Agenda - 2016 ACME All-Hands Meeting

Agenda in pdf form - CNCL-Agenda-2016_ACME_All-Hands_Meeting_20160602.pdf

2016 ACME All-Hands Plenary Sessions, Jun 7 - Jun 10

https://global.gotomeeting.com/join/453349589

(408) 650-3123

Access Code: 453-349-589

acme-gotowebinar1@lists.llnl.gov
pass: goto4acme

Breakout #1 Sessions, Jun 7 - Jun 10

https://global.gotomeeting.com/join/738036357

(571) 317-3122

Access Code: 738-036-357

acme-gotomeeting1@lists.llnl.gov
pass: goto4acme

Breakout #2 Sessions, Jun 7 - Jun 10

https://global.gotomeeting.com/join/946890981

(872) 240-3212

Access Code: 946-890-981

acme-gotomeeting2@lists.llnl.gov
pass: goto4acme

Session Time	Duration	Start - End Time	Session / Confluence Page	Plenary Room	BreakOut #1	BreakOut #2	Poster Room
Tuesday, Jun 7th, 2016							
							Posters Installation
10 min		8:00 - 8:10 am	Welcome Intro & Short ACME Business Review	Session Chair: Todd Ringler			
	2 min	8:00 - 8:02 am		Intro, Meeting Review and Charge, David C. Bader			
	3 + 2 min	8:02 - 8:07 am		Intro of new Collaborators and University Partners (Presentation 3 min + Questions 2 min), Dorothy Koch			
	3 min	8:07 - 8:10 am		Intro to Hackathon and Proposed Projects /Teams (Presentation 3 min), David C. Bader			
1h 10 min		8:10 - 9:20 am	ACME Group "Status and Future Roadmaps"	Session Chair: Todd Ringler 7x (Presentation 7 min + Questions 3 min)			
	7 min + 3 min	8:10 - 8:20 am		Atmosphere Group, Phil Rasch, Shaocheng Xie			
	7 min + 3 min	8:20 - 8:30 am		Land Group, Peter Thornton, Bill Riley			
	7 min + 3 min	8:30 - 8:40 am		Ocean/Ice Group, Todd Ringler, Stephen Price			
	7 min + 3 min	8:40 - 8:50 am		Workflow Group, Dean N. Williams, Valentine Anantharaj			
	7 min + 3 min	8:50 - 9:00 am		Performance Group, Patrick Worley, Phil Jones			
	7 min + 3 min	9:00 - 9:10 am		SE/CPL Group, Andy Salinger, Robert Jacob			
	7 min + 3 min	9:10 - 9:20 am		Coupled Simulations, David C. Bader, Mark Taylor, Ruby Leung			
40 min		9:20 - 10:00 am	Super Lightning Poster Presentations	Session Chair: Stephen Price			
	40 min	9:20 - 10:00 am		All posters present one slide to introduce their poster (one slide with one plot/image and one highlight, less then 1 min)			
20 min		10:00 - 10:20 am	Break				
6h		10:20 - 5:40pm	Individual Groups Parallel Meetings	Session Chair: Stephen Price			

	2h	10:20 - 12:20pm		**Atmosphere Group** will include invited talks: "Non-BFB test, Non-bit-for-bit solution reproducibility: a new test based on time step convergence", Hui Wan, Kai Zhang, Phil Rasch, Balwinder Singh, Xingyuan Chen, Jim Edwards "High-dimensional big data exploration for model tuning and evaluation", Hui Wan, Jonas Lukasczyk, David Rogers, Phil Rasch	**Ocean/Ice Group** will include invited talks: "A new ice sheet / ocean interaction model for Greenland Fjords using discontinuous Galerkin method" Michal A. Kopera (UCSC), Wieslaw Maslowski (NPS), Francis X. Giraldo (NPS) "Reduced Framework for Screening mBGC Feedbacks: Comparison and Balance" Scott Elliott, Corinne Hartin, Susannah Burrows, Philip Cameron-Smith, Forrest Hoffman, Shanlin Wang, Nicole Jeffery, Mark Petersen, Alex Jonko, Steve Smith, Katherine Calvin, Benjamin Bond-Lamberty, Robert Link, Nate Collier, Oliver Wingenter, Olu Ogunro, Elliot Sherman, Robert Letscher, Keith Moore, Li Xu, Lynn Russell	**Workflow Group**	
1h		12:20 - 1:20pm	Lunch				
	2h	1:20 - 3:20 pm		**Land Group** will include invited talks: "Estimating Global Maps of Trait Distributions" Ethan Butler, University of Minnesota "Developing fast implicit spin--up capabilities for CESM to study the dynamics o the ocean's nitrogen and carbon cycles" François Primea and Keith Moore, UC Irvine "Hypsometric analysis improves topography-based subgrid structures for the ACME Land Model" Teklu K Tesfa and Ruby Leung "Quantifying the Impacts of Parametric Uncertainty on Biogeochemistry in the ACME Land Model" Khachik Sargsyan, Daniel Ricciuto	**Performance Group**	**SE Group**	
20 min		3:20 - 3:40 pm	Break				
	2h	3:40 - 5:40 pm		**Coupled Simulations Group**	Breakout #1	Breakout #2	Posters Installation
1h 20 min		5:40 - 7:00 pm	Dinner				
2h			Evening Sessions				
	1h	7:00 - 8:00 pm		Breakout #3	Evening Exec/Council/GLs Meeting	Breakout #4	Posters Installation
	1h	8:00 - 9:00 pm		Breakout #5	Assessment of AIE in ACME v1 atmosphere model, Breakout #6	Deep Dives Rehearsal Phil Jones Breakout #7	
Wednesday, Jun 8th, 2016							
35 min		8:00 - 8:35 am	Welcome, Program Managers Talks, part 1/2	Session Chair: Peter Thornton			
	10 min	8:00 - 8:10 am		ACME Overview David C. Bader			
	15 min	8:10 - 8:25 am		BER - Dorothy Koch, Sharlene Weatherwax			
	15 min	8:25 - 8:40 am		Awards Dorothy Koch			

