Update on CESM Activities

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CESM Chief Scientist

NCAR

Liaison Resources

- Due to budget reductions, community liaison resources have declined

- The following groups currently have no community science liaison:
  - Land Model Working Group
  - Ocean Model Working Group
  - Polar Climate Working Group
  - Societal Dimensions Working Group

- The following "development" groups currently have no software engineering liaison:
  - Ocean Model Working Group
  - Polar Climate Working Group

All of these lost during last ~year

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CESM Tutorial

Providing lectures describing component models and applications and practical sessions that give hands-on experience in running and modifying the model

- 4th Annual Tutorial was held 12-16 August, 2013

- 5th Annual Tutorial planned for 11-15 August, 2014

- Application deadline is 1 March 2014

- About 80 Participants

- Tutorial materials on-line, including practical sessions

Thanks to NSF and DOE for co-sponsoring student participation!

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Climate Variability Diagnostics Package

- Focus on coupled model behavior using centuries of model output, with comparison to observations.

- Provides quantifiable metrics for major modes of climate variability.

- Compares CESM with previous model versions to assess model improvement.

- Compares CESM with other CMIP5 models.

- Easy to run; fast; outputs data files in netcdf format; user specifies observational and model data sets and periods of record.

- Will be released soon – early February

Thanks to Adam Phillips and Clara Deser for leading this effort!

Climate Variability Diagnostics Package

NCAR UCAR | CGD's Climate Analysis Section
Climate Variability Diagnostics Package

Methodology | Metrics Table
Climatological Period Used: Full
Input Namelists: OBS | Models
Derived Namelists: PR | PSL | SND | TAS | TS
Created: Wed Dec 4 19:52:25 MST 2013
CVDP Version 1.8.0

CSM/CCSM/CESM Comparison

Means and Standard Deviation Maps

SST	DJF	MAM	JJA	SON	Annual
TAS	DJF	MAM	JJA	SON	Annual
PSL	DJF	MAM	JJA	SON	Annual
PR	DJF	MAM	JJA	SON	Annual

Coupled Modes of Variability

AMO	Pattern	Timeseries	Power Spectra
PDO	Pattern	Timeseries	Power Spectra
ENSO	Spatial Composites	JJA^0	SON^0
		DJF^{+1}	MAM^{+1}
		El Niño Hovmöller	La Niña Hovmöller
	Niño3.4	Timeseries	Power Spectra
		Monthly Std. Dev.	Running Std. Dev.

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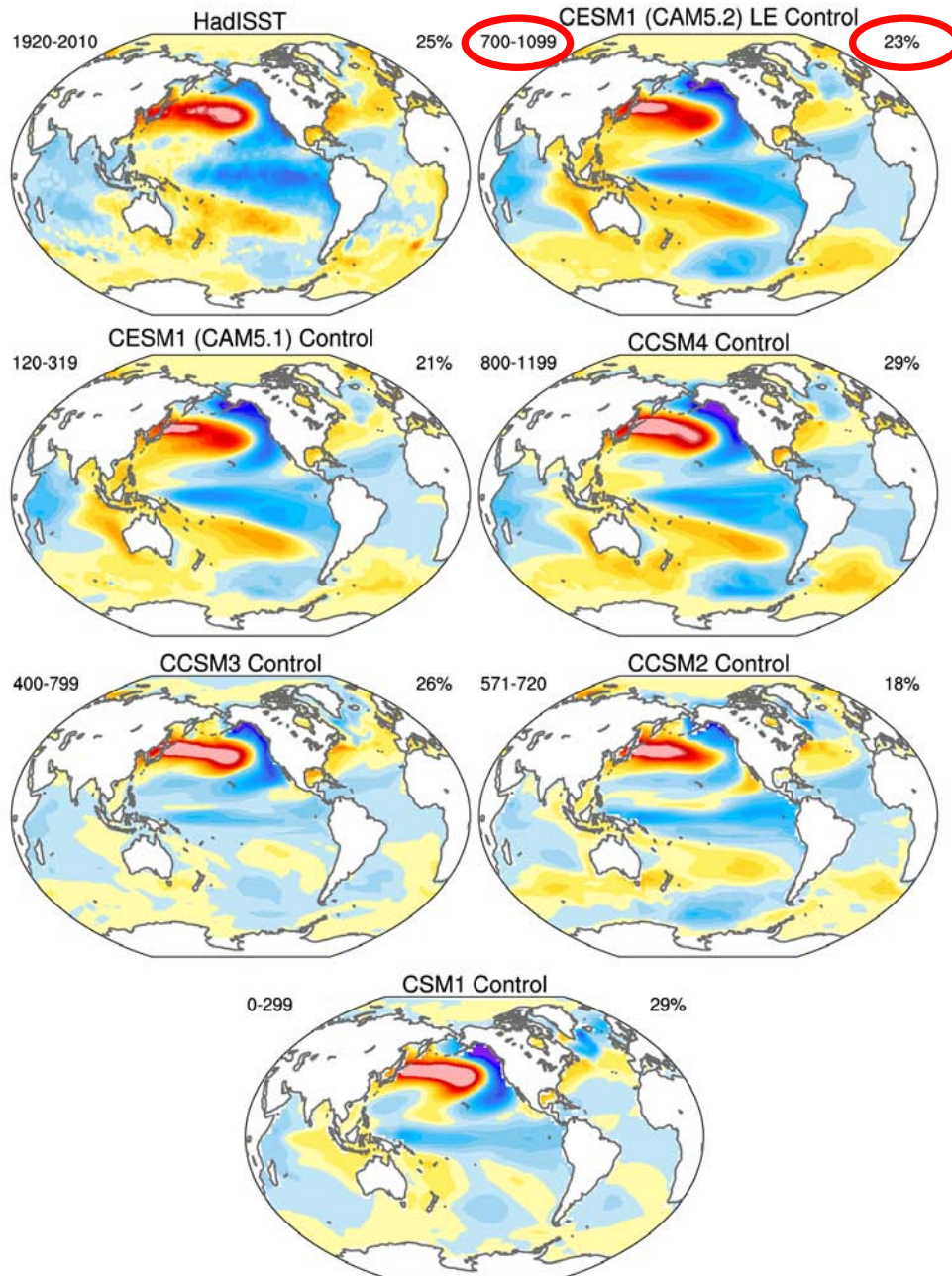
Climate Variability Diagnostics Package

