Estimating Antarctic ice sheet surface mass balance contribution to future sea level using MAR

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Antarctic Surface Mass Balance

Cold microphysics, turbulence

Surface (snow-pack) processes

High resolution

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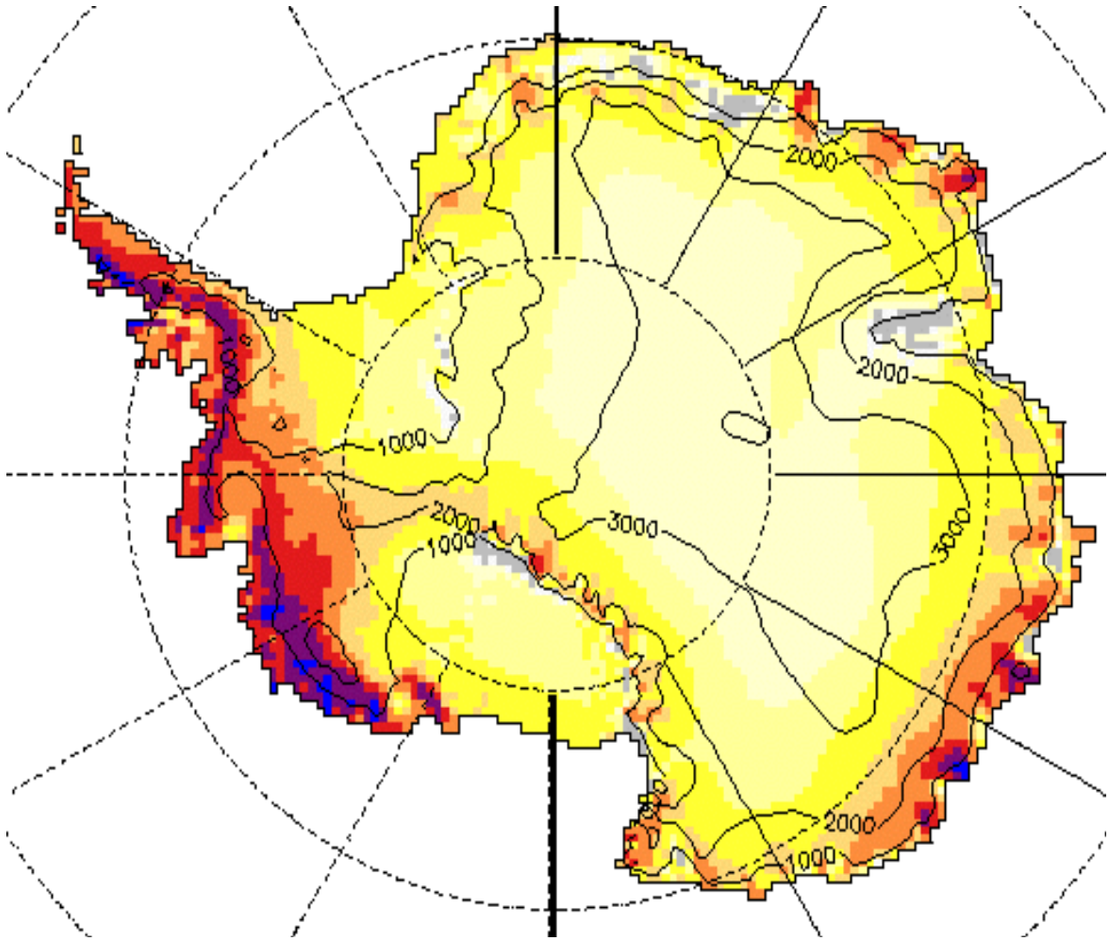
Large-scale circulation

