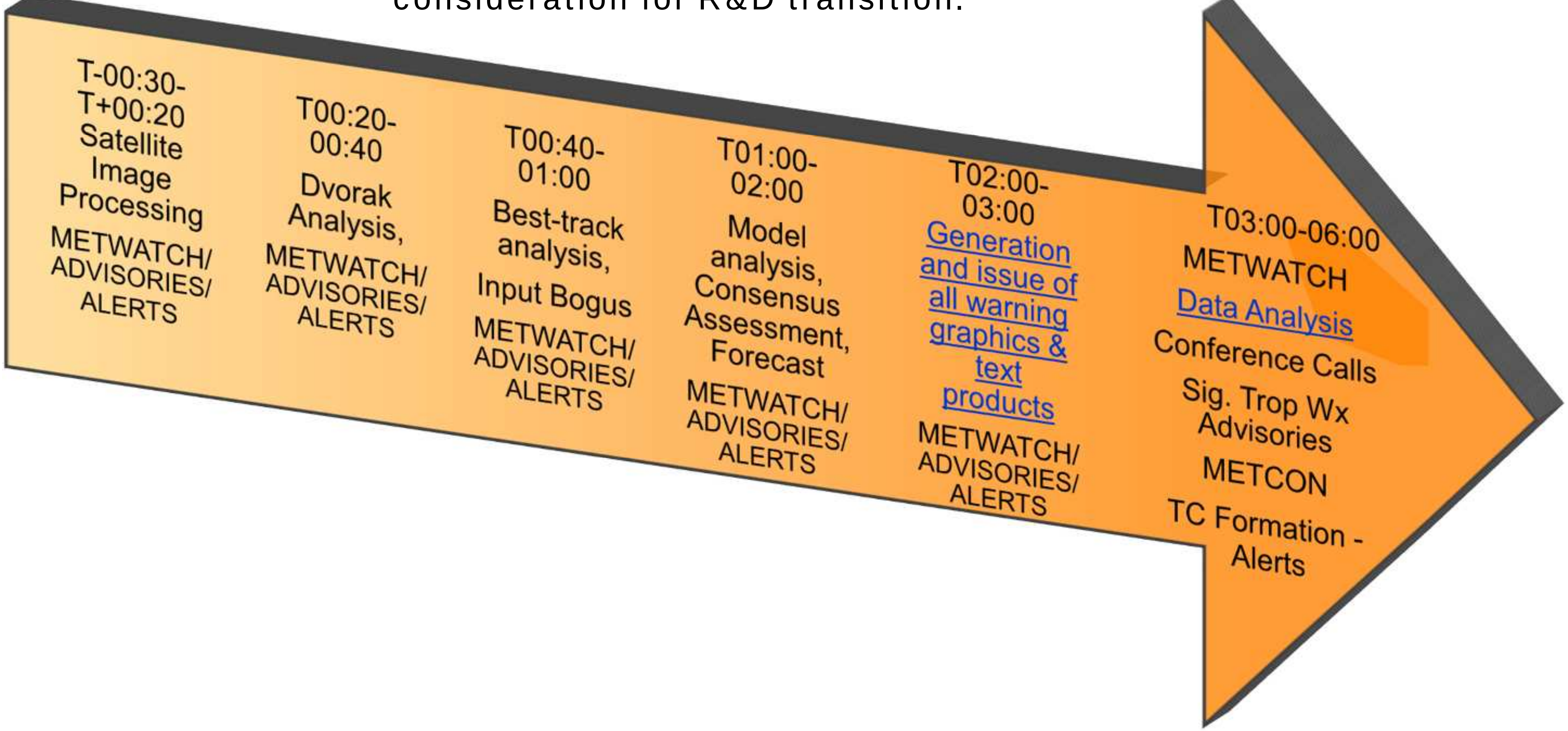
JTWC TC Forecasting Process

Including Introduction to JTWC TC Products and TC Forecast Exercises (as time allows)

JTWC WATCH TIMELINE

The JTWC AOR encompasses over 110 million sq. miles and nearly 89% of global TC activity. Process efficiency must be a critical performance parameter consideration for R&D transition.

