

Influence de la résolution spatiale sur la modélisation du bilan de masse en surface de la calotte glaciaire du Groenland

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6-10 septembre 2011**

1. Définition

Bilan de masse \approx Accumulation – Ablation

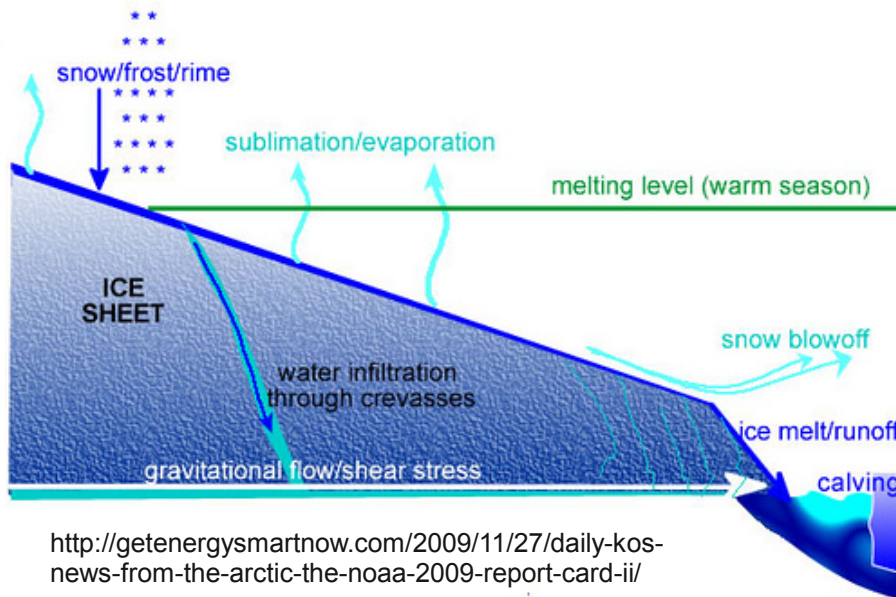
**Précipitations neigeuses
- évaporation/sublimation**

**Run-off
(production d'eau liquide
- rétention d'eau de fonte)**

Vêlage des glaciers

Fonte à la base

Flux de neige en surface

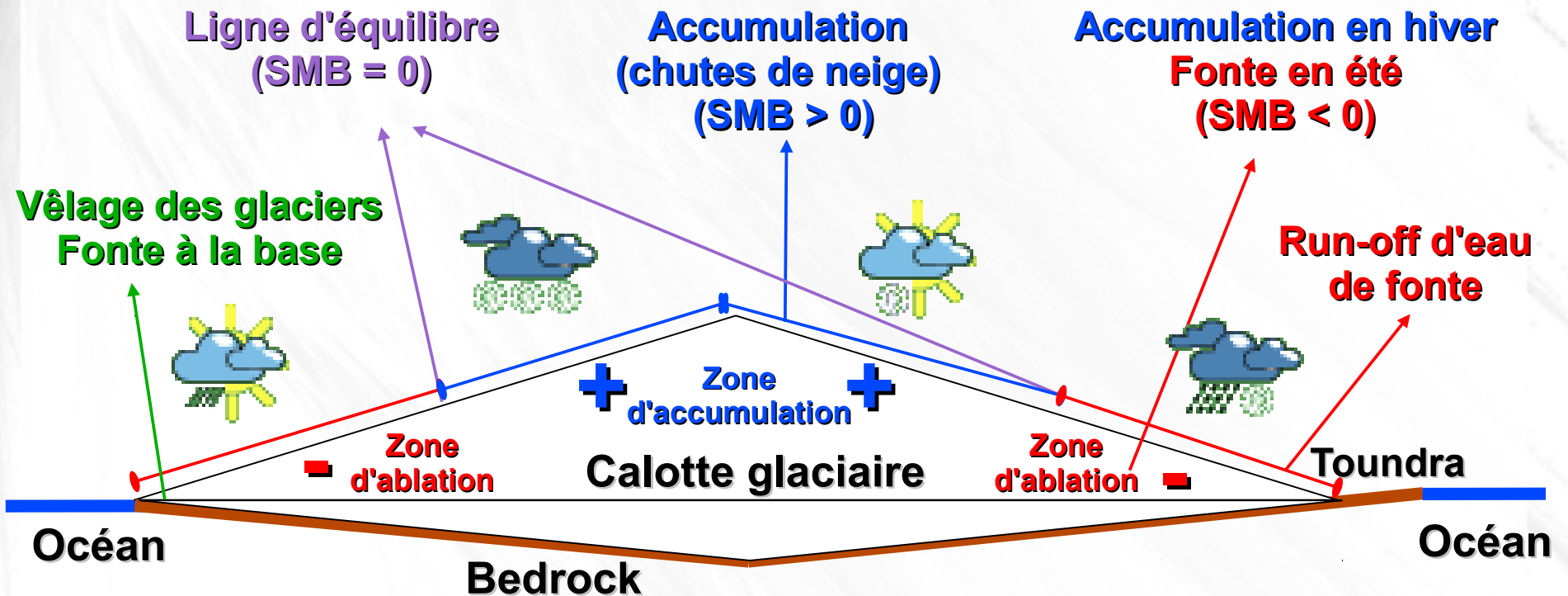


<http://getenergysmartnow.com/2009/11/27/daily-kos-news-from-the-arctic-the-noaa-2009-report-card-ii/>

**Glace de mer
non incluse**

1. Définition

Bilan de masse en surface \approx Accumulation – Run-off



Dynamique de la glace et flux de neige en surface non inclus

2. Le modèle régional du climat MAR

MAR (Modèle Atmosphérique Régional) Hubert Gallée (LGGE)

Hydrostatique ou non-hydrostatique

Schéma radiatif
ECMWF (Morcrette)

**ERA-40
ECMWF** →
(forçage toutes
les 6 heures)

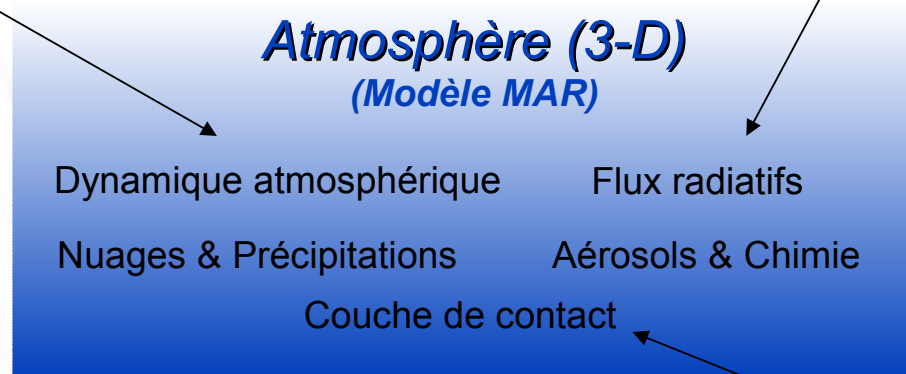


Schéma convectif
(Bechtold)



