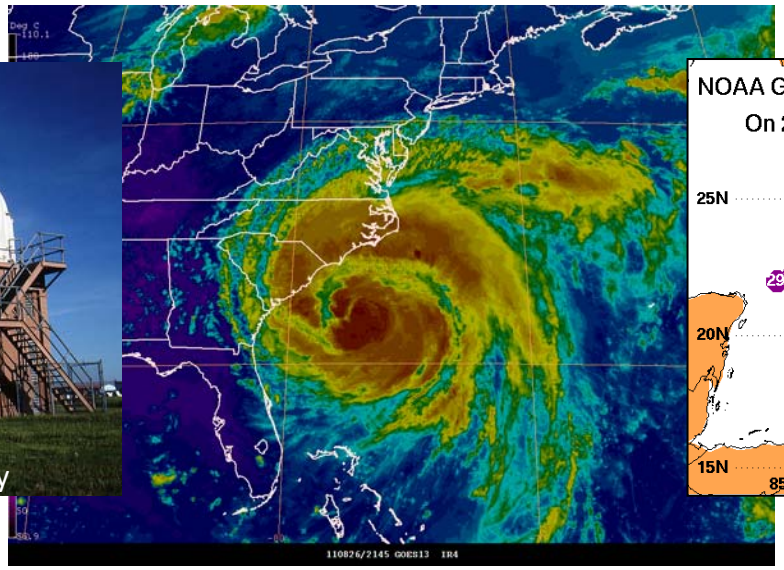
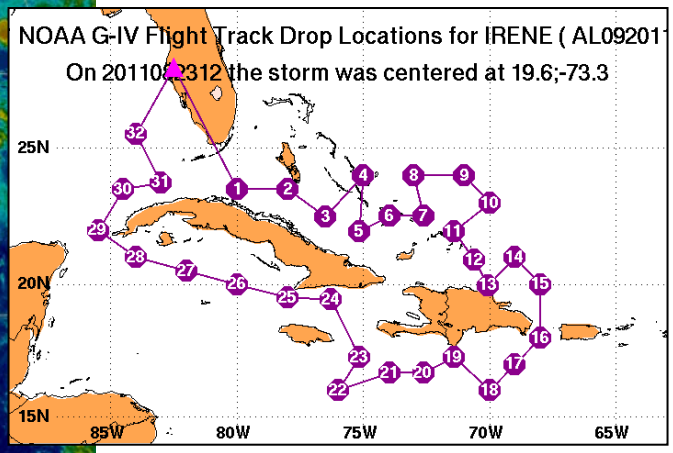
The Impact of Dropwindsonde and Supplemental Rawinsonde Observations on Track Forecasts for Hurricane Irene (2011)





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Interdepartmental Hurricane Conference

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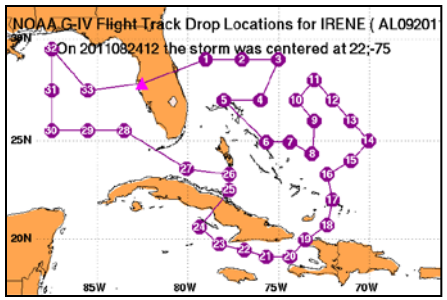
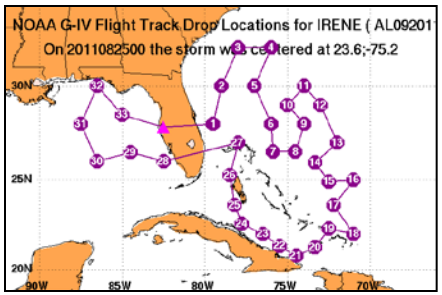
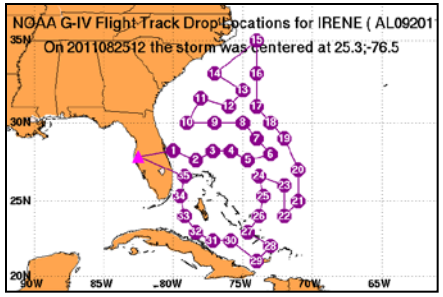
Motivation – Case of Opportunity

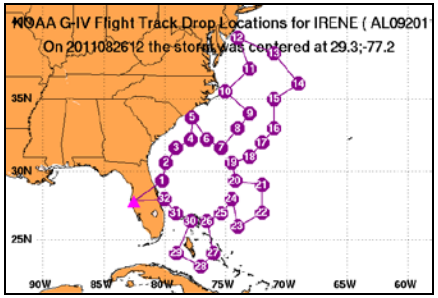
- Irene was one of the most sampled tropical cyclones in history in terms of observations in the inner core, in the near-storm environment, and in the environment well upstream
- 10 synoptic surveillance missions were flown from 23-27 August
- Supplemental rawinsondes requested starting at 18Z 22 August in the Southeast and Mid-Atlantic, and expanded to cover all of the CONUS from the Rockies eastward at 06Z 25 August

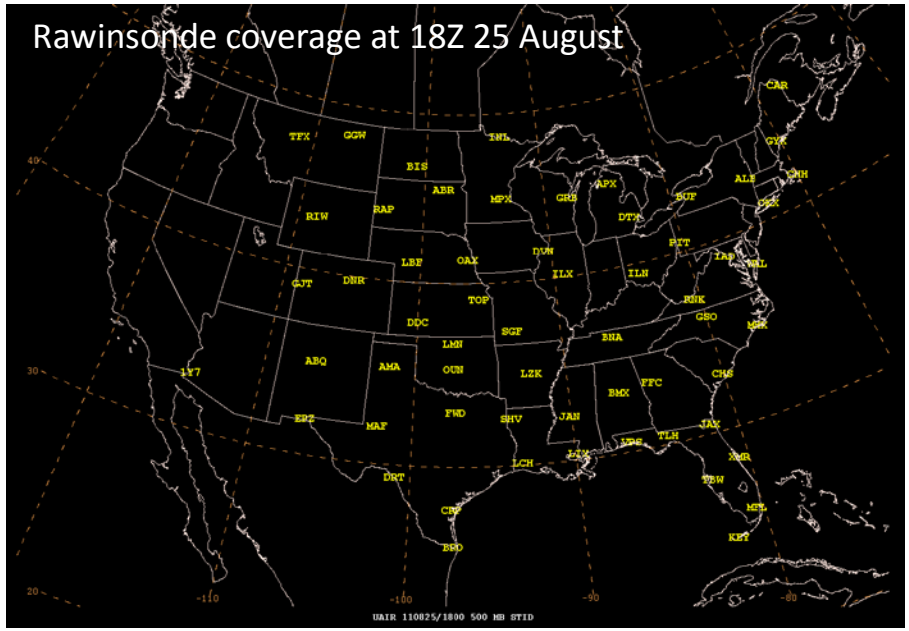
What impact did these data have on model track forecasts?





