Eastern Dryline Climatology and Synoptic-Scale Environment

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Introduction

Background
The dryline is an airstream boundary that typically sets up meridionally over the High Plains during spring. It marks a very strong moisture gradient between the hot, dry air from off the Mexican Plateau and the warm, moist air originating over the Gulf of Mexico. It is also a zone of enhanced convergence, which makes it a focal point for convective initiation (Schultz et al., 2007), and the focus of much research. A number of dryline climatologies have been created, however, the published climatologies (Hoch and Markowski, 2005 and Rhea, 1966) have all focused on the Great Plains drylines. This project is a study of the drylines that move atypically eastward.

Objectives
- Create a 5-year climatology of dryline passages east of 95°W [hereafter referred to as “eastern drylines”].
- Construct composites of synoptic conditions associated with eastern drylines.

Methods
- Five years (2007 – 2011) of data was used from the North American Regional Reanalysis (NARR) dataset to create the climatology:
  • 32 km grid spacing
  • 3-Hourly
- A computer algorithm was written that identified drylines according to three criteria:
  • A positive specific humidity gradient of at least
  3 x 10^7 m^-1 (0.3 kg m^-1 km^-1) across the boundary
  • Wind direction from 170° to 280° west of the boundary and wind direction from 80° to 150° east of the boundary
  • A temperature gradient of less than 0.5°C km^-1
- Parcels either side of the algorithm identified drylines were run through NOAA’s Hybrid Single-Particle Lagrangian Integrated Trajectory, or HYSPLIT, (http://ready.arl.noaa.gov/HYSPLIT.php) model to visualize the parcel trajectories and verify the origins of the air parcels.
- Composite fields of eastern dryline days were created using the NCEP/NARR Reanalysis Dataset through the Earth System Research Laboratory Physical Sciences Division (http://www.esrl.noaa.gov/pmel/data/composites/hour/).

Results

2007 – 2011 Climatology
A total of 17 dryline cases in the domain were identified from 2007 through 2011

Table 1: Comparison of synoptic features associated with synoptically-active drylines in the south central US (Texas, Oklahoma) (Schultz et al. 2007) with features associated with synoptically-active drylines in the domain of this study.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Schultz et al. (2007)</th>
<th>This Study</th>
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<tbody>
<tr>
<td>Dryline Passage State</td>
<td>300mb omega anomaly composite</td>
<td>500mb omega anomaly composite</td>
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<tr>
<td>Relative Frequency of Dryline Longitude Hits</td>
<td>90°-135°</td>
<td>90°-135°</td>
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<tr>
<td>Dryline Passages Through Domain By Month, 2007-2011</td>
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Conclusions and Future Work

Conclusions
- Dryline passages through the lower Mississippi River Valley region are perhaps more common than typically believed.
- These drylines occur in winter and spring. This is earlier than typical Great Plains drylines, which are most common in May (Hoch and Markowski, 2005). Their passages are associated with very active synoptic setups in the south central and southeast U.S. with strong jet streams aloft, midlevel shortwave troughs, and surface cyclones.
- These drylines are oftentimes analyzed as cold fronts.
- There are oftentimes severe weather outbreaks on days when drylines move atypically eastward.

Future Work
- A full 30 year climatology will be made of eastern drylines using the computer algorithm
- The domain will be expanded northward to 47°N
- Synoptic patterns will be further refined
- The location of convective initiation on eastern dryline days will be examined in order to determine which boundary (front) connection was initiated first.

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References