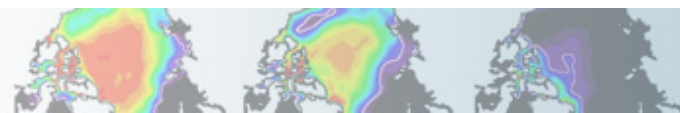


# WACCM Updates

A. Gettelman, L. M. Polvani, M. Mills  
+ “WACCM Team”



# Outline

- Logistics
- CESM2 Timelines
- WACCM Development (examples)

# Agenda For This Week

- Today: WACCM (FL2-1022)
  - Overview & Updates
  - Summary from major groups
  - Science!
  - Discussion
- Wednesday AM: Joint with AMWG/ChemWG (FL)
  - Joint science and discussion (FL2-1022)
- Wednesday PM and Thurs: Joint (CG)
  - WACCM overview
  - Make sure WACCM is represented in CESM2

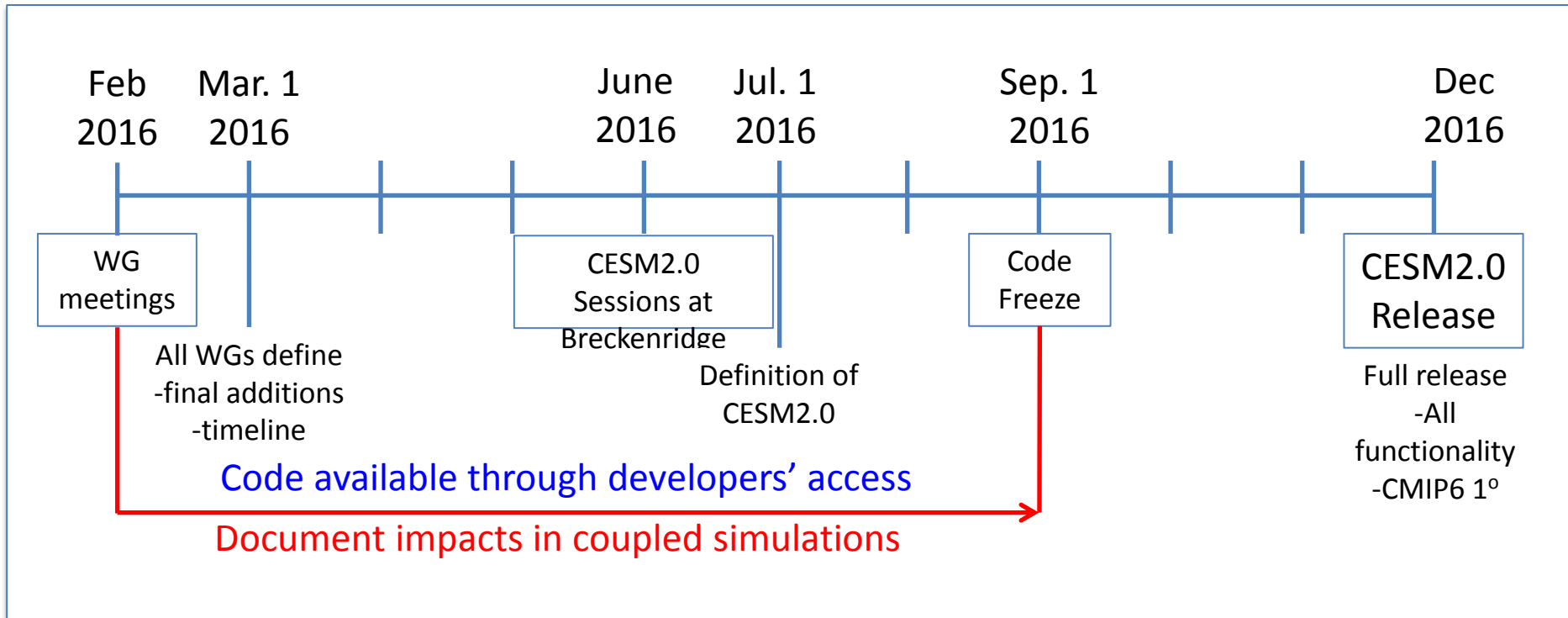
# Logistics

- CESM Meeting Agendas, Bus schedule
  - <https://www2.cesm.ucar.edu/events/meetings/20160208>
  - Google “cesm working groups 2016”
- Today and Wed AM: This Room
- Wed PM/Thursday: Center Green

# CESM Tutorial: 8-12 August 2016

- Excellent introduction to CESM
  - Science and practical sessions
- WACCM Special session
- Applications now until March 4, 2016
- <https://www2.cesm.ucar.edu/events/tutorials/2016>
- Please mention WACCM, talk to Mills or Gettelman and mention us on application

