

# Evaluation of MARv3.14 over Greenland and Impact of Model Resolution

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# About MAR versions

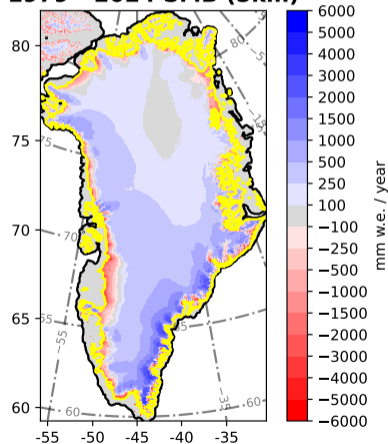


# Introduction

## Goals:

- Evaluate MARv3.14 at 5 km
  - MAR *vs*
    - SMB data
    - AWS measurements
    - Albedo data
- Identify the main biases
- Influence of the resolution ?

1979 - 2024 SMB (5km)

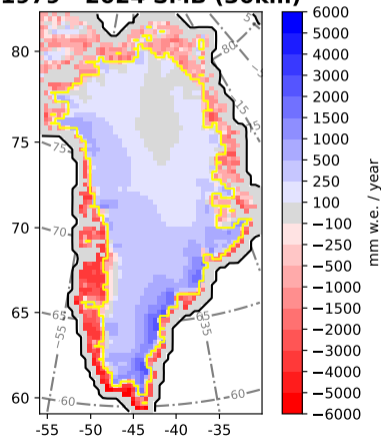


# Introduction

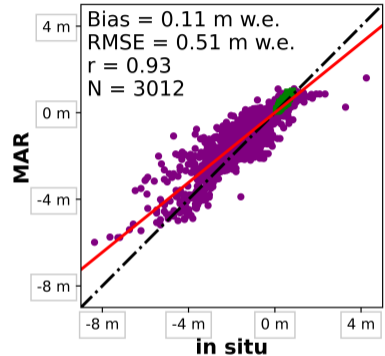
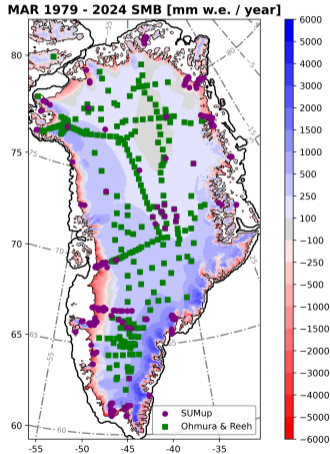
## Goals:

- Evaluate MARv3.14 at 5 km  
→ MAR vs
  - SMB data
  - AWS measurements
  - Albedo data
- Identify the main biases
- Influence of the resolution ?

1979 - 2024 SMB (30km)

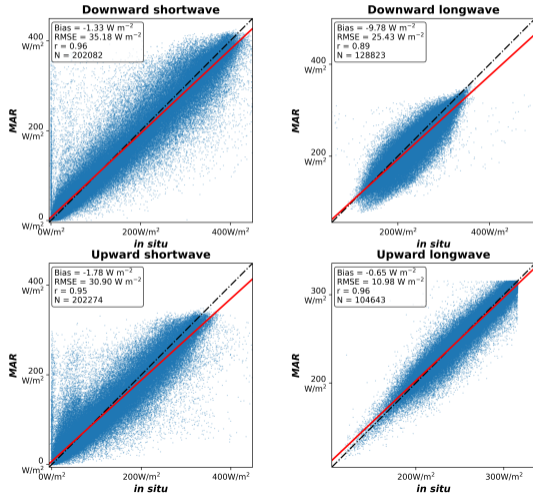


# SMB: MAR (5 km) vs SUMup & ice cores

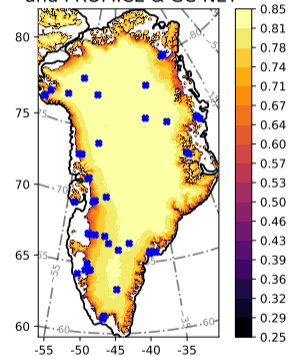


- Non-significant errors
- Ablation underestimation
- **/!\ No in situ data in SE GrIS**

