Experimental
Extended Range (45 days) GEFS

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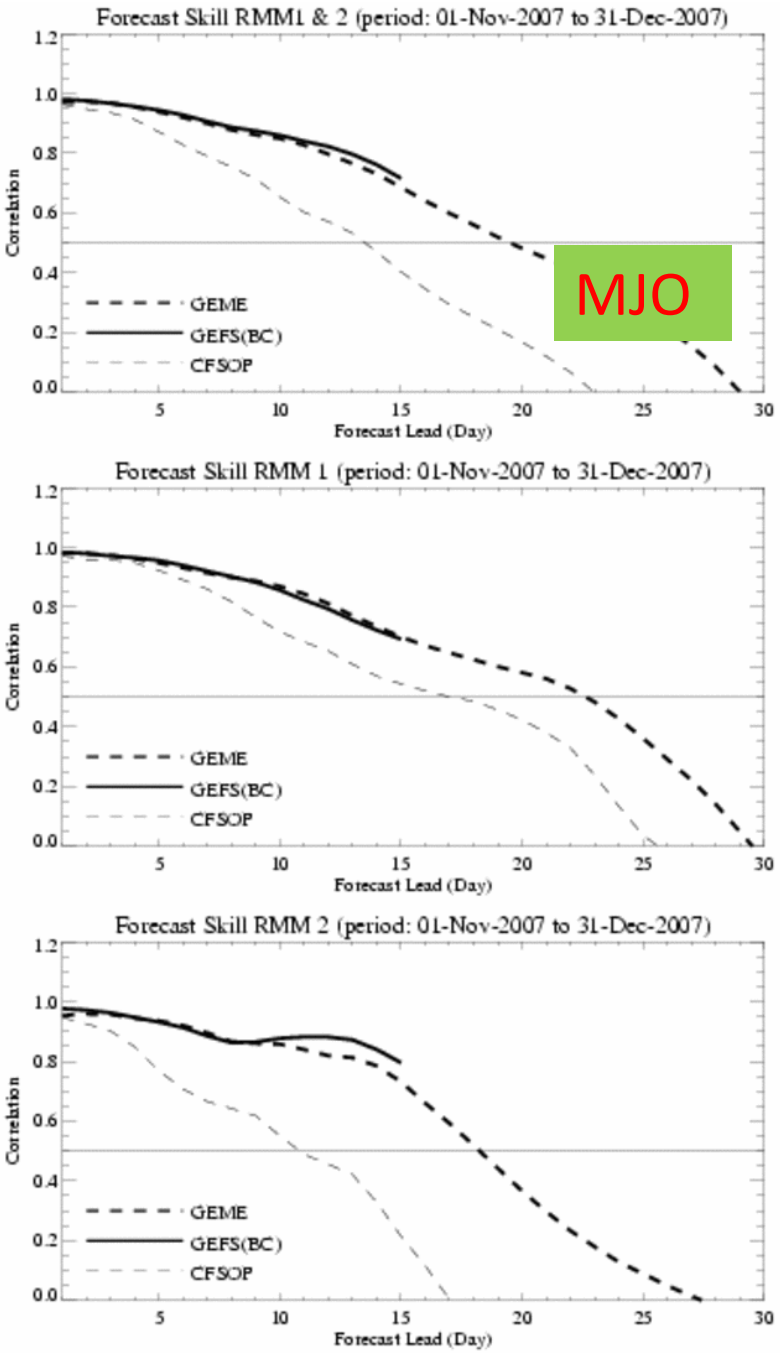
Global ensemble systems at NCEP

- Coupled CFSv2 45 days currently in operations and associated hindcast
  - Initial conditions not optimized to represent weather forecast uncertainty
  - Frozen model and hindcast
- GEFS state of the art atmospheric model
  - Uncoupled model
  - No hindcast

Past evaluations

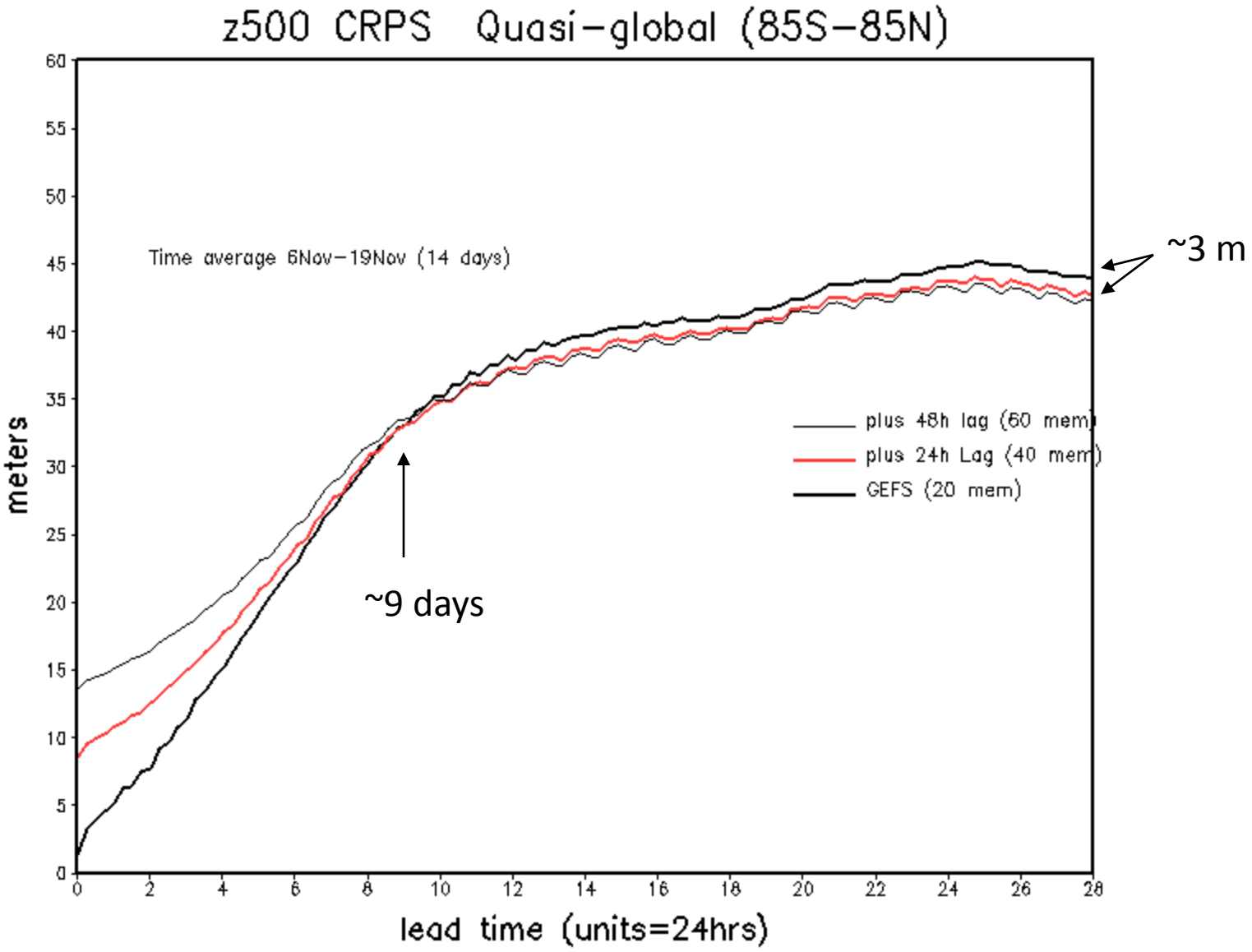
- Evaluations of experimental GEFS (in operations in 2007) showed AC > 0.5 at around 20 days for the two modes of MJO
- It ouperformed the CFSv1. With a limited sample size (two months) it there is a large uncertainty.
- The new CFSv2 now also outperforms the CFSv1
- No evaluations have been carried out of the two current ensemble systems



