Assessment of sub-seasonal predictability and probabilistic prediction skill over the U.S.

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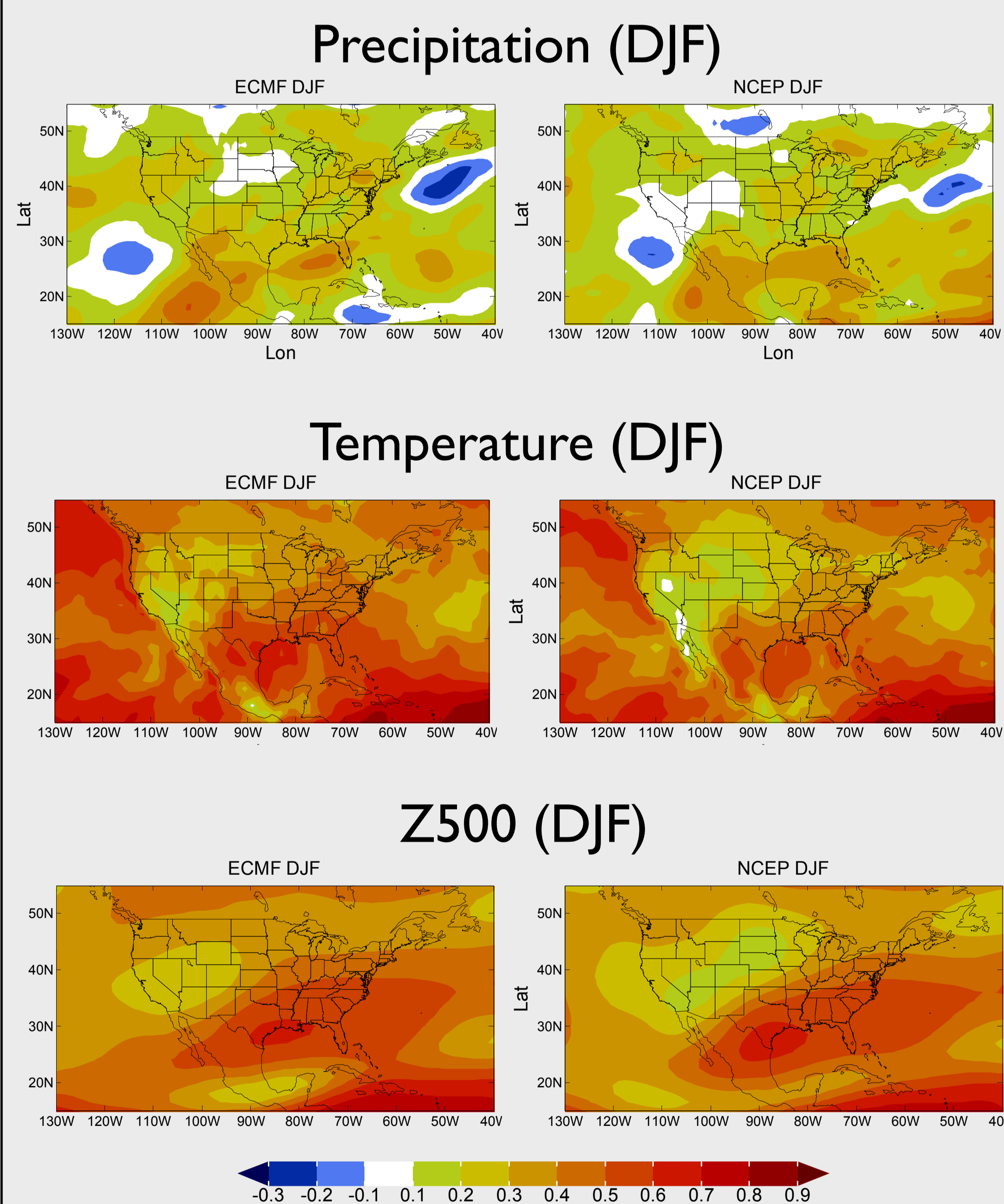
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Introduction

The subseasonal predictability of precipitation and temperature is examined for two global ensemble prediction system reforecast sets from the S2S Database, 1999–2010 (ECMWF VarEPS and NCEP CFSv2).

