In the original set of about 80 cases, HEDAS showed promise in assimilating aircraft data, but had issues with a distinct weak bias at initial times for strong storms (spinup).

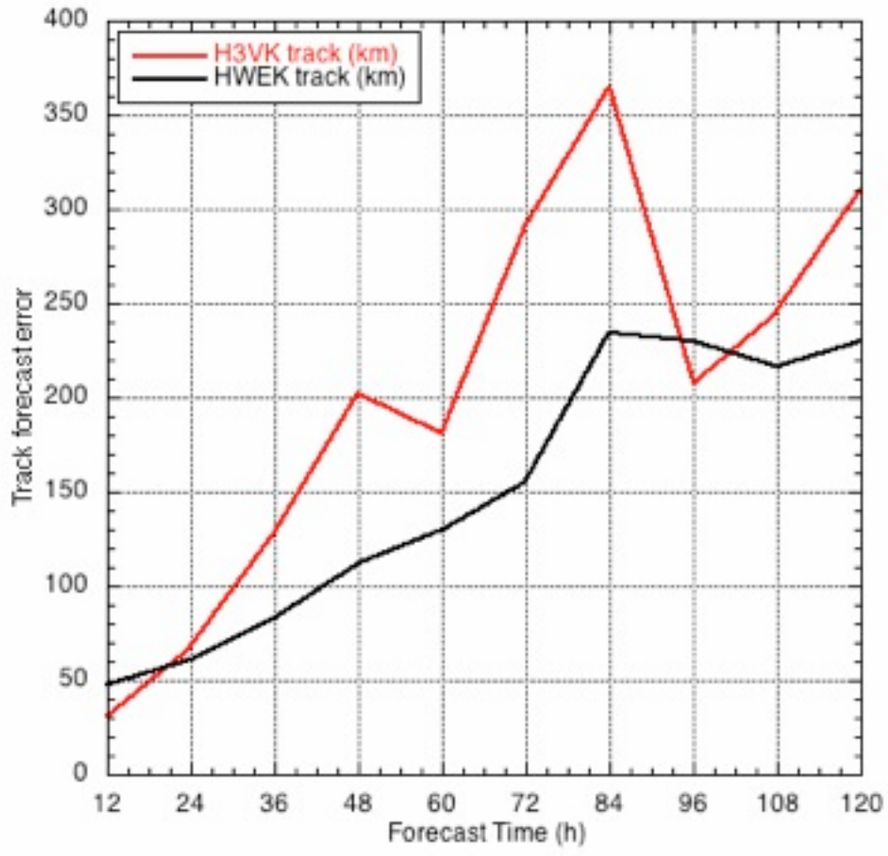
For 2012, a number of upgrades were made to HEDAS:

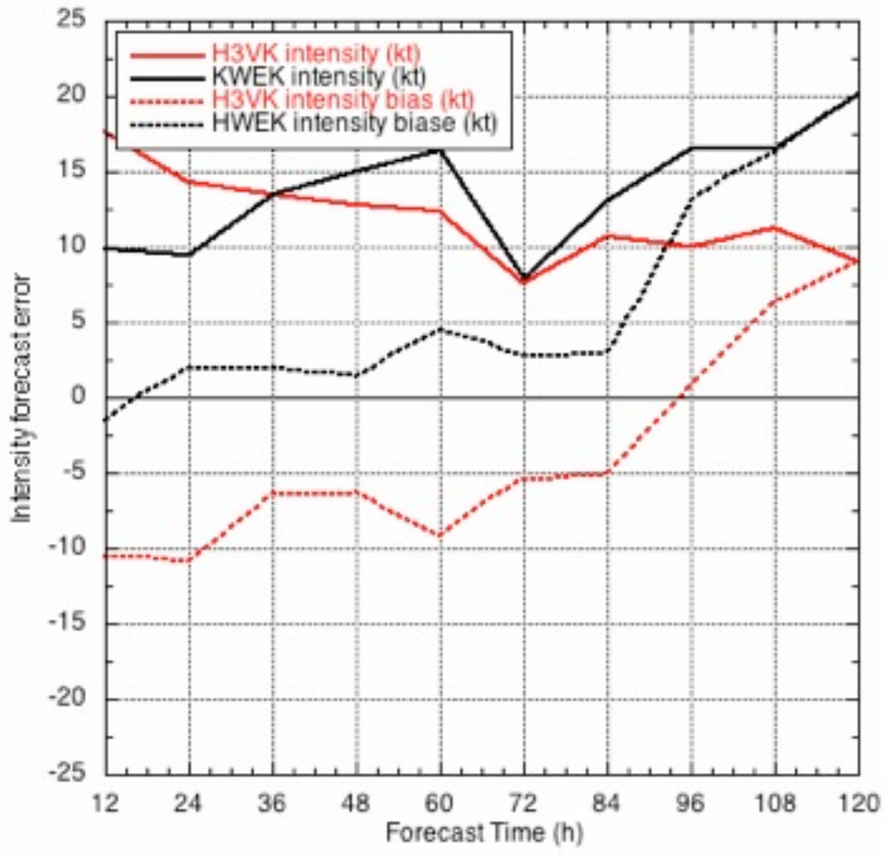
1. Use of the most recent version of HWRF (V3.4).
2. Use of restart files so that all prognostic variables are updated (including vertical motion tendency)
3. Cases are set to mimic operations (time window ±3 h instead of based on flights)
4. Data are assimilated in storm-relative coordinates due to possible stretching of vortex due to storm movement during cycling.

These changes were tested for Hurricane Earl (11 cases) and led to further substantial improvements to track forecasts and a reduction of the low intensity bias.

H3VK - 2011 version of HEDAS

HWEK - 2012 version of HEDAS





HEDAS has been run for 52 cases in the Atlantic during 2012 (whenever aircraft data are available).

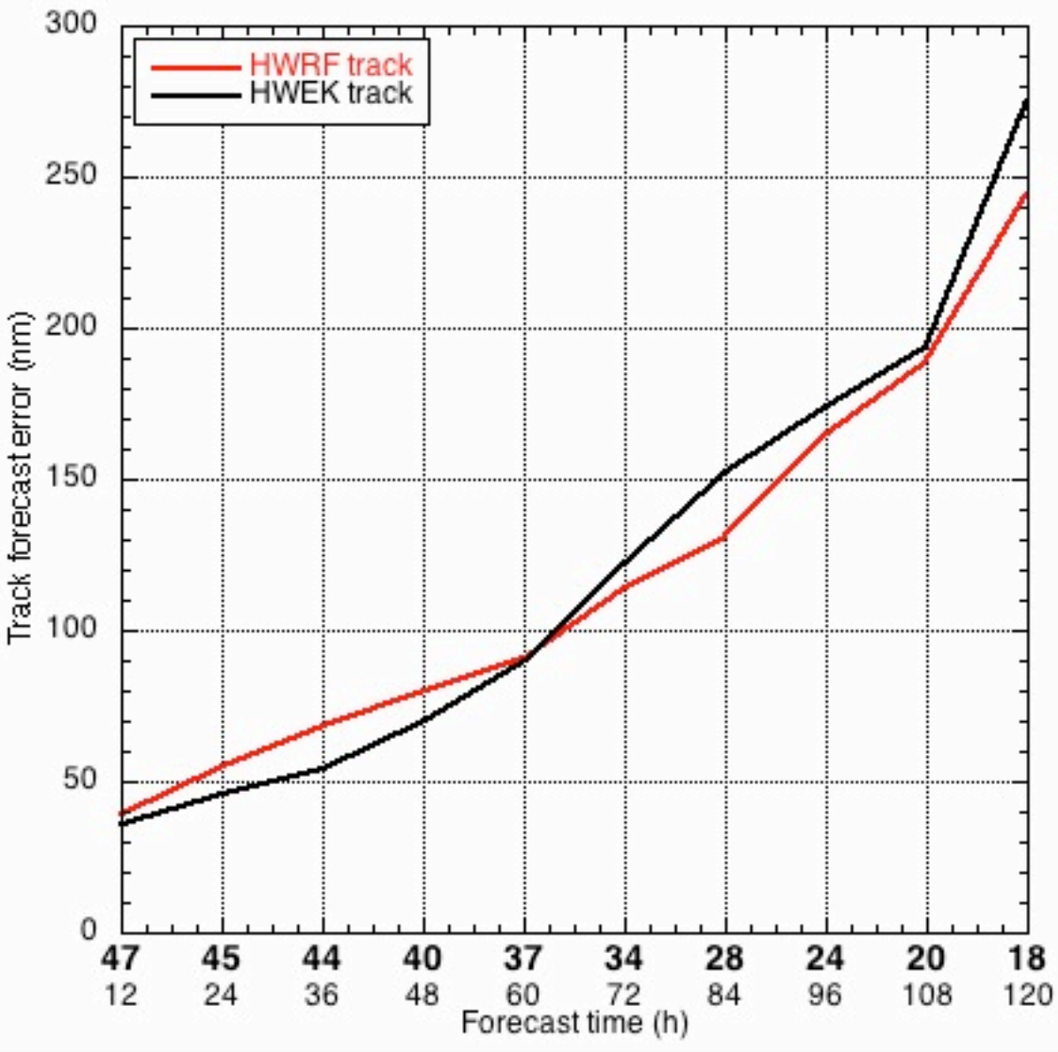
All aircraft data (dropwindsonde[1], flight-level[2], SFMR, Doppler) are assimilated if within the time window.

