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Weather conditions promoting the exceptional mid-October 2005 avian migration in the eastern Caribbean

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Abstract The middle of October 2005 was characterized by a number of new avian species records for Hispaniola and Puerto Rico. These species are very abundant migrants that generally travel through the Gulf of Mexico and Central America towards their wintering grounds. Here, we summarize those records and suggest that they occurred because of the unusually favorable conditions for hurricane buildup in the southwestern Caribbean at the time, a situation which resulted in a reversal of prevailing wind patterns for the whole month and the development of Hurricane Wilma, the largest hurricane in history, just before the birds appeared on these islands.

Keywords avian migration, Hispaniola, hurricanes, Neotropical migrant, new species records, Puerto Rico

Resumen Condiciones climáticas promovieron la excepcional migración de aves de mediados de octubre de 2005 en las Antillas Menores—Mediados de octubre de 2005 se caracterizó por una serie de nuevos registros de especies de aves para La Española y Puerto Rico. Estas especies son migrantes muy abundantes que generalmente viajan a través del Golfo de México y América Central hacia sus cuarteles de invernada. Hemos resumido aquí estos registros y sugerimos que se produjeron debido a las condiciones excepcionalmente favorables para el desarrollo de huracanes en el Caribe suroccidental en ese momento, una situación que dio lugar a una reversión de los patrones de viento que prevalecen durante todo el mes y al desarrollo del huracán Wilma, el huracán más grande de la historia, justo antes de que las aves aparecieran en estas islas.

Palabras clave huracanes, La Española, migración de aves, migrante Neotropical, nuevos registros de especies, Puerto Rico

Résumé Des conditions climatiques favorables à une migration exceptionnelle des oiseaux dans l'est de la Caraïbe à la mi-octobre 2005—Le milieu du mois d'octobre 2005 a été caractérisé par plusieurs mentions de nouvelles espèces d'oiseaux pour Hispaniola et Porto Rico. Il s'agit de migrants très abondants qui traversent généralement le golfe du Mexique et l'Amérique centrale vers leurs zones d'hivernage. Ces observations sont résumées ici. Ce phénomène a pu se produire en raison de conditions inhabituelles favorables à l'apparition d'un cyclone dans le sud-ouest de la Caraïbe, une situation qui a abouti à une inversion des vents dominants pendant le mois d'octobre et au développement du cyclone Wilma, un cyclone d'une force sans précédent, juste avant que les oiseaux n'apparaissent sur ces îles.

Mots clés cyclones, Hispaniola, mentions de nouvelles espèces, migrants néotropicaux, migration des oiseaux, Porto Rico

The autumn avian migration of 2005 was exceptional in the eastern Caribbean Sea for a number of new bird records. During October, Hispaniola recorded three new species (Eastern Wood-Pewee [*Contopus virens*], Swainson's Thrush [*Catharus ustulatus*], and Scarlet Tanager [*Piranga olivacea*]), plus several other unusual sightings (Landestoy *et al.* 2006). Puerto Rico added two new species (Veery [*Catharus fuscescens*] and Swainson's Thrush) at multiple sites, plus observations of Eastern Wood-Pewee and several *Empidonax* flycatchers (Lewis 2007). A band-

ing station on Guana Island, British Virgin Islands, which had captured single Swainson's Thrushes in 2000 and 2003, caught 26 individuals over a three-day period in October (Boal and Estabrook 2007). A Swainson's Thrush was also reported from La Desirade, Guadeloupe, (fide Lewis 2007) at this same period of time.

These species are among the most abundant long-distance migrants in the New World, so perhaps it is not unexpected for them to occasionally occur in the eastern Caribbean while moving to South America for the winter. The fact that they had not been recorded until 2005 suggests an extremely unusual set of weather conditions may have occurred. Lewis (2007) discussed these conditions briefly, noting that most of these observations were associated with surface winds from the west recorded at buoys in the Caribbean and associated with the occurrence of

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Hurricane Wilma. Here we provide a more complete picture of the unusual wind conditions associated with several hurricanes and presumably directing migration from Central America to the eastern Caribbean. We discuss how such winds may have affected the occurrence of trans-Gulf migrants in the Caribbean, if we have any evidence that these winds affected the abundance of winter residents on these islands, and what may happen if the frequency of such wind conditions increases in the future.

