
Happy
Birthday!

State of CESM

Jean-François Lamarque
CESM Chief Scientist
NCAR

CESM COMMUNITY

Jean-François Lamarque
lamar@ucar.edu

Worldwide use

Downloads over last 5 years

Jean-François Lamarque
lamar@ucar.edu

Community involvement

Code access

- ~5100 registered users 2010-2015
- 418 registered developers (SVN developers access) !!! Revised developer's policy !!!

DiscussCESM forums

- 53,688 sessions 2014- 2015
  - 25,971 returning user session
  - 27,717 new user sessions

Run database (https://csegweb.cgd.ucar.edu/expdb/):

- 1753 experiments entered into the database 2006-2015

CESM Tutorial

- Last year: 11-15 August 2014 (A. Phillips)
  - ➢ 90 participants

- 2015 Workshop to be held August 12-16, organized by C. Shields
- Thank you to NSF and DOE for their continuing funding

Jean-François Lamarque
lamar@ucar.edu

Simpler models

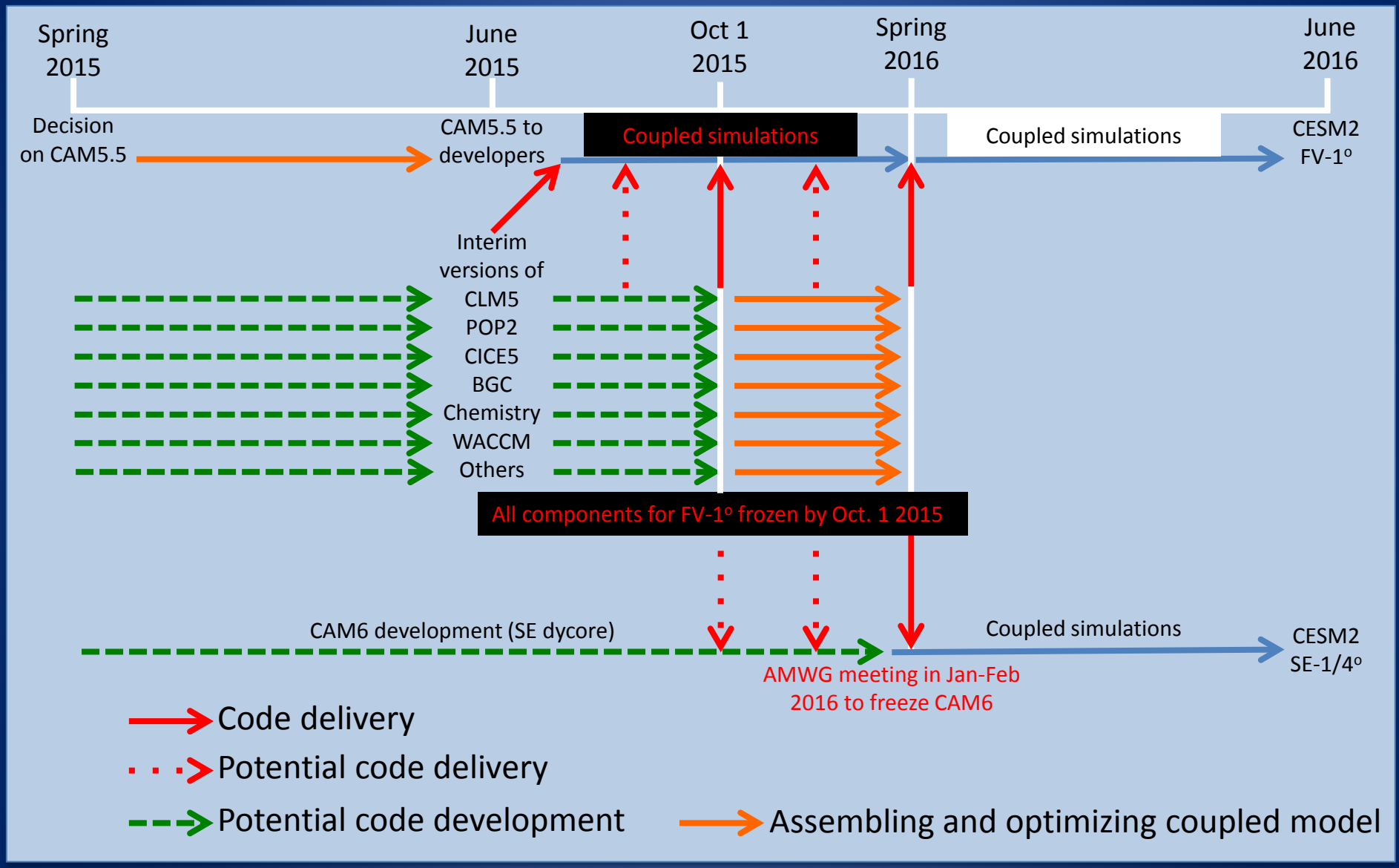
- Follow-up to recommendations from 2014 Breckenridge Cross-WG session
- Compsets for LC1 case with the spectral (aka Eulerian) dynamical core being tested (varying horizontal/vertical resolutions and horizontal diffusion parameters)
- Continuing work on aquaplanet configuration, including paper (Global radiative-convective equilibrium in CAM5, Reed et al., JAS, 2015)

