BioEarth

Biosphere-relevant earth system model

Tuesday-Wednesday, June 26-27, 2012
Location: CUE 518, CUB 212, CUE 512 (see specifics below)
Washington State University
Pullman, WA

AUDIO connection for June 26: 509-335-4700 pin number 5518#
AUDIO connection for June 27: 509-335-4700 pin number 1028#
VIDEO connection (no audio): http://breeze.wsu.edu/bioearth/

AGENDA

1:00 pm PDT **CUE 518**	**Welcome and Introductions** (Members who haven't done so already are encouraged to prepare a 1-slide introduction of themselves and which will also be posted here: http://www.cereo.wsu.edu/bioearth/biosketch.html**)**
1:30 pm	**Presentations of Progress Reports (If we run out of time for these on Tuesday, we can give some of these presentations first thing on Wednesday)** Project Overview and Integration - Jenny WG I – Atmospheric – Brian Terrestrial/Aquatic – Jenny Cyberinfrastructure – Joe WG II – Economics – Mike WG III – Communications – Liz
3:00 pm	**BREAK**
3:30-6:00 pm **CUB 212**	**Poster Session and Informal Break-Outs**
6:30 pm	**DINNER (Fireside Grill:** 1095 Southeast Bishop Boulevard**)**
9:00 am **CUE 512**	**Any Remaining Progress Reports from Tuesday, Followed by Presentations of Milestones** WG I – Jenny/Serena/Joe WG II – Mike WG III –Chad/Fok/Jennie Project Integration - Jenny
10:30 am	**BREAK**
11:00 am	**All-Hand Discussion on Milestones and Project Integration**
12:00-5:00 pm	**Lunch on your own (followed by time for informal break-outs in CUE 512 or elsewhere)**

Name	Institution, Department	Role	Team
Adam, Jennifer	WSU, Civil&Environmental Engineering	Principal lead, terrestrial team lead	Terrestrial
Allen, Liz	WSU, School of the Environment	PhD Student	Communications
Anderson, Sarah	WSU, Biology	PhD Student	Terrestrial/Atmospheric
Brady, Mike	WSU, School of Economics	Steering Committee, Economics Team lead	Economics
Chen, Yong	OSU	Core Faculty	Economics
Choate, Janet	UCSB, Bren School	Research Assistant	Terrestrial
Chung, Serena	WSU, Laboratory for Atmospheric Research	Steering Committee, atmospheric team lead	Atmospheric
Evans, Dave	WSU, Biology	Steering Committee	Terrestrial
Gould, Greg	WSU, Civil&Environmental Engineering	MS Student	Terrestrial
Gruber, George	WSU, Computer Sciences	MS Student	CyberInfrastructure
Guenther, Alex	NCAR	Core Faculty	Atmospheric/Terrestrial
Harrison, John	WSU, Vancouver, School of the Environment	Core Faculty	Terrestrial
Jiang, Xiaoyan	NCAR	Visiting Scientist	Atmospheric/Terrestrial
Kalyanaraman, Ananth	WSU, Computer Sciences	Core Faculty	CyberInfrastructure
Kruger, Chad	WSU, CSANR	Steering committee, communications team lead	Communications
Lamb, Brian	WSU, Laboratory for Atmospheric Research	Steering Committee	Atmospheric
Leung, Fok-Yan	WSU, Laboratory for Atmospheric Research	Core Faculty	Communications/ Atmospheric
Leung, Ruby	PNNL	Core Faculty	Atmospheric/Terrestrial
Liu, Mingliang	WSU, Civil&Environmental Engineering	Core Faculty	Terrestrial/Atmospheric
Malek, Keyvan	WSU, Biological Systems Engineering	PhD Student	Terrestrial
Miller, Cody	WSU, Vancouver, School of the Environment	MS Student	Aquatic/Terrestrial
Nergui, Tsengel	WSU, Laboratory for Atmospheric Research	PhD Student	Atmospheric/Terrestrial
Norton, Todd	WSU, Communications	Core Faculty	Communications
Perleberg, Andy	WSU, Forestry Extension	Core Faculty	Communications
Poinsatte, Justin	WSU, Biology	PhD Student	Terrestrial
Rajagopalan, Kirti	WSU, Civil&Environmental Engineering	PhD Student	Aquatic/Terrestrial
Reyes, Julian	WSU, Civil&Environmental Engineering	PhD Student	Terrestrial
Stephens, Jennie	Clark University	Core Faculty	Communications
Stockle, Claudio	WSU, Biological Systems Engineering	Steering Committee	Terrestrial
Tague, Christina (a.k.a. Naomi)	UCSB, Bren School	Core Faculty	Terrestrial
Vaughan, Joe	WSU, Laboratory for Atmospheric Research	Steering Committee, CI team lead	Cyberinfrastructure/ Atmospheric
Yoder, Jon	WSU, School of Economics	Core Faculty	Economics
Yoon, Jin-hu	PNNL	PostDoctoral Associate	Atmospheric/Terrestrial
Yorgey, Georgine	WSU, CSANR	Research Associate	Communications
Zhu, Jun	UCSB, Bren School	PostDoctoral Associate	Terrestrial

