Severe Marine Weather Studies using SMOS L-Band Sensor Data and Multi-Sensor Synergies

N. Reul

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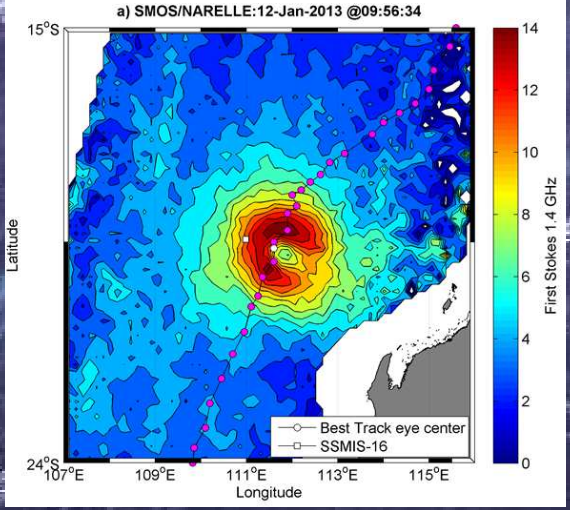


IGARSS
Milan JULY 2015

- Tropical cyclone & Extra-Tropical storm track prediction is steadily improving, while **storm intensity prediction has seen little progress** in the last quarter century.

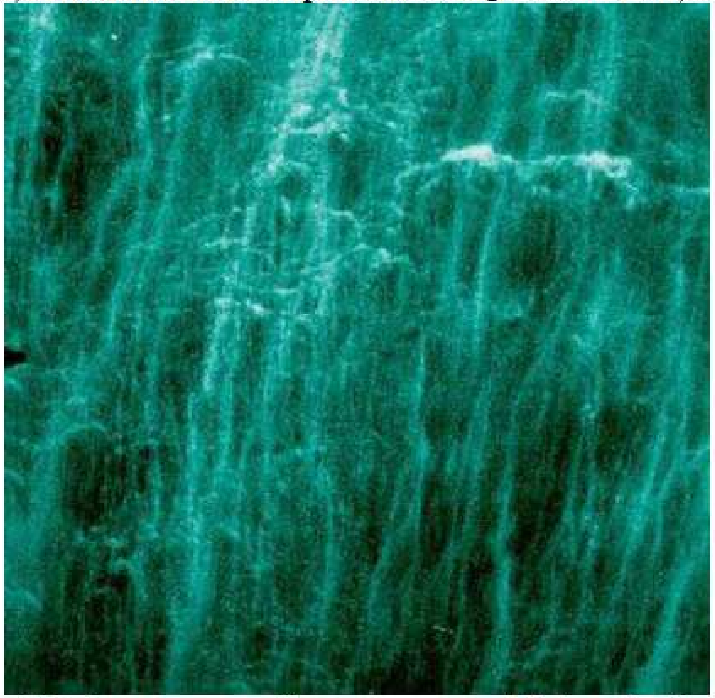
=>*Important physics are not yet well understood* and implemented in tropical cyclone forecast models.
Missing and unresolved physics, especially at the air-sea interface, are among the factors limiting storm predictions.

- Detail Information on **surface winds under Tropical Cyclones** are key to better storm forecasting. However, their **measurements from Space with traditional onboard instruments** (radars, high-frequency radiometers) **is challenging** (rain contamination, lost of sensitivity at very high winds,..)

- Focus here: study of low-microwave frequency radiometer capabilities & new inputs from L-band missions (SMOS, SMAP) for ocean surface remote sensing in extreme conditions

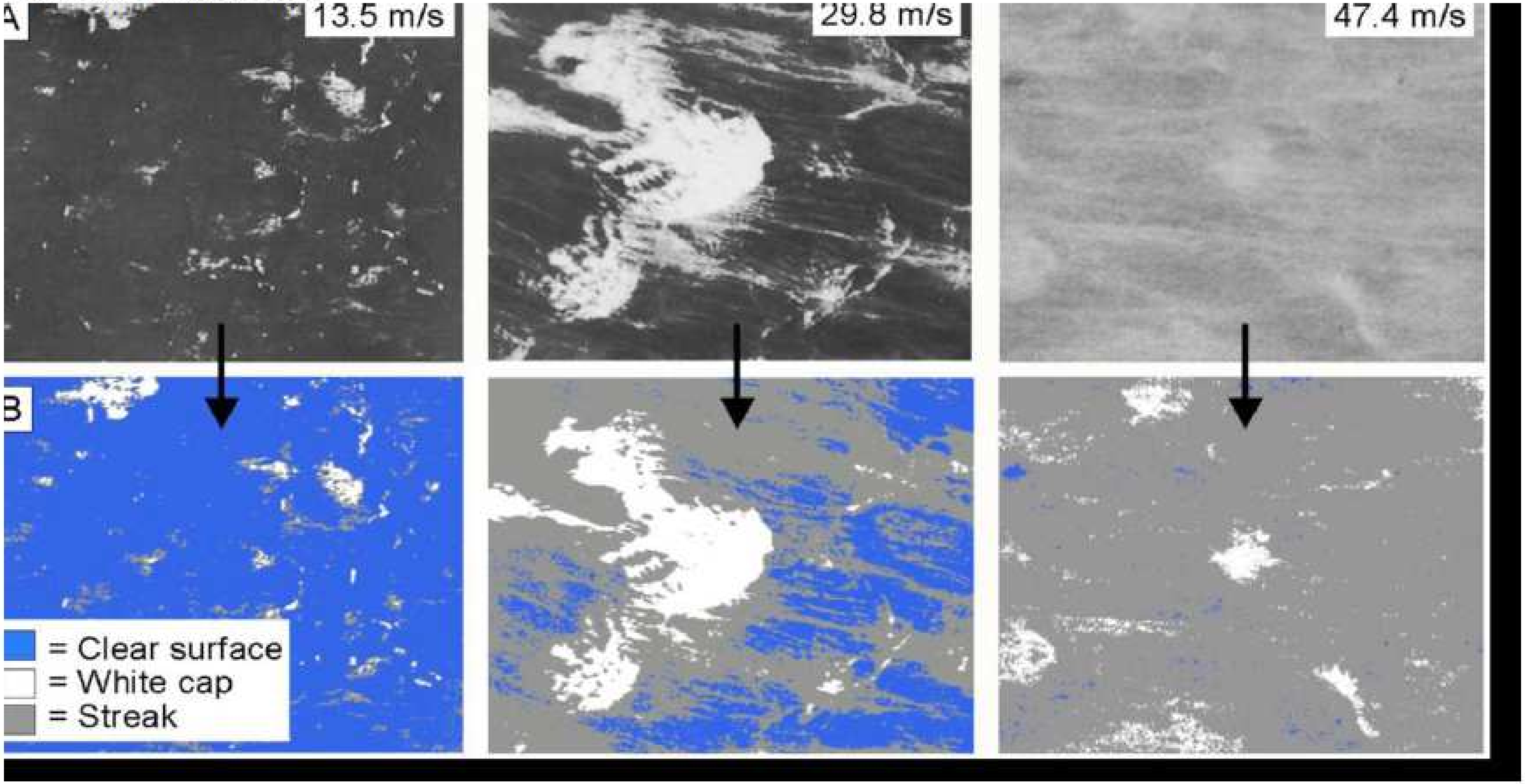
Ocean-Atmosphere Interface in very High Wind speed conditions

A breaking wave creates a patch of active foam at its crest – the white cap. As the wave moves on, the leading edge of the white cap follows the breaking crest but the trailing edge remains stationary and is slowly replaced by submerged bubbles in wind-aligned streaks. At very high wind speeds the white cap is blown off the crest in a layer of spray droplets. Under such conditions, the ocean-atmosphere interface is a foam, spray, bubble emulsion layer, which acts as a slip layer for the wind, rather than as a liquid surface [Powell et al., 2003; Emanuel, 2003].

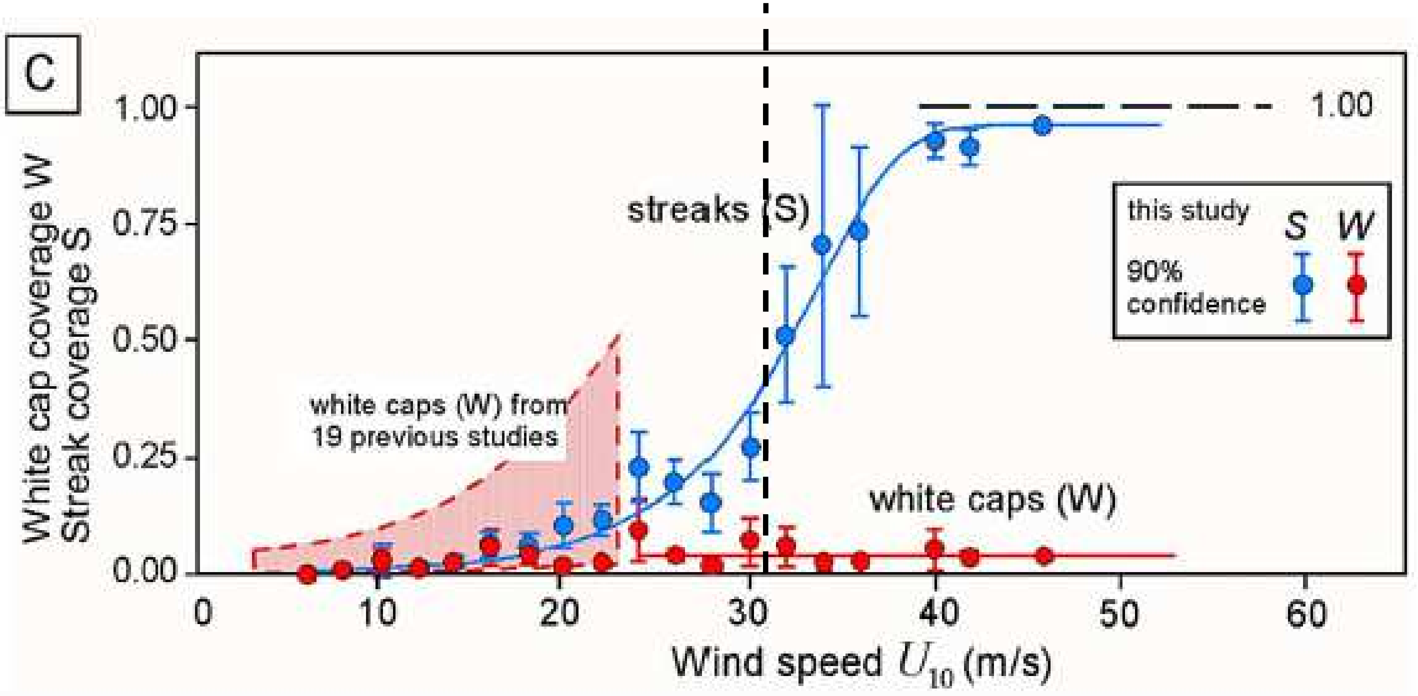


At very high wind speeds this layer covers the waves as a high-velocity white sheet, resulting in white out conditions.

Holthuijsen et al. 2012 investigate these processes using aerial reconnaissance films and GPS drop sondes in hurricanes



Separation of whitecap & streaks coverage



Holthuijsen et al. JGR 2012

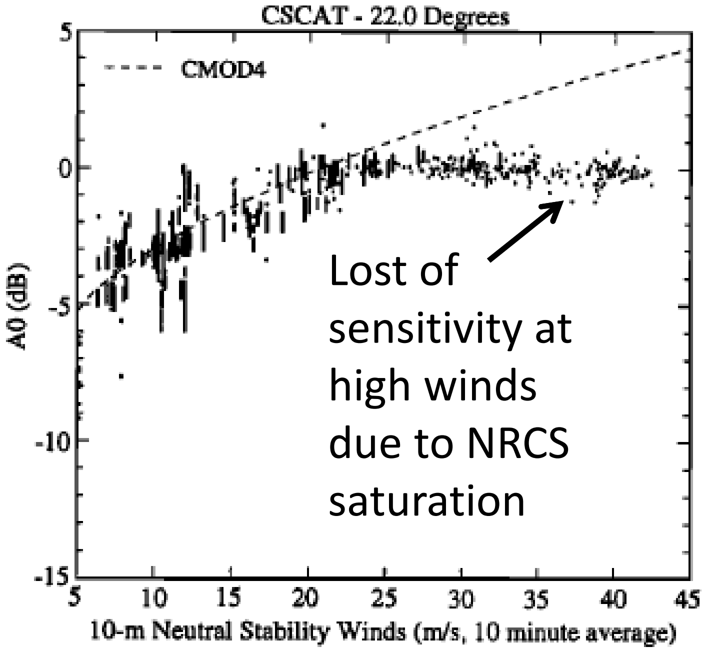
Most of the increased surface whitening at & above hurricane force (>33 m/s) is principally induced by the **increased streaks coverage- whitecap coverage is found ~constant above Hurricane force ~4 %**

Sea Surface Observation Capabilities from Space
in
Extreme Wind Conditions

Limitations of satellite microwave at high winds

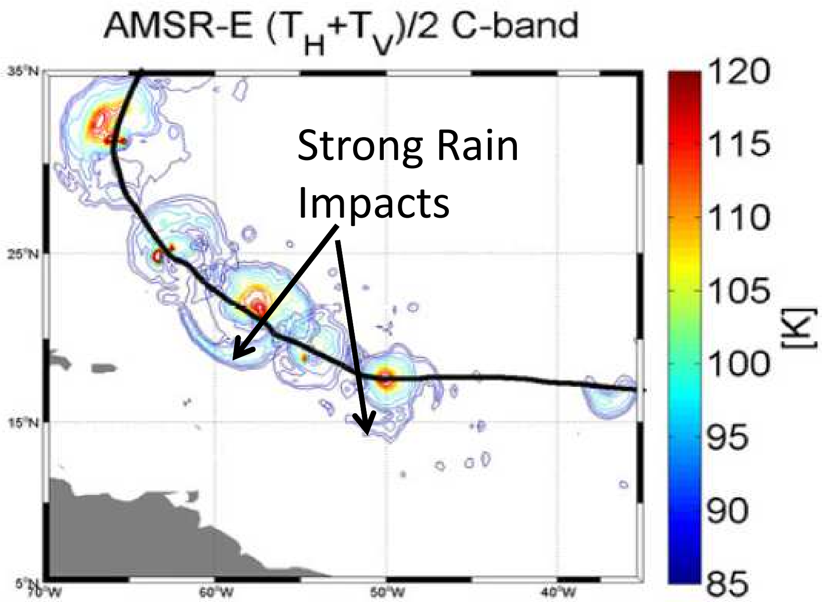
- Active microwave backscatter signal saturates under hurricane force winds and is heavily affected in the presence of high rain rates;

- Contrarily to scatterometer signal, radiometric signal does not saturate with high winds. Moreover, the sensitivity of microwave brightness temperature tends even to increase for the winds above 15 m/s



Lost of sensitivity at high winds due to NRCS saturation

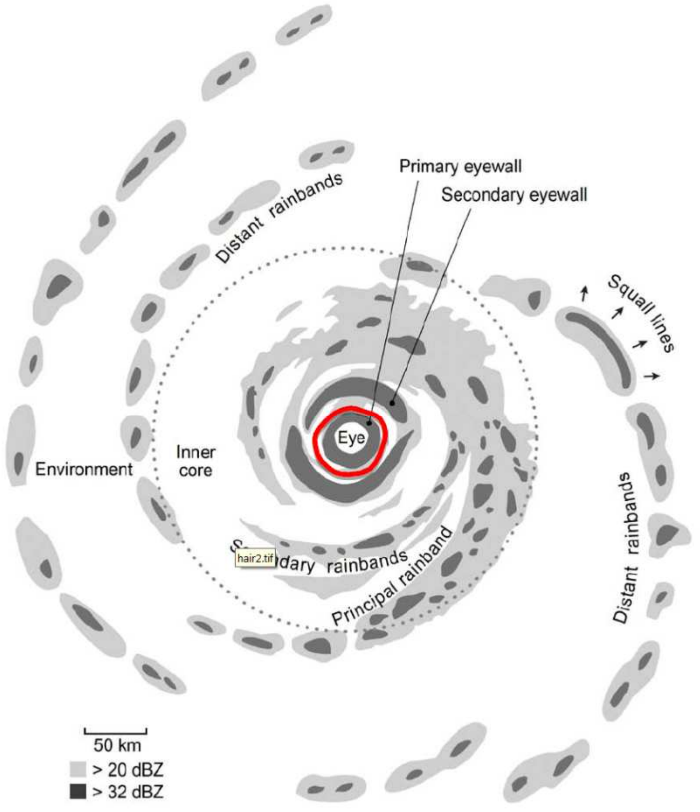
Donelly et al. 1998



Strong Rain Impacts

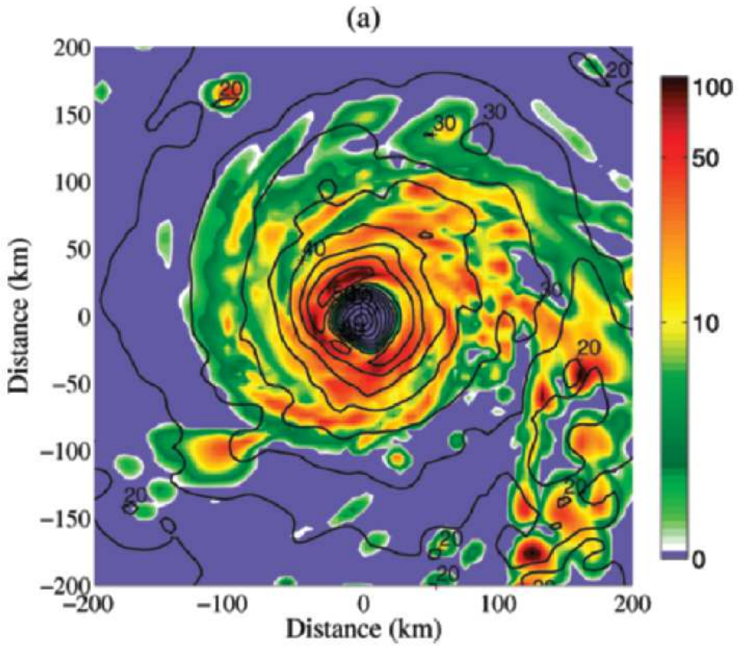
High winds in Hurricanes are very often associated with High rain rates

Rain Anatomy in a hurricane



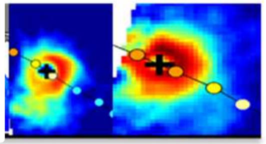
Houze 2010

Rain rate [mm/h]

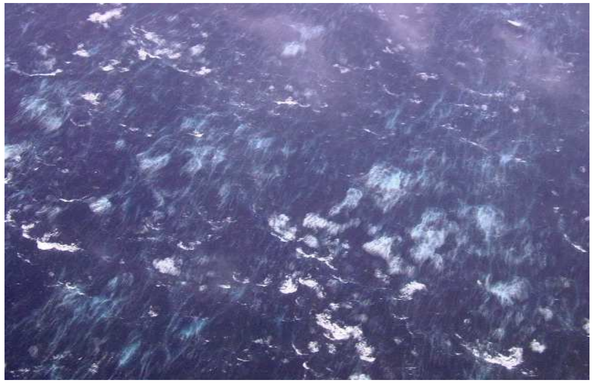


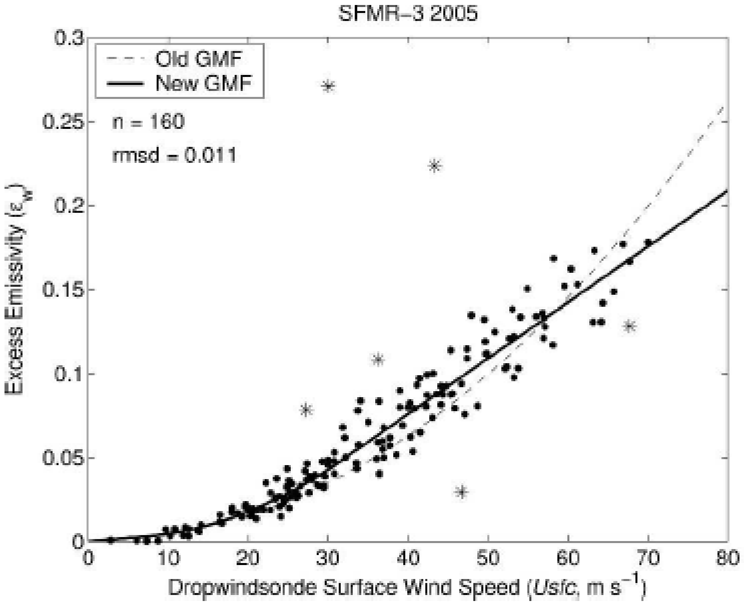
S.Shen and J. Tenerelli 2007

Wind speed retrieval in extreme winds : SFMR



Increase of the microwave ocean emissivity
with wind speed ⬄ surface foam change impacts



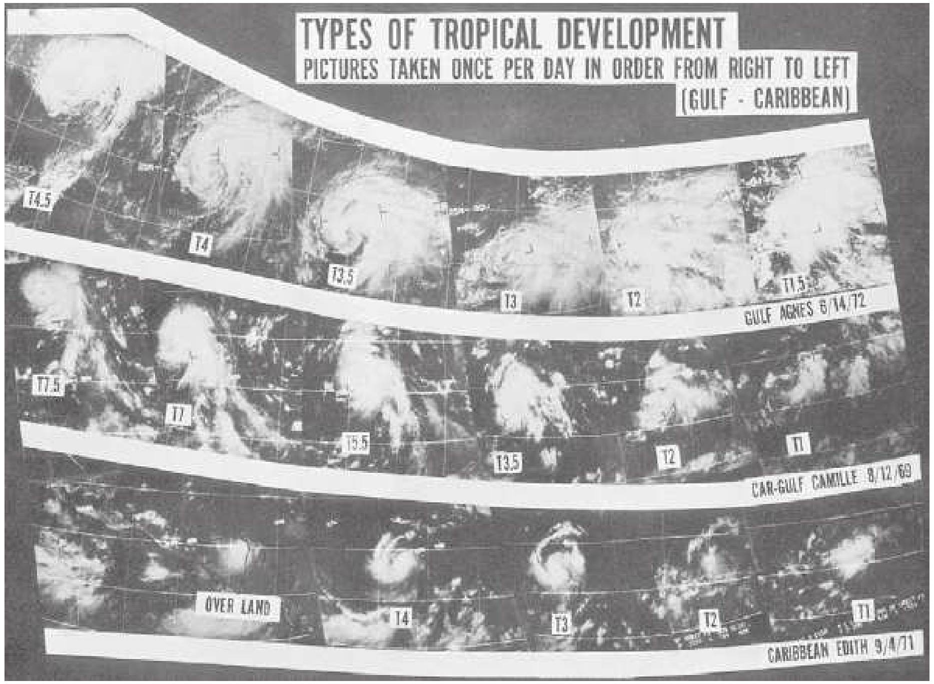


Hurricane hunter P-3

This information can be used to retrieve the surface wind speed in Hurricanes:

Principle of **the Step Frequency Microwave Radiometer** (SFMR) C-band:
=> Use mutli-frequency C-band channels to separate wind from rain effects
NOAA’s primary airborn sensor for measuring Tropical Cyclone surface wind speeds since 30 year (Ulhorn et al., 2003, 2007).

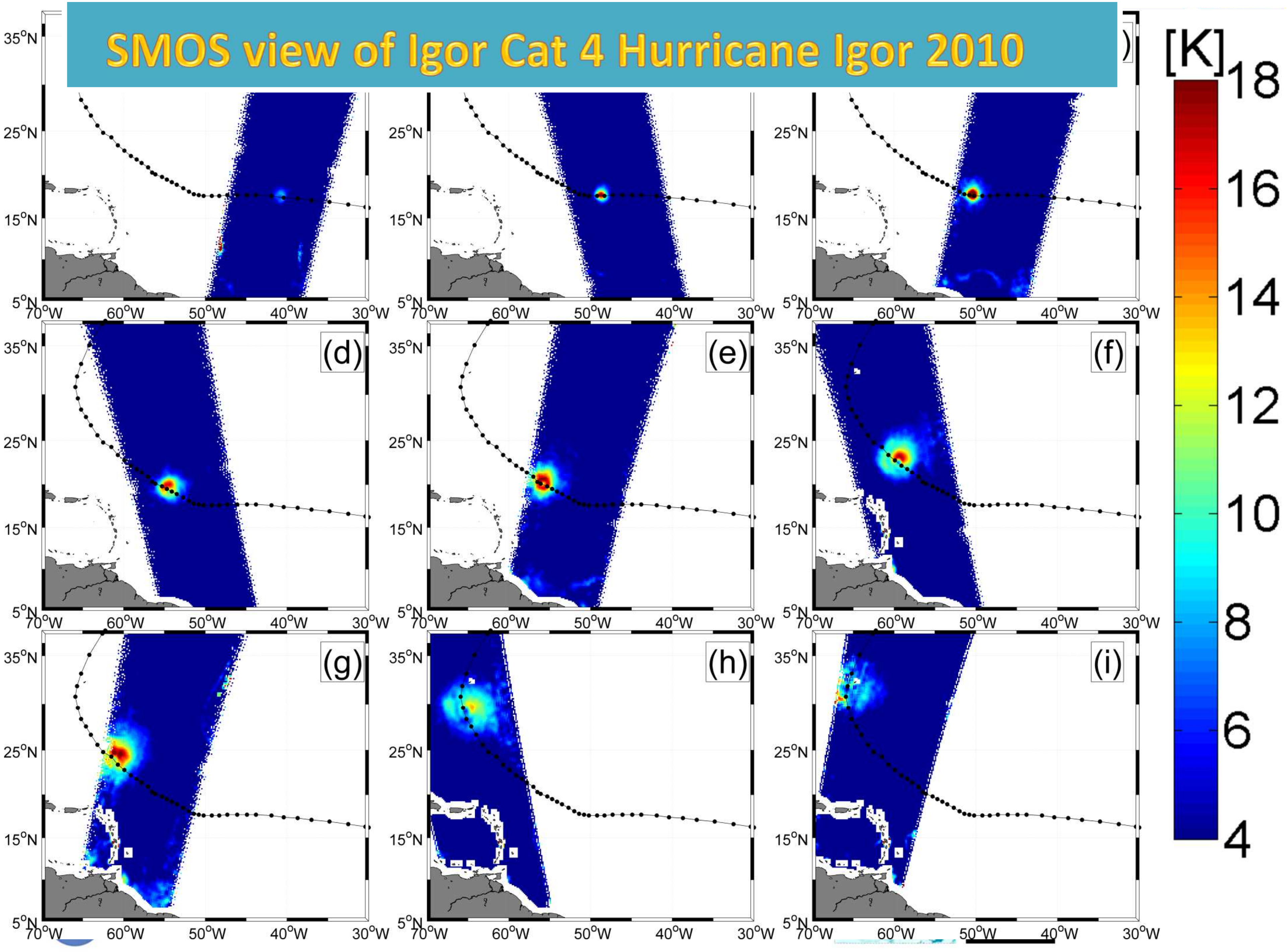
The Advanced Dvorak Technique (ADT)



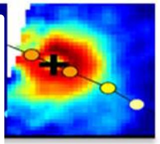
The Advanced Dvorak Technique (ADT) utilizes longwave-infrared, temperature measurements from geostationary satellites to estimate tropical cyclone (TC) intensity. The ADT is based upon the operational Dvorak Technique developed by Vern Dvorak of NOAA over 30 years ago..

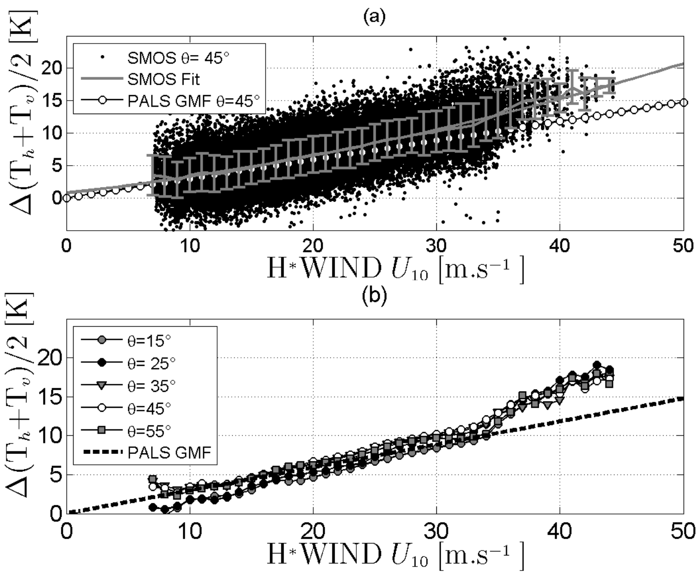
The Dvorak Technique continues to be the standard method for estimating TC intensity where aircraft reconnaissance is not available (all tropical regions outside the North Atlantic and Caribbean Sea), however it has several important limitations and flaws.

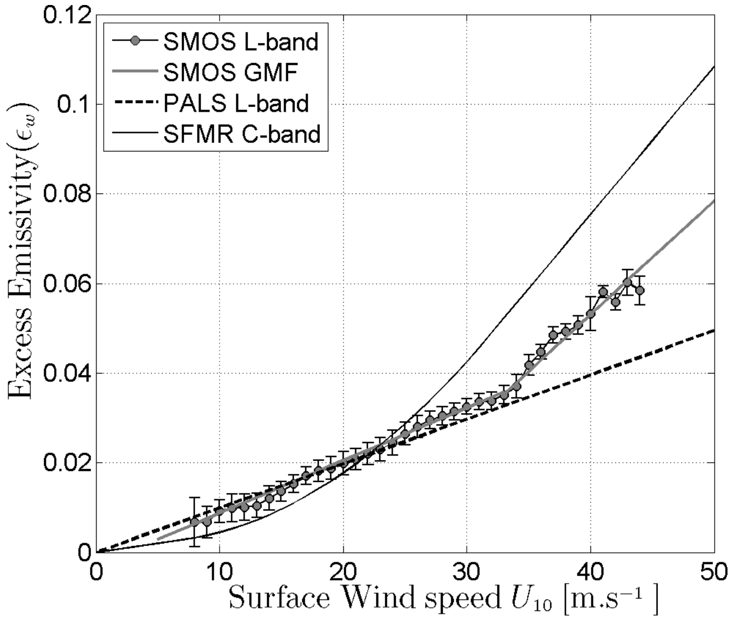
SMOS view of Igor Cat 4 Hurricane Igor 2010



Geophysical Model function: Tb=f(wind speed)







C-band

L-band:

0.7K/m/s
for hurricanes

0.3 k/(m/s)
below

$$\Delta I = \frac{\Delta(T_H+T_V)}{2} = 0.35\,U_{10}\text{-}1.3 \qquad U_{10} \le 33\ \ \mathrm{m.s^{-1}}$$

$$= 0.75\,U_{10}\text{-}14.5 \qquad U_{10} \ge 33\ \ \mathrm{m.s^{-1}}$$

Development of a SMOS wind speed GMF based on Hwind products in IGOR hurricane

Bilinear L-band dependencies with surface wind speed

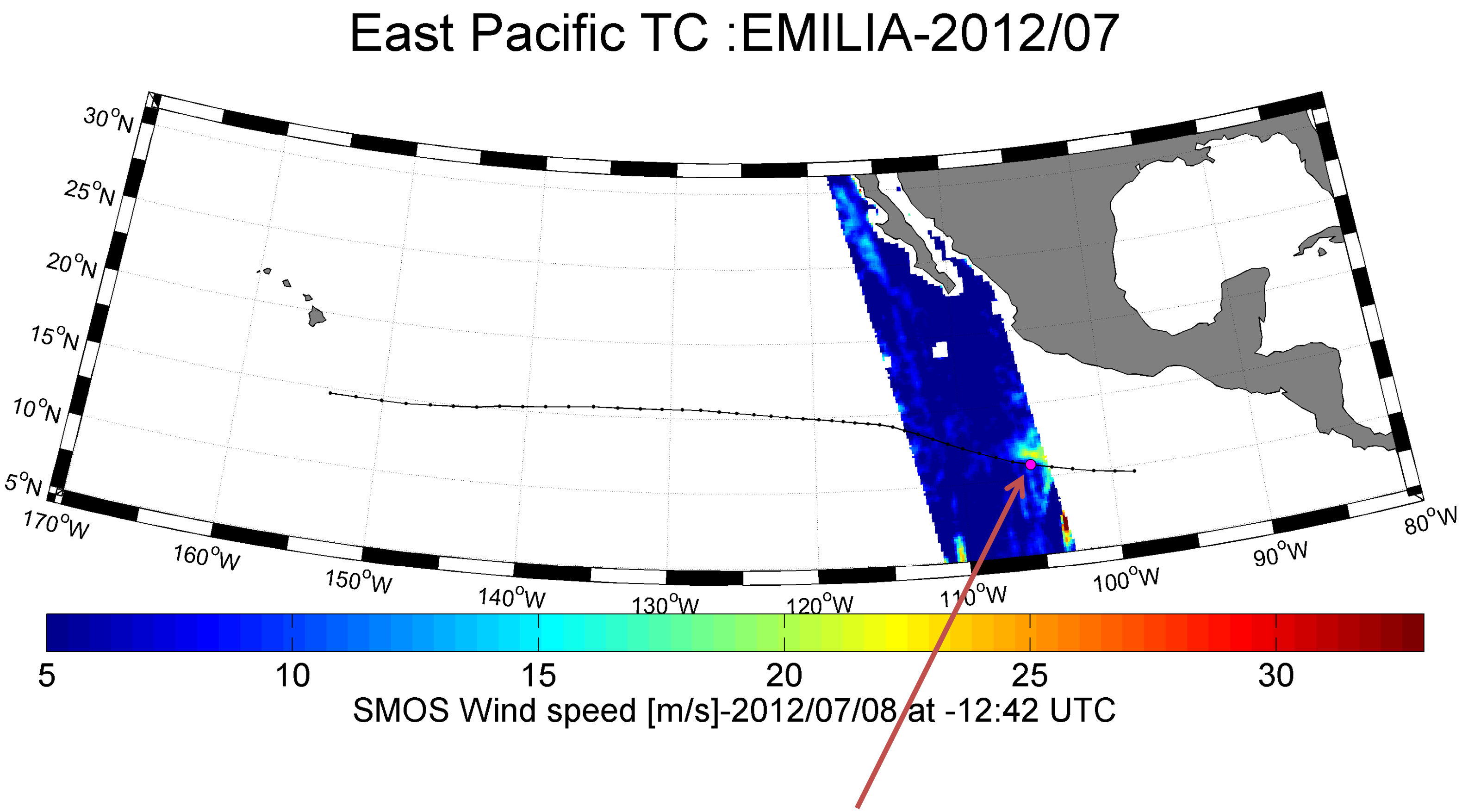
Reul et al., JGR, 2012

SMOS+STORM Evolution ESA-STSE project

Collaboration IFREMER & Met Office- (2 years: KO Apr 2014)

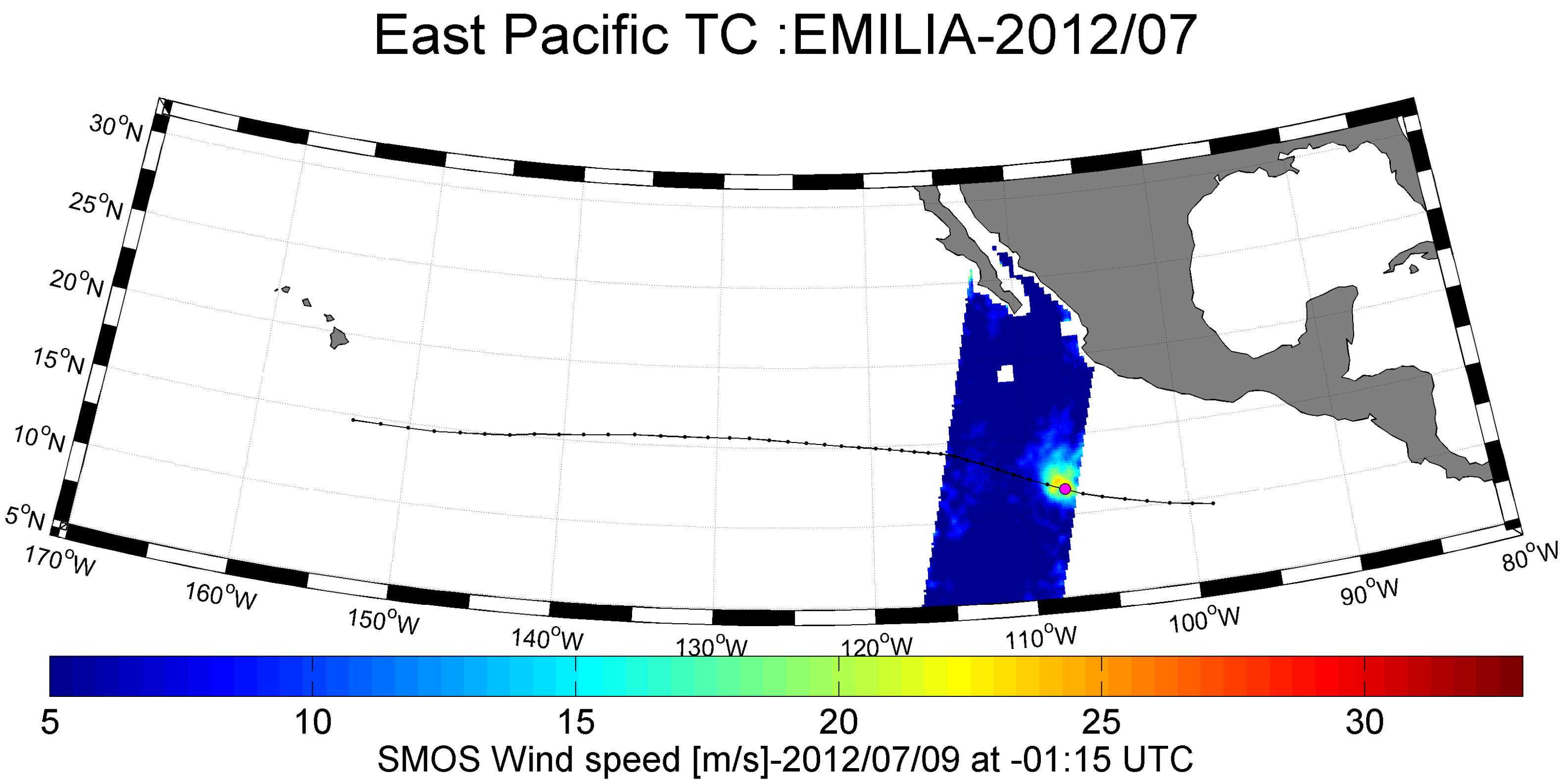
- Improve high wind speed retrieval algorithms (GMF, rain & wave impacts)
- Produce a Global Tropical Cyclone & Extra-Tropical Cyclone storm catalogue & database from 2010 to now
- Comparisons with NWP models & radiometer & scatterometer data
- Combine with other observations : AMSR2, WindSat, SMAP, CYGNSS
- Evaluate the impact of SMOS High Wind products assimilation on Metoffice forecast Errors: storm track & intensity forecasts

Detect the useful TC & ETC events in SMOS data: Example of EMILIA



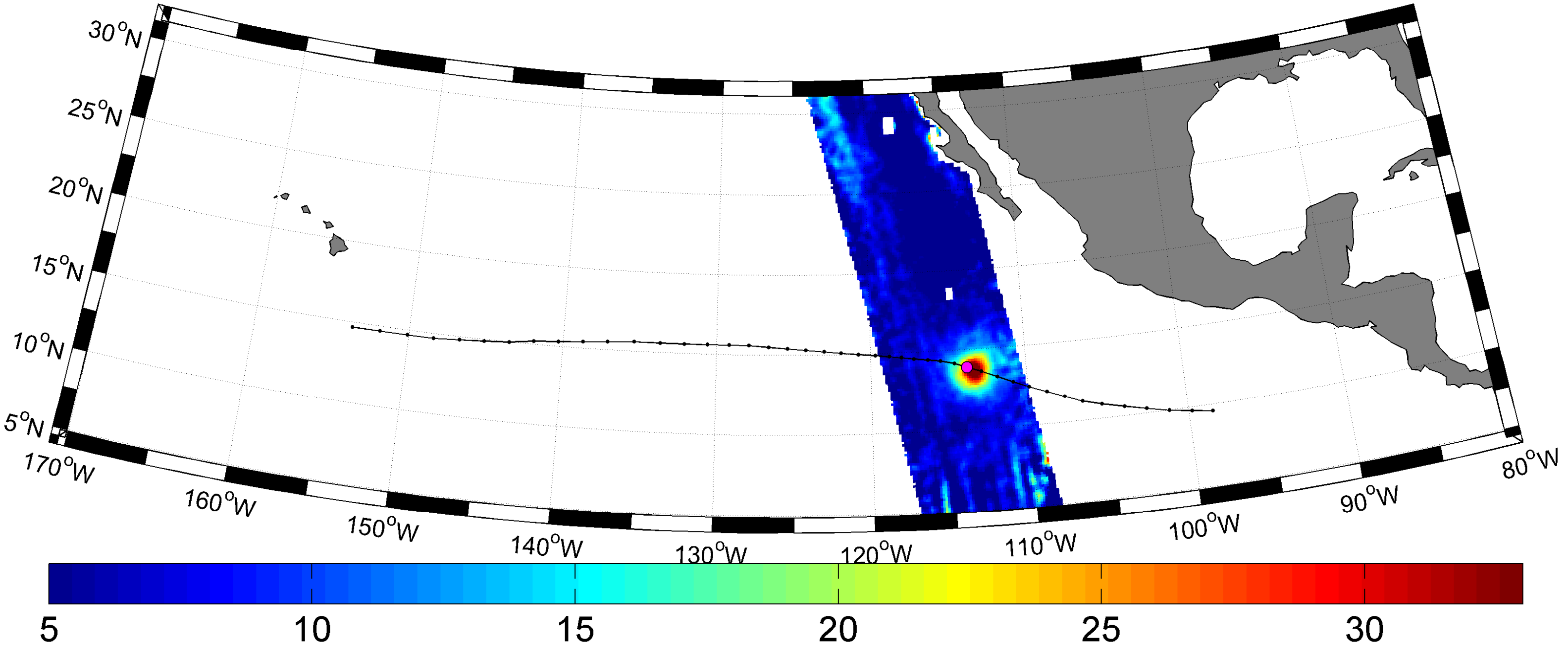
Position of the Storm center at the time of SMOS Aquisition

Tasks 2: Detect the useful TC & ETC events in SMOS data: Example of EMILIA



Tasks 2: Detect the useful TC & ETC events in SMOS data: Example of EMILIA

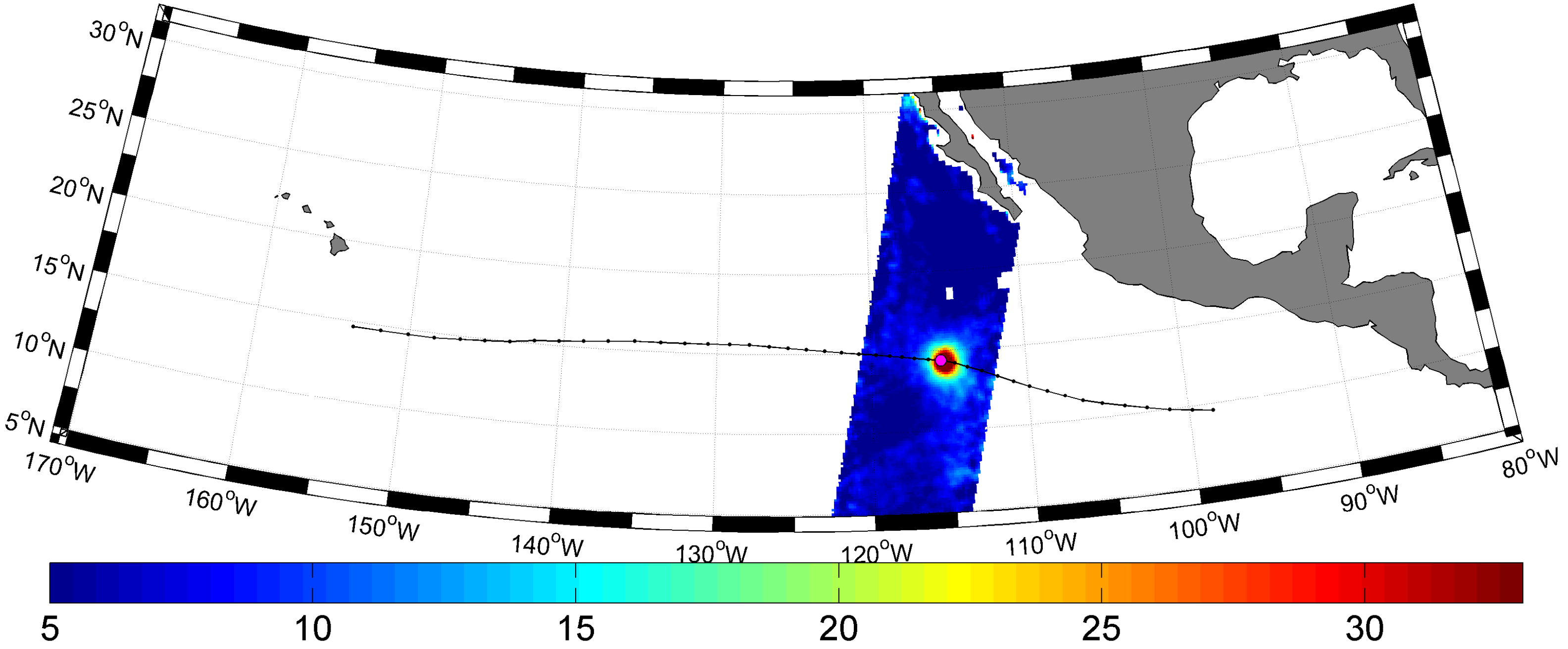
East Pacific TC :EMILIA-2012/07



SMOS Wind speed [m/s]-2012/07/10 at -13:04 UTC

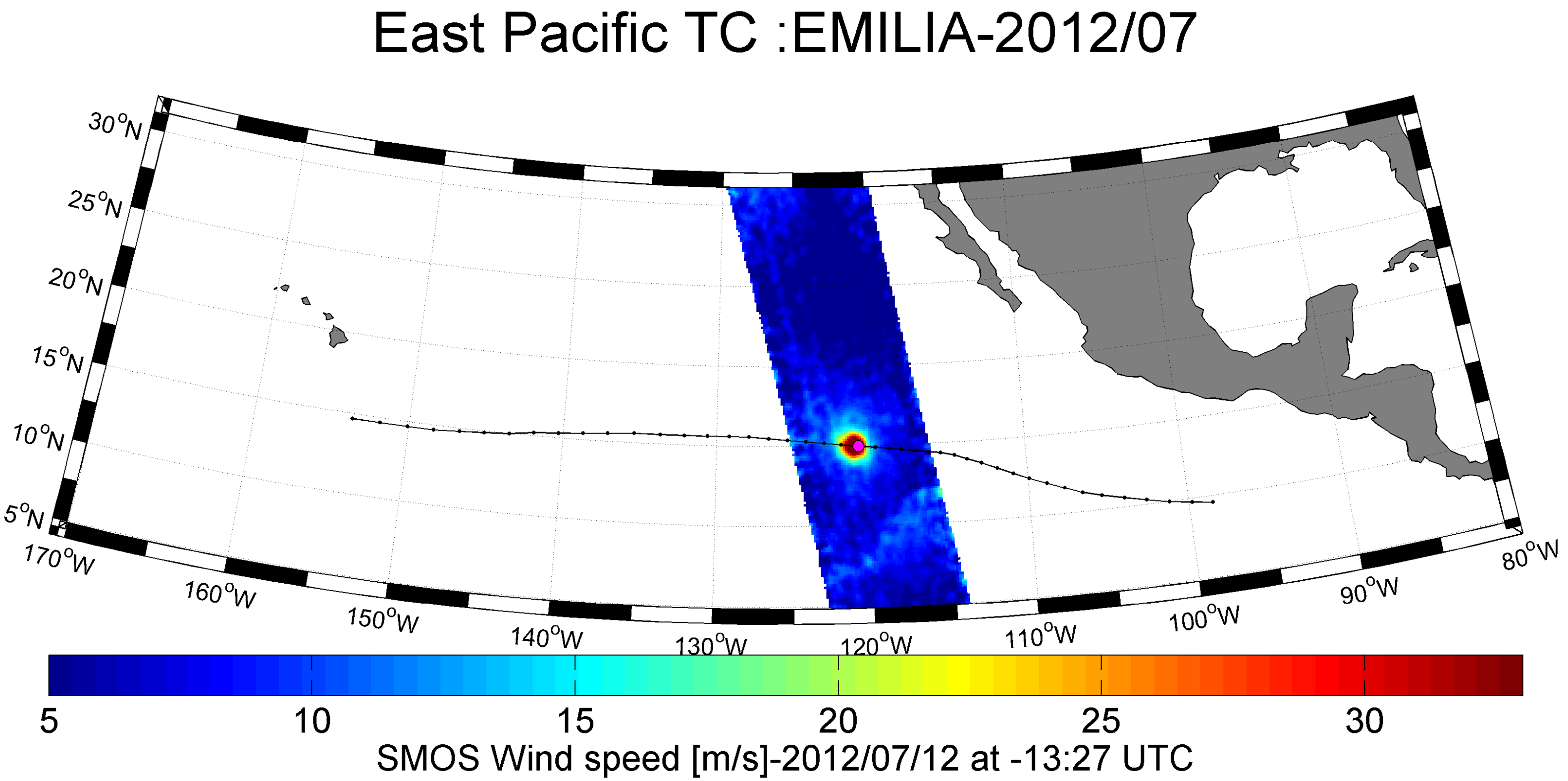
Tasks 2: Detect the useful TC & ETC events in SMOS data: Example of EMILIA

