

Tri-Agency Forecast Discussion for August 27, 2010

Created 1600 UTC August 26, 2010

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Summary: The Tri-Agency forecast domain is very active today. A mature Hurricane, Danielle, has intensified overnight and is now a category 4 storm. A Tropical Storm, Earl, is maintaining intensity and moving westward into the flight operations theater. An Easterly wave with associated pouch, PGI-36L, has recently been named an invest by the National Hurricane Center, and is expected to develop into a TC within the next couple of days. In addition, we have a hurricane, Frank, in the Eastern Pacific ocean. The Global Hawk unmanned aircraft is planning to fly an exploratory mission over Frank on Saturday 8/28 to sample its environment and inner structure. The DC-8 and its crew are focused on TC Earl as it is expected to approach the Antilles by Sunday. A DC-8 ferry to St. Croix with instrument and mission science personnel is planned for Saturday, August 28. Science missions into Earl are expected to follow on Sunday and Monday in close support of operations being flown by NOAA aircraft.

Forecast for 1600 UTC 8/27/2010:

Synoptic Overview:

Five systems are of interest today—Hurricane Frank south of Baja California, intense convection over the Gulf of Mexico, Hurricane Danielle, TS Earl, and PGI36/AL97L, all in the Atlantic (1). Important flow features are anticyclonic flow over the Gulf of Mexico, a middle latitude trough between the U.S. East Coast and Danielle, and another middle latitude trough between Danielle and Earl. Water vapor imagery shows large values of PW over much of the Gulf, Caribbean, and southern Atlantic. The exceptions are dry air from Africa that is streaming westward and partially surrounding the Atlantic TCs. Considerable dry air also is located over the northern Atlantic. This dry air plunges southward behind two middle wave cyclones. The MODIS aerosol product shows relatively high aerosol optical depth associated with the dry air from Africa. Thus, the dry air in the vicinity of the TCs also is aerosol laden. The aerosol region dissipates as one heads west into the Caribbean.

Hurricane Frank

The 11 AM EDT NHC fix on Frank consists of the following:

8:00 AM PDT Fri Aug 27

Location: 18.8°N 112.0°W

Max sustained: 75 mph

Moving: WNW at 6 mph

Min pressure: 987 mb

Frank has begun to weaken and further weakening is expected (25). Although the vertical shear remains approximately constant during the forecast period, the TC is beginning to move over considerably colder water. The current SST is ~ 27 C, but when the Global Hawk (GW) flies near it on Saturday, the SSTs are expected to be ~ 3 C colder. The model consensus forecast for the intercept period (~ 26 h into the 1200 UTC forecast) calls for winds to be reduced to 45-50 kt. The storm is projected to move slowly northward.

Gulf of Mexico Convection

A stationary frontal system extends from the Louisiana coast southwestward over the Gulf of Mexico. A large area of intense convection formed over this area last night and is persisting throughout the morning (26). Storm tops actually are higher in this region than in Frank. NHC has not mentioned this area in their discussion, and development seems unlikely due to proximity to land and other factors. A smaller, weaker area of deep convection is located just offshore of Brownsville. This region

is categorized as a PGI. No development is expected.

Tropical Storm Danielle

The 11 AM EDT NHC fix on Danielle contains the following:

11:00 AM AST Fri Aug 27

Location: 26.9°N 59.8°W

Max sustained: 135 mph

Moving: NW at 12 mph

Min pressure: 946 mb

Danielle has a well defined eye, and is producing well defined upper level outflow (4). Although the storm is encompassed by dry, aerosol laden Saharan air (10), it does not seem to have entered the core region and impacted the storm. The models show that Danielle is expected to begin weakening as she moves northward and then eastward over the northern Atlantic, encountering stronger wind shear and colder SSTs (11, 12).

PGI 36/ AL 97

PGI 36 moved off the African coast yesterday and produced a large area of convection during the evening hours—including a large squall line that propagated toward the southwest (18). The system has no closed circulation; however it already has considerable vorticity at 850 mb. The system is expected to develop further in the next 24 hours—following the same basic path as Danielle and Earl (20). The ECMWF is considerably more aggressive in producing development than is GFS (not shown).

PGI 36 is the latest in a train of waves exciting Africa. These waves are following very similar paths and are being influenced by the Low Level Jet. Long range models indicate that there may be a several day gap before the next system exits Africa. These are long range progs, and may have little skill.

Features of Interest:

Dust and Dry Air in the Atlantic Basin:

As of 1200 UTC, most of the Tropical east Atlantic was dust-laden above climatology oceanic values (7). The dusty area covered the area bounded by 50W between 10N and 20N. The exceptions being inside the cloud shields of TC Earl and PGI-36L/AL97L. North of 15N and west of 50W the basin is also very dry (6). This area is under the influence of the mid-Atlantic ridge and ridging patterns aloft, and contributed to the baroclinic zone supporting an enhanced African Easterly Jet. Of note is the fact that MODIS and GEOS-5 suggest that dust and dry air are wrapping around TC Earl. GEOS-5 expects the track of TC Earl and its cyclonic flow to bring low levels of dust over the central Caribbean starting on Saturday 8/28 near 0000 UTC. The dust is forecast to spread as far west as the East coast of Nicaragua by 0600 UTC on 9/1, but will soon after dissipate as Earl turns northward, and the dust source region is cut off.

Hurricane Danielle/PGI-31L:

Hurricane Danielle strengthened to a major hurricane overnight and is now a Category 4 hurricane with a well-defined eye and surrounding ring of cold cloud tops (8). Danielle is currently in a moderately low shear environment ($5-10 \text{ m s}^{-1}$) (9) and, as opposed to yesterday, there appears to be entrainment of some dry air at low to mid-levels in the outer bands (10).

The models are in good agreement that Hurricane Danielle will continue to move NW for the next 24 hours, then turn north, and finally be absorbed by a trough exiting the eastern United States at 48 hours from latest runs initialized at 1200 UTC 27 August 2010. This will accelerate the motion of Danielle to the NE, with no threat of impact to Maine or coastal regions of Canada (11). SHIPS has shear

continuing to decrease for the next 24 hours, however at 48 hours, shear increases significantly to near 30 m s^{-1} with interaction of the trough. In terms of intensity, less than half of the models keep Danielle as a Category 4 hurricane out to 36 hours, but most have the hurricane weakening starting at 24 hours. Any further intensification of Danielle is limited due to the possibility of further entrainment of dry air and the eventual travel into to an environment with increased wind shear (12).

The increased proximity of the trough will increase shear and absorption of Danielle by 72 hours will usher in the beginning of extratropical transition. In addition, after 72 hours Hurricane Danielle will transition into an environment with SSTs colder than 26°C , which will contribute to additional weakening.

Hurricane Earl/PGI-34L:

As of the 5am advisory, the NHC has Tropical Storm Earl located near 15.9N/41.6W, minimum sea level pressure of 1003hPa, maximum sustained winds of 40kt, and moving west at 15kt. As of the 11am advisory, the NHC has Tropical Storm Earl located near 15.7N/43.6W, with maximum sustained winds of 40kt (13). The convective activity was more concentric this morning, unlike yesterday when the convection was seemingly elongated north/south (14, 15). The convection is very much cyclic and not deep in all quadrants (14, 15). As of 1345UTC, the main convection was to the west with mostly anvil in other quadrants (14, 15). The tropical storm is very much disorganized. Overall, dust does not seem to be as present, but dry air (perhaps from subsidence) is prevalent. There are a number of upper-level features near Earl; Danielle to the northwest, an upper-level dry cyclonic circulation immediately to the west and an upper-level trough to north (4). The upper-level trough to the north is the main ventilation flow for Danielle as an impressive stream of high water vapor is emerging from the anticyclonic outflow, and entering the western side of the trough (3). For Earl, a stream of moisture is emerging from the northern outflow of Earl, and flowing into the downstream portion of the trough (4); the flow looks almost diffluent over Earl. The deep vertical wind shear (850-200 hPa) is weak (5-10kt) over Earl (5). All signs point to gradual intensification this weekend as it gets farther west from the upper-level trough, maintains relatively favorable upper-level winds and increasing SSTs. The model spread of intensification is shown in (16). The consensus (from 1200UTC today) is for hurricane status sometime Sunday morning, a CAT1 hurricane through Monday with intensification to CAT2 by 0000UTC Tuesday, and finally perhaps a major hurricane Wednesday 0000UTC. Looking forward, Earl may be in range from Florida late Wednesday/early Thursday as it maintains a northwestward track.

The consensus track for 0600UTC is as follows:

28/0600UTC: 47W/17N; 29/0600UTC: 55W/18N; 30/0600UTC: 58W/19N; 31/0600UTC: 63W/21N; 01/0600UTC: 66W/24N

The consensus track for 1200UTC is as follows (17):

28/1200UTC: 49.5W/17N; 29/1200UTC: 55.5W/17.5N; 30/1200UTC: 60W/18.5N; 31/1200UTC: 63W/20.5N; 01/1200UTC: 66W/25N

The GFS 0600UTC initialization forecast for MSLP is as follows:

27/1200UTC: 42W/16N; 27/1800UTC: 44W/17N; 28/0000UTC: 46W/17N; 28/0600UTC: 50W/17N; 28/1200UTC: 51W/17N; 28/1800UTC: 53W/17N; 29/0000UTC: 55W/17N; 29/0600UTC: 56W/17N; 29/1200UTC: 57W/17N; 29/1800UTC: 58W/17N; 30/0000UTC: 59W/18N; 30/0600UTC: 60W/18N; 30/1200UTC: 61W/18N; 30/1800UTC: 63W/19N; 31/0000UTC: 64W/20N; 31/0600UTC: 64W/21N; 31/1200UTC: 65W/21N; 31/1800UTC: 66W/22N; 01/0000UTC: 66W/23N; 01/0600UTC: 67W/23N; 01/1200UTC: 68W/24N;

01/1800UTC: 70W/25N; 02/0000UTC: 71W/26N; 02/0600UTC: 72W/27N; 02/1200UTC: 73W/28N; 02/1800UTC: 73W/29N; 03/0000UTC: 73W/30N; 03/0600UTC: 70W/33N

The ECMWF 0000UTC initialization forecast for MSLP is as follows:

27/0000UTC: 40W/15N; 28/0000UTC: 47W/17N; 29/0000UTC: 53W/18N; 30/0000UTC: 59W/19N; 31/0000UTC: 61W/21N; 01/0000UTC: 63W/26N; 02/0000UTC: 65W/33N

HWRP has a CAT2 by 0600UTC Monday and CAT3 by 1800UTC Monday so perhaps a potential for rapid intensification on Monday in the HWRP. The track is similar to consensus. GFDL is more aggressive; at hurricane by 1800UTC Saturday and a CAT2 by 18Z Sunday.

