



Evaluation of the CFSv2 45 day forecasts to capture stratospheric events and usefulness for intra-seasonal forecasts of stratospheric winter hemispheric conditions

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Outline

- CFSv2 info
- Use of CFSv2 for Strat-Trop purposes
- Purpose of this study
- Expectations
- Realities
- Suggestions for improvement

CFS implementation

- Two essential components:
 - A new Reanalysis (CFSR) of the atmosphere, ocean, sea ice and land over the 32-year period (1979-2010) is required to provide consistent initial conditions for:
 - A complete Reforecast of the new CFS over the 29-year period (1982-2010), in order to provide stable calibration and skill estimates of the new system, for operational seasonal prediction at NCEP/Climate Prediction Center.
- CFSR was run in T382L64 resolution for this 32 year period.

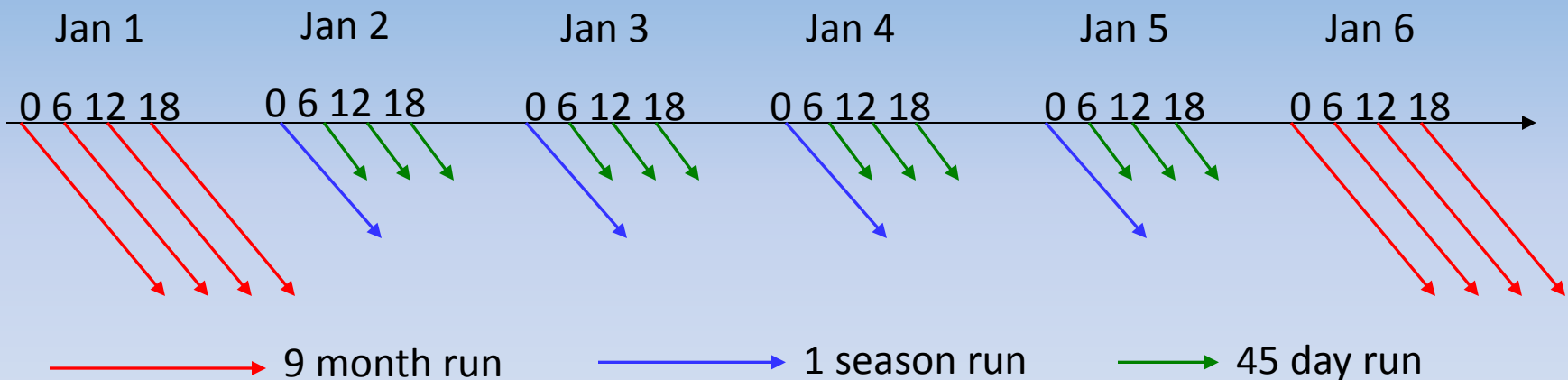
CFS in Operations

- An atmosphere at high horizontal resolution (Post 2011: T574, ~27 km) and high vertical resolution (64 sigma-pressure hybrid levels) for the real time analysis (CFSR)
- An atmosphere of T126L64 for the real time forecasts (CFSv2)
 - An interactive ocean with 40 levels in the vertical, to a depth of 4737 m, and horizontal resolution of 0.25 degree at the tropics, tapering to a global resolution of 0.5 degree northwards and southwards of 10N and 10S respectively
 - An interactive 3 layer sea-ice model
 - An interactive land model with 4 soil levels

Reforecast Configuration

Reforecast Configuration for CFSv2 (T126L64)

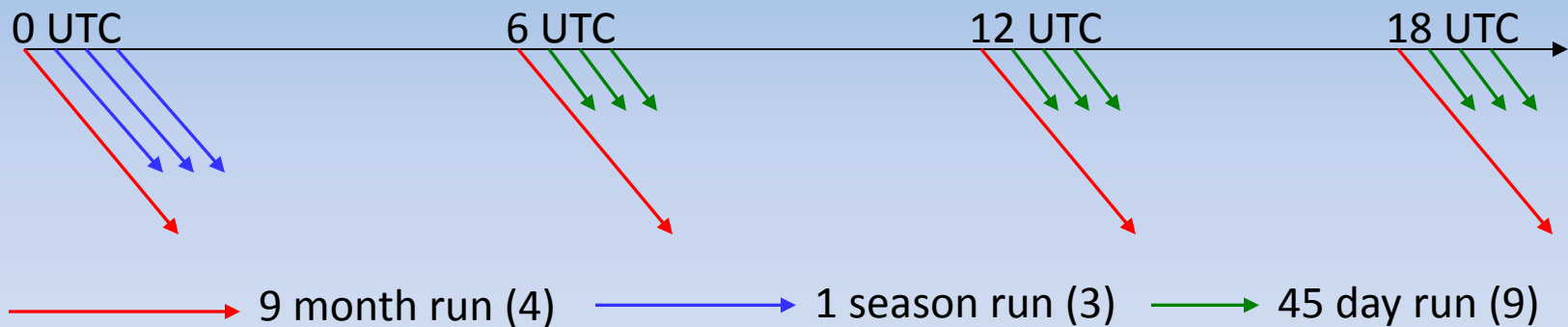
- **Three 45-day (1-month) hindcast runs from every 6, 12 and 18 UTC cycles, over the 12-year period from 1999-2010.** This is required for the operational CPC week3-week6 predictions of tropical circulations (MJO, PNA, etc)
- 9-month hindcasts initiated from every 5th day and run from all 4 cycles of that day, beginning from Jan 1 of each year, over a 29 year period from 1982-2010. **This is required to calibrate the operational CPC longer-term seasonal predictions (ENSO, etc)**
- A single 1 season (123-day) hindcast run, initiated from every 0 UTC cycle between these five days, over the 12 year period from 1999-2010. **This is required to calibrate the operational CPC first season predictions for hydrological forecasts (precip, evaporation, runoff, streamflow, etc)**



Operational Configuration

Operational Configuration for CFSv2 real time forecasts (T126L64)

- There will be 4 control runs per day from the 0, 6, 12 and 18 UTC cycles of the CFS real-time data assimilation system, out to 9 months.
- In addition to the control run of 9 months at the 0 UTC cycle, there will be 3 additional runs, out to one season. These 3 runs per cycle will be initialized as in current operations.
- **In addition to the control run of 9 months at the 6, 12 and 18 UTC cycles, there will be 3 additional runs, out to 45 days. These 3 runs per cycle will be initialized as in current operations.**
- There will be a total of 16 CFS runs every day, of which 4 runs will go out to 9 months, 3 runs will go out to 1 season and 9 runs will go out to 45 days.



Use of CFSv2 for Stratospheric Purposes

- NCEP GFS can capture SSW events ~ 10-14 days in advance.
- Can the 45 day runs provide extended forecasts of stratospheric events such as:
 - Sudden Stratospheric Warmings
 - Non occurrence of SSW
 - Wave activity
 - Positive anomaly > warm vortex
 - Negative anomaly > cold vortex
 - In SH, can it provide info that polar vortex will be cold : large ozone hole potential- extended life span.
 - Or polar vortex will be warm: small ozone hole – short life span.

