17D.4 PREDICTABILITY ASSOCIATED WITH EXTRATROPICAL TRANSITION OF TROPICAL CYCLONES AS DEFINED BY OPERATIONAL ENSEMBLE PREDICTION SYSTEMS

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1 INTRODUCTION

The poleward movement of a decaying tropical cyclone often results in a rapidly-moving, explosively-deepening midlatitude cyclone. The re-intensification of the remnant tropical cyclone as an extratropical cyclone depends on the phasing between the decaying tropical cyclone and a midlatitude environment that is favorable for midlatitude cyclogenesis (Klein et al. 2001). Because of the typical rapid translation speed (Jones et al. 2003) of the decaying tropical cyclone, accurate extended-range prediction of the phasing between the remnant tropical circulation and the midlatitude environment into which it is moving is critical. However, the complex physical interactions that occur during the structural changes associated with extratropical transition (ET) of the decaying tropical cyclone often contribute to large errors in numerical forecasts from operational global forecast models. Furthermore, forecast errors associated with the ET may propagate rapidly downstream and upstream of the ET location.

In this study, measures of the relative predictability in global numerical weather forecasts during ET events are computed based on ensemble prediction systems. Often, a poleward-moving tropical cyclone is related to an increase in variability among ensemble members, which implies a decrease in predictability. Ensemble prediction systems are utilized in a framework defined relative to the poleward-moving tropical cyclone. The increase in standard deviation in ensemble members due to the tropical cyclone's influence on the midlatitude circulation is measured as it propagates upstream and downstream of the ET location.

ET events have been classified as several types. Over the western North Pacific, ET has been categorized as either a northwest or northeast type, depending on the location of the primary midlatitude cyclone relative to the poleward-moving tropical cyclone

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Over the North Atlantic, ET types have been identified as either a tropical or baroclinic mode. Over the eastern South Indian Ocean the midlatitude flow has been described as either cradling or capturing a decaying tropical cyclone. Just as there are common features to all these regional paradigms of ET, it is expected that there will be common aspects in the impact of ET on regional predictability.

2 ANALYSIS

The month of September 2003 is chosen to initially examine the temporal and spatial distributions of the standard deviation in 500 hPa heights in the NCEP operational ensemble prediction system (EPS). During this period, there were two ET events over the North Atlantic (Hurricanes Fabian and Isabel) and over the western North Pacific (Typhoons Maemi and Choi Wan). Often, movement of a tropical cyclone into the midlatitudes excites upper-level downstream wave activity due to export of low potential vorticity air in the outflow layer of the tropical cyclone. This influence on the

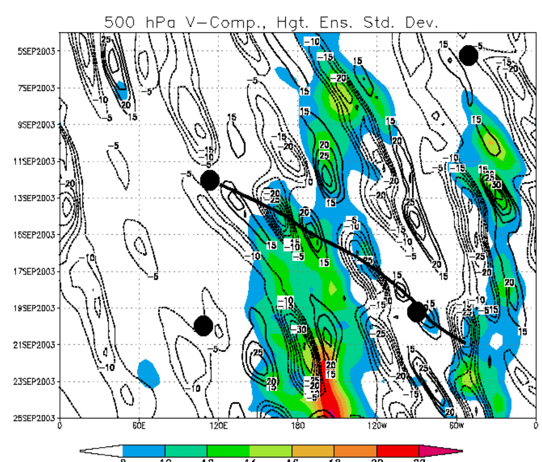

Fig. 1 *Hovmoller plot of analyzed 500 hPa meridional wind (contours, m s^{-1}) and 00 h ensemble standard deviation of 500 hPa heights (shaded, m) over the Northern Hemisphere between 40°N-50°N from 5 September-25 September 2003. Each ET event is marked by a circle and a wave train that followed the ET of TY Maemi is marked by the black line.*

midlatitude circulation often occurs days before the start of ET. A well-defined wave train that coincided with Typhoon Maemi began 12 September 2003 near 120°E (Fig. 1). The wave train amplitude was similar to a previous event that began near 5 September. However, the wave train that began at the time of the ET of TY Maemi was characterized by a prolonged period of increased standard deviation at 00 h in the EPS (shading in Fig. 1) that propagated across the North Pacific with the wave activity.

