

On the Identification of Synoptic-Scale Controls Associated with the Presence or Absence of Tornado Outbreaks

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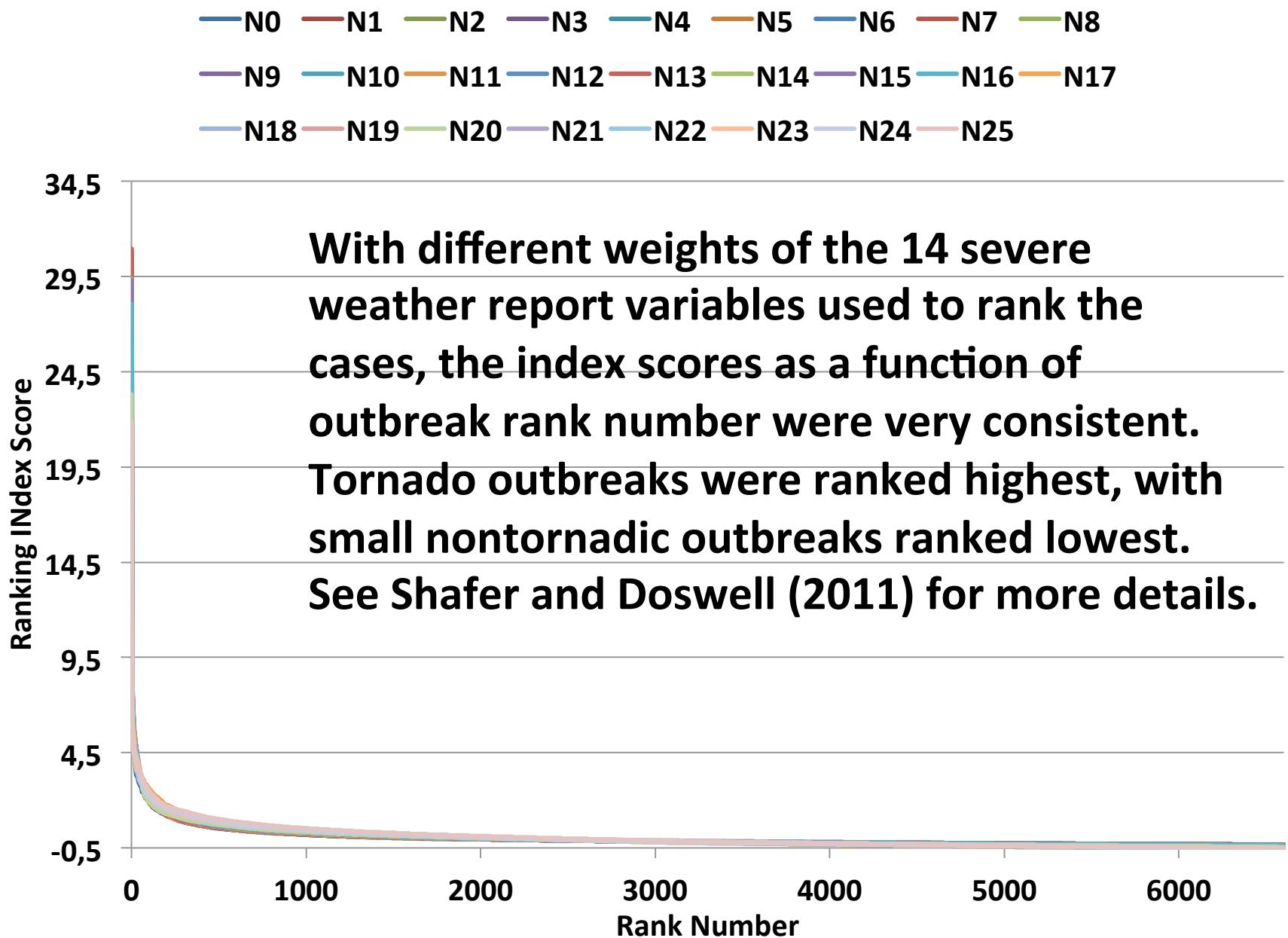
European Conference on Severe Storms
Helsinki, Finland

Primary Objectives

- Determine “state of the science” of severe weather outbreak diagnosis
- Diagnose and predict significant severe weather outbreaks from precursor synoptic-scale processes/phenomena
- Develop a probabilistic framework for convective outbreak diagnosis