# CESM2 revised timeline



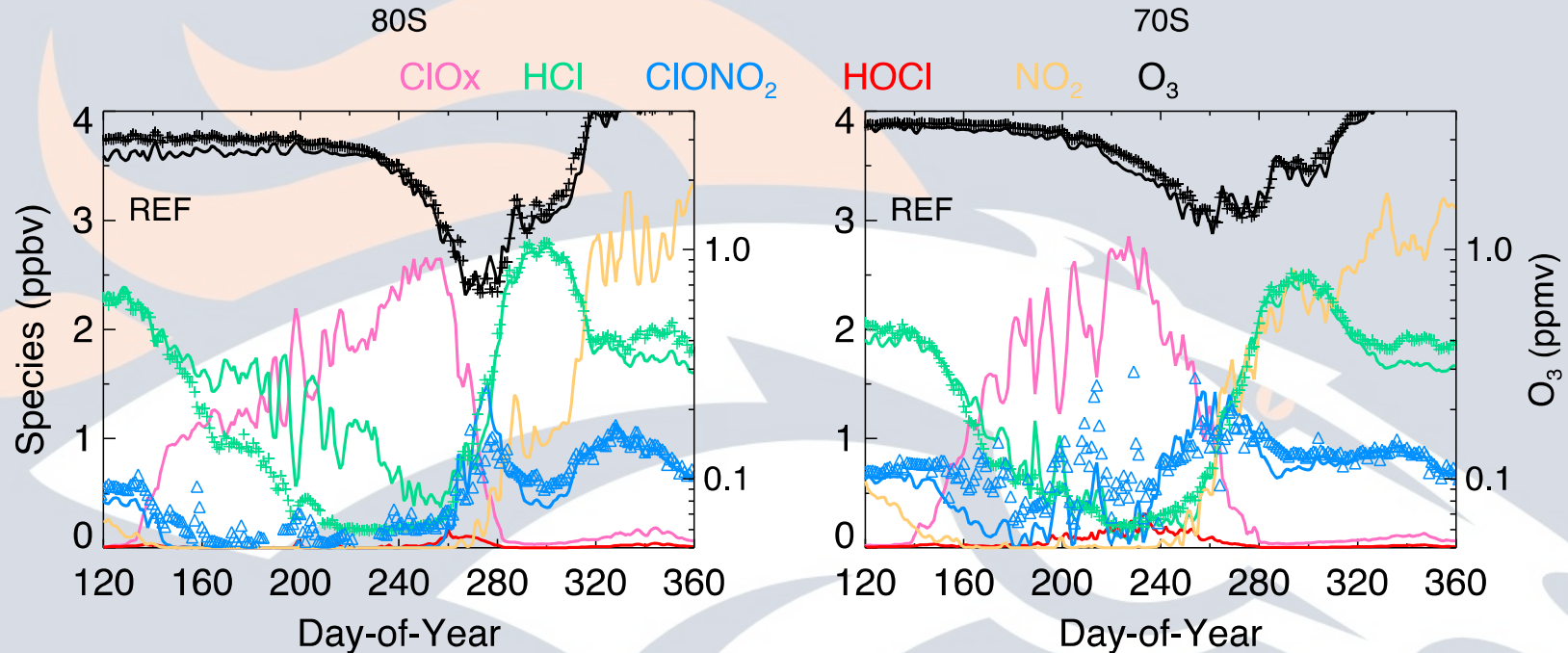
Pending approval by the SSC

# WACCM Development Updates

- WACCM-CCMI
- WACCM5.4 Tuning
- WACCM5.5
- WACCM-X
- Prognostic Volcanoes

# WACCM-CCMI

## Evaluation of Stratospheric Chemistry (SD-WACCM / MERRA)



Amazing representation of stratospheric chemistry. Comparisons above are made with: Aura MLS (HCl, O<sub>3</sub>); MIPAS (ClONO<sub>2</sub>).

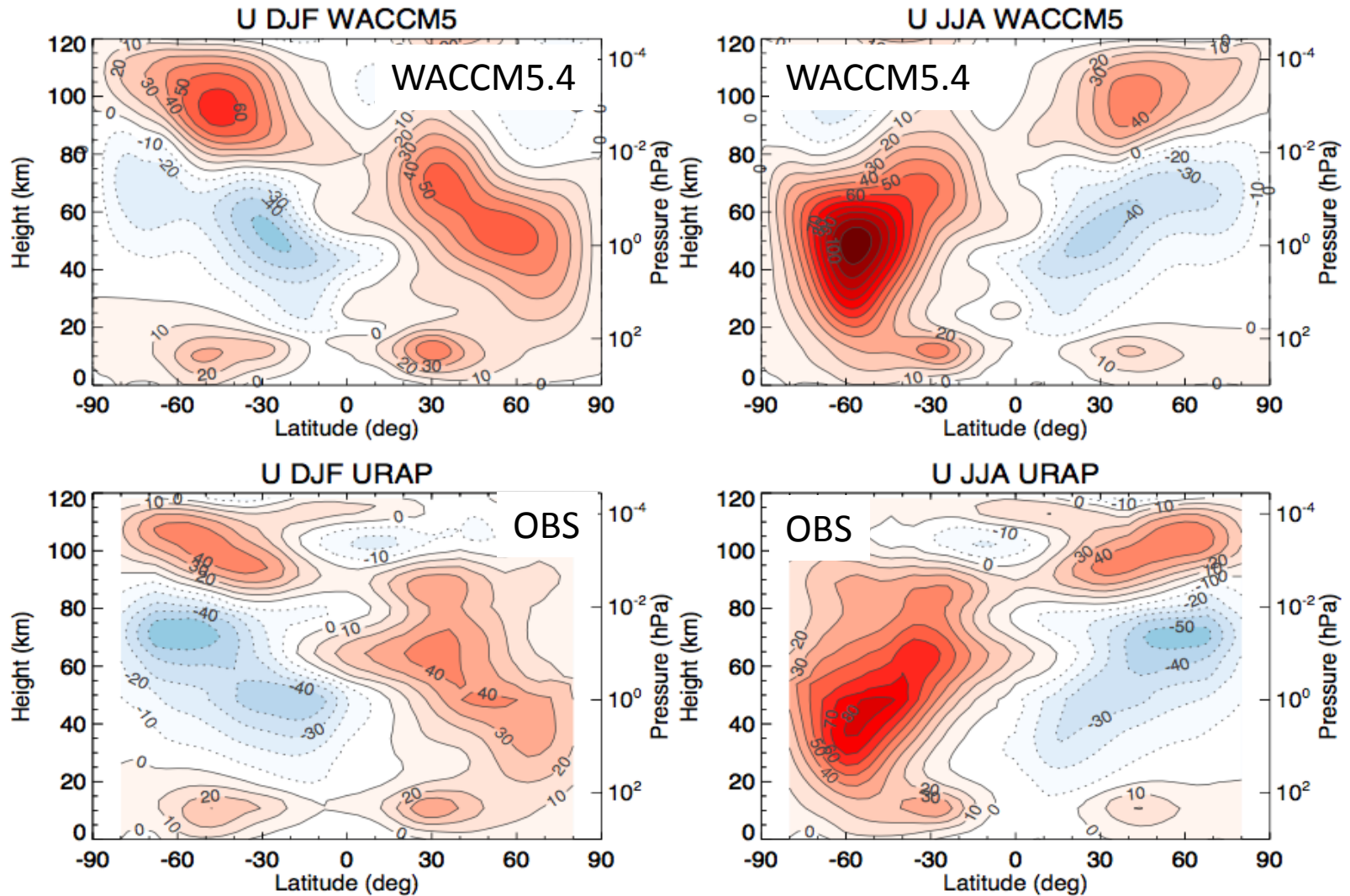
Wegner, T, D. E. Kinnison, R. R. Garcia, S. Madronich, and S. Solomon, Polar Stratospheric Clouds in SD-WACCM4, *J. Geophys. Res.*, VOL. 118, 1-12, doi:10.1002/jgrd.50415, 2013.

