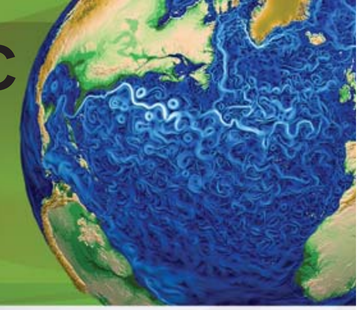
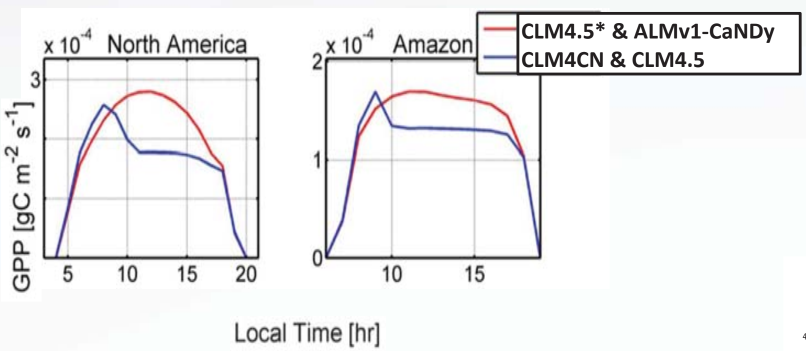
R: ALMv1-CaNDy: A Multi-Nutrient BGC Representation for ALMv1

W.J. Riley, Q. Zhu, J.Y. Tang
Lawrence Berkeley National Laboratory

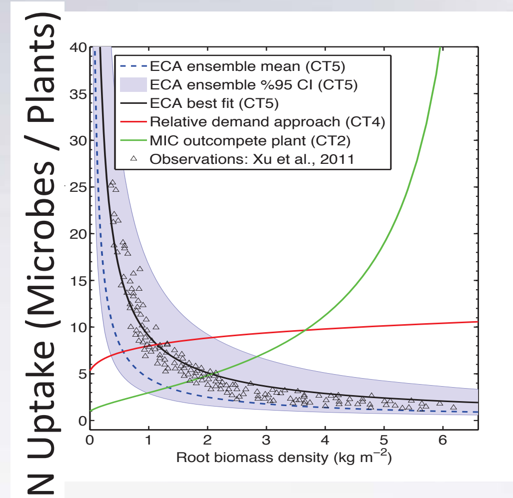


ALMv1-CaNDy

- Based on Equilibrium Chemistry Approximation
- Multiple time scales with different dominant processes are represented
- Relevant observations being integrated in ILAMB
- Poster reviews several ALM publications on this topic over the past year

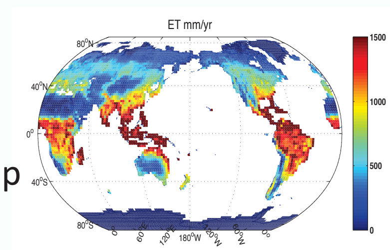


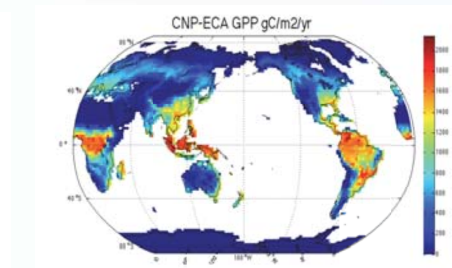
- In ALMv0, CLM4CN, and CLM4.5
  - GPP is predicted to have an unrealistic dip in the diurnal cycle
- Problem has been rectified in ALMv1-CaNDy
- Motivated our integration of root and leaf traits



- **The ACME BGC Experiment is motivated by the inclusion of Nitrogen and Phosphorus constraints on terrestrial C cycling**
- **We show here that the ECA approach quantitatively and qualitatively matches the ^{15}N observations**

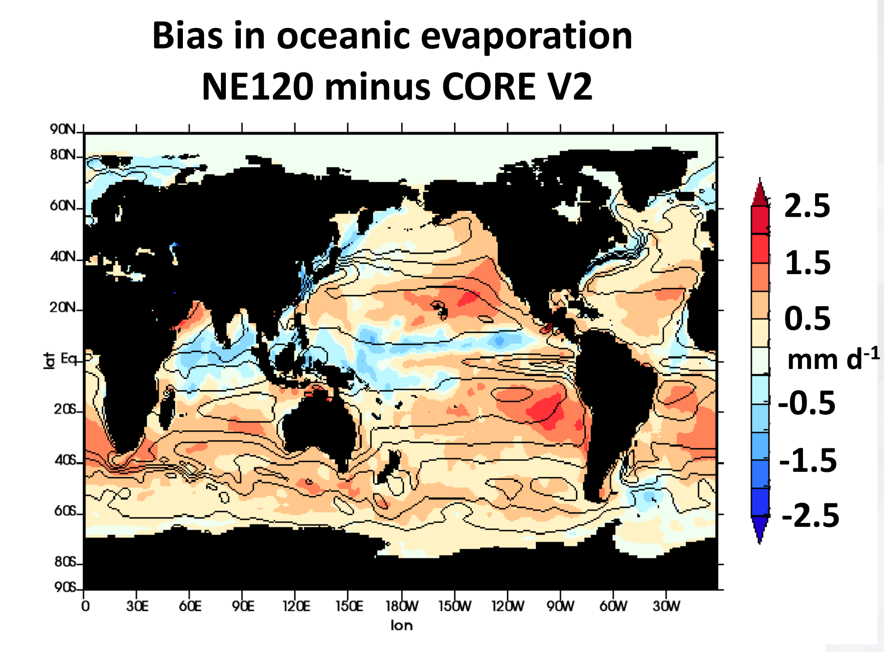
Global ALMv1-CaNDy simulations and evaluation underway





R: Issues with the Hydrologic Cycle in the ACME v0.3 Model

Christopher Terai, Peter Caldwell, Stephen Klein,
Marcia Branstetter, Qi Tang, and Philip Rasch



Objective

We evaluated the ATM water cycle in the ACME v0.3 model using AMIP simulations

We highlight major issues that the model struggles to capture

Major issues with the v0.3 model

The model drizzles too frequently

The oceanic evaporation can be biased by +40% of the mean over subtropics

We also examine precipitation biases over Eastern ITCZ and Amazon

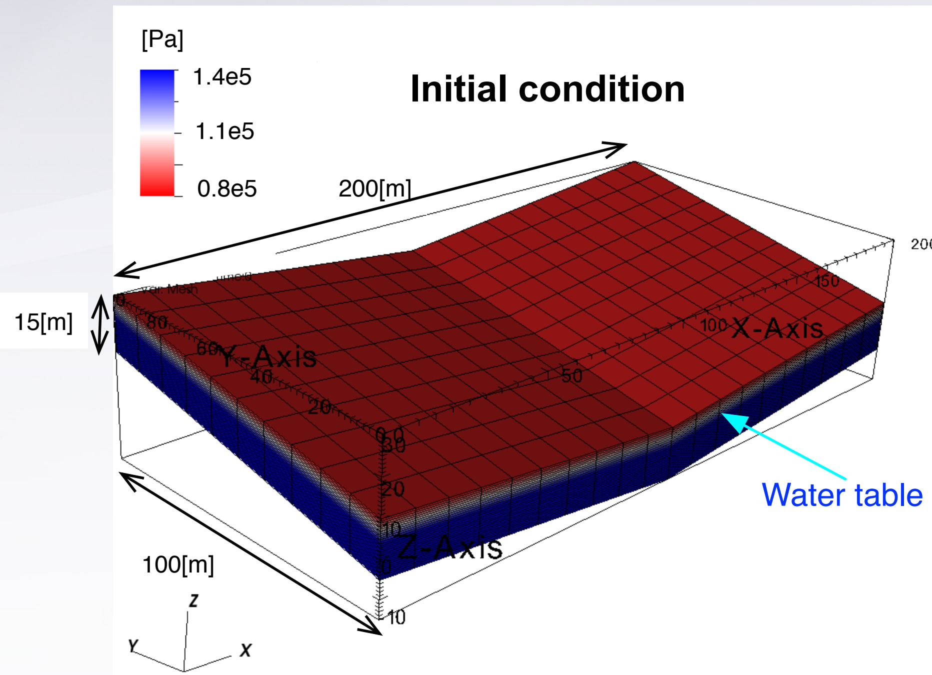
R: Biophysics development for the ALM v2

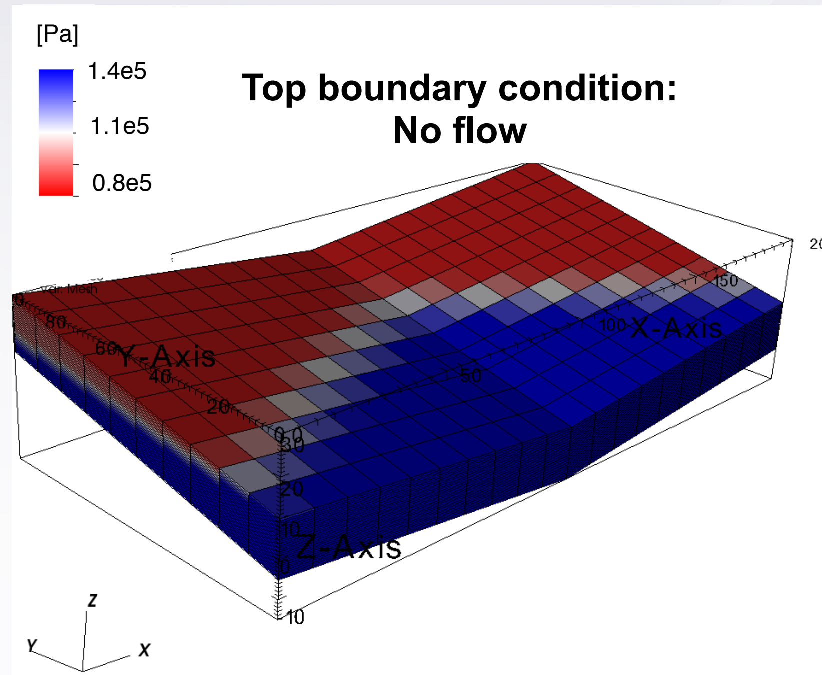
Gautam Bisht and William Riley

Objective

- Include climate-relevant biophysics that are presently omitted [Lateral subsurface flow]
- Re-use existing infrastructure [MPAS, PFLOTRAN]
- Use 3rd party solvers [PETSc]

Lateral subsurface flow simulation results on a V-channel





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For additional information, contact:
Gautam Bisht
Software Developer

Lawrence Berkeley National Laboratory
(510) 486-6246
gbisht@lbl..gov

climatemodeling.science.energy.gov/acme

POSTER #04

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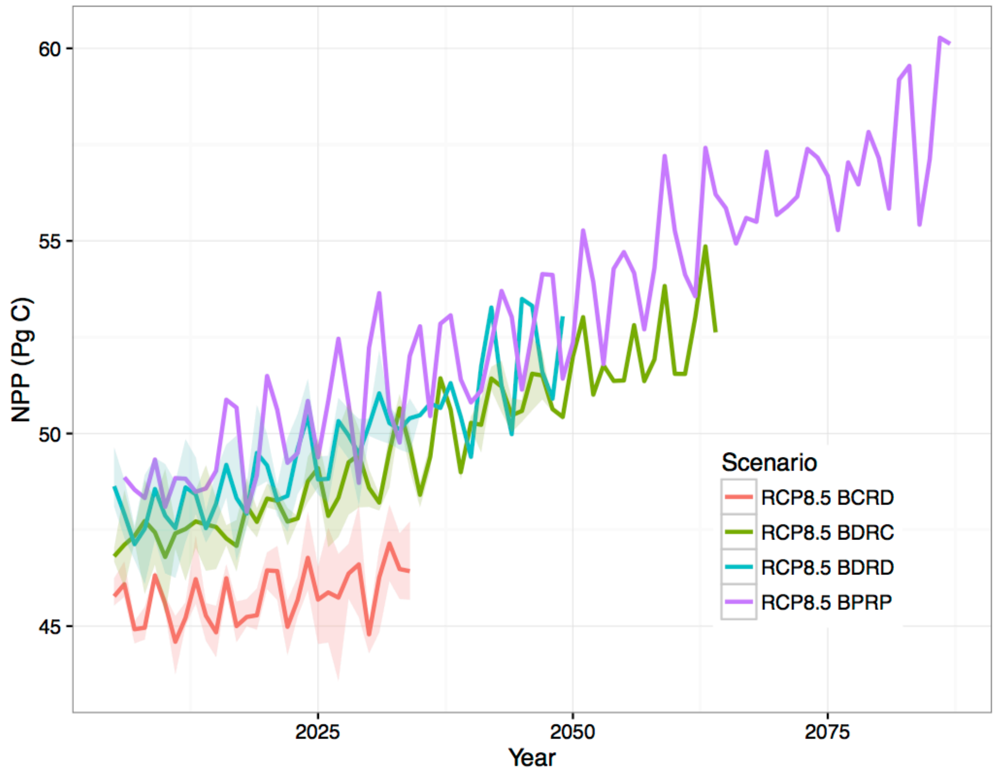
POSTER 5

Carbon–climate–human interactions

Kate Calvin, Andy Jones, Xiaoying Shi, Ben Bond-Lamberty

- What is the relative influence of CO_2 fertilization versus climate change?
- How does coupling affect future projections?
- How do these factors influence human systems?



