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The extratropical transitions of eastern Pacific Hurricane Lester (1992) and Atlantic Hurricane Andrew (1992): A comparison.

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1. Introduction

Considerable attention has been given to the transition of tropical cyclones to extratropical cyclones in the recent literature (e.g. Jones et al. 2003). This process is referred to as extratropical transition (ET). A review of the literature reveals that ET occurs in the Atlantic (Hart and Evans 2001), western Pacific (Klein et al. 2000), and Australian (Sinclair 2002) ocean basins. The only region to experience frequent tropical cyclones and not experience ET is the eastern Pacific. It has been argued that the synoptic-scale environment is not conducive to the ET process in this region.

This work will show a bonafide example of an eastern Pacific ET event, Hurricane Lester, which occurred near 0000 UTC 25 August 1992. In addition, the near ET of Hurricane Andrew, which occurred after 0000 UTC 28 August, will also be studied. Finally, the upscale impact of both Lester and Andrew led to downstream development and the generation of a “vorticity seed” in the western Atlantic. Despite relatively warm water and low vertical wind shear, no tropical system developed (hereafter ND). These events are also investigated in this study.

2. Data and Methodology

European Center for Medium Ranger Weather Forecasts (ECMWF) uninitialized gridded analyses are used to examine the evolutions of Lester, Andrew, and ND. The analyses were available from the National Center for Atmospheric Research (NCAR). The grids were obtained on a 1.125° latitude-longitude grid on 12 pressure levels. A potential vorticity (PV) – dynamic tropopause (DT) perspective, following Morgan and Nielsen-Gammon (1998) is utilized for the analysis.

3. Results

Figure 1 shows the PV on the 345 K surface and the 850 hPa relative vorticity. Hurricane Lester (1992) made landfall on the Baja Peninsula and northwestern Mexico near 0000 UTC 24 August ahead of a broad, synoptic-scale, positively tilted trough (Fig. 1 a-d). ET occurred as the Lester circulation became embedded within the deep-layer thickness gradient, indicating that Lester no longer maintained a warm core structure (not shown). While the remnants of Lester did not reintensify, the ET process resulted in considerable precipitation (in excess of 60 mm) from Arizona/New Mexico, northeastward through Colorado and Nebraska. The rainfall from Lester accounted for the single largest rainfall during the southwest US monsoon season dating back to 1948.

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Nearly two days after Lester’s landfall, Hurricane Andrew made its second landfall western Louisiana just after 0000 UTC 26 August (Fig. 1e). The remnants of Andrew drifted north-northeastward and eventually interacted with the same large-scale trough responsible for the transition of Lester. It is unclear, however, if Andrew underwent the "classic" ET process. Andrew’s evolution resembled that of the type-B ET described by Matuno and Sekioka (1971) as the remnant Andrew center remained in the warm air ahead of the main cyclogenesis event.

One of the interesting aspects of this study is that one large-scale trough was responsible for the potential transition of two storms. The first interaction led to a complete ET, though non-reintensifying, event (Lester). The second interaction, while not a classic ET (Andrew), saw the remnant vorticity seed of Andrew incorporated into a warm-front wave within the envelope of a deepening midlatitude cyclone.

Another noteworthy event during this period occurred over the western Atlantic. An examination of Figure 1 shows a PV filamentation and fracture near Bermuda beginning around 0000 UTC 24 August. The diabatic heating associated with the outflows of both Lester and Andrew aided the development of a large-scale ridge, as reflected by the poleward extension of low PV air, over the central United States. This sequence of events leads to the downstream development and wave breaking over the western Atlantic (Fig 1d-h). Low-level cyclonic vorticity develops in response to the positive PV anomaly near Bermuda by 0000 UTC 25 August (Fig. 1d). The deep-layer vertical wind shear weakens (not shown) and the vortex slowly strengthens. Yet, tropical cyclogenesis did not ensue. The presence of dry air (values of RH < 50%) at midlevels (not shown) likely hinders tropical development, despite the presence of favorable vertical wind shear.

