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Weeks 3-6 GEFS: Uncoupled model experiments

MOTIVATION, STATUS AND PLANS

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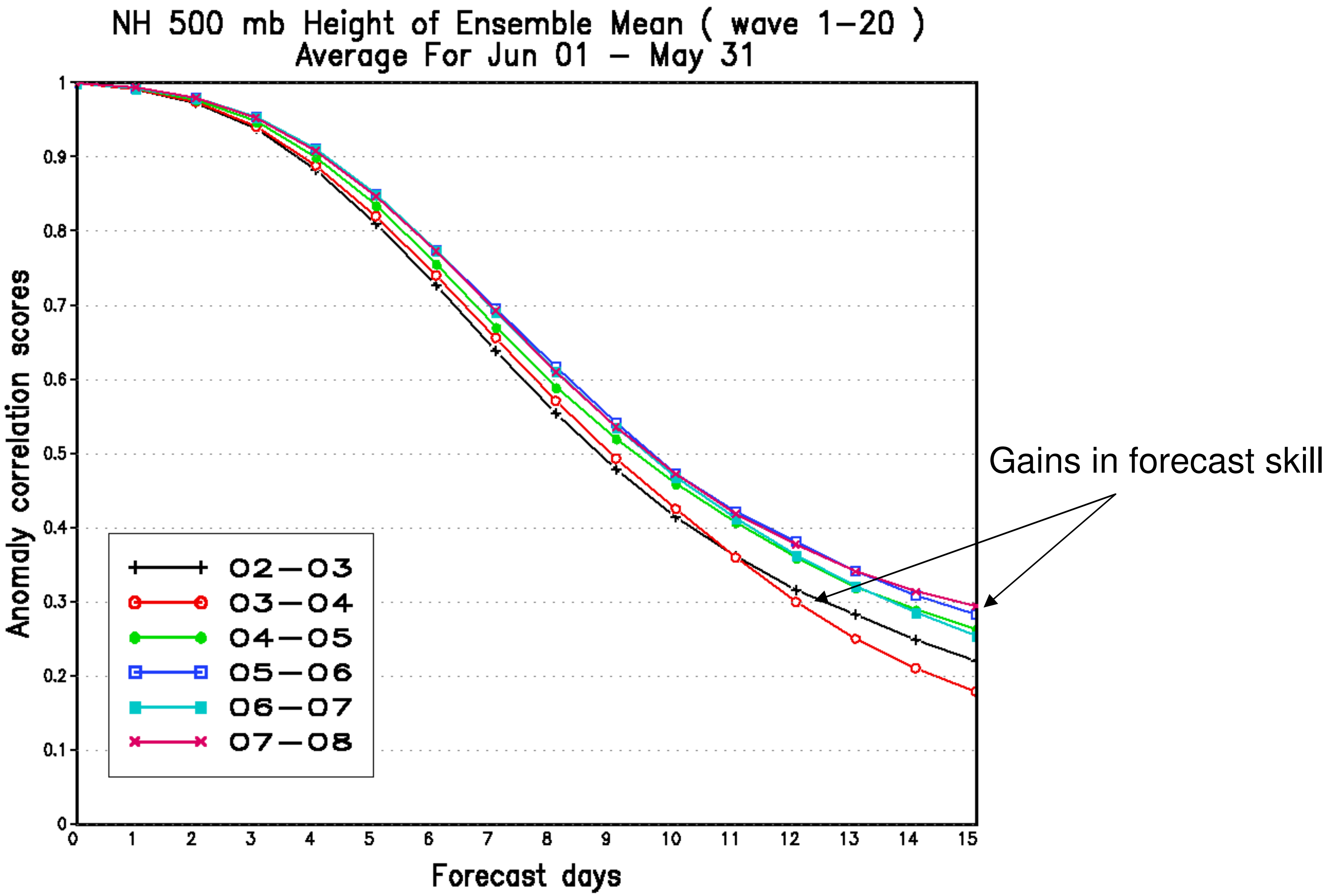
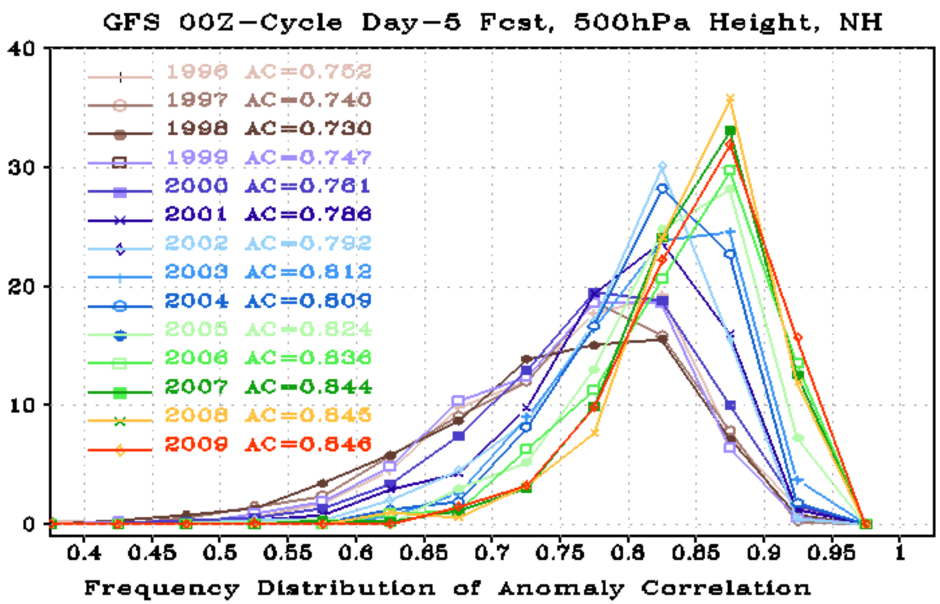
PROGRESS SINCE 1994