Step 1

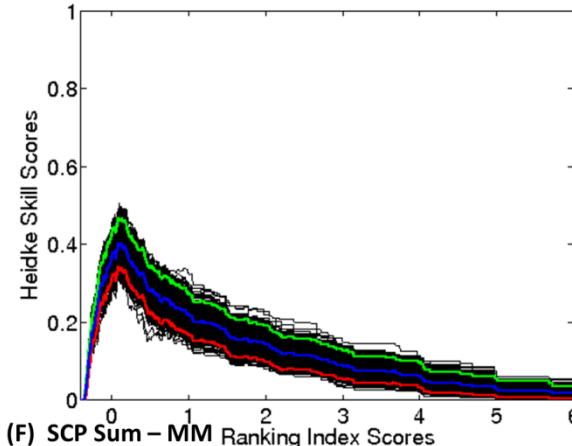
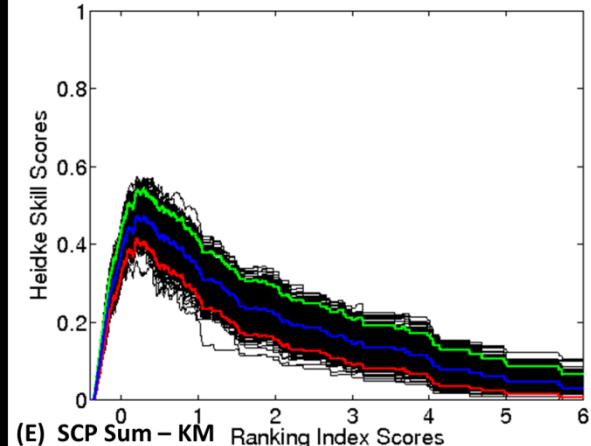
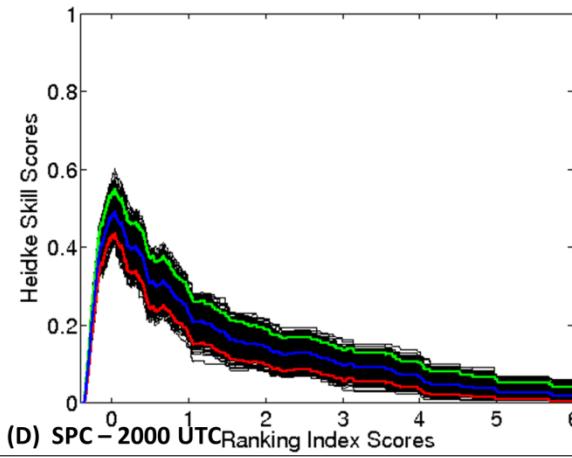
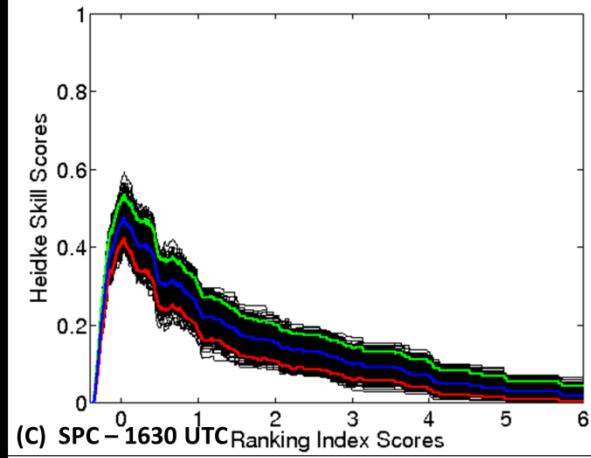
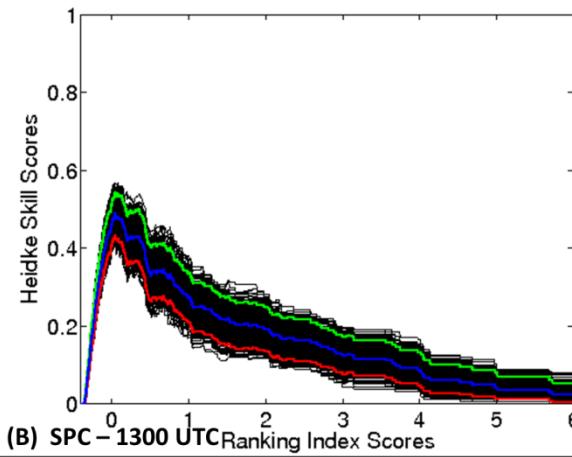
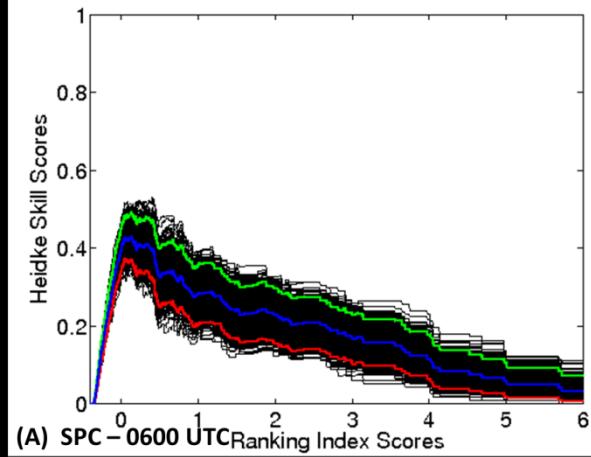
- Rank outbreaks based on preconceived notions regarding their meteorological significance and societal impacts
- See Doswell et al. (2006; WAF), Shafer and Doswell (2010, 2011; EJSSM)



