# Hurricane Data Assimilation Meeting

# 25 November 2008

1. News from HRD Aberson
2. HFIP teams discussions
   - DA team
   - Obs team
3. ESRL plans Hamill
4. Data warehouse Xie, et al.
5. Quikscat impacts Majumdar
6. Data impact in time Aberson

# News from HRD

More flights in Paloma

- collected huge amount of data in 2008 for assimilation into models
- quick look at NOAA data available at ftp://ftp.aoml.noaa.gov/pub/hrd/aberson/hfp2008
- other data available from AFRES aircraft and T-PARC/TCS08
- http://www.aoml.noaa.gov/hrd, click on “Data”

Great progress made on Hurricane Research System model at HRD - running in real-time through much of 2008 season.

HRD to hire a data assimilation expert (ZP-IV position). Announcement in final stages of approval and will hopefully be advertised soon.

# HFIP teams

NOAA put together teams to plan HFIP programs:

1. Global model development
2. Regional model development
3. **Data assimilation**
4. Non-hydrostatic mesoscale model physics
5. Global model physics
6. Verification
7. Model diagnostics
8. Post-processing and diagnostics development
9. Ensemble systems development
10. **Observations**
11. Coupled ocean/wave model development

# ESRL plans
# Hamill

# Hurricane Data Warehouse

Yuanfu Xie, Sharan Majumdar, Sim Aberson,
Steve Albers, Sundararaman.G.Gopalakrishnan
and Nicholas Carrasco

We would like to propose a DA warehouse for hurricane data assimilation community.

- Controlled access the data
- Operational DA analyses
- Display capability
- Evaluation tools for hurricanes

# Existing Facility

- AOML has started this warehouse:
  - http://www.aoml.noaa.gov/hrd/

    For all aircraft data and post-processed SFMR data. Real time aircraft data can be found at
  - http://www.nhc.noaa.gov/reconlist.html

    We may need to expand this for all data sources (raw and post-processed), a unified data ingest capability and DA analysis display and evaluation.

# Existing Facility

- ESRL/GSD has also a warehouse hosting all types of data (obs and background in NetCDF) over the globe in archive and real time.
- MADIS (more easily accessible) has mainly point observations
- NIMBUS has additional observations from satellite and model grids
- AOML observations can potentially be added to MADIS and/or NIMBUS
- MADIS/NIMBUS data also available on Jet

# Observations

- A unified observation data format for each observation data type (AOML).
- Possible near real time data update.
- Some basic data interface (Maybe ESRL/ LAPS or possible ESRL/MADIS).
- Basic QC criteria (LAPS and MADIS have various QCs).
- DA users' account management.

# Datasets

- All in-situ observations;
- Raw radar and pre-analyzed radar data from AOML/HRD;
- Microwave observations;
- Satellite radiance data;
- Others…
- Model backgrounds.

# Display and evaluation

- Display capability for all DA products in near real time, EnKF, GSI, LAPS, and STMAS.
- Evaluation tools for hurricane DA analyses and forecast impact.
- Discussion forum for improvement of all DA schemes.

# Baby Steps toward the near real time warehouse

- Compile a list of observation instruments for hurricane DA;
- Define a unified data format, observations and model backgrounds;
- Setup servers with archive capability at AOML, GSD or both.

# Notes on the use of QuikSCAT in the NCEP GFS

Sharan Majumdar (RSMAS/Umiami)
Bob Atlas (NOAA/AOML)
Joe Ardizzone et al. (NASA Goddard)
NCEP/EMC Data Assimilation Group
11/25/08

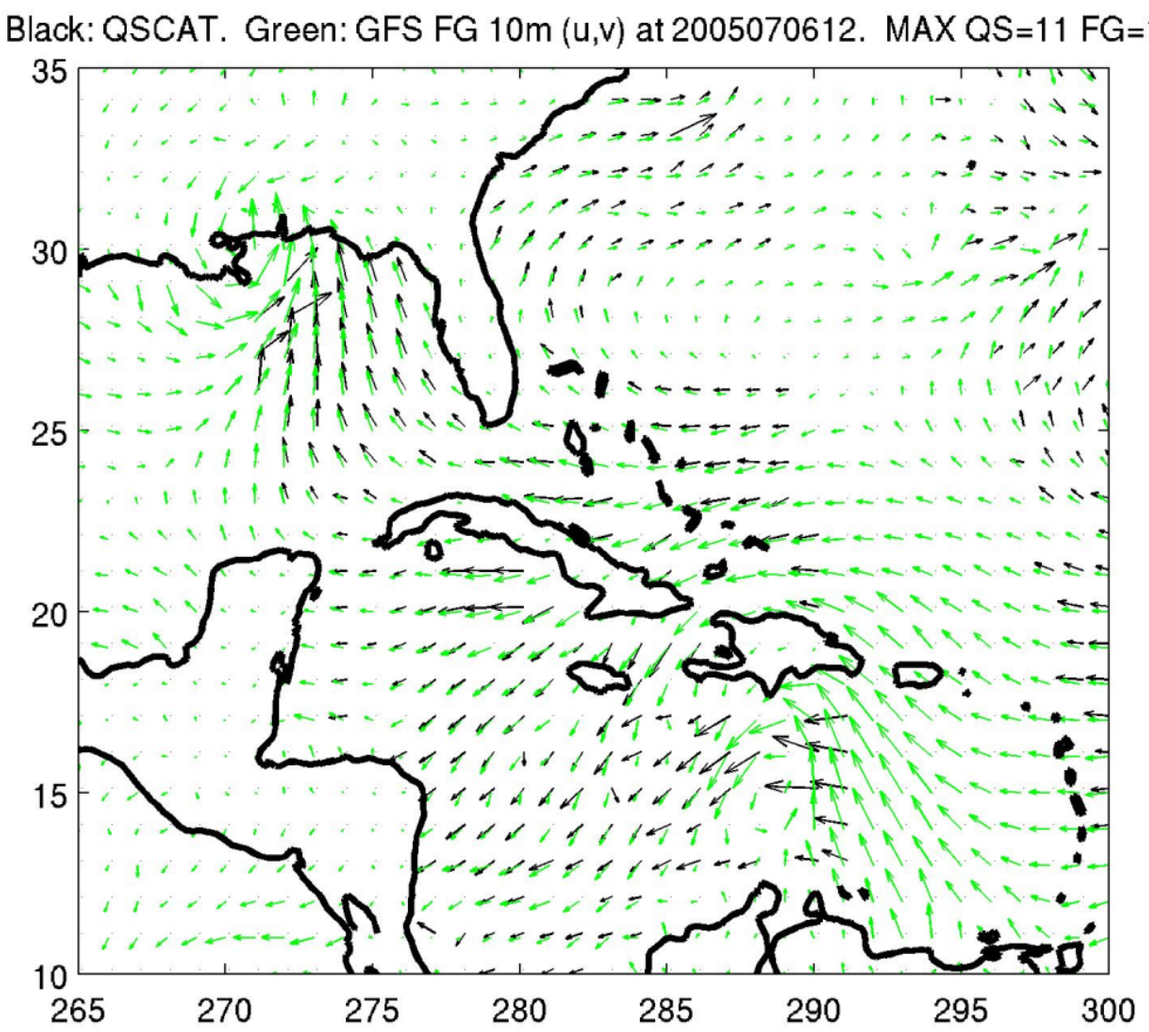
# Issue

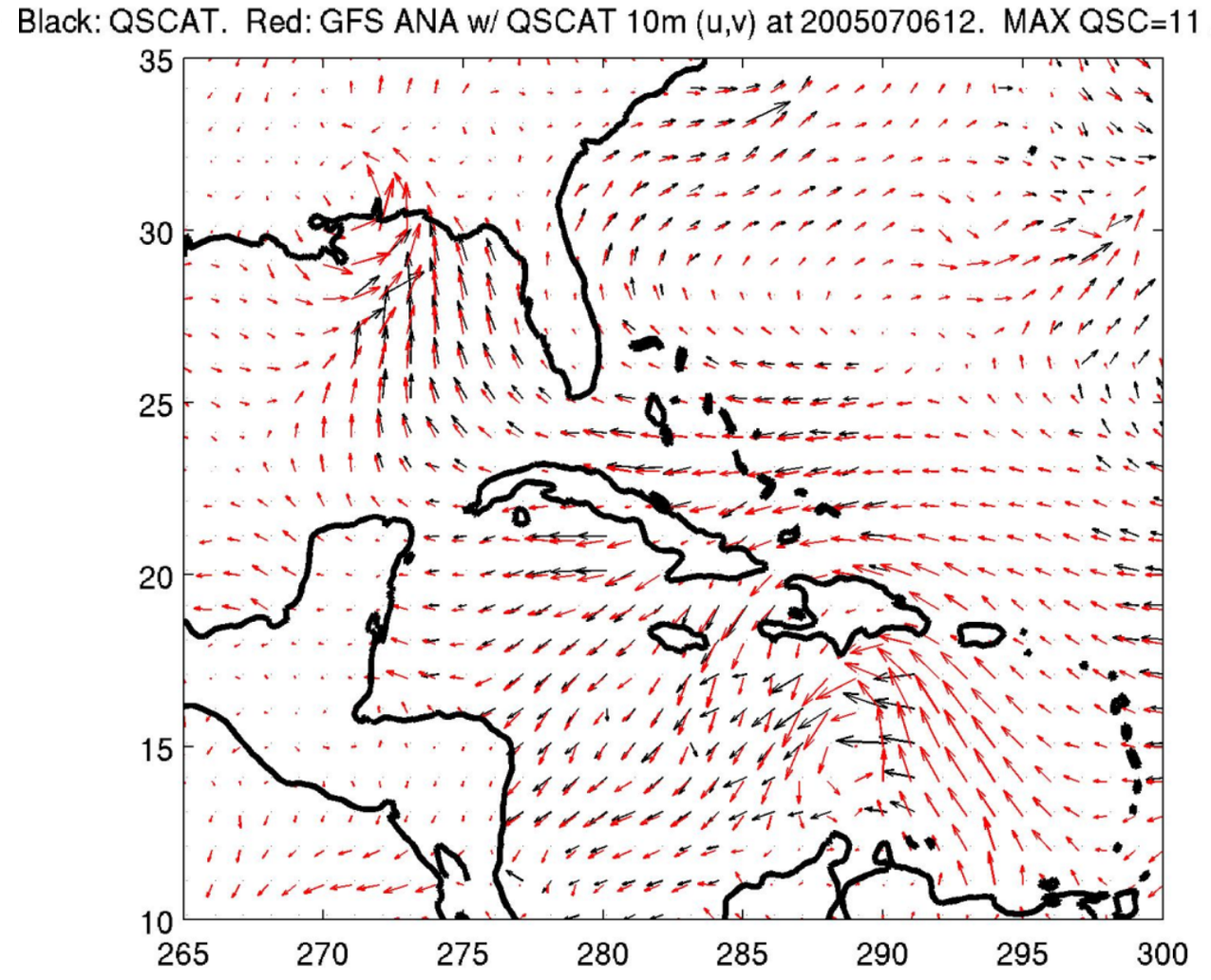
- The assimilation of wind vectors derived from QuikSCAT yields a minimal impact on NCEP GFS/GSI analyses and forecasts of tropical cyclone track and surface winds.

- (NCEP internal study with 2007 version of GFS/GSI, for periods during 2005 and 2006 hurricane seasons)

# Example: Developing TS Dennis

- LEFT: QuikSCAT vectors (black, not super-obbed) significantly different from NCEP GFS first guess (green) south of Hispaniola
- RIGHT: GFS/GSI Analysis (red) appears considerably more similar to first guess (green) than to QuikSCAT (black).

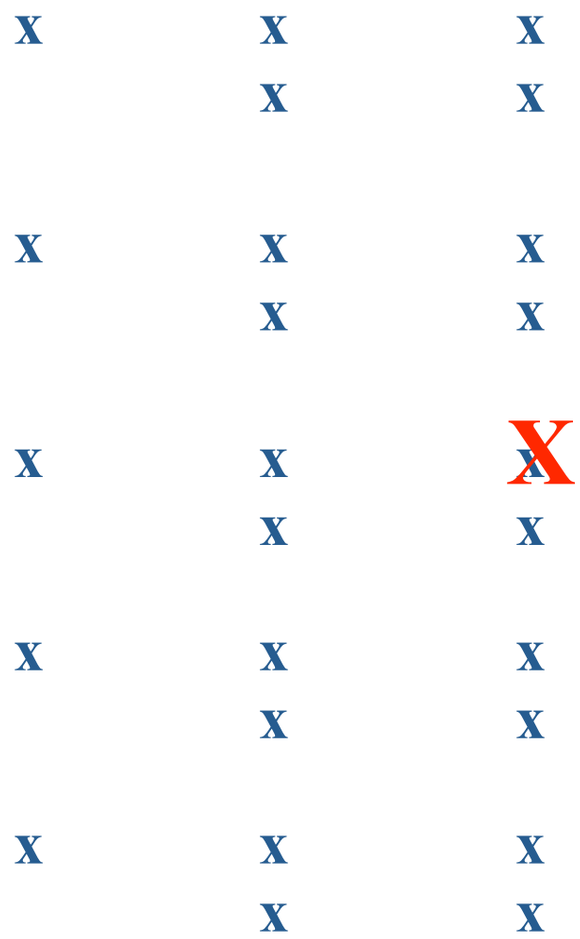


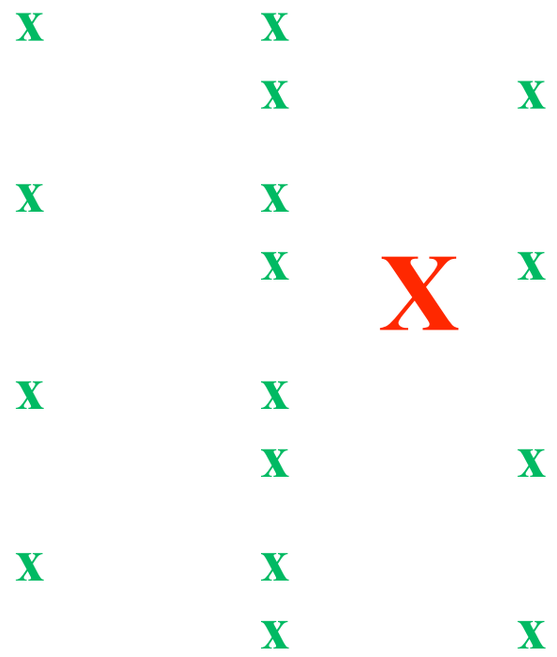



# Items for investigation

1. Retrieval algorithm: backscatter to wind vectors
2. Quality Control process
3. **Averaging / super-obs technique**
4. **Observation error statistics**
5. Data Assimilation in GSI
   A. All operational observations assimilated
   B. Single 995mb u observation
   C. Single surface pressure observation

# 3. Super-Obs method





- Unclear whether 5x5 or 4x4 lattice is representative of NCEP's method.