1h		8:40 - 9:40 am	ACME Exec Talks on ACME Status and Vision	Session Chair: Peter Thornton			
	15 min + 5 min	8:40 - 9:00 am		David C. Bader - ACME Status and 1, 5 and 10-year Vision (Presentation + Questions)			
	15 min + 5 min	9:00 - 9:20am		Ruby Leung - Science Status and 1, 5 and 10-yearVision (Presentation + Questions)			
	15 min + 5 min	9:20 - 9:40 am		Mark Taylor - Computational Status and 1, 5 and 10-yearVision (Presentation + Questions)			
20 min		9:40 - 10:00 am	Break				
2h		10:00 -12:00 pm	Invited Science Talks part 1/2	Session Chair: Bill Riley (Talk 15 min + Discussion 5 min)			
	15 min + 5 min	10:00 - 10:20 am		Initial Results from Fully Coupled High-Resolution ACME V0.1, *Julie McClean, David C. Bader, Mark Taylor, Mathew Maltrud, Milena Veneziani, Qi Tang, Jack Ritchie,Marcia Branstetter, Kate Evans, Salil Mahajan*			
	15 min + 5 min	10:20 - 10:40 am		Ocean Cavities Below Ice Shelves, *Mark Petersen, Xylar Asay-Davis, Doug Jacobsen, Jeremy Fyke, Matt Hoffman, Adrian Turner, Jon Wolfe, Stephen Price*			
	15 min + 5 min	10:40 - 11:00 am		Evaluating monsoon circulations in ACME v1 ne30 experiments, *Bryce Harrop,Phil Rasch, Po-Lun Ma*			
	15 min + 5 min	11:00 - 11:20 am		Huge divergence in land-atmosphere carbon exchange resulting from ambiguous numerical coupling between carbon and nitrogen dynamics, *Jinyun Tang, Bill Riley*			
	15 min + 5 min	11:20 - 11:40 am		Towards low cloud-permitting cloud superparameterization, *Michael S. Pritchard, Hossein Parishani, Mathew C. Wyant, Marat Khairoutdinov, Balwinder Singh, Christopher S. Bretherton* *University of California, Irvine*			
	15 min + 5 min	11:40 - 12:00 pm		Scale-aware hydrologic and biogeochemical modeling for the Amazon and the world: model enhancement, multi-scale strategies and dataset generation, *Chaopeng Shen, William J. Riley and John M. Melack* Civil and Environmental Engineering, Pennsylvania State University Earth Sciences Division, Lawrence Berkeley National Laboratory Earth Research Institute, University California, Santa Barbara, CA			
10 min		12:00 - 12:10 pm	Program Managers Talks, part 2/2	Session Chair: Bill Riley			
	10 min	12:00 - 12:10 pm		Climate and Environmental Sciences Division (CESD) Division Director's Perspective, Gerald Geernaert			
1h		12:10 - 1:10 pm	Lunch				
1h		1:10 - 2:10 pm	Invited Science Talks part 2/2	Session Chair: Bill Riley (Talk 15 min + Discussion 5 min)			
	15 min + 5 min	1:10 - 1:30 pm		Ocean biogeochemistry in the Earth system modeling framework: applications and approach, *Matthew Long,* Climate and Global Dynamics Laboratory, National Center for Atmospheric Research			
	15 min + 5 min	1:30 - 1:50 pm		An examination of systematic biases in ACME solar heating rates - comparison with multi-stream Solar-J, *Michael Prather, Juno Hso, Alex Viedenbaum, Alex Nicolau* University of California, Irvine			