Jean-François Lamarque
lamar@ucar.edu

CESM2 AND CMIP6

Jean-François Lamarque
lamar@ucar.edu

Timeline for CESM2



Jean-François Lamarque
lamar@ucar.edu

Evolution of CAM

Model	CAM4 CCSM4	CAM5.1 CESM1.0.3	CAM5.3 CESM1.2.0
Release	Apr 2010	June 2011	June 2013
PBL	HB	UW	UW
Shallow conv.	Hack	UW	UW
Deep conv.	ZM	ZM	ZM
Microphysics	RK	MG	MG
Macrophysics	RK	Park	Park
Radiation	CAMRT	RRTMG	RRTMG
Aerosols	BAM	MAM3	MAM3
Dynamics	FV	FV	SE

CAM5.4
May 2015
UW
UW
ZM
MG2
Park
RRTMG
MAM4
FV

CAM5.5
June 2015
CLUBB
CLUBB
ZM
MG2
CLUBB
RRTMG
MAM4
FV

CAM5.5
June 2015
UW
UNICON
UNICON
MG2
Park
RRTMG
MAM4
FV

= New parameterization/dynamics

Jean-François Lamarque
lamar@ucar.edu

Process for CLUBB/UNICON evaluation

- Formed an independent panel (Thank you!)
  - A. Capotondi (NOAA/CIRES)
  - S. Klein (LBNL)
  - P. Kushner (U. Toronto)
  - B. Mapes (U. Miami)
  - M. Miller (ECMWF)
- Scientific evaluation of CLUBB and UNICON in various configurations (all 1° FV): Focus on coupled simulations!
- Started October 2014
- Outcome in Spring 2015 was that neither were ready for prime-time (issues with ENSO were flagged)
- Changes to CLUBB and UNICON (not other components!) were made to improve ENSO and led to new assessment in May

Evolution of CAM

Model	CAM4 CCSM4	CAM5.1 CESM1.0.3	CAM5.3 CESM1.2.0	CAM5.4	CAM5.5
Release	Apr 2010	June 2011	June 2013	May 2015	June 2015
PBL	HB	UW	UW	UW	CLUBB
Shallow conv.	Hack	UW	UW	UW	CLUBB
Deep conv.	ZM	ZM	ZM	ZM	ZM
Microphysics	RK	MG	MG	MG2	MG2
Macrophysics	RK	Park	Park	Park	CLUBB
Radiation	CAMRT	RRTMG	RRTMG	RRTMG	RRTMG
Aerosols	BAM	MAM3	MAM3	MAM4	MAM4
Dynamics	FV	FV	SE	FV	FV

http://www.cesm.ucar.edu/working_groups/Atmosphere/development/cam6/CAM5.5_panel_rec_Jun15.pdf
http://www.cesm.ucar.edu/working_groups/Atmosphere/development/cam6/cam5.5-process/

= New parameterization/dynamics

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Next steps

- CAM5.4 and CAM5.5 only candidates for CAM in CESM2 FV 1° scientific release (and CMIP6)
- Coupled integrations with interim then final (Oct. 1) components
- Continued interest in UNICON as part of CESM2 release and further developments

Jean-François Lamarque
lamar@ucar.edu

Target CESM2 versions: ocean at 1°

1. physical climate (1°, FV, low-top) (1x)
2. + biogeochemistry (1°, FV, CO_2 emission and/or concentration driven, low-top) (1.6x)
3. + atmospheric chemistry + biogeochemistry (1°, FV, CO_2 emission driven, high-top) (8.5x)
4. physical climate (1/4° atm, SE, low-top) (150x)

(scaling of computational cost relative to version #1)

Notes:

1. Ocean at 0.1° research topic and not considered for CMIP6
2. Cost & scaling subject to model development and optimization