From Qin Zhang (CPC-NOAA)

Lagged 30days GEFS to form Lag-super-ensemble

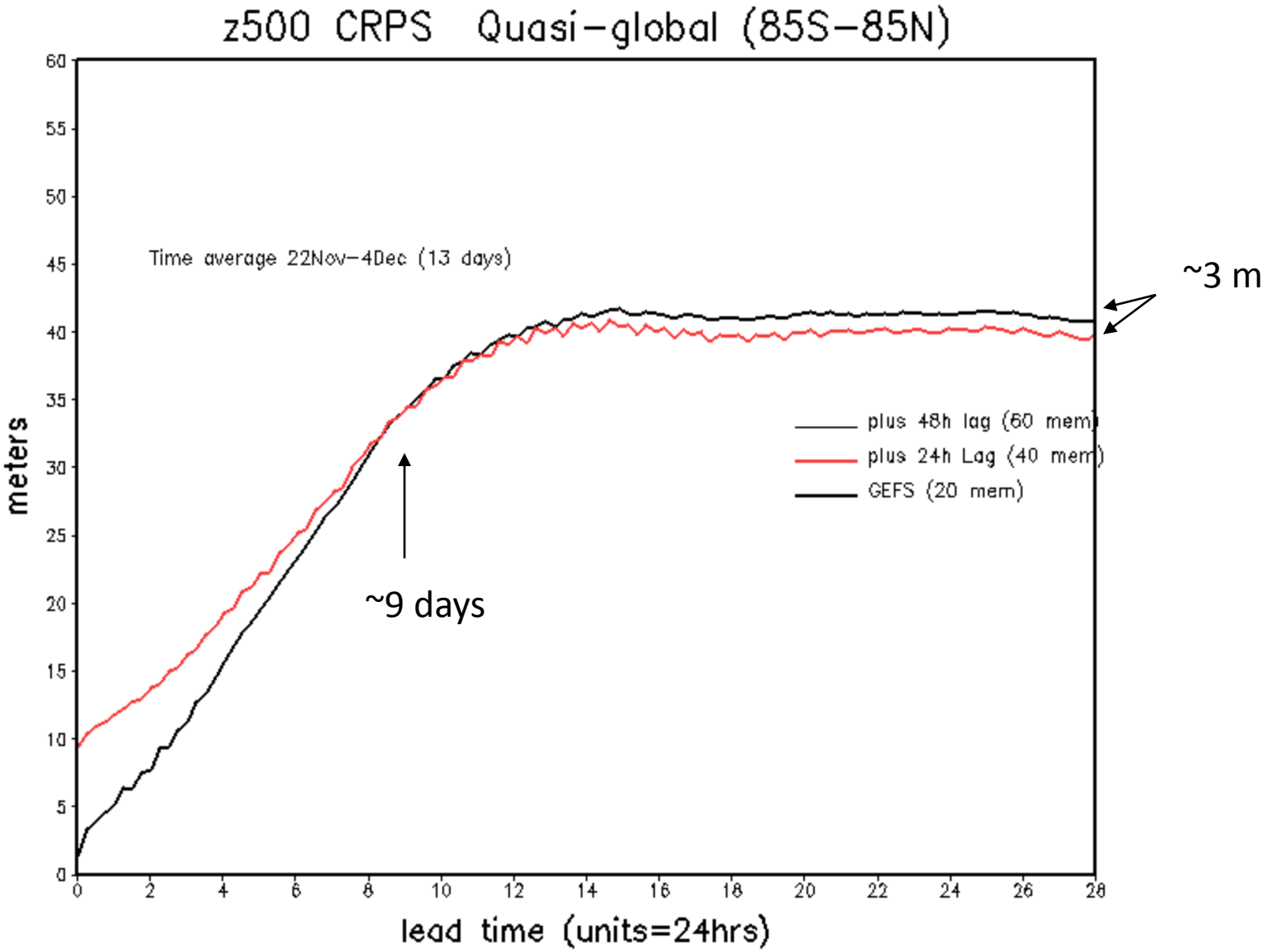
Experimental 30-days forecasts



Lag-super-ensemble has better CRPS beyond 9 days.

