Antarctic surface signature of ozone depletion

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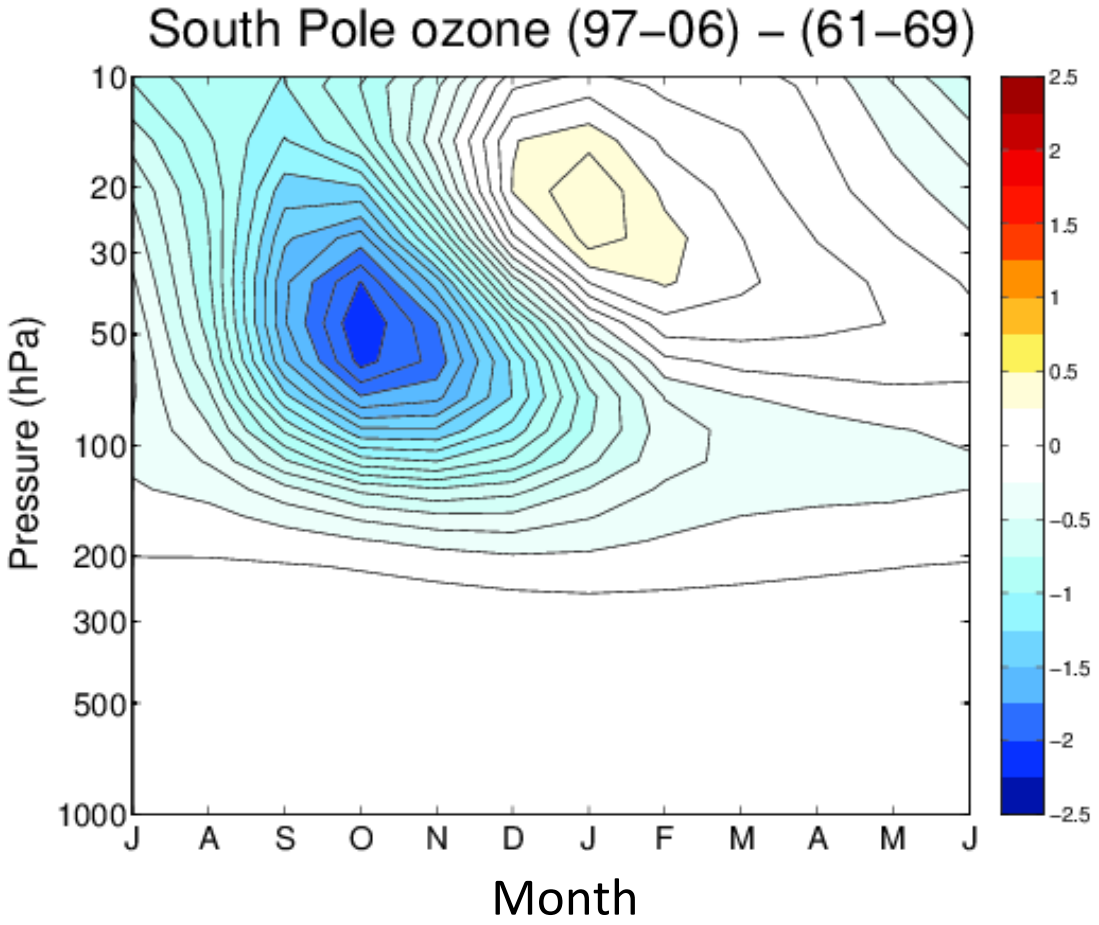
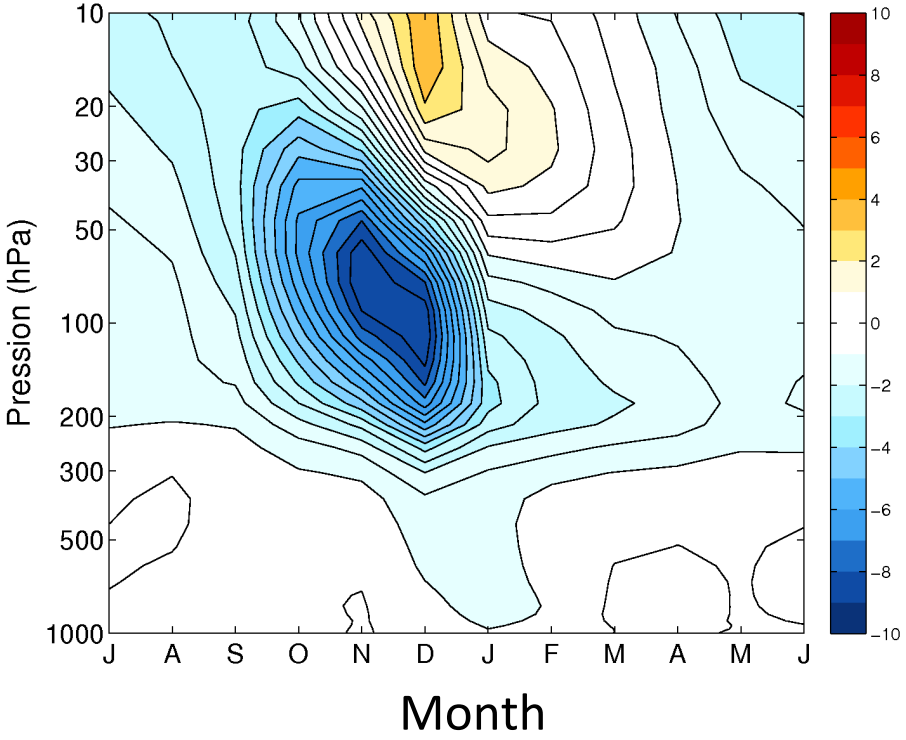
2x20-years simulations:

