



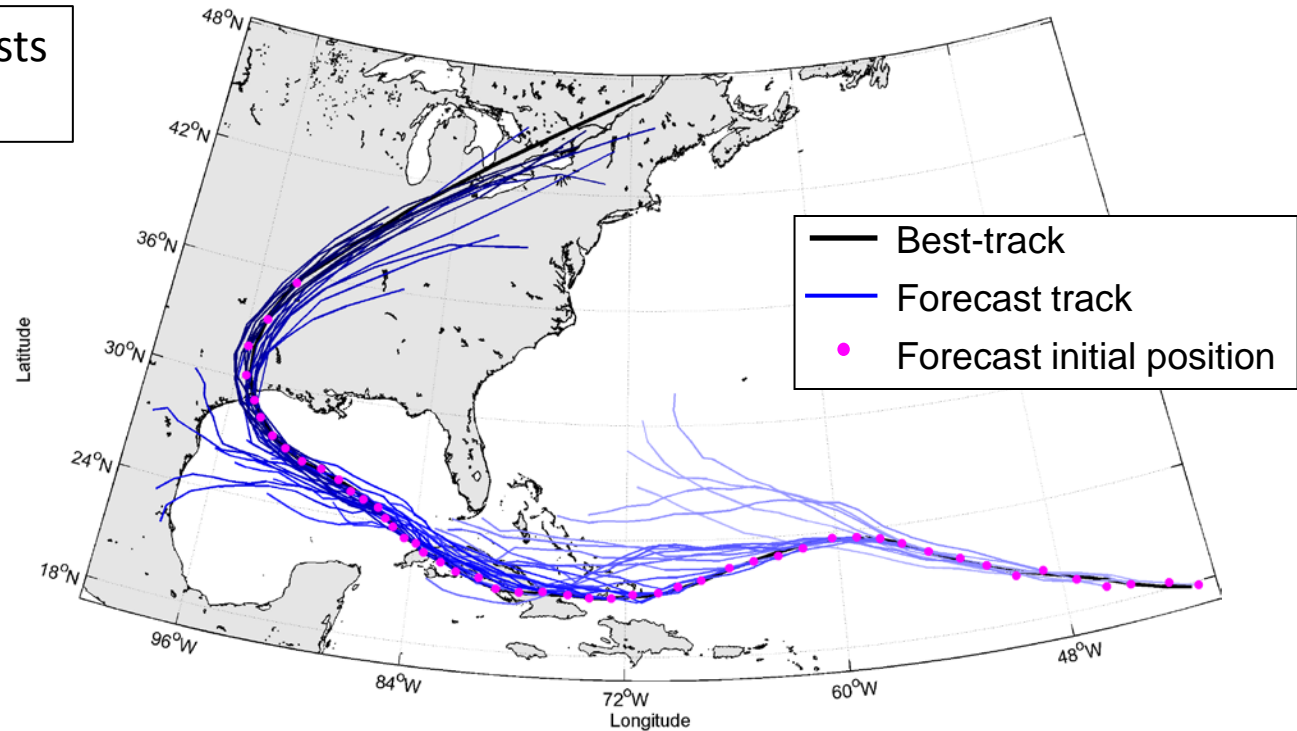
Diagnostic verification of COAMPS-TC performance for the HFIP retrospective forecasts

Jonathan R. Moskaitis¹, J. Doyle¹,
Y. Jin¹, and R. Hodur²

66th Interdepartmental Hurricane Conference
7 March 2012

¹ Naval Research Laboratory
² SAIC

COAMPS-TC track forecasts for Hurricane Ike (2008)



Acknowledgements: ONR and NOAA HFIP



Objective and Outline

Demonstrate verification methods we have utilized at NRL in development of COAMPS-TC, particularly as applied to the 2008/2009/2010 HFIP retrospective forecasts (~550 cases)



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Demonstrate verification methods we have utilized at NRL in development of COAMPS-TC, particularly as applied to the 2008/2009/2010 HFIP retrospective forecasts (~550 cases)

(1) Verification of COAMPS-TC track and intensity forecasts

- Storm-by-storm and overall bias assessment
- Error distribution and outlier errors
- Stratified verification

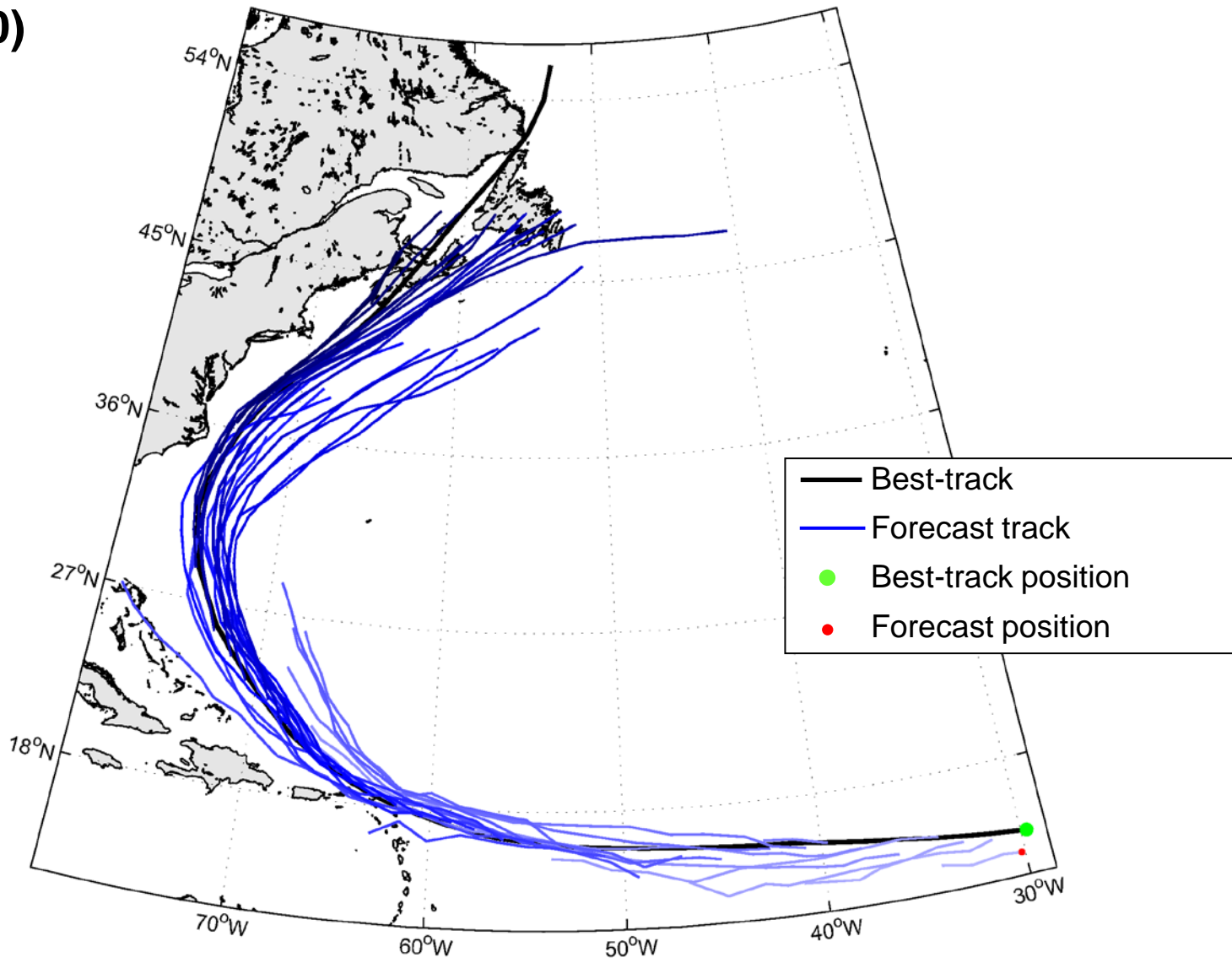
(2) Verification of COAMPS-TC synoptic-scale forecasts



COAMPS-TC track and intensity performance: Storm-by-storm track verification

Earl (2010)

COAMPS-TC, TC = a1072010, DTG = All, Time = 8/25/12z

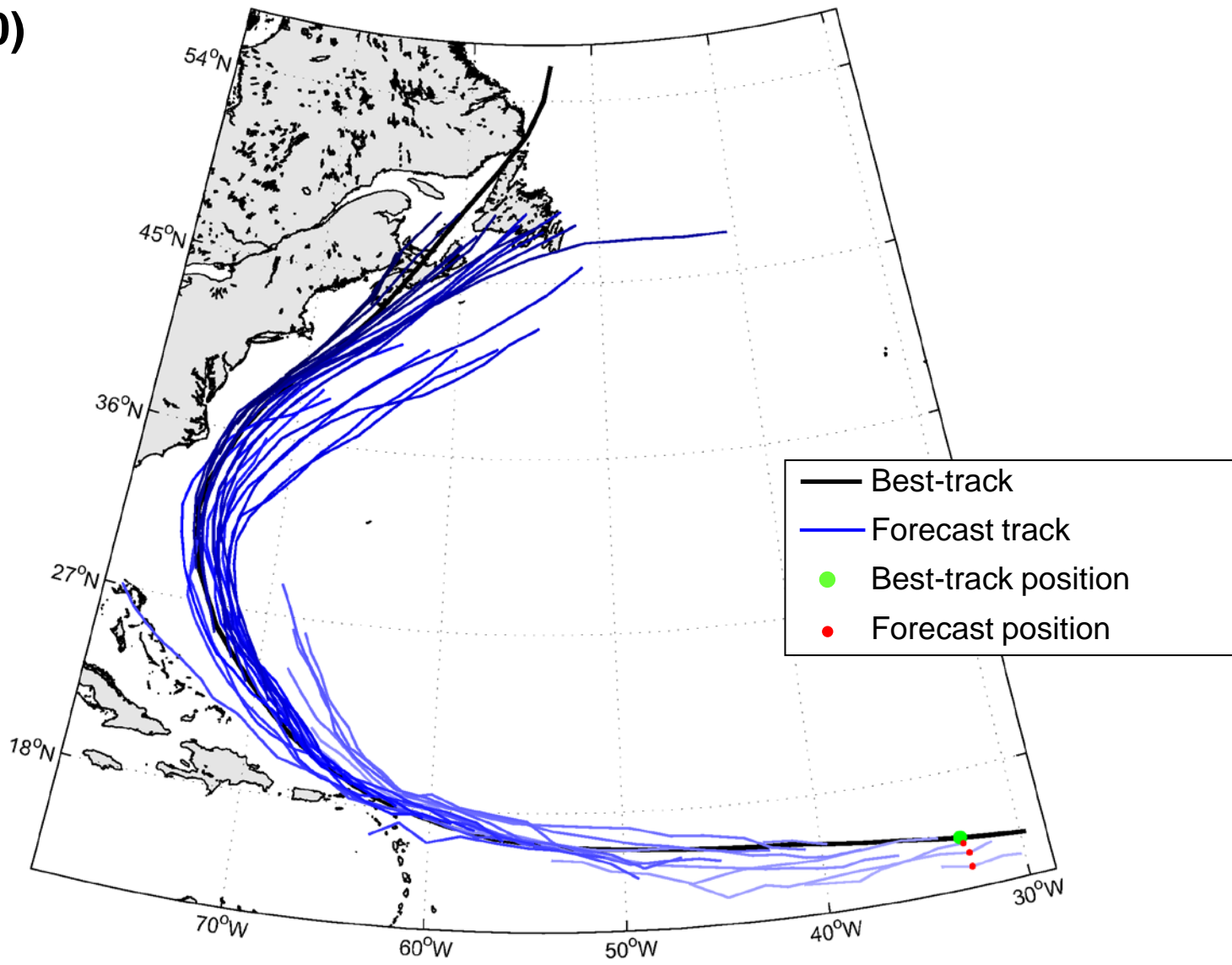




COAMPS-TC track and intensity performance: Storm-by-storm track verification

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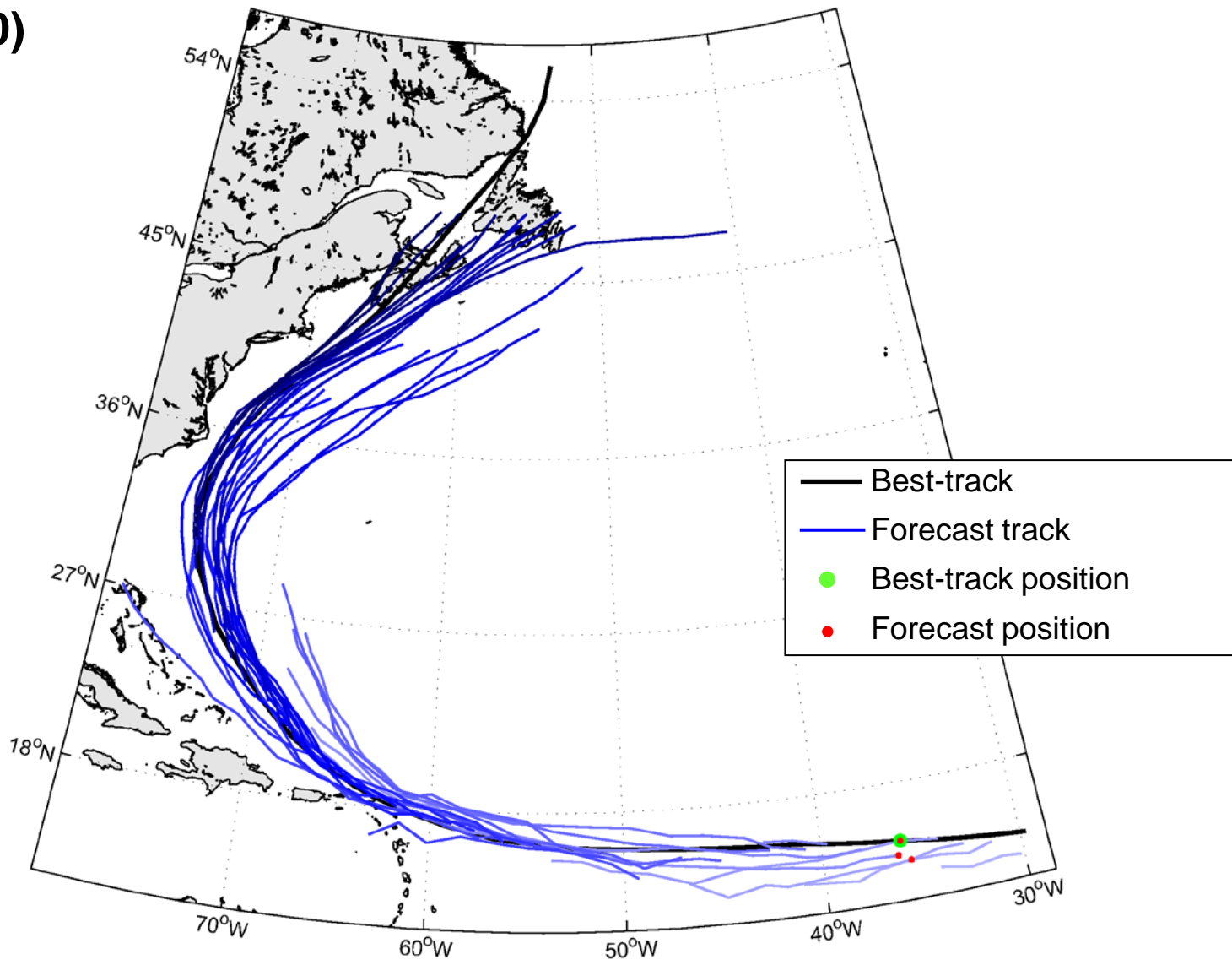




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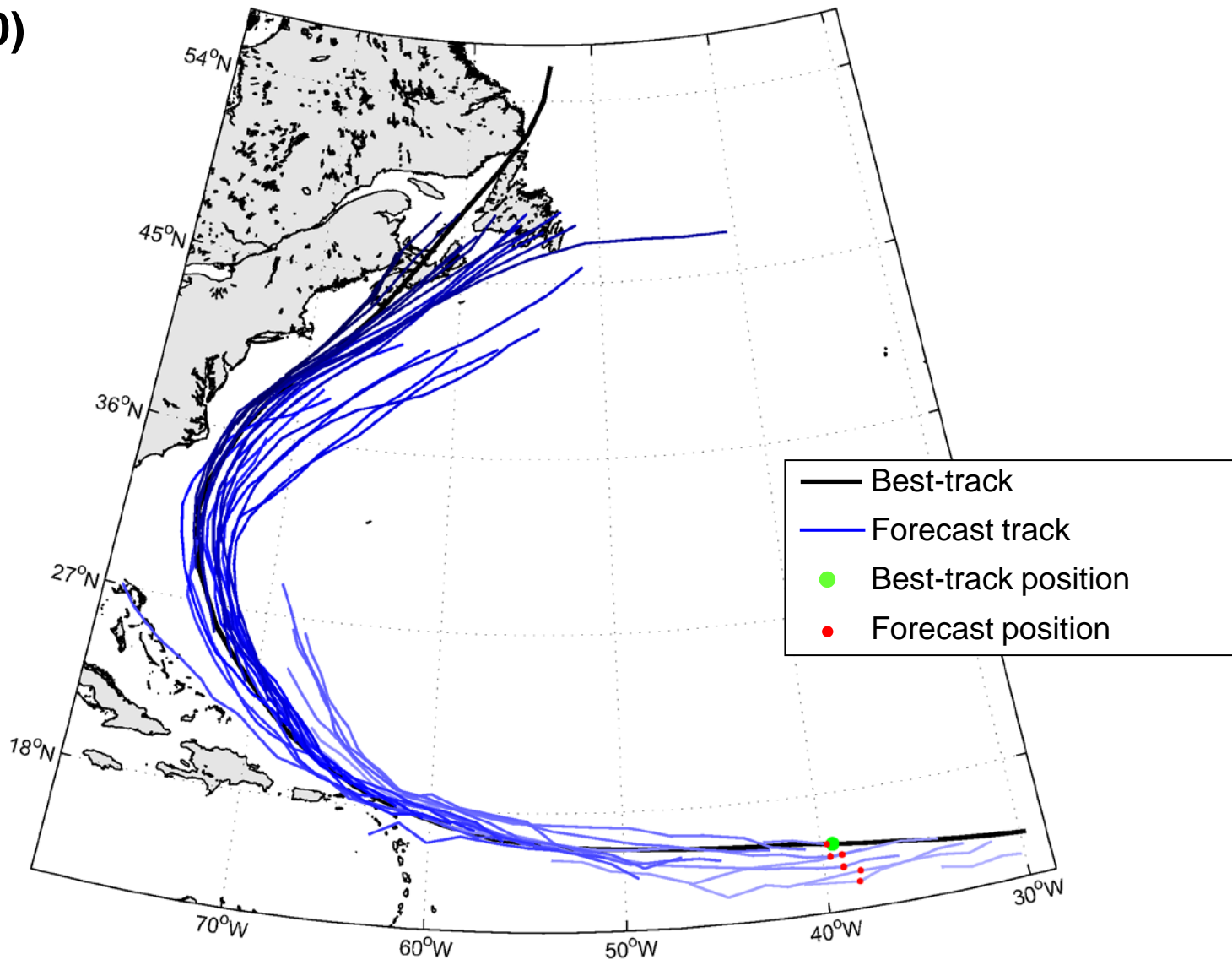




COAMPS-TC track and intensity performance: Storm-by-storm track verification

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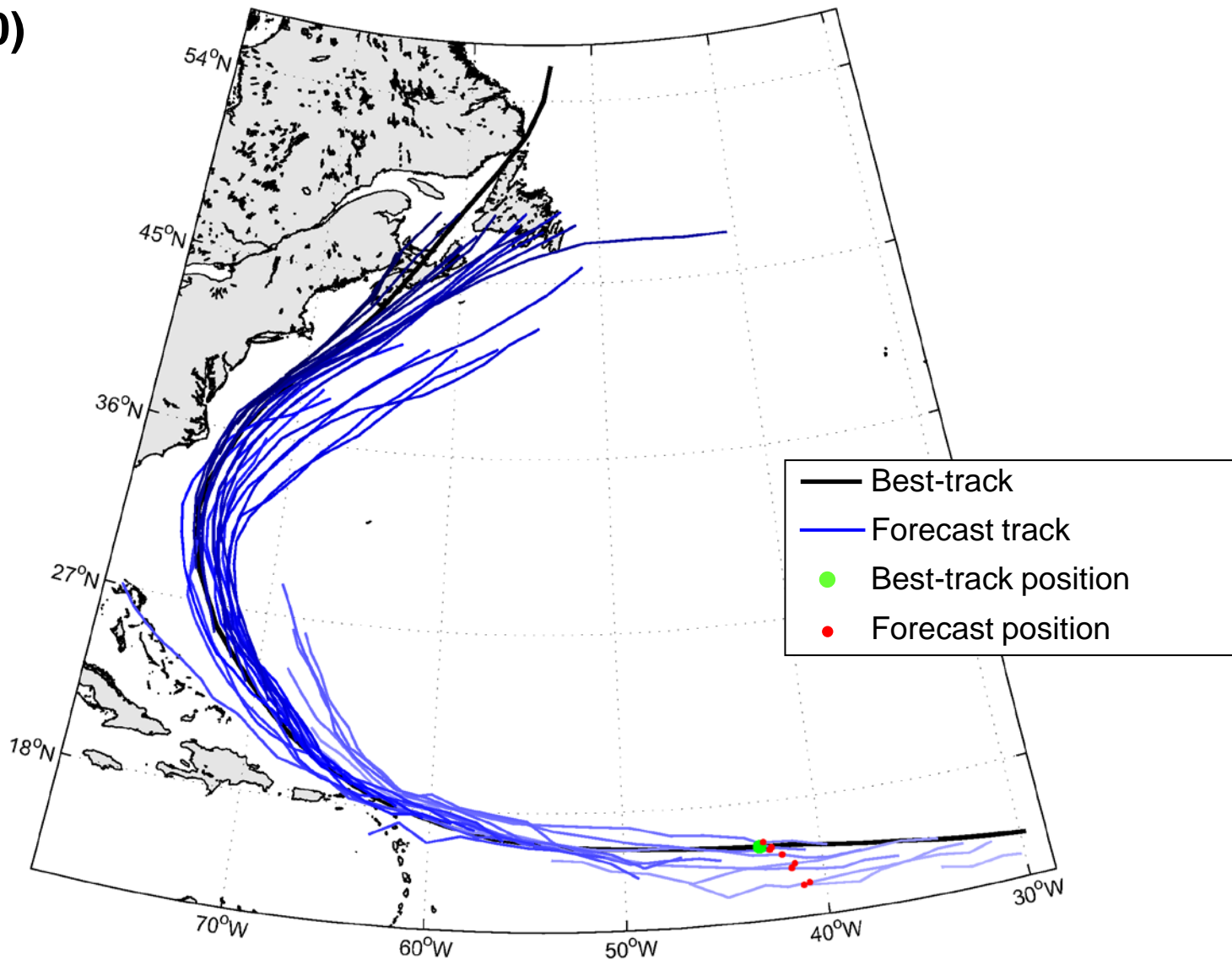