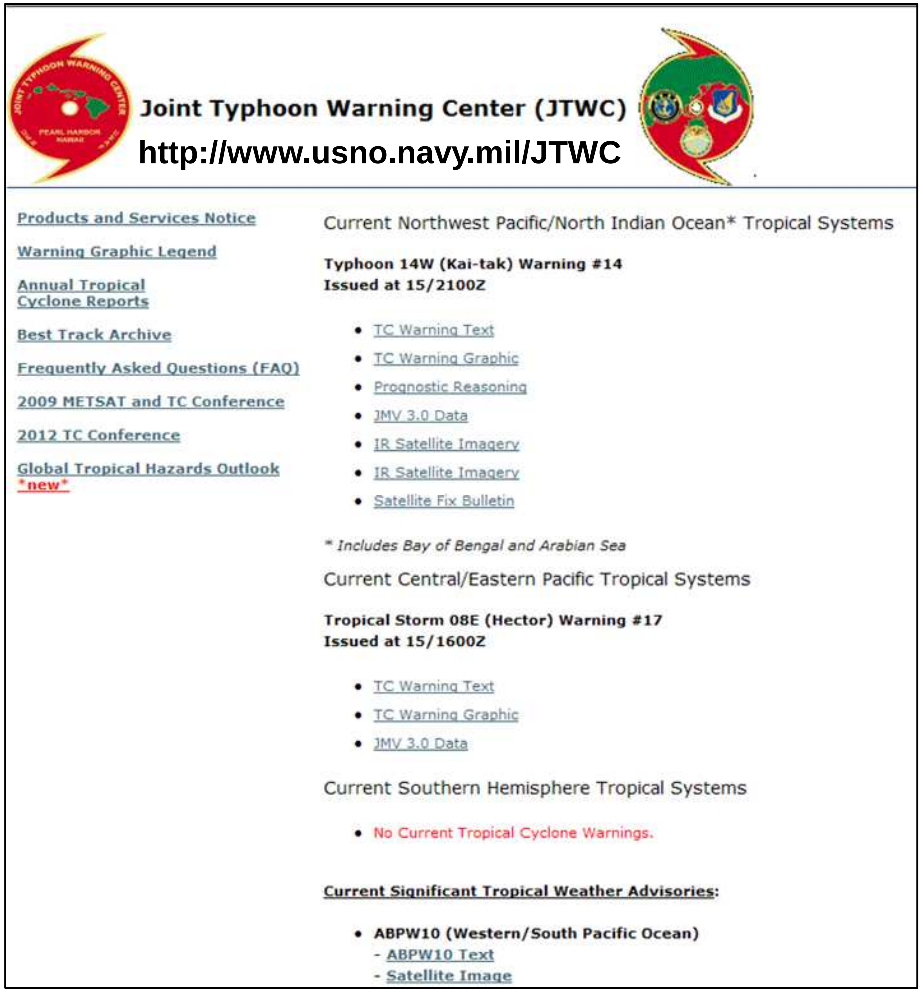


UNCLASSIFIED

JTWC Tropical Cyclone Products

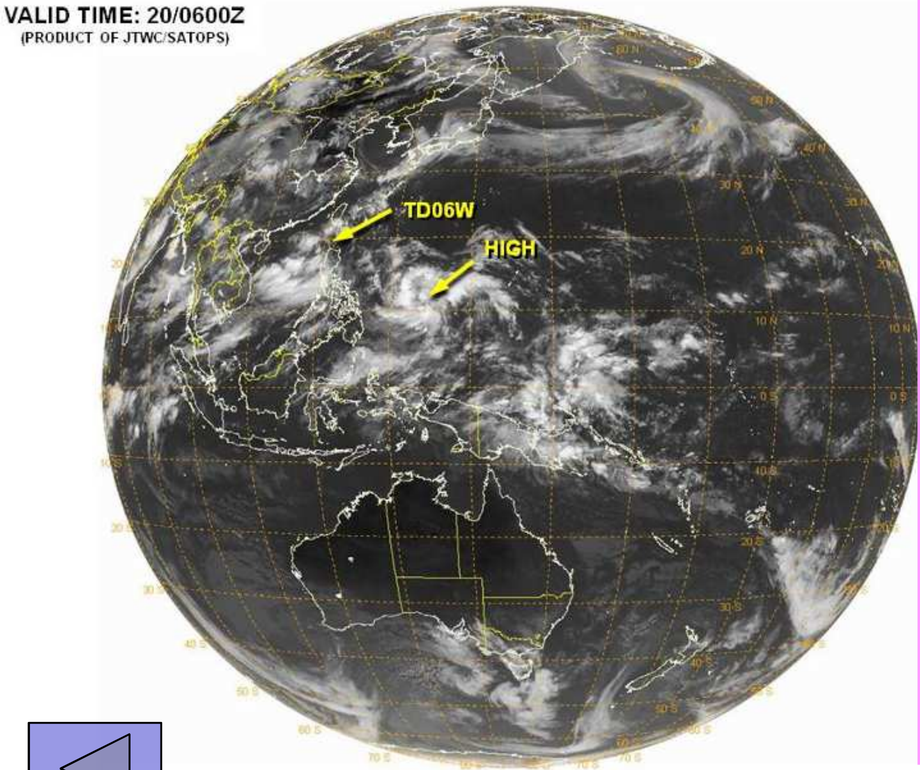
Customer Support Products:

- Significant Weather Advisories
- Streamline Analysis
- Tropical Fix Bulletins
- Tropical Cyclone Formation Alerts
- Tropical Cyclone Warnings
- Prognostic Reasoning Message
- 3 Hourly Updates (JTUP)
- Conference Call



Significant Tropical Weather Advisory

- Issued daily @ 0600Z/1800Z
- Contains info on:
  -- Tropical Cyclones in warning/TCFA status
  -- Disturbances or “Suspect Areas” being monitored for potential development (Low/Med/High)



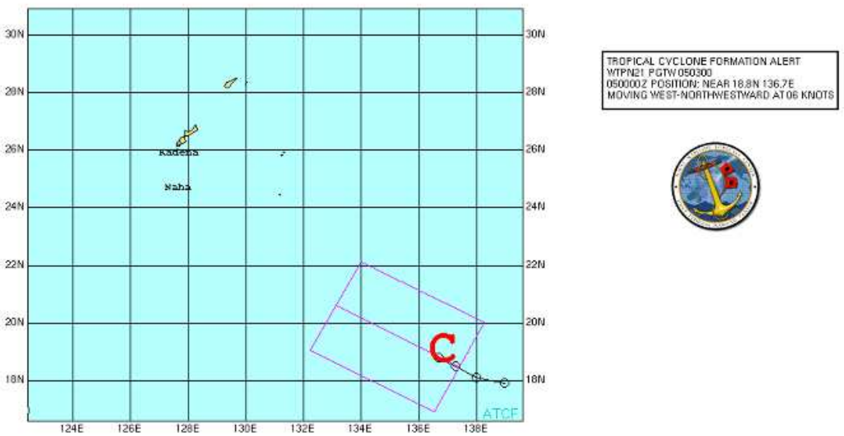
ABPW10 PGTW 200600
MSGID/GENADMIN/NAVMARFCSTCEN PEARL HARBOR HI/JTWC//
SUBJ/SIGNIFICANT TROPICAL WEATHER ADVISORY FOR THE WESTERN AND /SOUTH PACIFIC OCEANS/200600Z-210600ZJUN2011//
REF/A/MSG/NAVMARFCSTCEN PEARL HARBOR HI/200151ZJUN2011//
REF/B/MSG/NAVMARFCSTCEN PEARL HARBOR HI/200221ZJUN2011//
NARR/REF A IS A TROPICAL CYCLONE WARNING. REF B IS A TROPICAL CYCLONE FORMATION ALERT.//
RMKS/
1. WESTERN NORTH PACIFIC AREA (180 TO MALAY PENINSULA):
A. TROPICAL CYCLONE SUMMARY:
(1) AT 200000Z, TROPICAL DEPRESSION 06W (SIX) WAS LOCATED NEAR 20.3N 120.0E. MAXIMUM SUSTAINED SURFACE WINDS WERE ESTIMATED AT 30 KNOTS GUSTING TO 40 KNOTS. SEE REF A (WTPN31 PGTW 200300) FOR FURTHER DETAILS.
(2) NO OTHER TROPICAL CYCLONES.
B. TROPICAL DISTURBANCE SUMMARY:
(1) THE AREA OF CONVECTION PREVIOUSLY LOCATED NEAR 6.5N 139.3E IS NOW LOCATED NEAR 10.8N 135.5E, APPROXIMATELY 170 NM WEST-NORTHWEST OF YAP. RECENT ANIMATED MULTISPECTRAL SATELLITE IMAGERY
SHOWS DEEP CONVECTION INCREASING NEAR A CONSOLIDATING LOW LEVEL CIRCULATION CENTER (LLCC), ALSO EVIDENT IN A 192133Z SSMIS IMAGE. THE DISTURBANCE IS PASSING THROUGH AN AREA OF LOW VERTICAL WIND SHEAR AND VERY FAVORABLE UPPER-LEVEL OUTFLOW ENHANCED BY A TROPICAL UPPER TROPOSPHERIC TROUGH (TUTT) CELL TO THE NORTHEAST. MAXIMUM SUSTAINED SURFACE WINDS ARE ESTIMATED AT 15 TO 20 KNOTS. MINIMUM SEA LEVEL PRESSURE IS ESTIMATED TO BE NEAR 1005 MB. BASED ON
INCREASING ORGANIZATION AND VERY FAVORABLE UPPER LEVEL SUPPORT, THE POTENTIAL FOR THE DEVELOPMENT OF A SIGNIFICANT TROPICAL CYCLONE WITHIN THE NEXT 24 HOURS IS UPGRADED TO HIGH.
(2) NO OTHER SUSPECT AREAS.
2. SOUTH PACIFIC AREA (WEST COAST OF SOUTH AMERICA TO 135 EAST):
A. TROPICAL CYCLONE SUMMARY: NONE.
B. TROPICAL DISTURBANCE SUMMARY: NONE.//

