Interdepartmental Hurricane Conference, 4-7 March 2012

FNMOC Collaborations in Tropical Cyclone Forecasting and Aids

Charles E. Skupniewicz[1]
Carey Dickerman[1]
Paul Wittmann[1]
David Ramsaur[1]
Isaac Ginnis[2]
Morris Bender[3]
Carolyn Reynolds[4]
James Doyle[4]
Buck Sampson[4]
Tom Murphree[5]

1 - Fleet Numerical Meteorology and Oceanography Center
2 - University of Rhode Island
3 - Geophysical Fluid Dynamics Laboratory
4 - Naval Research Laboratory Marine Meteorology Division
5 - Naval Postgraduate School

Topics

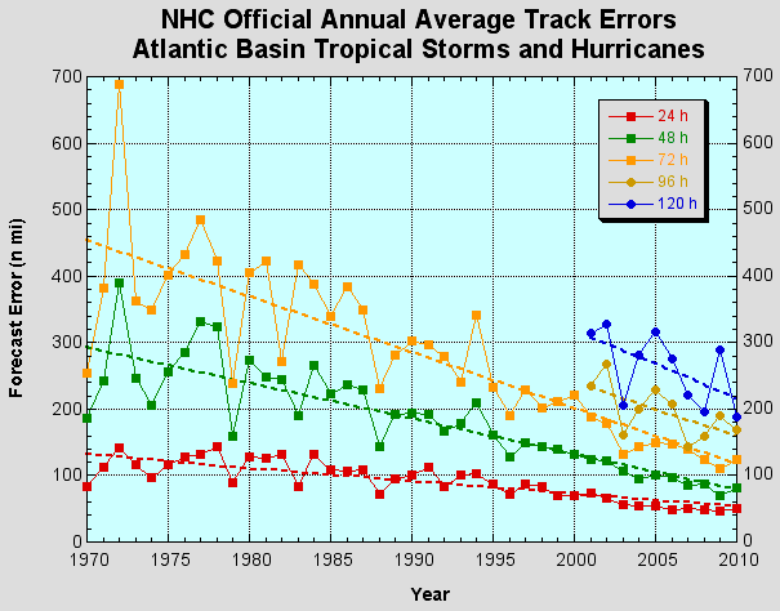
- NOGAPS / NAVGEM
- Ensemble Forecast System
- GFDN – focus on WPAC
- COAMPS TC – new aid for intensity
- WW3 TC OFCL – bogus wind fields
- Advanced Climate Analysis and Forecast System (ACAF) - climatological tropical statistics

Comparison of NOGAPS with ECMWF

- Annual Mean 500mb anomaly height correlation at forecast time of 6 days

Year	NOGAPS	ECMWF	**Delta E - N**	GFS	**Delta G - N**
2007	0.705	0.808	**0.103**	0.756	**0.051**
2008	0.704	0.810	**0.106**	0.755	**0.051**
2009	0.685	0.808	**0.123**	0.757	**0.072**
2010	0.737	0.828	**0.091**	0.787	**0.050**
2011	0.740	0.826	**0.086**	0.779	**0.039**

NOGAPS: Track Performance



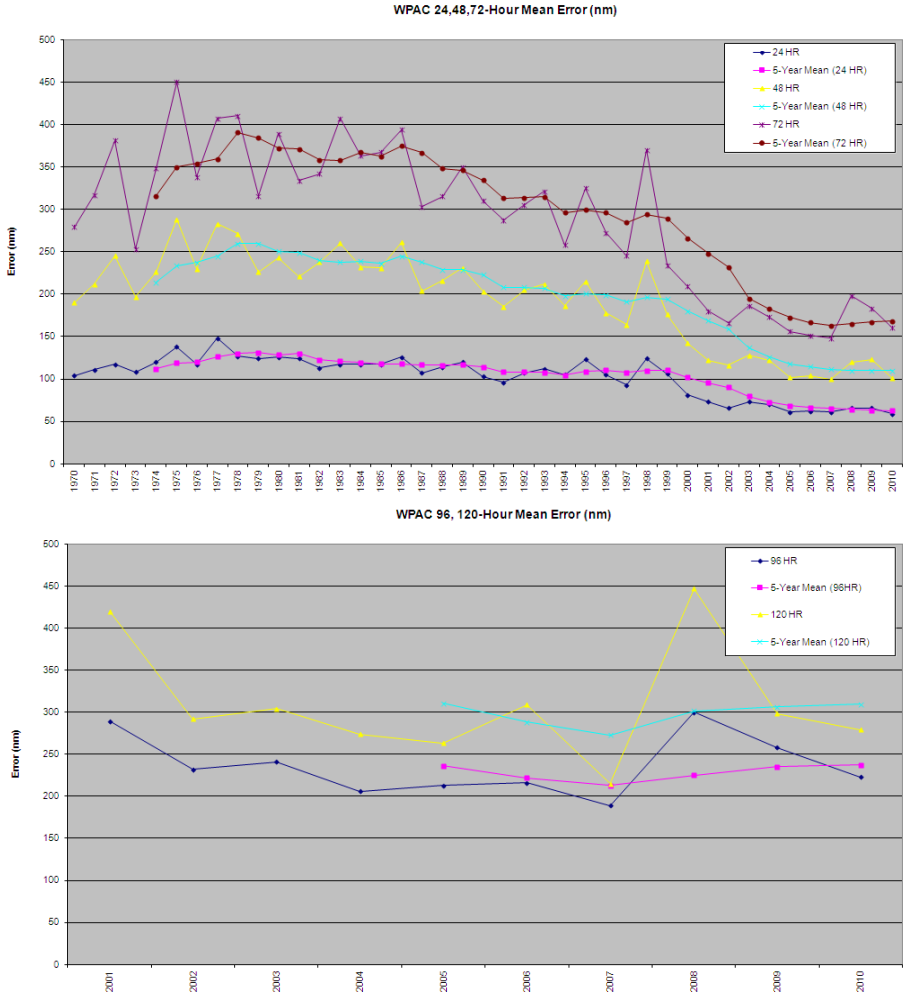
From NHC Web site

NOGAPS - North Atlantic

Horizontal lines are OFCL 48, 72, 120

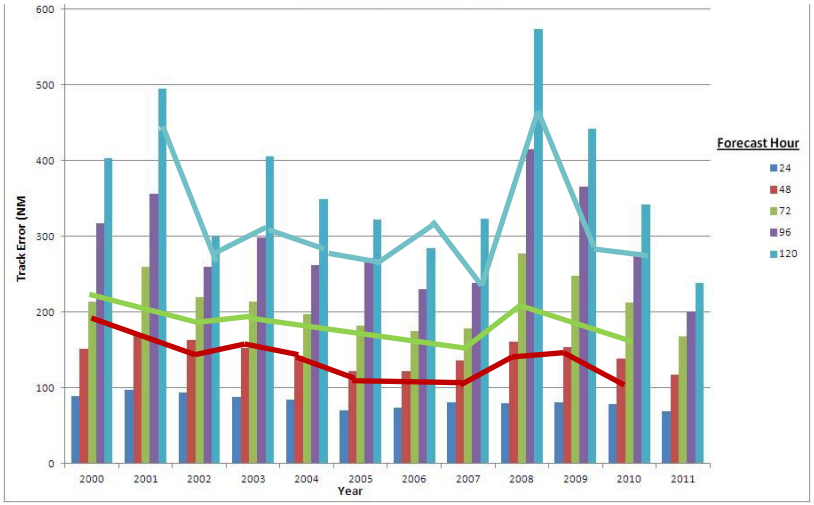
(colors changed to match histogram)