Fully coupled iESM runs exploring CO_2 versus climate effects on net primary production (NPP) for RCP 8.5. Constant CO_2 and diagnostic (evolving) climate (BCRD); diagnostic CO_2 and fixed climate (BDRC); diagnostic CO_2 and climate (BDRD); fully prognostic (BPRP).

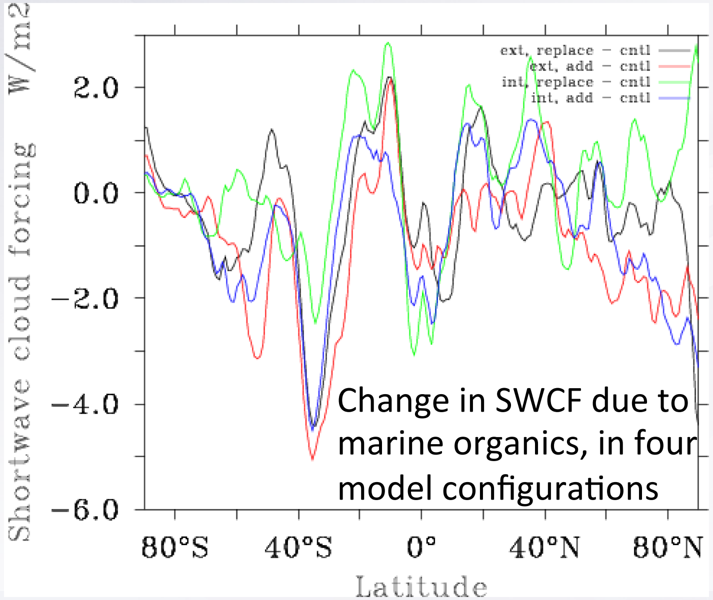
Climate impacts of marine organic aerosols

Susannah M. Burrows[1], Scott Elliott[2], Po-Lun Ma[1], Philip Cameron-Smith[3], Hailong Wang[1],Shanlin Wang[2], Balwinder Singh[1], Xiaohong Liu[4], Kai Zhang[1], Richard Easter[1], Philip J. Rasch[1]

1 – Pacific Northwest National Laboratory ; 2 – Los Alamos National Laboratory
3 – Lawrence Livermore National Laboratory ; 4 – University of Wyoming

Objective

Phytoplankton adds organic matter to sea spray aerosol, with impacts on remote marine cloud brightness and reflected shortwave radiation.



Implementation and evaluation of a new representation of marine organic matter emissions in ACME

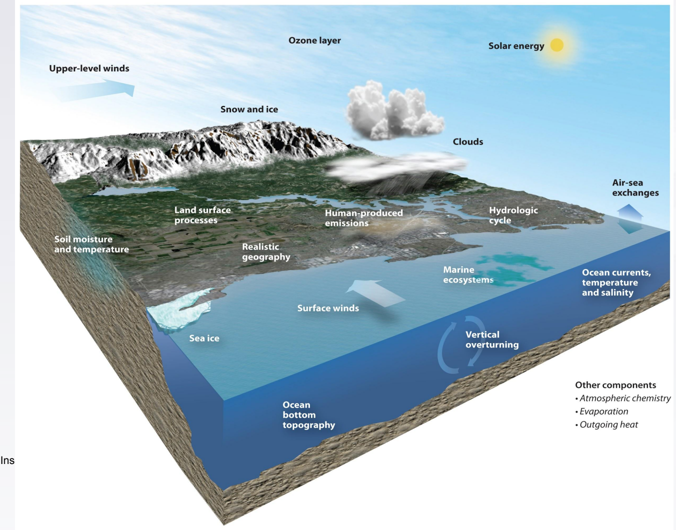
- Atmosphere portion of a new marine organic aerosol representation (Burrows et al., 2014) is fully implemented in ACME v1.
- Initial evaluation shows impacts on cloud forcing over the Southern Ocean of a few W/m^2 in DJF season, appears to agree with top-down estimates of sensitivity.

F: Unified Modeling Framework for ACME

Doug Jacobsen, Gautam Bisht, Susannah Burrows, Jim Foucar, Jeremy Fyke, Matthew Hoffman, Rob Jacob, Jayesh Krishna, Azamat Mametjanov, Andy Salinger, Balwinder Singh, Jon Wolfe

Hypothesis

The ACME model would benefit from a significant software update / refresh.



Poster Summary

This poster summarizes benefits of a software update for the ACME model. Additionally, it lays out potential plans for how such an update could be achieved.

ACME Accelerated Climate Modeling for Energy

For additional information, contact:
Doug Jacobsen
Staff Scientist
LANL
(505) 665-6251
douglasj@lanl.gov

climatemodeling.science.energy.gov/acme

U.S. DEPARTMENT OF ENERGY

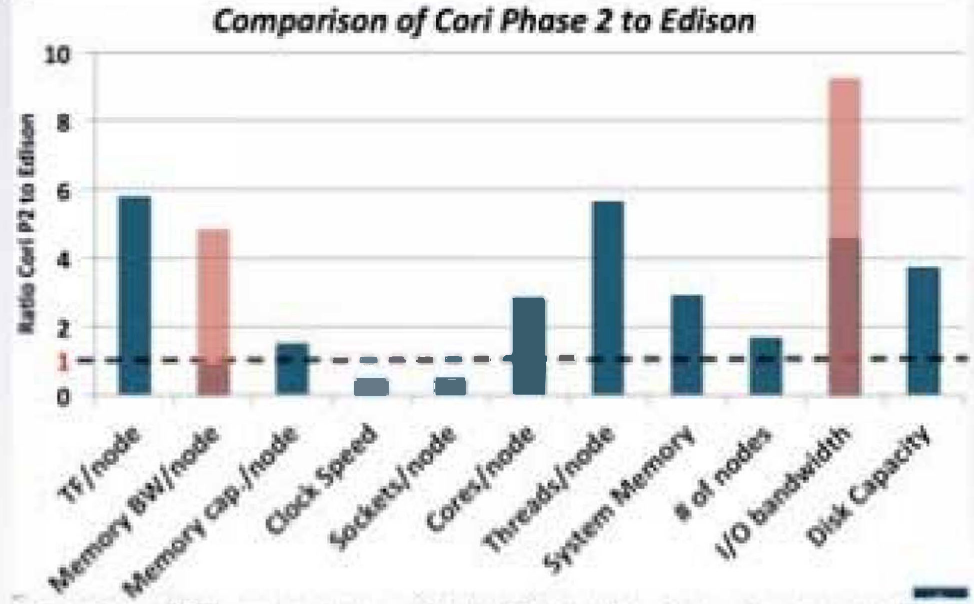
F: NERSC Exascale Science Application Program

Doug Jacobsen, Hans Johansen, Noel Keen, Mark Taylor

ACME will run on Cori "Phase 2" but …

… code changes will be needed:

threading, vectorization, and optimizing memory allocation / bandwidth to best take advantage of Cori's 30 PFLOPS!



Cori's Intel KNL nodes have ~6x FLOPS, but good performance will need to come from threads and vectorization, not "free" at ½ the clock speed

NERSC Exascale Science Application Program (NESAP)

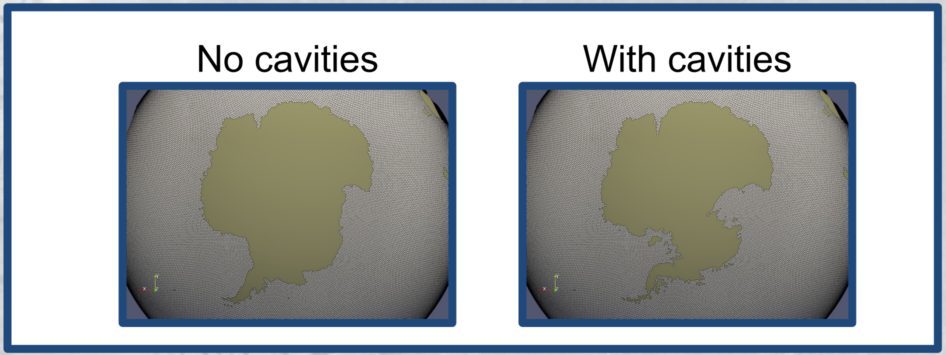
Both MPAS-O and ACME have early access to Cori P2:

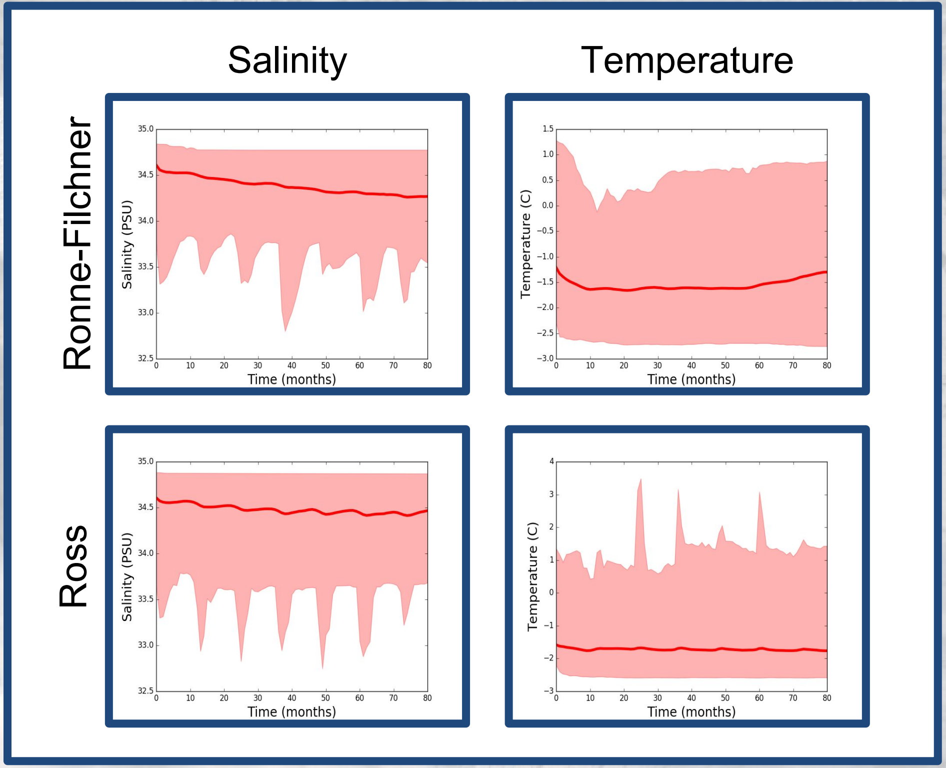
Although ACME will probably run on the KNL nodes, but it will perform poorly without some code changes and significant tuning. Through NESAP we have help and early access to NERSC, Intel, and Cray resources to help us troubleshoot (specific!) performance issues.