- LMDZ with imposed climatological SST
- 144x142x39 levels (resolved stratosphere)
- Imposed ozone from CCMVal: 1961-69 and 1997-2006.

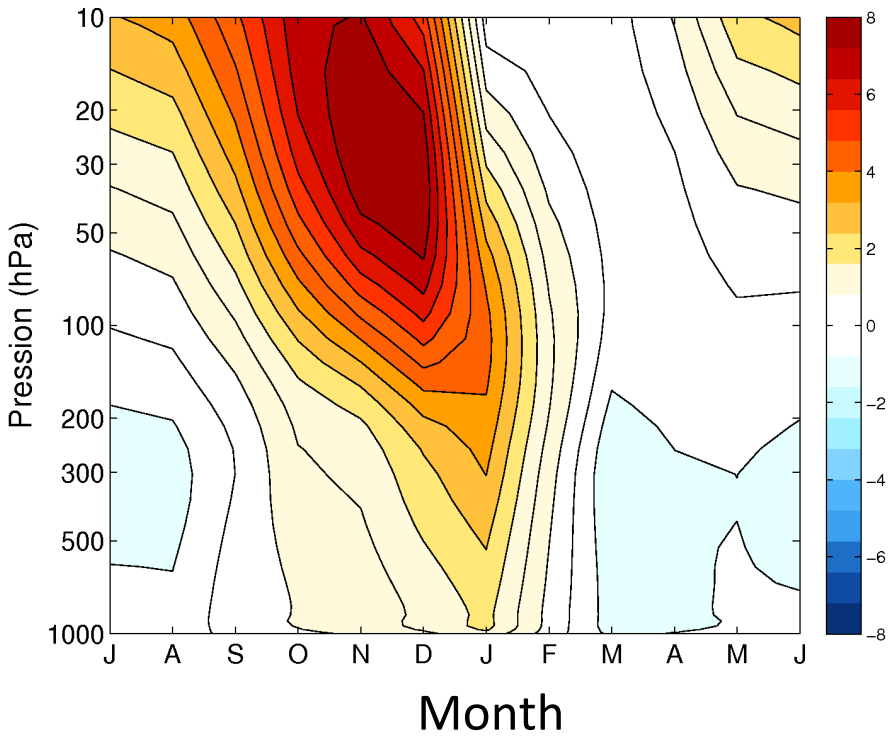


Seasonal differences

Temperature (60°-90° S)