What are we looking for in SSW forecasts

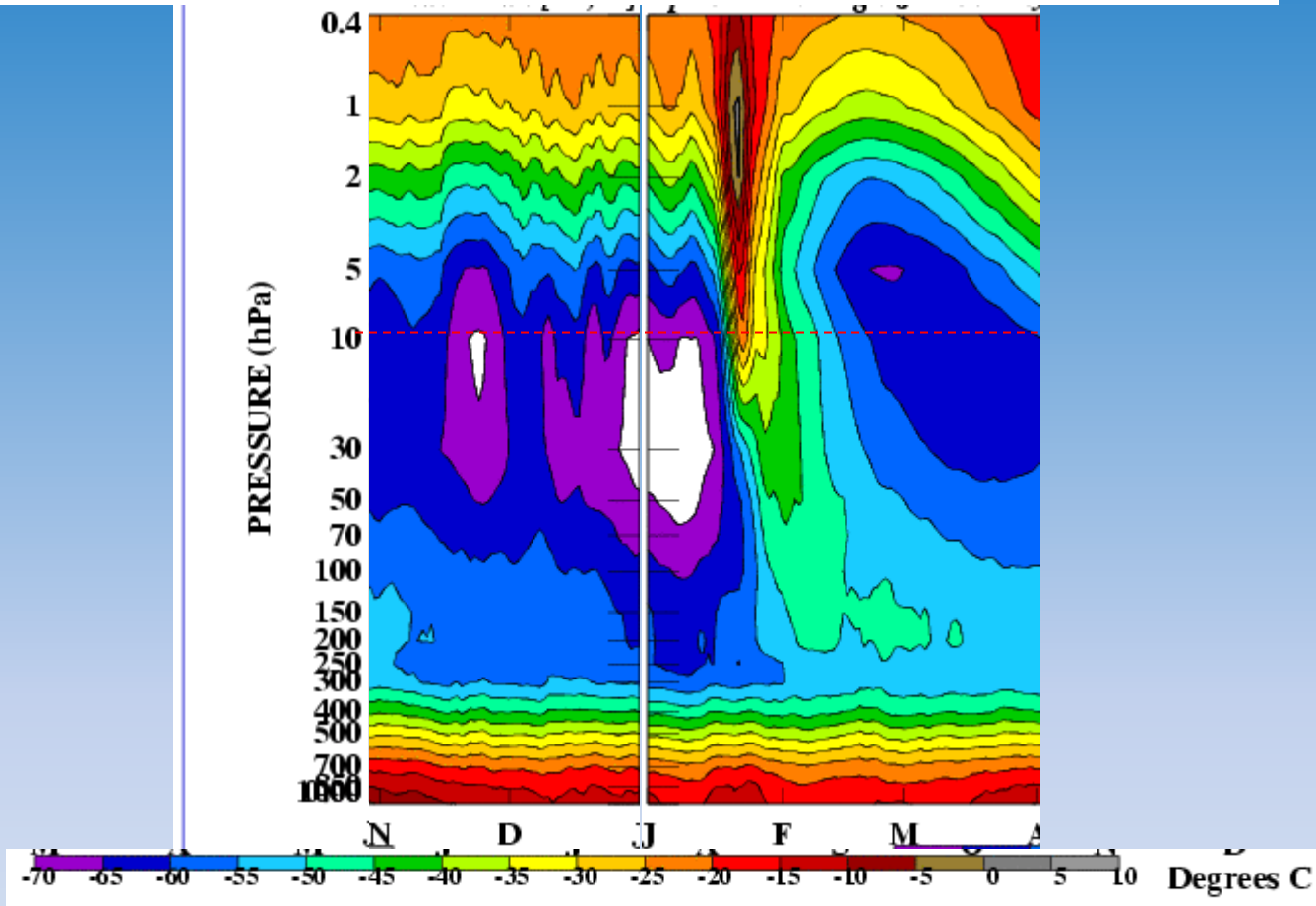
- When (how many days in advance) does the CFSv2 capture the SSW event.
 - Temperatures
 - Winds
- How much day to day variability there is in the forecasts and how (if) this variability decreases as the event is approached.
- What happens after the SSW event.
- Does the GPH anomalies indicate a change in the AO?

What are we looking for in cold vortex forecasts?

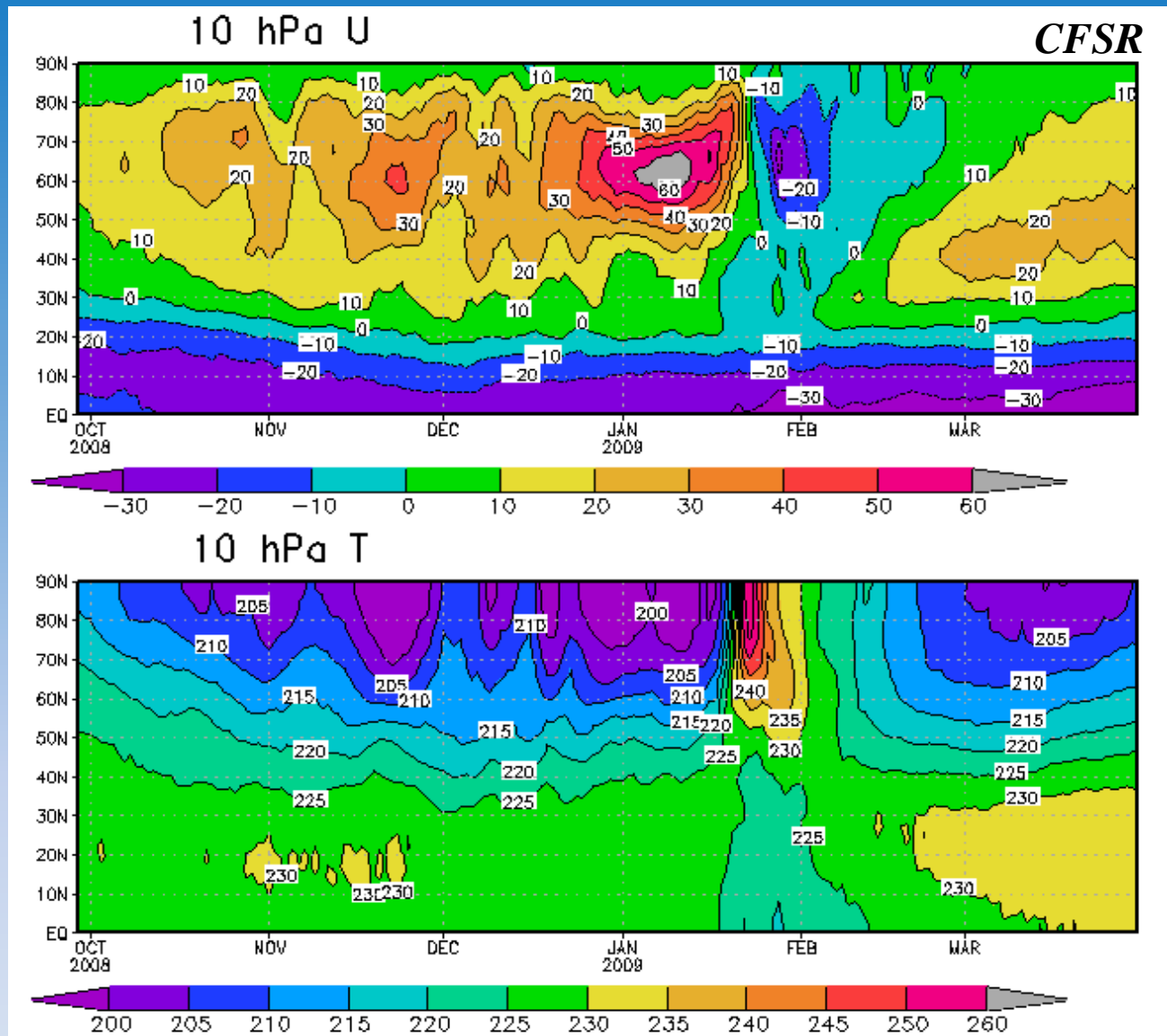
- Focus is for SH winter/spring
- How well does CFSv2 forecast waves (1 and 2) and poleward heat flux.
- Can it distinguish between a warm SH polar winter and a cold winter.
- Can this indicate the size of the T_{nat} area:
 - Size of ozone hole
 - Longevity of ozone hole (vortex)