Coupling Ice Shelf Cavities into the ACME Model

D. Jacobsen, X. Asay-Davis, M. Petersen, A. Turner, J. Fyke

- **Ice shelf cavities have been successfully incorporated in coupled ACME**
- **Cavities permitted via:**
  - Upper ocean pressure displacement
  - Sea ice limitation
  - Flux masking/re-routing
  - Land runoff alteration
  - Ocean/ice sheet interactions via physically-based 3-equation solve for melt, salt and heat fluxes
- **Coupling demonstrated via multi-year oe60to30/ne30 B-compset simulation**
- **Initial simulation indicates:**
  - Ongoing equilibration
  - Resolution of seasonal cycle in sub-shelf cavities
  - Periodic influx of warm ocean waters
  - Connection to seasonal sea ice cycle
- **Work ongoing to:**
  - Arrive at equilibrated coupled state
  - Correct remaining duplication in snow-capping/sub-shelf fluxes to ocean
  - Begin higher-resolution cavity-enabled simulations





POSTER #09

Evaluating the ACME Land Model (ALM) with ILAMBv2

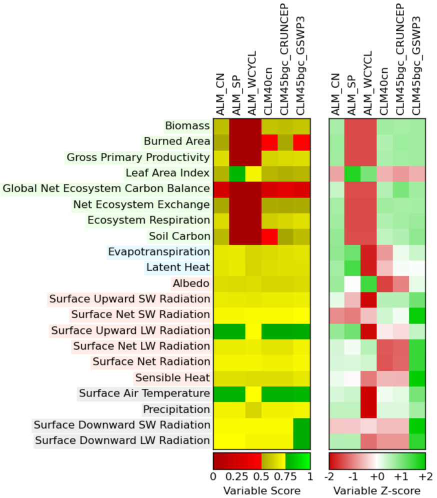
Forrest M. Hoffman, Min Xu, Nathan Collier, William J. Riley, Daniel M. Ricciuto, Xiaojuan Yang, and Peter E. Thornton

Objectives:

- Systematically assess fidelity of the ACME Land Model (ALM)
- Leverage ongoing development of the ILAMB package

Highlights:

- Over the last 6 months, we switched from ILAMBv1 (NCL) to ILAMBv2 (python).
- ILAMB provides ACME the ability to routinely evaluate land model performance through comparison of 24 variables with 60 best-available observational datasets.
- Scoring system allows developers to track evolving performance across model revisions and configurations.
- Processing scripts and ILAMB package will soon be integrated into ACME workflow.



Summary graphic depicting model performance across variables, showing absolute (left) and relative (right) performance with respect to observations. Collier et al. (2016), The ILAMB Benchmarking System, doi:10.18139/ILAMB.v002.00/1251621.

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For additional information, contact:
Forrest M. Hoffman
Senior Computational Climate Scientist
Oak Ridge National Laboratory
(865) 576-7680
forrest@climatemodeling.org

climatemodeling.science.energy.gov/acme

POSTER #10

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R:

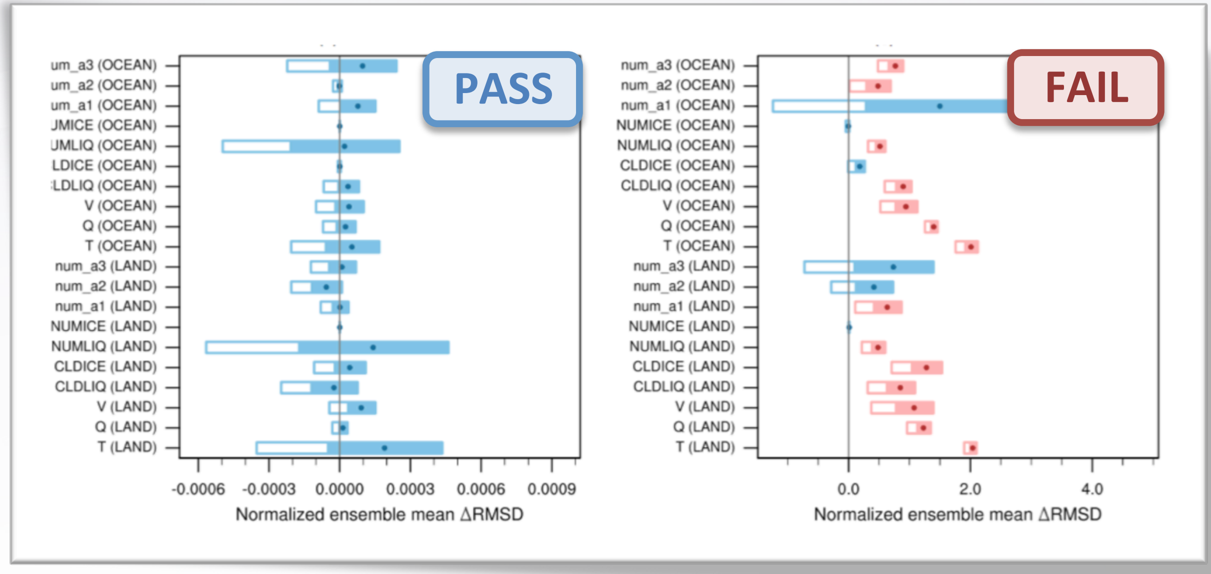
Non-BFB Solution Reproducibility:

A New Test Based on Time Step Convergence

Hui Wan, Kai Zhang, Phil Rasch, Balwinder Singh, Xingyuan Chen (PNNL), and Jim Edwards (NCAR)

Model results are no longer bit-for-bit identical to a reference run − has the climate changed as well?

Our objective and easy-to-implement test method can provide the answer in minutes!

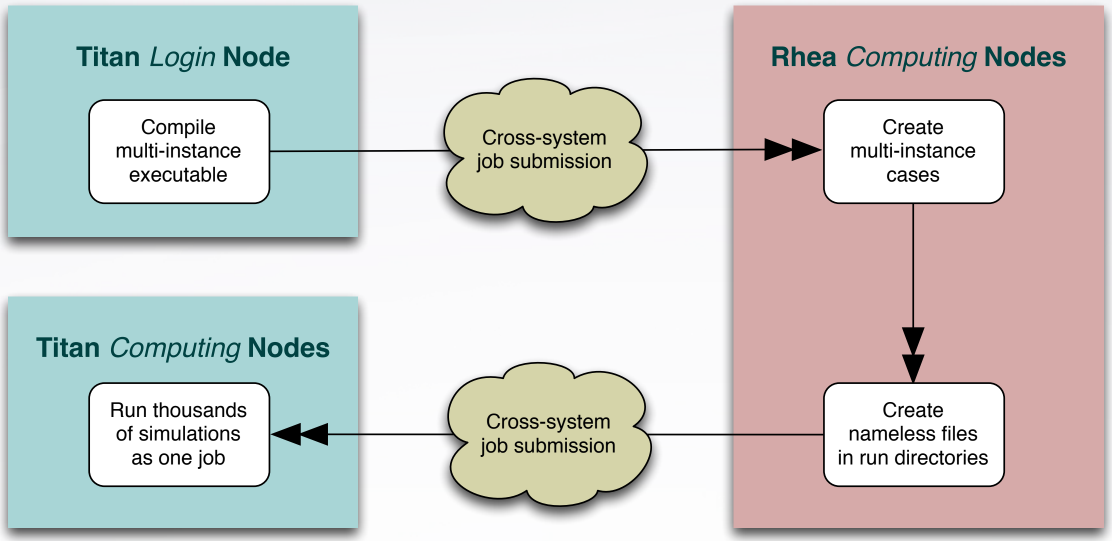


R: Ensemble Simulation Workflow for UQ

Hui Wan, Balwinder Singh, Benjamin Mayer, Phil Rasch, Kai Zhang, and Yun Qian

How we configured and finished thousands of simulations in hours

- The multi-instance capability allowed for a level of bundling invisible to PBS.
- Cross-system job submission facilitated better use of computational resources.



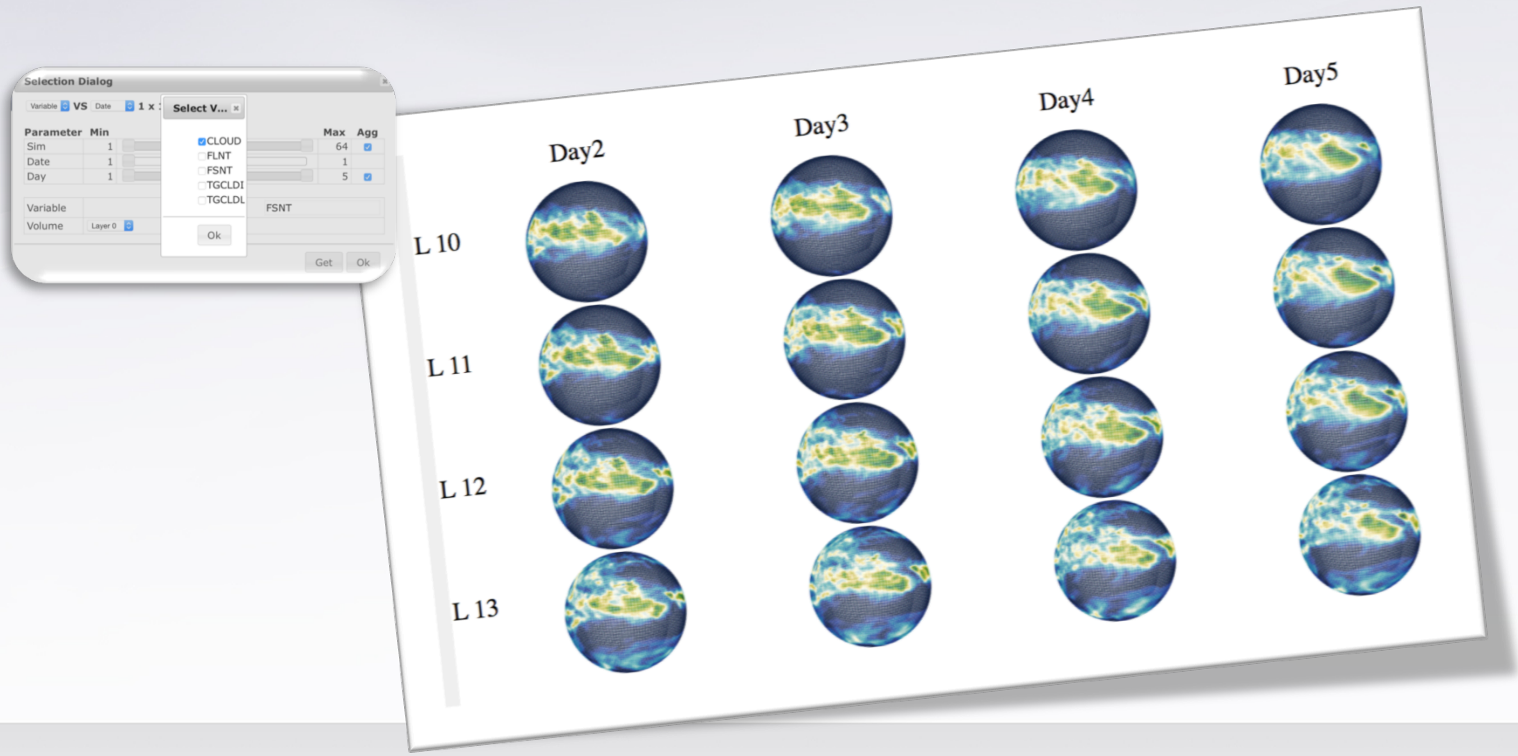
F: High-dimensional Big Data Exploration

for Model Tuning and Evaluation

Hui Wan, Jonas Lukasczyk, David Rogers, Phil Rasch, Ross Maciejewski, and Hans Hagen

If you have a lot of simulations and model variables to analyze…

Our visualization experts have a tool that could help you navigate through the high-dimensional space – and save weeks/months of scripting time!



