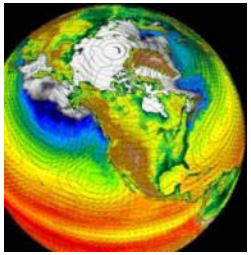
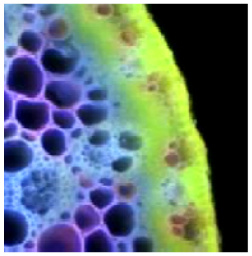
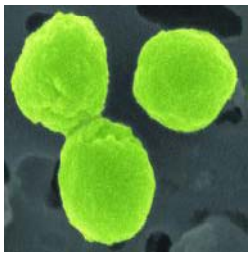


Climate and Environmental Sciences Division

BERAC update

February 21-22, 2013

G. Geernaert
BER/CESD

Outline

- People
- Executing the strategic plan
  - Bold vision
  - Role of interagency partnerships
  - Funding instruments
- Management updates
  - Solicitations, meetings, workshops, reviews
- Science
  - Facilities updates
  - Science Highlights

Climate and Environmental Sciences Division

(Gary Geernaert)

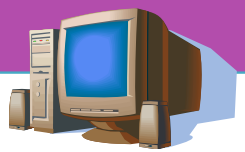
(Karen Carlson-Brown; Leslie Runion, TBD; Nver Mekerdijian)

Atmospheric Science

- Atmospheric System Research (Ashley Williamson; Sally McFarlane)
- 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)