Regional atmospheric climate model

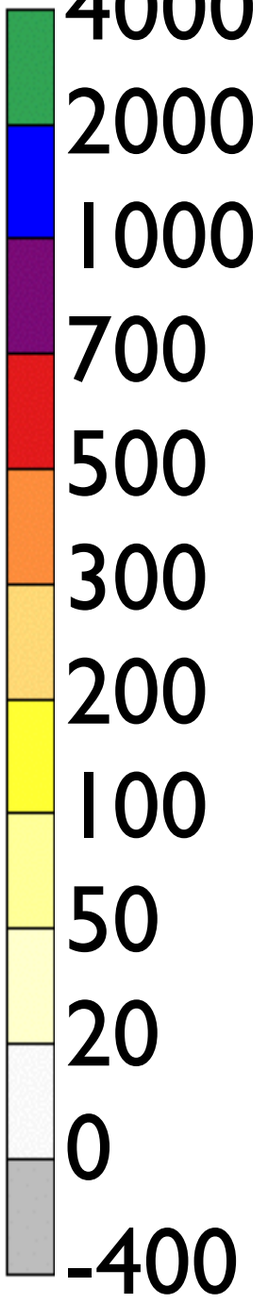
Global climate model

MAR-Antarctica : ERA-Interim forcing

MAR ERA-Interim (40km)
SMB 1979-2011

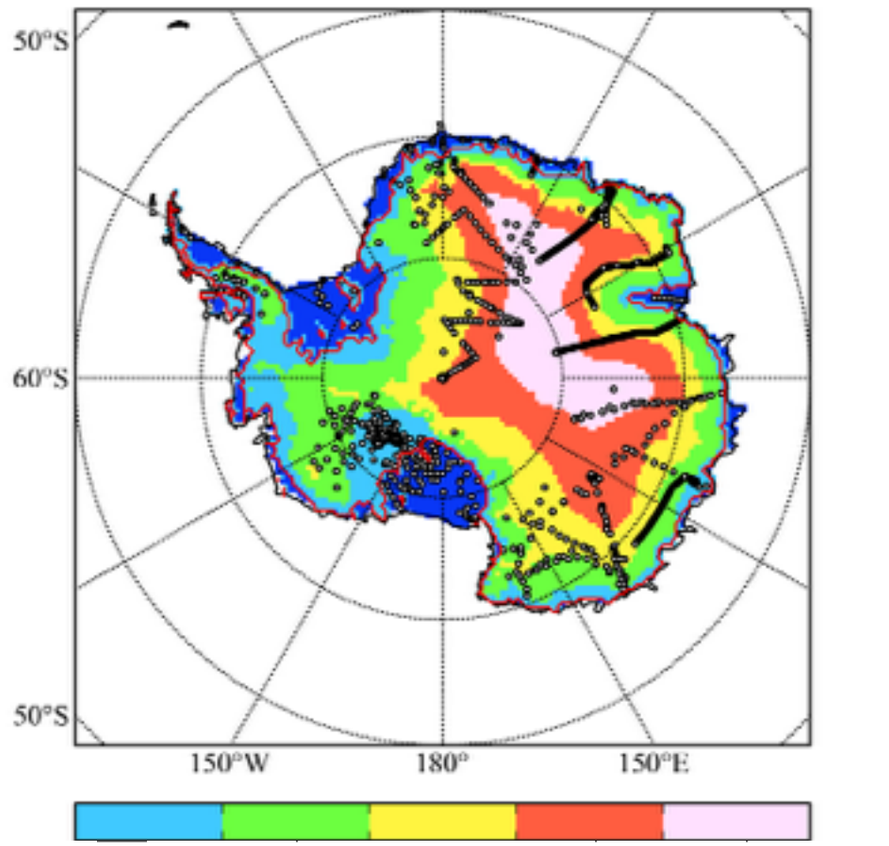


kg m^{-2} y^{-1}



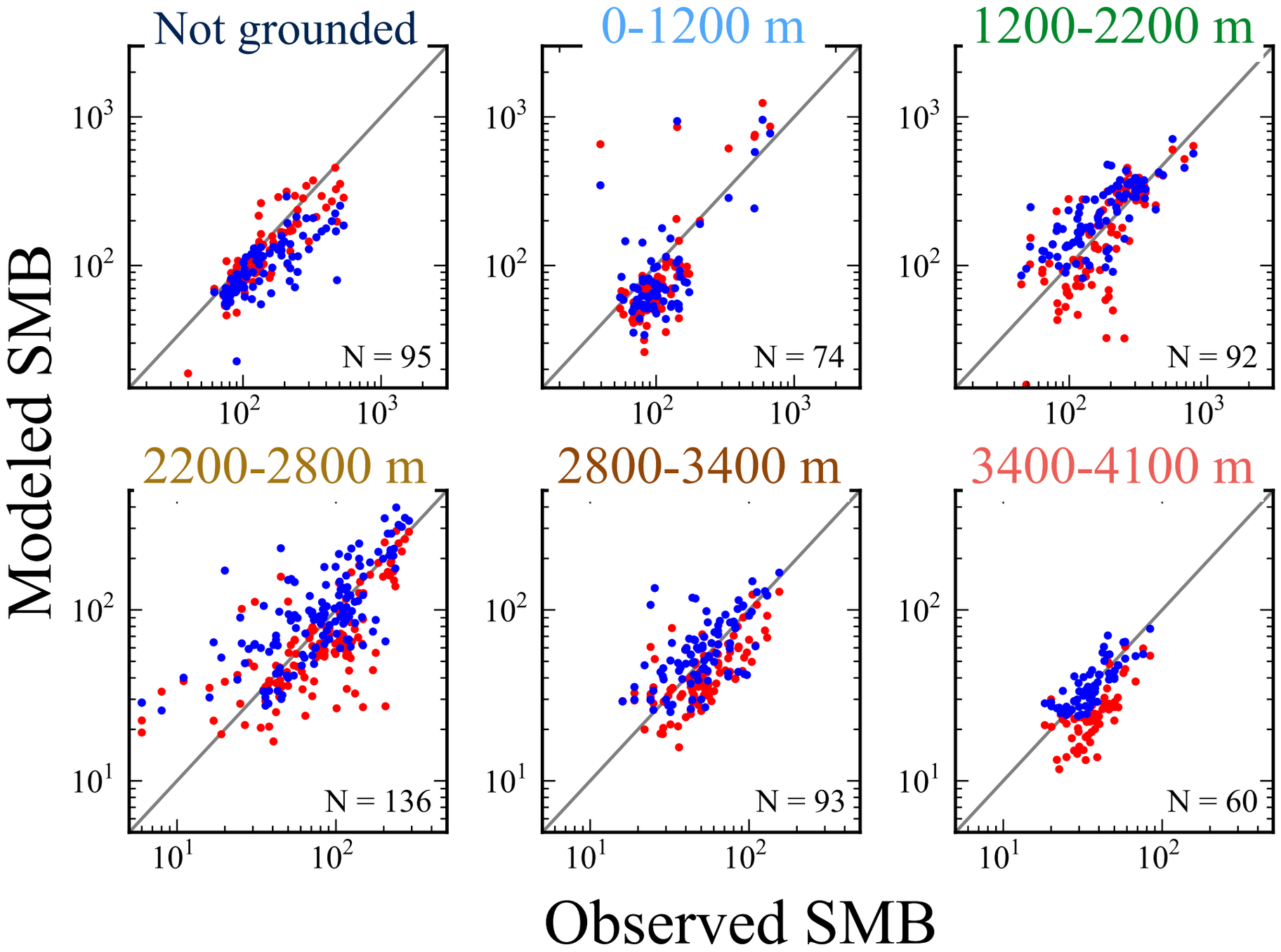
Grounded :
166 kg m^{-2} y^{-1} / 2000 Gt y^{-1}

GLACIOCLIM-SAMBA
quality-controled SMB dataset



MAR-Antarctica : ERA-Interim forcing

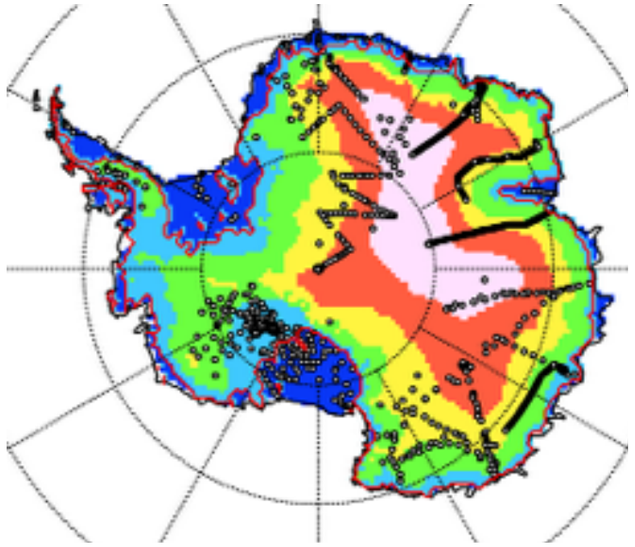
GLACIOCLIM-SAMBA quality-controled SMB dataset



MAR 40km

RACMO2.1 27km

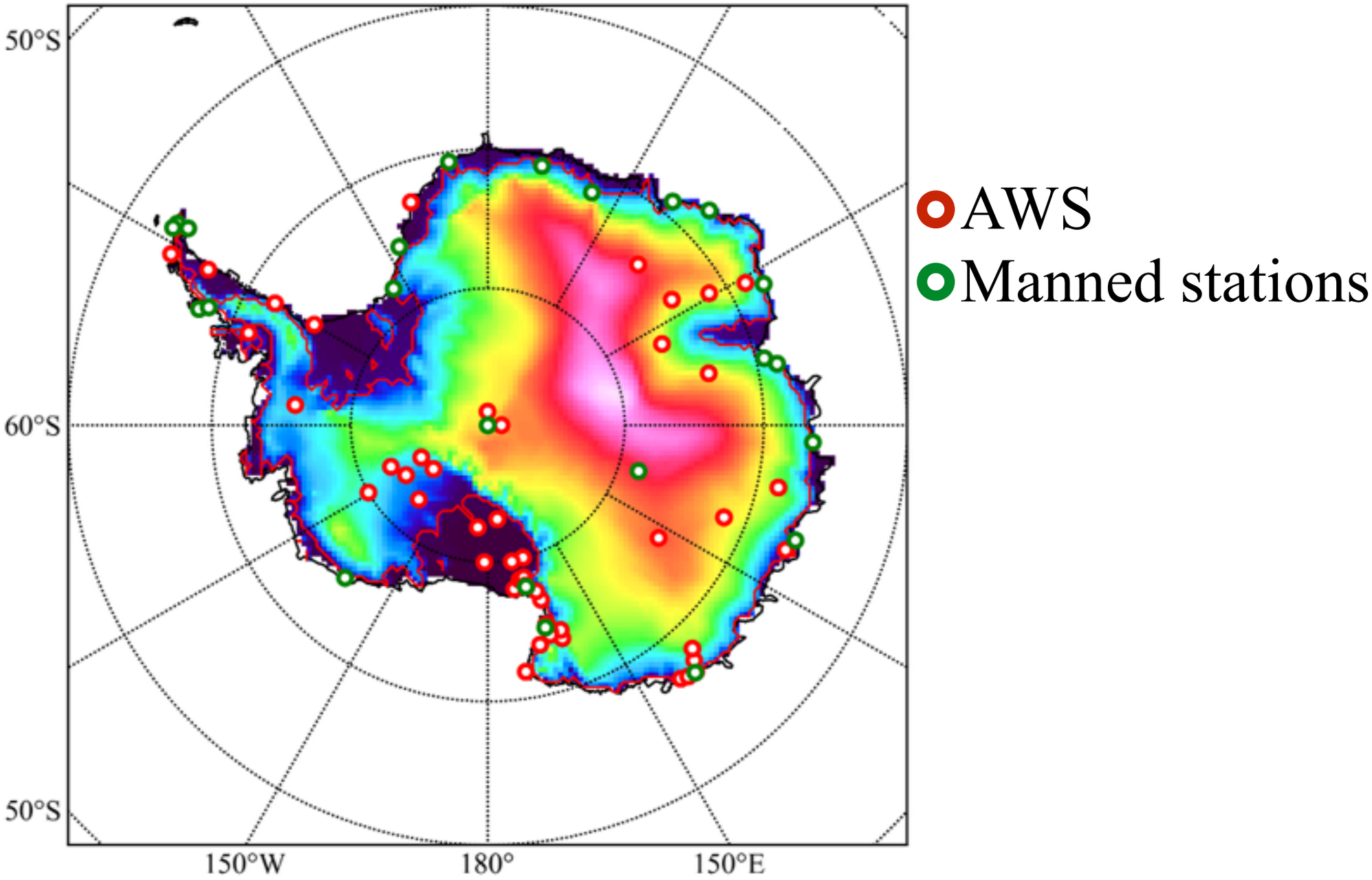
(Lenaerts et al. 2012)



