**Tri-Agency Forecast Discussion**
28 September 2010

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Current Conditions/Synoptic Overview

The synoptic-scale flow pattern across the North Atlantic basin is illustrated by the CIMSS water vapor and upper-level cloud-tracks wind analysis valid at 1015 UTC 28 Sep (**image 1**). Over Central America and the Caribbean, Tropical Depression 16 (PGI50L) is embedded within broad diffluent upper-level outflow, widespread deep convection, and a west-east elongated closed circulation at 700 hPa (**image 2**). A deep trough over the Ohio Valley extends into the southern Gulf of Mexico (note the very dry air over the northern and western Gulf in **image 3**). Low-level southwesterly flow on the forward flank of the trough (**image 2**) is helping to draw tropical moisture from the northern Caribbean poleward along the Eastern Seaboard (**image 3**). Downstream of the Ohio Valley trough, a tropospheric-deep anticyclone is positioned over the western North Atlantic. South of this anticyclone, a cold upper-level low east of the Lesser Antilles is imparting strong southwesterly winds on the periphery of disorganized convection over the central tropical Atlantic. Two disturbances within the central tropical Atlantic convection, PGI51L and PGI48L, are located in a very moist environment (**image 3**) beneath strong anticyclonic flow aloft (**image 1**) and weak easterly flow at low levels (**image 2**). Farther east, PGI49L is embedded in strong easterly flow on the southern edge of an anticyclone over the eastern North Atlantic (**image 2**).

The pouches being followed today are (from west to east): PGI50L (TD 16) over the northwestern Caribbean, PGI51L and PGI48L over the central tropical North Atlantic, and PGI49L over the eastern tropical North Atlantic. Discussion of each of these pouches follows below:

**T.D. 16 (PGI50L):** At 1500 UTC, what had been tracked as PGI50L/Invest 96 was classified by the NHC as T.D. 16. At this time, T.D. 16 was located at 20.6 N, 82.5 W with an intensity of 30 kt/1001 hPa. This center location is just to the south of the Isle of Youth. Movement is estimated at 20 deg/9 kt. Visible satellite imagery and Air Force reconnaissance data indicate that the center of T.D. 16 is located well to the north of the majority of deep convective activity across the northwestern Caribbean (**image 4**). This is confirmed by Cuban radar imagery (not shown) and a subjective analysis of the 925 hPa dropsonde data from the NCAR/NSF G-V (**image 5**). This analysis also indicates that the lower tropospheric circulation associated with T.D. 16 is somewhat ill-defined with the strongest winds found to the south and east of the center of circulation. As we have seen over the past few days, the surface center of T.D. 16 is located within a broader region of cyclonic flow encompassing much of the western Caribbean, southern Gulf of Mexico, and eastern East Pacific (**image 6**). Aloft, T.D. 16 is located in a marginally favorable environment just to the south of 20-30 kt of upper-tropospheric westerly winds in the base of a seasonably deep (-1 to -2 sigma) trough across the eastern U.S. (**image 7**).

**PGI51L and PGI48L:** As of 1800 UTC 28 Sep, PGI51L and PGI48L were located over the central tropical Atlantic at 12.2 N, 50.5 W and 13.0 N, 42.2 W, respectively, within a region of disorganized deep convection, upper-level divergence (**image 8**), and cyclonic low-level vorticity (**image 9**). The initial position of the pouch sweet spot for both these disturbances is somewhat uncertain based on the large position spread among the dynamical models (**image 8**, **image 9**). Although these disturbances presently are in an environment of low to moderate vertical wind shear, shear increases rapidly just to the north and west (**image 8**) in association with strong southwesterly winds accompanying an upper-

level trough (**image 1**). The environment surrounding PGI51L and PGI48L otherwise appears favorable for development, with considerable moisture present (TPW > 55 mm, **image 3**) and high SSTs (30+ C, not shown).

**PGI49L:** At 18Z, PGI49L was located at 11N, 28.5W southeast of the Cape Verde Islands. Scattered convection was located primarily to the south of the estimated pouch position (**image 10**, top). The low-level relative vorticity was also highest to the south with maximum values of 5 x 10^-5 s^-1. Upper-level winds are from the NE over PGI49L with modest levels of upper-level divergence over the system. The bottom panel in **image 10** shows that there is some dry air to the northwest of the system. Vertical wind shear is approximately 10 knots from the northwest.

Day 1 Forecast

**T.D. 16 (PGI50L):** Per the NHC, T.D. 16 is expected to intensify slightly into a tropical storm as it tracks north-northeastward across Cuba during this period (**image 11**). On the forecast path, T.D. 16 is expected to make landfall in Cuba shortly after F012, accelerating as it does so. This projected motion will bring T.D. 16 under the influence of the aforementioned 20-30 kt westerly flow aloft on the southeastern edge of the upper trough across the eastern United States. The resultant vertical wind shear coupled with 6-12 hr over Cuba will help to keep T.D. 16 from becoming significantly better organized through F024 despite modest diffluence aloft and very warm sea surface temperatures. It is anticipated that the effects of this trough will maintain T.D. 16 as an asymmetric storm with the strongest winds found to the south and east of the center of circulation. This is reflected by the NHC forecast 34-kt wind radii (not shown), highlighting a broad expanse of 34 kt winds east of the system with no 34 kt winds expected to the west. By F024, model-derived cyclone phase space forecasts (not shown) indicate that T.D. 16 will likely begin to undergo extratropical transition.

The 0-24 hr official NHC forecast for T.D. 16 is as follows:
INITIAL 28/1500Z 20.6N 82.5W 30 KT
12HR VT 29/0000Z 21.6N 81.8W 35 KT
24HR VT 29/1200Z 23.5N 80.7W 40 KT

**PGI48L/PGI51L**: The dynamical model forecasts indicate that PGI51L and PGI48L will move west and either dissipate entirely or remain quite weak (**image 8**, **image 9**). The model pouch parameter time series for PGI51L (**image 12**) show relatively high moisture in the pouch, but near-zero Okubo-Weiss values, very low (~2 x 10^-5 s^-1) low-level relative vorticity, and moderate deep-layer wind shear (15-25 kt). For PGI48L, the model pouch parameter time series indicate similar conditions (**image 13**), except that deep-layer wind shear is expected to be a bit lower (10-20 kt) since PGI48L is farther displaced from the upper-level trough to the west (**image 1**). The GFS shows PGI51L as the more robust of the two disturbances (the GFS dissipates PGI48L during this period), whereas the ECMWF and UKMET indicate that PGI48L will be more robust.

**PGI49L:** PGI49L is forecasted to move toward the west or west-northwest in the short term (**image 14**). The ECMWF starts out with negative OW values before increasing them slightly by the end of day one. The GFS shows the system persisting with weak values of OW. On the other hand, the NOGAPS shows a pronounced increase in OW and relative vorticity. Given current trends and lack of organization, the NOGAPS seems rather dubious at this time. The environment around PGI49L is forecasted to remain moist with low values of vertical shear generally between 4-8 m/s.

Day 2 Forecast

**T.D. 16 (PGI50L):** An analysis of the model-derived cyclone phase space forecasts (not shown) implies that T.D. 16 should undergo extratropical transition between F024 and F048. The ET of T.D. 16 is presumed to be in response to substantial baroclinic forcing associated with the aforementioned seasonably deep trough across eastern North America. During this time, T.D. 16 is expected to accelerate to the north-northeast in response to increasingly fast southwesterly flow aloft with northward extent (e.g. 250 hPa southwesterly winds of 25 kt at MFL and 50 kt at JAX at 1200 UTC 28 September 2010). This results in the progression of the system from the north shore of Cuba to east of the Georgia/Florida border during this period (**image 11**). Intensity-wise, T.D. 16 is expected to reach its peak intensity as a tropical cyclone early within this period before it encounters substantial south-southwesterly vertical wind shear (e.g. 30+ kt as diagnosed by the 1800 UTC 28 September 2010 SHIPS diagnostic output). Interaction with land is likely to have minimal impact on the intensity of the system given its projected fast forward motion and increased derivation of kinetic energy from the baroclinic/vertically sheared midlatitude flow.

