Utilisation des observations micro-ondes passives AMSU-B/MHS pour l'étude des nuages précipitants

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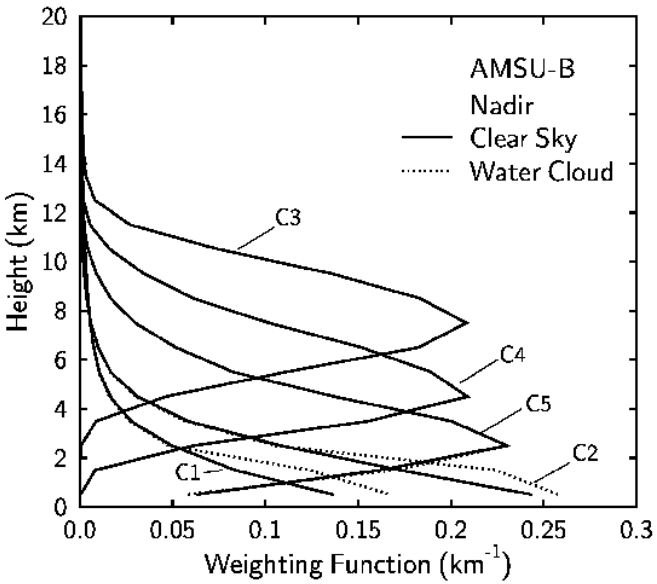
AMSU-B/MHS



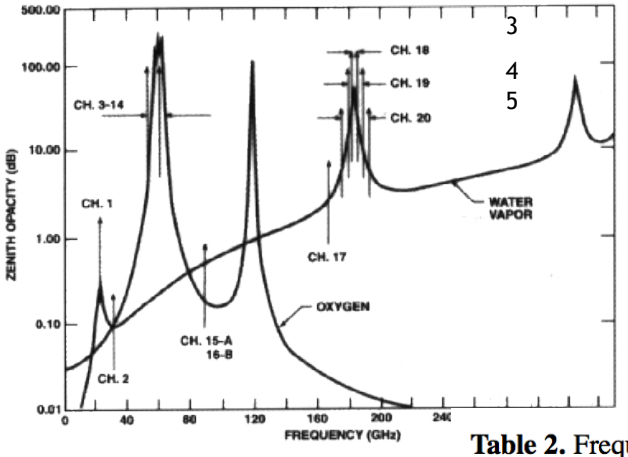


Table 2. Frequencies of AMSU-B and MHS channels.

Channel Number	AMSU-B Center Freq. (GHz)	MHS Center Freq. (GHz)
1	89	89
2	150	157
3	183 ± 1	183 ± 1
4	183 ± 3	183 ± 3
5	183 ± 7	190

Platform	Radiometer	Launch Date	LTAN	
NOAA-15	AMSU-B	13/05/1998	19:20	16:37
NOAA-16	AMSU-B	21/09/2000	14:24	19:02
NOAA-17	AMSU-B	24/06/2002	22:25	20:38
NOAA-18	MHS	20/05/2005	13:41	14:03
Metop-A	MHS	19/10/2006	21:30	21:31
NOAA-19	MHS	06/02/2009	13:43	13:36
NPP	ATMS	28/10/2011	13 :30	-------
Metop-B	MHS	17/10/2012	21:30	-------

Tableau 1: Liste des plateformes ayant à leur bord les radiomètres AMSU-B/MHS et caractéristiques principales : LTAN (Local Time Ascending Node- Heure locale du nœud ascendant) au moment du lancement et en décembre 2010 (dû à des dérives de l'orbite).

WHY AMSU–B/MHS?

- AMSU-B water vapor channels have unique advantages, such as:

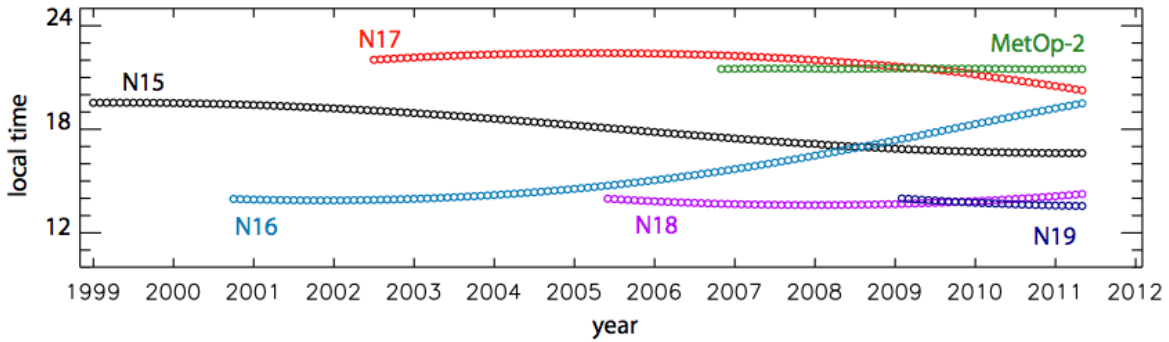
- high sensitivity to frozen hydro-meteors in precipitating clouds [e.g.,Burns et al., 1997;Wang et al., 1997; Bennartz and Bauer, 2003],

- different sensitivities to vertical distributions of frozen hydrometeors [e.g., Burns et al,1997; Bennartz and Bauer ,2003],

- and negligible impact of the ground surface and liquid water cloud in the lower to middle troposphere [e.g., Muller et al., 1994; Wang et al., 1997; Greenwald and Christopher, 2002; Bennartz and Bauer, 2003].

- AMSU has improved horizontal and spectral resolutions compared to its predecessor (MSU).Resolution spatiale: 16 km, fauchée 2200 km.

- Continuous coverage: AMSU-B/MHS instrument has been collecting data onboard NOAA and METOP satellites since 1999.



STRATEGY

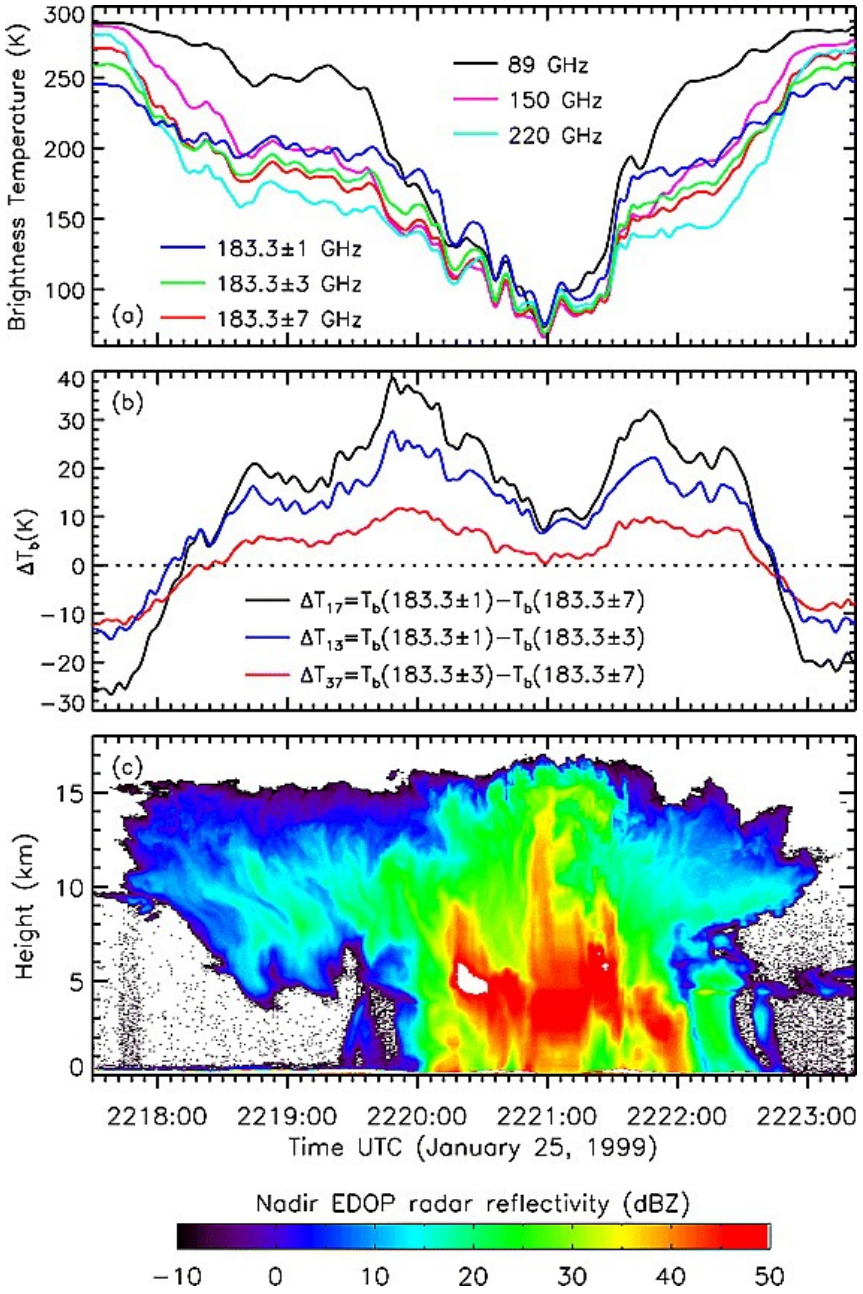
There is no attempt to determine a rain rate as proposed by other authors (e.g. Kongoli et al., 2007; Vila et al., 2007; Surussawadee and Staelin, 2009; Di Tomaso et al., 2009; Laviola and Levizzani, 2011).
Two reasons:

- the weak correlation of scattering intensity and instantaneous rain rate at the surface (e.g. Bennartz and Petty, 2001).
- saturation issues (e.g. Lima et al., 2007) might indeed lead to an under-estimation of large rain rates associated with severe events, which are of special interest in the HYMEX project.

We have favoured an approach in which we detect precipitating clouds / deep convection occurrences.

In the following, we show:

- 3 diagnostics: MR ("Moderate rain"), DC ("Deep convection"), COV ("Convective Overshootings"
- Some applications of these diagnostics.



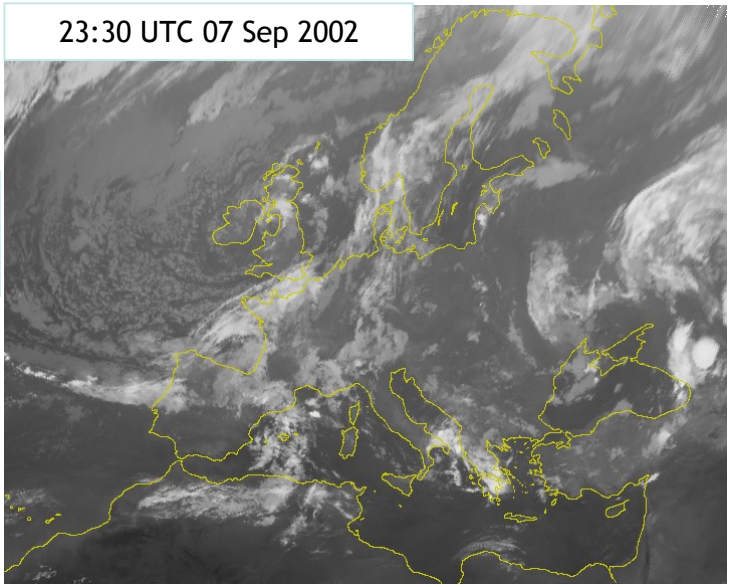
2 critères différents pour:
-Deep convection (DC)
B3m5, B3m4, B4m5, all>or = 0

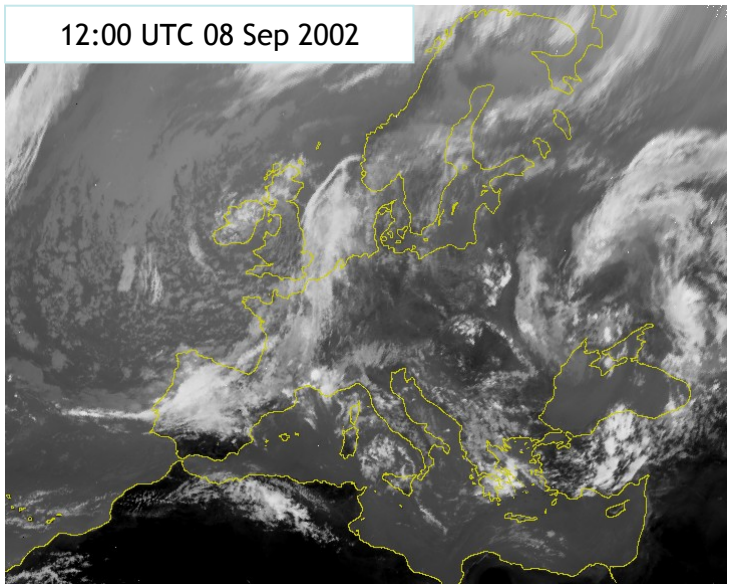
-Convective Overshootings (COV)
B3m5>B3m4>B4m5>or = 0

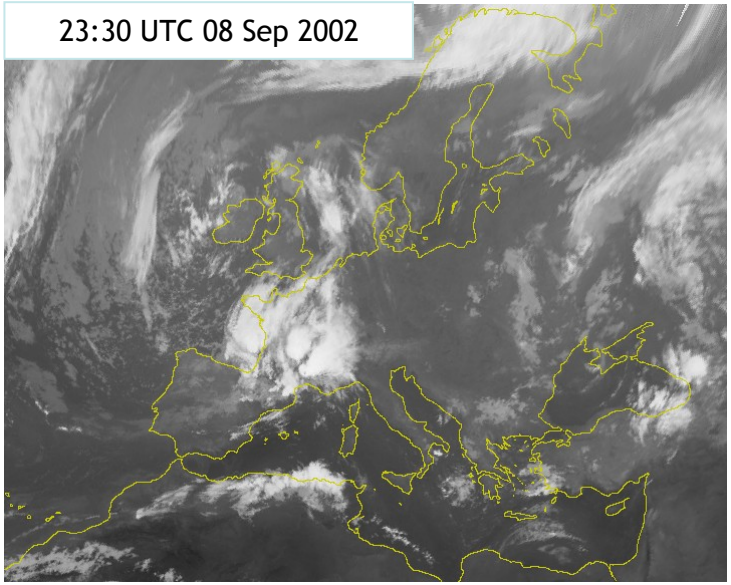
Hong et al., 2005
Detection of tropical deep convective clouds from AMSU-B vapour channels measurements

