Performance of real-time COAMPS-TC forecasts during the 2015 TCI field campaign

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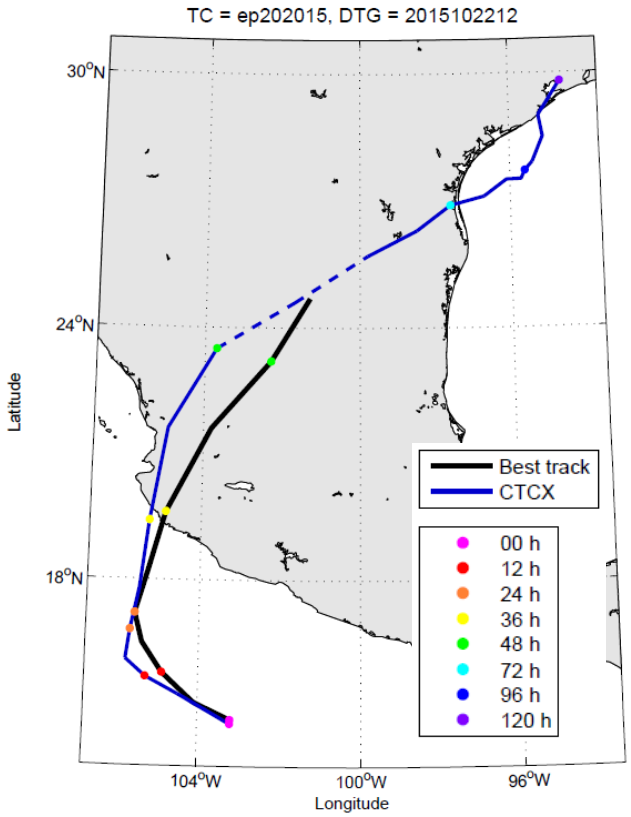
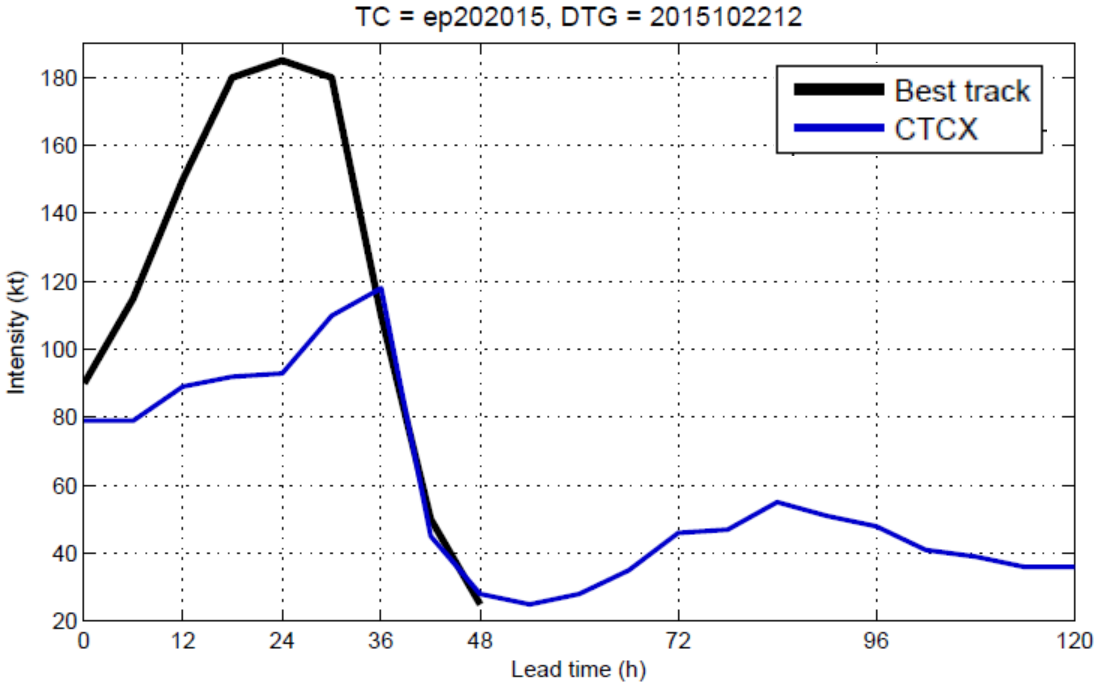
ONR TCI Science Meeting 18 October 2016

Patricia, forecast initial time = 2015102212

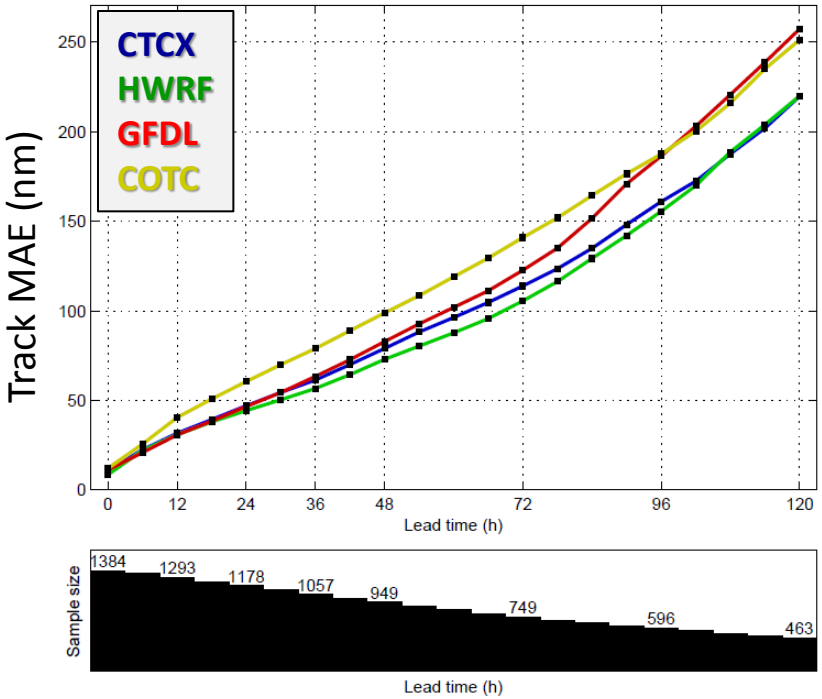


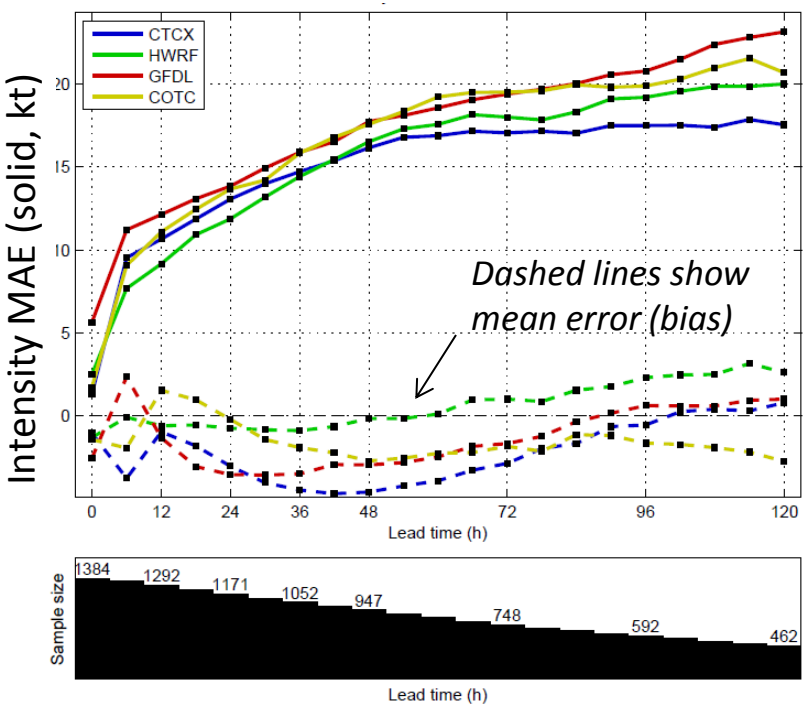


(1) Background: COAMPS-TC

COAMPS-TC is the Navy's new regional dynamical TC prediction model

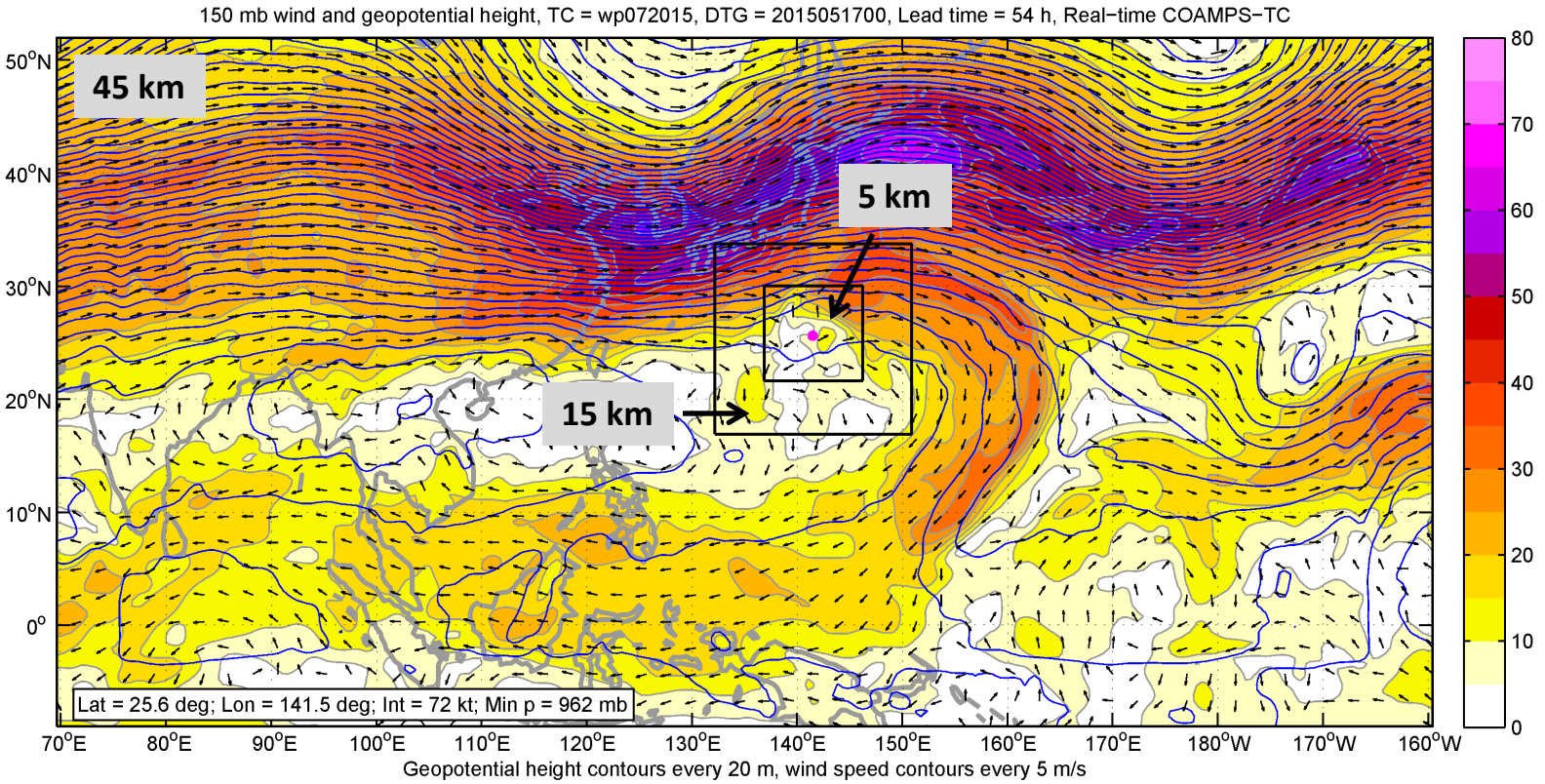
- **Two real-time runs for TCs worldwide**
  - COTC: FNMOC operational run using NAVGEM as parent model
  - CTCX: NRL demonstration run using GFS as parent model
- **CTCX used in 2015 TCI field campaign for guidance on TC track, intensity, and outflow structure. Forecast products available in MTS, PATS, and field catalog.**
- **CTCX track and intensity performance very good overall for 2015 NH TCs**





