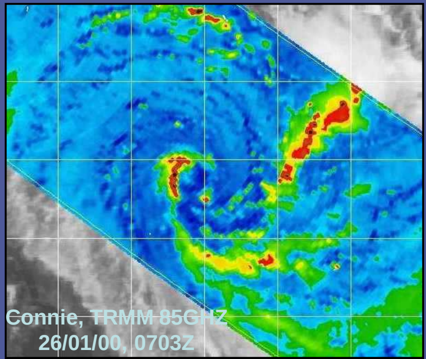
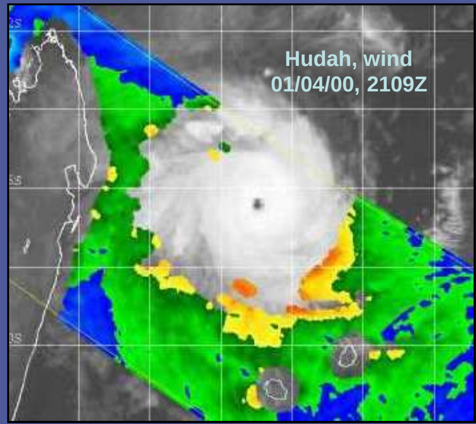
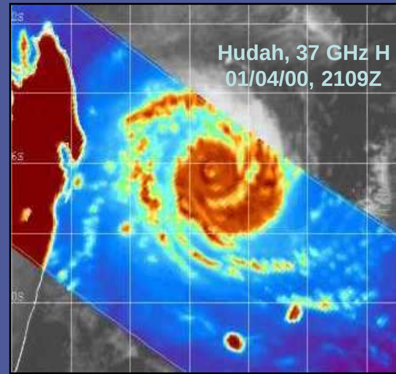




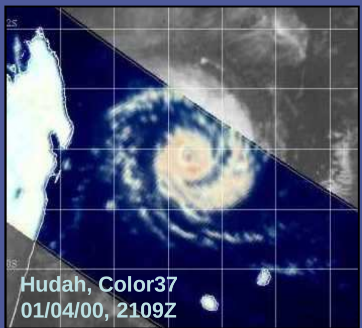


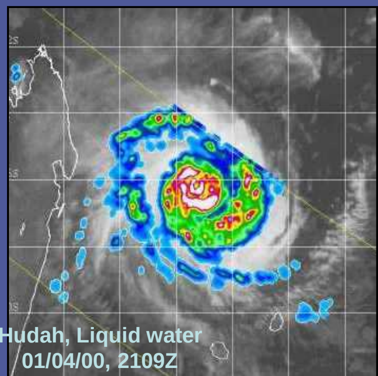
Satellite technology
Applications to tropical cyclones

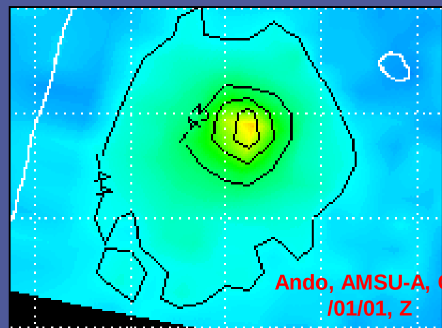
7th training course about tropical cyclones

WMO / Météo-France

September 2015







Anne-Claire FONTAN
Thierry DUPONT
Sébastien LANGLADE
METEO-FRANCE

METEO FRANCE
Toujours un temps d'avance

Outline

1. Synopsis on microwaves
2. SSMI, SSMI(S), GMI, AMSR2, Windsat ,AMSU-B sensors
3. TC Intensity estimate: objective guidances
4. Scatterometers
5. Cloud drift winds

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The Advanced Dvorak Technique (ADT)

Derrick Herndon, Timothy Olander and Chris Velden

University of Wisconsin - Madison

Cooperative Institute for Meteorological Satellite Studies

CIMSS

METEO FRANCE
Toujours un temps d'avance

ADT (Advanced Dvorak Technique)

• **Goal: use of IR imagery to objectively assess TC intensity by using the set of rules defined by Dvorak**
Objectif: Utilisation de l'imagerie Infrarouge pour déterminer objectivement l'intensité des phénomènes cycloniques selon les règles définies par Dvorak

•Limitations of the manual Dvorak technique:

- really subjective sometimes … (find the center, cloud pattern, measures …)
- can take a significant time to master for new analyst.
- lack of statistical relationships between various environmental parameters and intensity

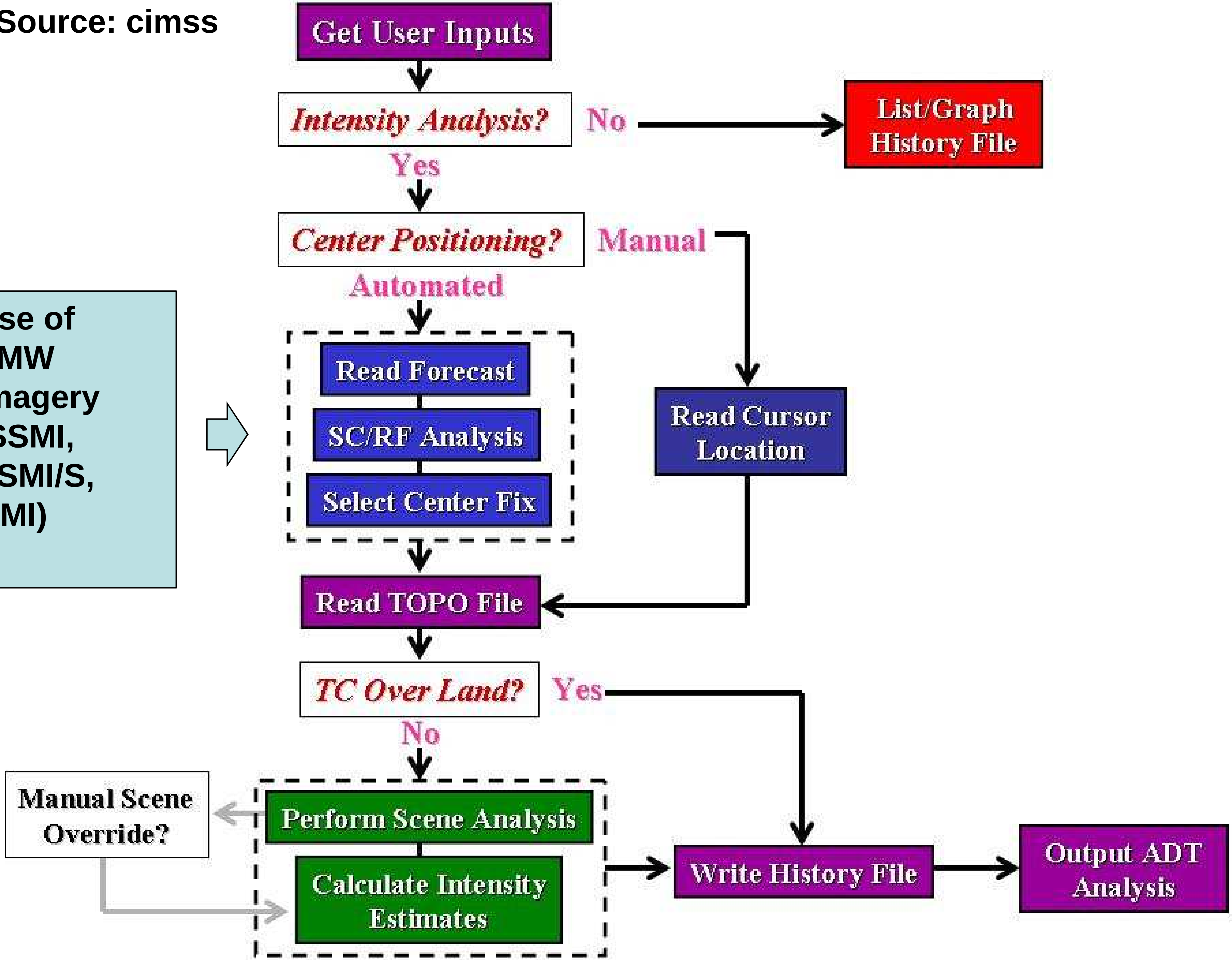
• The ADT (and its predecessors the ODT and AODT) sought to alleviate many of the limitations found within the Dvorak technique:

• objective storm center determination scheme and cloud pattern determination logic

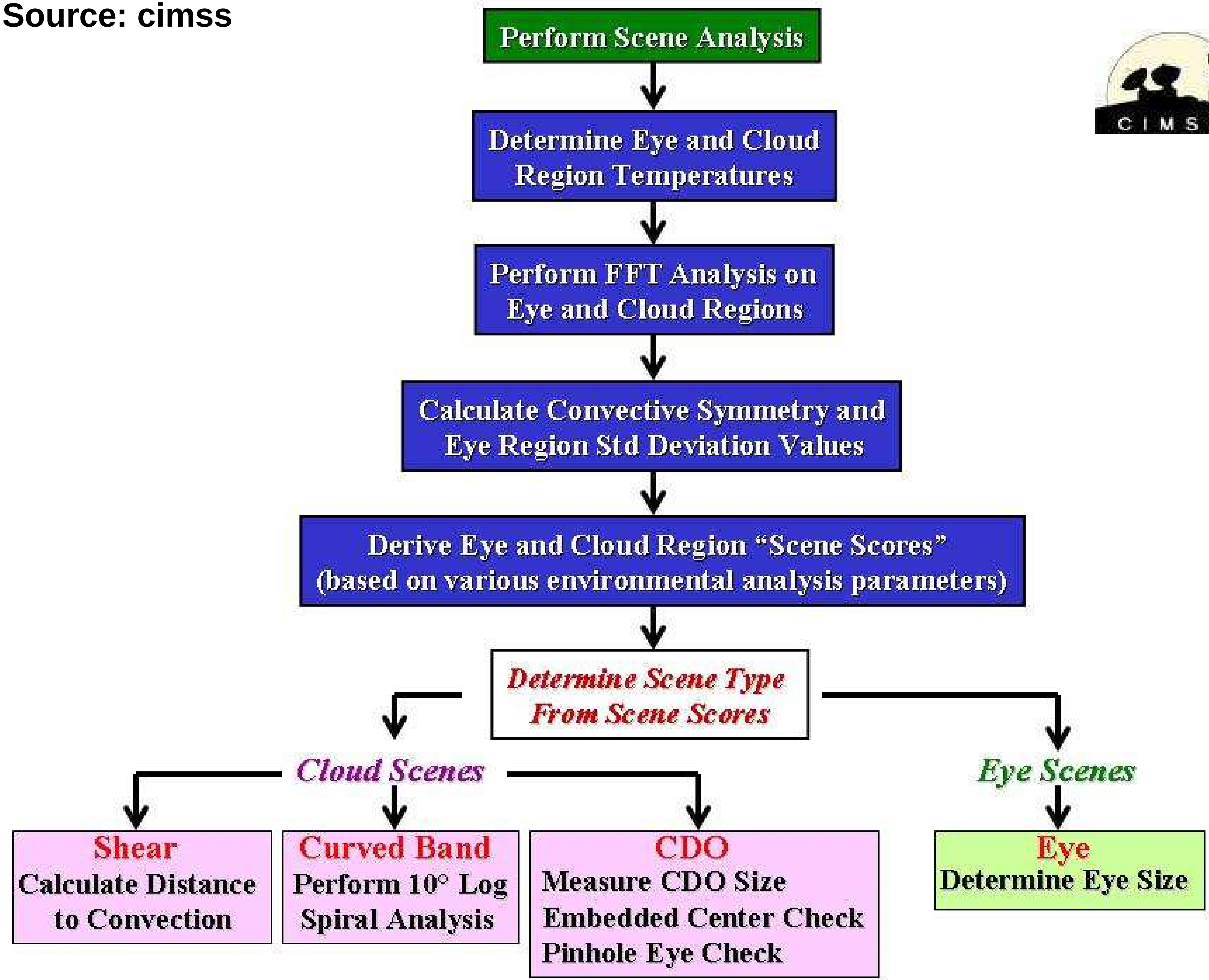
• use of statistical analysis results obtained from a 10+ year sample of North Atlantic storms, along with a significant sample of West and East Pacific storms, covering the entire spectrum of TC intensities to derive a regression-based intensity value estimate for various phases of the TC lifecycle.

Source: cimss

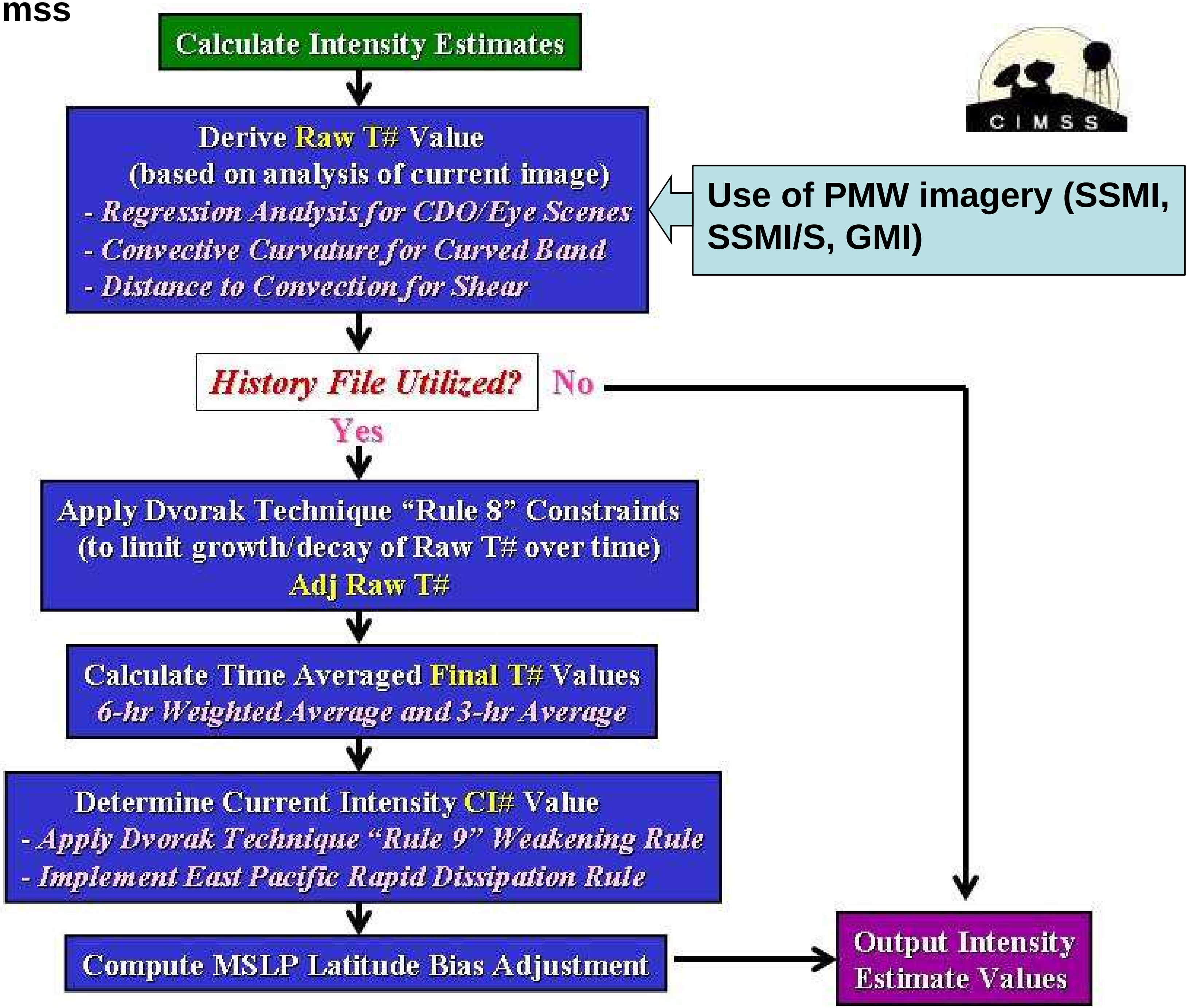
Use of PMW imagery (SSMI, SSMI/S, GMI)



Source: cimss



Source: cimss



Where can I find ADT outputs ?

