BioEarth

Biosphere-relevant earth system model

Monday-Tuesday, April, 11-12, 2011
Locations: CUE 412 (on Monday) and Wilson 4 (on Tuesday)
Washington State University
Pullman, WA

1:00 pm, Day 1	**Welcome and Introductions (5 min presentations each)**
2:00 pm, Day 1	**Overview of Project with Time for Discussion** Jenny/Brian
3:00 pm, Day 1	**BREAK**
3:30 pm, Day 1	**Presentations on Stand-Alone Models** WRF and WRF/VIC existing linkages: Ruby CMAQ and CMAQ/WRF existing linkages: Serena/Brian VIC / ColSim: Jenny CropSyst and VIC/CropSyst existing linkages: Claudio/Jenny RHESSys: Christina NEWS: John CREM and CREM/VIC existing linkages: Mike
5:00 pm, Day 1	**Presentations on Outreach Plan and Communications Research** Fok/Jennie/Chad/Andy
5:30 pm, Day 1	**BREAK**
6:30 pm, Day 1	**Dinner at Dupus Boomers**
8:30 am, Day 2	**Description of Objectives for Break-Out Discussions** Jenny/Brian
9:00 am, Day 2	**Break-Out Discussions (discussion objectives related to specific objectives outlined in proposal)** Modeling and Cyberinfrastructure Economics Outreach and Extension
10:00 am, Day 2	**Presentations from Break-Out Discussions**
10:45 am, Day 2	**Discussion on Model Integration Steps and Project Timeline** Discussion Lead: Jenny/Brian
11:45 am, Day 2	**Concluding Remarks**

2. Work Plan

The anticipated start date for most new research activities is January, 2011, although recruiting of PhD students and post-docs will begin immediately after notification of the award. Table 2 illustrates the staged processes of model linkages and synthesis we expect to occur over the five year project. Below we list the details for each item in Table 2, including the source of funding (NSF or leveraged from other projects) and the responsible faculty.

Table 2. Timeline for proposed research and dissemination of results; grey boxes indicate where activities will take place. We anticipate a start date of January, 2011.

Activity	Sp. 2011	Fa. 2011	Sp. 2012	Fa. 2012	Sp. 2013	Fa. 2013	Sp. 2014	Fa. 2014	Sp. 2015	Fa. 2015
Research										
Atmospheric Modeling										
WRF-offline sims	X	X	X							
WRF-CMAQ sims			X	X	X	X	X	X	X	
Terrestrial Modeling										
VIC-CropSyst integration/params	X	X								
VIC-RHESSys integration/params	X	X	X	X	X	X				
RHESSys evaluations	X	X								
CropSyst evaluations	X	X								
VIC evaluations	X	X	X	X	X	X				
MEGAN integration and sims			X	X	X	X				
Aquatic Modeling										
ColSim irrigation development	X	X	X							
NEWS params and sediment		X	X	X	X	X	X			
Regional Economic Modeling										
Spatially-explicit framework	X	X	X	X	X	X	X	X		
Bio-EaSM Integration										
Step-wise integration	X	X	X	X	X	X	X	X		
Predictive sims								X	X	X
Uncertainty analysis	X	X	X	X	X	X	X	X	X	X
Cyber Infrastructure										
Evaluations of resource needs	X	X	X							
New algorithms				X	X	X	X	X		
Ongoing development	X	X	X	X	X	X	X	X	X	
Ecology										
Interpretation of simulations			X	X	X	X	X	X	X	X
Communications										
Analysis of perception evolution			X	X	X	X	X	X	X	X
Final Reporting										
Draft Final									X	
Final										X
Information Dissemination										
Extension Workshops										
Agriculture	X		X		X		X		X	
Forest Resources		X		X		X		X		X
External Advisory Committee Meetings		X		X		X		X		X
NSF PI Meetings		X		X		X		X		X
AGU conference		X		X		X		X		X
Other conference			X		X		X		X	
Peer-reviewed publications			X	X	X	X	X	X	X	X
Web page updates			X	X	X	X	X	X	X	X

