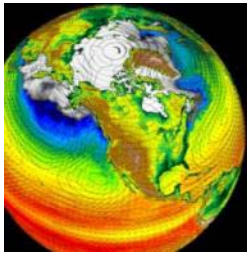
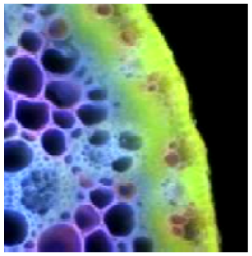
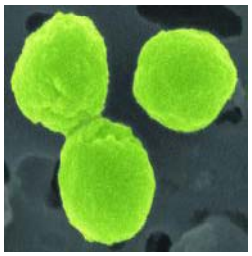


Climate and Environmental Sciences Division

G. L. Geernaert

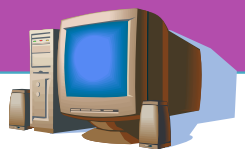
Climate and Environmental Sciences Division

(Gary Geernaert)

(Karen Carlson-Brown; Leslie Runion, Patrick Horan; Nver Mekerdijian)

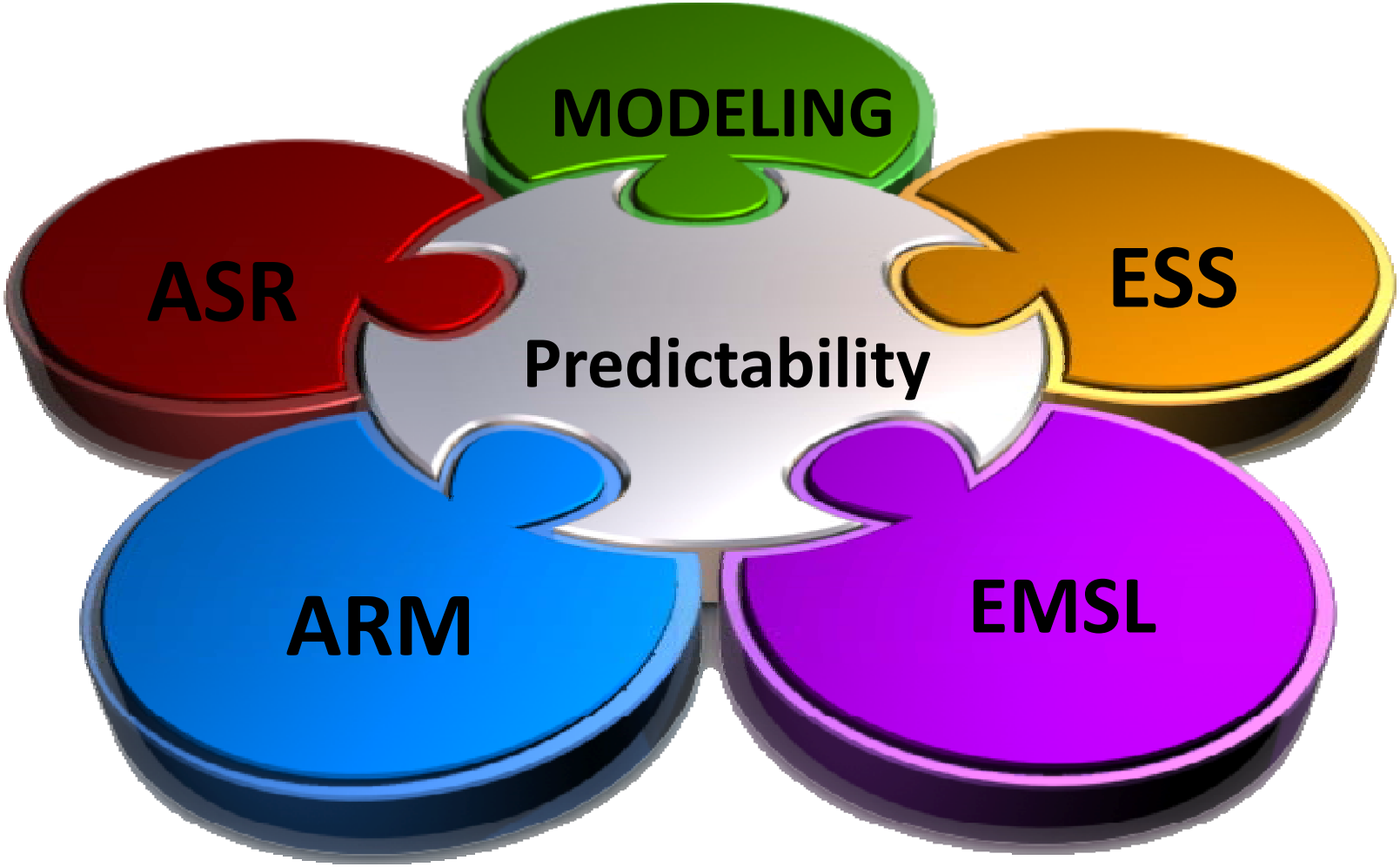
- Atmospheric Science
  - Atmospheric System Research (Ashley Williamson)
  - Atmospheric Radiation Measurement (ARM) Climate Research Facility (Wanda Ferrell; Rick Petty)