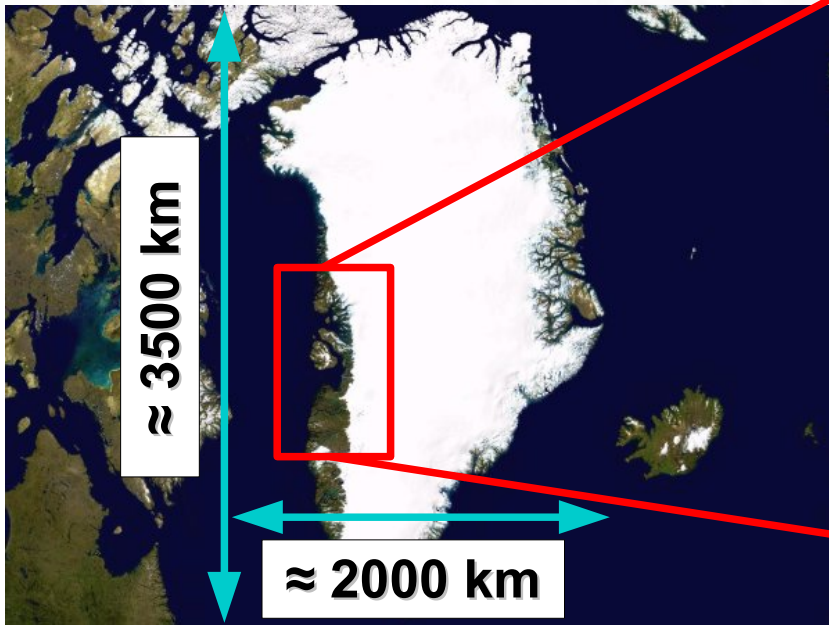
SISVAT

Soil Ice Snow Vegetation Atmosphere Transfer

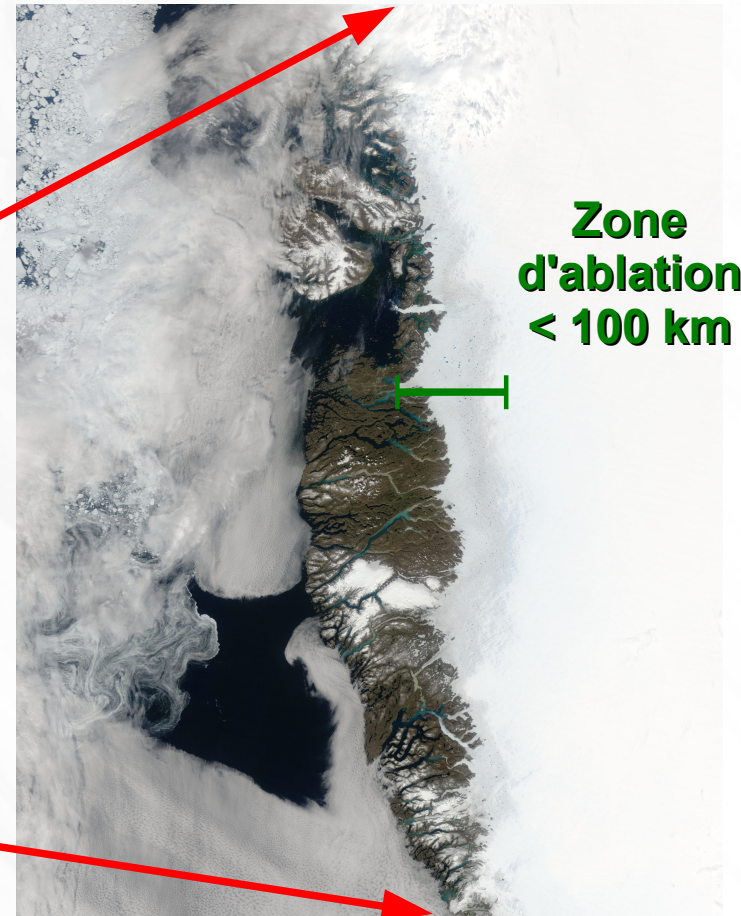
3. Résolution spatiale

Quel est l'impact de la résolution spatiale du modèle ?

- Topographie accidentée
- Zone d'ablation étroite



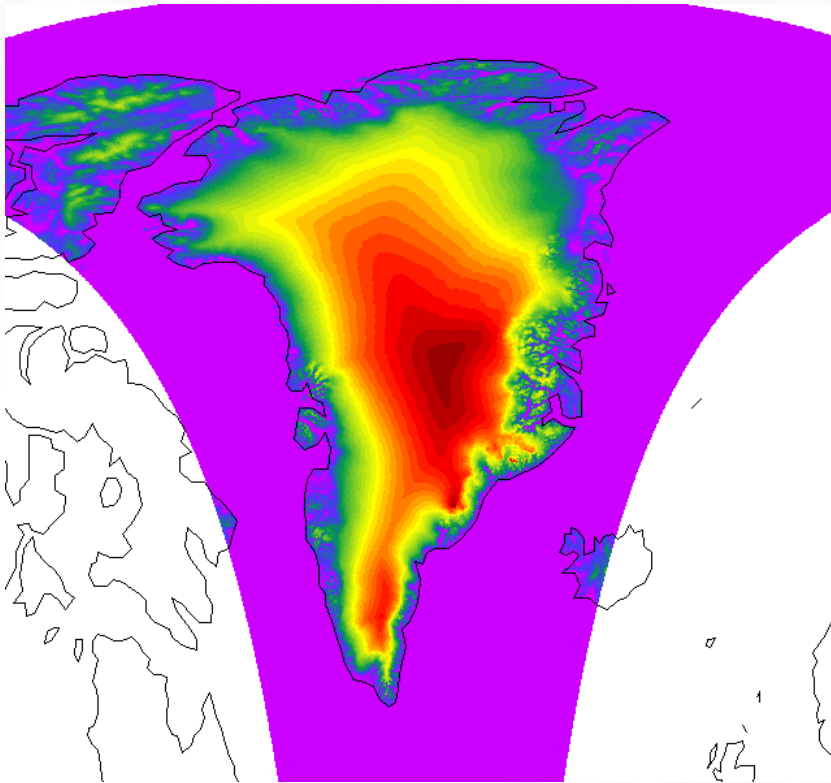
<http://news.softpedia.com/news/New-Approach-on-Greenland-Ice-Sheet-Retreat-38402.shtml>



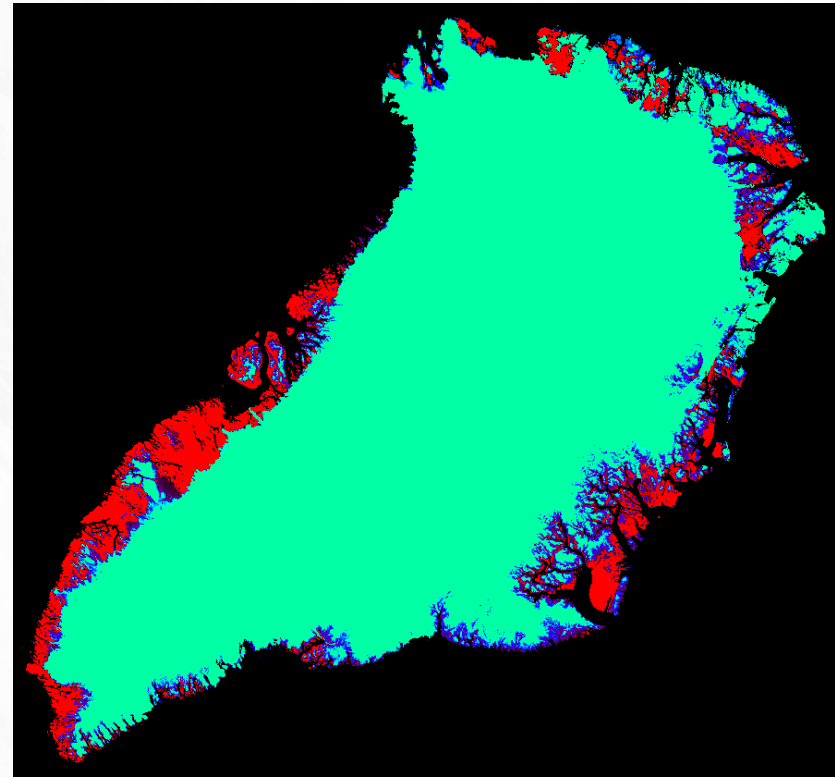
http://upload.wikimedia.org/wikipedia/en/3/36/Melt_Ponds_on_the_Greenland_Ice_Sheet.jpg

3. Résolution spatiale

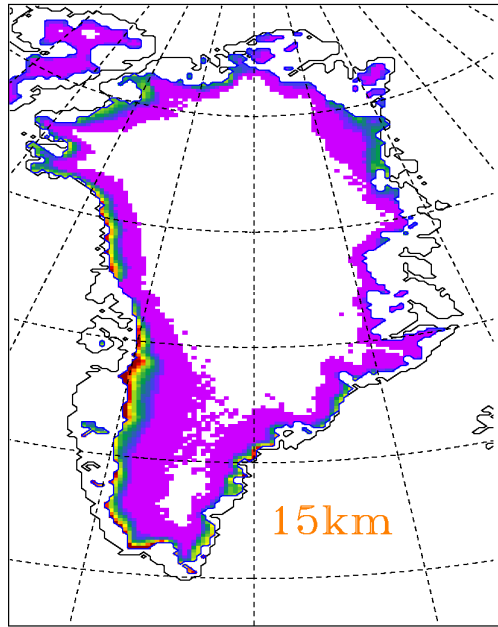
Topographie : Bamber (2001)
→ imagerie radar : 5km



