

CESD Modeling Testbeds for Cloud and Aerosol Research

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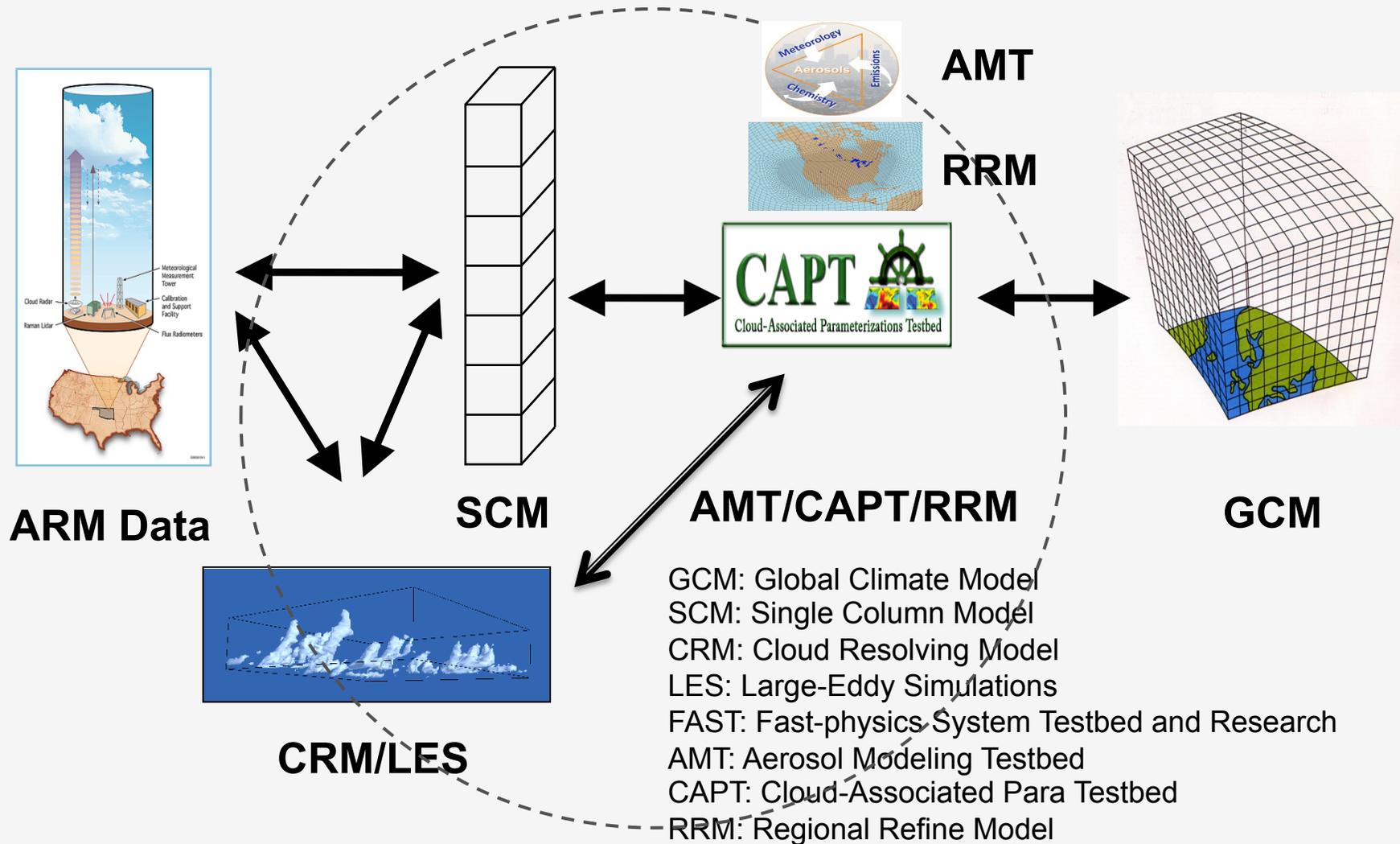


What Is a Testbed?