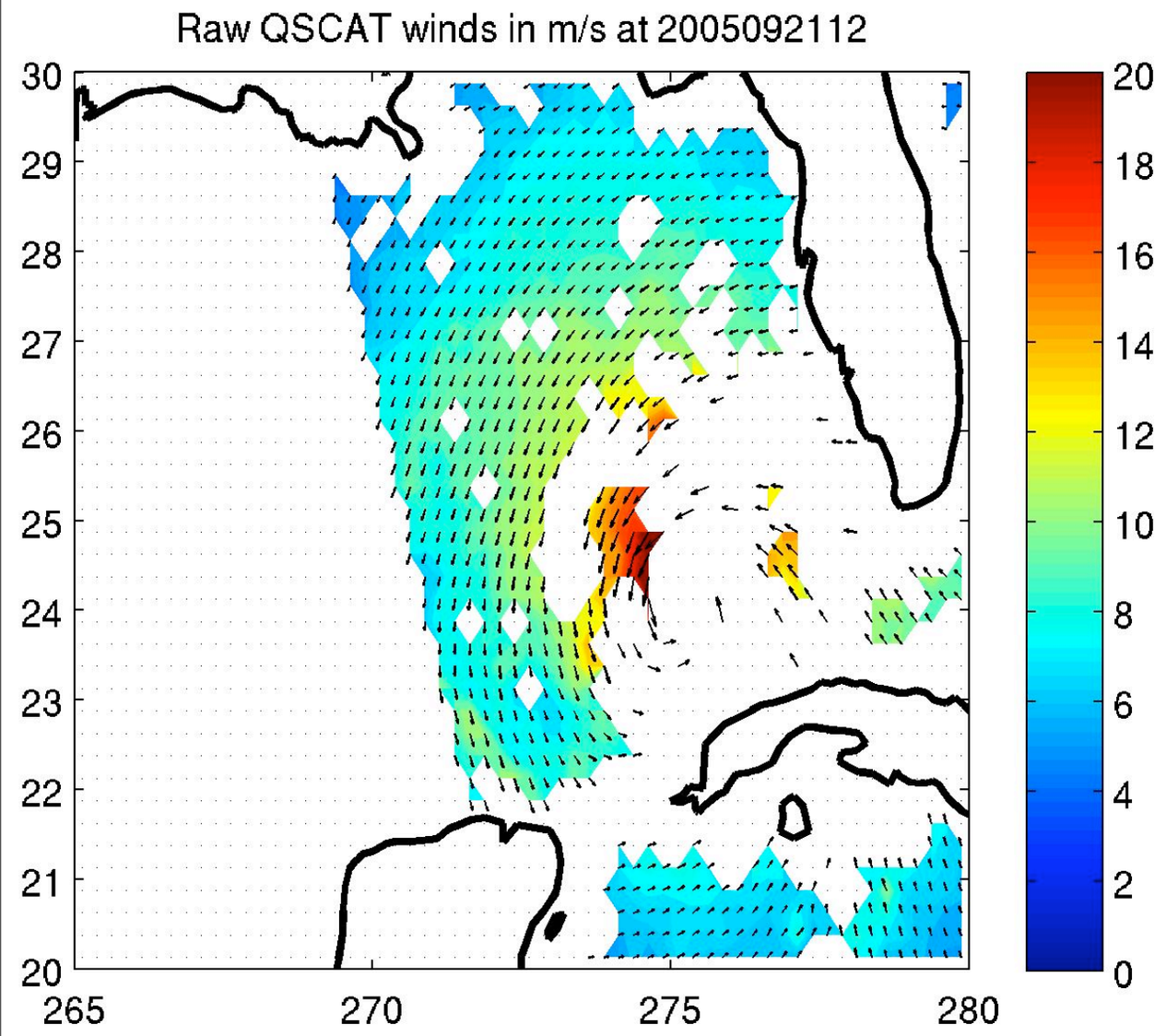
# 3. Super-Obs method

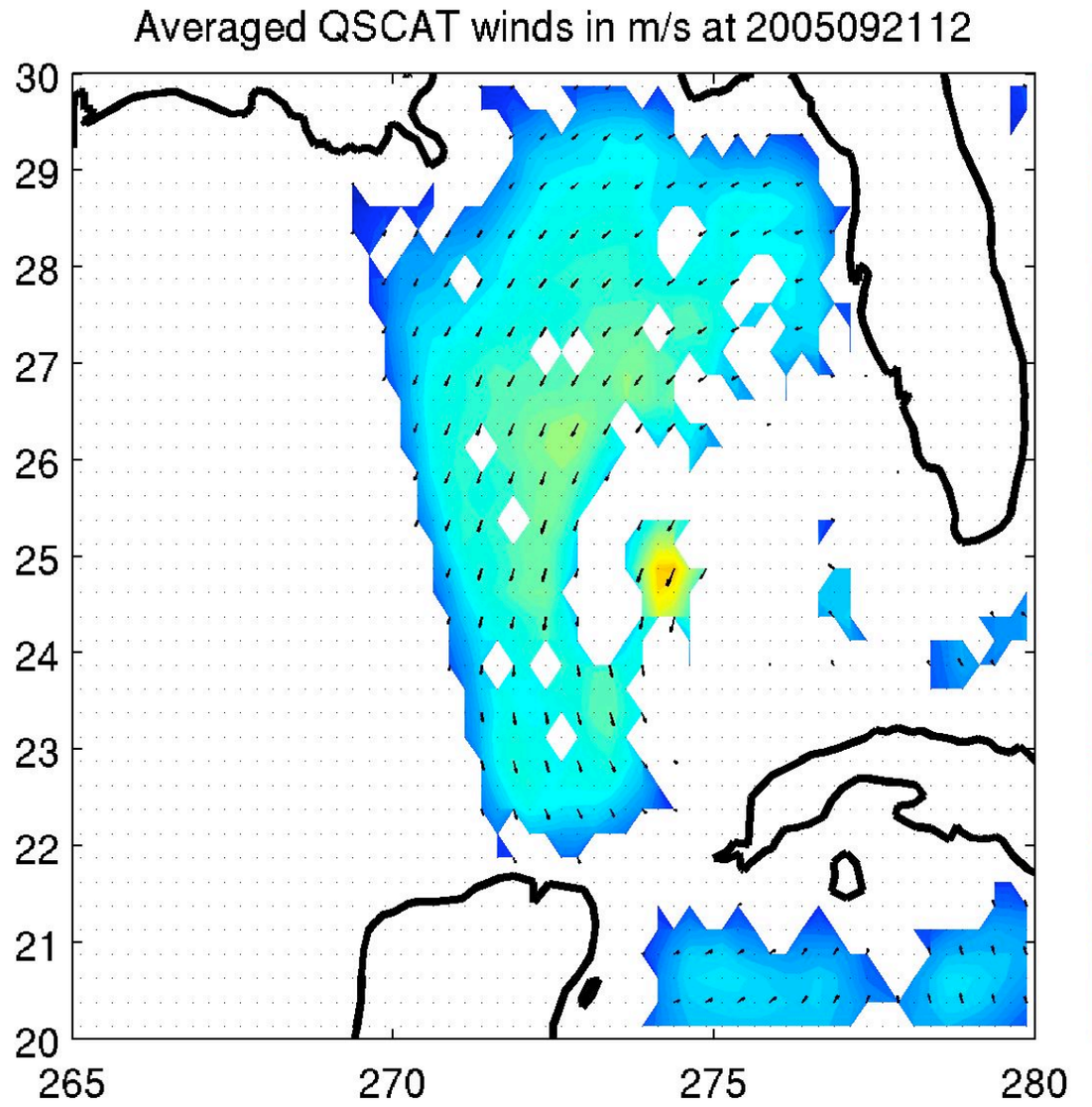
- Next 8 slides: Hurricane Rita in Gulf of Mexico

- Left panel: QuikSCAT winds at 0.25$^{o}$ resolution (rain-flagged)
- Right panel: Super-obbed (averaged) QuikSCAT winds for each grid point at 0.5$^{o}$ resolution.
- Super-obbing is done over 5x5 lattice for each grid point. Note: this may not be NCEP's method.

- (White areas: no obs or rain-flagged)

# 3. Super-Obs method



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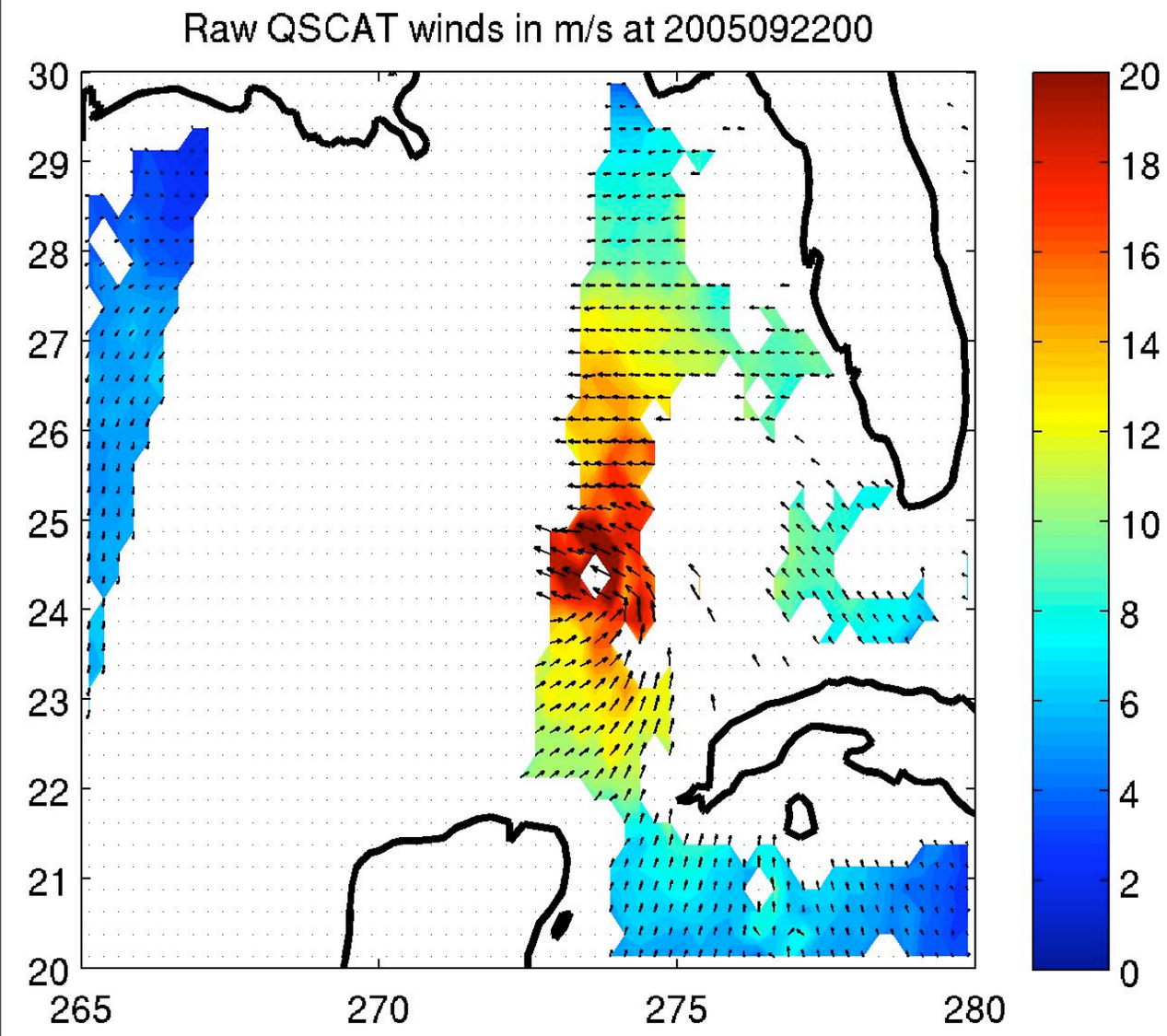