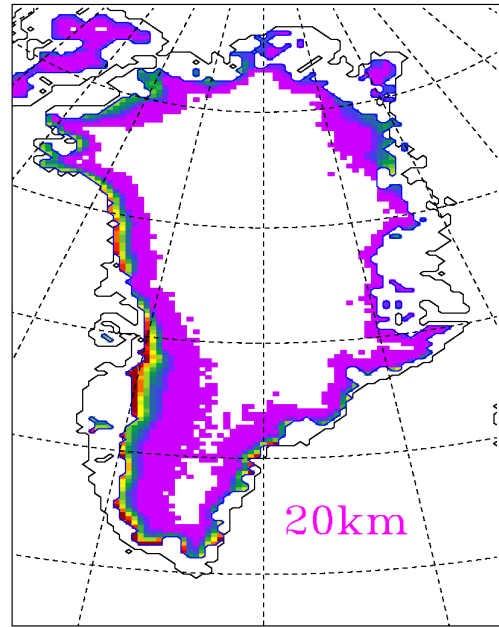
Masque de glace : Box (2008)
→ images de radiance : 1,25km



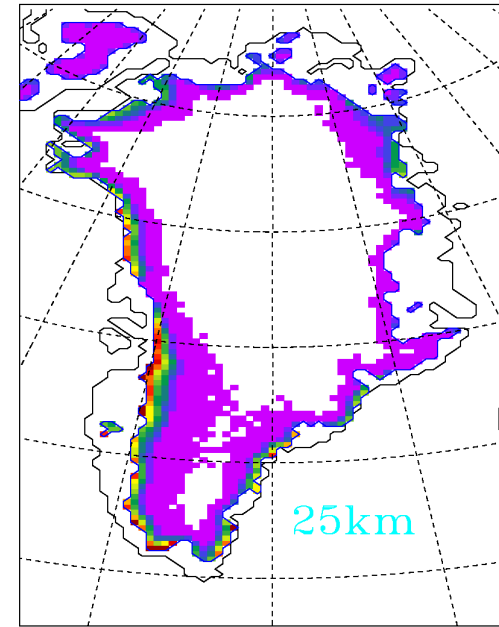
Simulations 1990-2010 → 15, 20, 25, 30, 40 & 50km



Total run-off = $305 \text{ km}^3 \text{ yr}^{-1}$

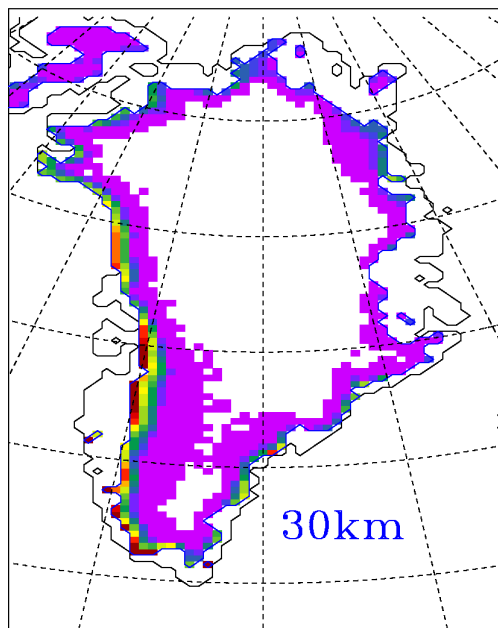


Total run-off = $331 \text{ km}^3 \text{ yr}^{-1}$

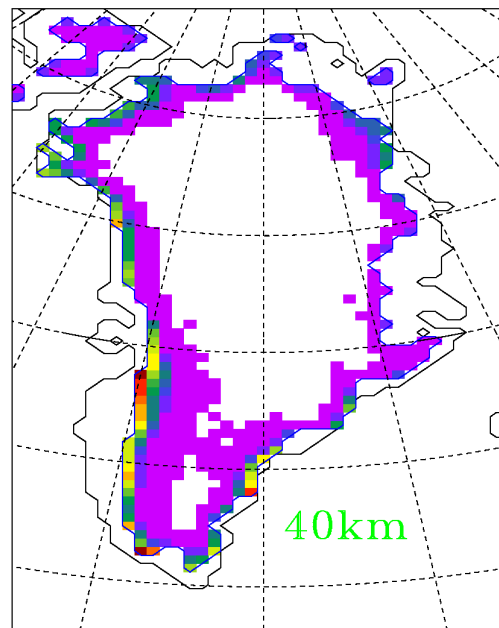


Total run-off = $307 \text{ km}^3 \text{ yr}^{-1}$

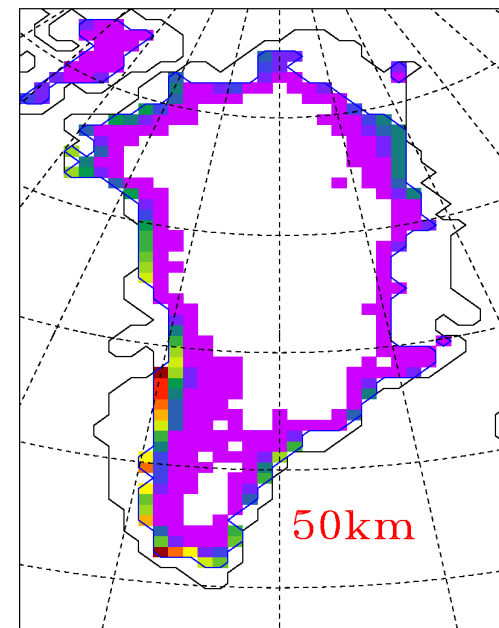
Run-off (mm/an) → 1990-2010



Total run-off = $340 \text{ km}^3 \text{ yr}^{-1}$



Total run-off = $277 \text{ km}^3 \text{ yr}^{-1}$



Total run-off = $290 \text{ km}^3 \text{ yr}^{-1}$

3. Résolution spatiale

Résolution (km)	Précipitations neigeuses (km ³ /an)	Run-off (km ³ /an)	Bilan de masse en surface (km ³ /an)
15	642	305	328
20	648	331	309
25	649	307	335
30	657	340	310
40	657	277	375
50	691	290	398

