CPC's Week 3–4 Severe Weather Project

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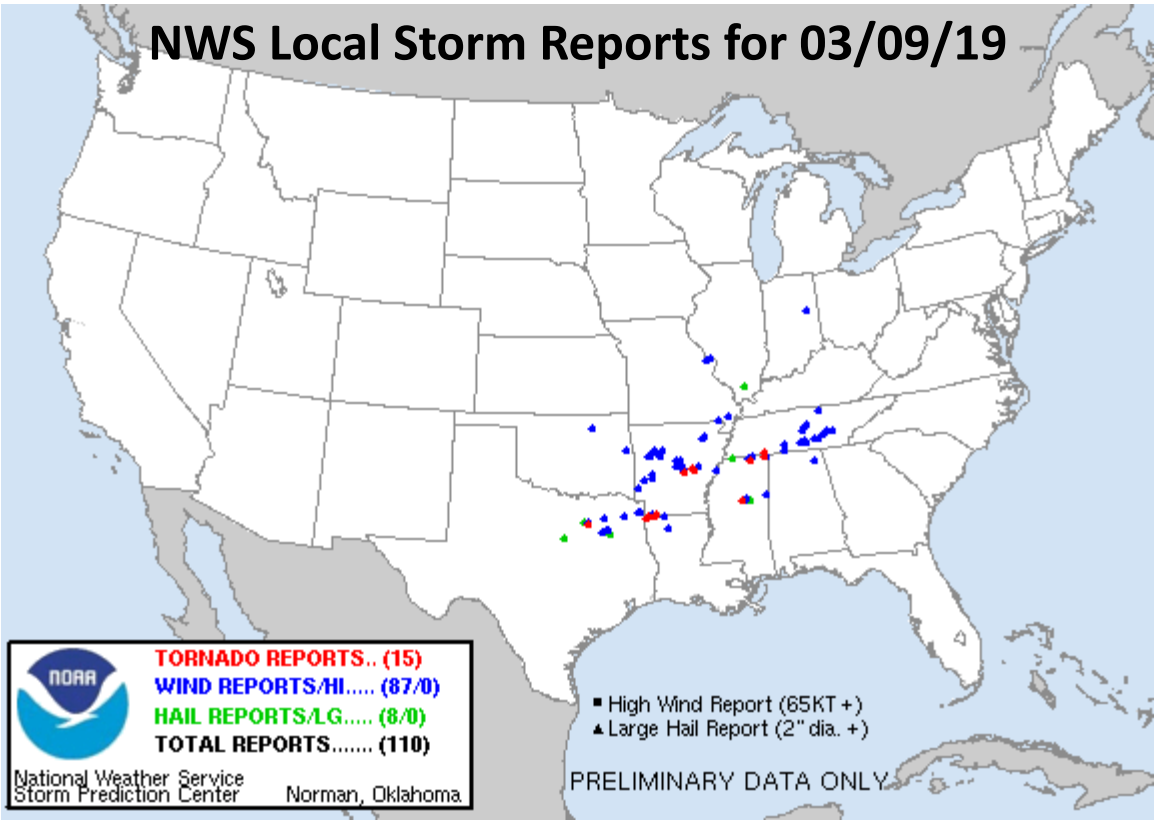
Week 3-4/GTH Group Meeting
22 March 2019

Severe Weather

Local Storm Report (LSR)

- **Tornado**
- **Damaging wind**
- **Hail**



LSR3 = Total reports of tornadoes, wind and hail events

Project Goal:

Forecast: Weekly severe weather activity (LSR3)

Lead times: Week 2, Week 3, and Week 4

Subseasonal Severe Weather Project

- **Week 2**
  - To develop forecast tools for week-2 severe weather
  - GEFS 16-day hindcast/forecast

- **Weeks 3–4**
  - To apply the forecast tools for week 3-4 severe weather
  - CFSv2 45-day hindcast/forecast

Methodology

Severe weather
- Small spatial scale
- Short life time

Hybrid dynamical–statistical model

- Using dynamical model predicted VAR as a predictor
- Statistical relationship between model VAR and OBS LSR3

Hindcast Historical OBS

SCP (Supercell Composite Parameter)

$$\mathbf{SCP} = (\mathbf{CAPE}/1000\ \mathrm{J\ kg^{-1}})\times(\mathbf{SRH}/50\ \mathrm{m^{-2}\ s^{-2}})\times(\mathbf{BWD}/20\ \mathrm{m\ s^{-1}})$$

- CAPE: Convective available potential energy
- SRH: Storm-relative helicity
- BWD: Bulk wind difference

When SCP > 1, the chance for severe weather to occur is high.