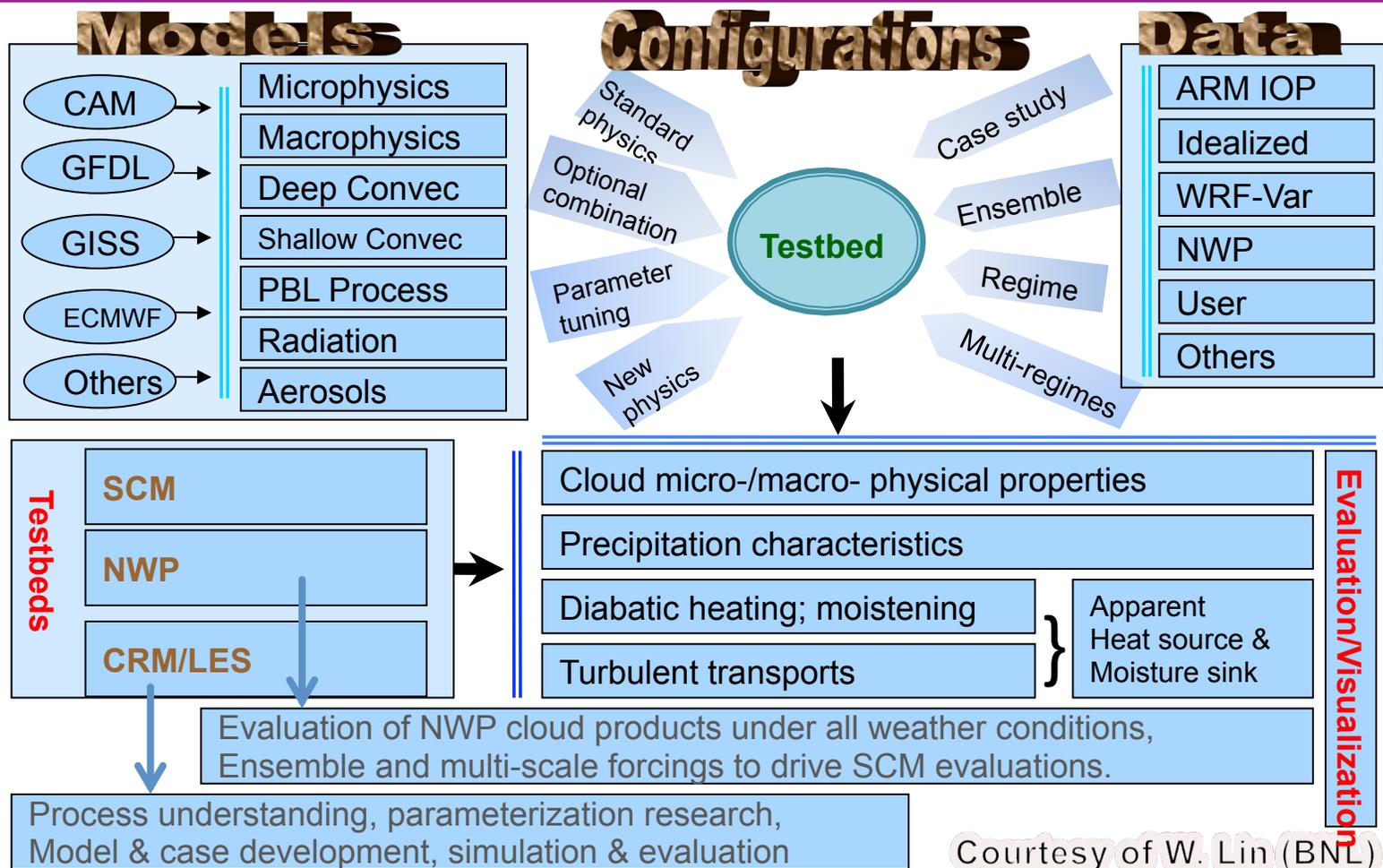
- It is a process-model in which the large-scale dynamic fields are often specified from either observations or NWP analyses so that its physical parameterizations can be tested
- It is often run for some specific field campaigns where rich detailed observations are available for forcing and evaluating its simulation results
- It can link model deficiencies to a specific physical process
- It is most useful during model development by providing a process-level understanding and testing of candidate physical parameterizations for the being developed climate models.