MAR-Antarctica : ERA-Interim forcing

READER surface weather dataset

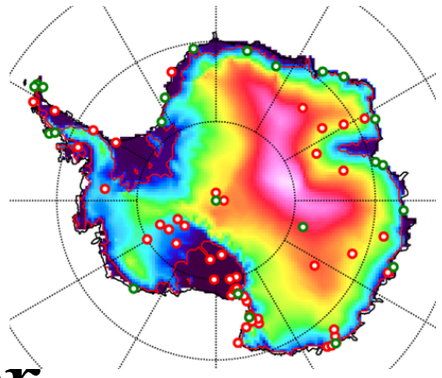
Surface temperature



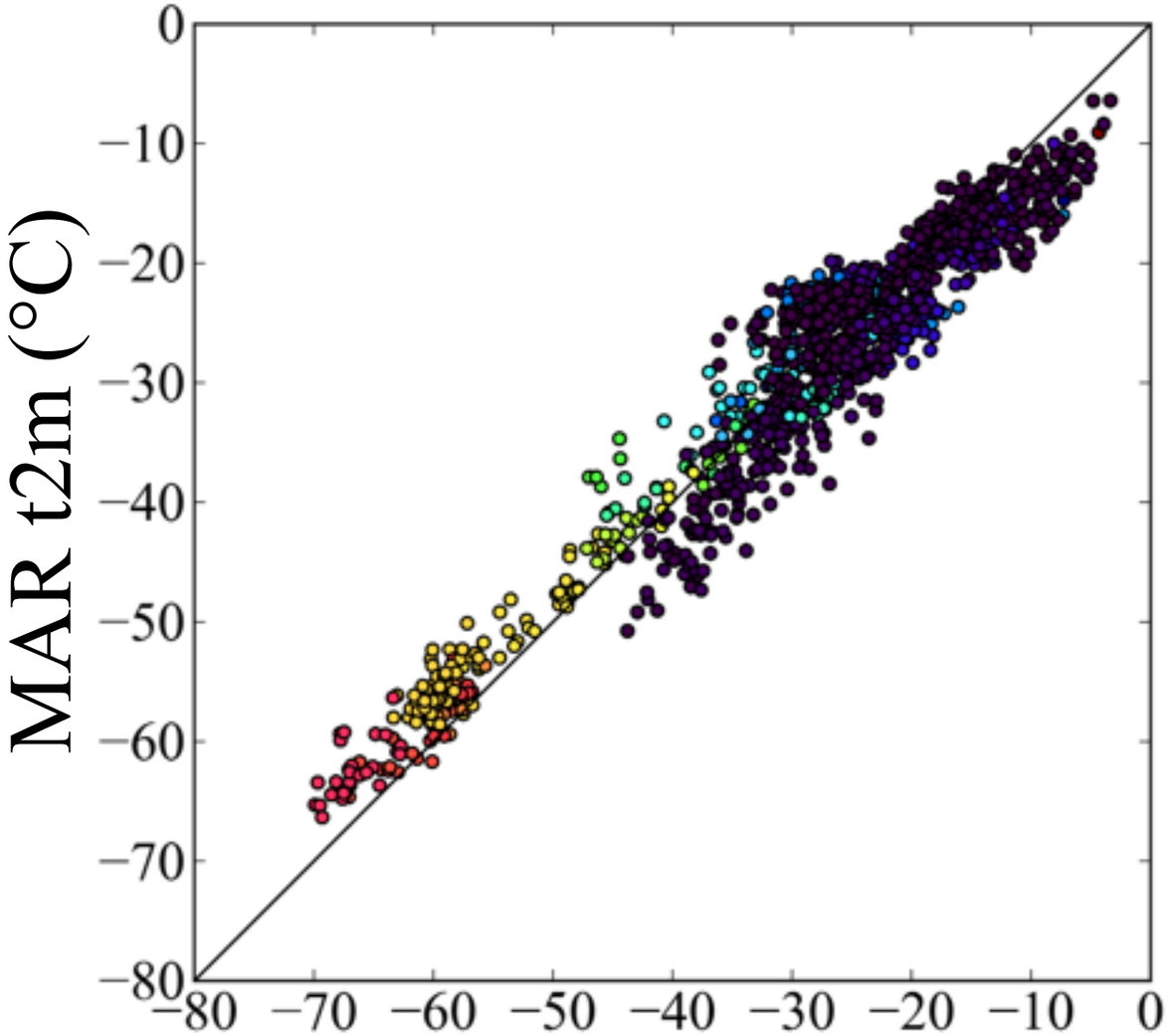
MAR-Antarctica : ERA-Interim forcing

READER surface weather dataset

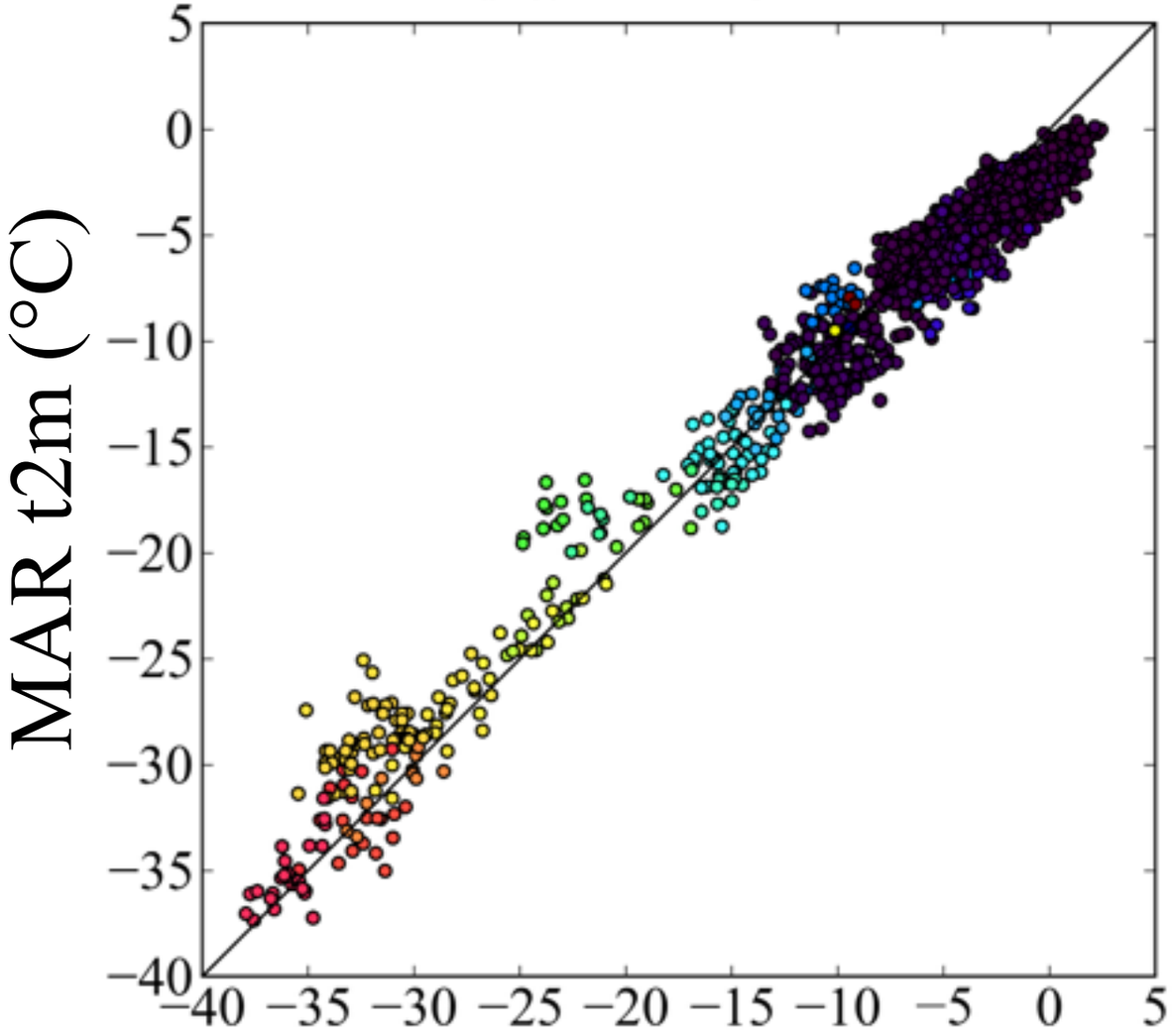
Surface temperature



Winter



Summer



MAR-Antarctica 21st century : CMIP5 forcing

