Life cycle of Super Typhoon Haiyan (31W) "Yolanda"

by

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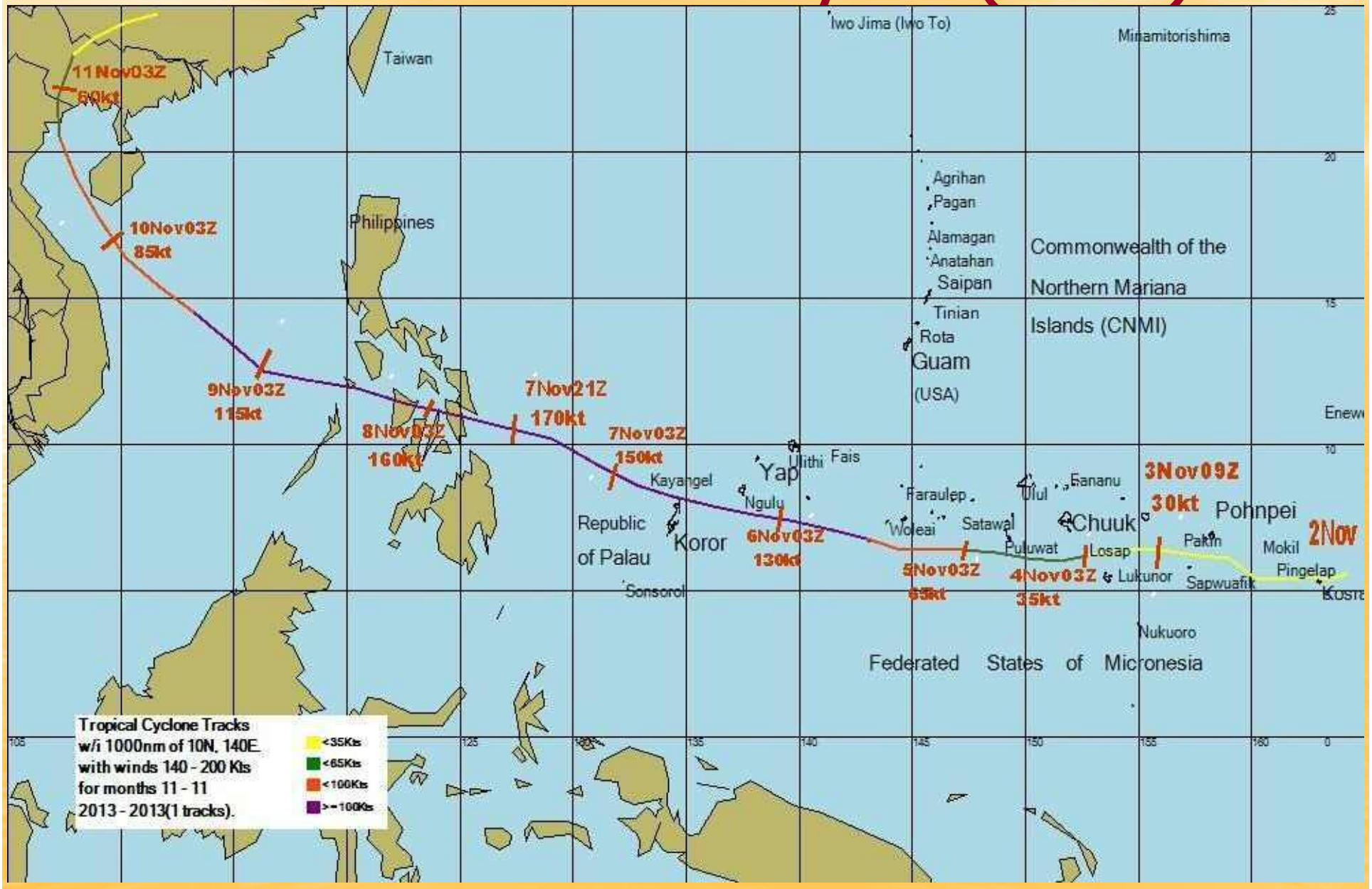
8th IWS/2nd TRCG Forum
2 – 6 December 2013
Macao Science Center, Macao, China

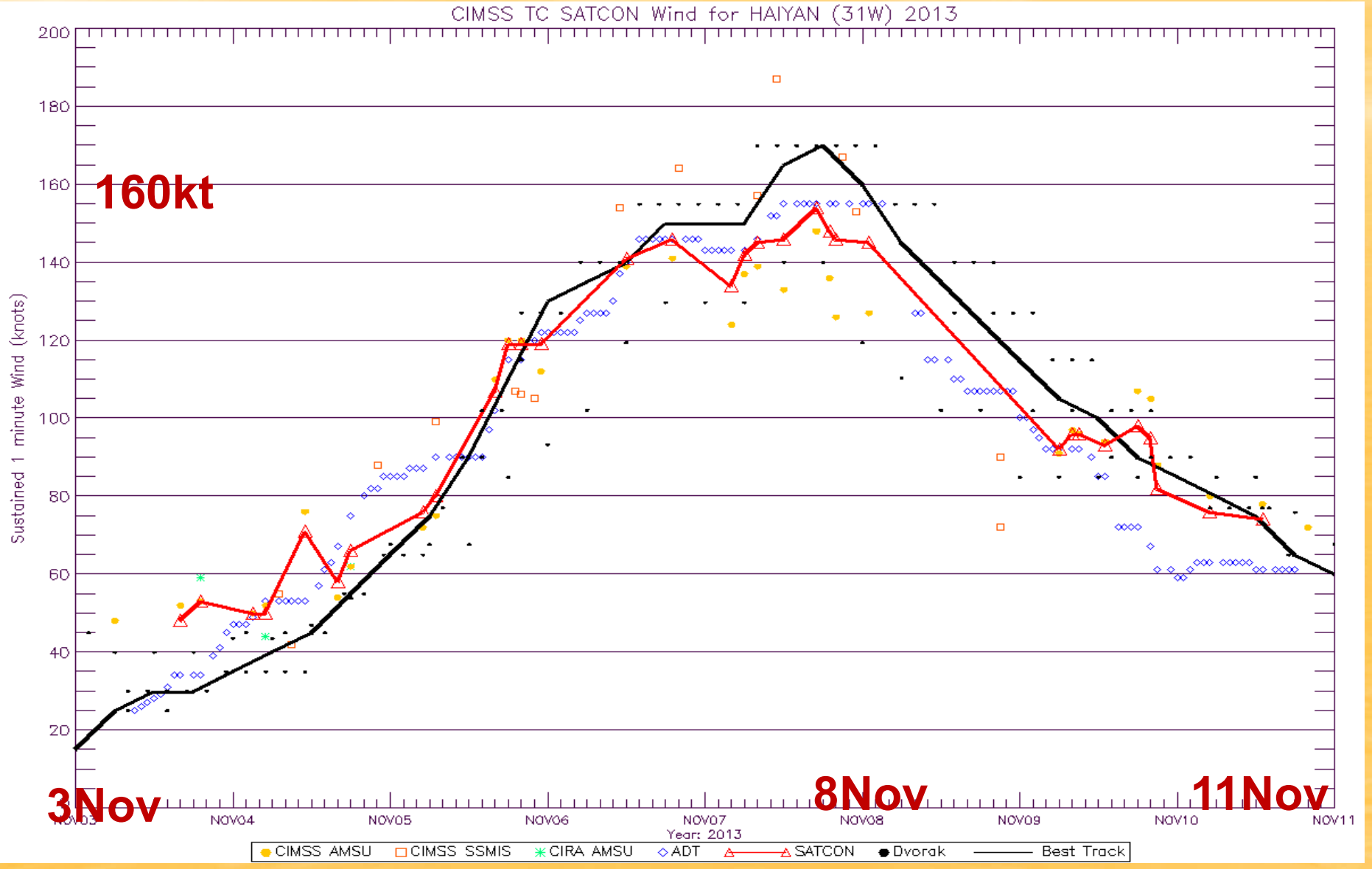
Track through Micronesia, Philippines and South China Sea

- Date Formed (warned and best track)2/3Nov
- Intensification and initial Damage 4-5Nov
- Missing Ngulu but hitting Kayangel (ROP) 6-7Nov
- Disaster through the Philippines 8Nov
- Final track brushing by Hainan and into Vietnam/China on…10-11Nov
- Speed of movement…fast
- Period of rapid intensification (RI)

Track of STY Haiyan (31W)



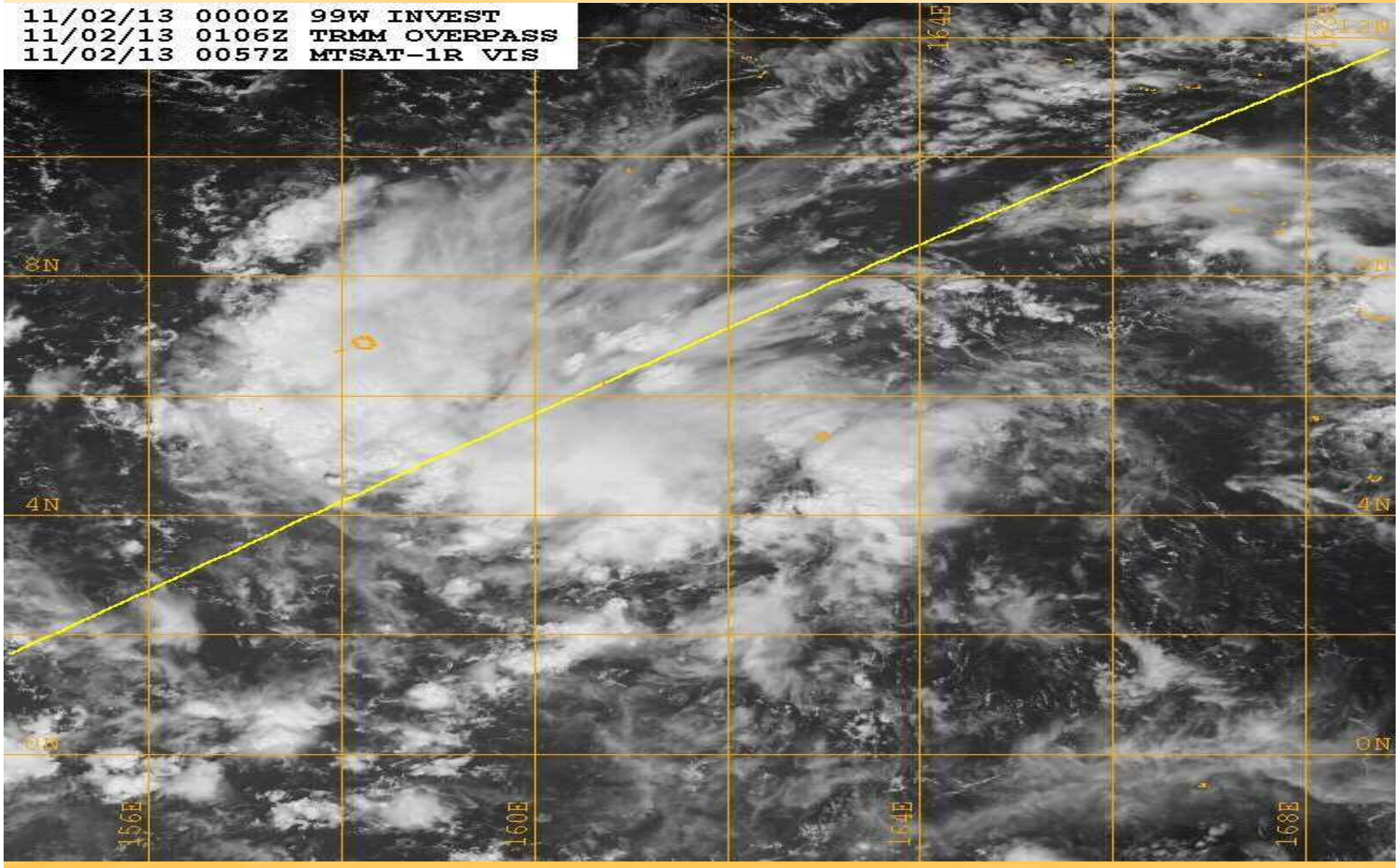
Reconnaissance Intensities (Sat Dvorak and AMSU)



Initial Stages

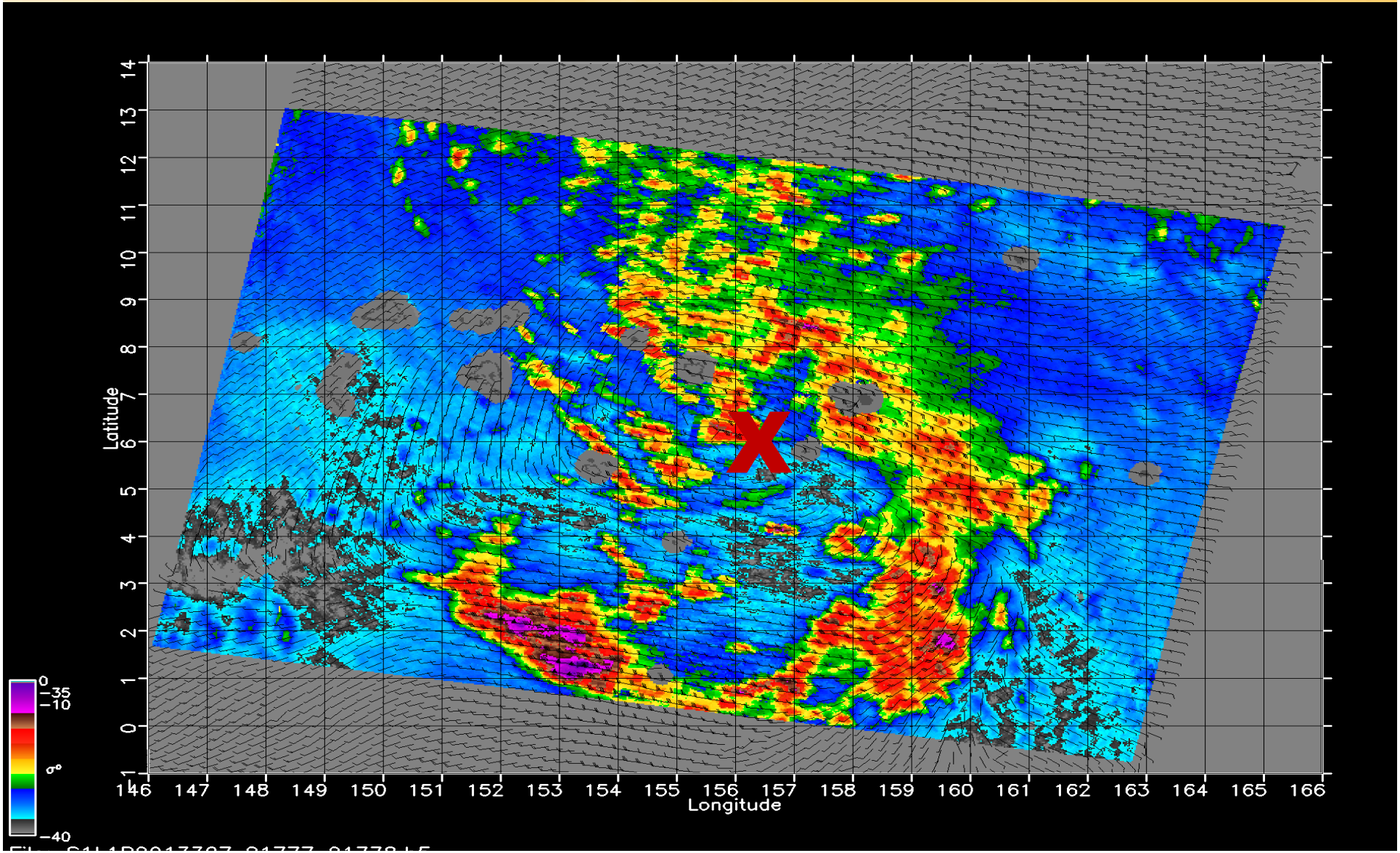
- Imagery in the monsoon
- Wide open center
- Some scatterometer 'bursts' of winds
- Over Lukunor (nearly as a TS)…hard to tell whether these are TC winds or environmental winds