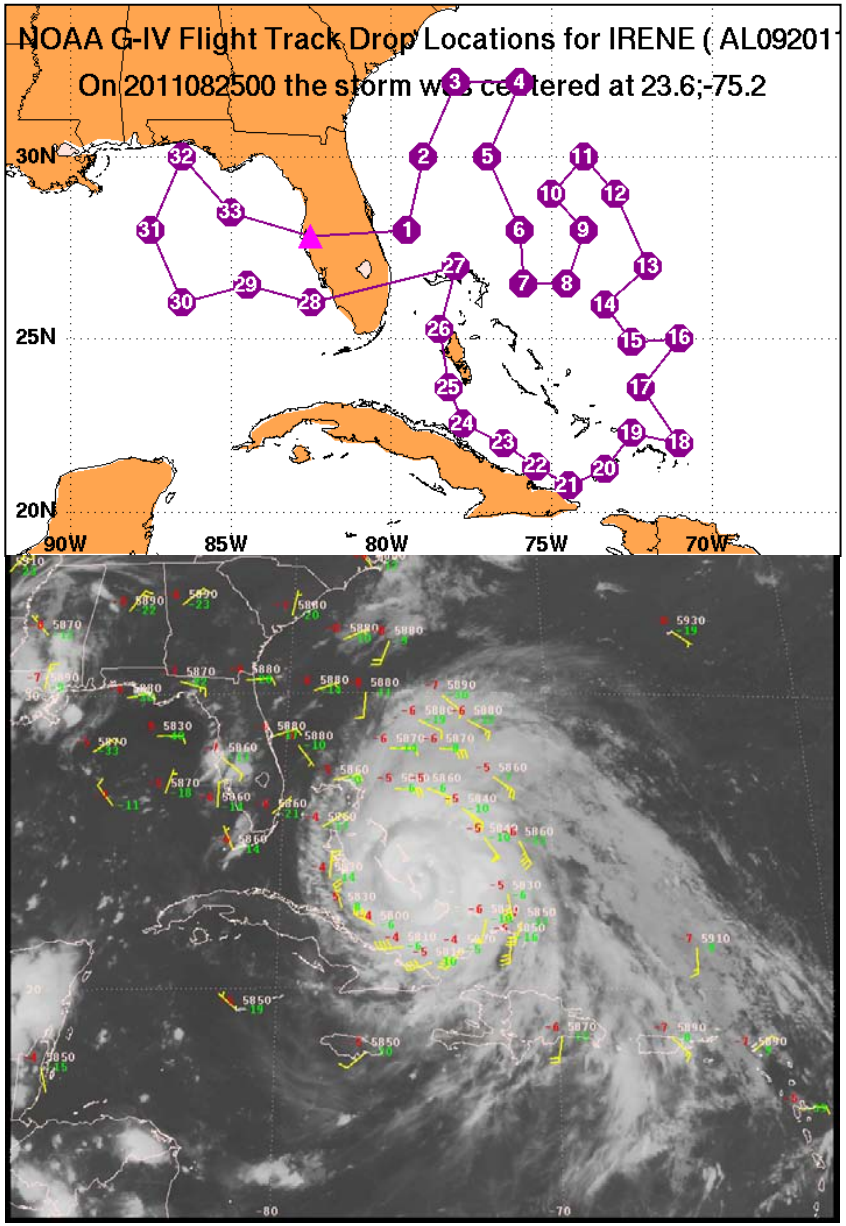






Background

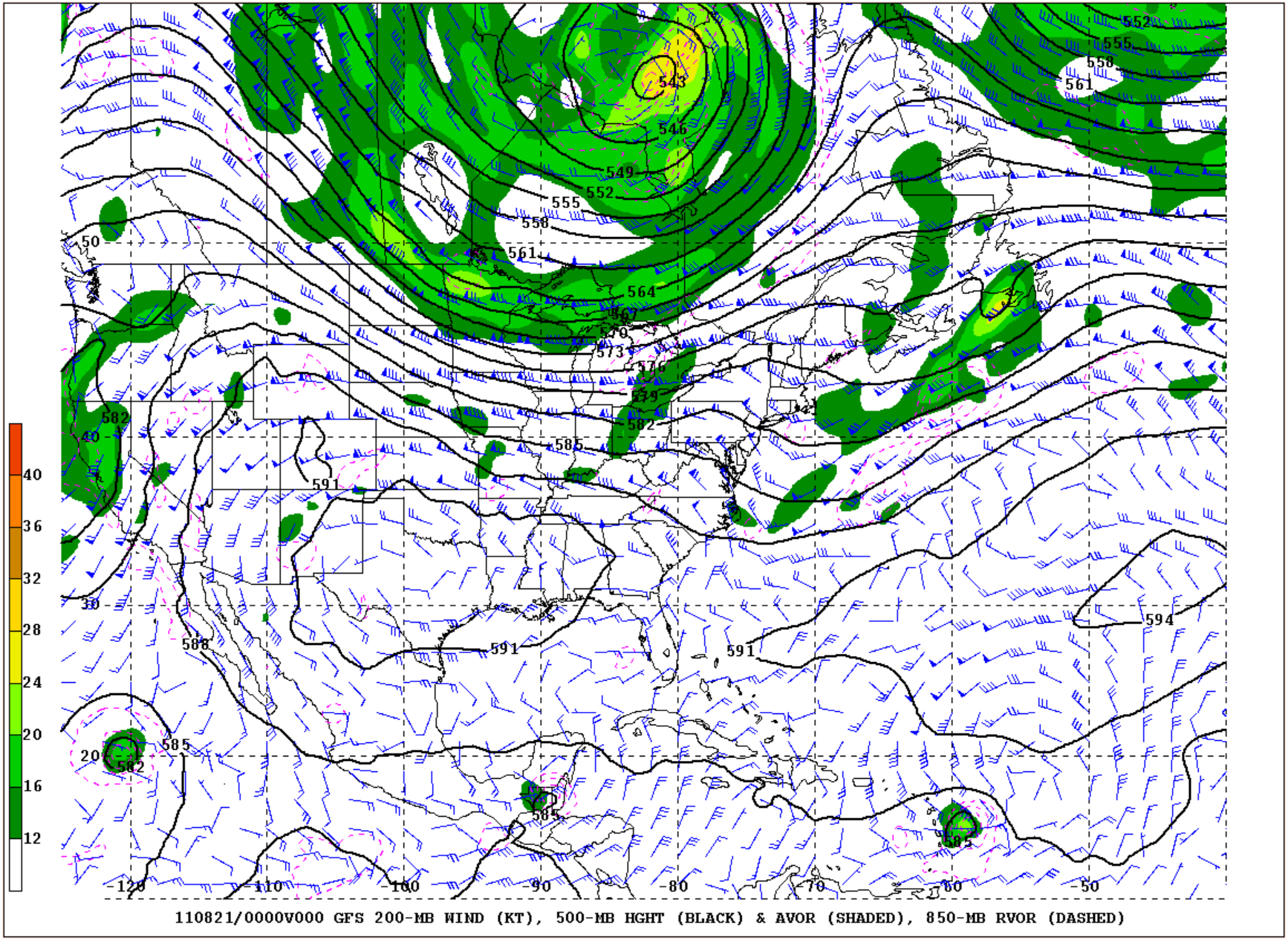
- G-IV synoptic surveillance missions are flown to reduce track uncertainty for the issuance of U.S. Hurricane Watches and Warnings
- Flight tracks are drawn to ensure symmetric distribution of drops (and available raobs) within 3° of the TC center, fill gaps in the radiosonde network, and target features of interest (e.g., ridge axis, deep trough, etc.)
- Aberson (2010) studied the impact of 176 missions from 1997-2006 and found an average 10%–15% improvement in GFS track forecasts during the first 60 h of the forecast
  - Little improvement found in regional model (GFDL) track and intensity forecasts