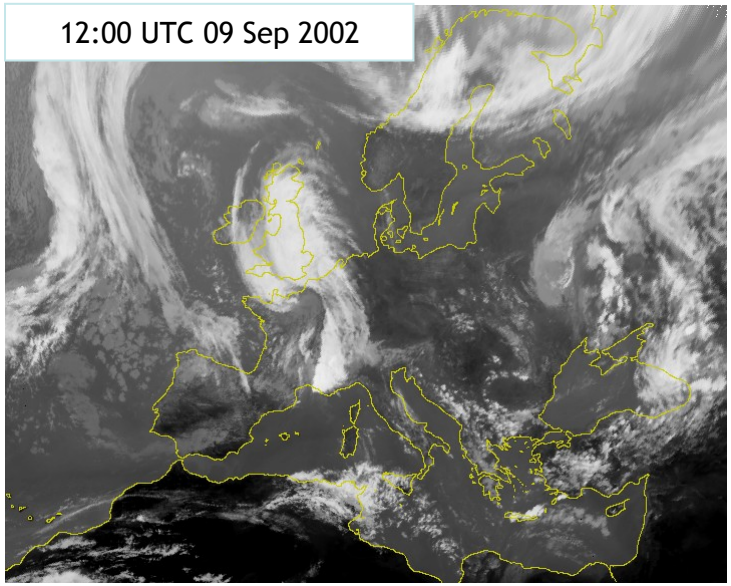
Case Study: Nîmes-Marseille (8-9 September 2002)

Meteosat IR



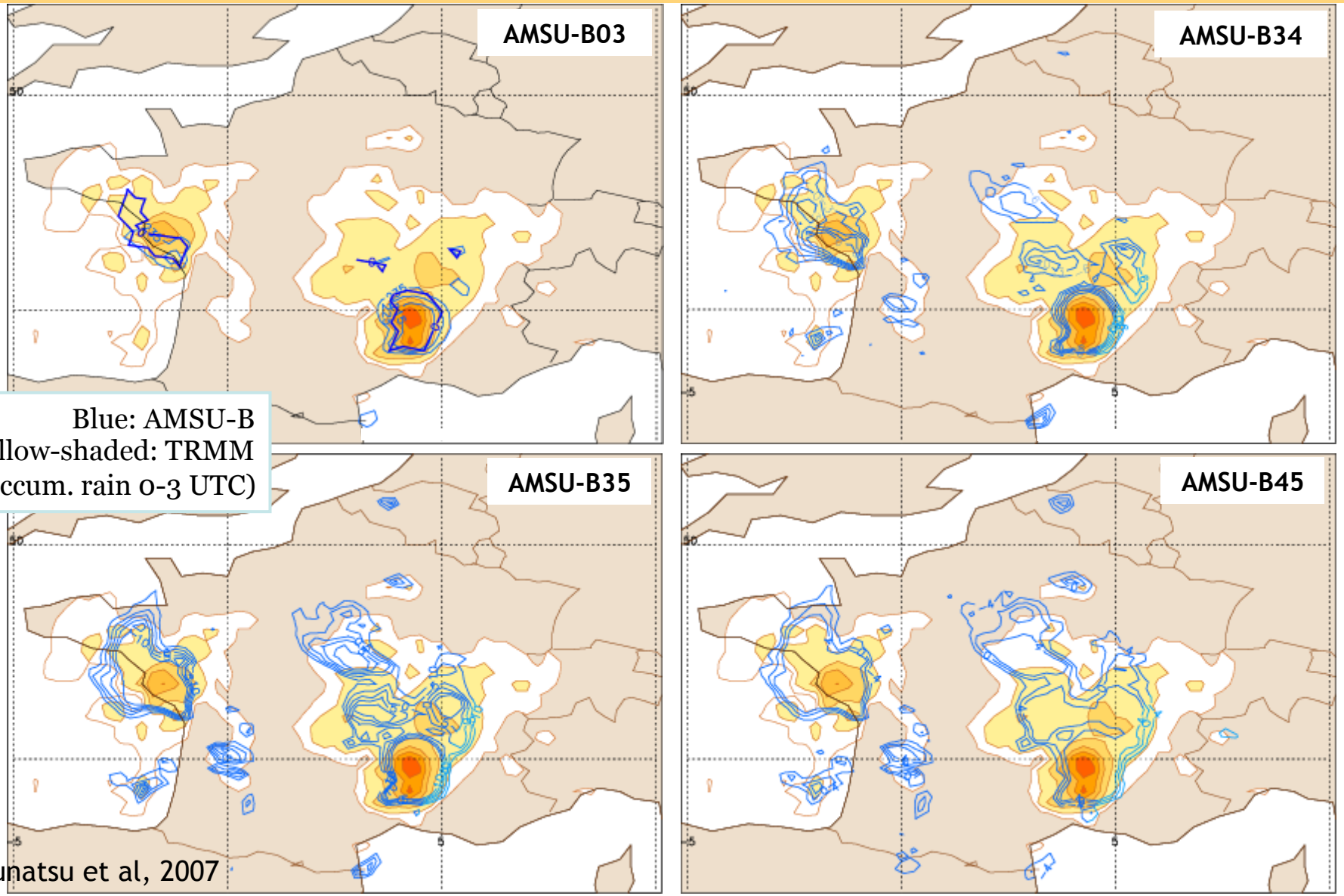






Precipitation and AMSU-B: Comparison with TRMM3B42

Nîmes-Marseille – 02 UTC 9 September 2002



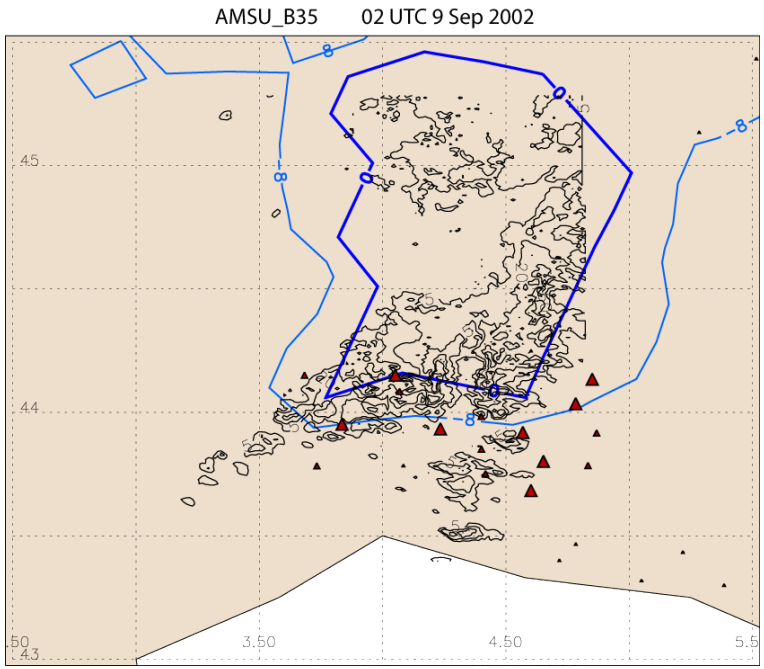
Blue: AMSU-B
Yellow-shaded: TRMM
(accum. rain 0-3 UTC)

Funatsu et al, 2007

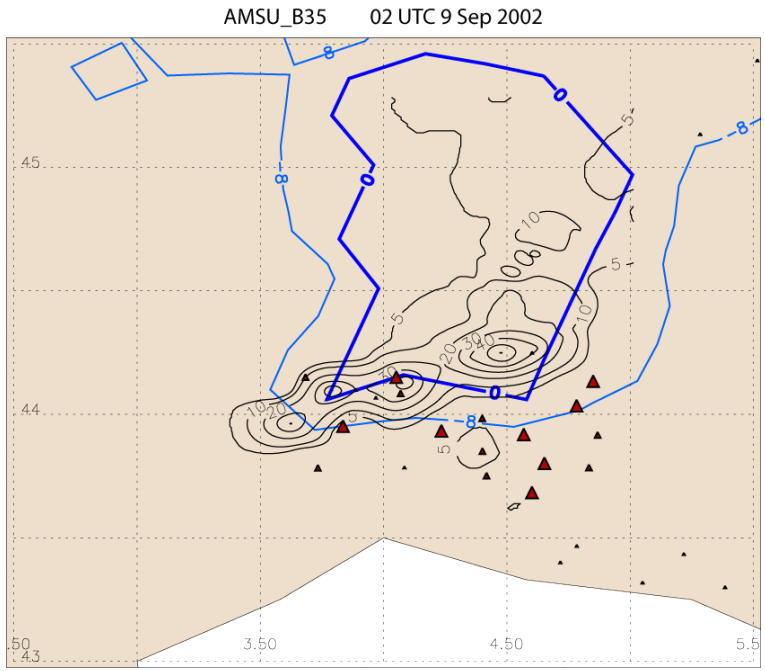
Precipitation and AMSU-B: Comparison with Ground Data