Solomon, S., D. E. Kinnison, J. Bandoro, R. Garcia, Simulations of Polar Ozone Depletion: An Update, *J. Geophys. Res.*, 120, 7958-7974, doi:10.1002/2015JD0233652015.



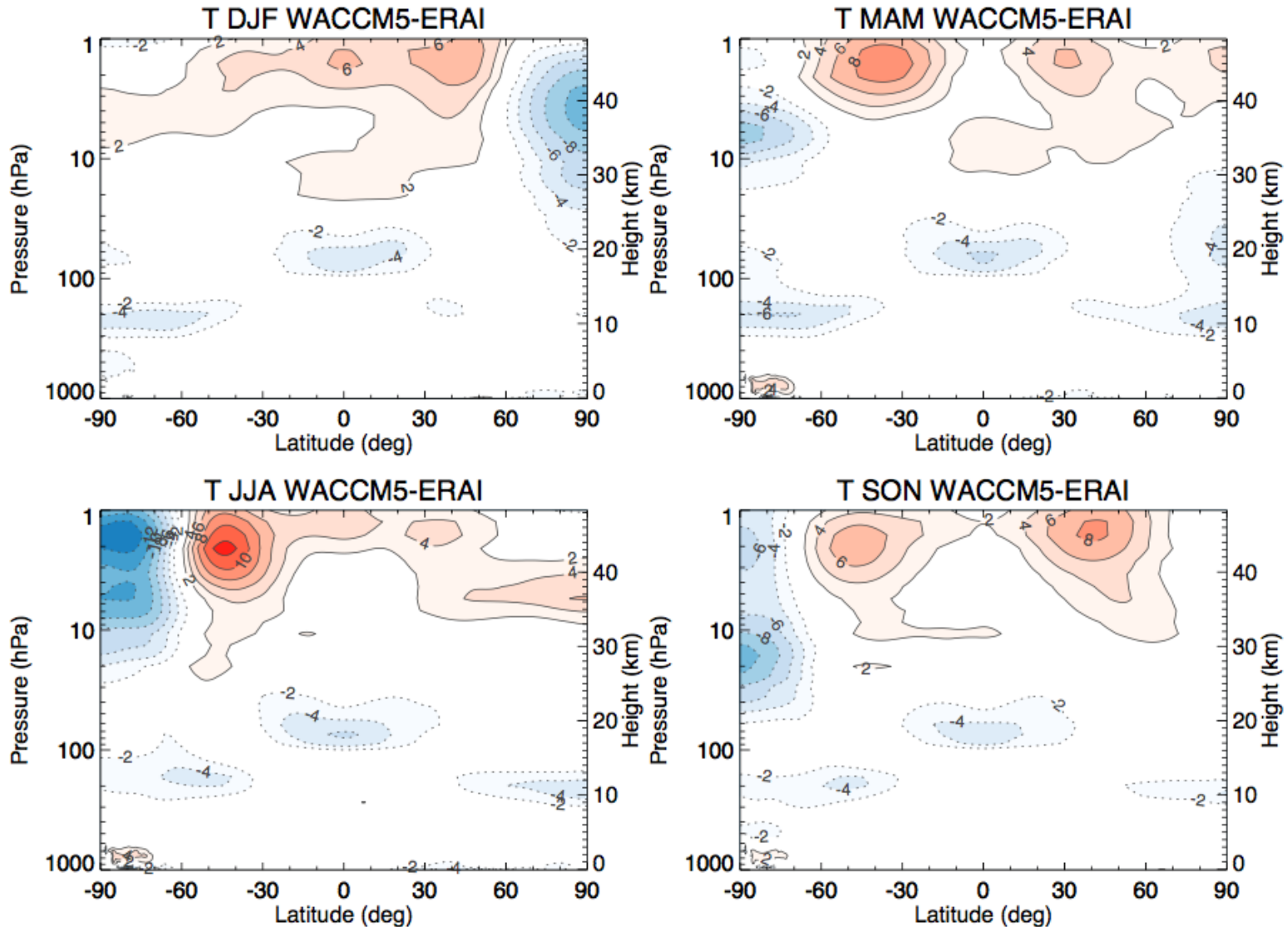
# WACCM5.4 – U Climatology

WACCM5.4 does a good job of reproducing wind climatology



# WACCM5.4 – T Anomalies

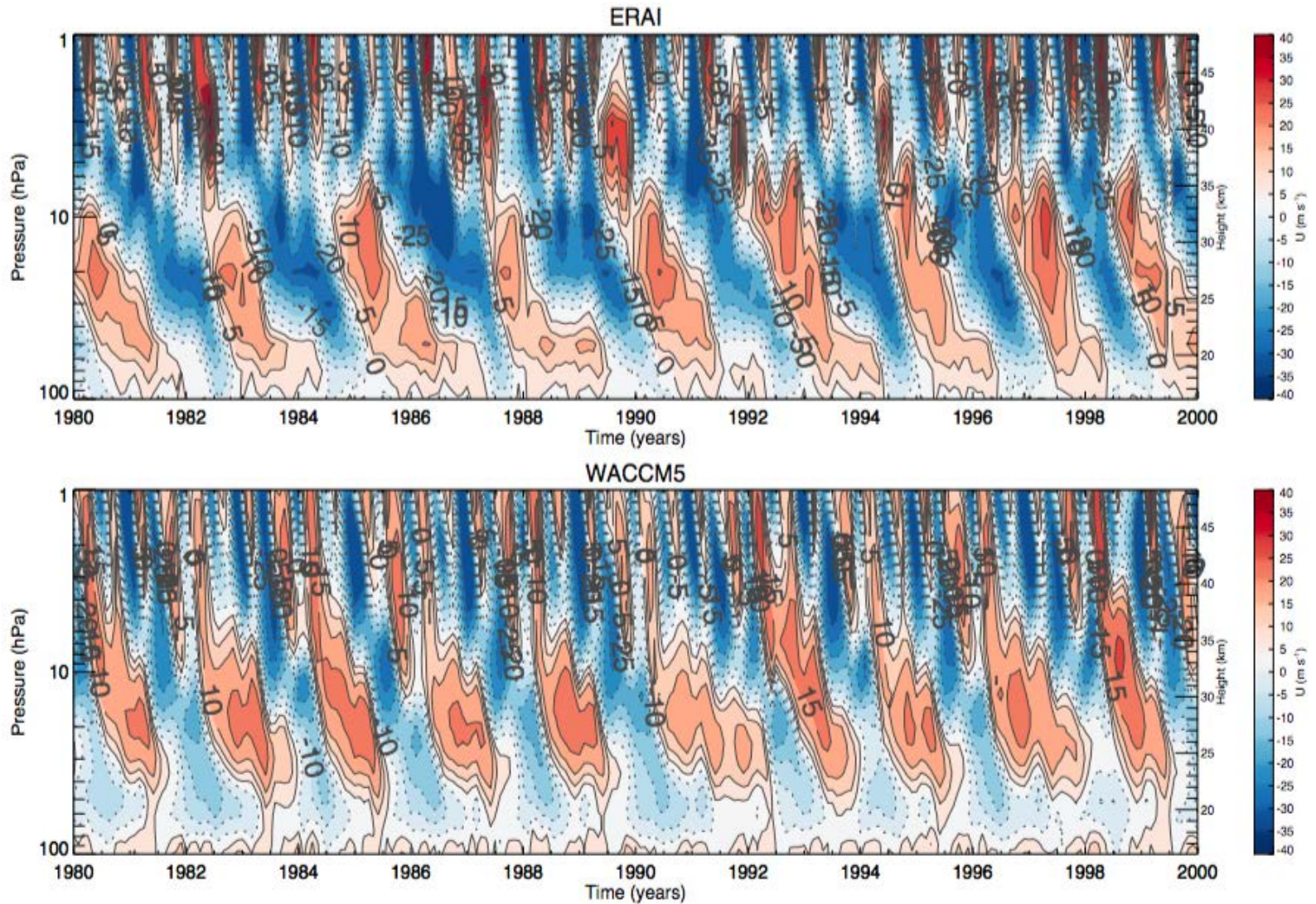
WACCM5.4 does a good job of reproducing temperatures



From J. Richter

# WACCM5.4: QBO

WACCM5.4 has an internally Generated QBO @ 70 Levels (Better for 110L)