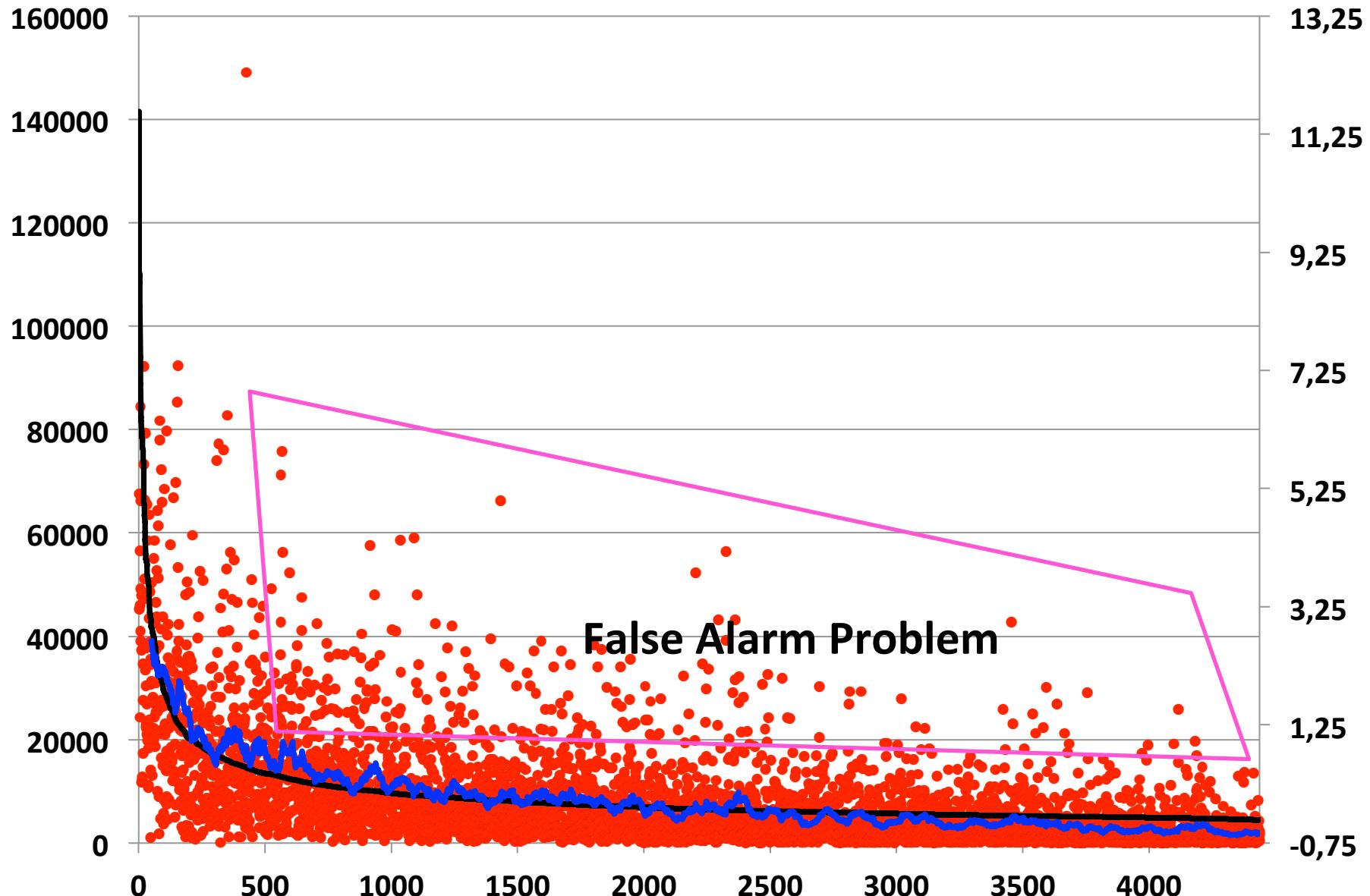
Step 2

- Develop objective means of diagnosing whether a significant severe weather outbreak occurs for a given environment
- Mercer et al. (2009; MWR) proposed a method using principal component analysis (Richman 1986; JCLIM), which effectively distinguished major tornado and primarily nontornadic outbreaks.
- Shafer et al. (2010; EJSSM) used spatial coverage of severe weather diagnostic variables to diagnose outbreak severity, showing comparable skill to the PCA technique and to SPC forecasts.

Comparison of the so-called areal coverage technique with SPC Day-1 Convective Outlooks, in which moderate or higher risks were considered forecasts of major severe weather outbreaks, Heidke skill scores were not statistically significantly different for all N15 indices tested. See Shafer et al. (2012; WAF).

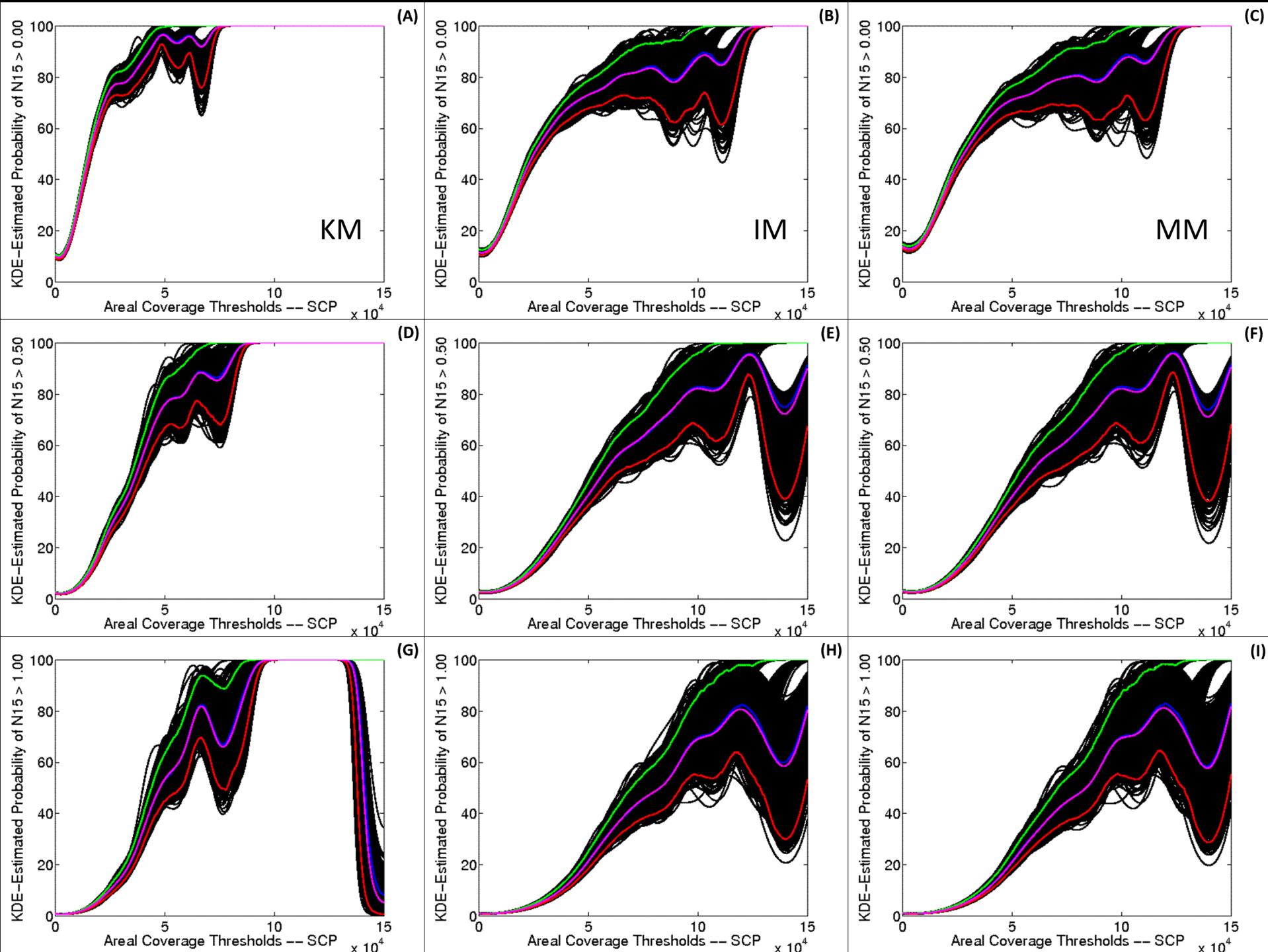


- SCP (KDE Method)
- N15
- 50 Periode gleit. Durchschn. (SCP (KDE Method))