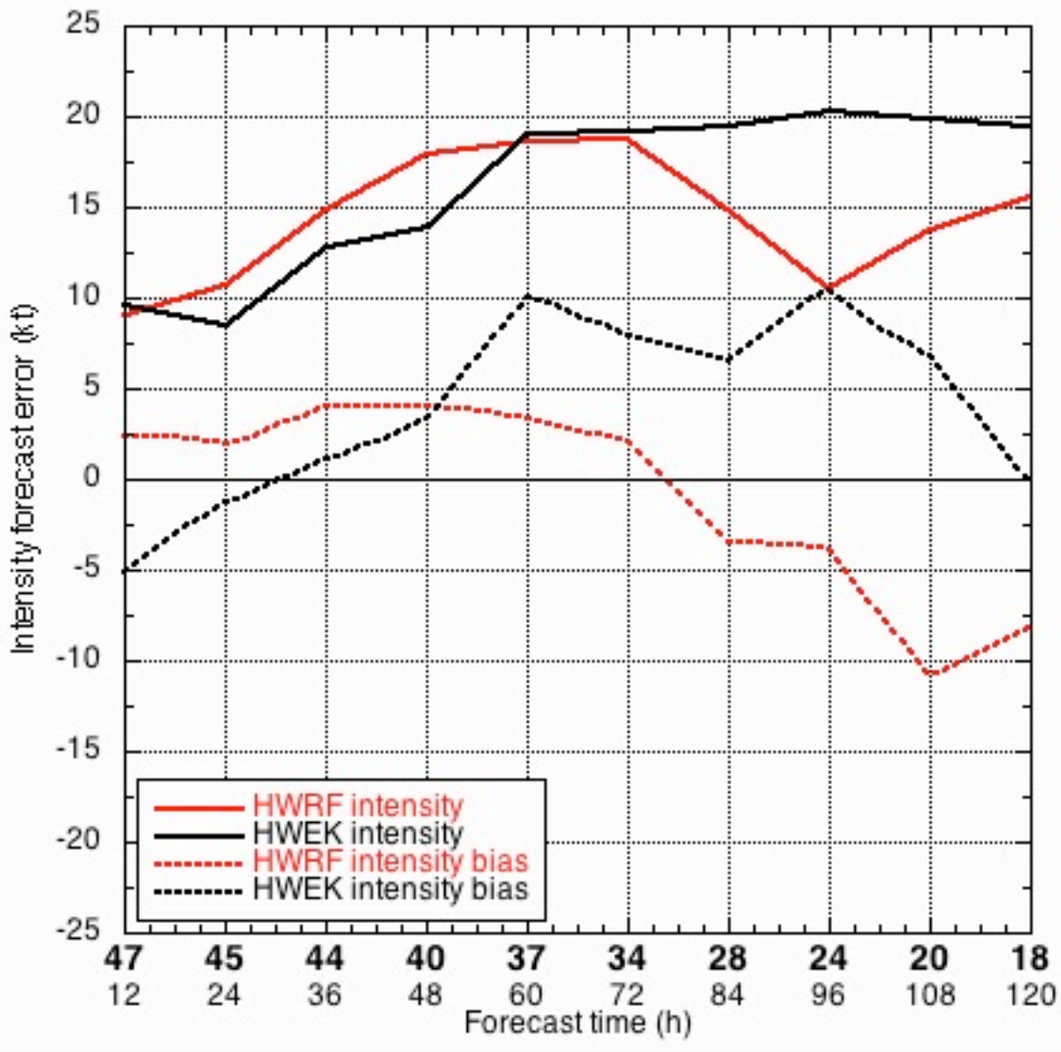
9 P-3 flights were conducted in Isaac and 3 in Leslie for 13 HEDAS cases with Doppler data (one flight had data in two separate forecasts.

Isaac had the second highest number of flights since we started in 2008 (Earl had 11).

[1]Including sensor drift
[2]Including new data from G-IV

HEDAS ICs allowed for improved track (up to 21%) and intensity (up to 22%) forecasts versus HWRF through about 60 h