As a disturbance east of Pohnpei
2Nov 2013

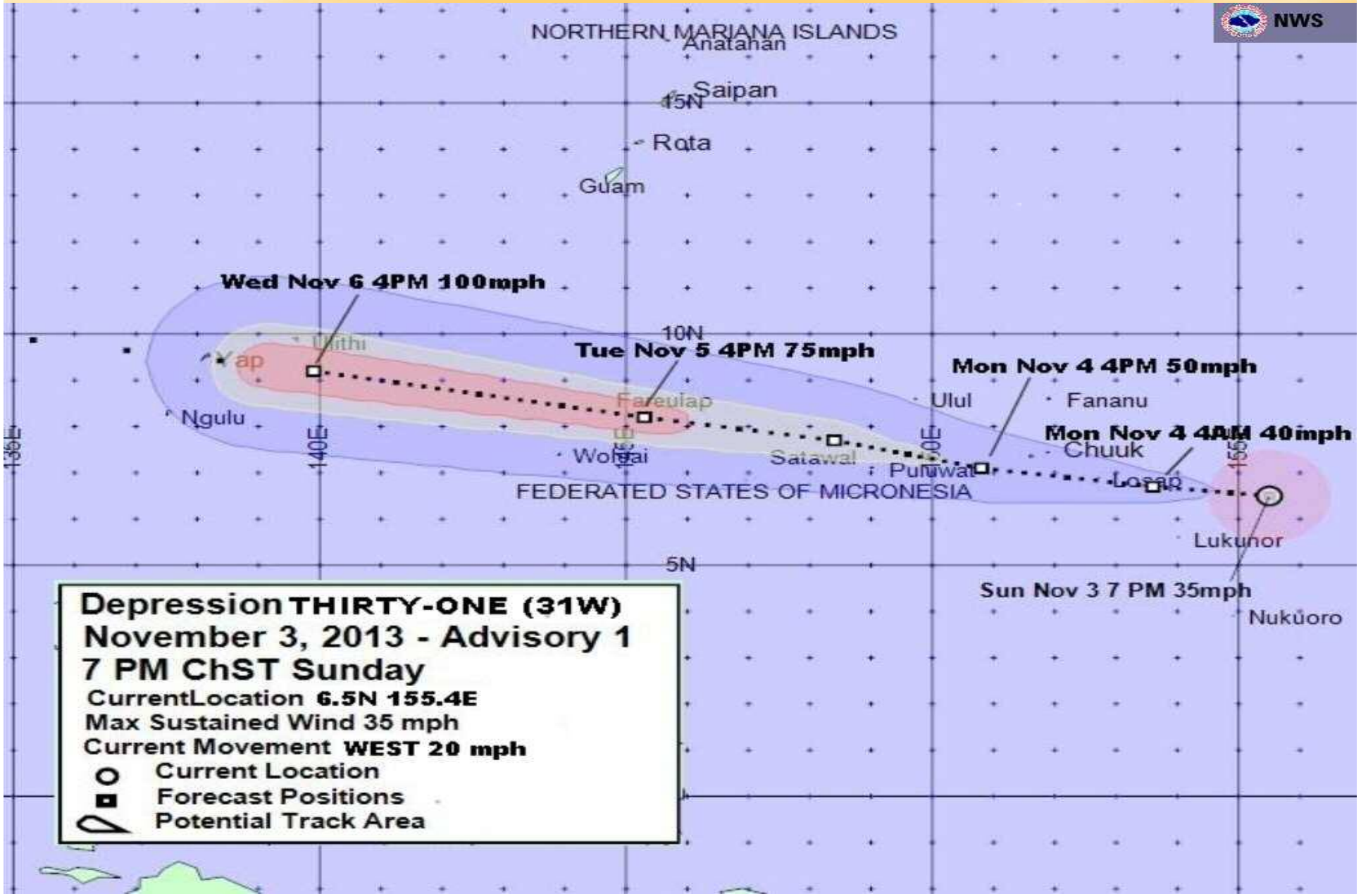


3Nov Suspect area 99W

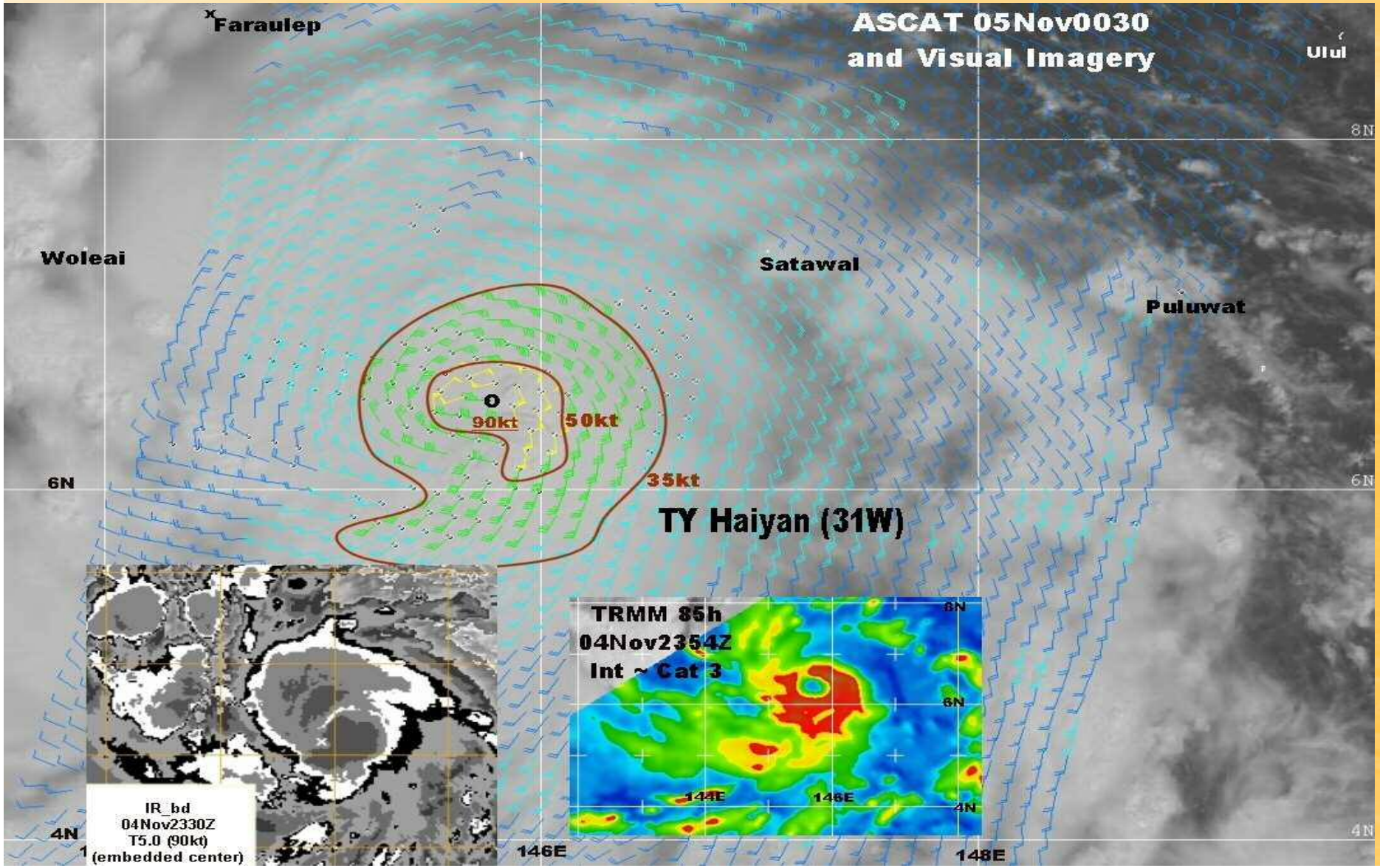
Hi-res Scatterometer (BYU)



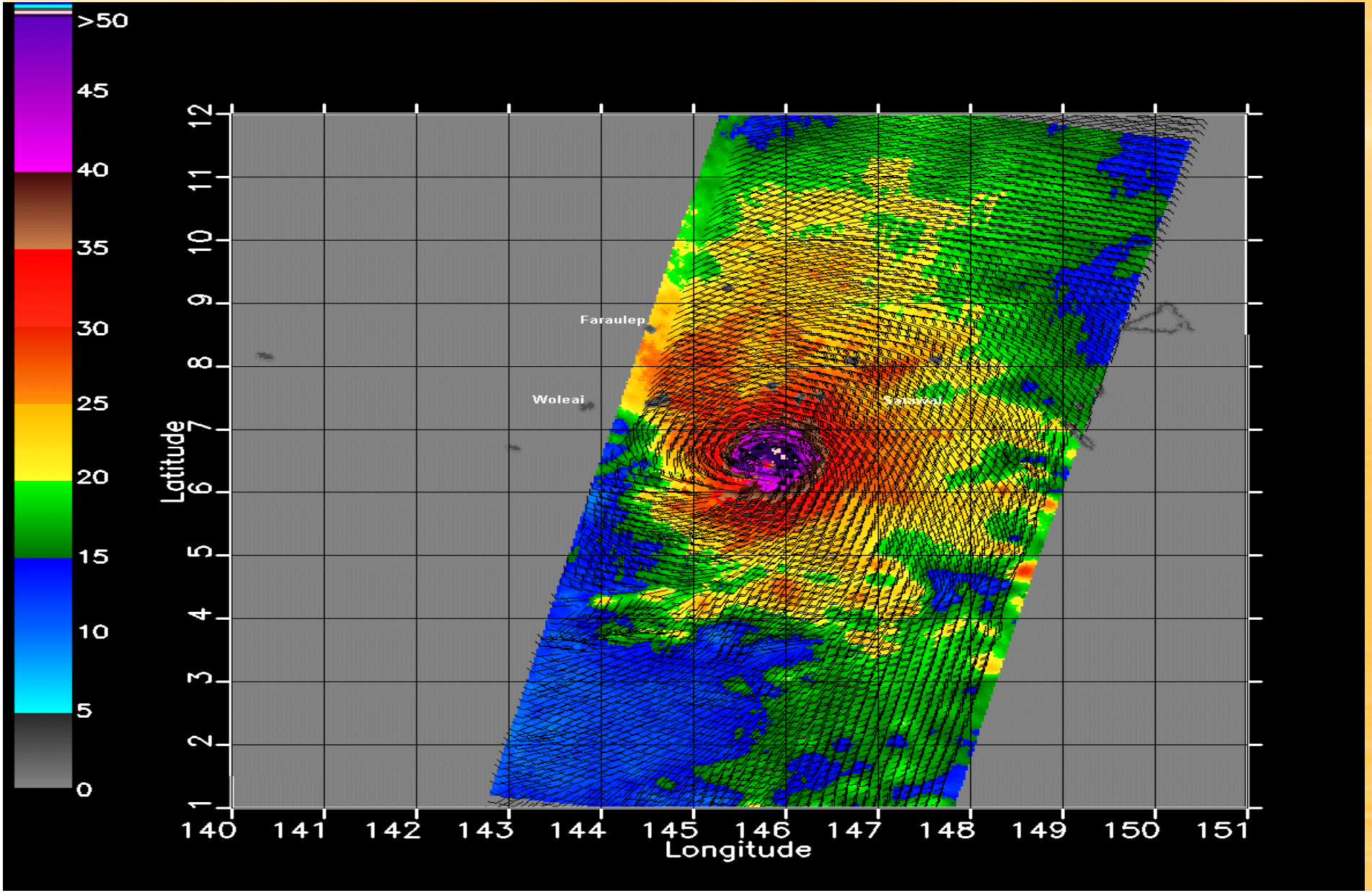
Track 1: Fast and Intense

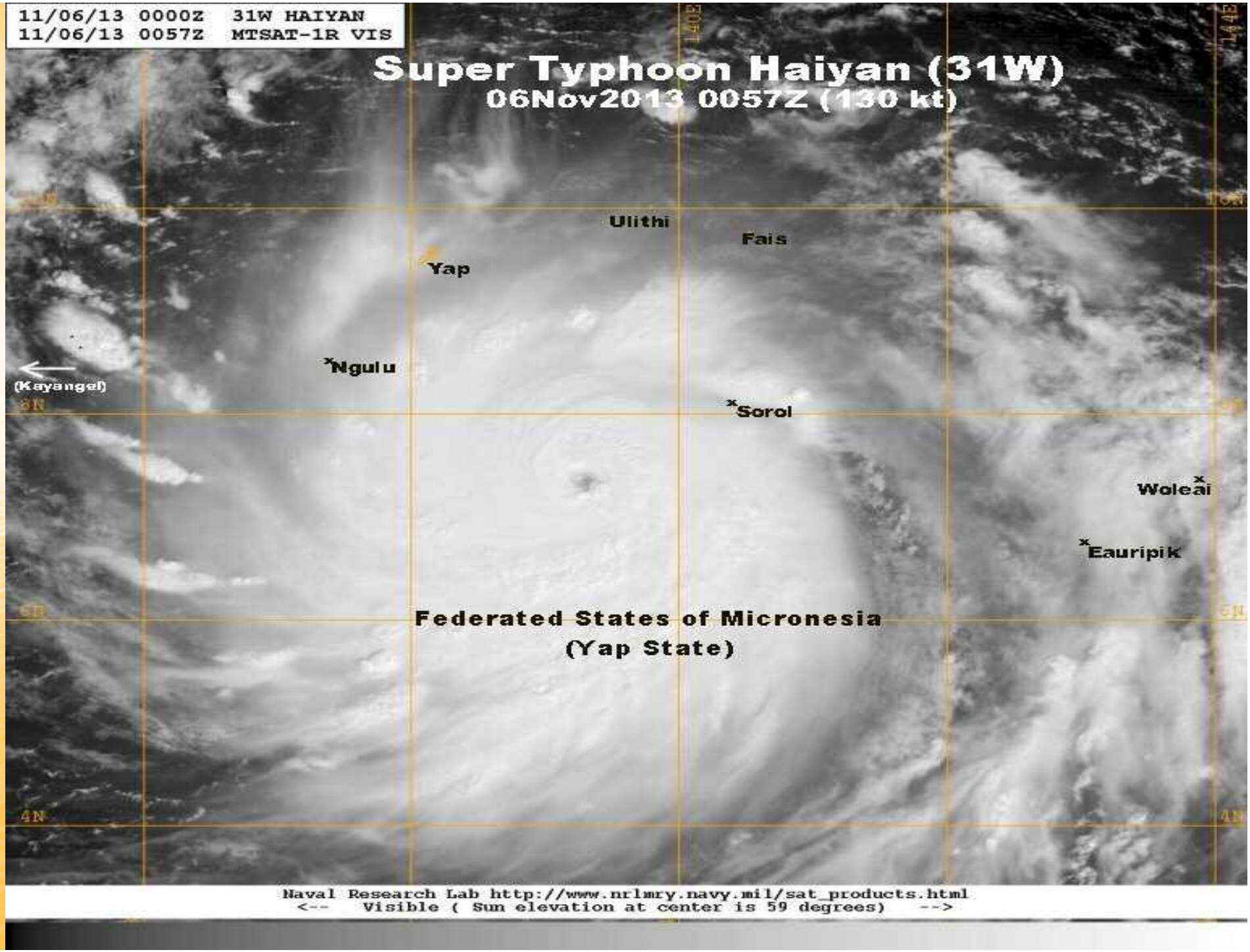


Point of rapid intensification 5Nov 0000UTC



Becoming a small but powerful typhoon

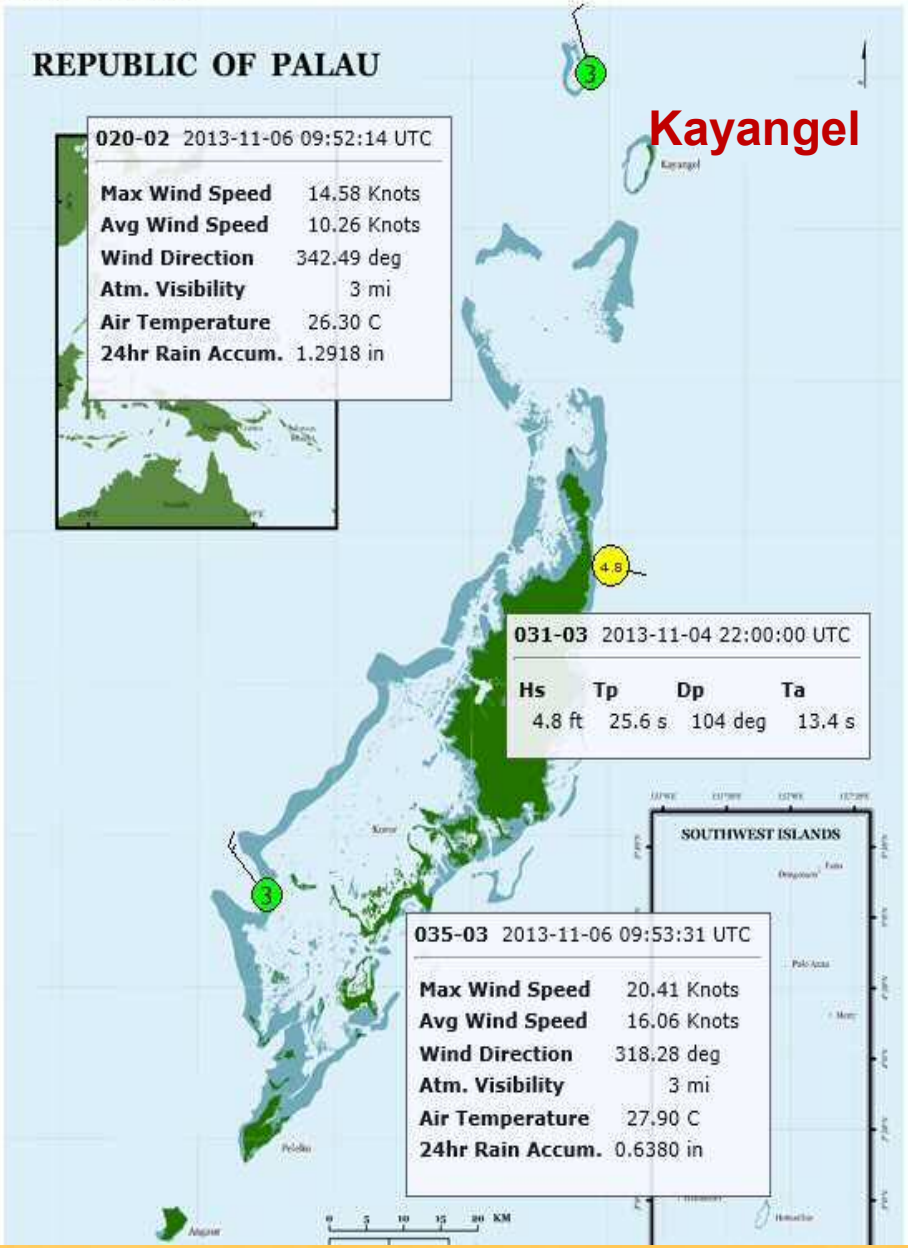



11/06/13 0000Z 31W HAIYAN
11/06/13 0057Z MTSAT-1R VIS
Super Typhoon Haiyan (31W)
06Nov2013 0057Z (130 kt)
Ulithi
Fais
Yap
Ngulu
(Kayangal)
Sorol
Woleai
Eauripik
Federated States of Micronesia
(Yap State)
8N
6N
4N
Naval Research Lab http://www.nrlmry.navy.mil/sat_products.html
<-- Visible (Sun elevation at center is 59 degrees) -->