(1) Background: 2015 CTCX configuration

- **Fixed outer domain (45 km) with two storm-following grids (15 km & 5 km)**
- **Explicit convection on 5 km grid, Kain-Fritsch on 15 and 5 km grids**
- **GFS forecast lateral boundary conditions, 2-way interactive nests**
- **Initial conditions from GFS along with insertion of idealized wind and mass fields for TC vortex**
- **Physics optimized for TCs: C_d, boundary layer, dissipative heating, etc.**



(2) Objectives

Validation of track and intensity predictions from CTCX and other operational regional dynamical TC models for Marty, Joaquin, and Patricia

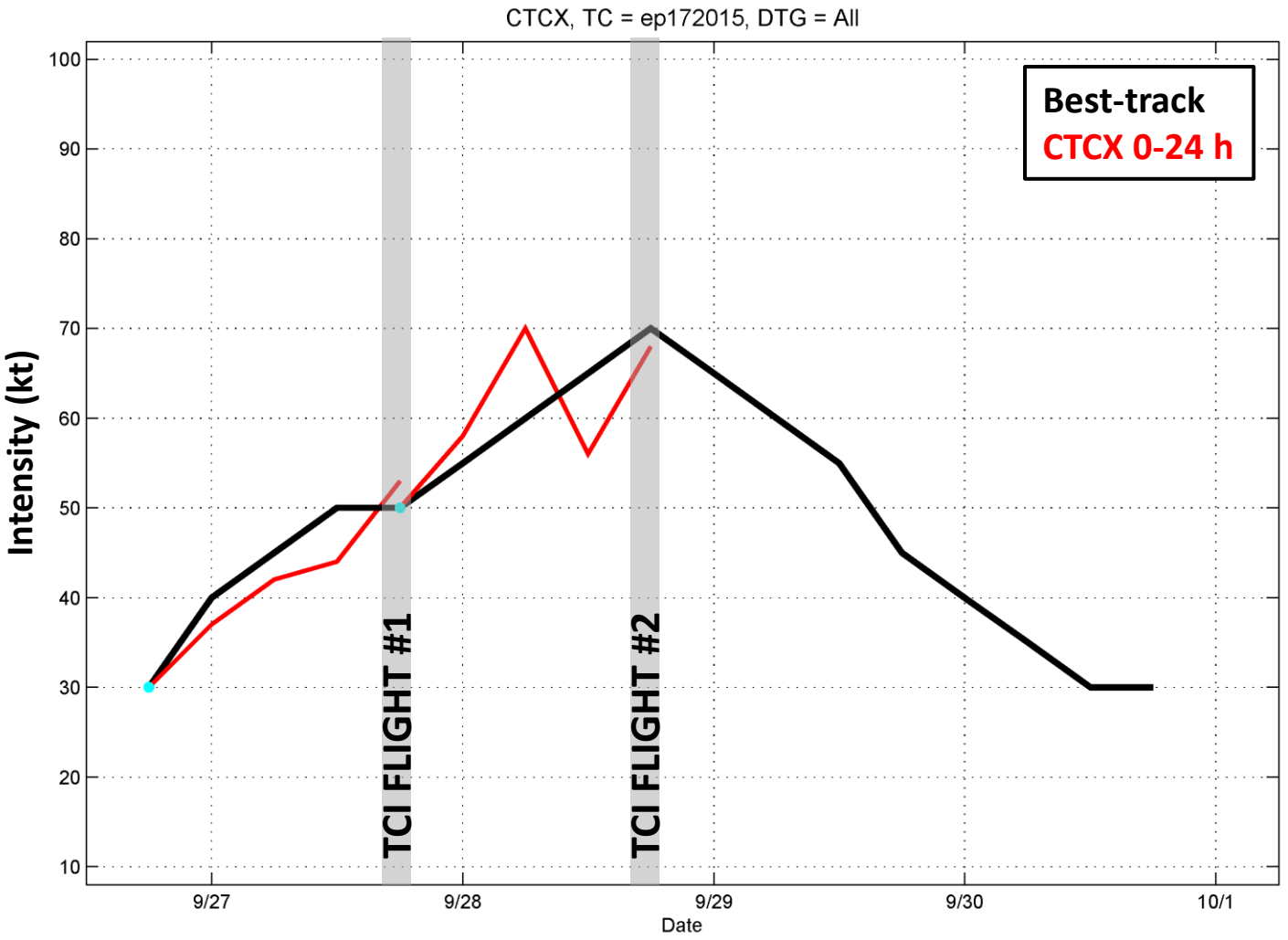
- Do CTCX forecasts provide a plausible first order (e.g. position, intensity) representation of the TC such that we can evaluate detailed structure of the outflow layer and inner core, w.r.t. TCI observations?
- Where is there potential for improvement in the CTCX forecasts, through assimilation of TCI observations or changes to the model?
- Are the error characteristics of other operational regional dynamical models similar to CTCX?

Availability of CTCX forecast data to TCI researchers

- Forecast fields
- Graphics

(3) Forecast Validation: Marty

Short range intensity forecast: 24-h intensity forecast validating near time of TCI obs

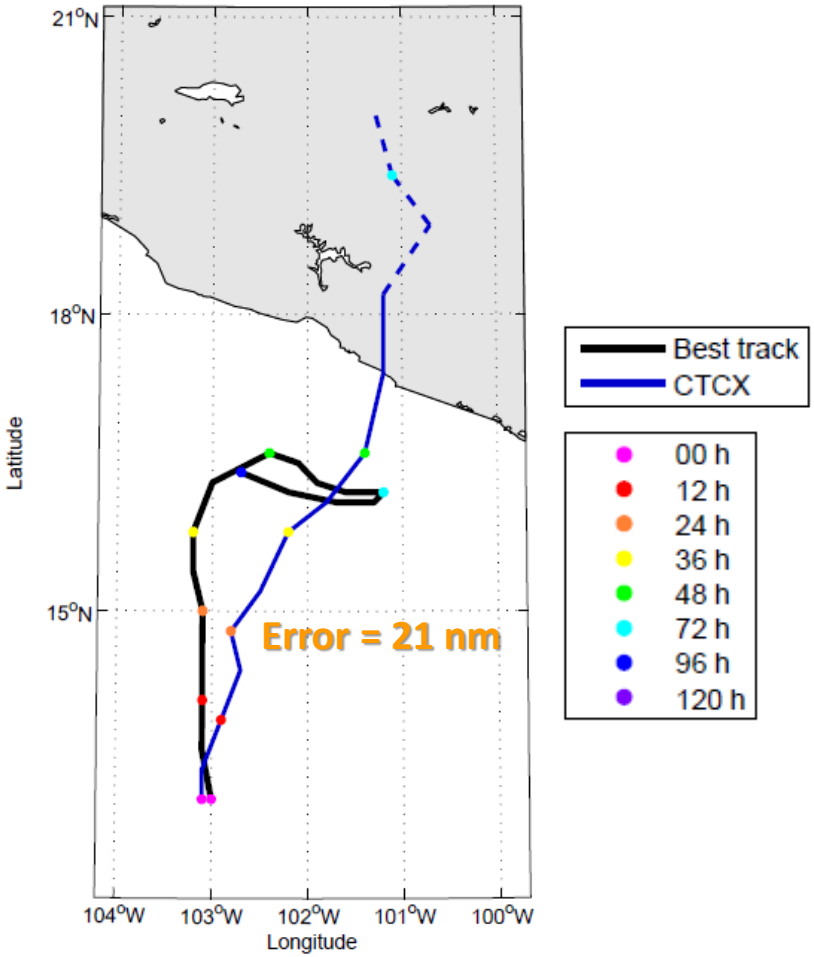


- Both 24 h CTCX intensity forecasts for Marty were excellent, within 5 kt of best-track

