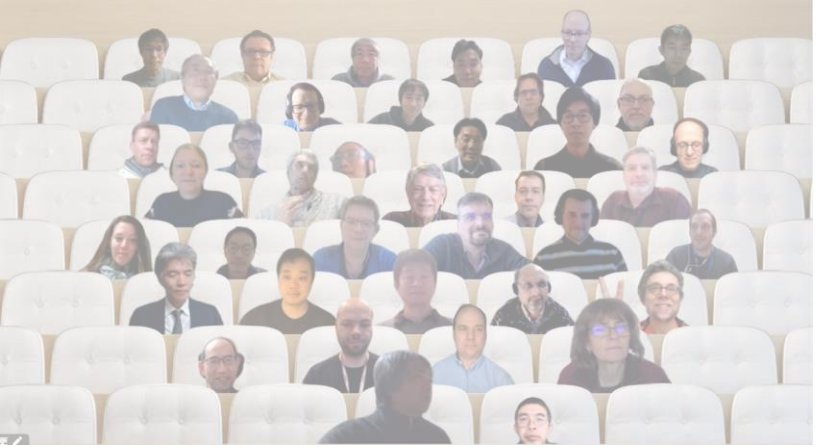

EarthCARE Modeling Workshop
- Day 1 summary and discussion

Woosub Roh

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Contents of Day 1

Introduction:

- Masaki Satoh (AORI/The University of Tokyo) "General remarks: introduction to model-satellite collaborations": Quick Introduction of WS
- Hajime Okamoto (RIAM/CIRAP, Kyushu University) "Development of algorithms and expected products for EarthCARE mission"
- Takuji Kubota (JAXA) "EarthCARE Overview"
- Tobias Wehr (ESA) "EarthCARE ESA product"

Simulators:

- Tempei Hashino (Kouchi Tech. Univ.) "Overview of Joint Simulator and application to GCM"
- Alejandro Bodas-Salcedo (Met Office) "COSP contributions to CMIP5&6"

Assimilations:

- Mark Fielding (ECMWF) "Using EarthCARE assimilation as a route to model evaluation"
- Zhiquan Liu (NCAR) "Assimilation of all-sky data from geostationary imagers with the Model for Prediction Across Scales"

Summary of overview 1

Prof. Satoh

- Introduction to the topic and issues of workshop
- EarthCARE (ECARE) launch: Sep. 2023
- Model activities using NICAM and Joint simulator for ECARE
- Evaluation history of NICAM using ISCCP, CALIPSO-COSP, T3EF-SDSU, J-SIM, ground observations
- Intercomparison of global storm resolving models (DYAMOND)
- Tunning of microphysics (terminal velocity of snow, rain) for MJO simulations.

Prof. Okamoto

- Doppler cloud radar higher sensitivity -35dBZ (-28dBZ CloudSat), increase of low cloud detection
- HSRL, new parameter (lidar ratio), direct observation of extinction
- Introduction to KU cloud type algorithms using CloudSat and CALIPSO
- Ice particle type for ATLID using lidar ratio and depolarization ratio
- Fast multiple scattering for Water clouds in ATLID
- Dust extinction affects ice cloud fraction (Kawamoto et al. 2021)
- Muti-filed-of-view multiple-scattering polarization lidar and ground – based validation for EarthCARE

Summary of overview 2

- Dr. Kubota
  - Introduction to JAXA EarthCARE product
  - Needs (the vertical structure of clouds and aerosol layers)
  - Mean local time: approx. 14:00(Descending), 2:00 (Ascending)
  - More sensitivity than CloudSat/CPR with 2.5m antenna
  - CPR L1 product (JAXA) ATLID, MSI,BBR (ESA) data ,6 months after launch, L2a (single) 9 months after launch, L2b (synergy), 18 months after launch
  - L2 algorithms development by 6 PIs
  - JAXA A-Train product for the EarthCARE
  - Promotion for weather/climate model communities (MIROC, MSRI-ESM, CReSS, Asuca, MASINGAR, SPRINTARS, VENUS/NICAM-Chem)
  - QnA: about radiation product, radiation heating for clear sky, yes
  - QnA: about the launch date, high confidence, technical issues about ATLID, CPR

Summary of overview 3

Dr. Wehr

- The flow chart of ESA product, Nomenclature of data product
- X-JSG: joint standard grid

Vertical approx. 103 m, along-track approx. 1km , Across-track resolution fixed 1km

