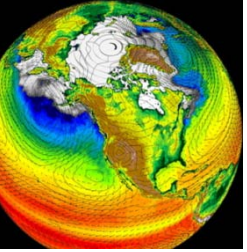


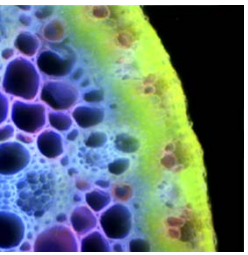
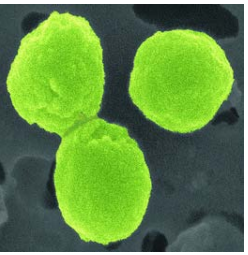

Atmospheric System Research Science Plan

(http://www.sc.doe.gov/ober/Atmospheric System Research Science Plan.pdf)

2010 ASR Science Team Meeting

North Bethesda Marriott Hotel

Bethesda, MD

March 16, 2010

Ashley Williamson, Ph.D.
Program Manager, Atmospheric System Research
Climate and Environmental Sciences Division

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- Bob Ellingson
- Steve Schwartz
- Warren Wiscombe
- Steve Klein
- Steve Ghan
- Jeff Gaffney
- Many others via WG interactions, meetings, etc.

Atmospheric System Research

- New program by combining Atmospheric Science Program (ASP) and the Atmospheric Radiation Measurement (ARM) science program
- Focuses on process research needed to improve the representation of clouds and aerosols in the climate models
- New ARM instruments open new research opportunities for ASR
- Program Managers Kiran Alapaty and Ashley Williamson
- Teamed with ARM Facility Program Managers, Wanda Ferrell and Rick Petty

ASR Science Plan Overview

- 1.0 Introduction (*who we are and what we're about*)
  - 1.1 Historical Background
  - 1.2 Scientific Motivation
  - 1.3 Programmatic Strategy
- 2.0 Process Research (*what we study*)
  - 2.1 Aerosol Life Cycle
  - 2.2 Cloud Life Cycle
  - 2.3 Aerosol-Cloud-Precipitation Interactions
- 3.0 Measurement and Process Modeling Research (*how we do it – tools and techniques*)
  - 3.1 Observational Methods and Tools
  - 3.2 Process Modeling Methods and Tools
- 4.0 Future Directions
- Appendix A - ARM Instrumentation
- Appendix B - Accomplishments of the ARM and ASP Programs

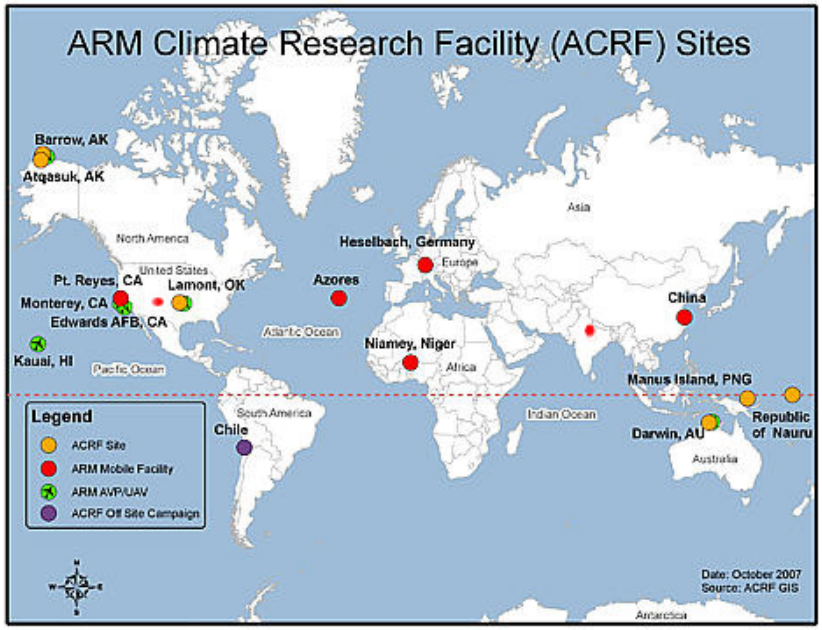
Goal of Atmospheric System Research

The goal of ASR, in partnership with the enhanced ARM Facility, is to quantify the interactions among aerosols, clouds, precipitation, radiation, dynamics, and thermodynamics to improve fundamental process-level understanding, with the ultimate goal to reduce the uncertainty in global and regional climate simulations and projections.