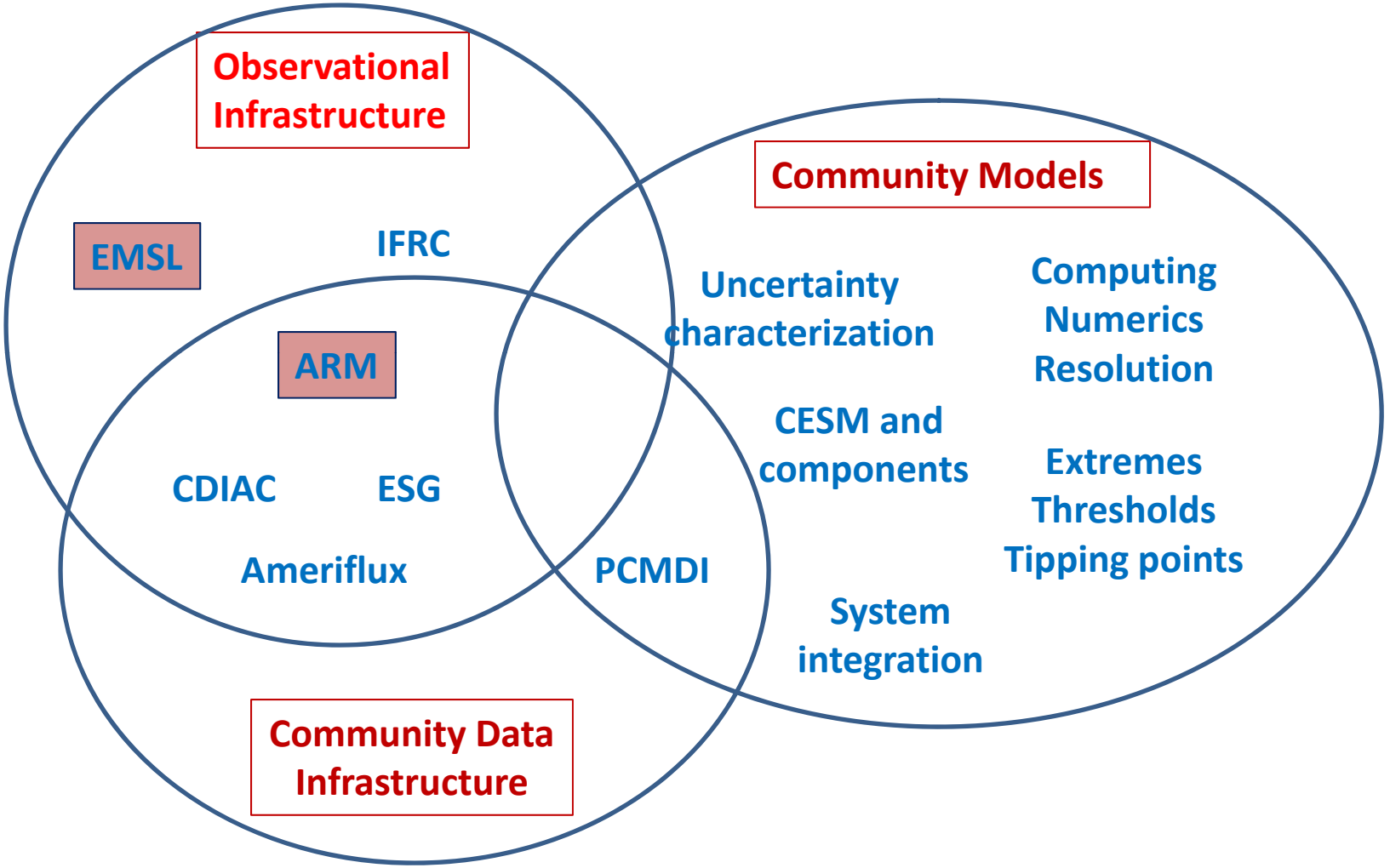
Environmental System Science

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

Staffing: recruitment

- Science Assistant
  - Applications just received
  - Focus: support to the Division's administration
- Physical scientist (data, informatics)
  - New position just announced
  - Focus: data, informatics, visualization

Platforms for science integration



Executing the strategic plan

- **Accelerate capabilities in predictive modeling**
- **Observational and data capabilities: ARM, EMSL, data mgmt**
- **MODEX: analysis based integration of "modeling and experiment"**
- **Balanced funding mechanisms: SFA's, boutiques, and university grants**
- **Interagency collaboration**

Funding instruments

- National labs are an incredible resource
  - Roughly ½ of CESD research dollars
  - Maintaining a balance of SFA's and boutiques
    - Target roughly ¾ investment in laboratories as SFA's
    - SFA's have decade time scale, i.e., as important growth science
    - Boutiques can be research that…
      - might influence existing SFAs, or
      - Can lead to creation of new SFA's
- University creativity and talent pool
  - Roughly ½ of CESD research dollars
  - Shorter term science projects
  - Generate science and talent for longer term DOE challenges

CESD meetings/workshops

***PI Meetings*:**

- ASR Working Group Meeting: Oct 29-31, 2012
- CSSEF meeting: Nov 1-2, 2012
- ASR Science Team Meeting: March 18-22, 2013
- Modeling PI meeting: May 6-10, 2013
- ESS PI meeting: May 14-15, 2013

Workshops

- Water cycle workshop: Sept 24-26, 2012
- IGIM CMIP meeting: Oct 3-4, 2012
- EU – US (ARM) joint meeting: Nov 13-16, 2012
- Model development strategy: Dec 7-8, 2012
- EMSL Workshop on Aerosol Chemistry: Jan 30, 2013
- NACP: February 4-7, 2013

Committee of Visitors

- Date: July 8-10, 2013

Management updates – facts/figures

- *FOA's in FY13*
  - TES FOA. 121 proposals under review. Review panel Mar 4-7, 2013
  - ASR FOA. Will issue in March; due in May
  - GoAMAZON joint FOA. Will issue in March; due in June

SFA/CA - triennial reviews

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

- LBNL TES Apr 2013
- LBNL ASR Apr 2013
- LBNL climate Fall 2013
- BNL ASR Fall 2013
- PNNL SBR Fall 2013

