Joint Typhoon Warning Center

Mean Annual TC Activity

El Nino TC Activity Anomalies

Hurricane Forecast Improvement Program
Annual Review
17-19 NOV 2015

Joint Typhoon Warning Center — Forward, Ready, Responsive Decision Superiority
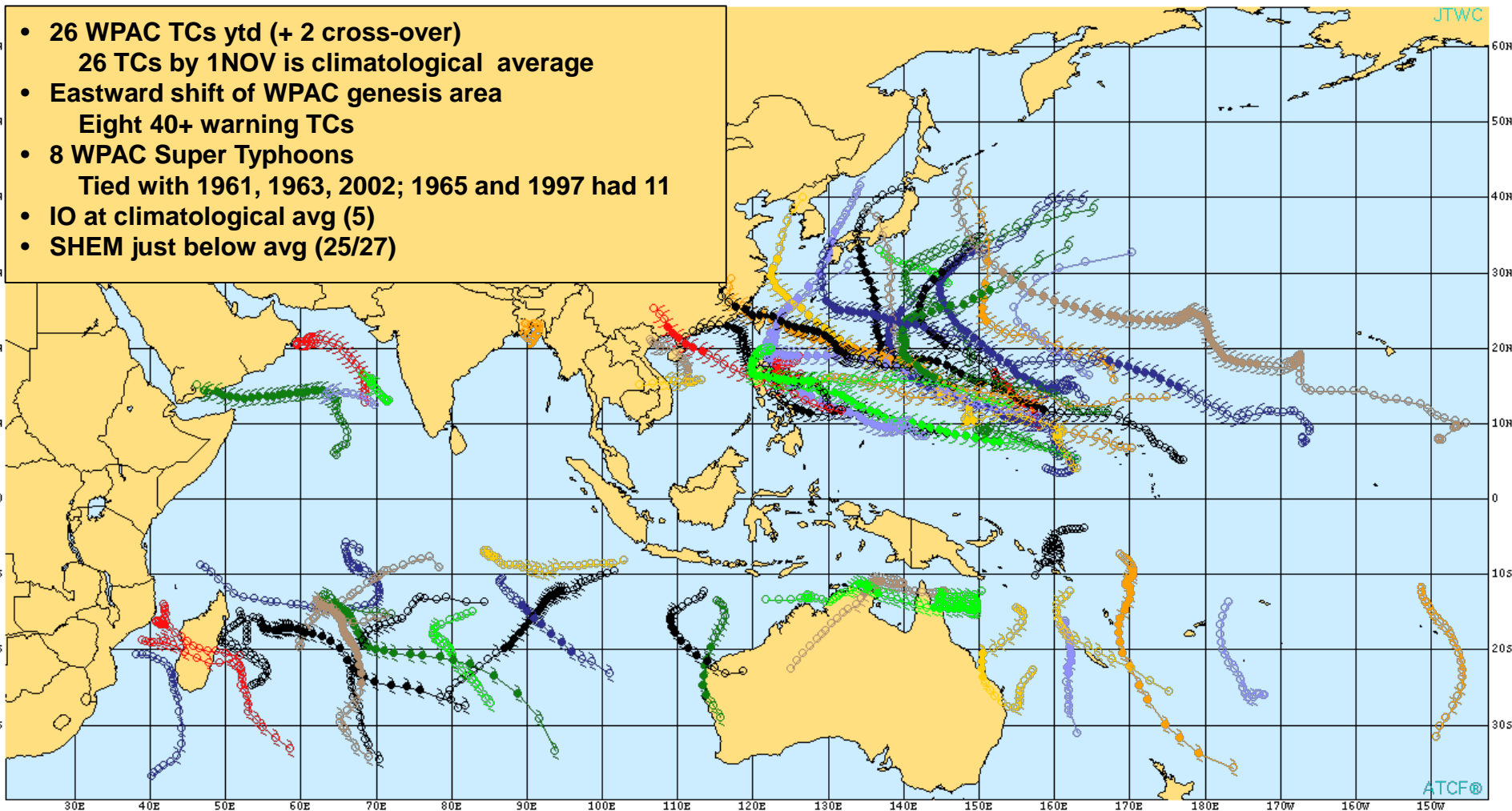
The Threat
2015 Tropical Cyclone Tracks through 06NOV