East Pacific TC :EMILIA-2012/07

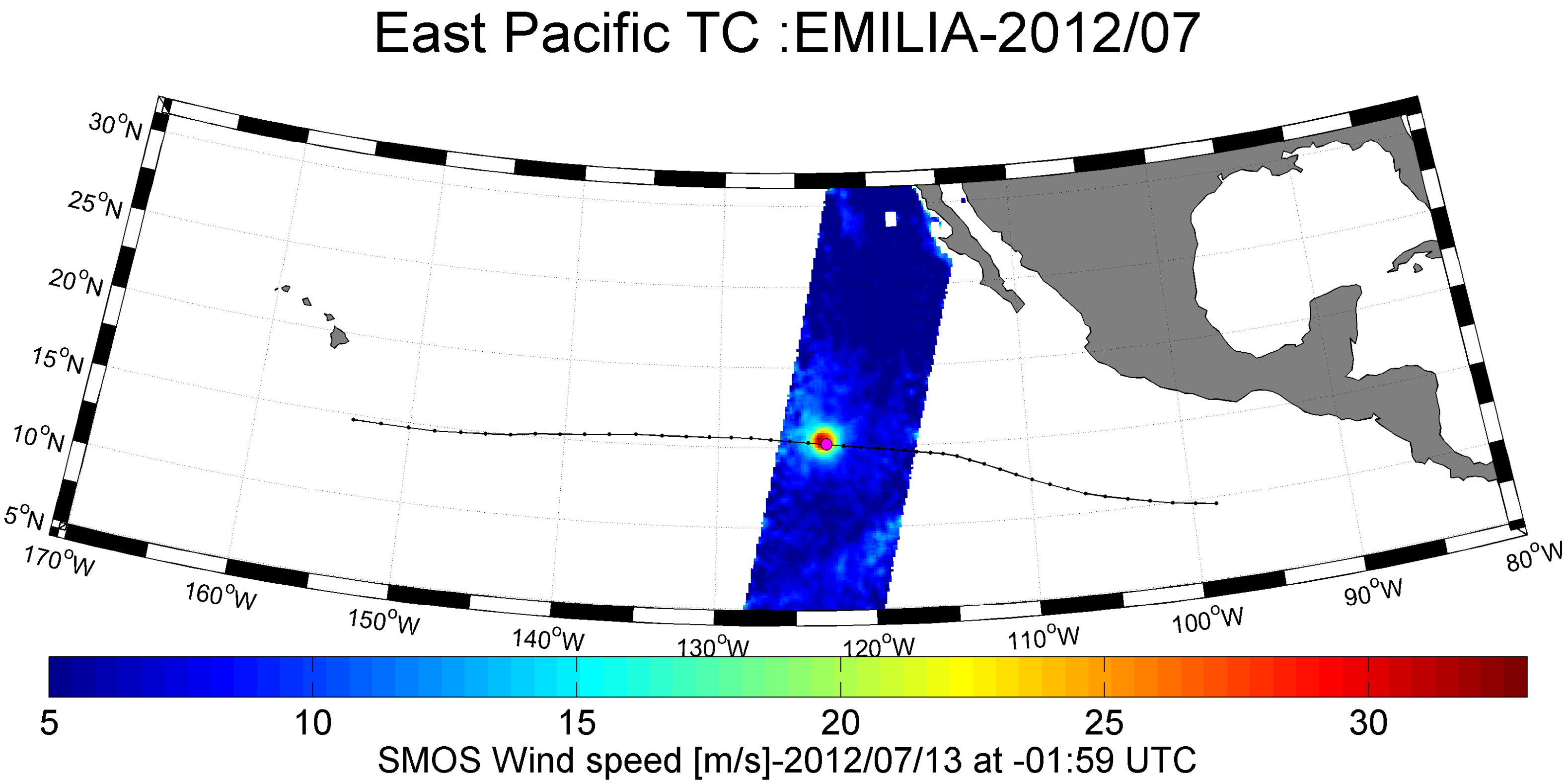


SMOS Wind speed [m/s]-2012/07/11 at -01:37 UTC

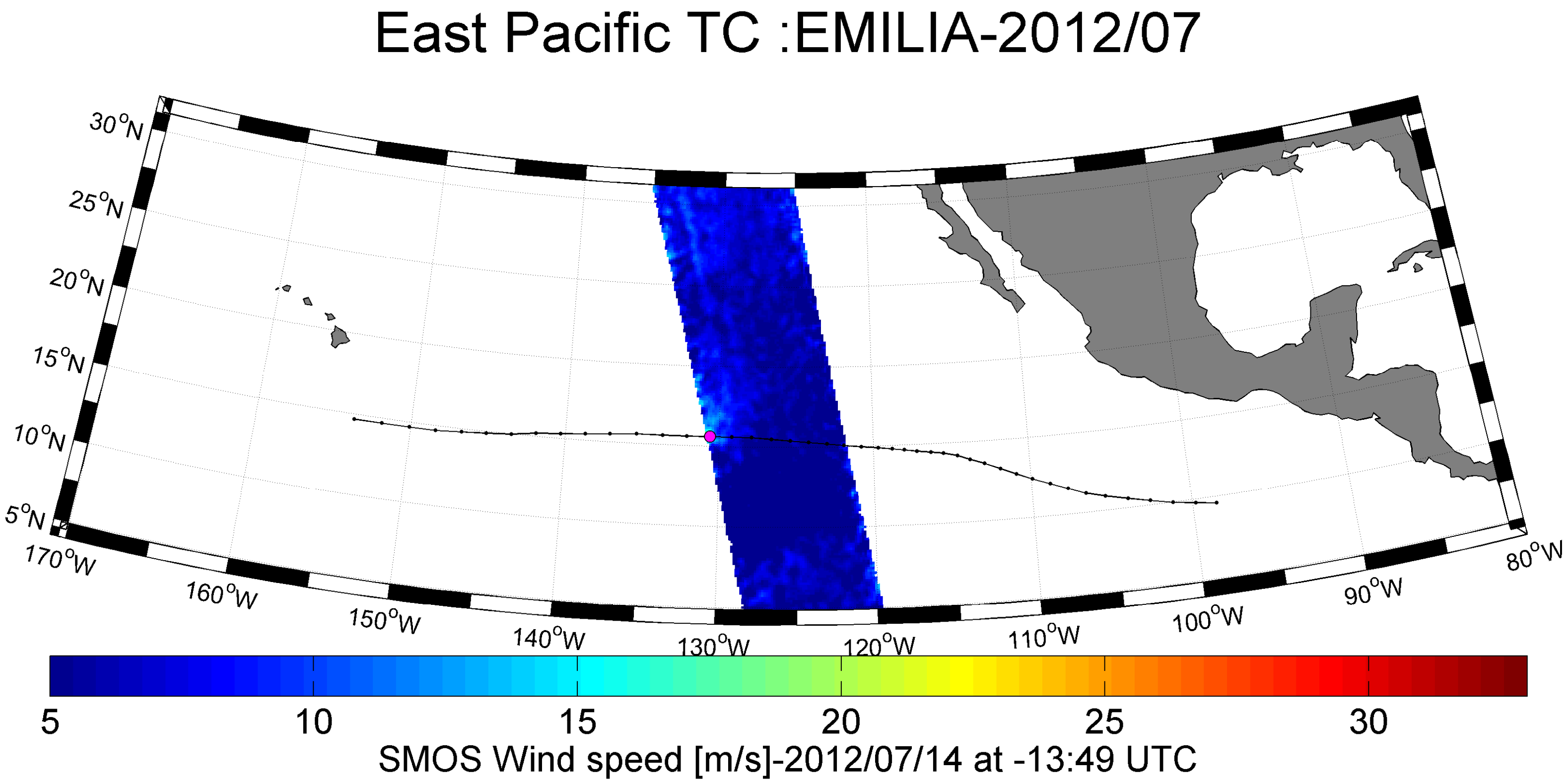
Tasks 2: Detect the useful TC & ETC events in SMOS data: Example of EMILIA



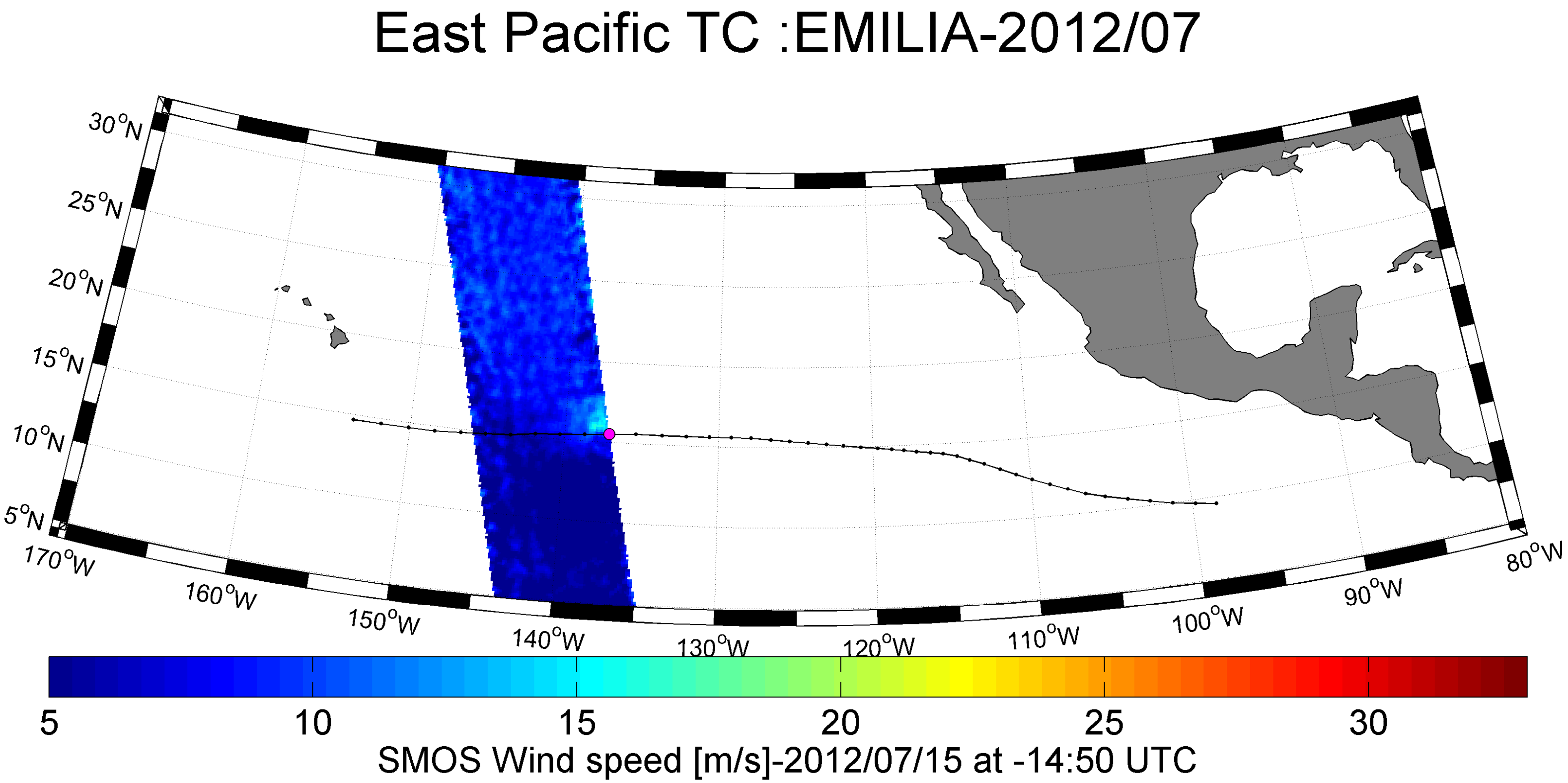
Tasks 2: Detect the useful TC & ETC events in SMOS data: Example of EMILIA



Tasks 2: Detect the useful TC & ETC events in SMOS data: Example of EMILIA

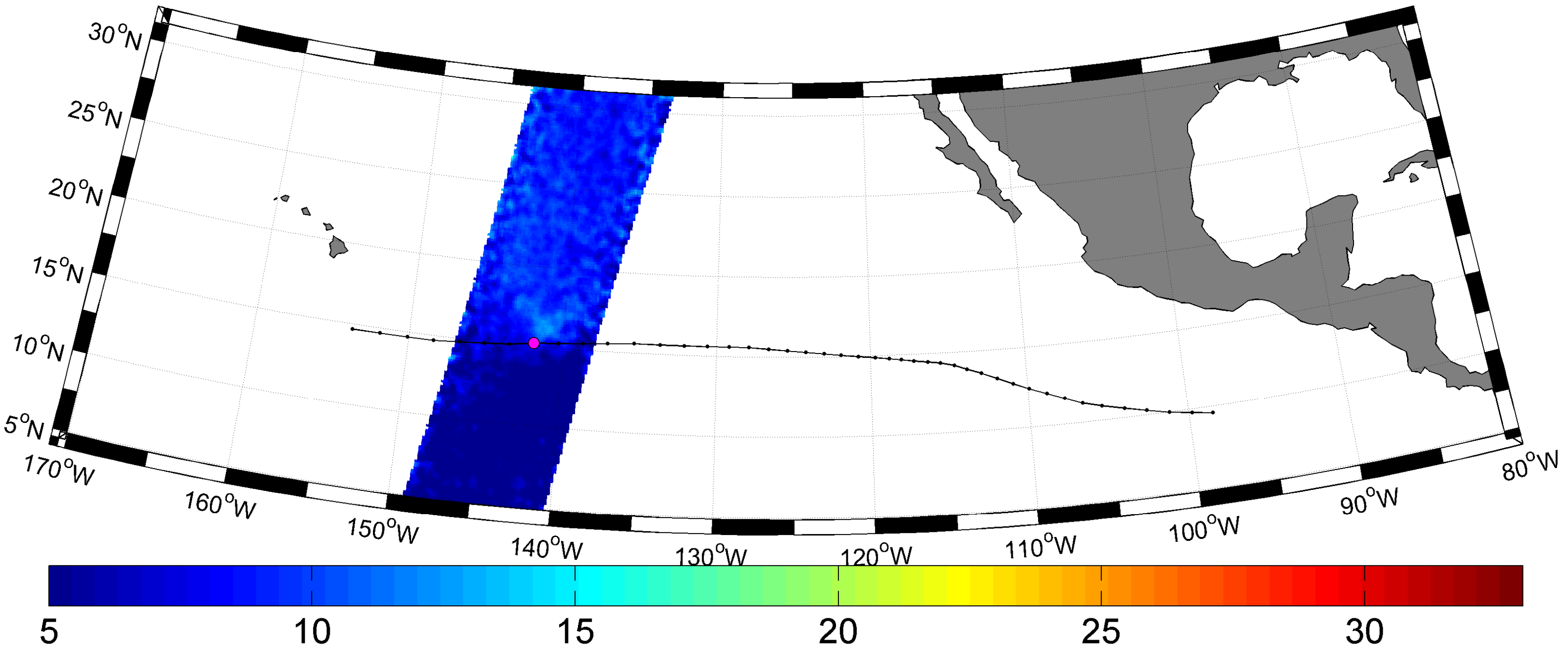


Tasks 2: Detect the useful TC & ETC events in SMOS data: Example of EMILIA



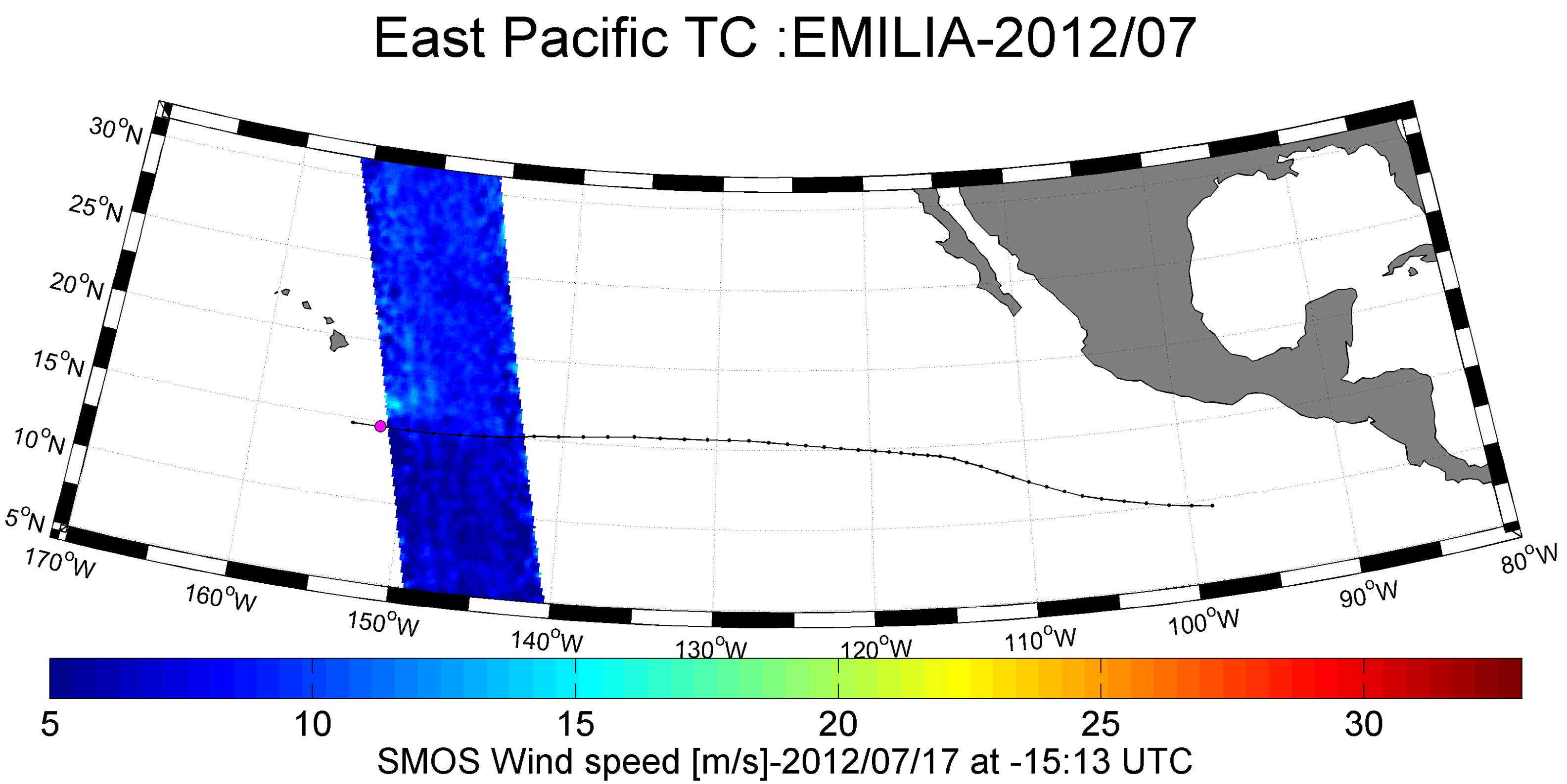
Tasks 2: Detect the useful TC & ETC events in SMOS data: Example of EMILIA

East Pacific TC :EMILIA-2012/07

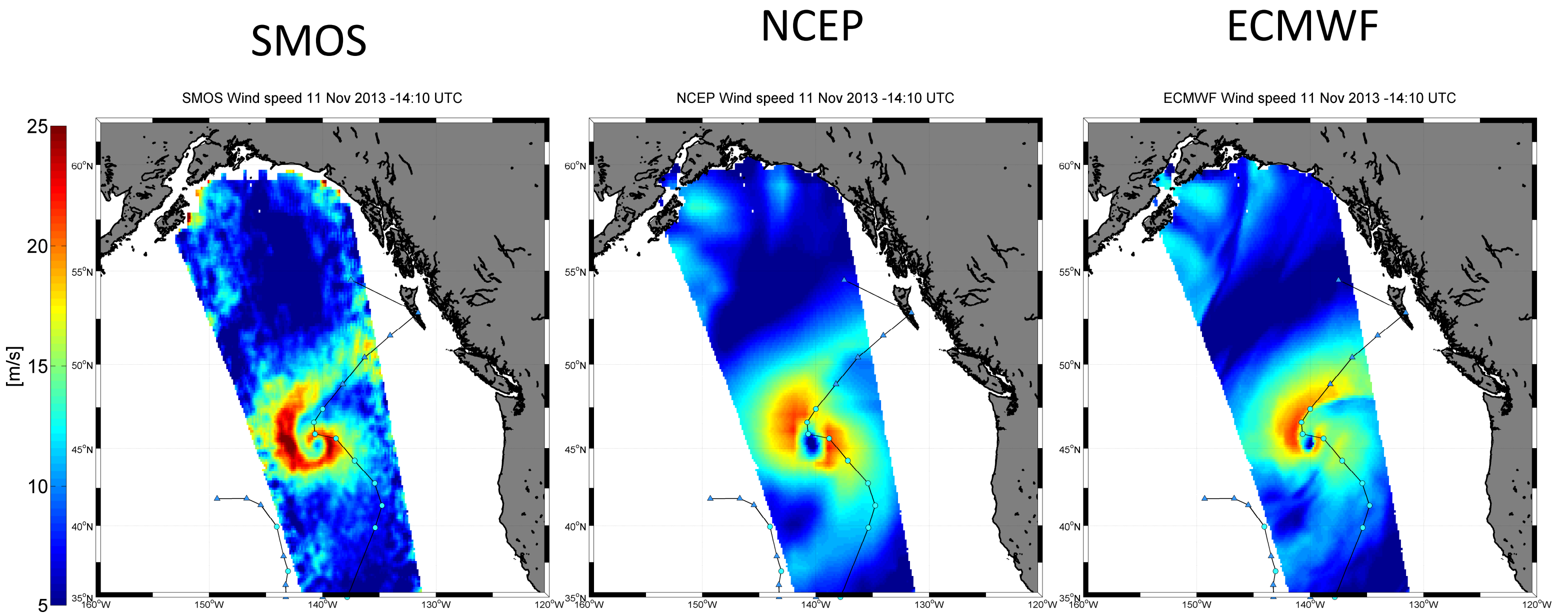


SMOS Wind speed [m/s]-2012/07/16 at -03:22 UTC

Tasks 2: Detect the useful TC & ETC events in SMOS data: Example of EMILIA



Monitoring Surface Winds with SMOS in Extra-Tropical Cyclones



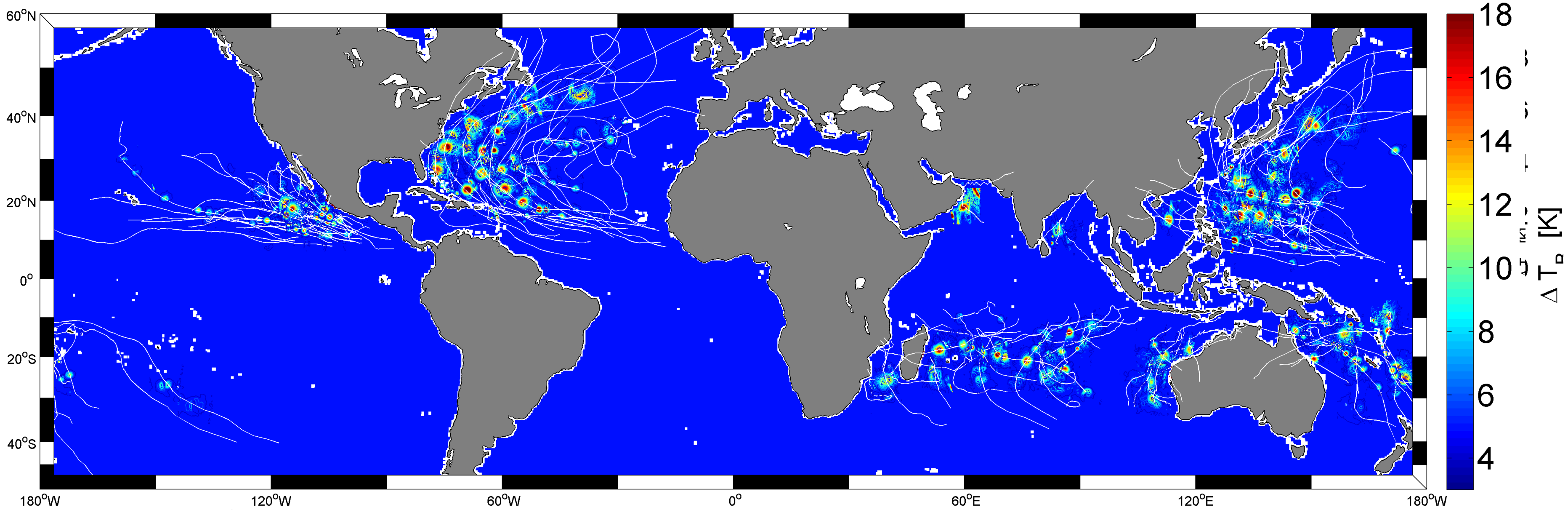
SMOS

NCEP

ECMWF

SMOS systematically detects higher wind speeds & could help re-phasing the Storms structures in opereational weather forecast models

A view at the SMOS-STORM 2010-2015 TC database

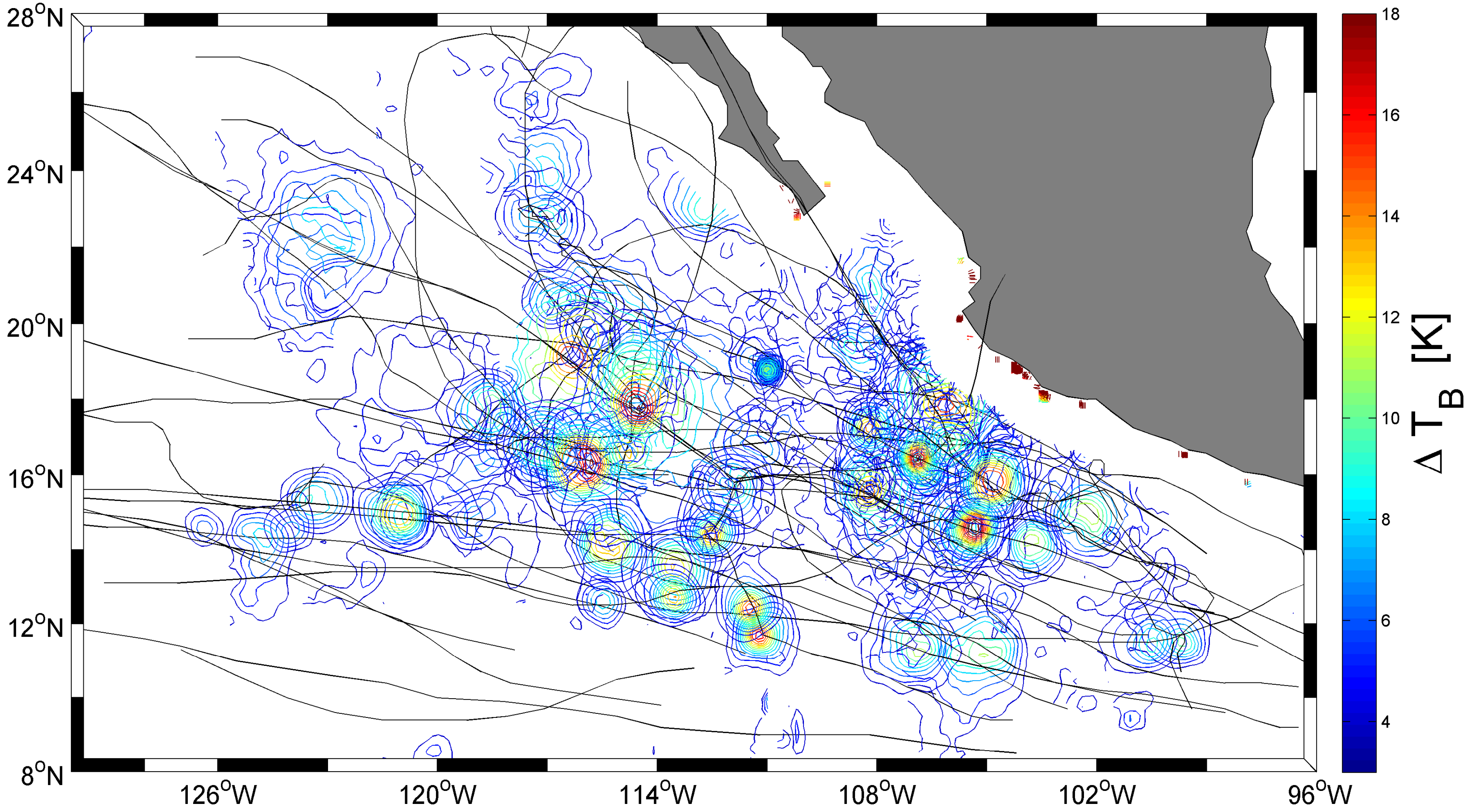


Ensemble of SMOS-TC 320 intercepts considered for Analysis

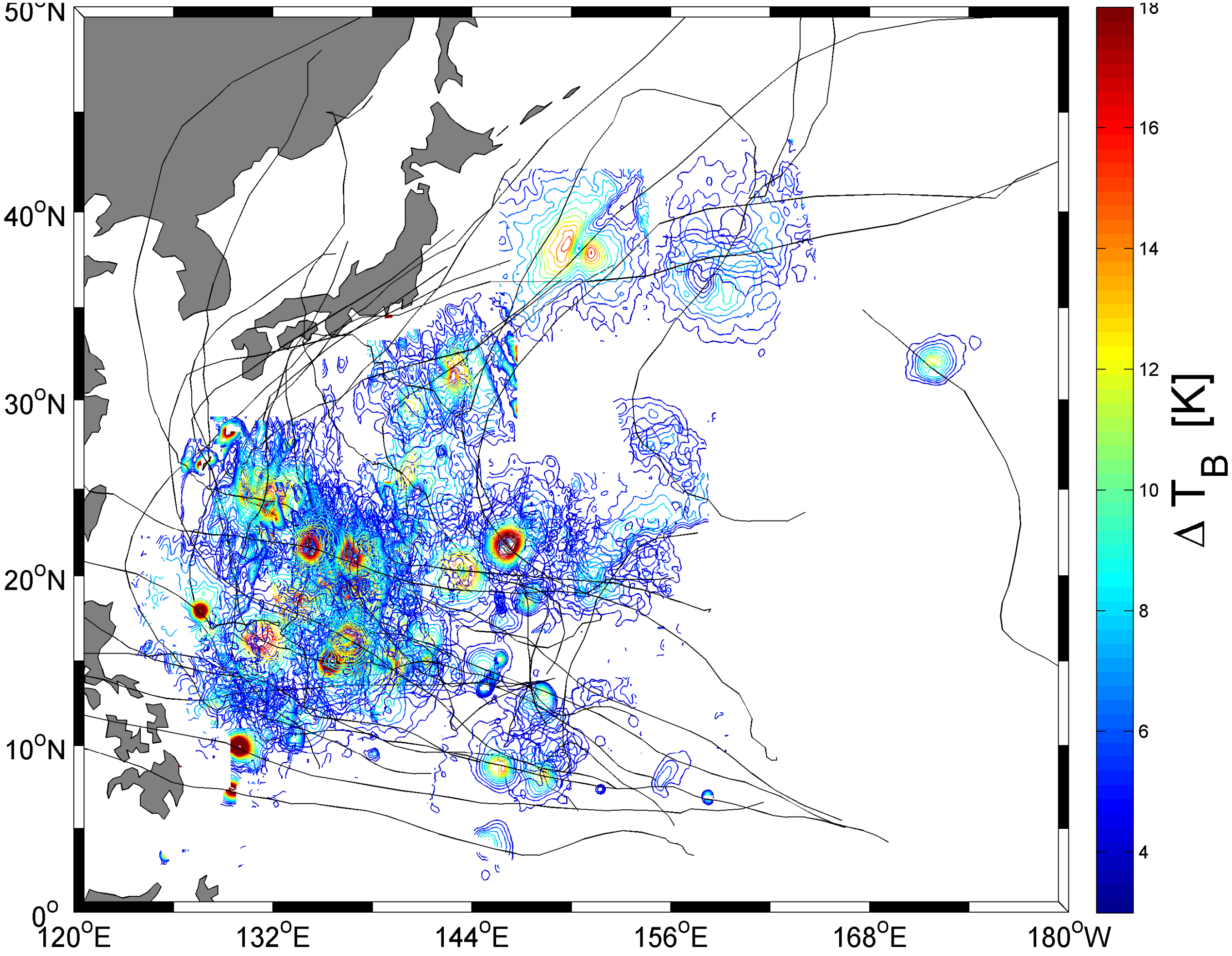
A subset of 320 SMOS swath intercepts with TCs over 2010-2015,
free of Radio Frequency Interferences and with pixel distances >150 km from coasts
are selected

Data available at **http://www.smosstorm.org/**

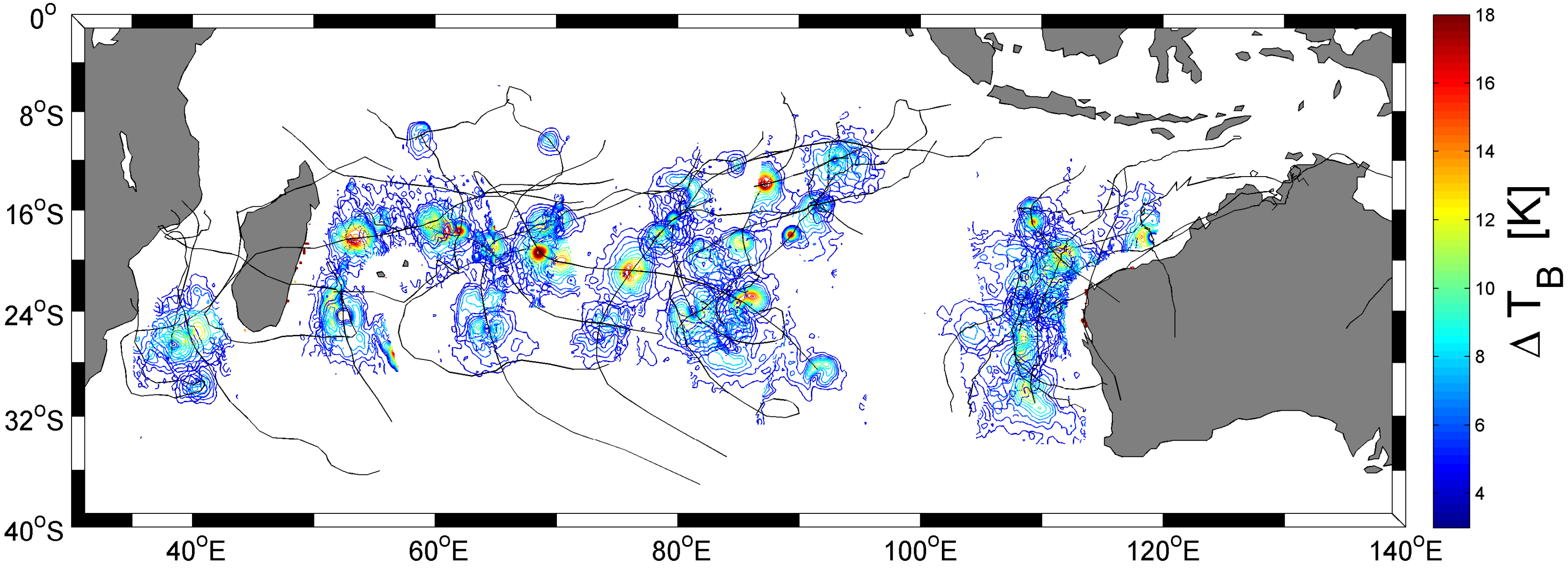
East Pacific SMOS intercepts with 2010-2014 TCs



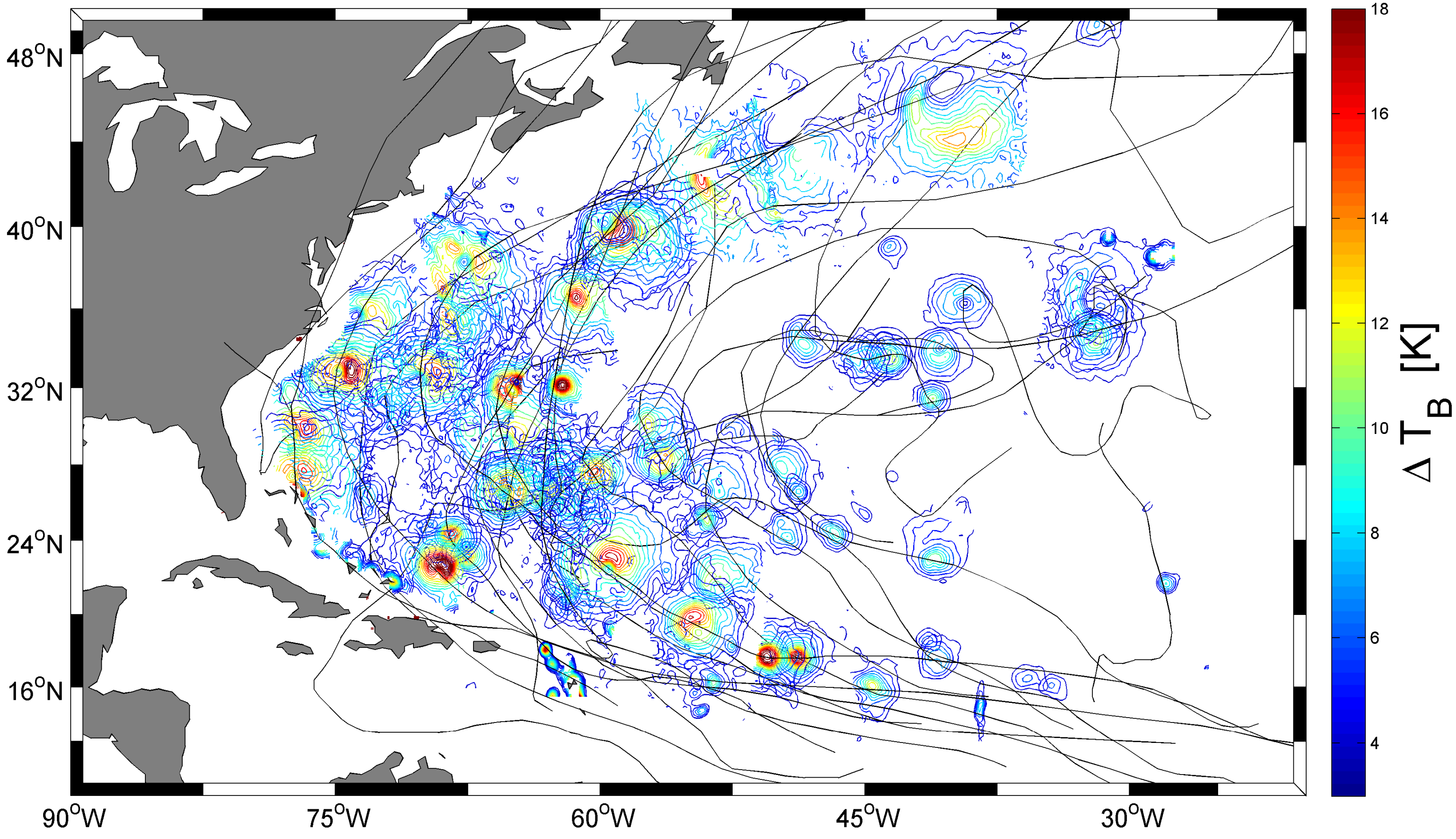
West Pacific SMOS intercepts with 2010-2014's TCs



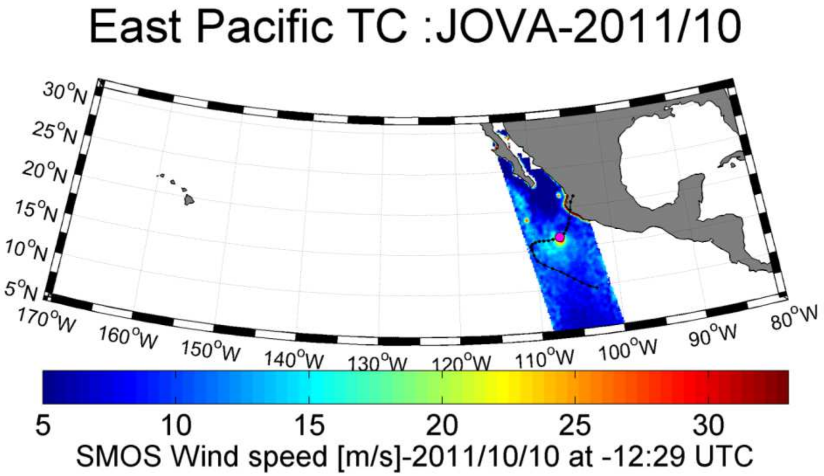
South Indian SMOS intercepts with 2010-2014's TCs



North Atlantic SMOS intercepts 2010-2014 TC

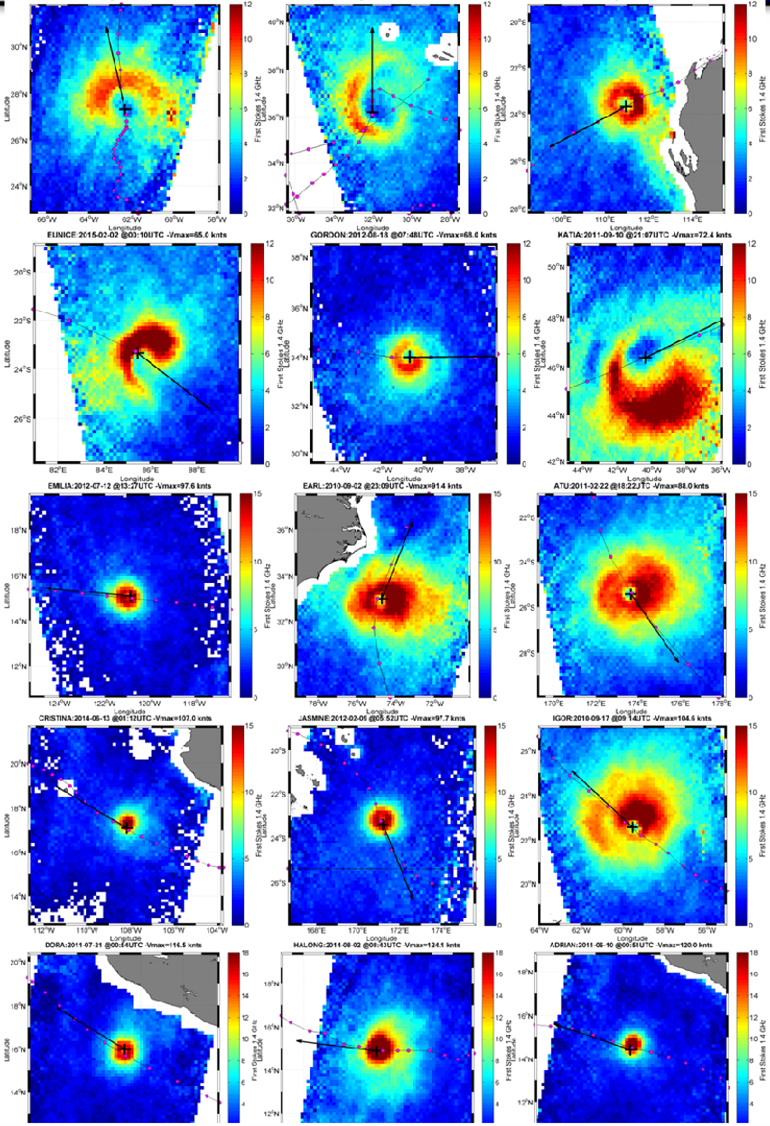


Analysing the GMF more in depth and TC intensity meter capability of SMOS



For each TC, multi-incidence Tb contrasts is collected

smos+ storms
support to science element



Tropical Storms

Category 1

Category 2

Category 3

Category 4

Saffir–Simpson hurricane wind scale

Category	Wind speeds
Five	≥70 m/s, ≥137 knots ≥157 mph, ≥252 km/h
Four	58–70 m/s, 113–136 knots 130–156 mph, 209–251 km/h
Three	50–58 m/s, 96–112 knots 111–129 mph, 178–208 km/h
Two	43–49 m/s, 83–95 knots 96–110 mph, 154–177 km/h
One	33–42 m/s, 64–82 knots 74–95 mph, 119–153 km/h

Additional classifications

Tropical storm	18–32 m/s, 35–63 knots 39–73 mph, 63–118 km/h
Tropical depression	<17 m/s, <34 knots <38 mph, <62 km/h

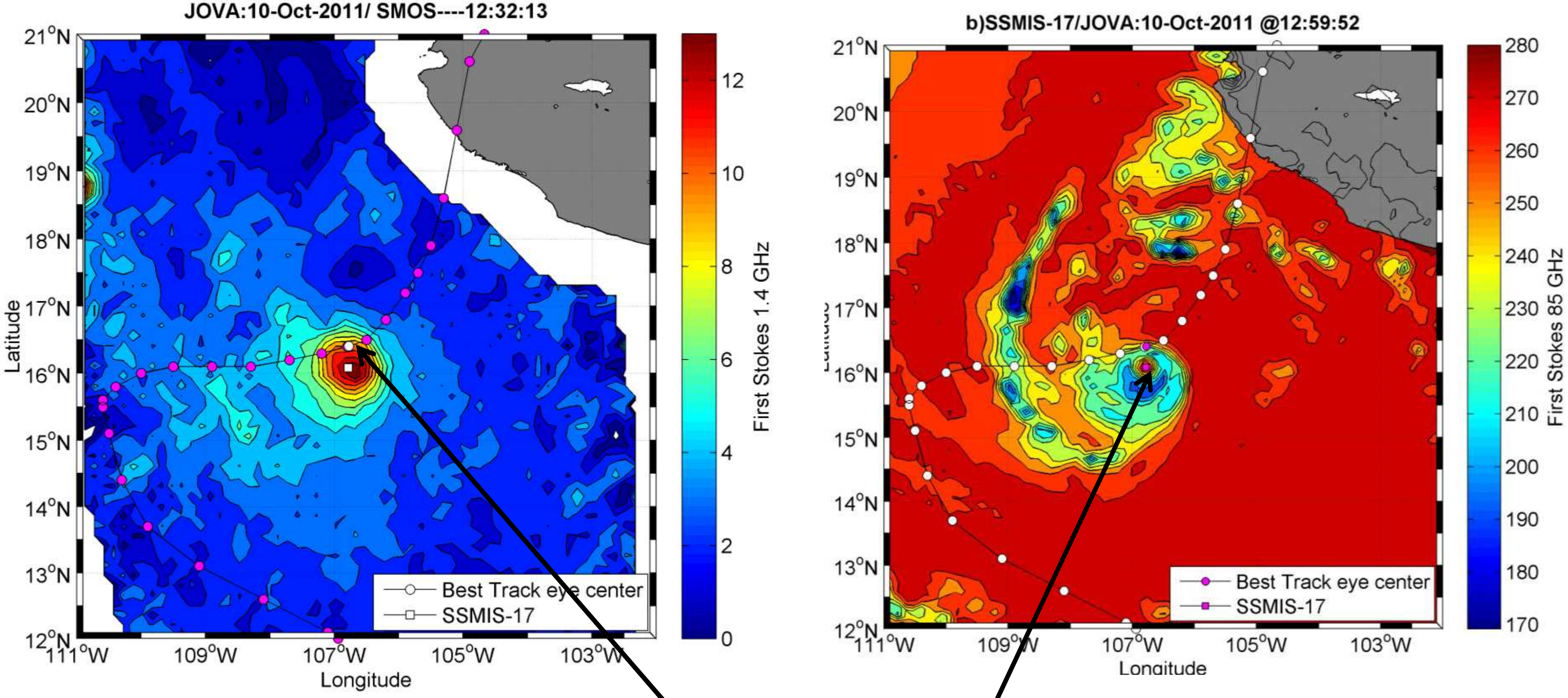
esa

Ifremer

SOLab
Satellite Oceanography Laboratory

Met Office

oceandatalab
making sense of the deep blue sea



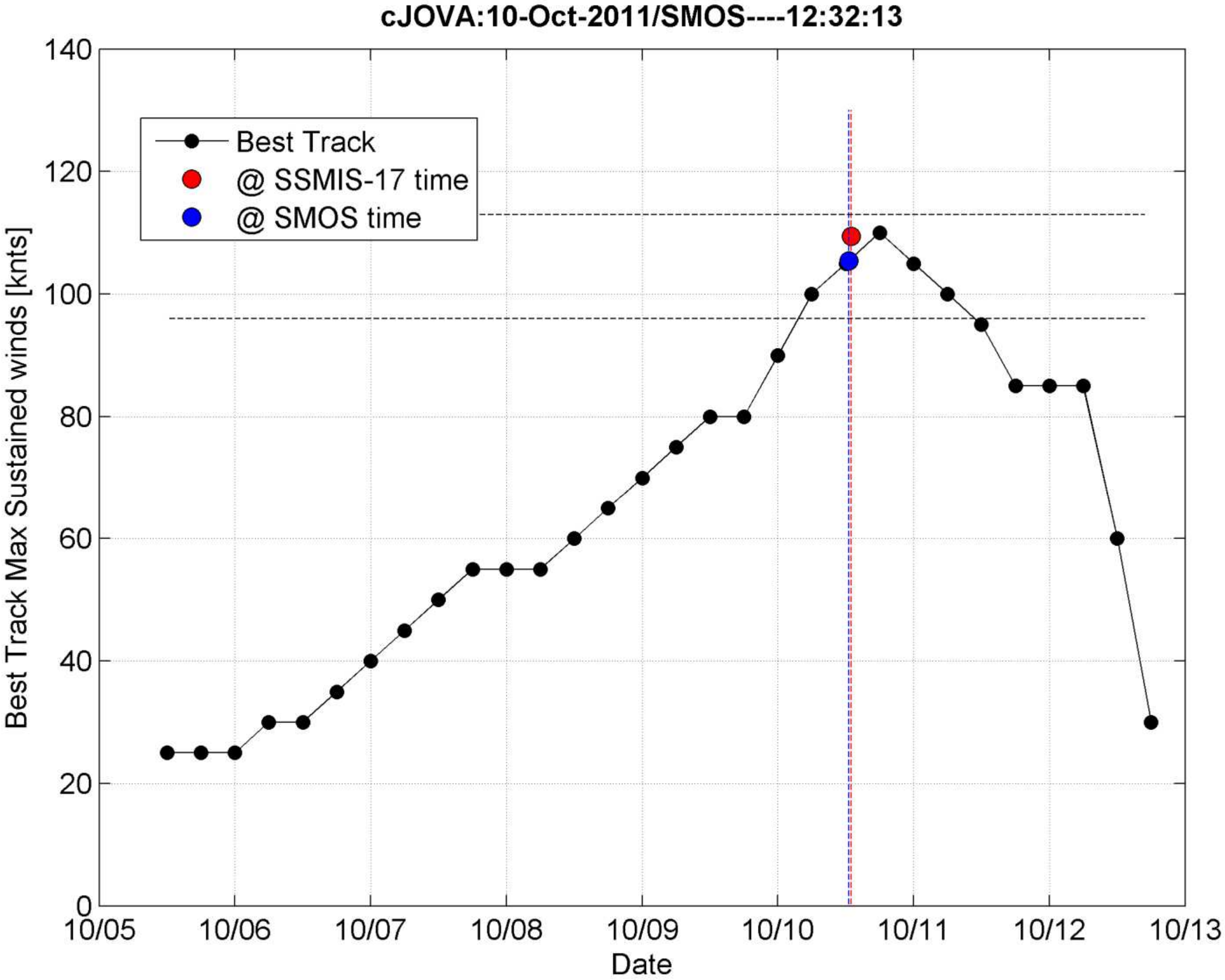
JOVA:10-Oct-2011/ SMOS----12:32:13

b)SSMIS-17/JOVA:10-Oct-2011 @12:59:52

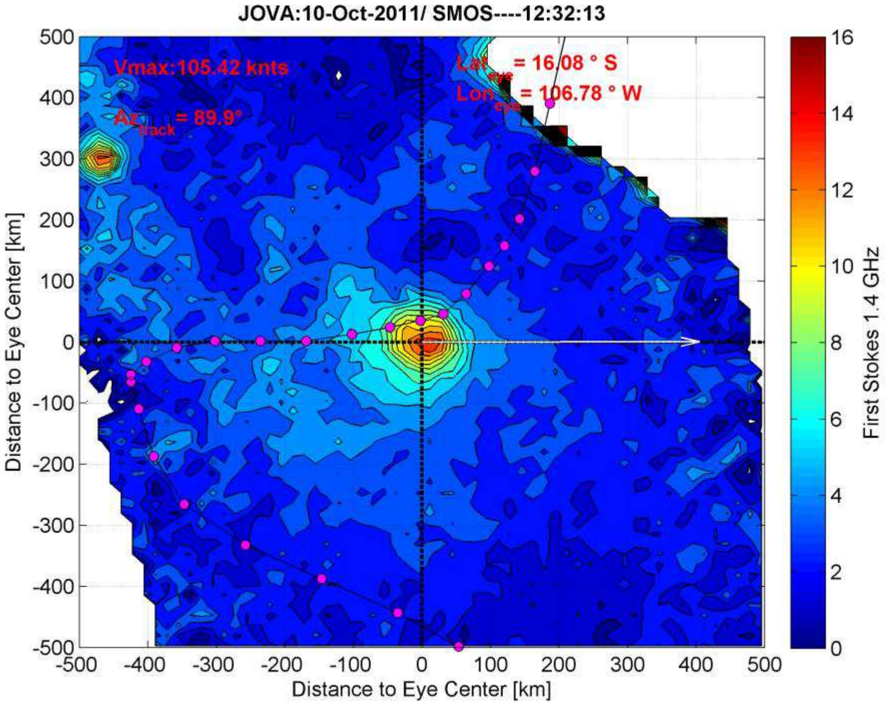
Best track eye position

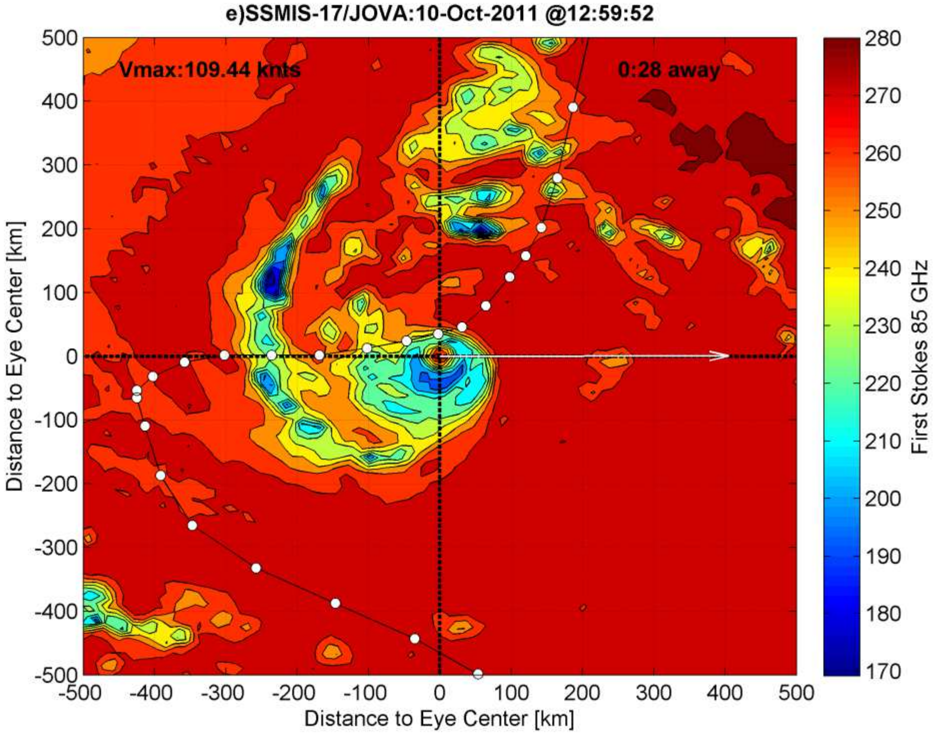
actual eye position

TC eye position is adjusted using 85 GHz datasets

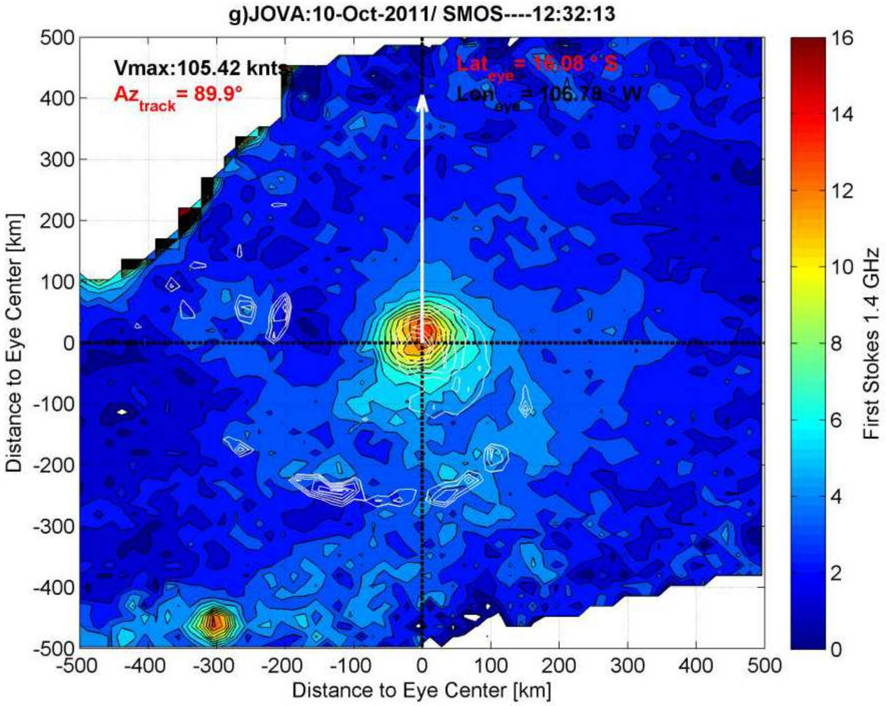


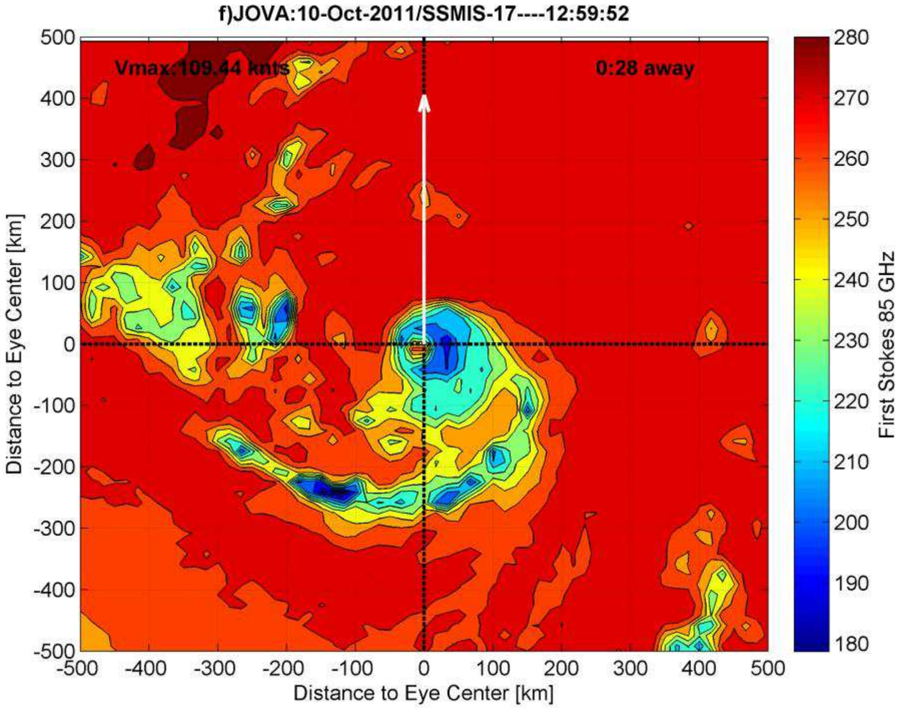
Storm intensity is evaluated using Best track data and used for further classification


