WACCM Updates

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New Model Capabilities

- WACCM with specified chemistry (SC-WACCM).
  - Identified as a key development requirement in the last WG meeting.
  - A factor of ~3.5 saving over interactive chemistry.
  - Being evaluated against interactive chemistry version.
- Improved stratospheric heterogeneous chemistry: Updated, tested and released in CESM1.0.3.

CESM 1.0.4 Release

- Thermosphere extension of WACCM (WACCM-X).
  - WACCM-X compset: F-2000-WACCMX (solar max)
  - One year CESM 1.0.4/WACCMX control simulation.
- Dave Williamson found bug in molecular diff routine that affected lowest layer. Bug fixed.
- Molecular diffusion not input correctly in gravity wave module. Bug fixed.
- CESM 1.0.4/WACCM4 control run for climate validation completed.

Capability of CESM1.04-WACCMX

- Study the compositional, thermal, and wind structures from the Earth's surface to exobase (0-~500km)
- Sun-Earth connection; space environment (space weather and space climate); aeronomy, comparative aeronomy; upper atmosphere driving by the lower atmosphere processes.
- NSF Coupling, Energetics, Dynamics of Atmospheric Regions (CEDAR) and Geospace Environment Modeling (GEM) Communities.

WACCM-X Model Components

Model Framework	Chemistry	Physics	Physics	Resolution
Extension of the NCAR Community Atmosphere Model (CAM) Finite Volume Dynamical Core	MOZART+ Ion Chemistry Fully-interactive with dynamics.	Long wave/short wave/EUV IR cooling (LTE/non-LTE) Major/minor species diffusion (+UBC) Molecular viscosity and thermal conductivity (+UBC) Species dependent Cp, R, m. Parameterized GW (including thermosphere)	Parameterized electric field at high mid, low latitudes. IGRF geomagnetic field. Auroral processes, ion drag and Joule heating Ion/electron energy equations Ambipolardiffusion Ion/electron transport due to Lorentz force Ionospheric dynamo Coupling with plasmasphere/magnetosphere	Horizontal: 1.9° x 2.5° (lat x lon configurable as needed) Vertical: 81 levels (125 levels) 0-~500km •< 1.0km in Upper Troposphere/ Lower Stratosphere • 1-2 km in strat. • 0.5 scale height in mesosphere/ thermosphere (0.25 scale height in mesosphere/thermosphere with 125 levels)

Green: Thermosphere extension.

Red: Ionosphere extension.

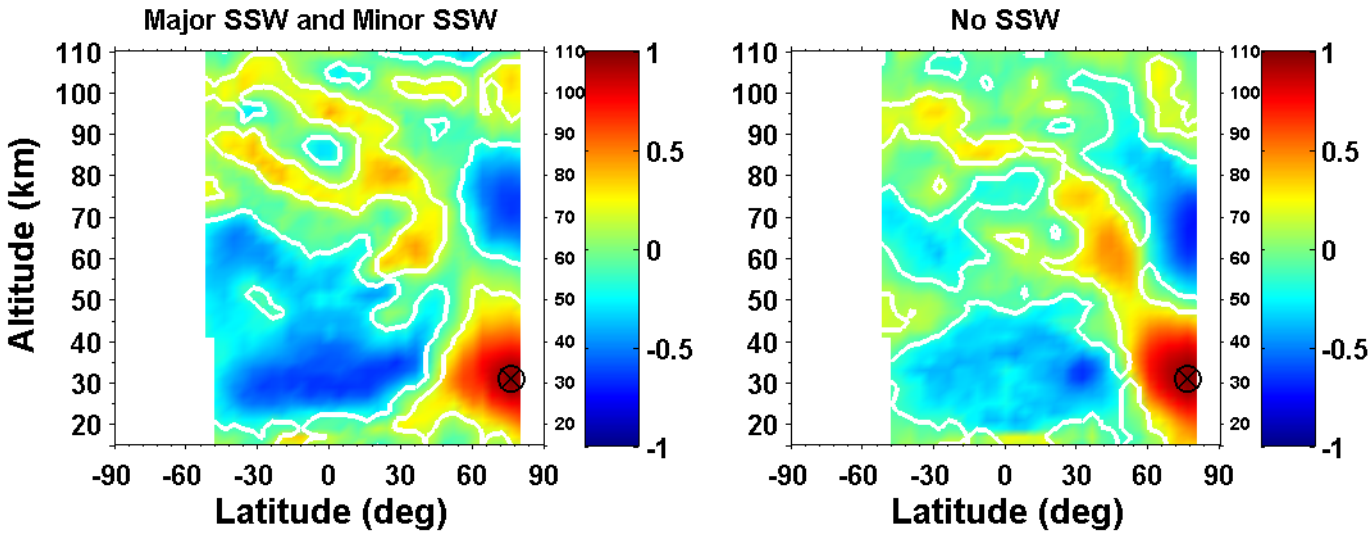
New Model Capabilities Under Development

