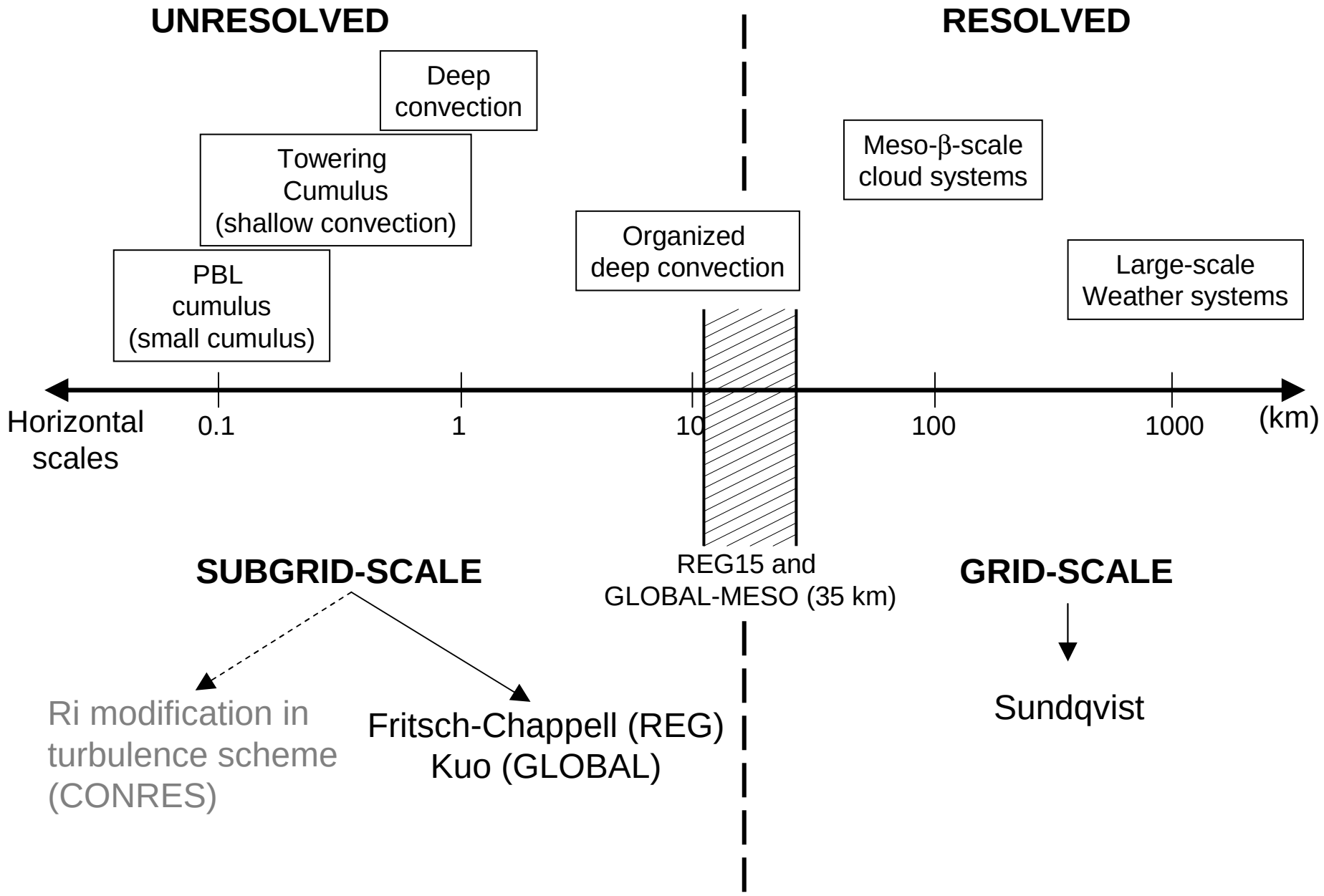
Nuages stratocumulus et cumulus dans GEM

Stéphane Bélair

Séminaire RPN
19 septembre 2003

Représentation des nuages dans GEM



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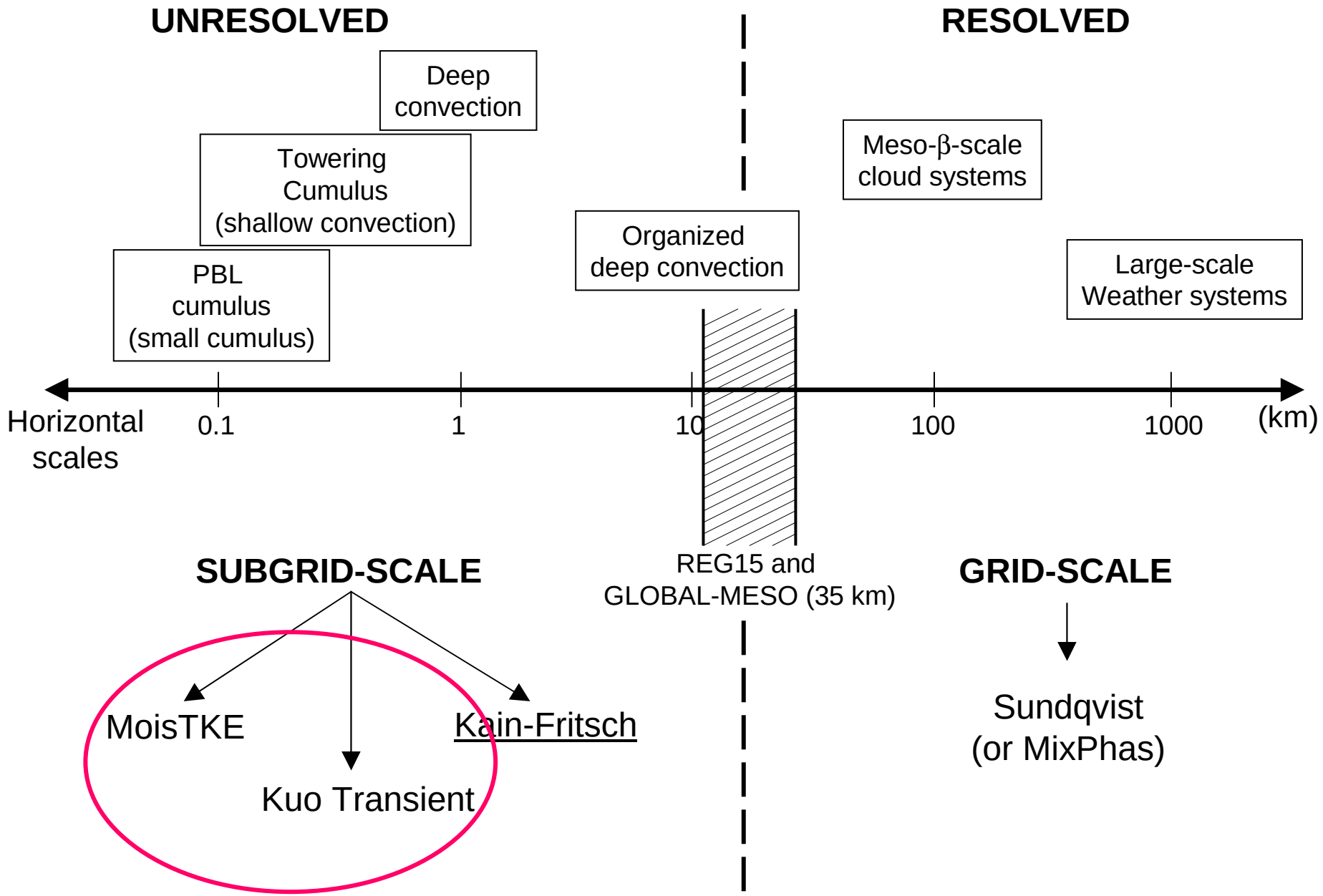


Objectifs

- Montrer que les schémas de la nouvelle suite de nuages proposée pour REG15 et GLOBAL-MESO est en mesure de représenter la grande variété de nuages qui existent dans les systèmes grande-échelle et méso-échelle (hivernal et estival)

- Examiner l'impact que les nuages stratocumulus et cumulus ont sur la précipitation

Résultats extraits de deux études

Bélair, S., J. Mailhot, C. Girard, and P. Vaillancourt, 2004: Boundary-layer and shallow cumulus clouds in a medium-range forecast of a large-scale weather system. To be submitted.

Bélair, S., and J. Mailhot, 2004: Influence of implicit, explicit, and boundary-layer cloud processes on the statistical properties of precipitation produced by a meso-beta-scale model. To be submitted.

Plus tard cette annee: Séminaire sur Global-Méso par Paul Vaillancourt et Michel Roch
Infos sur Global-Meso: http://euclide (cliquer sur modèle global-méso)

Le schéma Kuo Transient pour la convection restreinte

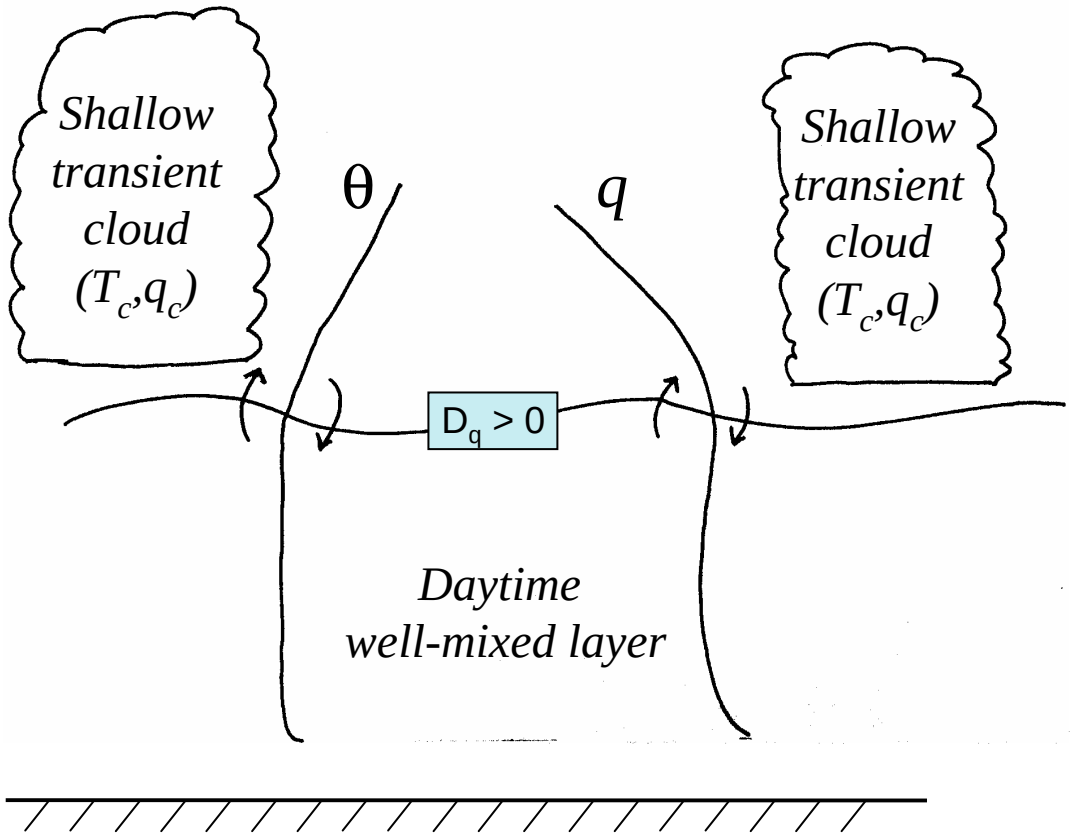
Transient shallow cloud model driven at its base by turbulent boundary layer fluxes developed at RPN by Claude Girard.