Methods

The records of bird observations for the islands of Hispaniola, Puerto Rico, and the Lesser Antilles were summarized from recent literature. A survey of eBird records provided by the Laboratory of Ornithology of Cornell University (www.ebird.org) did not provide any new observations for the period of interest. To understand the weather conditions that may have led to this unusual migration, and because the altitude of long-distance songbird migration over the Caribbean is poorly known (Richardson 1976), we analyzed wind patterns aloft at the 925 mb (about 3,000 ft or 914 m above sea level[asl]), 850 mb (about 5,000 ft or 1,524 m asl), and 700 mb (about 10,000 ft or 3,048 m asl) atmospheric levels. We generated the winds aloft maps using derived data from the National Centers for Environmental Prediction (NCEP) Reanalysis Project provided by the National Oceanic and Atmospheric Administration (NOAA), Office of Oceanic & Atmospheric Research (OAR), Earth System Research Laboratory (ESRL), Physical Sciences Division (PSD), Boulder, Colorado, USA (www.esrl.noaa.gov/psd/about/). We also examined text from archived surface wind data from the NOAA National Data Buoy Center, Historical Meteorological Data Search (www.ndbc.noaa.gov/hmd.shtml).

Mean winds aloft maps for the month of October for the 925, 850, and 700 mb atmospheric levels were generated on the ESRL/PSD web site for Monthly/Seasonal Climate Composites (www.esrl.noaa.gov/psd/cgi-bin/data/composites/printpage.pl) with the following settings: “vector wind” variable, “925 mb”, “850 mb”, “700 mb” atmospheric pressure levels, “October” start and end month, “1948 to 2013 minus 2005” range of years, color map with shading, “Mean” plot type, “200” percent plot scale, custom map projection with the following coordinates (0 to 30 for lowest to highest latitudes and -100 to -60 for western-most and eastern-most longitudes), and “cylindrical equidistant” for

custom projection. The resulting plot for the 700 mb level shows the mean wind pattern for the month of October 1948–2013.

Mean winds aloft maps for the 925, 850, and 700 mb atmospheric levels for the month of October 2005 were generated from the same web site but the following variables were changed: “2005” range of years, and “anomaly” plot type. The resulting plot for the 700 mb level shows anomalous wind vectors for the month of October 2005 in relation to the long-term mean for the month of October from 1981–2010.

Because the bulk of the new bird observations occurred in the middle of October, we also examined daily wind patterns throughout October 2005 to better understand the unusual series of events that coincide with the observations of birds in the area of study. Daily composite wind maps for the 925, 850, and 700 mb levels for the month of October 2005 for the Gulf and Caribbean area were generated at the following web site: www.esrl.noaa.gov/psd/data/composites/day/, and we retrieved text files of surface wind direction and velocity data (NOAA National Data Buoy Center, Historical Meteorological Data Search) recorded from the Central Caribbean Buoy (Buoy 42058), situated 210 nautical miles SSE of Kingston, Jamaica, and from the buoy (MGIP4) near Magueyes Island, Puerto Rico, as referenced by Lewis (2007).

Results

Bird Records

Multiple new species were recorded for Hispaniola and Puerto Rico during the fall migration of 2005 (Table 1). One thrush species (Swainson’s Thrush) had its first confirmed records on both Hispaniola and Puerto Rico, while another (Veery) was new for Puerto Rico (Keith *et al.* 2003). Swainson’s Thrush was observed in numbers on Puerto Rico as early as 12 October, with as many as 16 individuals at a single location and records from 6 separate locations (Lewis 2007). Two Swainson’s Thrushes were observed on 16 October 2005 near Las Salinas in southwestern Dominican Republic (Landestoy *et al.* 2006). Records for this species on both islands continued until 24 October. Boal and Estabrook (2007) reported having netted single Swainson’s Thrush in October of 2000 and 2003; they netted 26 individuals during 13–15 October 2005, with most found to be in poor body condition. Lewis (2007) notes an observation of Swainson’s Thrush on La Desirade, Guadeloupe, on 21–23 October 2005. The Veery was

Table 1. Summary of first and second records of species in the Eastern Caribbean during October and November 2005.