Jean-François Lamarque
lamar@ucar.edu

Improved throughput of WACCM on Yellowstone

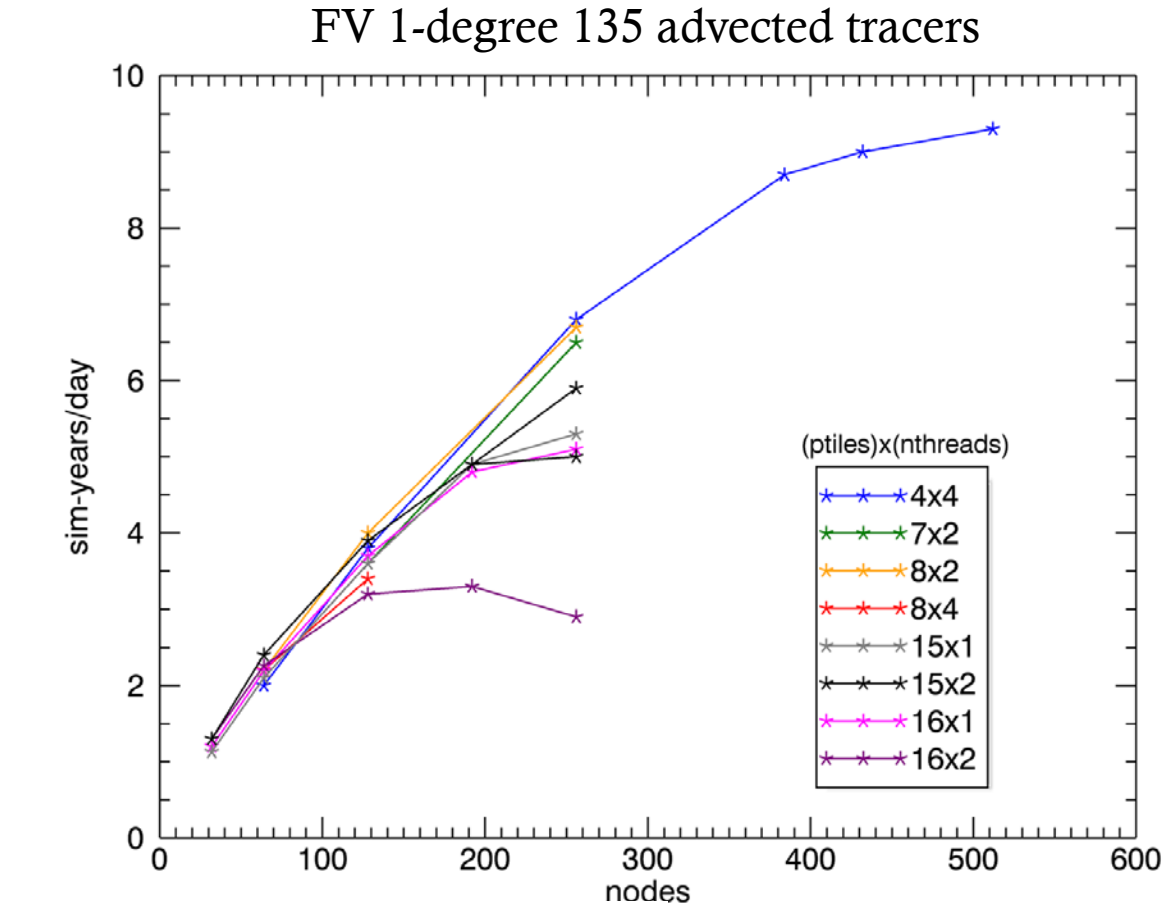


Figure courtesy of S. Santos and F. Vitt

Jean-François Lamarque
lamar@ucar.edu

Improved throughput of WACCM on Yellowstone

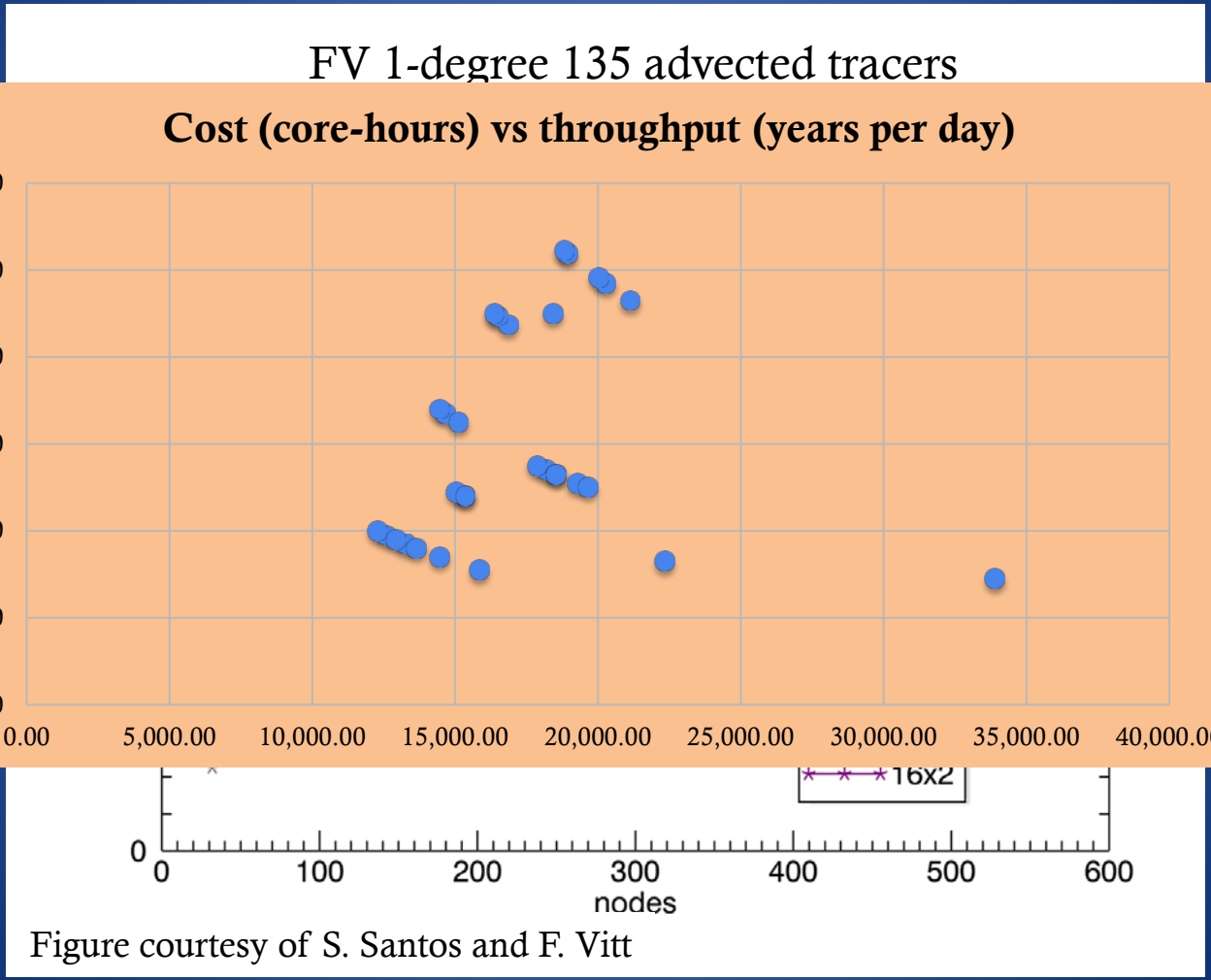