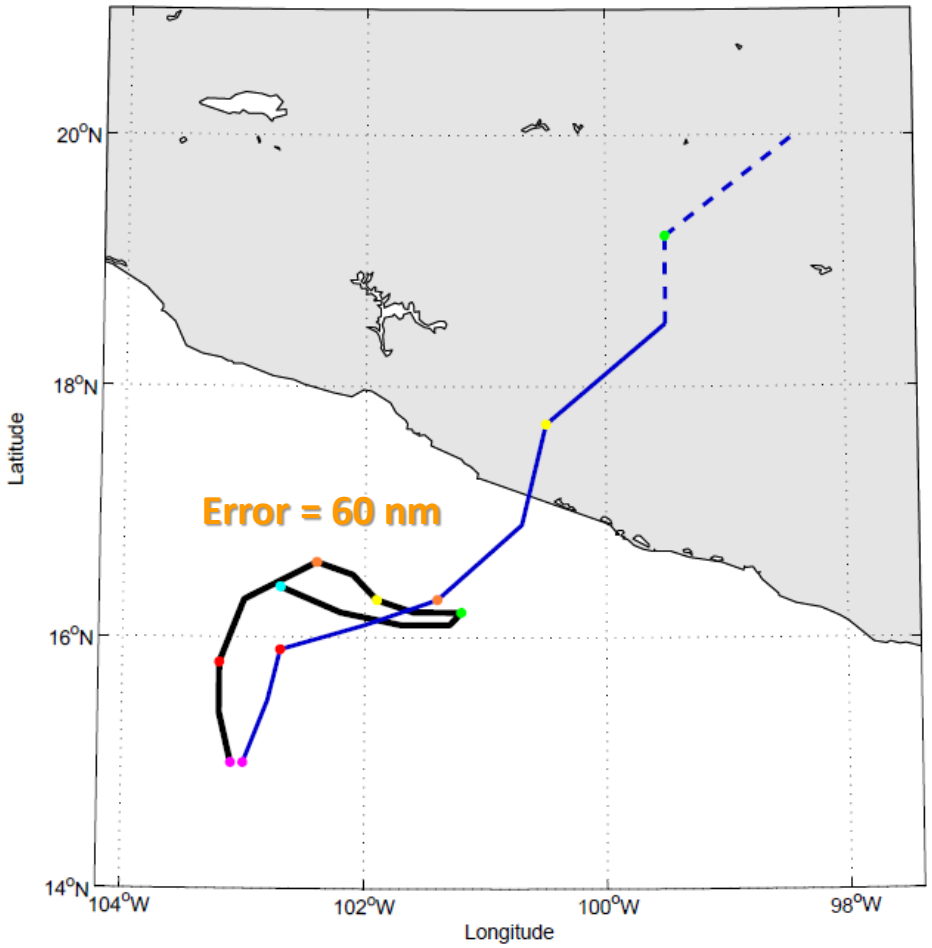
(3) Forecast Validation: Marty

Short range track forecast: 24-h track forecast validating near time of TCI obs

Initial time = 2015092618



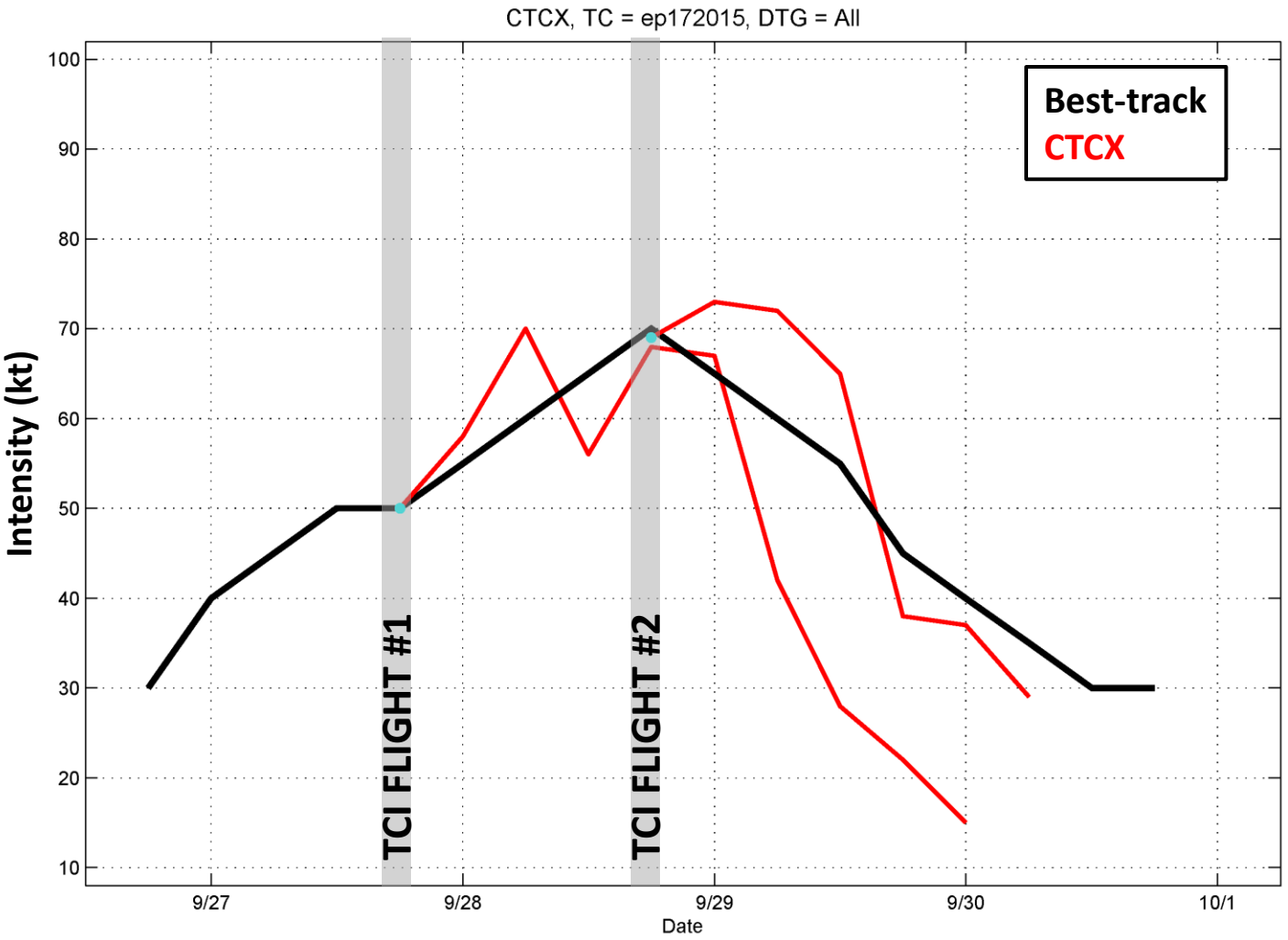
Initial time = 2015092718



- First forecast good, second forecast has larger-than-average 24 h error

(3) Forecast Validation: Marty

Intensity forecasts initialized near time of TCI obs

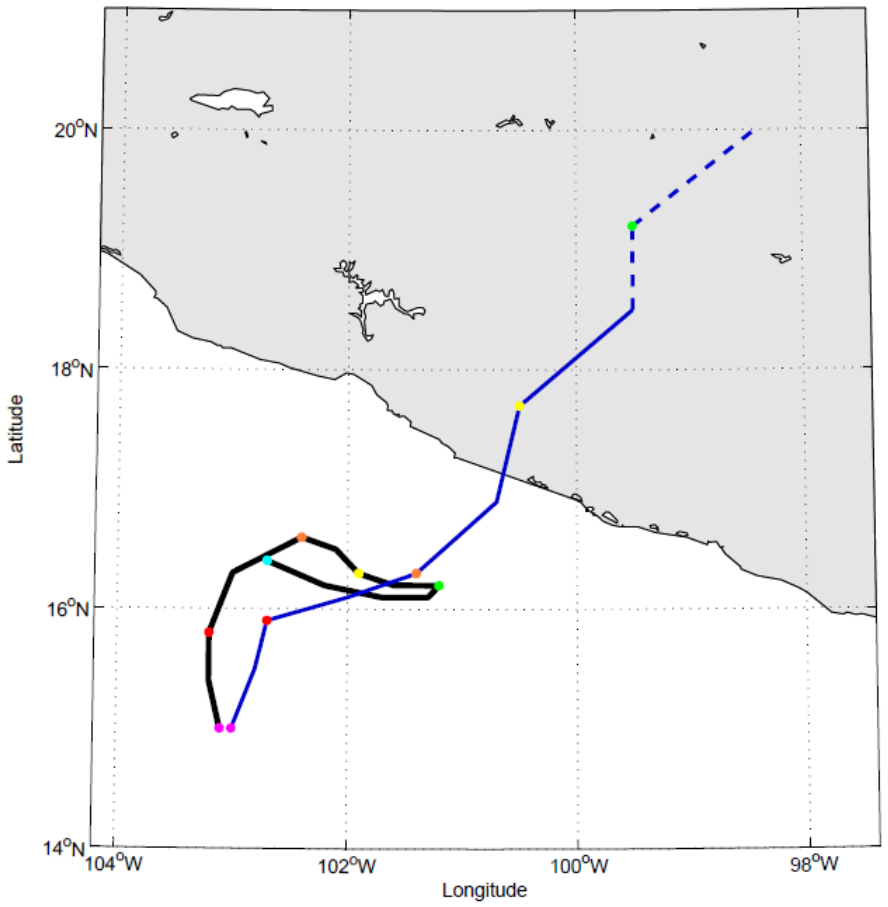


- Primary issue is weakening associated with (erroneous) landfall

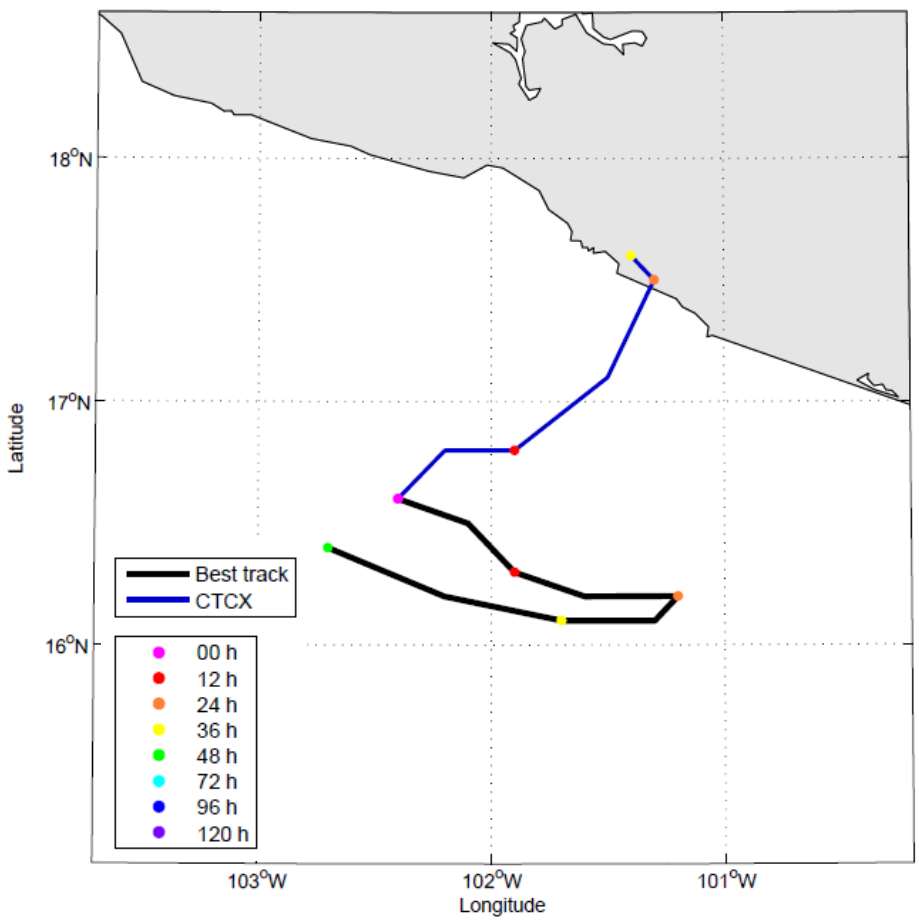
(3) Forecast Validation: Marty

Track forecasts initialized near time of TCI obs

Initial time = 2015092718



Initial time = 2015092818

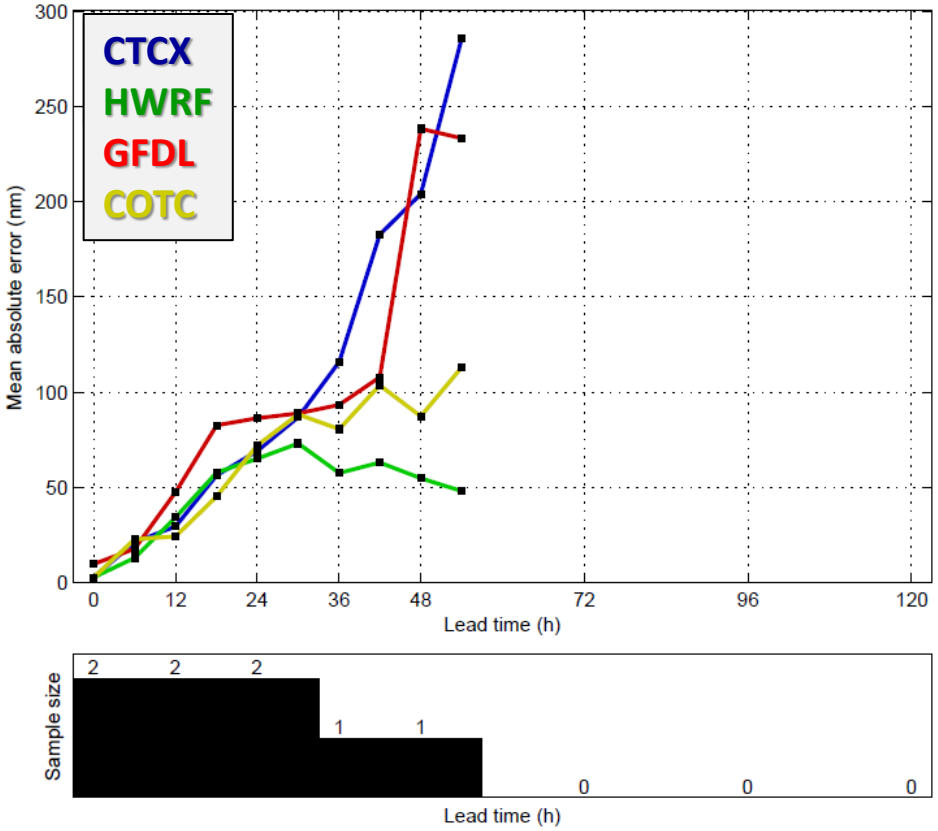


- Track forecasts make landfall, whereas Marty stayed offshore and weakened

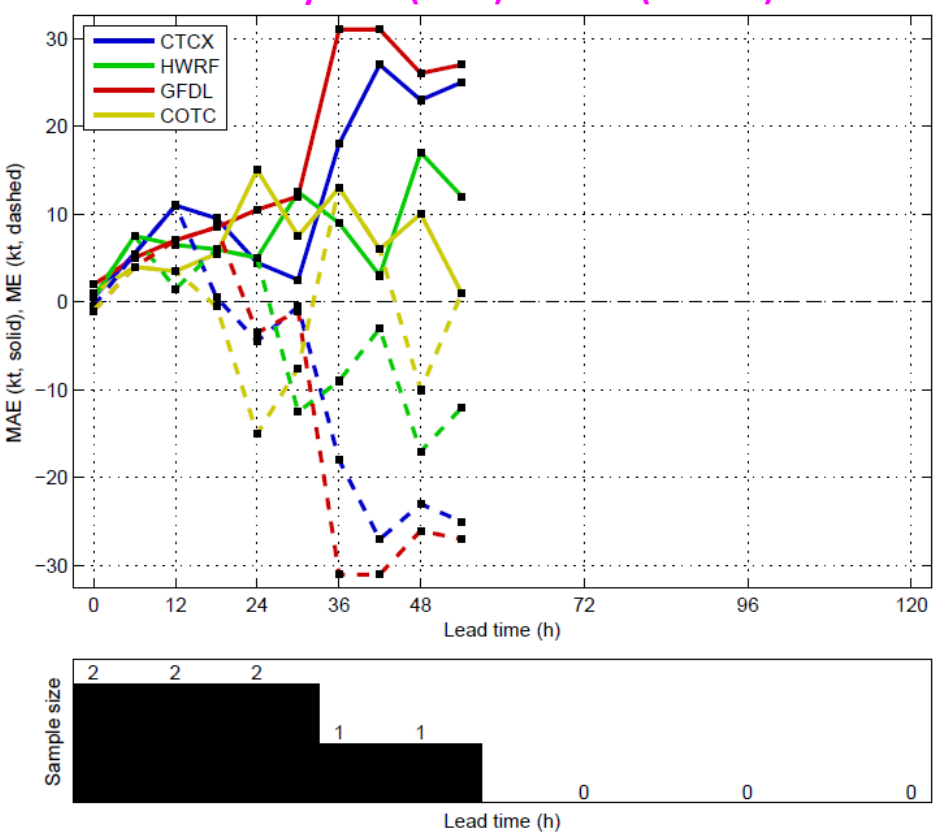
(3) Forecast Validation: Marty

Multi-model errors for forecasts initialized near time of TCI obs

Track MAE



Intensity MAE (solid) and ME (dashed)