PDO (Monthly)

Pacific Decadal Oscillation
(Global SST Regressions on PC1 North Pacific SST)

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Comparison to CMIP5

OBS

Climate Variability Diagnostics Package

CCSM4-CESM-WACCM

Historical SLP Trends 1950-2005 (DJF)

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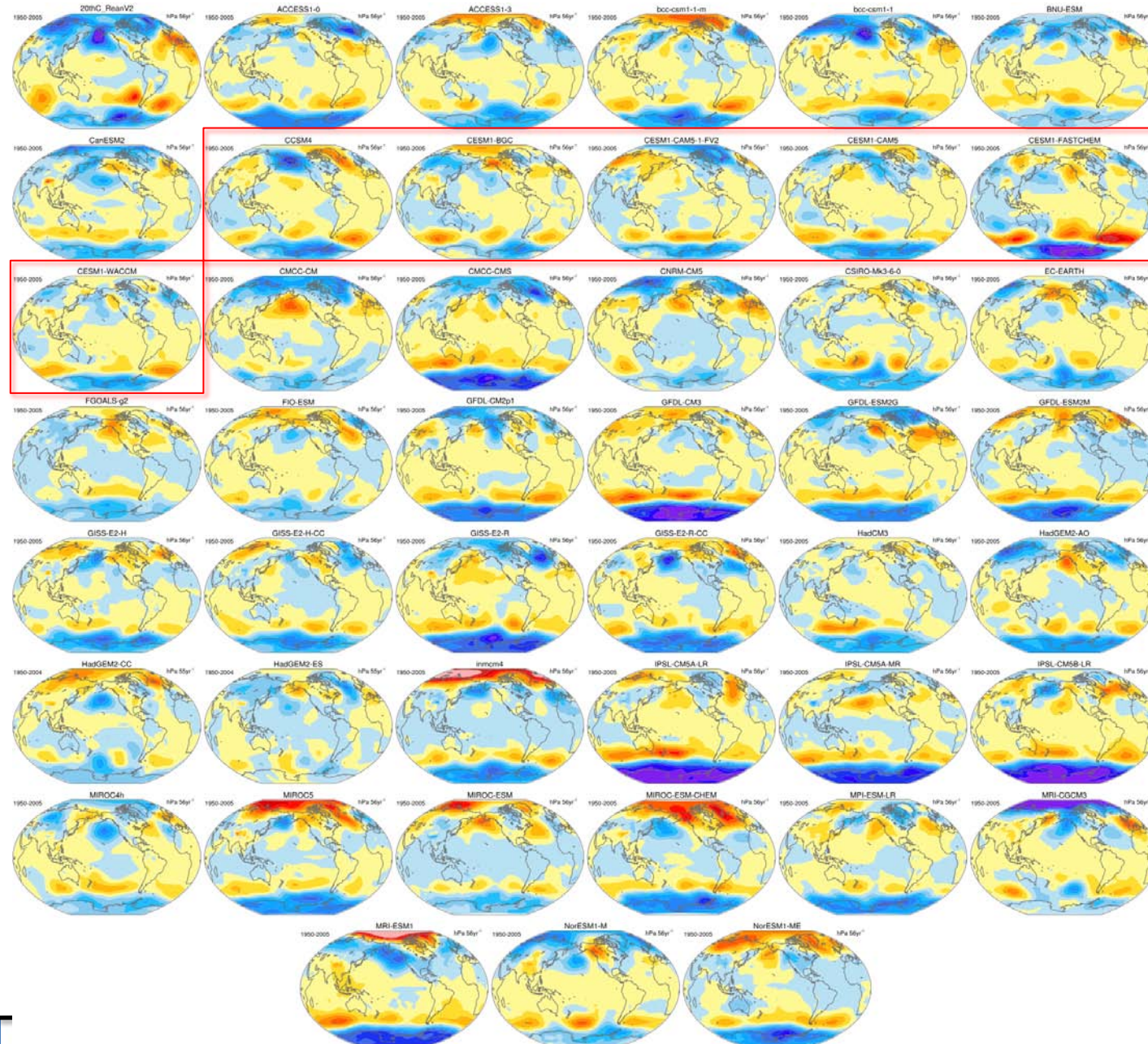
Climate Variability Diagnostics Package