Lagged 30days GEFS to form Lag-super-ensemble

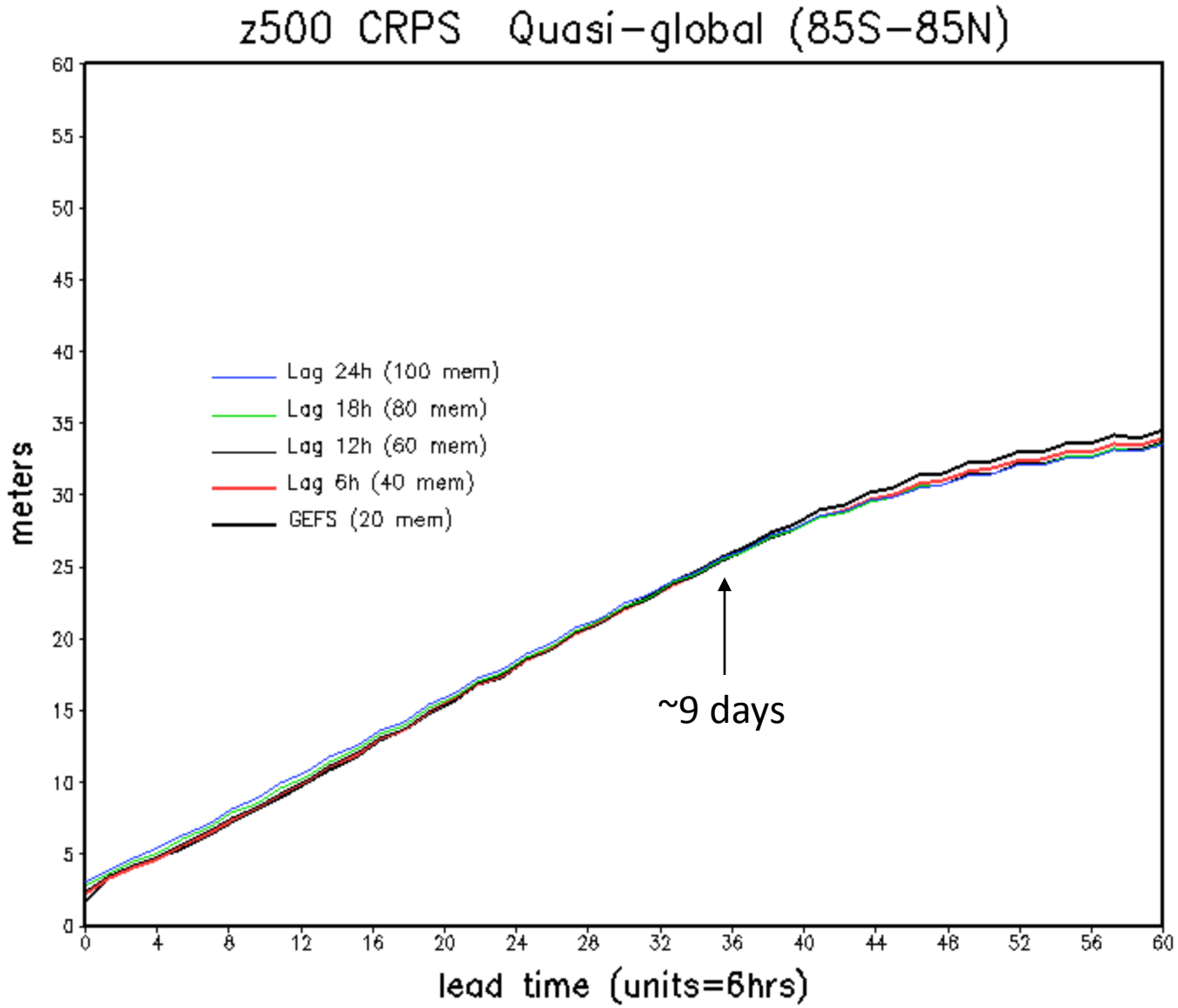
Experimental 30-days forecasts



Similar results for a second half of data

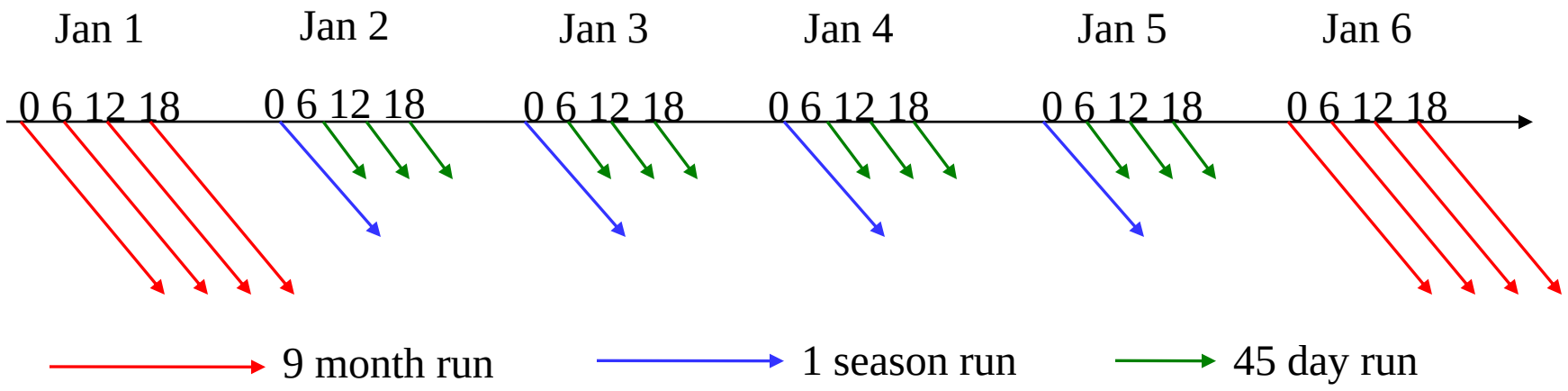
Lagged GEFS to form Lag-super-ensemble

Operational 16-days forecasts



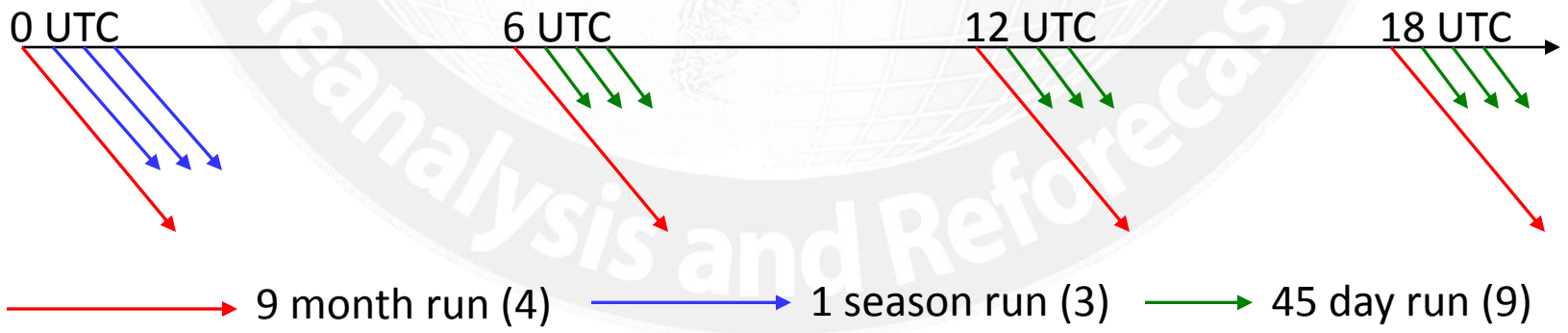
Hindcast Configuration for CFSv2

- 9-month hindcasts were 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)
- There is also 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)
- In addition, there are 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)



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.



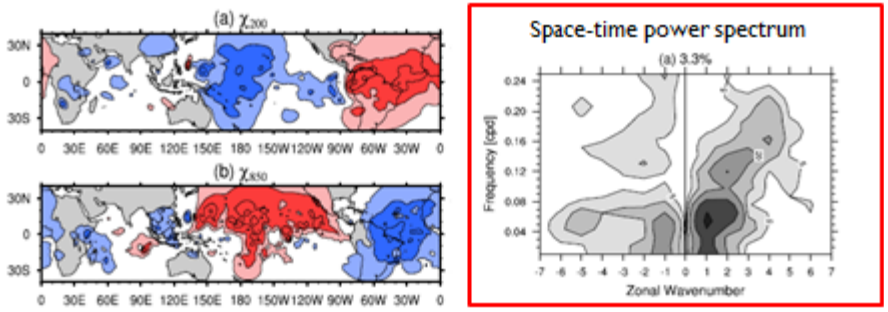
Coupled Breeding Experiments

- Researched BV in the coupled CFSv1 in parallel with NASA team.