JOVA:10-Oct-2011/ SMOS----12:32:13

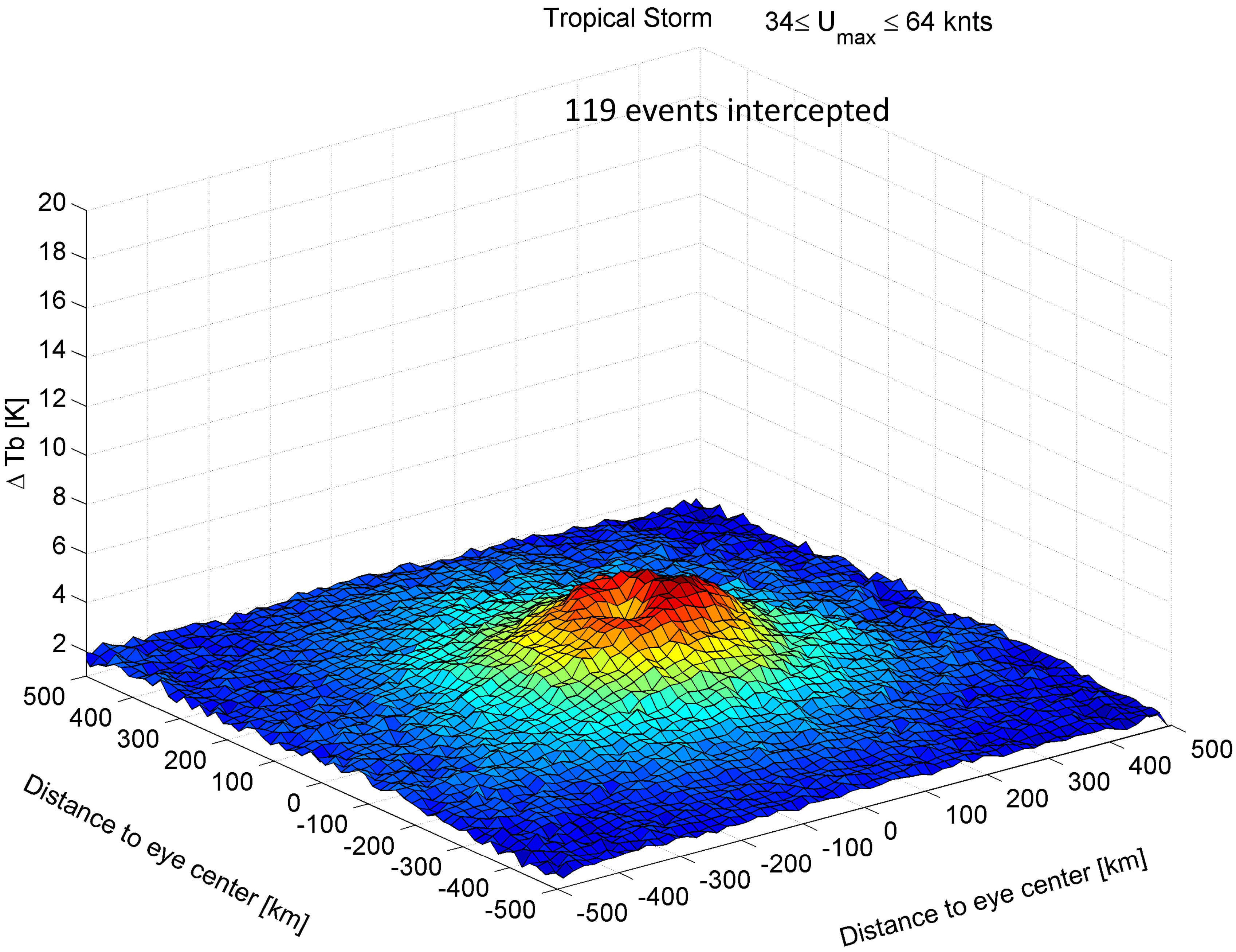

e)SSMIS-17/JOVA:10-Oct-2011 @12:59:52

SMOS Tb is recentered on a TC eye-centered frame
and
storm propagation direction is evaluated



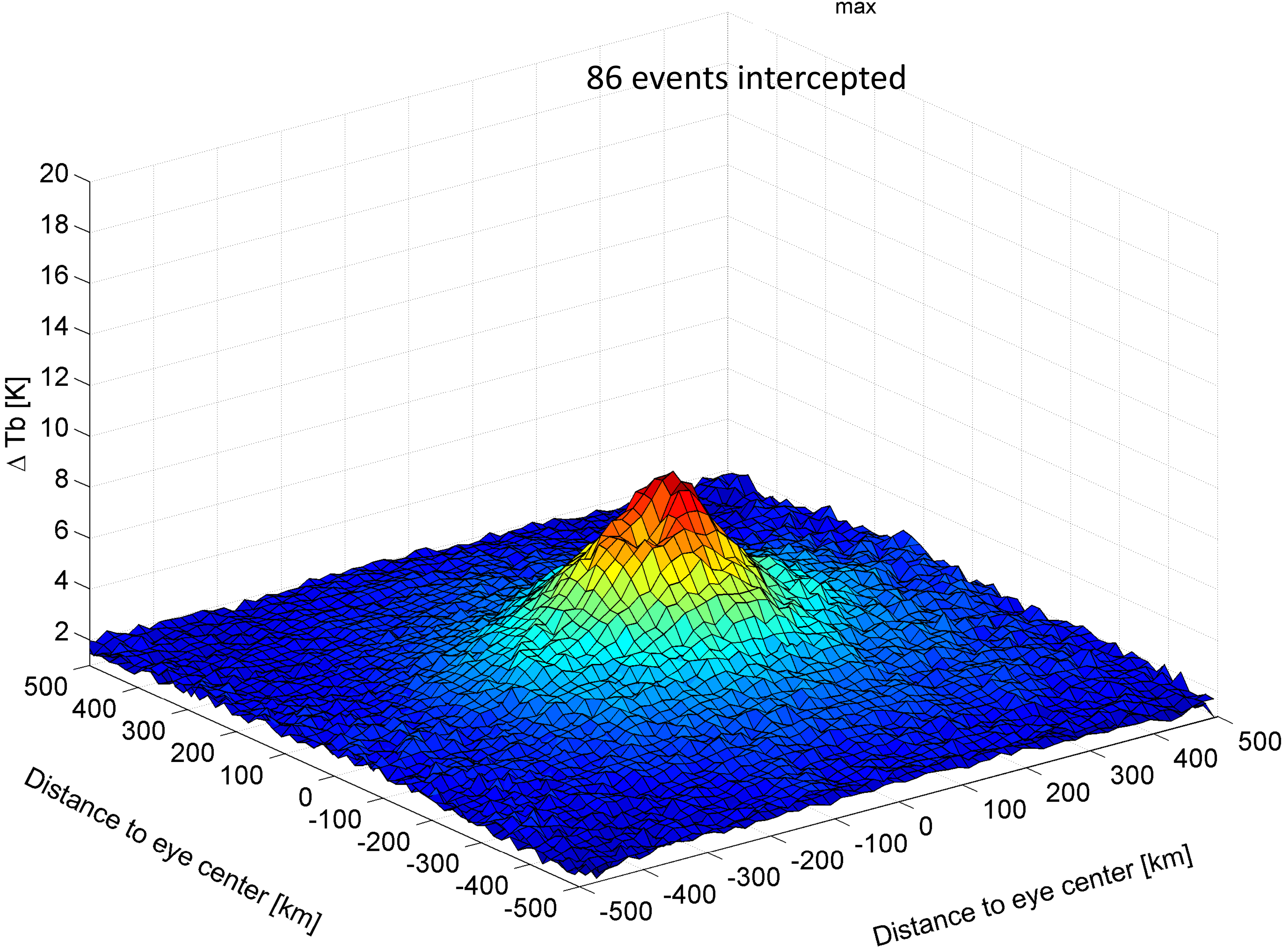


SMOS Tb is rotated to a fix North propagation direction for further Tbs averaging


Tropical Storm
34≤ U_max ≤ 64 knts
119 events intercepted
Δ Tb [K]
20
18
16
14
12
10
8
6
4
2
500
400
300
200
100
0
-100
-200
-300
-400
-500
Distance to eye center [km]
-500
-400
-300
-200
-100
0
100
200
300
400
500
Distance to eye center [km]

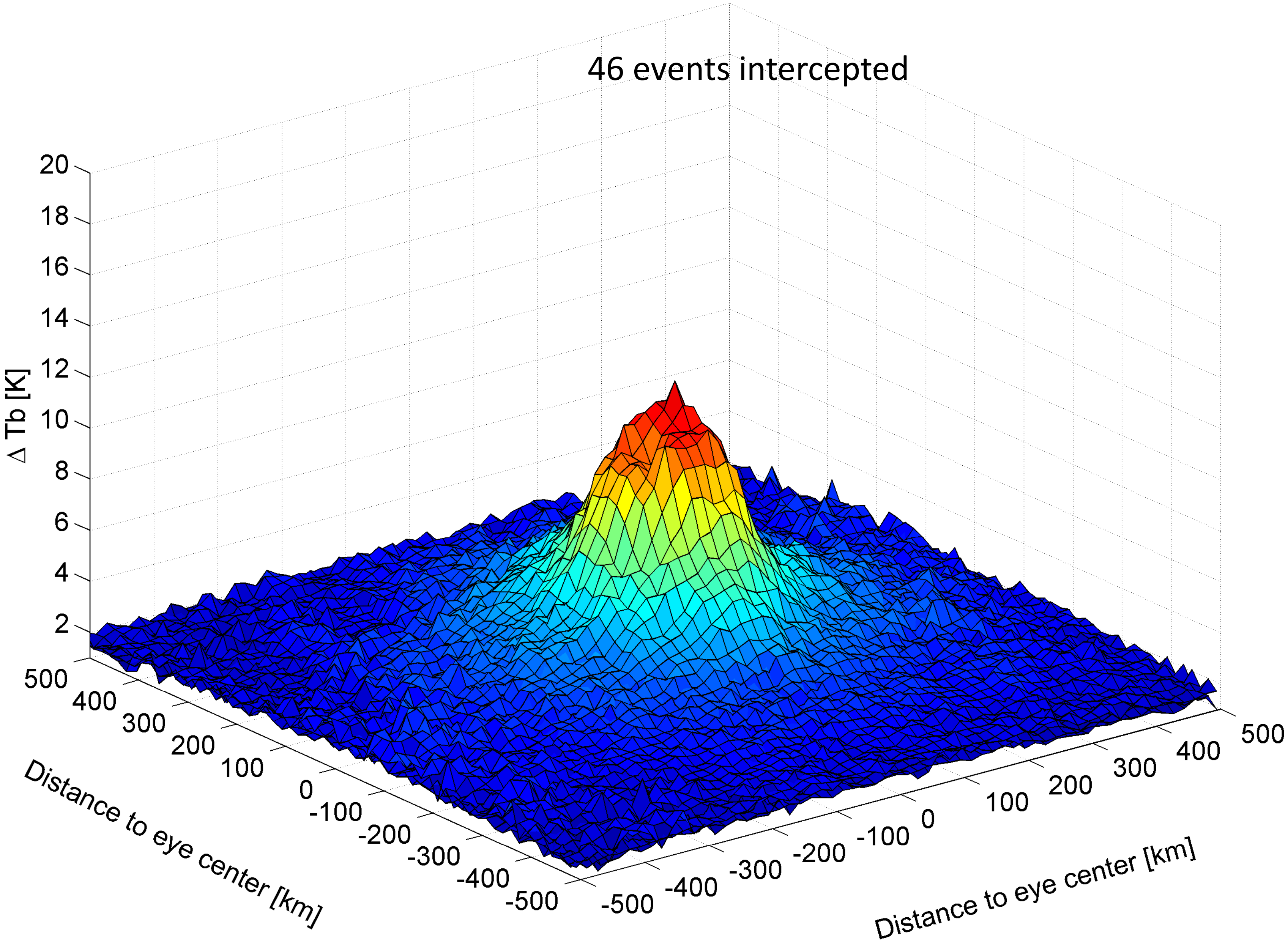
Category 1 $84 \leq U_{max} \leq 95$ knts

86 events intercepted



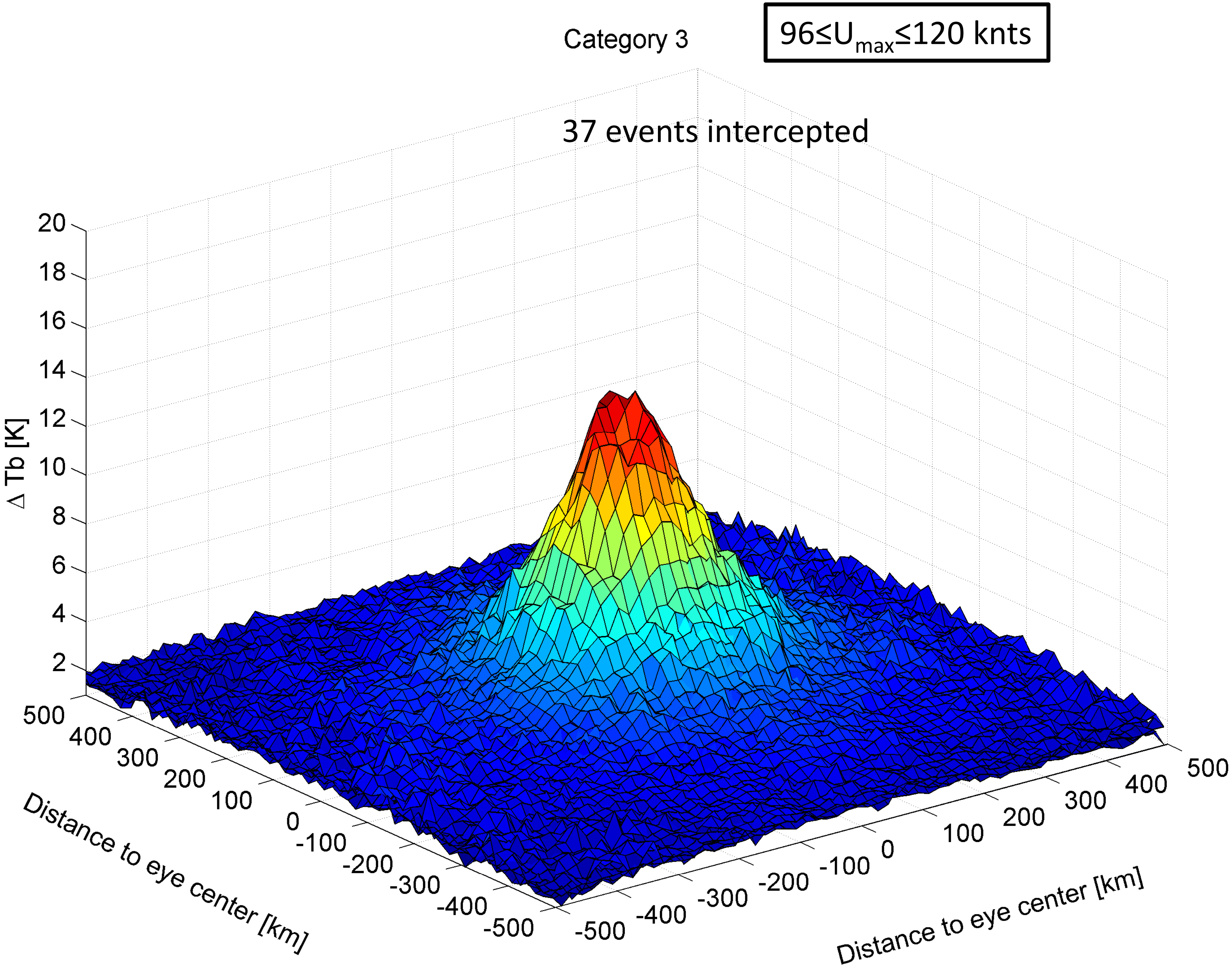
Category 2 : $95 \leq U_{max} \leq 112$ knts

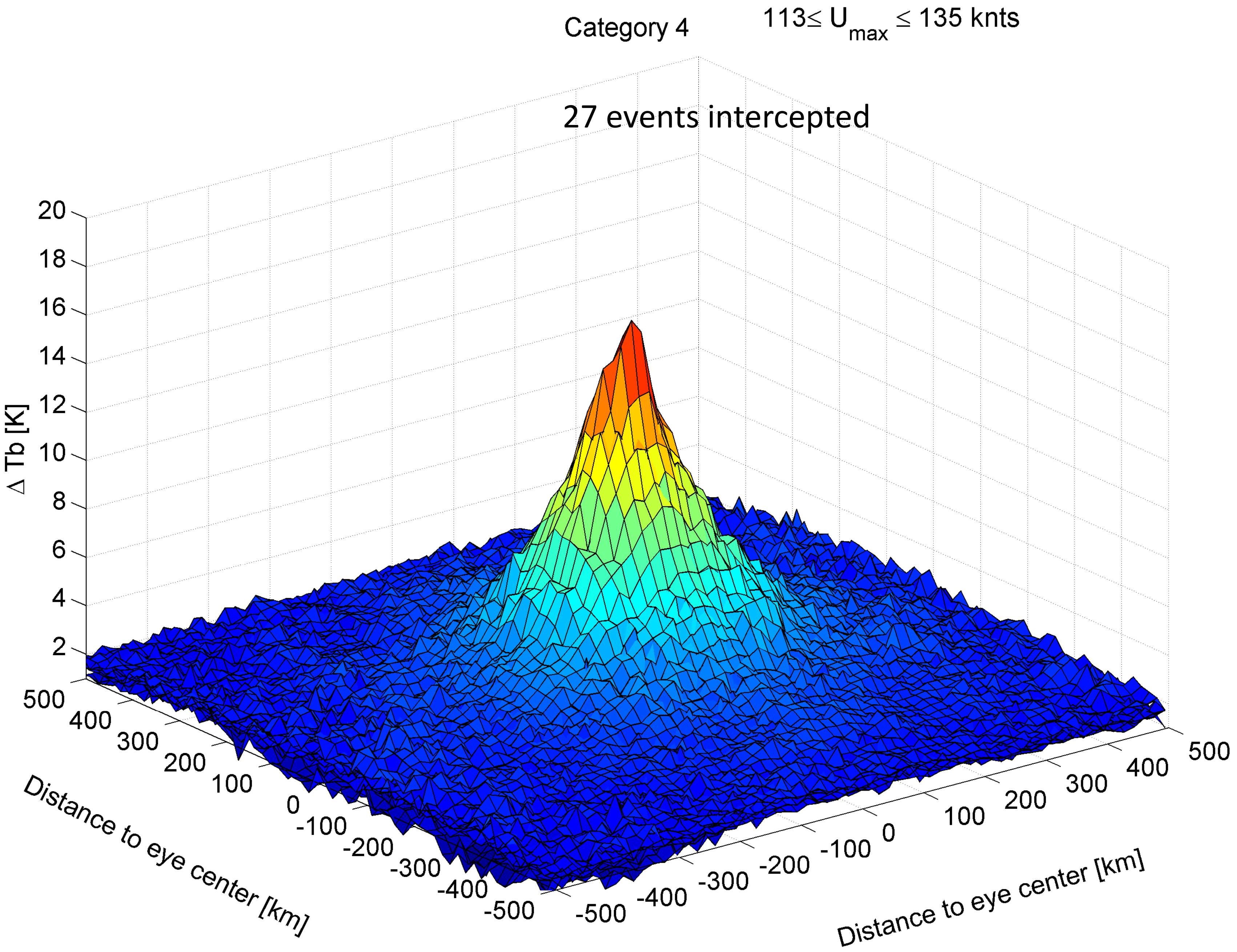
46 events intercepted



96≤U_{max}≤120 knts

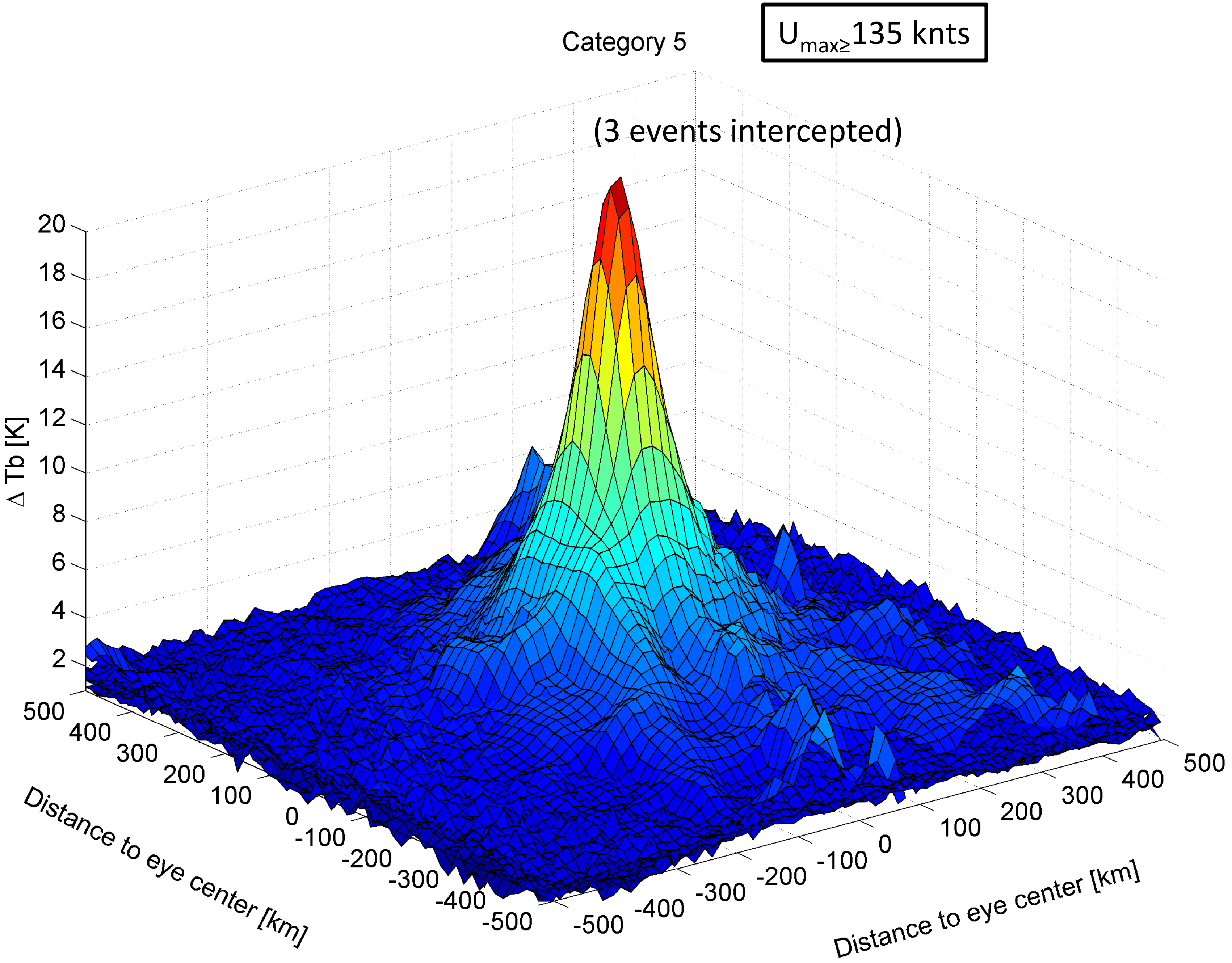
37 events intercepted





Category 4 113≤ U_{max} ≤ 135 knts

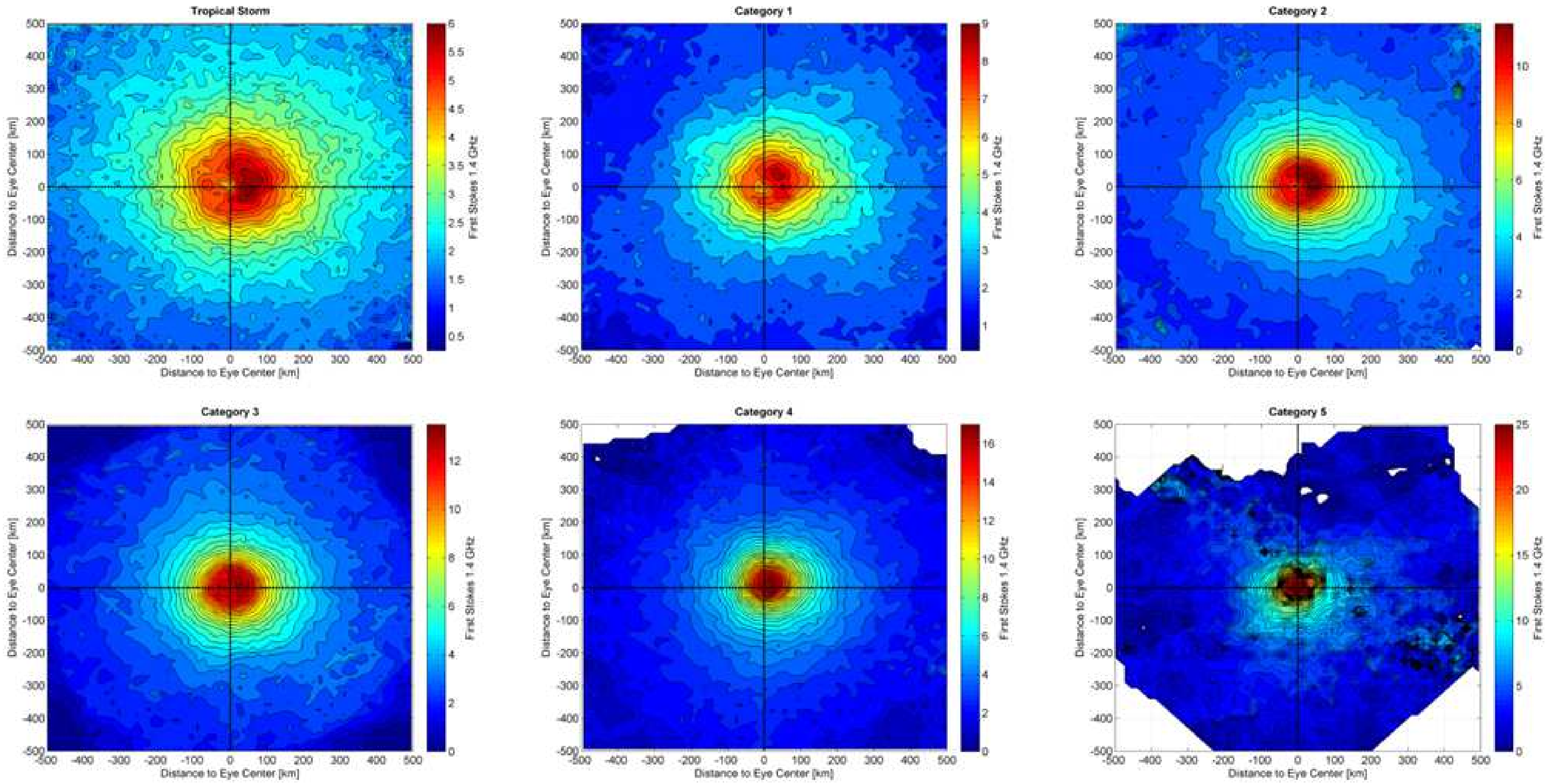
27 events intercepted



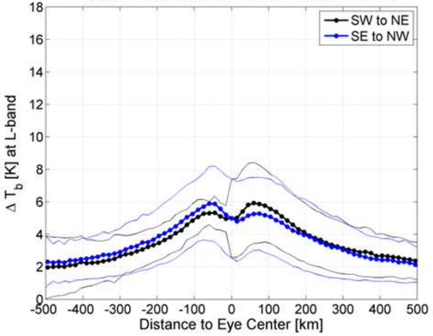
$U_{max\geq}$135 knts

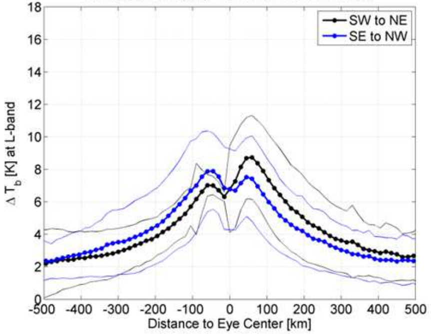
(3 events intercepted)

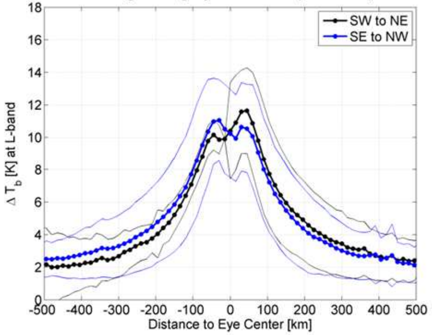
Average L-band Tb contrasts as function of storm Intensity & sectors

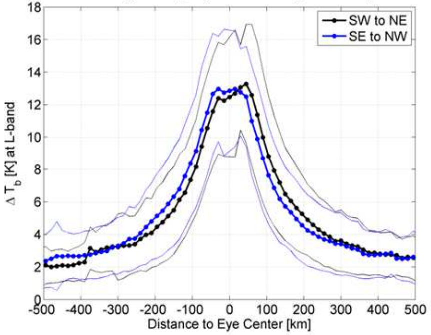


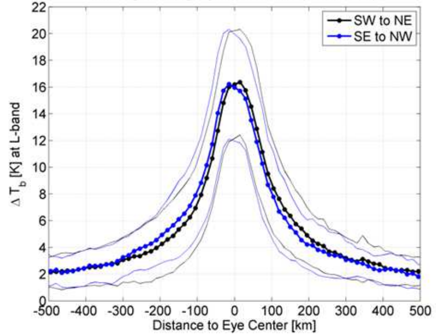
Systematic right-hand sectors asymetries in Tb as expected in wind & waves distribution in TCs (extended fetch=>Young, 2003; MacAfee and Bowyer, 2005

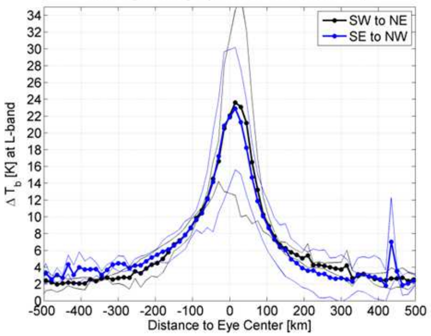

Averaged Tropical Storm structure (124 events)

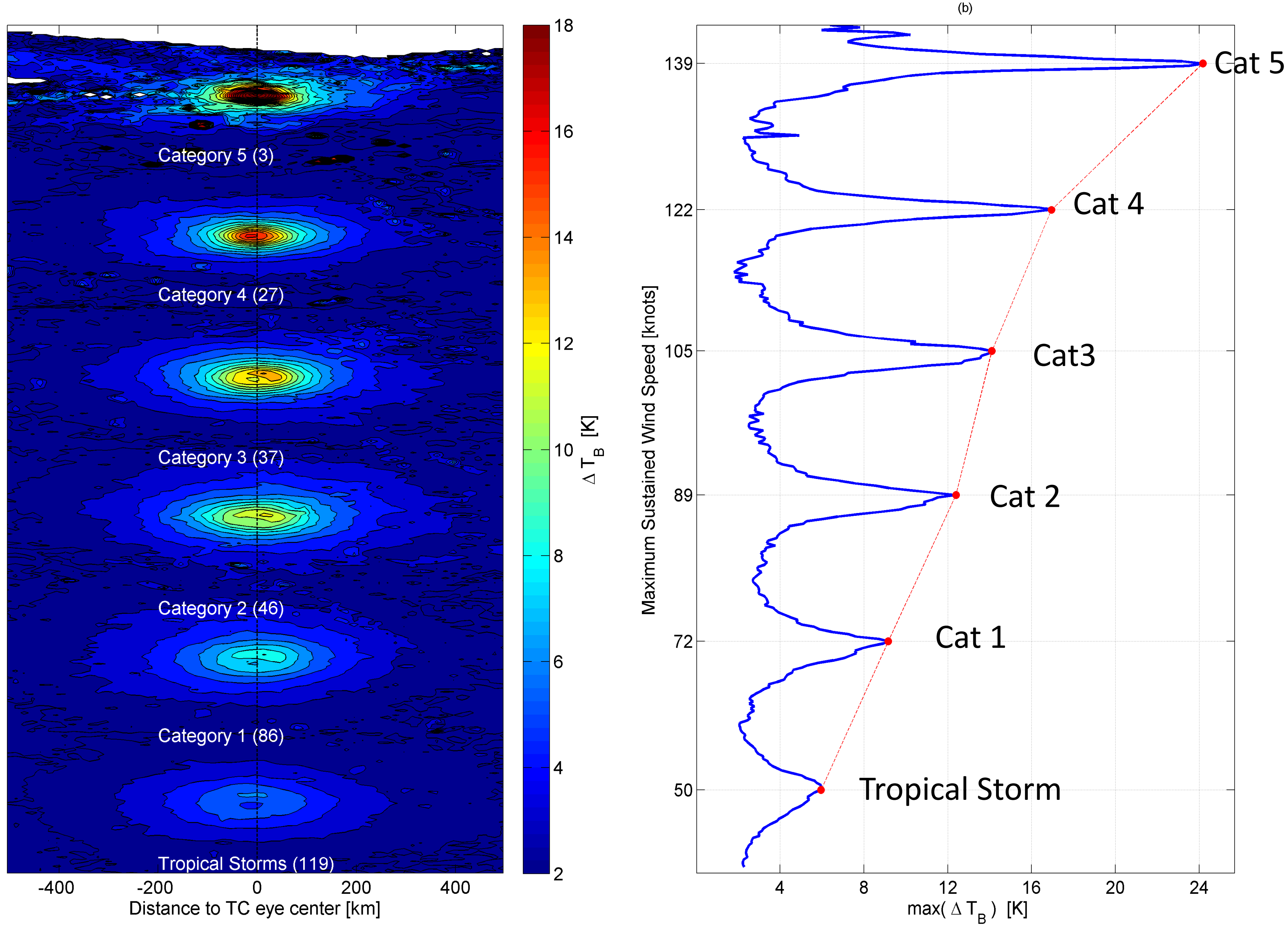

Average Category 1 structure (74 events)

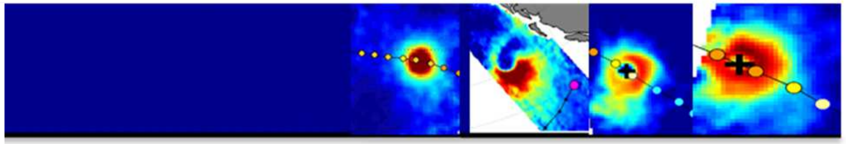

Average Category 2 structure (41 events)

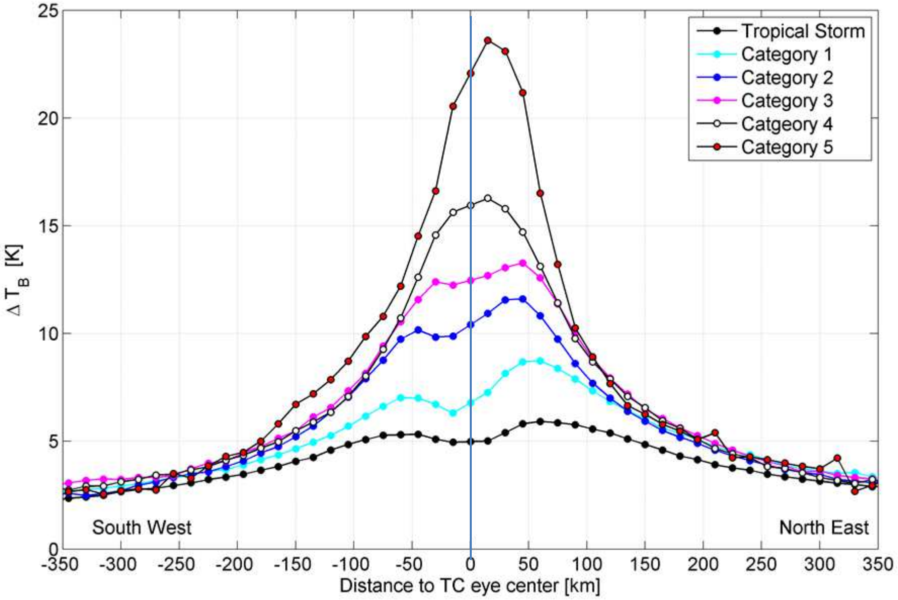

Average Category 3 structure (36 events)

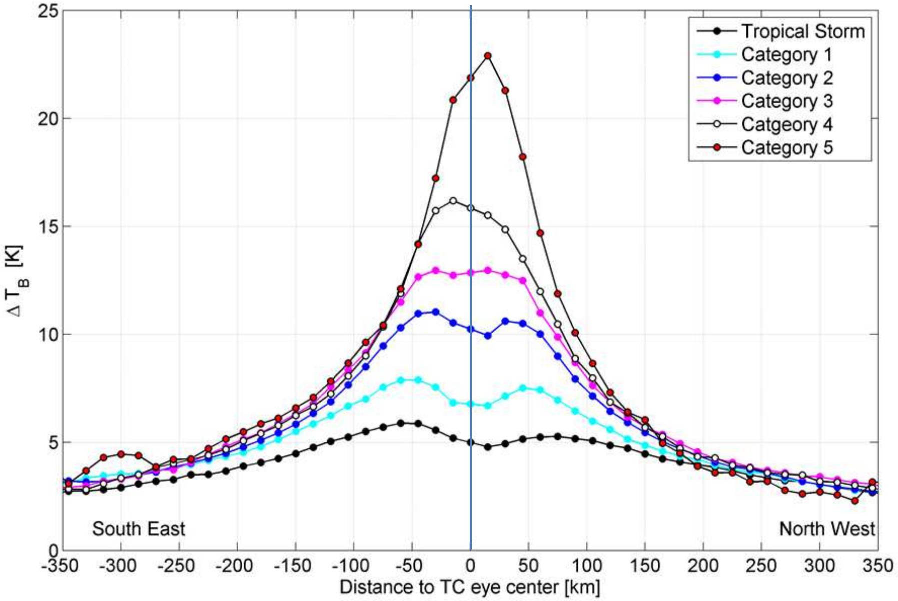

Average Category 4 structure (22 events)


Average Category 5 structure (3 events)


Category 5 (3)
Category 4 (27)
Category 3 (37)
Category 2 (46)
Category 1 (86)
Tropical Storms (119)
-400
-200
0
200
400
Distance to TC eye center [km]
18
16
14
12
10
8
6
4
2
ΔT_B [K]
(b)
139
122
105
89
72
50
Maximum Sustained Wind Speed [knots]
4
8
12
16
20
24
max(ΔT_B) [K]
Cat 5
Cat 4
Cat3
Cat 2
Cat 1
Tropical Storm



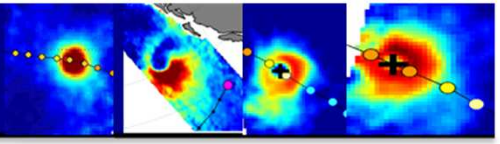




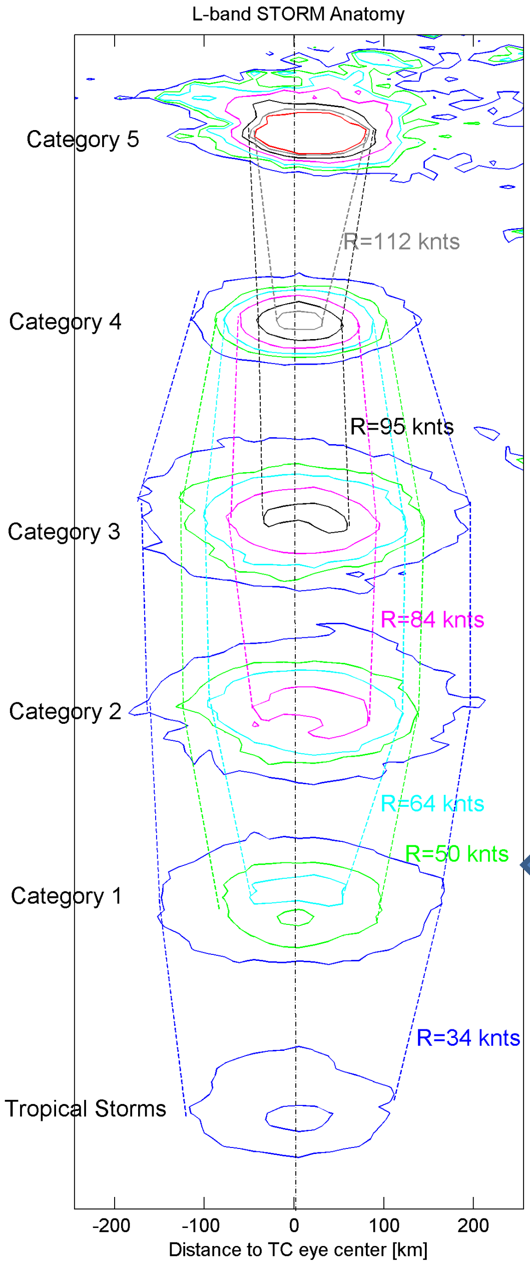
SMOS surface Tb data
reveal a clear average
growth of amplitude
with storm intensity

=> Can be used as a
Tropical cyclone
intensity meter

SMOS shows sector
Distribution asymetries with max
in RHS Storm quadrants (east)
=> Inforrmation on sea state ?



SMOS STORM SHAKER



New 'average ' structural
Information on
tropical cyclones
in terms of radius of high winds

General limits of orbiting scatterometer
Wind speed monitoring capabilities

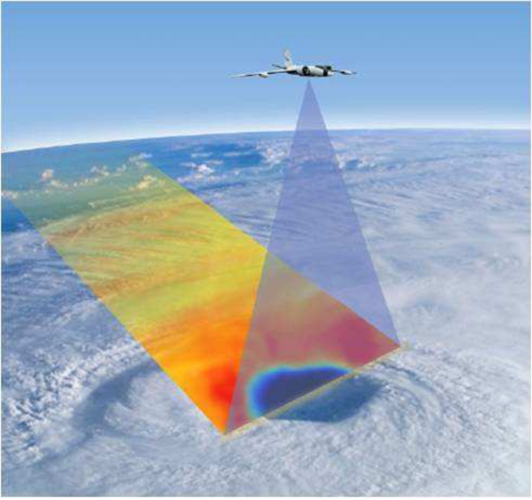
Derivation of a revised Geophysical Model Function U=f(Tb) using co-located SFMR wind speed data

64 - SFMR flights were co-localized with SMOS-STORM Tb database over 2010-2014

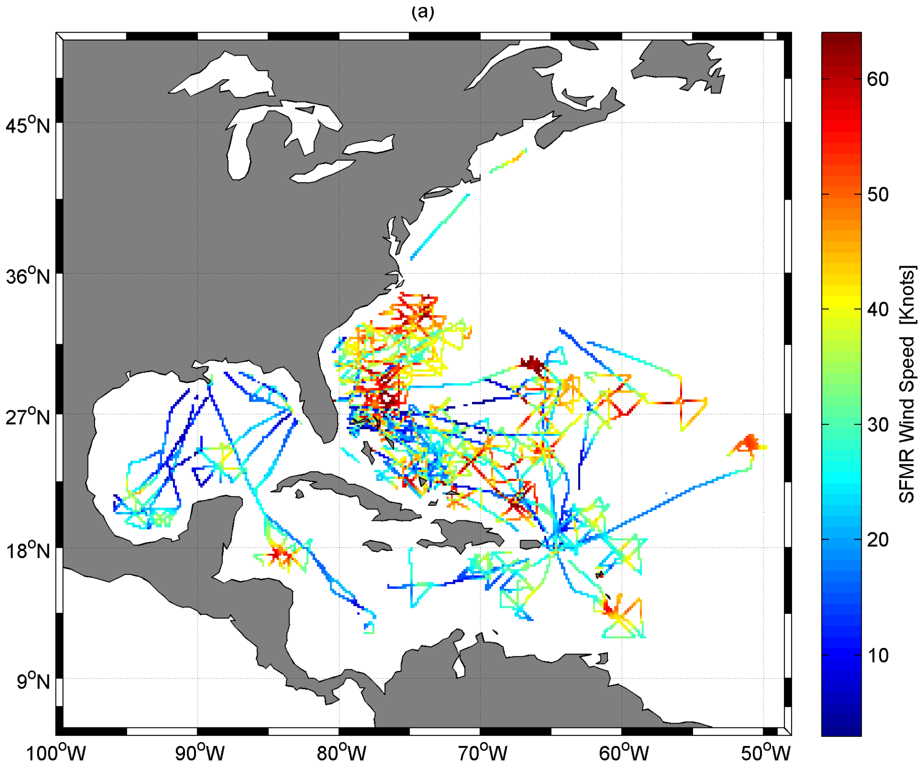
<u>SFMR data from NOAA:</u>
-C-band Tbs
-retrieved surface wind speed (6 km res)
-retrieved rain rate
-SSS along track (climato)
-SST along track (IR data ?)