The 24-48 hr official NHC forecast for T.D. 16 is as follows:
24HR VT 29/1200Z 23.5N 80.7W 40 KT
36HR VT 30/0000Z 26.5N 80.0W 40 KT
48HR VT 30/1200Z 31.0N 78.5W 40 KT...POST-TROP/EXTRATROP

**PGI48L/PGI51L:** No substantial development of either PGI51L or PGI48L is expected during the period. Both the UKMET and ECMWF show dissipation of PGI51L by 1200 UTC on 30 Sep, but the GFS maintains the disturbances and brings it to near 13 N, 55W by this time (**image 12**). For PGI48L, the reverse situation is true in the UKMET and ECMWF solutions. The UKMET and ECMWF both maintain PGI48L and by 1200 UTC 30 Sep bring it to approximately the same position as the GFS does for PGI51L (**image 13**). Environmental conditions for the two disturbances are forecast to be similar to those in the 0-24 h period, with the exception that deep-layer vertical wind is expected to decrease somewhat (**image 12, image 13**).

**PGI49L:** PGI49L is forecast to move toward the west-northwest or northwest during day two (**image 14**). The ECMWF and GFS both do not develop PGI49L, whereas the UKMET begins to show slightly better structure. However, the UKMET shows an eastward tilt with height (not shown). The NOGAPS continues to develop PGI49L and exceeds the subjective definition of genesis quickly. With regards to the environment around PGI49L, the low-levels remain quite moist with low to moderate values of vertical wind shear. The dry air to the NE of PGI49L does not appear to be entrained into the pouch of PGI49L.

Extended Forecast

**T.D. 16 (PGI50L):** T.D. 16 is expected to become extratropical before F048 as it accelerates north-northeastward along the U.S. east coast (e.g. **image 11**). Thereafter, there exists some disagreement with respect to the evolution of the extratropical remnants of T.D. 16. The available model guidance offers two potential scenarios. The first, favored by the GFS, indicates that the remnants of T.D. 16 will continue to race north-northeastward along the Atlantic seaboard, ultimately merging with another extratropical cyclone across eastern Canada. The second, hinted at by the ECMWF, NOGAPS, and others, indicates that the remnants of T.D. 16 will dissipate shy of the North/South Carolina coastline as a secondary extratropical cyclone develops across the lower Mid-Atlantic States. This latter solution

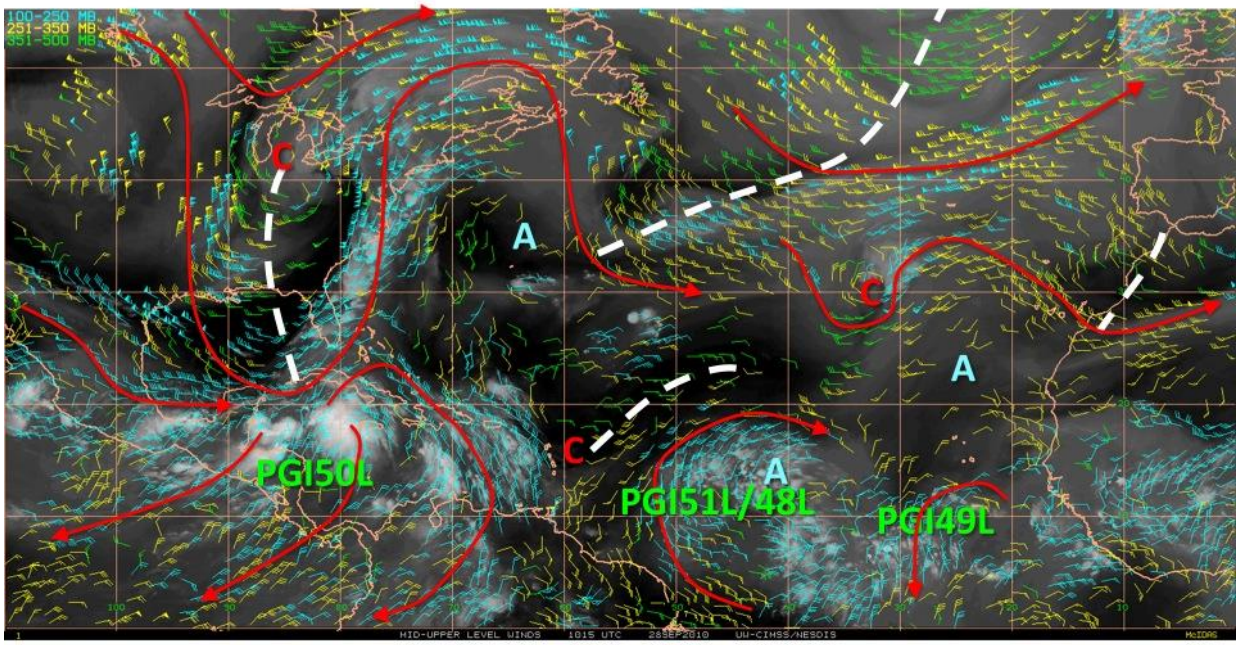
is favored by the NHC at this time. Either way, a significant rainfall and potential downstream development scenario appears to unfold along and east of the eastern U.S. seaboard in association with the recurvature of T.D. 16 between F048 and F084.

Both the GFS and ECMWF indicate that another tropical cyclone may form between F084 and F120 across the northwestern Caribbean Sea between Jamaica and Cuba. Longer-range model forecasts indicate that any such development would likely track to the northeast across Cuba and the Bahamas, similar to but shifted somewhat eastward of that associated with T.D. 16. The current NHC experimental 5-day genesis product indicates a 20% chance for tropical development following Matthew across the northwestern Caribbean through F120. This potential development will be closely monitored in the coming days.

The 48+ hr official NHC forecast for T.D. 16 is as follows:
48HR VT 30/1200Z 31.0N 78.5W 40 KT...POST-TROP/EXTRATROP
72HR VT 01/1200Z...DISSIPATED

**PGI48L/PGI51L:** PGI51L is not forecast to develop by any of the models as it continues westward. However, the ECMWF suggests that PGI48L may start to develop on 30 Sep or 1 Oct as it turns toward the west-northwest (**image 13**). The forecast increase in strength by the ECMWF is indicated by the increase in Okubo-Weiss values associated with PGI48L to ~2 x 10^-9 s^-2 starting at ~0000 UTC 1 October. The ECMWF ensemble forecast (not shown) reveals that many members indicate slow organization of PGI48L in the 3-4 day time range. None of the members of the NCEP ensemble (not shown) forecast genesis from either PGI48L or PGi51L through 3-5 days.

**PGI49L:** PGI49L is forecasted by the consensus of the models to move toward the northwest in the extended range (**image 14**). The GFS is the only model which does not show any development. The ECMWF and some of its ensemble members show development toward day 4 and 5. This can be seen in the deterministic run with a slight uptick in OW and relative vorticity values by day 5. However, an examination of the OW fields indicates that the system has trouble attaining vertical coherence. The UKMET and NOGAPS are the strongest of the models. The tilt seen on day 2 in the UKMET disappears by day 3 indicative of a deeper, stronger circulation. As PGI49L moves poleward, it may have to deal with increasing amounts of vertical wind shear – upwards of 12-16 m/s by the end of the period. The GFS increases the vertical wind shear much more quickly, and hence, may be why it doesn't develop PGI49L at all.