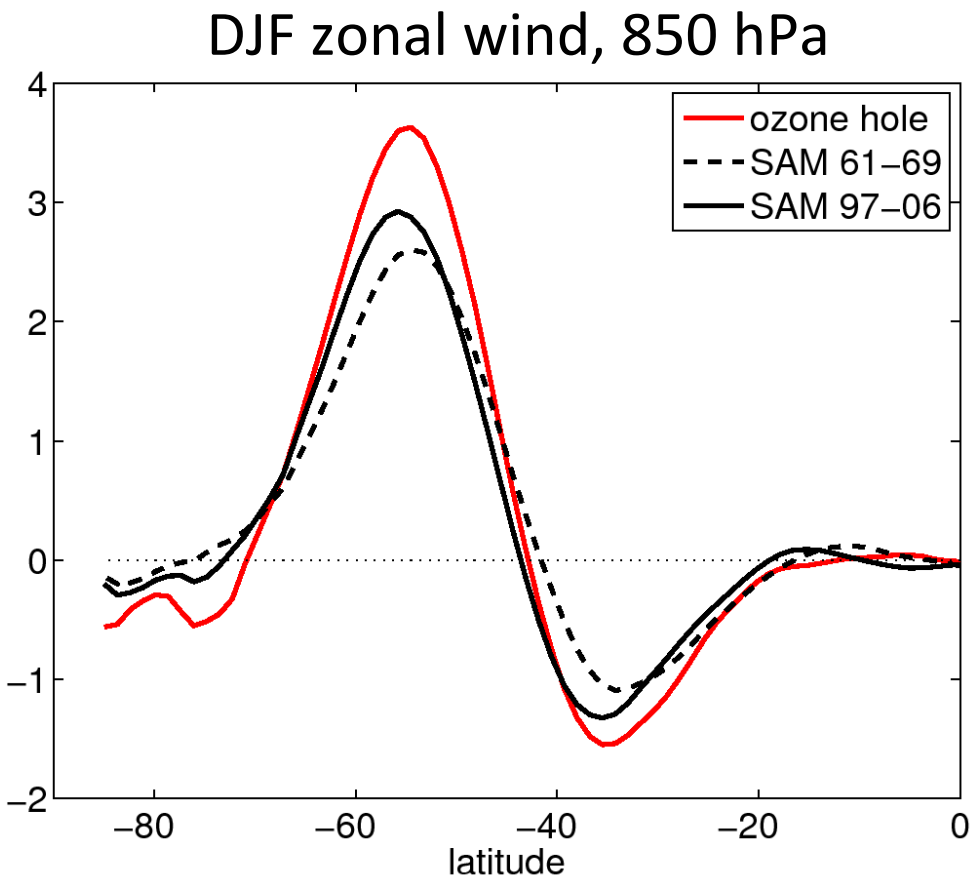


Zonal wind (50-70° S)



- Max anomalies in Nov-Dec (stratosphere)
  Dec-Feb (surface)

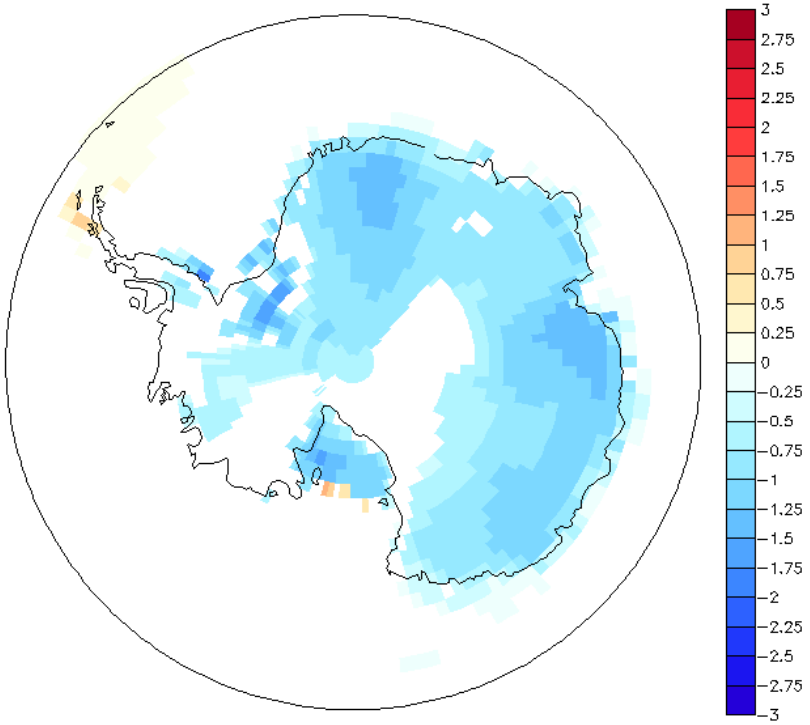
Circulation response : poleward jet shift. projects strongly on the SAM



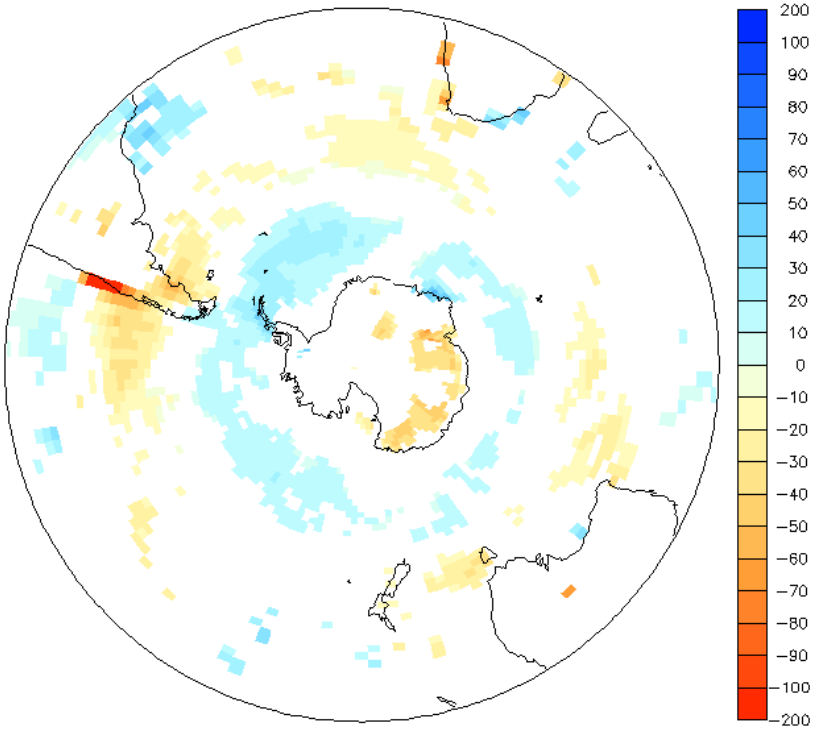
- EOF 1, intraseasonal variability
- Mean impact of ozone depletion