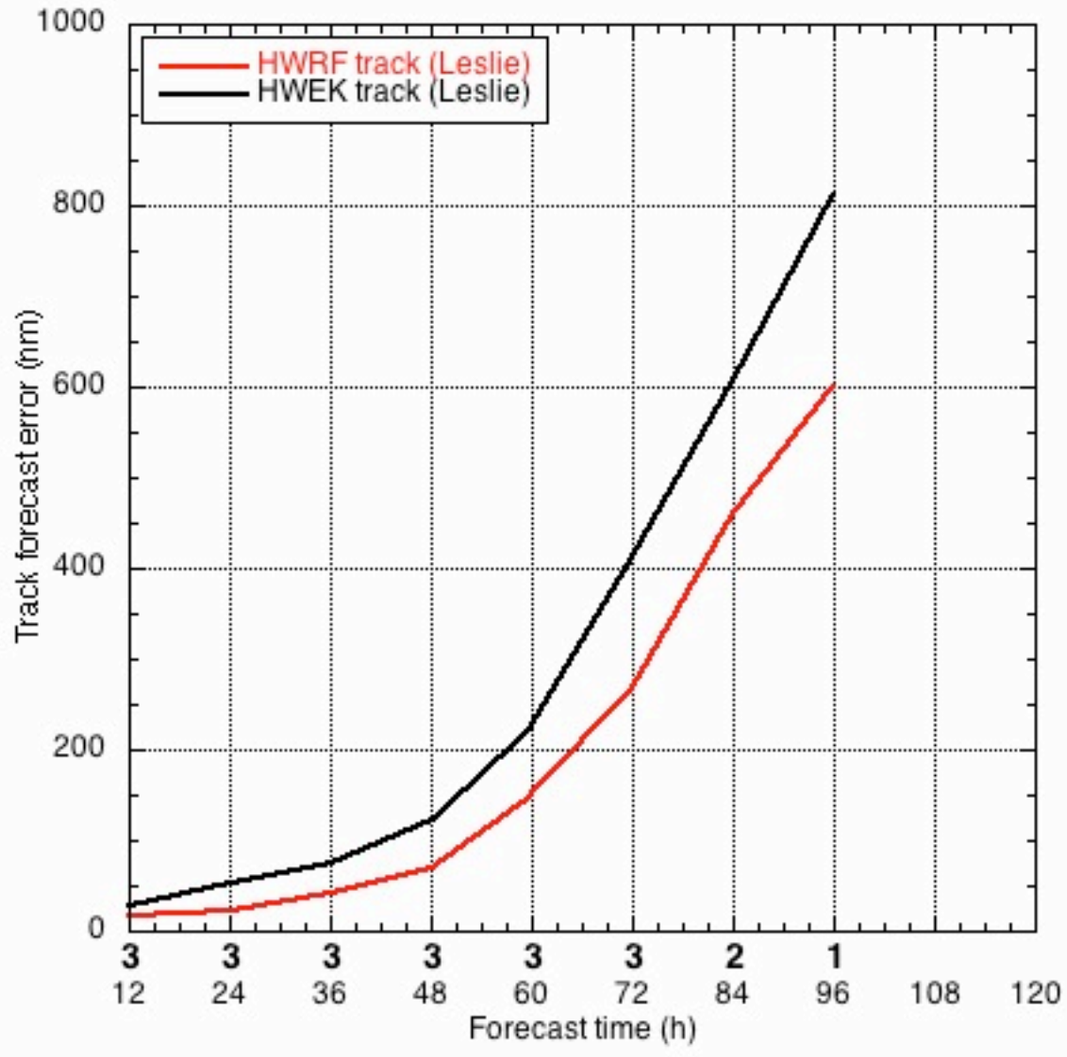


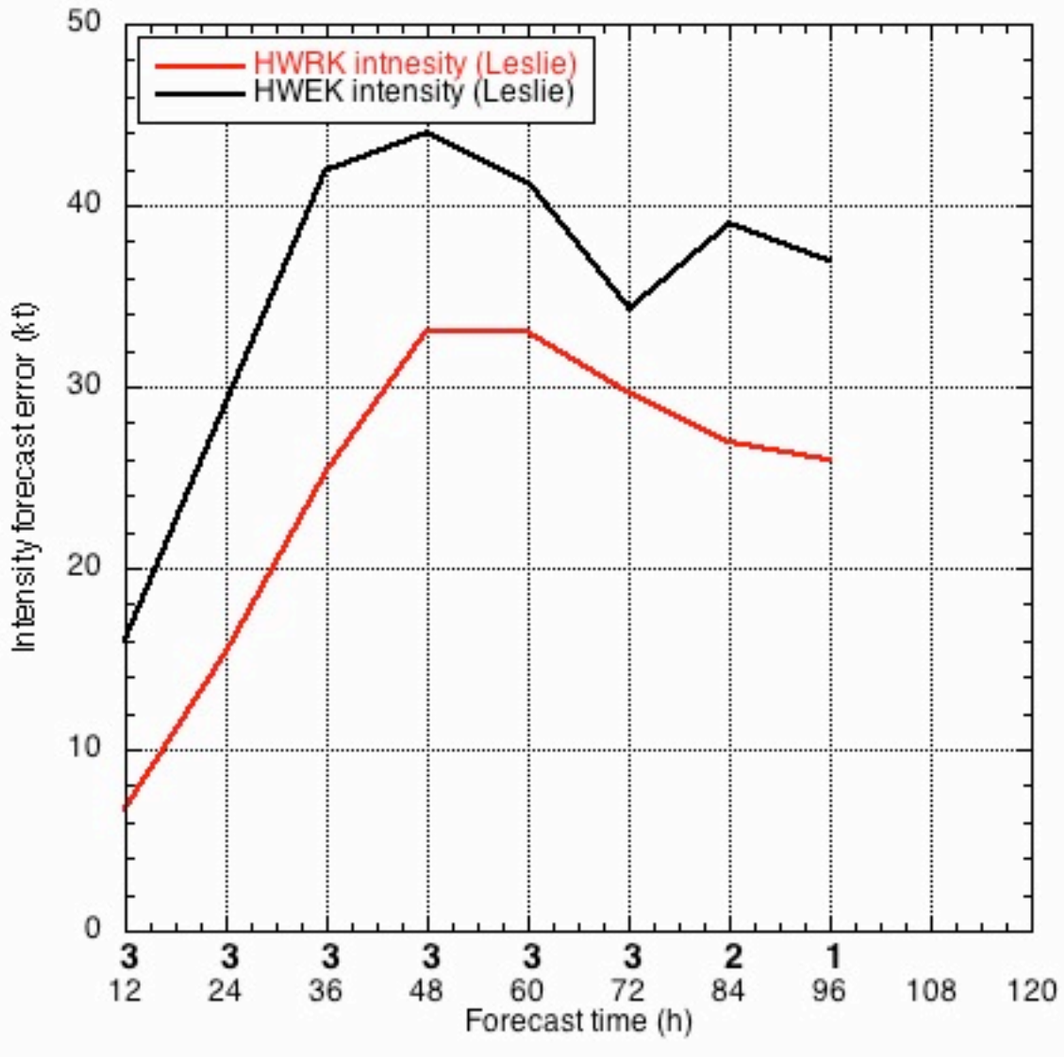


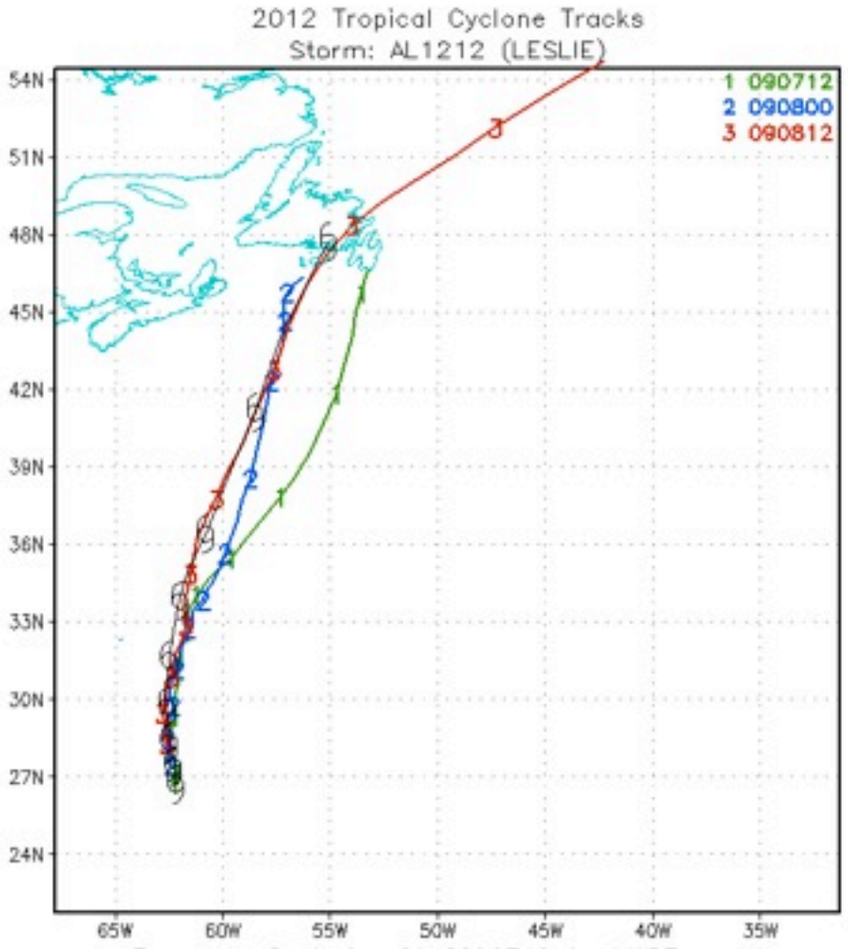
Hurricane Leslie

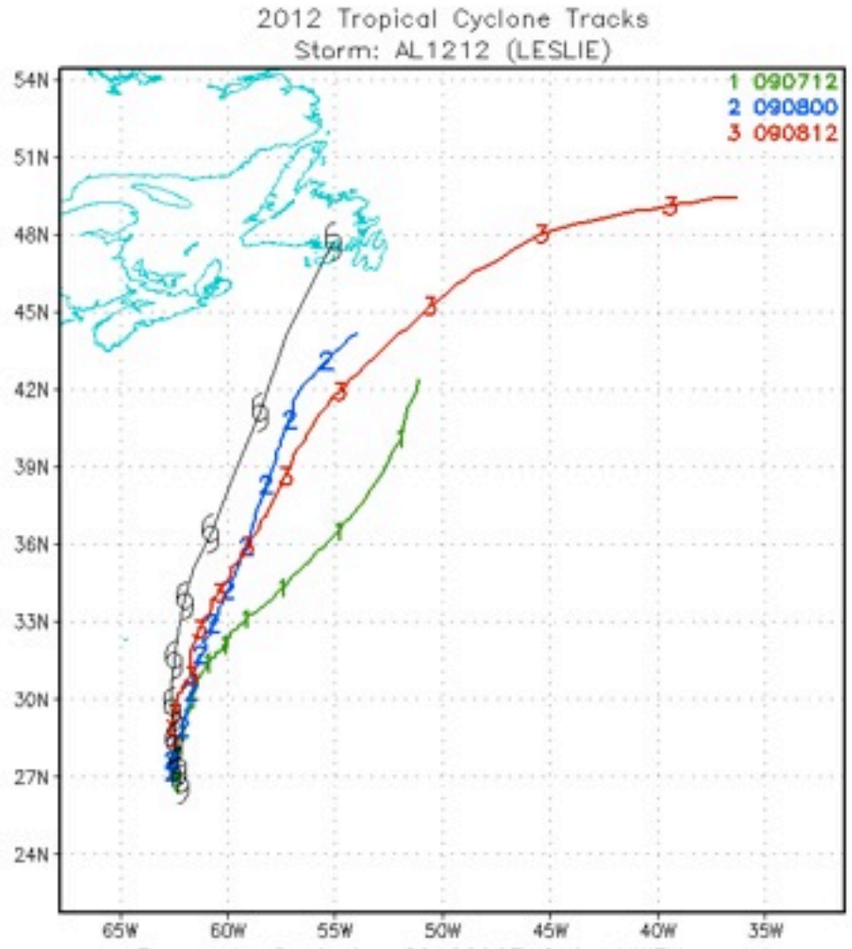
3 cases, all with Doppler data

Large forecast degradations






2012 Tropical Cyclone Tracks
Storm: AL1212 (LESLIE)
1 090712
2 090800
3 090812
54N
51N
48N
45N
42N
39N
36N
33N
30N
27N
24N
65W
60W
55W
50W
45W
40W
35W
Forecasts: Beginning 2012090712 for HWRF model
Observed: Beginning 2012090712, every 12 hours


2012 Tropical Cyclone Tracks
Storm: AL1212 (LESLIE)
1 090712
2 090800
3 090812
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36N
33N
30N
27N
24N
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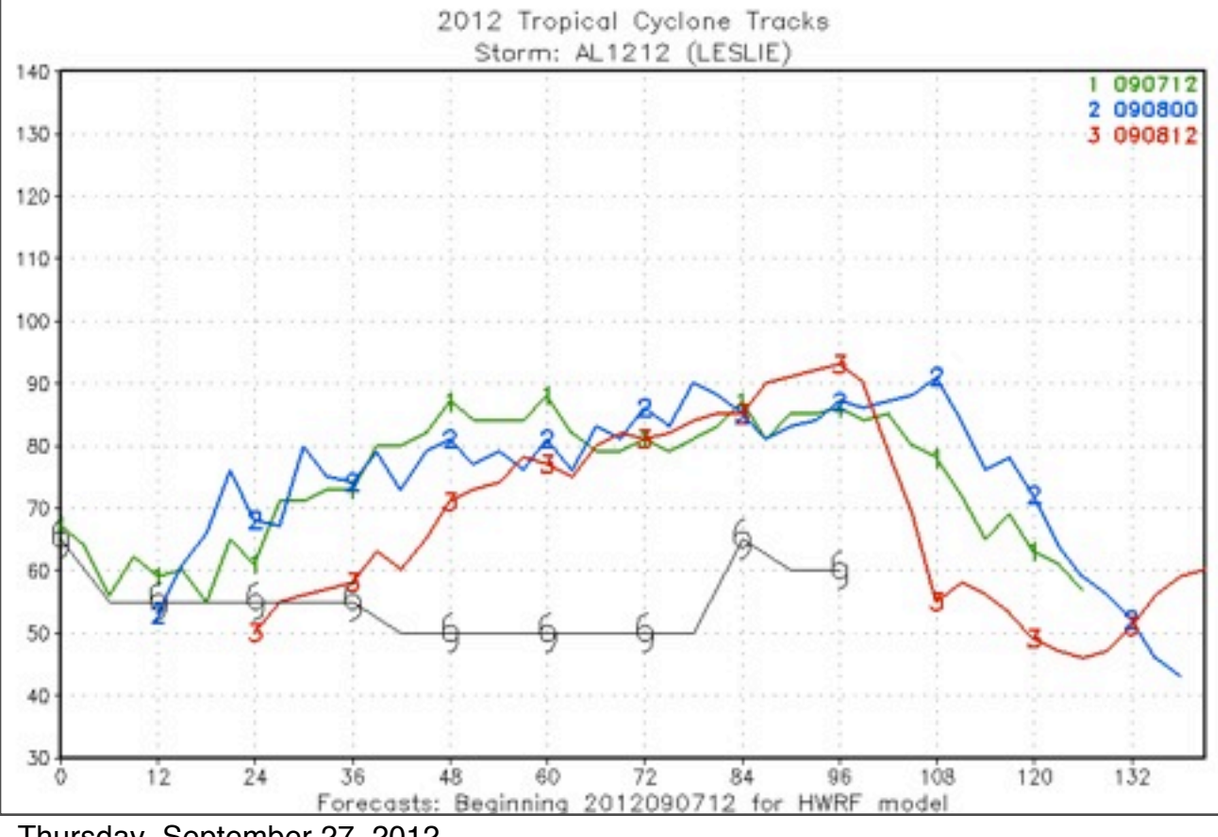
45W
40W
35W
Forecasts: Beginning 2012090712 for HWEK model
Observed: Beginning 2012090712, every 12 hours


2012 Tropical Cyclone Tracks
Storm: AL1212 (LESLIE)
1 090712
2 090800
3 090812
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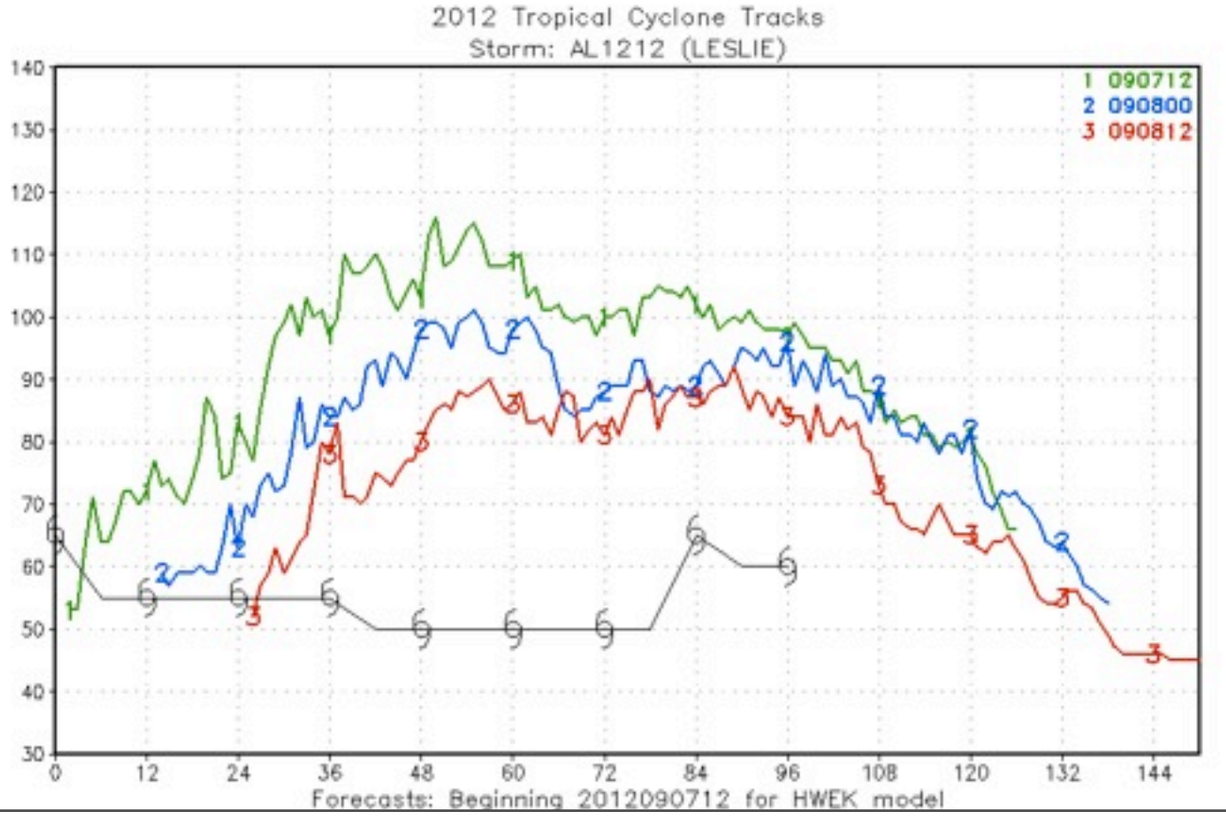
Forecasts: Beginning 2012090712 for HWRF model