Metrics Table
Pattern correlations/RMS differences: An objective way to assess model performance.

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Pattern Correlations/RMS Differences    Observations vs. Model(s)
```

|	CESM1 (CAM5.2) LE Control	CESM1 (CAM5.1) Control	CCSM4 Control	CCSM3 Control	CCSM2 Control	CSM1 Control
ENSO SST (DJF+1)	0.83/0.35	0.83/0.35	0.87/0.37	0.80/0.32	0.78/0.36	0.76/0.37
ENSO SLP (DJF+1)	0.80/0.82	0.74/0.90	0.72/1.17	0.77/0.76	0.50/1.13	0.72/0.77
AMO (Monthly)	0.73/0.34	0.77/0.36	0.71/0.35	0.73/0.29	0.76/0.29	0.56/0.43
PDO (Monthly)	0.85/0.07	0.84/0.06	0.83/0.07	0.73/0.08	0.74/0.08	0.76/0.08
NAM (DJF)	0.94/0.34	0.91/0.41	0.91/0.53	0.97/0.33	0.93/0.39	0.91/0.39
SAM (DJF)	0.93/0.31	0.93/0.30	0.91/0.35	0.91/0.39	0.97/0.58	0.93/0.46
SST Std Dev (Ann)	0.63/0.09	0.63/0.09	0.69/0.10	0.64/0.10	0.59/0.09	0.43/0.16
PSL Std Dev (Ann)	0.95/0.12	0.95/0.12	0.93/0.16	0.94/0.15	0.94/0.17	0.94/0.13
PR Std Dev (Ann)	0.86/0.15	0.85/0.16	0.88/0.15	0.78/0.18	0.78/0.19	0.65/0.23
AVERAGE	0.84/0.29	0.83/0.31	0.83/0.36	0.81/0.29	0.78/0.36	0.74/0.34

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CESM Community Integrations

- CESM integrations with broad cross-working group science applications

- To be made available in timely fashion to scientific community via ESG

- Three projects:
  - Large Ensemble
  - Last Millennium Ensemble
  - High Resolution Control Run

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Community Integrations: Last Millennium Ensemble

Thanks to Bette Otto-Bleisner for overseeing this activity!

Volcanic
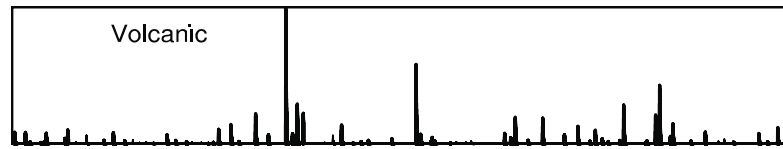
on

SH DJF Solar Insolation

- Motivation: To assess and attribute climate variations over the last millennium.

- Simulations from 850-2005; ensembles of fully-forced + single forcing CESM-CAM5 experiments (16) and fully-forced WACCM runs (2) at FV2x1 resolution.

- CESM1-CAM5 2-degree pre-industrial controls are completed.

- Six runs have finished 850AD to ~1800AD for all forcings and each forcing separately (GHG, Volcanic, Solar, Orbital, LULC).

- Additional ensemble members underway (8 full forcing; additional single forcing); extending to 2005

CESM-CAM5 Last Millennium Single forcings

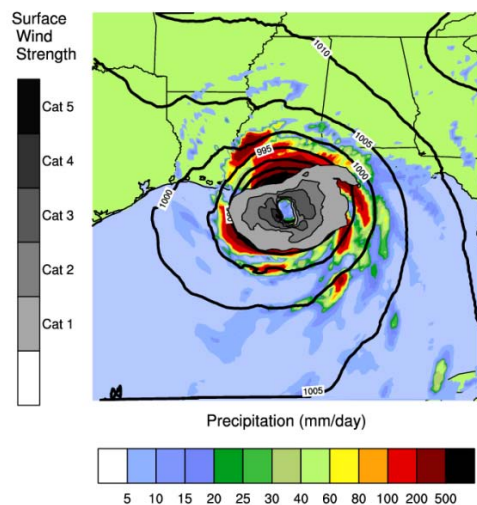MCA (950-1250) - LIA(1400-1700)
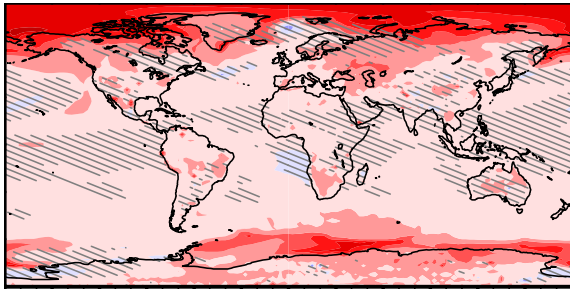
6 0.8   1   1.2 1.4

Hatched areas not significant at 95% CI

Courtesy of Bette Otto-Bleisner

Community Integrations – High Resolution Control