CIMSS ADT: http://tropic.ssec.wisc.edu/real-time/adt/adt.html
NESDIS ADT: http://www.ssd.noaa.gov/PS/TROP/adt.html

ADT821 LIST 20W.ODT CKZ=YES
===== ADT-Version 8.2.1 =====

		----Intensity---			-Tno Values--			---Tno/CI Rules---			-Temperature-									
Date	Time (UTC)	CI	MSLP/Vmax (CKZ)/	(kts)	Fnl Tno	Adj Raw	Ini Raw	Cnstrnt Limit	Wkng Flag	Rpd Wkng	Cntr Region	Mean Cloud	Scene Type	EstRMW (km)	MW Score	Storm Location Lat	Lon	Fix Mthd	Sat	VZA
Comments																				
2015SEP14	193000	1.5	1006.8	25.0	1.5	1.5	1.5	NO LIMIT	OFF	OFF	-58.31	-44.04	UNIFRM	N/A	N/A	17.19	-151.83	FCST	MTSAT2	21.6
2015SEP14	200000	1.6	1006.6	26.0	1.6	1.7	1.7	NO LIMIT	OFF	OFF	-58.31	-45.08	UNIFRM	N/A	N/A	17.23	-151.76	FCST	MTSAT2	21.6
2015SEP14	203000	1.6	1006.6	26.0	1.6	1.7	1.7	NO LIMIT	OFF	OFF	-50.31	-42.87	UNIFRM	N/A	N/A	17.27	-151.73	FCST	MTSAT2	21.6
2015SEP14	210000	1.7	1006.3	27.0	1.7	1.9	2.2	0.2T/hour	OFF	OFF	-35.83	-41.11	CRVBND	N/A	N/A	17.30	-151.70	FCST	MTSAT2	21.7
2015SEP14	213000	1.7	1006.3	27.0	1.7	1.9	2.3	0.2T/hour	OFF	OFF	-14.00	-37.44	CRVBND	N/A	-4.0	17.34	-151.67	FCST	MTSAT2	21.7
2015SEP14	220000	1.8	1006.0	28.0	1.8	2.1	2.3	0.2T/hour	OFF	OFF	-10.79	-32.87	CRVBND	N/A	-4.0	17.37	-151.64	FCST	MTSAT2	21.7
2015SEP14	223000	1.8	1005.9	28.0	1.8	2.0	2.0	NO LIMIT	OFF	OFF	-5.91	-28.70	CRVBND	N/A	-4.0	17.41	-151.61	FCST	MTSAT2	21.8
2015SEP14	231500	1.9	1005.6	29.0	1.9	2.2	2.5	0.2T/hour	OFF	OFF	-3.11	-22.64	SHEAR	N/A	-4.0	17.47	-151.58	FCST	MTSAT2	21.8
2015SEP14	233000	2.0	1004.2	30.0	2.0	2.2	2.5	0.2T/hour	OFF	OFF	-1.80	-20.78	SHEAR	N/A	-4.0	17.49	-151.56	FCST	MTSAT2	21.8
2015SEP15	003000	2.1	1003.6	31.0	2.1	2.1	2.1	NO LIMIT	OFF	OFF	9.06	-23.29	CRVBND	N/A	-4.0	18.05	-151.57	FCST	MTSAT2	22.4
2015SEP15	010000	2.1	1003.6	31.0	2.1	2.3	2.3	NO LIMIT	OFF	OFF	14.46	-21.33	CRVBND	N/A	-4.0	18.09	-151.53	FCST	MTSAT2	22.5
2015SEP15	013000	2.2	1003.2	32.0	2.2	2.3	2.5	0.2T/hour	OFF	OFF	9.41	-22.85	SHEAR	N/A	-4.0	18.00	-151.40	FCST	MTSAT2	22.3
2015SEP15	020000	2.2	1003.2	32.0	2.2	2.2	2.2	NO LIMIT	OFF	OFF	11.35	-21.82	CRVBND	N/A	-4.0	18.03	-151.37	FCST	MTSAT2	22.3
2015SEP15	023000	2.2	1003.2	32.0	2.2	2.3	2.3	NO LIMIT	OFF	OFF	14.90	-21.33	CRVBND	N/A	-4.0	18.07	-151.33	FCST	MTSAT2	22.4
2015SEP15	030000	2.2	1003.2	32.0	2.2	2.3	2.3	NO LIMIT	OFF	OFF	11.13	-20.71	CRVBND	N/A	-4.0	18.10	-151.30	FCST	MTSAT2	22.4
2015SEP15	033000	2.2	1003.2	32.0	2.2	2.3	2.3	NO LIMIT	OFF	OFF	9.41	-19.18	CRVBND	N/A	-4.0	18.14	-151.26	FCST	MTSAT2	22.4
2015SEP15	040000	2.2	1003.2	32.0	2.2	2.1	2.1	NO LIMIT	OFF	OFF	2.01	-16.96	CRVBND	N/A	-4.0	18.17	-151.23	FCST	MTSAT2	22.4
2015SEP15	043000	2.2	1003.2	32.0	2.2	2.1	2.1	NO LIMIT	OFF	OFF	-7.27	-17.50	CRVBND	N/A	-4.0	18.20	-151.19	FCST	MTSAT2	22.5
2015SEP15	051500	2.2	1003.1	32.0	2.2	2.3	2.3	NO LIMIT	OFF	OFF	5.18	-19.81	CRVBND	N/A	-4.0	18.25	-151.14	FCST	MTSAT2	22.5
2015SEP15	053000	2.2	1003.1	32.0	2.2	2.3	2.3	NO LIMIT	OFF	OFF	8.60	-19.65	CRVBND	N/A	-4.0	18.27	-151.12	FCST	MTSAT2	22.5
2015SEP15	063000	2.2	1001.3	32.0	2.2	2.1	2.1	NO LIMIT	OFF	OFF	15.13	-24.04	CRVBND	N/A	-4.0	18.34	-151.05	FCST	MTSAT2	22.6
2015SEP15	070000	2.2	1001.3	32.0	2.2	2.5	2.5	NO LIMIT	OFF	OFF	10.44	-26.93	SHEAR	N/A	-4.0	18.37	-151.01	FCST	MTSAT2	22.6
2015SEP15	073000	2.3	1000.8	33.0	2.3	2.5	2.5	NO LIMIT	OFF	OFF	11.91	-29.83	SHEAR	N/A	-4.0	18.40	-150.97	FCST	MTSAT2	22.6
2015SEP15	080000	2.4	1000.5	34.0	2.4	2.7	3.1	0.5T/hour	OFF	OFF	-68.20	-55.33	IRRCDO	N/A	-4.0	18.07	-150.32	FCST	MTSAT2	22.0
2015SEP15	083000	2.4	1000.5	34.0	2.4	2.4	2.4	NO LIMIT	OFF	OFF	-68.20	-60.25	UNIFRM	N/A	-4.0	18.09	-150.26	FCST	MTSAT2	22.0
2015SEP15	090000	2.4	1000.5	34.0	2.4	2.5	2.5	NO LIMIT	OFF	OFF	-61.38	-61.43	UNIFRM	N/A	-4.0	18.10	-150.20	FCST	MTSAT2	22.0
2015SEP15	093000	2.5	1000.1	35.0	2.5	2.6	2.6	NO LIMIT	OFF	OFF	-52.93	-61.63	UNIFRM	N/A	-4.0	18.12	-150.14	FCST	MTSAT2	22.0
2015SEP15	100000	2.5	1000.1	35.0	2.5	2.9	3.4	0.7T/6hr	OFF	OFF	-48.79	-59.54	CRVBND	N/A	-4.0	18.13	-150.08	FCST	MTSAT2	22.0
2015SEP15	103000	2.6	999.1	37.0	2.6	2.9	2.9	NO LIMIT	OFF	OFF	-54.02	-58.46	CRVBND	N/A	-4.0	18.14	-150.02	FCST	MTSAT2	22.0
2015SEP15	111500	2.7	998.1	39.0	2.7	2.9	2.9	NO LIMIT	OFF	OFF	-49.80	-56.06	CRVBND	N/A	-4.0	18.16	-149.94	FCST	MTSAT2	22.0
2015SEP15	113000	2.7	999.1	39.0	2.7	2.9	2.9	NO LIMIT	OFF	OFF	-36.24	-54.24	CRVBND	N/A	-4.0	18.20	-149.97	EXTRP	MTSAT2	22.1
2015SEP15	123000	2.8	997.9	41.0	2.8	2.8	2.8	NO LIMIT	OFF	OFF	-67.47	-57.79	UNIFRM	N/A	-4.0	18.33	-149.62	FCST	MTSAT2	22.1
2015SEP15	130000	2.8	997.9	41.0	2.8	2.9	2.9	NO LIMIT	OFF	OFF	-65.36	-58.90	UNIFRM	N/A	-4.0	18.36	-149.55	FCST	MTSAT2	22.1
2015SEP15	133000	2.8	997.8	41.0	2.8	2.9	2.9	NO LIMIT	OFF	OFF	-69.68	-59.94	UNIFRM	N/A	-4.0	18.41	-149.50	FCST	MTSAT2	22.2
2015SEP15	140000	2.9	996.6	43.0	2.9	3.0	3.0	NO LIMIT	OFF	OFF	-67.83	-60.88	UNIFRM	N/A	-4.0	18.44	-149.43	FCST	MTSAT2	22.2
2015SEP15	143000	2.9	996.6	43.0	2.9	3.1	3.1	NO LIMIT	OFF	OFF	-64.33	-60.79	UNIFRM	N/A	-4.0	18.47	-149.36	FCST	MTSAT2	22.2
2015SEP15	150000	2.9	996.6	43.0	2.9	3.0	3.0	NO LIMIT	OFF	OFF	-66.05	-61.34	UNIFRM	N/A	-4.0	18.50	-149.30	FCST	MTSAT2	22.2
2015SEP15	153000	2.9	996.6	43.0	2.9	3.2	3.3	0.7T/6hr	OFF	OFF	-67.83	-58.91	IRRCDO	N/A	-4.0	18.53	-149.23	FCST	MTSAT2	22.2
2015SEP15	160000	3.0	995.4	45.0	3.0	3.2	3.2	NO LIMIT	OFF	OFF	-66.75	-57.92	IRRCDO	N/A	-4.0	18.56	-149.16	FCST	MTSAT2	22.2

ADT (Advanced Dvorak Technique)

- **Why do we still need the manual Dvorak analysis ?**

  - Feedbacks show that finding the right center is still an issue …(hard to automatically find the true center …)

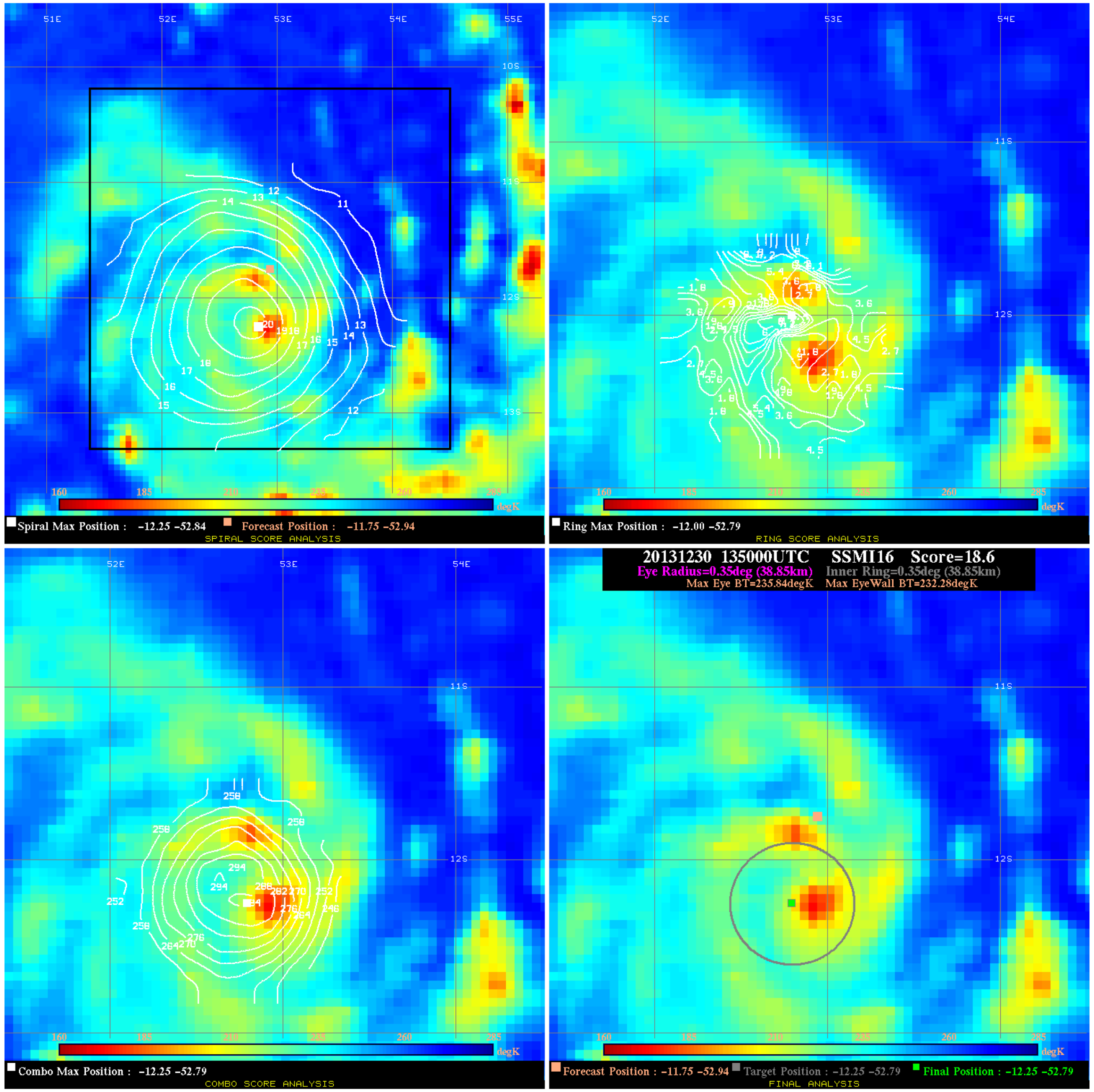
  - Passive microwave imagery is not used for intensity estimate under 55 kt (1' winds) to rule out weak but highly symetric TCs

- ***Pourquoi devons nous encore faire des analyses manuelles de Dvorak ?***

  - *Le retour d'expérience montre que la détermination automatique du centre reste un problème … (il est illusoire de penser qu'on peut à coup sûr trouver le vrai centre de façon complètement automatique)*

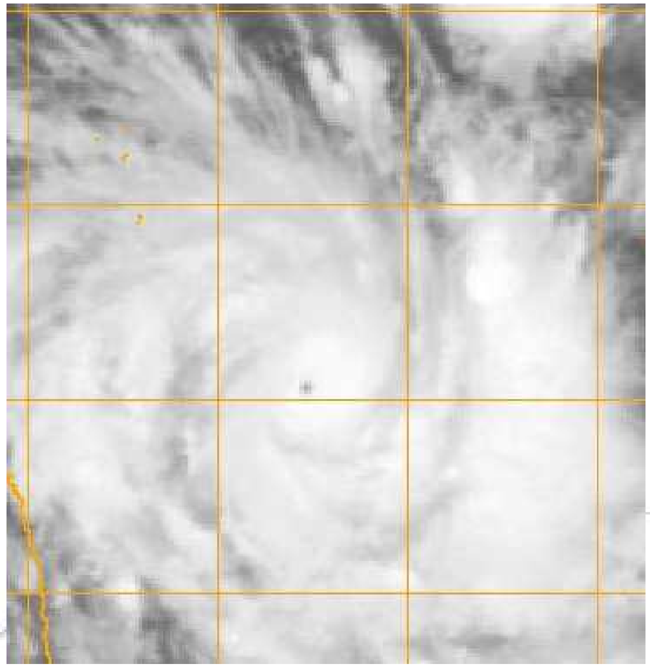
  - *L'utilisation de l'imagerie micro-ondes ne se fait pour l'estimation de l'intensité qu'à partir de 55 kt (1' min) pour éliminer les cas de faibles systèmes présentant une structure très symétrique.*

ADT (Advanced Dvorak Technique)



2013DEC30 140000 3.6 995.0 **57.0** 3.6 3.6 3.6 NO LIMIT OFF OFF -65.76 -67.50 UNIFRM N/A 18.6 -**11.79 -52.94 FCST** MET7 14.6

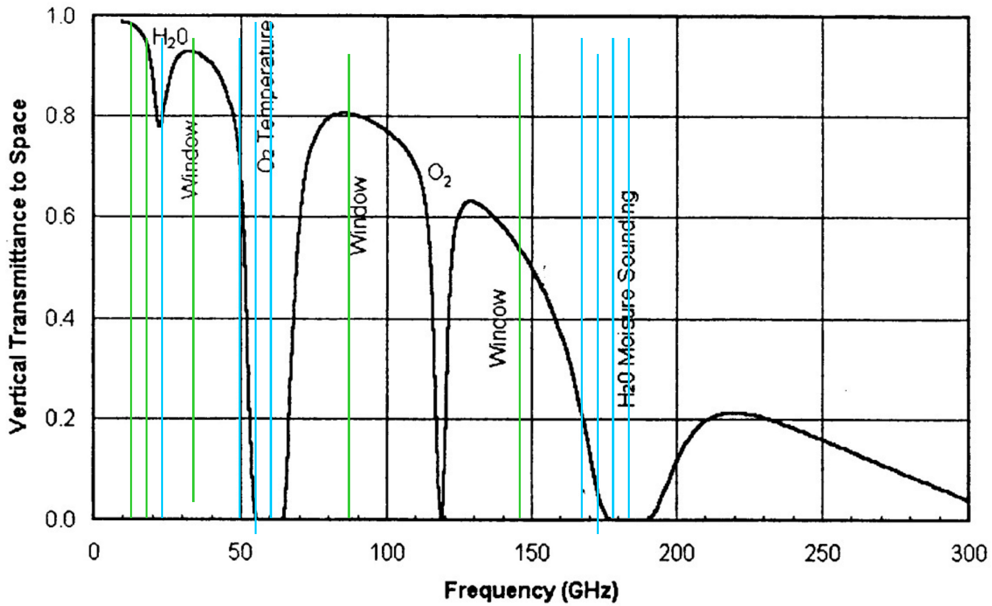
BT data at 90 kt at 12Z !!



