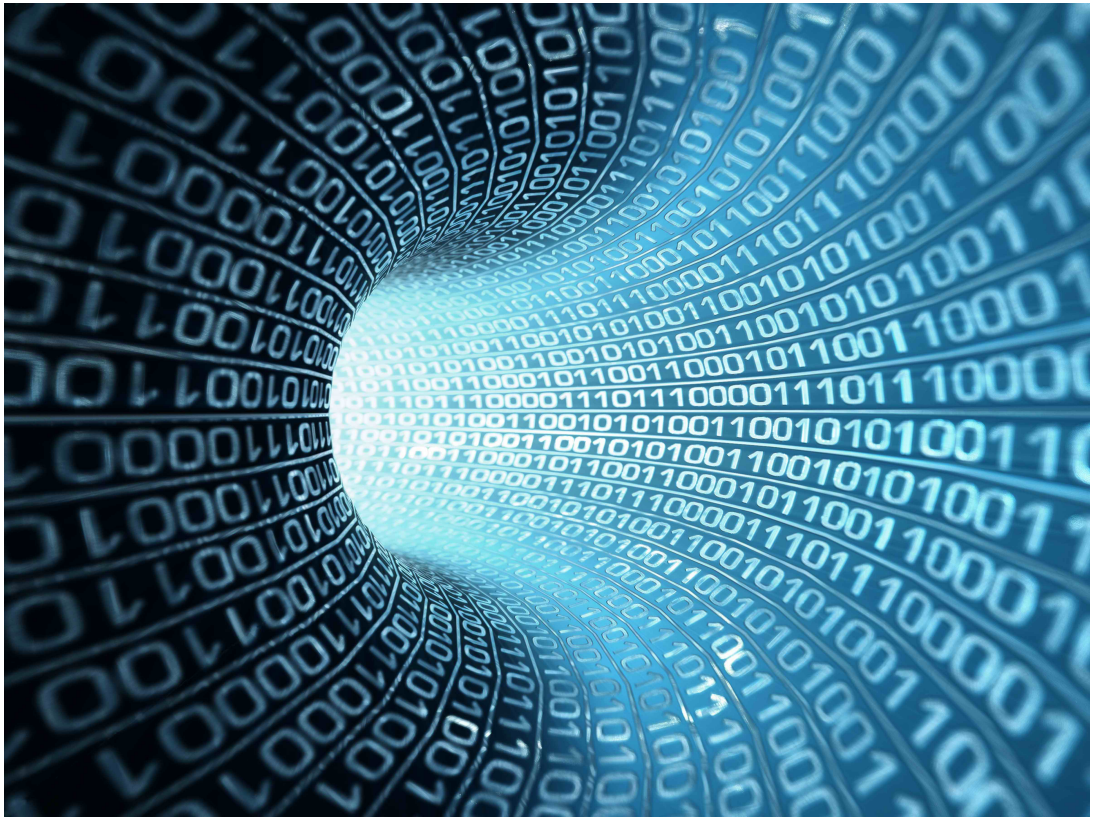
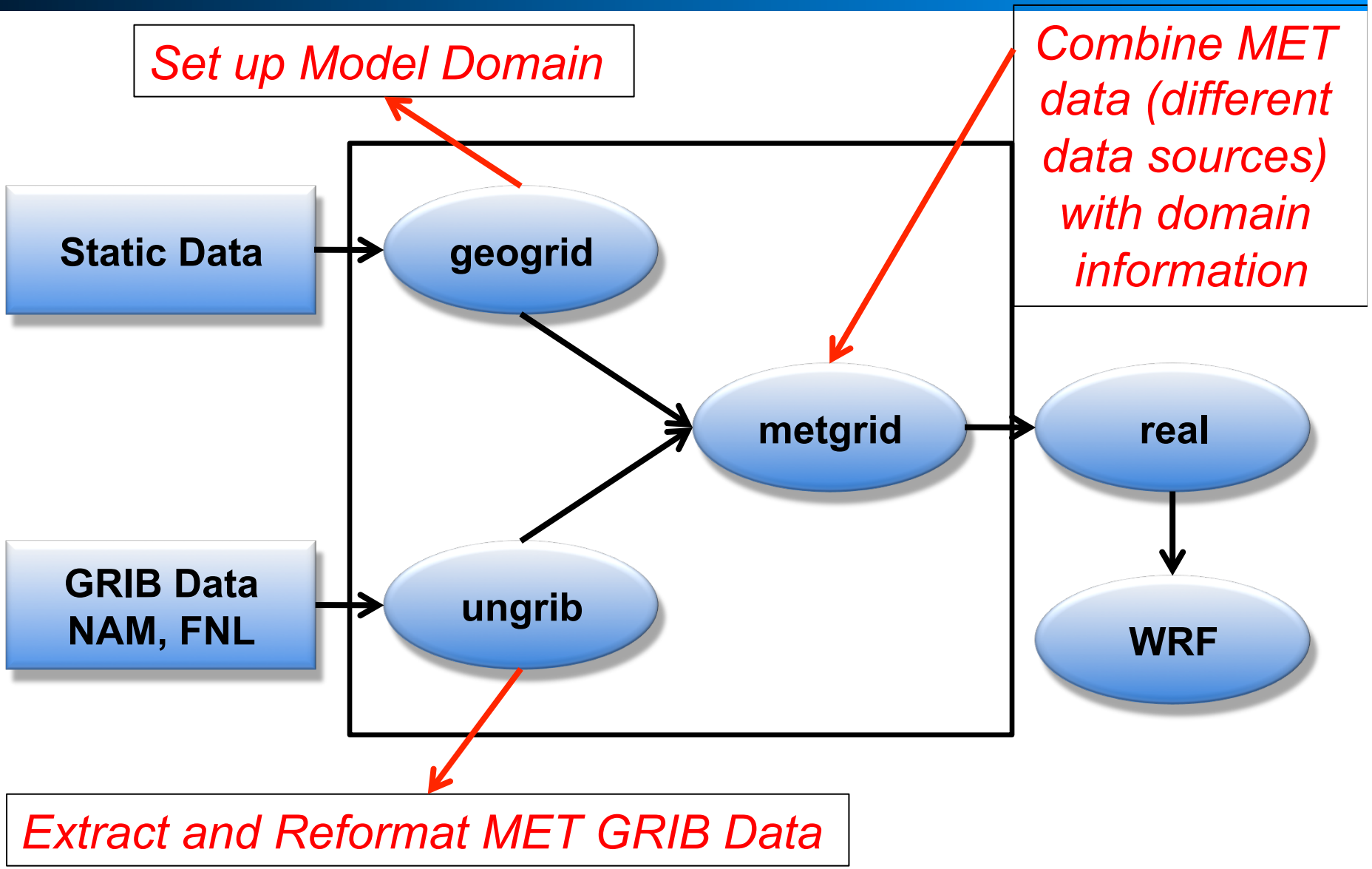
Data for Regional Climate Model Initialization