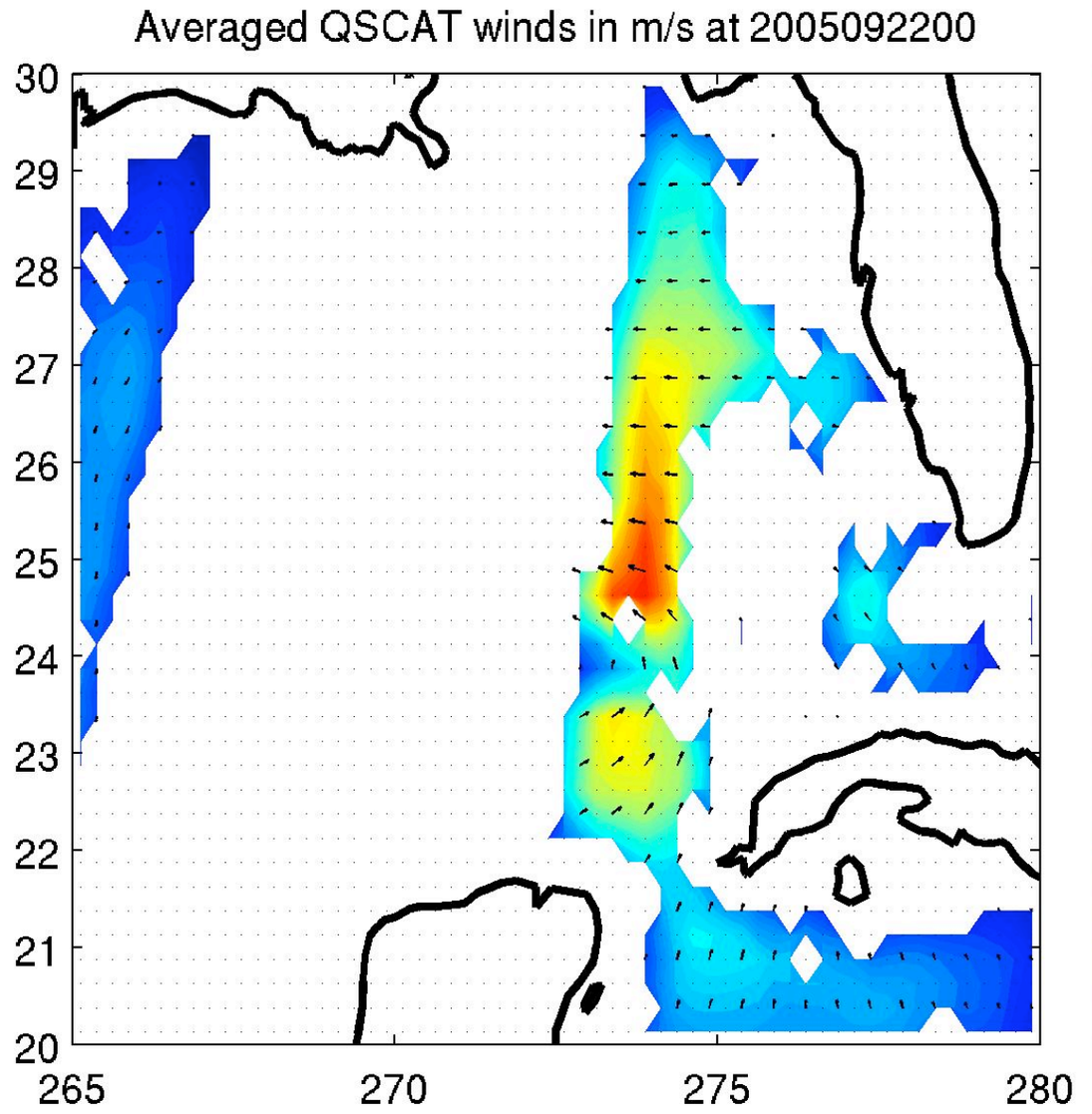

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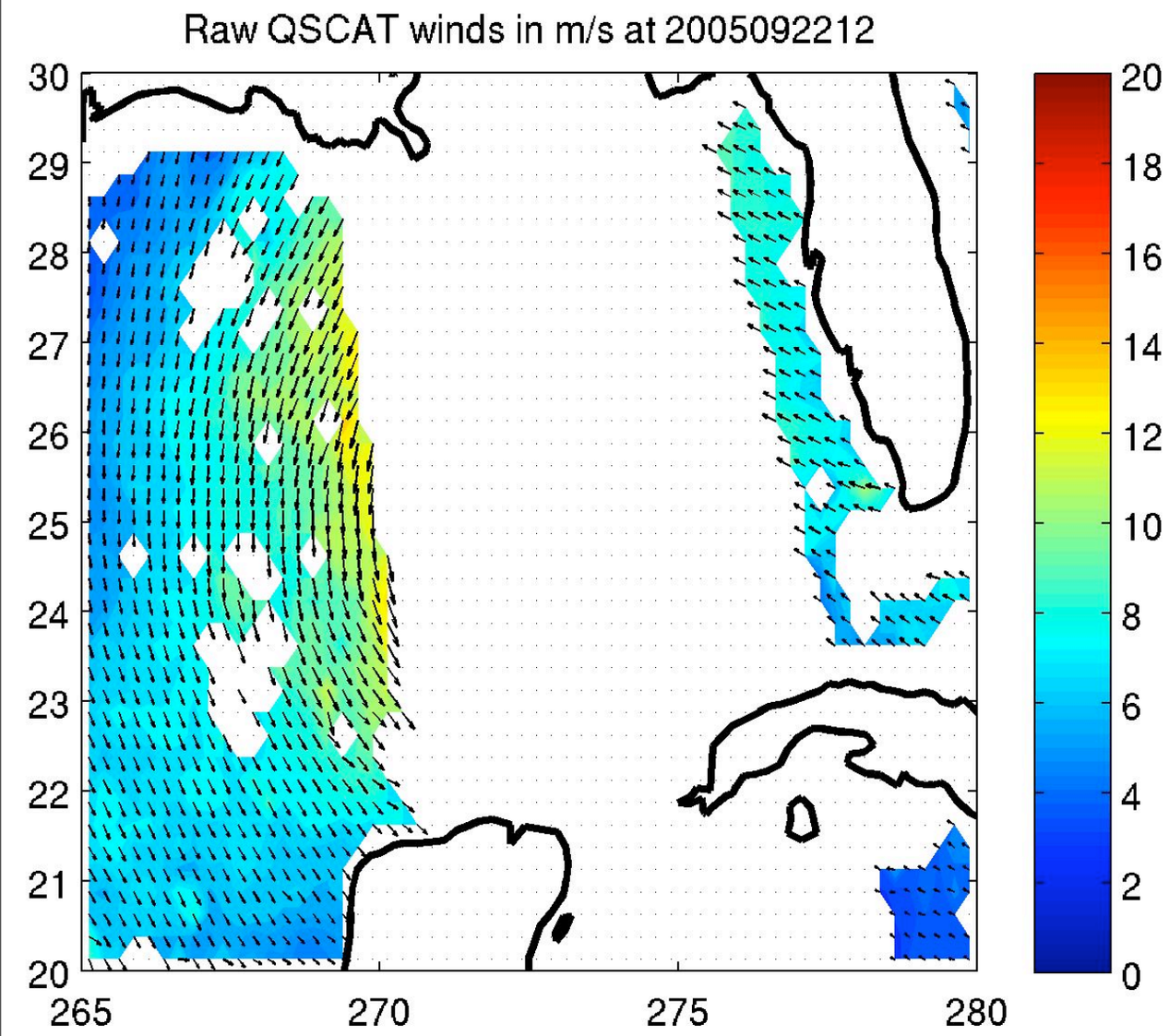


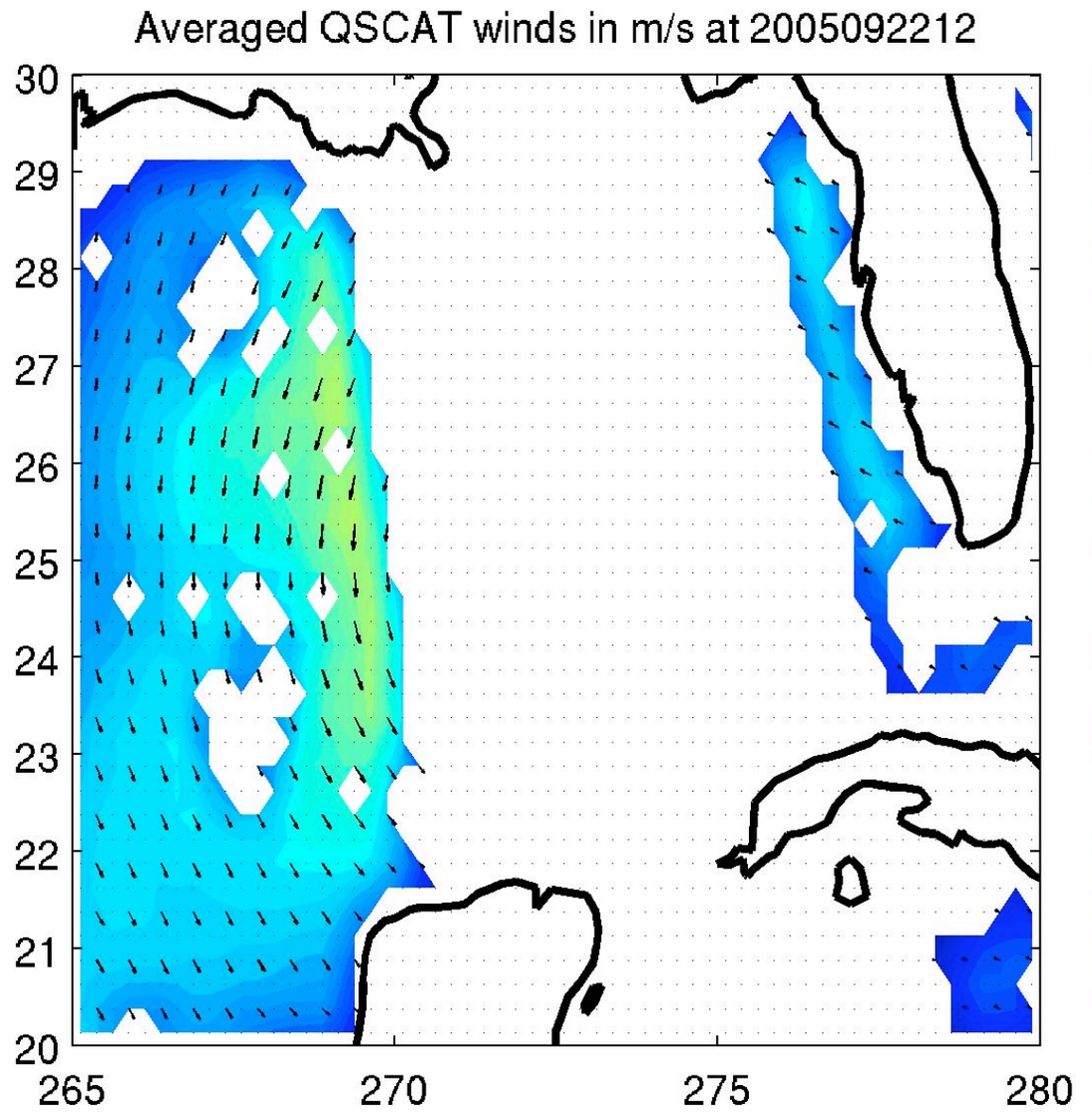

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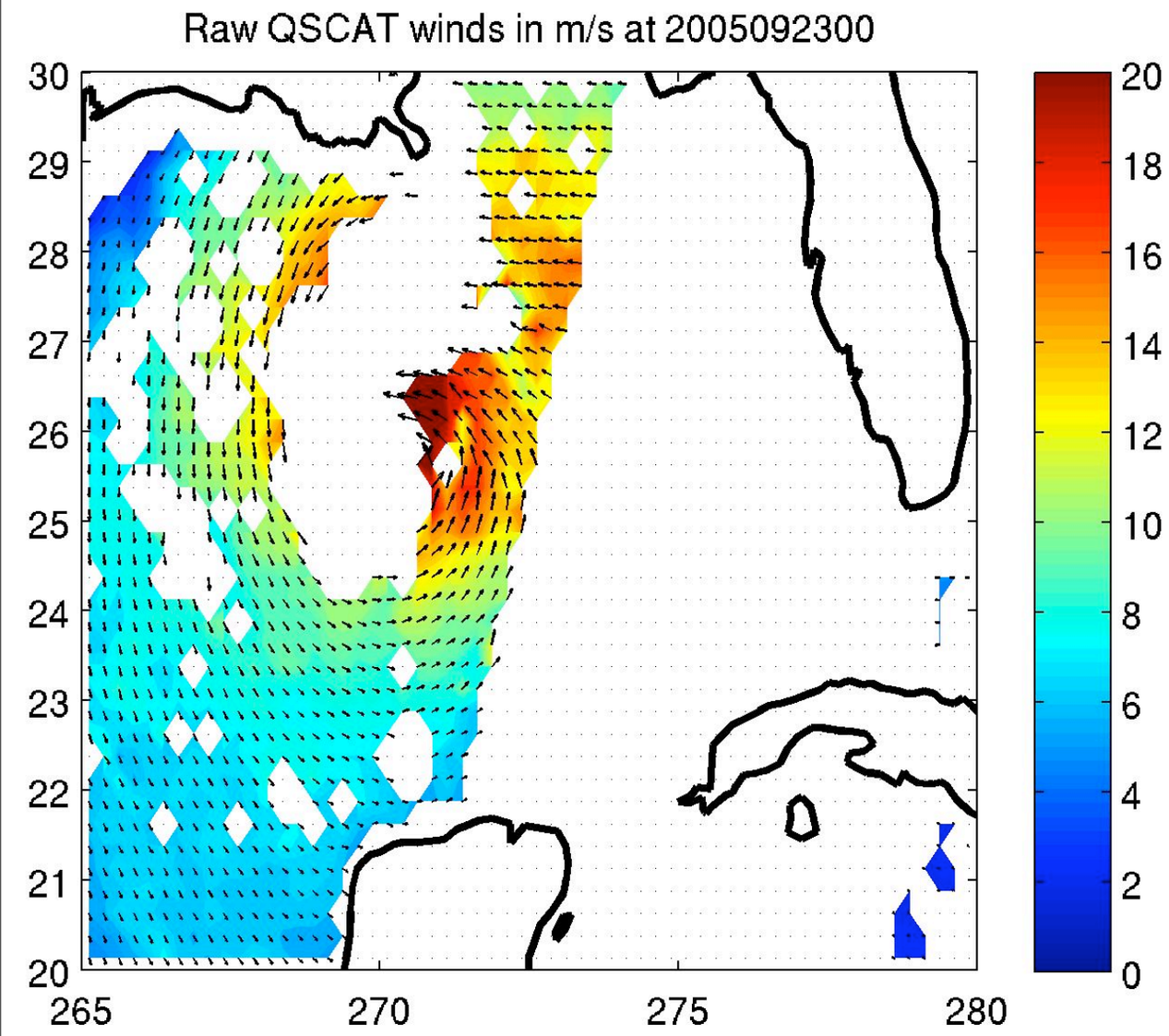