Methodology

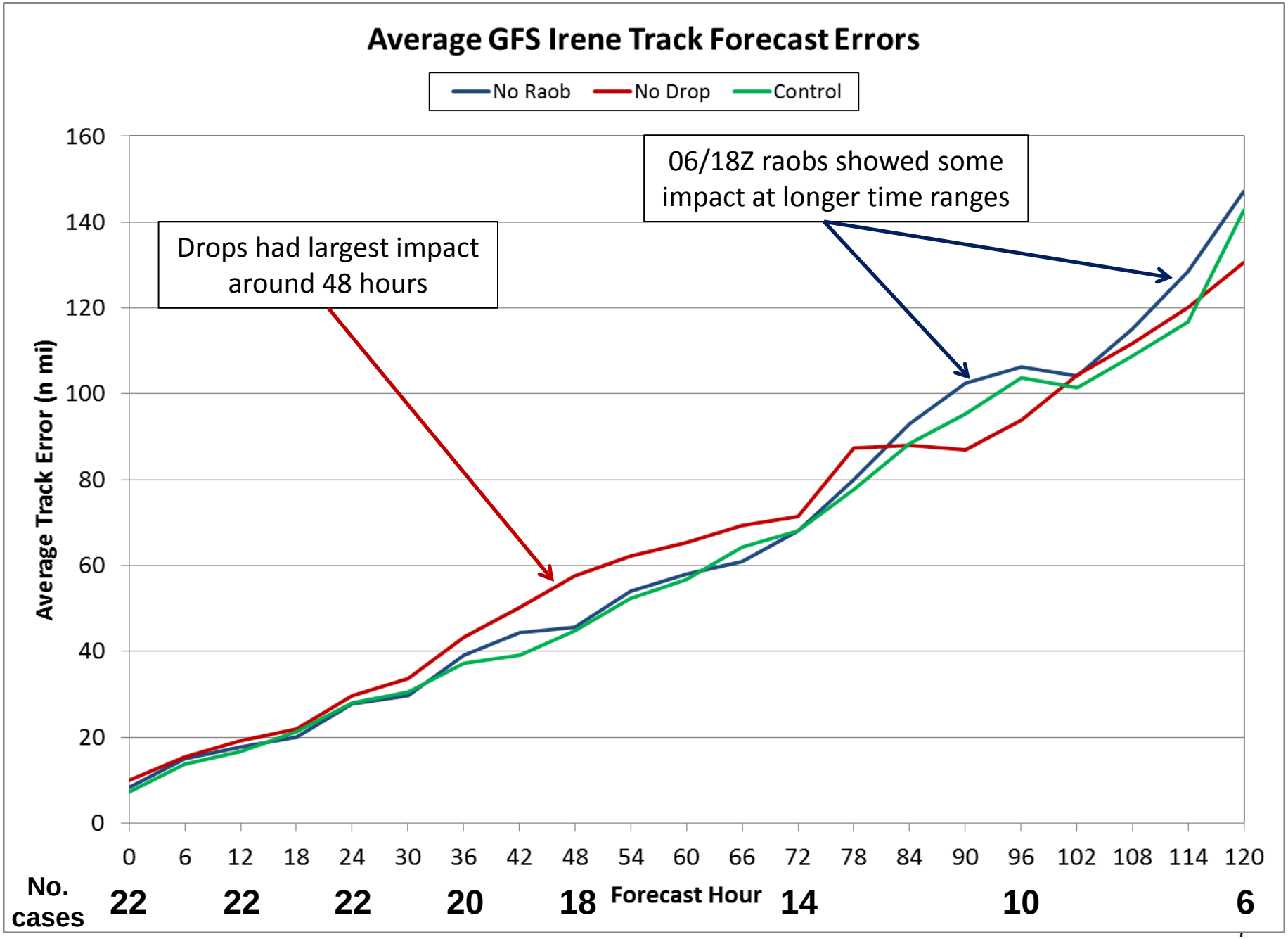
- Compare experimental GFS and HWRF runs withholding supplemental data to runs with all data
- Experiments:
  1. Control – rerun GFS and HWRF with all data
  2. Supplemental rawinsonde denial
  3. Dropwindsonde denial
  4. Supplemental rawinsonde and dropwindsonde denial

