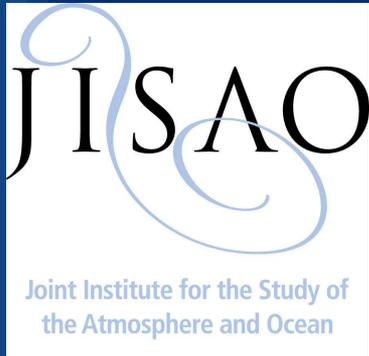


Portal Magic for Forecasts and Ensembles

the LAS team
presented by Roland Schweitzer

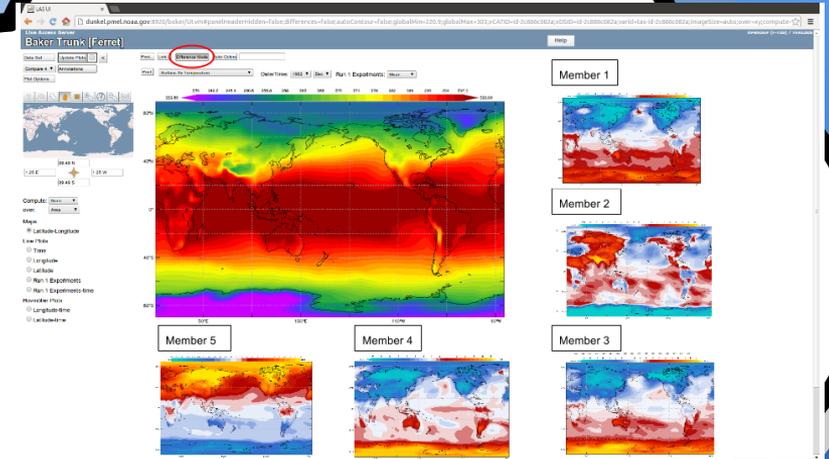


PMEL

Pacific Marine Environmental Laboratory



Some ideas...



...that won't necessarily be built.



Harness the power of LAS to...

- Slice and dice ensemble collections of forecasts (6D data sets).
- Apply analysis transformations along appropriate axes.
- Make specialized plot types (Taylor diagrams...)

Underlying technology...

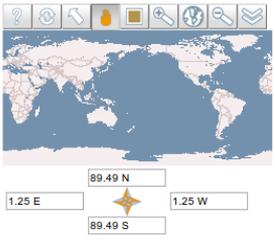
- LAS depends on external tools to organize, categorize and geo-reference and time stamp data.
- THREDDS Catalogs, CF Conventions, Time and Union Aggregations including nested NCML aggregations for ensembles (and forecasts)...

Some early success

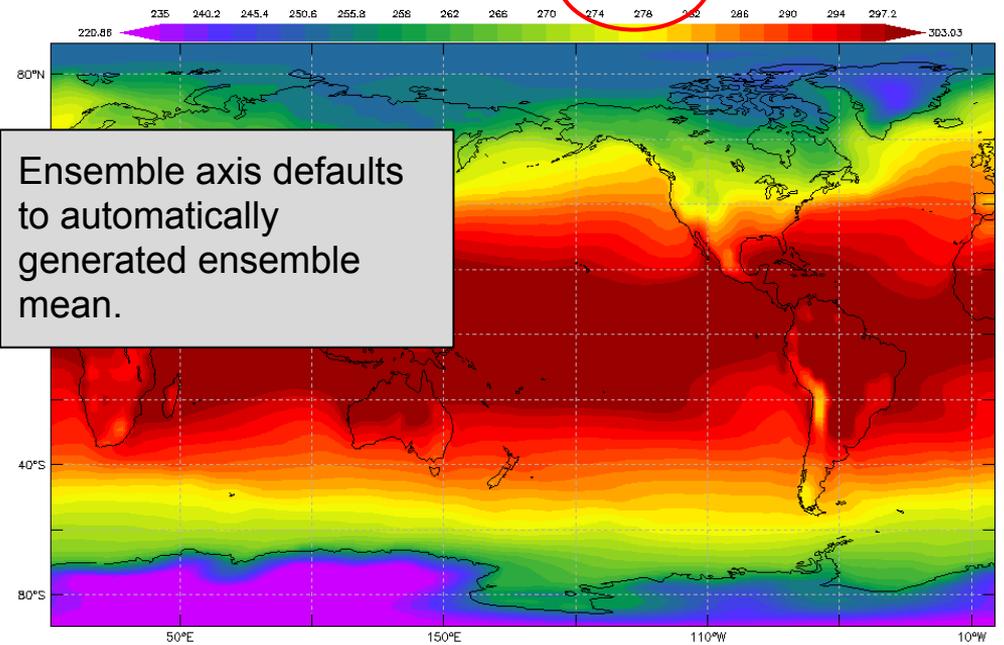
- Added capability for viewing Ensembles in LAS with special UI features and specific ensemble products
- Did not have provisions for second time axis found in collections of forecast runs