	15 min + 5 min	1:50 - 2:10 pm		Incorporate realistic spectral emissivity of surfaces into the CESM and the influence on simulated radiation budget, mean climate, and climate changes, *Xianglei Huang* University of Michigan			
40 min		2:10 - 2:30 pm	ACME Group Picture	Session Chair: Bill Riley			
	20 min			Group Picture			
20 min		2:30 - 2:50 pm	Break				
2h 40 min		2:50 - 5:30 pm	Entertainment + Poster Session	Session Chair: Bill Riley			
	20 min	2:50 - 3:10 pm					Entertainment Phil Jones
	2h 20 min	3:10 - 5:30 pm					Poster Session
1h 30 min		5:30 - 7:00 pm	Dinner				
2h			Evening Sessions				
	1h	7:00 - 8:00 pm		Cross-group tuning activities and coordination, Shaocheng Xie, Phil Rasch, Chris Golaz, Peter Caldwell Breakout #8	Evening Exec + Lab Managers Meeting	"Coupler / mask changes to allow for dynamic component land ice / sea ice / ocean extent" Stephen Price Breakout #9	Poster Session - Continuation
	1h	8:00 - 9:00 pm		Cross-group tuning activities and coordination, Shaocheng Xie, Phil Rasch, Chris Golaz, Peter Caldwell Breakout #10	Elevation Classes: coupling between atmosphere and land/ocean Steve Ghan Breakout #11	Global coupled biogeochemistry coordination and planning Forrest Hoffman, Philip Cameron-Smith, Scott Elliott, Bill Riley, Susannah Burrows Breakout #12	Poster Session - Continuation
Thursday, Jun 9th, 2016							
~ 3h		8:00 - 11:05 am	Cross-Group Speed Dating	Session Chair: Shaocheng Xie			
	30 min + 5 min change rooms	8:00 - 8:30 am		A-P: Atmosphere - Performance Groups	W-L: Workflow - Land Groups	O-S: Ocean/Ice - SE/CPL Groups	Posters Take Down
	30 min + 5 min change rooms	8:35 - 9:05 am		A-L: Atmosphere - Land Groups	W-S: Workflow - SE/CPL Groups	O-P: Ocean/Ice - Performance Groups	
	30 min + 5 min change rooms	9:10 - 9:40 am		A-S: Atmosphere - SE/CPL Groups	W-O: Workflow - Ocean/Ice Groups	L-P: Land - Performance Groups	
20 min		9:40 - 10:00 am	Break				
	30 min + 5 min change rooms	10:00 - 10:30 am		A-O: Atmosphere - Ocean/Ice Groups	L-S: Land - SE/CPL Groups	P-W: Performance -Workflow Groups	
	30 min + 5 min change rooms	10:35 - 11:05 am		A-W: Atmosphere - Workflow Groups	L-O: Land - Ocean/Ice Groups	P-S: Performance -SE/CPL Groups	
2h		11:05 - 2:20 pm	ACME v1 Session	Session Chair: Shaocheng Xie			
	30 min +10 min	11:05 - 11:45 am		Operational Plans on Running v1 Major Experiments (Chris Golaz /coupled) (Presentation + Discussion)			

1h 15 min		11:45 - 1:00 pm	Lunch				
	30 min + 10 min	1:00 - 1:40 pm		v1 Process for Data Management, infrastructure and Diagnostics (Dean N. Williams) (Presentation + Discussion)			
	30 min + 10 min	1:40 - 2:20 pm		Overview and Discussion on Papers written/in writing/to be written (Todd Ringler, Peter Thornton, Phil Rasch) (Presentation + Discussion)			
2h 20 min		2:20 - 4:40 pm	ACME v2 Session	Session Chair: Phil Rasch			
15	10 min + 5 min	2:20 - 2:35 pm		v2 Development Cycle Overview David C. Bader (Presentation + Discussion)			
25	15 min + 10 min	2:35 - 3:00 pm		v2 New Development Ruby Leung (Presentation + Discussion)			
25	15 min + 10 min	3:00 - 3:25 pm		v2 Planned Experiment Ruby Leung (Presentation + Discussion)			
20 min		3:25 - 3:45 pm	Break				
25 min	10 mi + 15 min	3:45 - 4:10 pm		LC Infrastructure Discussion Mark Taylor (Presentation + Discussion) (Machines, Availability, Turnaround, low res and high res runs - problems / solutions / strategies)			
30 min	20 min + 10 min	4:10 - 4:40 pm		ACME Human Component Katherine Calvin (Presentation + Discussion)			
20 min		4:40 - 5:00 pm	Closing Remarks	Session Chair: Phil Rasch			
				Exec Closing Remarks			
2 h		5:00 - 7:00 pm	Dinner				
1h		7:00 - 8:00 pm		Breakout #13	Breakout #14	Breakout #15	
Friday, Jun 10th 2016							
		8 am - 5 pm	Hackathon for all	Hackathon Ideas for 2016 All-Hands Meeting			
		8 am - 2 pm	ACME Review for Council + GLs	ACME 2016 Review guidance - agenda - criteria.pdf			

