Monitoring des classes de neige des calottes polaires par Envisat

(Résultats de WOOPI)

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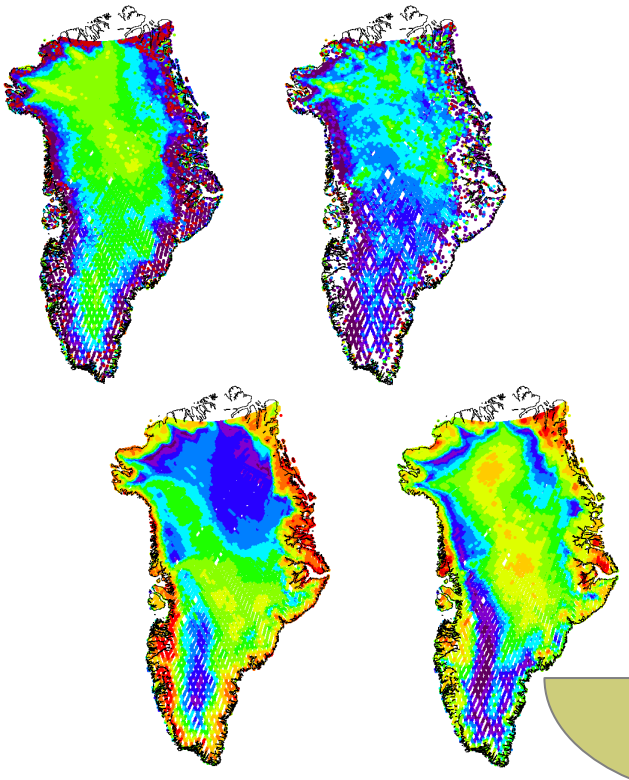
Calottes glaciaires & classification de la neige/glace

- There are uncertainties in estimating the correct height over ice sheet because of the radar wave penetration within the cold and dry snow medium. They display dependencies on snowpack characteristics which vary seasonally and spatially.

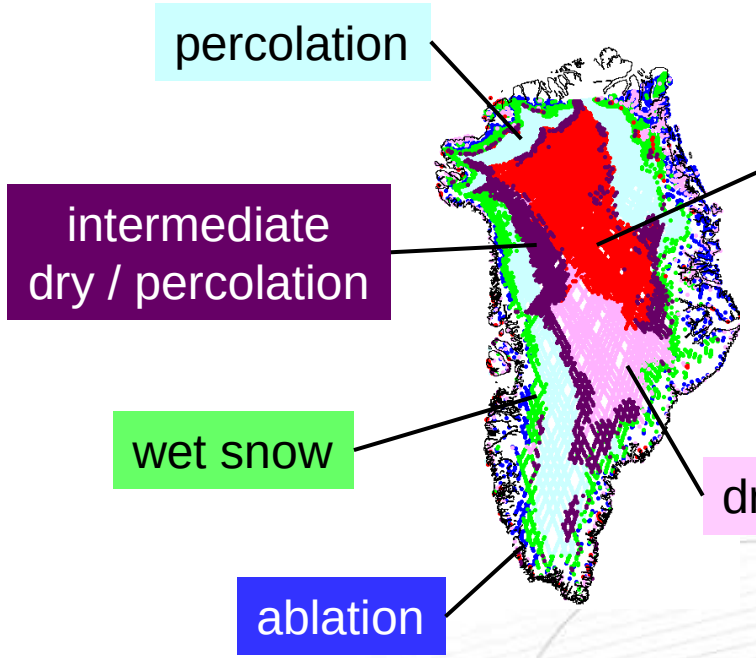
- Partition of ice sheet into different homogeneous regions can help for the interpretation of altimetry data.

- The monitoring of the extent changes of these regions would be a good indicator of the climate change effects on Greenland and Antarctica.

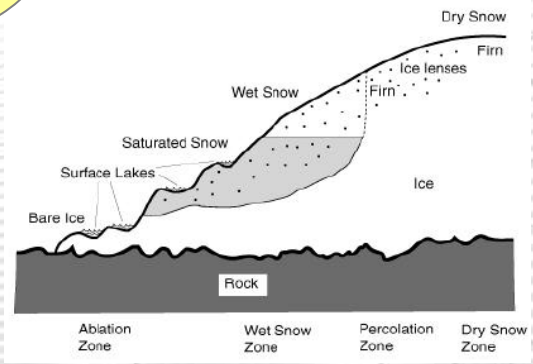
Greenland partition

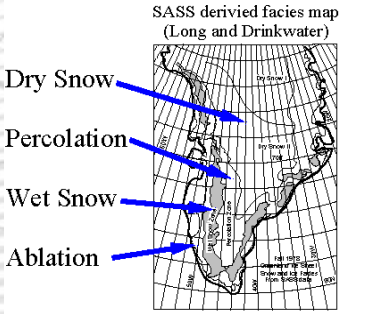


(Ku σ0, Ku-S σ0, Avg_TB, ratio_TB)



Related to accumulation patterns, snow layering as a consequence of the topographically - influenced wind regime, temperature and local melt effects.

