CIPS
Analog-Based Severe Probability Guidance

Alex Elmore
Dr. Charles Graves
How We Use Analogs

Old CIPS Analog System

- Analogs: Past weather patterns
- **STEP 1:** Find analogs that match the forecast
- **STEP 2:** Frequency of hazard or threshold showing up at a grid point in analogs
How We Use Analogs

Old CIPS Analog System

- Analogs: Historical Weather Patterns
- **STEP 1:** Find analogs that match the forecast
- **STEP 2:** Frequency of hazard or threshold showing up at a grid point in analogs

Approximate frequency around St. Louis=~30%. This translates to ~5 out of 15 analogs having severe here.
Not Your Father’s CIPS

New CIPS Analog System

- Still uses top matching analogs
- Still uses severe reports
- Machine Learning-based probabilities

...Why are we doing this?
VISION
A Weather-Ready Nation: Society is prepared for and responds to weather, water, and climate-dependent events.

MISSION
Provide weather, water, and climate data, forecasts, and warnings for the protection of life and property and the enhancement of the national economy.
“Integrating the power of human skill with the efficiency of new computing technology will revolutionize hazard forecasting, enabled by machine learning and advanced probabilistic tools.”
How Does It Work?
**STEP 1:** Analogs are found based on the 24-192 hour forecasts of 0000 UTC GEFS Mean

<table>
<thead>
<tr>
<th>0000 UTC GEFS</th>
<th>F024</th>
<th>F048</th>
<th>F072</th>
<th>F096</th>
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**Fields Used**

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<tr>
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<td>500mb Temps</td>
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<td>Moisture Fields</td>
<td>700mb Specific Humidity</td>
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**STEP 2:** Machine Learning algorithm examines the relationship between analogs and severe reports
**STEP 3:** Machine Learning algorithm applies historical relationship to forecast. Output is probability of severe within 110km of a grid point.
Hazards

Probability of All Severe Hazards

Probability of Severe Wind

Probability of Severe Hail

Probability of Tornado
Analog Seasonal Source

Top 100 Analog Seasonality - Spring

Top 100 Analog Seasonality - Summer
Best Matching Analog Fields

Frequency of Analog Fields as Top 3 Scoring Fields - Spring

Frequency of Analog Fields as Top 3 Scoring Fields - Summer
Worst Matching Analog Fields

Frequency of Analog Fields as Lowest 3 Scoring Fields - Spring

Frequency of Analog Fields as Lowest 3 Scoring Fields - Summer
Most Used Fields

All Severe Probabilities - Spring
Frequency of Occurrence as 3 Most Used Fields

All Severe Probabilities - Summer
Frequency of Occurrence as 3 Most Used Fields
Least Used Fields

All Severe Probabilities - Spring
Frequency of Occurrence as 3 Least Used Fields

All Severe Probabilities - Summer
Frequency of Occurrence as 3 Least Used Fields
How Does It Perform?
All Severe Reliability

Reliability - Spring All Severe Probability

Reliability - Summer All Severe Probability
Wind Reliability

Reliability - Spring Wind Probability

Reliability - Summer Wind Probability
Hail Reliability

Reliability - Spring Hail Probability

Reliability - Summer Hail Probability
Tornado Reliability

Reliability - Spring Tornado Probability

Reliability - Summer Tornado Probability
Limitations
Limitations:

Anomalous Events
Limitations:
Late Period & Mesoscale Events
Ongoing Work

New Version:

- Each GEFS member is processed individually
- Allows for use of percentile statistics (assess uncertainty)
Summary

Purpose:
- Provide probabilistic guidance for severe weather

Strengths:
- Identifies severe potential of large-scale pattern
- Provides forecast certainty/uncertainty

Limitations:
- Based on single model/ensemble
- Early- or late-period events
- Mesoscale events

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- NWS and SPC collaborators
- Kyle Perez - Springfield, MO WFO
  (Former SLU Master’s Student)

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Contact:
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- @CIPSAnalogs

Link to real-time guidance:
- www.eas.slu.edu/CIPS/SVRprob/SVRprob.php