Ngulu Atoll, Yap State

PALAU
Overview
Satellite (loop)
Swell Model Animation

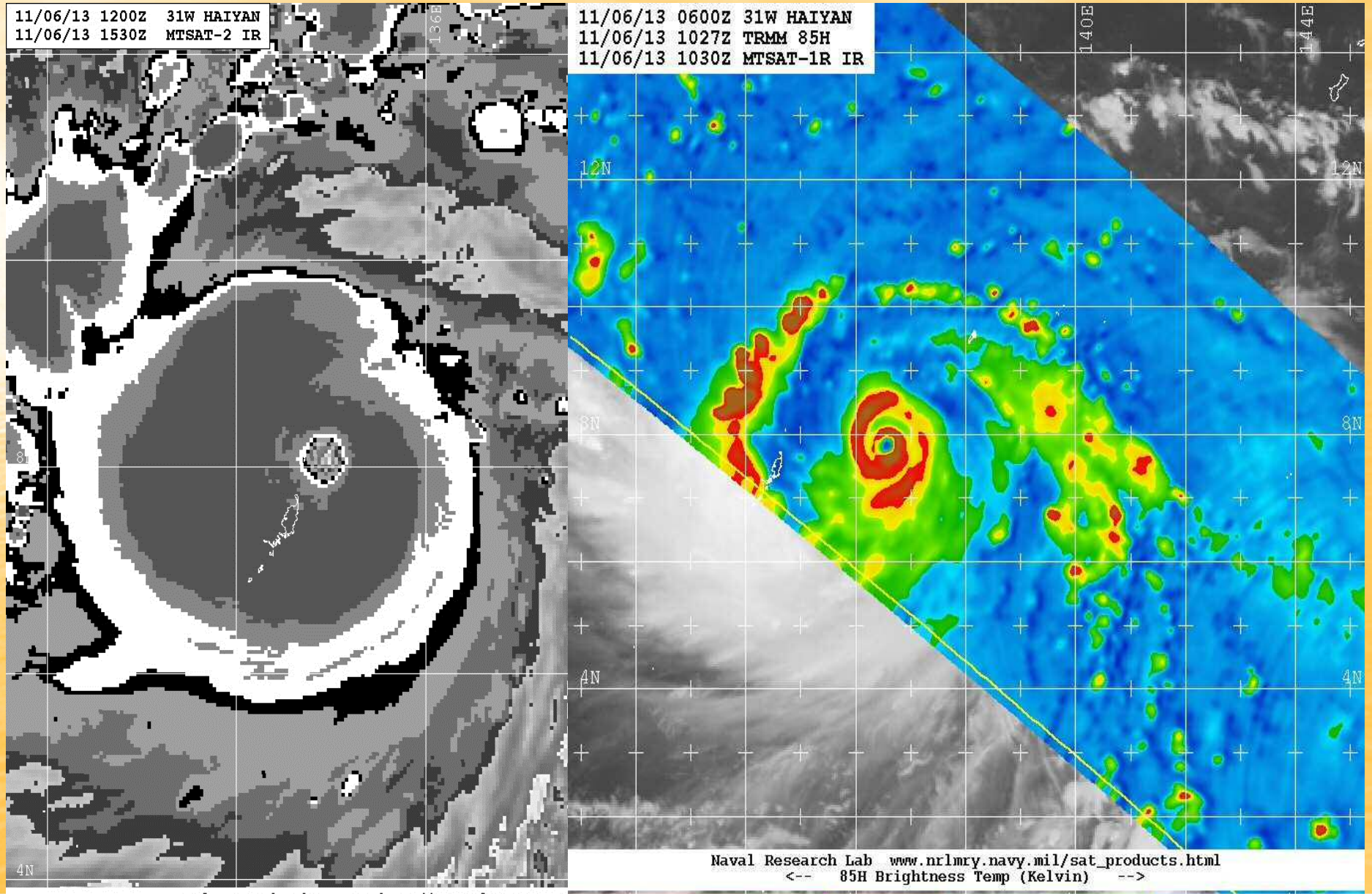
Palau Weather



Palau: 2013-11-06 19:02:12
UTC: 2013-11-06 10:02:12
US West: 2013-11-06 02:02:12

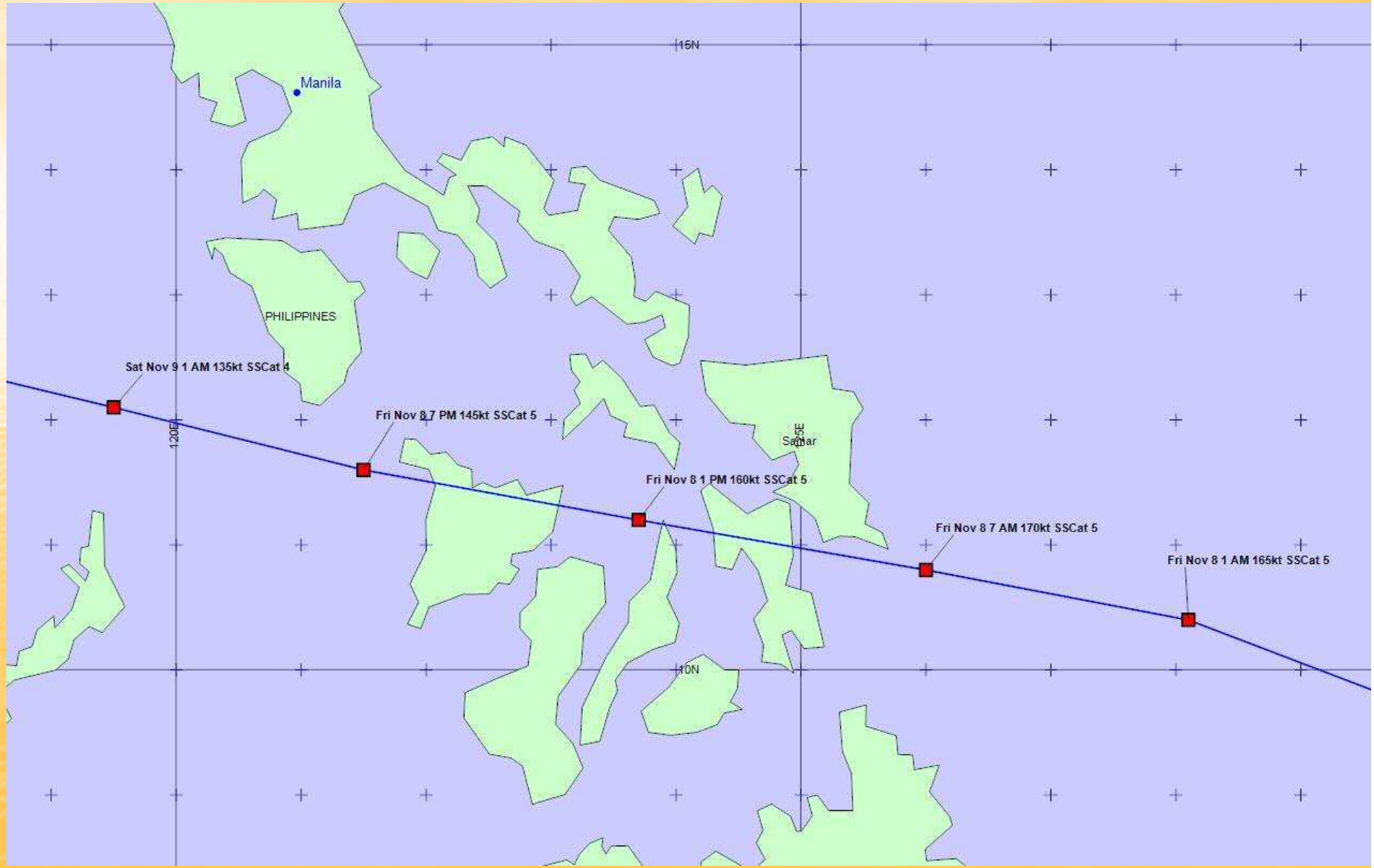
	Today	Tomorrow
Sunrise:	5:49 AM	5:49 AM
Sunset:	5:41 PM	5:41 PM

Moving towards Kayangel, ROP (Cat 5)

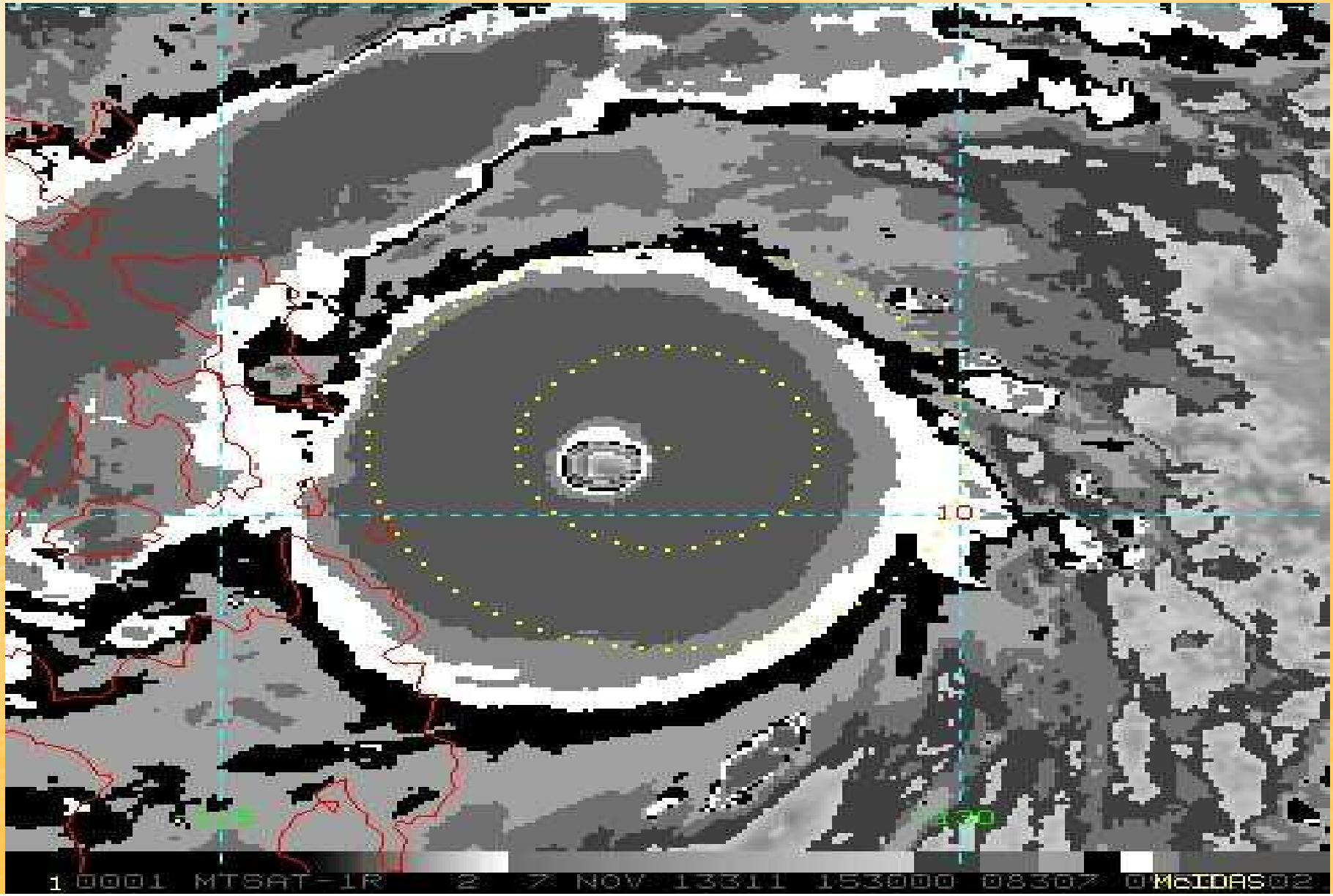


Kayangel, ROP

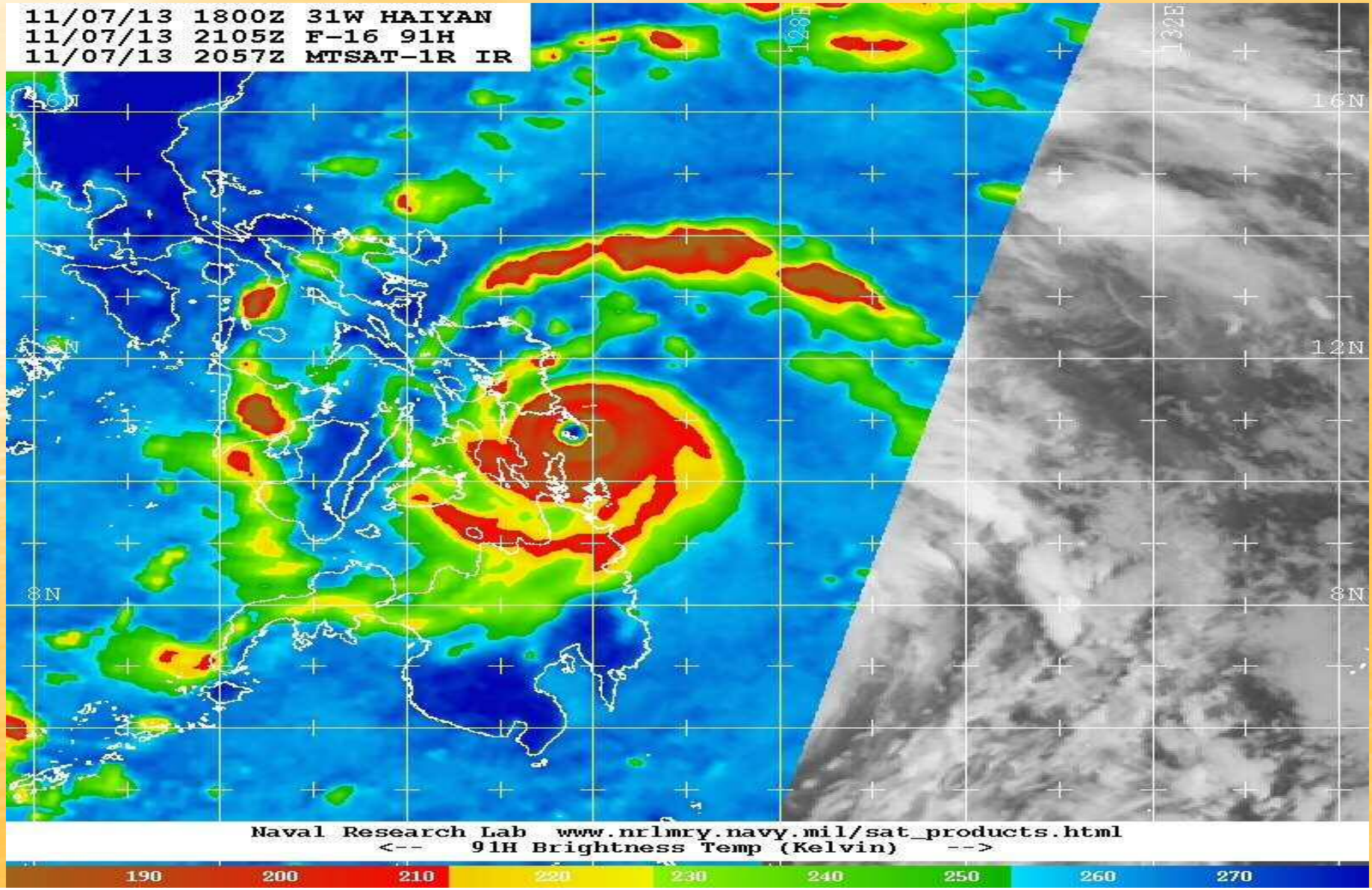
Track through the Philippines



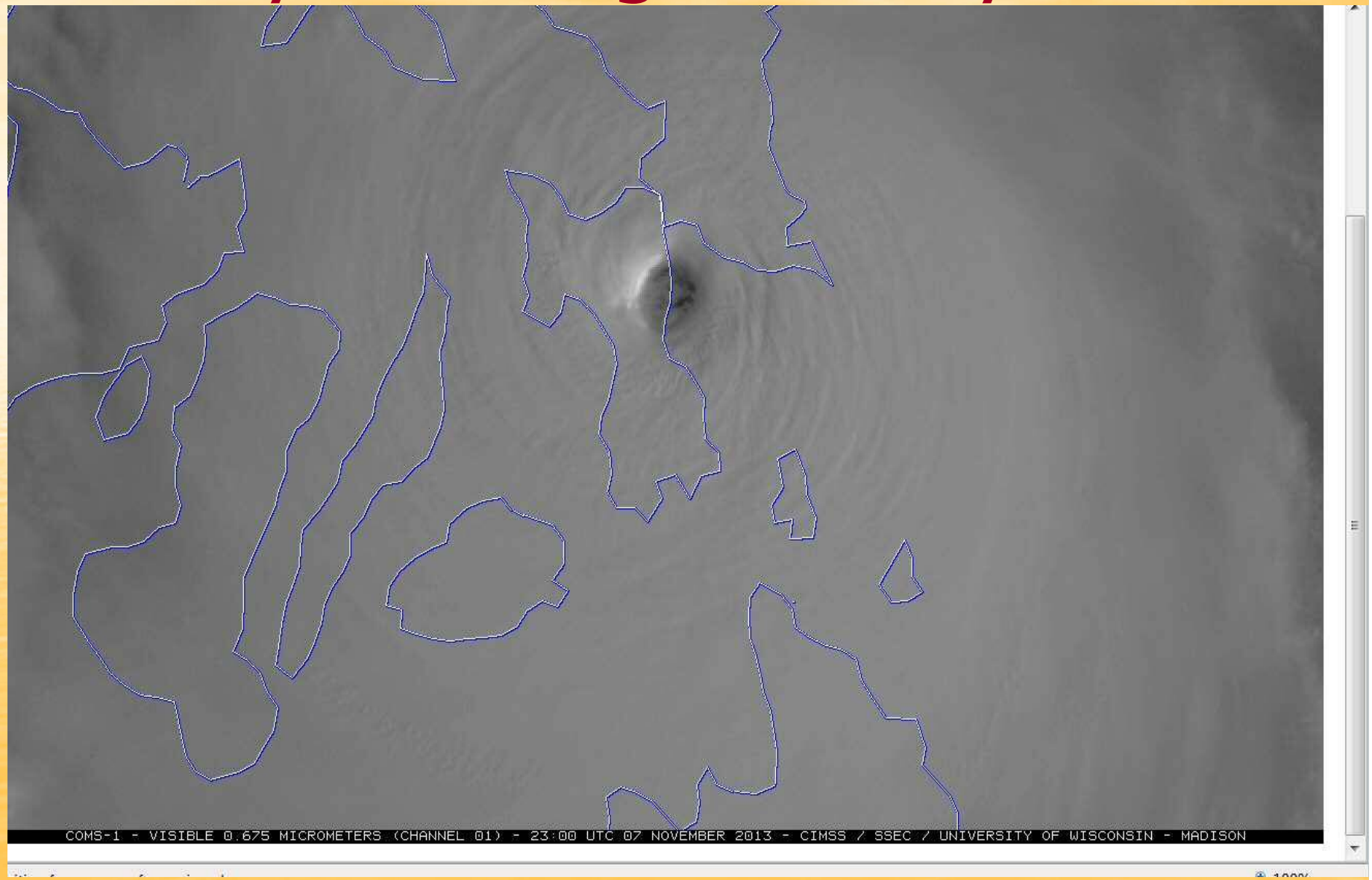
Dvorak Curve Irbd (dark grey not used)