Invited Talks

- Invited Science Talks - Plenary, Wednesday June 8th, 2016, 10 am to 2 pm
    - Initial Results from Fully Coupled High-Resolution ACME V0.1, Julie McClean, David C. Bader, Mark Taylor, Mathew Maltrud, Milena Veneziani, Qi Tang, Jack Ritchie, Marcia Branstetter, Kate Evans, Salil Mahajan
    - Ocean Cavities Below Ice Shelves, Mark Petersen, Xylar Asay-Davis, Douglas Jacobsen, Jeremy Fyke, Matthew Hoffman, Adrian Turner, Jon Wolfe, Stephen Price
    - Evaluating monsoon circulations in ACME v1 ne30 experiments, Bryce Harrop, Phil Rasch, Po-Lun Ma
    - Huge divergence in land-atmosphere carbon exchange resulting from ambiguous numerical coupling between carbon and nitrogen dynamics, Jinyun Tang, Bill Riley
    - Towards low cloud-permitting cloud superparameterization, Michael S. Pritchard, Hossein Parishani, Mathew C. Wyant, Marat Khairoutdinov, Balwinder Singh, Christopher S. Bretherton
    - Scale-aware hydrologic and biogeochemical modeling for the Amazon and the world: model enhancement, multi-scale strategies and dataset generation, Chaopeng Shen, William J. Riley and John M. Melack
    - Ocean biogeochemistry in the Earth system modeling framework: applications and approach, Matthew Long,
    - An examination of systematic biases in ACME solar heating rates - comparison with multi-stream Solar-J, Michael Prather, Juno Hso, Alex Viedenbaum, Alex Nicolau
    - Incorporate realistic spectral emissivity of surfaces into the CESM and the influence on simulated radiation budget, mean climate, and climate changes, Xianglei Huang
- Invited Science Talks - Atmosphere Group, Tuesday June 7th, 2016,   10:20 am to 12:20 am, Plenary Room
    - "Non-BFB test, Non-bit-for-bit solution reproducibility: a new test based on time step convergence", Hui Wan, Kai Zhang, Phil Rasch, Balwinder Singh, Xingyuan Chen, Jim Edwards
    - "High-dimensional big data exploration for model tuning and evaluation", Hui Wan, Jonas Lukasczyk, David Rogers, Phil Rasch
- Invited Science Talks - Ocean/Ice Group, Tuesday June 7th, 2016,   10:20 am to 12:20 am, Breakout Room #1
    - "A new ice sheet / ocean interaction model for Greenland Fjords using discontinuous Galerkin method" Michal A. Kopera (UCSC), Wieslaw Maslowski (NPS), Francis X. Giraldo (NPS)
    - "Reduced Framework for Screening mBGC Feedbacks: Comparison and Balance" Scott Elliott, Corinne Hartin, Susannah

Burrows, Philip Cameron-Smith, Forrest Hoffman, Shanlin Wang, Nicole Jeffery, Mark Petersen, Alex Jonko, Steve Smith, Katherine Calvin, Benjamin Bond-Lamberty, Robert Link, Nate Collier, Oliver Wingenter, Olu Ogunro, Elliot Sherman, Robert Letscher, Keith Moore, Li Xu, Lynn Russell

- Invited Science Talks - Land Group, Tuesday June 7th, 2016,   1:20 pm to 3:20 pm, Plenary Room
    - "Estimating Global Maps of Trait Distributions" Ethan Butler, University of Minnesota
    - "Developing fast implicit spin--up capabilities for CESM to study the dynamics o the ocean's nitrogen and carbon cycles" François Primea and Keith Moore, UC Irvine
    - "Hypsometric analysis improves topography-based subgrid structures for the ACME Land Model" Teklu K Tesfa and Ruby Leung
    - "Quantifying the Impacts of Parametric Uncertainty on Biogeochemistry in the ACME Land Model" Khachik Sargsyan, Daniel Ricciuto

Invited Science Talks - Plenary, Wednesday June 8th, 2016, 10 am to 2 pm

Initial Results from Fully Coupled High-Resolution ACME V0.1*, Julie McClean, David C. Bader, Mark Taylor, Mathew Maltrud, Milena Veneziani, Qi Tang, Jack Ritchie, Marcia Branstetter, Kate Evans, Salil Mahajan*

The explicit simulation of oceanic and atmospheric mesoscale phenomena with spatial scales of 10s and 100s of kilometers, respectively, are expected to enhance the prediction capability of fully coupled climate models by reproducing mesoscale air-sea interactions, eddy-mean flow interactions, and realistic mesoscale ocean mixing processes. Towards this goal, a 100-year 1850 pre-industrial control (PICNTRL) simulation and an ensemble of idealized transient simulations approximating 1970-2010 climate change, were carried out using fully coupled high-resolution ACME V0.1. This model has enhanced horizontal resolution in each of its components relative to standard coupled climate model resolution, and consists of the 1/4° Community Atmosphere Model 5 - Spectral Element (CAM5-SE) /Community Land Model 5 (CLM5), and 1/10° Parallel Ocean Program 2 (POP2)/CICE4 (sea ice model). The atmospheric model parameters used in the PICNTRL control were adjusted ("tuned") in fully coupled mode to produce an acceptably small top of the atmosphere (TOA) radiation imbalance.

The transient ensemble members were initialized from an atmospheric reanalysis-forced 0.1° POP2/CICE4 simulation configured in the same framework as the fully coupled model. This initialization approach has been used in decadal predictability studies, hence we adopted it here as our prediction time scales are multi-decadal rather than centennial. Initial conditions were selected to represent a spread in climate mode variability from the late 1960s to the late 1970s. The transients were run for 1970-2015. The transient ensemble member TOA imbalances reduced to roughly the observed present-day value during the last decade of the simulations. The simulated climate system was then assessed in terms of drift and bias, especially focusing on comparisons of present-day observations and the transient ensemble. Particularly, we examined sea surface temperature biases, the meridional ocean heat transport and overturning circulation, sea ice thickness and concentration biases, and the veracity of the simulated climate mode variability.