Figure courtesy of S. Santos and F. Vitt

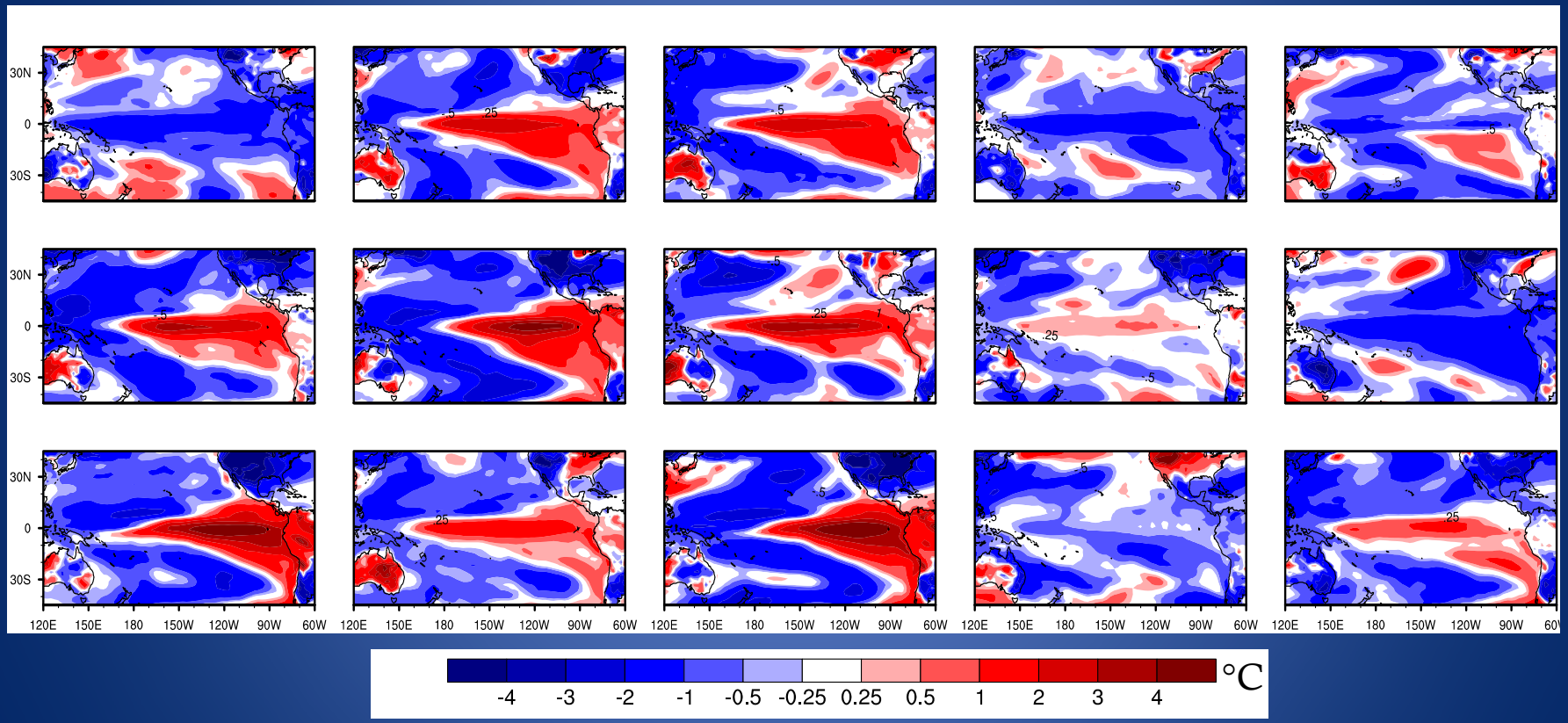
Jean-François Lamarque
lamar@ucar.edu

HIGHLIGHTS

Jean-François Lamarque
lamar@ucar.edu

Last Millennium Ensemble:
El Niño Responses: Tambora (1815) Eruption

Post-Tambora, Winter 1816/1817

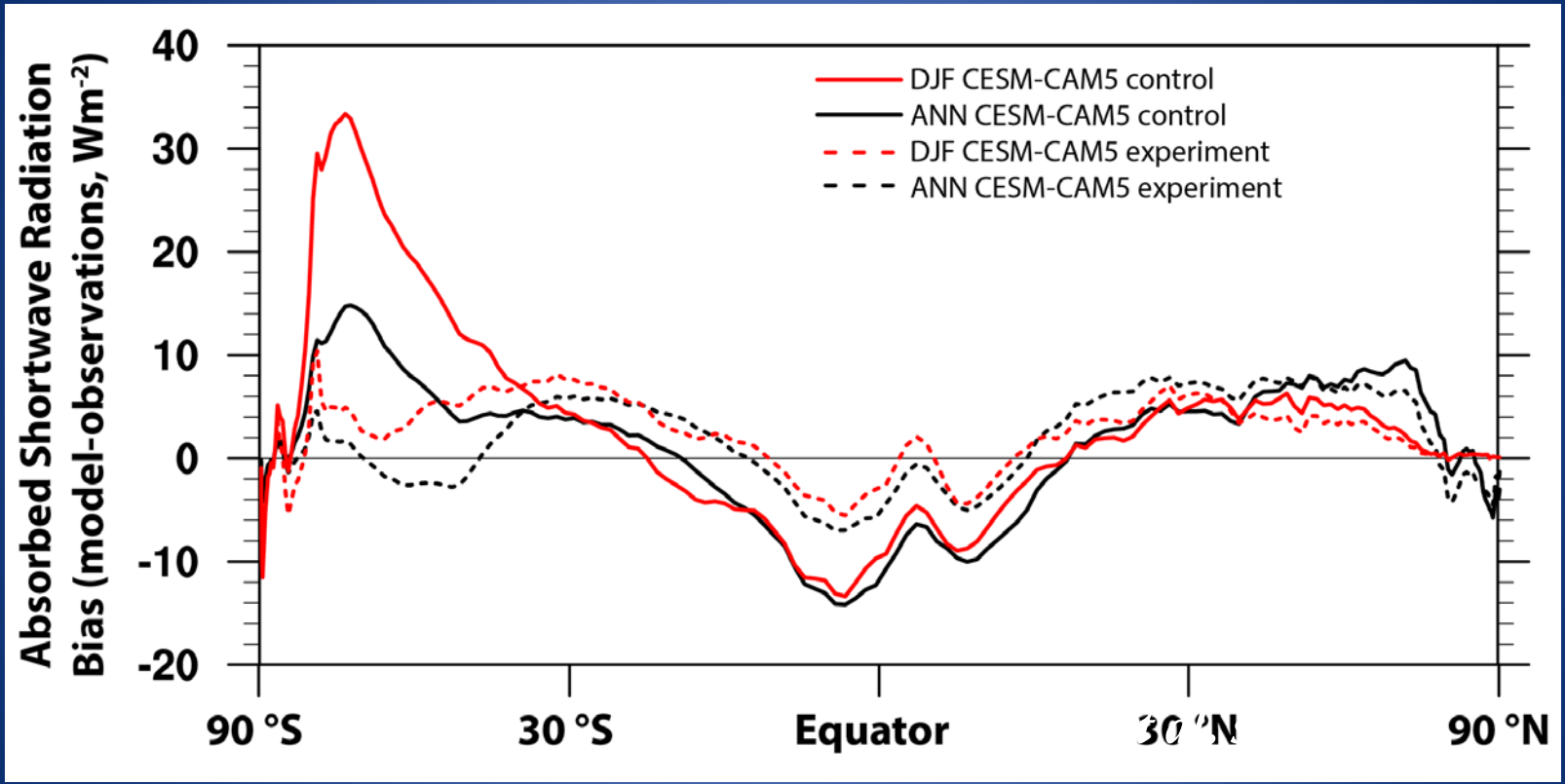