- **26 WPAC TCs ytd (+ 2 cross-over)**
    - 26 TCs by 1NOV is climatological average
- **Eastward shift of WPAC genesis area**
    - Eight 40+ warning TCs
- **8 WPAC Super Typhoons**
    - Tied with 1961, 1963, 2002; 1965 and 1997 had 11
- **IO at climatological avg (5)**
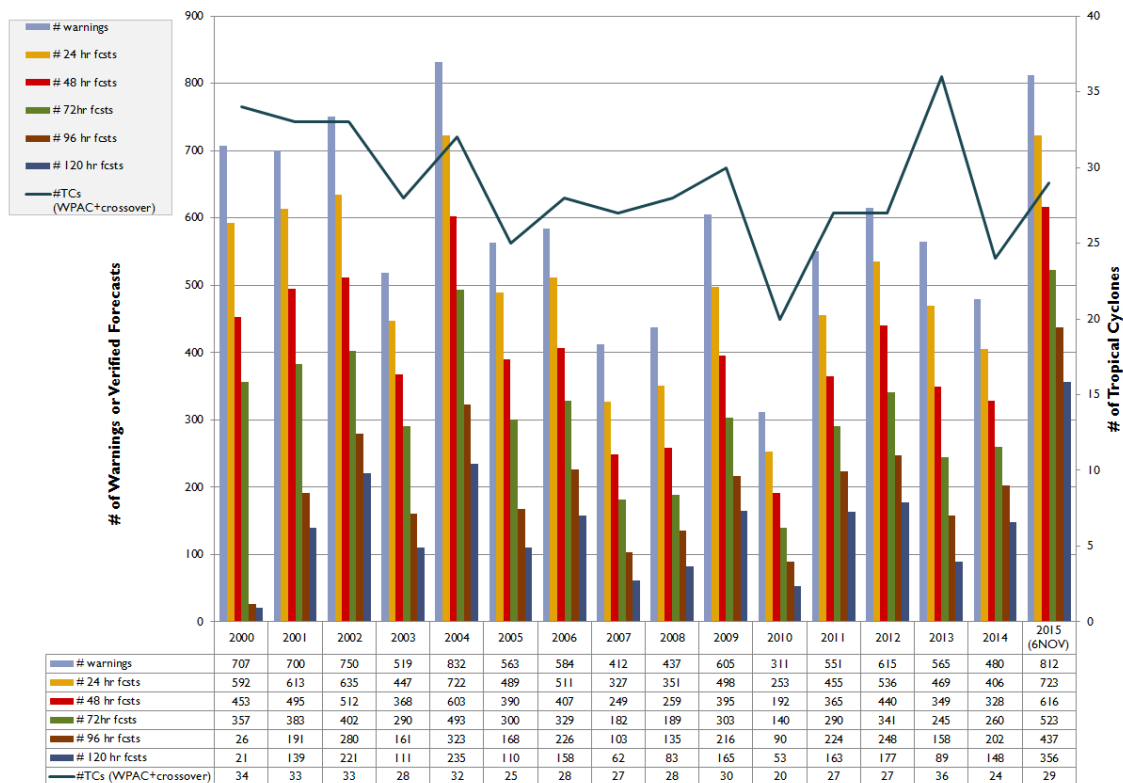- **SHEM just below avg (25/27)**

JTWC

ATCF®

17 OWS

Impact of ENSO

- **El Nino - Number of WPAC TCs remains fairly constant, however, shift in genesis region leads to long-lived TCs, higher mean intensity**

- **Number of JTWC WPAC warnings issued ytd highest since 2004**

- **Average # of T+120 hr verifying forecasts since 2001: 137**

  2015 ytd: 356

- **JTWC SATOPS performed > 12,300 fixes**
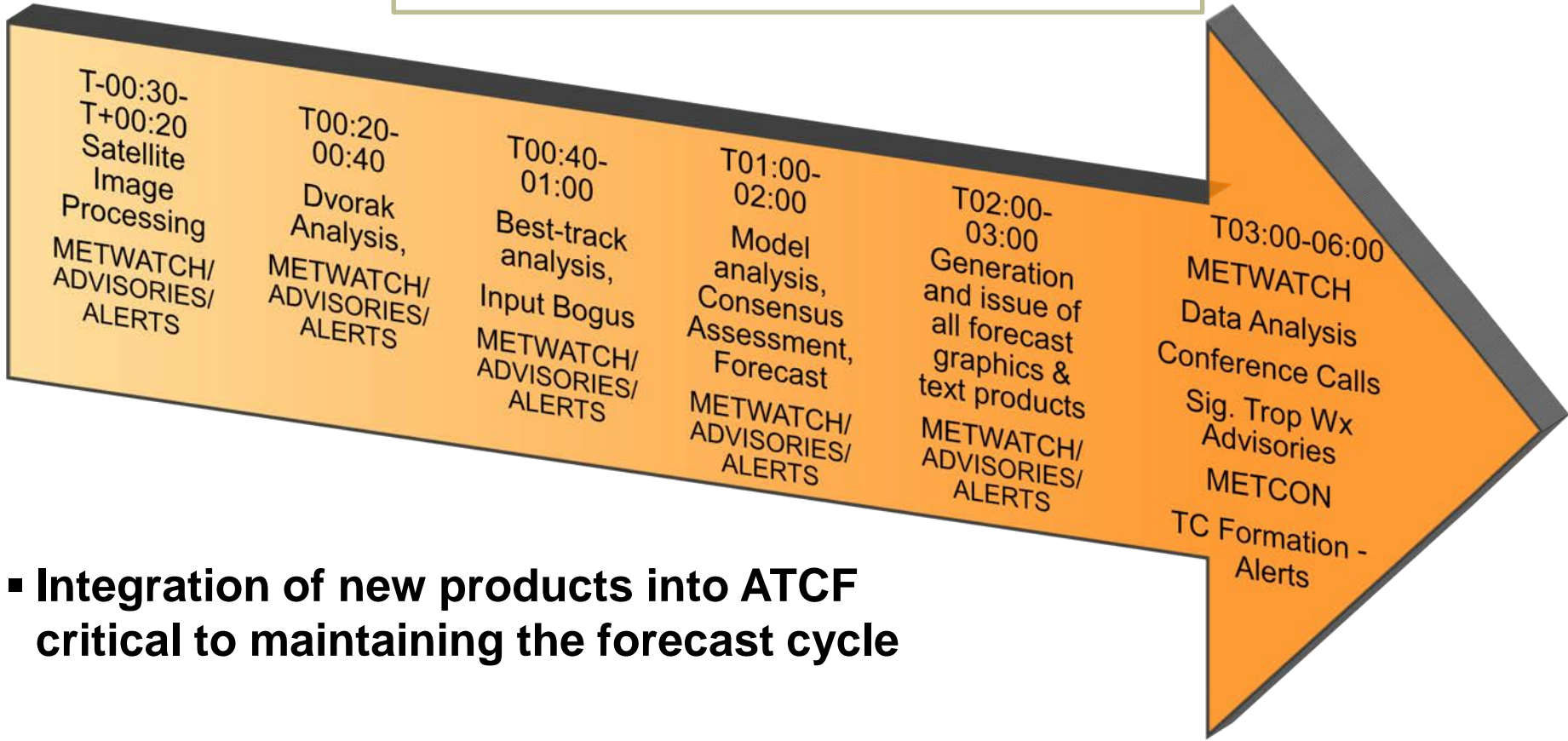
- **Busy year for TDOs and Sat analysts!**