Ocean Cavities Below Ice Shelves, *Mark Petersen, Xylar Asay-Davis, Douglas Jacobsen, Jeremy Fyke, Matthew Hoffman, Adrian Turner, Jon Wolfe, Stephen Price*

Sub-ice shelf ocean cavities are a significant new capability in ACME. Ice shelf-ocean interactions are important to the global climate system. Warmer ocean currents may speed up ice shelf melting and retreat. At the same time, changing land ice fluxes could affect ocean temperature, salinity, and currents below ice shelves, altering Southern Ocean water mass formation.

The Ronne-Filchner and Ross ice shelves sit on top of areas of ocean, each at least the size of California. Despite this, ice shelf cavities have not been included in any fully-coupled global climate model to date because of the numerical modeling challenges and lack of observational data for validation.

This talk will summarize the ACME effort to add static ice shelf cavities, the technical challenges, and early results. The work is the result of tight collaboration between staff with expertise in ocean, land ice, and sea ice modeling, software engineering, and coupling.

Evaluating monsoon circulations in ACME v1 ne30 experiments, *Bryce Harrop, Phil Rasch, Po-Lun Ma*

The monsoon circulations are the dominant mode of seasonal variability in the tropics. Marked by its strong annual cycle in precipitation, the global monsoon system brings water to approximately half of the world's population. Despite the importance of the monsoon in the current climate, several shortcomings still exist in our understanding as well as our ability to accurately model monsoon behavior. As part of the development of the Accelerated Climate Modeling for Energy model version 1 (ACME v1), it is important to evaluate the model's ability to represent the monsoon (both globally and regionally). To evaluate the monsoon circulation within ACME v1, we compare with an older version of the model (ACME v0), another commonly used climate model (the Community Atmosphere Model), and a number of observational datasets. Several important metrics have been identified from the literature as important markers of the monsoon circulation *and these are used to quantify the evaluation of the monsoon. Globally, the monsoon simulated by ACME v1 compares well with observations, but regional biases remain.*

Huge divergence in land-atmosphere carbon exchange resulting from ambiguous numerical coupling between carbon and nitrogen dynamics*, Jinyun Tang, Bill Riley*

With the V0 ACME land model, we analyzed the land-atmosphere carbon exchange as simulated with carbon and nitrogen dynamics coupled using three legitimate but different numerical implementations of nitrogen limitation: (1) mineral nitrogen based limitation (MNL), (2) net nitrogen uptake based limitation (NUL), and (3) proportional nitrogen flux based limitation (PNL). For the 1850-2000 period, the three approaches resulted in very similar global distributions of carbon and nitrogen stocks, and many almost overlapping mass and energy fluxes. However, a strong divergence occurred in the simulated land-atmosphere carbon exchange for the 2001-2300 period under the RCP4.5 atmospheric CO_2 forcing. Quantitatively, this divergence is as large as that of the CMIP5 models by 2100 and is about ~1000 Pg C by year 2300. Detailed analysis indicates that this divergence resulted from (1) the MNL, NUL, and PNL schemes predict progressively weaker nitrogen limitation, so that the PNL scheme leads to higher nitrogen loss through aerobic and anaerobic denitrification and surface and subsurface hydrological transport and (2) the usually high carbon to nitrogen ratio. Therefore, considering that the ratios of carbon to nutrients (other than nitrogen) are often high, we expect small inconsistencies in imposing nutrient limitation would likely lead to large divergence in predicted ecosystem carbon stocks. Since the MNL scheme was used in both V0 and V1 versions of the ACME land module, we recommend next versions to use more robust numerical coupling (e.g., PNL scheme) between carbon and nutrients. A paper on this work has been submitted for review.

Towards low cloud-permitting cloud superparameterization, *Michael S. Pritchard, Hossein Parishani, Mathew C. Wyant, Marat Khairoutdinov, Balwinder Singh, Christopher S. Bretherton*

University of California, Irvine

Results are shown from a prototype “ultra-parameterized” version of the Community Atmosphere Model. In this approach, O(10k) embedded cloud resolving models (CRMs) are used within a 2-degree global climate model (i.e. a Multiscale Modeling Framework, or MMF) but with radically refined interior resolution relative to standard superparameterization — with CRM horizontal resolution approaching 250 m and vertical resolution approaching 20 m in the marine boundary layer inversion zone. Philosophically, the goal is to explicitly capture the outer scales of turbulence involved in marine boundary layer (MBL) dynamics towards a more robust treatment of global low cloud feedback in climate models. To make the approach computationally feasible, an algorithm for accelerating the mean state evolution of CRMs is implemented, as well as software engineering for enhanced parallel scalability and GPU co-processing. Pilot hindcast tests reveal a more satisfying representation of MBL vertical decoupling dynamics and surface fluxes but also an unintended consequences of chronically low liquid water concentration linked to overentrainment symptoms, inconsistent with offline LES benchmark studies. Fixing an error in how surface fluxes are transmitted to CRMs in the MMF helps recover some missing coastal cloud fraction and using CRM grids with an extreme aspect ratio (~200) helps recover much of the missing LWP in association with modified turbulent kinetic energy statistics. Overall this highlights emerging issues and potential tuning strategies at a previously unencountered frontier within the grey zone of quasi-resolved turbulence for multi-scale climate modeling.

