

# Examining the strength of the link between surface temperature and surface mass balance in ice cores and models over the last centuries in Antarctica

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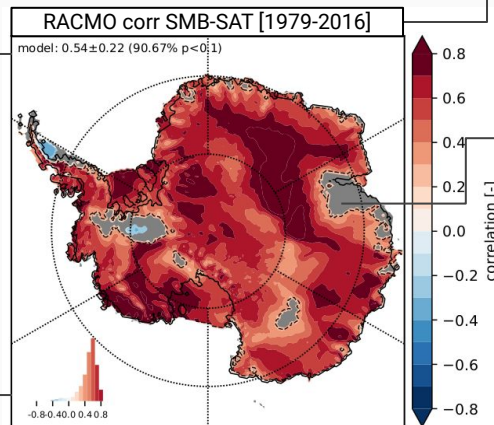
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# General info: how to read my figures

Average of correlation values over the region shown in the figure, +/- spatial standard deviation, (percentage of surface area with significant correlation values)

Describes which two variables are used for the correlation and the time interval that the correlation is calculated over



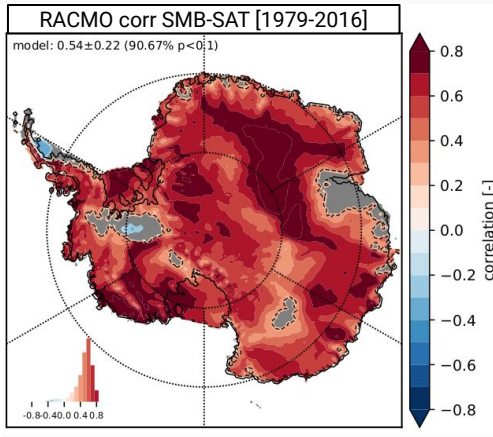
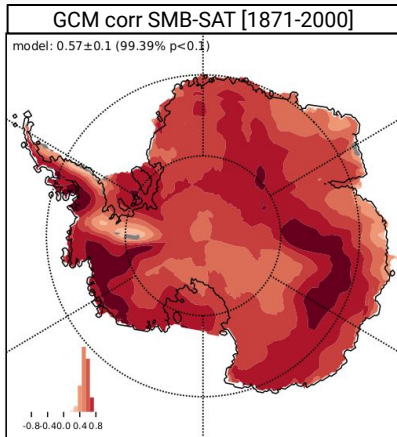
Greyed-out areas = areas with a correlation p-value > 0.1

Histogram of correlation values over the region shown in the figure

**ACRONYM DEFINITIONS**  
 GCM=Global Climate Model  
 RACMO=Regional Atmospheric Climate Model (version 2.3p2 used here)  
 SMB=Surface Mass Balance (~snowfall in Antarctica)  
 SAT=Surface Air Temperature  
 MSWD=Mean Slope in the Wind Direction

# The SMB-SAT link varies with spatial scale

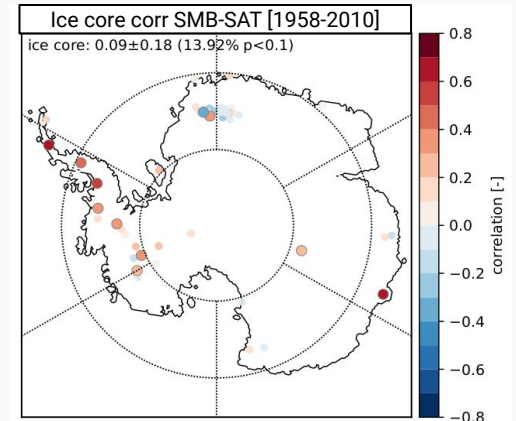
## Models



RACMO resolution = 27 km

Strong & positive SMB-SAT link in global climate models & regional climate model RACMO2.3  
(~ same results for SMB- $\delta^{18}\text{O}$  link)

## Ice cores



Large difference in correlation strength

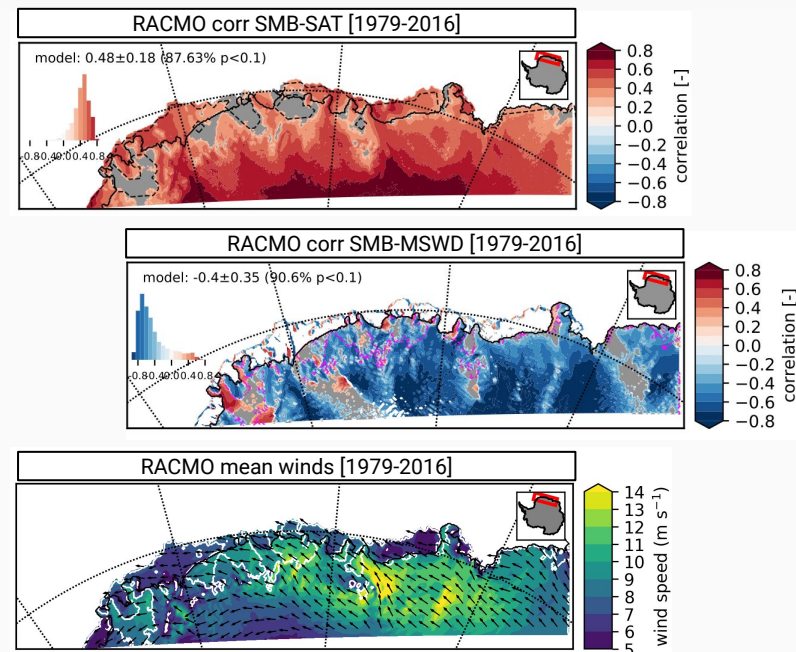
Weak SMB-SAT link for ice cores (~same results for SMB- $\delta^{18}\text{O}$  link)