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015 (6NOV)
# warnings	707	700	750	519	832	563	584	412	437	605	311	551	615	565	480	812
# 24 hr fcsts	592	613	635	447	722	489	511	327	351	498	253	455	536	469	406	723
# 48 hr fcsts	453	495	512	368	603	390	407	249	259	395	192	365	440	349	328	616
# 72hr fcsts	357	383	402	300	493	300	329	182	189	303	140	290	341	245	260	523
# 96 hr fcsts	26	191	280	161	323	168	226	103	135	216	90	224	248	158	202	437
# 120 hr fcsts	21	139	221	111	235	110	158	62	83	165	53	163	177	89	148	356
#TCs (WPAC+crossover)	34	33	33	28	32	25	28	27	28	30	20	27	27	36	24	29

The JTWC AOR encompasses over 110 million sq. miles and nearly 89% of global TC activity.

T-00:30- T+00:20 Satellite Image Processing

METWATCH/ ADVISORIES/ ALERTS

T00:20- 00:40 Dvorak Analysis,

METWATCH/ ADVISORIES/ ALERTS

T00:40- 01:00 Best-track analysis, Input Bogus

METWATCH/ ADVISORIES/ ALERTS

T01:00- 02:00 Model analysis, Consensus Assessment, Forecast

METWATCH/ ADVISORIES/ ALERTS

T02:00- 03:00 Generation and issue of all forecast graphics & text products

METWATCH/ ADVISORIES/ ALERTS

T03:00-06:00 METWATCH Data Analysis Conference Calls Sig. Trop Wx Advisories METCON TC Formation - Alerts

- **Integration of new products into ATCF critical to maintaining the forecast cycle**

JTWC/CONW Track Error Since HFIP Inception

- **Model, DA improvements since HFIP began have contributed to reduced mean JTWC consensus (CONW) errors**

- **Combination of above improvements and investment in ATCF and recon contributing to lower mean JTWC forecast track error**

- **2015 set to have lowest JTWC mean track errors at all taus**
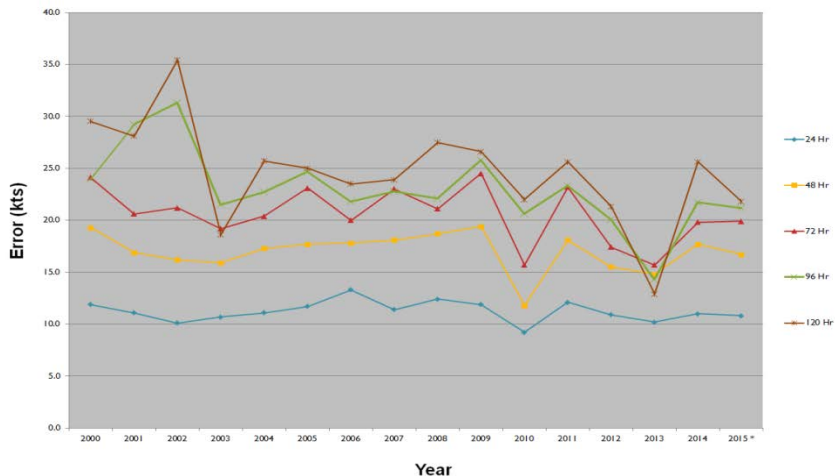
  - **3-day error < 100nm**

  - **5-day error < 200nm**

JTWC and CONW Forecast Track Errors (2010-2015 ytd*)

* As of 06NOV2015
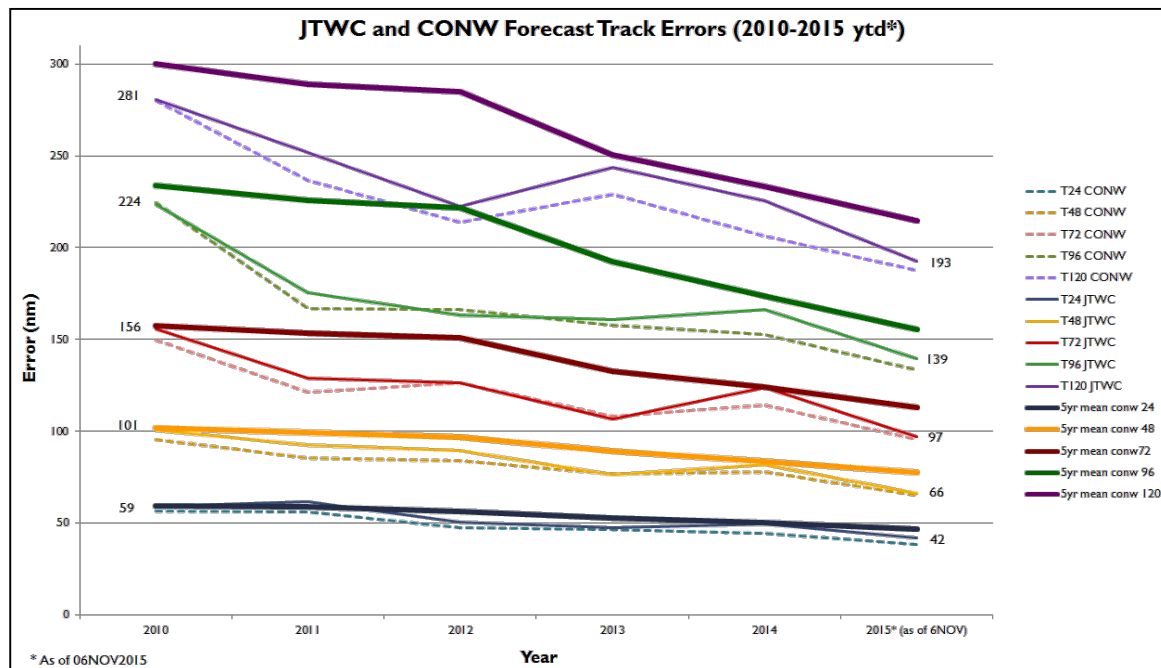
Intensity

JTWC Average Intensity Errors
Preliminary Data, As of Nov 6, 2015

- **Intensity errors remain mostly flat**

- **2015 improved over 2014, despite increase of strong TCs and RI**

- **TC intensity change, particularly onset and duration of RI still #1 forecast improvement priority**