BioEarth all-hand meeting poster session June 2012

Last Name of First Author	Title	Poster #
Adam	A New Project -- An Earth Systems Modeling Framework for Understanding Biogeochemical Cycling in the Context of Climate Variability	1.1
Vaughan	Specifying, executing and tracking BioEarth modeling experiments using the Kepler Workflow	1.2
Orr	Overview of the Watershed Integrated System Dynamics Modeling (WISDM) project	1.3
Kruger	Climate Friendly Farming: Improving the carbon footprint of agriculture in the Pacific Northwest	1.4
Brown	Site-Specific, Climate-Friendly Farming	1.5
Allen	Researchers' Perceptions of Stakeholder Engagement in the Development of a Regional Earth Systems	2.1
Tillotson	Stakeholder perception comparison through the use of mental models	2.2
Rajagopalan	Assessing the impact of climate change on Columbia River Basin agriculture through integrated	2.3
Yorgey	Enhancing stakeholder feedback received on the 2011 Long-Term Water Supply and Demand Forecast through quantitative feedback	2.4
Bernacchi	Climate, Land Use and Agricultural and Natural Resources: Activities in Interdisciplinary Research, Education and Outreach	2.5
Carpenter-Boggs	OFoot: An Integrated Research-Extension Project	2.6
Creighton	A Needs Assessment of Pacific Northwest Family Forest Owners Regarding Climate Change	2.7
Brady	Modeling Economic Decision Making Across Time and Space in Integrated Modeling Frameworks	3.1
Neville	The Goldilocks Hypothesis: Misspecifications, Omissions and Errors in “Sparing Land for Nature”	3.2
Anderson	Linking isotopic measurements and atmospheric modeling to understand sources and patterns of nitrogen deposition in the northwestern United States	4.1
Chung	Effects of Global Change on Nitrogen Deposition in the Western US	4.2
Nergui	Relationship between inter-annual climate variability and seasonal nitrate and ammonium wet deposition in the western United States	4.3
Waldo	Regional Approaches to Climate Change (REACCH) in the Inland Pacific Northwest: Eddy Covariance Flux Measurements for High and Low Rainfall Wheat Cropping Systems	4.4
Eigenbrode	The Cereal Leaf Beetle and its Parasitoid under Projected Climates in the Pacific Northwest	5.1
Huggins	Dynamic Agroecological Zones for the Inland Pacific Northwest, USA	5.2
Malek	Effect of climate change and agricultural practices on Yakima River basin	5.3
Reyes	Management impacts on nitrogen uptake in managed grasslands: Evaluation of the nitrogen dilution	5.4
Stockle	Assessment of climate change impact on Eastern Washington agriculture	5.5
Dinesh		5.6
Dugger	Forest-hydrology interactions under a warmer climate: Effects of vegetation productivity dynamics and mortality on streamflow predictions in a semi-arid New Mexico mountain system	6.1
Edburg	Quantifying the impact of bark beetle outbreaks on carbon cycling in the western US from 1997 to	6.2
Gould	Progress towards assessing the large-scale impacts of forest fires on runoff erosion across the Pacific	6.3
Liu	Spatial-temporal variations of evapotranspiration and runoff/precipitation ratios responding to the changing climate in the Pacific Northwest during 1921-2006	6.4
Liu	Estimating scaling effects of RHESSys within the schema of BioEarth	6.5
Poinsatte	Evaluating the impact of atmospheric nitrogen deposition on biogeochemical cycling in high elevation communities in the North Cascades	6.6
Tague	Accounting for spatial heterogeneity in eco-hydrologic modeling for snow-dominated mountain	6.7
Zhu	Sensitivity of N-retention and export to temperature and nitrogen deposition forcing for a humid Pacific North West conifer site	6.8
Dilley		7.1
Nguyen	Large scale hydrological modelling for highly-connected river-aquifer systems: a case study of the	7.2
Preece	Detection and Quantification of the Cyanotoxin, Microcystin, in Fish Muscle Tissue Preliminary Results	7.3
McDonald	Hydropower benefits of artificial recharge in the Spokane Valley -- Rathdrum Prairie aquifer	7.4
McDonald	Climate change impacts on reservoir management in the Upper Columbia River Basin	7.5