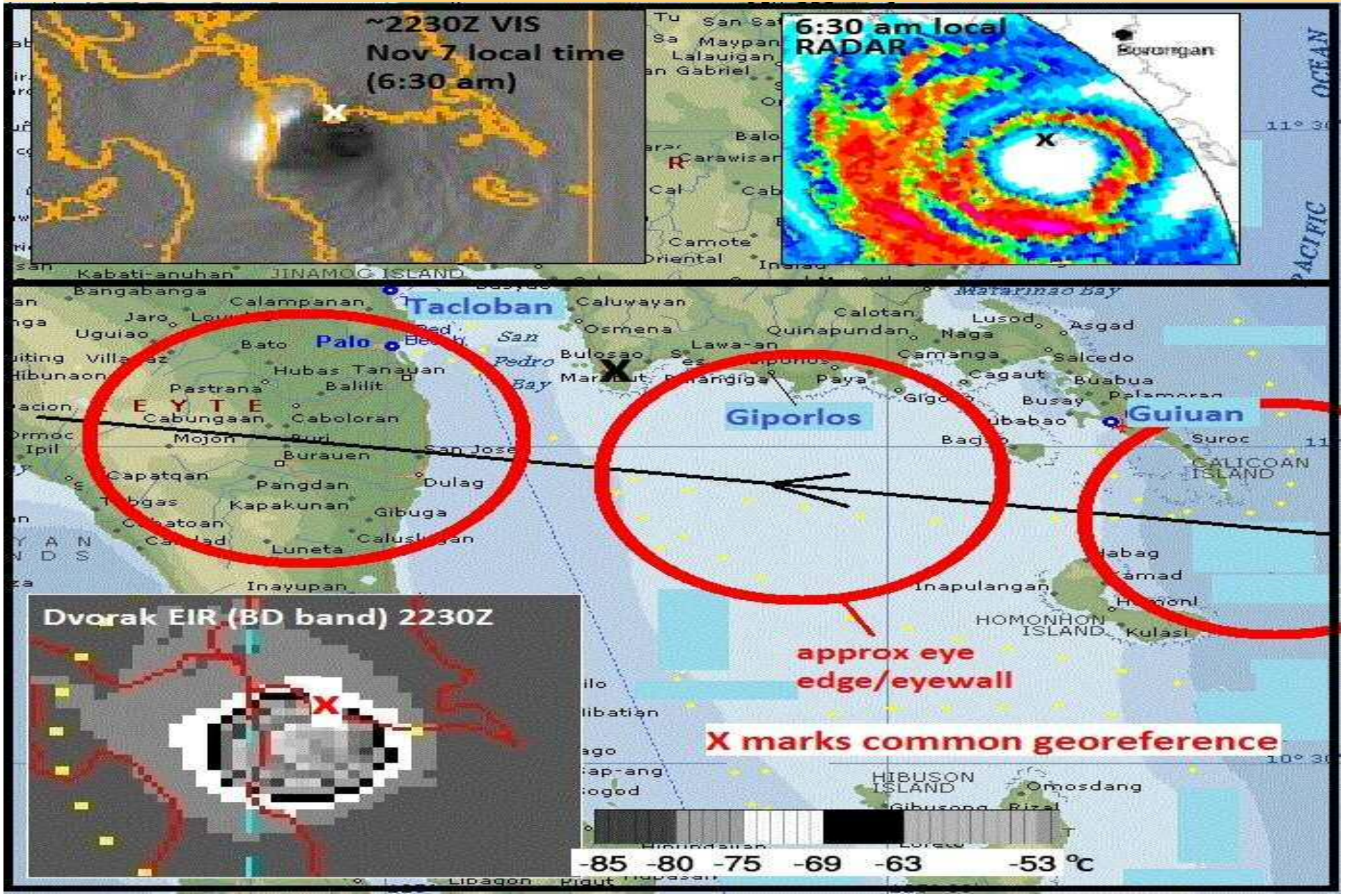
Very Intense MI 85h signature!



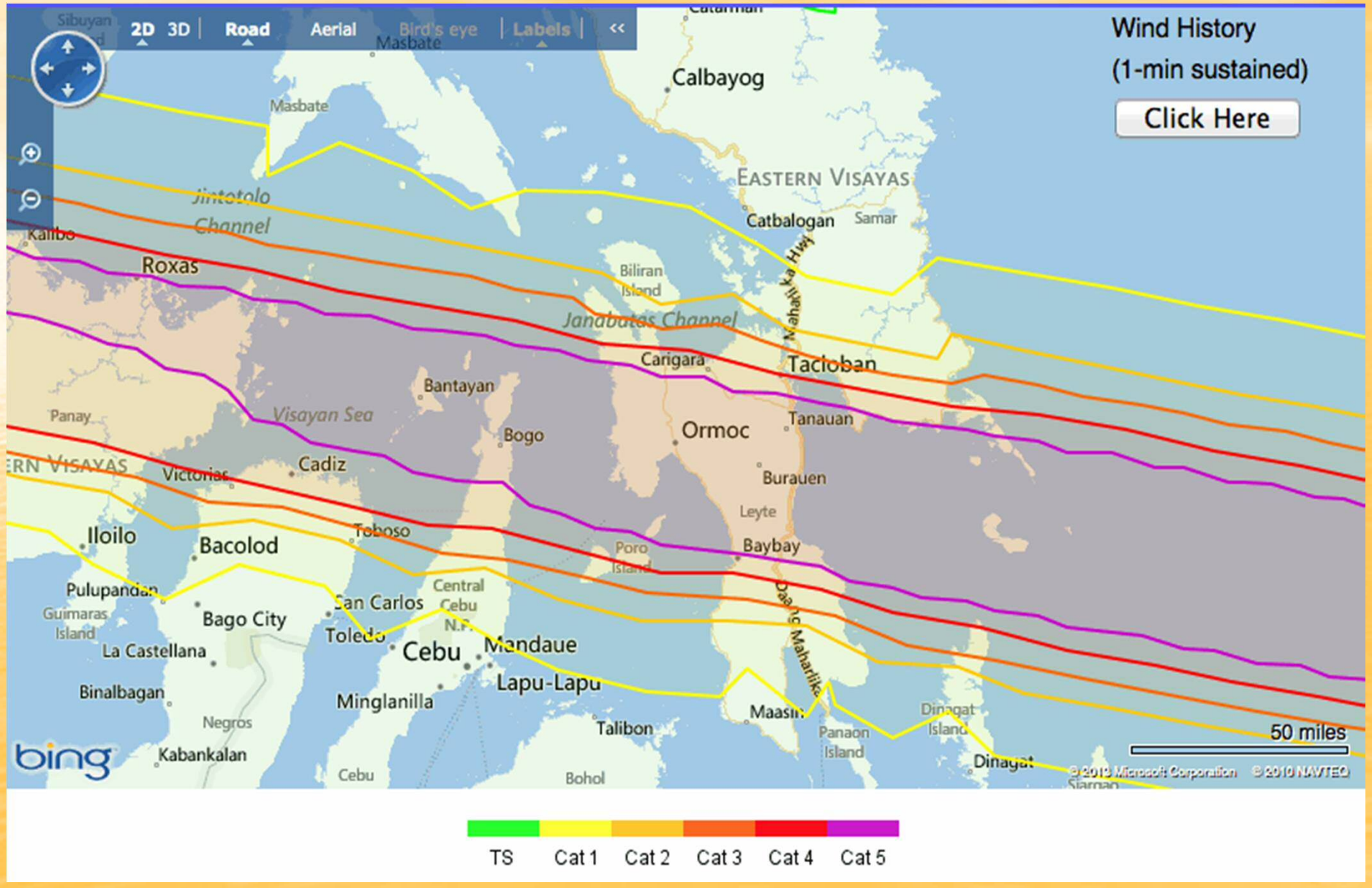
Eye moving over Leyte



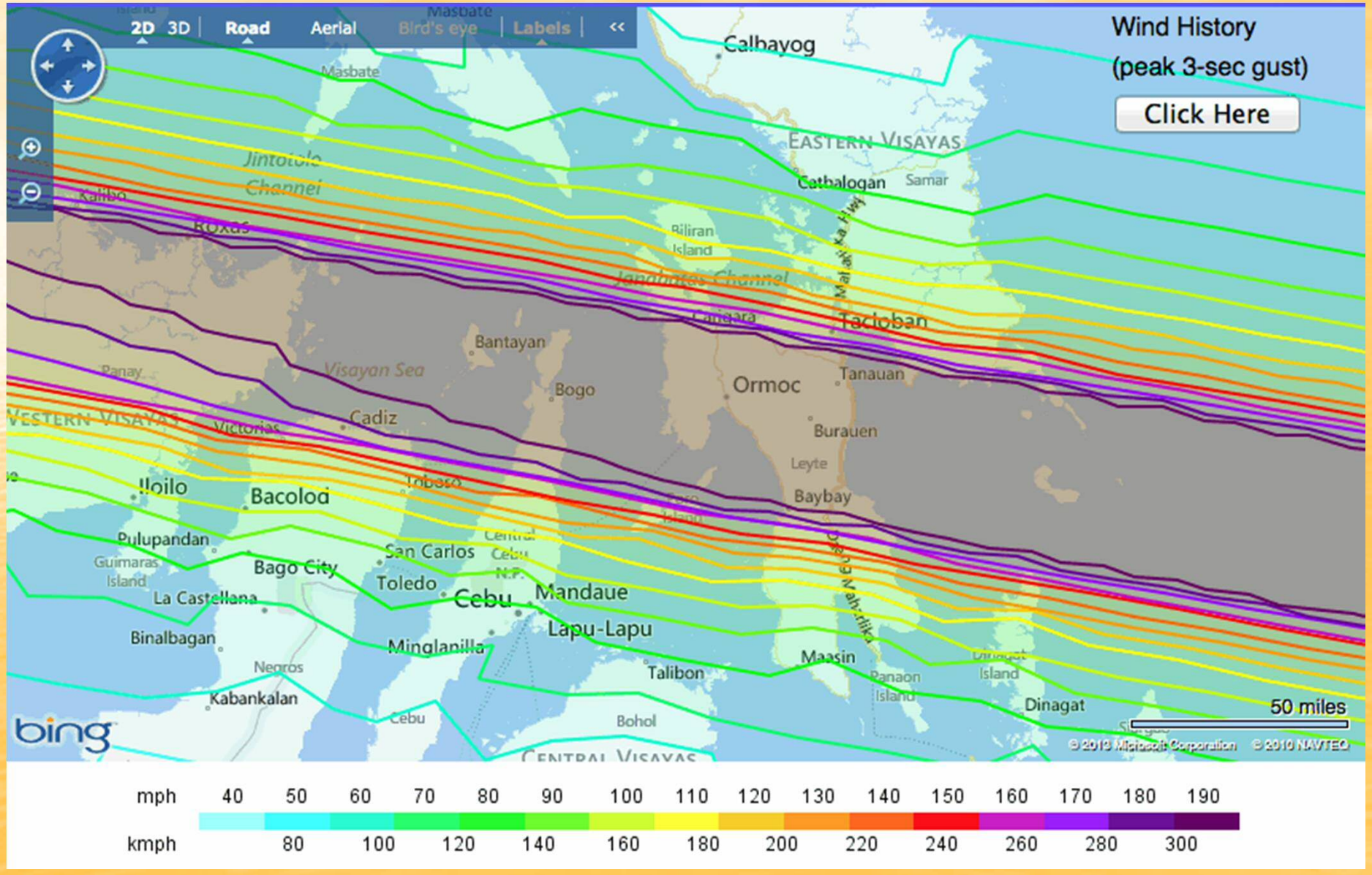
From Chris Fogarty



From Mark Saunders-1 minute sustained



From Mark Saunders—3 sec gusts



Extreme gradients!!

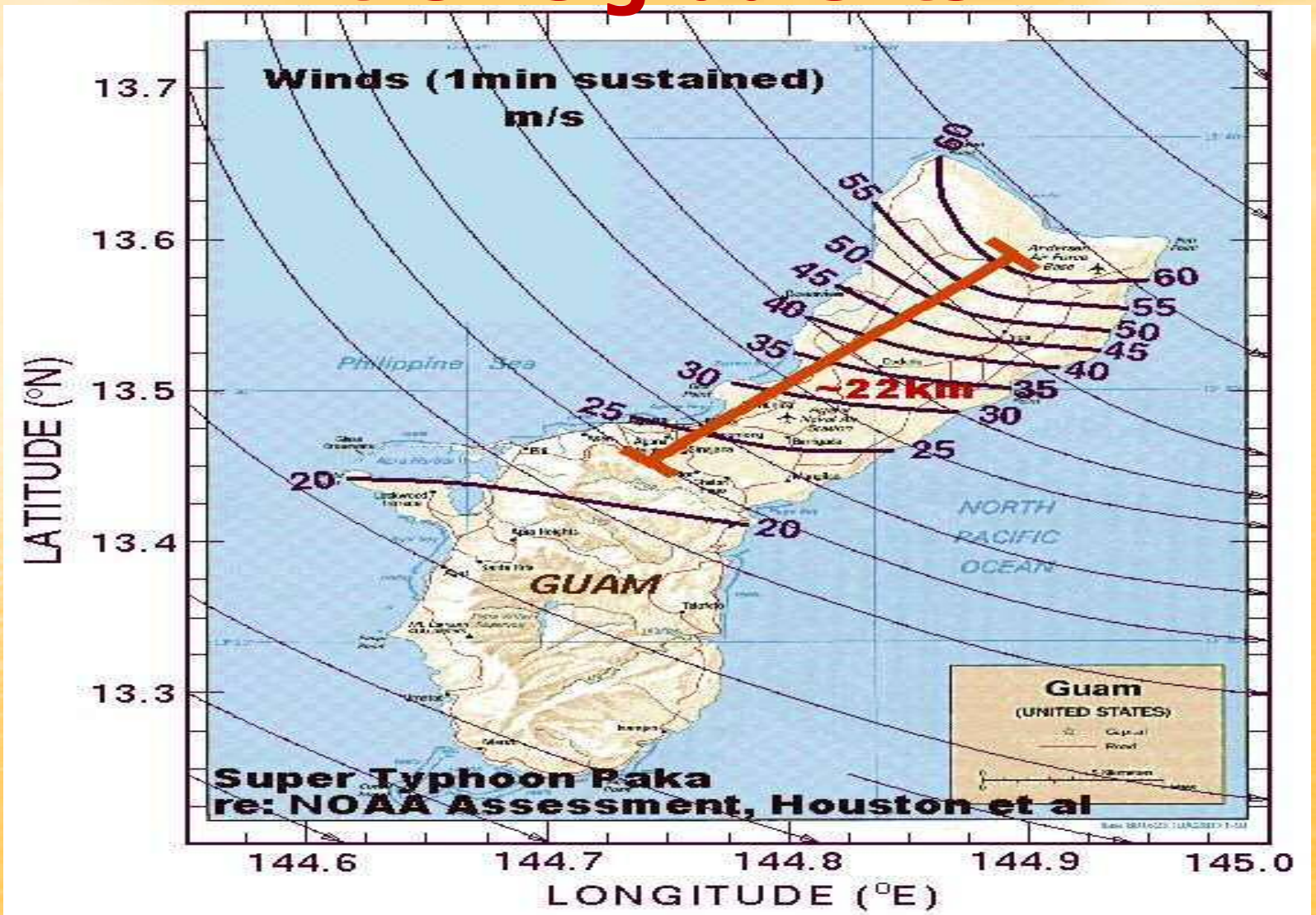
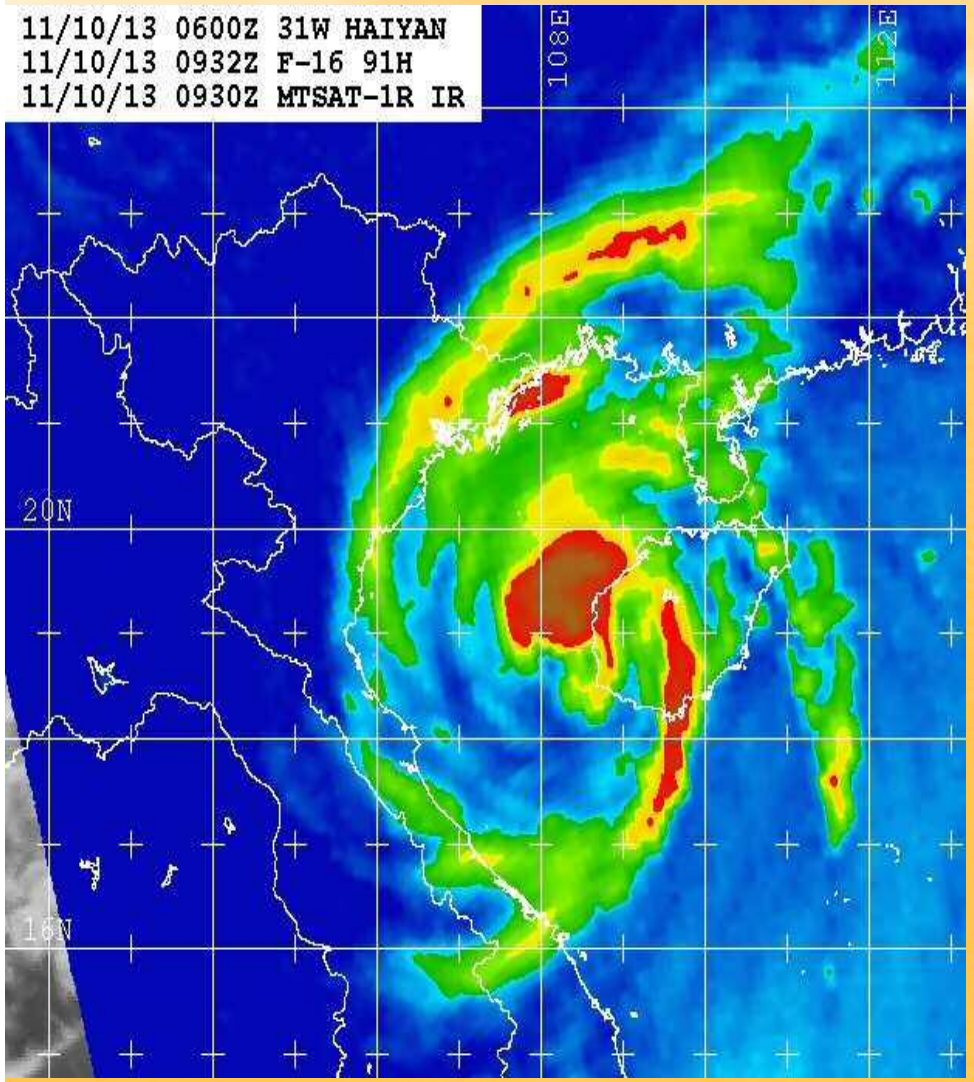


