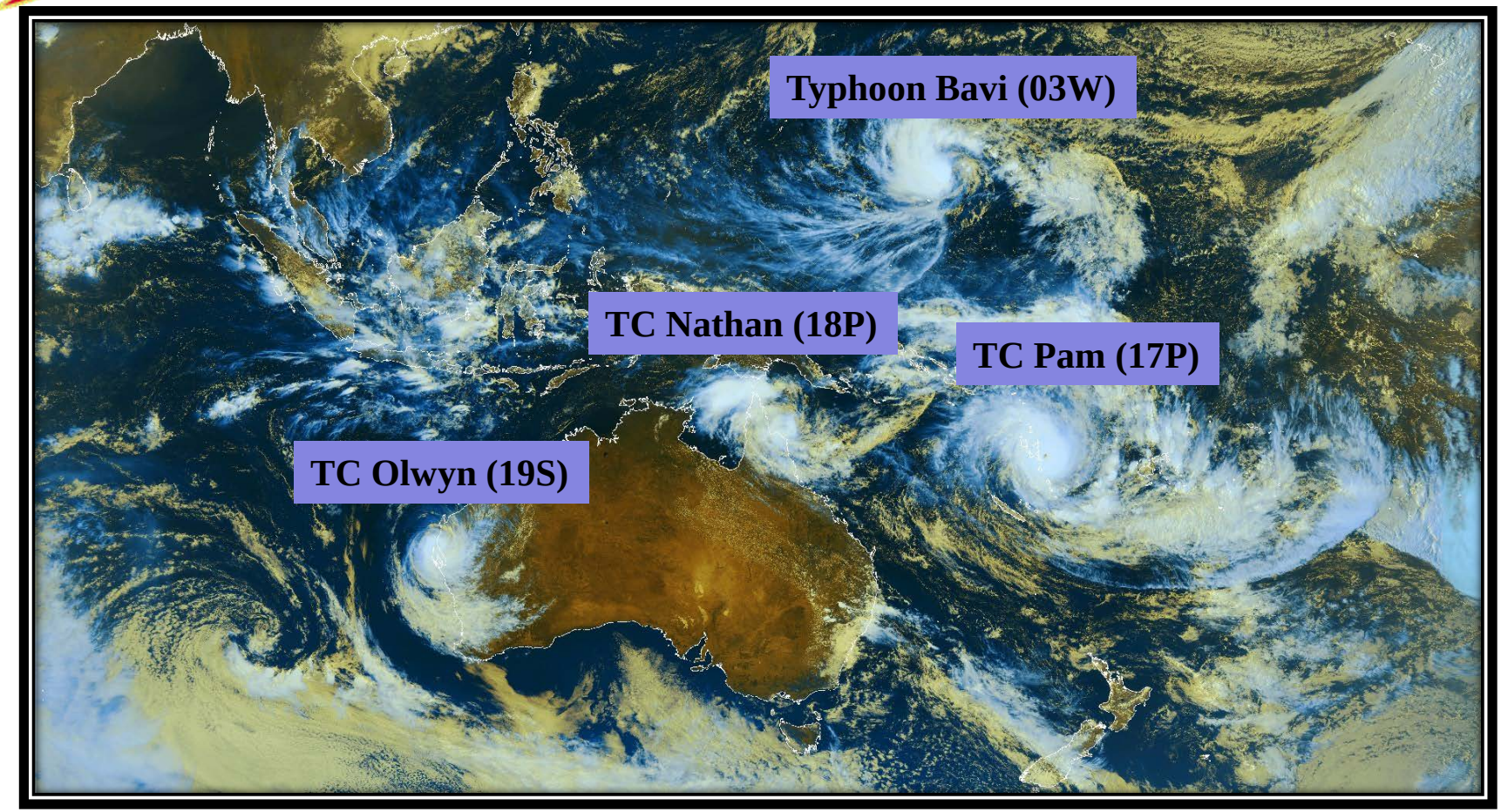
# TROPICAL CYCLONE OPERATIONS




**2016 Tropical Cyclone Operations and Research Forum**

**(70th Interdepartmental Hurricane Conference)**

**RSMAS, Miami FL**

**15-17 March 2016**

**Mr. Robert (Bob) Falvey**
**Director, Joint Typhoon Warning Center**

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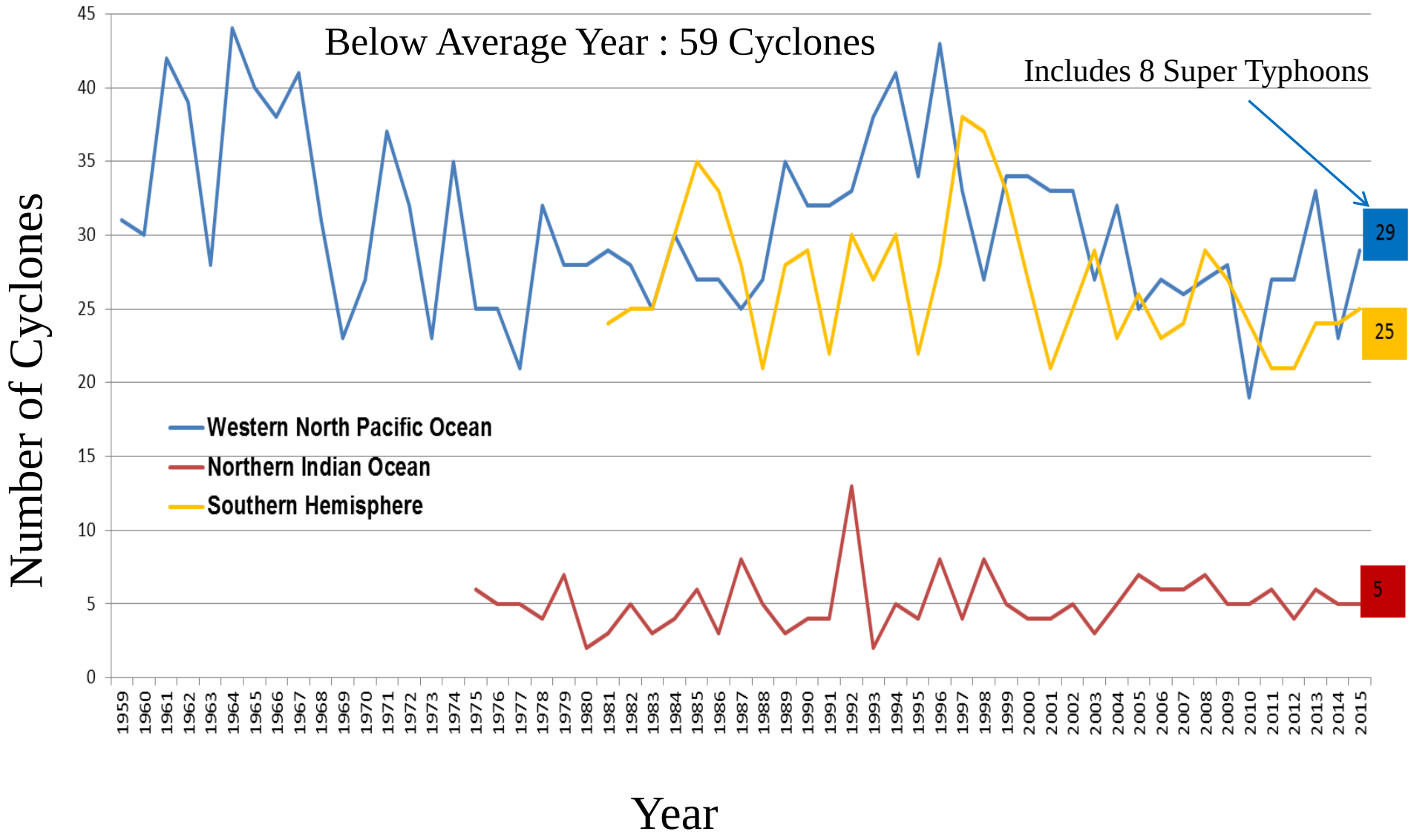
# OUTLINE

- **Brief Seasonal Summary**
- **Reconnaissance Summary and Challenges**
- **Forecast Summary and Challenges**
- **Research Priorities**

