Method of Detecting Convective Initiation due to Differences in Land Cover

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Research Goal

Develop an object-oriented method to explore radar data to assess the effect land use (e.g., urban vs. rural) has on the spatial distribution of convective initiation (CI).

Introduction

The Storm Cell Identification and Tracking algorithm (SCIT; Johnson et al. 1998) is a valuable tool for operational meteorologists. However, issues arise when interrogating these data for specific climatological research goals (e.g., Mohee and Miller 2010). While more recent studies have employed radar mosaics to process data directly from multiple radar installations (Zhang et al. 2011; Ashley et al. 2012; Kain et al. 2013), the application of these mosaic data have typically been confined to model verification (Clark et al. 2012; Kain et al. 2013). The initial goal of this investigation was to combine the spatial independence requirement of CI illustrated in Lakshmanan and Kain (2012) and the object-oriented analysis (Sellars et al. 2013) described in Kain et al. (2013) to develop an algorithm for use with observed national radar mosaic data. The resulting algorithm can detect an isolated convective initiation event (CI) that develops into an established thunderstorm.

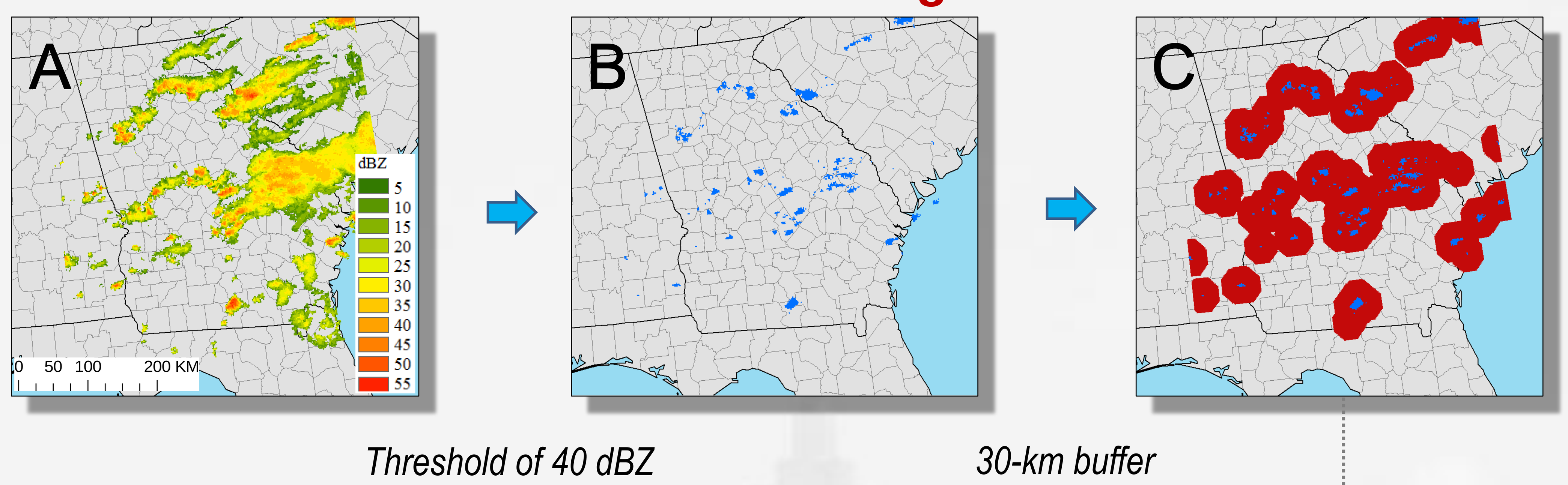
Data & Methods

This study employed NOWrad^{tm} national mosaic composites (see Parker and Knievel 2005). These data have 5-minute and 2 x 2 km temporal and spatial resolution, respectively. Convective pixels are defined as pixels with reflectivity values greater than or equal to 40 dBZ (Ashley et al. 2012). To identify isolated and persistent CI events, runs of eight sequential radar scans representing a 35 minute interval are analyzed using two main requirements:

1) CI must take place at least 30 km from existing convective pixels; and
2) CI events must develop into a thunderstorm that lasts at least 30 minutes.