4. References

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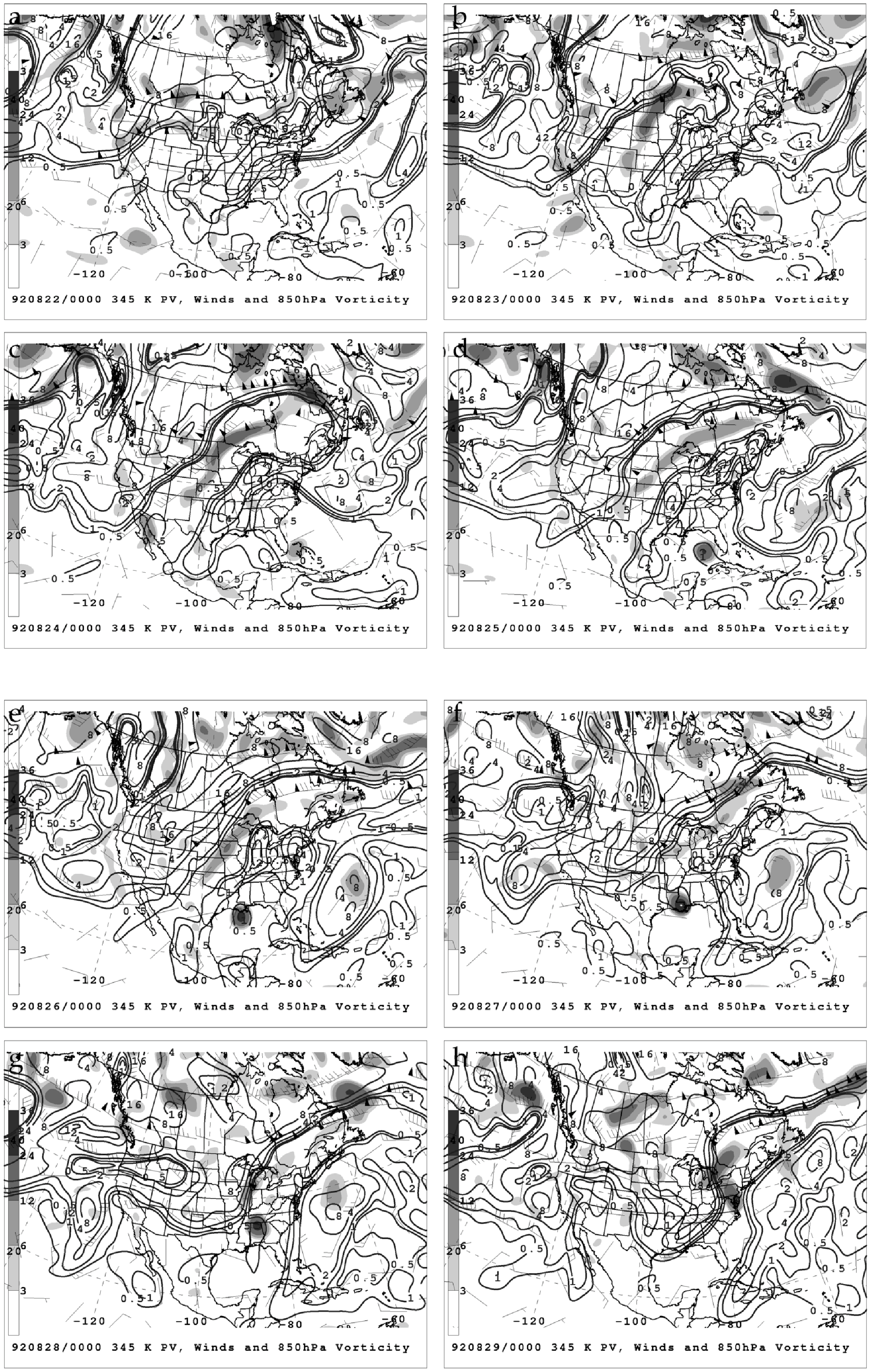

Figure 1: Potential vorticity (in PVU, 1 PVU = 10^{-6} m^2 s^{-1} K Kg^{-1}) (contoured), winds (m s^{-1}, 1 full barb = 5 m s^{-1}) on the 345 K surface and 850 hPa relative vorticity (shaded).