2012 Tropical Cyclone Tracks
Storm: AL1212 (LESLIE)
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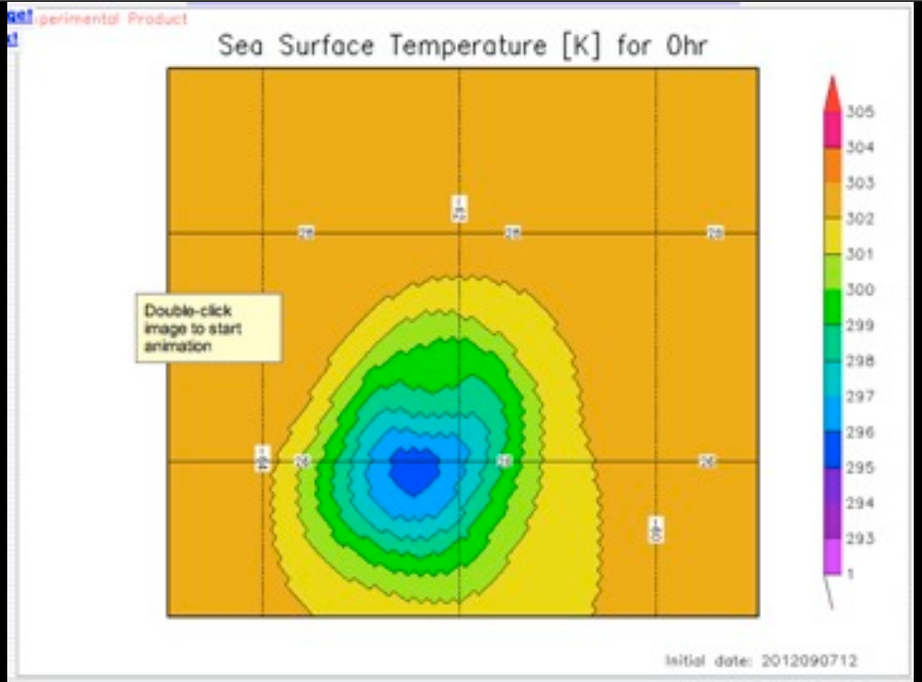
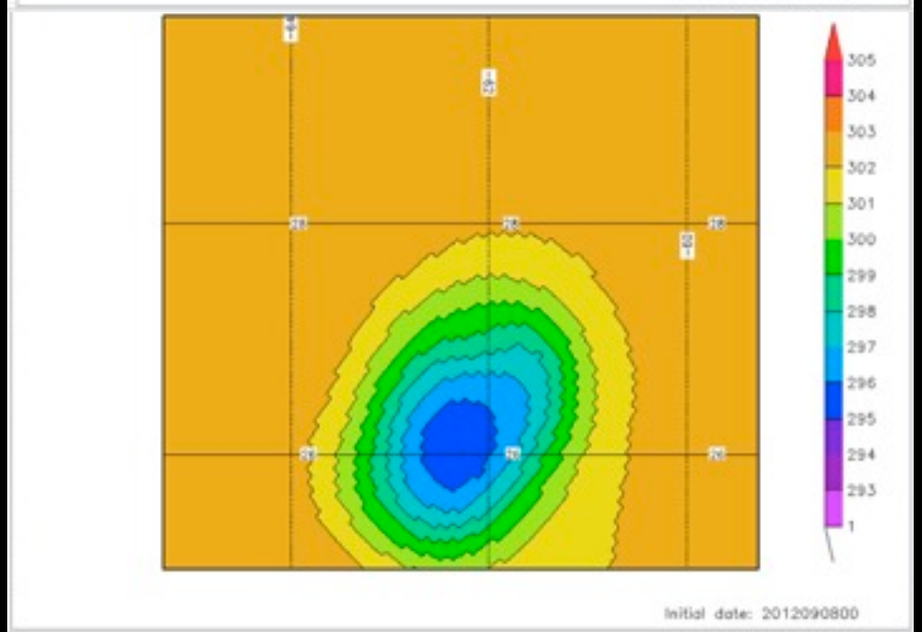
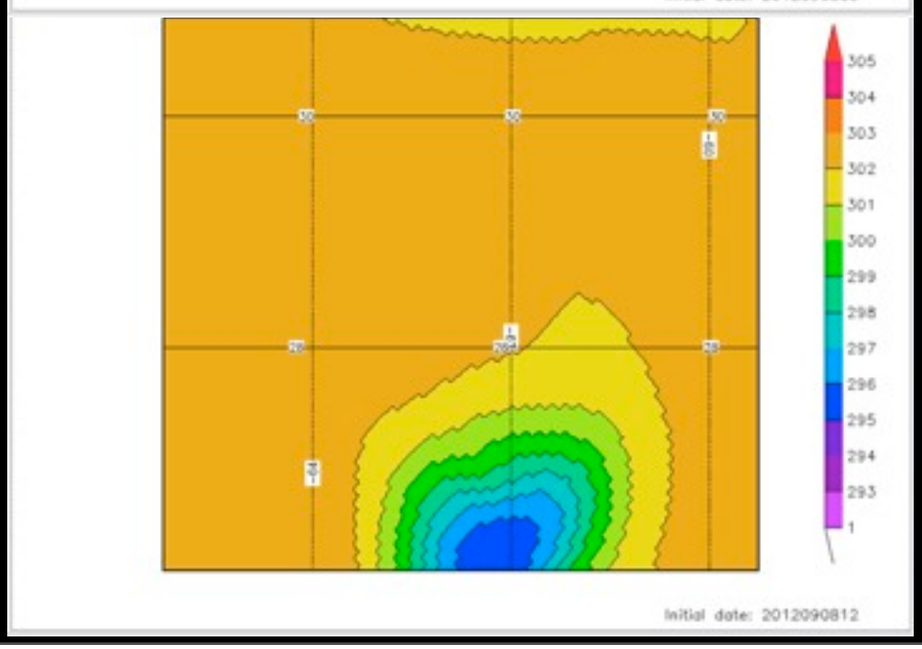
Forecasts: Beginning 2012090712 for HWEK model