Experimental Design for BV

- Model : GEOS5 Coupled GCM (Tag : Natanas-replay-7_21mom)
- Period : Oct 1992 – Dec 1995
- Norm variable : Velocity Potential at 200hPa over 40-180E, 20S -20N
- Rescaling time scale : 1day, 2day, and 5day
- Rescaling norm magnitude : Variously tested

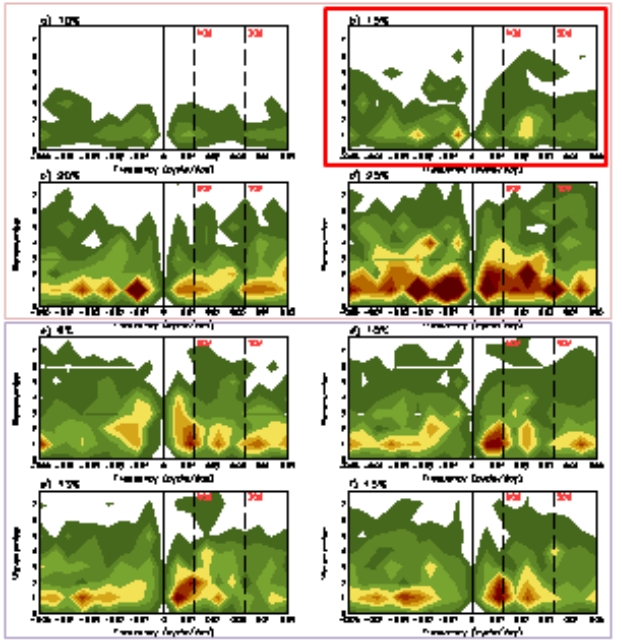
Chikamoto et al. 2007
BV : 1-day rescaling with 3.3% norm magnitude



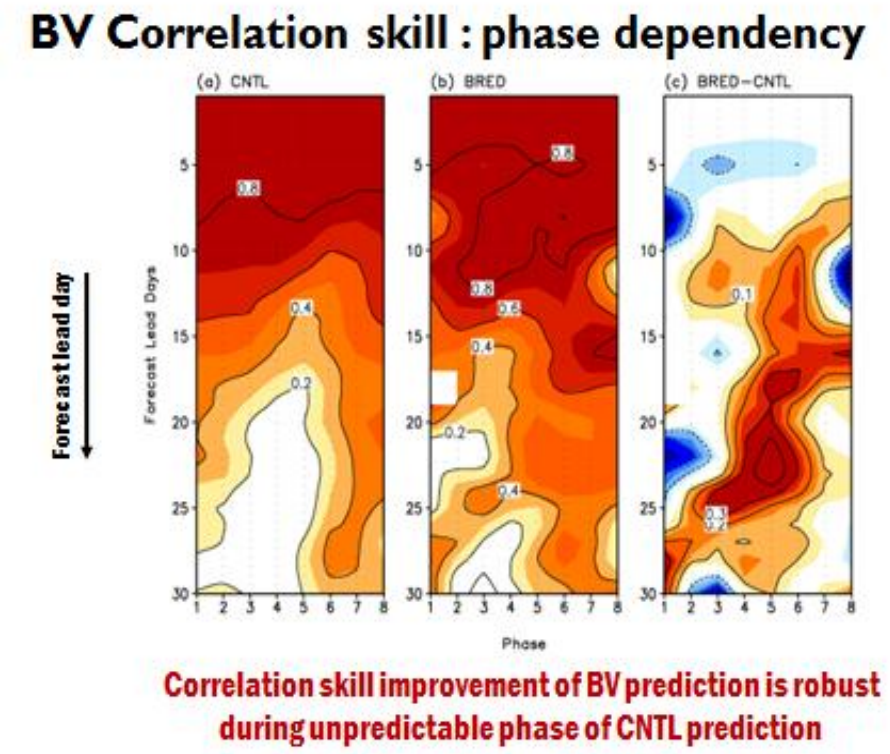
BV Experiments – Space-time power spectrum

2-day rescaling

5-day rescaling



Coupled Breeding



Yoo-Geun and Shubert 2011

- Work is still on hold as a suitable coupled model is under development at EMC
- Technical difficulties to perform Breeding in CFSv2

Plan (Aug 2011)

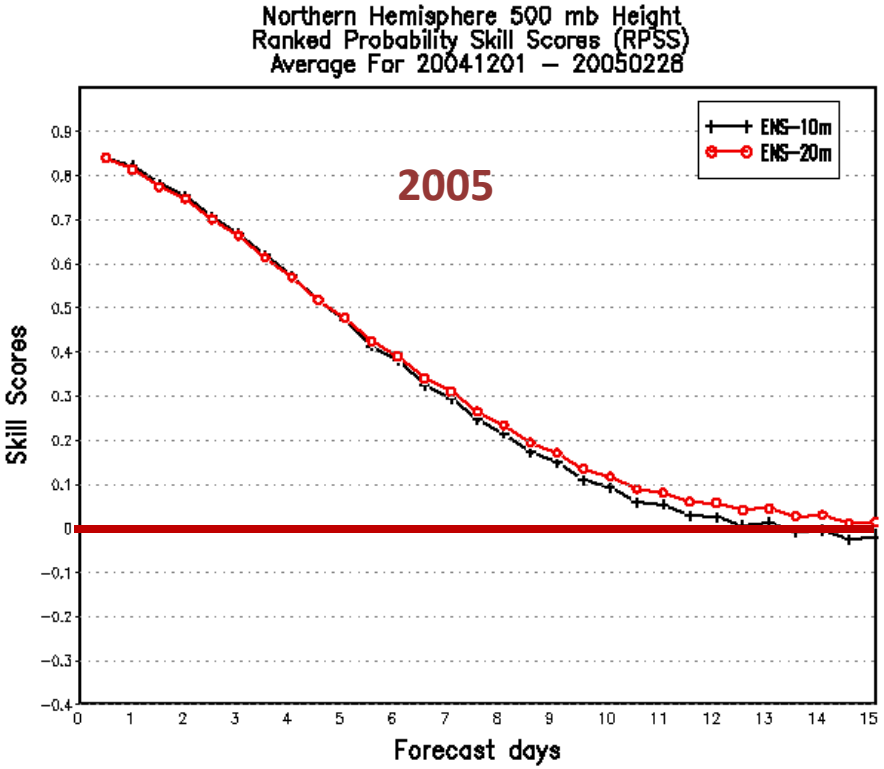
- Resolutions for forecast day 16-45 days: T126L42 (consider L64 as in CFS); Restart from day 16, not necessary to use digital filter
- Frequency and content: Once per day from June 1st 2011; Pgrba file at 1x1 degree resolution
- Basic evaluations: 5-day, weekly, and 10-day mean performance from raw ensembles; Probabilistic evaluation; Lag ensembles (1-day, 2-day, one week …..)
- Hindcasts: Opportunities: ESRL Refcst, CFSRR; device suitable real-time generation for next versions
- Monthly forecast and comparisons (Collaboration w CPC)
- Exchange with CMC (NAEFS extension forecast)