Nîmes-Marseille – 02UTC 9 Septembre 2002

AMSU-B [3-5] and DCT



Thin black – radar (precip intensity in mm/h at 02:30UTC)



Black – accum. precip between 2-3 UTC

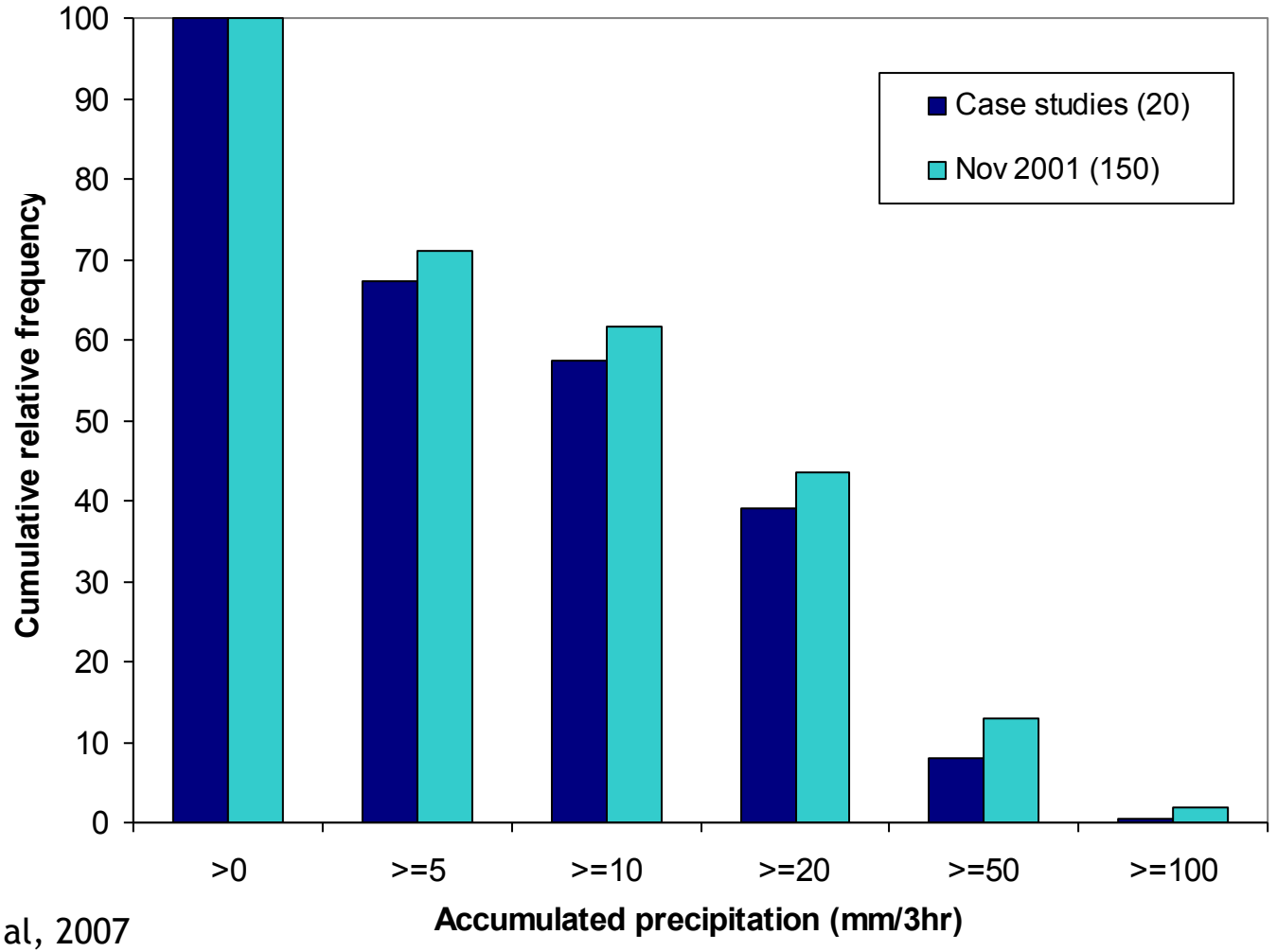
▲ - station SQR (precip. accum. during 24h)

Funatsu et al, 2007

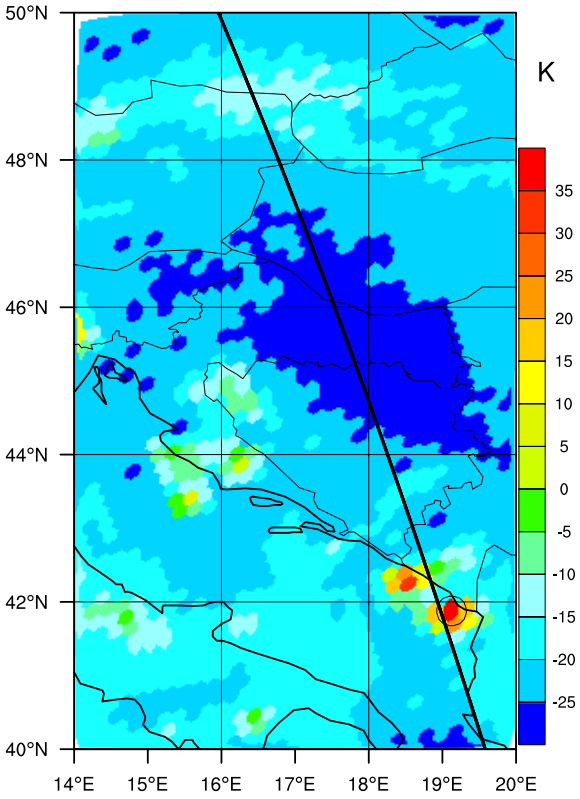
Radar and accumulated precip. provided by Brice Boudevillain (LTHE)
SQR data provided by METEO-France (Véronique Ducrocq)

