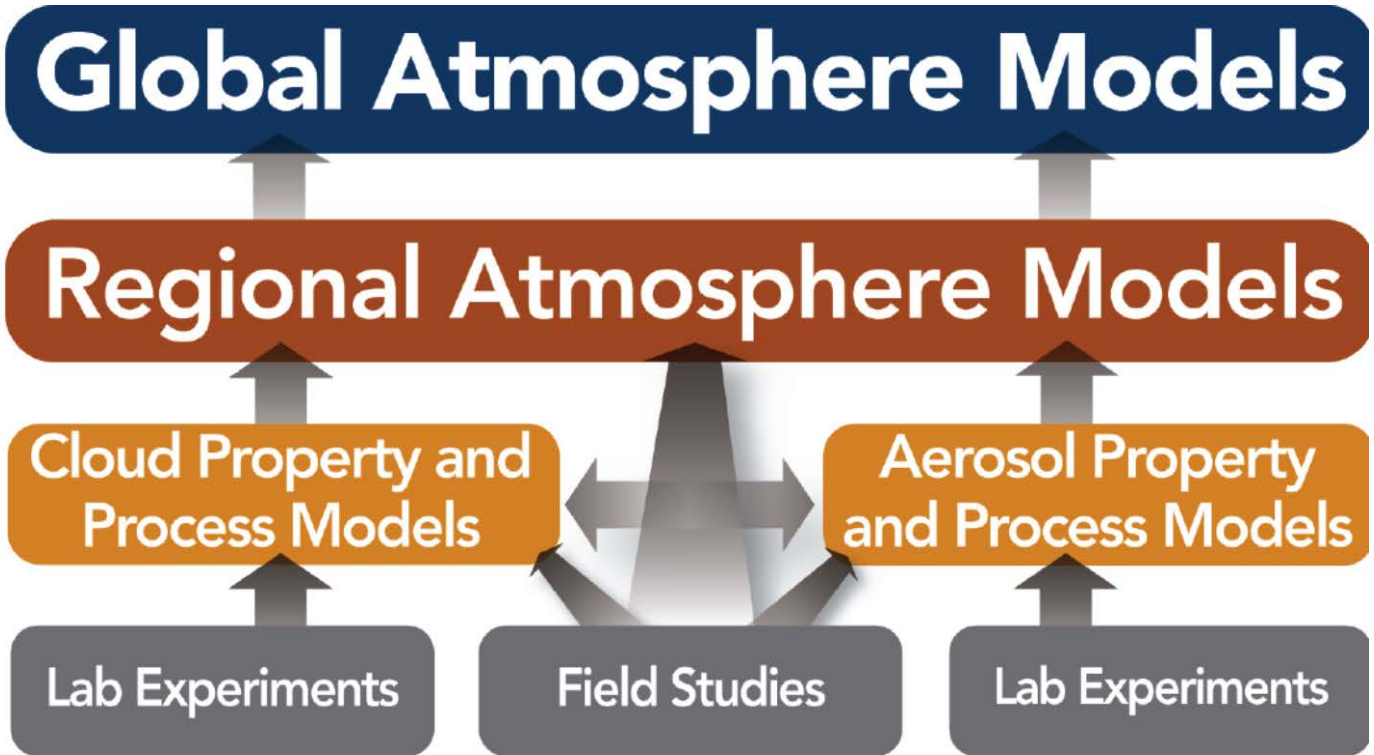
Answering Shallow Warm Clouds Science Questions

ASR Atmospheric System Research

- Why do climate models produce a large aerosol indirect effect?
- What processes control diversity in the sensitivity of warm low clouds to aerosol perturbations?



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Field Studies

VOCALS stratocumulus

Azores stratocumulus

CHAPS shallow cumulus

ISDAC mixed-phase stratocumulus

RACORO Long-term aircraft sampling of sub-cloud aerosol and then profiles through shallow convective clouds

MAGIC transitions from closed to open celled shallow convection

Aircraft campaign over Azores to validate microphysics, vertical velocity, entrainment retrievals

CORMORANT shallow cumulus Galapagos

SOCRATES southern ocean

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Measurements

Combine satellite and surface data to estimate CCN at cloud base (D. Rosenfeld)

Retrieve vertical distribution of CCN from a suite of ground-based sensors (Z. Wang and Z. Li)

Retrieve droplet number from satellite (D. Rosenfeld)

Retrieve droplet effective radius from satellite (D. Rosenfeld, Z. Li)

Retrieve droplet effective radius from surface (C. Chiu, D. Turner, Z. Li, Z. Wang)

Retrieve LWP for thin clouds (D. Turner)

Retrieve LWP under drizzling conditions (D. Turner, M. Cadeddu, R. Hogan)

Retrieve light drizzle (P. Kollias)

Estimate subadiabaticity in LWP from retrieved LWP, cloud base, and cloud top (L. Riihimaki)

Measure entrainment rate above stratocumulus clouds (Y. Liu)