NOGAPS: Track Performance



from JTWC 2010 Annual Report

NOGAPS - North WPac



NAVGEM

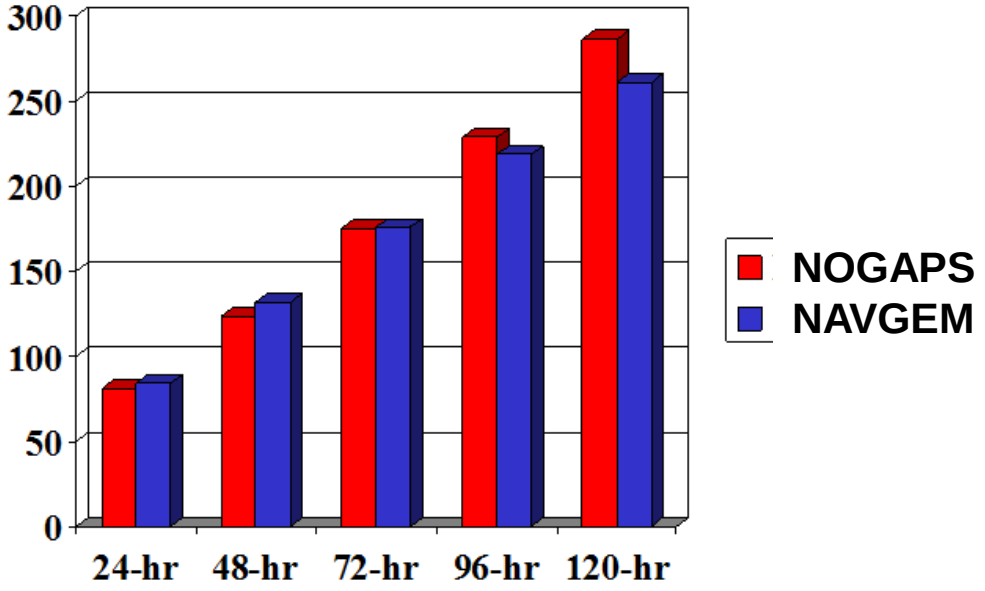
- Navy Global Environmental Model (NAVGEM)
  - replacement for NOGAPS
  - semi-lagrangian, semi-implicit to reduce execution time/increase resolution
- Recent Events
  - NRL release v1 [1 Sep 2011]
  - Validation Report approved by Oversight Panel [Nov 2011]
  - OPTEST results unsatisfactory for some parameters [Dec 2011]
    - Returned to NRL for further development
- Plans
  - T359L42 [1QFY13]
  - T425L60 [FY13]

NAVGEM Validation Test

TROPICAL STORM TRACK ERROR

July 1, 2010 – Sept 30, 2010

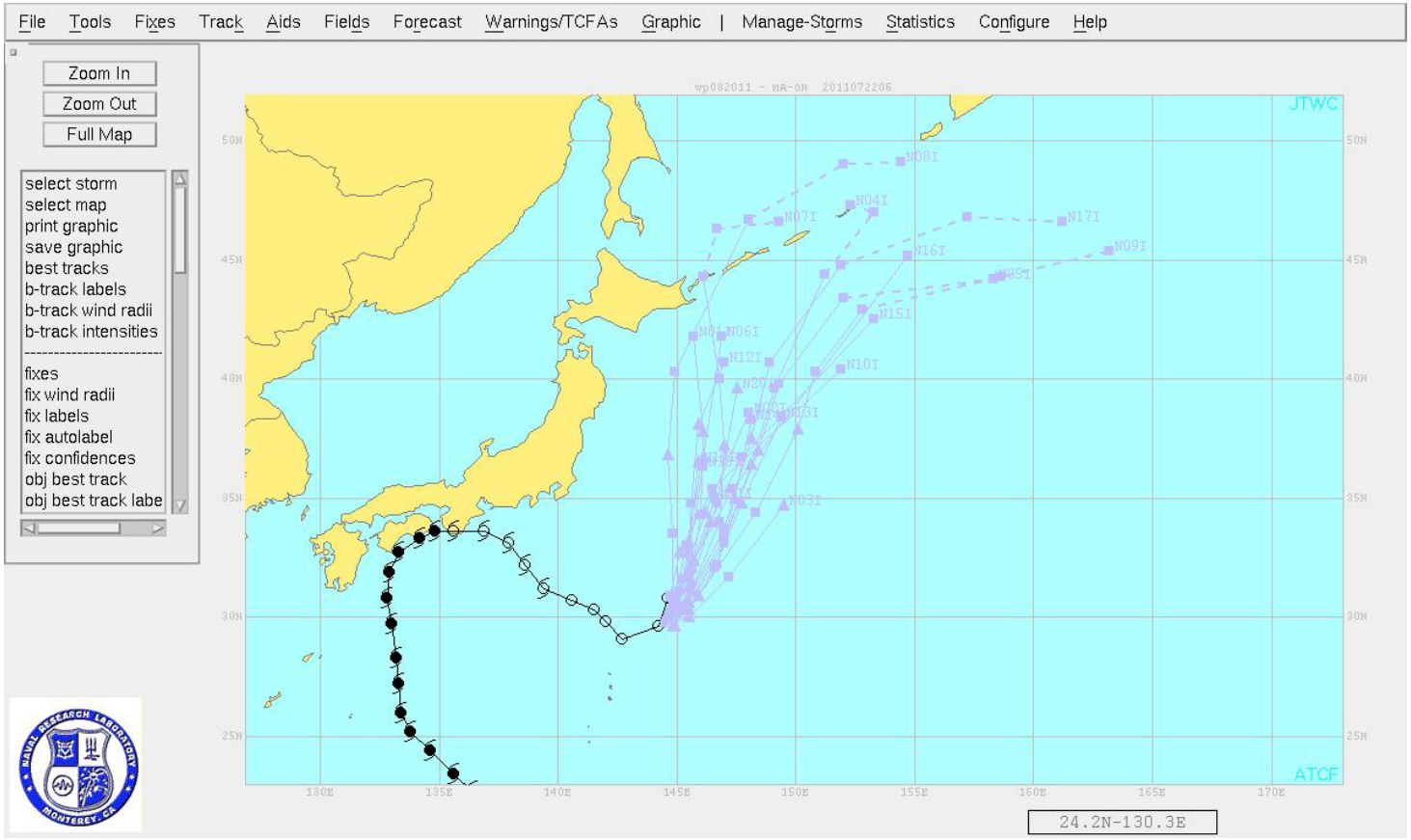
Homogeneous Comparison



No of verifications: 210 152 113 79 50

Significant difference in red, not significant in blue.