Invest AL97L/PGI-36L:

On the morning of 8/27 PGI-36L was named Invest 97L by the National Hurricane Center. The easterly wave which moved off the African coast near 0000 UTC on 8/26 now contains an analyzed surface low pressure center located at 22W/13N. It is unclear from ASCAT surface winds whether there is a closed circulation at this time. Infrared imagery from METEOSAT shows two distinct areas of convective activity. The primary cluster has formed a squall-line over the last 12 hours from 30W/13N extending southeast to 25W/8N. Cloud tops in this line were near -65 C this morning. The second convective center was near 26W/13N. Both of these are West of the cyclonic vorticity center at 850 mb according to CIMSS analysis. (18). TPW is high in the near storm environment with values between 60 and 65 mm according to AMSU. The Saharan Air Layer is currently located more than 5 degrees to the north of the system according to TPW and MODIS aerosol optical depths. GEOS-5 model forecasts for dust particle mass suggest that the dusty airmass should stay well to the north of this system as a depression tries to form. The convection is located over a fairly warm ocean surface with temperatures just over 28 degrees C. the system should enter warmer sea surface temperatures as it follows the forecast track guidance. Deep layer shear over AL97L is northeasterly with moderate values near 10-12 kt. The wave is just south of a strong upper layer ridge. This wave is part of a very active African monsoon flow. The African Easterly Jet axis is located just to the north of AL 97L and extends well to it east, reinforcing cyclonic vorticity within Tropical Storm Earl as well (19). The above listed factors add up to a very favorable environment for development of this system. GFS and ECMWF both develop the Okubo-Weiss vorticity at 700 mb within this system beyond the threshold critical for development ($2 \times 10^{-9} \text{ s}^{-2}$). GFS waits 84 hours for significant development. ECMWF is more bullish and the OW threshold is met by today at 1200 UTC, after this point the vorticity and OW quickly increase off the provided scale (20). The ECMWF seems to have a more accurate handle on the environmental conditions as its initial shear values are closer to what is currently analyzed. Model guidance for intensity suggests that AL97L will eventually become a hurricane, but that this will slowly happen over the next 72-96 hours (21).

Hurricane Frank:

Frank is still a minimal category one hurricane with winds of 75 mph as of 1500 UTC August 27, 2010. At 15 UTC, Frank was located at 18.8N/112.0W and moving to the WNW at 6 mph. Satellite imagery indicates that the deep convection associated with Frank has decreased over the past 12-24 hours (22). Frank is currently located in a region with SSTs around 27°C and relatively low wind shear. However, the storm's forecast track will take Frank into much cooler waters over the next couple days (23). In fact, there is good model consensus that Frank's winds will decrease to tropical storm force within the next 24 hours.

The mid-latitude trough currently off the U.S. Pacific coast is expected to deepen and force Frank to begin curving northward in the next 24-36 hours **(24)**. At that time, Frank will move into a region with SSTs cooler than 26°C. Therefore, the models agree that Frank will continually weaken over the next several days **(25)**. Currently, the Global Hawk is scheduled to depart for Frank on Saturday at 1300 UTC. When the Global Hawk reaches the storm around 1600 UTC Saturday, Frank will most likely be a tropical storm with winds of 45-55 knots. Frank is expected to dissipate by Tuesday, and the remnant low will continue drifting slowly northward towards Baja California.

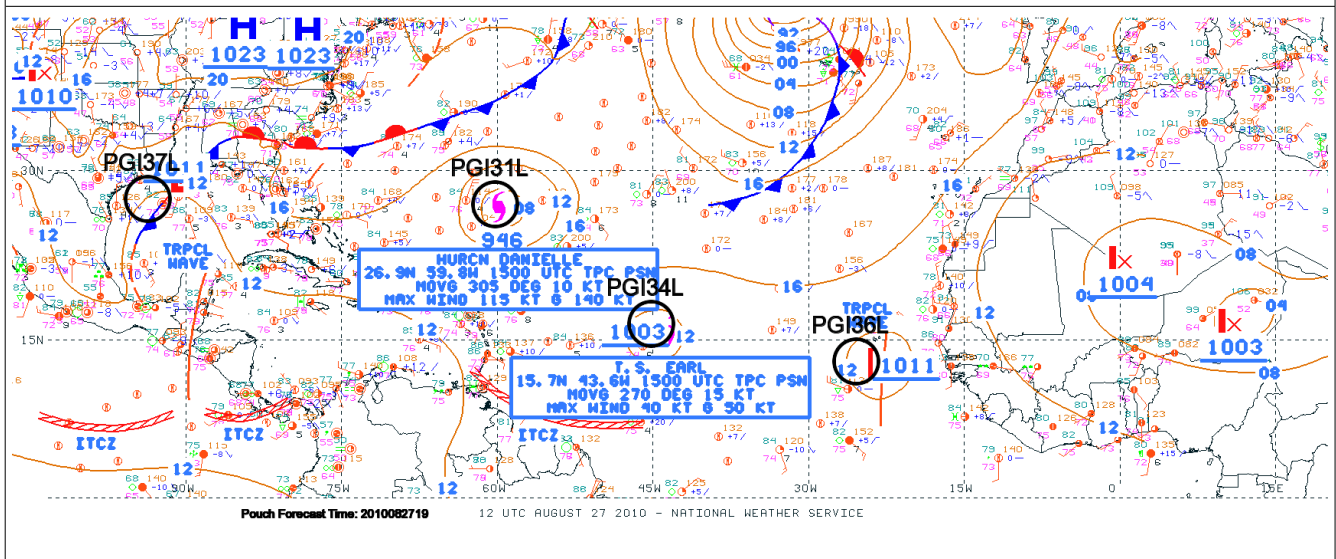
The NHC forecast track for MSLP within Frank is as follows:

28/0000UTC: 19.3N/112.7W; 28/1200UTC: 20.0N/113.6W; 29/0000UTC: 20.8N/114.0W;
29/1200UTC: 21.2N/114.0W; 30/1200UTC: 22.0N/114.0W; 31/1200UTC: 22.5N/114.0W (remnant low)

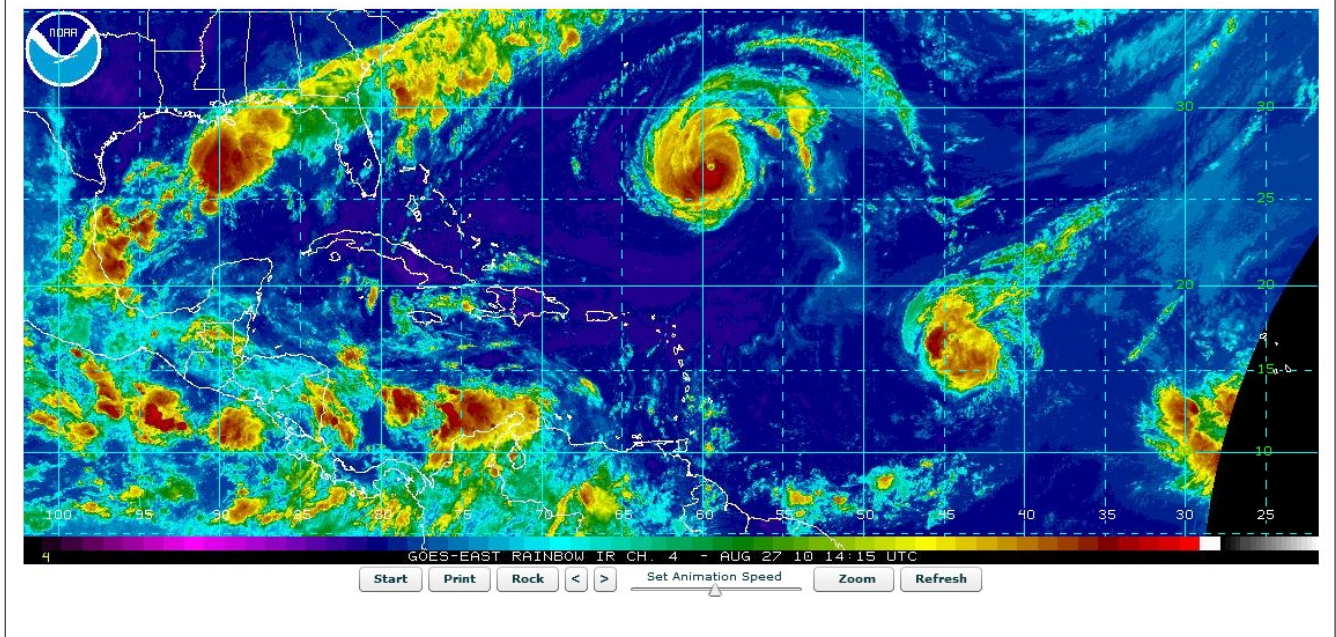
Figures Referred to in the Discussion:

Synoptic Overview:

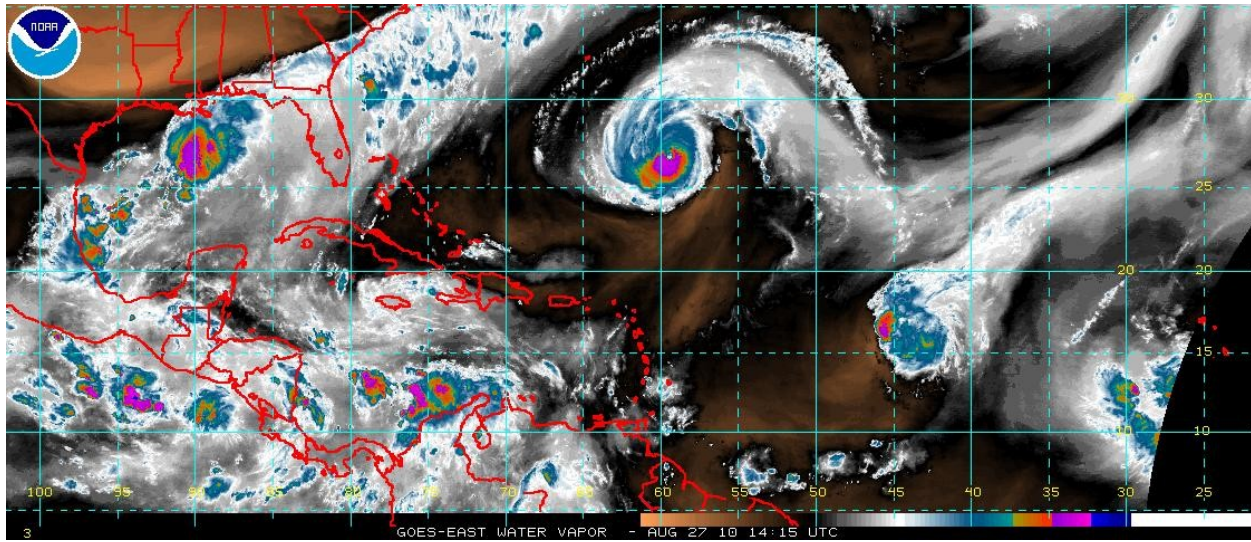
1) Unified Surface Analysis from the Tropical Prediction Center at 1200 UTC



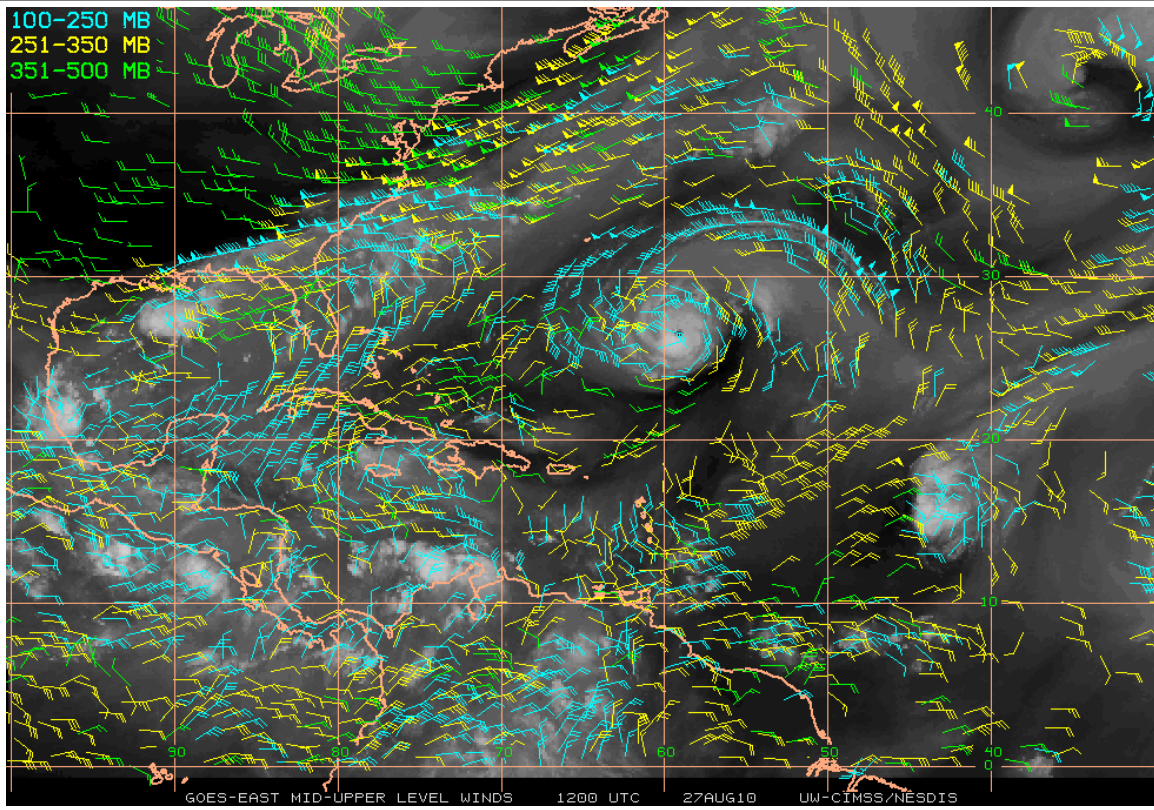
2) Atlantic basin-wide Infrared from GOES, 1415 UTC August 27, 2010



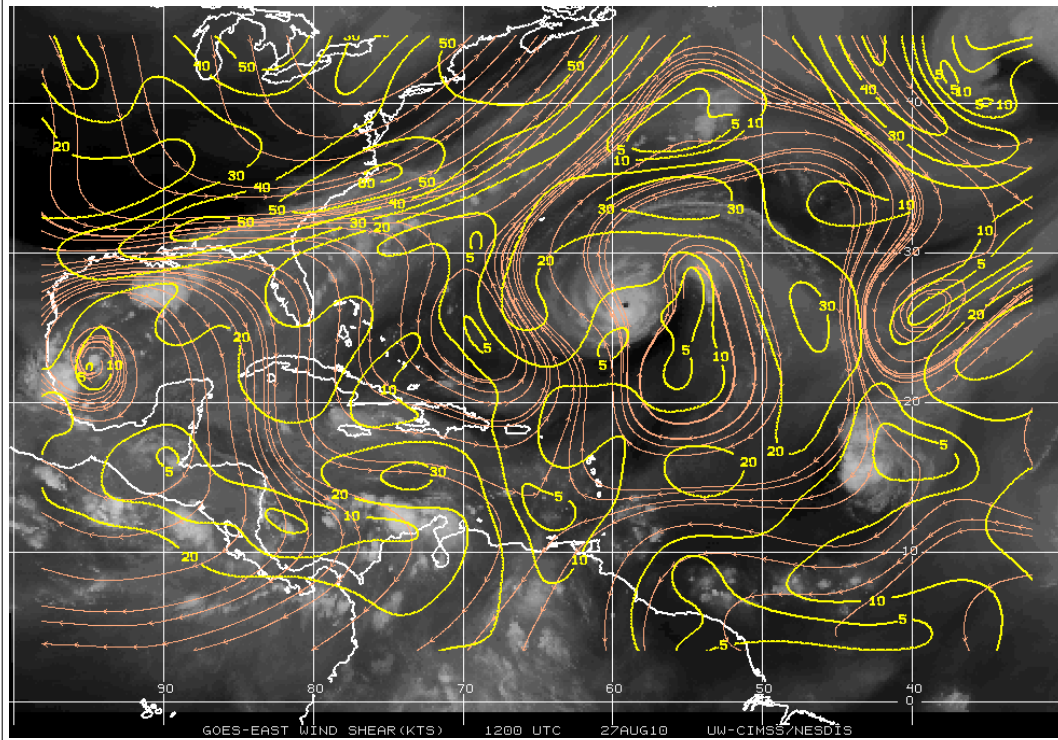
3) Atlantic basin-wide water vapor, 1415UTC 27 August 2010



