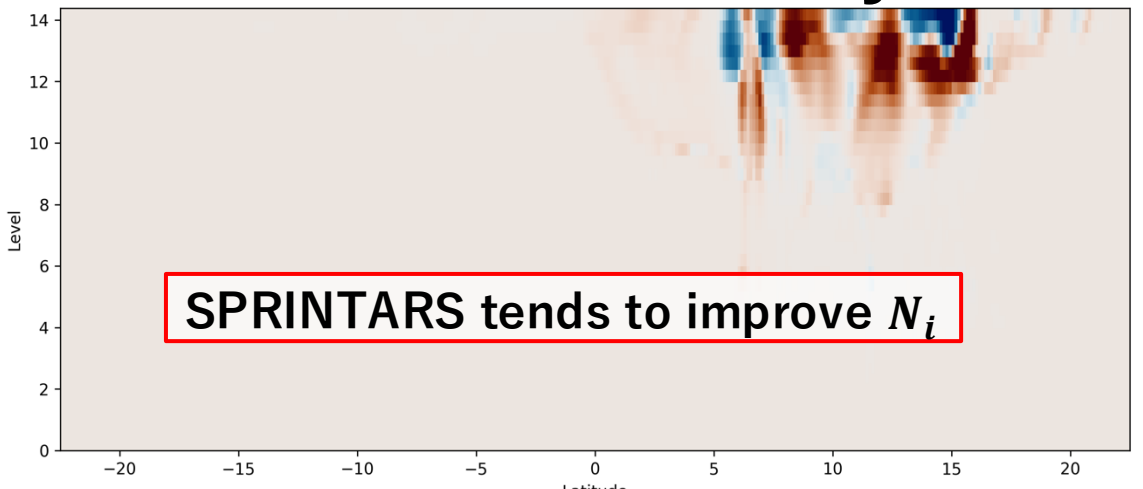
EarthCARE AC-CLP



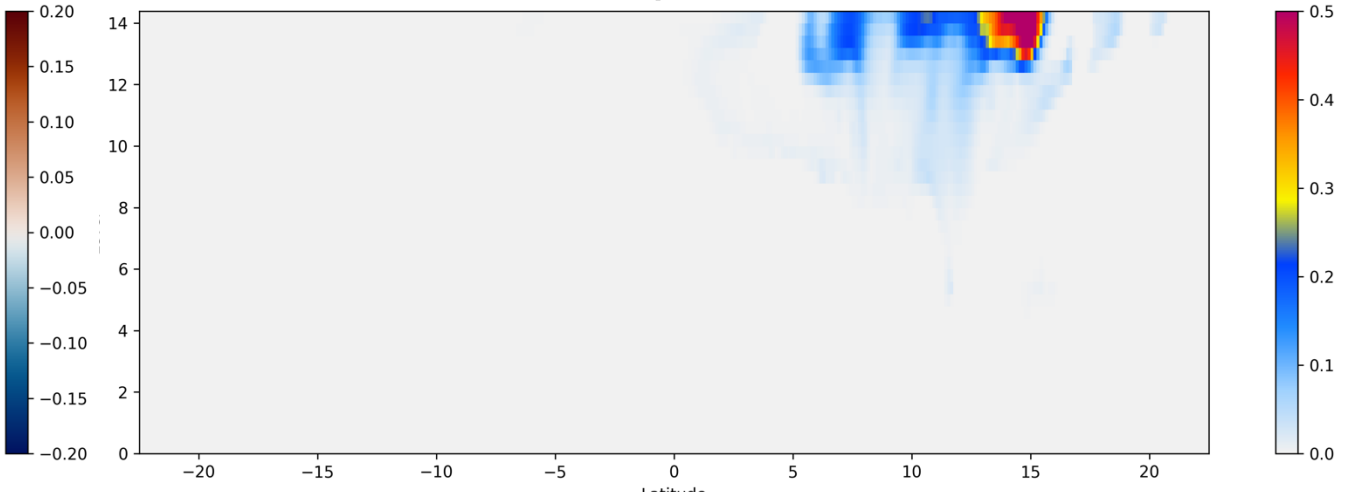
NICAM-SPRINTARS



NICAM anomaly