Courtesy of Esther Brady

Jean-François Lamarque
lamar@ucar.edu

Southern Ocean

Increasing supercooled cloud liquid enables reductions in large and long-standing CESM shortwave radiation biases.

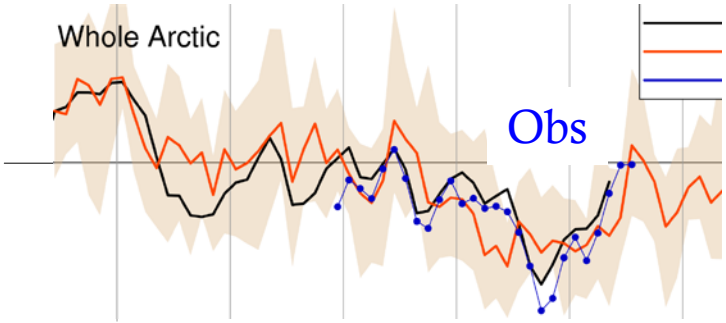


See J. Kay's talk in Southern Ocean cross-working group session will describe impacts of bias reduction on CESM climate (stronger SH jet, no ITCZ shift)

Jean-François Lamarque
lamar@ucar.edu

Predicted growth of Atlantic sea-ice extent in the coming decade

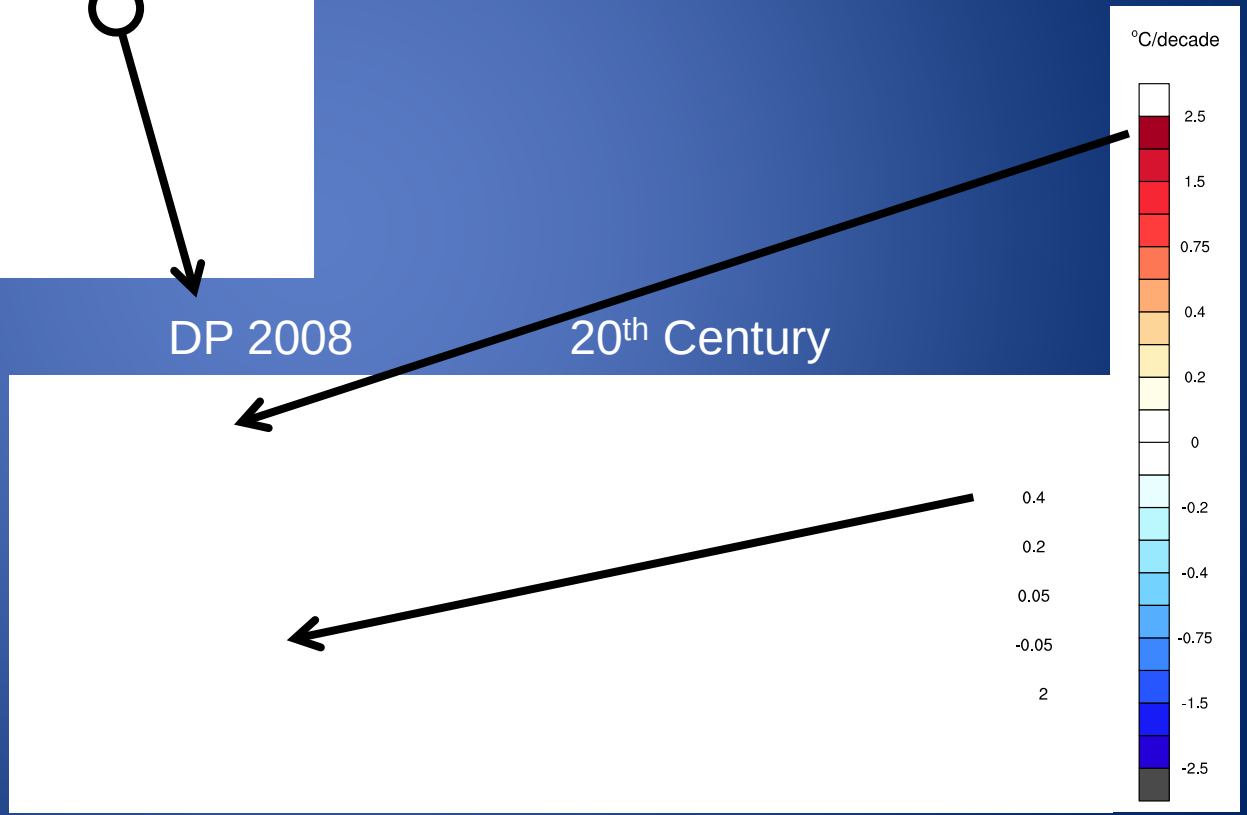
Yeager et al., 2015, to be submitted.