- **Nearly all guidance better than 2014**

- **S5YY (dynamical+SHIPS+CHIPS) overall best performer**

- **Large variation between same model/different parent noted**

  - **COTC (NAVGEM) and CTCI (GFS)**

  - **GFDN (NAVGEM) and GFDL (GFS)**

Intensity Aid Error (2014-2015)
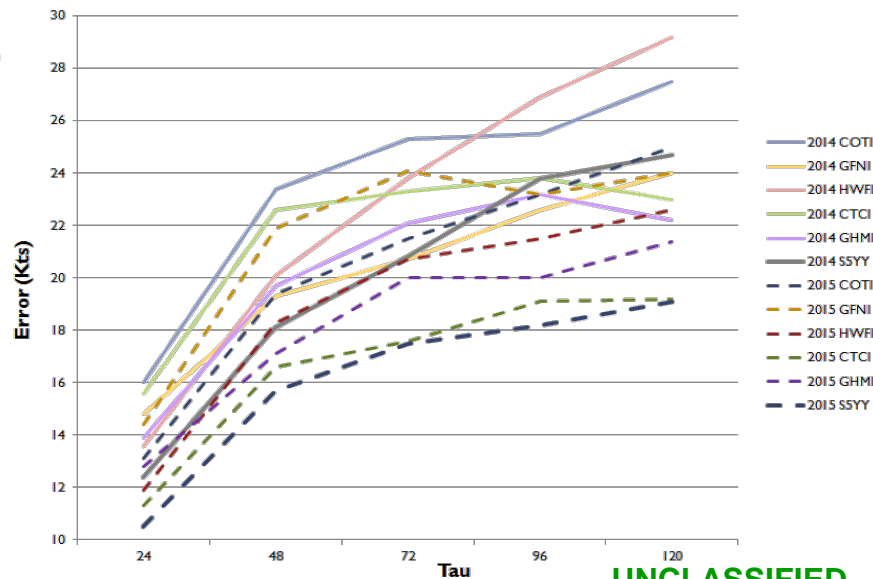
Need for Improved RI Guidance

- **On average, nearly 50% of WPAC TCs that reach tropical storm strength will have at least one RI event**

- **Two-thirds of TCs that reach Typhoon strength undergo RI**

- **Higher resolution models now routinely forecast RI and STY intensities**

    - **Timing and FAR needs work**

- **TDOs tend to look at intensity trend over raw values**

- **GFDL ensemble provides easy to interpret RI data point**
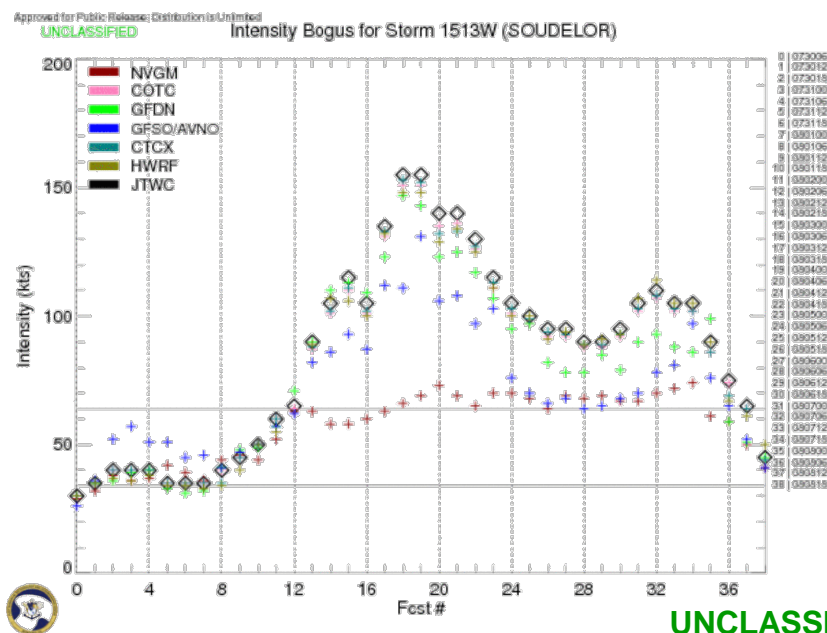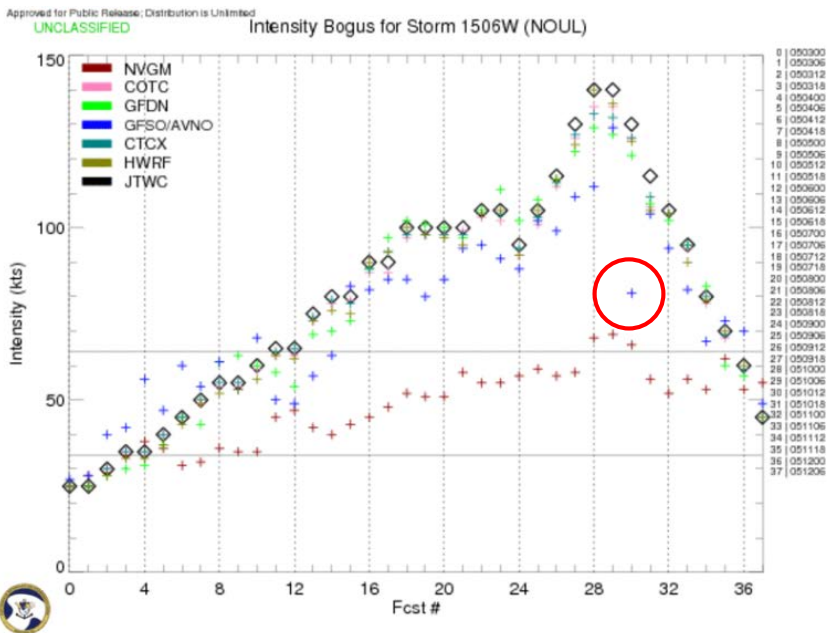
- **SHIPS-RI added to ATCF for 2015**