This scheme is essentially the same as the Kuo Symmetric scheme (also by C. Girard) in which the humidity "accession" is given by the tendencies from the vertical diffusion scheme:

$$\left(\frac{\partial q}{\partial t}\right)_{shallow} = K(q_c - q) - D_q$$

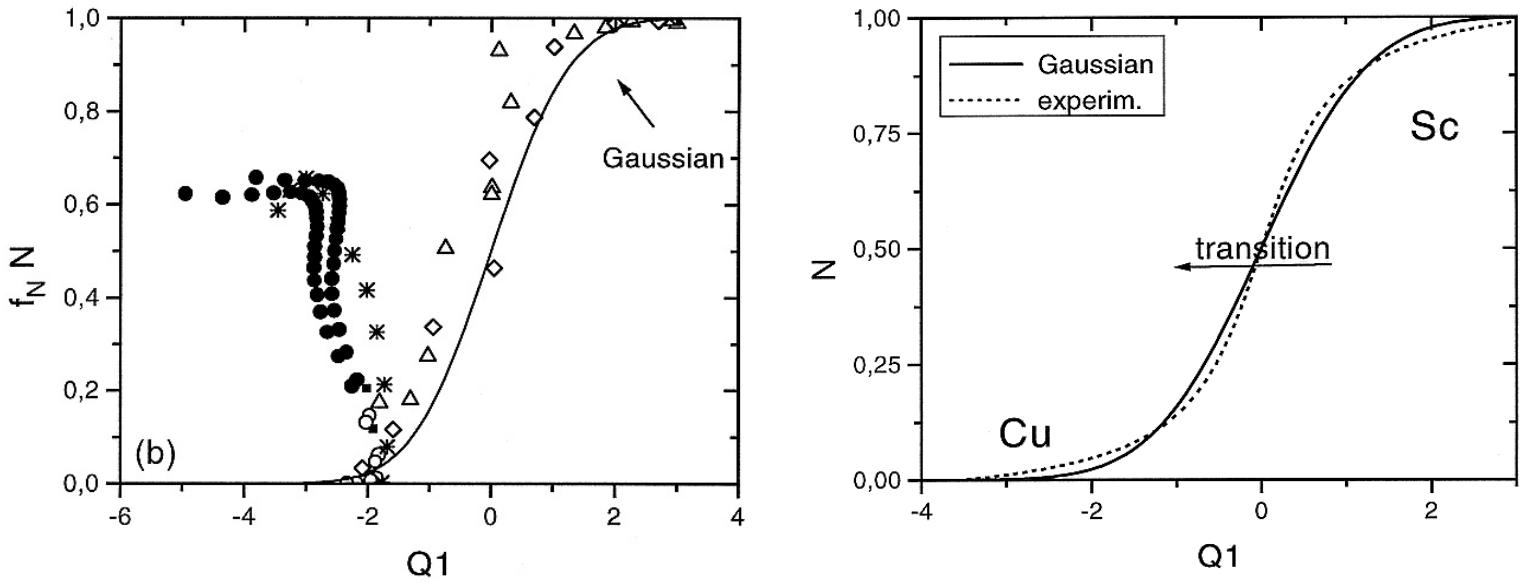
$$\left(\frac{\partial T}{\partial t}\right)_{shallow} = K(T_c - T)$$

in which the *K* coefficients are calculated using the energy conservation principle.



Le schéma MoisTKE pour les nuages de couche limite

- From Jocelyn Mailhot
- Unified approach for turbulence-cloud interactions
- Implicit cloudiness scheme with treatment of mixed-phase clouds
- Appropriate for TKE model
- Based on Bechtold et al.
- Unified description of stratiform clouds and shallow non-precipitating convection
- Mixing and dissipation lengths from Bougeault-Lacarrère



Flux enhancement factor (f_N) and implicit cloud fraction (N) as a function of Q_1, a normalized measure of supersaturation for a series of observational experiments (taken from Bechtold and Siebesma 1998)

La configuration de la physique pour REG15 et GLOBAL-MESO

- Constant thermodynamic roughness over water surfaces
- Bougeault-Lacarrere mixing length for the vertical diffusion
- MoisTKE for boundary-layer clouds
- Shallow convection with Kuo Transient
- Deep convection with Kain-Fritsch
- Grid-scale condensation with a modified Sundqvist scheme (consun)
- Modifications to the radiative “fix” at the model top (only for GLOBAL-MESO)

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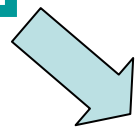
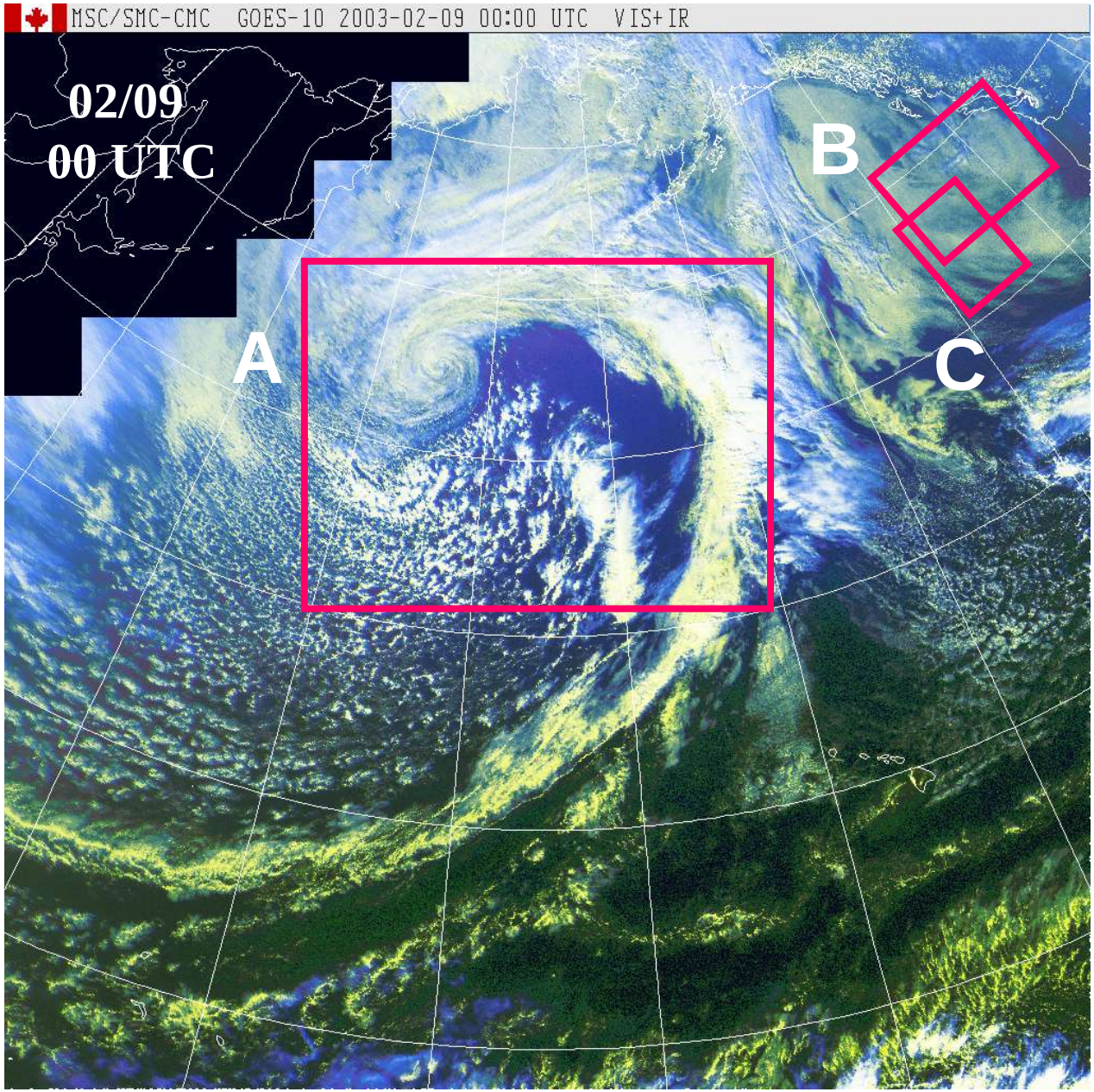


Total cloud fraction and cloud water content

Un système grand échelle au-dessus du Pacifique

GOES
(visible + IR)

