Cloud Lifecycle Working Group Science

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Working Groups Home

Science and Infrastructure Steering Committee (SISC)

+ Aerosol Life Cycle

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Research Projects

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Highlights and accomplishments

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+ Cloud-Aerosol-

Only 4 for 2010 so far

Cloud Life Cycle

Mission Statement

The mission of the Cloud Life Cycle Working Group is to document from observations and modeling and thereby develop understanding of the dynamical, thermodynamical, microphysical, and radiative processes that together determine the evolution of clouds from formation to dissipation, and to translate this understanding into methods for representing cloud processes in numerical weather and climate models.

Objectives

- Identify guiding science questions regarding cloud life cycles that are based on model uncertainties/limitations, that can be addressed using ACRF observations, and that support broader programmatic objectives outlined in the ASR Science Plan.
- Facilitate, organize, and maximize the efforts of individual Principle Investigator projects towards answering these broader scientific questions through the formation and organization of subgroups with similar and complementary research goals.
- Identify, prioritize, and help implement the observational campaigns, measurement strategies, and data products that are needed to understand cloud lifecycle processes and represent them in models.

The ASR Science Plan defines the scope of CLWG activities:

- Many of the uncertainties in GCMs stem from poor representation of cloud processes that operate at fine scales

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- Three broad areas:
  - Dynamics (vertical air motions, entrainment, convective initiation)
  - Microphysics (cloud PSDs, ice crystal fall speed and habit, precipitation formation)
  - Radiation (cloud optical depth, spectral dependence of ice absorption, radiative heating profile)

Input for Guiding Science Questions

- Breakout discussions at last spring's Science Team Meeting
- Discussions among WG co-chairs and Steering Committee
- Emerging themes from this meeting?

Cirrus clouds

- Ice supersaturation, cirrus and strat-trop moisture exchange
- Particle size distribution, evolution, importance of small particles
- Process control of cirrus properties (nucleation, particle growth, sedimentation, sublimation)
- Cirrus retrieval algorithm complexity, minimum set needed?
- What are the radiative impacts of different cirrus types?
- Why are thin cirrus so common and widespread in the tropics?
- Why do cirrus not contribute much to variability among GCMs?
- What determines areal coverage of anvils (detrainment, wind shear, radiative spreading, precipitation, sublimation)?

Deep convective clouds

- Triggering and occurrence of deep convection
- Mesoscale organization: conditions, effect on anvil properties and lifetime
- Convective diabatic heating profiles
- Entrainment: representation, effects on strength, depth, clouds, precipitation, heating/drying
- Heating/drying-large scale flow interaction, dynamical variability
- Vertical velocity characterization, effect on precip, cirrus
- Representation of microphysical processes, especially ice
- Characterization/representation of subgrid inhomogeneity
- What aspects of cumulus parameterization should be prognostic?
- Should cumulus parameterizations be stochastic, and if so, how?

Low clouds (warm)

- Factors controlling entrainment
- Control of precipitation onset, rate, efficiency
- Relation of cloud properties to near-surface and overlying air properties
- Processes responsible for transitions (Sc-Cu, Cu-Cb)
- Processes controlling diurnal cycle of marine Sc, continental Cu
- Why do models over-predict precip occurrence and underpredict incidence of thin low clouds?
- Effect of mesoscale inhomogeneity (w, LWC) on drizzle, radiation
- Which of these processes determine how stratus, stratocumulus, cumulus will respond to a climate change?

Low clouds (cold)