Future Research (Objective 1)

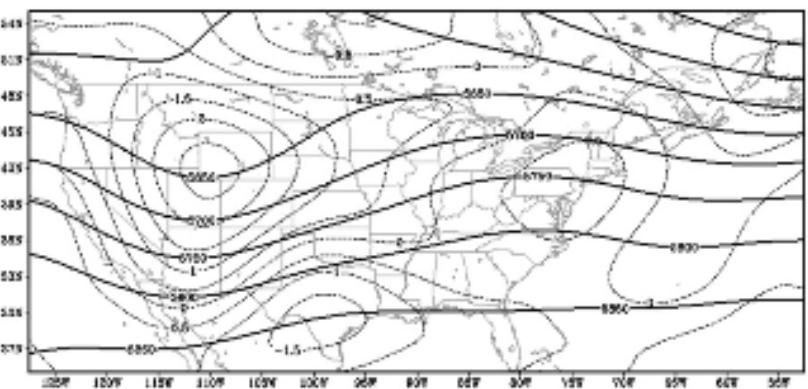
- Develop a probabilistic framework for diagnosing outbreak severity



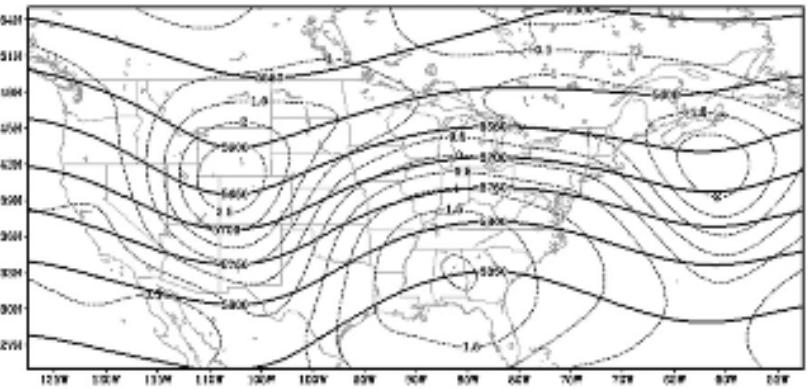
Step 3

- Identify synoptic precursors to various types of severe weather outbreaks
- Mercer et al. (2012; MWR) developed composites of tornado outbreaks and primarily nontornadic outbreaks using rotated principal component analysis (RPCA; Richman 1986) versus simple unsupervised averaging techniques, using coarse NCEP/NCAR Reanalysis data.
- Findings suggested considerable differences in predecessor large-scale environments between the two outbreak types.

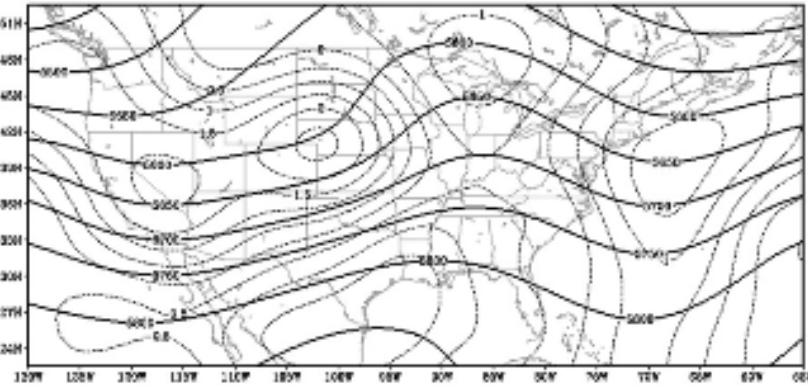
Tornado Outbreaks



(a)

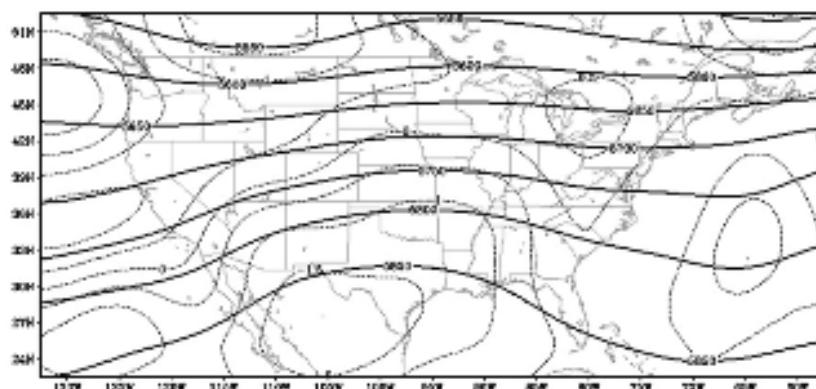


(b)

