



HiLAT

Wilbert Weijer and the HiLAT team

HiLAT Overview

- High-Latitude Application and Testing of Global and Regional Climate Models
- New DOE project
 - June 1, 2015
- Focuses on evaluating climate feedbacks wrt **changes in the cryosphere**
- Joint between LANL and PNNL

HiLAT Team

LANL	PNNL
Phil Jones	Phil Rasch
Wilbert Weijer	Susannah Burrows
Jeremy Fyke	Jin-Ho Yoon
Matthew Hecht	Hailong Wang
Elizabeth Hunke	Catrin Mills
Nicole Jeffery	
Joel Rowland	
Nathan Urban	
Jorge Urrego-Blanco	
Milena Veneziani	
Shanlin Wang	
Scott Elliott	
Alex Jonko	
Joseph Schoonover	

HiLAT as RGCM project

- **HiLAT** is funded by the **RGCM** program
 - Regional & Global Climate Modeling
 - Program manager: Renu Joseph
 - Climate model application and testing
- **ACME** is funded by the **ESM** program
 - Earth System Modeling
 - Program manager: Dorothy Koch
 - Climate model development

HiLAT Team: Overlap with ACME

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Matthew Hecht	Hailong Wang
Elizabeth Hunke	Catrin Mills
Nicole Jeffery	
Joel Rowland	
Nathan Urban	
Jorge Urrego-Blanco	10 out of 19
Milena Veneziani	
Shanlin Wang	
Scott Elliott	
Alex Jonko	
Joseph Schoonover	

HiLAT Team: Diverse Capabilities

LANL	PNNL
Phil Jones	Phil Rasch
Wilbert Weijer	Susannah Burrows
Jeremy Fyke	Jin-Ho Yoon
Matthew Hecht	Hailong Wang
Elizabeth Hunke	Catrin Mills
Nicole Jeffery	
Joel Rowland	
Nathan Urban	
Jorge Urrego-Blanco	Sea Ice
Milena Veneziani	Land Ice
Shanlin Wang	Ocean
Scott Elliott	Atmosphere
Alex Jonko	Marine Biogeochemistry
Joseph Schoonover	Terrestrial Hydrology