# ANNUAL TC ACTIVITY

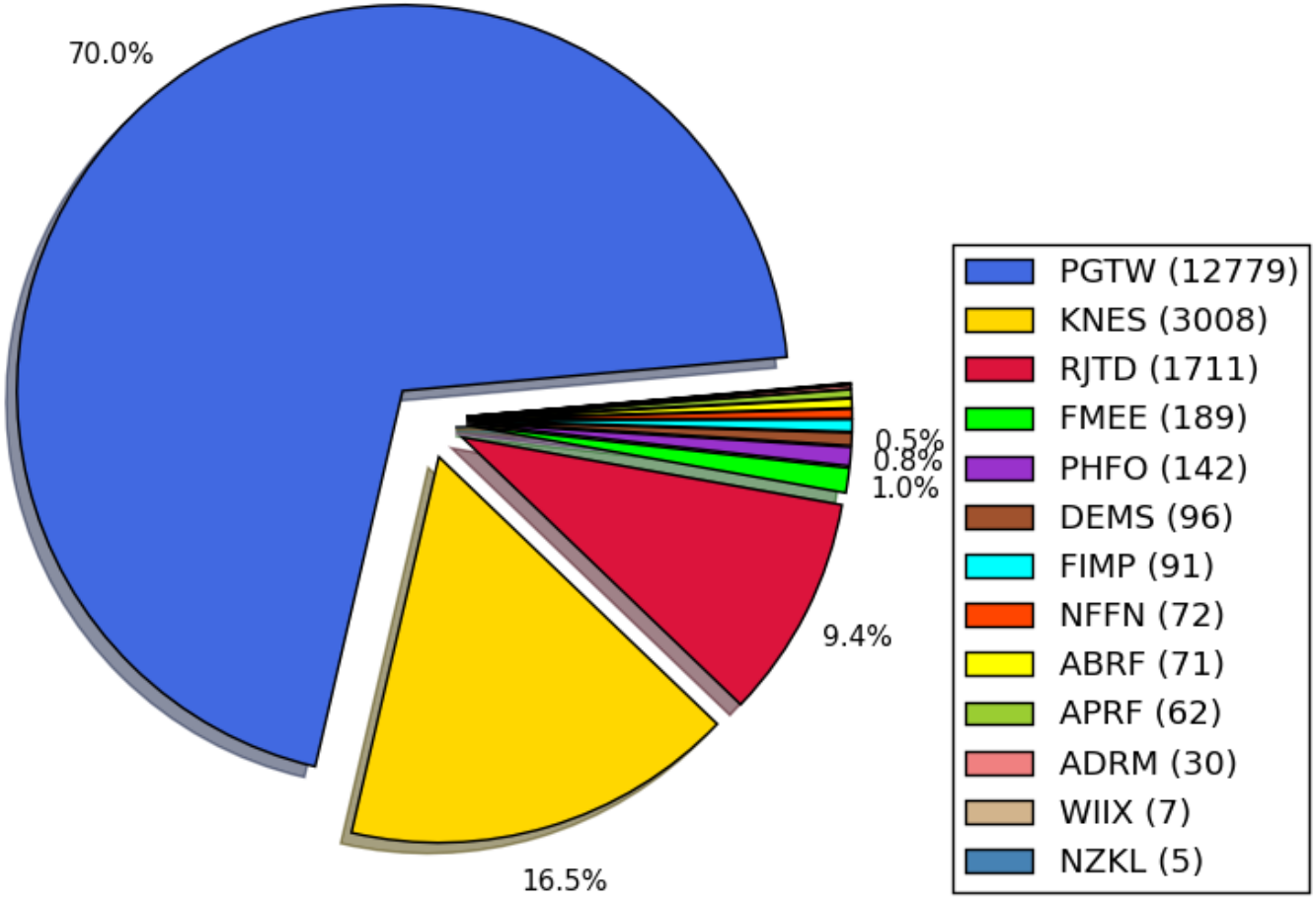
## (All Intensities All Basins – Based on Genesis Location)



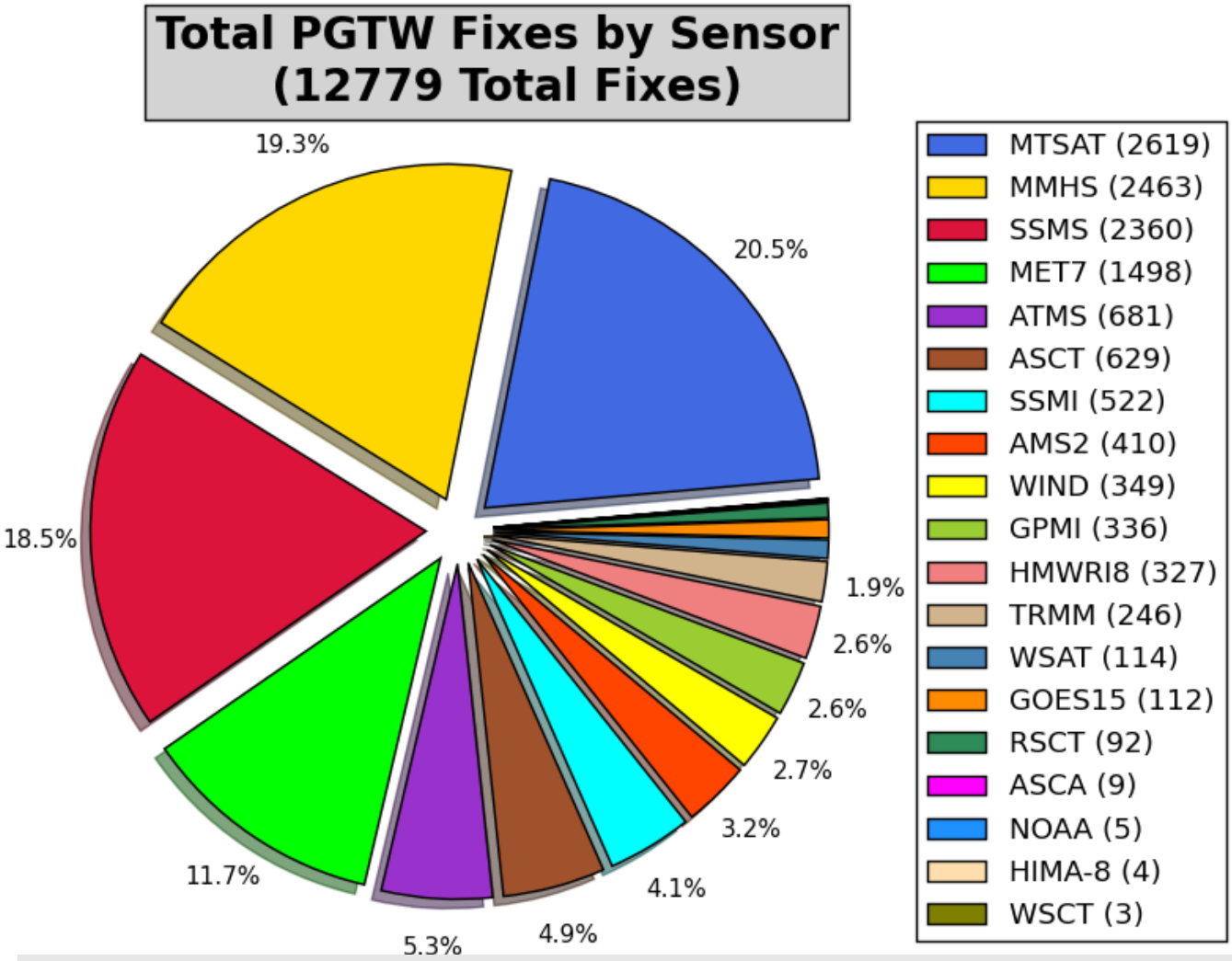
# 2015 SATELLITE RECON

## Fixes by Agency

**Fixes by Agency (18263 Total Fixes**



# 2015 SATELLITE RECON

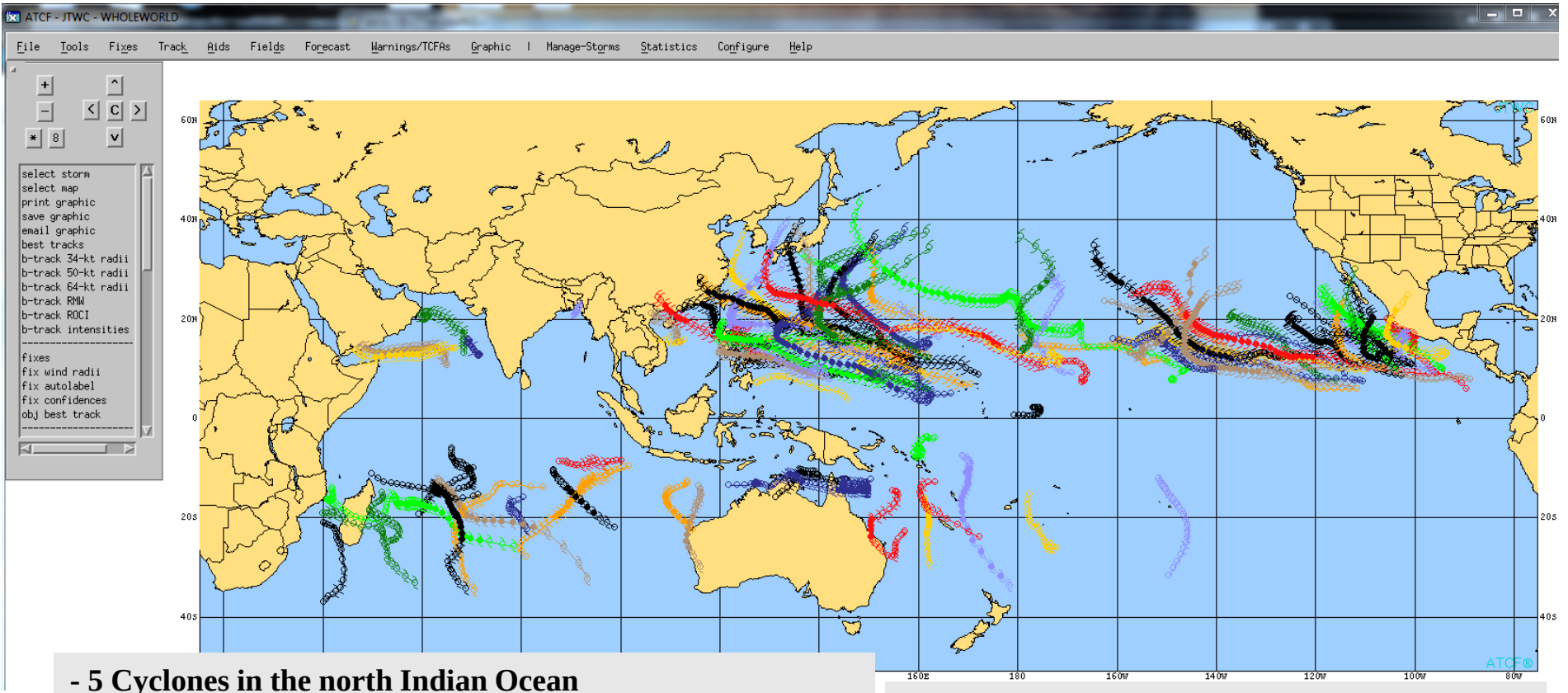



- Over 4.5K fixes using geostationary imagery ~ 36%
- Over 7.3K fixes using microwave imagery from polar orbit ~ 57%
- Over 800 scatterometry fixes ~7%

# SATELLITE RECON CHALLENGES

- METEOSAT-7 Deorbit
  - End of 2016
  - No viable replacement identified (China, Russia, India)
  - Arabian Sea & Bay of Bengal on limb of “Allowed” satellites
- Himawari Data
  - Direct Read Out (DRO) into USAF Mark IVB in Hawaii and Guam
    - 5 of 16 channels – 14 available later this FY
  - No DRO into USN FMQ-17
    - Time-late data from FNMOC
    - Via Hawaii Mark IVB to 557 WW to FNMOC
    - Air Force Network outage = JTWC recon mission failure
    - Working DRO requirement through Navy Headquarters
- Microwave (MW) Data
  - Availability of MW sensors decreasing – more than ½ of fixes
  - DMSP F-19 anomaly / no funding to launch F-20
  - Weather Satellite Follow-on (WSF) – little to no progress
- Ocean Surface Vector Winds (OSVW)
  - Vital for storm structure analysis, model initialization & TCFA/Warning timing
  - Active scatterometers preferred over passive MW retrievals – future tenuous
  - ASACT A/B overlap, WINDSAT life expectancy/funding, RSCAT mission ending?