Scale-aware hydrologic and biogeochemical modeling for the Amazon and the world: model enhancement, multi-scale strategies and dataset generation, *Chaopeng Shen, William J. Riley and John M. Melack*

Civil and Environmental Engineering, Pennsylvania State University
Earth Sciences Division, Lawrence Berkeley National Laboratory
Earth Research Institute, University California, Santa Barbara, CA

Modeling hydrology and biogeochemistry faces several prominent challenges including insufficient subsurface flow representation, hydrologic and coupled biogeochemical scaling issue and lack of high quality verification datasets. Our project addresses these issues with a rich set of activities which also target generic improvements in hydrologic modeling in future Earth System modeling, especially in data-poor regions. We have made progress in (a) model improvement: we implemented a Global Process-based Adaptive Watershed Simulator with Community Land Model, (PAWS+CLM4.5) package with Fortran-native reflection capabilities to enable detailed, process-based hydrologic modeling in the world and convenient modeling coupling; (b) multi-scale methods: we investigated several scaling methods including moment matching, reduced-order modeling and soil-moisture-fractal-based scaling, and are testing a perturbed prototype scaling method which seems promising; (c) channel-land interactions: we created data extraction algorithm for physically-based channel modeling, and examined the influence of channel processes on simulated water and carbon fluxes and states; (d) Amazon water budgets: we modeled hydrology in several basins in the Amazon, which highlighted the importance of groundwater flow in streamflow and evapotranspiration (ET) seasonality; and (e) production of “hydrologic-model-free” verification data using satellite products, including a GRACE-assisted-Budyko-curve global ET product and a GRACE-based streamflow change estimate (we focus on GRACE as it is not *sensitive to the heavy canopy in the Amazon, unlike MODIS and SMAP). These activities have resulted in a list of publications and will serve to broaden the capabilities of the Earth System models.*

Ocean biogeochemistry in the Earth system modeling framework: applications and approach, *Mat thew Long,*

Climate and Global Dynamics Laboratory, National Center for Atmospheric Research

Marine biogeochemical cycles play a fundamental role regulating climate, most directly through impacts on atmospheric carbon dioxide. This has motivated the development of ocean biogeochemistry modules as components of Earth system models, primarily for the purpose of simulating changes in ocean sinks for carbon dioxide under future emissions scenarios. These models, however, can be applied to a range of other interesting problems related to marine ecology and biogeochemistry. In this talk, I provide a brief overview of some research questions in ocean biogeochemistry and ecology that I find interesting. I then describe our efforts to develop the Marine Biogeochemistry Library (MARBL), which is a modular implementation of ocean biogeochemistry that aims to be flexible and capable of operating within different physical frameworks---thereby enabling research across a broad array of questions.

An examination of systematic biases in ACME solar heating rates - comparison with multi-stream Solar-J, *Michael Prather, Juno Hso, Alex Viedenbaum, Alex Nicolau*

University of California, Irvine

As part of the development of a combined photolysis-heating module for DOE's ACME, we have taken the better-resolved photolysis code (Cloud-J, < 778 nm) and merged it with the RRTMG bins longward of 778 nm. For clear-sky calculations, the results are similar as expected, but for cirrus and stratus decks the 2-stream models in RRTMG produce significant biases that vary as a function of solar zenith angle and cloud optical depth when compared with the 8-stream Solar-J model. This is expected, but the size is significant, and may affect the mean meteorology. We present comparisons of the different options for solar heating codes used in CESM and ACME with those from the newly developed Solar-J.

Incorporate realistic spectral emissivity of surfaces into the CESM and the influence on simulated radiation budget, mean climate, and climate changes, *Xianglei Huang*

University of Michigan

The actual surface emissivity is spectrally dependent, for both oceans and lands. Like many state-of-the-art GCMs, the atmospheric radiation scheme in the CESM still assumes the surface being blackbody. A few recent studies showed that the surface spectral emissivity could have impact on the simulated radiation budget and climate, which motivated this study. First, we developed a global surface spectral emissivity dataset suitable for the GCM and NWP models. The dataset is based on the first-principle calculation for the far-IR. It is anchored on MODIS surface emissivity retrievals for the mid-IR and validated against IASI retrieved surface spectral emissivity. Using LBLRTM, we also carry out a benchmark study to understand the errors in the RRTMG_LW scheme when surface spectral emissivity is included.

We implement this dataset into the CESM and modify code to ensure consistency between land module and atmosphere module of the CESM. Comparing to the standard CESM, the slab-ocean run shows a change of 1.9 Wm-2 for the global-mean TOA net radiative flux (downward positive). The atmospheric column net radiativing cooling changes by -0.6 Wm-2. The changes have distinct spatial patterns. The results from 20-year fully coupled CESM run show similar but generally smaller changes than the slab-ocean run. The impact on simulated precipitation and surface temperature will be also discussed.