N34   **NAO**

PNA

Methodology

1. Anomaly correlation skill of week 3-4 averages: ECMWF reforecasts from all the Monday and Thursday start dates in DJF are used; 3-day lagged ensembles are used for the CFSv2.

2. Pattern correlations of observed fields with observed NAO, PNA and Nino 3.4 indices, using dekadal averages.

3. Calibrated probabilistic forecasts using extended logistic regression based on Monday starts during JFM, and simple equal-weight MME. The training/validation is with leave-one-year-out cross validation.

4. All analyses are based on ensemble means.

Temperature correlations (DJF)

N34   **NAO**

PNA

-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

Week 3-4 Anomaly Corr. Skill

Precipitation (DJF)
ECMF DJF   NCEP DJF

Temperature (DJF)
ECMF DJF   NCEP DJF

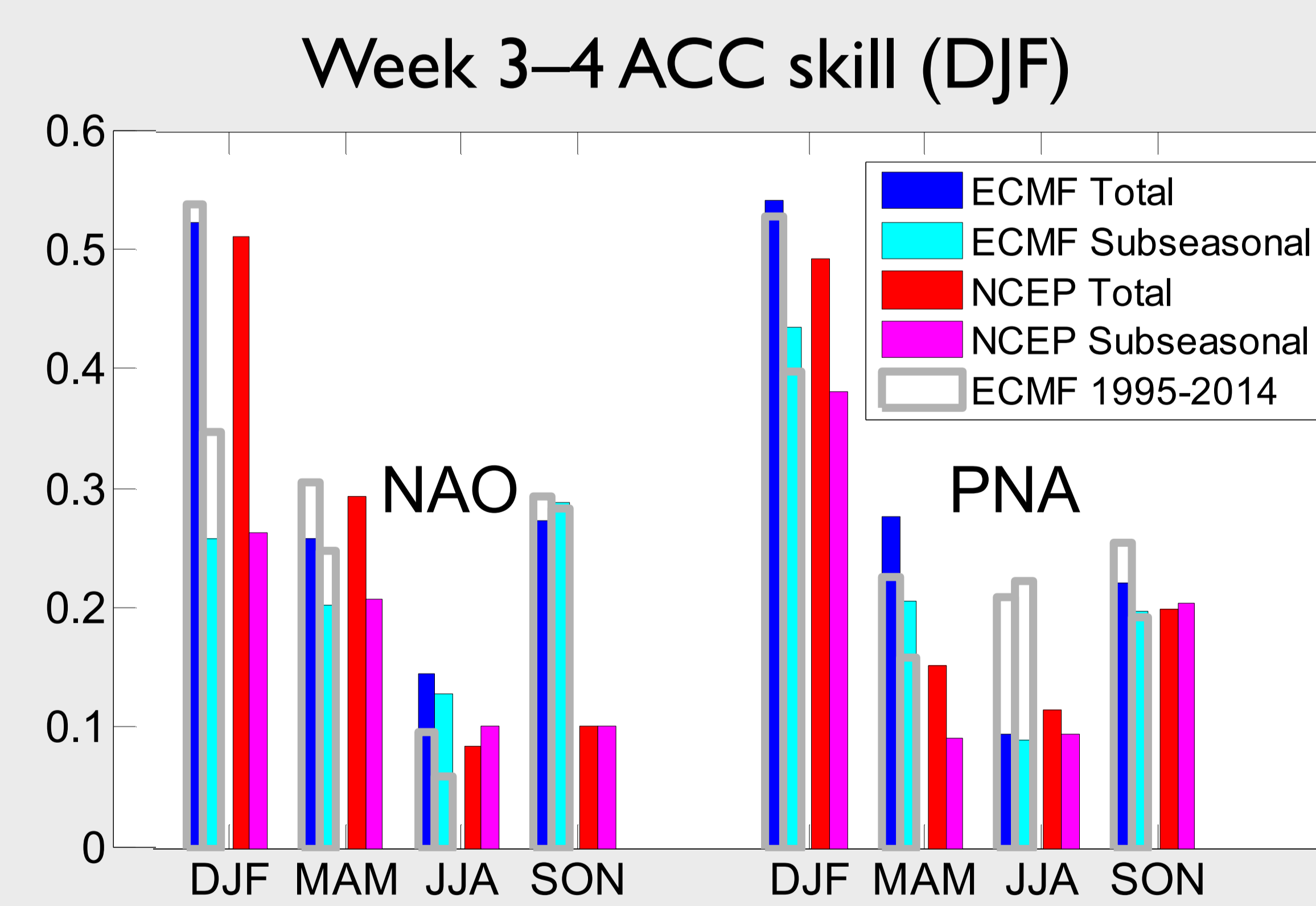### Z500 (DJF)