NH SSW: 2008-2009

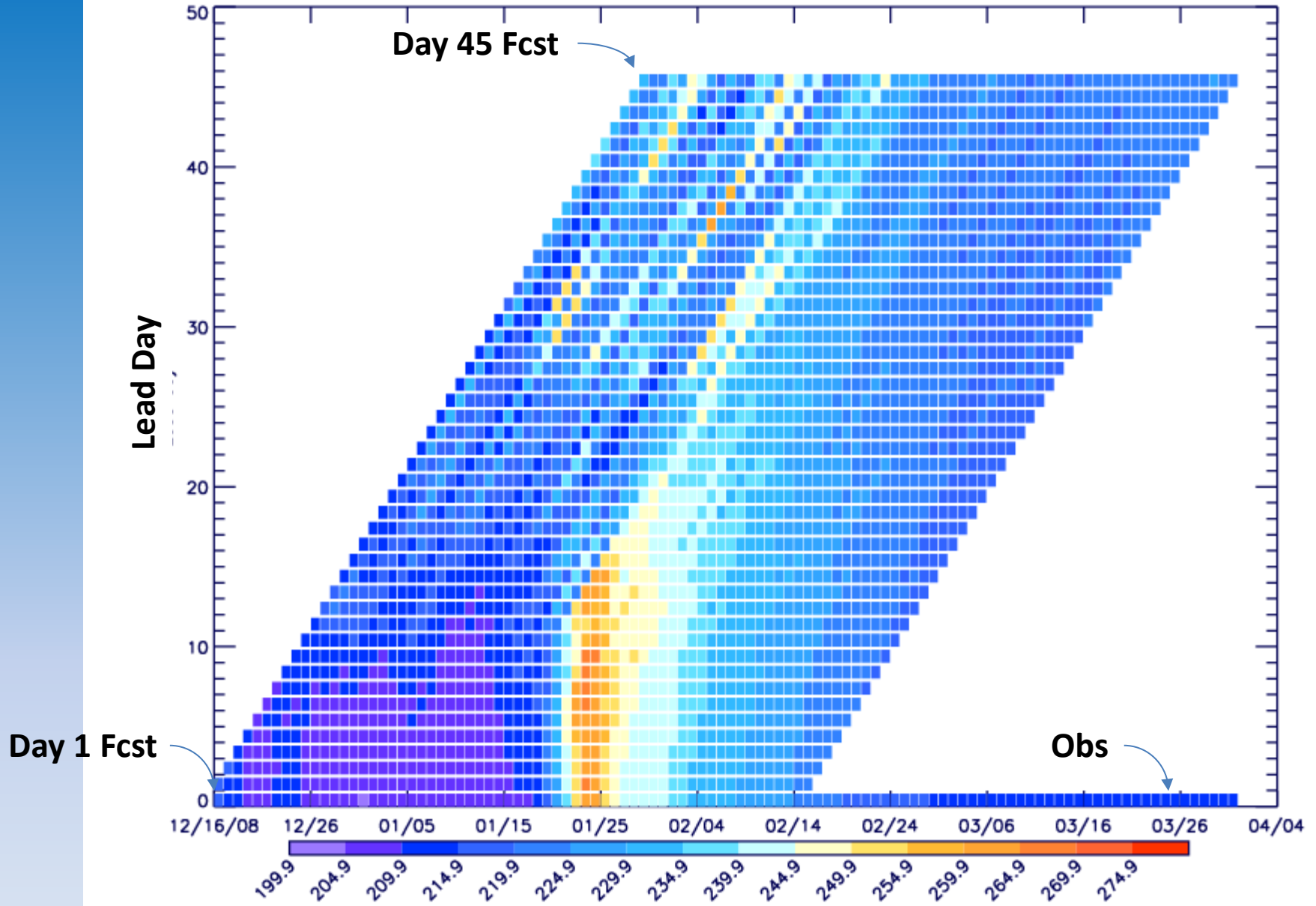
GDAS-CPC Zonal Temperature Time Series 2008-2009
60N-90N