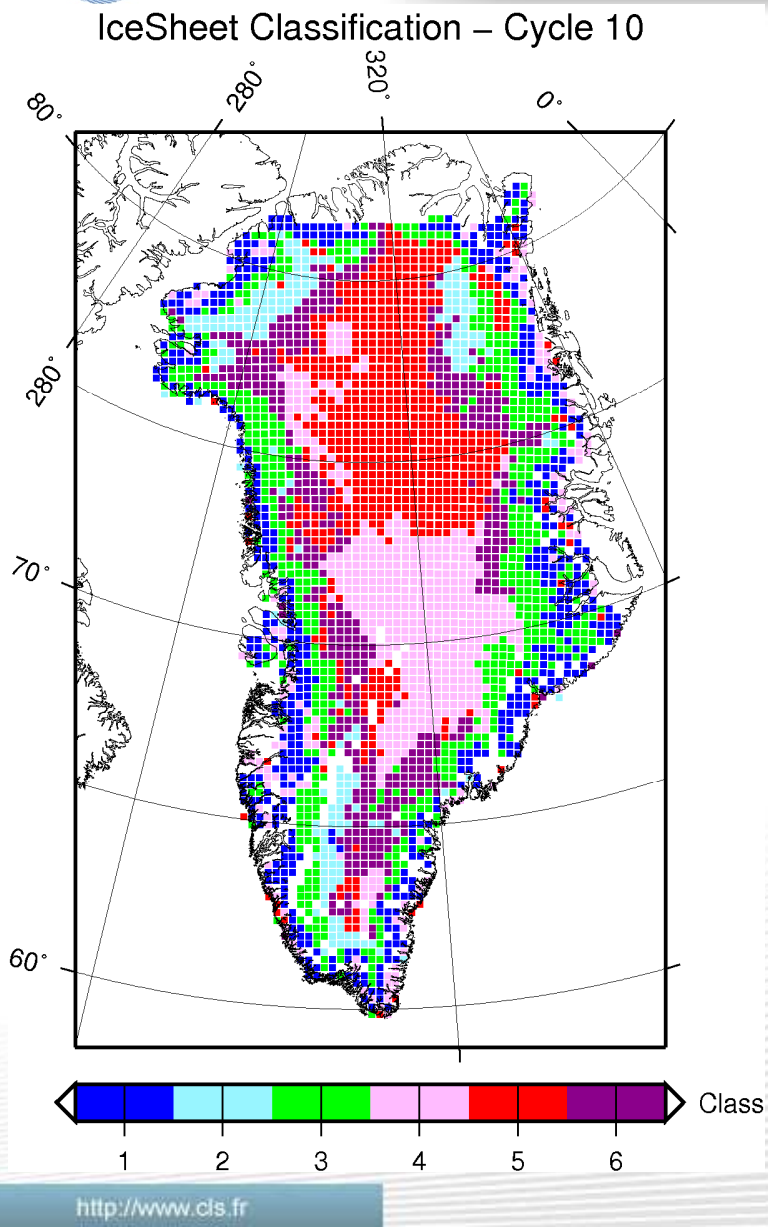




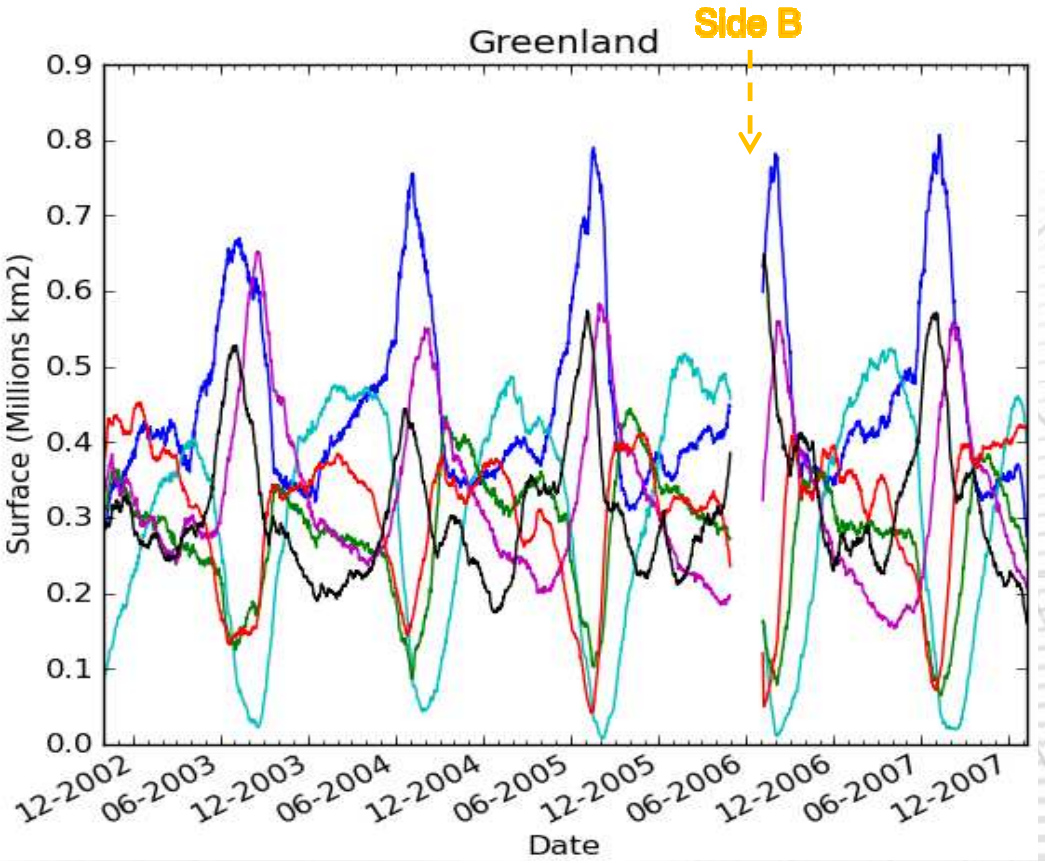
Drinkwater (2001) & Benson (1962)

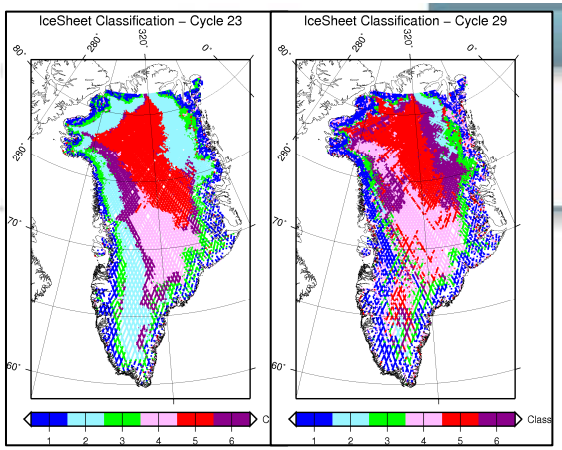
Cycles 10-64, before S-band lost

25-km grid, 35-day running window, reprocessed data



2004 bias (old-reproc)	**Greenland** (scatterplot)	**Antarctica** (scatterplot)	**Ocean cycles 005-93 (old-reproc)**
Sigma0 Ku (dB)	-0,043	-0,009	0,02
Sigma0 S (dB)	-0,023	0,001	-0,08
TB 23 (K)	1,34	0,46	0,8
TB 36 (K)	2,25	2,24	2,4





Seasonal & interannual variations of extent

(35-day running window)