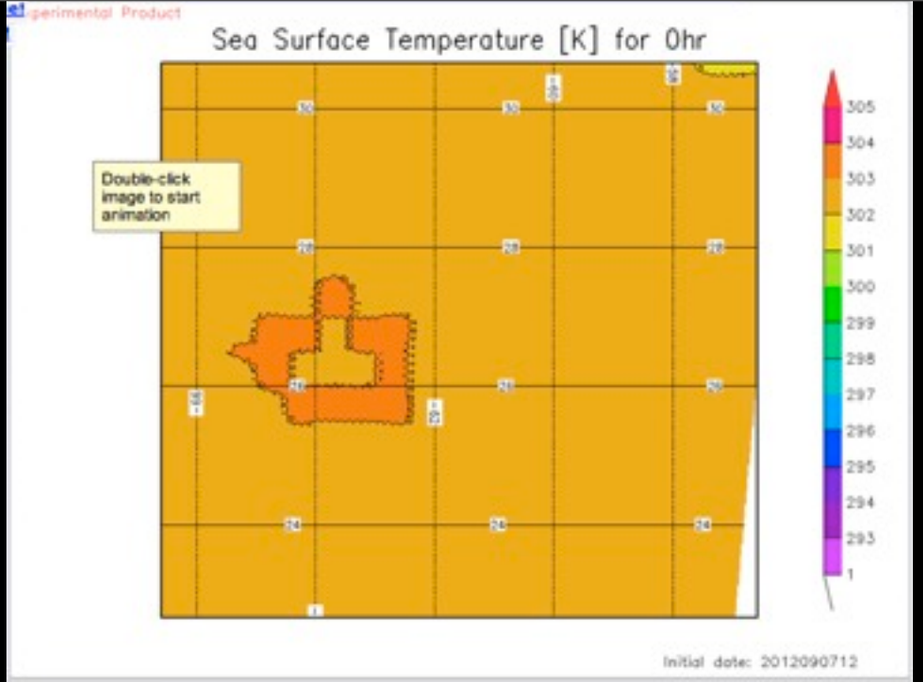


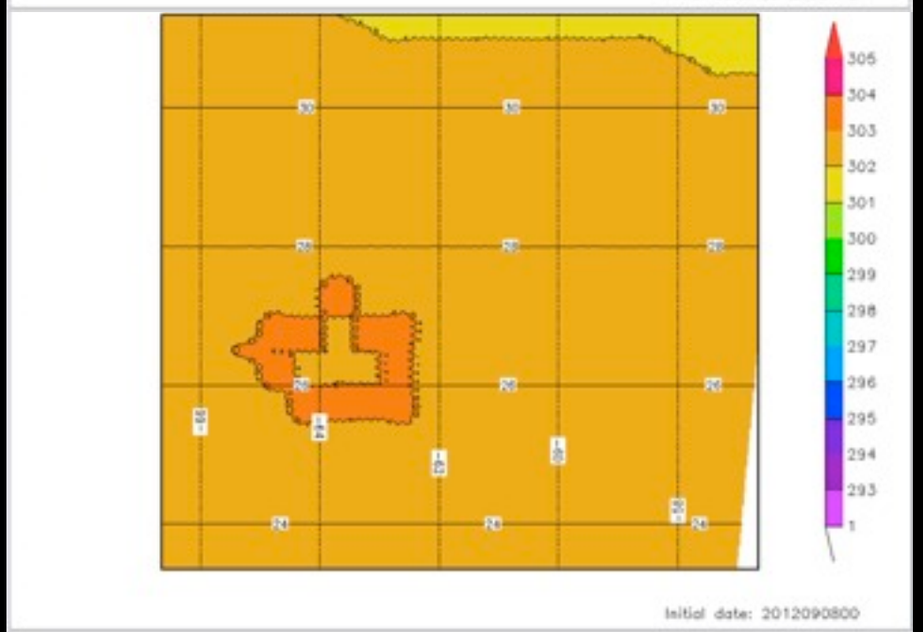


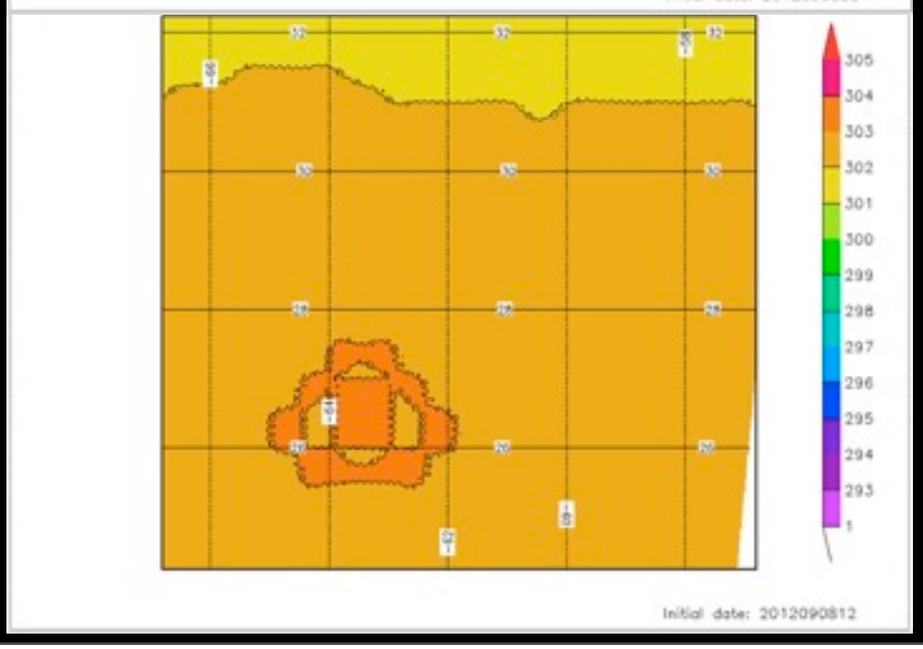
HWRF

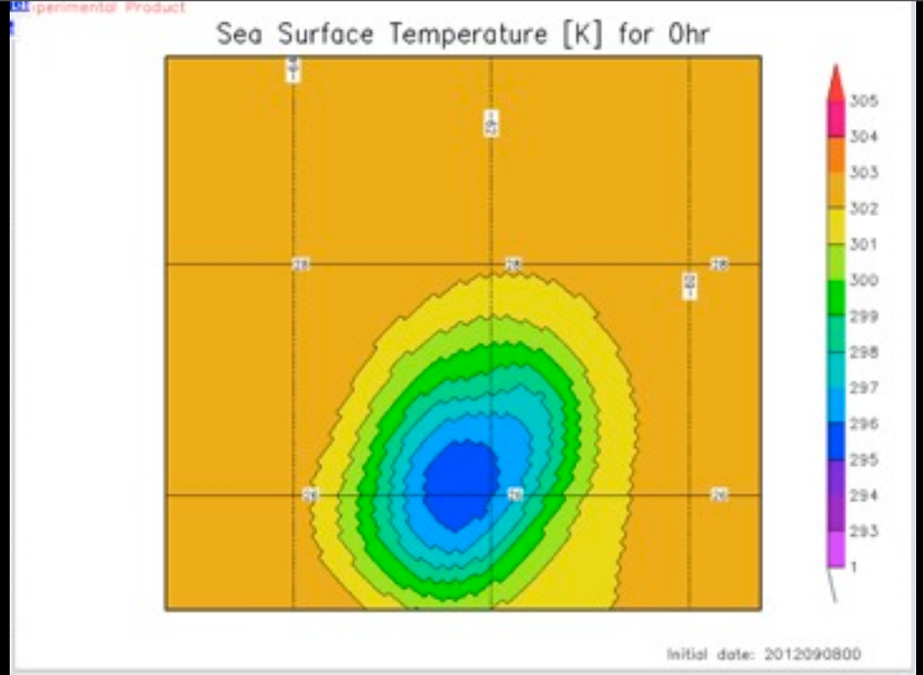
It is likely that the ocean had a major impact on this case due to its very slow motion. HWRF with HEDAS IC is not coupled, uses GFS SST analysis.

HWEK








Sea Surface Temperature [K] for 0hr
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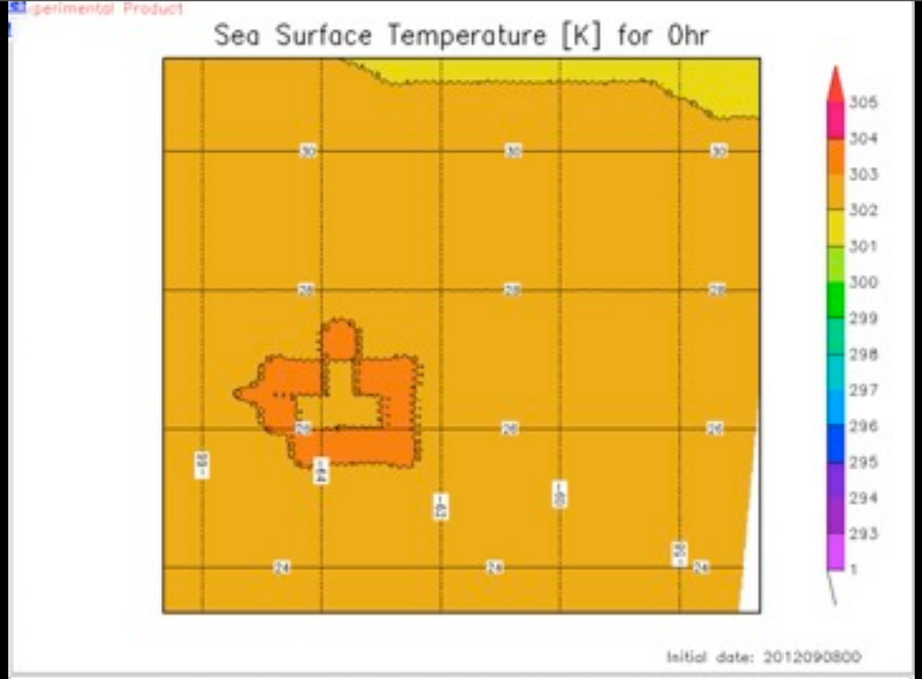
Initial date: 2012090800


Sea Surface Temperature [K] for 0hr
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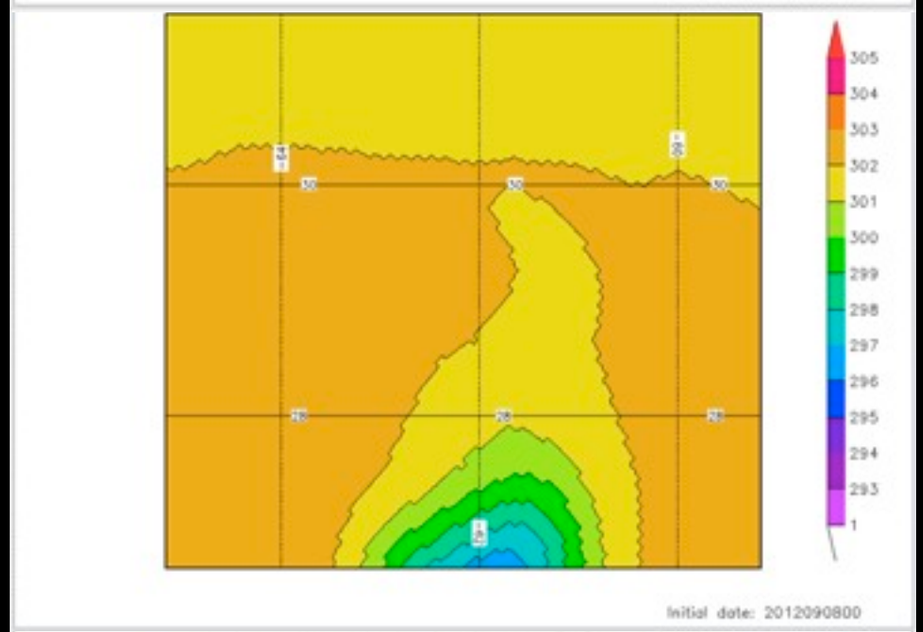
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Initial date: 2012090800

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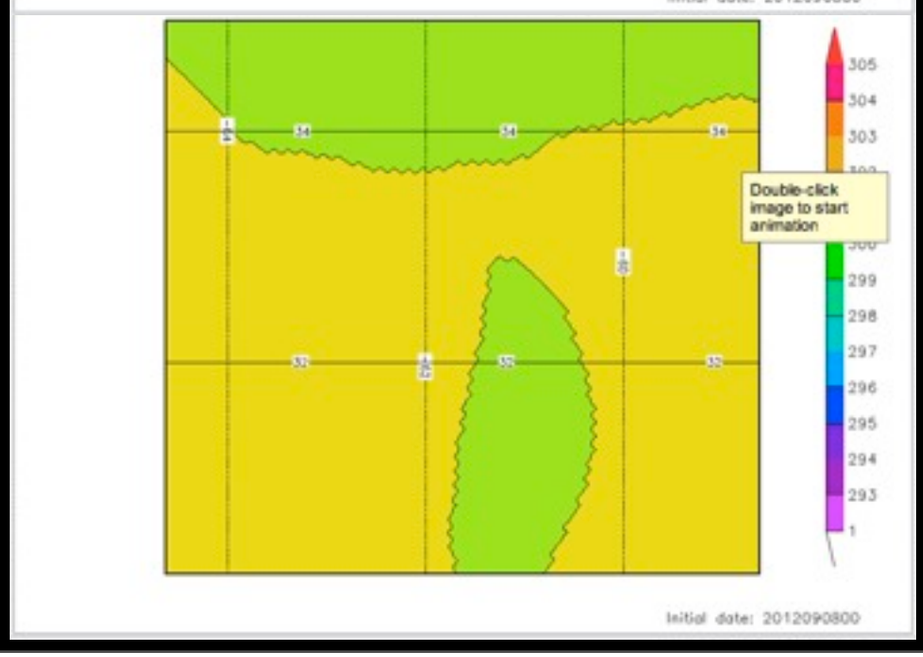
Initial date: 2012090800