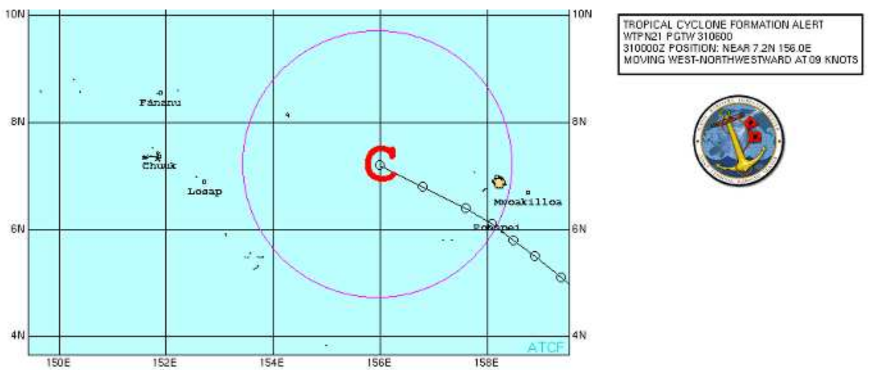
UNCLASSIFIED

Tropical Cyclone Formation Alert

(Pre-Warning)

- Issued as required
- Used to advise expected TC formation within 12-24 hours
- Provides preliminary expected movement
  - -- Circle = nearly stationary
  - -- Box = movement along centerline of box





WTPN21 PGTW 102000

RMKS/ 1. FORMATION OF A SIGNIFICANT TROPICAL CYCLONE IS POSSIBLE WITHIN A 180 NM RADIUS OF 5.1N6 155.8E9 WITHIN THE NEXT 06 TO 24 HOURS. AVAILABLE DATA DOES NOT JUSTIFY ISSUANCE OF A NUMBERED TROPICAL CYCLONE WARNING AT THIS TIME. WINDS IN THE AREA ARE ESTIMATED TO BE 18 TO 23 KNOTS. METSAT IMAGERY AT 101930Z4 INDICATES THAT A CIRCULATION CENTER IS LOCATED NEAR 5.1N6 156.1E3. THE SYSTEM IS MOVING WEST-SOUTHWESTWARD AT 03 KNOTS.

2. REMARKS: THE AREA OF CONVECTION PREVIOUSLY LOCATED NEAR 5.2N7 156.4E6 IS NOW LOCATED NEAR 5.1N6 156.1E3, APPROXIMATELY 165 NM SOUTHWEST OF POHNPEI, AND HAS TRACKED WEST-SOUTHWESTWARD AT 3 KNOTS OVER THE PAST 6 HOURS. ANIMATED SATELLITE IMAGERY AND 200 MB ANALYSIS INDICATES UNORGANIZED CONVECTION IN A REGION OF WEAK TO MODERATE VERTICAL WIND SHEAR. SYNOPTIC ANALYSIS AND A QUIKSCAT PASS INDICATED A LOW LEVEL CIRCULATION CENTER ASSOCIATED WITH THIS REGION. MAXIMUM SUSTAINED SURFACE WINDS ARE ESTIMATED AT 18 TO 23 KNOTS. MINIMUM SEA LEVEL PRESSURE IS ESTIMATED TO BE 1003 MB. THE POTENTIAL FOR THE DEVELOPMENT OF A SIGNIFICANT TROPICAL CYCLONE WITHIN THE NEXT 24 HOURS IS NOW GOOD. 3. THIS ALERT WILL BE REISSUED, UPGRADED TO WARNING OR CANCELLED BY 112000Z4.//

Message example

D

Tropical Cyclone Warning

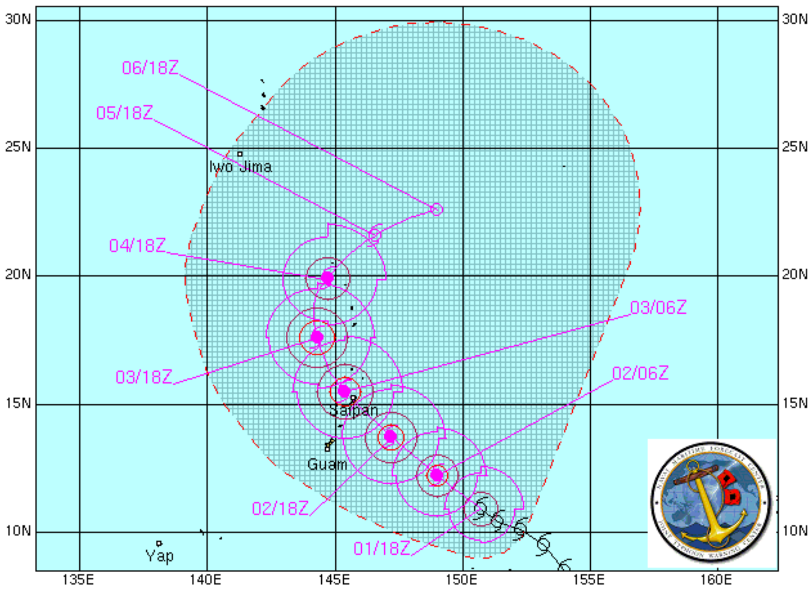
- Issued 4 times per day NLT 03/09/15/21Z
- 120 hour (5-day) forecast
- Contains track, 34/50/64 knot wind radii, closest points of approach, bearing/distance, area of 34 knot wind potential (hatched area)

SUBJ/TROPICAL CYCLONE WARNING//
RMKS/WTPN31 PGTW 040900
1. TYPHOON 01W (KONG-REY) WARNING NR 016
01 ACTIVE TROPICAL CYCLONE IN NORTHWESTPAC
MAX SUSTAINED WINDS BASED ON ONE-MINUTE AVERAGE

WARNING POSITION:
040600Z --- NEAR 21.1N 145.2E
MOVEMENT PAST SIX HOURS - 030 DEGREES AT 16 K
POSITION ACCURATE TO WITHIN 060 NM
POSITION BASED ON CENTER LOCATED BY SATELLI
PRESENT WIND DISTRIBUTION:
MAX SUSTAINED WINDS - 065 KT, GUSTS 080 KT
RADIUS OF 050 KT WINDS - 050 NM NORTHEAST QUADF
045 NM SOUTHEAST QUADRANT
040 NM SOUTHWEST QUADRANT
040 NM NORTHWEST QUADRANT
RADIUS OF 034 KT WINDS - 100 NM NORTHEAST QUADF
085 NM SOUTHEAST QUADRANT
085 NM SOUTHWEST QUADRANT
080 NM NORTHWEST QUADRANT
REPEAT POSIT: 21.1N 145.2E

FORECASTS:
12 HRS, VALID AT:
041800Z --- 23.6N 147.5E
MAX SUSTAINED WINDS - 055 KT, GUSTS 070 KT
DISSIPATING AS A SIGNIFICANT TROPICAL CYCLONE OVEF
RADIUS OF 050 KT WINDS - 045 NM NORTHEAST QUADF
040 NM SOUTHEAST QUADRANT
035 NM SOUTHWEST QUADRANT
030 NM NORTHWEST QUADRANT
RADIUS OF 034 KT WINDS - 085 NM NORTHEAST QUADF
080 NM SOUTHEAST QUADRANT
075 NM SOUTHWEST QUADRANT
070 NM NORTHWEST QUADRANT

