BioEarth

Biosphere-relevant earth system model

Welcome to the BioEarth All-Hand Meeting No. 3!

February 20, 2013
Pullman, WA

Recognized need to improve predictability of Earth System Models

- Multiple agencies are recognizing the need to ensure that scientific knowledge gained by modeling efforts is useful for planning and decision making
- Example: NSF/DOE/USDA EaSM program
  - Finer in time: decadal climate variability and change (also, we are interested in understanding <u>changes in variance</u> as well as changes in means)
  - Finer in space: dynamics at regional scale resolved
  - Impacts on ecological, agricultural, and other human systems (e.g., feedbacks between ecosphere and anthrosphere)
  - Effectively translate model results and uncertainties for decision making under climate change

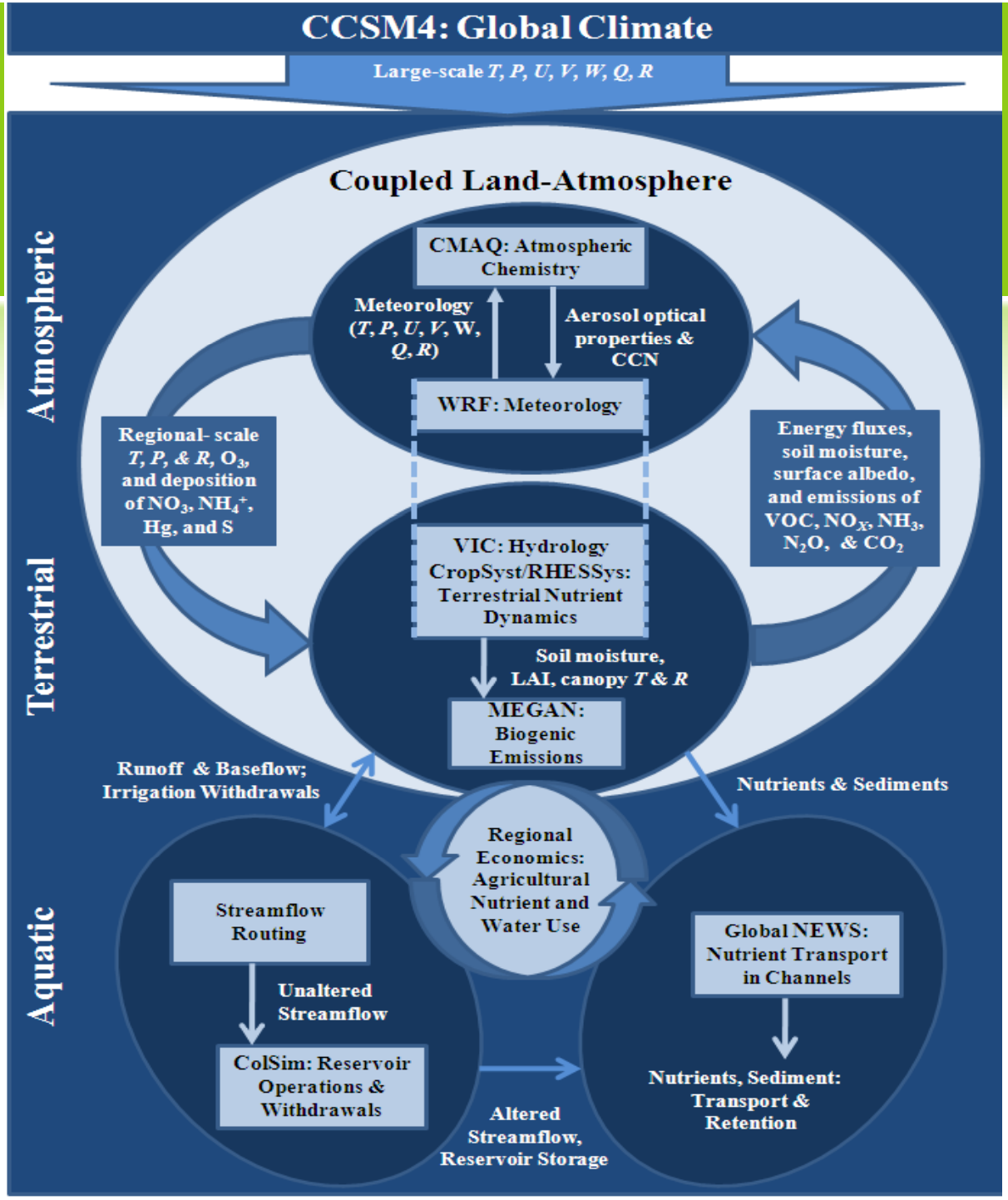
Goal and Objectives

Overarching Goal: To improve the understanding of regional and decadal-scale C:N:H_2O interactions in context of global change to better inform decision makers involved in natural and agricultural resource management.

