Hi all,

Friday map discussion resumed on 8 Sep. Links, imagery, and text used during the discussion can be found here (http://www.atmos.albany.edu/mapdisco/20170908/). Older Friday map discussion synopses going back to April 2014 can be found here (http://www.atmos.albany.edu/mapdisco/). Tomer Burg and Eric Bunker assisted with the discussion.

I'll start with a few forecast comments. We need to step back in time 10–20 years and remember that typical TC track and intensity city errors were much larger back then than they are now. The improvements in the skill of global numerical weather prediction models in the last 10–20 years have been nothing short of extraordinary by any measure. Likewise, the introduction of ensemble-based operational numerical weather prediction made possible by rapid computational advances has been equally extraordinary. Kudos to all of the folks everywhere, the vast majority of whom have gone unrecognized, who have made these extraordinary advances in global numerical weather prediction possible.

That said, there have been uncertainties in the forecast track of Irma that have already been discussed on the map listserv with the dominant error being forecasts that were initially too far east on Irma's turn poleward and a tad too fast on its poleward movement. When you have a westward-moving TC and the NNW-SSE oriented Florida peninsula located westward of the TC in play for a possible Florida landfall you have a very difficult forecast challenge when a turn to the north is forecast for any TC near the ~250 km wide Florida peninsula. This forecast challenge can be illustrated nicely through Brian Tang's Tropical Cyclone Guidance web page (http://www.atmos.albany.edu/facstaff/tang/tcguidance/index.html). Brian's web page contains a very useful separate link to real-time TC track and intensity errors for a variety of deterministic and ensemble forecasts (http://www.atmos.albany.edu/facstaff/tang/tcguidance/index.html). If, for example, we compare the probabilistic track information for TC Irma from the EPS and GEFS runs from 0000 UTC 9 Sep 2017 from Brian's web site (see appended maps below), we see that there is a
~150–200 km difference in the location of the centroid of the probabilistic track envelope between the two models with the EPS farther to the west (correctly) than the GEFS. This 150–200 km difference in centroid location represents a significant subset of the 250 km width of the Florida peninsula at its widest point (TPA–MLB) and illustrates the difficult nature of the practical forecast challenge. Kudos to the NHC folks for rising to the occasion and to the TC Irma forecast challenge under trying circumstances with their usual professionalism and dedication.

Although the EPS has outperformed the GEFS on TC Irma's track and intensity as of this writing (Sat afternoon 9 Sep), the width of the EPS probabilistic track envelope based on a probability value of ~50% on the left and right side of this envelope is ~200–250 km. This

200–250 km value is comparable to the mean absolute error (MAE) of various model forecasts between 72–96 h for TC Irma according to Brian Tang's statistics (see image below). In the case of Irma, the FEMA and state emergency management folks have had to make evacuation decisions when the MAE was comparable to or even larger than the width of the Florida peninsula (e.g., 96 h). Given these uncertainty numbers and given that TCs that are forecast to track anywhere near Florida can induce "hurricane hysteria" in a subset of the population, the challenge, magnitude and timing of any evacuation effort is readily apparent.

The science issue we wrestled with during Friday map discussion was the possible sources of forecast error on the delayed poleward turn of TC Irma relative to the available numerical guidance. On Sunday 3 Sep 2017, I sent the following email to Ryan Torn with four testable hypotheses that could be used to examine the expected future behavior of TC Irma. During Friday map discussion, we created a fifth hypothesis that is related to TC Katia in the southwestern Gulf of Mexico. This fifth hypothesis is appended below my aforementioned email. Hopefully, some members of the map listserv will take the dangled bait.

No Friday map discussion next week because of the departmental picnic.

Lance

From: "Bosart, Lance F" <lbosart@albany.edu>

Subject: Re: So, where will TC Irma go?