# 2015 TROPICAL CYCLONE ACTIVITY



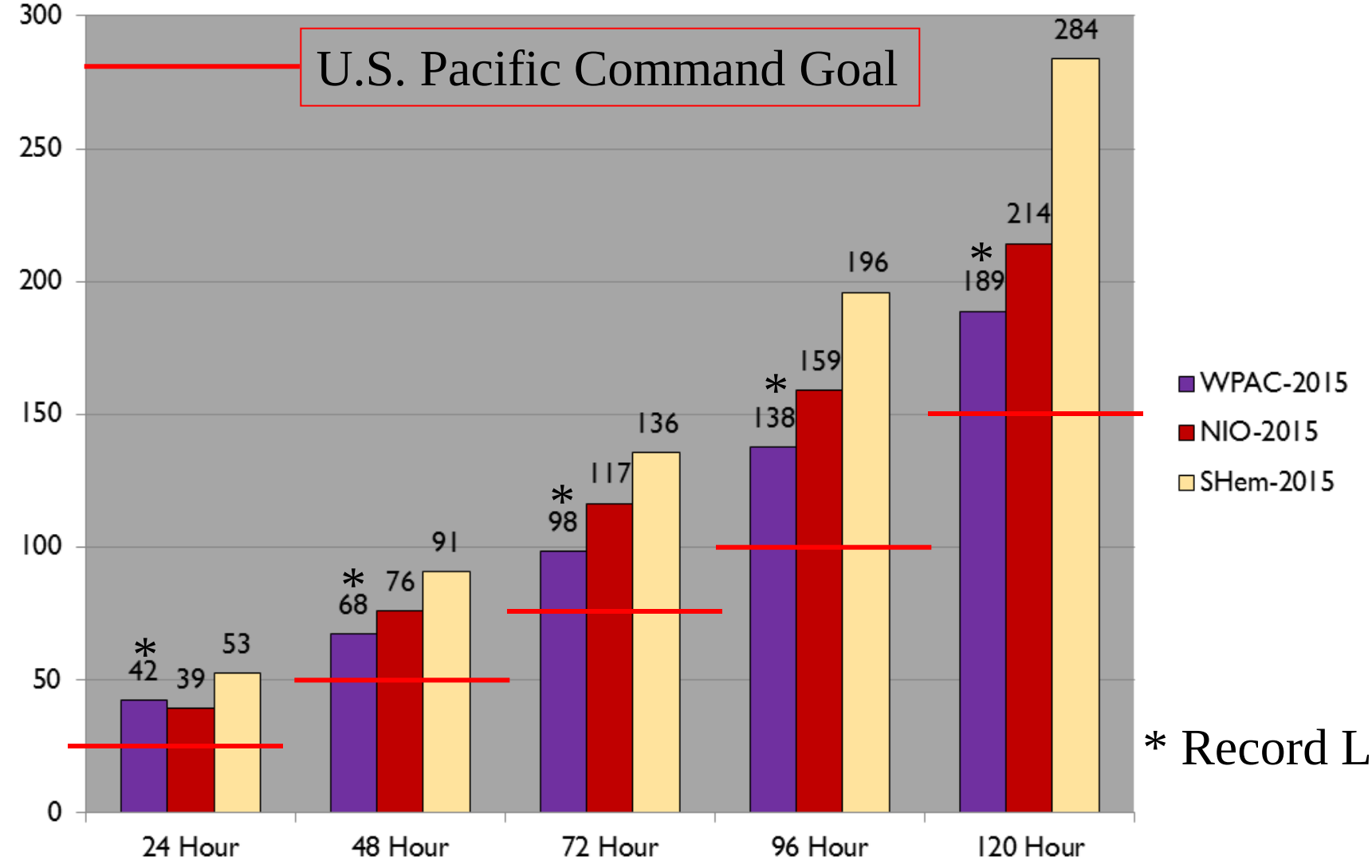

- 5 Cyclones in the north Indian Ocean
- Most significant cyclone was TC 04A (Chapala) with a peak intensity of 130 kts -- landfall in Yemen

- Strong El Nino shifted genesis eastward
- More typical tracks, only a few north movers

- Fairly typical SHEM season with 25 cyclones – 2 below the long term average
- Most significant cyclones:
  -- TC 19S (Olwyn) – 90 kt peak intensity impacted Learmonth at 80 kts
  -- TC 24S (Quang) – 115 kt peak intensity impacted Learmonth at 70 kts

# 2015 JTWC TRACK ERRORS

## All Basins (preliminary)

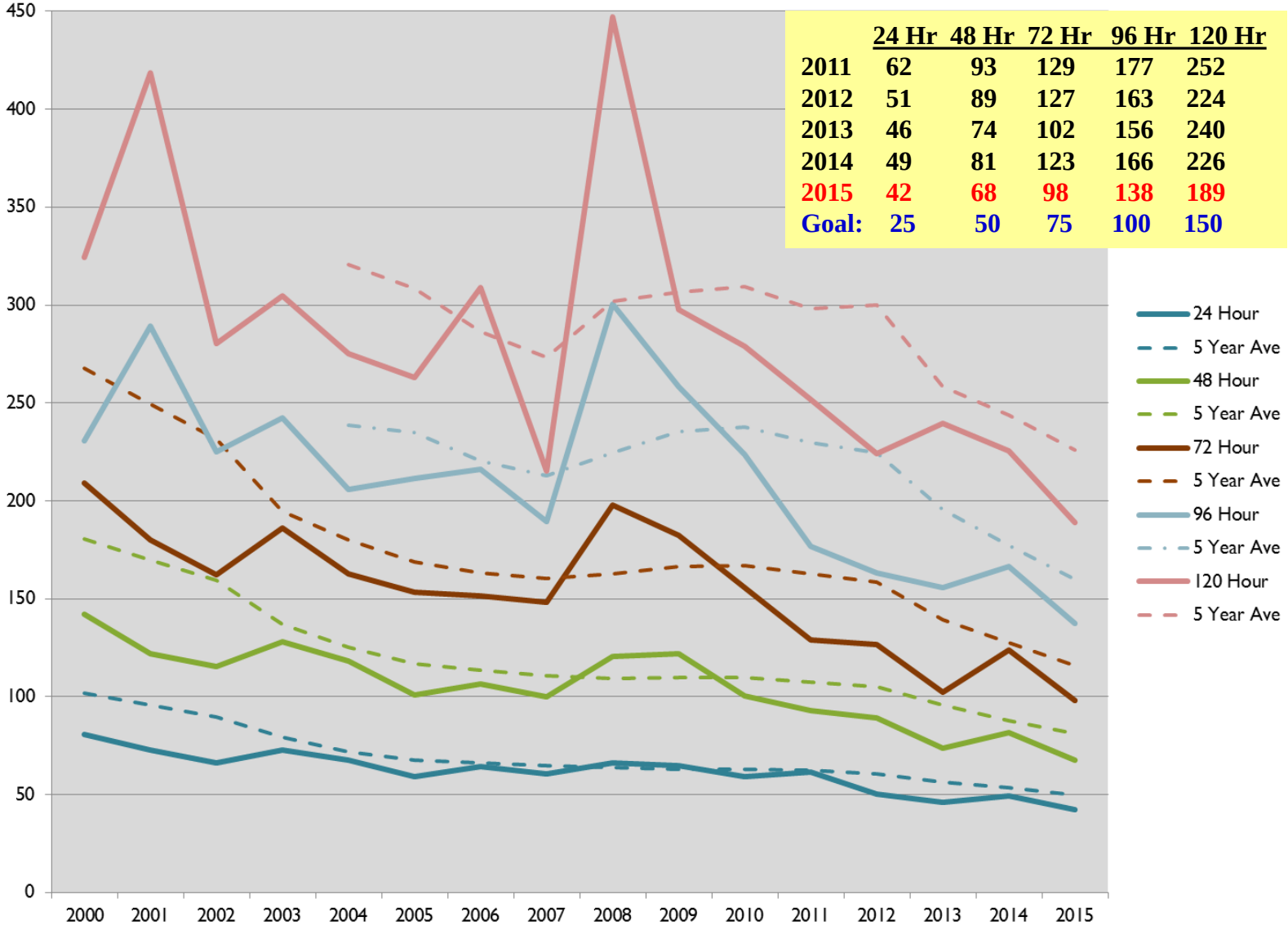



* Record Low

# JTWC TRACK ERRORS

## Western North Pacific (preliminary)

| | 24 Hr | 48 Hr | 72 Hr | 96 Hr | 120 Hr |
|---|---|---|---|---|---|
| 2011 | 62 | 93 | 129 | 177 | 252 |
| 2012 | 51 | 89 | 127 | 163 | 224 |
| 2013 | 46 | 74 | 102 | 156 | 240 |
| 2014 | 49 | 81 | 123 | 166 | 226 |
| 2015 | 42 | 68 | 98 | 138 | 189 |
| Goal: | 25 | 50 | 75 | 100 | 150 |