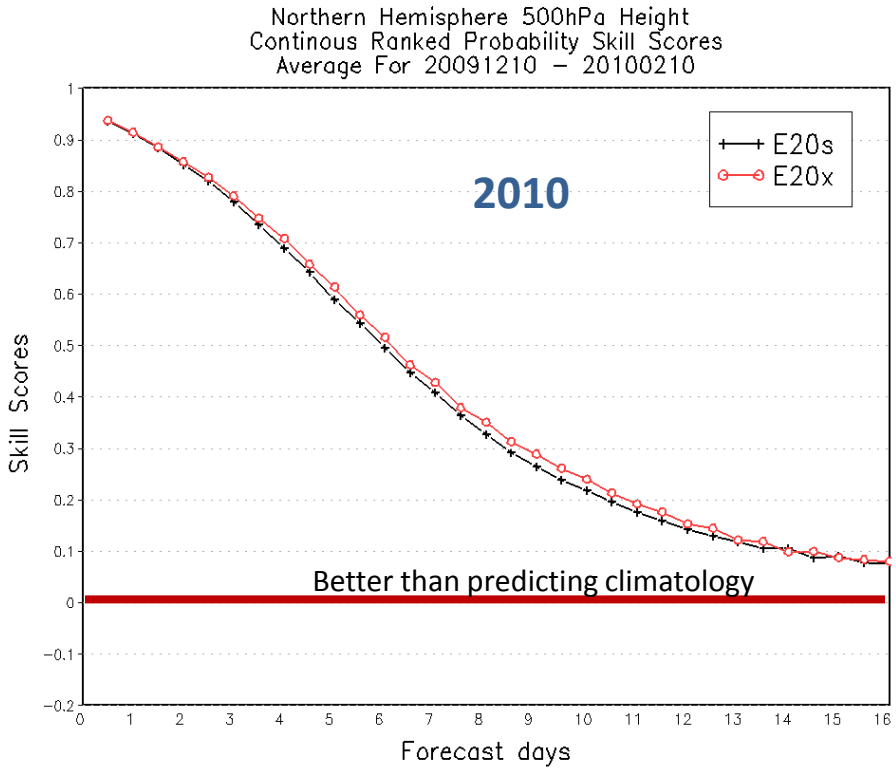
Can GEFS add value beyond 16 days?

- Additional computation cost to current GEFS set up ~ 10%
- Are uncoupled NWP's suitable to predict beyond 2 weeks? Need to evaluate …
- Useful to bridge medium-range weather to seasonal prediction
- Users may consider the accurate prediction of weekly or one-month means

Historical RPSS for GEFS

20 Member Ensemble





- GEFS constantly improving: Better I.C., higher resolution, most recent GFS
- GEFS currently outperforms climatology beyond 16 days; slowly approaching to zero

Extended GEFS: Characteristics

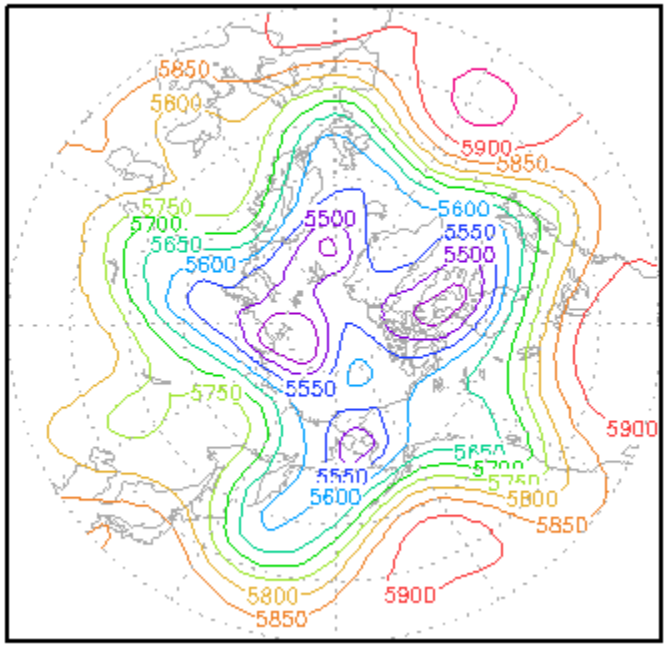
- Latest version of GEFS
- Identical GFS and ET perturbations
- Three forecast segments:
  - High Resolution:
    - T254L42; 00h to 192h (8 days)
  - Low Resolution:
    - T190L42; 192h to 384h (16 days)
  - Ext Resolution:
    - T126L42; 384h to 1080h (45 days)

Extended GEFS: Experimental Setup

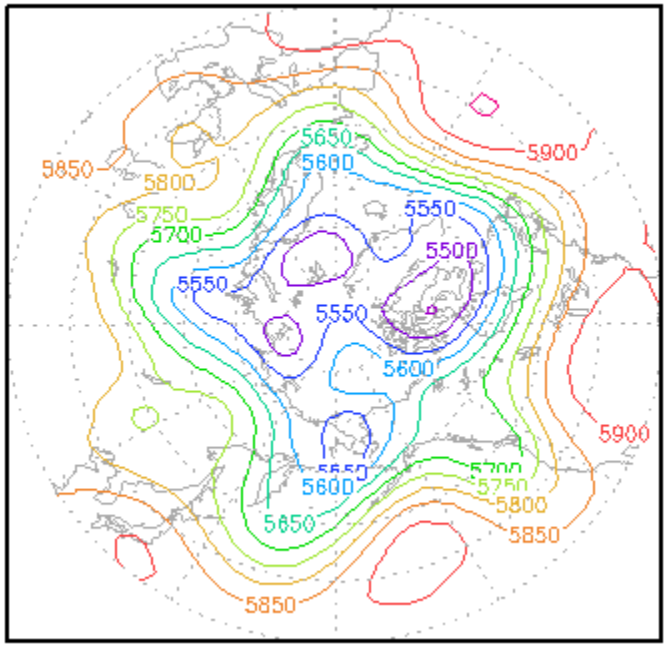
- Currently runs in a NEW Linux super-computer system – Took several weeks to establish and still have some problems
- Runs daily; Initial conditions: 00Z, no cycling
- Period of analysis: 1 year, starting July 2011 (not complete)
- Full runs from 0 to 45 days takes < 3h in the Linux system