1015 UTC 28 Sep

A = Upper-level anticyclone

C = Upper-level cyclone

Representative streamline

Upper-level trough axis

**Image 1**

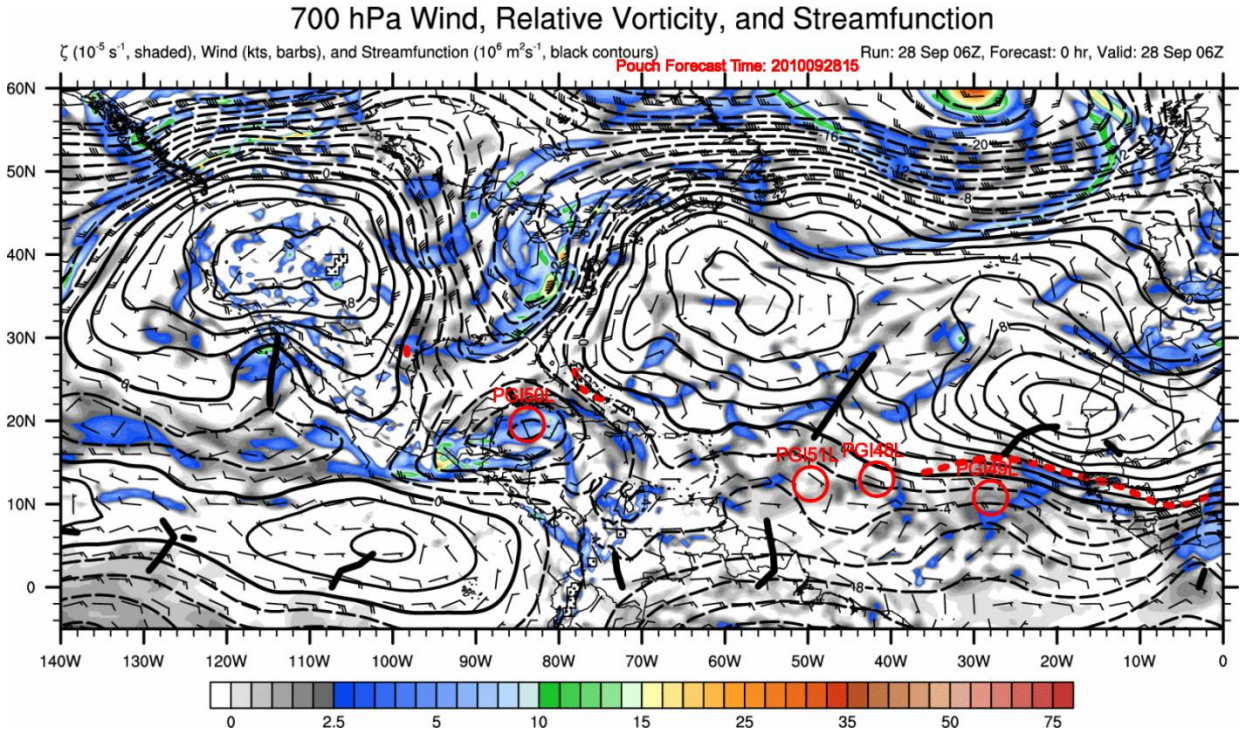

700 hPa Wind, Relative Vorticity, and Streamfunction
ζ (10^-5 s^-1, shaded), Wind (kts, barbs), and Streamfunction (10^6 m^2s^-1, black contours)
Run: 28 Sep 06Z, Forecast: 0 hr, Valid: 28 Sep 06Z
Pouch Forecast Time: 2010092815
60N
50N
40N
30N
20N
10N
0
140W
130W
120W
110W
100W
90W
80W
70W
60W
50W
40W
30W
20W
10W
0
PGI50L
PGI51L
PGI48L
PGI49L
0
2.5
5
10
15
25
35
50
75

**Image 2**

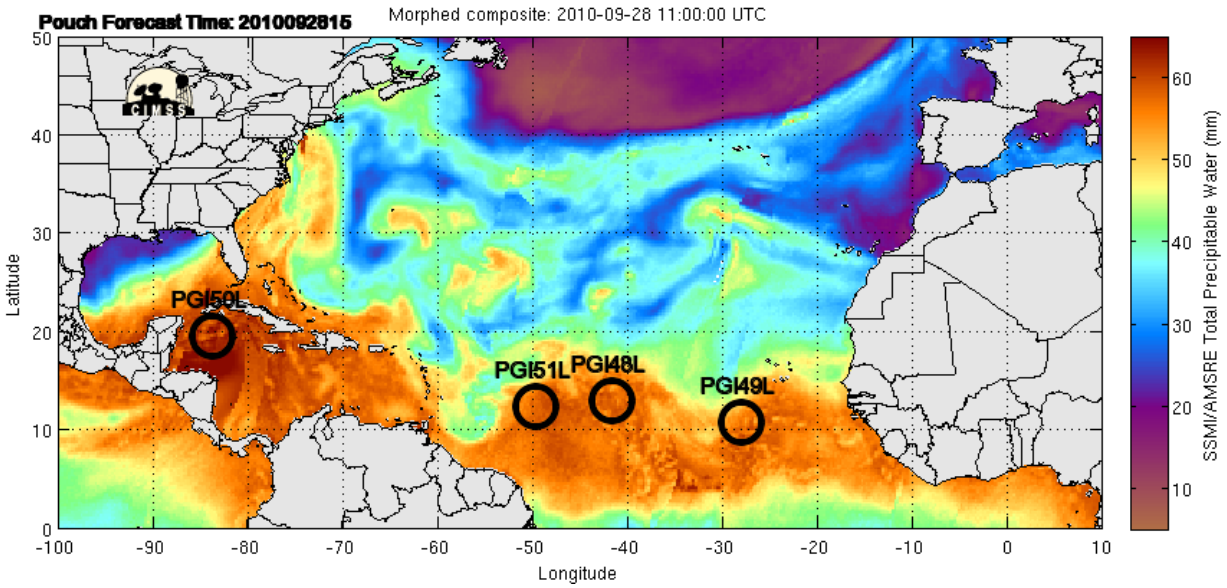

Pouch Forecast Time: 2010092815
Morphed composite: 2010-09-28 11:00:00 UTC
PGI50L
PGI51L
PGI48L
PGI49L
Latitude
Longitude
SSMI/AMSRE Total Precipitable Water (mm)

