The Use of OPeNDAP in web-based Weather and Climate Tools

Using OPeNDAP to access/analyze and plot climate data makes available far more data than one group can reasonably store. Accessing data this way has various issues including speed, availability, file storage structure metadata but large benefits.

Project: Set up Web page that plots and analyzes a group of reanalyses datasets and allows users to post results at **www.reanalyses.org.**
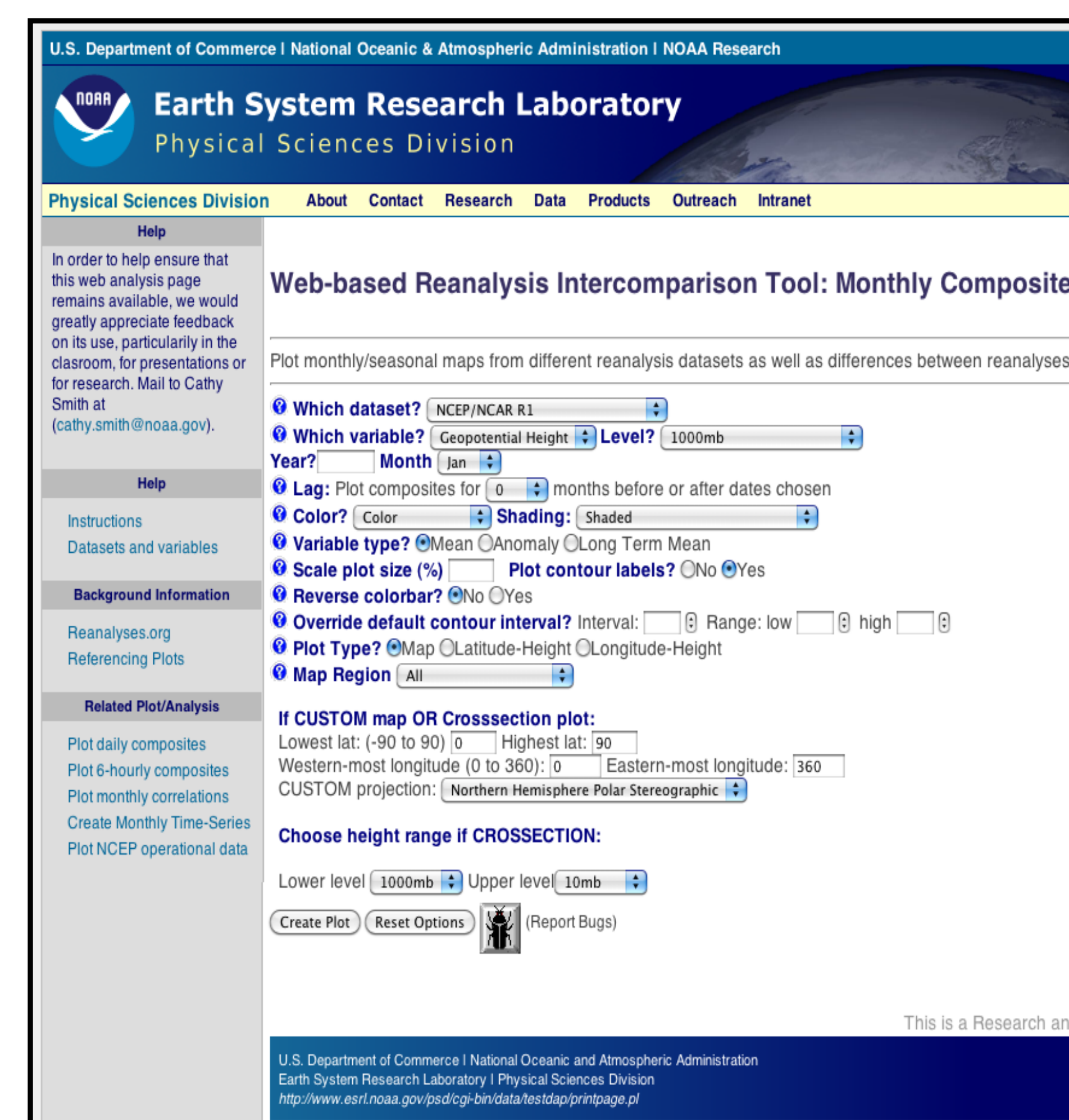