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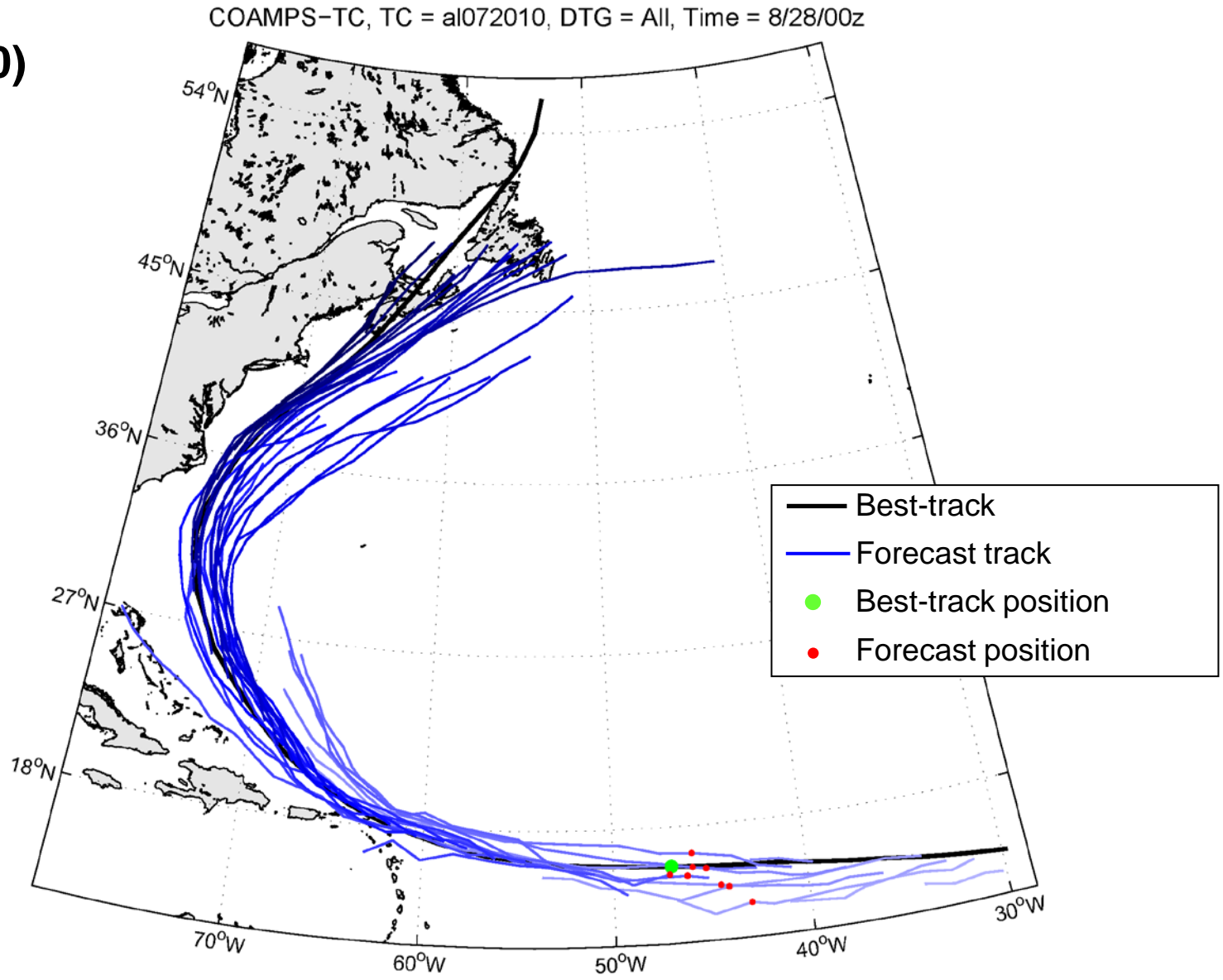
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COAMPS-TC track and intensity performance: Storm-by-storm track verification

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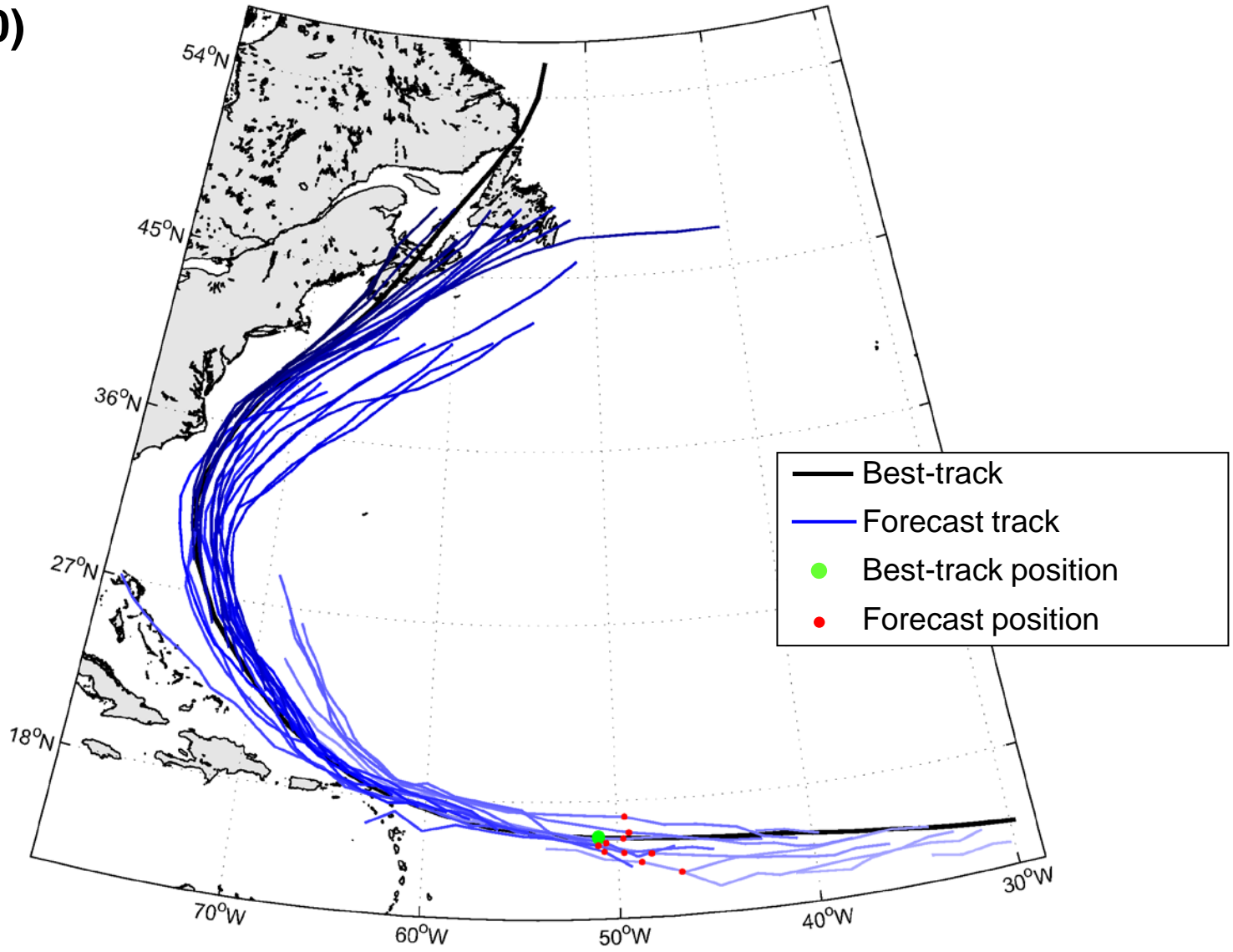




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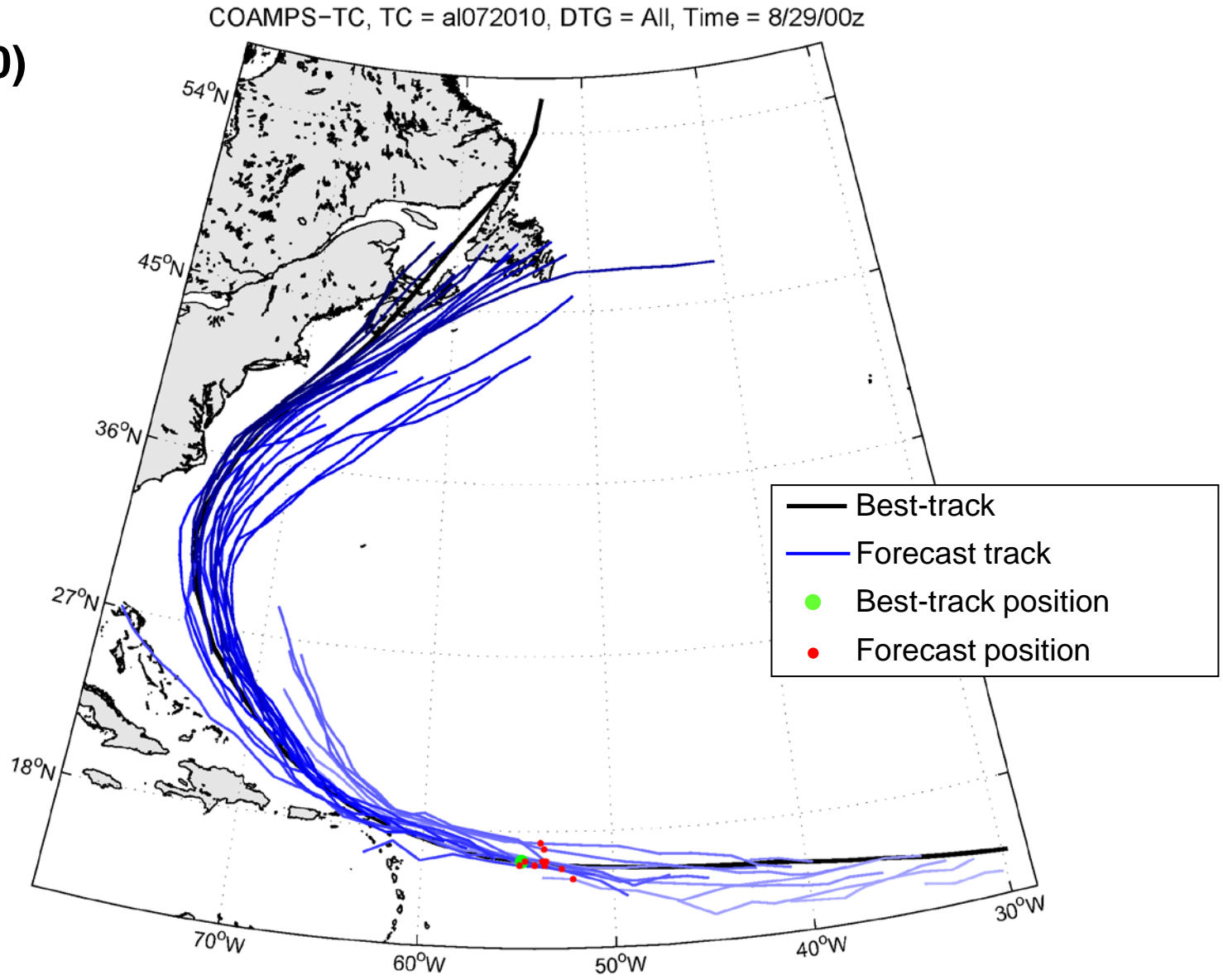
COAMPS-TC, TC = al072010, DTG = All, Time = 8/28/12z





COAMPS-TC track and intensity performance: Storm-by-storm track verification

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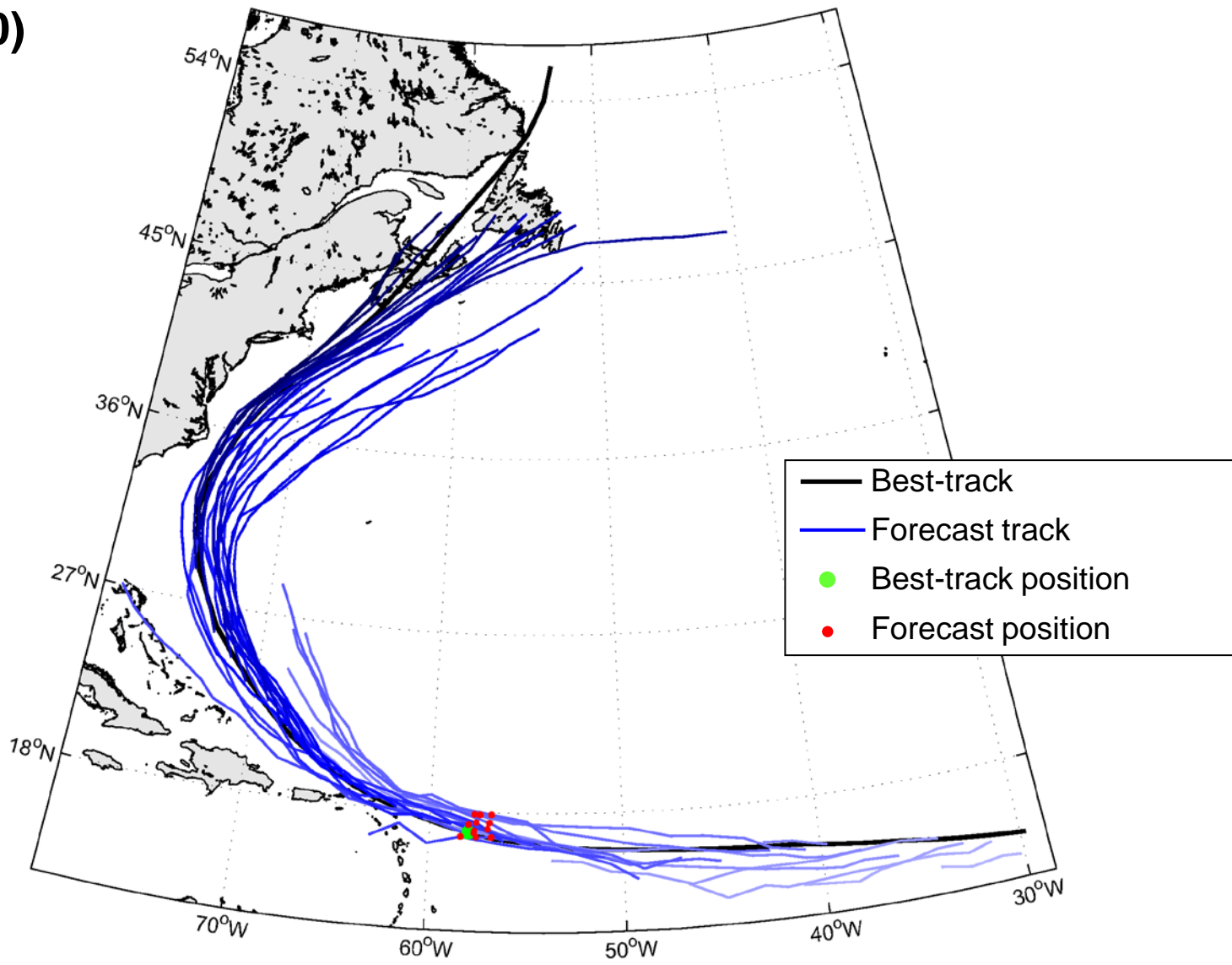




COAMPS-TC track and intensity performance: Storm-by-storm track verification

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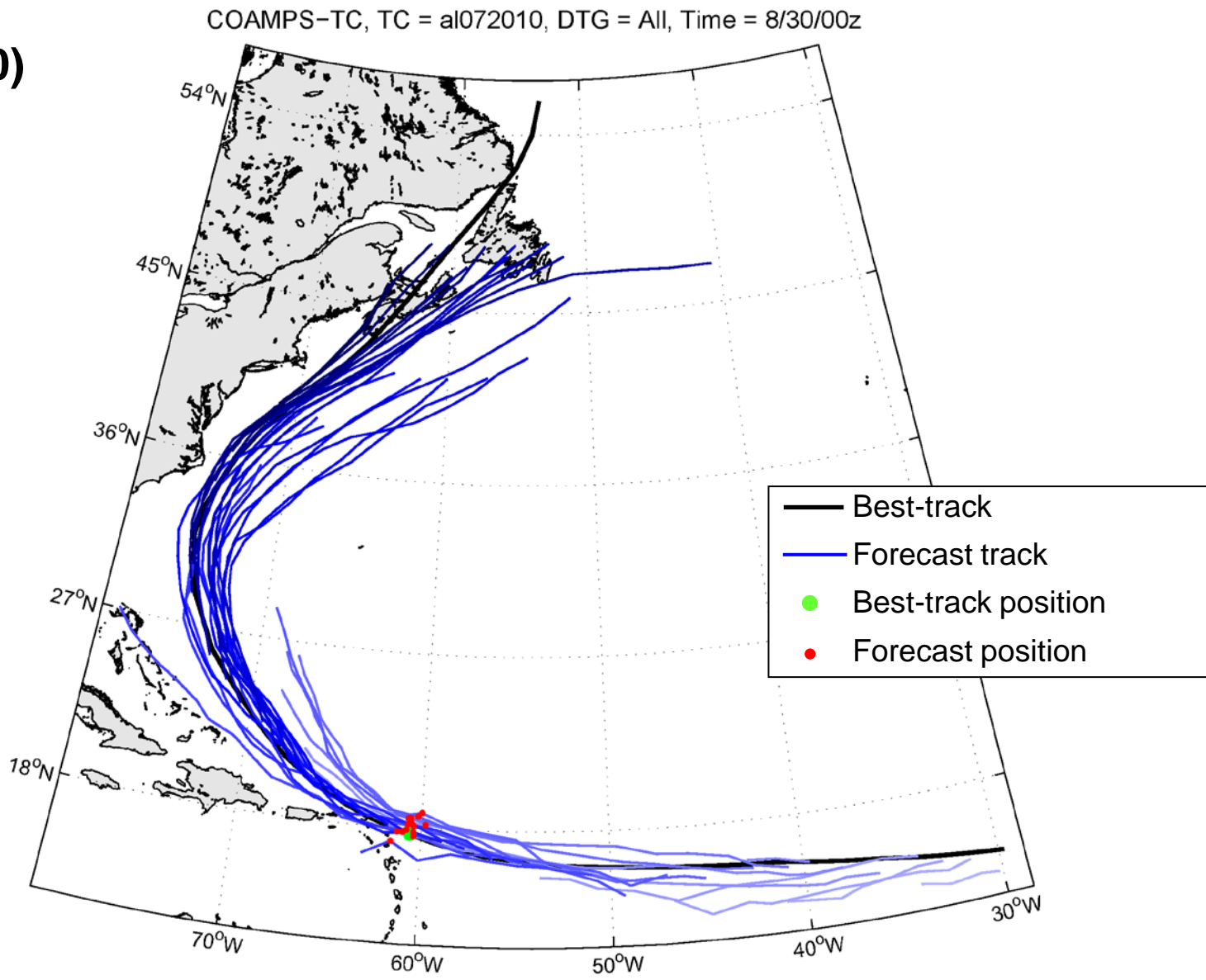
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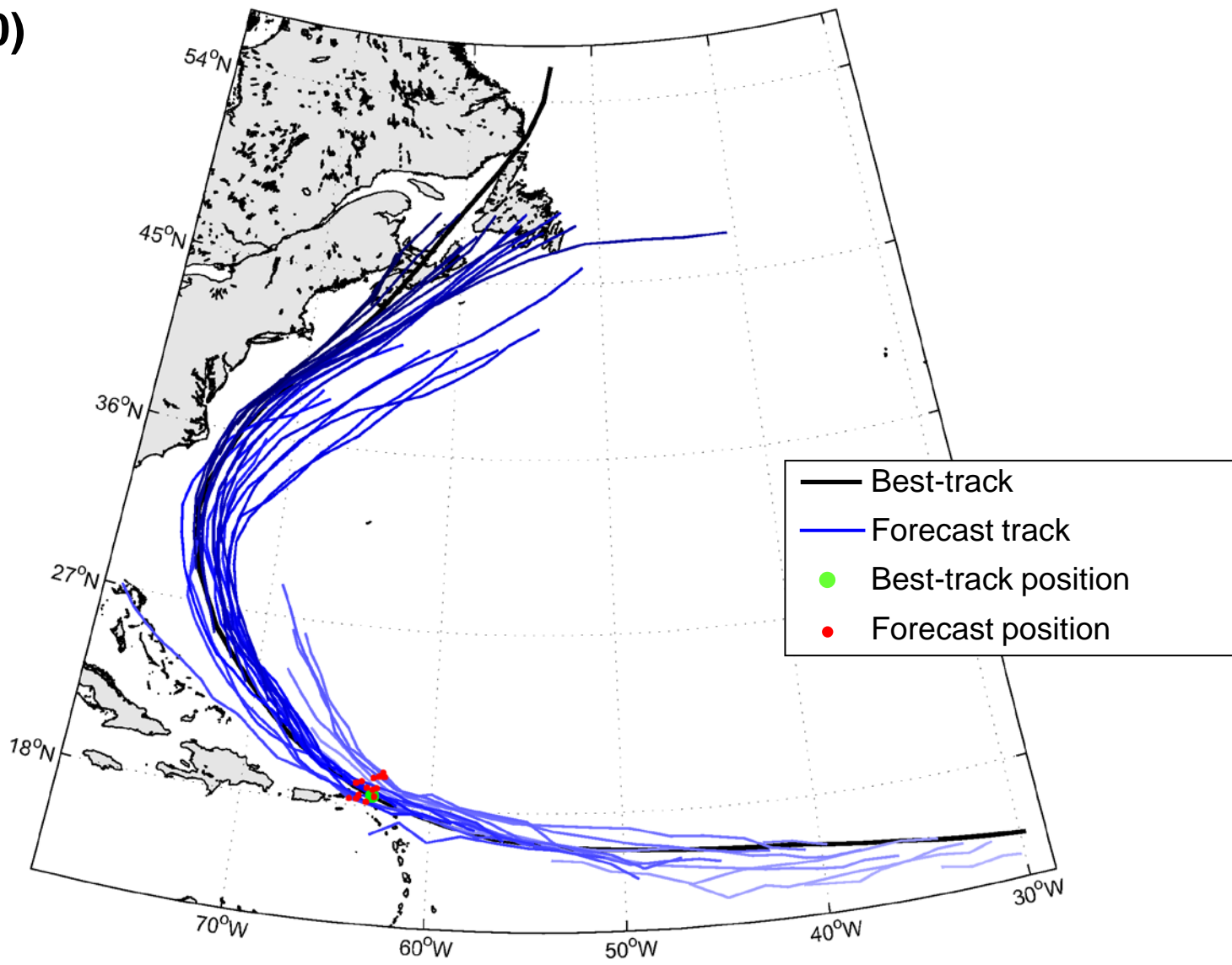