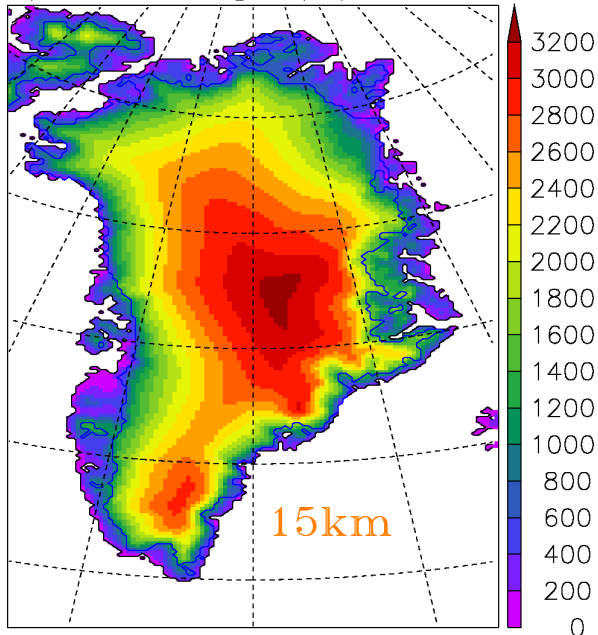
Impact de la résolution

Domaine d'intégration

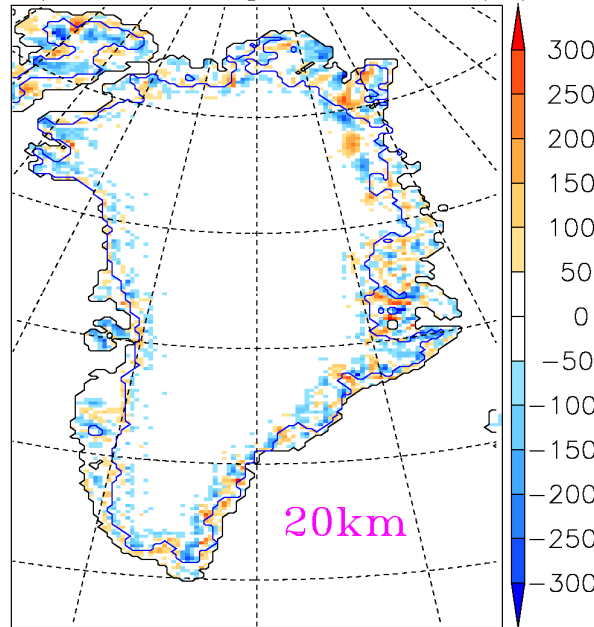
Masque de glace

Topographie

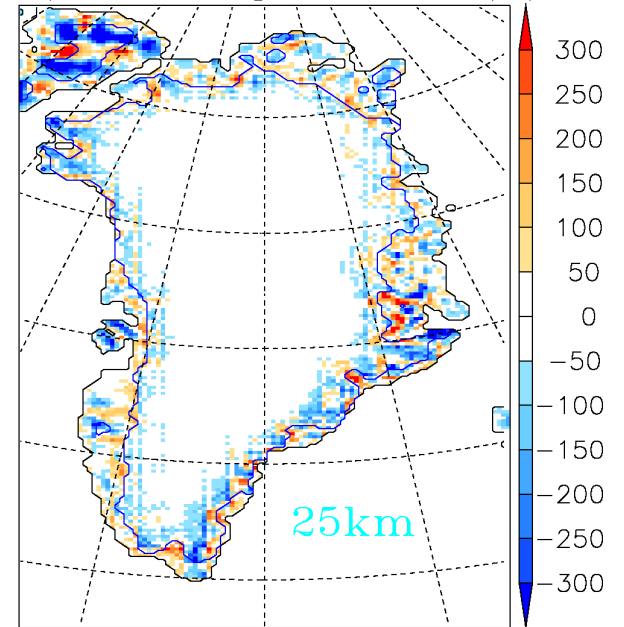
a) Surface height (m)



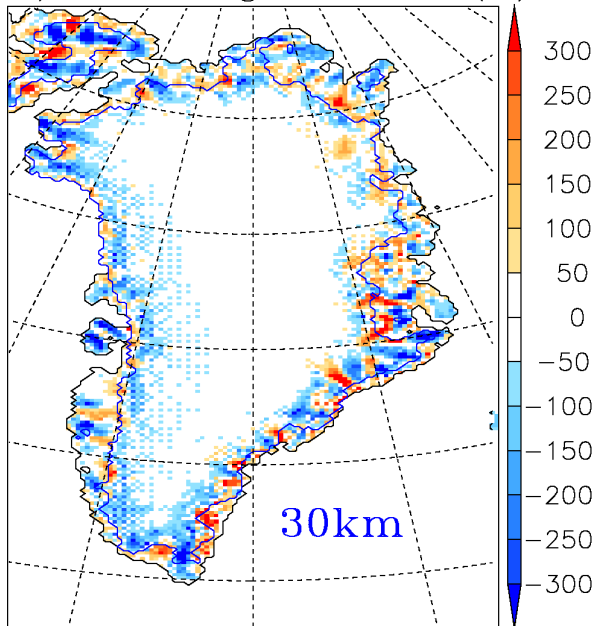
b) Surface height anomalies (m)



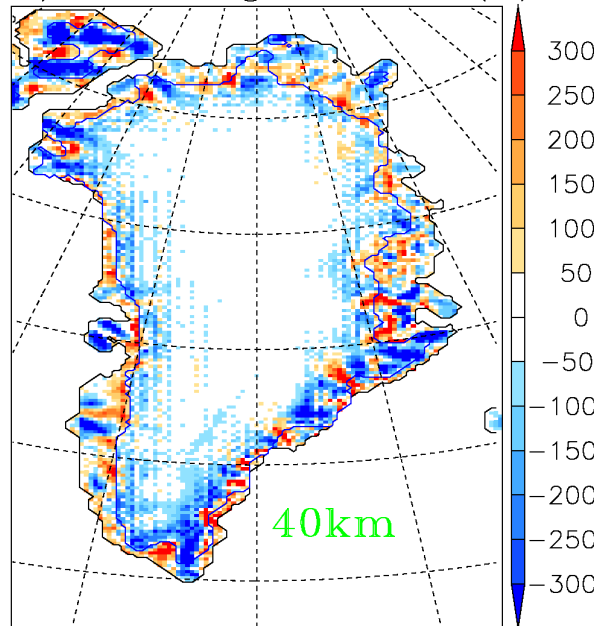
c) Surface height anomalies (m)



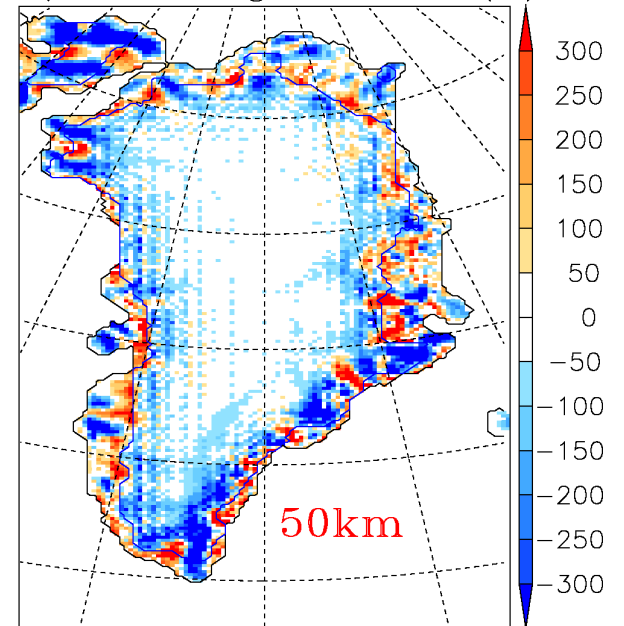
d) Surface height anomalies (m)



e) Surface height anomalies (m)

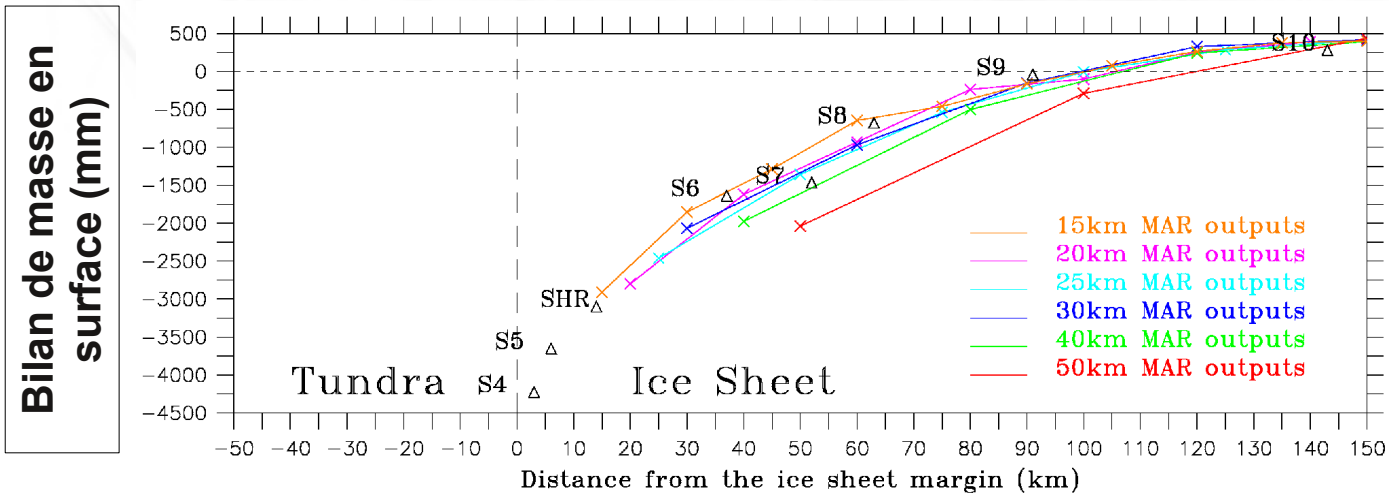
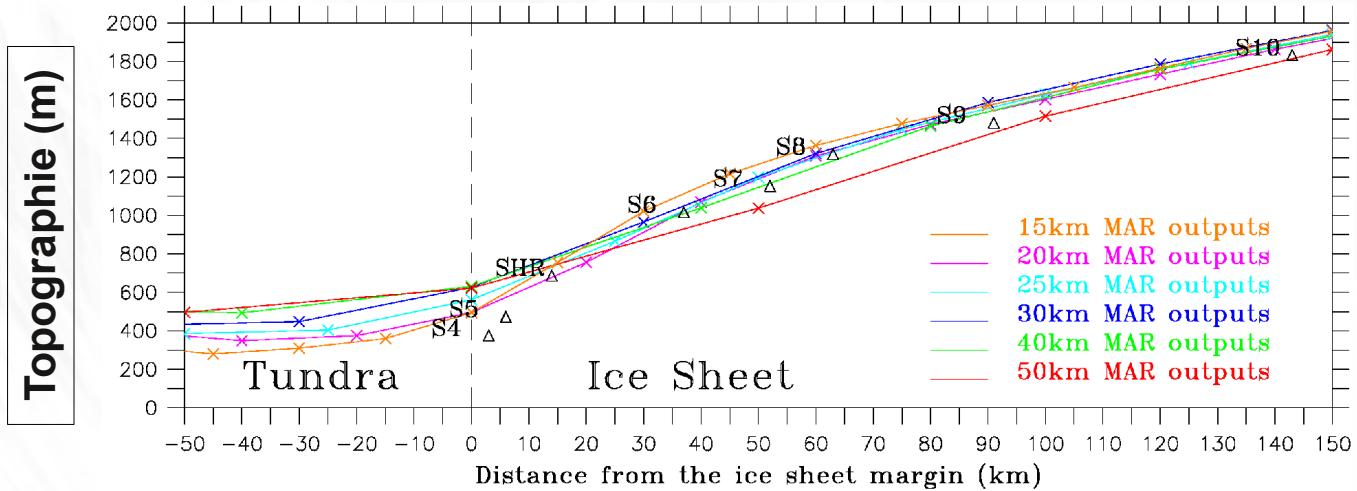


