Dryline Position Errors in experimental convection-allowing NSSL-WRF Model Forecasts and the operational NAM

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Introduction

Recent work performing verification of convection-allowing modeling systems has largely focused on the ability of these models to forecast convective storms and rainfall systems. The location, timing, and evolution of simulated storms are connected to large-scale environmental parameters, so the verification of these large-scale fields is important. The present study evaluates forecasts of a common feature of convection initiation in the southern High Plains during Spring that is tied to large-scale environmental parameters: the dryline. 24 May 2011 served as the motivation for this work as it was a case in which the forecasted position of the dryline was over 100 km east of the actual position (see Figure 1).

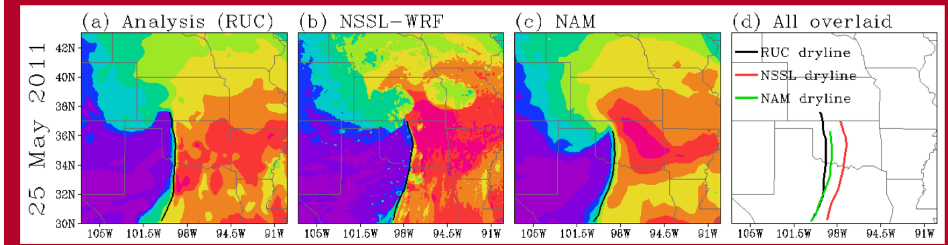

Figure 1: Specific humidity (shaded; gkg-1) valid 0000 UTC 25 May 2011 with manually defined dryline locations denoted by black lines for (a) RUC analysis, (b) 24 hour NSSL-WRF forecast, and (c) 24 hour NAM forecast. (d) dryline locations for (a)– (c) are shown together.

Methods

Daily 0000 UTC initializations of the NSSL-WRF and NAM are compared to the RUC dataset over the five year period of 2007 – 2011 for the months April –June. Out of the 455 days within the analysis period, drylines were indentified in the RUC analyses on 134 days (~29%). Out of those 134 days, drylines were also identified on 116 days in both the NSSL-WRF and the NAM datasets. For these 116 cases, coordinates were recorded along the axis of maximum specific humidity gradient (see Figure 2).

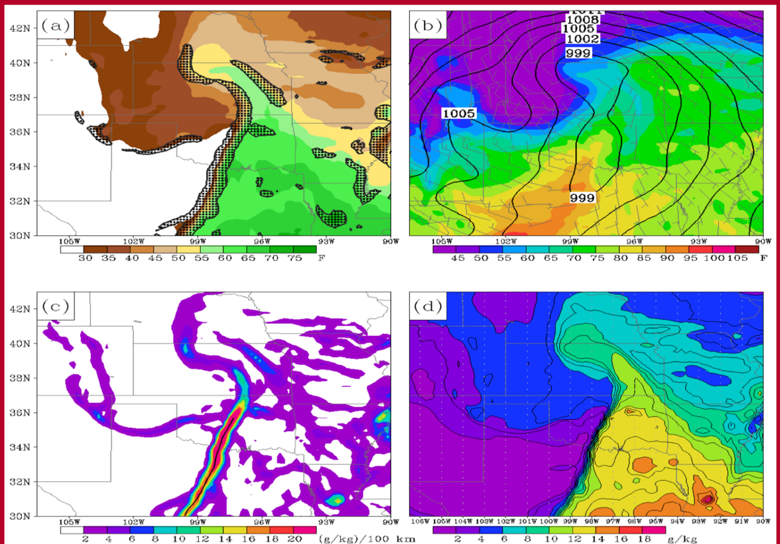

Figure 2: 0000 UTC 15 April 2011 RUC analysis fields. (a) 2-m dewpoint (shaded; F) and 2-m specific humidity gradient magnitude greater than 4 g kg-1 [100km]-1 (hatched), (b) mean-sea-level pressure (contours; mb), 2-m temperature (shaded; F), and 10-m wind barbs, (c) 2-m specific humidity gradient magnitude [shaded; gkg-1 [100 km]-1] with the manually defined dryline denoted by the black line, (d) 2-m specific humidity.

Results and Conclusions

No systematic east-west dryline placement errors were found for the 24-hr NAM forecasts; however, an eastward bias was found in the 24-hr NSSL-WRF forecasts (see Figure 3). The eastward biases seemed to be largest for the subgroups that favored "active" drylines, those associated with a progressive synoptic scale weather system, as opposed to "quiescent" drylines that tend to be present with weaker tropospheric flow (see Figure 4). An awareness of this bias will be valuable to severe weather forecasters and of use to model developers, especially those working on boundary layer parameterization. Future work is underway examining the sensitivity of predicted dryline position to the boundary layer parameterization scheme used in the convection-allowing NSSL-WRF.

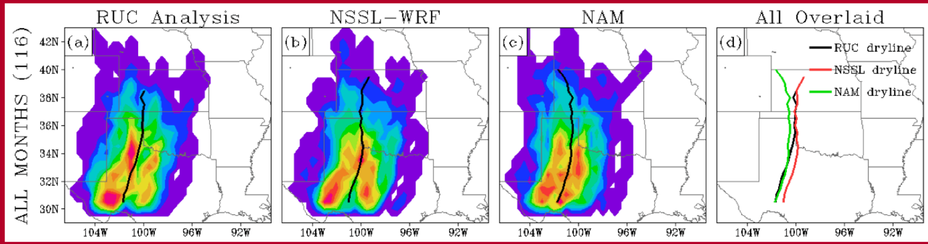

Figure 3: Dryline frequency (shaded) with average dryline location indicated by black line are shown in (a) RUC, (b) NSSL-WRF, and (c) NAM analyses. Average dryline location in the RUC, NSSL-WRF, and NAM is shown in (d).

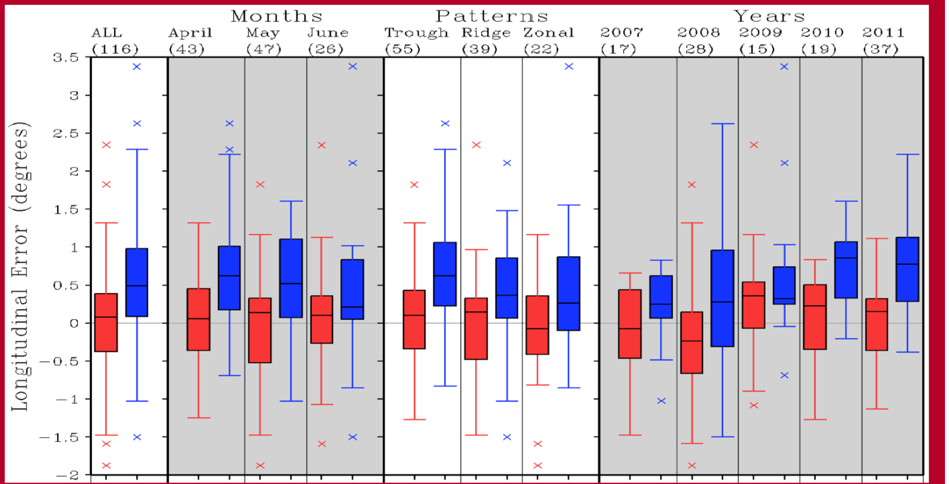

Figure 4: Box-plots for the distributions of average longitudinal dryline errors in the NAM (red) and NSSL-WRF (blue) over all cases, and different months, synoptic patterns, and years.