Mean surface impacts

(DJF, significant differences)



Surface temperature:
Antarctic cooling

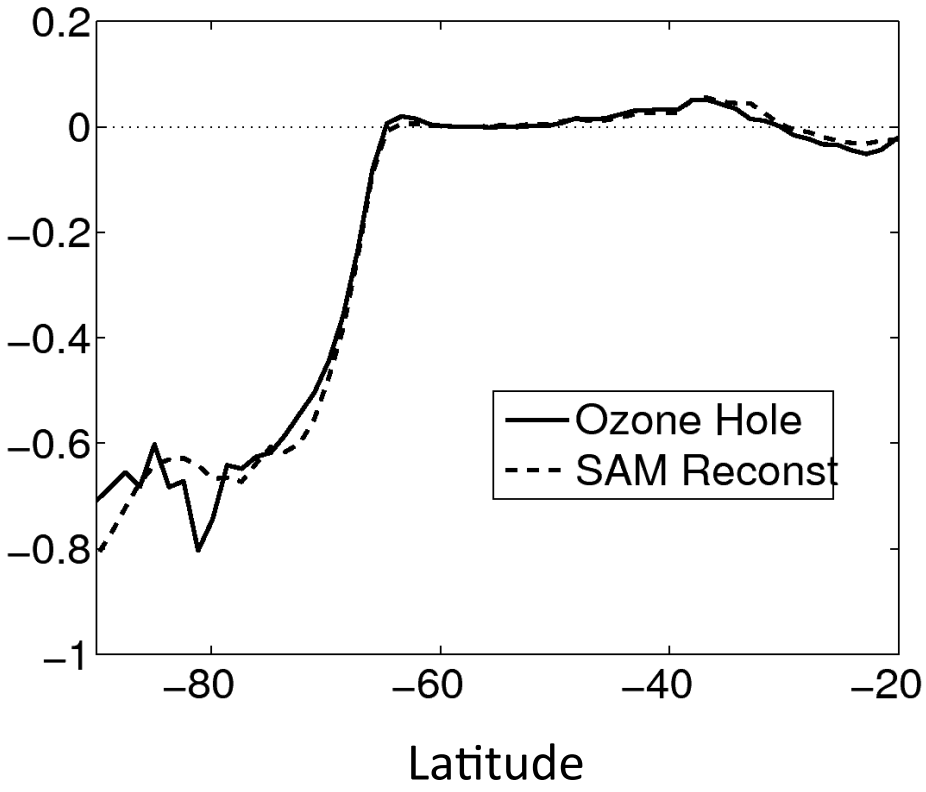


Precipitation (in %):
Southern Ocean dipole
Antarctic drying

Comparison with impacts of the SAM: Surface temperature

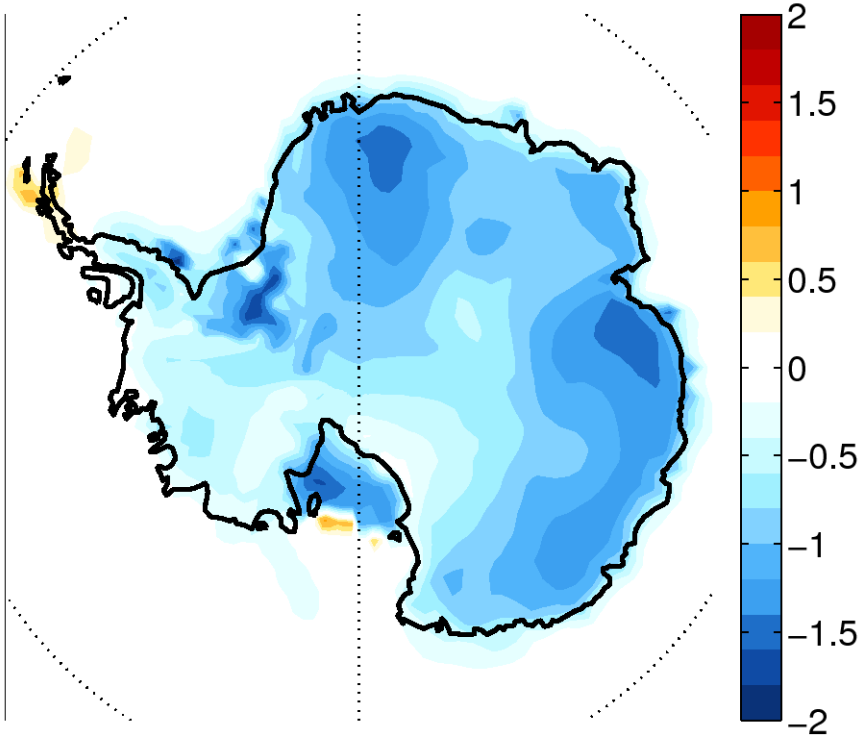
——— Total response

- - - - SAM-related (computed from month-to-month regression)