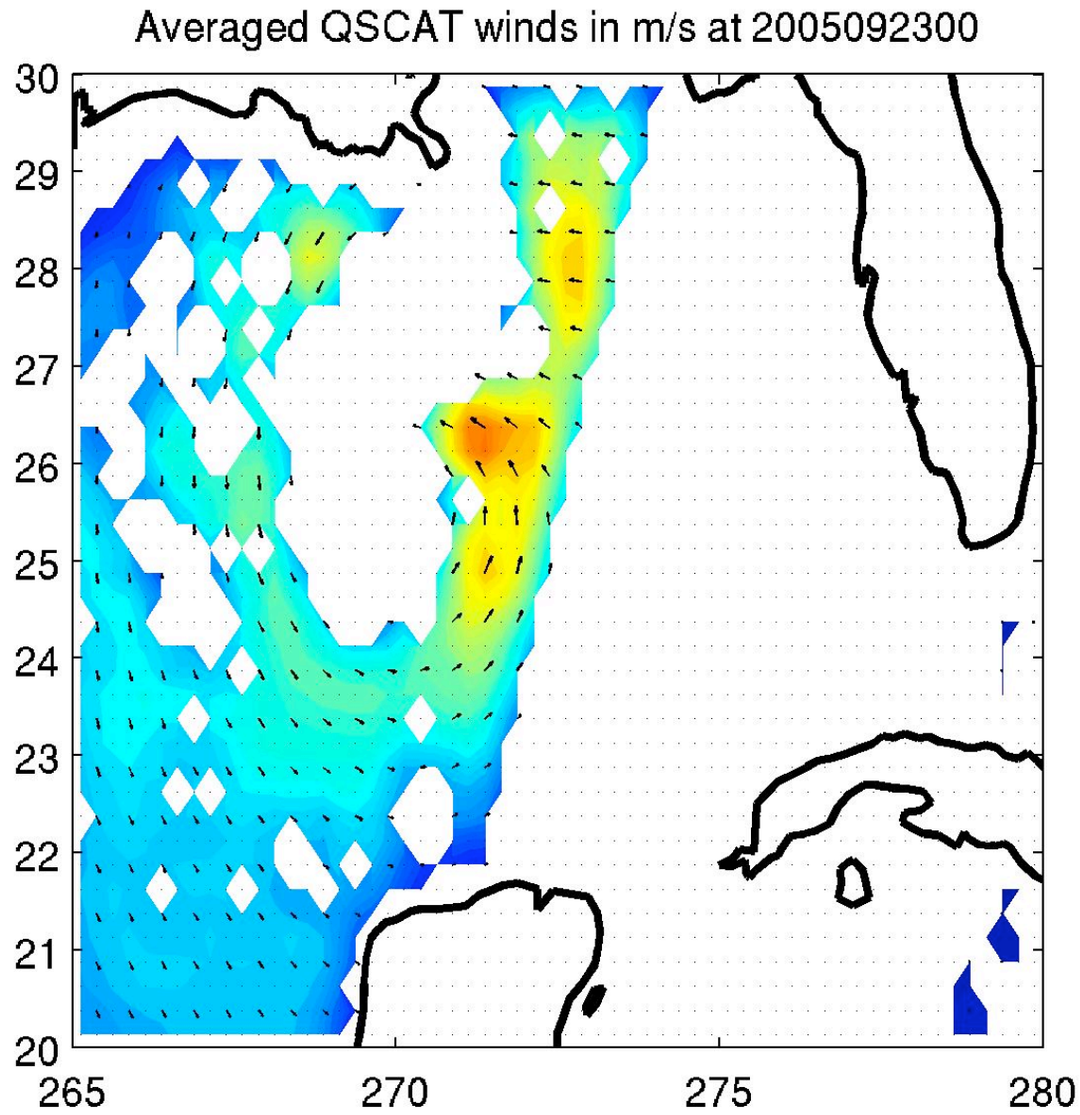

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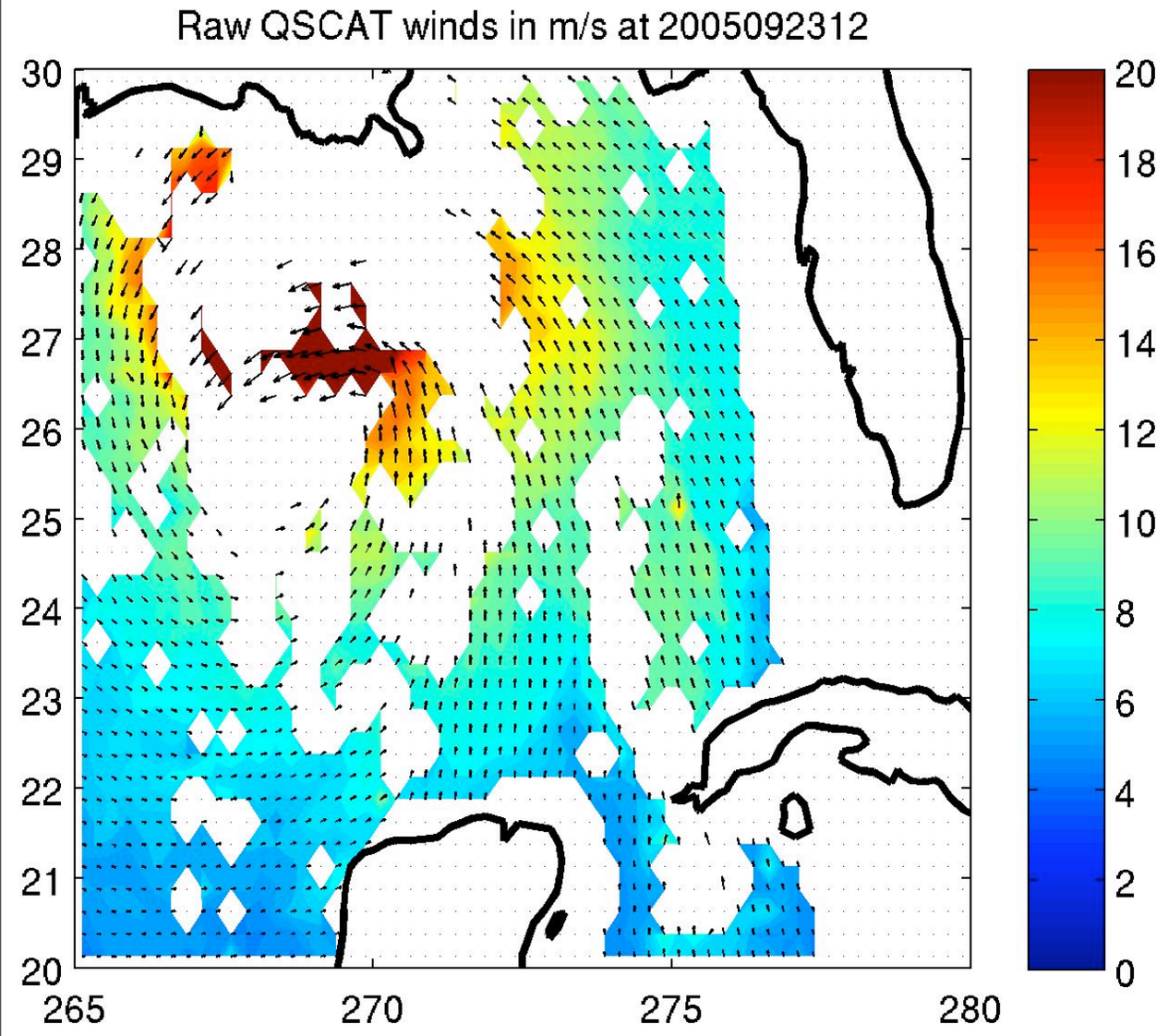


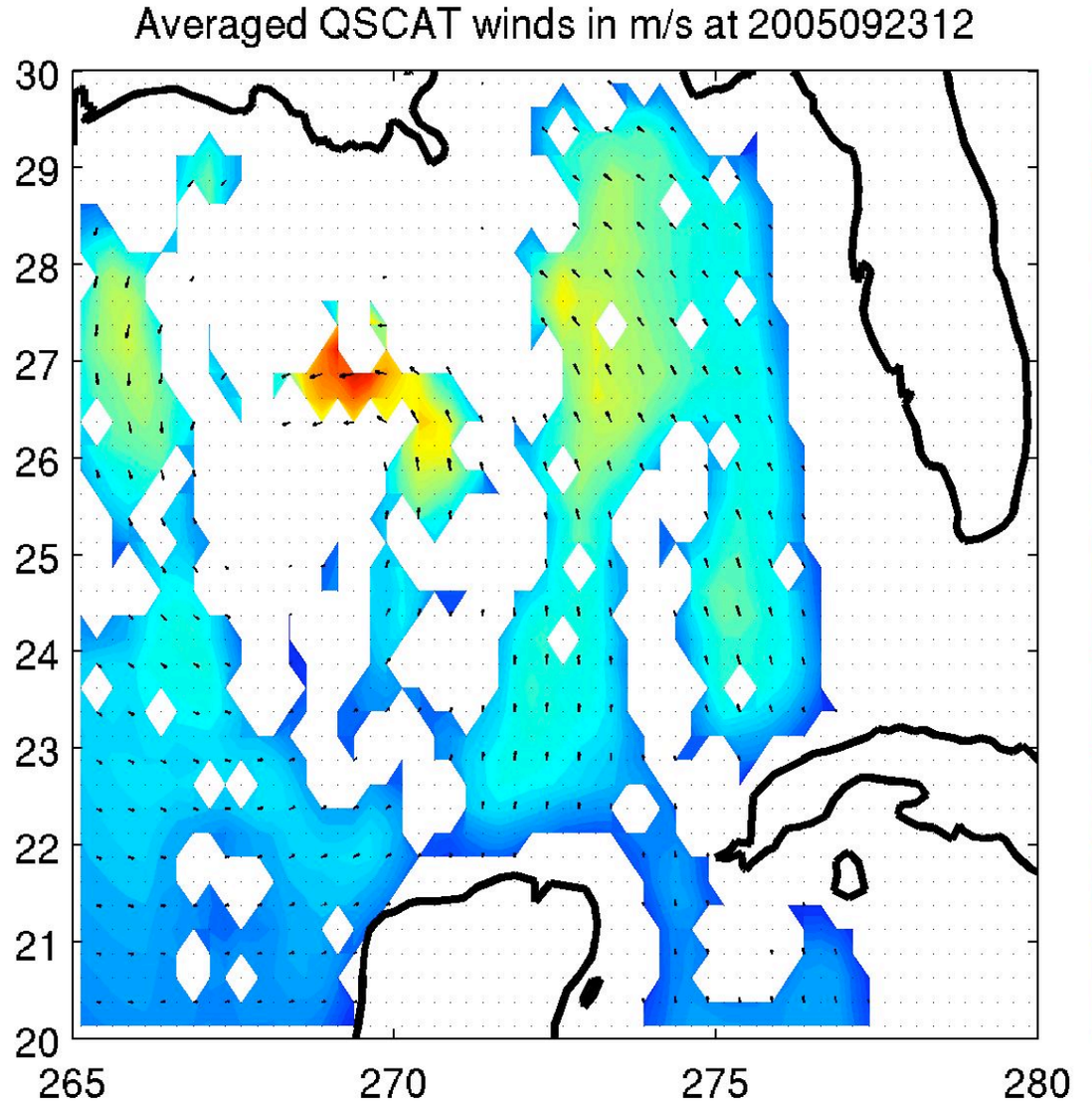

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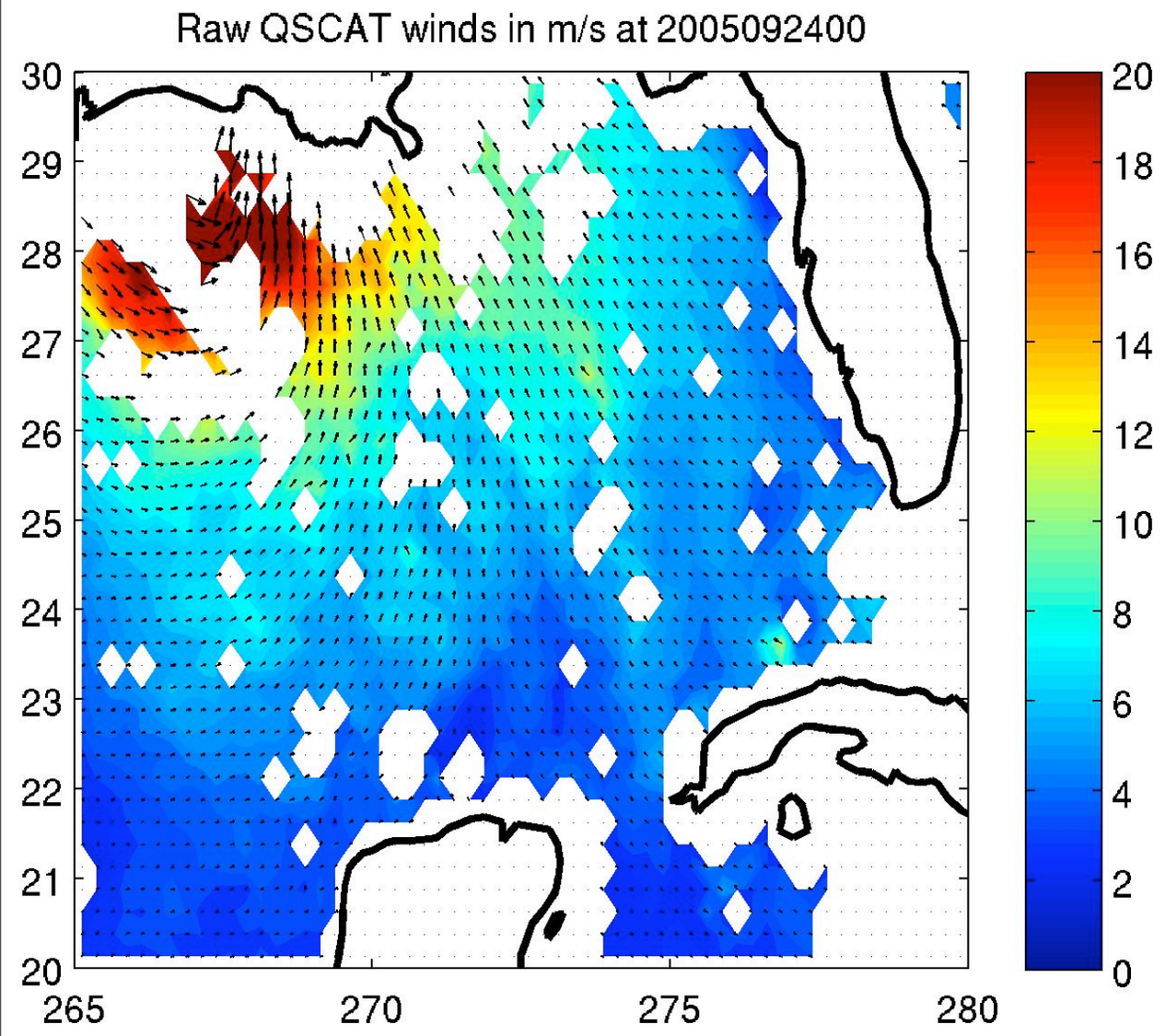