MAR forcings

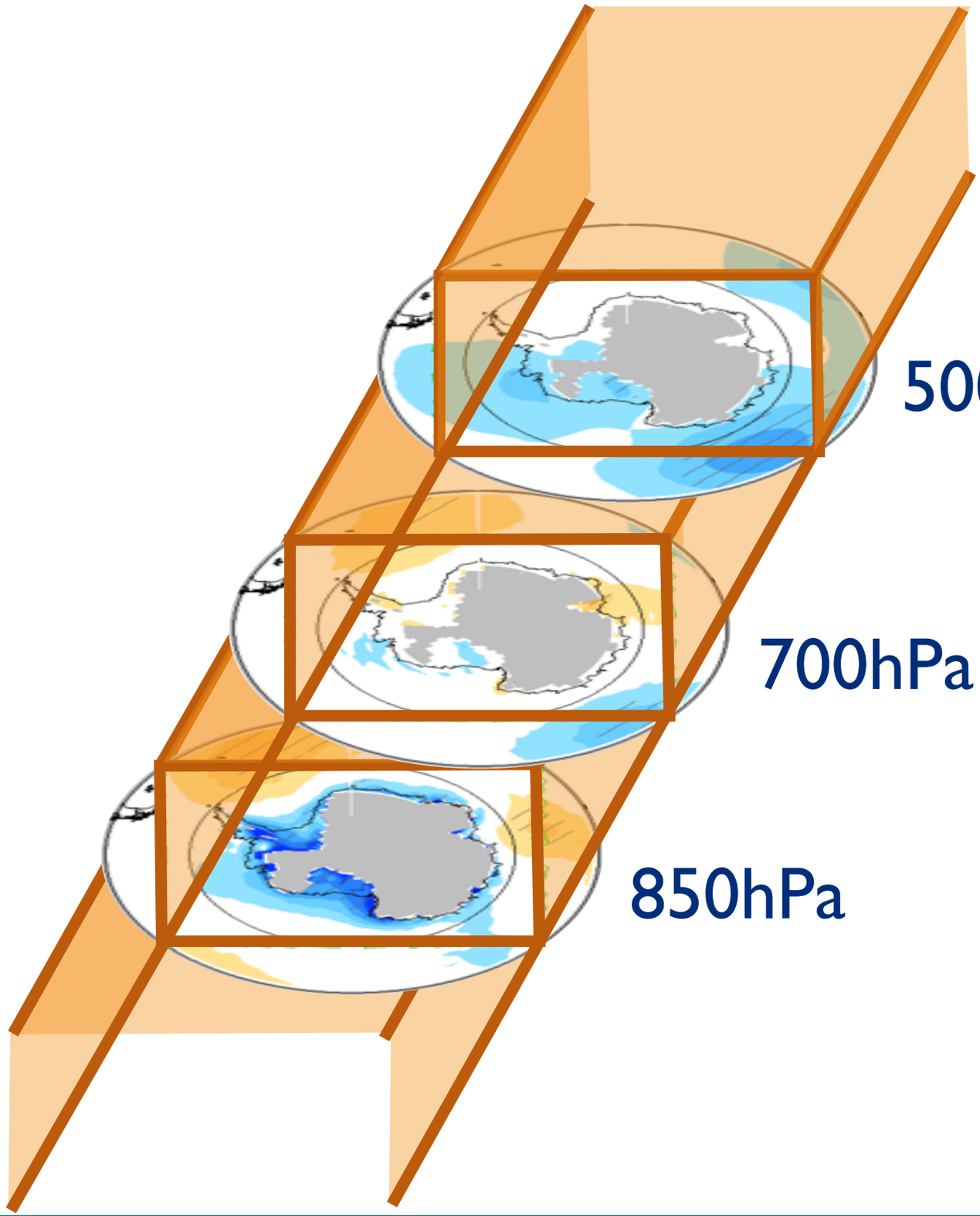
Lateral boundaries

+

Top of tropopause

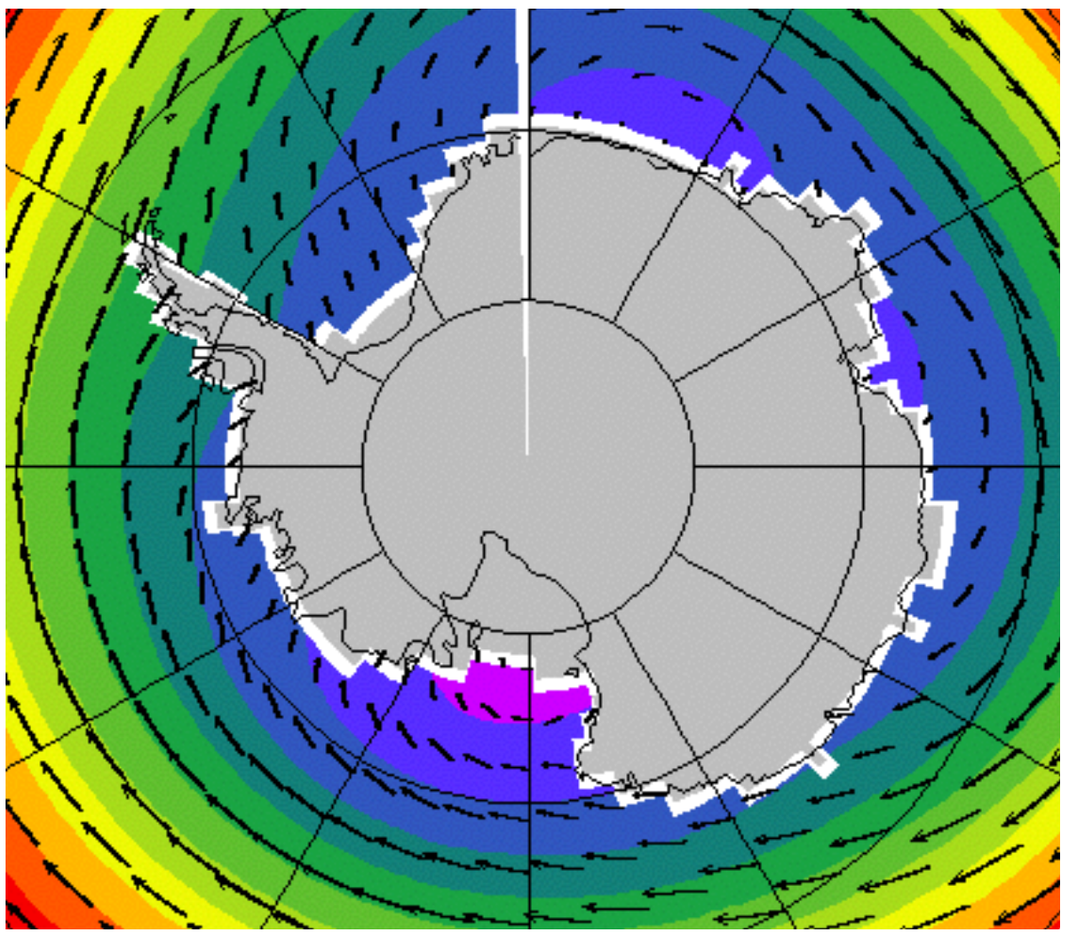
+

Sea surface conditions

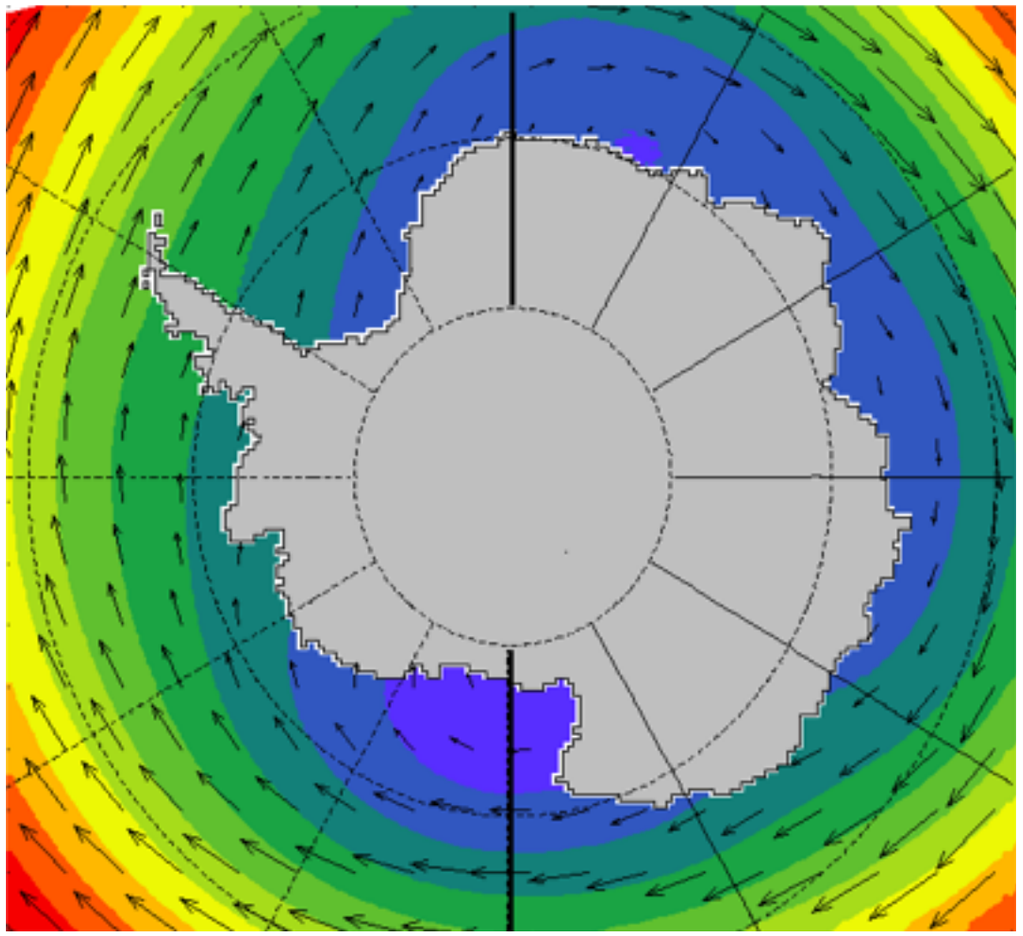


MAR-Antarctica 21st century : CMIP5 forcing

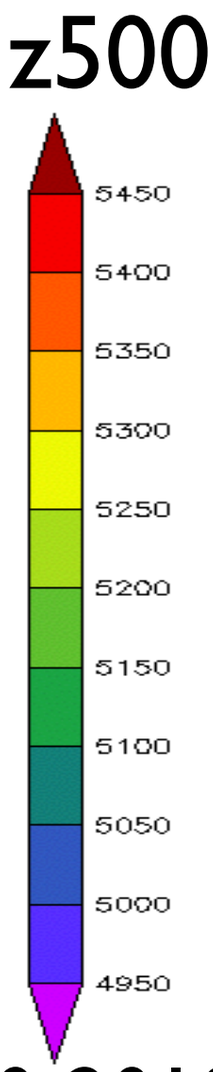
MAR circulation ≈ GCM circulation