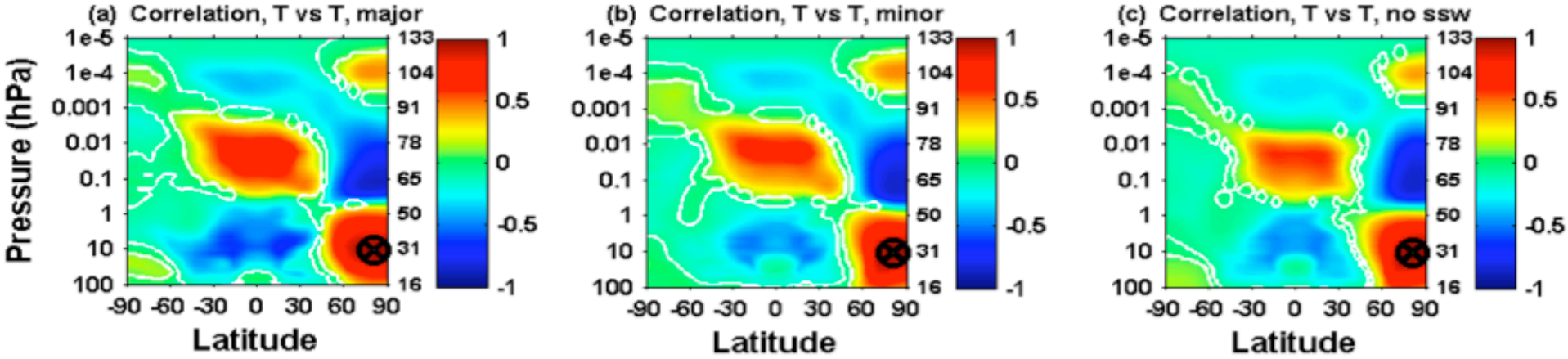
- WACCM5
  - RRTMG radiative code added
  - UW planetary boundary layer (PBL) scheme added
  - Morrison-Gettelman cloud physics added
  - Modal aerosol model (MAM) under development
    - prognostic: for detailed comparison to CAM5 runs
    - prescribed: to be WACCM5 default, for faster calculation
- WACCM-SE (spectral element)
  - cubed-sphere spectral element dynamical core added, validation pending
  - conservative semi-Lagrangian multi-tracer transport scheme (CSLAM) developed for the SE dycoreunder development
- Community Aerosol and Radiation Model for Atmosphere (CARMA) Bin Microphysics
  - Will be available on the CAM developer trunk shortly (this month)
  - Science models for a variety of aerosols under development (Bardeen, Mills, Toon group)
- SD-WACCM-X (specified dynamics): under development

Research Progress

- Climate studies:
  - CMIP5 simulations using WACCM4 and CCSM4.
  - WACCM climatology of SSW, blocking and relationship.
  - “World avoided”: ozone collapse and climate implications.
  - “World to avoid”: Nuclear winter simulations.
  - Climate mitigation: geoengineering, GeoMIP.
- Stratospheric/mesospheric impact of solar spectral variability.
- Middle/upper atmosphere dynamics:
  - Inertial gravity wave forcing and the “Cold pole bias”.
  - Internally generated QBO with parameterized IGW.
  - Lunar tides in the upper atmosphere.
  - Upper Stratosphere/Lower Mesosphere (USLM) disturbances.
  - Whole atmosphere teleconnection.

