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Supplementary material of *melting trends over the Greenland ice sheet (1958-2009) from spaceborne microwave data and regional climate models*

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1 Yearly melt extent analysis

In the list hereafter, we focus on single years (compared to Figs. 5 and 6 of the manuscript) and discuss specific cases when the RCMs outputs and remote sensing results agree or not:

1982. The models favorably simulate a melting season limited to the period June-August as detected by T19Hmelt. As mentioned above, generally the melting season starts in May and lasts until September. However, we see that MAR overestimates the melt extent in June and RACMO2 overestimates it in July. We also observe a large difference between the melt extent estimated by T19Hmelt and ExtXPGR in September. As September 1987, 1990, 1994, 1999 and 2004, T19Hmelt seems not to be sensitive to the presence of bare ice at the surface or internal liquid water into the snow pack, differently from ExtXPGR, being the latter in agreement with results from the models.

1983-1992. During these summers, a very low melt extent value is suggested by both the models and satellite after the El Chichon (1983) and Mont Pinatubo (1992) eruptions. Volcanic eruptions are known to induce cooling and low melting rate by injecting large amounts of aerosols in the atmosphere, reducing the amount of solar energy reaching the Earth surface.

1984. In July 1984, the melt extent simulated by RACMO2 is very high compared to MAR and satellite.

1986. The models simulate successfully no melt on the north-west of the ice sheet where the number of days with melt detected by T19Hmelt (resp. ExtXPGR) is usually about 30 (resp. 60) days.

1987. Models underestimate the number of melt days along the east coast compared to satellite. However, results from both satellite and models agree regarding the highest melting event, occurring in June.

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1989. A the end of May 1989, a very large melt extent is simulated and observed ($\sim 15\%$ of the GrIS area) compared to the average ($<5\%$ of the GrIS area).

1995. The succession of two high melt events interrupted by a colder period at the beginning of July 1995 is well reproduced by the models.

1996. MAR overestimates the number of melt days (detected with the LWC threshold) compared to RACMO2 and ExtXPGR over southern Greenland.

1997. The highest melt event occurring during mid-August (which is very late in comparison with other years) is well captured by the models.

1998. The melt extent is overestimated by RACMO2 (if LWC is used as melt threshold) with respect to MAR and microwave data.

1999. The performance of both RCMs is antagonistic in 1999 with an overestimation (resp. underestimation) of the melt extent simulated by MAR (resp. RACMO2) at the end of June and the contrary at the beginning of August.

2000. Both models and satellite agree to show three significant melt events in 2000 while MAR overestimates the first one.

2002. Spaceborne microwave data shows a melt area at the north-east of the ice sheet larger (reaching 2000m a.s.l.) and longer (about four times the standard deviation) than normal. This positive anomaly is well simulated by the models while they underestimate the melt period of 10 days.

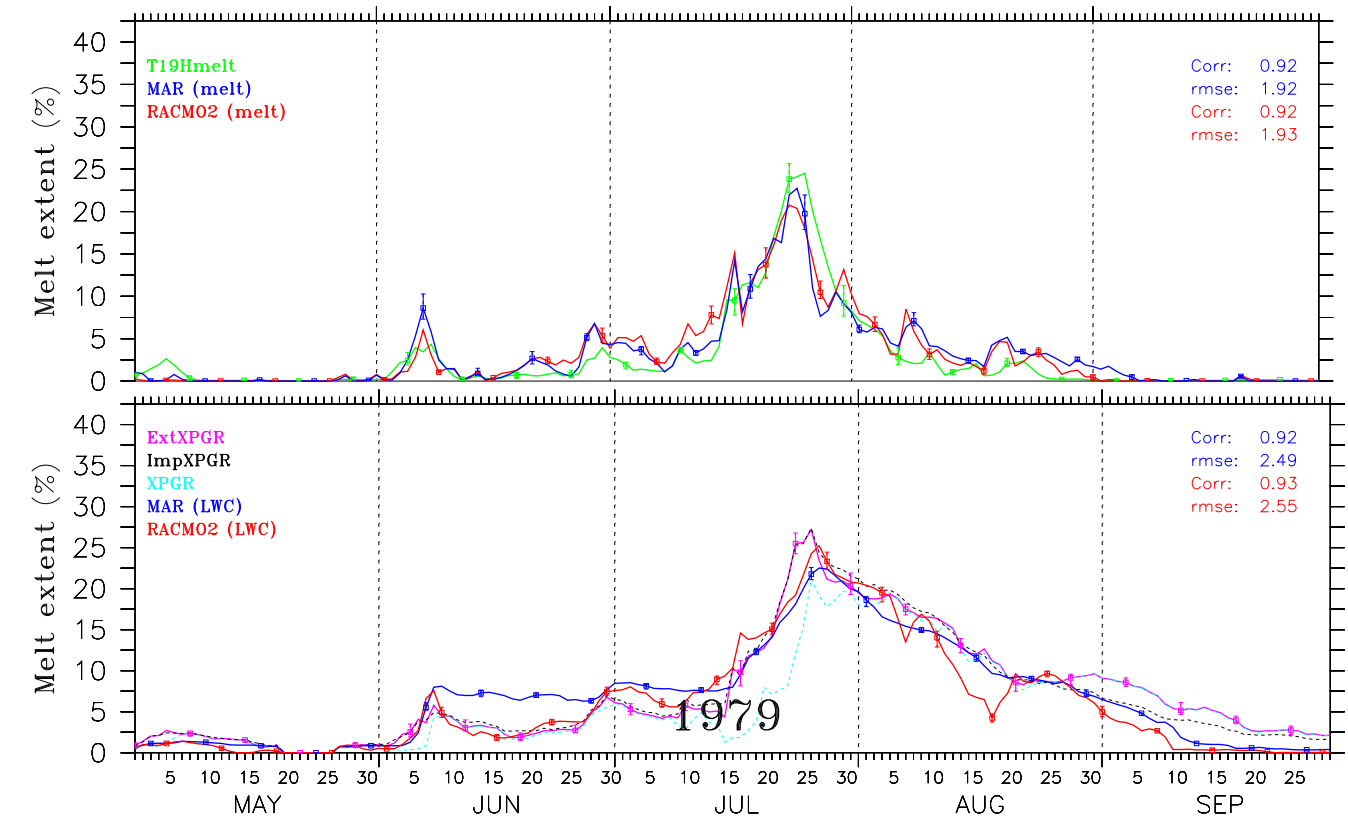
2003. At the end of September 2003, satellite-based observation and modelisation show a high melt event when the cold season has normally already begun.

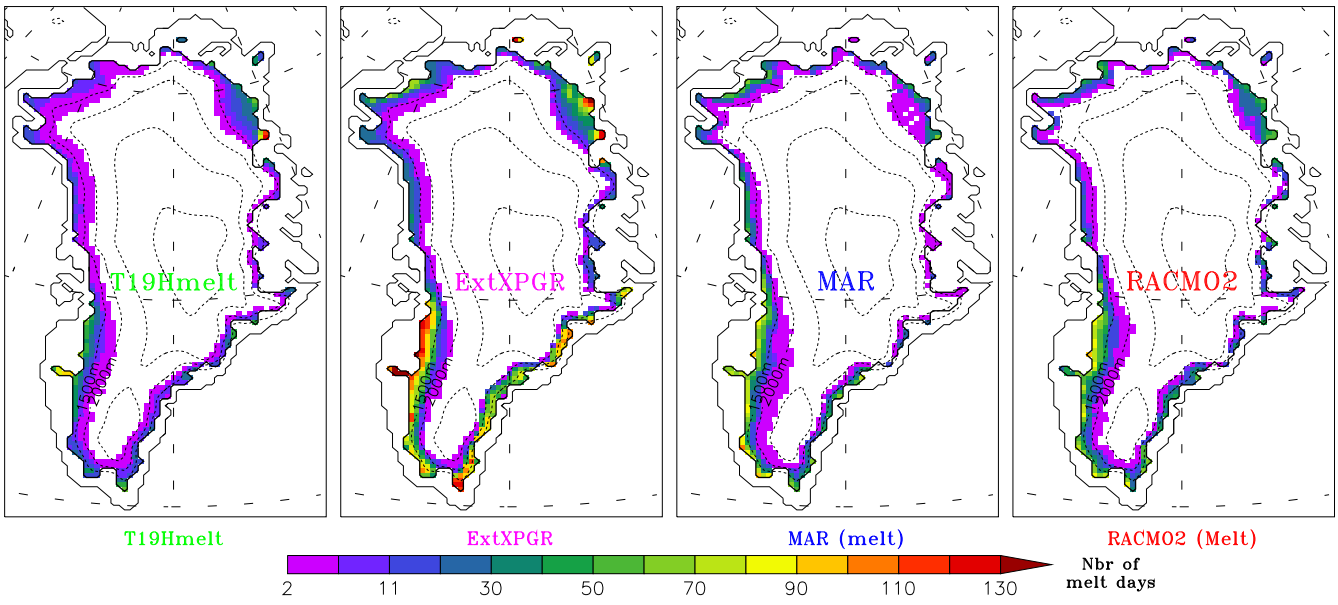
2005. In July 2005, the largest melt area is retrieved from satellite although it is underestimated by 10% of the GrIS area by the models.

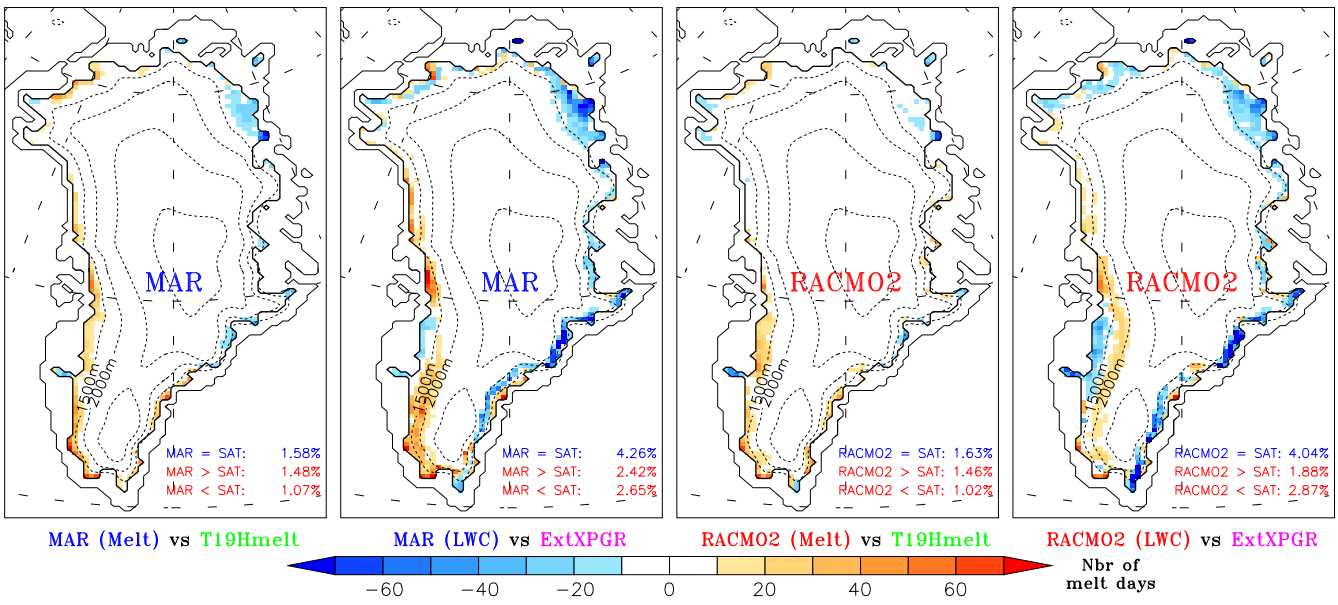
2007. Summer 2007 presents an abnormal high number of melt days (at least two times the norm) at the south of the ice sheet according to Tedesco et al. (2008). This is confirmed by the models.

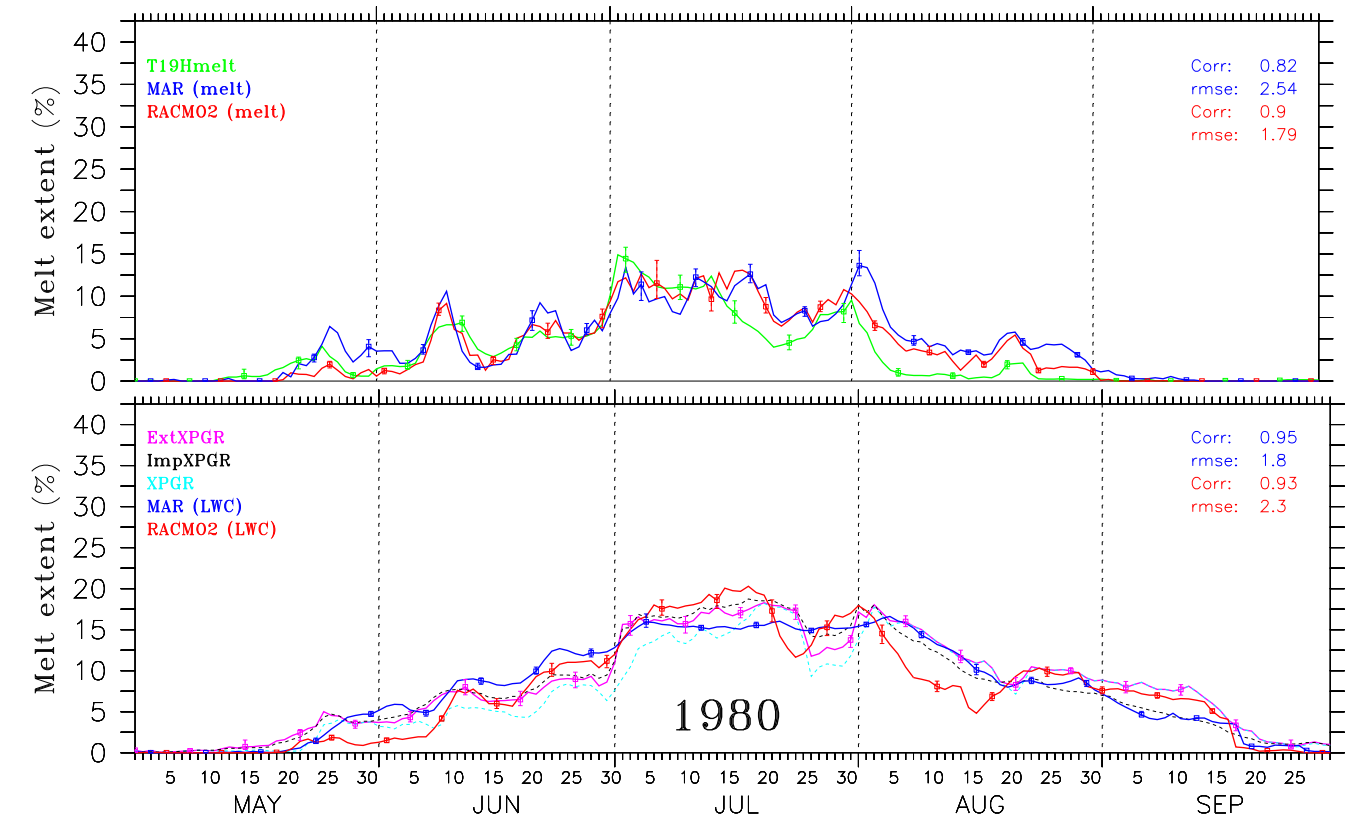
2008. The 2008 melt season is about one month longer at the north of the ice sheet than the average.

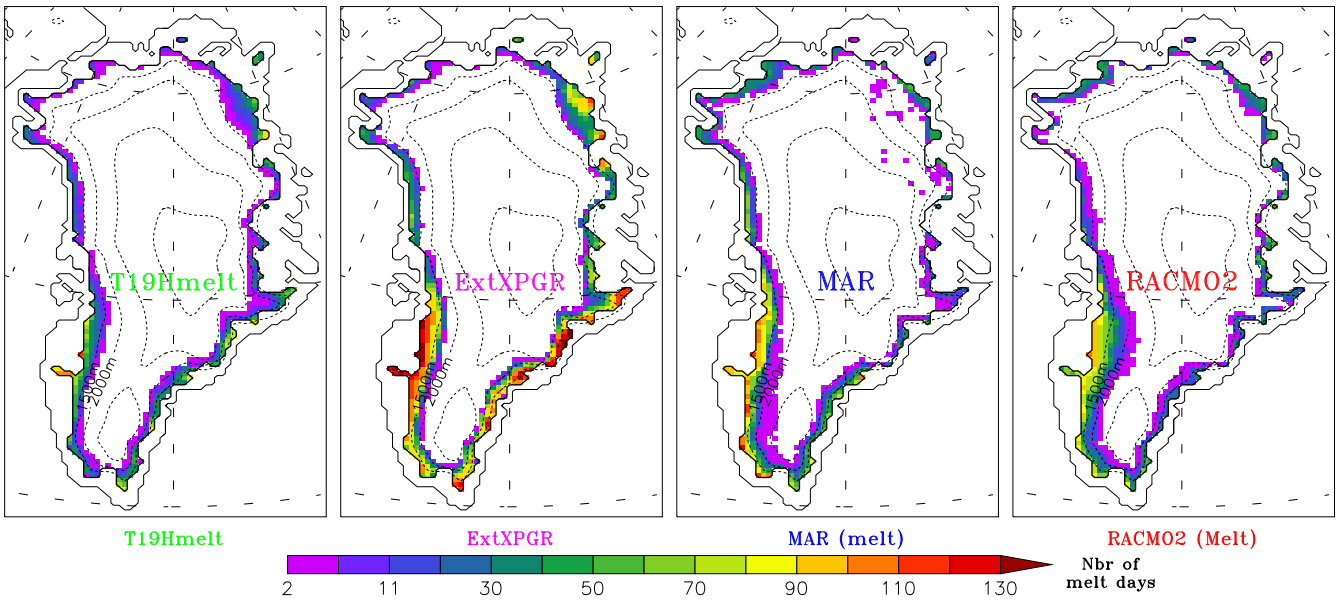
The legend of the figures hereafter are the same as Fig. 5 and 6 of the manuscript but for each year from 1979 to 2009.

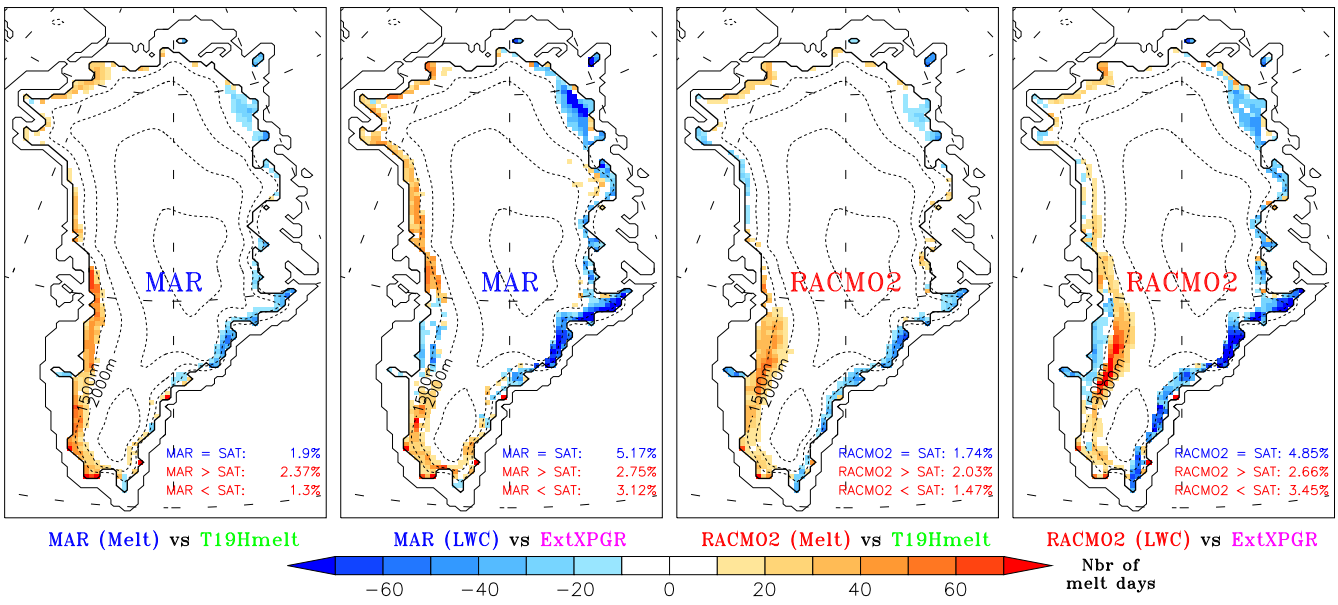

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.92
rmse: 1.92
Corr: 0.92
rmse: 1.93
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.92
rmse: 2.49
Corr: 0.93
rmse: 2.55
1979
MAY
JUN
JUL
AUG
SEP

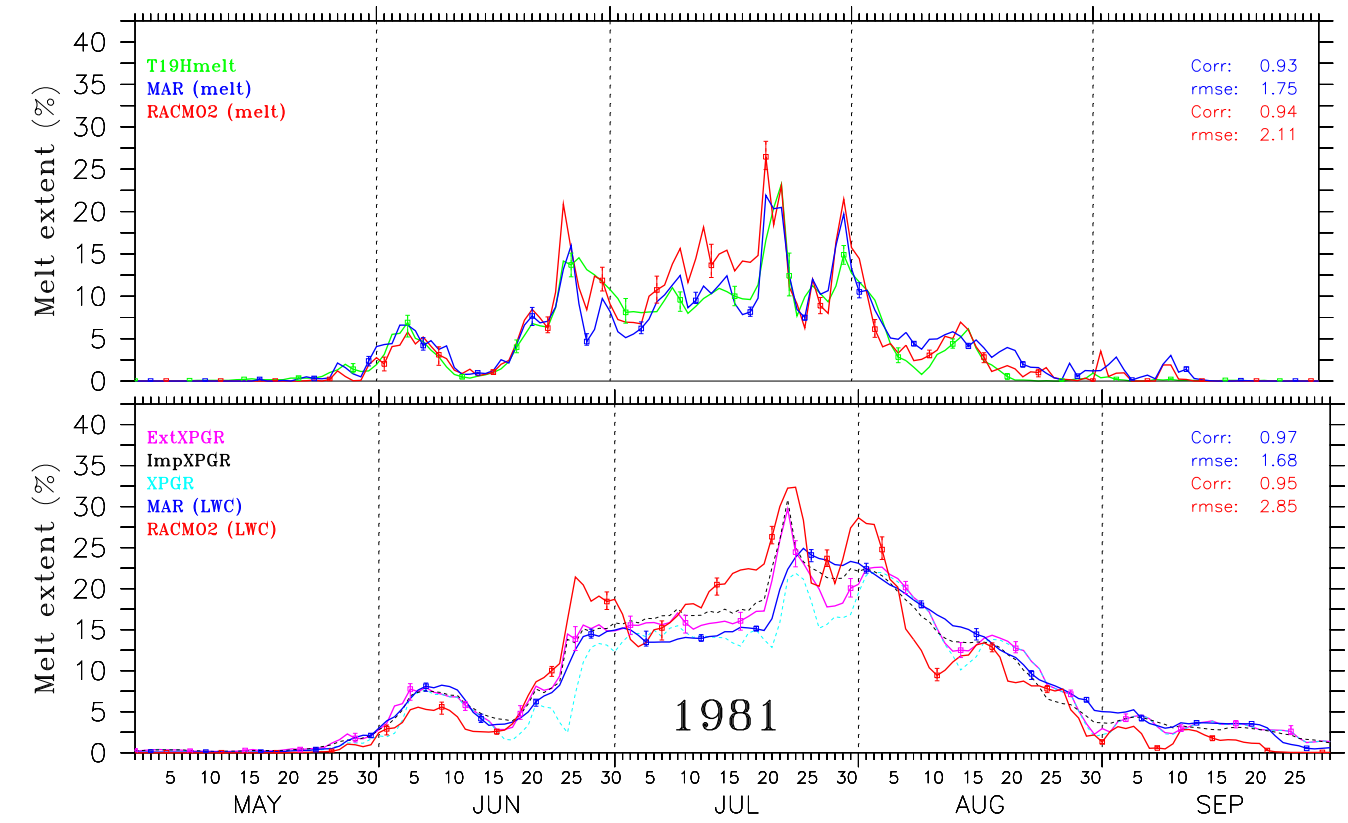

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

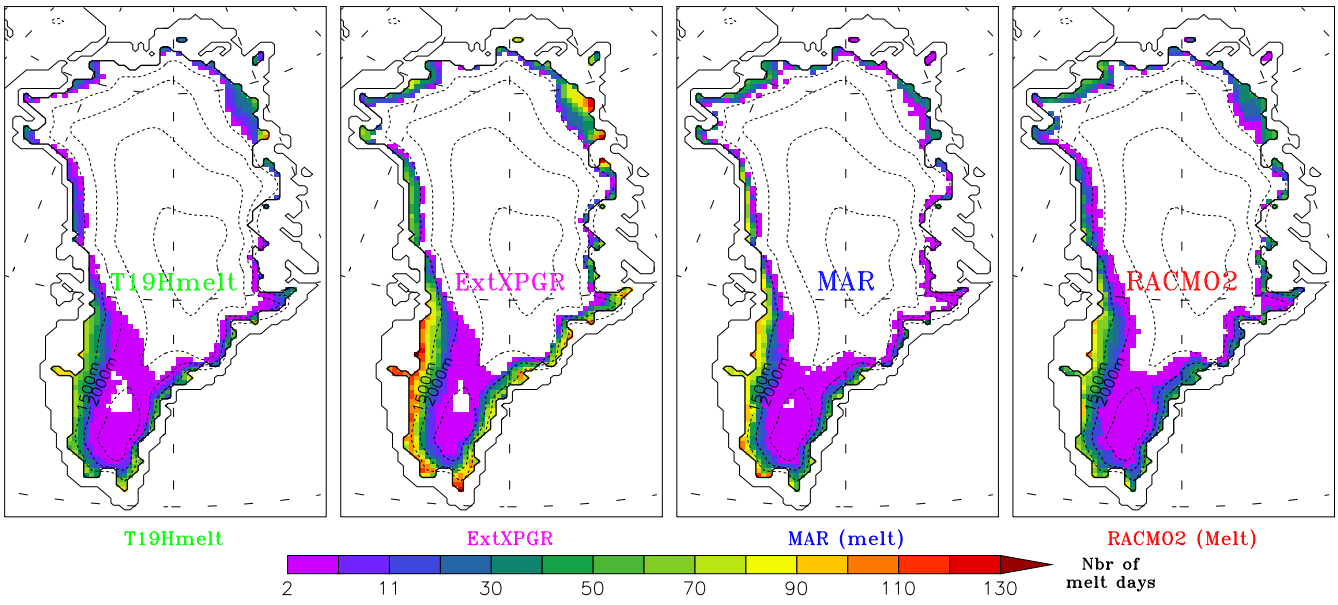

MAR
MAR
RACMO2
RACMO2
MAR = SAT: 1.58%
MAR > SAT: 1.48%
MAR < SAT: 1.07%
MAR = SAT: 4.26%
MAR > SAT: 2.42%
MAR < SAT: 2.65%
RACMO2 = SAT: 1.63%
RACMO2 > SAT: 1.46%
RACMO2 < SAT: 1.02%
RACMO2 = SAT: 4.04%
RACMO2 > SAT: 1.88%
RACMO2 < SAT: 2.87%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

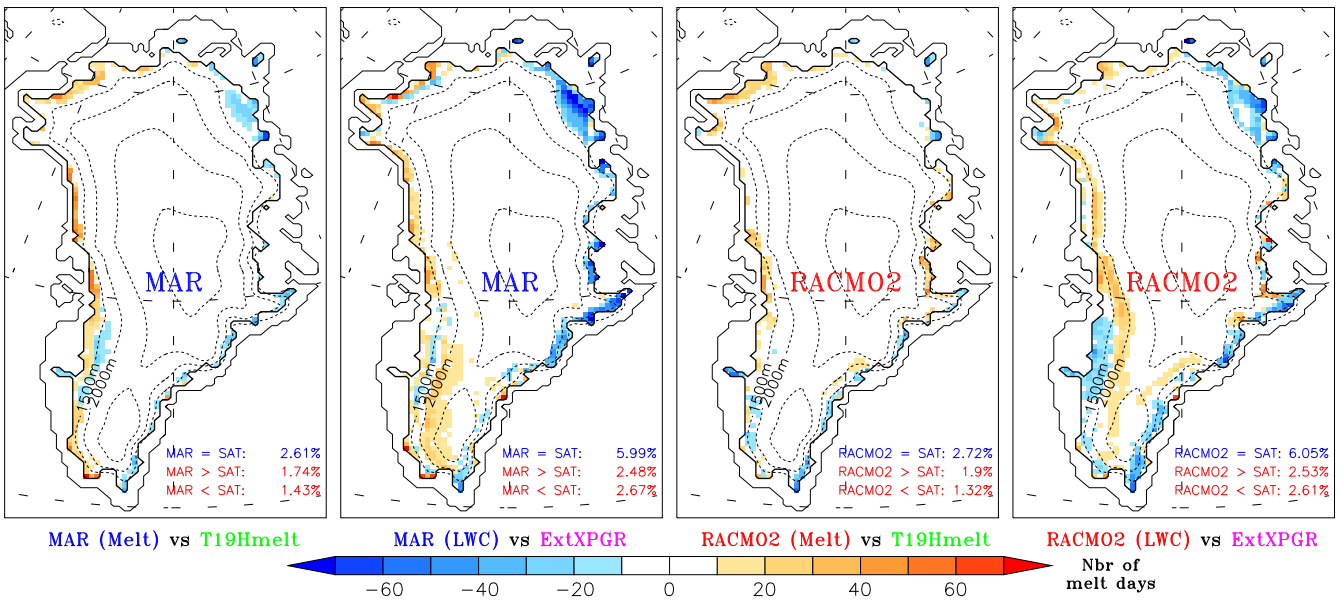

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.82
rmse: 2.54
Corr: 0.9
rmse: 1.79
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.95
rmse: 1.8
Corr: 0.93
rmse: 2.3
1980
MAY
JUN
JUL
AUG
SEP

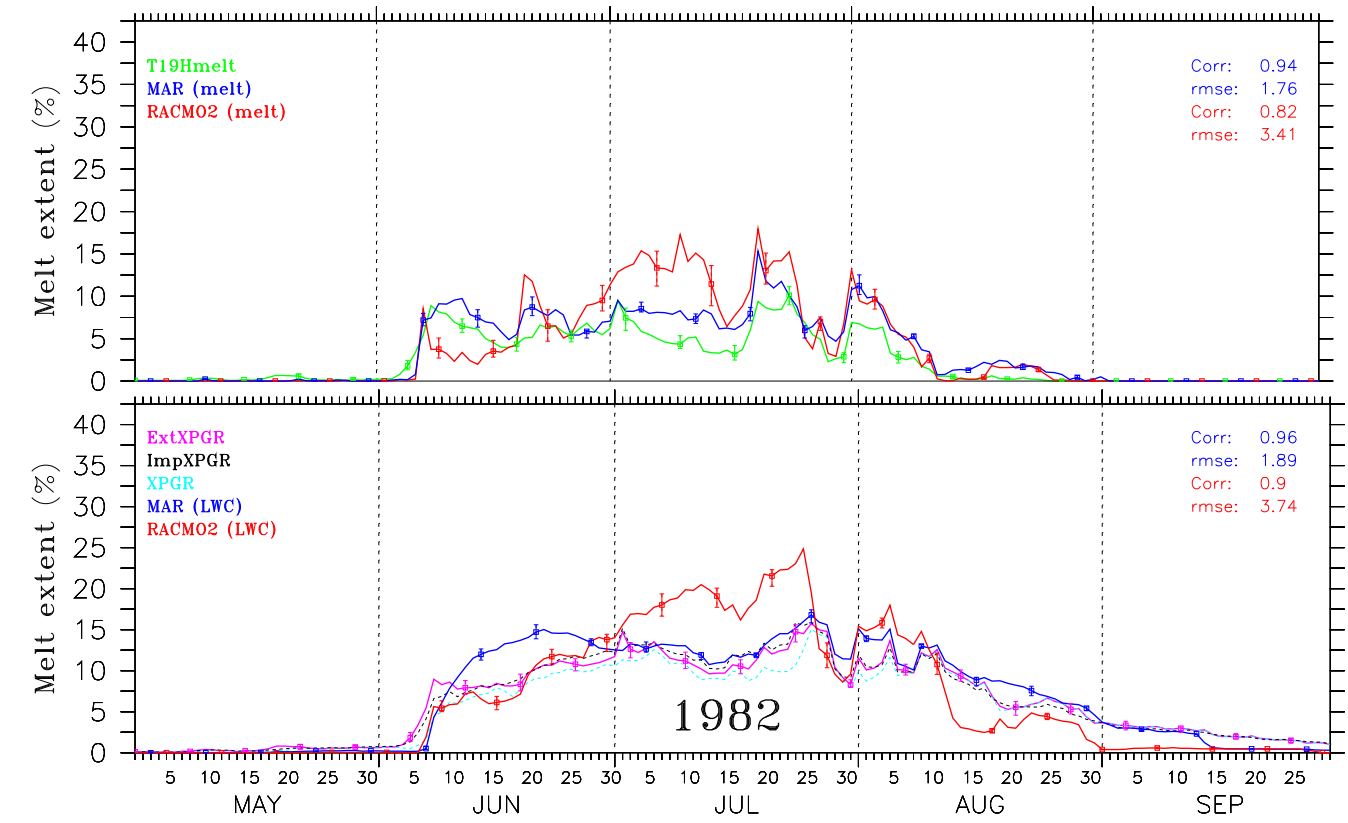

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

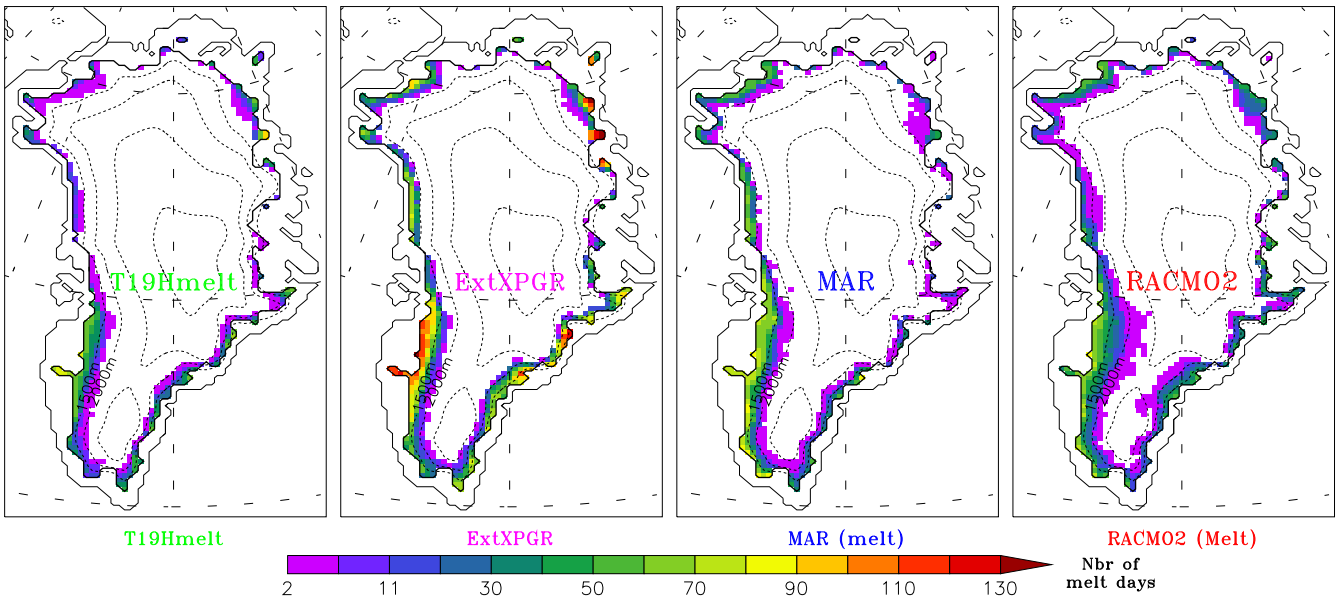

MAR
RACMO2
1500m
2000m
MAR = SAT: 1.9%
MAR > SAT: 2.37%
MAR < SAT: 1.3%
MAR = SAT: 5.17%
MAR > SAT: 2.75%
MAR < SAT: 3.12%
RACMO2 = SAT: 1.74%
RACMO2 > SAT: 2.03%
RACMO2 < SAT: 1.47%
RACMO2 = SAT: 4.85%
RACMO2 > SAT: 2.66%
RACMO2 < SAT: 3.45%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days