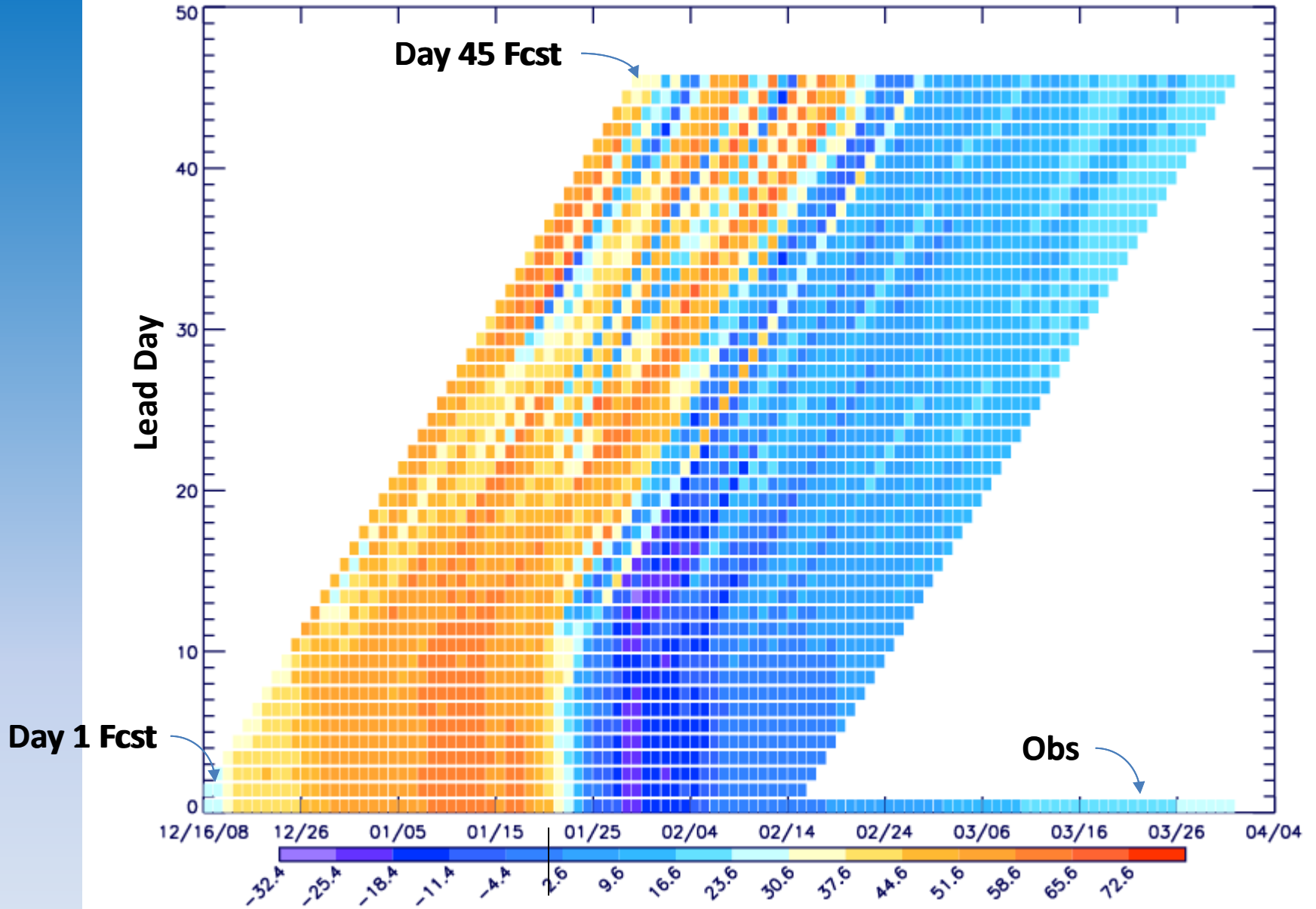
NH SSW: 2008-2009

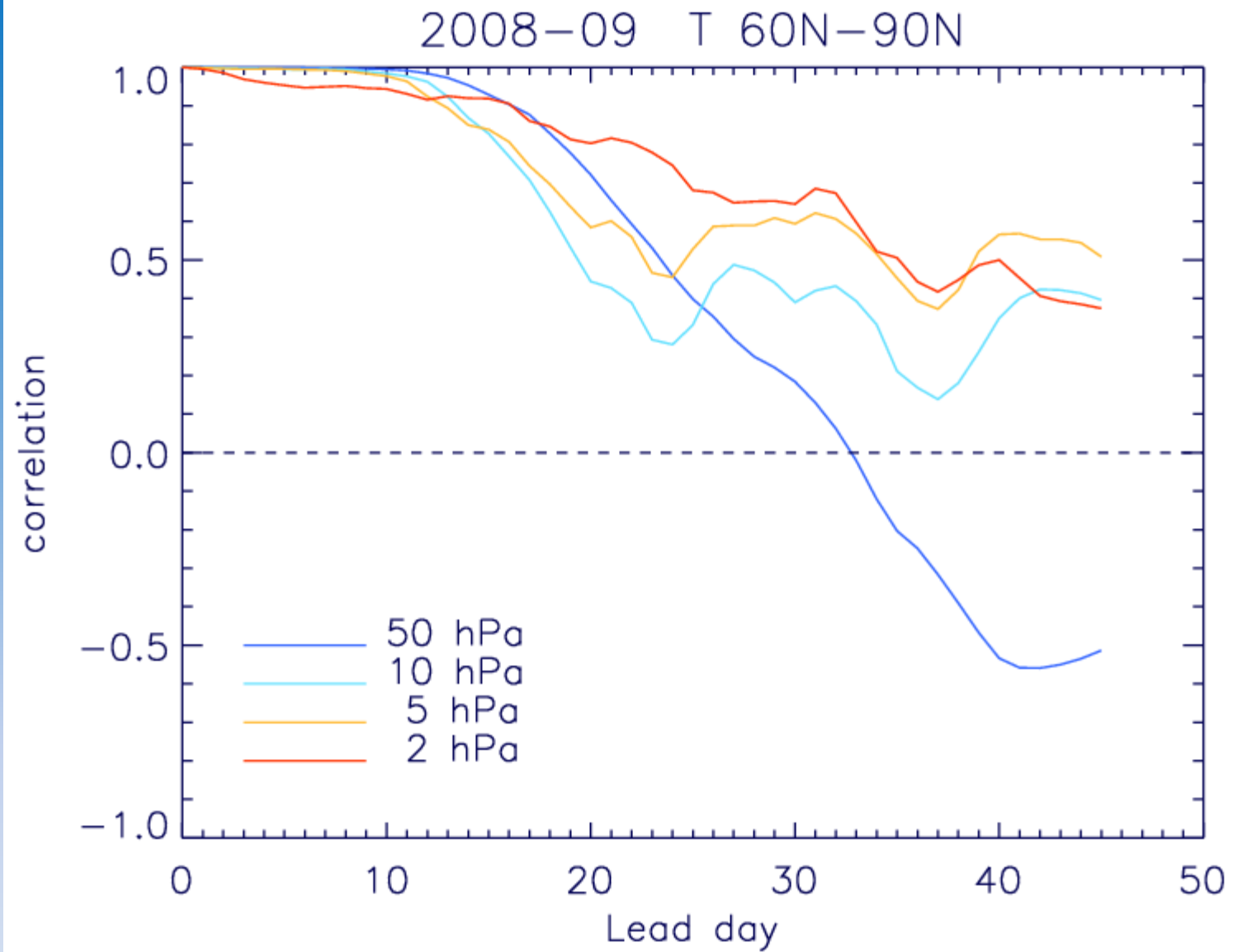


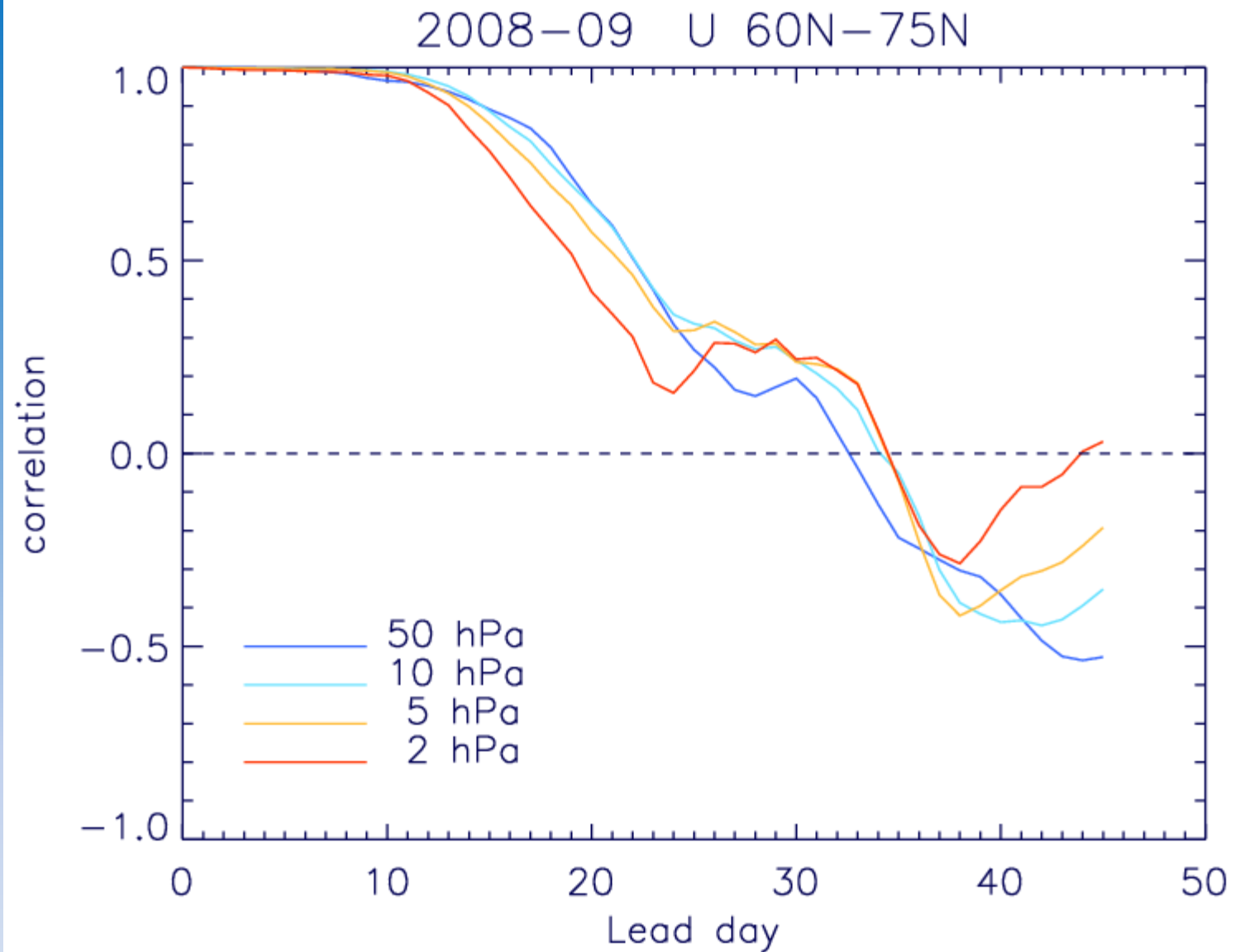
CFSv2 Forecast : 10 hPa : T : 60N-90N



CFSv2 Forecast : 10 hPa : u : 60N-90N