4) CIMSS upper-level winds, 1200UTC 27 August 2010

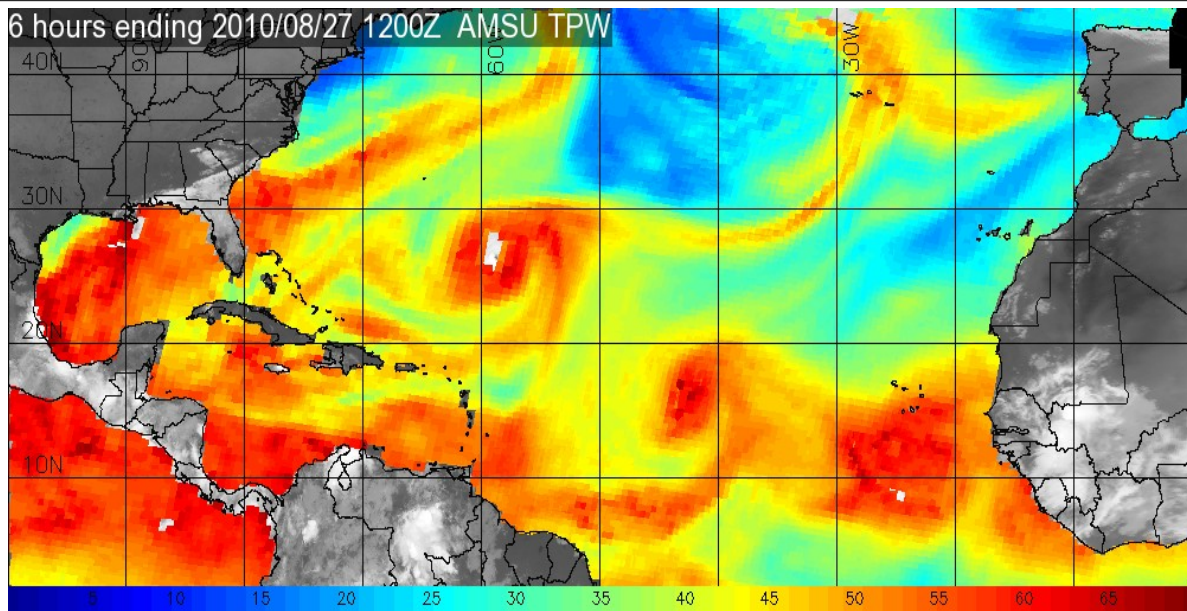


5) CIMSS vertical wind shear, 1200UTC 27 August 2010

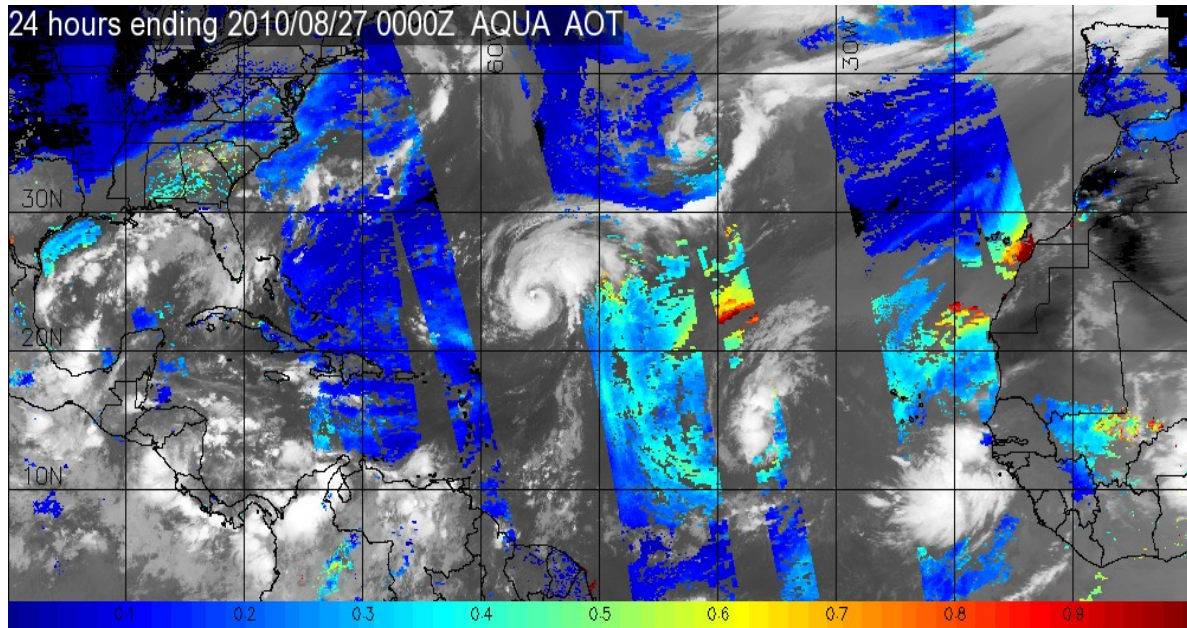


DUST/SAL:

6) 6-hour MIMIC TPW Composite from AMSU ending at 1200 UTC on 8/27

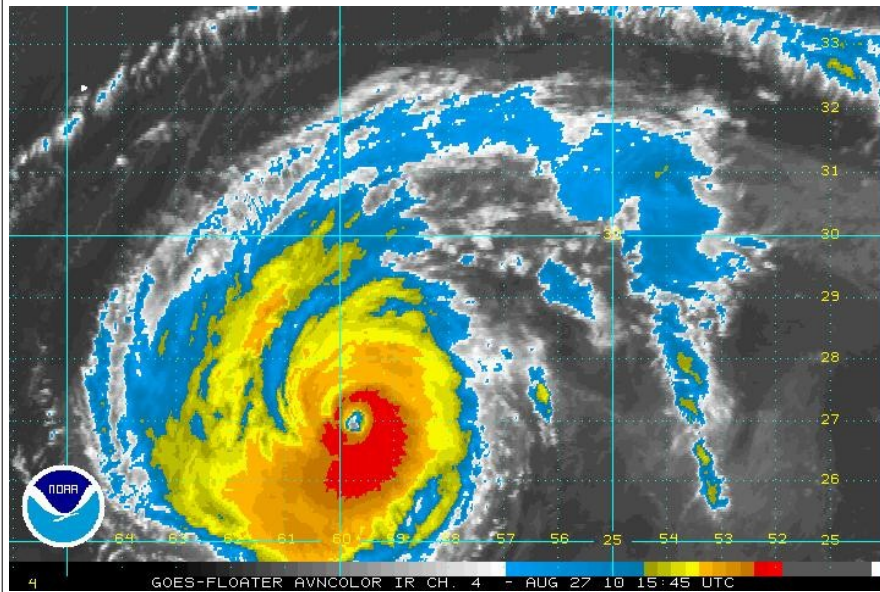


7) Aqua AOT 24-hour composite ending at 0000 UTC on 8/27

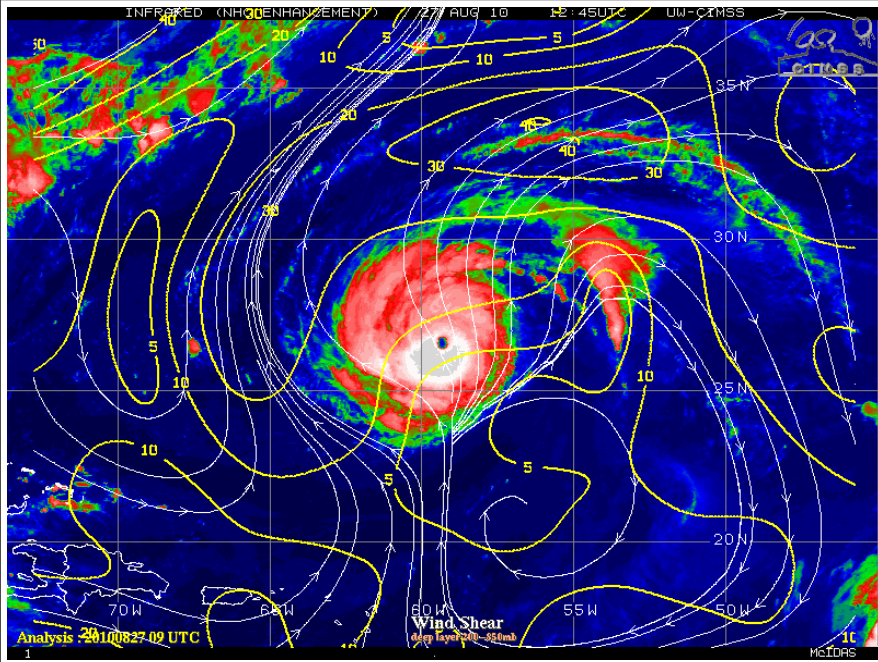


Danielle:

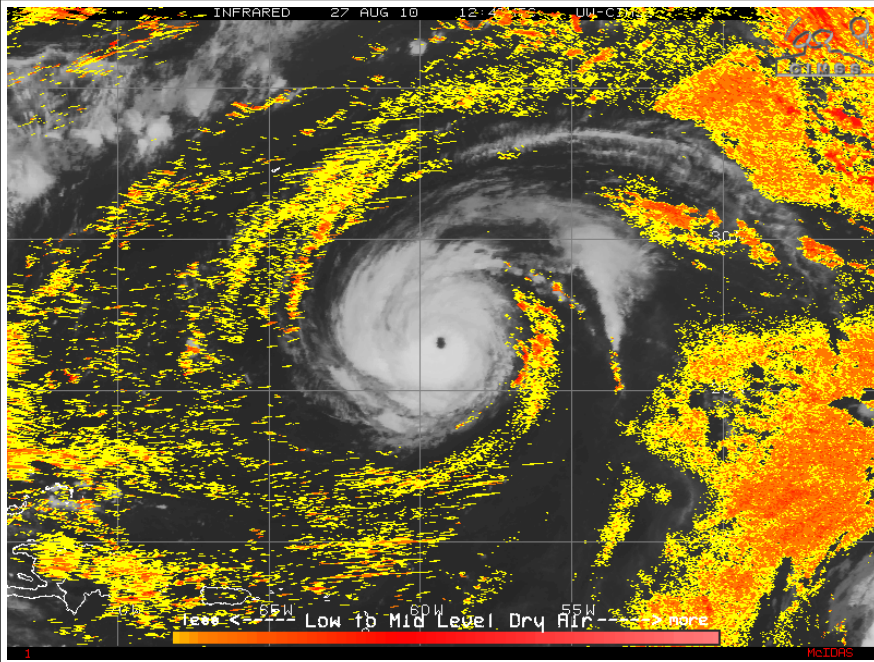
8) GOES infrared Channel 4 satellite image of Hurricane Danielle showing cold cloud tops around central eye valid at 1545 UTC 27 August 2010.