- Climate and Earth System Modeling
  - Regional & Global Climate Modeling (Renu Joseph)
  - Earth System Modeling (Dorothy Koch)
  - Integrated Assessment (Bob Vallario)

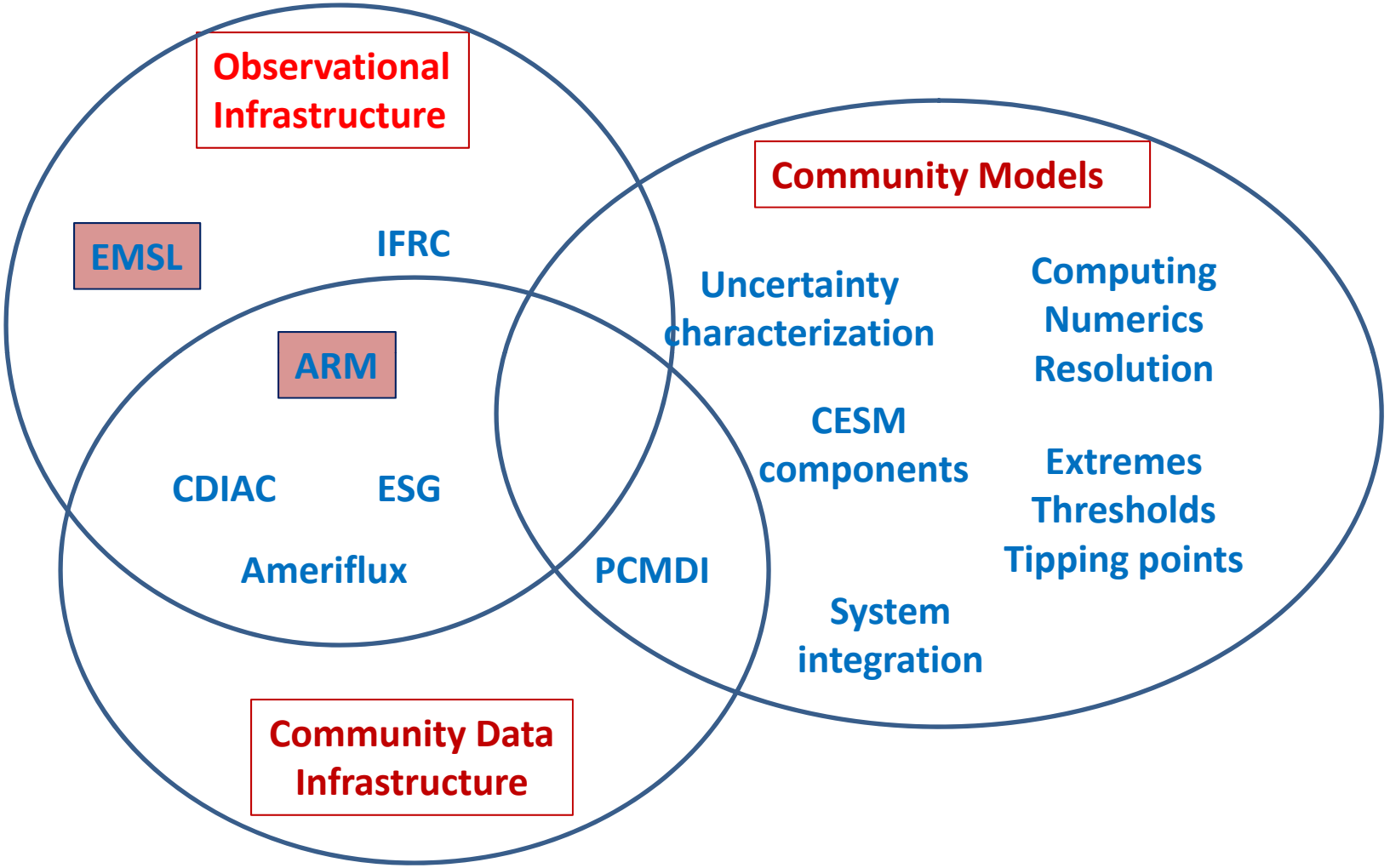


- Environmental System Science
  - Terrestrial Ecosystem Science (Mike Kuperburg, Dan Stover)
  - Subsurface Biogeochemical Research (Todd Anderson, David Lesmes)
  - Environmental Molecular Sciences Laboratory (Paul Bayer)