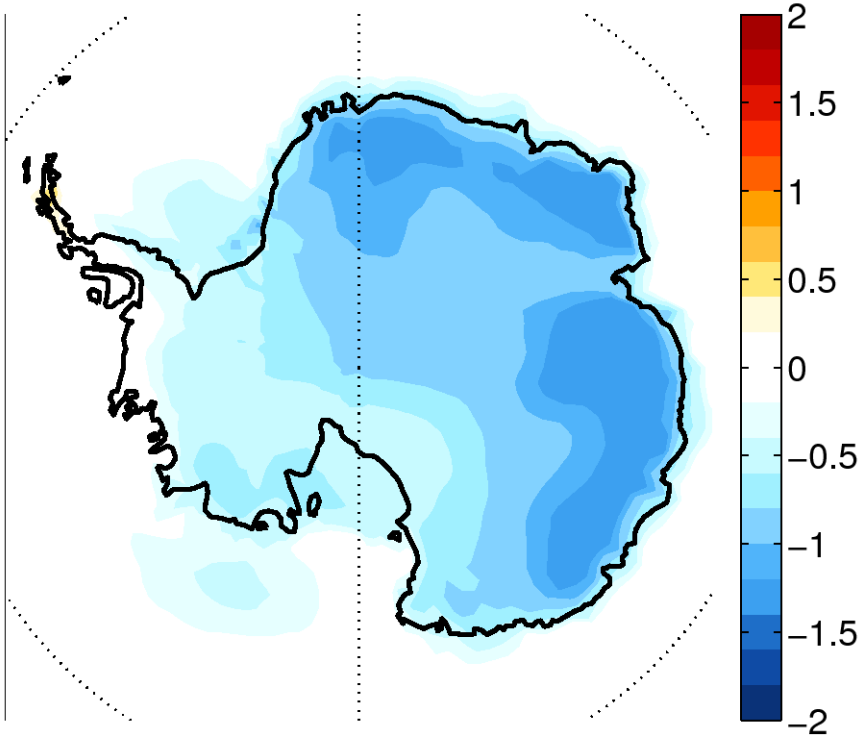


➢ Good reconstruction over Antarctica

Temperature spatial structure

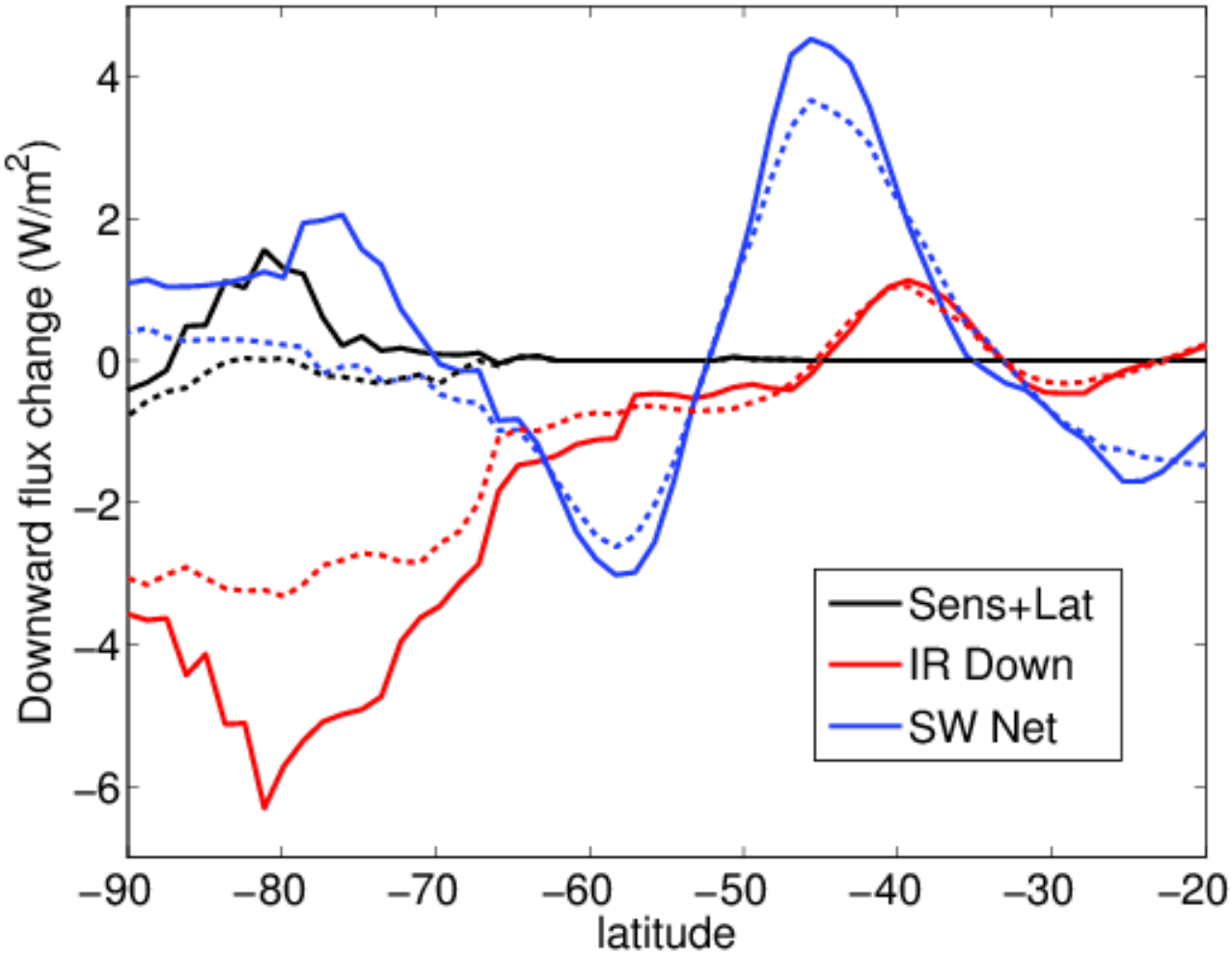


Total ozone depletion impact