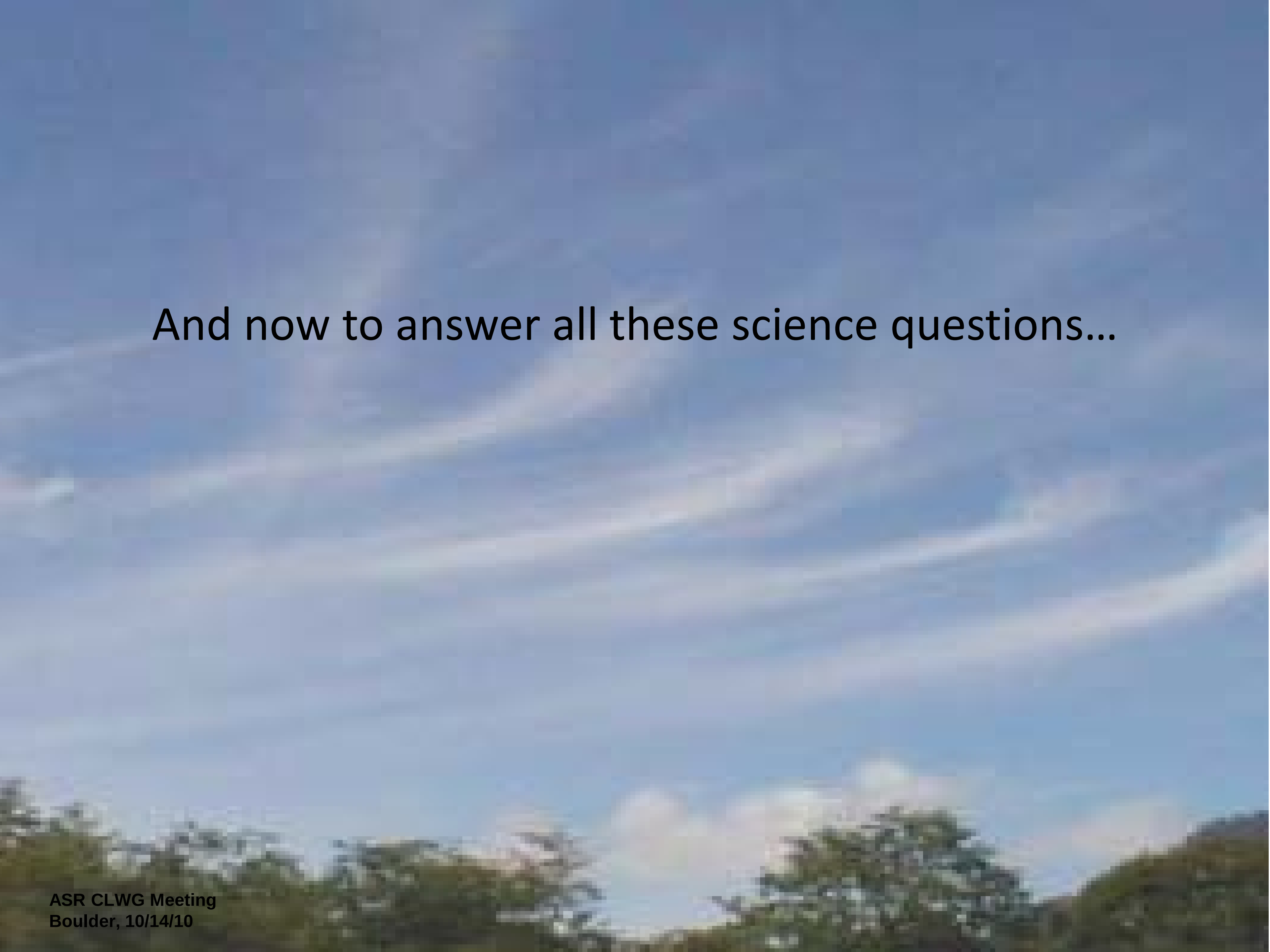
- What determines cloud phase (radiative cooling, moisture advection, surface fluxes, turbulence, aerosols)? Appropriate level of complexity in models?
- What ice nucleation mechanisms are important in cold clouds with/without liquid water?
- What determines precipitation efficiency? Role of persistent slow precip vs. episodic strong precip in Arctic precip budget
- How do clouds/precip affect low-level stratification in Arctic?
- How do Arctic stratus affect sea ice melt onset, duration, freezeup?
- Are recent Arctic sea ice trends driven by stratus, and if so, how?
- How will Arctic cloud properties respond to climate changes?
- Why do models over-predict winter near-surface thin ice clouds?

Midlatitude storm clouds

- Role of diabatic heating in generation of EAPE in synoptic storms and their role in climate change; how well do models simulate diabatic heating and poleward energy transport?
- Tilt, coverage, microphysical and radiative properties of clouds formed by mesoscale frontal circulations
- What spatial resolution is required for models to represent midlatitude storm cloud properties and transports?
- Do climate models need to parameterize symmetric instability?
- How can climate models better predict snow vs. rain occurrence in winter storms?

From ARM to ASR

- WG structure intended to get observers and modelers together
- More emphasis on data analysis and process understanding as intermediary between observations and models
- Abundance of new instruments but not-so-abundant addition of new people requires priority setting for science, VAPs- this meeting is your chance!
- Increased emphasis on PI data products
- Emphasis on focus group formation to make progress on important topics


And now to answer all these science questions…
ASR CLWG Meeting
Boulder, 10/14/10