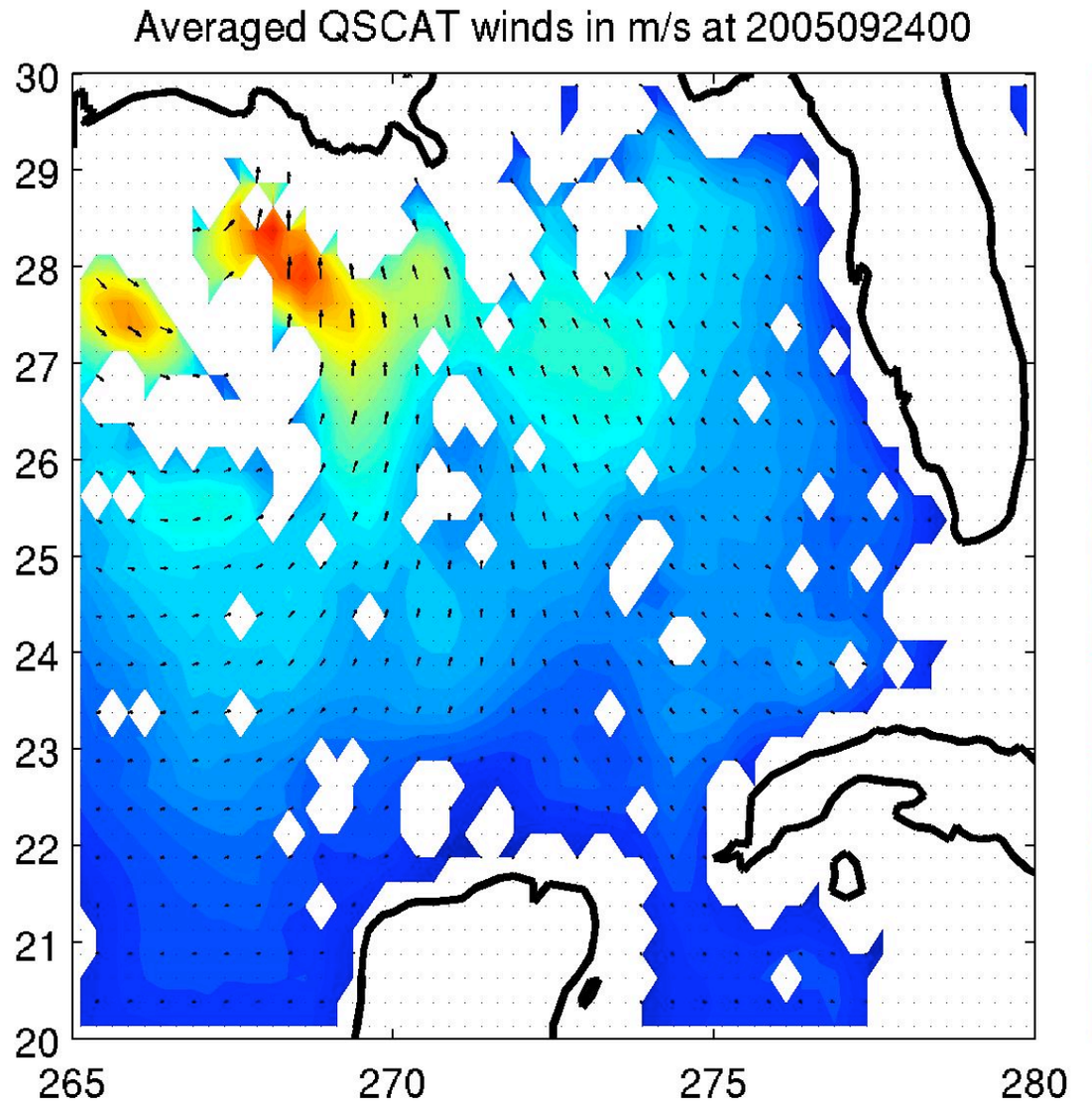

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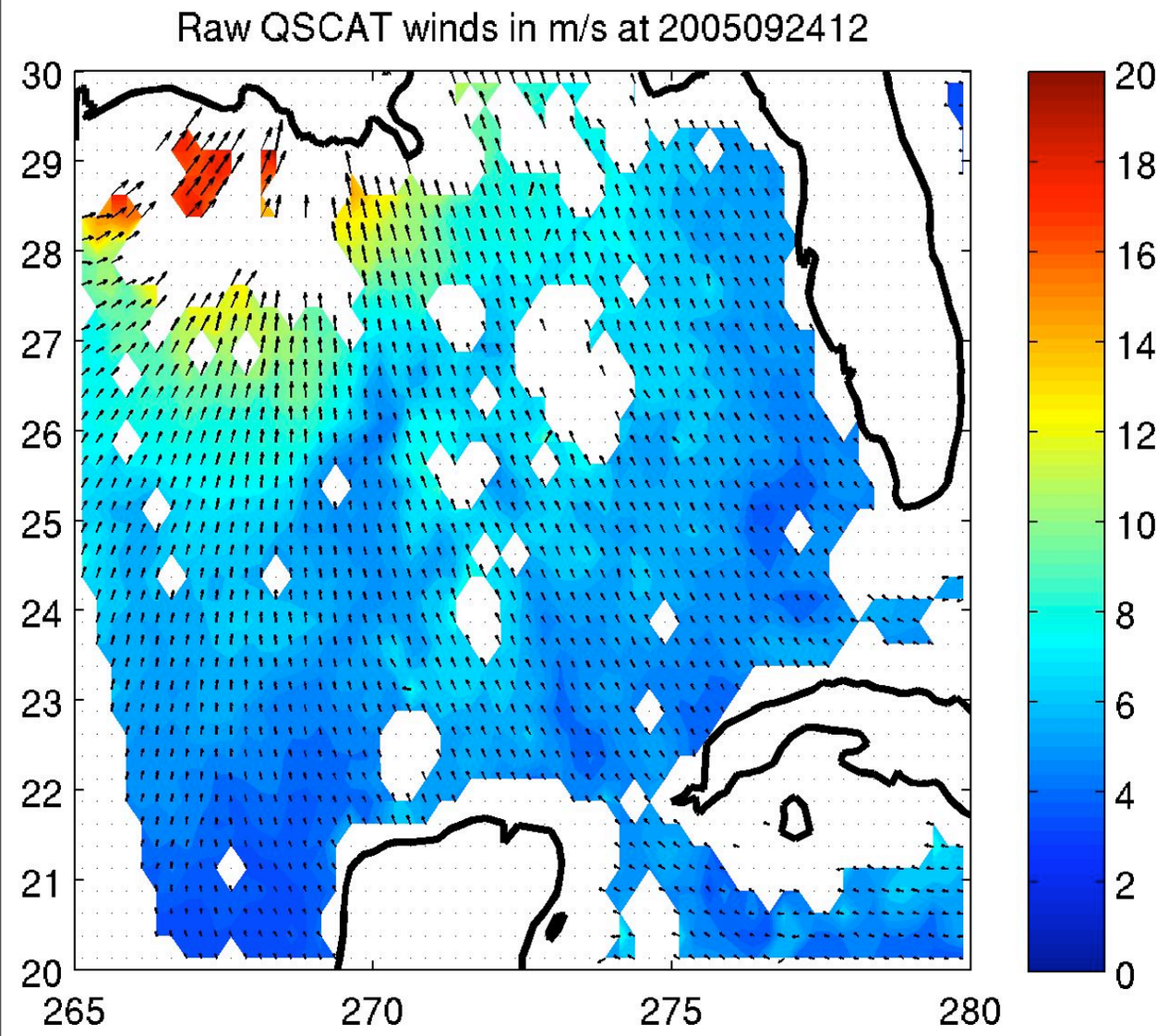


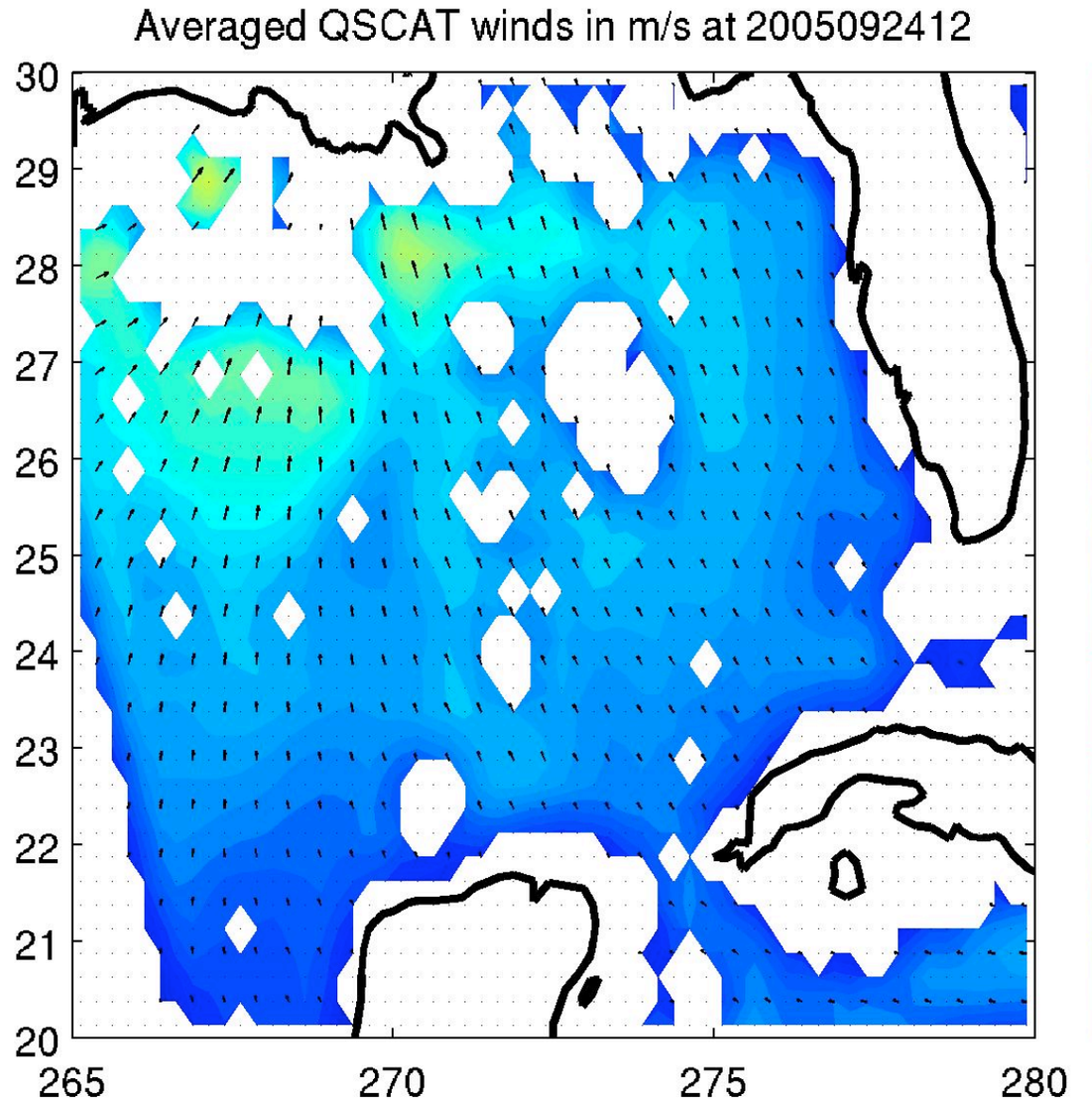

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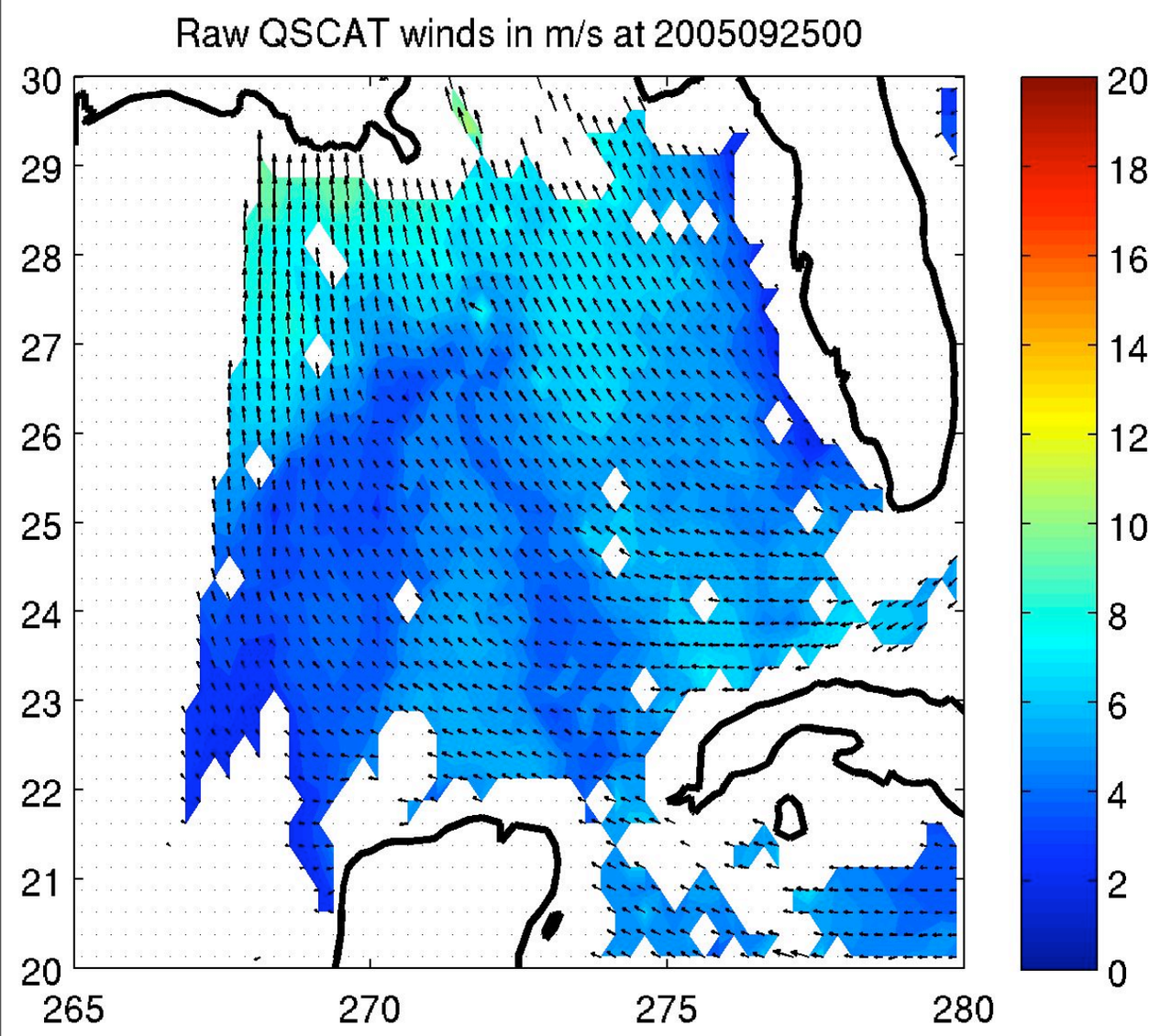
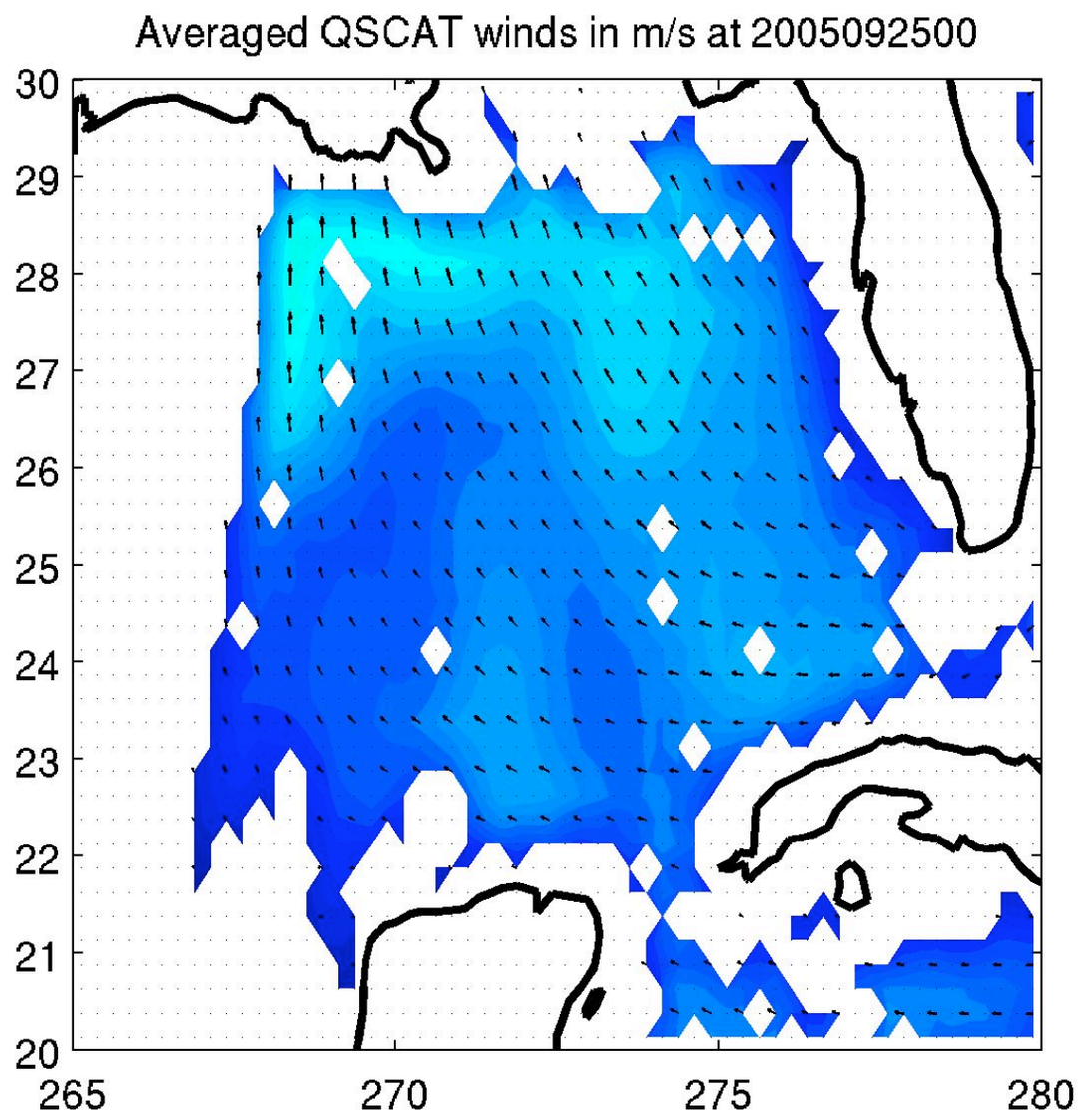


# 3. Super-Obs method: Conclusions

- For Rita, some significant wind vectors of speed >20m/s that passed the basic QC have been thinned by super-obbing (averaging).