Invited Science Talks - Atmosphere Group, Tuesday June 7th, 2016, 10:20 am to 12:20 am, Plenary Room

"Non-BFB test, Non-bit-for-bit solution reproducibility: a new test based on time step convergence", Hui Wan, Kai Zhang, Phil Rasch, Balwinder Singh, Xingyuan Chen, Jim Edwards

An important category of testing method is currently missing in the ACME test suite: tests that determine whether non-bit-for-bit result changes are climate changing or not. We have developed a new method to test the solution reproducibility using the concept of time step convergence (TSC). The basic idea is that when the model equations have changed or when the code is not compiled/exercised correctly, the results will not converge to the reference solutions produced by a trusted model on a trusted computing environment.

This poster introduces the new method and shows examples of test results using CAM5.3 which is very similar to the atmosphere component of the ACME V0 model. The new TSC test is objective, easy to implement, and computationally efficient. We expect that the same methodology can be used for other components of the ACME model, and would be interested in discussing this with colleagues from other groups.

"High-dimensional big data exploration for model tuning and evaluation", Hui Wan, Jonas Lukasczyk, David Rogers, Phil Rasch

Model tuning and evaluation, including uncertainty quantification exercises like the parametric uncertainty analysis, are challenging and time-consuming tasks. The many simulations and the large number of output variables result in a high-dimensional space that needs to be explored in a timely manner. The prototype of a web-based interactive ensemble viewer is presented in this poster. The new tool can substantially reduce the need for tedious scripting and facilitate the evaluation of model results by large groups of modelers. We think further development and possible incorporation of the tool in the ACME analysis tool suite will be useful to the project, and invite people to stop by and learn about the new viewer.

Invited Science Talks - Ocean/Ice Group, Tuesday June 7th, 2016,   10:20 am to 12:20 am, Breakout Room #1

"A new ice sheet / ocean interaction model for Greenland Fjords using discontinuous Galerkin method" Michal A. Kopera (UCSC), Wieslaw Maslowski (NPS), Francis X. Giraldo (NPS)

One of the key outstanding challenges in modeling of climate change and sea-level rise is the ice-sheet/ocean interaction in narrow, elongated and often geometrically complicated fjords around Greenland. The goal of the Fjord-DG (FDG) project is to build a separate, highresolution module for use in Earth System Models (ESMs) to realistically represent the fjord bathymetry and coastlines and the fine-scale processes occurring within the fjord and at the ice shelf interface, using discontinuous Galerkin (DG) methods.

FDG is currently at the first stage of development. We used NUMA (Non-hydrostatic Unified model of the Atmosphere) framework to develop the incompressible Navier-Stokes equation (INSE) solver, which will be used as a dynamical core in the fjord ocean model. We will present some preliminary results of idealized INSE test cases, and discuss further avenues of the project progress.

The key features of the FDG module will be high-order accuracy, geometrical flexibility and nonconforming adaptive mesh refinement to resolve the processes occurring near the ice-sheet/ ocean interface without introducing prohibiting computational cost. The non-hydrostatic model will account for the stationary ice-shelf with sub-shelf ocean interaction, basal melting and subglacial meltwater influx, with boundary conditions at the surface to account for floating sea ice. The boundary conditions will be provided to the model via CPL7 coupler to emulate the integration with ESM.

FDG will be tested initially on Sermilik Fjord using real bathymetry, boundary and initial conditions, and evaluated against observations and other model results for this fjord. The overarching goal of the project is to be able to resolve the ice-sheet/ocean interactions around the entire Greenland's coast and two-way couple with climate models like ACME.

"Reduced Framework for Screening mBGC Feedbacks: Comparison and Balance" Scott Elliott, Corinne Hartin, Susannah Burrows, Philip Cameron-Smith, Forrest Hoffman, Shanlin Wang, Nicole Jeffery, Mark Petersen, Alex Jonko, Steve Smith, Katherine Calvin, Benjamin Bond-Lamberty, Robert Link, Nate Collier, Oliver Wingenter, Olu Ogunro, Elliot Sherman, Robert Letscher, Keith Moore, Li Xu, Lynn Russell

A compartmentalized ocean drawn from the reduced climate model HECTOR is applied to assess balance between carbonate and certain marine bioorganic feedbacks operating on upcoming environmental change. Emission doubling and business-as-usual scenarios drive near-term evolution of oceanic primary production, which is in turn projected beyond carbon drawdown to study global scale macromolecular chemistry. Biopolymer synthesis, biogenic aerosol precursors, dissolved detritus in water or sea ice and ultimately cloud-pack physical structure are all considered. Critical effects span the great majority of the planetary exterior. Baseline ocean computations are passed into pattern scaling and radiation transfer parameterizations also taken from the HECTOR code. Details for any new geochemical pathways are extracted from recent generation Earth System Models. Combined results illustrate the full variety of marine biogeochemical loops which may modulate climate change. We suggest that chronic warming amplification via atmospheric CO2 retention *should be closely contrasted with acute, basin scale alterations to cloud and ice albedo. Strong reflectivity impulses are concentrated at middle to high latitudes, coinciding with convective nutrient injections. Examples are provided from the simulation of phytoplanktonic biomacromolecular synthesis pathways and tracers, with optimization-validation conducted in automated tools derived from land modeling. Multiple teleconnections are identified from the central ocean back to the continents. There hydrology and weather extremes become relevant in the human context. Outcomes depend heavily on an introduction of physicochemical interface modules into community conception of the system. This suggests that further processes be explored –surfactants influencing sea-air transfer of generalized gases, momentum, heat and water vapor. Pelagic polymer kinetics plus colloidal and anti-colligative properties in the low temperature brine may also be of interest. Finally, results are extended backward in time toward the preindustrial. We conclude that macromolecular and surface processes must additionally be represented in the pre-forcing natural background.*