**Image 3**

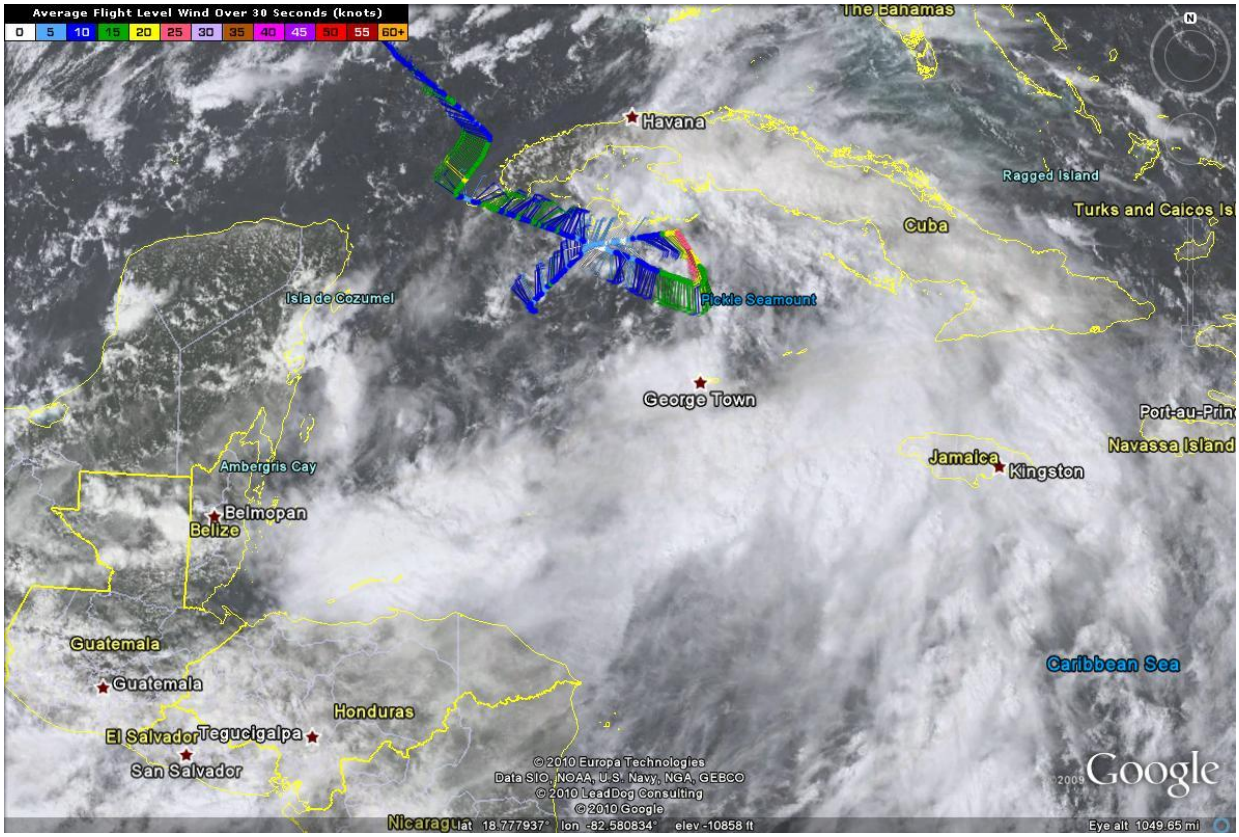

Average Flight Level Wind Over 30 Seconds (knots)
0 5 10 15 20 25 30 35 40 45 50 55 60+
The Bahamas
Havana
Ragged Island
Cuba
Turks and Caicos Is
Isla de Cozumel
Pickie Seamount
George Town
Port-au-Prin
Navassa Island
Jamaica
Kingston
Ambergris Cay
Belmopan
Belize
Guatemala
Guatemala
Caribbean Sea
Honduras
El Salvador
Tegucigalpa
San Salvador
Nicaragua
© 2010 Europa Technologies
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2010 LeadDog Consulting
© 2010 Google
Google
lat 18.777937° lon -82.580834° elev -10858 ft
Eye alt 1049.65 mi