BioEarth Milestones, Atmospheric Group Relevant Portion: June 2012
Note: Year 2 = April 1 2012 to Mar 30 2013

PROJECT INTEGRATION: Years 2-5

1. Model Full Integration Timeline
    a. Years 1-2:
        i. Terrestrial:
            1. VIC-RHESSys integration/parameterization

               Approach identified, scaling studies and parameterizations in progress.

            2. Routing and reservoirs online with VIC. *In progress.*
        ii. Atmospheric:
            1. WRF-VIC parameterization over our western US domain

               VIC parameters used in the NLDAS simulations performed by Ed Maurer are used in our offline VIC and coupled WRF-VIC simulations over the western US.

            2. WRF-CMAQ over our western US domain

               CMAQv5.0, which can be coupled to WRFv3.3, was released in February 2012. We have successfully run the benchmark case in off-line mode on Aeolus. For online mode coupled to WRFv3.3, we had to request files for a benchmark case, which were made available in May. We plan on testing it in online mode soon.

    b. Year 3-5:
        i. Terrestrial:
            1. Inclusion of crops into RHESSys
            2. VIC-RHESSys-MEGAN (i.e., incorporation of newest version MEGAN (version 3.0) for biogenic emissions, as is currently being done for CLM)
        ii. Atmospheric: (WRF-CMAQ)/VIC
        iii. All WG I: (WRF-CMAQ)/(VIC-RHESSys-MEGAN)
    c. Years 2 through 5: Economic
        i. Development and full integration of a grid-based economic model than the richer model being developed for sequential simulations
2. Offline Model Simulations and Development (for addressing relevant questions that don't require the fully integrated BioEarth model, and for determining scaling relationships needed for scaling to larger domain, but may run sequentially with BioEarth components)
    a. Terrestrial:
        i. RHESSys focus study sites: Years 1-2
        ii. VIC-CropSyst improvements and focus study sites: Years 1-3
        iii. NEWS: Years 2-5
    b. Economic:
        i. rich economic analysis over basin: Year 1
3. Land Cover Consistency
    a. Use of NLDAS2 in WRF-VIC during years 1-2

VIC parameters used in the NLDAS simulations performed by Ed Maurer are used in our offline VIC and coupled WRF-VIC simulations over the western US.

b. Use of Guenther land cover dataset for all BioEarth terrestrial models starting year 3

The newest land cover dataset is 30-m in resolution, uses CLM plant functional types, and includes species composition for crops, trees, shrubs, grass. The database integrates CDL, NLCD, FIA, and NRCS data with adjusted NLCD in urban areas. Also included is MODIS 8-day LAI for individual years

