Hurricane Sandy (2012): A Multiscale Trough Interaction Perspective

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Motivation

Hurricane Sandy, a storm of historical proportions, provided a serendipitous research opportunity to examine a wellsampled and well-documented storm from pre-genesis to post-landfall (soup-to-nuts).

Noteworthy aspects of Hurricane Sandy's lifecycle included multiple trough interactions, an unusual "Hazel (1954)-like" track, and an unprecedented post-landfall Appalachian snowstorm.

Outline

- Pre-genesis environment
- First trough interaction
- Second trough interaction
- Third trough interaction
- Sandy vs. Hazel (1954) and 38' Hurricane
- Conclusions

Sandy Track Map 0000 UTC 16 October – 1800 UTC 2 November 2012



Pre-Genesis Environment





1200 UTC 17 October 2012





-80	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	50
-													

Potential vorticity (shaded, PVU), pressure (contours, hPa), winds (barbs, m s⁻¹)

0000 UTC 21 October 2012





Potential vorticity (shaded, PVU), pressure (contours, hPa), winds (barbs, m s⁻¹)



First Trough Interaction: Poleward Convective Cloud Expansion



Potential vorticity (shaded, PVU), pressure (contours, hPa), winds (barbs, m s⁻¹)



Second Trough Interaction: First Westward Turn



Potential vorticity (shaded, PVU), pressure (contours, hPa), winds (barbs, m s⁻¹)



Potential vorticity (shaded, PVU), pressure (contours, hPa), winds (barbs, m s⁻¹)

1445 UTC 26 October 2012

Image courtesy of the NOAA's Environmental Visualization Laboratory





Third Trough Interaction: Second Westward Turn and Landfall



Potential vorticity (shaded, PVU), pressure (contours, hPa), winds (barbs, m s⁻¹)



Potential vorticity (shaded, PVU), pressure (contours, hPa), winds (barbs, m s⁻¹)







850-hPa tangential wind (shaded) and total wind (barbs) centered on TC Sandy



Sandy (2012), Hazel (1954) and the 1938 New England Hurricane: A Perspective

Sandy: 1800 UTC 21 October – 1200 UTC 31 October 2012 Hazel: 0600 UTC 5 October – 1200 UTC 18 October 1954 1938 New England Hurricane: 1200 UTC 9 September – 0000 UTC 23 September 1938





250-hPa wind speed (shaded, m s⁻¹), temperature (dashed red contours, °C), and geopotential height (black solid contours, dam)



250-hPa wind speed (shaded, m s⁻¹), 1000–500-hPa thickness (dashed red/blue contours, dam), and mean sea level pressure (black solid contours, hPa)



850-hPa frontogenesis [shaded, K (100 km)⁻¹ (3 h)⁻¹], temperature (dashed red contours, °C), and geopotential height (black solid contours, dam)



250-hPa wind speed (shaded, m s⁻¹), temperature (dashed red contours, °C), and geopotential height (black solid contours, dam)



250-hPa wind speed (shaded, m s⁻¹), 1000–500-hPa thickness (dashed red/blue contours, dam), and mean sea level pressure (black solid contours, hPa)



850-hPa frontogenesis [shaded, K (100 km)⁻¹ (3 h)⁻¹], temperature (dashed red contours, °C), and geopotential height (black solid contours, dam)

Synopsis of Sandy Trough Interactions



330–335K layer-averaged 0.4 (blue), 0.8 (purple), and 2.0 (red) PVU curves for 1200 UTC 23 Oct, 1200 UTC 27 Oct, and 1800 UTC 29 Oct 2012, respectively. 925–850-hPa layer-averaged cyclonic relative vorticity (black contours every $0.5 \times 10^{-4} \text{ s}^{-1}$). 250-hPa wind speed (shaded, m s⁻¹) at 1800 UTC 29 Oct 2012. Inset shows total rainfall (snowfall) in green (blue) shading in inches (adapted from NOAA/NWS/WPC).



- Antecedent baroclinic zone over Gulf of Mexico supports warmair advection with first trough interaction and results in a poleward cloud expansion
- Sandy expands in size, but remains warm core as it turns northwestward during second trough interaction
- Sandy-induced westward-directed negative PV advection helps to establish a well-defined PV hook during third trough interaction
- "Sandy-like" storm tracks have occurred previously (e.g., Hazel 1954 and the 1938 New England Hurricane)