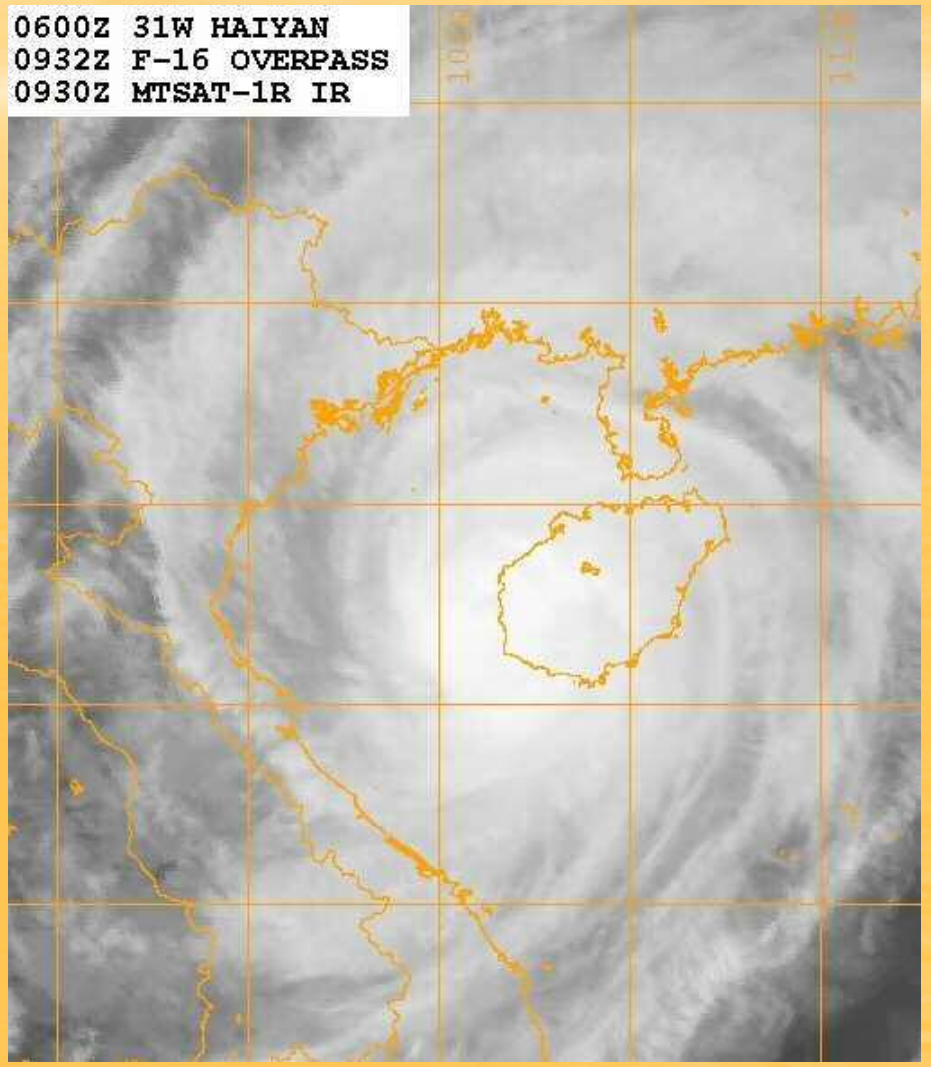
Figure 7: Snapshot of Super Typhoon Paka's 10 m, maximum 1-min sustained winds for 0630 UTC 16 December 1997 shown as streamlines and isotachs (units = m s^{-1}). This wind field is valid only for open terrain over land exposure at 10 m. The streamlines are the thin lines with arrows and the isotachs are the labeled thicker line segments over Guam.

Final into the South China Sea, Hainan Island and Vietnam

- Images of a weaker but still strong typhoon
- Track error…first time during the life of the TC
- Brushing by Hainan Island
- Into the Vietnamese and Chinese Border

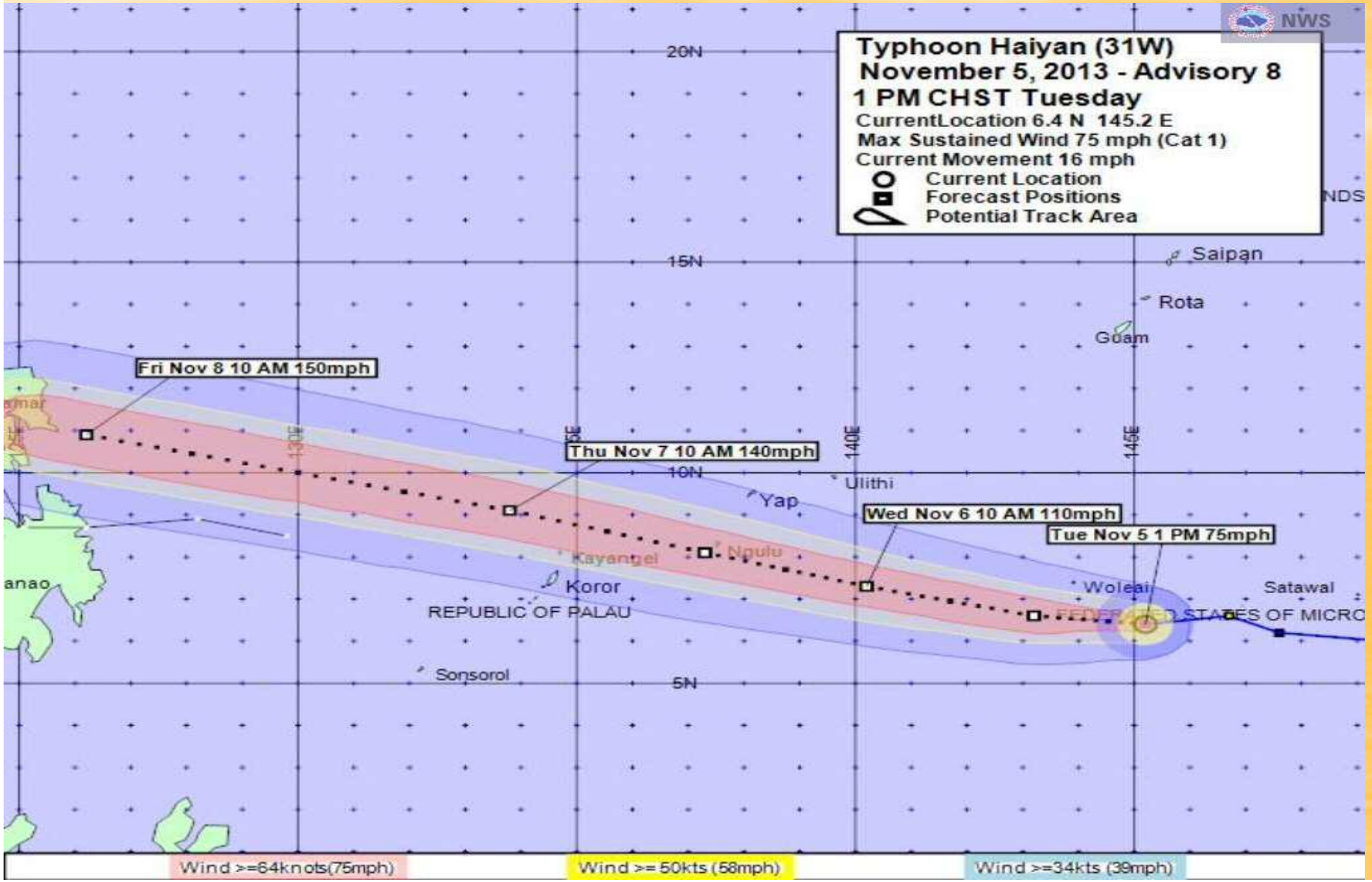
Near Hainan Island



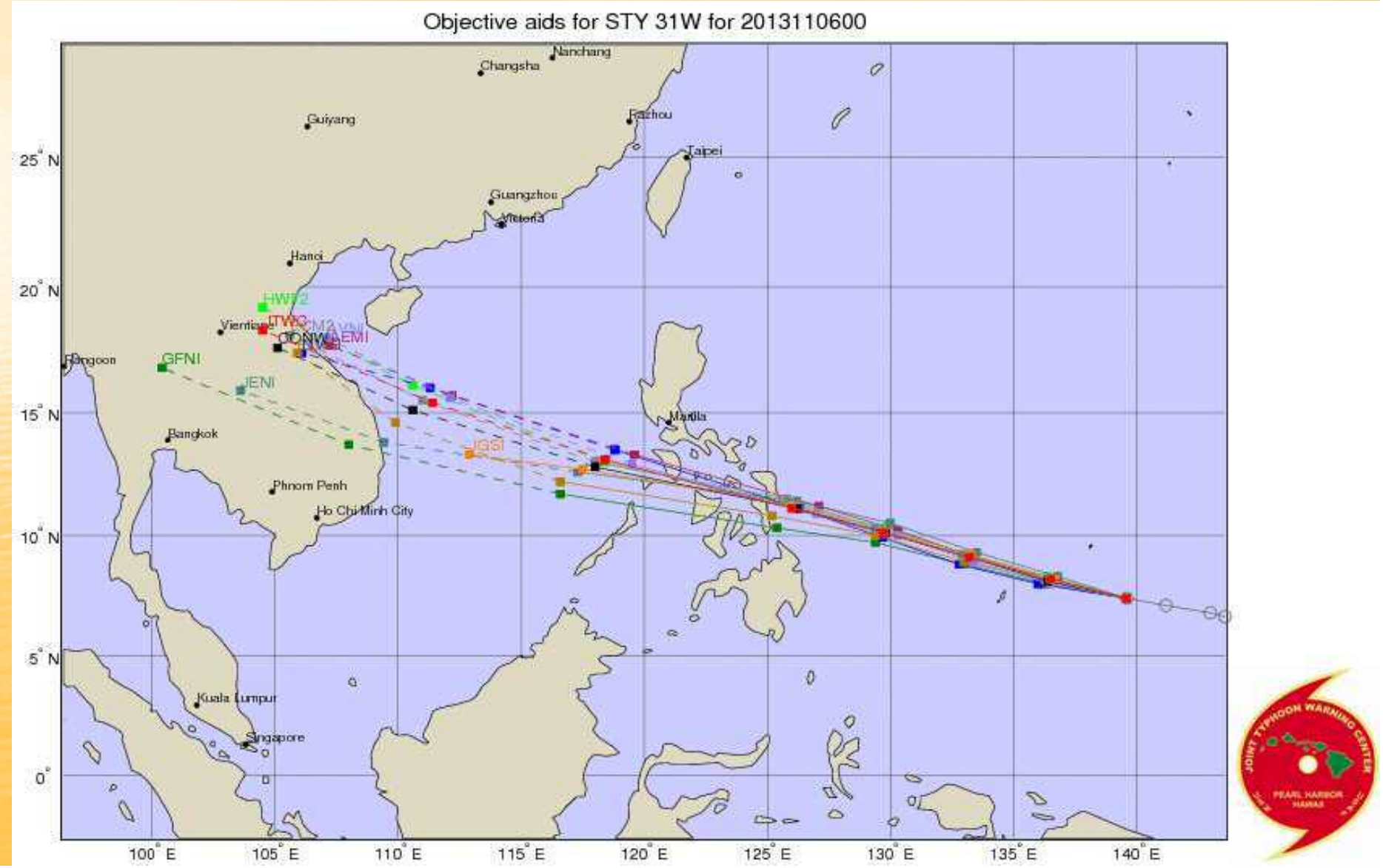


How were the forecasts?

Warning #8, 5 Nov 0300UTC



JTWC forecast aids (NWP)



Consensus of Models from JMA

HAIYAN (T1330) (36)

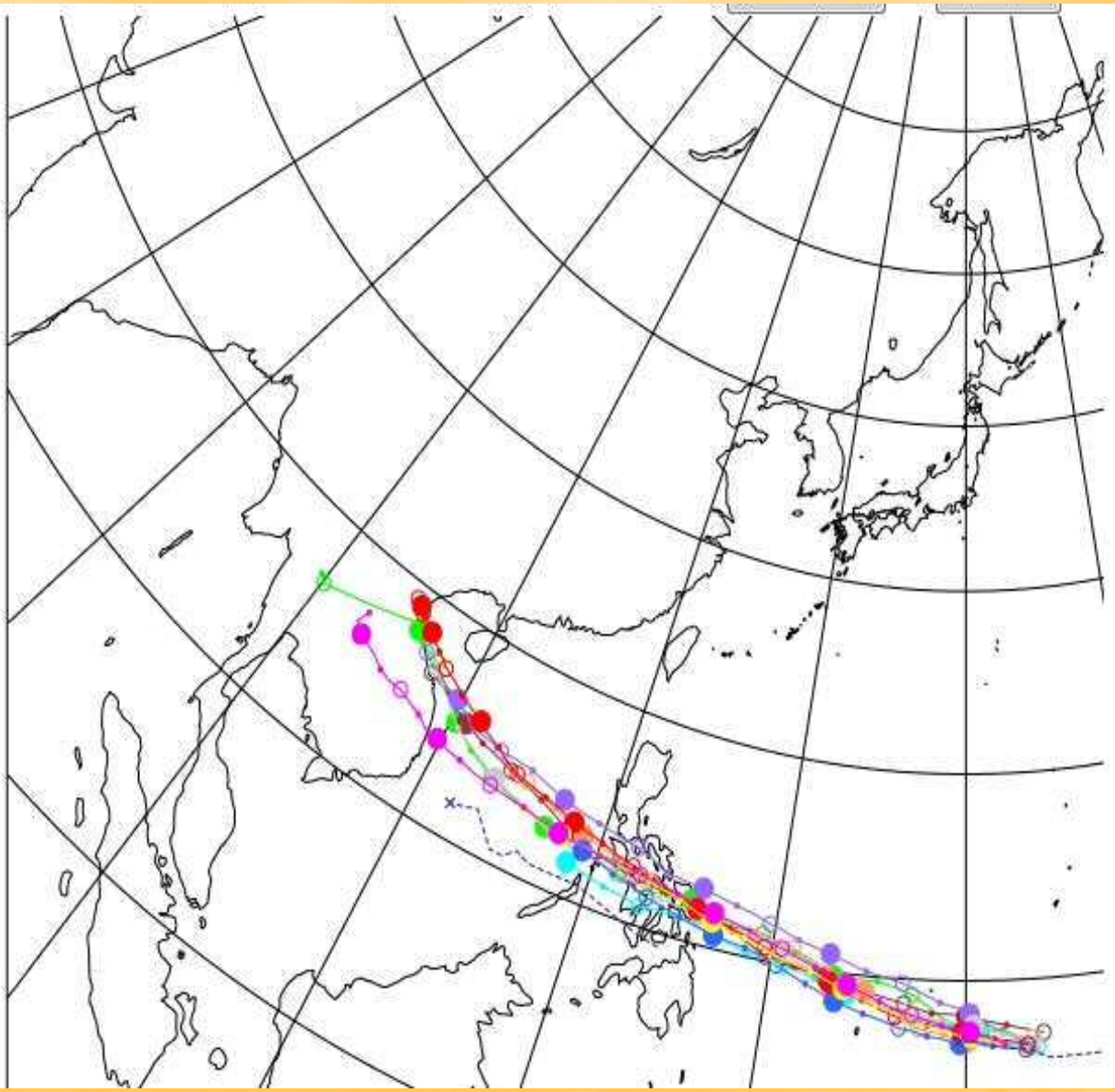
- BoM 2013110512UTC Initial
- MSC 2013110512UTC Initial
- CMA 2013110512UTC Initial
- DWD 2013110512UTC Initial
- KMA 2013110512UTC Initial
- UKMET 2013110512UTC Initial
- NCEP 2013110512UTC Initial
- ECMWF 2013110512UTC Initial
- GSM 2013110518UTC Initial
- TEPS 2013110518UTC Initial

CONSENSUS RESET

Latest Analysis 2013110600UTC

Tropical Depression (37)

- BoM 2013110512UTC Initial
- MSC 2013110512UTC Initial
- CMA 2013110512UTC Initial
- DWD 2013110512UTC Initial
- KMA 2013110512UTC Initial
- UKMET 2013110512UTC Initial
- NCEP 2013110512UTC Initial



[JMA Ensemble Prediction]

Data Table Prognostic Reasoning

Black Back Initialize

HAIYAN (T1330) (36)

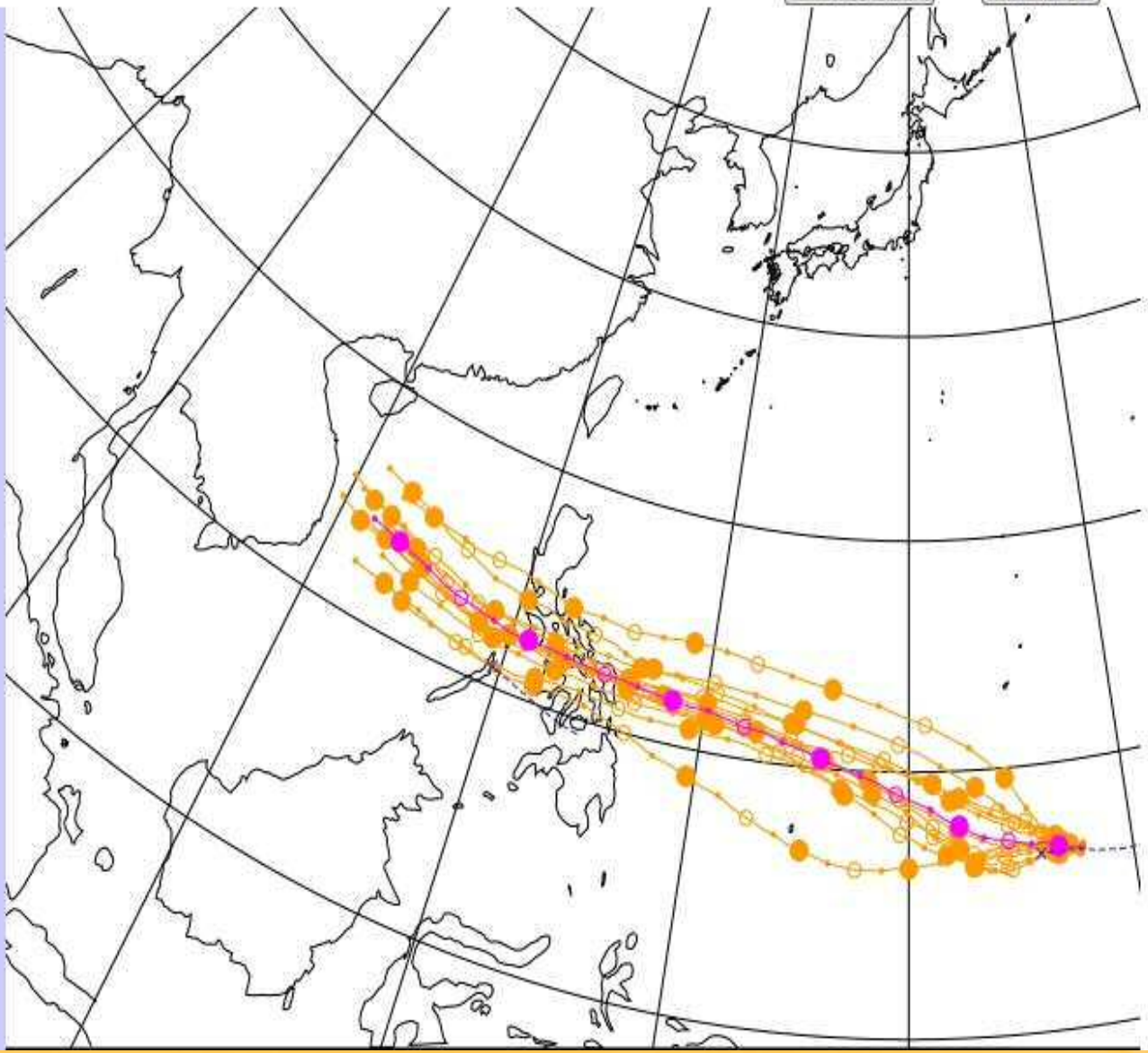
- control 2013110418UTC Initial
- 01P 2013110418UTC Initial
- 01M 2013110418UTC Initial
- 02P 2013110418UTC Initial
- 02M 2013110418UTC Initial
- 03P 2013110418UTC Initial
- 03M 2013110418UTC Initial
- 04P 2013110418UTC Initial
- 04M 2013110418UTC Initial
- 05P 2013110418UTC Initial
- 05M 2013110418UTC Initial
- TEPS 2013110418UTC Initial