Solution: Use **OPeNDAP** Access to Datasets stored elsewhere. Use NCL as the backend data processing/plotting code. Test URL: **http://www.esrl.noaa.gov/psd/cgi-bin/data/ testdap/printpage.nodap.pl**

OPeNDAP Tools

A variety of apps can read files via OPeNDAP. These include GrADS, NCL, NCO, CDO, IDV… We have chosen NCL for both the quality of the plots generated as well as the ability to easily read grib and convert to netCDF. It also has extensive data analysis routines available (regridding, climatologies) as well as the ability to add more. By standardizing the input format, it is far easier to write code that will apply to all the datasets. There are online plotting packages such as IDV and NetCDF but they are limited to mean plots and don't do the analyses most scientist need.

Selection of Datasets Available via OPeNDAP

Dataset	Format at Source	Total Size	OPeNDAP URL
NCEP CFSR	Grib2	77T	http://nomads.ncdc.noaa.gov/ thredds/dodsc/cfsrmon/
NASA's MERRA	Grib2	70T	http:// goldsym3.sci.gfsc.nasa.gov: 8080/
NCEP/NCAR Reanalysis I	NetCDF: PSD Grib2: NCEP	.5T (at PSD)	http://www.esrl.noaa.gov/psd/ thredds/dods/Datasets/ ncep.reanalysis.derived/
Twentieth Century Reanalysis: Ensemble Means	NetCDF	4.4T	http://www.esrl.noaa.gov/psd/ thredds/dods/Datasets/ ncep.reanalysis.derived/
Twentieth Century Reanalysis: Ensemble Members	NetCDF	5.4T	http://portal.nersc.gov/

Issues with Local Storage for Web App

- **Size: Cost of storage (1K/T).** Cost of Backup. Restoring from Disk Failure
- **Format**: If not converted, users have to read each dataset differently; grib, netCDF and others
- **Conversion:** Conversion takes time and code. Errors can be introduced.
- **Changes to original data:** Data changes at source can be missed. Even if not, changes can take time.