Section 1.3, p 10

Accomplishing the Mission (1)

Maintain and augment the collection of comprehensive and continuous long-term datasets that provide measurements of radiation, aerosols, clouds, precipitation, dynamics, and thermodynamics over a range of environmental conditions at several fixed and mobile sites situated in climatically diverse locations



Section 1.3, p 10

Accomplishing the Mission (2)

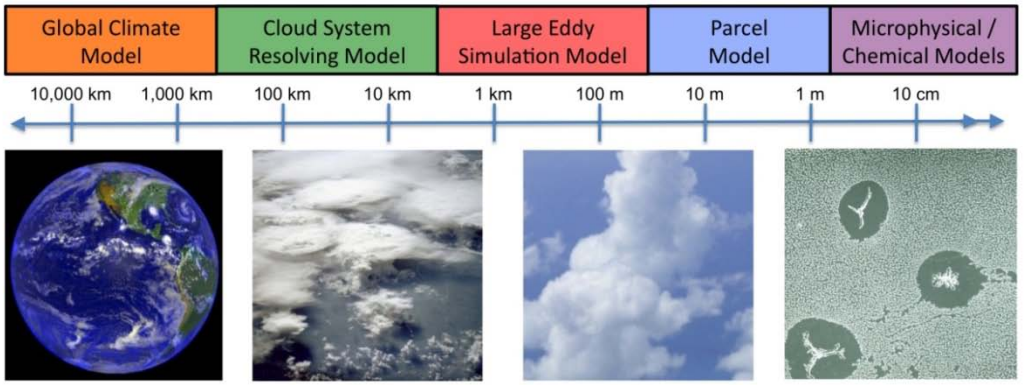
Supplement the long-term datasets with laboratory studies and shorter-duration field campaigns, both ground-based and airborne, to target specific atmospheric processes under a diversity of locations and atmospheric conditions

Section 1.3, p 10

Accomplishing the Mission (3)

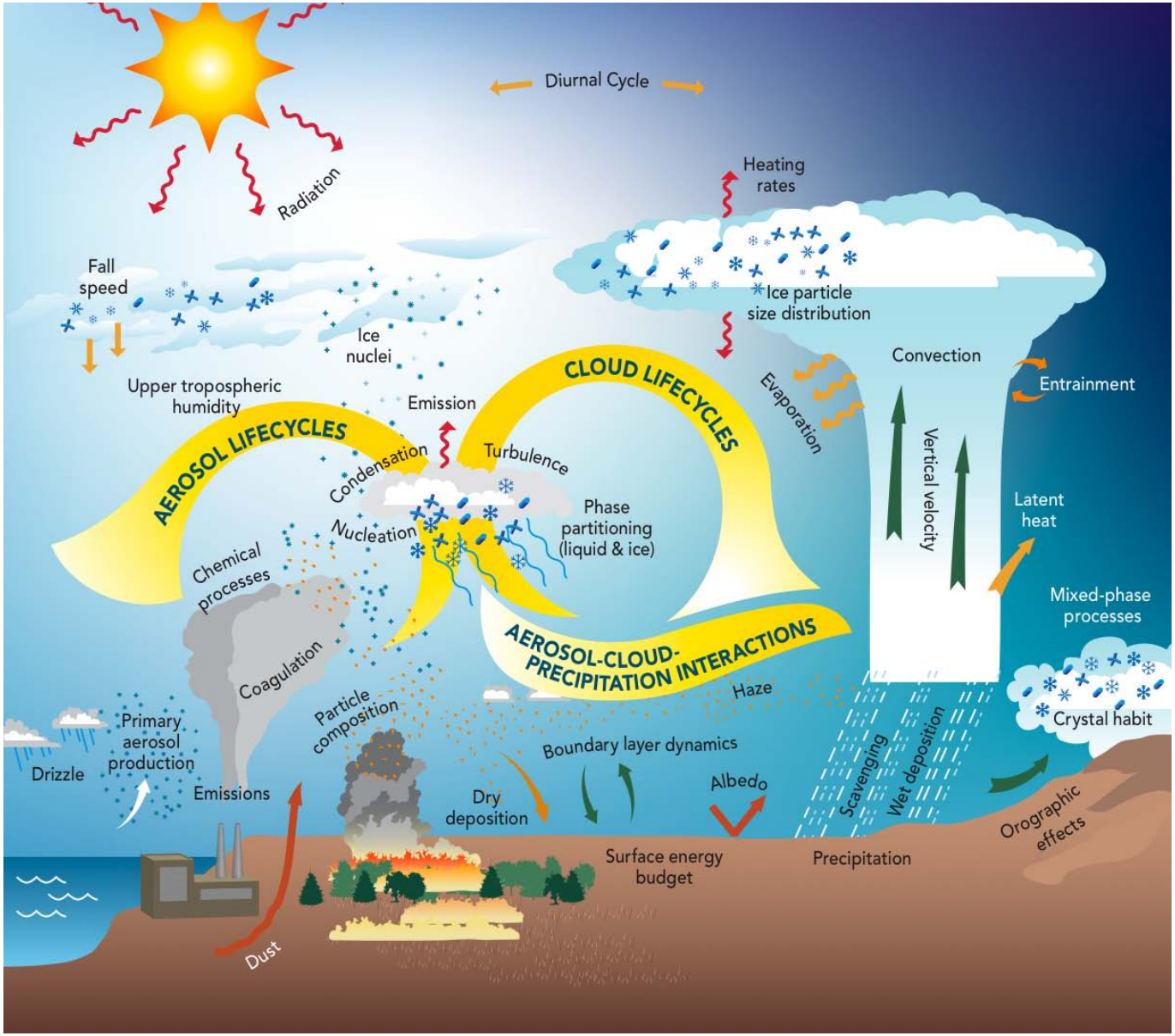
- **Use these data, together with models, to understand and parameterize the processes that govern the atmospheric components and their interactions over all pertinent scales**