**Image 4**

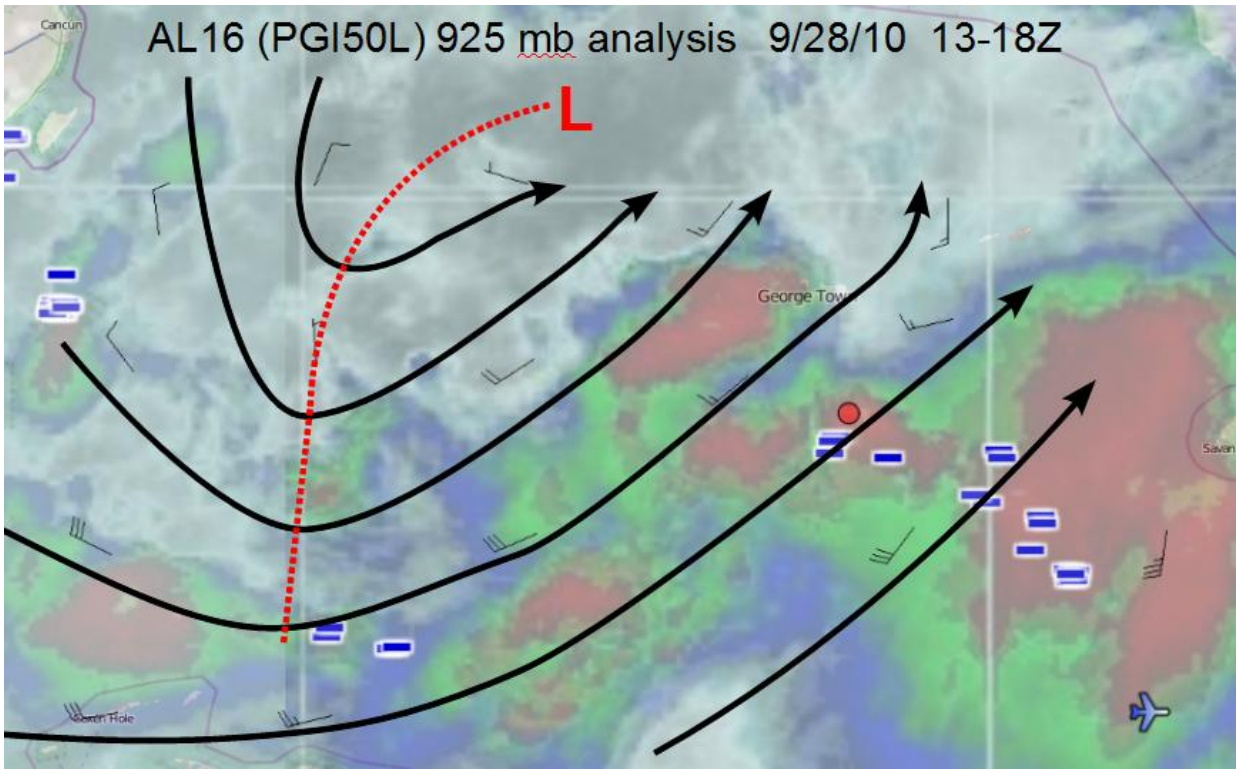



**Image 5**

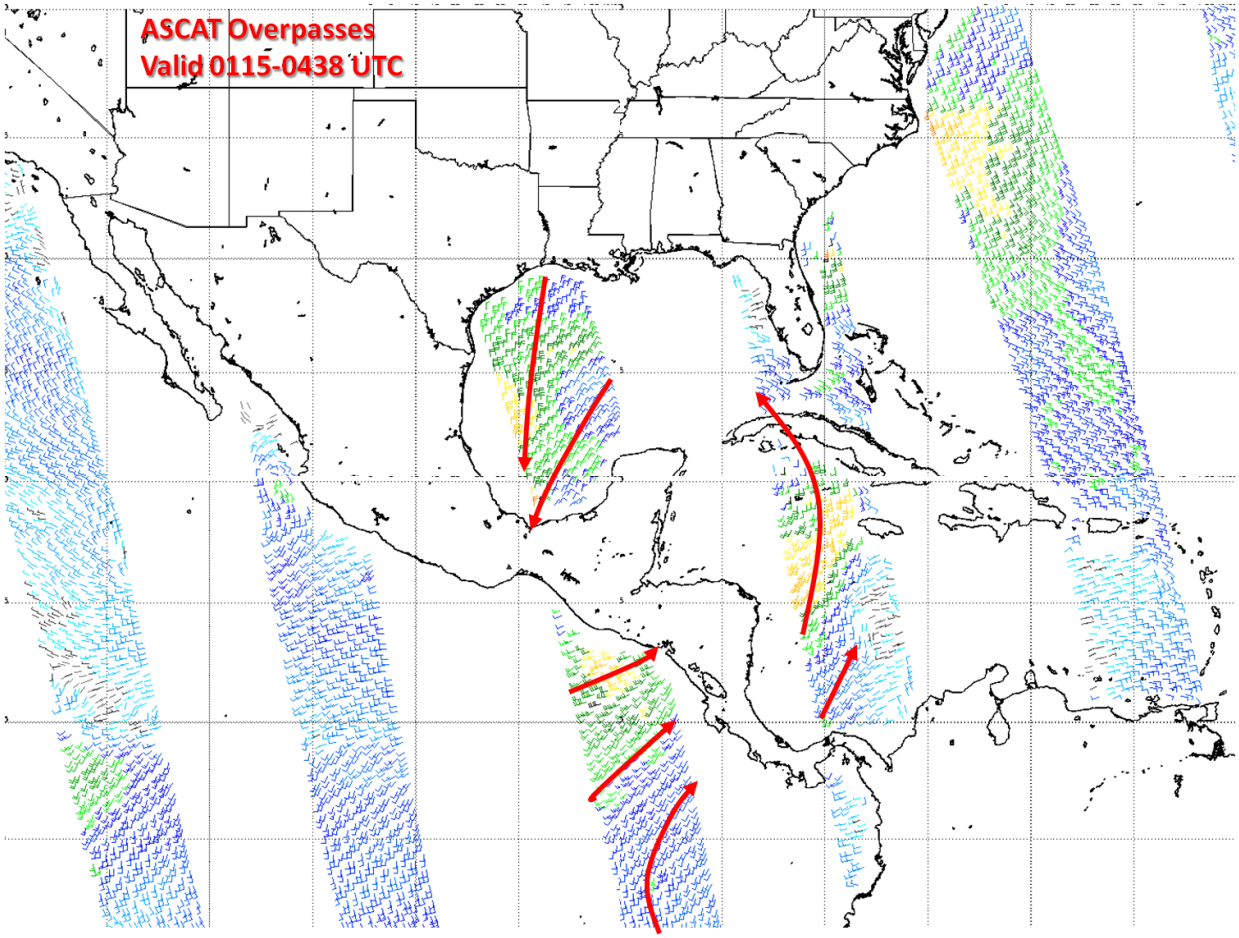



**Image 6**

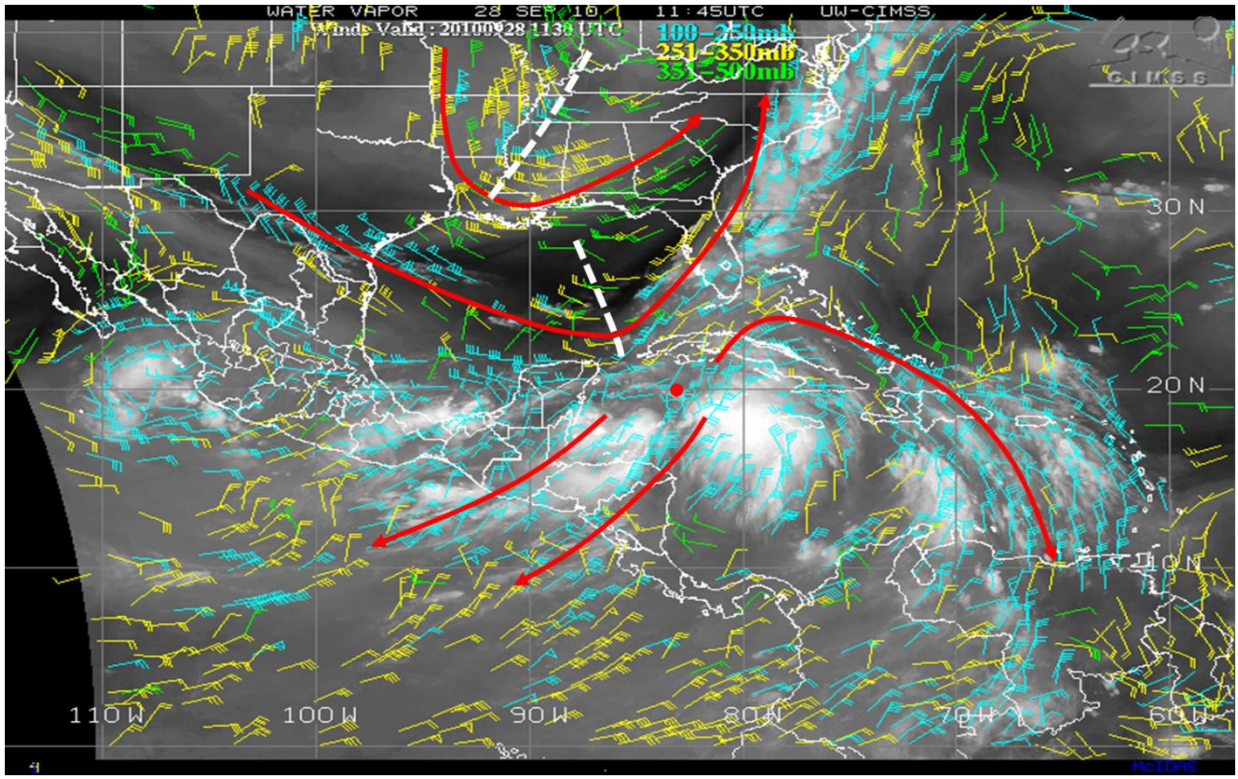

WATER VAPOR 28 SEP 10 11:45UTC UW-CIMSS
Winds Valid:20100928 1130 UTC
100-250mb
251-350mb
351-500mb
30 N
20 N
10 N
110 W
100 W
90 W
80 W
70 W
60 W