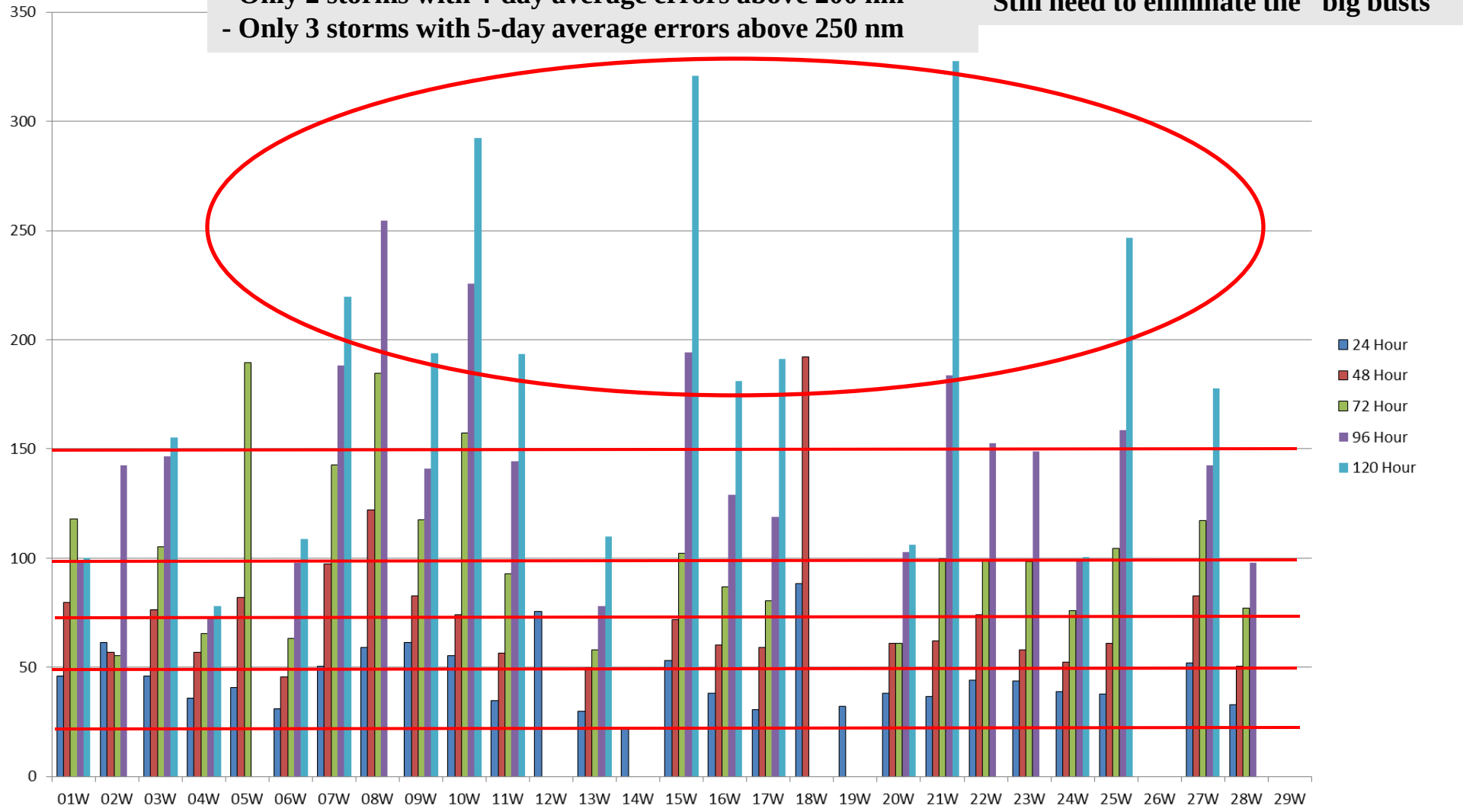


# 2015 TRACK ERRORS BY STORM

## Western North Pacific (preliminary)

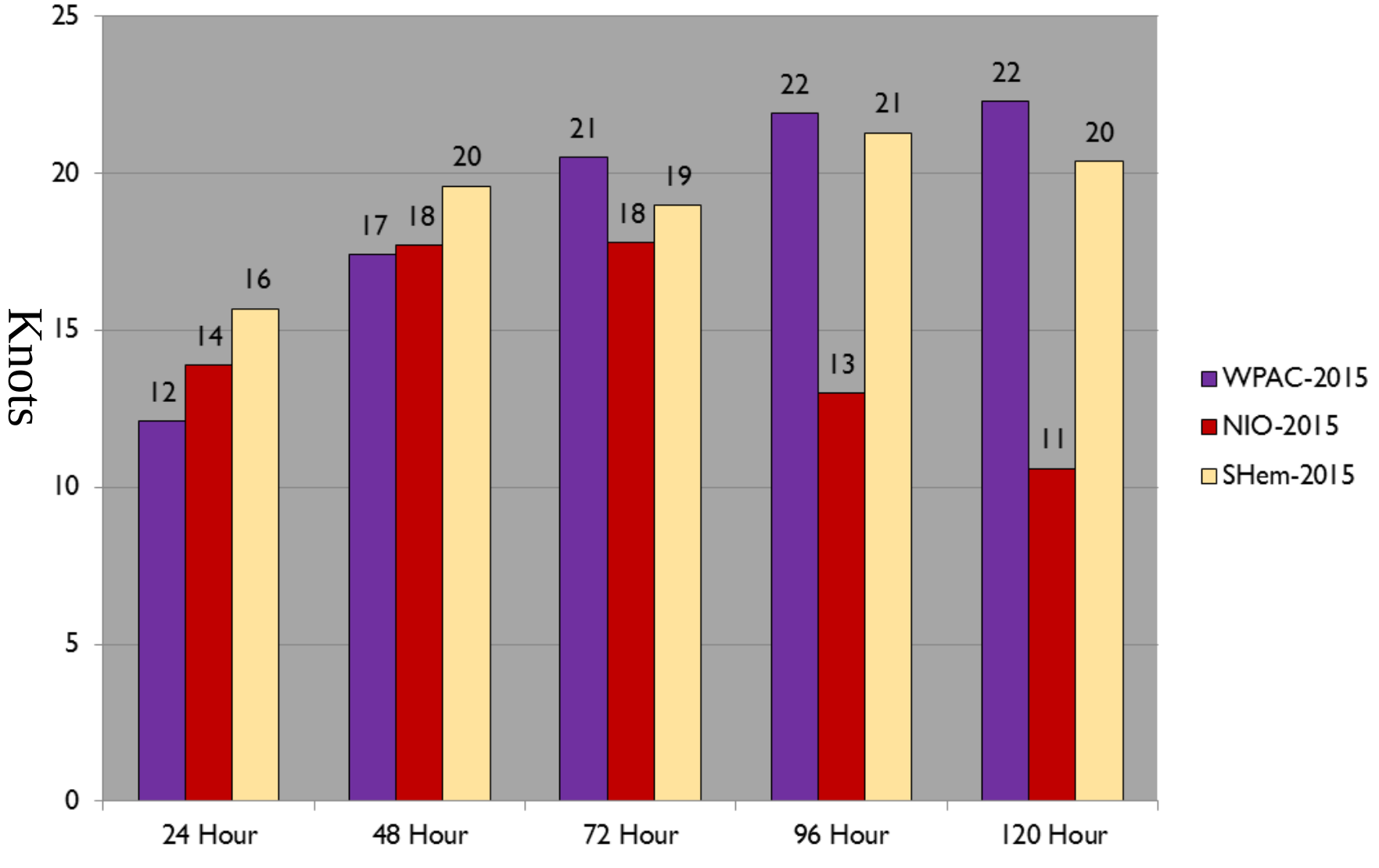
- Only 4 storms with 3-day average errors above 150 nm
- Only 2 storms with 4-day average errors above 200 nm
- Only 3 storms with 5-day average errors above 250 nm

Still need to eliminate the “big busts”