Cindy Bruyère

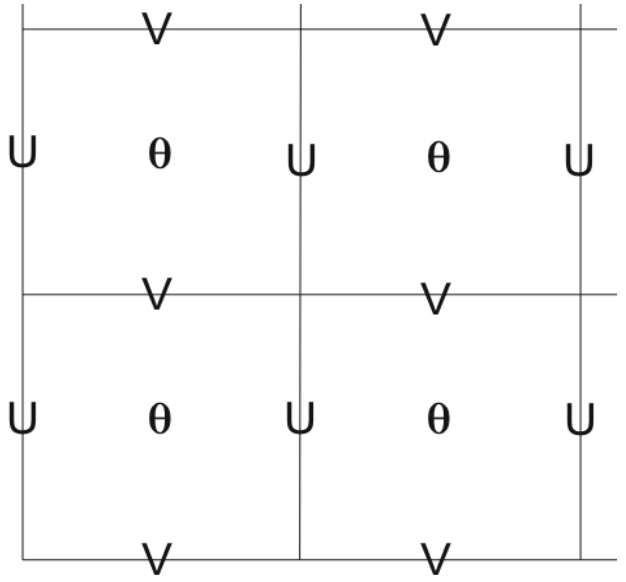


WRF System


Set up Model Domain
Combine MET data (different data sources) with domain information
Static Data
geogrid
metgrid
real
GRIB Data NAM, FNL
ungrib
WRF
Extract and Reformat MET GRIB Data

Fields in geo_em files

- All invariant (static) data
  - XLAT & XLONG
  - MAPFAC
  - LANDMASK
  - HGT
  - GREENFRAC
  - LANDUSEF & LU_INDEX
  - ALBEDO12M & SNOALB
  - SOILTEMP; SOILCTOP & SOILCBOT



Data availability: http://www.mmm.ucar.edu/wrf/users/

Fields needed for IM files – 6hourly

3D Data (e.g. data on pressure levels)

- Temperature ; U and V components of Wind
- Geopotential Height; Relative Humidity

2D Data

- Surface Pressure; Mean Sea Level Pressure
- Skin Temperature
- 2 meter Temperature and Relative Humidity
- 10 meter U and V components of wind

Recommended

- LANDSEA
- Soil data (temperature and moisture) & soil height
- SST (climate runs – requires)
- Water equivalent snow depth & SEAICE

Ungrib: Example Vtable

GRIB1 Param	Level Type	From Level1	To Level2	UNGRIB Name	UNGRIB Units	UNGRIB Description
11	100	*		T	K	Temperature
33	100	*		U	m s-1	U
34	100	*		V	m s-1	V
52	100	*		RH	%	Relative Humidity
7	100	*		HGT	m	Height
11	105	2		T	K	Temperature at 2 m
52	105	2		RH	%	Relative Humidity at 2 m
33	105	10		U	m s-1	U at 10 m
34	105	10		V	m s-1	V at 10 m
1	1	0		PSFC	Pa	Surface Pressure
130	102	0		PMSL	Pa	Sea-level Pressure
144	112	0	10	SM000010	kg m-3	Soil Moist 0-10 cm below grn layer
144	112	10	40	SM010040	kg m-3	Soil Moist 10-40 cm below grn layer
144	112	40	100	SM040100	kg m-3	Soil Moist 40-100 cm below grn layer
144	112	100	200	SM100200	kg m-3	Soil Moist 100-200 cm below gr layer
85	112	0	10	ST000010	K	T 0-10 cm below ground layer (Upper)
85	112	10	40	ST010040	K	T 10-40 cm below ground layer (Upper)
85	112	40	100	ST040100	K	T 40-100 cm below ground layer (Upper)
85	112	100	200	ST100200	K	T 100-200 cm below ground layer
91	1	0		SEAICE	proprtn	Ice flag
81	1	0		LANDSEA	proprtn	Land/Sea flag (1=land,2=sea in GRIB2)
7	1	0		HGT	m	Terrain field of source analysis
11	1	0		SKINTEMP	K	Skin temperature
65	1	0		SNOW	kg m-2	Water equivalent snow depth
223	1	0		CANWAT	kg m-2	Plant Canopy Surface Water
224	1	0		SOILCAT	Tab4.213	Dominant soil type category
225	1	0		VEGCAT	Tab4.212	Dominant land use category

ungrib : External Data Sources

- NNRP (R1)
  http://rda.ucar.edu/datasets/ds090.0/
- NCEP / DOE Reanalysis II (Jan 1979 to Dec 2010)
  http://rda.ucar.edu/datasets/ds091.0/
- ERA Interim Data (~ 0.7^{o} Global data; Jan 1979 to present)
  http://rda.ucar.edu/datasets/ds627.0/
- NCEP Climate Forecast System Reanalysis (CFSR) (~38km, global data; Jan 1979 to Dec 2010)
  http://rda.ucar.edu/pub/cfsr.html

ungrib : External Data Sources

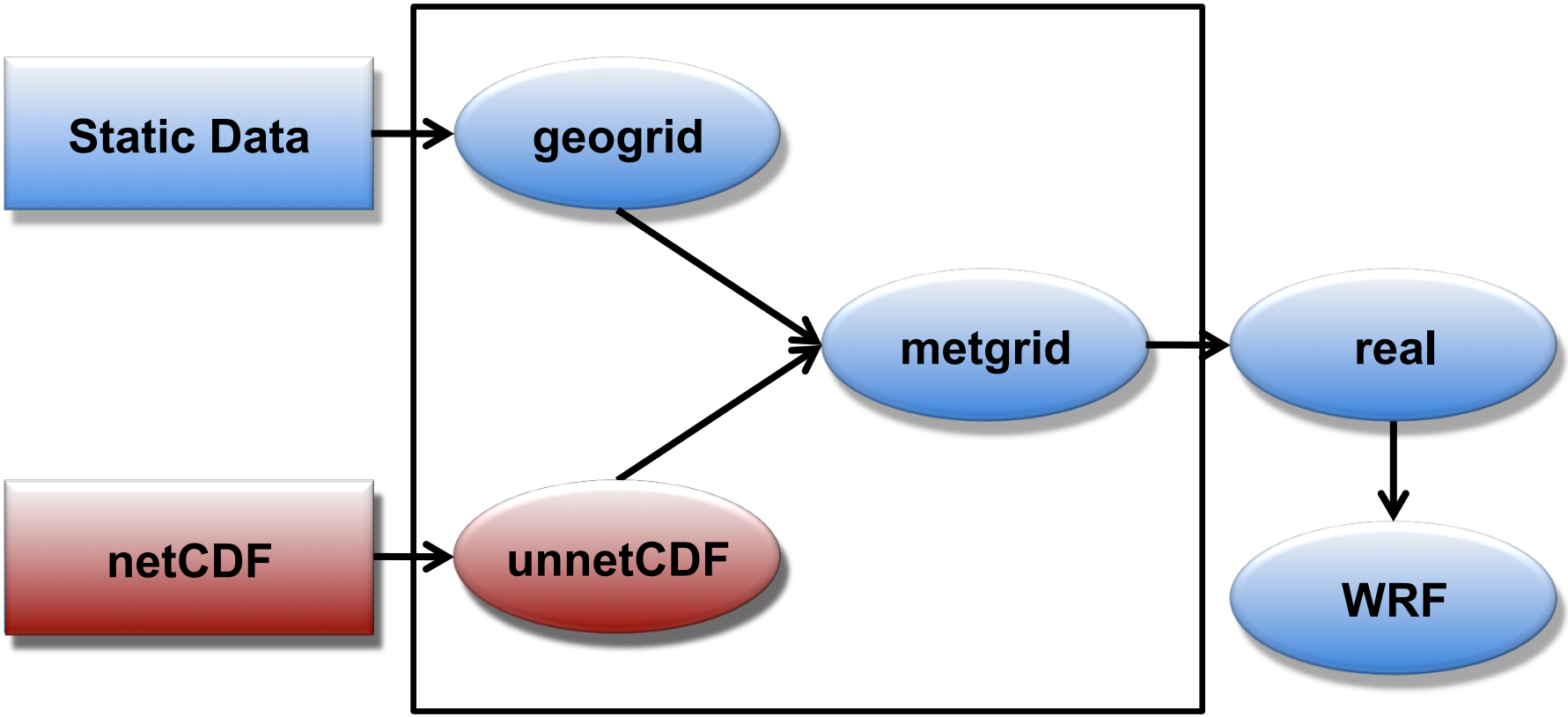
- GFS Real-time 1^{o} data
  http://www.emc.ncep.noaa.gov/
- Final Analysis (FNL)
  http://rda.ucar.edu/datasets/ds083.2
- GFS 0.5^{o} Global data (Dec 2002 to present)
  http://rda.ucar.edu/datasets/ds335.0/
- SST data
  http://polar.ncep.noaa.gov/sst/oper/Welcome.html
  http://nomad3.ncep.noaa.gov/pub/sst/weekly/