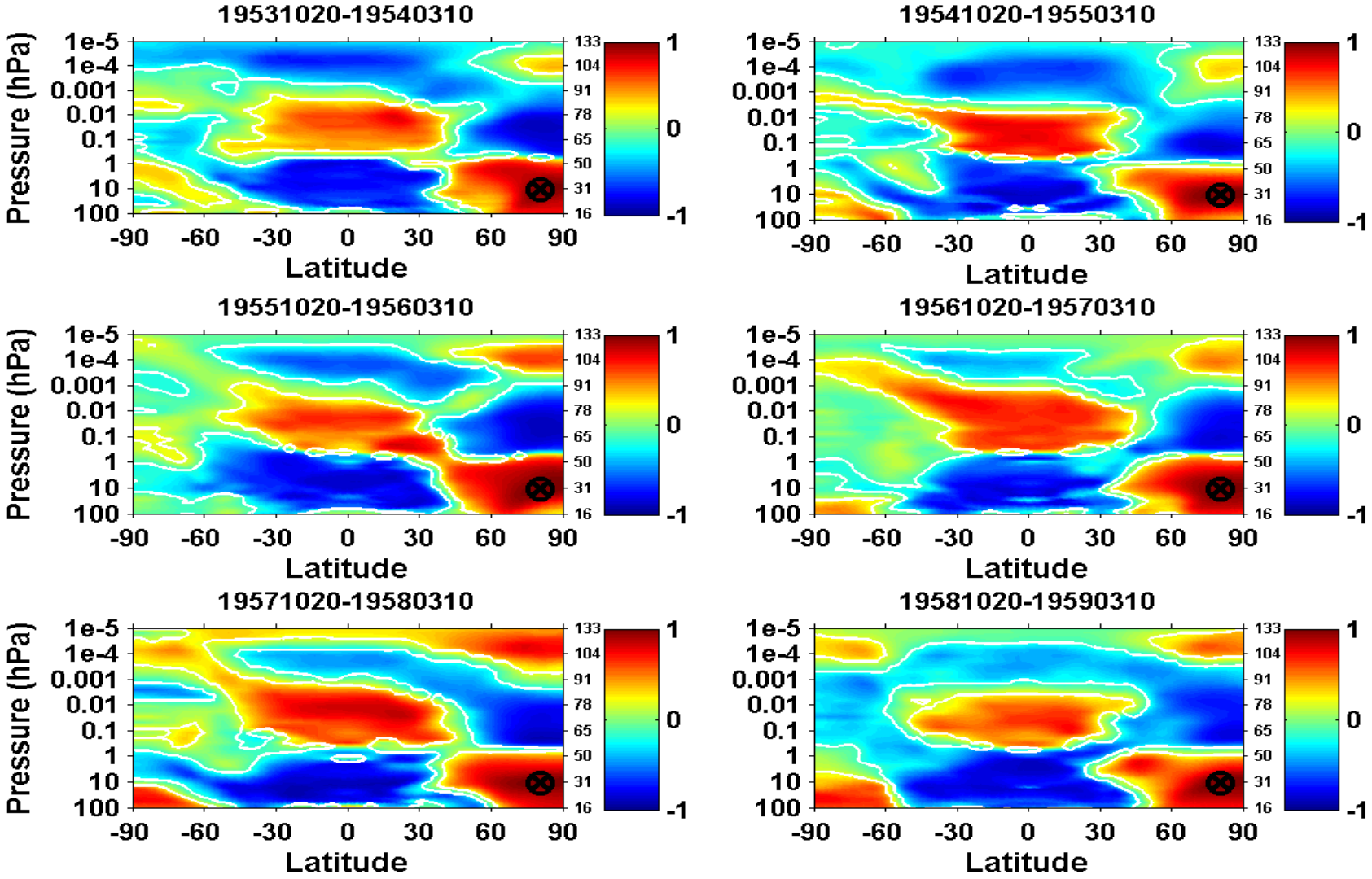
Correlation patterns from SABER and WACCM





Tan et al. (submitted)

Correlation patterns of each year to show inter-annual variations



Correlation patterns between the WACCM temperature anomalies at the reference point (10 hPa, 80°N) and at all latitudes and altitudes for the winters from 1953 to 1958. The title of each subplot gives the dates of data period in the format of "yyyymmdd–yyyymmdd". The symbol "X" is the reference point used for the correlations. White solid lines denote the 95% significance level.

New Opportunities

- NSF Frontiers in Earth System Dynamics (FESD) relevant for whole atmosphere studies:
  - Sun to Ice: Impacts on Earth of Extreme Solar Events (PI: Harlan Spence, U. New Hampshire; NCAR PI: Stan Solomon)
  - Electrical Connections and Consequences Within the Earth System (PI: Jeff Forbes, CU; NCAR PI: Art Richmond)
- NCAR-Wyoming Supercomputing Center (NWSC): Yellowstone
  - Nominally 30x bluefire performance.
  - Higher resolution simulations.
  - Larger ensemble members and better statistics.