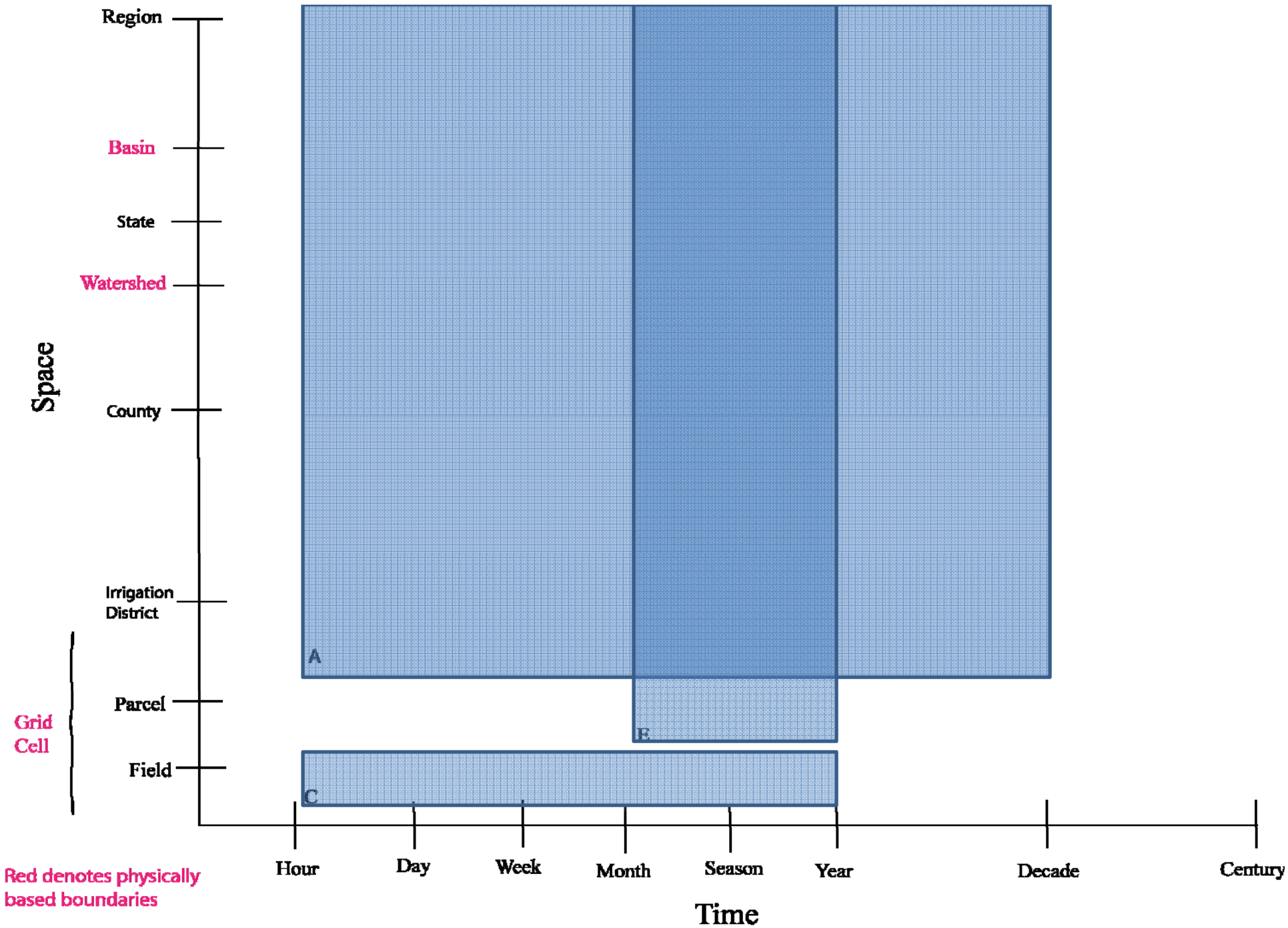
Set	Purpose	Time period	Model Configuration model	input	Compute Facility	Who	When
1	Establish baseline results of models as they are; model evaluation & calibration	2000 to 2009	WRF-Noah	reanalysis	bluefire	WSU	first year
			offline CMAQ & MEGAN	modeled meteorology	WSU	WSU	first 15 months
			offline CropSyst	observed meteorology	WSU	WSU	
				modeled meteorology			
			offline RHESSys	observed meteorology (and deposition?)			
				modeled meteorology, deposition, and ozone			
				modeled meteorology; no deposition, no ozone			
			offline VIC	observed meteorology	WSU	WSU	
				modeled meteorology			
2	Impacted of integrated WRF-VIC (without biogeochemistry modeling)	2000 to 2009	WRF- VIC w/o RHESSys/CropSyst	reanalysis	bluefire	PNNL	first year
			offline CMAQ & MEGAN	modeled meteorology	WSU	WSU	first 18 months
			offline CropSyst	modeled meteorology, deposition, & ozone	WSU	WSU	
			offline RHESSys				
			offline VIC-RHESSys-CropSyst		WSU	WSU	
3	Integrate all model components	2000 to 2009	WRF-VIC with RHESSys/CropSyst coupled to CMAQ & MEGAN	NCEP reanalysis	NCAR Wyoming	WSU	3rd or 4th year?
4	Future scenario	2010 to 2050	WRF-VIC with RHESSys/CropSyst coupled to CMAQ and MEGAN + CREM	CCSM4 climate	NCAR Wyoming	WSU	4th and 5th year