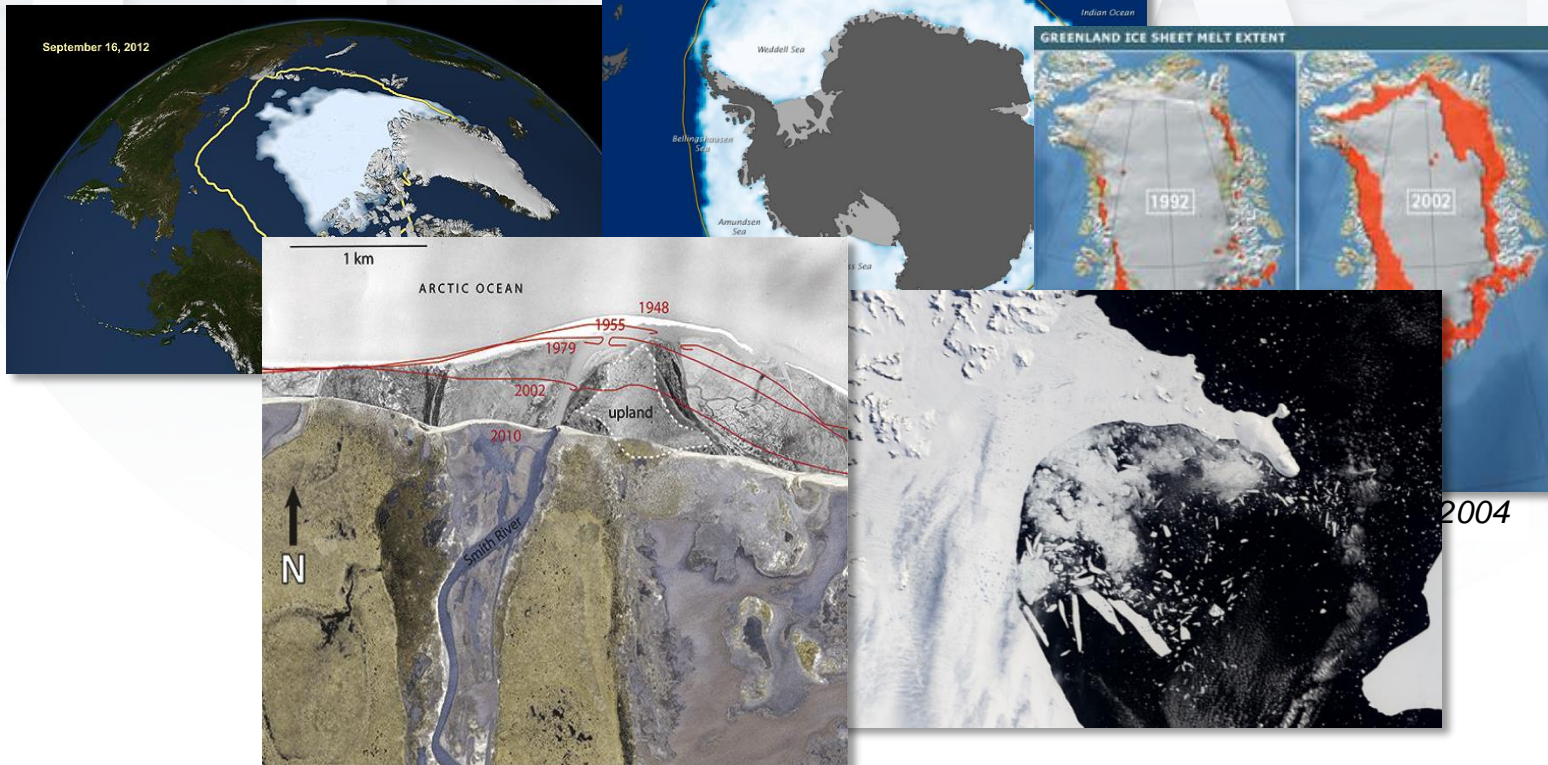
HiLAT Charge

- Develop **cross-cutting projects** that involve a significant subset of these disciplines

HiLAT

Central Theme

- Global warming strongly affects cryosphere
 - What are the regional and global consequences?



USGS

Vision: High-Latitude Feedbacks

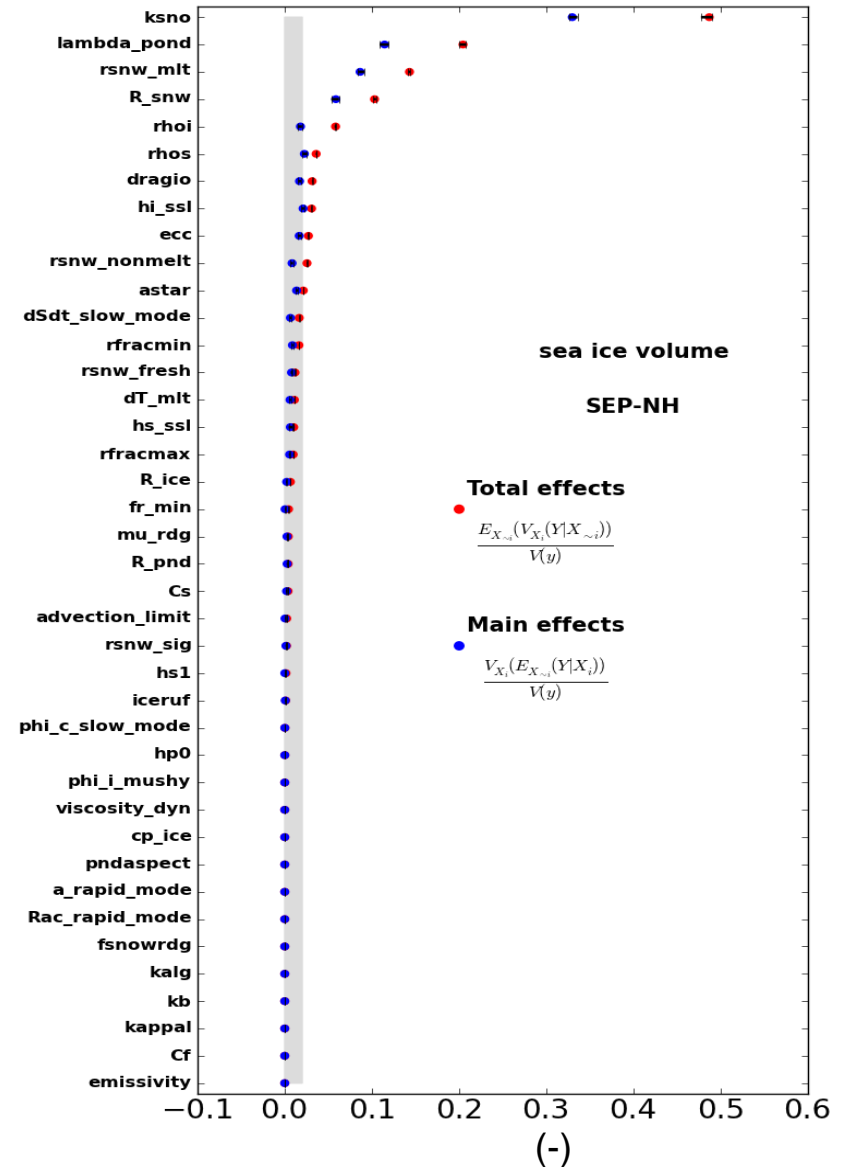
- Quantify **feedbacks** between the **cryospheric changes** and the Earth's **heat and water budgets**
 - improve projections of high-latitude climate change...
 - ...and the resulting regional and global impacts
- Theme 1: **Regional feedbacks**
 - Cryospheric changes affect high-latitude processes that modulate regional warming (polar amplification)
- Theme 2: **Global feedbacks**
 - Cryospheric changes affect polar/extrapolar interactions that modulate global warming