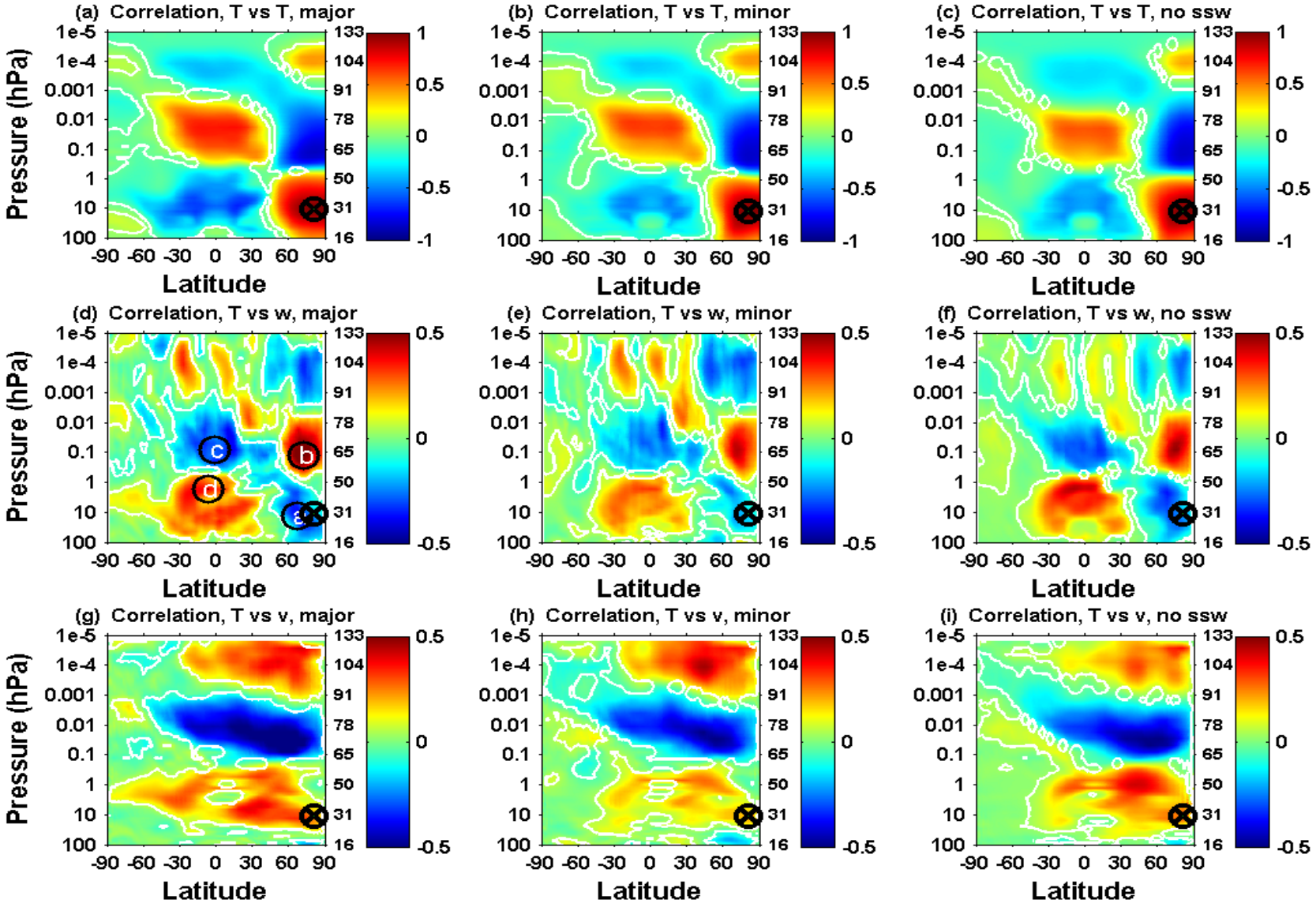
CESM Tutorial: July 30 – August 3, 2012
NCAR, Boulder, CO