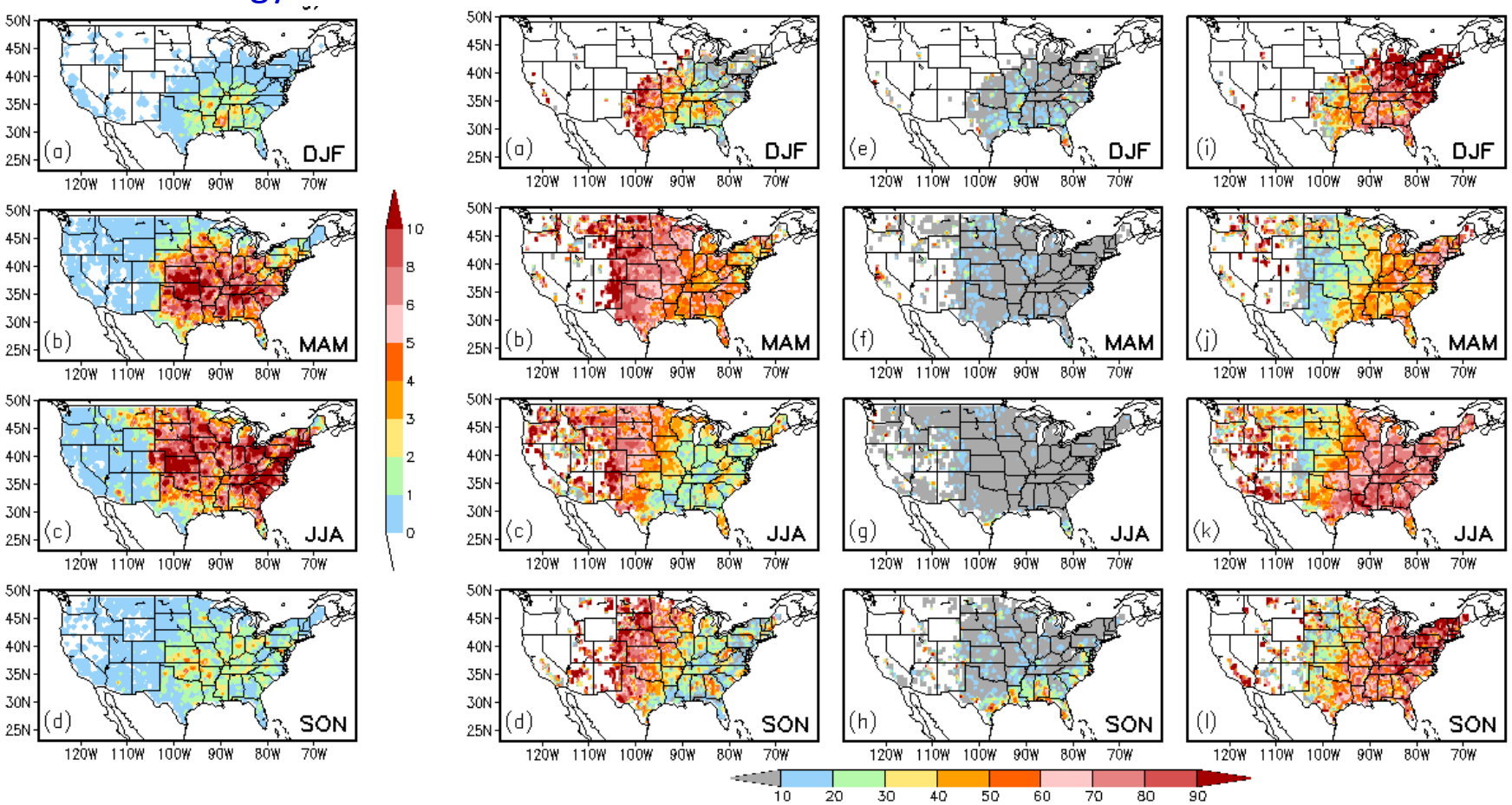
Climatology

LSR3 = Hail + Tornado + Damaging Wind

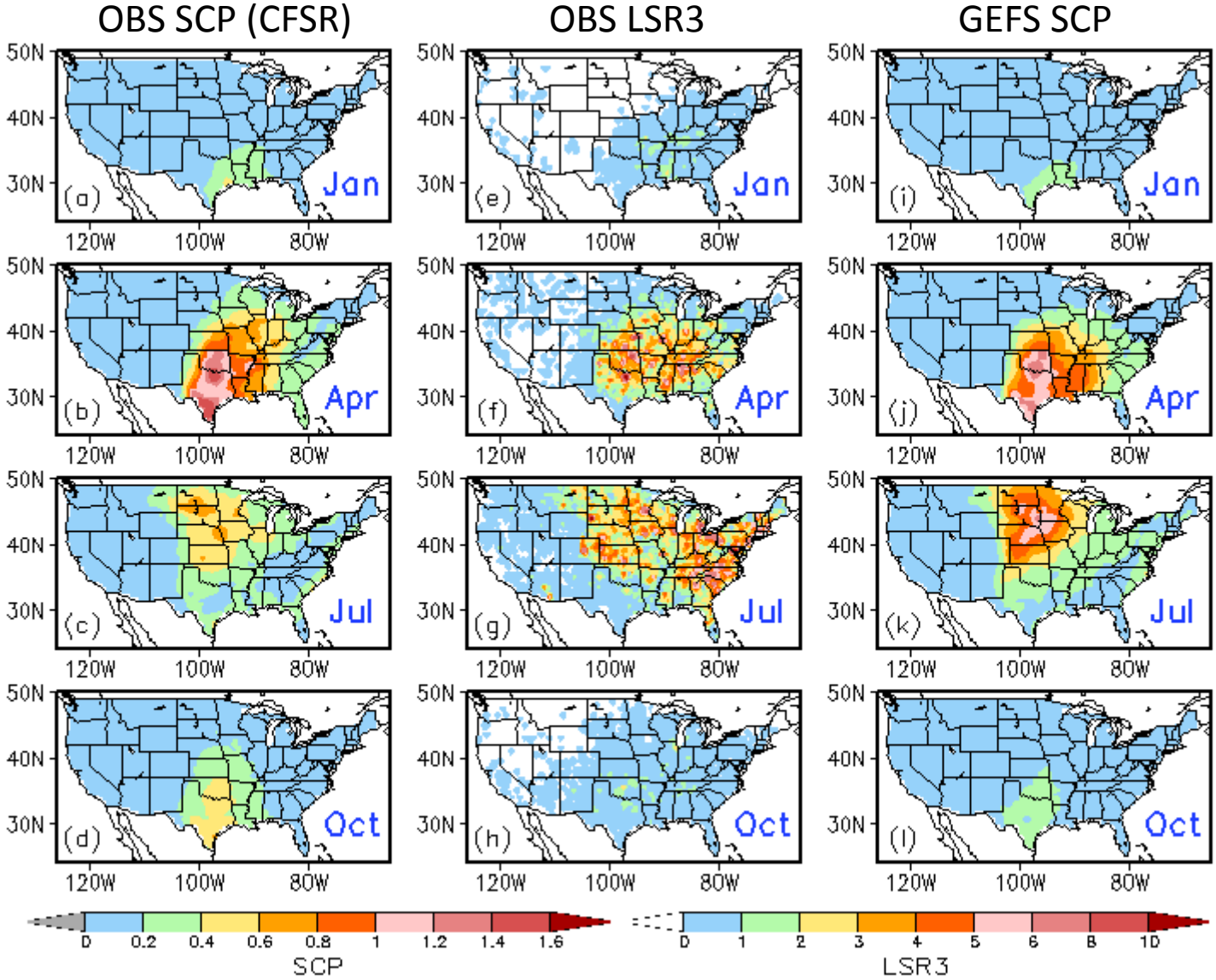
LSR3 Climatology