ungrib : External Data Sources

- For climate runs CMIP data are available *(netCDF)*
- There are also data available from NCAR for CCSM3 *(netCDF plus converter)*
- NCAR CESM – CMIP5 data *(netCDF plus converter)* http://rda.ucar.edu/datasets/ds316.0/
- NorESM data from Norway *(netCDF plus converter ; data in IM format also available)*

ungrib : External Data Sources

- **Input data from climate models are typically in netCDF format**



Create your own IM files

```
Record 1:     IFV
Record 2:     HDATE, XFCST, MAP_SOURCE, FIELD, UNITS, DESC,
              XLVL, NX, NY, IPROJ
Record 3:     STARTLOC, STARTLAT, STARTLON, DELTALAT, DELTALON,
              EARTH_RADIUS
Record 4:     IS_WIND_EARTH_REL
Record 5:     2D DATA SLAB
```

```
call ncvgt( cdfid,id_var,is_sst,ie_sst,SST_DATA,rcode )
    field  = "SST"
    units  = "K"
    Desc   = "Sea Surface Temperature"
    xfcst = 0.0
    write(11) 5
    write(11) hdate, xfcst, field, units, Desc, 200100.0,
               1440, 720, 0
    write(11) -89.875, 0.125, 0.25, 0.25, earth_rad
    write(11) wind_type
    write(11) SST_DATA
```

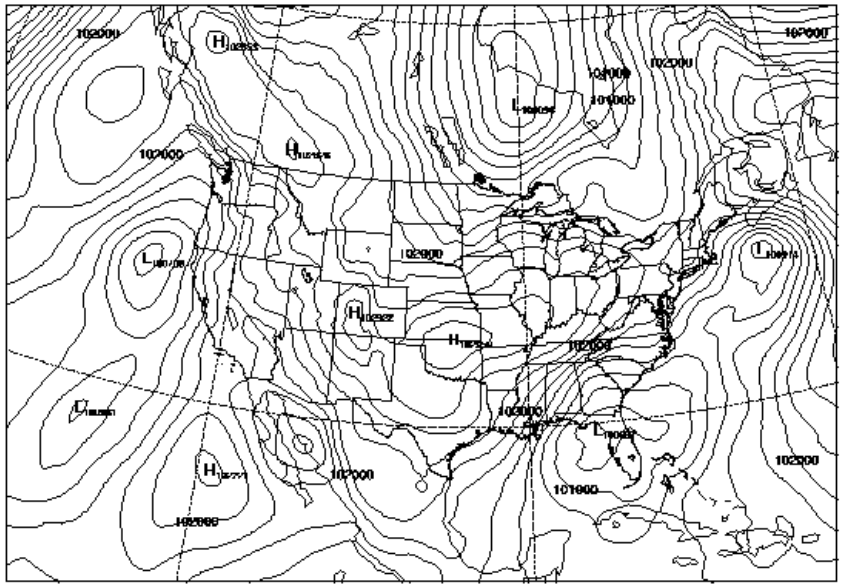
Utility: rd_intermediate

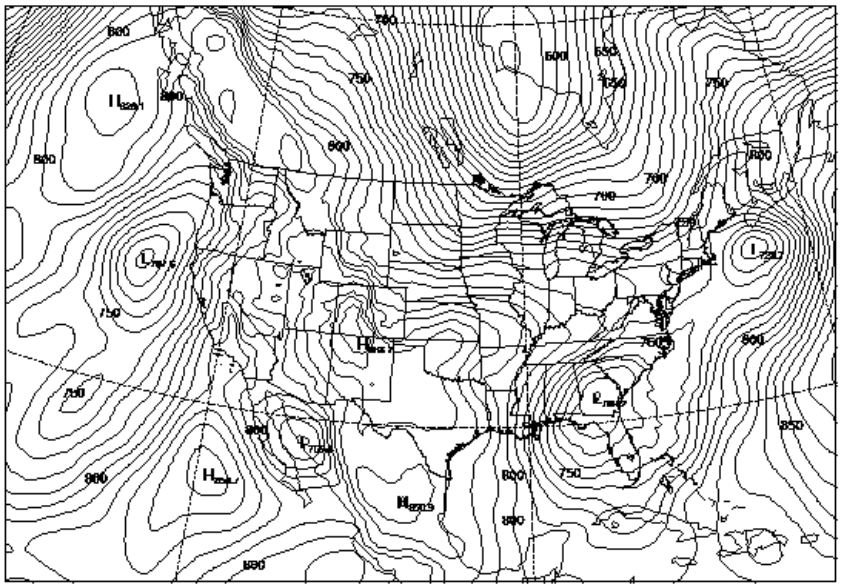
The rd_intermediate lists information about the fields found in an intermediate-format file

```
================================================
FIELD = TT
UNITS = K DESCRIPTION = Temperature
DATE = 2000-01-24_12:00:00 FCST = 0.000000
SOURCE = unknown model from NCEP GRID 212
LEVEL = 200100.000000
I,J DIMS = 185, 129
IPROJ = 1
  REF_X, REF_Y = 1.000000, 1.000000
  REF_LAT, REF_LON = 12.190000, -133.459000
  DX, DY = 40.635250, 40.635250
  TRUELAT1 = 25.000002
DATA(1,1)=295.910950
================================================
```

Utility: plotfmt

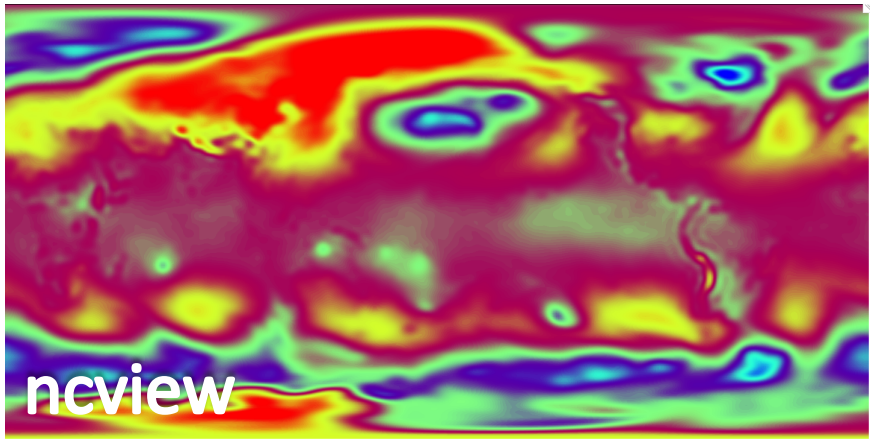
The plotfmt program plots the fields in the ungrib intermediate-formatted files