NOGAPS EFS TC Guidance

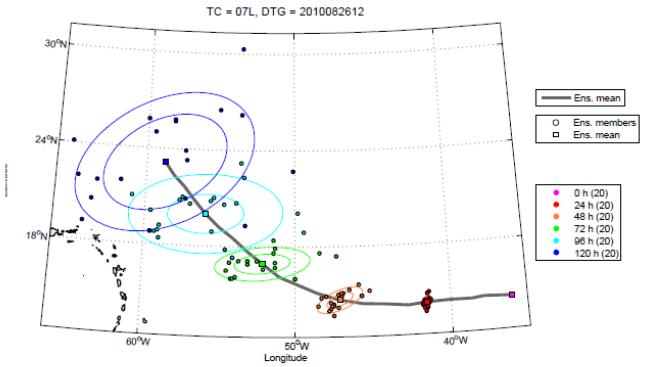


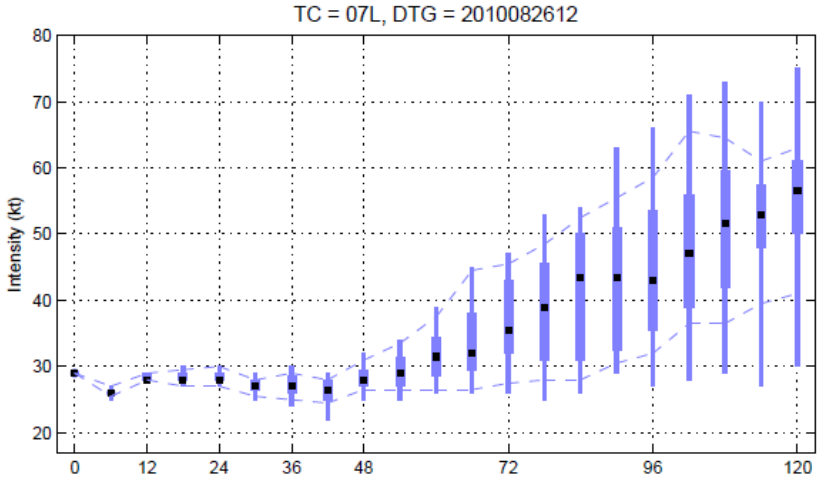
- NOGAPS EFS Tracker Operational June 2011
  - 20 members sent to ATCF

Ensemble Forecast System

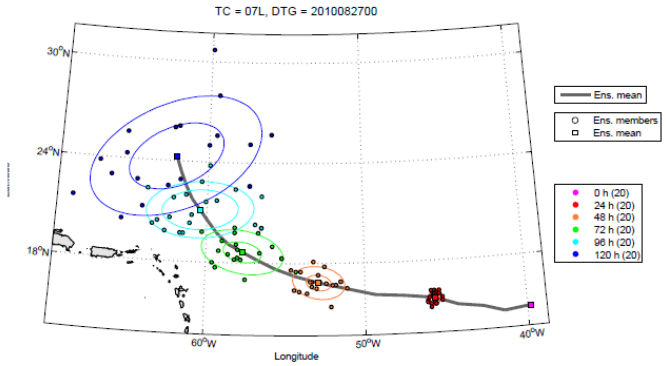
- Recent Upgrades
  - 9-Band Ensemble Transform initialization [Sep 2011]
  - Full set of NUOPC (FNMOC + NCEP) graphics available on Navy Enterprise Portal Oceanography http://www.usno.navy.mil/FNMOC/ [Jan 2012]
- Plans
  - NAEFS/NUOPC multi-model products [3QFY12]
    - Add CMC members along with those from EFS and GFS
  - Bias Corrected Fields using NCEP algorithm [3QFY12]
  - Increased resolution (T159 → T239) [4QFY12]
    - Preference is to use NAVGEM
    - Alternative is to use NOGAPS, with creativity
      - E.g. T239 to 8 days, truncate to T159 for days 8 to 16
  - Stochastic Forcing [FY13]
  - Verification and validation web page
    - Winds and waves
      - Calculations operational [1 Feb 2012]
        - » Significant wave height, 2m temperature, 10m wind
        - » Metrics as defined in NUOPC Metrics subcommittee
      - Visualization on Navy Enterprise Portal Oceanography [3QFY12]
    - All forecast vs. observation metrics (except precipitation and clouds) [4QFY12]
    - Forecasts vs. analysis metrics [1QFY13]