Contributions (%) to the LSR3 Climatology from

Hail | Tornado | Wind



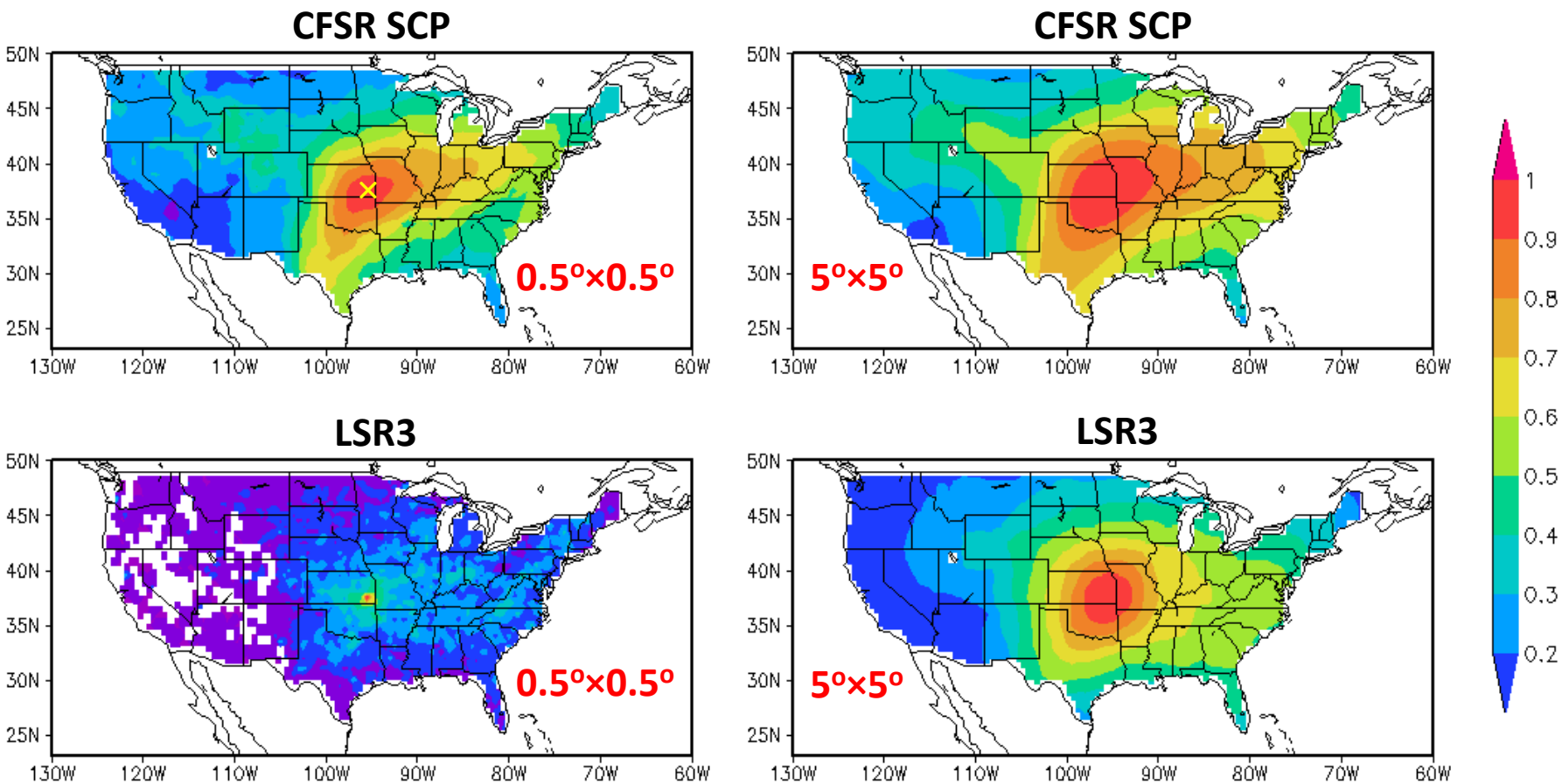
Seasonality



Spatial Covariation: SCP vs. LSR3

Weekly data
1996 – 2012

One-point Correlation (95.5°W, 37.5°N)



Higher spatial coherence

Forecasting weekly LSR3 over a large domain (5°×5°) may have a better skill than over a small area (0.5°×0.5°).