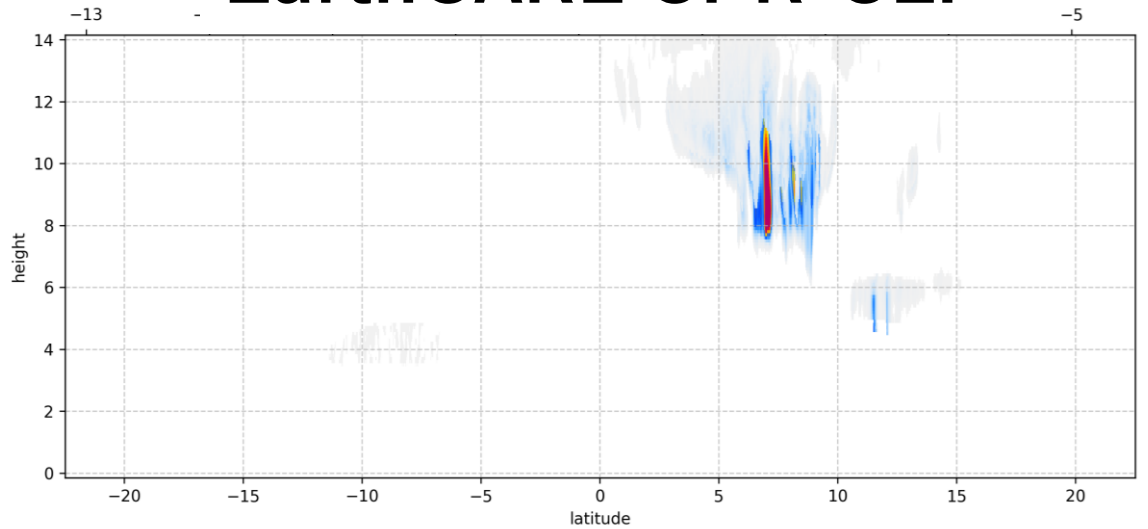
NICAM w/o feedback



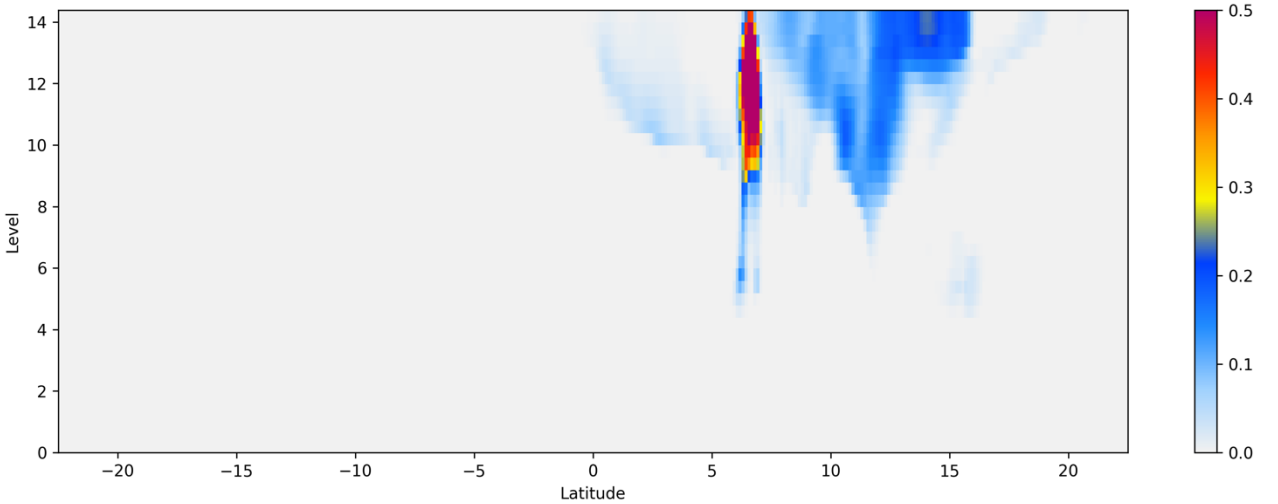
13rd AUG event comparison: retrieval

mixing ratio of cloud ice [g/kg]