A hierarchy of process models is the key to bridge the scale-gap



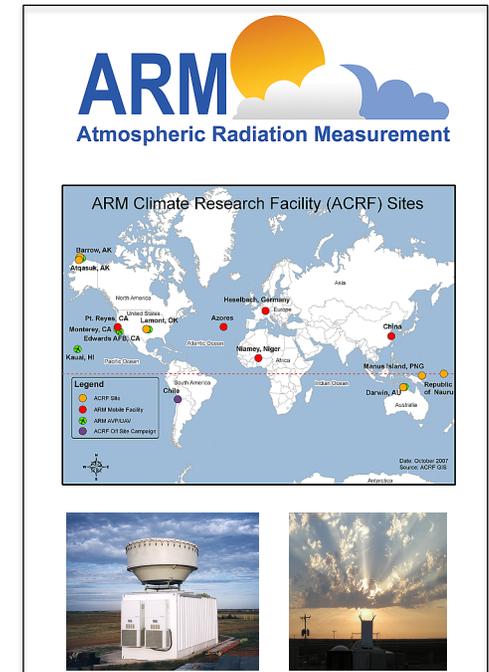
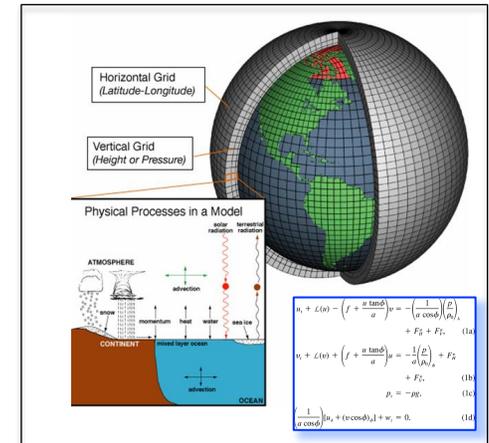
The DOE Fast-Physics Testbed (Y. Liu, W. Lin - BNL)



The Cloud-Associated Parameterizations Testbed (LLNL and NCAR) S. Klein, S. Xie, H. Ma



- A research effort bridging the modeling and observational programs
- Hindcast approach with climate models (as known as the Transpose-AMIP approach), mainly the CESM and now ACME
- Research foci of CAPT
 - Compare model simulations to detailed process observations available from the DOE ARM climate research facility.
 - Diagnose the origin of cloud and precipitation errors in climate simulations to improve the fidelity of climate prediction.
 - Test new model parameterizations to identify their strengths/weaknesses in simulating cloud-associated processes for next-generation climate models



Aerosol Modeling Testbed (PNNL)

Courtesy of Jerome Fast

A computational framework that streamlines the process of testing and evaluating aerosol and cloud process modules over a range of spatial scales

Host Model:

- ▶ WRF-Chem regional model – more interoperable to simplify implementation of new modules and targets aerosol processes

Testbed Cases:

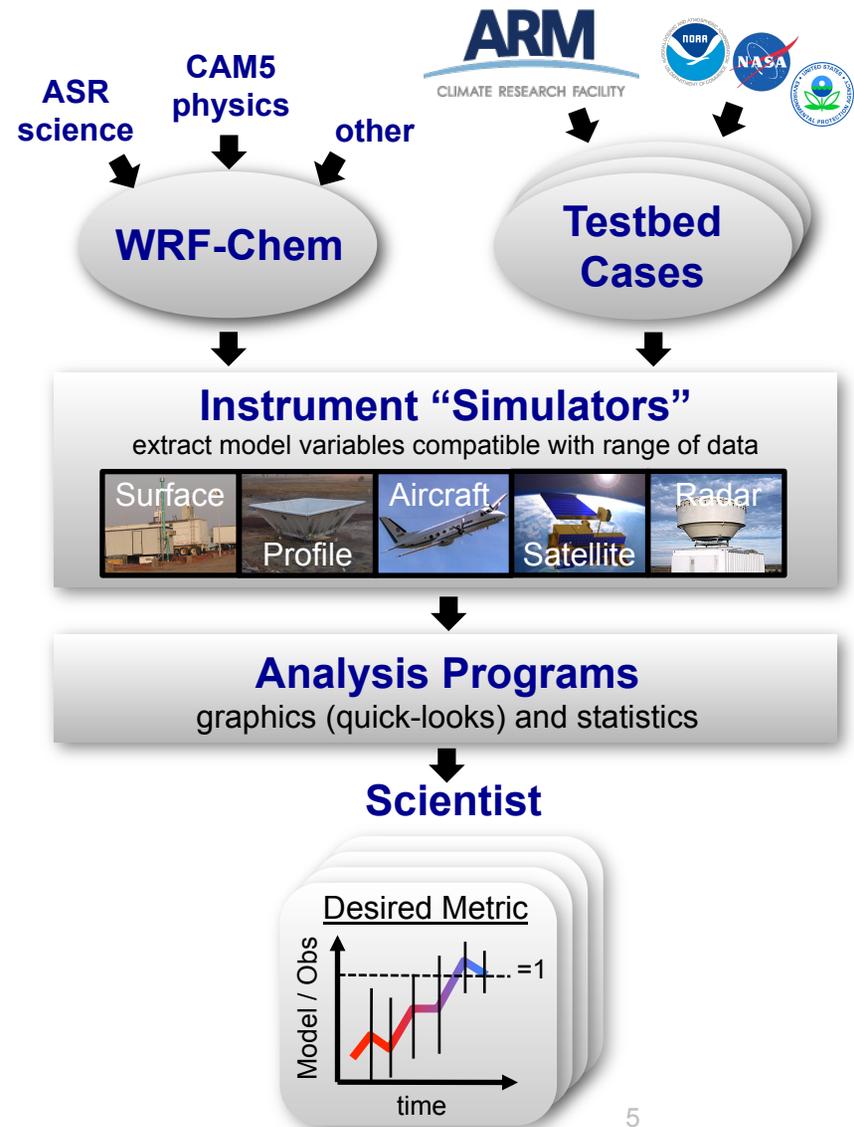
- ▶ Sets of ARM field campaign data coupled with other ancillary data targeting specific processes that affect the aerosol lifecycle

Community Tools:

- ▶ Suite of tools that graphically and statistically compare a wide range of observed and simulated quantities

Long-Term Archive (aspiration):

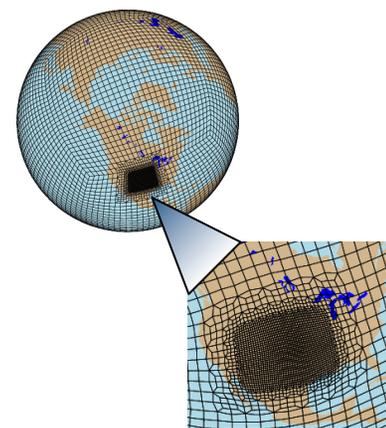
- ▶ Goal of documenting performance over time and useful for data mining by non-modelers