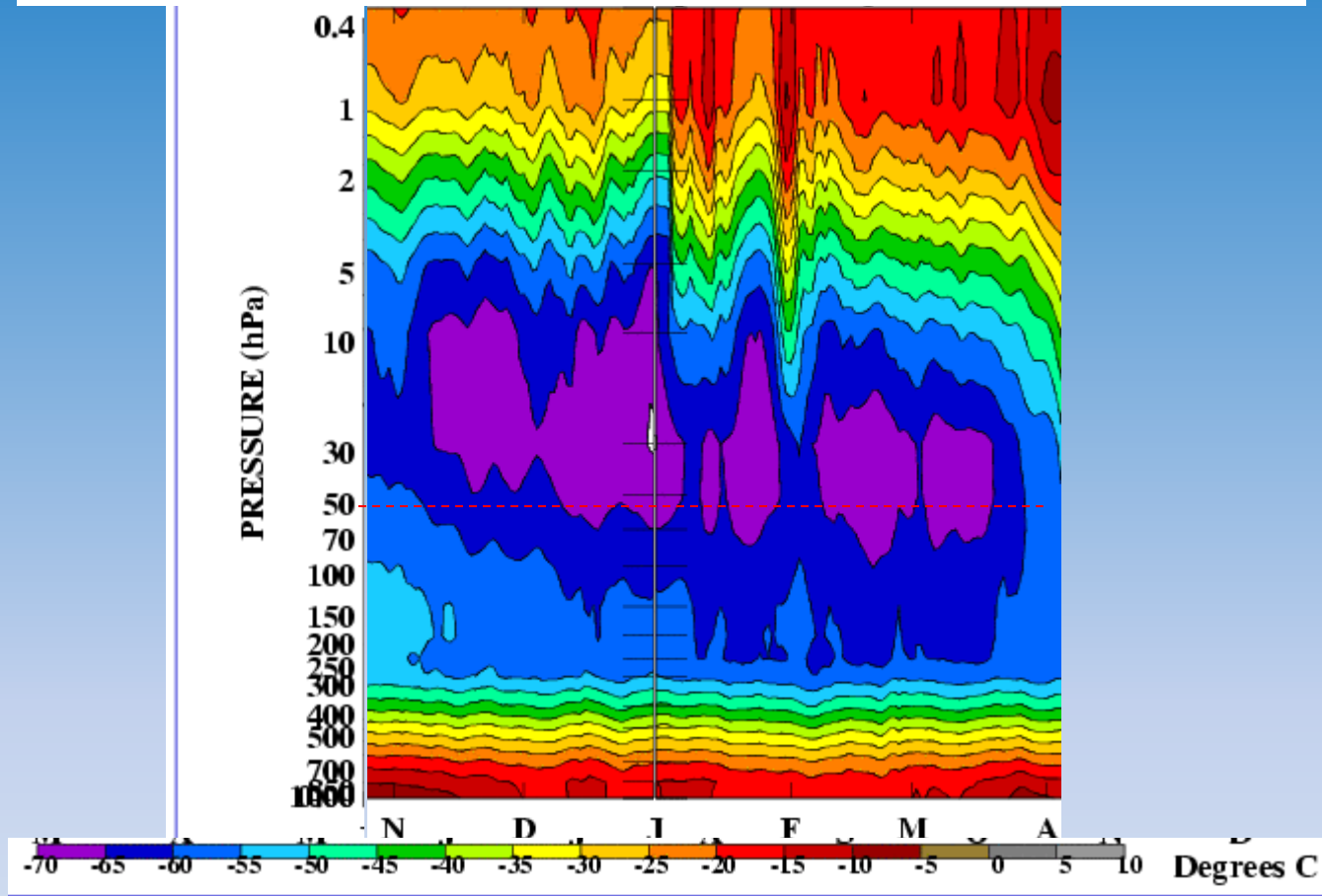




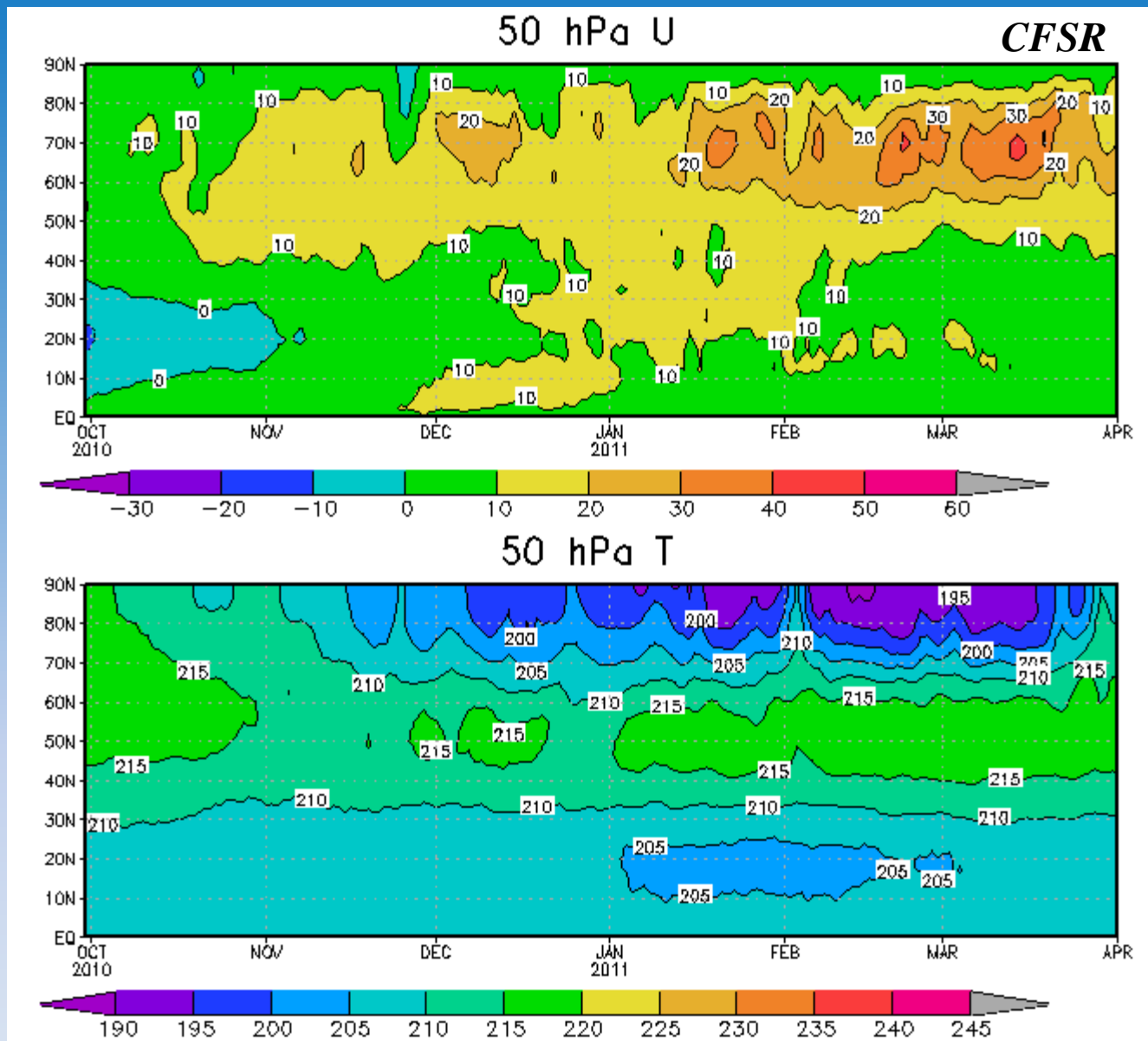


NH Cold Winter: 2010-2011

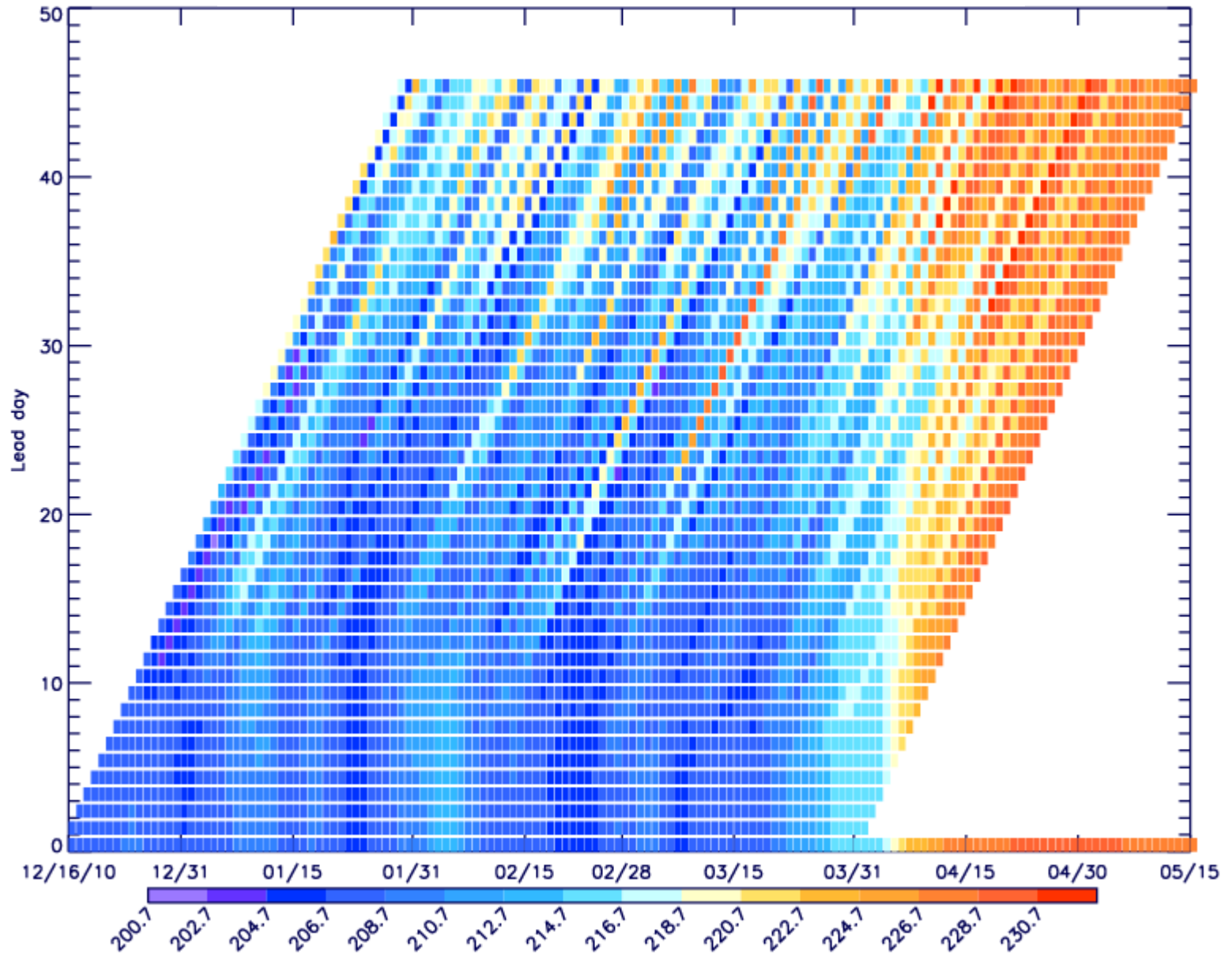
GDAS-CPC Zonal Temperature Time Series 2008-2009
60N-90N