WG Ia ATMOSPHERIC GROUP: Year 2

1. January through July

Because of delays in setting up WRF-VIC and memory issues with the original version of coupled WRF-VIC in which VIC was not parallelized, this part has been delayed. We also anticipate that there might be cold bias in WRF-VIC. Current status of WRF-VIC simulation is as follows:

a. WRF-VIC historical runs
   i. VIC params (plan to use NLDAS2 soil and veg prior to integrating with MEGAN and RHESSys)

   Testing of WRF-VIC on a western US domain started in March 2012. To generate initial conditions for VIC, input data (meteorological forcing, VIC surface input data and VIC parameter files) were prepared and offline VIC simulations were run using NLDAS2 forcing for 10 years. Testing of the coupled WRF-VIC then proceed, but we encountered memory issues because the western US domain has many grid cells (due to the high resolution) and VIC was not parallelized. More recently we obtained a parallelized version of WRF-VIC and have started testing the new version. Also, WRF-VIC resulted in large positive biases in temperature in Arctic areas; the source of the problem has been identified.

   ii. Evaluation of simulations over historical period
   iii. WRF-VIC offline simulations complete by end of July – be sure to give at least 4 hour output for CMAQ to make sure that WRF-VIC provides all the output needed CMAQ (may require adding more variables to WRF output by changing the Registry)

   This timeline has been pushed back depending on when WRF-VIC results will be verified. We have already done offline VIC simulations needed for initialization of coupled WRF-VIC simulations for Ruby's WRF-CLM western US grid. We plan on running coupled WRF-VIC on this domain for a relatively short period (1-2 years?) to verify the performance of coupled WRF-VIC for the western US, which has never been done before. Once Ruby is satisfied with the WRF-VIC results, she will switch to a new grid because her WRF-CLM grid is incompatible with CMAQ (see below).

b. CMAQ setup
   i. By early Jan – get domain/terrain info from Ruby

Ruby provided the grid/domain info of her WRF-CLM simulations to WSU. Unfortunately, this grid is incompatible with CMAQ. The WRF-CLM grid uses Lambert conformal conic with one standard parallel. CMAQ requires that the projection have two standard parallels. We have now decided on a different grid that is compatible with CMAQ. The new grid still covers the western US using 12-km x 12-km grid cells, but the domain is slightly smaller than Ruby's WRF-CLM domain.

ii. Get anthropogenic emissions and fire emissions processing using SMOKE scripts– Jan –Mar (*Rodrigo will help Tsengel*)

This has been delayed for reasons mentioned above. We plan on doing short WRF-Noah simulations using the "finalized" grid to get SMOKE scripting setup instead of waiting on final WRF-VIC simulations. The new expected timeline for this is July - October 2012. We will use 2002 National Emissions Inventory (NEI 2002) for anthropogenic emissions. For fire emissions, we already have historical fire emissions output processed by BlueSky for 1995-2004. Tsengel will do the SMOKE setup with Rodrigo's help.

iii. Setup offline MEGANv2.1 simulations (this was not explicitly written out in the original milestone document).

MEGANv2.1 uses the most recent land cover data set (see section 3b of project integration), estimates emissions of 138 compounds, and includes CO_2 effects. It can be run in offline mode or online mode coupled to CLM4. A paper on MEGANv2.1 has been published in Geophysical Model Development Discussions (Guenther et al., 2012; http://www.geosci-model-dev-discuss.net/5/1503/2012/).

Tsengel will setup offline MEGANv2.1 run with help from Alex and Xiaoyan. The timeline is November 2012.

iv. ENSO variability analysis over historical period.

Tsengel has been applying the wavelet analysis to measured wet nitrogen deposition rates from NADP/NTN. Preliminary results indicate that there is no 2-7 year cycle in wet N deposition for the 32 NADP sites in the western US for which there are continuous wet N deposition data, suggesting that wet N deposition is not modulated by ENSO. On the other hand, cross wavelet transform and coherent wavelet transform show some significance in common variance, particularly during the 1997/1998 El Nino event for some sites. We plan to look at correlations with other climate indices, e.g., AO, and extending the analysis to include dry deposition data from CASTNET.

v. Determine what chemical boundary conditions to use for CMAQ runs and get them

We have 2007 MOZART-4 output from Louisa Emmons of NCAR and plan on using this for chemical boundary conditions. This means that we will not be able to look at inter-annual variability of long-range transport impact, which

we suspect to have relatively small for N deposition in the western US during the historical period. If of interest, we can uses MOZART-4 results for 2008 and 2009 in the future to see how N deposition may vary between 2007-2009 due to different long-range transport patterns during those three years.