AMSU
Advanced Microwave Sounder Unit

METEO FRANCE
Toujours un temps d'avance

Microwave channel selection

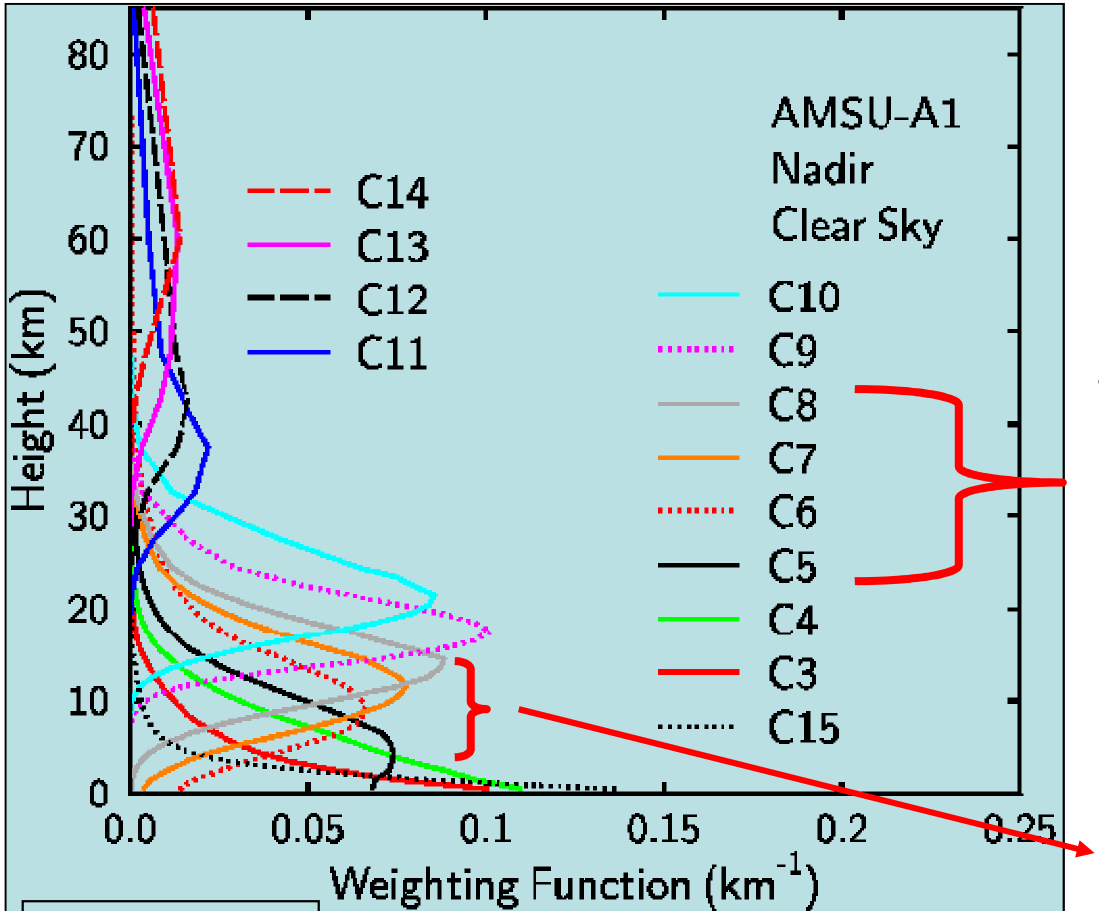


- **Canaux "imageurs"**
  - utilisent les canaux de la fenêtre de transmission
  - sont destinés à observer la surface, les nuages et la pluie, etc.
  - mesurent souvent la polarisation**.**
- ***Imaging channels***
  - *Generally use window channels*
  - *Aim to observe surface, clouds, rain, etc*
  - *Often measure polarization*

- **Canaux "sondeurs"**
  - canaux situés en bordure des bandes principales d'absorption
  - détectent le rayonnement de l'air ou de la vapeur d'eau
  - sont destinés à produire des profils verticaux de température, d'humidité etc...
  - ne mesurent pas la polarisation
- ***Sounding channels***
  - *Closely spaced channels on edge of major absorption band.*
  - *Detect radiation from air or water vapour.*
  - *Aim to produce vertical profiles of temperature, moisture, etc*
  - *Usually don't measure polarization**.***

AMSU-A

- 15 canaux d'AMSU sont calibrés pour correspondre chacun à une tranche atmosphérique
- *Each of the 15 AMSU channels are calibrated to correspond to an atmospheric level*



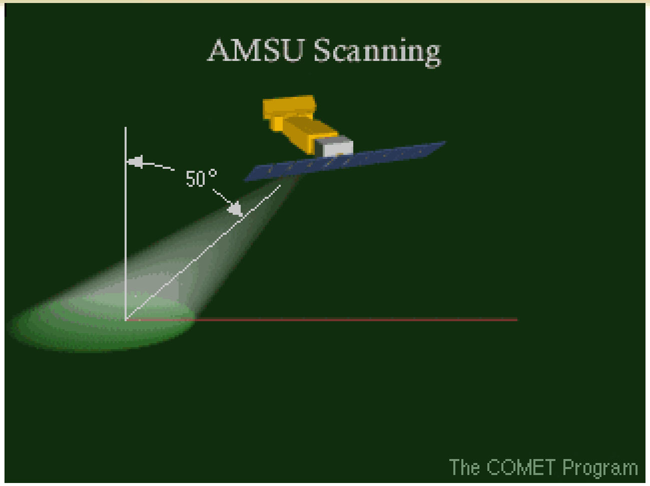
Source CIMSS

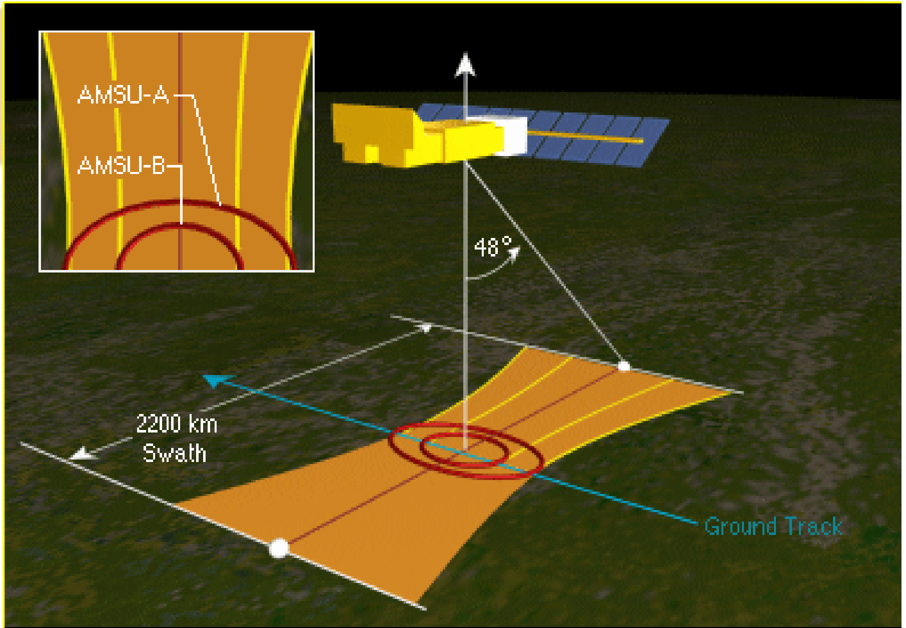
Les canaux 5 à 8 couvrent la haute troposphère et sont donc à même de détecter les cœurs chauds des cyclones.

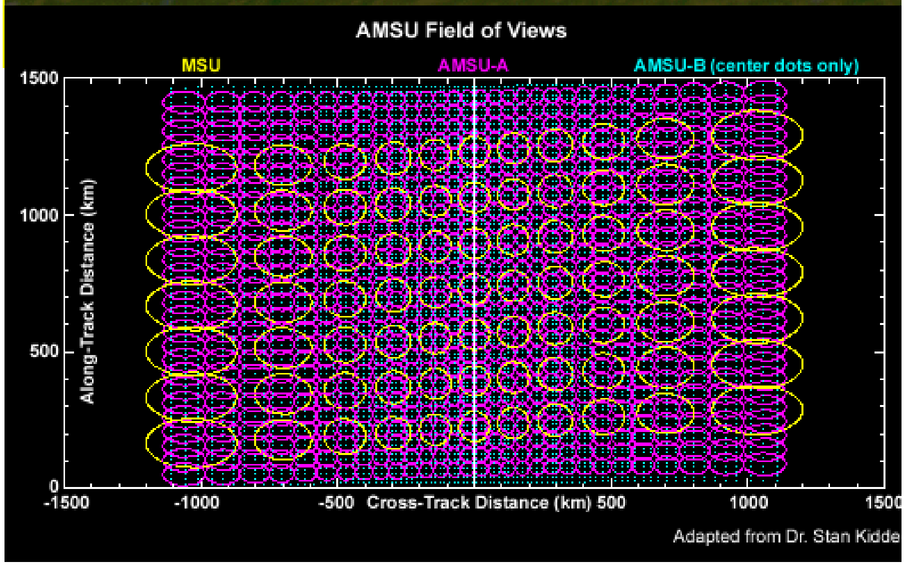
Channels 5 to 8 cover upper troposphere – so, can be used for detecting tropical cyclones warm core

Canal 8 (55.5 Ghz) ~100 mb (~15km)
Canal 7 (54.94 Ghz) ~200 mb (~12km)
Canal 6 (54.46 Ghz) ~350 mb (~10km)
Canal 5 (53.6 Ghz) ~550 mb (~ 5km)

AMSU - *General ideas 1*







- **Balayage transverse**
  - Angle d'incidence variable
  - Nécessite la correction «bord de fauchée »
- **Largeur de fauchée de 2200 km.**
  - Plus large que SSM/I
- **Résolution 15 - 50 km.**
- **Deux différents instruments dits AMSU-A et AMSU-B**

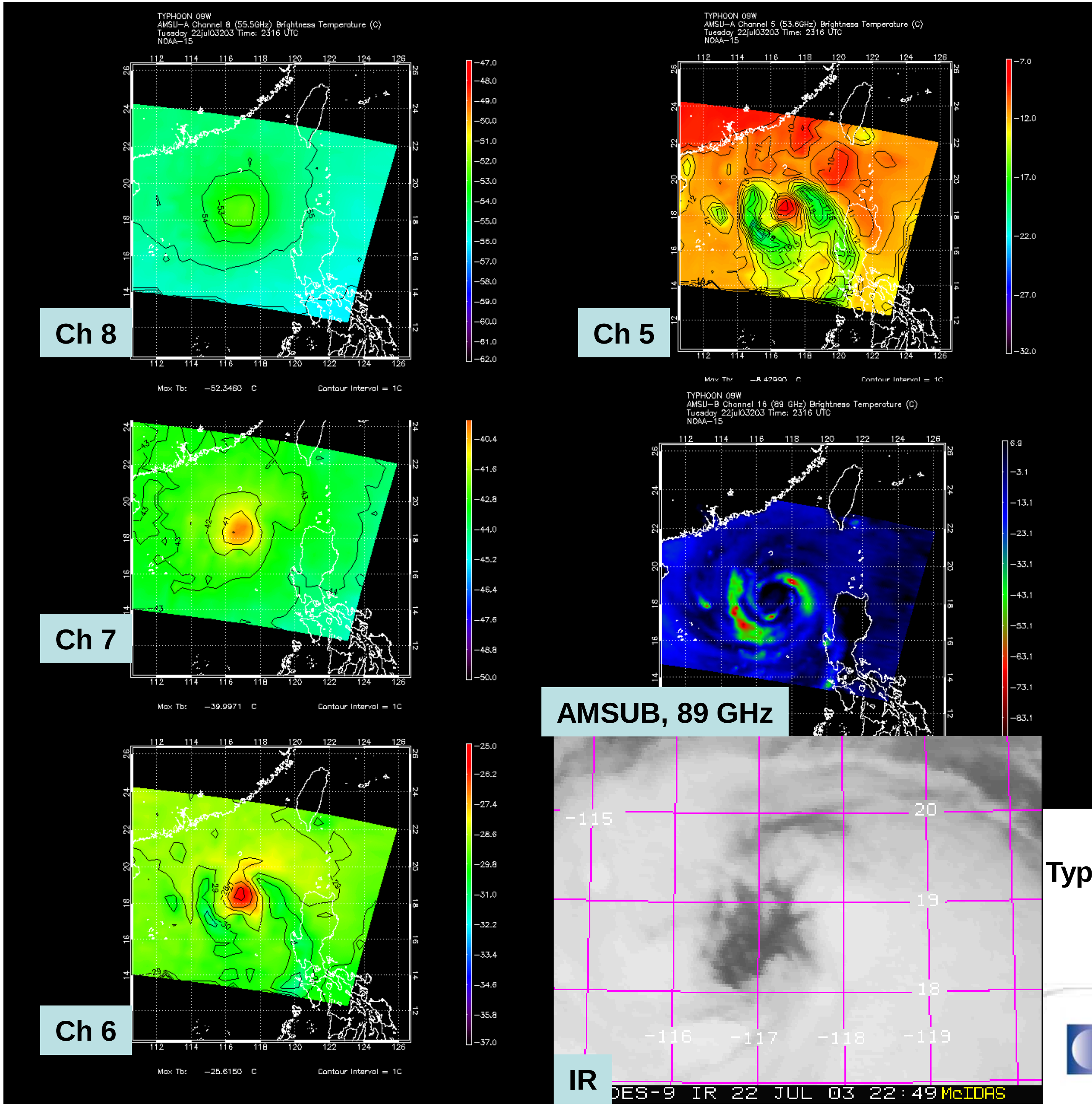
- ***Cross-scanning***
  - *Incidence angle varies*
  - *Need to "limb-correct".*
- ***Swath width 2200 km***
  - *Wider than SSM/I.*
- ***Resolution 15 - 50 km.***
- ***Two different kinds of instruments; AMSU-A and AMSU-B***

AMSU-A : 23-55-175 GHz, 48 km au nadir.

AMSU-B : 89-145 GHz, 15 km au nadir.

Images : COMET

AMSU-A
Brightness temperature



Typhon IMBUDO, juillet 2003

Images CIMSS

METEO FRANCE
Toujours un temps d'avance

AMSU-A - *Temperature anomaly*

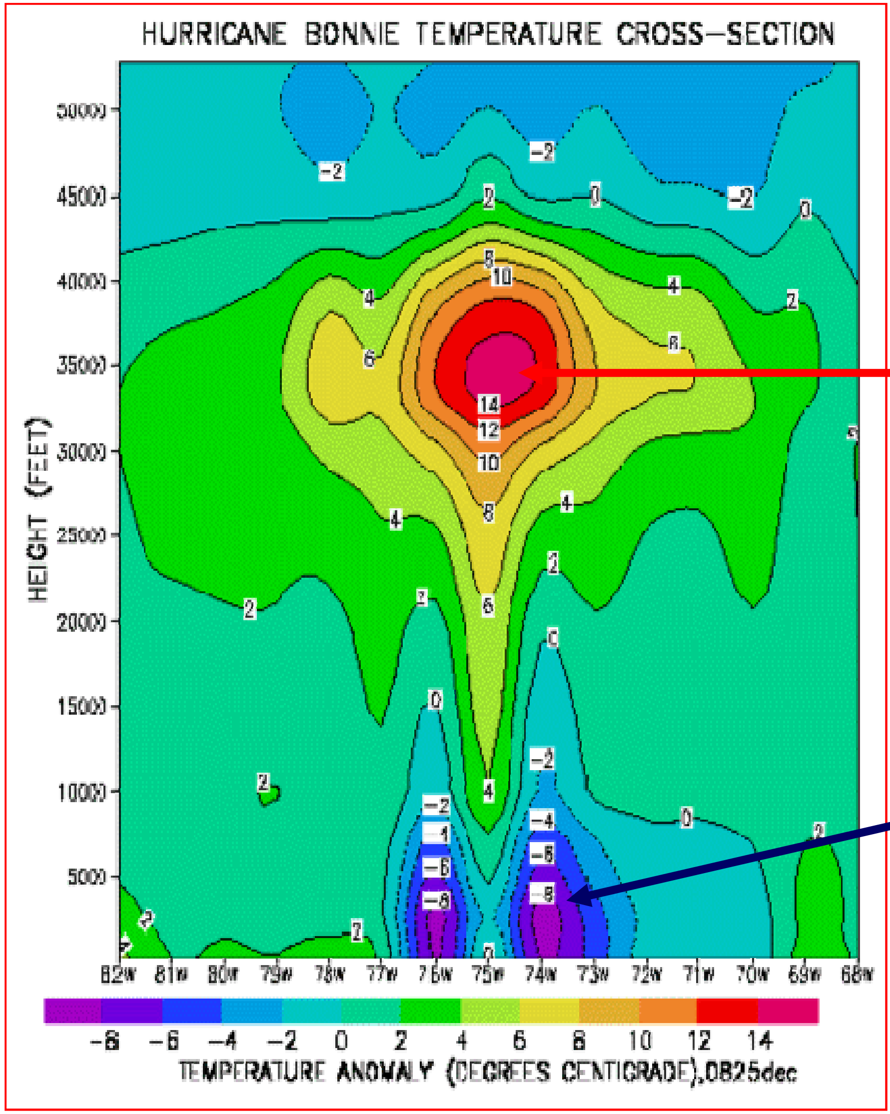


Image : Noaa/Jim Purdom

Coupe transversale de l'anomalie de température dans le cyclone BONNIE, calculée d'après AMSU-A.

Cross-section of temperature anomaly in hurricane Bonnie

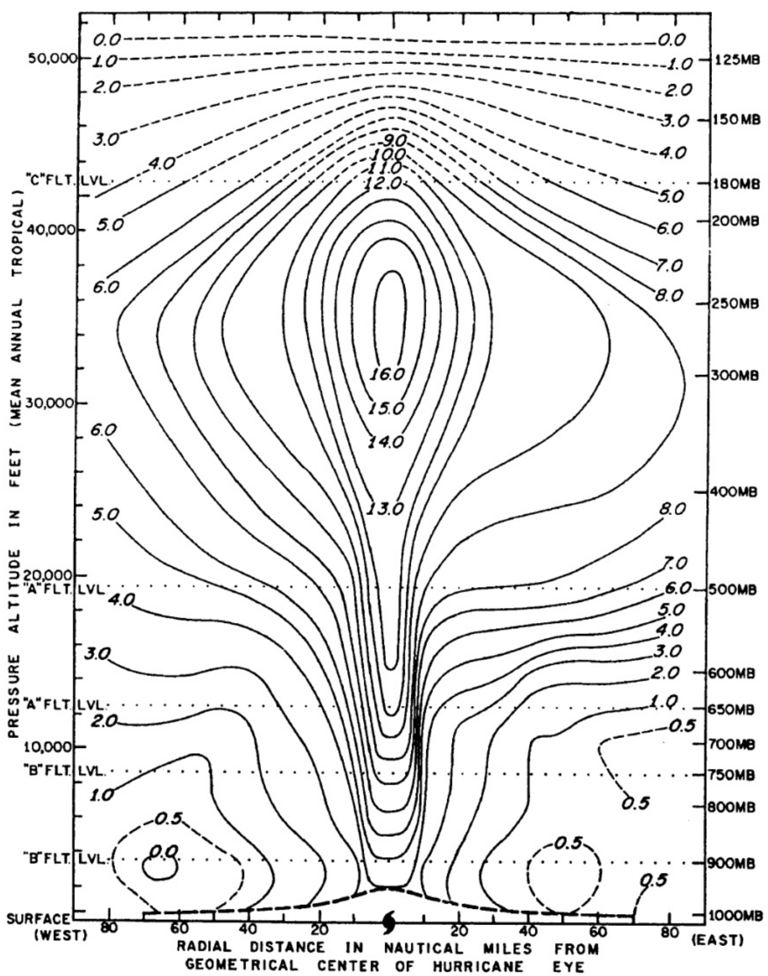
A noter l'important cœur chaud en altitude, s'étendant vers le bas, au niveau de l'œil.