<u>SMOS data:</u>
-Multi-incidence Tbs
-retrieved wind speed from SMOS 1st GMF
-SST ostia
-SSS from SMOS data composite of L3 during the week preceeding each storms

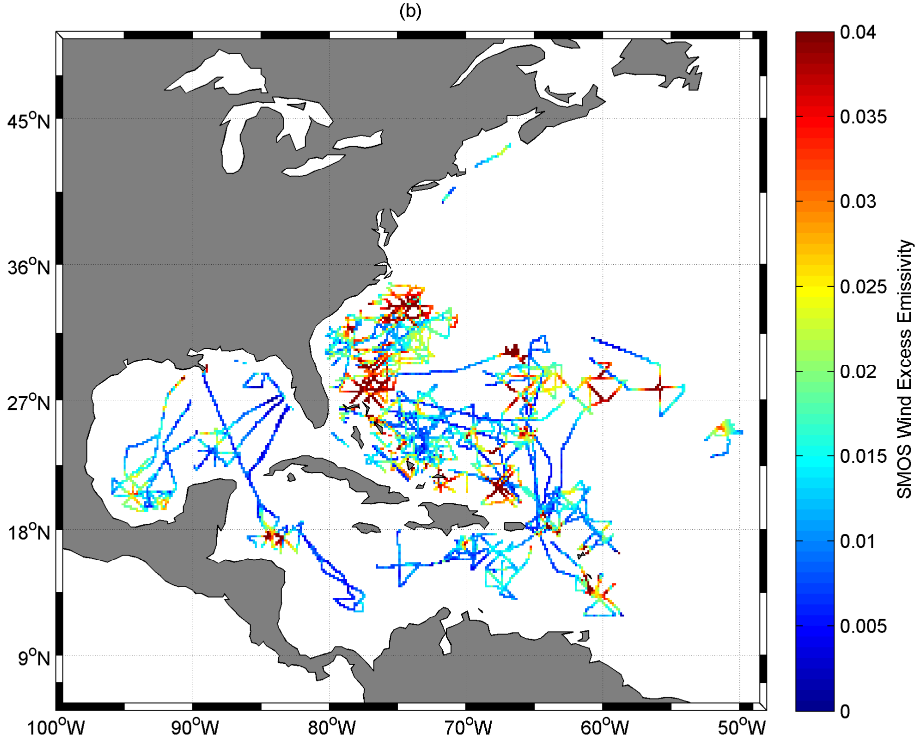
NOAA Hurricane hunter P-3



Derivation of a revised GMF: comparisons with SFMR



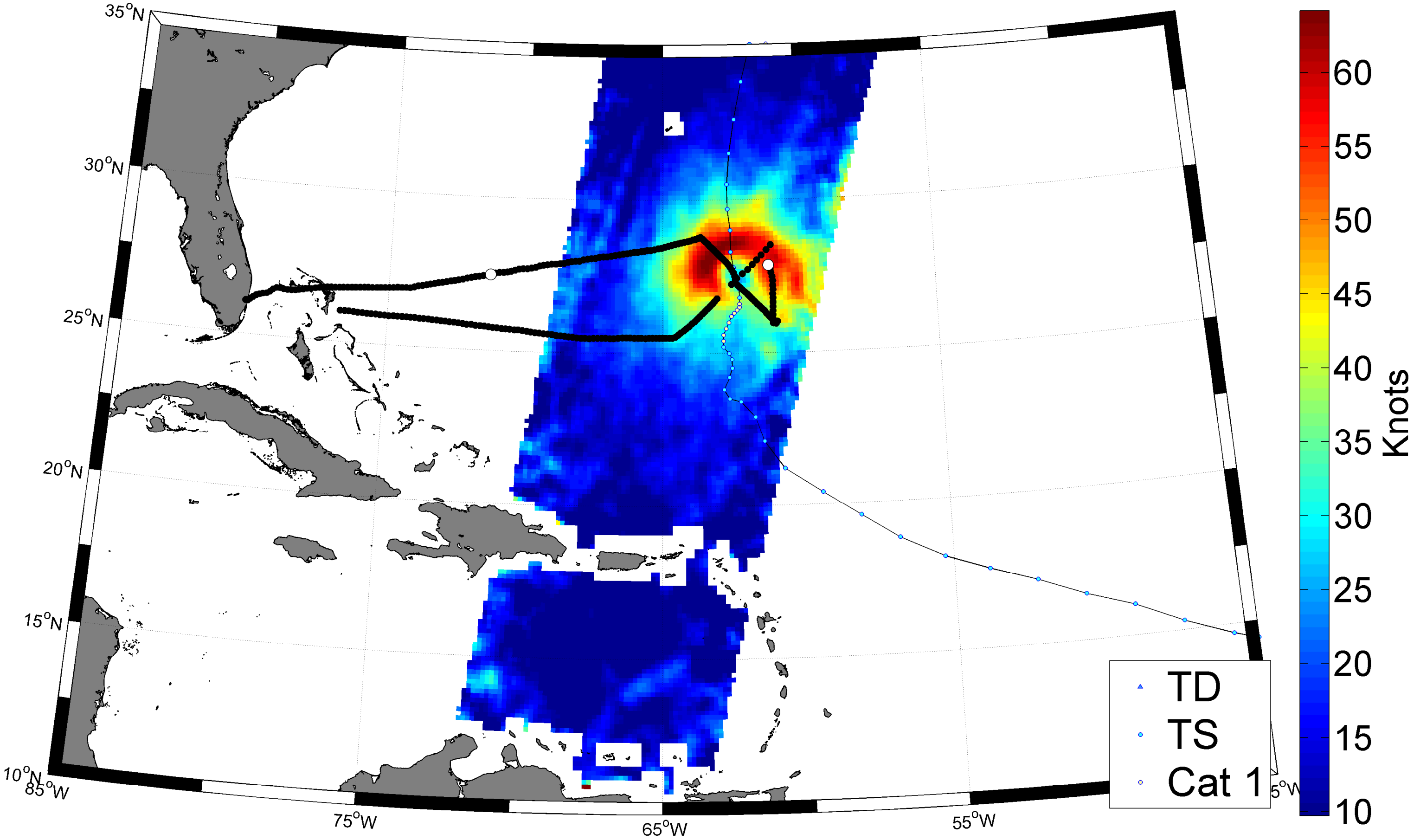
Ensemble of SFMR tracks &
Wind Speed [knots]



Co-localized SMOS wind Excess Emissivity
Δtime (SMOS-SFMR) < 10 hours

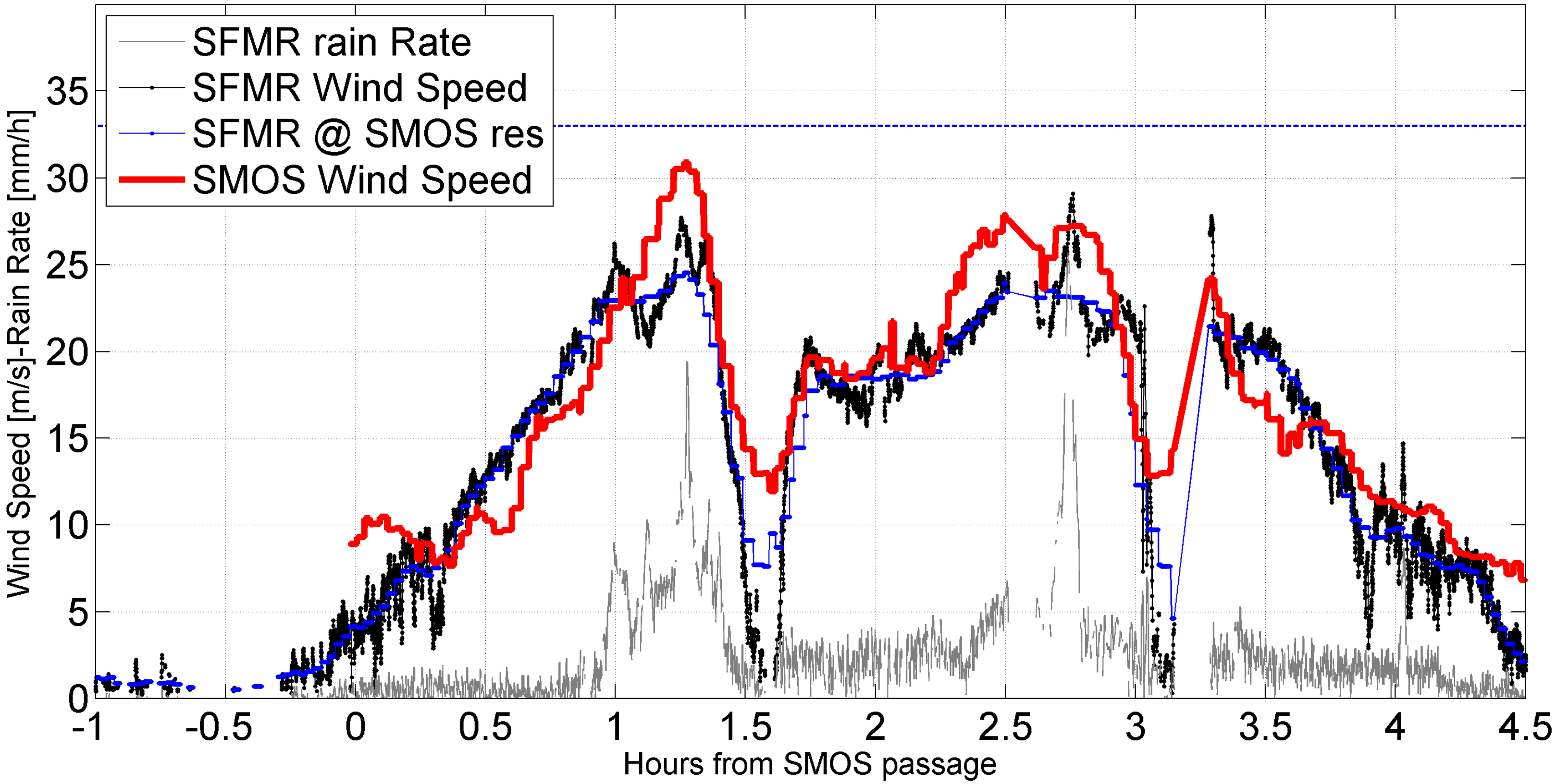
Validation: comparison with NOAA/Hurricane Research Division aircraft data : in moderately strong winds (TS &Cat 1)

North Atlantic TC :leslie-2012/09



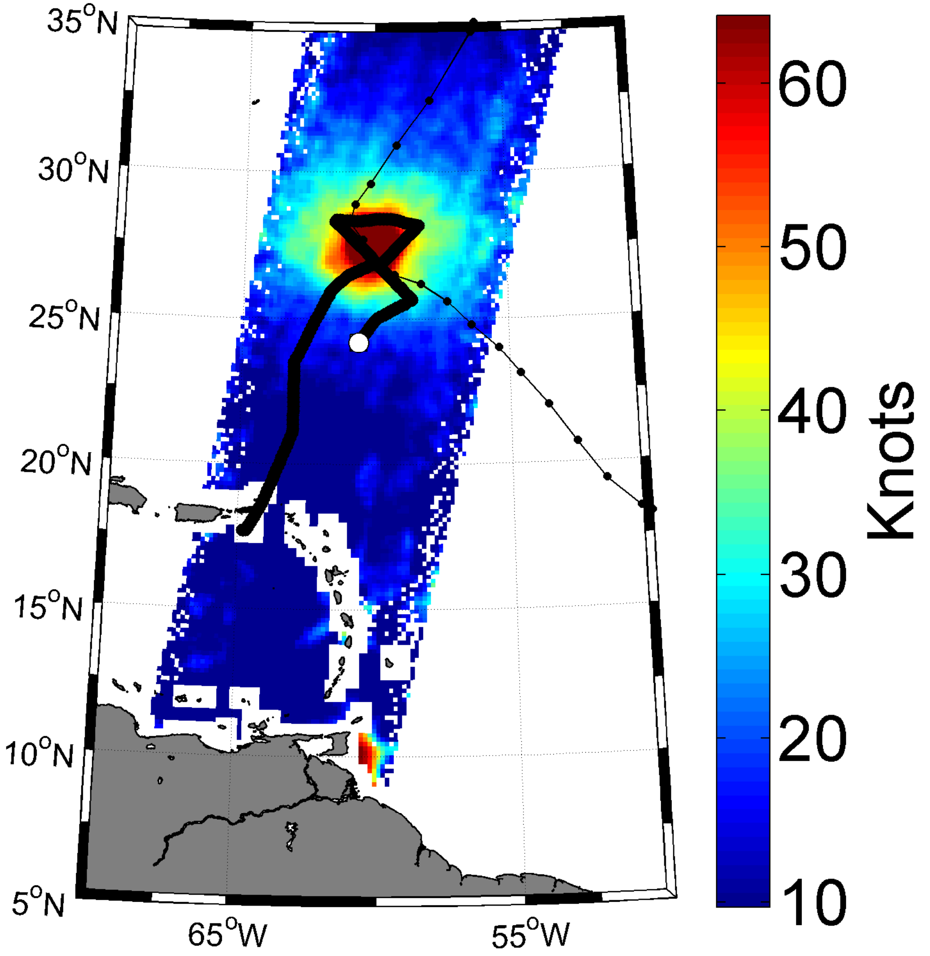
SMOS Wind speed -2012/09/07 at -22:19 UTC

Hurricane Leslie 2012/9/7 22:19 UTC

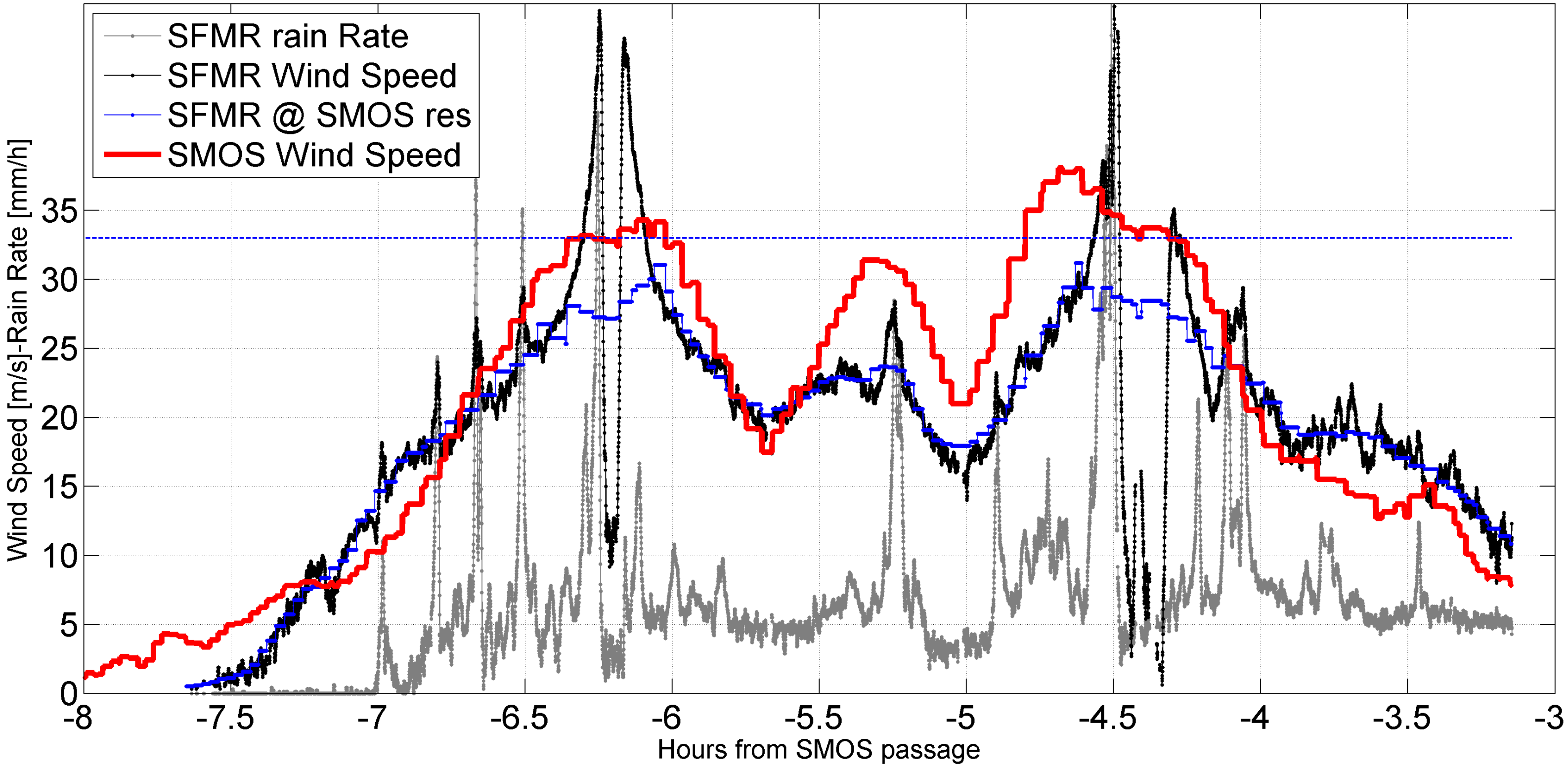


Good agreement

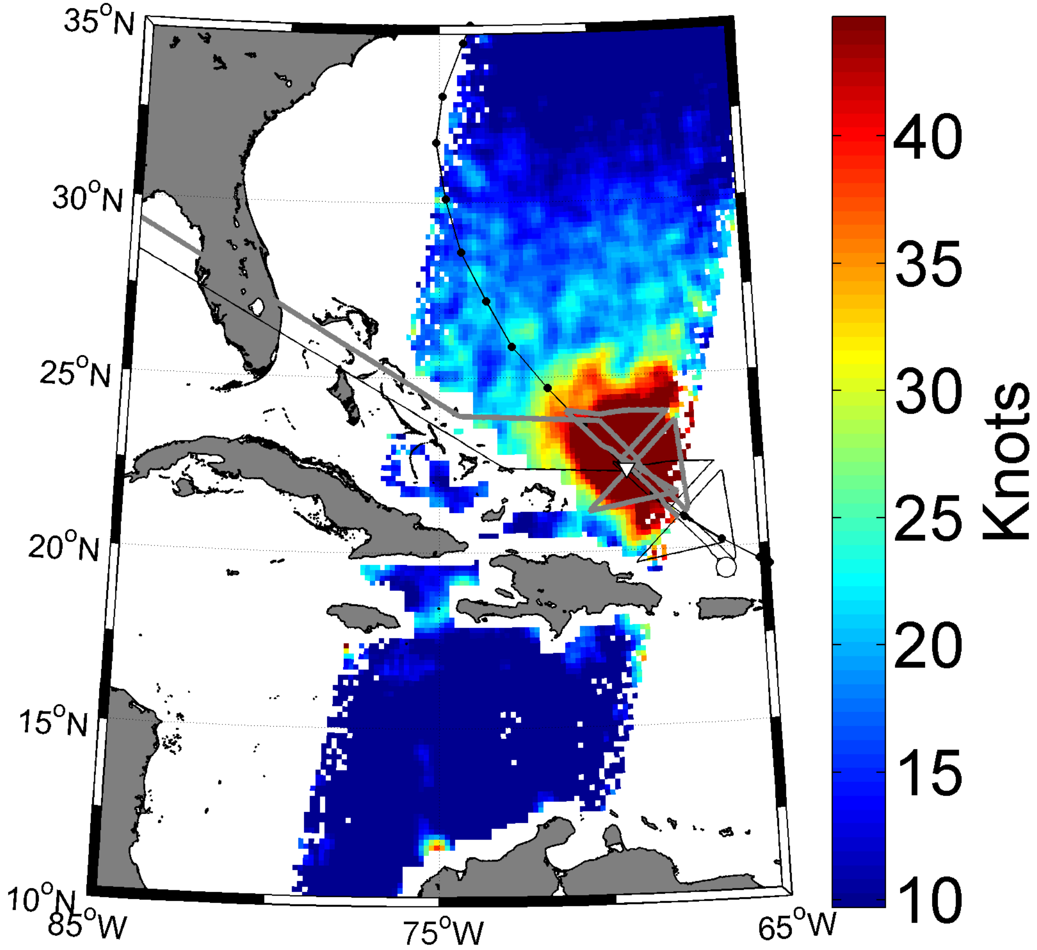
North Atlantic TC :DANIELLE-2010/08



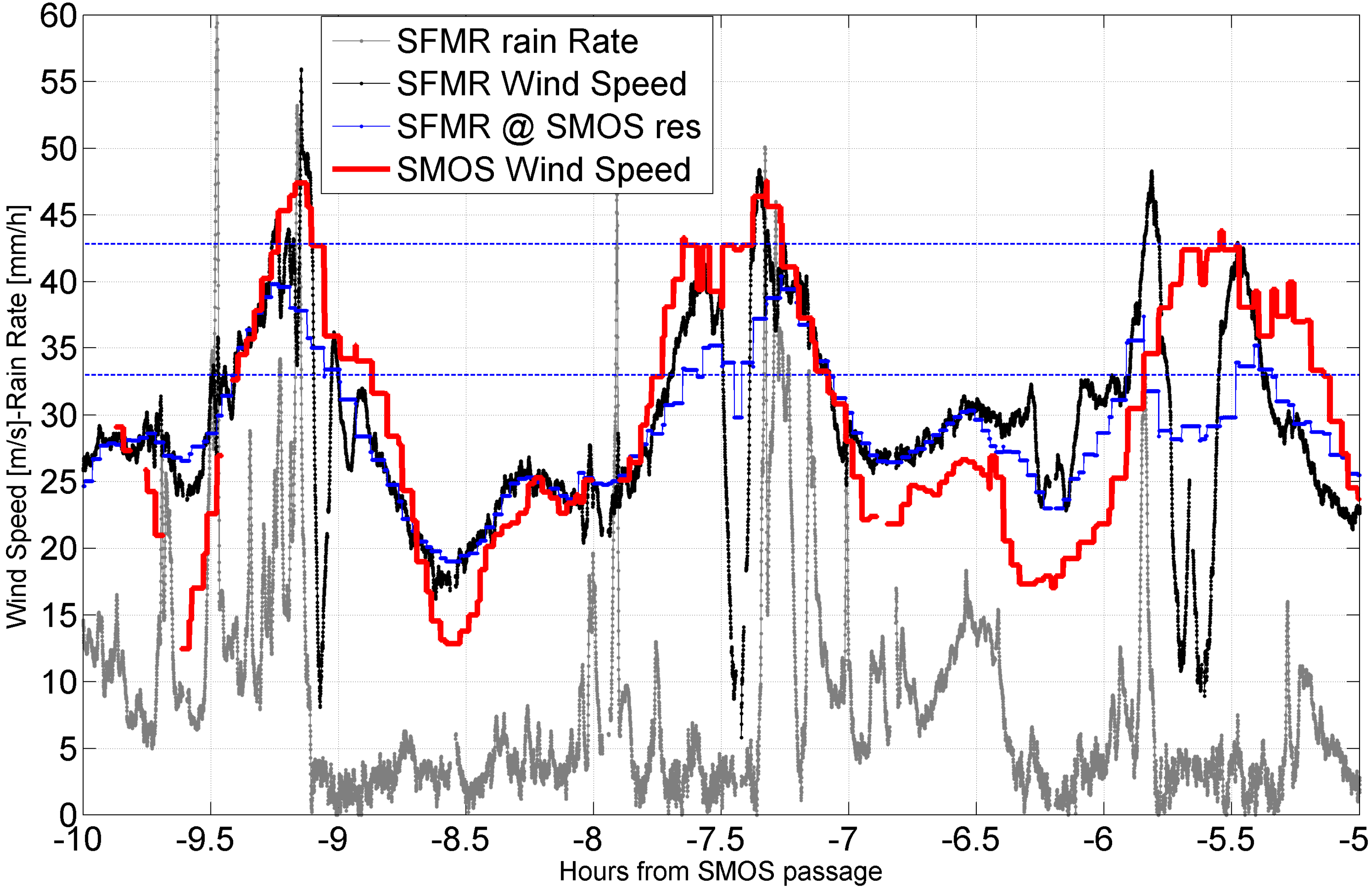
SMOS Wind speed -2010/08/27 at -22:02 UTC


SFMR rain Rate
SFMR Wind Speed
SFMR @ SMOS res
SMOS Wind Speed
Wind Speed [m/s]-Rain Rate [mm/h]
0
5
10
15
20
25
30
35
-8
-7.5
-7
-6.5
-6
-5.5
-5
-4.5
-4
-3.5
-3
Hours from SMOS passage

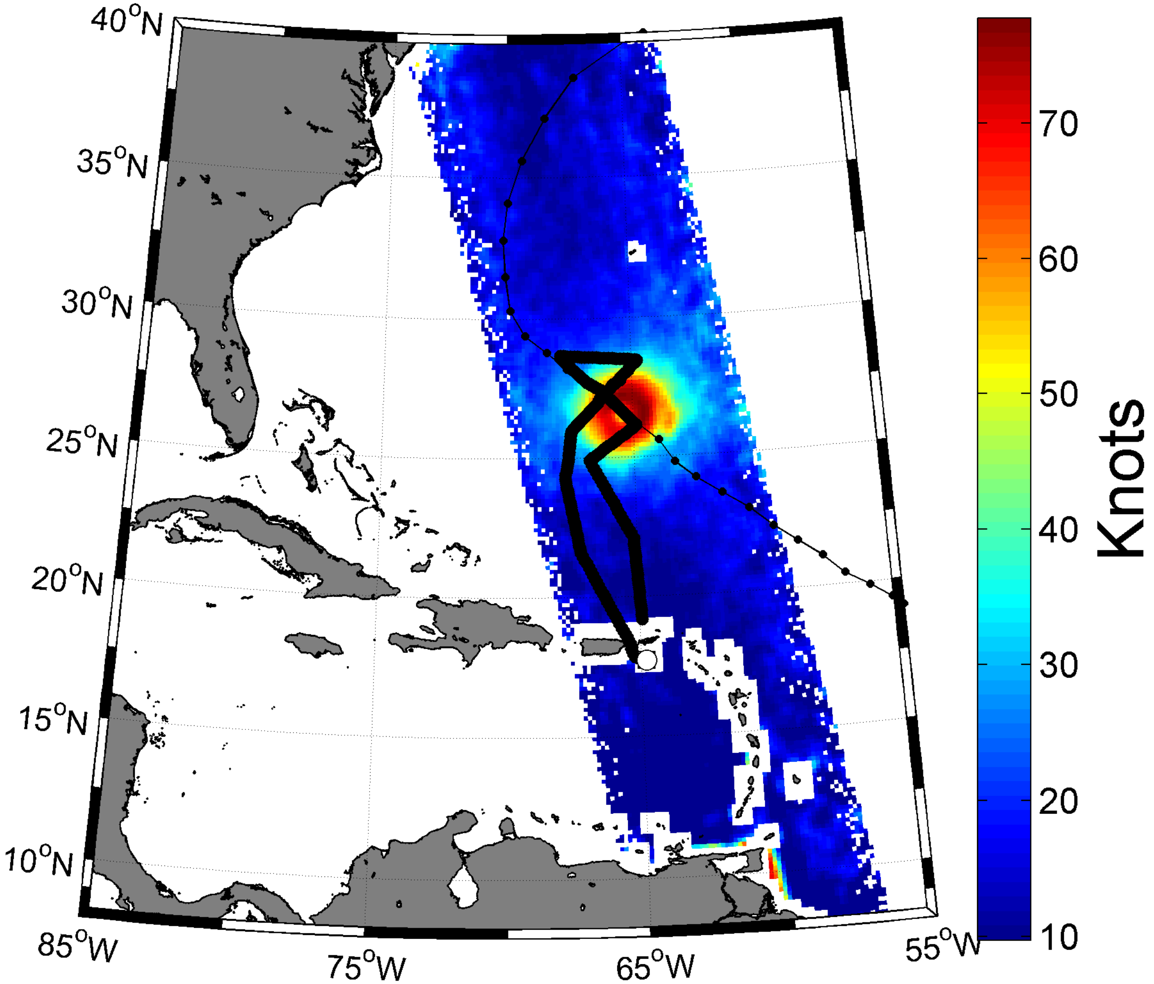
North Atlantic TC :EARL-2010/08



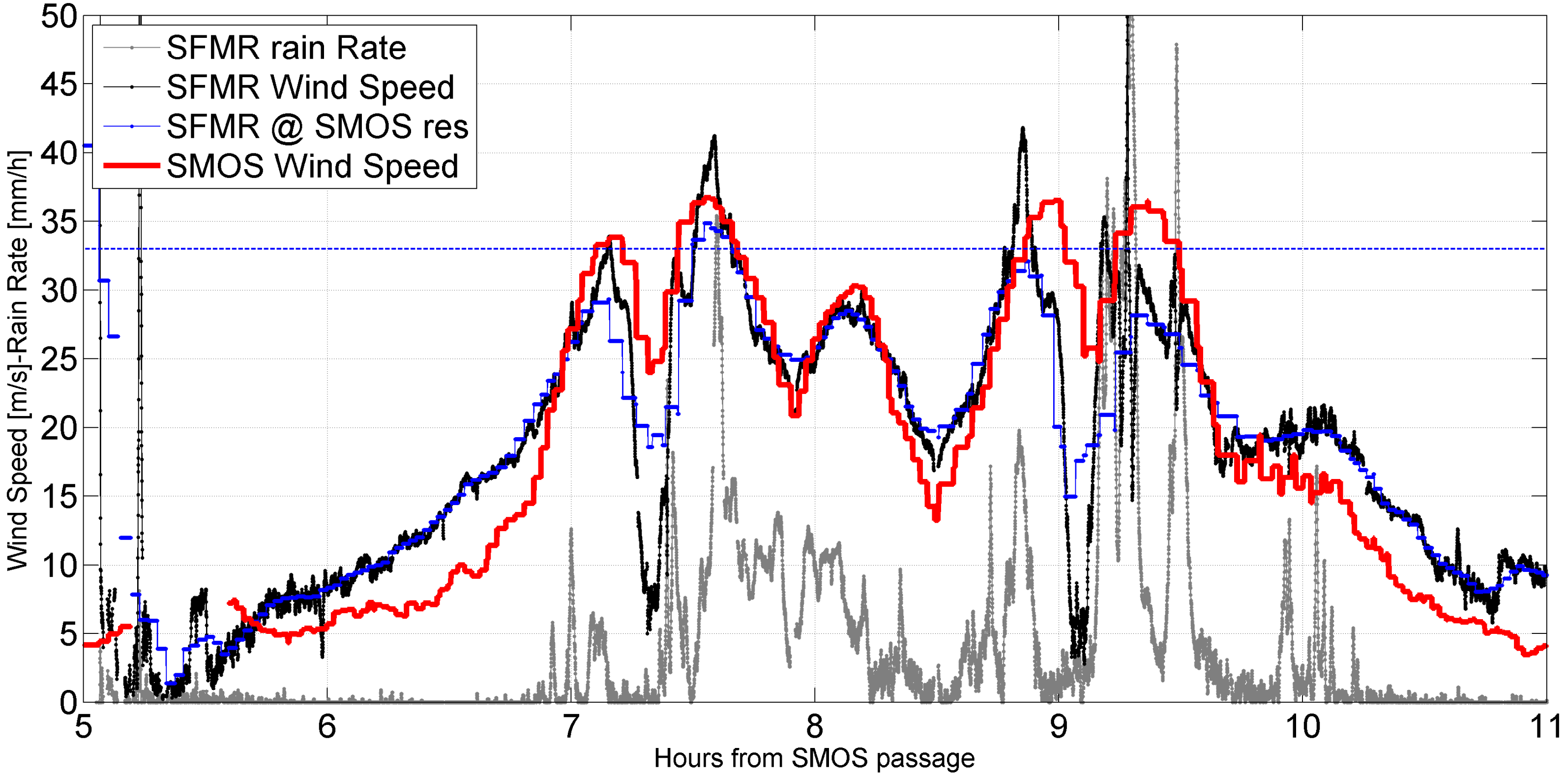
SMOS Wind speed -2010/08/31 at -22:47 UTC


SFMR rain Rate
SFMR Wind Speed
SFMR @ SMOS res
SMOS Wind Speed
Wind Speed [m/s]-Rain Rate [mm/h]
0
5
10
15
20
25
30
35
40
45
50
55
60
-10
-9.5
-9
-8.5
-8
-7.5
-7
-6.5
-6
-5.5
-5
Hours from SMOS passage

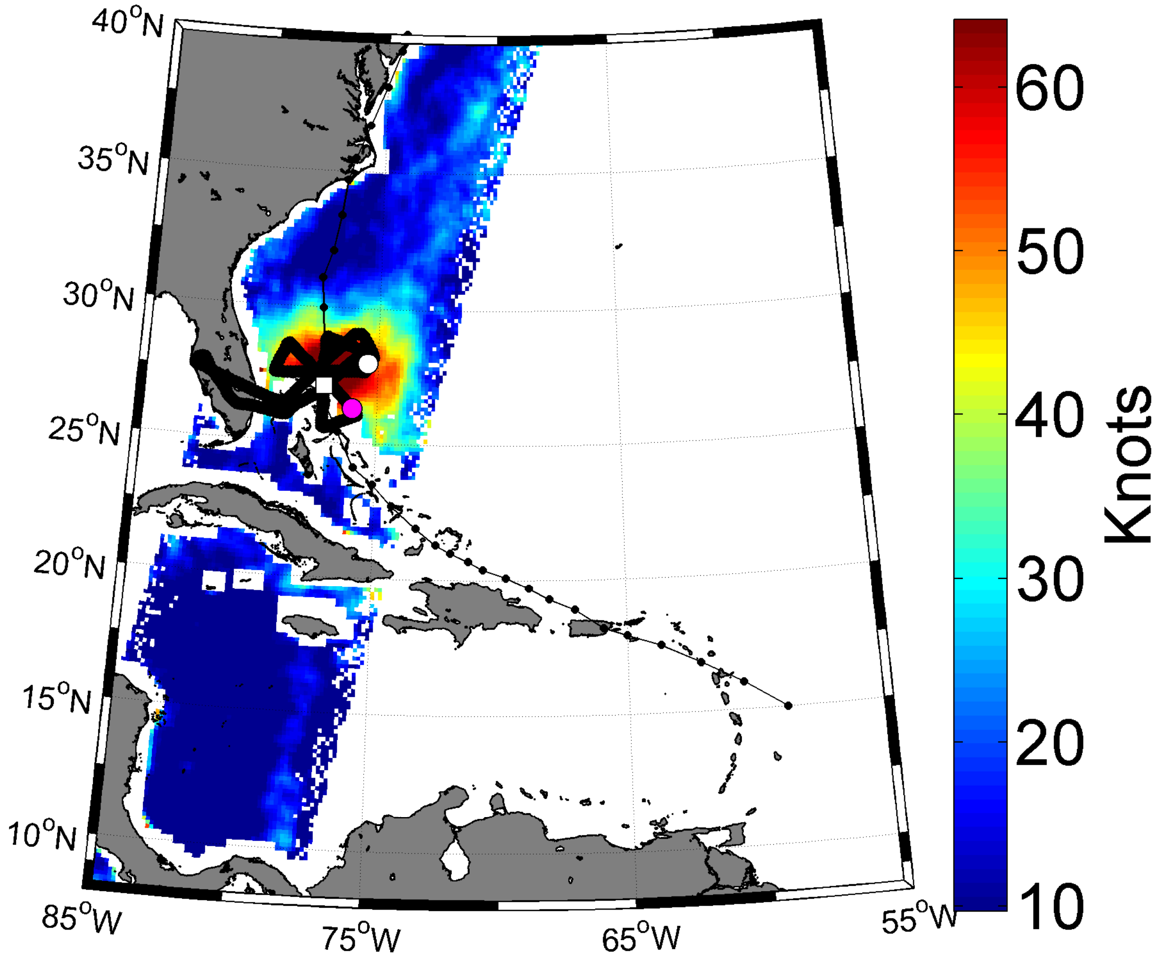
North Atlantic TC :KATIA-2011/09



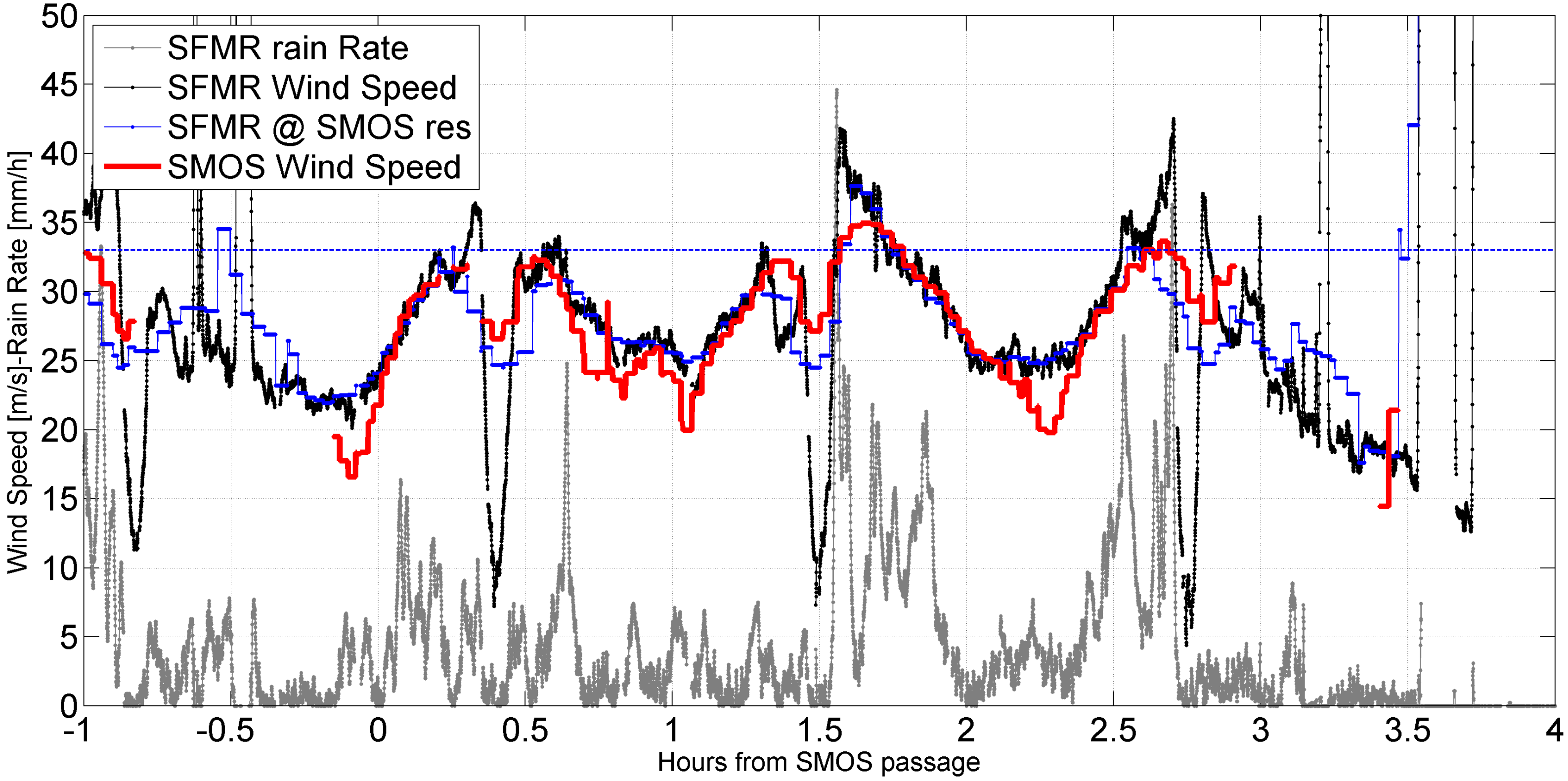
SMOS Wind speed -2011/09/06 at -09:35 UTC


SFMR rain Rate
SFMR Wind Speed
SFMR @ SMOS res
SMOS Wind Speed
Wind Speed [m/s]-Rain Rate [mm/h]
50
45
40
35
30
25
20
15
10
5
0
5
6
7
8
9
10
11
Hours from SMOS passage

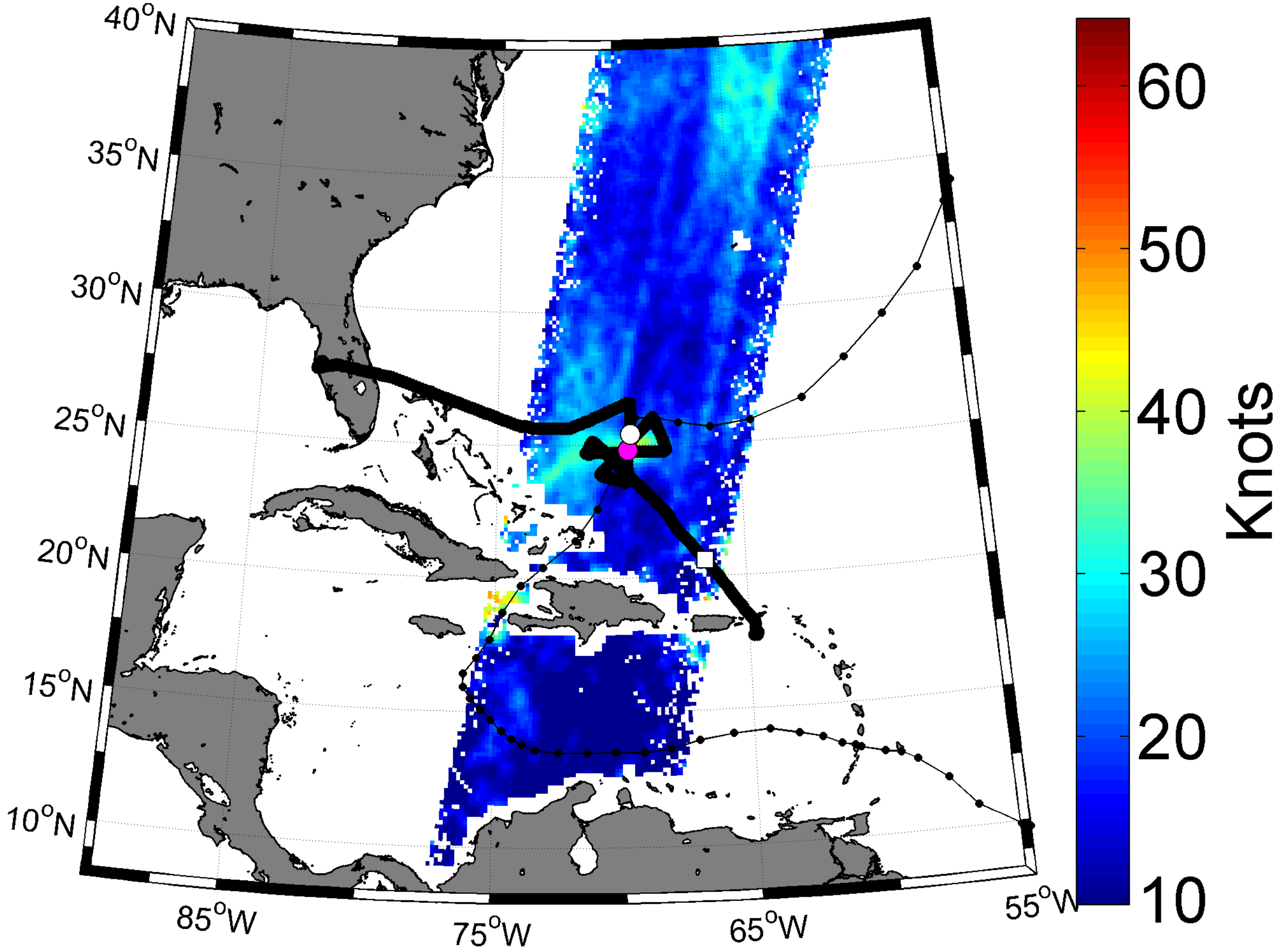
North Atlantic TC :IRENE-2011/08



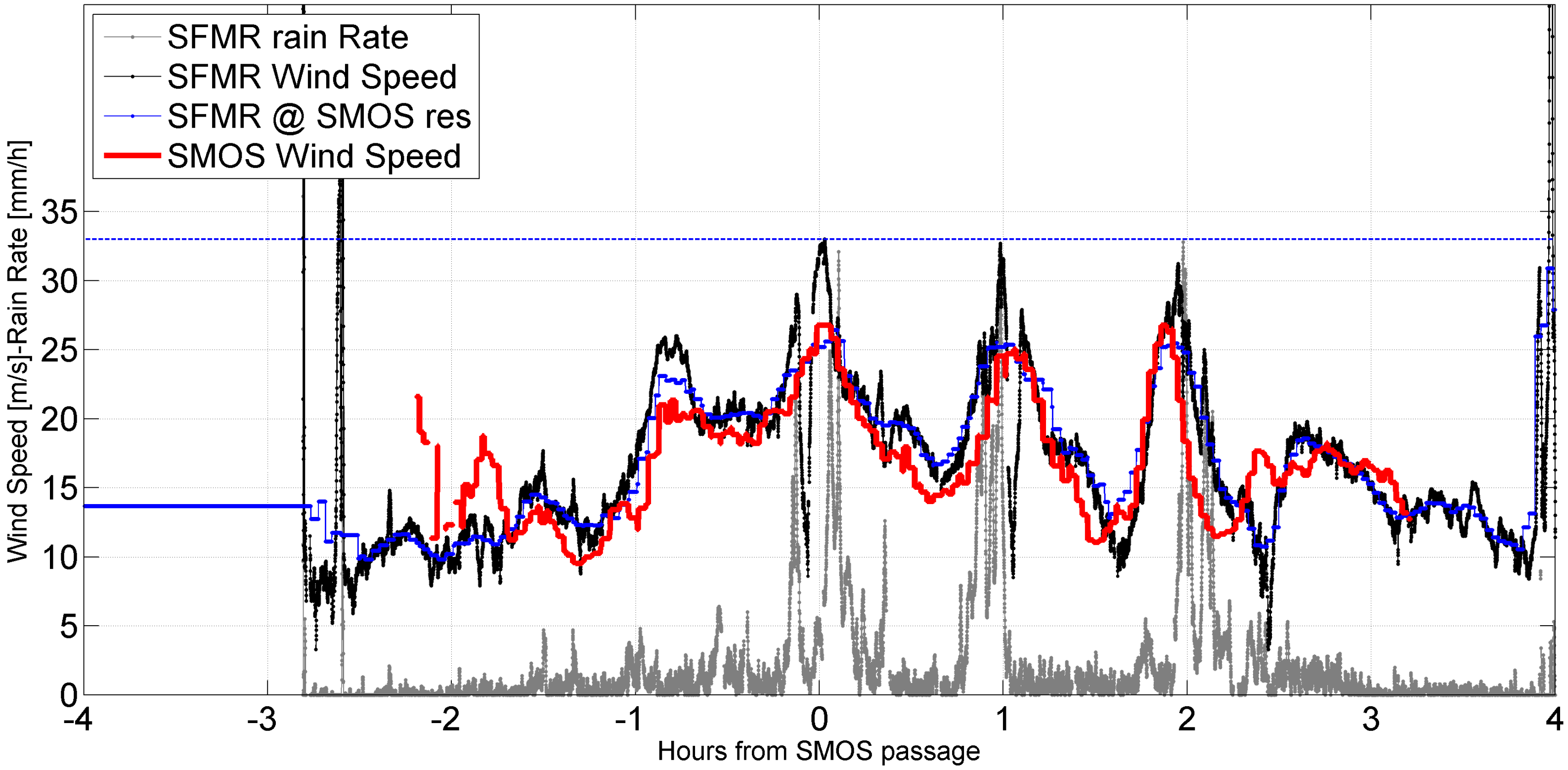
SMOS Wind speed -2011/08/25 at -23:13 UTC


SFMR rain Rate
SFMR Wind Speed
SFMR @ SMOS res
SMOS Wind Speed
Wind Speed [m/s]-Rain Rate [mm/h]
50
45
40
35
30
25
20
15
10
5
0
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
Hours from SMOS passage