Invited Science Talks - Land Group, Tuesday June 7th, 2016, 1:20 pm to 3:20 pm, Plenary Room

"Estimating Global Maps of Trait Distributions" Ethan Butler, University of Minnesota

Plant traits have been measured at diverse sites, but there are still wide areas with minimal or non-existent measurements. This spatial limitation necessitates some method of interpolation to construct continuous trait surfaces for use in independent modeling or as input to global land surface models. Here we present two distinct methodologies to leverage a sub-set of the global database of plant traits, TRY, to create continuous maps of trait distributions for leaf nitrogen, specific leaf area, and mass based maximum photosynthesis rate. First, a categorical method, leveraging classification of the species observed in TRY and satellite estimates of their plant functional type abundances - analogous to how traits are currently assigned to PFTs in land surface models. Second, a spatial statistical method which additionally estimates how the distribution of a trait changes in accord with both climate and soil covariates. These methods produce global maps of full trait distributions at a resolution commensurate with many other observational datasets and Earth System Models and may be used as input or cross validation for such models.

"Developing fast implicit spin--up capabilities for CESM to study the dynamics o the ocean's nitrogen and carbon cycles" François Primea and Keith Moore, UC Irvine

We are investigating the impacts of non--Redfield plankton stoichiometry on the marine carbon cycle using CESM. We tested two methods to generate non--Redfield patterns (th Redfield N/P ratio of 16/1 is used i th standard CESM):

a. *We assign fixed stoichiometry to different phytoplankton functional groups. We have tested a range of stoichiometry. For the small phytoplankton we tested lower P quotas (higher N/P ratios). For the diatoms we tested higher P quotas (lower N/ ratios).*
b. *We assign the P quotas dynamically in the model as a function of ambient phosphate concentration following the empirical formulation of Galbraith and Martiny, (2014)*

We are evaluating the different formulations by comparing the simulations to field observations o [PO3 an N = [NO3]--16[PO4]. The model evaluation is still ongoing, but is showing promising results, which we will present along with comparisons to recent inverse model results.

We will also present an update on the development of the fast implicit biogeochemical tracer solver and our plan for using the solver to evaluate the impacts of non--Redfield stoichiometry on the oxygen--, phosphorous--, nitrogen--, and carbon--cycle dynamics of the ocean.

"Hypsometric analysis improves topography-based subgrid structures for the ACME Land Model" Teklu K Tesfa and Ruby Leung

Topography exerts a major control on land surface processes through its influence on atmospheric forcing, soil and vegetation properties, network topology and drainage area. Land surface spatial structure that captures spatial heterogeneity influenced by topography is expected to improve representation of land surface processes in land surface models. For example, land surface modeling using subbasins instead of regular grids as computational units has demonstrated improved scalability of simulated runoff and streamflow processes. Two methods (Global and Local) are applied to derive new land surface spatial structures by further dividing subbasins into subgrid units based on topographic properties to take advantage of the emergent patterns and scaling properties of atmospheric, hydrologic, and vegetation processes in land surface models. The Global method utilizes the elevation classification scheme employed in Leung and Ghan (1995; 1998) combined with classifications of topographic slope and aspect to discretize each subbasin into multiple subgrid units. While, in the Local method, each subbasin is divided into multiple subgrid units using elevation classes derived based on hypsometric characteristics combined with classes of topographic aspect. In this study, the relative merits of using hypsometric characteristics in deriving topography-based subgrid structures are evaluated over the topographically contrasting regions of the Northwestern United States. Results highlight the relative advantages of the Local method over the Global method in capturing topographic heterogeneity and spatial patterns of atmospheric forcing and land cover.

"Quantifying the Impacts of Parametric Uncertainty on Biogeochemistry in the ACME Land Model" Khachik Sargsyan, Daniel Ricciuto

A surrogate construction is a routine approach for highly expensive models enabling studies that otherwise require an infeasible number of model evaluations. Polynomial chaos machinery is a convenient tool for representing uncertain parametric inputs, propagating them through a model of interest, as well as for surrogate construction. However, large number of input parameters pose significant challenges. We develop advanced UQ and machine learning methods for construction of high-dimensional model surrogates. In particular, this poster will highlight Weighted Iterative Bayesian Compressed Sensing algorithm that enables efficient surrogate construction and uncertainty decomposition. We applied the technique to the ACME Land Model, focusing on biogeochemistry, for several output QoIs at nearly 100 FLUXNET sites covering multiple plant functional types and climates, varying 65 input parameters over broad ranges of possible values.