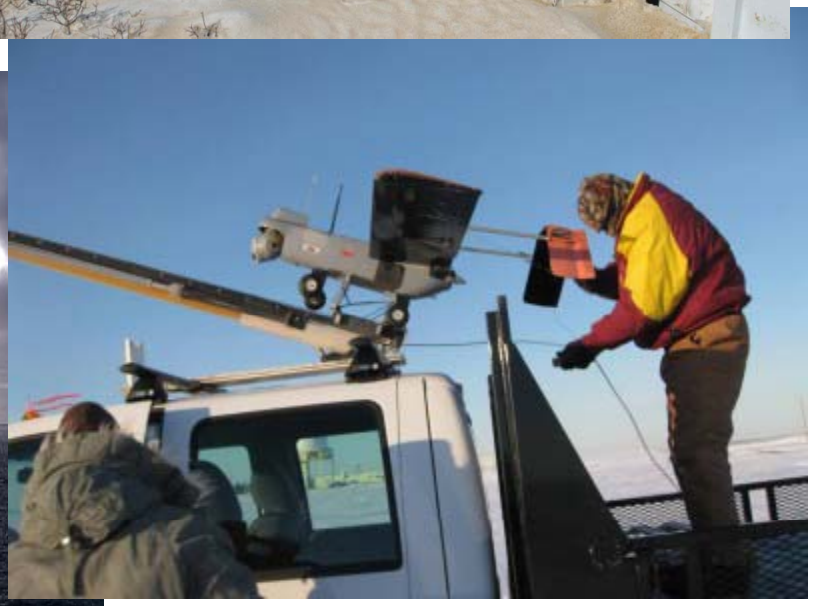
Science Highlights

- Facility updates
  - ARM
  - EMSL
- Science
  - Hindcasting the Younger Dryas
  - Aerosol impacts on South Asian monsoon
  - Small scale variability and cloud prediction
  - River routing modeling
  - Forest dynamics and insects
  - Root infection by bacteria

ARM Climate Research Facility – Current

- **AMF1**. FY13: MAGIC - Marine ARM GPCI Investigation of Clouds. Horizon *Spirit* makes a r/t LA-HNL, each 2 weeks.
- **AMF2**. FY12-13: TCAP – Two column aerosol project. Cape Cod.
- **AMF3**. FY13--:

  Oliktok, AK. UAV's demonstrated in November 2012.



ARM Climate Research Facility: FY13-FY15

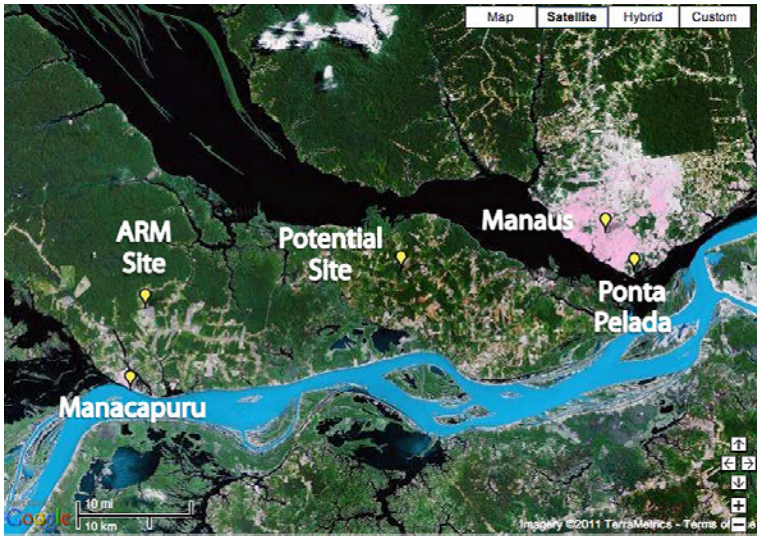
- Airborne campaigns in FY13

  G1 to measure biomass burning emissions in WA and AR.