% of Tropical Cyclones with Rapid Intensification*
WESTPAC

Legend:
- # Total TC
- # TC w/RI
- %STY-RI
- %TY-RI
- %TS-RI

Cumulative Average: 98%, 67%, 44%
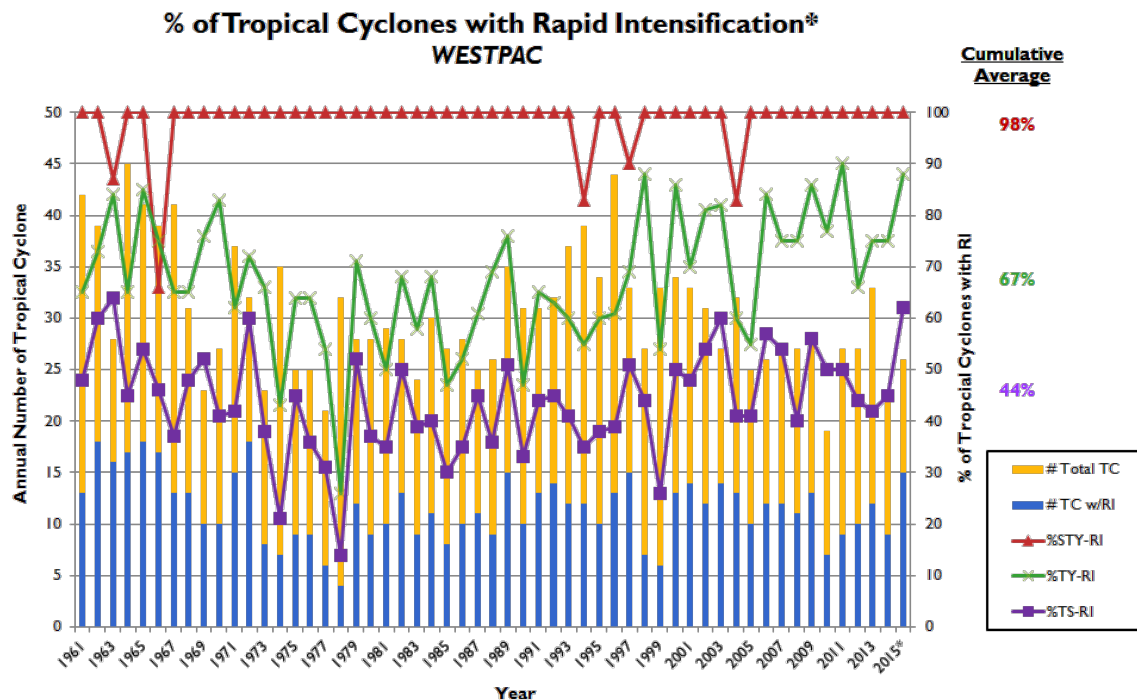
*RI defined as the an increase of 30 kts or more per 24 hours. Only the first occurrence of RI per TC is counted.