dry snow I

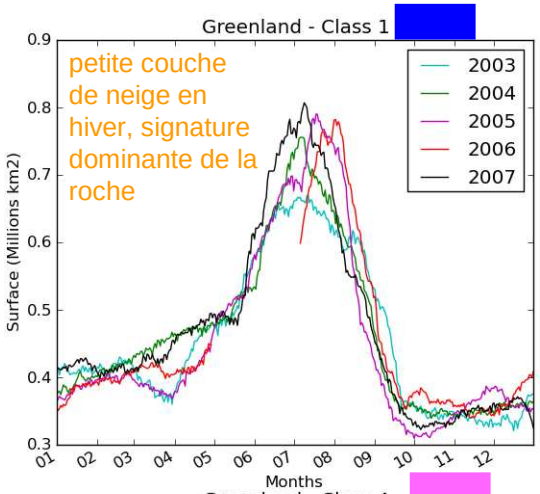
dry snow II

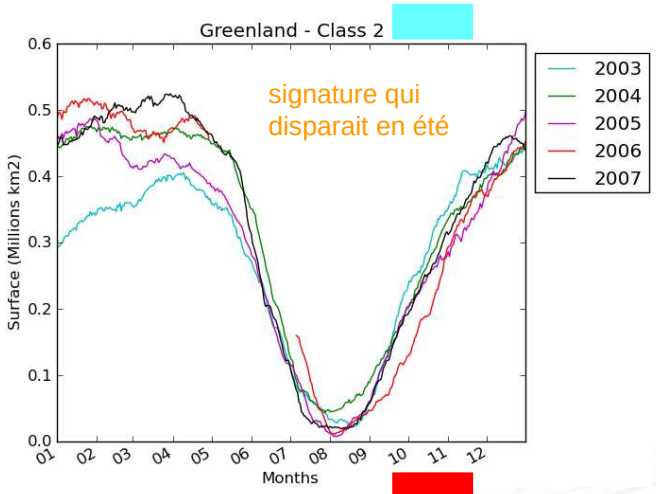
intermediate dry / percolation

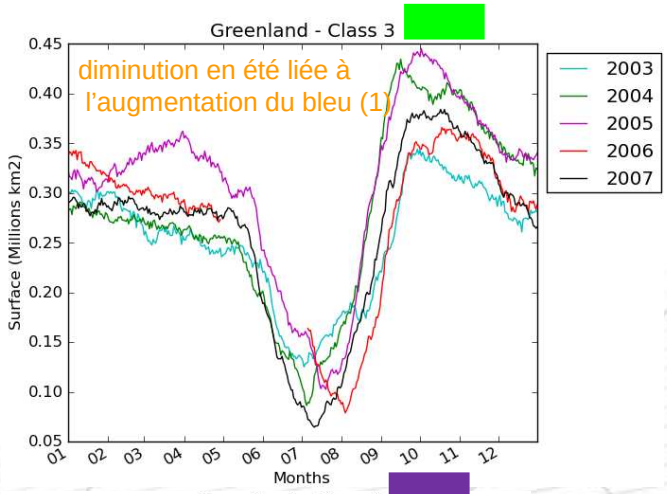
wet snow

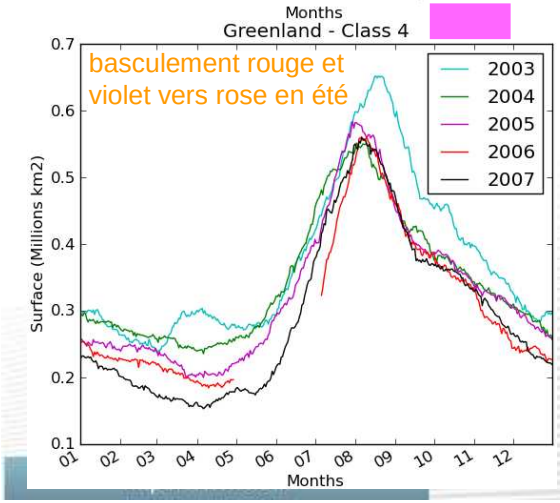
percolation

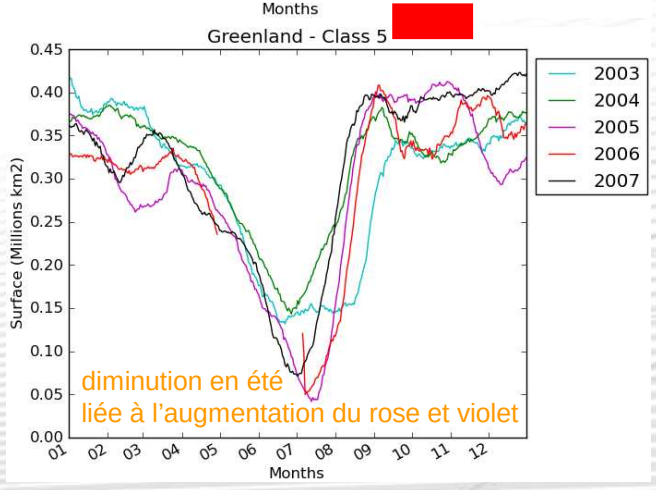
ablation

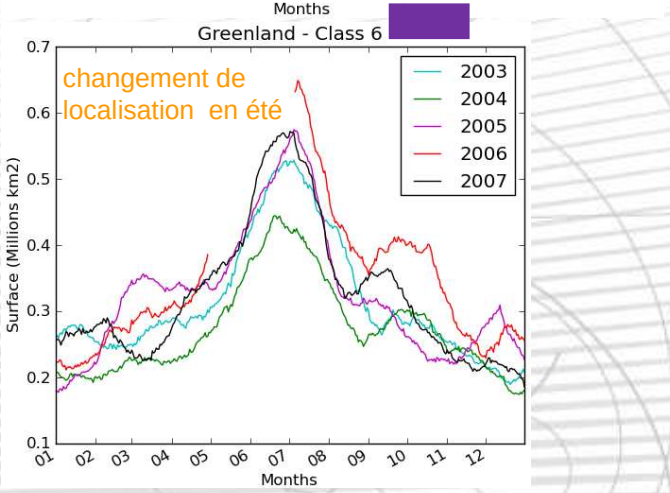




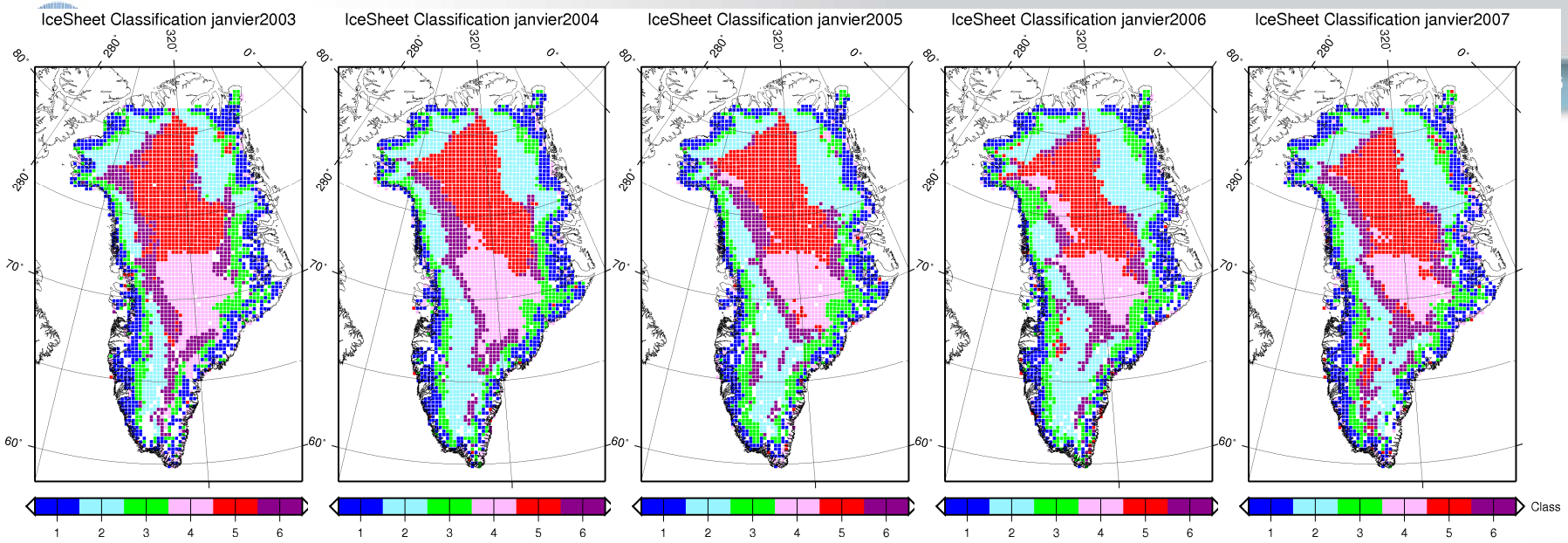


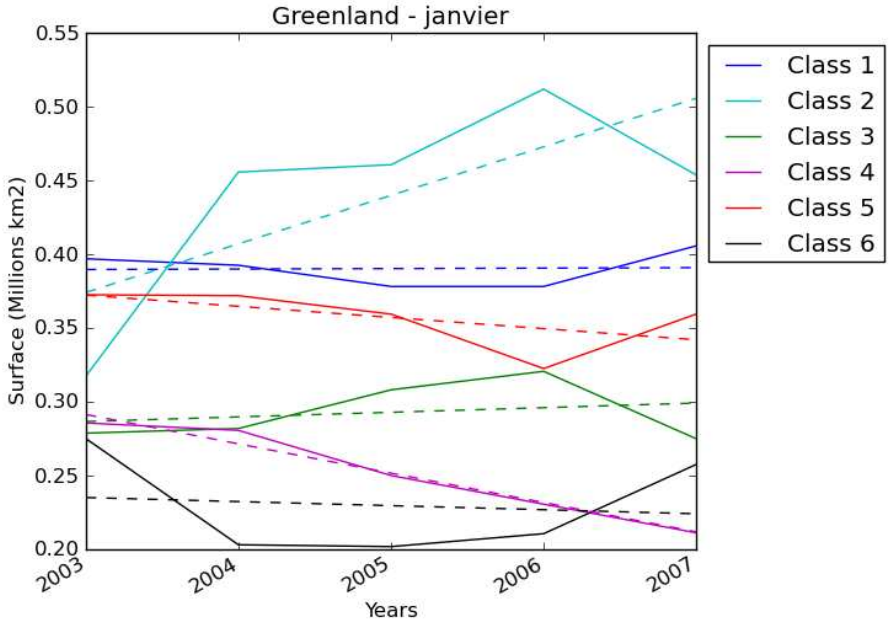






January 2003 to 2007

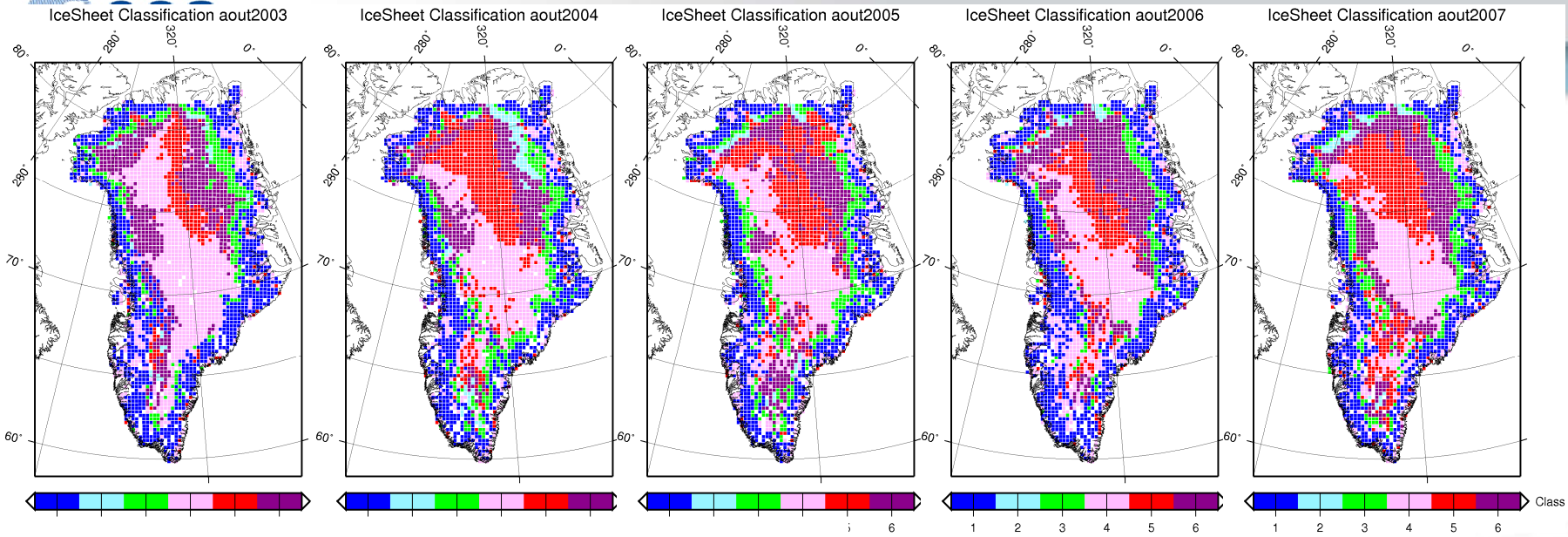


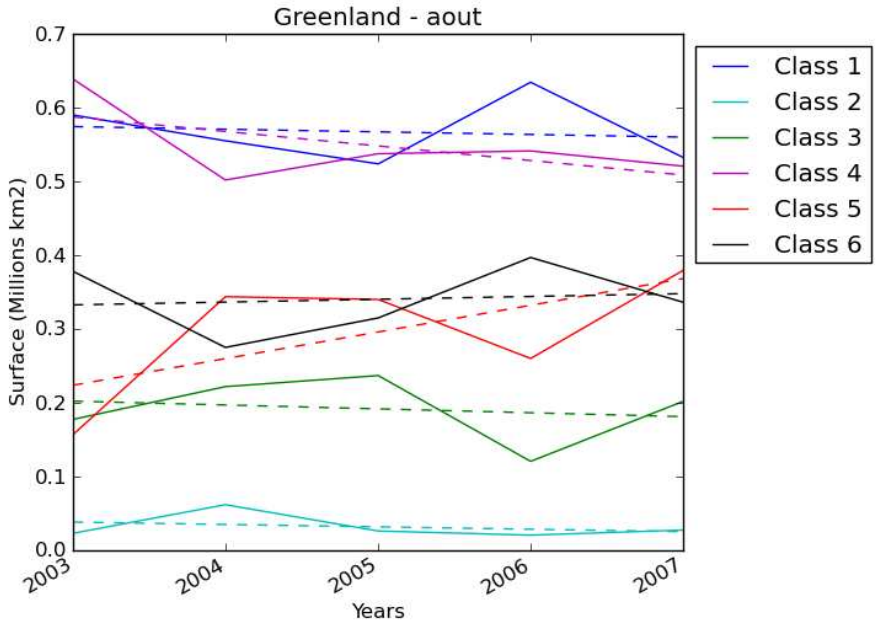


Slope (millions km²/year)

Class 1: +0.00031 → stable
Class 2: +0.03287 → increase (1.5%)
Class 3: +0.00312