**Image 7**

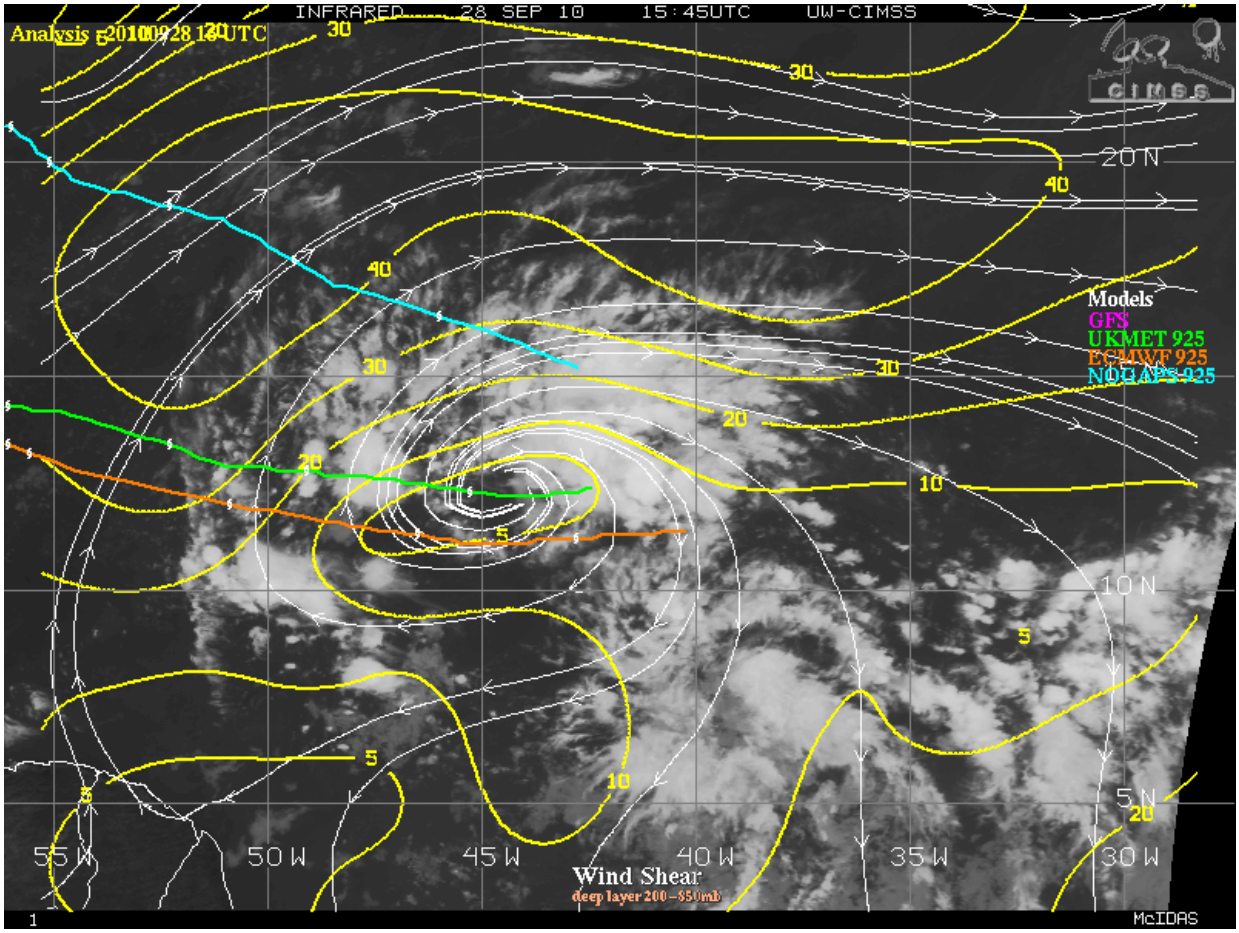

INFRARED 28 SEP 10 15:45UTC UW-CIMSS
Analysis 20100928 18UTC
CIMSS
20 N
10 N
5 N
Models
GFS
UKMET 925
ECMWF 925
NOGAPS 925
55 W
50 W
45 W
40 W
35 W
30 W
Wind Shear
deep layer 200-850mb
McIDAS

**Image 8**

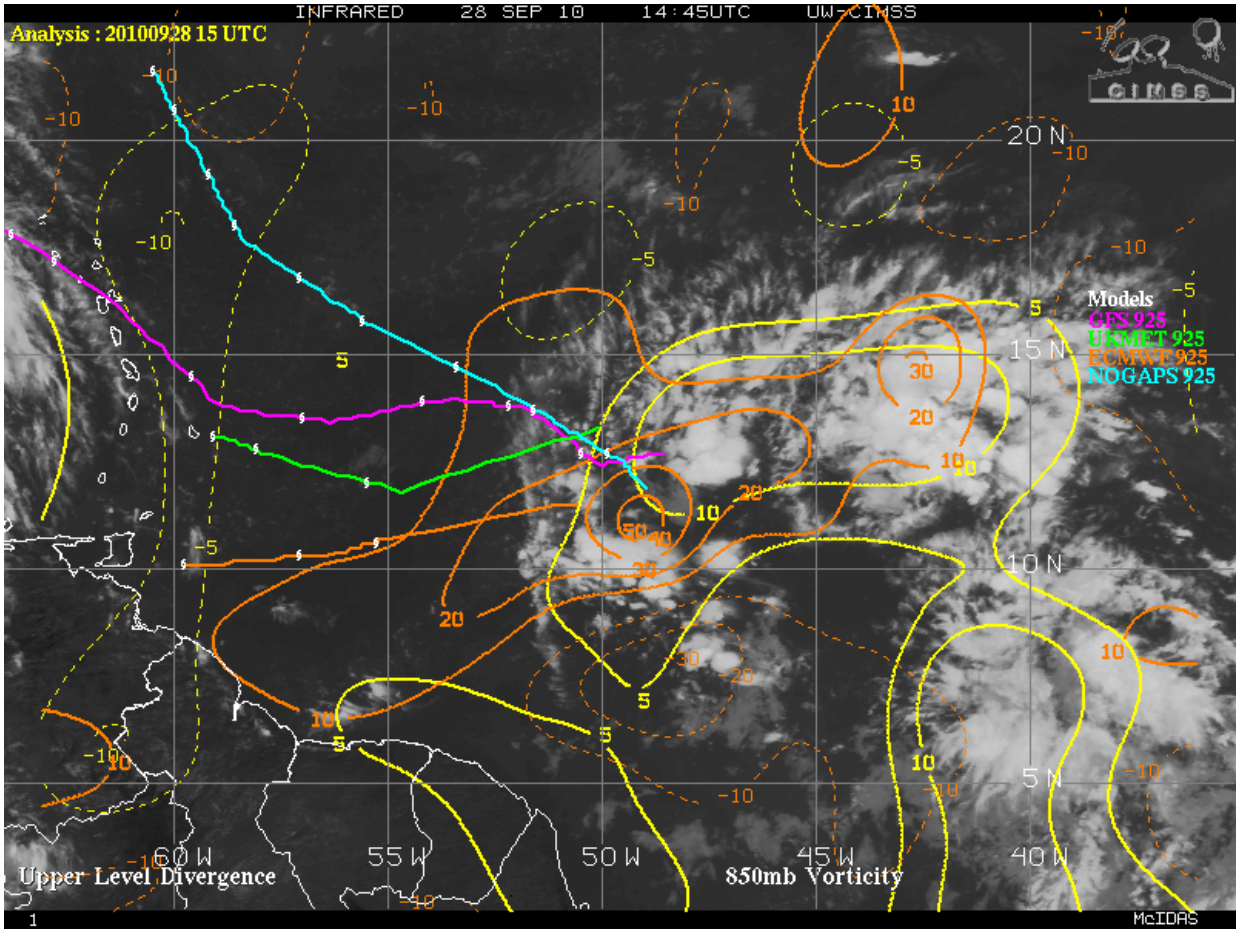

INFRARED 28 SEP 10 14:45UTC UW-CIMSS
Analysis : 20100928 15 UTC
CIMSS
20 N
15 N
10 N
5 N
60 W
55 W
50 W
45 W
40 W
Models
GFS 925
UKMET 925
ECMWF 925
NOGAPS 925
Upper Level Divergence
850mb Vorticity
1
McIDAS