  Cessna 206 to measure trace gases above SGP

- GOAMAZON. Jan 2014 thru mid 2015. AMF1 to Manuas, Brazil. Purpose to study aerosol and cloud life cycles, particularly the susceptibility to cloud-aerosol-precipitation interactions, within the Amazon Basin.

- Biogenic aerosols and climate. Jan 2014. AMF2 to Hyytiala, Finland. Purpose to investigate the formation and evolution of organic aerosols from northern boreal forests.



New EMSL Capabilities coming on-line in FY13

Radiochemistry Annex

- Sample prep space and instrument labs
- Capabilities
  - Nuclear Magnetic Resonance (NMR)
  - X-ray Photo Emission Spectrometers
  - Electron Microscopy (TEM & SEM)
  - Electron Microprobe
- Fully open to users April 2013
- Details – 1/28/13 issue of C&E News

RADIOCHEMISTRY LAB ESTABLISHED

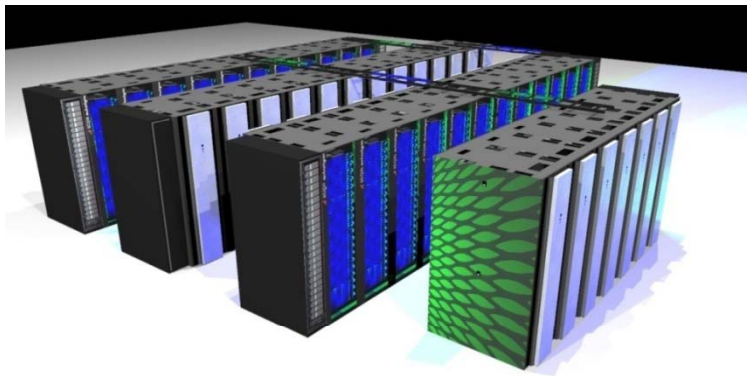
DEDICATED INSTRUMENTATION will enhance study of nuclear fuels and waste, environmental contamination

JYLLIAN KEMSLEY, C&EN WEST COAST NEWS BUREAU

EMSL RA # 6 Environmental Scanning Electron Microscope System

Next Generation Supercomputer

- Mid-range system
- Peak Performance of 3.4 PFLOPS
- 184,000 gigabytes of memory
- Available to users October 2013

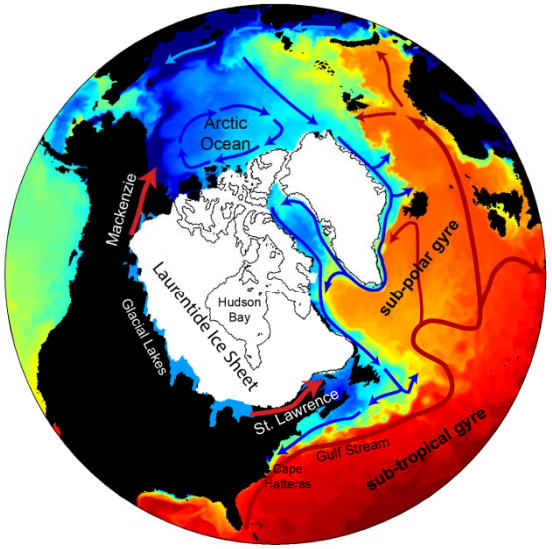


EMSL

Meltwater from the Arctic slows the Atlantic Ocean Circulation: Lessons from Paleoclimate

1) Introduction

For >30 yrs, scientists have debated whether the last major cold period on Earth (Younger Dryas, ~12 yr BP) was triggered by meltwater from the Arctic or the Gulf of St. Lawrence.