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Contact: **Hui Wan** (Hui.Wan@pnnl.gov), **Jonas Lukasczyk** (jl@jluk.de)

POSTER #13

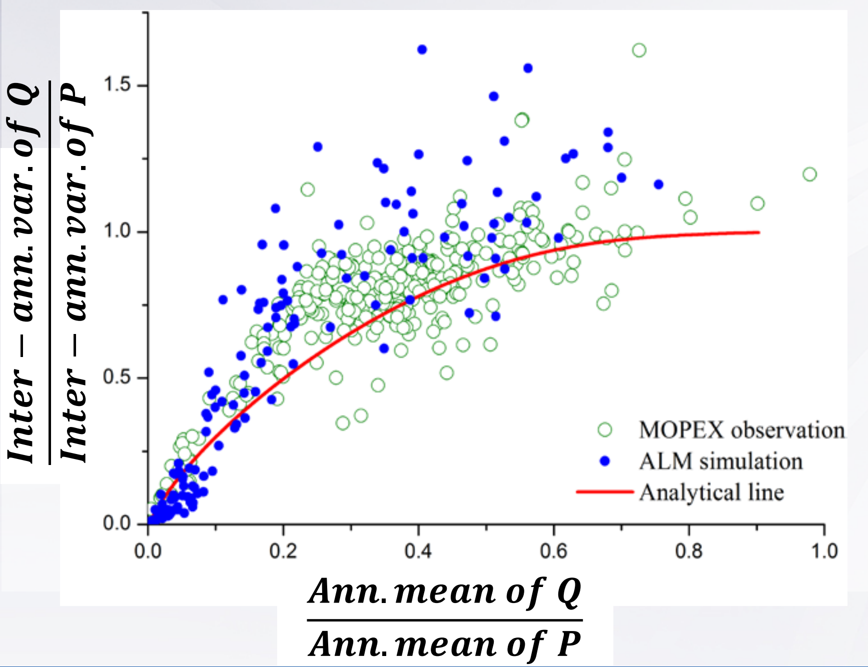
U.S. DEPARTMENT OF ENERGY

R: Hydrological Metrics for Earth System Models

Hong-Yi Li, Wei Wang, L. Ruby Leung (PNNL)

Emergent patterns from real watersheds

- Observed runoff data from over 250 natural watersheds in USA
- Emergent linkages among annual mean, inter- and intra-annual variability of runoff and floods
- Math. framework suggests underlying interconnections between different hydrological processes



Questions/implications to Earth System Modeling

- How can we identify the specific mechanisms behind these linkages?
- Can Earth system models reproduce these linkages, and the underlying process interconnections?
- Are these linkages useful metrics for informing model performance, the causes of model biases, or implications in the larger context of Earth system model performance?

For additional information, contact:
Hong-Yi Li
Research Scientist
PNNL
(509) 375-6914
Hongyi.li@pnnl.gov

R: Teleconnections of Precipitation Extremes: ACME v0

Salil Mahajan, Katherine J. Evans, Marcia L. Branstetter

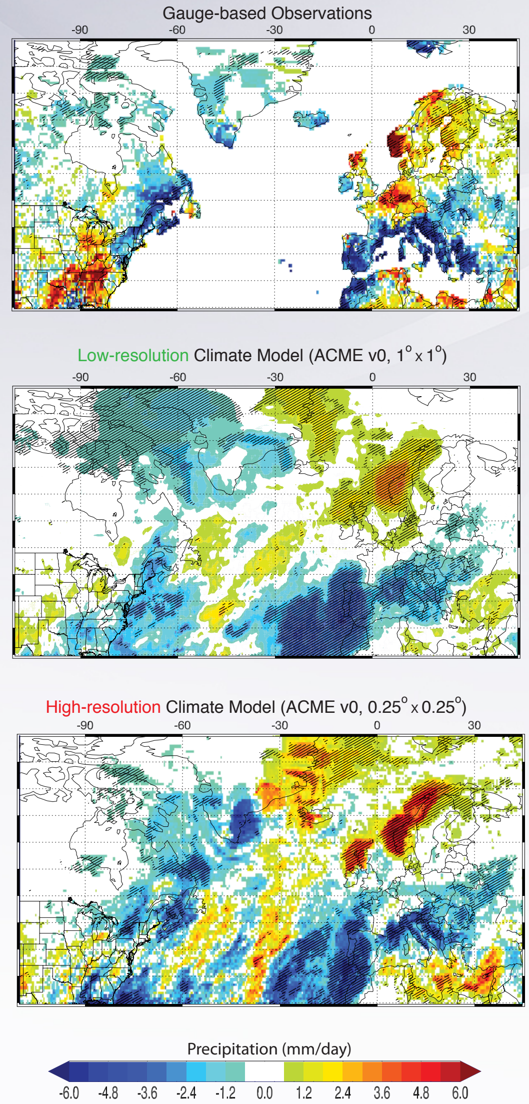
Objective:

Evaluate simulation of precipitation extremes and their tele-connections with low frequency variability (NAO) in high-resolution and low-resolution models using Generalized Extreme Value (GEV) theory

Research Highlight:

-High resolution model produces larger precipitation extremes

-High resolution model is generally better at reproducing observed tele-connection of precipitation extremes with NAO

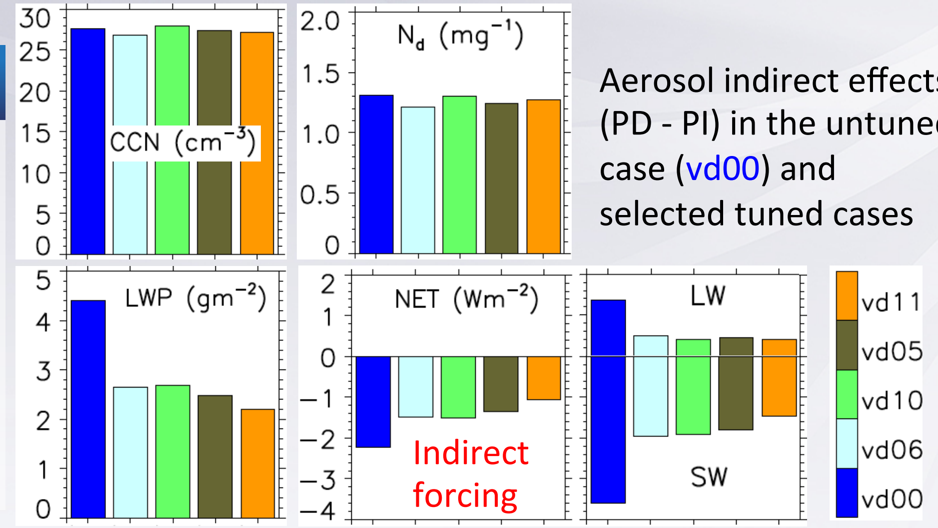


R: Spatial distributions and radiative forcing of aerosols in ACME v1

Hailong Wang, Po-Lun Ma, Richard Easter, Balwinder Singh, Kai Zhang, Susannah Burrows, Yun Qian, Steve Ghan, Phil Rasch

Objective

Several new treatments to the representations of aerosols and cloud-aerosol interactions have been implemented in the ACME v1. This study is to assess their impact on aerosol spatial distributions and radiative forcing. We also explored ways to further tune down aerosol indirect forcing.



Aerosol indirect effects (PD - PI) in the untuned case (vd00) and selected tuned cases

Improved aerosol spatial distributions and estimates of aerosol indirect forcing in ACME v1

- New SOA gas emissions datasets are produced for ACME simulations
- Aerosol spatial distributions are significantly improved due to some of the new aerosol/cloud treatments and the new emissions
- The advanced treatments and initial tuning of TOA radiation gave a strong aerosol indirect forcing (SW: -3.6; NET: -2.2 Wm^{-2}), but we managed to tune down the forcing to -1.5 and -1.1 Wm^{-2}
- The strong forcing is to due a large increase in present-day LWP, as opposed to N_d
- Further investigation is needed to understand the aerosol effects

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Contact: Hailong.Wang@pnnl.gov, 509-372-6106

POSTER #18

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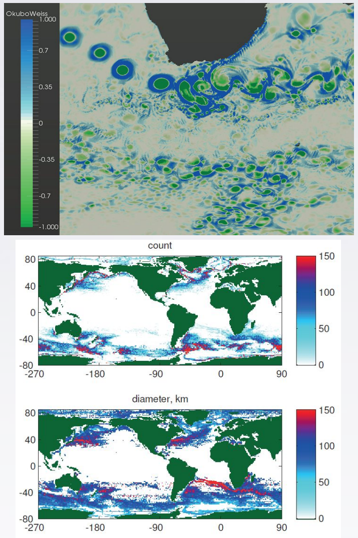
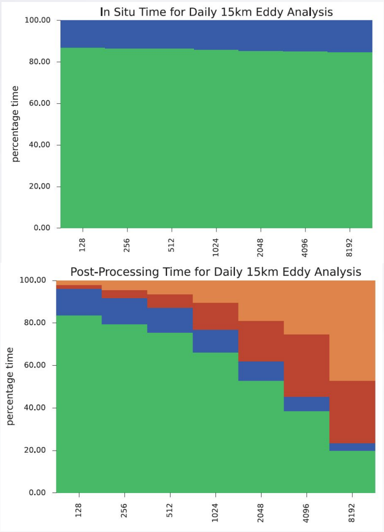
R: In Situ Eddy Analysis in MPAS Ocean

Jonathan Woodring, Mark Petersen, Andre Schmeisser, John Patchett, James Ahrens, Hans Hagen

Problem

The study of eddies in global ocean-climate models requires large-scale, high-resolution simulations. This poses a problem for temporally frequent eddy censuses due to the volume of generated data.





Solution & Impact

In response, we have developed an *in situ* eddy census analysis in MPAS-Ocean, which scales well to ten-thousand processing elements. This study demonstrates that *in situ* analysis has many advantages that pertain to climate model analysis tasks, as we move to higher spatial and temporal resolutions. We report the strong- and weak-scaling performance of the eddy analysis, along with the early science results of eddy censuses in MPAS-Ocean.

For additional information, contact:
Jonathan Woodring
Research Scientist
Los Alamos National Laboratory
(505) 695-6161
woodring@lanl.gov

Irrigation Water Use in ACME Land Model

Guoyong Leng, L. Ruby Leung, Hongyi Li, Maoyi Huang

Pacific Northwest NATIONAL LABORATORY
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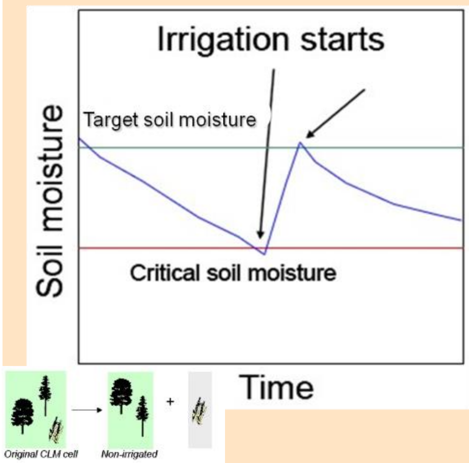
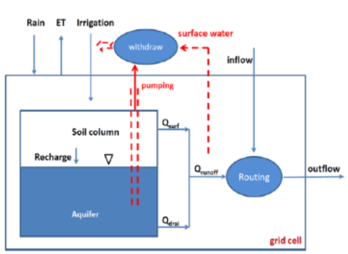
To represent irrigation water use in ALM in a comprehensive way