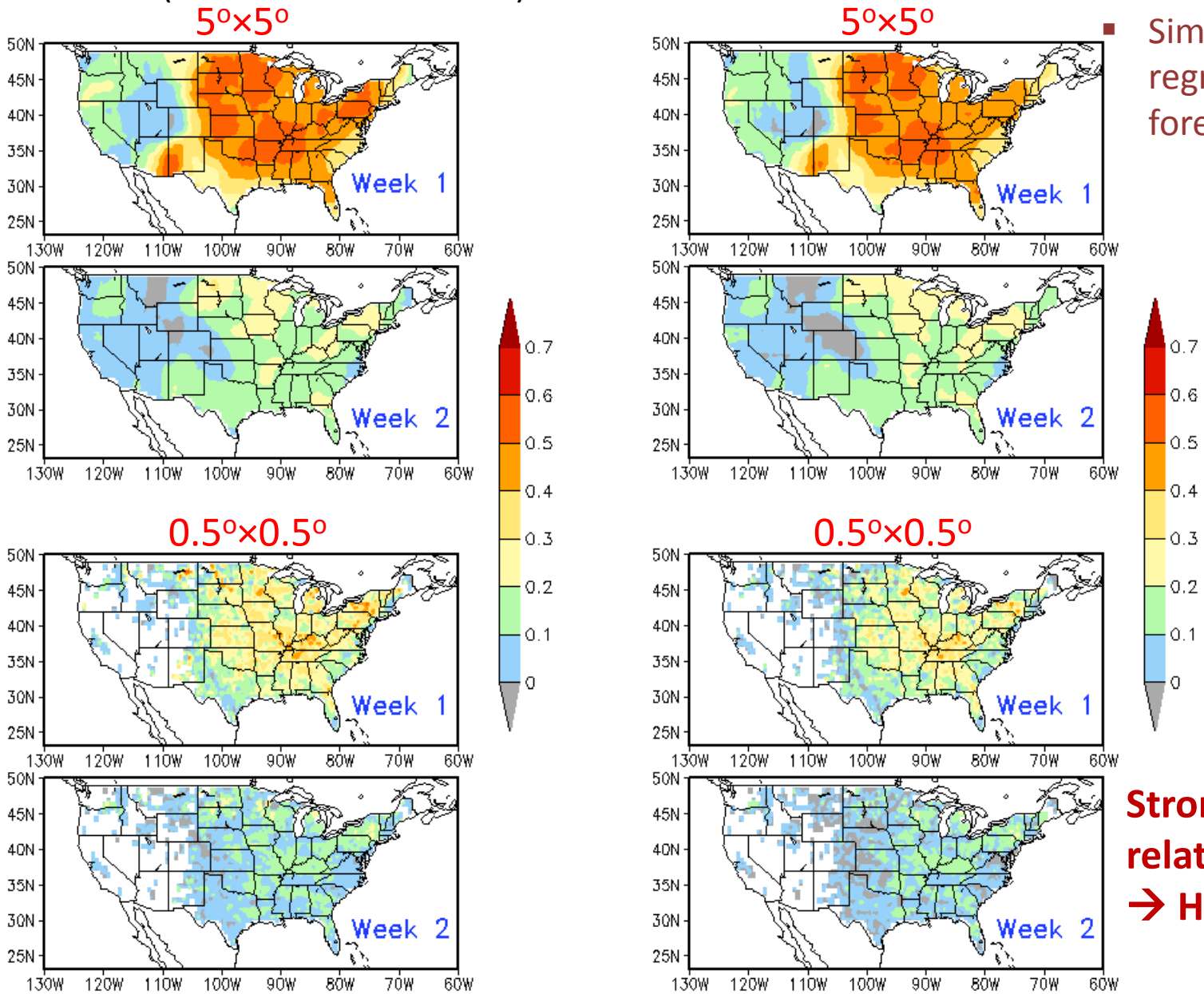
Relationship: SCP & LSR3

MAM 1996 – 2012

Correlation (GEFS SCP & OBS LSR3)