Note strong upper warm core extending downwards in eye

Les zones apparemment froides des couches inférieures sont dues au fortes précipitations (courant descendant)

Apparenty cold patches in low levels are due to heavy precipitations (downdraft)

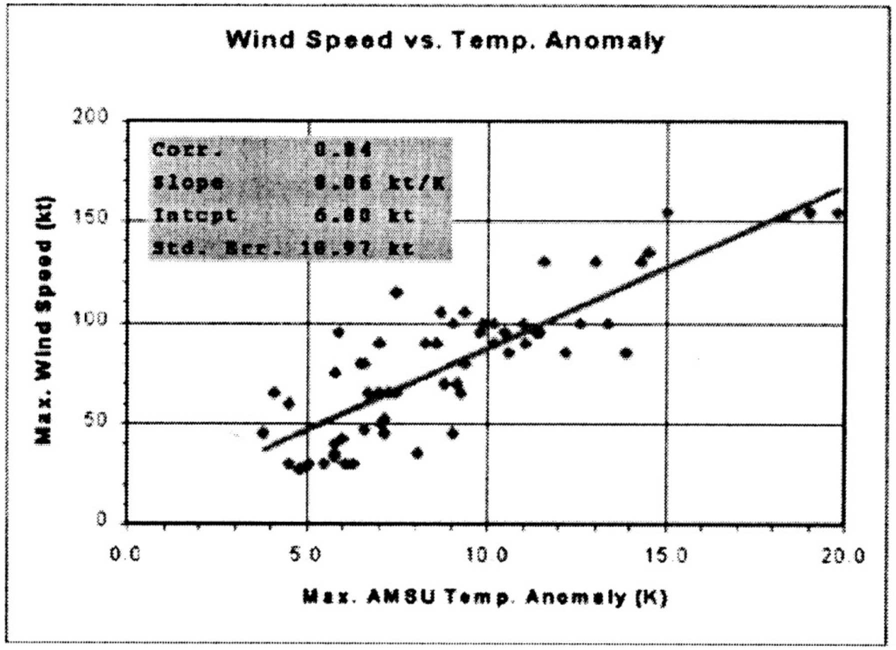
AMSU-A - Upper Warm Core

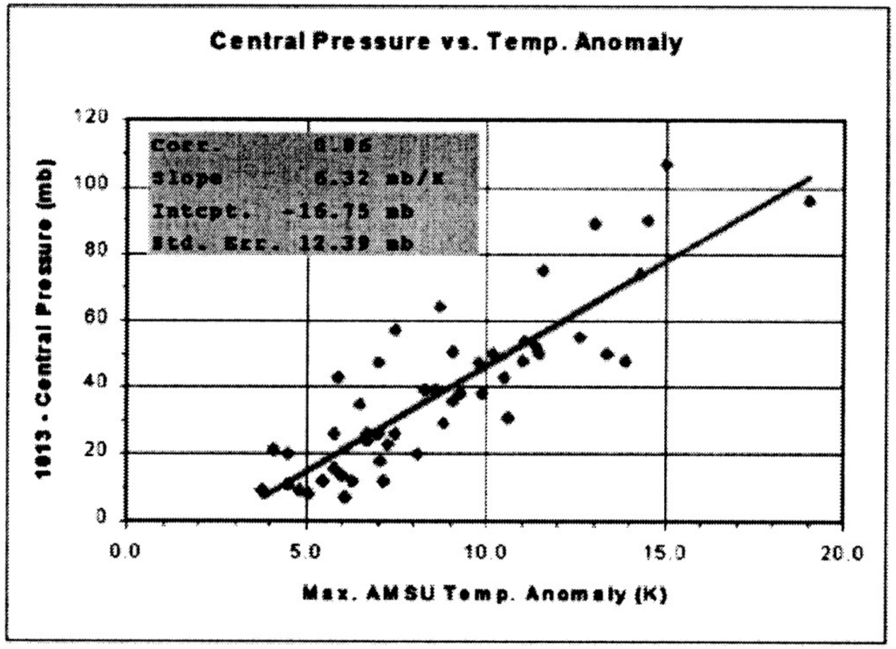


- **Données avion de l'ouragan Hilda**
- **Très similaire aux images AMSU de Bonnie**

- ***Aircraft data in Hurricane Hilda***
- ***Very similar to AMSU image of Bonnie***

Image: Hawkins and Rubsam, 1968





AMSU-A - *Temperature anomalies Intensity*

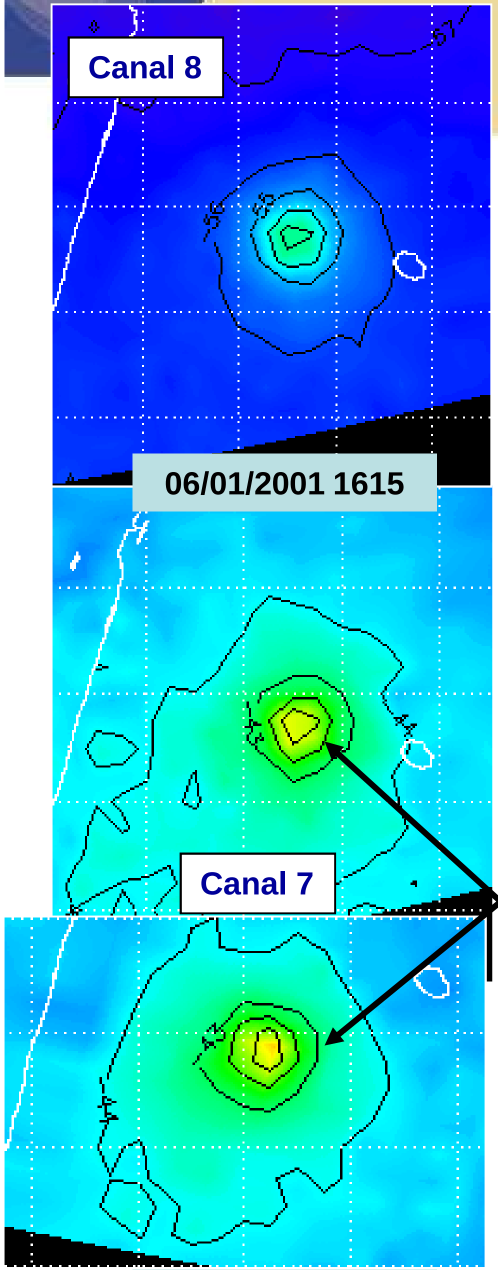
- **Les anomalies de de température obtenues d'après AMSU-A permettent**
  - de calculer des champs de vent
  - d'estimer l'intensité du phénomène en obtenant
    - la vitesse du vent
    - la pression au centre.

- ***Temperature anomalies calculated thanks to AMSU-A allow***
  - *Wind fileds calculations*
  - *Intensity estimation by providing*
    - Wind speed
    - *Minimal pressure*

Source : Kidder et al (2000) :
Satellite analysis of tropical cyclone using the Advanced Microwave Sounding Unit (AMSU). *Bull. Amer. Met. Soc.*, 81, 1241-1259.

METEO FRANCE
Toujours un temps d'avance

AMSU-A - *Data access*



07/01/2001 0325

En comparant une imagette à l'autre, on constate l'intensification.

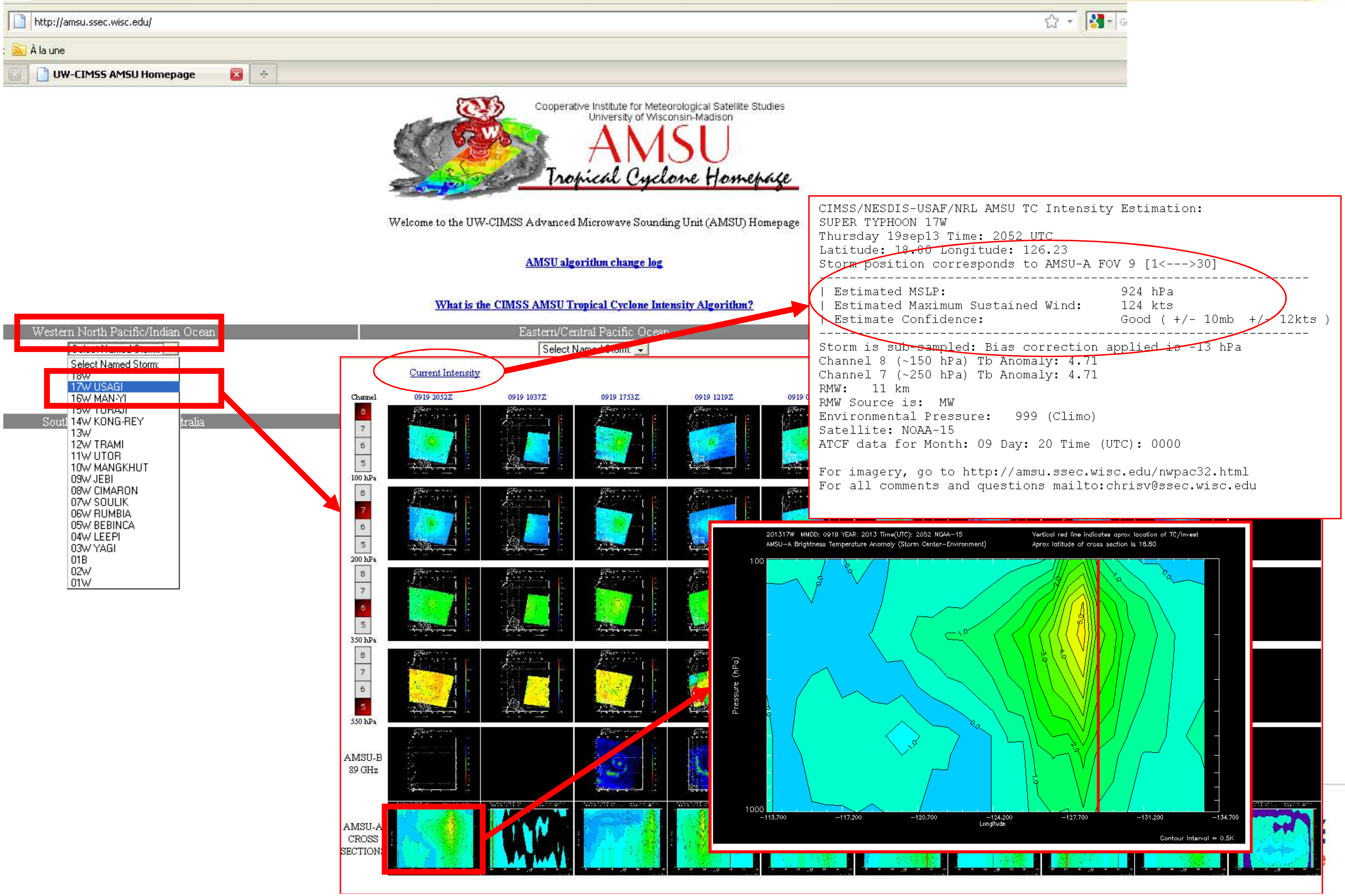
From a picture to another, we get an idea of the intensification

- Le CIMSS a depuis développé un algorithme permettant d'obtenir, à partir des données AMSU-A, la pression min et les vents max.
- Ces résultats sont disponibles sur le Web : http://amsu.ssec.wisc.edu

- *CIMSS has now developed an algorythme allowing to obtain quantitative min pressure and max wind*
- *These results are available on the web :* **http://amsu.ssec.wisc.edu**

Source : http://cimss.ssec.wisc.edu

http://amsu.ssec.wisc.edu



Limits of AMSU TC intensity estimates

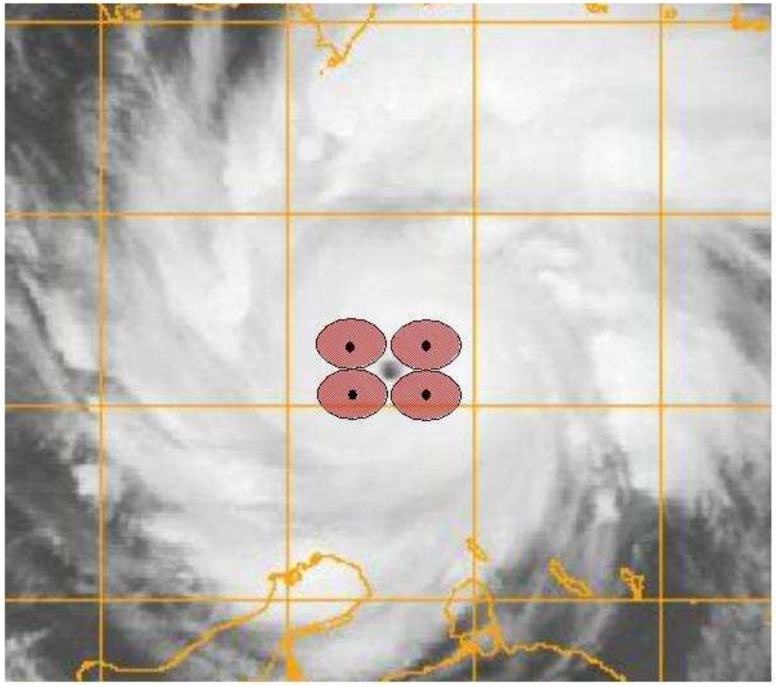
• The presence of mixed-phase and frozen hydrometeors can act to reduce the Tb sensed by the instrument. This effect is most severe at lower channels but can reach as high as channel 8

• AMSU is a cross-track scanning radiometer (~ 50 km at nadir decreasing to ~ 100 km at the limb), thus storms viewed near the scan limb will not be as well-resolved as those near nadir.

• Even at nadir the highest resolution of the instrument is 50 km. Because the eye of a TC constrains much of the warm core eyes with a diameter less than 50 km will result in the warm core being sub-sampled.

• The storm may fall in-between scan views (an effect known as bracketing). Because the storm core may only be 20 km in diameter and AMSU scan views may be 100 km apart this effect can result in sub-sampling of the warm core

Limits of AMSU TC intensity estimates



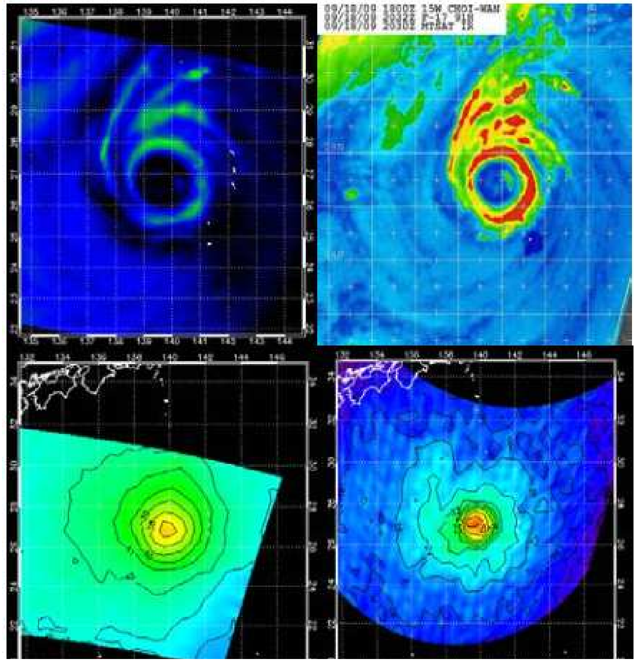
The AMSU algorithm was developed using reconnaisance-based verification of MSLP and MSW for 470 cases from 1998-2004 then independently tested using 264 cases from 2005-2006

	Bias	AAE	RMSE
MSLP	0.3 mb	5.4 mb	7.8 mb
MSW	-1.9 kts	7.8 kts	10.0 kts

Negative bias indicates method was too weak.

Source: http://tropic.ssec.wisc.edu/misc/amsu/info.html

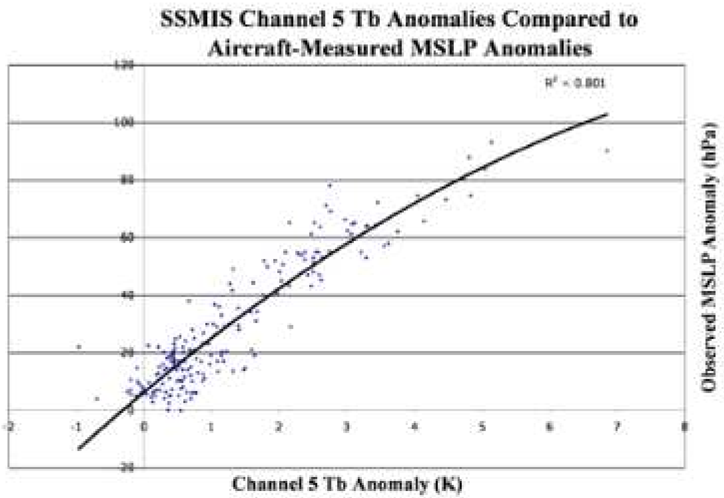
New TC estimates based on sounders: Sounders SSMIS



• **Homogenous résolution at 37.5 km within the conical swath (improvment compare to AMSU-A data) for channel of interest (3-5, 53-55 Ghz)**

• **Associated to a good quality 91 Ghz imageur, use of passive microwave to derive eye size**

• **Better result for TC estimate than AMSU-A**



TC Intensity Estimation: SATellite CONsensus (SATCON)

Derrick Herndon and Chris Velden

University of Wisconsin - Madison

Cooperative Institute for Meteorological Satellite Studies

CIMSS

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TC Intensity Estimation:
SATellite CONsensus (SATCON)

Plusieurs methodes objectives d'estimation de l'Intensité existent mais l'objectif de SATCON est d'aider les prévisionnistes à améliorer leur analyses d'intensité en combinant chacune des méthodes en une seule qui pourraient être considérée comme la meilleure.