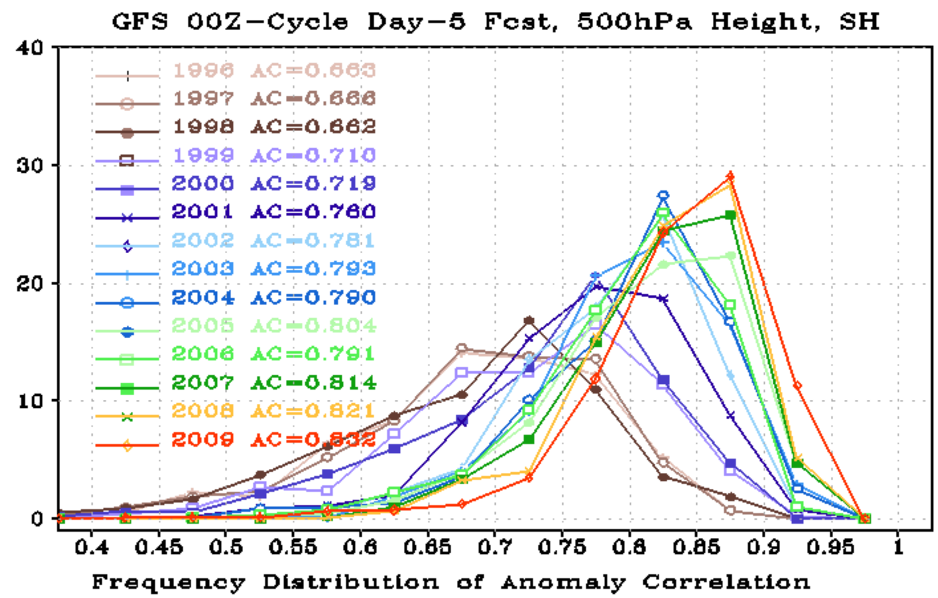


- Significant ~3-day gain in last 5 yrs at day 12 (same 0.3 AC score)
  - Estimated 8-day gain at day 12 since 1994
- **Time to extend integrations period beyond 16 days**

Factors of Improvement

- GFS model alone has undergone major skill improvements over the years





After S. Lord, EMC Review

- Increasing ensemble size, resolution
- Refinements in ensemble perturbation scheme
  - Breeding to Ensemble Transform with Rescaling (ETR)

EXTENSION OF GEFS TO 35 DAYS - Rationale

- Skill in intra-seasonal time scale originates from both
  - Initial condition + dynamical projection of fast system (atmosphere)
  - Initial condition + dynamical projection of slow system (ocean
- Uncoupled GEFS extension exploits fully only first source of predictability
  - Slow system considered through persisted SSTA

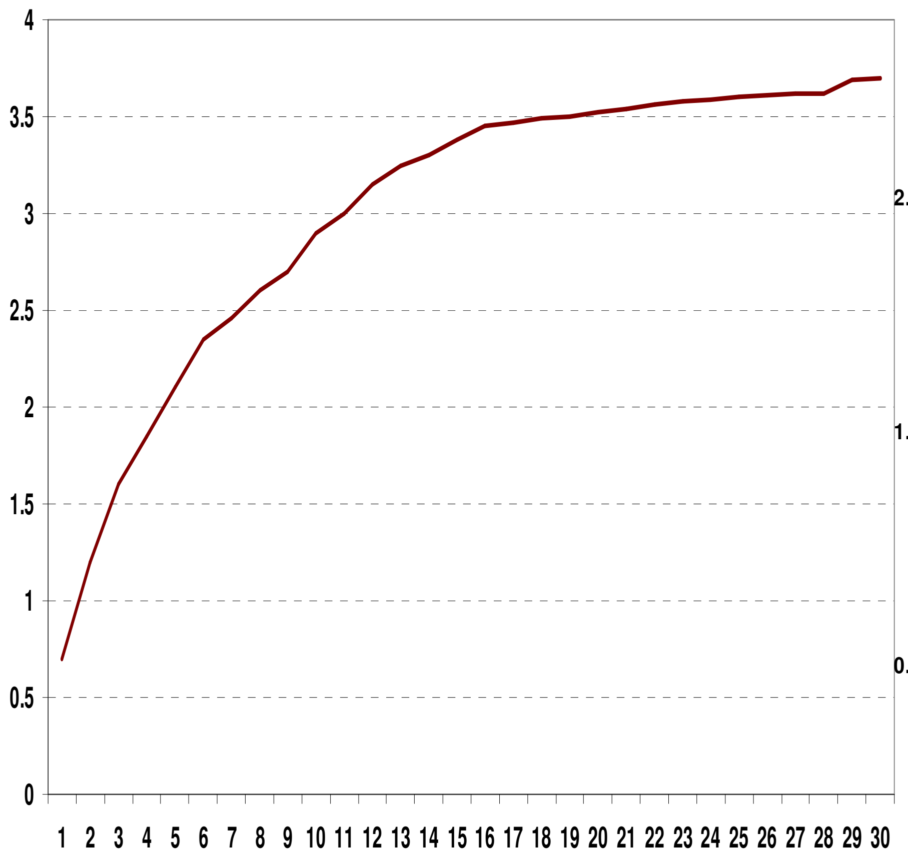
Questions:

- How far information from initial state is retained in the uncoupled system?
- How much and where lagged ensemble forecasts benefits skill for long leads