AC Skill for LSR3

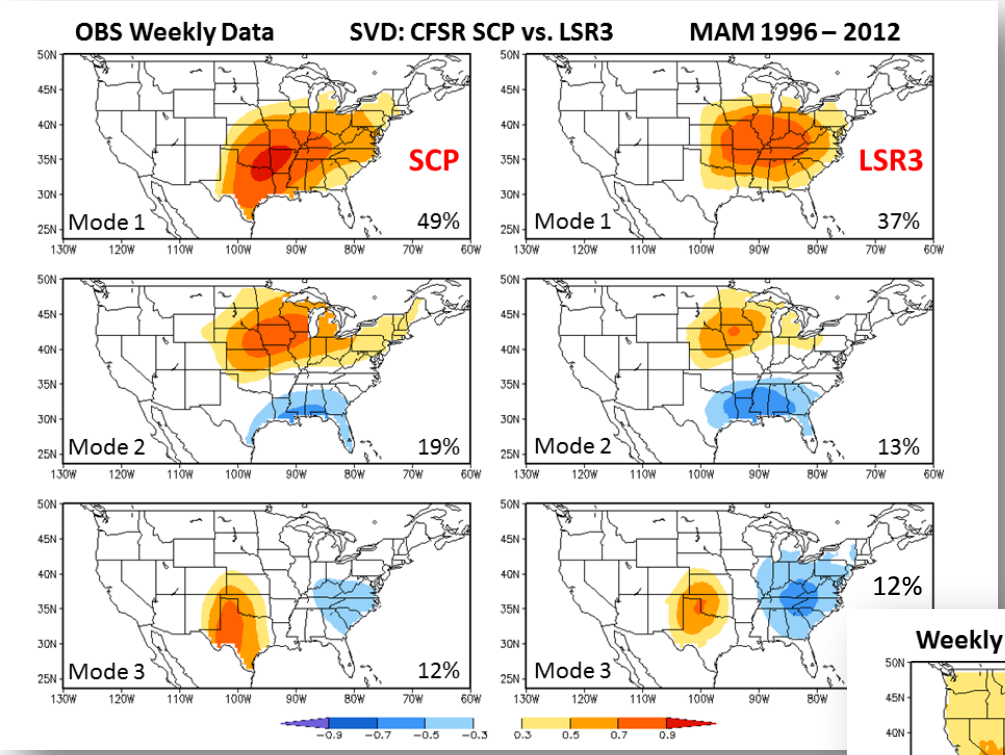
- Cross-validation
- Simple linear regression forecast model



