

**P1.76** AN INVESTIGATION OF THE EXTRATROPICAL TRANSITION OF HURRICANE ERIN (2001)  
USING THE GLOBAL MODEL OF THE GERMAN WEATHER SERVICE

Matthias Rößcke<sup>1</sup>, Sarah C. Jones<sup>1</sup> and Detlev Majewski<sup>2</sup>  
<sup>1</sup>Meteorological Institute, University of Munich, Munich, Germany  
<sup>2</sup>Deutscher Wetterdienst, Offenbach, Germany

1. INTRODUCTION

Hurricane Erin underwent extratropical transition (ET) in September 2001. This study investigates the ET of Erin and the subsequent impact on the downstream flow using analyses from the German Weather Service (DWD) and the European Centre for Medium-Range Weather Forecasts (ECMWF) along with forecasts from the global model (GME) of the DWD (Majewski et al. 2002).

2. SYNOPTIC OVERVIEW

Erin reached its peak intensity on 10 September then weakened slightly and turned towards the northeast (Fig. 1). On 15 September 0600 UTC the National Hurricane Center classified Erin as an extratropical cyclone. The remnants of Erin underwent rapid re-intensification as an extratropical cyclone between 15 and 16 September (Fig. 1b).

The upper-level trough that steered Erin to the northeast can be seen on 10 September to the northwest of the Great Lakes as a region of high potential temperature ( $\theta$ ) on the dynamic tropopause (Fig. 2). Subsequently this tropopause anomaly extended meridionally and thinned significantly and on 15 September at the start of the reintensification was located due west of Erin. At this time Erin was located between two upper-level jet streaks (Fig. 2d), a favourable location for intensification as an extratropical system.

3. FORECASTS

A sequence of forecasts for the time period 10 to 17 September has been performed using the GME Model initialised with ECMWF and DWD analyses. The forecasts initialised on 10 September (not shown) had significant track errors. The ECMWF-initialised forecast predicted an ET but with Erin located over Northern Canada on 17 September. In the DWD-initialised forecast Erin did not undergo ET. The forecast errors in both cases could largely be attributed to the evolution of the upstream upper-level trough. The track forecasts improved with decreasing lead-time of the forecast. The forecasts from 13 September and later represented the track of Erin well. In contrast, the rapid intensification from 15 to 16 September is only captured in the 24 h forecast initialised on 14 September. This is the only forecast in which the double jet structure seen in Fig. 2d

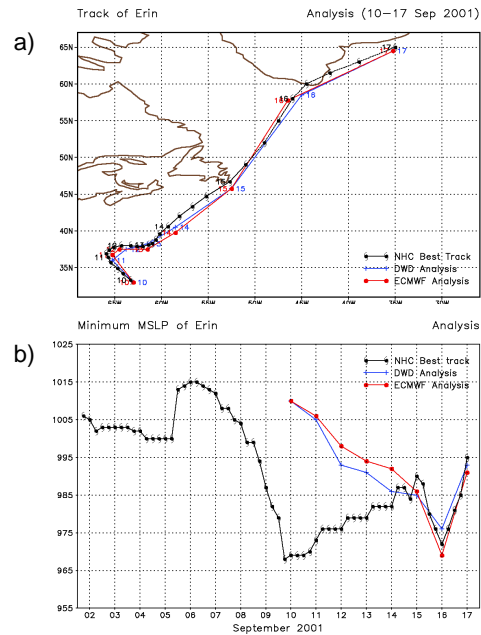


Figure 1: (a) Track of Hurricane Erin plotted from 10 to 17 September 2001, and (b) minimum mean sea level pressure from best track data and ECMWF and DWD analyses.

is reproduced. Thus the forecasts indicate that the double jet structure was crucial for the reintensification of Erin after ET.

4. TROPICAL STORM GABRIELLE

Tropical Storm Gabrielle developed from a weak low in the Gulf of Mexico that intensified to Tropical Storm strength on 14 September. On 15 September Gabrielle was situated over Florida (Fig. 2c). A vertical cross-section through Gabrielle and the tropopause  $\theta$  anomaly shows that the tropopause is raised in the outflow region to the northeast of Gabrielle leading to a tropopause step in the region of the southern jet streak. We hypothesise that Gabrielle enhanced the southern jet streak and thus played a role in the reintensification of Erin as an extratropical system. This hypothesis is supported by trajectory calculations (not shown).

5. DOWNSTREAM IMPACT

The outflow from Hurricane Erin can be seen on 10 September as a region of high  $\theta$  on the tropopause around the hurricane (Fig. 2a). On 13 September the high  $\theta$  anomaly on the tropopause extends northeastwards from Erin across the Atlantic (Fig. 2b) and by 15 September has reached Spain (Fig. 2c). Trajectory calculations show that some of this high- $\theta$  air

\* Corresponding author address: Sarah C. Jones, Meteorologisches Institut, Theresienstr. 37, 80333 München, GERMANY.  
e-mail: sarah@meteo.physik.uni-muenchen.de