0000 UTC
9 Feb 2003



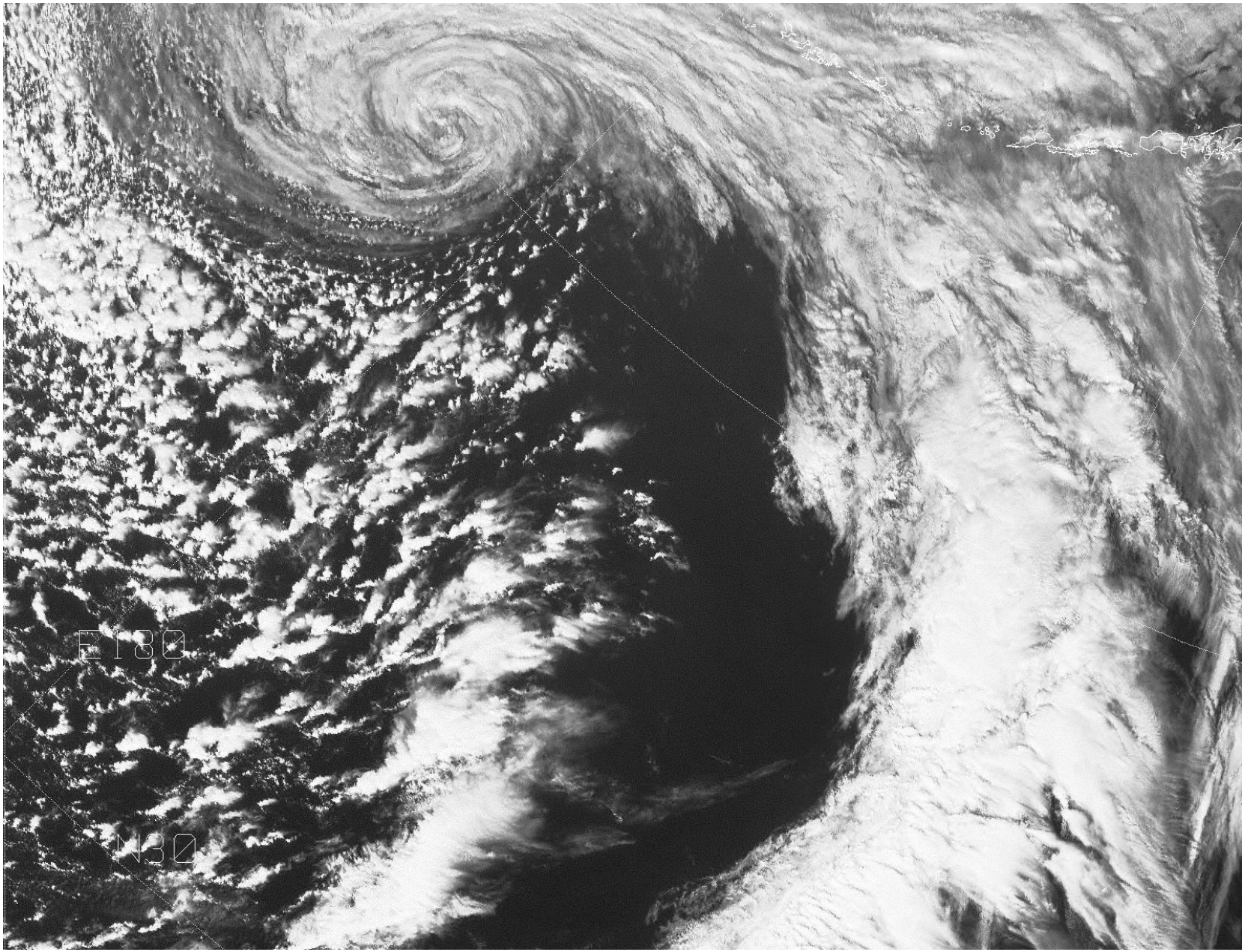
Les cumulus à l'arrière du système

http://ronlx.edm.ab.ec.gc.ca/mrsid.htm
Merci à René Servranckx

A

GOES visible

Valide à 2200 UTC le 8/02/2003



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B

GOES visible

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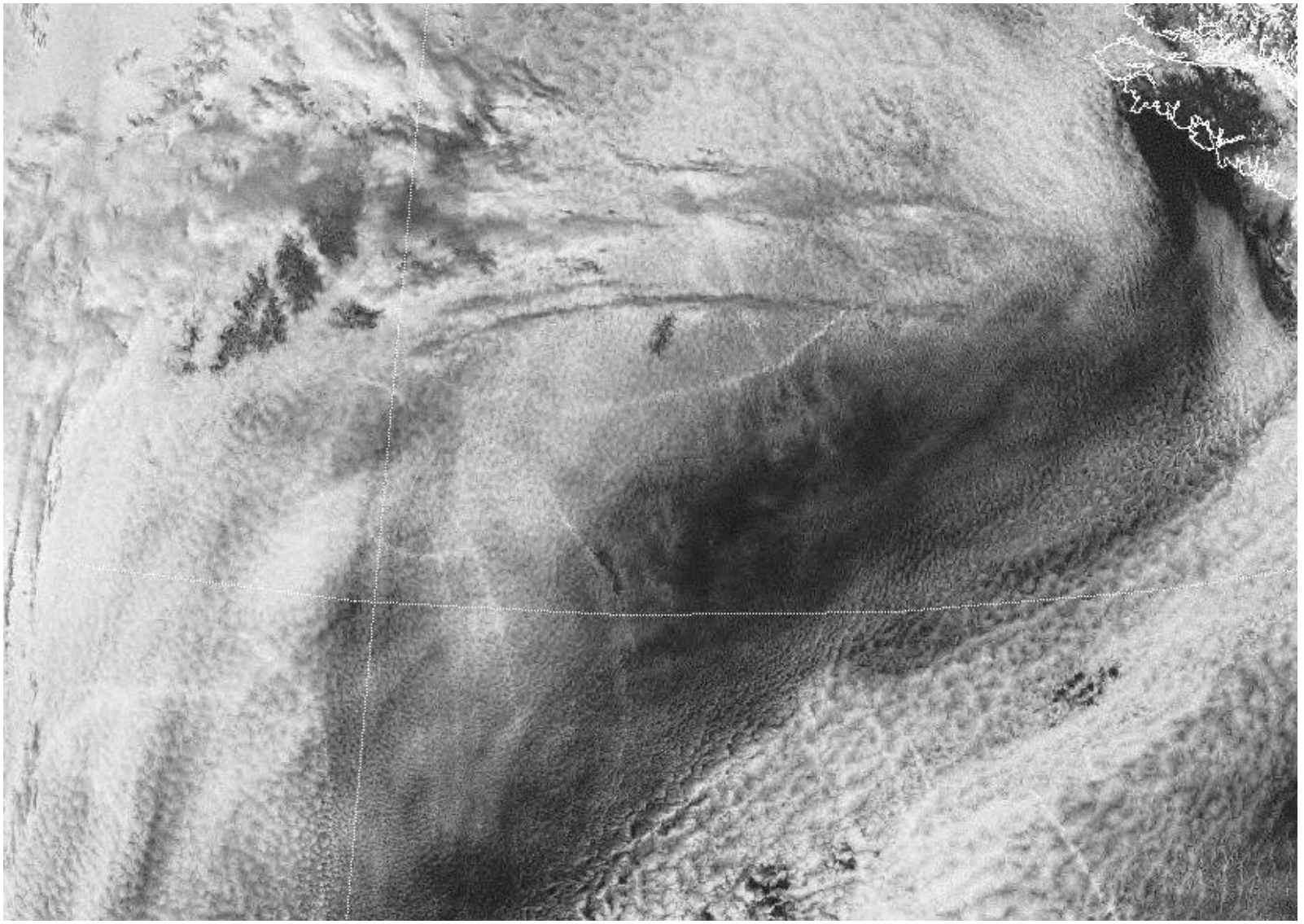
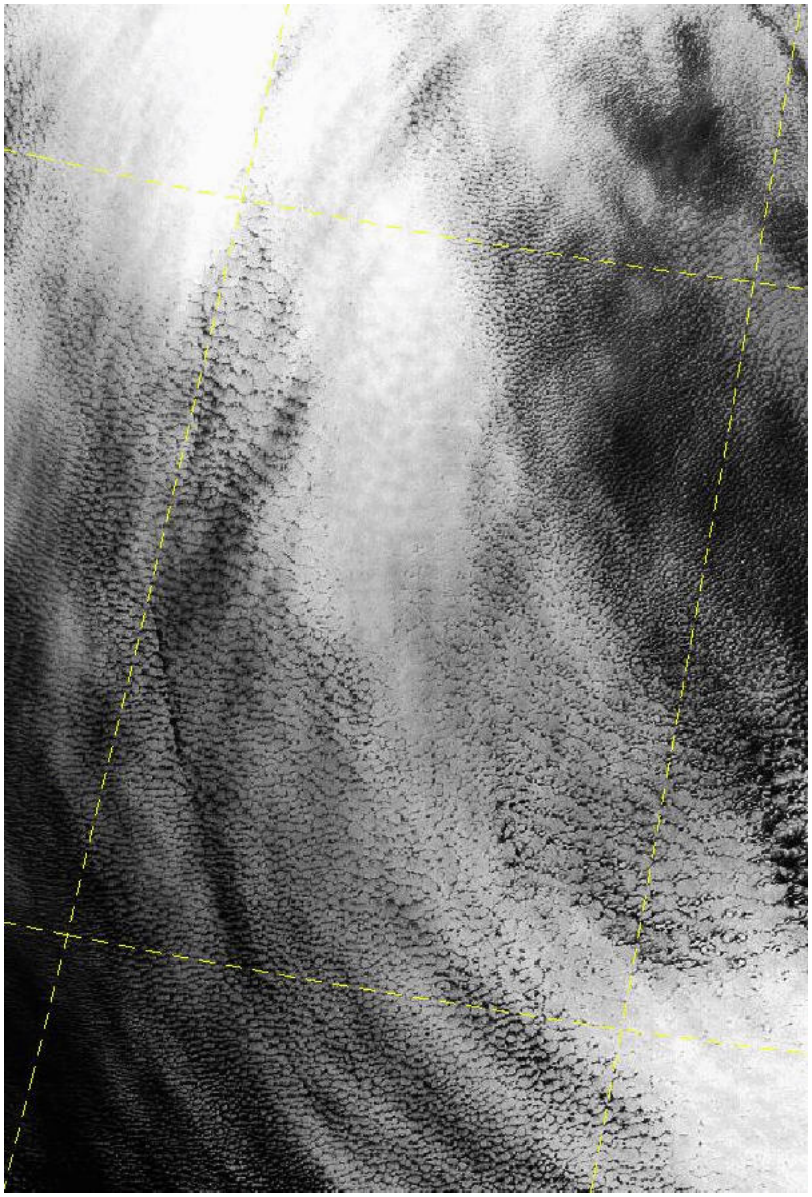
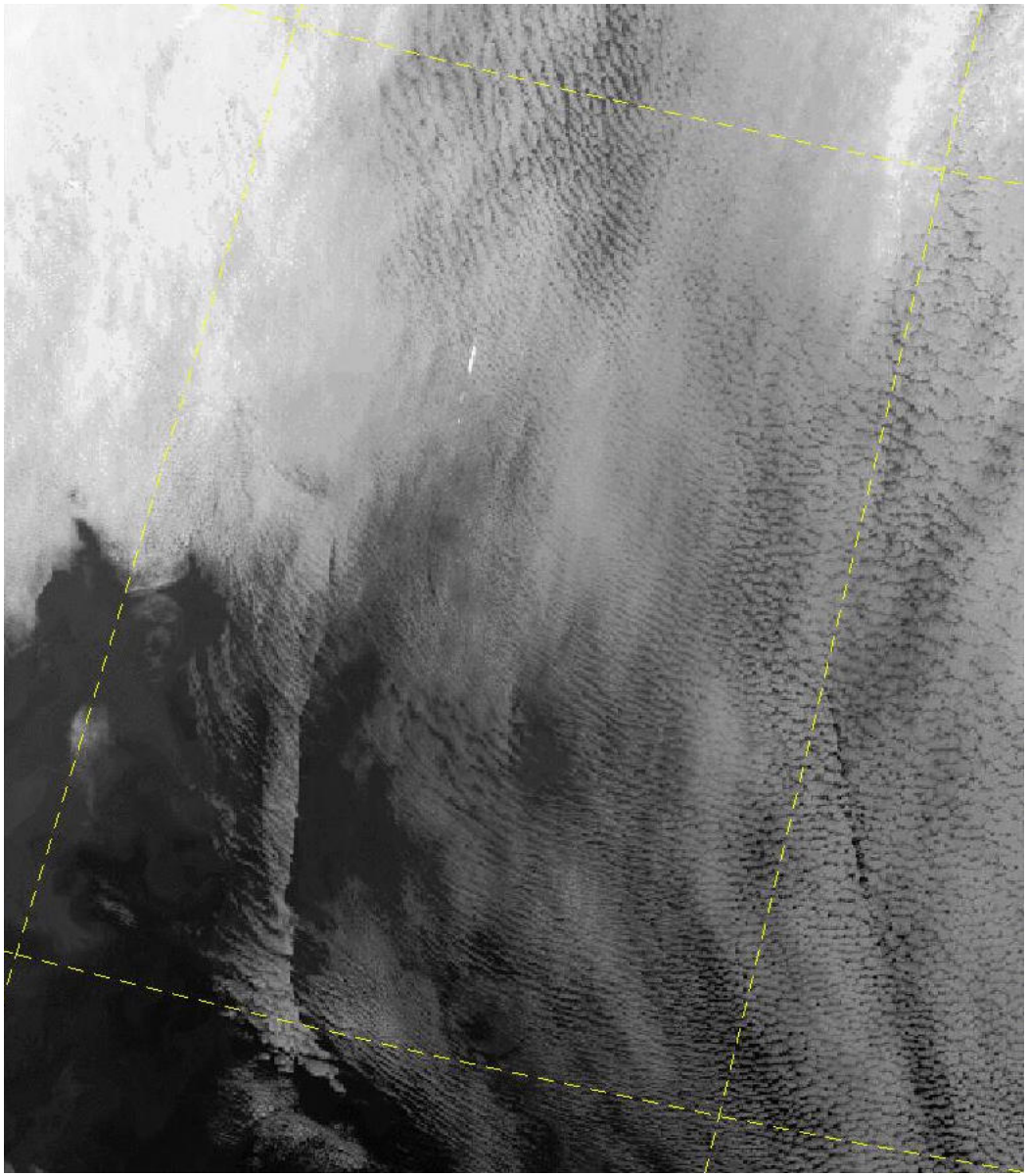