Species	Island	First Date	Last Record	Notes
Hudsonian Godwit	Hispaniola	16 October	16 October	Second record (Landestoy <i>et al.</i> 2006)
Philadelphia Vireo	Puerto Rico	12 October	12 October	Second record (Lewis 2007)
Eastern Wood-Pewee	Puerto Rico	12 October	Not listed	Many (Lewis 2007)
	Hispaniola	16 October	16 October	2 at Las Salinas, DR (Landestoy <i>et al.</i> 2006)
Veery	Puerto Rico	12 October	20 October	2 individuals at Cabo Rojo (Lewis 2007)
Swainson’s Thrush	Puerto Rico	12 October	26 October	6 locations; up to 16 individuals/site (Lewis 2007)
	Hispaniola	16 October	24 October	2 at Las Salinas, DR (Landestoy <i>et al.</i> 2006)
	Guana Island	13 October	17 October	26 netted, 300–500 estimated (Boals and Estabrook 2007)
	La Desirade	21 October	23 October	Noted by Lewis (2007)
Scarlet Tanager	Hispaniola	11 November	11 November	Sierra de Baoruco, DR (Landestoy <i>et al.</i> 2006)

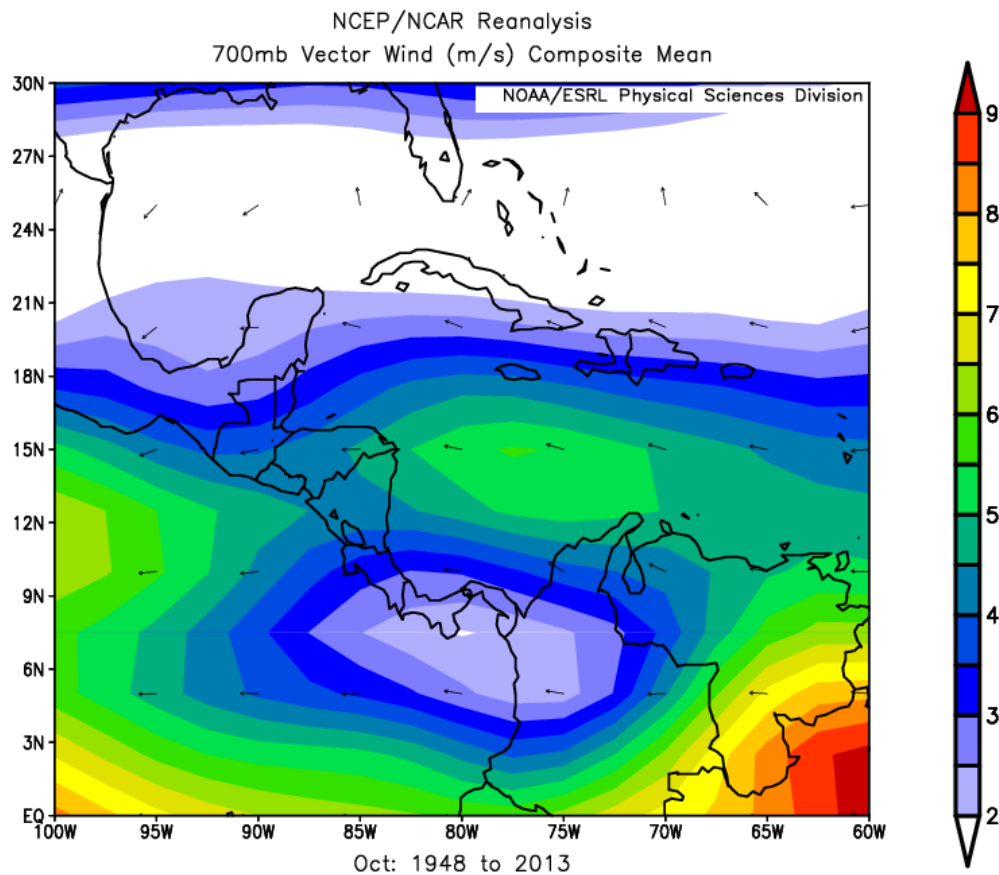


Fig. 1. Map showing mean winds for October at the 700 mb pressure level (about 10,000 ft or 3,048 m above sea level[asl]) for the period 1948–2013 minus the year 2005. Climatological wind vectors are plotted over shading and contours indicating the wind speed (in m/s). Maps showing the same winds at the 925 mb (about 3,000 ft or 914 m asl) and 850 mb pressure level (5,000 ft or 1,524 m asl) are virtually identical with regard to wind direction but differ slightly with regard to velocity.

seen at Cabo Rojo on the southwest tip of Puerto Rico starting on 12 October (2 individuals) and lasting until 20 October (1 individual; Lewis 2007).