2007-2017 trends in SST and winter sea-ice extent from initialized decadal prediction ensemble (DP 2008) and uninitialized 20th cent. Ensemble:

DP 2008

20th Century



Jean-François Lamarque
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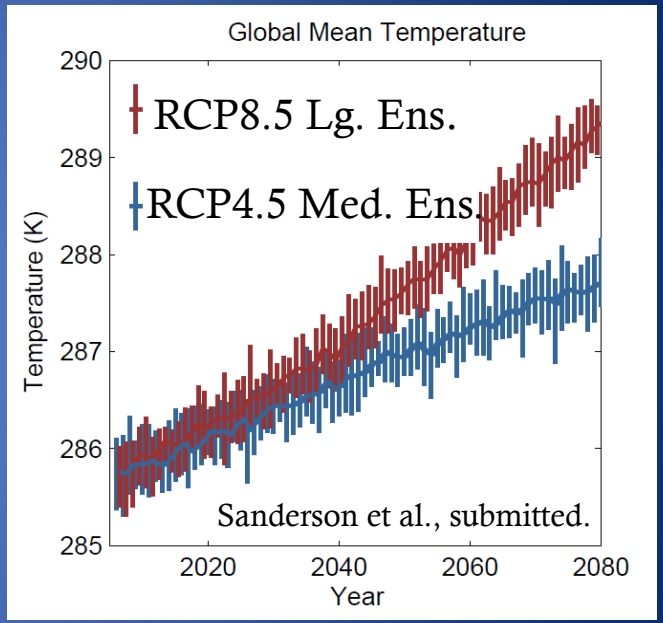
Benefits of Reduced Anthropogenic Climate changE (BRACE)

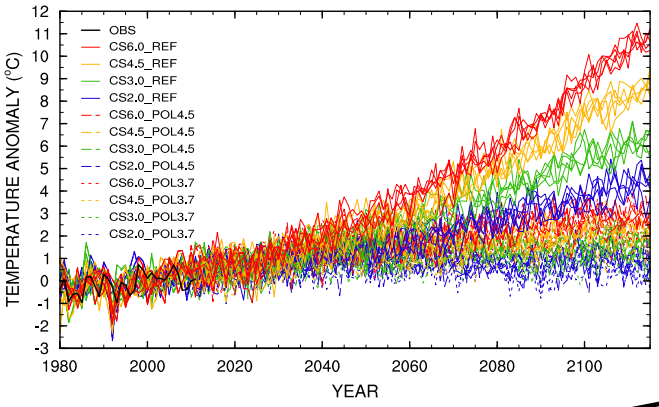
- Focuses on differences in impacts resulting from climate change driven by a higher emissions and radiative forcing scenario (the RCP-8.5 scenario) versus a lower scenario (the RCP-4.5 scenario)
- Employing CESM ensembles for RCP8.5 (40 members) and RCP4.5 (15 members) to investigate differences in impacts
- Special issue of *Climatic Change* established and under way, 20+ papers involving NCAR and 8 other institutions



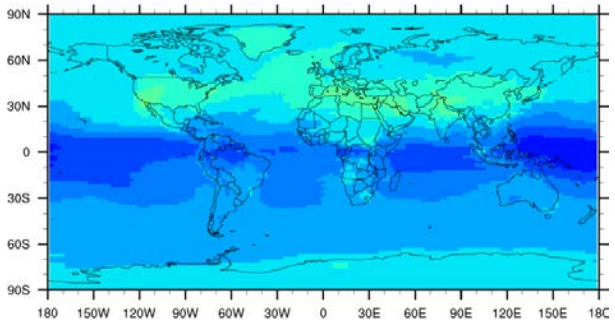
Impacts of climate change and policy on air quality & health