Les nuages stratocumulus à l'avant du système

C





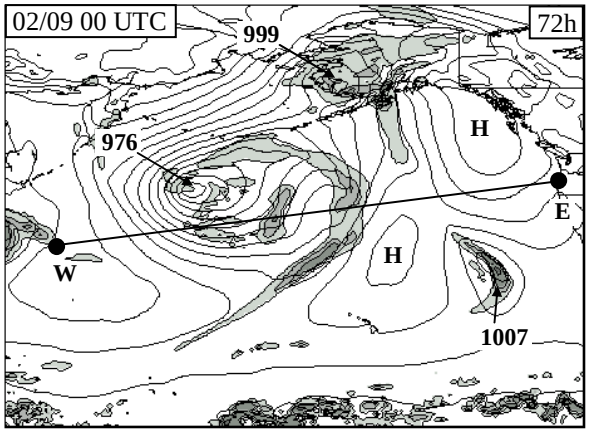
(merci a Serge T.)

AVHRR (~ 1 km)

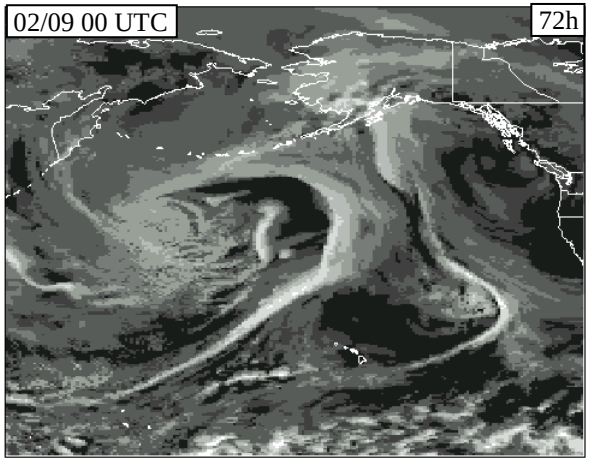
Valide a 0700 UTC 9 Feb 2003

La prévision 72-h du GLOBAL MESO

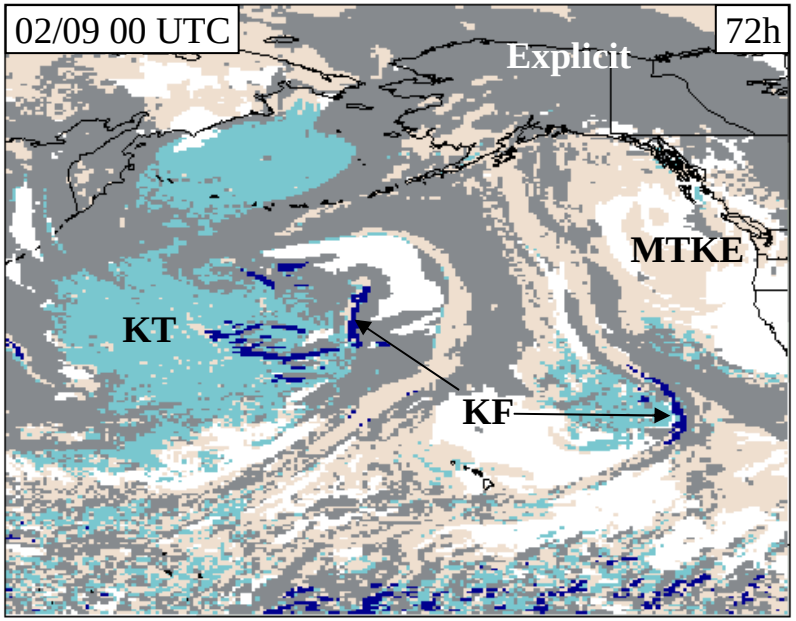