- Lectures on simulating the climate system
- Practical sessions on running CESM, modifying components, and analyzing data
- Targeted at graduate student level
  - Max 80 students with financial support for up to 40 students
  - Acceptance criteria:
    - Preference given to early career graduate students, though we will aim for a mix of graduate students, postdocs, and early career research scientists and faculty
    - Project descriptions and their fit with broader CESM goals and activities
    - Balance attendees across institutions
- How to Apply:
  - Application website online at:

    http://www.cesm.ucar.edu/events/tutorials/073012/announcement.html
  - Application deadline: March 23, 2012
  - Accepted students informed by late April
  - Questions should be directed to Dave Bailey(dbailey@ucar.edu)

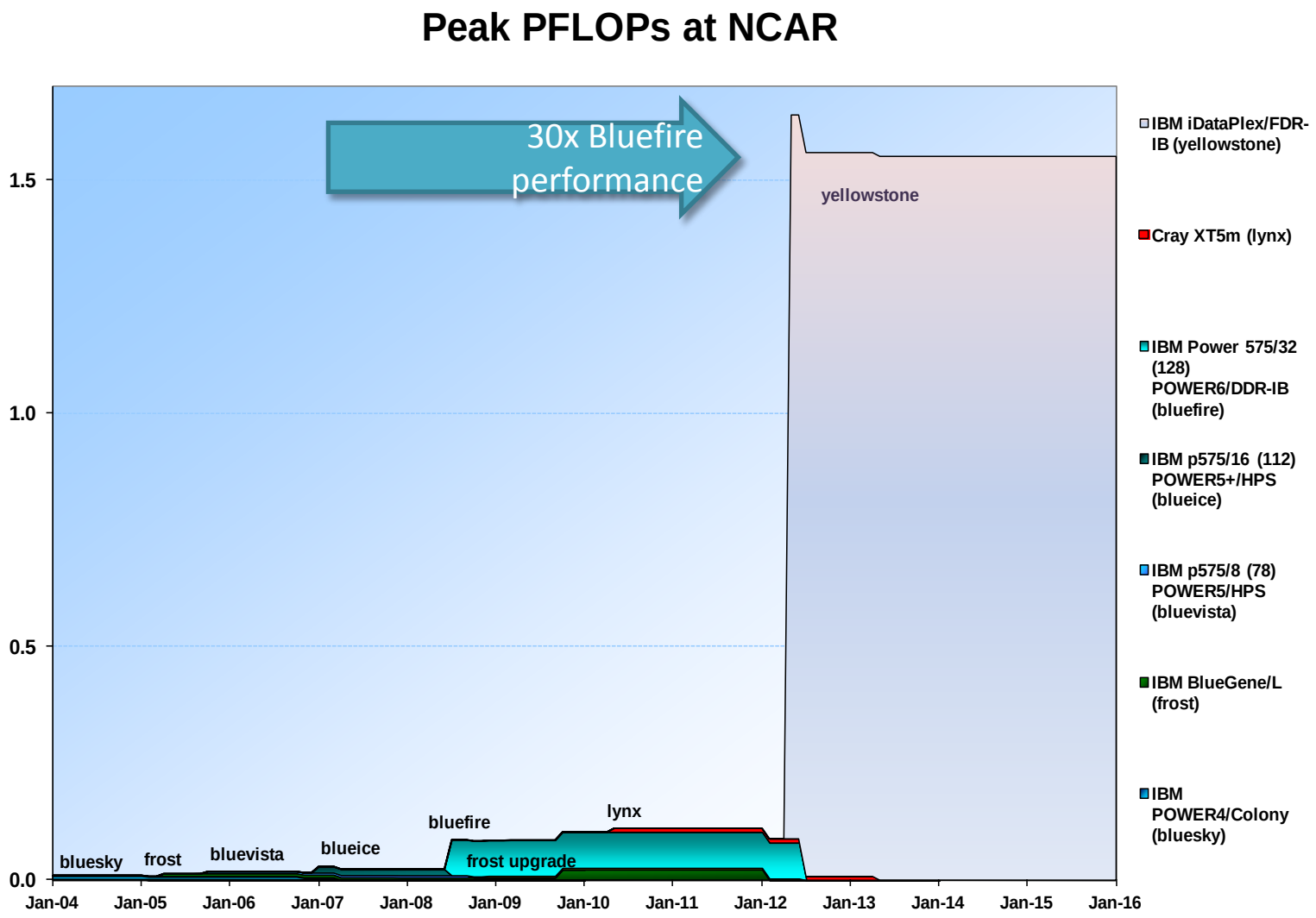
Thank you!