2m T CRPS NH Land Only

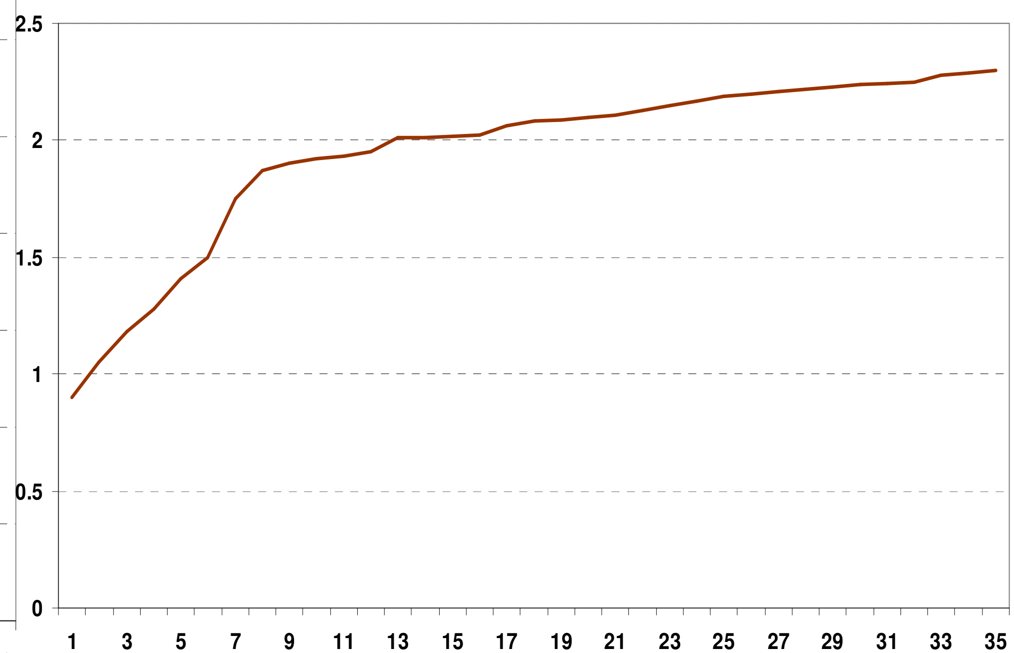
2007. Dec 01-Jan 31

No stochastic perturbations



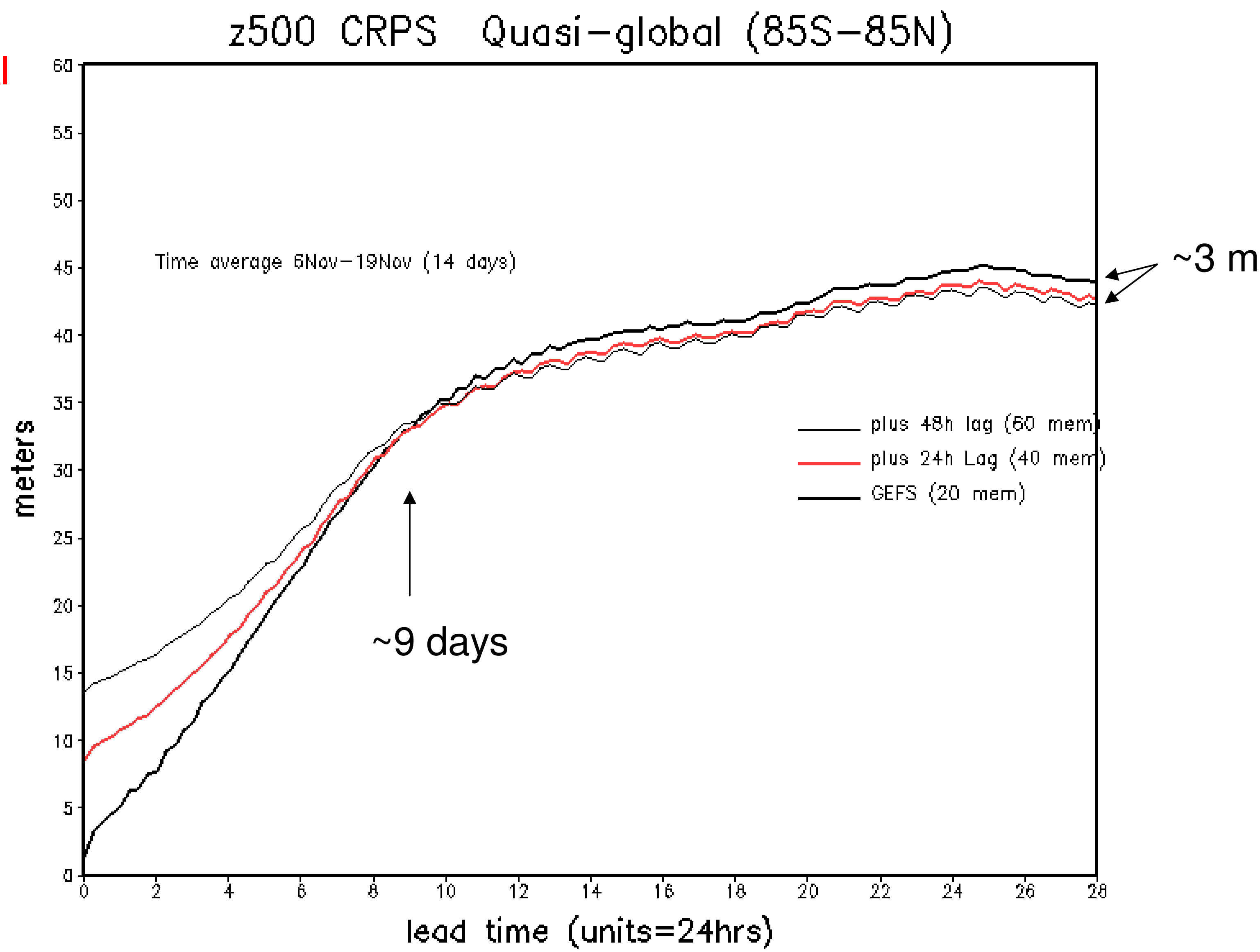
2007. Aug.01-Sep.30

With stochastic perturbation scheme