f) Surface height anomalies (m)



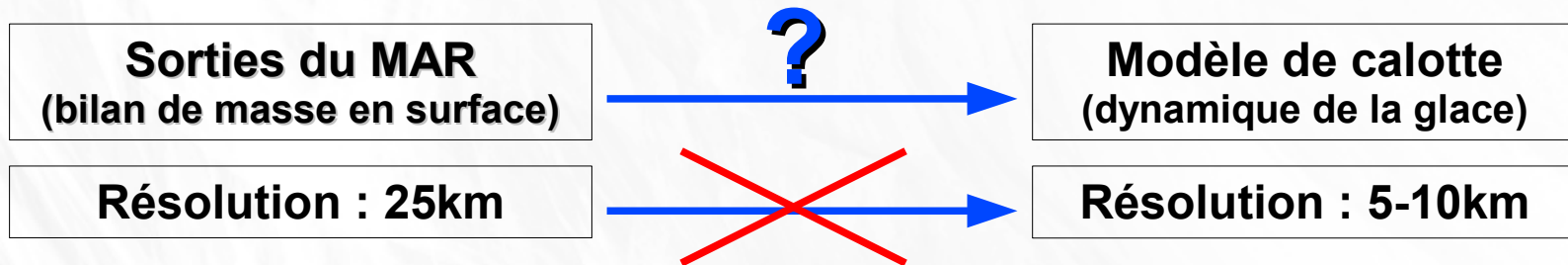
3. Résolution spatiale

Validation avec les données du K-transect (67°N, 54°W)



4. Interpolation

Peut-on employer les sorties du MAR pour forcer un modèle de calotte glaciaire ?



Résolution du MAR (km)	Temps de calcul pour 1 an de simulation (jour)
50	1,5
40	3
30	8
25	12
20	30
15	60
12,5	108



4. Interpolation

Évaluer la perte d'information lors de l'interpolation

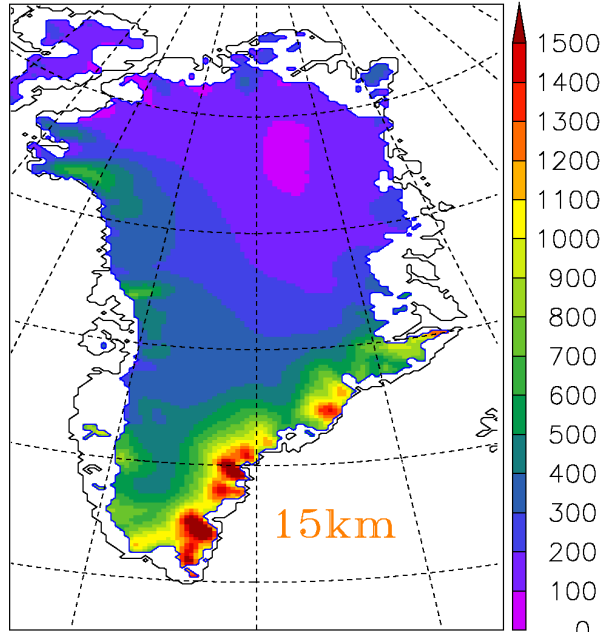
Sorties du MAR
20, 25, 30, 40 & 50km

Sorties du MAR
15km

Skill score (Connolley, 2007) : RMSE normalisé

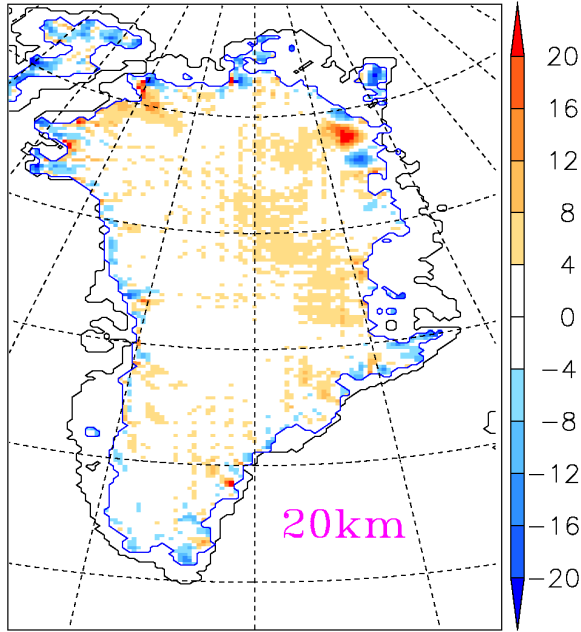
Résolution (km)	Précipitations neigeuses	Run-off	Bilan de masse en surface
20	0,98	0,99	0,97
25	0,96	0,99	0,94
30	0,93	0,99	0,90
40	0,86	0,97	0,92
50	0,69	0,89	0,64

a) Precipitation (mmWE yr⁻¹)



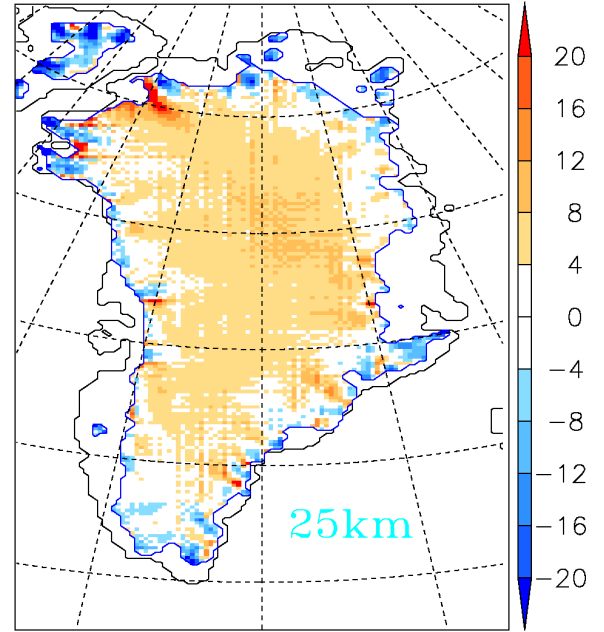
Total precipitation = 642 km³ yr⁻¹

b) Precipitation anomalies (%)



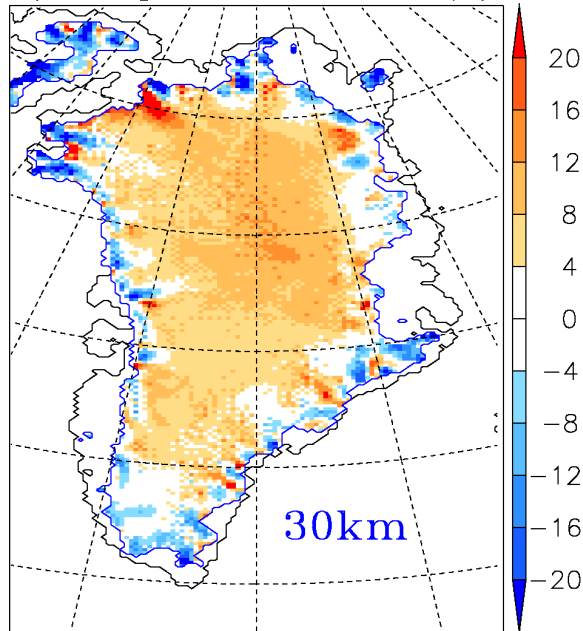
Total precipitation = 642 km³ yr⁻¹
NRMSE = 0.98

c) Precipitation anomalies (%)