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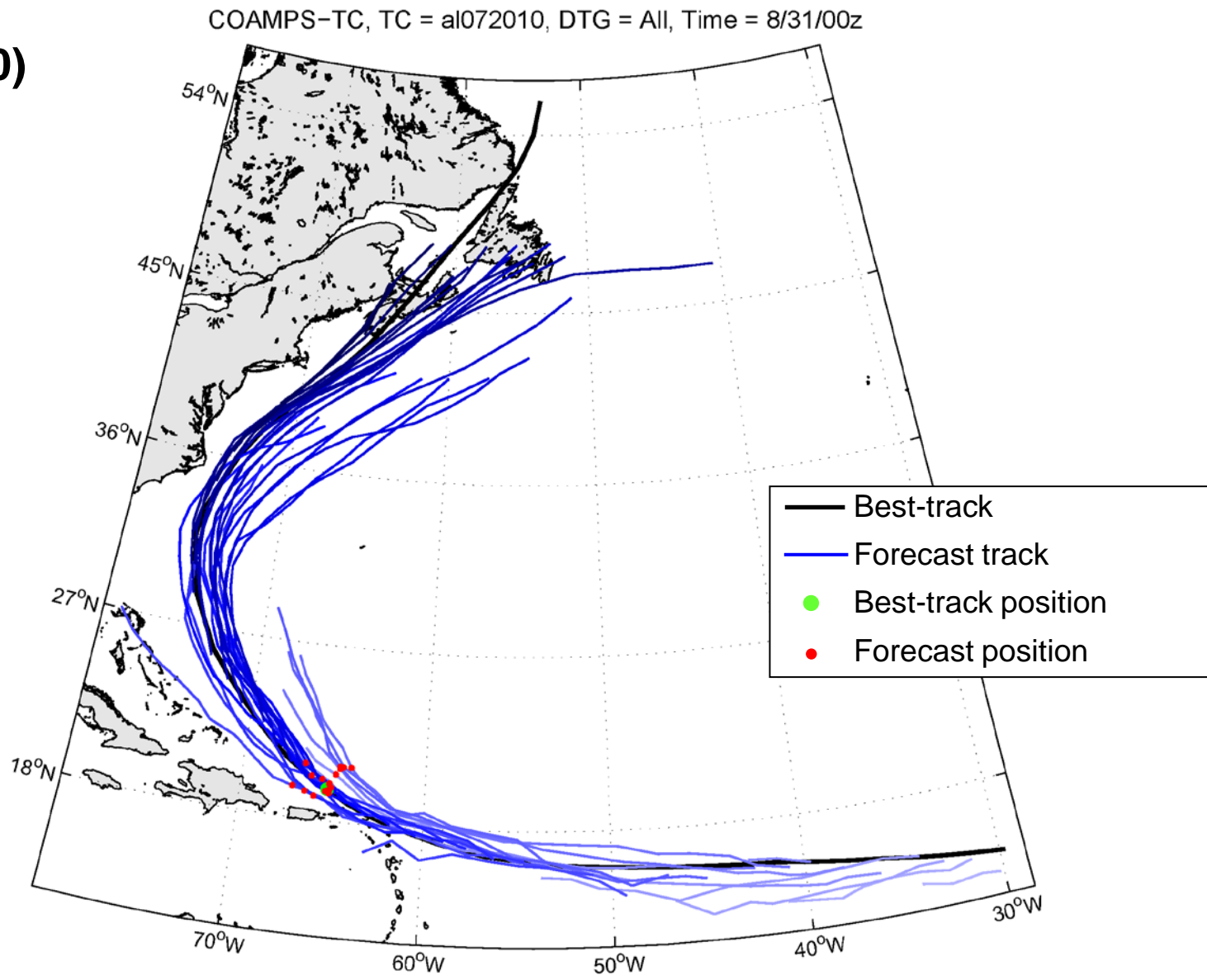
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COAMPS-TC track and intensity performance: Storm-by-storm track verification

Earl (2010)

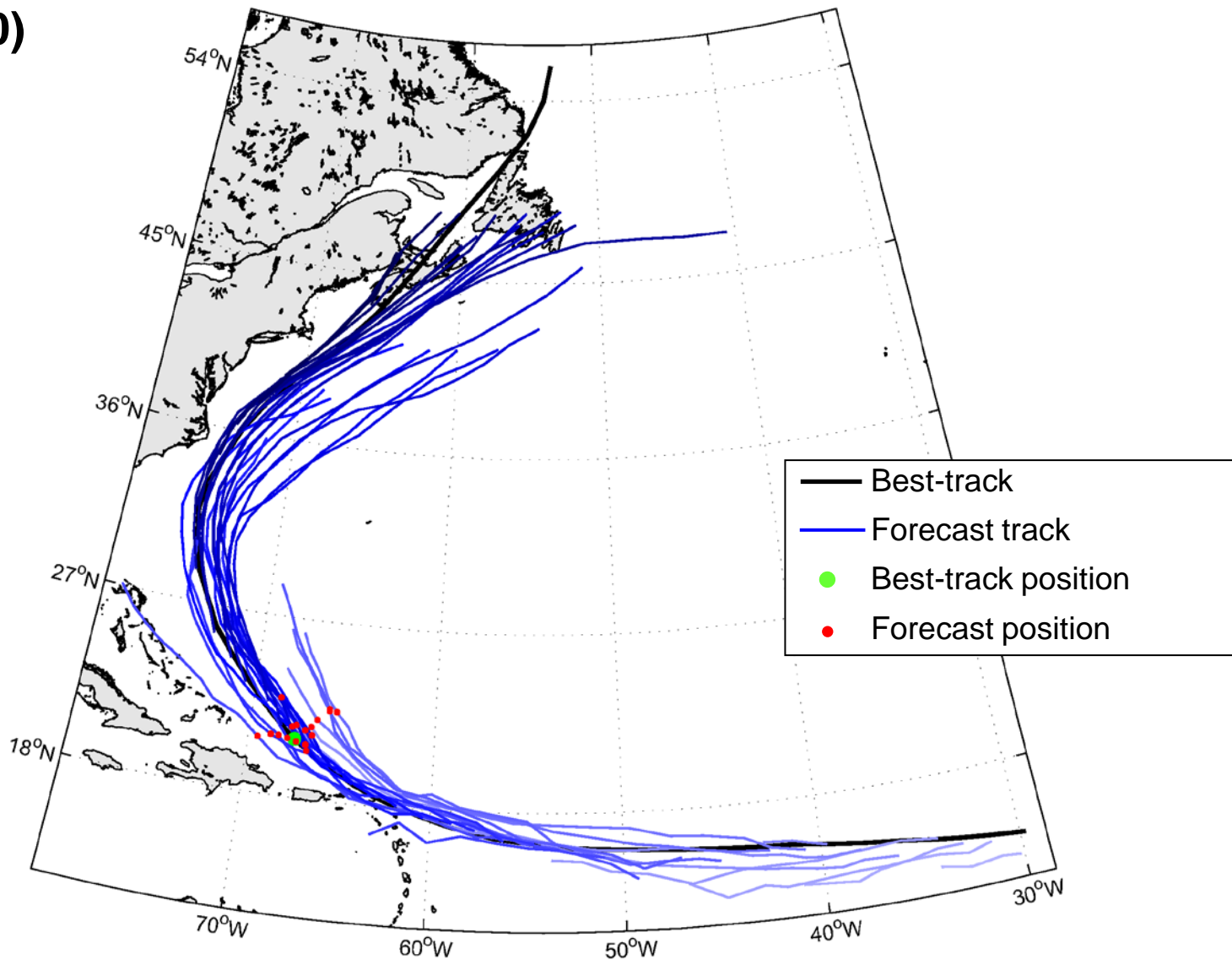




COAMPS-TC track and intensity performance: Storm-by-storm track verification

Earl (2010)

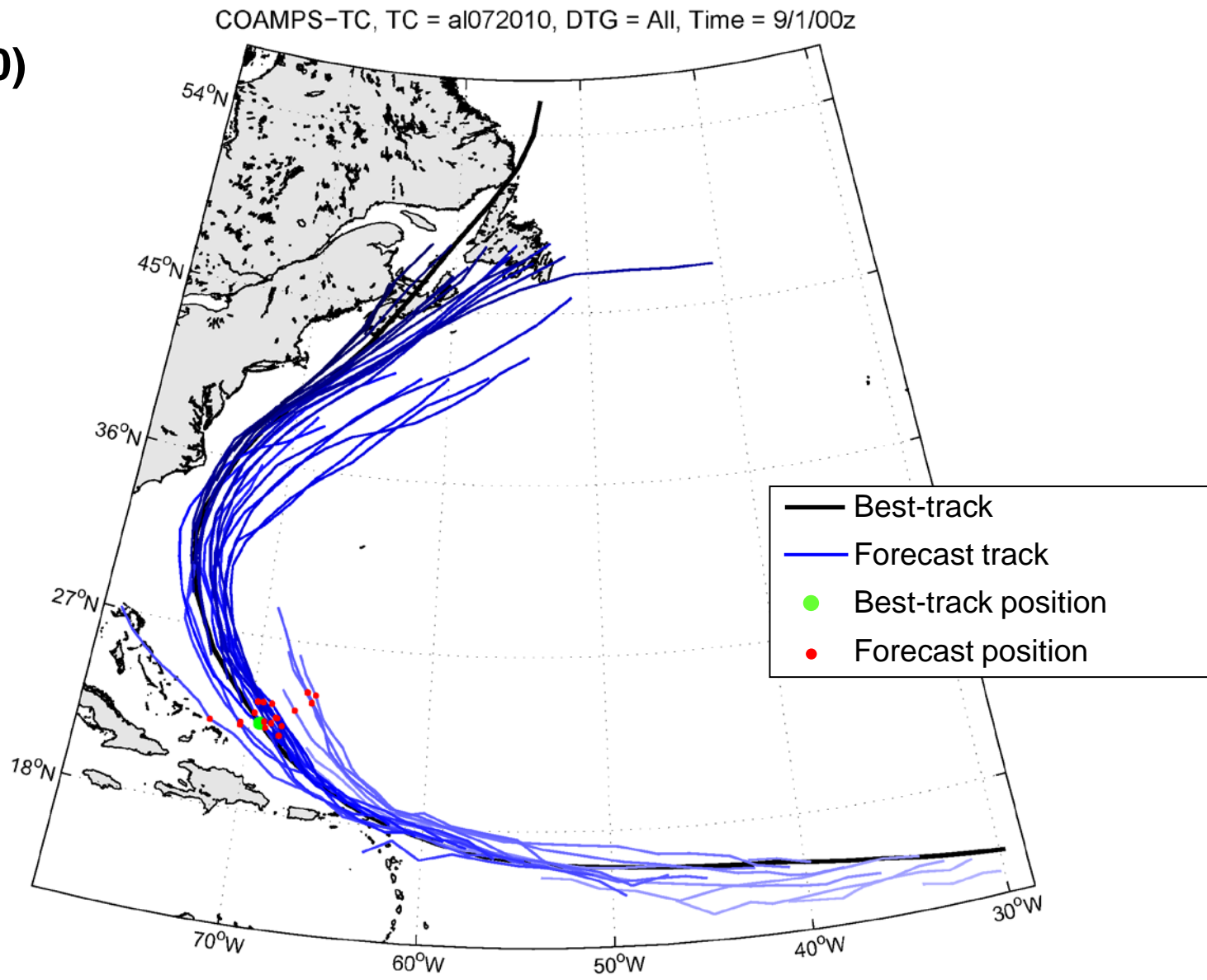
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COAMPS-TC track and intensity performance: Storm-by-storm track verification

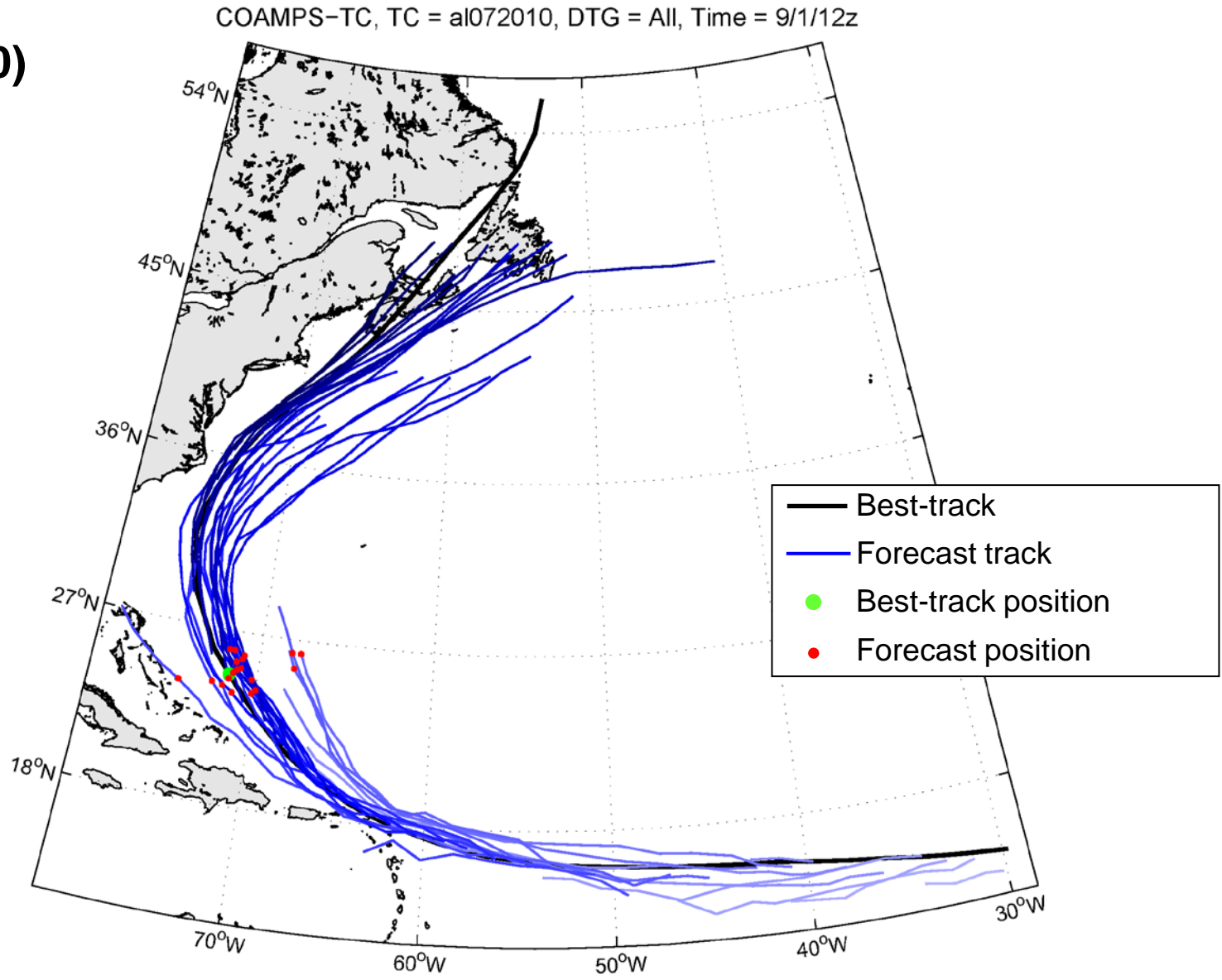
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COAMPS-TC track and intensity performance: Storm-by-storm track verification