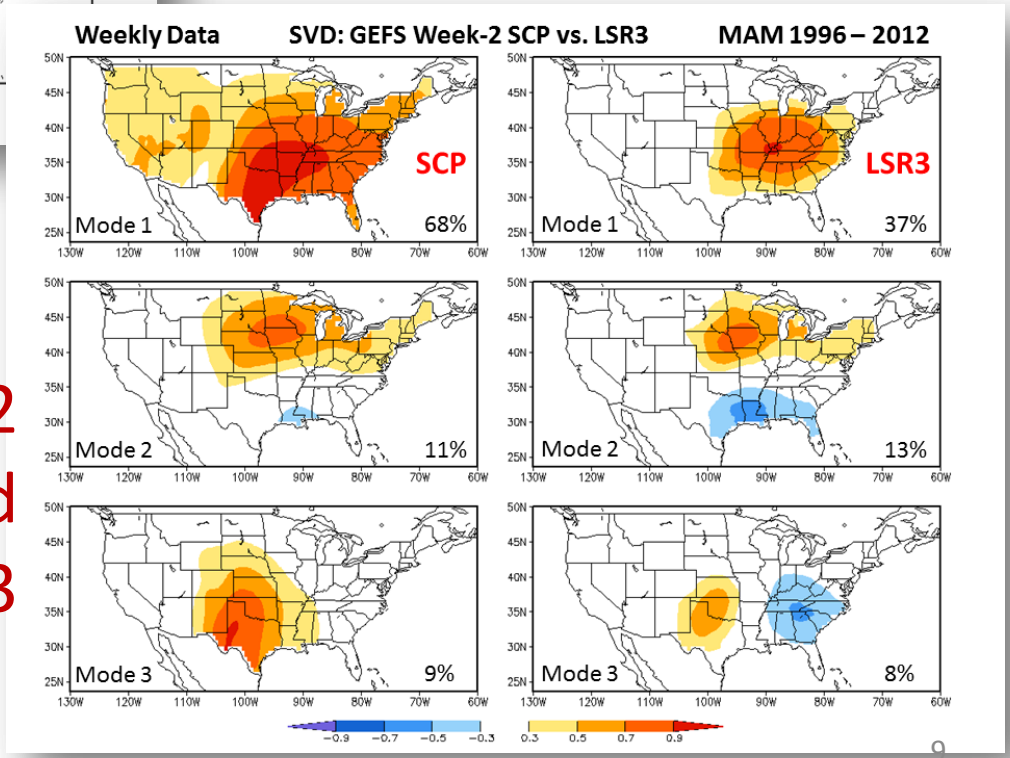
Stronger relationship → Higher skill

SVD: Spatial Covariation of SCP and LSR3

OBS



GEFS Week-2 FCST SCP and OBS LSR3

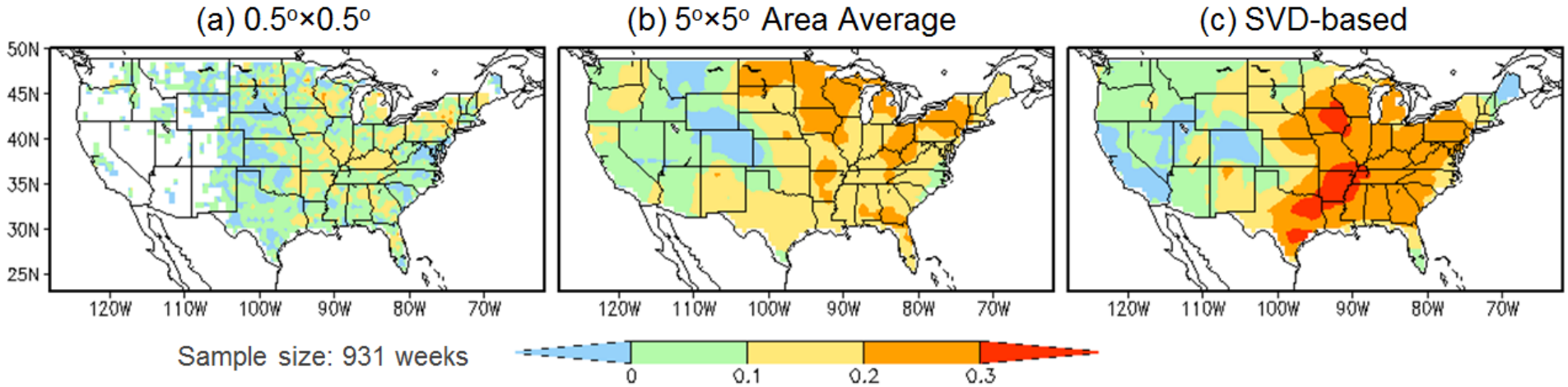


Forecast Skill for Week-2 Severe Weather

Cross-validation over MAM 1996 – 2012

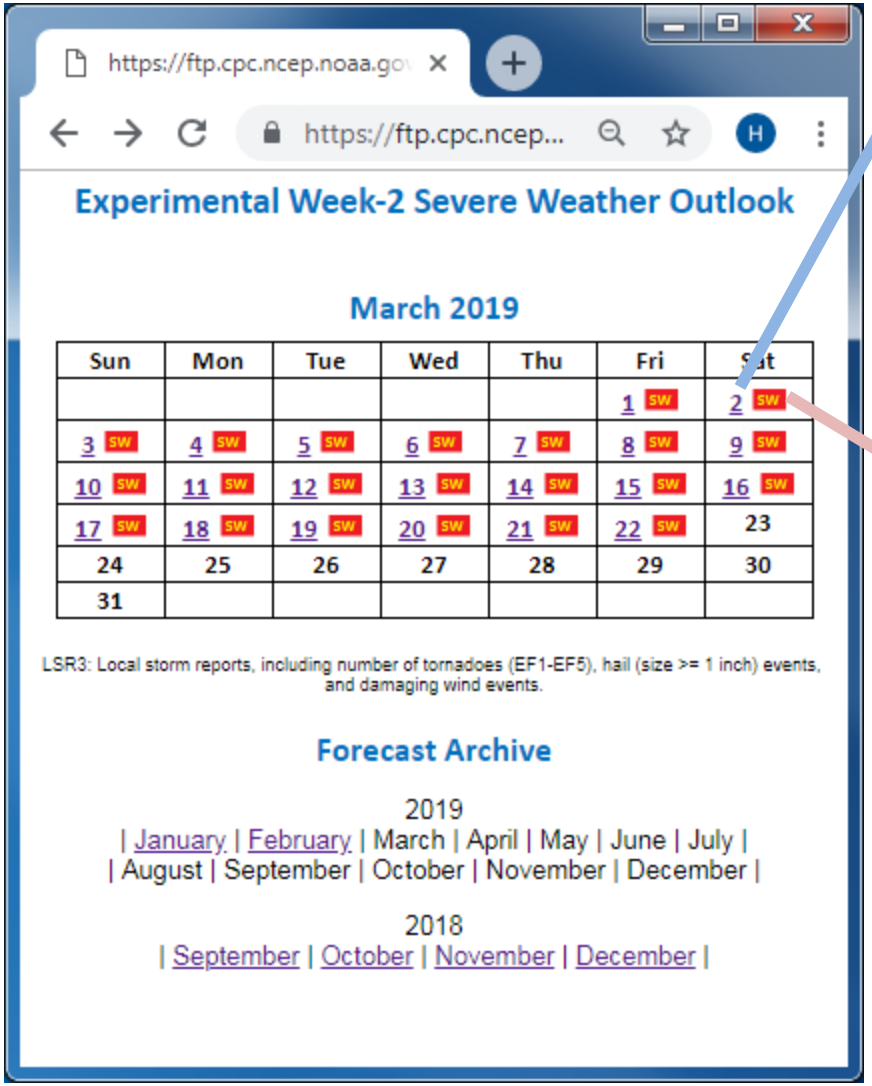
Simple linear regression model

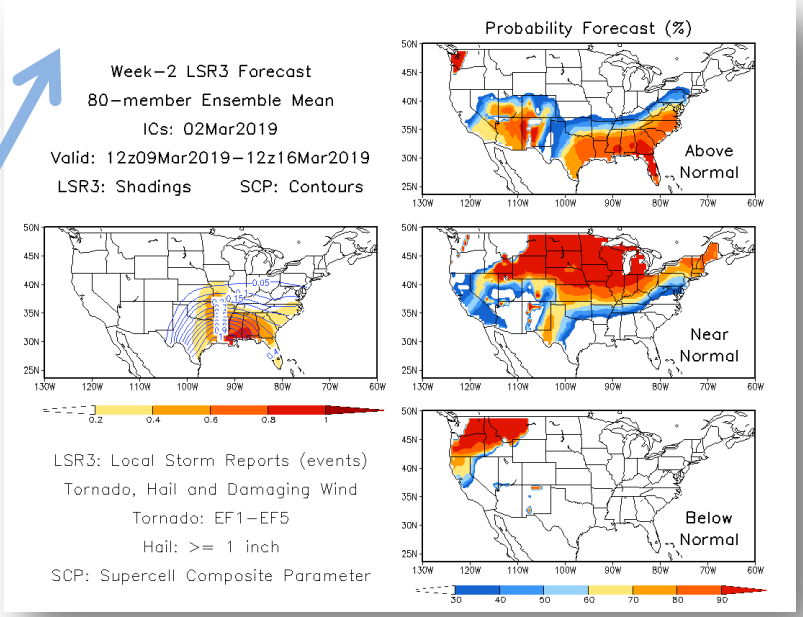
SVD-based hybrid model