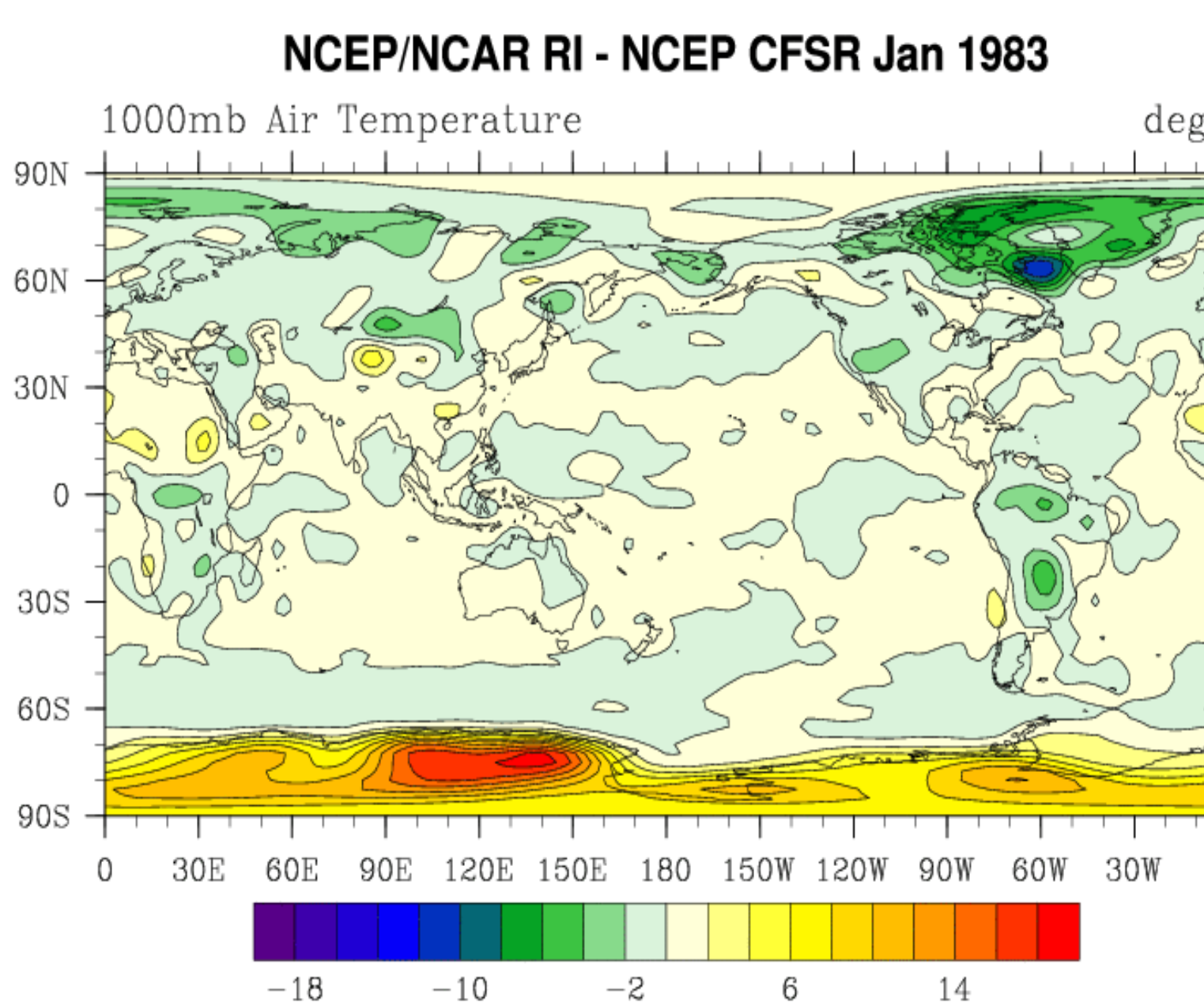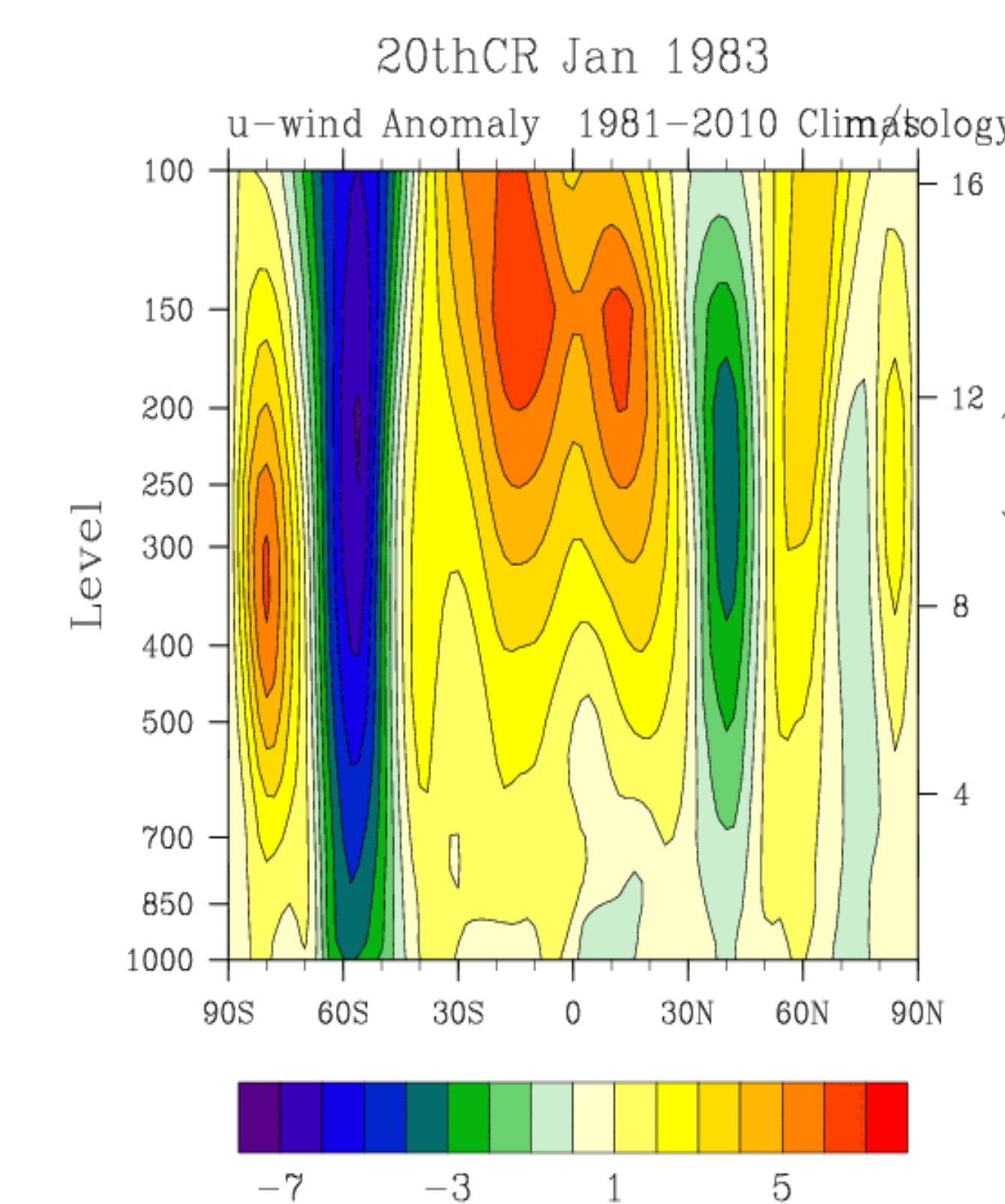