Lagged 30days GEFS to form Super-ensemble

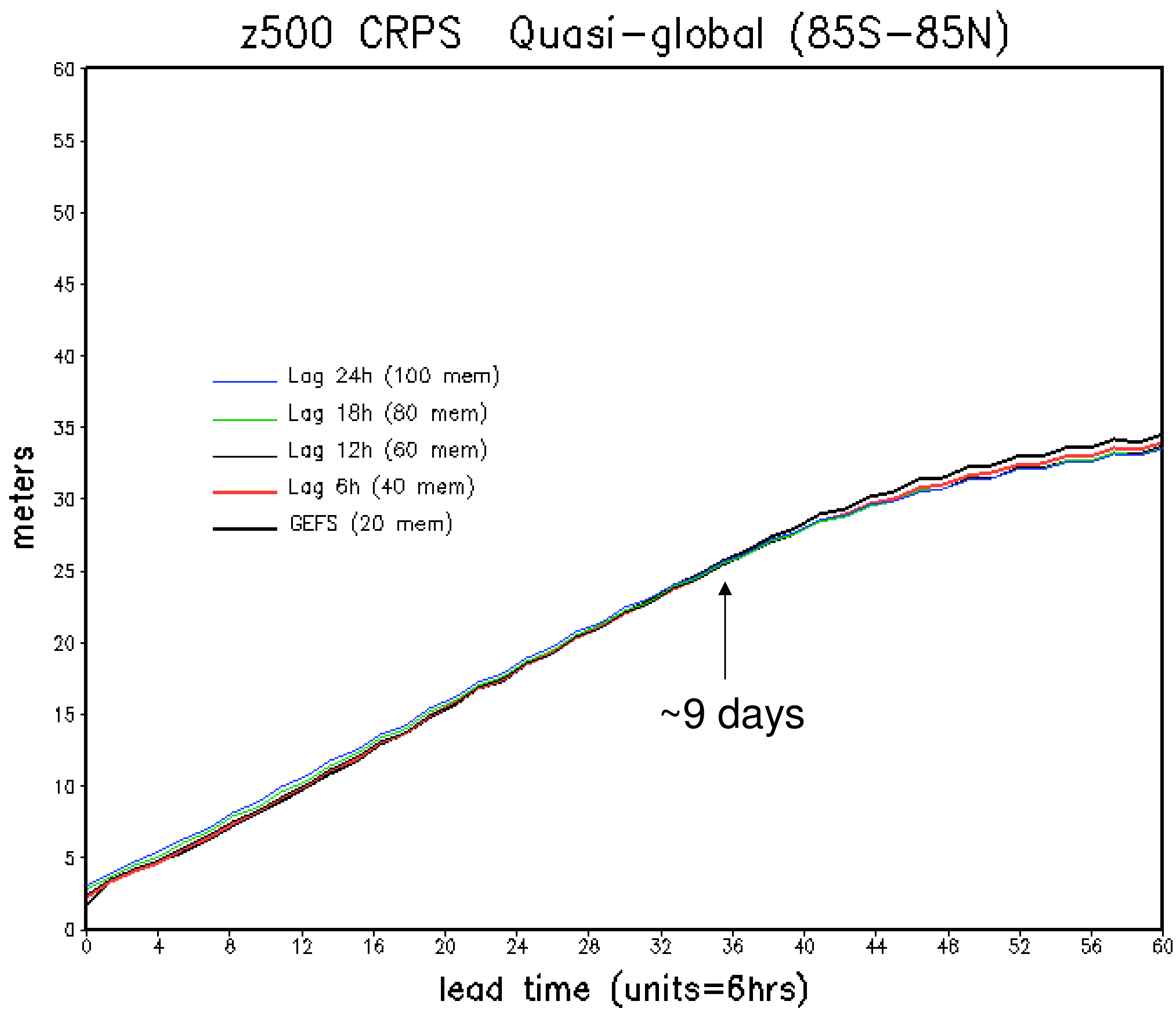
Experimental 30-days forecasts



We expect a larger number of ensemble members will produce a rapid damp to climatology