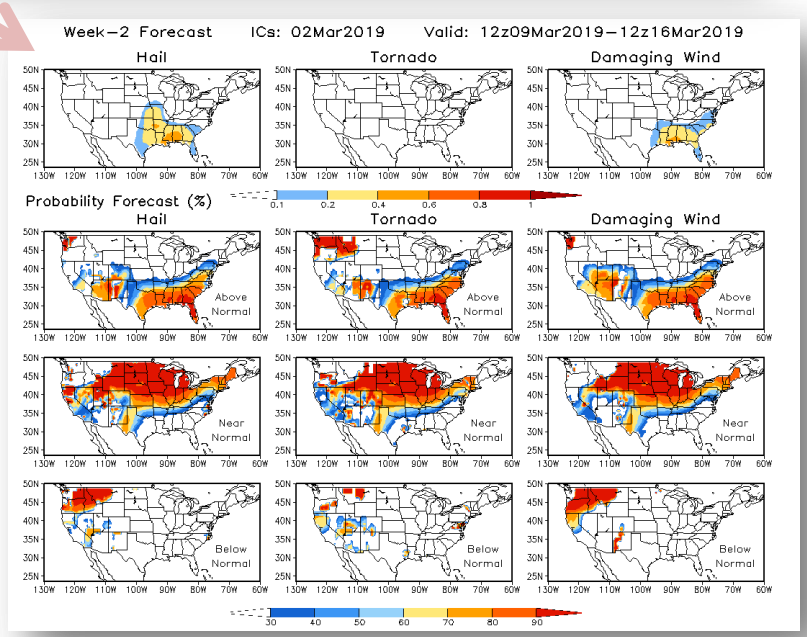


By considering the spatial covariations of both SCP and LSR3, the forecast skill can be significantly improved.

Experimental Real-time Forecast







→ **CPC's Week-2 U.S. Hazards Outlook**

Future Work

Implement real-time week 3-4 severe weather outlooks with the CFSv2 45-day Forecast

- SVD-based relationship between CFSv2 SCP and OBS LSR3
- Regional forecasts for a larger domain
- New predictors