Date: 3 September, 2017 at 23:28:13 GMT

To: "Torn, Ryan" <rtorn@albany.edu>

Cc: "Bosart, Lance F" <lbosart@albany.edu>

Hi Ryan,

Appended are four half-baked testable hypotheses that I formulated based on a relatively quick and dirty examination of the current and recent past flow patterns and a sampling of GEFS and EPS forecasts beginning with the 0000 UTC 3 Sep 2017 forecast cycle.

1. Hypothesis #1: A combination of northerly flow behind an observed (but poorly forecast) PV streamer extending equatorward to near 20 N and westward to near 30 W at 1200 UTC 1 Sep 2017 combined with a less amplified and poleward shifted 500-hPa anticyclone located near 32 N and 35 W at the same time collectively act to alter the central Atlantic steering currents sufficiently over the next 48–60 h to force TC Irma to deviate temporarily to the WSW as it moves westward across the North Atlantic. The extent of the temporary WSW deviation in Irma's track contributes to how the storm will interact with a trough over the eastern CONUS later this week.

2. Hypothesis #2: Stronger than forecast cyclonic wave breaking associated with the ET of TC Sanvu in the northwestern Pacific on 1–2 Sep 2017 resulted in the amplification of the downstream flow, the formation of a Rossby wave train, and a negatively tilted trough over the northeastern Pacific. The development of the negatively tilted trough over the northeastern Pacific facilitates ridge amplification over western Canada through diabatically induced negative PV advection by the irrotational wind. Ridge amplification over western Canada enables a stronger and deeper short wave trough to reach ND/MN by 1200 UTC 4 Sep. If this trough lifts out to the northeast before it can interact with TC Irma then the storm is less likely to curve out to sea after it turns poleward.

3. Hypothesis #3: If the ND/MN trough lifts out to the northeast too quickly and is followed by an eastward-buidlin ridge across southern Canada in the absence of any significant additional upstream troughing then Irma could be trapped under the ridge as the SW flow steering current weakens and an "escape route" to the northeast closes after making landfall in the Southeast. In this case, Irma would be left to wander aimlessly as it fills and rains itself out with the possibility of devastating flooding over parts of the central Appalachians.

4. Hypothesis #4: If a weak upper-level trough rotating around the deep trough forecast to set up shop in the east-central Pacific by 4 Sep 2017 can break through the western Conus ridge could be in a position to interact with Irma as the upper-level flow flattens and the western CONUS ridge builds eastward across southern Canada as Irma reaches the southeastern coast of the U.S. A "Fujiwhara-like" interaction of the upper-level trough associated with Irma with any subsequent trough that breaks through the western CONUS ridge would further facilitate the trapping of Irma under the expanding and flattening ridge along the U.S.-Canada border, a situation that could pose a significant flooding threat if the storm stalls near the central Appalachians.