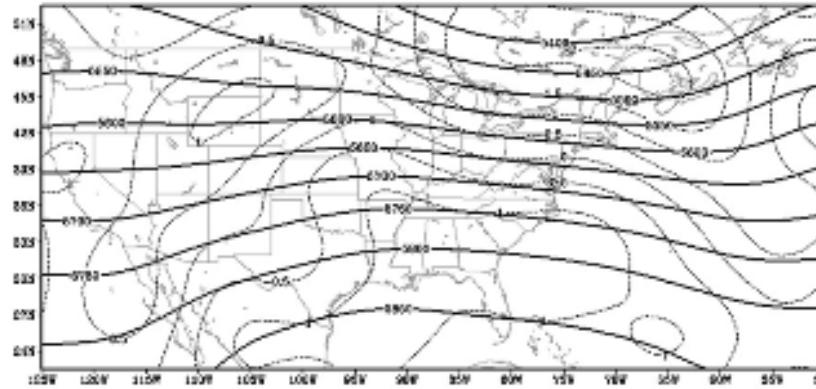


(c)

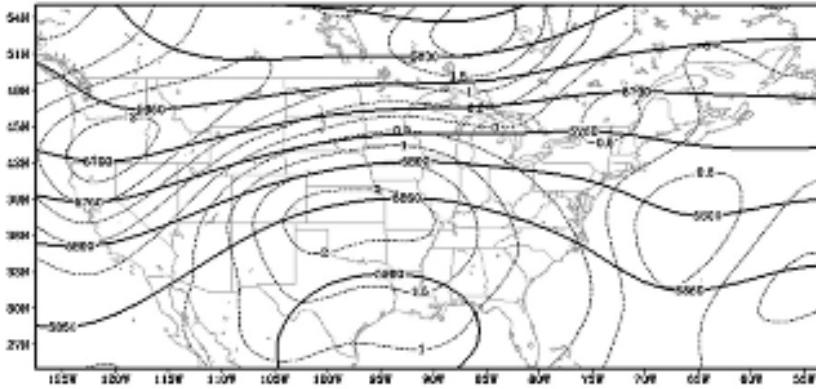
Nontornadic Outbreaks



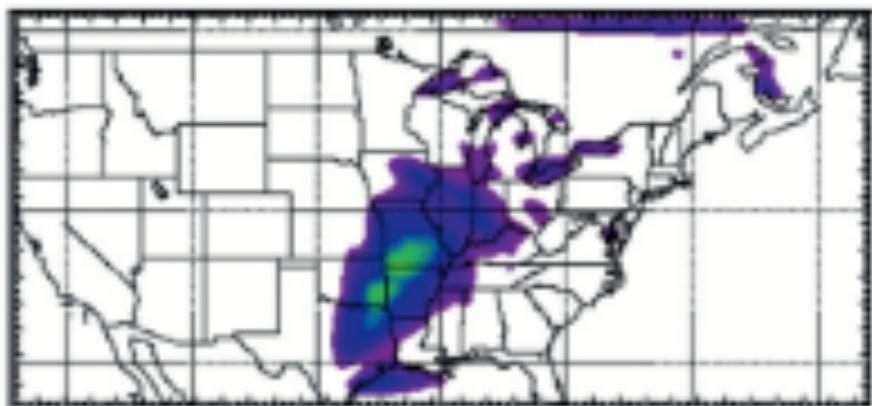
(a)



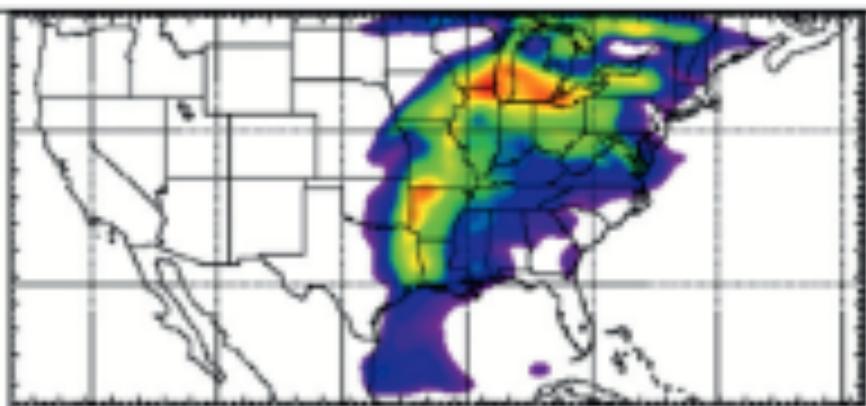
(b)



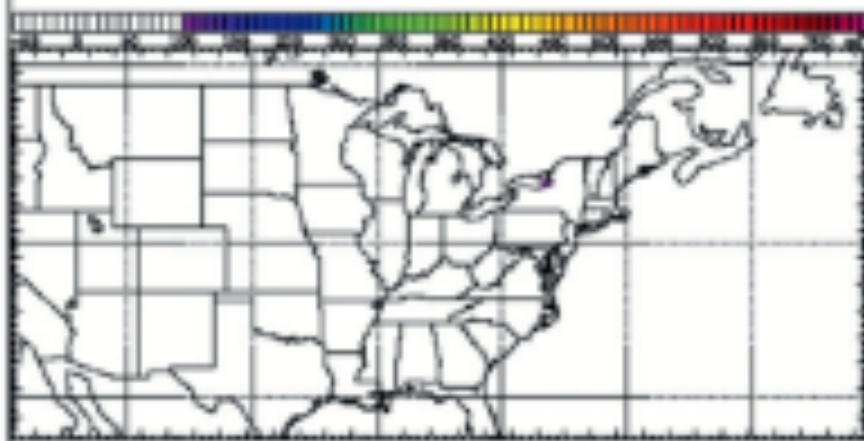
(c)