Table 2 of Proposal Description						How We Are Going to Do It				
Set	Purpose	Time period	Model Configuration model	input	output	Computer Facility	By Whom	When	GAUs	Notes
1	Establish baseline results of models as they are; model evaluation & calibration	current	WRF using Noah LSM	NCEP reanalysis for boundary & initial conditions	met-1, SR_{WRF}-1, $f_{heat,WRF}$-1, SM_{WRF}-1	NCAR bluefire	WSU	first year		
			offline MEGAN	met-1; MODIS LAI & PFT	f_{BVOC}-1,$f_{NOx,MEGAN}$-1	WSU	WSU	first 14 months		
			offline CMAQ	met-1, f_{BVOC}-1,f_{NOx}-1	O_3-1, aerosol-1, deposition-1	WSU	WSU	first 14 months		
			offline CropSyst	obs met	$f_{CO2,ag}$-1a, $f_{N2O,ag}$-1a	WSU	WSU			
			offline CropSyst	met-1	$f_{CO2,ag}$-1b, $f_{N2O,ag}$-1b	WSU	WSU			
			offline RHESSys	obs met & obs deposition	$f_{CO2,nv}$-1a, $f_{N2O,nv}$-1a, $f_{heat,RHESSys}$-1a, $SR_{RHESSys}$-1a, $SM_{RHESSys}$-1a	?	?			
			offline RHESSys	met-1, deposition-1, O_3-1	$f_{CO2,nv}$-1b, $f_{N2O,nv}$-1b, $f_{heat,RHESSys}$-1b, $SR_{RHESSys}$-1b, $SM_{RHESSys}$-1b	?	?			
			offline RHESSys	met-1, no deposition (.ie., no N limitation), no O_3	$f_{CO2,nv}$-1c, $f_{N2O,nv}$-1c, $f_{heat,RHESSys}$-1c, $SR_{RHESSys}$-1c, $SM_{RHESSys}$-1c	?	?			
			offline VIC	observed met	$f_{heat,VIC}$-1a, SR_{VIC}-1a, SM_{VIC}-1a, runoff-1a	WSU	WSU			
			offline VIC	met-1	$f_{heat,VIC}$-1b, SR_{VIC}-1b, SM_{VIC}-1b, runoff-1b	WSU	WSU			
2	Impacted of integrated WRF-VIC (without biogeochemistry modeling)	current	WRF using VIC w/o RHESSys/CropSyst	NCEP reanalysis for boundary & initial conditions	met-2, SR_{WRF}-2, $f_{heat,wrf}$-2, SM_{wrf}-2	NCAR bluefire	PNNL	first year		
			offline MEGAN	met-2; MODIS LAI & PFT	f_{BVOC}-2, $f_{NOx,MEGAN}$-2	WSU	WSU	first 14 months		
			offline CMAQ	met-2, f_{BVOC}-2, f_{NOx}-2	O_3-2, aerosol-2, deposition-2	WSU	WSU	first 18 months		
			offline CropSyst	met-2; deposition-2	$f_{CO2,ag}$-2, $f_{N2O,ag}$-2	WSU	WSU			
			offline RHESSys	met-2; deposition-2	$f_{CO2,nv}$-2, $f_{N2O,nv}$-2, $f_{heat,RHESSys}$-2, $SR_{RHESSys}$-2, $SM_{RHESSys}$-2	?	?			
			offline VIC-RHESSys-CropSyst	met-2; deposition-2; O_3-2	$f_{CO2,VIC}$-2, $f_{N2O,VIC}$-2, $f_{heat,VIC}$-2, SR_{VIC}-2, SM_{VIC}-2, runoff-2	WSU	WSU			
3	Integrate all model components	current	WRF with VIC-RHESSys/CropSyst	NCEP reanalysis for boundary & initial conditions	met-3, SR-3, f_{BVOC}-3, f_{NOx}, O_3-3, aerosol-3, f_{CO2}-3, f_{N2O}-3, f_{heat}-3, SR-3, SM-3, runoff-3	NCAR Wyoming	WSU	3rd or 4th year?		
			MEGAN	online met, LAI & PFT, canopy temperature and radiation						
			CMAQ	online met and emissions						
			CropSyst	online met and deposition						
			RHESSys	online met and deposition						
4	Future scenario	2010-2050	WRF with VIC-RHESSys/CropSyst	CCSM3 results for boundary& initial conditions	met-4, SR-4, f_{BVOC}-4, f_{NOx}, O_3-4, aerosol-4, f_{CO2}-4, f_{N2O}-4, f_{heat}-4, SR-4, SM-4, runoff-4, land cover, crop yield	NCAR Wyoming	WSU	4th and 5th year		
			MEGAN	online met, LAI & PFT, canopy temperature and radiation						
			CMAQ	online met						
			CropSyst	online met and deposition						
			RHESSys	online met and deposition						
			CREM	water availability, water irrigation, biomass yield, soil nutrient level, water regulatory and other environmental policies, fertilizer prices						