Class 4: -0.01987
Class 5: -0.00756 } lost (<1%)
Class 6: -0.00275

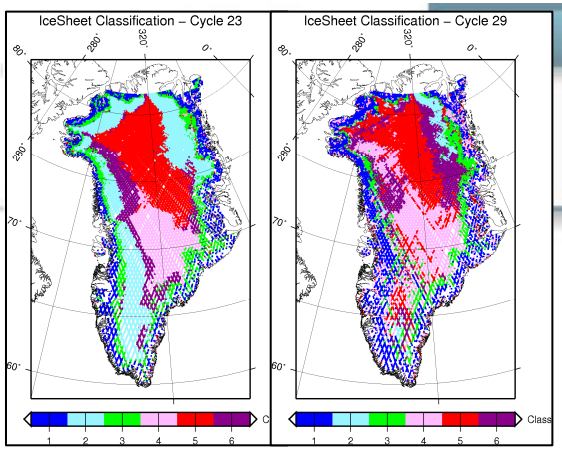
August 2003 to 2007





Slope (millions km²/year)

Class 1: -0.00356
Class 2: -0.00325
Class 3: -0.00525
Class 4: -0.01968 → lost (0.9%)
Class 5:+0.03612 → increase (1.6%)
Class 6:+0.00381

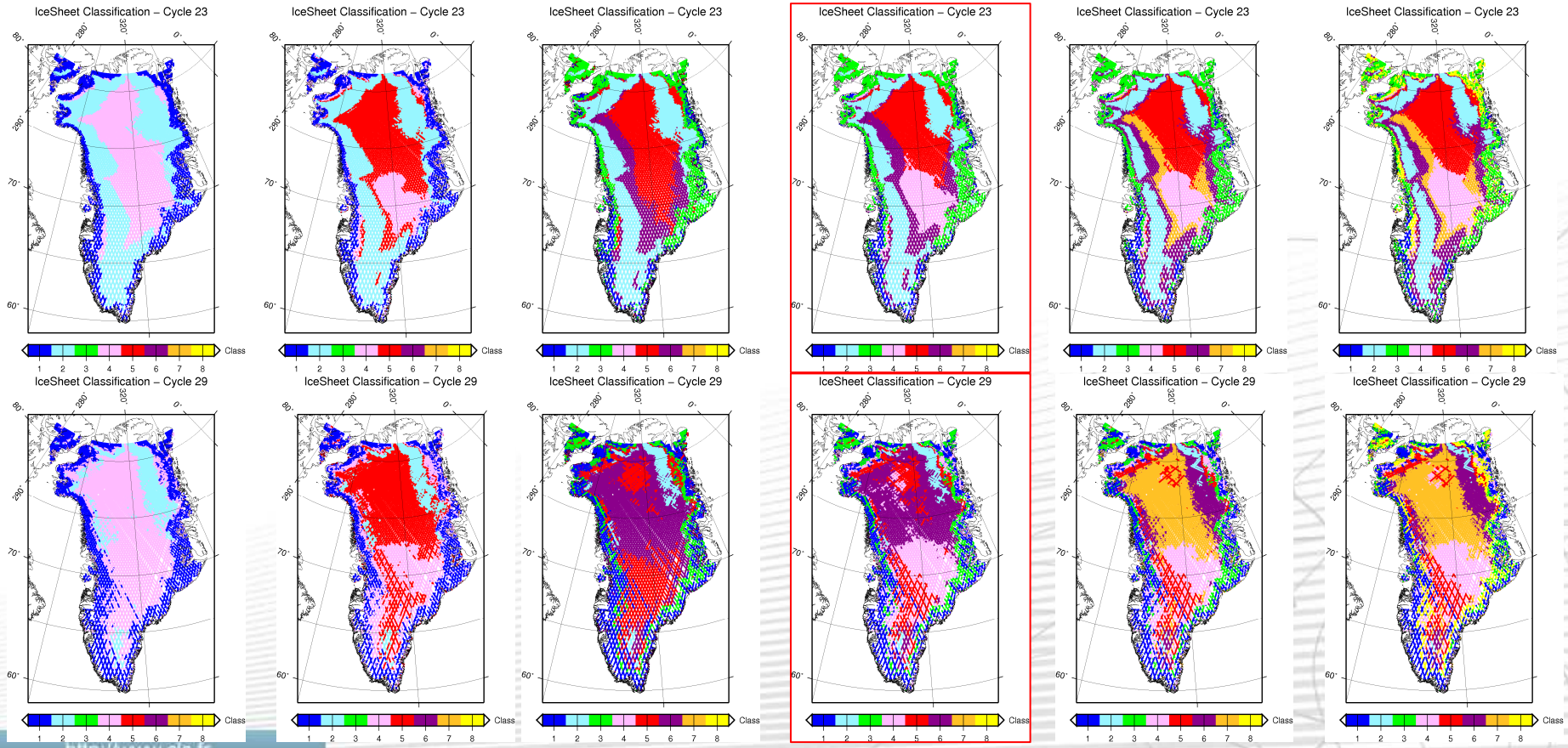


6-class

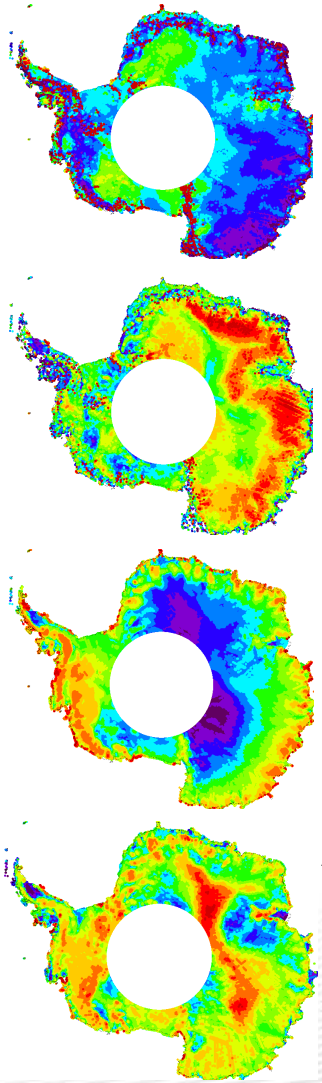
Test without the S-band data

- moins d'information en profondeur, information de surface prépondérante
- bleu (ablation) qui disparaît en hiver dans la partie nord au dépend du vert (wet snow)
- plus de violet (intermediate dry/percolation) en été