Specific Objectives:

1. ***Air to Land Linkage***: To investigate the role that atmospheric processes play in land surface C:N:H_2O cycles.
2. ***Coupled Air/Land***: To explore how ecosystem changes in the PNW affect land/atmosphere interactions.
3. ***Coupled Air/Land/Human***: To examine how potential policy changes might affect the interactions between C:N:H_2O cycles and regional-scale climate.
4. ***Communication:*** To explore how to best communicate the model results to resource managers and policy makers.

BioEarth


CCSM4: Global Climate
Large-scale T, P, U, V, W, Q, R
Coupled Land-Atmosphere
Atmospheric
Terrestrial
Aquatic
CMAQ: Atmospheric Chemistry
Meteorology (T, P, U, V, W, Q, R)
Aerosol optical properties & CCN
WRF: Meteorology
Regional- scale T, P, & R, O3, and deposition of NO3, NH4+, Hg, and S
Energy fluxes, soil moisture, surface albedo, and emissions of VOC, NOX, NH3, N2O, & CO2
VIC: Hydrology
CropSyst/RHESSys: Terrestrial Nutrient Dynamics
Soil moisture, LAI, canopy T & R
MEGAN: Biogenic Emissions
Runoff & Baseflow; Irrigation Withdrawals
Nutrients & Sediments
Regional Economics: Agricultural Nutrient and Water Use
Streamflow Routing
Unaltered Streamflow
ColSim: Reservoir Operations & Withdrawals
Altered Streamflow, Reservoir Storage
Global NEWS: Nutrient Transport in Channels
Nutrients, Sediment: Transport & Retention

BioEarth Features for Natural and Agricultural Resource Management

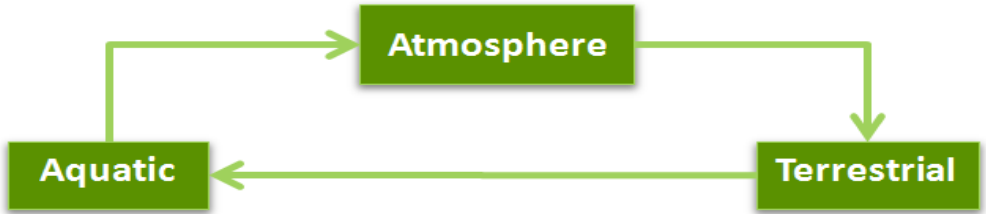
- Emphasis on details needed to inform agricultural and natural resource use and management
  - Economics (macroeconomic drivers, regional dynamics, individual response)
  - Crop producer decisions, including modeling of crop growth and phenology
  - Water management, including modeling of reservoirs and curtailment
  - Nitrogen management, including modeling of coupled biogeochemical cycles
  - Forest management decisions, including modeling of biomass and succession
- Relevant outputs for decision making: air & water quality, water availability, crop & forest productivity, greenhouse gas emissions, carbon sequestration, hydropower potential, economic impacts
- Communications research; stakeholder engagement throughout and after development

Reminder: BioEarth Coupling Terminology

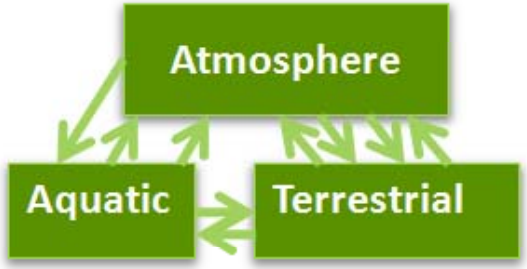
LOOSELY-COUPLED

- SEQUENTIAL or OFFLINE

- ITERATIVE



- FULLY COUPLED or TIGHTLY COUPLED



Something to keep in mind regarding the scope of the BioEarth project….

- While development of the full BioEarth modeling framework is one goal for this project, the BioEarth project is much more than this one output.
- Groups are working on answer research questions that involve single model components, or single linkages between model components (see hand-out). Trade-offs exist when deciding when to run models offline, loosely coupled, or tightly coupled. Although each of these efforts are contributions in and of themselves, they all contribute to BioEarth's overarching question as well as inform us on model development.