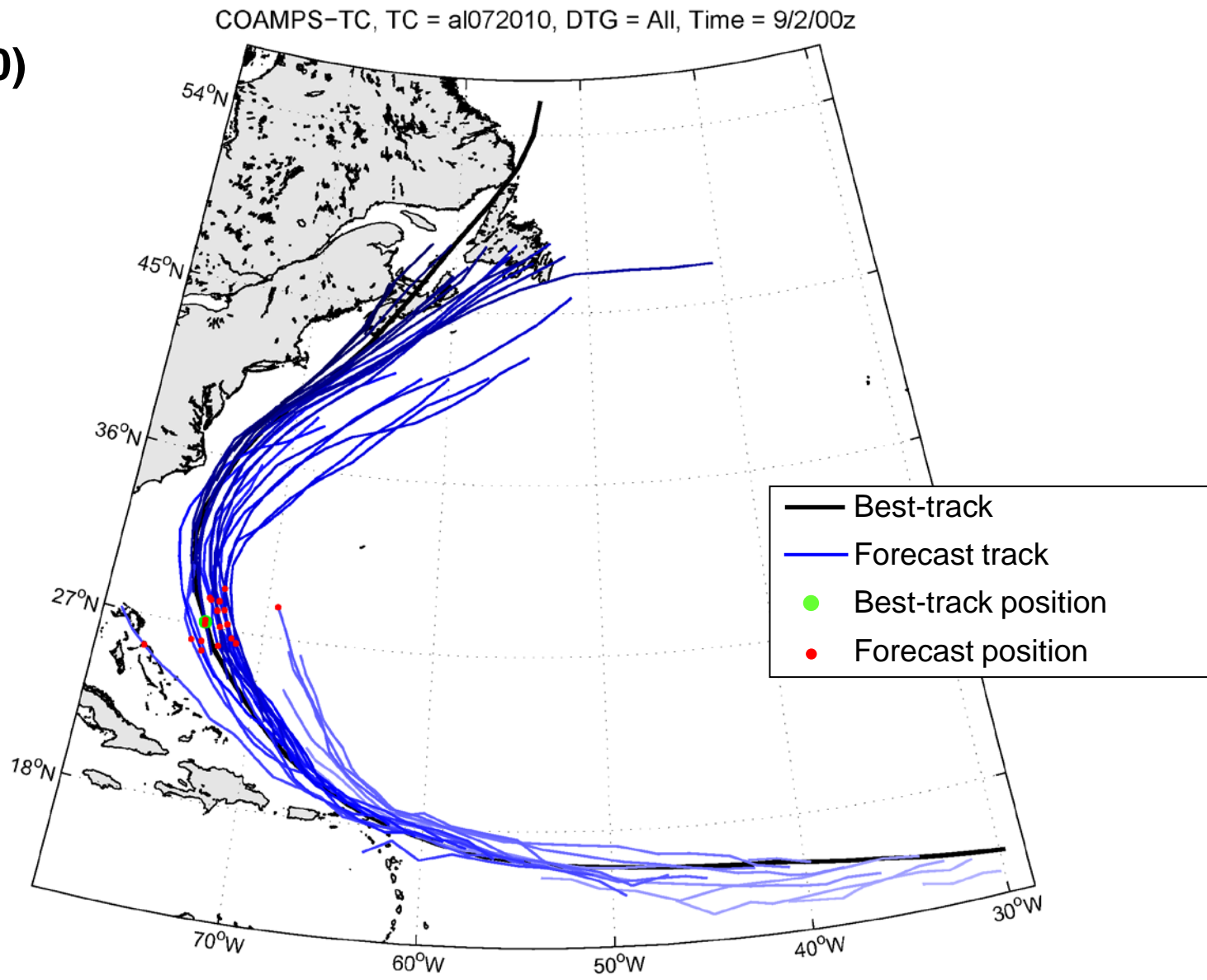
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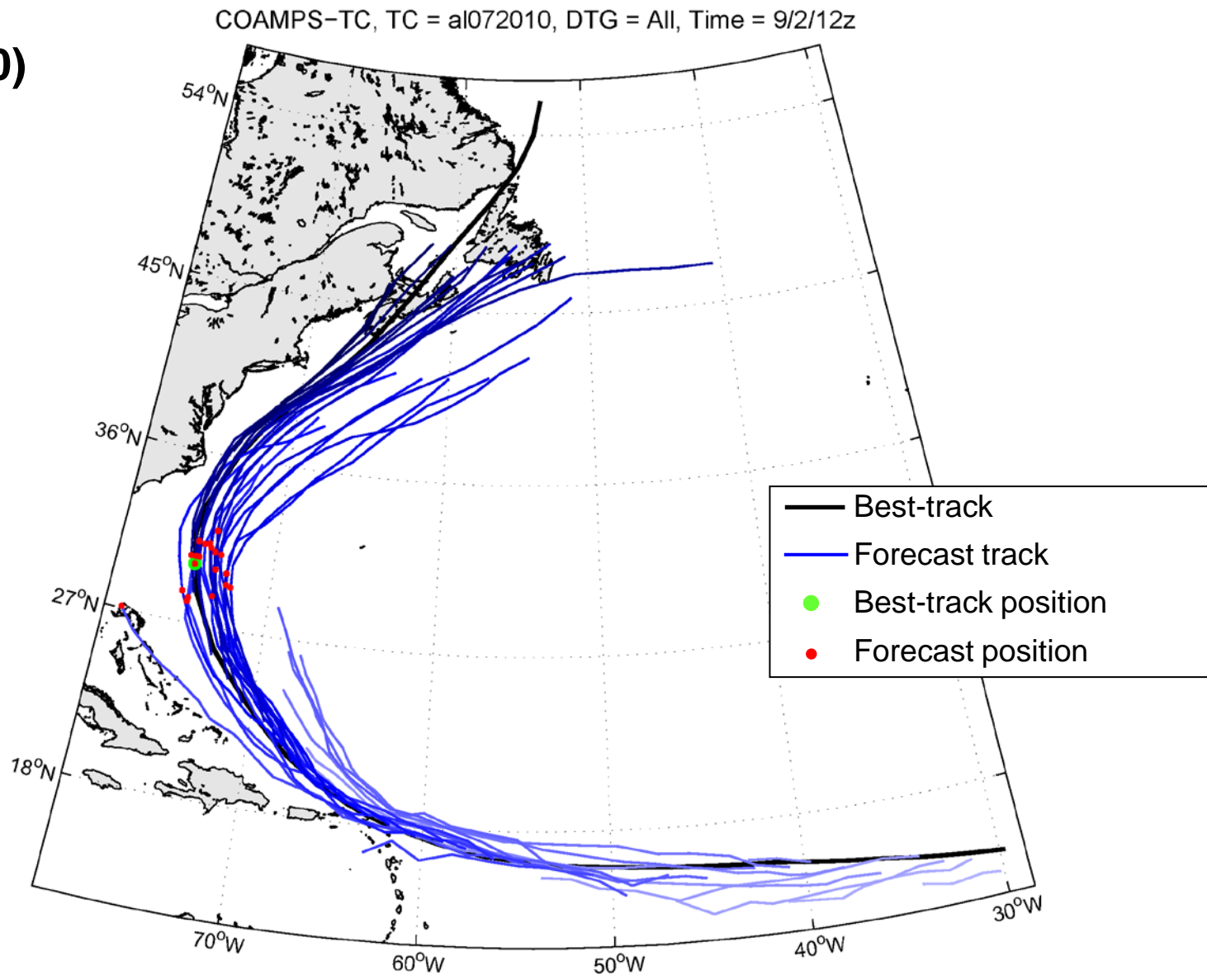
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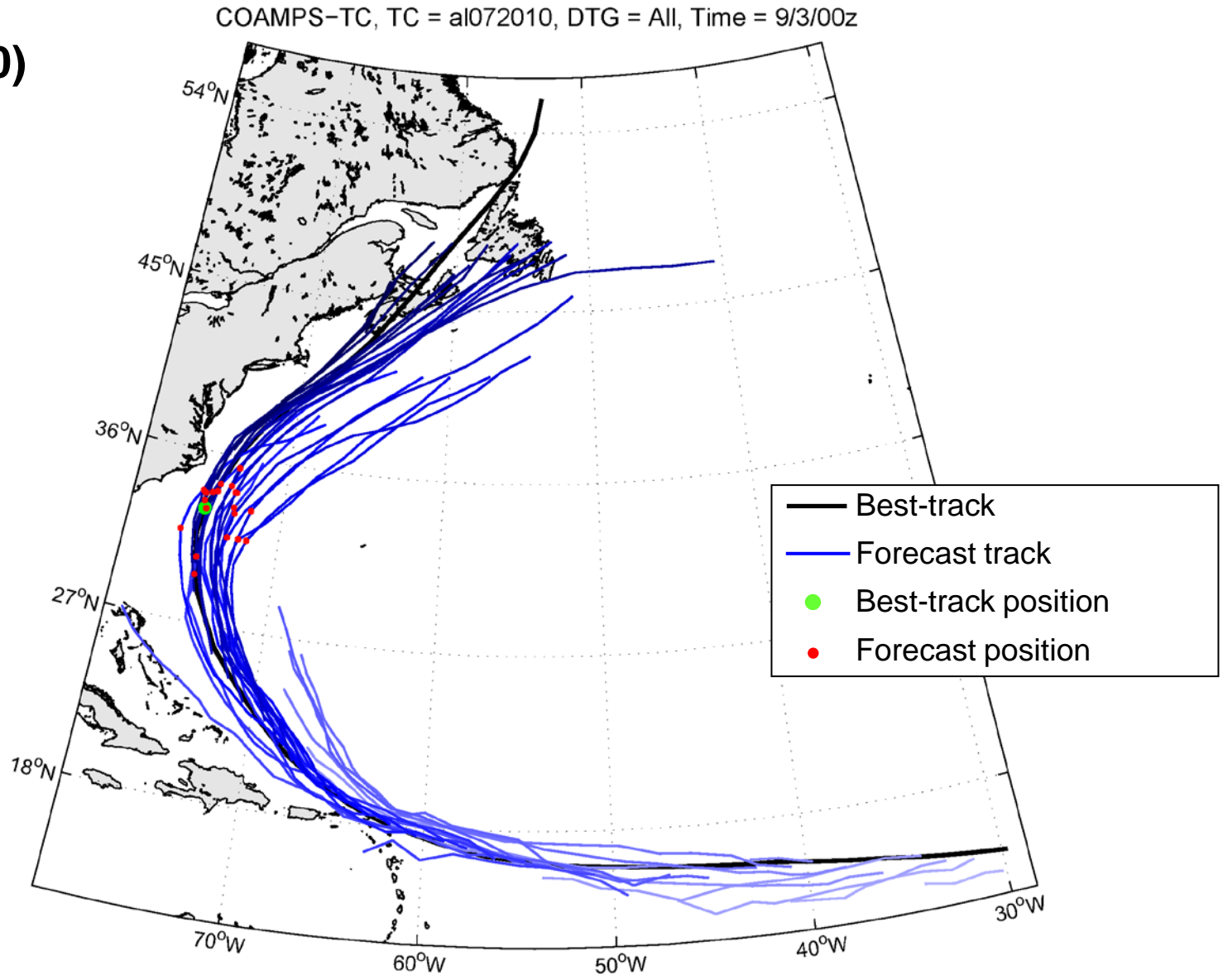
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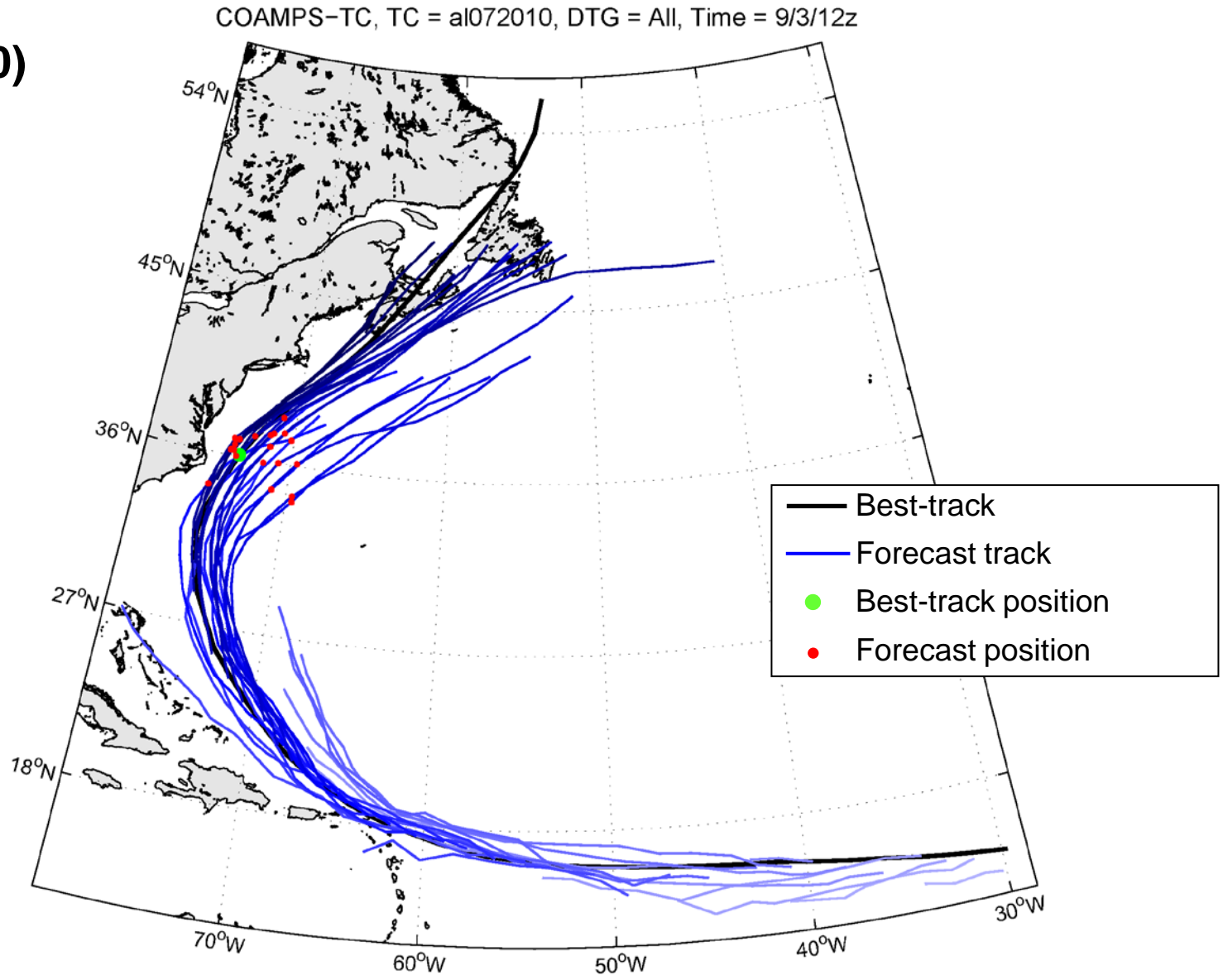
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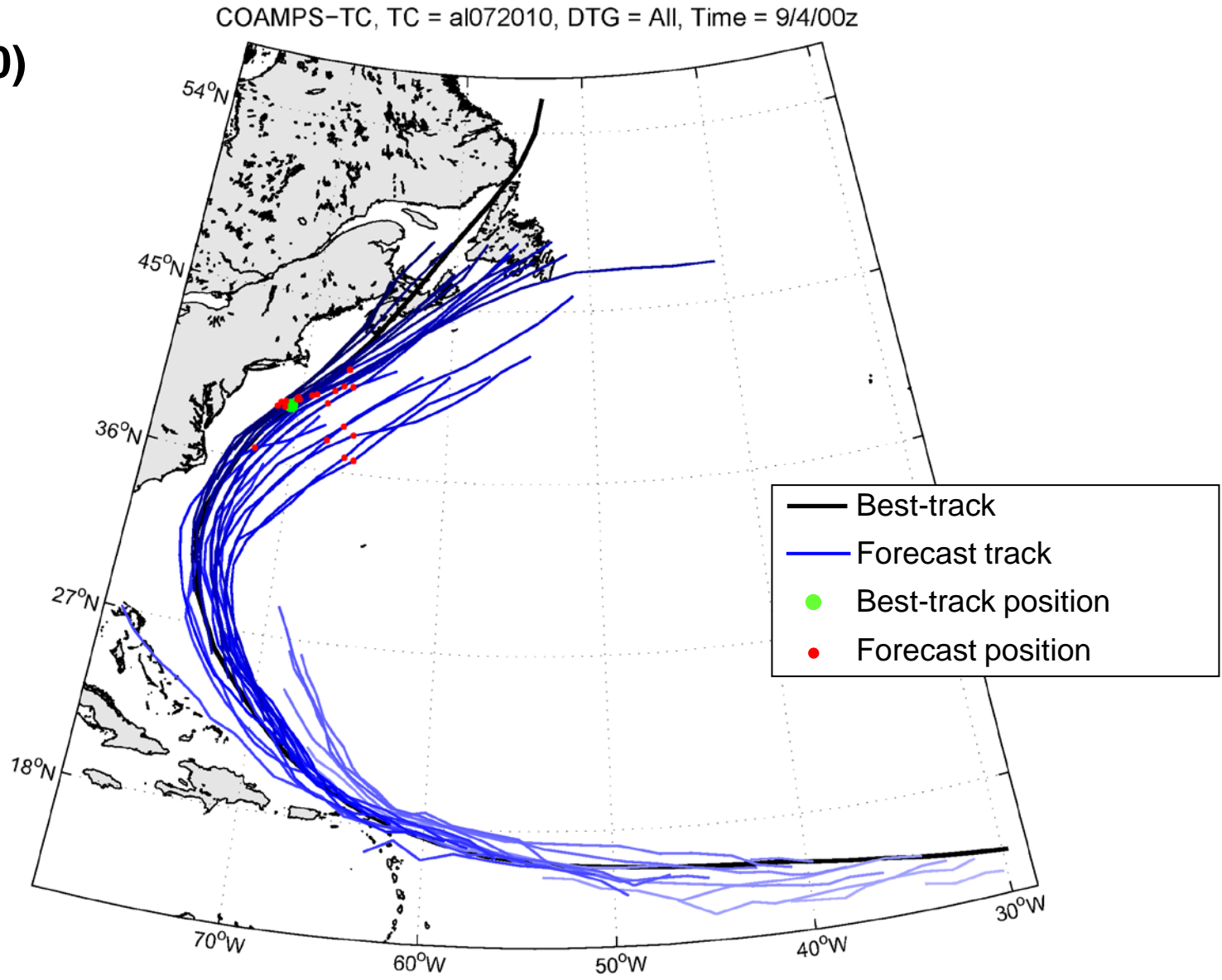
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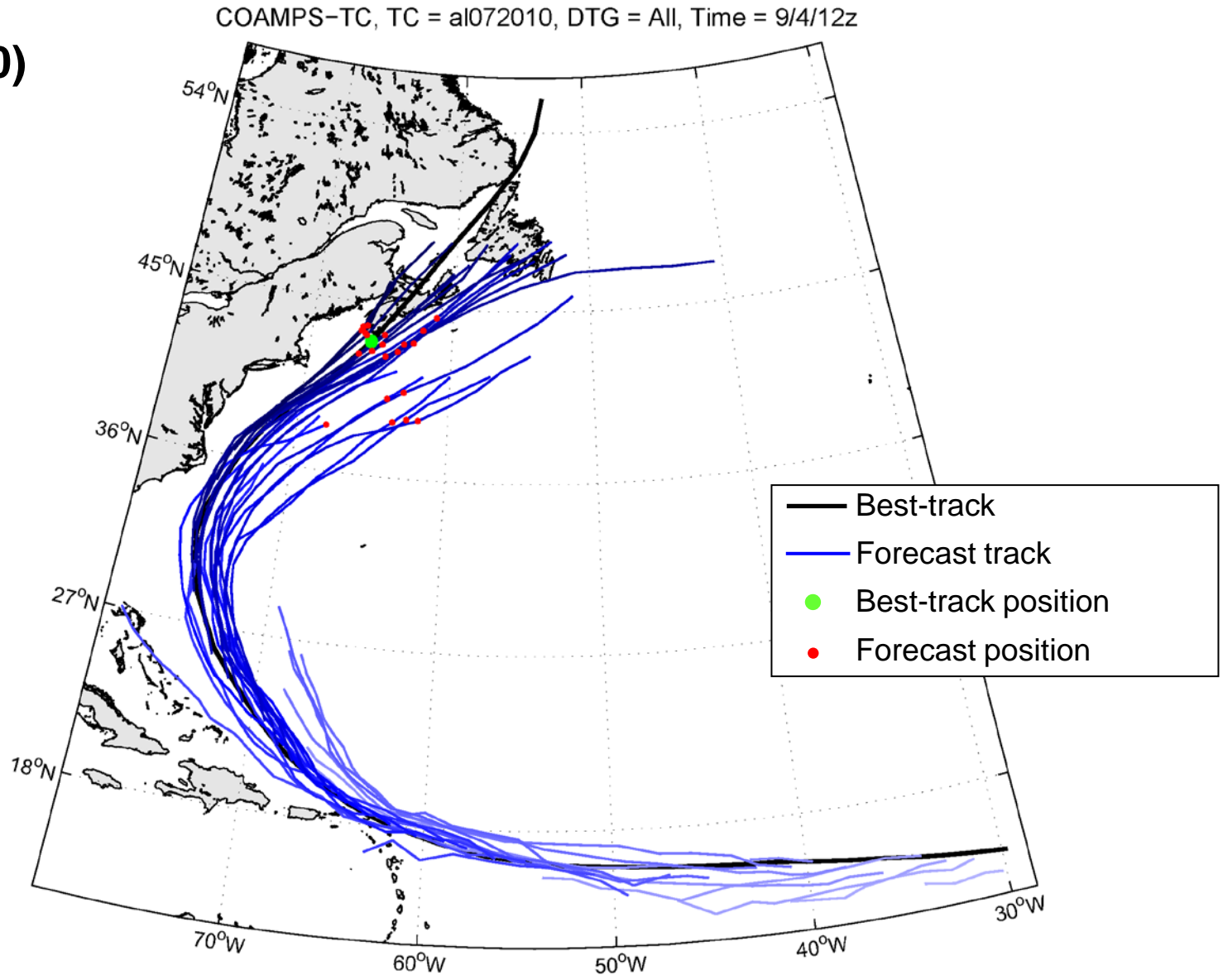
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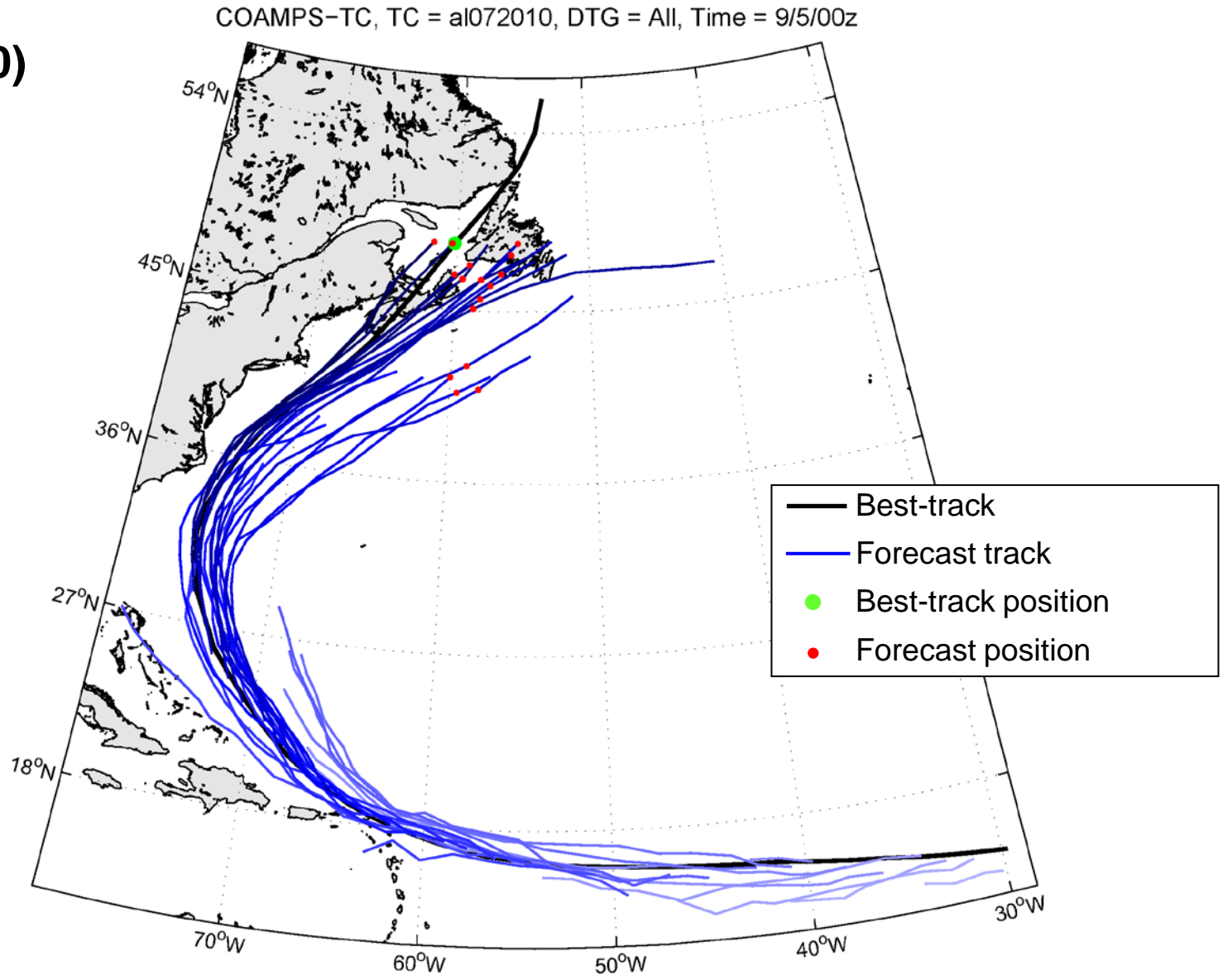
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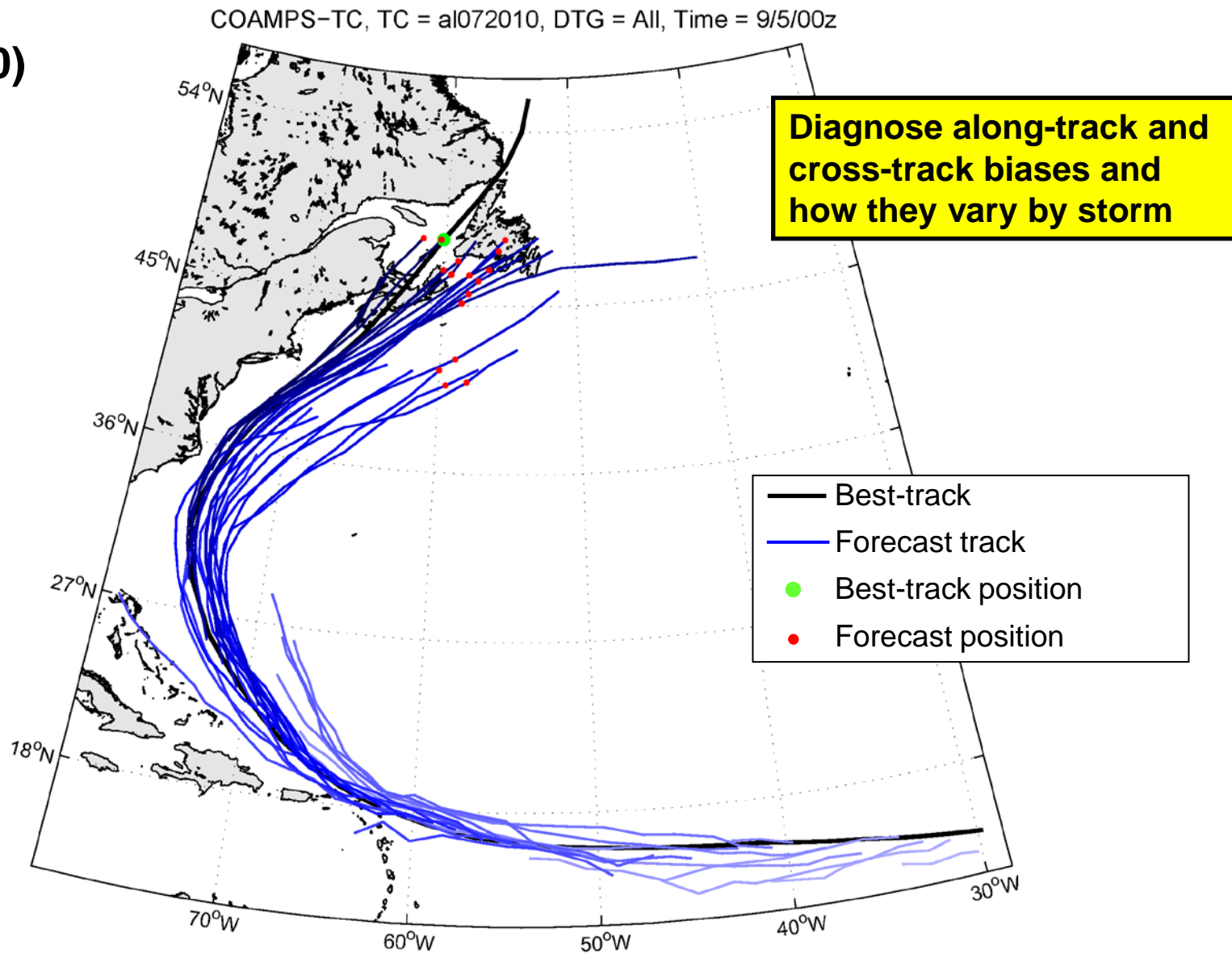
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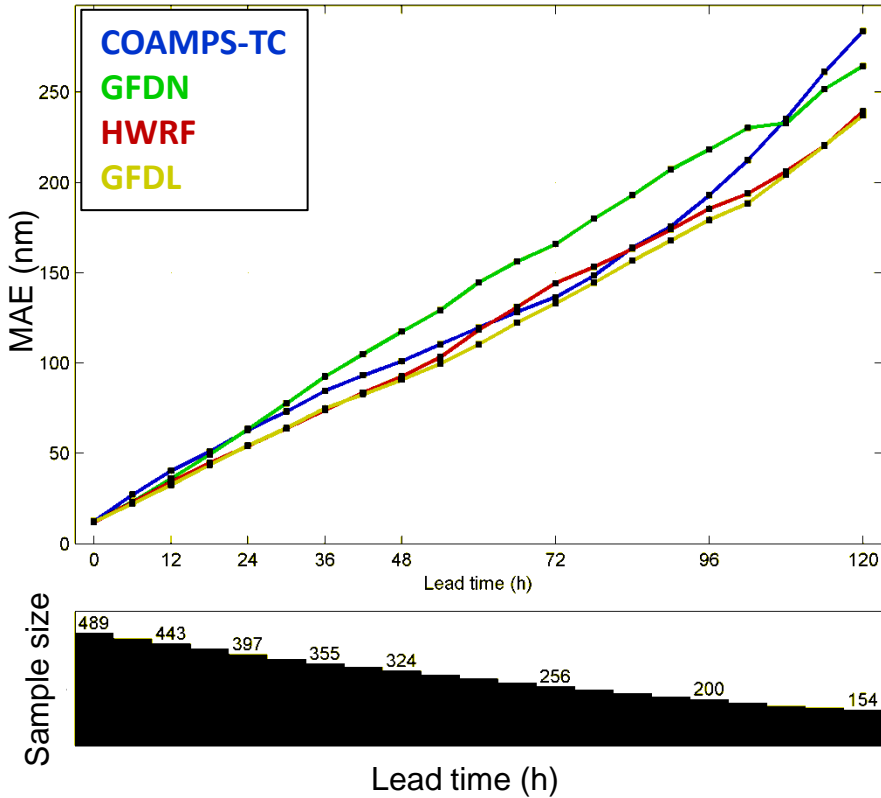
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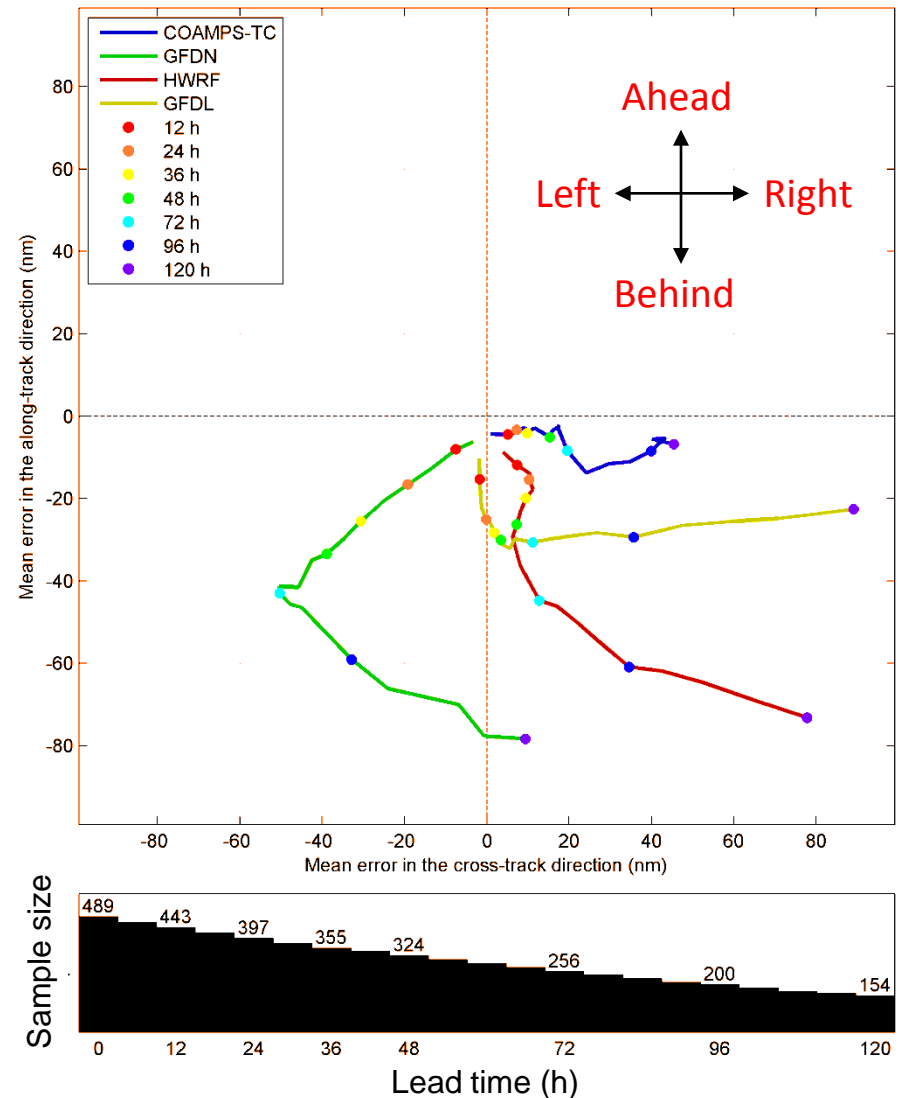