ERA-Interim



MAR-ERA-Interim



1980-2010

➡ GCM forcing : Major source of uncertainty

Evaluation of CMIP5 GCMs

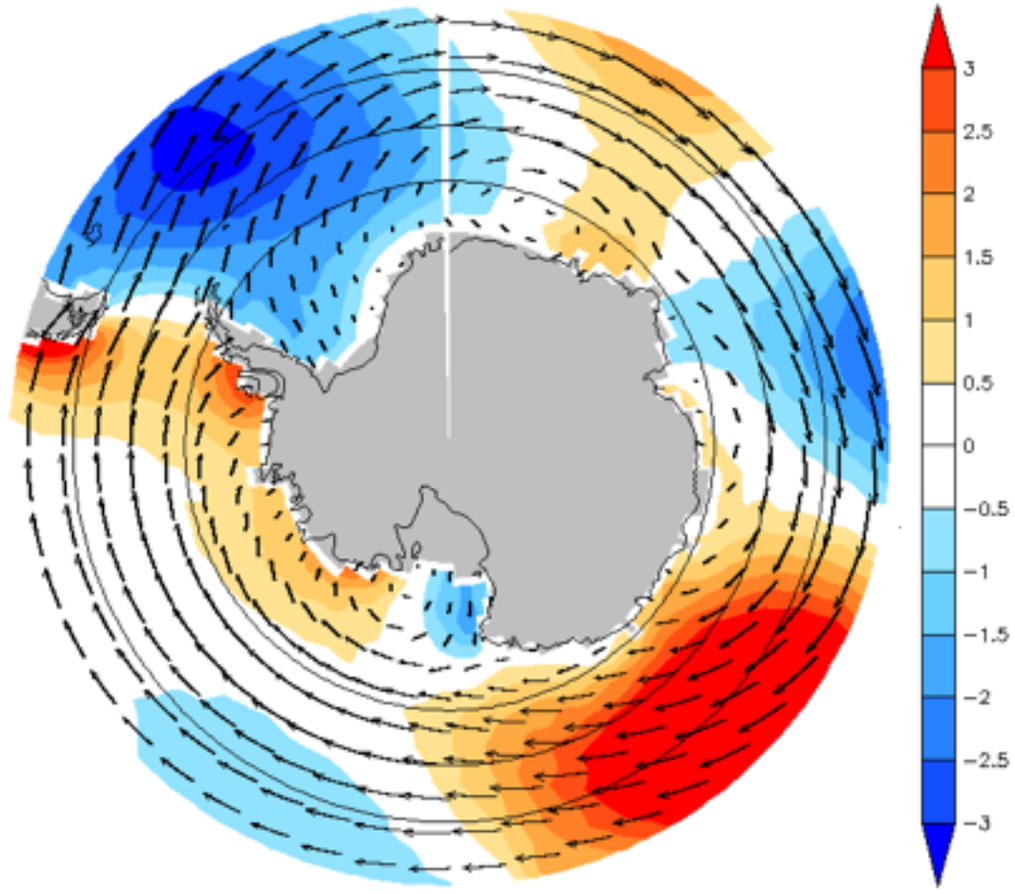
SMB component → Key forcing fields

Melting → Low-level Summer air temperature (ta 850hPa)

Precipitation → Large-scale circulation (z500)
→ Low-level meridional water vapor flux (mwpf 850hPa)