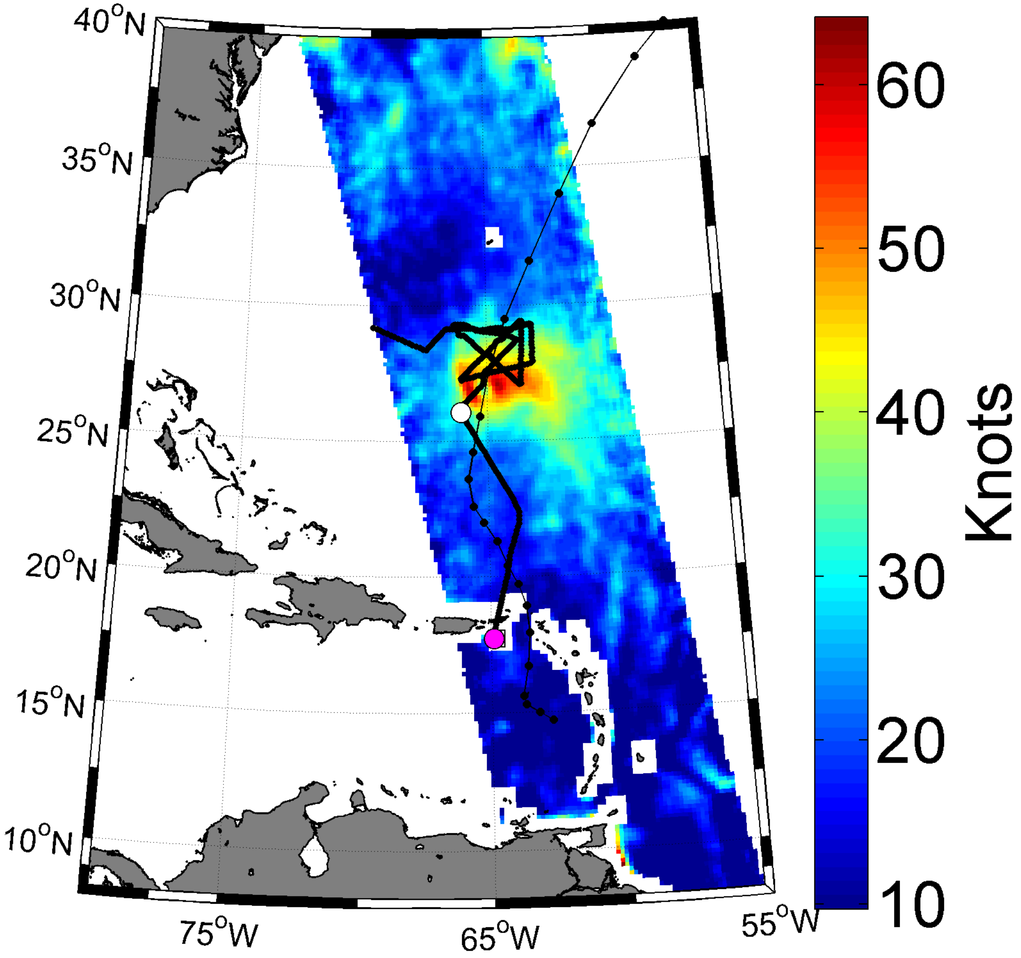
North Atlantic TC :TOMAS-2010/11



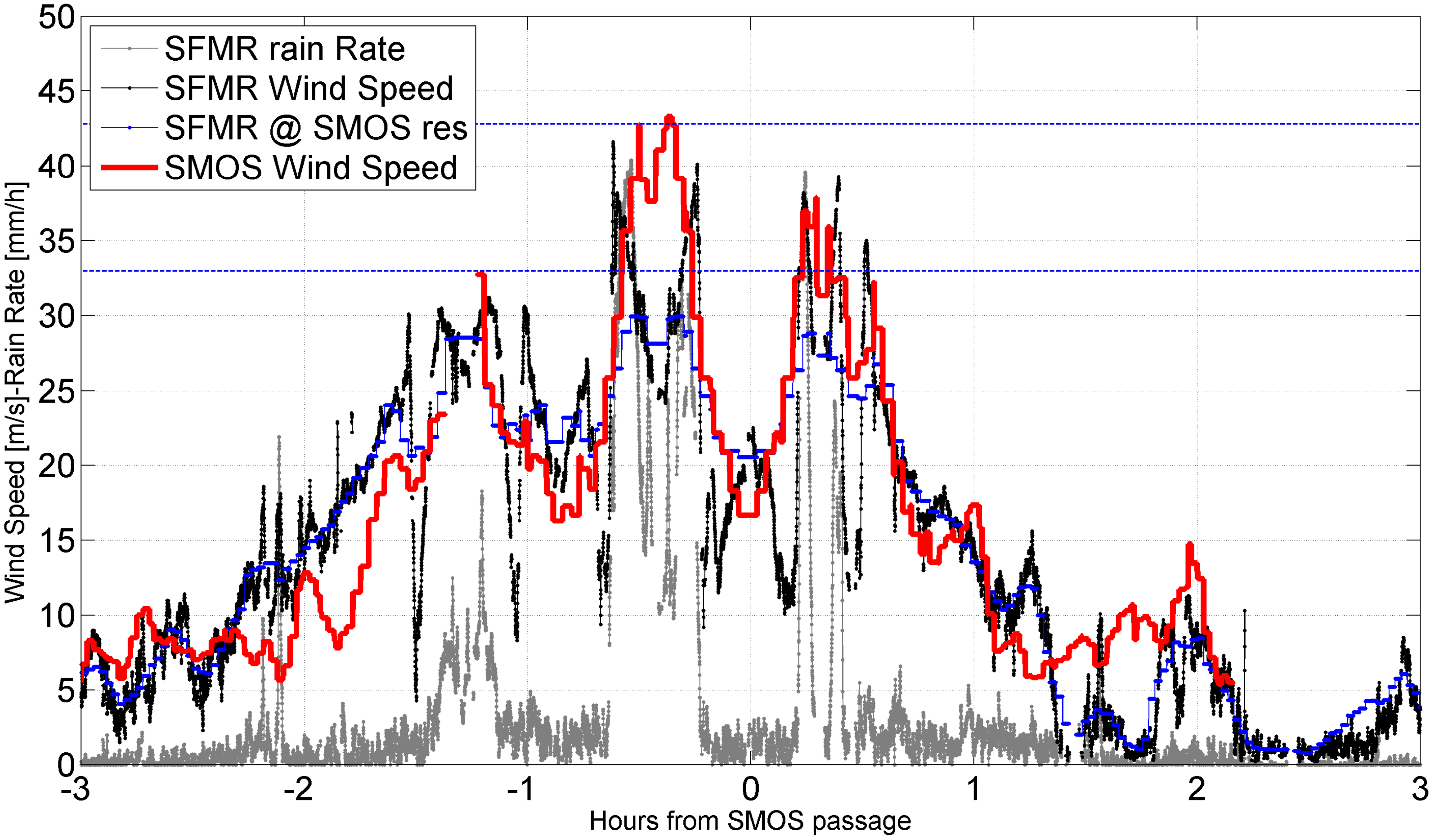
SMOS Wind speed -2010/11/06 at -22:38 UTC


SFMR rain Rate
SFMR Wind Speed
SFMR @ SMOS res
SMOS Wind Speed
Wind Speed [m/s]-Rain Rate [mm/h]
0
5
10
15
20
25
30
35
-4
-3
-2
-1
0
1
2
3
4
Hours from SMOS passage

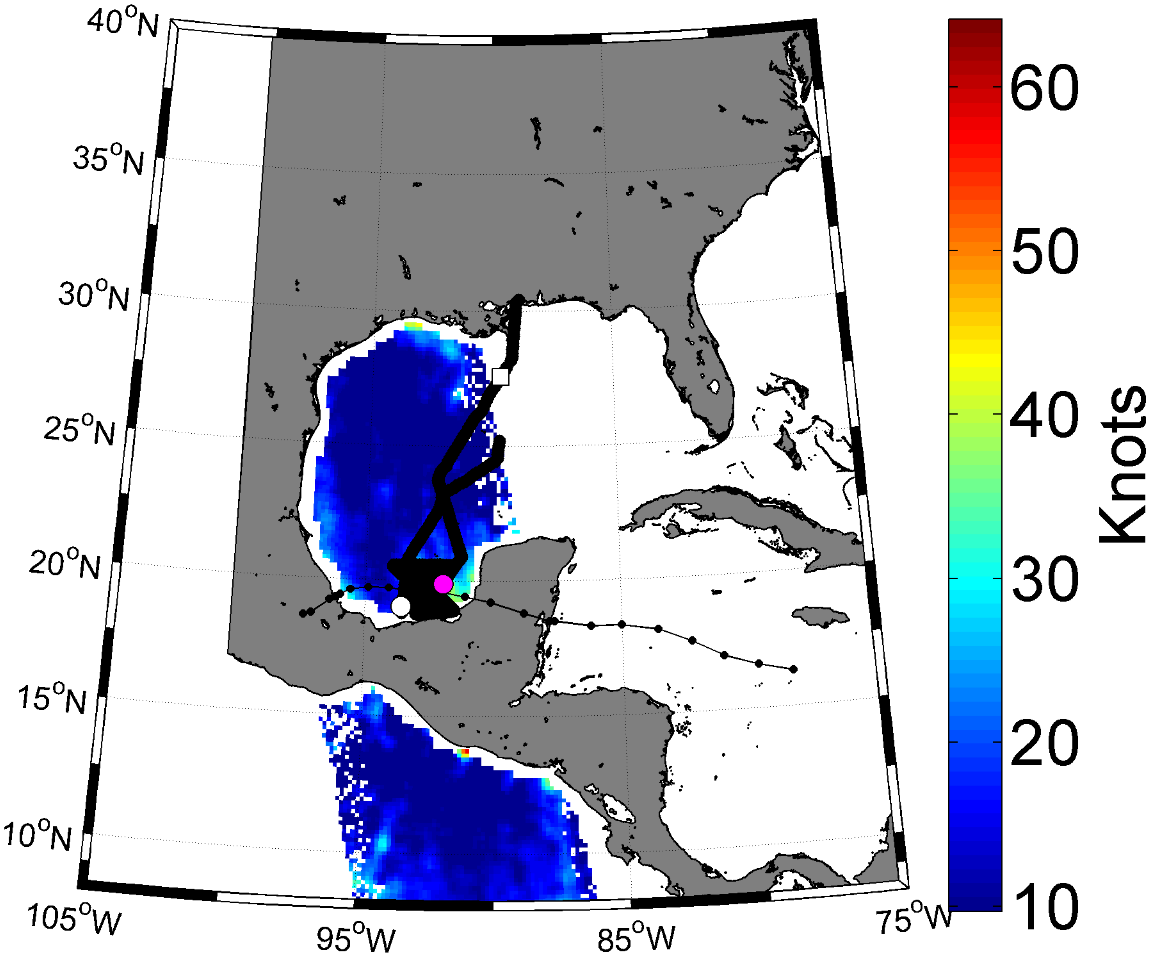
North Atlantic TC :RAFAEL-2012/10



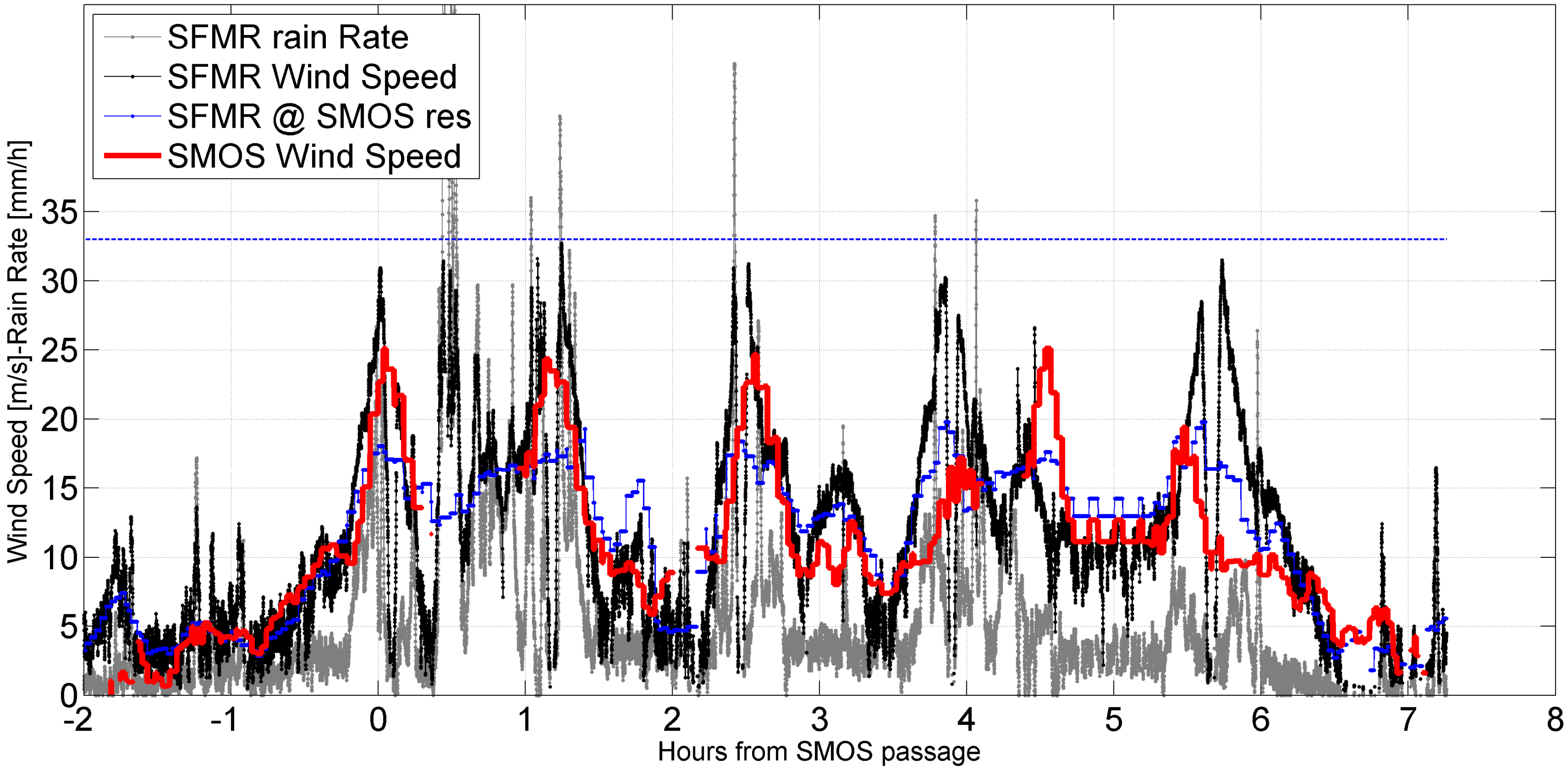
SMOS Wind speed -2012/10/16 at -09:30 UTC


SFMR rain Rate
SFMR Wind Speed
SFMR @ SMOS res
SMOS Wind Speed
Wind Speed [m/s]-Rain Rate [mm/h]
50
45
40
35
30
25
20
15
10
5
0
-3
-2
-1
0
1
2
3
Hours from SMOS passage

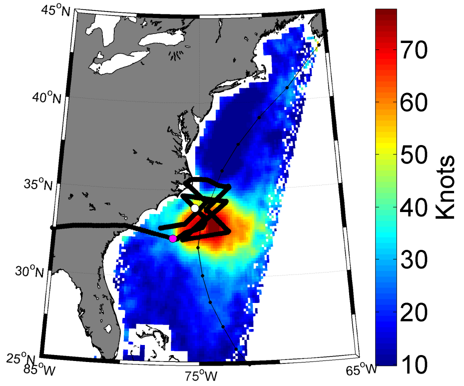
North Atlantic TC :KARL-2010/09



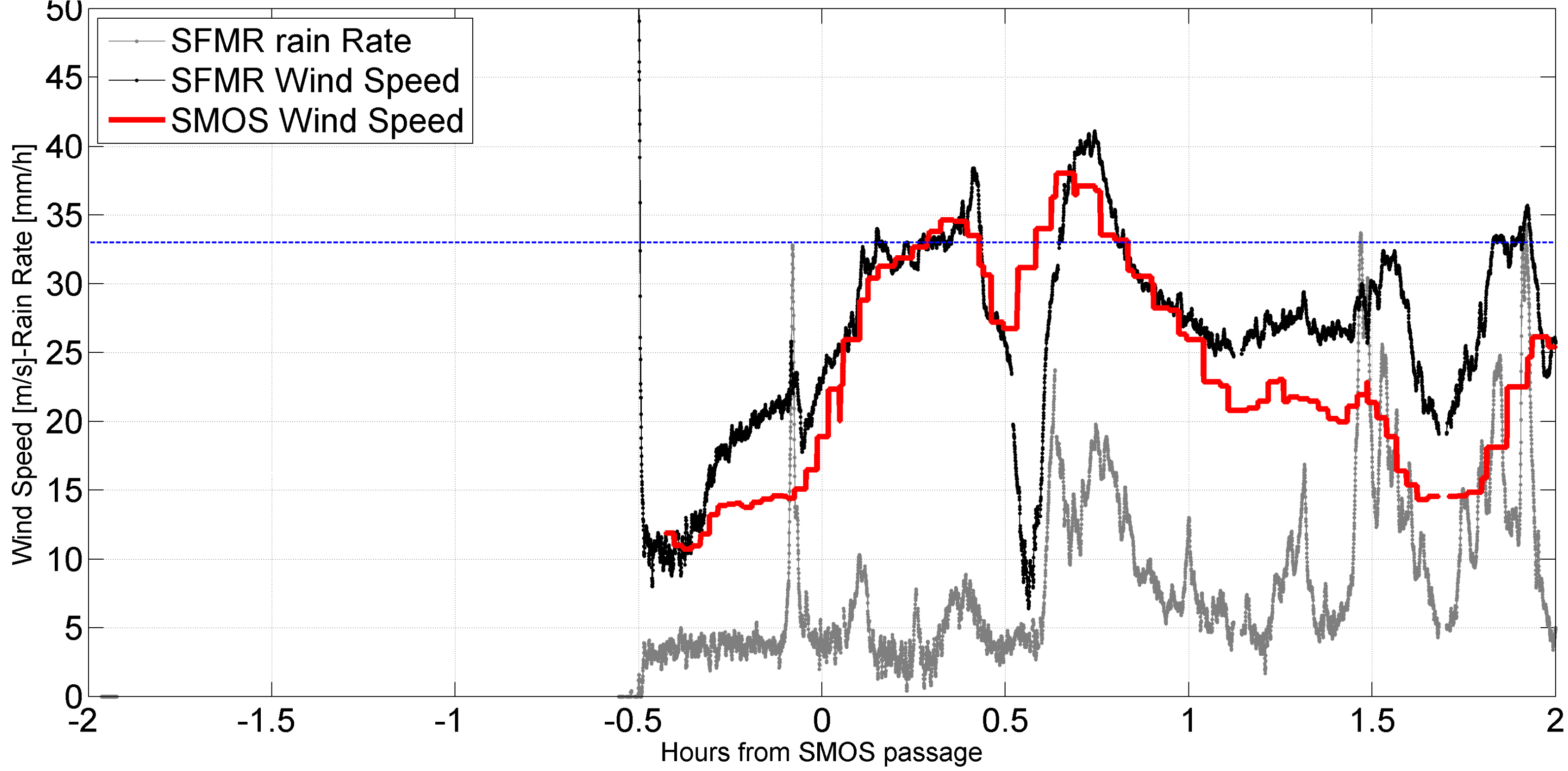
SMOS Wind speed -2010/09/16 at -11:32 UTC


SFMR rain Rate
SFMR Wind Speed
SFMR @ SMOS res
SMOS Wind Speed
Wind Speed [m/s]-Rain Rate [mm/h]
0
5
10
15
20
25
30
35
-2
-1
0
1
2
3
4
5
6
7
8
Hours from SMOS passage

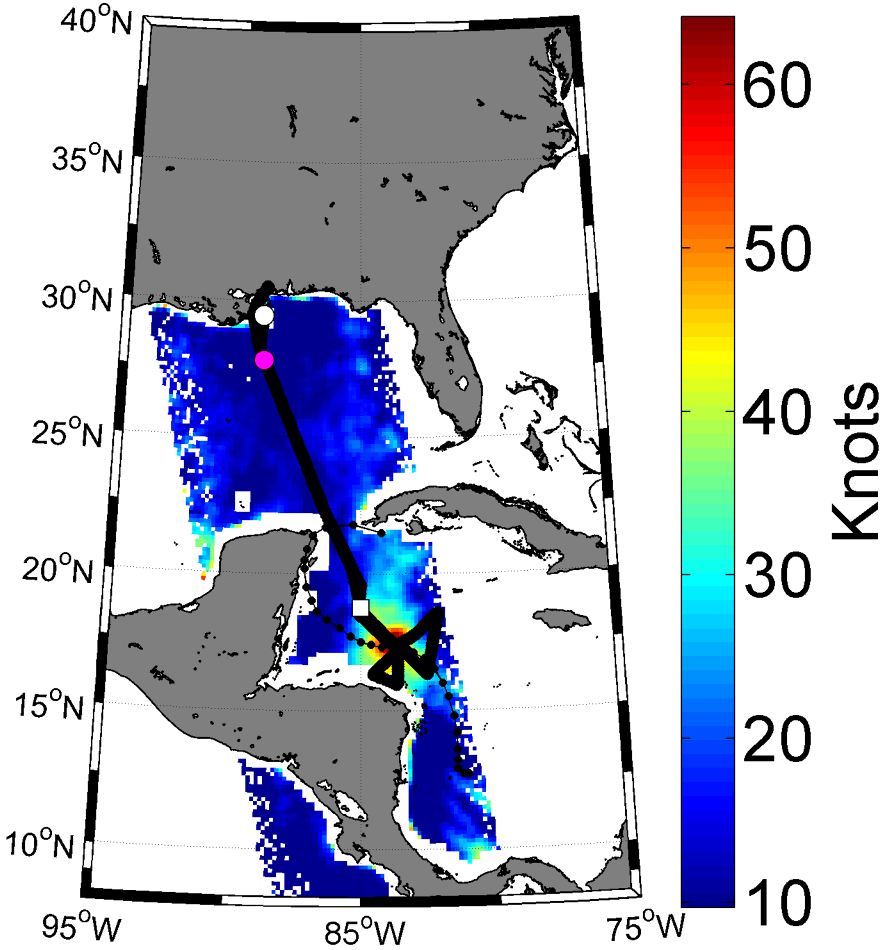
North Atlantic TC :EARL-2010/09



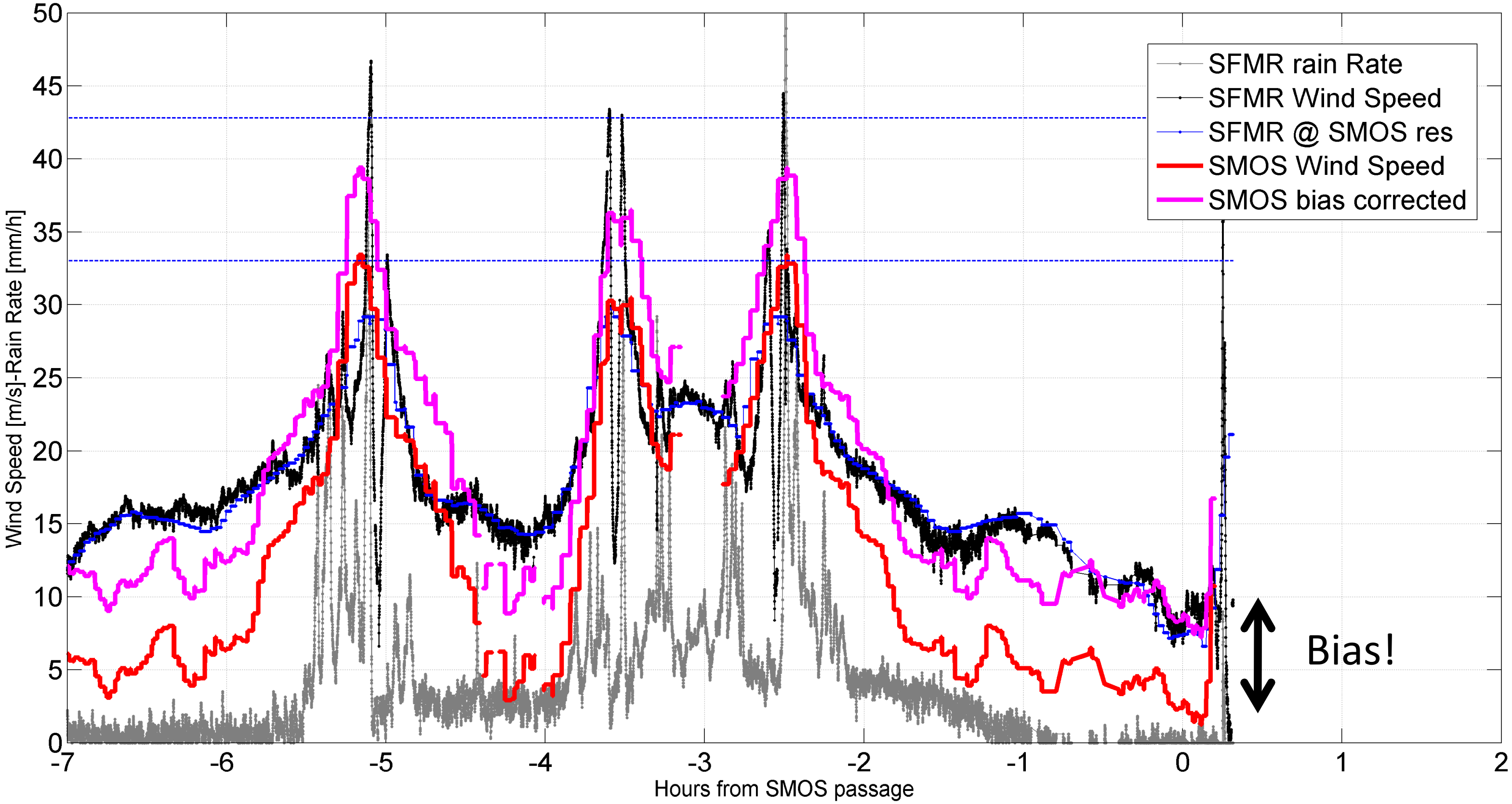
SMOS Wind speed -2010/09/02 at -23:09 UTC



North Atlantic TC :RINA-2011/10

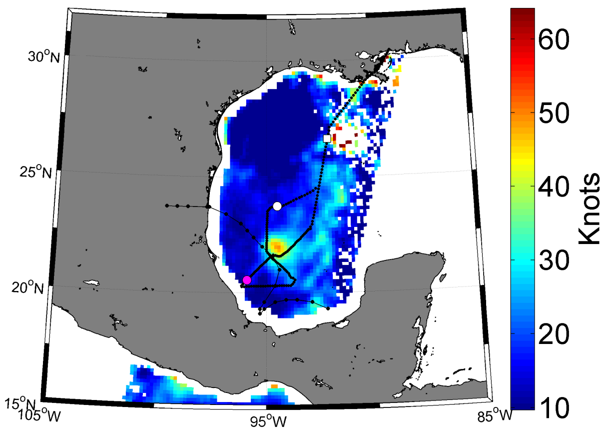


SMOS Wind speed -2011/10/25 at -11:06 UTC

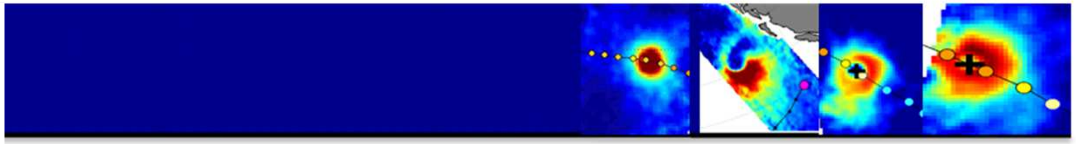

50
45
40
35
30
25
20
15
10
5
0
Wind Speed [m/s]-Rain Rate [mm/h]
-7
-6
-5
-4
-3
-2
-1
0
1
2
Hours from SMOS passage
SFMR rain Rate
SFMR Wind Speed
SFMR @ SMOS res
SMOS Wind Speed
SMOS bias corrected

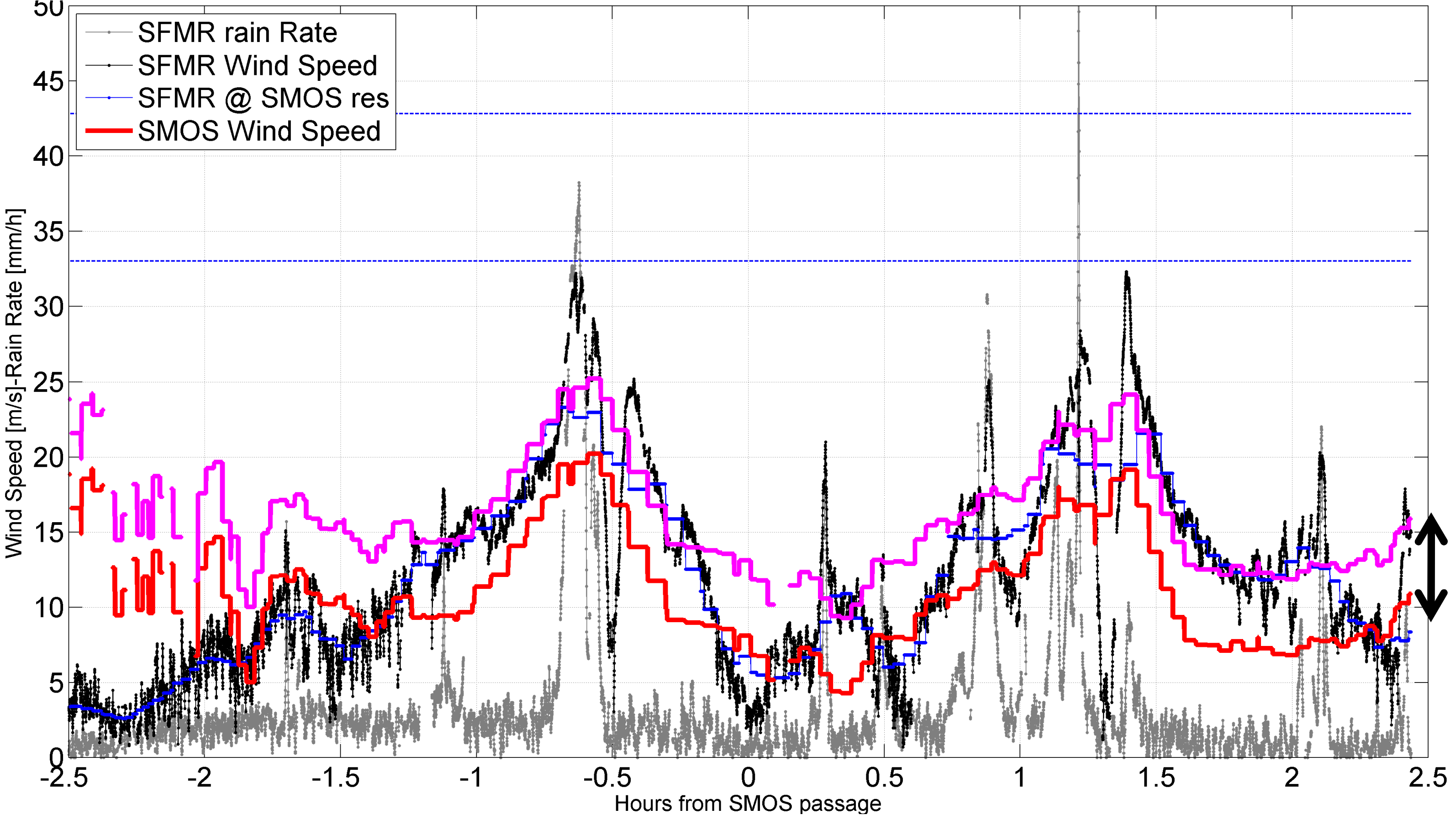
Bias!

North Atlantic TC :INGRID-2013/09

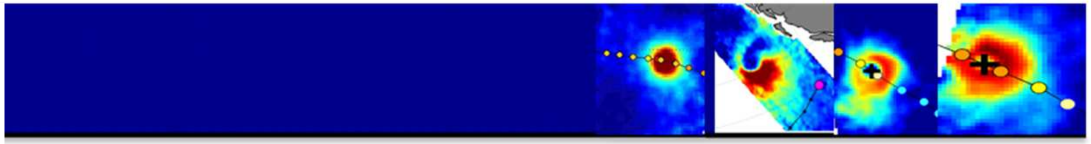


SMOS Wind speed -2013/09/15 at -00:19 UTC

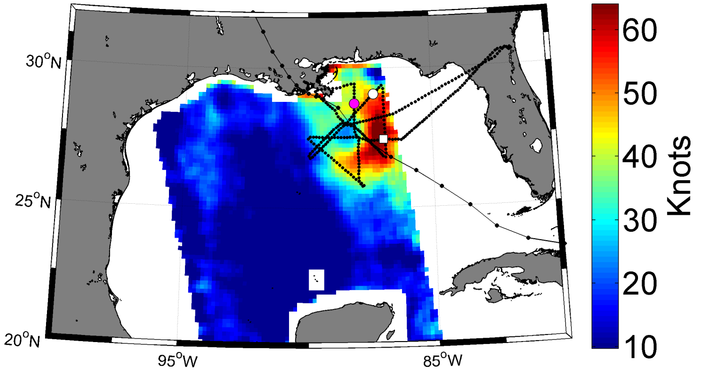




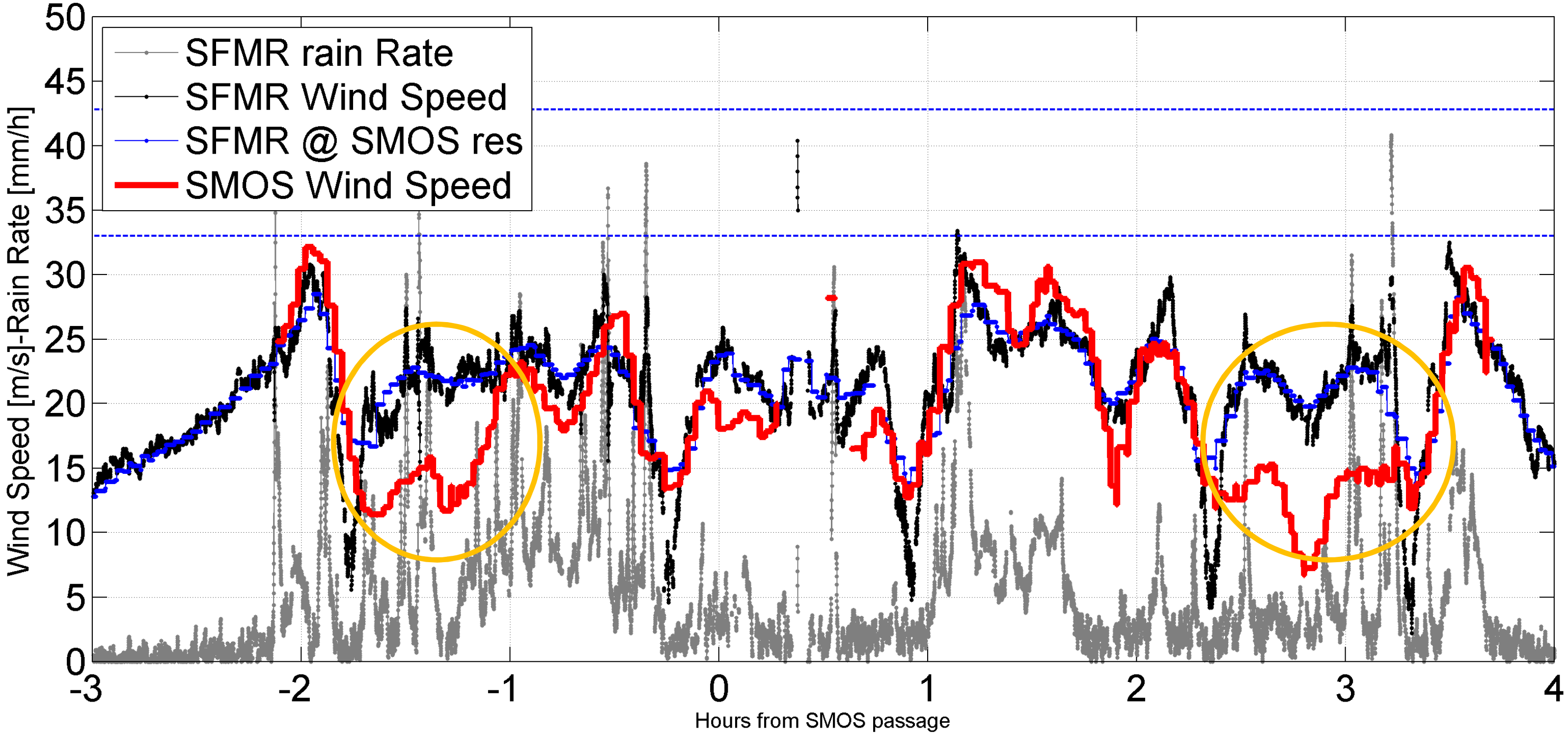
Bias!

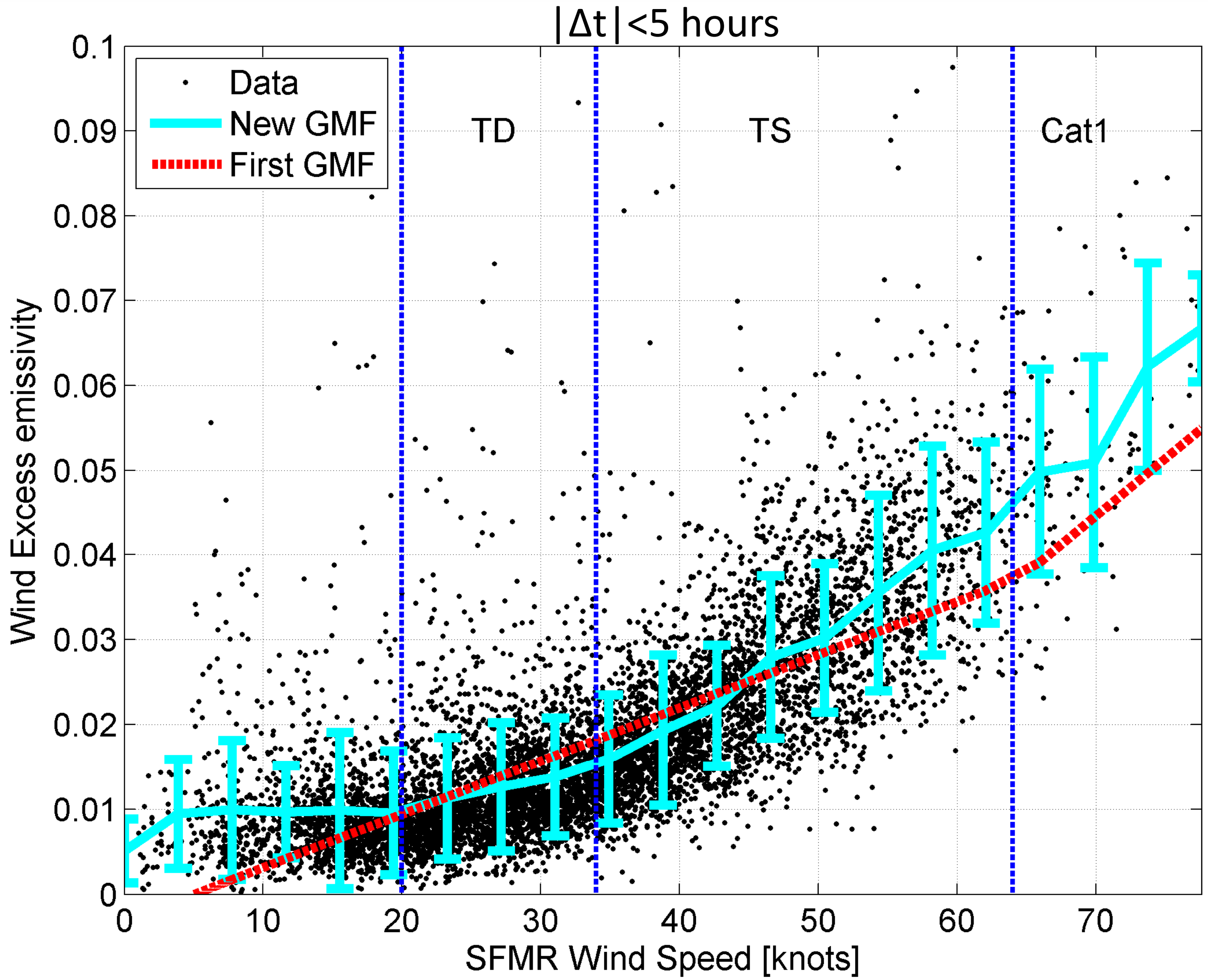


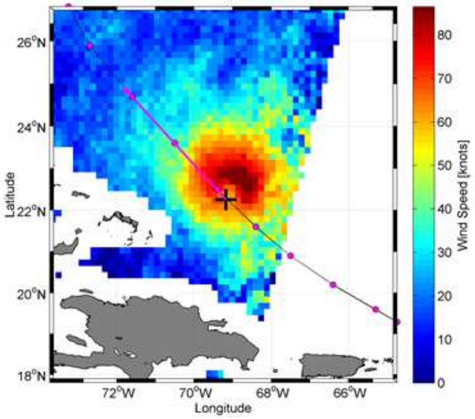
North Atlantic TC :ISAAC-2012/08

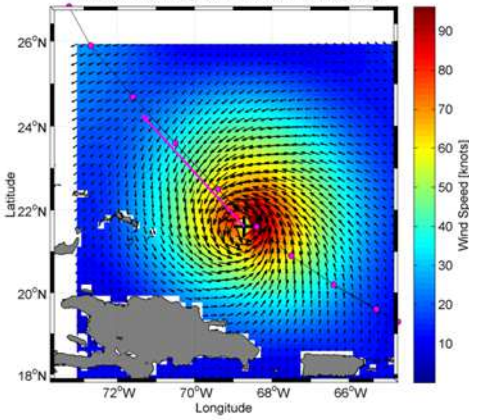


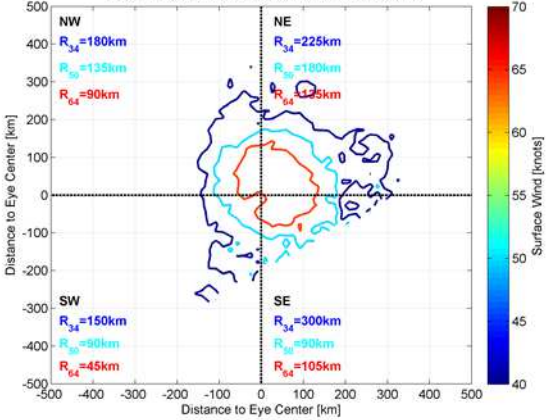
SMOS Wind speed -2012/08/28 at -11:17 UTC

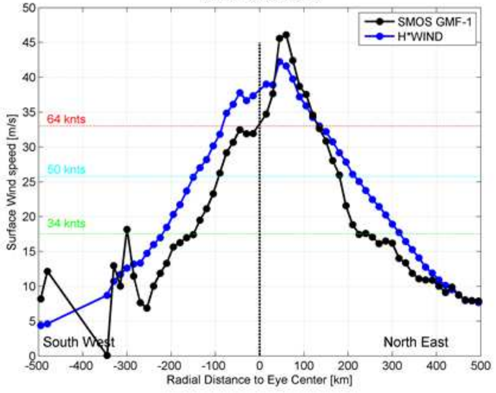


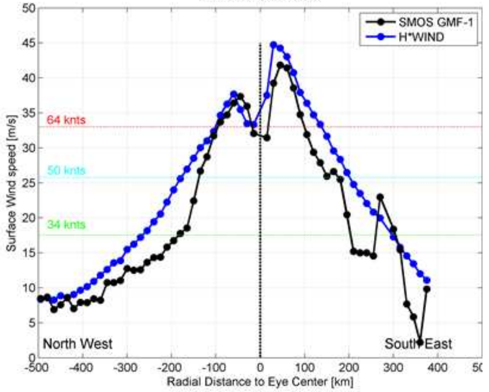

|Δt|<5 hours
Data
New GMF
First GMF
TD
TS
Cat1
Wind Excess emissivity
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
SFMR Wind Speed [knots]
0
10
20
30
40
50
60
70

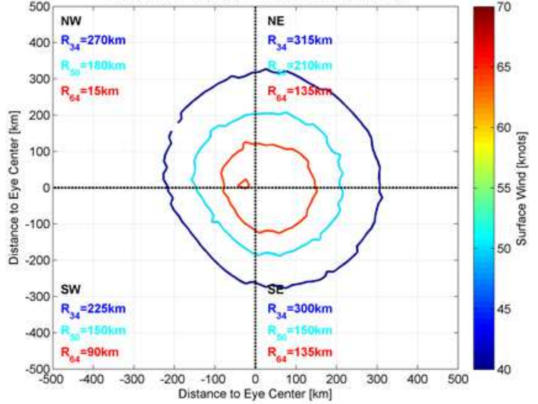

EARL-SMOS WIND GMF1-31-Aug-2010 22:47:00Vmax=95.3 knts

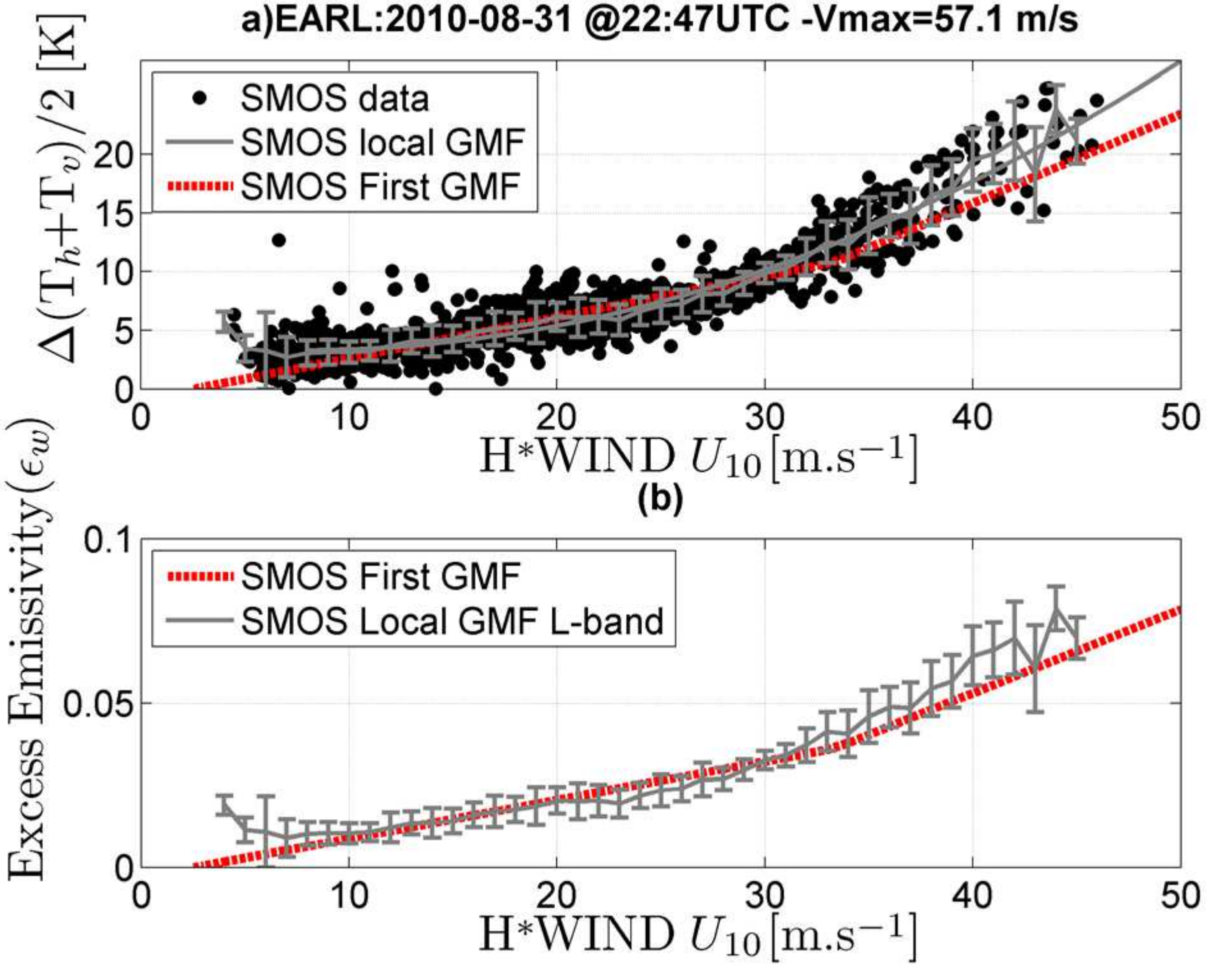

EARL-HWIND-31-Aug-2010 19:30:00Vmax=96.2 knts


EARL-SMOS-31-Aug-2010 22:47:03 Vmax=95.3 knts

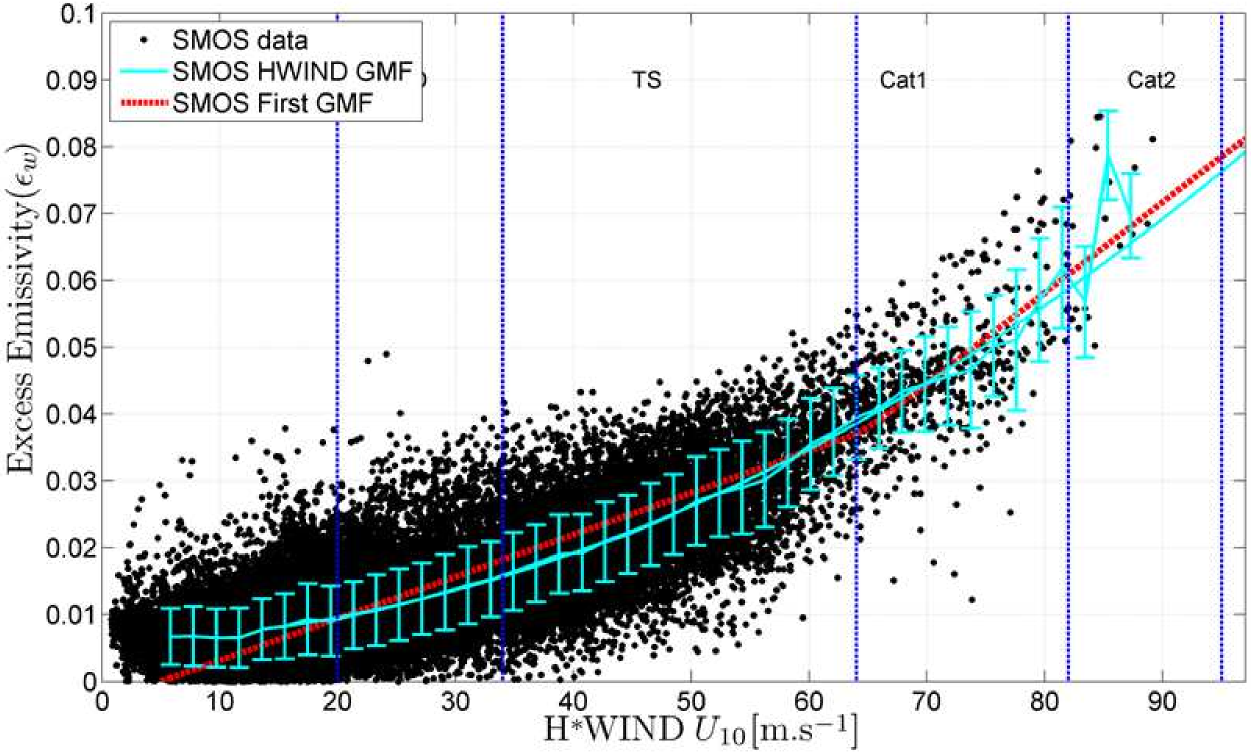

Earl 2010-09-02 22:30

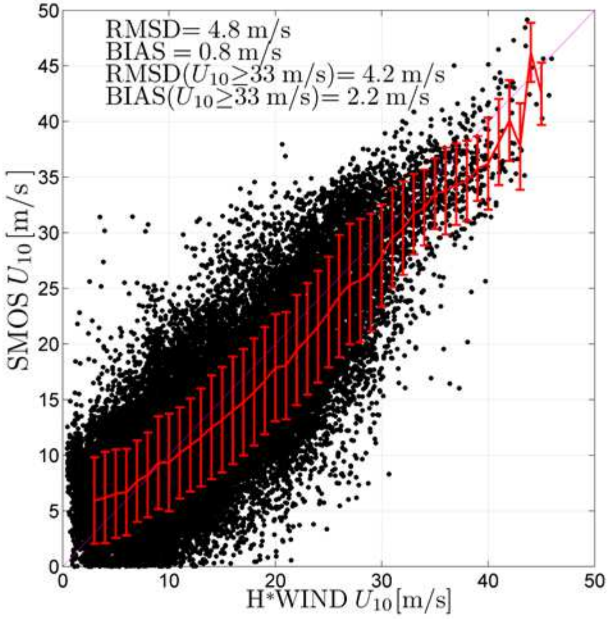

Earl 2010-09-02 22:30

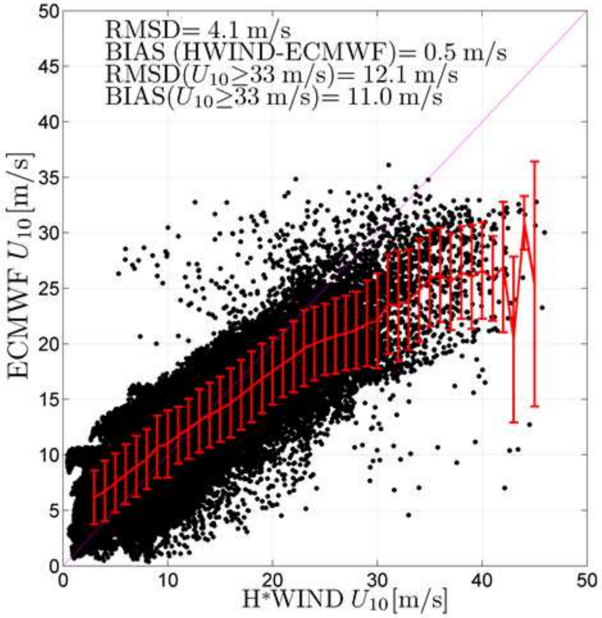

EARL-H*WIND-31-Aug-2010 22:47:00 Vmax=89.1 knts

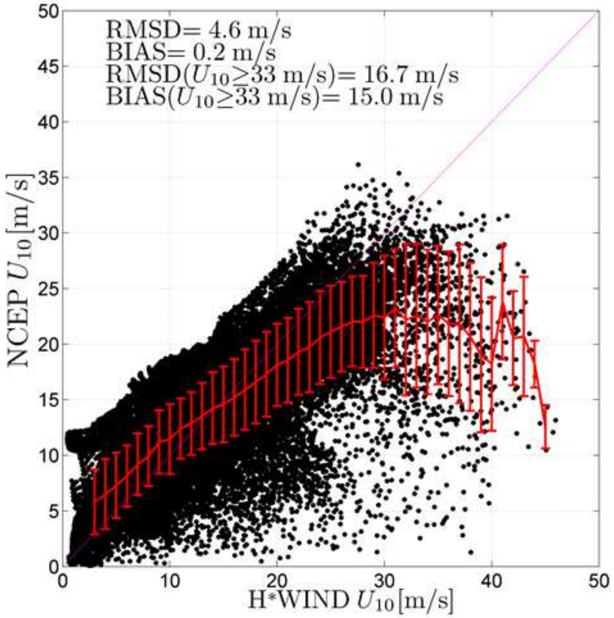

a)EARL:2010-08-31 @22:47UTC -Vmax=57.1 m/s
SMOS data
SMOS local GMF
SMOS First GMF
$\Delta(T_h+T_v)/2$ [K]
0
5
10
15
20
0
10
20
30
40
50
H*WIND U_{10}[m.s^{-1}]
(b)
SMOS First GMF
SMOS Local GMF L-band
Excess Emissivity(ϵ_w)
0
0.05
0.1
0
10
20
30
40
50
H*WIND U_{10}[m.s^{-1}]