T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.93
rmse: 1.75
Corr: 0.94
rmse: 2.11
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.97
rmse: 1.68
Corr: 0.95
rmse: 2.85
1981
MAY
JUN
JUL
AUG
SEP

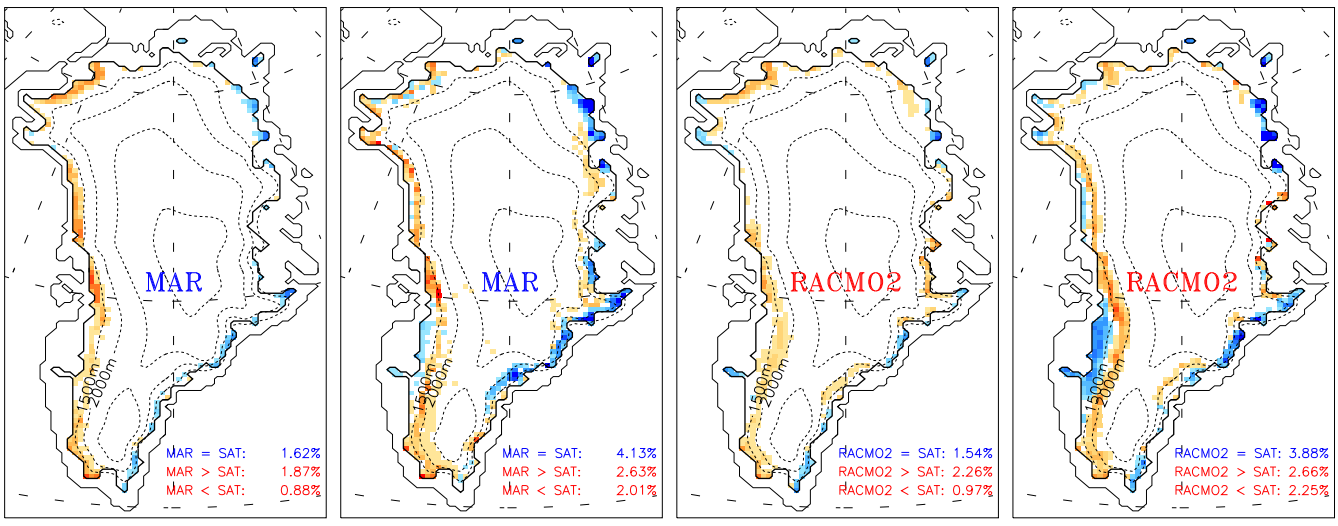

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days


MAR
RACMO2
1500m
2000m
MAR = SAT: 2.61%
MAR > SAT: 1.74%
MAR < SAT: 1.43%
MAR = SAT: 5.99%
MAR > SAT: 2.48%
MAR < SAT: 2.67%
RACMO2 = SAT: 2.72%
RACMO2 > SAT: 1.9%
RACMO2 < SAT: 1.32%
RACMO2 = SAT: 6.05%
RACMO2 > SAT: 2.53%
RACMO2 < SAT: 2.61%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

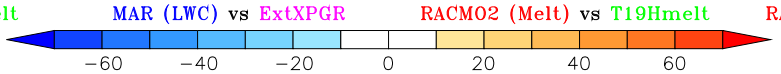


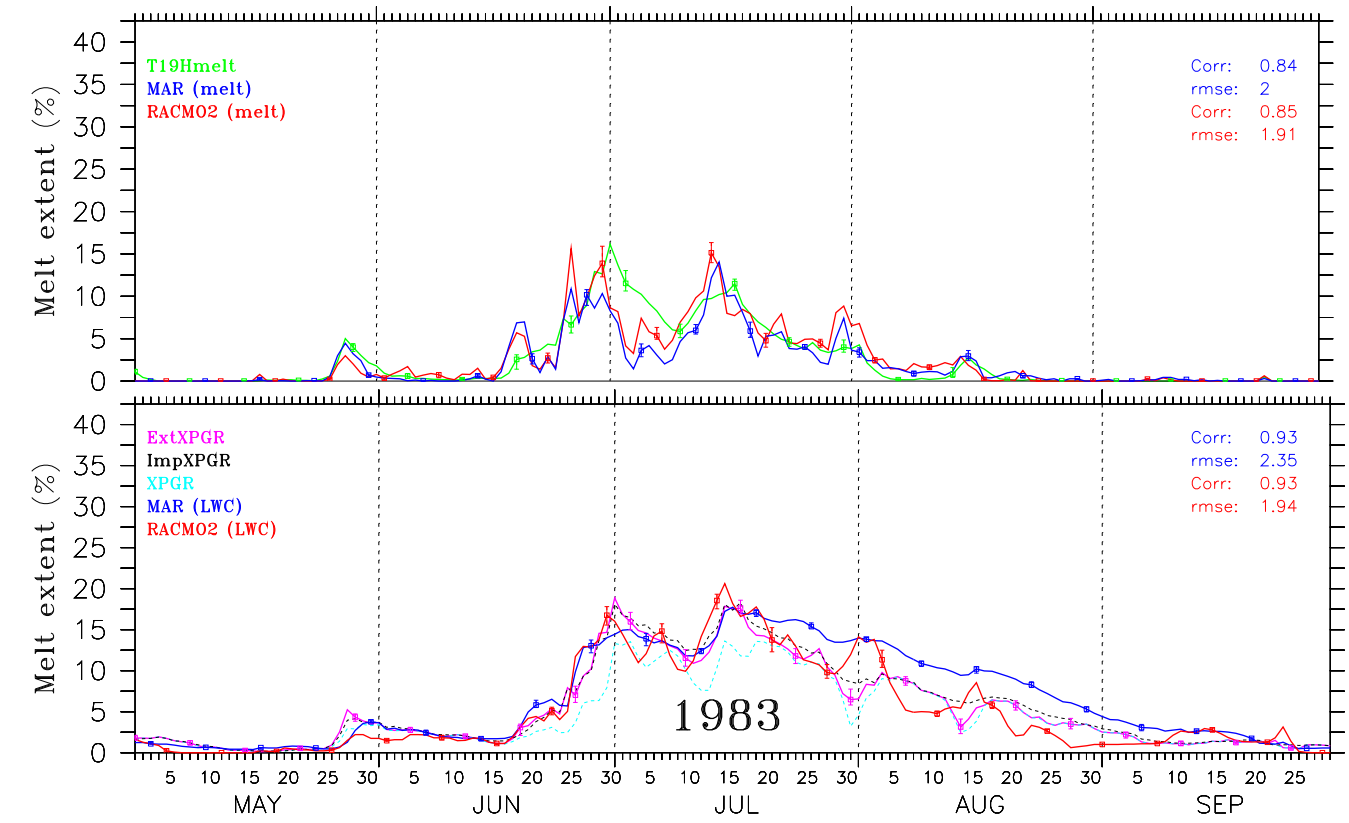


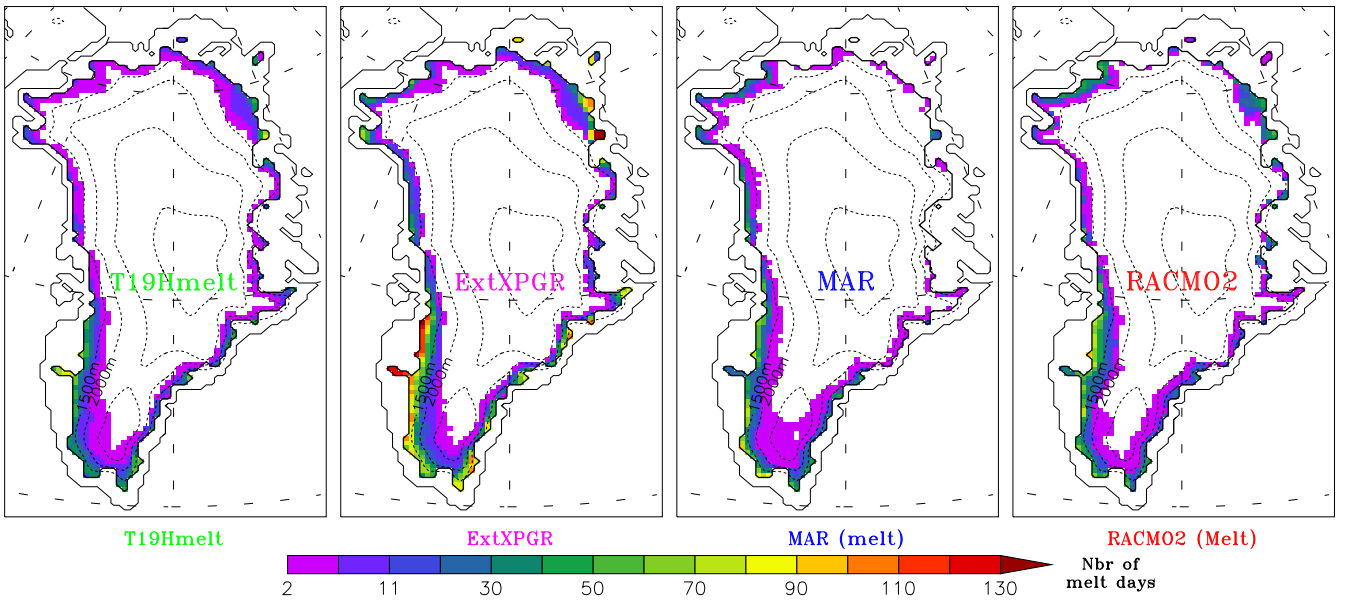
T19Hmelt ExtXPGR MAR (melt) RACMO2 (Melt)

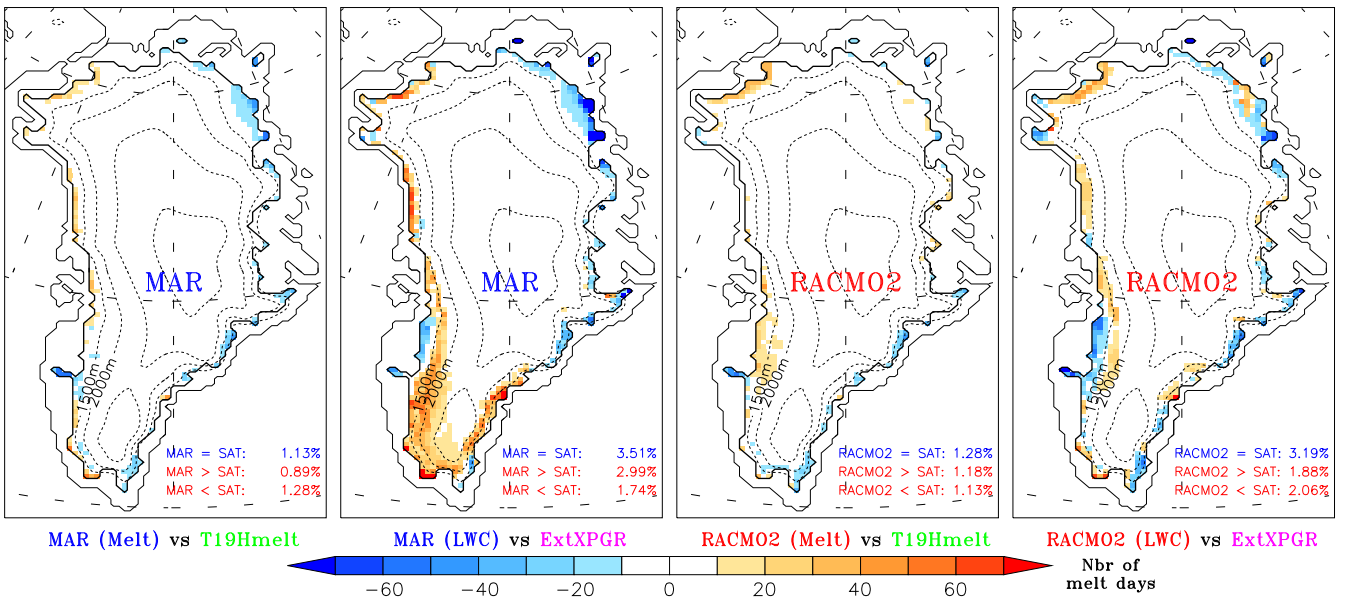


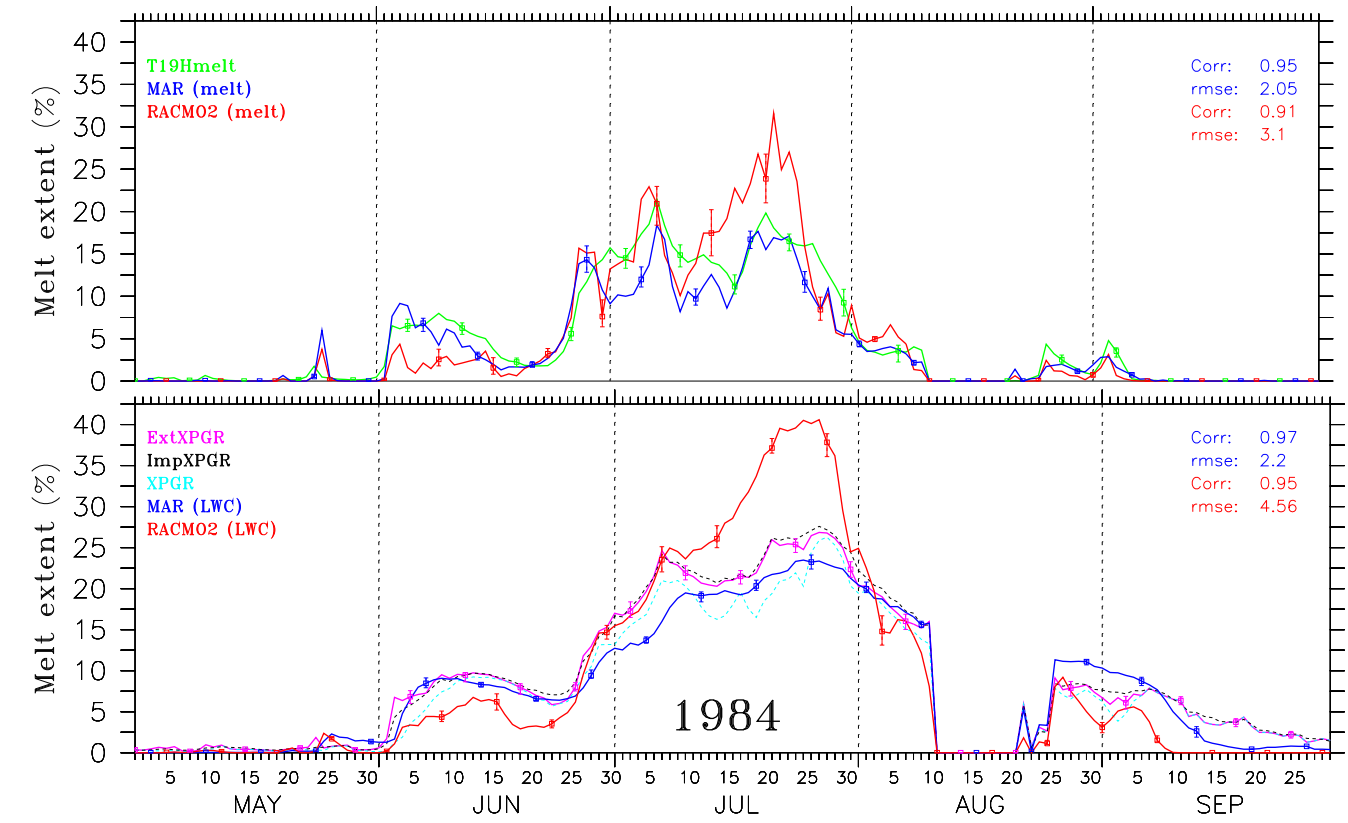
MAR (Melt) vs T19Hmelt MAR (LWC) vs ExtXPGR RACMO2 (Melt) vs T19Hmelt RACMO2 (LWC) vs ExtXPGR

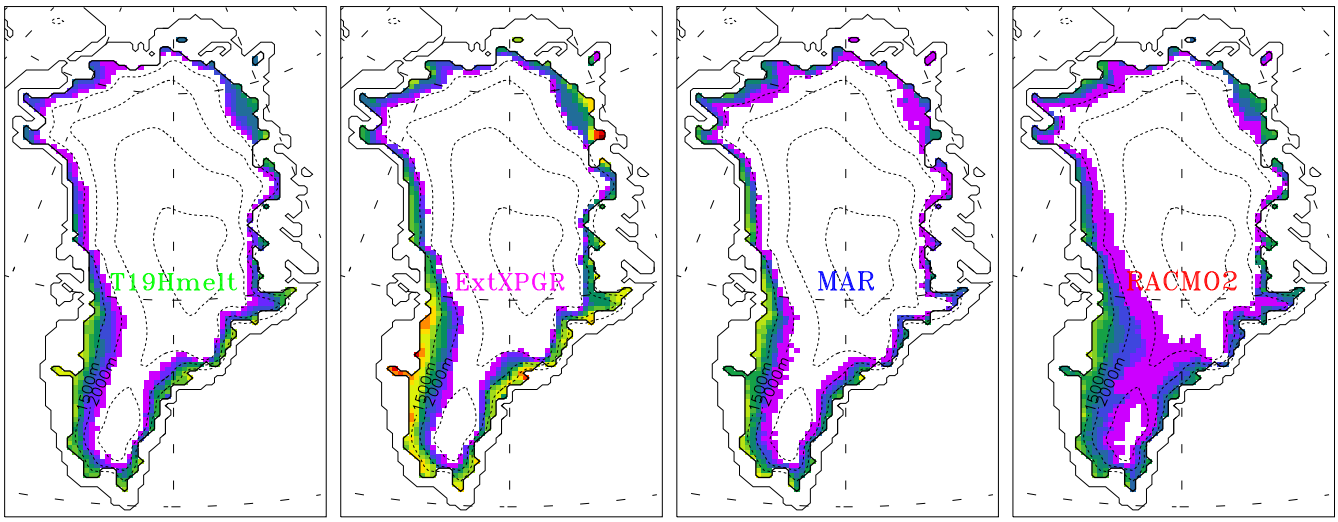


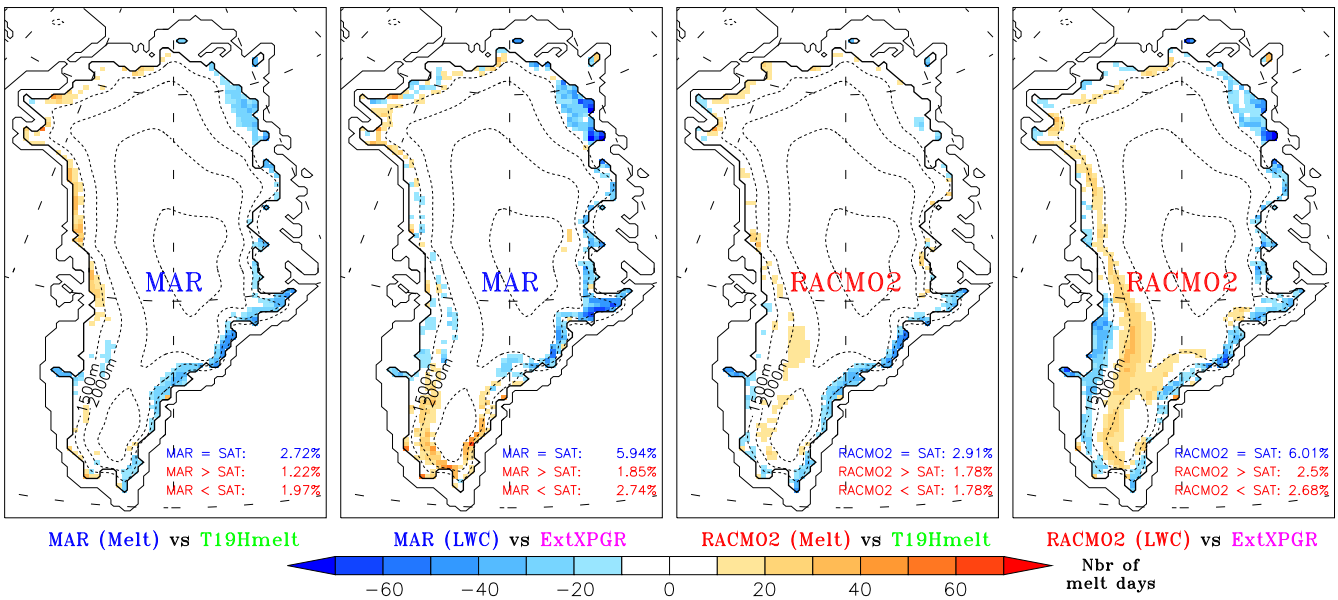

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.84
rmse: 2
Corr: 0.85
rmse: 1.91
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.93
rmse: 2.35
Corr: 0.93
rmse: 1.94
1983
MAY
JUN
JUL
AUG
SEP

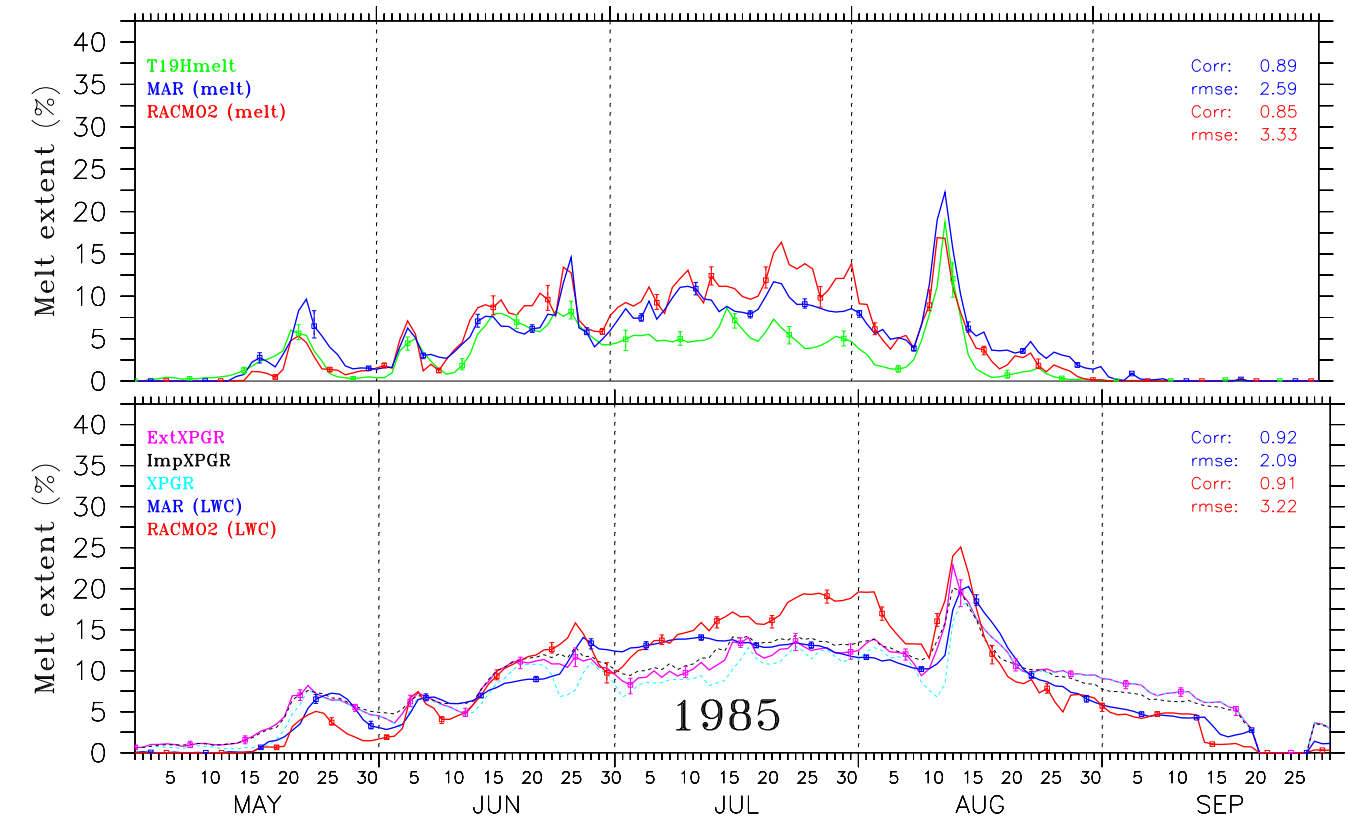

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
1000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

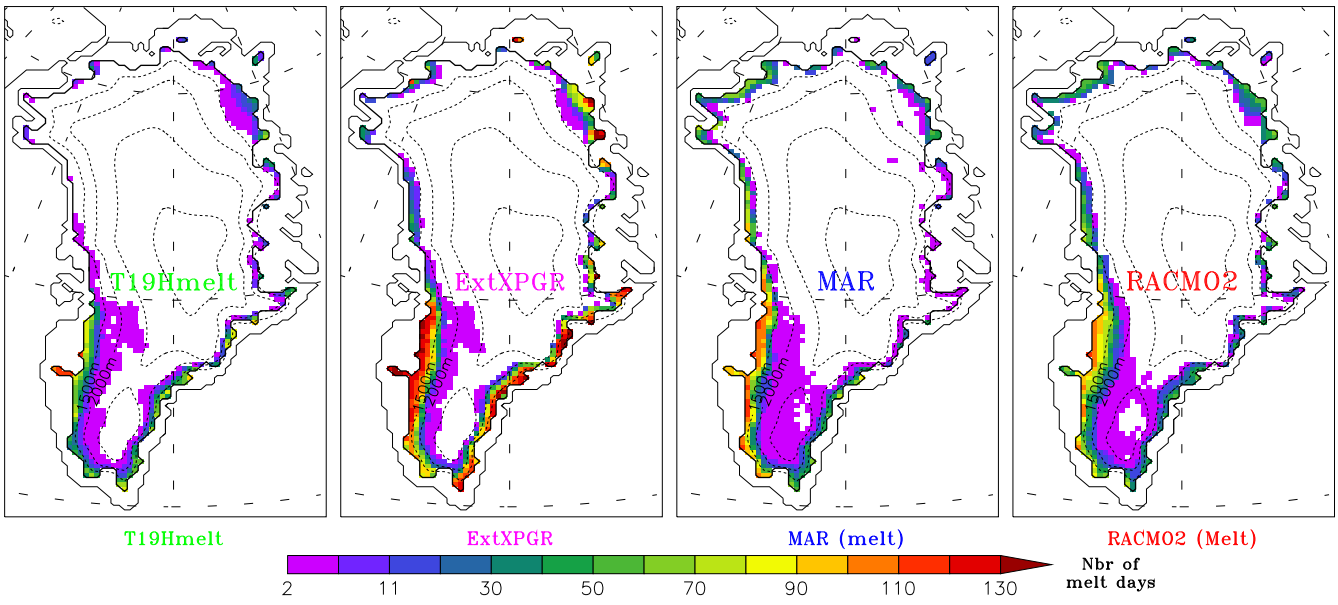

MAR
RACMO2
1500m
1000m
MAR = SAT: 1.13%
MAR > SAT: 0.89%
MAR < SAT: 1.28%
MAR = SAT: 3.51%
MAR > SAT: 2.99%
MAR < SAT: 1.74%
RACMO2 = SAT: 1.28%
RACMO2 > SAT: 1.18%
RACMO2 < SAT: 1.13%
RACMO2 = SAT: 3.19%
RACMO2 > SAT: 1.88%
RACMO2 < SAT: 2.06%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

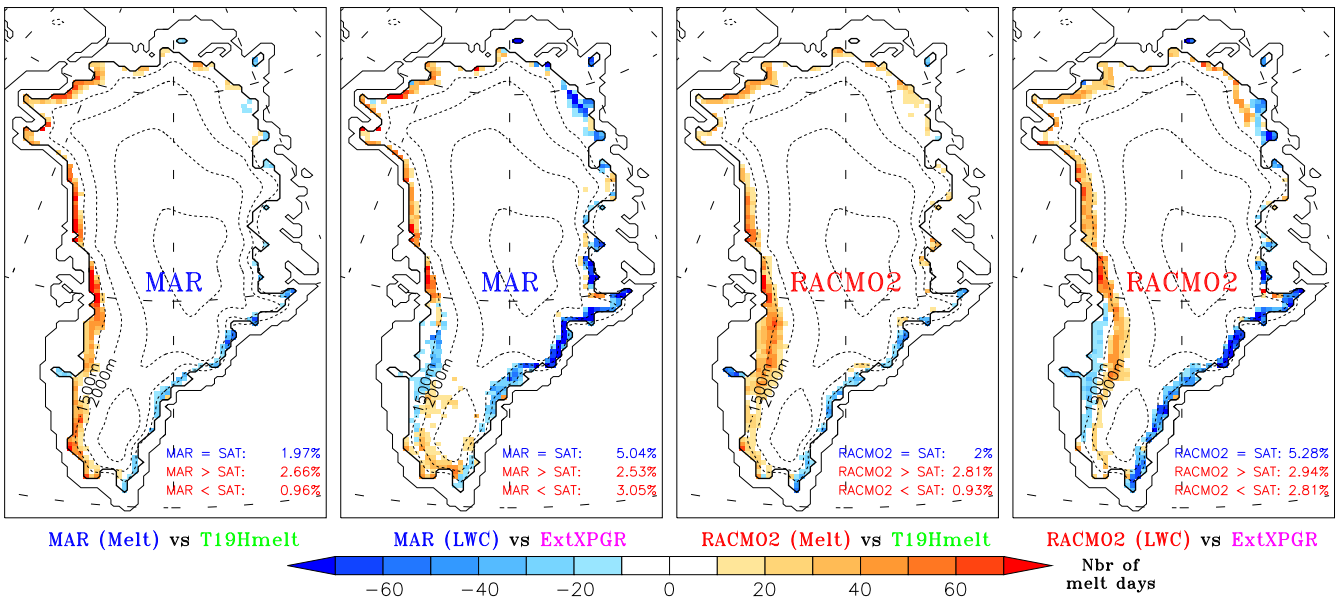

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.95
rmse: 2.05
Corr: 0.91
rmse: 3.1
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.97
rmse: 2.2
Corr: 0.95
rmse: 4.56
1984
MAY
JUN
JUL
AUG
SEP

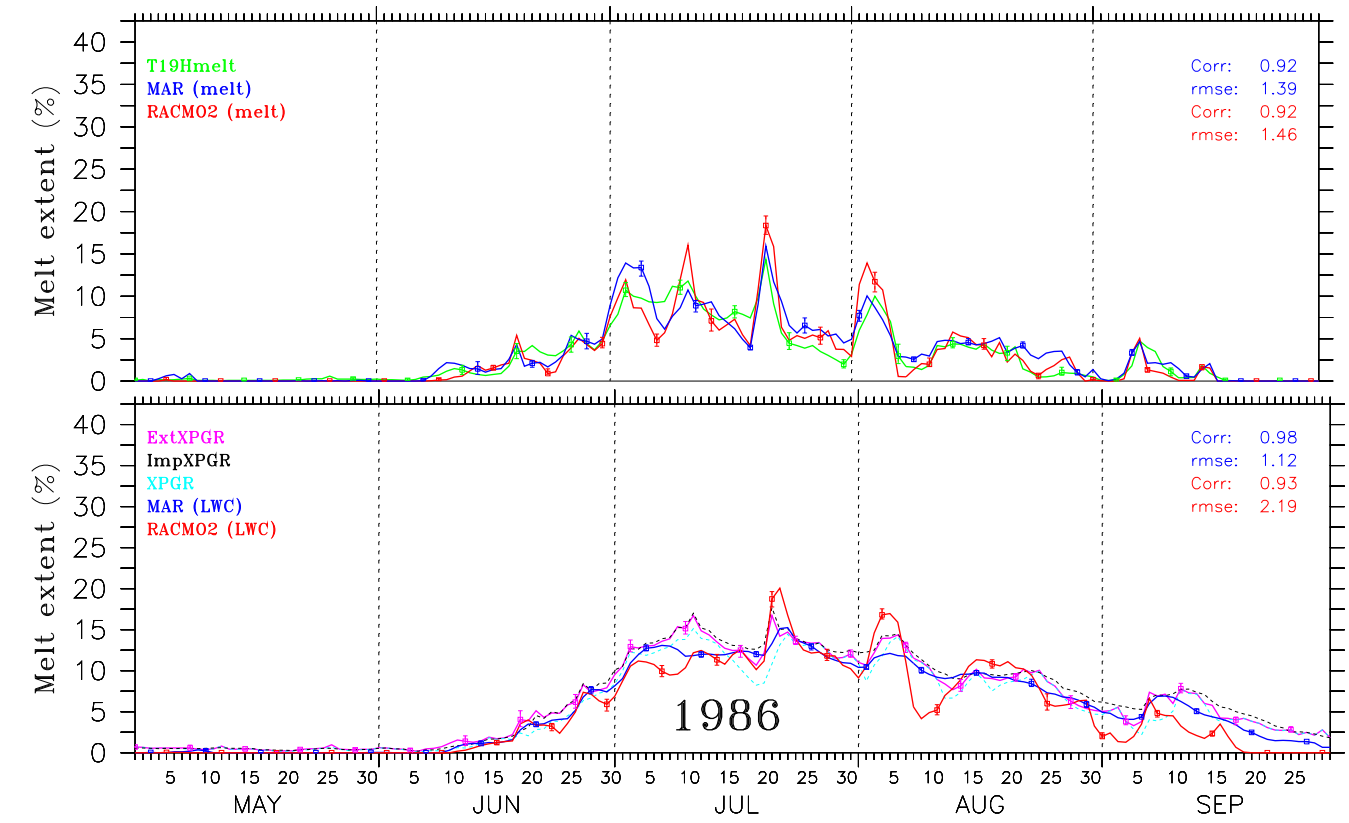

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

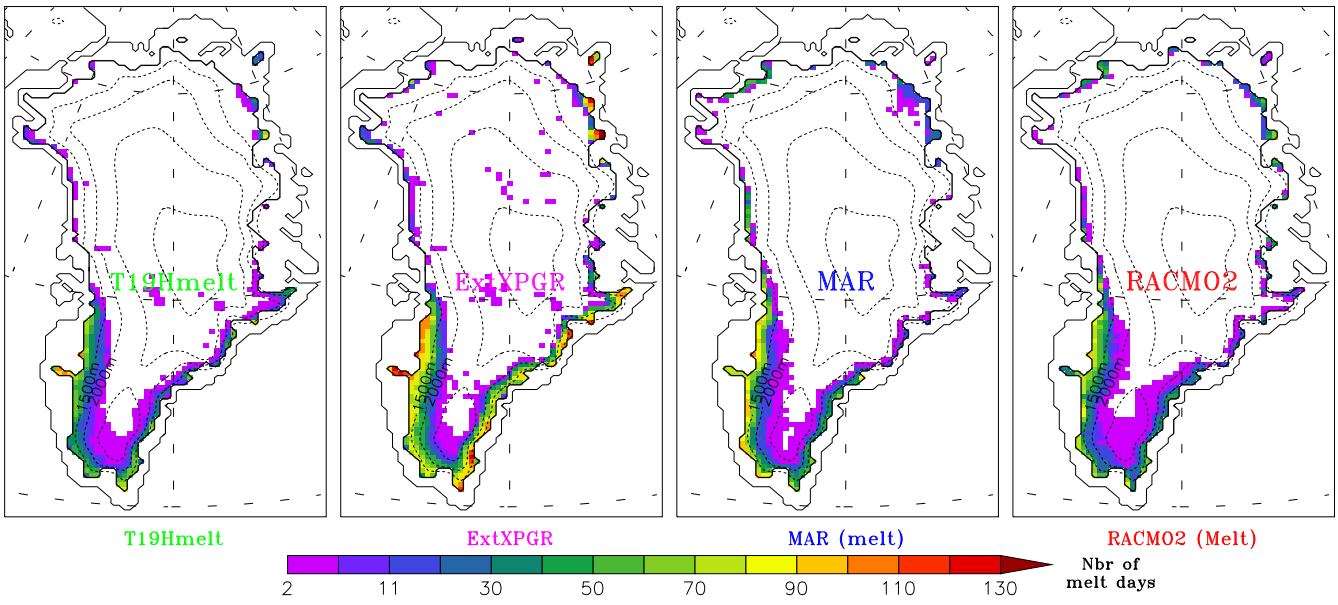

MAR
RACMO2
MAR = SAT: 2.72%
MAR > SAT: 1.22%
MAR < SAT: 1.97%
MAR = SAT: 5.94%
MAR > SAT: 1.85%
MAR < SAT: 2.74%
RACMO2 = SAT: 2.91%
RACMO2 > SAT: 1.78%
RACMO2 < SAT: 1.78%
RACMO2 = SAT: 6.01%
RACMO2 > SAT: 2.5%
RACMO2 < SAT: 2.68%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