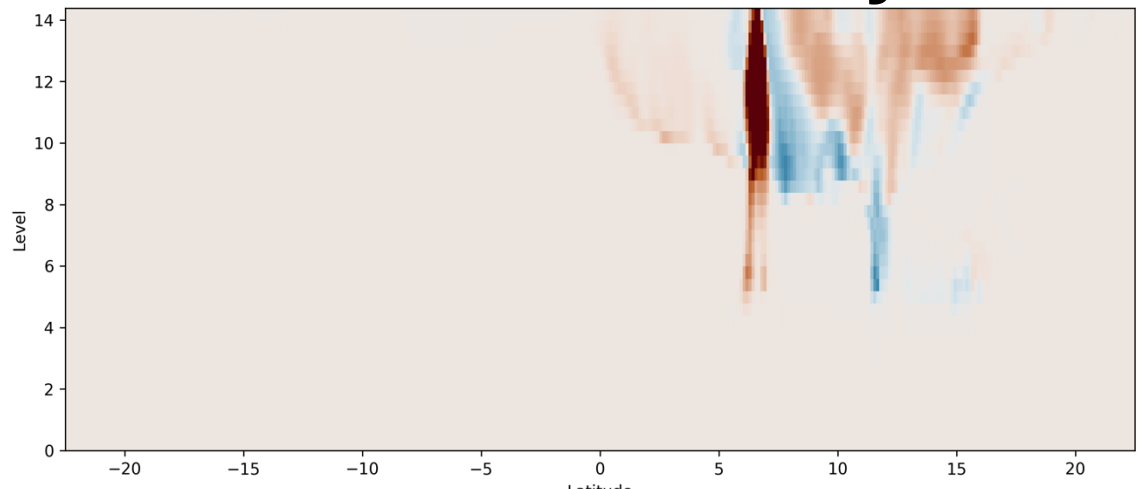
EarthCARE CPR-CLP



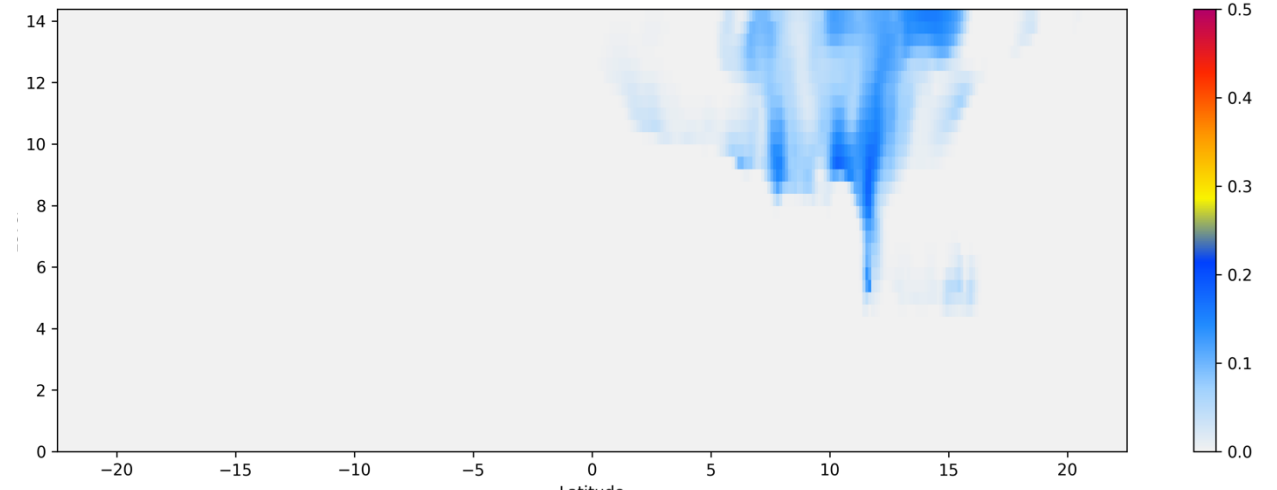
NICAM-SPRINTARS



NICAM anomaly



NICAM w/o feedback

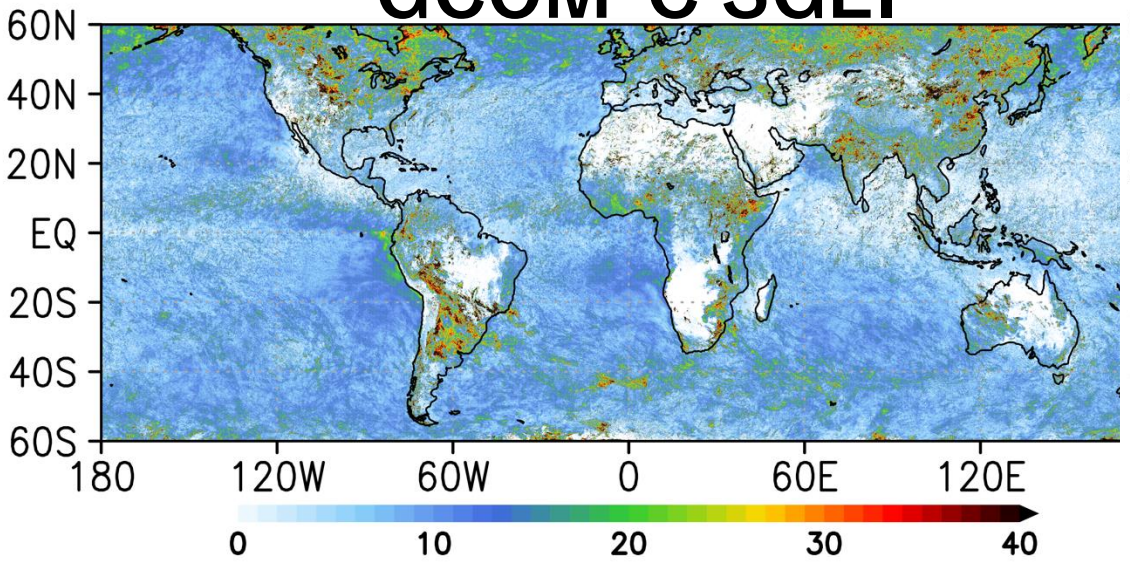


AUG 2024 monthly mean comparison

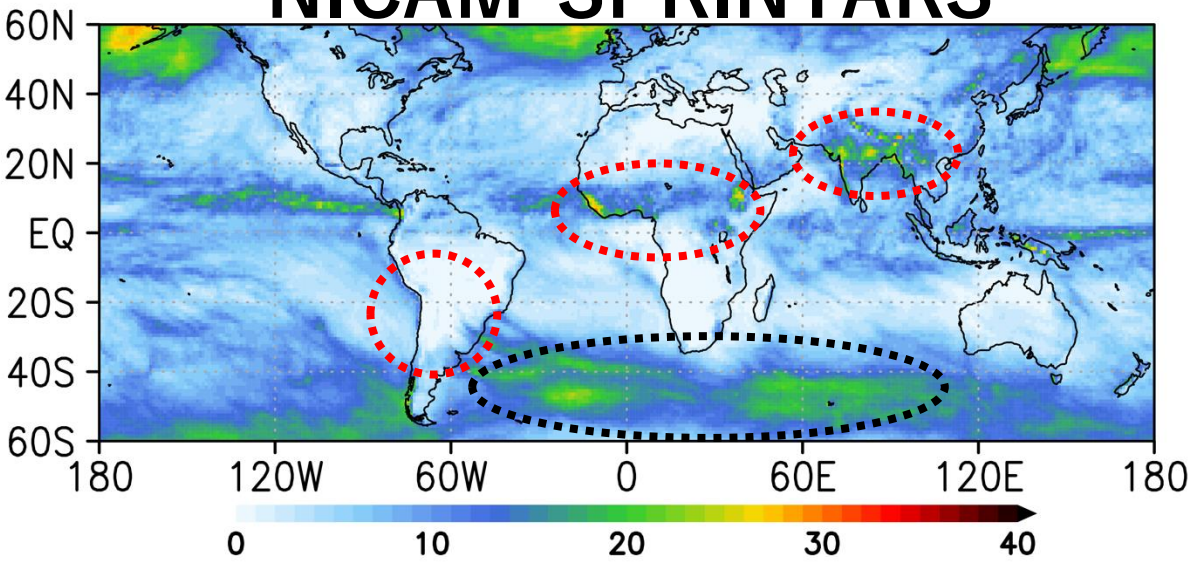
cloud optical thickness

liquid

GCOM-C SGLI



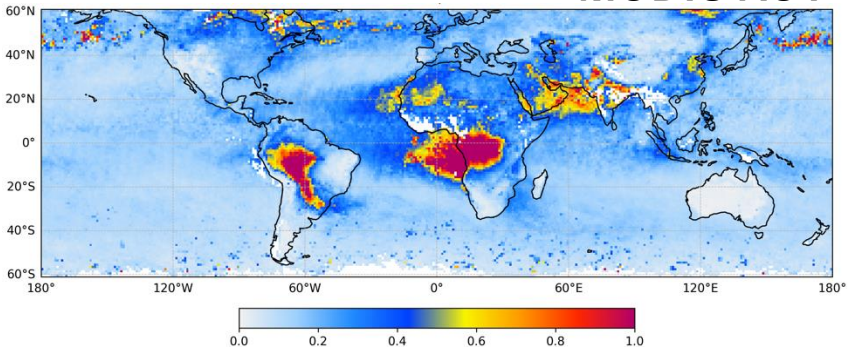
NICAM-SPRINTARS



- **underestimated over lands**: around high concentrations area of carbon and dust aerosols
  → consistent with case study

- **overestimated over southern ocean**: sea salt AOT is overestimated in NICAM
  → This can be coupled bias for southern ocean clouds.

