An Investigation of the Interaction Between Hurricane Sandy and its Large-Scale Environment

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Hurricane Sandy made landfall at New Jersey in late October 2012 while a blocking, midtropospheric anticyclone drifted westward from the mid-Atlantic Ocean and intensified. It is thought that the retrogression of this anticyclone, together with the slow eastward progression of a midtropospheric trough over North America, forced Sandy's unusual northwestward turn toward the U.S. coastline. It is further hypothesized that the retrogression and intensification of the anticyclone were due in part to anticyclonic potential vorticity (APV) generated by condensational warming in Sandy and advected away from the storm. However, calculations with reanalysis data reveal that while there was considerable production of APV due to condensational warming in Sandy, this APV remained confined to the storm. Instead, ageostrophic winds at 250 mb advected cyclonic PV away from Sandy, both northwest and northeast of the storm. In each of these locations, the effective APV advection was opposed by geostrophic cyclonic PV advection. However, the ageostrophic APV advection was dominant northeast of Sandy, yielding net geopotential height rises there. These height rises, coupled with geostrophically forced height falls over eastern North America, forced a southeasterly geostrophic motion tendency near and to the north of Sandy at 250 mb. Thus, ageostrophic outflow from Sandy appeared to modify its large-scale environment such that the flow turned southeasterly over Sandy, steering it into New Jersey.

An interesting aspect of the blocking anticyclone coinciding with Sandy is that it was associated with persistently and anomalously large poleward heat fluxes in the upper troposphere and upward wave activity fluxes from the troposphere to the stratosphere, but it was not associated with a weakening of the polar stratospheric vortex as would be climatologically expected under these conditions. Thus, Sandy's interaction with the large-scale environment appeared to be confined to the troposphere.