Precipitation and AMSU-B: « Deep Convection Threshold » Analysis using TRMM

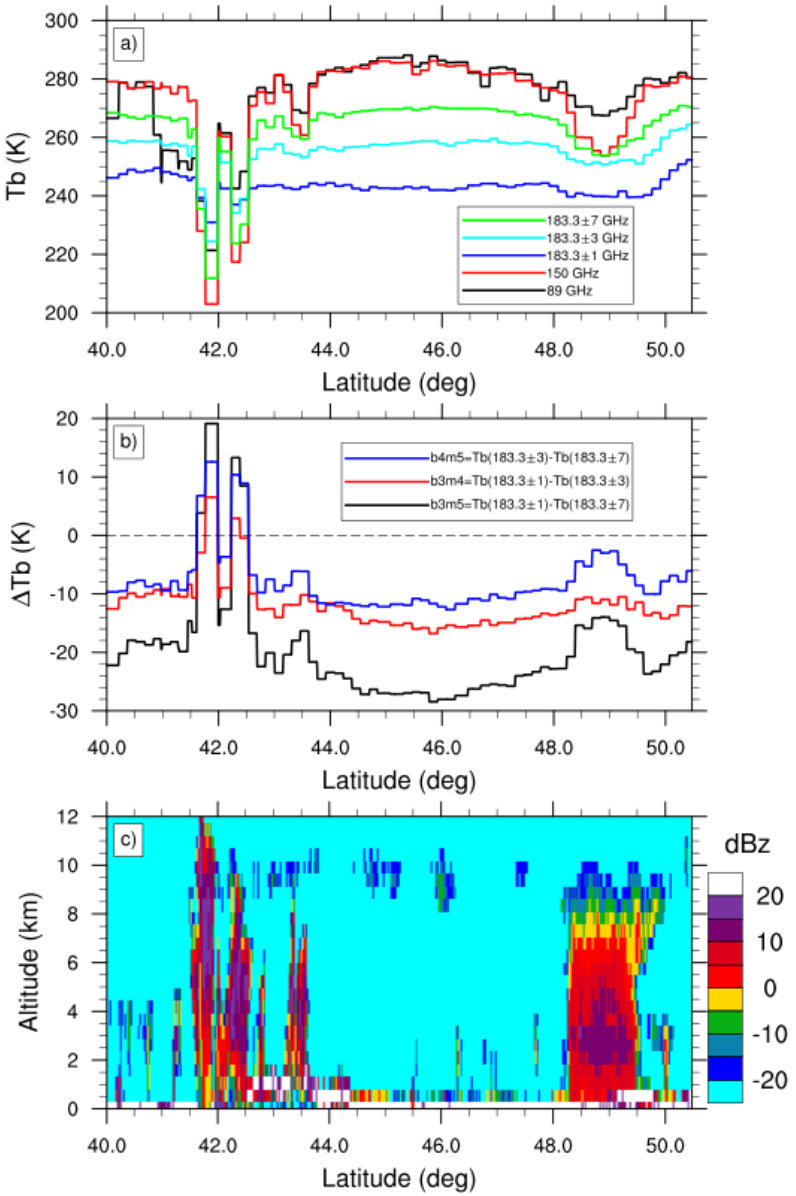
Frequency distribution for “Deep Convection Threshold” of Hong et al. (2005)
DCT = AMSU_B45 ≥ 0 **and** AMSU_B35 ≥ 0 **and** AMSU_B34 ≥ 0



Funatsu et al, 2007

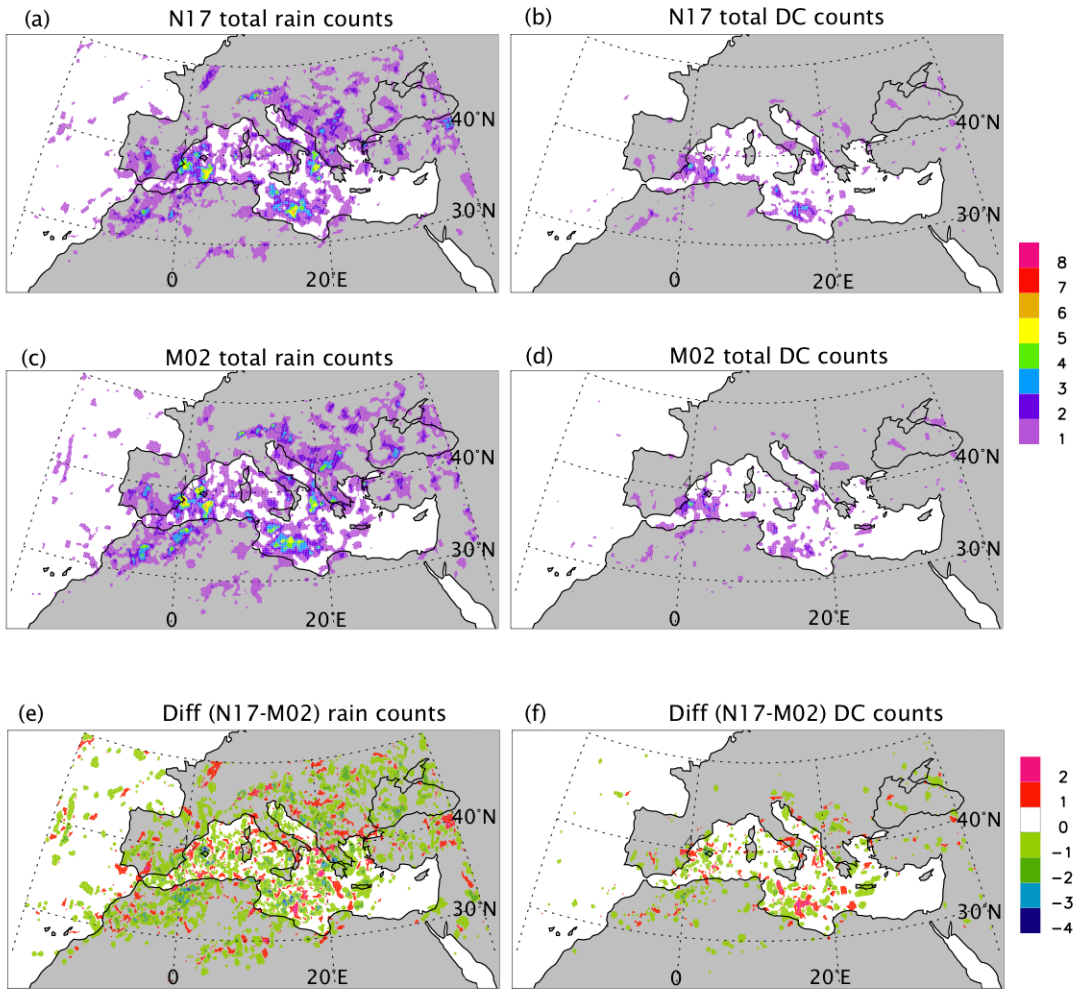


B3m5 NOAA18
CloudSat (#10mn)