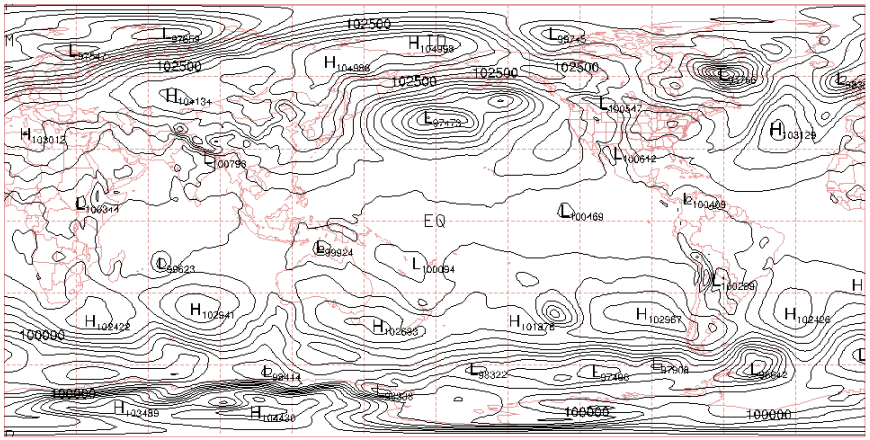


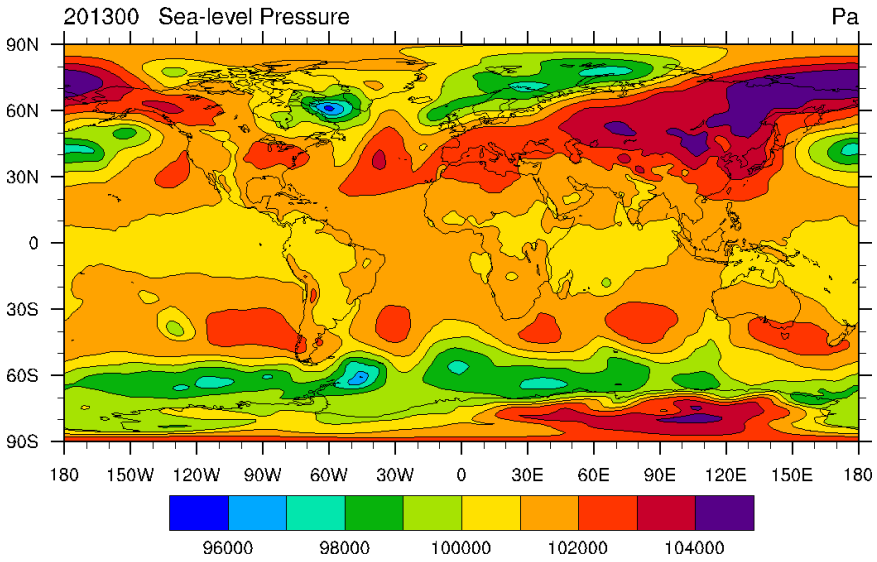


Intermediate Files in netCDF Format

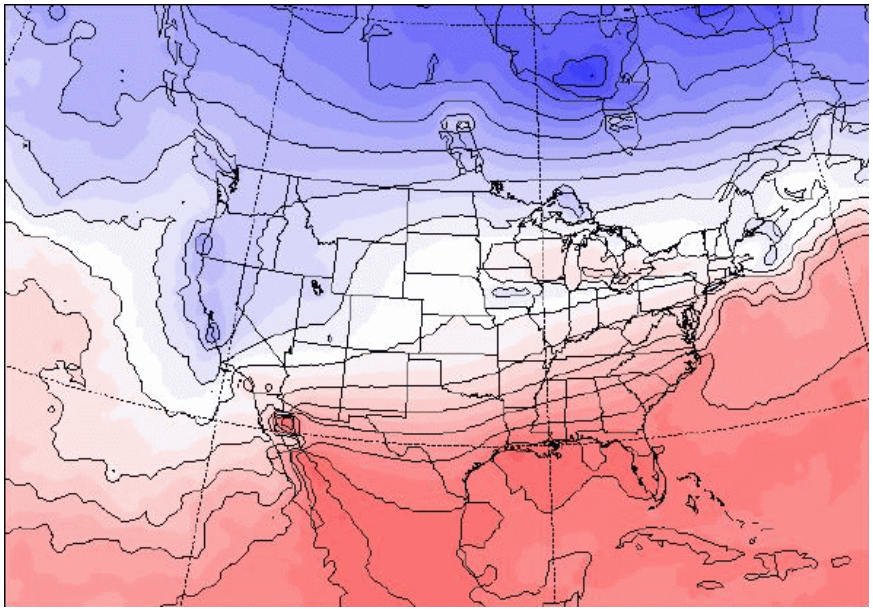
Utility: int2nc.exe
Plot: plotfmt_nc.ncl