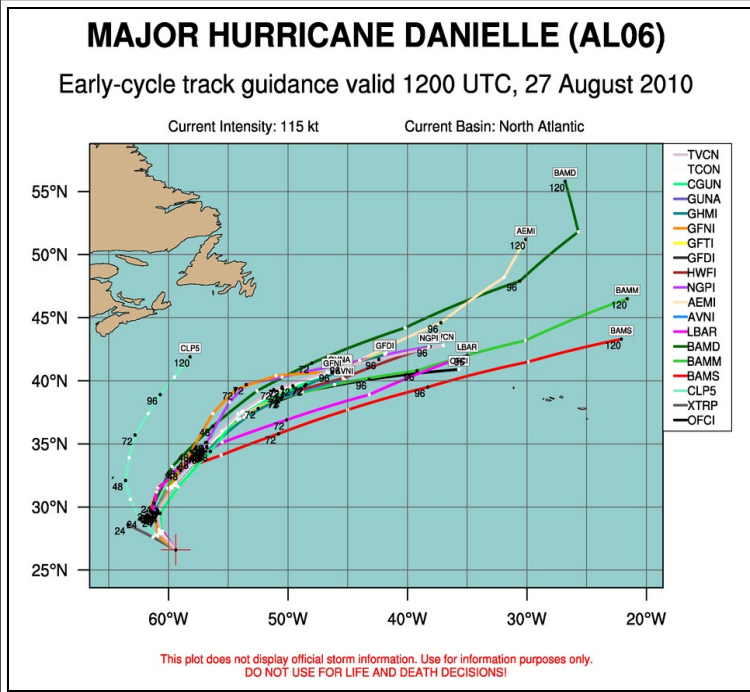
9) CIMSS 4-Km multi-product view of Danielle with infrared satellite imagery with NHC color enhancement and contours of wind shear.



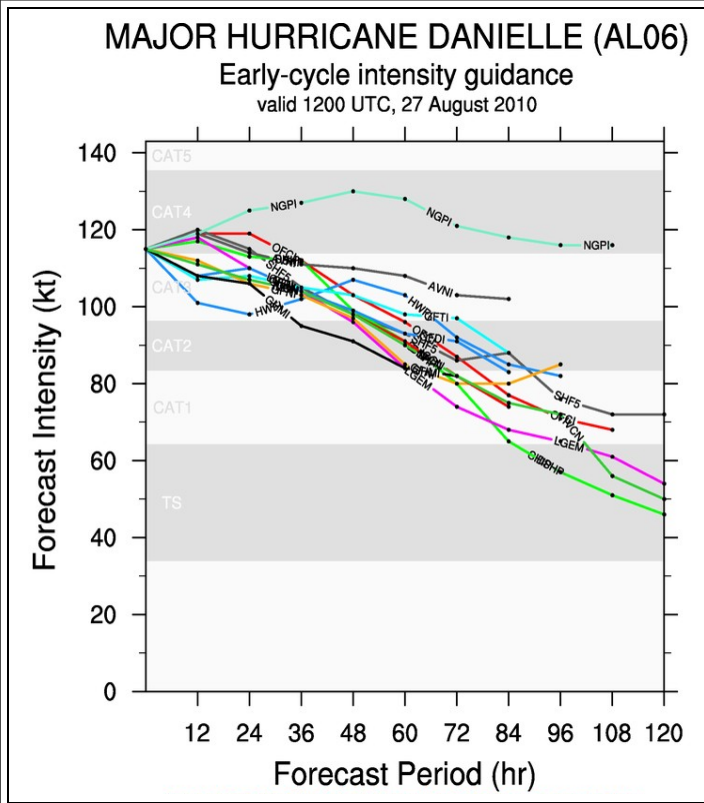
10) Infrared satellite imagery of Hurricane Danielle with overlaid SAL/Dry Air satellite products.



11) Track guidance for Hurricane Danielle valid at 1200 UTC 27 August 2010 (from <http://euler.atmos.colostate.edu/~vigh/guidance/>).

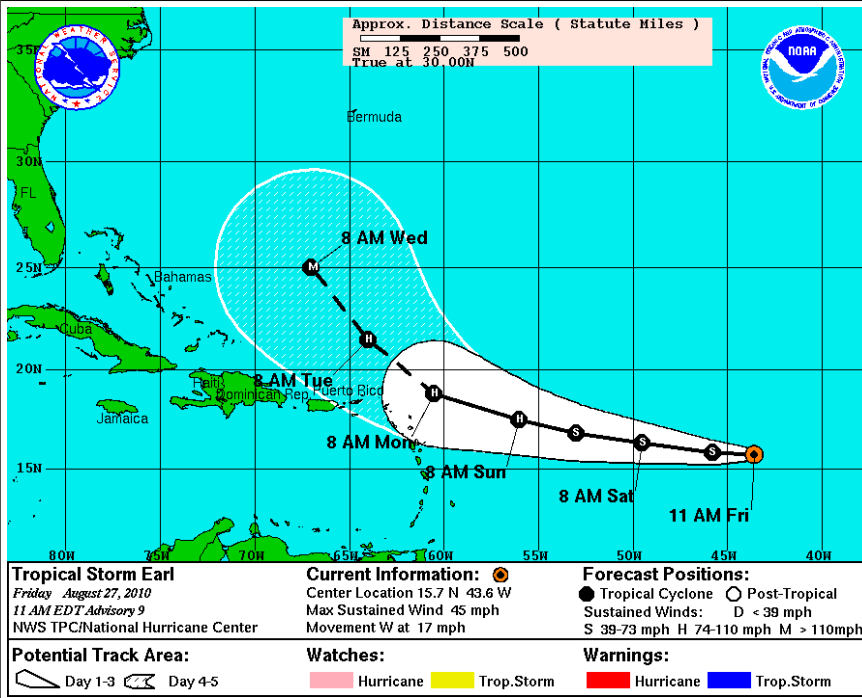


12) Intensity guidance for Hurricane Danielle valid at 1200 UTC 27 August 2010 (from <http://euler.atmos.colostate.edu/~vigh/guidance/>).

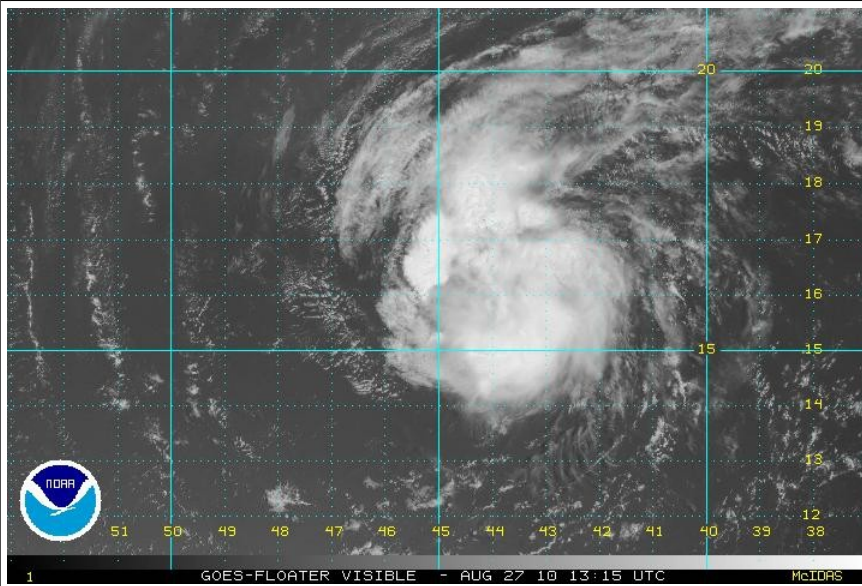


Earl:

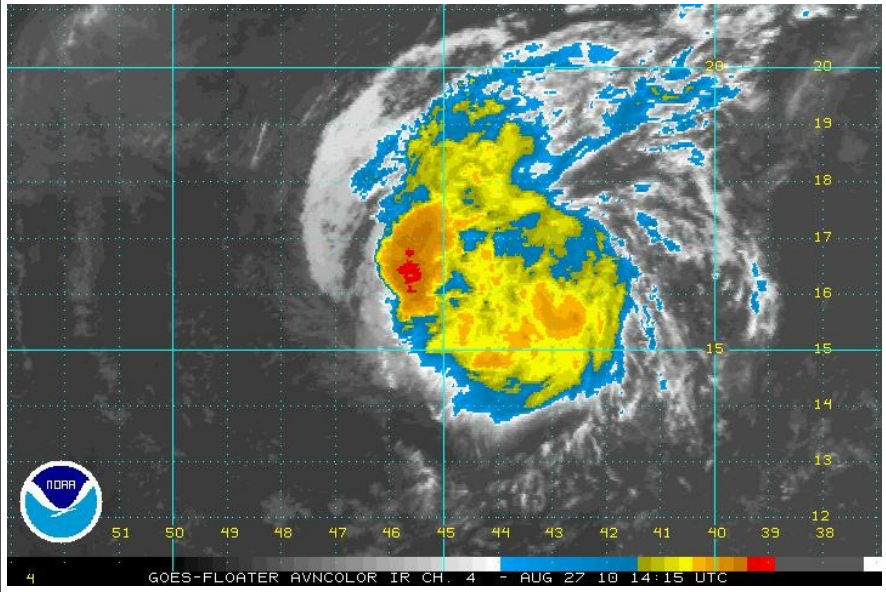
13) NHC 11am advisory for Tropical Storm Earl