COAMPS-TC track and intensity performance: Track summary measures

Mean absolute error



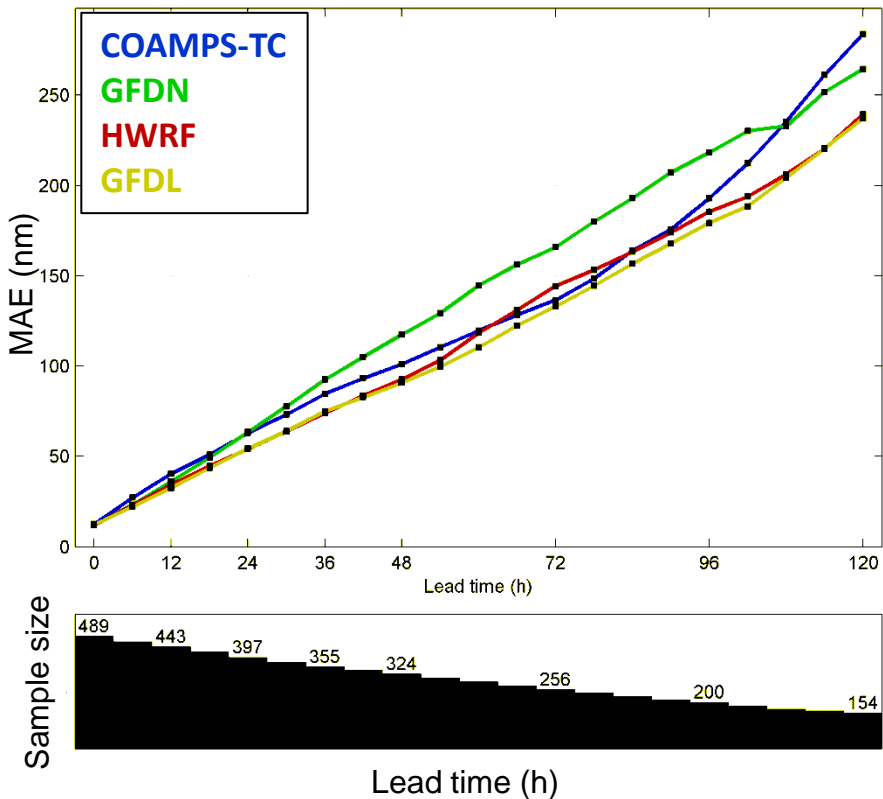
Mean error in storm-relative coordinates





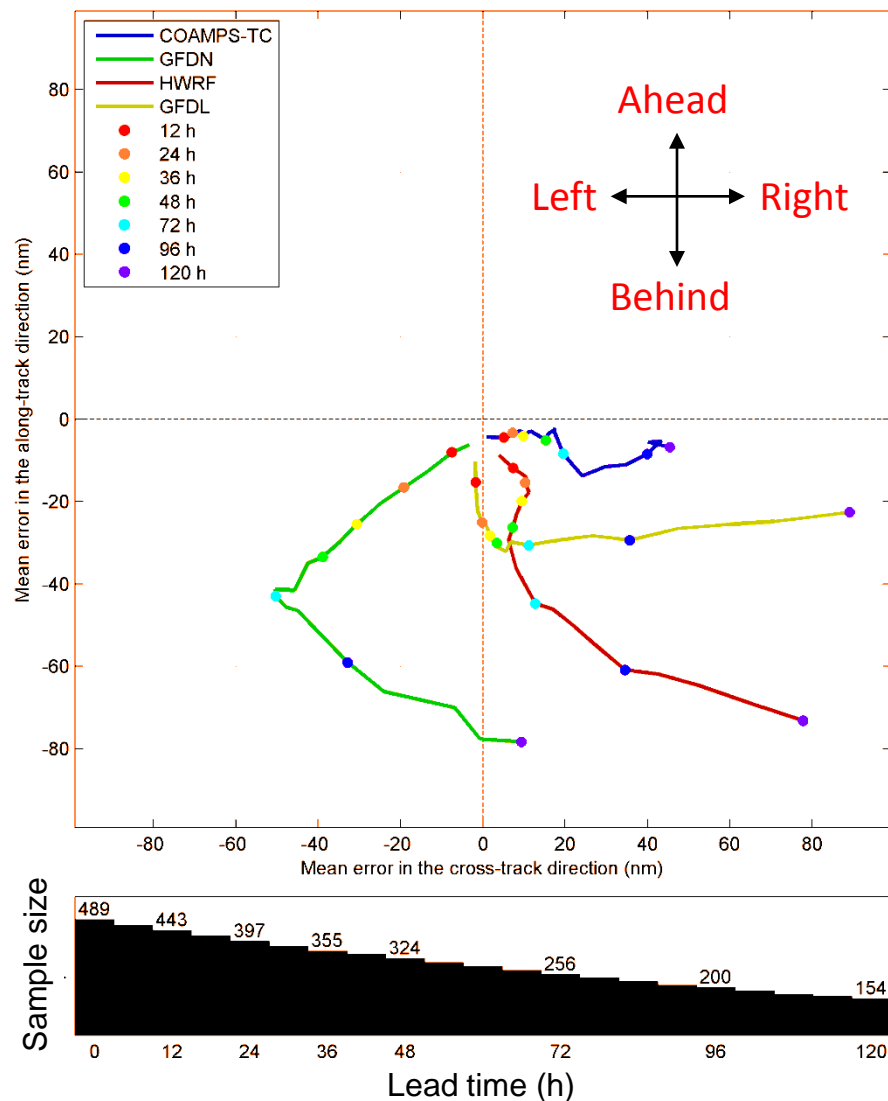
COAMPS-TC track and intensity performance: Track summary measures

Mean absolute error



COAMPS-TC track bias is improved relative to the previous Atlantic basin HFIP retrospective forecast sample

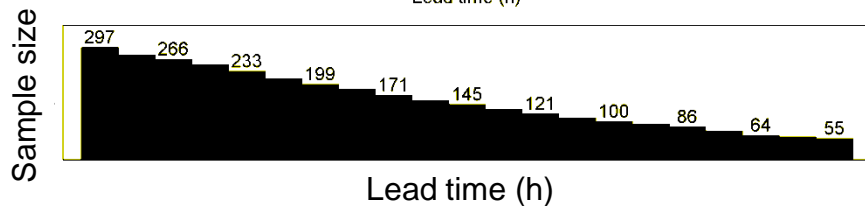
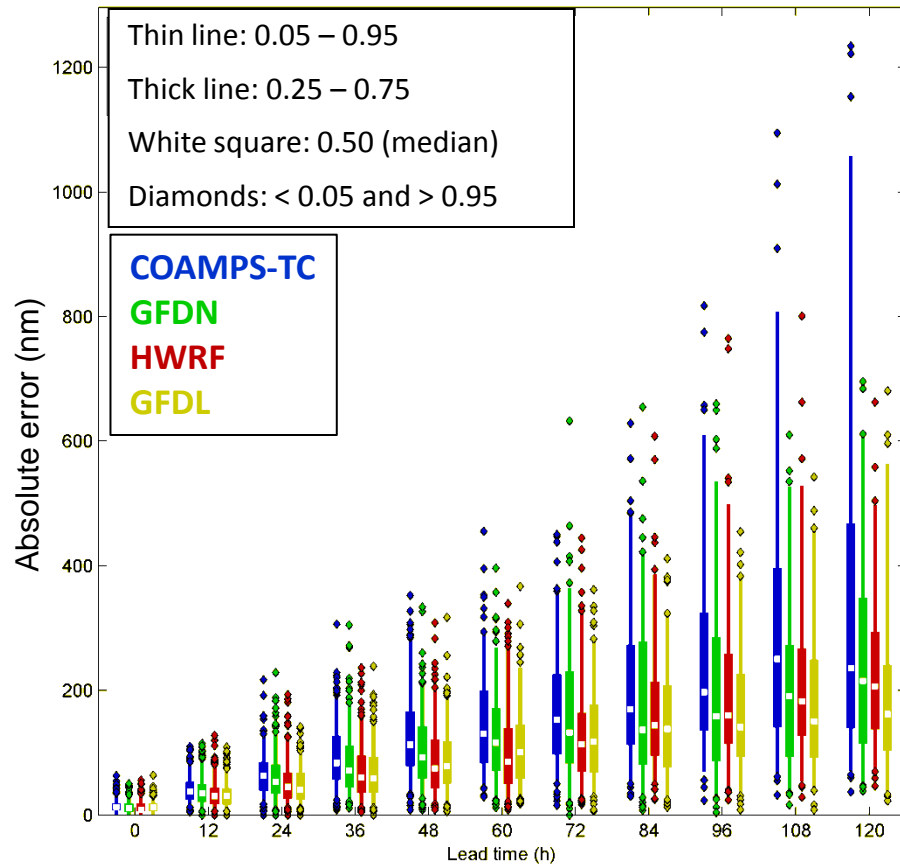
Mean error in storm-relative coordinates



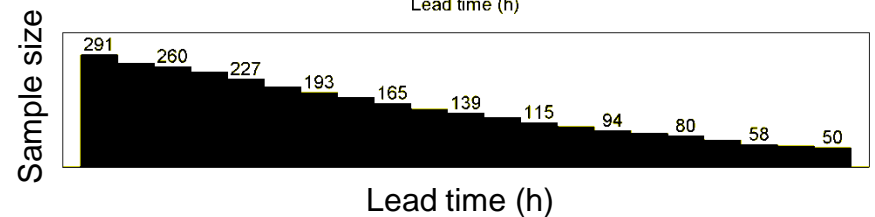
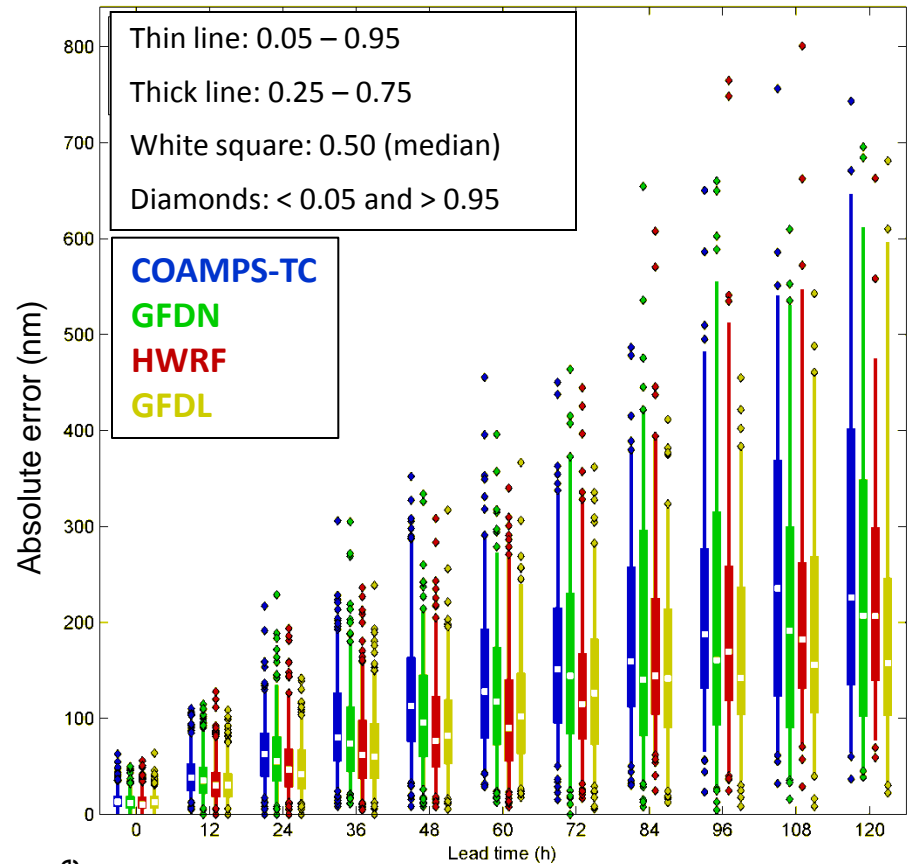


COAMPS-TC track and intensity performance: Track error distribution

2011 real-time Atlantic basin



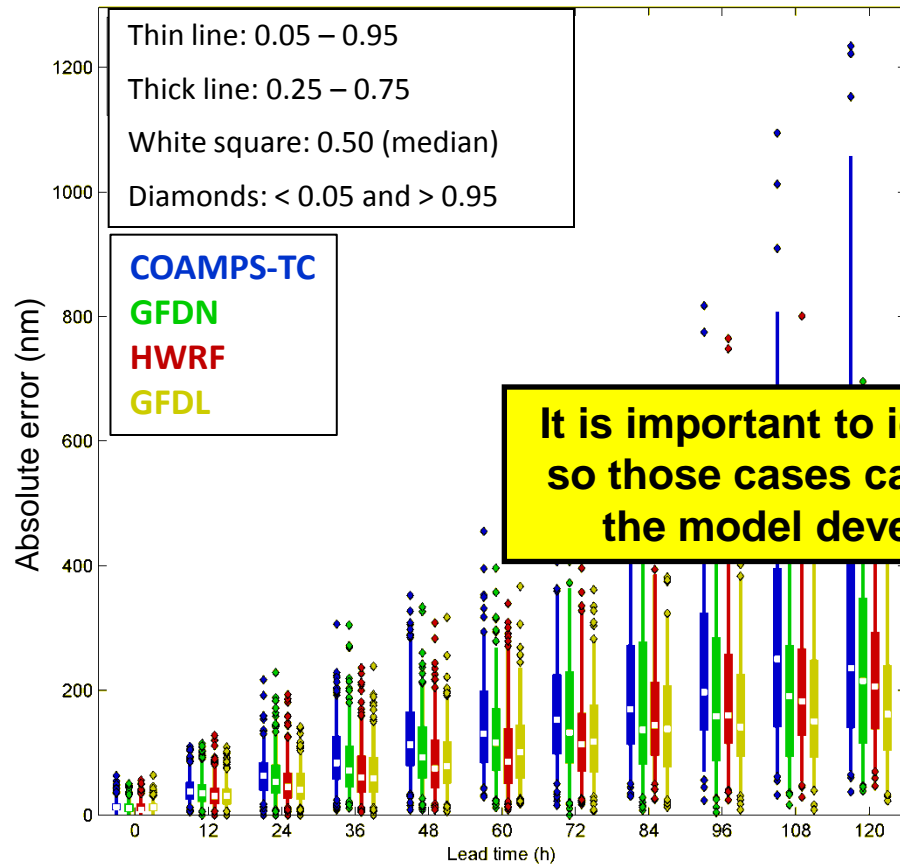
2011 real-time Atlantic basin, without 6 Katia forecasts



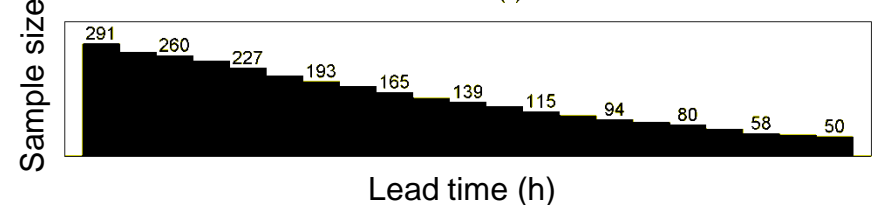
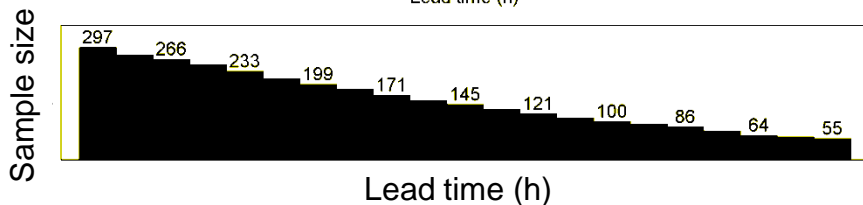
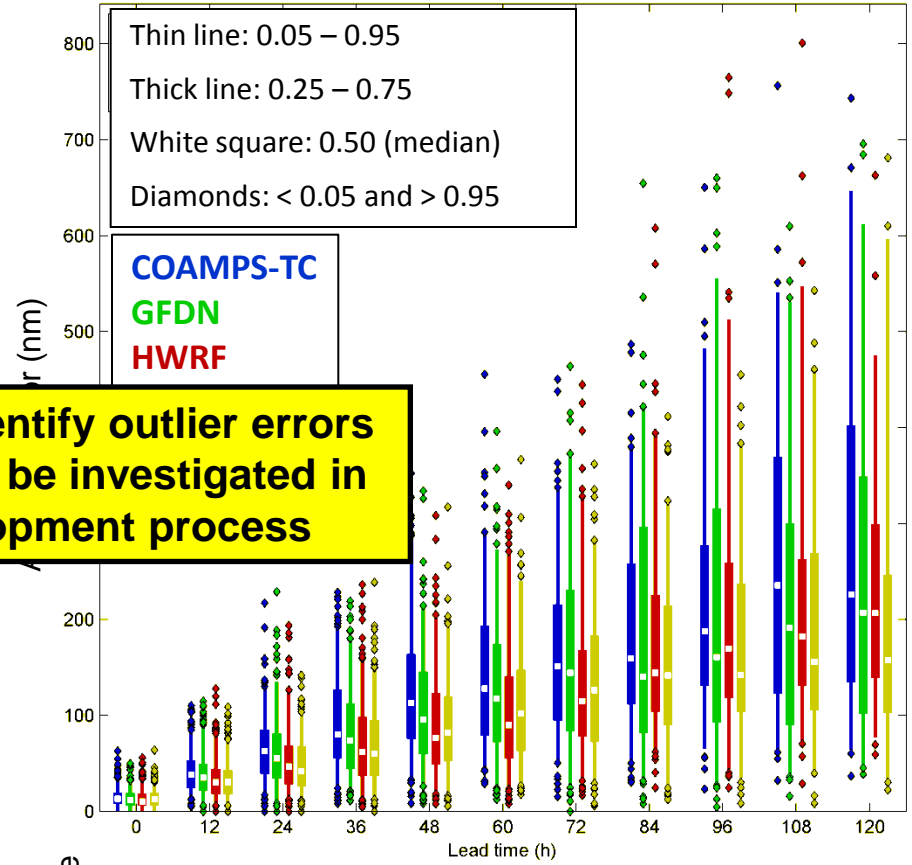