PNM + 6h precip



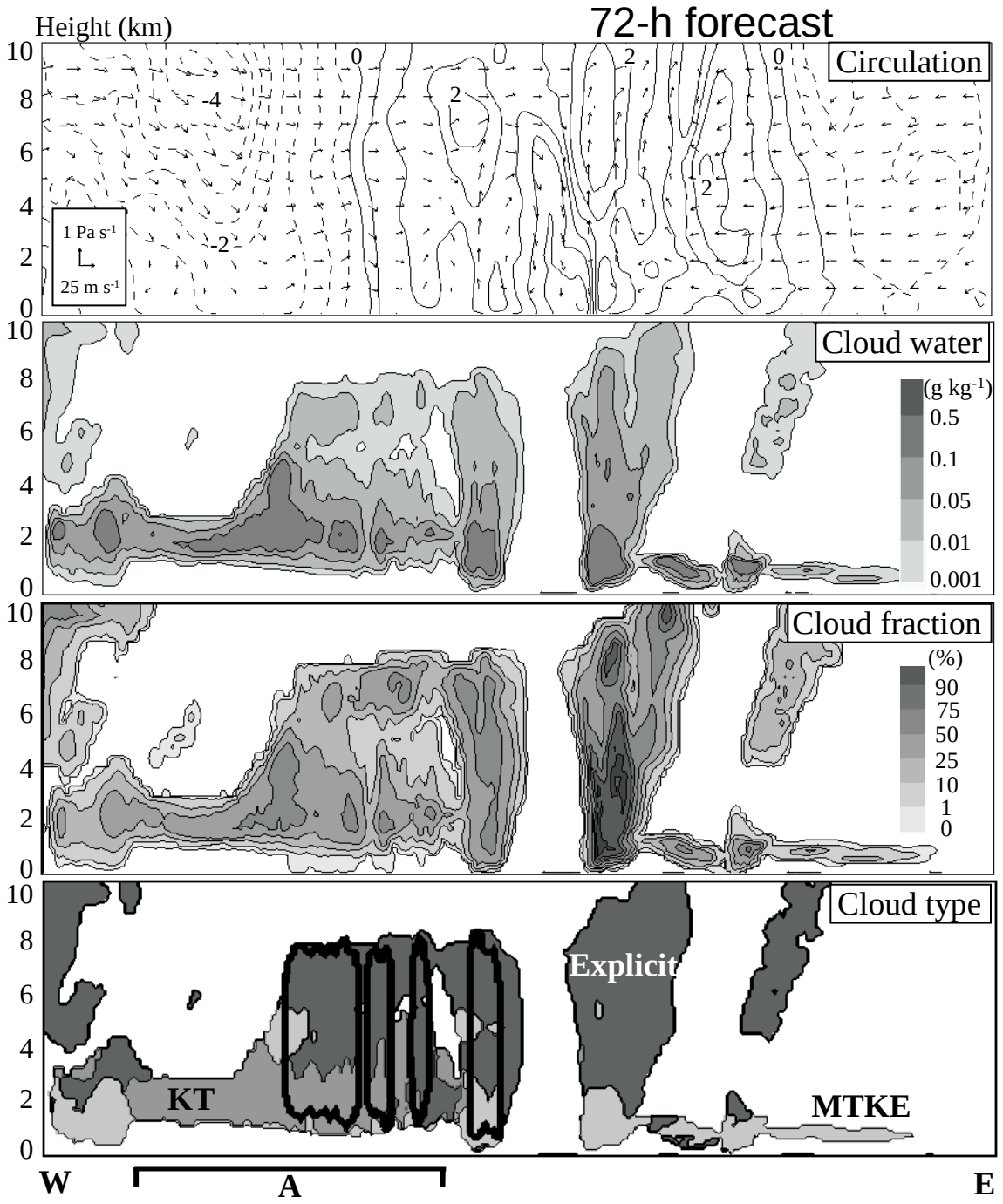
Integrated cloud water content



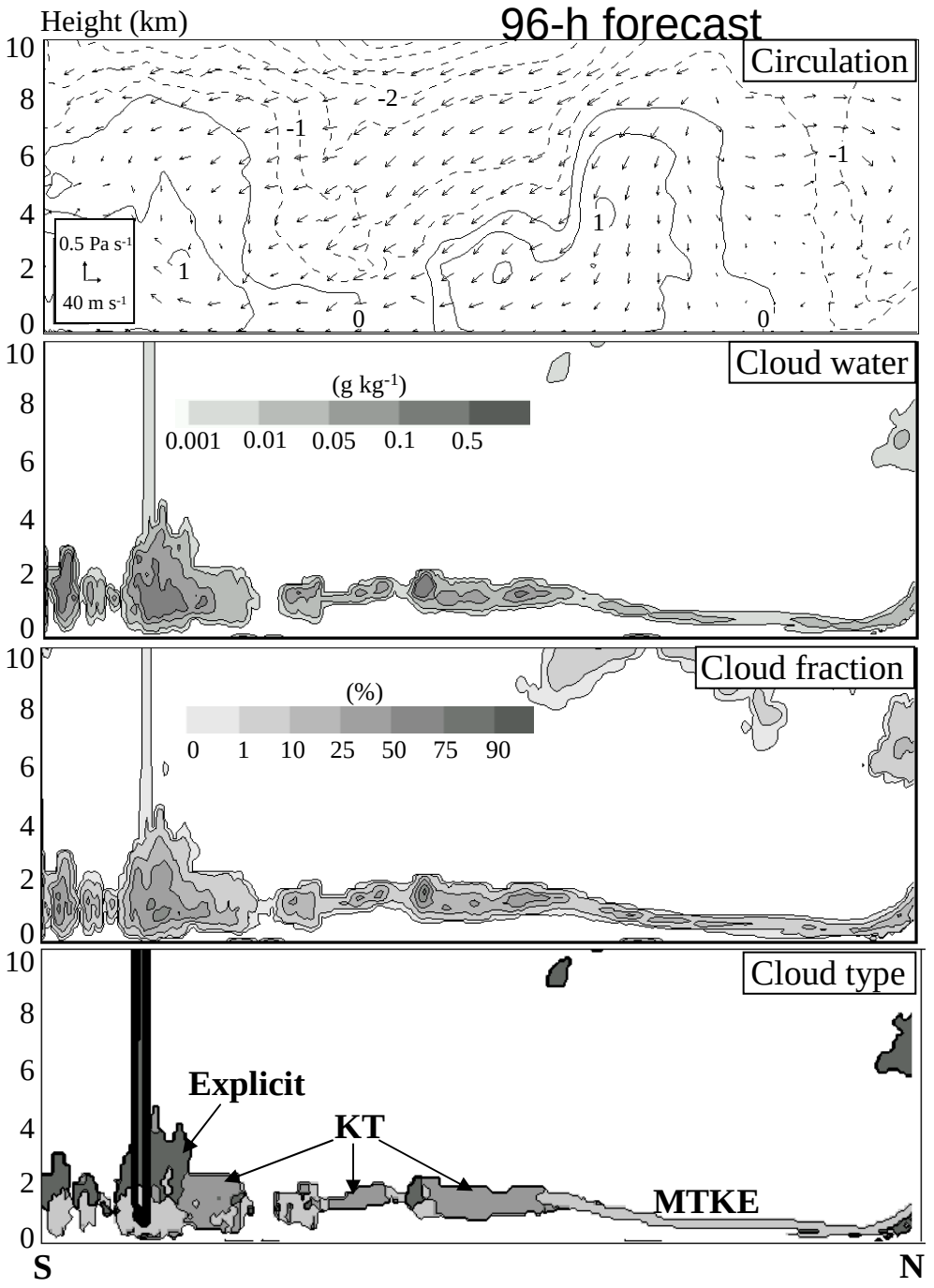
Dominant cloud types



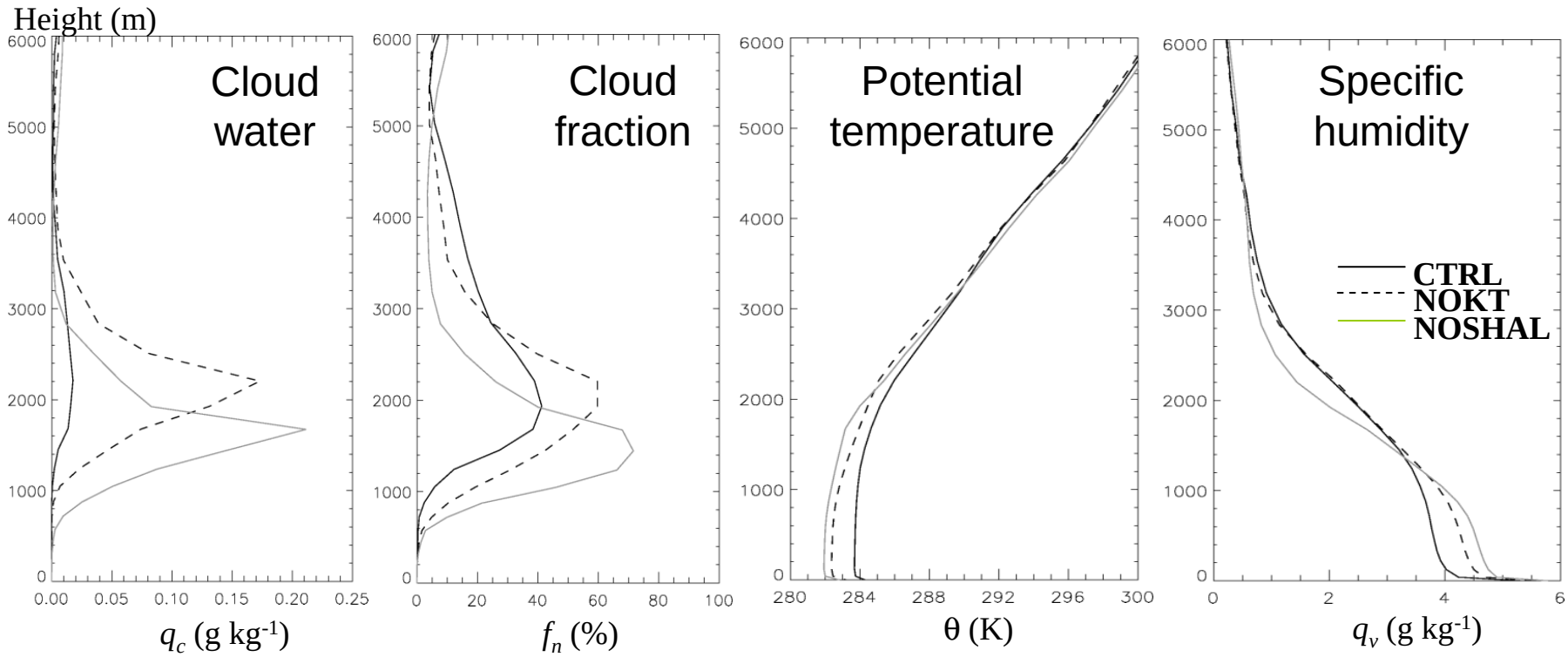
Coupes Ouest-Est



Coupes Sud-Nord

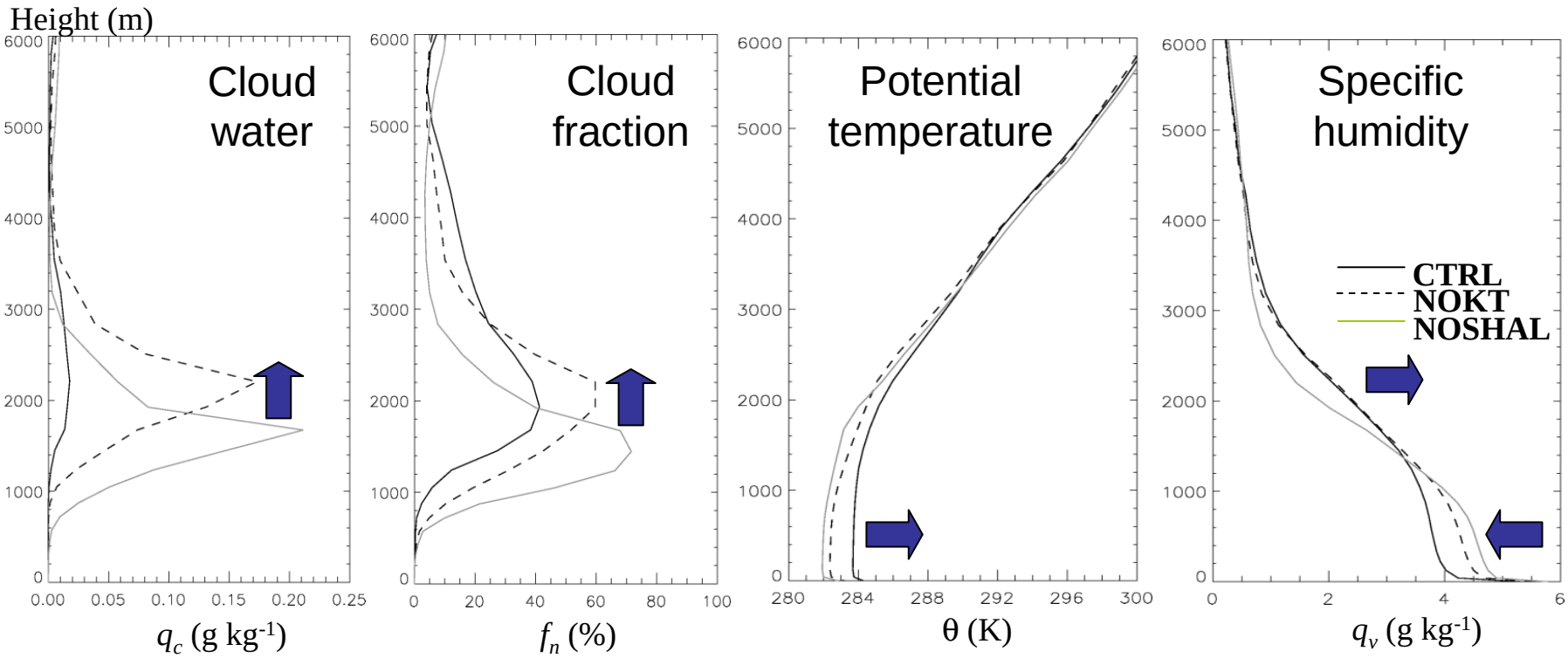