REMARKS:
040900Z POSITION NEAR 21.7N 145.8E.
TYPHOON (TY) 01W (KONG-REY), LOCATED APPROXIMATELY 305 NM SOUTH-EAST OF IWO JIMA, HAS TRACKED NORTH-NORTHEASTWARD AT 16 KNOTS OVER THE PAST SIX HOURS. CURRENT INTENSITY IS BASED ON DVORAK ESTIMATES RANGING FROM 55 TO 90 KNOTS. RECENT ANIMATED WATER VAPOR SATELLITE IMAGERY INDICATES RAPID WEAKENING OF CORE CONVECTION OVER THE PAST 06 HOURS WITH THE MAJORITY OF CONVECTION SHEARED NORTH AND NORTHEAST OF THE CENTER. MAXIMUM SIGNIFICANT WAVE HEIGHT AT 040600Z IS 23 FEET. NEXT WARNINGS AT 041500Z, 042100Z, 050300Z AND 050900Z.//



TROPICAL STORM 01W (KONG-REY) WARNING #6
011800Z POSIT: NEAR 10.9N 150.7E
MOVING 305 DEGREES TRUE AT 09 KNOTS
MAXIMUM SIGNIFICANT WAVE HEIGHT: 20 FEET
01/18Z, WINDS 060 KTS, GUSTS TO 075 KTS
02/06Z, WINDS 070 KTS, GUSTS TO 085 KTS
02/18Z, WINDS 080 KTS, GUSTS TO 100 KTS
03/06Z, WINDS 085 KTS, GUSTS TO 105 KTS
03/18Z, WINDS 085 KTS, GUSTS TO 105 KTS
04/18Z, WINDS 065 KTS, GUSTS TO 080 KTS
05/18Z, WINDS 040 KTS, GUSTS TO 050 KTS
06/18Z, WINDS 030 KTS, GUSTS TO 040 KTS

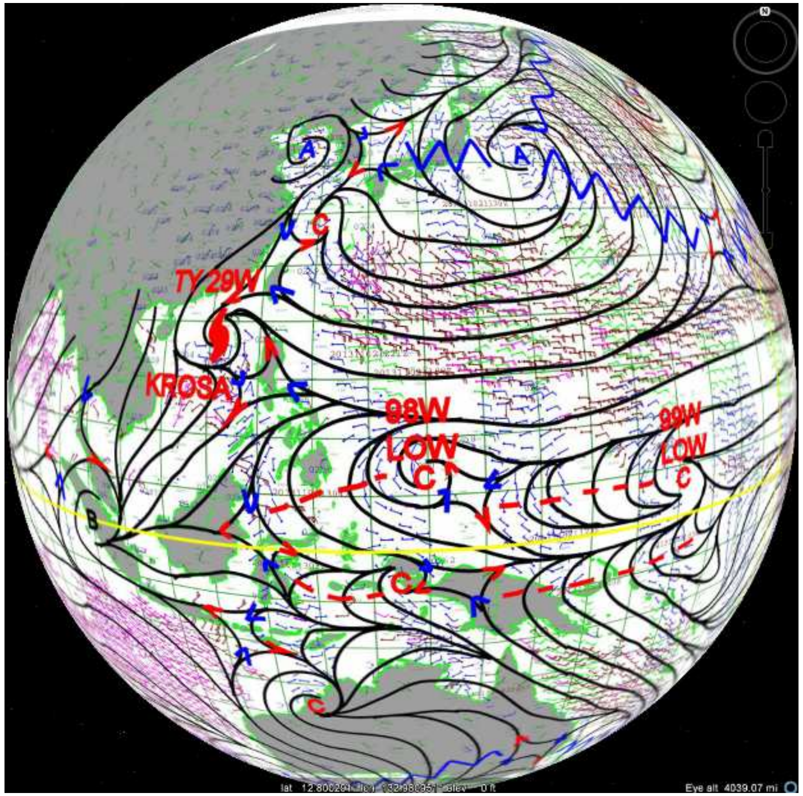
CPA TO:	NM	DTG
IWO_JIMA	336	05/06z
MINAMI_TORI_SHIMA	291	06/18z
ANDERSEN_AFB	95	03/01z
NAVSTA_GUAM	120	03/01z
SAIPAN	5	03/04z
WFO_GUAM	107	03/01z

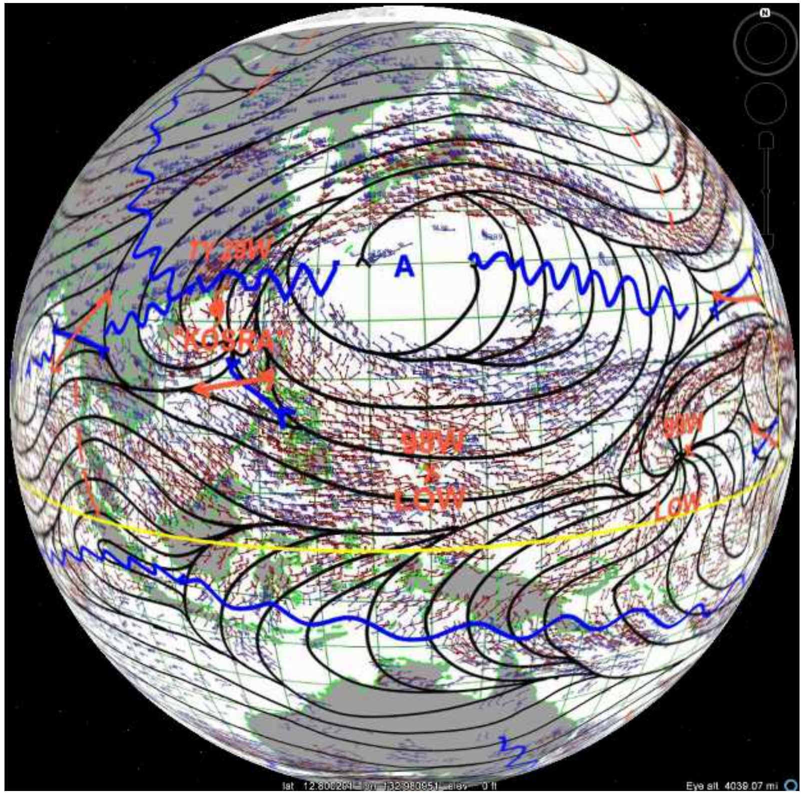
BEARING AND DISTANCE	DIR	DIST (NM)	TAU (HRS)
IWO_JIMA	147	349	72
ANDERSEN_AFB	90	134	24
	352	237	48
	358	372	72
NAVSTA_GUAM	83	153	24
	356	253	48
	1	390	72
SAIPAN	138	121	24
	329	168	48
	348	289	72
WFO_GUAM	85	140	24
	353	248	48
	359	384	72

O TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
PAST 6 HOURLY CYCLONE POSITS IN BLACK
FORECAST CYCLONE POSITS IN COLOR

Streamline (wind) Analysis

-**Hand analysis completed twice daily @ 0000Z/1200Z (Now done using digital technology)**
- **Key to assessing general environmental conditions across AOR and specific conditions around TCs**
- **Shared with 17 OWS to meet AFMAN requirement**





Surface and Upper Level Analyses

Fundamental Tool – Manual Streamline Analysis

- Both JTWC tool and product
  - Provided to US military weather and US NWS
- Whole AOR
- Sfc and 200mb levels
- 0000Z (UTC) and 1200Z (UTC)
- Estimation of current atmospheric conditions depicted used in initial consideration of other “tools” or data.