# Radiative Fluxes: MAR (5km) vs PROMICE & GC-NET

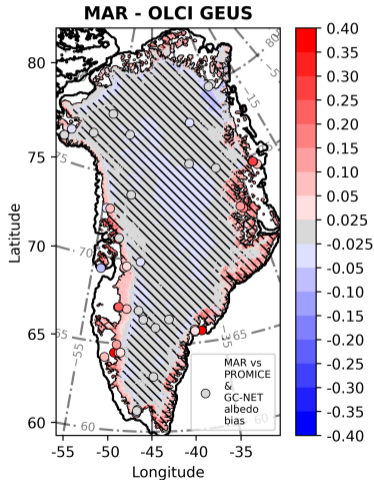


MAR summer albedo (2017 - 2019) and PROMICE & GC-NET

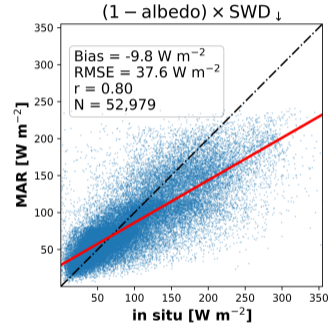
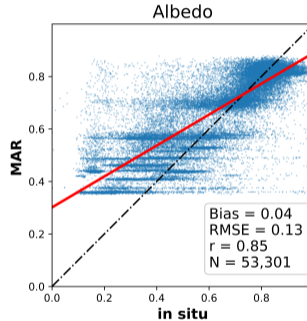


← Non-significant errors

# Albedo: MAR (5km) vs OLCI-GEUS + PROMICE & GC-NET

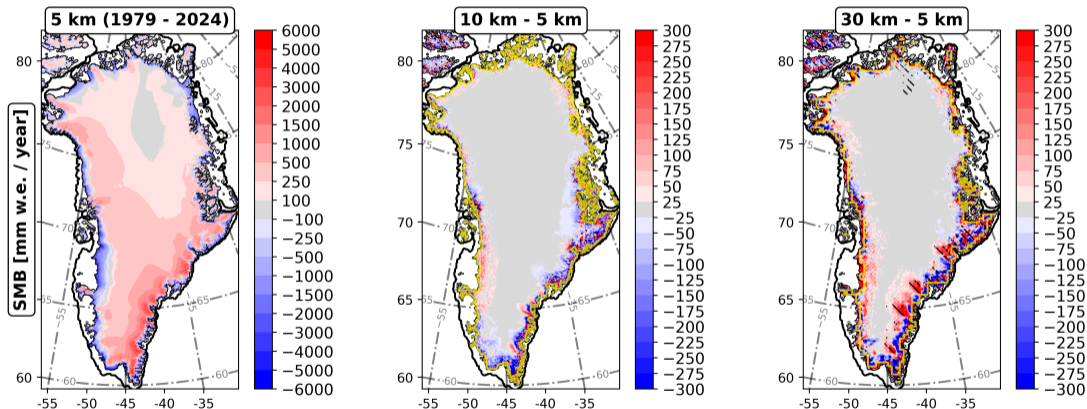


MAR vs PROMICE & GC-NET summer (JJA)



- Ablation zone: albedo overestimation  
⇒ Ablation underestimate  
⇒ Runoff underestimate