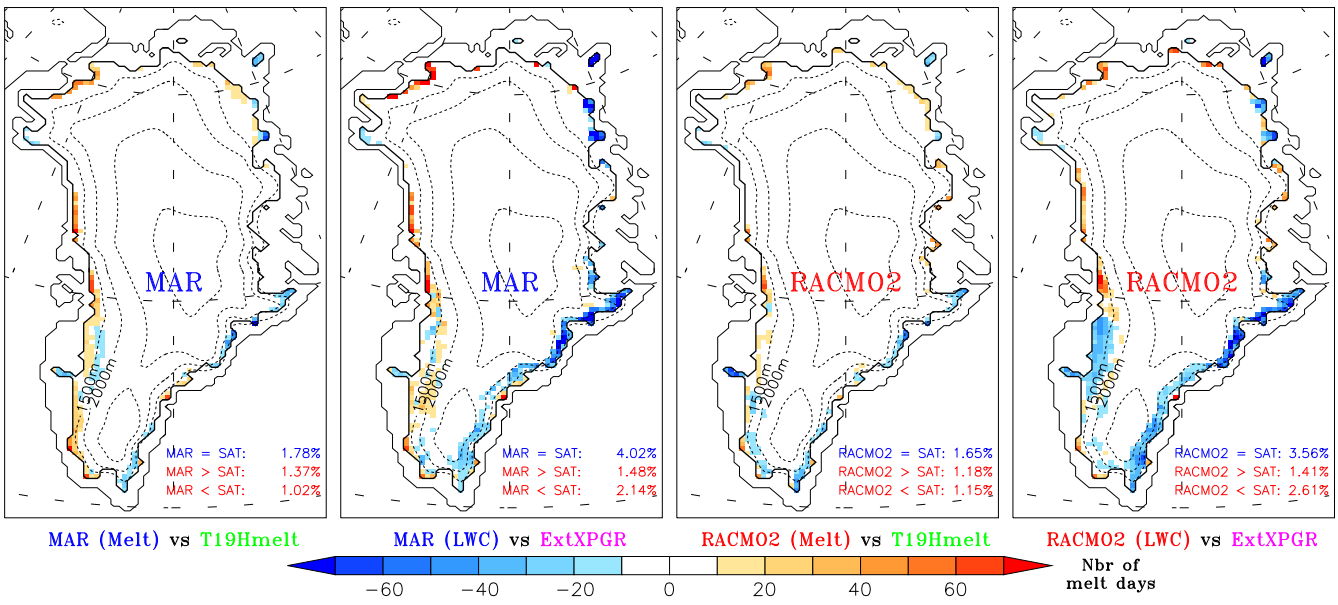

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.89
rmse: 2.59
Corr: 0.85
rmse: 3.33
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.92
rmse: 2.09
Corr: 0.91
rmse: 3.22
1985
MAY
JUN
JUL
AUG
SEP

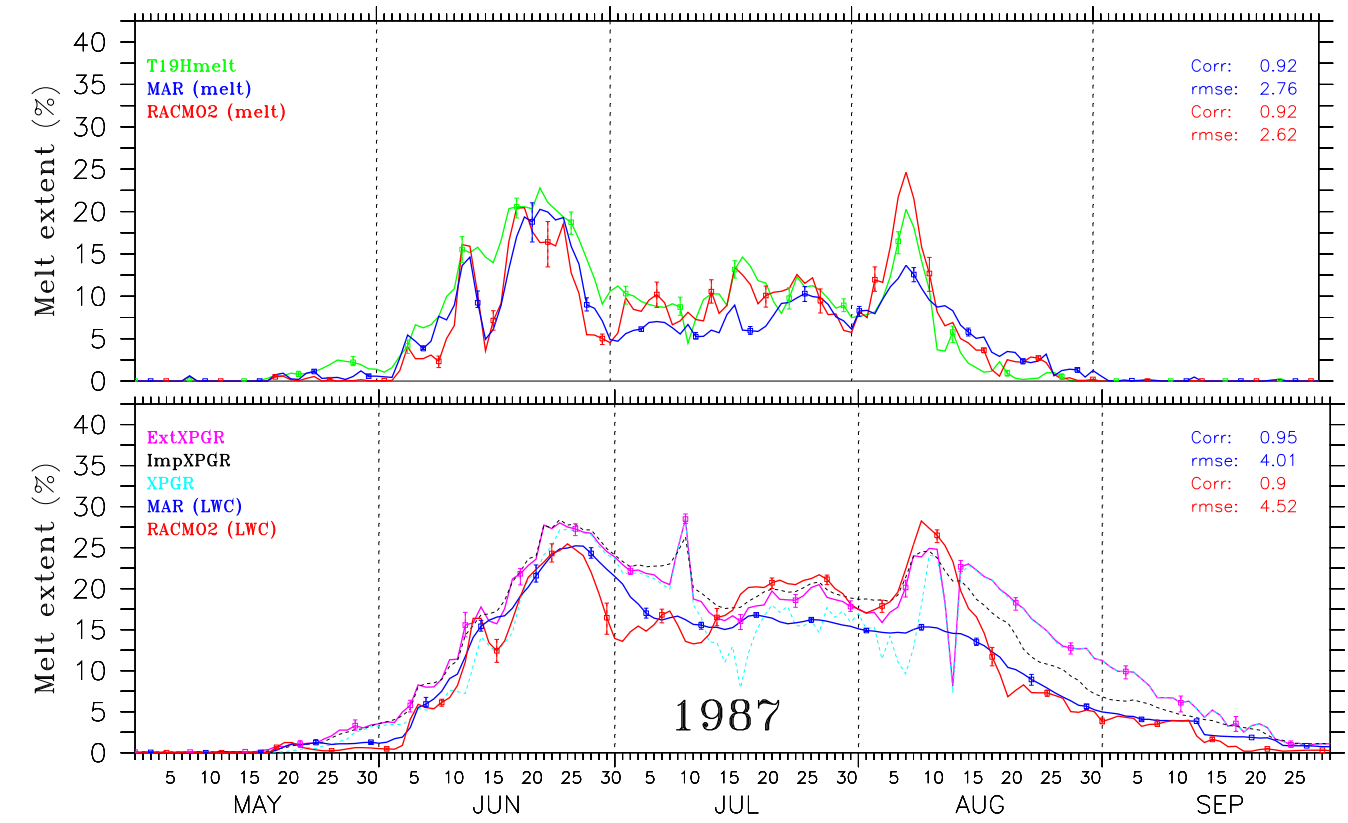

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

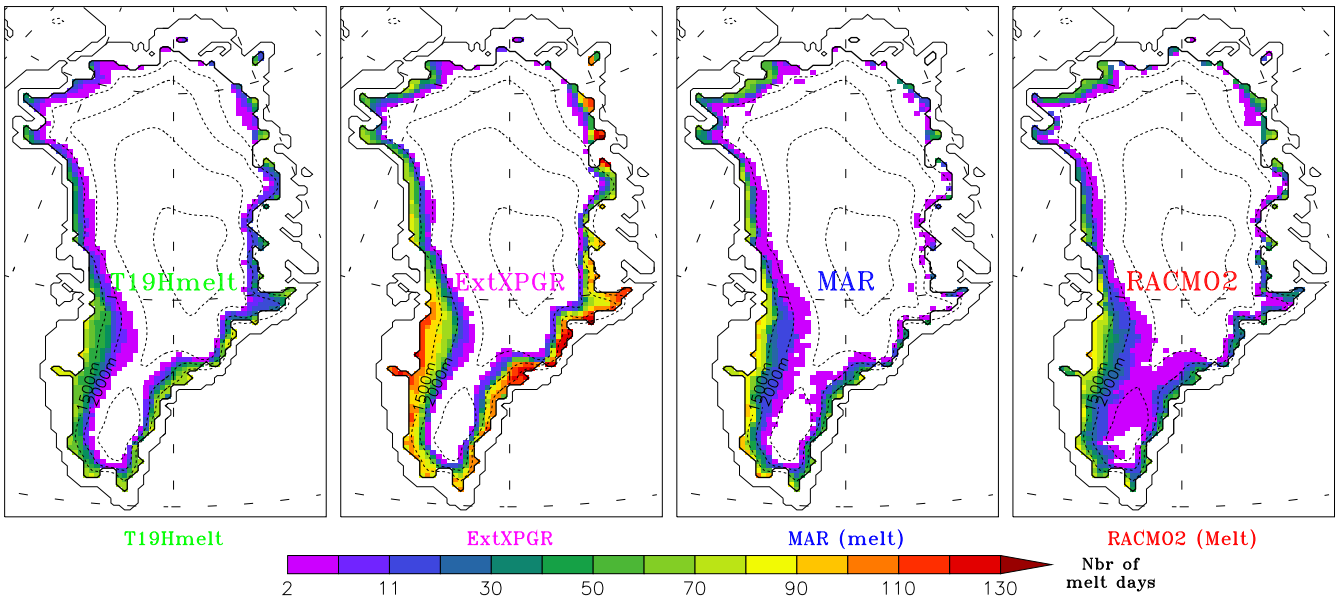

MAR
RACMO2
1500m
2000m
MAR = SAT: 1.97%
MAR > SAT: 2.66%
MAR < SAT: 0.96%
MAR = SAT: 5.04%
MAR > SAT: 2.53%
MAR < SAT: 3.05%
RACMO2 = SAT: 2%
RACMO2 > SAT: 2.81%
RACMO2 < SAT: 0.93%
RACMO2 = SAT: 5.28%
RACMO2 > SAT: 2.94%
RACMO2 < SAT: 2.81%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

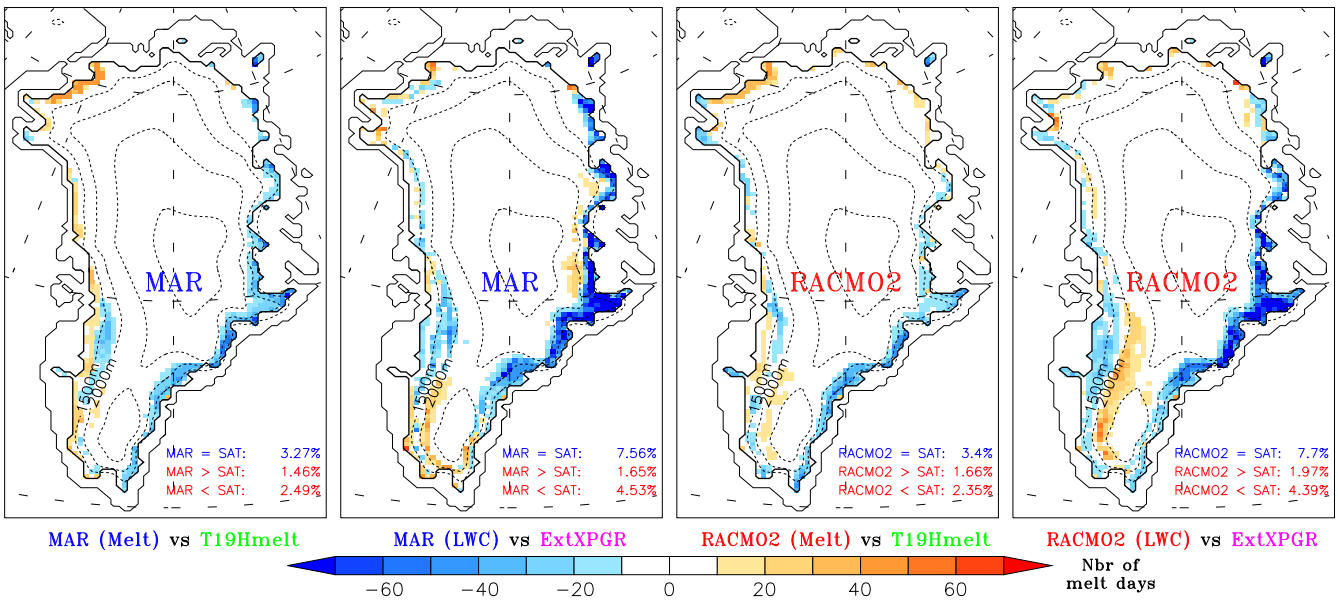

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.92
rmse: 1.39
Corr: 0.92
rmse: 1.46
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.98
rmse: 1.12
Corr: 0.93
rmse: 2.19
1986
MAY
JUN
JUL
AUG
SEP

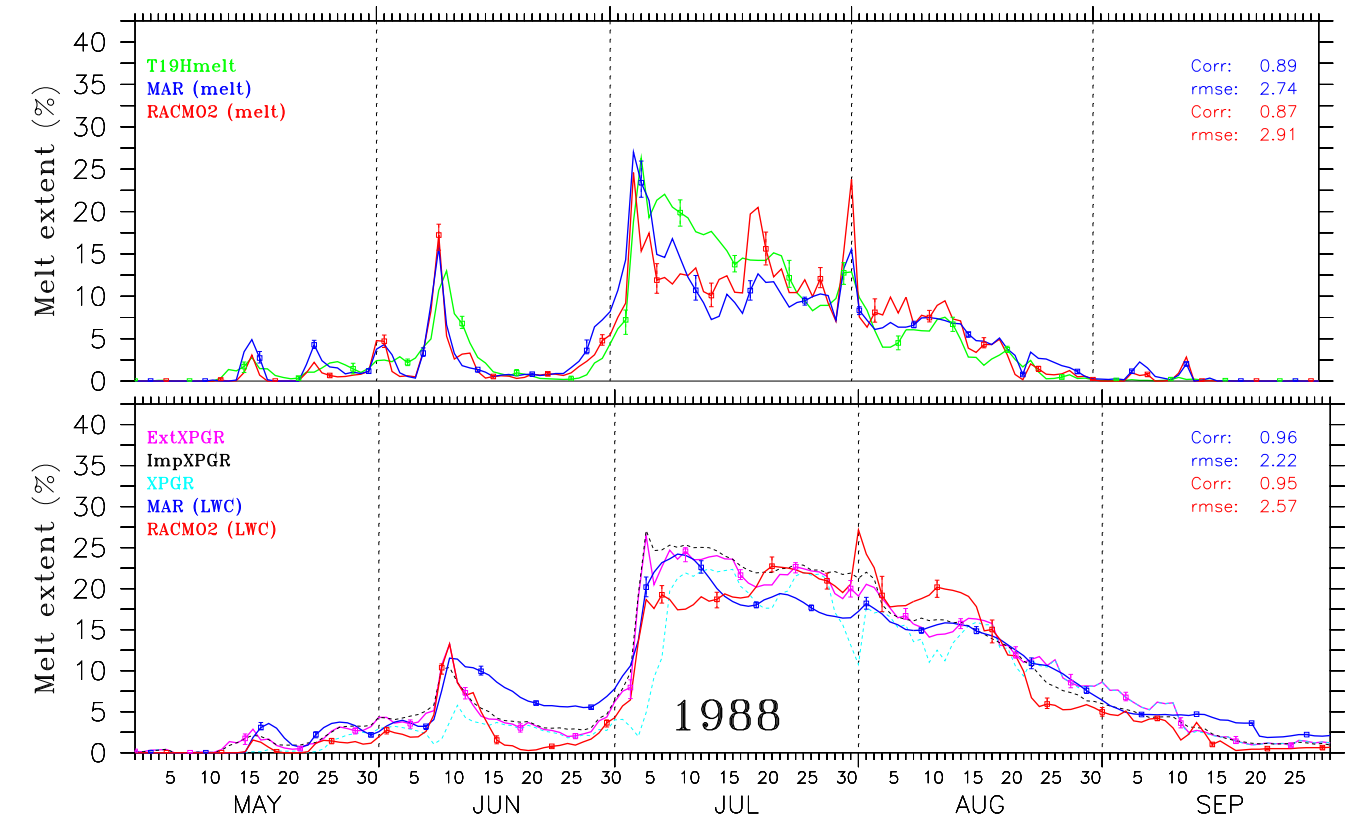

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

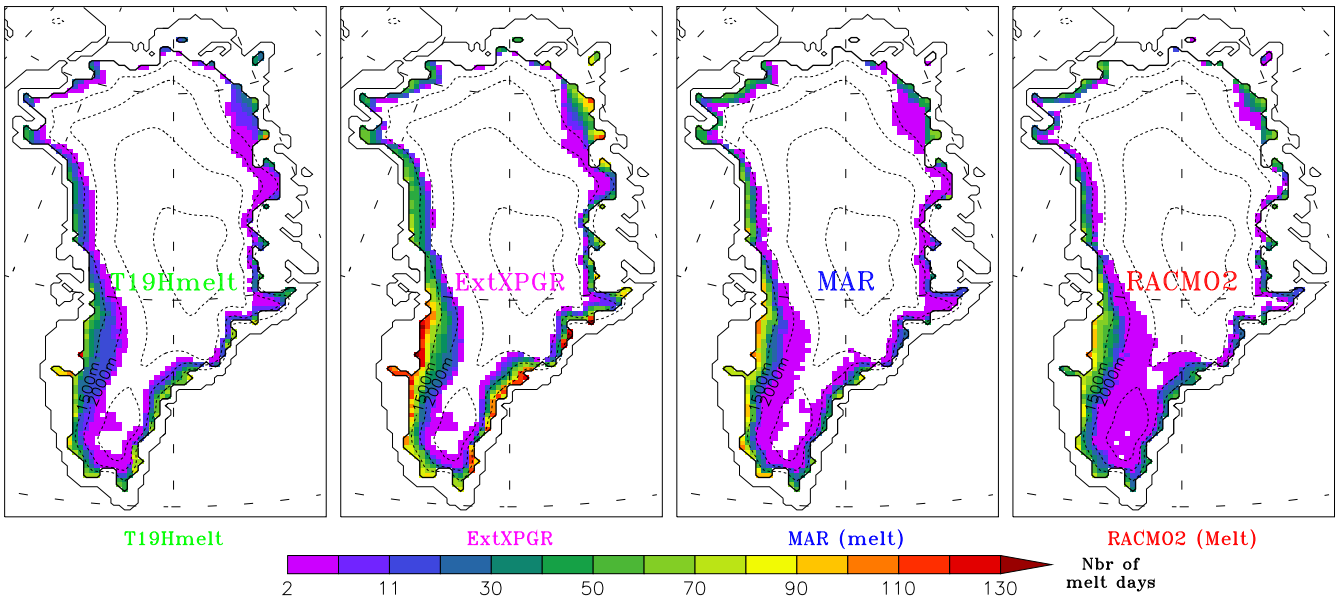

MAR
RACMO2
MAR = SAT: 1.78%
MAR > SAT: 1.37%
MAR < SAT: 1.02%
MAR = SAT: 4.02%
MAR > SAT: 1.48%
MAR < SAT: 2.14%
RACMO2 = SAT: 1.65%
RACMO2 > SAT: 1.18%
RACMO2 < SAT: 1.15%
RACMO2 = SAT: 3.56%
RACMO2 > SAT: 1.41%
RACMO2 < SAT: 2.61%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

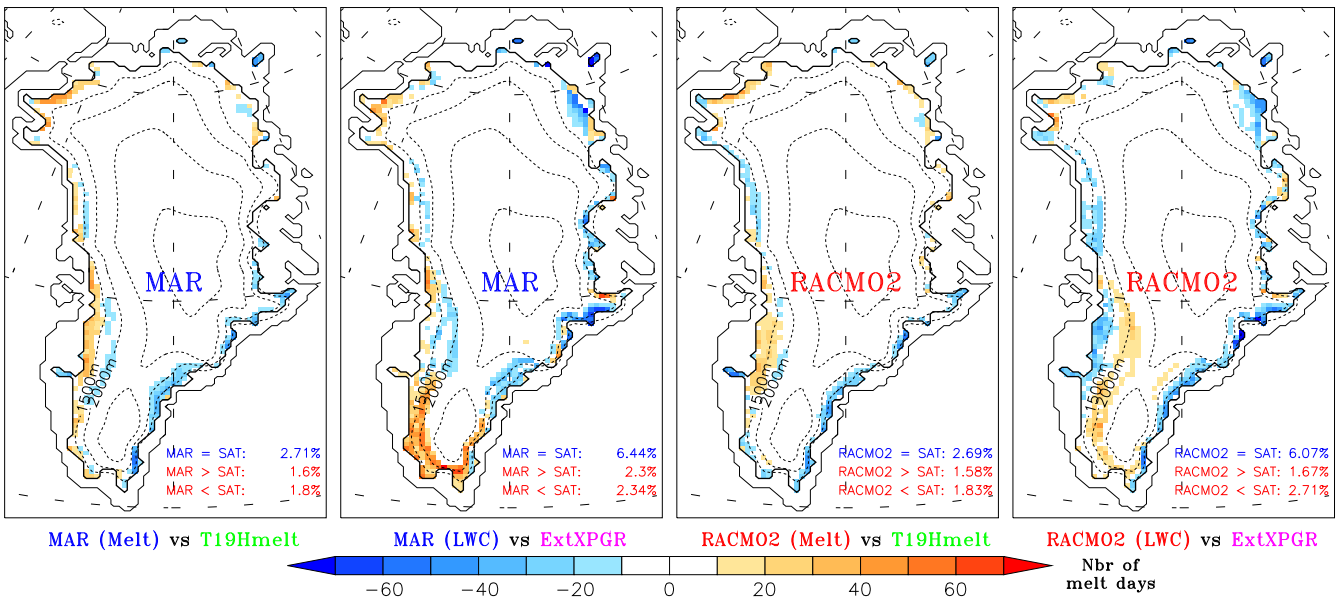

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.92
rmse: 2.76
Corr: 0.92
rmse: 2.62
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.95
rmse: 4.01
Corr: 0.9
rmse: 4.52
1987
MAY
JUN
JUL
AUG
SEP

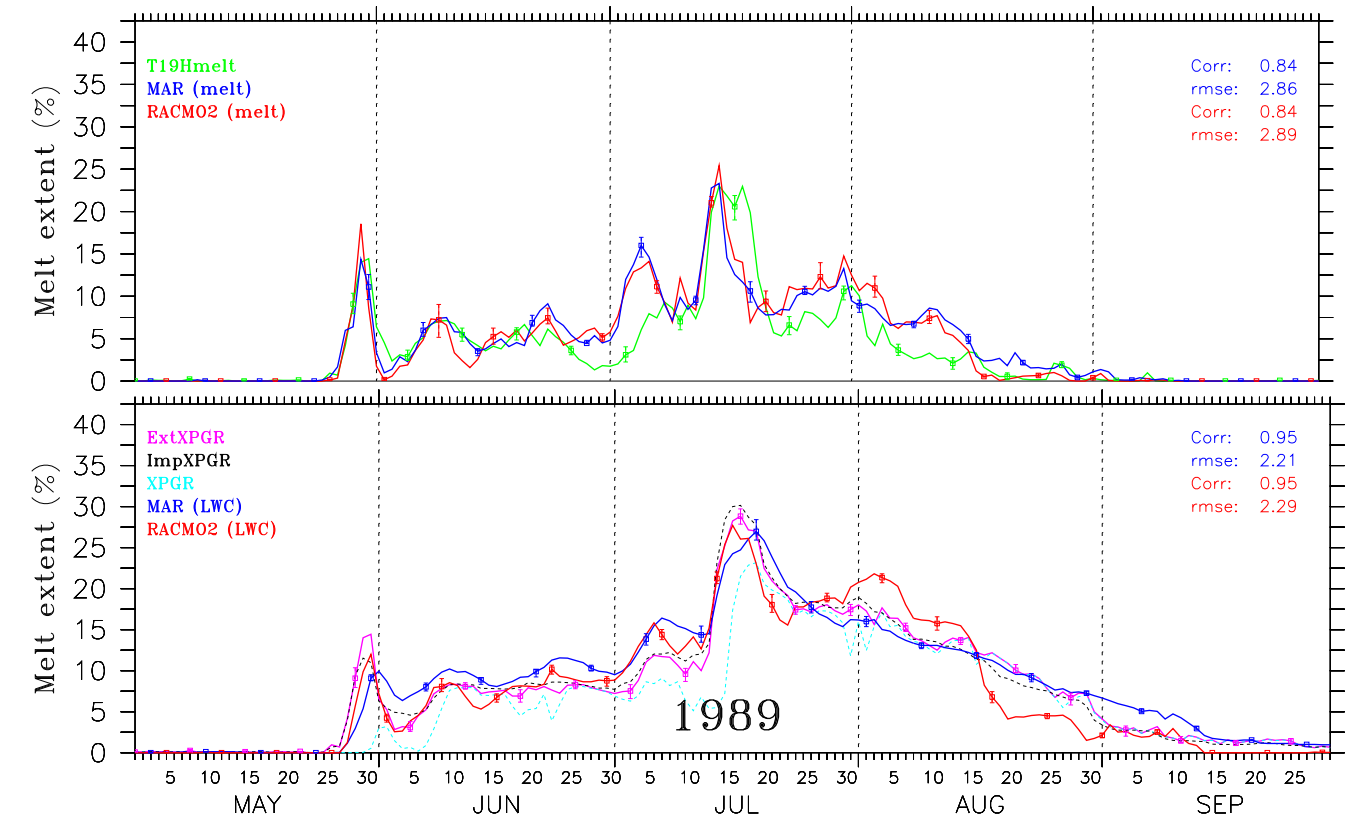

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

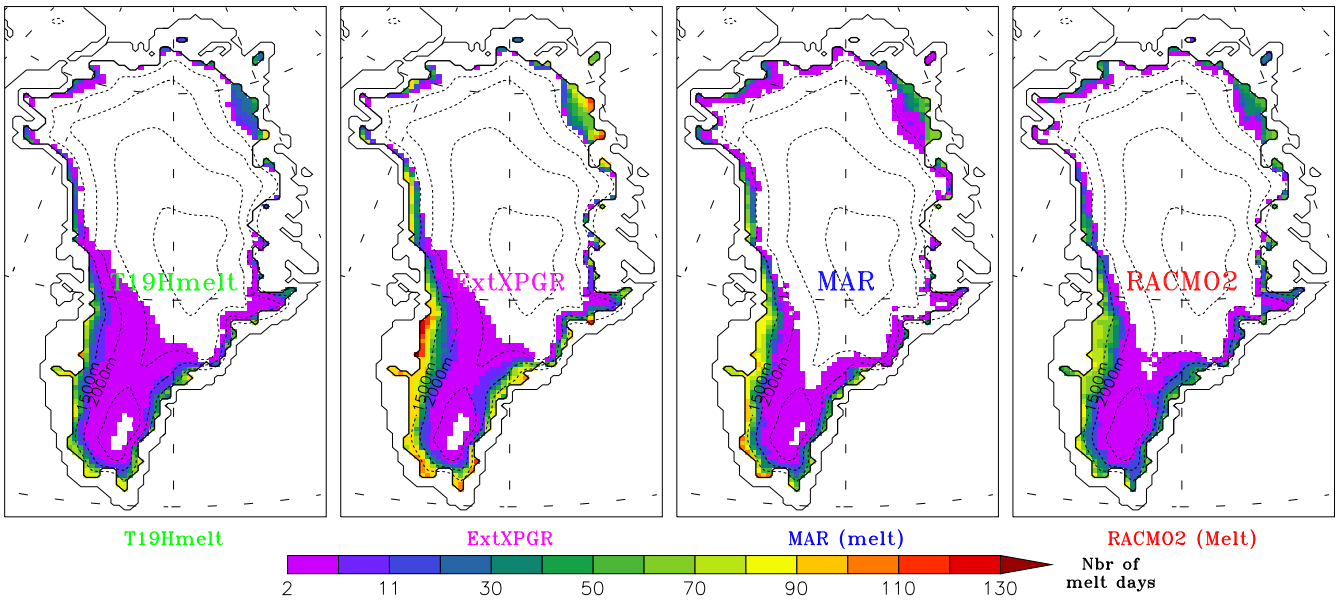

MAR
RACMO2
MAR = SAT: 3.27%
MAR > SAT: 1.46%
MAR < SAT: 2.49%
MAR = SAT: 7.56%
MAR > SAT: 1.65%
MAR < SAT: 4.53%
RACMO2 = SAT: 3.4%
RACMO2 > SAT: 1.66%
RACMO2 < SAT: 2.35%
RACMO2 = SAT: 7.7%
RACMO2 > SAT: 1.97%
RACMO2 < SAT: 4.39%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

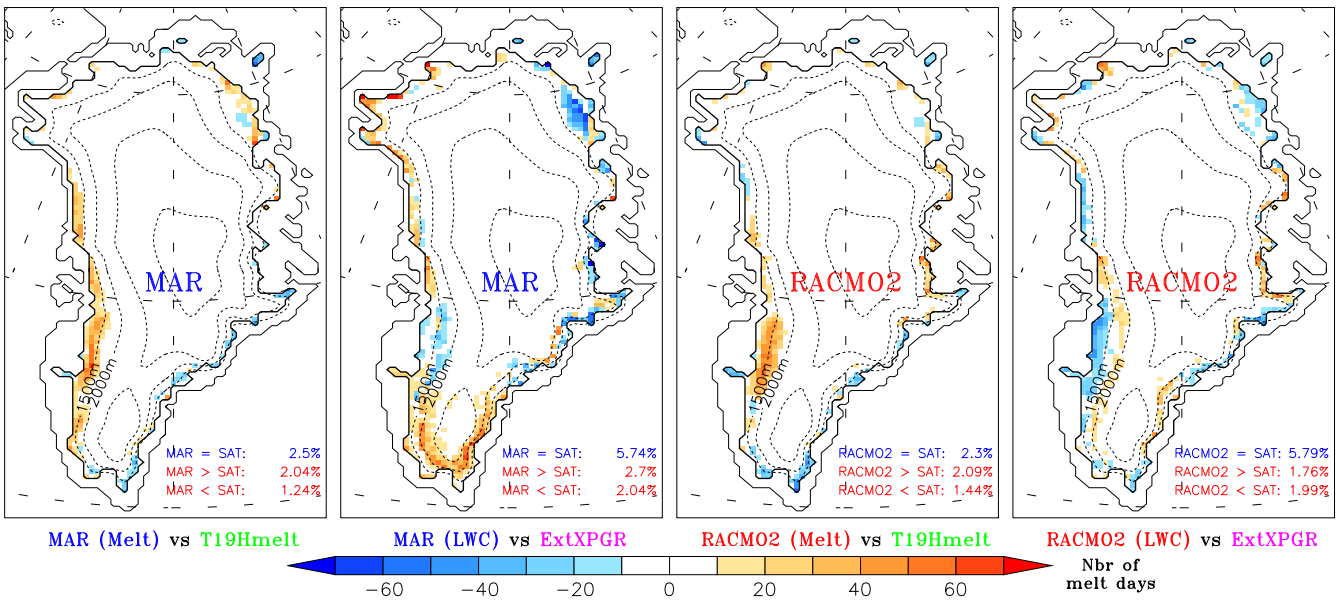

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.89
rmse: 2.74
Corr: 0.87
rmse: 2.91
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.96
rmse: 2.22
Corr: 0.95
rmse: 2.57
1988
MAY
JUN
JUL
AUG
SEP

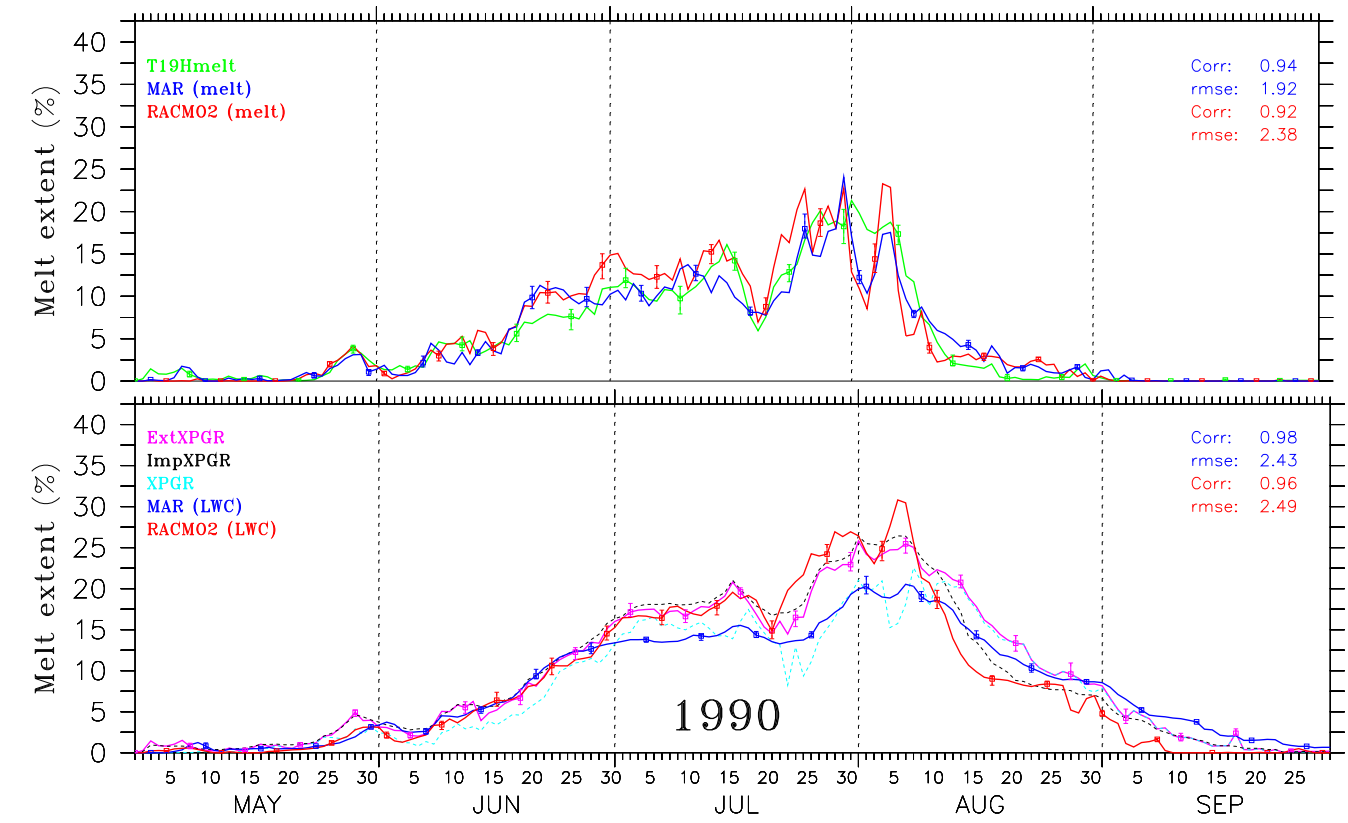

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

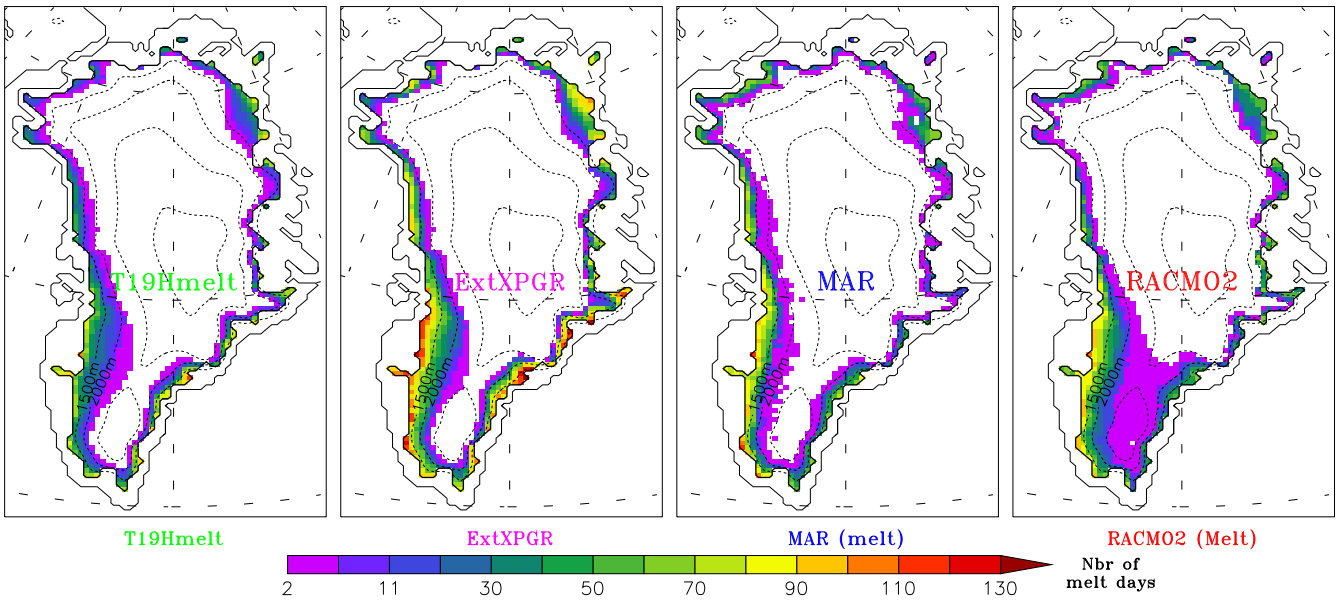

MAR
RACMO2
MAR = SAT: 2.71%
MAR > SAT: 1.6%
MAR < SAT: 1.8%
MAR = SAT: 6.44%
MAR > SAT: 2.3%
MAR < SAT: 2.34%
RACMO2 = SAT: 2.69%
RACMO2 > SAT: 1.58%
RACMO2 < SAT: 1.83%
RACMO2 = SAT: 6.07%
RACMO2 > SAT: 1.67%
RACMO2 < SAT: 2.71%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