Impact de MoisTKE + Kuo Transient sur les nuages



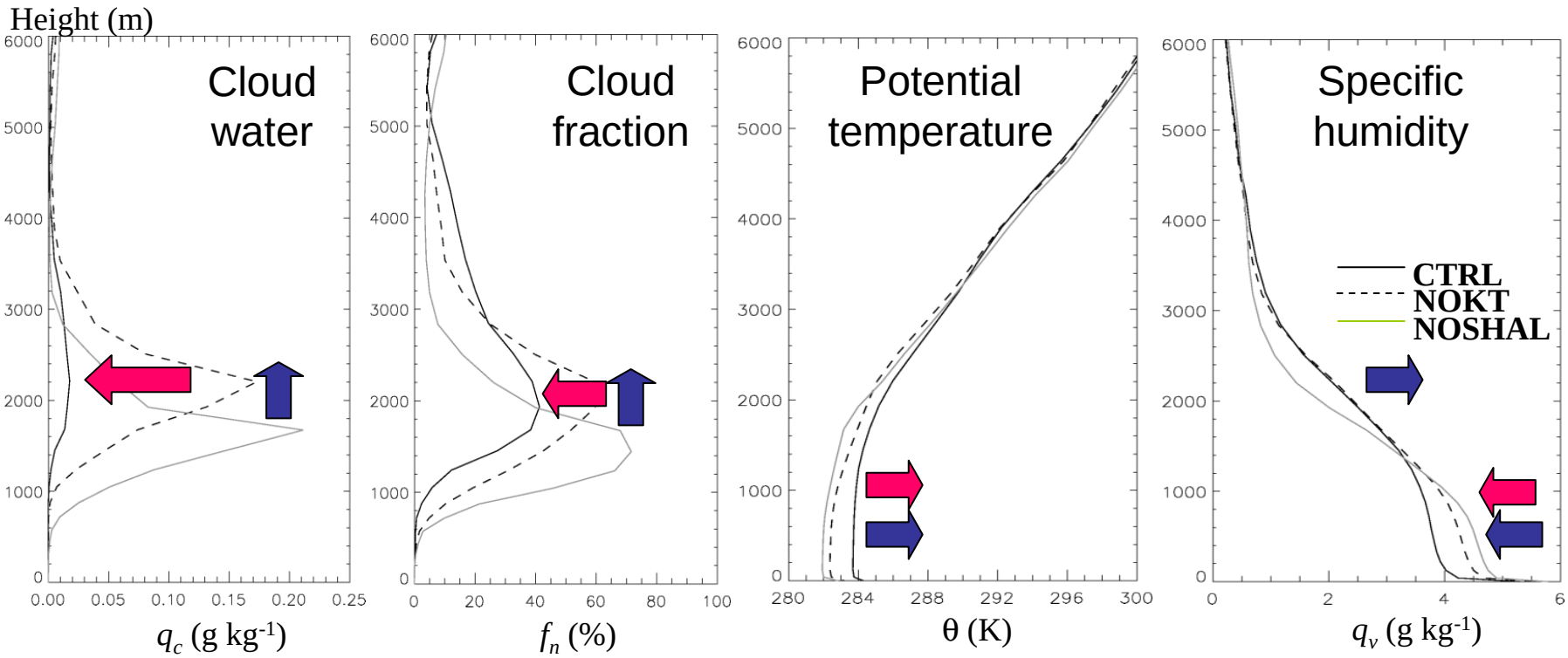
Impact de MoisTKE + Kuo Transient sur les nuages

MoisTKE

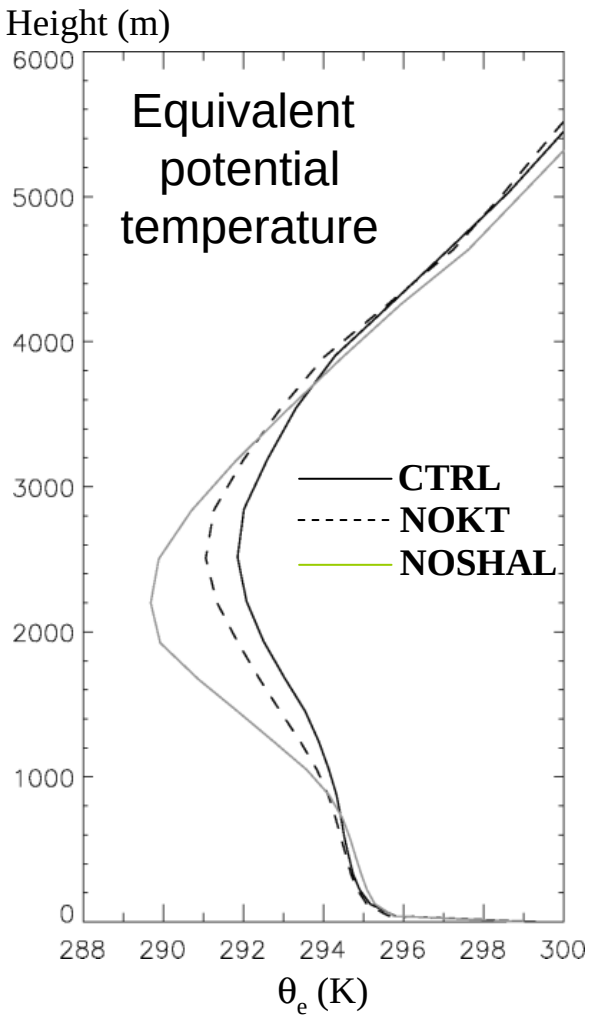


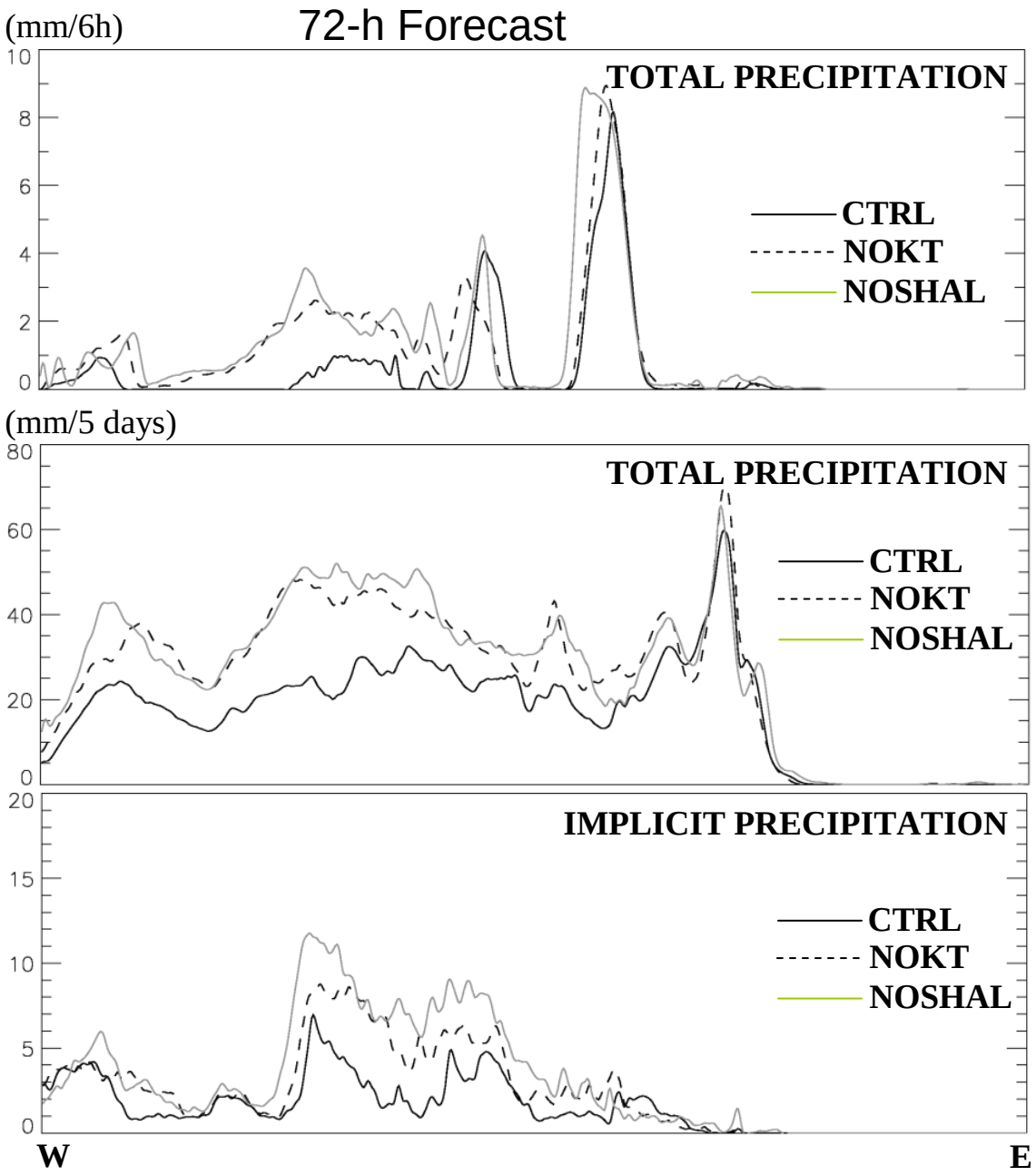
Impact de MoisTKE + Kuo Transient sur les nuages