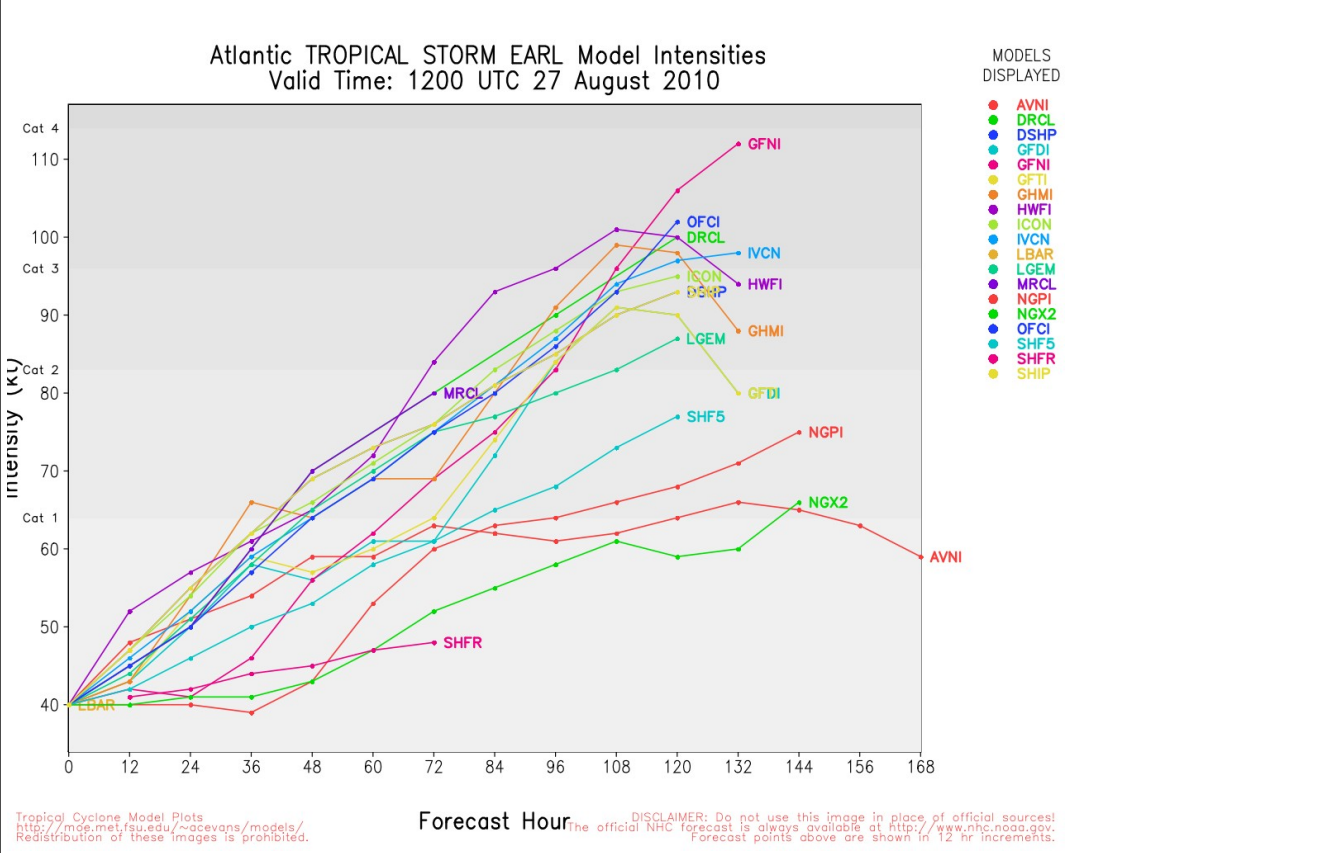
14) Floater visible image of Earl, 1315UTC 27 August 2010



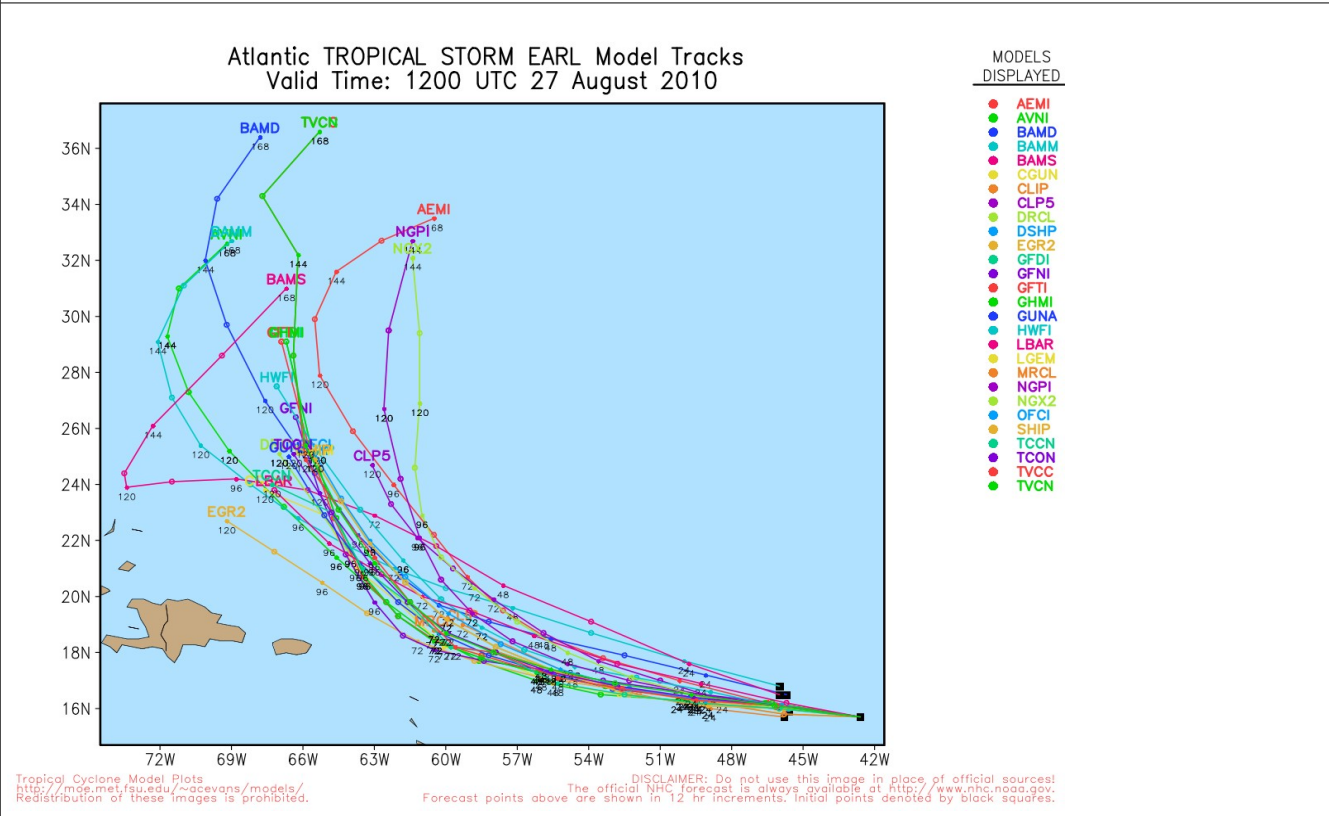
15) Floater IR image of Earl, 1415UTC 27 August 2010



16) Tropical Storm Earl Intensity Guidance, 1200UTC 27 August 2010

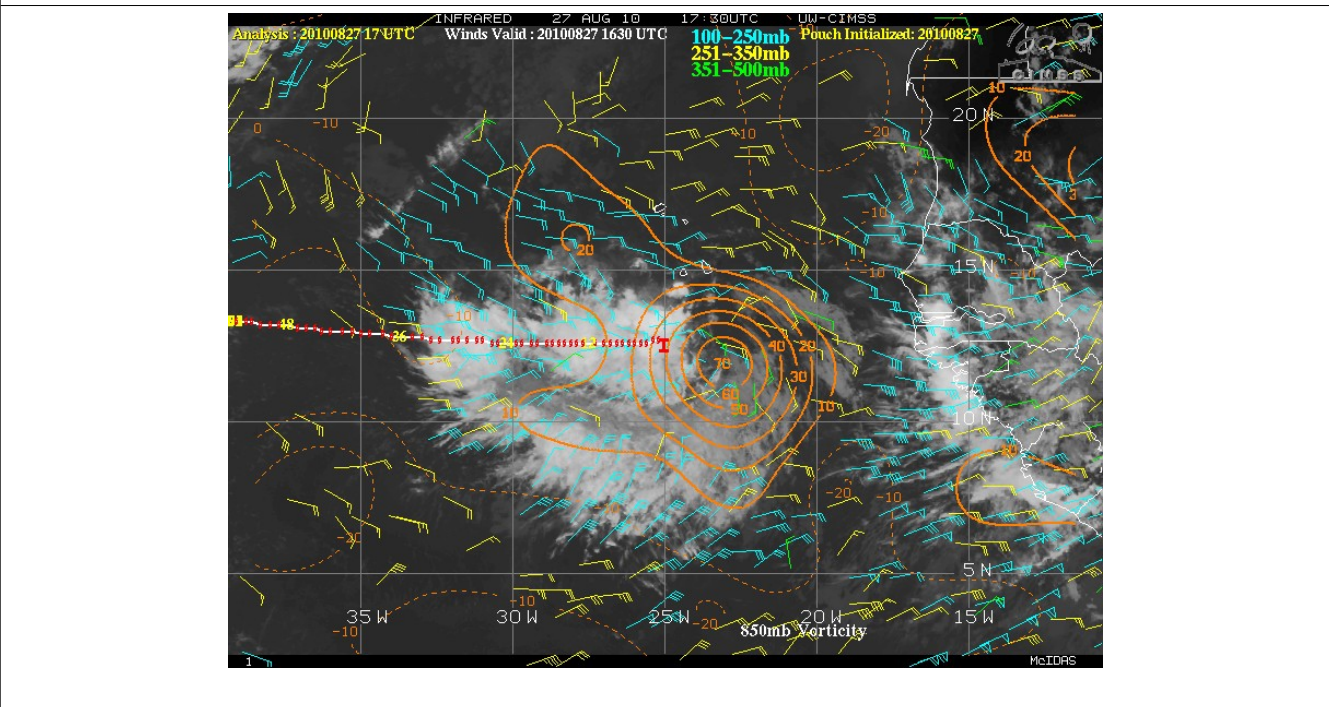


17) Tropical Storm Earl Track Guidance, 1200UTC 27 August 2010



PGI-36L / AL-97L:

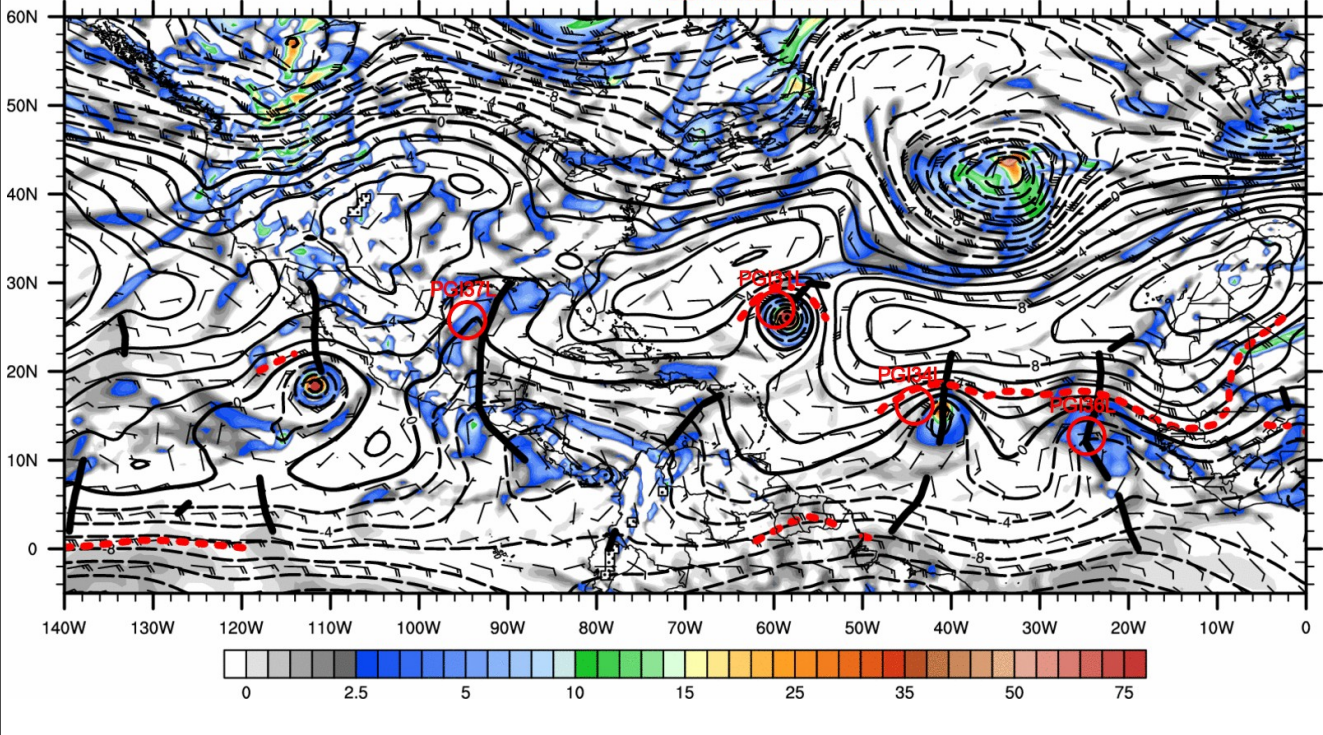
18) CIMSS 4km multi-product view for PGI-36L with consensus track, CIMSS 850 hPa vorticity analysis, upper-level water vapor channel winds, and METEOSAT IR from 1600 UTC



19) SUNY-Albany analysis of troughs and jets in GFS 06 UTC analysis 700 hPa winds and vorticity

700 hPa Wind, Relative Vorticity, and Streamfunction

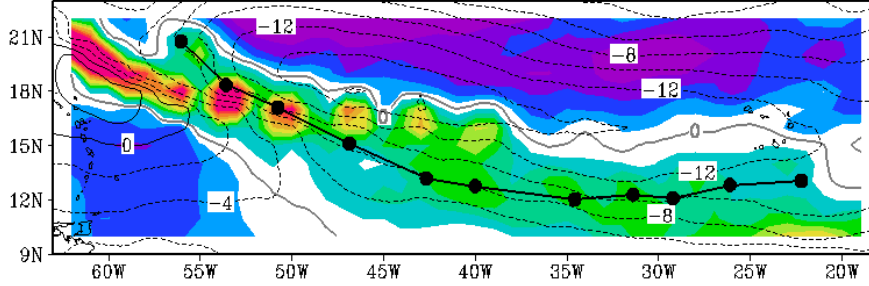
ζ (10^{-5} s^{-1} , shaded), Wind (kts, barbs), and Streamfunction ($10^6 \text{ m}^2 \text{ s}^{-1}$, black contours) Run: 27 Aug 06Z, Forecast: 0 hr, Valid: 27 Aug 06Z
Pouch Forecast Time: 2010082715



20) NPS Pouch-Tracking guidance for PGI-36L from ECMWF model forecast

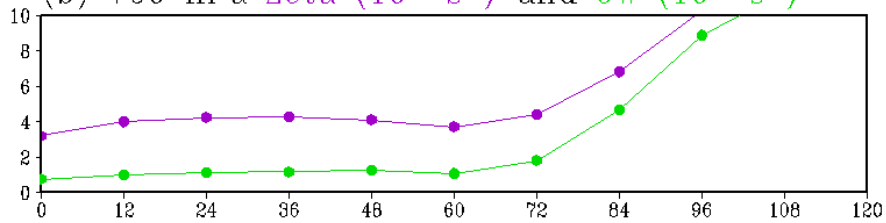
PGI36L: 5-Day Forecast Based on GFS
 Initialized at 2010082700

(a) Track, 700 hPa U and Zeta (5-day average)

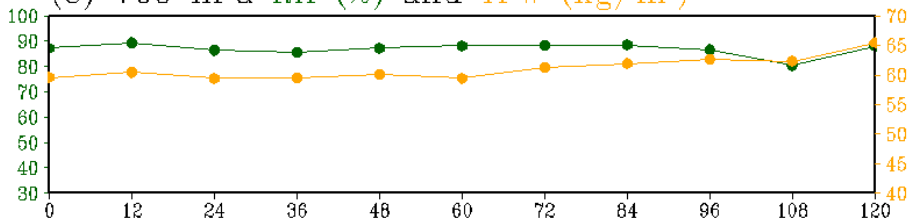


3x3 degree box averages following the pouch:

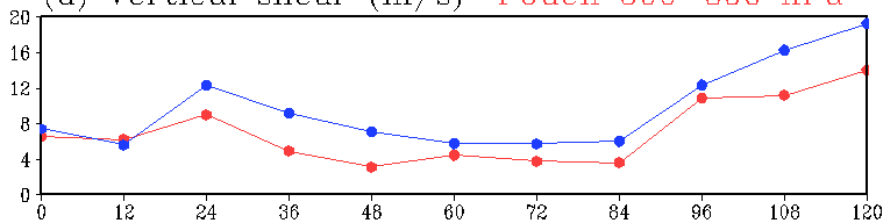
(b) 700 hPa Zeta (10^{-6} s^{-1}) and OW (10^{-9} s^{-2})



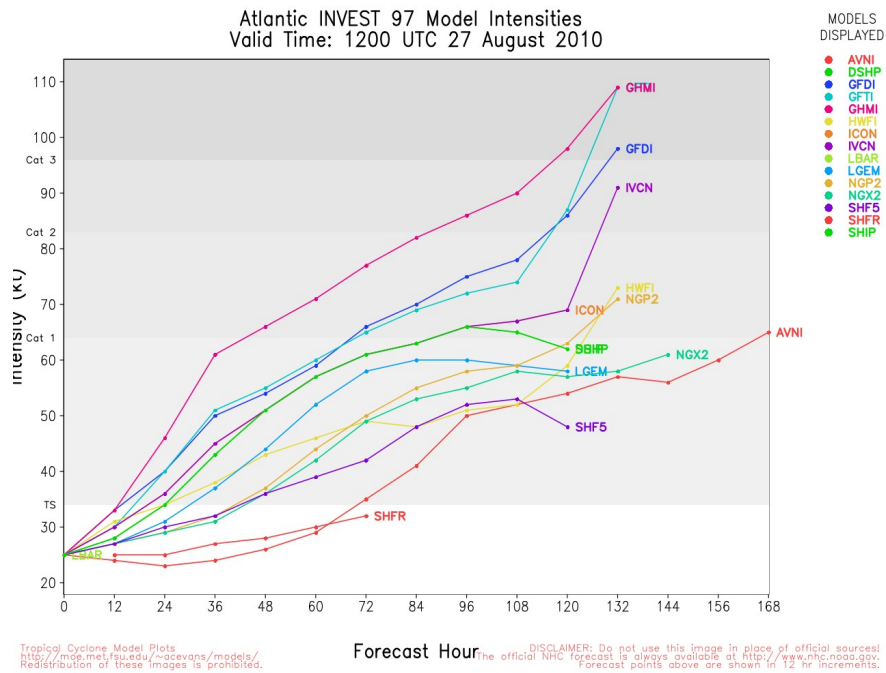
(c) 700 hPa RH (%) and TPW (kg/m^2)