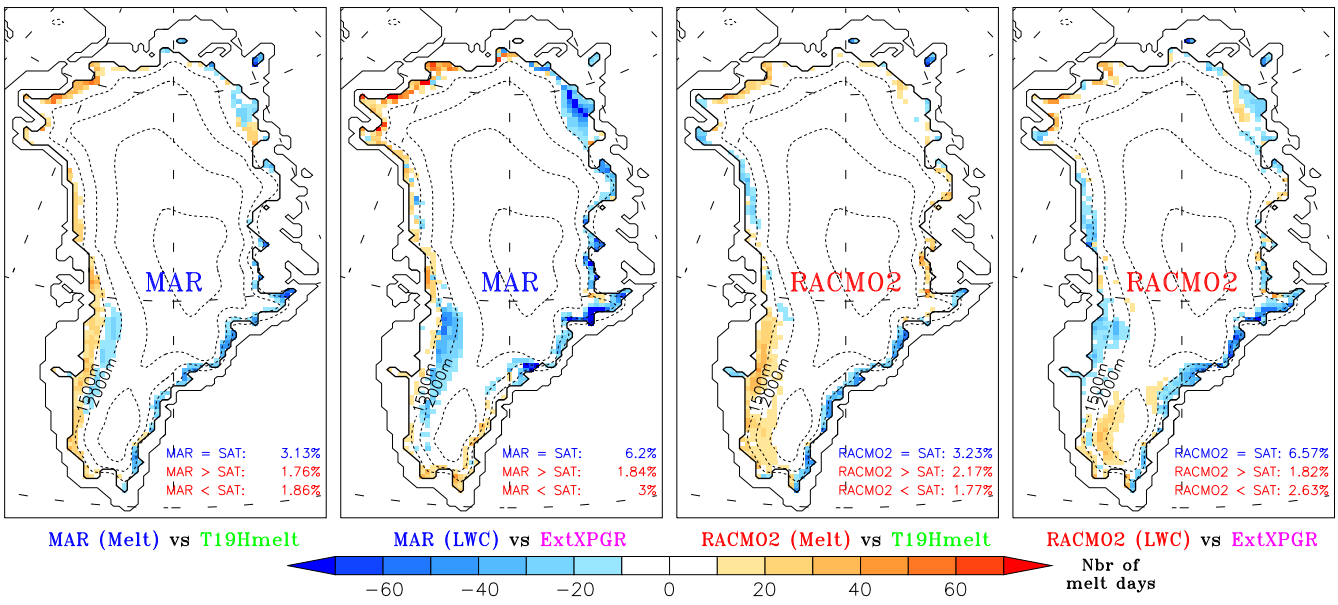

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.84
rmse: 2.86
Corr: 0.84
rmse: 2.89
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.95
rmse: 2.21
Corr: 0.95
rmse: 2.29
1989
MAY
JUN
JUL
AUG
SEP

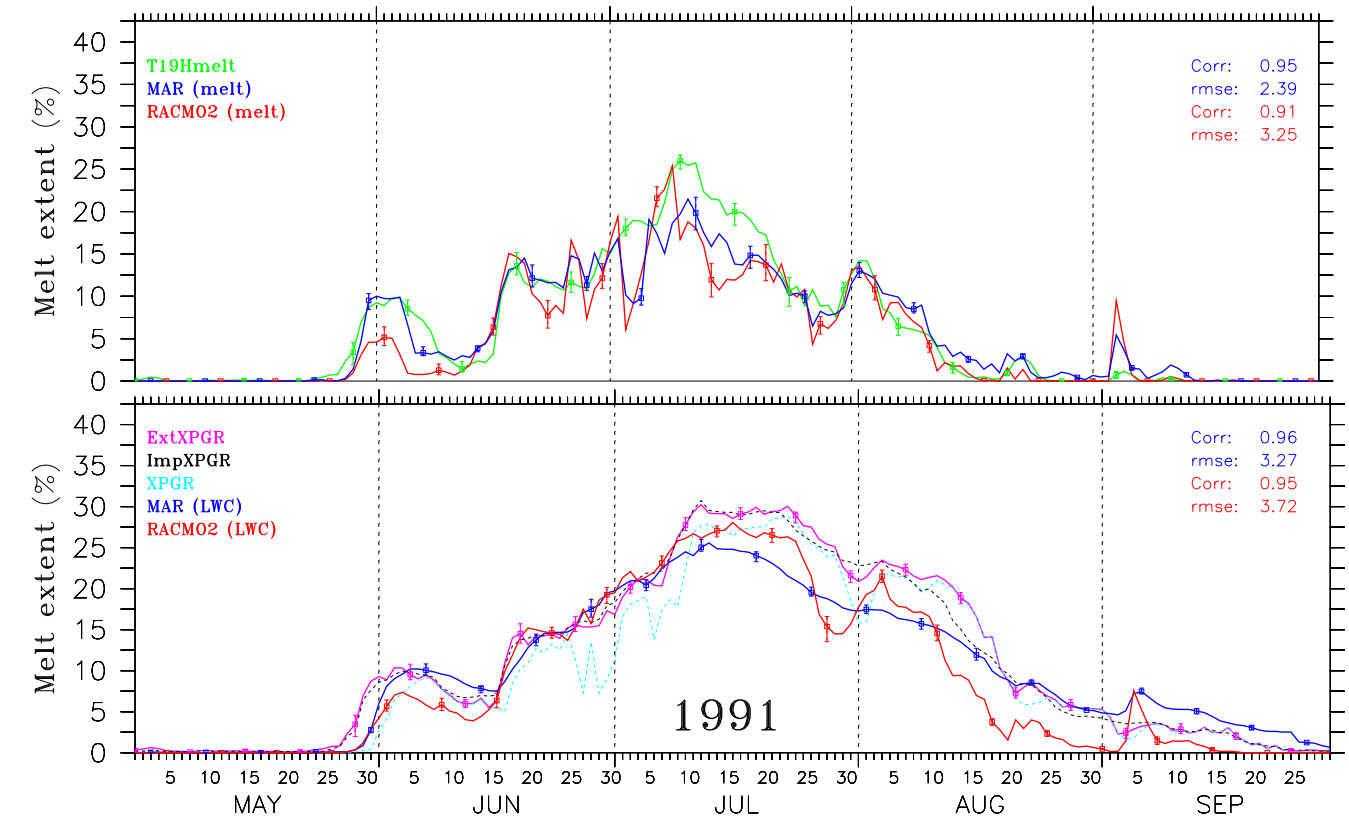

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

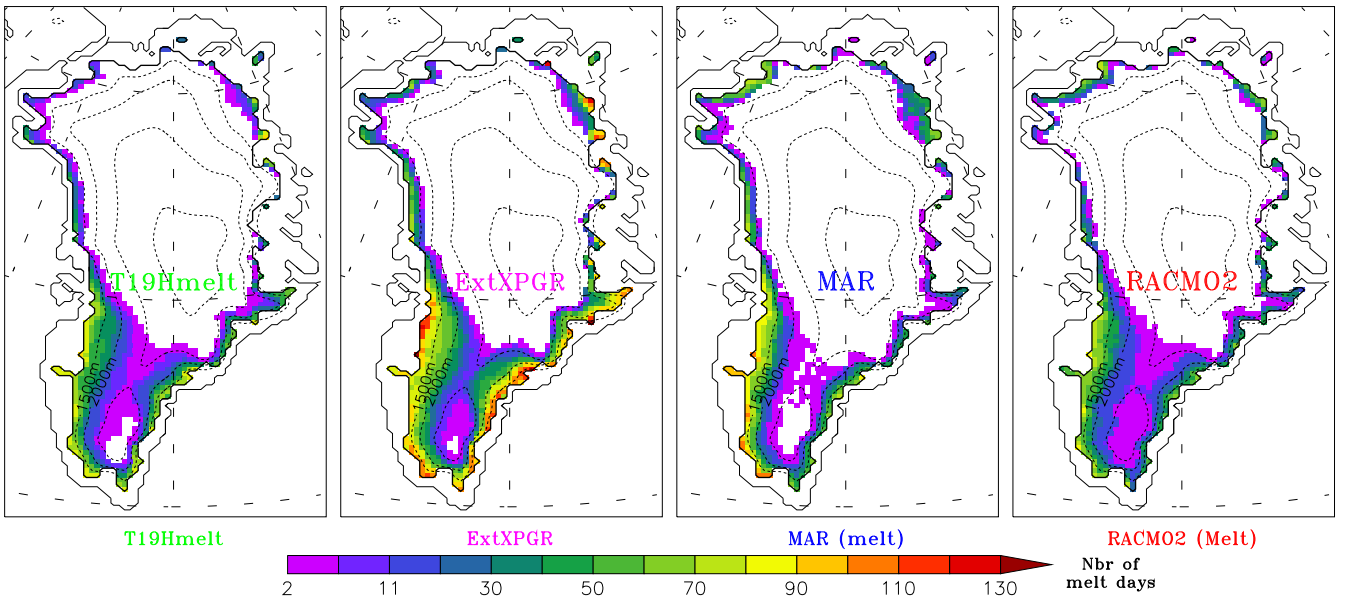

MAR
RACMO2
1500m
2000m
MAR = SAT: 2.5%
MAR > SAT: 2.04%
MAR < SAT: 1.24%
MAR = SAT: 5.74%
MAR > SAT: 2.7%
MAR < SAT: 2.04%
RACMO2 = SAT: 2.3%
RACMO2 > SAT: 2.09%
RACMO2 < SAT: 1.44%
RACMO2 = SAT: 5.79%
RACMO2 > SAT: 1.76%
RACMO2 < SAT: 1.99%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

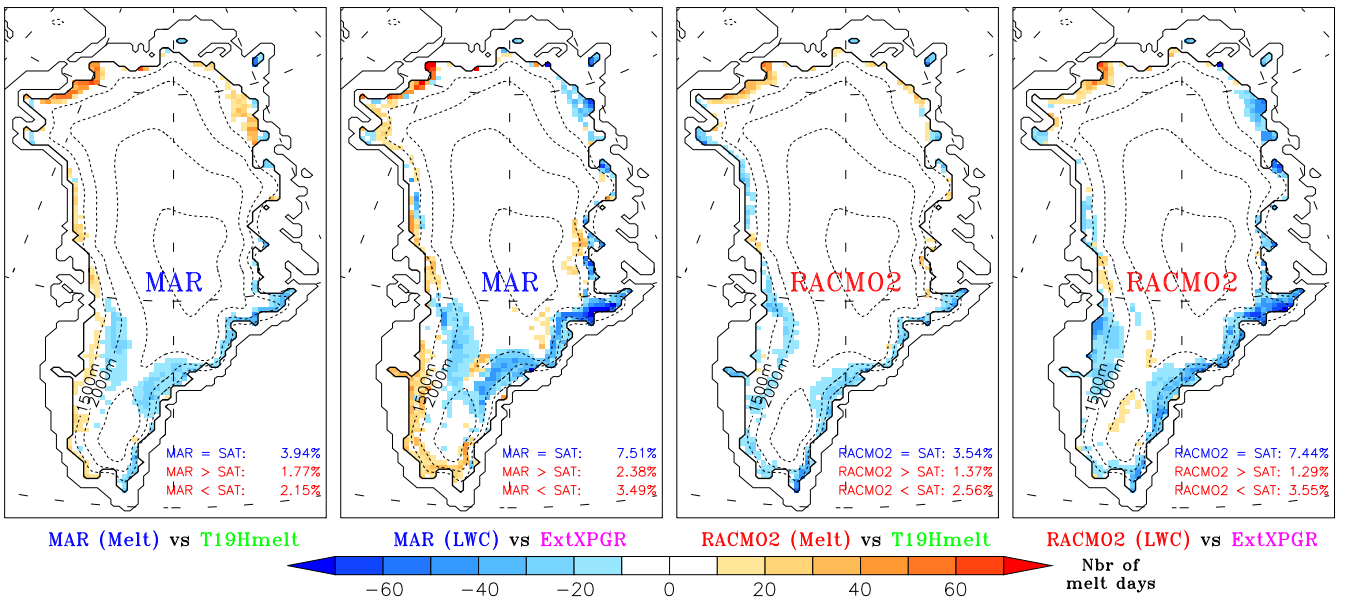

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.94
rmse: 1.92
Corr: 0.92
rmse: 2.38
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.98
rmse: 2.43
Corr: 0.96
rmse: 2.49
1990
MAY
JUN
JUL
AUG
SEP

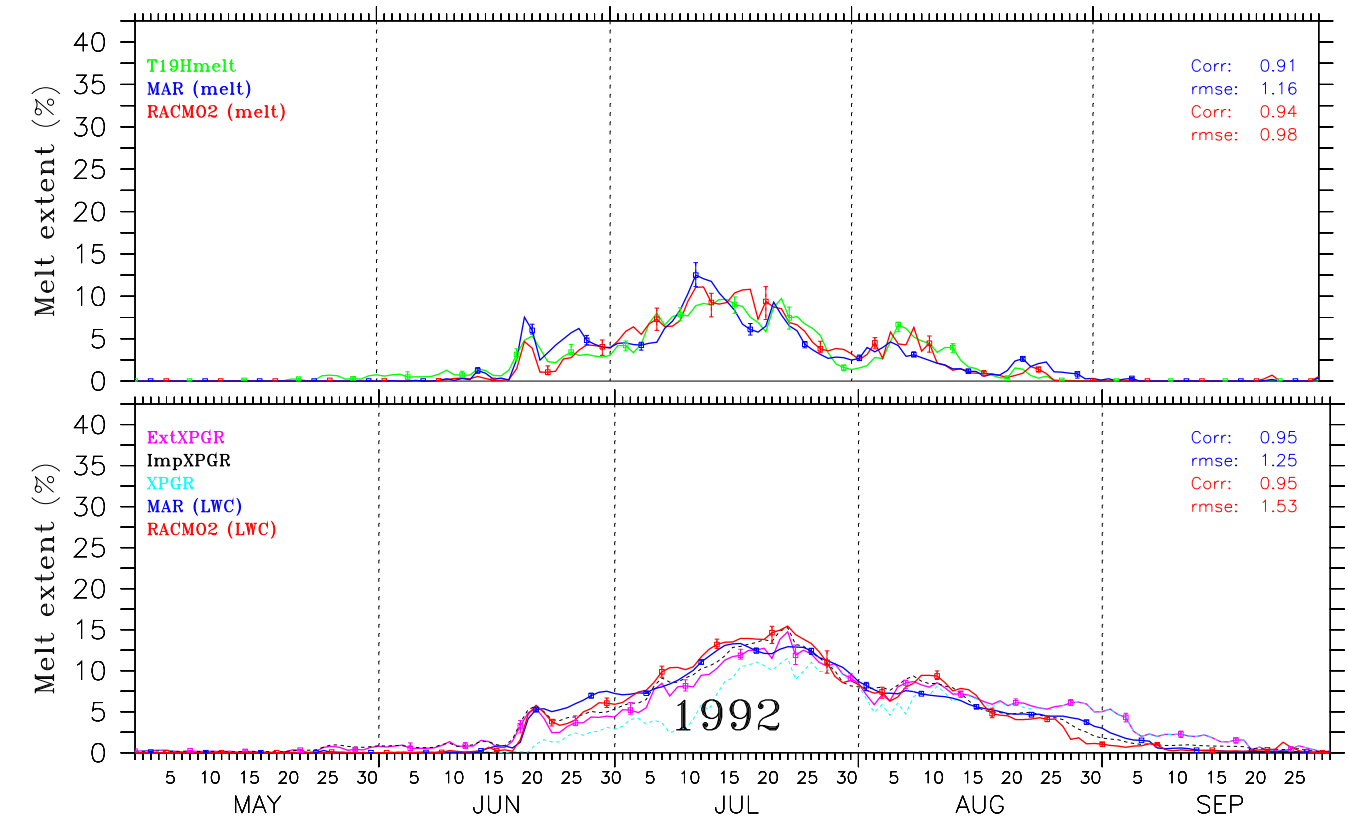

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

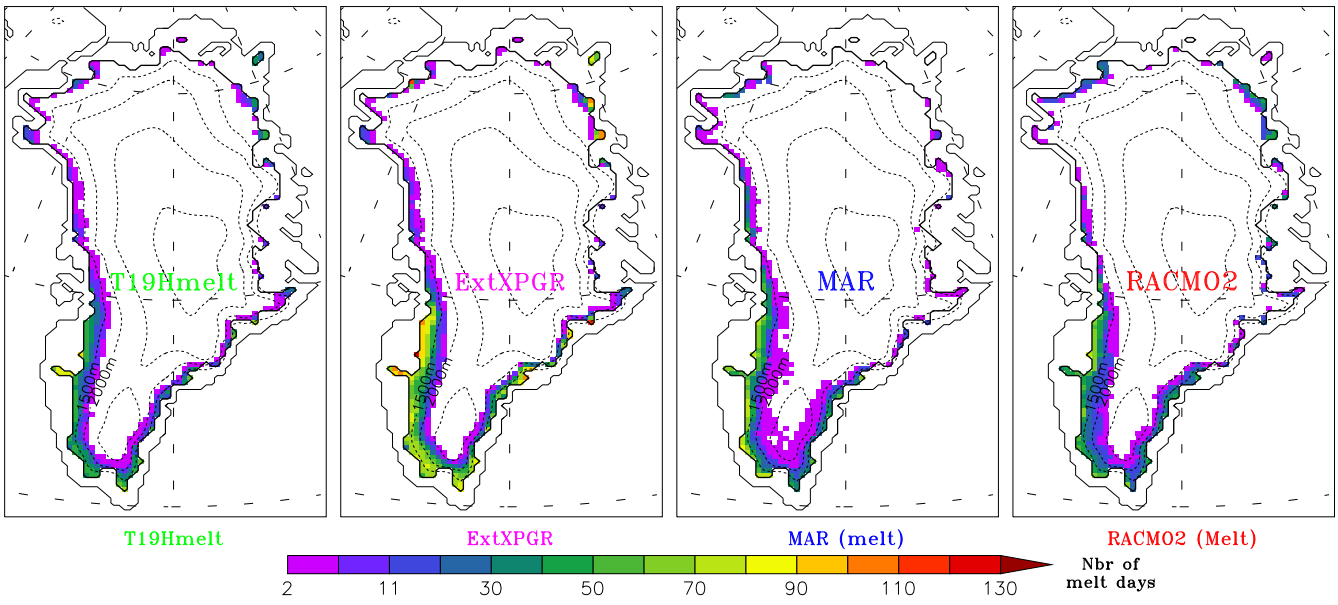

MAR
RACMO2
MAR = SAT: 3.13%
MAR > SAT: 1.76%
MAR < SAT: 1.86%
MAR = SAT: 6.2%
MAR > SAT: 1.84%
MAR < SAT: 3%
RACMO2 = SAT: 3.23%
RACMO2 > SAT: 2.17%
RACMO2 < SAT: 1.77%
RACMO2 = SAT: 6.57%
RACMO2 > SAT: 1.82%
RACMO2 < SAT: 2.63%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

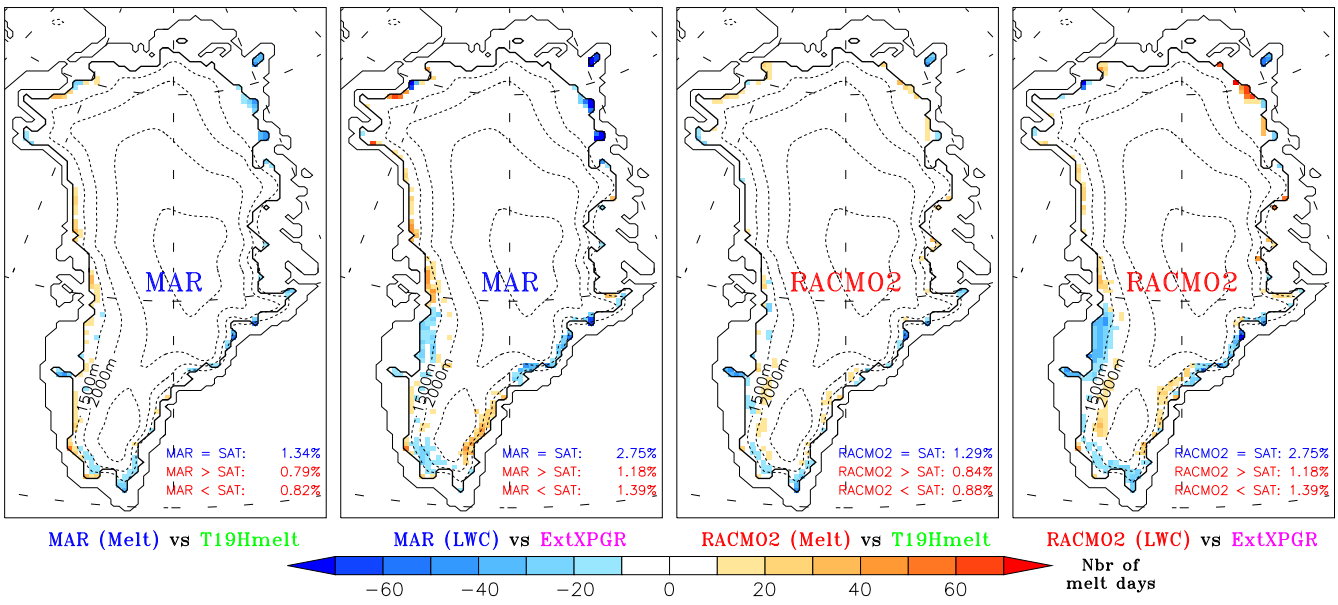

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.95
rmse: 2.39
Corr: 0.91
rmse: 3.25
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.96
rmse: 3.27
Corr: 0.95
rmse: 3.72
1991
MAY
JUN
JUL
AUG
SEP

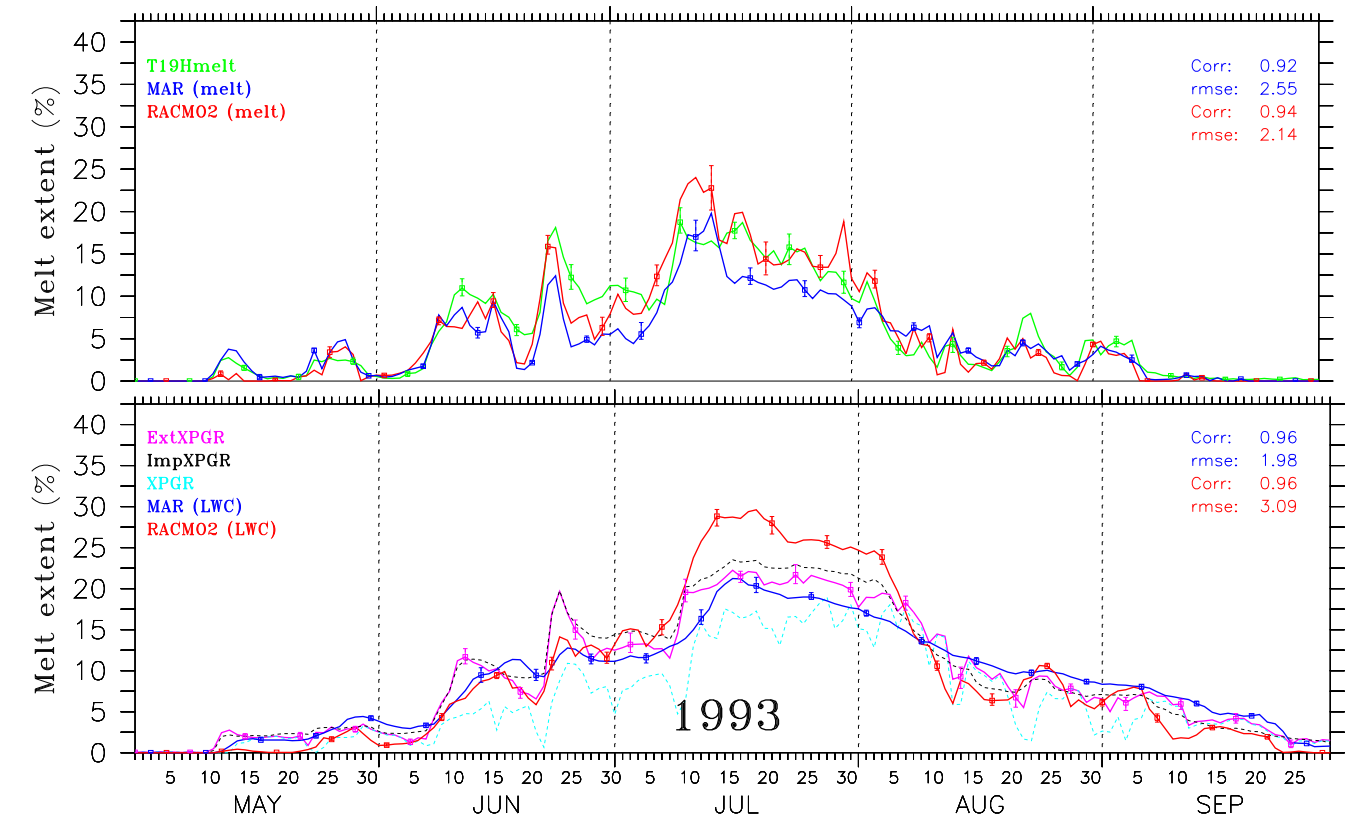

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

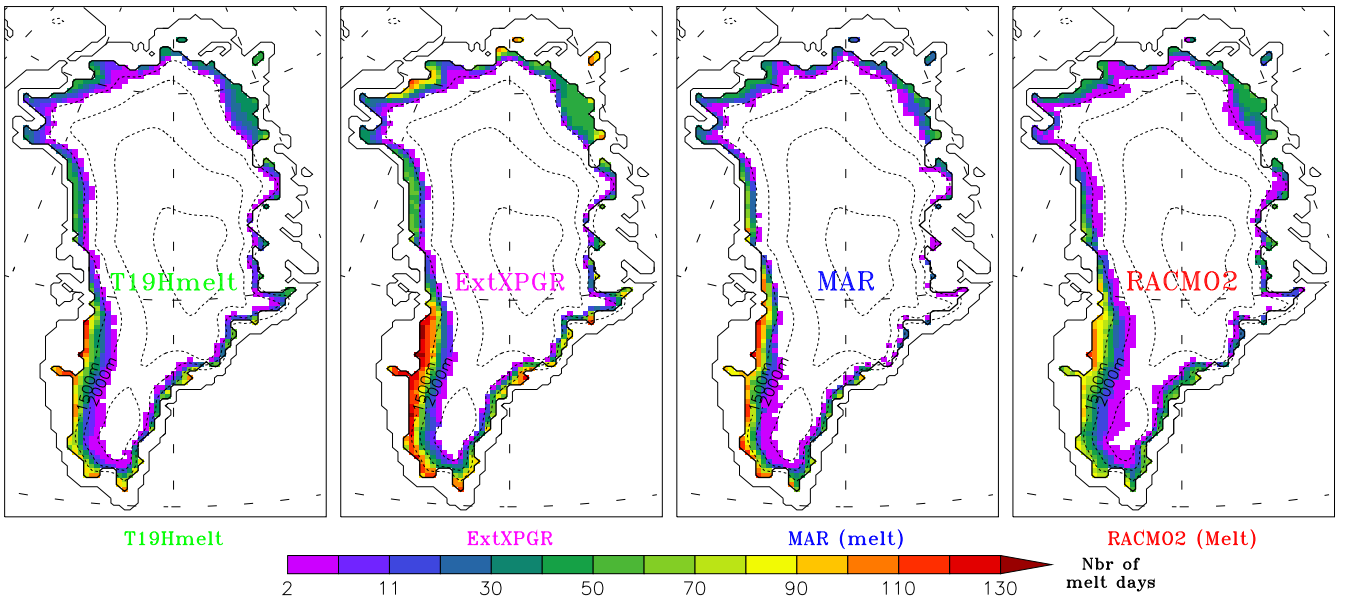

MAR
RACMO2
MAR = SAT: 3.94%
MAR > SAT: 1.77%
MAR < SAT: 2.15%
MAR = SAT: 7.51%
MAR > SAT: 2.38%
MAR < SAT: 3.49%
RACMO2 = SAT: 3.54%
RACMO2 > SAT: 1.37%
RACMO2 < SAT: 2.56%
RACMO2 = SAT: 7.44%
RACMO2 > SAT: 1.29%
RACMO2 < SAT: 3.55%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

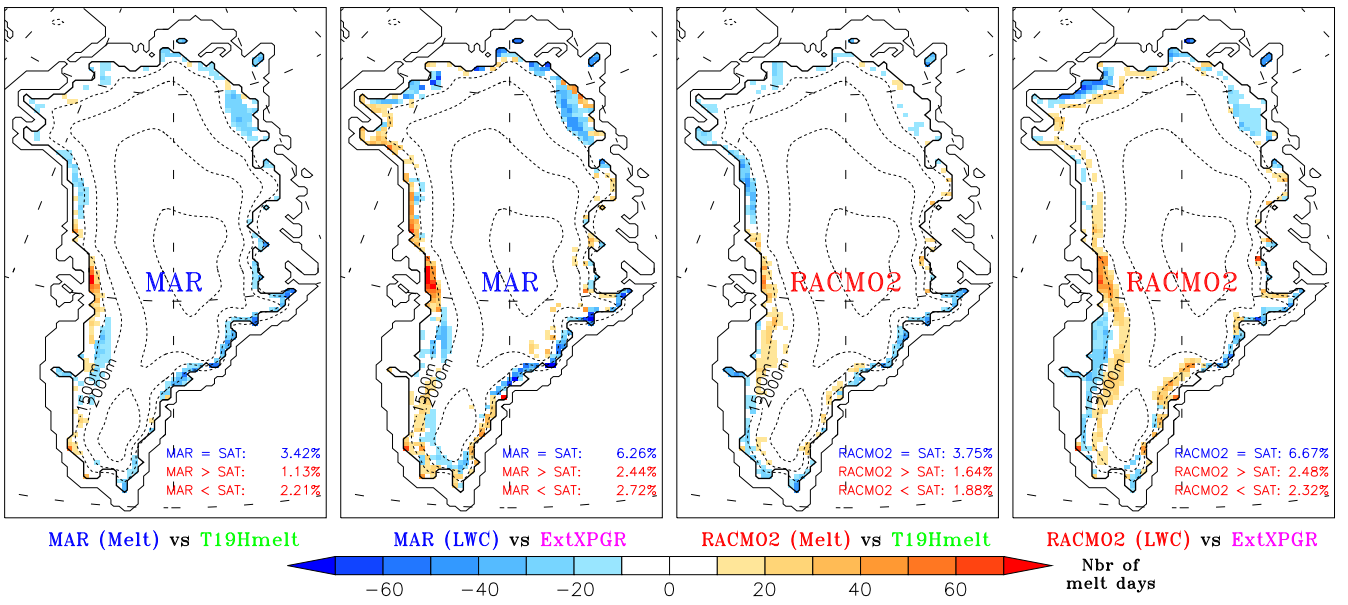

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.91
rmse: 1.16
Corr: 0.94
rmse: 0.98
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.95
rmse: 1.25
Corr: 0.95
rmse: 1.53
1992
MAY
JUN
JUL
AUG
SEP

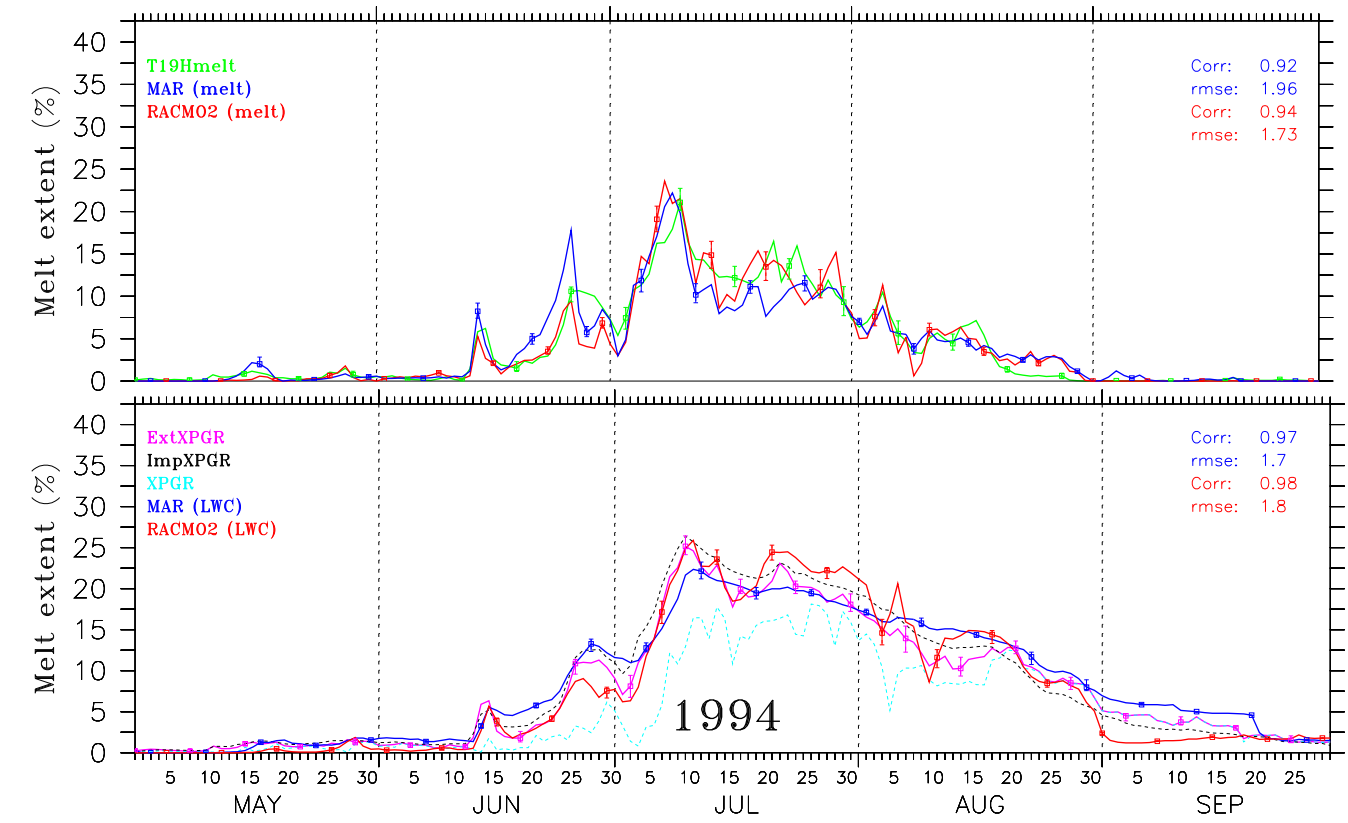

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

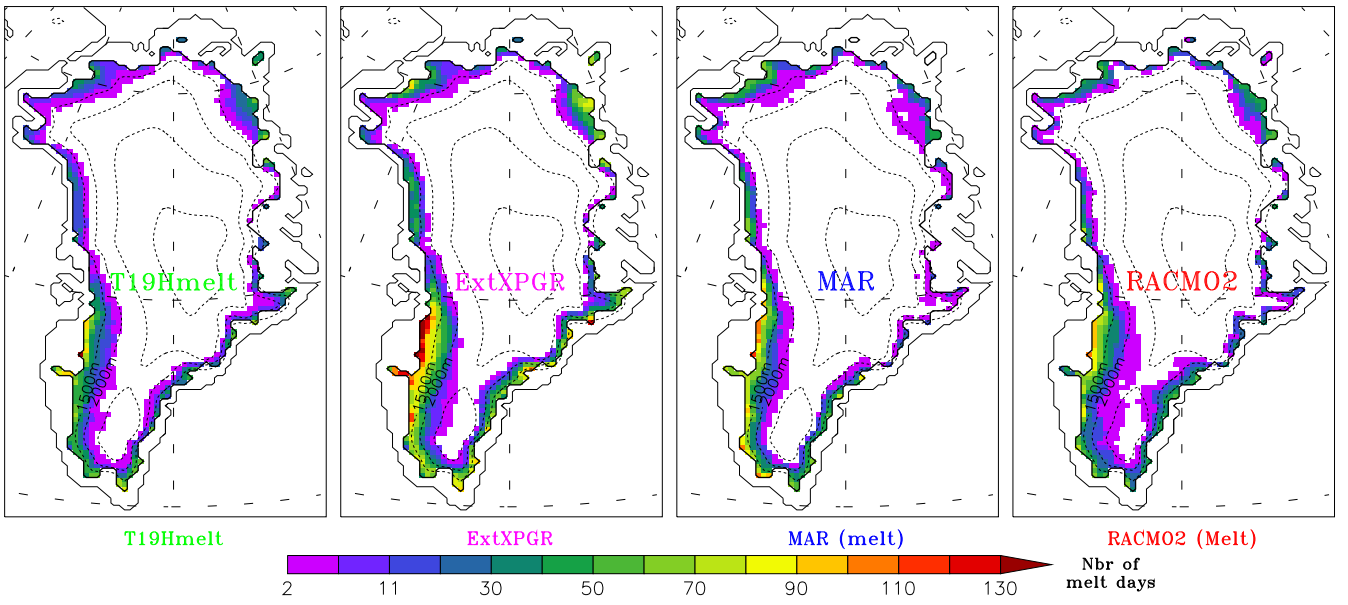

MAR
RACMO2
1500m
2000m
MAR = SAT: 1.34%
MAR > SAT: 0.79%
MAR < SAT: 0.82%
MAR = SAT: 2.75%
MAR > SAT: 1.18%
MAR < SAT: 1.39%
RACMO2 = SAT: 1.29%
RACMO2 > SAT: 0.84%
RACMO2 < SAT: 0.88%
RACMO2 = SAT: 2.75%
RACMO2 > SAT: 1.18%
RACMO2 < SAT: 1.39%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