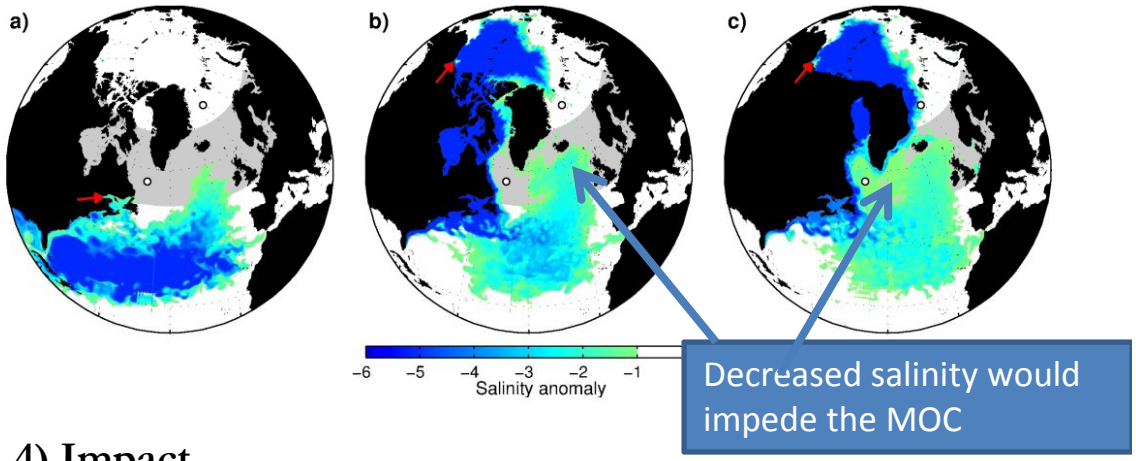
The influx of freshwater to the surface ocean is assumed to weaken the Meridional Overturning Circulation (MOC)

2) Methods

The MITgcm was used to determine which meltwater route caused the MOC to weaken the most.

3) Results

Only meltwater from the Arctic significantly weakens the MOC; meltwater from the St. Lawrence was transported to the sub-tropical Atlantic; too far south to impact the MOC.



4) Impact

This study highlights the Arctic MacKenzie Valley as a primary trigger for climate change. This is especially relevant considering the rapid changes in this region in the last 10 years.

U.S. DEPARTMENT OF ENERGY

Condron, A. and P. Winsor, 2012, "Meltwater routing and the Younger Dryas", *Proc. of the Nat. Acad. of Sciences*, www.pnas.org/cgi/doi/10.1073/pnas.1207381109.

Untangling aerosol “fast” and “slow” impacts on the South Asian monsoon

Background

Previous studies have found multiple effects of aerosol pollution in South Asia on the monsoons

Approach

- Century-long coupled-climate simulations with the Community Earth System Model were conducted
- Thermal, radiative, dynamical, and hydrological responses to the various effects of anthropogenic aerosols on the South Asian monsoon system were evaluated.
- Responses subdivided into :

Fast = response to direct impact on radiation, clouds and land surface;