Retrieve updraft velocity at cloud base (V. Ghate, E. Luke, P. Kollias)

Analysis of Droplet Number Effects

Investigate relationships between AOD and CCN to improve the global estimate of CCN from satellite and AERONET for GCM applications

Compare Rosenfeld retrieval of CCN with Ghan and Feingold retrievals at SGP (D. Rosenfeld, G. Feingold and S. Ghan)

Compare Rosenfeld retrieval of droplet number with surface-based number estimated from retrieved CCN spectrum and updraft velocity (D. Rosenfeld, C. Chiu, and S. Ghan)

Explore relationships between aerosols and cloud properties and dynamics (updraft speed, entrainment rates, rainfall frequency and rate) using ground-based, aircraft and satellite retrievals (Z. Li, R. Wood)

Determine ACI metrics across low cloud data sets; systematically examine how they change with cloud dynamics, spatiotemporal scale (A. McComiskey, G. Feingold)

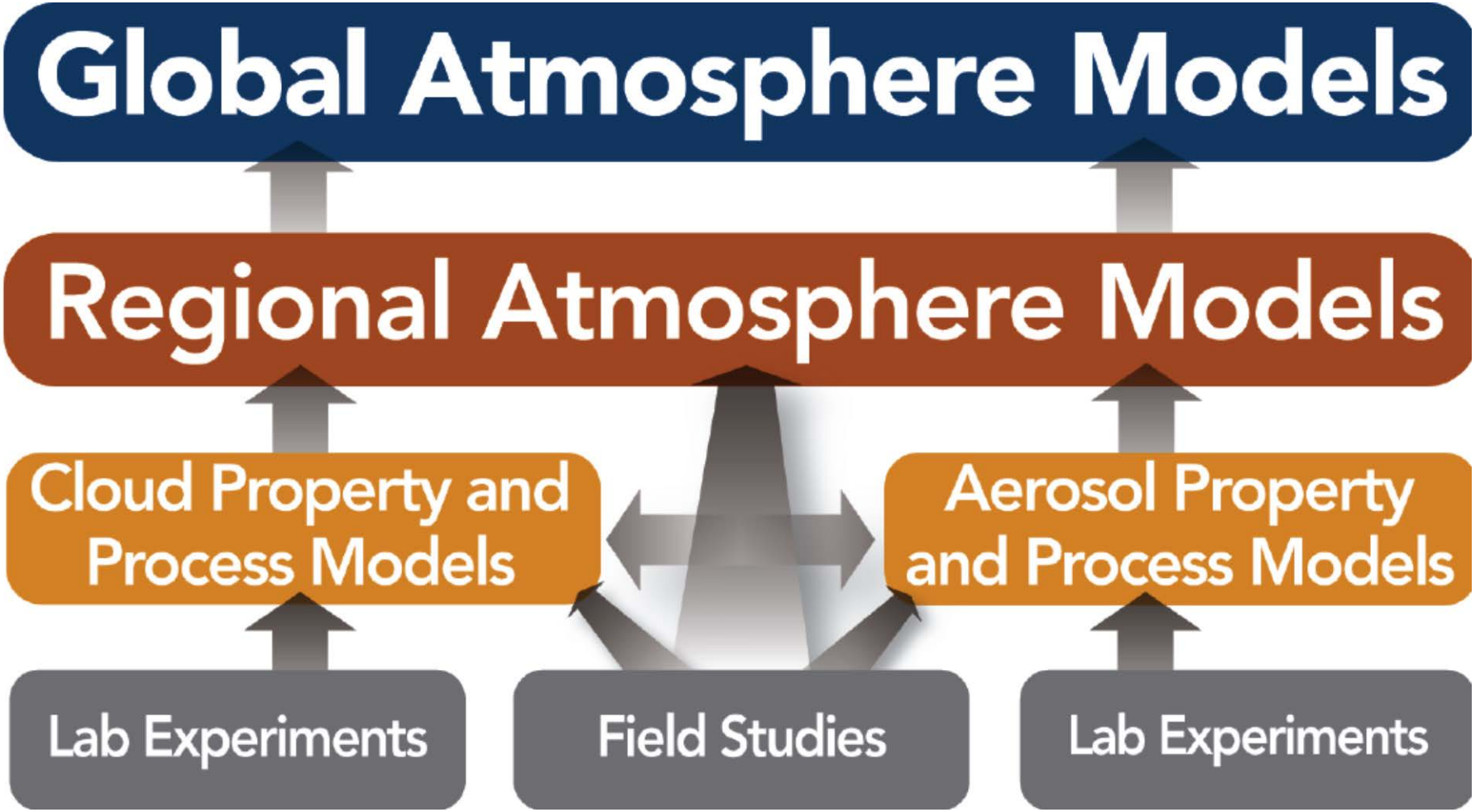
Analysis of Liquid Water Impacts

Estimate precip susceptibility metrics for existing low cloud datasets (G. Feingold, R. Wood, C. Chiu)