Vortex Initialization

- **Better matching between analyzed intensity and model analysis**

  - **HWRF and COAMPS-TC typically match JTWC bogus values**

  - **Noticeable improvement in GFS for strong TCs**

  - **NAVGEM initialization significantly lower for strong TCs**

- **GFS frequently over-analyzes tropical storms**

- **JTWC is studying gaps for 7-day warnings**

  - **Manpower**

    - **Impact to forecast cycle**

    - **Augmentation required for > 2 TCs, not uncommon**

  - **R&D of new and extended aids, evaluation of forecast skill needed**

    - **Must be coordinated with ATCF**

  - **More 7-day models needed**

- **ATCF buttonology exists to create 7-day warnings**

- **ECM/EEMN performing well**

2015 JTWC Tropical Activity Timeline

```
average track errors (NM) FOR HOMOGENEOUS SAMPLE
           24     48     72     96    120    144    168
AEMI      40.1   71.2  110.5  163.8  231.4  307.7  388.3
AVNI      39.8   67.6  104.4  154.3  233.7  316.1  409.5
ECM2      36.7   62.7   93.3  132.9  185.7  228.7  251.5
NVGI      51.7   88.0  135.0  186.6  233.1  311.9  406.0
EEM2      38.4   64.4   93.5  134.8  186.2  227.1  255.0
#CASES    218    185    157    127    100     75     50
```
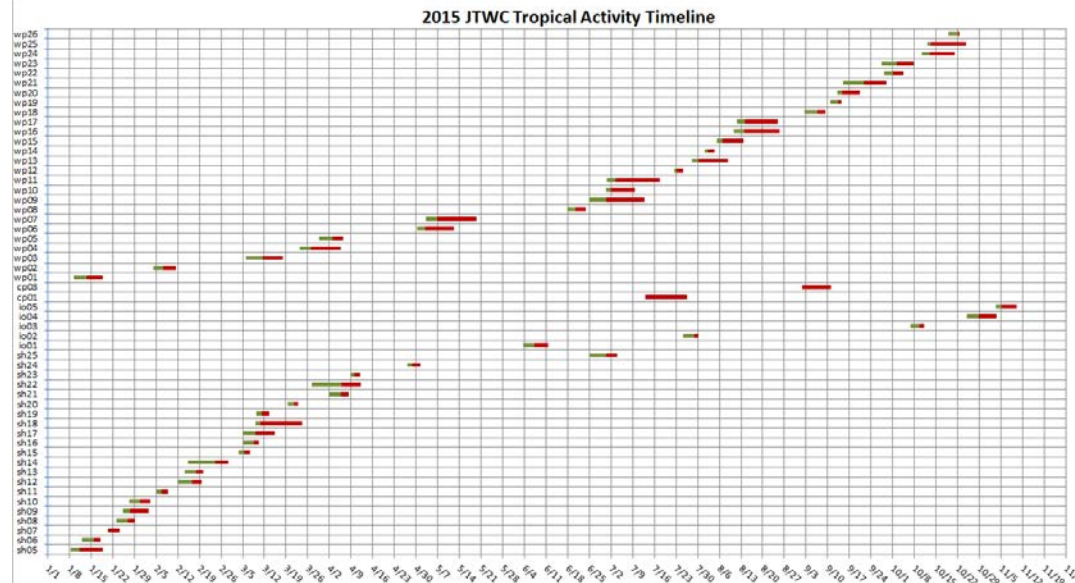
Following HFIP/NHC Work on TC Genesis

- **JTWC is studying capability for pre-genesis track and intensity warnings**

    - **Significant impact on manpower given number of JTWC invests**

    - **R&D of new aids, evaluation of forecast skill needed**
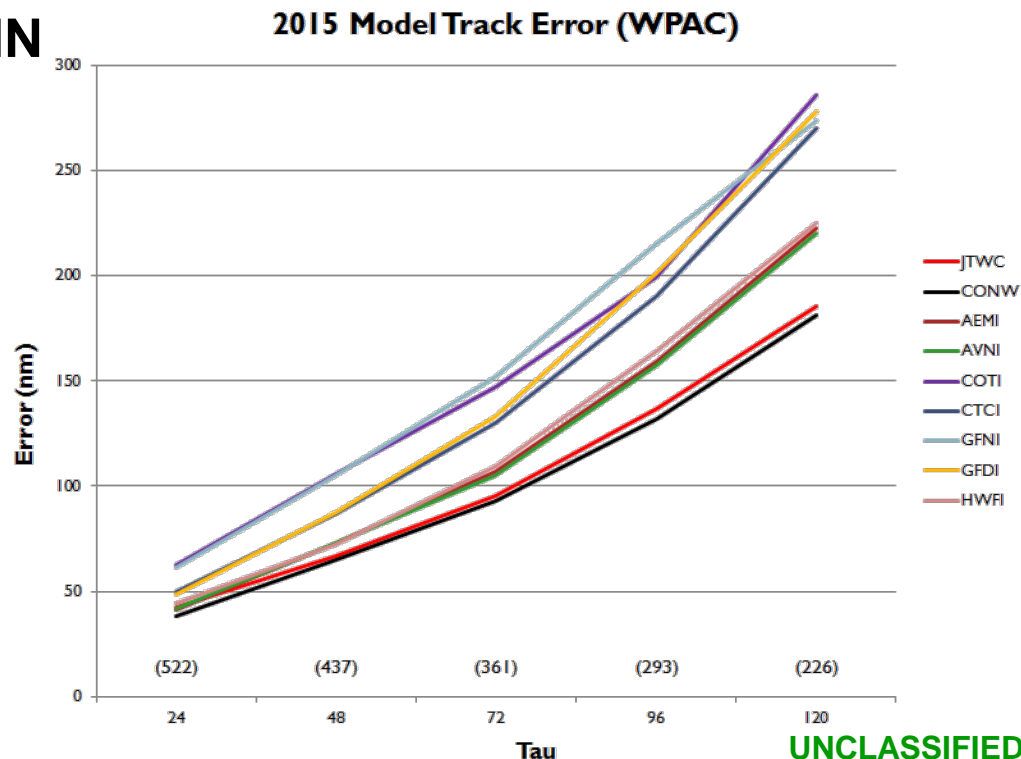
    - **Additional ATCF functionality required**