Data Set

DATASET: CLIVAR model output prepared for GFDL Seasonal-Interannual Experimental Forecasts Coupled Data Assimilation Experiment
VARIABLE: [e=1:5@Average] (K)
TIME : 16-DEC-1982 00:00 JULIAN
OPeNDAP URL: http://data1.gfdl.noaa.gov:8380/thredds3/dods/clivar_r1
LAS 8./Ferret 6.86 NOAA/PMEL



Print Surface Air Temperature Date/Time: 1982 Dec Run 1 Experiments: Mean



Ensemble axis defaults to automatically generated ensemble mean.

Compute: None
over: Area
Maps
 Latitude-Longitude
Line Plots
 Time
 Longitude
 Latitude
 Run 1 Experiments
Hovmöller Plots
 Longitude-time
 Latitude-time

Data Set Update Plot Print... Link... Animate Correlation Viewer Google Earth Show Values Export to Desktop Application Save As...

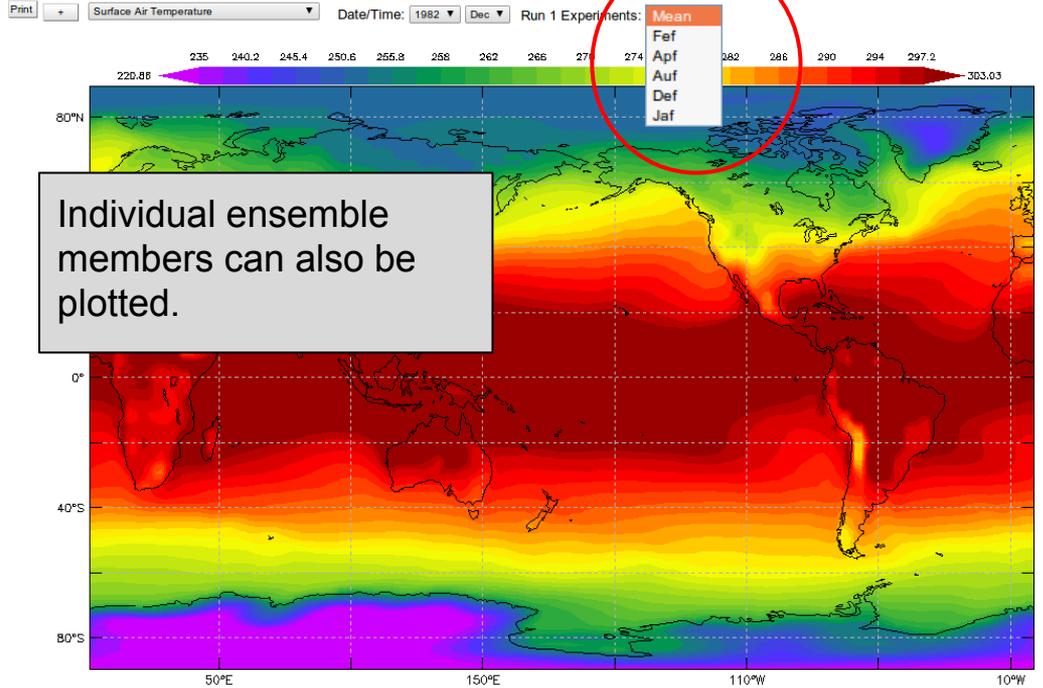
One Plot Annotations

Plot Options



89.49 N
1.25 E  1.25 W
89.49 S

DATASET: CLIVAR model output prepared for GFDL Seasonal-Interannual Experimental Forecasts Coupled Data Assimilation Experiment X
VARIABLE: [e=1:5@Average] (K)
TIME : 16-DEC-1982 00:00 JULIAN
OPeNDAP URL: http://data1.gfdl.noaa.gov:8380/thredds3/dodsC/clivar_r1
LAS 8./Ferret 6.86 NOAA/PMEL



Individual ensemble members can also be plotted.