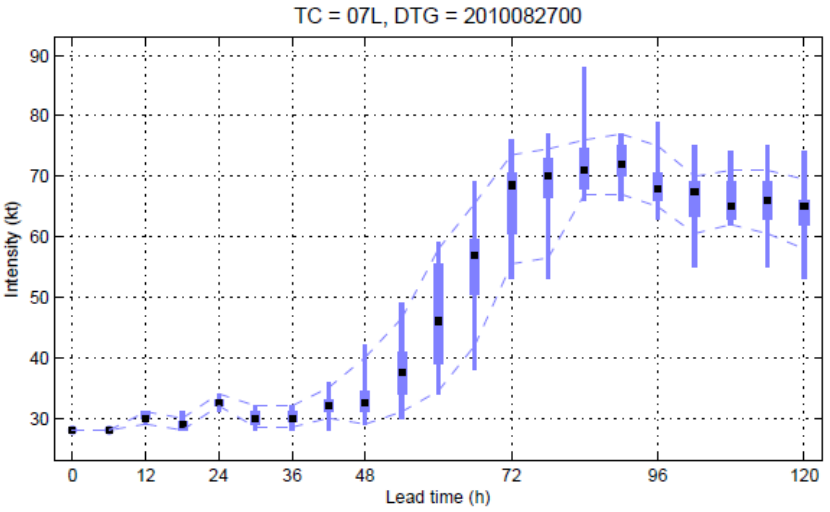
Exploring Ensemble Guidance Products





courtesy
Jon Moskaitis, NRL

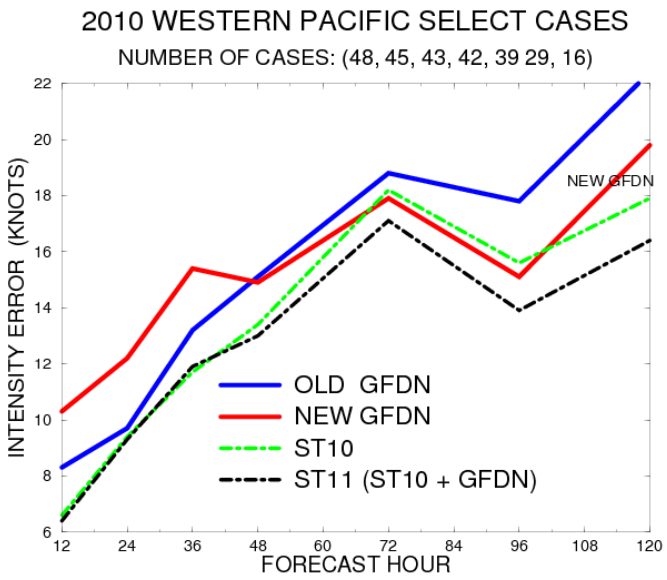


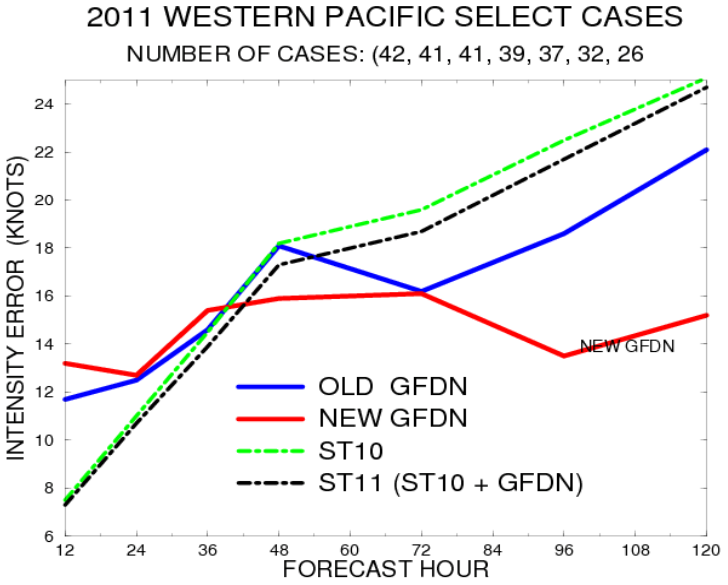


GFDN

- Recent Upgrades
  - Physics upgrade to align with NCEPs GFDL
    - WestPac [15 Aug 2011]
    - EastPac and WestAtl [14 Sep 2011]
    - Rest of the world [29 Sep 2011]
  - 3D Ocean coupling in Southern Hemisphere and Indian Ocean [Dec 2011]
    - Princeton Ocean Model
- Plans
  - Only maintenance for 2012

GFDN WPAC Validation



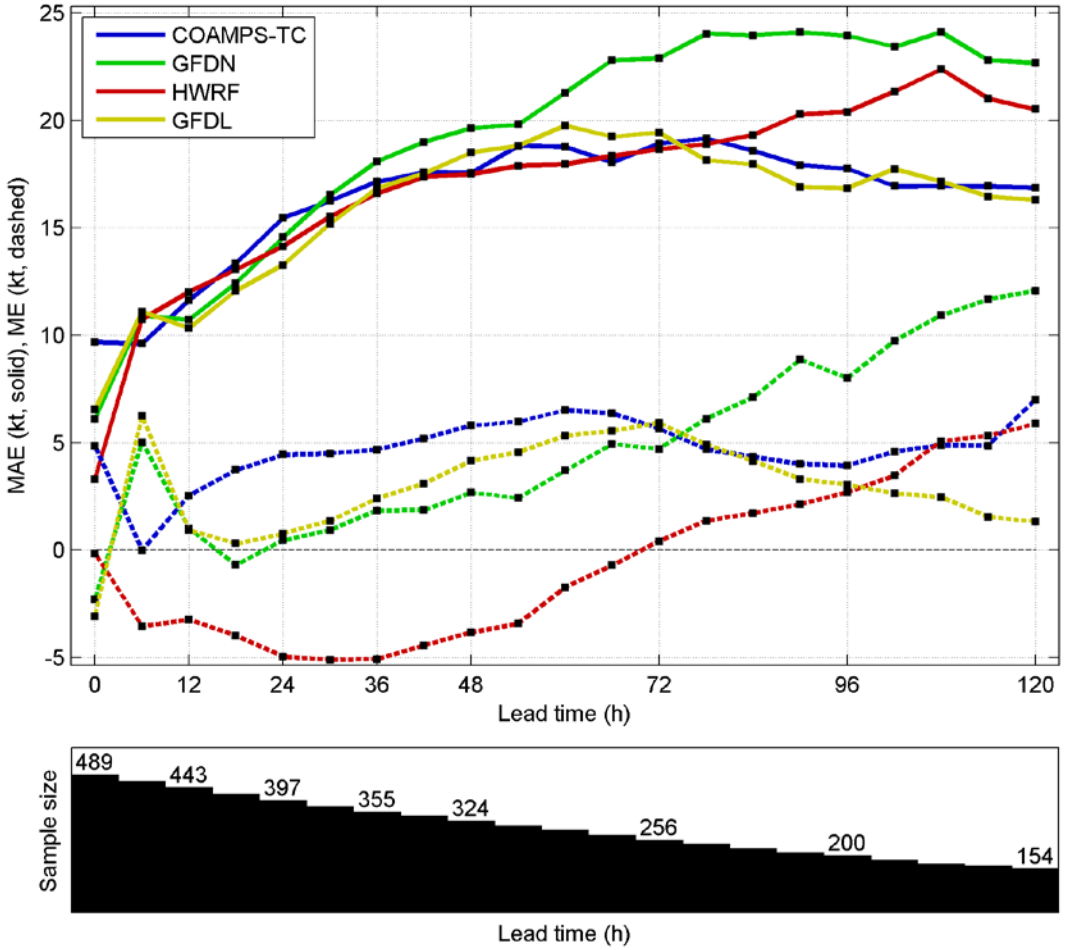


2010 storms selected by JTWC:

1. 07W (Fujiwhara)
2. 09W (Fujiwhara)
3. 15W (RI)
4. 08W (Classic recurve, may have "played" in dynamics of fujiwhara)
5. 10W (Multiple circ centers with erratic track)
6. 03W (Straight runner with re-intensification in SCS)
7. 13W (Recurve)
8. 12W (Straight runner with stair-step)
9. 05W (Recurve TS)
10. 04W (Straight runner)