Synoptic Overview – 21-29 August 2011

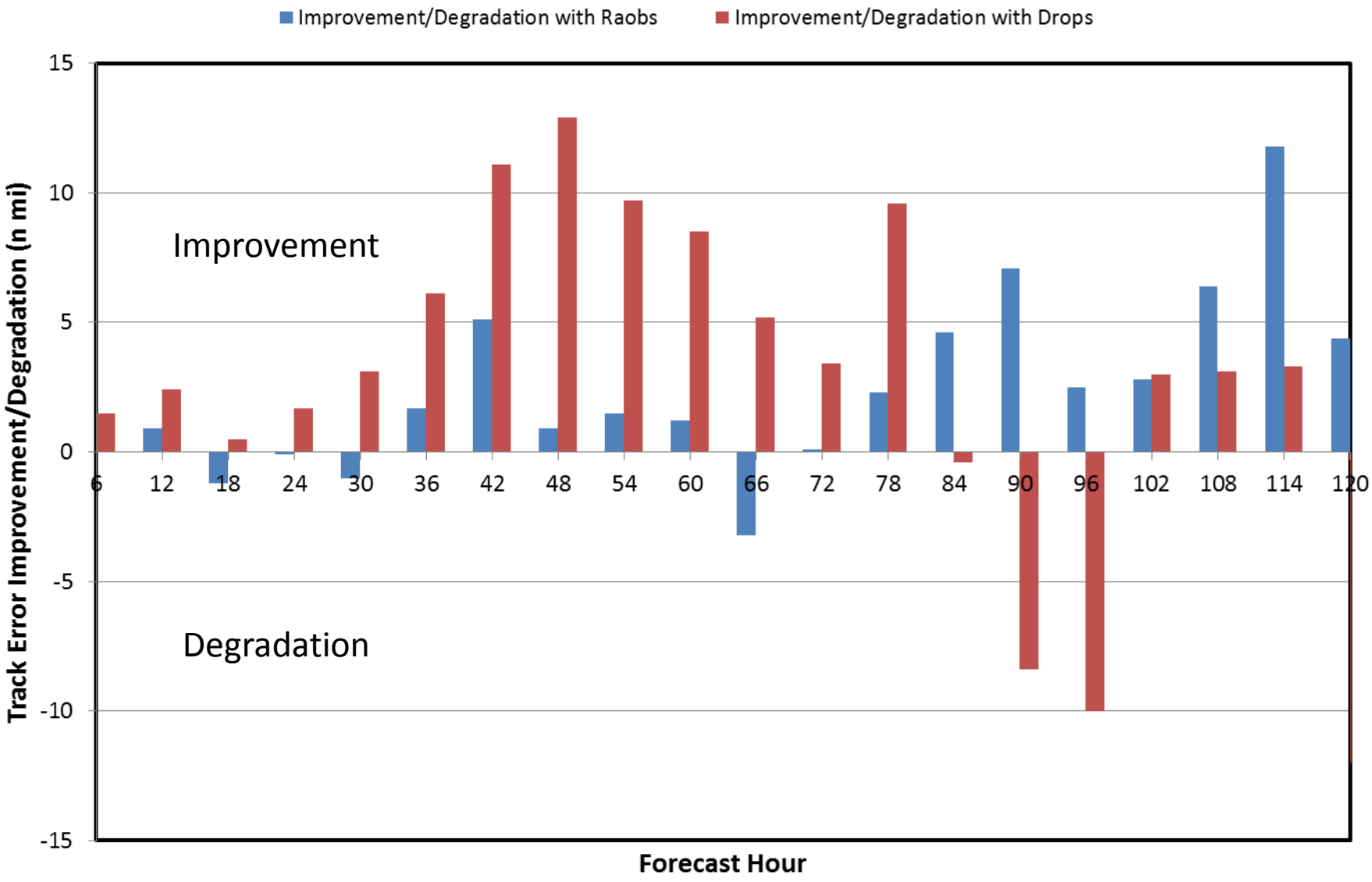


Results

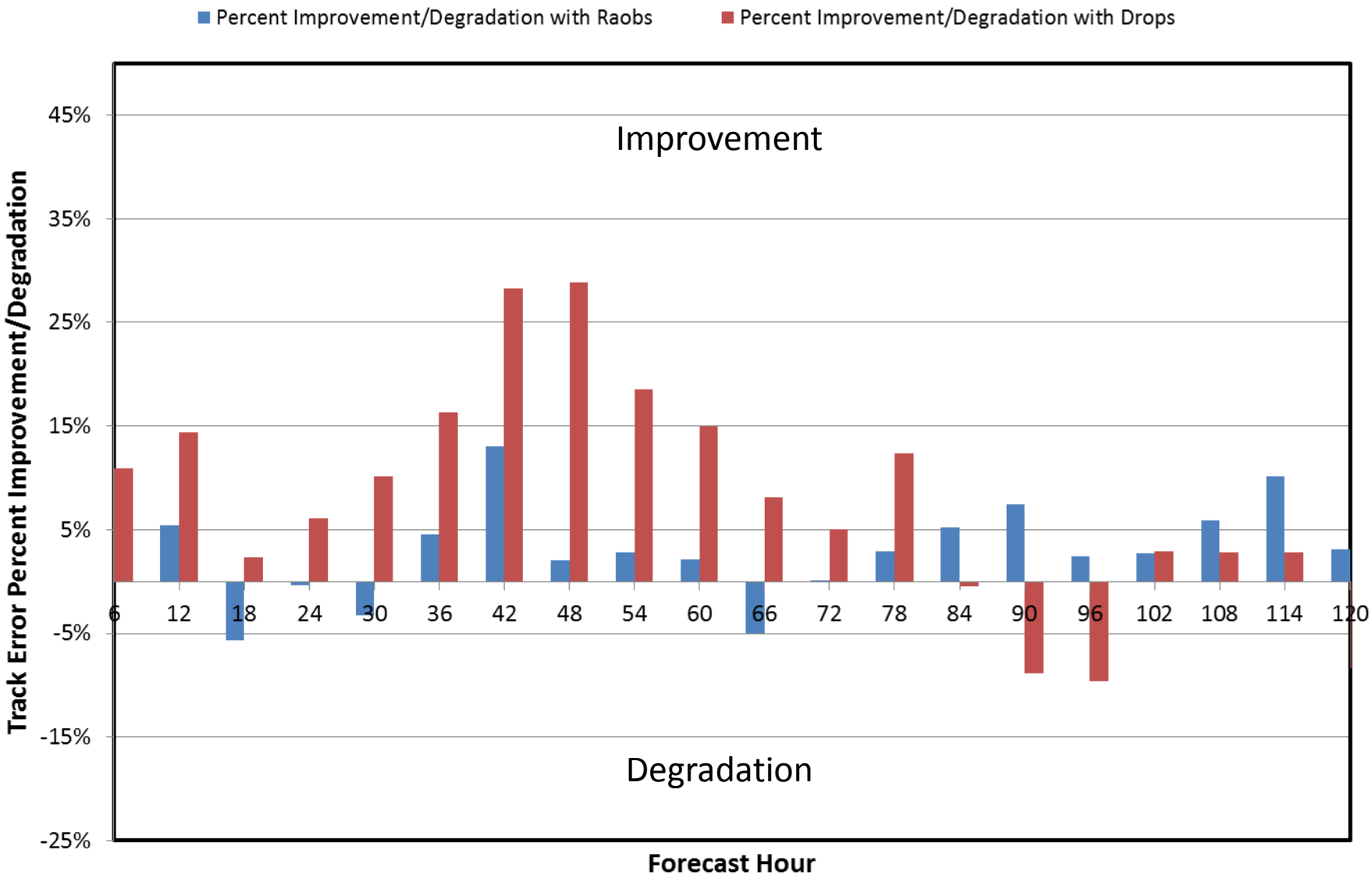
GFS and HWRF Track Forecast Errors


Average GFS Irene Track Forecast Errors
No Raob
No Drop
Control
06/18Z raobs showed some impact at longer time ranges
Drops had largest impact around 48 hours
Average Track Error (n mi)
0
20
40
60
80
100
120
140
160
0
6
12
18
24
30
36
42
48
54
60
66
72
78
84
90
96
102
108
114
120
Forecast Hour
No. cases
22
22
22
20
18
14
10
6

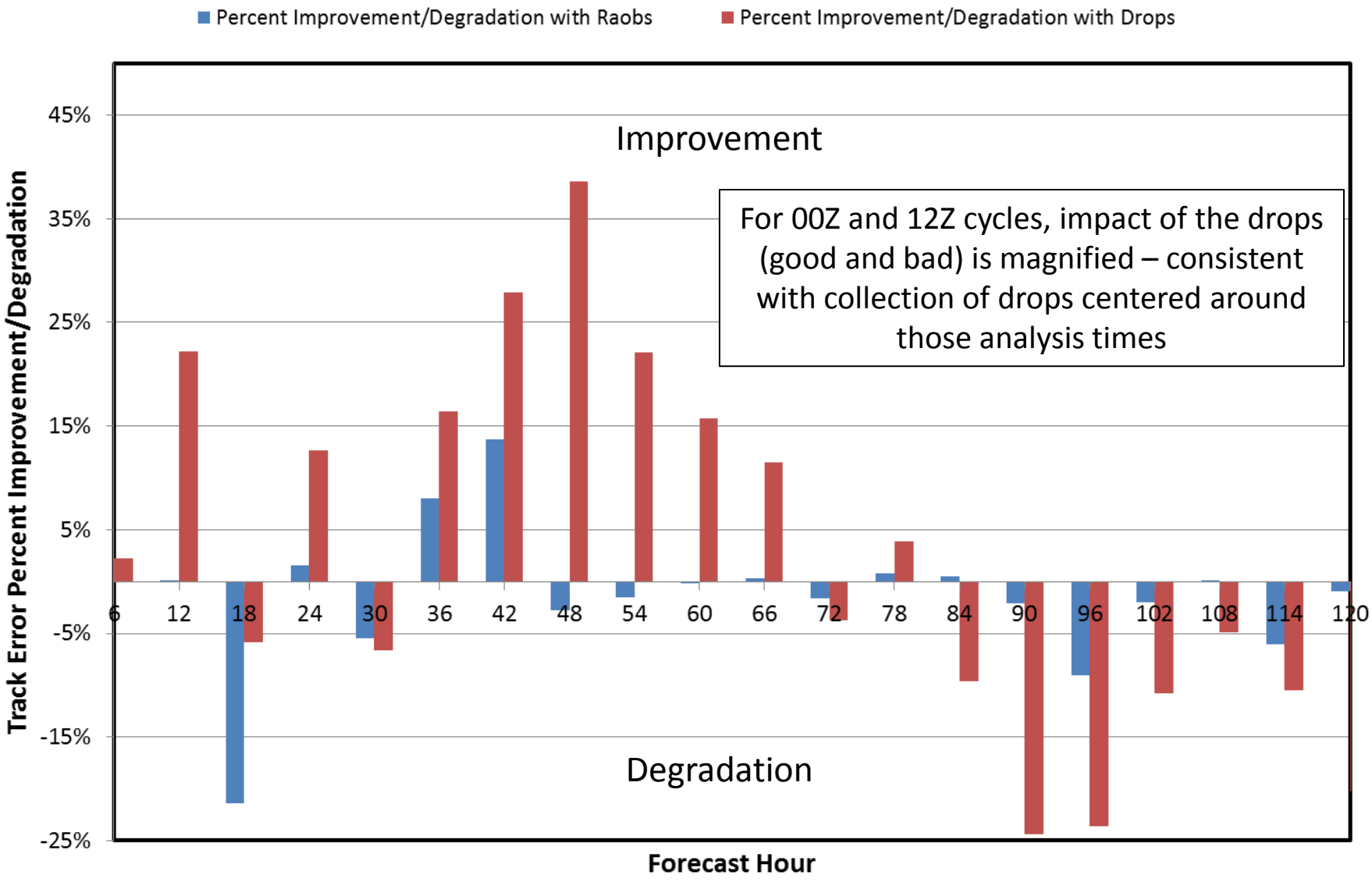
Average GFS Irene Track Forecast Improvement/Degradation With Drops and Raobs