Compute: None

over: Area

Maps

- Latitude-Longitude

Line Plots

- Time
- Longitude
- Latitude
- Run 1 Experiments

Hovmöller Plots

- Longitude-time
- Latitude-time

Baker Trunk [Ferret]

Help

Data Set

DATA SET: CLIVAR model output prepared for GFDL Seasonal-Interannual Experimental Forecasts Coupled Data Assimilation Experiment
VARIABLE: Surface Air Temperature (K) vs Ensemble Member
LONGITUDE : 178.8E
LATITUDE : 1S
TIME : 16-DEC-1982 00:00 JULIAN
OPeNDAP URL: http://data1.gfdl.noaa.gov:8380/thredds3/dods/clivar_r1
LAS 8./Ferret 6.86 NOAA/PMEL



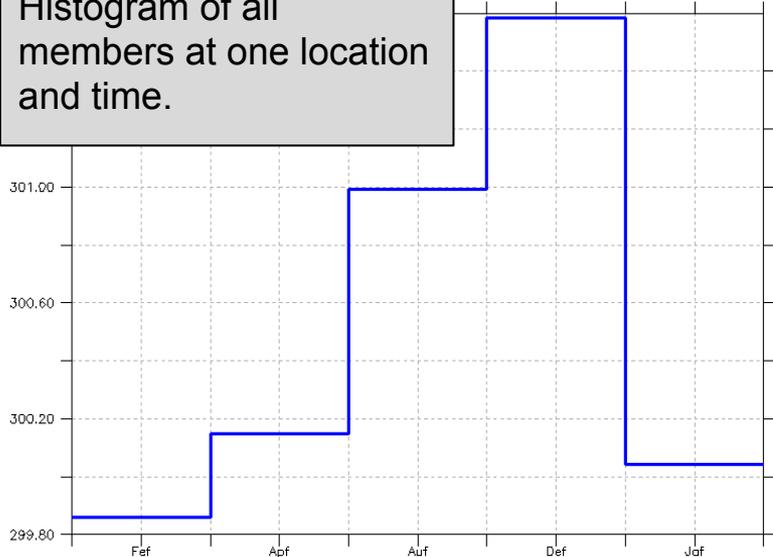
0 S
180 E 180 E
0 S

Start Run 1 Experiments:

Compute:
over:

- Maps
- Latitude-Longitude
- Line Plots
- Time
 - Longitude
 - Latitude
 - Run 1 Experiments
- Hovmöller Plots
- Longitude-time
 - Latitude-time

Histogram of all members at one location and time.



LAS UI

dunkel.pmel.noaa.gov:8920/baker/UI.vm#panelHeaderHidden=false;ifferences=false;autoContour=false;globalMin=0;globalMax=0;xCATID=id-2c886c08;☆

Live Access Server OPeNDAP (F-TDS) / THREDDS

Baker Trunk [Ferret]

[Help](#)

Data Set

One Plot

Plot Options



45 N
129.38 E 95.63 W
14.06 S

Start Run 1 Experiments:

End Run 1 Experiments:

Compute:

over:

Line Plots

Time

Run 1 Experiments

DATA SET: CLIVAR model output prepared for GFDL Seasonal-Interannual Experimental Forecasts Coupled Data Assimilation Experiment

VARIABLE: Surface Air Temperature [$x = 129.375:264.375@Average$ $y = -14.0625:45@Average$] (K) vs Ensemble Member