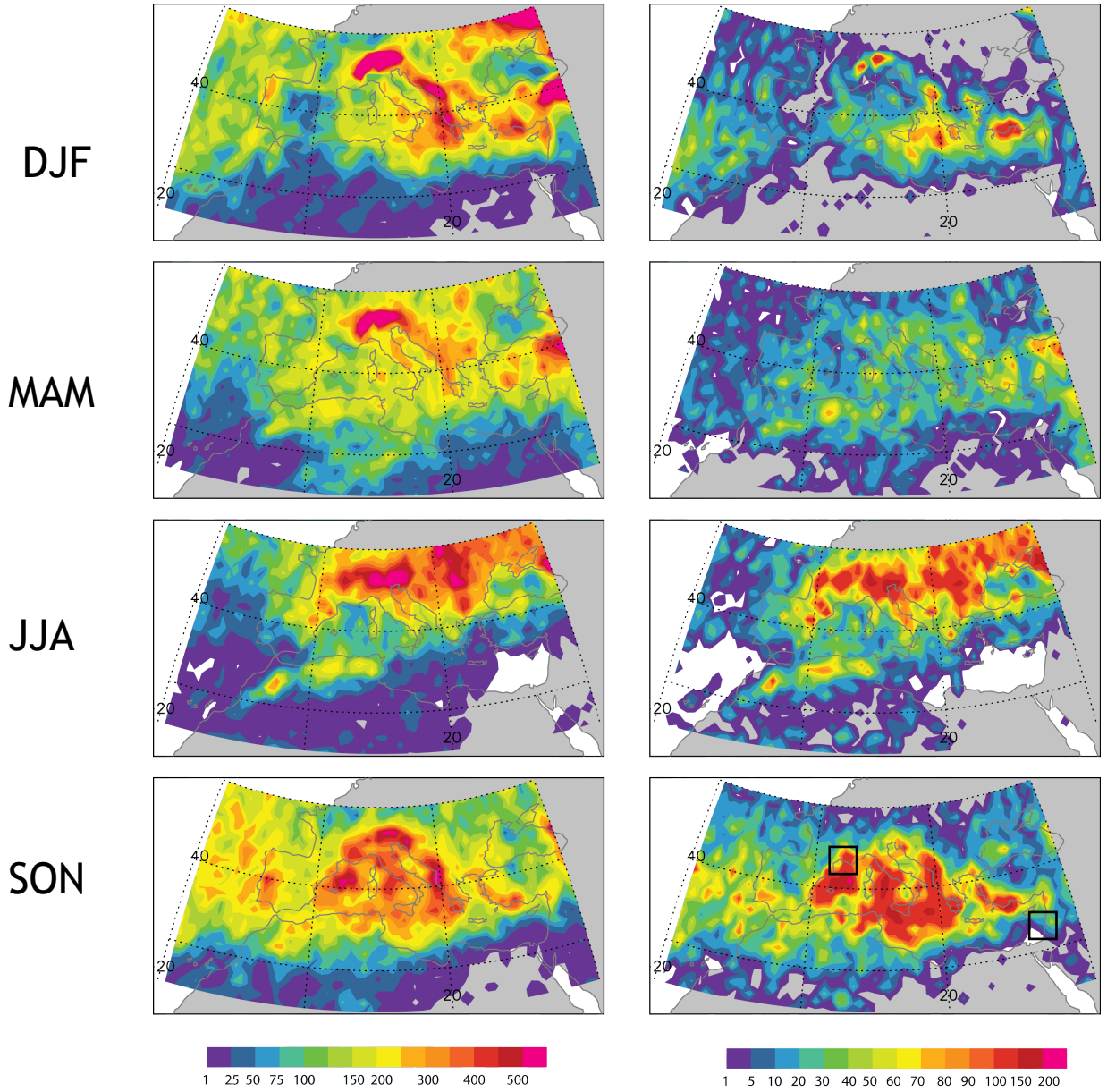
From AMSU-B to MHS

exp: oct 2007



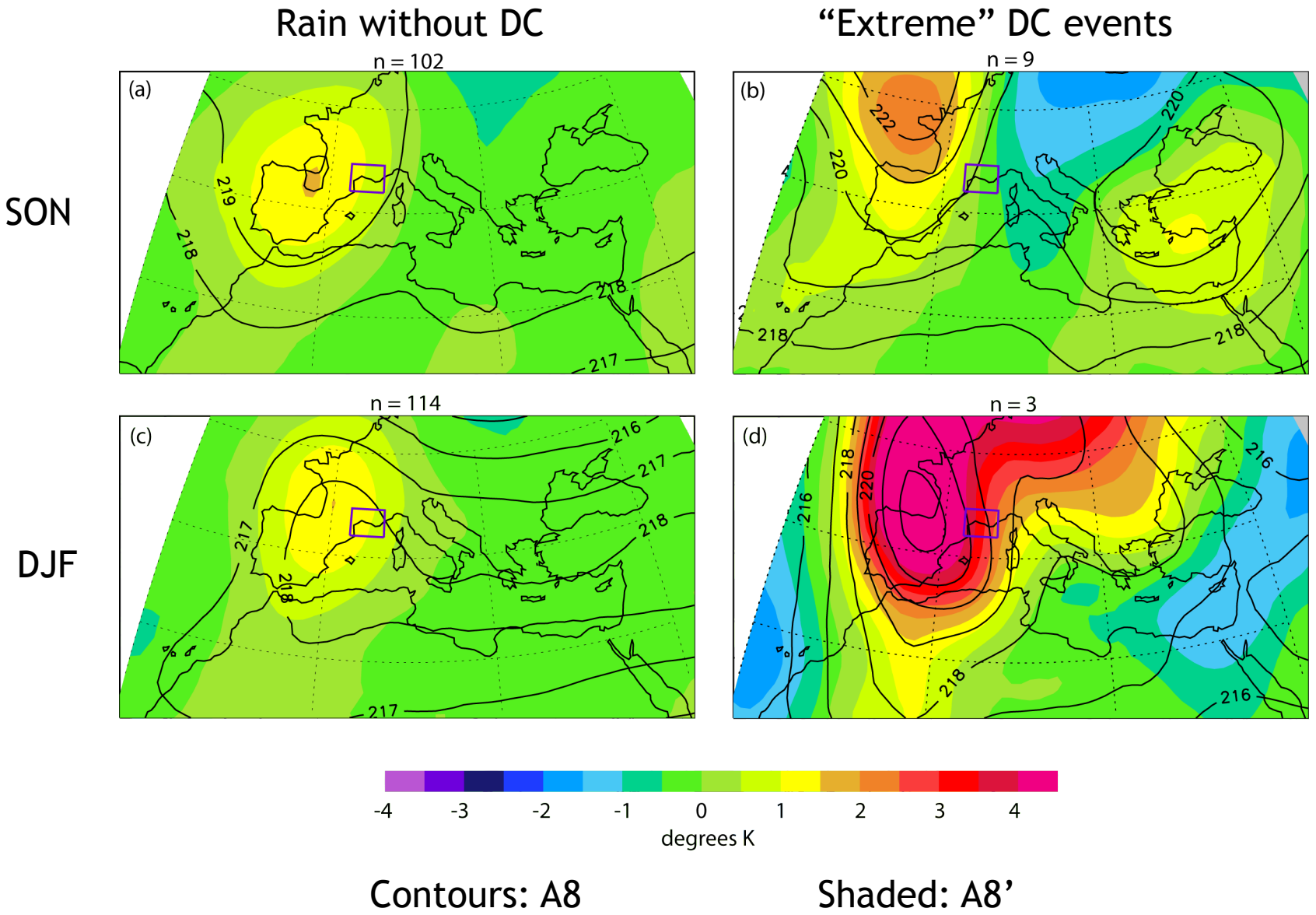
Now there is ATMS…

Seasonal Distribution of precipitation and Deep Convection occurrences

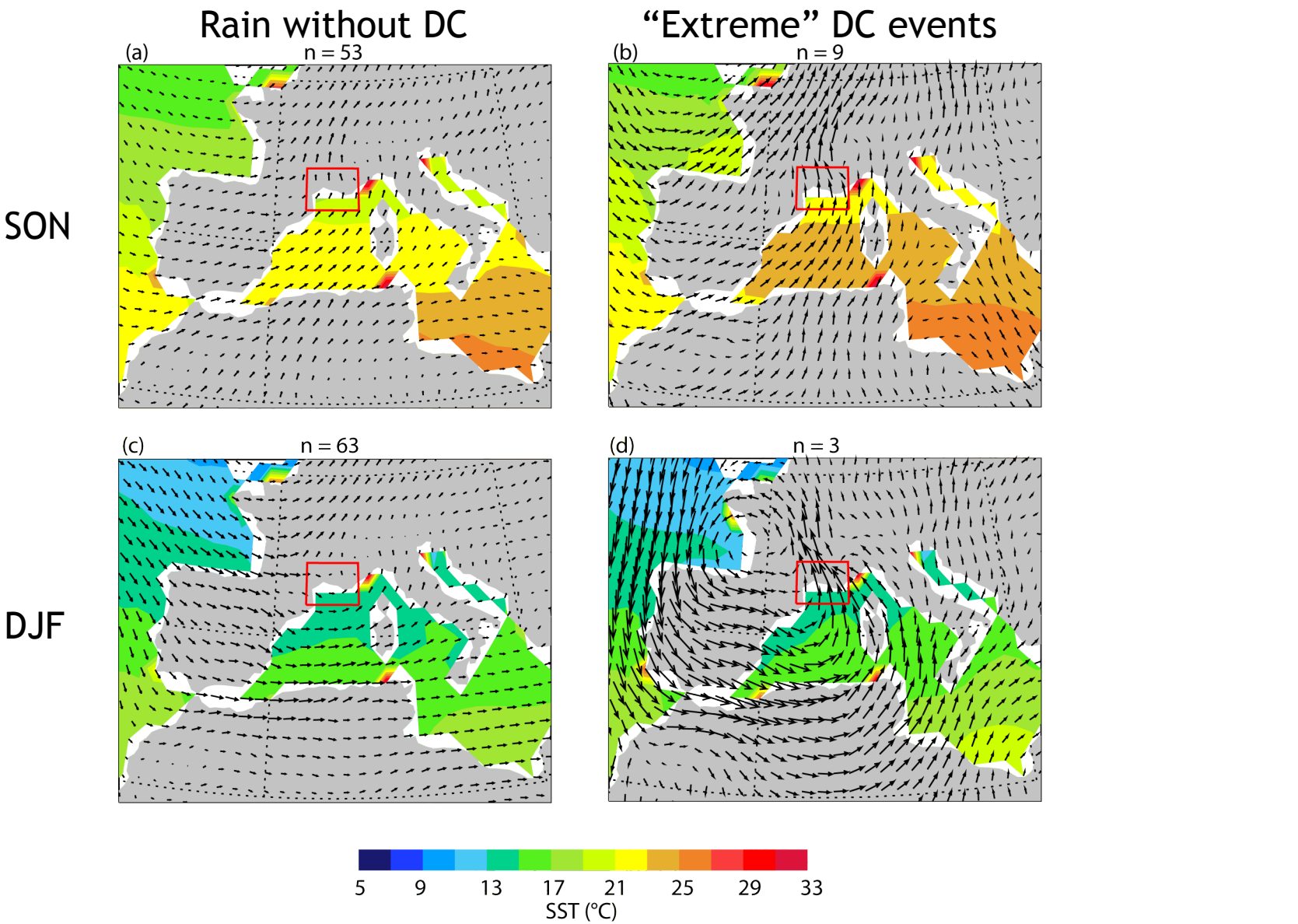


Data: NOAA-16 2001-2007

Southern France - Upper-level structures



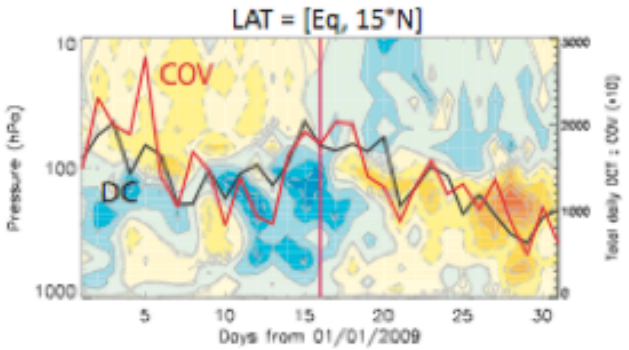
Southern France - SST and wind at 850 hPa



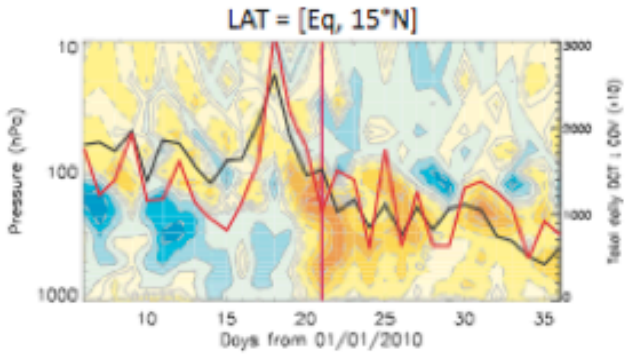
SST and wind fields from Operational ECMWF analyses