**Image 9**

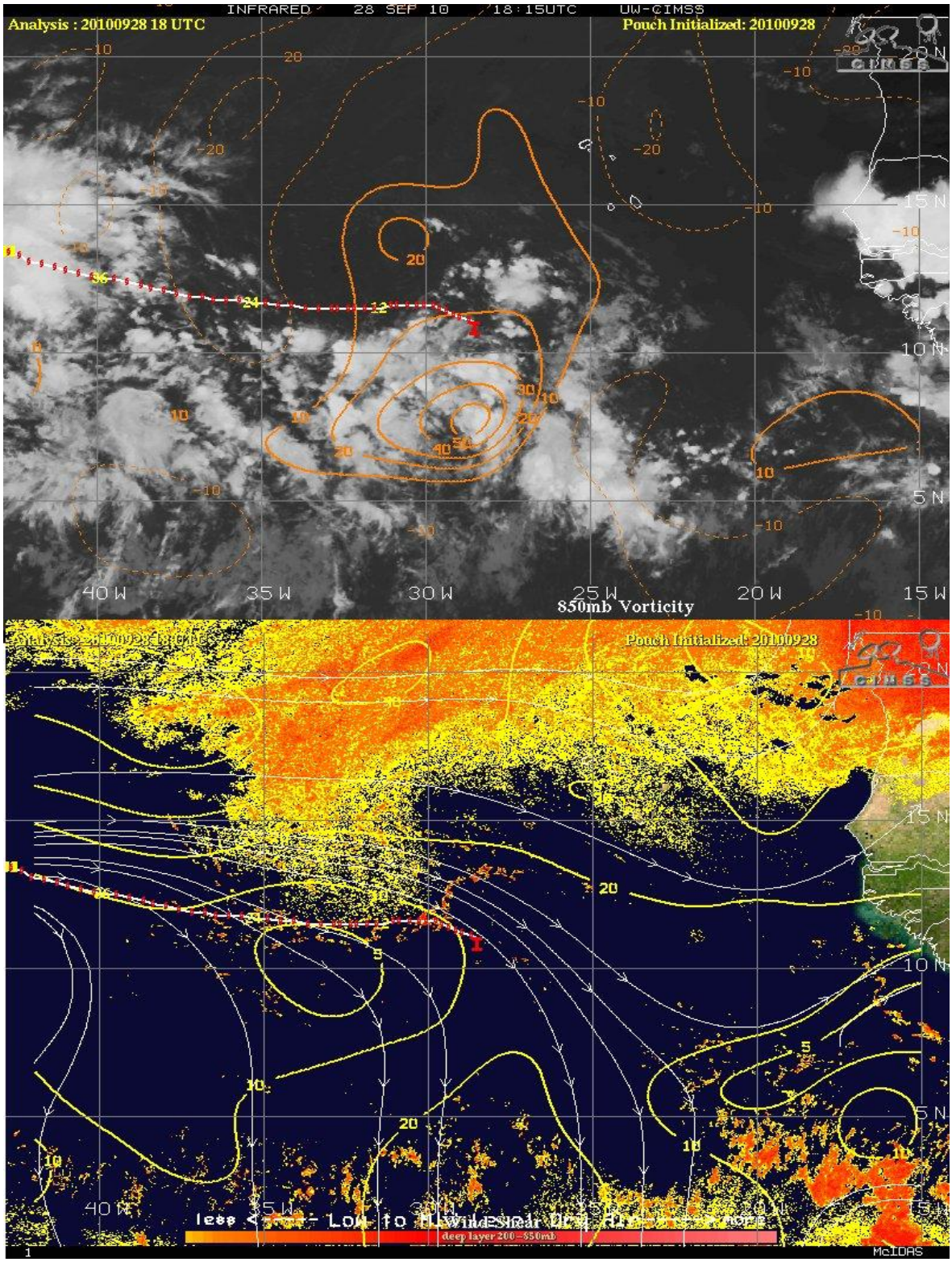
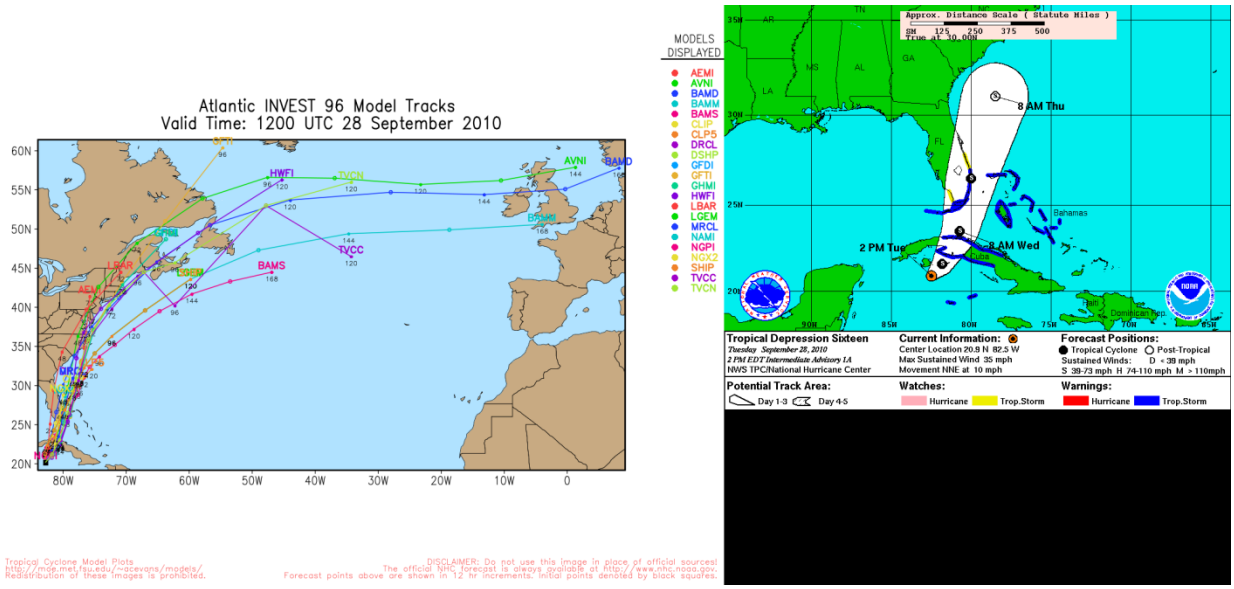

INFRARED 28 SEP 10 18:15UTC UW-CIMSS
Analysis : 20100928 18 UTC
Pouch Initialized: 20100928
850mb Vorticity
Pouch Initialized: 20100928
40 W
35 W
30 W
25 W
20 W
15 W
20 N
15 N
10 N
5 N
deep layer 200-850mb
McIDAS

**Image 10**




Tropical Cyclone Model Plots
http://moe.met.fsu.edu/~acevans/models/
Redistribution of these images is prohibited.

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.

**Image 11**

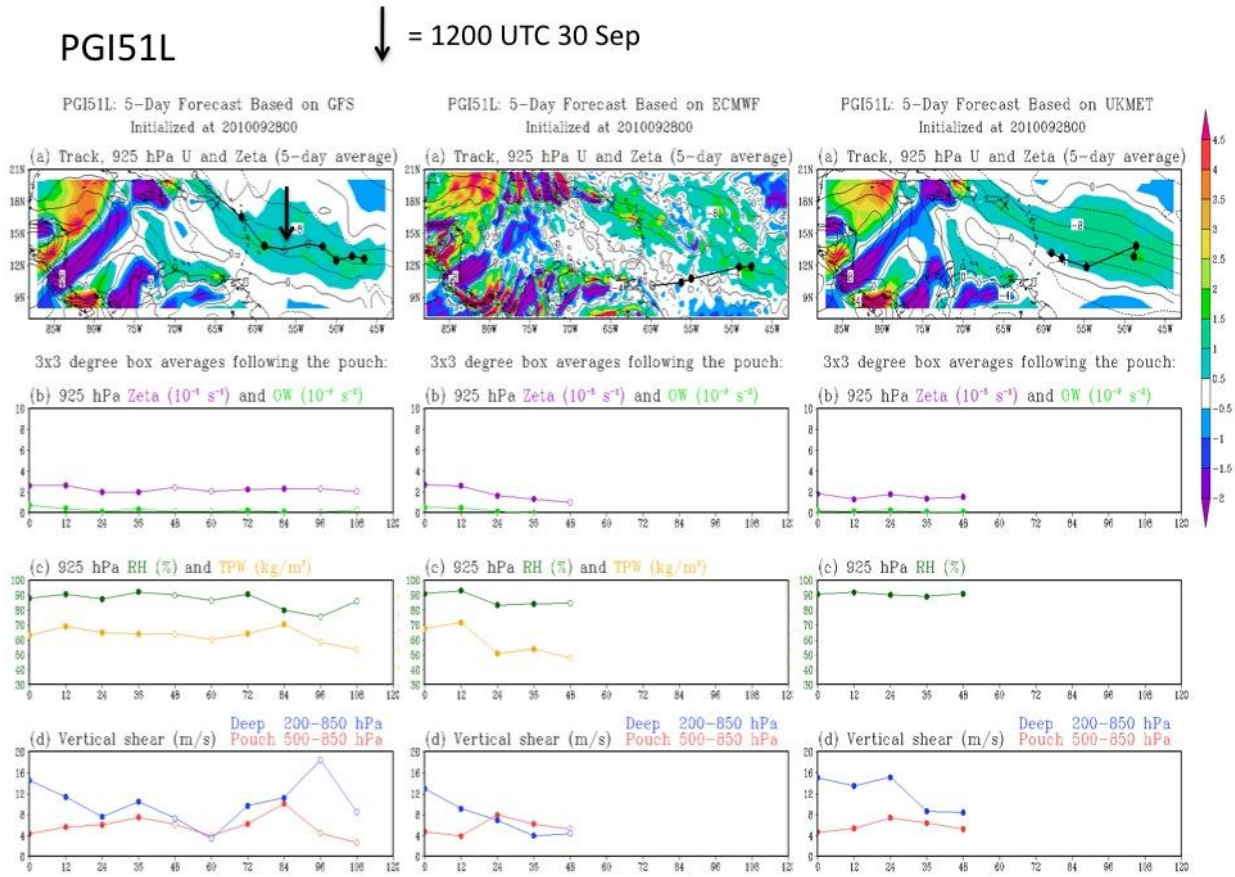

PGI51L
= 1200 UTC 30 Sep
PGI51L: 5-Day Forecast Based on GFS
Initialized at 2010092800
PGI51L: 5-Day Forecast Based on ECMWF
Initialized at 2010092800
PGI51L: 5-Day Forecast Based on UKMET
Initialized at 2010092800
(a) Track, 925 hPa U and Zeta (5-day average)
3x3 degree box averages following the pouch:
(b) 925 hPa Zeta ($10^{-6}$ $s^{-1}$) and OW ($10^{-9}$ $s^{-2}$)
(c) 925 hPa RH (%) and TPW ($kg/m^2$)
(d) Vertical shear (m/s)
Deep 200-850 hPa
Pouch 500-850 hPa