At least two Eastern Wood-Pewees were seen near Las Salinas, Dominican Republic, on 16 October 2005; these constitute the first records for this species on Hispaniola. Numerous Eastern Wood-Pewees were also seen on Puerto Rico starting on 12 October. Also observed on Puerto Rico at this time was a migrant *Empidonax* flycatcher, as Puerto Rico has no resident *Empidonax*. Keith *et al.* (2003) lists West Indian records for the Yellow-bellied (*Empidonax flaviventris*), Acadian (*E. virescens*), Willow (*E. traillii*), and Least (*E. minimus*) Flycatchers; all are considered very rare and records are confined to Cuba, the Cayman Islands, and Jamaica. Evaluation of photos has suggested the Puerto Rican bird was an Acadian Flycatcher (Lewis 2007).

Although observed later in the year, a Scarlet Tanager observed on the north side of the Sierra de Bahoruco National Park, Dominican Republic, on 11 November constitutes the first verified record for Hispaniola (Landestoy *et al.* 2006).

Another species observed on 12 October 2005 but with few records on Puerto Rico was the Philadelphia Vireo (*Vireo philadelphicus*; Lewis 2007). Unusual records from Hispaniola on 16 October included the sixth island record of the Red-eyed Vireo (*Vireo olivaceus*), fifth records of the Blackburnian Warbler (*Se-*

tophaga fusca), and Chestnut-sided Warbler (*Setophaga pensylvanica*), and second record of the Hudsonian Godwit (*Limosa haemastica*; Landestoy *et al.* 2006).

The 11 November trip to the Bahoruco Mountains that found the tanager also saw two Baltimore Orioles (*Icterus galbula*), for which there are only about a dozen records from the Dominican Republic (Keith *et al.* 2003). It is interesting to note that the long-term (40 year) banding project at Guánica in southwest Puerto Rico caught its first ever Baltimore Oriole on 7 January 2006 (J. Faaborg pers. obs.). In general, though, it appears that most of these misguided migrants had left Puerto Rico and Hispaniola by early to mid-November 2005.

Although most of the observations on Hispaniola were made on 16 October, it is likely these birds appeared in the region as early as 12 October, when they were first observed on Puerto Rico and netted in the British Virgin Islands. Puerto Rico has more birders, so they may have been able to note the unusual migration at the time it actually happened.

Weather Conditions

Under normal conditions, the eastern Caribbean region is dominated by the trade winds that blow from the east or east-southeast at all altitudes. Normally, the trade winds extend from around 24° N latitude to the equator; they continue