2. July through December

   Due to reasons mentioned above, this timeline has been pushed back by at least 6 months.

   a. CMAQ runs using WRF-VIC output: time needed depends on number of years for simulation
   b. Analysis on deposition results from CMAQ output
   c. ENSO analysis on WRF-VIC simulations
   d. papers out on ENSO and land/atm interactions as modulated by ENSO cycles
3. Post December: climate change experiments – e.g., CMIP5 data being prepared from CCSM4 – creating of WRF input files from this
4. One objective of Sarah's research is to measure the nitrogen and oxygen isotope composition of historic NADP samples and analyze results with CMAQ and HYSPLIT to separate geographic emission locations and emission sources for the Pacific Northwest. Initial samples have been analyzed for isotope composition. Goals for the upcoming year are to expand the temporal and spatial scale of samples and to integrate isotopic results with CMAQ and HYSPLIT. A second objective is to use biological indicators (mosses, lichens) to extend the temporal scale from years to decades. Preliminary experiments to address this objective will begin this year.

WG Ib TERRESTRIAL GROUP: Year 2

1. RHESSys focus study sites (i.e., improvements of RHESSys on N processes and evaluations over small watersheds)
   a. Site selection: Wet – McKenzie (Willamette); Dry – TBD (Deschutes) - *DONE*
   b. Data collection for sites: *complete for wet site, dry site complete by Aug 2012*
   c. wet site simulations and analysis – *Partially done – see Zhu et al poster*
   d. dry site simulations and analysis – *complete during year 2*
   e. submission of first paper. Research question: How do increases in temperature (and associated shifts from snow to rain) impact local/patch-scale N retention and export for a range of local settings, including: 1) elevation, 2) vegetation type and biomass, and 3) N-loading. This analysis focuses on local processes only and does not include the impact of hillslope-watershed redistribution. – *complete by Aug 2012*
   f. submission of second paper. Research question: How does watershed redistribution of moisture and N impact the sensitivity of watershed N-retention and export to a warming temperatures? (This analysis is on the
   a. hillslope/watershed-scale) – *draft manuscript by end of year 2*
   b. reporting scaling strategy based on focus site analysis for upscaling RHESSys: trade-off between resolution and processing time *– approach identified, scaling relationships determined during year 2*
2. Regional-Scale VIC/RHESSys work *completed* during Year 1

a. Finished an analysis on the effects of historical climate change on regional evapotranspiration and runoff by using an offline VIC simulations with 6-km resolution driving forces data; submitted for publication
b. Finished an offline VIC simulations over the North America with NLDAS-2 forcing data and parameters and parallelized VIC code through OpenMP;
c. Added a NetCDF format climate data reader for RHESSys;
d. Produced multiple resolution spatial data sets for running RHESSys over the Pacific Northwest;
e. Generated consistent land-use and land-cover data sets from USDA Cropland Data Layer (CDL), CESM (Community Earth System Model)/CLM (Community Land Model), and MEGAN emission types for running off-line RHESSys (Regional Hydro-Ecologic Simulation System), MEGAN (Model of Emissions of Gases and Aerosols from Nature), and WRF-VIC (Weather Research and Forecasting Model – Variable Infiltration Capacity Model);
f. Processed historical LAI data sets (1981-2011) for running VIC in order to study how changes in phenology can affect regional water cycles;
g. Identified strategies to combine VIC components into RHESSys.