Irrigation Amount

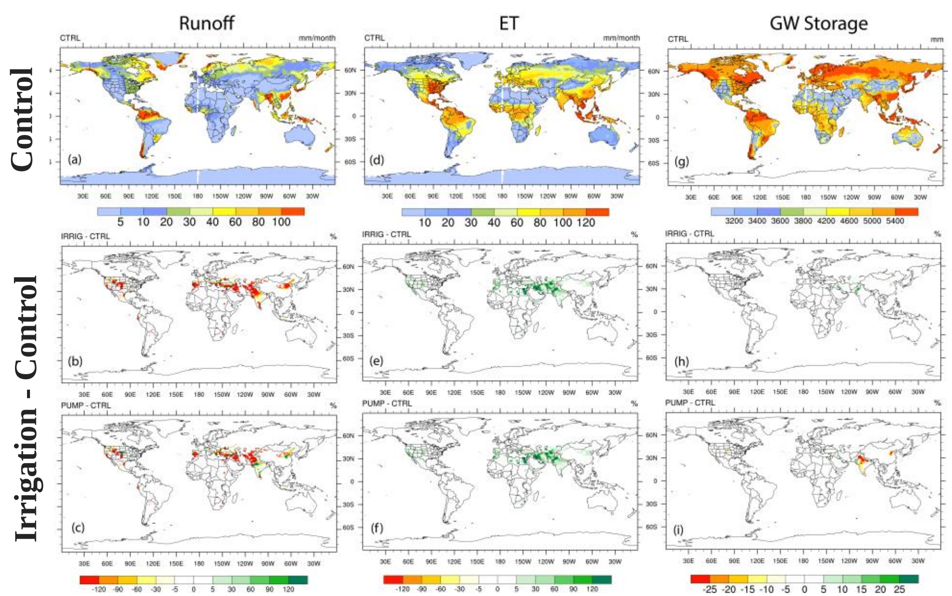


Irrigation Source

- q_{irrig} is partitioned to surface- and groundwater withdrawals (q_{wdr_srf} and q_{wdr_grd}) based on prescribed ratios.
- $q_{wdr,srf}$ is subtracted from the total runoff in CLM4
- $q_{wdr,grd}$ is added as a sink term to update the groundwater storage



Global impact of Irrigation water use



- Calibrated irrigation amount
- Surface water and groundwater abstraction
- Different irrigation methods

Irrigation Method

Sprinkler

Flood

Drip

P:

Land-Use Change in ACME

George Hurtt[1], Louise Chini[1], Ritvik Sahajpal[1], Peter Thornton[2]

[1] Department of Geographical Sciences, University of Maryland-College Park

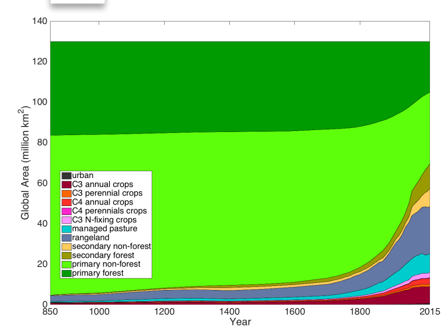
[2] Climate Change Science Institute/Environmental Sciences Division, Oak Ridge National Laboratory

UNIVERSITY OF MARYLAND

Issue: Uncertainty in land-use effects on climate

Human land-use activities have significantly altered biogeochemical and biogeophysical properties at local to planetary scales, and these alterations have influenced the environment including the Earth's climate system. Yet the *precise magnitude and character of land-use effects on climate remain uncertain, and this uncertainty in turn limits the accuracy of future projections*. The overall goal of this contribution is to develop an expanded and fully consistent treatment of land-use of in ACME.

A



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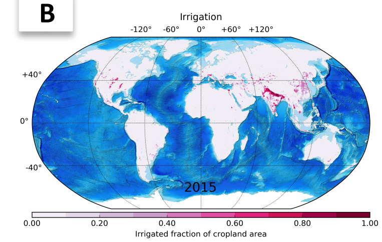

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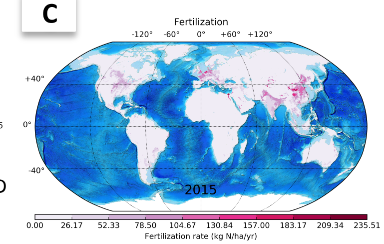


A. Time-series of global land area occupied by each land-use state from 850AD to 2015AD

B. Global irrigated fraction of cropland area

C. Global industrial fertilization rate

Solutions: Expanded and fully consistent treatment of land-use in ACME

Solution 1 (LG-144): Establish use of the new expanded land-use harmonization dataset in ACME.

For CMIP6, the new required land-use harmonization dataset is updated and contains ~50x the information used in CMIP5. This new information is at higher resolution over longer time domain, and includes additional new land-use transitions, crop types, and agriculture management information not previously available. We will develop new algorithms and code to include these new data into ACME.

Solution 2 (LG-145): Develop and implement fully consistent (1 carbon cycle) historical land-use treatment for ACME.

Global land-use history datasets are traditionally developed independently offline using best available historical information, and then used as input to global models. While efficient, this separation leads to inconsistencies, as past land-use activities may be prescribed in areas inconsistent with modeled climate and vegetation. These inconsistencies in turn lead to model errors. We will integrate the ACME land model with our land-use harmonization product to reduce these errors, thereby eliminating major sources of within model error/uncertainty.

ACME Accelerated Climate Modeling for Energy

For additional information, contact:
George Hurtt
Professor & Research Director

University of Maryland, College Park
(301) 405-8541
gchurtt@umd.edu

climatemodeling.science.energy.gov/acme

U.S. DEPARTMENT OF ENERGY

POSTER #21

R: Modeling river flow and inundation in the Amazon Basin: Uncertainties in topography, channel geometry and flow representation

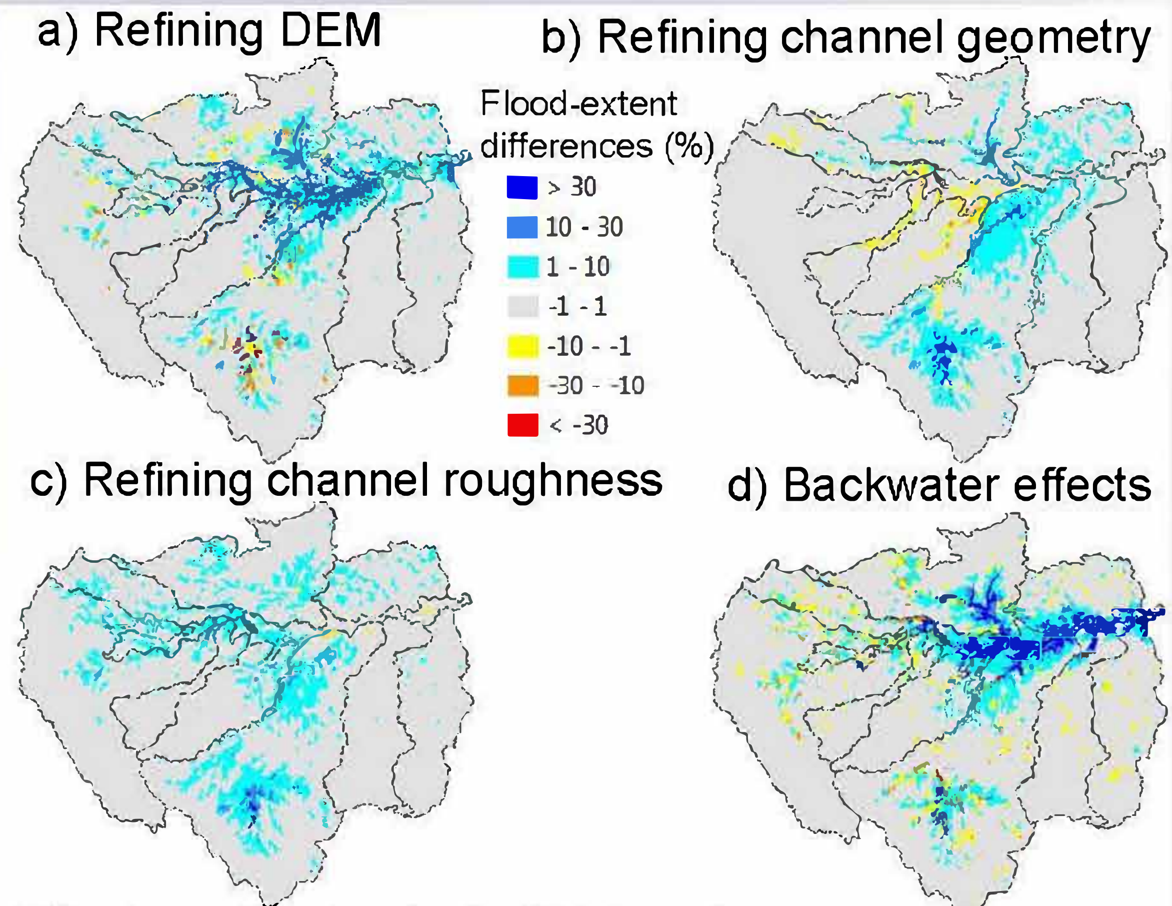
Xiangyu Luo[1], Hong-Yi Li[1], L. Ruby Leung[1], Teklu K. Tesfa[1] & Augusto C.V. Getirana[2]
1 PNNL; 2 NASA Goddard

Objective

To improve the modeling of surface hydrology in river basins with extensive inundation, especially at regional or larger scales.

Research Highlights

Refining floodplain topography, channel cross-sectional geometry, channel roughness, as well as accounting for backwater effects evidently improve the simulated surface water dynamics of the Amazon Basin.



Effects on flood extent of high-water season (averages of 13 years (1995 – 2007)). Blue colors indicate increases of flood extent.

F: New method to determine crop planting date in ALM

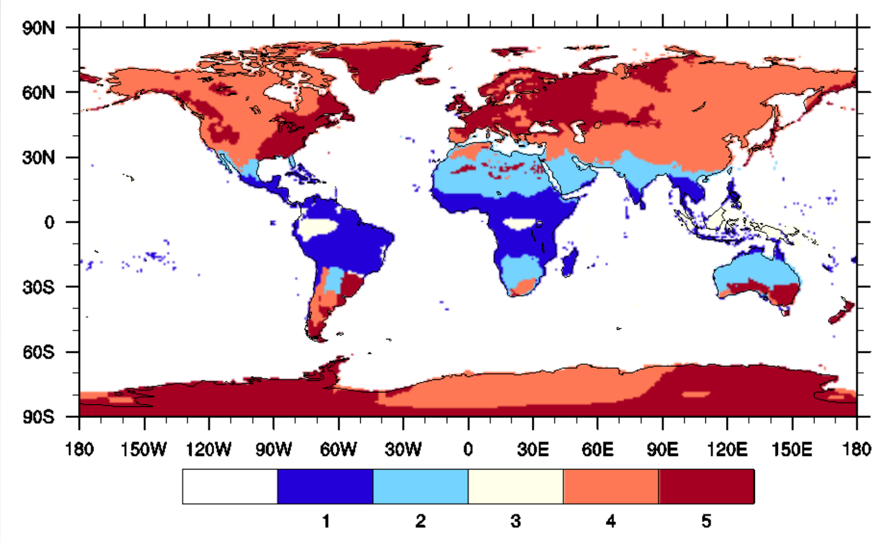
Beth Drewniak

Crop planting triggered by temperature threshold

Limits crop production to mid-latitudes and does not include other factors important for planting

Need a solution that will:

1) Function globally
2) Be flexible under climate change



Use temperature and precipitation seasonality to establish planting dates

Method (from Waha et al., 2012):

Determine seasonality of grid cell from temperature and precipitation CV (see above figure)

If temperature seasonality: temperature threshold determines plant month

If precipitation seasonality: Precipitation:PET ratio determines plant month

Advantages:

No need for external inputs, works globally, planting date can evolve with changes in local climate, and can determine potential planting date for crops currently not grown in a grid cell

ACME Accelerated Climate Modeling for Energy

For additional information, contact:

Beth Drewniak
Assistant Climate Scientist

Argonne National Laboratory
(630) 252-3732
bbye@anl.gov

climatemodeling.science.energy.gov/acme

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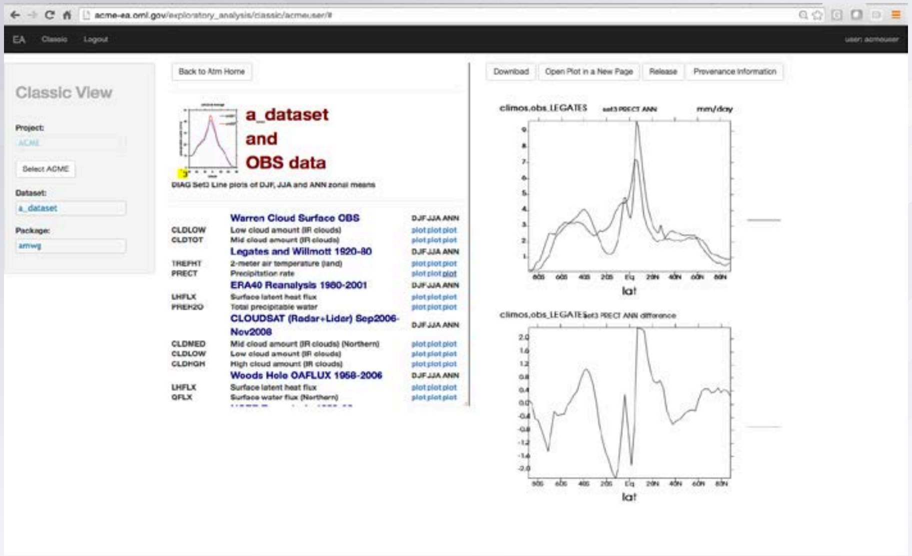
P: The ACME "Classic Viewer"

John Harney, Marcia Branstetter, Daniel Ricciuto, Ben Mayer, Kate Evans, Valentine Anantharaj (ORNL)

Issue

Sharing diagnostics plots:

The process of sharing output plots from AMWGand LMWGis currently a tedious process (e.g. emailing, USB, etc). Figures should be viewable from the web.