CONSENSUS RESET

Latest Analysis 2013110500UTC

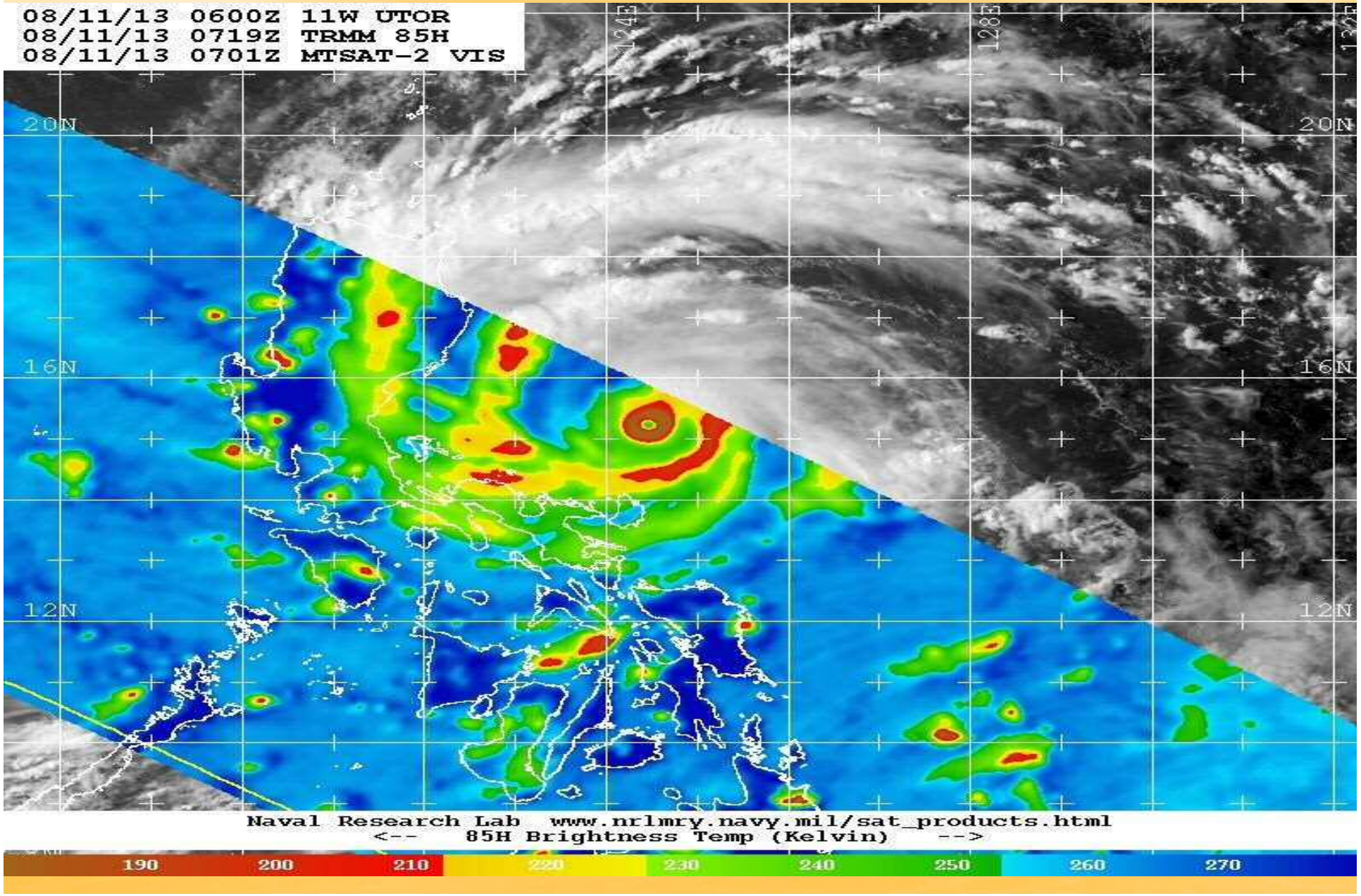
Tropical Depression (37)

- control 2013110418UTC Initial
- 01P 2013110418UTC Initial
- 01M 2013110418UTC Initial
- 02P 2013110418UTC Initial
- 02M 2013110418UTC Initial

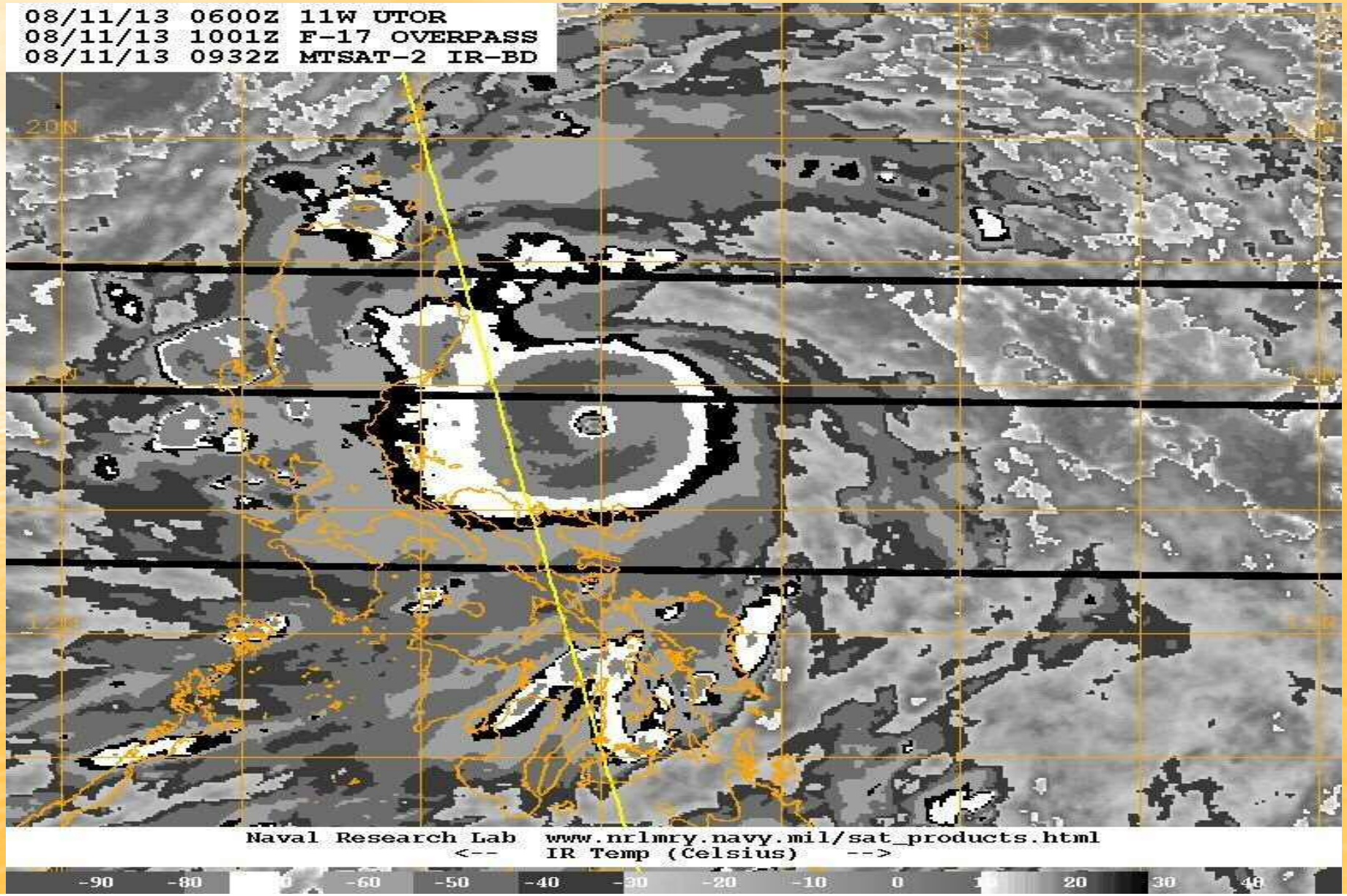


Is STY Haiyan the most intense…TC… ever?

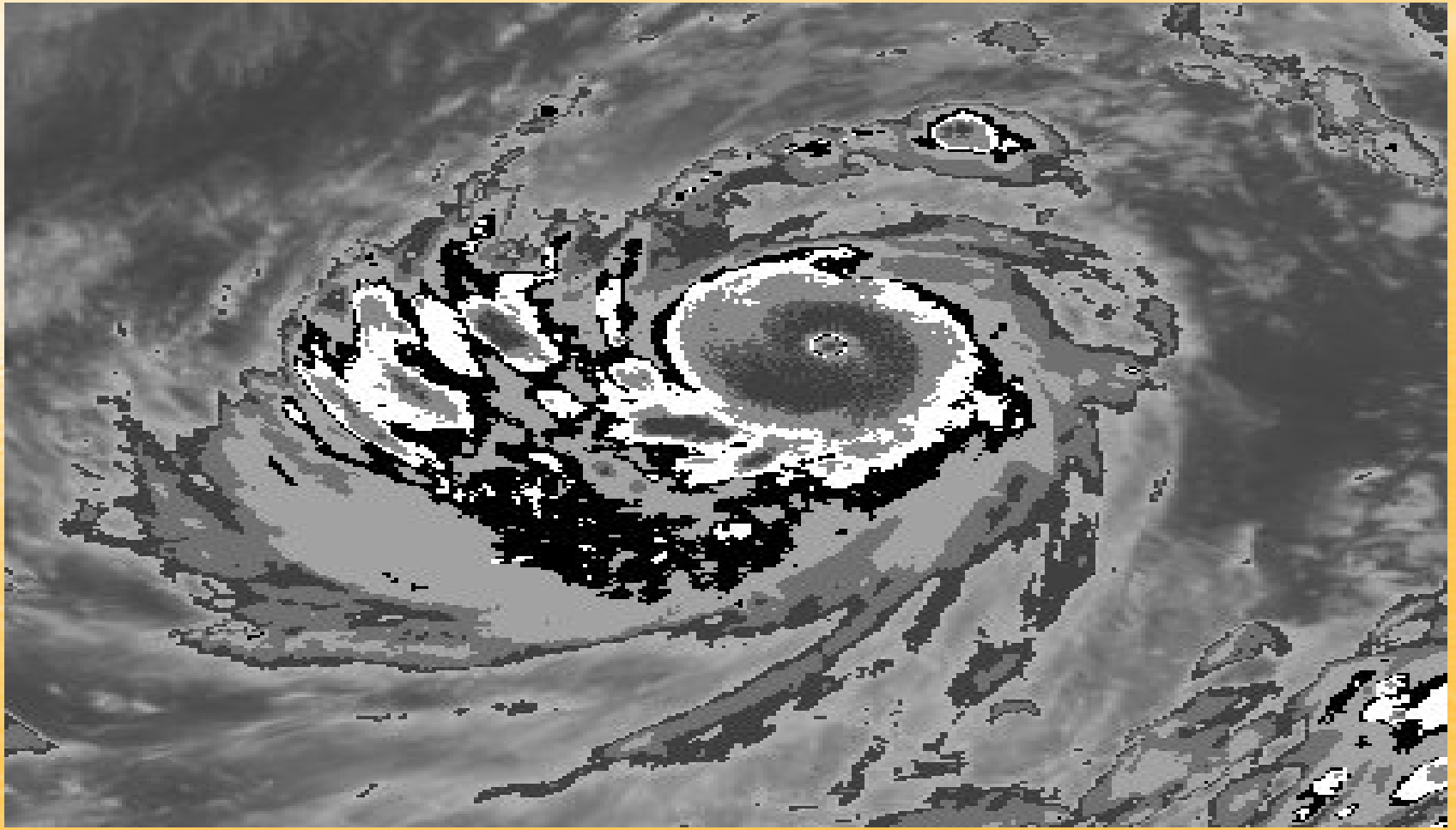
Very intense STY Utor approaching Luzon



STY Utor approaching Luzon in Aug 2013



Super Typhoon Tip (870mb)
Nov 1979 ~165kt?



Lowest aircraft sfc pressure measurement

```
WTPN33 PGTW 072100
MSGID/GENADMIN/JOINT TYPHOON WRNCEN PEARL HARBOR HI//
SUBJ/TROPICAL CYCLONE WARNING//
RMKS/
1. SUPER TYPHOON 31W (HAIYAN) WARNING NR 019
   01 ACTIVE TROPICAL CYCLONE IN NORTHWESTPAC
   MAX SUSTAINED WINDS BASED ON ONE-MINUTE AVERAGE
   WIND RADII VALID OVER OPEN WATER ONLY
    ---
   WARNING POSITION:
   071800Z --- NEAR 10.6N 127.0E
     MOVEMENT PAST SIX HOURS - 280 DEGREES AT 21 KTS
     POSITION ACCURATE TO WITHIN 020 NM
     POSITION BASED ON EYE FIXED BY SATELLITE
   PRESENT WIND DISTRIBUTION:
   MAX SUSTAINED WINDS - 170 KT, GUSTS 205 KT
   WIND RADII VALID OVER OPEN WATER ONLY
   RADIUS OF 064 KT WINDS - 050 NM NORTHEAST QUADRANT
                            045 NM SOUTHEAST QUADRANT
                            040 NM SOUTHWEST QUADRANT
                            050 NM NORTHWEST QUADRANT
   RADIUS OF 050 KT WINDS - 065 NM NORTHEAST QUADRANT
                            060 NM SOUTHEAST QUADRANT
                            060 NM SOUTHWEST QUADRANT
                            070 NM NORTHWEST OUADRANT
```

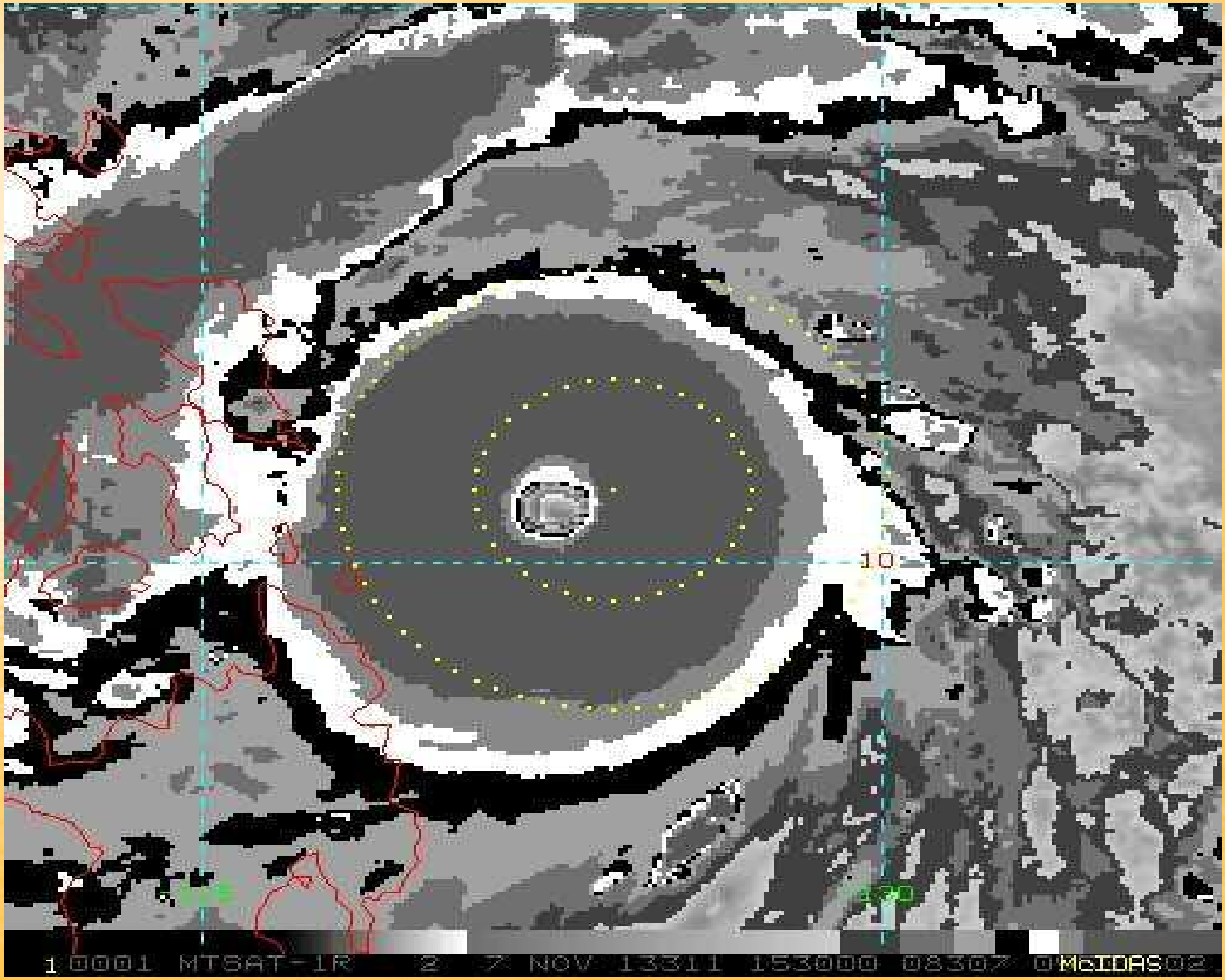
TY 1330 (HAIYAN)
Issued at 21:45 UTC, 7 November 2013