- **Develop integrated, scale-bridging testbeds for model parameterizations that incorporate this process-level understanding of the life cycles of aerosols, clouds, and precipitation in numerical models**



Section 1.3, p 10

One Subset of Important Atmospheric Processes



Program Focus and Directions

- Process-related research (*what we study*)
- Measurement and process-modeling related research (*how we do it – tools and techniques*)

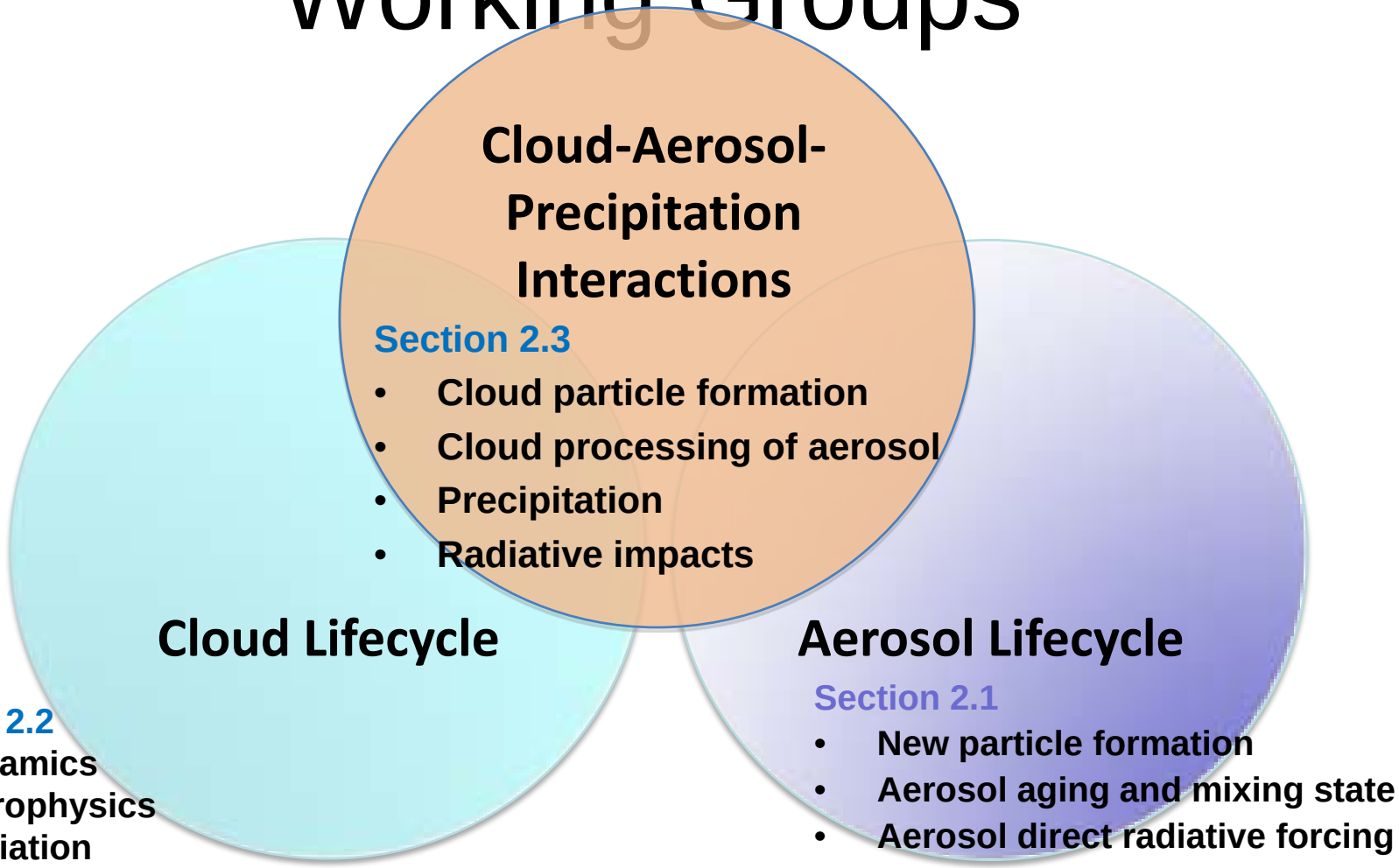
Sections 2 and 3, respectively

Overarching Objectives – Process Research

- **Determine the properties of, and interactions among, aerosols, clouds, precipitation, and radiation that are most critical to understand in order to improve their representation in climate models**
- **Ascertain the roles of atmospheric dynamics, thermodynamic structure, radiation, surface properties, and chemical and microphysical processes in the life cycles of aerosols and clouds, and develop and evaluate models of these processes**
- **Identify and quantify processes along the aerosol-cloud-precipitation continuum that affect the radiative fluxes at the surface and top of the atmosphere and the radiative and latent heating rate profiles**

Section 2, p 14

Process Grouping & ASR Working Groups



Approach – Observations and Modeling (1)

- **Determine the essential characteristics of the coordinated laboratory and field measurements necessary to understand aerosol and cloud life cycles and aerosol-cloud-precipitation-radiation interactions (e.g., variables measured, measurement accuracy, sampling strategies)**
- **Develop research strategies to create the integrated data products necessary to improve the understanding of aerosol-cloud-radiation-precipitation interactions (e.g., retrieval development, uncertainty analysis, data product collation, quality control)**

Section 3, p 27

Approach – Observations and Modeling (2)

- **Utilize the integrated data products to evaluate, and ultimately improve, the parameterization of aerosol-cloud-precipitation-radiation processes in models over a range of scales (e.g., what data products are needed, what metrics are used to evaluate model improvement)**
- **Evaluate the tradeoff between the minimum level of model complexity and model accuracy required to represent the range of atmospheric conditions that determine climatically relevant aerosol and cloud properties and aerosol-cloud-precipitation-radiation interactions**

Section 3, p 27

Measurement and Process Modeling Research

Observational methods and tools

- **Aerosol observations**
- **Cloud observations**
- **Precipitation observations**
- **Radiation observations**
- **Dynamics and thermodynamics observations**

