Forecast support for the Colorado region of the Deep Convective Clouds and Chemistry (DC3) experiment: Overview and evaluation of probabilistic forecasts

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INTRODUCTION

- In May-June 2012, the Deep Convective Clouds and Chemistry (DC3) experiment was conducted, with the goals of understanding the transport of chemical species by deep convective storms
- The project focused on three regional domains: eastern Colorado, northern Alabama, and western Oklahoma/Texas Panhandle
- Forecasters from each region made probabilistic forecasts for deep convection within their domain, and provided briefings to the DC3 science team each morning
- The Colorado forecasters were based at Colorado State University, and included faculty, staff, and students from CSU, and staff from the Cooperative Institute for Research in the Atmosphere (CIRA)
- 8 CSU graduate students were part of the forecast team, gaining valuable experience in convective weather forecasting and a look at the operation of a large field campaign
- **This poster includes an overview of the Colorado forecast efforts, along with evaluation of the probabilistic human forecasts of deep convection**

THE FORECAST PROCESS

- From 10 May-30 June 2012, forecasters for each of the domains issued probabilistic forecasts and briefings every morning by 8:30 am Central time, in addition to an overview briefing given by the DC3 lead forecaster
- The probabilistic forecasts covered the current day and "day 2", and included guidance about the expected convective mode (isolated, scattered, supercells, MCS, etc.)

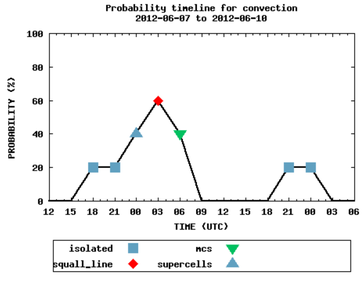

Fig. 1: *Example probabilistic forecast issued by the Colorado forecast team on the morning of 7 June 2012. Shown here are the probabilities and expected convective mode for each 3-h period from 12 UTC 7 June through 06 UTC 10 June.*

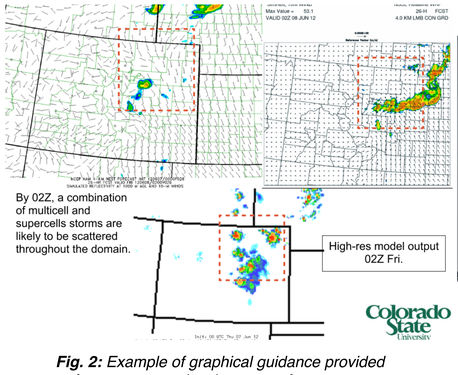

Fig. 2: *Example of graphical guidance provided to forecast team, showing output from convection-allowing numerical model forecasts*

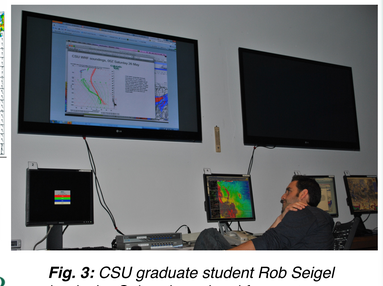

Fig. 3: *CSU graduate student Rob Seigel leads the Colorado regional forecast briefing in the CIRA weather center*

FORECAST EVALUATION METHODS

- We wish to objectively evaluate the human-issued probabilistic forecasts of deep convection for each of the three domains
- The NSSL Q2 composite radar reflectivity mosaics (0.01° lat/lon grid, from NWS radars) are used to evaluate the forecasts
- We define "deep convection" here as 15 or more pixels with composite reflectivity ≥ 50 dBZ within the domain (a 0.25° buffer on each side was used since forecasters were asked to forecast "in or near" the domain)

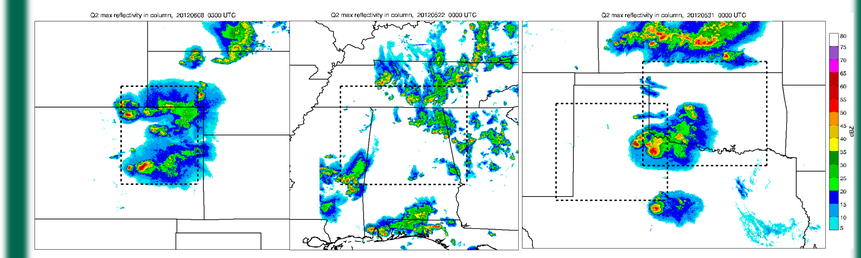

Fig. 4: *Q2 composite reflectivity at (left) 0300 UTC 8 June 2012, (middle) 0000 UTC 22 May 2012, and (right) 0000 UTC 31 May 2012, with the respective domains outlined in the thick dashed lines*

- A "yes/no" determination for deep convection was made every 3 h during the DC3 experiment, and the probabilistic human forecasts were evaluated against these observations using the area under the ROC curve and reliability diagrams