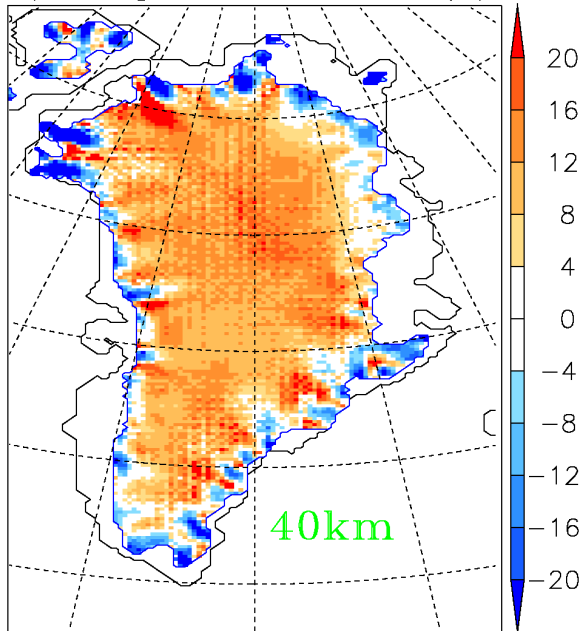
Total precipitation = 642 km³ yr⁻¹
NRMSE = 0.96

d) Precipitation anomalies (%)



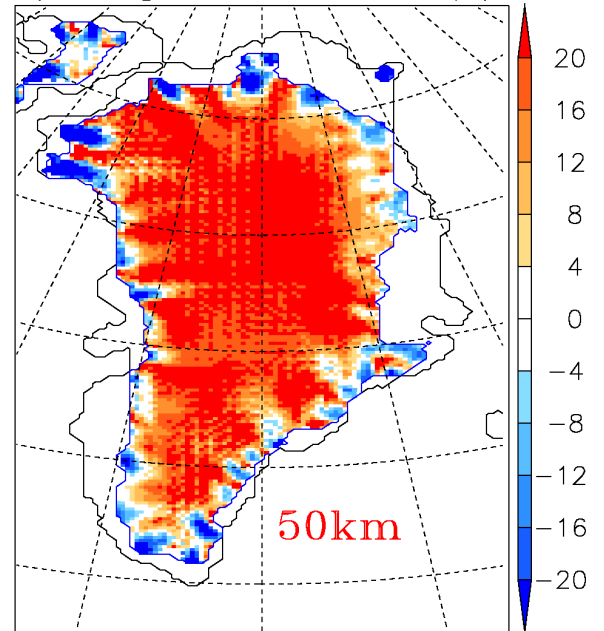
Total precipitation = 657 km³ yr⁻¹
NRMSE = 0.93

e) Precipitation anomalies (%)



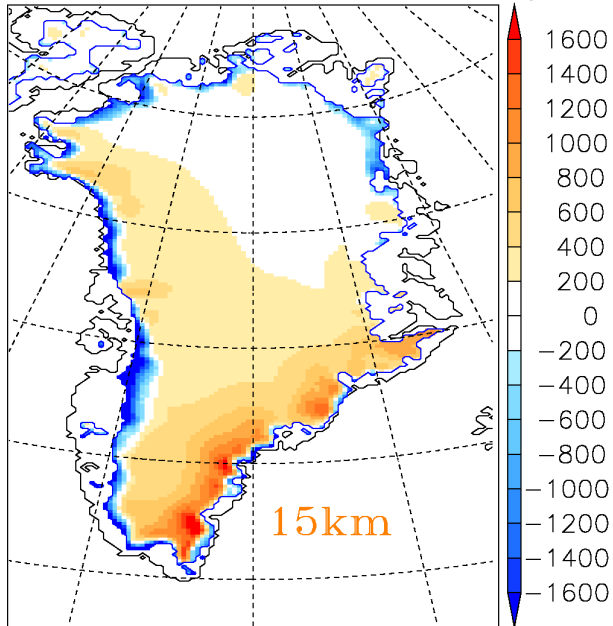
Total precipitation = 652 km³ yr⁻¹
NRMSE = 0.86

f) Precipitation anomalies (%)



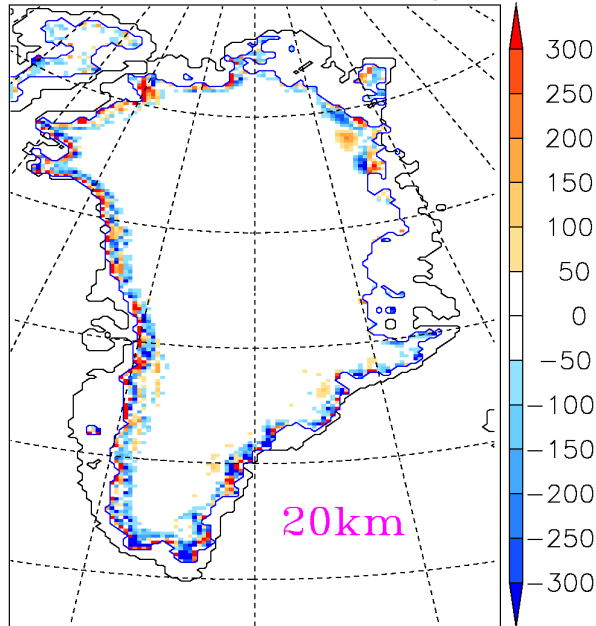
Total precipitation = 683 km³ yr⁻¹
NRMSE = 0.69

a) Surface Mass Balance (mmWE yr^{-1})



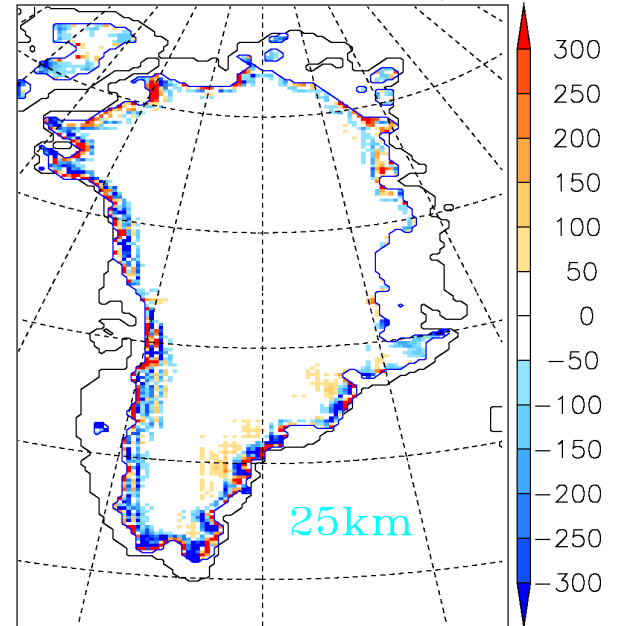
Total GrIS SMB = $328 \text{ km}^3 \text{ yr}^{-1}$

b) SMB anomalies (mmWE yr^{-1})



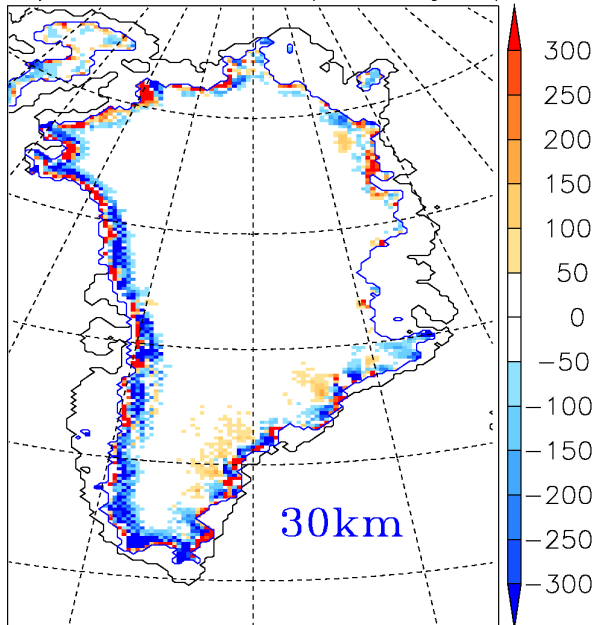
Total GrIS SMB = $323 \text{ km}^3 \text{ yr}^{-1}$
NRMSE = 0.97

c) SMB anomalies (mmWE yr^{-1})