JTWC Track Forecasting

- Analysis for establishment of initial position and intensity
  - Establish continuity from last position and intensity
  - Or, make past track/intensity revision(s)
  - Ensure reasoning provided for all decisions
- Provide input to numerical models
- Review numerical model output along with previous forecasts

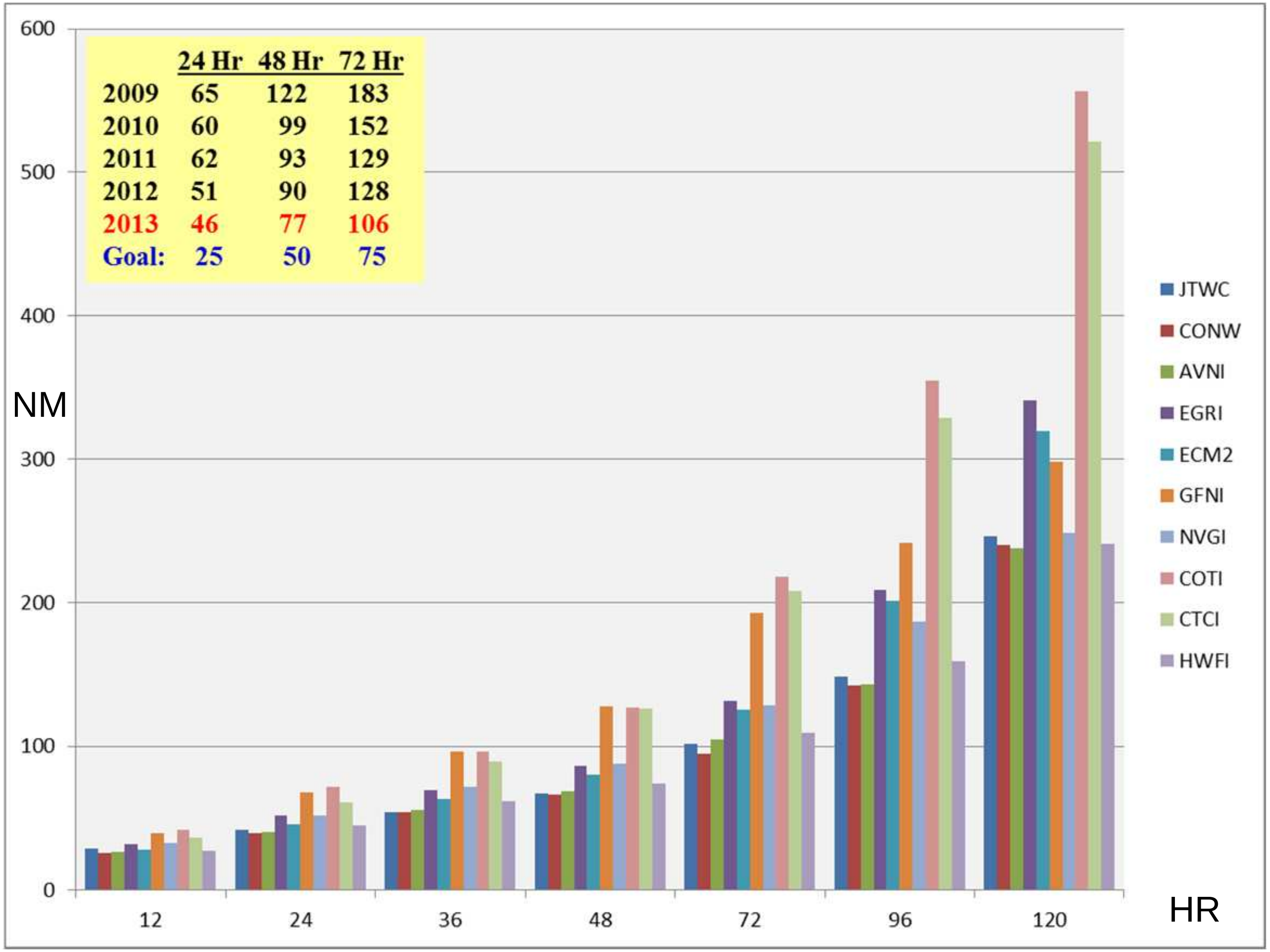
JTWC Multi-model Ensemble Consensus (Jul 2013)

- The JTWC consensus forecast track aid, CONW, is computed by averaging eight dynamic model and two ensemble mean TC track forecasts.
- The CONW member tracks are interpolated from the model TC track forecasts.
  - The original (vice interpolated) track forecasts are produced at or after the forecast time (unavailable to the JTWC Typhoon Duty Officer at forecast production time)
  - An earlier numerical track forecast must be interpolated, then used for CONW computations.
- The CONW based on the noted interpolated numerical track forecasts are computed from the models noted in column 2 and consists of five global models, three mesoscale models and two ensemble models

NVGI	US Navy Global Spectral Model (NAVGEM)
AVNI	US NWS Global Forecast model (GFS)
JGSI	Japan Global Spectral Model (JGSM)
EGRI	UK Met Office model
ECM2	ECMWF model
GFNI	US Navy Mesoscale Model; converted US NWS GFDL model
CTCI	US Navy COAMPS-TC mesoscale model
HWFI	US Hurricane Research and Forecasting model
JENI	Ensemble mean from the JMA typhoon ensemble predictions systems (TEPS)
AEMI	Ensemble mean from the GFS Ensemble System (GEFS)

2013 MODEL TRACK ERRORS

(Western North Pacific – Homogeneous)



JTWC Intensity Forecasting Initial Considerations or Efforts

- Determine current position and intensity & review previous intensity forecast
  - Bogus or initialize numerical models
  - Initialize statistical-dynamical forecast aid production
  - Review previous JTWC warning
    - Possible change to forecast “philosophy” or logic
      - Amend previous forecast or revise intensity forecast in next warning

Intensity Forecast
Data Review

- Review streamline analyses
- Review statistical-dynamical and dynamical intensity forecasts
- Review numerical track forecasts
  - Intensity forecasts related to synoptic pattern affecting cyclone
- Review water vapor satellite loop to consider upper tropospheric patterns for outflow influence
  - Rapid intensification
- Review numerical track forecast in consideration of phase change and/or vertical shear.

JTWC Guidance to Forecaster

(Extract from JTWC Intensity Forecast Training Reference)

A thorough understanding of the factors that drive intensity changes, and analysis of the current and forecast environment for the presence or absence of those features, will greatly assist the forecast in generating a good intensity forecast. Special attention should be paid to the intensity trend, and potential changes to that trend, as well as the documented errors that inevitably occur when forecasting tropical cyclone intensity.