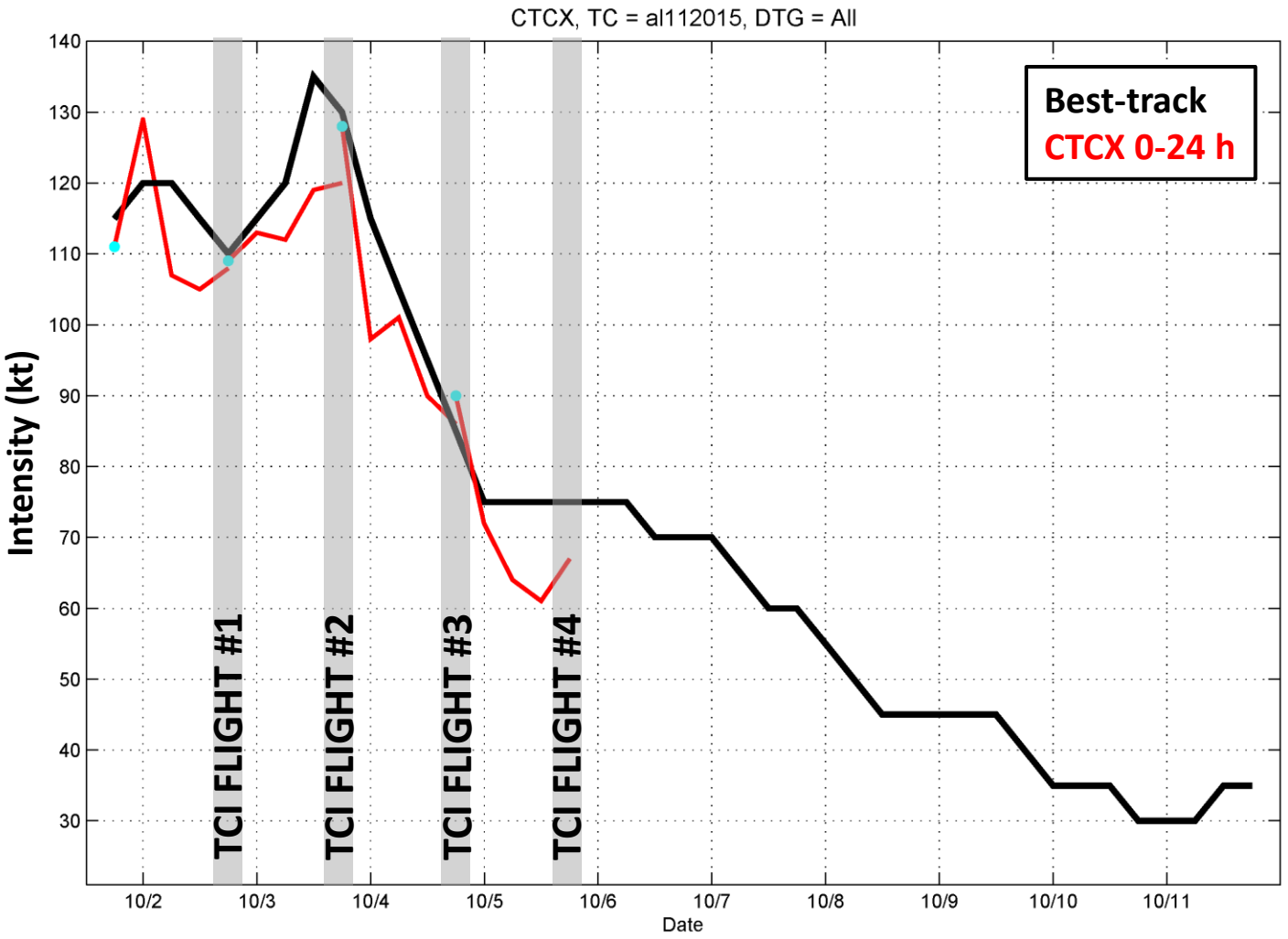


- All models either made landfall or moved the TC far too close to the coast

- Intensity errors mostly associated with erroneous landfall; models with better track predictions also had better intensity

(3) Forecast Validation: Joaquin

Short range intensity forecast: 24-h intensity forecast validating near time of TCI obs

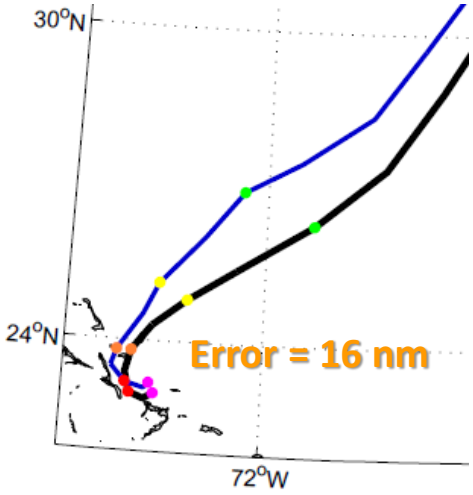


- Forecasts validating at times of 2nd and 4th flight about 10 kt too weak, otherwise good

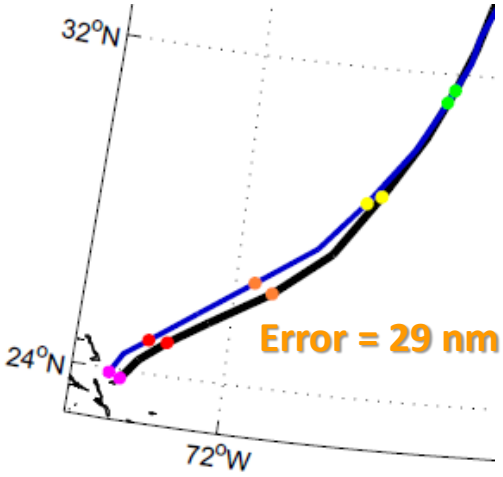
(3) Forecast Validation: Joaquin

Short range track forecast: 24-h track forecast validating near time of TCI obs

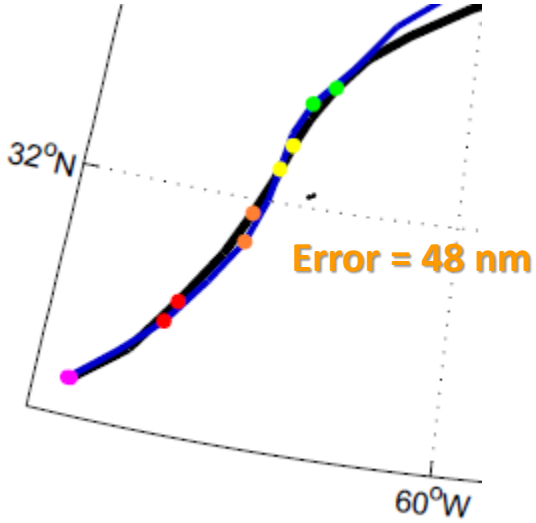
Initial time = 2015100118



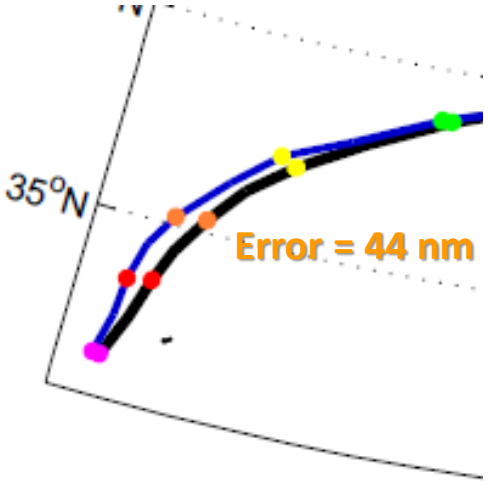
Initial time = 2015100218

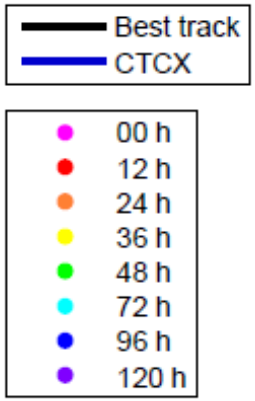


Initial time = 2015100318



Initial time = 2015100418

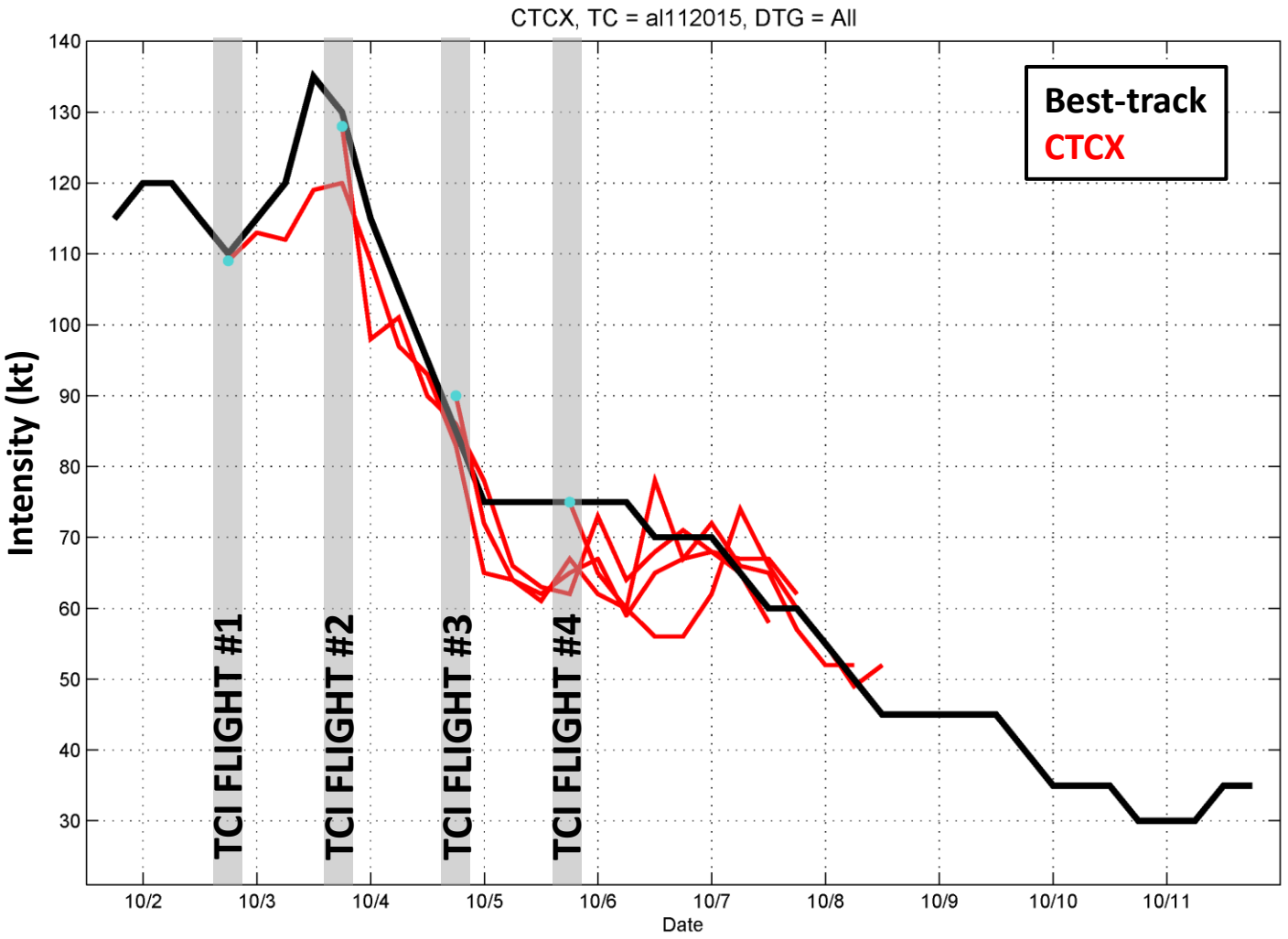




- First two forecasts are quite accurate, third and fourth forecasts have 24 h errors near average