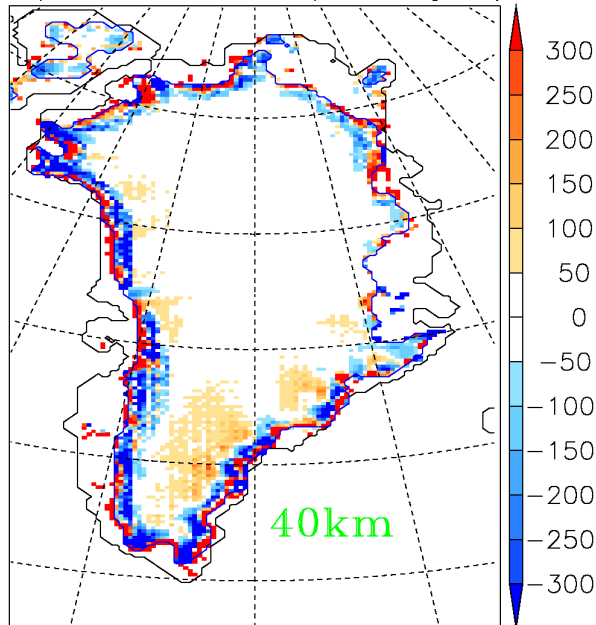
Total GrIS SMB = $351 \text{ km}^3 \text{ yr}^{-1}$
NRMSE = 0.94

d) SMB anomalies (mmWE yr^{-1})



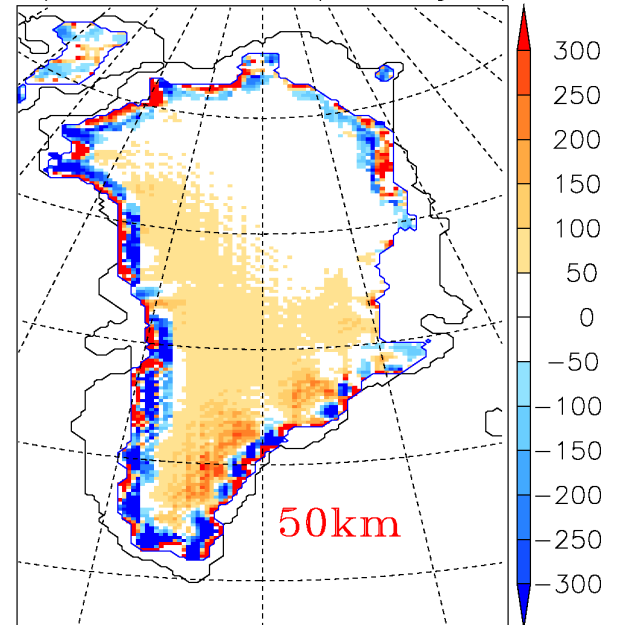
Total GrIS SMB = $307 \text{ km}^3 \text{ yr}^{-1}$
NRMSE = 0.9

e) SMB anomalies (mmWE yr^{-1})



Total GrIS SMB = $390 \text{ km}^3 \text{ yr}^{-1}$
NRMSE = 0.82

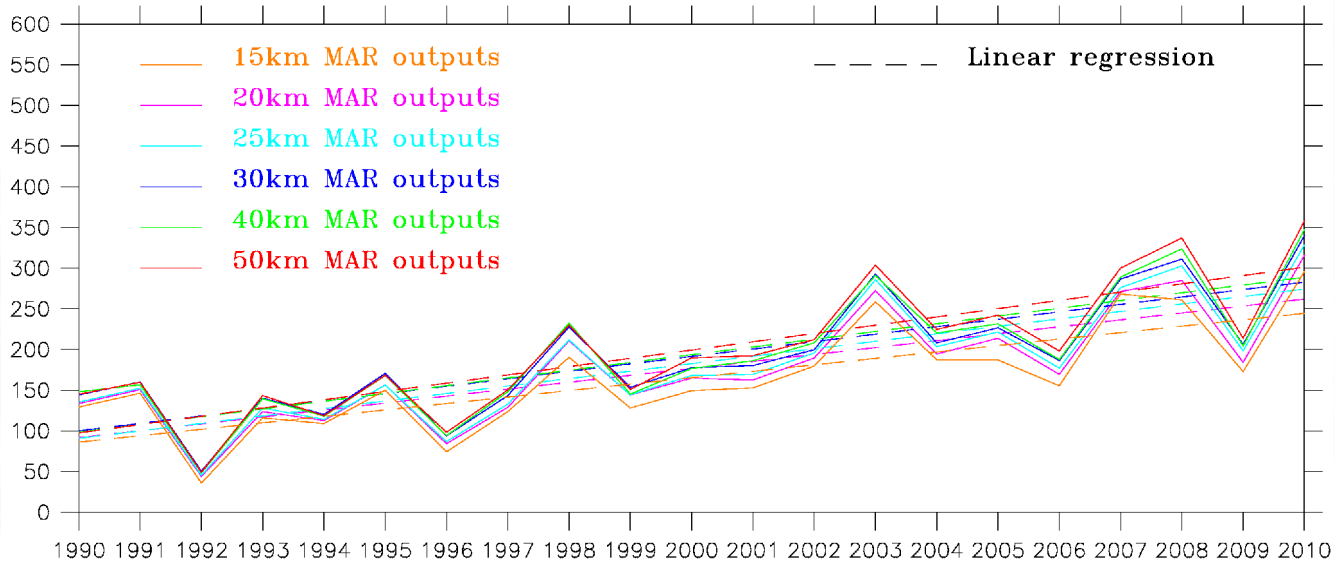
f) SMB anomalies (mmWE yr^{-1})



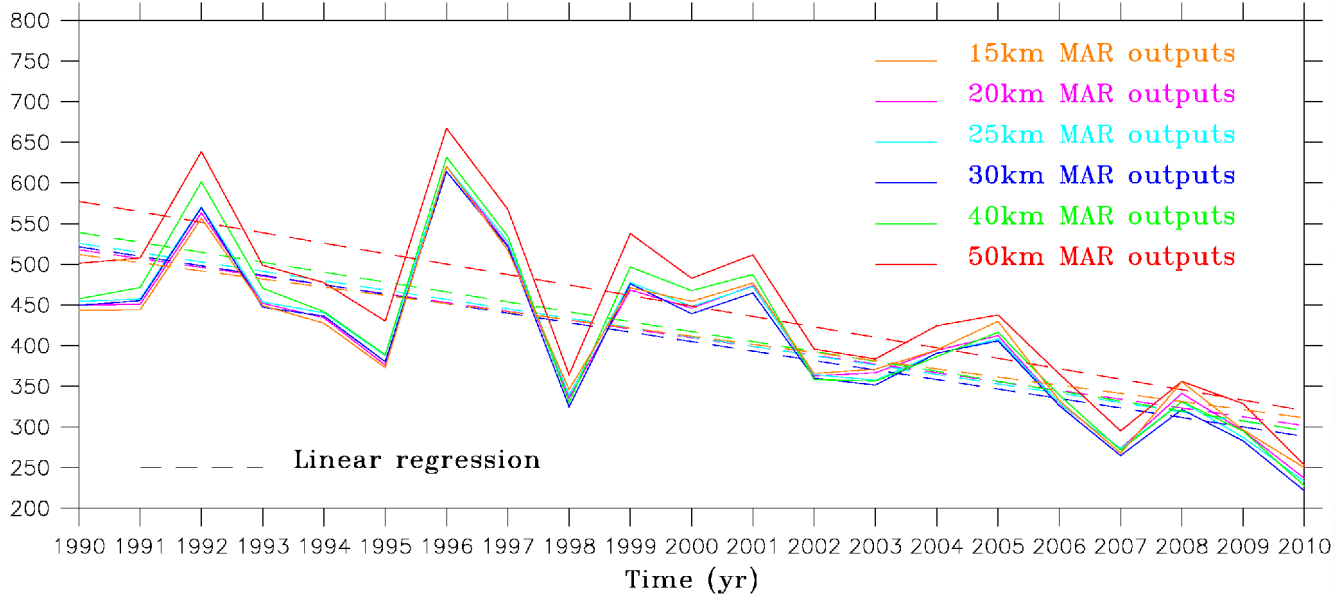
Total GrIS SMB = $415 \text{ km}^3 \text{ yr}^{-1}$
NRMSE = 0.64

L'interpolation conserve-t-elle la variabilité inter-annuelle ?