Sea Ice Sensitivity & Predictability

Jorge, Nathan, Elizabeth

- Systematically explore the sensitivity of sea ice (CICE5) to different parameters

Most sensitive CICE5 parameters



Urrego-Blanco, Urban and Hunke
(*J. Geophys. Res.*, *subm.*)

Arctic Deltas and River Inputs

Joel

- Study response of Arctic deltas to climate change

- River discharge
- Permafrost thawing
- Sea level rise
- Sea ice changes

Lena River Delta

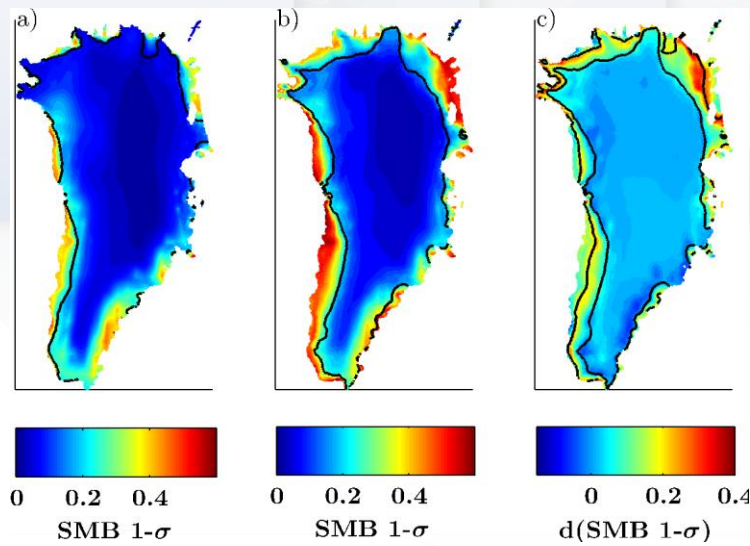


ESA

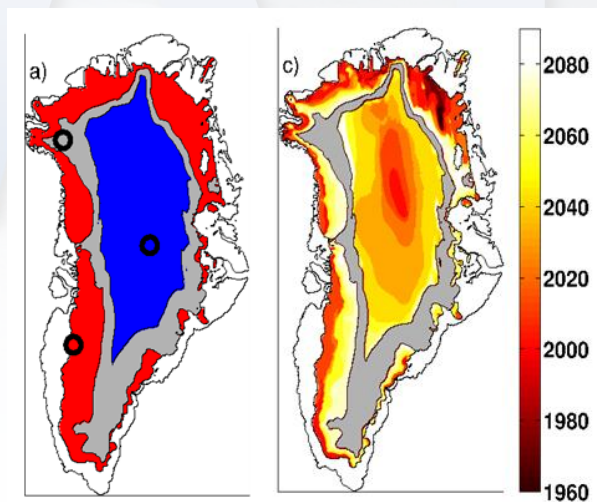
Greenland Ice Sheet Evolution

Jeremy

- Quantify rates, variability of GrIS mass loss
- Detect and attribute anthropogenic signal in GrIS
- Assess feedbacks between ice sheet and climate



Surface Mass Balance variability in CESM

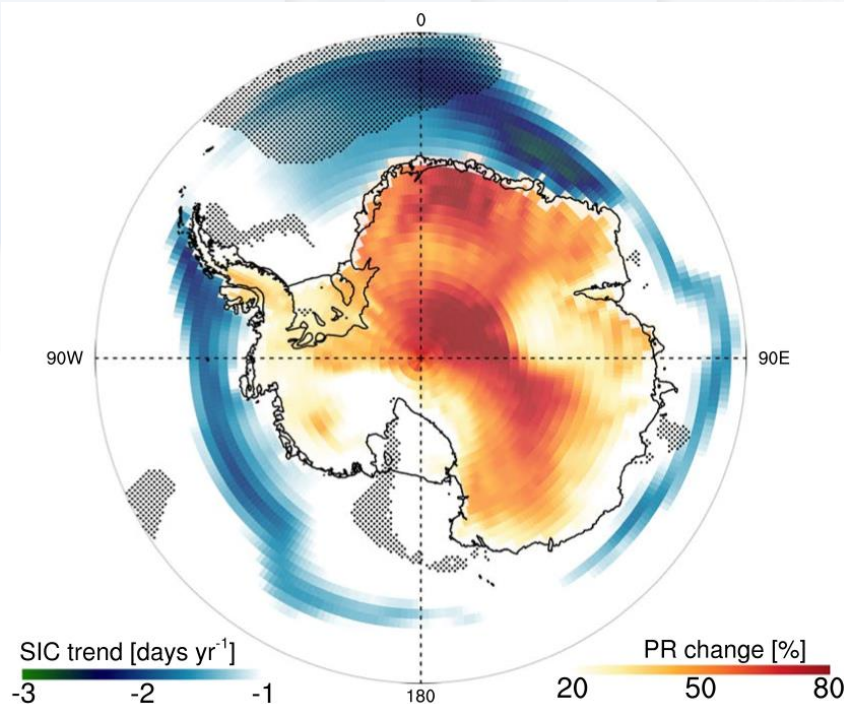


Emergence of anthropogenic signal

Antarctic Ice Sheet Mass Balance

Jeremy, Hailong

- Surface water mass balance of Antarctica
 - Enhanced precipitation
 - Where does precipitation come from?
 - Water vapor tracking