(3) Forecast Validation: Joaquin

Intensity forecasts initialized near time of TCI obs

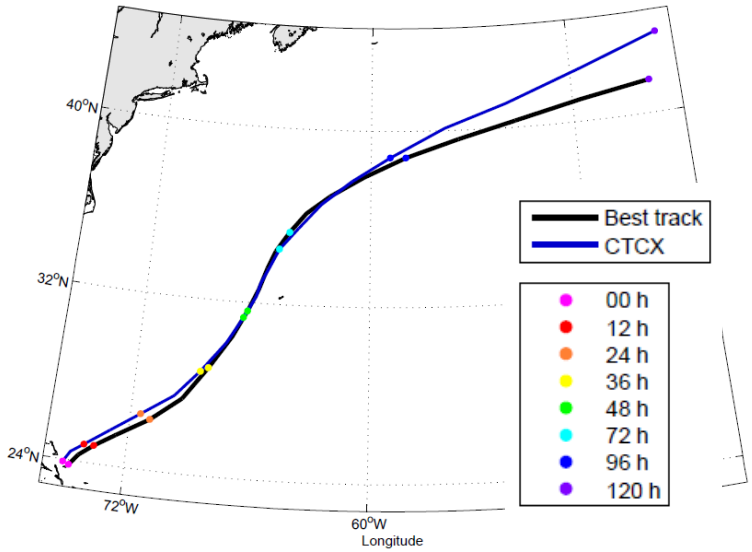


- CTCX intensity forecasts are excellent, except for missing most of the spike to 135 kt and missing the 75 kt plateau in intensity from 10/5 to 10/6

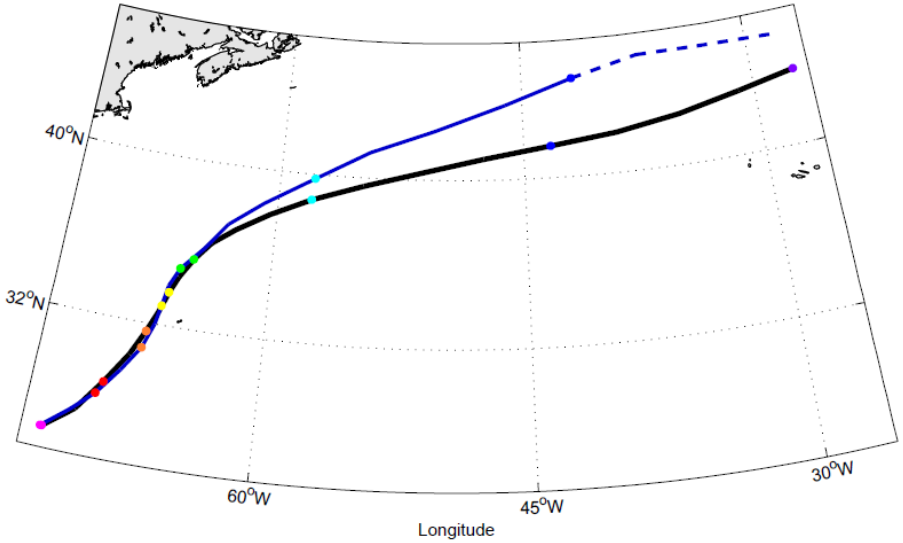
(3) Forecast Validation: Joaquin

Track forecasts initialized near time of TCI obs

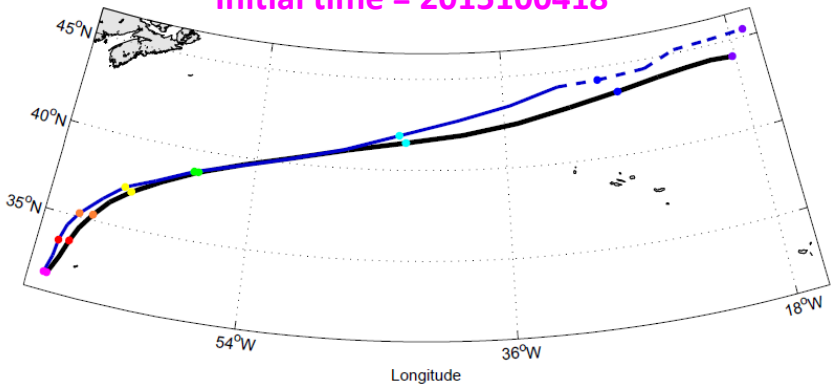
Initial time = 2015100218



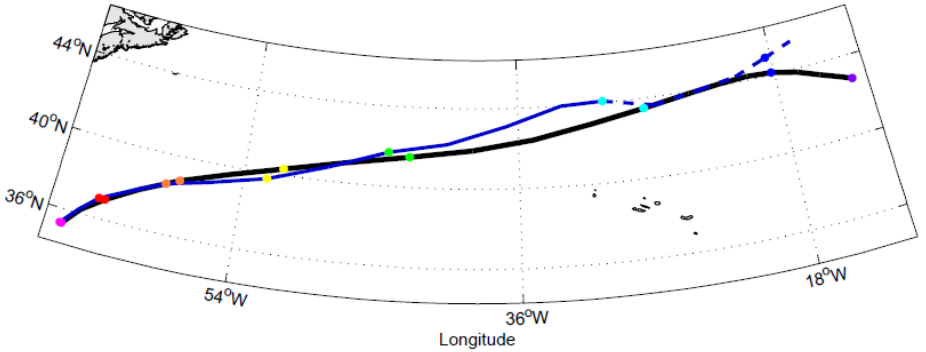
Initial time = 2015100318



Initial time = 2015100418



Initial time = 2015100518

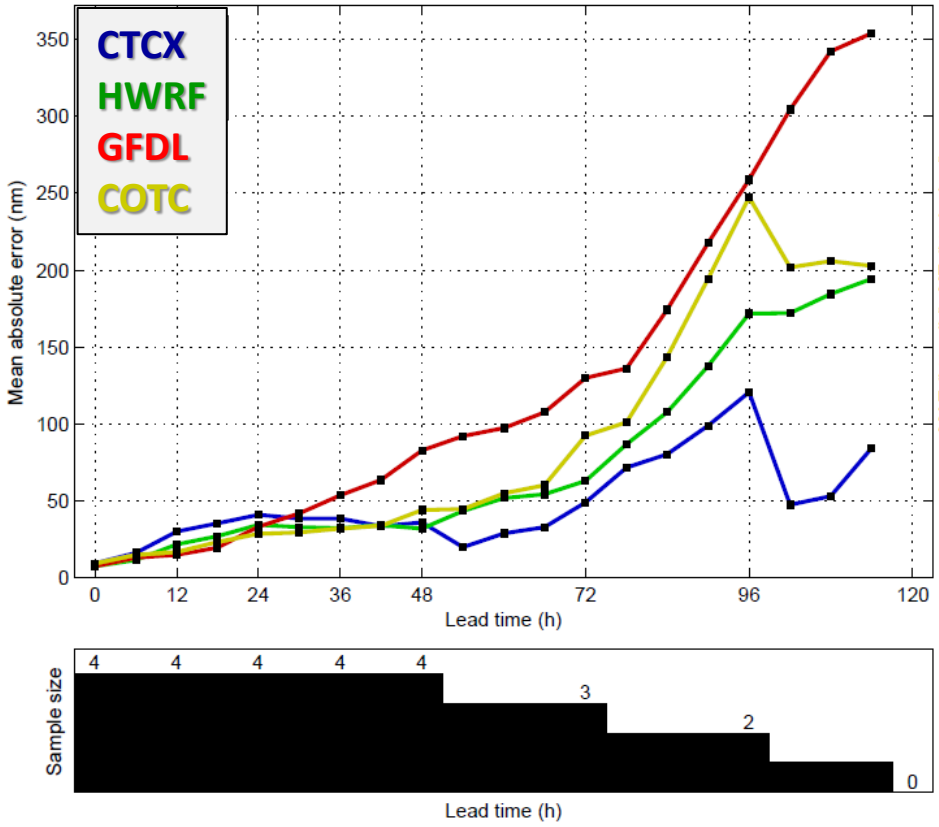


- Other than a little left-of-track bias, CTCX track forecasts are very accurate

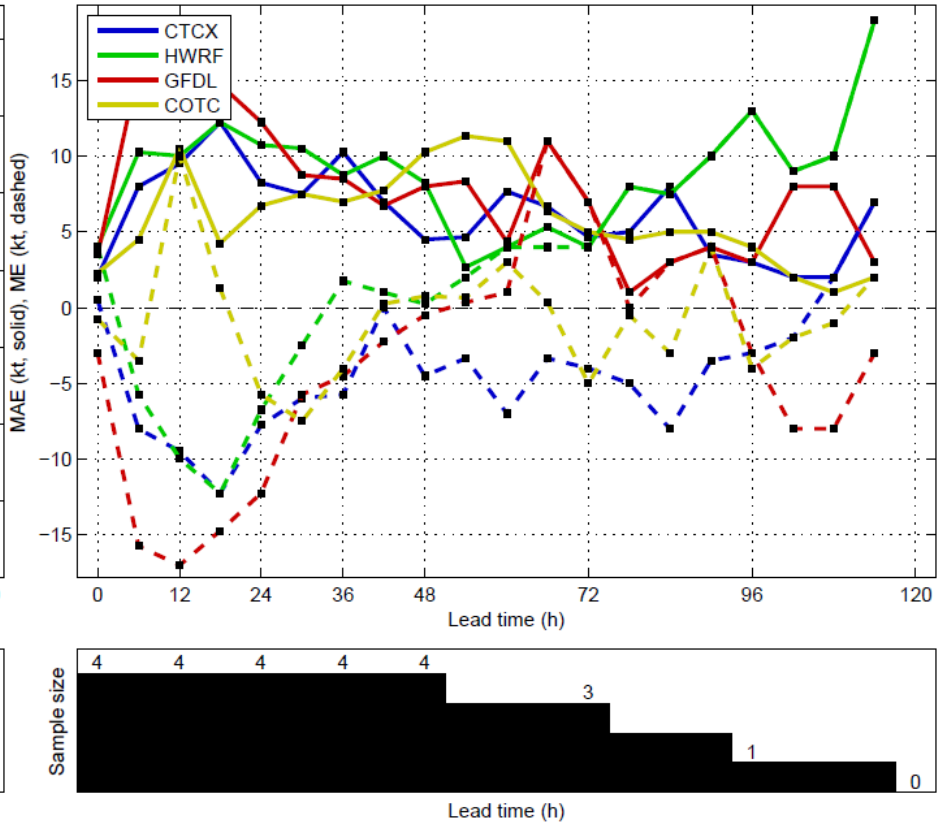
(3) Forecast Validation: Joaquin

Multi-model errors for forecasts initialized near time of TCI obs

Track MAE



Intensity MAE (solid) and ME (dashed)