# 2015 JTWC INTENSITY ERRORS

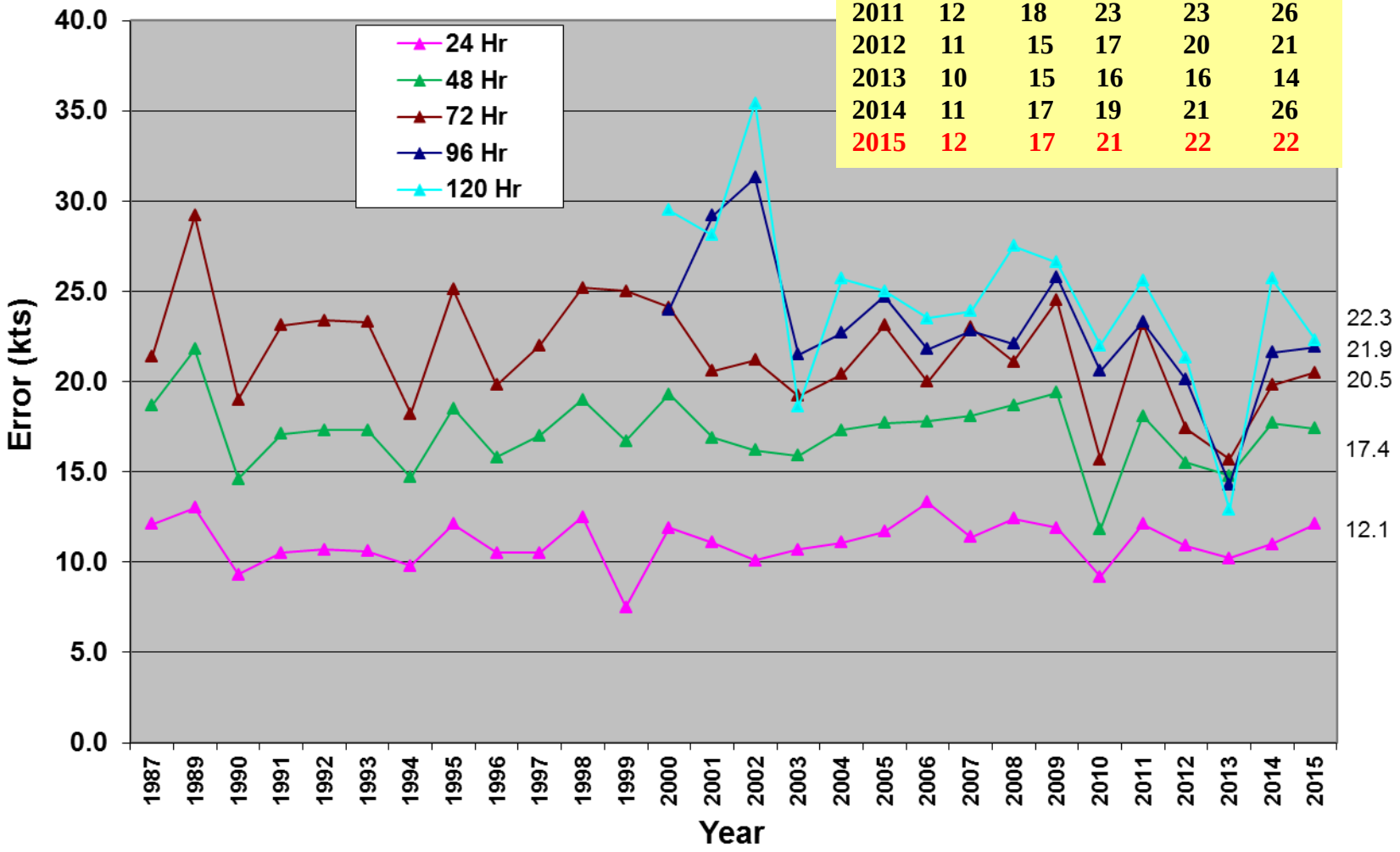
## All Basins (preliminary)



# JTWC INTENSITY ERRORS

## Western North Pacific 24 - 120 Hours (preliminary)

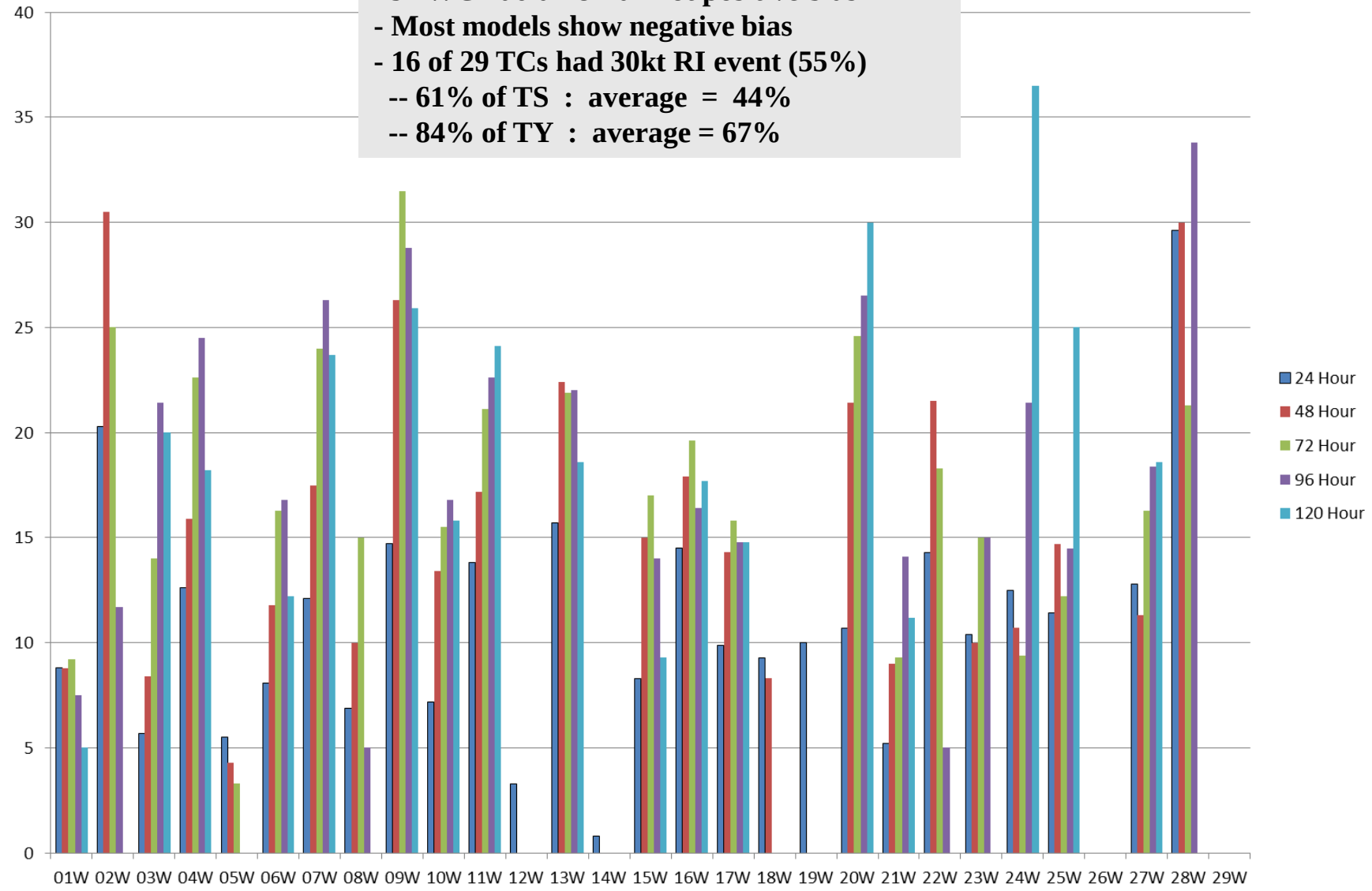
| | 24 Hr | 48 Hr | 72 Hr | 96Hr | 120Hr |
|---|---|---|---|---|---|
| 2011 | 12 | 18 | 23 | 23 | 26 |
| 2012 | 11 | 15 | 17 | 20 | 21 |
| 2013 | 10 | 15 | 16 | 16 | 14 |
| 2014 | 11 | 17 | 19 | 21 | 26 |
| 2015 | 12 | 17 | 21 | 22 | 22 |



# 2015 INTENSITY ERRORS BY STORM

## Western North Pacific (preliminary)

- JTWC had an 8-10 knot positive bias
- Most models show negative bias
- 16 of 29 TCs had 30kt RI event (55%)
  -- 61% of TS : average = 44%
  -- 84% of TY : average = 67%



# FORECASTING CHALLENGES

- Rapid Intensity Change
  - Current RI guidance only predicts 0-24 hours
  - RI often happens at day 3 to day 5
- Intensity Forecast Guidance
  - Mahalo to HFIP Program and scientists for progress to date
  - Some new tools developed or being developed – need more
  - Statistical-Dynamical performs best, on average – but not for RI magnitude
  - Meso-models still under forecast RI, but “trend” is useful
    - COAMPS_TC performed best, followed by HWRF
- Data Visualization and Fusion Tool
  - Diagnosis of model prediction via fields key
  - WXMAP/JMV/ATCF insufficient
  - AWIPS-2 coming, but may not realize benefits for 2-3 years
- Storm Structure (wind radii)
  - Primarily climatologically based, with known small bias
  - Local ROT used to adjust to fit synoptic / meso environment
  - Dynamic model consensus being evaluated for use

# 2016 JTWC Research Priorities

| Priority | Need | Priority | Need |
|---|---|---|---|
| **1** | Probabilistic and deterministic forecast guidance for TC intensity change, particularly the onset, duration, and magnitude of rapid intensification events and eyewall replacement cycles, as well as over-water rapid weakening events | **4** | Enhancements to the operational environment that increase forecaster efficiency by expediting analysis, forecast, coordination, and/or communication activities. In particular, transitioning of successful guidance products to integrated operational forecast systems such as the ATCF or AWIPS. |
| **2** | Techniques or products that improve the utility and exploitation of microwave, ocean surface wind vector, and radar data for TC location, intensity and structure analysis, and/or for diagnosing RI, ETT, ERC, *etc*. (*e.g*., a "Dvorak-like" technique using microwave imagery). | **5** | Probabilistic guidance of TC genesis timing as well as forecast guidance of track, intensity and structure of pre-genesis tropical disturbances. Guidance should be given for both the short-range (0-48hours) and the medium-range (48-120 hours), and exhibit a high probability of detection and a low false alarm rate. |
| **3** | Accurate deterministic and probabilistic guidance to improve TC track forecast skill, particularly wrt identification and reduction of large error outliers, including speed errors (e.g., accelerating recurvers and Q-S systems), direction errors (e.g., loops), and specific forecast problems such as upper-level trough interaction, near/over-land, elevated terrain, and extratropical transition. | **6** | Techniques to diagnose and predict the formation of TCs via transition of non-classical disturbances, *e.g.* monsoon depressions, sub-tropical cyclones, hybrids, **etc**., and to forecast track, intensity, and structure prior to TC transition. |