30 co-localisations SMOS/HWIND

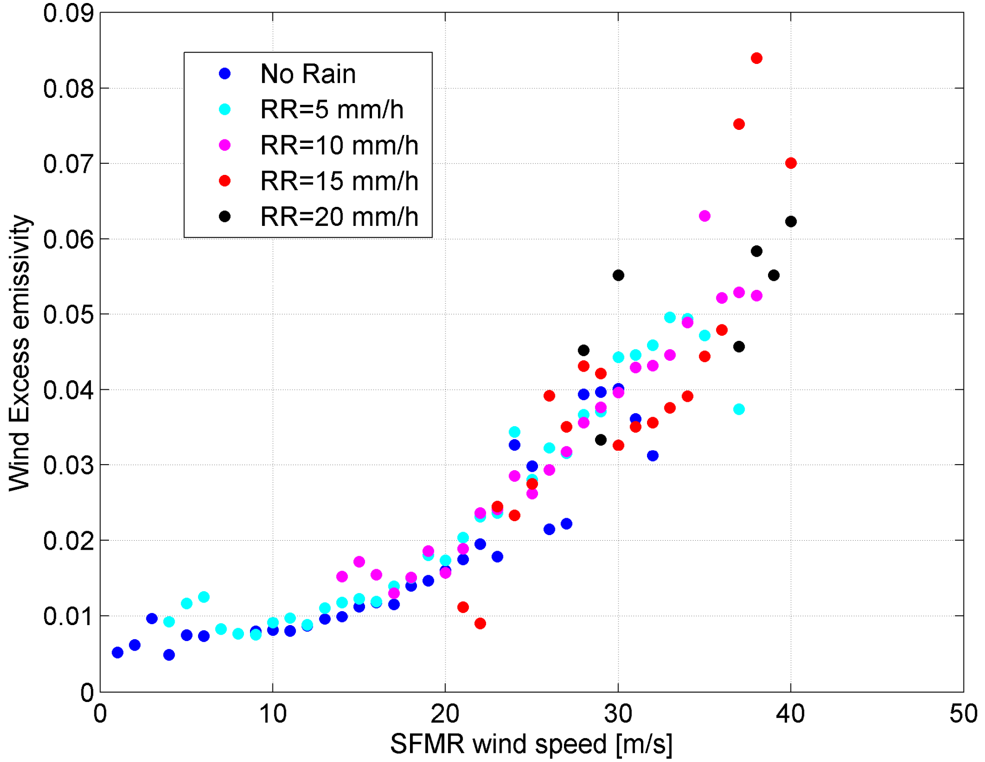



RMSD= 4.8 m/s
BIAS = 0.8 m/s
RMSD(U_{10}≥33 m/s)= 4.2 m/s
BIAS(U_{10}≥33 m/s)= 2.2 m/s
SMOS U_{10}[m/s]
H*WIND U_{10}[m/s]
0
5
10
15
20
25
30
35
40
45
50


RMSD= 4.1 m/s
BIAS (HWIND-ECMWF)= 0.5 m/s
RMSD(U_{10}≥33 m/s)= 12.1 m/s
BIAS(U_{10}≥33 m/s)= 11.0 m/s
ECMWF U_{10}[m/s]
H*WIND U_{10}[m/s]
0
5
10
15
20
25
30
35
40
45
50


RMSD= 4.6 m/s
BIAS= 0.2 m/s
RMSD(U_{10}≥33 m/s)= 16.7 m/s
BIAS(U_{10}≥33 m/s)= 15.0 m/s
NCEP U_{10}[m/s]
H*WIND U_{10}[m/s]
0
5
10
15
20
25
30
35
40
45
50

Potential Rain Effects



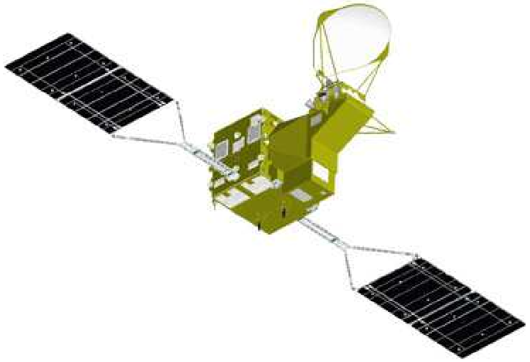
No clear signal associated
with rain but still difficult
To firmly conclude

Preparing New Low Microwave frequency merged surface wind Products in TCs

Step1: Merged SMOS+AMSR2 surface winds (on going)

Step2: Merged SMOS+AMSR2+SMAP …(To be developed in the coming year)

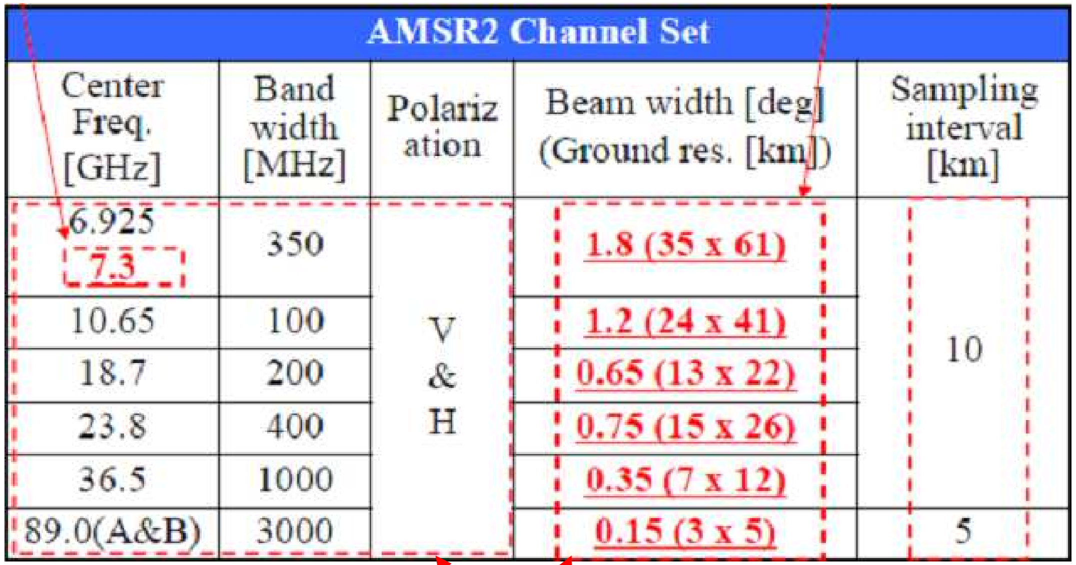
Towards Merged SMOS-AMSR-2-SMAP High wind products



On 18 May 2012 Japan launched a new passive microwave instrument with the largest in the world diameter of antenna - Advanced Microwave Scanning Radiometer (AMSR2) onboard Global Change Observation Mission – Water satellite (GCOM-W1 "Shizuku")

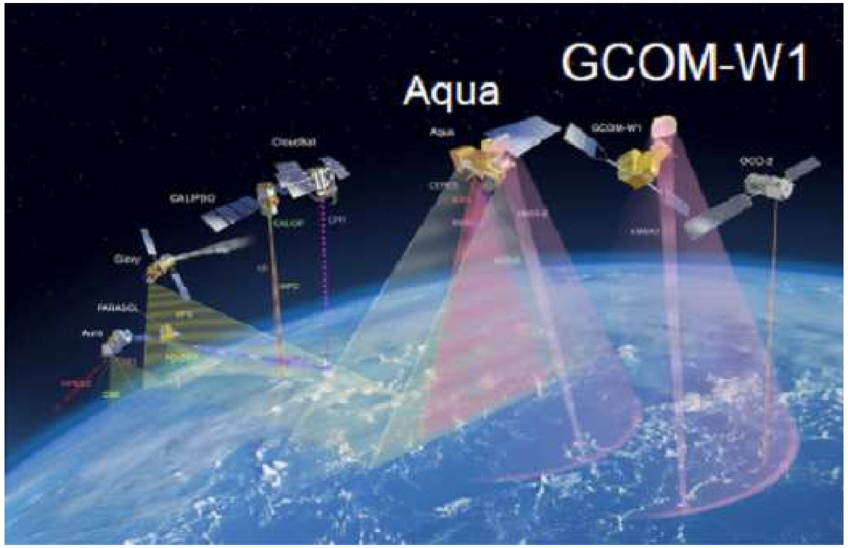
Additional channel

Better than AMSR-E



AMSR2 Channel Set				
Center Freq. [GHz]	Band width [MHz]	Polarization	Beam width [deg] (Ground res. [km])	Sampling interval [km]
6.925 7.3	350	V & H	1.8 (35 x 61)	10
10.65	100		1.2 (24 x 41)	
18.7	200		0.65 (13 x 22)	
23.8	400		0.75 (15 x 26)	
36.5	1000		0.35 (7 x 12)	
89.0(A&B)	3000		0.15 (3 x 5)	5

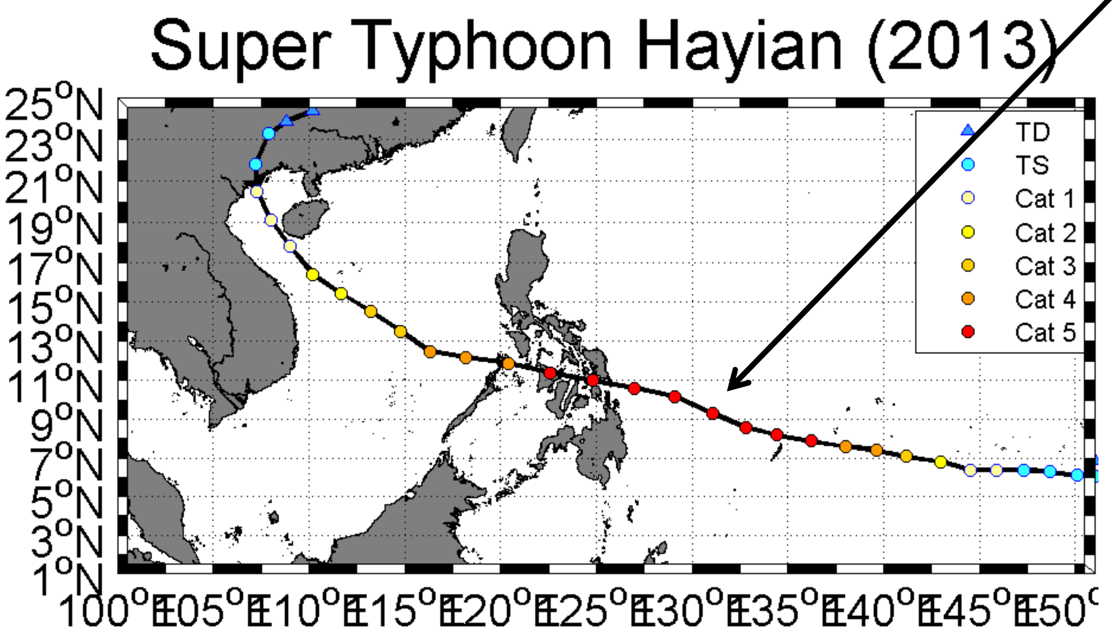
Same as AMSR-E



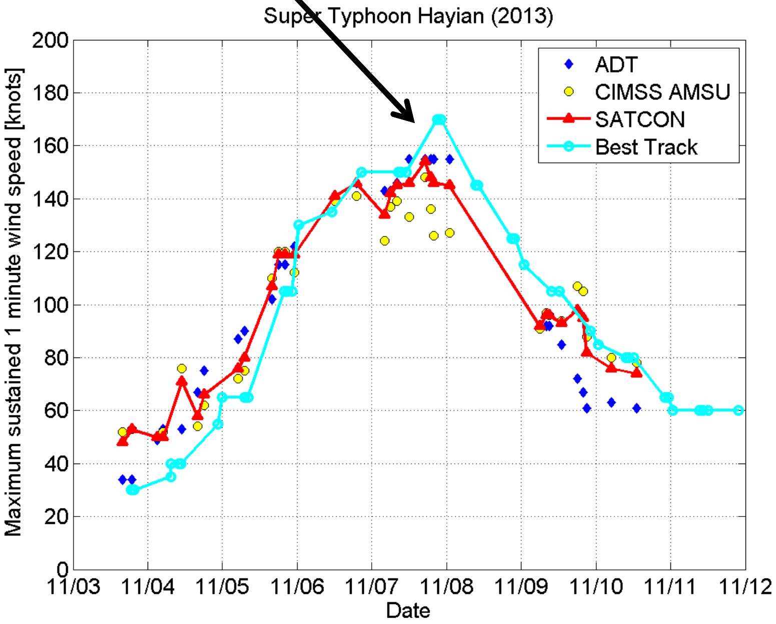
Potential accuracy for SWS retrievals is 1 m/s

An extreme extreme: the super typhoon Hayan in 2013

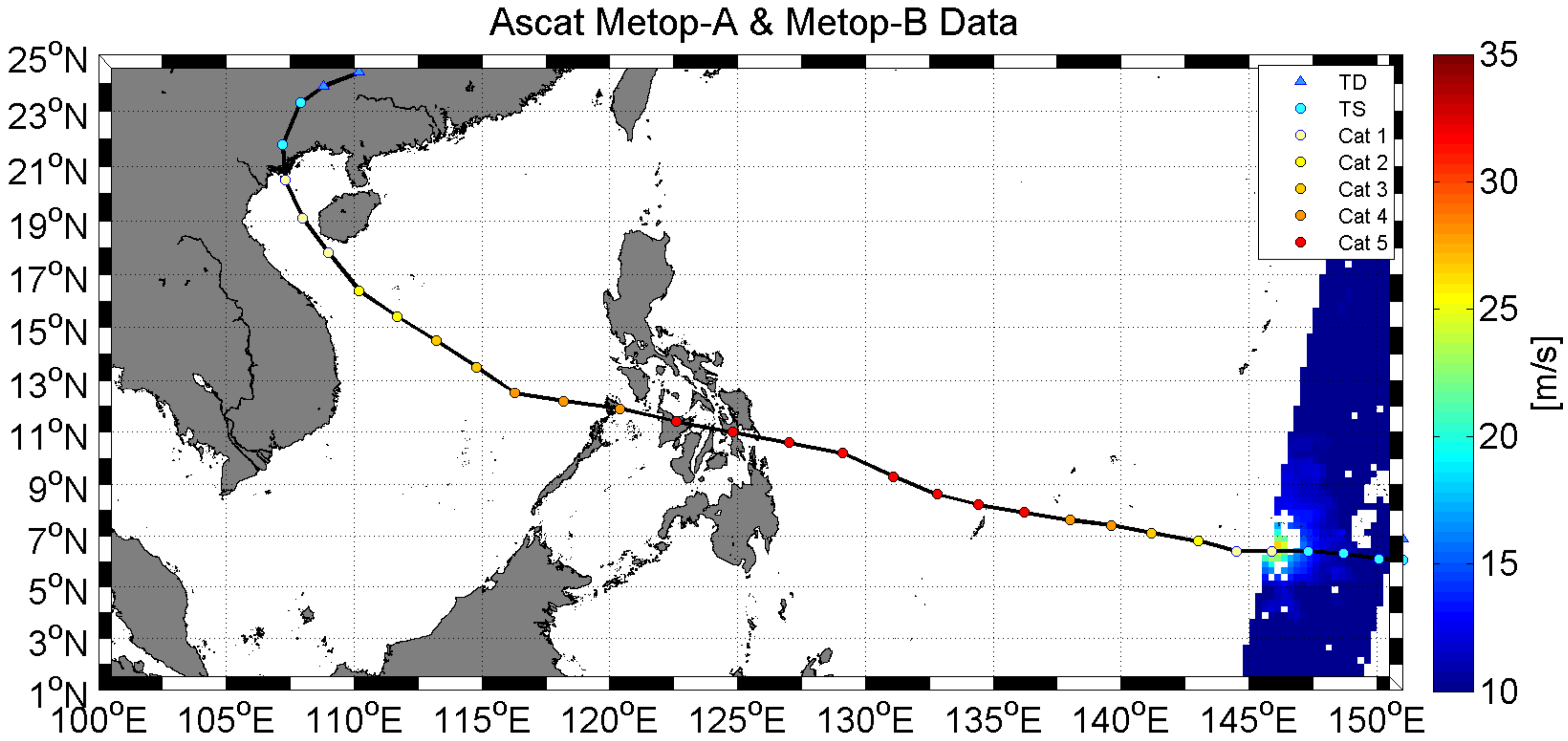
Super Typhoon
Maximum sustained Wind
Reaching ~150-170 knots

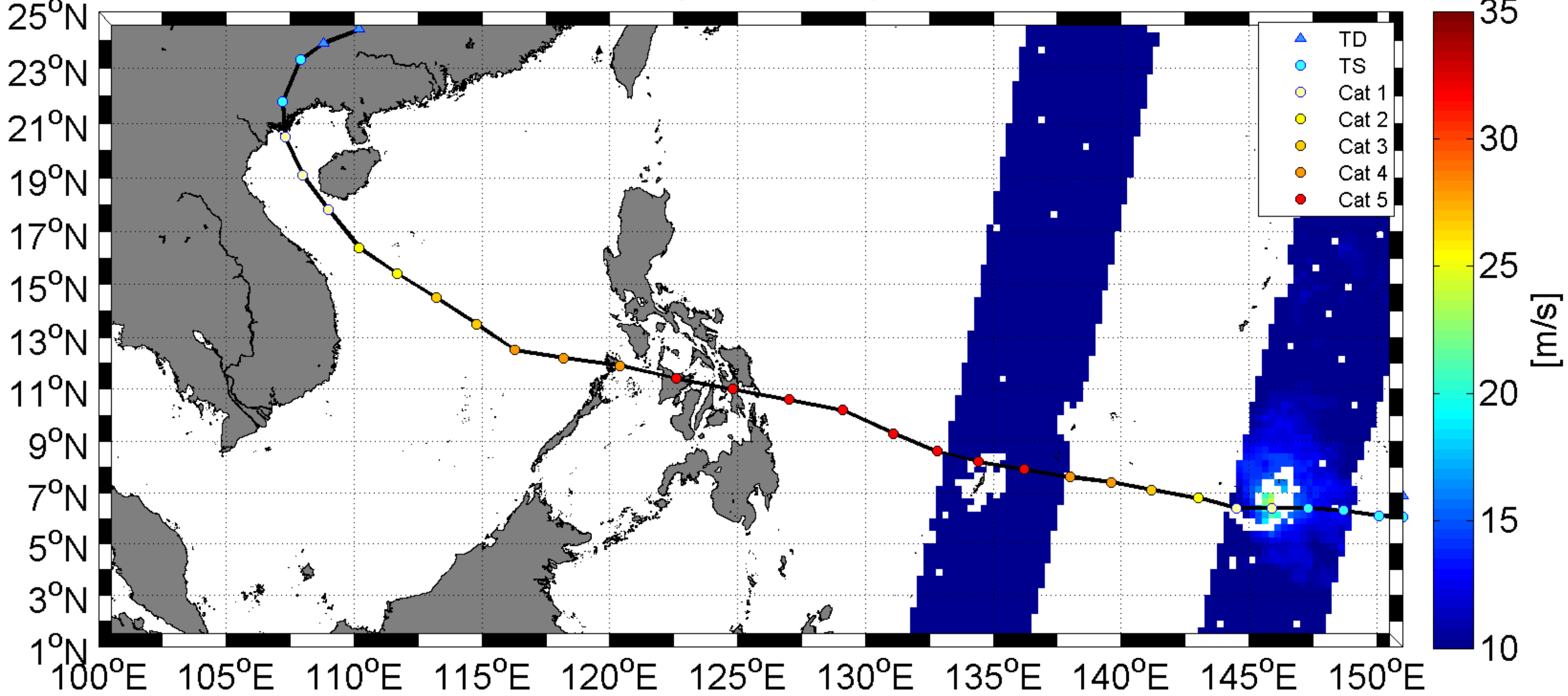


Super Typhoon Hayian (2013)



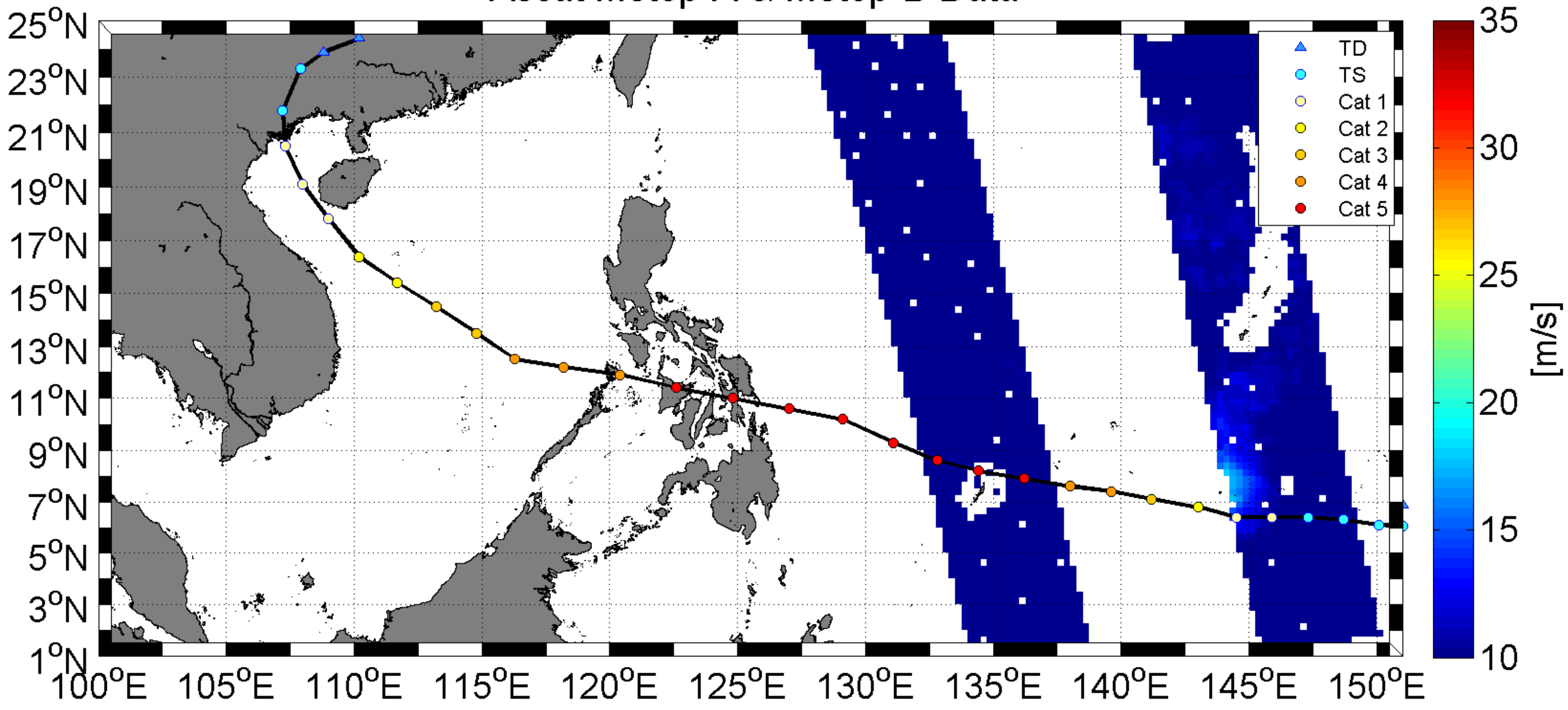
Super Typhoon Hayian (2013)


Ascat Metop-A & Metop-B Data
25°N
23°N
21°N
19°N
17°N
15°N
13°N
11°N
9°N
7°N
5°N
3°N
1°N
100°E
105°E
110°E
115°E
120°E
125°E
130°E
135°E
140°E
145°E
150°E
TD
TS
Cat 1
Cat 2
Cat 3
Cat 4
Cat 5
35
30
25
20
15
10
[m/s]

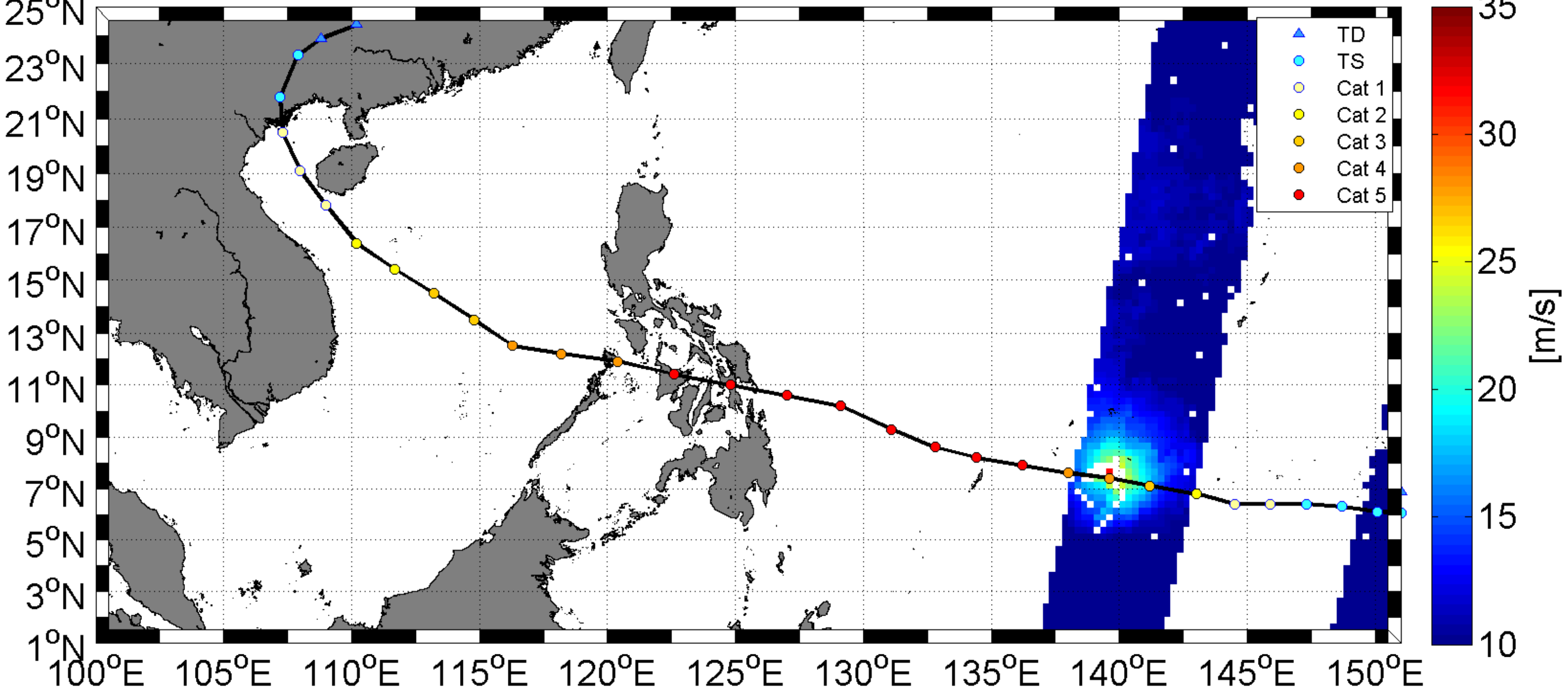


Ascat Metop-A & Metop-B Data

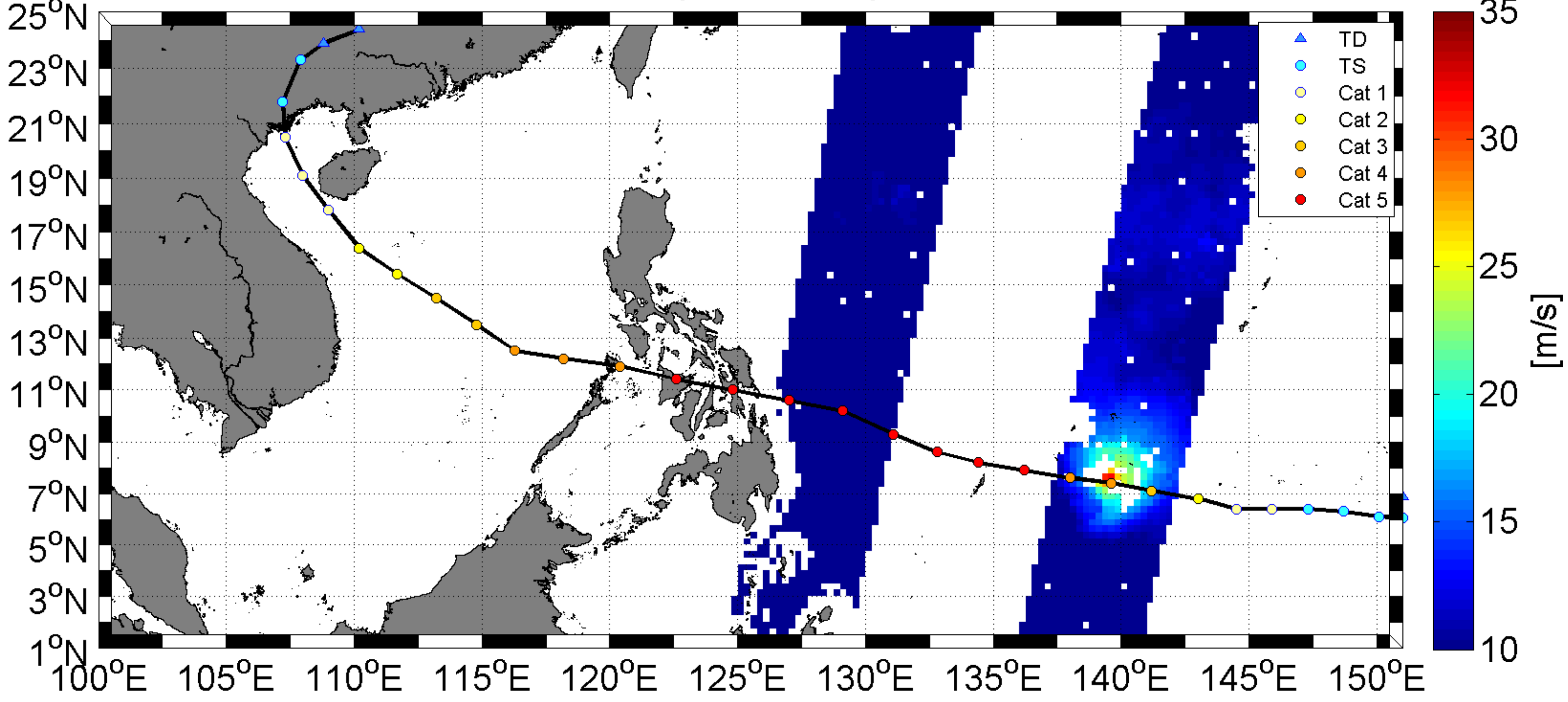
Ascat Metop-A & Metop-B Data



Ascat Metop-A & Metop-B Data



Ascat Metop-A & Metop-B Data



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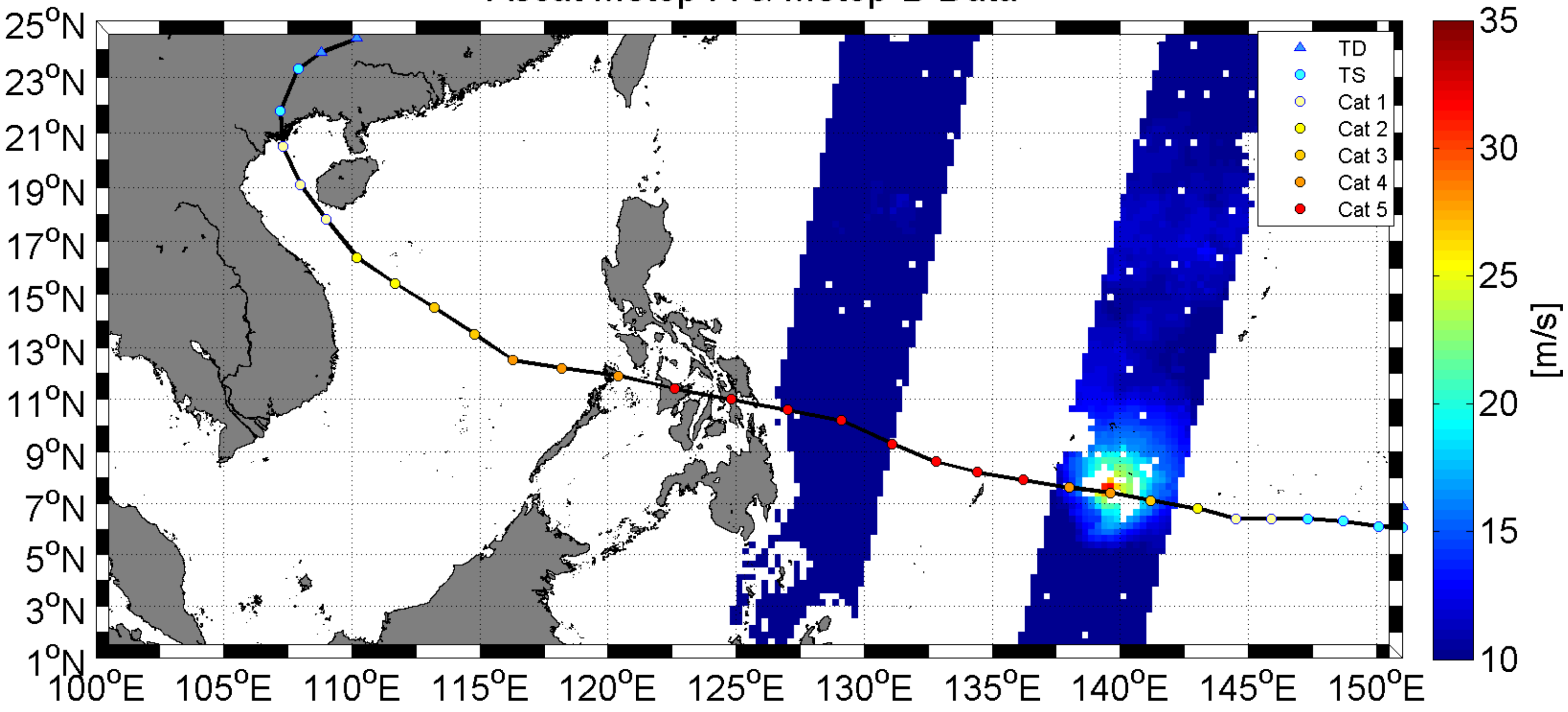
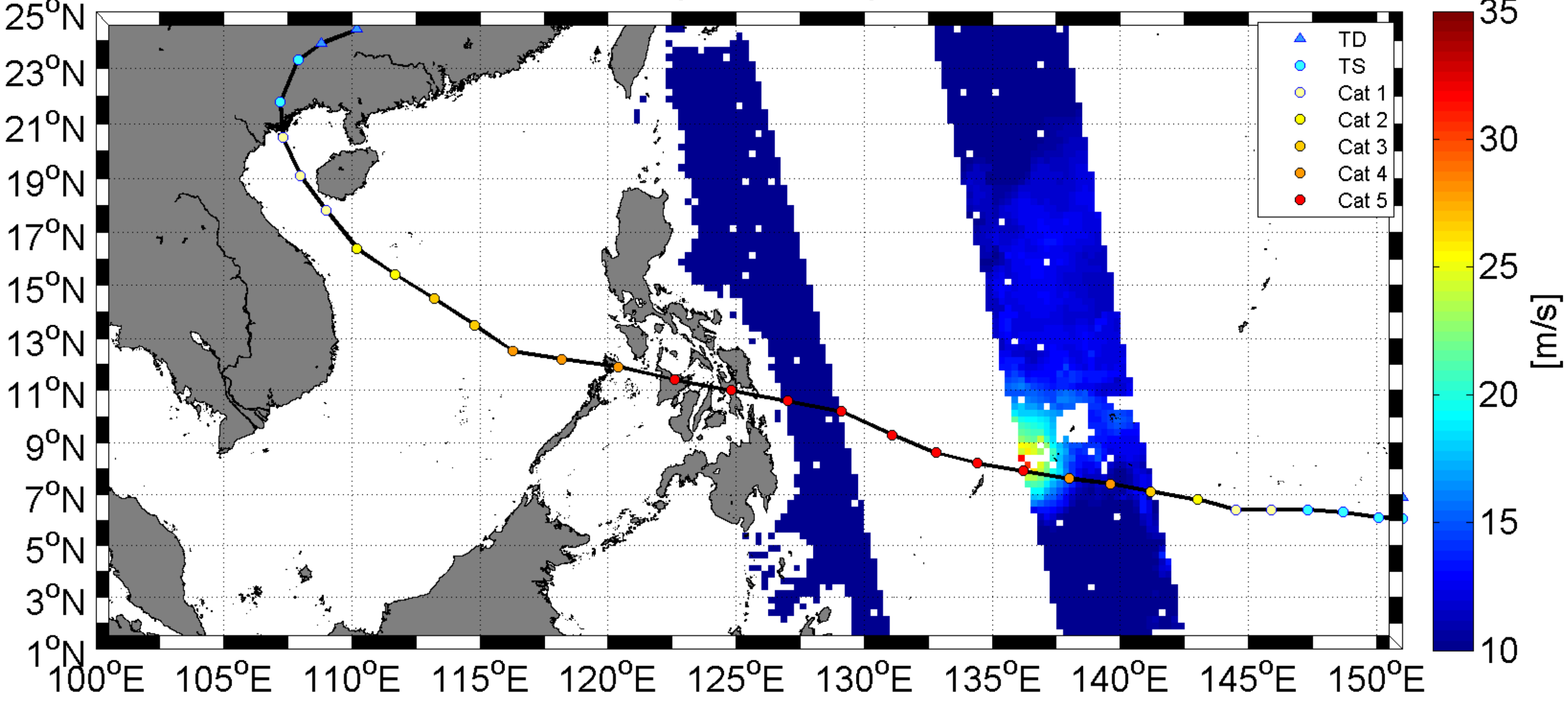
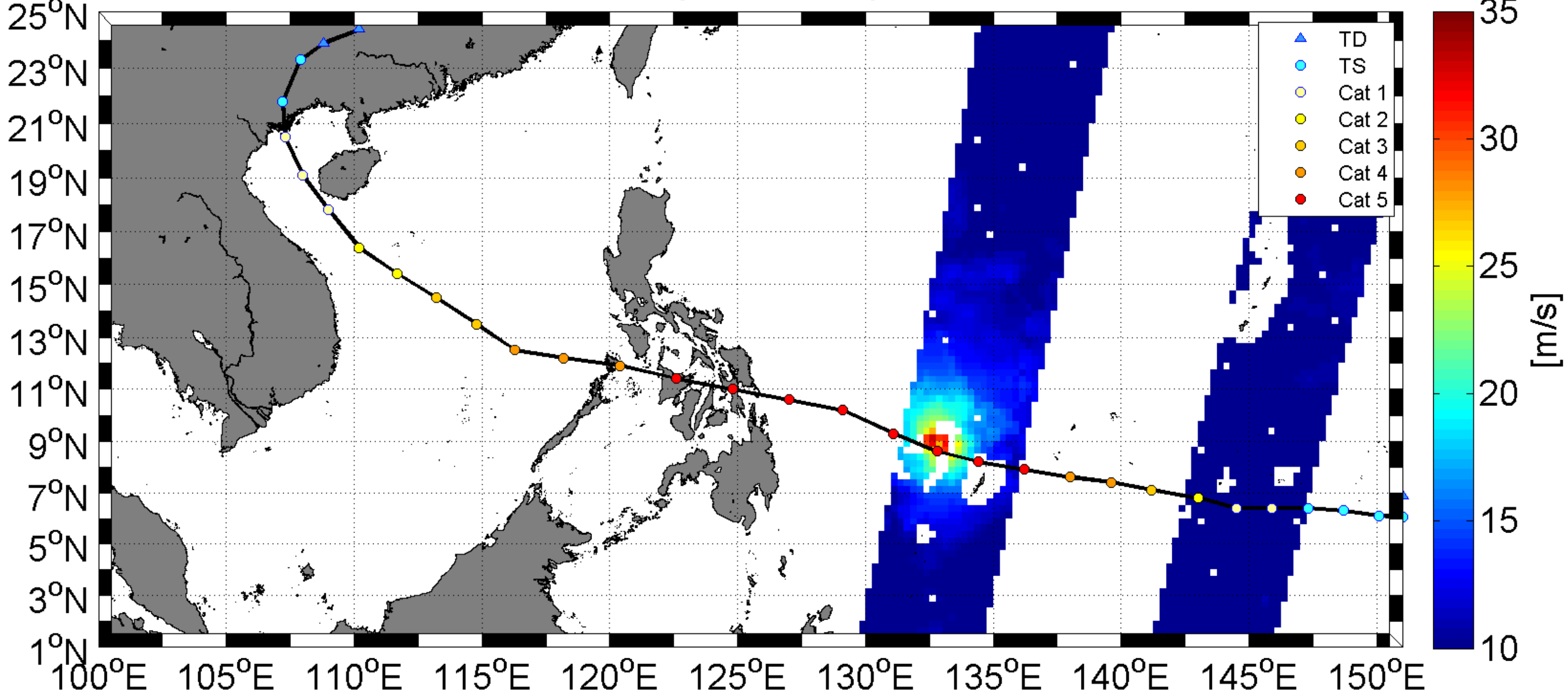


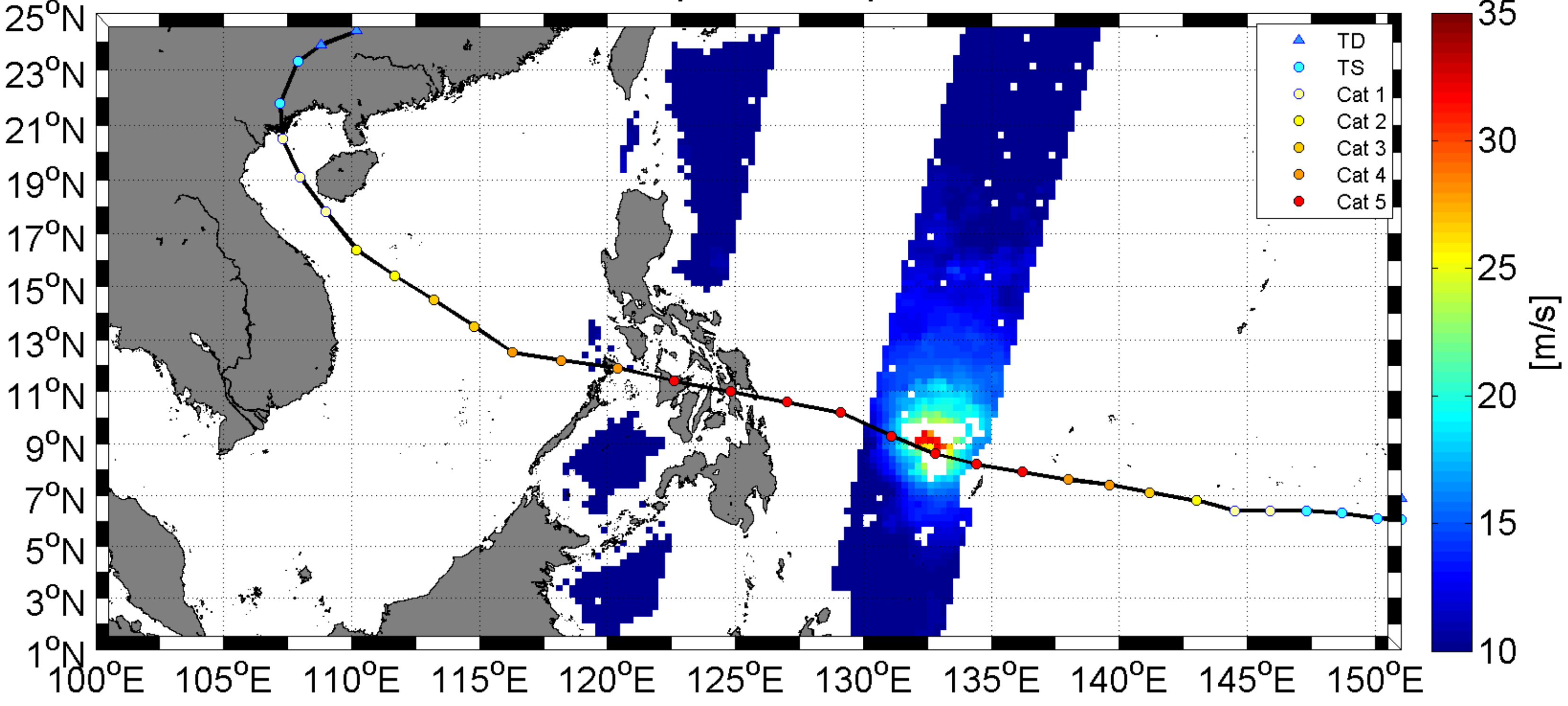


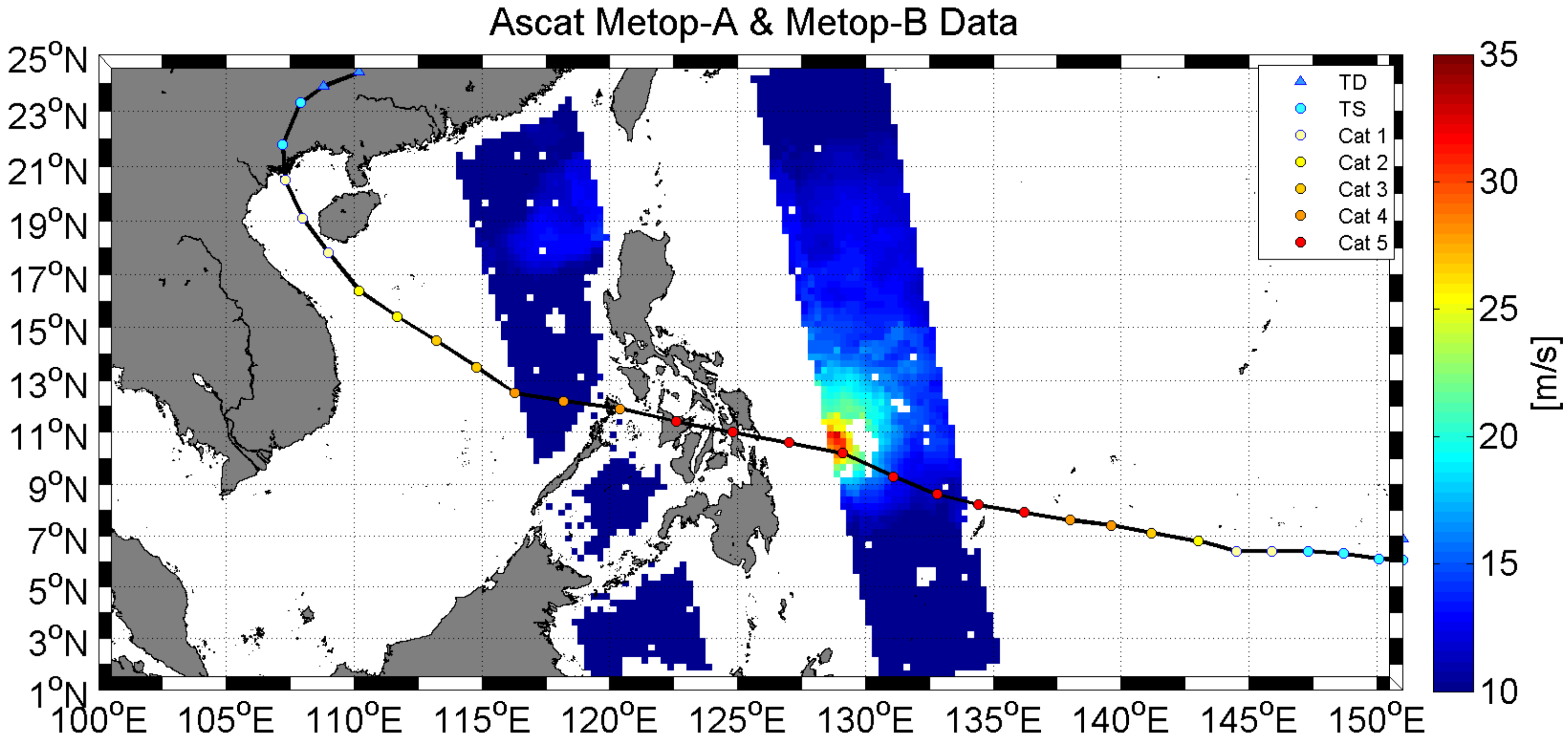
Ascat Metop-A & Metop-B Data

Ascat Metop-A & Metop-B Data



Ascat Metop-A & Metop-B Data




Ascat Metop-A & Metop-B Data
25°N
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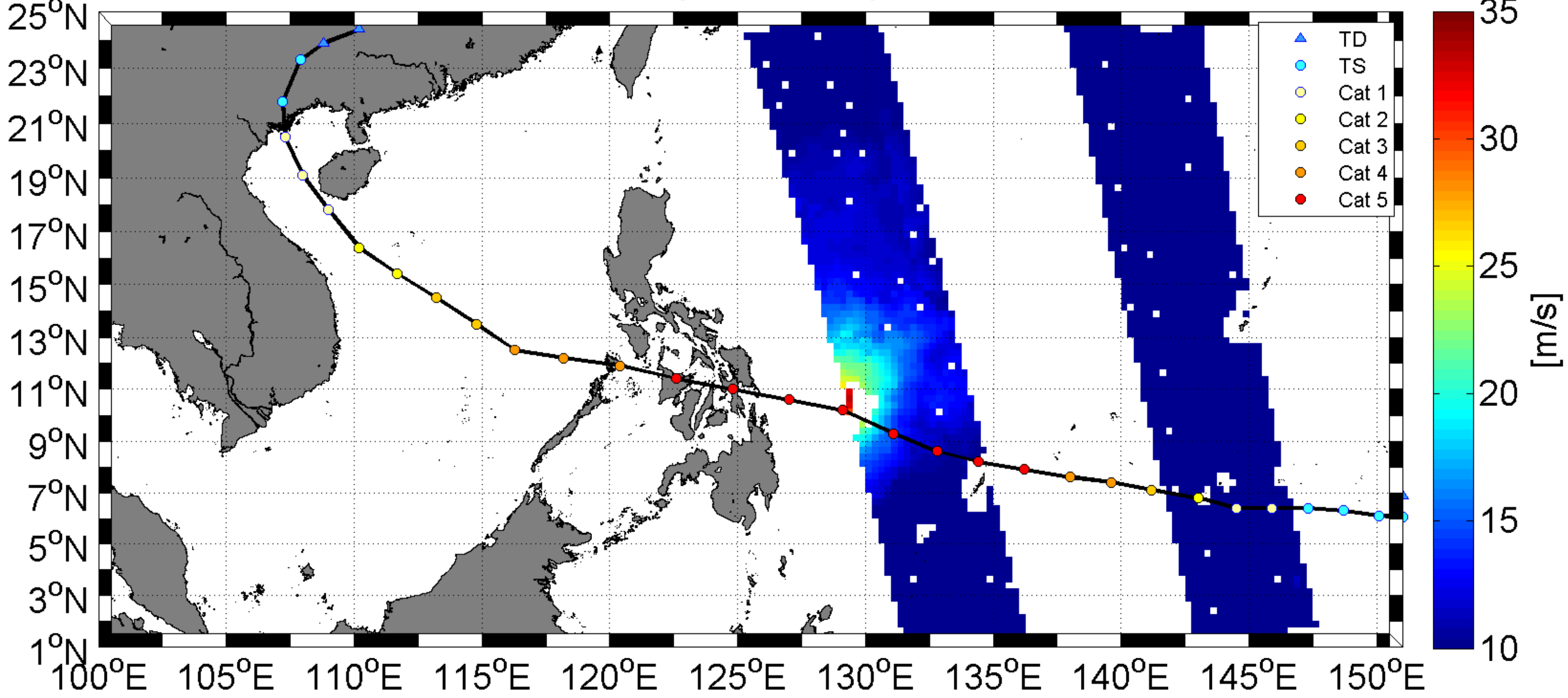
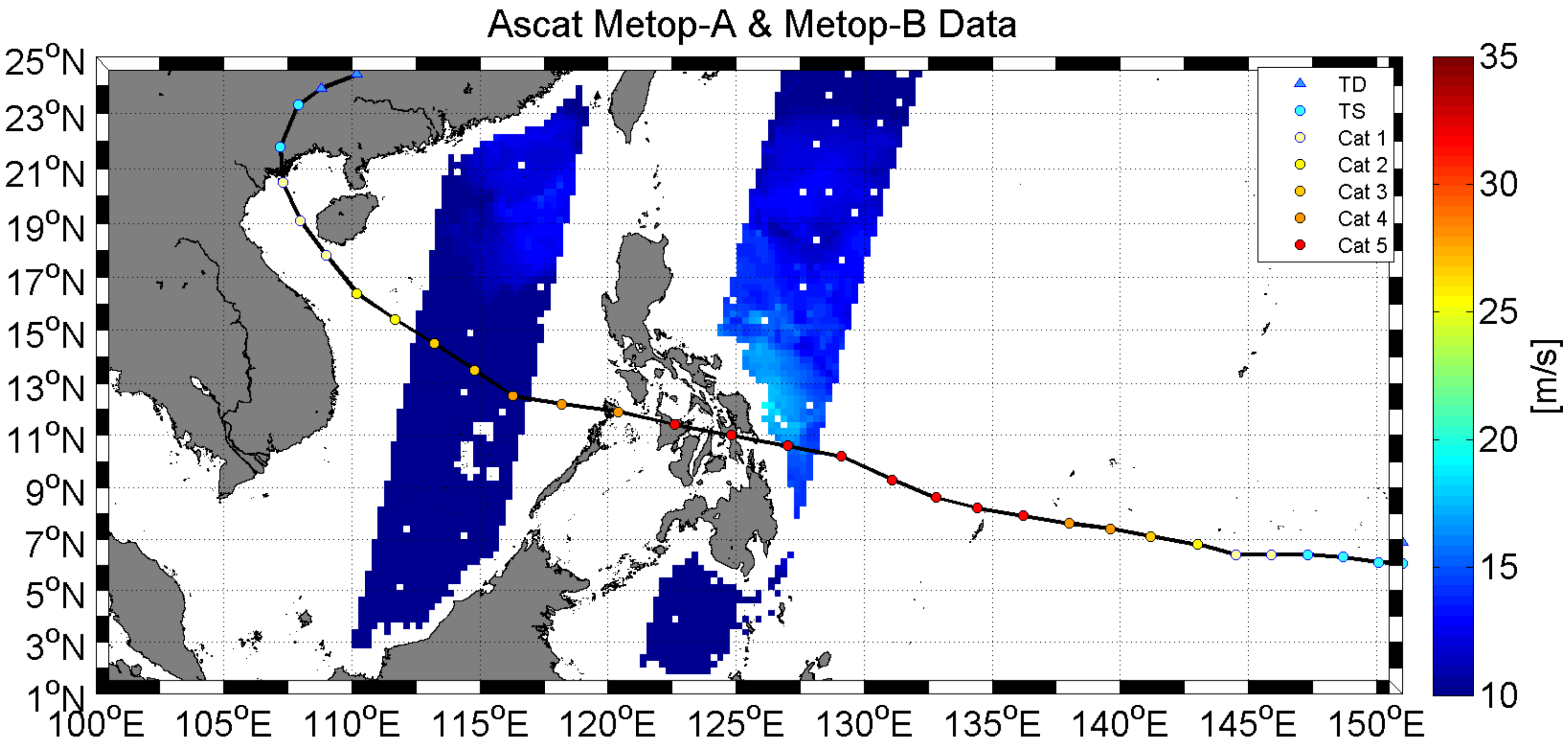
7°N
5°N
3°N
1°N
100°E
105°E
110°E
115°E
120°E
125°E
130°E
135°E
140°E
145°E
150°E
TD
TS
Cat 1
Cat 2
Cat 3
Cat 4
Cat 5
35
30
25
20
15
10
[m/s]