Climate and Environmental Sciences: packaging, culture



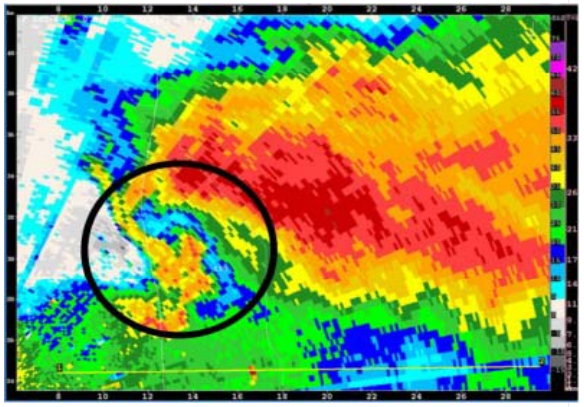
Platforms for science integration

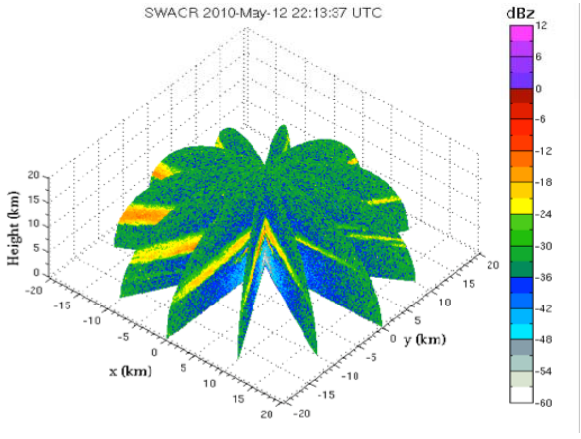


Interdisciplinary Science Projects

- NGEE
  - Globally important
  - Climatically sensitive
  - Relatively unstudied

- ARM / modeling
  - Weather/climate/cal-val
  - Extremes events 3D
  - Clouds/aerosols/ppt





May 23: Hook echo at SGP

- CESM / societal dimensions

Management updates – facts/figures

- *FOA's*
  - Jan2012: SCIDAC modeling: 9 rec'd; 3 selected
  - Jan2012: TES: 141 rec'd; 11 selected
  - May2012: Ameriflux: 4 rec'd; 1 selected
  - May2012: RGC/ASR: 46 rec'd, 5 selected
  - May2012: EASM proposals due - w/NSF, USDA
  - Jun2012: ASR: 109 Rec'd; 15-20? to be selected
  - Aug2012: TES FOA to be issued

CESD meetings/workshops

***PI Meetings*:**

- ASR: March 12-16, 2012
- TES: April 23-25, 2012
- Subsurface: April 30- May 3, 2012
- EASM PI meeting: July 9-11
- ARM science board meeting: Aug 22-23
- SCIDAC PI meeting: Sept 10-11

Workshops

- Root modeling workshop: March 7-9
- TES Experiment-model fusion workshop: March 19-21
- NGEE tropics: June 4-6
- Integrated water cycle: September 24-26, 2012
- ARM science strategy workshop US/EU: November 13-16

SFA/CA - triennial reviews

***SFA triennial reviews this FY*:**

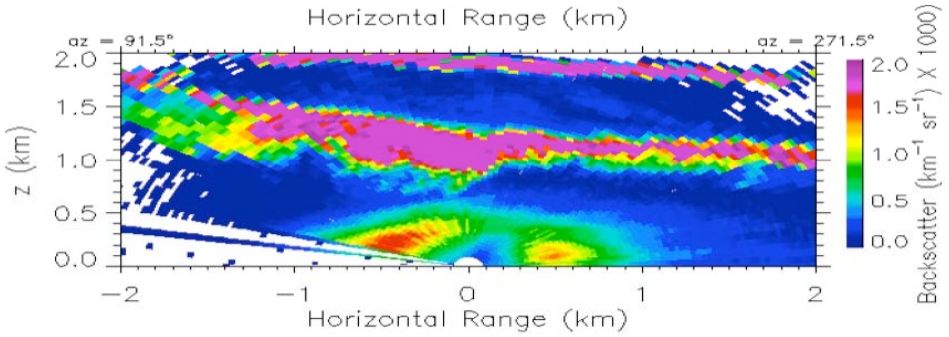
• BNL climate	Nov 2010	accepted
• PNNL SBR	March 2011	accepted
• LANL modeling	July 2011	accepted
• ORNL TES	April 2012	accept/rev
• ANL SBR	May 2012	accepted
• ORNL SBR	May 2012	
• UCAR CA	June 2012	
• LLNL SBR	June 2012	
• PNNL ASR/model	Aug 2012	
• LLNL modeling/ASR/IA	Sept 2012	