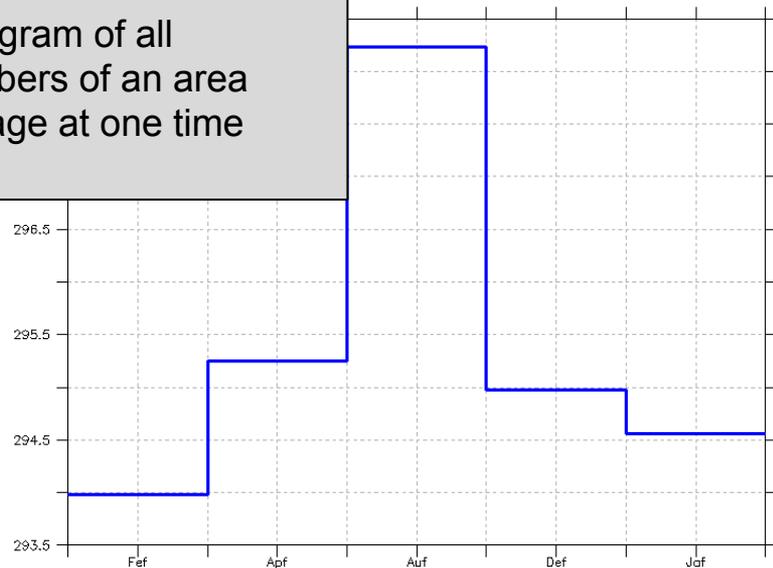
TIME : 16-DEC-1982 00:00 JULIAN

OPeNDAP URL: http://data1.gfdl.noaa.gov:8380/thredds3/dodsC/clivar_r1

LAS 8./Ferret 6.86 NOAA/PMEL

Surface Air Temperature

Histogram of all members of an area average at one time step.



Month	Temperature (K)
Fef	294.0
Apr	294.8
Auf	296.0
Def	294.2
Jaf	294.5

Data Set Update Plot
One Plot Annotations
Plot Options



0 S
180 E 180 E
0 S

Start date/time: 1982 Dec
End date/time: 2010 Nov

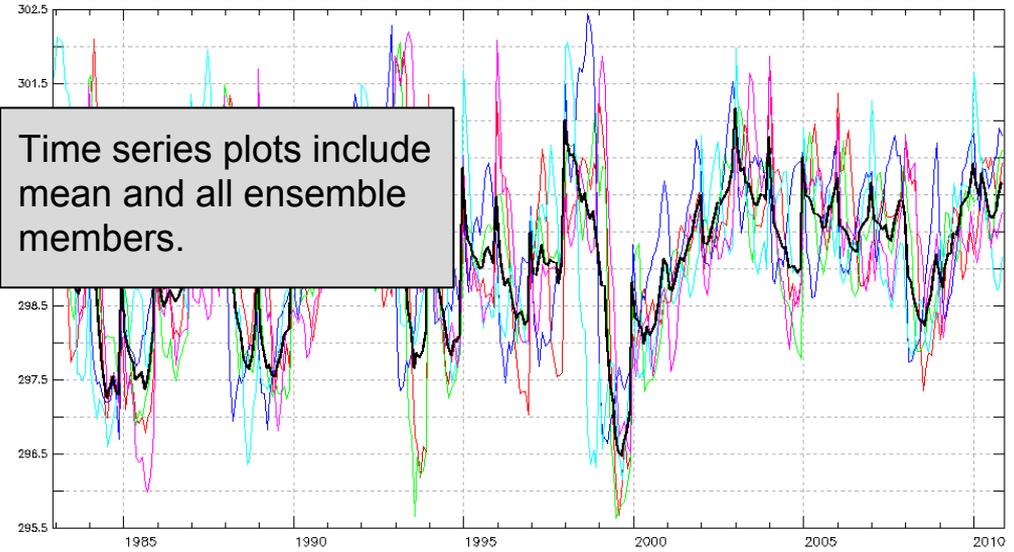
Compute: None
over: Area

- Maps
- Latitude-Longitude
- Line Plots
- Time
 - Longitude
 - Latitude
 - Run 1 Experiments
- Hovmöller Plots
- Longitude-time
 - Latitude-time

Print... Link... Animate Correlation Viewer Google Earth Show Values Export to Desktop Application Save As...

DATASET: CLIVAR model output prepared for GFDL Seasonal-Interannual Experimental Forecasts Coupled Data Assimilation Experiment
VARIABLE: [e=1:5@Average] (K)
LONGITUDE : 178.8E
LATITUDE : 1S
• CALENDAR: JULIAN
LAS 8./Ferret 6.86 NOAA/PMEL

Print Surface Air Temperature Run 1 Experiments: Mean



Time series plots include mean and all ensemble members.

— Mean	— Auf
— Fef	— Def
— Apf	— Jaf

Data Set Update Plot <

One Plot Annotations

Plot Options



0 S

180 E 180 E

0 S

Start date/time: 1983 Jan

End date/time: 1983 Dec

Compute: None

over: Area

- Maps
- Latitude-Longitude
- Line Plots
- Time
 - Longitude
 - Latitude
 - Run 1 Experiments
- Hovmöller Plots
- Longitude-time
 - Latitude-time

Print... Link... Animate Correlation Viewer Google Earth Show Values Export to Desktop Application Save As...