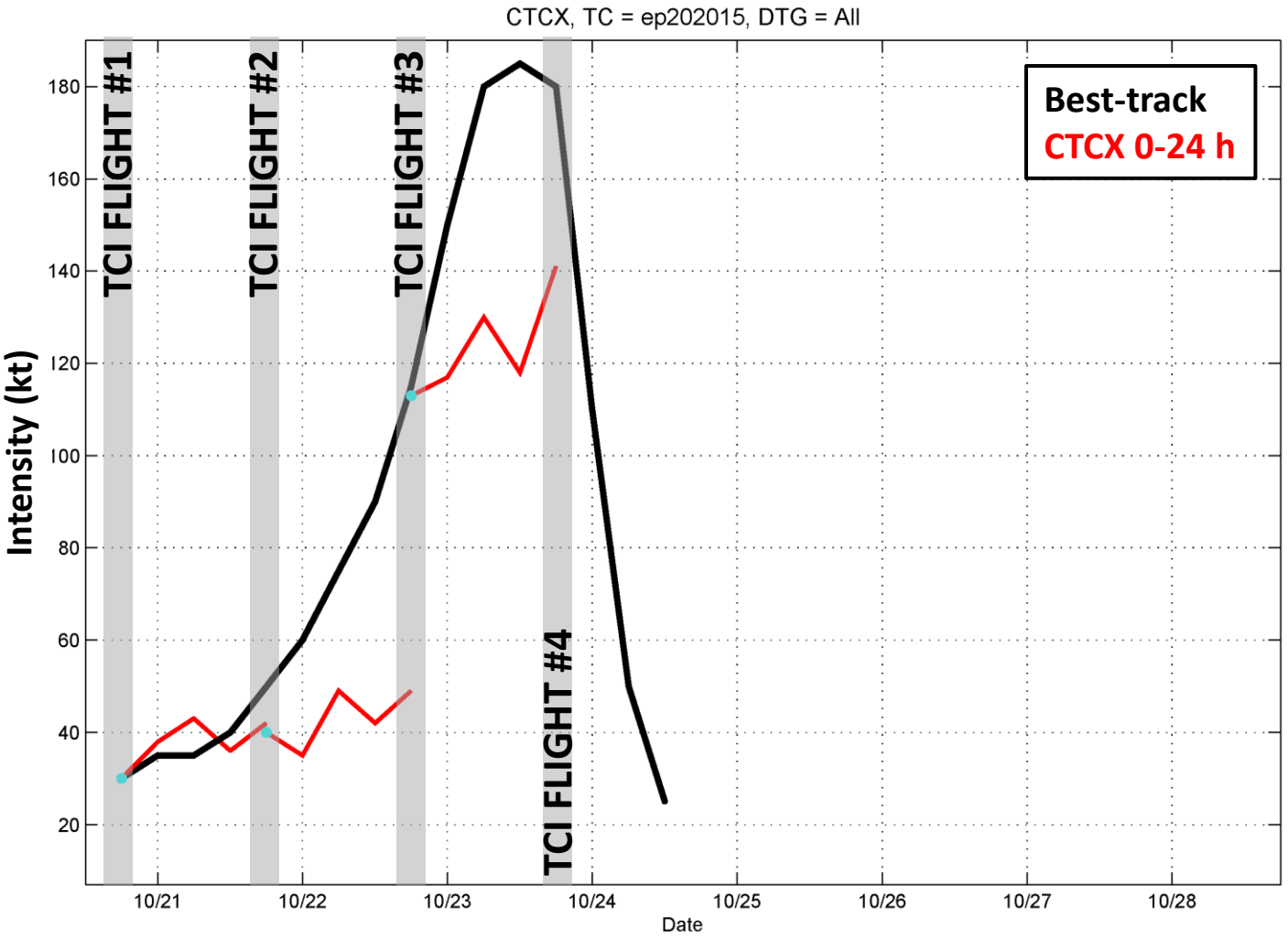


- Other models had more of a left-of-track bias than CTCX

- Models all performed reasonably well for intensity; MAE mostly < 10 kt

(3) Forecast Validation: Patricia

Short range intensity forecast: 24-h intensity forecast validating near time of TCI obs

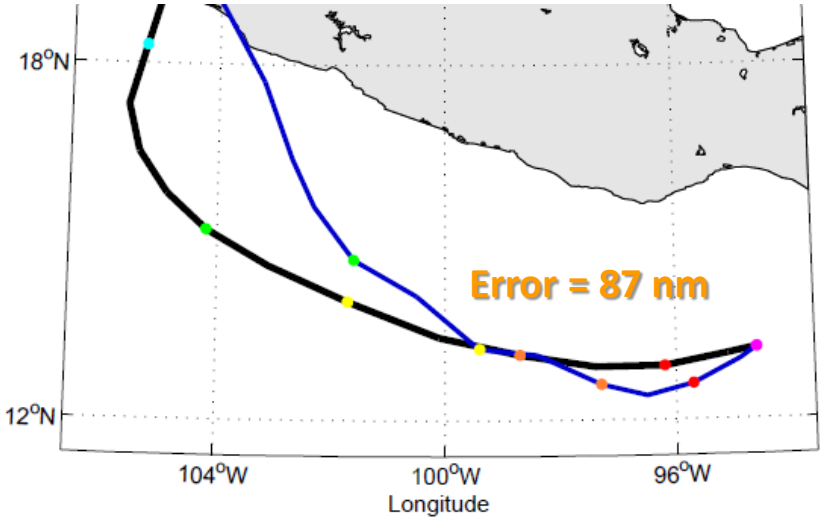


- Forecasts validating at times of 3rd and 4th flight are far too weak

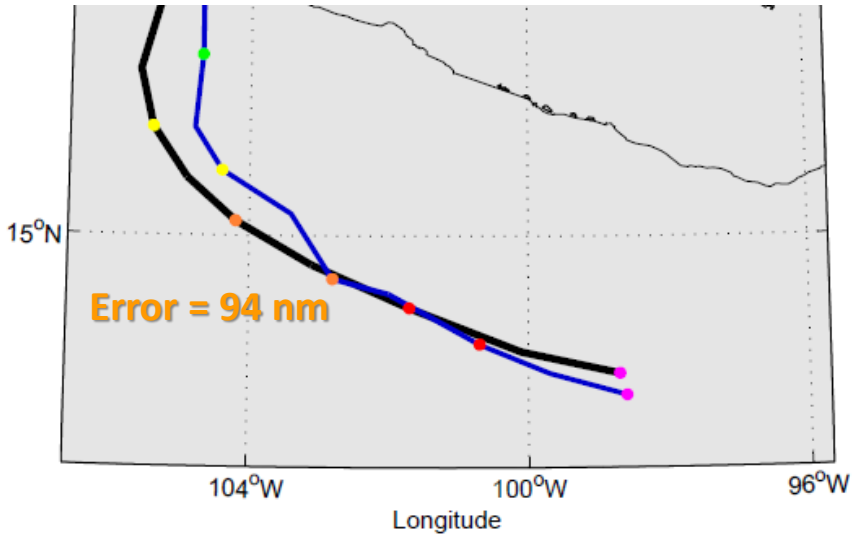
(3) Forecast Validation: Patricia

Short range track forecast: 24-h track forecast validating near time of TCI obs

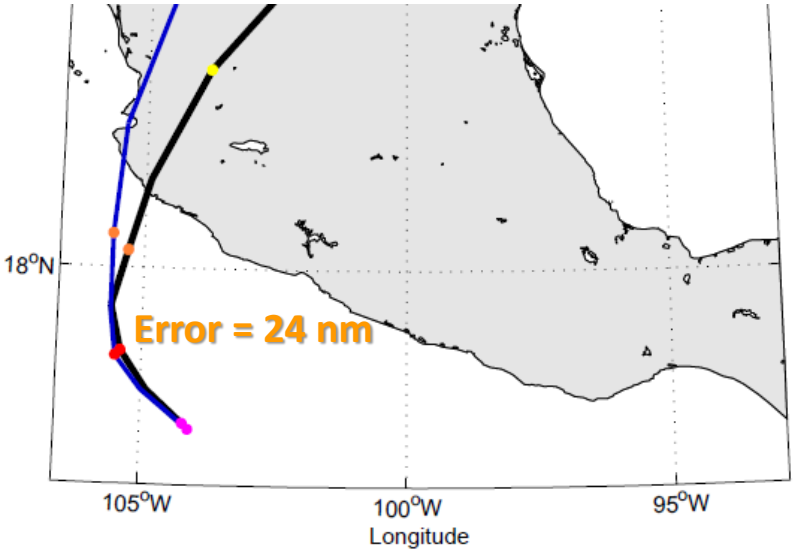
Initial time = 2015102018



Initial time = 2015102118



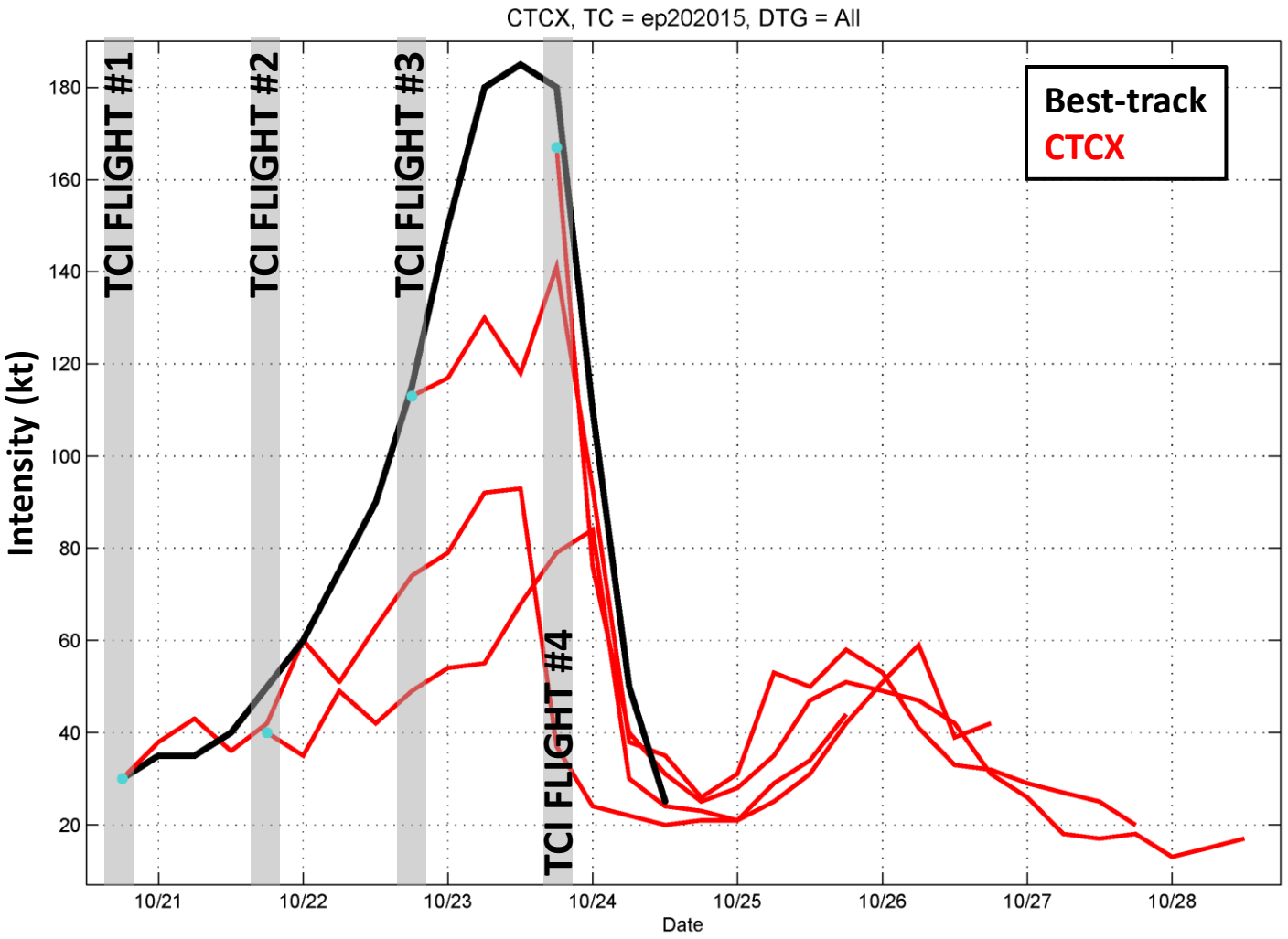
Initial time = 2015102218



- Third forecast is quite accurate, but first and second forecasts have 24 h forecast errors about 2x average