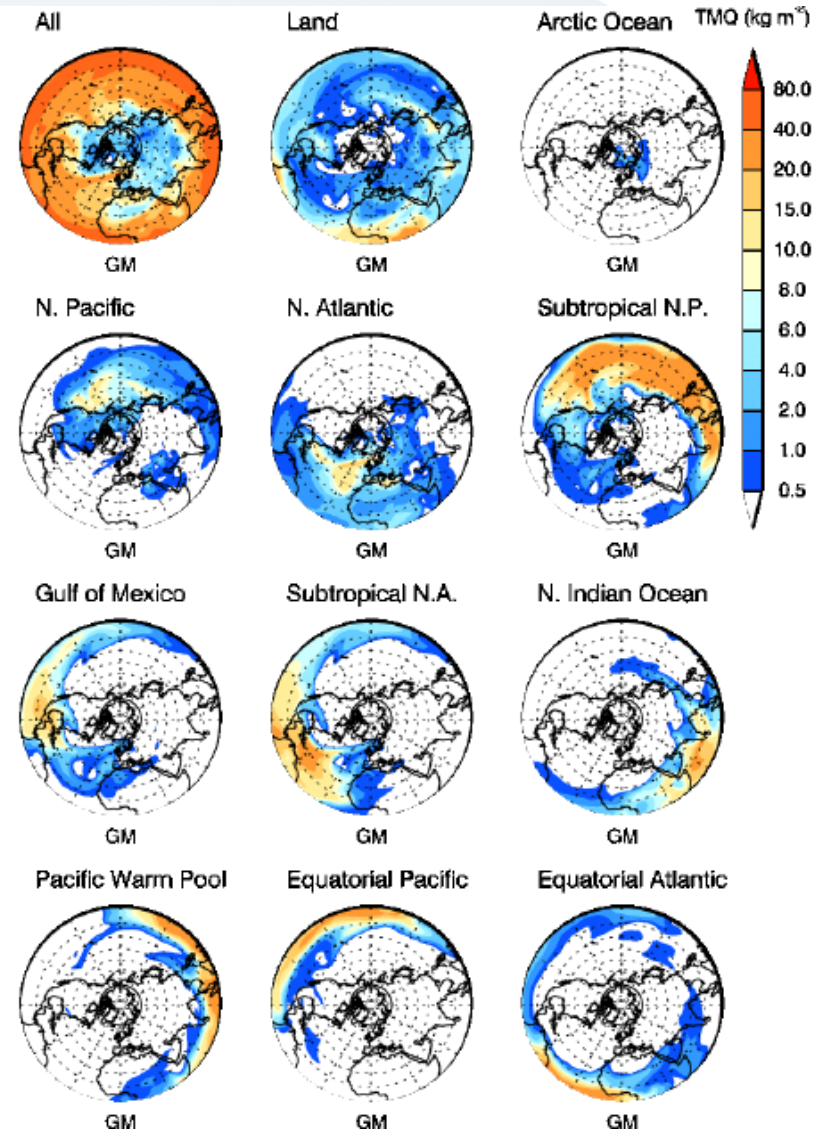
Trend in sea ice covered days during 21st century
Relative precipitation change

Lenaerts, Vizcaino, **Fyke**, et al.
(*Clim. Dyn.*, 2016)

Polar/Extrapolar Atmospheric Exchanges

Hailong, Jin-Ho, Phil R.

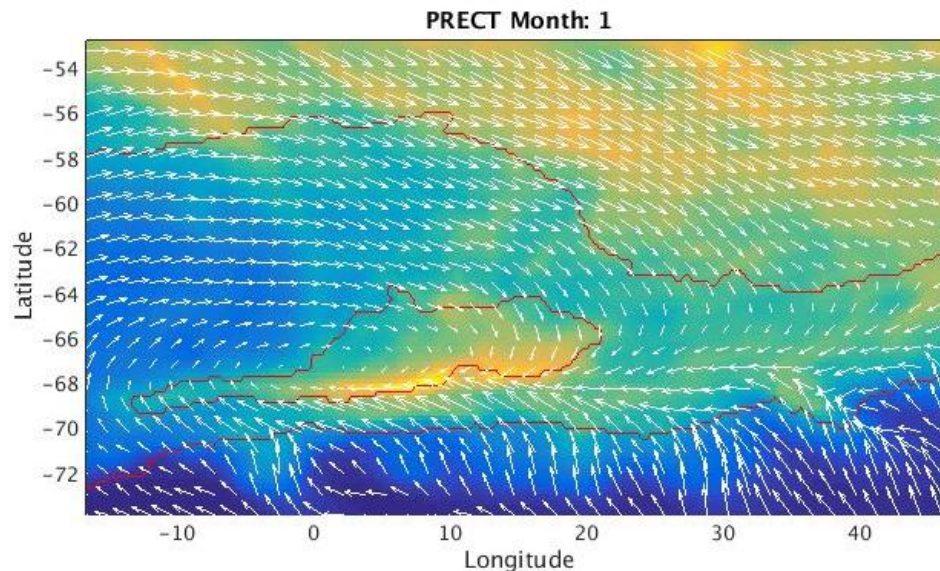
- Study response of polar/extrapolar atmospheric exchanges to Arctic sea ice decline
 - Water vapor tracking
 - Source/receptor analysis