Several objective TC intensity methods exist, but the goal of SATCON is to assist forecasters in assessing current intensity by combining the confident aspects of the individual objective estimates into a single "best" estimate

SATCON

Les forces et les faiblesses de chaque méthode sont évaluées en fonction d'une analyse statistique qui permet d'attribuer des pondérations à chacune d'elle en fonction des situations afin de produire un consensus unique tenant compte des performances de chaque méthode (en fonction des situations)

The strengths and weaknesses of each method are assessed based on statistical analysis, and that knowledge is used to assign weights to each method in the consensus algorithm based on situational performance to arrive at a single intensity estimate

Un autre aspect de SATCON est de pouvoir partager les informations disponibles entre les méthodes individuelles pour améliorer les performances de chacune d'elle et de produire un consensus pondéré de meilleure qualité.

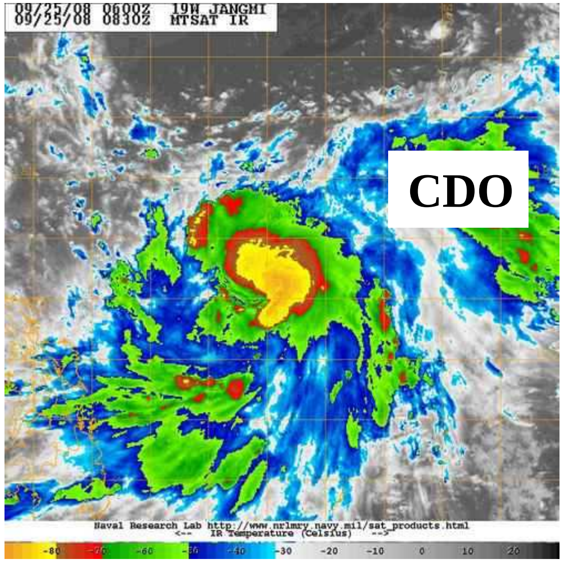
Another component of SATCON is cross-method information sharing to improve the performance of each algorithm, then the weights re-derived to produce an improved weighted consensus

SATCON Weighting Scheme

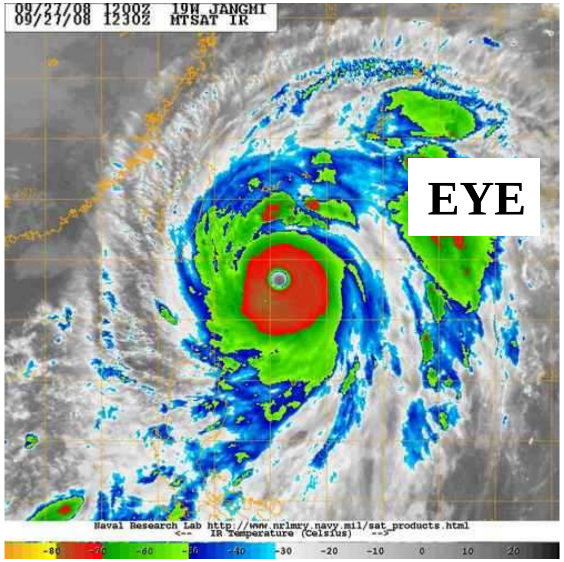
Weights are based on situational analysis for each member

- Separate weights for MSW and MSLP estimates
- Example criteria: scene type (ADT)
  scan geometry/sub-sampling (AMSU)

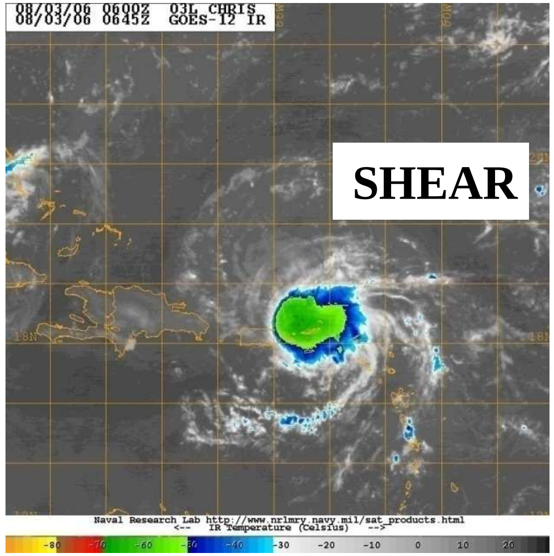
Example: ADT Scene type vs. performance



RMSE 14 knots

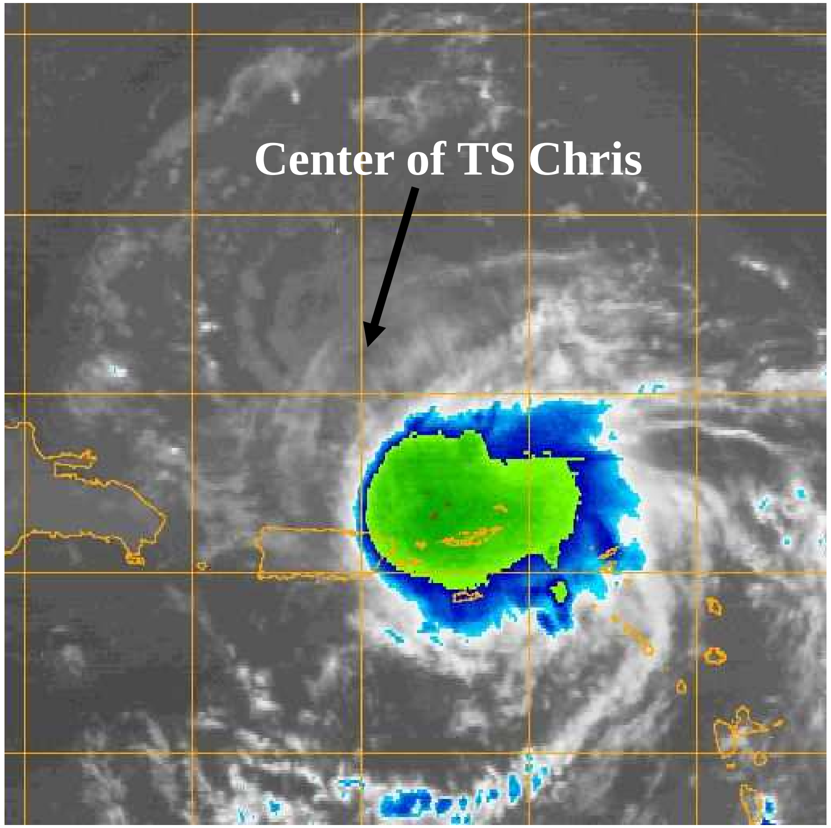


RMSE 12 knots



RMSE 18 knots

Examples



ADT determines scene is a SHEAR scene

CIMSS AMSU indicates no sub-sampling present

CIRA AMSU: little sub-sampling due to position offset from FOV center

SATCON Weighting:

ADT = 18 % CIMSS AMSU =41 % CIRA AMSU = 41 %

1999-2010 performance stats (MSW)
Atlantic – East Pacific – West Pacific

N = 289	CIMSS AMSU	CIMSS ADT	CIRA AMSU	**SATCON**
BIAS	0.6	-2.5	-7.1	**-0.5**
AVG ERROR	8.7	10.9	11.7	**7.1**
RMSE	11.1	14.3	15.6	**8.9**

Accuracy of Maximum Sustained Wind (MSW) estimates (Kts) derived from satellite-based methods compared to 3-member SATCON and individual members verified against recon-coincident Best Track MSW. Negative method bias indicates underestimate. Cases include Atlantic (263), East Pacific (8) and West Pacific (18)

1999-2010 SATCON compared to a simple straight consensus
(Atlantic – East Pacific – West)

N = 289	SATCON MSLP	SIMPLE MSLP	SATCON MSW	SIMPLE MSW
BIAS	0.1	-1.6	-0.5	-3.0
AVG ERROR	4.6	5.0	7.1	8.1
RMSE	6.5	7.5	8.9	10.5

Comparison of SATCON with a simple average (no weighting) of the three members. Verification for MSLP is recon-measured MSLP. MSW verification is Best Track MSW coincident with recon.

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1999-2010 SATCON compared to operational Dvorak

(Atlantic – East Pacific – West Pacific)

N = 289	SATCON MSLP	Dvorak MSLP	SATCON MSW	Dvorak MSW
BIAS	0.1	-2.0	-0.5	-1.9
AVG ERROR	4.6	6.8	7.1	7.7
RMSE	6.5	9.3	8.9	9.9

Comparison of performance between SATCON estimates and coincident operational Dvorak estimates. Verification for MSLP is recon- measured MSLP. MSW verification is Best Track MSW coincident with recon. Dvorak is average of TAFB and SAB estimates. Cases include Atlantic (263), East Pacific (8) and West Pacific (18).

Recent improvments on SATCON

1) Use of SSMIS TC intensity

2) Interpolation of SSMIS and AMSU estimates to each ADT estimates.

3) Inclusion of a pressure-wind SATCON estimate. That P-W estimate is combined with the SATCON member Vmax consensus using a 25% weight

4) A 5 point smoother is applied to remove the noise

5) Inclusion of error bounds for SATCON showing ± 2 standard deviations.

6) Bias correction to adjust SATCON during the first 36 hours of TC age

SATCON Web Site :
http://tropic.ssec.wisc.edu/real-time/satcon/

CURRENT ESTIMATE

Date (yyyy mmddhhmm): 2014 10191835

SATCON: MSLP = 998 hPa   MSW = 61 knots

SATCON Member Consensus: 63.0 knots

Pressure -> Wind Using SATCON MSLP: 54 knots

Distance to Outer Closed Isobar Used is 170 nm

Eye Size Correction Used is 0 knots   Source: NA

Member Estimates

ADT: 983 hPa   75 knots   Scene: CDO   Date: OCT191900

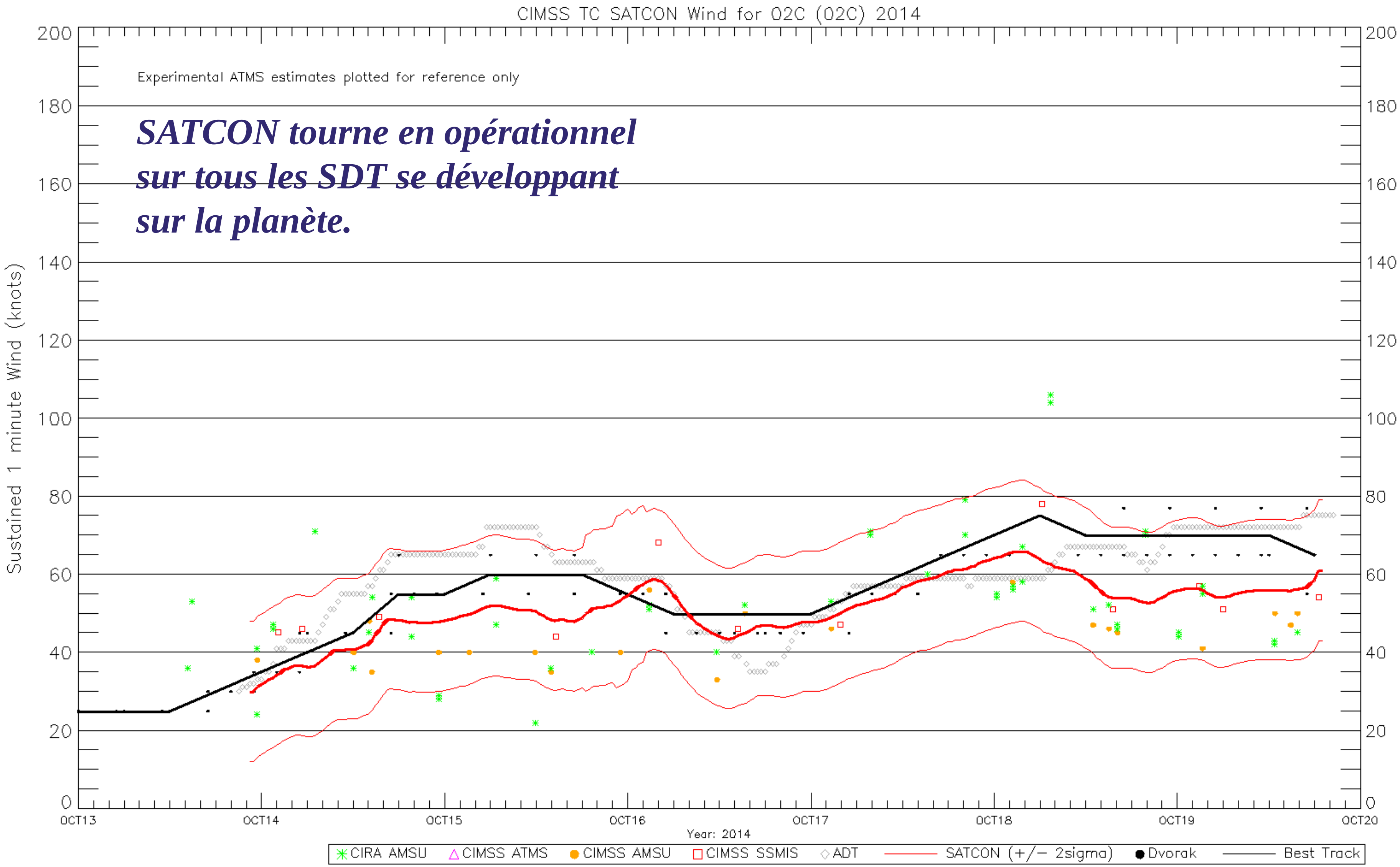
CIMSS AMSU: 995 hPa   50 knots   Bias Corr: 0 (MW)   Date: 10191545

SSMIS: 1002 hPa   54 knots   Date: 10191835

CIRA AMSU: NA hPa   NA knots   Tmax: NA

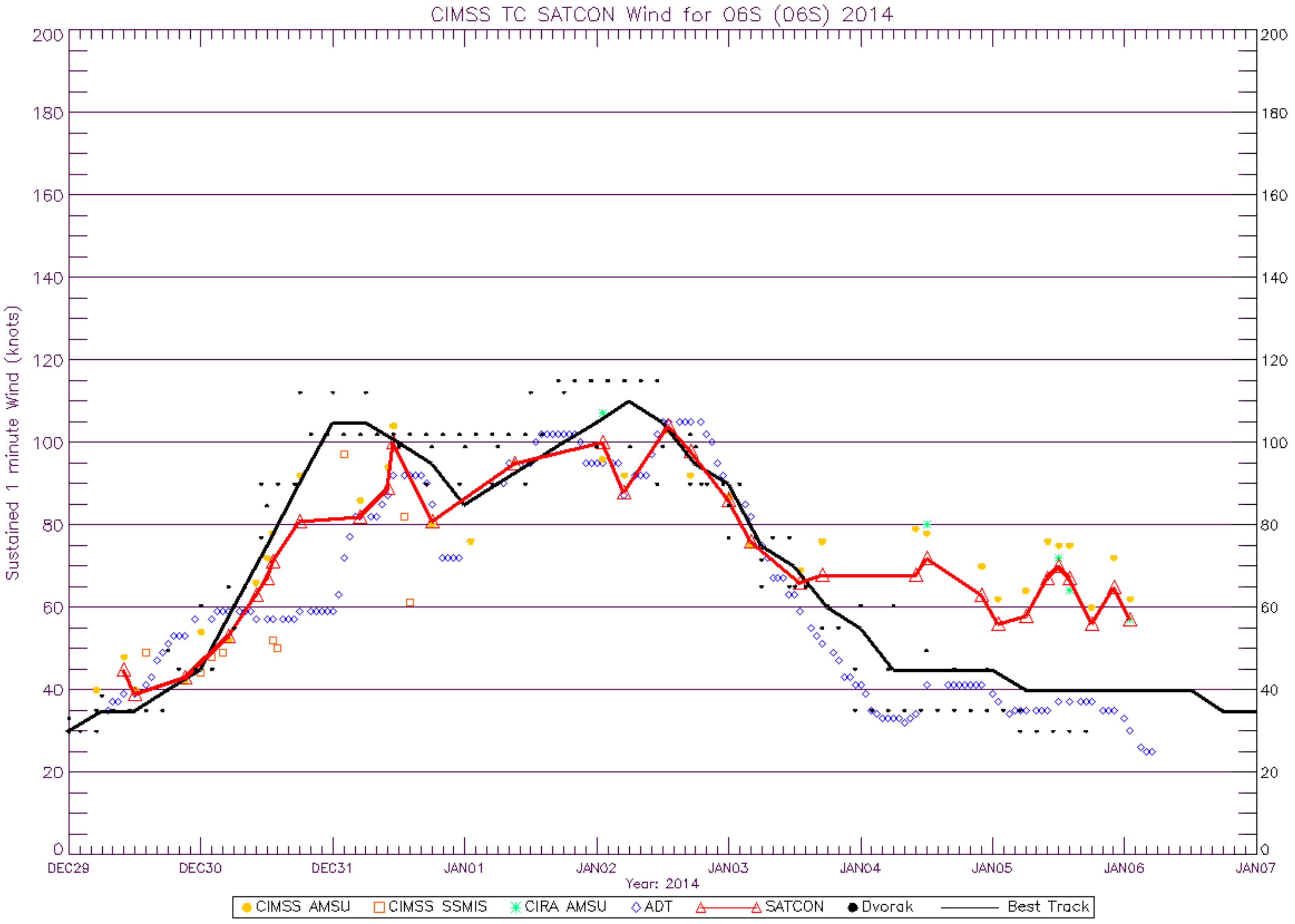
SATCON pour TC Ana (02C)

SATCON Web Site :
http://tropic.ssec.wisc.edu/real-time/satcon/



SATCON tourne en opérationnel sur tous les SDT se développant sur la planète.

