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Subject: **Synopsis of Friday map discussion for 1 Feb 2013**
Date: 4 February 2013 11:21:45 AM EST
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Hi Everyone,

The focus of Fri map discussion for 1 Feb was on very recent heavy rains and flooding in parts of eastern Australia and southern Africa. Philippe Papin and Alicia Bentley provided critical assistance in digging up information about both events and creating the imagery and loops used during map discussion (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/).

I. Australian heavy rains:

As for Australia, first came the hell (discussed last week) and then came the high water (discussed this week). The heavy rains were associated with weak, wet and wild TC Oswald. Oswald (track map can be found here: http://en.wikipedia.org/wiki/File:Oswald_2013_track.png) formed from a weak area of lower pressure over the Gulf of Carpentaria in 17 Jan, performed a counterclockwise loop and made landfall over the southwestern Gulf of Carpentaria on 19 Jan, continued to move clockwise and emerged back over the Gulf of Carpentaria. TC Oswald achieved tropical cyclone status on 21 Jan before it made a second landfall on the Cape York Peninsula and traversed Cape York on 23 Jan. Subsequently, Oswald tracked southeastward just inland from the northeast coast of Australia and dissipated north of Brisbane on 26-27 Jan. The Oswald remnants tracked poleward along the east coast of Australia, interacted with several eastward-moving midlatitude troughs, and underwent an extratopical transition (ET) east of Tasmania on 29 Jan (the Oswald ET was far lest spectacular than the Narelle ET discussed the previous week).

A brief synopsis of the primary impacts from Oswald over Australia as extracted from Wikipedia includes a statement that: "Although a relatively weak storm, Oswald produced torrential rains over much of Queensland. Rainfall peaked in Tully where approximately 1,000 mm (39 in) of rain fell, with 632 mm (24.9 in) falling over a 48 hour span. The township of Scherger received a record-breaking

370 mm (15 in) in just 24 hours. These rains caused widespread flooding in the state that shut down many roads and isolated communities. The town of Ingham was completely cut off due to high waters. Residents in the town were advised to stock up on emergency supplies as the Herbert River rose rapidly after 200 mm (7.9 in) of rain fell in the town in just three hours. In Cairns, winds up to 90 km/h (56 mph) left many homes without power and waves up to 4 m (13 ft) prompted the cancellation of most coastal activities. Additionally, a brief tornado or waterspout with winds of 140 km/h (87 mph) touched down near Hay Point.[38] As of 29 January, four people have been confirmed dead in relation to Cyclone Oswald[39] Across Australia, damage from the storm amounted to at least A$126 million (US$131.6 million).[40]"

An infrared satellite loop for the Oswaldo period can be found here (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/ir_aus.html). Other available loops include: 1) DT potential temperature and winds, and layer-mean 925-850 hPa relative vorticity (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/dt_spac.html), 2) 300-200 hPa PV/winds/irrotational winds, 500 hPa vertical velocity, PW, and SLP (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/jet_spac.html), 3) 500 hPa heights, relative vorticity and winds, a 500 hPa vertical motion (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/500vort_spac.html), and 4) 850 hPa winds, temperatures, vertical motion, and SLP (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/850temp_spac.html), respectively. Interesting features revealed by these loops include: 1) a series of PV streamers (tails) that propagate equatorward along the east coast of Australia on the eastern side of an entrenched continental anticyclone on 2-3 Jan, 10-12 Jan, and 15-18 Jan, 2) a weak 500 hPa cyclonic vorticity minimum (SH) that propagates eastward and equatorward around the eastern end of the aforementioned continental anticyclone on 14-16 Jan; this vorticity minimum stalls, enlarges, and morphs into a broad vortex over coastal northern Australia west of the Gulf of Carpentaria on 17-18 Jan, 3) a well-defined SLP/ 850 hPa cyclonic circulation and weak cold pool that forms below the 500 hPa vortex, 4) a corridor of coastal PW values between 60-70 mm and an accompanying strip of high layer-mean 925-850 hPa relative vorticity along which the Oswald remnants traverse southeastward, and 5) multiple 300-200 hPa diabatically driven divergent outflow interactions with progressive PV tail remnants on 23-24 Jan, 26-27 Jan, and 28-29 Jan.

Science issues and opportunities raised by this event include: 1) determining the possible linkage of increased cooling in the upper troposphere beneath the equatorward extensions of equatoeward-displaced PV tails on convective organization and coverage in the monsoon region of northern Australia in summer, 2) quantifying the contribution of "ridge rollers" (dynamic tropopause disturbances moving anticyclonically around continental anticyclones) to the total monsoon summer rainfall and surface disturbance/TC formation along the monsoon trough over northern Australia, and 3) investigating the dynamical and thermodynamical processes associated with multiple TC-PV streamer interactions for poleward-moving TCs and the impact of these interactions on prolonged and heavy rainfall. More generally, an investigation of the dynamical and thermodynamical linkages between continental subtropical anticyclones, ridge roller disturbances, organized convection and heavy rainfall in different parts of the world would probably be enlightening.