COAMPS-TC track and intensity performance: Track error distribution

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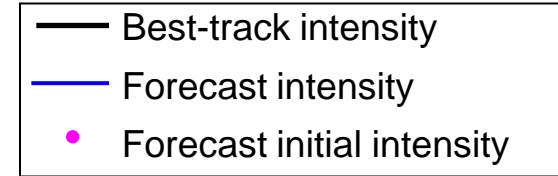


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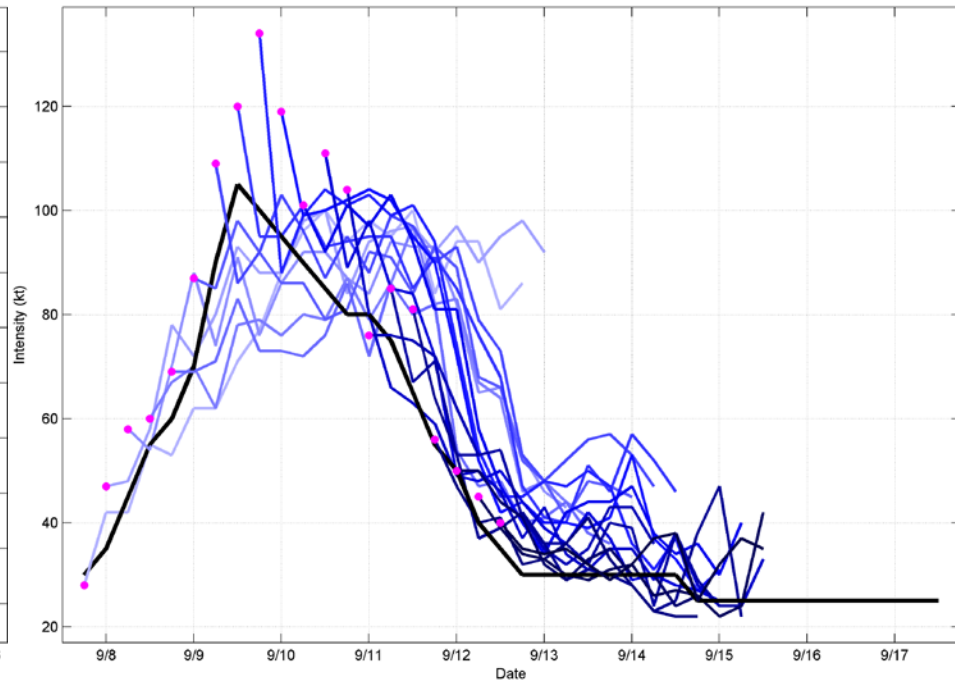
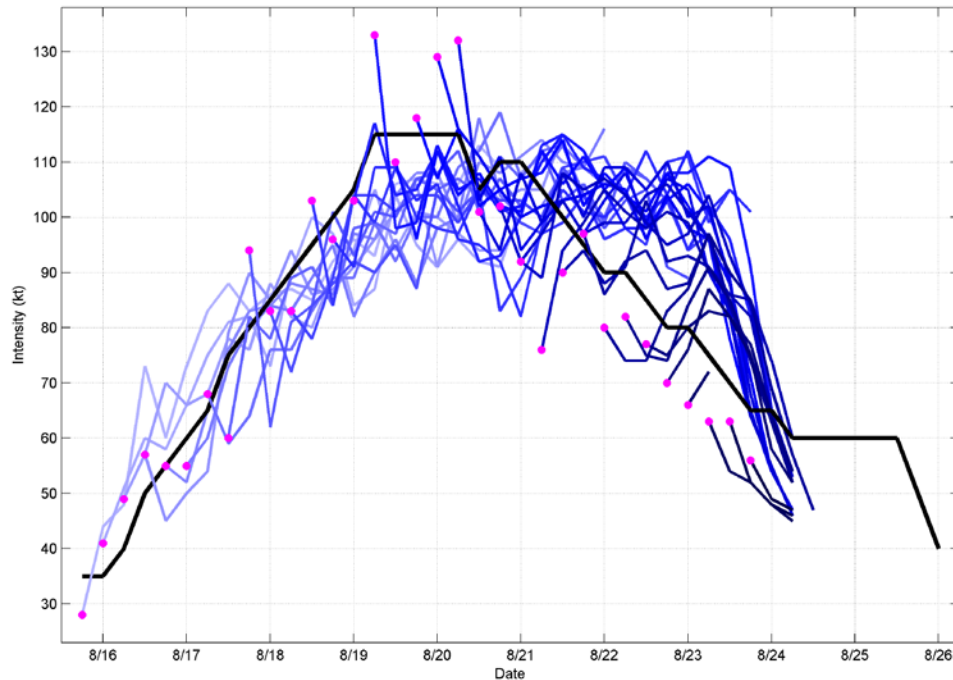


COAMPS-TC track and intensity performance: Storm-by-storm intensity verification



Bill (2009)

Fred (2009)

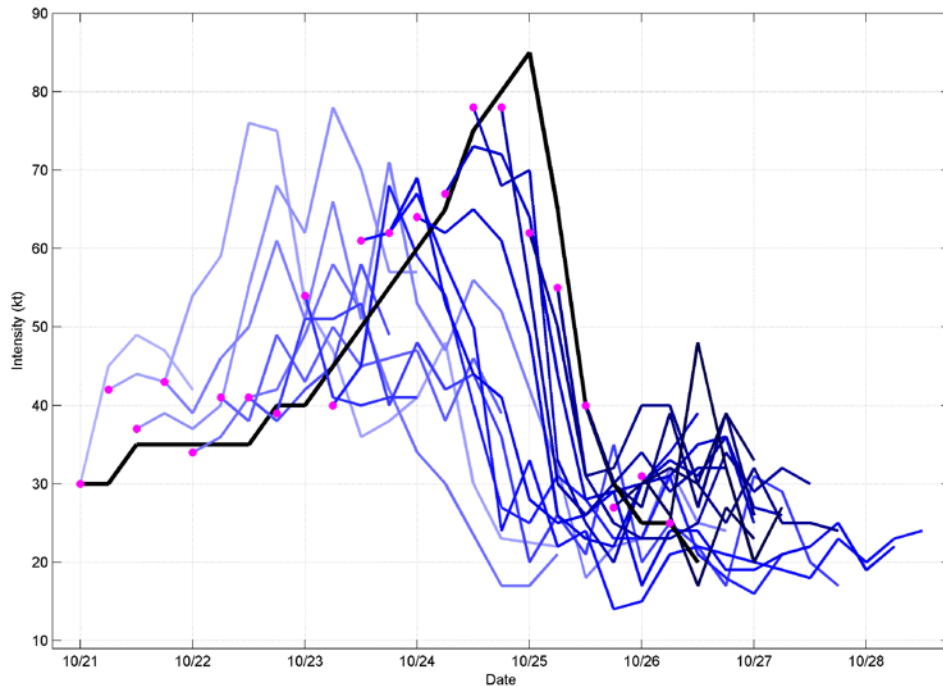


Diagnose how intensity bias varies by storm

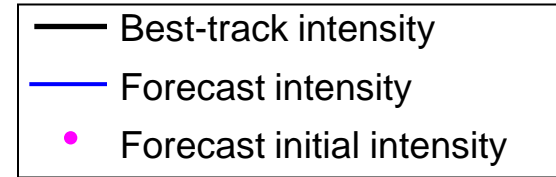
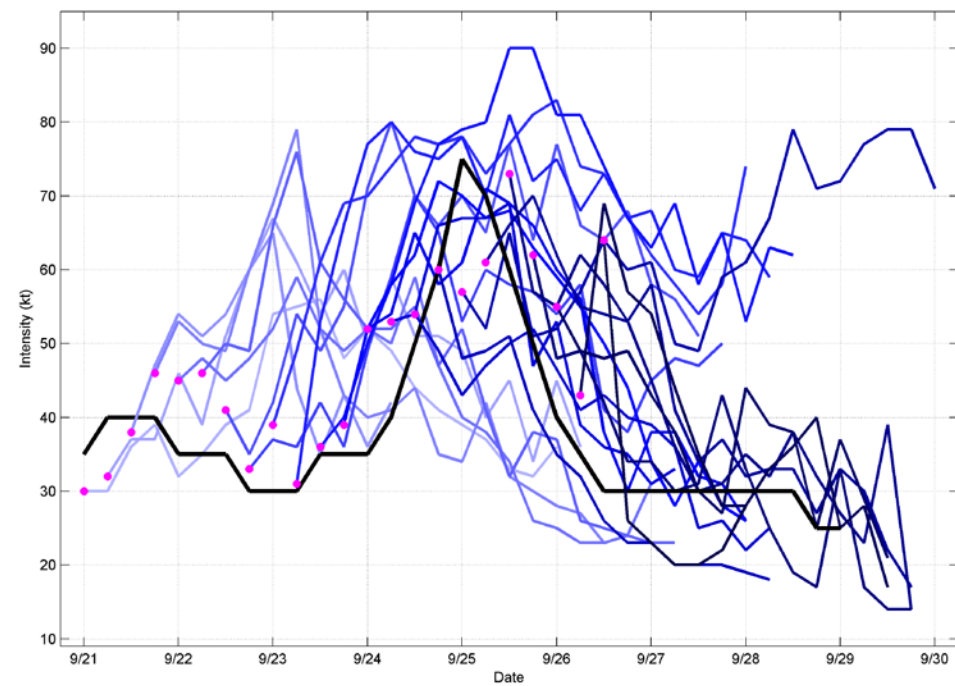


COAMPS-TC track and intensity performance: Storm-by-storm intensity verification

Richard (2010)



Lisa (2010)

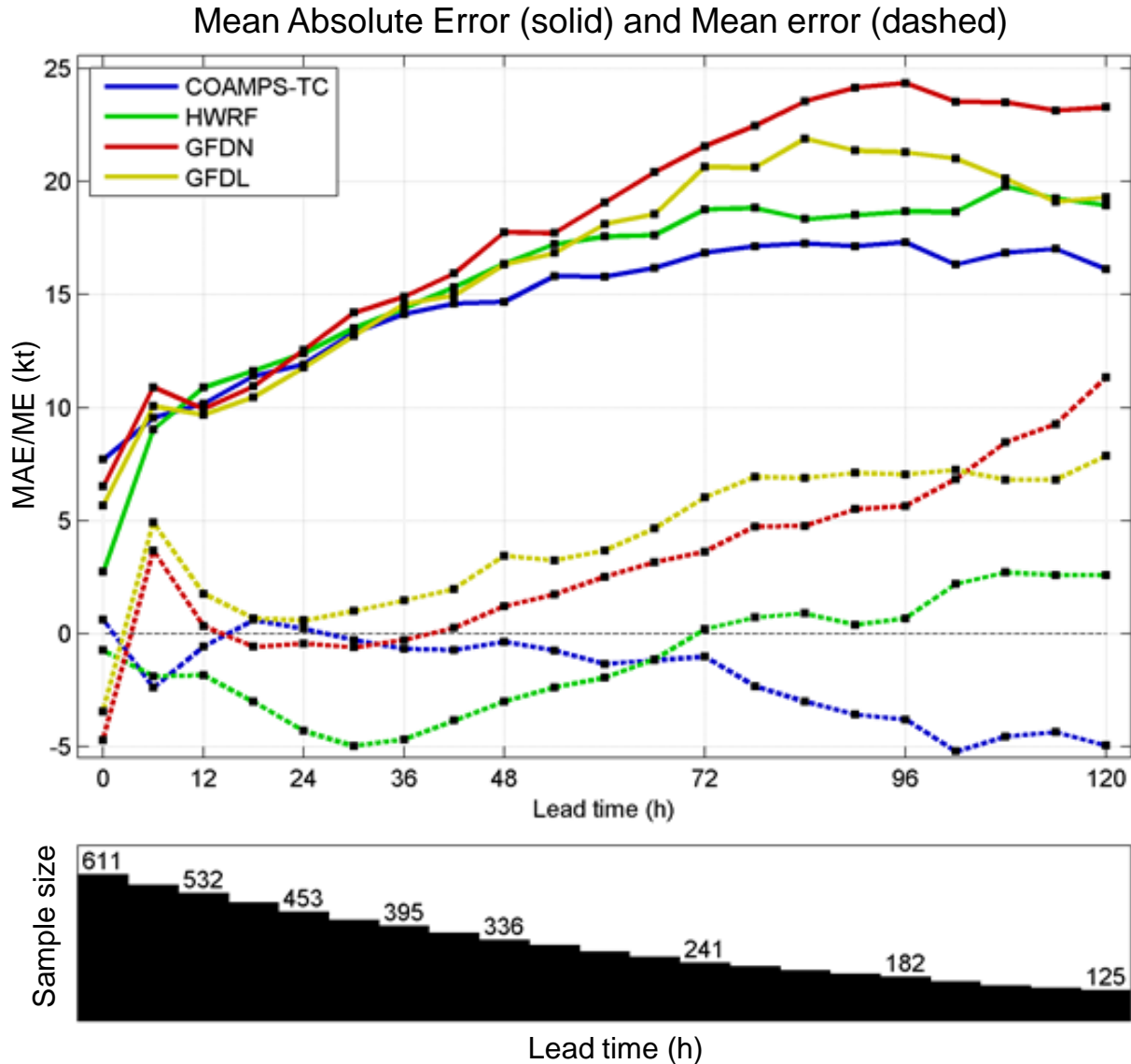


Diagnose how intensity bias varies by storm



COAMPS-TC track and intensity performance: Intensity summary measures

**2010/2011
real-time
forecasts**





COAMPS-TC track and intensity performance: Stratification by best-track initial intensity

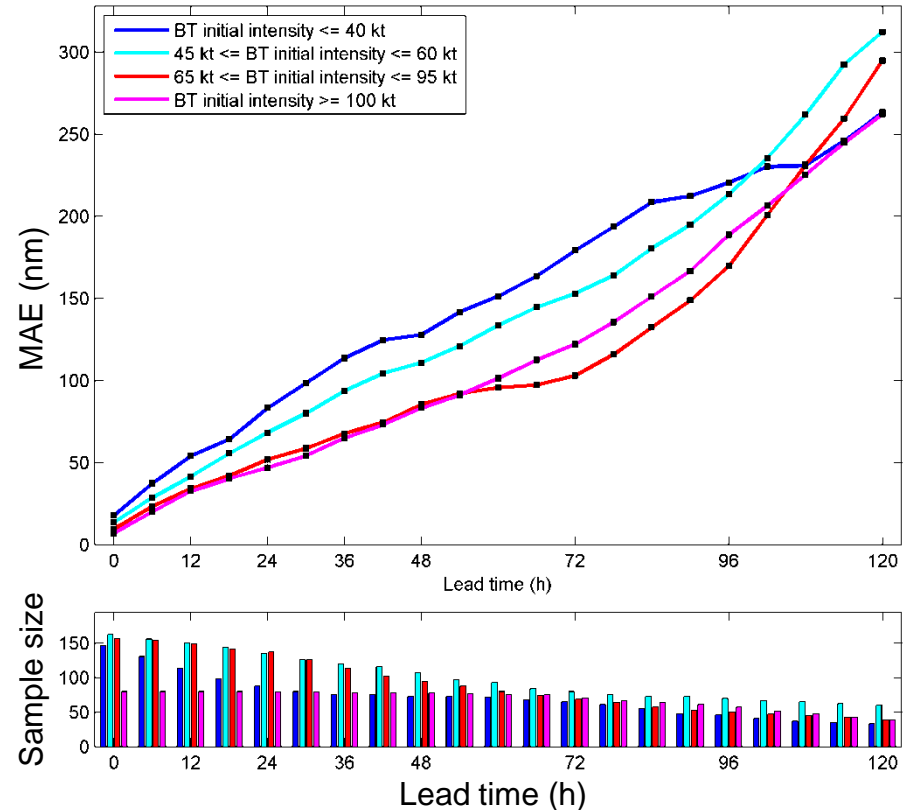
Does COAMPS-TC track forecast performance depend on the initial intensity of the predicted storm?

Stratify sample into four categories according to the best-track intensity at the forecast initial time:

- **Weak TS and TD (≤ 40 kt)**
- **Strong TS (45 – 60 kt)**
- **Weak Hurricane (65 – 95)**
- **Strong Hurricane (≥ 100 kt)**

COAMPS-TC has the lowest track errors for TCs of hurricane intensity at the initial time

Track forecast mean absolute error

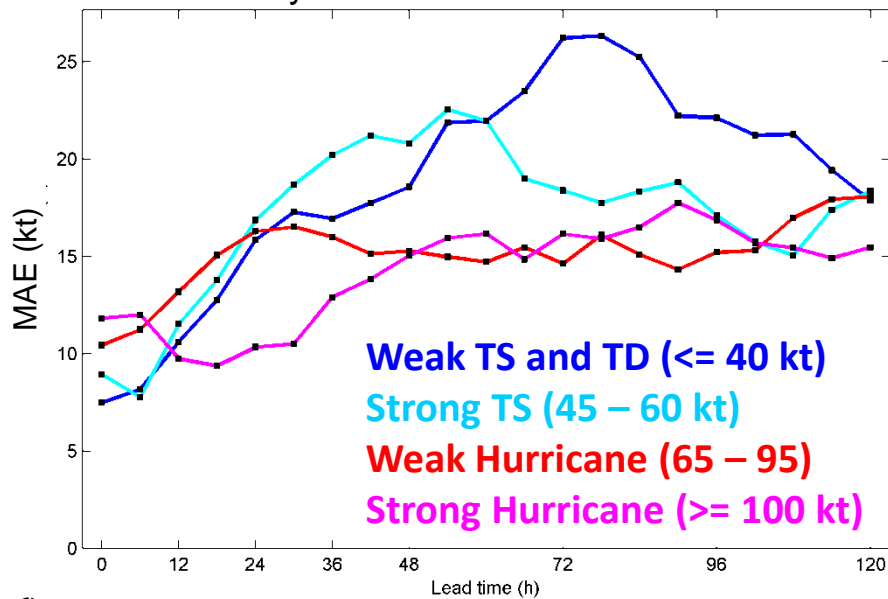




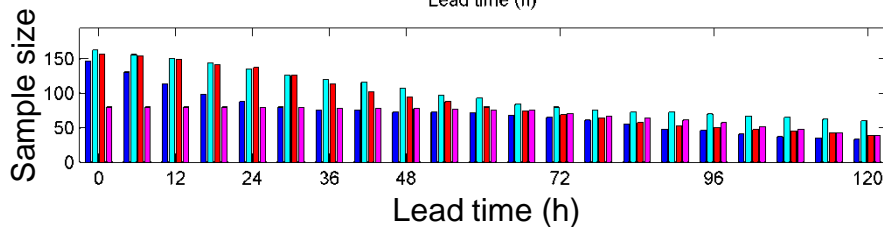
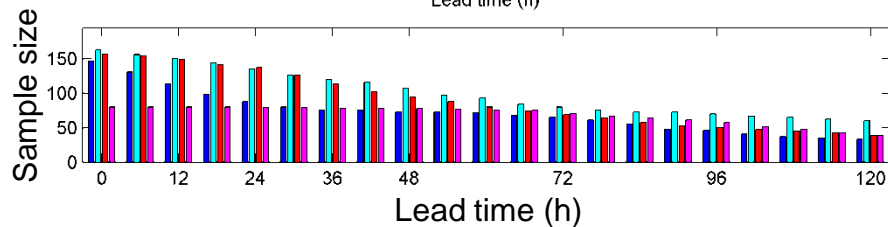
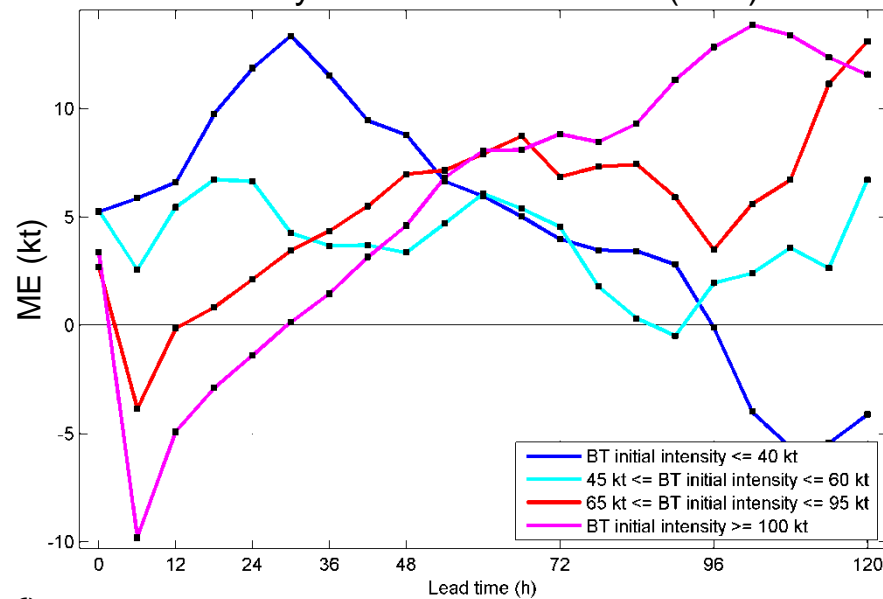
COAMPS-TC track and intensity performance: Stratification by best-track initial intensity

Does COAMPS-TC intensity forecast performance depend on the initial intensity of the predicted storm?