DATASET: CLIVAR model output prepared for GFDL Seasonal-Interannual Experimental Forecasts Coupled Data Assimilation Experiment

VARIABLE: [e=1:5@Average] (K)

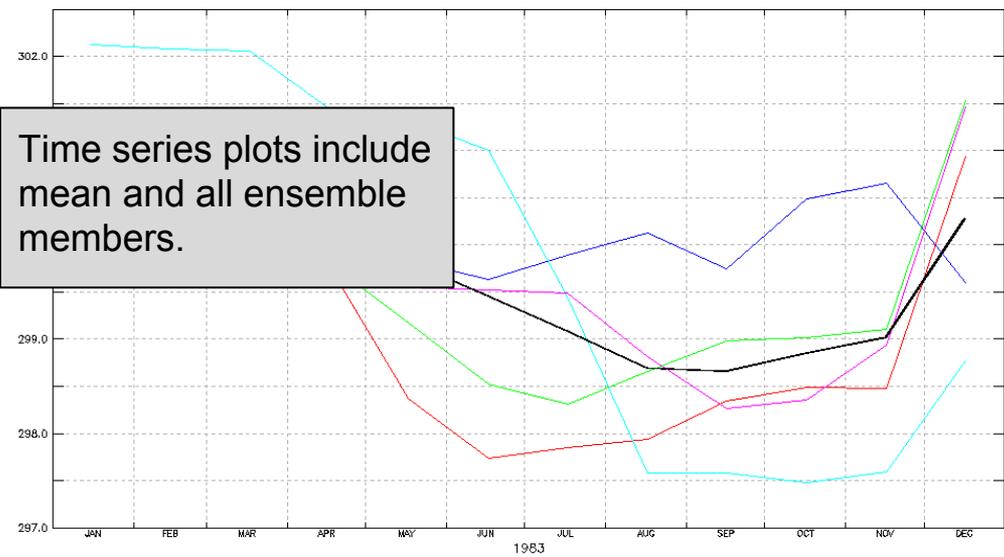
LONGITUDE : 178.8E

LATITUDE : 1S

- CALENDAR: JULIAN

LAS 8./Ferret 6.86 NOAA/PMEL

Print + Surface Air Temperature Run 1 Experiments: Mean



Time series plots include mean and all ensemble members.

— Mean — Auf

— Fef — Def

— Apf — Jaf

Data Set Update Plot

Print... Link... Animals Correlation Viewer Google Earth Show Values Export to Desktop Application Save As...

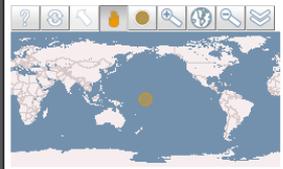
One Plot Annotations

DATA SET: CLIVAR model output prepared for GFDL Seasonal-Interannual Experimental Forecasts Coupled Data Assimilation Experiment
VARIABLE: Surface Air Temperature (K)
LONGITUDE : 178.8E
LATITUDE : 1S
Ensemble Member: Def
OPeNDAP URL: http://data1.gfdl.noaa.gov:8380/thredds3/dodsC/clivar_r1

- CALENDAR: JULIAN

LAS 8./Ferret 6.86 NOAA/PMEL

Plot Options



0 S
180 E 180 E
0 S

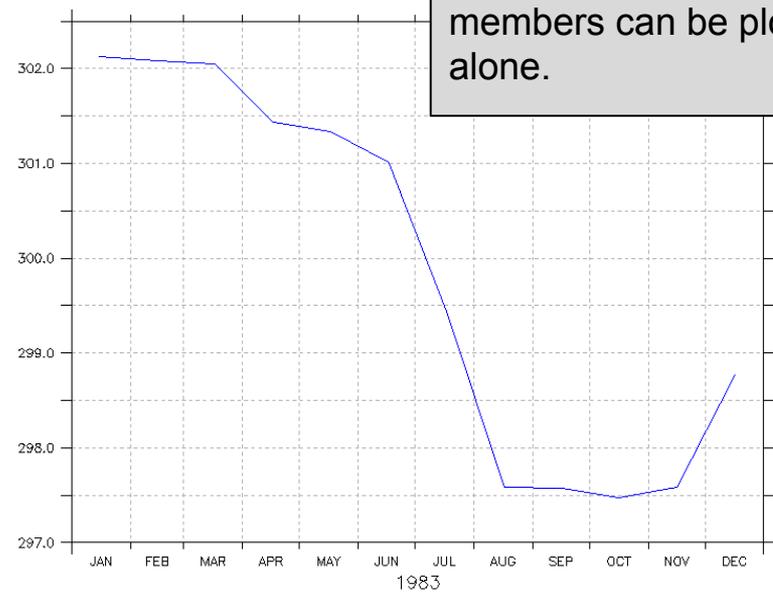
Start date/time: 1983 Jan
End date/time: 1983 Dec