3-class | 4-class | 5-class | **6-class** | 7-class | 8-class



Antarctica partition



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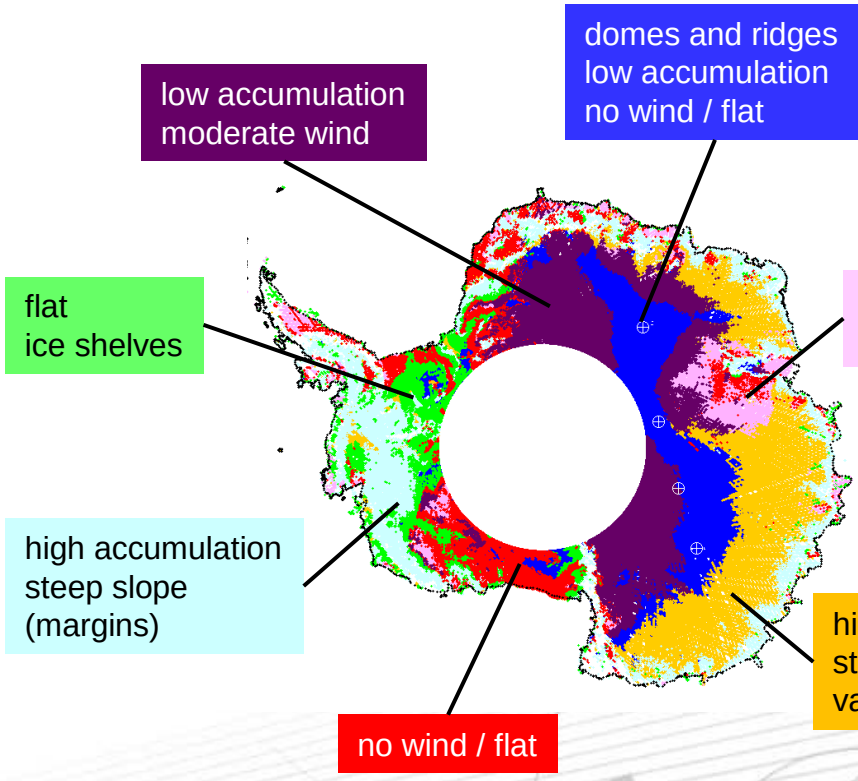


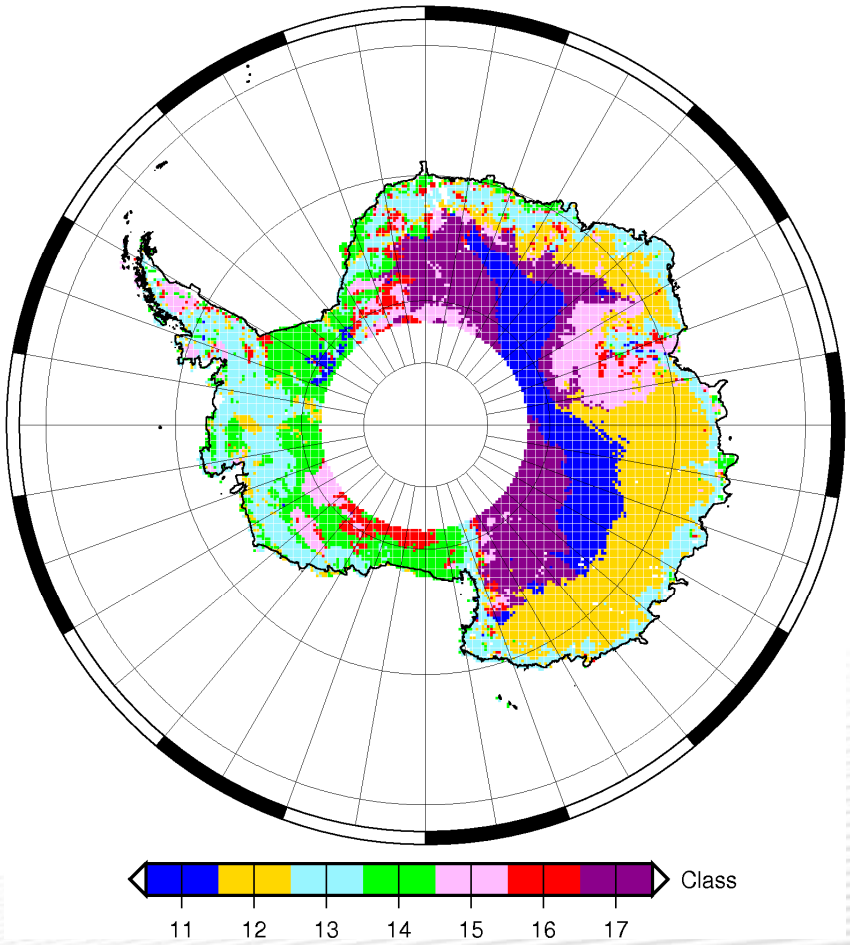
No other study to compare with.

Related to **accumulation patterns** and **snow layering** as a consequence of the **topographically-influenced wind regime**.