Solution Idea

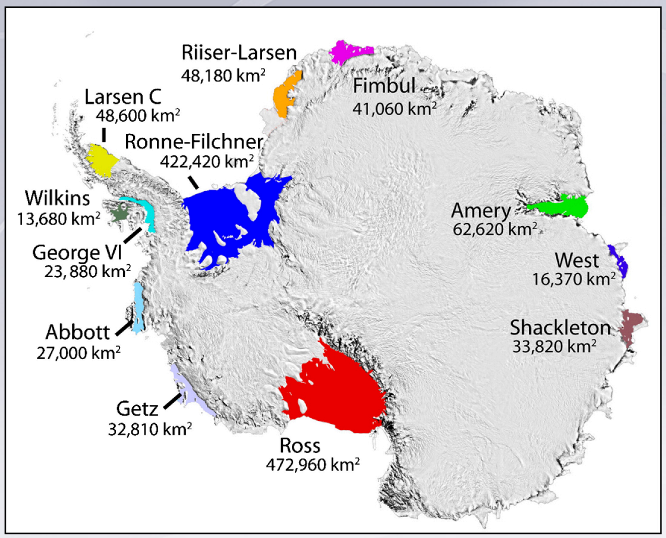
The simple classic viewer workflow makes this possible:

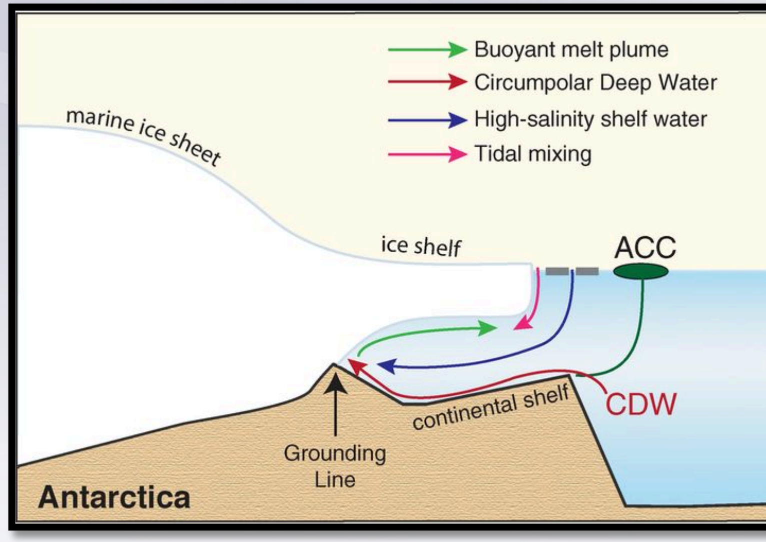
- Organize images in a simple hierarchy
- Move the plots to CADES using an easy-to-use python and batch scripts
- View and navigate through the plots in a similar manner to original AMWG
- See confluence:

https://acme-climate.atlassian.net/wiki/display/WORKFLOW/ACME+Classic+Diagnostics+Viewer+Details

R: Ocean Cavities Below Ice Shelves

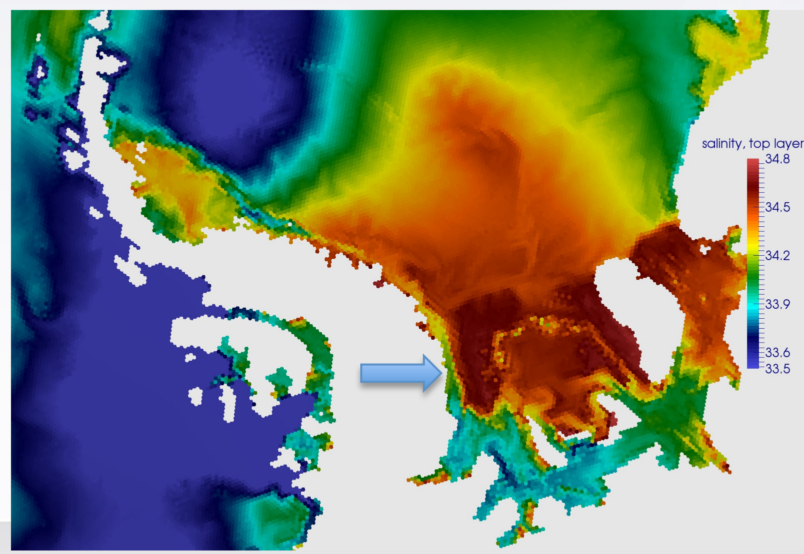
Mark Petersen, Xylar Asay-Davis, Jeremy Fyke, Douglas Jacobsen





MPAS-Ocean can now run with cavities, due to:

1. Versatile vertical grid that can tilt & expand
2. Advanced pressure gradient formulation
3. Initialization process of ice pressure/ice draft
4. Addition of land ice melt fluxes to ocean
5. Thorough testing: idealized and realistic



ACME Accelerated Climate Modeling for Energy

For additional information, contact:
Mark Petersen
Research Scientist

Los Alamos National Laboratory
(505) 500-2739
mpetersen@lanl..gov

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R: Parametric sensitivity in ACME-V1 atmosphere model revealed by short Perturbed Parameters Ensemble (PPE) simulations

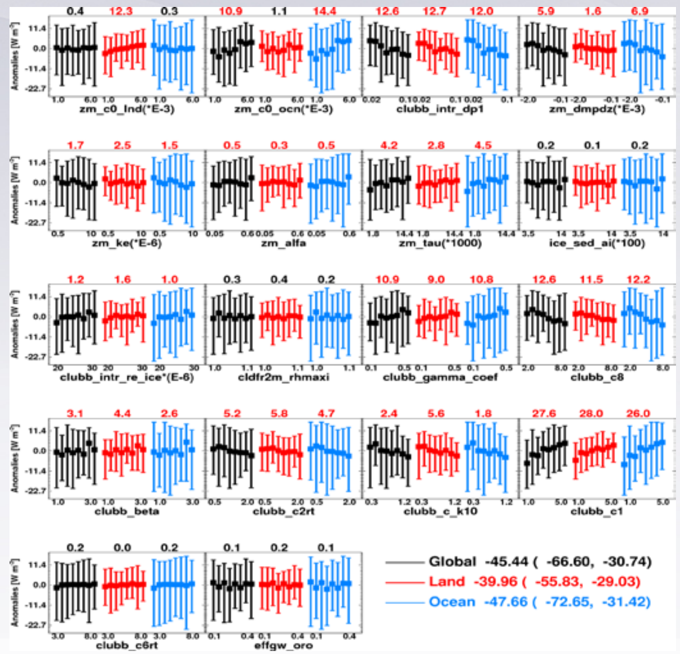
Yun Qian, Hui Wan, Phil Rasch, Kai Zhang, Po-Lun Ma, Wuyin Lin, Shaocheng Xie, Balwinder Singh, Vince Larson, Rich Neale, Andrew Gettelman, Peter Bogenschutz, Hailong Wang and Chun Zhao

Motivation

In one-at-a-time model tuning we often encounter

(1) tuning of one parameter leads to an offset of the accomplishment from the tuning of another parameter;

(2) improvement in one target variable leads to degradation of model fidelity in another target variable.



Anomalies of **SWCF** in response to 18 parameters. The numbers above each plot box represent the relative contribution (%) of each input parameter to the overall variable variations and the red indicates the contribution has 95% statistical significance.

Impact

- Identified the most influential parameters and quantified the model response to these parameters for a number of important fidelity metrics.
- Provided a more complete picture of the ACME-V1 model behavior and information on the tuning potential of different parameters, thus can help guide the tuning activities.

Accelerated Climate Modeling for Energy

For additional information, contact:
Yun Qian
Pacific Northwest National Laboratory
(509) 372-6404
yun.qian@pnnl.gov

POSTER #27

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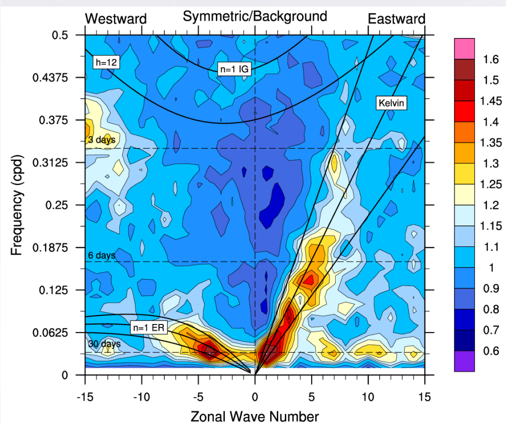
R: Perturbed Convection Parameter Experiments

Rich Neale (NCAR), Cecile Hannay (NCAR) Po-Lun Ma (PNNL)

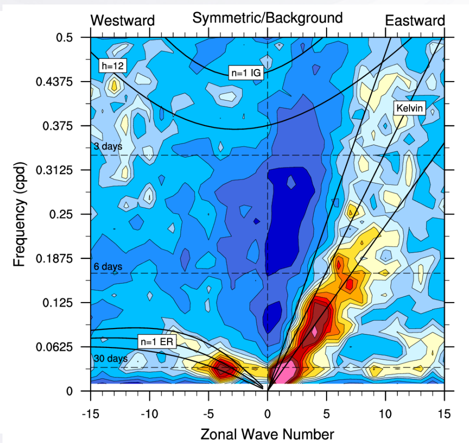
ACME Atmosphere Biases

- Significant biases persist in the tropics
  - Tropical Modes of variability
  - Amazon precipitation
- Implications for ACME science Qs
  - Water/Biogeochemical Cycles
- Role of deep convection processes?