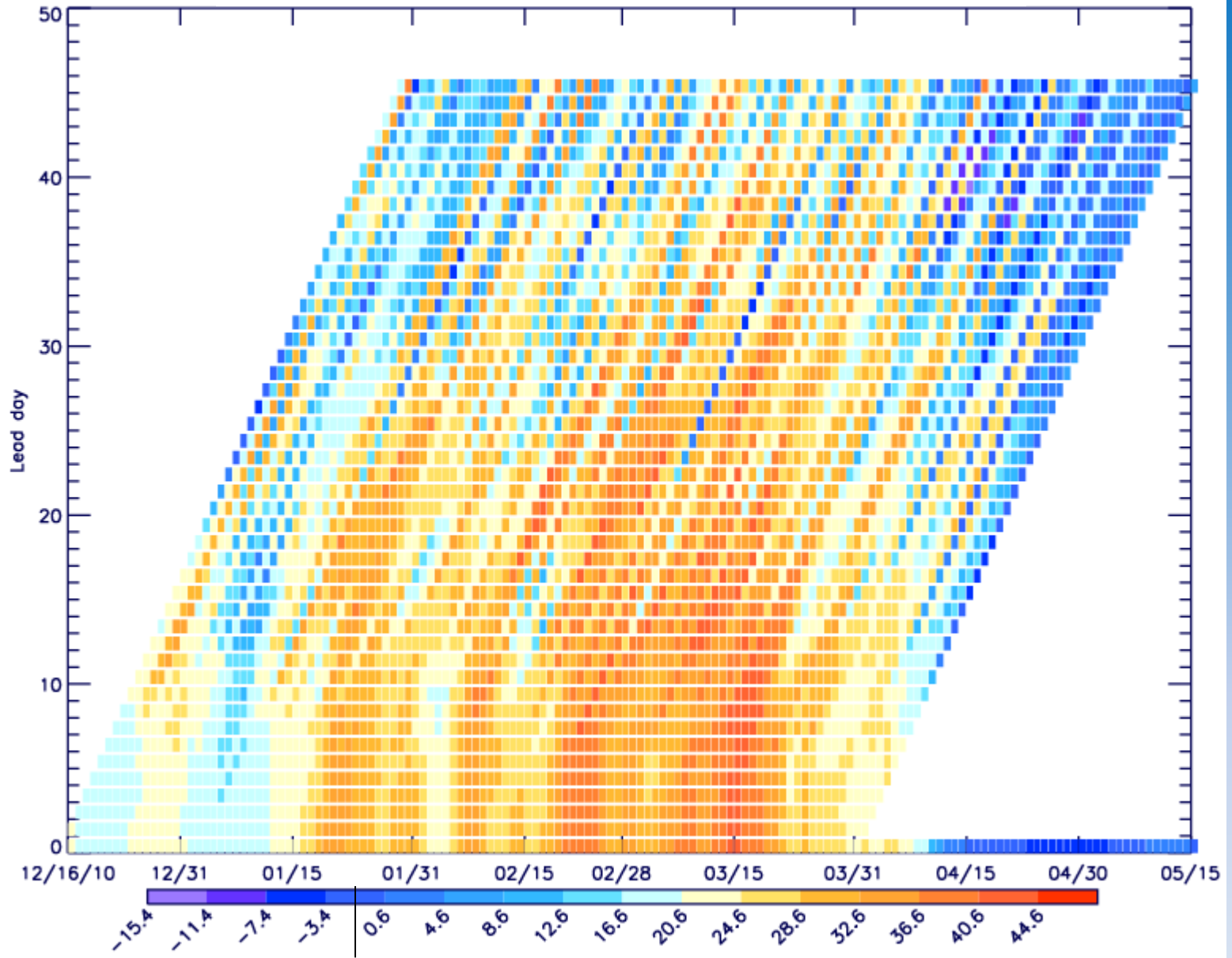
NH Cold Winter: 2010-2011

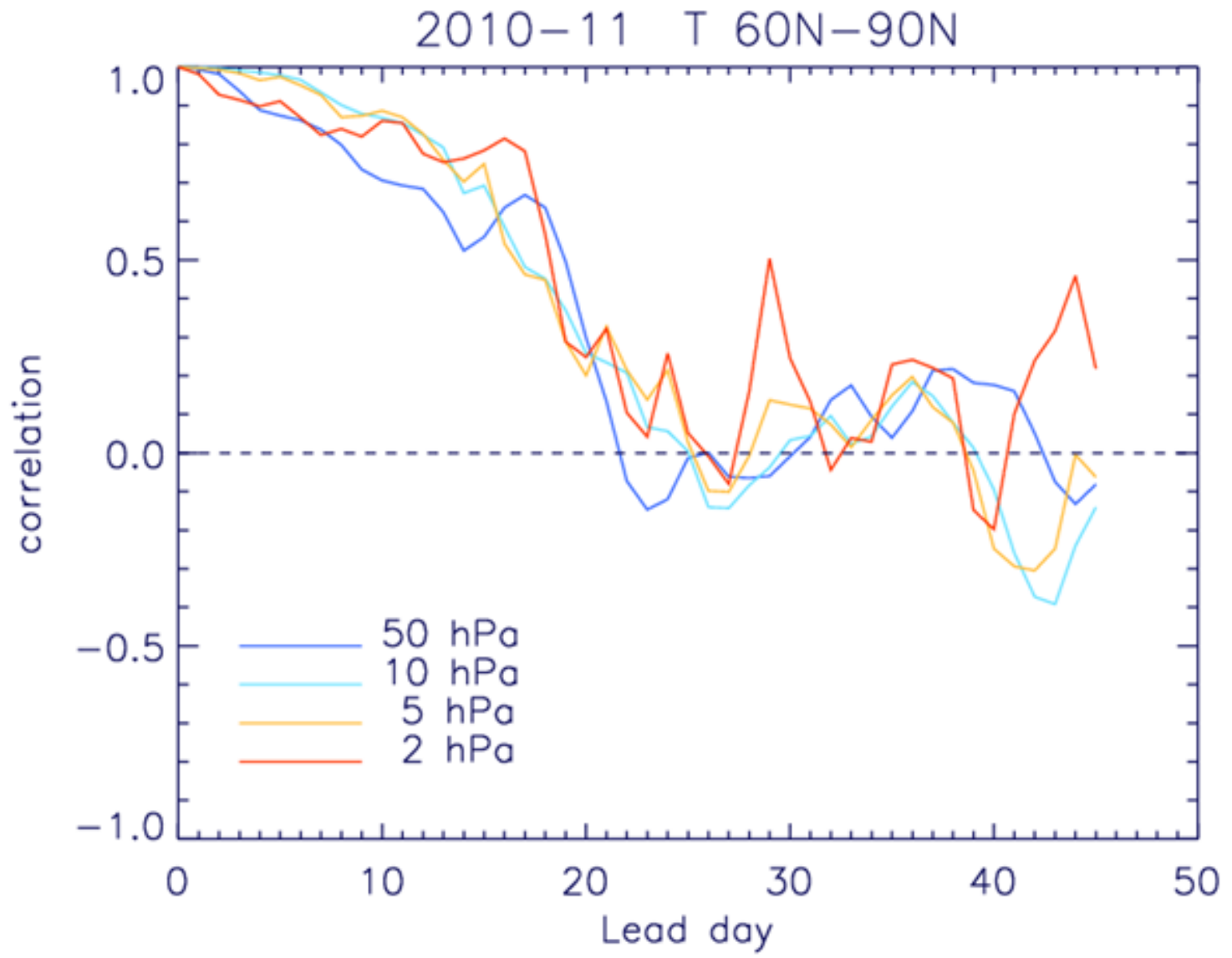


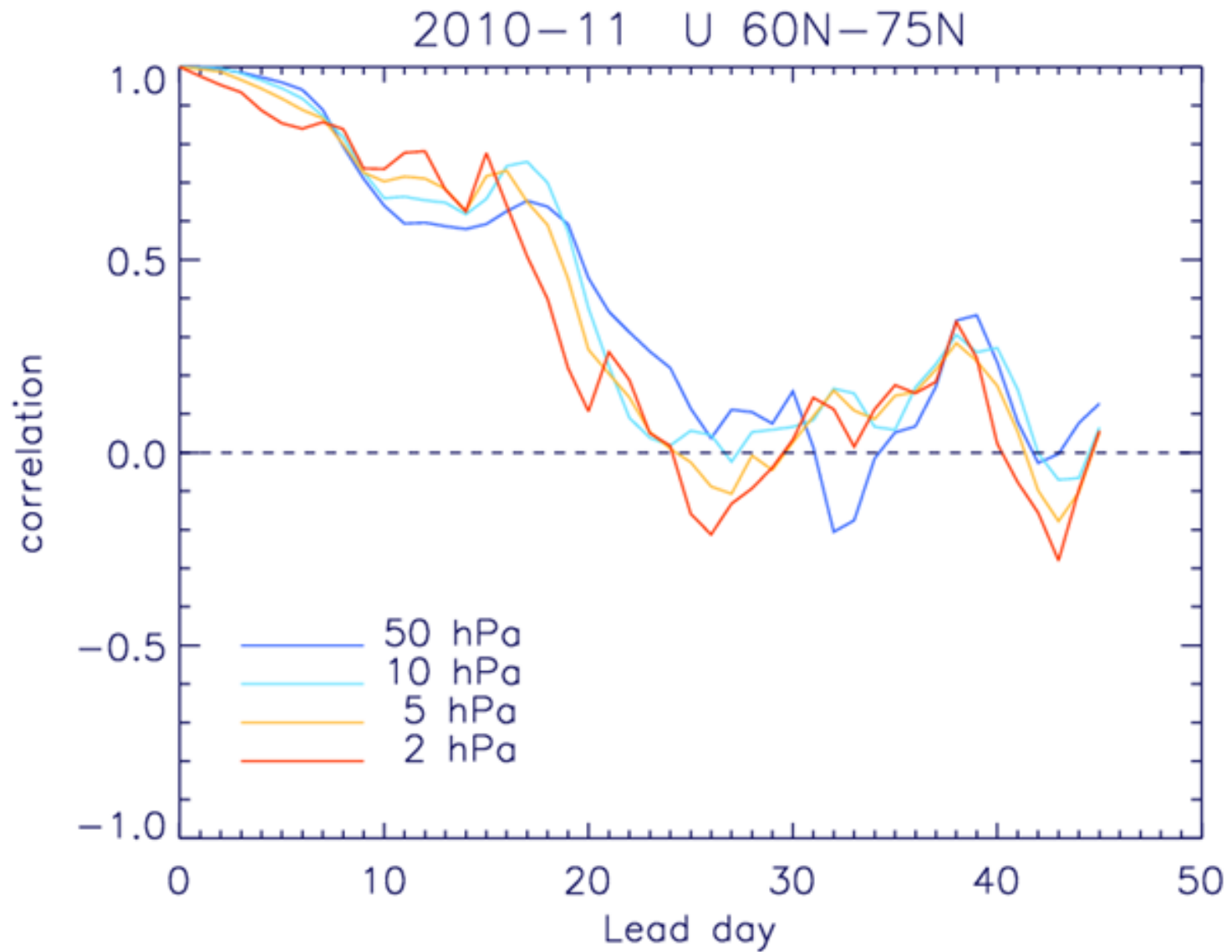
CFSv2 Forecast : 50 hPa : T : 60N-90N



CFSv2 Forecast : 50 hPa : u : 60N-90N

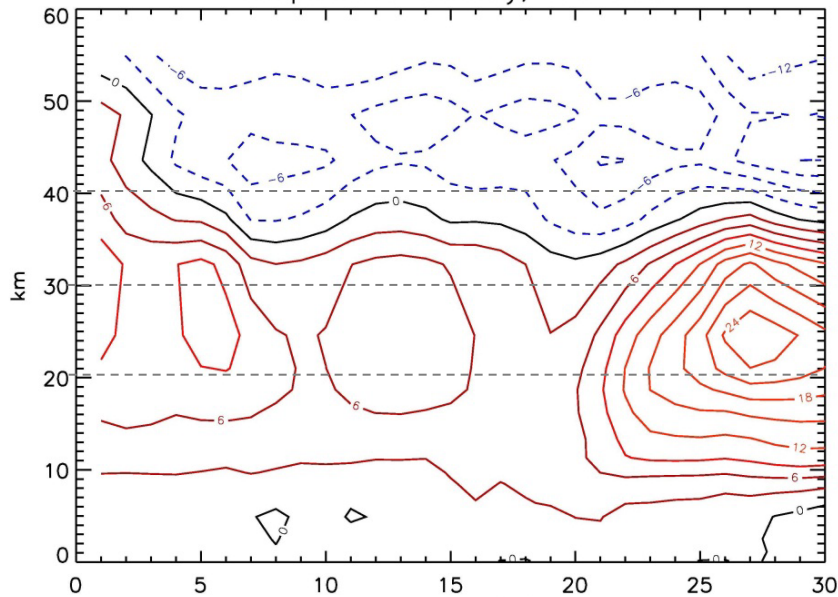