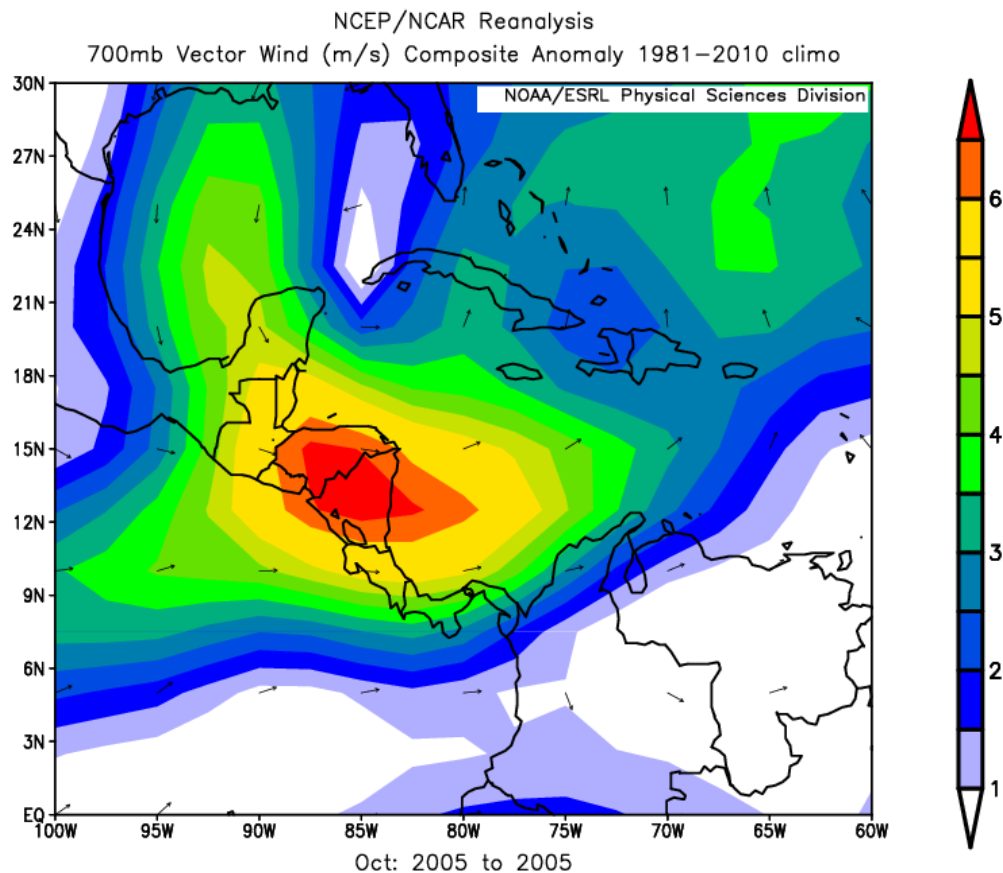


Fig. 2. Mean winds for October 2005 at the 700 mb level (about 10,000 ft or 3,048 m above sea level[asl]), showing a major anomaly from mean wind pattern for October 1948–2013 minus the year 2005. Climatological wind vectors are plotted over shading and contours indicating the wind speed (in m/s). The maps for the 925 mb (about 3,000 ft or 914 m asl) and 850 mb (5,000 ft or 1,524 m asl) levels show identical vectors but even stronger velocities in the southwestern Caribbean area.

in a westerly direction until deflected by contact with the major landmasses of Central or North America (Fig. 1). For the month of October 2005, mean winds in this region moved in an opposite direction (Fig. 2). Although this provided favorable south winds for migrants wanting to fly across the Gulf of Mexico, these winds curved to the east and were very strong over Honduras and Nicaragua in Central America. These winds pushed migrants eastward over the Caribbean Sea, then turned northward near Hispaniola and Puerto Rico. It appears that it would have been easy for a trans-Gulf migrant headed to South America to be lured into departing with tail winds across the Gulf, only to be forced eastward by the strong winds of the southern Caribbean blowing in the opposite direction of normal.

The unusual mean wind conditions for October 2005 (Fig. 2) were undoubtedly heavily influenced by a series of tropical storms that occurred in this region that year, but this does not explain the concentration of bird observations that occurred during the period 12–16 October 2005. Daily records show a massive low-pressure system that developed over Costa Rica on 10 October and formed a pressure trough to the northeast for the next 5 days with accompanying winds blowing from southwest to northeast. The center of this trough ran along the water gap between Hispaniola and Puerto Rico for the period of 11–12 October before moving into the Atlantic Ocean (Fig. 3). Associ-

ated with this trough was the development of Hurricane Wilma, the most powerful storm ever recorded in the Atlantic basin (National Hurricane Center 2005). Wilma formed southwest of Jamaica on 11 October and became an official tropical depression on 14 October; it moved slowly to the northwest before hitting Cozumel and mainland Mexico, then turned to the northeast and crossed south Florida before heading up the east coast and disappearing by 26 October.