Illustration 10-d Averages

NH 500hPa, July 11, 2011



ANA

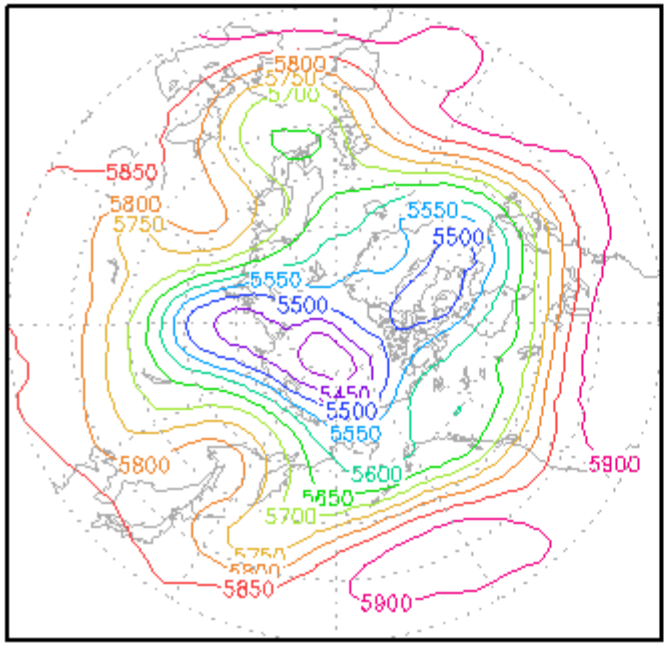


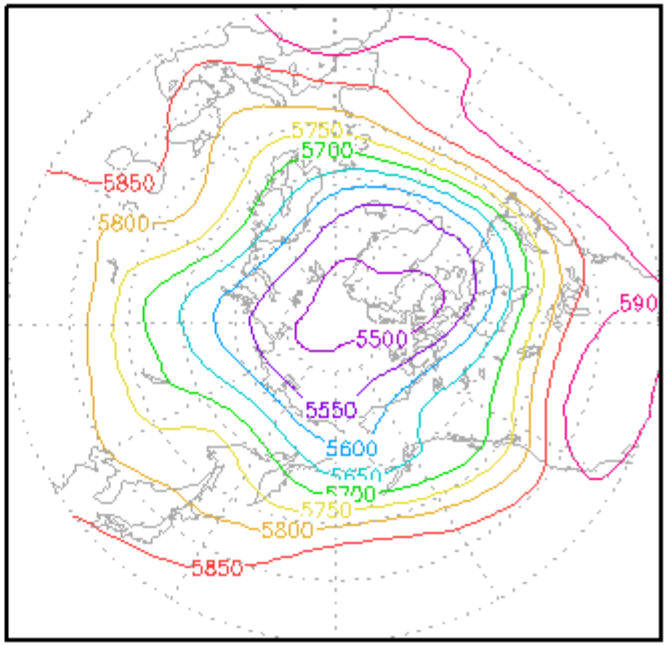
FCST

ANA

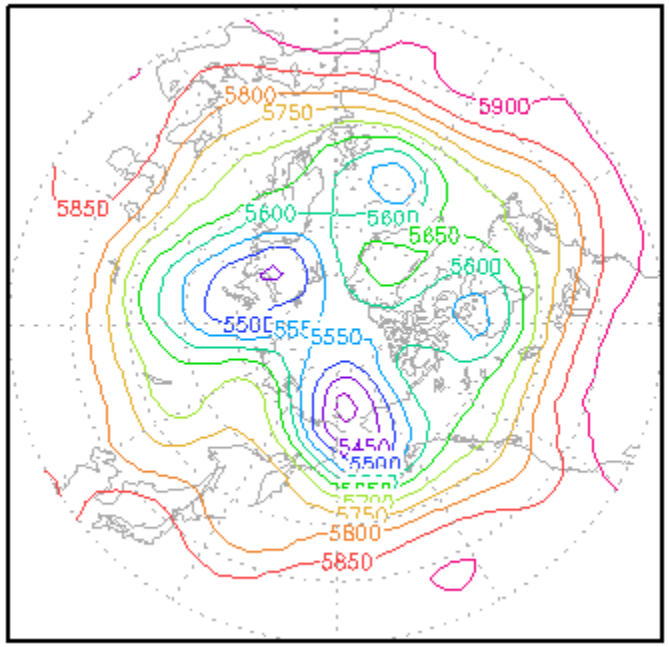
FCST

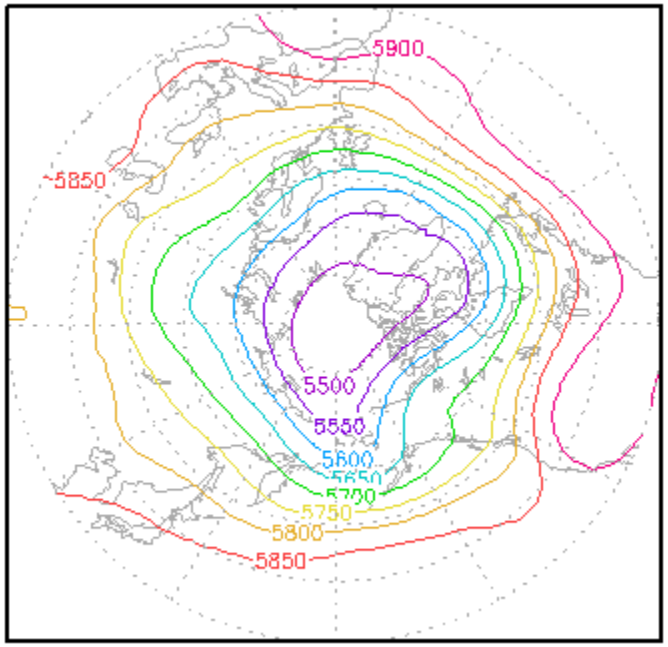
10-20 ave





20-30 ave





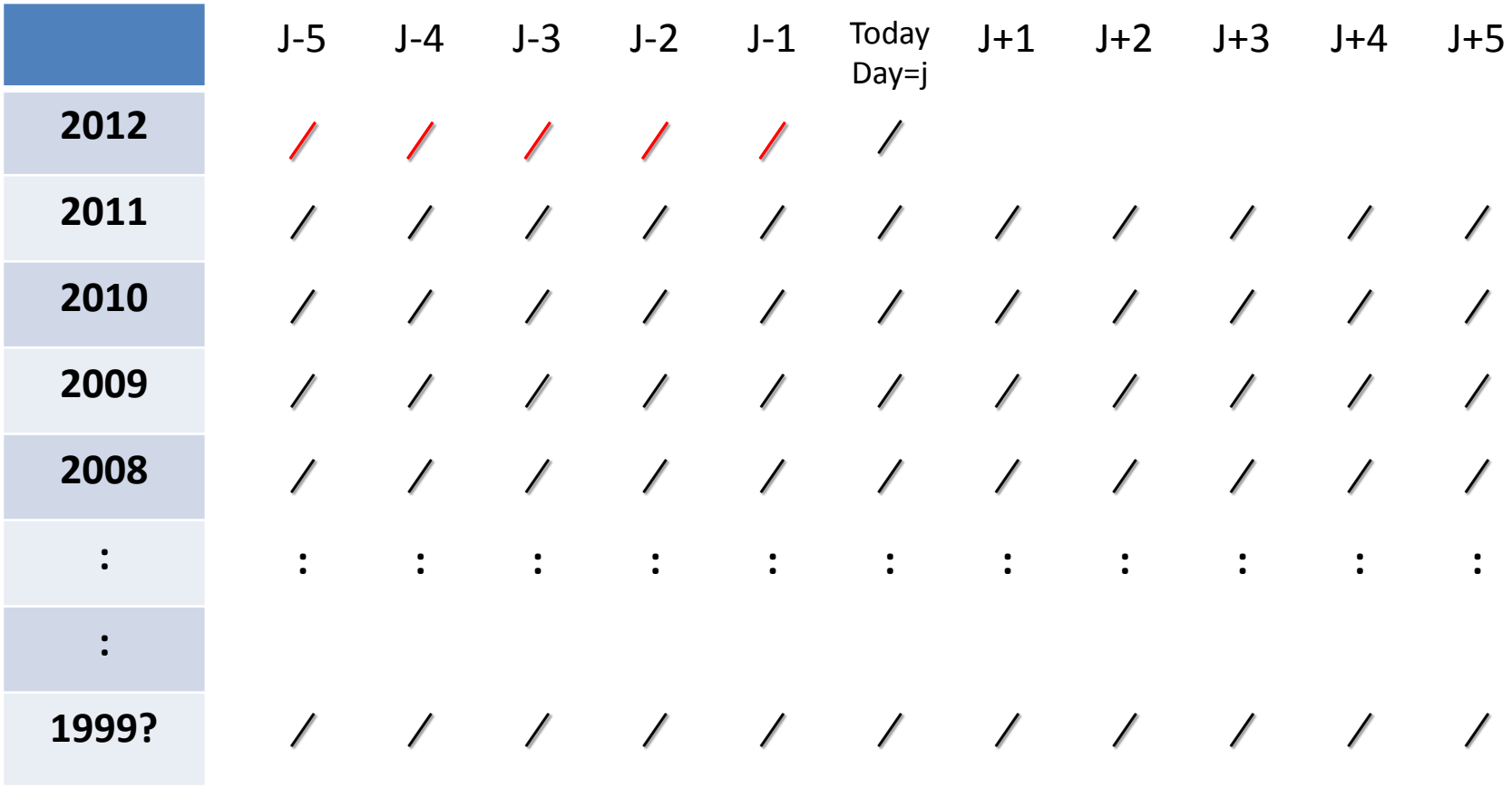
Next steps

- Streamline codes, check unstable cases and add other components (STTP, storm track)
- Version to run in both Linux and AIX environments
- Perform basic evaluation (as described in plan)
- Skill assessment and comparisons (in partnership with CPC)
- If evaluation warrants, prepare operational version