Compute: None
over: Area

- Maps
- Latitude-Longitude
- Line Plots
- Time
 - Longitude
 - Latitude
 - Run 1 Experiments
- Hovmöller Plots
- Longitude-time
 - Latitude-time

Print + Surface Air Temperature Run 1 Experiments: Def

Individual ensemble members can be plotted alone.



Baker Trunk [Ferret]

Help

Data Set Update Plot
One Plot Annotations
Plot Options



30 N
135 E 75 W
30 S

Start date/time: 1983 Jan
End date/time: 1983 Dec

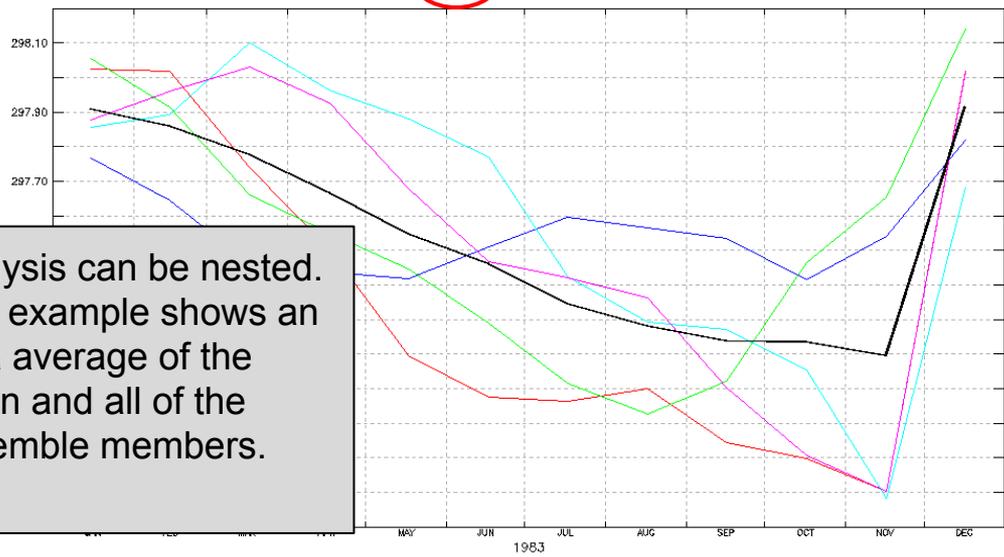
Compute: Average
over: Area

Line Plots
 Time
 Run 1 Experiments

Print... Link... Animate Correlation Viewer Google Earth Show Values Export to Desktop Application Save As...

DATASET: CLIVAR model output prepared for GFDL Seasonal-Interannual Experimental Forecasts Coupled Data Assimilation Experiment
VARIABLE: Surface Air Temperature [x=135:285@Average y=-30:30@Average] (K)
LONGITUDE : 135E to 75W
LATITUDE : 30S to 30N
Realizations: averaged all
• CALENDAR: JULIAN
LAS 8./Ferret 6.86 NOAA/PMEL

Print Surface Air Temperature Run 1 Experiments: Mean



Analysis can be nested.
This example shows an area average of the mean and all of the ensemble members.