# Inter-resolution SMB differences

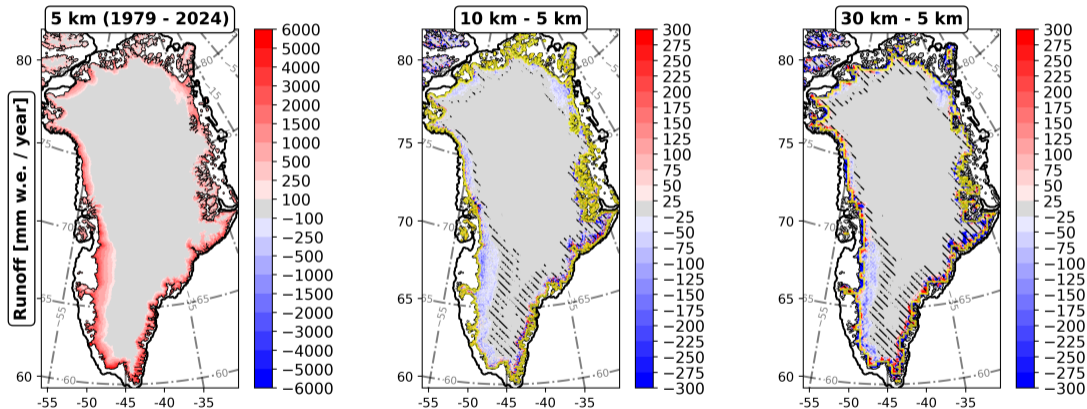


- $\text{SMB}_{5\text{km}} = 334.4 \pm 116.6 \text{ Gt}$

- $\Delta\text{SMB}_{10\text{km}} = -0.8 \%$

- $\Delta\text{SMB}_{30\text{km}} = +22.7 \%$

# Inter-resolution runoff differences

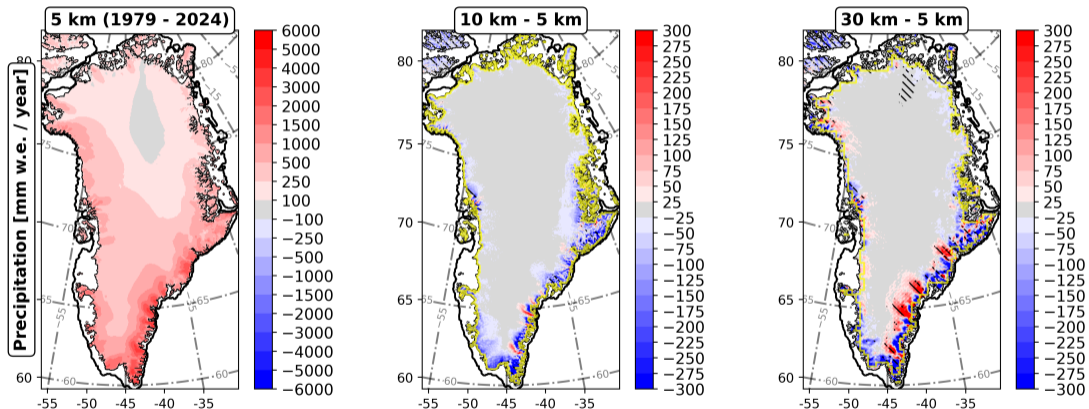


- $\bullet$   $RU_{5km} = 422.0 \pm 112.7$  Gt

- $\bullet$   $\Delta RU_{10km} = -13.5 \%$

- $\bullet$   $\Delta RU_{30km} = -31.9 \%$

# Inter-resolution precipitation differences

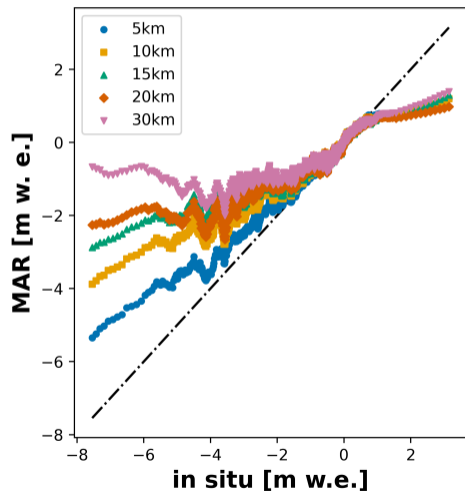


- $\bullet$   $PR_{5km} = 812.6 \pm 70.3 \text{ Gt}$

- $\bullet$   $\Delta PR_{10km} = -8.1 \%$

- $\bullet$   $\Delta PR_{30km} = -9.2 \%$

# Conclusion



- Evaluation of the latest MAR version
- non-significant SMB errors
- Albedo = main source of error for ablation
- 10 km is a fair trade-off for projections