SATCON Web Site : http://tropic.ssec.wisc.edu/real-time/satcon/



Outline

1. Synopsis on microwaves
2. SSMI, SSMI(S), GMI, AMSR2, Windsat ,AMSU-B sensors
3. TC Intensity estimate: objective guidances
4. Scatterometers
5. Cloud drift winds

Radar Scatterometers

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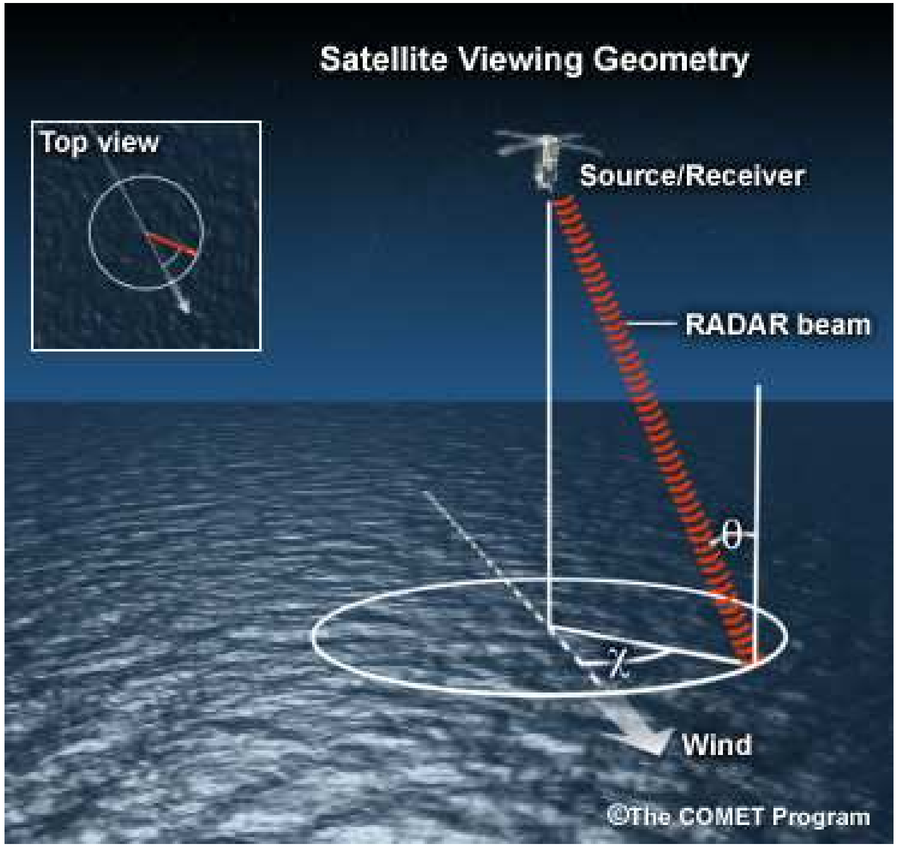
Scatterometers - *How do scatterometers work?*



- **Diffusiomètre : radar micro-ondes mesurant le signal rétro-diffusé par les ondes capillaires et de gravité à la surface de la mer**

- ***Scatterometers measure radar reflectivity due to Bragg scattering from capillary and short gravity waves.***

Scatterometers - *Issues 1*

La mesure est perturbée par tout phénomène qui détruit les ondes capillaires :
la pluie, les vents très faibles ou très forts.
Measure can be incorrect due to any parameter destroying capillary waves : rain, very weak or very strong winds

- **Vents forts**
  - **Mer confuse, moutons**
  - **Saturation**
  - **Nombre limité de données nécessaires à la calibration**
- **Vents faibles**
  - **Signal de retour faible (s'accompagne d'une erreur d'obs. relativement grande)**
  - **Données de calibration de qualité médiocre (spécialement en direction)**

> Gamme de fiabilité des vents diffusiométriques: 6 - 40 kt

- ***High winds***
  - ***Whitecaps, tilt effects, confused sea***
  - ***Saturation***
  - ***Limited amount of calibration data***
- ***Low winds***
  - ***Weak returned signal (obs. error relatively large)***
  - ***Calibration data of poor quality (especially direction)***

> Best skill of the measure for winds from 6 to 40 kt

Scatterometers - *Issues 2*

- **Pluie**
  - **Atténuation du signal radar (incident et diffusé)**
  - **Rétro-diffusion du signal par la pluie**
  - **Rend la surface de la mer rugueuse**
  - **La direction des vents est biaisée perpendiculairement à la fauchée**
  - **Biais généralement positif dans la vitesse.**
- **La résolution de 25 km limite les pointes de vent dans les gradients serrés.**
- **Ambiguïté directionnelle**

- ***Rain***
  - ***Attenuation of radar signal (coming and scattered)***
  - ***Backscatter of radar signal by rain***
  - ***Roughens ocean surface***
  - ***Cross-swath bias in wind direction***
  - ***Speed bias generally positive***
- ***Resolution - 25 km will limit peaks in tight gradients***
- ***Directional ambiguity***

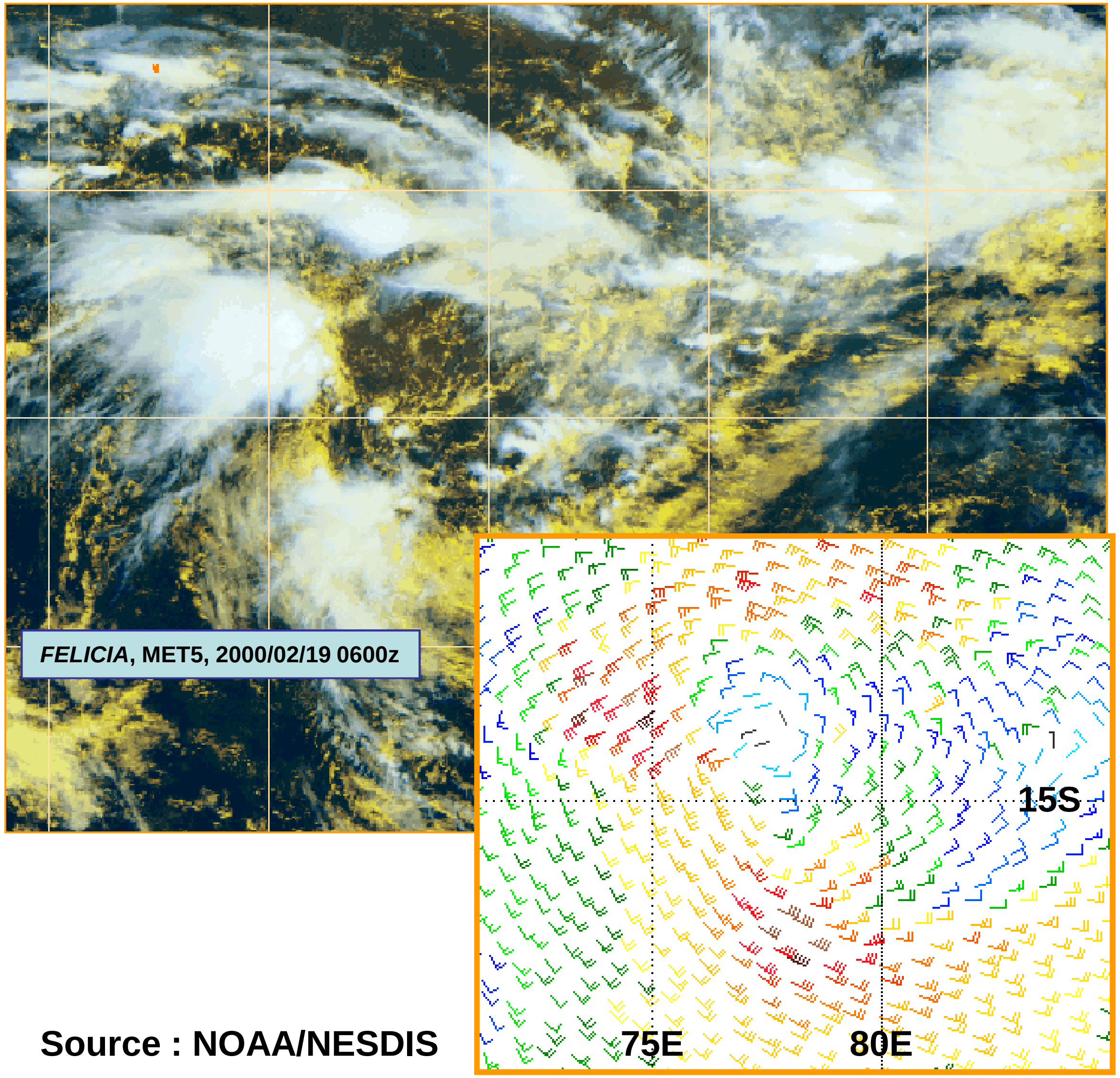
Scatterometers characteristics

Short Background	Period in Service	Spatial Resolution	Product Grid Spacing	Scan Characteristics	Operational Frequency	Detailed Background
SeaSat-A Scatterometer	1978/7/7 - 1978/10/10	50 km	100 km	Two sided Double swath	Ku band (14.6 GHz)	Background
ERS-1 Scatterometer	1991/7 - 1997/5/21	50 km	50 km	One sided Single swath	C band (5.3 GHz)	Background
ERS-2 Scatterometer	1997/5/21 - 2011/7	50 km	50 km	One sided Single swath	C band (5.3 GHz)	Background
NSCAT	1996/9/15 - 1997/6/30	25 km	25 km	Two sided Double swath	Ku band (13.995 GHz)	Background
SeaWinds on QuikSCAT	1999/7/19 - 2009/11/23	25 km	12.5 km	Conical scan One wide swath	Ku band (13.4 GHz)	Background
SeaWinds on ADEOS II	2002/12 - 2003/10	25 km	12.5 km	Conical scan One wide swath	Ku band (13.4 GHz)	Background
ASCAT-A	2006/10 - Present	50 km	12.5 km	Two sided Double swath	C band (5.255 GHz)	Background
ASCAT-B	2012/10/29 - Present	50 km	12.5 km	Two sided Double swath	C band (5.255 GHz)	Background
OCEANSAT2	2009/9/23 - 2014/	25 km	25 km	Conical scan One wide swath	Ku band (13.5 GHz)	Background
HY-2A	2011/9? - Present	25 km	25 km	Conical scan One wide swath	Ku band (13.256 GHz)	Background
ISS RapidSCAT	2014/09/20 - Present	25 km	12.5 km	Conical scan One wide swath	Ku band (13.4 GHz)	Background

Source: https://coaps.fsu.edu/scatterometry/about/overview.php

Scatterometers – *Applications*

Location of TC centres



Source : NOAA/NESDIS

- Particulièrement utile pour
  - les systèmes faibles et
  - la cyclogénèse

- ***Especially valuable for***
  - ***weak systems and***
  - ***pre-genesis***

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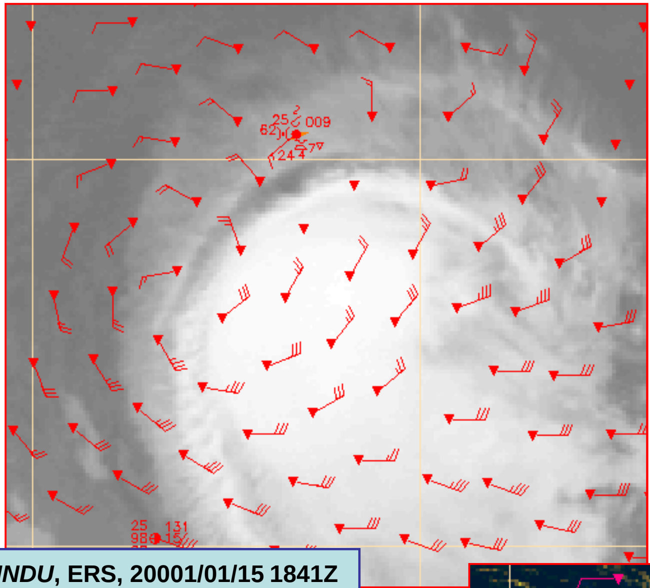
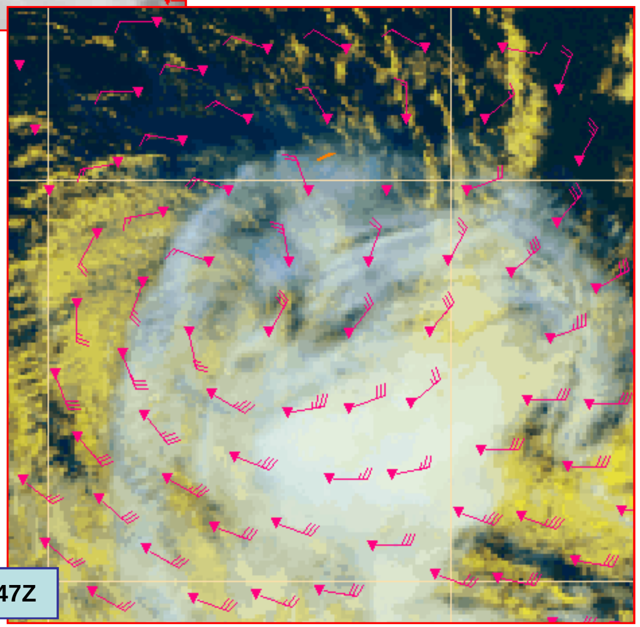
Scatterometers – *Applications*

Location of TC centres



BINDU, ERS, 20001/01/15 1841Z



BINDU, ERS, 20001/01/16 0547Z

- Particulièrement utile pour
  - Les systèmes cisaillés

- ***Especially valuable for***
  - ***Sheared systems***

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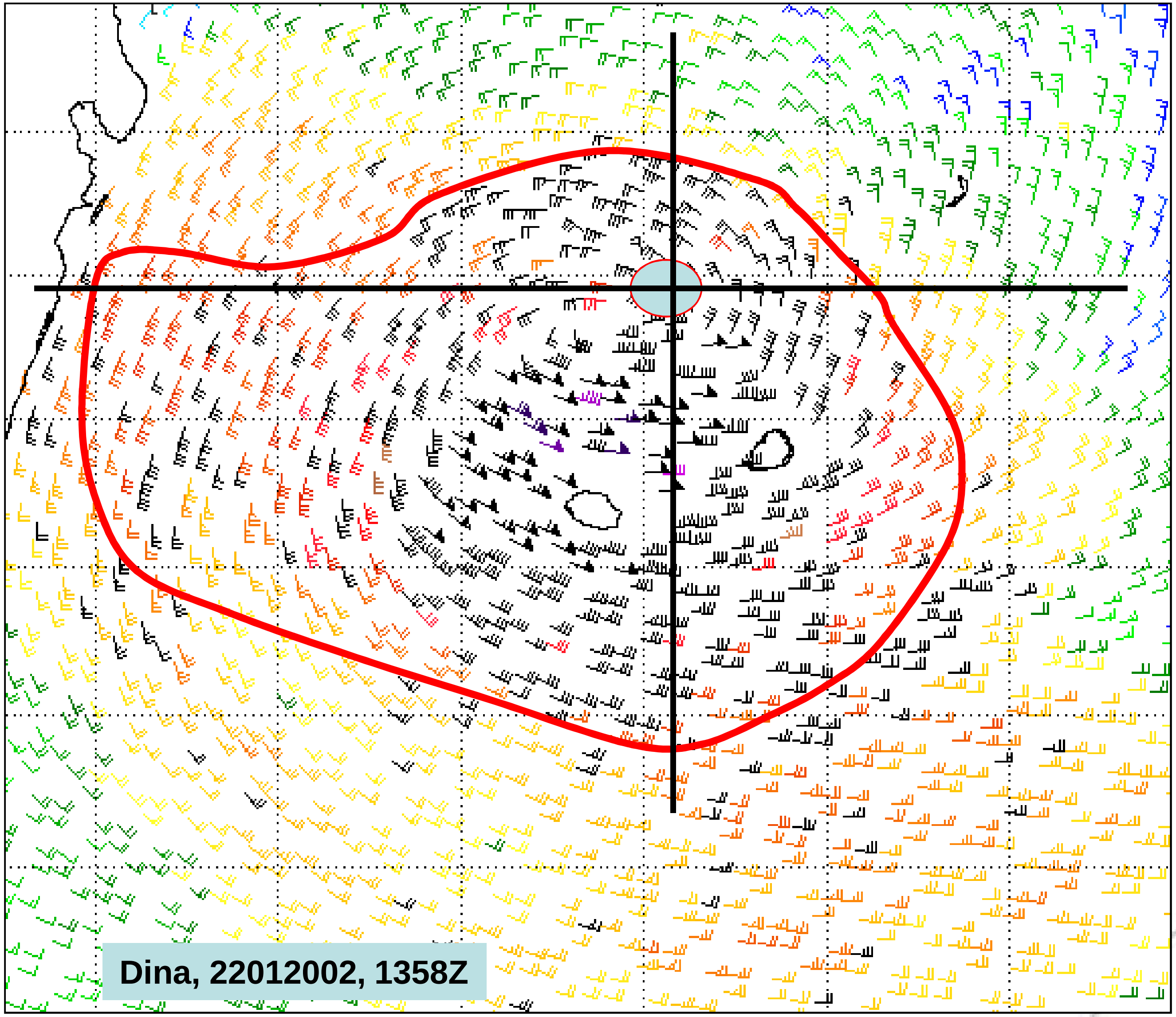
Scatterometers – *Applications*