Freshwater Impacts on NADW/AABW

Wilbert, Milena, Matthew, Nicole, Alex

- Changes in high-latitude freshwater discharge
 - AMOC/polar/subpolar exchanges
 - AABW formation
 - Polynyas



Precipitation and winds
over Weddell Sea polynya;
NCAR ASD simulation with
0.1° POP

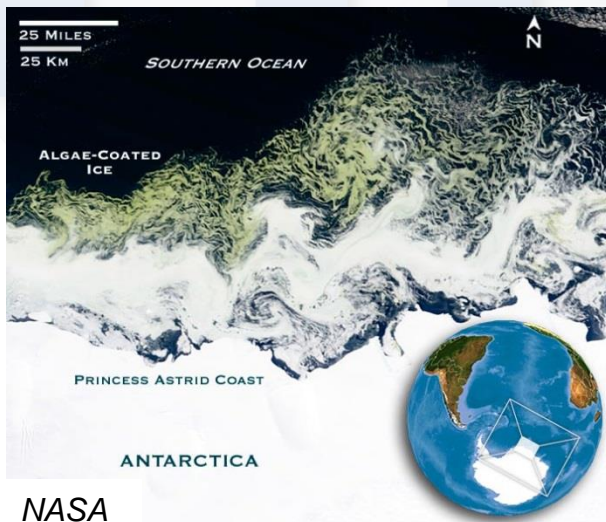
Weijer et al.
(*J. Clim.*, *subm*)

Impacts on Ecosystems and Clouds

Shanlin, Nicole, Susannah, Scott, and the rest of us

- Sensitivity of marine ecosystems to
 - Changes in sea ice cover and seasonality
 - Freshwater/nutrient inputs from ice sheets
 - Changes in riverine inputs in the Arctic