- **As noted, good overall model performance**

  - **CONW best guidance**

  - **ECMF, UKMO best dynamical models (greatly reduced sample size)**

- **HWRF on par with GFS, AEMN**

- **JTWC processing ECMF ensemble mean, and will evaluate MOGREPS**

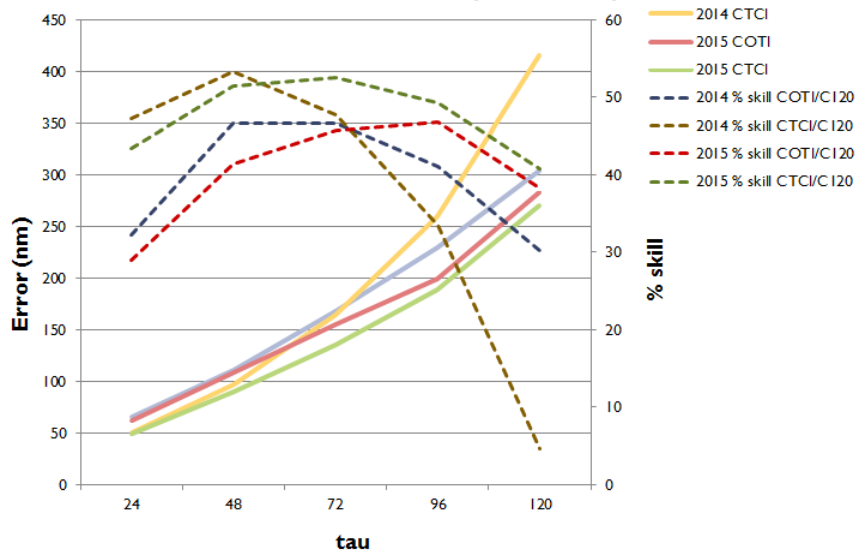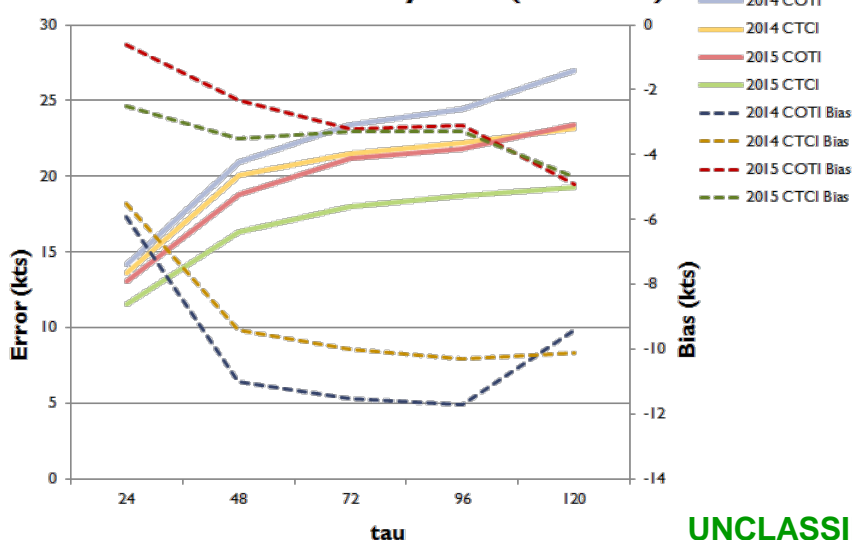
2015 Model Track Error (WPAC)

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COAMPS-TC

- **Significant improvements for 2015, particularly NRL/HFIP version**
    - **Top performing intensity model, low negative bias**
    - **Routinely handling super-typhoon intensity**
    - **Corrected initial spin-down issues**
- **JTWC desires WPAC COAMPS-TC ensemble**
- **Excellent support for experimental CTCI from NRL-MRY**
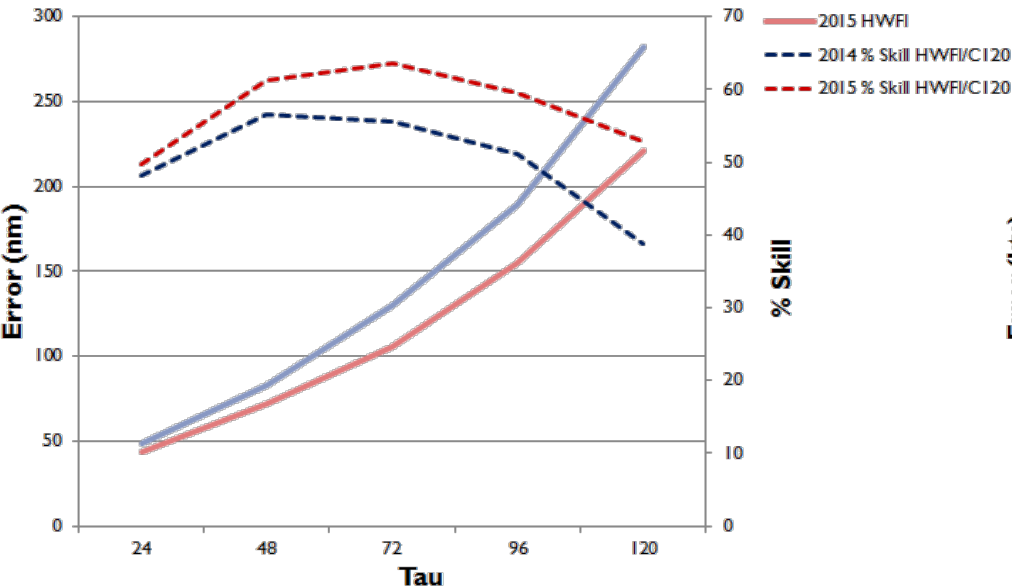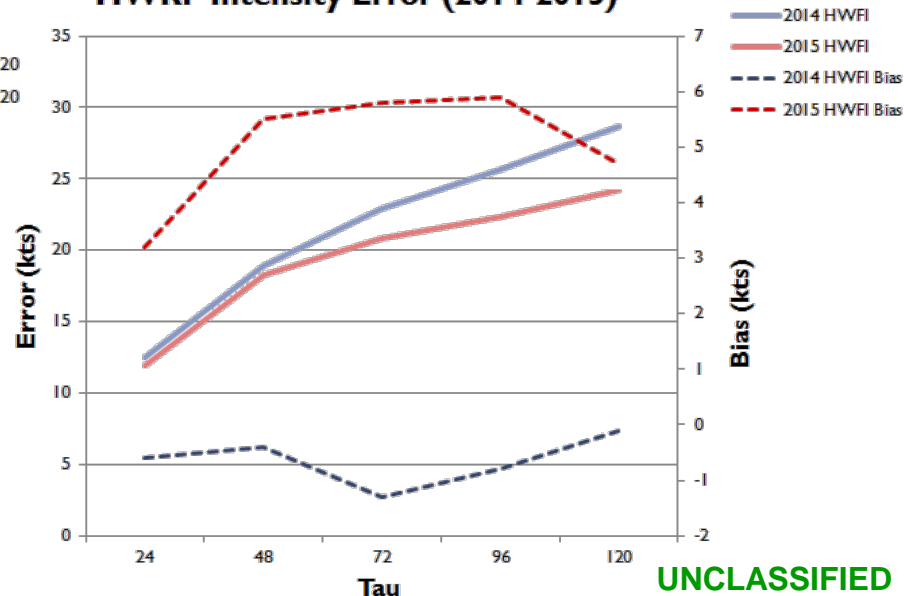
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HWRF