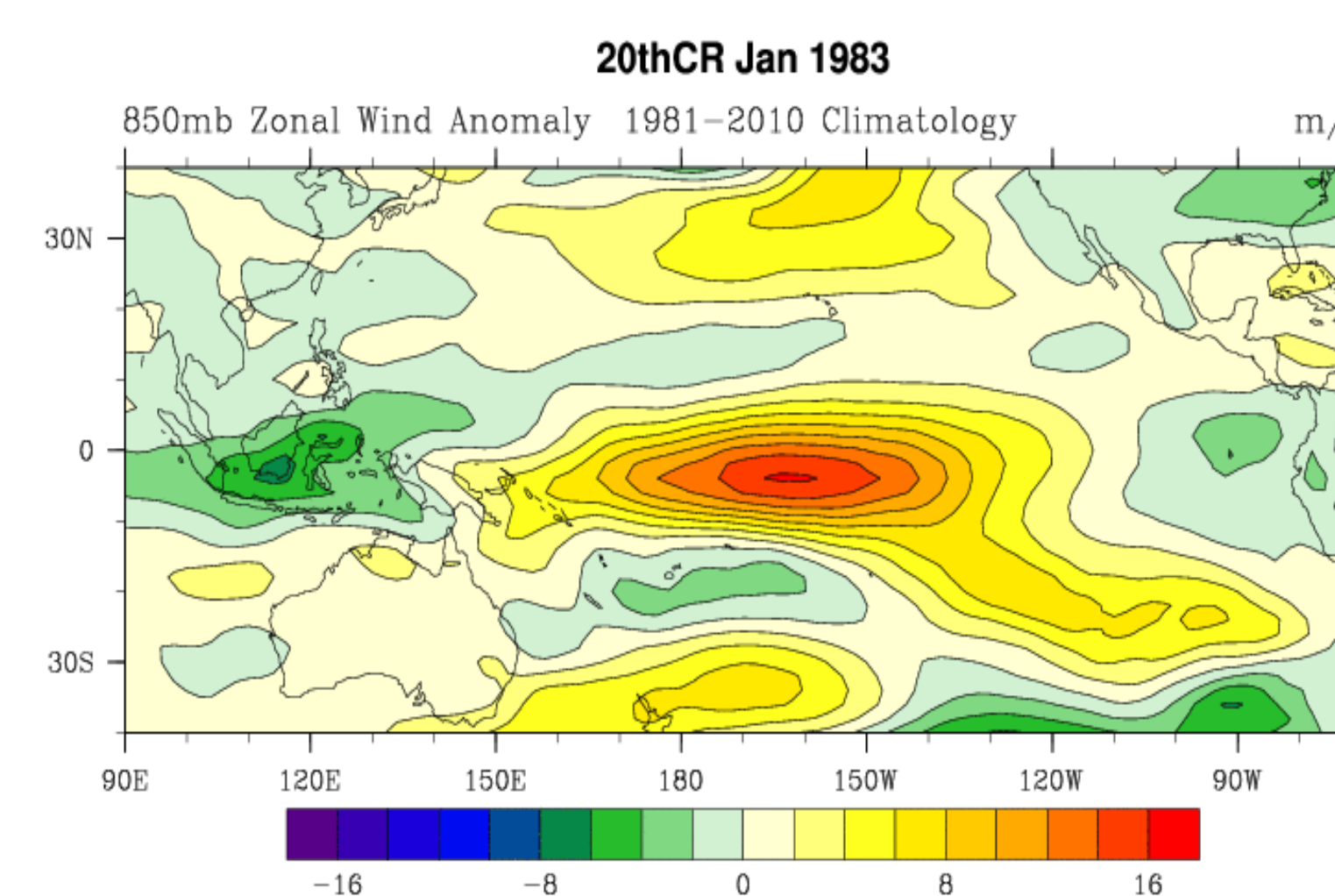Web-based Reanalysis Intercomparison Tool: Monthly Composites