Process modeling methods and tools

- **Model development**
- **Model evaluation**

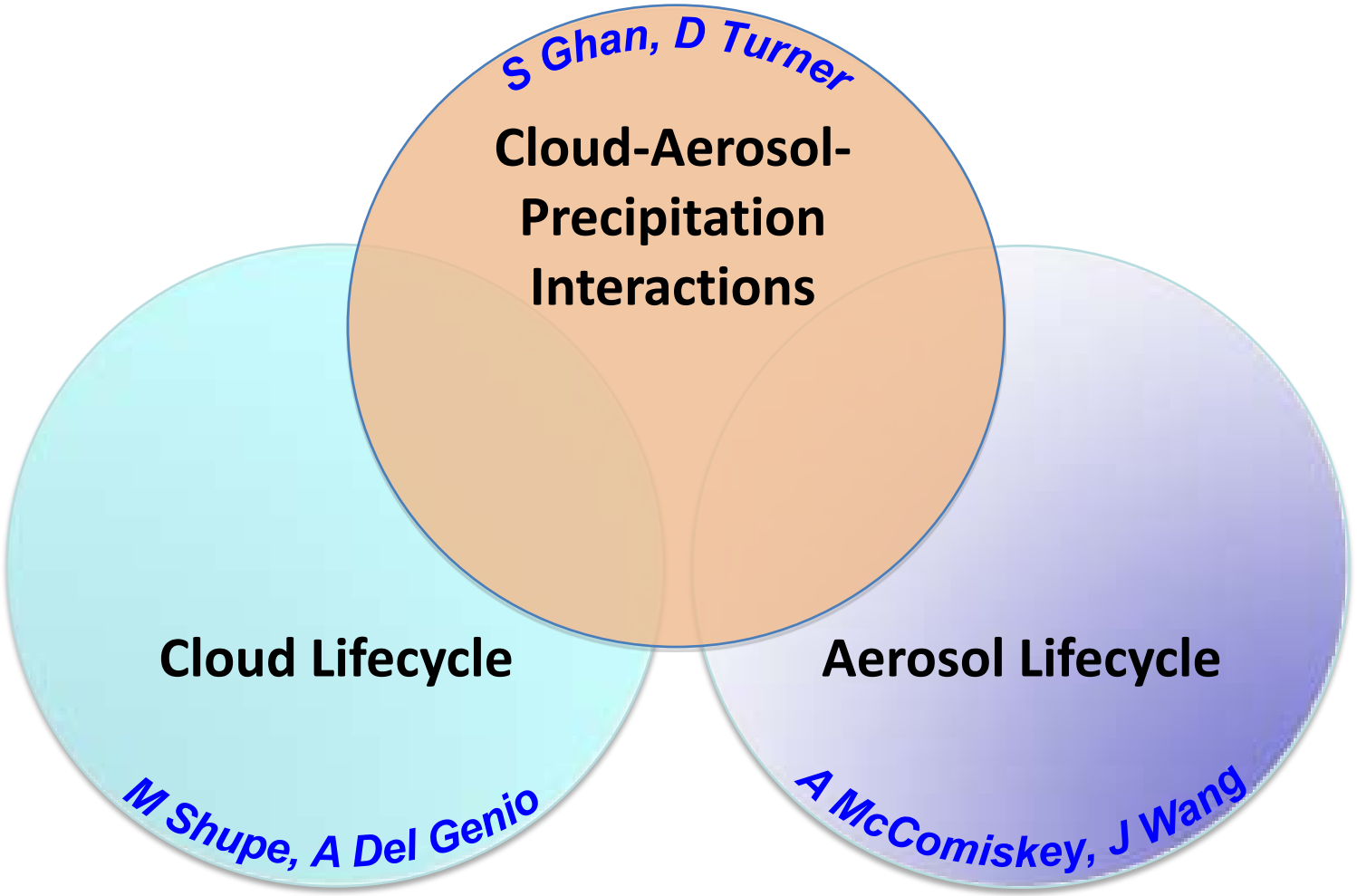
Section 3

Looking to the Future

- **Recommend climatic locations that need further investigation (i.e., with either fixed ACRF sites or AMF deployments)**
- **Expansion of the aerial facility**
  - **Better sampling of the modes of variability (e.g., diurnal, synoptic, seasonal)**
  - **Develop new in-situ instrumentation to measure variables not measured or not well measured**
- **Develop new remote sensing capabilities to measure geophysical variables that are currently only made in-situ or not at all**
- **Laboratory facility to study aerosol and cloud processes in a controlled environment**

Section 4

ASR Working Groups



Working Groups are where the science comes together – participate!