Calculate S_{pop} from ARM measurements at SGP and Azores (Z. Li, X. Dong, and R. Wood)

Cloud Effects on Aerosol

Measure aerosol scavenging/ precipitation efficiency



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Modeling

Analyze CRM results to determine influence of subgrid variations in droplet number and cloud liquid water on autoconversion (G. Feingold)

Compare SCM and CRM simulations driven by boundary conditions from CAM5 (J. Penner)

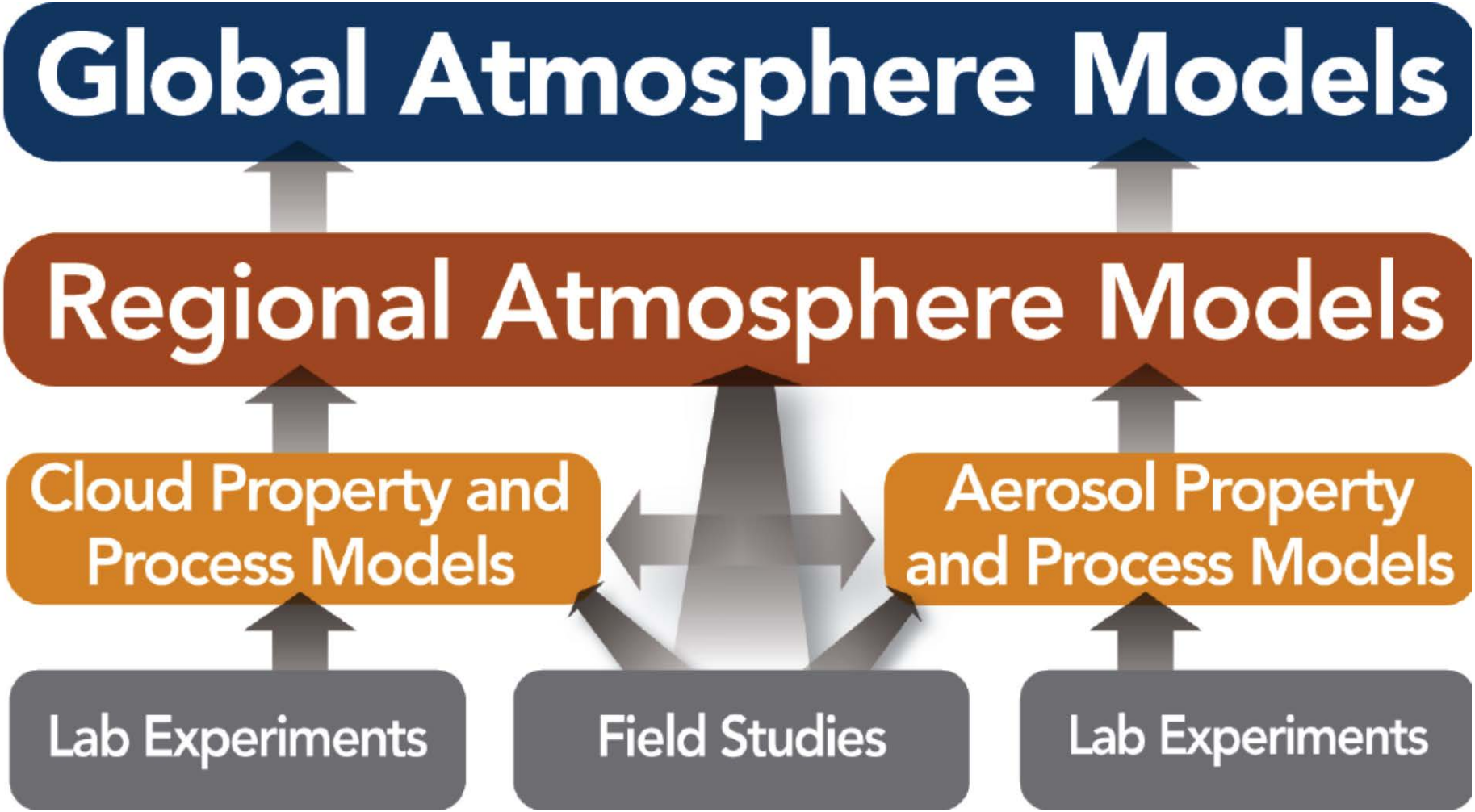
Compare autoconversion ratio in multiple global models (S. Ghan)

Compare simulated autoconversion ratio with measurements (H. Morrison, R. Wood)

Add subgrid covariance between cloud water and rain to cloud microphysics in global models (H. Morrison)

Add prognostic precipitation to global models (H. Morrison, L. Donner)

Represent aerosol effects on shallow cumulus clouds in CAM5, including dependence on entrainment (G. Zhang, S. Ghan).



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What is Missing?

- Some tasks have no one assigned
- Comparisons of simulations with measurements
- Measurements, analysis and modeling during transition from closed cell polluted conditions to open cell clean conditions