Reconstruction from SAM

Surface heat fluxes

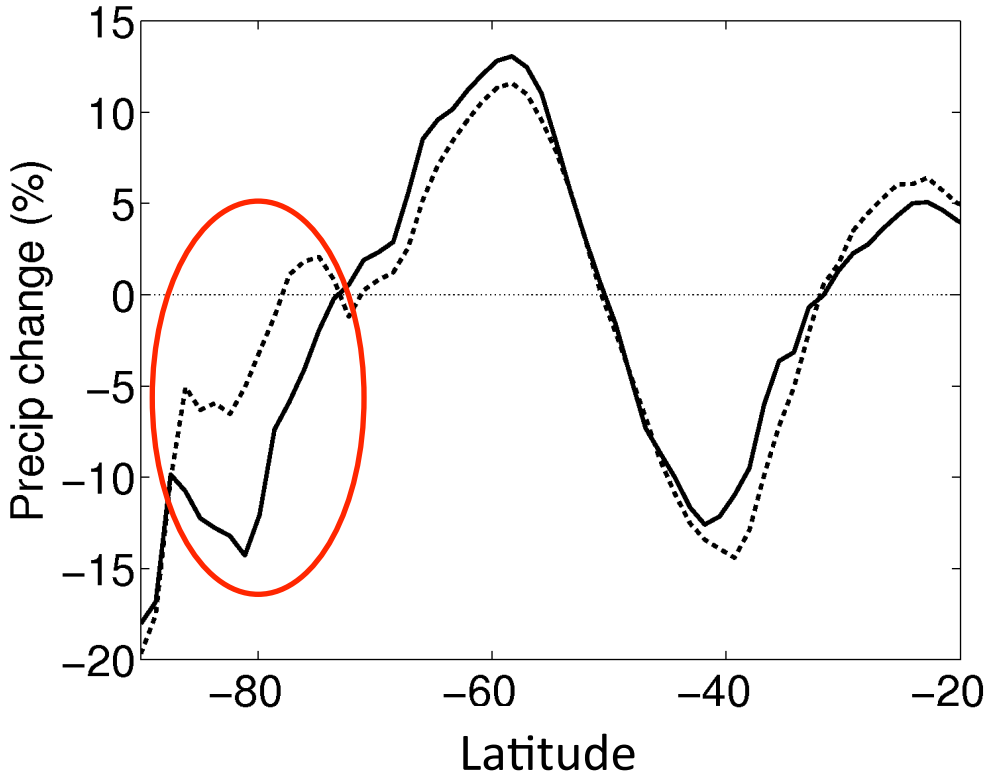


- Cooling driven dy downward IR
- Partial compensation by solar and sensible
- Direct ozone impact over Antarctica