FREQUENCY OF CONVECTION

- During May-June 2012 in eastern Colorado, deep convection occurred frequently in the late afternoon and evening, and rarely in the morning and early afternoon, consistent with the climatology of warm-season precipitation in this area
- Alabama had a similar diurnal cycle with more frequent convection
- The OK/TX domain had convection most frequently, but it was also the largest domain in terms of area. The peak was at 0000 UTC with relatively frequent overnight convection

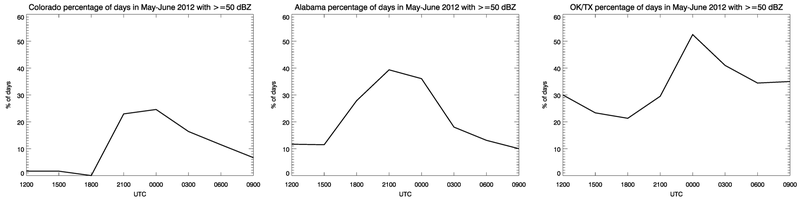

Fig. 5: *Diurnal distribution of the frequency of deep convection in the (left) Colorado, (middle) Alabama, and (right) Oklahoma/Texas domains during 1 May-30 June 2012.*

ACKNOWLEDGMENTS

- Thanks to the students and staff who woke up early all summer to contribute to the Colorado DC3 forecast team!
- Thanks to DC3 lead forecaster Morris Weisman, Don Burgess, Lamont Bain, and the DC3 science team, for help and guidance
- Thanks to Vidal Salazar and Gregg Stossmeister (NCAR) for organization and maintenance of the DC3 field catalog and forecast archive
- Thanks to Steve Rutledge and Paul Hein (CSU) for providing the Q2 radar composites
- Thanks to CIRA for allowing us to use their weather lab each morning

RESULTS

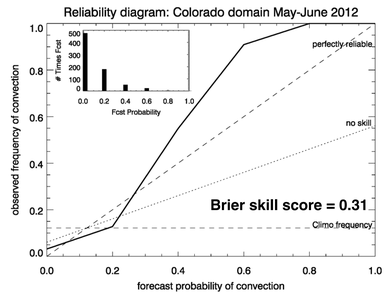

Fig. 6: *Reliability diagram for all Colorado domain forecasts*

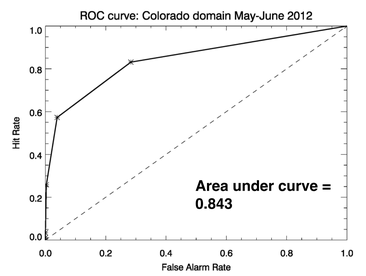

Fig. 7: *Receiver operating characteristic (ROC) curve for all Colorado domain forecasts*

- Overall, the human probabilistic forecasts for the Colorado domain were skillful, with the Brier Skill Score above 0 and the area under ROC curve > 0.8.
- The human forecasts were underconfident: when forecasting a 60% probability of deep convection, it occurred 91% of the time, and when forecasting an 80% probability it occurred 100% of the time. However, the sample size for these high-probability forecasts is very small; only two 80% probabilities were issued and only one 100% probability.

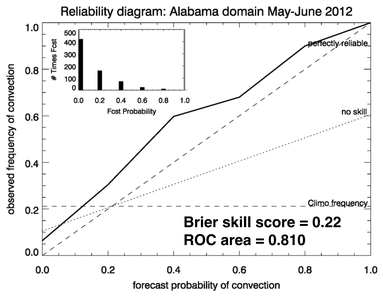

Fig. 8: *As in Fig. 6, but for the Alabama domain*

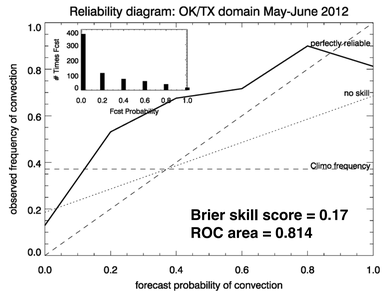

Fig. 9: *As in Fig. 6, but for Oklahoma/Texas domain*

- Forecasters for the other domains were also skillful, with comparable scores for all three domains. Alabama forecasters had a slight "dry" bias but were otherwise well calibrated; Oklahoma/Texas forecasters underpredicted at moderate probabilities but were overconfident at the 100% probability category
- Convective forecasts for all three domains were more skillful on day 1 (i.e., 0-24 hours) than on day 2 (24-42 hours) (not shown)
- Scores may have suffered because forecasters sought to predict convection of interest to the field project, and thus reduced probabilities for weaker or shorter-lived convection that still met our criteria for "deep convection"
- Forecasters were only offered probability choices in increments of 20%, and noted that they would have preferred a 5% or 10% probability on some days when they issued 20%.

SUMMARY AND DISCUSSION

- Teams of forecasters provided probabilistic forecasts of deep convection in support of the DC3 field experiment
- These forecasts were objectively evaluated against radar observations of deep convection
- The human probabilistic forecasts were found to be skillful, although the forecasts were underconfident – high probabilities were not issued frequently enough
- We encourage future field campaigns to include a human forecast component that can be evaluated directly against numerical model forecasts