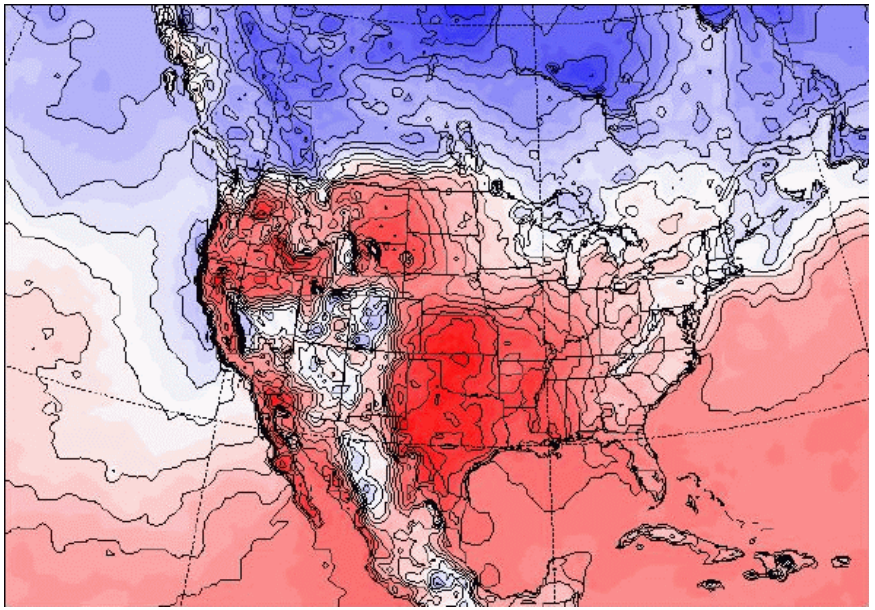






SST vs SKINTEMP





`io_form_auxinput4 = 2`

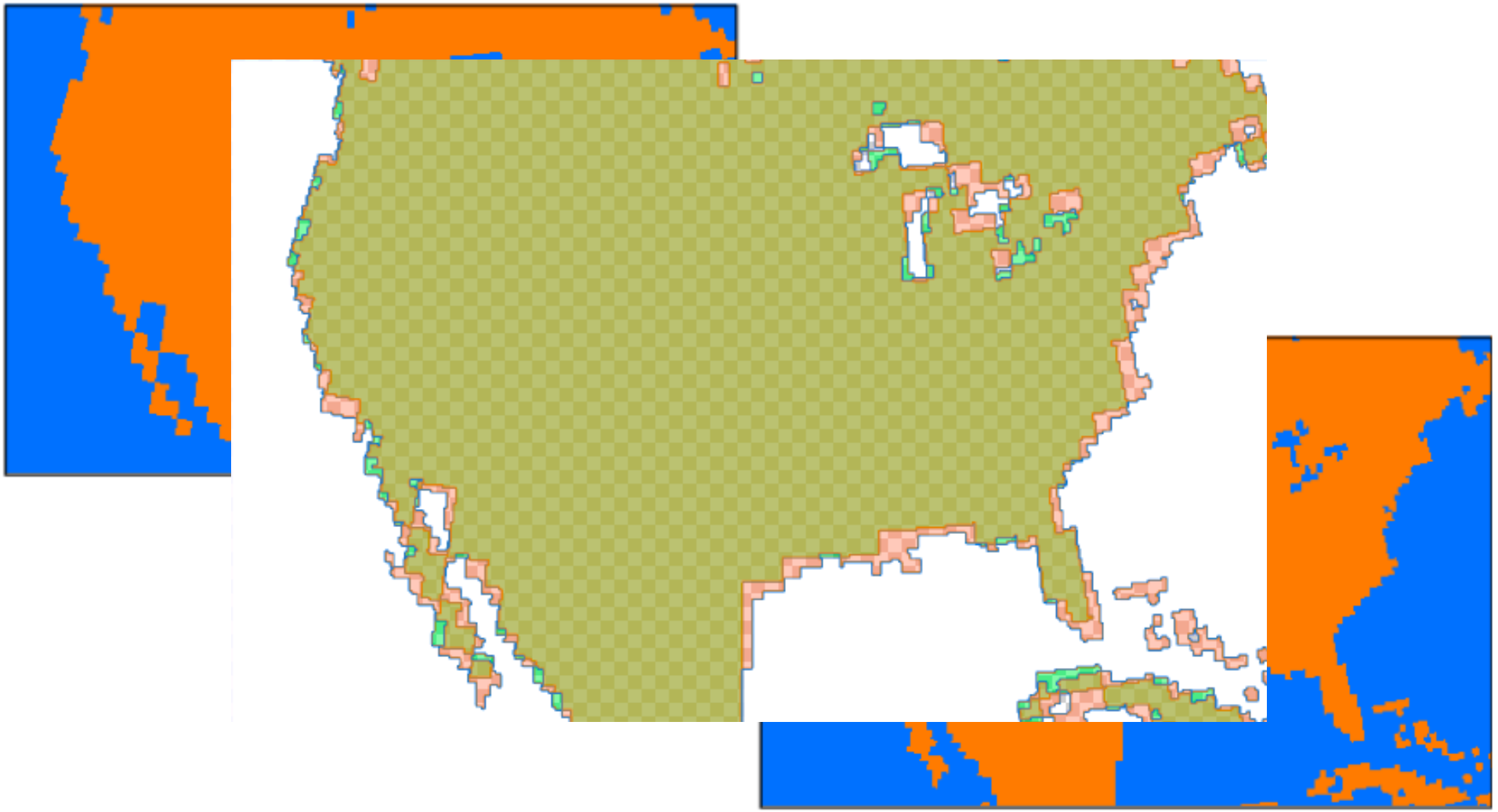
`auxinput4_inname` = "wrflowinp_d<domain>" (created by `real.exe`)

`auxinput4_interval` = 360, 360, 360,

and in *&physics*

`sst_update = 1`

SST vs SKINTEMP



Running WPS

```
Use: Vtable.GFS
link_grib.csh    ./gfs_<date>*

./ungrib.exe
```

```
&ungrib
 prefix     = 'GFS'
```

```
GFS:<date>
```

```
Use: Vtable.SST
link_grib.csh    ./sst_<date>*

./ungrib.exe
```

```
&ungrib
 prefix     = 'SST'
```

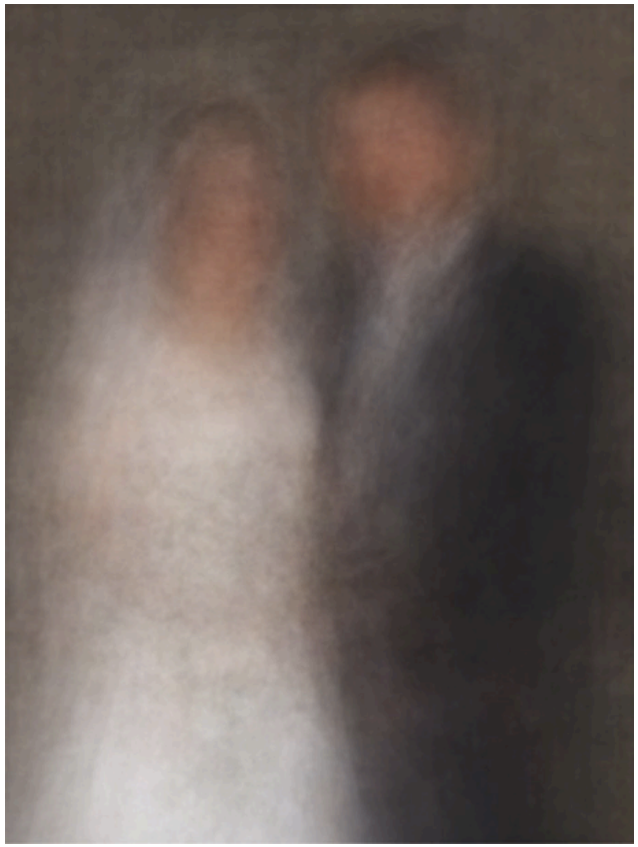
```
SST:<date>
```

Need either unmasked SST data, or a LANDSEA mask that match the SST input dataset

```
./metgrid.exe
```

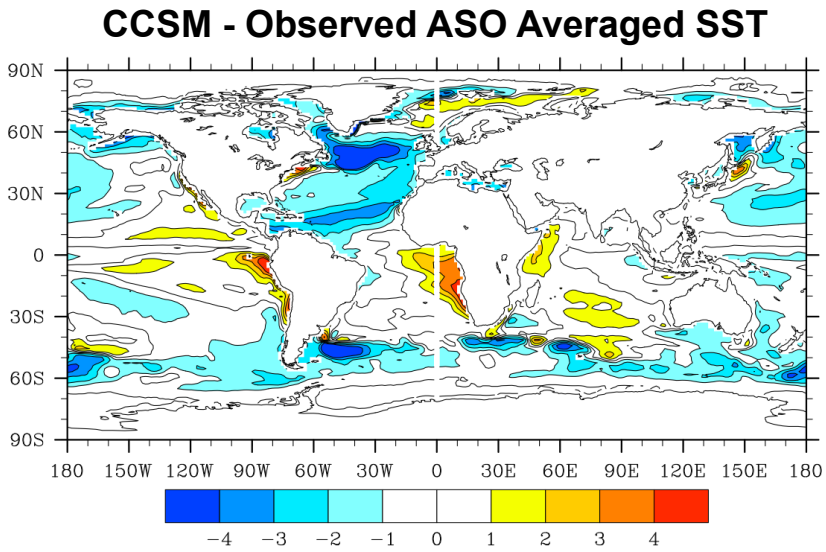
```
&metgrid
 fg_name        = 'GFS'   'SST'
```