- **Success story for transition of stream 1.5 to operations**
  - **Transition to OPS allows JTWC to receive full upgrade suite**
  - **Supports NWS interests in Micronesia, American Samoa**
- **Improvement in track and intensity for 2015**
- **JTWC interested in basin-scale HWRF – numerous concurrent TCs in WPAC**


HWRF Track Error (2014-2015)

Legend: 2014 HWFI, 2015 HWFI, 2014 % Skill HWFI/CI20, 2015 % Skill HWFI/CI20

HWRF Intensity Error (2014-2015)

Legend: 2014 HWFI, 2015 HWFI, 2014 HWFI Bias, 2015 HWFI Bias

Joint Typhoon Warning Center ———— *Forward, Ready, Responsive Decision Superiority*

GFDL

- **Continuation of GFDL/Ensemble in WPAC, and expansion to SHEM, IO appreciated**
    - **Second best mesoscale model intensity guidance in 2015 (GFDL)**
    - **JTWC desires continued GFDL/GFDN support**
- **Only single model ensemble currently available in JTWC AOR**
- **Ensemble data depictions well received by TDOs**
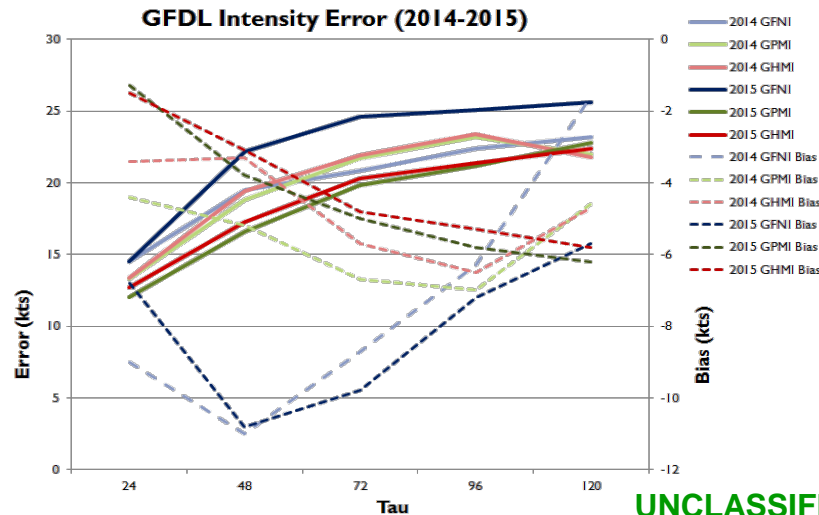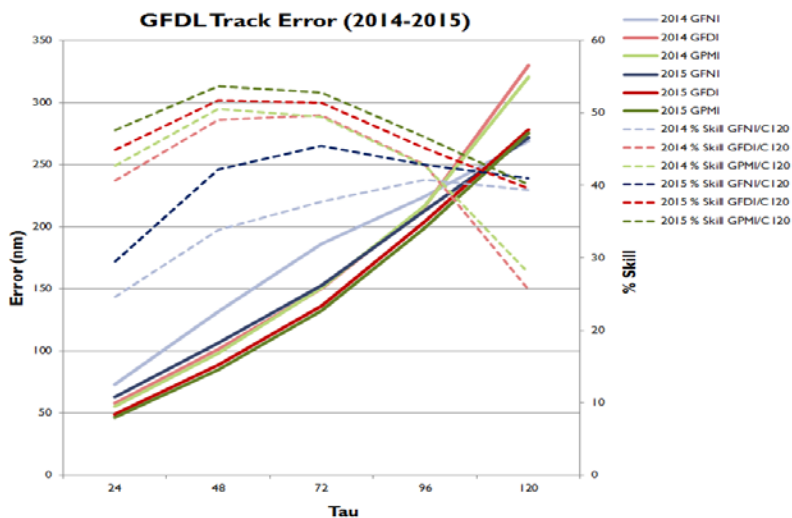
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Other Strategic Priorities

- **Confidence-based Error Swath**

  - **Evaluating ATCF capability to weight swath size by ratio of GPCE to GPCC**

- **TC Structure analysis/forecast improvements**

  - **Evaluating use of model-derived R34 in objective wind radii analysis and forecast consensus**

    - **Address JTWC "small" bias in wind radii specification**

- **ATCF Development**

Chapter 5   Technical Development Summary

Section 1: Operational Priorities

The top operational priority of the Joint Typhoon Warning Center is sustained development and support of The Automated Tropical Cyclone Forecast System (ATCF). ATCF is the DOD's primary toolkit for analyzing and forecasting tropical cyclones (TCs), and is the principal software platform through which emerging research transitions into JTWC operations. Without ATCF, JTWC could not generate TC formation alerts or warnings. The systems tracks all TC activity and invest areas, automatically processes objective forecasting aids, produces TC formation alert, warning text and graphical products, and provides core capabilities for analyzing TCs and their environment. Additionally, ATCF provides JTWC Contingency of Operations Plan (COOP) backup capabilities to FWC-Norfolk and analytic support to FWC-San Diego for tasks such as setting TCCOR, forecasting on-station wind speed, designating OTSR "MODSTORM" locations, and preparing diverts and advisories. JTWC upgraded to the latest version of ATCF (v5.7) in June 2014. This upgrade incorporated new data displays such as composite microwave imagery overlays and radar, and a host of other improvements to the efficiency of data processing and filtering.

The collaborative efforts of the many agencies, labs, and academia through HFIP are making a difference.

Questions?