3. Regional-Scale VIC/RHESSys work to be completed during Year 2
    a. Close the surface energy budget and improve the soil thermal dynamics in RHESSys by combining with VIC;
    b. Parallelize RHESSys code to handle huge number of patches for large-scale regional simulations;
    c. Add stream routing processes in RHESSys;
4. Regional-Scale VIC/RHESSys work to be completed during Year 3
    a. Add management processes for agricultural ecosystems in RHESSys by introducing methods from VIC/CropSyst coupled model;
    b. Calibrate RHESSys with field observations over the CRB and make offline simulations with air quality data (i.e. nitrogen deposition and surface ozone concentration) from CMAQ/WRF coupled simulations;
    c. Start coupling RHESSys with WRF by implementing a coupler (CPL7) to map watershed and patch scale simulated results of RHESSys to grid cells of WRF;
    d. Provide preliminary offline simulation results and spatial data sets to aquatic ecosystem model (NEWS) and social economic model trying to study material and energy exchange between the interfaces of terrestrial system, aquatic ecosystems, and social economics.
5. VIC-CropSyst development for focus study site, Yakima River Basin
    a. Improve soil physics in VIC for coupling with CropSyst – *progress made, will complete by aug 2012*
    b. Improved soil parameters and recalibration over Yakima – *will complete by aug 2012*
    c. Manuscript preparation: examination of relative impacts of climate change and irrigation efficiency on crop yield – *will complete by aug 2012*
6. NEWS nutrient export
    a. Compile observed data sources for evaluation of regional-scale model along major tributaries of the CRB (and for select smaller tributaries): solute concentration, discharge, etc…
7. The objective of Justin's research is to determine community-specific responses to atmospheric deposition in the subalpine zone of the central Cascade Range. Preliminary modeling of responses was completed 2011-12 using DayCent. Future objectives are to 1) identify sources of atmospheric deposition in snow using stable isotope analyses; 2) establish manipulative

experiments to measure responses of three communities; and 3) integrate experimental results into Rhesys to inform BioEarth and management decisions.

WG Ic CYBERINFRASTRUCTURE: Year 2

1. Support for BioEarth communications:
    a. Forum is already in place. **Goal is by Dec 2012 all users will be using the forum as a major means of project communication and generating memorandum/a documenting progress.** ***Not accomplished – perhaps something to be dropped****?*
    b. Support for tele-web-conferencing of the group. **Solve need for web-conferencing support by February 2012.** ***Using Adobe Connect, courtesy of Chad Kruger.***
2. Support for BioEarth codes:
    a. Code acquisition – Background: an earlier request for people to communicate/covey codes and data to Joe has resulted in zero codes offered for transfer. Next step is, by **February 2012, to solicit individual project members and negotiate a plan and schedule for code acquisition**. **Goal is for basic codes to be collected by December 2012.** ***Not accomplished yet***
    b. Code storage -- we'll use subversion for storage of codes and scripts. **Conduct a *subversion* training by March 2012.?** ***Not accomplished yet***
    c. work-flow -- we've identified Kepler as a promising tool to create script-like control codes. **Sequential workflow for WRF implemented as test by March 2012.** ***Late but in progress June 2012, contingent on WRF.***
    Sequential workflow that integrates more than one model program by June 2012. ***In progress June 2012, contingent on WRF.***
    Implementing Provenance features for the implemented workflows by December 2012. *Still reachable for December 2012.*

WG II ECONOMICS: Year 2

1. Completion of economic stochastic dynamic regional equilibrium model for sequential integration with other modeling components. Steps required to achieve this task:
    a. Determine how to use output from climate modeling to make probabilistic statements about changes in variability.
    b. Parameterize production functions in the economic model to reflect crop growth process modeling used elsewhere in the project.
    c. Settle on a land cover dataset that defines irrigated spatial extent.
2. Determine whether Yong Chen's work on spatially explicit land use change modeling of residential development can be adapted to this project as the base for the second economic model that can be fully integrated into RHESSys.
3. Provide model output on climate driven changes in nitrogen use that can be used as an input into NEWS to assess impacts.

WG III COMMUNICATIONS: Year 2

1. Host 2 stakeholder workshops during year 2
2. Initiate analysis of interactive communication between scientists and stakeholders
3. Submit manuscript on scientist survey on stakeholder perceptions