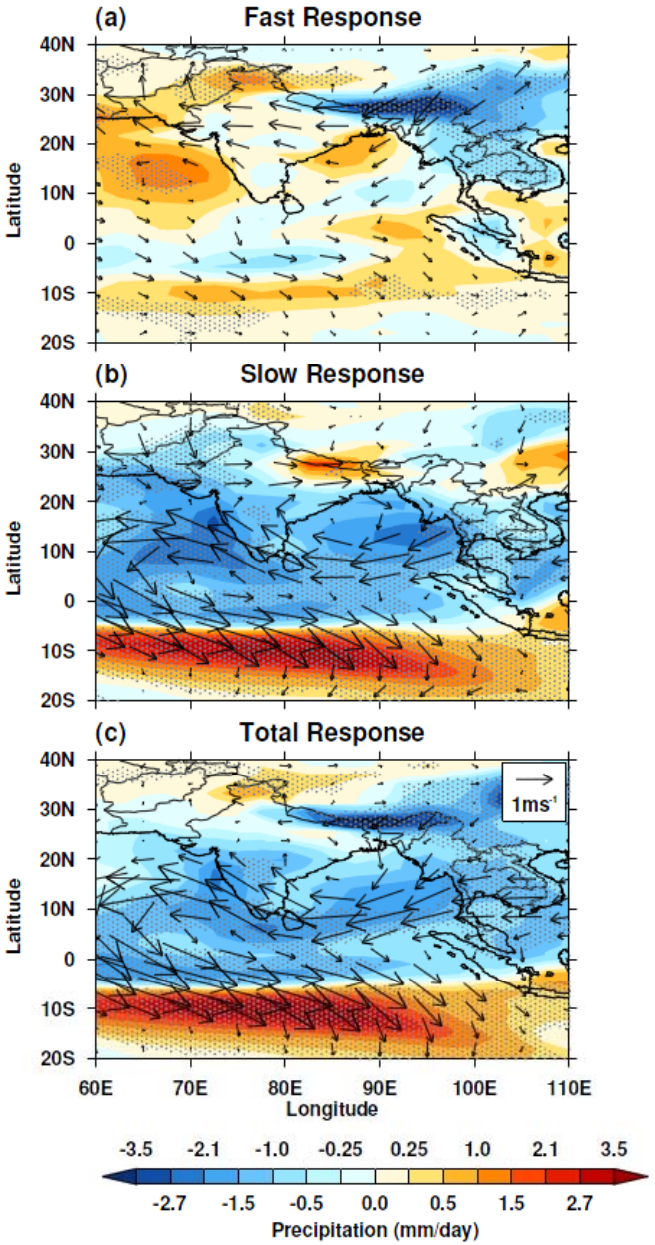
Slow = feedbacks associated with SST changes

Impact

The dominant effect is reduced South Asian monsoon precipitation from the slow-response, in which aerosols cool the sea-surface, weaken the north-south temperature gradient, reduce the Hadley circulation and decrease the northward transport of moisture over the continent.

Superimposed on this is the fast-response, an east-west asymmetry of circulation responses, likely responsible for the simulated and observed asymmetry in trends of monsoon precipitation over the continent (in north).

Ganguly D, PJ Rasch, H Wang, and J-H. Yoon. 2012. “Fast and slow responses of the South Asian monsoon system to anthropogenic aerosols,” *Geophysical Research Letters* 39: L18804. DOI:10.1029/2012GL053043



Summertime (JJAS) mean (a) fast, (b) slow and (c) total responses in precipitation and winds (at 860 hPa) caused by aerosols.

New Treatment of Small-Scale Variability Has Big Impact on Cloud Forecasts

Objective

- Improve treatment of fair-weather clouds within the community Weather Research and Forecasting (WRF) regional model.

Approach

- Replace the trigger function used to initiate convective clouds in the model.
- Explicitly account for the small-scale (sub-grid scale) variations in temperature and humidity.
- Represent a family of clouds—not all clouds are the same size.
- Include impact of fair-weather clouds on the amount of sunshine reaching the surface.

The Cumulus Potential (CuP) parameterization leads to improved forecasts of fair-weather clouds.

Impact

- Use of the new parameterization significantly increases the simulated amount of fair weather clouds over the central United States, consistent with observations.
- Net decrease in the amount of model simulated sunshine reaching the surface, also consistent with observations.

Reference: Berg LK, WI Gustafson Jr., EI Kassianov, and L Deng. 2012. "Evaluation of a Modified Scheme for Shallow Convection: Implementation of CuP and Case Studies." *Monthly Weather Review* 141, 134–147. DOI:10.1175/MWR-D-12-00136.1

A New Physically Based Large Scale River Routing Model for Coupling with Earth System Models

