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TITLE: Synoptic/Planetary-Scale Interactions and Blocking Over the North Atlantic Ocean

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SIGNIFICANT ACCOMPLISHMENTS IN THE PAST YEAR:

Work this past year has continued to focus on the development of a blocking anticyclone that formed over the North Atlantic in January 1979 and a marine cyclone that deepened explosively prior to the onset of the block. The "extended" height tendency equation has been used as the primary diagnostic tool. Focusing on the domain encompassing the migrating ridge that eventually formed the block, we have found that vorticity advection played the dominant role in the development of the ridge and the formation of the block. This negative vorticity advection was especially pronounced during the 48 h period prior to initial block formation and immediately following the upstream explosive cyclone development. This advection was attributed primarily to the northward advection of negative relative vorticity on the anticyclonic side of jet that formed east of the cyclone system.

Also of interest has been an attempt to evaluate the relative importance of synoptic-scale, planetary-scale, and synoptic/planetary-scale interactions as the block developed. To accomplish this, all data fields were partitioned into synoptic and planetary-scale components using a Barnes-type filter. Results of this work indicate that during explosive cyclone development the height tendencies were dominated by planetary/synoptic-scale interactions. However, as the migrating ridge became stationary, built northward, and finally formed a closed high, the interaction forcing diminished and became comparable to the synoptic-scale forcing. Throughout this time period the planetary-scale forcing was one-half or less than the other two partitioned forcing components.

Finally, we began a diagnosis of the cyclone by examining the low level static stability fields associated with the cyclone's development. Low level static stabilities decreased throughout the explosive development period and then increased. This is in sharp contrast to two continental cyclone cases that we had previously studied. In these, the low level static stabilities increased as the cyclones developed. This contrast suggests that boundary layer sensible heat transfer, which in turn acts to decrease the low level static stability, may play a more significant role in marine than in continental cyclone cases.

FOCUS OF CURRENT RESEARCH AND PLANS FOR NEXT YEAR

Of course we are continuing toward completion of the blocking anticyclone study. In addition, we are giving more attention to the upstream cyclone. In particular we are now and will continue to examine the role of boundary layer sensible and latent heat transfer, horizontal moisture transport, and latent heat release. The latter two are coupled through diagnoses now in progress of the convective latent heating as revealed by the Kuo parameterization scheme. In this scheme the horizontal moisture convergence plays a key role. Initial calculations suggest good placement of the latent heating compared with satellite cloud images but with magnitudes that are often too small. We are hypothesizing that a portion of this underestimate is attributed to underestimates of the moisture convergence, which in turn results from moisture gradients that are too weak. In the coming year we will be attempting to use satellite data to improve the moisture fields.

In addition, we will be initiating a study designed to assess the overall impact of satellite data included in the GLA SOP-I analyses. In this study we will use GLA analyses prepared without the inclusion of satellite information (known as the NOSAT analyses) to do some of the same diagnostic calculations already done with the standard GLA analyses. The two sets of calculations will then be compared to see the influence of satellite data on higher order diagnostic quantities.

PUBLICATIONS

1. Refereed paper

Smith, P.J., and C.-H. Tsou, 1988: Static stability variations during the development of an intense extratropical cyclone. Monthly Weather Review, vol. 116, in press.

2. Non-refereed papers

Tsou, C.-H., and P.J. Smith, 1988: The role of synoptic/planetary-scale interactions during the development of a blocking anticyclone. Preprints of the Palmen Memorial Symposium on Extratropical Cyclones, Aug. 29 - Sept. 2, 1988, Helsinki, Finland, in press.

Smith, P.J., C.-H. Tsou, and M.N. Baker, 1988: Static stability variations during a winter marine cyclone development. Preprints of the Palmen Memorial Symposium on Extratropical Cyclones, Aug. 29 - Sept. 2, 1988, Helsinki, Finland, in press.