Etudes aux Tropiques : Utilisation de DC et COV pour étudier les couplages tropiques/extra-tropiques

2009



2010



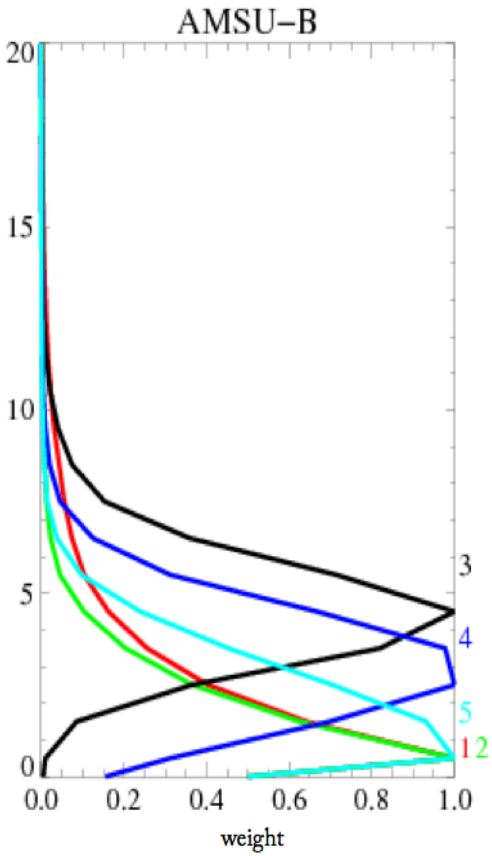
Diagrammes Hovmöller jours/altitude de l'anomalie de vitesse verticale normalisée (issue de la réanalyse Era-Interim)

-→ Modulation de l'activité convective aux tropiques en lien avec les échauffements stratosphériques soudains dans la stratosphère arctique

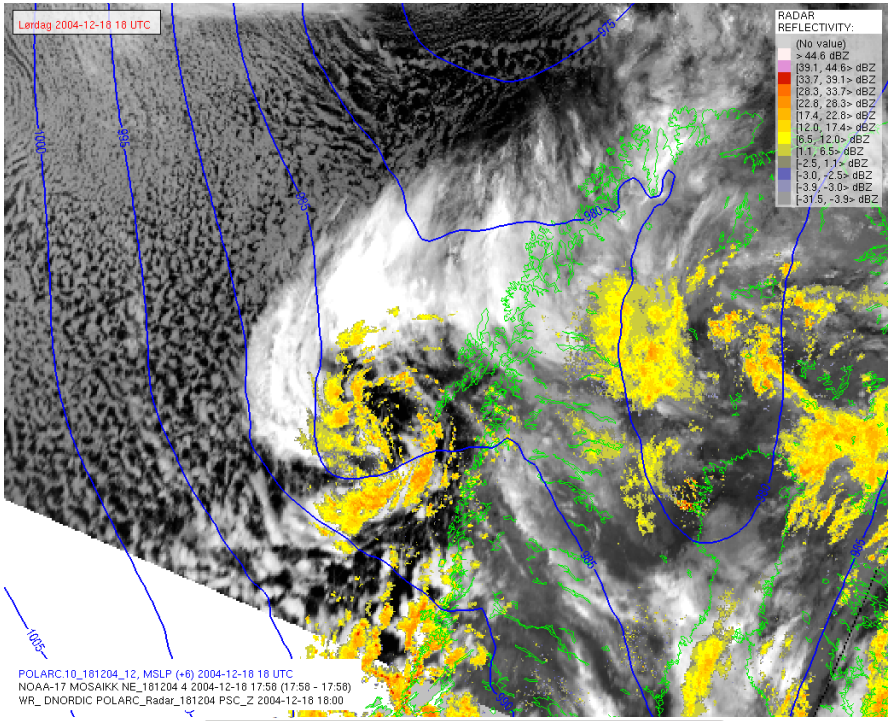
+ Etude cycle diurne convection en Amazonie: Funatsu et al, JGR, 2012

