Evaluation of SPC Outlooks using the Symmetric Extremal Dependence Index

Nathan M. Hitchens[1,2] and Harold E. Brooks[3]

[1]Department of Geography, Ball State University, Muncie, Indiana
[2]Cooperative Institute of Mesoscale Meteorological Studies, University of Oklahoma, Norman, Oklahoma
[3]NOAA/OAR/National Severe Storms Laboratory, Norman, Oklahoma

Introduction

Recent research has focused on the evaluation of the accuracy and skill of the Storm Prediction Center's categorical convective outlook products [1][2][3], but this approach cannot be directly applied to probabilistic outlooks. As a result, a verification measure developed for rare-event forecasts, the symmetric extremal dependence index (SEDI) [4], is examined. This measure has many beneficial properties which are not present in most other verification measures used with rare events, including:

- Convergence toward a meaningful limit
- Fixed range between -1 and 1
- Meaningful origin
- Non-trivial to hedge

The objective of this project is to assess the SEDI as a useful measure in the evaluation of the SPC's probabilistic convective outlook forecasts.

Data and Methods

Convective outlooks and storm reports are plotted on 10 km × 10 km grids, and aggregated to various grid spacings, ranging from 10 to 300 km. A standard 2 × 2 contingency table is constructed by comparing the outlook and report grids for each day, and the values are used to calculate the SEDI.

		Observed: Yes	Observed: No
Forecast	Yes	a	b
Forecast	No	c	d

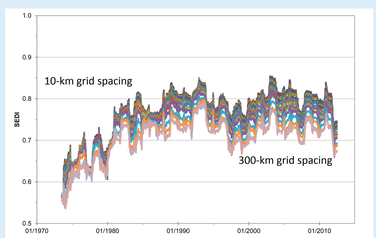
$$\text{Hit Rate (H)} = \frac{a}{a+c}$$

$$\text{False-alarm Rate (F)} = \frac{b}{b+d}$$

$$\text{SEDI} = \frac{\log F - \log H - \log(1-F) + \log(1-H)}{\log F + \log H + \log(1-F) + \log(1-H)}$$

A 365-day smoother is applied to the time series of daily contingency table values by summing each of the 365 values, centered on each day. The resulting contingency table is used to calculate SEDI values for each day.

Results

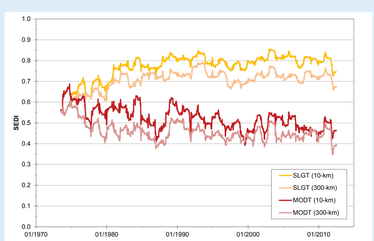


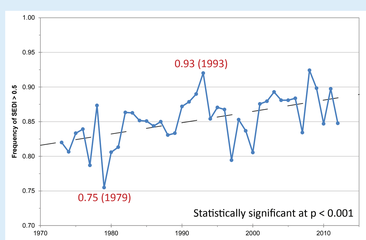
Slight Risk Areas

- SEDI with 365-d smoother
- 1973-2012
- Grid spacing 10-300 km

Slight and Moderate Risks

- SEDI with 365-d smoother
- 1973-2012
- Grid spacing 10 and 300km



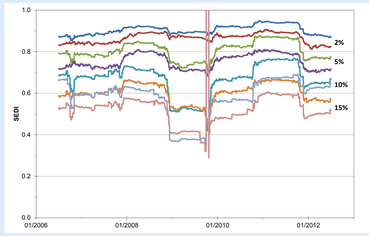


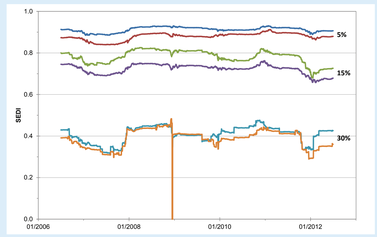
Annual Freq of SEDI > 0.5

- Slight Risk areas
- 1973-2012
- Grid spacing 80 km

Tornado Probabilities

- SEDI with 365-d smoother
- 2006-12
- Grid spacing 10 and 300km



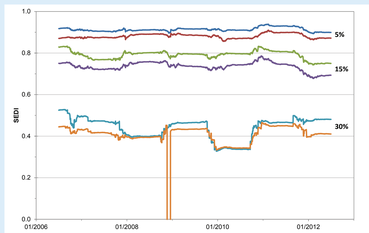


Wind Probabilities

- SEDI with 365-d smoother
- 2006-12
- Grid spacing 10 and 300km

Hail Probabilities

- SEDI with 365-d smoother
- 2006-12
- Grid spacing 10 and 300km



Summary

- Smoothed SEDI values show relatively little variation over a wide range of grid spacings
- Works well in assessing the accuracy of categorical and probabilistic forecasts
- No apparent way to assess forecast skill

References

[1] Hitchens, Nathan M., and Harold E. Brooks, 2012: Evaluation of the Storm Prediction Center's Day 1 Convective Outlooks. *Wea. Forecasting*, **27**, 1580–1585.

[2] Hitchens, Nathan M., Harold E. Brooks, and Michael P. Kay, 2013: Objective Limits on Forecasting Skill of Rare Events. *Wea. Forecasting*, **28**, 525–534.

[3] Hitchens, Nathan M., and Harold E. Brooks, 2014: Evaluation of the Storm Prediction Center's Day 3 through Day 1 Convective Outlooks. *Wea. Forecasting*, **29**, 1134–1142.

[4] Ferro, Christopher A. T., and David B. Stephenson, 2011: Extremal Dependence Indices: Improved Verification Measures for Deterministic Forecasts of Rare Binary Events. *Wea. Forecasting*, **26**, 699–713.