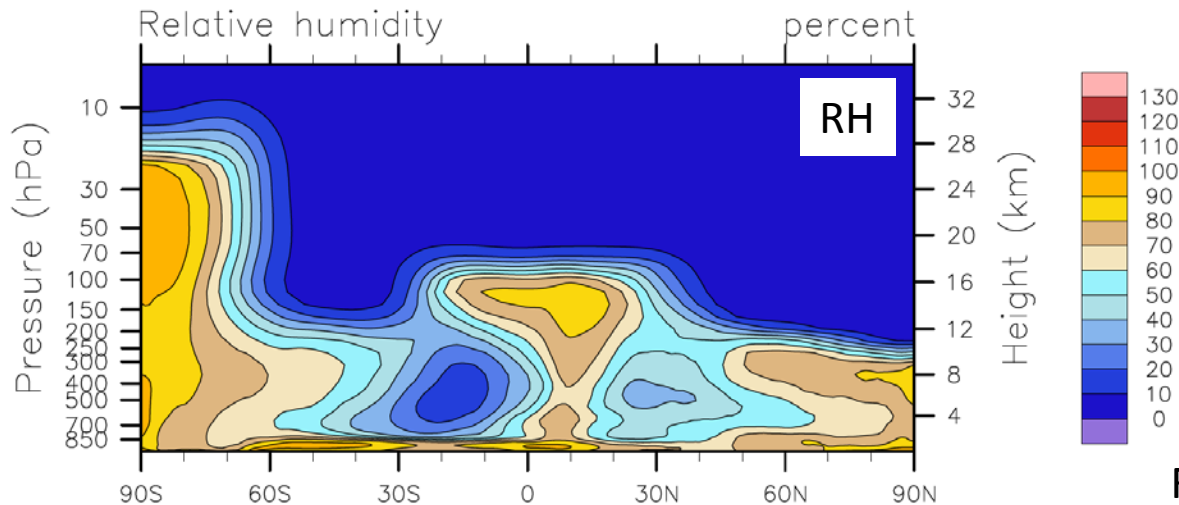
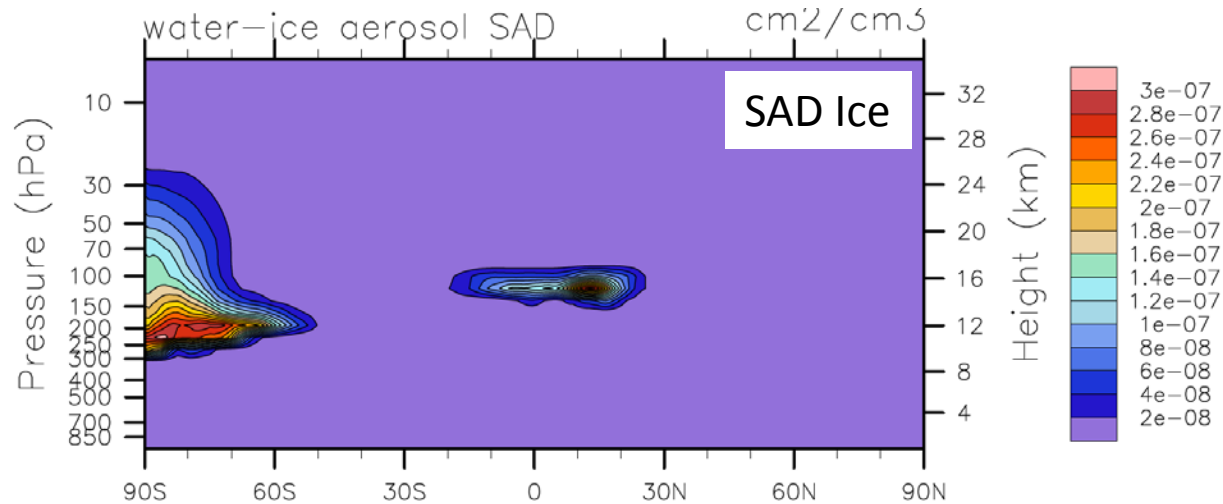


# WACCM5.5 Updates

- Get WACCM5.5 working with CAM5.5 Physics
- Issues
  - Conservation
  - Dehydration
  - SAD Ice (Type 2 PSCs)

# WACCM5.5: Type-2 PSCs

July, SD WACCM5.5