Capeten=5

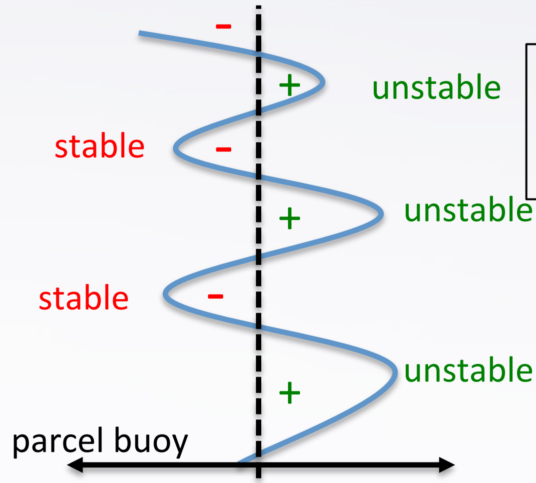


Capeten=1



Convection Parameter Sensitivities

- Non-standard Zhang-McFarlane convection parameters: parcel temperature, microphysics, momentum transport, non-constant **entrainment** and **timescale**
- Parameter related to negative buoyancy
- Ultimately restricts number of stable layers



Cape sum(+)
def: max of **5-**
new: max of **1-**

R: Simulating Marine Ice Sheet Dynamics in MPAS Land Ice

Matt Hoffman, Mauro Perego, Stephen Price,
William Lipscomb, Andy Salinger, Irina Tezaur,
Ray Tuminaro, Dan Martin, Doug Jacobsen

Objective

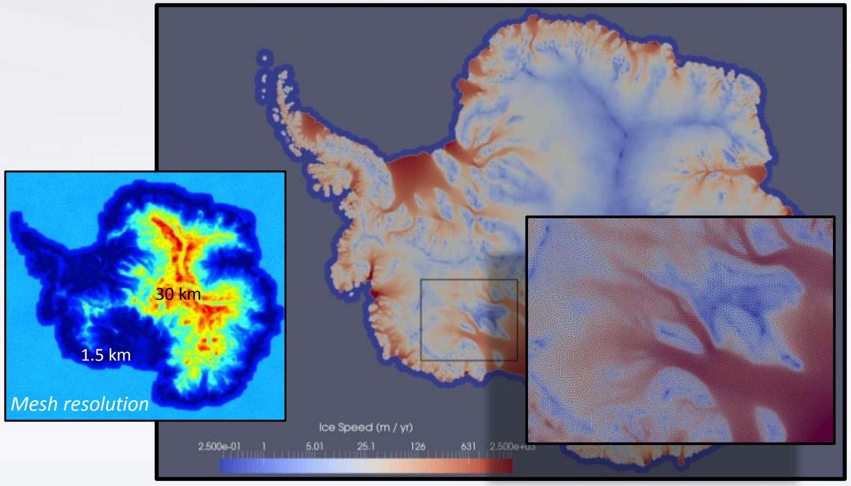
Grounding line dynamics:

- Processes there have a first-order control on ice sheet stability and associated sea level changes.
- Challenging to model accurately in ice sheet models.

Marine Ice Sheet Model Intercomparison Project for planview models (MISMIP3D)

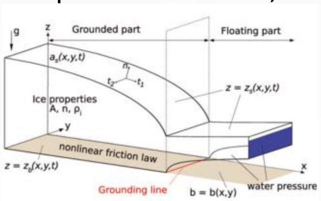
- Series of community benchmarks for grounding line dynamics and marine ice sheet modeling fidelity.
- Success here is required before simulating Antarctica.

Continuing work:
Generate variable resolution meshes of Antarctica with necessary high resolution at grounding lines.

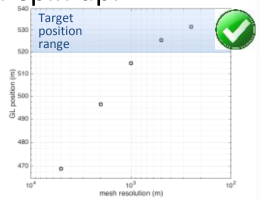


MISMIP3D Results Using MPAS Land Ice with Albany velocity solver

"Stnd" test: Starting from no ice and steady accumulation rate, grow a marine ice sheet. Study grid convergence of steady state grounding line position after 30,000 year spin up.

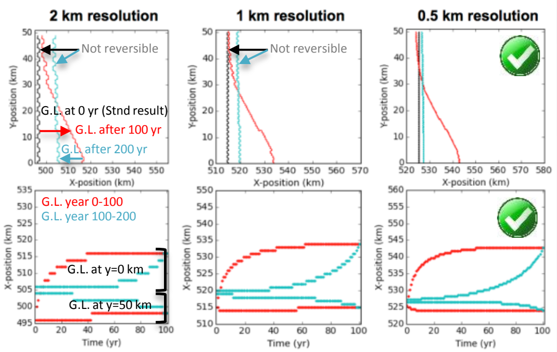


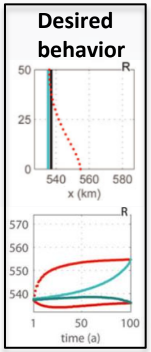
Geometry at the end of the Stnd experiment



Grid convergence. Sub-km resolution is necessary.

"P75" test: Starting from final Stnd geometry, add 'slippery' patch at middle of G.L. for 100 yr, forcing grounding line advance. Then remove slippery patch, and G.L. should return to original position after another 100 yr.





Summary: At sub-km resolution, MPAS-Land Ice passes MISMIP3D tests. Similar results at ~km resolution can be achieved with a Grounding Line Parameterization (in progress).

R: Surface wind stress biases in the Southern Ocean

Julio Bacmeister, Cécile Hannay, Po-Lun Ma

Objective

ACME (and CESM) overestimate the surface wind stress in the Southern Ocean.

We investigate the impact of orographic and frontal gravity waves (GW) on this bias.

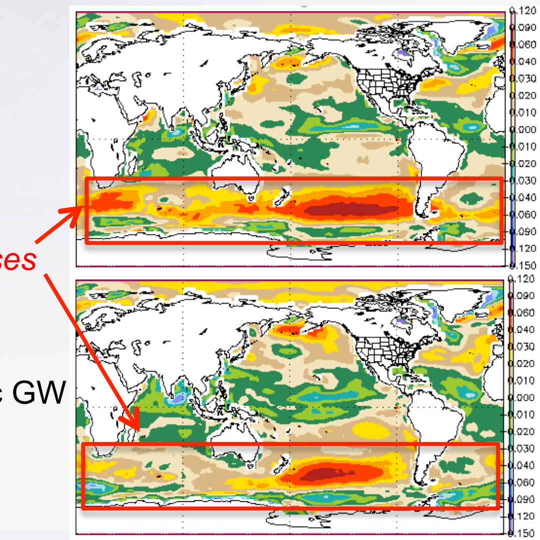
We significantly improve the wind stress bias.

Wind stress biases (compared Large-Yeager)

Control run

Improved biases

Tuning of orographic GW



Tuning knobs

taubgnd is the momentum flux launched at source level by the frontal GW scheme

effgw_oro is the efficiency of orographic GW. We adjust it in Southern Hemisphere (SH).

	taubgnd	effgw_oro
Control run	2.5e-3	0.4
taubgnd x 10	2.5e-2	0.4
effgw_oro_SH x 4	2.5e-3	0.4 (NH), 1.6 (SH)
effgw_oro_SH x 4 taubgnd x 0.4	1.0e-3	0.4 (NH), 1.6 (SH)

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For additional information, contact:
Julio Bacmeister
Research Scientist

NCAR
(303) 497 1340
juliob@ucar.edu

climatemodeling.science.energy.gov/acme

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POSTER #33

R: Hypsometric analysis improves topography-based subgrid structures for the ACME Model

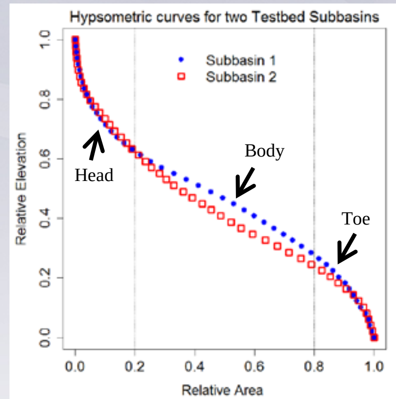
Teklu K. Tesfa and L. Ruby Leung

Objective

Explore new topography-based subgrid structures for land surface modeling and evaluate the methods with respect to their ability to capture topographic, climate, and land cover heterogeneity

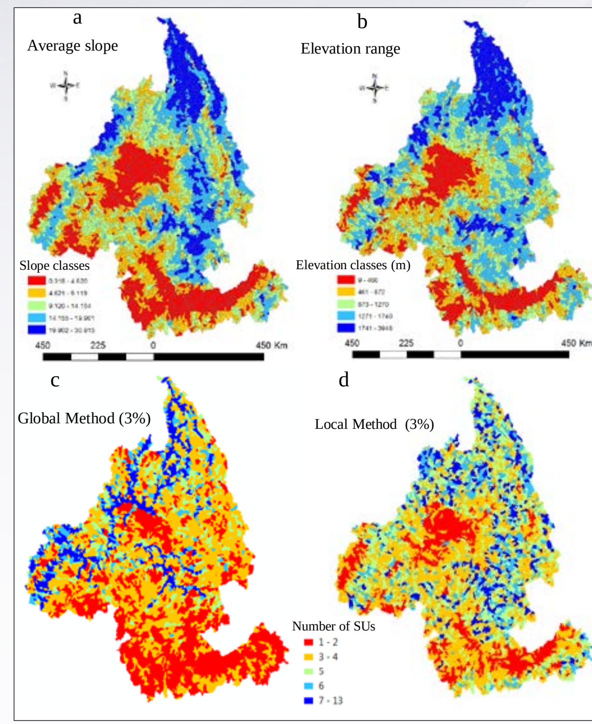
Major Findings

Taking advantage of hypsometric analysis, the Local method can capture slope variability implicitly so it improves representation of topographic, climatic, and vegetation variability with nominal increase in computational cost for improving land surface modeling



Hypsometric curves of two subbasins with extreme contrast of elevation variability discretized into three parts: head, body, and toe, as used in the Local method.

Number of elevation-based geo-located SUs per subbasin derived using the Global (c) and Local (d) methods compared against the spatial pattern of the topographic slope (a) and elevation ranges of the subbasins in the study area.



Tuning the ne30 L72 ACME V1 Atmosphere Model

Po-Lun Ma, Phil Rasch, Shaocheng Xie, Hailong Wang, Balwinder Singh, Wuyin Lin, Kai Zhang, Hui Wan, Yun Qian, Chris Golaz, Julio Bacmeister, Richard Easter, Steve Ghan, Rich Neale, Cecile Hannay, Yaga Richter, Susannah Burrows, Philip Cameron-Smith, Pete Bogenschutz, Vince Larson, Peter Caldwell, Bryce Harrop

Task Summary

- Over 250 1-yr and multi-year simulations completed in 4 months
- Tunable parameters kept within physically justifiable range
- Cocktail approach: calibrated cloud microphysics, shallow convection, turbulence, deep convection, aerosols, gravity wave drag, and turbulent mountain stress.
- Atmosphere compset delivered at the end of February with near 0 TOA energy balance
- Working with the coupled team, compset updated every month
- Model features are calibrated against observations: CERES-EBAF for shortwave and longwave cloud forcing, GPCP, TRMM, and CMORPH for precipitation, MERRA and ERA-Interim for temperature and sea level pressure, CALIPSO and Satellite-AERONET composite for aerosols, Large-Yeager dataset for surface wind stress, etc.
- A strong QBO and smaller aerosol indirect effects (from $-4W/m^2$ to $-1.07W/m^2$)
- Our ongoing effort includes merging various configurations and addressing issues associated with regional features such as precipitation over Amazon, southern ocean wind stress, etc., through parameter adjustment (short-term) and improvement of process representation (longer term).