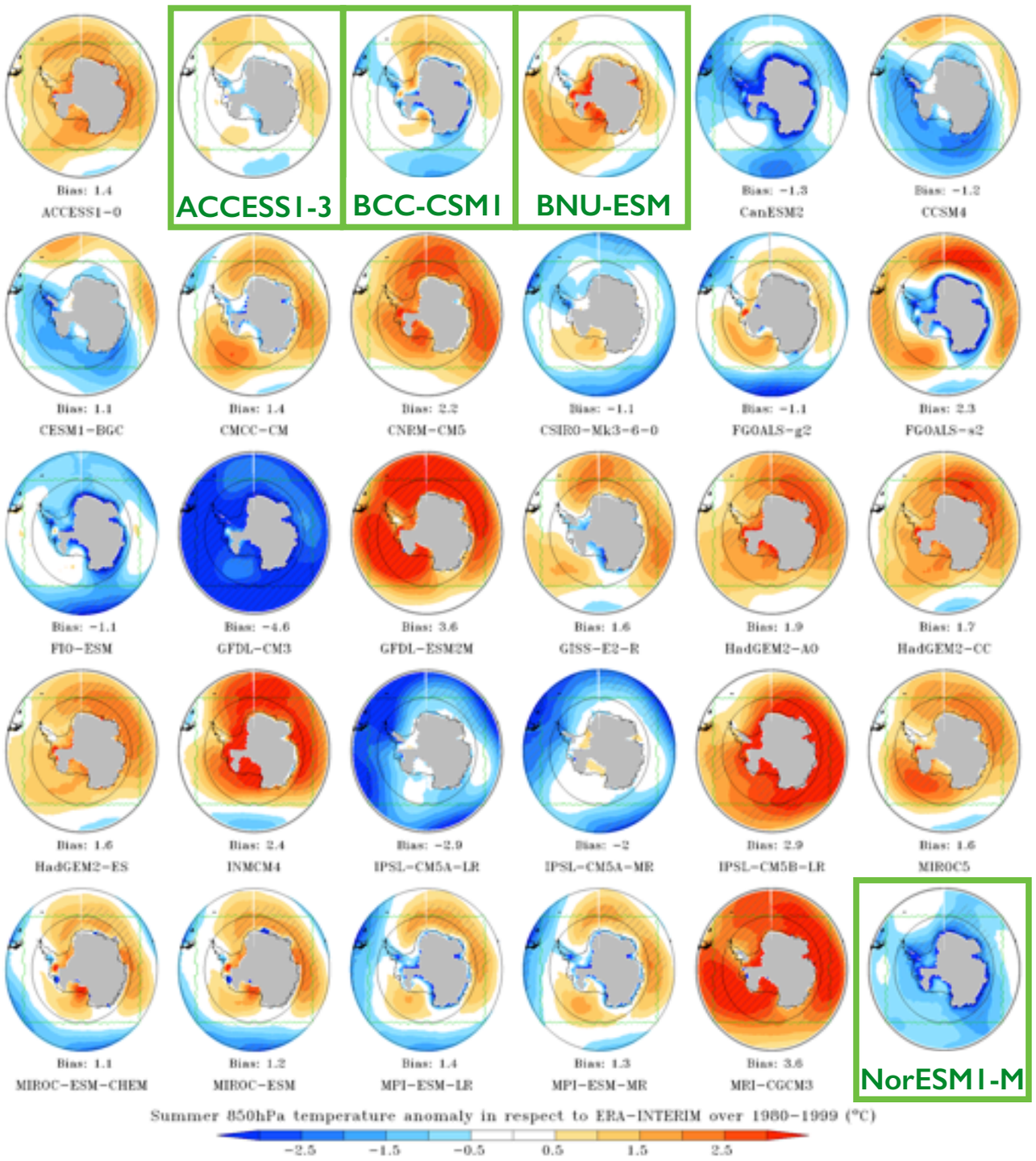
$$\mathrm{mwpf} = -qv$$

mwpf ERA-Interim
1979-2010
850 hPa
(g kg^{-1} m s^{-1})

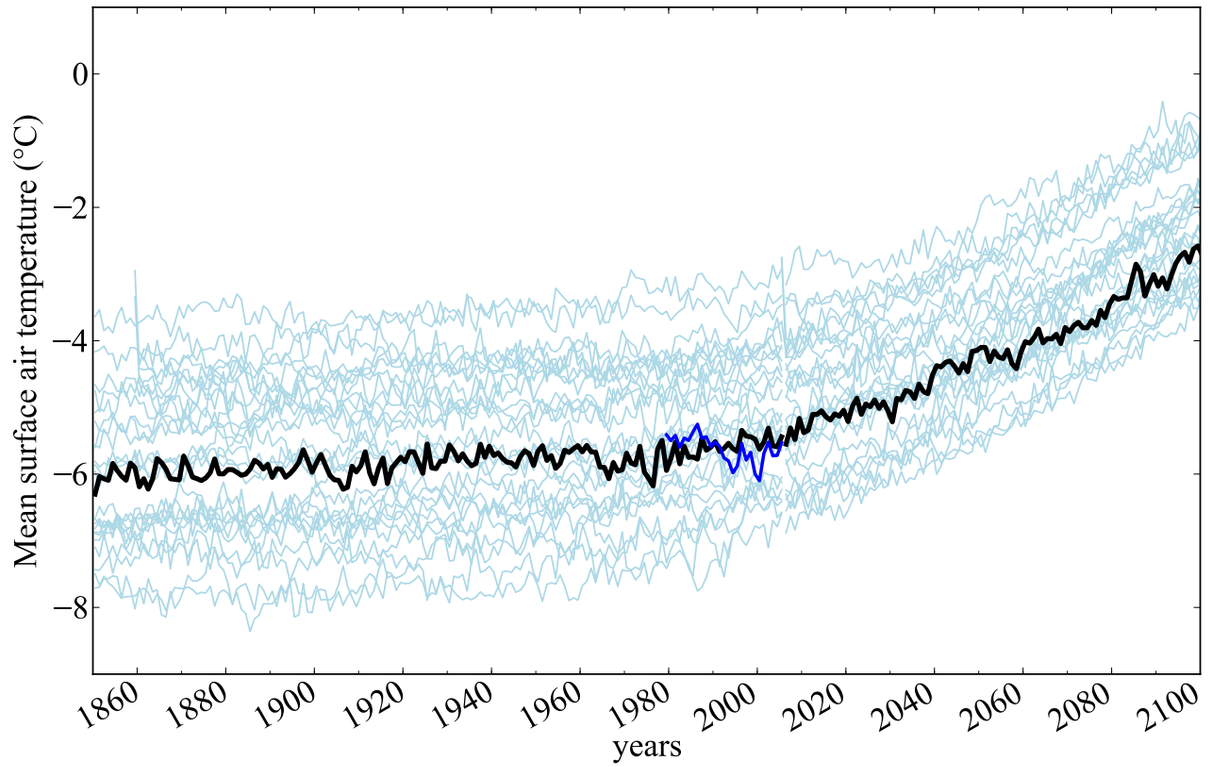


Evaluation of CMIP5 GCMs

Summer air temperature (ta 850hPa)