Notes
For CMAQ, current anthropogenic emissions (ie., NEI2002) will be used for all simulations.
ag = agricultural
nv = natural vegetation
f_x = flux of x
SM = soil moisture
SR = surface radiation
VIC evaluation period 1950-2000 (when data available)
WRF and CMAQ evaluation period 2000-2010

Ruby's WRF-CLM whole western US at 12-km resolution
341 x 337 grid cells
114917 grid cells
6648.0909 MB storage for 24 hours
2426553.2 MB storage for 1 year
24265532 MB storage for 10 years
23696.808 GB storage for 10 years
23.141414 TB storage for 10 years

Earth System Model	Project Co-Investiagator(s)	Name of code(s)	Reference host system	Source language	Compiler preferences & restrictions	Operating system	Scripting language	Backgrd or Interactive	GUI or command line operation	Required libraries	Parallel or single processor	if parallel, what flavor parallelism	Required datasets	Upstream Models	Downstream Models	Parallel Models	Notes:	link to model info/docs		
WRF-Chem (for example)	Serena Chung	wrf-chem	aeolus.wsu.edu	FORTRAN	PGF	linux	csh	backgrd	command line	netCDF, m3-io/ap	parallel	MPI	multiple	global climate	VIC, ...			Users_guide from NOAA WRF Working Gr		
VIC	Adam	vic	aeolus.wsu.edu	C	gcc or any c cor	linux	csh	backgrd	command line	netCDF	single		multiple	WRF	NEWS	RHESSys, CropSyst		http://www.hydro.washington.edu/Letter		
VIC/CropSyst	Adam/Stockle	vic	aeolus.wsu.edu	C/C++	?	linux	csh	backgrd	command line	netCDF	single		multiple	WRF	NEWS	RHESSys, Col	VIC/CropSyst is being completed Spring 2011			
ColSim	Adam					Windows								WRF	NEWS	VIC/RHESSys	This is currently in Stella, but will be converted to C for operatio			
RHESSys	Tague	rhessys	rhessys.svn.sou	C, GRASS for I/O		MacOS,U	bashrc	backgrd	command line	GRASS (to generat	single (calibrations done parallel)		multiple	WRF/VIC (to be developed fo		CropSyst		http://fiesta.bren.ucsb.edu/~rhessys/		



E=Economics; A=Atmospheric; H=hydrology; C=Cropping; S=Streamflow & reservoir; D=Sediment;

to: Earth System Modeling Project Investigators
from: Joe Vaughan
date: January 21, 2011
subject: Cyber Infrastructure Planning for EaSM

This memo reflects discussions at the January 20th meeting meeting at WSU; attending were Jen Adam, Brian Lamb, Ananth Kalyanaraman, Serena Chung and myself. Our objective for this meeting was to sketch out the categories of cyber-infrastructure (CI) support required for our project and also to make a beginning identifying candidate software components. Below are listed the five categories we identified along with a summary of our discussion and listing of software mentioned.

Please respond to me with comments and or recommendations as to:

CI requirements that we have not yet identified,
CI projects, tools, software, libraries, etc., that you would recommend,
Software to be avoided due to known institutional policies or other factors.

1) **Code versioning software** for storage of code and scripts, tracking versions, maintaining development history structure and version specific modifications. Source codes and associated scripting would be stored and maintained in this system. Here is a useful survey of such software
http://en.wikipedia.org/wiki/Comparison_of_revision_control_software
Candidates: subversion, cvs, git

2) **Data Storage** for maintenance, sharing and secure backup of observational data and model simulation results associated with EaSM models. This requirement area is poorly characterized at this time, but conceptually it involves large capacity storage for files (datasets of model results and of observational data) and perhaps support for storage of associated metadata such as source (model & version or instrument), date, investigator, quality assurance status.
Candidates: DateOne, HDF (including versions thereof)

3) **Cluster Software support** for optimization of model computational performance to address model-specific computational characteristics (challenges), to exploit potential for multi-processor parallelism, and optimize inter-model communication.
Candidates: Virtualization, MapReduce, Hadoop

4) **Document sharing** to support collaborative creation and access for project documents including plans, reports, presentations, etc.
Candidates: DropBox, SharePoint, Google Group, code.google.com

5) **Video-conferencing** to support project meetings across multiple sites, including web-mediated seminar presentation ('webinar').
Candidates: Evo, MeetingPlace, LiveMeeting (MS), BigBlueButton, SharePoint

List of Participants	
Adam, Jennifer	WSU, Civil&Environmental Engineering
Anderson, Sarah	WSU, Biology
Brady, Mike	WSU, School of Economics
Chen, Yong	OSU
Chinnayakanahalli, Kiran	WSU, State of Washington Water Research Center
Chung, Serena	WSU, Laboratory for Atmospheric Research
Evans, Dave	WSU, Biology
Guenther, Alex	NCAR
Harrison, John	WSU, Vancouver, SEES
Kalyanaraman, Ananth	WSU, Computer Sciences
Kruger, Chad	WSU, CSANR
Lamb, Brian	WSU, Laboratory for Atmospheric Research
Leung, Fok	WSU, Laboratory for Atmospheric Research
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Malek, Keyvan	WSU, Biological Systems Engineering
Meng, Lei	Cornell University
Perleberg, Andy	WSU, Forestry Extension
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