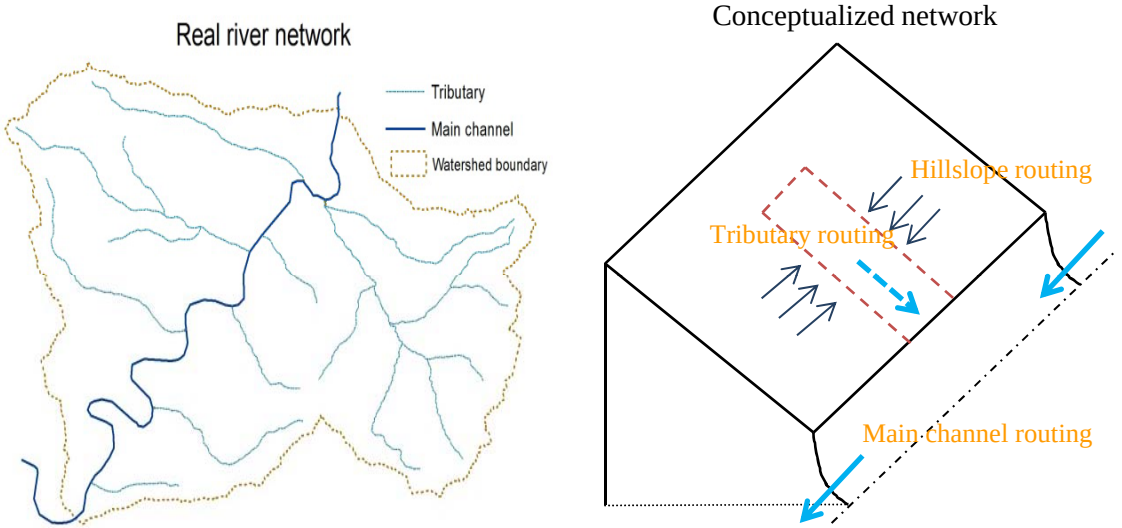
Objective

- Develop a physically based runoff routing model, Model for Scale Adaptive River Transport (MOSART), for coupling with land surface and earth system models across local, regional and global scales

Approach

- Divide each spatial unit into hillslope, tributaries and main channel and describe them separately
- All model parameters are physically based, with only a small subset requiring calibration
- Evaluate simulations at multiple resolutions against observed streamflow and channel velocity from USGS stations

MOSART explicitly represents subgrid and channel routing in a scale-consistent way



Impact

- MOSART provides a flexible framework for modeling terrestrial fluxes into the ocean for complete linkages across the atmosphere, land, and ocean components in earth system models.
- The model also serves as a cornerstone for integrating the human and earth system components of the water cycle.

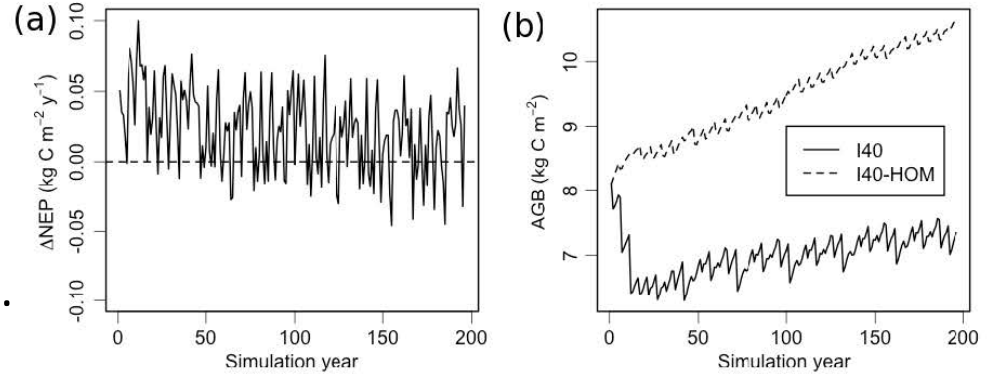
Li H, MS Wigmosta, H Wu, M Huang, Y Ke, AM Coleman, and LR Leung. 2013. "A physically based runoff routing model for land surface and earth system models." *Journal of Hydrometeorology*, *in press February 2013*. DOI:10.1175/JHM-D-12-015.1