- BBR L2B data is reliable.
- The flux calculation using synergic retrieval data shows better performances.
- Algorithm testing using GEM model
- QnA: 4-sensors radiation calculation from Masunaga, interaction of 4-sendor products between JAXA and ESA → independent
- QnA: about precipitation product from Johannes, rain and snow using ground temperature

Summary of simulator 1

- Prof. Hashino
  - Introduction to Joint simulator
  - Visible and infrared imager, Broadband, microwave radiometer, Radar, lidar
  - Radar-lidar diagnosis for IWC and Reff (BETTER diagram)
  - Impacts of phases of cloud particles on radiation
  - Joint-simulator work flow for GCM and CRM
  - Comparison of COSP and J-SIM (Good agreement on scattering ratio, differences in dBZ)
  - Uncertainty in the signal simulation for coarse GCM outputs
  - Precipitation fraction assumption has a large impact on CFAD.
  - Application of Doppler velocity (W vs Height, Ze Vs Doppler velocity)
  - How to use Doppler velocity of the EarthCARE in GCM?
  - QnA Issues of GCM applications (Bjorn), identification of difference dBZ between COSP, J-SIM (scattering model, precipitation fraction), ice sedimentation of stratiform precipitation in GCM grid (Satoh)
  - QnA a few kilometer simulation has also heterogenous condition (Dufreesne)

Summary of simulator 2

Dr. Bodas-Salcedo

- Introduction to COSP contributions to CMIP5&6
- ISCCP, CloudSat, CALIPSO, MODI, MISR, PARASOL, CLARA
- Explanations about the simulation setup of CMIP6 (Webb et al. 2017)
- The potential of multidecade spaceborne lidar record to constrain cloud feedback (Chepfer et al. 2018)
- Too few, too bright of tropical low-cloud problem in CFMP5 models (Nam et al. 2012)
- Evaluating climate model's cloud feedbacks against expert judgment (Zelinka et al. 2022)
- Origins of the solar radiation biases over the Southern Ocean in CFMIP2 models using CALIPSO and ISCCP (Boda-Salcedo et al., 2014)
- EarthCARE in COSP (consideration about uv lidar)
- QnA ECARE lidar ratio in COSP and Doppler velocity in COSP (Suzuki)
- Comment 3 years mission life, the 6 months commissioning phases (Wehr)

Summary of data assimilations 1

Dr. Fielding

- How can assimilating EarthCARE improve forecasts and improve the presentation of cloud processes?
- Observation operators for radar and lidar on satellite (Michele 2012, Fielding 2021)
- Observation error and operator error
- Data assimilation
- Indirect: model validation using observation operators as instrument simulator, monitoring of instruments/product to detect instrument/model problems,
- Direct: best estimate of initial state
- Future research: Reducing microphysical uncertainty via observation operator parameters, Interactive parameter estimations
- Online observation operators: instant qualitative check, higher resolution simulations (→ online calculation)
- Examples using CFODDs (Suzuki et al. 2010)
- To maximize EarthCARE's potential, boundary layer cloud and Doppler velocity
- Off-line parameter estimation of observation operator microphysical assumption
- Multi-parameter minimization using microwave radiances (Geer 2021, AMT)
- QnA uncerntainty of 3D cloud fields in model, 4D product of EarthCARE userful (Satoh)

Summary of data assimilations 2

Dr. Liu

- Introduction to assimilation of all-sky AMSU-A and ABI/AHI with Global JEDI-MPAS
- Evaluations of WSM6 and Thomson schemes using AHI CH 9
- Tests of clrama, cldama, abiahi (data assimilation)
- Experiment setting: Dual-resolution 3DEnVar, 1200km horizontal, 6km vertical, WSM6, CRTM
- Clarama better results for specific humidity
- Larger impact from all-sky AMSU-A
- Interested in use of the EarthCARE

Collocated data(merged data) for simulator users

- Collocated data or merged data with ATLID, CPR, MSI, BBR

  (X-JSG: joint standard grid

  Vertical approx. 103 m, along-track approx. 1km , Across-track resolution fixed 1km)
- Calibration of the L1 data, reliable product?
- The resolution of the data
  - Reduction of errors of sensors with more sampling or integration
  - What is the suitable resolution of observation data for modelers and accuracy?
  - 1km, 5km (GSRMs), 10km (GCMs)?

Discussion and comment?

- What kinds of physical parameters and information of the EarthCARE are needed?
- How to understand the uncertainty of the EarthCARE products?
- What is an expected result from the experience from CloudSat and CALIPSO?
- The careful points to use satellite simulators (forward operator) like J-SIM or COSP to simulate signals of the EarthCARE satellite?
- The issues of the subgrid in the model?

Thank you