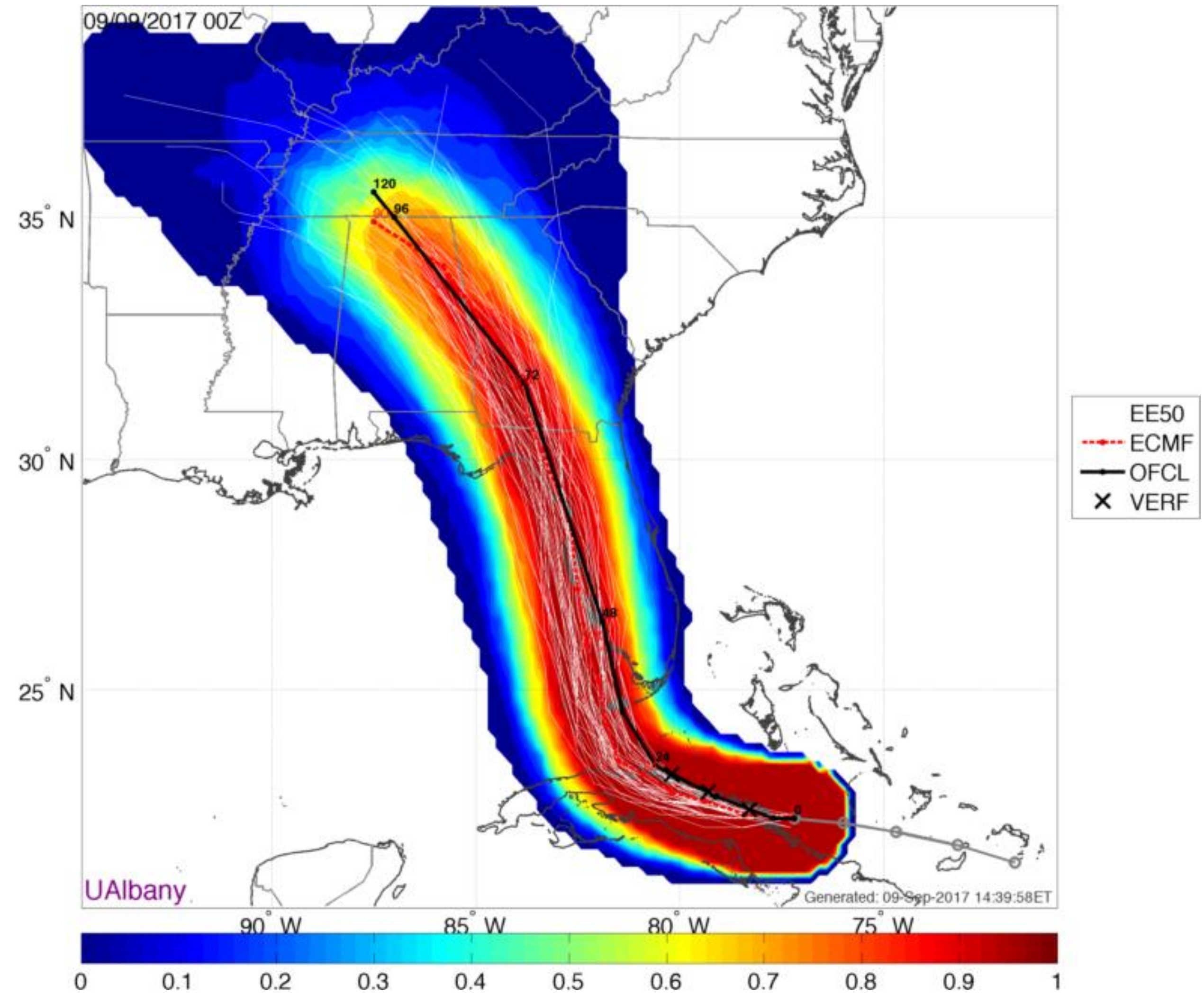
You pay your money and you take your chances.