Cycles 10-64, before S-band lost

25-km grid, 35-day running window, reprocessed data

IceSheet Classification – Cycle 10



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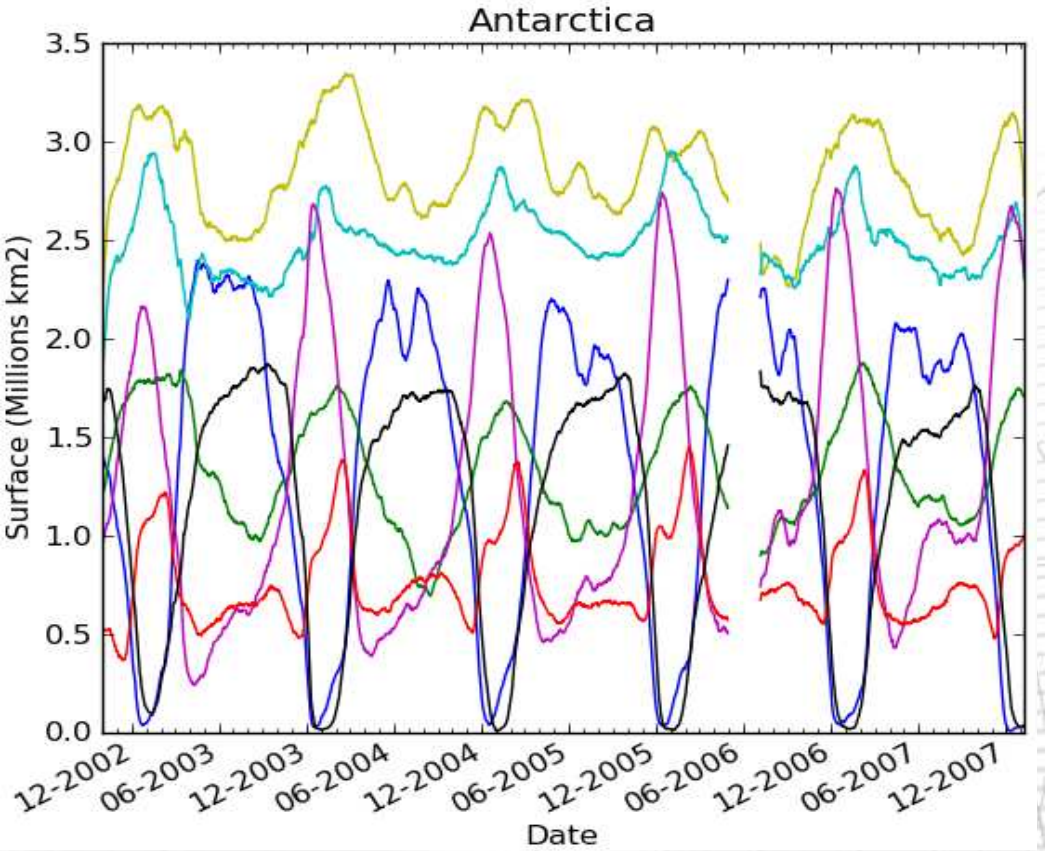
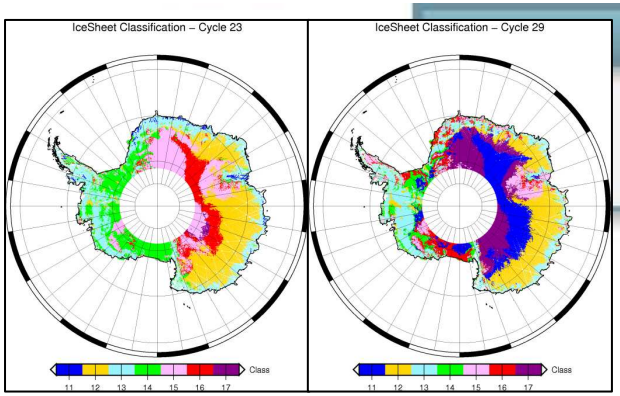
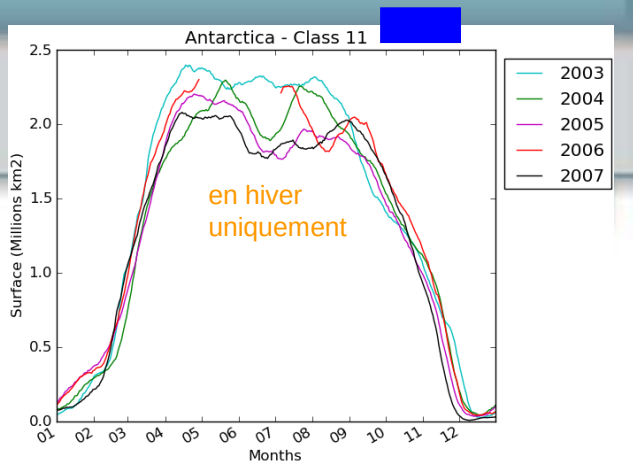
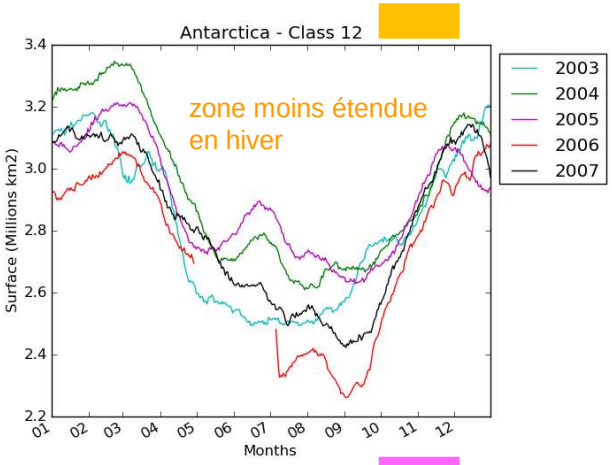


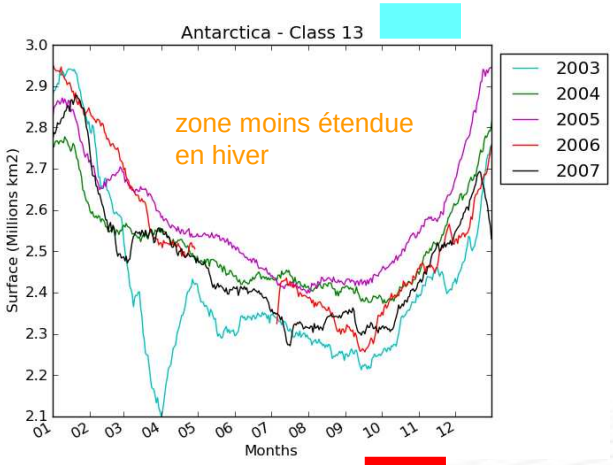
Seasonal & interannual variations of extent

