

Modulation of the Southern Hemisphere circulation by large-scale geoengineering

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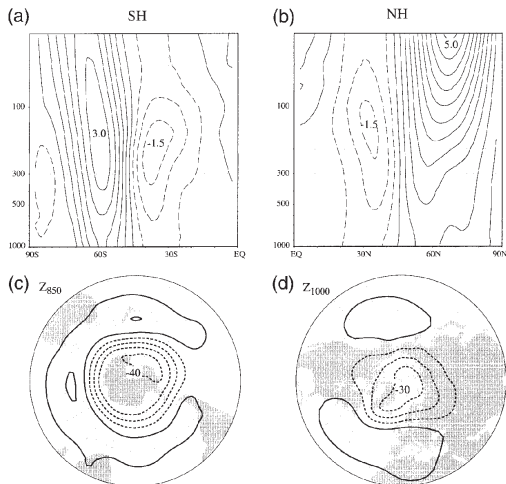
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Australia

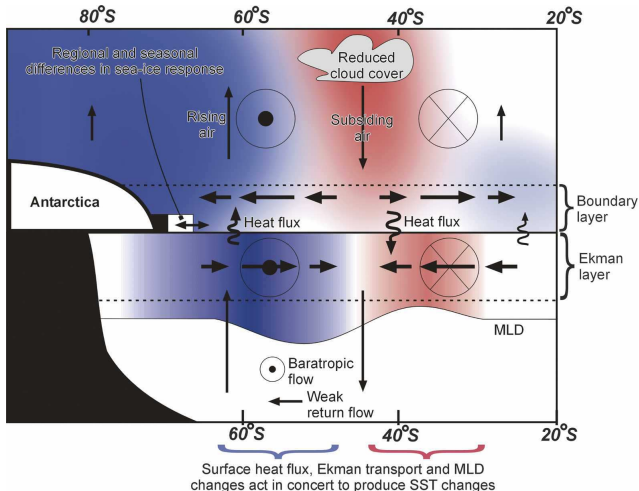
Fourth GeoMIP Meeting
24–25 April 2014

The Southern Annular Mode



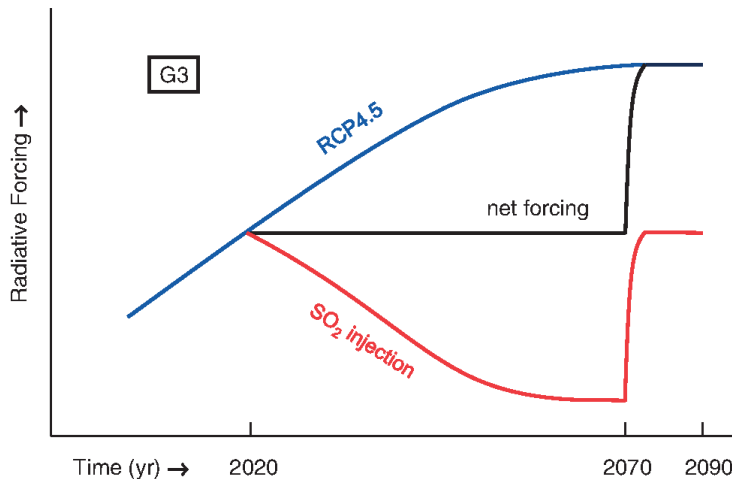
Thompson and Wallace (2000), *J. Climate*

Climatic effects of the positive phase of SAM



Sen Gupta and England (2006), *J. Climate*

Schematic of GeoMIP experiments G3 and G3solar



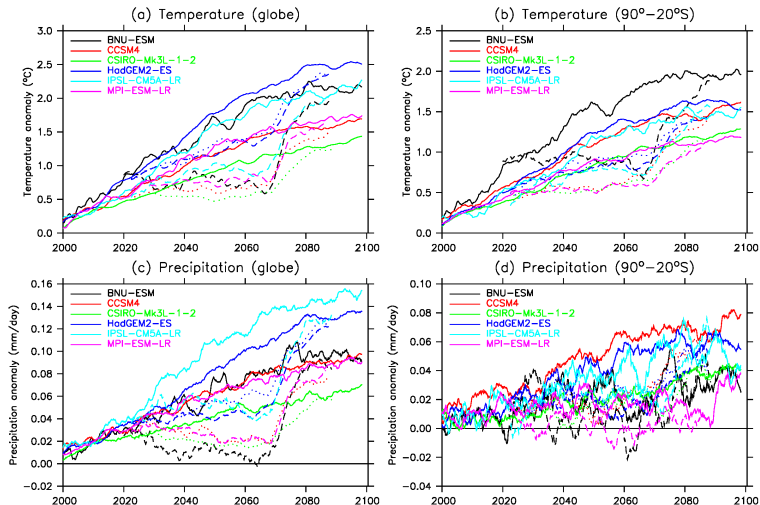
Kravitz et al. (2011), *Atmos. Sci. Lett.*