Ascat Metop-A & Metop-B Data




Ascat Metop-A & Metop-B Data
25°N
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9°N
7°N
5°N
3°N
1°N
100°E
105°E
110°E
115°E
120°E
125°E
130°E
135°E
140°E
145°E
150°E
TD
TS
Cat 1
Cat 2
Cat 3
Cat 4
Cat 5
35
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25
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15
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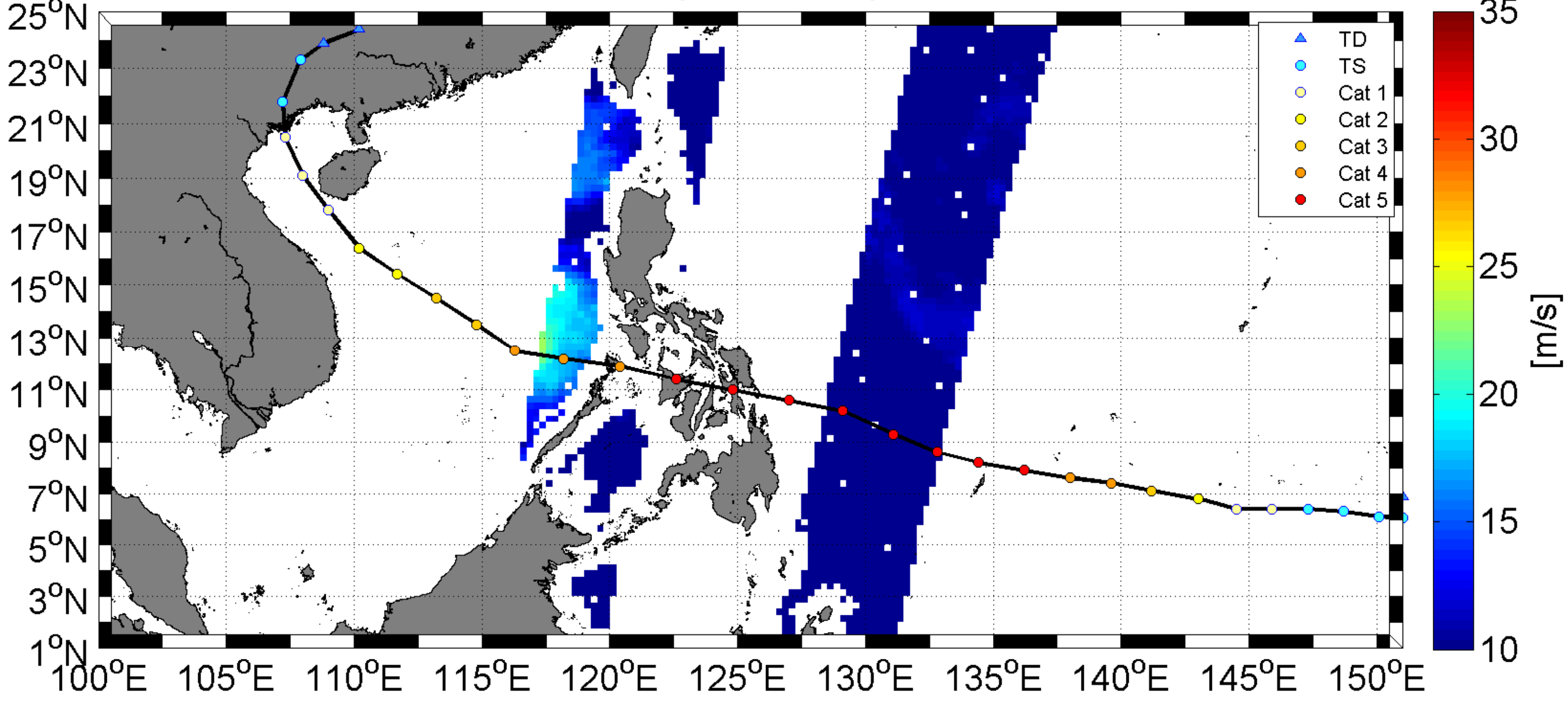
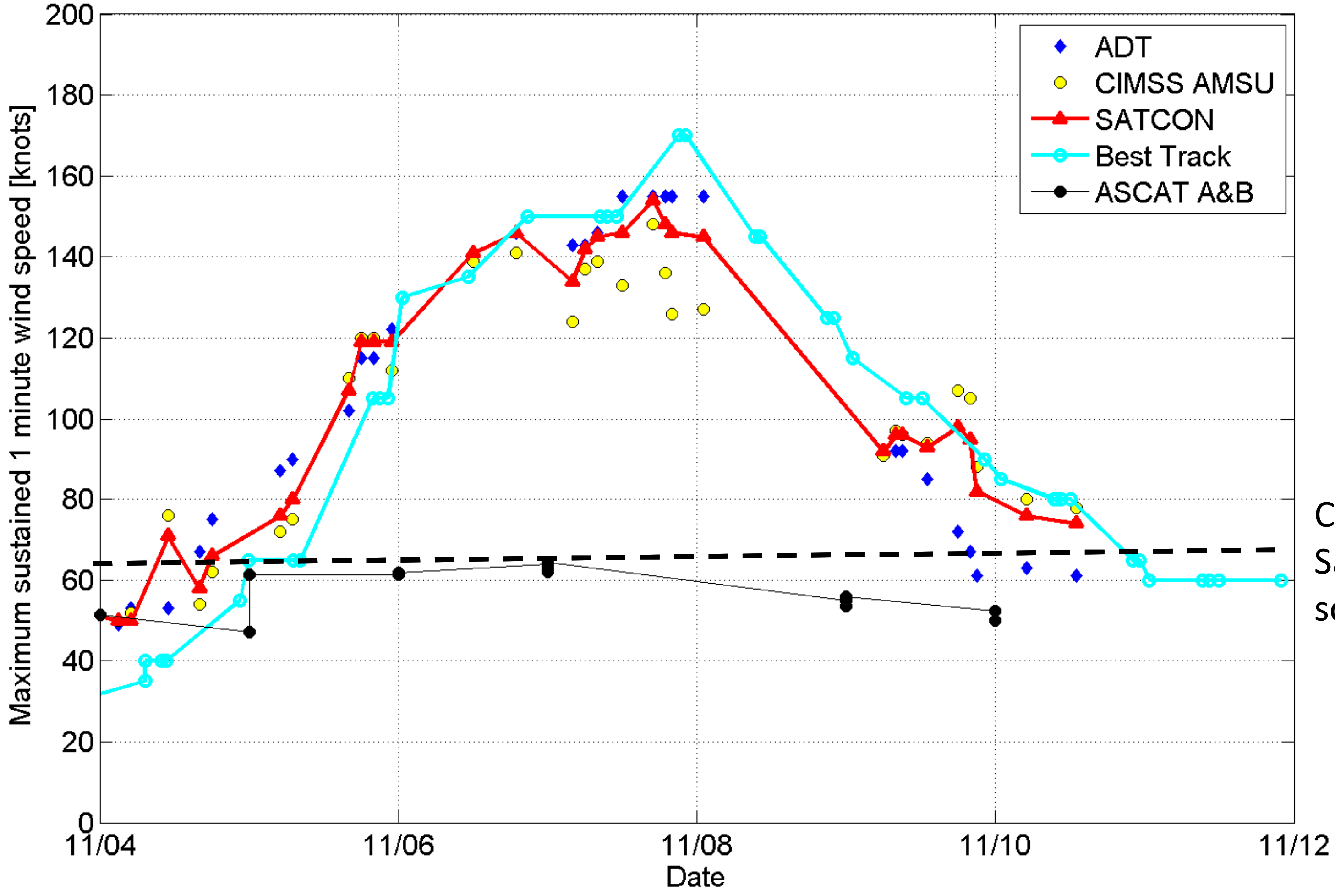
[m/s]

Ascat Metop-A & Metop-B Data





Cat 1 on Saffir-Simpson scale

Unability of the scatterometer to measure wind speeds above hurricane force (64 knots)

Haiyan Super Typhoon Signature in SMOS data

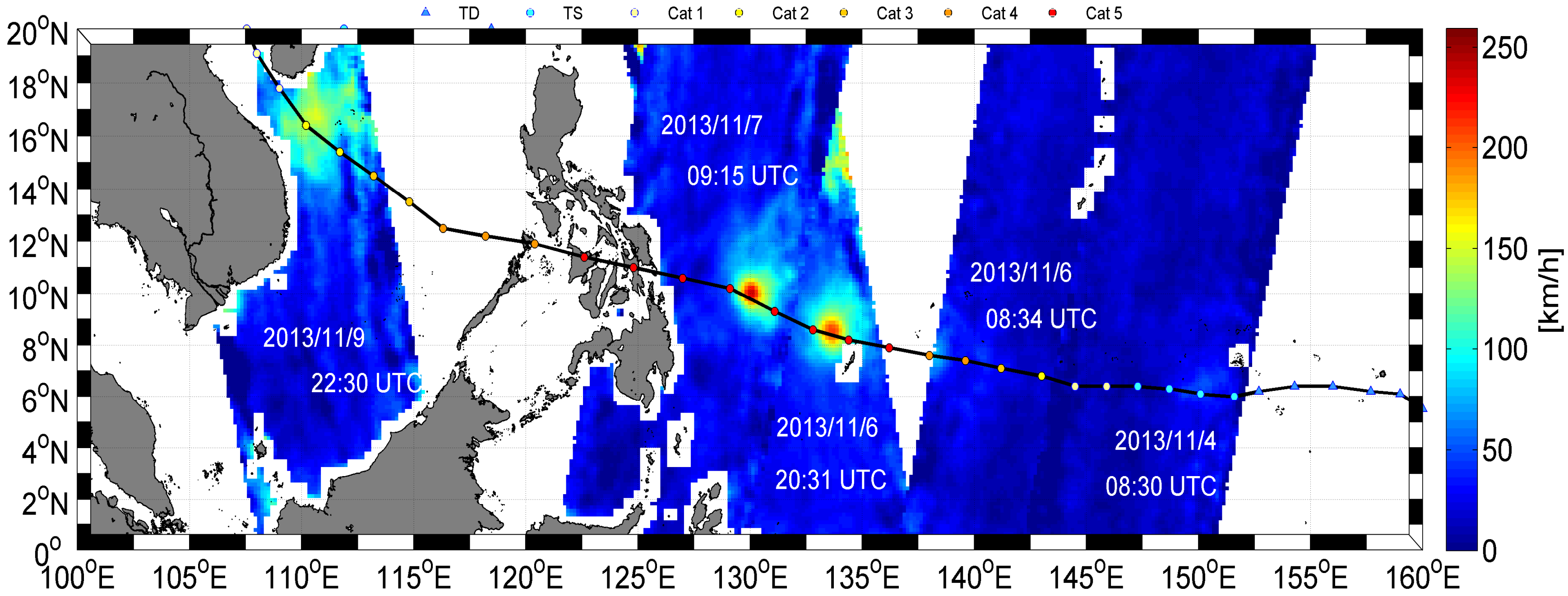
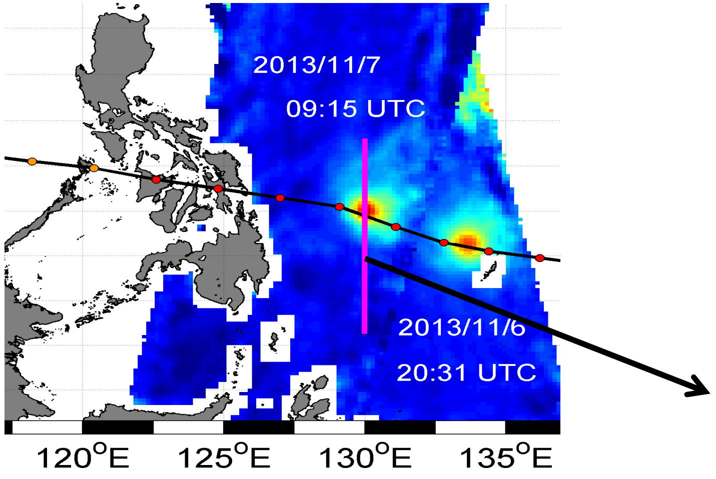
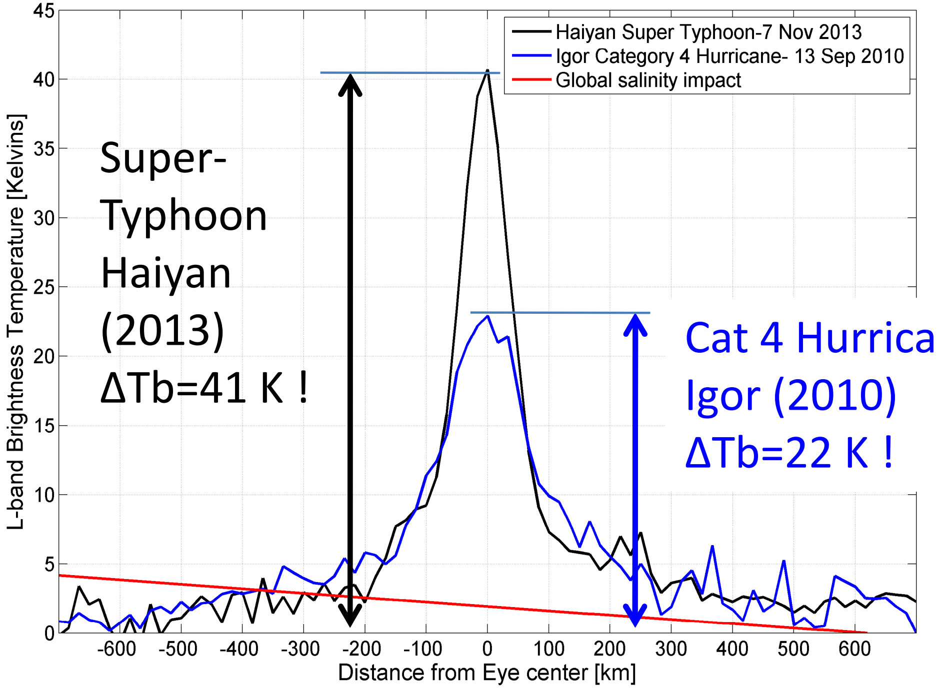


Figure 1: SMOS retrieved surface wind speed [km/h] along the eye track of super typhoon Haiyan from 4 to 9 Nov 2013.

Haiyan Super Typhoon Signature in SMOS data



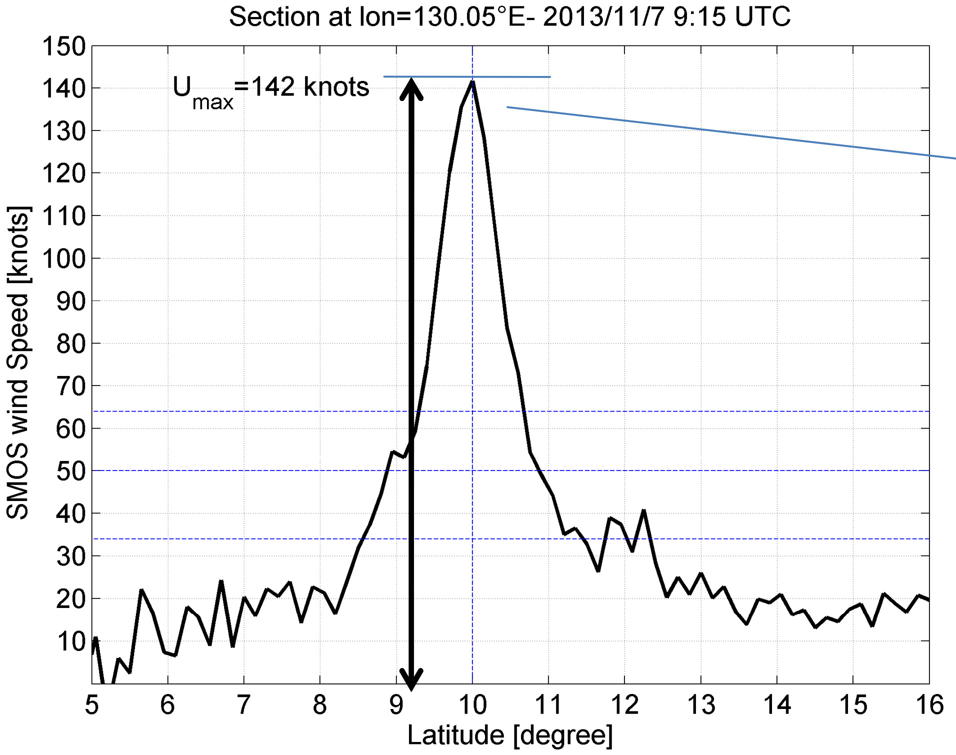


Super-
Typhoon
Haiyan
(2013)
ΔTb=41 K !

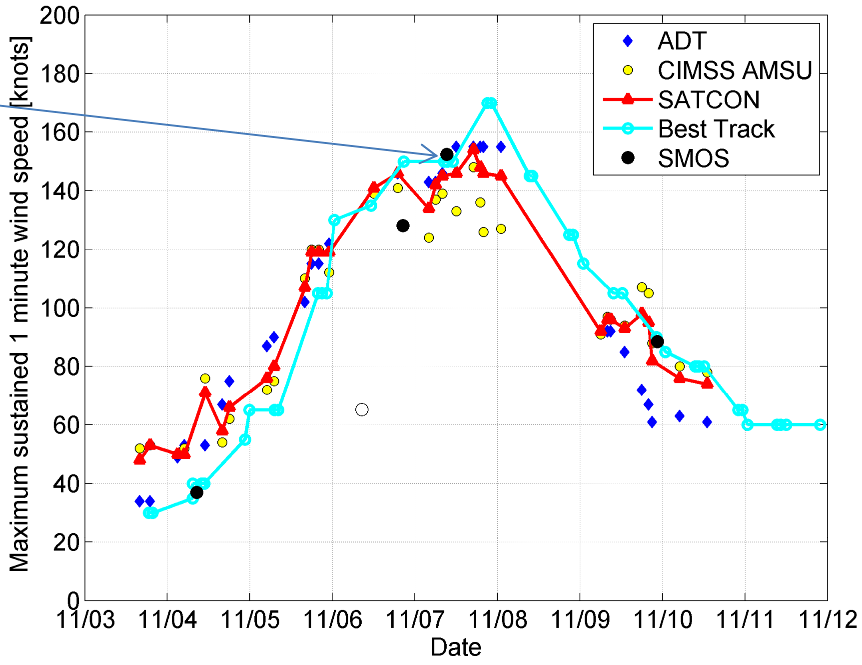
Cat 4 Hurricane
Igor (2010)
ΔTb=22 K !

Haiyan Typhoon in 2013:
The brightest natural source of L-band radiation ever measured over the oceans
=>an unprecedented natural extreme

Haiyan Super Typhoon Signature in SMOS data



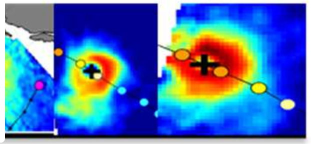
Surface wind speed deduced from the SMOS estimated excess brightness temperature.



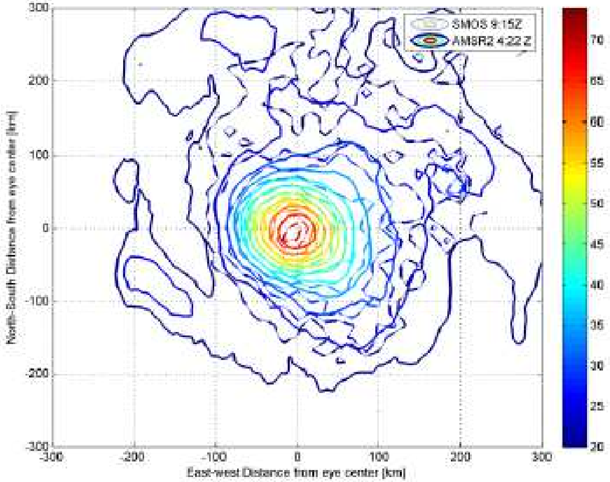
Maximum sustained 1 minute wind speed estimated during Haiyan Typhoon. From SMOS data (black filled dots) compared to Advanced Dvorak Technique (ADT=blue diamond), CIMSS (yellow filled dots), SATCON (red) and Best Track from NHC (cyan).

Excellent agreement between SMOS max winds estimates and other traditional Top of the atmosphere estimates datasets (Dvorak, Best track,..)

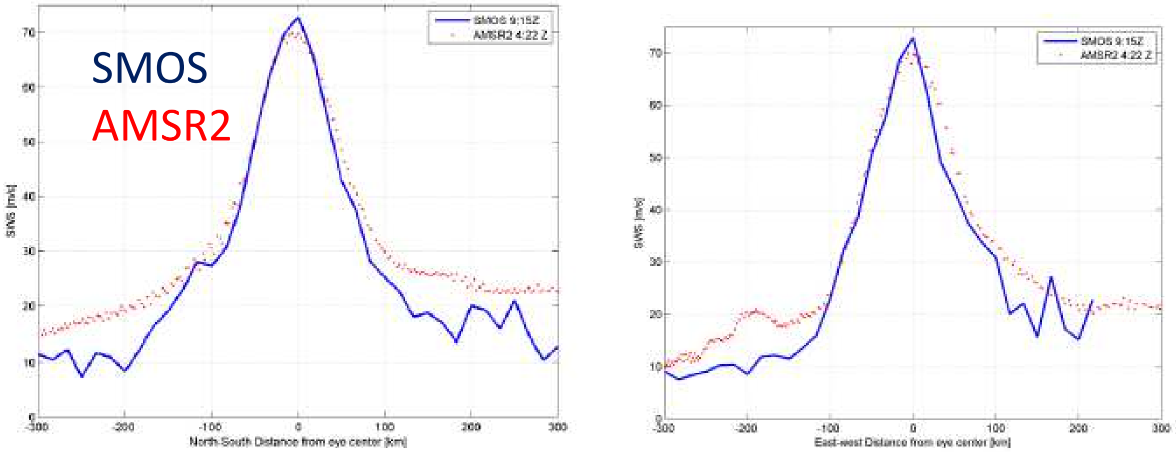
SMOS versus AMSR2 SWS in Haiyan



Zabolotskikh E.V., L.M. Mitnik, N. Reul, B. Chapron, (2015). New possibilities for geophysical parameter retrievals opened by GCOM-W1 AMSR2. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (JSTARS), doi: 10.1109/JSTARS.2015.2416514. I F 2.827



Very Coherent L (SMOS) & C (AMSR-2) SWS retrievals 5 hours appart

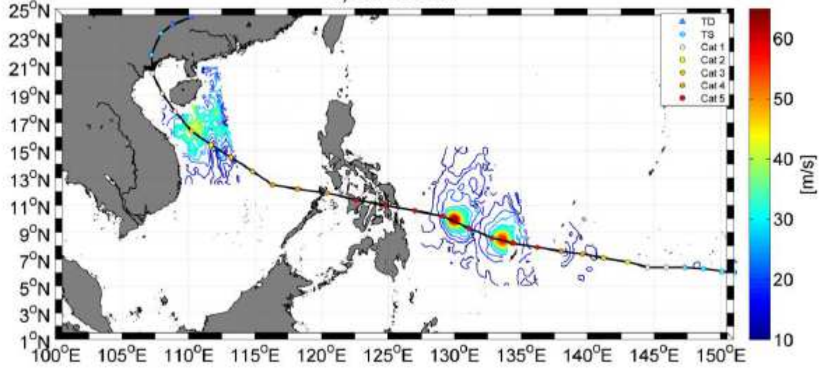


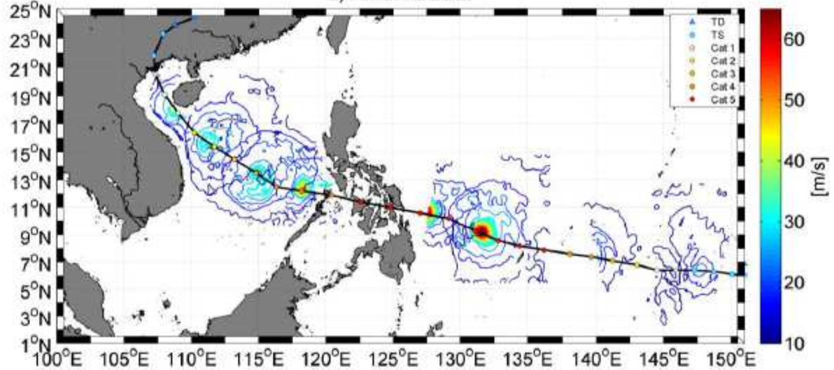
SMOS

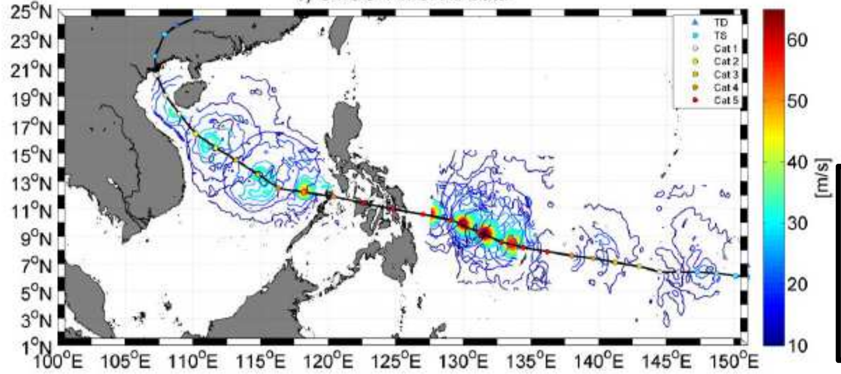
AMSR2

Figure 20: Top: *Superimposed contrours of SMOS (dashed) and AMSR2 (filled) surface wind speed fields estimated 5 hours apart as the sensors overpassed the super Typhoon Haiyan on the 7 Nov 2013. Bottom: North-South (left) and East-West (right) sections of the retrieved wind speed through the storm (blue=SMOS; red=AMSR2).*

Towards Merged SMOS-AMSR-2-SMAP High wind products


a) SMOS Data


b) AMSR-2 Data


c) SMOS+AMSR-2 Data

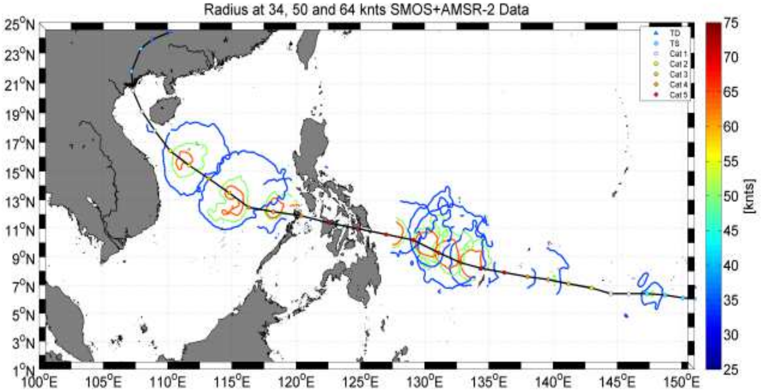
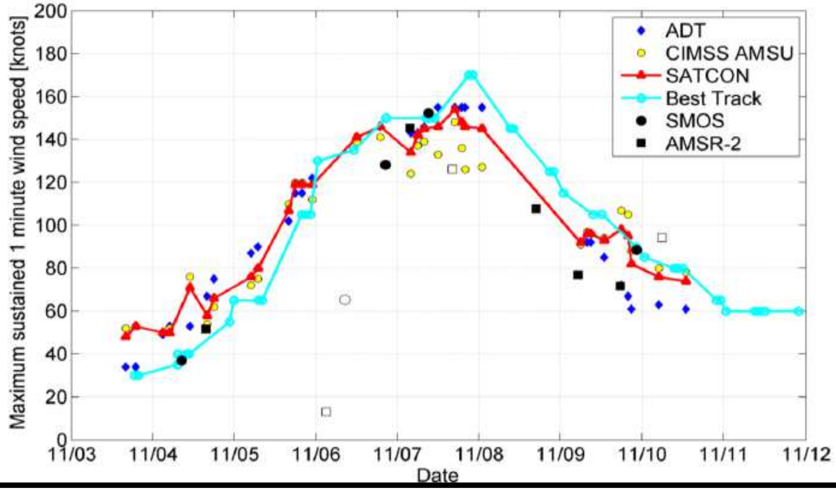
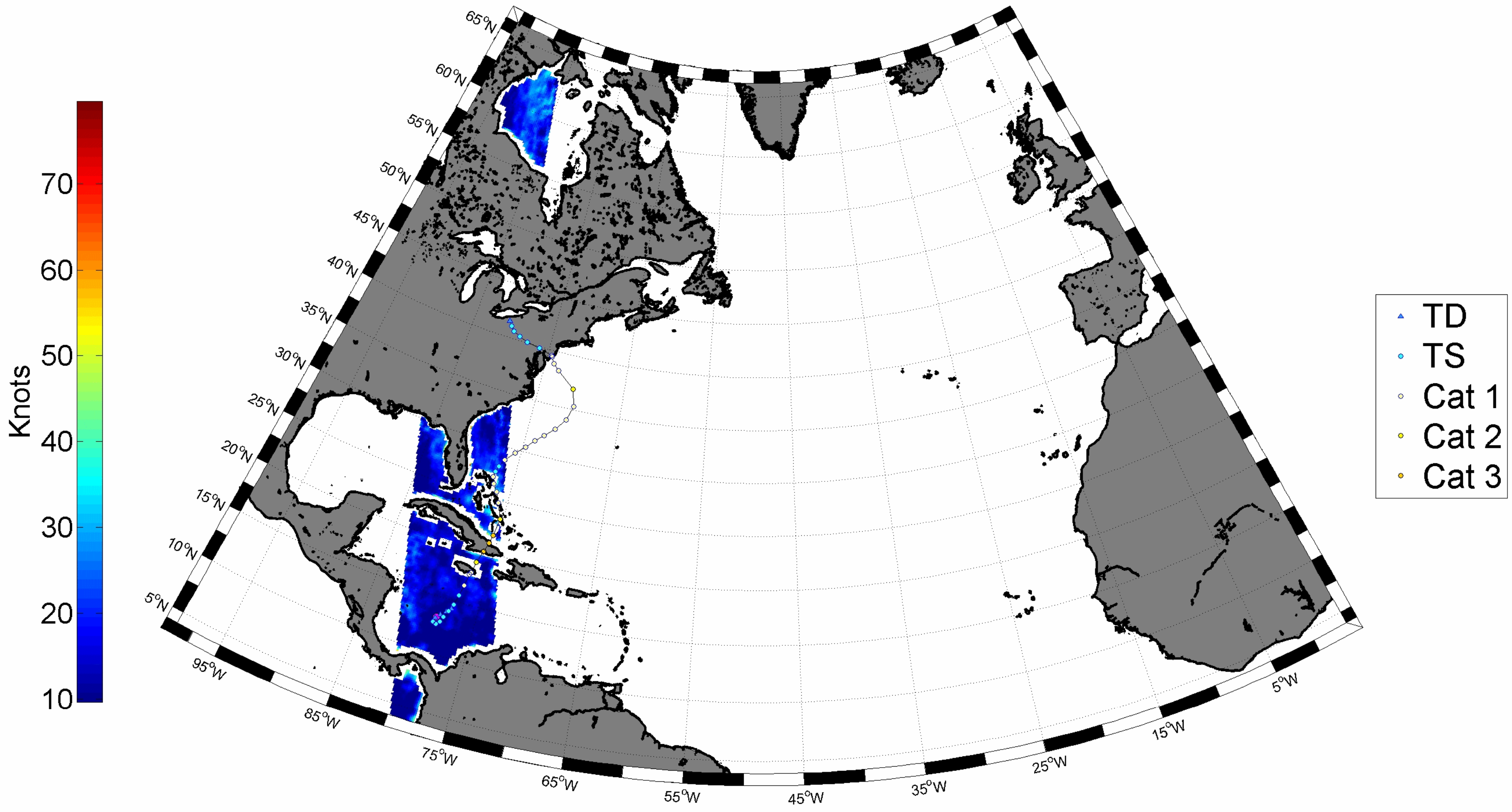

Radius at 34, 50 and 64 knts SMOS+AMSR-2 Data

Figure 22: *Contours of the merged SMOS+AMSR2 retrieved winds over Haiyan at the threshol levels of 34 (blue), 50 (green) and 64 (orange) knots.*



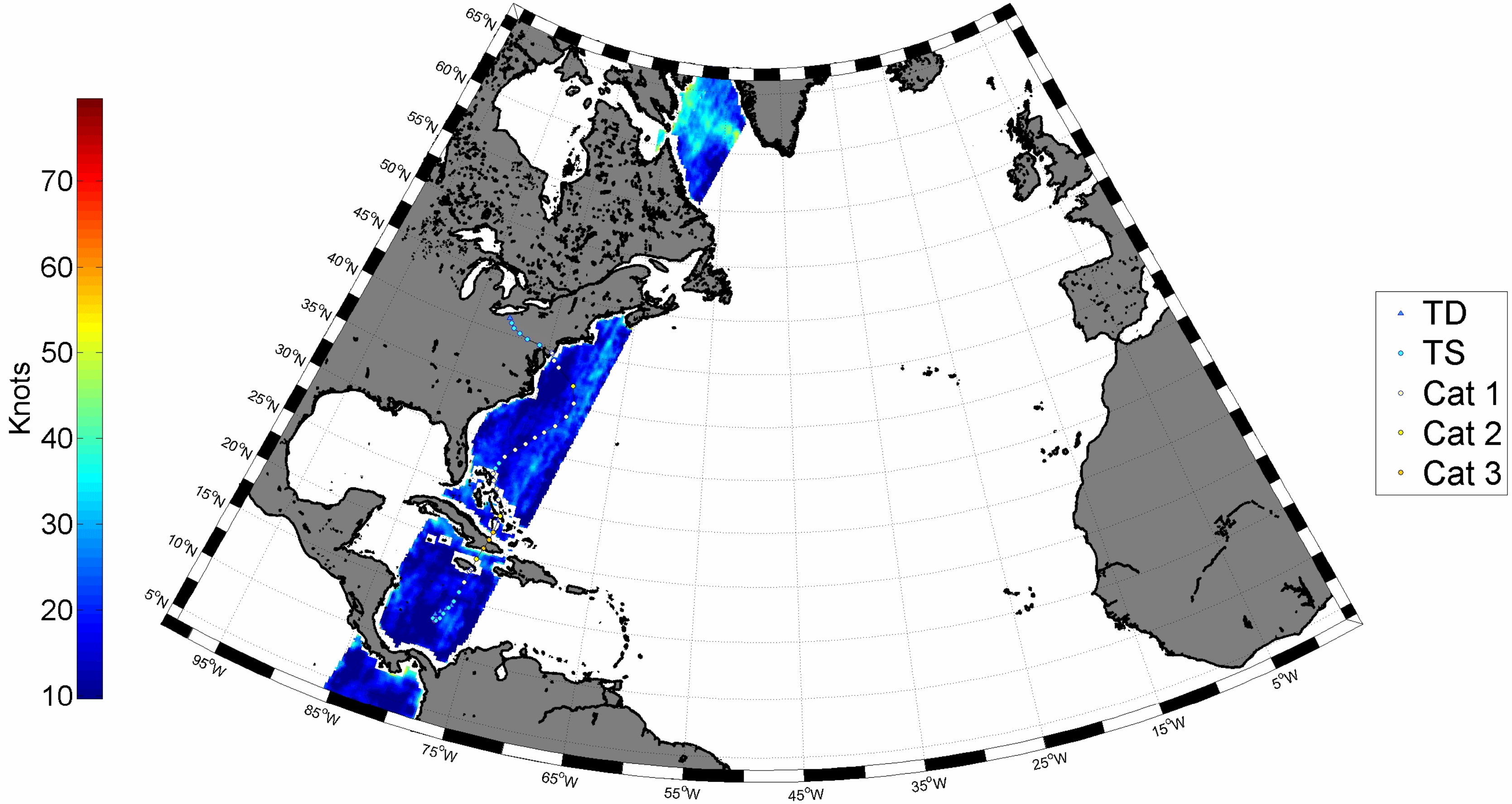
Excellent agreement between SMOS+AMSR2 & Traditional methods of Max wind Estimate (Dvorak)

North Atlantic TC :SANDY-2012/10



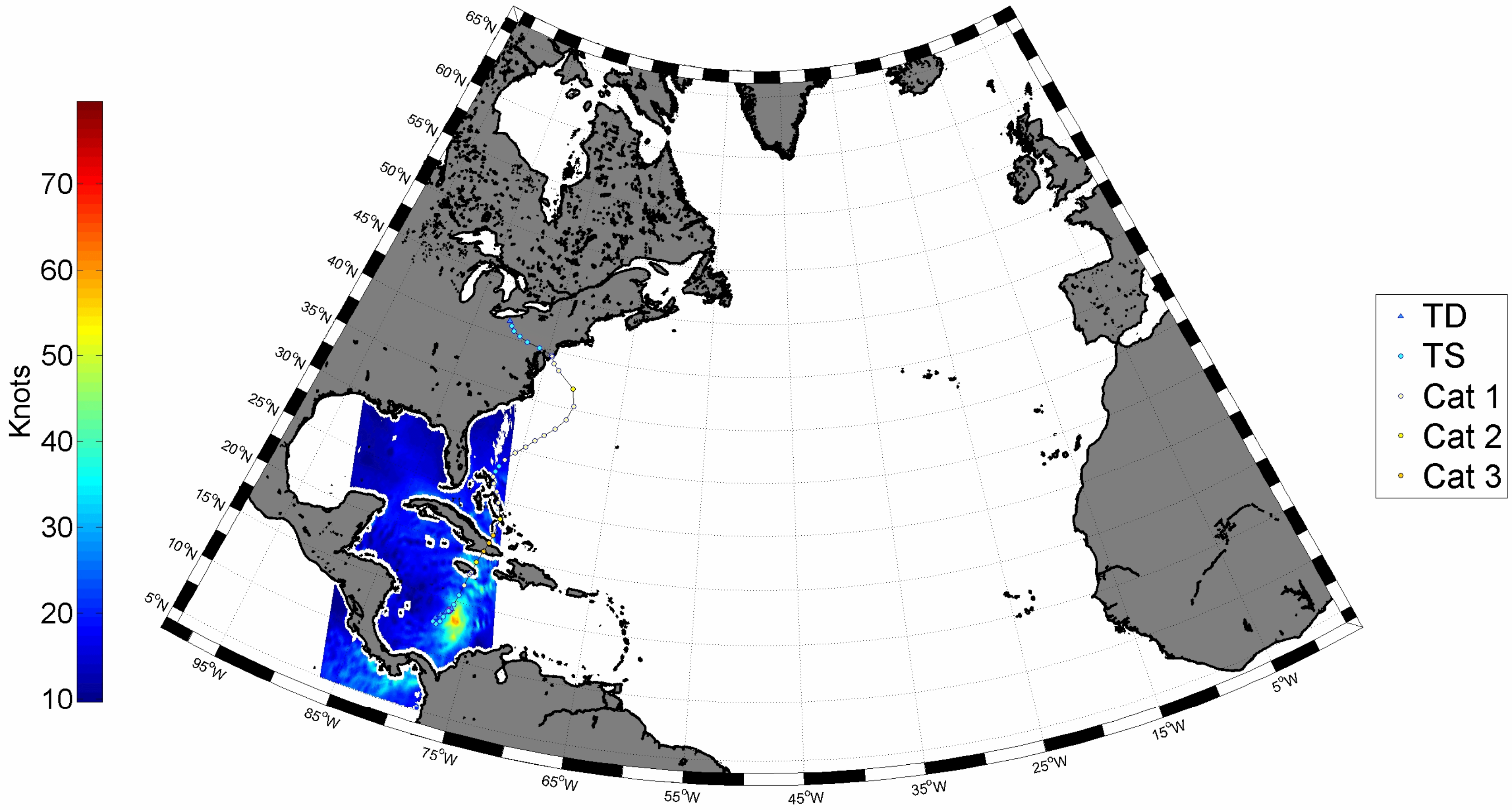
SMOS Wind speed -2012/10/22 at -10:36 UTC

North Atlantic TC :SANDY-2012/10



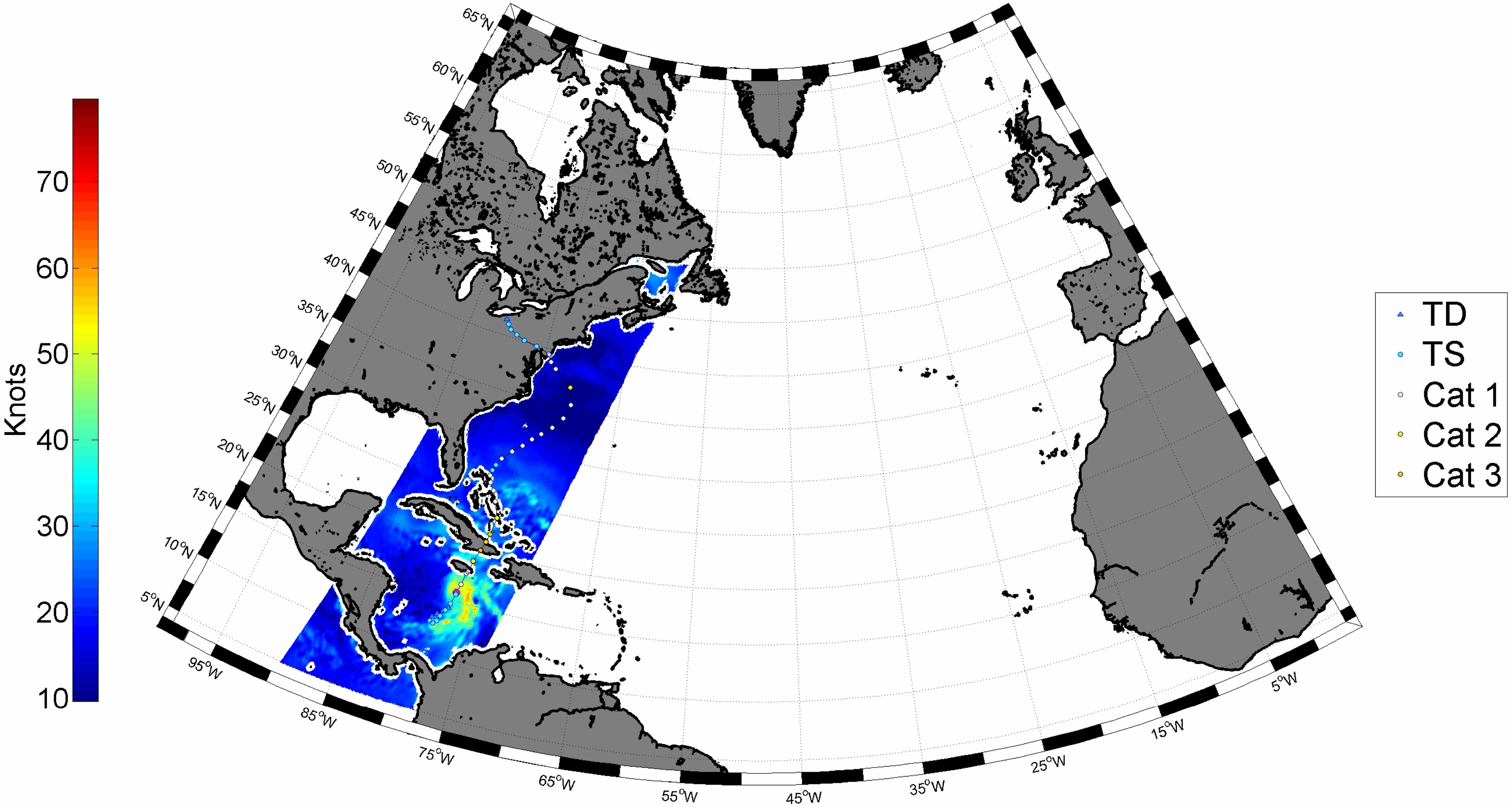
SMOS Wind speed -2012/10/22 at -23:08 UTC