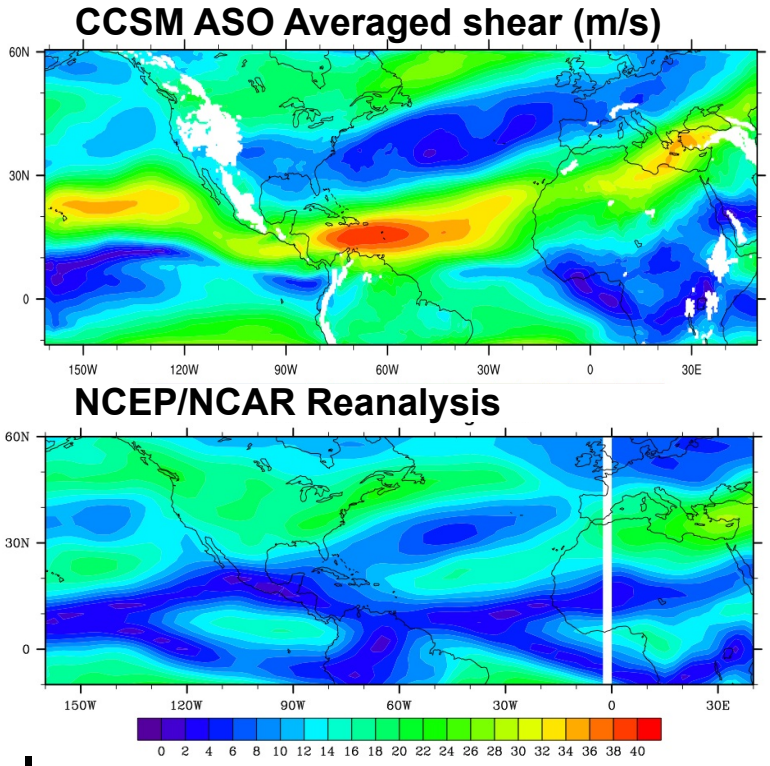
Model Average



Jason Salavon
http://cabinetmagazine.org/issues/15/salavon.php

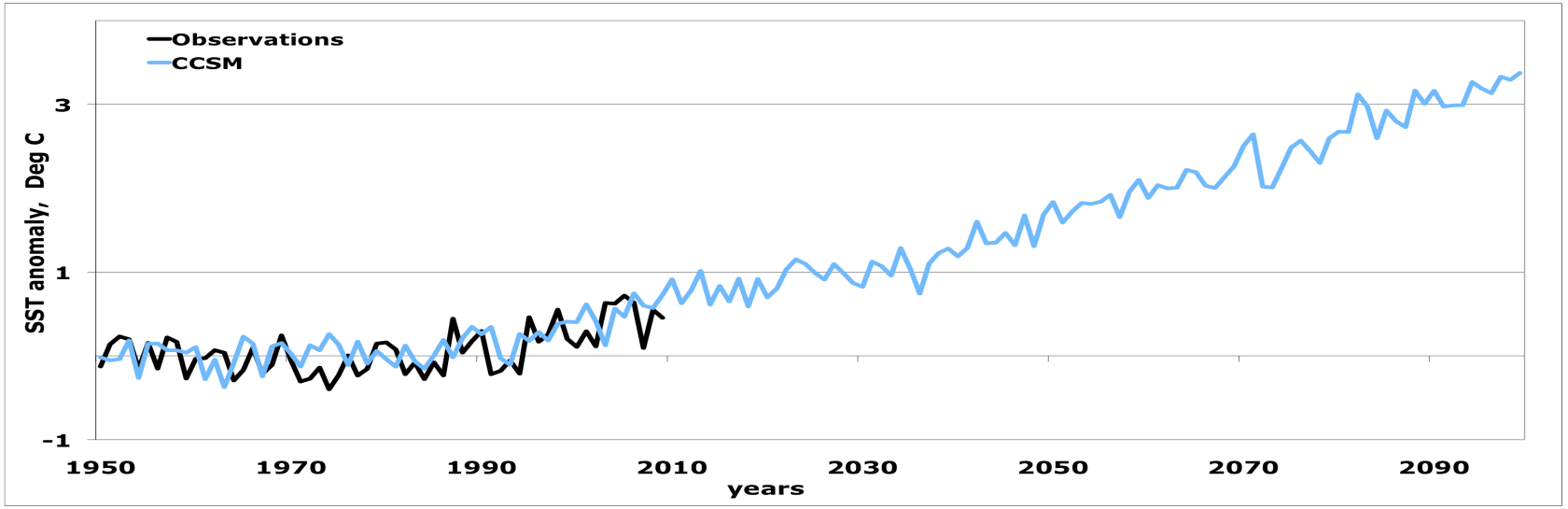
Bias in CCSM Model

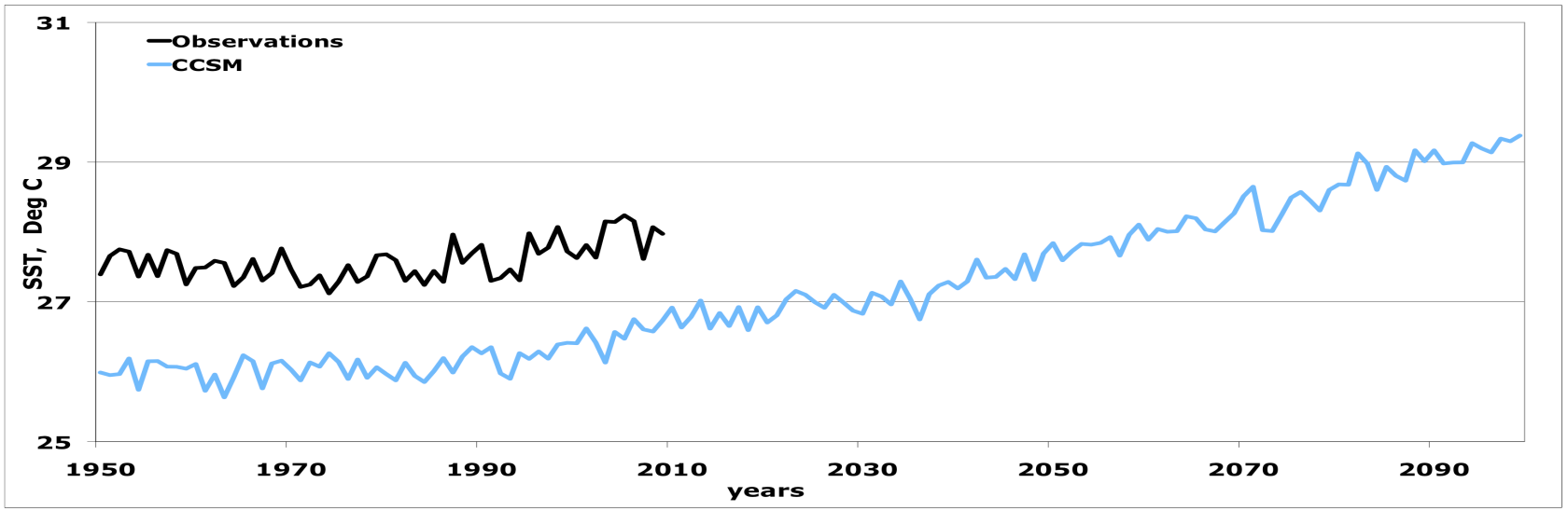




- The accepted approach in evaluating climate models is to utilize anomalies rather than absolute fields.
  - If decadal anomaly trends in the current climate is correct, we have some degree of confidence in the future anomaly predictions.
  - *We have confidence in the anomalies, even if there may be biases in the absolute fields.*

Climate Model Fields *(SST in MDR)*



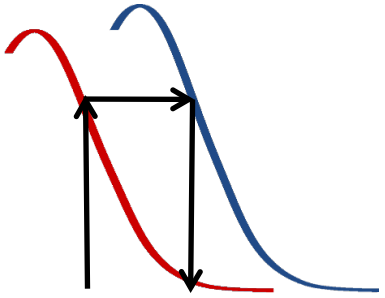


Correcting Biases

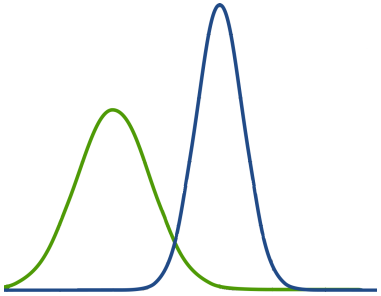
- Altering the mean state

- Perturbing current climate (Pseudo Global Climate Warming)