COAMPS-TC Validation Test

Intensity
Atlantic

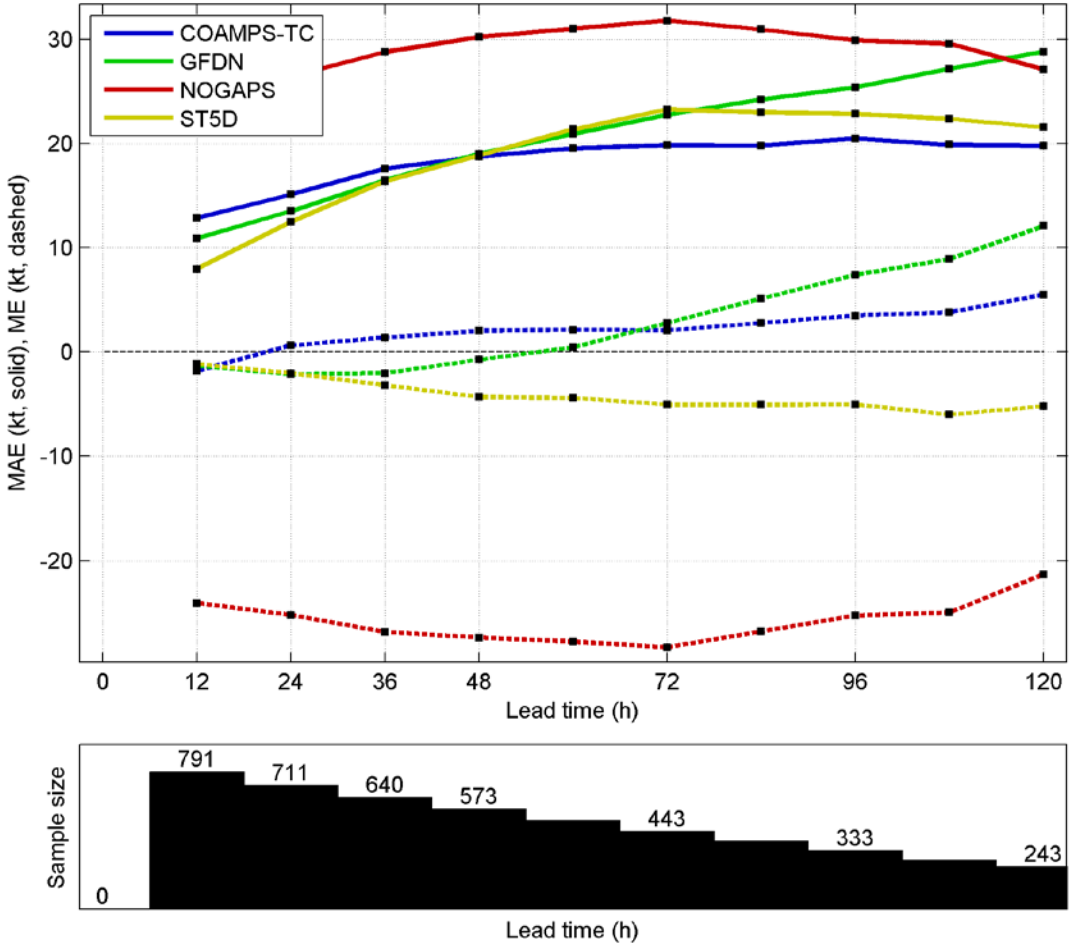


- Final Report Issued

- Scores passed/ Approval expected

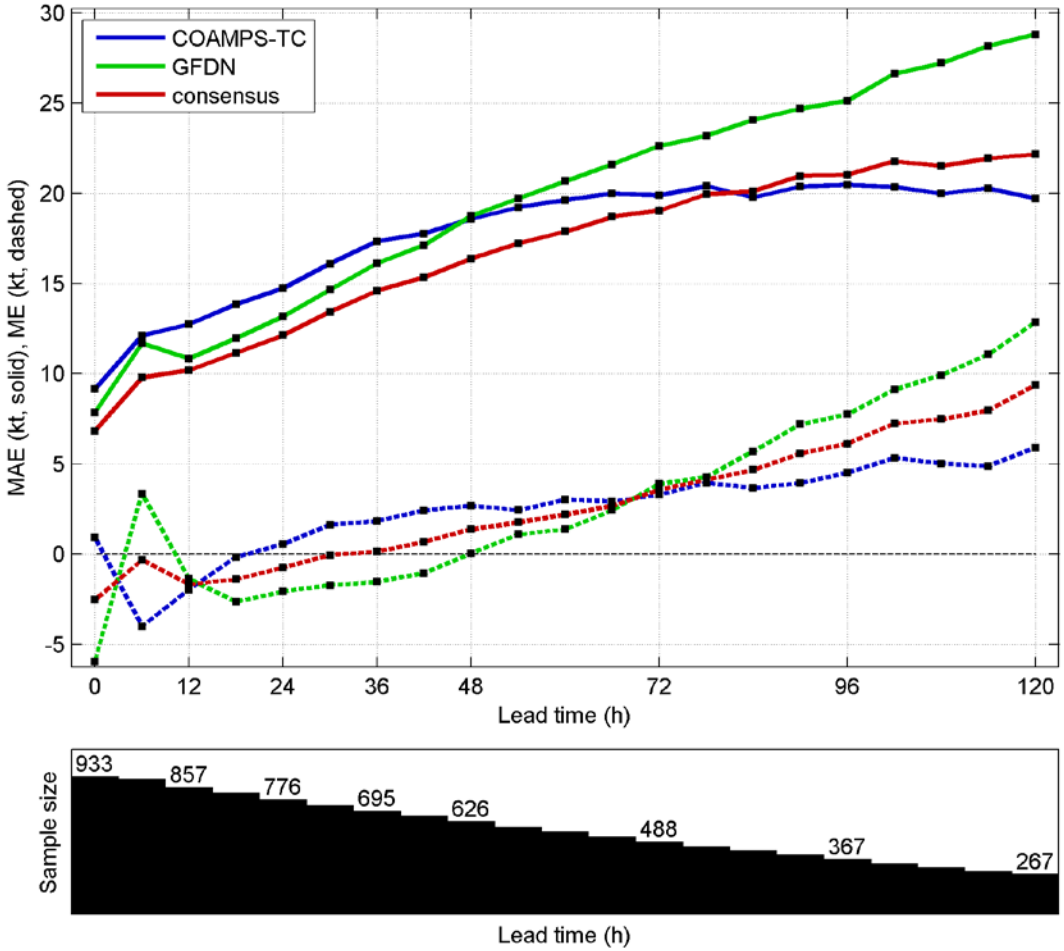
Atlantic intensity mean absolute errors (solid) and mean errors (dashed) for a homogeneous sample of retrospective COAMPS-TC forecasts and real-time GFDN, HWRF, and GFDL forecasts. The cases are from the 2008, 2009, and 2010 seasons, as described in Sec. 3.2.3. Sample size is shown in the lower panel.