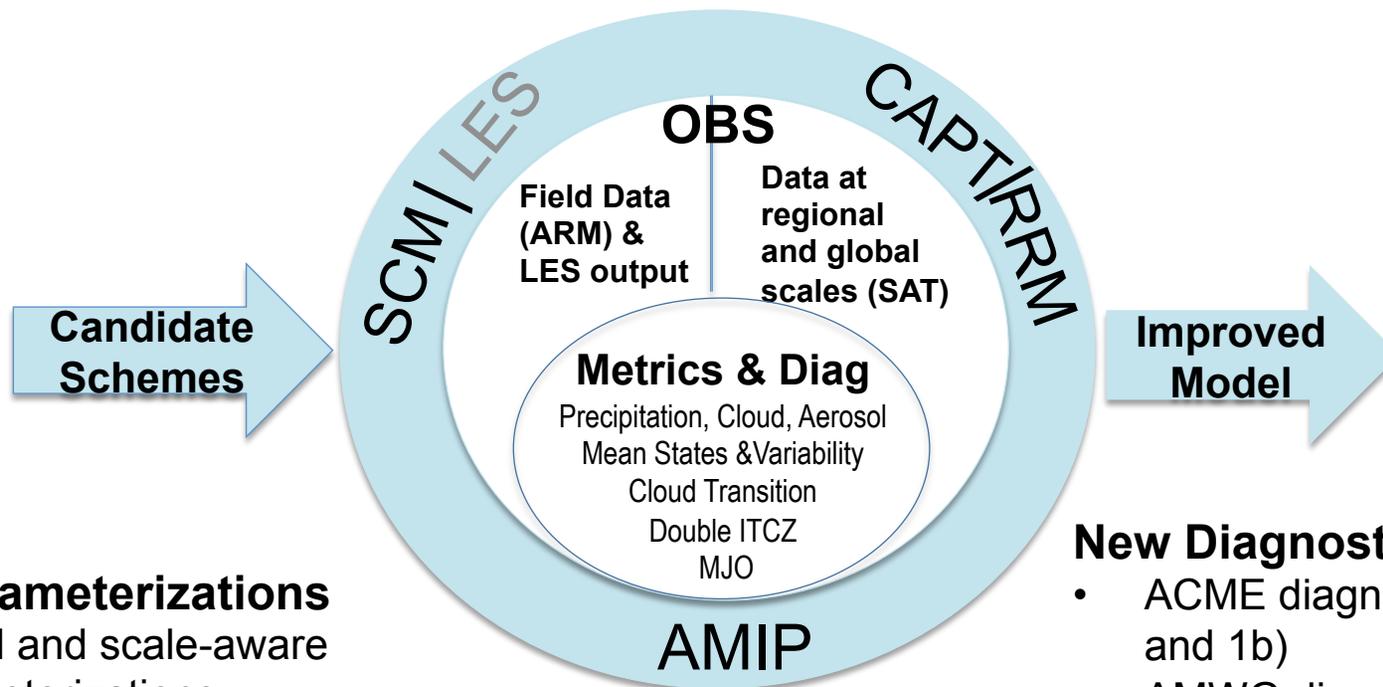
Regionally-Refined Model (S. Klein, M. Taylor)

- Purpose / Rationale
 - Test new atmosphere parameterizations in very high resolution models
 - Trouble-shoot problems (particularly for precipitation) too expensive for systematic testing with Global-High-Resolution Atmosphere model (e.g., Summertime nocturnal precipitation over central USA)
- Model
 - Regionally-Refined CAM or now ACME model
- Methods
 - Hindcast tests
 - Test new physical parameterizations
 - Thorough exploration of parameter space with perturbed-parameter ensembles
- Observations
 - ARM obs
 - Satellites (particularly w/ simulators)
 - Develop other very-high resolution datasets as needed (e.g. surface precip from NEXRAD)

Spectral Element
Dynamical Core with
Regional Refinement



Multi-scale Testbeds for ACME



New Parameterizations

- unified and scale-aware parameterizations
- macrophysics/microphysics
- aerosols
- turbulence
-

Observations & LES Output

- Error Bar?
- Detailed cloud and aerosol properties
- Support scale-aware para dev – 3D forcing?

New Diagnostic tools

- ACME diagnostics (Tier 1a and 1b)
- AMWG diagnostics with multiple view tool
- Simulators (COSP)
- ARM diagnostics & ARM Simulators