(3) Forecast Validation: Patricia

Intensity forecasts initialized near time of TCI obs

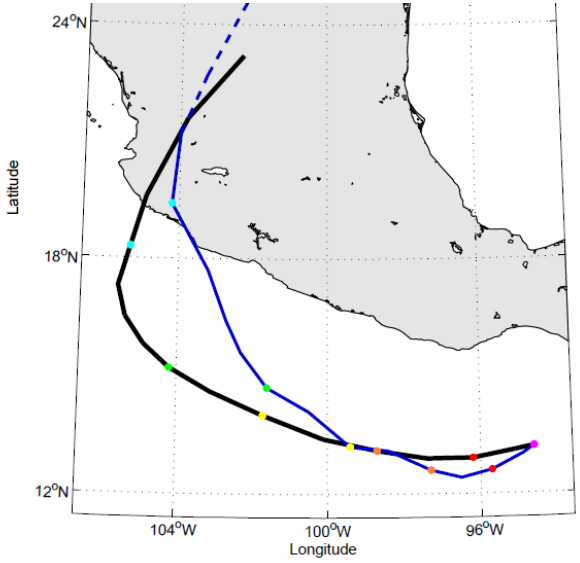


- Intensity forecasts didn't come close to keeping up with Patricia's record-breaking intensification

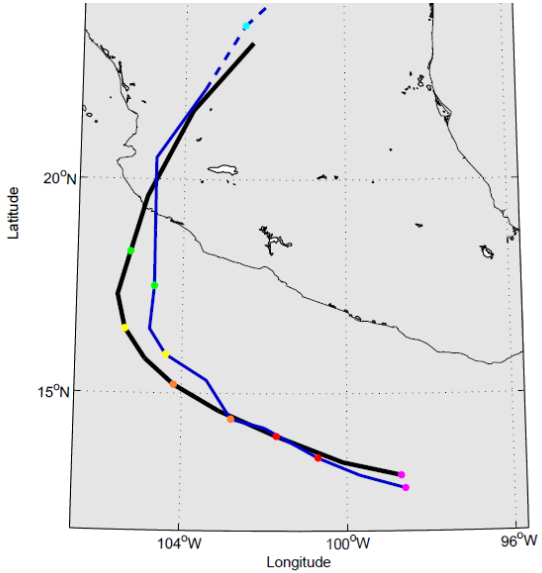
(3) Forecast Validation: Patricia

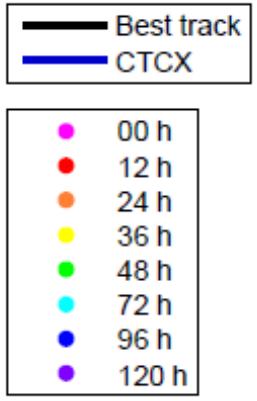
Track forecasts initialized near time of TCI obs

Initial time = 2015102018

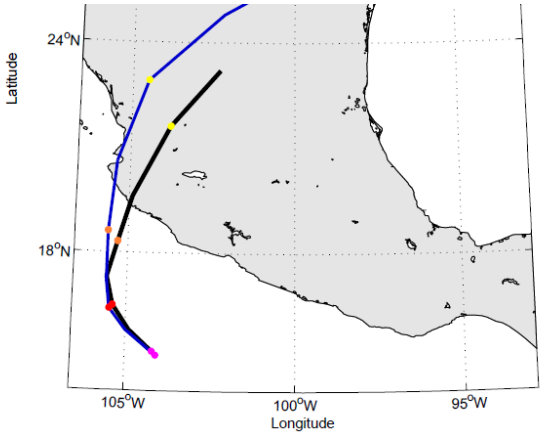


Initial time = 2015102118

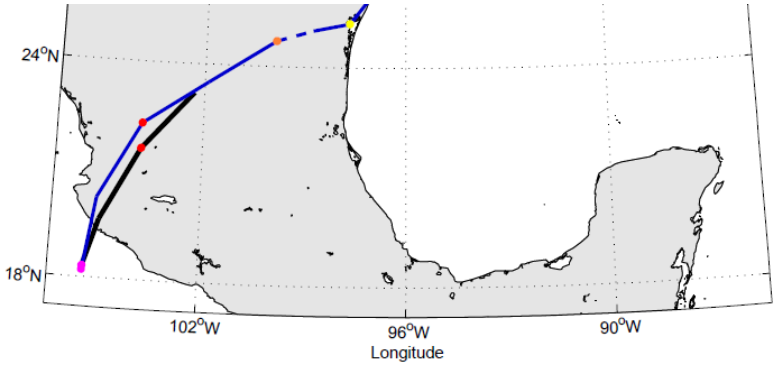




Initial time = 2015102218



Initial time = 2015102318

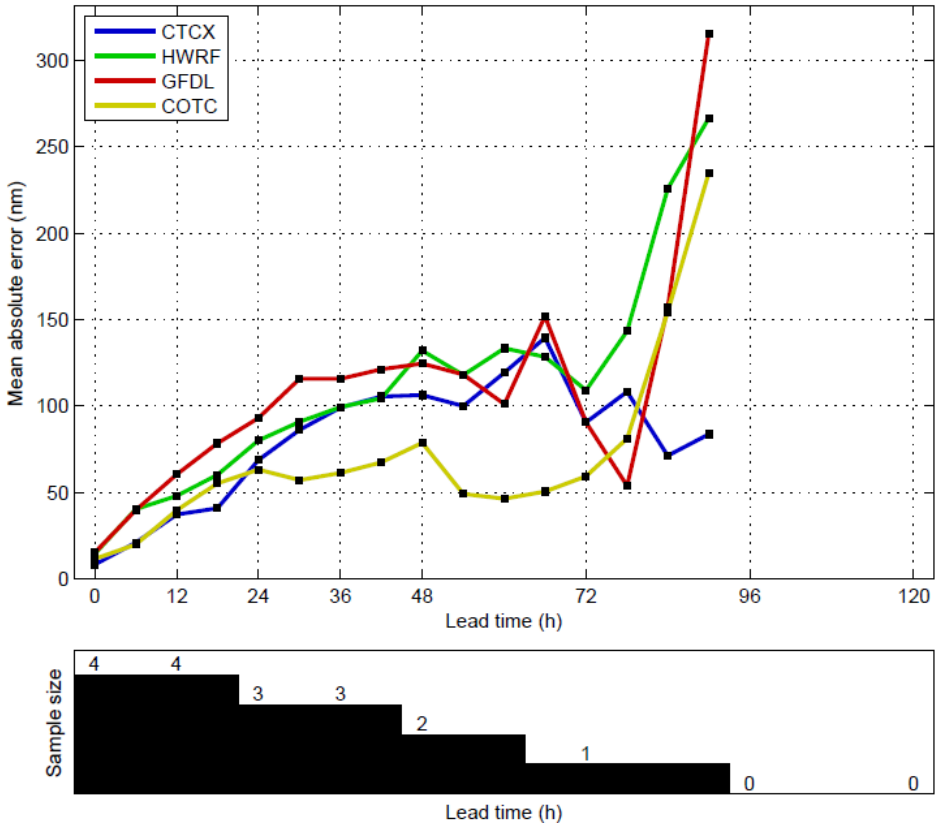


- Earlier forecasts were biased slow and right-of-track. Could be in part related to intensity prediction.

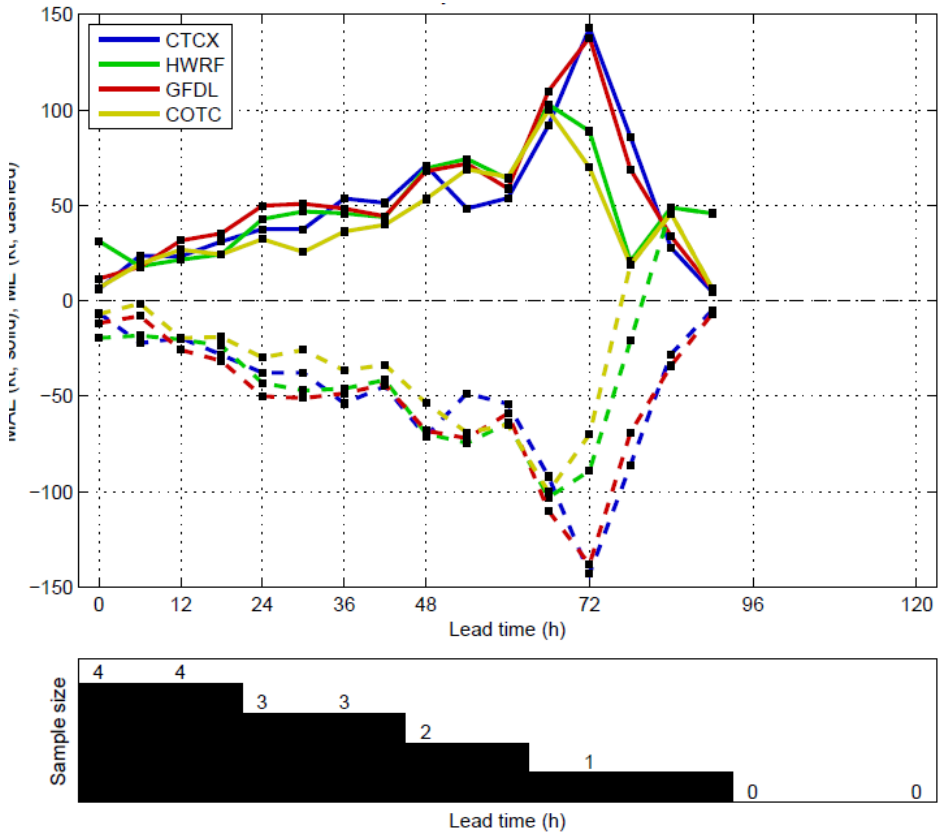
(3) Forecast Validation: Patricia

Multi-model errors for forecasts initialized near time of TCI obs

Track MAE



Intensity MAE (solid) and ME (dashed)



- The GFS-based models (CTCX, HWRF, GFDL) made similar errors

- None of the models predicted the exceptional intensification

(3) Forecast Validation: Summary

Short-range (24 h) CTCX forecasts validating near times of TCI obs

- Average or below-average track and intensity errors for Joaquin and Marty, with the exception of the track in the 2nd Marty case
- Unusually large errors for two of the three Patricia cases

CTCX forecasts initialized near times of TCI obs

- Marty: Erroneous landfall degrades otherwise reasonable intensity predictions
- Joaquin: Only minor errors for track and intensity
- Patricia: No surprise the intensity forecasts could not keep up with Patricia, but early track forecasts could also be substantially improved

Multi-model forecasts initialized near times of TCI obs

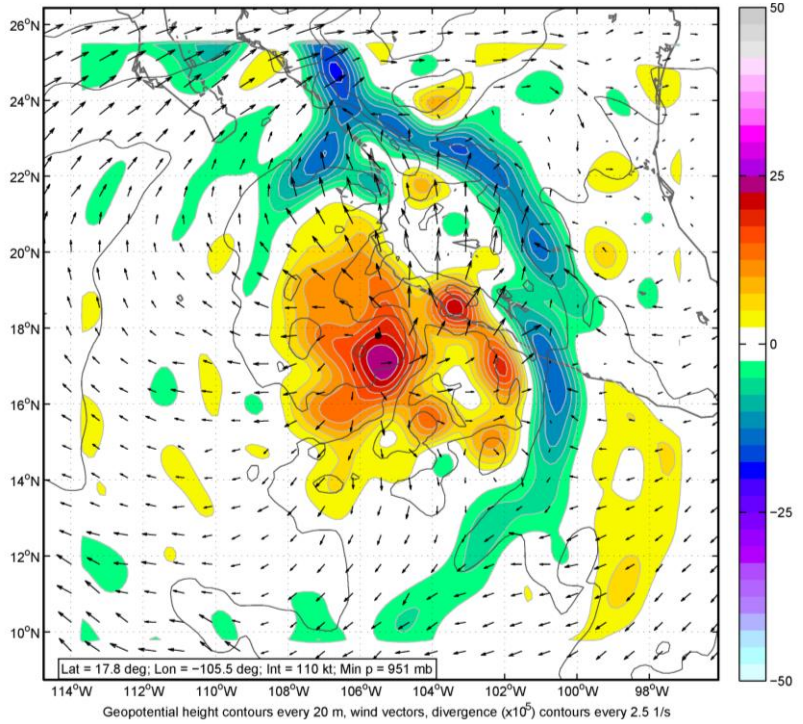
- To first order, forecast issues similar amongst the models
- Suggests common deficiencies in initial state that could potentially be addressed through DA of TCI obs, or common model deficiencies.