Plankton blooms along retreating ice edge



Sediment bearing iceberg



Raiswell

McKenzie River plume

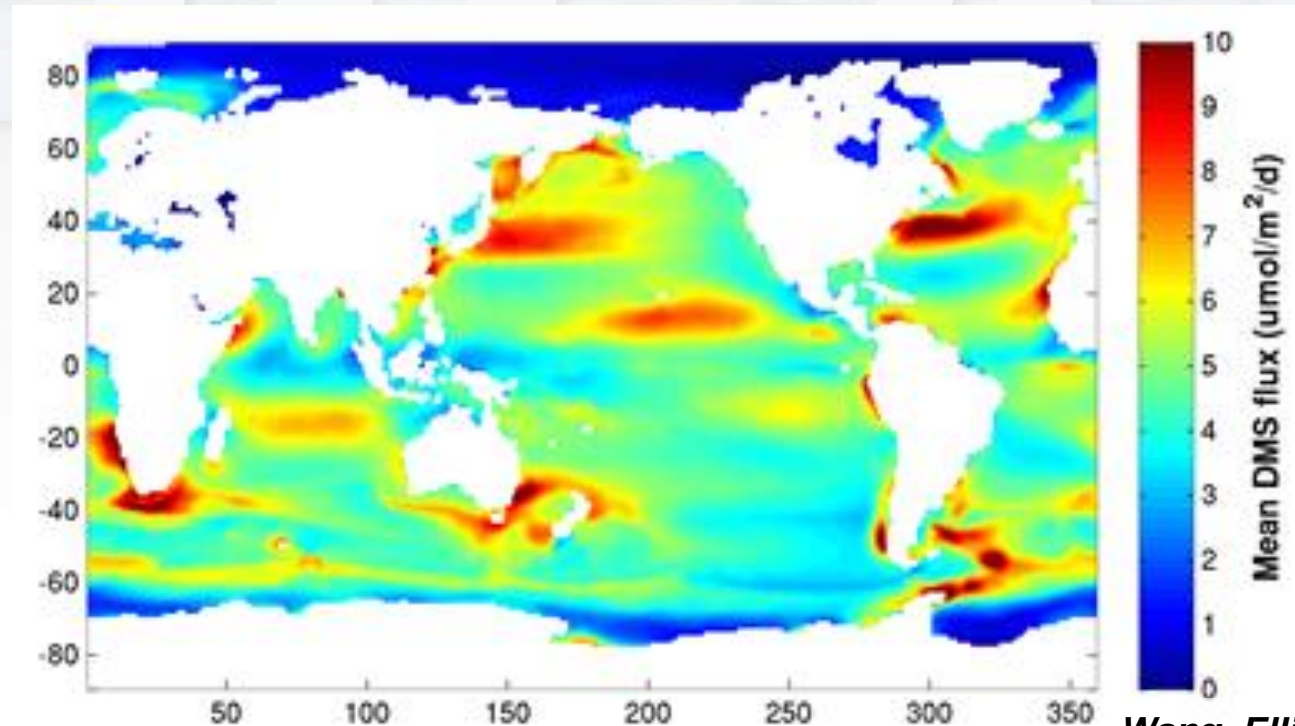


eosnap.com

Impacts on Ecosystems and Clouds

Shanlin, Nicole, Susannah, Scott, and the rest of us

- → Biogenic aerosol emissions
 - Dimethyl Sulfide (DMS)
 - Marine Organics



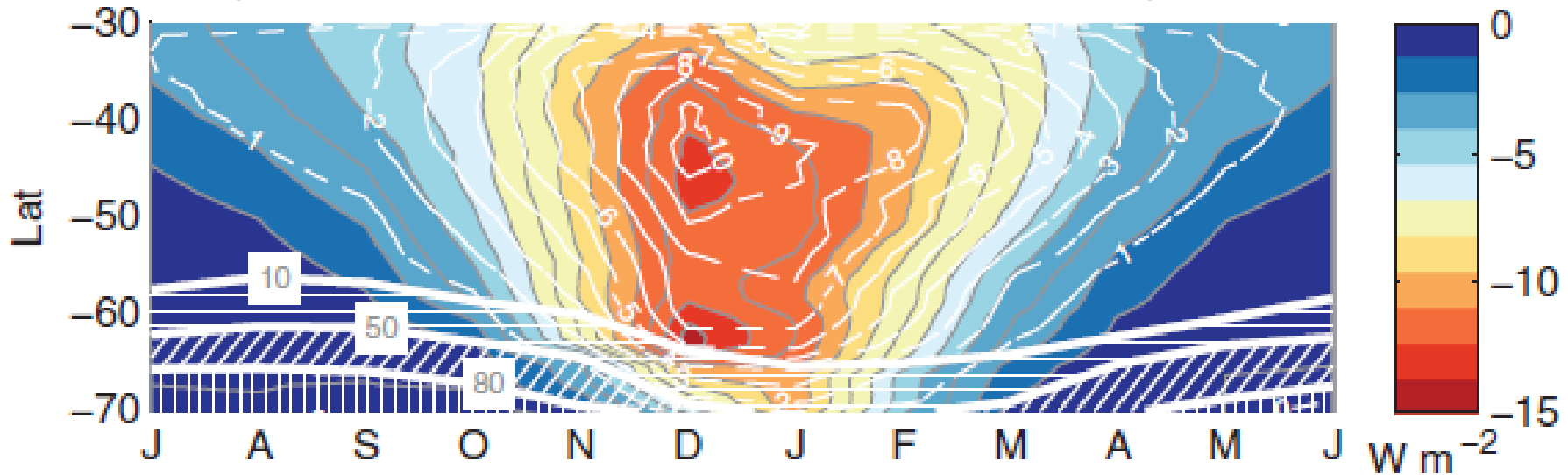
Wang, Elliott et al.
(*J. Geophys. Res.* 2015)

Impacts on Ecosystems and Clouds

Shanlin, Nicole, Susannah, Scott, and the rest of us

- Clouds, radiation budget

Change in reflected shortwave radiation due to sulfate and marine organic aerosols