MIT Integrated Global System Model

Integrated socioeconomic & climate projections



CAM-Chem

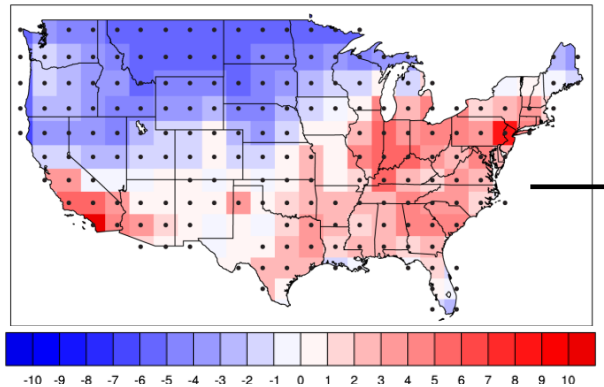


Climate Change Impacts:
- O_3 & $PM_{2.5}$ concentrations
- AQ-related health effects

Uncertainty Sources:
- Policy and emissions
- Climate sensitivity
- Natural variability

Air quality impacts:

Climate-induced change in annual-avg. O_3 (ppb) from 2000 to 2100 under no-policy scenario



Health & economic impacts:

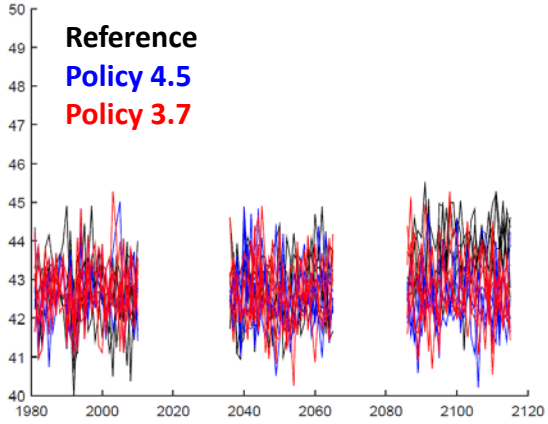
Avoided U.S. mortality under climate policy (P45,P37) relative to Reference scenario

Policy Impacts ($\mu g\ m^{-3}$)		Avoided premature deaths (95% CI)
Ref → P45	*2050*	11,000 (4,000 - 19,000)
	2100	52,000 (19,000 - 87,000)
Ref → P37	*2050*	13,000 (4,800 - 22,000)
	2100	57,000 (21,000 - 95,000)

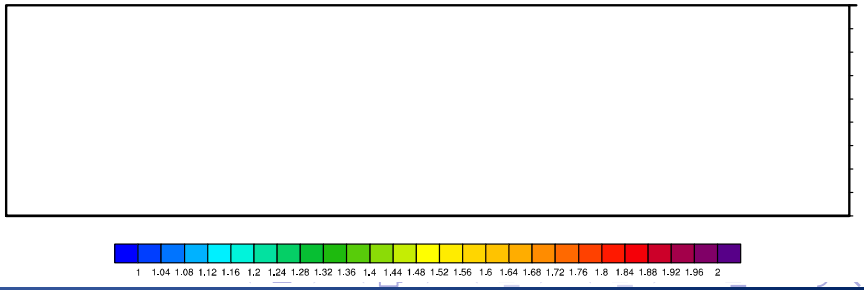
From N. Selin & F. Garcia Menendez

Uncertainty Analysis:

U.S. pop.-weighted annual O_3 (ppb) under different scenarios and multiple ICs



CAM-SE-CSLAM

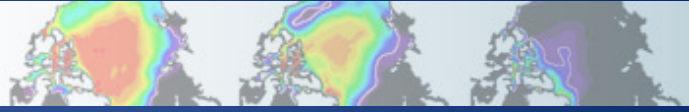


From P. Lauritzen

Jean-François Lamarque
lamar@ucar.edu

Questions?
Comments?

Jean-François Lamarque
lamar@ucar.edu



2015 CESM Distinguished Achievement Award

Jean-François Lamarque
lamar@ucar.edu

Keith Moore (University of California, Irvine)

"Keith Moore has been a key member of the Biogeochemistry Working Group for over 10 years. He, with Scott Doney and Keith Lindsay, designed and assembled the first version of the biogeochemistry component of the ocean model. And he has been since involved in all further developments of this component"

Jean-François Lamarque
lamar@ucar.edu