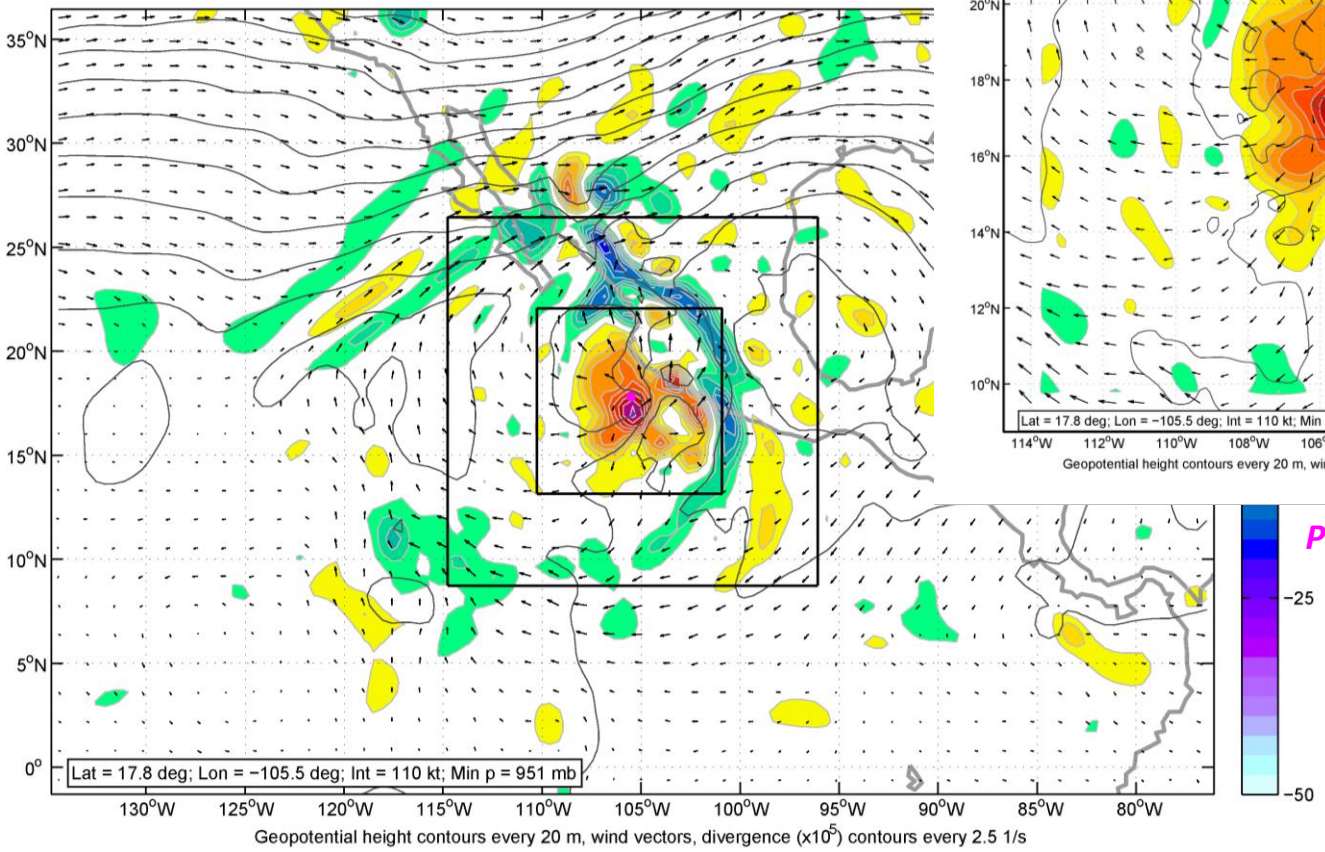
(4) CTCX Data Availability

The CTCX real-time forecasts made during TCI are a resource for the TCI group

- **Field data (IEEE flat files)**
- **Forecast graphics (pdf files)**

Contact me at jon.moskaitis at nrlmry.navy.mil





Patricia, init. time = 2015102212

Tau = 30 h, 100 mb winds, heights, and divergence

(4) CTCX Data Availability

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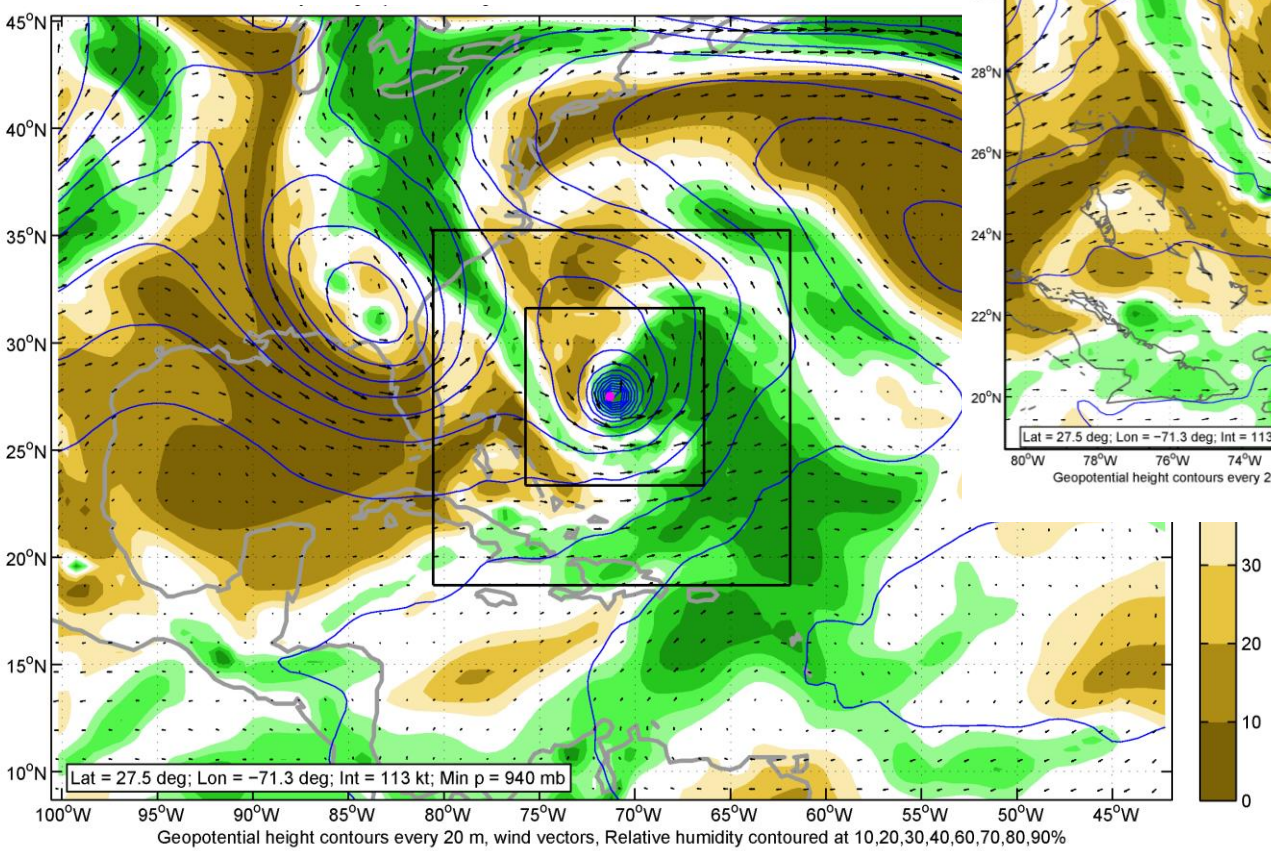
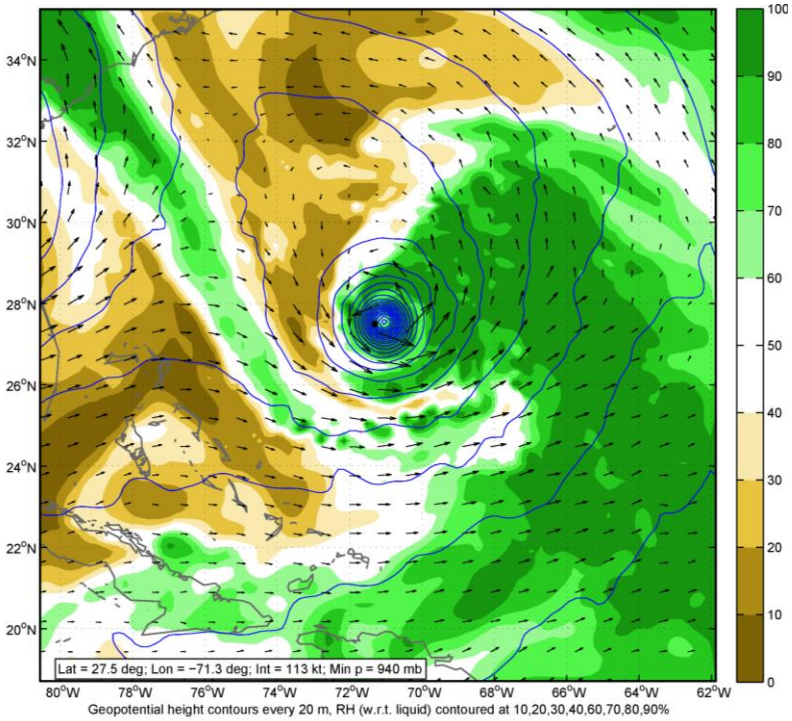




Joaquin, init. time = 2015100118

Tau = 60 h, 500 mb RH, heights, and winds

Extra Slides

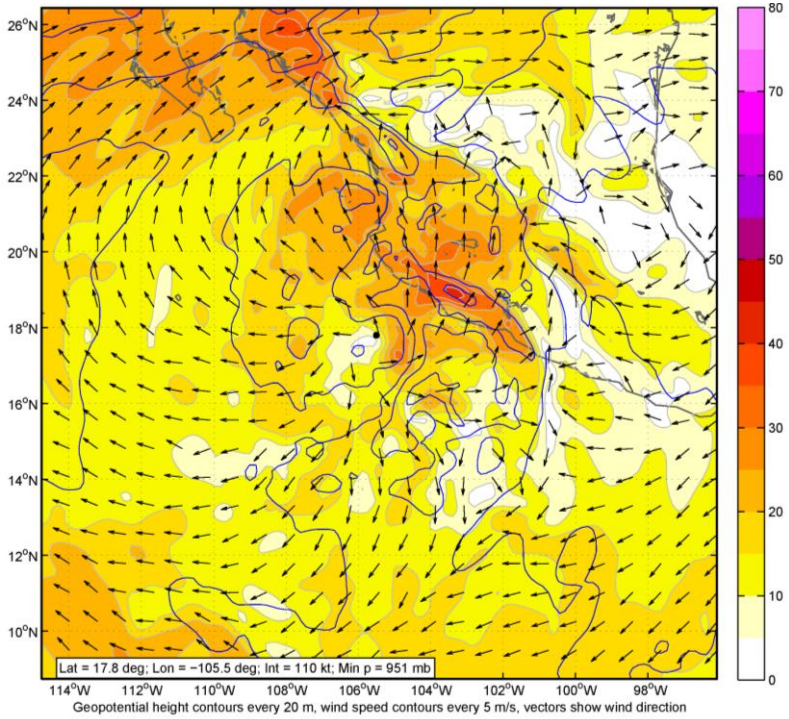
Performance of real-time COAMPS-TC forecasts during the 2015 TCI field campaign

Jon Moskaitis and the COAMPS-TC team
Naval Research Laboratory, Monterey, CA

ONR TCI Science Meeting
18 October 2016

Patricia, forecast initial time = 2015102212

Tau = 30 h, 100 mb winds and heights



Tau = 30 h, 100 mb winds, heights, and divergence