North Atlantic TC :SANDY-2012/10



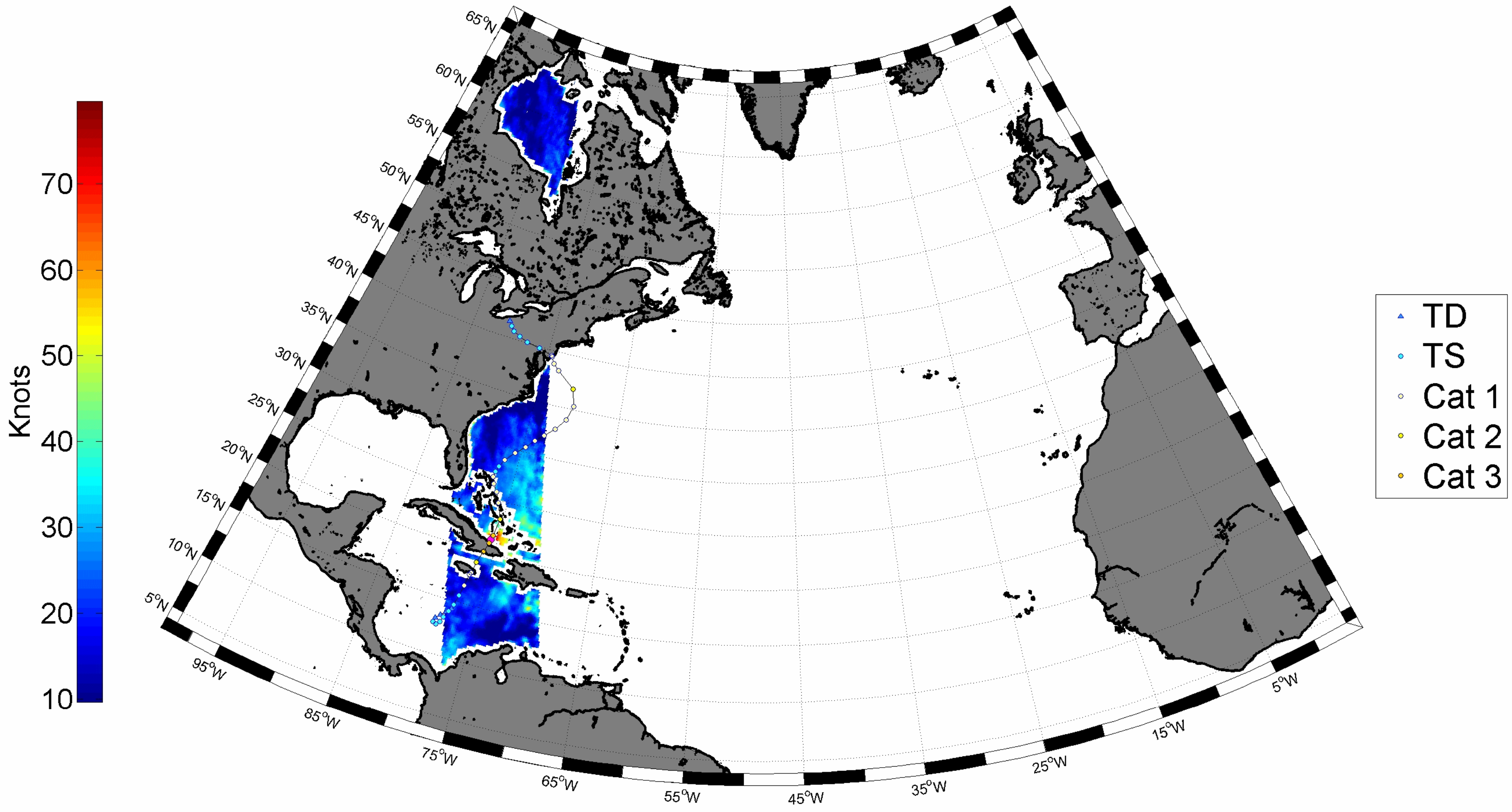
AMSR2 Wind speed -2012/10/23 at -18:40 UTC

North Atlantic TC :SANDY-2012/10



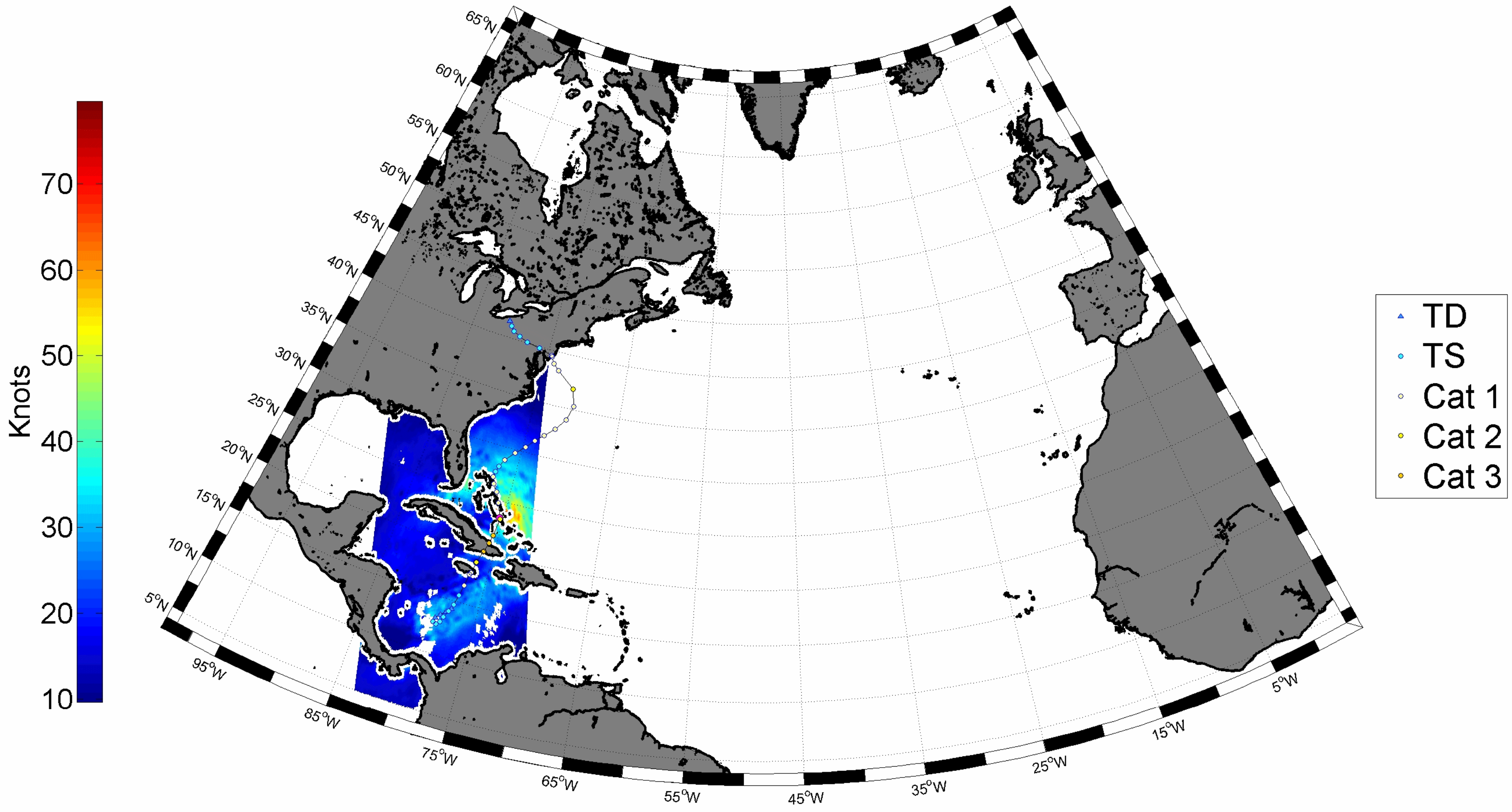
AMSR2 Wind speed -2012/10/24 at -07:02 UTC

North Atlantic TC :SANDY-2012/10



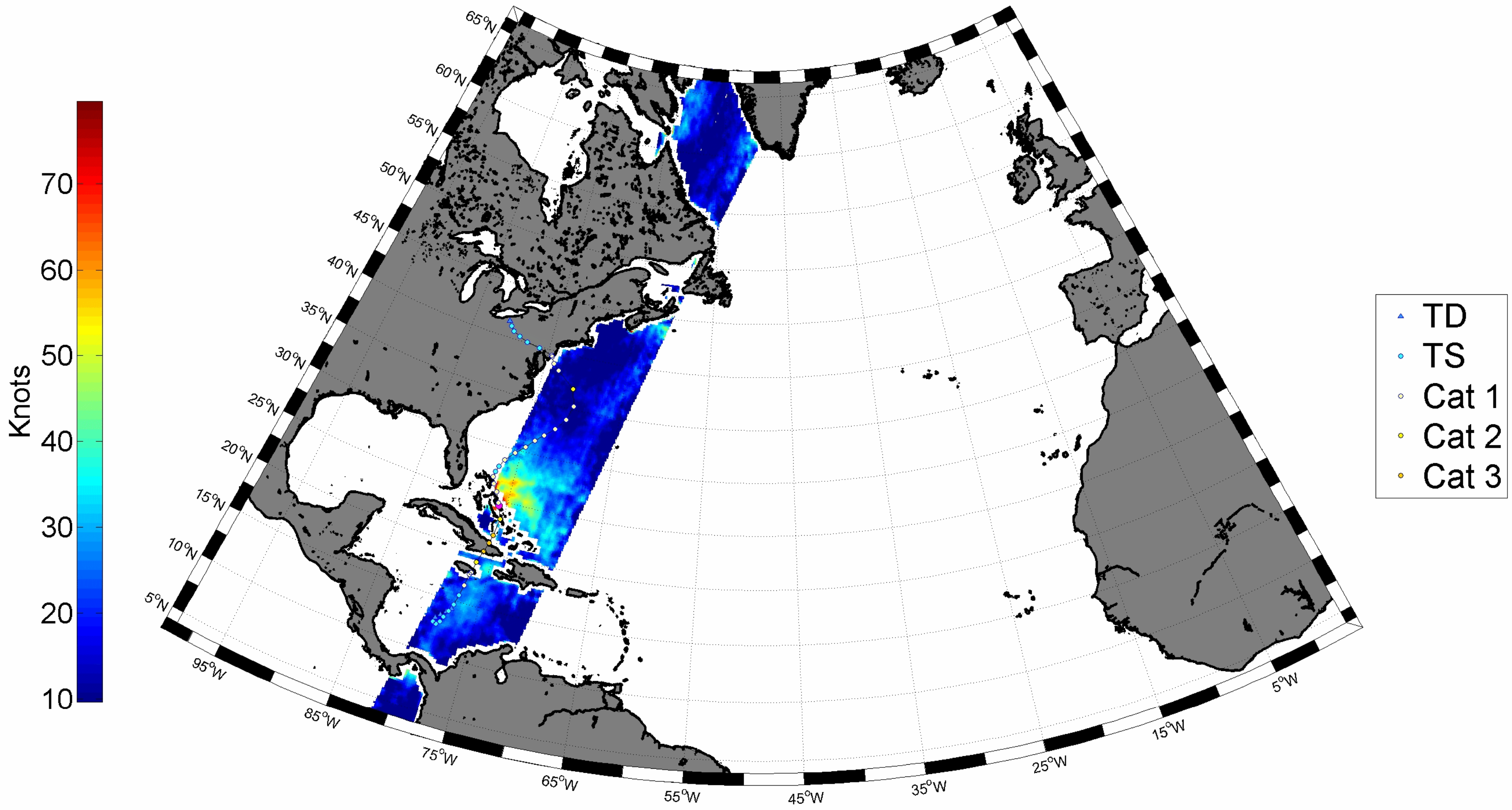
SMOS Wind speed -2012/10/25 at -10:19 UTC

North Atlantic TC :SANDY-2012/10



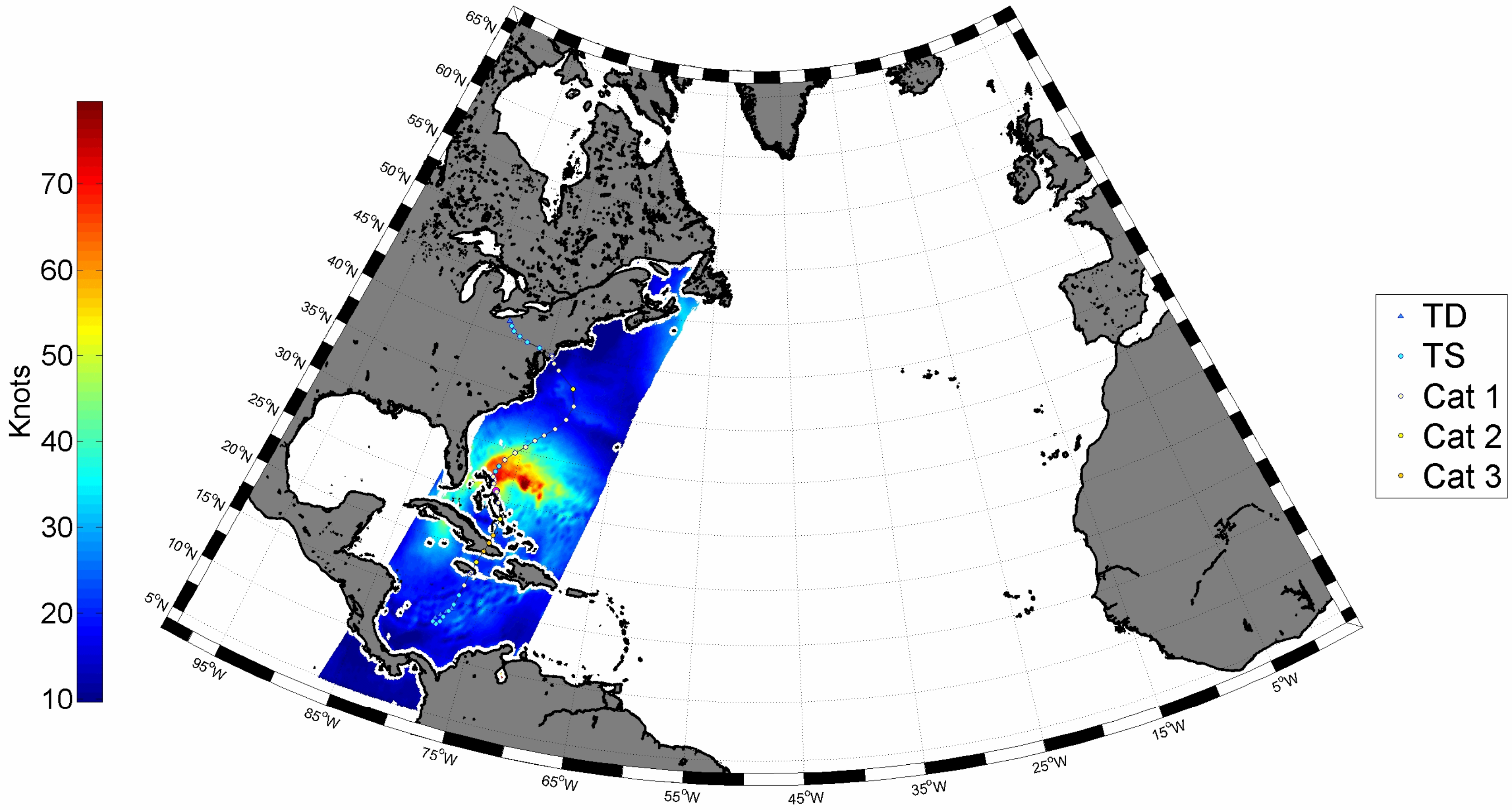
AMSR2 Wind speed -2012/10/25 at -18:28 UTC

North Atlantic TC :SANDY-2012/10



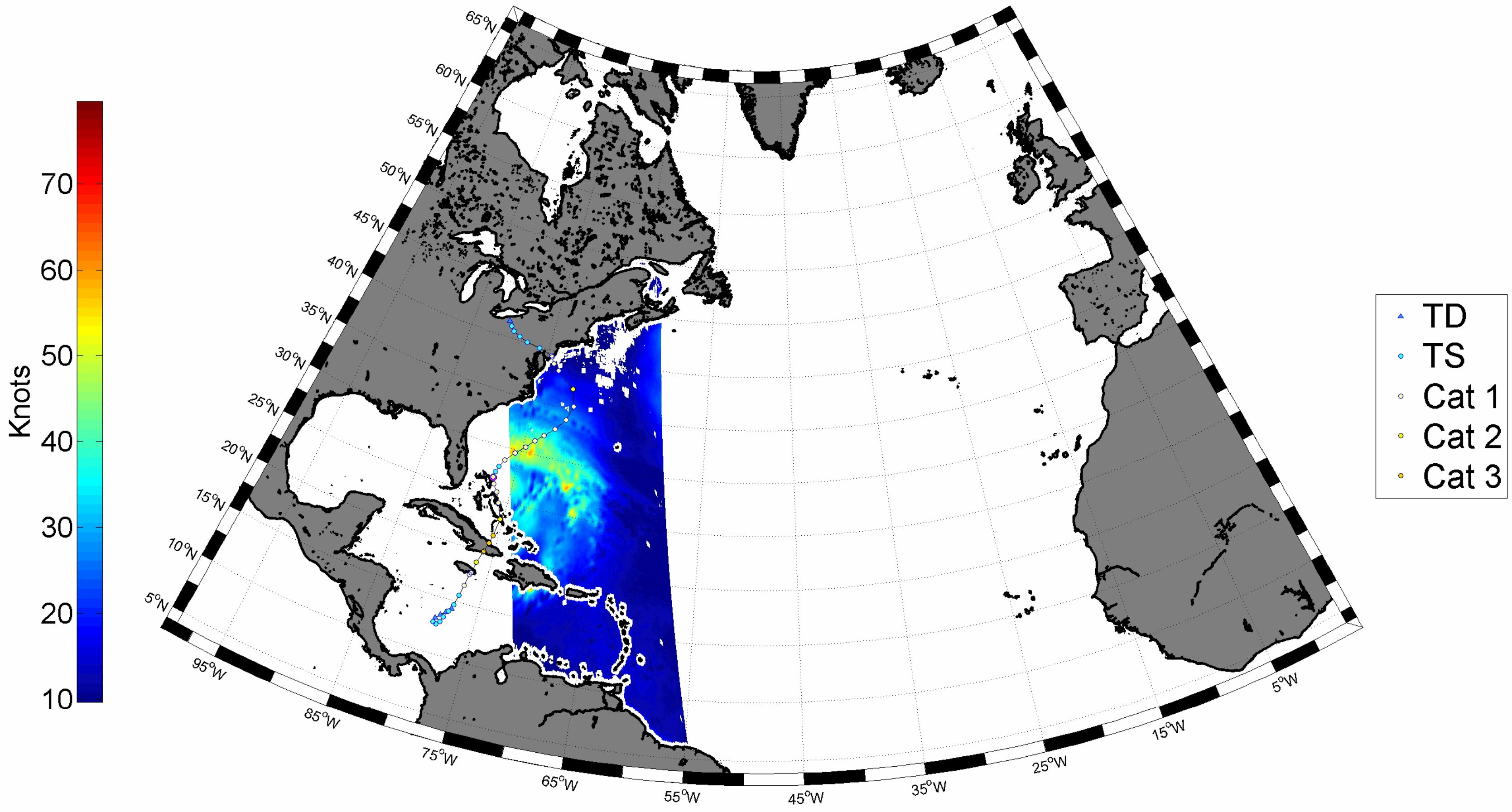
SMOS Wind speed -2012/10/25 at -22:51 UTC

North Atlantic TC :SANDY-2012/10



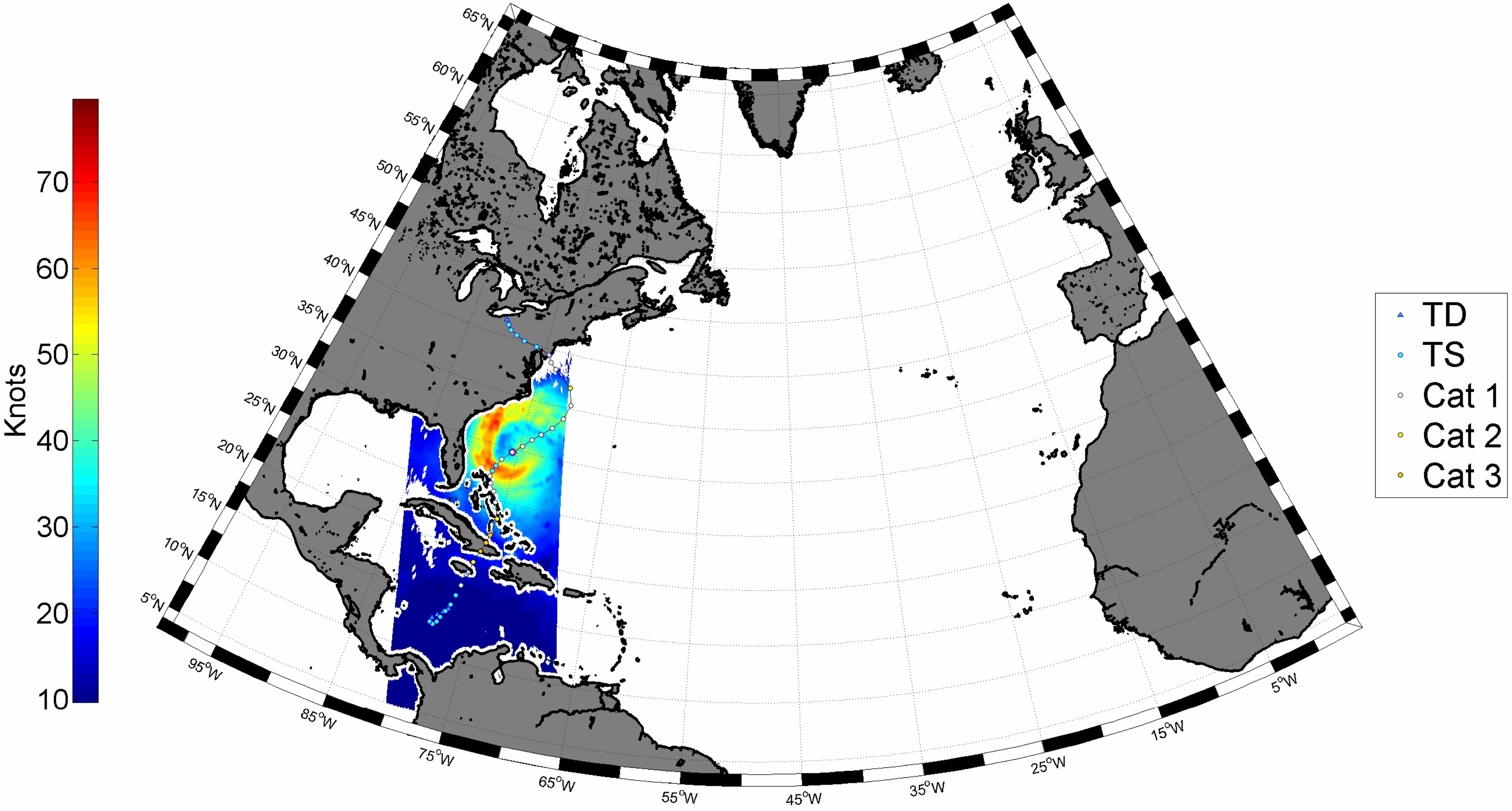
AMSR2 Wind speed -2012/10/26 at -06:49 UTC

North Atlantic TC :SANDY-2012/10



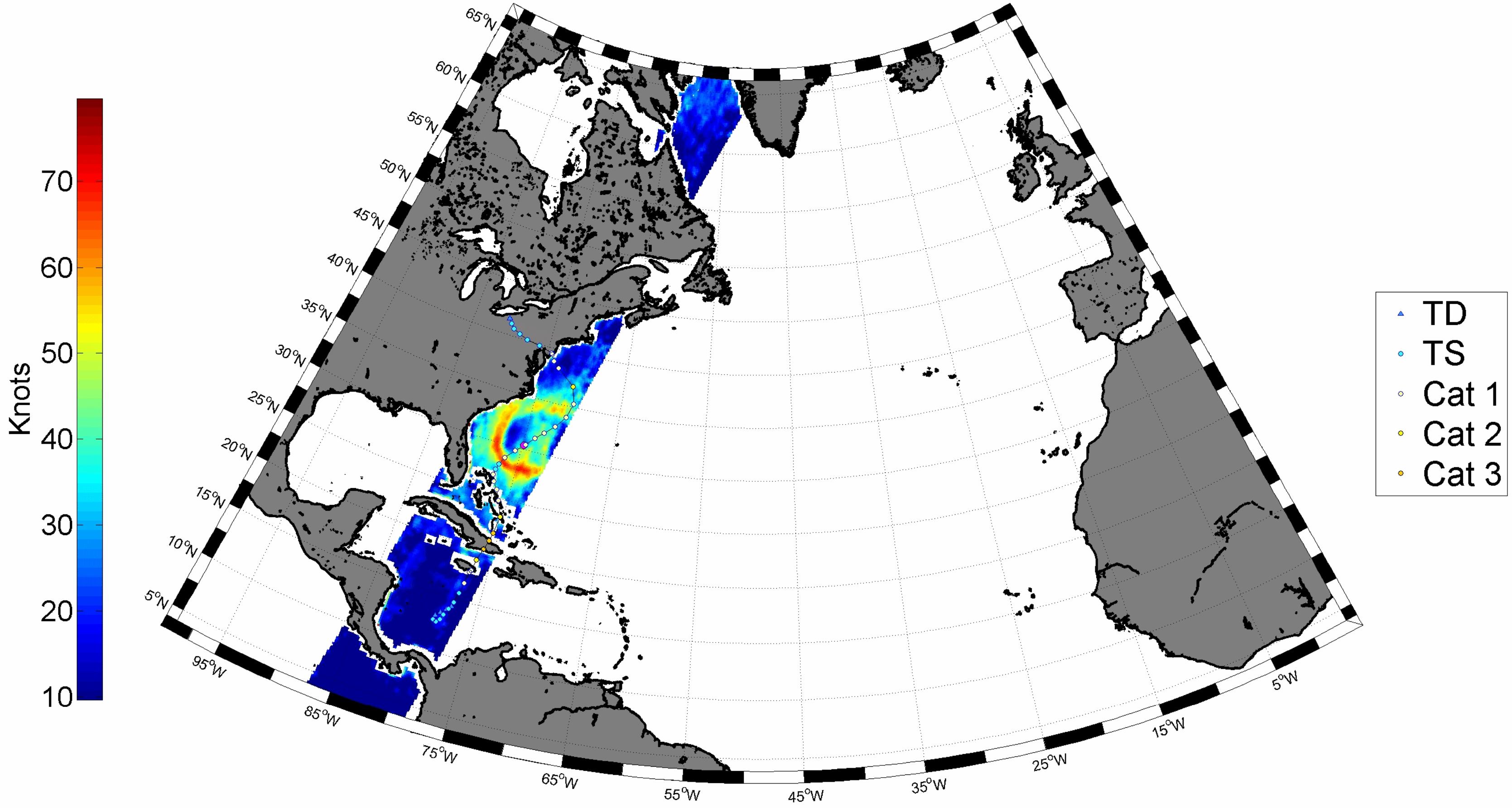
AMSR2 Wind speed -2012/10/26 at -17:32 UTC

North Atlantic TC :SANDY-2012/10



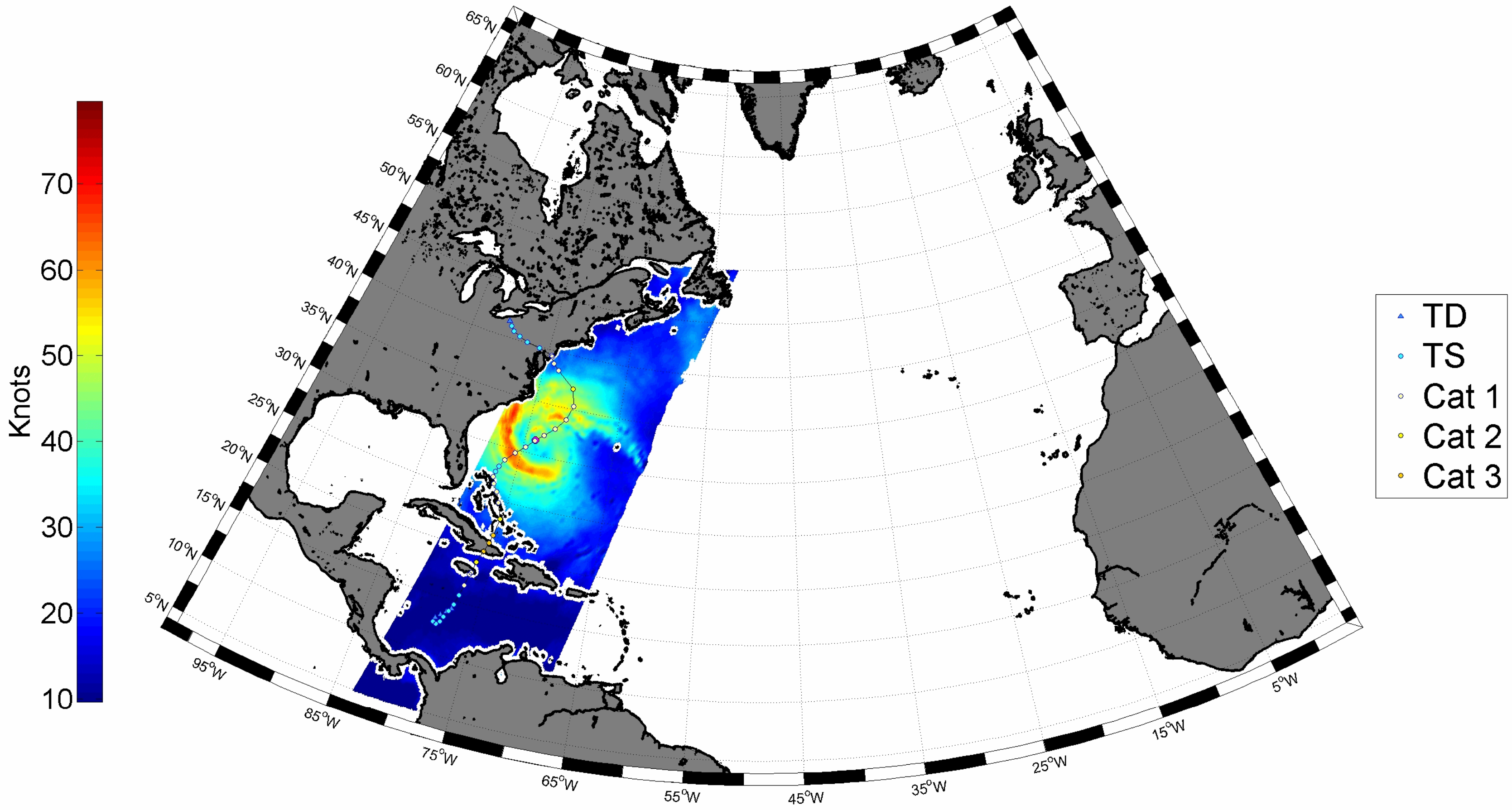
AMSR2 Wind speed -2012/10/27 at -18:15 UTC

North Atlantic TC :SANDY-2012/10



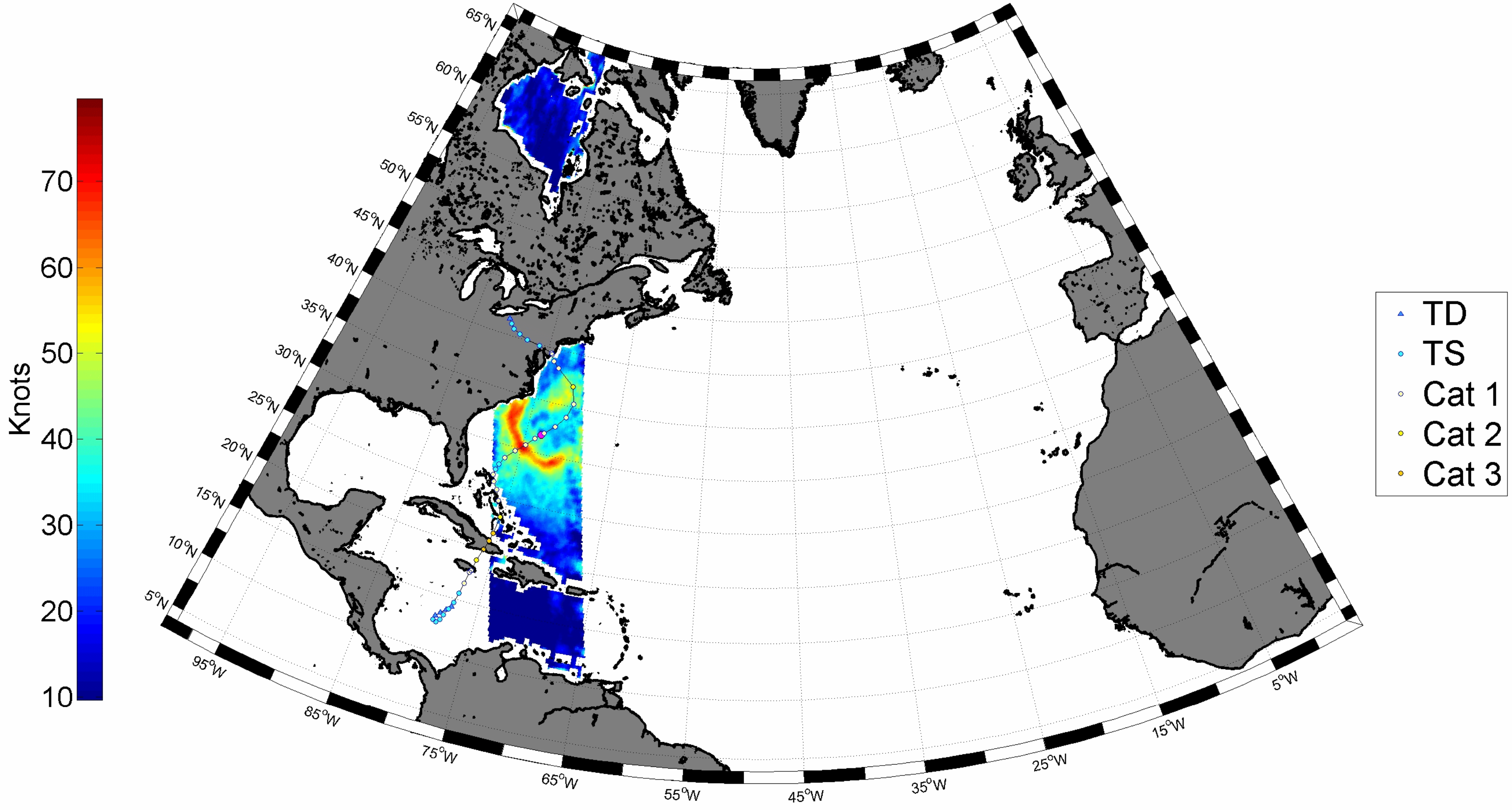
SMOS Wind speed -2012/10/27 at -23:13 UTC

North Atlantic TC :SANDY-2012/10



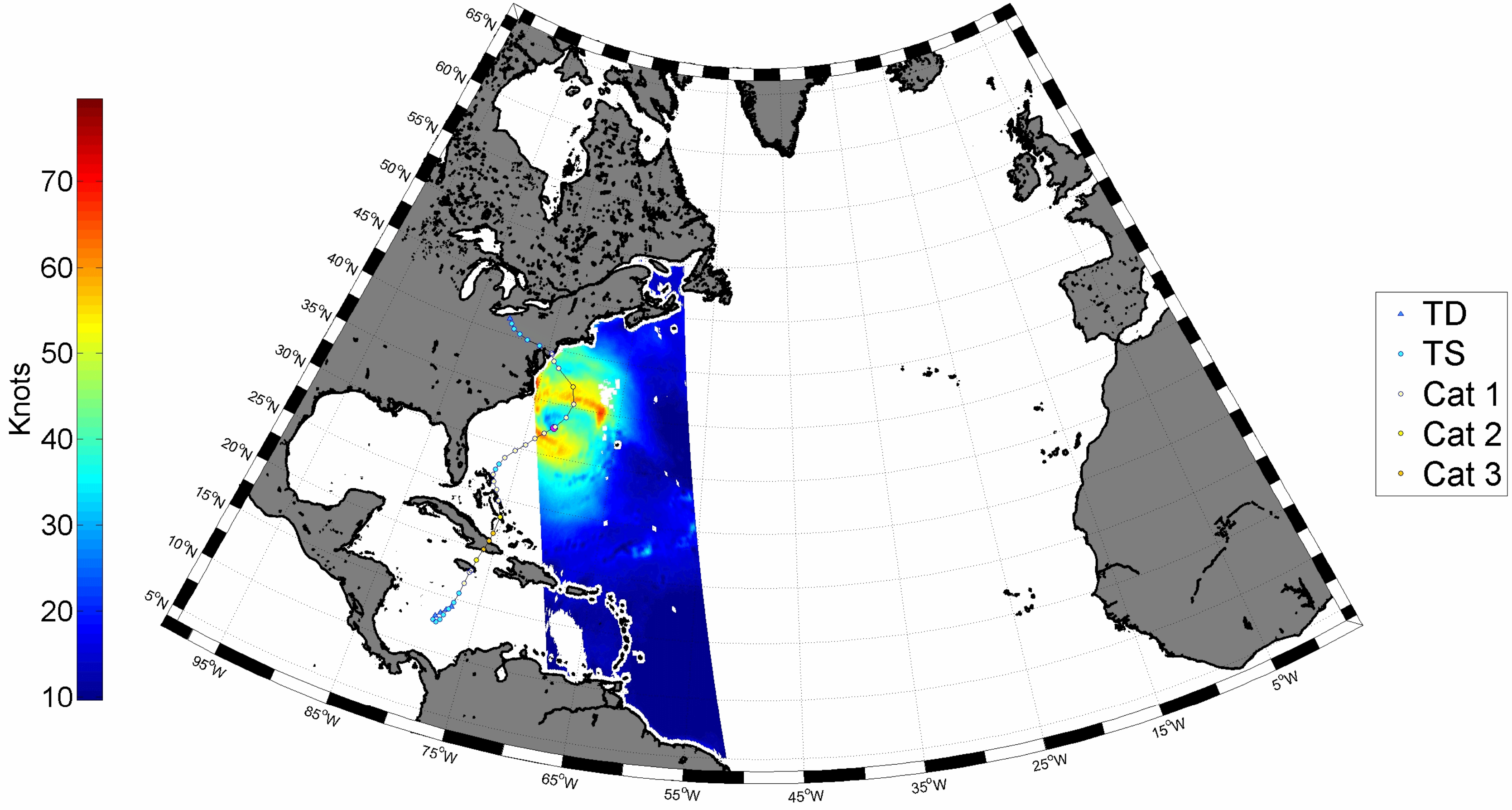
AMSR2 Wind speed -2012/10/28 at -06:37 UTC

North Atlantic TC :SANDY-2012/10

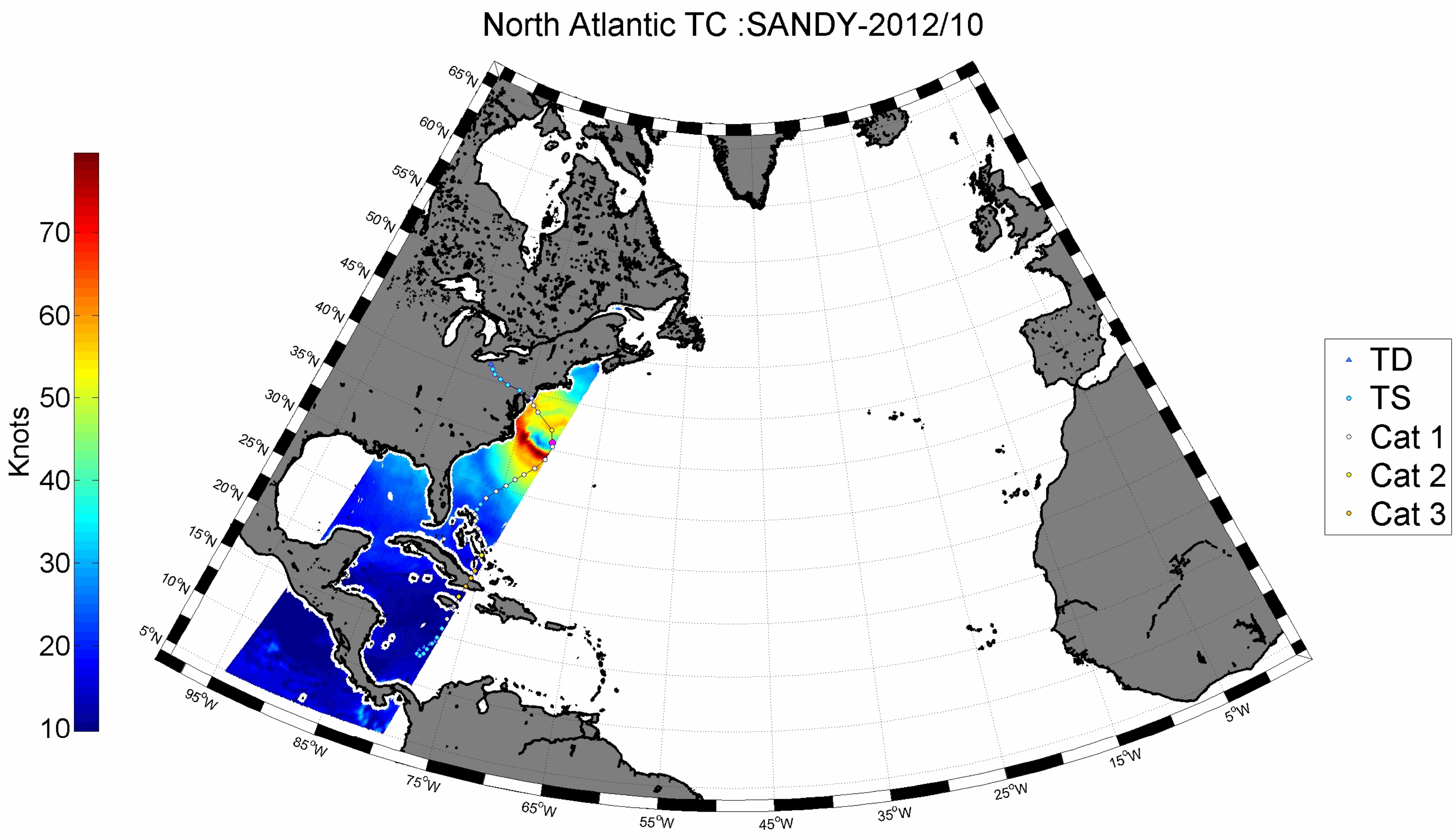


SMOS Wind speed -2012/10/28 at -10:03 UTC

North Atlantic TC :SANDY-2012/10



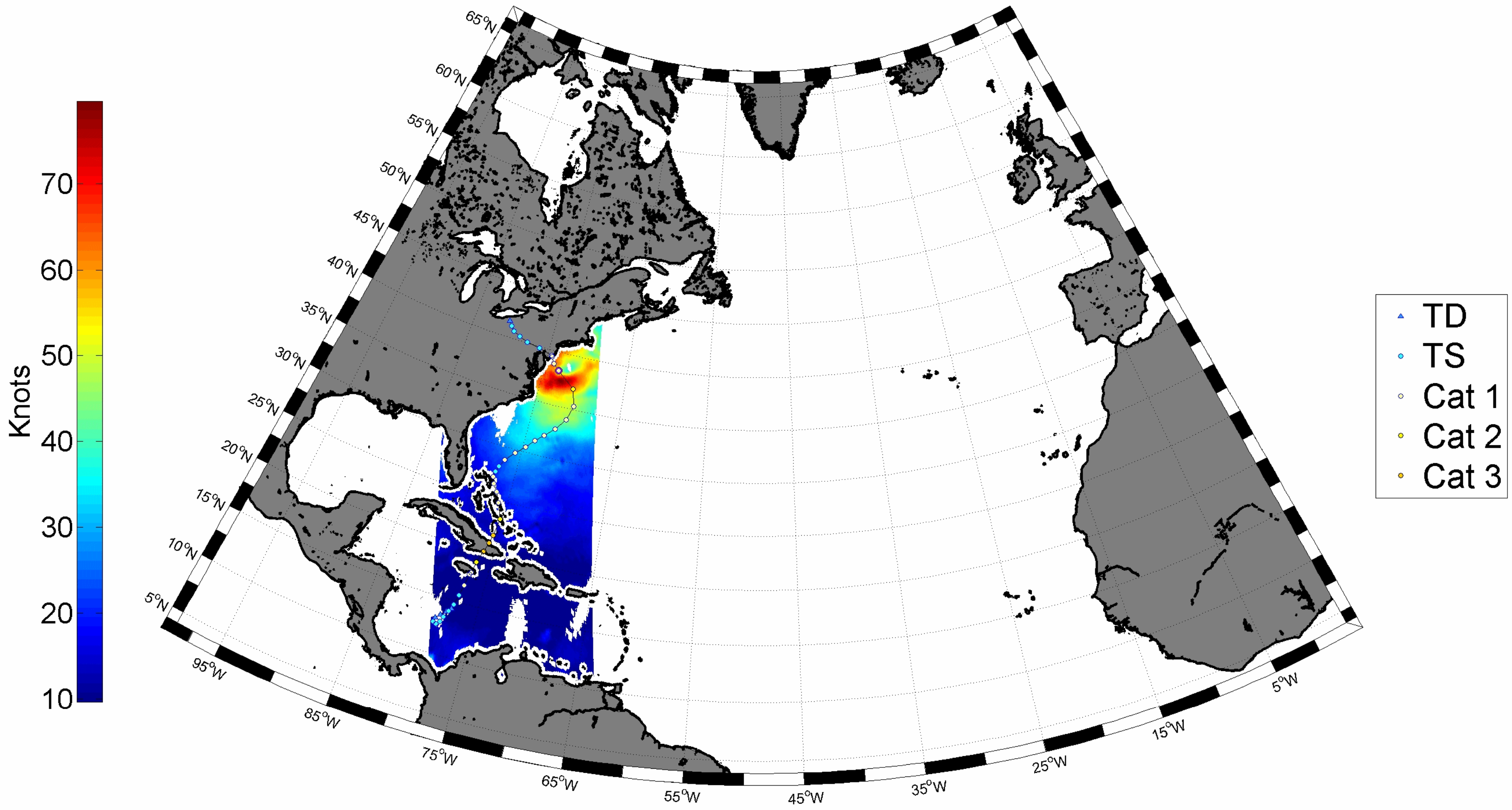
AMSR2 Wind speed -2012/10/28 at -17:20 UTC



North Atlantic TC :SANDY-2012/10

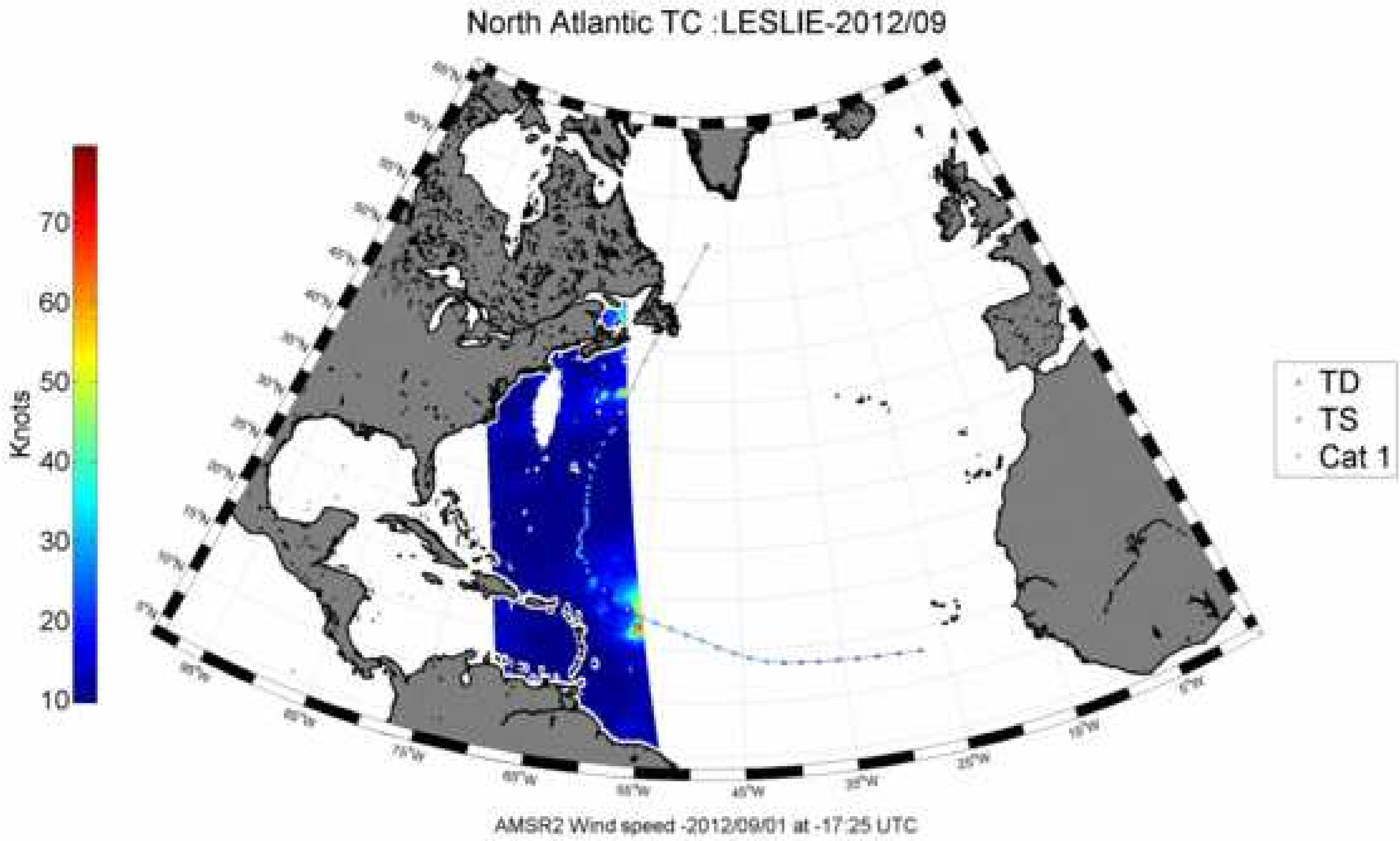
AMSR2 Wind speed -2012/10/29 at -07:20 UTC

North Atlantic TC :SANDY-2012/10



AMSR2 Wind speed -2012/10/29 at -18:03 UTC

Towards Merged SMOS-AMSR2-SMAP High wind products



Summary

- We evidenced clear SMOS brightness temperature signal (ΔT_B) associated with the passage of Tropical Cyclones

- Correlations between L-band Tb increase with TC intensity from Cat 1 to Cat 5 was demonstrated

- L-band observations provide a first non-atmosphere corrupted view of the ocean surface in extreme conditions=> wind speed retrieval with ~5m/s accuracy

- A complete storm database as been generated for the SMOS mission archive:

TC & ETC 2010-now

- We have shown that SMOS can allow to retrieve important structural surface wind features within hurricanes such as the radius of wind speed larger than 34, 50 and 64 knots. These are Key parameters to monitor tropical cyclone intensification

Ascat can provide R34, sometimes R50, but not above R64 =>SMOS does

Perspectives

- Merged low-frequency radiometer observations in extremes : SMOS+AMSR-2+SMAP +…CYGNSS=> new opportunity to study air-sea interactions in extreme wind conditions: foam & whitecaps properties, ocean response to TC passage, drag coefficient..
- SMOS wind speed data assimilation experiments into UK Metoffice forecasts model will be performed in the next months to investigate the data impact on:

-storm track & intensity forecasts skills