MoisTKE **Kuo Transient**



Impact de MoisTKE + Kuo Transient sur la précipitation

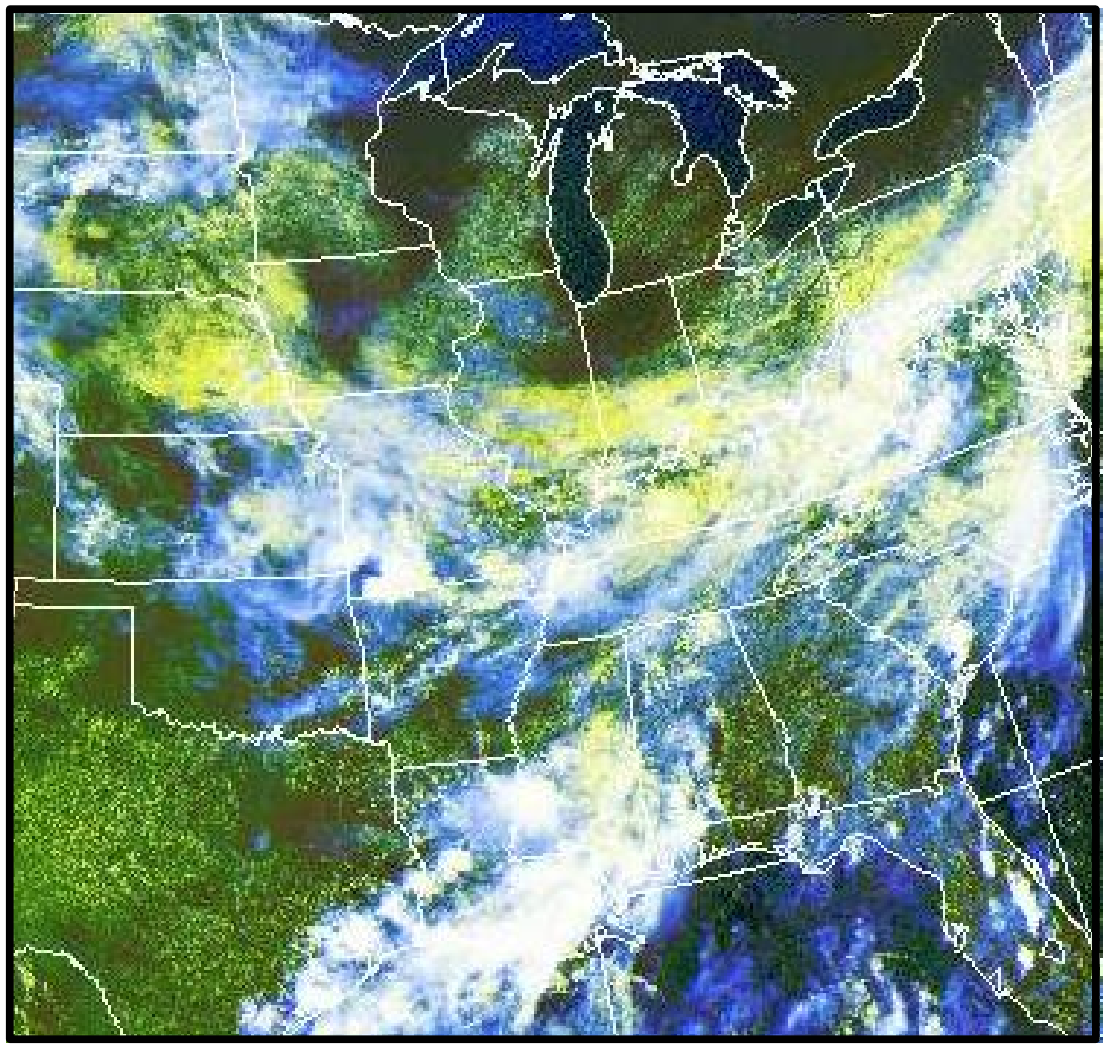




Un cas d'été

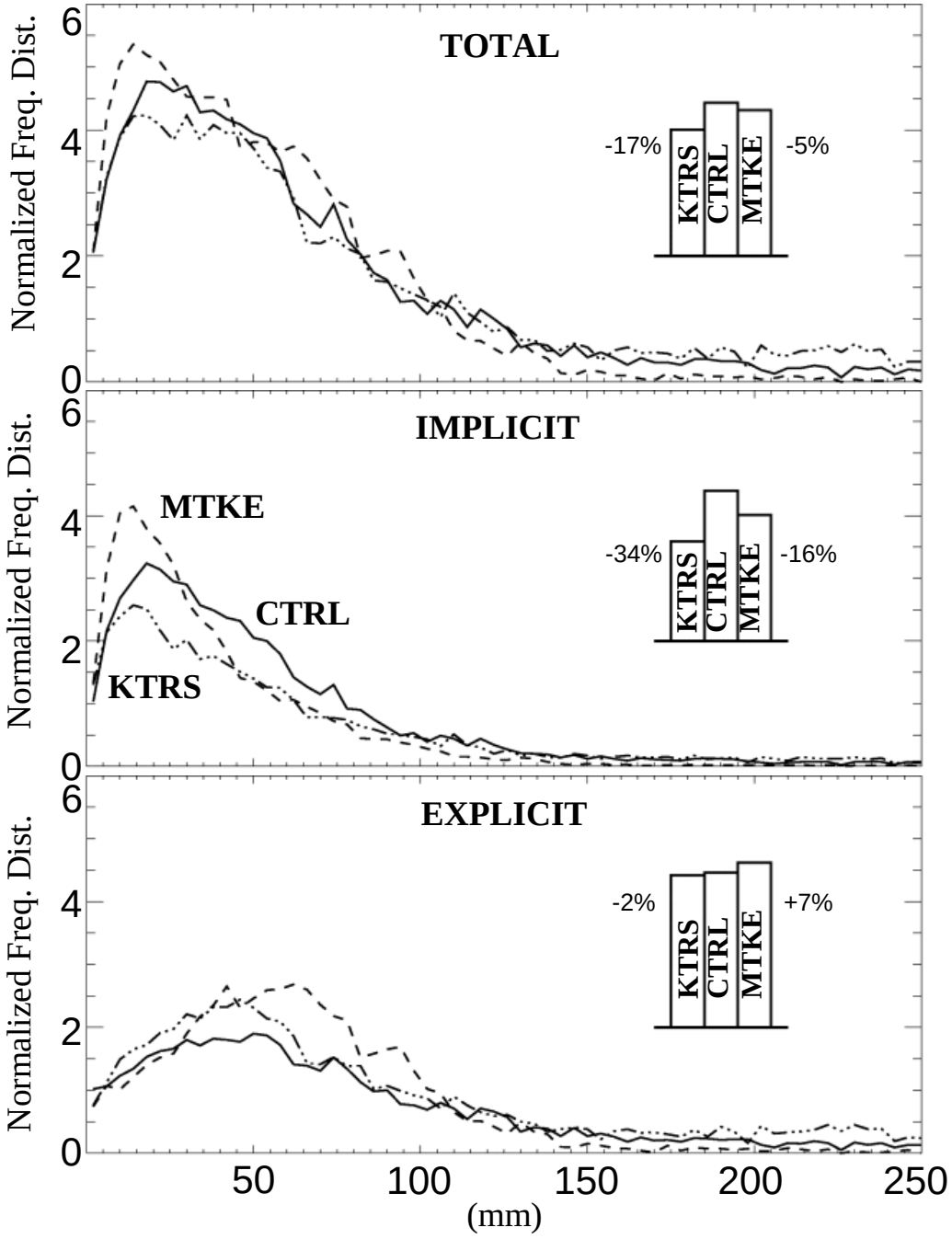
GOES
(visible + IR)

1800 UTC
26 July 2001

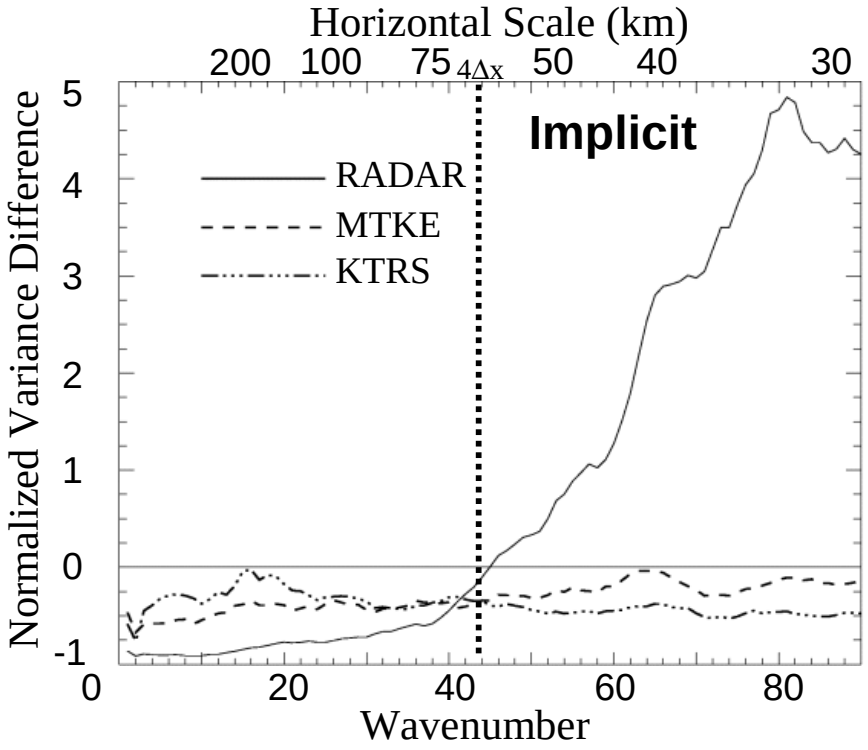


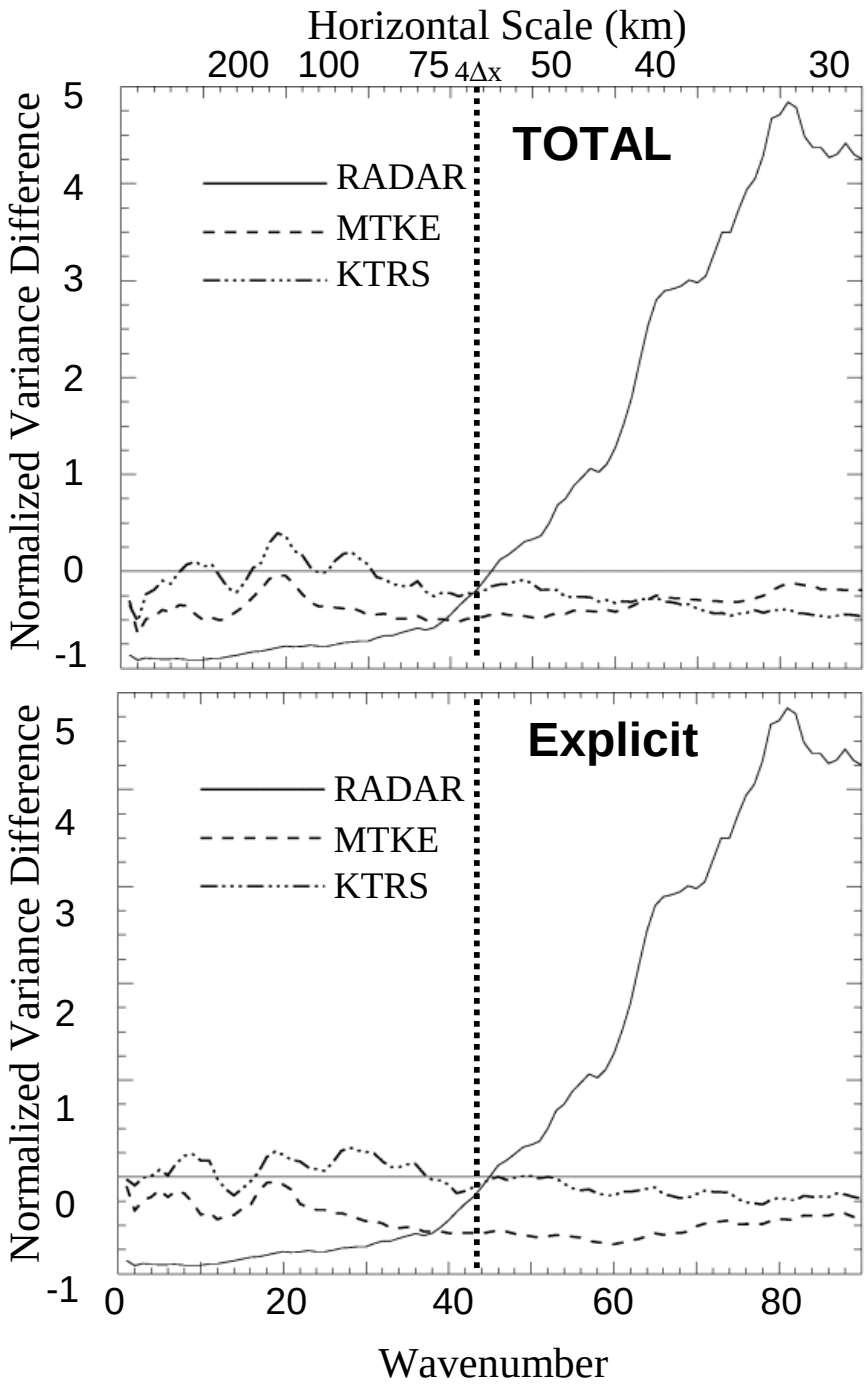
Impact de MoisTKE et de Kuo Transient sur la partition implicite / explicite de la précipitation (36-h)