Comparison with impacts of the SAM: Precipitation

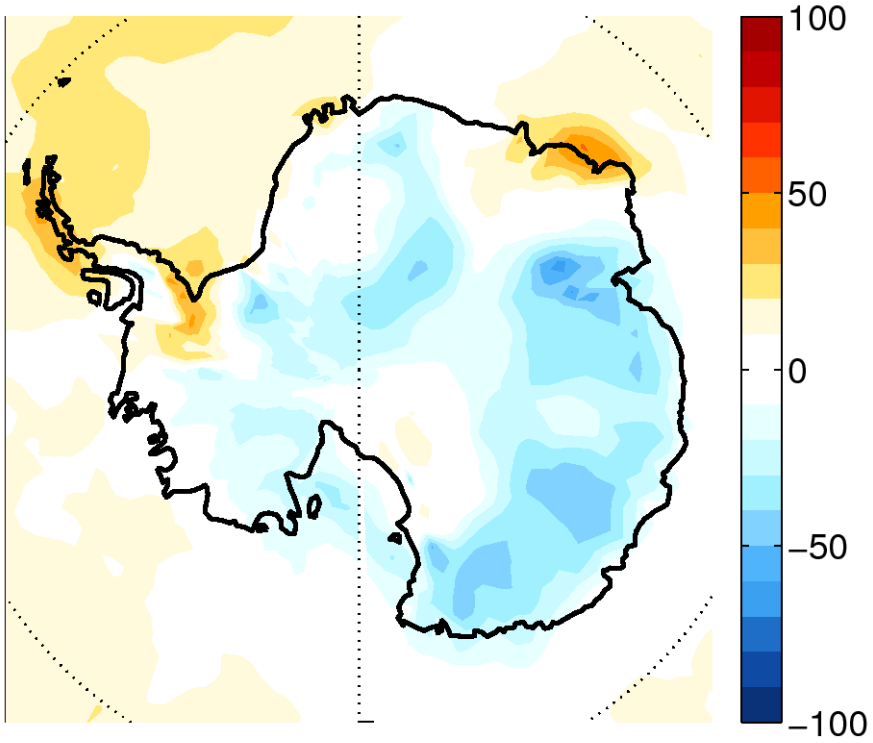
——— Total response

- - - - SAM-related (computed from month-to-month regression)

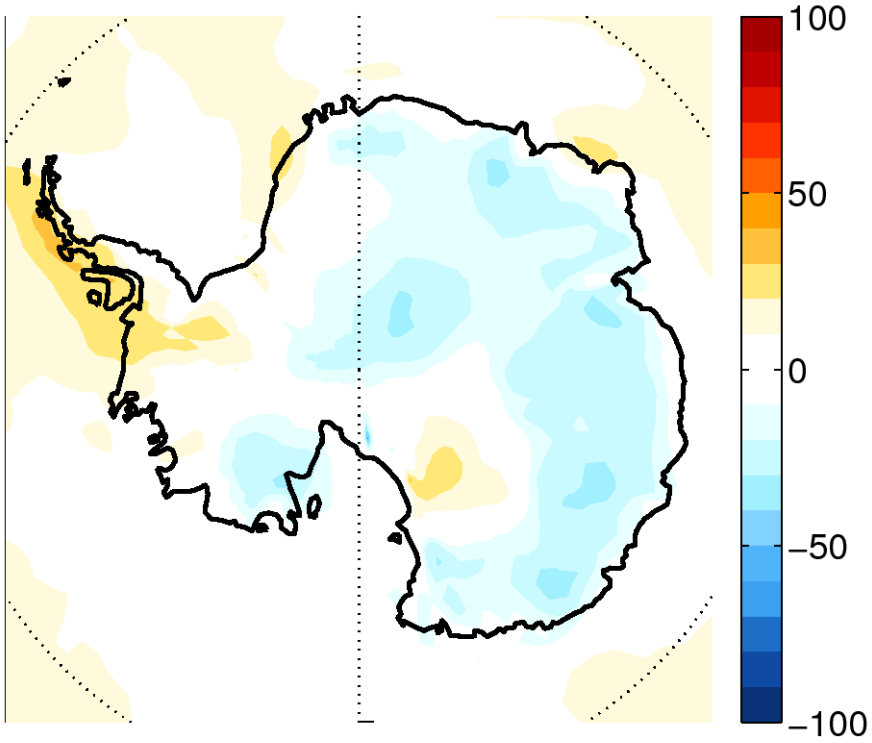


- Good reconstruction in mid-latitudes
- Missing (50%) share of Antarctic precipitation

