North Atlantic Hurricanes Contributed By African Easterly Waves North and South of the African Easterly Jet, Part II

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Introduction

Although tropical cyclone (TC) track forecasting has improved within the last 10 years, intensification forecasting remains difficult. Understanding TC intensification is of utmost importance, as intensification is not well predicted by operational meteorological models. A better understanding of the physical processes behind intensification will likely improve models, which will ultimately result in more accurate forecasts, saving property and lives. This project aims to examine African Easterly Waves (AEWs), which are weather disturbances that travel westward from the western coast of Africa. Some of these waves dissipate quickly, but others develop into TCs and in some cases, powerful hurricanes. It is hypothesized that waves which develop north of the African Easterly Jet (AEJ), or northern waves, generally do not strengthen, as moisture is restricted in this region due to the Saharan Air Layer (SAL). On the contrary, it is hypothesized that waves traveling south of the AEJ, or southern waves, have a greater likelihood of development and eventual intensification due to ample moisture. This study aims to explore these hypotheses. In addition, Hurricane Karl (2010) is examined. This TC began as a northern wave but managed to cross south of the AEJ, which likely resulted in its eventual intensification.

Methodology

- Karl is backtracked to its genesis location to analyze its movement and intensity change with time.
- Vertically integrated liquid water content is compared north and south of the AEJ during Karl's lifetime.
- Latitudinal vertical cross sections of zonal wind are analyzed to determine the evolution of the AEJ before, during, and after Karl crosses the AEJ.
- Streamlines at 925 hPa, 850 hPa, 700 hPa, 600 hPa, 500 hPa, and 300 hPa are used to predict the movement of Karl. A comparison of the streamlines at these respective levels offers insight into the vertical depth of Karl's circulation.

