Pacific Northwest
NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

An Aerosol Lidar Simulator for Global Climate Models

Po-Lun Ma[1], Hélène Chepfer[2], David M. Winker[3], Steven J. Ghan[1], Philip J. Rasch[1]

[1]PNNL, [2]LMD/IPSL, [3]NASA/LARC

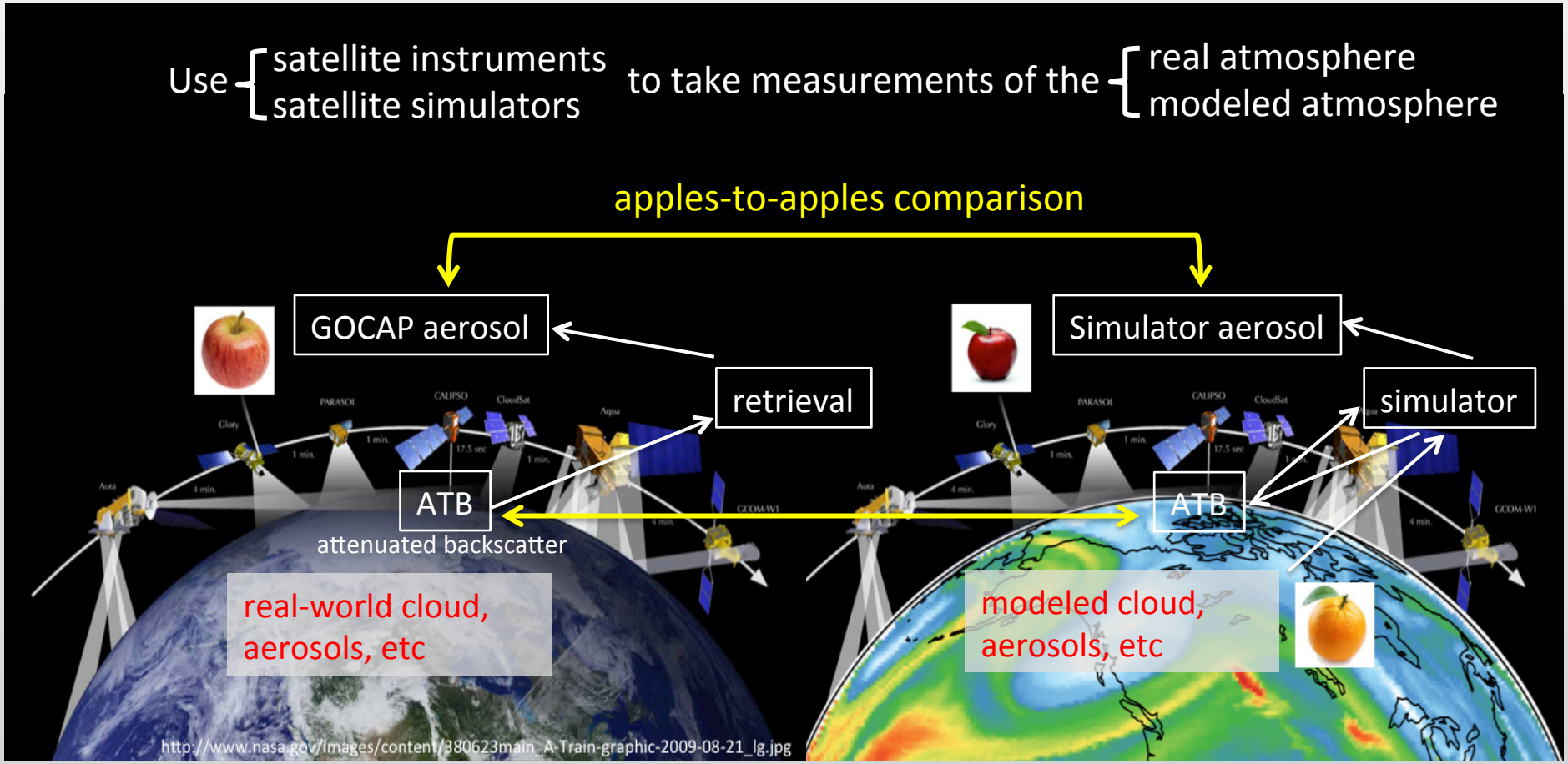
Acknowledgement:
Alma Hodzic, Kuo-Nan Liou, Robert Pincus, Johannes Quaas, Philip Stier, PNNL PJR team
DOE ESM (Simulator) and RGCM (GOCAP)
DOE EMSL Cascade at PNNL

U.S. DEPARTMENT OF ENERGY

Minimize Sampling and Algorithmic Differences between Models and Observations

Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

Concept: Compare the satellite measurements (of the real atmosphere) with the simulator measurements (of the modeled atmosphere).