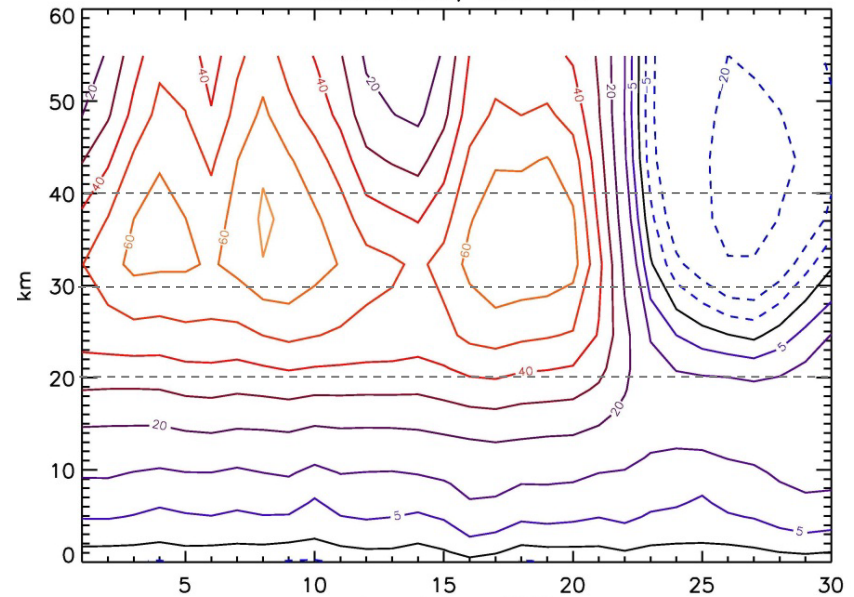
SH SSW: 2002

Temperature Anomaly, 60S-90S



Day of September, 2002

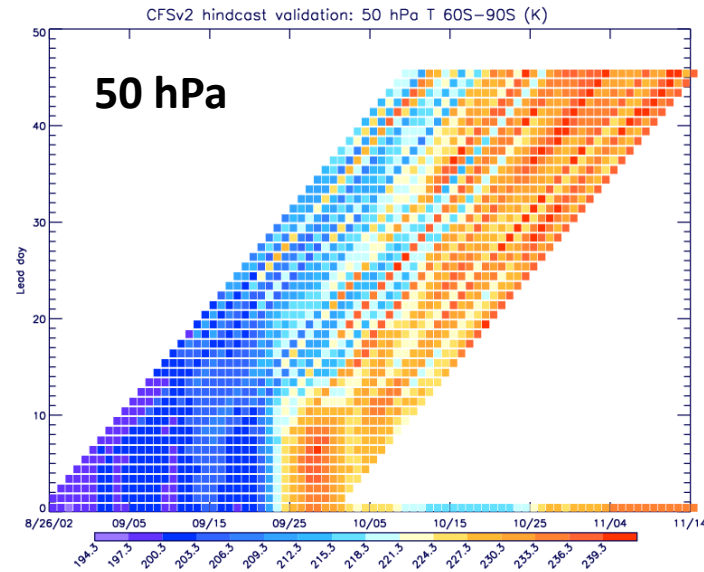
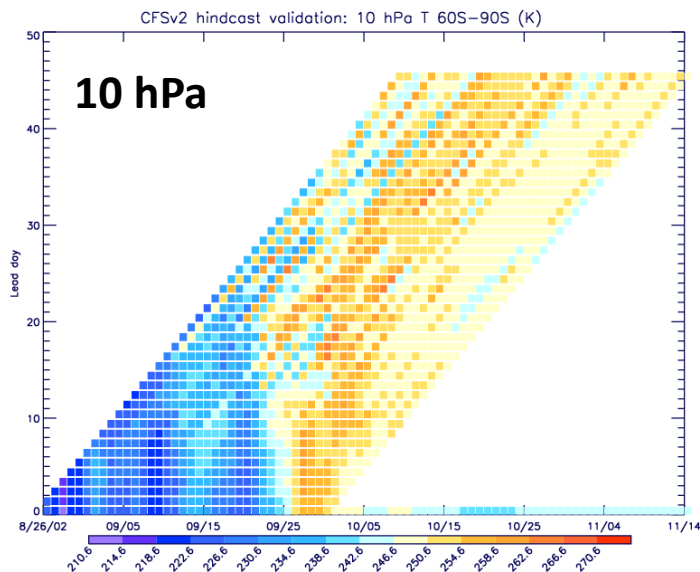
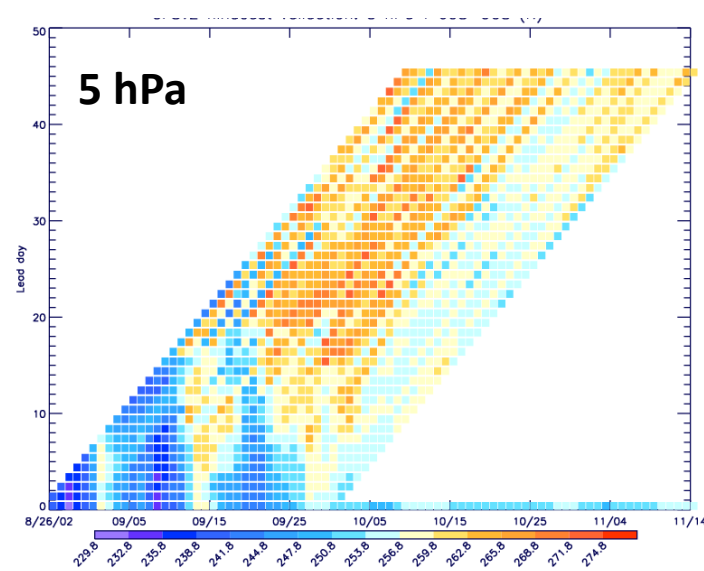
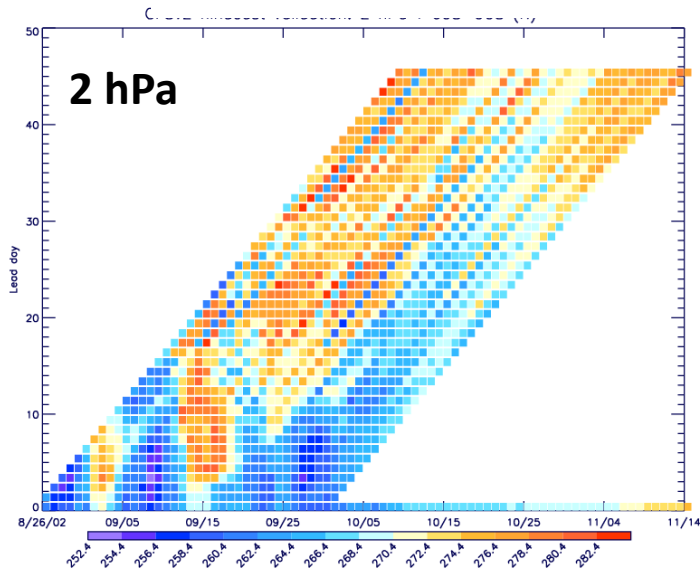
Zonal Wind, 60S-90S