- Adjusting CAM6 physics
1. Conservation ( $\text{H}_2\text{O}$ )
  2. RH
  3. SAD Ice (Type-2 PSCs)
  4. Retune ice clouds

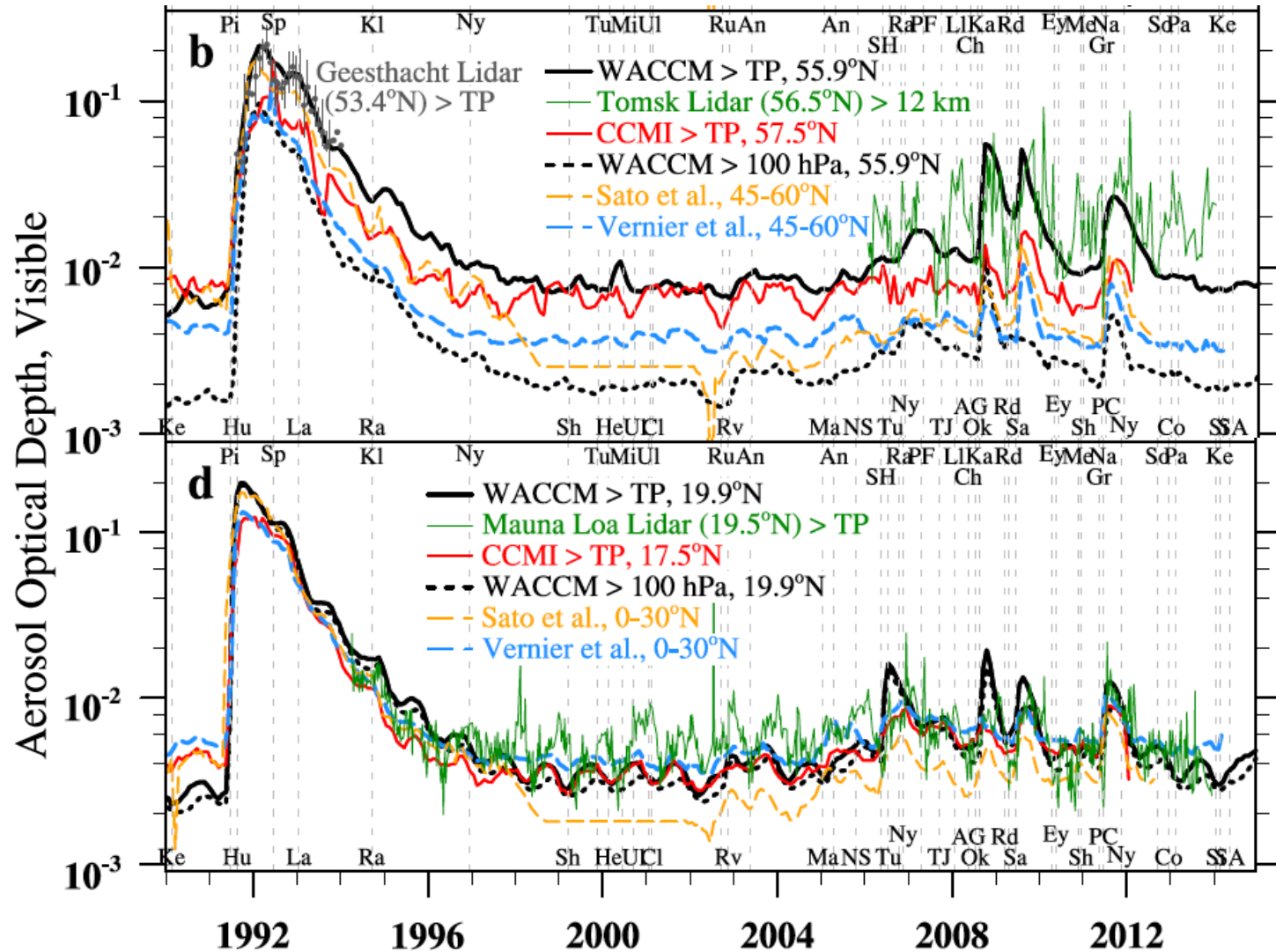
This result: from step 3  
Will discuss process later