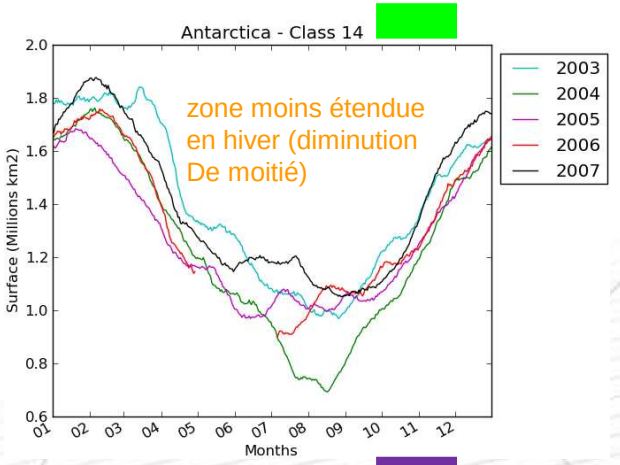


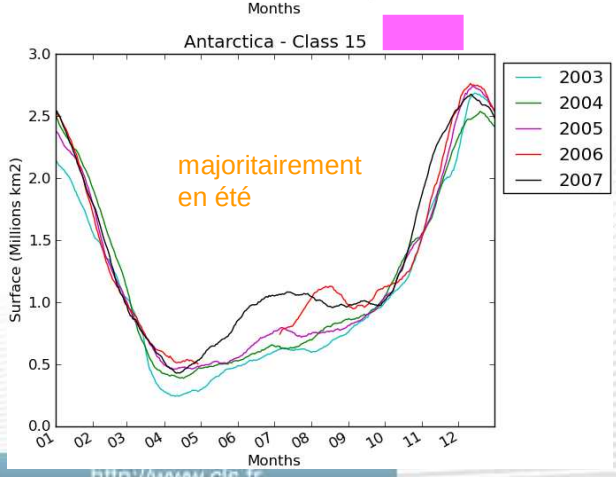
summer winter

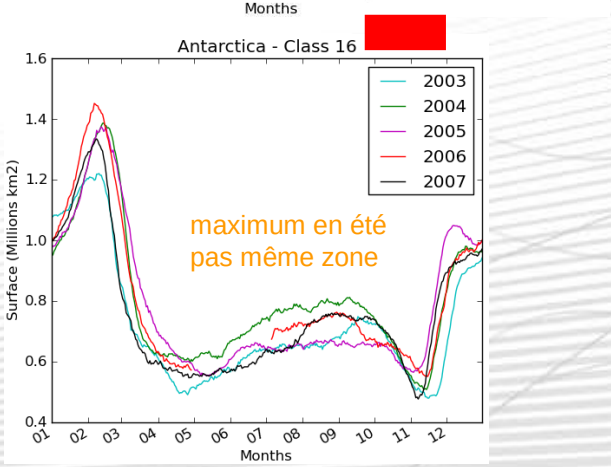


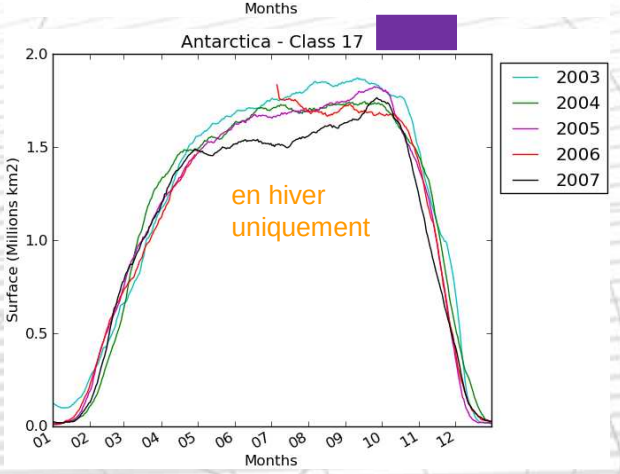




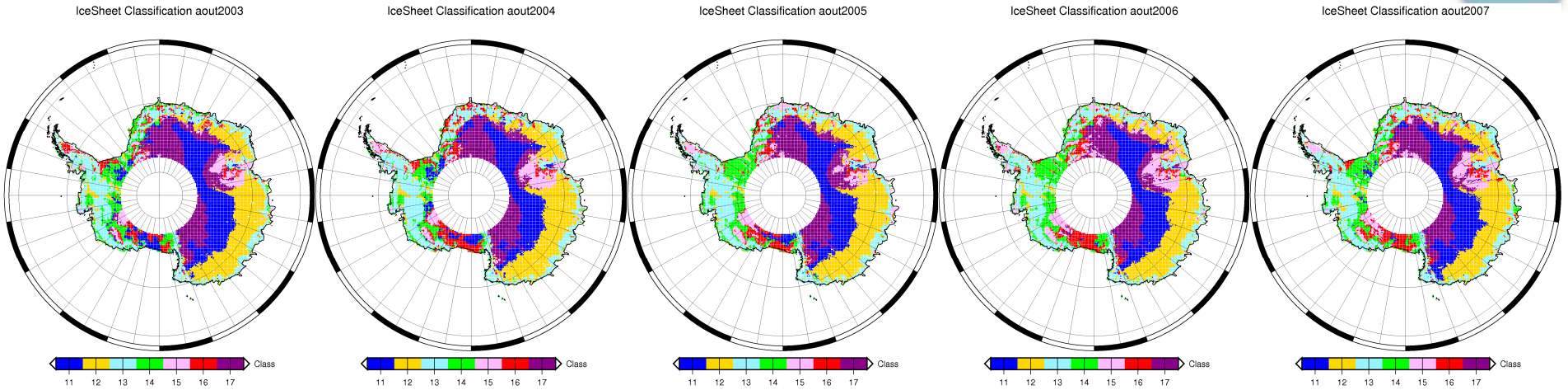


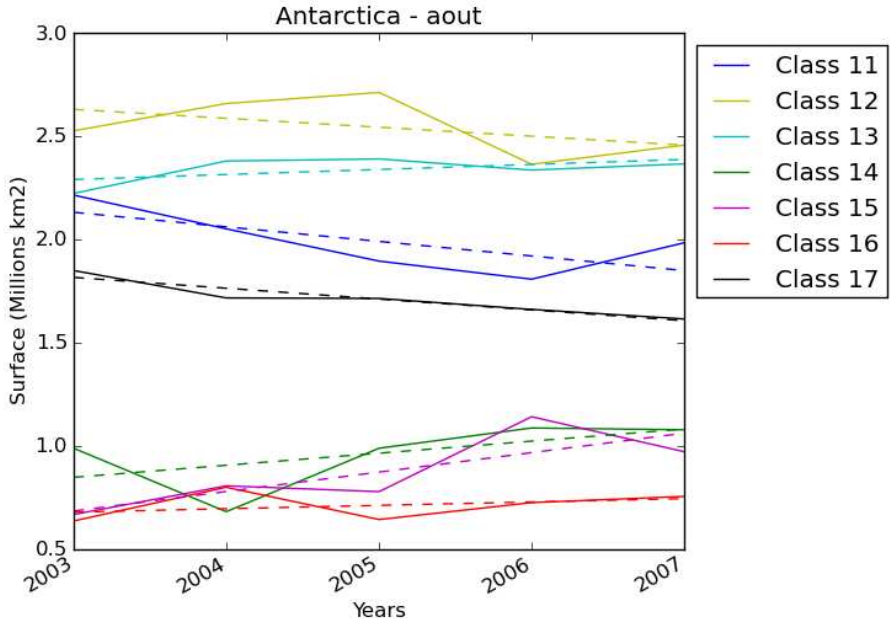






August 2003 to 2007 (austral winter)





Slope (millions km²/year)

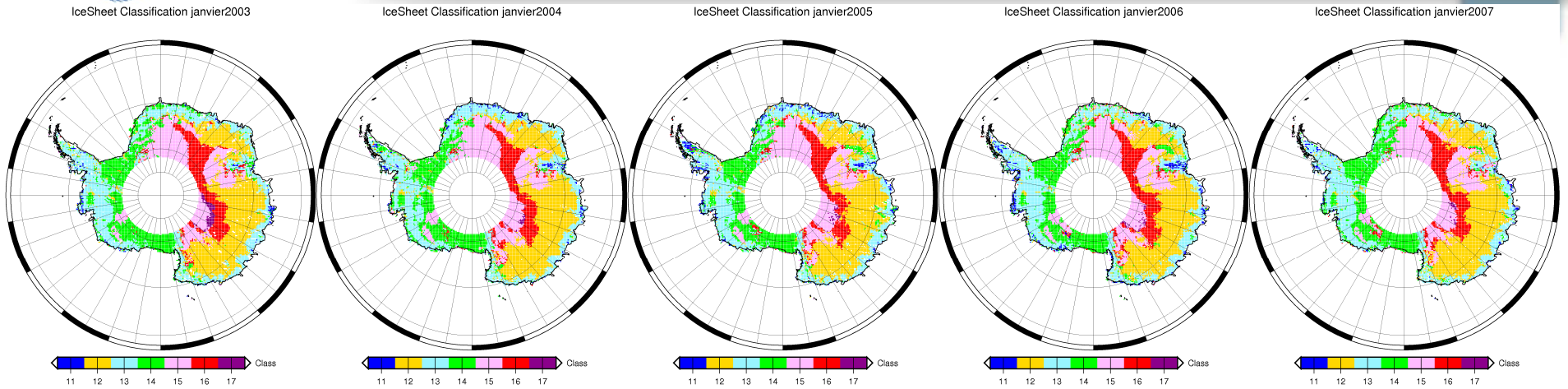
Class 11: -0.07050
Class 12: -0.04325
Class 13: +0.02425
Class 14: +0.05837
Class 15: +0.09418
Class 16: +0.01631
Class 17: -0.05243

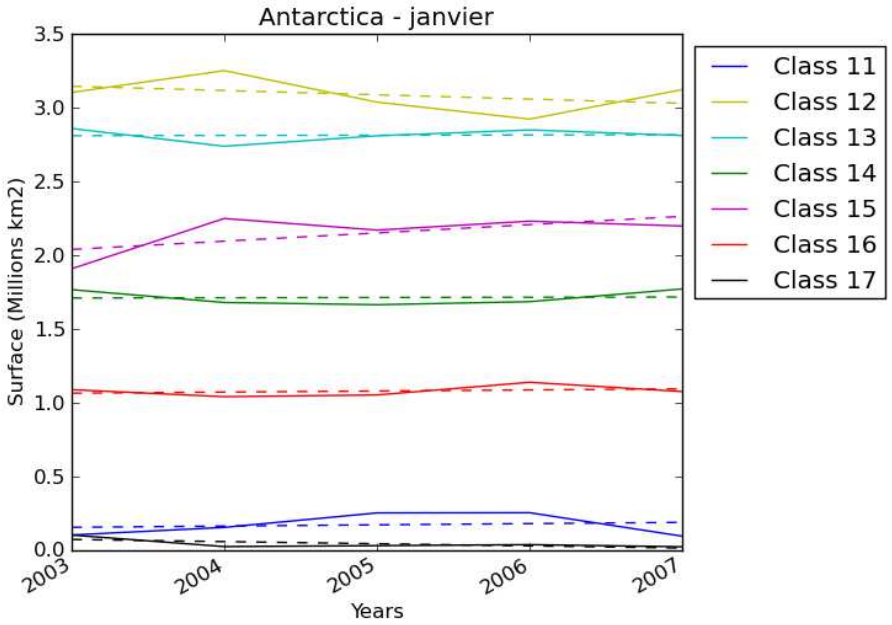
lost (0.3-0.5%)

increase (0.4-0.7%)

→ lost (0.3%)

January 2003 to 2007 (austral summer)

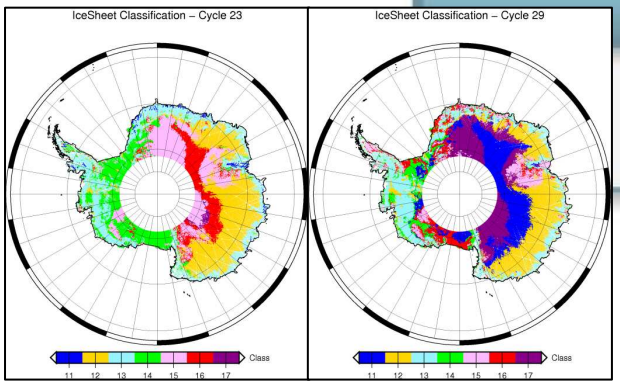




Slope (millions km²/year)