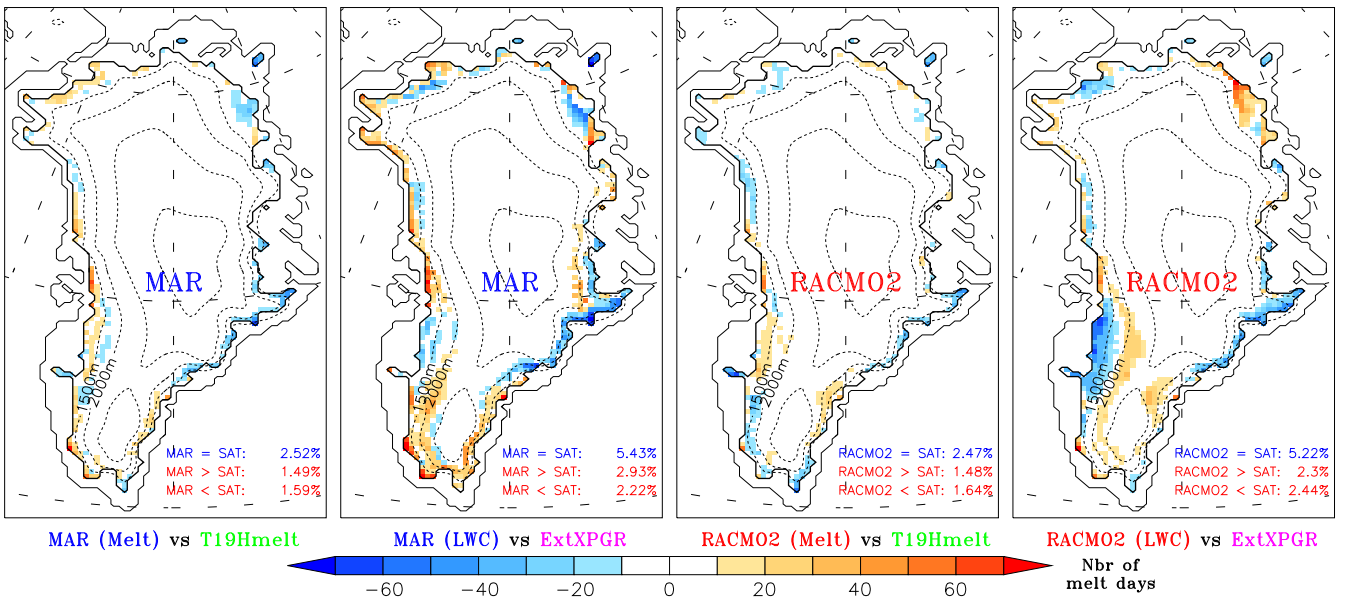

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.92
rmse: 2.55
Corr: 0.94
rmse: 2.14
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.96
rmse: 1.98
Corr: 0.96
rmse: 3.09
1993
MAY
JUN
JUL
AUG
SEP

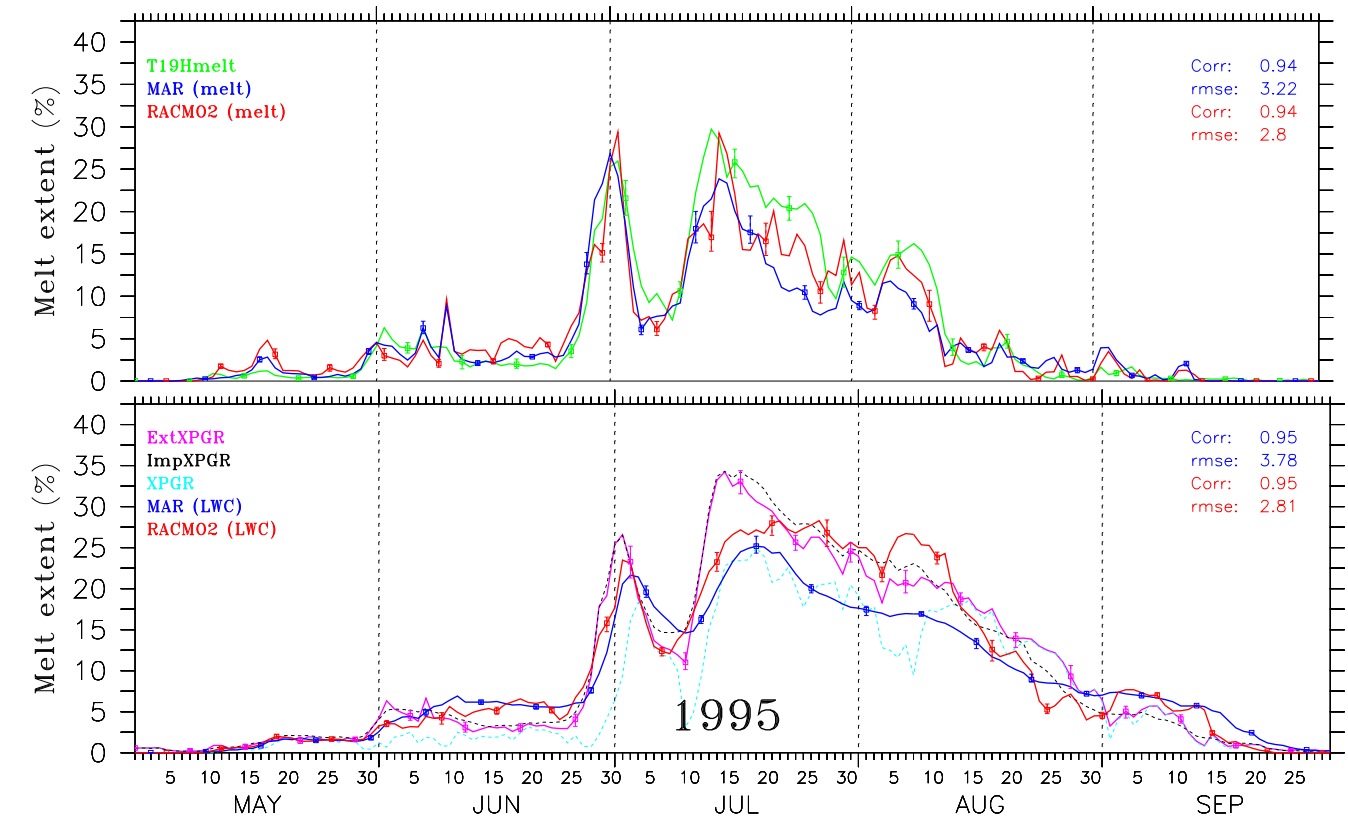

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

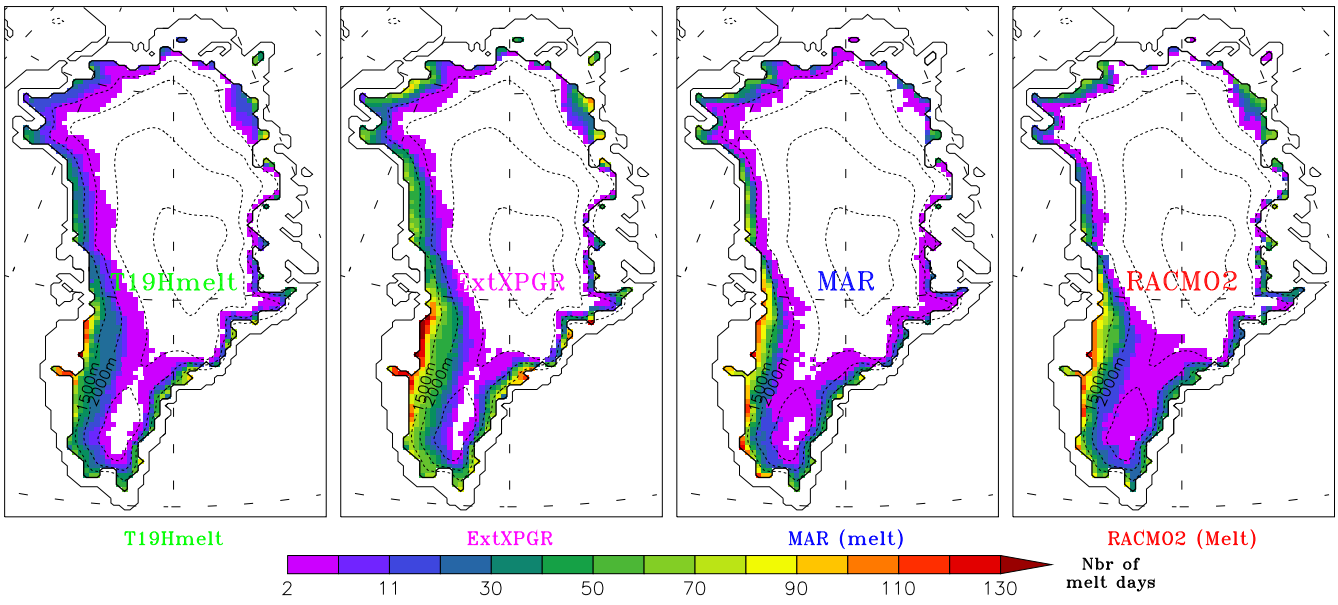

MAR
RACMO2
MAR = SAT: 3.42%
MAR > SAT: 1.13%
MAR < SAT: 2.21%
MAR = SAT: 6.26%
MAR > SAT: 2.44%
MAR < SAT: 2.72%
RACMO2 = SAT: 3.75%
RACMO2 > SAT: 1.64%
RACMO2 < SAT: 1.88%
RACMO2 = SAT: 6.67%
RACMO2 > SAT: 2.48%
RACMO2 < SAT: 2.32%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

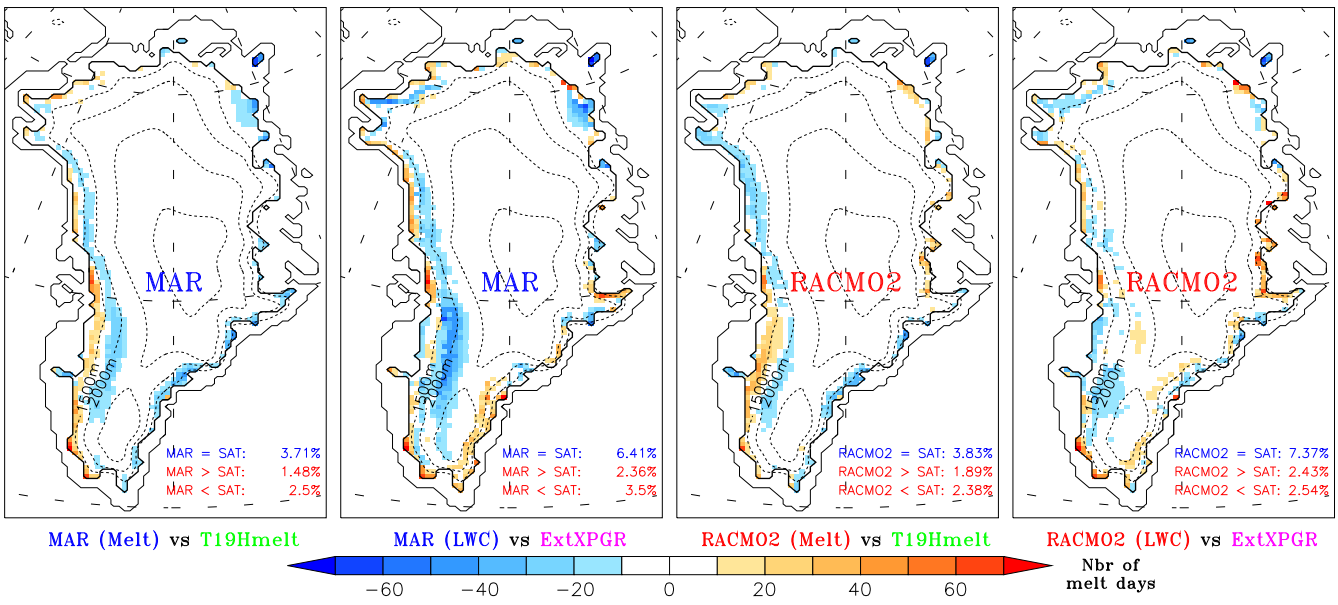

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.92
rmse: 1.96
Corr: 0.94
rmse: 1.73
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.97
rmse: 1.7
Corr: 0.98
rmse: 1.8
1994
MAY
JUN
JUL
AUG
SEP

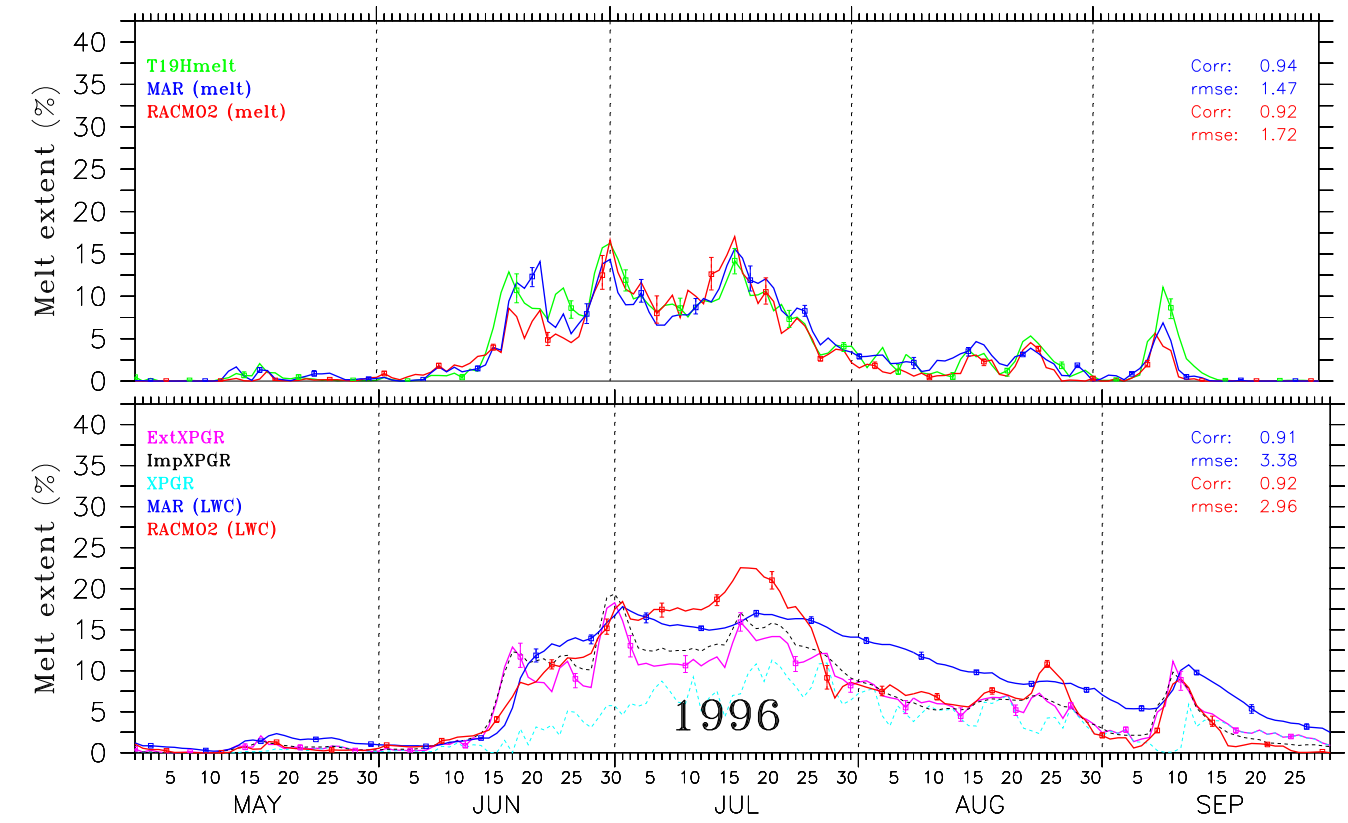

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

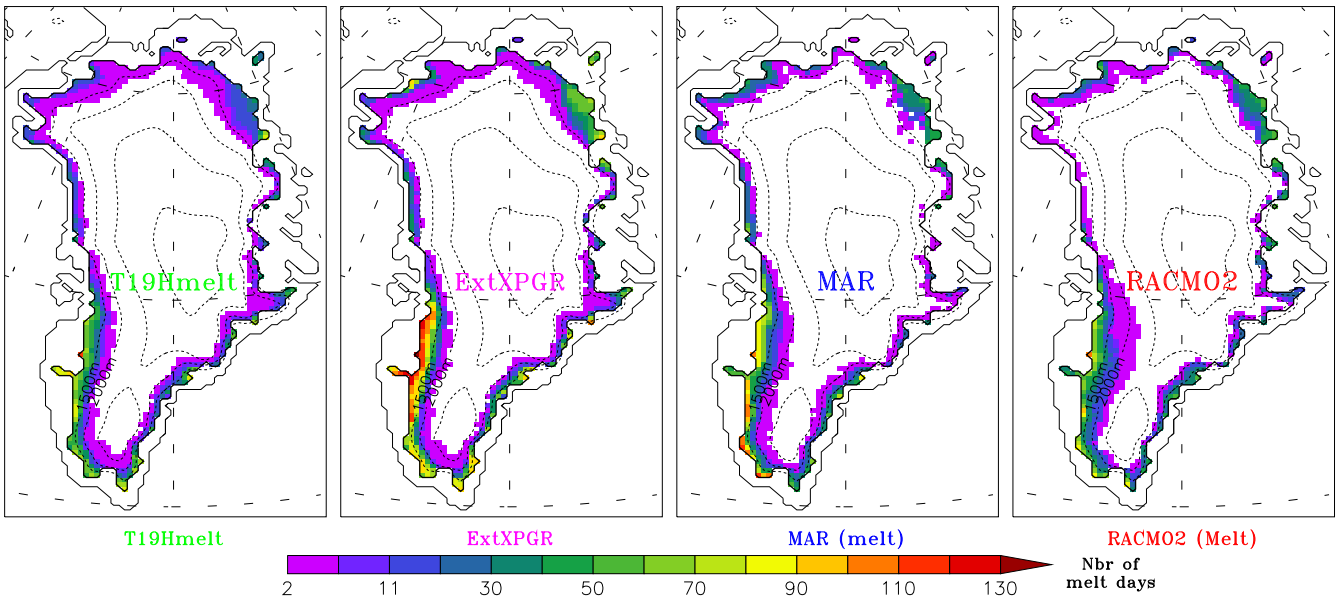

MAR
RACMO2
MAR = SAT: 2.52%
MAR > SAT: 1.49%
MAR < SAT: 1.59%
MAR = SAT: 5.43%
MAR > SAT: 2.93%
MAR < SAT: 2.22%
RACMO2 = SAT: 2.47%
RACMO2 > SAT: 1.48%
RACMO2 < SAT: 1.64%
RACMO2 = SAT: 5.22%
RACMO2 > SAT: 2.3%
RACMO2 < SAT: 2.44%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

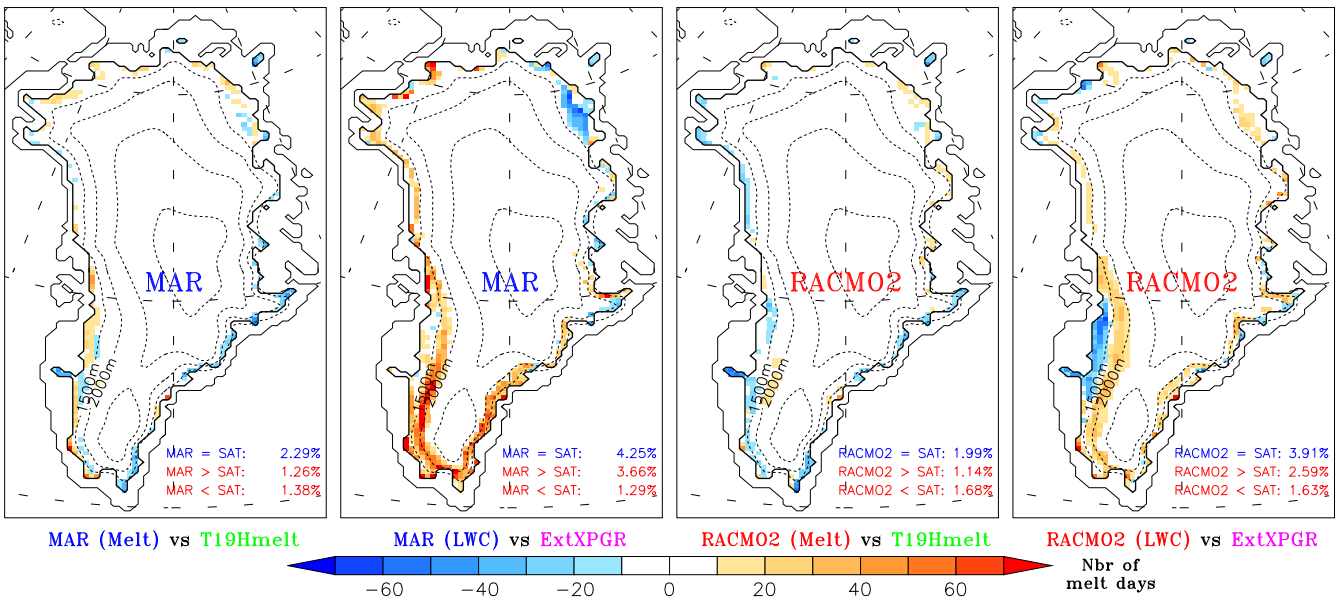

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.94
rmse: 3.22
Corr: 0.94
rmse: 2.8
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.95
rmse: 3.78
Corr: 0.95
rmse: 2.81
1995
MAY
JUN
JUL
AUG
SEP

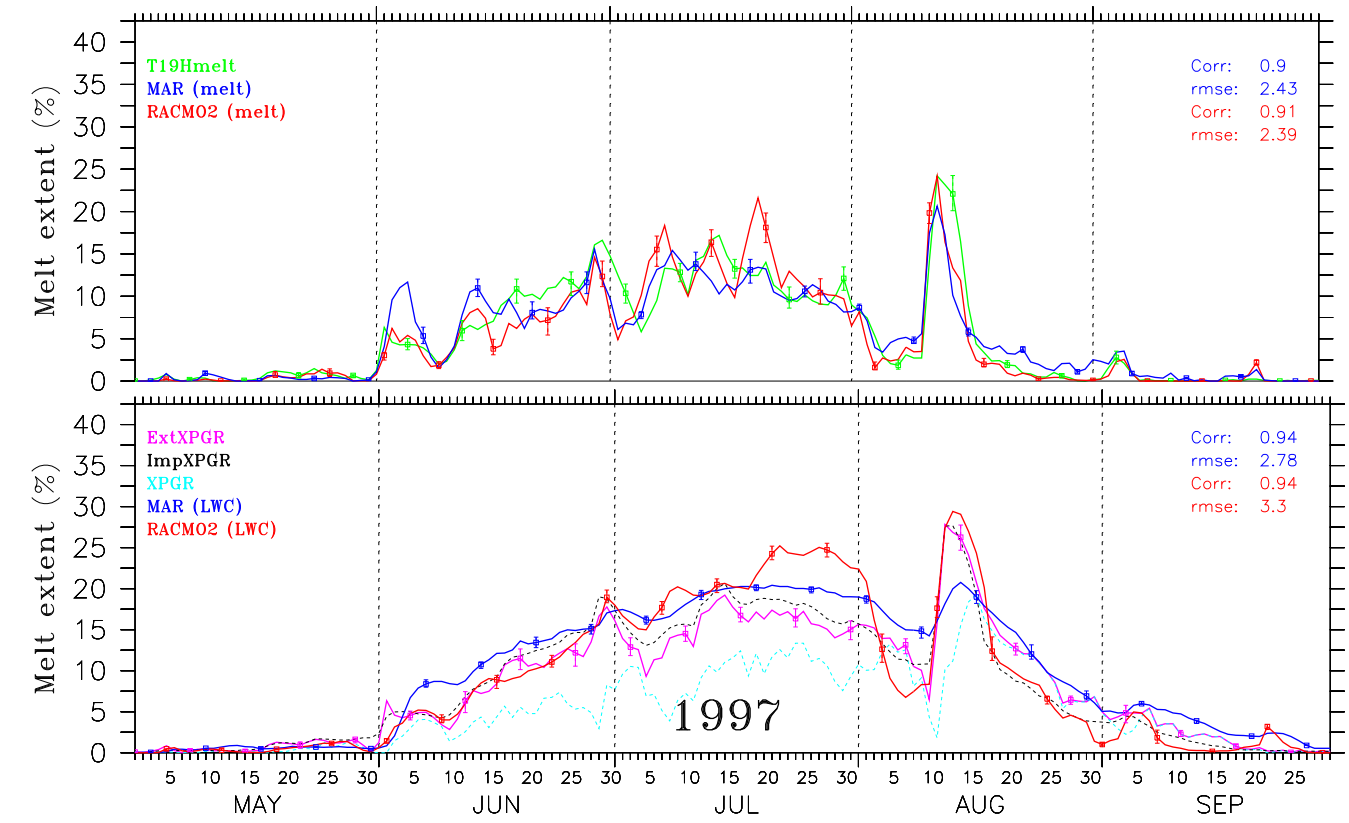

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

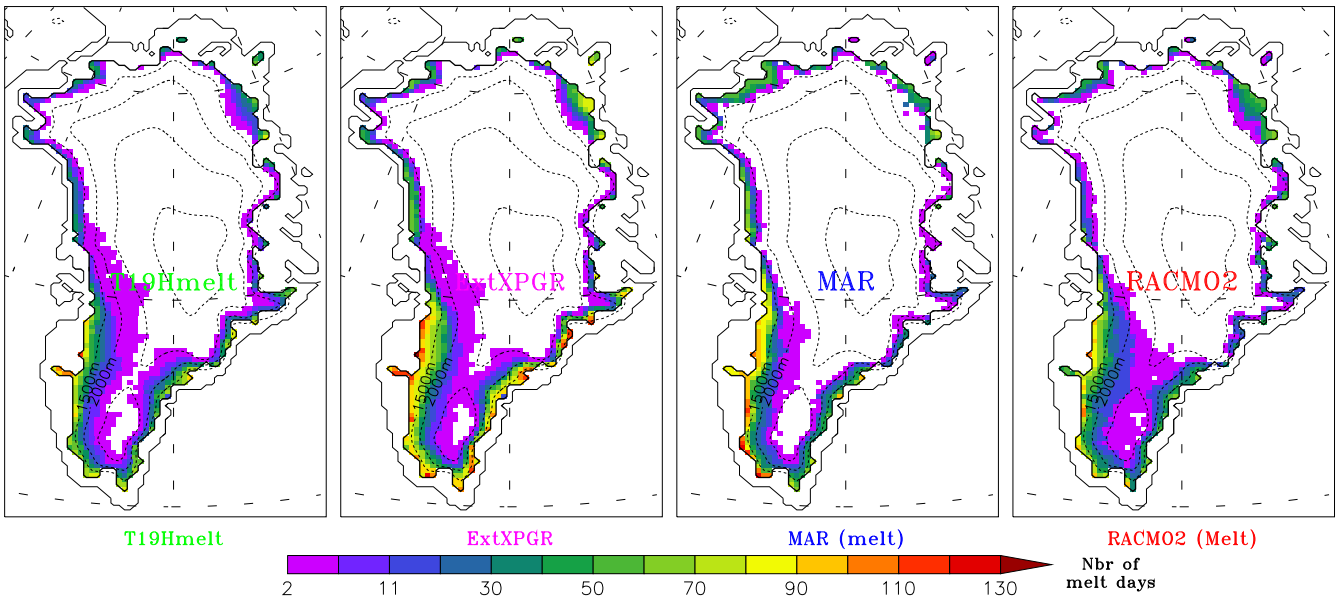

MAR
RACMO2
MAR = SAT: 3.71%
MAR > SAT: 1.48%
MAR < SAT: 2.5%
MAR = SAT: 6.41%
MAR > SAT: 2.36%
MAR < SAT: 3.5%
RACMO2 = SAT: 3.83%
RACMO2 > SAT: 1.89%
RACMO2 < SAT: 2.38%
RACMO2 = SAT: 7.37%
RACMO2 > SAT: 2.43%
RACMO2 < SAT: 2.54%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

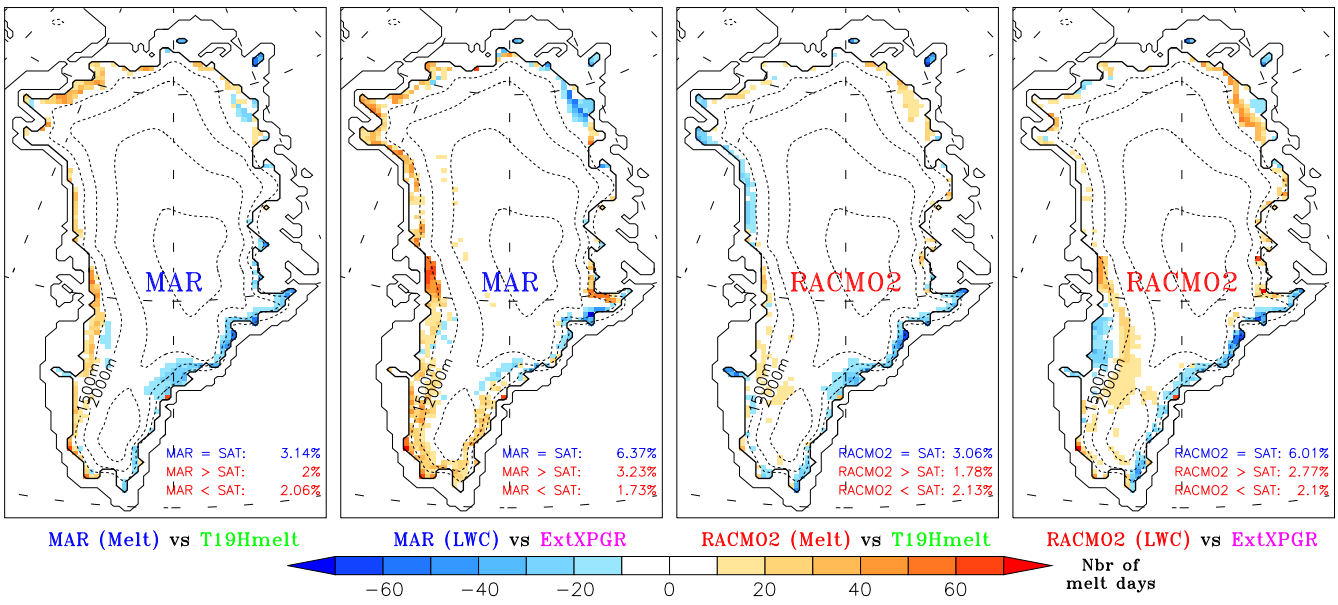

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.94
rmse: 1.47
Corr: 0.92
rmse: 1.72
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.91
rmse: 3.38
Corr: 0.92
rmse: 2.96
1996
MAY
JUN
JUL
AUG
SEP

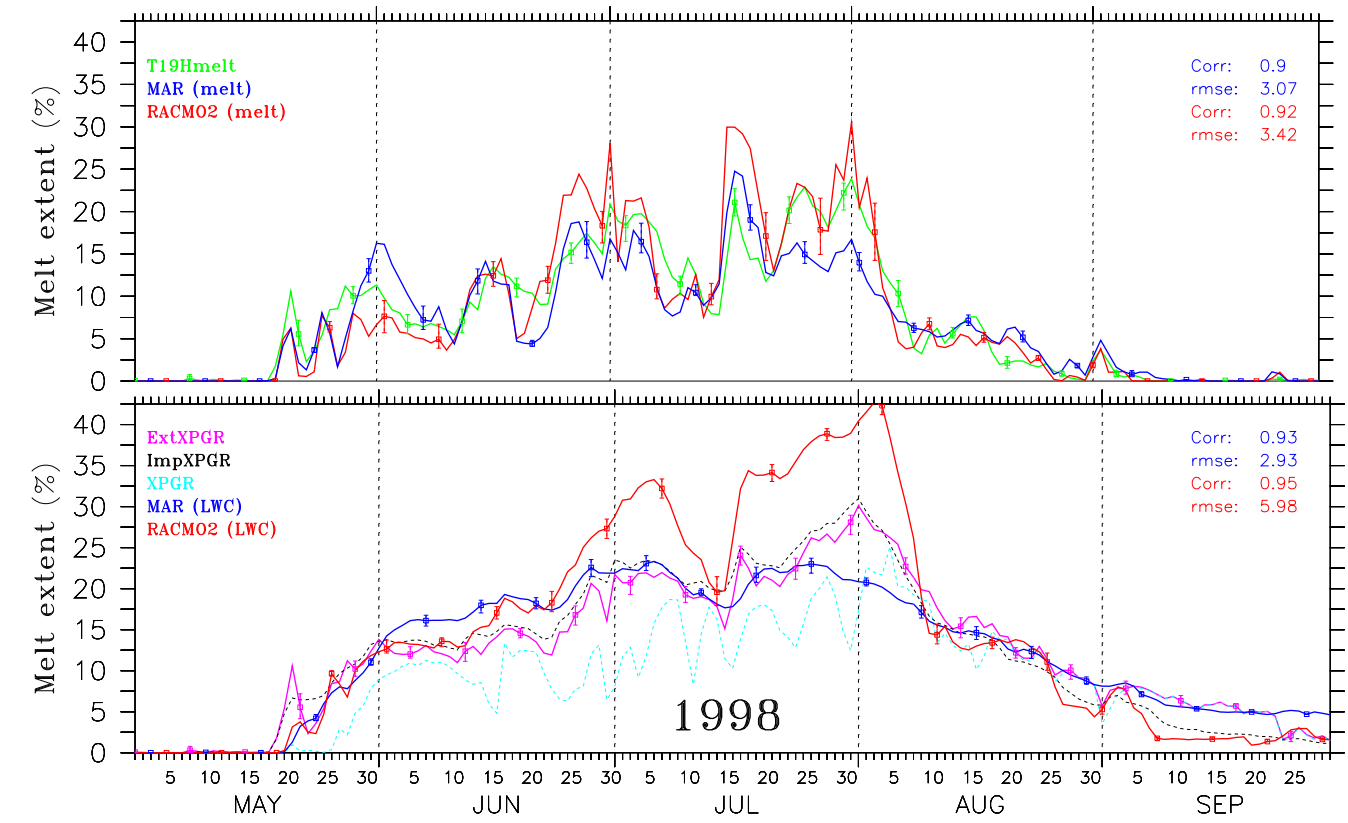

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

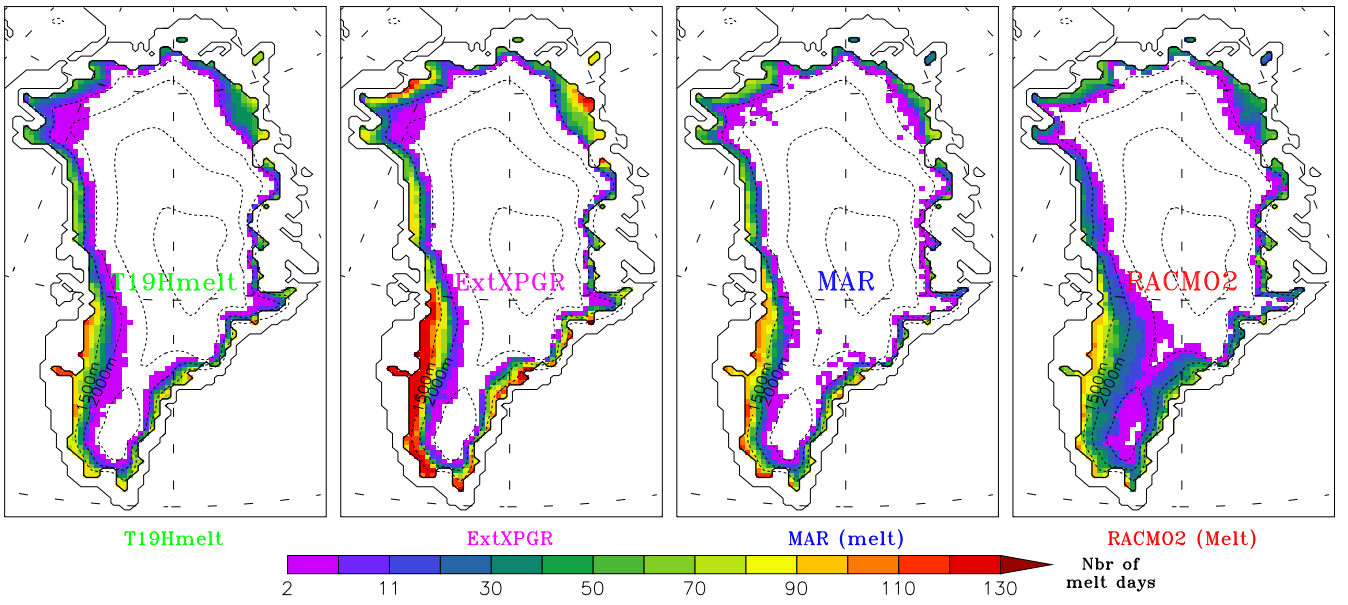

MAR
RACMO2
MAR = SAT: 2.29%
MAR > SAT: 1.26%
MAR < SAT: 1.38%
MAR = SAT: 4.25%
MAR > SAT: 3.66%
MAR < SAT: 1.29%
RACMO2 = SAT: 1.99%
RACMO2 > SAT: 1.14%
RACMO2 < SAT: 1.68%
RACMO2 = SAT: 3.91%
RACMO2 > SAT: 2.59%
RACMO2 < SAT: 1.63%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