The development of this storm undoubtedly was the main cause for such anomalous upper level wind conditions for that part of the month; it appeared to affect surface level winds in the eastern Caribbean primarily while it was forming and as it moved past Florida, as those were the times when the surface buoys showed the most atypical winds (Lewis 2007). The Central Caribbean Buoy showed westerly surface winds during the period 9–14 October and southwest winds during 21–23 October. The buoy near Puerto Rico showed winds from the west during 10–12 October but was normal the rest of the month. Wilma was preceded by Hurricane Stan, a smaller storm which formed east of the Yucatan peninsula on 1 October and moved across the Yucatan the next day, and Tropical Storm Tammy, which formed east of Florida on 5 October. Wilma was followed by Tropical Storm Alpha, which formed south of Hispaniola on 23 October and Tropical Storm Beta, which formed southeast of Nicaragua

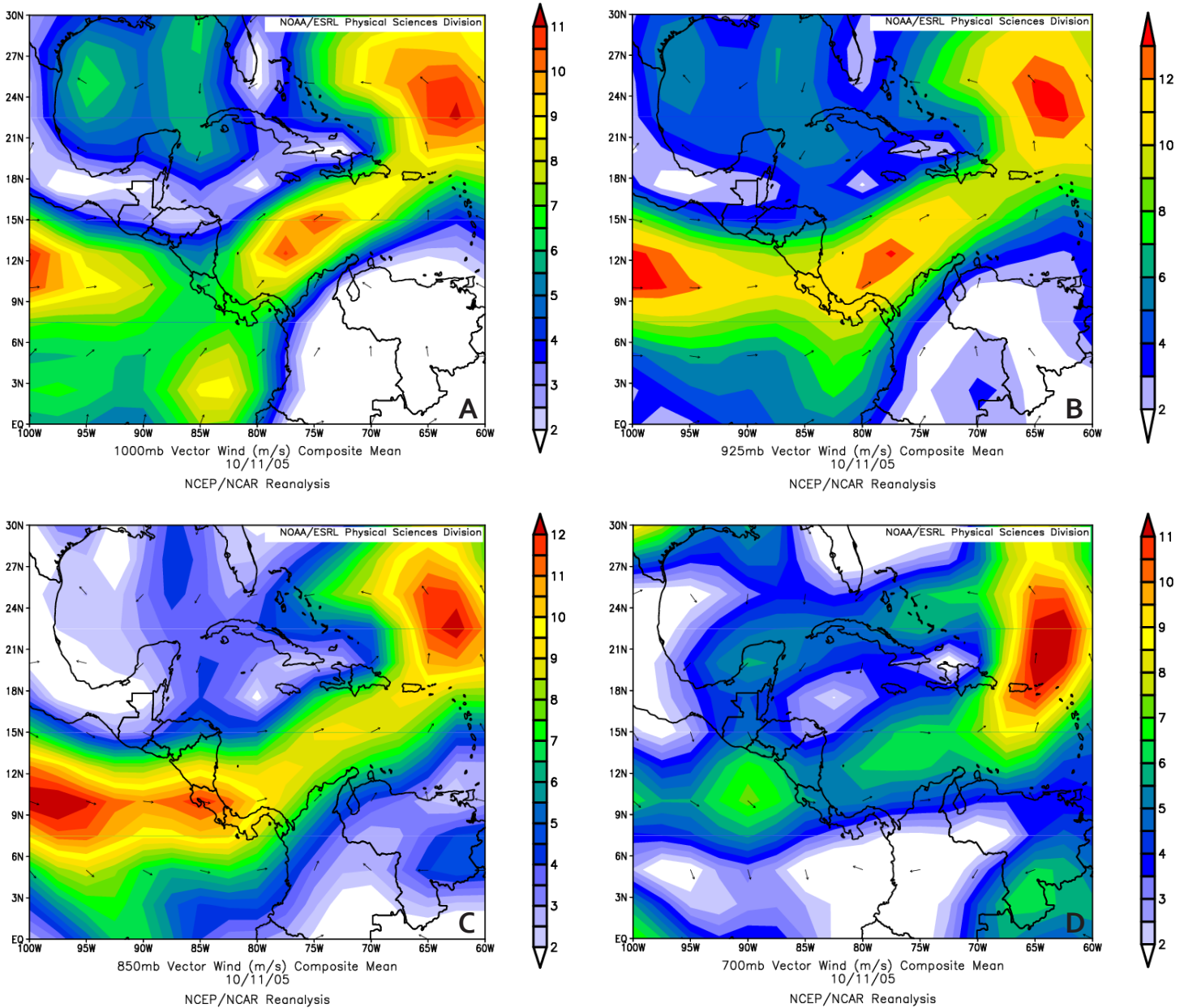


Fig. 3. Winds across the Caribbean Sea for 11 October 2005 in m/s at (A) 1,000 mb (about 300 ft or 91.4 m above sea level[asl]), (B) 925 mb (about 3,000 ft or 914 m asl), (C) 850 mb (about 5,000 ft or 1,524 m asl), and (D) 700 mb (about 10,000 ft or 3,048 m asl). Climatological wind vectors are plotted over shading and contours indicating the wind speed (in m/s). These winds would force any migrant headed for South America off course in the direction of Hispaniola and Puerto Rico. These conditions also resulted in the development of Hurricane Wilma just southwest of Jamaica.

on 29 October and moved onshore the next day. All of these storms would have accentuated the effect of Hurricane Wilma on mean winds occurring in the Caribbean during October.

Discussion

Species such as the Swainson’s Thrush and Eastern Wood-Pewee are among the most common migrants that use the trans-Gulf of Mexico route to South America, yet they had rarely or never been recorded on Hispaniola or Puerto Rico before 2005. This suggests that a very unusual meteorological situation must have taken place that forced these birds off course

enough that they appeared on these islands in fairly high numbers. Lewis (2007) noted the unusual number of hurricanes in the Gulf of Mexico at that time and he presented wind direction data from two locations in the Caribbean that showed unusual wind direction before the migration occurred. Landestoy *et al.* (2006) did not explain a possible cause for their observations.

We feel that a broader look at the wind conditions at higher altitudes associated with these unusual migratory movements reveals how easily trans-Gulf migrants could have been forced into the eastern Greater Antilles at that period of time, resulting in so many new or unusual records on these islands. Given