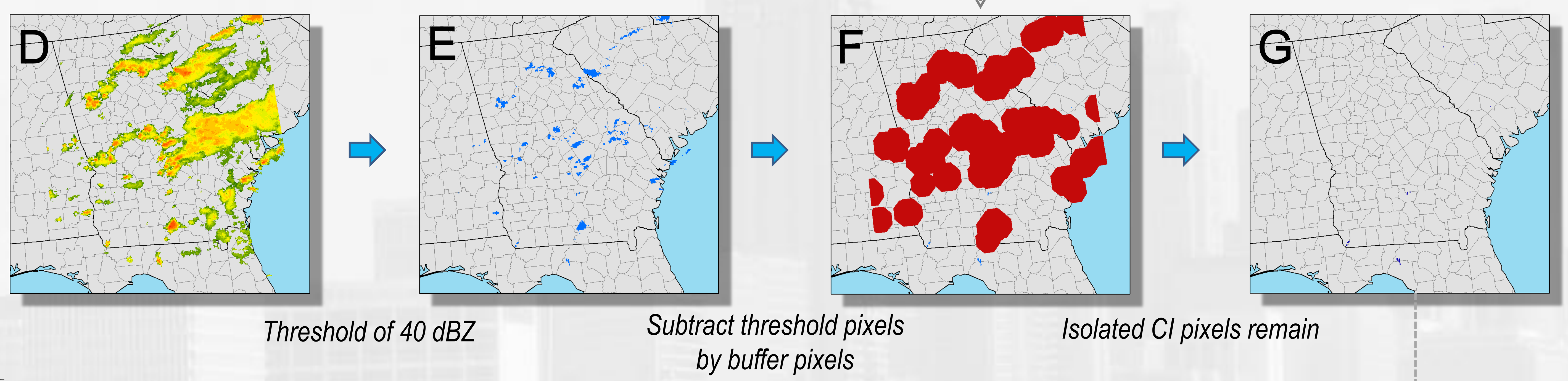
Determine areas of existing convection

The first scan (**A**) in the eight scan run is used to identify existing convective (≥ 40dBZ) pixels (**B**). Around these pixels, a 30-km buffer is created (**C**).



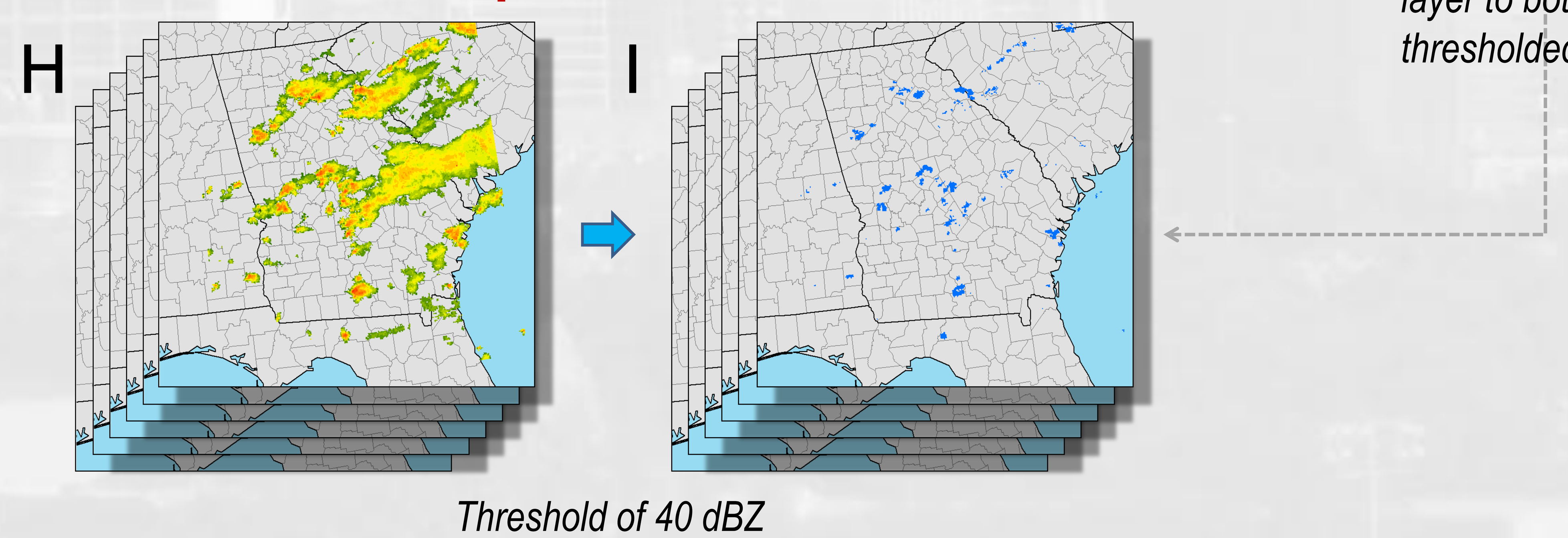
Determine areas of new, isolated convection

Convective pixels from the second scan (**D**) are identified (**E**). If any of these pixels (**E**) are within the 30-km buffer (**F**), they are removed (**G**).