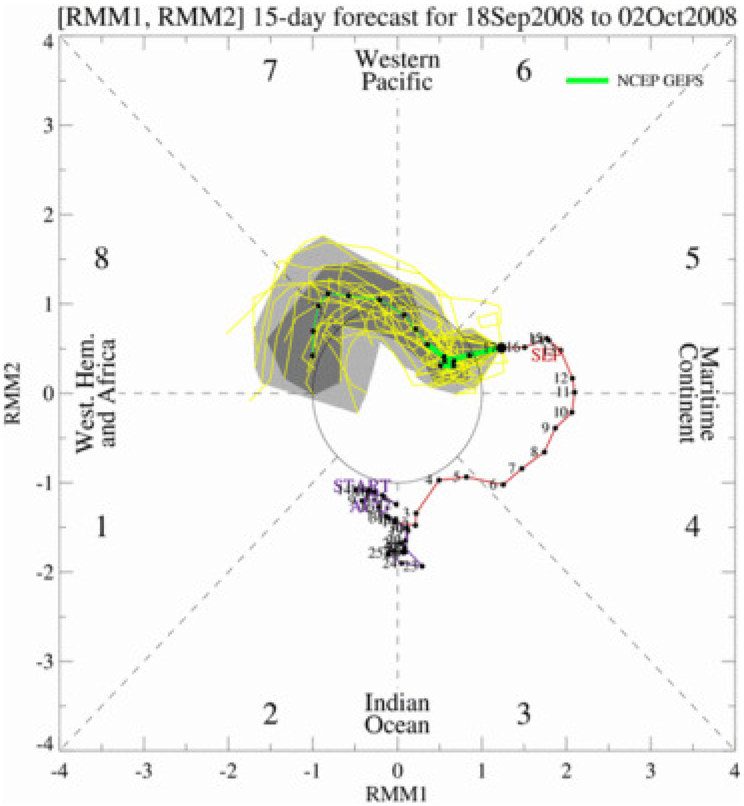
Lagged GEFS to form super-ensemble

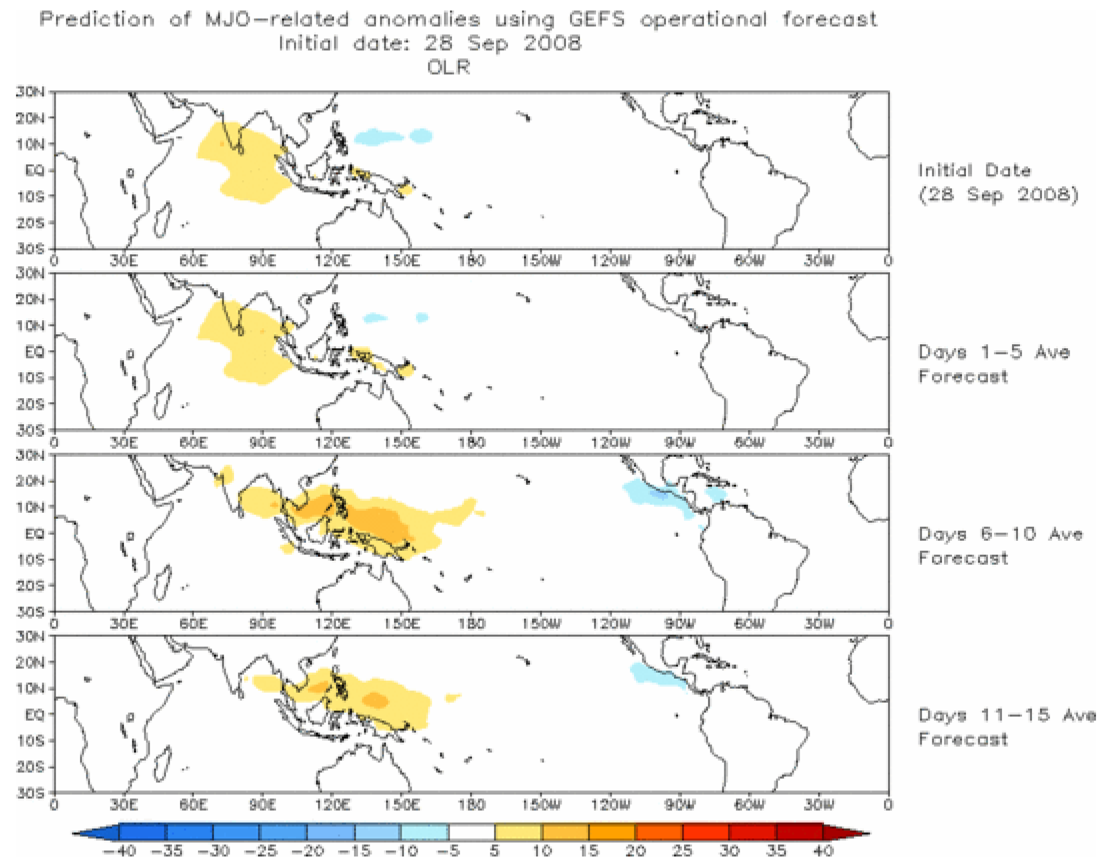
Operational 16-days forecasts

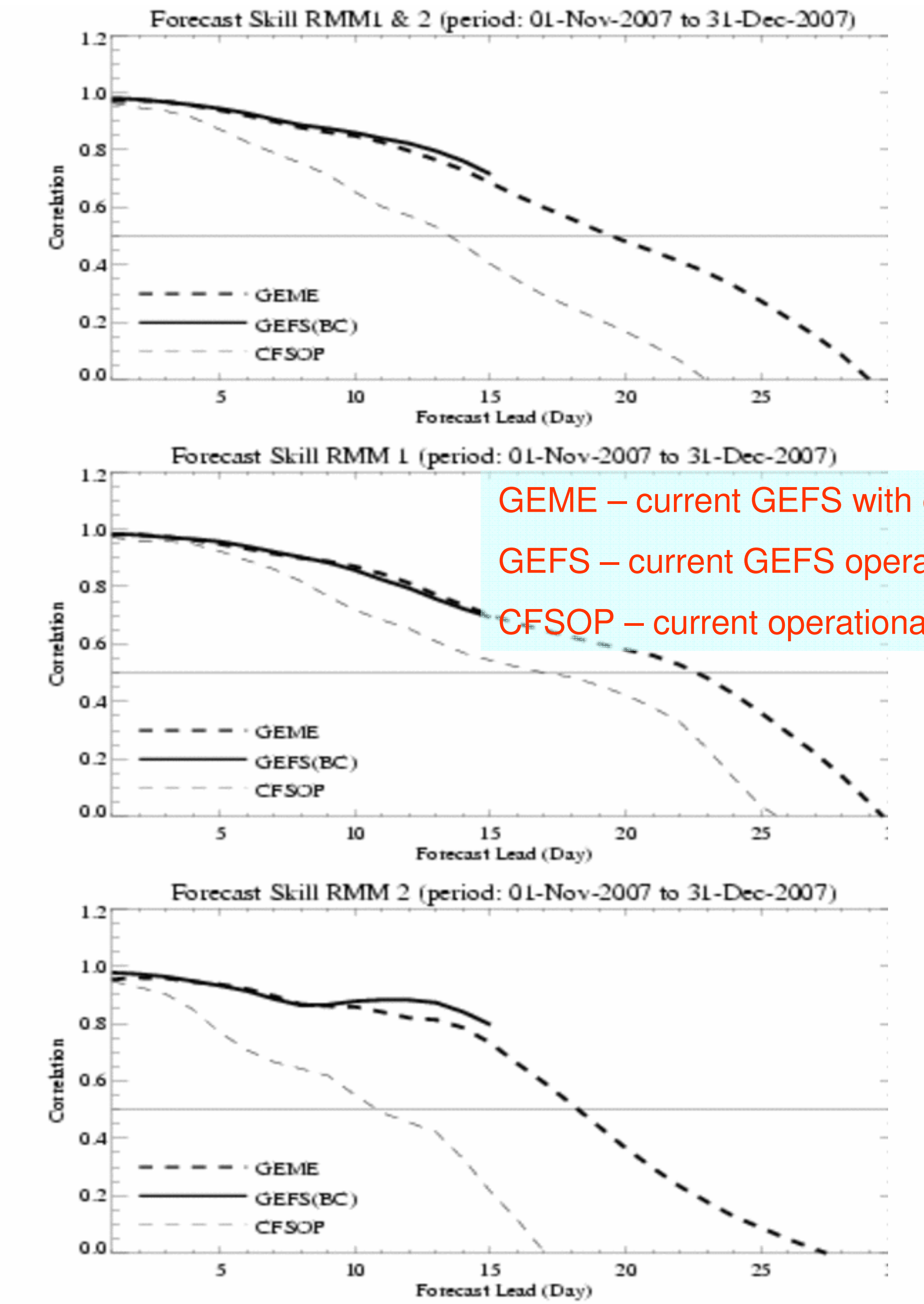


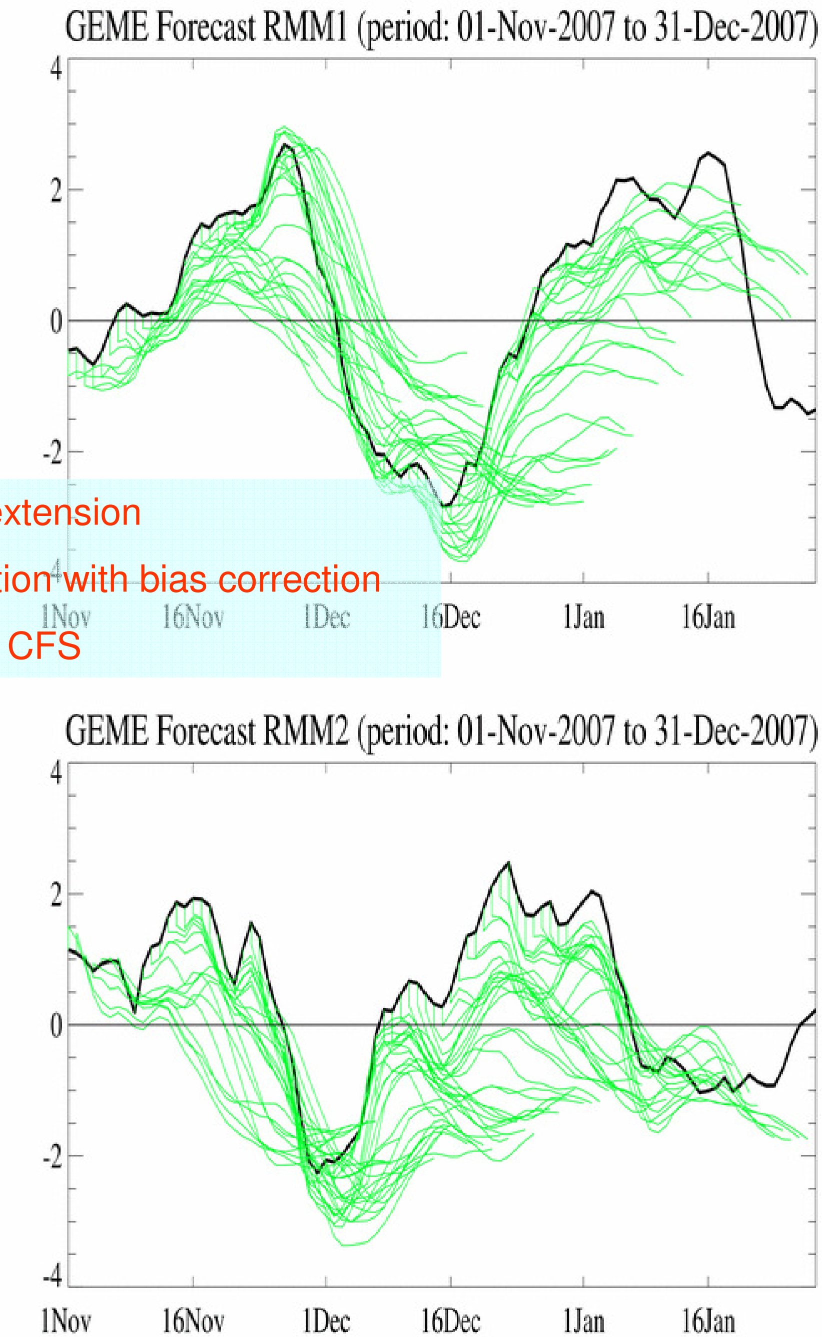
EXAMPLE FROM CPC MJO OUTLOOK PAGE

GEFS WEEK-2









GEME – current GEFS with extension

GEFS – current GEFS operation with bias correction

CFSOP – current operational CFS

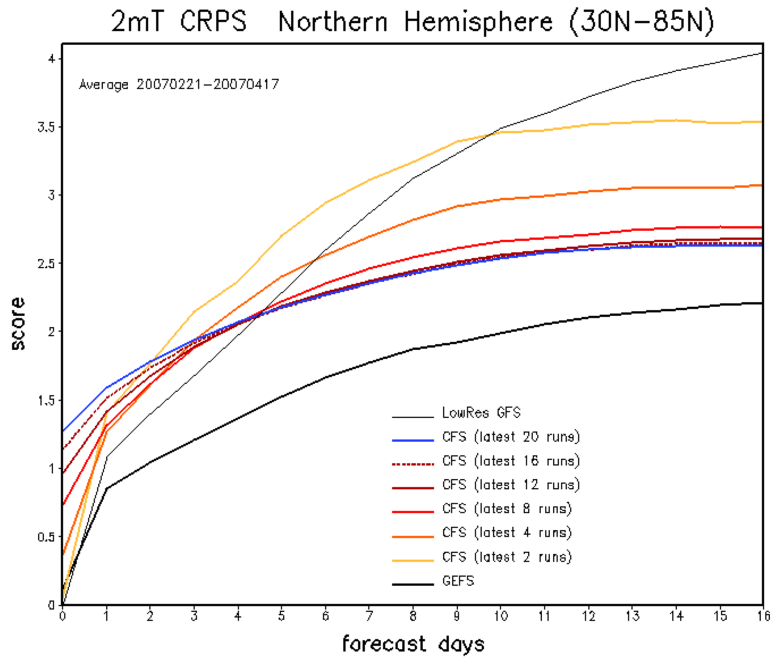
Courtesy of Qin Zhang

Comparison with operational CFS

- Extension of uncoupled GEFS
  - From 16 days to 35 days at T126 resolution
  - Once a day (at 00Z)

- Users
  - CPC
  - INFORM project (CA hydro consortium)

- Reference is operational CFS
  - Only operationally available numerical guidanc
    - 20 latest lagged ensemble
    - Bias corrected using ~25 year CFS hind-casts
    - Verified against its own analysis



- Evaluation periods Aug-Sept & Nov-Dec 2007

- Conservative estimates as GEFS scores reflect
  - No bias correction (lack of human / disc resources)
  - Resolution degraded to 2.5 degree lat/lon (disc space limitations)
  - No hires for 2nd week integration (reflects initial testing)
  - No stochastic perturbations for Nov-Dec 07 period (reflects initial testing)

- Results
  - 2m temp - ~10 day gain in skill in winter
  - MJO - ~5+ day gain in skill