Windfield structure



- Extension du grand frais
- Assymétries

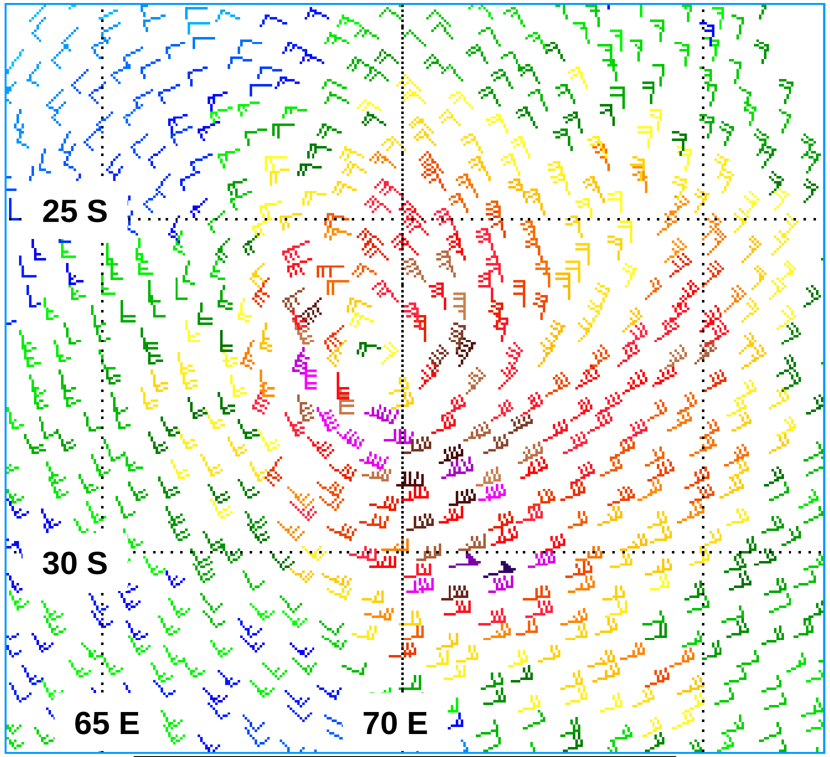
- *Extension of gale force winds*
- *asymmetries*

Scatterometers – *Applications*

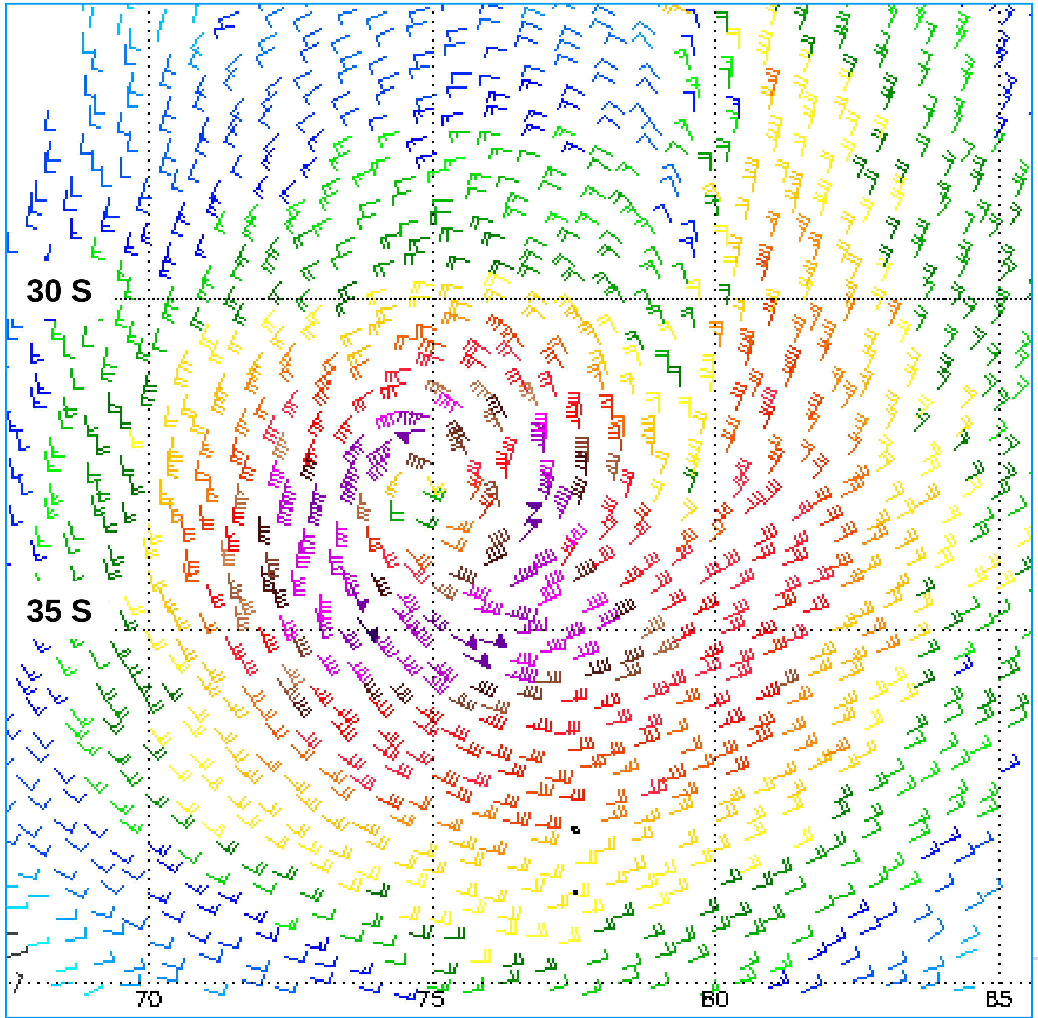
Structure changes

- Changement de taille
- Transition extratropicale

- *Size changes*
- *Extratropical transitions*

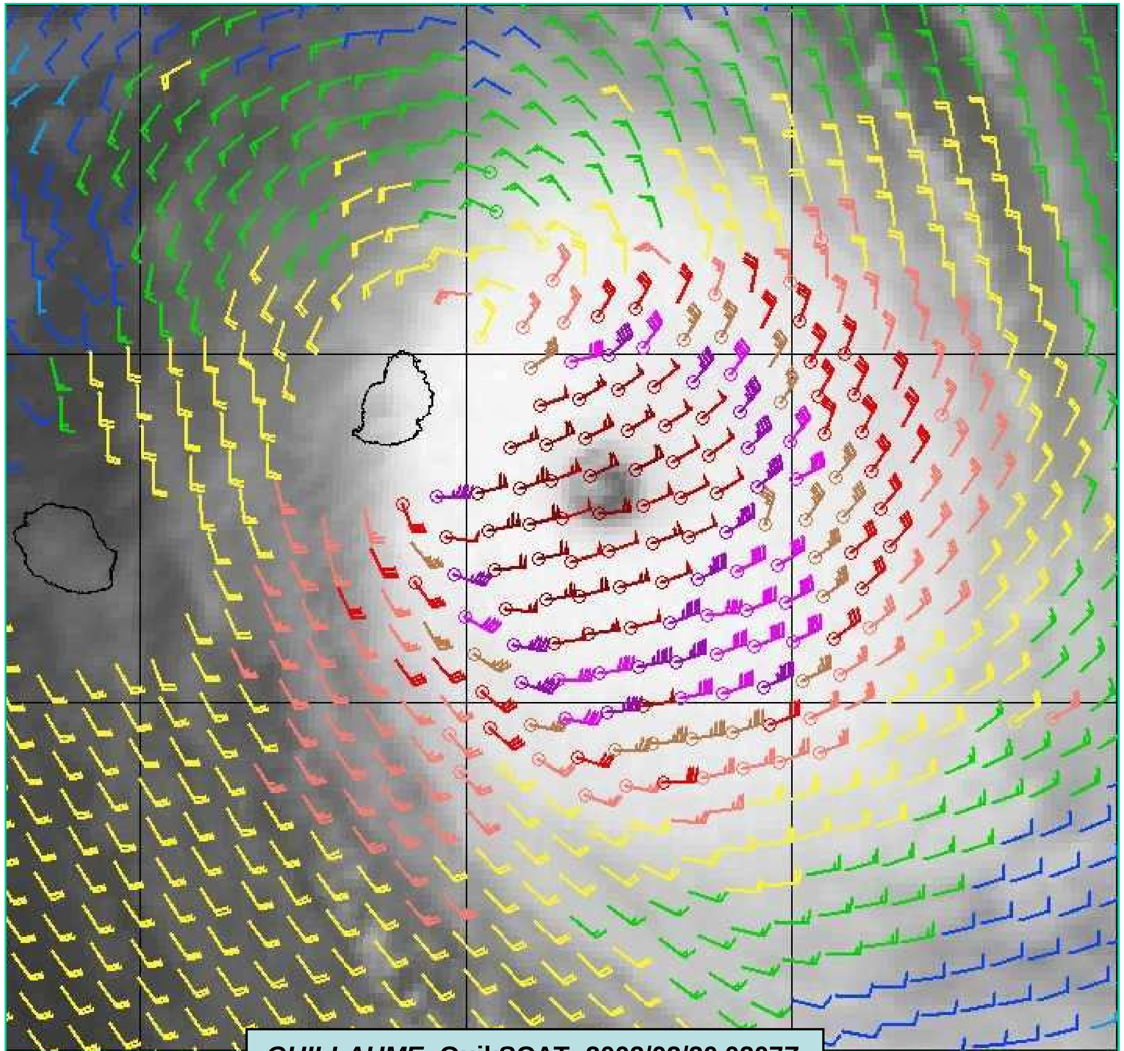


BABIOLA, **QuikSCAT, 2000/01/12 1308Z**



BABIOLA, **QuikSCAT, 2000/01/13 1227Z**

Scatterometers – *Issues*



GUILLAUME, QuikSCAT, 2002/02/20 0207Z

- **Mauvais positionnement du centre de basses couches**
- **Mauvaise solution pour la levée de l'ambiguïté**
- **Contamination par la pluie**
- **Problème de bordure**

- ***Mispositioning of LLCC***
- ***Wrong solution for the ambiguity selection***
- ***Rain contamination***
- ***Edge problems***

Source : Monterey

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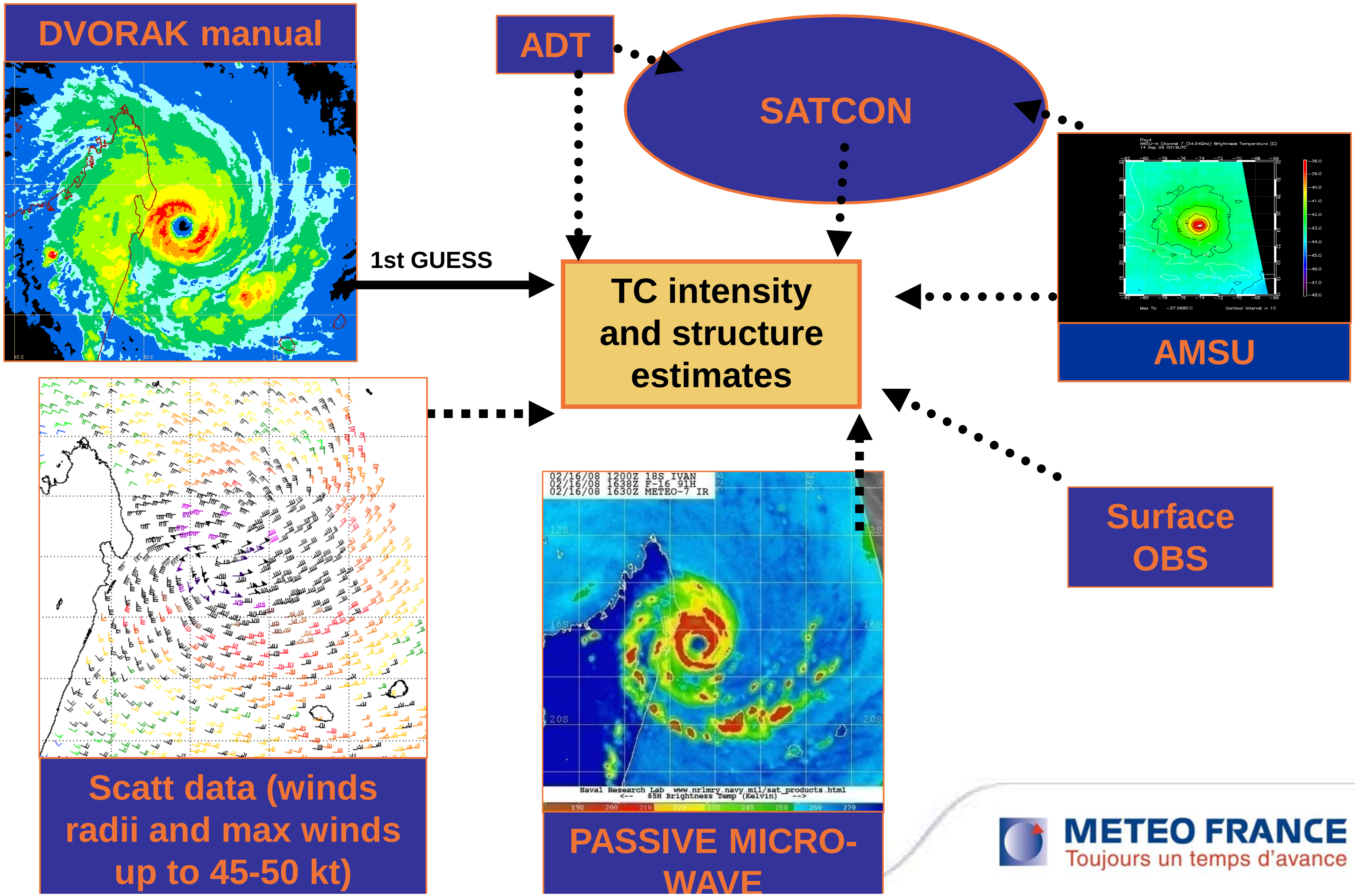
TC intensity & structure estimates: a blend of several inputs



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Toujours un temps d'avance

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Champs (Vents, Pressions, Cisaillement, Divergences, Convergences) dérivés des satellites

Satellite-derived Fields

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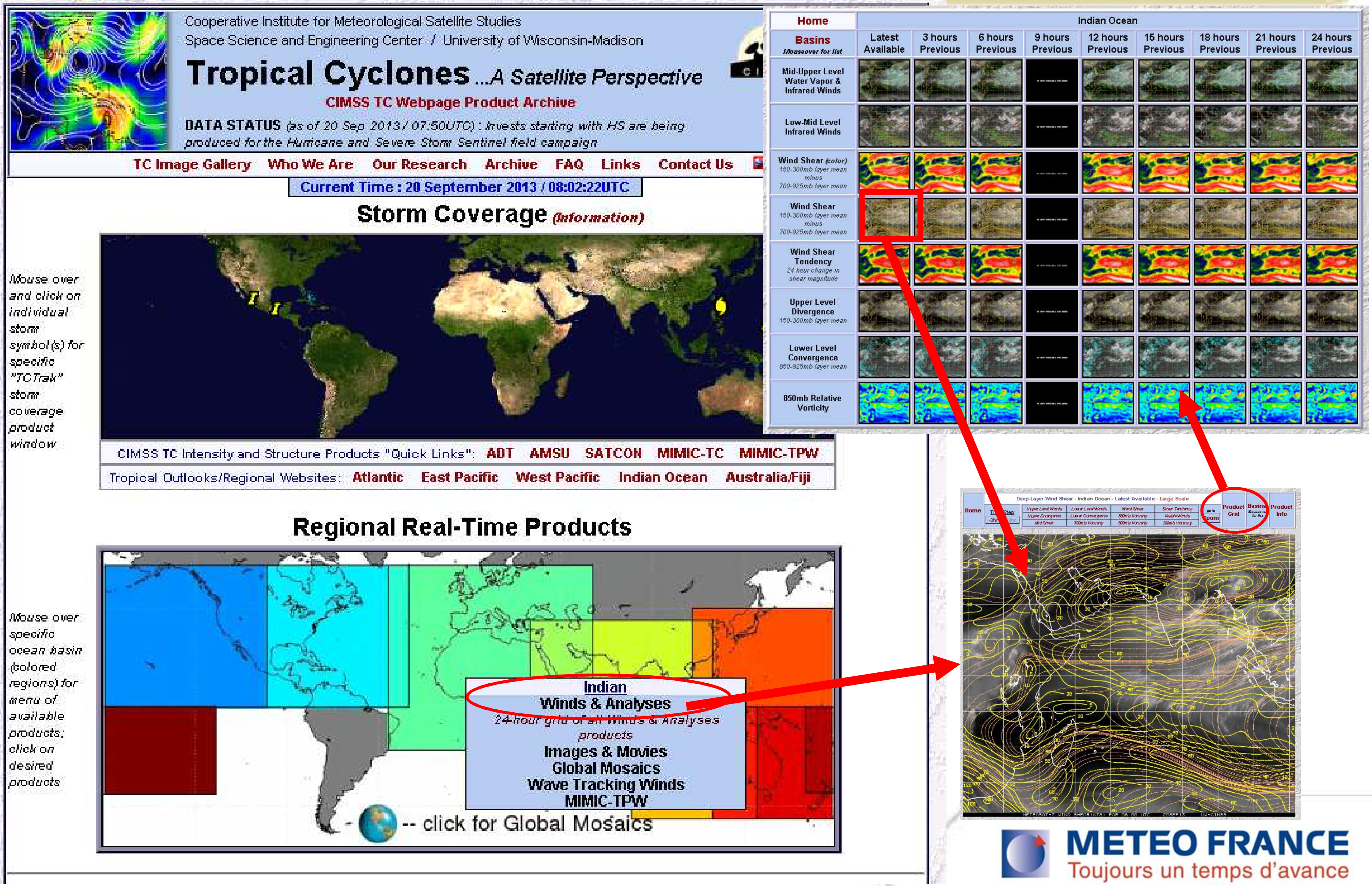
http://tropic.ssec.wisc.edu/