Lance

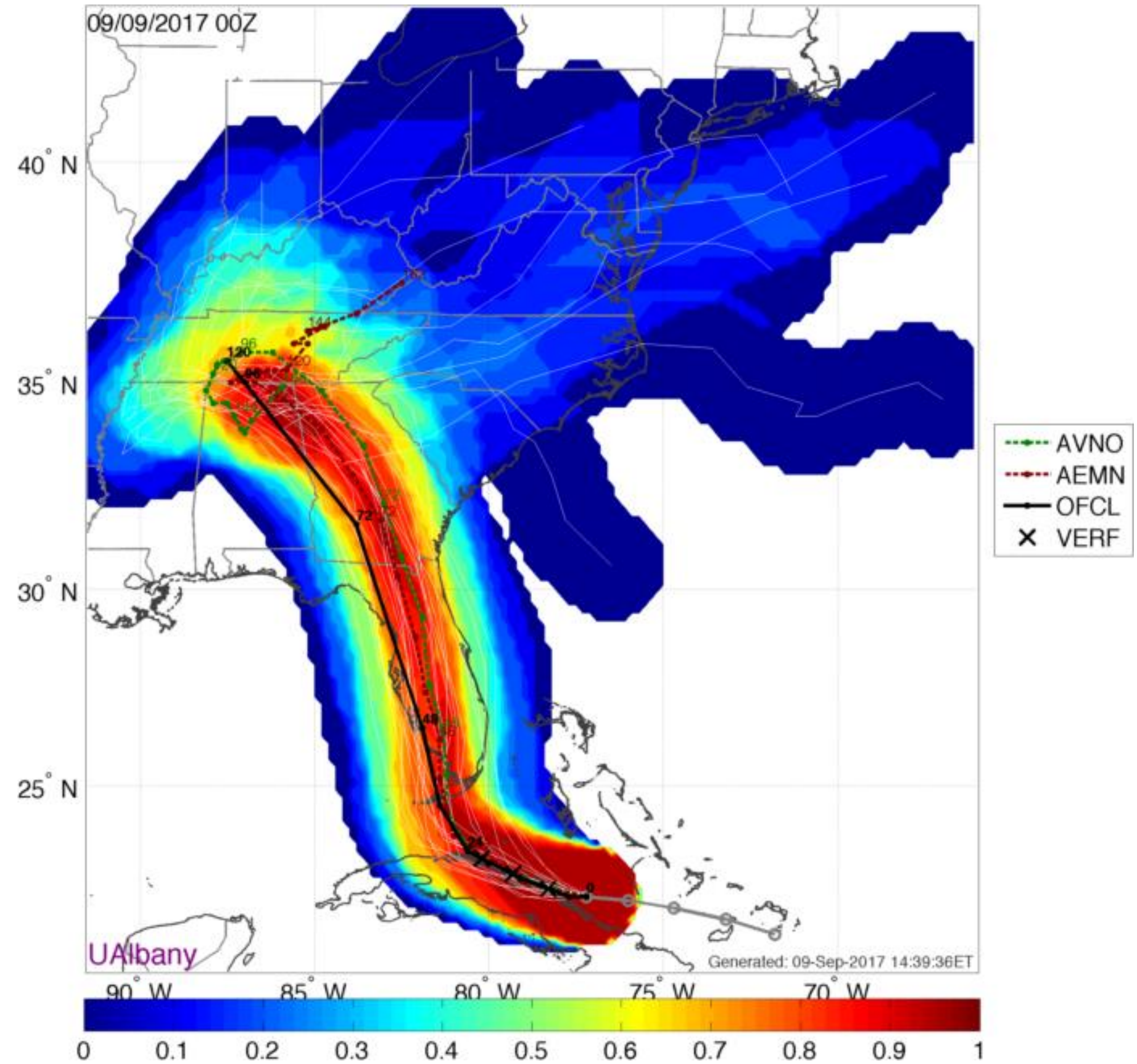
…………………..

Hypothesis #5: Poleward-directed diabatically driven upper-level outflow from TC Katia and from TC Irma collectively acted to effectively extend the axis of the upper-level anticyclone located over the western North Atlantic back to the Gulf of Mexico. This westward extension of the axis of the aforementioned upper-level anticyclone enabled a stronger deep easterly steering current in which TC Irma was embedded to extend farther westward than forecast. This fifth hypothesis rest on the idea that the global models are like underestimating the magnitude of TC-related diabatically driven upper-level outflow.