- Tentative Recommendation: assimilate non-averaged winds at 0.25$^{o}$ resolution.

# 4. Observation error statistics

- NCEP background error variance in surface wind is approx. 2 m/s?
- also is this for wind speed or u,v?
  - Likely not appropriate near tropical cyclones.
- QuikSCAT wind speed error in GSI: 3.5 m/s
  - (Not sure how wind component errors are derived)
  - Errors are uncorrelated?
  - NOTE: a preliminary study by National Taiwan University showed a rms difference of 2 m/s between QuikSCAT and dropwindsonde wind speed, for winds weaker than 17.2 m/s.

# Ten years of G-IV missions

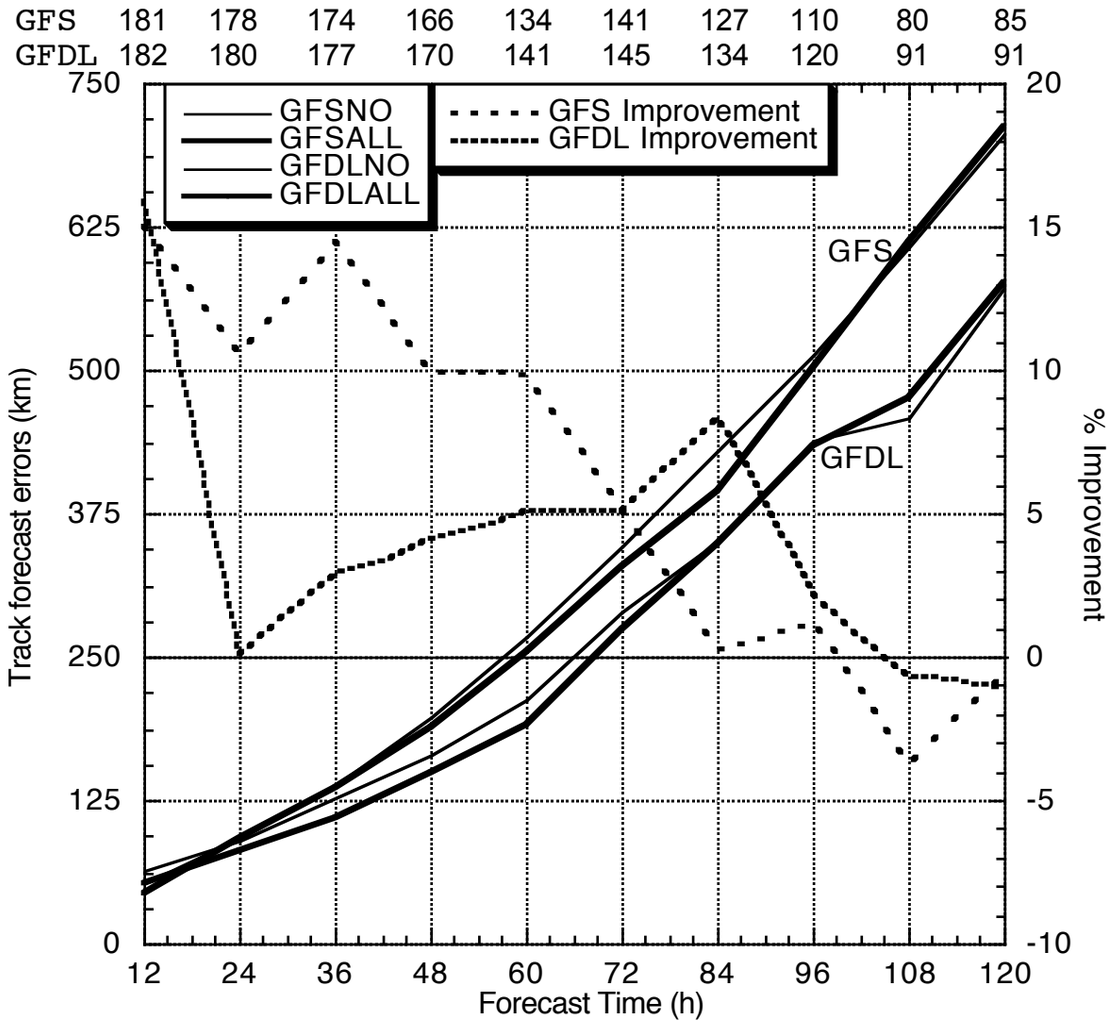
15% average track improvement through 60 h in GFS at mission nominal (synoptic time)

Missions conducted every 12 or 24 h.

Questions:

1. Does positive impact remain 6 and 12 h after the mission nominal time?

2. Does positive impact increase as regular missions continue every 24 h? Every 12 h?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GFDL Improvement
GFS
GFDL
Track forecast errors (km)
% Improvement
Forecast Time (h)
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500
375
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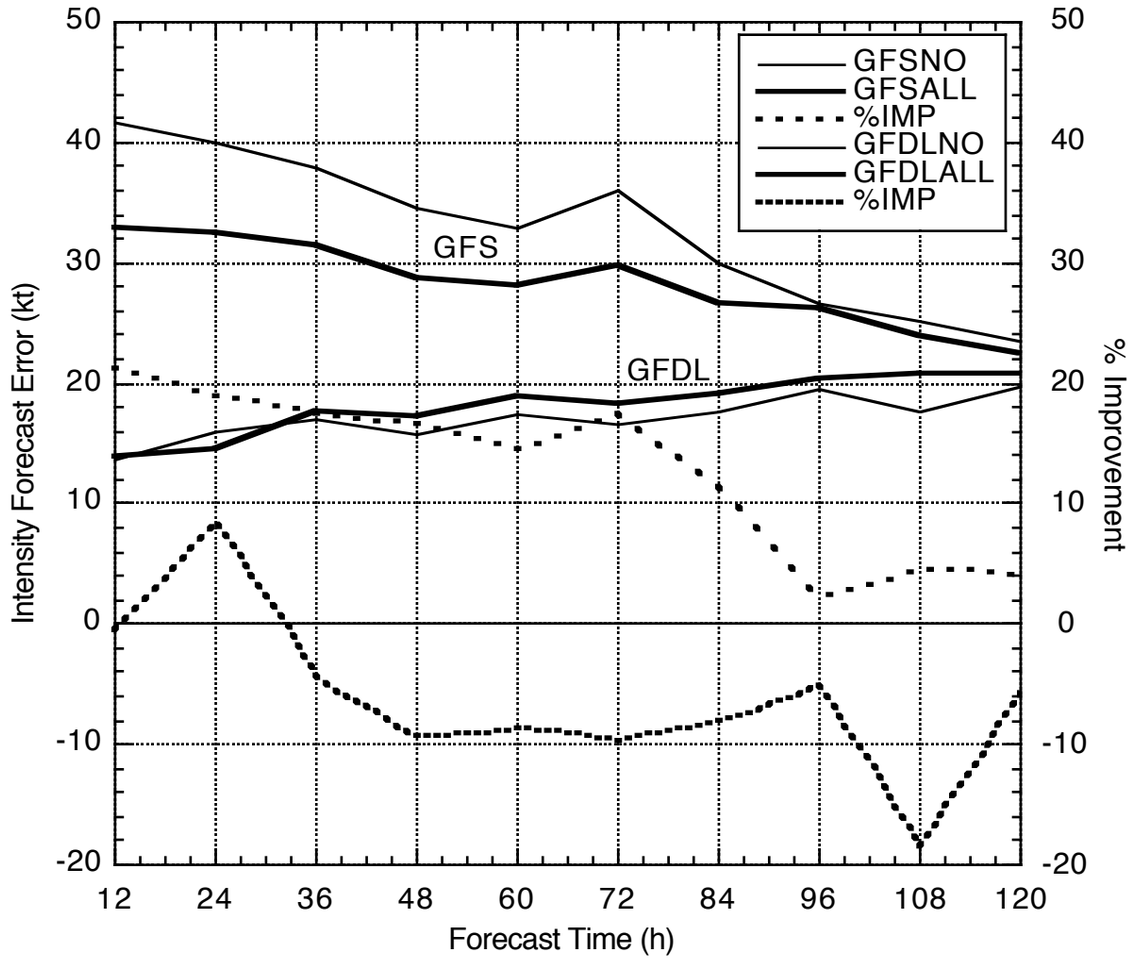
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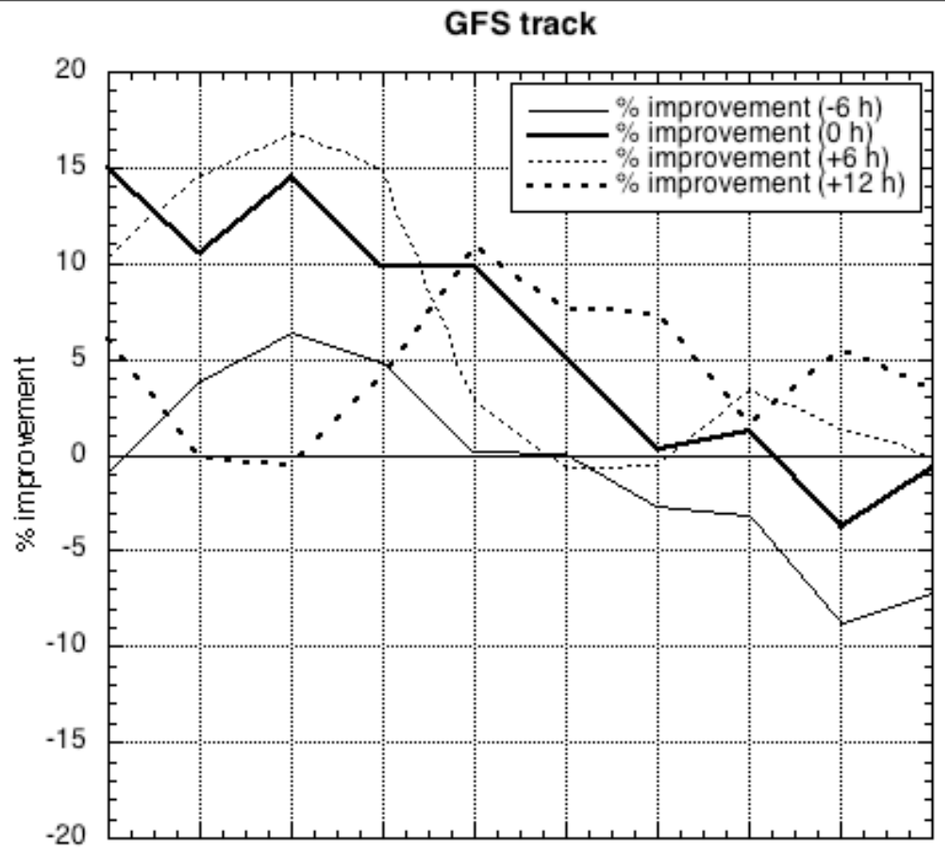
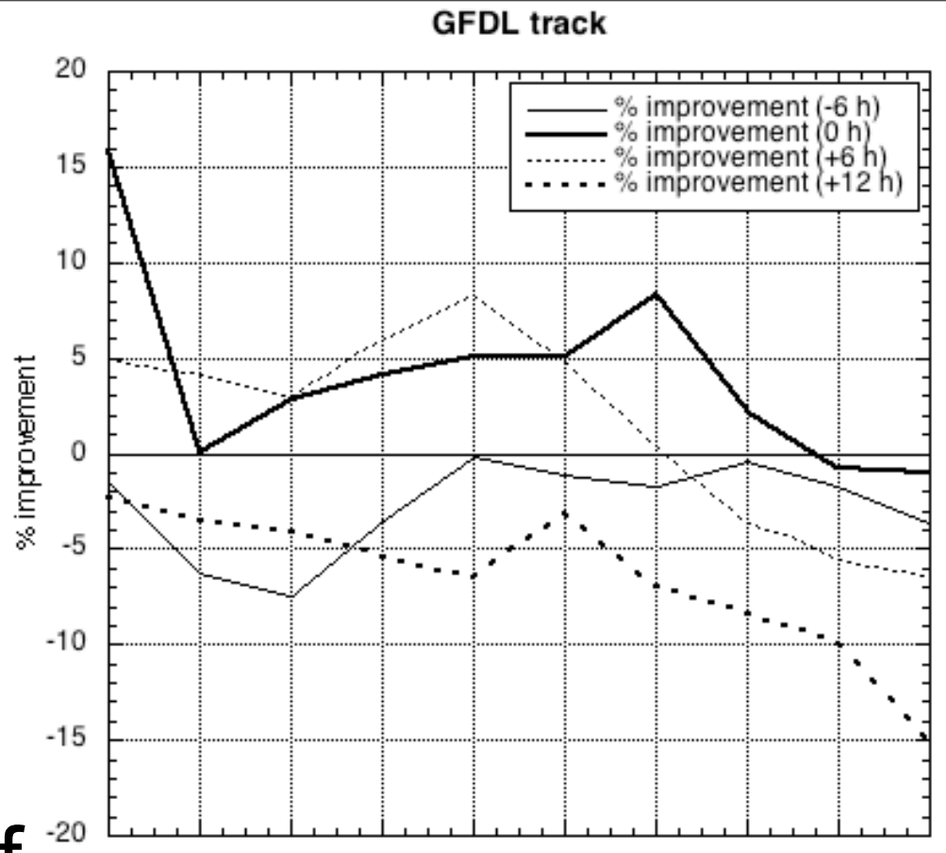
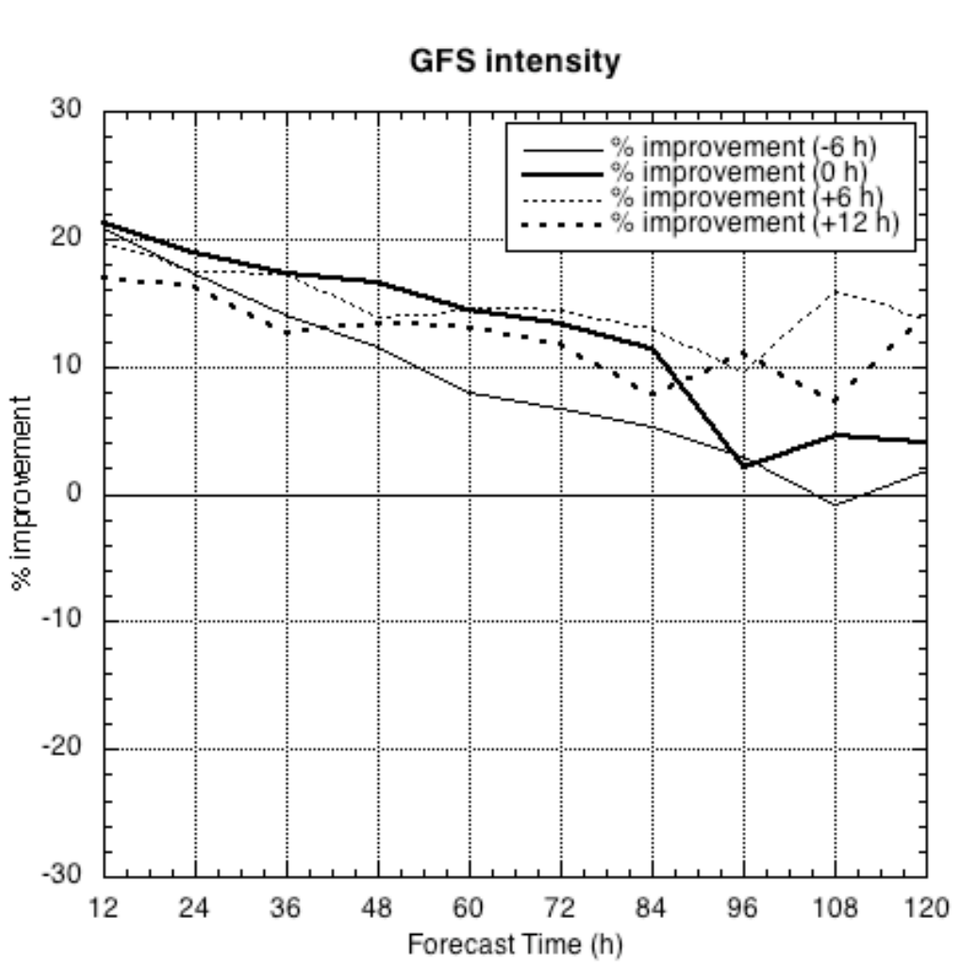
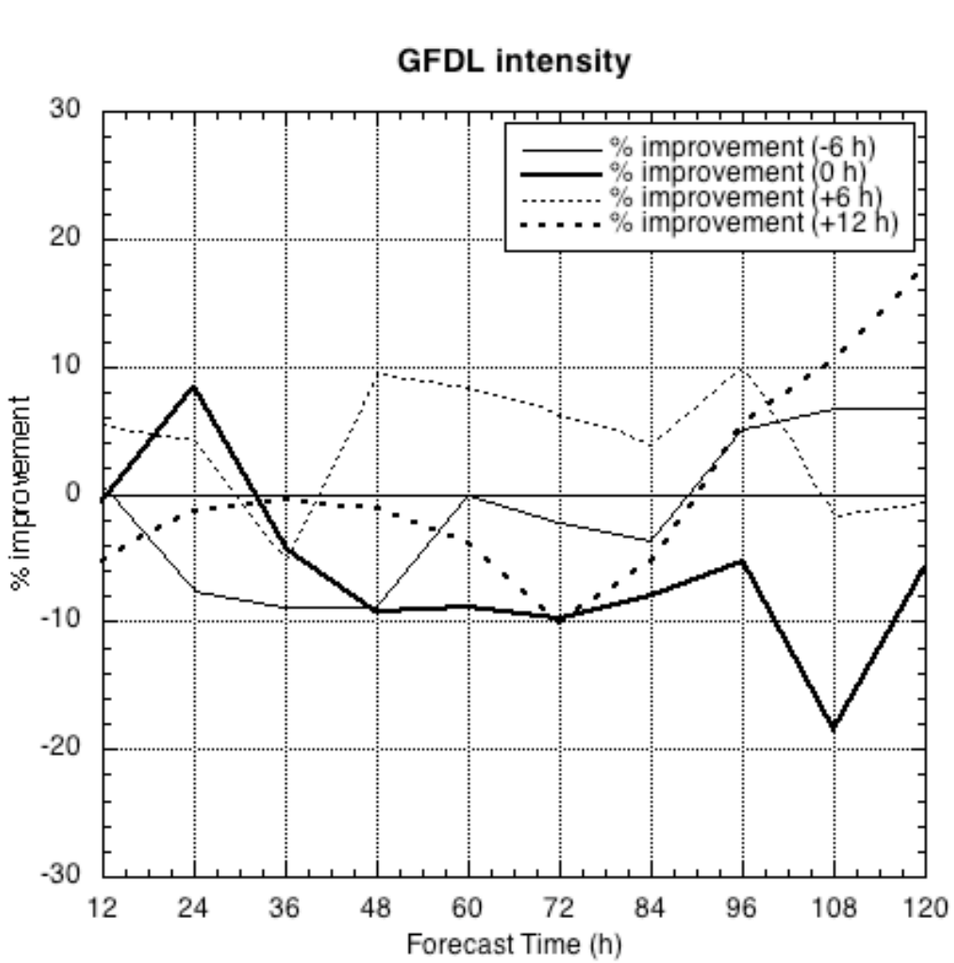