ECMF DJF   NCEP DJF

- Correlations between model week 3–4 hindcasts and GCPC and ERA-interim (T & Z500) data.
- Skill is comparable in both models.
- Precipitation skill is highest south of 30N, with some skill over the NE and NW U.S.
- Temperature skill is highest over Oceans and south & east U.S.
- Lobe of high skill in Z500 corresponds well with skillful areas in precip. and temperature.
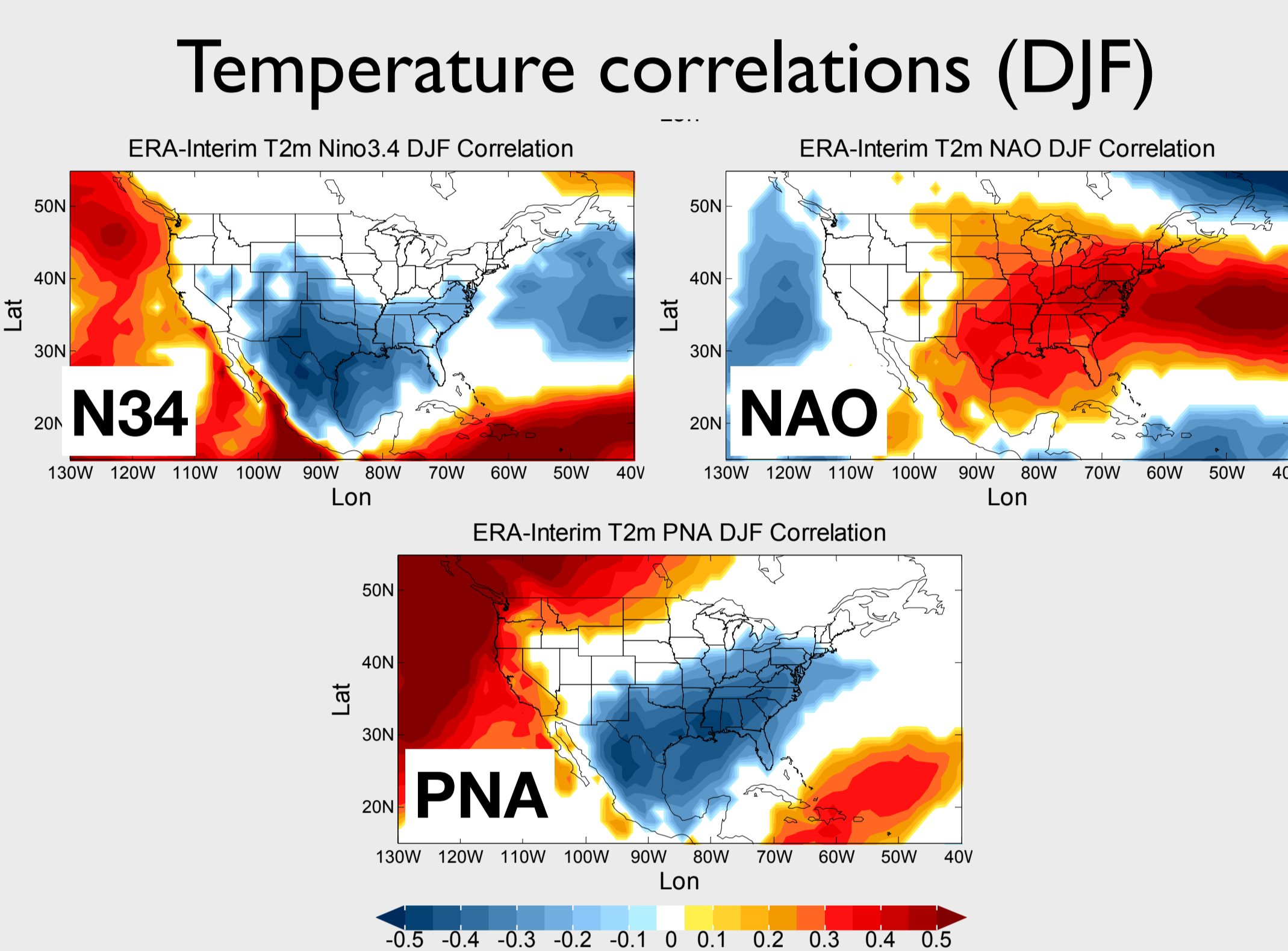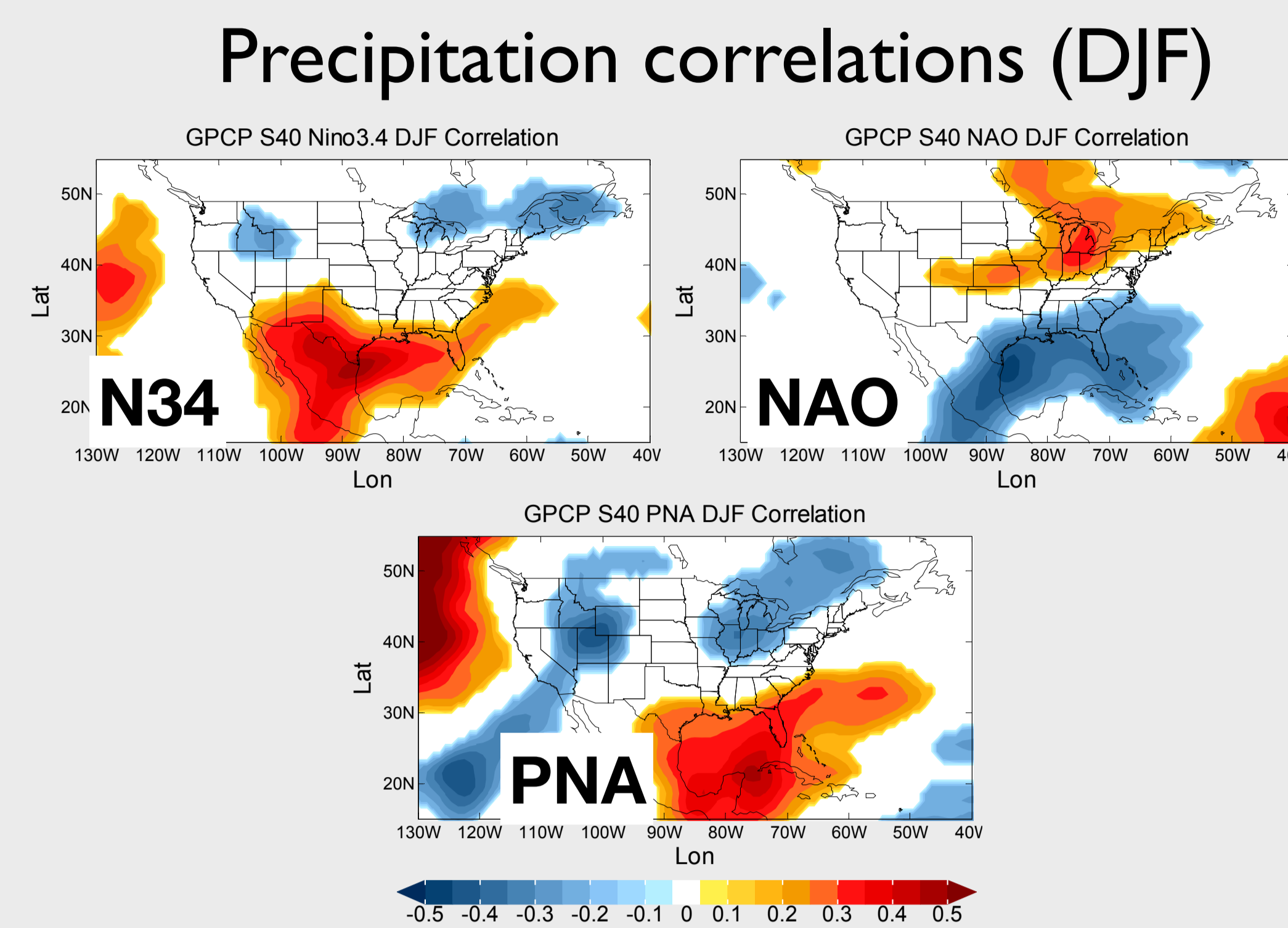
- Maps are computed with dekadal averages with the seasonal cycle subtracted.
- Both observed precip. and temperature exhibit high correlations with all 3 indices south of 30N, and moderate correlations over the NE U.S.
- Temperature correlations are higher, consistent with higher skill.
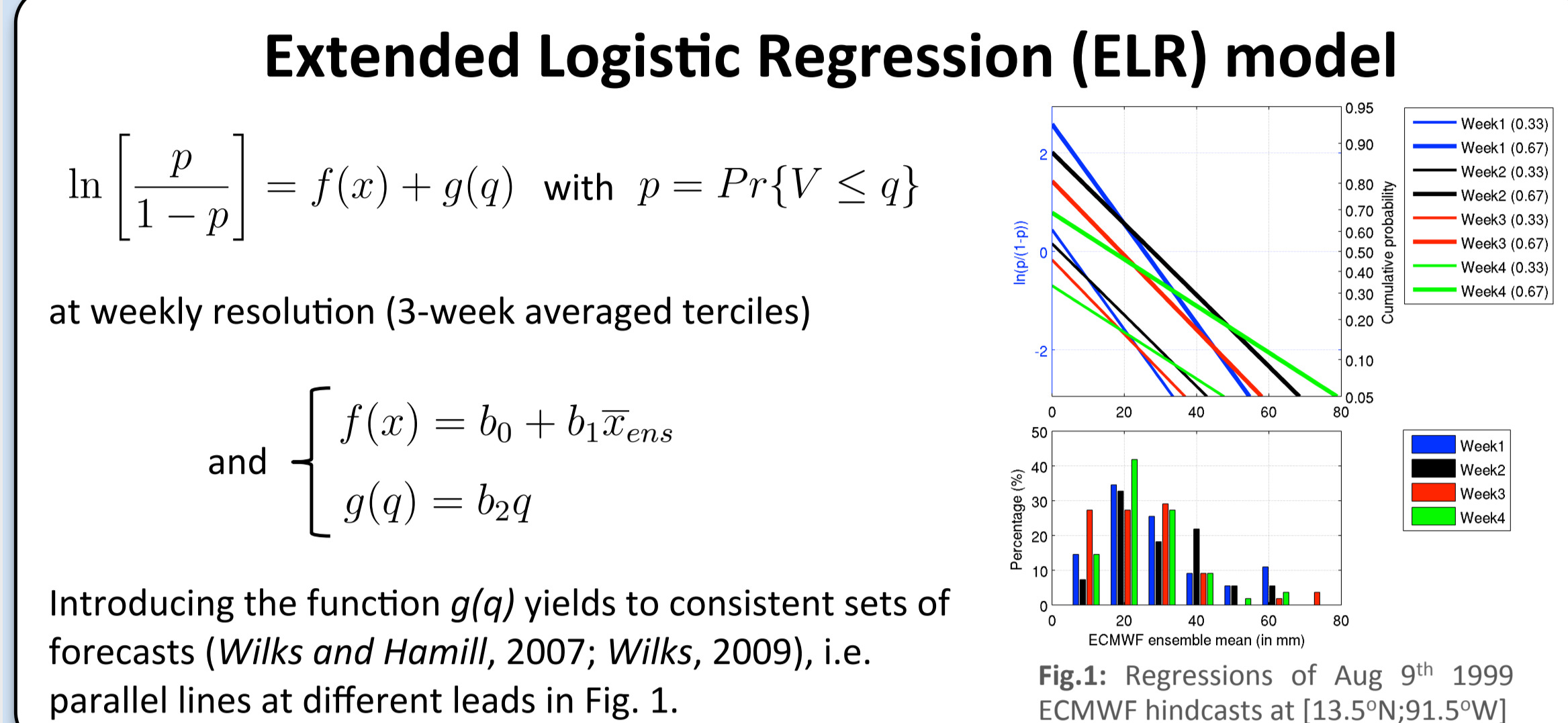
Model teleconnection skill