- Quantile-Quantile mapping

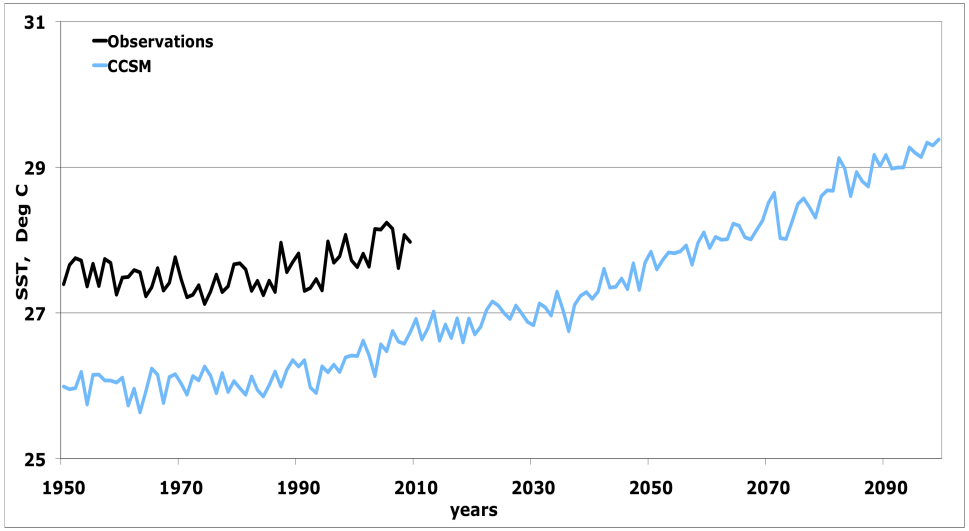


- Altering the mean and variance

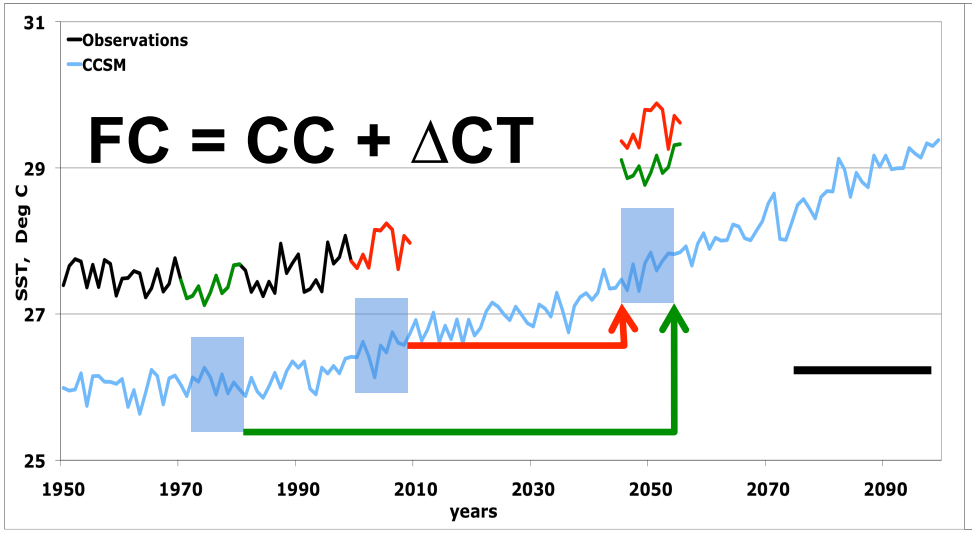


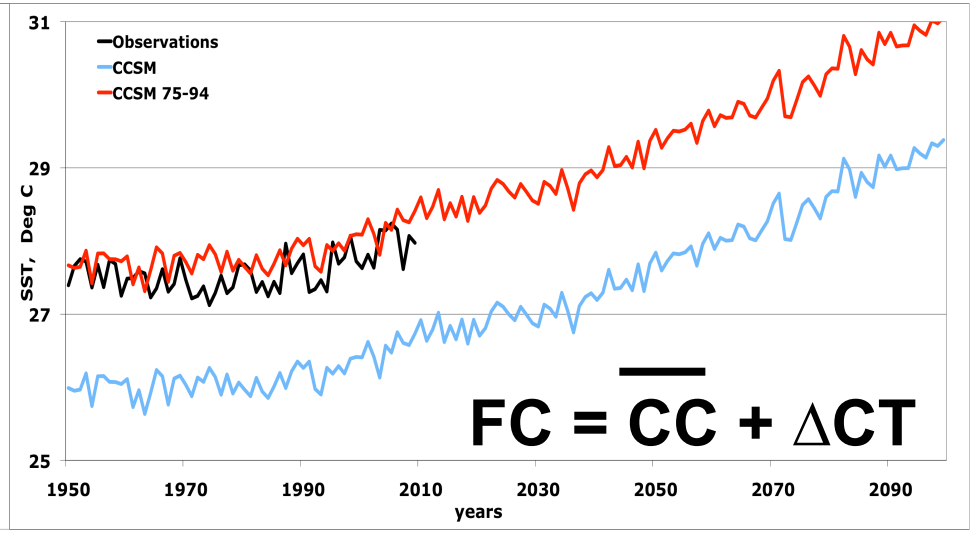
Biases in Climate Model Data

Use current climate variability, and perturb with an estimated climate change



Use a current climate average and the predicted future climate tends and variability





Bias Correction

• Describe 6-hourly CCSM data for entire simulation (1950-2060) as an average annual cycle plus a perturbation term:

$$CCSM = \overline{CCSM} + CCSM' \quad (1)$$

- using a 20-year averaging period (1975-1994),
- applied to variables: *U,V,Z,T,RH,Surface T and PMSL*

• Do the same for NCEP-NCAR Reanalysis data:

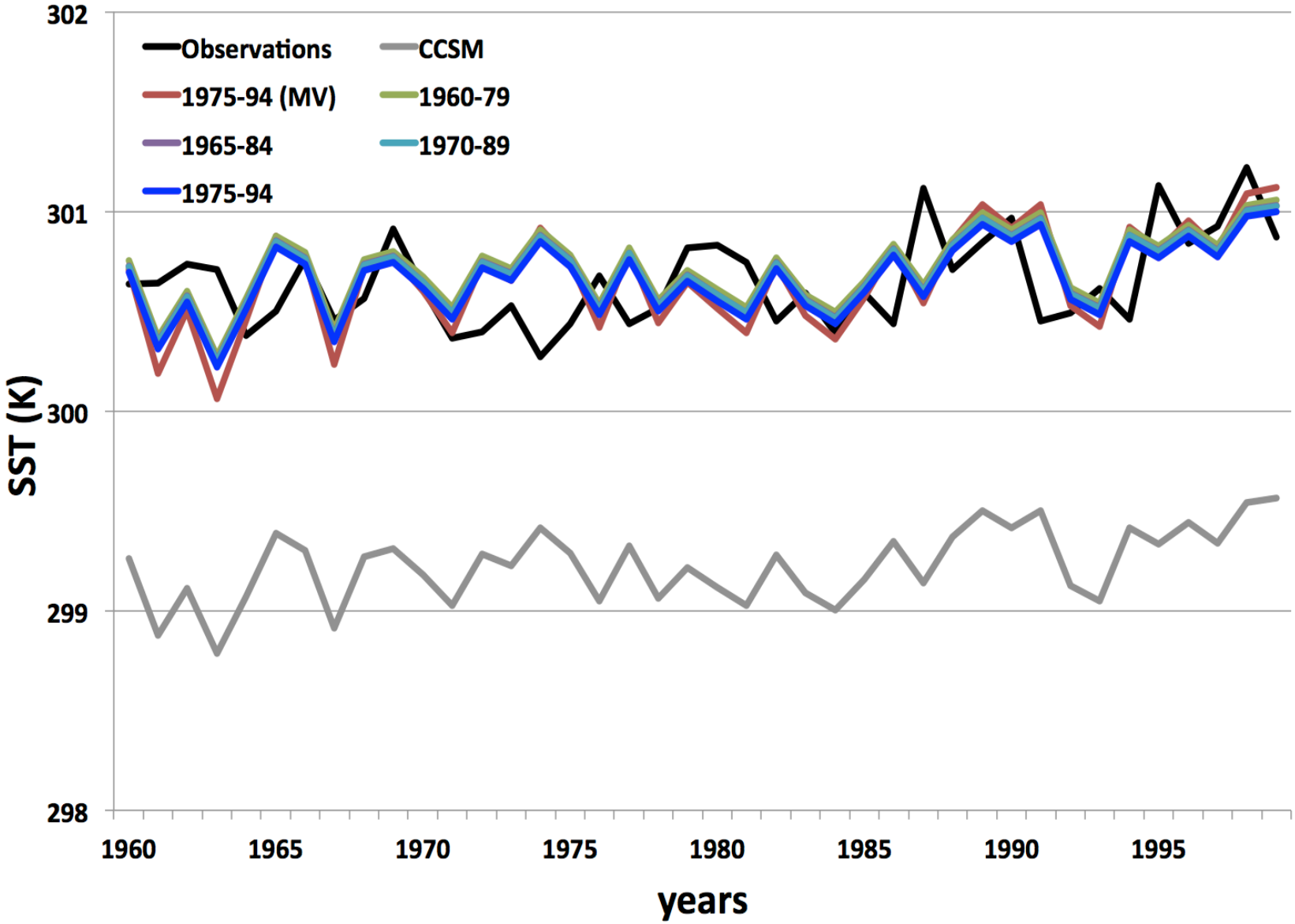
$$NNRP = \overline{NNRP} + NNRP' \quad (2)$$

• Replace $\overline{CCSM}$ with $\overline{NNRP}$:

$$CCSMc = \overline{NNRP} + CCSM' \quad (3)$$

Base climate provided by NCEP-NCAR Reanalysis data and the weather and climate change signal provided by CCSM

Choice of Base Period & Variance



Regional Climate Model Data Availability

CISL Research Data Archive
Managed by NCAR's Data Support Section
Data for Atmospheric and Geosciences Research

Go to Dataset: nnn.n

Home | Find Data | Ancillary Services | About/Contact | For Staff

NCAR Nested Regional Climate Model (NRCM)
ds601.0

For assistance, contact Thomas Cram (303-497-1217).

Description | Data Access | Documentation

Abstract: This dataset contains climate model output data from the NCAR's Nested Regional Climate Model (NRCM). The NRCM combines the strengths of NCAR's Weather Research and Forecasting (WRF) model and NCAR's Community Climate System Model (CCSM) into an instrument that will allow for fundamental progress on the understanding and prediction of regional climate variability and change. In particular, embedding WRF within CCSM will allow scientists to resolve processes that occur at the regional scale, as well as the influence of those processes on the large-scale climate, thereby improving the fidelity of climate change simulations and their utility for local and regional planning.

The output fields in this dataset consist of two- and three-dimensional arrays at three- and six-hourly intervals. A basic set of 3-D parameters is provided on model pressure levels: relative humidity, temperature, wind components, geopotential height, and potential vorticity. Additional 2-D parameters are provided at the model surface or near-surface level, and potential vorticity arrays are also provided on the 320 K and 345 K isentropic surfaces.

Data are available as monthly time series files in NetCDF. The data currently provided are from the climate runs with regional model domain over the North Atlantic Ocean and USA. The simulation covers the periods 1995-2005, 2020-2030, and 2045-2055.

Temporal Range: 1995-01-01 00:00 +0000 to 2005-12-31 21:00 +0000 (Entire dataset)
Period details by subset

Variables:

Air Temperature	Geopotential Height	Humidity	Longwave Radiation
Outgoing Longwave Radiation	Precipitable Water	Precipitation Amount	Runoff
Sea Level Pressure	Shortwave Radiation	Skin Temperature	Snow
Snow Depth	Snow Water Equivalent	Soil Moisture/Water Content	Surface Pressure
Surface Winds	Upper Level Winds		

Vertical Levels: See the detailed metadata for level information
Data Types: Grid
Spatial Coverage: Longitude Range: Westernmost=49.396E Easternmost=161.396W
Latitude Range: Southernmost=11.117S Northernmost=60.495N
Detailed coverage information
Data Contributors: UCAR/NCAR/MMM
Related Resources: *NCAR Nested Regional Climate Model*
Library of sample plot figures from the NRCM RCPP 36-km simulation
Publications: Done, J.M., G.J. Holland, C.L. Bruyere, L.R. Leung, and A. Suzuki-Parker, 2012: *Modeling high-impact weather and clin*
Lessons from a tropical cyclone perspective. NCAR/TN-490+STR, NCAR, 28 pp. (DOI: 10.5065/D61834FM).

How to Cite This Dataset: Mesoscale and Microscale Meteorology, National Center for Atmospheric Research, University Corporation for Atmo
Research. 2013. *NCAR Nested Regional Climate Model (NRCM)*. Research Data Archive at the National Center for Atn
RIS
Research, Computational and Information Systems Laboratory. http://rda.ucar.edu/datasets/ds601.0. Accessed dd m
yyyy.

http://rda.ucar.edu/datasets/ds601.0/

http://www.mmm.ucar.edu/prod2/nrcm/RCPP/RCPP.html

NRCM 36km RCPP WRF Simulation

Fields: Daily Precipitation (mm)
Average Fields: Average Potential Vorticity 200hPa

<< < September 2004 > >>
< Simulation date >

Sun	Mon	Tue	Wed	Thu	Fri	Sat
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	1	2
3	4	5	6	7	8	9

Displayed Hour:
00
00:00 September 2, 2004

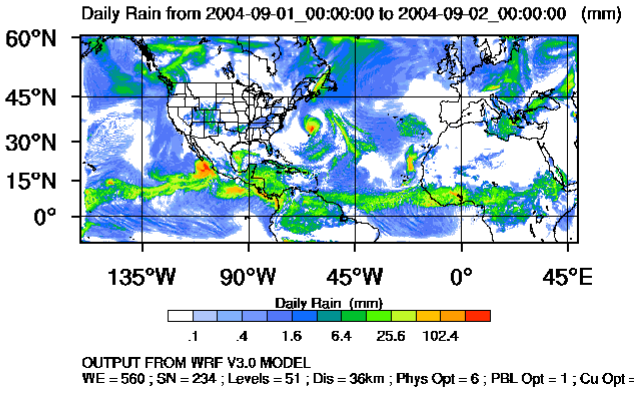
Play Stop

Web Page by Cindy Bruyere(MMM), Carl Drews (ACD), Sherrie Fredrick (MMM)

Regional Climate Prediction Program

36 Km WRF-ARW

Start Date : 1995-01-01 00:00:00



OUTPUT FROM WRF V3.0 MODEL
WE = 560 ; SN = 234 ; Levels = 51 ; Dis = 36km ; Phys Opt = 6 ; PBL Opt = 1 ; Cu Opt =