GeoMIP simulations

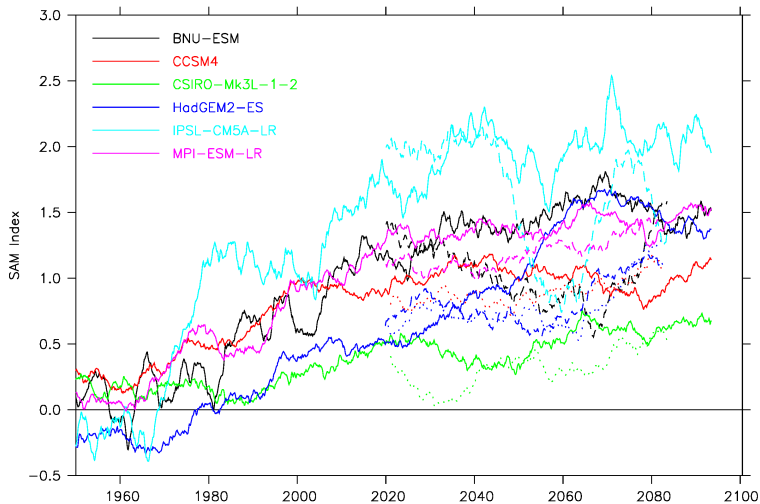
Model	G3	G3solar	Ozone
BNU-ESM	1	-	Prescribed
CCSM4	-	3	Prescribed
CSIRO-Mk3L-1-2	-	3	Fixed
HadGEM2-ES	3	3	Prescribed
IPSL-CM5A-LR	1	-	Calculated
MPI-ESM-LR	3	-	Prescribed

Acknowledgements: Olivier Boucher, James M. Haywood, Duoying Ji, Andy Jones, John Moore, Ulrike Niemeier, Hauke Schmidt, Michael Schulz and Simone Tilmes

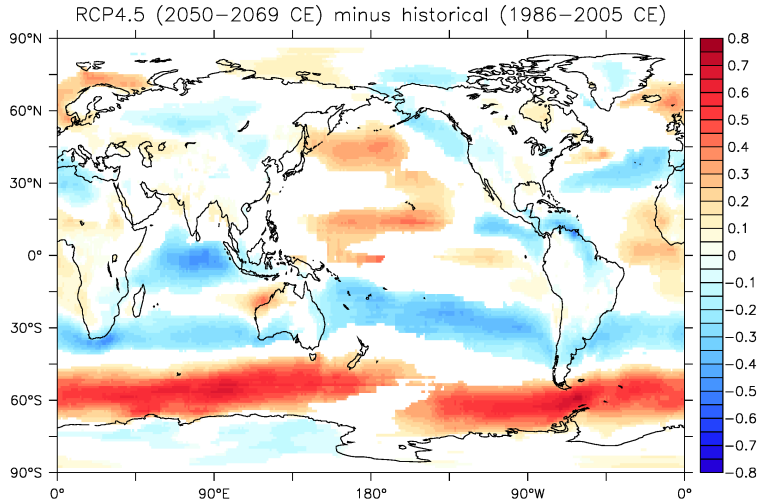
Evolution of temperature and precipitation