Week 3–4 ACC s...

ECMF Total	
ECMF Subseasonal	
NCEP Total	
NCEP Subseasonal	
ECMF 1995-2014	

NAO   PNA

0.6 0.5 0.4 0.3 0.2 0.1 0

DJF MAM JJA SON   DJF MAM JJA SON

How well do the models predict teleconnection modes?
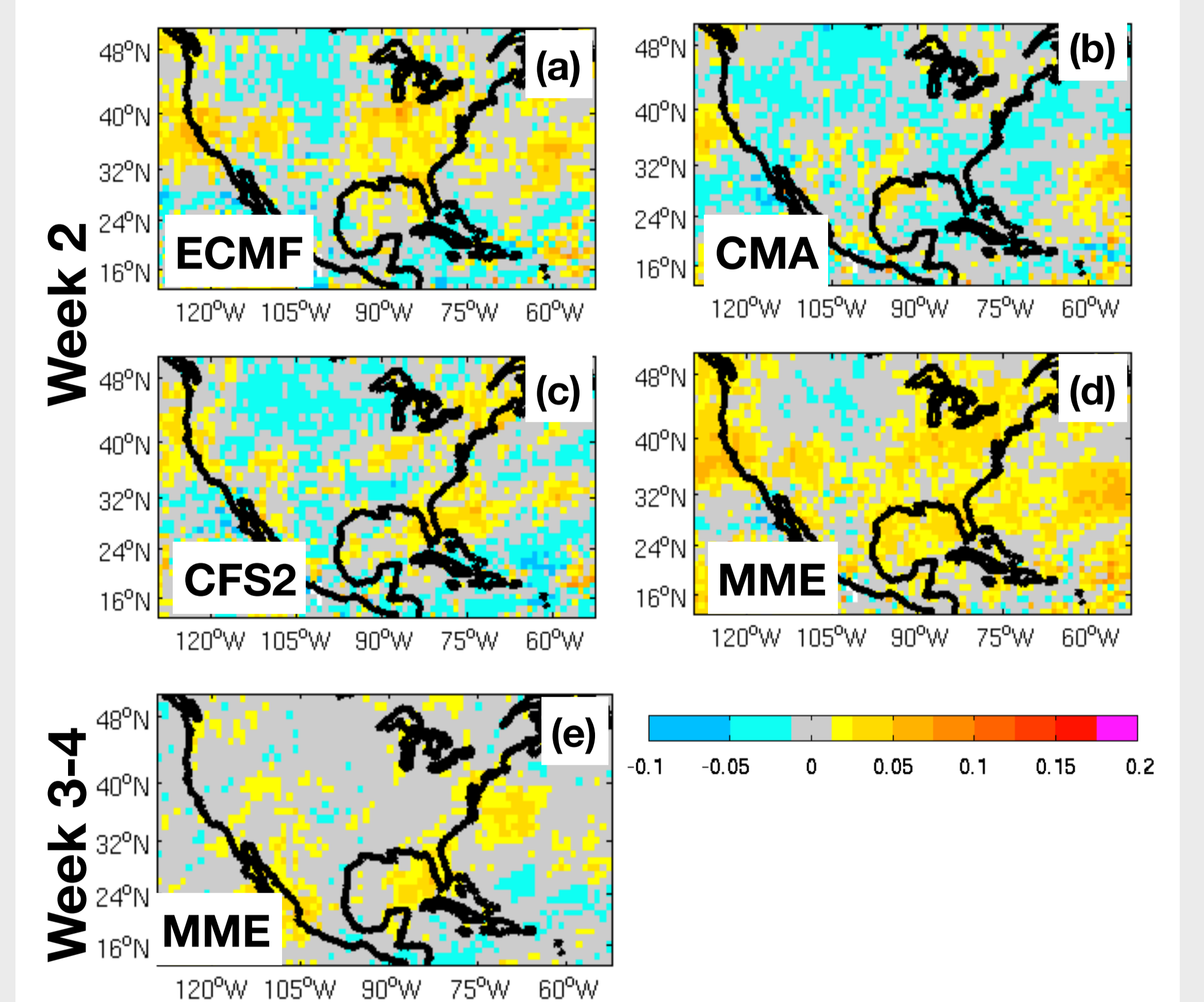- Skill is highest in winter, lowe...
- Both models have skill exce... NAO and PNA.