Science Highlights

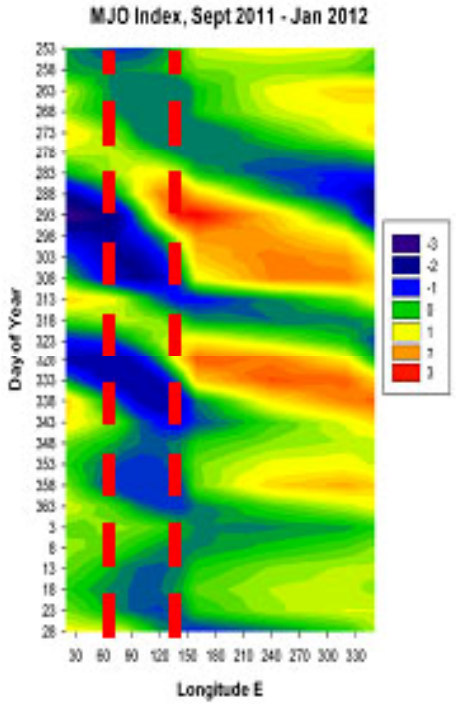
- **ARM, aerosols, and CAM5**
- **Snow albedo**
- **Ocean warming and sea level rise with RCP's**
- **Dynamic ecology**
- **Subsurface sciences**

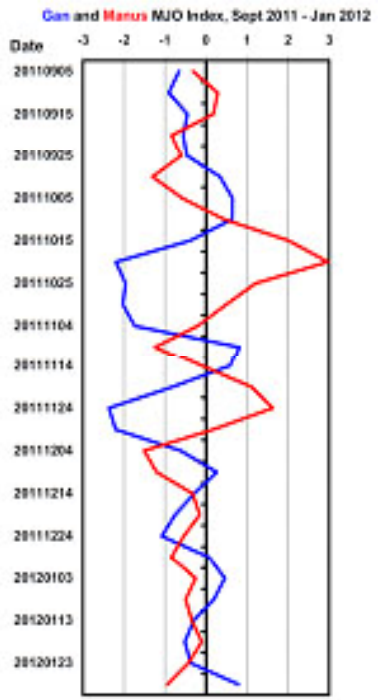
ARM campaigns

- Permanent
  - Azores install
- Mobile
  - 3: Oliktok FY12-15+
  - 1: TCAP FY12
  - 2: MAGIC FY13
  - 1: GOAMAZON FY14



Aerosol layer over India





Aerosol First Indirect Effects on Non-Precipitating Low-Level Liquid Cloud CAM5 passes tests at ARM Sites

Chuanfeng Zhao (LLNL), Stephen A. Klein (LLNL), Shaocheng Xie (LLNL), Xiaohong Liu (PNNL), James S. Boyle (LLNL), and Yuying Zhang (LLNL)

Hypothesis and approach

More aerosols lead to higher cloud albedo

- Quantify Aerosol First Indirect Effect (FIE): aerosol amount vs cloud liquid effective radius
- CAM5 CAPT forecasts, using 2008-2010 data

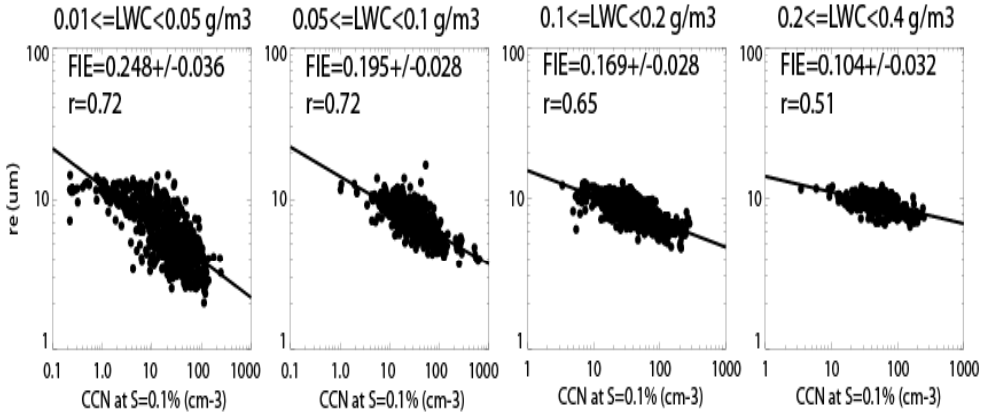


Fig. 1 Droplet size decreases with particle number. FIE at NSA lies between 0.10 and 0.25, within the range calculated from numerous observation studies

Conclusions

- CAM5 simulates aerosol FIE as observed.
- FIE is sensitive to aerosol and LWC
- The overestimation of aerosol cloud effects in CAM5 found by other studies may be a problem from 2nd or semi indirect effect rather than FIE.