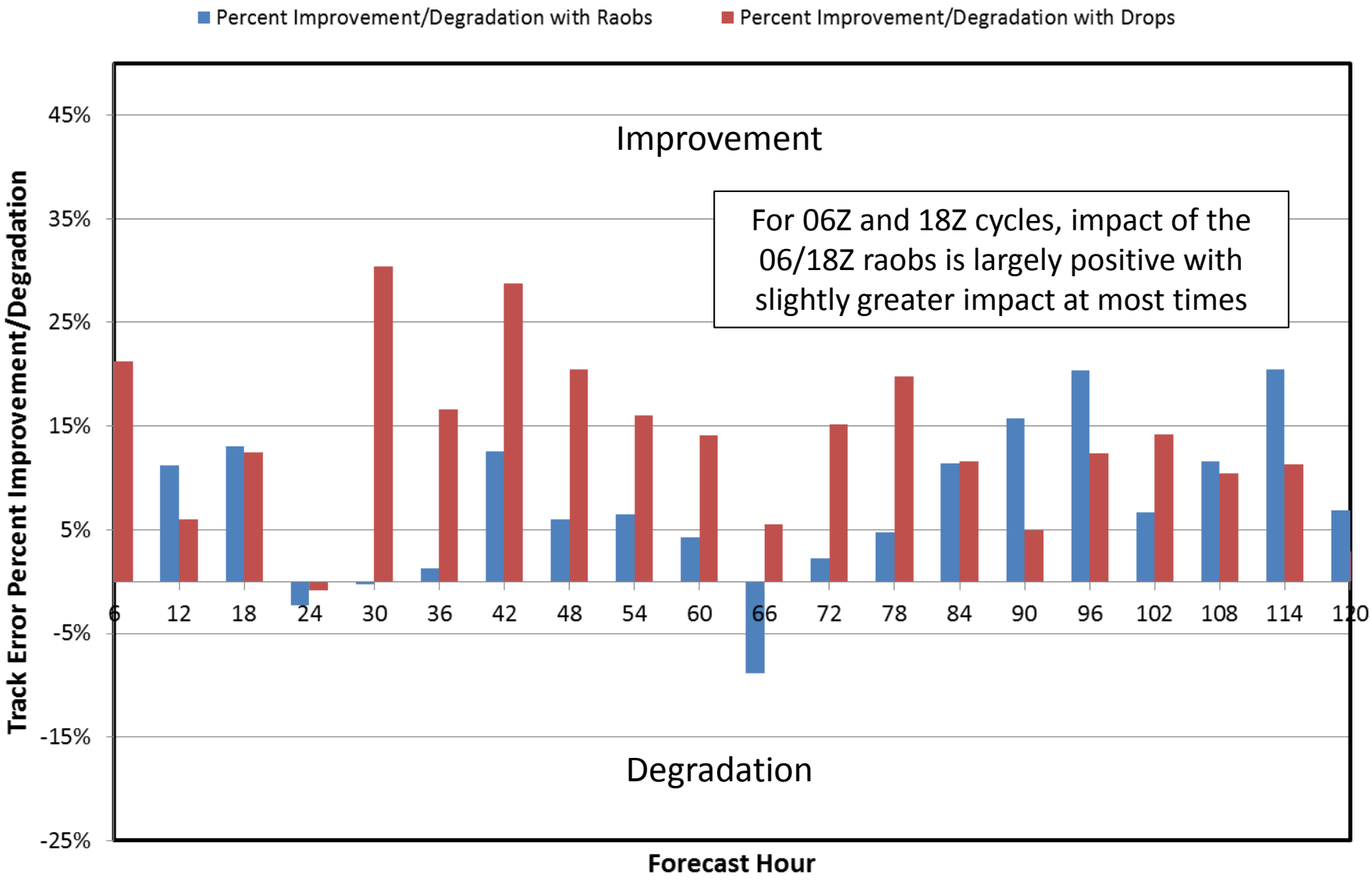
Average GFS Irene Track Forecast Percent Improvement/Degradation With Drops and Raobs



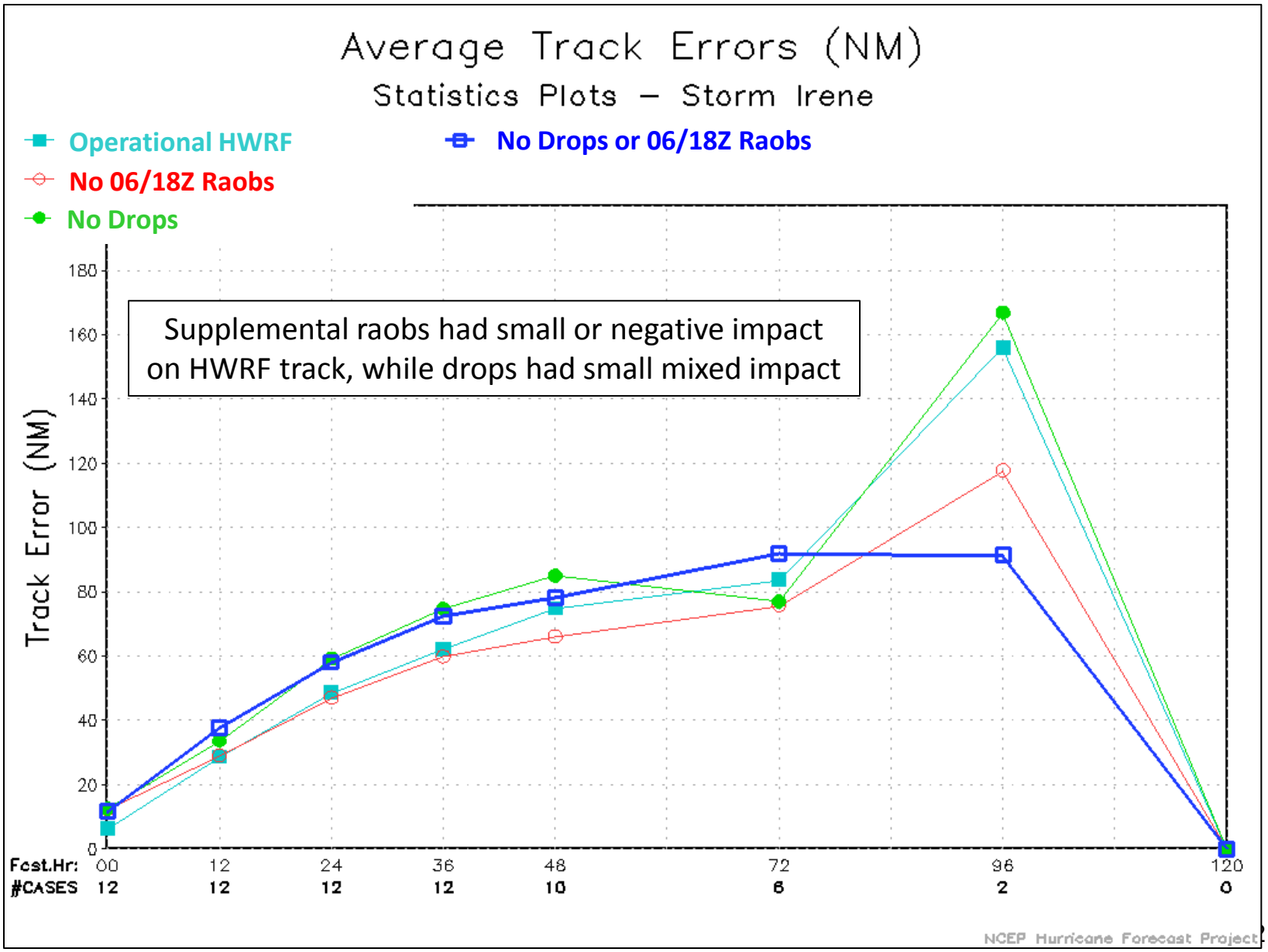
Average GFS Irene Track Forecast Percent Improvement/Degradation With Drops and Raobs for 00Z and 12Z Cycles



Average GFS Irene Track Forecast Percent Improvement/Degradation With Drops and Raobs for 06Z and 18Z Cycles