Intensity forecast mean absolute error



Intensity forecast mean error (bias)



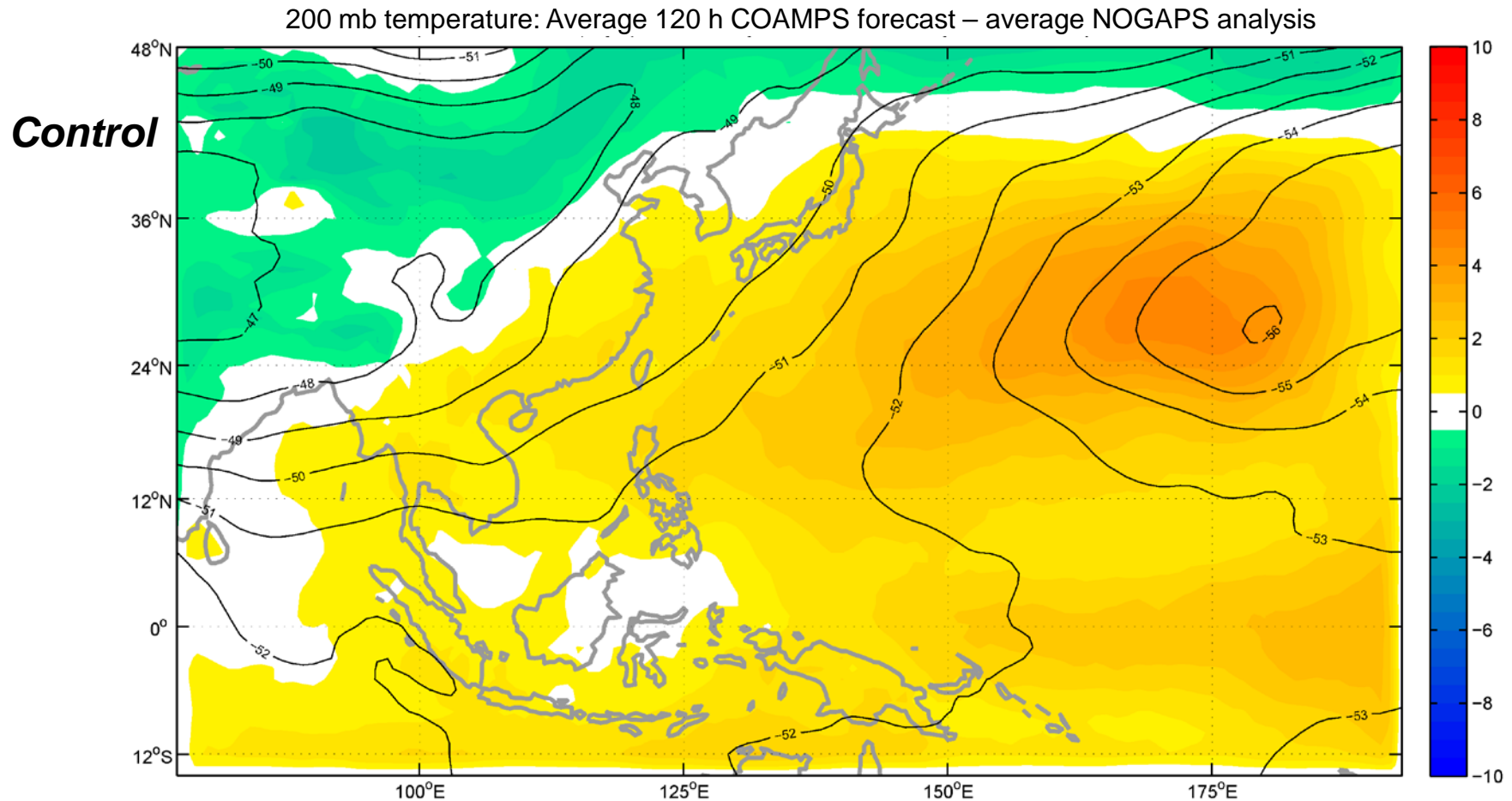
As for track, COAMPS-TC has the lowest intensity errors for TCs of hurricane intensity at the initial time



COAMPS-TC synoptic-scale forecast verification

Process: Run two months of cycling COAMPS-TC forecasts using only the 45 km mesh. Calculate average 120 h forecast and compare to average NOGAPS analysis.

Example: Western Pacific domain, Aug-Sept 2010. Control vs. Fu-Liou radiation experiment



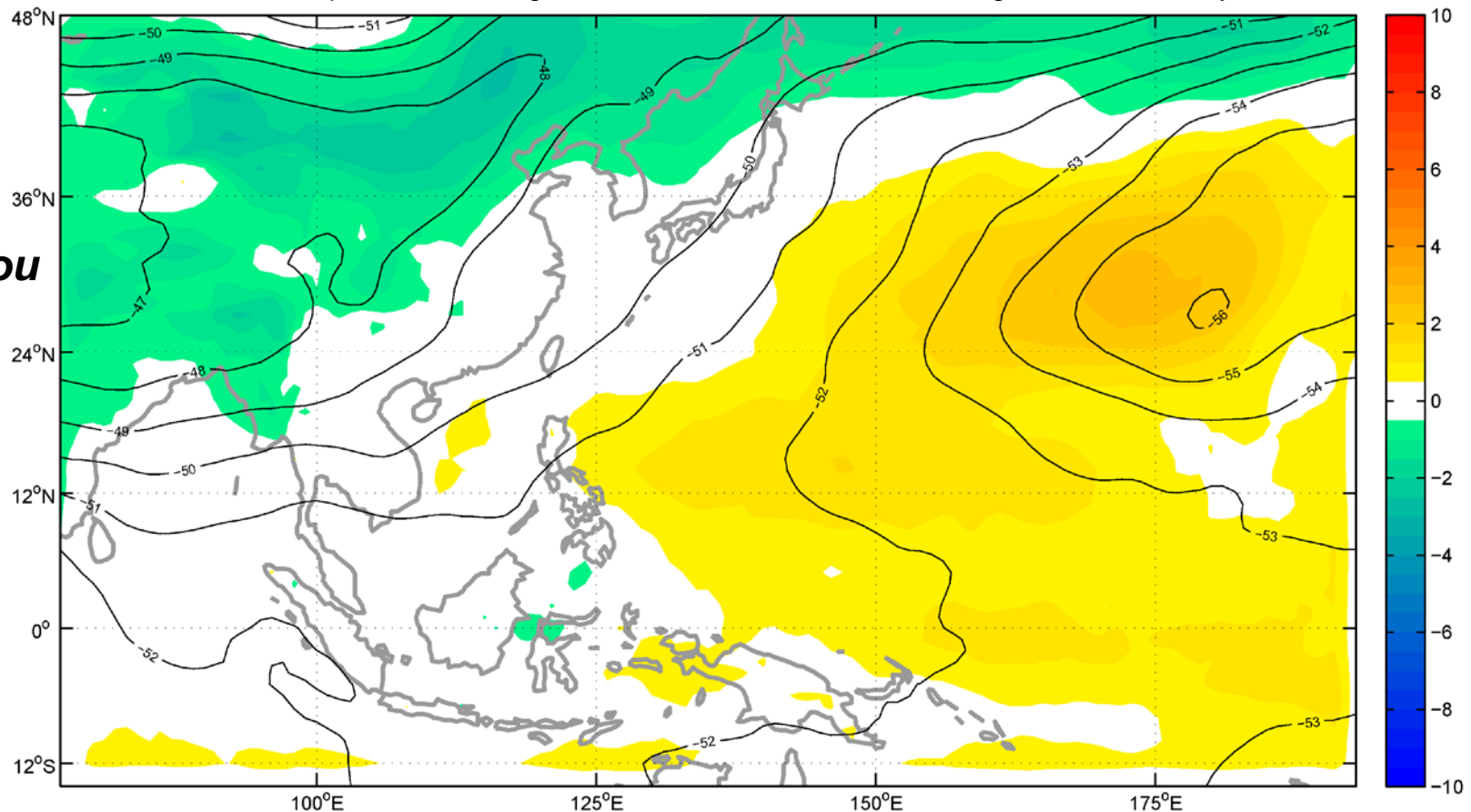


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200 mb temperature: Average 120 h COAMPS forecast – average NOGAPS analysis



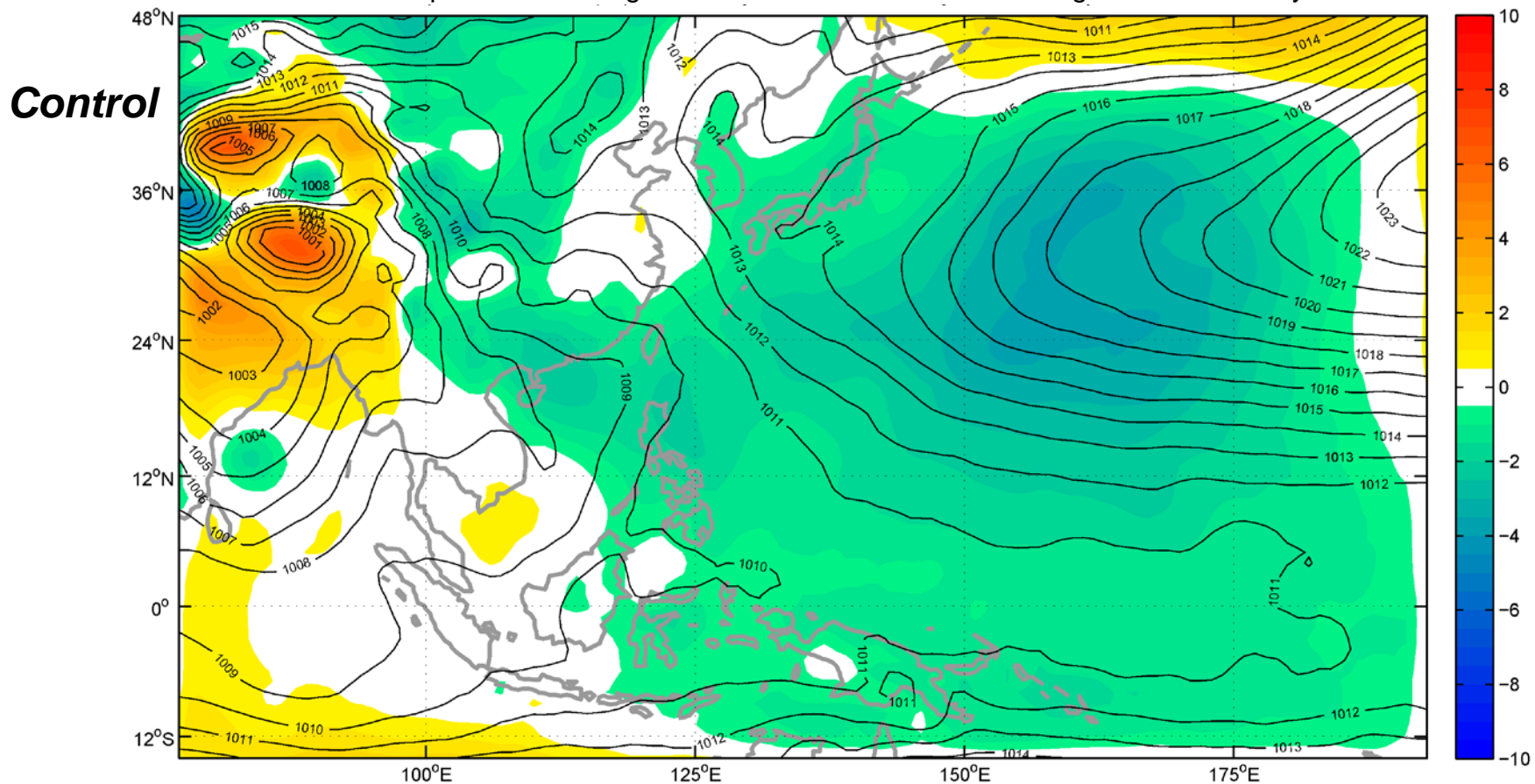


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Sea-level pressure: Average 120 h COAMPS forecast – average NOGAPS analysis



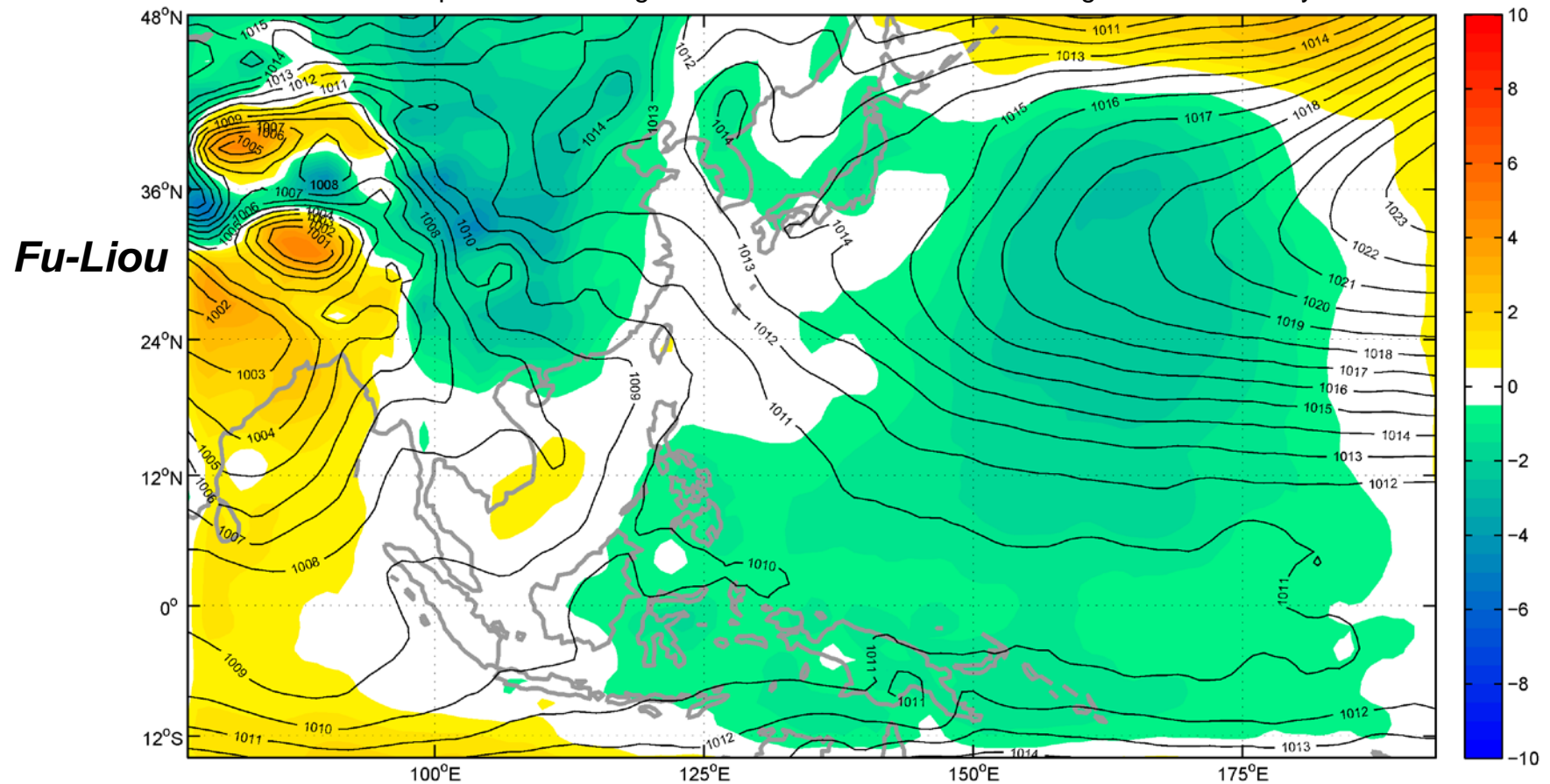


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Sea-level pressure: Average 120 h COAMPS forecast – average NOGAPS analysis



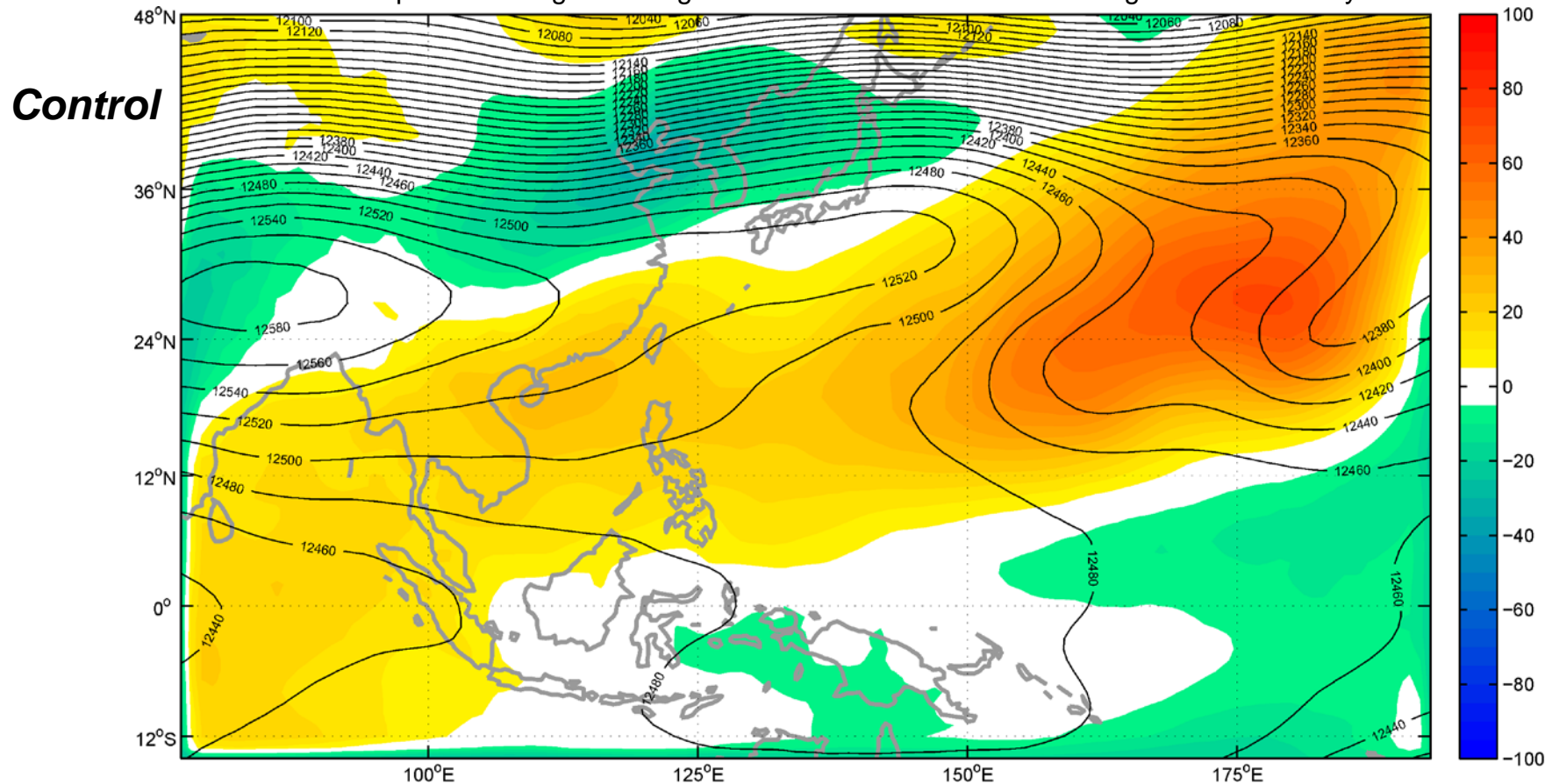


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200 mb Geopotential Height: Average 120 h COAMPS forecast – average NOGAPS analysis



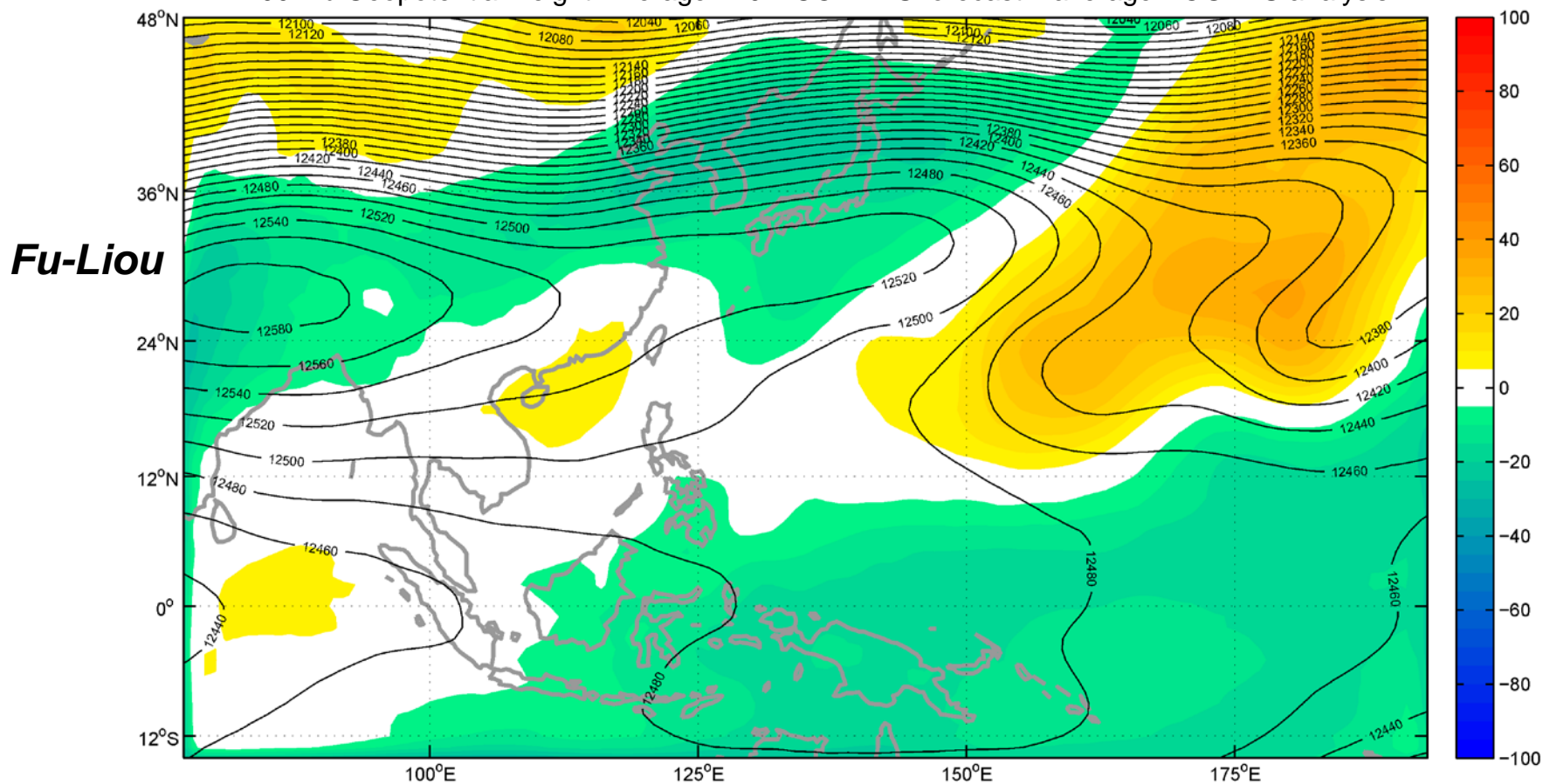


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200 mb Geopotential Height: Average 120 h COAMPS forecast – average NOGAPS analysis