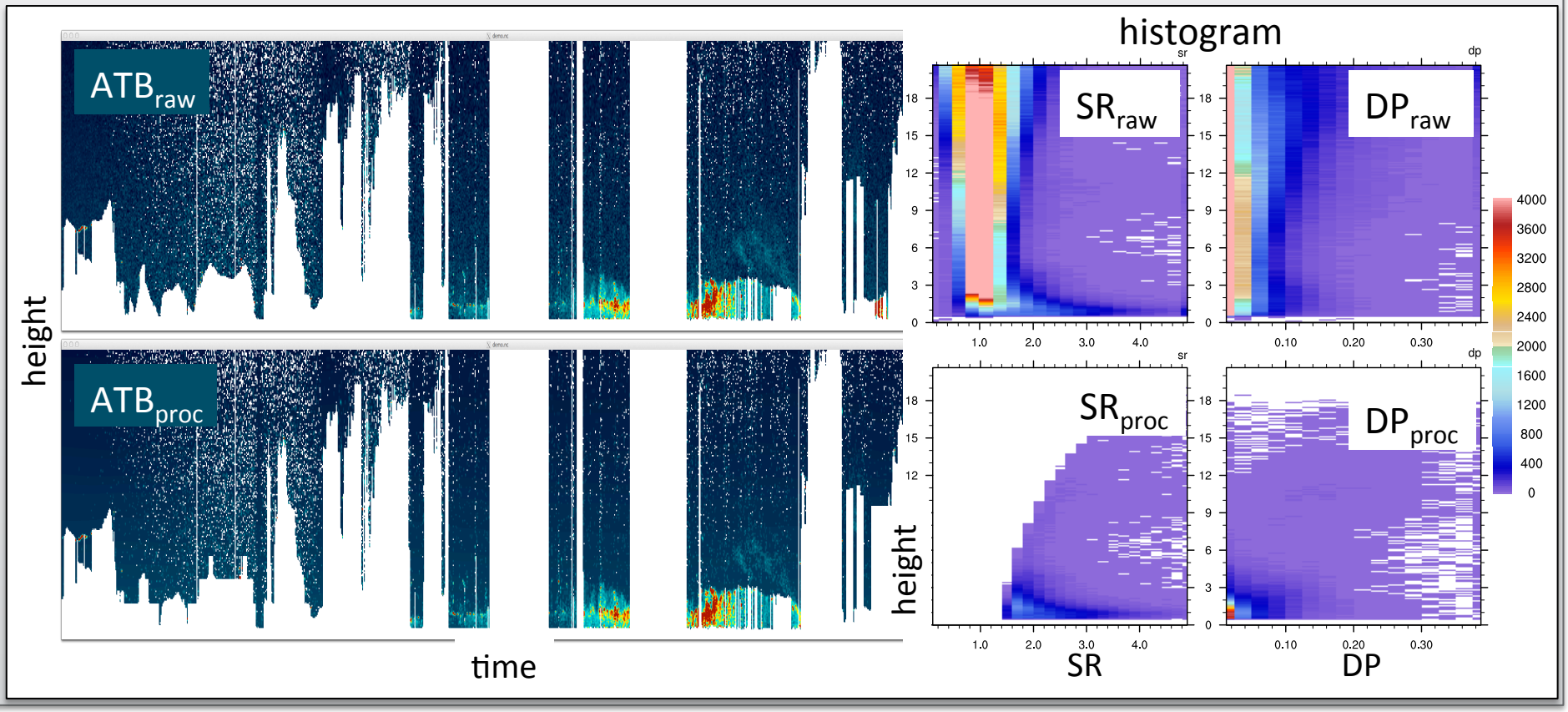


GOCAP:
GCM-Oriented CALIPSO Aerosol Product

Pacific Northwest
NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

Observational dataset optimized for evaluating GCM with simulator

- **Level 1.5**: CALIPSO L1.5 Attenuated Backscatter (ATB) data (cloud screened)
- **Level 1.5+**: Aerosol Layer Detection/Noise Reduction; scattering ratio (SR) and depolarization ratio (DP) calculation



GOCAP L2/L3:
Retrieval, Aerosol Typing, Regridding

- **Level 2**: Aerosol typing (SR, DP, surface, height))/Retrieval (orbit data; dx=20km, dz=60m)
- **Level 3**: Lat-lon grid (0.25-deg, 2-deg); daily, monthly, annual mean

GOCAP dataset

1. ATB (3D)
2. Scattering Ratio (3D)
3. Depolarization (3D)
4. Extinction by aerosol types (3D)
5. AOD (2D)

Aerosol types

1. Polluted continental
2. Clean continental
3. Desert dust
4. Polluted dust
5. Biomass burning
6. Marine

Aerosol Lidar Simulator for GCMs: Consistency between Models and Observations

Approach (consistent with GOCAP)

- Orbital sampling
- Aerosol optics (backscatter)
- Cloud masking (subgrid scale)
- Solver for elastic lidar equation
- Aerosol layer detection
- Retrieval/Aerosol typing

Simulator Output

1. ATB (3D)
2. Scattering Ratio (3D)
3. Extinction by aerosol types (3D)
4. AOD (2D)

Proposal: Using the Aerosol Lidar Simulator and GOCAP for Future AeroCOM Studies

Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

New science opportunities

- Apples-to-apples comparison: Evaluate aerosol between models, and between models and observations, using consistent algorithms and sampling strategy

Use the aerosol simulator and GOCAP dataset for other GCMs

- Current status: code implemented on COSP1.4 (will work with Robert Pincus and Dustin Swales for implementation in COSP2.0); manuscripts in preparation
- Aerosol optics (180-degree backscatter for aerosols)
- Nudged simulation (2008)
- Output necessary fields for running COSP plus aerosol fields (backscatter by species)