HWRF Track Errors

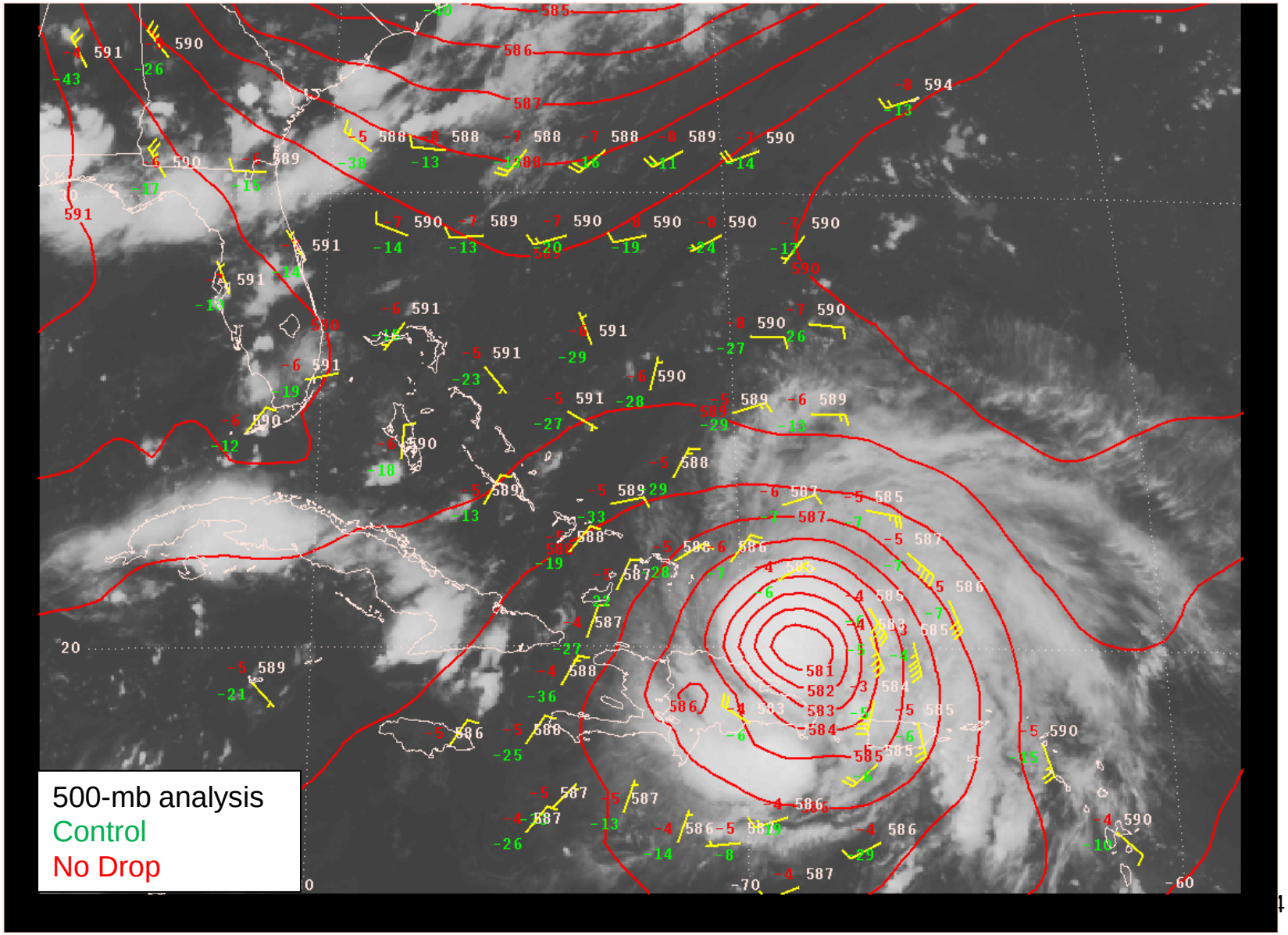


Case Example

GFS – 00Z 23 August Cycle

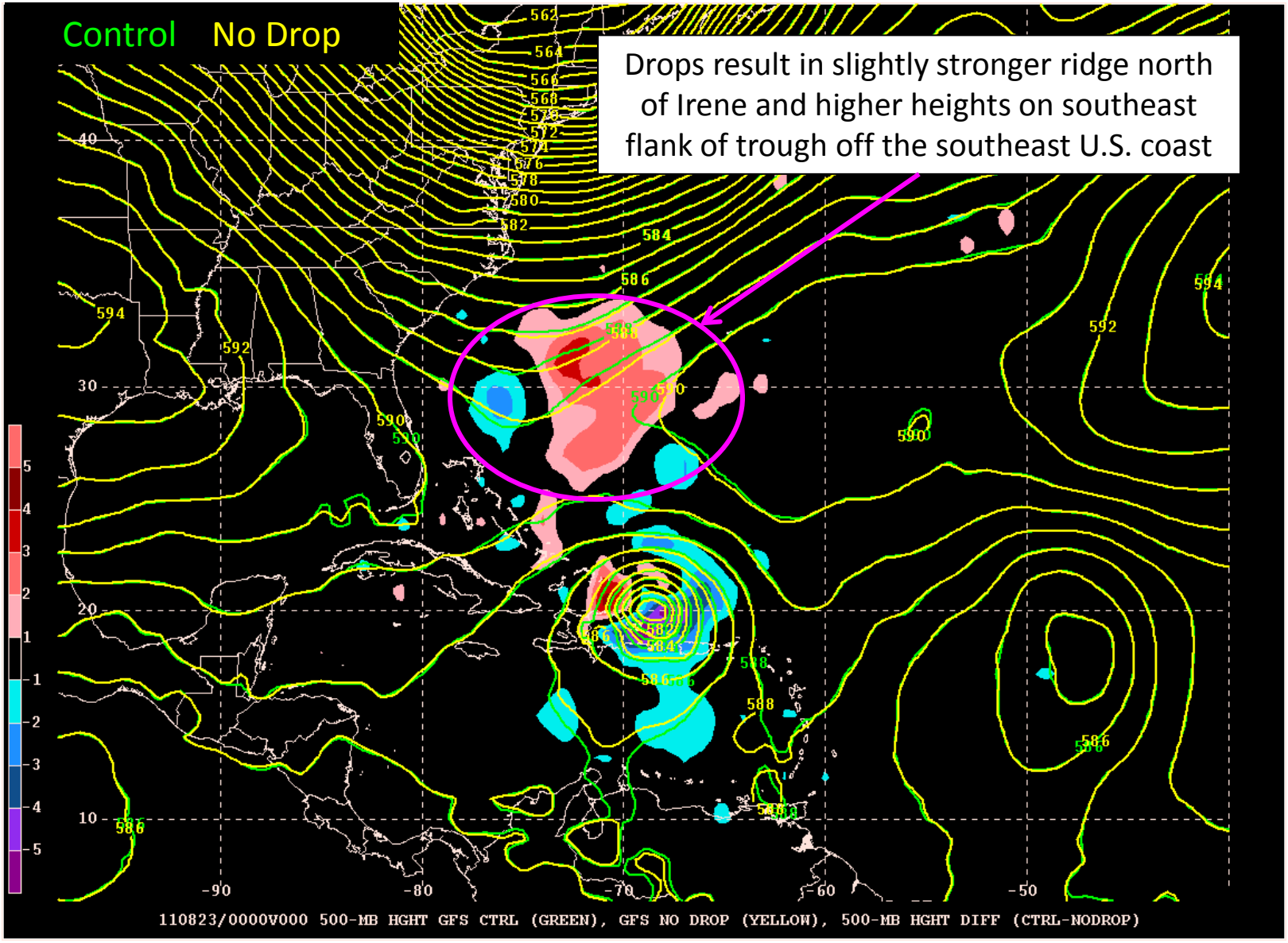
00Z 23 August 2011

First dropsonde missions centered around this time



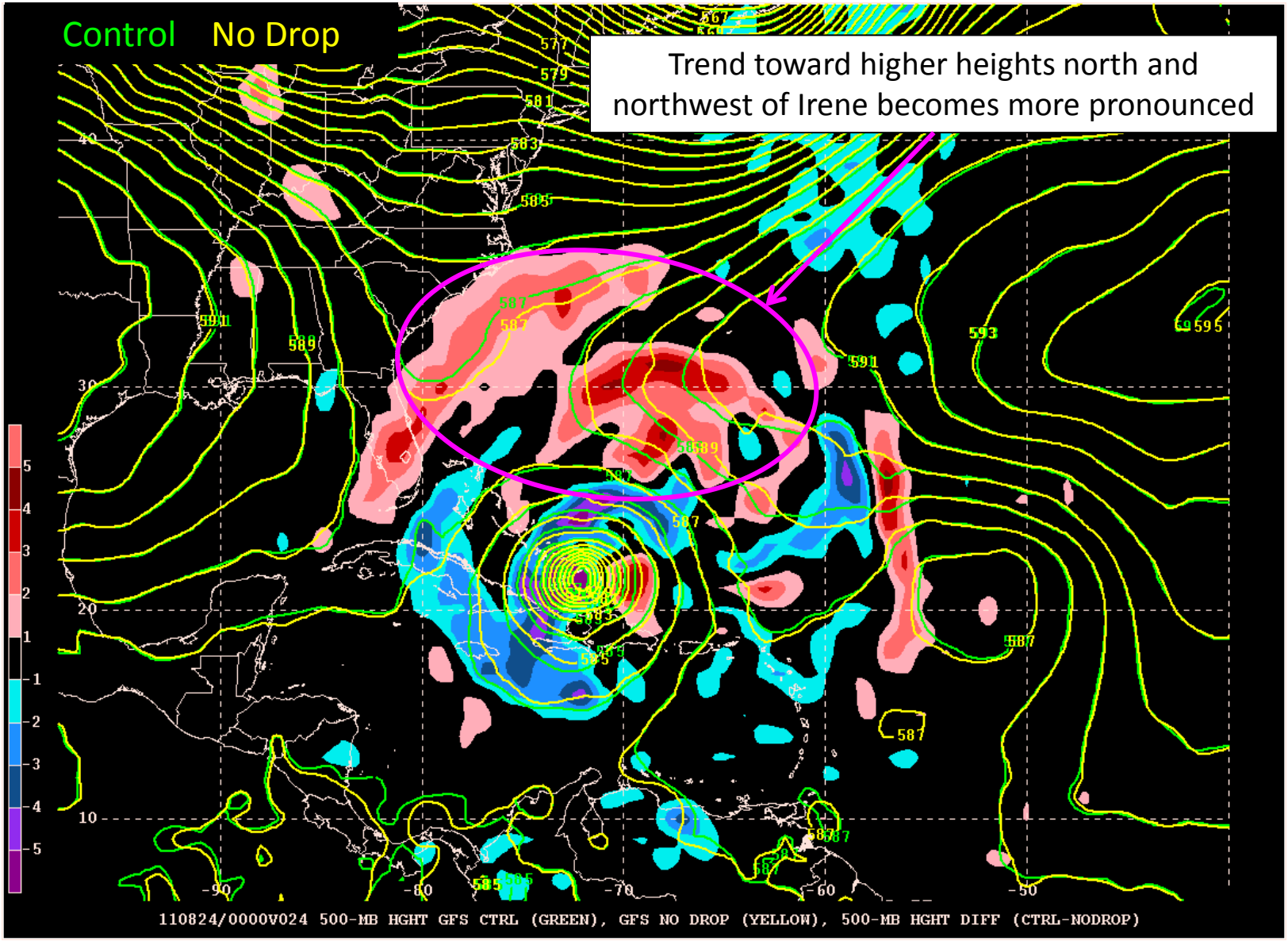