- Data Exchange with NAEFS partners

Plan: Hindcast generation

- Take advantage of ESRL's new hindcast
- Tom Hamill's group at ESRL uses the same GFS model version and ET perturbations as the Extended GEFS
- Use ESRL's hindcast to design a slim hindcast for next major GEFS version
- For next versions of the GEFS: necessary to setup a realtime hindcast generation procedure.

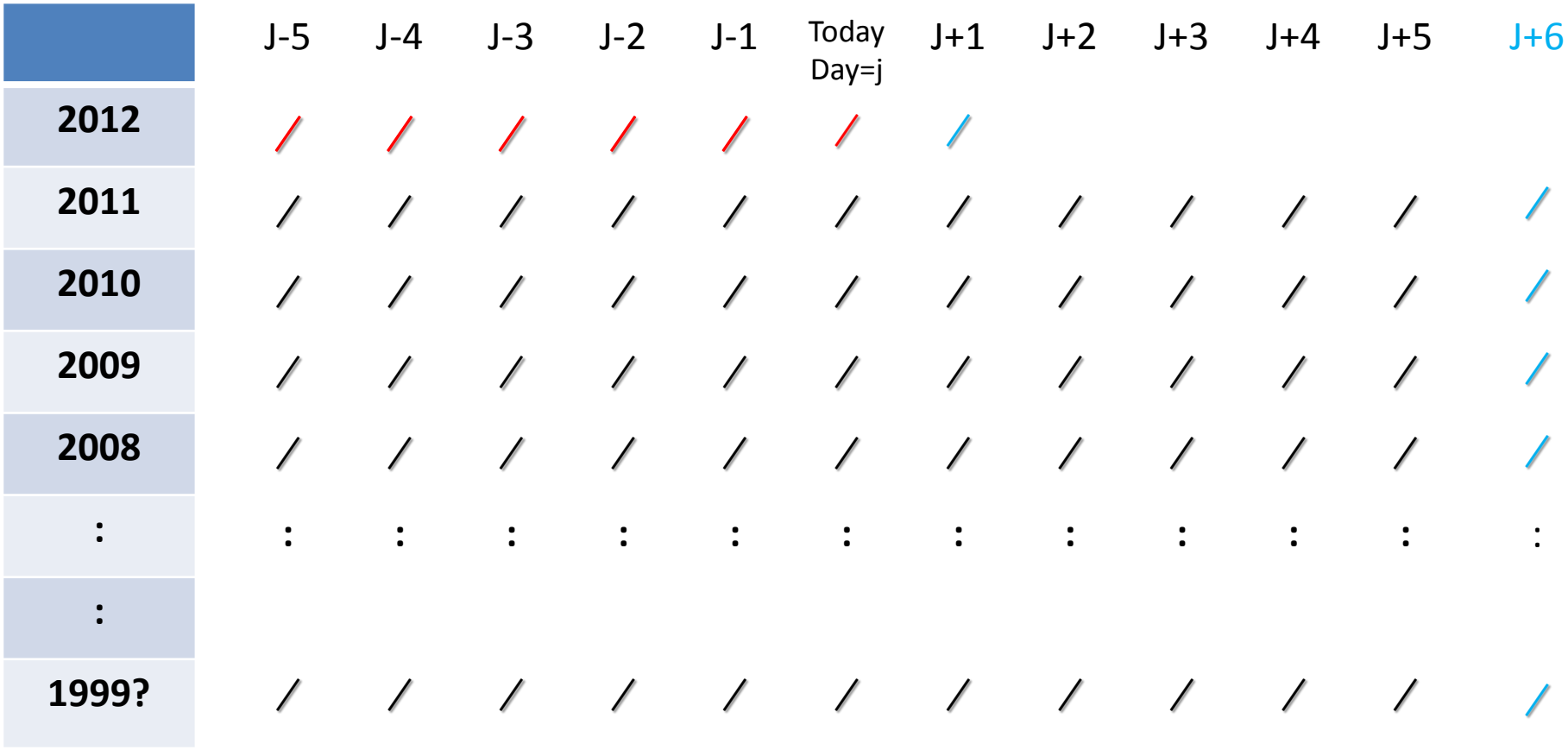
One possible design



J= Julian Day

Possibly two types of bias corrections merged or weighted: Use average of past few days (or decaying average) for short range and hindcasts for SE beyond 3-4 days