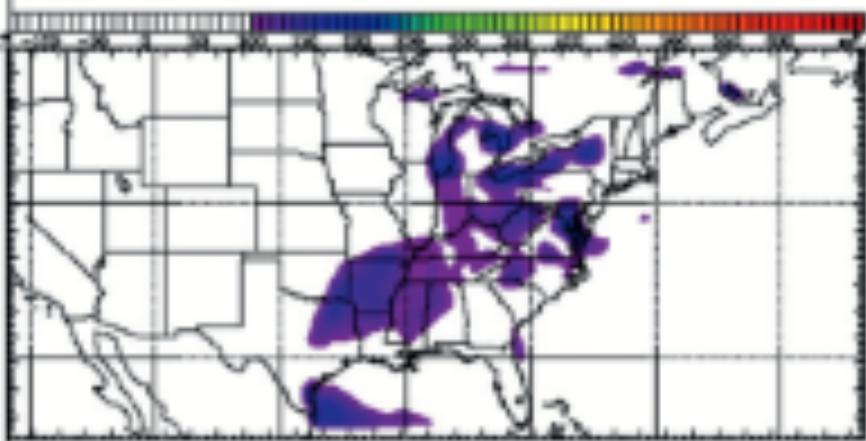
(A) TO1



(B) TO5



(C) NTO2

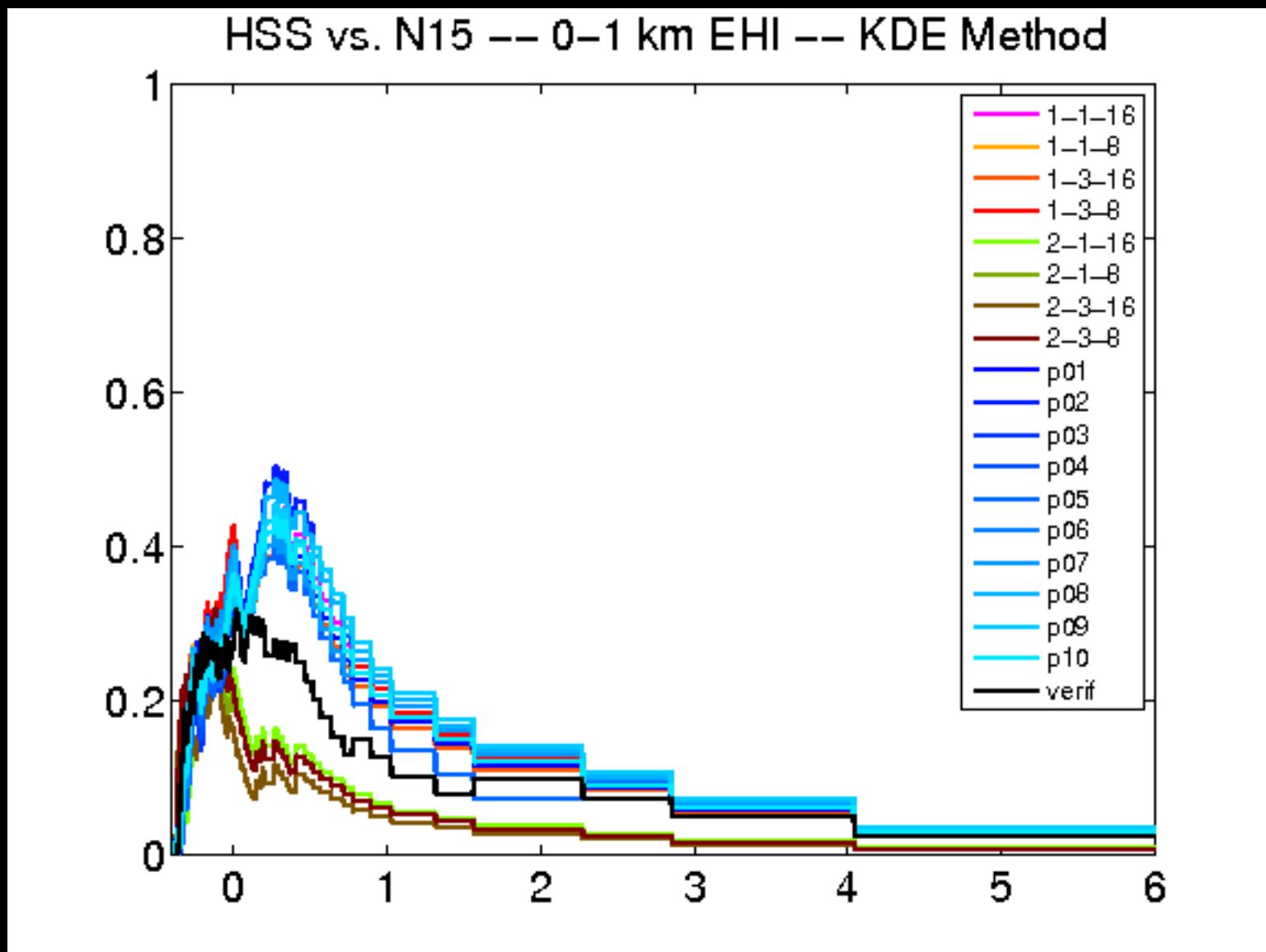


(D) NTO4

Future Research (Objective 2)

- Expand the list of events for compositing to any outbreak type (>6000 candidates from 1960 to the present).
- Perform QG diagnostics of the composites.
- Conduct potential vorticity (PV) surgery to assess sensitivities of model simulations of initial composite data to perturbations in the PV fields.