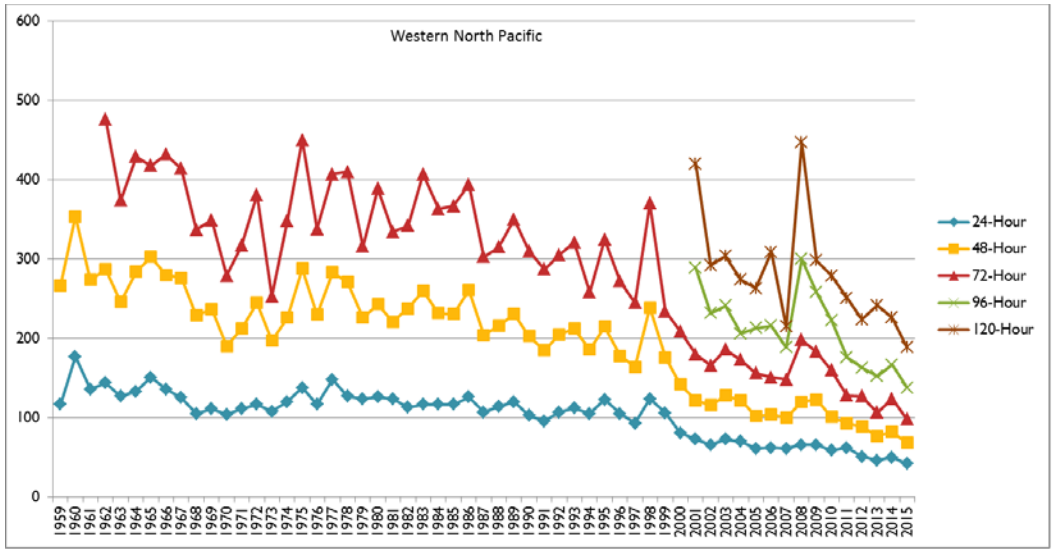
# TROPICAL CYCLONE OPERATIONS

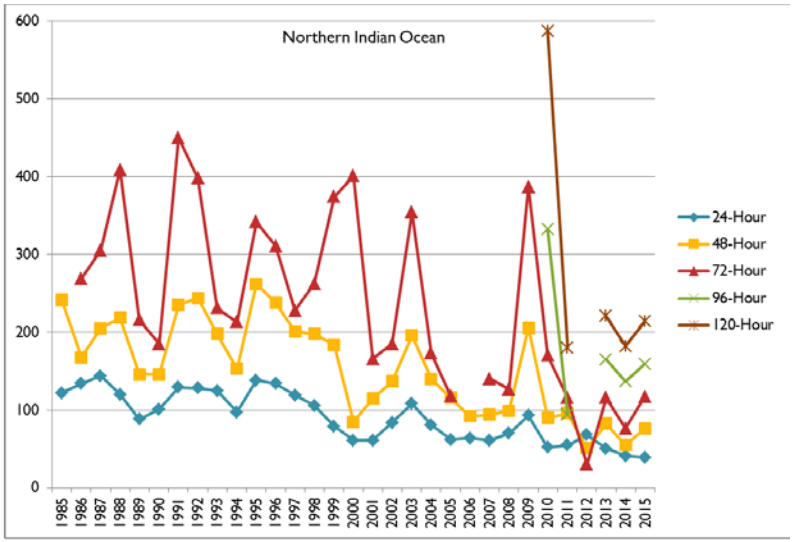
??QUESTIONS??