Double-click image to start animation
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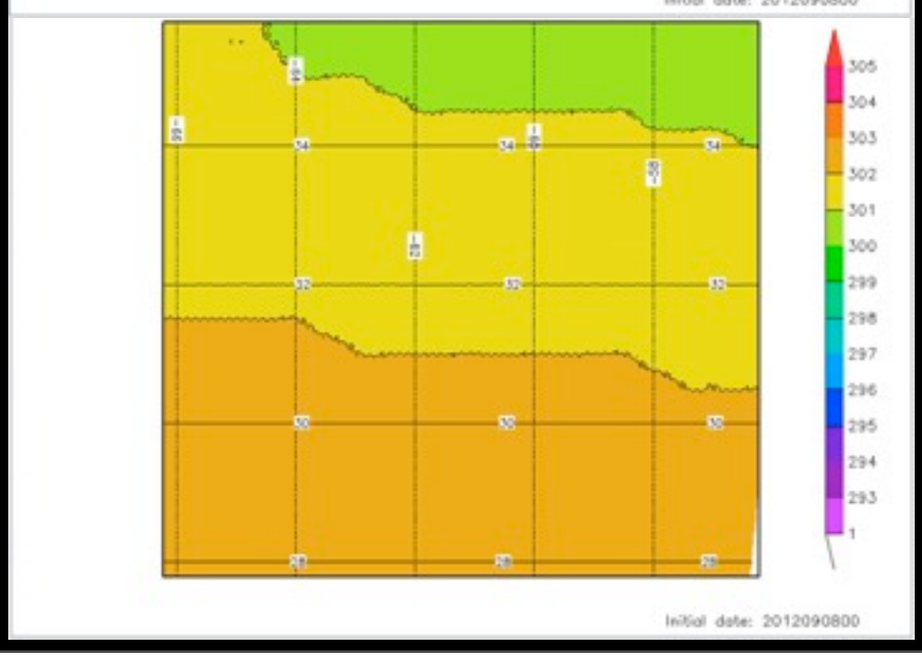
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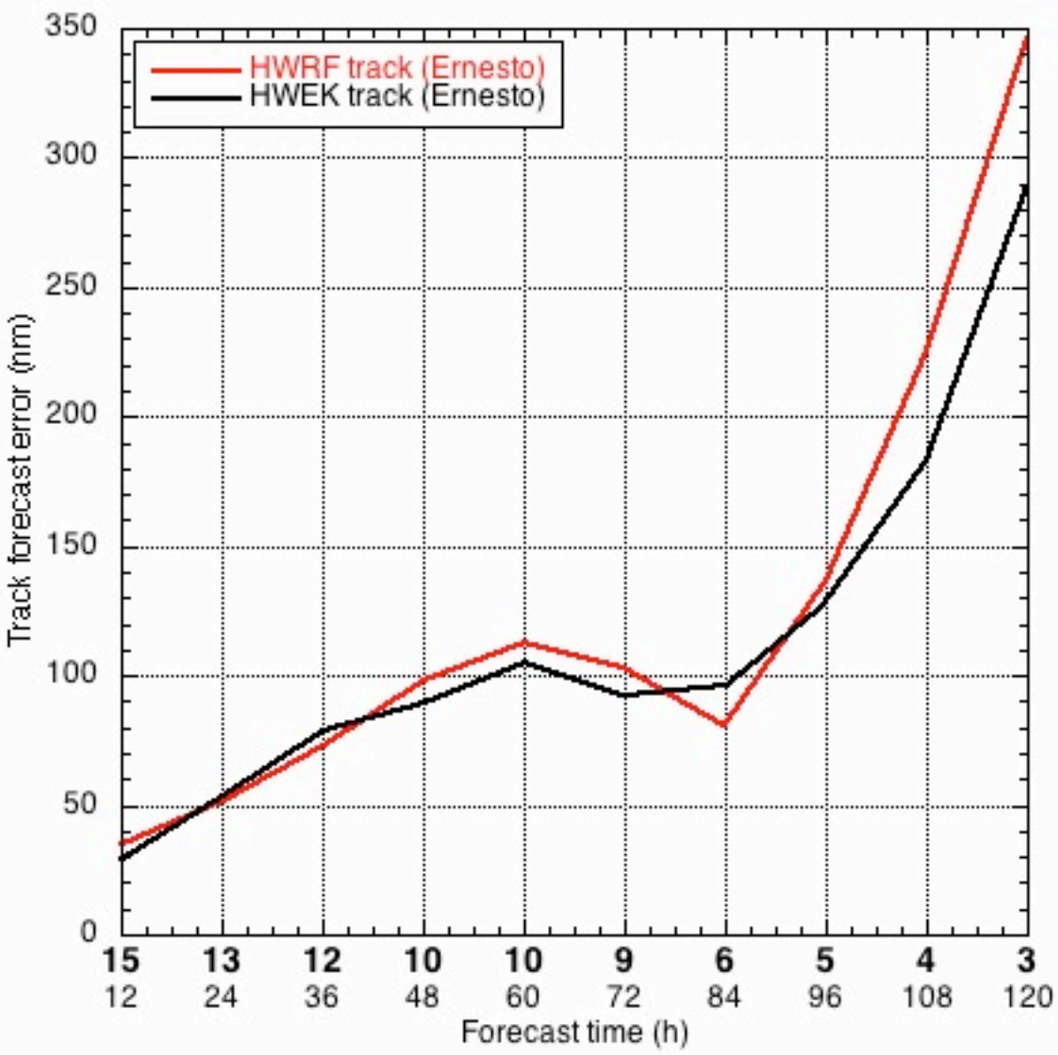
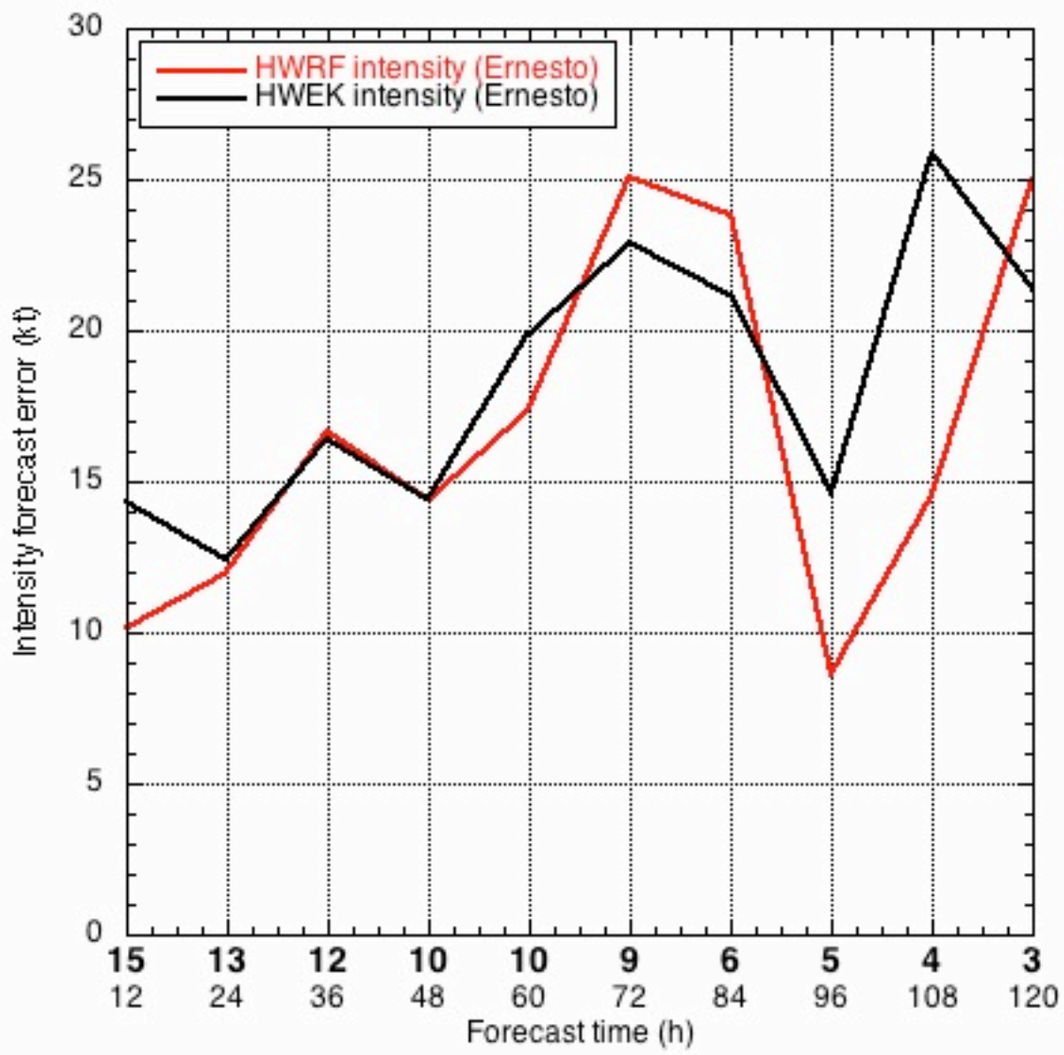
Initial date: 2012090800