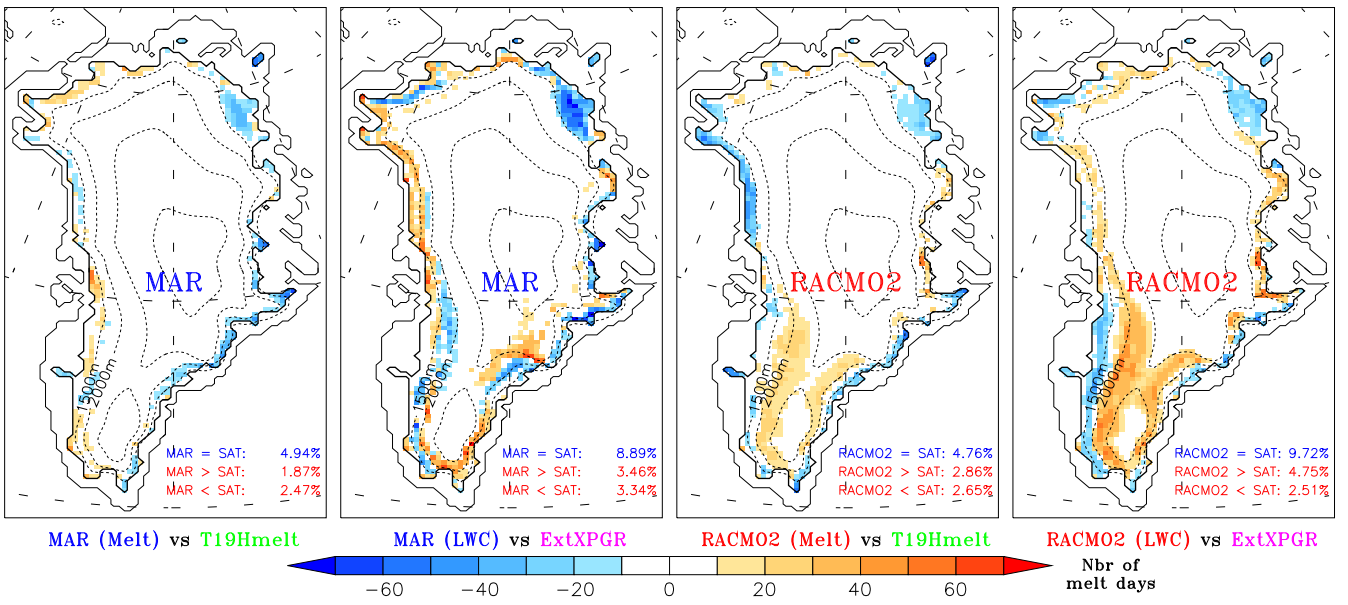

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.9
rmse: 2.43
Corr: 0.91
rmse: 2.39
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.94
rmse: 2.78
Corr: 0.94
rmse: 3.3
1997
MAY
JUN
JUL
AUG
SEP

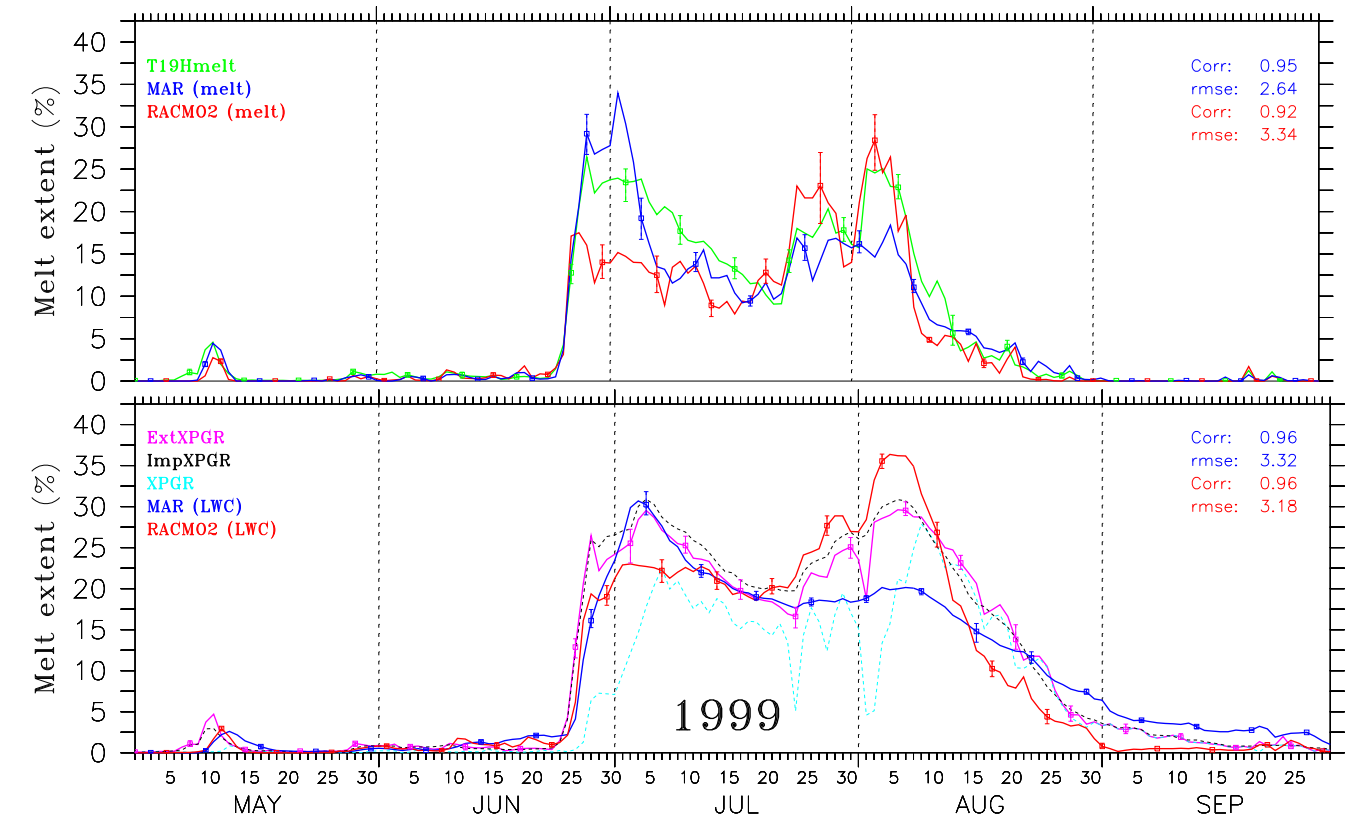

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

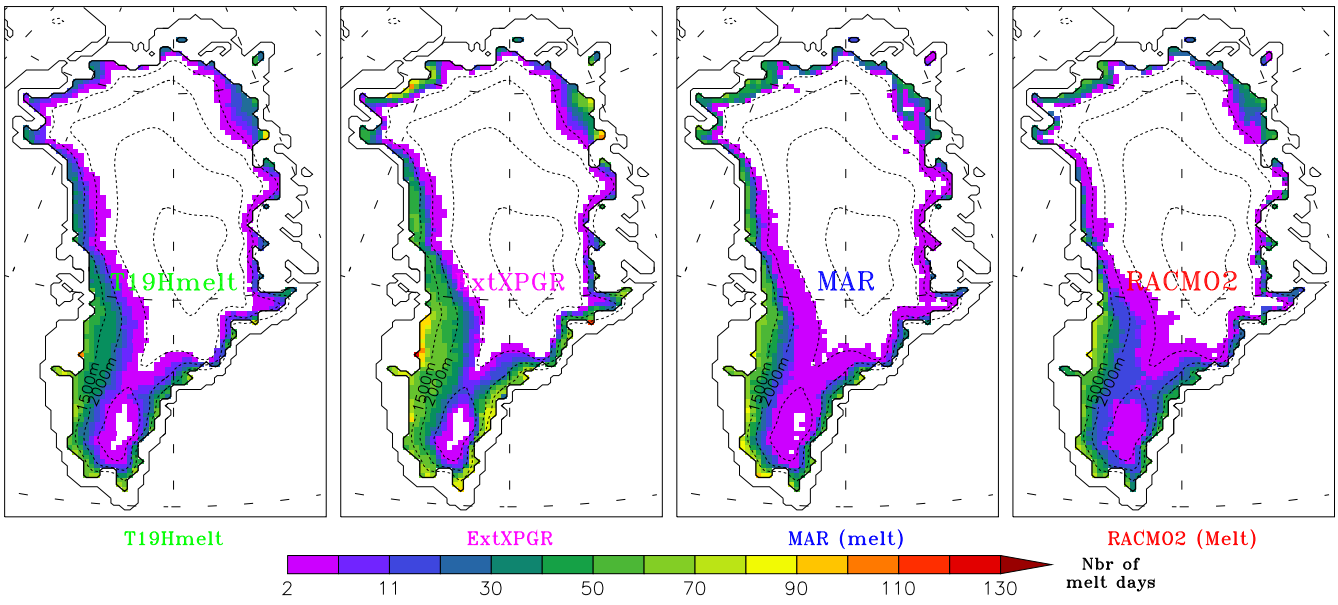

MAR
RACMO2
1500m
2000m
MAR = SAT: 3.14%
MAR > SAT: 2%
MAR < SAT: 2.06%
MAR = SAT: 6.37%
MAR > SAT: 3.23%
MAR < SAT: 1.73%
RACMO2 = SAT: 3.06%
RACMO2 > SAT: 1.78%
RACMO2 < SAT: 2.13%
RACMO2 = SAT: 6.01%
RACMO2 > SAT: 2.77%
RACMO2 < SAT: 2.1%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

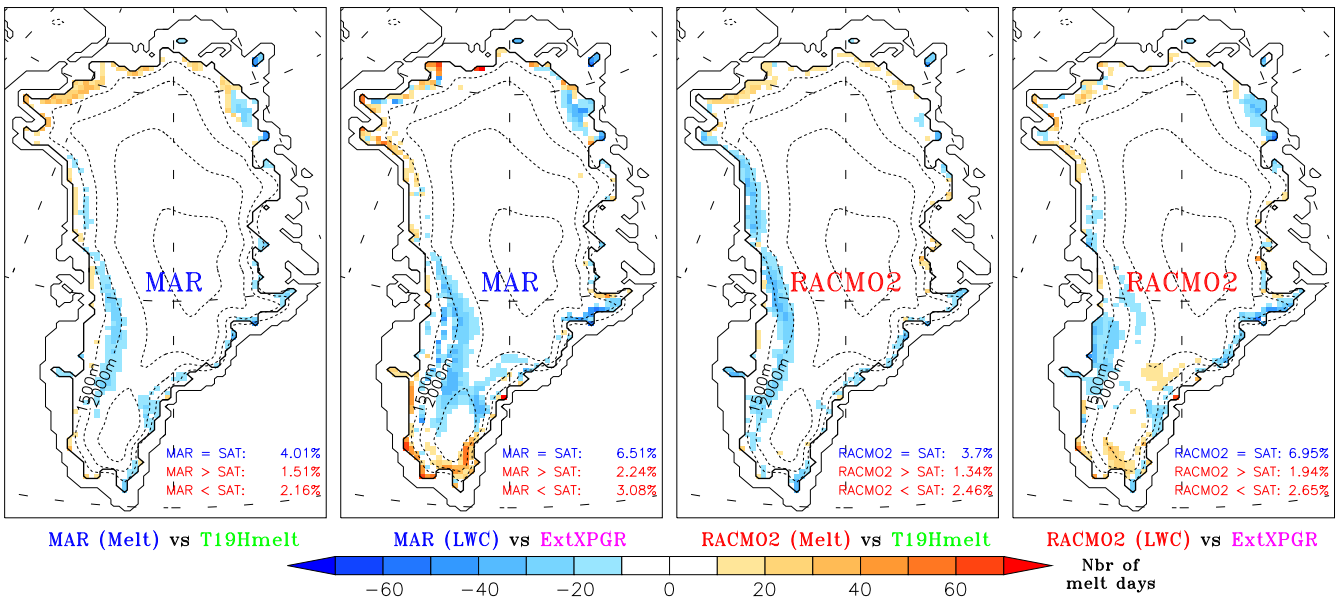

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.9
rmse: 3.07
Corr: 0.92
rmse: 3.42
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.93
rmse: 2.93
Corr: 0.95
rmse: 5.98
1998
MAY
JUN
JUL
AUG
SEP

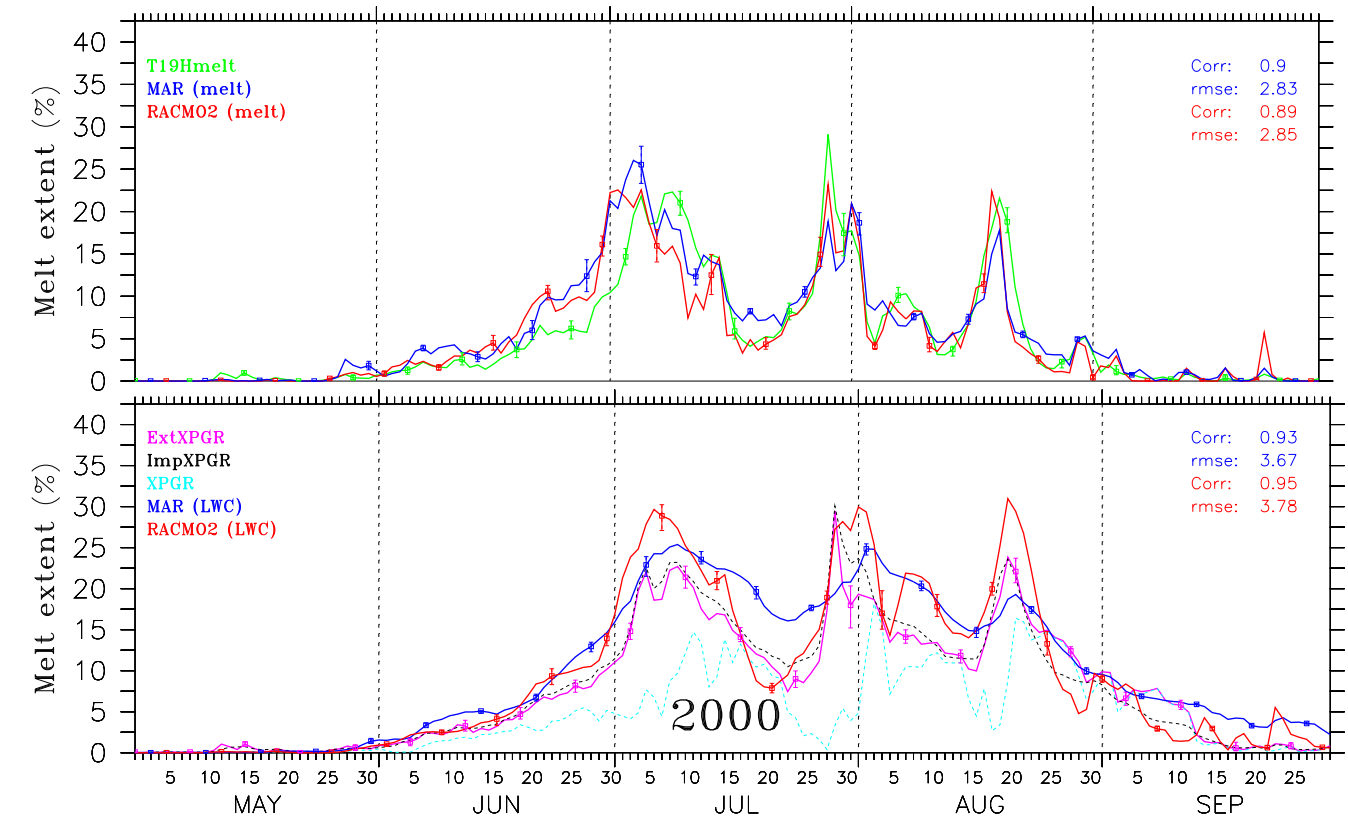

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

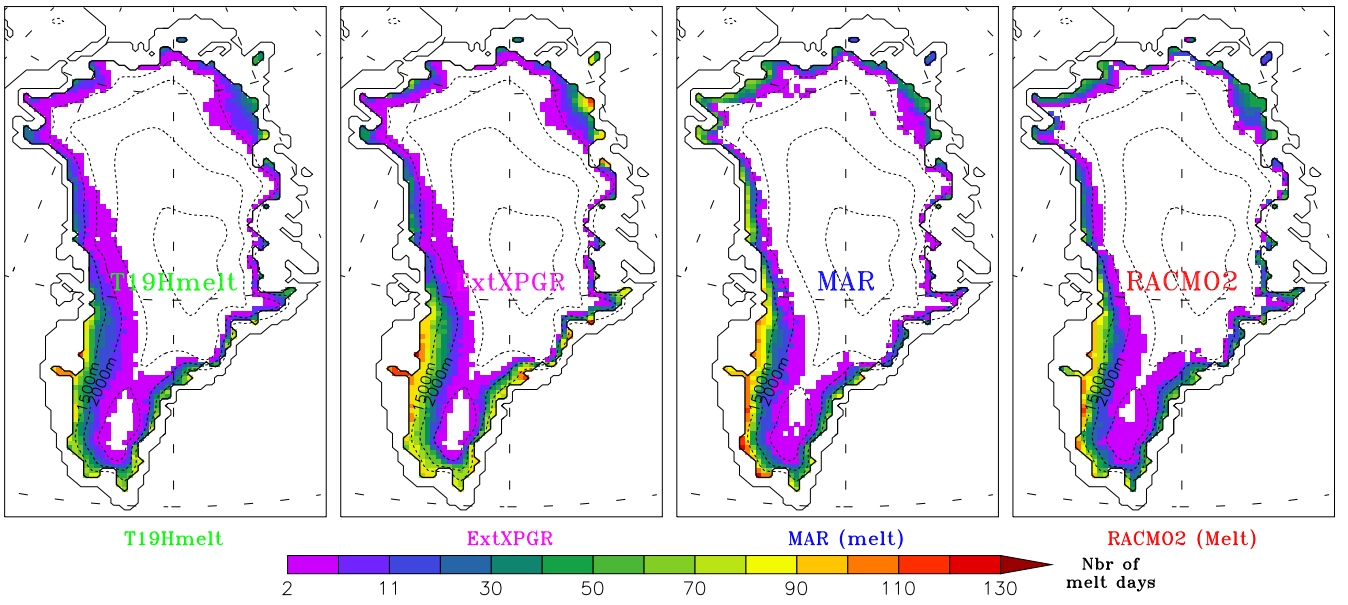

MAR
RACMO2
MAR = SAT: 4.94%
MAR > SAT: 1.87%
MAR < SAT: 2.47%
MAR = SAT: 8.89%
MAR > SAT: 3.46%
MAR < SAT: 3.34%
RACMO2 = SAT: 4.76%
RACMO2 > SAT: 2.86%
RACMO2 < SAT: 2.65%
RACMO2 = SAT: 9.72%
RACMO2 > SAT: 4.75%
RACMO2 < SAT: 2.51%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

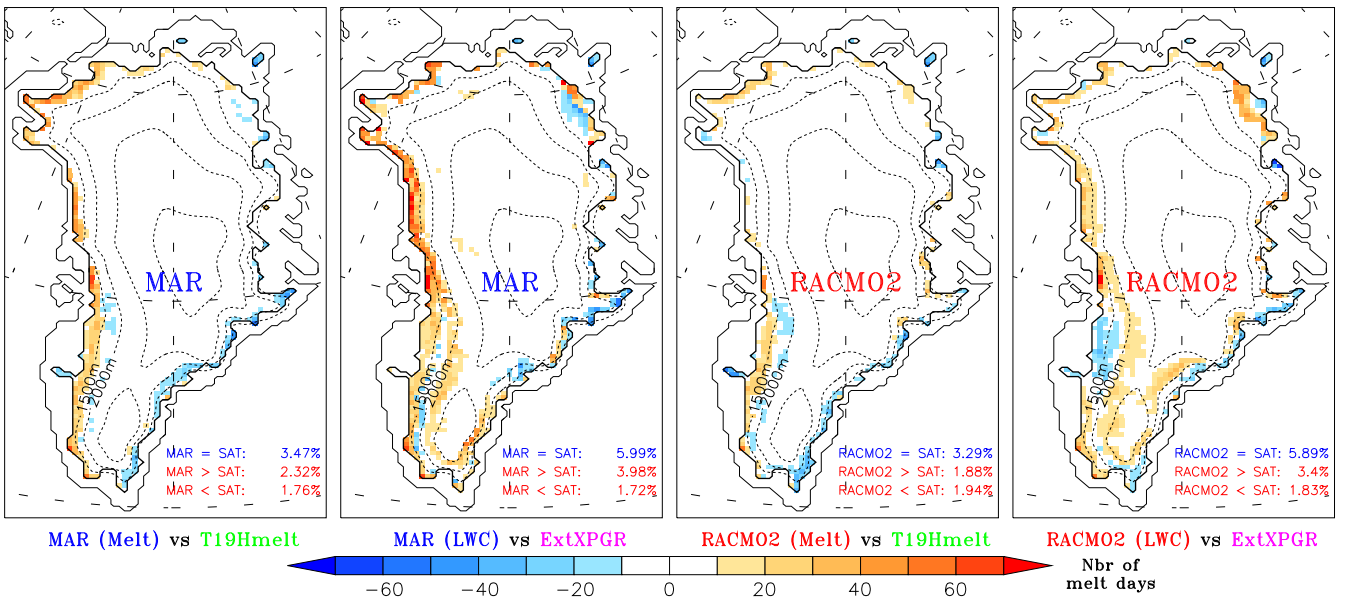

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.95
rmse: 2.64
Corr: 0.92
rmse: 3.34
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.96
rmse: 3.32
Corr: 0.96
rmse: 3.18
1999
MAY
JUN
JUL
AUG
SEP

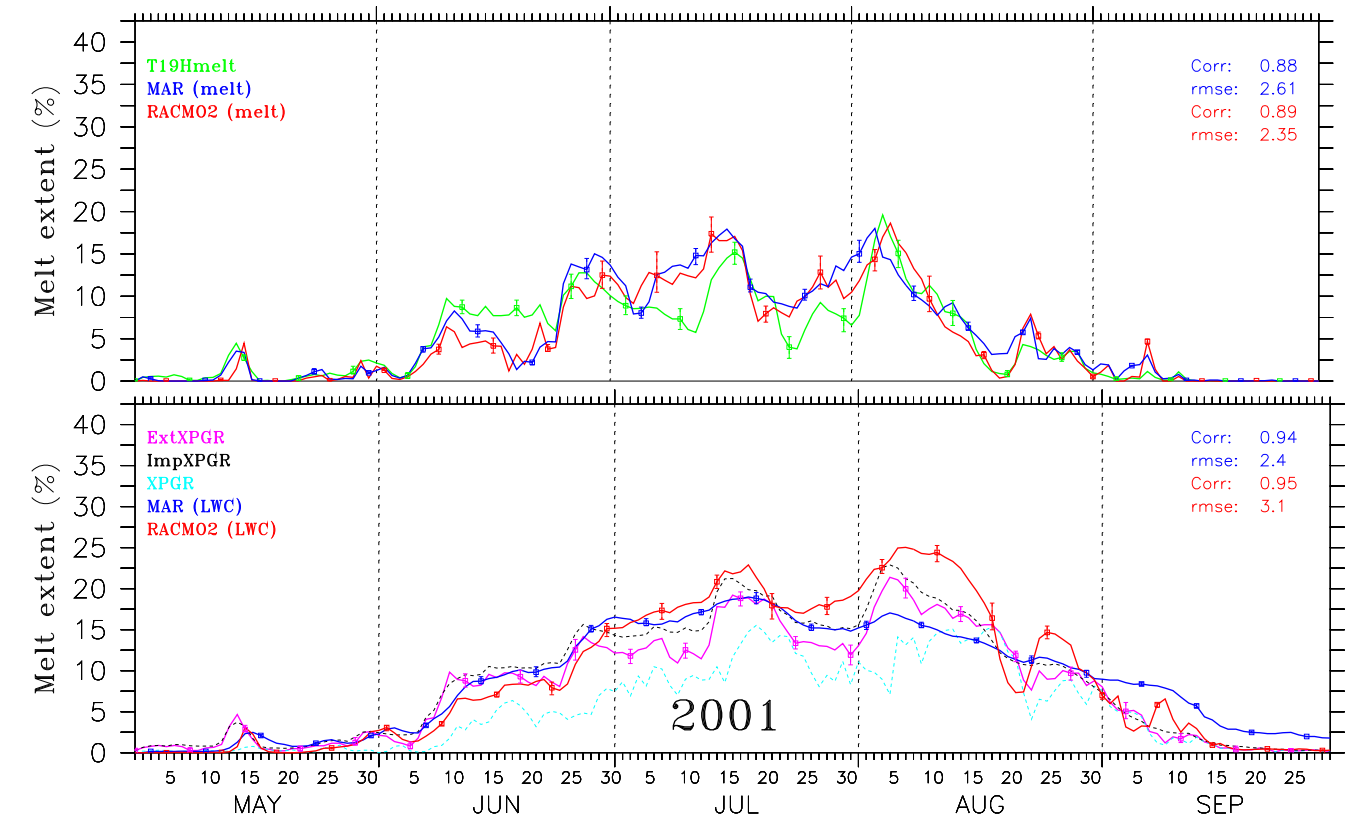

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

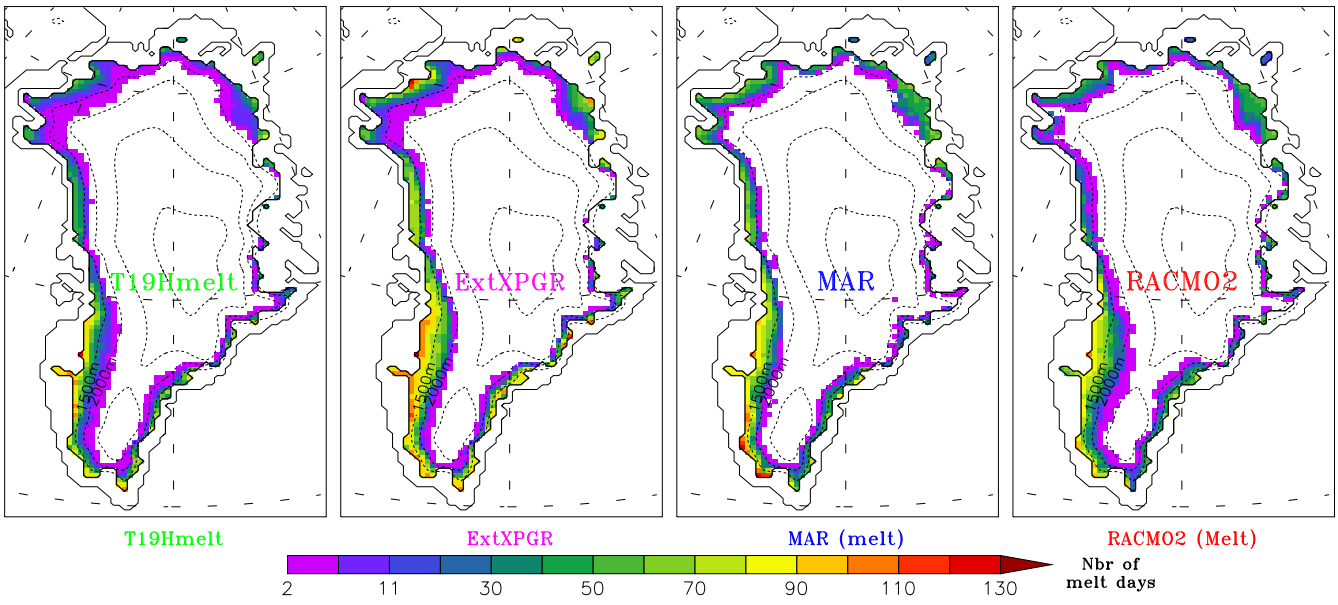

MAR
RACMO2
1500m
2000m
MAR = SAT: 4.01%
MAR > SAT: 1.51%
MAR < SAT: 2.16%
MAR = SAT: 6.51%
MAR > SAT: 2.24%
MAR < SAT: 3.08%
RACMO2 = SAT: 3.7%
RACMO2 > SAT: 1.34%
RACMO2 < SAT: 2.46%
RACMO2 = SAT: 6.95%
RACMO2 > SAT: 1.94%
RACMO2 < SAT: 2.65%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

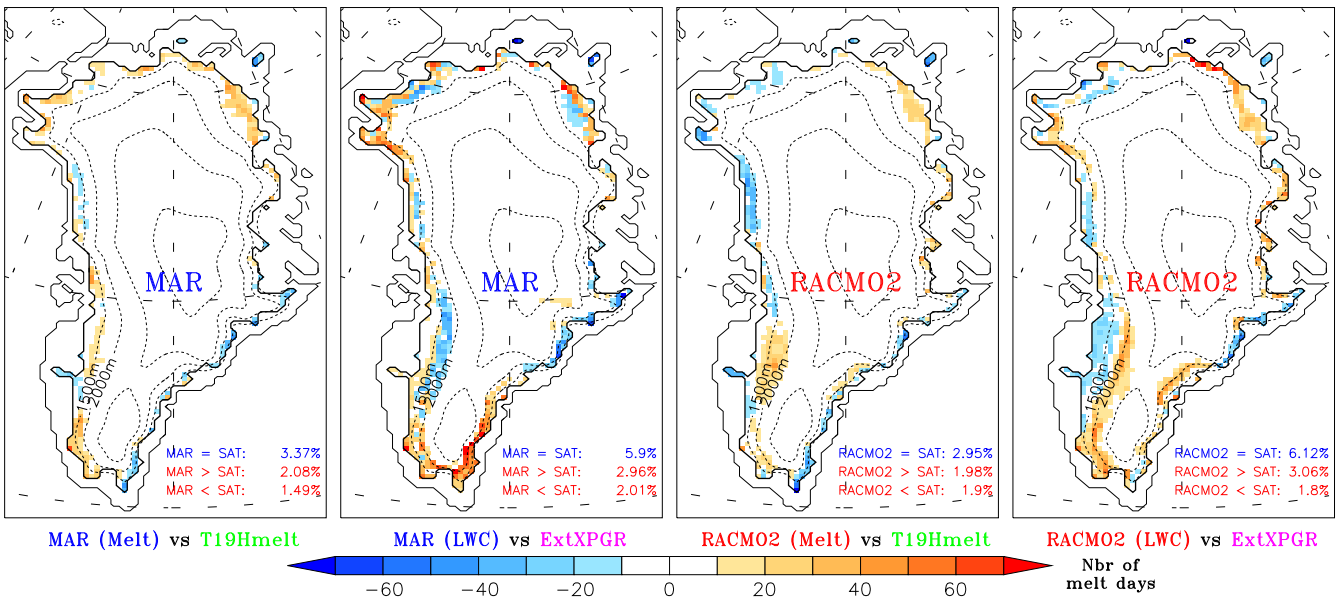

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.9
rmse: 2.83
Corr: 0.89
rmse: 2.85
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.93
rmse: 3.67
Corr: 0.95
rmse: 3.78
2000
MAY
JUN
JUL
AUG
SEP