egusphere-2026-2341 | Relation: TC | Submitted 23 Apr 2026 | Research article

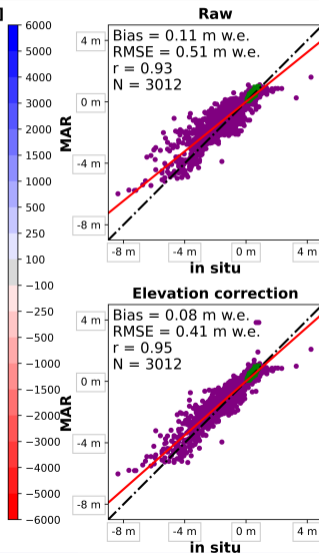
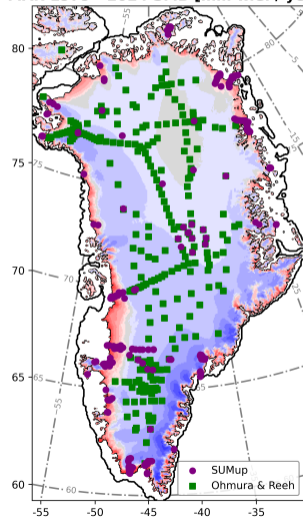
[Evaluation of MARv3.14 over the Greenland Ice Sheet](#)

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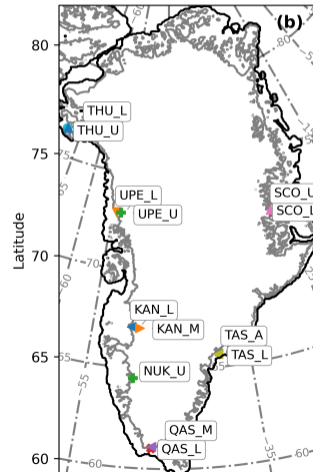
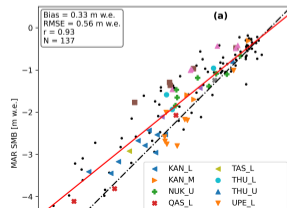
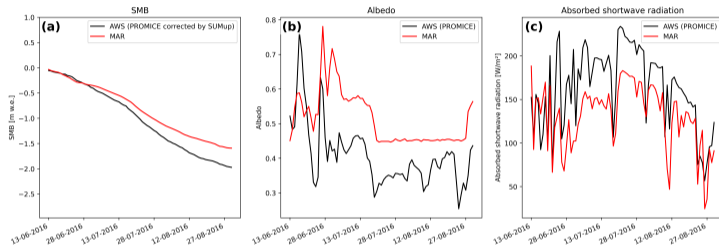
# Results: SMB [MAR vs SUMup and ice cores]

MAR 1979 - 2024 SMB [mm w.e. / year]



- $RMSE < \sigma_{obs}$
- Ablation underestimation
- $\neq$  No in situ data in SE GrIS

# Origin of ablation biases



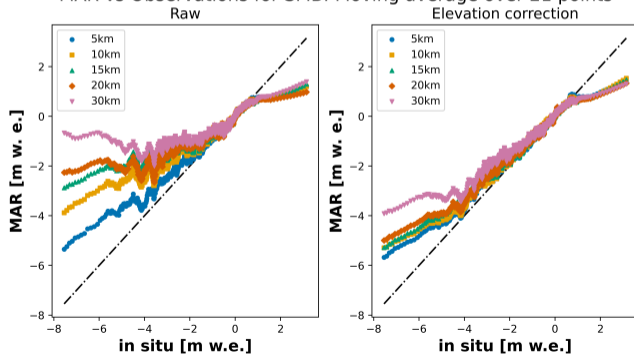
Enables identifying albedo as main source of uncertainty for ablation