that dozens of fairly secretive birds were observed on some islands and 26 individuals were captured with only a dozen mist nets operated for part of the day implies that a large number of birds were involved. Boal and Estabrook (2007) suggested that 300–500 Swainson's Thrushes were in the vicinity of their banding station; they also found that most of their 26 captured birds were in poor body condition, with 71% having no fat at the time of initial capture. One bird that was repeatedly recaptured was able to add 5.0 g of fat in three days before it disappeared.

One cannot help but wonder about the fate of these birds given that the dominant winds for October worked against their moving southward to South America. No records of thrushes were made after 23 October, at which time Wilma had moved into the Atlantic Ocean, but two further tropical storms occurred in the western Caribbean at that time. While a few unusual records were made in early November in the Dominican Republic, the only individual of these unusual migrants known to stay on these islands was the oriole captured in southwest Puerto Rico in January. Certainly, if the winds forced these birds in an undesired direction, one would assume that many did not stop on Puerto Rico and Hispaniola when possible and perished.

It is likely that these unusual winds during October could have affected those migrants that winter on the Greater Antilles, most of which presumably fly from their breeding sites across the Atlantic to the Antilles. The dominant winds during most of October were directed to the north, which would have made such a migration impossible for many days. Our long-term monitoring project in southwestern Puerto Rico showed no decline in winter resident populations in January 2006 (Faaborg *et al.* 2012), but two of the focal species in this study (Black-and-white Warbler [*Mniotilta varia*] and American Redstart [*Setophaga ruticilla*]) had shown sharp declines in 2005. A study by Steven Latta in the Dominican Republic showed distinct declines in winter residents in all his study sites between 2005 and 2006 samples (S. Latta pers. comm.). Certainly these unusual winds occurred during at least part of the migration of these winter residents and must have affected some individuals.

The year 2005 had a record number of hurricanes in the Gulf of Mexico and Caribbean. Hurricane Wilma was part of a string of hurricanes that occurred relatively late in the season; Wilma combined the characteristics of being both huge and slow moving. These conditions may have been unusual enough to explain the large number of new bird records on the islands. Whether it

caused more mortality than most tropical storms that affect migrants is impossible to say. While some might use this situation as evidence of the effects of global climate change, this is probably not appropriate at this time, as assigning individual events such as these hurricanes to global change is questionable (Kerr 2013). It is interesting to note that no major hurricane (Category 3–5) has occurred in this region since 2005, so perhaps this was indeed just an unusual event.

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