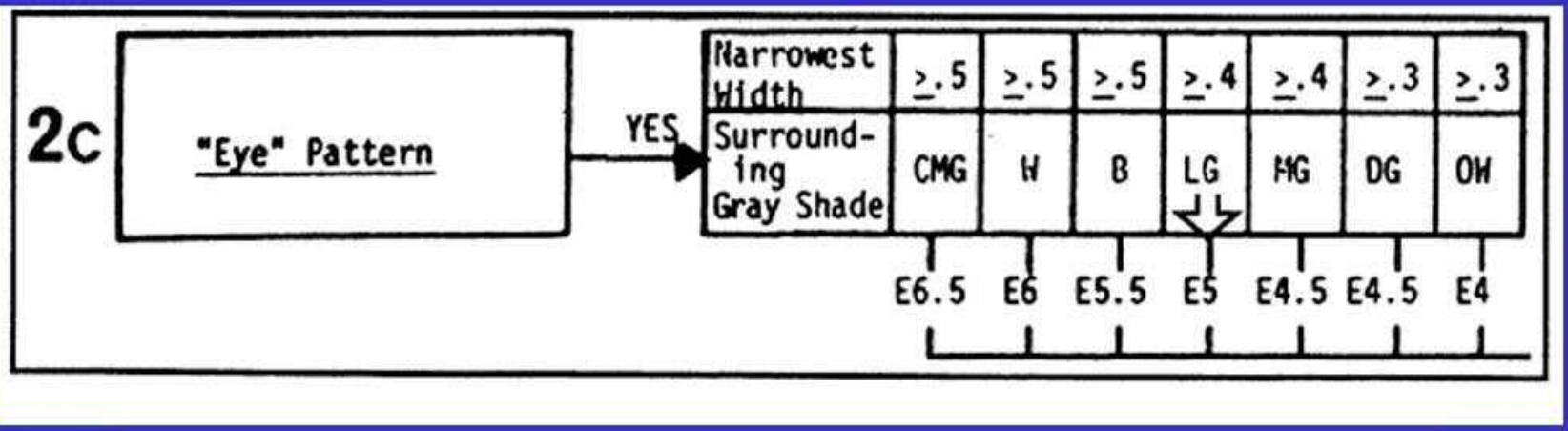
<Analyses at 07/21 UTC>	
Scale	-
Intensity	Violent
Center position	N10°50'(10.8°)
	E125°55'(125.9°)
Direction and speed of movement	W 35km/h(20kt)
Central pressure	895hPa
Maximum wind speed near the center	65m/s(125kt)
Maximum wind gust speed	90m/s(175kt)
Area of 50kt winds or more	ALL130km(70NM)
Area of 30kt winds or more	N330km(180NM)
	S280km(150NM)

Comparison of Dvorak Intensities JTWC vs. JMA

(Conversion to 1')

T Number	JTWC (1min)	JMA (10min) →	10' to 1'
2	30	30	33.6
2.5	35	35	39.2
3	45	45	50.4
3.5	55	55	61.6
4	65	65	72.8
4.5	77	70	78.4
5	90	77	86.2
5.5	102	85	95.2
6	115	93	104.7
6.5	127	100	112.0
7	140	107	119.8
7.5	155	115	128.8
8	170	122	136.6


10
1 0001 MTSAT-1R 2 7 NOV 13311 153000 08307 0 McIDAS02

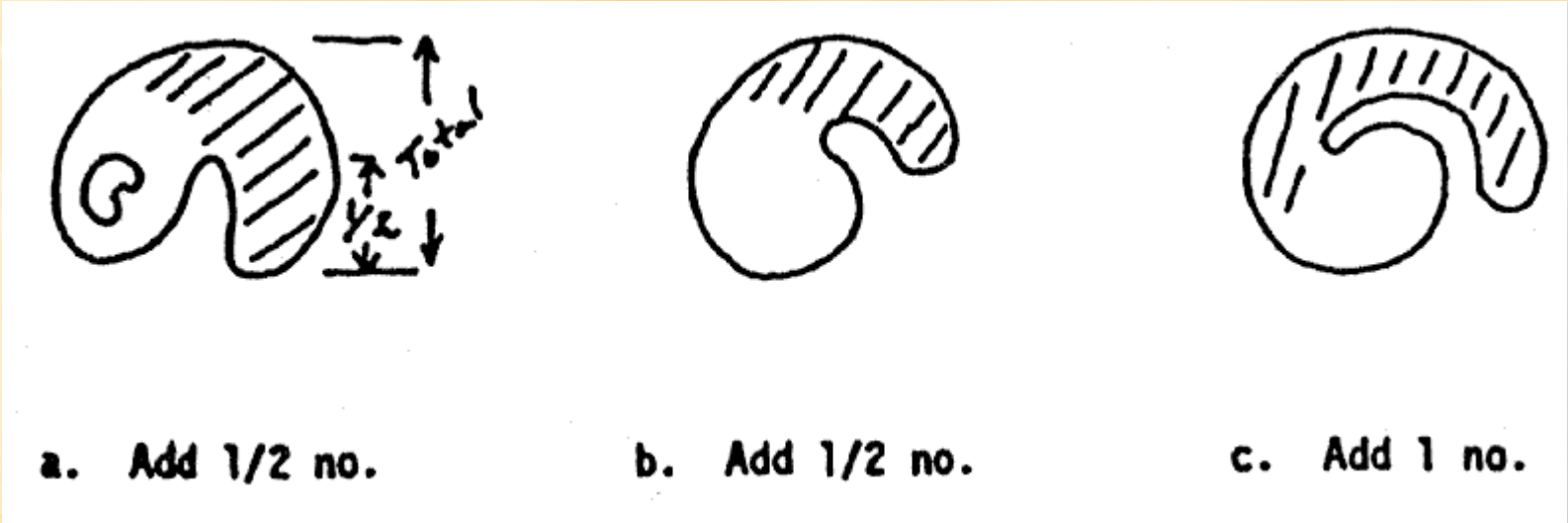


Eye Temperature

Surr. Ring Temp.	WMG	OW	DG	MG	LG	B	W
OW	0	-0.5					
DG	0	0	-0.5				
MG	0	0	-0.5	-0.5			
LG	+0.5	0	0	-0.5	-0.5		
B	+1.0	+0.5	0	0	-0.5	-0.5	
W	+1.0	+0.5	+0.5	0	0	-1.0	-1.0
CMG	+1.0	+0.5	+0.5	0	0	-0.5	-1.0

Infrared Technique

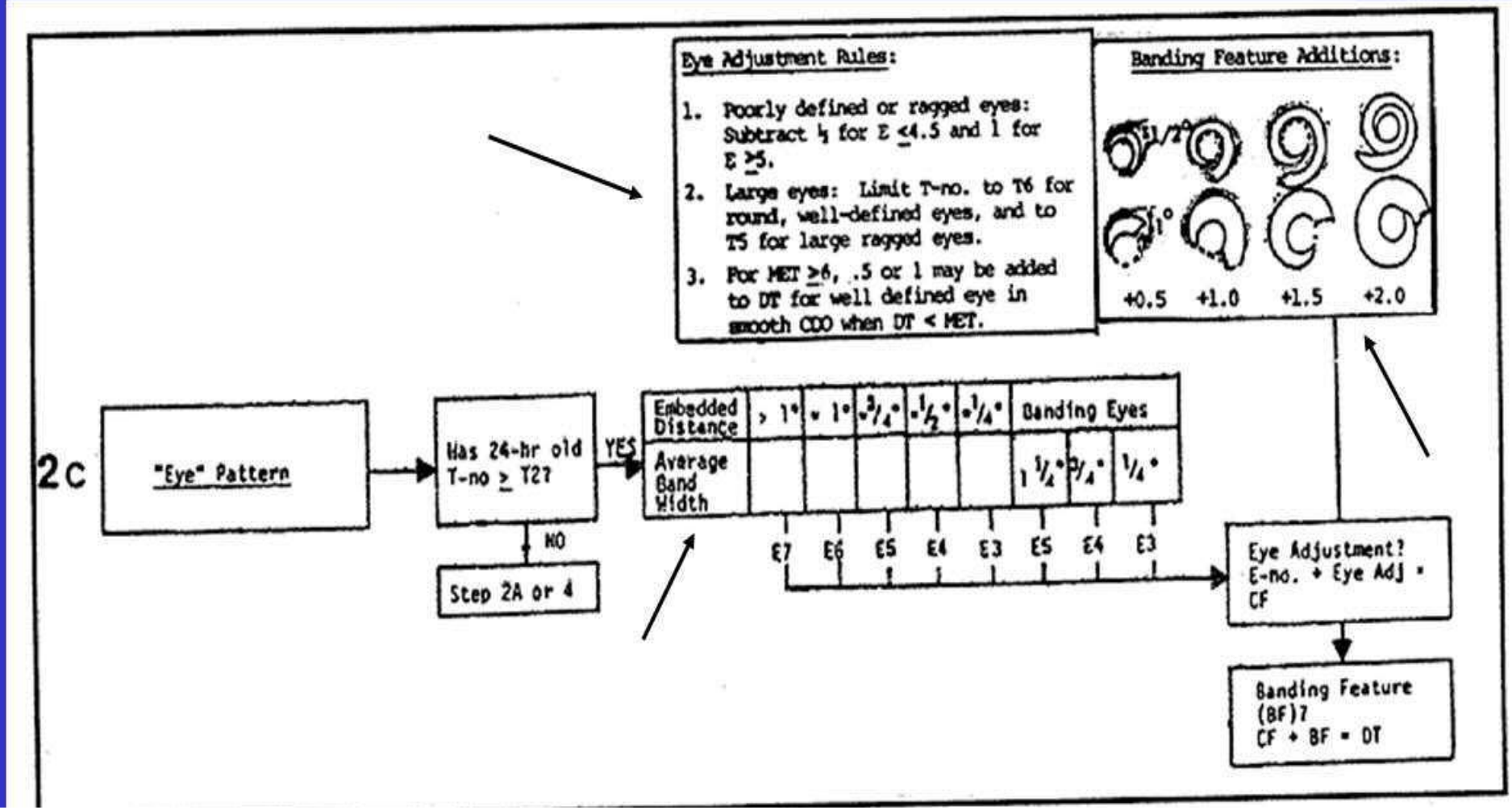
Infrared banding



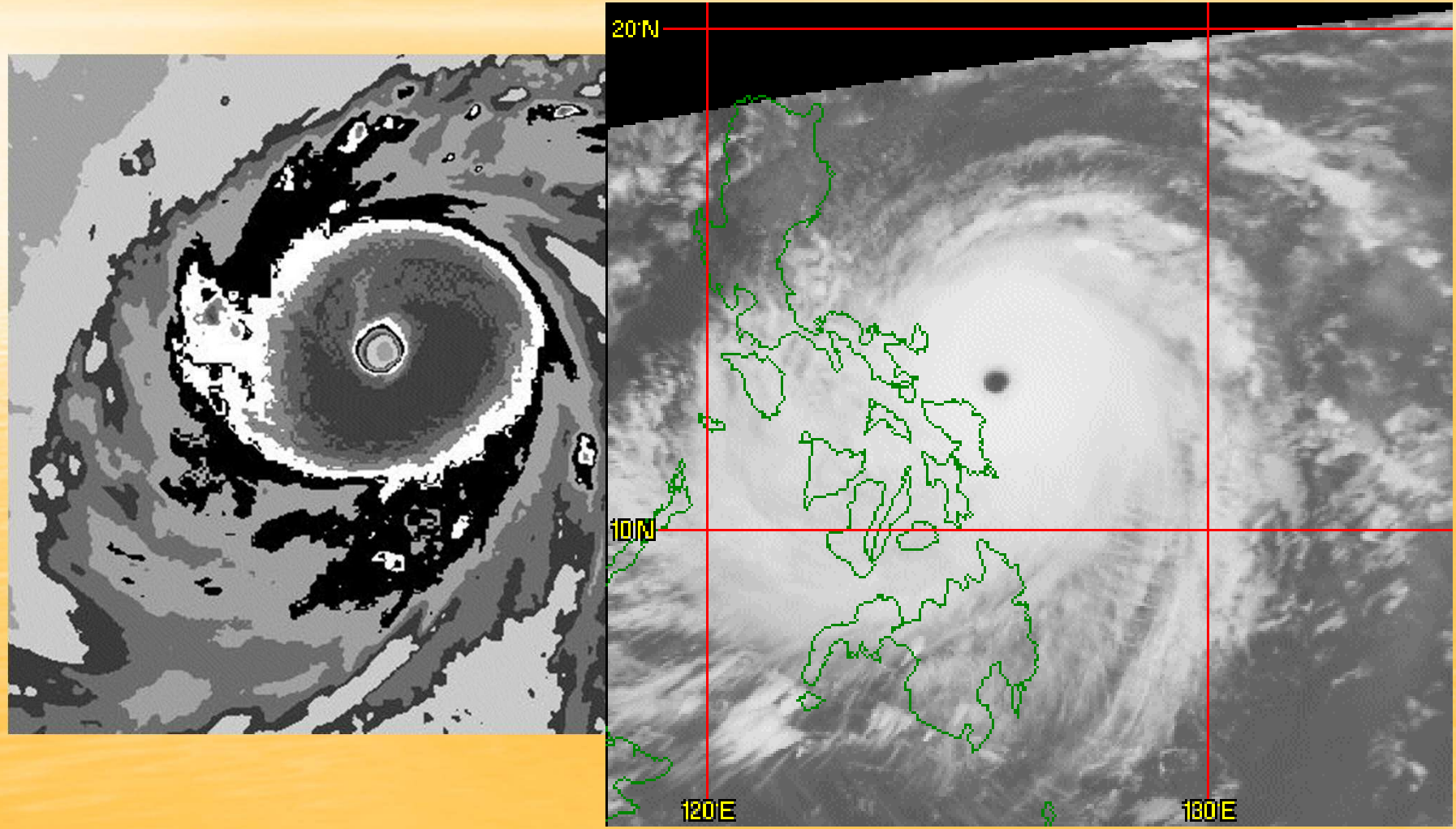
- Differs significantly from visible banding
- Used only when DT without banding is less than MET
- Used only for cloud patterns of CF=4 or more

Visual Technique (probably not used)