Station	Lon	Lat	SMB mm w e d <sup>-1</sup>	$\alpha$ -	SWD	SWD <sub>abs</sub> W m <sup>-2</sup>	LWD	SWU	$\Delta z$ m	N
KAN_L	-49.9	67.1	3.2	-0.03	-7.8	2.0	-10.3	-8.2	-11	811
KAN_M	-48.8	67.1	3.6	0.12	-4.9	-31.5	-6.8	24.0	13	193
NUK_U	-49.3	64.5	2.9	0.07	-3.2	-16.9	-0.9	13.1	-1	178
QAS_L	-46.9	61.0	2.4	0.17	-0.7	-37.7	-5.4	33.2	23	237
QAS_M	-46.8	61.1	7.6	0.09	12.7	-9.8	-11.2	22.0	12	91
SCO_L	-26.8	72.2	14.0	0.18	1.6	-42.1	-10.9	26.4	475	336
SCO_U	-27.3	72.4	11.1	0.18	-23.7	-54.0	0.6	21.8	212	370
TAS_A	-38.9	65.8	1.4	0.14	-4.9	-38.2	-14.4	28.3	10	51
TAS_L	-38.9	65.6	4.9	0.11	-10.5	-34.8	-4.1	20.9	3	85
THU_L	-68.3	76.4	7.7	0.12	-10.1	-32.2	-12.9	-8.7	-25	212
THU_U	-68.1	76.4	1.8	0.05	4.3	-5.5	-17.1	21.7	-26	49
UPE_L	-54.3	72.9	-2.0	-0.03	-5.7	3.9	-9.1	-12.4	-8	632
UPE_U	-53.5	72.9	5.1	0.09	-10.1	-26.1	-8.5	11.9	5	378

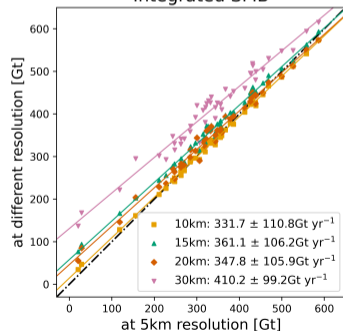
# Inter-resolution SMB differences (1/2)

MAR can be run at various spatial resolutions, influencing the computation time.  
 ⇒ What is the most appropriate resolution?

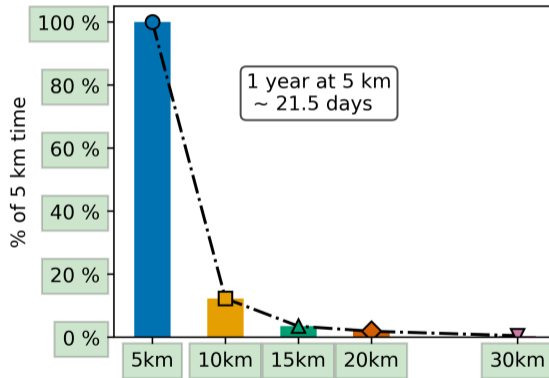
MAR vs Observations for SMB: Moving average over 21 points



Integrated SMB



# Inter-resolution SMB differences (2/2)



# RMSE & standard deviation

$$\text{RMSE} \left( = \sqrt{\frac{\sum_{i=1}^n (\hat{y}_i - y_i)^2}{n}} \right) < \sigma_{\text{obs}} \left( = \sqrt{\frac{\sum_{i=1}^n (\bar{y} - y_i)^2}{n}} \right)$$