00Z 23 August – Analysis

500-hPa geopotential height and difference field (CTRL-NODROP)



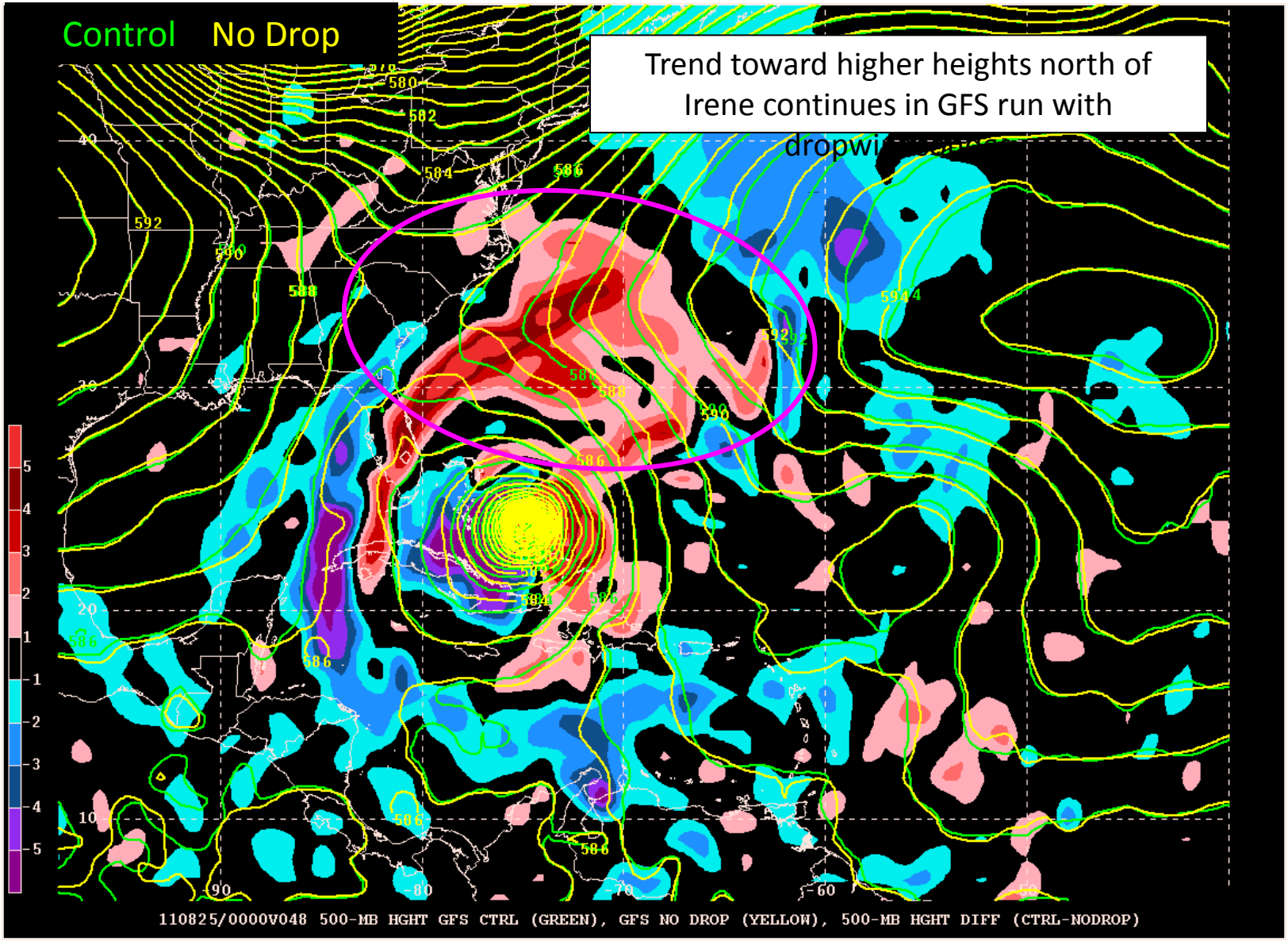
00Z 23 August – 24-h Forecast

500-hPa geopotential height and difference field (CTRL-NODROP)