Tropical Storm Ernesto

15 cases, none with Doppler data

Mixed results

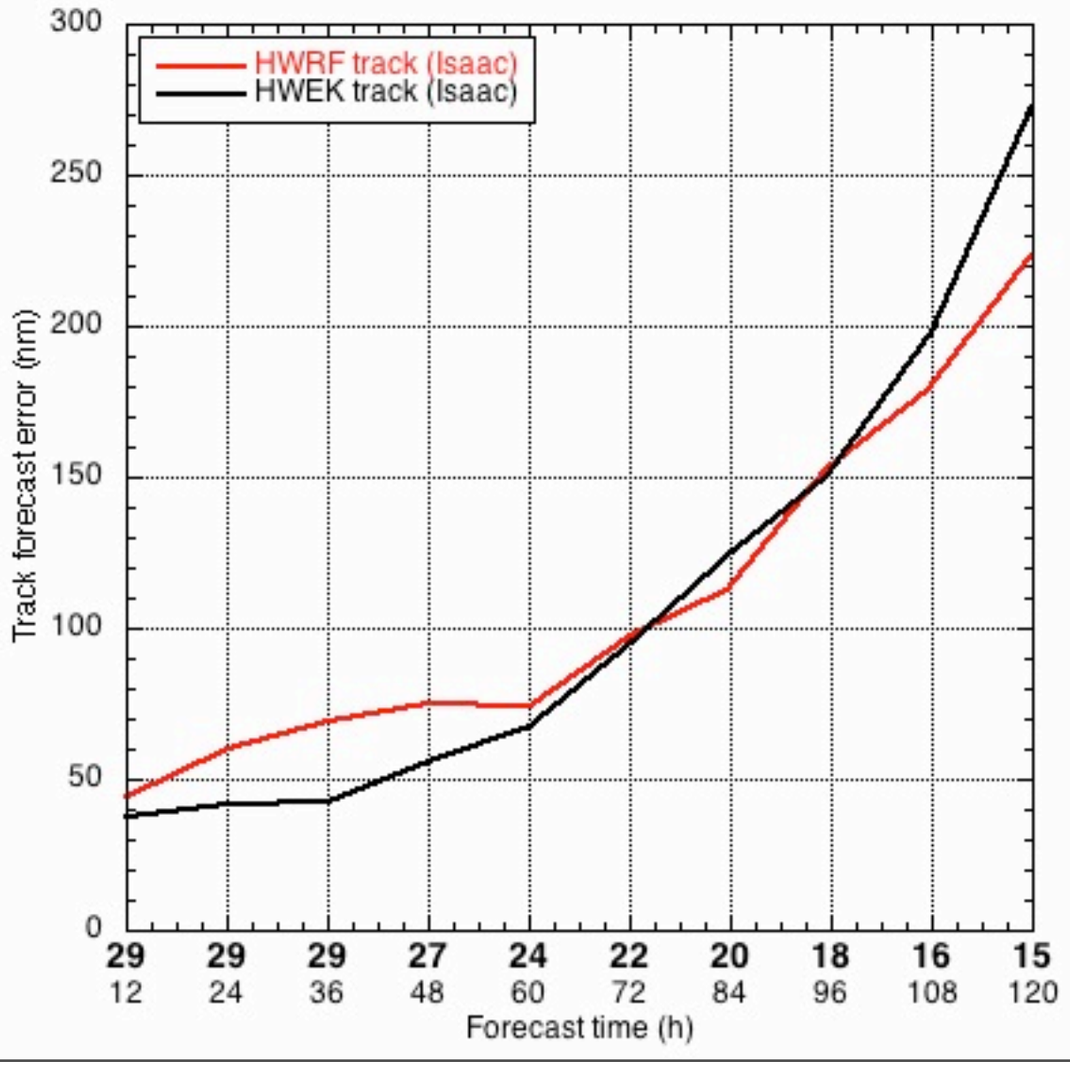


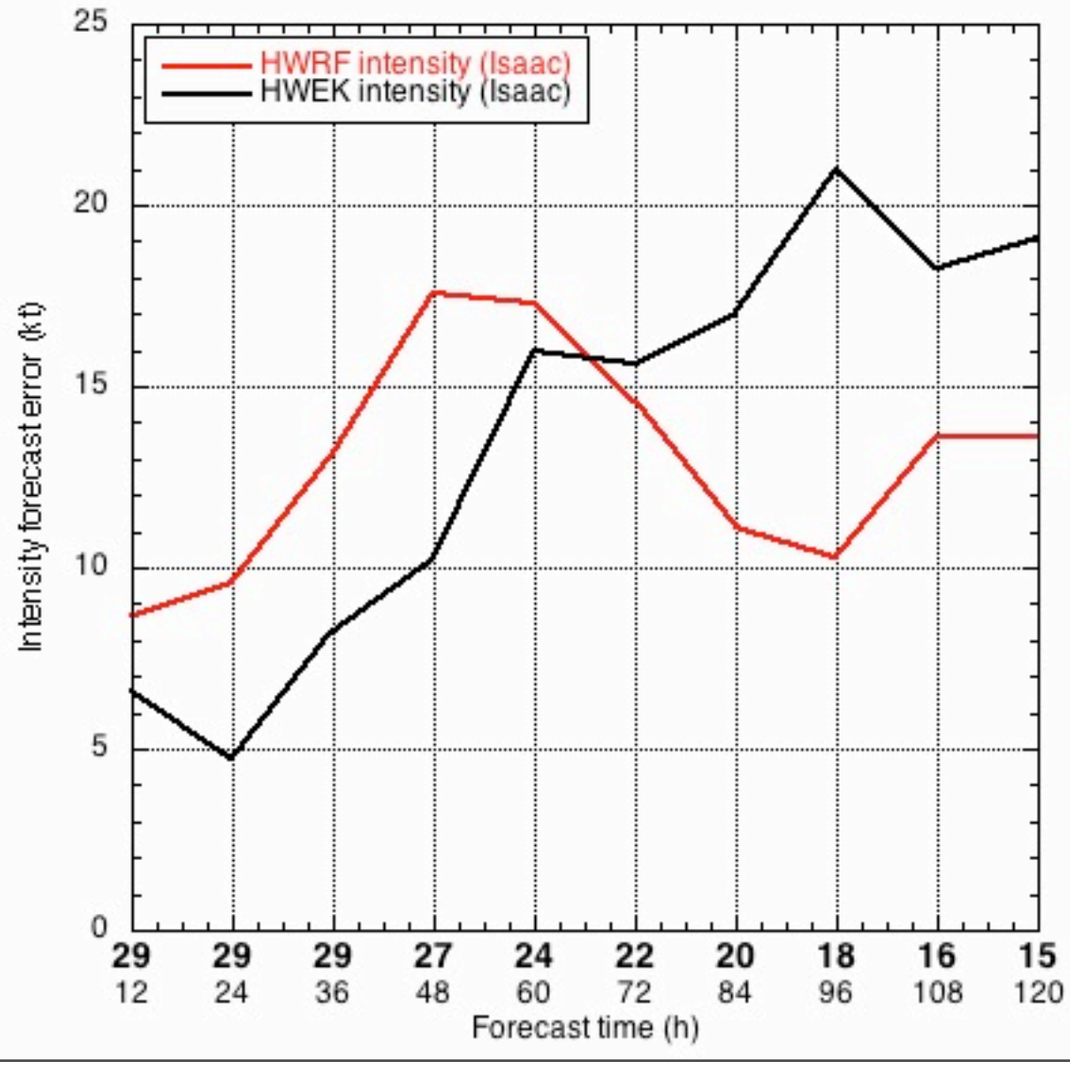


Hurricane Isaac

29 cases, 10 with Doppler data

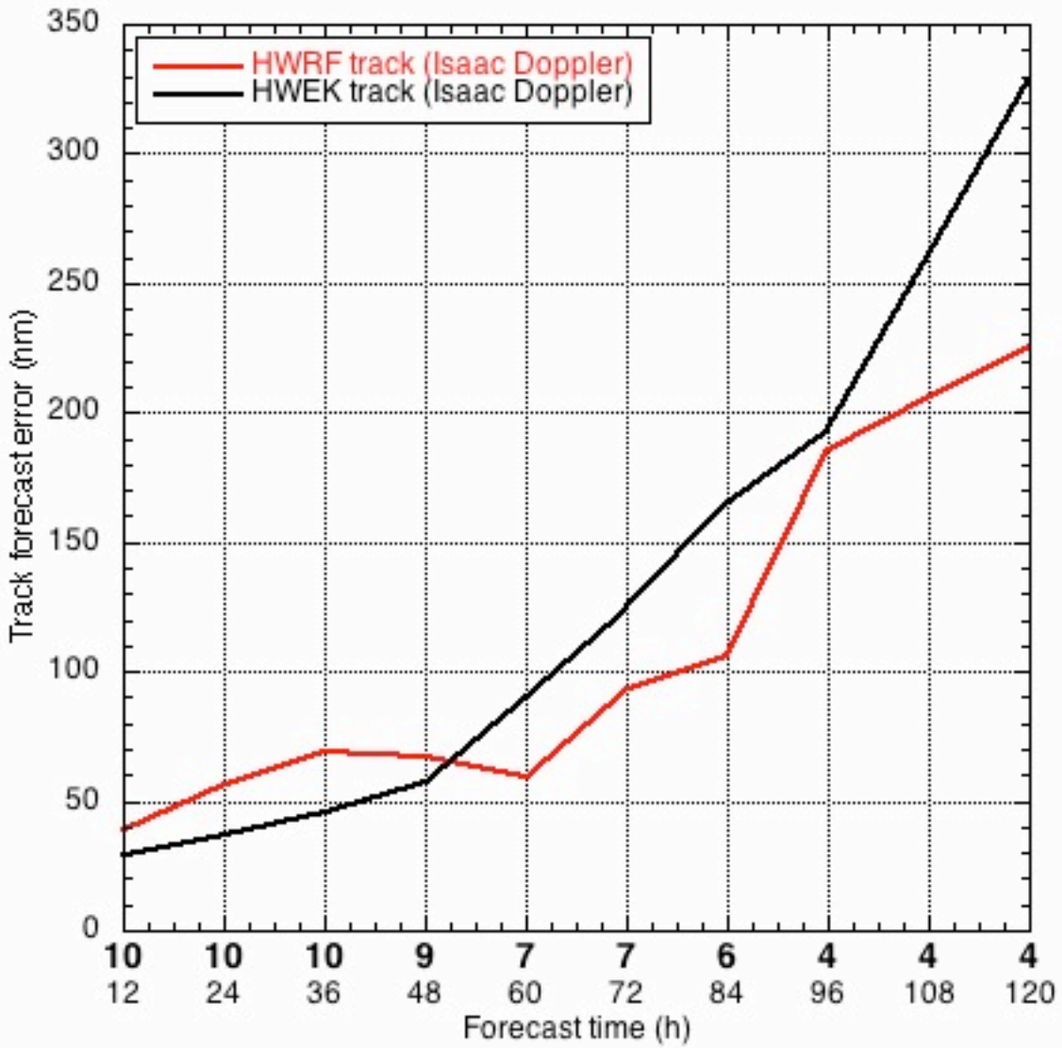
Large track and intensity forecast improvements through 60 h

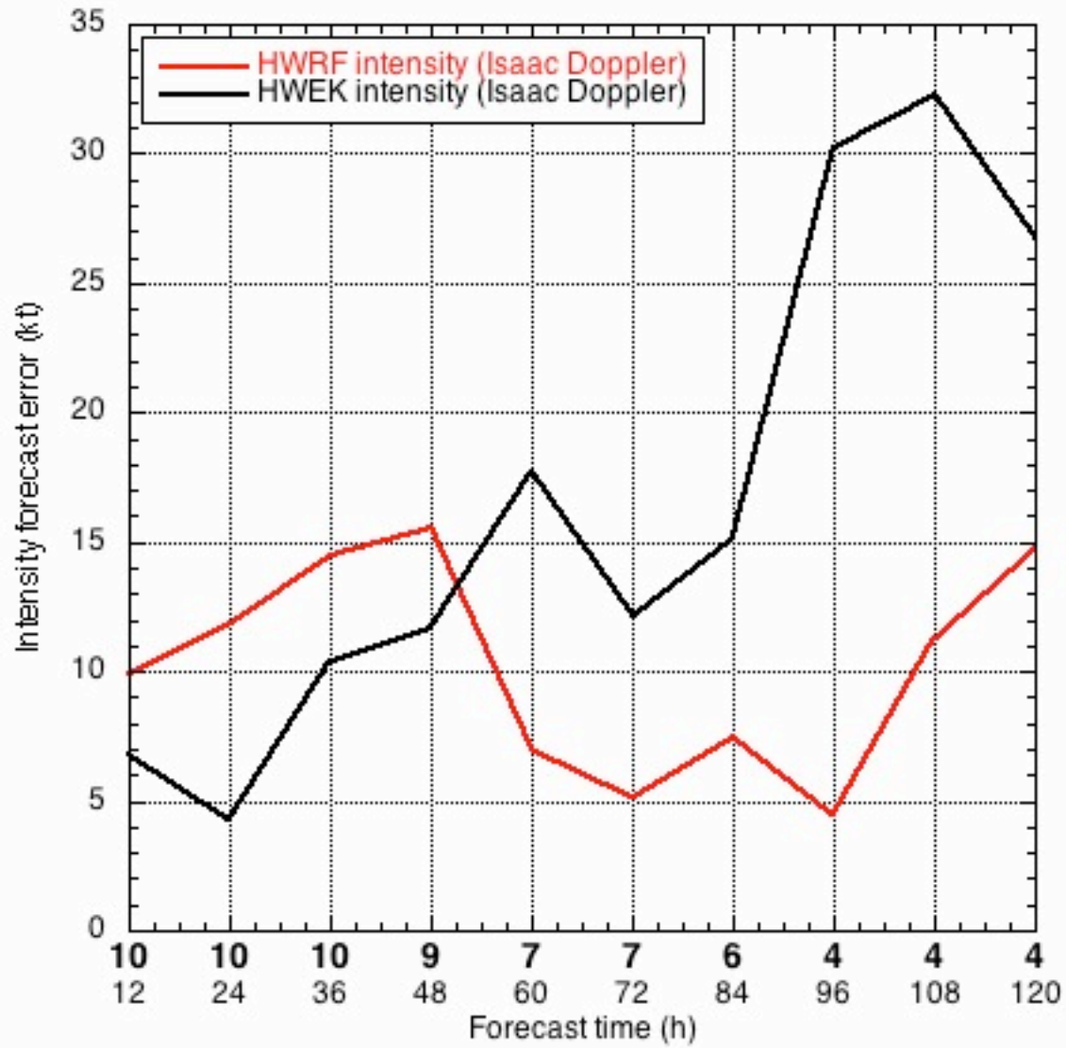




Hurricane Isaac (Doppler data cases only)