Results

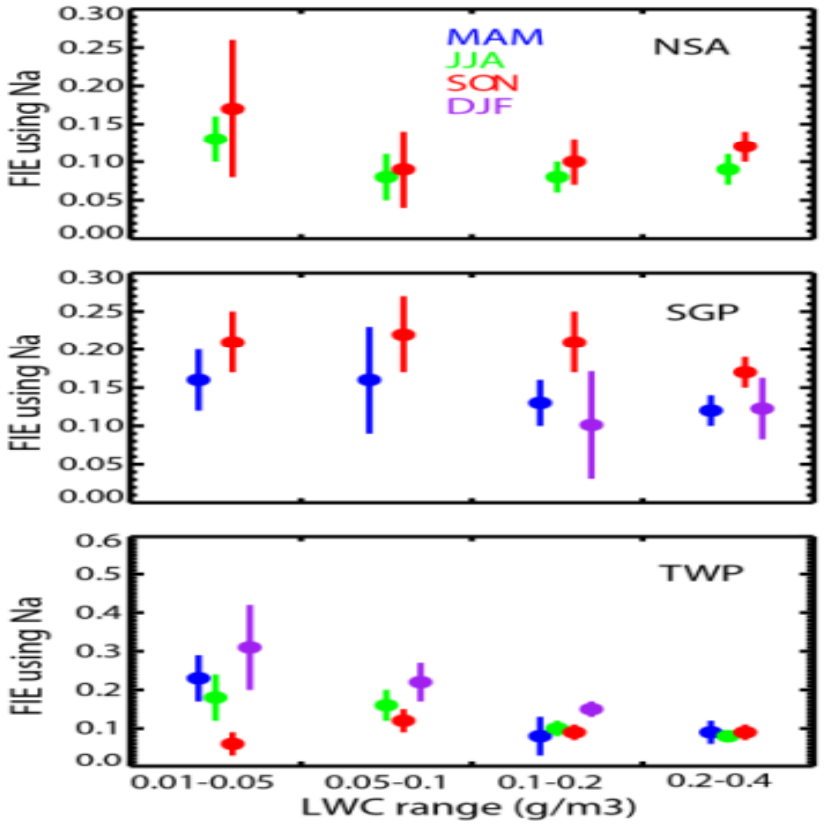


Fig. 2 For coastal (NSA and TWP) cases, FIE roughly decreases with LWC (except SON). FIE shows weak sensitivity to location and season. Results are consistent with a large amount of observational findings.

Zhao, C., S. A. Klein, S. Xie, X. Liu, J. Boyle, and Y. Zhang (2012): Aerosol First Indirect Effects on Non-Precipitating Low-level Liquid Cloud Properties as Simulated by CAM5 at ARM Sites, *Geophy. Res. Lett.*, 39, L08806, doi:10.1029/2012GL051213.

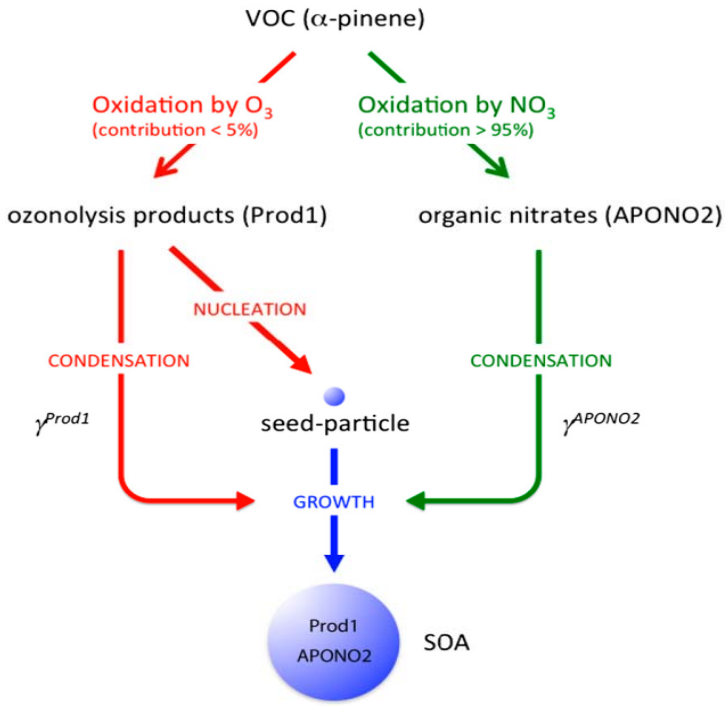
EMSL Capabilities Help ASR-Funded Scientists Understand the Formation, Growth and Longevity of Secondary Organic Aerosols