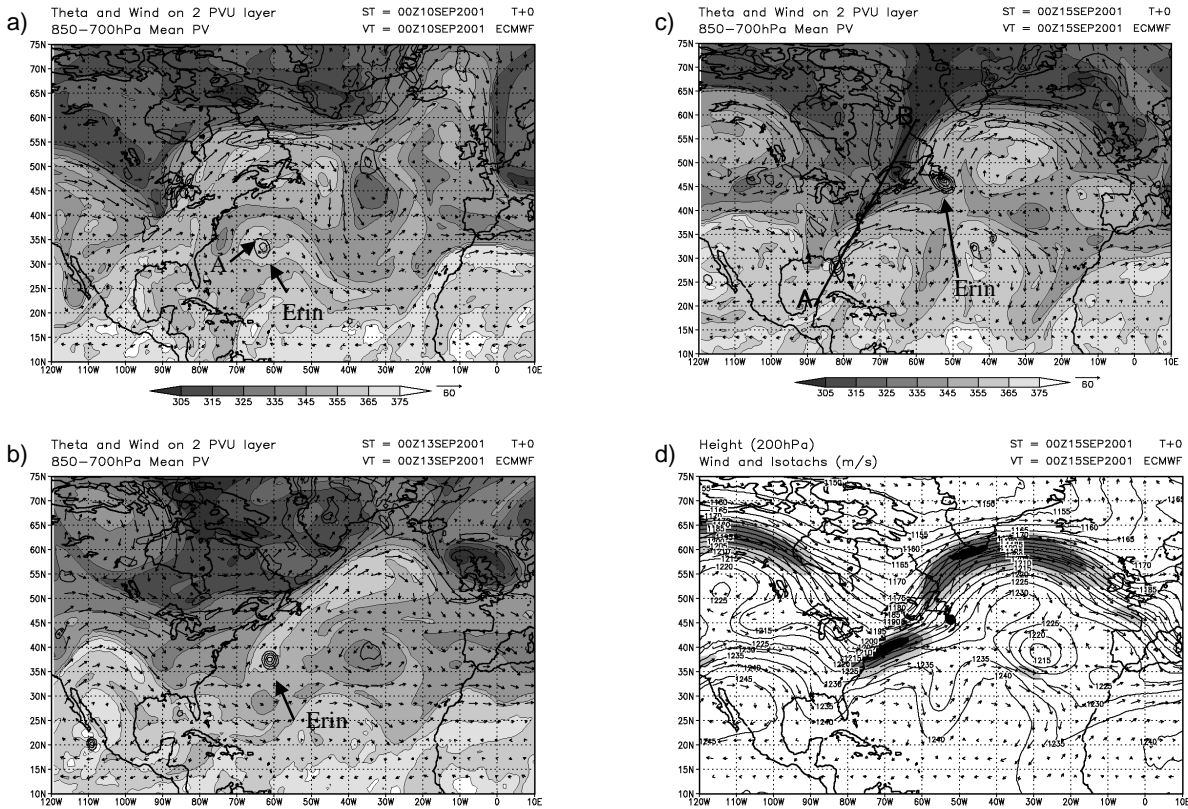


Figure 2: ECMWF analyses of  $\theta$  on the dynamic tropopause (shaded) and PV averaged from 850-700 hPa (contours) for (a) 10 September (b) 13 September (c) 15 September. (d) 200 hPa height (contours) and wind (vectors and shading) on 15 September.

on the tropopause over Spain originated in the outflow of Erin (Fig. 4).

## 6. CONCLUSIONS

We have identified several mechanisms involved in the ET of Hurricane Erin (2001). The structure and evolution of the upper-level trough was crucial for the subsequent ET. The development of a double jet structure allowed Erin to reintensify as an extratropical system. We hypothesize that Tropical Storm Gabrielle helped to create this jet structure. Thus in order to forecast the reintensification as an extratropical cyclone it would have been necessary to forecast the development of Gabrielle. The outflow of Erin can be tracked across the Atlantic indicating that Erin influenced the synoptic weather pattern over Europe.

**Acknowledgements.** We are grateful to Barbara Fay and Andreas Klein (DWD) for the trajectory calculations. Matthias R6bcke and Sarah Jones acknowledge support from the Office of Naval Research, Marine Meteorology.

## REFERENCES

Majewski, D., D. Liermann, P. Prohl, B. Ritter, M. Buchhold, T. Hanisch, G. Paul, and W. Wergen, 2002: The operational global icosahedral-hexagonal gridpoint model GME: description and high-resolution tests. *Mon. Wea. Rev.*, **130**, 319-338.

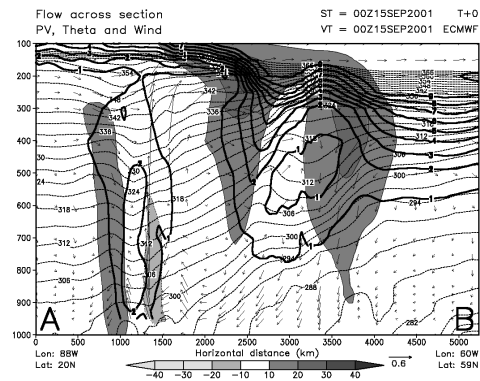


Figure 3: Vertical cross-section through Tropical Storm Gabrielle on 15 September of  $\theta$  (thin contours), PV (thick contours), wind in section (arrows) and wind perpendicular to section (shaded). Location indicated in Fig. 2c

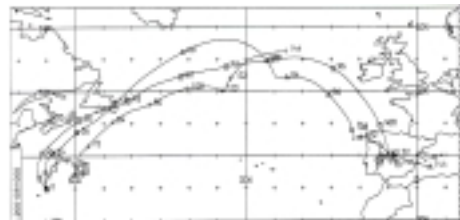


Figure 4: 6 day forward in time trajectories initialized on 10 September 0000 UTC at 35N, 65W (point A in Fig. 2a) and 250hPa, 200hPa and 150 hPa.