From: Bardeen

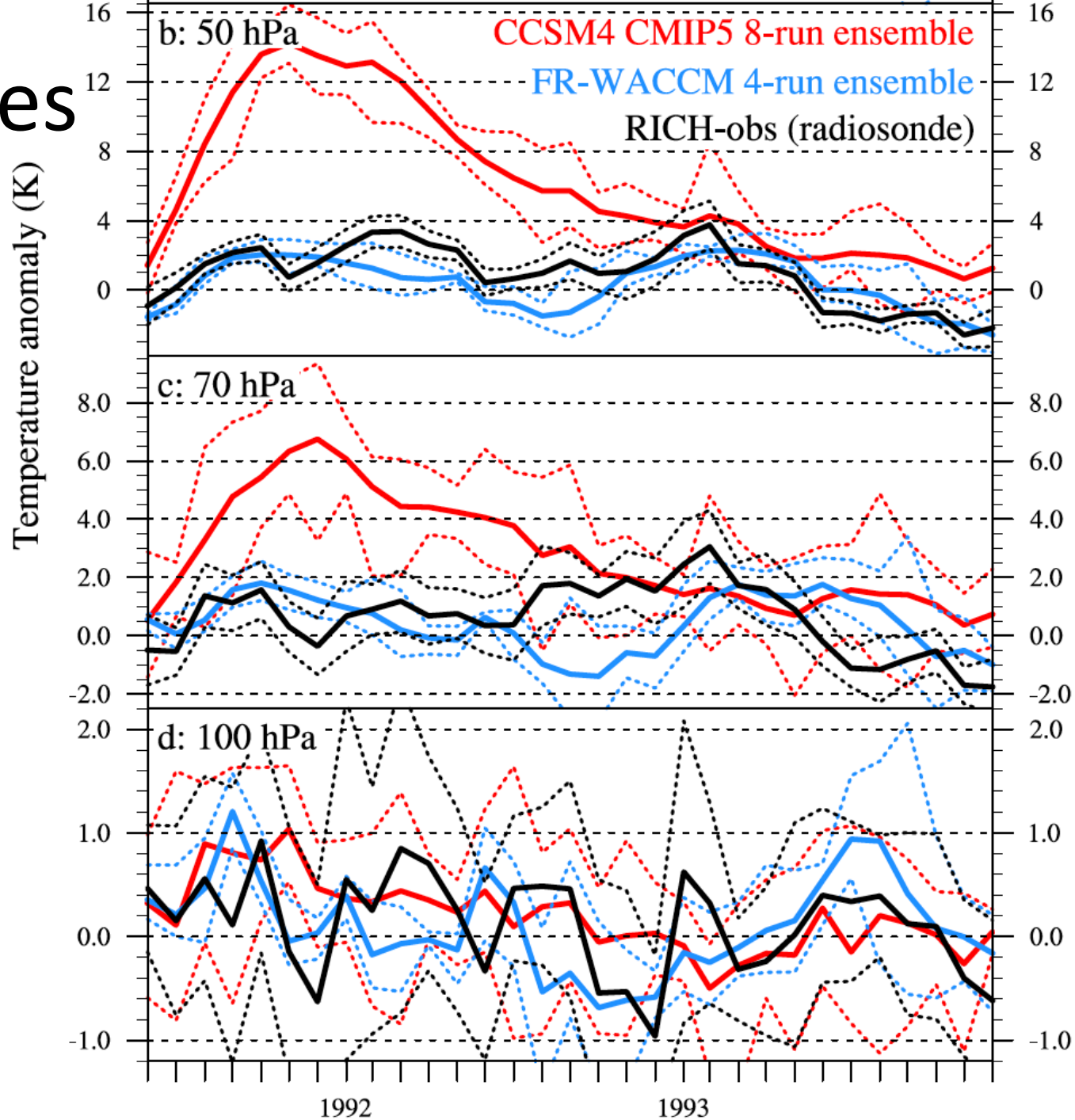
# Volcanoes

Prognostic Stratospheric Sulfur in WACCM

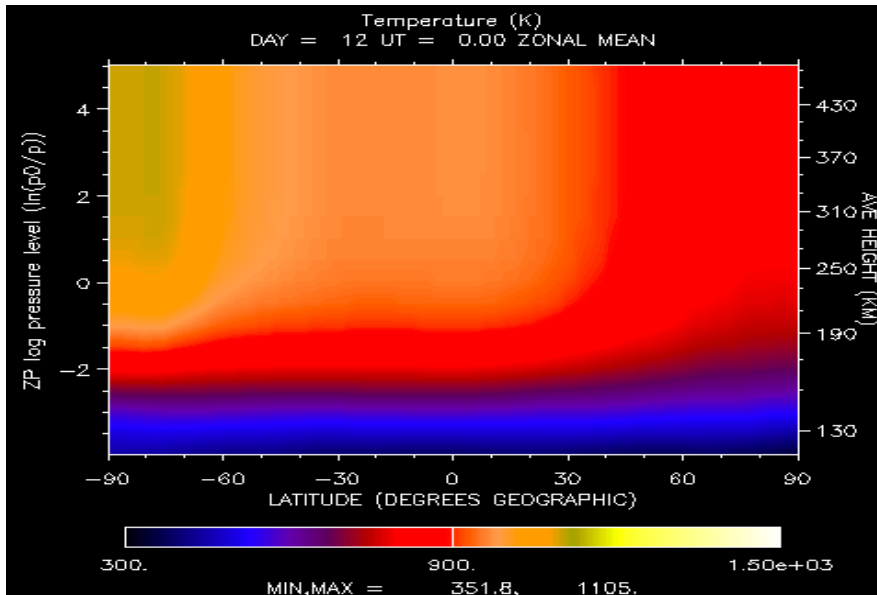
Mills et al 2016, submitted



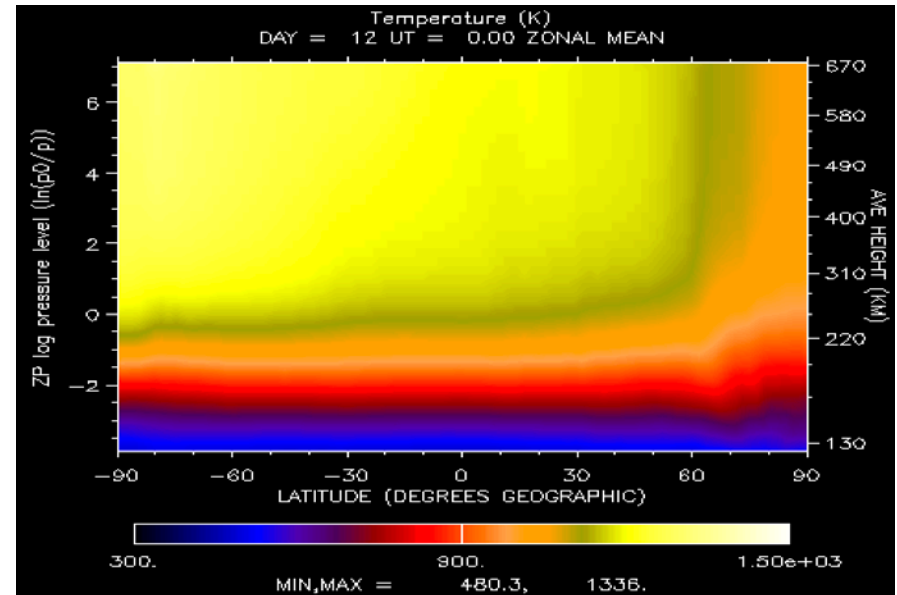
# T anomalies



## Previous WACCM-X Release



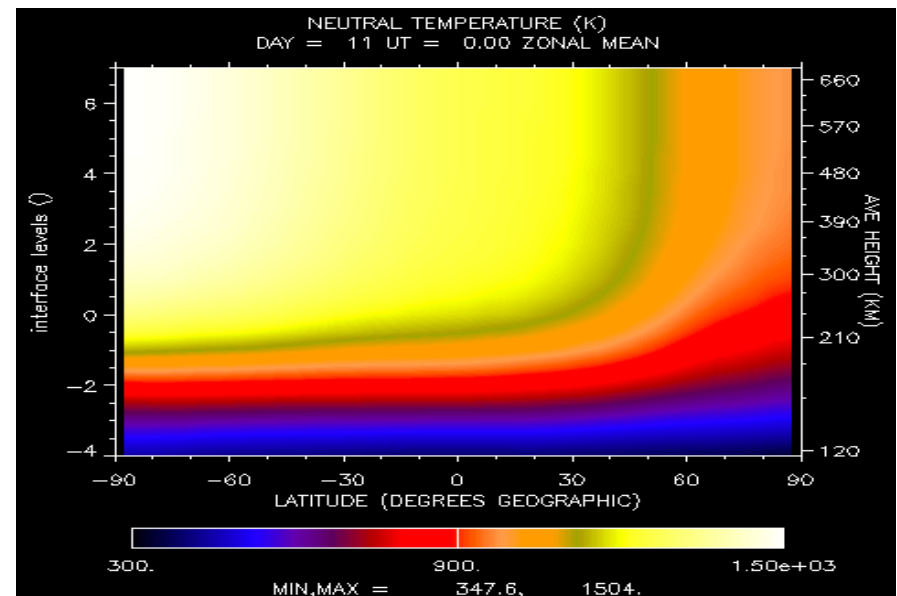
## Current WACCM-X



# WACCM-X Thermosphere Temperature Structure (January)

See McInerney Talk

## TIE-GCM





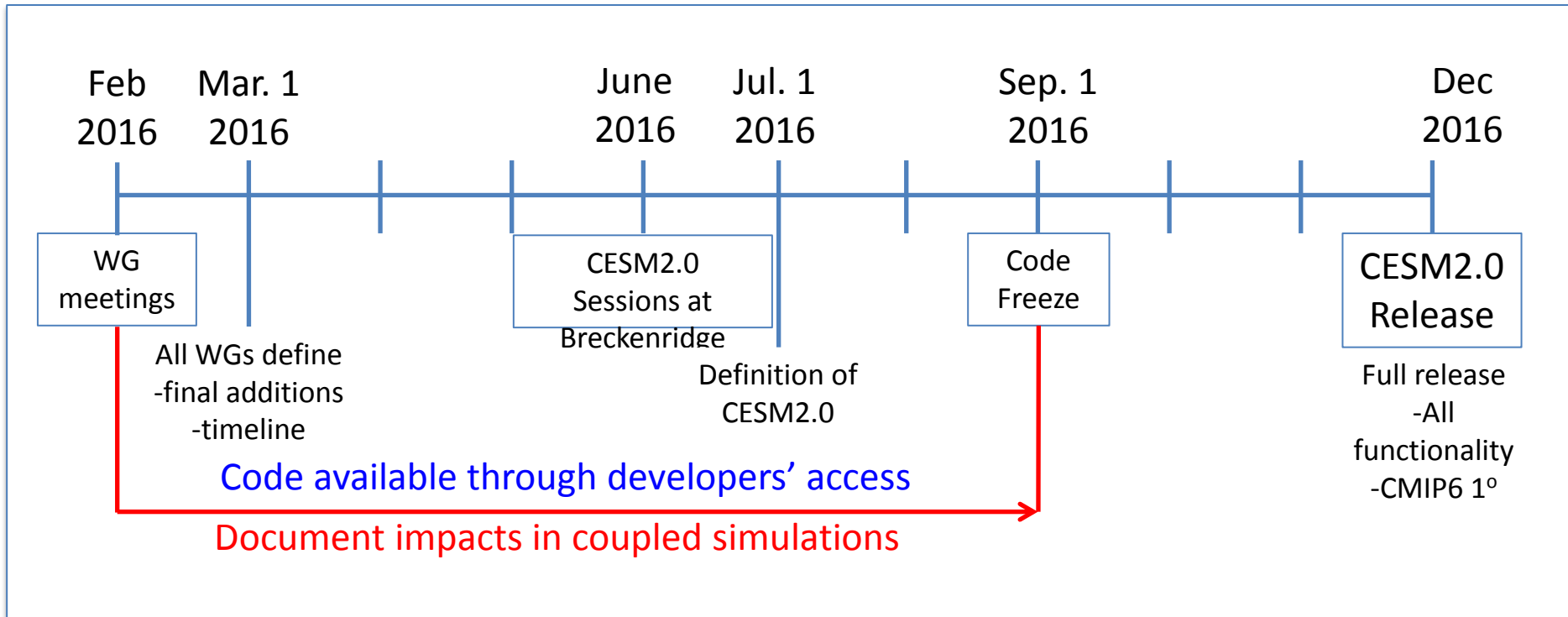
# Other Science Efforts

- Will hear from colleagues about other efforts with WACCM
  - CU
  - FMI
  - U. Leeds
  - NRL

# WACCM Developments/Plans

A. Gettelman, L. M. Polvani, M. Mills  
+ “WACCM Team” (You!)


# CESM2 revised timeline



Pending approval by the SSC

# Proposed WACCM Configurations

- WACCM6 L70, 1°, FV
  - Specified and full chemistry
- WACCM6 L110, 1°, FV
  - Matches a L64 CAM
  - Specified and full chemistry
- ~~• WACCM6 L110, 2°, FV~~
  - ~~– Specified and Full Chemistry~~
- WACCM-X 2.0
  - Includes description of ionosphere



This is probably  
either 1° OR 2°