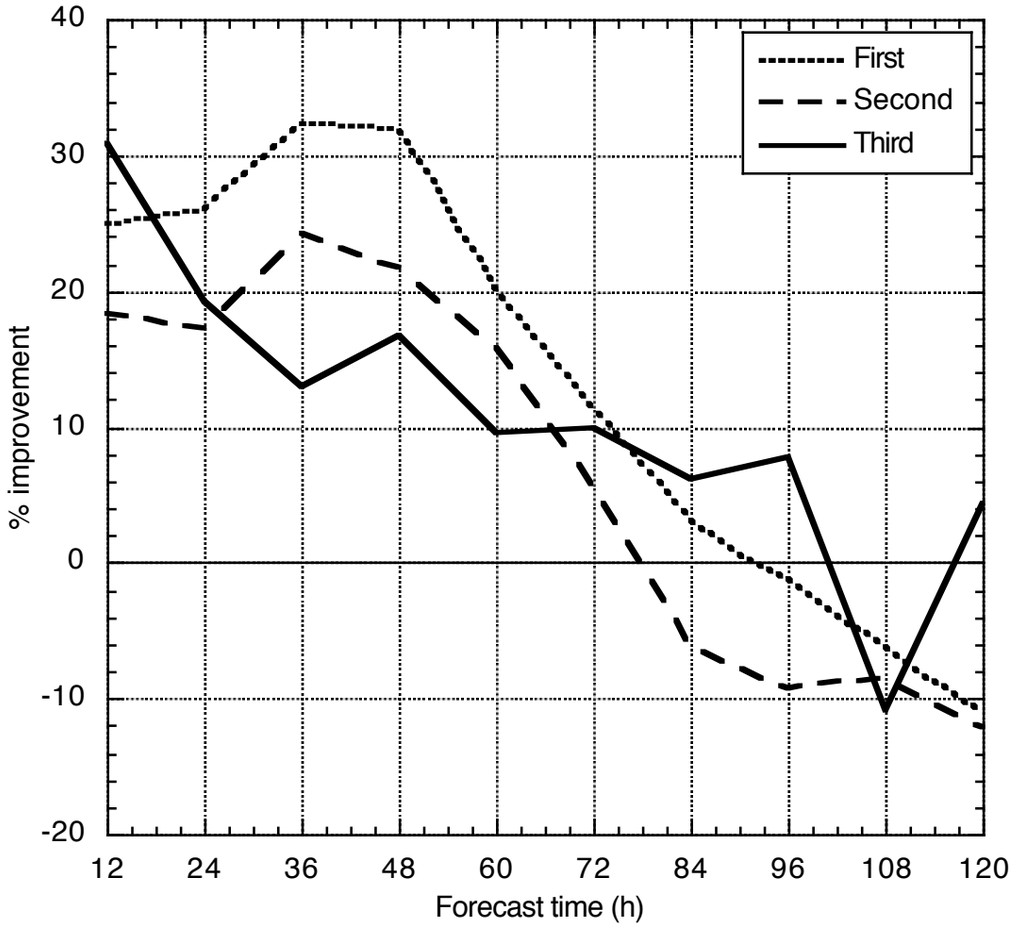




# Impact of sondes in time

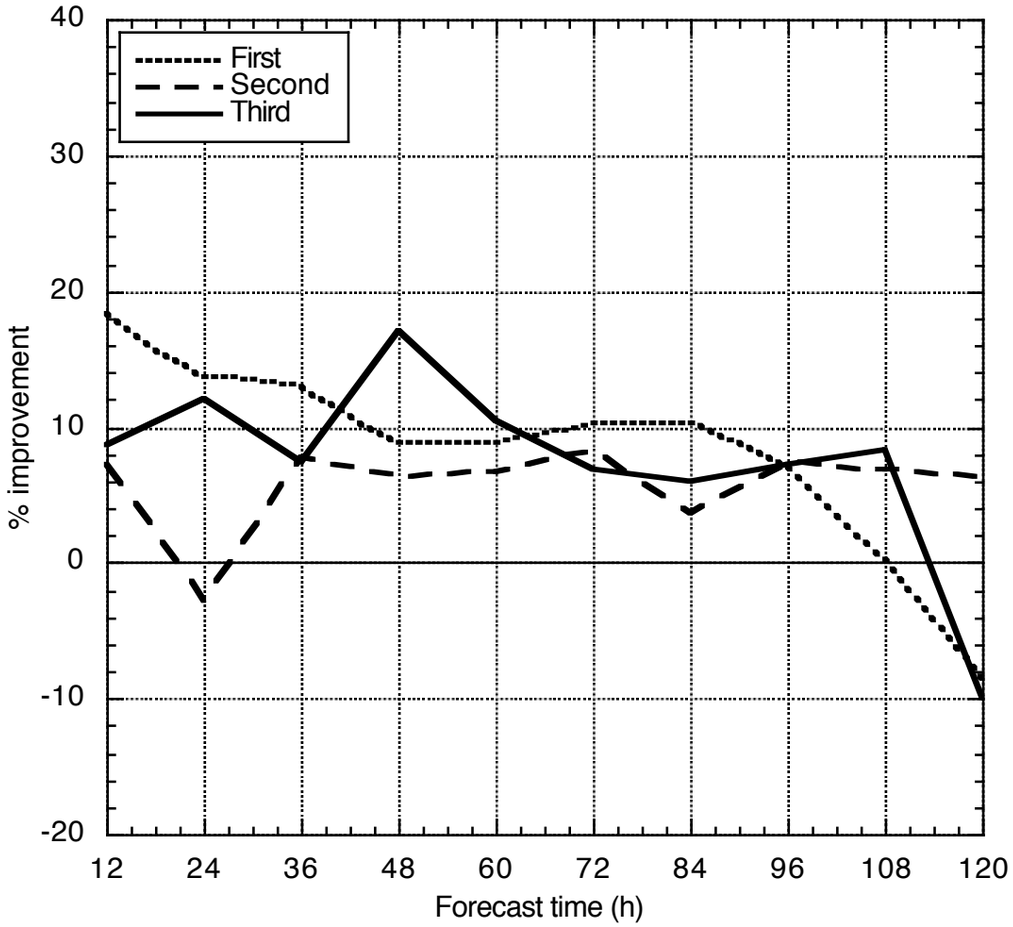


GFS track

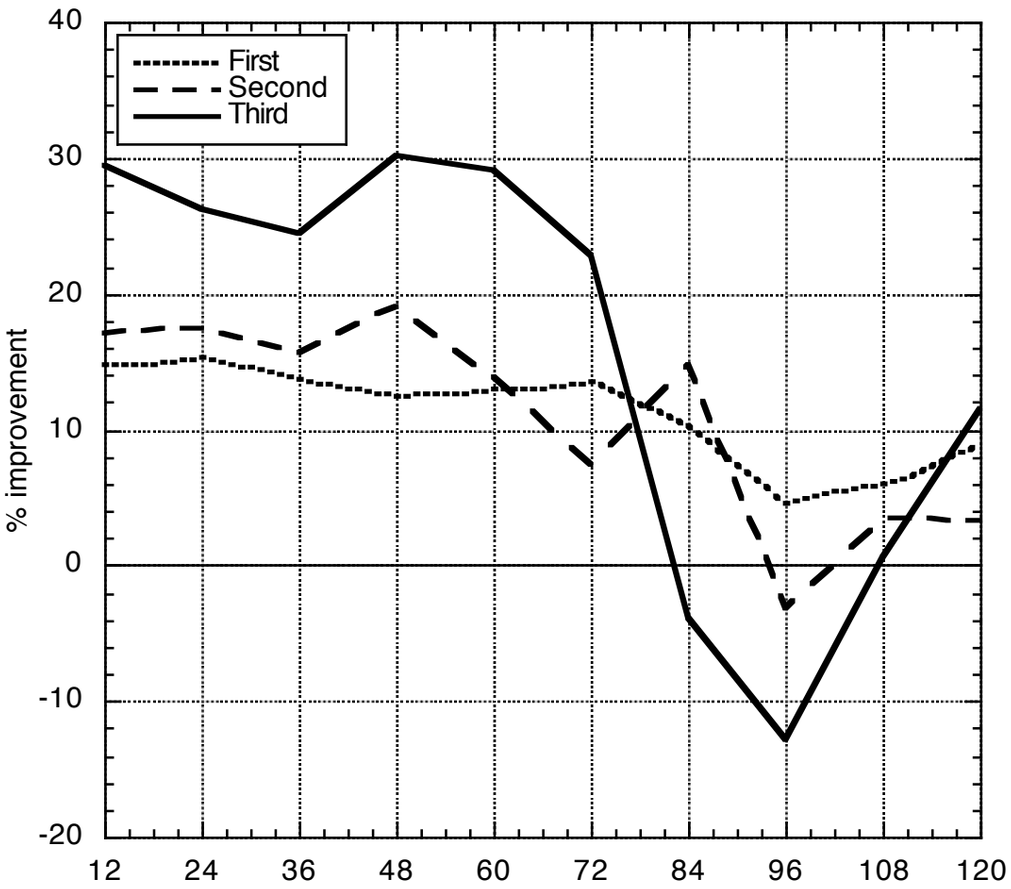



GFDL track

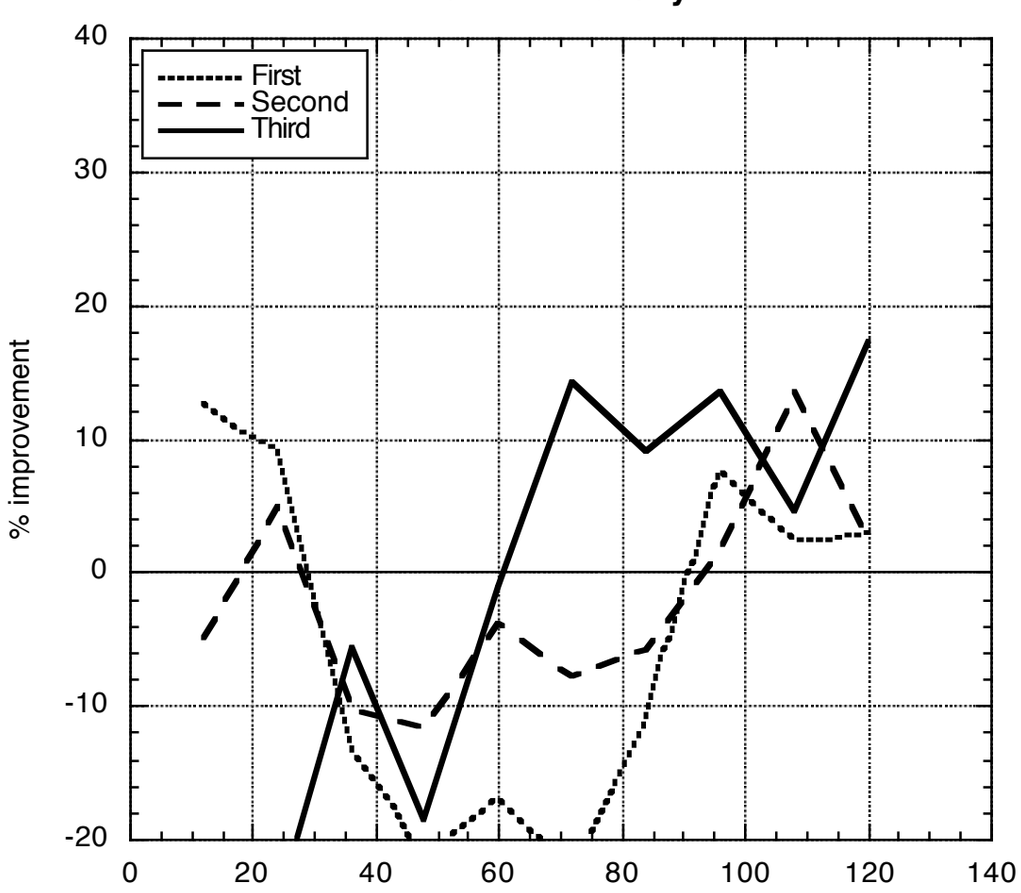


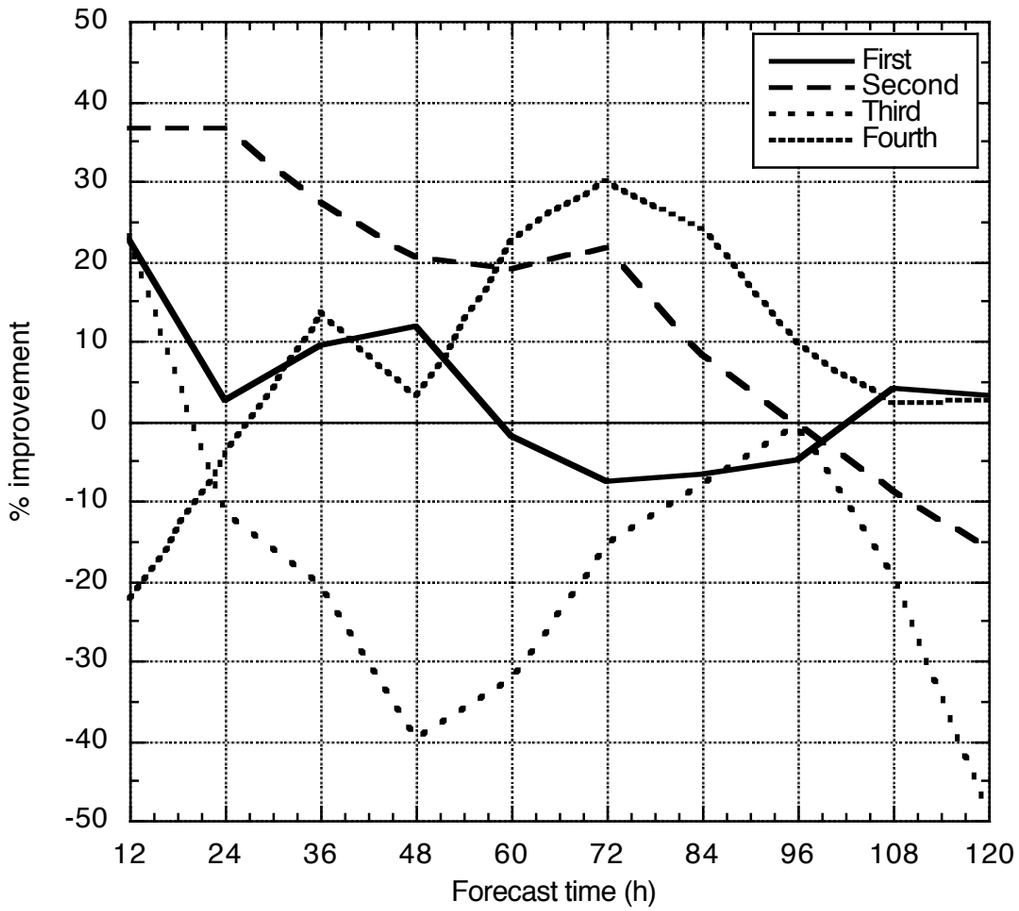

Missions separated by 24 h

GFS intensity

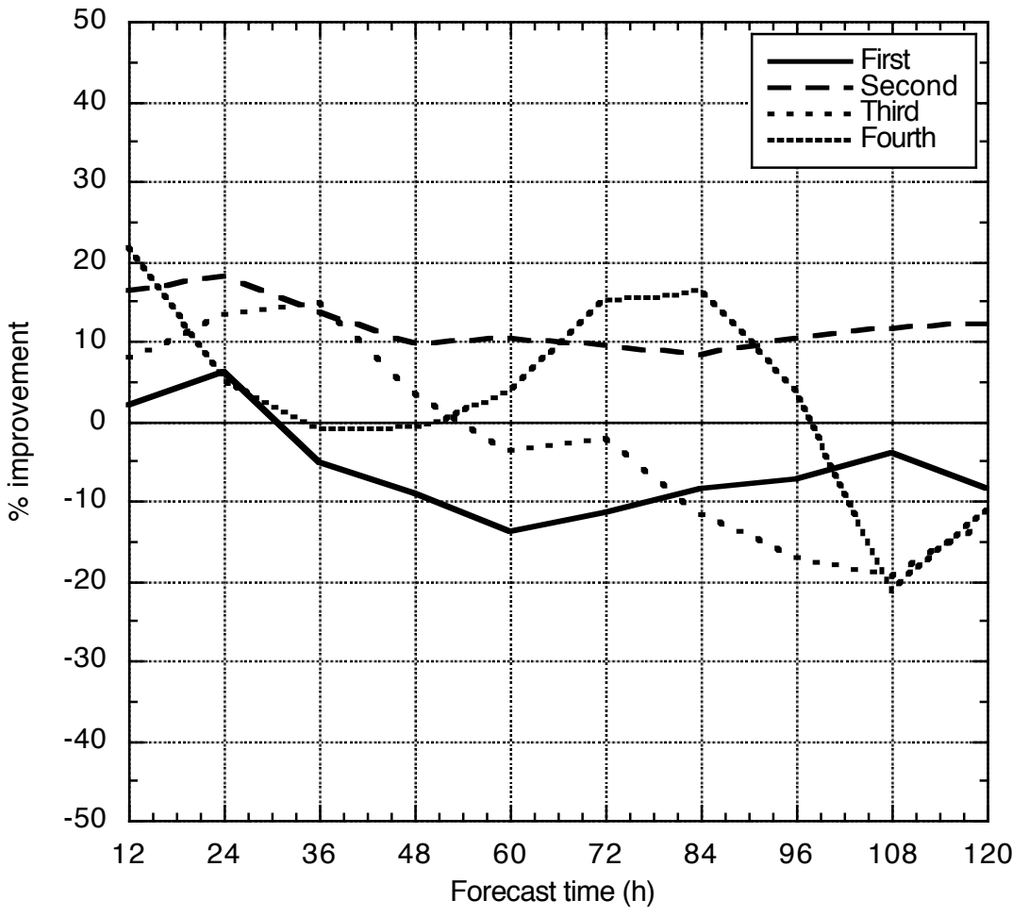


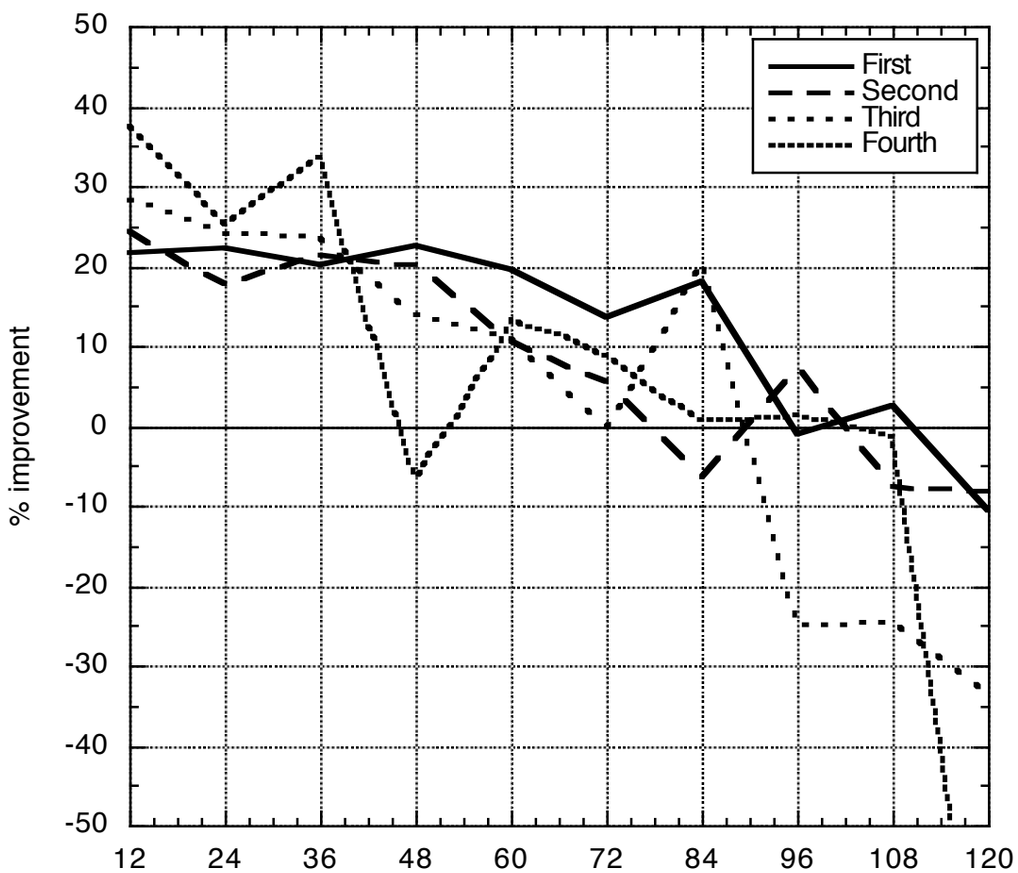

GFDL intensity

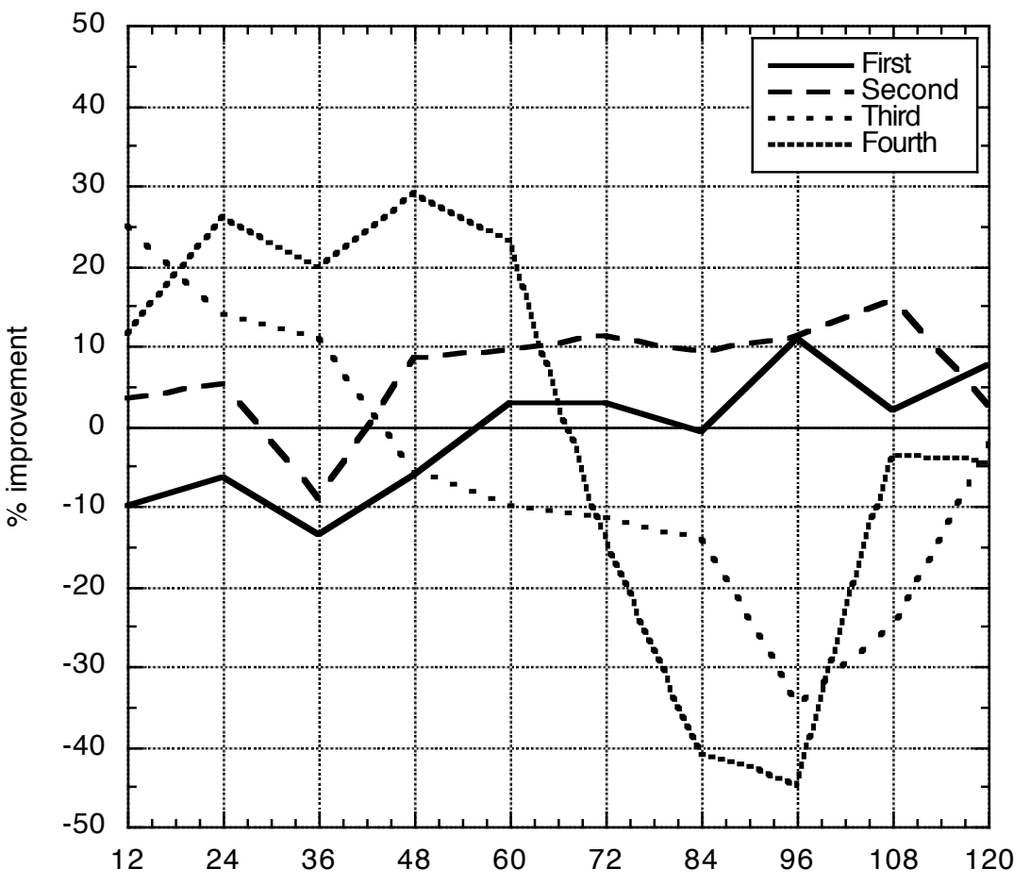





Missions separated by 12 h



# Ten years of G-IV missions

Positive track impact only in first three days of forecasts.

All the data (t=0 h) provides more impact than the early subset (t=-6 h) for track and GFS intensity, but degrades GFDL intensity.

Even larger positive track impact through 48 h, and intensity impact after 60 h, at t=6 h.  Impact gets much smaller by t=12 h.

In a ***24-h*** mission cycle, **first mission** has larger track impact than **second mission**.  Results are mixed for intensity.

In a ***12-h*** mission cycle, **second mission** has larger positive track and GFDL intensity impact than **first mission**.  The result is opposite for GFS intensity.