Application à l'étude des polar lows

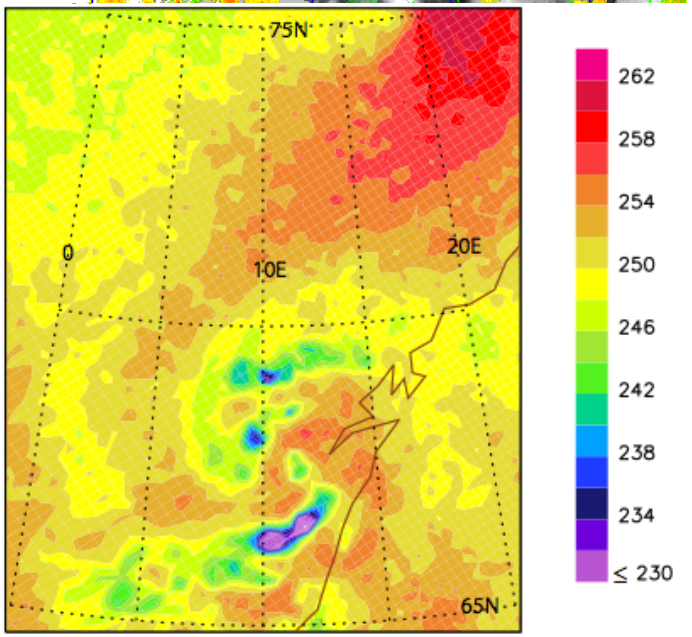
Cas du 12 Décembre 2008



Fonctions de poids AMSU-B, profil subarctique

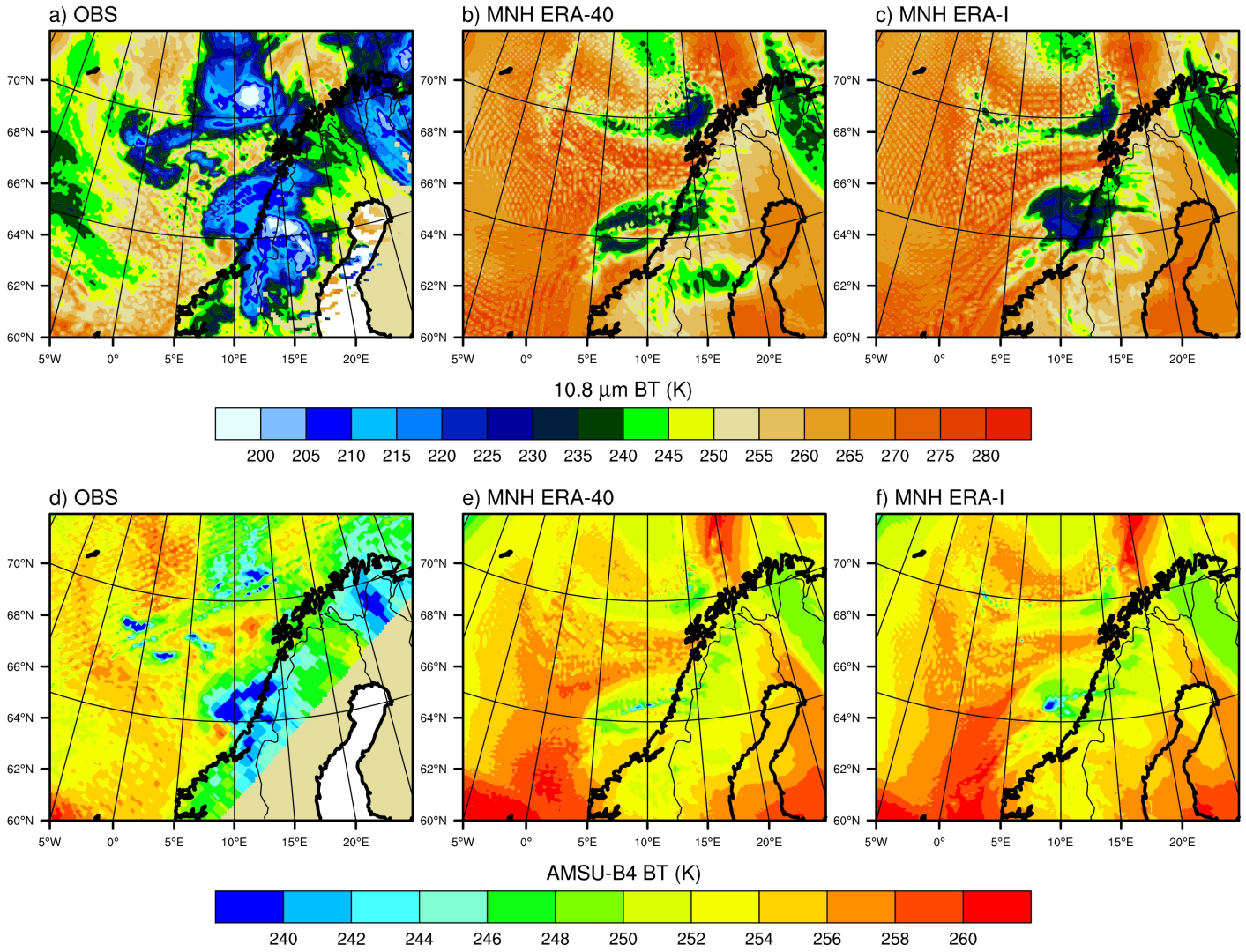


AMSU-B canal4



Application à l'étude des polar lows: Validation simulations Meso-NH par une approche modèle-vers-satellite

AMSU-B4



Conclusions & perspectives

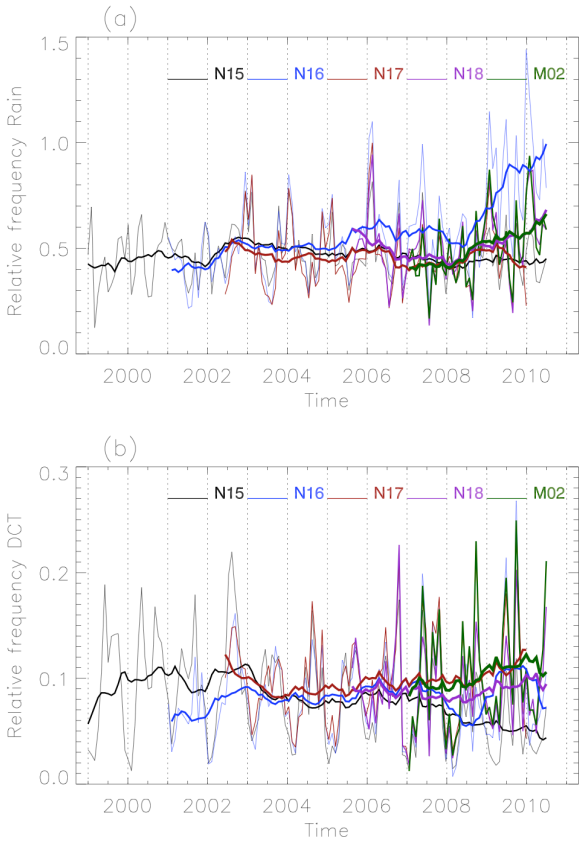
Intérêt de AMSU-B/MHS pour la détection de nuages précipitants/convectifs illustré pour différentes latitudes/situations

Limitations/projets de travaux:

- Changement de radiomètres/ dérives des plateformes
- Problème de la neige (précipitation): Signal en diffusion potentiellement masqué par le signal en émission (Liu et Seo, 2013)

Solution: approche statistique couplée à CloudSat

- Problème des surfaces froides/enneigées
- …



Etude de la convection profonde durant la SOP HyMeX par synergie instrumentale

- Capteur IR de Meteosat
- Réseau Euclid (détection des éclairs)
- Radar nuage aéroporté Rasta
- Canaux vapeur d'eau MHS

Exemple : IOP 12a 12 octobre 2012