- **Objective:**

  Determine if Secondary Organic Aerosols (SOA) form and grow in accordance with the assumptions of current atmospheric models

- **Approach:**

  Using Single Particle Laser Ablation Mass Spectrometer II (SPLAT II), the team examined particles and reactions produced by oxidation of alpha pinene by O_3 and NO_3 radicals



Representation of SOA formation and growth based on experimental results

- **Results/Impacts:**

  Particles became seed particles that lead to the formation of SOAs

  Resulting SOAs are quasi-solids that persist in the atmosphere

  Aerosol models might to be reformulated to account for longer lifetimes

Perraud, *et.al,* 2012. *PNAS* 109(8):2836-2841

Snow Albedo Reduction by Black Carbon

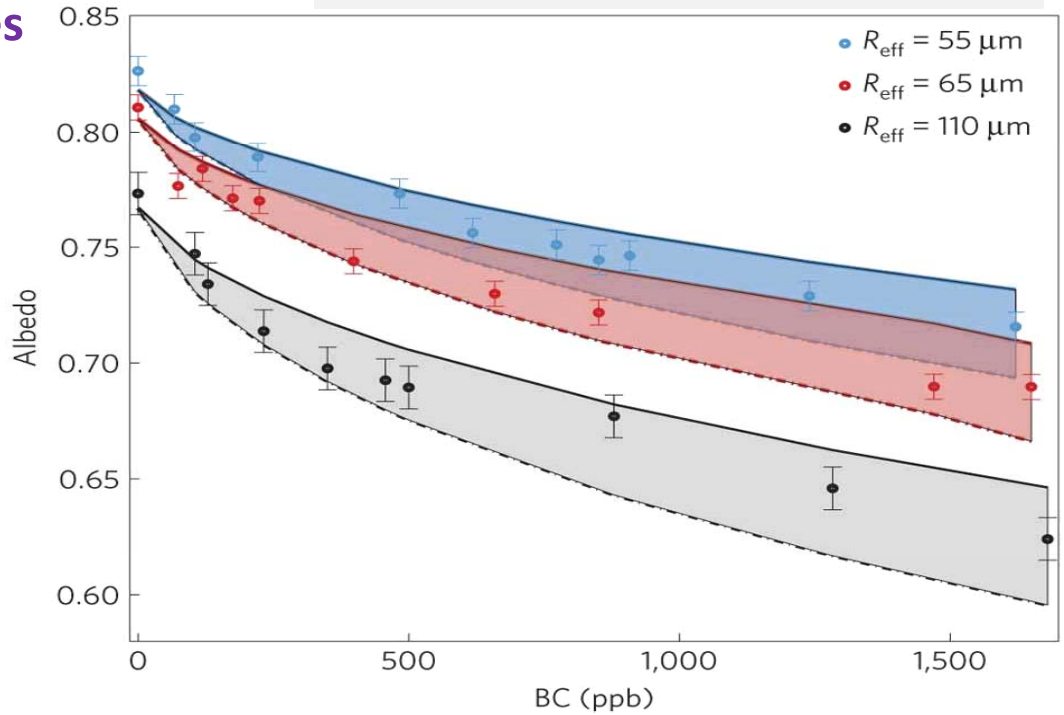
Objective:

- Black carbon significantly increases snow melting ?

Approach:

- Laboratory: BC-laden snow
- Measure albedo, BC loading, snow grain size
- Compare with field observations
- CESM / SNICAR (Snow Ice and Aerosol Radiative model)

Hadley and Kirchstetter, (2012) *Nature Climate Change*, doi:10.1038/nclimate1433



Spectrally weighted snow albedo for three snow grain sizes. Dots = experimental results; Shaded bands = range from SNICAR model

Results/Impacts:

- Snow albedo reduction is comparable with SNICAR predictions
- Larger snow grains cause greater BC -induced albedo reduction is greater for larger snow grains, indicating positive feedback as snow ages