# Current developments for CESM2

Two levels: (1) CMIP/DECK issues, (2) Other configurations (More flexible on (2))

- Pace CAM6 Physics
  - WACCM6 climatology: Temp, RH, SAD<sub>ice</sub>, O<sub>3</sub>
  - Adjustments to Gravity Waves
  - Use CCMI chemistry
- Forcing data sets
  - Volcanic forcing (Neely, Schmidt database)
  - Solar forcing (new specification)
  - Lower Boundary Condition files? Past 2005?
- WACCM-X release
- What is missing for CESM2? (Needed for March)

# Capturing Other Development

Do we want these for the WACCM Trunk?

- Available as options?
- WACCM-X (Common interface w/ NRL Ionosphere: Timestep dependence of climate)
- FMI D-Region Ions (Yes: try)
- WACCM-DART? ‘Should run: Dart Scripting’ (Yes)
- CU PSCs
- CARMA Updates (PSCs, Aerosols) Maybe?
- Leeds Metal ions
- (h4 capturing zonal mean for TEM, include GW forcing in CCMI...)
- WACCM-SC mesosphere ozone fix (Marsh)
- Sathist Scaling (slow).

# WACCM6 Development Strategy

- CCM1 Chemistry: DONE
- WACCM6 with CAM6 physics: functional: DONE
- Adjust SAD ice, check O<sub>3</sub> (SD-WACCM)
- Tune H<sub>2</sub>O and RH (Free running) To CAM
- Incorporate any changes to drag/momentum From CAM
- Tune GWD for T climatology, QBO, SSW, SAO, Tides

# Timing

- Finish WACCM mods to CAM physics (1-2 months)
- Will need to discuss any changes to Momentum
- Start tuning GWD for Temps and SSWs by April
  - Aiming for June-Sept
  - 90% tuning with current GW schemes
  - Tune in WACCM-SC (beginning)
- WACCM-SC Timing? DECK with WACCM6-SC?
  - Do most



# Questions for other WGs...

- When does WACCM need to be ready?
  - How are we spinning up an ocean?
  - Careful on configurations between CAM/WACCM
  - What are we running (multiple ensembles)
  - Forcing: daily zonal means (confirm)? Or 3D? ChemWG
- What are plans for surface stress/wave drag
  - CESM co-chair level group working on this
  - No more coupled tuning until we decide.
- What configurations do we recommend/support?
  - Is this consistent with rest of CESM2.
- DECK with WACCM6-SC? [may have to tweak code]
  - Do most MIPs with high top model
- Other Questions for Tomorrow...