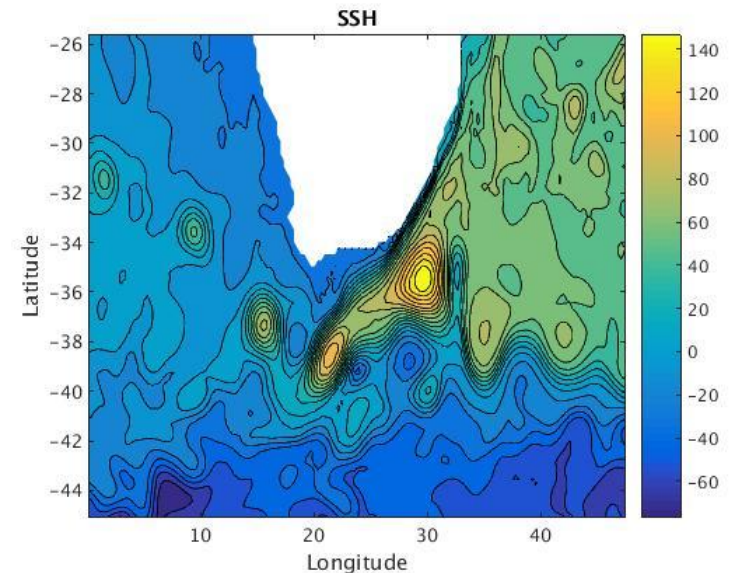
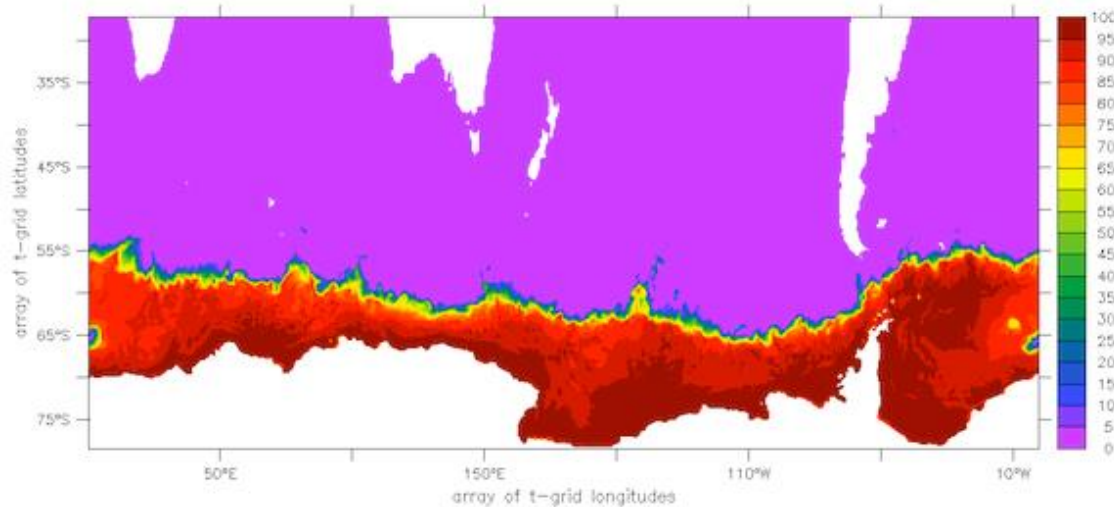
McCoy, Burrows, Elliott, Rasch et al.
(Sci. Adv. 2015)

Code Base

- ACME v0.1
 - Branched off of CESM1 (1.3 beta 10)
 - POP2
 - CAM5, with polar modifications
 - Still deciding on FV or SE core
- Additional developments
 - CICE5 physics
 - Marine biogenic aerosols
 - DMS and Marine Organics
- Most experiments done at gx1v6
 - But also new eddy-permitting version at 0.3°/ne30

Eddy-permitting version of CESM

- Motivation: Better resolve critical transport features
 - Transient *and* standing eddies important for SO heat transport
 - Boundary currents carry freshwater/nutrients from ice sheets
 - e.g., Labrador Current, Antarctic Slope Current
 - Also interest in Agulhas Leakage, Zapiola Anticyclone
- Early tests are promising



Conclusion

- HiLAT new project focused on high-latitude climate change
 - Wide range of topics
 - Strongly interdisciplinary
 - Great challenge for a group with limited experience in coupled simulations
- Excited to collaborate with PCWG community