Human induced global ocean warming on multi-decadal timescales

Robotic float deployment for measuring ocean temperatures

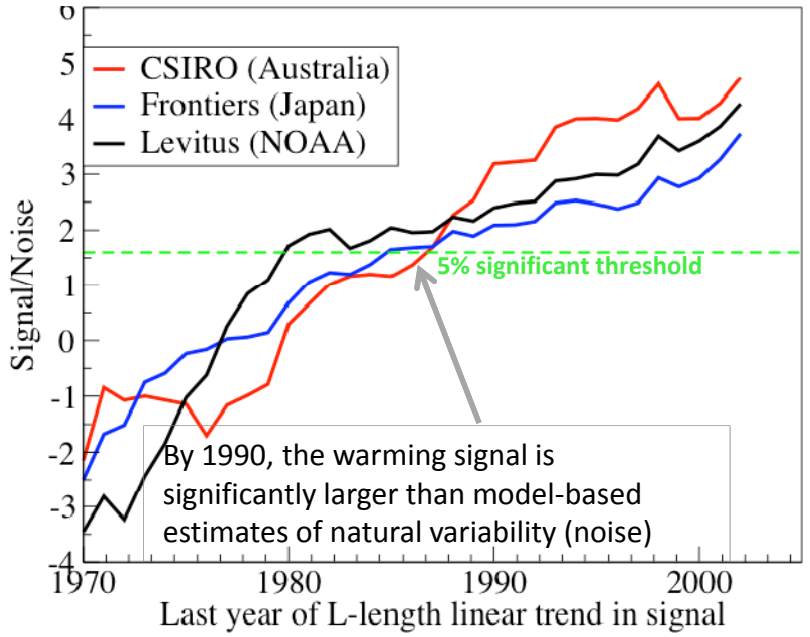
Objective

- Examine the possible causes of observed ocean warming (since 1960) in light of recent bias corrections to historical in-situ temperature measurements (surface to 700 meters)
- Explore the impacts of key uncertainties on the detection and attribution (D&A) of upper ocean warming

Approach

- Collaboration with three leading observational teams (NOAA, Australian, and Japanese), each of which treat observational uncertainty very differently
- Using well-established D&A techniques, the warming pattern or "fingerprint" of the CMIP3 multi-model ensemble is compared to observations and estimates of natural variability
- Systematically test how model and data uncertainties impact D&A conclusions, including incomplete observational coverage, simulation drift removal strategies and technical choices in the application of the D&A method

Signal to noise analysis of basin scale changes in temperature (surface to 700 meters)
Linear trends beginning in 1960



Impact

- *Evidence of human induced ocean warming is substantially strengthened by the comprehensive nature of this study*

[1] Gleckler P., B. Santer, C. Domingues, D. Pierce, T. Barnett, J. Church, K. Taylor, K. AchutaRao, T. Boyer, M. Ishii, and P. Caldwell, Nature Climate Change, *in press*

Relative outcomes of climate change mitigation related to global temperature versus sea level rise

Objective

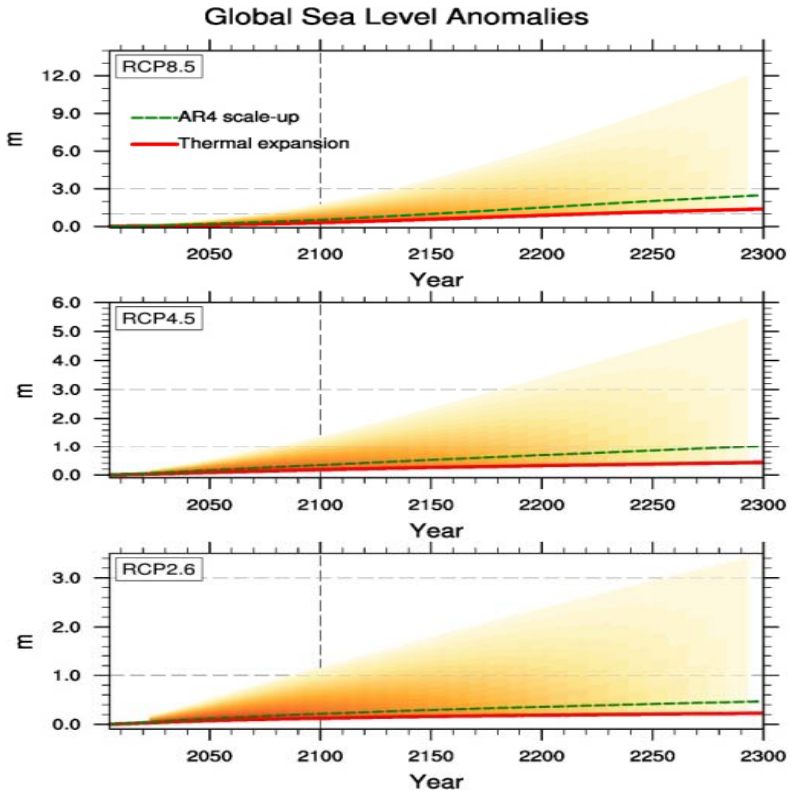
- Perception is that climate mitigation significantly reduces rate of sea level rise.
- The objective is to quantify sea level rise rate due to mitigation problem.