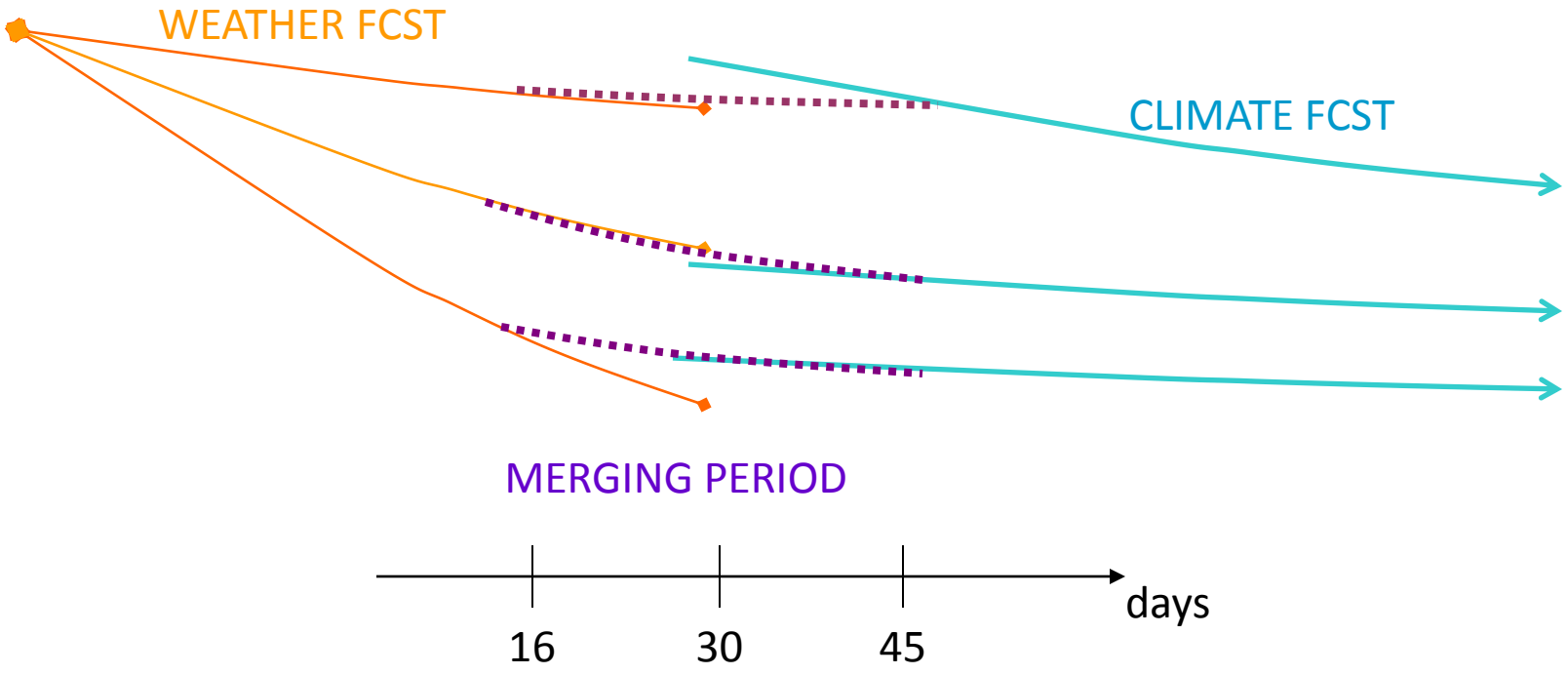
One possible design

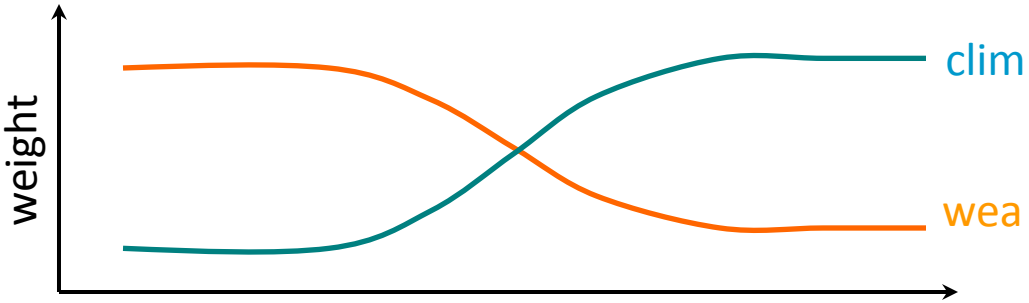


J= Julian Day

The following day only J+1 in 2012 and column J+6

Plan: Merge GEFS to CFS

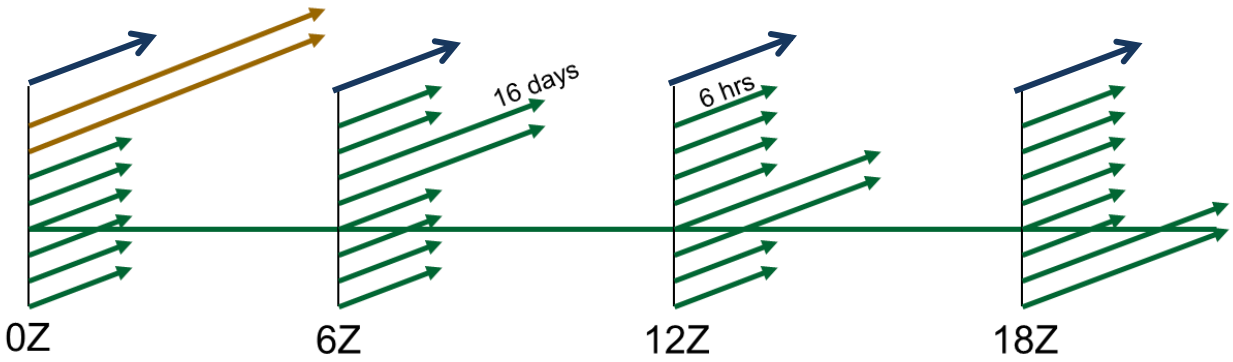




A possible scheme

Proposed GEFS

- Fully coupled OLA model
  - Captures variability and uncertainty of coupled system
  - Out to 45 days
- Large hindcast dataset
  - Real-time
  - Upgrades frequently
- ET coupled
  - Represents analysis uncertainty of the coupled ocean-atmosphere system



Real-time hindcast

- Once per cycle a fraction the real-time hindcast can be generated

Extended GEFS runs

- Once per day 20 perturbations can be integrated forward for 45 days