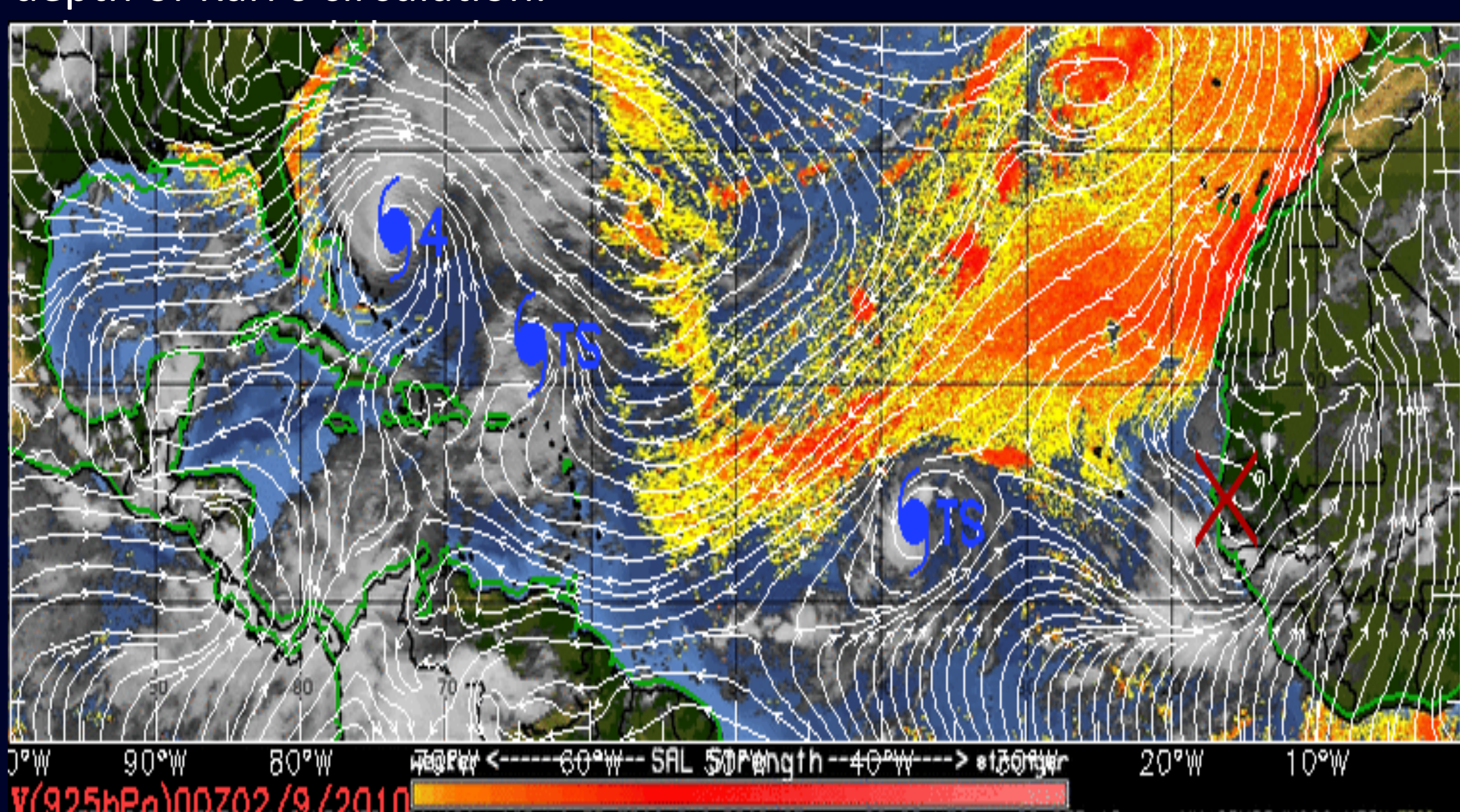

FIG. 1. Saharan Air Layer overlaid by 925 hPa streamlines at 0000 UTC on 2 Sept.. Existing TCs are in blue and Karl's perturbation is in red.

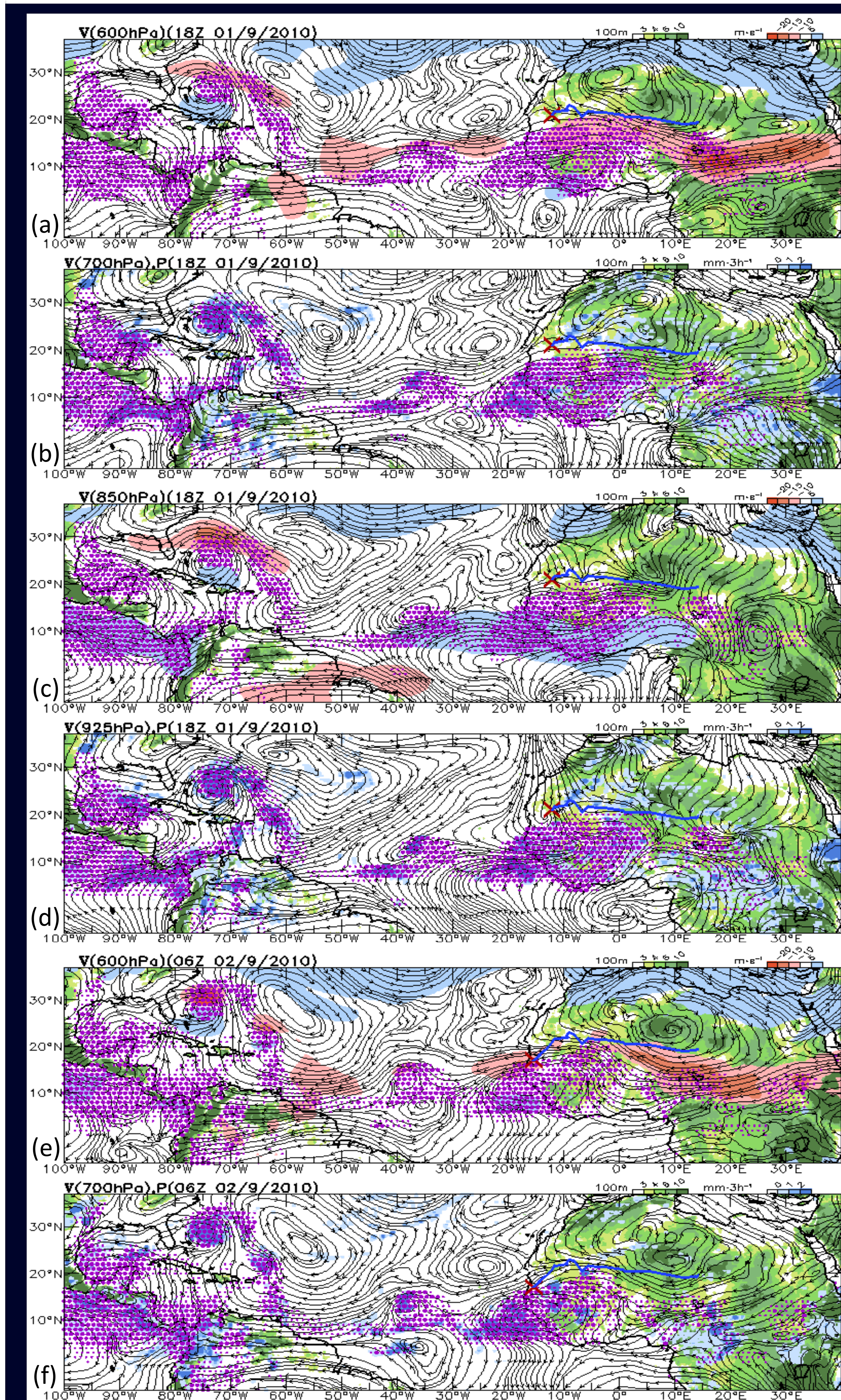

FIG. 2. Streamlines (black) and zonal wind at (a) 600 hPa at 1800 UTC on 1 Sept., (c) 850 hPa at 1800 UTC on 1 Sept., and (e) 600 hPa at 0600 UTC on 2 Sept.. Streamlines (black) and 6-hourly accumulated precipitation (blue) at (b) 700 hPa 1800 UTC on 1 Sept., (d) 925 hPa at 1800 UTC on 1 Sept., and (f) 700 hPa at 0600 UTC on 2 Sept.. Purple dots represent vertically integrated liquid water content above 50 kg/m^2.