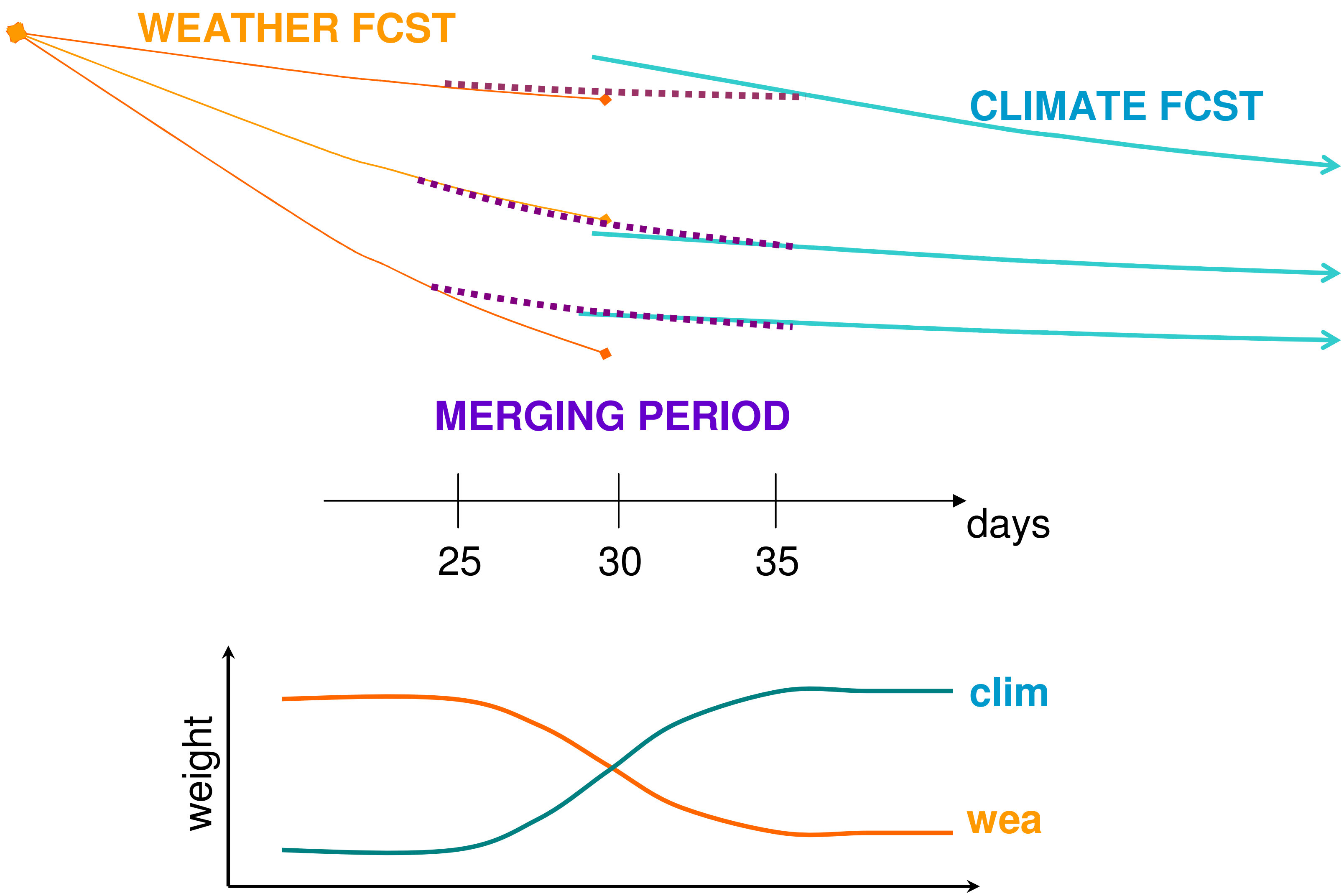
Plan: Merging weather and seasonal ensemble forecasts

- Assumption: separate systems for weather and climate
  - True for a number of years
    - Weather forecast systems update frequently
    - Climate forecast systems are frozen for several years
- Users would prefer a seamless weather-climate prediction

Possible approach

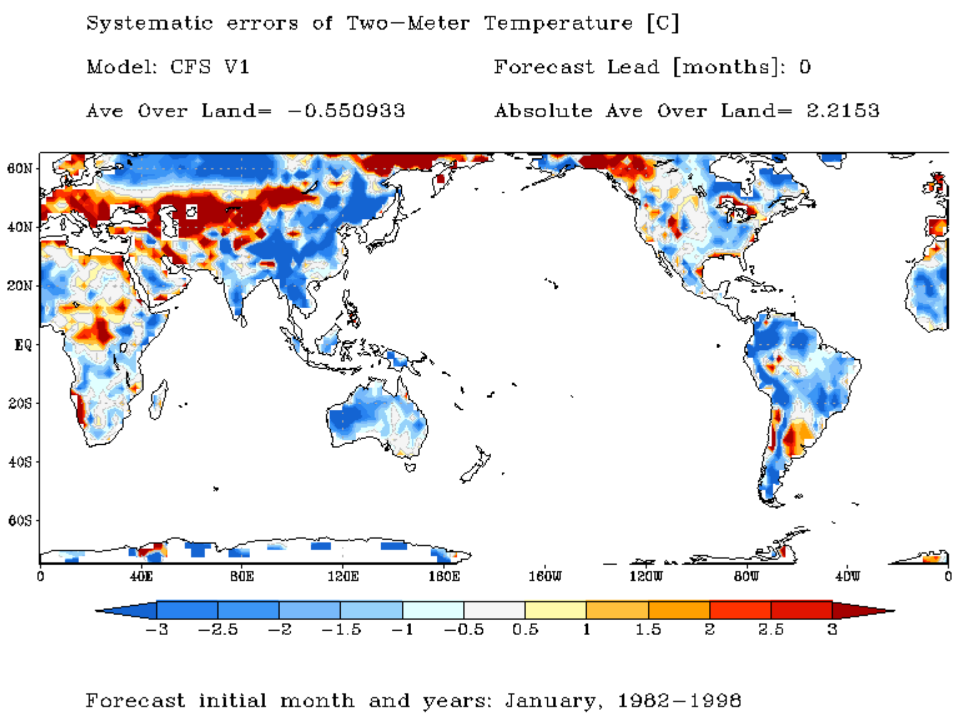
1. Use common procedures for both systems to infer statistics
2. Merge information from the systems over the transition period
3. Adjust ensemble members from each system