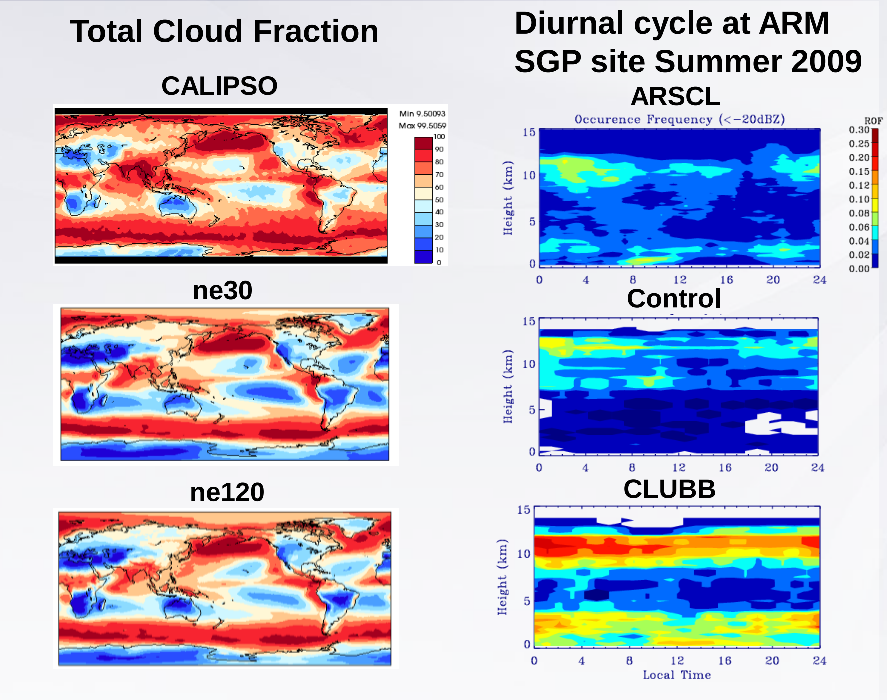
R:

Using Satellite- and Ground-based Simulators to Evaluate the ACME Simulated Clouds

Yuying Zhang[1], Shaocheng Xie[1], Wuyin Lin[2], Steve Klein[1], Marcia Branstetter[3], and Kate Evans[3]

Objective

- Implement satellite simulators (COSP) and ARM ground-based radar simulator into ACME v1 for cloud evaluation
- Examine resolution dependency in clouds explored in ACME v0.3 ne30/ne120 runs
- Examine summertime diurnal cycle of clouds at SGP using ARM observations



Evaluate cloud simulations using simulators

- The ACME v0.3 model simulated clouds are not sensitive to change of model horizontal resolution, which is different from what we see in the ACME v1 ne120L72 model.
- The control run is lack of non-precipitating low clouds. CLUBB reduces this bias but overestimates low and high clouds. Both models show difficulty to capture the diurnal phase.

ACME Accelerated Climate Modeling for Energy

For additional information, contact:
Yuying Zhang
Research Scientist

Institution or Organization
(925) 423-8505
zhang24@llnl.gov

climatemodeling.science.energy.gov/acme

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POSTER #36

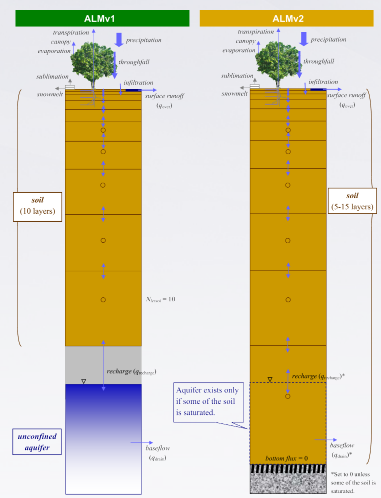
F: Including variable soil thickness in ALMv2

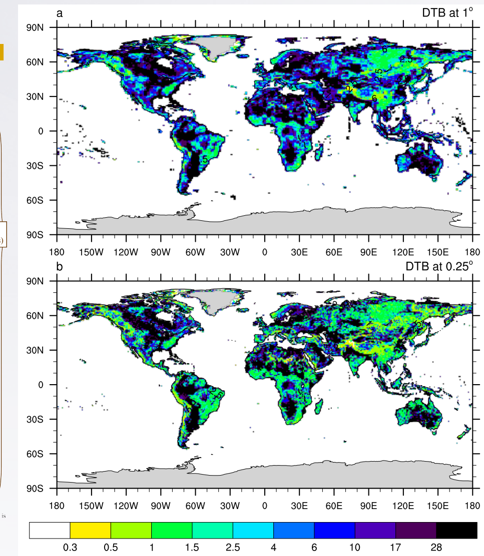
Michael A. Brunke, Patrick Broxton,
Pieter Hazenberg, and Xubin Zeng

ARIZONA

Problem

- ACME's soil thickness is a constant with a poorly-defined aquifer below.
- We are working to implement variable soil thickness into ALM based on global DTB estimate.





The advantages of implementing variable soil thickness in ALM

- Variability of soil thickness in complex terrain is better represented at 0.25^{o} resolution.
    - Even better represented with elevation-based sub-grid tiles.
- This will facilitate the inclusion of horizontal water movement modeling.

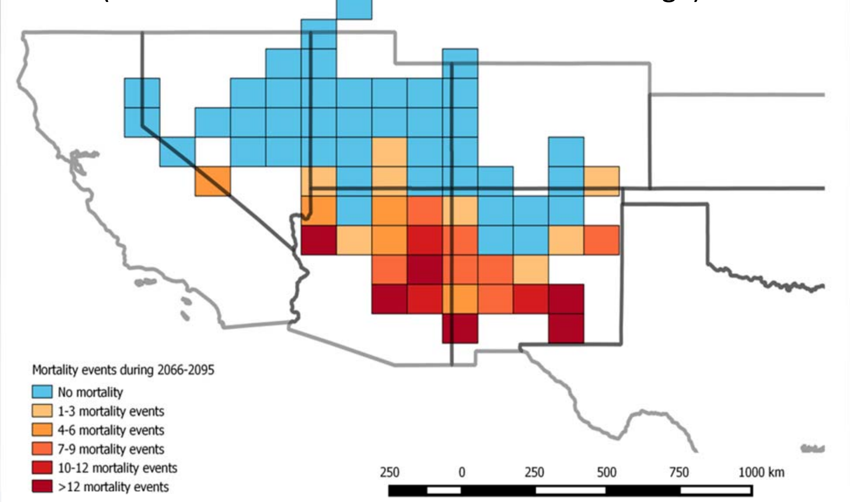
R: Toward a better prediction of water stress on vegetation dynamics in ALM

Chonggang Xu, Bradley Christoffersen, Daniel Johnson, Wei Liang, Sanna Sevanto, Rosie Fisher, Henry Adams, Nate McDowell
Los Alamos National Laboratory

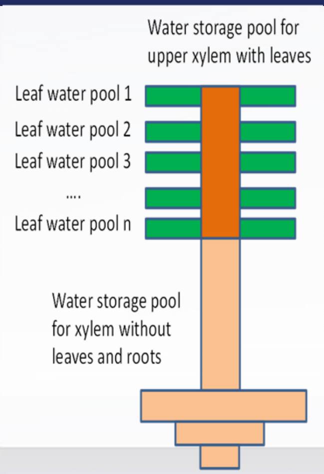
Objective

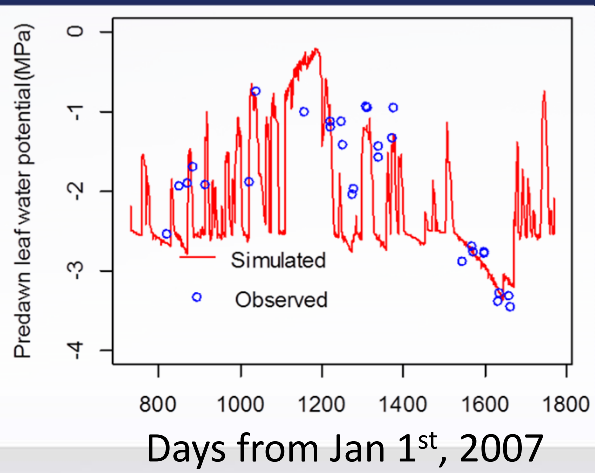
We are developing process-based plant hydrodynamic models to predict the impact of water stress on vegetation growth and tree mortality, for a better prediction of terrestrial carbon and water cycles in ACME.

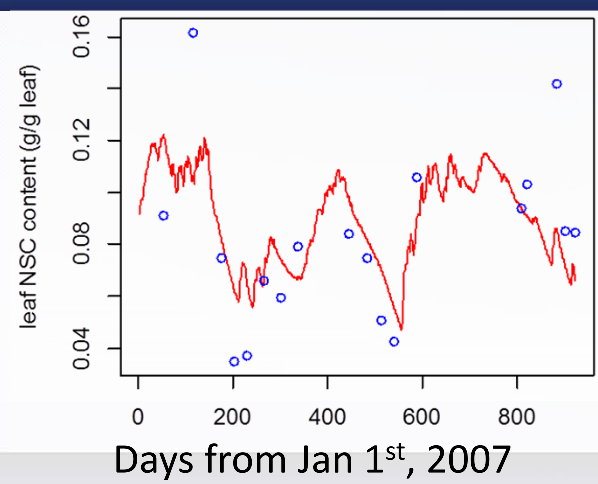
Predictions of piñon pine mortality events using our hydrodynamic model (McDowell et al 2016. Nature Climate Change).



Plant hydrodynamic model and its evaluations at one drought-experimental site in New Mexico







ACME Accelerated Climate Modeling for Energy
For additional information, contact:
Chonggang Xu
Los Alamos National Laboratory
505-665-9773
cxu@lanl.gov
climatemodeling.science.energy.gov/acme
U.S. DEPARTMENT OF ENERGY

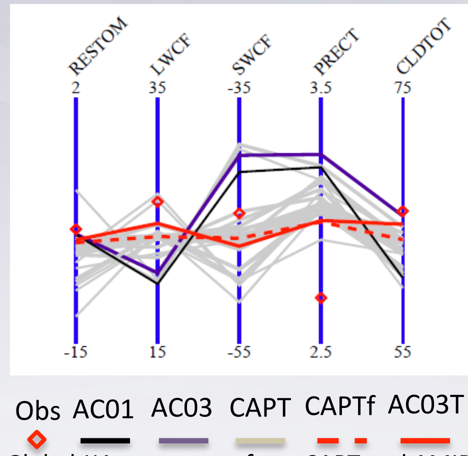
R: Strategy for Tuning High-Resolution ACME V1 Model

W. Lin[1], S. Xie[2], P. Ma[3], P. Rasch[3], Y. Qian[3], H. Wan[3], S. Klein[2], C. Golaz[2], P. Cameron-Smith[2], Q. Tang[2], H. Wang[3], K. Zhang[3], S. Burrows[3], J. Bacmeister,[4] R. Neal[4], C. Hannay[4], V. Larson[5], A. Gettelman[4]

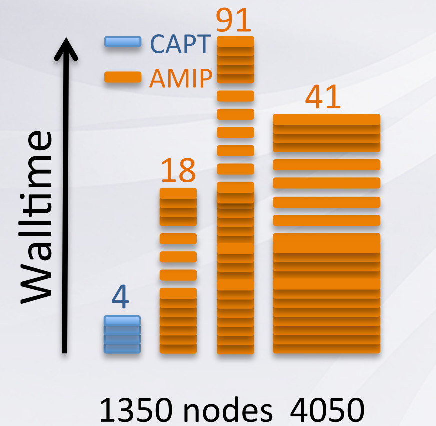
1 BNL, 2 LLNL, 3 PNNL, 4 NCAR, 5, UWM

Objective

The ACME V1-alpha atmosphere model, while well tuned for 1° resolution, needs to be retuned for 0.25° resolution to reduce large mean biases. The computational burden is heavy. This work describes an effective strategy for tuning high-resolution ACME model through extensive use of the Cloud Associated Parameterization Testbed (CAPT) framework for an iterative CAPT-AMIP approach during each stage of development cycle.



Global JJA mean stats from CAPT and AMIP runs. AC01 and AC03 use default. CAPTf and AC03T use same tuning parameters



Illutration of walltime for CAPT (5day) and AMIP (JJA or 15mon) simulations on Titan. One unit is 42 minutes.

Highlight of Results

- **Large biases in key quantities in high-res. model when using parameters well-tuned for low-res.**
- **A small number of CAPT hindcasts are used to effectively gauge the tuning response at high-res.**
- **Computational cost for a CAPT test is 1/25th or less compared to a typical AMIP test.**
- **Walltime as small as 1/100th with bundling; turnaround even quicker as large but short jobs favorable.**
- **CAPT hindcasts reproducing large biases for quantities closely related to physical parameterizations.**
- **Well-tuned configuration based on CAPT consistently lead to improved AMIP simulations.**
- **So far only need 1-2 AMIP simulations to reach the tuning target for each stage of development.**
- **CAPT framework will be further explored for tuning other aspects of the ACME model.**