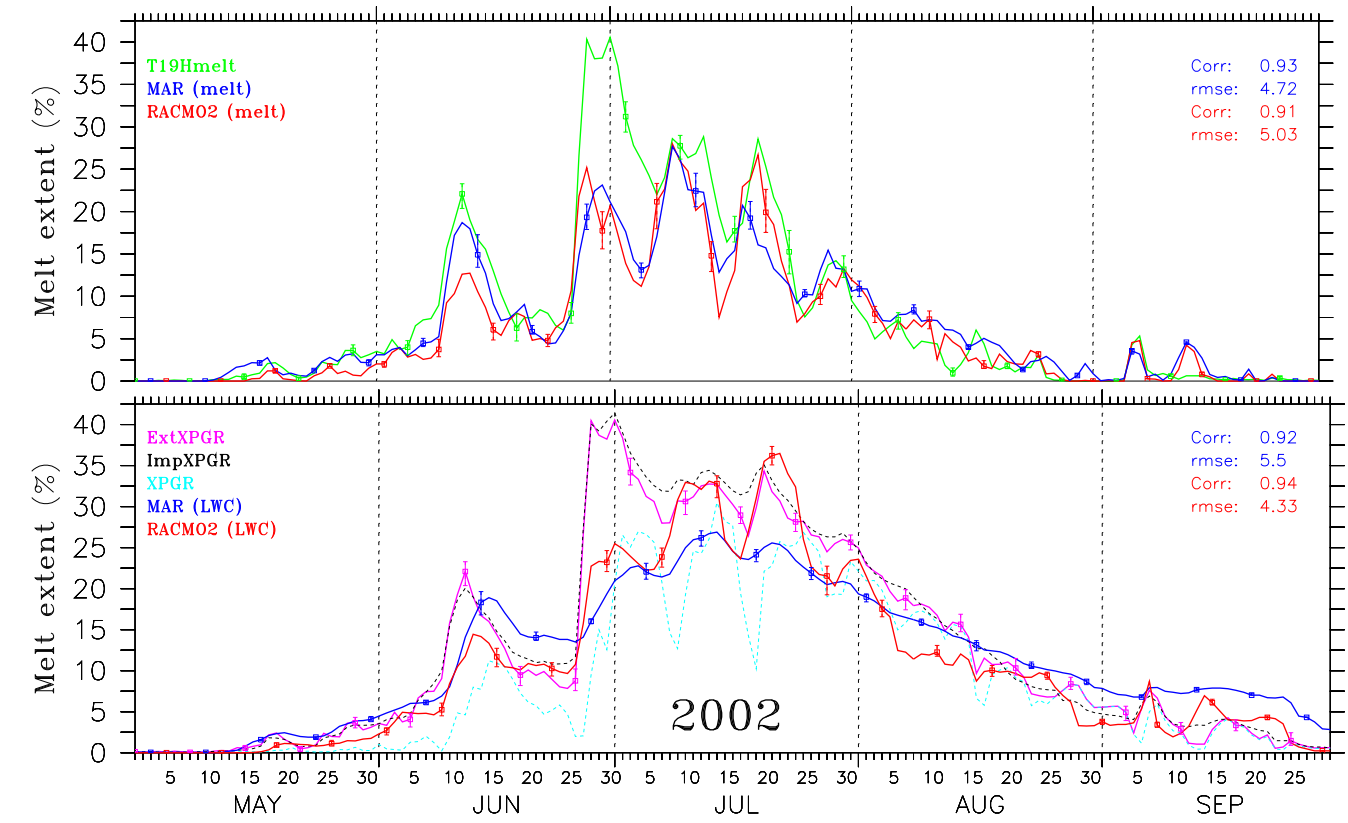

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

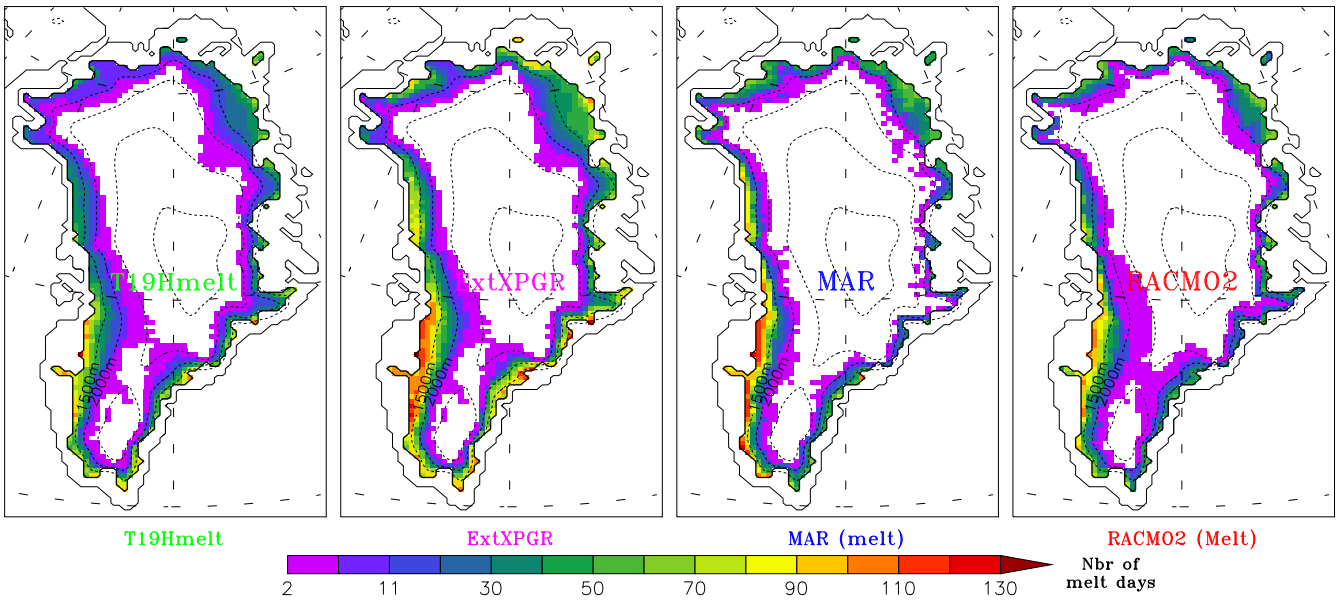

MAR
RACMO2
1500m
2000m
MAR = SAT: 3.47%
MAR > SAT: 2.32%
MAR < SAT: 1.76%
MAR = SAT: 5.99%
MAR > SAT: 3.98%
MAR < SAT: 1.72%
RACMO2 = SAT: 3.29%
RACMO2 > SAT: 1.88%
RACMO2 < SAT: 1.94%
RACMO2 = SAT: 5.89%
RACMO2 > SAT: 3.4%
RACMO2 < SAT: 1.83%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

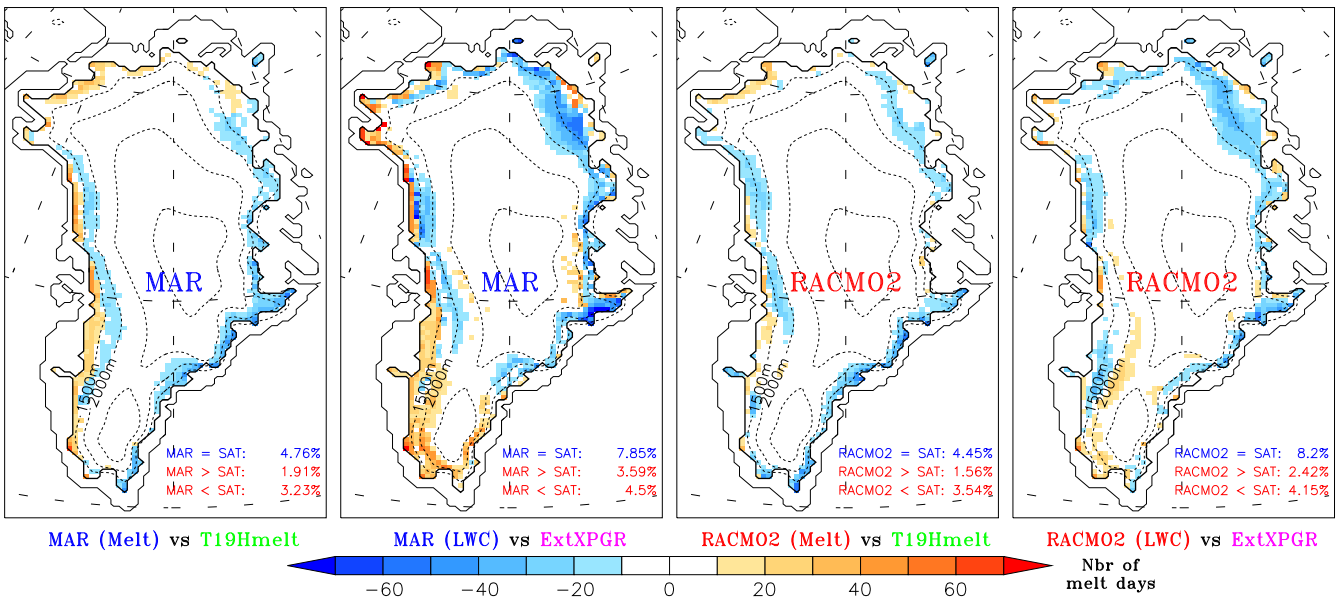

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.88
rmse: 2.61
Corr: 0.89
rmse: 2.35
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.94
rmse: 2.4
Corr: 0.95
rmse: 3.1
2001
MAY
JUN
JUL
AUG
SEP

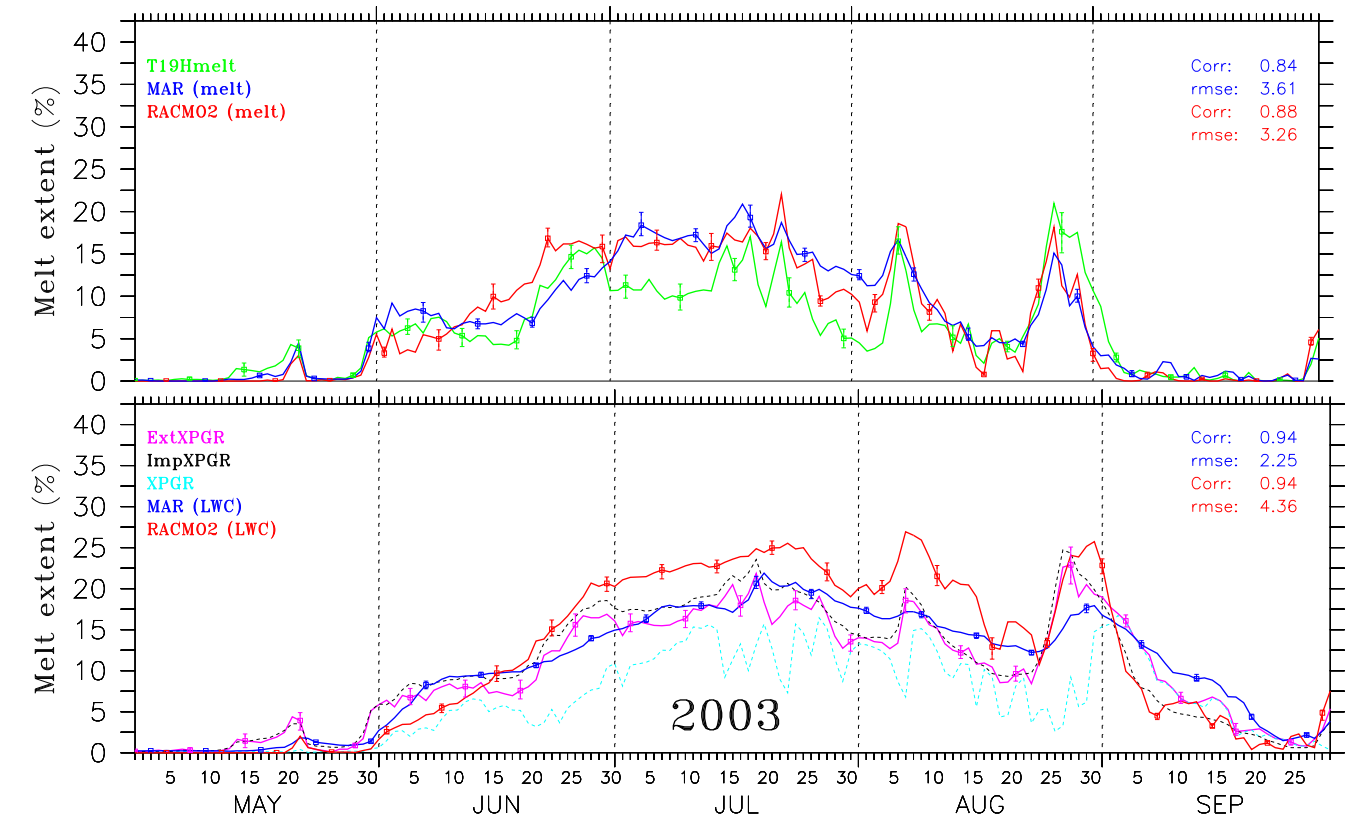

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

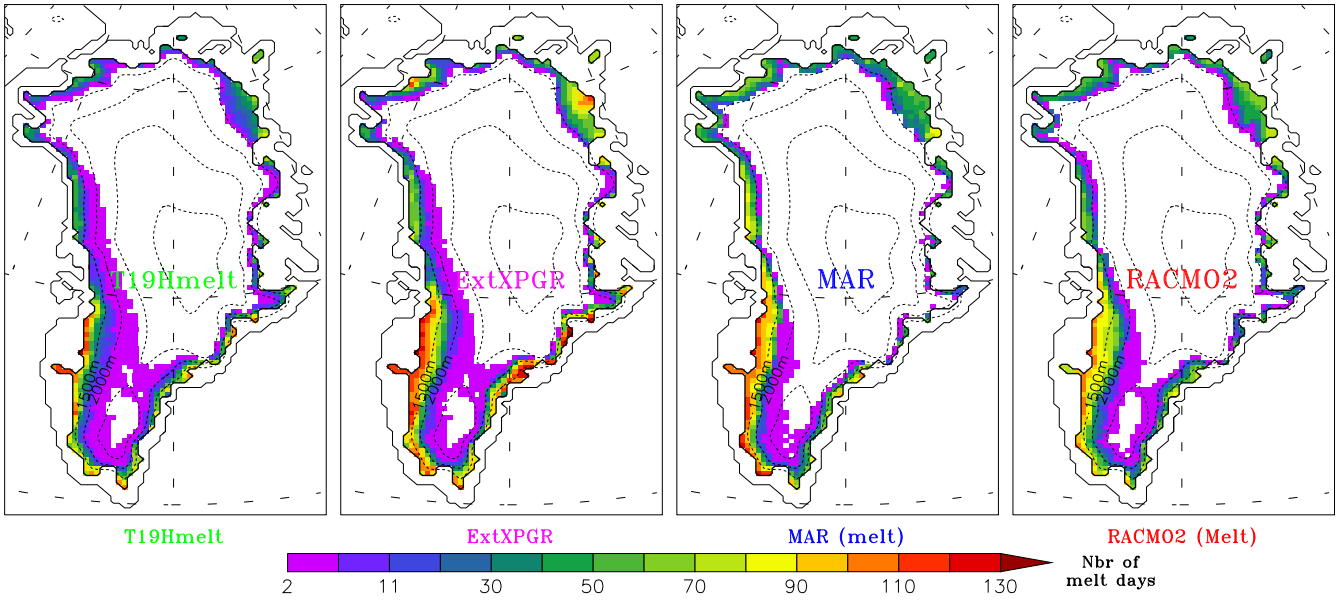

MAR
RACMO2
1500m
2000m
MAR = SAT: 3.37%
MAR > SAT: 2.08%
MAR < SAT: 1.49%
MAR = SAT: 5.9%
MAR > SAT: 2.96%
MAR < SAT: 2.01%
RACMO2 = SAT: 2.95%
RACMO2 > SAT: 1.98%
RACMO2 < SAT: 1.9%
RACMO2 = SAT: 6.12%
RACMO2 > SAT: 3.06%
RACMO2 < SAT: 1.8%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days


T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.93
rmse: 4.72
Corr: 0.91
rmse: 5.03
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.92
rmse: 5.5
Corr: 0.94
rmse: 4.33
2002
MAY
JUN
JUL
AUG
SEP

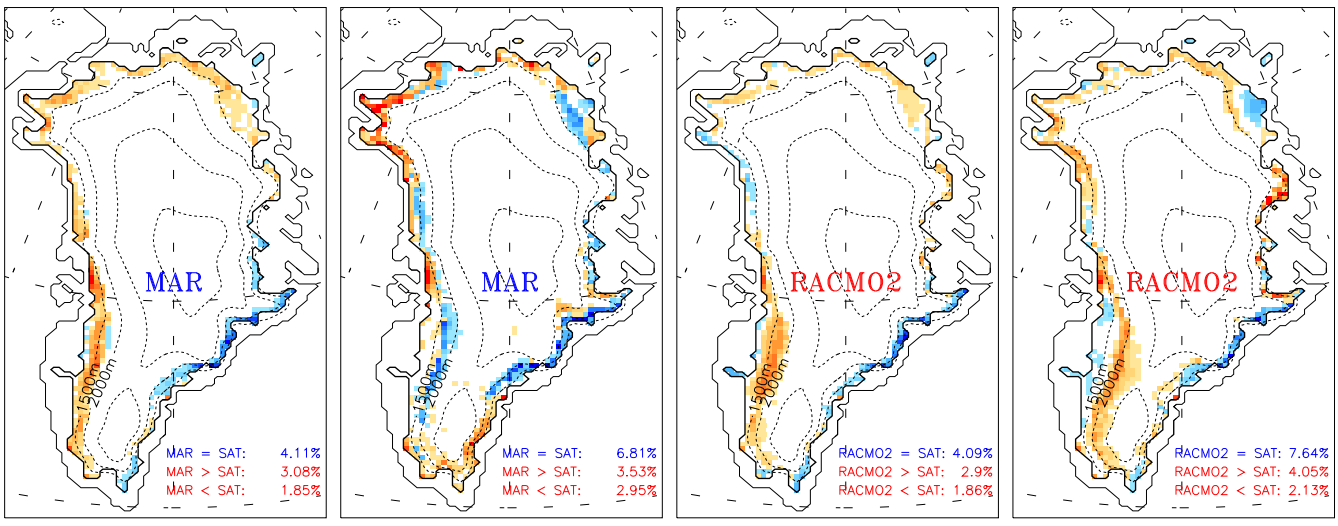

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days


MAR
MAR
RACMO2
RACMO2
MAR = SAT: 4.76%
MAR > SAT: 1.91%
MAR < SAT: 3.23%
MAR = SAT: 7.85%
MAR > SAT: 3.59%
MAR < SAT: 4.5%
RACMO2 = SAT: 4.45%
RACMO2 > SAT: 1.56%
RACMO2 < SAT: 3.54%
RACMO2 = SAT: 8.2%
RACMO2 > SAT: 2.42%
RACMO2 < SAT: 4.15%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

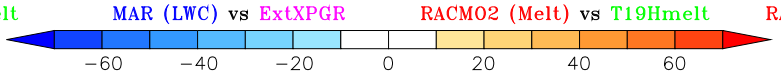


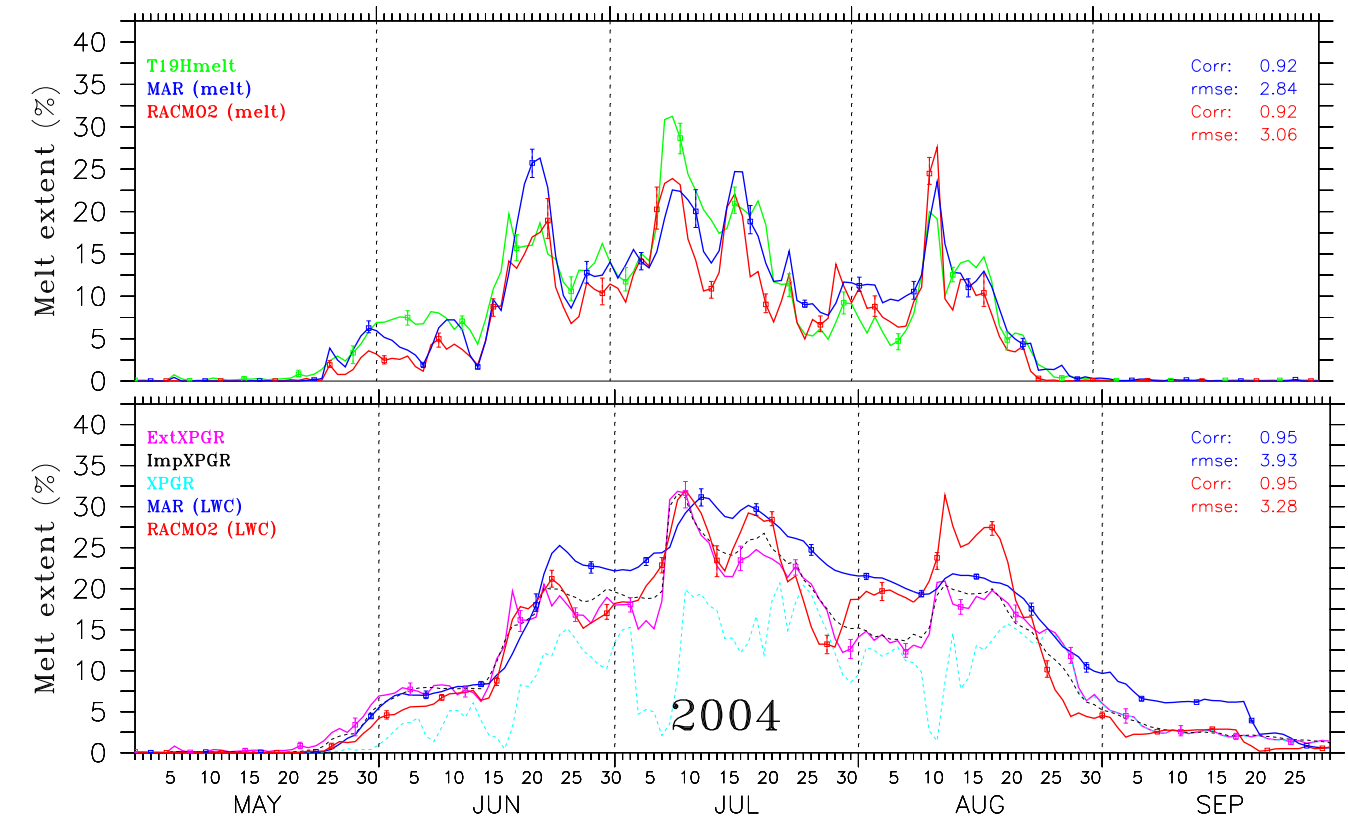


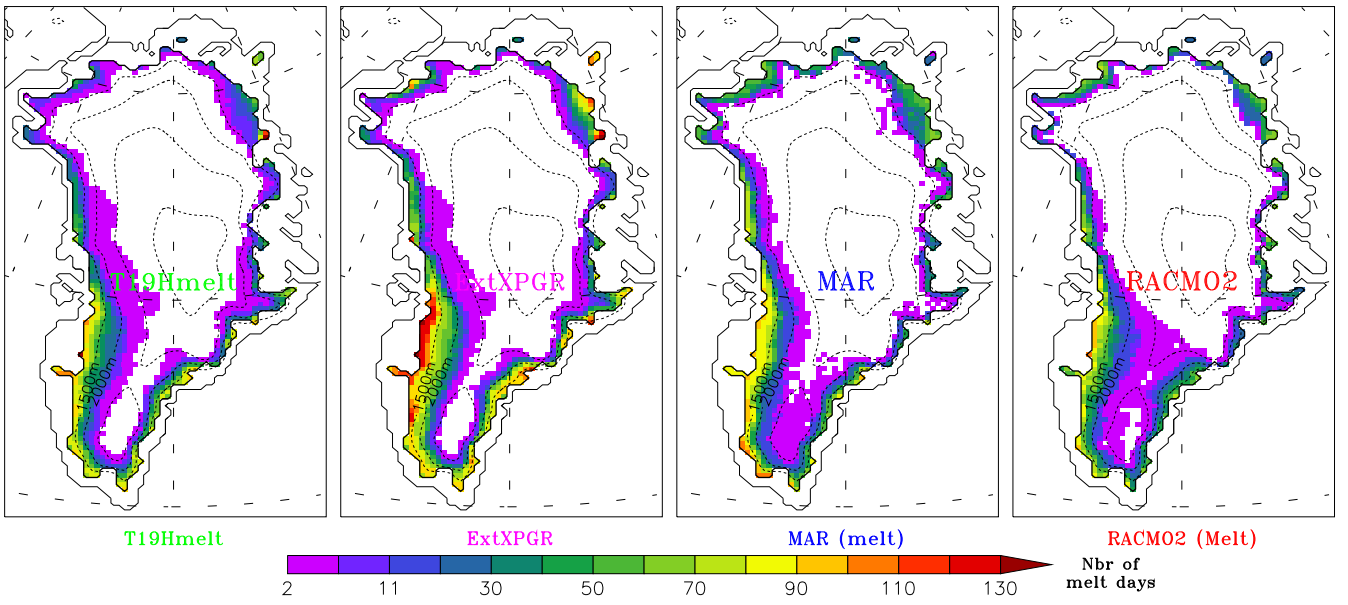
T19Hmelt ExtXPGR MAR (melt) RACMO2 (Melt)

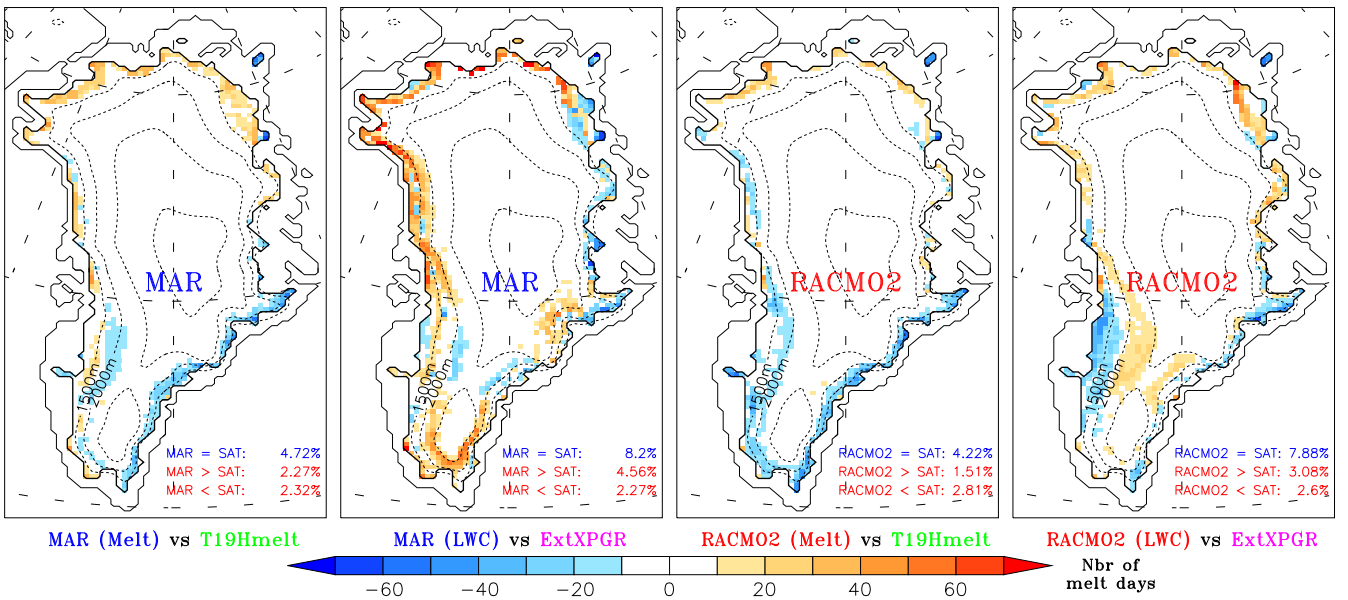


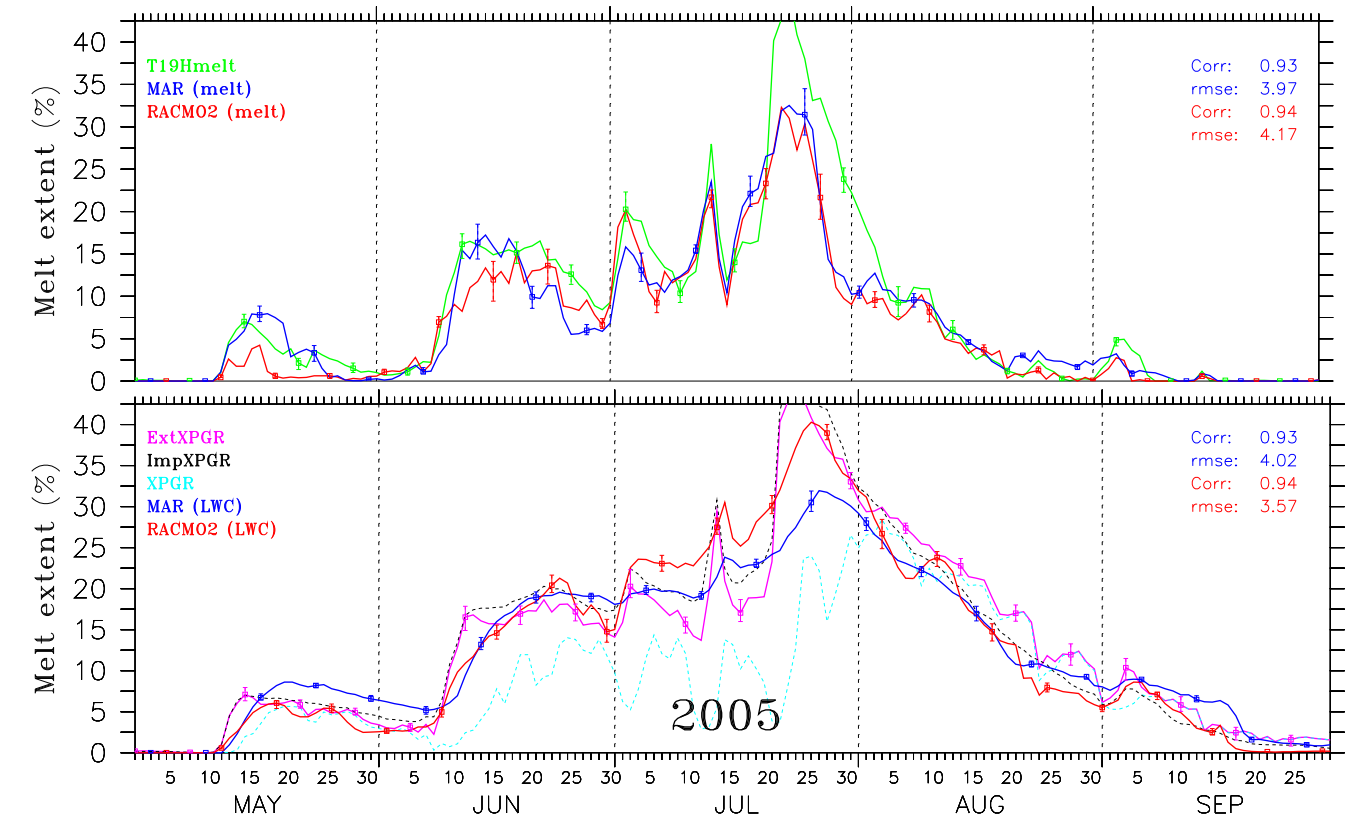
MAR (Melt) vs T19Hmelt MAR (LWC) vs ExtXPGR RACMO2 (Melt) vs T19Hmelt RACMO2 (LWC) vs ExtXPGR

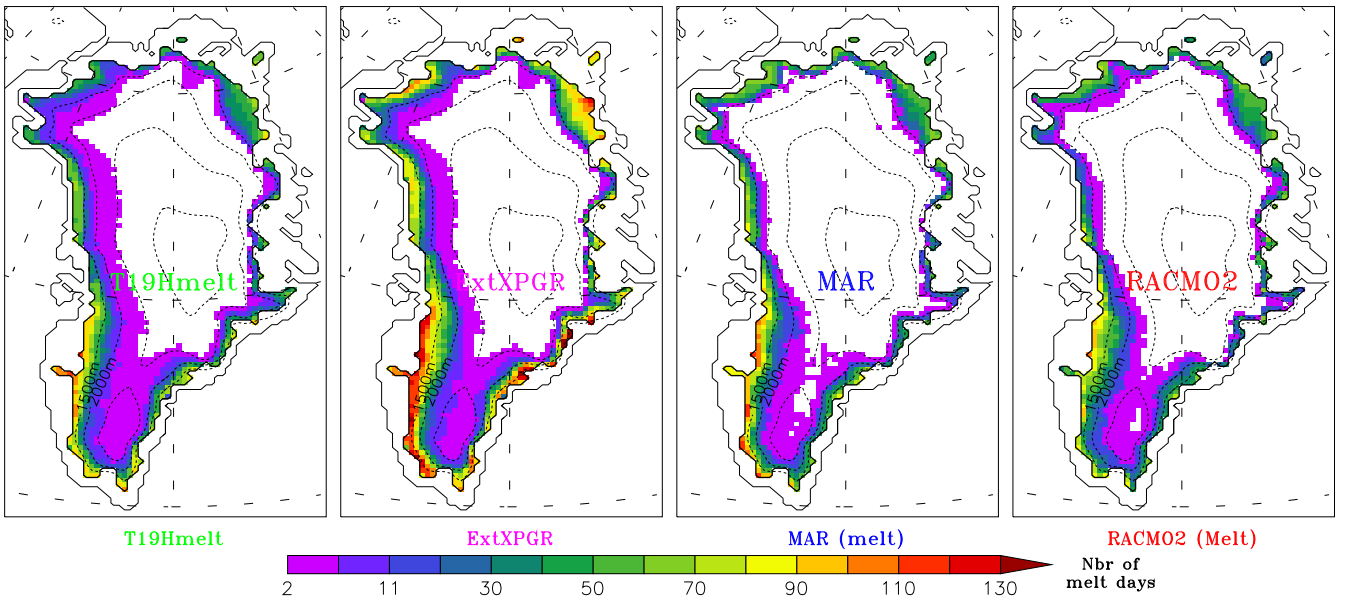


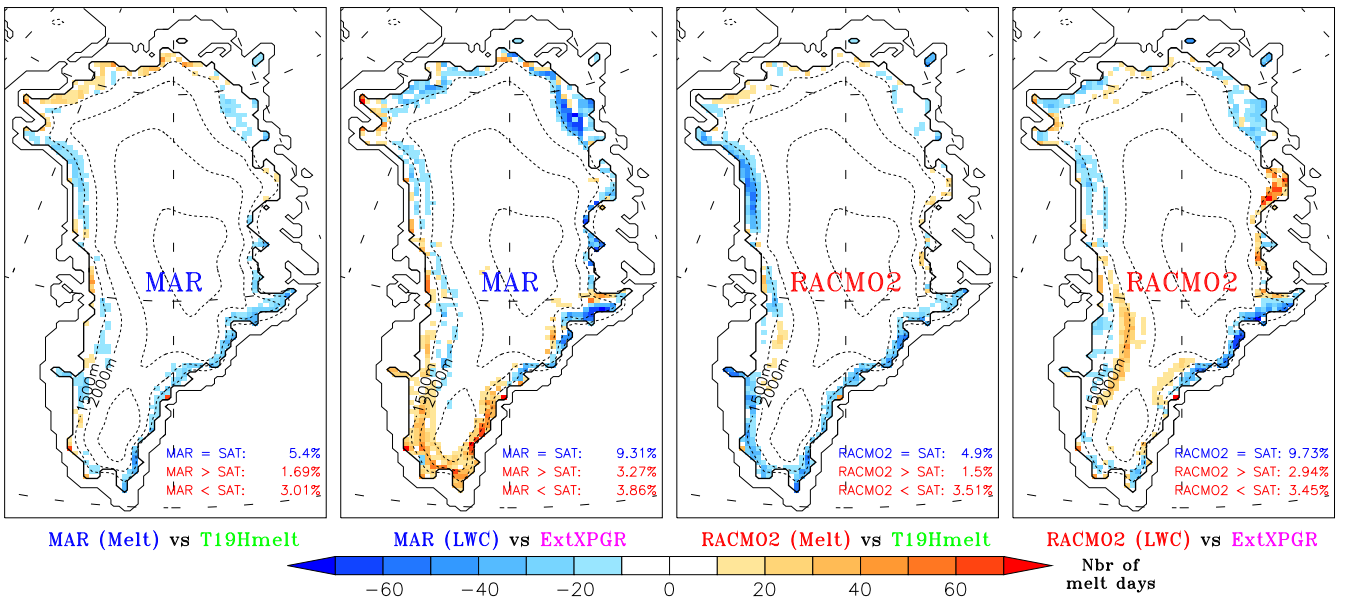

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.92
rmse: 2.84
Corr: 0.92
rmse: 3.06
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.95
rmse: 3.93
Corr: 0.95
rmse: 3.28
2004
MAY
JUN
JUL
AUG
SEP

