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A seasonal-scale climatological analysis correlating spring tornadic activity with antecedent fall–winter drought in the southeastern United States

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Abstract
Using rain gauge and satellite-based rainfall climatologies and the NOAA Storm Prediction Center tornado database (1952–2007), this study found a statistically significant *tendency for fall–winter drought conditions to be correlated with below-normal tornado days the following spring* in north Georgia (i.e. 93% of the years) and other regions of the Southeast. Non-drought years had nearly twice as many tornado days in the study area as drought years and were also five to six times more likely to have multiple tornado days. Individual tornadic events are largely a function of the convective-mesoscale thermodynamic and dynamic environments, thus the study does not attempt to overstate predictability. Yet, the results may provide seasonal guidance in an analogous manner to the well known Sahelian rainfall and Cape Verde hurricane activity relationships.

Keywords: drought, tornadic activity, seasonal prediction, water cycle, extreme events, natural hazards

1. Introduction

The Intergovernmental Panel on Climate Change (IPCC 2007) recently projected that frequency and severity of droughts may increase over time. Very little is known about how drought conditions affect the frequency or intensity of severe weather hazards like tornadoes. Because of the lack of studies on drought–severe-weather interactions, there is a need to provide observational and modelling analyses relating the frequency and intensity of meteorological hazards to extreme hydroclimate anomalies like drought.

1.1. Motivation

Satellite-derived rainfall anomalies (figure 1) illustrate that cumulative rainfall was 20–60% below normal from Feb 2006 to Feb 2008 for a significant portion of the southeast United States (study area 2), including north Georgia (study area 1). During the 2006–2008 drought, several deadly tornado outbreaks struck north Georgia, including the central business district of Atlanta on 14 Mar 2008. This outbreak motivated a research question concerning the relation between drought conditions and tornadic activity. There is a paucity of literature documenting how drought conditions feedback to the frequency or intensity of tornadic activity. There are several reasons for the lack of study on regional tornado-activity–drought relationships. The evidence for changes in the number or intensity of tornadoes relies on local reports and may have discontinuities and gaps related to mode of reporting, population density or assessment, and technological advancements (IPCC 2007, Ashley 2007, Verbout *et al* 2006, Brooks and Doswell 2001).

Galway (1979) noted a weak relationship between both annual and seasonal precipitation totals and tornado activity