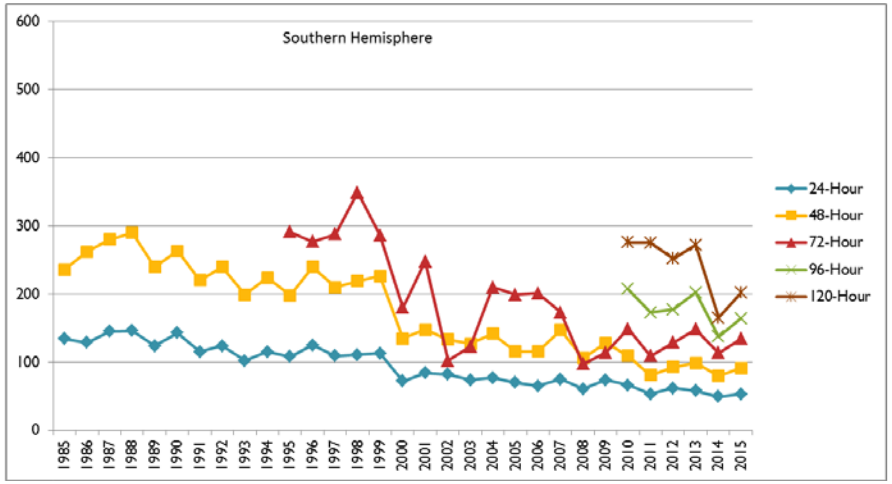
# BACKUP SLIDES

# JTWC TRACK ERRORS

## All Basins

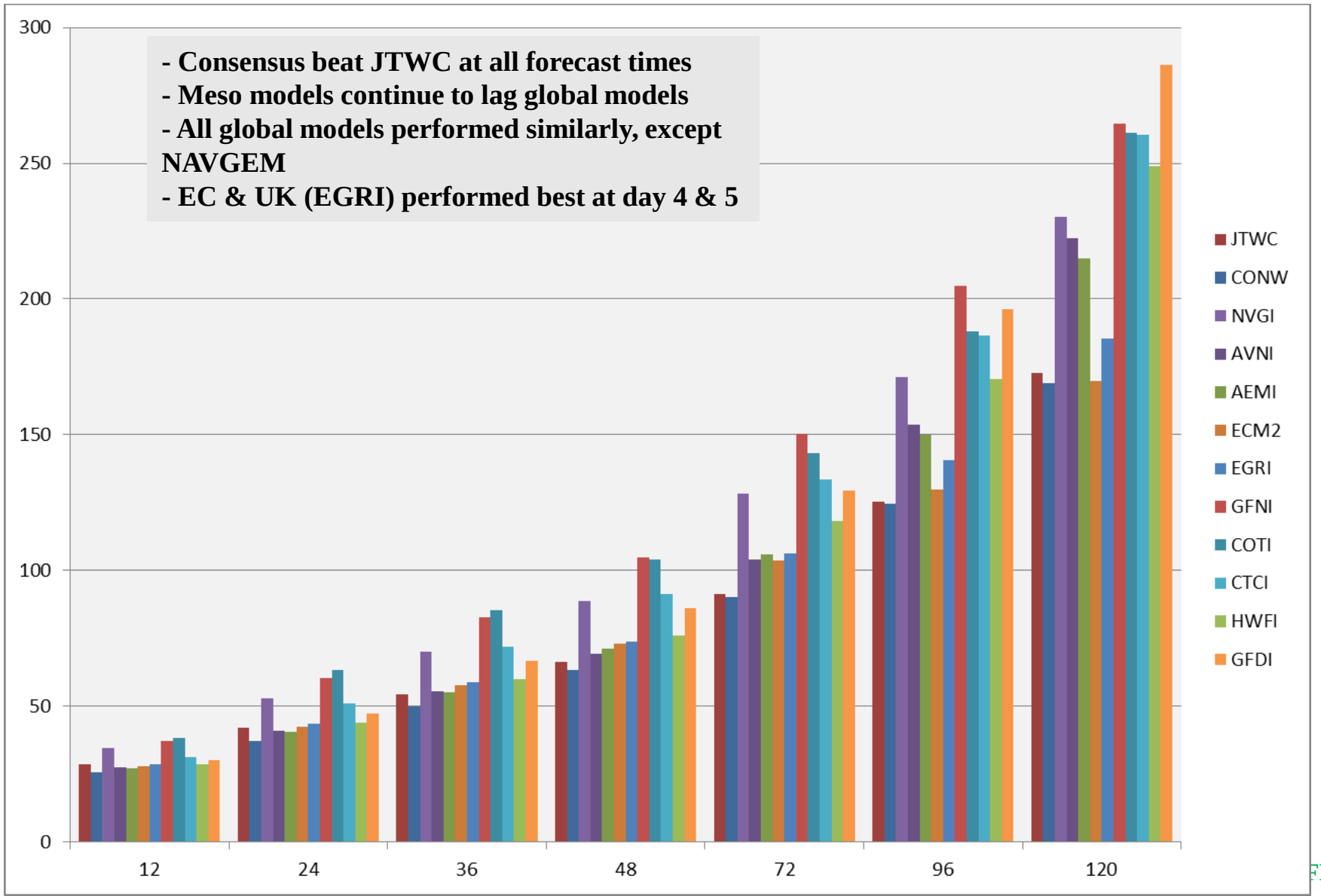


# 2015 MODEL TRACK ERRORS

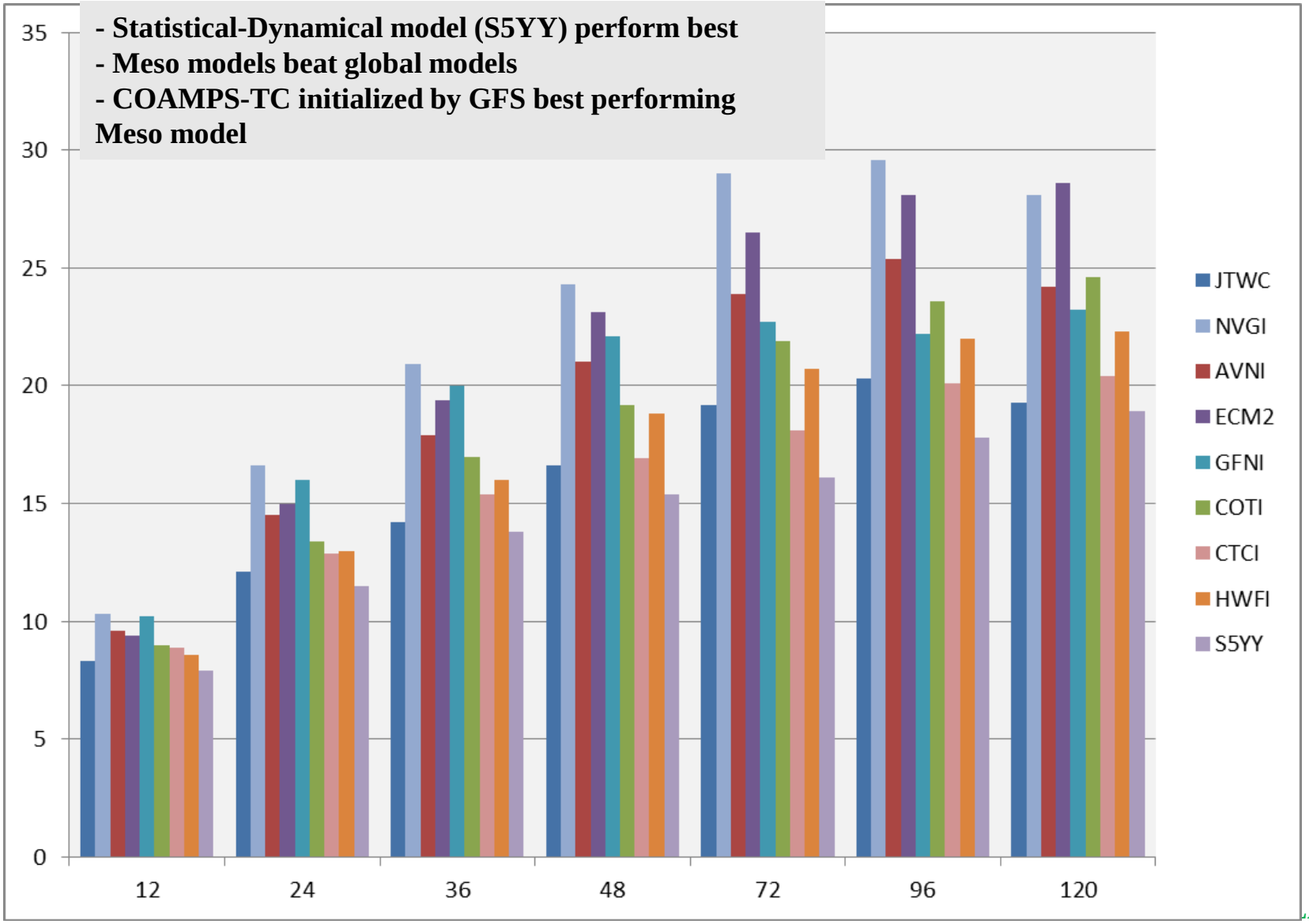
## Western North Pacific – Homogeneous (preliminary)



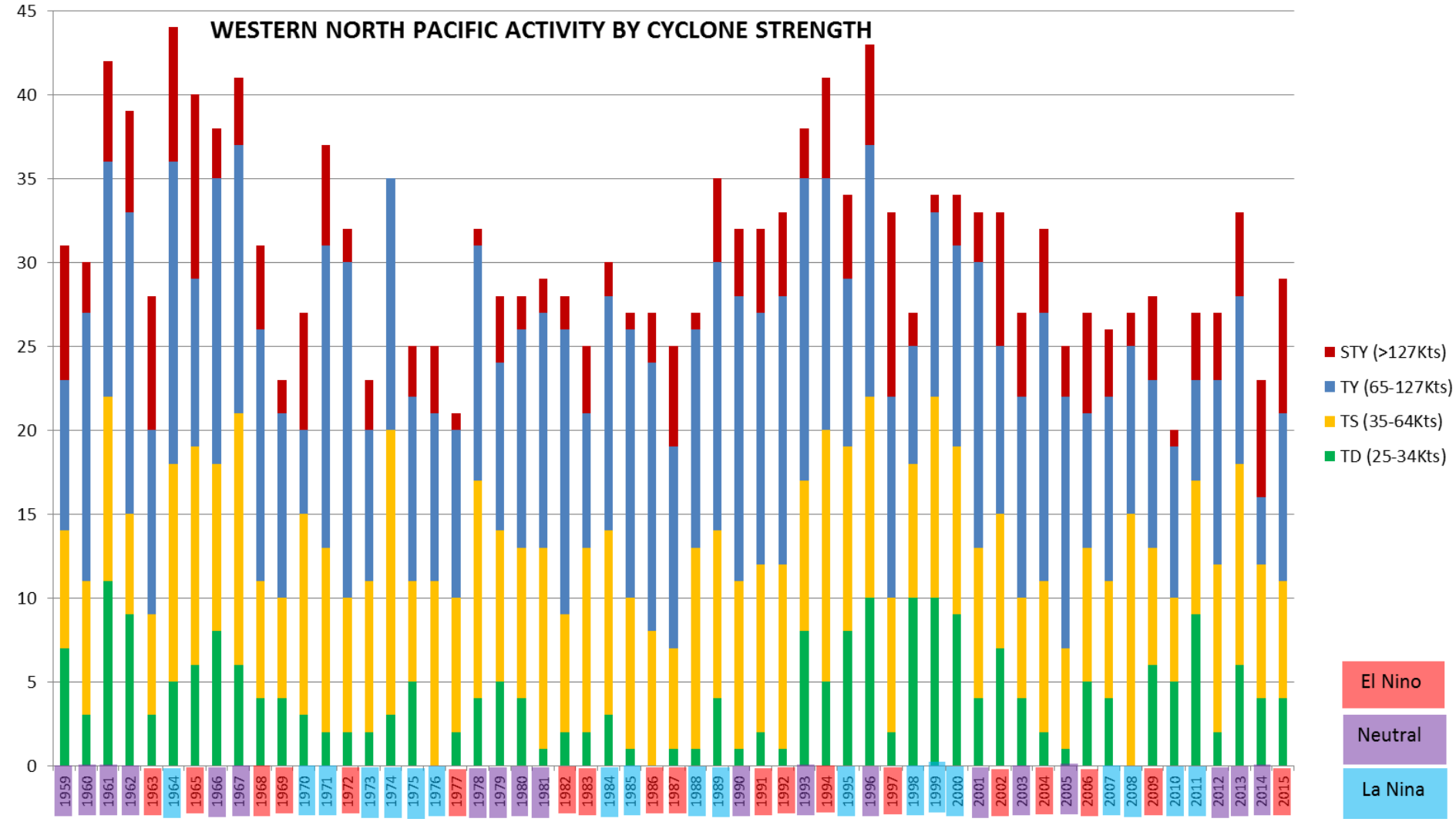
# 2015 MODEL INTENSITY ERRORS

## Western North Pacific – Homogeneous (preliminary)

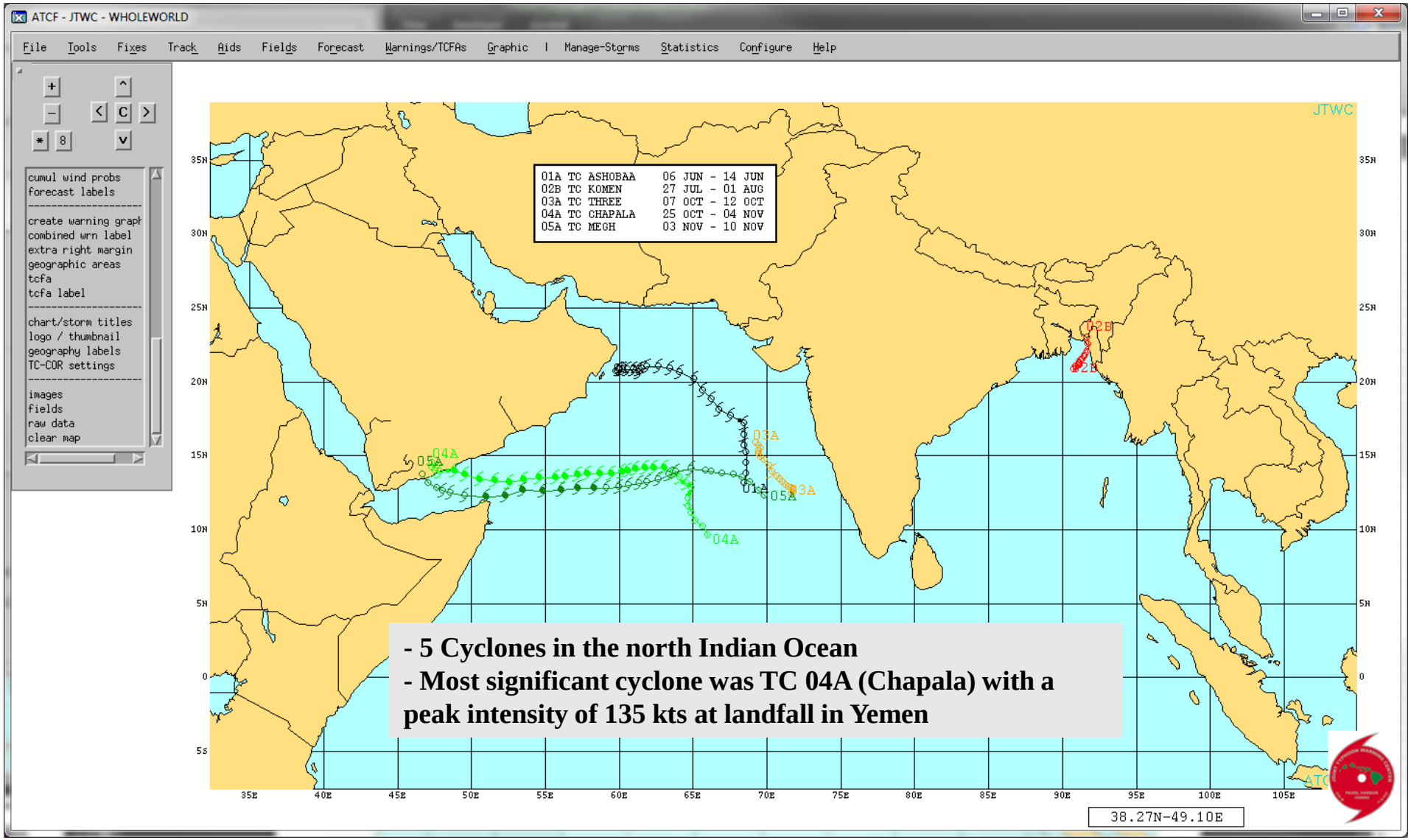
- Statistical-Dynamical model (S5YY) perform best
- Meso models beat global models
- COAMPS-TC initialized by GFS best performing Meso model