Forest Carbon Dynamics and Insect Disturbance

The modified Ecosystem Demography 2 model (ED2) was used to simulate the impact of insect disturbance (gypsy moth) on carbon dynamics in the New Jersey pine barrens

Modeled results:

- Defoliated trees are more susceptible to drought
- Regular defoliation of trees by gypsy moths can result in up to 50% reduction in carbon storage across the forest
- Need to correctly specify temporal/spatial defoliation patterns to accurately simulate the corresponding carbon dynamics
- When the "cost" of defoliation is spread across all trees, the impact on carbon dynamics is less than when the same "cost" is borne completely by a few trees.



D. Medvigy, K.L. Clark, N.S. Skowronski and K.V.R Schafer (November 2012) Simulated impacts of insect defoliation on forest carbon dynamics. Environ. Res. Lett. 7 (2012) doi:10.1088/1748-9326/7/4/045703.

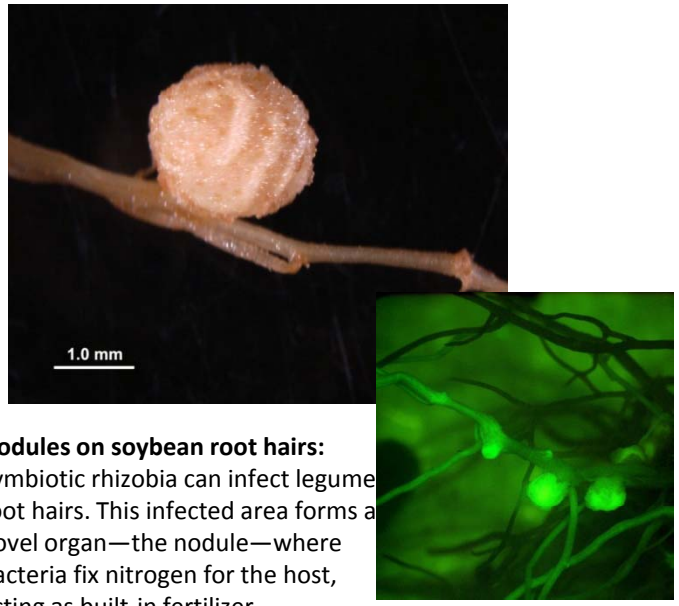
Proteomics of Soybean Root Hair Interactions with Bacteria

Objective

- Determine the molecular mechanism of root hair infection by symbiotic nitrogen-fixing soil bacteria

Approach

- EMSL's proteomics capabilities were used to identify the proteins involved in infecting root hairs with *Bradyrhizobium japonicum*.
- More than 200 root hair phosphoproteins appear to be involved



Nodules on soybean root hairs: Symbiotic rhizobia can infect legume root hairs. This infected area forms a novel organ—the nodule—where bacteria fix nitrogen for the host, acting as built-in fertilizer.

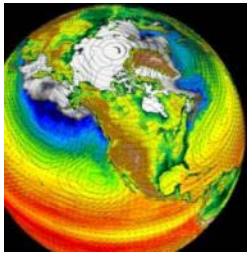
Significance and Impact

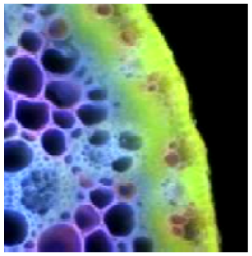
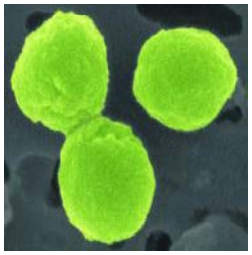
- Understanding the root hair/rhizobia relationship could help for redesigning plants and improving crop yields

Brechenmacher *et al.* 2012. *Proteomics* 12(22):3365-3373.

Nguyen *et al.* 2012. *Molecular and Cellular Proteomics* 11(11):1140-1155.

EMSL



Thank you!

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