Correlation patterns from WACCM simulations



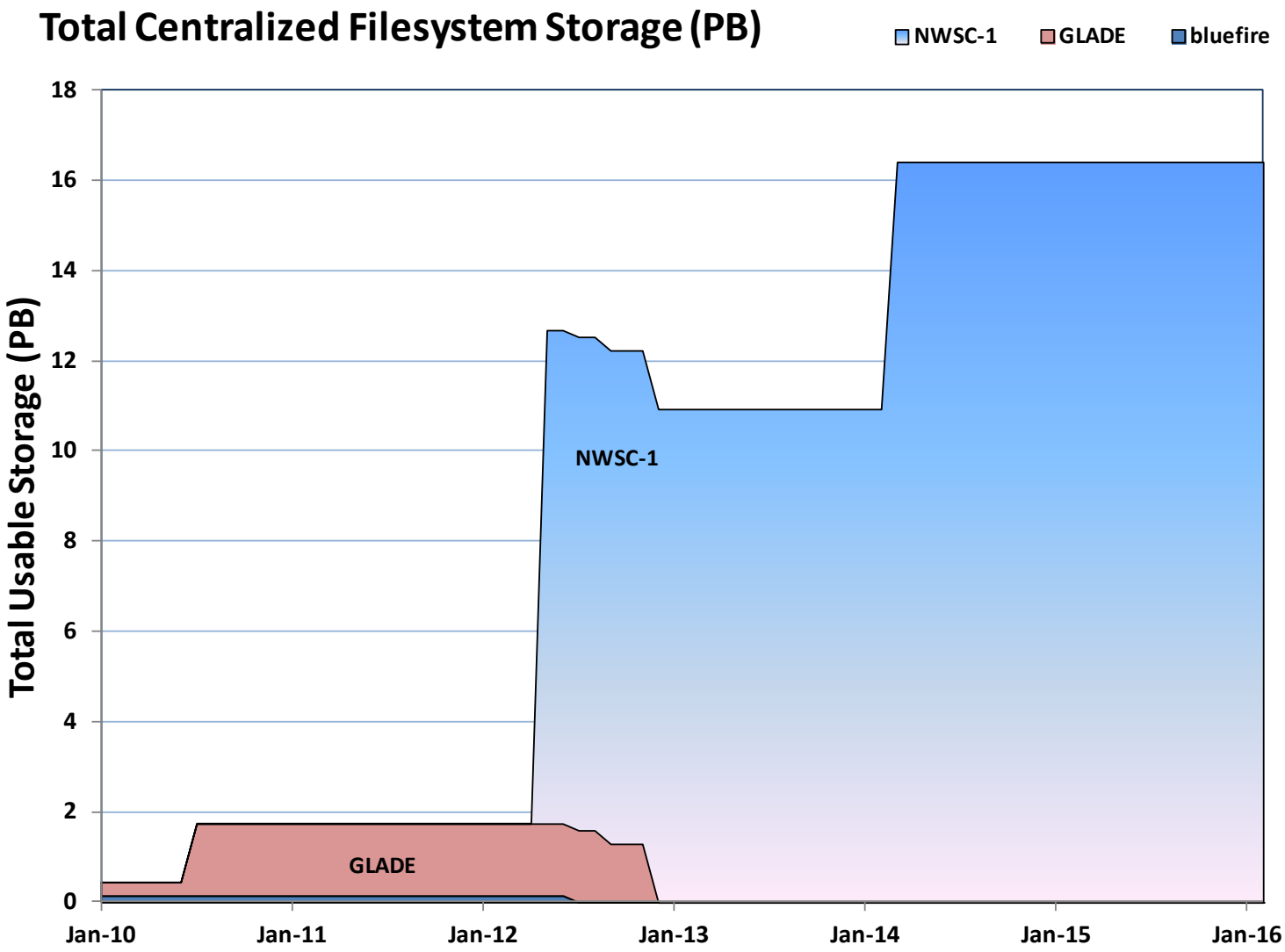
Correlation patterns between the WACCM (Oct 20 – Mar 10) temperature anomalies at the reference point (10 hPa, 80°N) and anomalies of T (first row), W (second row) and V (third row with major SSWs (left column), minor SSWs (middle column) and without SSWs (right column).

NCAR HPC Profile



Courtesy: David Hart (CISL)

NCAR Disk Storage Capacity Profile



Courtesy: David Hart (CISL)