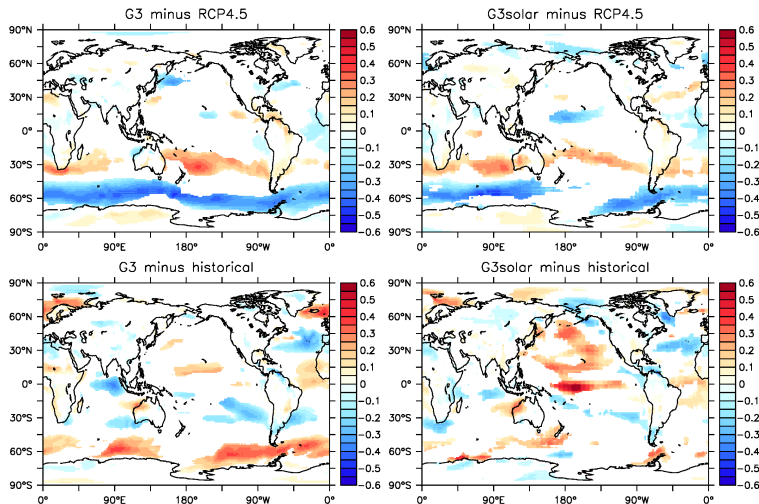
Evolution of the SAM Index



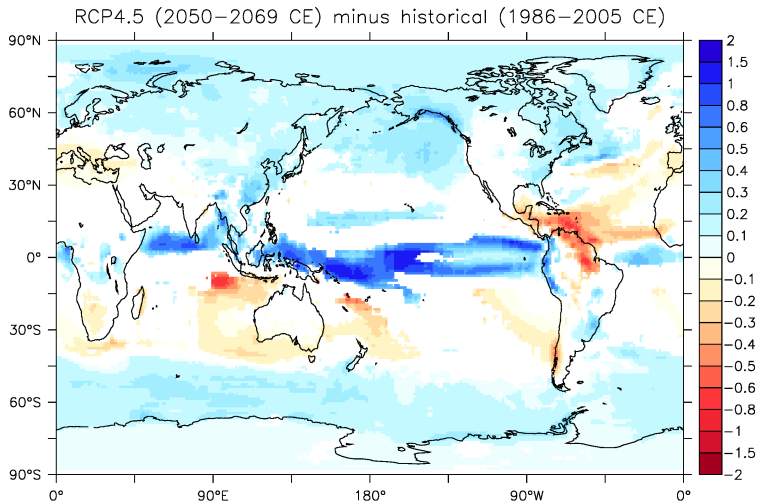
Impact of anthropogenic forcings on 10m u-wind (ms^{-1})



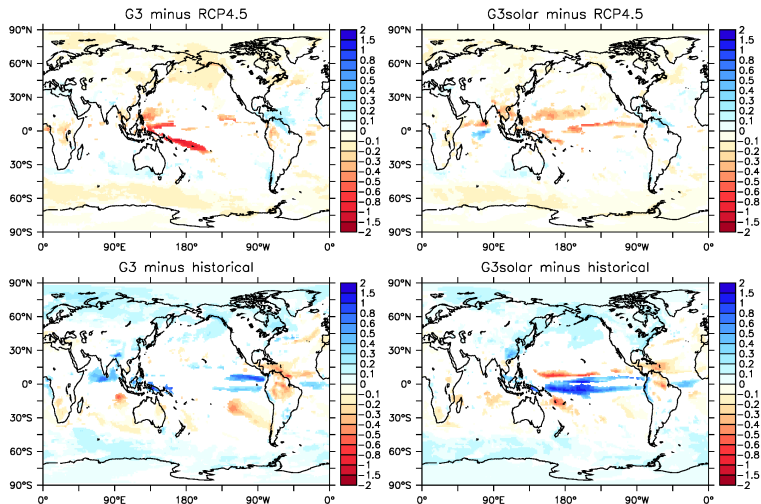
Impact of geoengineering on 10m u-wind (ms^{-1})



Impact of anthropogenic forcings on precip. (mm/day)



Impact of geoengineering on precip. (mm/day)



Conclusions

- In the Southern Hemisphere, the climatic response to large-scale geoengineering is characterised by a shift towards a more neutral state of the Southern Annular Mode.
- As a result, there is a northward shift and weakening of the Southern Hemisphere westerly winds.
- The shift in the storm tracks causes an increase in precipitation at $\sim 30^\circ\text{S}$, partially offsetting the anthropogenic drying trend.
- These trends are consistent between models and between experiments G3 and G3solar, despite the differing natures of the forcings applied.
- The climatic impacts dissipate within ~ 10 years of any cessation of geoengineering.