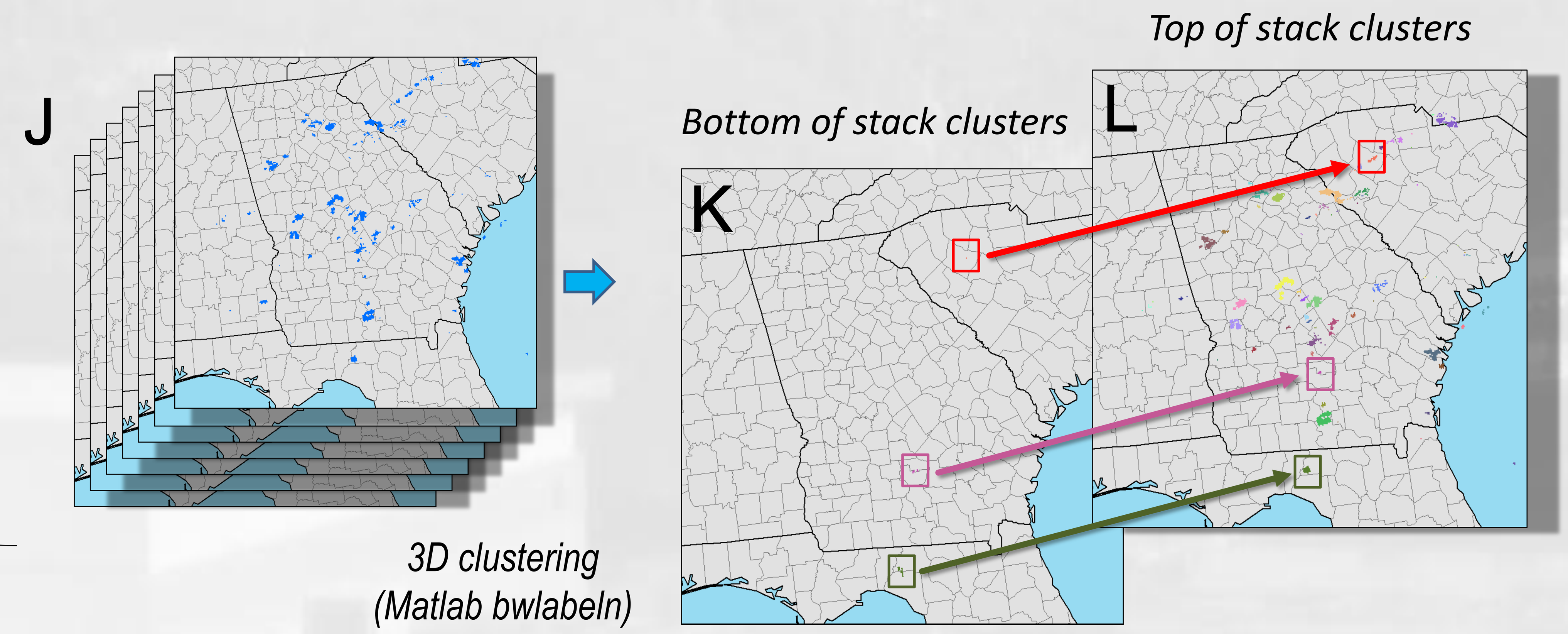
Extract convective pixels from next six scans

Convective pixels for the next six scans are identified (**H**). These are then stacked sequentially (**I**). Isolated convective pixels from the second scan (**G**) are inserted at the bottom of the stack.



Determine if isolated CI element develops into a thunderstorm using 3D clustering

3D clustering on the seven scan stack (**J**), using a nearest neighbor method, is performed. Only "precipitation objects" that are seven scans "tall" are retained (**K**). We see many other clusters can exist (**L**) but most were associated with ongoing convective pixels or those that initiated after (**D**).



Isolated CI pixels associated with 3D clusters seven scans "tall" (K through L) are stored and considered CI locations (K). These positions will be used to probe potential urban land cover effects on the spatiotemporal character of convection.