2. Southern Africa Mesoscale Convective System:

Parts of southern Africa, most notably Botswana, were impacted by very heavy rains between 15-19 Jan 2013 from what was called at "Botswana landphoon" (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/Landphoon1.jpg) that had the appearance of an almost synoptic-scale mesoscale convective vortex (MCV) in infrared (IR) satellite imagery (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/ir_africa.html). This event was eerily similar to earlier synoptic-scale MCV-like event that occurred on 29 Jan 2010 in almost the same region and was the subject of Fri map discussion that day with a subsequent post on 1 Feb 2010 (kudos to Kevin Tyle for remembering and finding the earlier post to the map listserv). The aforementioned IR satellite loops suggests the convection over the southern Congo, Angola, Zambia, Zimbabwe and Mozambique on 10 Jan became somewhat better organized during the next few days as it extended southeastward and offshore along the South African Convergence Zone. By 12 Jan, this organizing convection moved into northern Botswana and eastern Namibia. Although the convection over Namibia and Botswana weakened on 13-14 Jan, it reorganized over these two countries on 15-16 Jan and extended into parts of South Africa the next day. By 1800 UTC 17 Jan and continuing through part of 19 Jan an almost synoptic-scale MCV was evident in the IR imagery over northern Botswana, southern Zambia , extreme northeastern South Africa and Zimbabwe.

The environment in which this "MCV-like" synoptic-scale disturbance organized is depicted by means of selected mean and anomaly maps for 17-19 Jan that were derived from the NOAA/ESRL/PSD web site. The 200 hPa mean geopotential height field over southern Africa and vicinity is characterized by a strong subtropical anticyclone that extended from the South Atlantic eastward across northern Namibia and Botswana to the west of a trough over Madagascar (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/200Z_17-19Jan13.gif). Thje corresponding 850 hPa mean geopotential height map shows a weak vortex located over eastern Namibia and Botswana (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/850Z_17-19Jan13.gif), consistent with a modest negative 850 hPa height anomaly center that is located over southern Africa (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/850Z'_17-19Jan13.gif). The 850/200 hPa images suggest that the MCV disturbance over southern Africa is weakly warm care based on a quasi vertically stacked relative height minimum (maximum) at 850 (200) hPa over southern Africa, although at 850 hPa the MCV is characterized by a 3-4 C negative temperature anomaly (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/850T'_17-19Jan13.gif). The MCV is best defined at 700 hPa based upon a southerly-northerly meridional wind couplet of +6 m/s and -8 m/s (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/700v'_17-19Jan13.gif).

The atmosphere is relatively moist in the MCV region during 17-19 Jan based upon mean OLR anomalies of < 60 W/m**2 and PW anomalies > 12 mm (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/OLR'_17-19Jan13.gif; http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/PW'_17-19Jan13.gif). Soundings were taken once per day at 1200 UTC and 0000 UTC from Upington (68424) and Bloemfontein (68442), respectively. Both stations are in northern South Africa and were the only soundings I could find in interior southern Africa on the University of Wyoming web (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/PW'_17-19Jan13.gif; http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/sounding_FABL.html). Both sets of soundings suggest a transition from surface and near-surface mixed layers to quasi moist adiabatic lapse rates over a 48 h period as the MCV approaches from the north. Modest CAPE (< 600 J/kg) and shear (< 15-20 kt surface to 500 hPa) values are consistent with comparable values seen on MCV environments over the U.S. Comparison of the OLR/PW anomalies with the IR satellite imagery loops discussed previously suggests that a quasi-stationary northwest-southeast oriented moisture axis is in place over Zambia, Zimbabwe and

Mozambique. Inspection of the DT potential temperature/wind analyses and the 500 hPa height and vorticity analyses (http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/dt_africa.html; http://www.atmos.albany.edu/student/ppapin/mapdisco/20130201/images/500vort_africa.html) suggests that the midlevel 500 hPa circulation center seen at 0000 UTC 10 Jan over Mozambique formed from the northwestward end of a PV streamer that extended from a progressive trough over the South Indian Ocean. Successive PV streamers moved poleward near the east coast of Africa in conjunction with progressive eastward-moving Rossby wave trains over the Southern Indian Ocean. Easterly flow in the lower half of the troposphere between the 500 hPa vortex center and the subtropical ridge axis to the south enabled tropical moisture to flow westward across Zimbabwe, Zambia and Botswana in a low-shear environment. Subsequently, this moisture became trapped underneath the upper-level anticyclone, a situation favorable for the formation of deep convection a strongly heated, moist, low-shear environment.

Science issues and opportunities associated with this event, and the earlier event from 29 Jan 2010, center around: 1) determining the contributions of these "synoptic-like' MCVs to the warm season precipitation climatology of southern Africa in general and high-impact flooding events in particular, 2) establishing the relative importance of vortex fractures from the northwestern equatorward ends of PV streamers over eastern southern Africa to continental MCS formation and organization, 3) developing a warm-season PV streamer/fracture climatology for the South Atlantic to South Indian Ocean region, and 4) establishing to what extent the South African Convergence zone, the most transient of the three SH convergence zones (the South Pacific and South Atlantic Convergence Zones are better defined on time-mean maps), when present can be linked to poleward moisture transports ahead of PV streamers moving equatorward east of entrenched subtropical anticyclones over southern Africa.

III. Early Season Multiday Severe Weather Outbreak and MCS:

Map discussion concluded with a very brief discussion of the early season multi day severe weather outbreak of 30-31 Jan and the record-breaking warmth that preceded this event.

Lance