Large track and intensity forecast improvements through 48 h

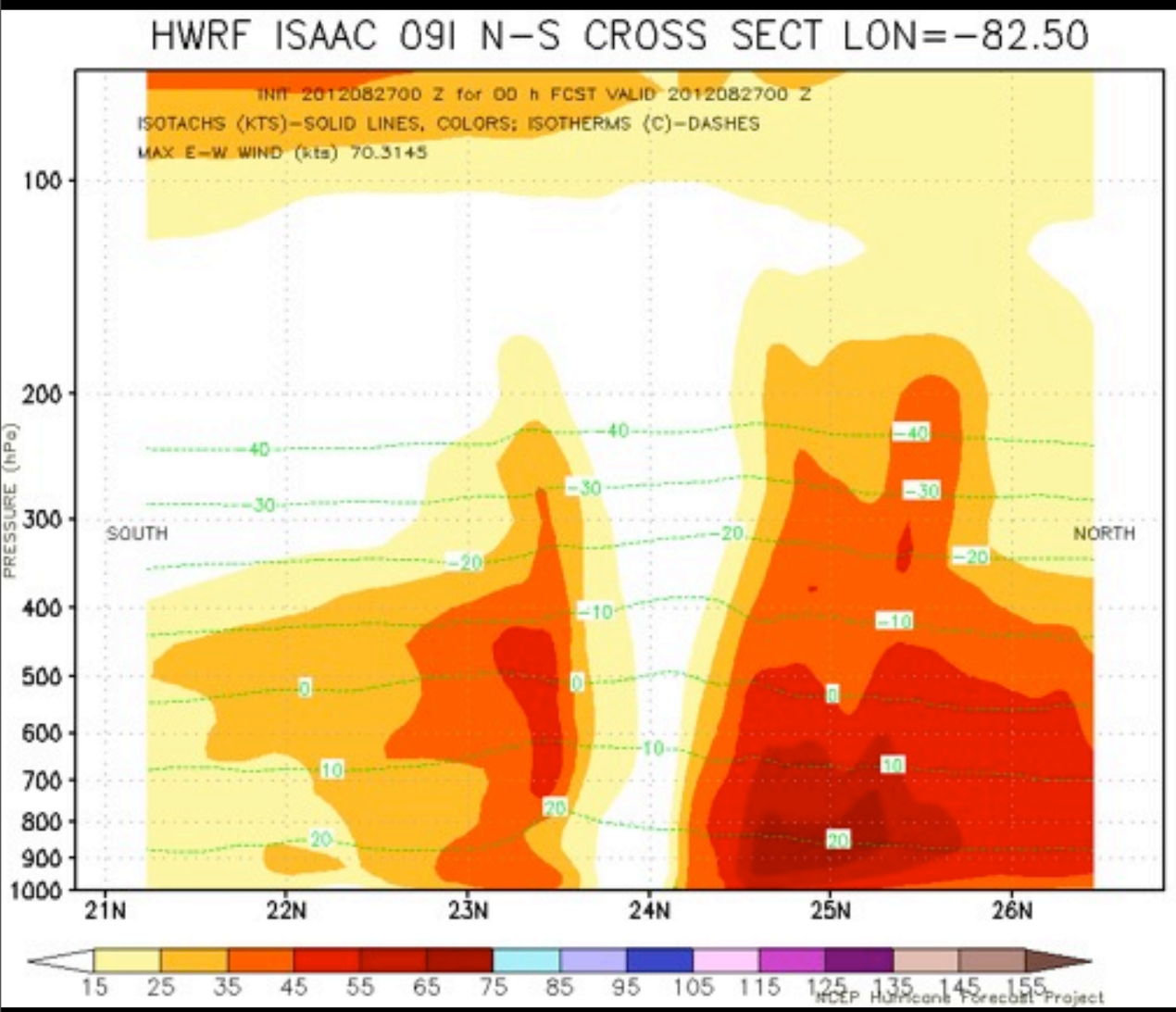


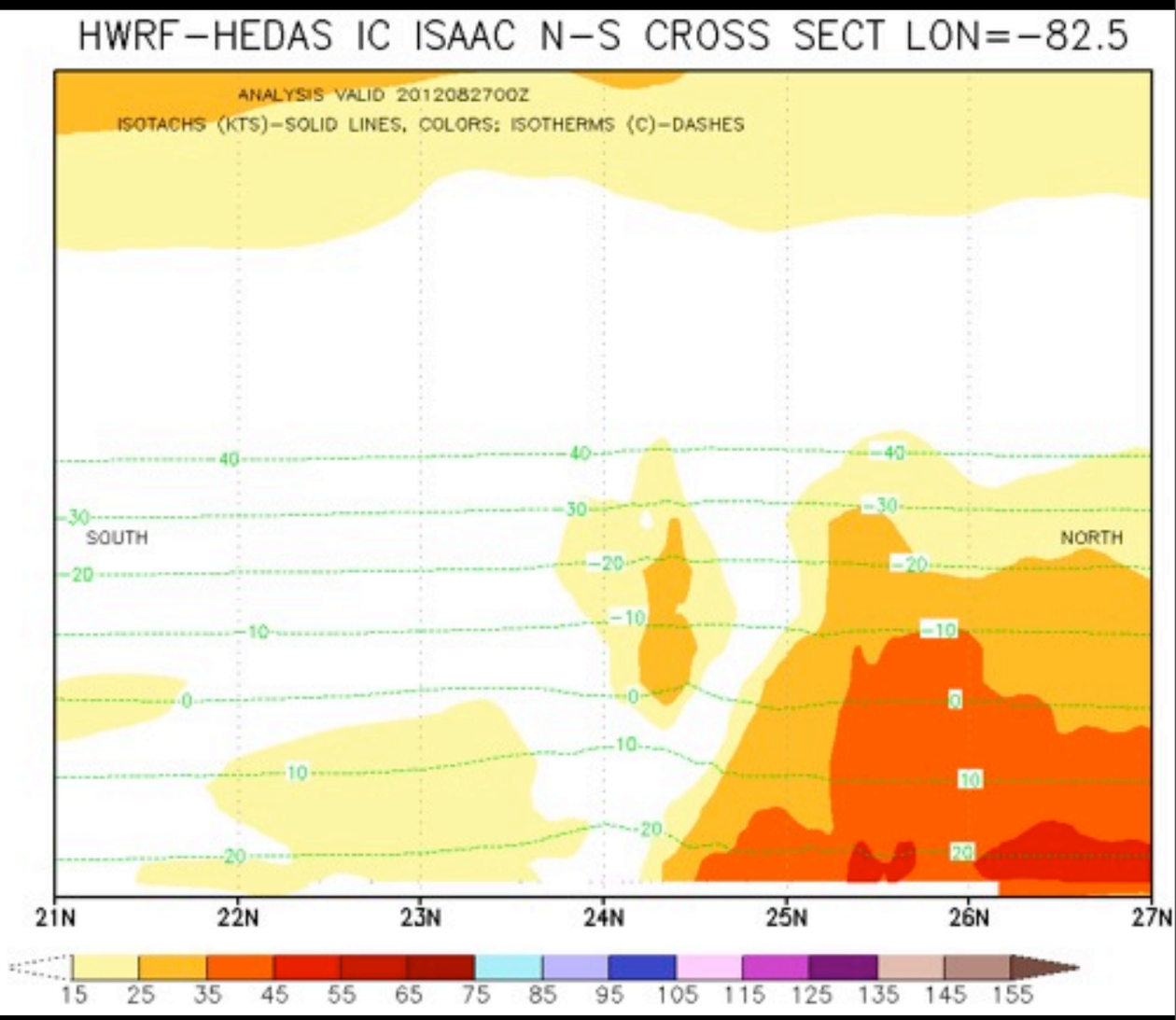


Comparison of initial conditions

HWRF

HEDAS





Publications

Aksoy, A., S. Lorsolo, T. Vukicevic, K. J. Sellwood, S. D. Aberson, and F. Zhang, 2012: An HWRF Hurricane Ensemble Data Assimilation System (HEDAS) for high-resolution data: The impact of airborne Doppler radar observations in an OSSE. *Mon. Wea. Rev.,* **140**, 1843-1862.

Aksoy, A., 2012: Storm-Relative Tropical Cyclone Data Assimilationwith an Ensemble Kalman Filter, *Mon. Wea. Rev.,* accepted. http://dx.doi.org/10.1175/MWR-D-12-00094.1

Aksoy, A., S. D. Aberson, T. Vukicevic, K. J. Sellwood, S. Lorsolo and X. Zhang, 2012: Assimilation of high-resolution tropical cyclone observations with an ensemble Kalman filter using NOAA/AOML/HRD's HEDAS: Evaluation of the 2008-2011 vortex-scale analyses. *Mon. Wea. Rev.,* accepted with revisions.

Vukicevic, T., A. Aksoy, P. Reasor, S. Aberson, K. Sellwood, F. MarksJoint impact of forecast tendency and state error biases in Ensemble Kalman Filter data assimilation of inner-core tropical cyclone observations, *Mon. Wea. Rev.*, accepted with revisions.

Rogers, R., S. Aberson, A. Aksoy, B. Annane, M. Black, J. Cione, N. Dorst, J. Dunion, J Gamache, S. Goldenberg, S. Gopalakrishnan, J. Kaplan, B. Klotz, S. Lorsolo, F. Marks, S. Murillo, M. Powell, P. Reasor, K. Sellwood, E. Uhlhorn, T. Vukicevic, J. Zhang and X. Zhang, 2012: NOAA's Hurricane Intensity Forecasting Experiment (IFEX): A Progress Report, *Bull. Amer. Met. Soc.,* accepted with revisions.