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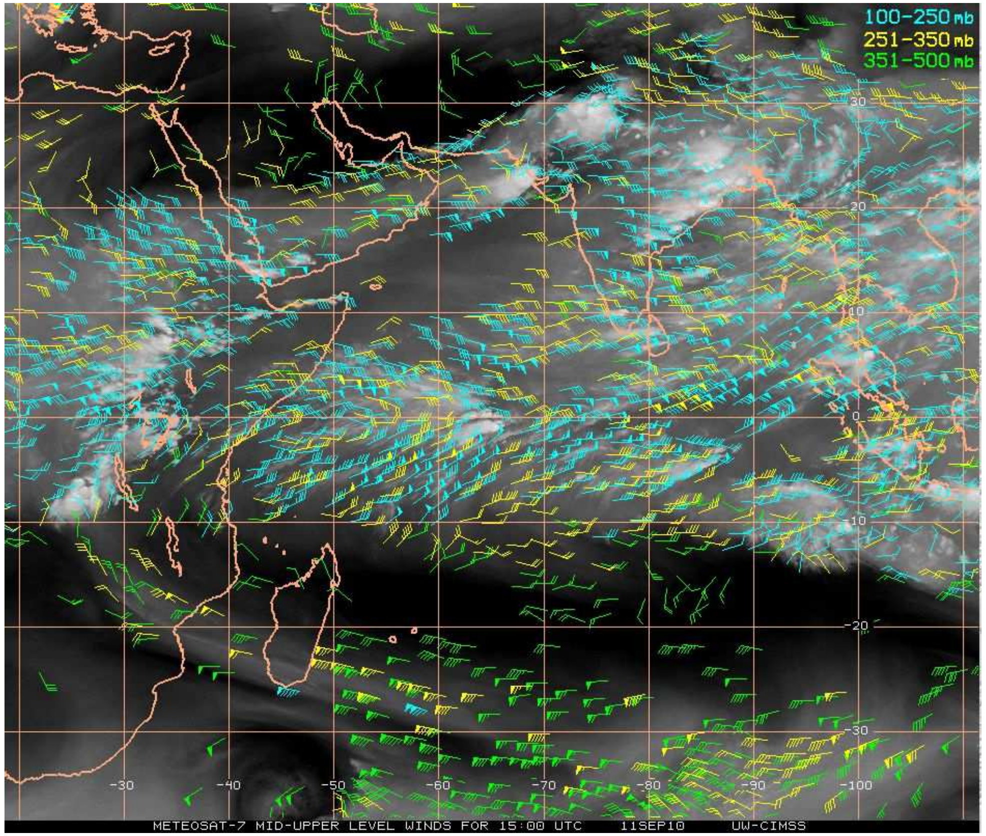
Satellite-derived winds – *Upper level winds*



- *Visualization of the environment of the system*
- *Intensity forecast during life cycle (outflow channels)*
- *Windshear monitoring (cyclolysis)*

- *Wind velocity is derived from automatic tracking of water vapor features in the mid-upper troposphere and cloud elements in the lower troposphere). The latter is limited to areas that are free of thick clouds. The assignment of heights is one of the main limitations to the accuracy of feature-tracked winds.*

Source : CIMSS

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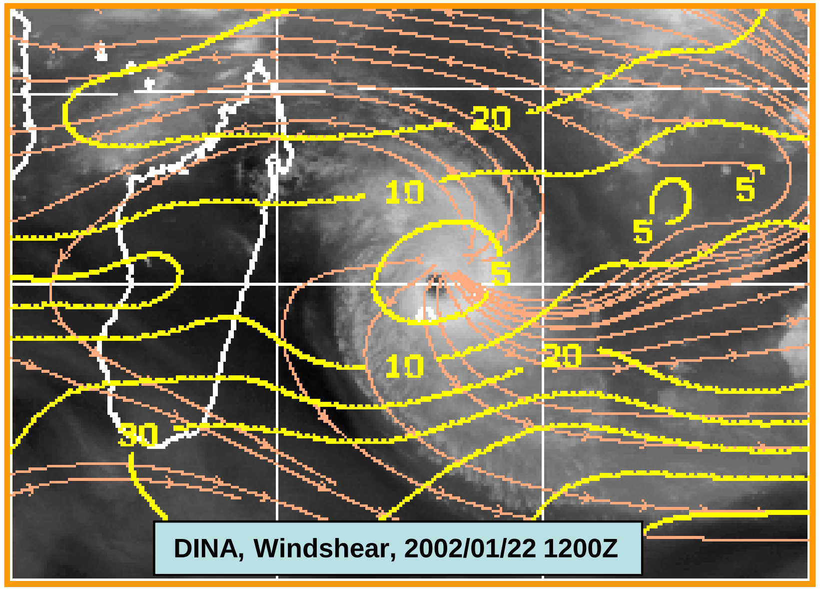
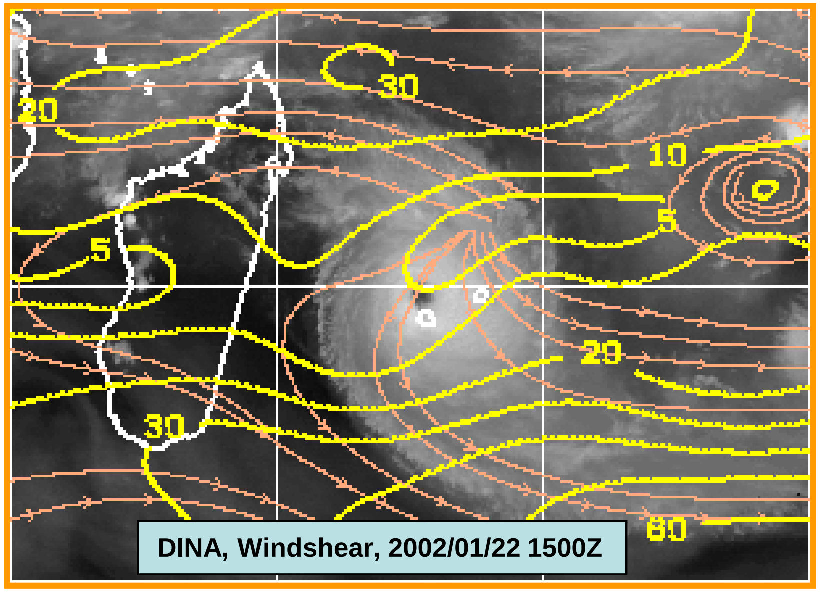
Toujours un temps d'avance

Satellite-derived winds - *Derived products*
Wind shear



DINA, Windshear, 2002/01/22 1200Z

- Estimation du potentiel de cyclogenèse
- Prévision d'intensité
- Contrôle du cisaillement de vent (cyclolyse)



DINA, Windshear, 2002/01/22 1500Z

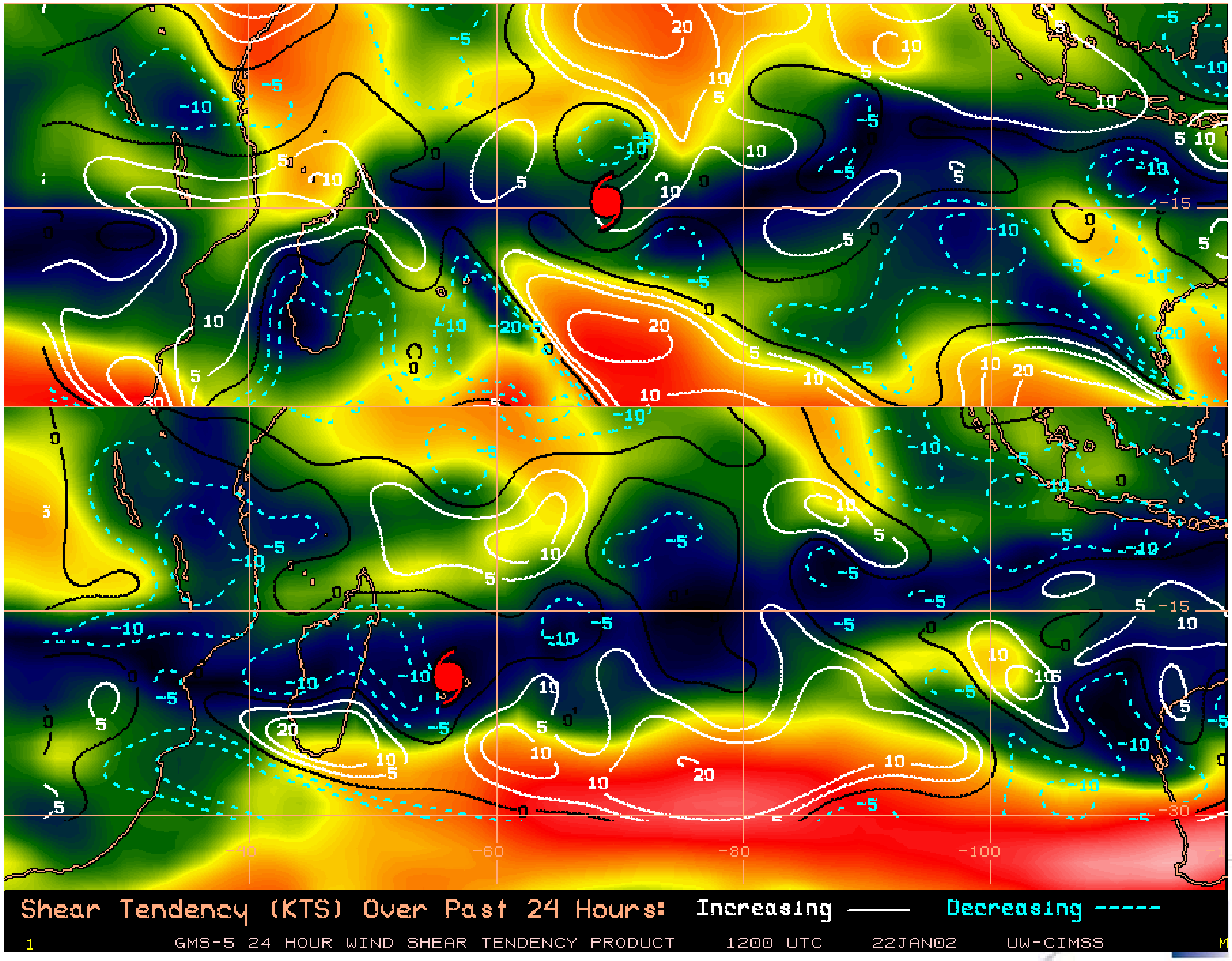
- *Estimation of cyclogenesis potential*
- *Intensity forecast during life cycle*
- *Windshear monitoring (cyclolysis)*

Source : CIMSS

Satellite-derived winds - *Derived products*

Shear Tendency

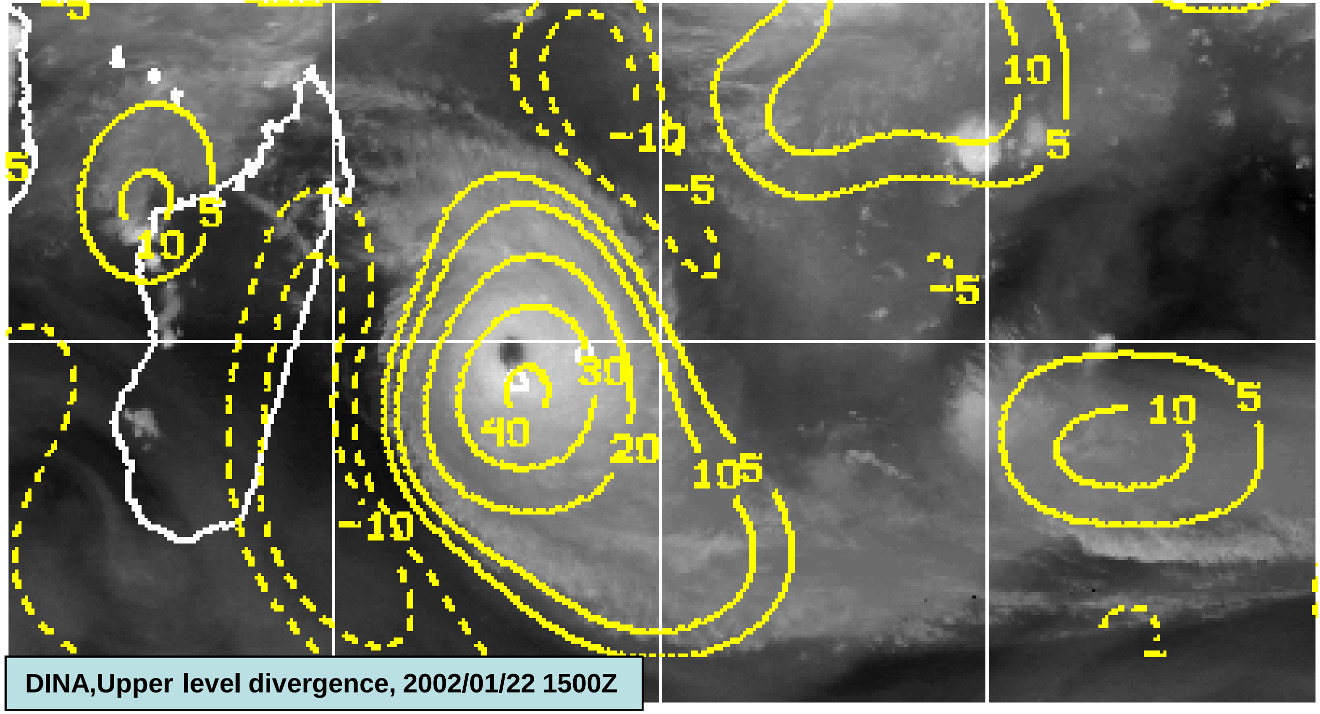
DINA



Source : CIMSS

Satellite-derived winds - *Derived products*

Upper level divergence



DINA,Upper level divergence, 2002/01/22 1500Z

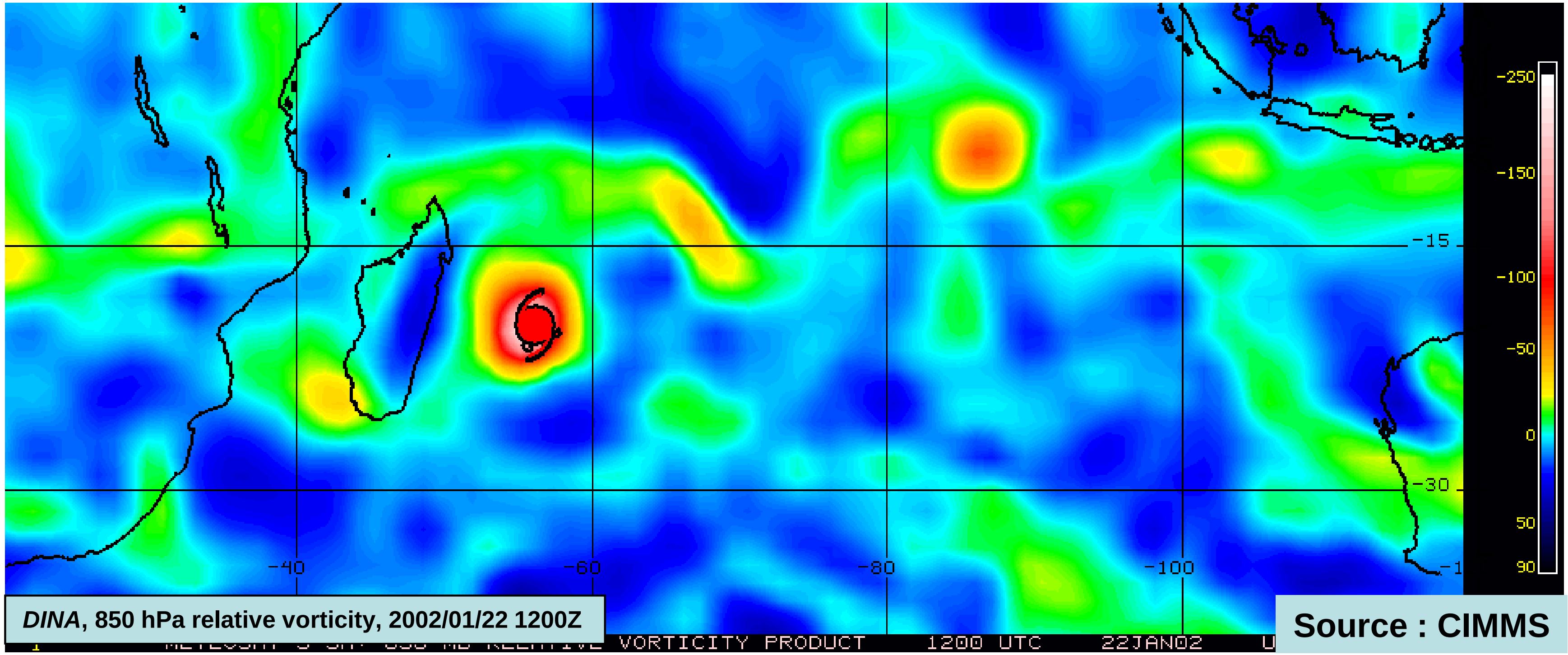
- **Estimation du potentiel de cyclogenèse**
- **Prévision d'intensité**

- ***Estimation of cyclogenesis potential***
- ***Intensity forecast during life cycle***

Source : CIMSS

Satellite-derived winds *- Derived products*

850 Hpa Vorticity



***DINA*, 850 hPa relative vorticity, 2002/01/22 1200Z**

Source : CIMMS

- Estimation du potentiel de cyclogenèse
- Advection de vorticité (poussées)
- Interaction avec les zones de vorticité avoisinantes
- Interaction avec les zones de convection

- *Cyclogenesis*
- *Vorticity advection (surges)*
- *TC interaction with surrounding areas of vorticity*
- *TC interaction with convective areas*

END