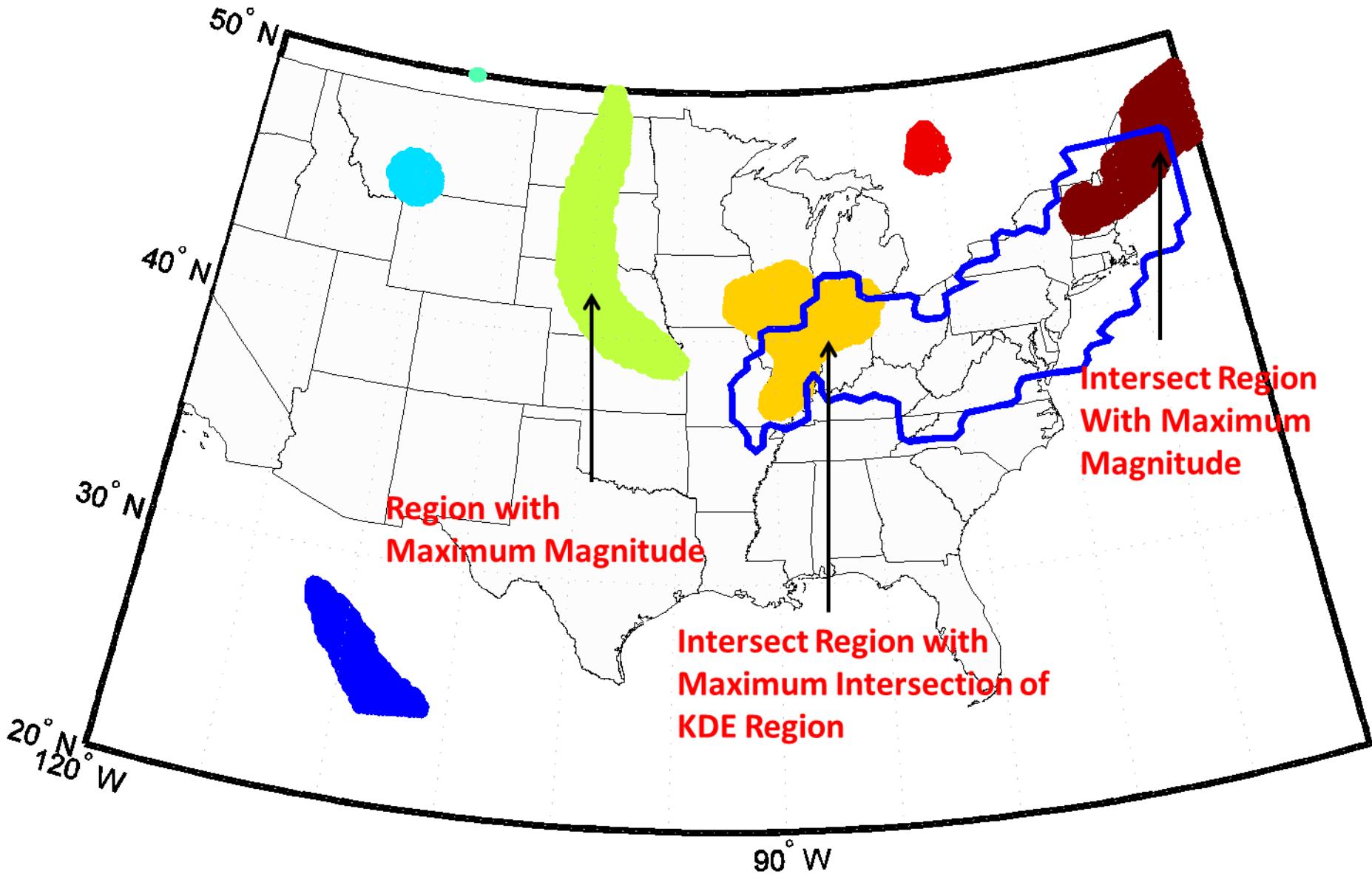
Future Research (Objective 3) – Model Ensembles