Current Features

- 5 Reanalyses models:NCEP1, NCEP2, 20CR, CFSR, MERRA
- Means, Anomalies, Climatologies
- Model Differences
- Maps, Vertical Cross-sections
- Plot Options
- Plot output options…..

Future Features

- Google Earth
- Additional Models including NARR
- "Timeseries" compositing
- Observation Differences
- Output Data Formats
- More Climatologies
- Smoothing of maps
- Obtain/Plot Timeseries…..

20thCR Jan 1983 — 850mb Zonal Wind Anomaly 1981–2010 Climatology m/s

20thCR Jan 1983 — u-wind Anomaly 1981–2010 Climatology

NCEP/NCAR RI - NCEP CFSR Jan 1983 — 1000mb Air Temperature degC

Issues in Using OPeNDAP

Security

Issue	Resolution
Firewall Access	???
Denial of Service (DNS)	Monitor Access, Apache Modules

File Structure at Source Differs

Issue	Resolution
Dates Divided Differently	NCL code must handle different types differently. Suggest Time Aggregation to Source
Variables divided differently	Table that matches variable to file

Dataset Availability

Issue	Resolution
File doesn't get read in (time out); no error code to check	???
OPeNDAP Server could be down	Script to check access
Variable doesn't read in all the way	???
Not all variables/levels exist	Table to check. Interpolate levels
Generally no climatologies provided	Create locally and store

Metadata Differences: Assume CF

Issue	Resolution
GSD Server has no units	Lookup table
Lat,lon and level are different	Table lookup
Description attribute and text not consistent	Set these locally and/or use Table lookup
Missing/Fill not always correct	Table Lookup
Variable Units can be different	Ideally use udunits library to convert.
Some longitudes -180 to 180 and not 0 to 360. Number of levels and grids different. Latitudes can go in 2 directions.	Code "kludges"

Speed

Issue	Resolution
Access Slow	Store some files locally. Cache results. ????

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