Is the skill due to seasonal or sub-seasonal variability?
- Sub-seasonal part is isolated by subtrac... seasonal averages.
- PNA skill is mostly sub-seasonal.
- NAO skill is both seasonal and sub-seas...
- Both models have comparable sub-seas...

Methodology

ECMWF/NCEP/CMA week 1-4
(interpo...

At weekly resolution over the 1999-2010 period
(Mondays starts)

Forecasted precipitation tercile

GPC1DD precipitation

We apply extended logistic regression to construct calibrated sub-seasonal *probabilistic* forecasts, and average the forecast probabilities from 3 models to obtain a multi-model combination.
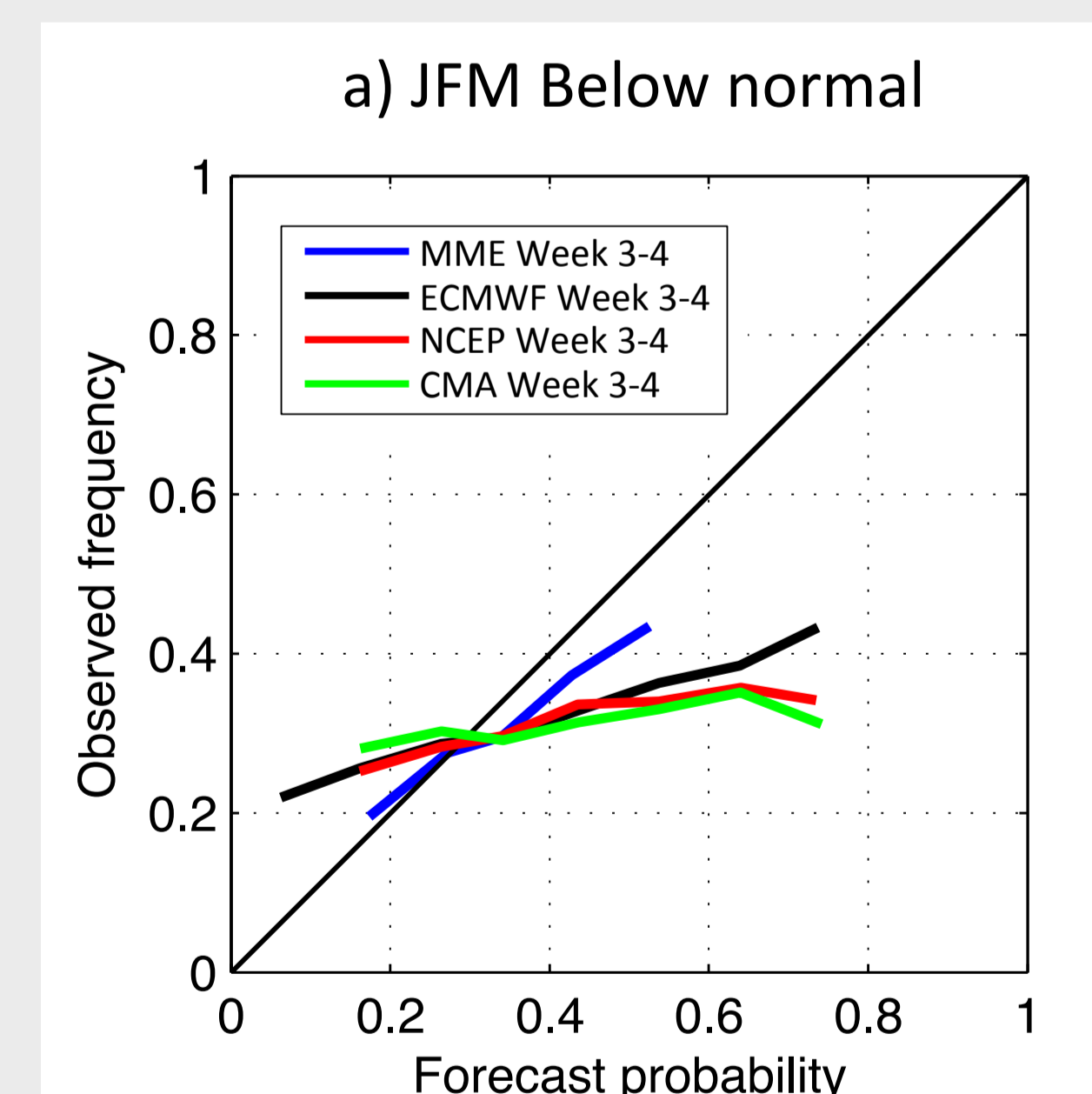
...gression (ELR) mode...

$$\ln\left[\frac{p}{1-p}\right] = f(x) + g(q) \quad \text{with} \quad p = Pr\{V \le q\}$$

at weekly resolution (3-week averaged terciles)

$$\text{and} \quad \begin{cases} f(x) = b_0 + b_1\overline{x}_{ens} \\ g(q) = b_2 q \end{cases}$$

Introducing the function $g(q)$ yields to consistent sets of forecasts (Wilks and Hamill, 2007; Wilks, 2009), i.e. parallel lines at different leads in Fig. 1.

Point Statistics @ [13.5°N;91.5°W]

Fig.1: Regressions ECMWF hindcasts a...

Precipitation RPSS Skill for JFM Starts

Week 2: (a) ECMF   (b) CMA   (c) CFS2   (d) MME

Week 3-4: (e) MME

-0.1 -0.05 0 0.05 0.1 0.15 0.2

- Good probabilistic skill at week 2 (days 8–14), especially in the multi-model combination.
- The MME improves the positive skill of the best model and largely removes negative skill values in individual forecasts.
- The skill is near-zero at week 3–4 lead; it is nonetheless higher than just the week 3 skill (not shown).

Reliability diagram for JFM Starts

a) JFM Below normal

MME Week 3-4
ECMWF Week 3-4
NCEP Week 3-4
CMA Week 3-4

Observed frequency
Forecast probability

- Reliability is notably increased by the multimodel combination

- Clear wintertime week 3–4 anomaly correlation model skill in PNA and NAO indices, as well as in geopotential height and surface fields.
- The PNA-related skill appears to be largely sub-seasonal, while the NAO skill has both sub-seasonal and seasonal components.
- Extended logistic regression plus multi-model combination produces well-calibrated and skillful probabilistic forecasts at week 2.