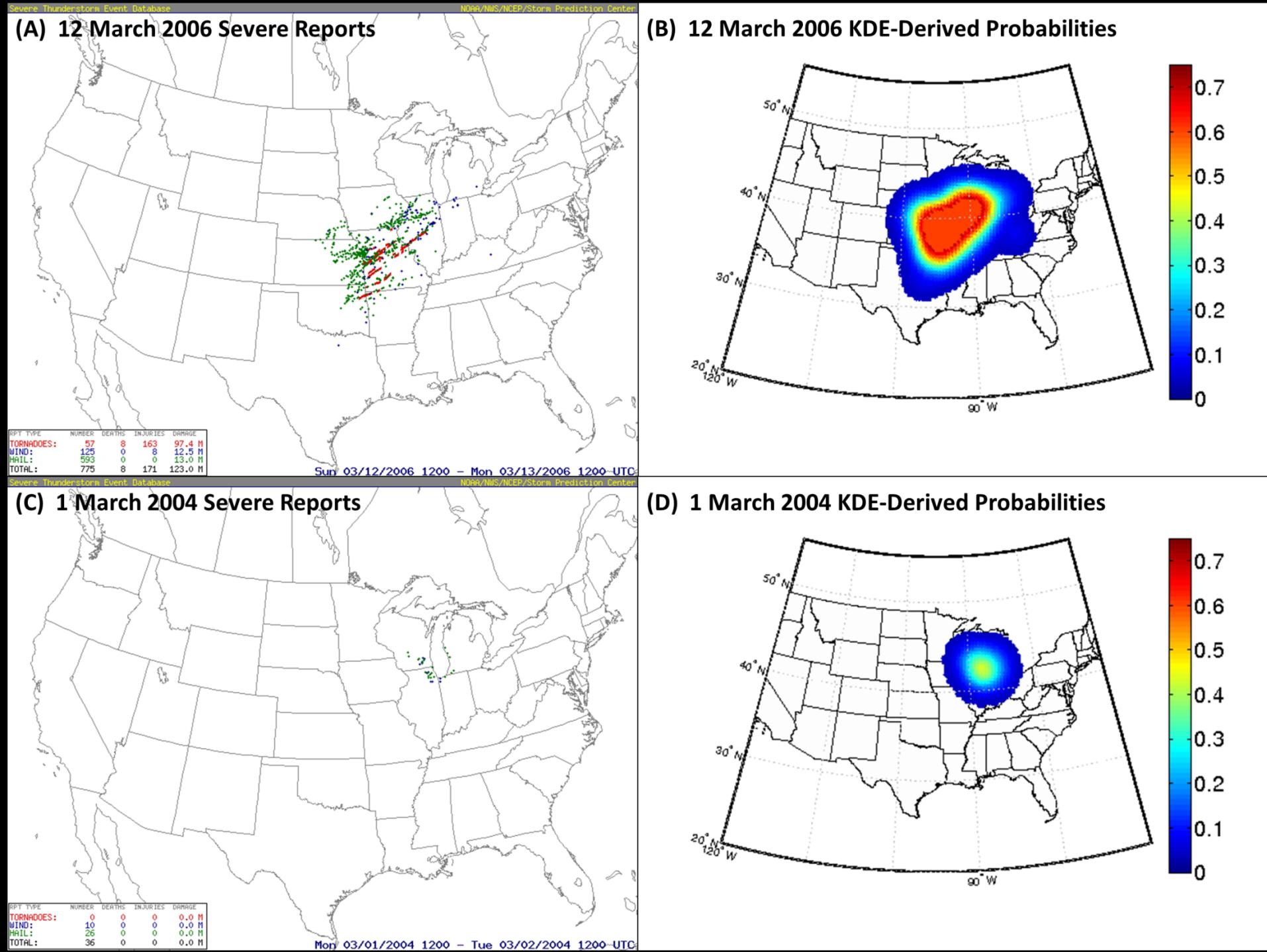


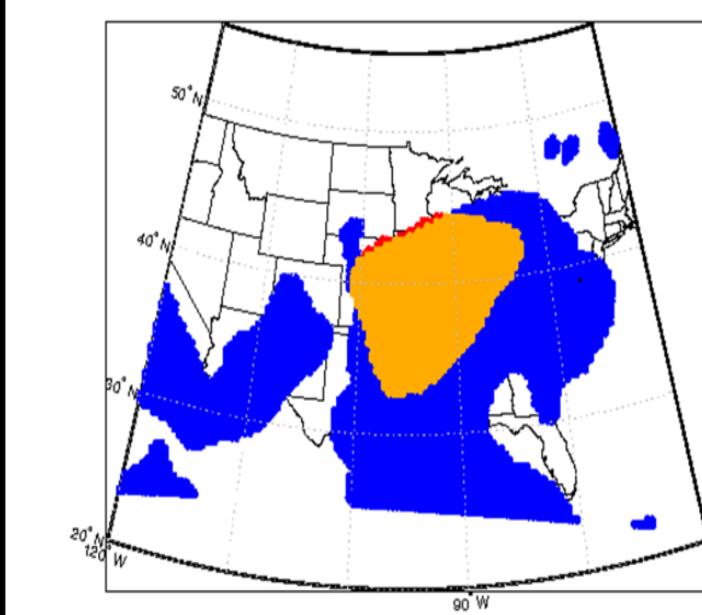
Acknowledgments

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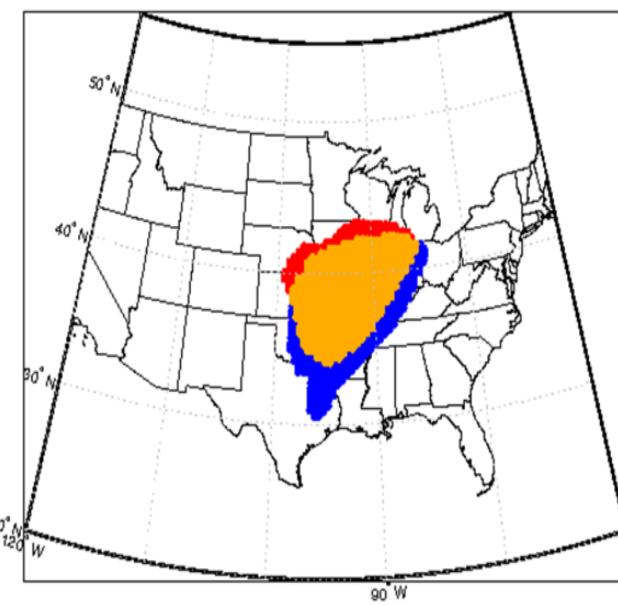
KDE Region and Reports for 18 July 2006





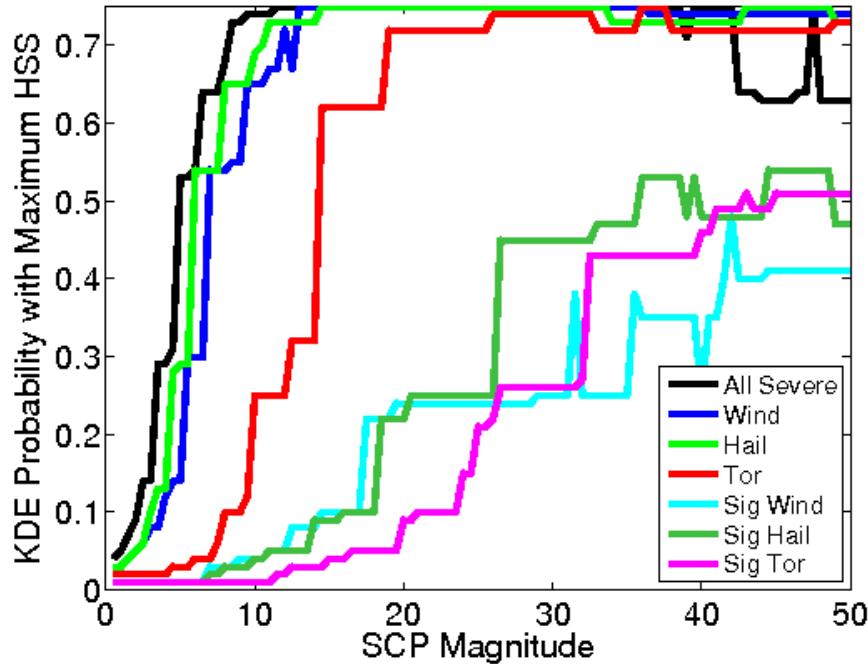


(A) – SCP ≥ 0.5 ; Observed Probability ≥ 0.01



(B) – SCP ≥ 10 ; Observed Probability ≥ 0.12

Unconditional -- 3-h



Unc Conv Req -- 3-h