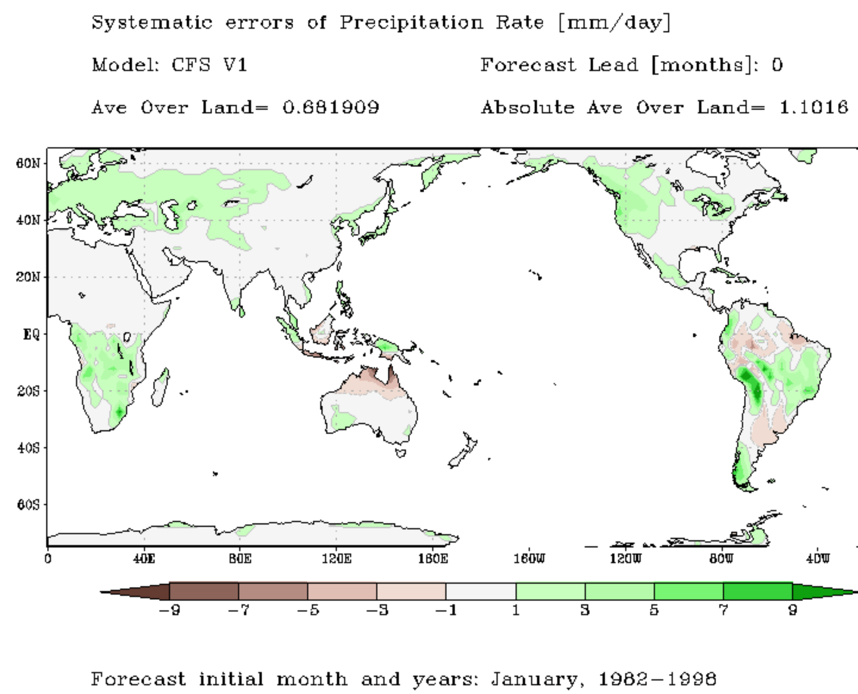
Schematic



WEATHER FCST
CLIMATE FCST
MERGING PERIOD
25
30
35
days
weight
clim
wea

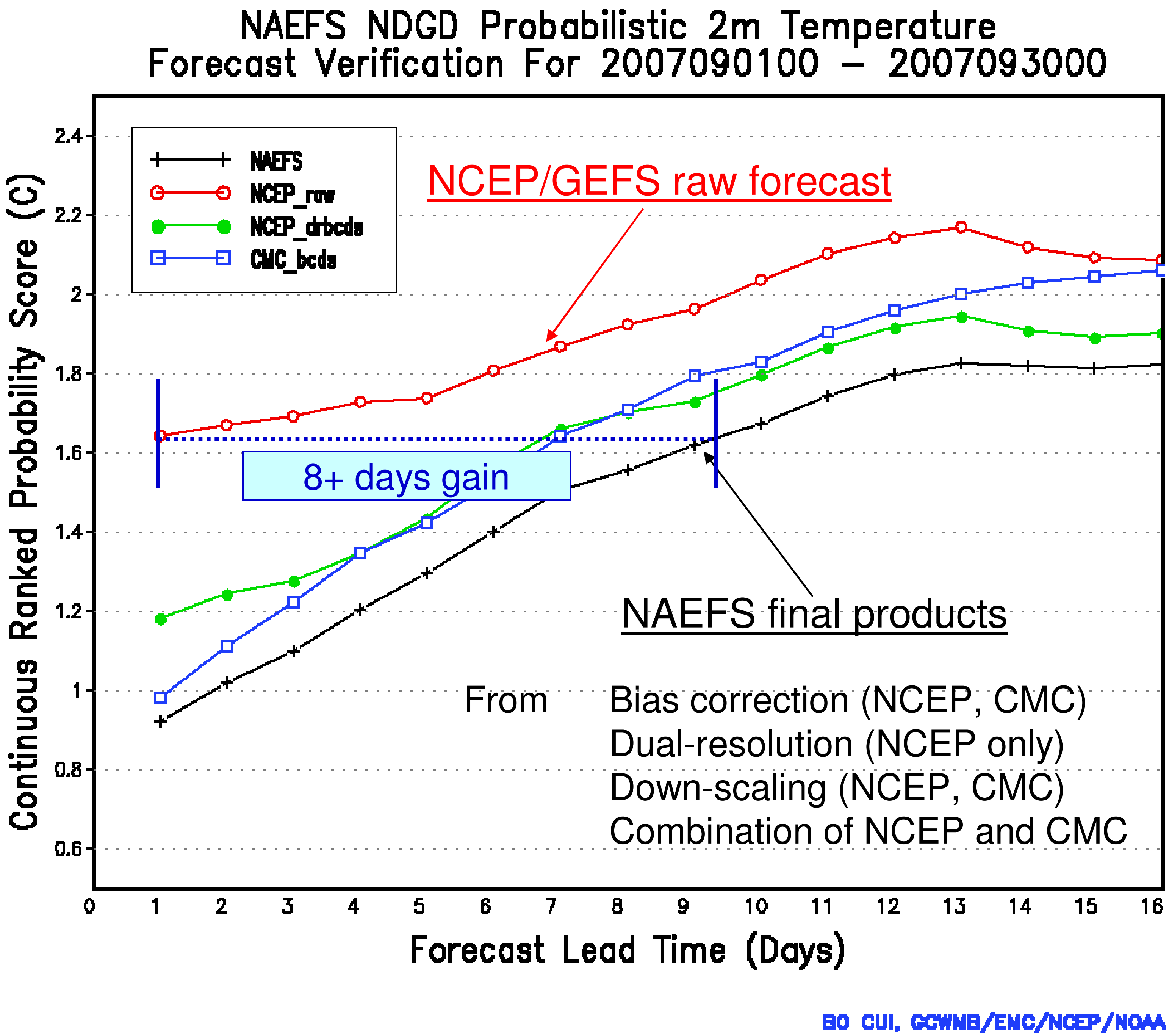
Systematic Error patterns





Develop suitable bias correction scheme for real-time applications

- Decaying average method is not suitable for such a long range
- Necessary to produce hindcast datasets to improve quality
    - Test other methods, including Bayesian methods
- Ideally, the scheme should be consistent with CFS bias correction scheme


NAEFS NDGD Probabilistic 2m Temperature
Forecast Verification For 2007090100 – 2007093000
NAEFS
NCEP_raw
NCEP_drbcds
CMC_bcds
NCEP/GEFS raw forecast
8+ days gain
NAEFS final products
From
Bias correction (NCEP, CMC)
Dual-resolution (NCEP only)
Down-scaling (NCEP, CMC)
Combination of NCEP and CMC
Continuous Ranked Probability Score (C)
Forecast Lead Time (Days)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
BO CUI, GCWMB/EMC/NCEP/NOAA

Remarks

- Several long (30 days and beyond) range GEFS forecast sets have been generated to assess the skill of the uncoupled forecast system
- Lag super-ensemble forecasts benefits skill at long leads
- Performance creates a benchmark for subseasonal forecasts to compare with coupled runs
- Work in progress to create a seamless 1 day to 6 weeks and seasonal forecasts
- Several issues:
  - Larger computer resources
  - Real time hindcast for Bias correction