To compare with the wave train during early September, which was not related to an ET event, the increase in 500 hPa EPS standard deviation from 00 h through 120 h of the 0000 UTC 5 September (Fig. 2) EPS is compared with the 00 h through 120 h standard deviation in the ensemble members from 0000 UTC 11 September (Fig. 3).

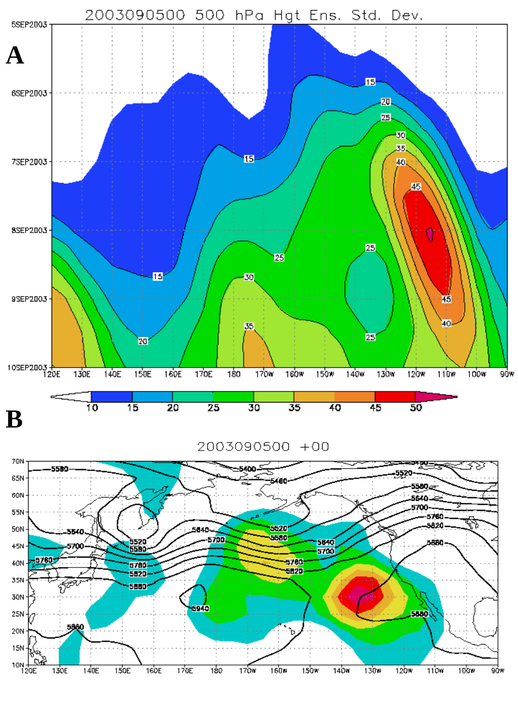

Fig. 2 *(a) Hovmoller plot of 500 hPa standard deviation (m) from 00 h through 120 h of the EPS from 0000 UTC 5 September. (b) EPS mean 00 h 500 hPa heights (contours, m) and standard deviation (shaded, m).*

On 5 September, the wave train is evident across the North Pacific (Fig. 2b) with increased standard deviation in each trough that increases with forecast range (Fig. 2a). The dramatic increase in standard deviation over the eastern North Pacific is associated with a merger of the area of high standard deviation off the west coast of North America (Fig. 2b) and the increase of the standard deviation south of the Aleutians.

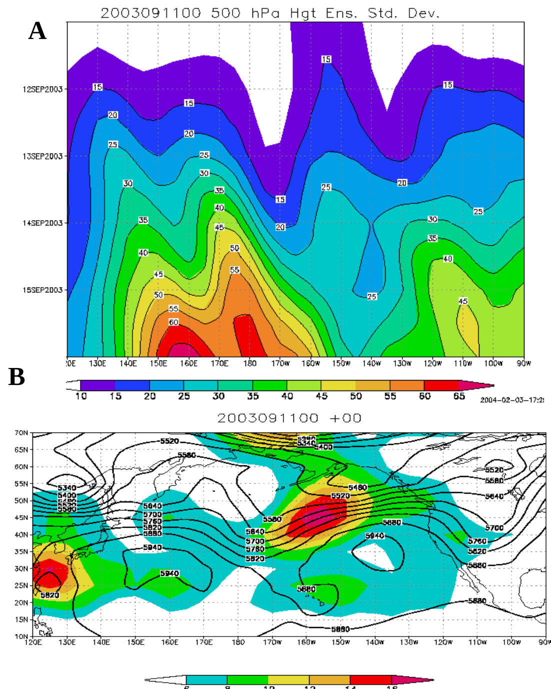

Fig. 3 *As in Fig. 2, except for 0000 UTC 11 September.*

On 11 September, the wave train across the North Pacific also contains increased EPS standard deviations at 00 h in each trough (Fig. 3b). There is also an area of increased standard deviation at 00 h south of Japan that is associated with TY Maemi. Although not as large as the standard deviation south of the Aleutians, the variability due to Maemi increases dramatically throughout the EPS integration (Fig. 2a). The presence of Maemi influences the start of several subsequent EPS cycles (Fig. 1). Although the increased standard deviation associated with the mid-Pacific trough was similar in Figs 2b and 3b, the impact of the ET near 11 September altered the pattern of increased standard deviation from that observed on 5 September. Further analysis will be conducted with respect to each paradigm of ET life cycle and its impact on predictability over the midlatitudes.

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