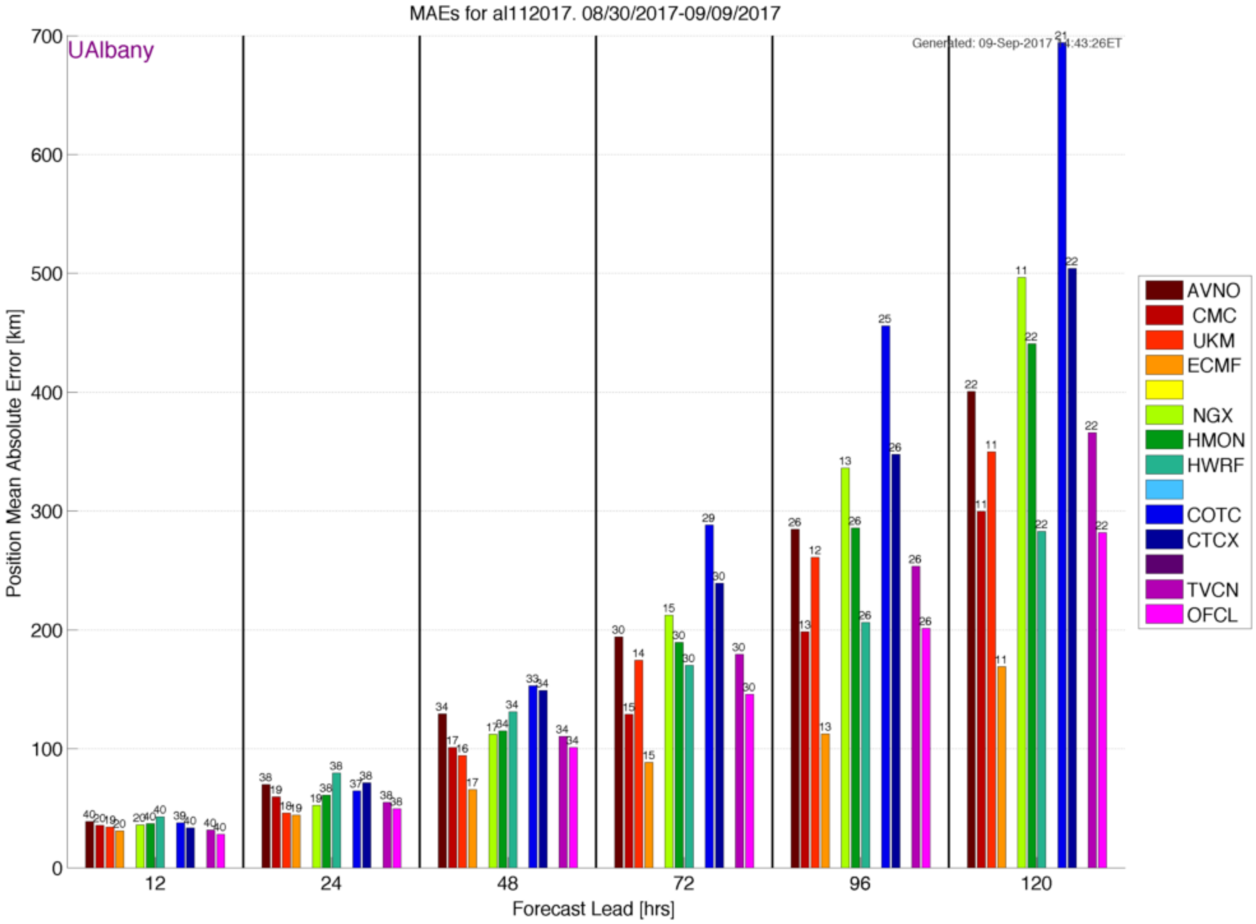
……………………..



09/09/2017 00Z
120
96
72
48
24
0
35° N
30° N
25° N
90° W
85° W
80° W
75° W
EE50
ECMF
OFCL
VERF
UAlbany
Generated: 09-Sep-2017 14:39:58ET
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1



09/09/2017 00Z
40° N
35° N
30° N
25° N
90° W
85° W
80° W
75° W
70° W
AVNO
AEMN
OFCL
VERF
UAlbany
Generated: 09-Sep-2017 14:39:36ET
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1



MAEs for al112017. 08/30/2017-09/09/2017
UAlbany
Generated: 09-Sep-2017 14:43:26ET
Position Mean Absolute Error [km]
Forecast Lead [hrs]
0
100
200
300
400
500
600
700
12
24
48
72
96
120
AVNO
CMC
UKM
ECMF
NGX
HMON
HWRF
COTC
CTCX
TVCN
OFCL