Tropical Cyclones
12-km CAM-SE Run

Surface Wind Strength
- Cat 5
- Cat 4
- Cat 3
- Cat 2
- Cat 1

Precipitation (mm/day)

5 10 15 20 25 30 40 60 80 100 200 500

Cubed Sphere

- Fully couple configuration
  - 25km CAM5-SE
  - 1-degree ocean

- Multi-century integration

- Configuration still in development

- Likely to start spring 2014

- Will solicit community input on desired output, etc.

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NCAR Climate & Global Dynamics

CESM2 Planning

- Target Release of CESM2 in June 2016

- Will include a number of scientifically supported options

  - With pre-industrial control runs, 20th century runs

- Additional "research" options – functionally supported versions – will be available

CESM2 Targets

For "scientifically supported" versions, include a limited set -

- Configurations:
  - Physical Climate w/CAM5+
  - Physical Climate w/CAM6,
  - Physical Climate w/WACCM,
  - Carbon Cycle/BGC with enhanced atm chem coupling,
  - Coupled Ice Sheet integrations (level of coupling TBD – particularly for ocean)

- Plan to use CAM5+ atmosphere for WACCM, Carbon Cycle, CISM Model Versions

Timeline

CESM2 Development

Coupled CAM5+ Runs

CAM5+ Finalized

Possible CAM5+ Release

CESM2 Components Finalized ← July 2015

Coupled Runs/Tuning

CESM2 Finalized ← Jan 2016

Control Runs

CESM2 Release

Additional Runs

Data Processing/Publishing

June 2014   Jan 2015   June 2015   Jan 2016   June 2016   Jan 2017

January 2013

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CESM Planning

CESM2 Timelines:

- **Fall 2015**: Coupled runs with CAM5+

- **Early 2015**: **CAM5+ model** finalized, subject to tuning, for use in the WACCM, BGC/chemistry, and CISM configurations.

- **July 2015**: **Component models for CESM2 are nearly final**, subject to modification (tuning) based on coupled model performance.

- **July-Dec, 2015**: Perform coupled simulations with finalized components; **Tuning** of component models as needed to maximize coupled simulation quality

- **Jan 2016**: **CESM2 supported configurations are finalized**, including final parameter settings, etc. for different component models

- **Jan-June 2016**: PI control runs and 20th century **runs performed** for supported CESM2 configurations

- **June 2016**: **CESM2 Model release**; To include PI control run, 20th century run, AMIP runs for supported configurations (at a minimum)
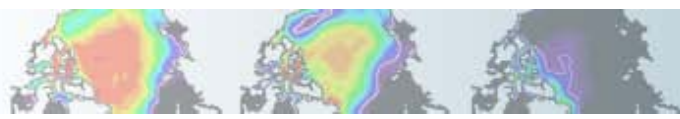
CESM2 Targets:

- "Bleeding edge" physical climate model version (with CAM6)
- Physical climate model with WACCM
- Carbon cycle/BGC model version with enhanced atmospheric chemistry coupling
- Coupled ice sheet integrations
- Physical Climate model with CAM5+

Possible CESM2 Targets – Research Options

- ## Possible Research options:
  - Coupled integrations with data assimilation via DART (decadal prediction)
  - Coarse resolution quick-development version
  - Isotope-enabled runs
  - Numerous physics options
  - Others?

Questions/Comments?

CESM2 Proposed Targets

- Resolutions:
  - 0.25^oATM/1^oOCN
    - To meet scientific interest in investigating high resolution
    - 0.25^o ATM has good simulation of tropical cyclones; higher resolution not much improved
  - 1^oATM/1^o OCN,
    - Work horse model; used for large ensembles, etc.
  - 2^oATM FV/1^oOCN? – Community discussion underway on "cheaper" and "simpler" models
  - Vertical resolution in atmosphere still TBD; being actively investigated

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CESM2 Targets

	0.25º/1º	1º/1º	2º/1º (TPD?)
Physical Climate	X	X	X
Physical Climate-High Top			X
Carbon Cycle		X	
Coupled CISM		X	

preindustrial control simulations, 20th century runs, AMIP runs available with release

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Redesign of Model Output/Processing Workflow

Category	CMIP3	CMIP5
Models	2 (CCSM3, PCM)	5 (CCSM4, CESM1-BGC, CESM1-CAM5, CESM1-WACCM, CESM1-CHEM)
Volume submitted	~9 TB (over 10 months)	~136 TB (over 1 year)

- Need to streamline future processing/publishing for large community integrations (like CMIP)

- Need to reduce CESM data storage

- Survey performed to determine user requirements

- Pursuing new post-processing/archiving of output

Effort led by John Dennis (CISL), Jim Edwards (CSEG), Mariana Vertenstein (CSEG)

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New (Port) Validation Tool in Development

M. Levy, J. Edwards, A. Mai, D. Nychka, J. Tribbia, M. Vertenstein, D. Williamson
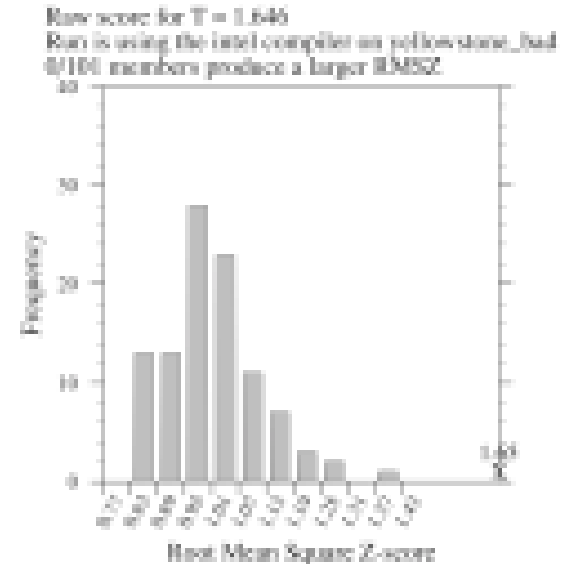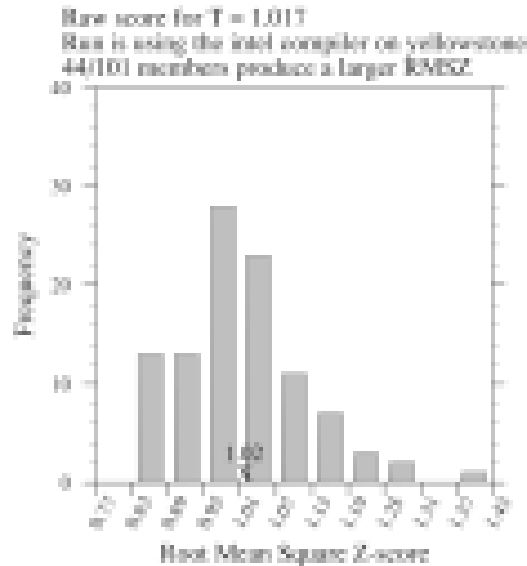
Generate 101-member 1 year control ensemble on a trusted machine

Generate 3 one-year runs of ported model

Assess ported model in the context of the control variations

Still determining what variables to examine, what denotes a "fail", …

Currently for "port" validation – need to better define a "climate" validation tool

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