Tutorial Practical Sessions – Predictability Day

These practical sessions provide analysis of a number of different aspects of predictability using output from the CESM Large Ensemble simulations.

To start practical sessions:

1. Login to Cheyenne
2. Start an interactive geyser session using “execdav -m 100G -t 3:00:00”
3. Go to appropriate directory using “cd PWS2018/day2”
4. If needed, load the idl module using “module load idl”
5. Copy over tutorial directory using “cp -r /glade/u/home/mholland/predict_tutorial .”
6. You also may need to load gv using “module load gv” (unless you use a different graphics viewer for ps files)

NOTE: A plain text version of the instructions below is in the README file within the relevant directory

Practical 1. Seasonal Predictors

Purpose: To assess predictors of 1) Hemispheric sea ice extent, 2) Alaskan Snow Covered Area, 3) Greenland Ice Sheet Melt or 4) Polar air temperature by computing correlations with prior environmental conditions.

Produces: Maps of correlation coefficients for the twelve months preceding the predictand.

Method: Uses monthly mean output from a decadal slice of the CESM Large Ensemble to compute correlations. This will generally use 30 members for 10 years resulting in 300 samples.

Instructions:

- Change into the appropriate directory using "cd predict_tutorial/predictors"
- Start an interactive IDL session by typing "idl" and run the idl script using ".r predictor"
- You will be prompted for input on:
  1. The predictand variable (extent=sea ice extent, aksno=AK snow cover, gismlt=GIS Melt, TREFHT=70-90 atmospheric reference temperature)
  2. If extent or TREFHT is chosen, then the hemisphere of interest
  3. The month to use for the predictand
  4. The predictor variable (see description list below)
  5. The year to start decadal analysis
- The script will run and produce a postscript file of the format: R_predictorname_and_month_predictandname_year.ps
- Use ghostview (or your own favorite graphics viewer) to view file: "gv filename" (it may be easiest to view the graphics files on a different laptop)

Possible predictor variables to assess:

Atmospheric variables:

- TREFHT – Atmospheric reference height temperature
- PBLH – Atmospheric Planetary Boundary layer height
- PRECSL – Large-scale snowfall rate
- PSL – Sea level pressure

Sea ice variables:

- hi – sea ice thickness
- aice – sea ice concentration
- hs – snow thickness on sea ice
- apond002 – pond fraction on sea ice (2^{nd} category)

ocean variables:

- SST – sea surface temperature
- HBLT – ocean boundary layer depth

Land variables:

- SNOWDP – terrestrial snow depth
- FSNO – terrestrial snow cover fraction
- QSNOMELT – terrestrial snow melt

Some comments and questions to consider:

- The lined contour interval on the plots is at 0.1 and the zero line is omitted
- Carefully consider timing of predictand and the predictor to analyze (for example GIS melt in January is probably not very relevant).
- Is there evidence for skillful predictors and if so, what are they?
- Do important predictors change with the changing climate? If so, why might this be?
- Do important predictors change seasonally? If so, why might this be?
- Do important predictors change with the region? If so, why might this be?

Practical 2. Boundary Forced Change

Purpose: To assess changing climate conditions relative to the pre-industrial control.

Produces: Plots of the seasonal histogram and timeseries of a specified variable relative to that from the pre-industrial control. The histogram is calculated for a user-specified decade.

Method: Reads in the timeseries of pre-processed variable for the CESM LENS and its pre-industrial control run. Computes the histogram of the variable for the decade of interest.

Instructions:

- Change into the appropriate directory using "cd predict_tutorial/histogram"
- Start an interactive IDL session by typing "idl"
- Run the script using ".r histogram_var"
- You will be prompted for input on:
  1. The variable to analyze (see description below)
  2. The region for analysis
  3. Which year to start decadal analysis
- The script will run and produce a postscript file of the format: variable_decade_region.ps
- Use ghostview to view file: "gv filename"

Some comments and questions to address:

- In the plots, values in red show the pre-industrial control. On right panels, the solid line is the ensemble (or PI) mean, the dotted lines are the range.
- When is a boundary forced signal apparent in the variable of interest?
- How does the emergence of this signal differ across variable? Why might this be?
- Is there a different between atmospheric, terrestrial, and marine variables?
- How might you define a metric for the emergence of a boundary forced signal?

Possible Variables to assess:

Atmospheric variables

- TREFHT - Atmospheric reference height temperature
- PRECL – Large-scale precipitation rate
- PSL– Sea level pressure
- PBLH– Atmospheric Planetary Boundary layer height
- PRECSL– Large-scale snowfall rate
- CLDTOT – total cloud fraction

Ice variables:

- extent – sea ice extent
- hi – sea ice volume

Land variables:

- Snow_Area – Snow covered area
- H2OSNO – Snow water equivalent

Practical 3. Initial value predictability

Purpose: To assess how simulations diverge from an initialized state.

Produces: Plots of the daily timeseries of an initialized variable of interest relative to the internal daily variability as diagnosed from the pre-industrial control simulation.

Method: Reads in the daily timeseries of pre-processed variable for the CESM LENS from the 1920 initialized state and its pre-industrial control run. Plots the timeseries of the variable for one year and compares to the spread from the PI control run. Computes the potential prognostic predictability (PPP) metric and plots the PPP timeseries for one year. PPP is the reduction in the prediction ensemble variance relative to internal variability from the control run, where PPP=1.-variance(prediction_ensemble)/variance(control)

Instructions:

- Change into the appropriate directory using "cd predict_tutorial/init_val"
- Start an interactive IDL session by typing "idl"
- Run the script using ".r init_val"
- You will be prompted for input on:
    1. The variable to analyze (see description below)
    2. The region for analysis
- The script will run and produce a postscript file of the format: variable_1920_region_daily.ps
- Use ghostview to view file: "gv filename"

Some questions to address:

- For how long does there appear to be initial value predictability for the variable of interest?
- How does this differ across variables? Are there differences across the atmosphere, land, marine system?
- Are there any common things that emerge across the different practical session exercises?

Possible Variables to assess:

Atmospheric variables

- TREFHT - Atmospheric reference height temperature
- PRECT – Total precipitation rate
- PSL – Sea level pressure
- PRECSL – Large-scale snowfall rate
- Z500 – 500mb geopotential height

Ice variables:

- extent – sea ice extent
- hi – sea ice volume

Land variables:

- FSNO – Snow covered fraction
- H2OSNO – Snow water equivalent
- SOILWATER_10CM – liquid water+ice in top 10cm of soil