Run-off (km³/an)

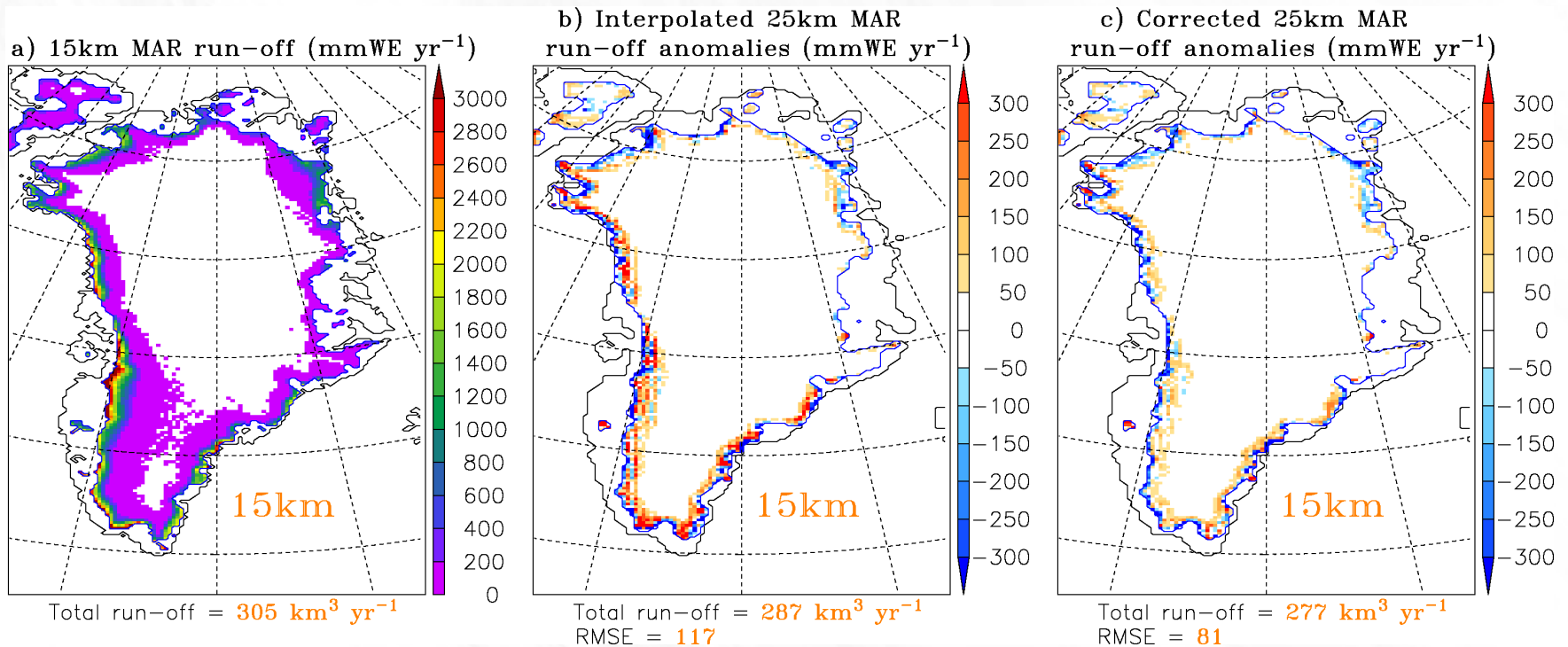


Bilan de masse en surface (km³/an)



4. Interpolation

Peut-on diminuer les anomalies dues à l'interpolation ?



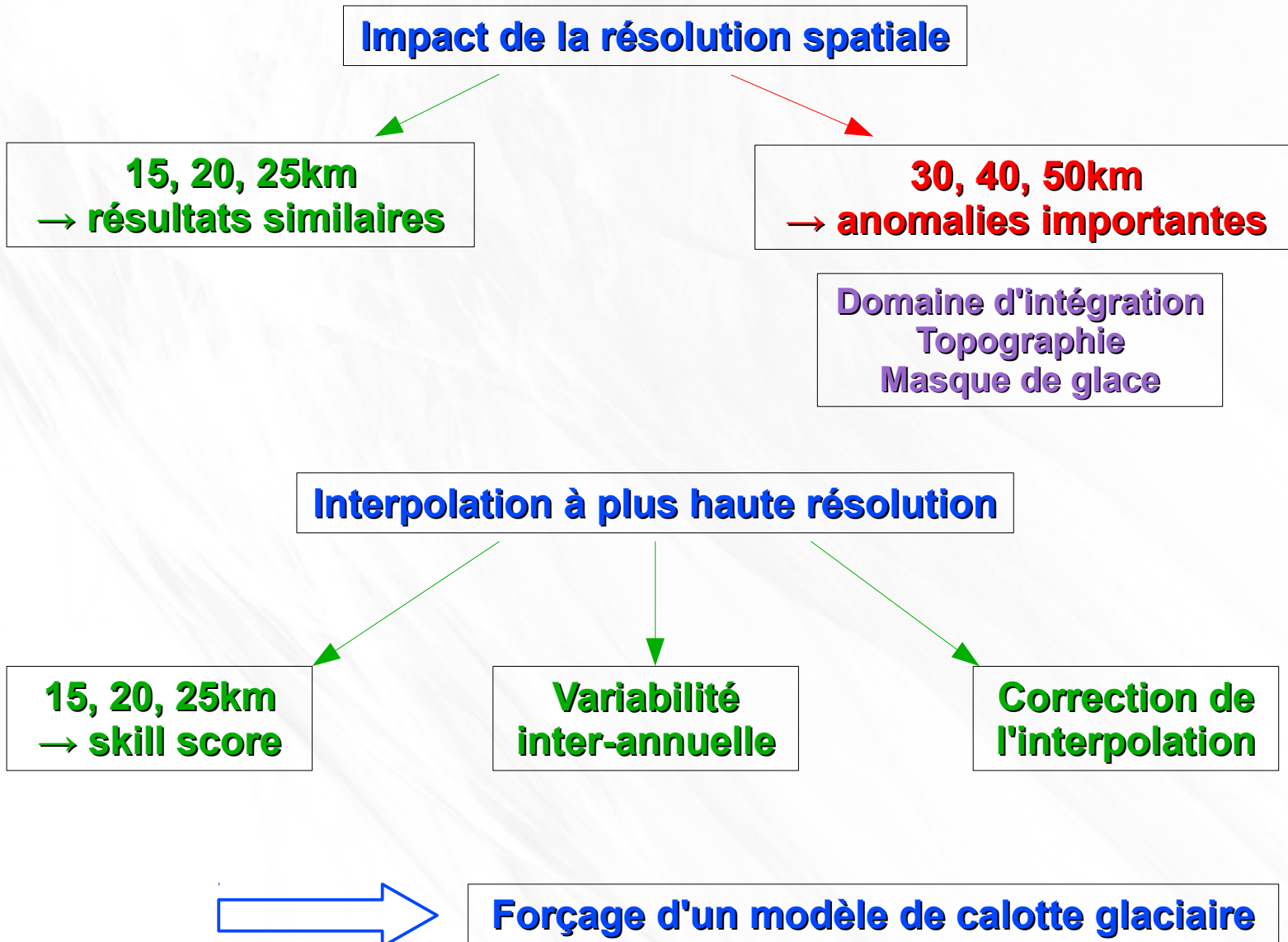
RMSE = 117

correction

RMSE = 81

16

5. Conclusion



An aerial photograph of a large, irregularly shaped ice floe floating in the ocean. The ice is a pale, milky white color, contrasting with the dark blue water. A person is visible on the left side of the floe, providing a sense of scale. The water around the floe shows some swirling patterns, possibly from a current or wind. The overall scene is captured from a high angle, looking down at the ice.

Merci de votre attention

N1602012
2001-02-11
04:21 UTC