# WPAC ENSO CLIMO



# 2015 NORTH INDIAN OCEAN




- 5 Cyclones in the north Indian Ocean
- Most significant cyclone was TC 04A (Chapala) with a peak intensity of 135 kts at landfall in Yemen

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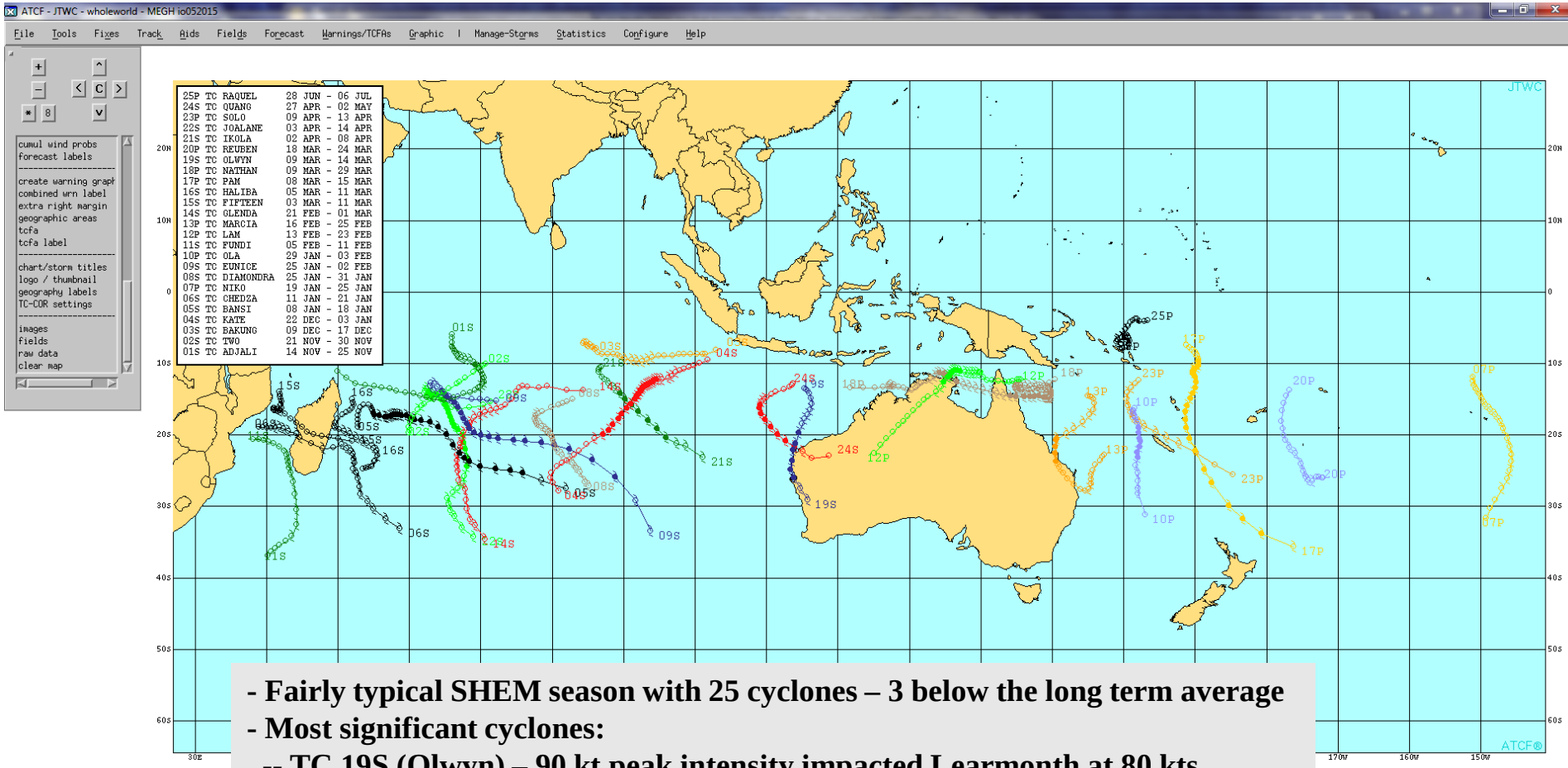
# 2015 SOUTHERN HEMISPHERE




- **Fairly typical SHEM season with 25 cyclones – 3 below the long term average**
- **Most significant cyclones:**
  - **-- TC 19S (Olwyn) – 90 kt peak intensity impacted Learmonth at 80 kts**
  - **-- TC 24S (Quang) – 115 kt peak intensity impacted Learmonth at 70 kts**

28.47N-137.67E

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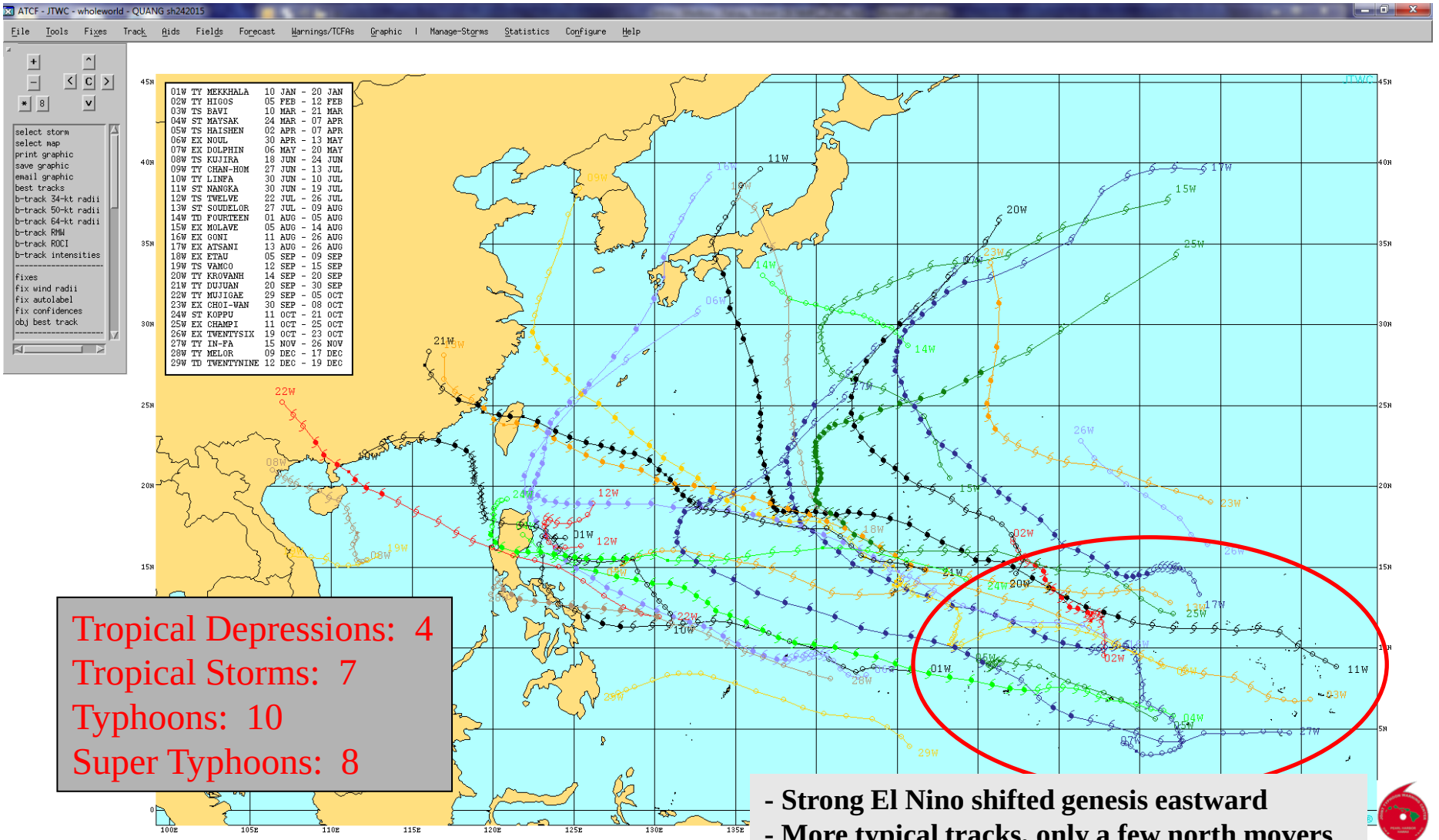
# 2015 WESTERN NORTH PACIFIC




Tropical Depressions: 4
Tropical Storms: 7
Typhoons: 10
Super Typhoons: 8

- **Strong El Nino shifted genesis eastward**
- **More typical tracks, only a few north movers**

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