COAMPS-TC Intensity - WPAC



Western North Pacific intensity mean absolute errors (solid) and mean errors (dashed) for a homogeneous sample of retrospective COAMPS-TC forecasts and real-time GFDN, NOGAPS, and ST5D (climatology and persistence) forecasts. The cases are from the 2009, 2010, and 2011 seasons, as described in Sec. 3.3.3. Sample size is shown in the lower panel.

COAMPS-TC/GFDN Consensus Intensity - WPAC



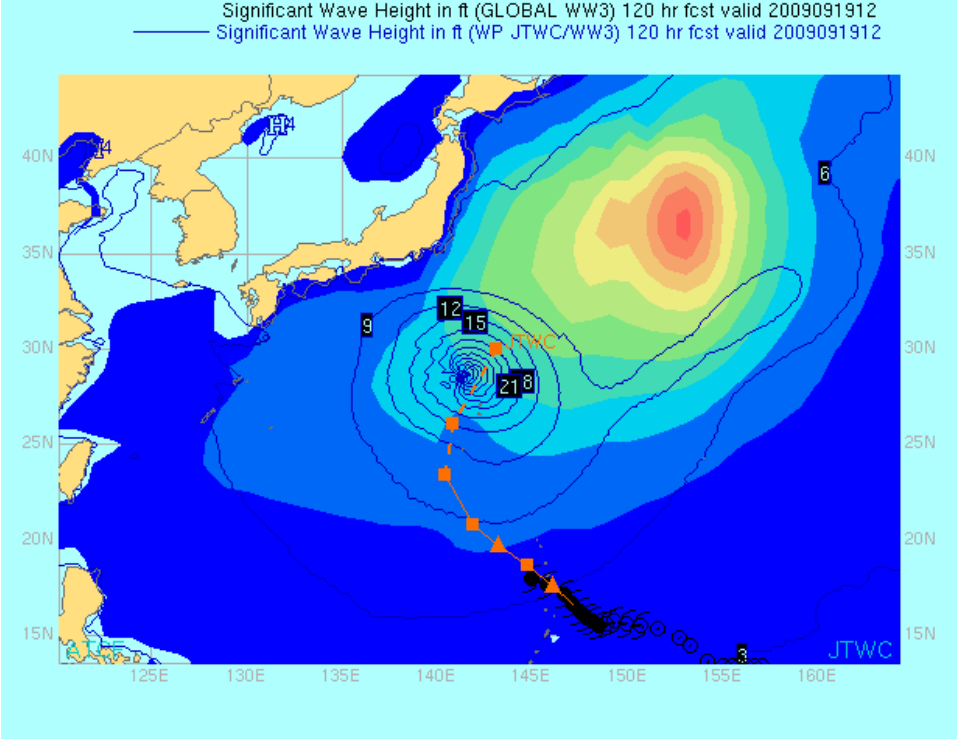
Western North Pacific intensity mean absolute errors (solid) and mean errors (dashed) for a homogeneous sample of retrospective COAMPS-TC forecasts, real-time GFDN forecasts, and consensus forecasts. The consensus forecast is the average of the retrospective COAMPS-TC forecast and the real-time GFDN forecast. The cases are from the 2009, 2010, and 2011 seasons, as described in Sec. 3.3.3. Sample size is shown in the lower panel.

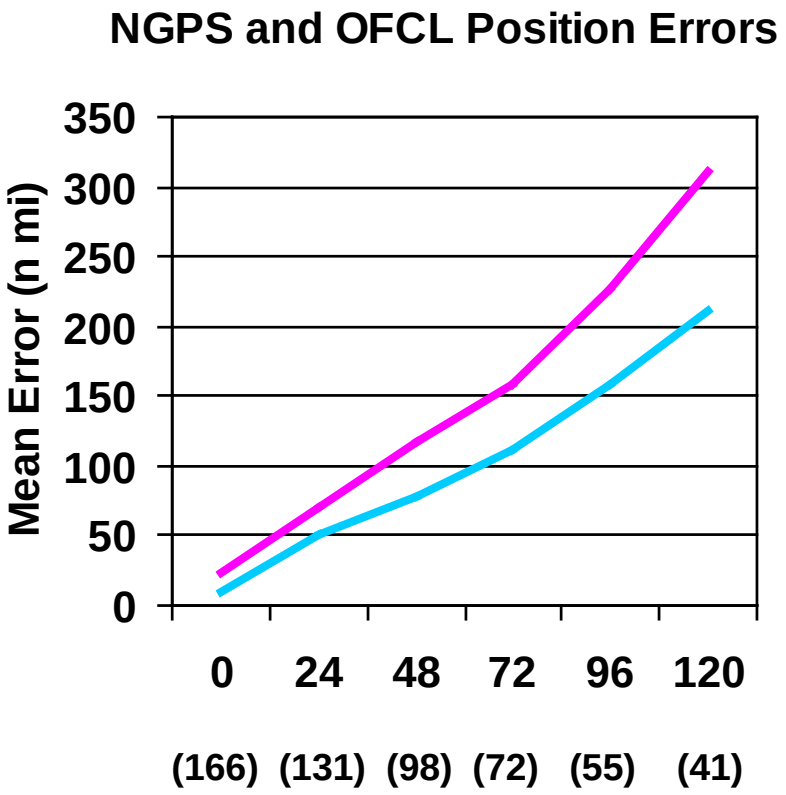
COAMPS-TC

- Plans
  - We are leaning forward with an ambitious plan
    - Begin testing code outside of COAMPS-OS using NRL R&D scripts in ALPHA [Feb 2012]
    - Obtain “Prerelease” of COAMPS-OS v2.3 to begin testing new functionality in ALPHA [April 2012]
    - AMOP TD2 for COAMPS-TC [April 2012]
    - Obtain official release of COAMPS-TC & COAMPS-OS 2.3 [May 2012]
    - Begin testing of full system under configuration management and SMS in BETA [May 2012]
    - Begin OPTEST [Jun 2012]
    - AMOP TD3 [Jul 2012]
    - Goal: If OPS HPC resources allow, run both COAMPS-TC and GFDN in parallel for remainder of 2012 season [4QFY12]