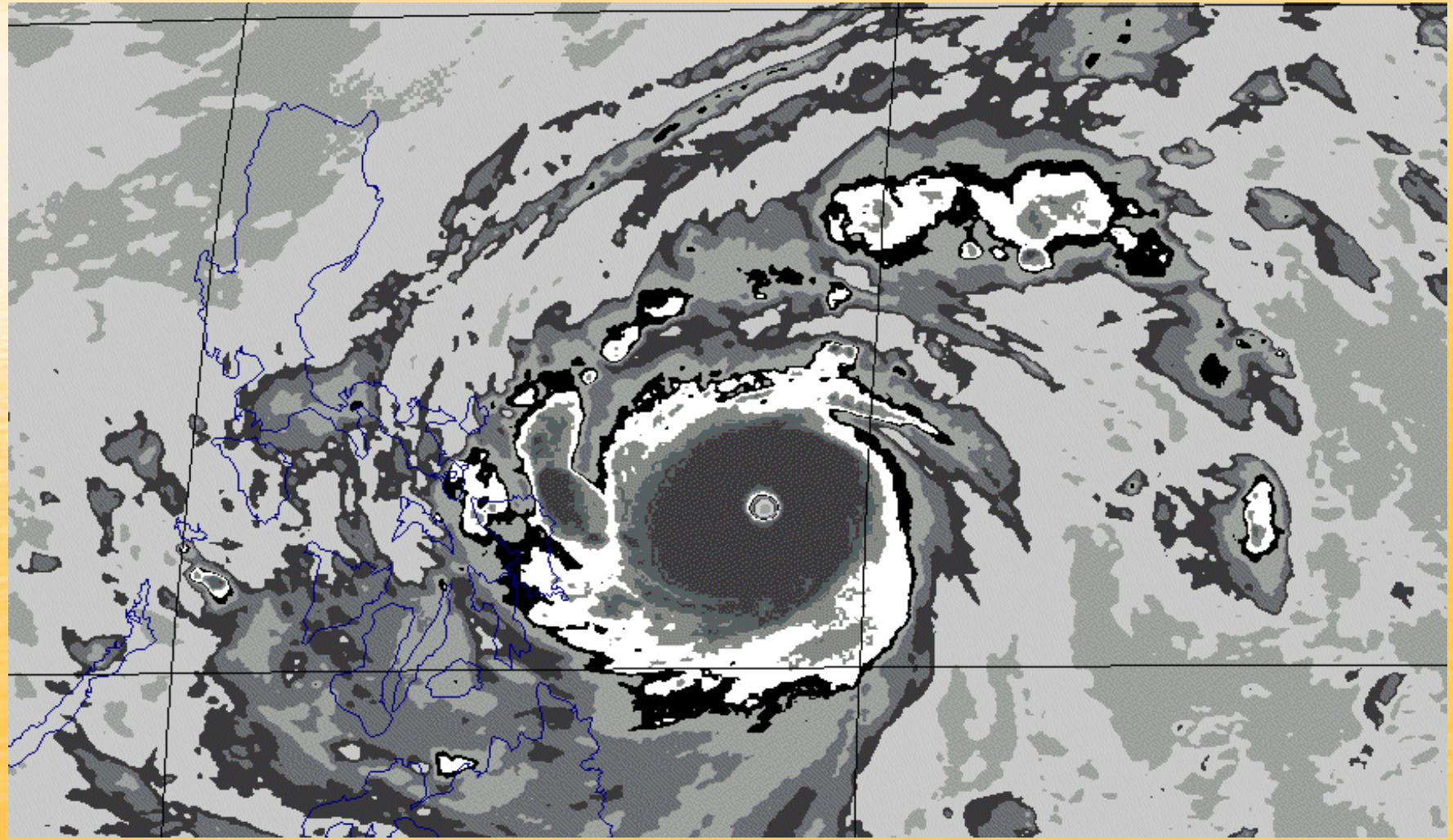
Step 2C - Eye Patterns



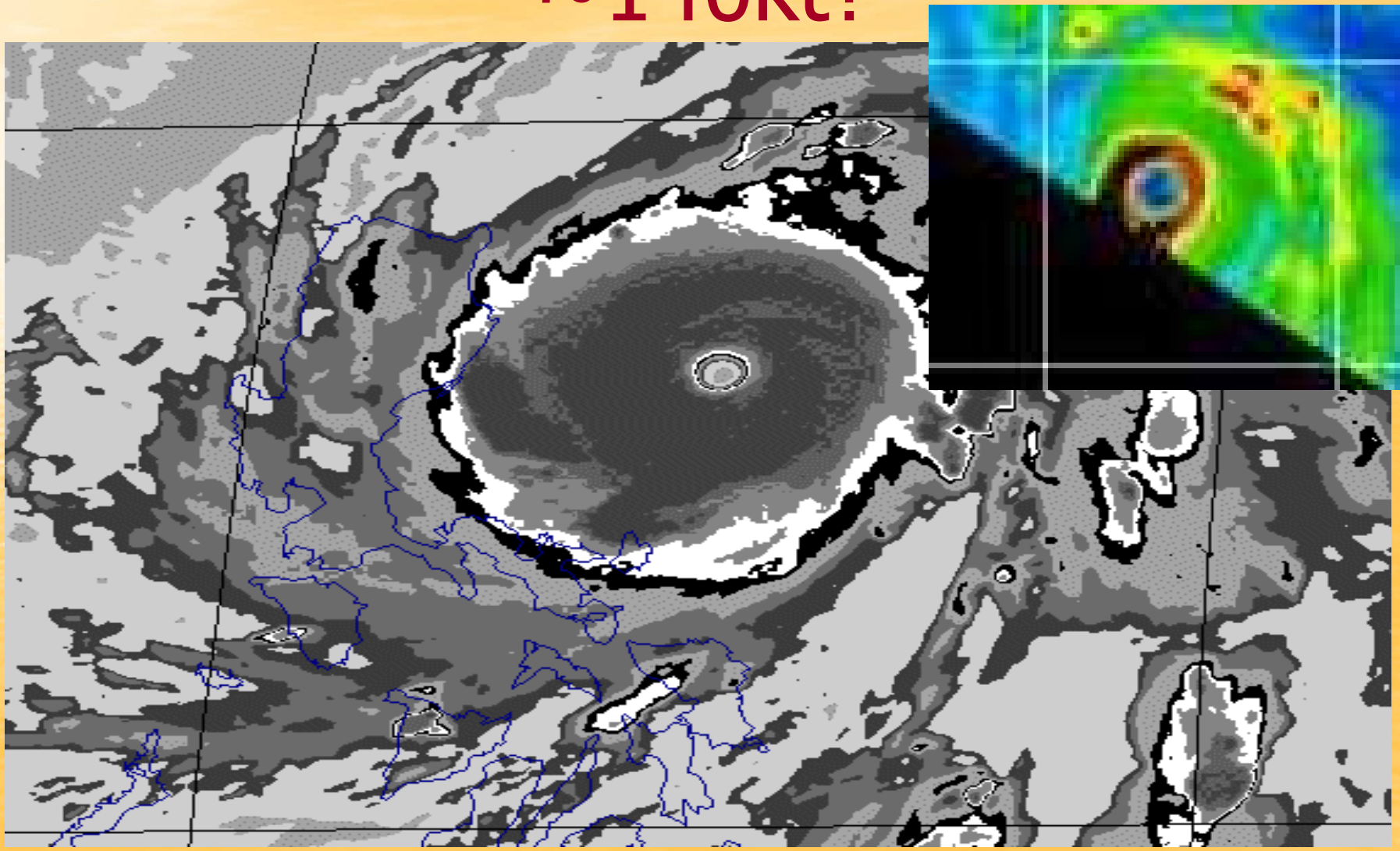
STY Nina Nov 1987



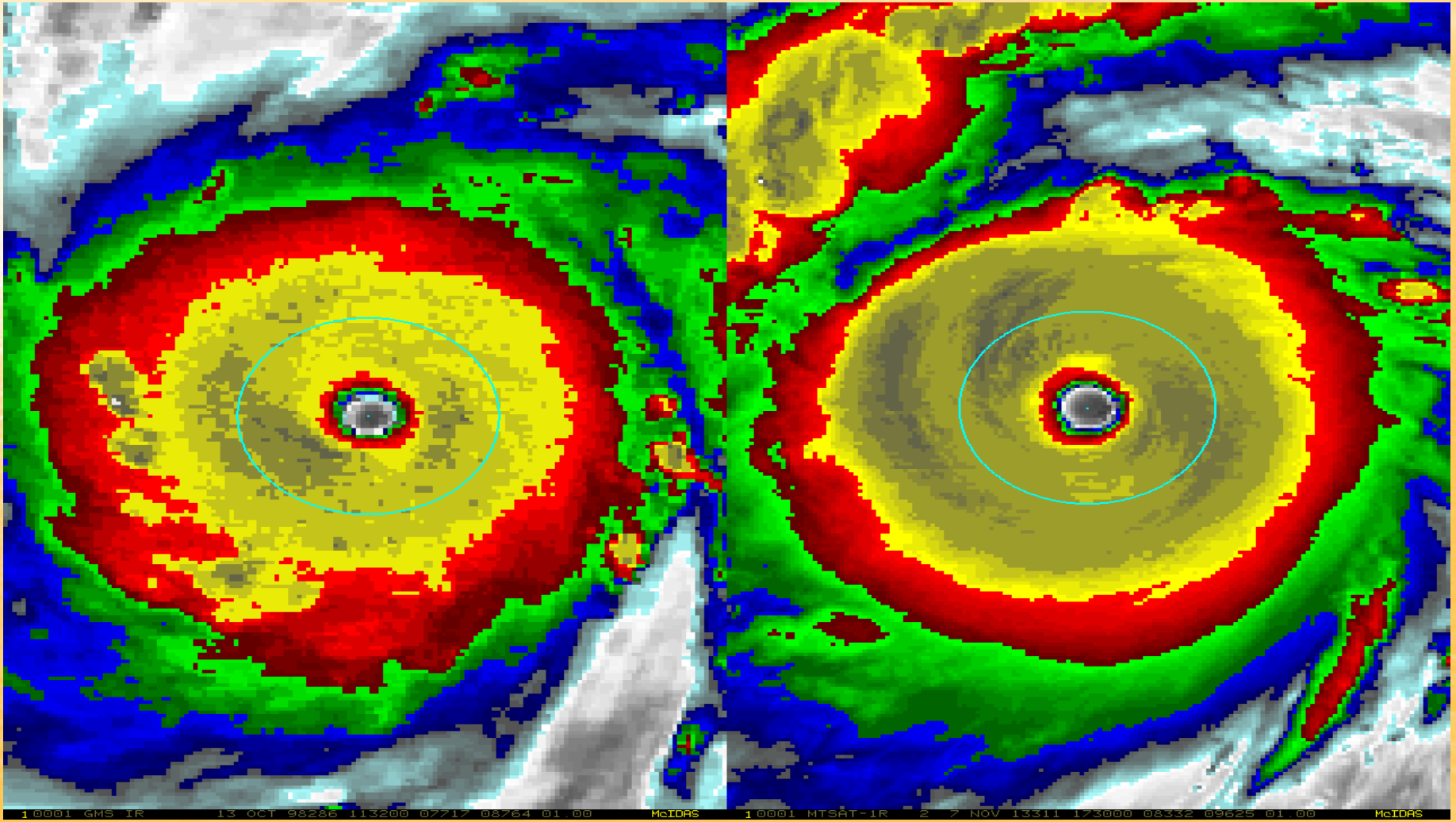
STY Angela Nov 1995
DT 8.5/8.6 (Highest value)



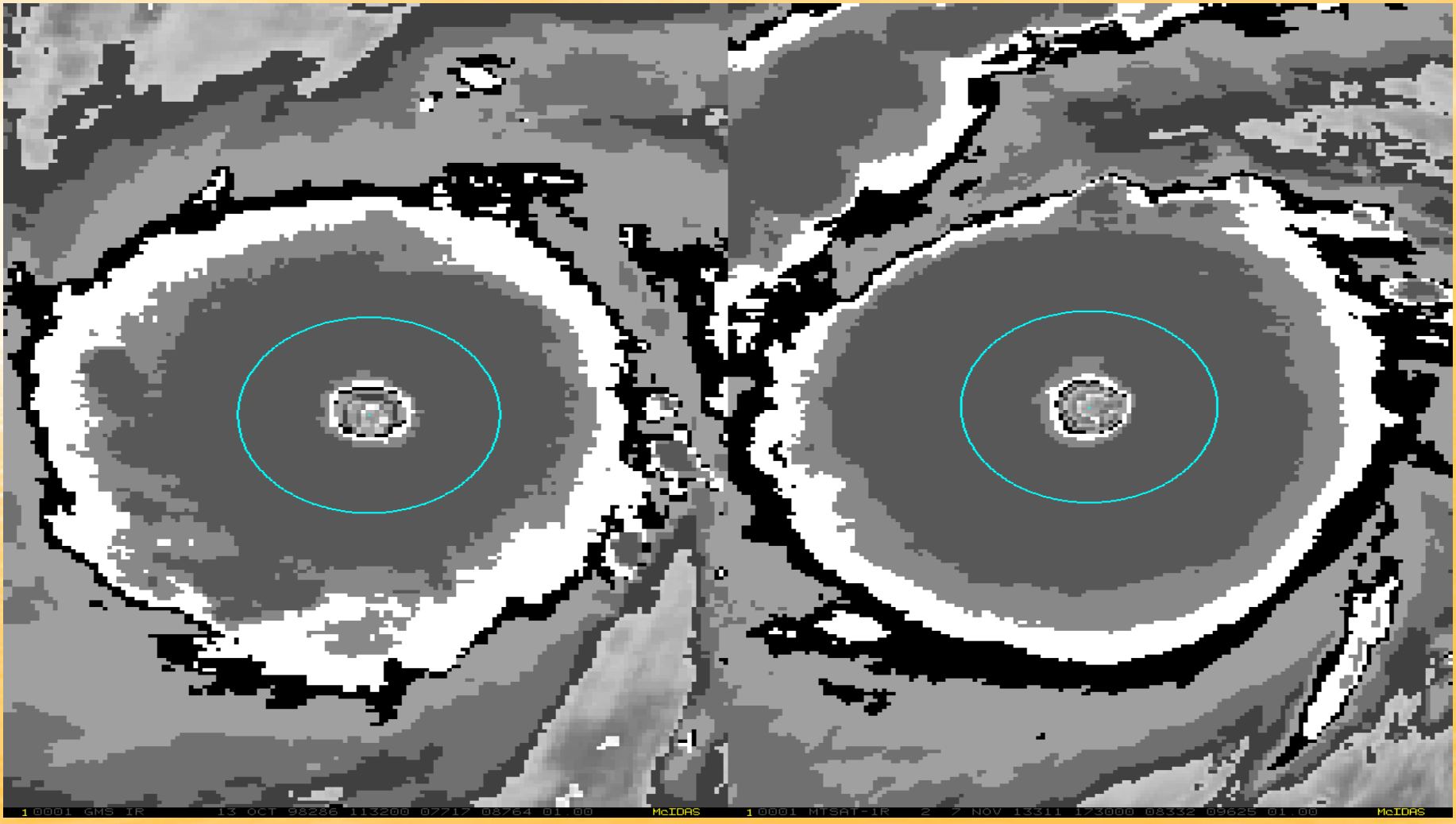
STY Zeb Oct 1998
~140kt?



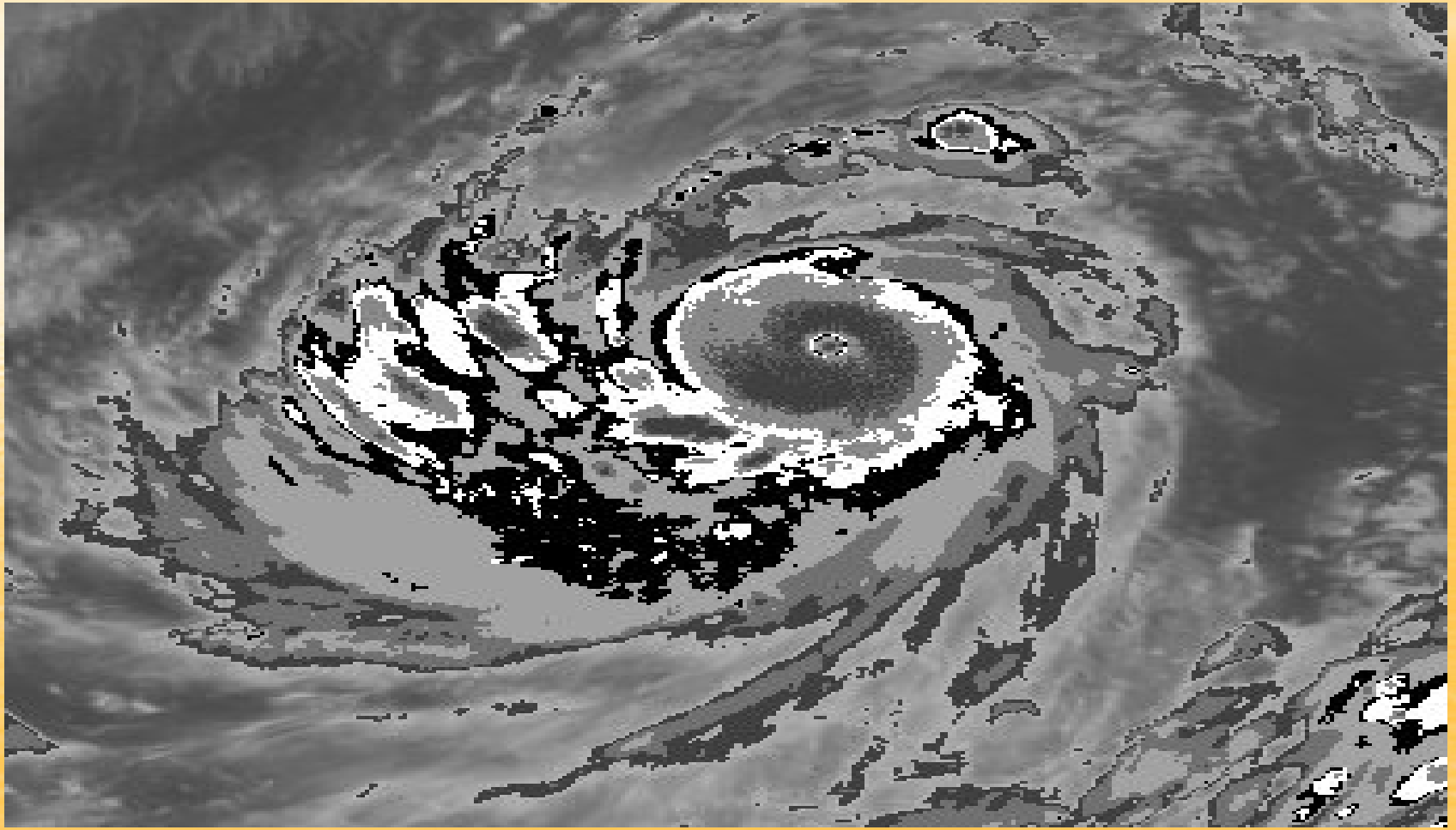
Zeb versus Haiyan



Zeb versus Haiyan



Super Typhoon Tip (870mb)
Nov 1979 ~165kt?



Lowest aircraft sfc pressure measurement

Diagram taken from Bruce Harper, Nov 2002

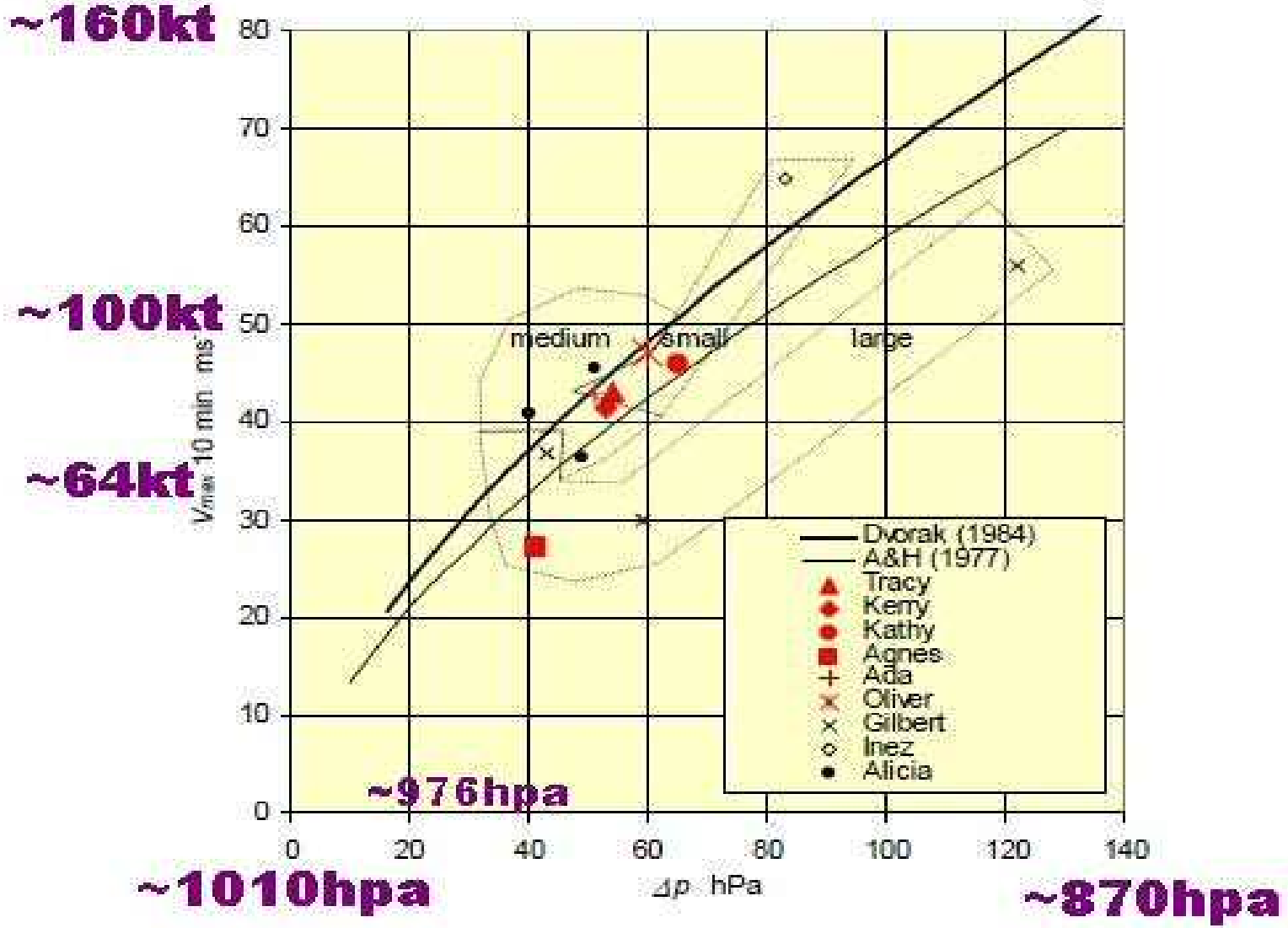


Figure 3.13 Data considered by Callaghan and Smith (1998)

Questions?