Ice core data compilations from [Thomas et al., 2017](#) (SMB); [Stenni et al., 2017](#) ( $\delta^{18}\text{O}$ ); surface air temperature from [Nicolas and Bromwich, 2014](#) (SAT)

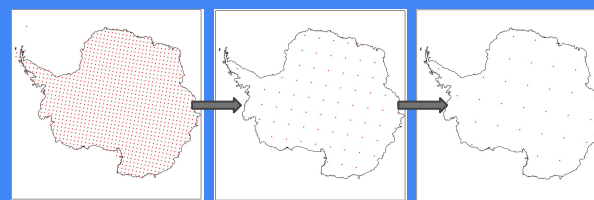
# Why does the SMB-SAT link vary with location?

Although most of AIS has a positive SMB-SAT link, a few areas have a weak SMB-SAT link.

These areas are likely linked to **wind-induced processes** interacting with surface topography that affects both SMB & SAT independently. E.g. Foehn winds ( $\Delta$ SAT across topography), katabatic winds that remobilize snow ( $\Delta$ SMB), topographic effects ( $\Delta$ SMB).



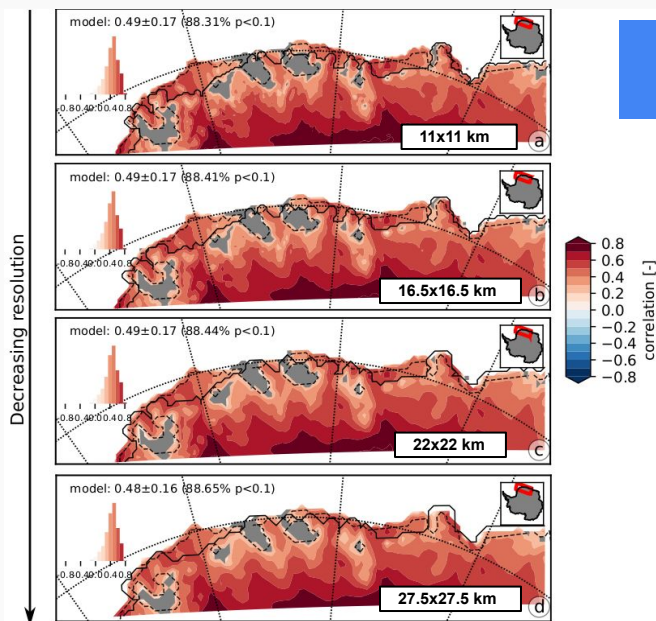
RACMO resolution = 5.5 km



# How does the SMB-SAT link vary with scale?

## Models

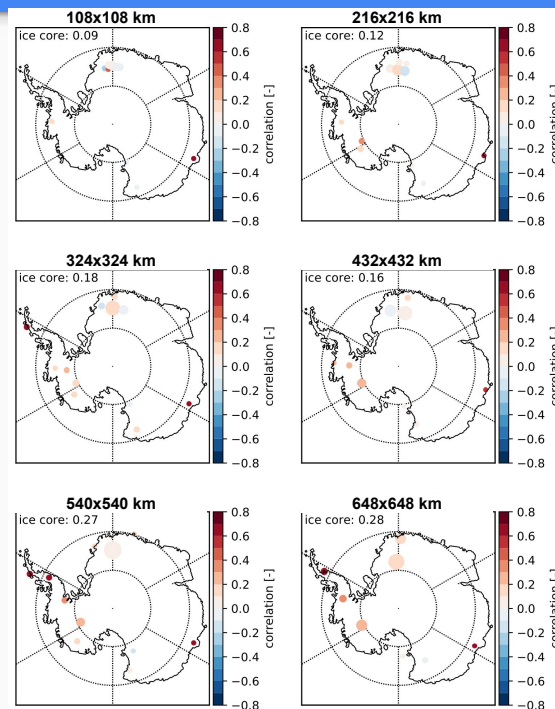
SMB-SAT link doesn't change. Remains strong & positive



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## Ice cores

SMB-SAT link increases but remains lower than for models



# Take away points

- GCMs and RACMO:

Strong & positive SMB-SAT (and  $\delta^{18}\text{O}$ -SMB) correlation over most of Antarctica. This correlation is spatial resolution-independent. Wind-induced processes interacting with surface topography reduce the correlation in a few specific regions of Antarctica.

- Ice cores and observed air temperatures:

Weak SMB-SAT (and  $\delta^{18}\text{O}$ -SMB) correlation, spatially aggregating individual ice core records increases the correlation due to likely random noise reduction. **BUT** correlation in ice cores remains lower than in the models.

- Local processes impact the spatial representativity of the ice core records?

Examine using radar-derived SMB as an intermediate spatial scale