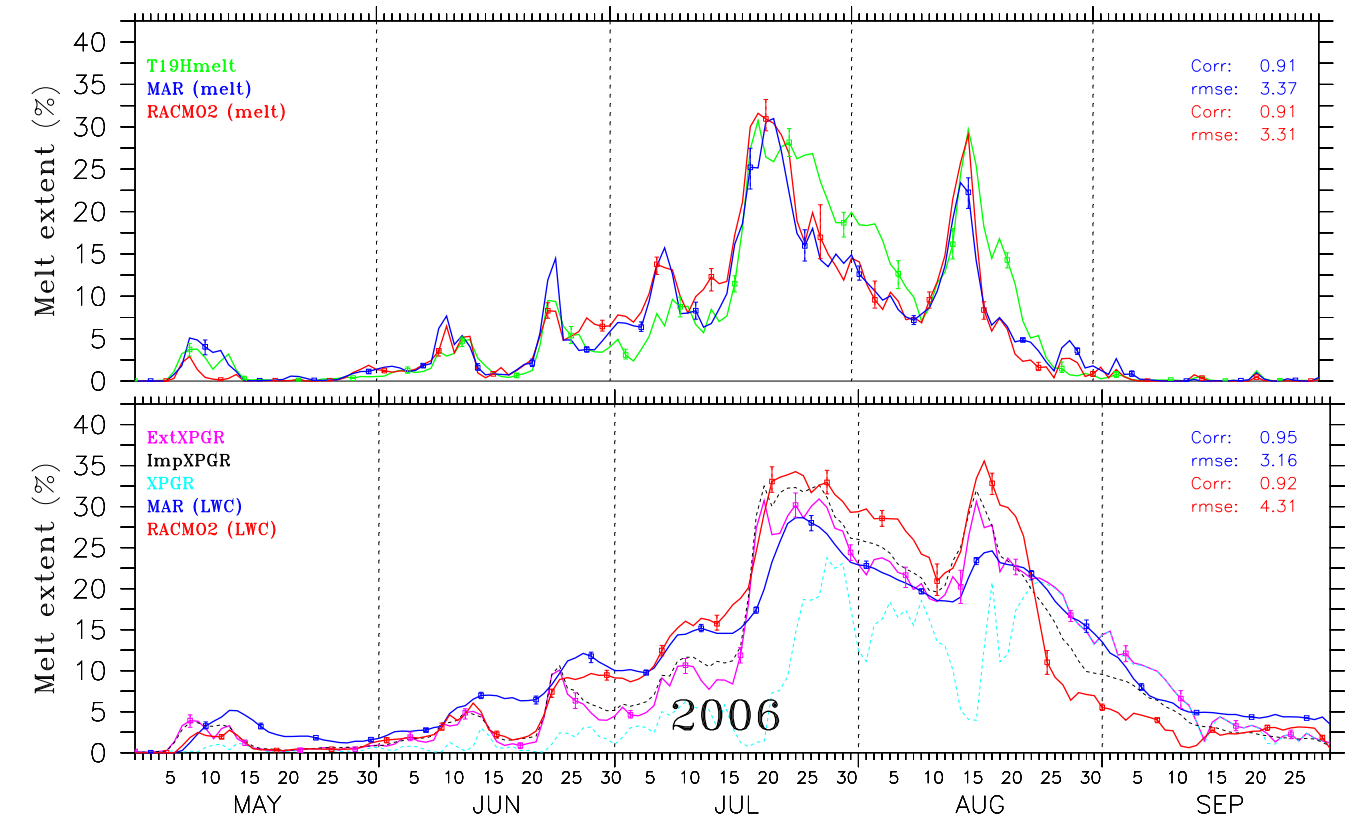

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

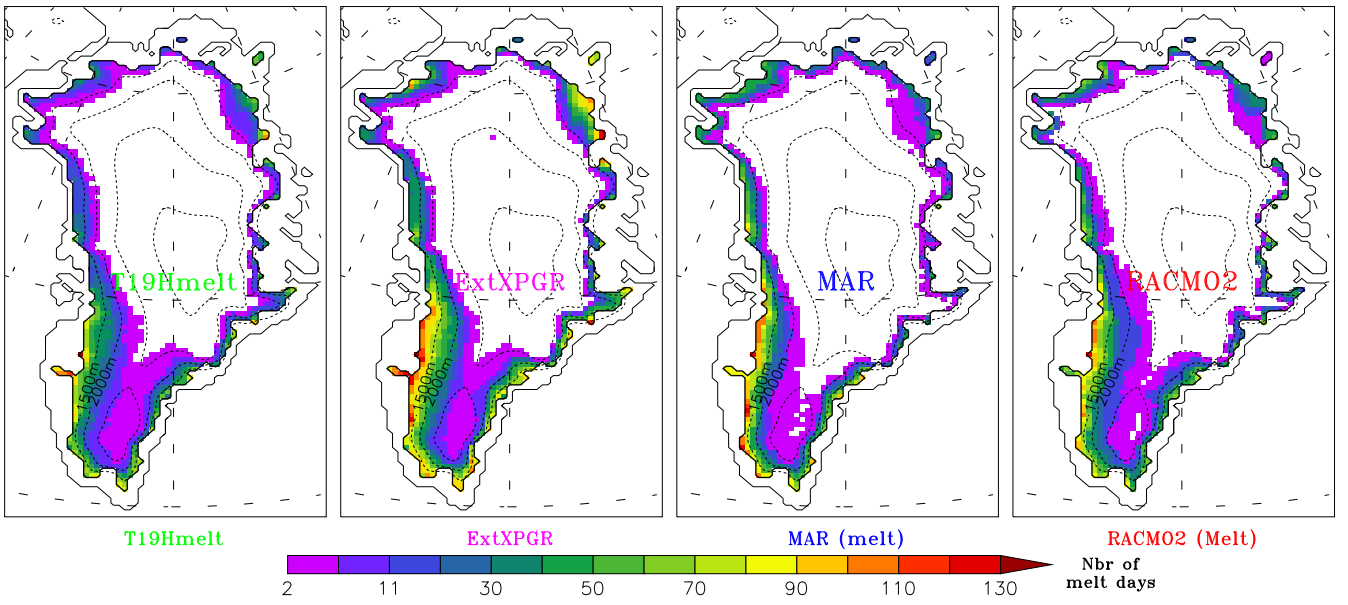

MAR
MAR
RACMO2
RACMO2
MAR = SAT: 4.72%
MAR > SAT: 2.27%
MAR < SAT: 2.32%
MAR = SAT: 8.2%
MAR > SAT: 4.56%
MAR < SAT: 2.27%
RACMO2 = SAT: 4.22%
RACMO2 > SAT: 1.51%
RACMO2 < SAT: 2.81%
RACMO2 = SAT: 7.88%
RACMO2 > SAT: 3.08%
RACMO2 < SAT: 2.6%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

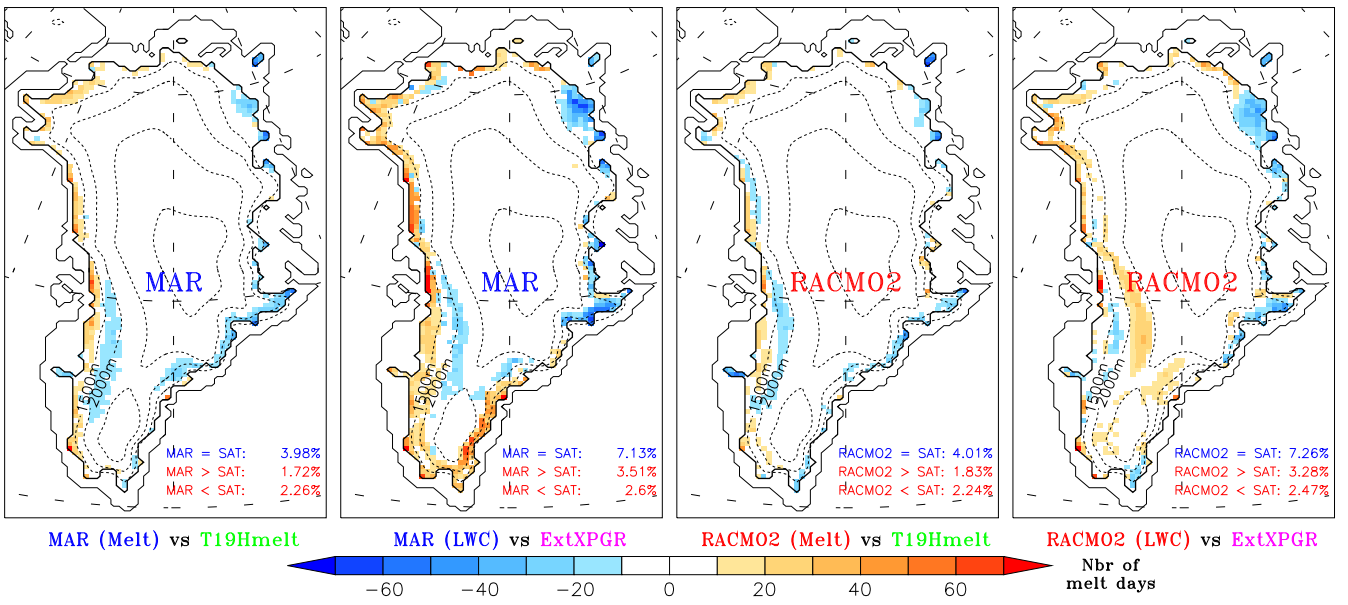

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.93
rmse: 3.97
Corr: 0.94
rmse: 4.17
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.93
rmse: 4.02
Corr: 0.94
rmse: 3.57
2005
MAY
JUN
JUL
AUG
SEP

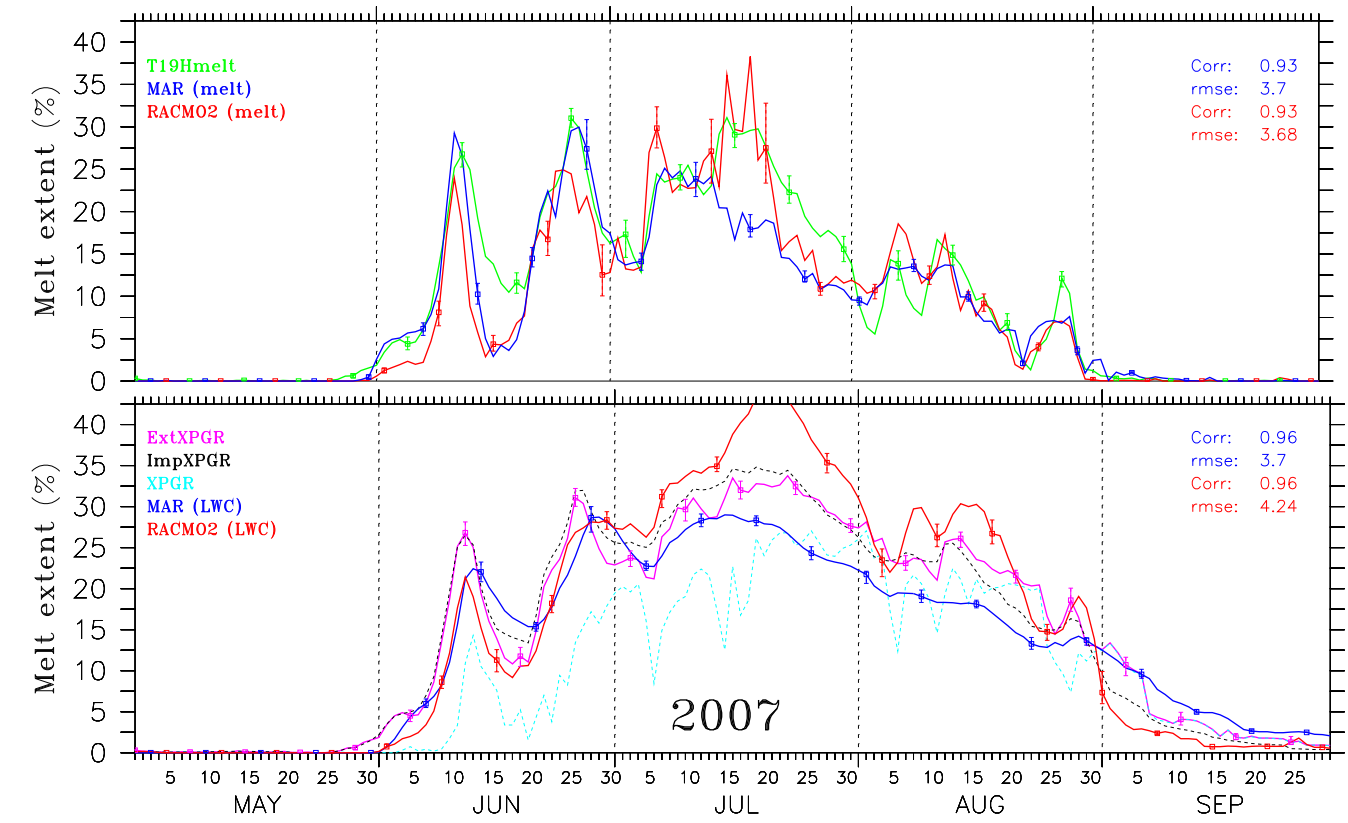

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

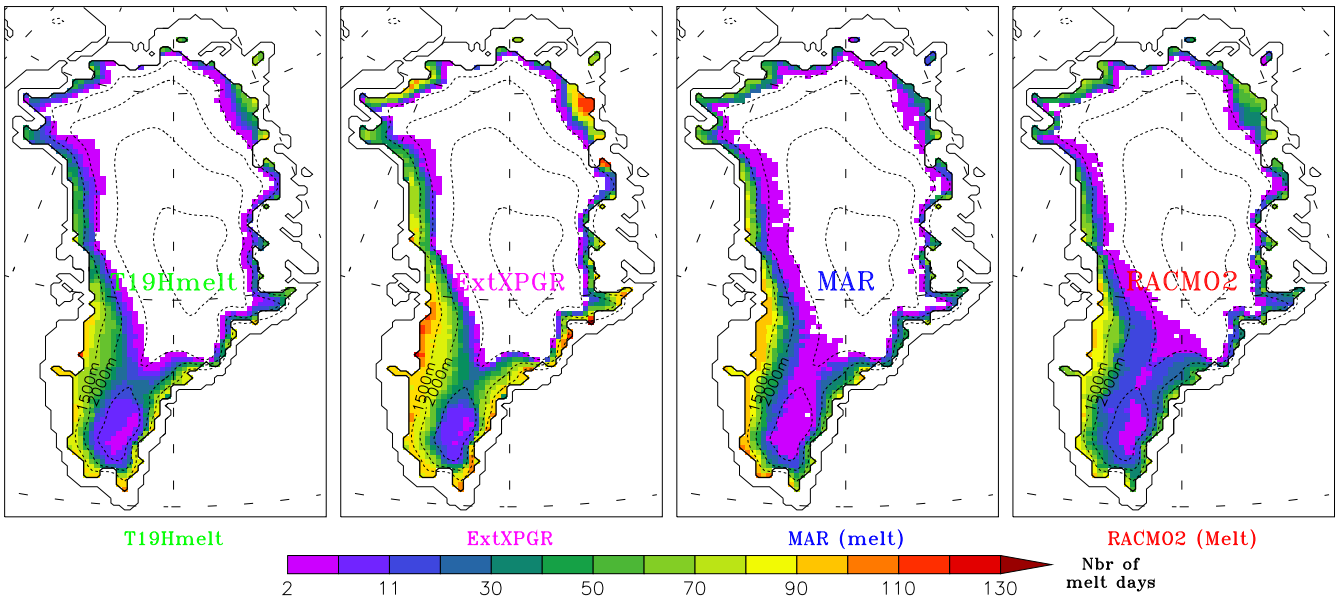

MAR
RACMO2
MAR = SAT: 5.4%
MAR > SAT: 1.69%
MAR < SAT: 3.01%
MAR = SAT: 9.31%
MAR > SAT: 3.27%
MAR < SAT: 3.86%
RACMO2 = SAT: 4.9%
RACMO2 > SAT: 1.5%
RACMO2 < SAT: 3.51%
RACMO2 = SAT: 9.73%
RACMO2 > SAT: 2.94%
RACMO2 < SAT: 3.45%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

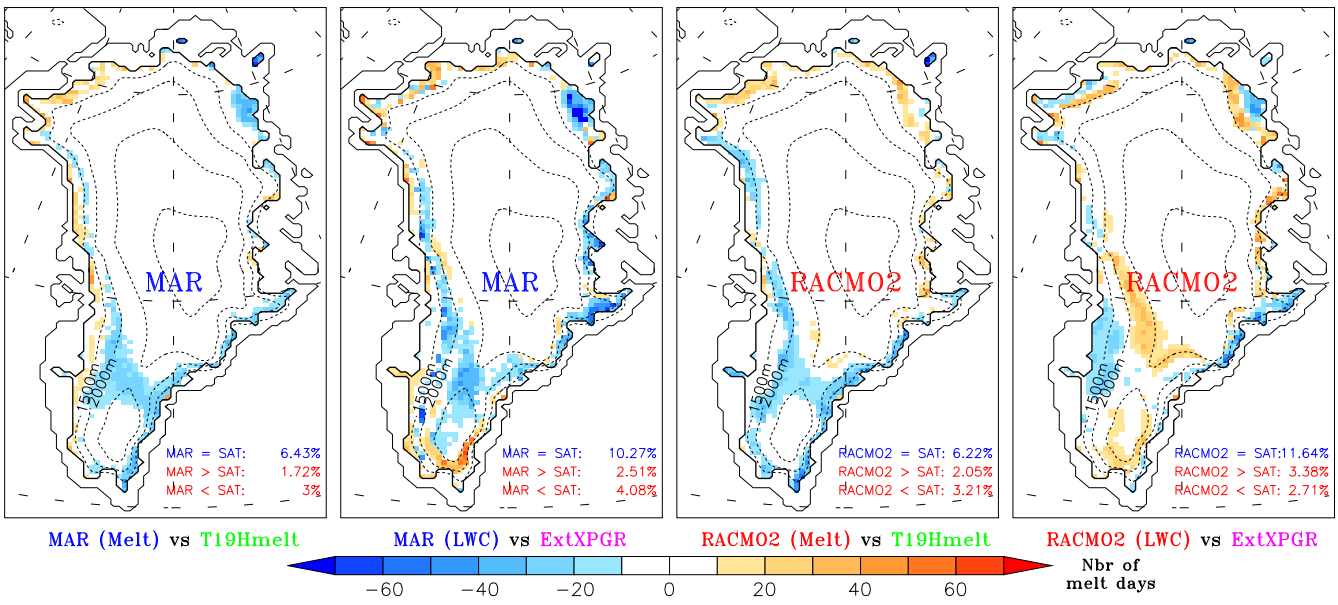

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.91
rmse: 3.37
Corr: 0.91
rmse: 3.31
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.95
rmse: 3.16
Corr: 0.92
rmse: 4.31
2006
MAY
JUN
JUL
AUG
SEP

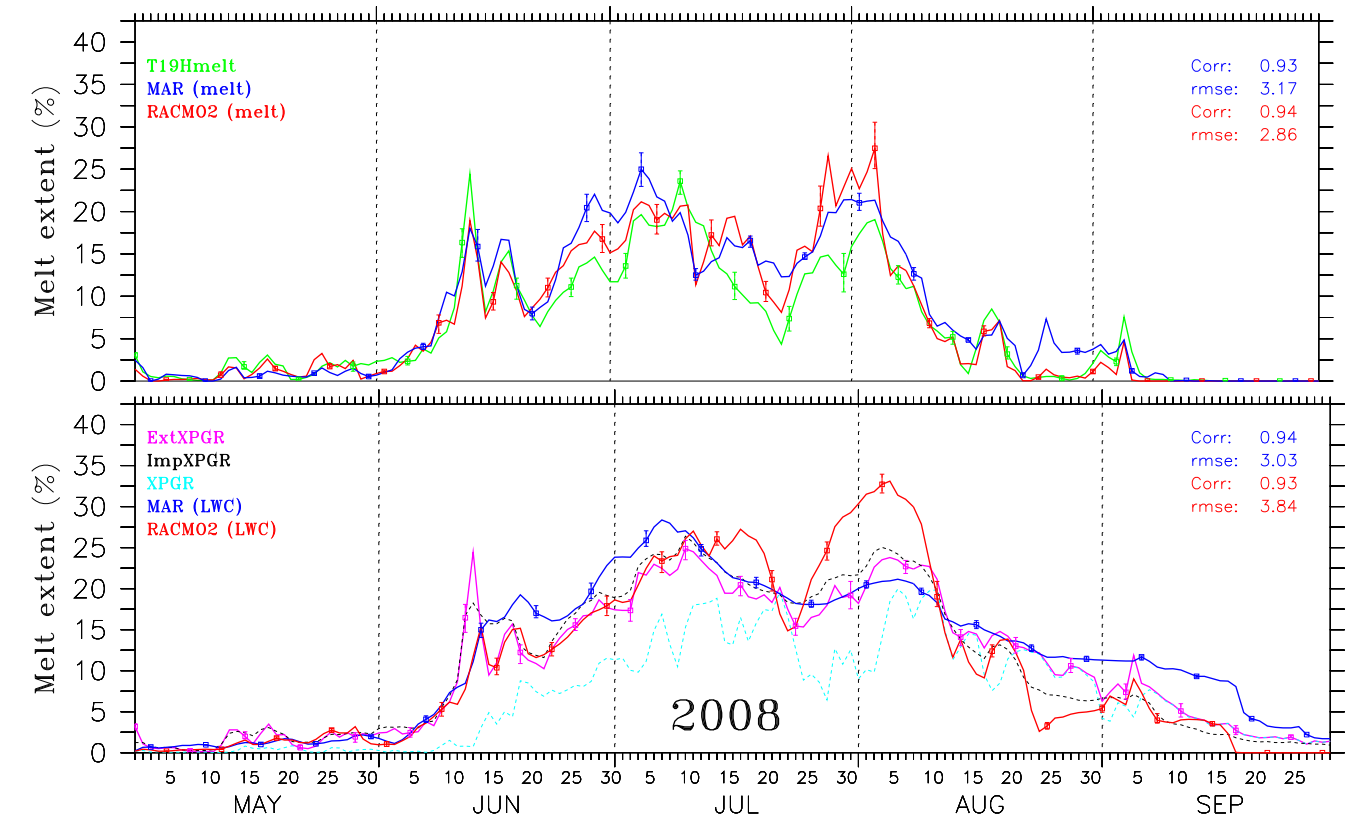

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

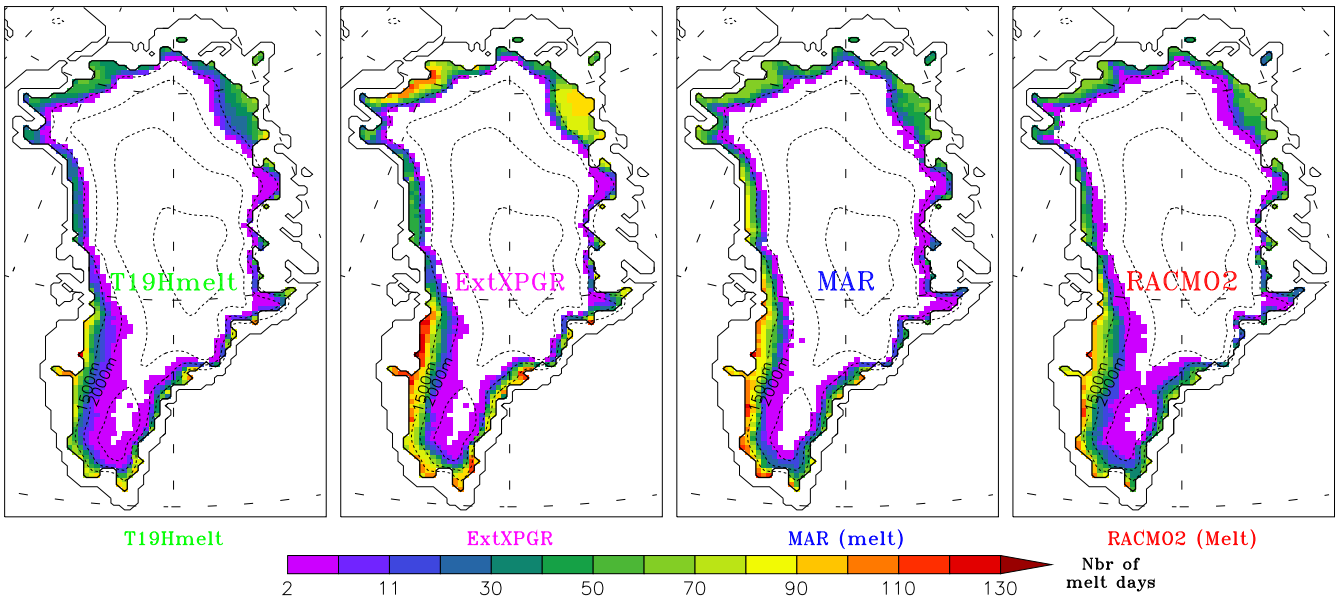

MAR
RACMO2
MAR = SAT: 3.98%
MAR > SAT: 1.72%
MAR < SAT: 2.26%
MAR = SAT: 7.13%
MAR > SAT: 3.51%
MAR < SAT: 2.6%
RACMO2 = SAT: 4.01%
RACMO2 > SAT: 1.83%
RACMO2 < SAT: 2.24%
RACMO2 = SAT: 7.26%
RACMO2 > SAT: 3.28%
RACMO2 < SAT: 2.47%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

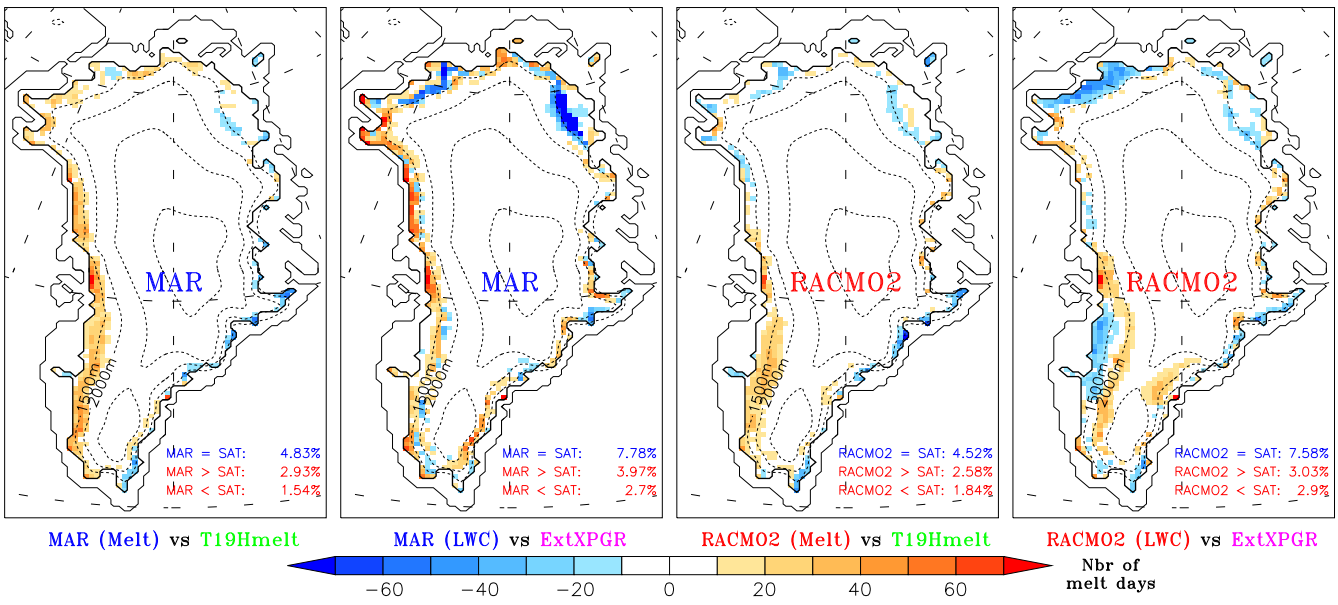

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.93
rmse: 3.7
Corr: 0.93
rmse: 3.68
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.96
rmse: 3.7
Corr: 0.96
rmse: 4.24
2007
MAY
JUN
JUL
AUG
SEP

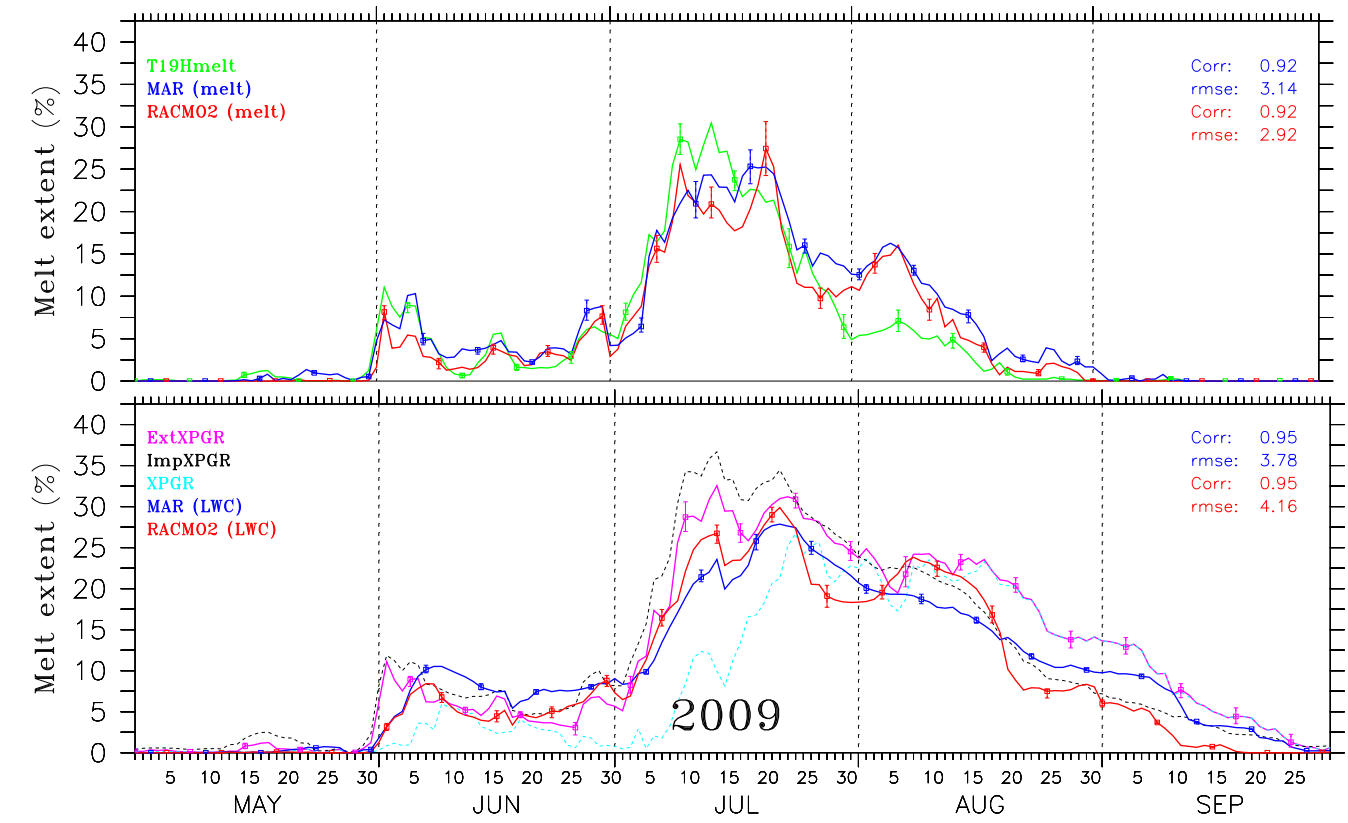

T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days

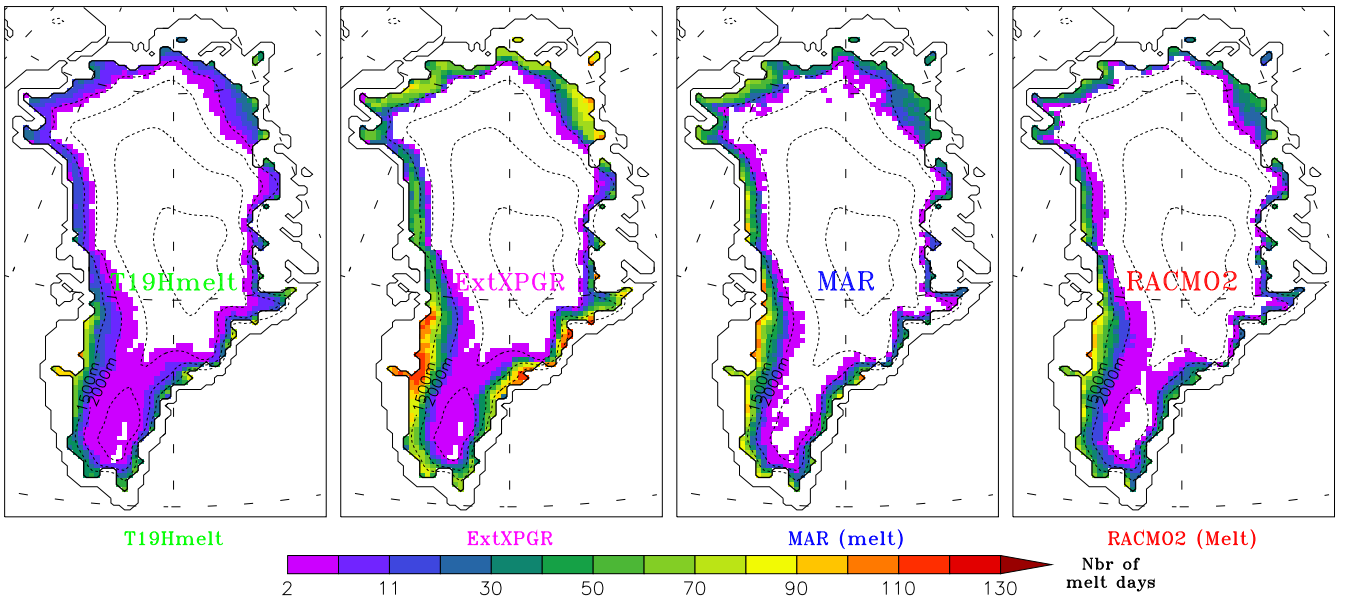

MAR
MAR
RACMO2
RACMO2
MAR = SAT: 6.43%
MAR > SAT: 1.72%
MAR < SAT: 3%
MAR = SAT: 10.27%
MAR > SAT: 2.51%
MAR < SAT: 4.08%
RACMO2 = SAT: 6.22%
RACMO2 > SAT: 2.05%
RACMO2 < SAT: 3.21%
RACMO2 = SAT:11.64%
RACMO2 > SAT: 3.38%
RACMO2 < SAT: 2.71%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days

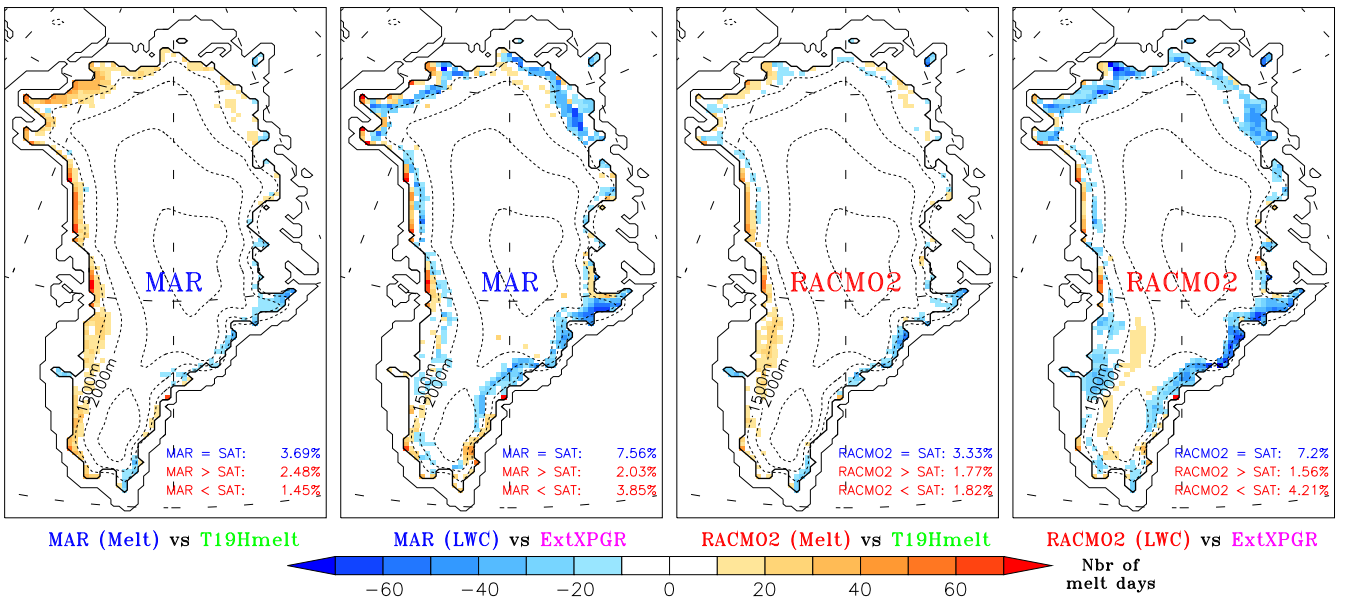

T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.93
rmse: 3.17
Corr: 0.94
rmse: 2.86
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.94
rmse: 3.03
Corr: 0.93
rmse: 3.84
2008
MAY
JUN
JUL
AUG
SEP


T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days


MAR
RACMO2
1500m
2000m
MAR = SAT: 4.83%
MAR > SAT: 2.93%
MAR < SAT: 1.54%
MAR = SAT: 7.78%
MAR > SAT: 3.97%
MAR < SAT: 2.7%
RACMO2 = SAT: 4.52%
RACMO2 > SAT: 2.58%
RACMO2 < SAT: 1.84%
RACMO2 = SAT: 7.58%
RACMO2 > SAT: 3.03%
RACMO2 < SAT: 2.9%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days


T19Hmelt
MAR (melt)
RACMO2 (melt)
Corr: 0.92
rmse: 3.14
Corr: 0.92
rmse: 2.92
Melt extent (%)
ExtXPGR
ImpXPGR
XPGR
MAR (LWC)
RACMO2 (LWC)
Corr: 0.95
rmse: 3.78
Corr: 0.95
rmse: 4.16
2009
MAY
JUN
JUL
AUG
SEP


T19Hmelt
ExtXPGR
MAR
RACMO2
1500m
2000m
T19Hmelt
ExtXPGR
MAR (melt)
RACMO2 (Melt)
2
11
30
50
70
90
110
130
Nbr of melt days


MAR
RACMO2
MAR = SAT: 3.69%
MAR > SAT: 2.48%
MAR < SAT: 1.45%
MAR = SAT: 7.56%
MAR > SAT: 2.03%
MAR < SAT: 3.85%
RACMO2 = SAT: 3.33%
RACMO2 > SAT: 1.77%
RACMO2 < SAT: 1.82%
RACMO2 = SAT: 7.2%
RACMO2 > SAT: 1.56%
RACMO2 < SAT: 4.21%
MAR (Melt) vs T19Hmelt
MAR (LWC) vs ExtXPGR
RACMO2 (Melt) vs T19Hmelt
RACMO2 (LWC) vs ExtXPGR
−60
−40
−20
0
20
40
60
Nbr of melt days