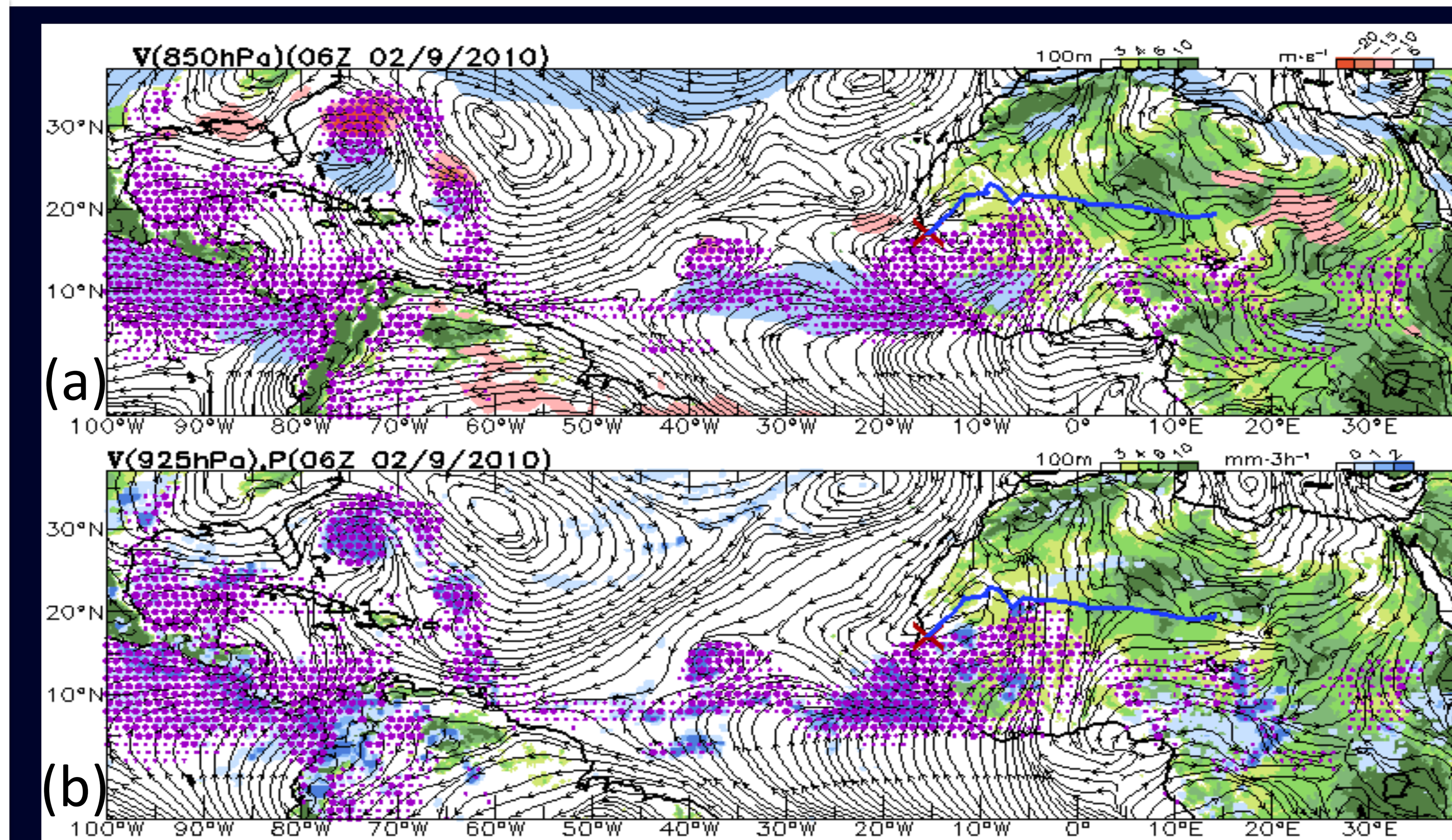

FIG. 3. (a) Streamlines (black) and zonal wind at 850 hPa at 0600 UTC on 2 Sept. and (b) 6-hourly accumulated precipitation for the same time. Purple dots represent vertically integrated liquid water content above 50 kg/m^2.