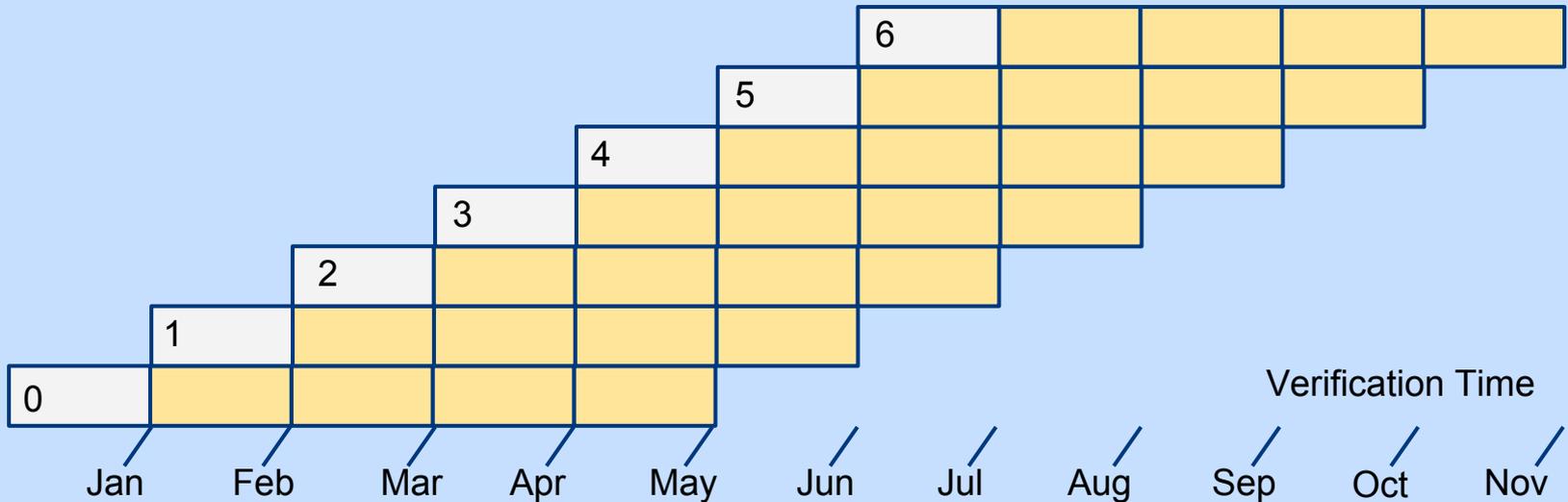
— Realizations: averaged all
— Fef
— Apf
— Auf
— Def
— Jaf

Adding another (time) dimension

- A collection of forecast runs with different initialization times...

How are forecast ensembles organized?

Initialization
Time



A Forecast Data Set - netCDF

6	Jul	Aug	Sep	Oct
5	Jun	Jul	Aug	Sep
4	May	Jun	Jul	Aug
3	Apr	May	Jun	Jul
2	Mar	Apr	May	Jun
1	Feb	Mar	Apr	May
0	Jan	Feb	Mar	Apr

6	Jul	Aug	Sep	Oct
5	Jun	Jul	Aug	Sep
4	May	Jun	Jul	Aug
3	Apr	May	Jun	Jul
2	Mar	Apr	May	Jun
1	Feb	Mar	Apr	May
0	Jan	Feb	Mar	Apr

A Forecast Data Set - CDM

```
double time(reftime1=372, time=65);  
:units = "Hour since 2014-10-20T00:00:00Z";  
:standard_name = "time";  
:long_name = "GRIB forecast or observation time";  
:calendar = "proleptic_gregorian";  
:_CoordinateAxisType = "Time";
```

A Forecast Ensemble - CDM Grib Feature Collection

Temperature_depth_below_surface_layer_ens: Grid

reftime: time3: ens: depth_below_surface_layer: lat: lon:

long_name: Temperature @ Depth below land surface layer

units: K

missing_value: NaN

abbreviation: TMP

coordinates: reftime time3 ens depth_below_surface_layer lat lon

Grib_Variable_Id: VAR_0-0-0_L106_layer

Grib2_Parameter: 0, 0, 0

Grib2_Parameter_Discipline: Meteorological products

Grib2_Parameter_Category: Temperature

Grib2_Parameter_Name: Temperature

Grib2_Level_Type: Depth below land surface

Grib2_Generating_Process_Type: Ensemble forecast

A Forecast Data Set - netCDF

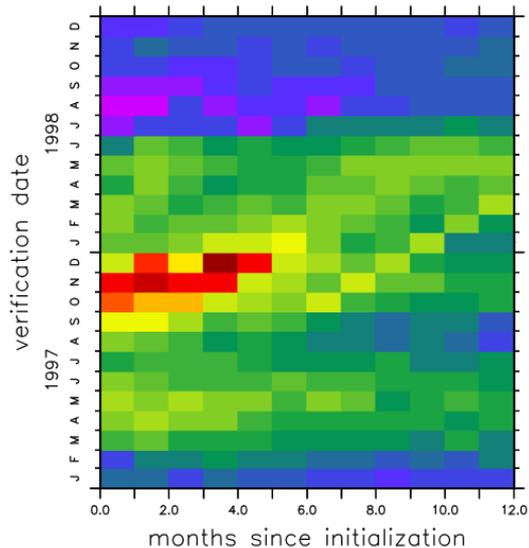
```
yes? show data/all
      currently SET data sets:
      1> http://thredds-dev.unidata.ucar.
edu/thredds/dodsC/grib/NCEP/GEFS/Global_1p0deg_Ensemble/members/TwoD (default)
name      title
TEMPERATURE_DEPTH_BELOW_SURFACE_LAYER_ENS
      Temperature @ Depth below land      1:360      1:181      1:1      1:65      1:21      1:371

yes? show grid TEMPERATURE_DEPTH_BELOW_SURFACE_LAYER_ENS
      GRID GPT16
name      axis      # pts      start      end
LON      LONGITUDE      360mr      0E      1W
LAT      LATITUDE      181 r      90S      90N
DEPTH_BELOW_SURFACE_LAYER DEPTH1 r- 0.05      0.05
TIME3      T      65 r      1      65
ENS      E      21 r      0      20
REFTIME      FORECAST      371 i      20-OCT-2014 00:00      17-FEB-2015 06:00
```

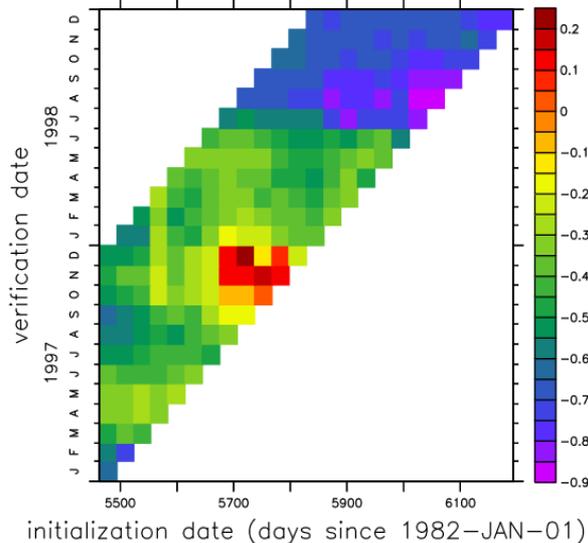
A Forecast Ensemble Data Set

forecast tau_x[x=180w,y=5s:5n@ave,e=@ave]

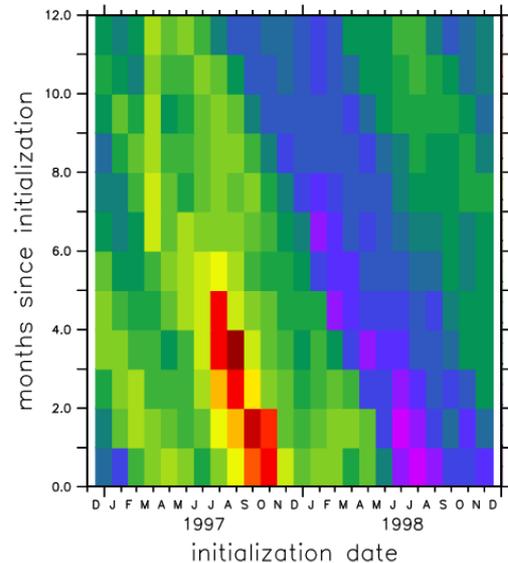
(a) Lead-dependent analysis



(b) Orthogonal, sparse



(c) Compact, close to data



Plots courtesy of Andrew Wittenberg, NOAA/GFDL

What we have...

- GRIB forecast ensemble feature collections
- CDM and Ferret code to read them
- ~~NCML netCDF aggregations~~

What do we need?

- netCDF feature collections for aggregations, ensembles and forecasts
- dynamic scanning for new forecasts to add to the collection

Needed for MIP Collections and ESGF

- Automatically identify and create ensemble collections
- Then we can apply the tools we have and build new ones for these collections

Given the infrastructure tools...



...we can decide what to build.



Join the conversation

CF, THREDDS, LAS and GO-ESSP mailing lists

Roland.Schweitzer@noaa.gov

<http://ferret.pmel.noaa.gov/Ferret>

<http://ferret.pmel.noaa.gov/LAS>

An example...

http://thredds-dev.unidata.ucar.edu/thredds/dodsC/grib/NCEP/GEFS/Global_1p0deg_Ensemble/members/TwoD