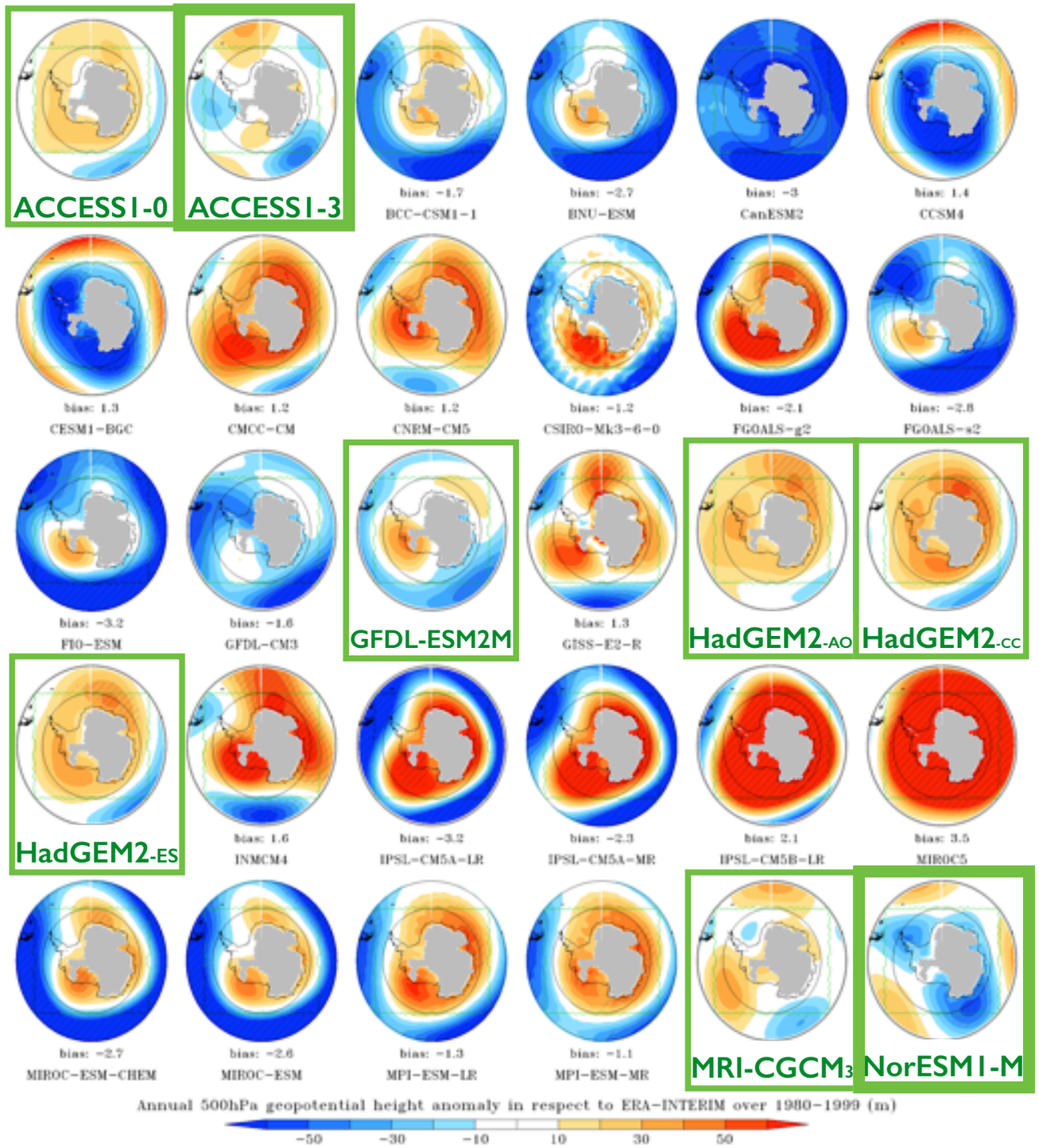


50S - 63S mean
ACCESS1-3 ERA-Interim



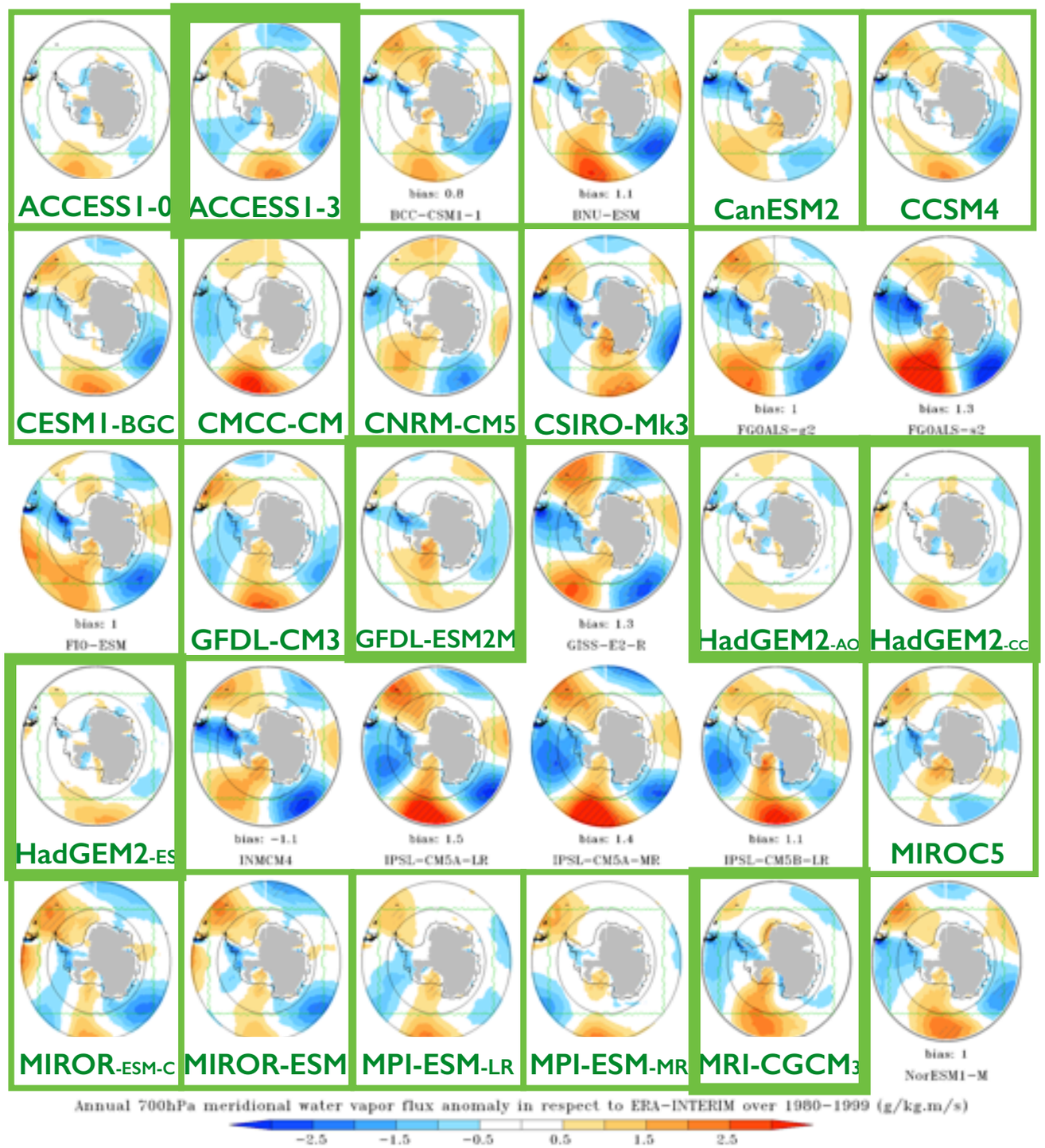
Evaluation of CMIP5 GCMs

Large-scale circulation (z500)