The standard model used by most forecasters for intensity forecasting is the simple expectation that the tropical cyclone will intensify or weaken at a rate of one Dvorak T-number per day (Dvorak 1984). In a very favorable environment, the intensification rate may exceed 1.5 T-numbers per day, and in an unfavorable environment, it may be well below one T-number per day.

In order to determine the favorability of the environment for intensification, and whether or not to modify the forecast from the one T-number per day model, the forecaster should consider the current and forecast upper-level outflow, sea surface temperature, and vertical wind shear, as well as the current intensity of the tropical cyclone. Post-storm reviews at JTWC indicate that most tropical cyclones develop slower than one T-number per day if the peak intensity is less than 80 knots, and at a rate greater than one T-number per day for the first 24 to 48 hours if the peak intensity is greater than 89 knots.

In addition to statistic model guidance (STIPS), satellite imagery is possibly the best tool available for assessing intensification potential. Animated water vapor imagery provides the forecaster a view of the evolving synoptic pattern, and can also be used to locate the subtropical ridge axis, TUTT and TUTT cells, tropical cyclone outflow patterns and mid-latitude features. Microwave imagery at different frequencies can highlight low-level inflow and convective structures, the vigorousness of deep convection, the presence or absence of spiral rain bands, the size of the eye, multiple eye wall configurations, eye wall contraction and dry air intrusion, regardless of the presence or absence of a central dense overcast (CDO) or cirrus canopy obscuring the tropical cyclone circulation.

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In addition to model guidance (SHIPS, S5YY, GFDL, etc.), satellite imagery is possibly the best tool available for assessing intensification potential. Animated water vapor imagery provides the forecaster a view of the evolving synoptic pattern, and can also be used to locate the subtropical ridge axis, TUTT and TUTT cells, tropical cyclone outflow patterns and mid-latitude features. Microwave imagery at different frequencies can highlight low-level inflow and convective structures, the vigorousness of deep convection, the presence or absence of spiral rain bands, the size of the eye, multiple eye wall configurations, eye wall contraction and dry air intrusion, regardless of the presence or absence of a central dense overcast (CDO) or cirrus canopy obscuring the tropical cyclone circulation.

Current JTWC Intensity Aids

- ST5D
- SHIPS
- S5XX
- S5YY
- In 2014 – LGEM (approx Apr 2014)

Primary Intensity Forecast Guidance Statistical-Dynamical; SHIPS & LGEM

New Statistical Intensity Forecast Models for Global Tropical Cyclones

Mark DeMaria, John Knaff, NOAA/NESDIS/STAR
Buck Sampson, NRL
John Kaplan, NOAA/HRD
Andrea Schumacher, Kate Musgrave, Holly Kessler, CIRA/CSU

Informal Briefing to JTWC and NWS/HFO
August 28, 2013

From DeMaria – Aug 2013

Overview of the SHIPS Model

- Multiple linear regression
  - $y = a_0 + a_1x_1 + \ldots a_Nx_N$
    - y = intensity change at given forecast time
      - $(V_6\text{-}V_0)$, $(V_{12}\text{-}V_0)$, …, $(V_{120}\text{-}V_0)$
    - x_i = predictors of intensity change
    - a_i = regression coefficients
- Different coefficients for each forecast time
- Predictors x_i averaged over forecast period
- x,y normalized by subtracting sample mean, dividing by standard deviation

From DeMaria – Aug 2013

SHIPS Predictors

1. Climatology (days from peak)
2. V_0 (V_{max} at t= 0 hr)
3. Persistence (V_0-V_{-12})
4. V_0 * Per
5. Zonal storm motion
6. Steering layer pressure
7. %IR pixels < -20°C
8. IR pixel standard deviation
9. Max Potential Intensity – V_0
10. Square of No. 9
11. Ocean heat content
12. T at 200 hPa
13. T at 250 hPa
14. RH (700-500 hPa)
15. θ_e of sfc parcel - θ_e of env
16. 850-200 hPa env shear
17. Shear * V_0
18. Shear direction
19. Shear*sin(lat)
20. Shear from other levels
21. 0-1000 km 850 hPa vorticity
22. 0-1000 km 200 hPa divergence
23. GFS vortex tendency
24. Low-level T advection

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From DeMaria – Aug 2013

Operational LGEM Intensity Model

$$dV/dt = \kappa V - \beta(V/V_{mpi})^n V$$

(A) (B)

V_{mpi} = Maximum Potential Intensity estimate

κ = Max wind growth rate (from SHIPS predictors)

β, n = empirical constants = 1/24 hr, 2.5

Steady State Solution: $V_s = V_{mpi}(\beta/\kappa)^{1/n}$

From DeMaria – Aug 2013
LGEM versus SHIPS

- Advantages
  - Prediction equation bounds the solution between 0 and V_{mpi}
  - Time evolution of predictors (Shear, etc) better accounted for
  - Movement between water and land handled better because of time stepping
- Disadvantages
  - Model fitting more involved
  - Inclusion of persistence more difficult

From DeMaria – Aug 2013

S5XX Specifics:

- STIPS developed by CIRA for WP
  - Implemented and run as ensemble

  - NVS5
    - NAVGEM track, fields run through STIPS
  - AVS5, JAS5
    - GFS track, wind fields, NAVGEM thermal fields
  - JUS5
    - UKMET track, wind fields, NAVGEM thermal fields
  - WBS5
    - WBAR track, NAGEM fields

- Other models
  - GFNI – interpolated GFDN, uses 24-h phase out
  - CTCI – interpolated COAMPS-TC, uses 24-h phase out
  - CHII - interpolated CHIPS, no phase out

From DeMaria – Aug 2013

• S5YY Specifics:

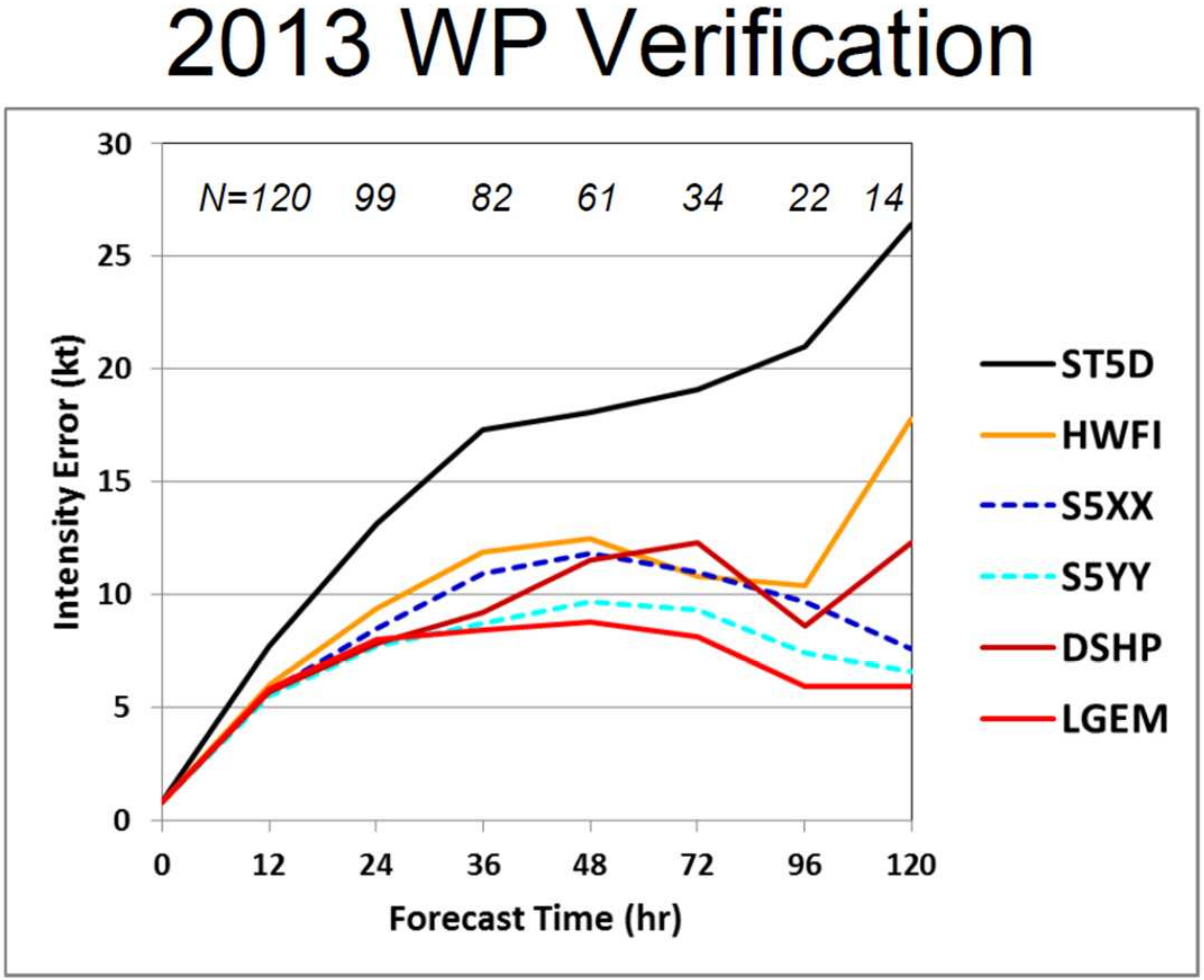
- SHIPS/LGEM developed by CIRA for WP
  - Implemented and run as ensemble, similar to ST10 at NRL

  - LGEN & DSHN
    - NAVGEM track, fields run through SHIPS and LGEM
  - LGEA & DSHA
    - GFS track, wind fields, NAVGEM thermal fields

- Other models
  - GFNI – interpolated GFDN, uses 24-h phase out
  - CTCI – interpolated COAMPS-TC, uses 24-h phase out
  - CHII - interpolated CHIPS, no phase out

- S5YY=LGEN+DSHN+LGEA+DSHA+GFNI+CTCI+CHII

From DeMaria - 2013



From DeMaria – Aug 2013

Additional SHIPS Model Features

- Storm type classification
  - Tropical, Subtropical, Extra-tropical
  - Based on Atlantic algorithm
  - Discriminant analysis for classification
  - Input includes GFS parameters similar to Bob Hart phase space, SST and IR features
- Rapid Intensification Index
  - Probability of max wind increase of 30 kt
  - Discriminant analysis using subset of SHIPS
  - Separate versions for WP, IO and SH

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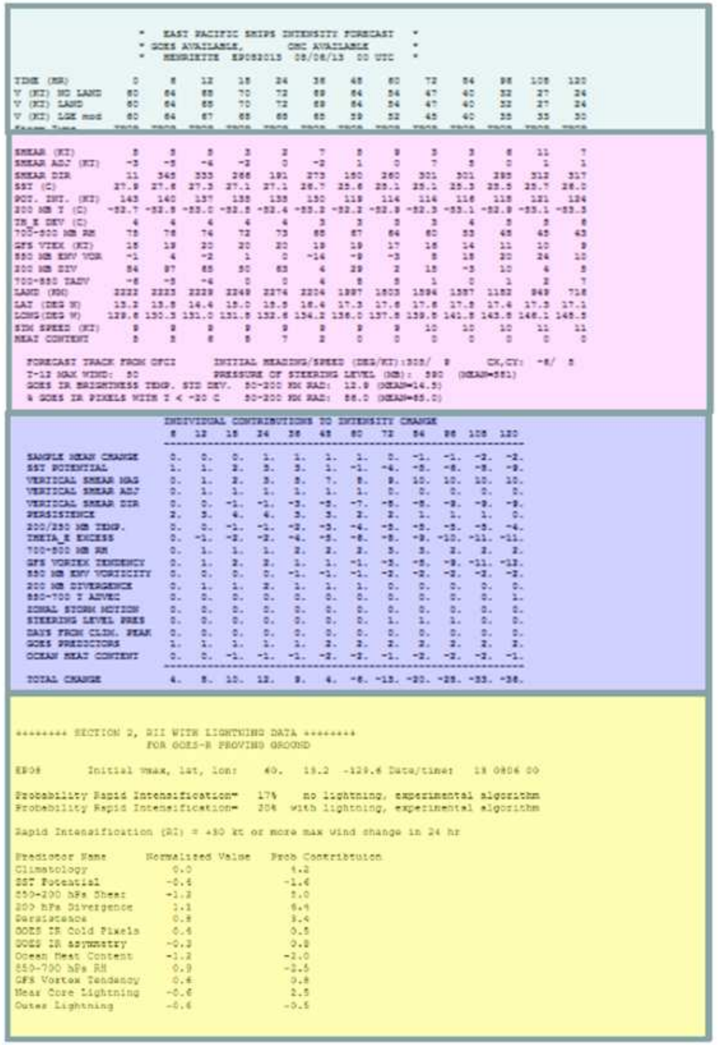
From DeMaria – Aug 2013

RII Predictors

1. Previous 12 h max wind change (persistence)
2. Maximum Potential Intensity – Current intensity
3. Oceanic Heat Content
4. 200-850 hP shear magnitude (0-500 km)
5. 200 hPa divergence (0-1000 km)
6. 850-700 hPa relative humidity (200-800 km)
7. 850 hPa tangential wind (0-500 km)
8. IR pixels colder than -30^{o}C
9. Azimuthal standard deviation of IR brightness temperature