Class 11: +0.00831
Class 12: -0.02900 → lost (0.2%)
Class 13: +0.00156
Class 14: +0.00156
Class 15: +0.05606 → increase (0.4%)
Class 16: +0.00725
Class 17: -0.01456

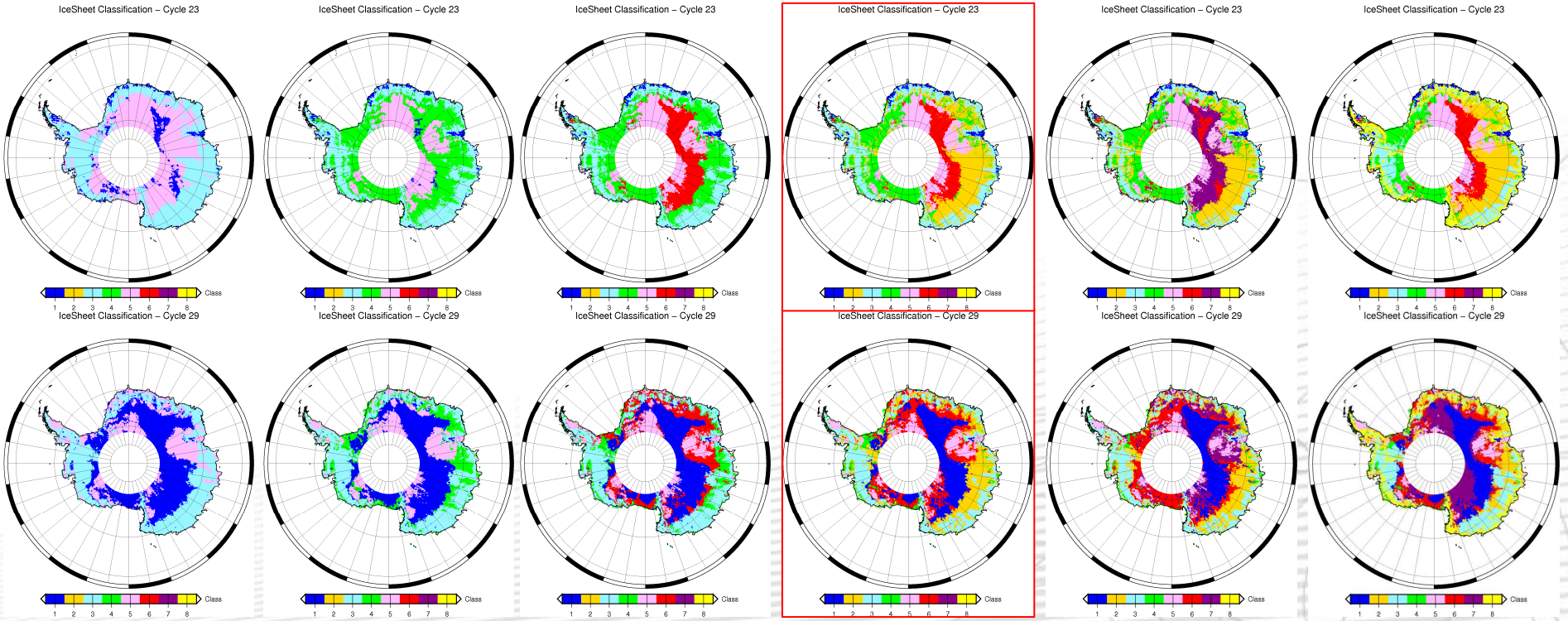
Test without the S-band data



summer winter

- moins d'information en profondeur, information de surface prépondérante
- violet disparait pour rouge et rose qui augmente
- orange moins étendue

3-class 4-class 5-class 6-class 7-class 8-class



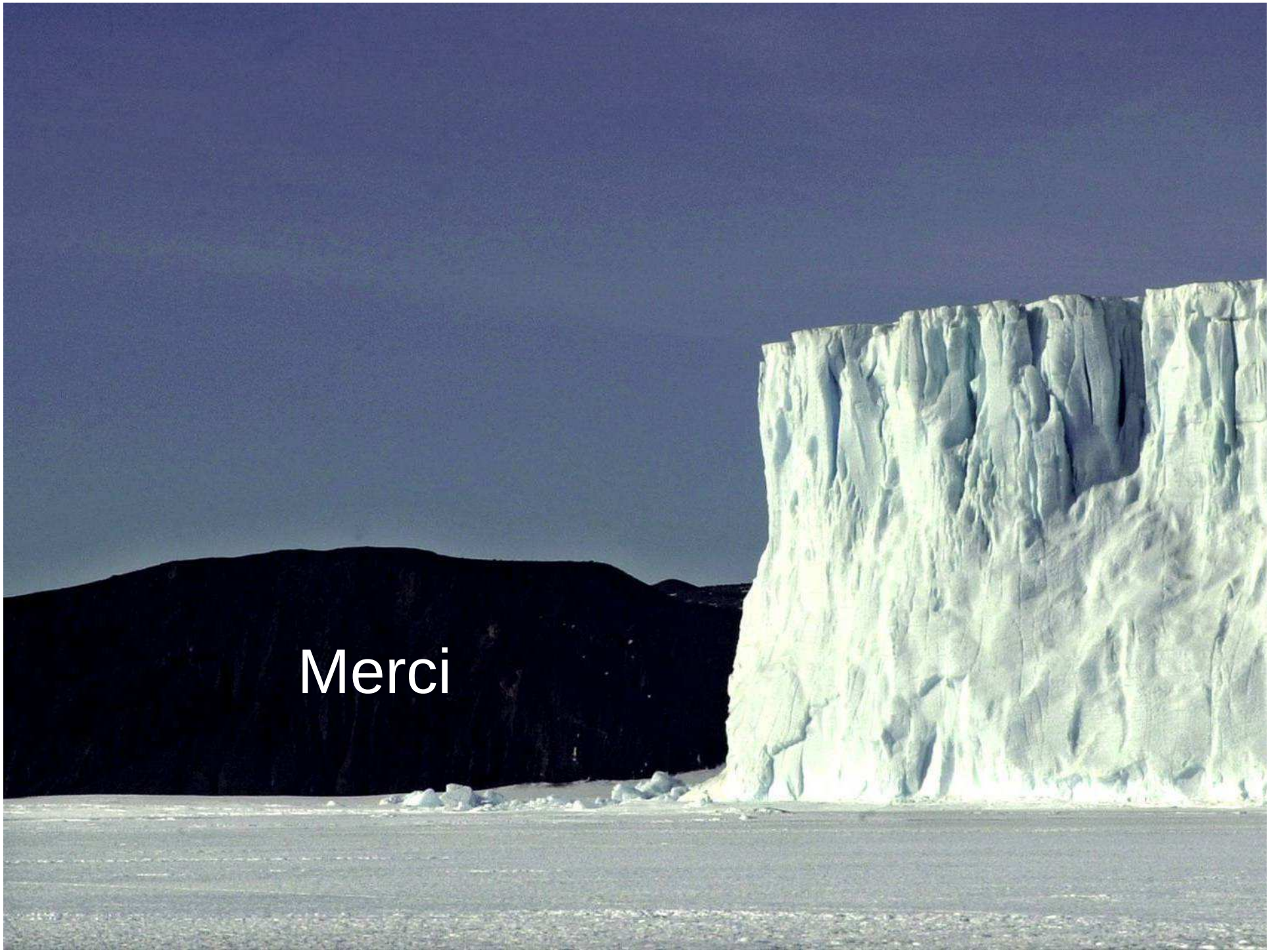
Conclusions and Perspectives

- The snow facies classifiers partition the 2 ice sheets into regions with similar microwave signatures.
  - The difference in snow morphology is due to variable conditions in local climate (accumulation rate, air temperature, wind) which is governed by topography.
  - Presence of surface liquid water changes also the microwave signatures.

- A partition into 7 classes looks interesting over Antarctica while a 6-class solution is preferred for Greenland.

- Observations of the effects of climate change through change in the microwave signal behavior might be more easily detected via the classification of the signatures.
  - This approach defines a tool for monitoring long-term spatial variations over the ice sheets.
  - Coming soon from WOOPI: application of alternative algorithms to the Envisat time-series 2003-2010 (without S-band).

- Perspectives to extent the monitoring: need of very long time-series to be interpretable for climate change
  - Application to Sentinel-3 records
  - Application to ERS, Altika data
  - Test on Cryosat-2 and CFOSAT data (combination of SWIM & SCAT)


Merci