WW3 TC-OFCL

WP152009

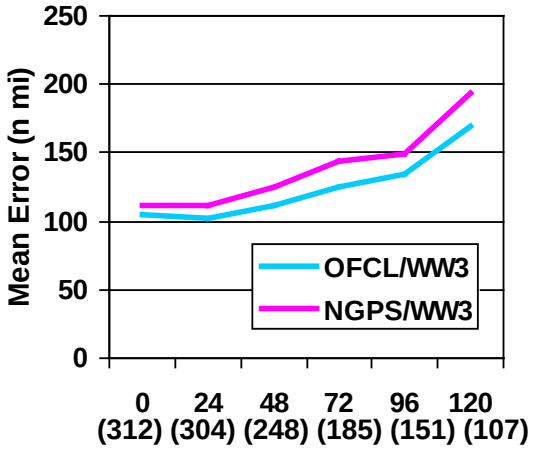




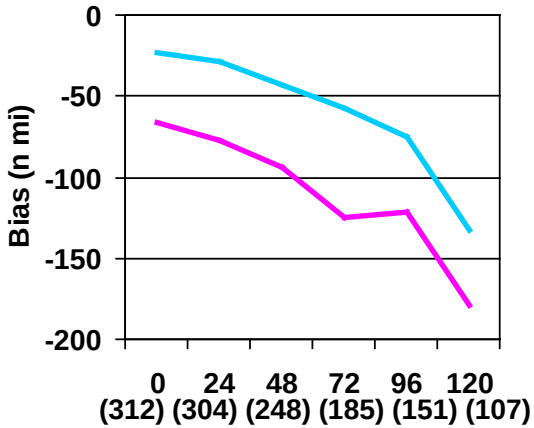
Purpose is to develop a set of wave products that are consistent with the official (OFCL) forecast (left). This could be based on either JTWC or NHC forecasts. One benefit to doing this is that the OFCL positions are significantly improved over NOGAPS (right), so the geographical location of the high seas should generally be better since they are highly correlated with the position of the maximum wind speeds.

WW3 TC-OFCL: TAFB Verification

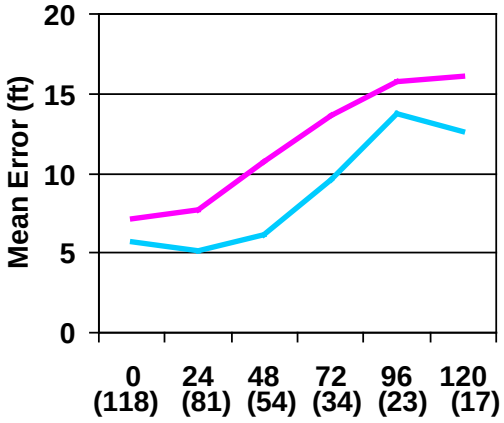
12-ft Seas Radii Errors



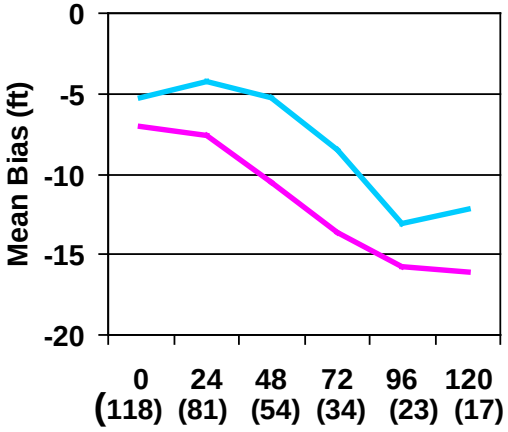
12-ft Seas Radii Biases



Max Sig Wv Ht Errors (ft)

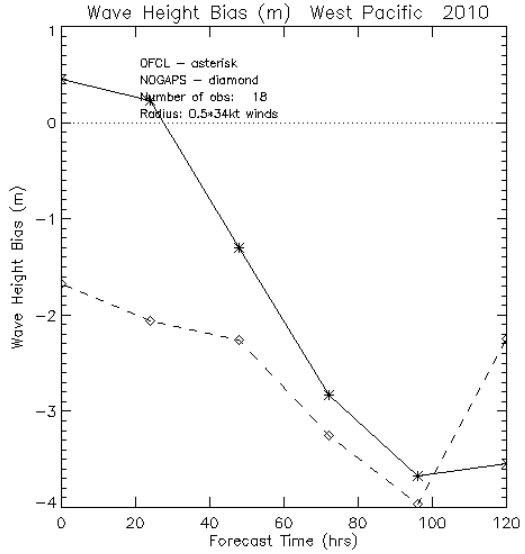


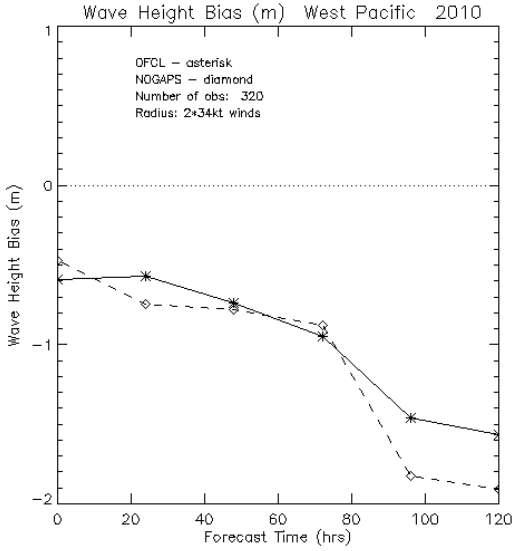
Max Sig Wv Ht Bias

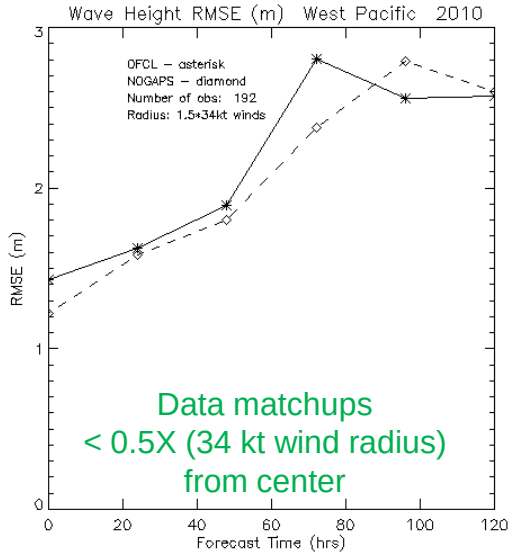


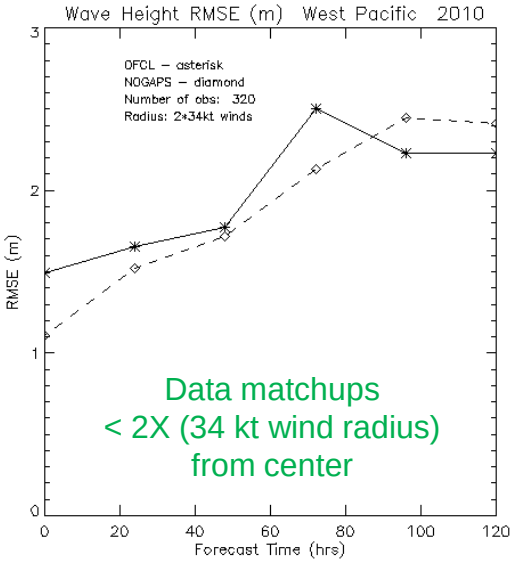
Atlantic 2010 season: Tropical Analysis and Forecast Branch analyses