From DeMaria – Aug 2013 Output



Forecast Section

SHIPS/LGEM Predictor Values

SHIPS Forecast Predictor Contributions

Rapid Intensification Index

From DeMaria – Aug 2013 Output

Forecast and Predictor Sections

* EAST PACIFIC SHIPS INTENSITY FORECAST *
* GOES AVAILABLE, OHC AVAILABLE *
* HENRIETTE EP082013 08/06/13 00 UTC *

TIME (HR)	0	6	12	18	24	36	48	60	72	84	96	108	120
V (KT) NO LAND	60	64	68	70	72	69	64	54	47	40	32	27	24
V (KT) LAND	60	64	68	70	72	69	64	54	47	40	32	27	24
V (KT) LGE mod	60	64	67	68	68	65	59	52	45	40	35	33	30
Storm Type	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP
SHEAR (KT)	5	5	5	3	2	7	5	9	3	3	6	11	7
SHEAR ADJ (KT)	-3	-5	-4	-2	0	-2	1	0	7	5	0	1	1
SHEAR DIR	11	345	333	266	191	273	180	260	301	301	295	312	317
SST (C)	27.9	27.6	27.3	27.1	27.1	26.7	25.6	25.1	25.1	25.3	25.5	25.7	26.0
POT. INT. (KT)	143	140	137	135	135	130	119	114	114	116	118	121	124
200 MB T (C)	-52.7	-52.8	-53.0	-52.5	-52.4	-53.2	-52.2	-52.9	-52.3	-53.1	-52.9	-53.1	-53.3
TH_E DEV (C)	4	4	4	4	4	3	3	3	3	4	5	5	6
700-500 MB RH	75	76	74	72	73	68	67	64	60	53	48	45	43
GFS VTEX (KT)	18	19	20	20	20	19	19	17	16	14	11	10	9
850 MB ENV VOR	-1	4	-2	1	0	-14	-9	-3	8	18	20	24	10
200 MB DIV	84	97	65	50	63	4	29	2	15	-3	10	4	5
700-850 TADV	-6	-5	-4	0	0	4	8	5	1	0	1	2	7
LAND (KM)	2222	2223	2229	2249	2274	2204	1997	1803	1594	1387	1182	949	716
LAT (DEG N)	13.2	13.8	14.4	15.0	15.5	16.4	17.3	17.6	17.6	17.5	17.4	17.3	17.1
LONG(DEG W)	129.6	130.3	131.0	131.8	132.6	134.2	136.0	137.8	139.8	141.8	143.8	146.1	148.5
STM SPEED (KT)	9	9	9	9	9	9	9	9	10	10	10	11	11
HEAT CONTENT	5	5	6	8	7	2	0	0	0	0	0	0	0

FORECAST TRACK FROM OFCI   INITIAL HEADING/SPEED (DEG/KT):305/ 9   CX,CY: -6/ 5
T-12 MAX WIND: 50   PRESSURE OF STEERING LEVEL (MB): 590 (MEAN=581)
GOES IR BRIGHTNESS TEMP. STD DEV. 50-200 KM RAD: 12.9 (MEAN=14.5)
% GOES IR PIXELS WITH T < -20 C 50-200 KM RAD: 86.0 (MEAN=65.0)

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Predictor Contribution Section

INDIVIDUAL CONTRIBUTIONS TO INTENSITY CHANGE	6	12	18	24	36	48	60	72	84	96	108	120
SAMPLE MEAN CHANGE	0.	0.	0.	1.	1.	1.	1.	0.	-1.	-1.	-2.	-2.
SST POTENTIAL	1.	1.	2.	3.	3.	1.	-1.	-4.	-5.	-6.	-8.	-9.
VERTICAL SHEAR MAG	0.	1.	2.	3.	5.	7.	8.	9.	10.	10.	10.	10.
VERTICAL SHEAR ADJ	0.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.
VERTICAL SHEAR DIR	0.	0.	-1.	-1.	-3.	-5.	-7.	-8.	-8.	-9.	-9.	-9.
PERSISTENCE	2.	3.	4.	4.	3.	3.	2.	2.	1.	1.	1.	0.
200/250 MB TEMP.	0.	0.	-1.	-1.	-2.	-3.	-4.	-5.	-5.	-5.	-5.	-4.
THETA_E EXCESS	0.	-1.	-2.	-2.	-4.	-5.	-6.	-8.	-9.	-10.	-11.	-11.
700-500 MB RH	0.	1.	1.	1.	2.	2.	2.	3.	3.	2.	2.	2.
GFS VORTEX TENDENCY	0.	1.	2.	2.	1.	1.	-1.	-3.	-5.	-9.	-11.	-12.
850 MB ENV VORTICITY	0.	0.	0.	0.	-1.	-1.	-1.	-2.	-2.	-2.	-2.	-2.
200 MB DIVERGENCE	0.	1.	1.	2.	1.	1.	1.	0.	0.	0.	0.	0.
850-700 T ADVEC	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
ZONAL STORM MOTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
STEERING LEVEL PRES	0.	0.	0.	0.	0.	0.	0.	1.	1.	1.	0.	0.
DAYS FROM CLIM. PEAK	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GOES PREDICTORS	1.	1.	1.	1.	1.	2.	2.	2.	2.	2.	2.	2.
OCEAN HEAT CONTENT	0.	0.	-1.	-1.	-1.	-2.	-2.	-1.	-2.	-2.	-2.	-1.
TOTAL CHANGE	4.	8.	10.	12.	9.	4.	-6.	-13.	-20.	-28.	-33.	-36.

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RII Section

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++++++++ SECTION 2, RII WITH LIGHTNING DATA ++++++++
                    FOR GOES-R PROVING GROUND

EP08       Initial vmax, lat, lon:    60.   13.2  -129.6 Date/time:   13 0806 00

Probability Rapid Intensification=   17%    no lightning, experimental algorithm
Probability Rapid Intensification=   20%  with lightning, experimental algorithm

Rapid Intensification (RI) = +30 kt or more max wind change in 24 hr

Predictor Name       Normalized Value   Prob Contribtuion
Climatology              0.0               4.2
SST Potential           -0.4              -1.6
850-200 hPa Shear       -1.2               8.0
200 hPa Divergence       1.1               6.4
Persistence              0.8               3.4
GOES IR Cold Pixels      0.4               0.5
GOES IR asymmetry       -0.3               0.8
Ocean Heat Content      -1.2              -2.0
850-700 hPa RH           0.9              -2.5
GFS Vortex Tendency      0.6               0.8
Near Core Lightning     -0.6               2.5
Outer Lightning         -0.6              -0.5
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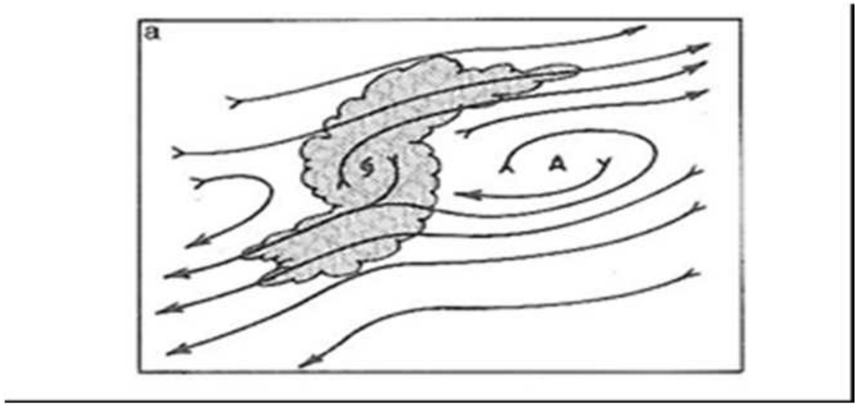
Dual Outflow Concept

- If two outflow channels exist, the tropical cyclone is said to have dual channel outflow
- Dual channel outflow is a key factor in many cases of rapid intensification.



Pau*

Questions or

Comments?

*Pau - [pau] – Hawaiian; Finished, done.