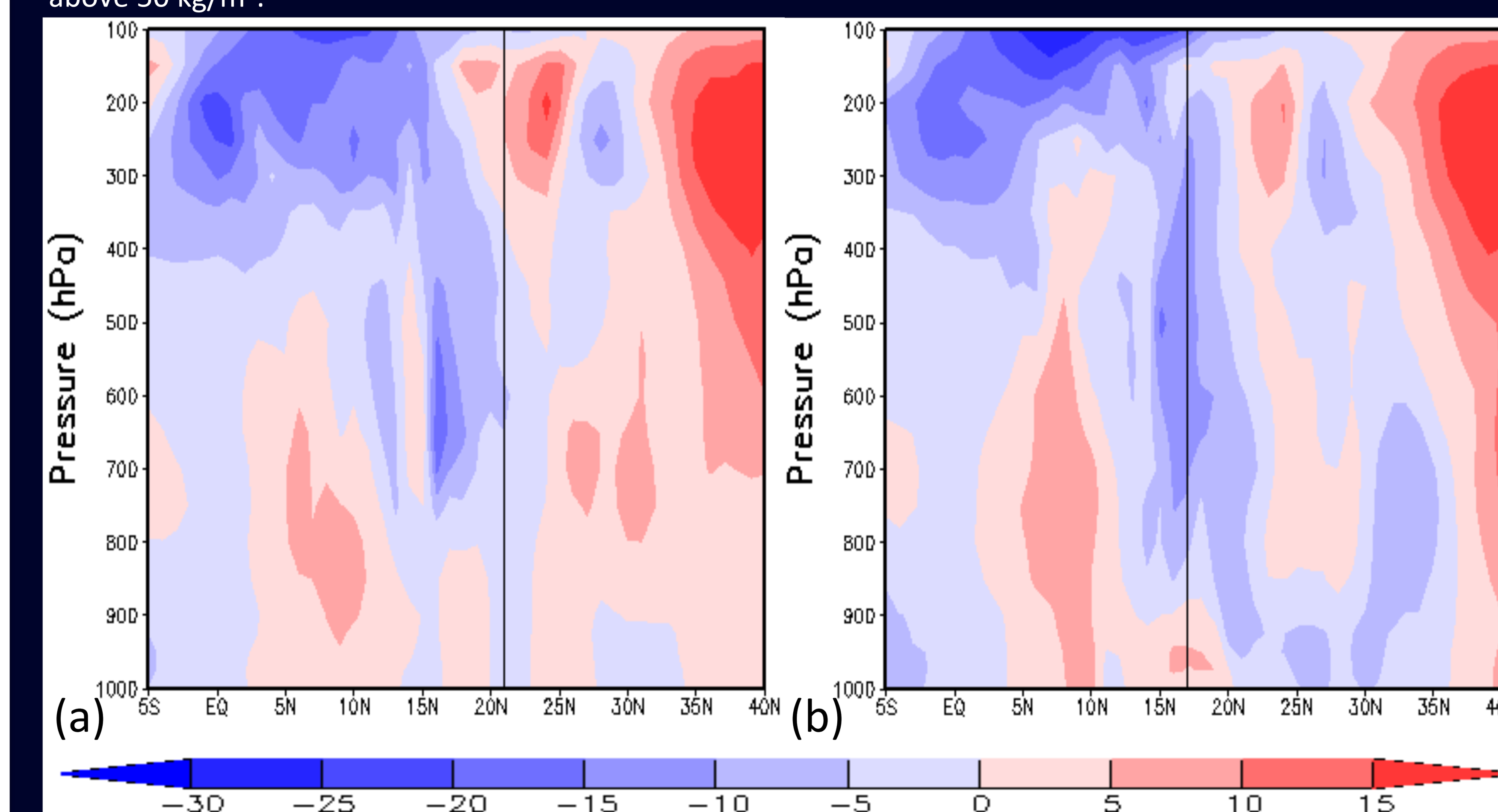

FIG. 4. Vertical latitudinal cross sections of zonal wind (m/s) at (a) 1800 UTC on 1 Sept. and (b) 0600 UTC on 2 Sept.. Karl's position is represented by a solid vertical line.

Conclusions

- Karl was a northern wave that crossed south of the AEJ.
- Vertically integrated liquid water content was greatest south of the jet, meaning that Karl likely had a greater potential to intensify after it moved south of the jet.
- Since Karl was a northern wave, its circulation was shallow near the surface. When Karl crossed south of the AEJ, there was no noticeable closed circulation at 925 hPa.
- The vertical base of the AEJ was positioned around 800 hPa when Karl crossed the jet. Because Karl's circulation was below the base of the AEJ, Karl was able to travel south of the jet.

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