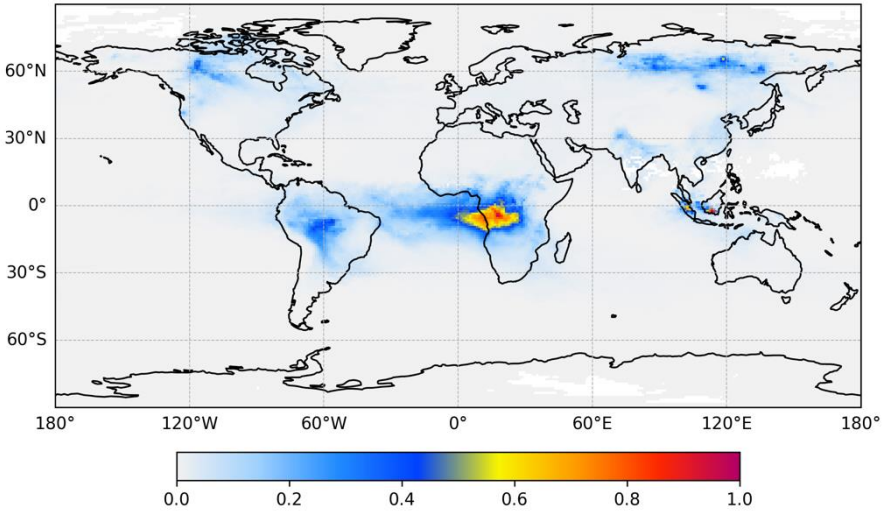
MODIS AOT



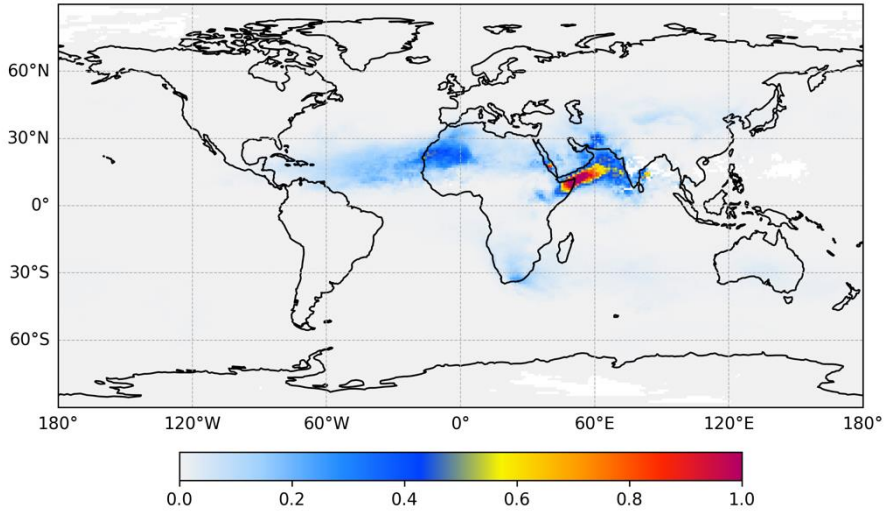
AOT decomposition NICAM-SPRINTARS

2024 AUG monthly mean, 1° deg

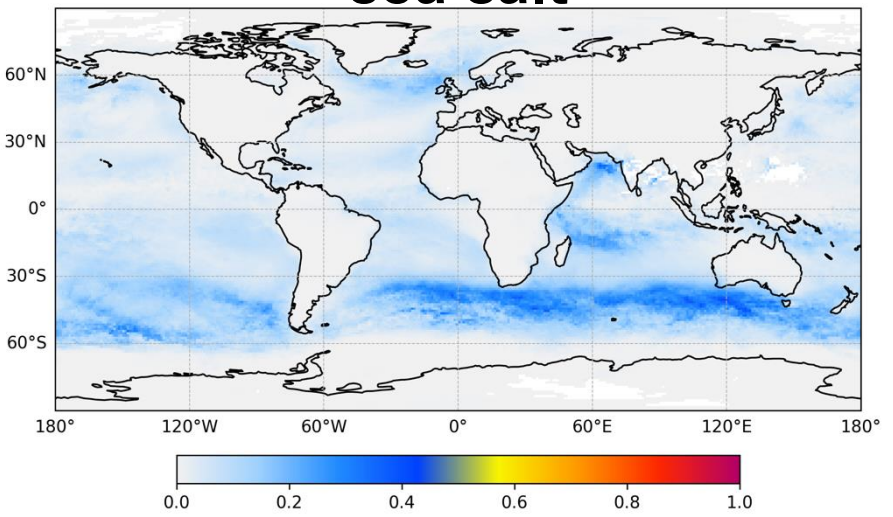
carbon



dust



sea salt



sulfate