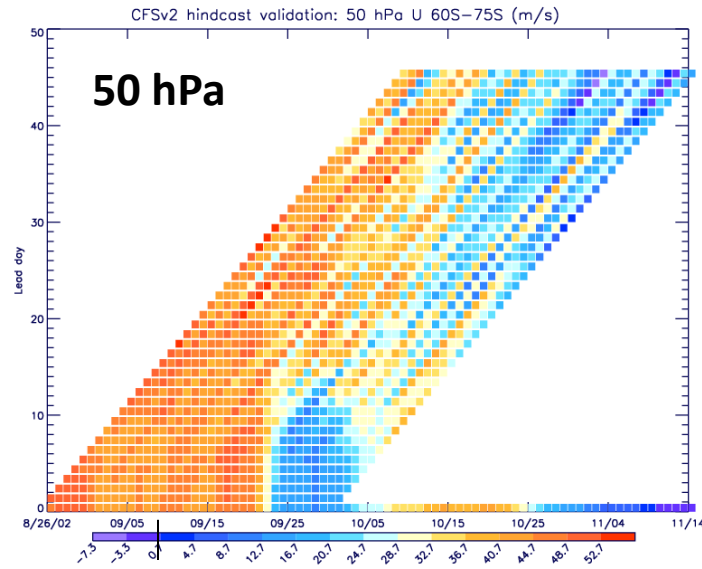
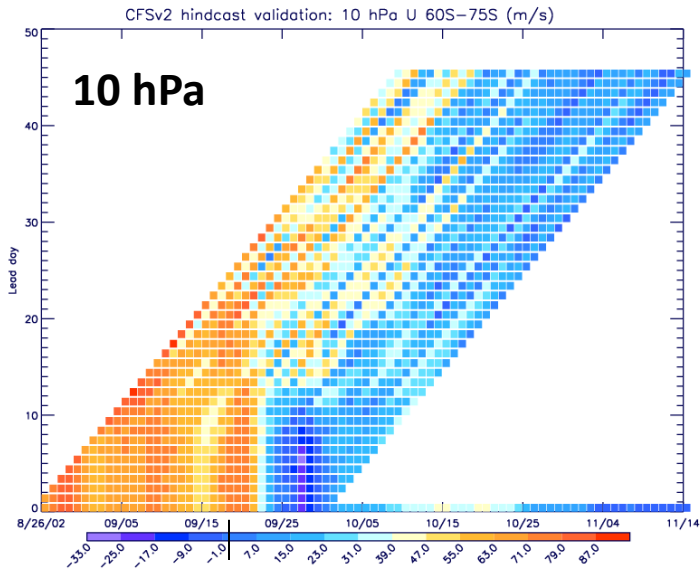
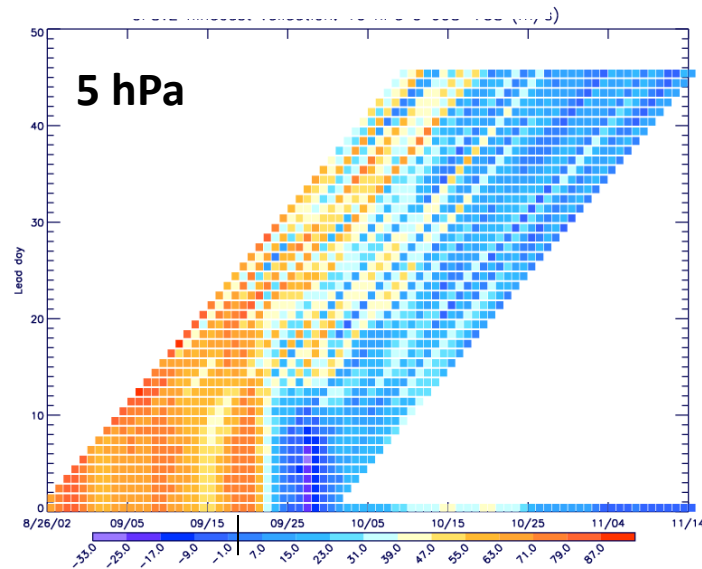
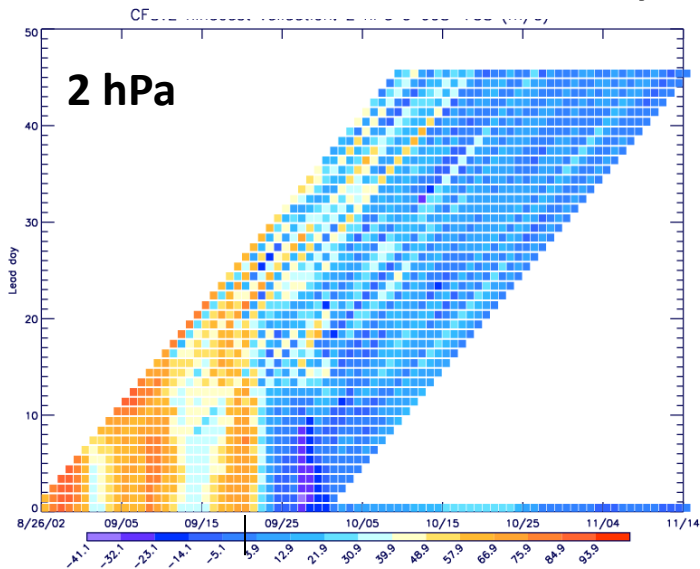
Day of September, 2002

- Observed south polar temperature anomaly and zonal wind
- Sudden temperature increase occurred in middle and lower stratosphere.
- Zonal wind reversed direction throughout the upper polar stratosphere.

CFSv2 Forecast : 2, 5, 10, 50 hPa : T : 60S-90S



CFSv2 Forecast : 2, 5, 10, 50 hPa : u : 60S-90S



Summary

- CFSv2 generates ensembles of 45 day forecasts.
- CFSv2 captures SSW within 15 days of occurrence.
- CFSv2 captures persistent cold conditions.
 - Low wave activity
- Not any better than using GFS forecasts
- Does not generate “pulse” that initiates SSW event
 - Research on what generates the “pulse”
 - Blocking?
 - Pre-conditioning?
- Will higher resolution CFSv3 capture events with greater lead time?