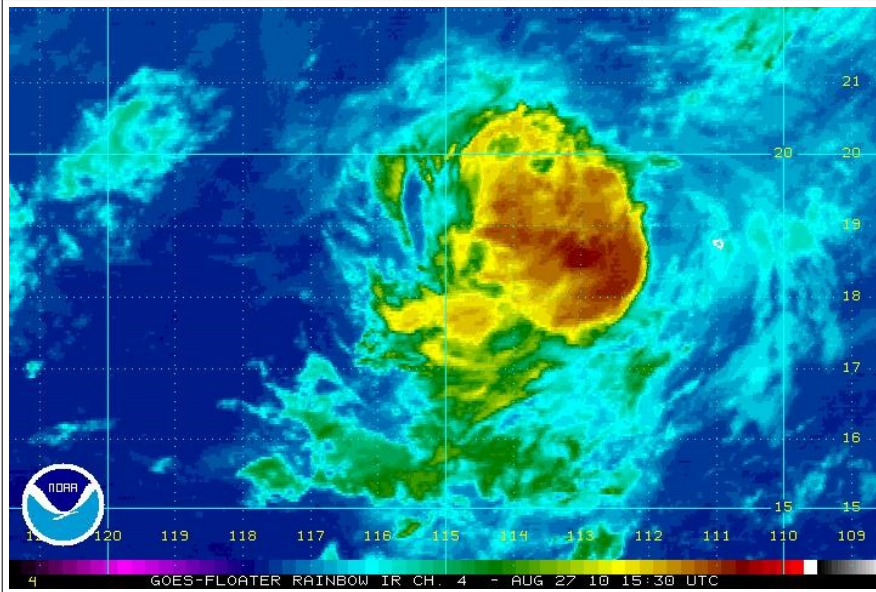
(d) Vertical shear (m/s)
 Deep 200-850 hPa (blue line)
 Pouch 500-850 hPa (red line)



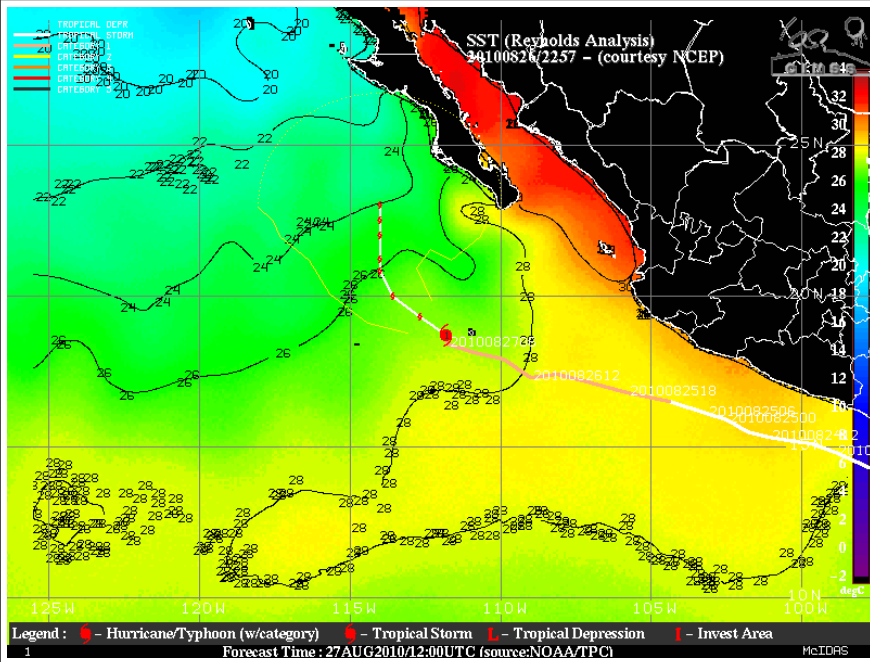
21) 120 hour Intensity Guidance for PGI-36L/AL97L from a suite of models initialized at 12 UTC on 8/27. (from <http://moe.met.fsu.edu/~acevans/models/>)



22) Enhanced IR satellite image of Hurricane Frank (1530 UTC Aug 27)

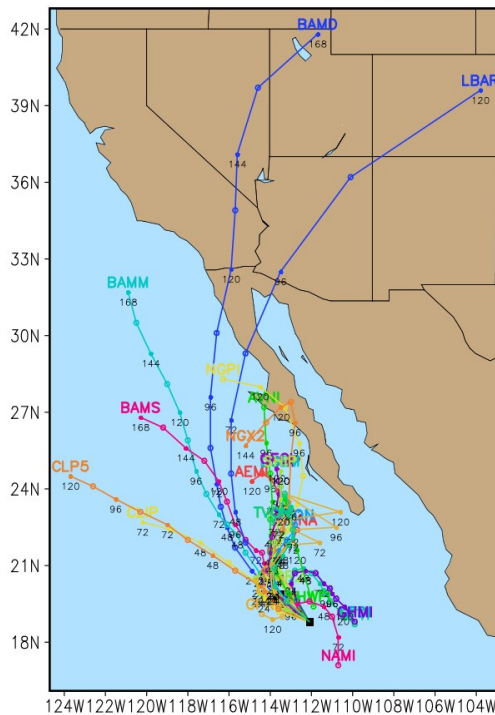


23) SST analysis and forecast track for Hurricane Frank (1200 UTC Aug 27)



24) Track guidance for Hurricane Frank valid 1200 UTC August 27

E. Pacific HURRICANE FRANK Model Tracks
Valid Time: 1200 UTC 27 August 2010



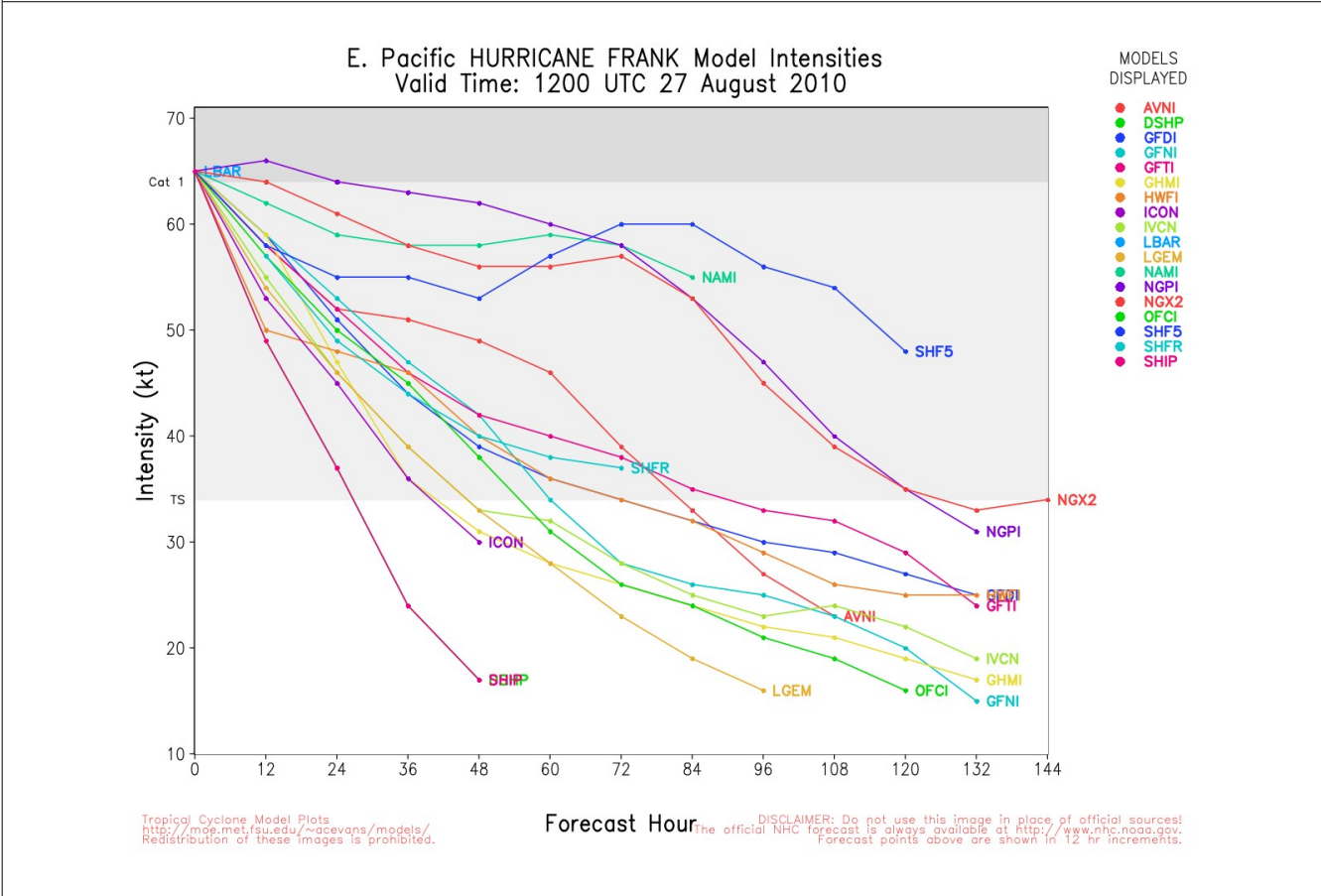
MODELS
DISPLAYED

- AEMI
- AVNI
- BAMD
- BAMB
- BAMS
- CLIP
- CLP5
- DSHP
- EGR2
- GFDL
- GFNI
- GFTI
- GHMI
- GUNA
- HWF1
- LBAR
- LGEM
- NAMI
- NGPI
- NGX2
- OFCI
- SHIP
- TCON
- TVCC
- TVCN

Tropical Cyclone Model Plots
<http://moj.met.fsu.edu/~acevans/models/>
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DISCLAIMER: Do not use this image in place of official sources!
The official NHC forecast is always available at <http://www.nhc.noaa.gov>.
Forecast points above are shown in 12 hr increments. Initial points denoted by black squares.

25) Intensity guidance for Hurricane Frank valid 1200 UTC August 27



Supplemental / Gulf of Mexico:

Enhanced IR image over the Gulf of Mexico at 1345 UTC 27 August.

