The THOR Project
Reducing the Impact of Thunderstorms on Aviation and the General Public Through A Multi-Agency Effort

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1. INTRODUCTION

Thunderstorms are high impact weather phenomena. They also pose an extremely challenging forecast problem. The National Oceanic and Atmospheric Adminstration (NOAA), the Federal Aviation Administration (FAA), the National Aeronautic and Space Administration (NASA), and Air Force Weather (AFW), have decided to pool technology and scientific expertise into an unprecedented effort to better observe, diagnose, and forecast thunderstorms. This paper describes plans for an operational field test called the **TH**understorm **O**perational **R**esearch **(THOR)** Project beginning in 2002, the primary goals of which are to:

1) Reduce the number of Thunderstorm-related Air Traffic Delays within the National Airspace System (NAS) and,
2) Improve severe thunderstorm, tornado and airport thunderstorm warning accuracy and lead time.

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Aviation field operations will be focused on the prime air traffic bottleneck in the NAS, the airspace bounded roughly by Chicago, New York City and Washington D.C (see THOR-North in Figure 1). A variety of new automated thunderstorm forecasting applications will be tested here that, when implemented into FAA-NWS operations, will allow for better tactical decision making and NAS management during thunderstorm days.

Severe thunderstorm operations will be centered on Northern Alabama (THOR-South in Figure 1). NWS meteorologists from the forecast office in Birmingham will test the utility of experimental lightning, radar, and profiler data from a mesoscale observing network being established by NASA's Marshall Space Flight Center. In addition, new tornado detection and thunderstorm nowcasting algorithms will be examined for their potential for improving warning accuracy. The Alabama THOR site will also serve as a test bed for new gridded, digital thunderstorm and flash flood warning products.

2. CONVECTIVE INITIATION AND LOW-LEVEL CONVERGENCE LINES

A key to any improvement in thunderstorm forecasting is better prediction of convective initiation. In turn, the key to better prediction of initiation is tied to better detection and forecasting of low-level convergence

lines (or boundaries). The SCAN Field Test (Smith et al. 1998) confirmed that reliable automated detection of boundaries is problematic. Human input and quality control of the automated techniques can however alleviate some of their shortcomings. A major thrust of THOR will be to demonstrate the effectiveness of human quality control in automated boundary detection on both local and regional scales.

3. THOR - North: Aviation

THOR-North will run in conjunction with the FAA s Corridor Integrated Weather System (CIWS) experiment. As part of CIWS, NCAR and MIT/Lincoln Laboratory scientists will be producing automated 1 and 2 hour regional forecasts of thunderstorms. This Regional Convective Weather Forecast (RCWF) product will be generated from a mulit-radar collection at Lincoln Laboratory and be distributed to a variety of aviation users. RCWF will contain components of both the of NCAR-developed National Convective Weather Forecast (NCWF) and the Lincoln Lab-developed Terminal Convective Weather Forecast (TCWF) that is part of the FAA s Integrated Terminal Weather System (ITWS). For THOR, a cadre of forecasters at the National Weather Service s Storm Prediction Center (SPC) in Norman, Oklahoma will be providing an hourly convective boundary analysis for the area shown in Figure 1. This analysis will be used as input as an interest field in the fuzzy logic component of RCWF. RCWF forecasts with and without the human boundary analysis will be verified by the Real-Time Verification System (RTVS; Mahoney et al. 2000). The boundary analysis cadre at SPC will be a collaborative team made up of scientists and forecasters from Air Force Weather, SPC, the Aviation Weather Center of the NWS, and the National Severe Storms Laboratory (NSSL).

4. THOR - South: Severe Local Storms

The focus of THOR-South is on improved diagnosis of severe local and tornadic storms. NWS forecasters and scientists will examine the ability of total lightning observations derived from NASA s 3-dimensional lightning mapping array to detect rapid updraft intensification in thunderstorms. Goodman et al. (1998) have observed a so-called jump in total lightning prior to the onset of hail, damaging winds and tornadoes in some storms in central Florida. NSSL will deploy a Warning Decision Support System-II at the NWS forecast office in Birmingham, Alabama that will allow forecasters to integrate the total lightning flash information with traditional radar, satellite and storm environment observations. As with THOR-North, THOR-South will also examine the impact of human quality control on improving the automated detection of small scale convergence zones in the boundary layer. These will be used as key input in the production of 30 and 60 min thunderstorm forecasts via NCAR s Thunderstorm Autonowcast system (Mueller et al 1997).

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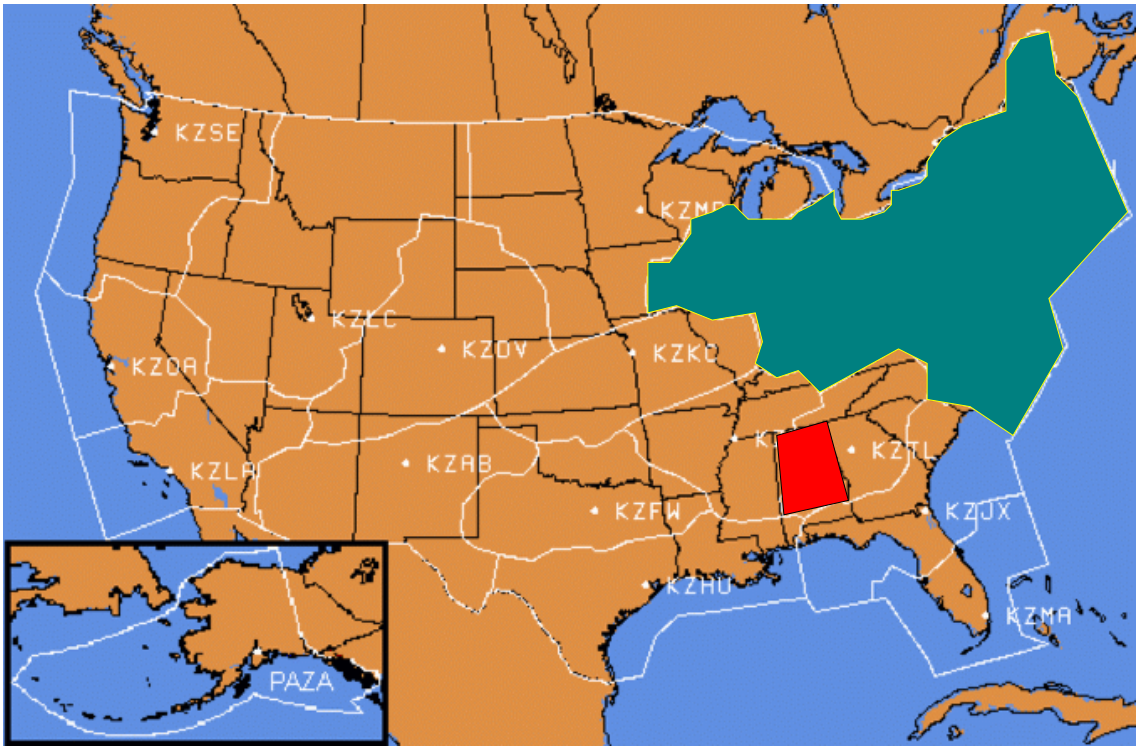

Figure 1: 2002-2005 Test area for THOR-North (Blue/Dark) and THOR-South (Red/Light)