Approach

- Analyze RCP scenarios run with CCSM4 from 2006 to 2300
- Calculate full ocean heat content and relate to the thermal expansion contribution to sea level rise
- Calculate total sea level rise due to thermal expansion and contributions from glaciers and ice sheets

Impact

- Assume stabilized global temperatures
- Sea level rise continues for next few hundred years, but it can be slowed down.



Thermal expansion (red line); Total SLR level two methods (green, orange lines) rise from two methods (green line and orange shading)

Meehl, G.A. and co-authors, 2012: Relative outcomes of climate change mitigation related to global temperature versus sea level rise. *Nature Climate Change*, in press.

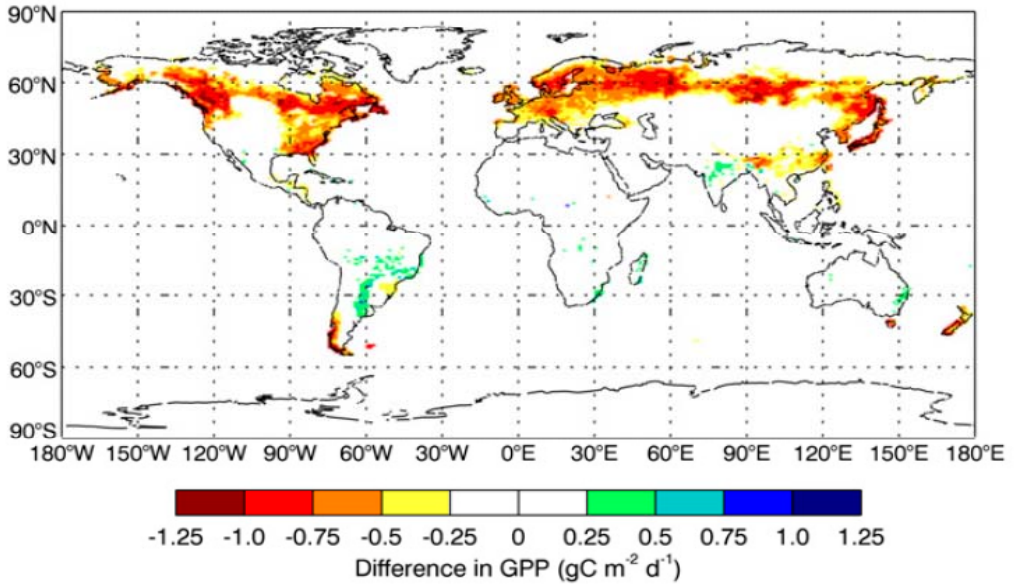
Including photoperiod improves model representation of global carbon cycle

Objective:

Understand the competing roles of temperature and photoperiod on photosynthetic activity in a changing climate

Approach:

Grew 23 tree species under nursery conditions with controlled temperature and photoperiod. Used CLM-4.0 to evaluate the impact of declining photoperiod



Influence of a photoperiod correction of V_{cmax} on global distribution of GPP.

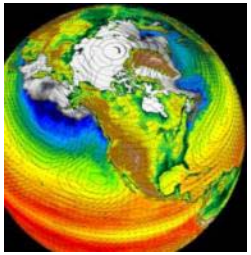
Results/Impacts:

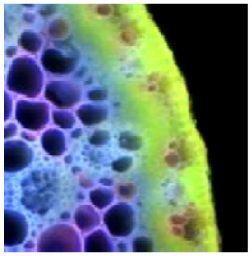
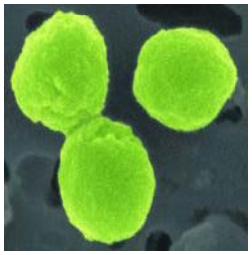
- Warming climate is projected to extend growing season and primary productivity
- This study finds that declining photoperiod (i.e., autumn) reduces photosynthesis even as leaves remain viable
- Including photoperiod seasonality of photosynthesis in CLM reduces modeled global gross primary production by 2.5%

Bauerle, et.al, (2012) PNAS
doi:10.1073/pnas.1119131109

Management – next 6-12 months

- Increasing the science value of SFA's wrto community models
- Advancing a DOE community of climate science users
- Building a community of agencies for our community platforms



Thank you!

Gary Geernaert
Gerald.Geernaert@science.doe.gov
http://science.energy.gov/ber/research/cesd/