WW3 TC-OFCL: Altimetry Verification









2010 Storms with altimeter overpasses

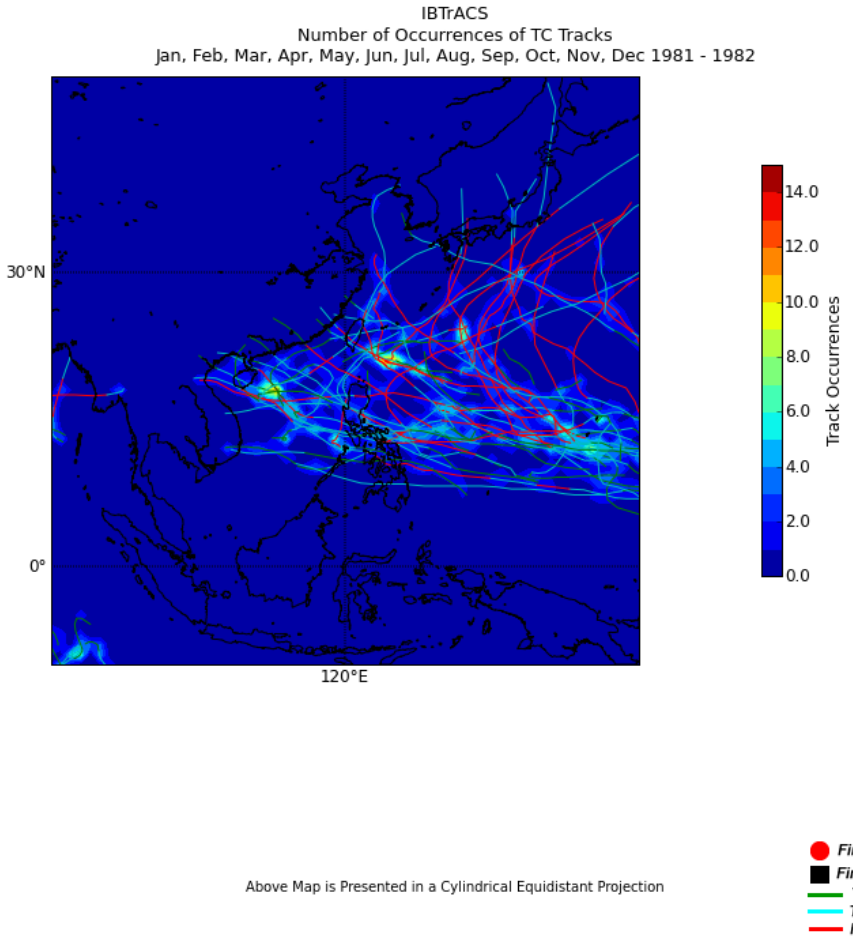
-Negative bias reduced near center

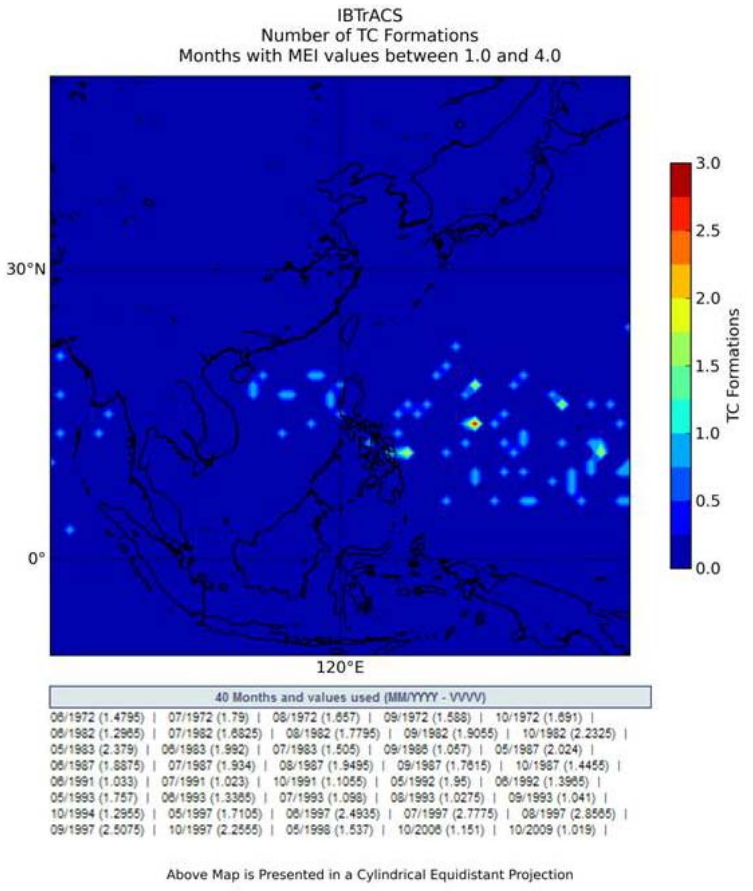
-neglible effect beyond 2X (34 kt wind radius)

WW3 TC-OFCL Status

- Distribution through web site graphics (WXMAP), METCAST/JMV
- Operational 15 May 2012
- Ensemble version TBD

Tropical Cyclone Statistics Upgrade





ACAF: Tropical Cyclone Statistics

Period: 1970 – 2009. user selected time range and the temporal extent of the data.

Basins: Preset to western North Pacific, eastern North Pacific, Atlantic, northern Indian Ocean, and Southern Hemisphere Products may be developed for any combination of these basins.

Formations and Tracks: Products will be able to provide information on single or multiple formation locations and/or tracks (formation and initial track locations determined by first best track entries).

Number of Occurrences: TC track, formations, tracks, and intensities by location

Related Variables: User selectable overlays of TCs on fields of related variables (e.g., overlays of tracks on the corresponding surface winds and waves).

Climate State Conditioning: filtering on tracks during El Nino, La Nina periods optional

Output Options: JPEG, KML, NETCDF: TC names and intensity details provided at the best track report location.

OPERATIONAL: MARCH 2012 – DOD website – Public web page TBD.