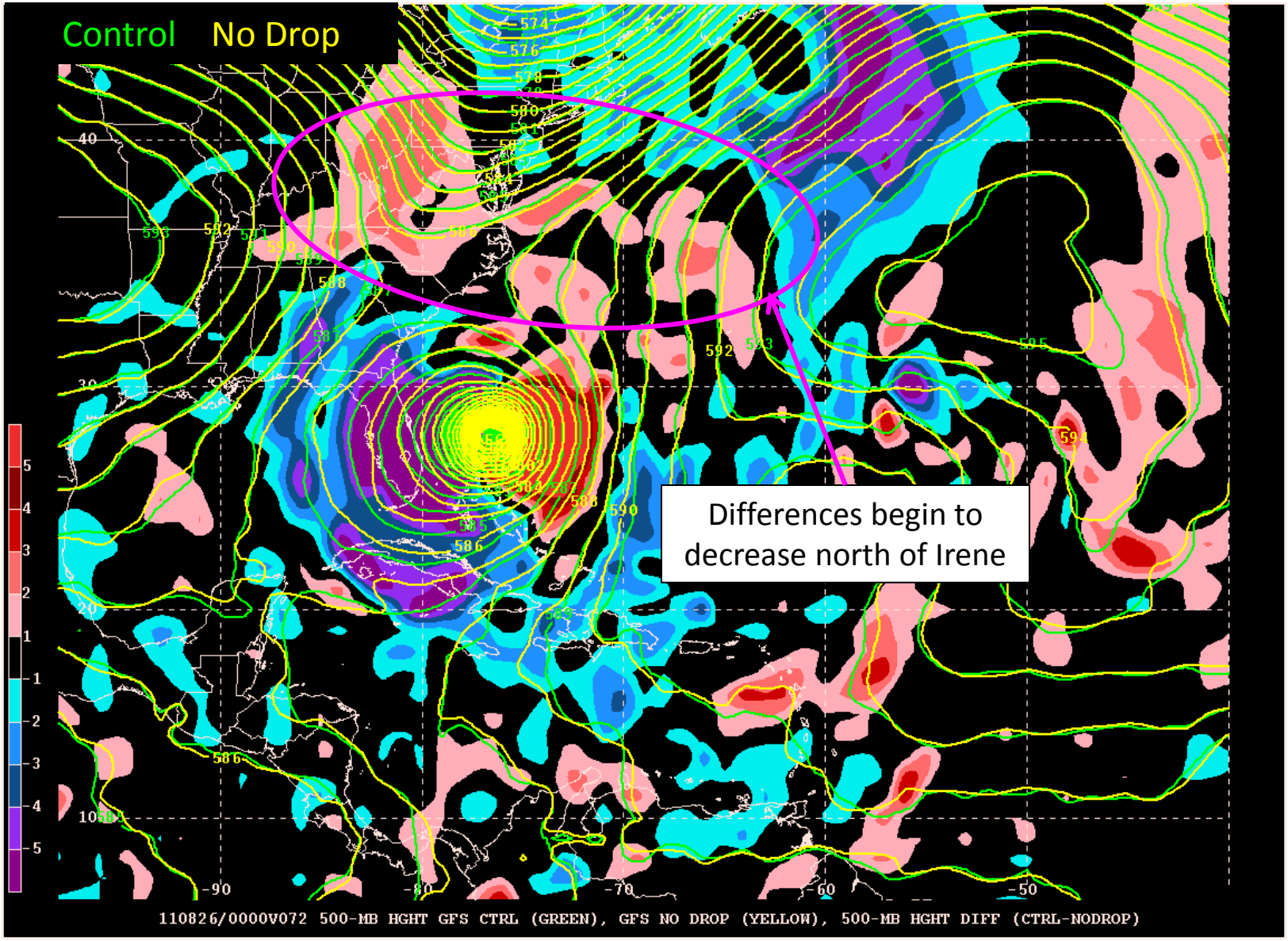
00Z 23 August – 48-h Forecast

500-hPa geopotential height and difference field (CTRL-NODROP)

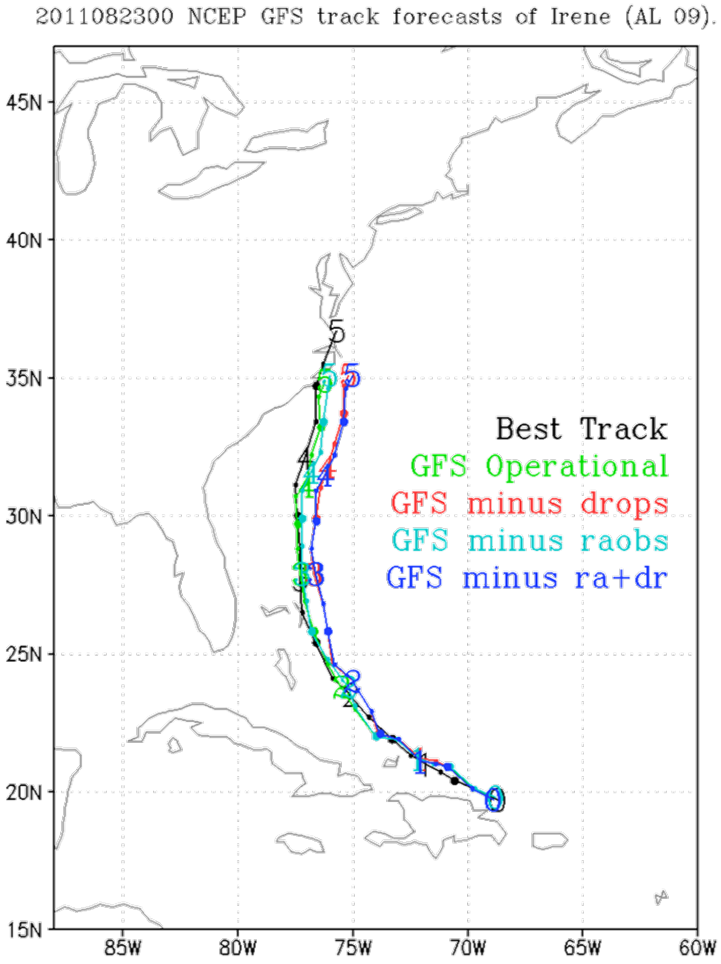


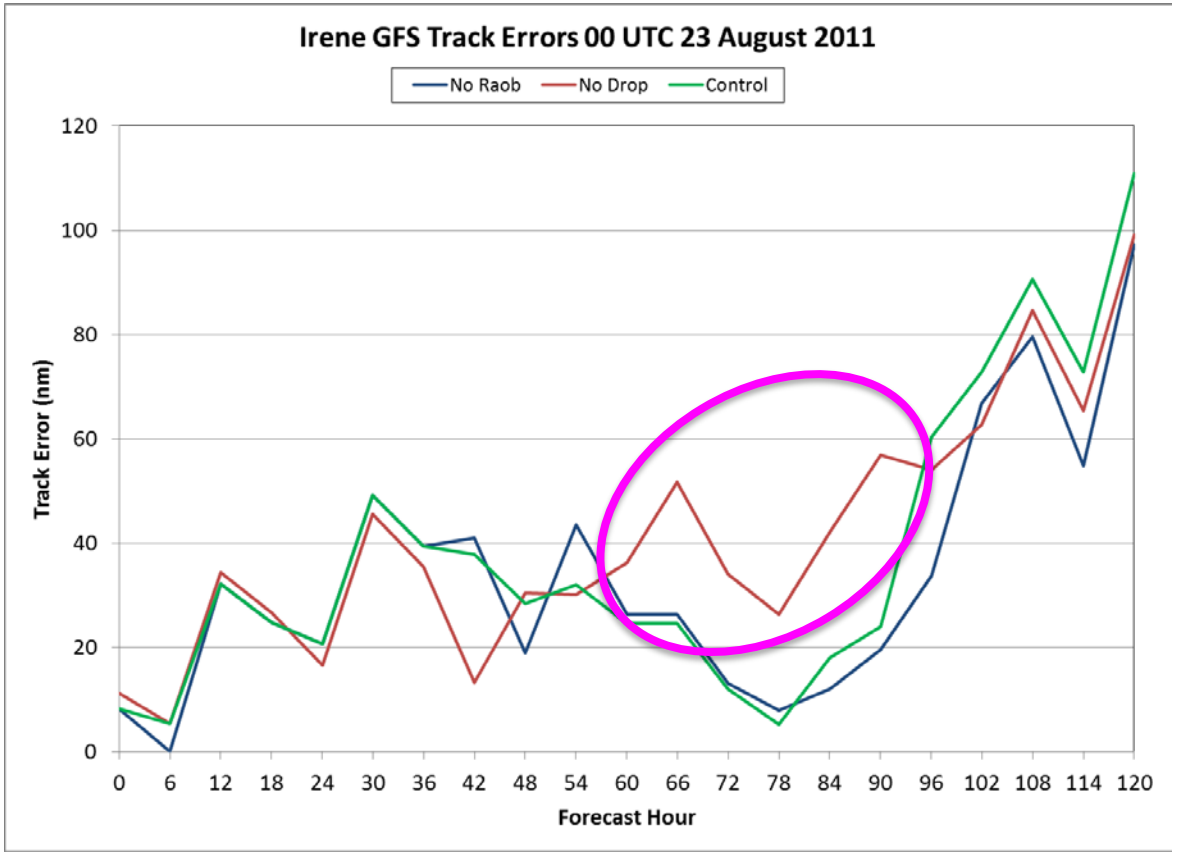
00Z 23 August – 72-h Forecast

500-hPa geopotential height and difference field (CTRL-NODROP)



00Z 23 August GFS Run





- Dropsonde impact seen at days 2.5–5 with westward shift in track without drops
- Largest error reductions due to drops at 60–90 hours
- Control run too slow by day 5, but drops seem to have little impact on forward speed

Preliminary Conclusions

- Small but positive impact from dropwindsonde and supplemental rawinsonde observations on GFS track of Irene
  - Little or negative impact seen at most times in the HWRF
- Dropwindsonde impacts generally consistent with Aberson (2010), who found 10%–15% improvement in GFS track forecasts in first 60 h (176 missions from 1997-2006)
  - Little improvement found in regional model track forecasts
- Dropwindsondes showed largest improvement in the 2–3 day lead time, while supplemental rawinsondes showed largest improvement at days 4–5
- More analysis to be done, so stay tuned for future results