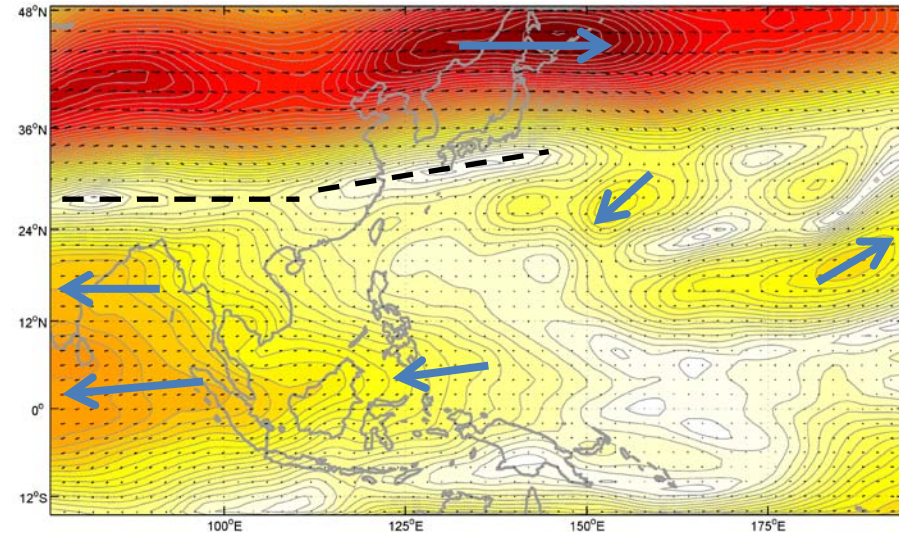


COAMPS-TC synoptic-scale forecast verification

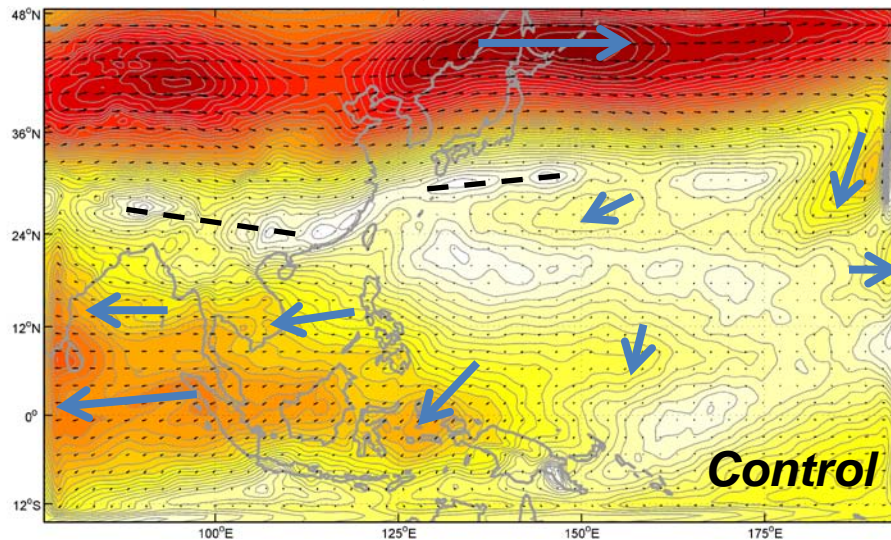
Example: Western Pacific domain, Aug-Sept 2010
Control vs. Fu-Liou radiation experiment

Synoptic-scale verification facilitates improvement to the COAMPS-TC predictions of the TC steering flow and thermodynamic environment

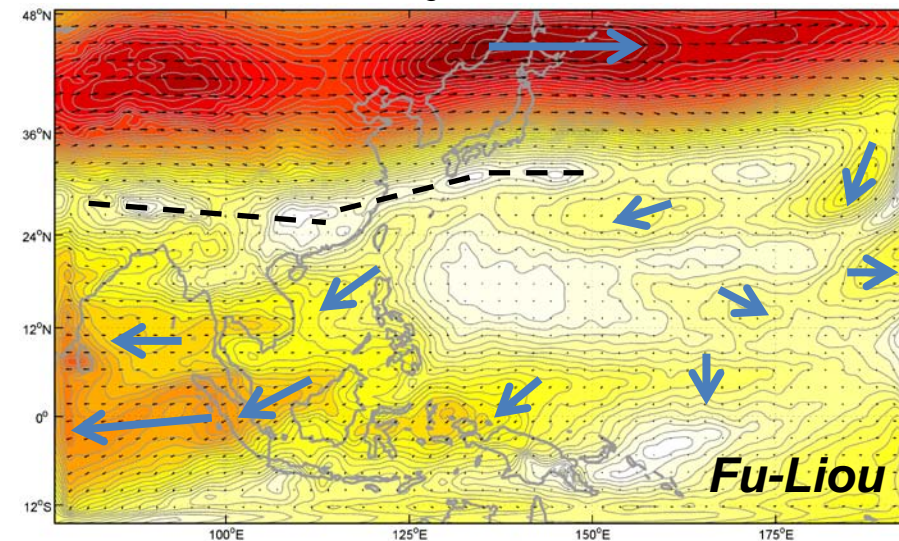
200 mb Wind: Average NOGAPS analysis



200 mb Wind: Average 120 h COAMPS forecast



200 mb Wind: Average 120 h COAMPS forecast





Conclusions

(1) Verification of COAMPS-TC track and intensity forecasts

- Storm-by-storm verification/visualization and stratified verification facilitate identification of situation-dependent track and intensity forecast biases
- Outlier error identification is an important component of the verification process
- Overall, very little correlation between COAMPS-TC track and intensity errors

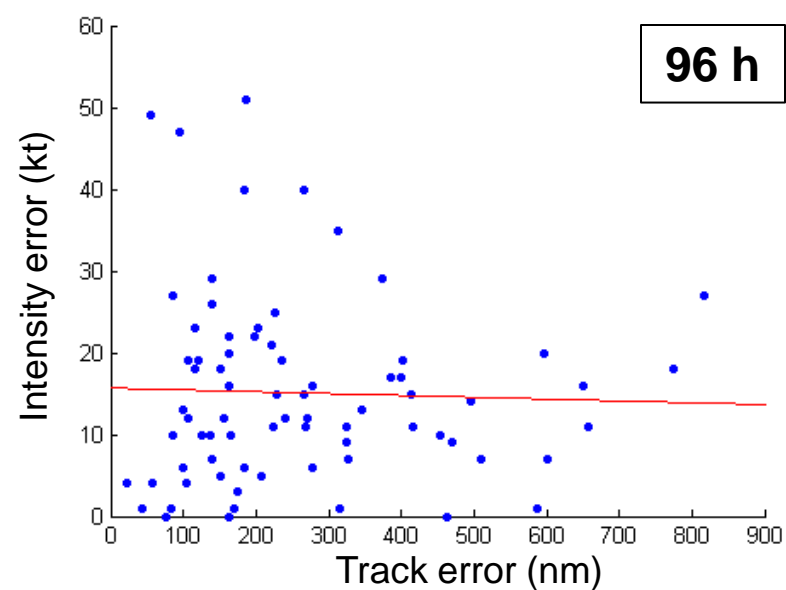
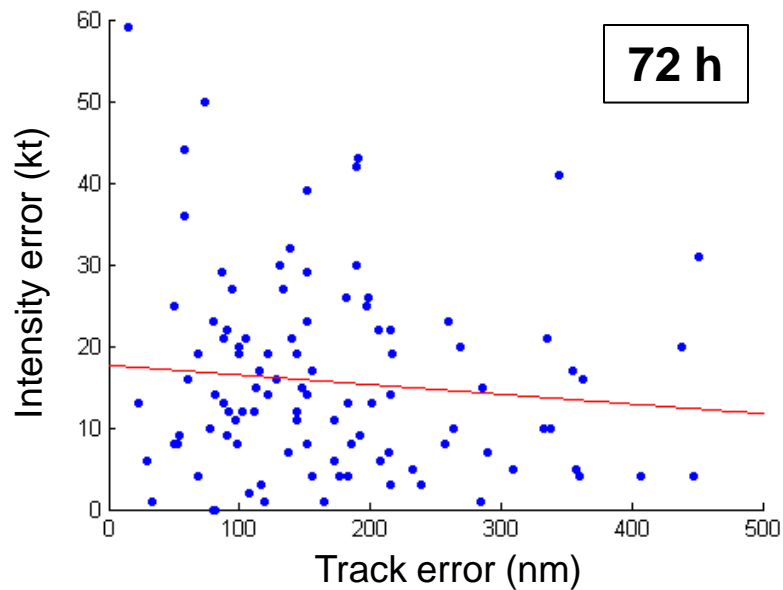
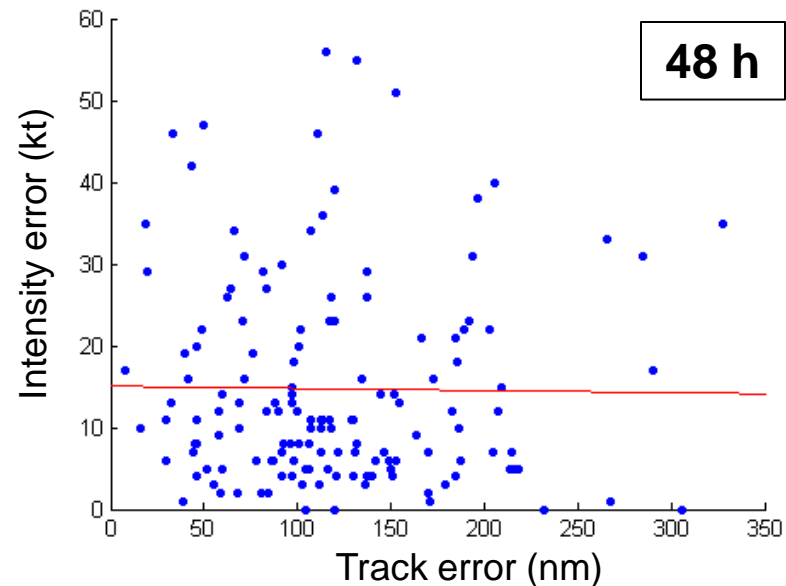
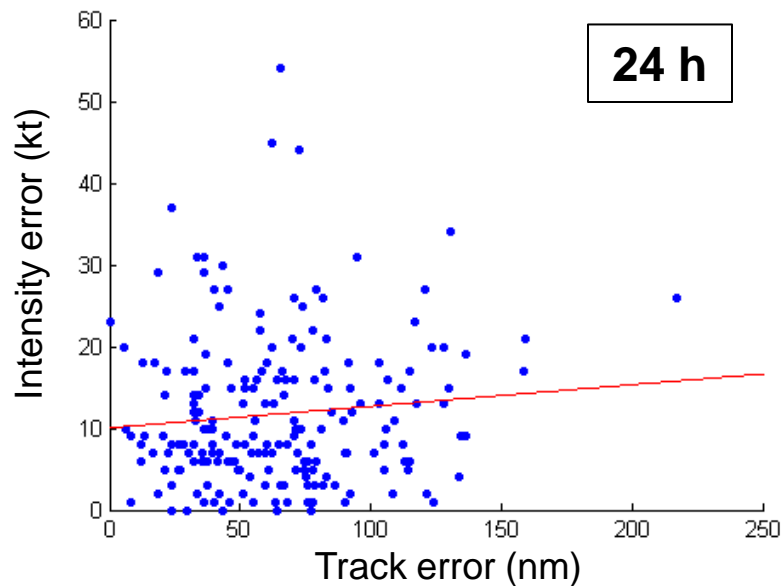
(2) Verification of COAMPS-TC synoptic-scale forecasts

- Promising new tool for regional TC model development

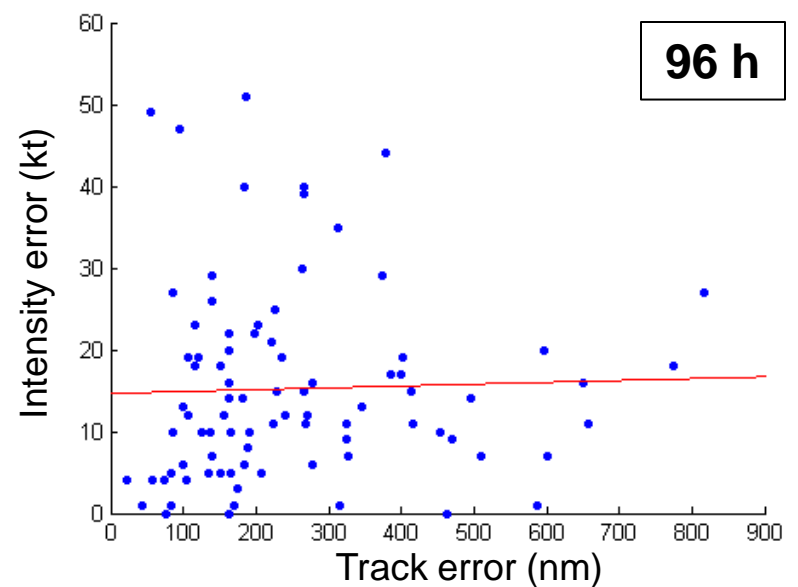
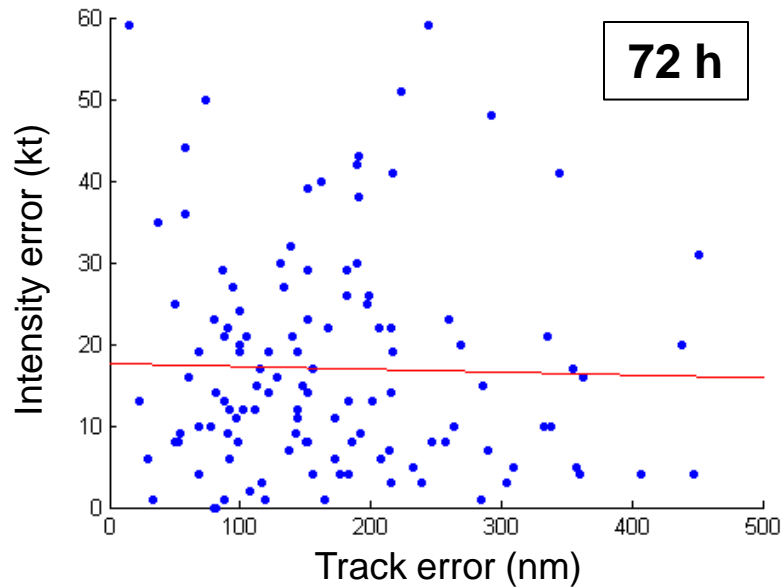
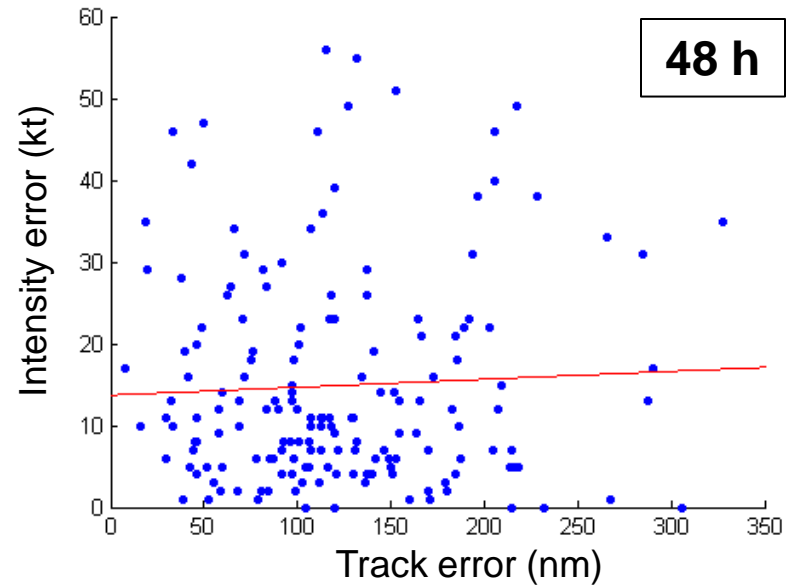
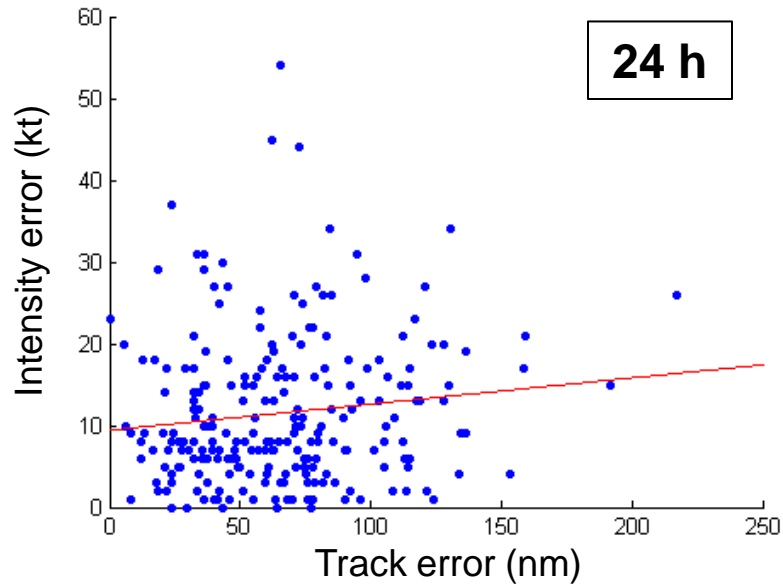


Extras

COAMPS-TC 2011 Atlantic basin real-time forecasts: Landfall cases excluded



COAMPS-TC 2011 Atlantic basin real-time forecasts: All cases



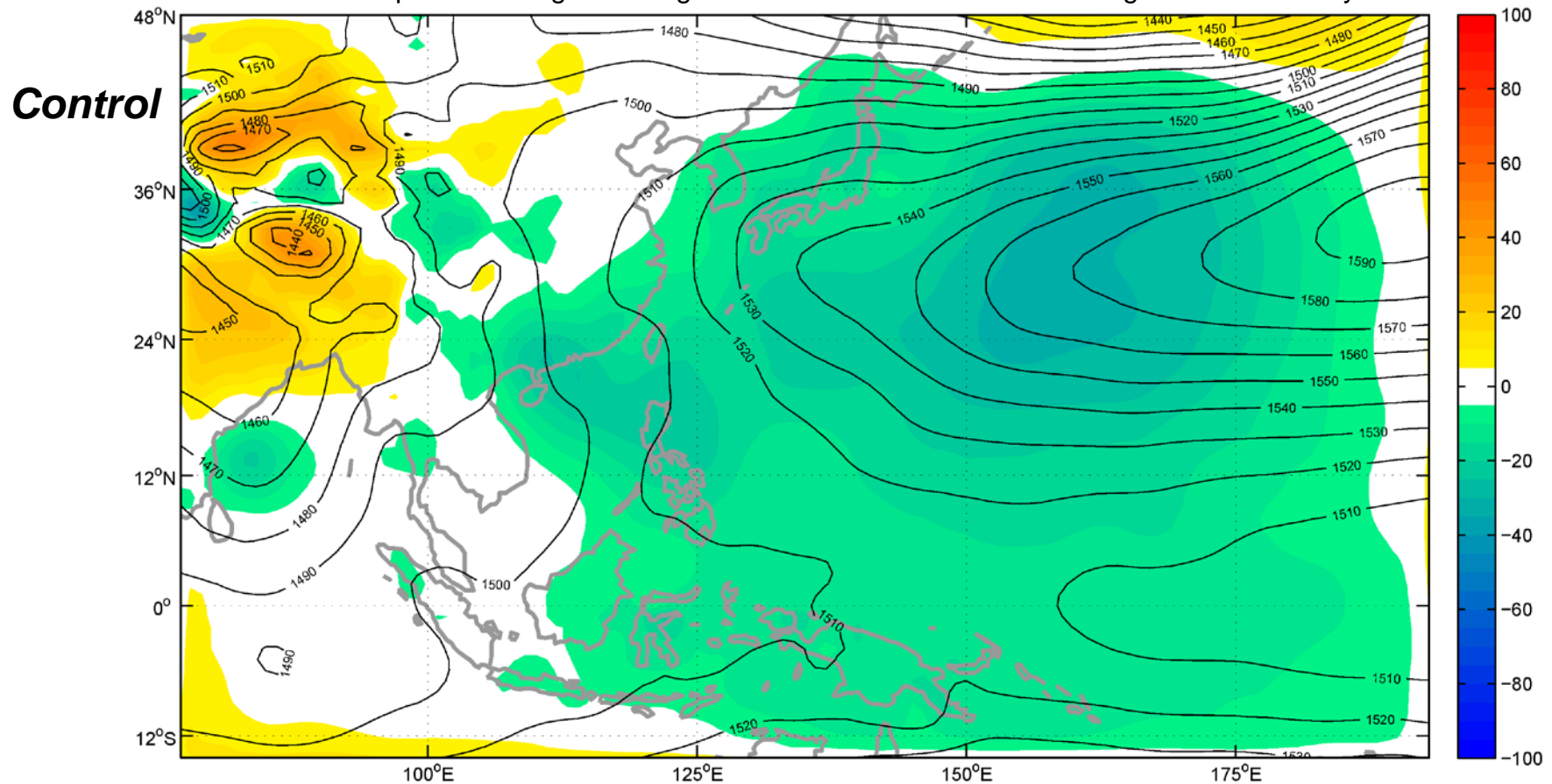


COAMPS-TC synoptic-scale forecast verification

Process: Run two months of COAMPS-TC forecasts using only the outer mesh.
Calculate average 120 h forecast and compare to average NOGAPS analysis

Example: Western Pacific domain, Aug-Sept 2010. Control vs. Fu-Liou radiation experiment

850 mb Geopotential Height: Average 120 h COAMPS forecast – average NOGAPS analysis





COAMPS-TC synoptic-scale forecast verification

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Calculate average 120 h forecast and compare to average NOGAPS analysis

Example: Western Pacific domain, Aug-Sept 2010. Control vs. Fu-Liou radiation experiment

850 mb Geopotential Height: Average 120 h COAMPS forecast – average NOGAPS analysis