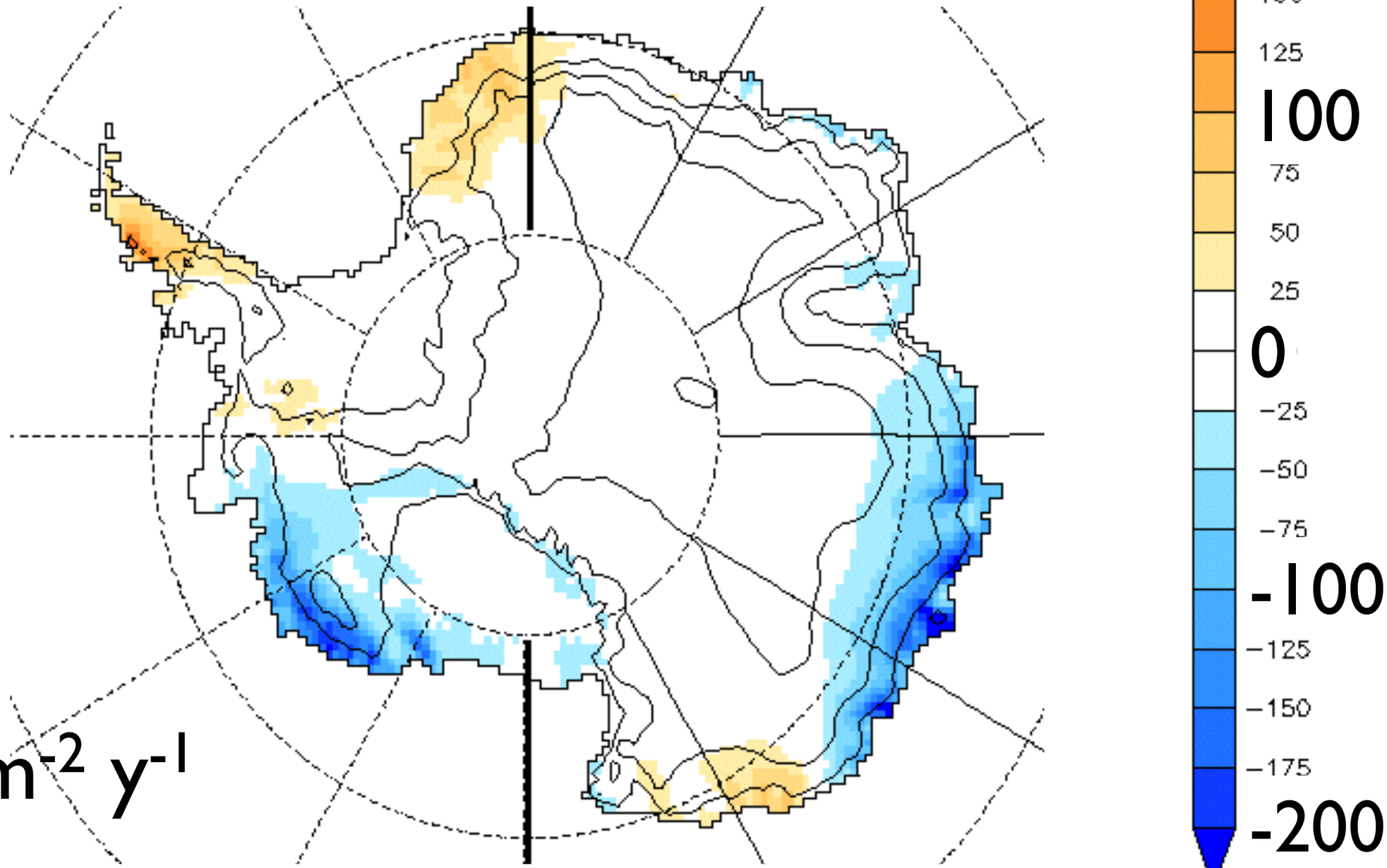
Evaluation of CMIP5 GCMs

Meridional water vapor flux (850hPa)



MAR : ERA-Int vs ACCESS1-3

Snowfall MAR-ACCESS1-3 - MAR-ERA
1976-2004 / 1979-2010 (kg m^{-2} y^{-1})



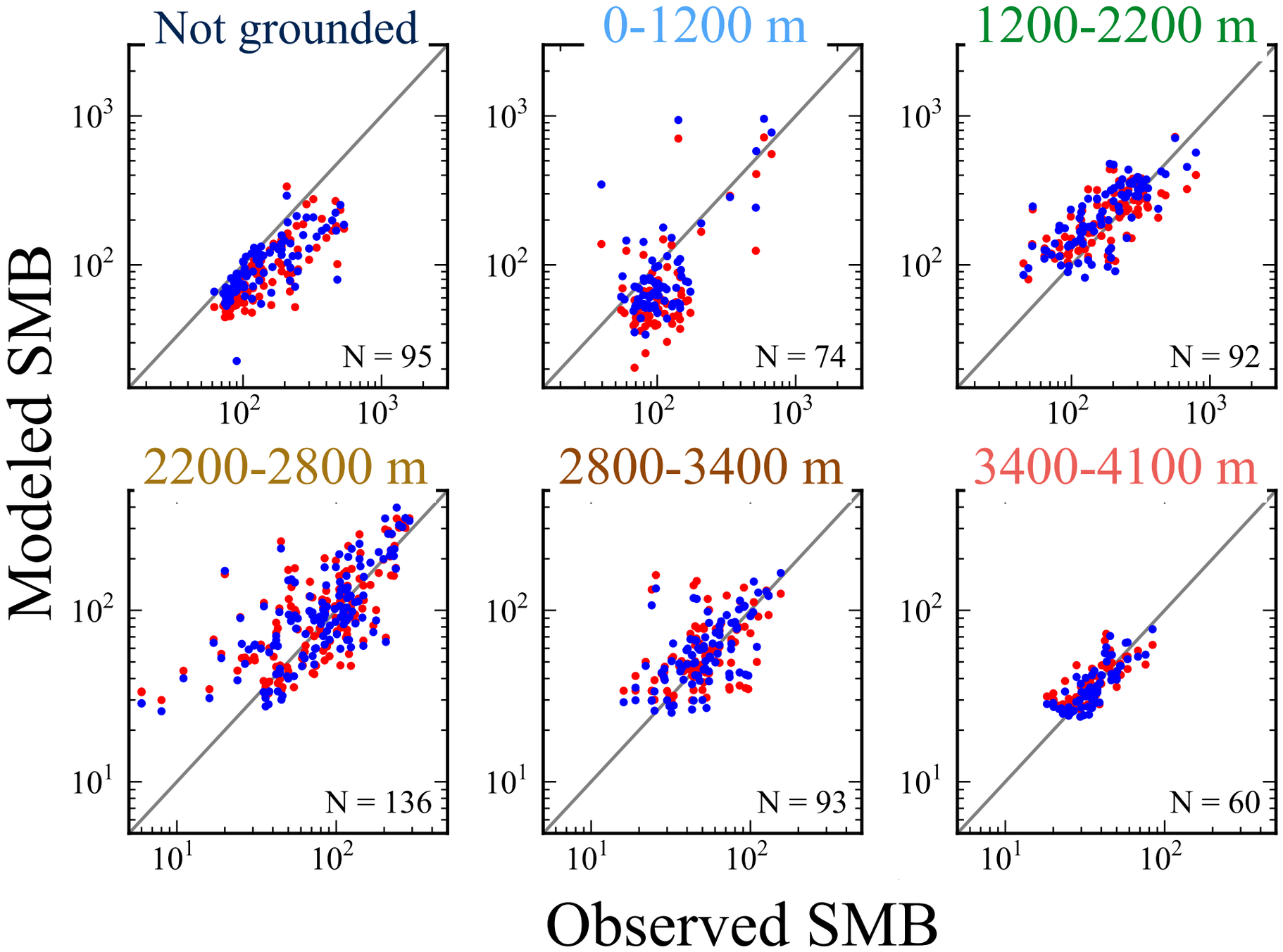
189

181

kg m^{-2} y^{-1}

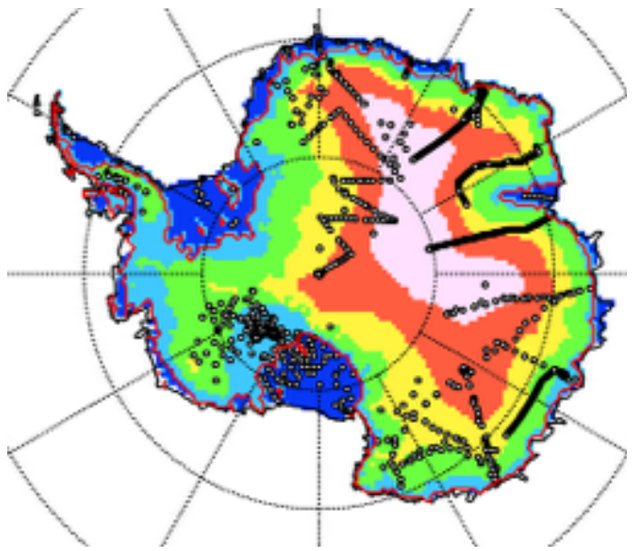
MAR : ERA-Int vs ACCESS1-3

GLACIOCLIM-SAMBA quality-controled SMB dataset



MAR-ERA

MAR-ACCESS1-3



Antarctic SMB for the 21st century

Antarctic Surface Mass Balance from CMIP5 with MAR:

to be continued …

21st century → MAR-ACCESS1.3

Why is MAR too warm in winter ?

Evaluation of smb uncertainties : RCM/GCM

Thank you

Liège Guillemins