- Precipitation distribution skewed towards small accumulations
- BUT the tail is important
- MoisTKE:
  - Decrease implicit precip
  - Increase explicit precip
  - Reduce number of events with very large precip accumulations
- Kuo Transient
  - Significant decrease of implicit precip
  - Not much change for explicit precip, except for the increase in large precipitation events
- Together: precipitation is MORE EXPLICIT (!) but better control of excessive precipitation accumulations (“grid point storms”)

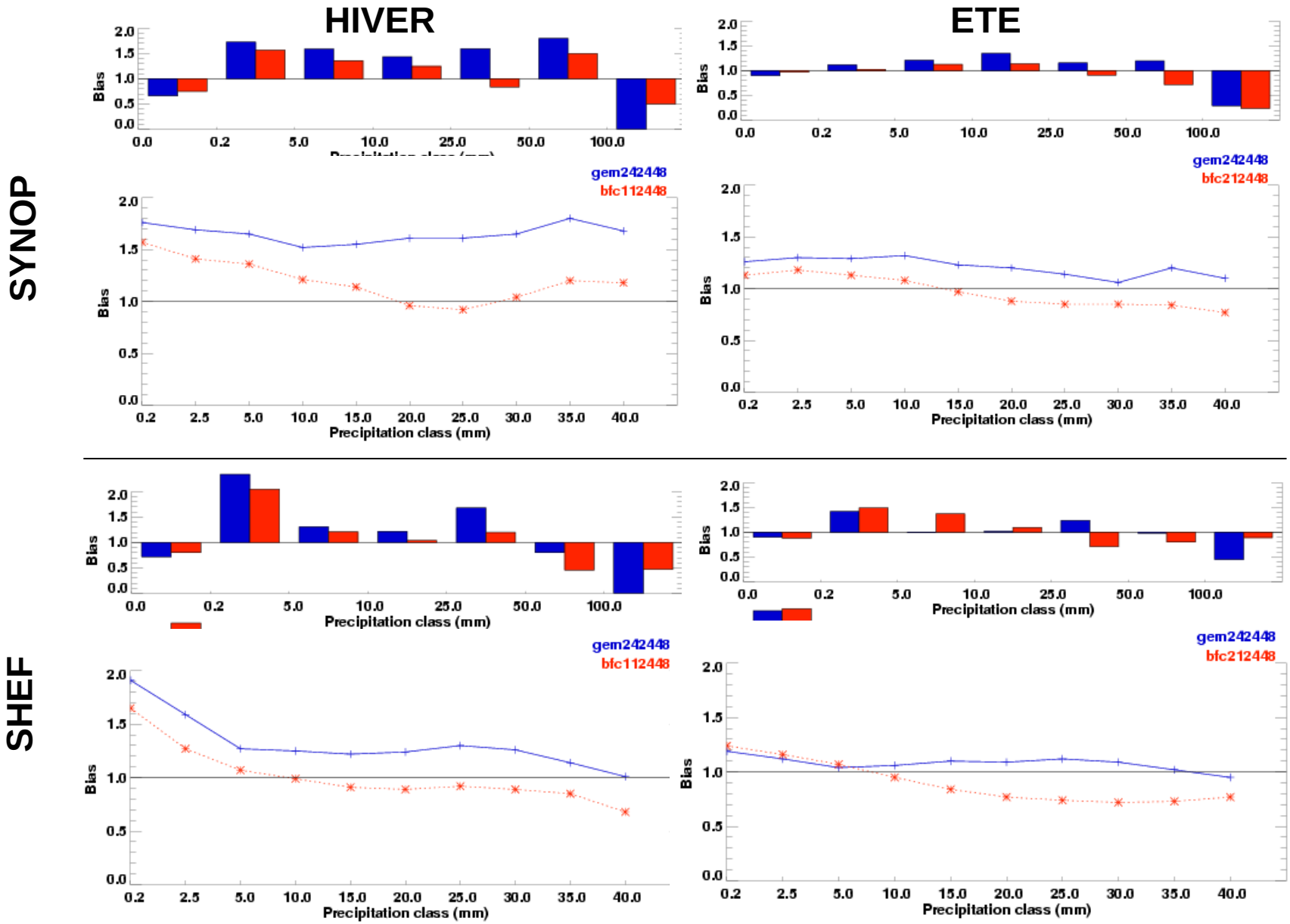


Impact de MoisTKE et de Kuo Transient sur les spectres de variance de la precipitation (36-h)





Résultats pour REG15 - BIAIS

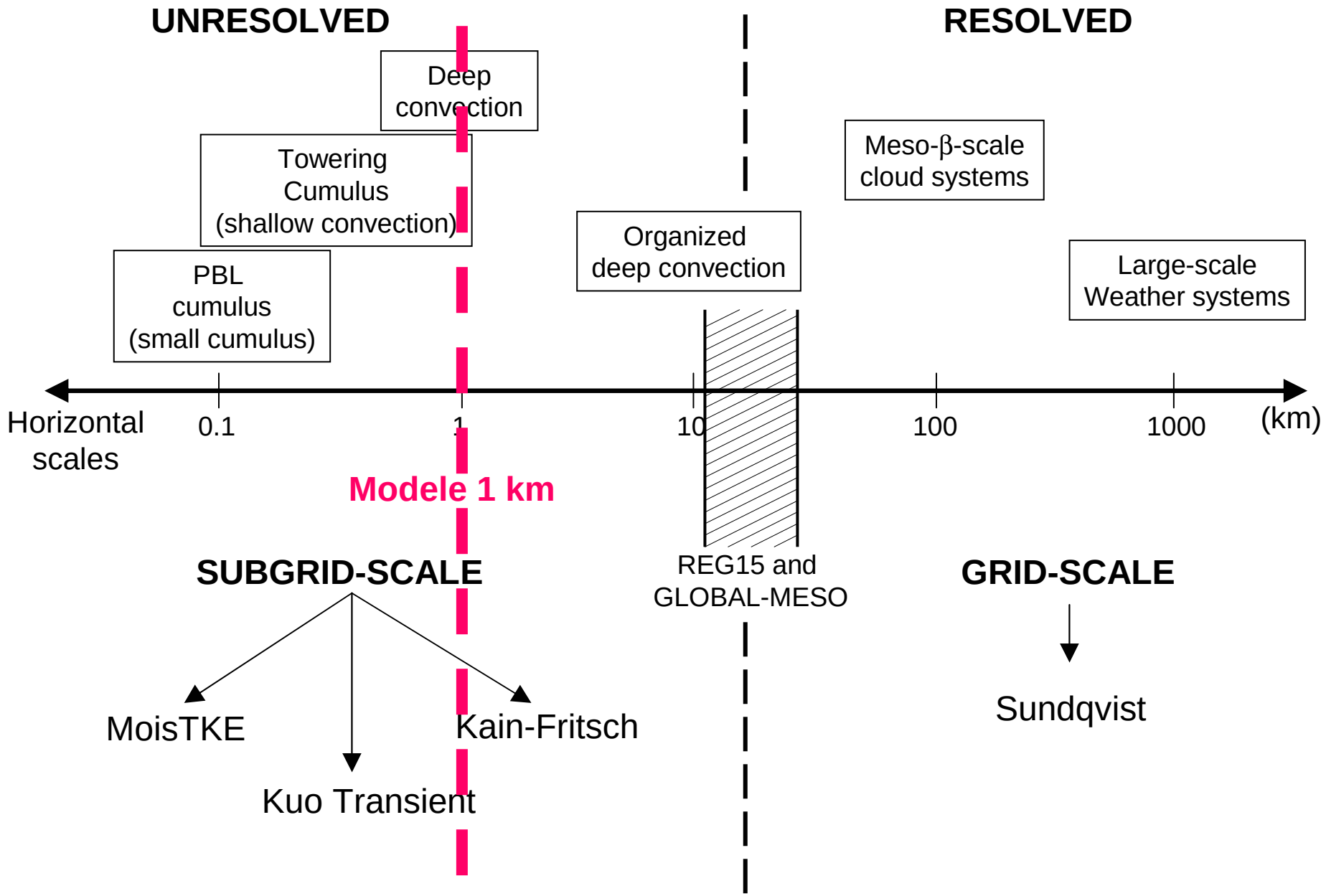


(Résultats de l'expérience bfc tels que donnés sur la page web de Donald Talbot)

Bénéfices

- Meilleure représentation des nuages dans REG15 et GLOBAL-MESO (impact sur la construction du nuage total et de son interaction avec le rayonnement)
- Réduit de manière significative la présence de minces couches nuageuses explicite au sommet de la couche limite dans les régions océaniques (stratus partout !)
- Réduit de manière significative la présence de “grid-point storms”
- Devrait permettre une meilleure balance entre la précipitation implicite (convection profonde) et la précipitation explicite (condensation à l’échelle du modèle); Peut-etre pas encore le cas dans REG15 à cause de problèmes de “spin-up” (?)
- Réduit de manière significative les biais de précipitation

Modèles haute-résolution (e.g., 1 km)



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