**Image 12**

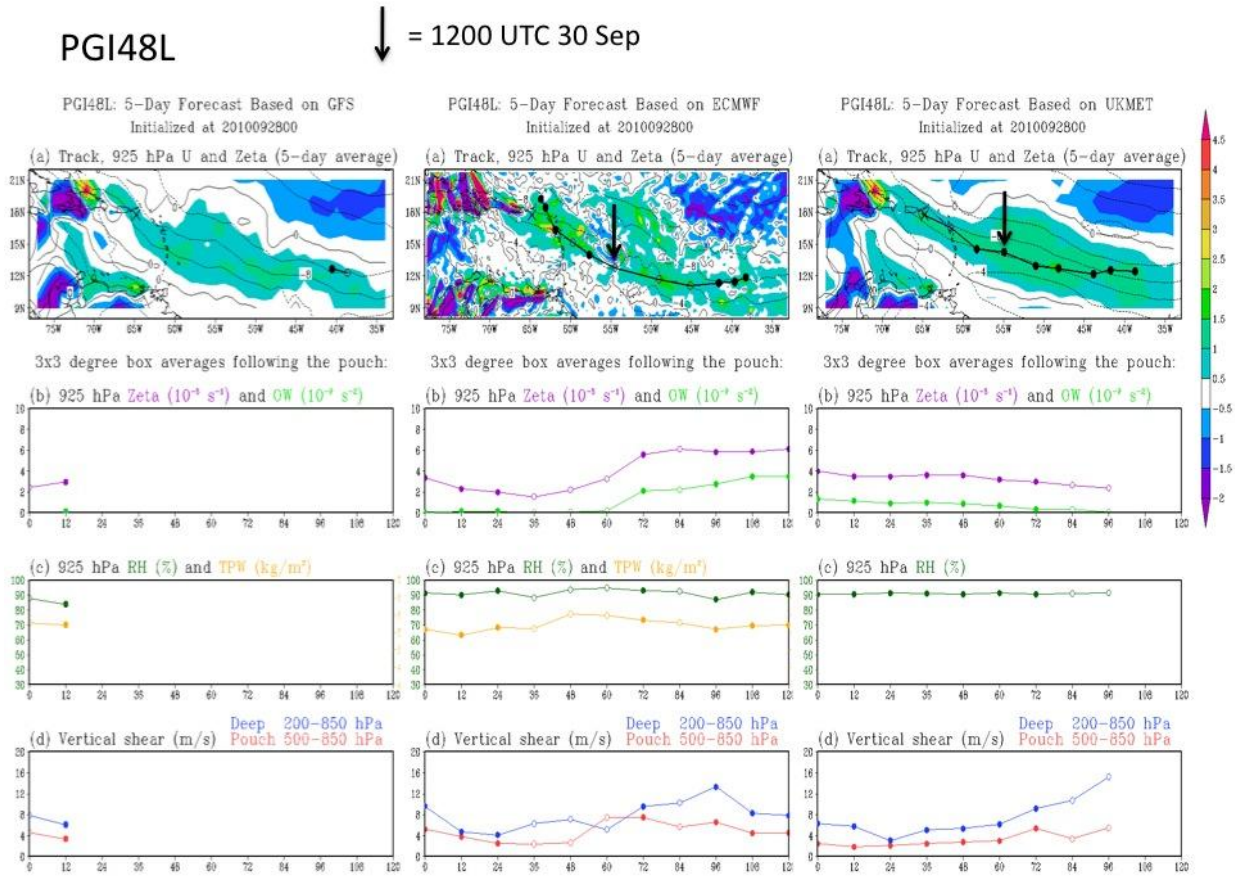

PGI48L
= 1200 UTC 30 Sep
PGI48L: 5-Day Forecast Based on GFS
Initialized at 2010092800
PGI48L: 5-Day Forecast Based on ECMWF
Initialized at 2010092800
PGI48L: 5-Day Forecast Based on UKMET
Initialized at 2010092800
(a) Track, 925 hPa U and Zeta (5-day average)
3x3 degree box averages following the pouch:
(b) 925 hPa Zeta ($10^{-6}$ $s^{-1}$) and OW ($10^{-6}$ $s^{-2}$)
(c) 925 hPa RH (%) and TPW (kg/m²)
(d) Vertical shear (m/s)
Deep 200-850 hPa
Pouch 500-850 hPa

**Image 13**

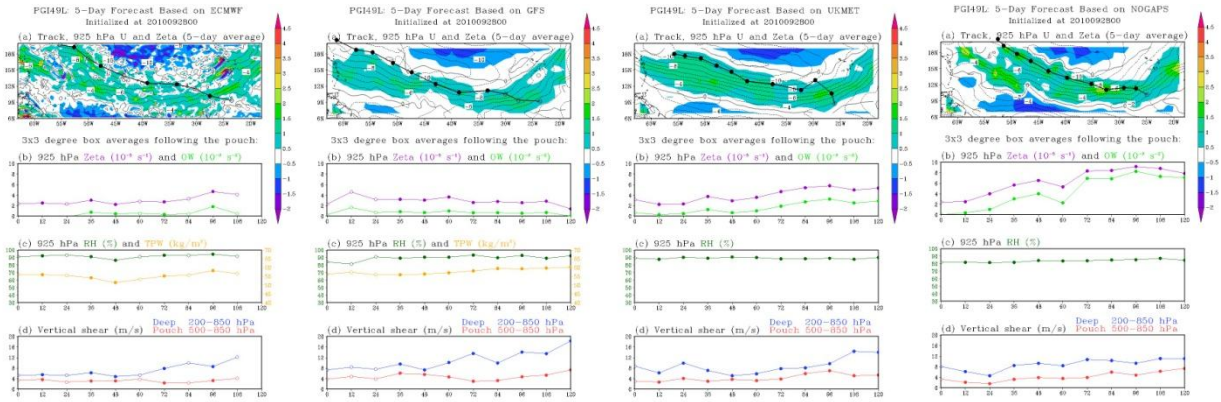

PGI49L 5-Day Forecast Based on ECMWF
Initialized at 2010092800
PGI49L 5-Day Forecast Based on GFS
Initialized at 2010092800
PGI49L 5-Day Forecast Based on UKMET
Initialized at 2010092800
PGI49L 5-Day Forecast Based on NOGAPS
Initialized at 2010092800
(a) Track, 925 hPa U and Zeta (5-day average)
3x3 degree box averages following the pouch:
(b) 925 hPa Zeta (10⁻⁵ s⁻¹) and OW (10⁻⁵ s⁻²)
(c) 925 hPa RH (%) and TPW (kg/m²)
(c) 925 hPa RH (%)
(d) Vertical shear (m/s) Deep 200–850 hPa Pouch 500–850 hPa

**Image 14**