Precipitation spatial structure:



Total ozone depletion impact



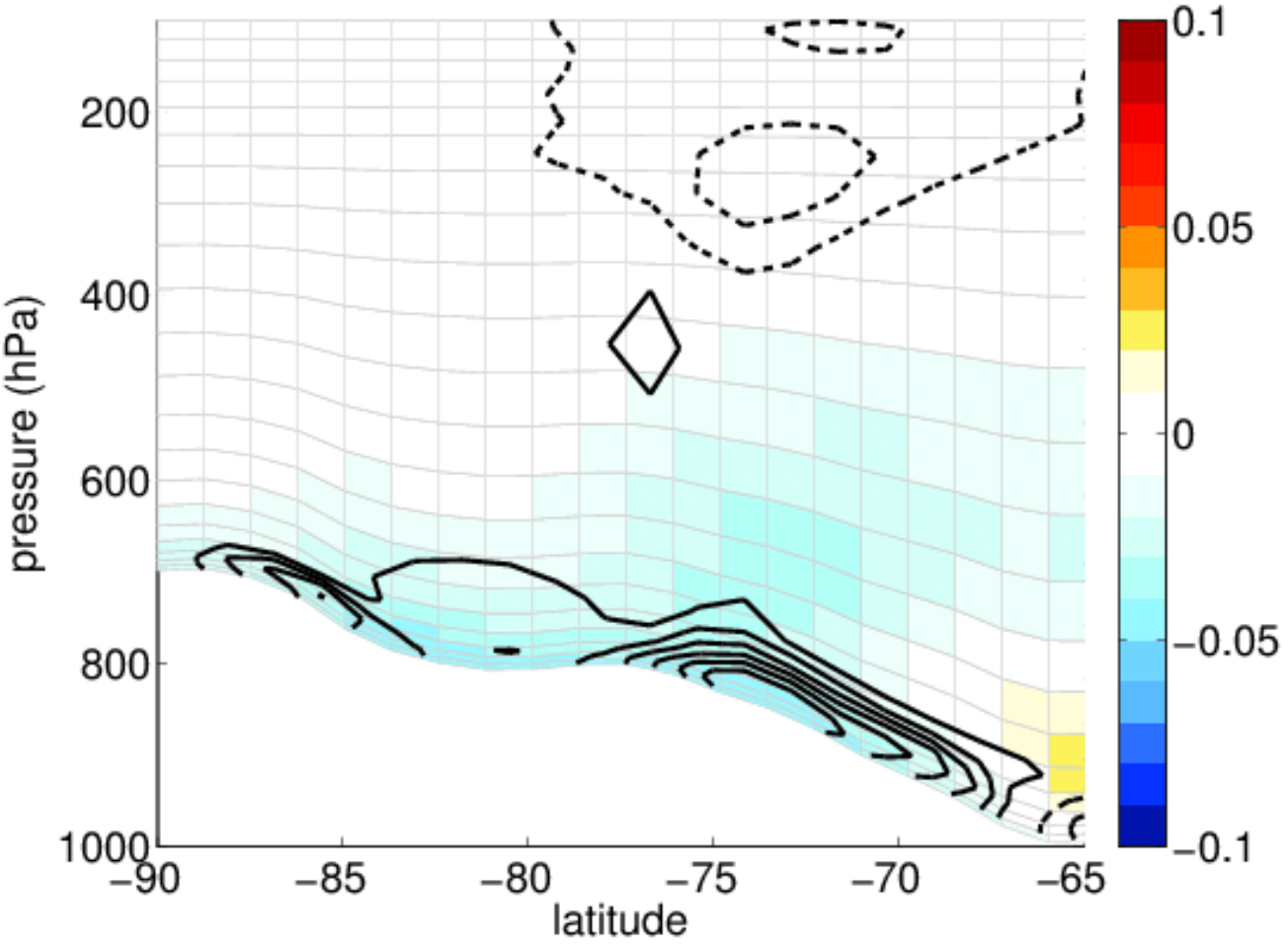
Reconstruction from SAM

➢ About half the amplitude missing

Ozone depletion impacts
(SAM-related part removed)

Water vapor
(color, g/kg)

Meridional wind
(contours)



➢ Surface drying driven by downslope winds?

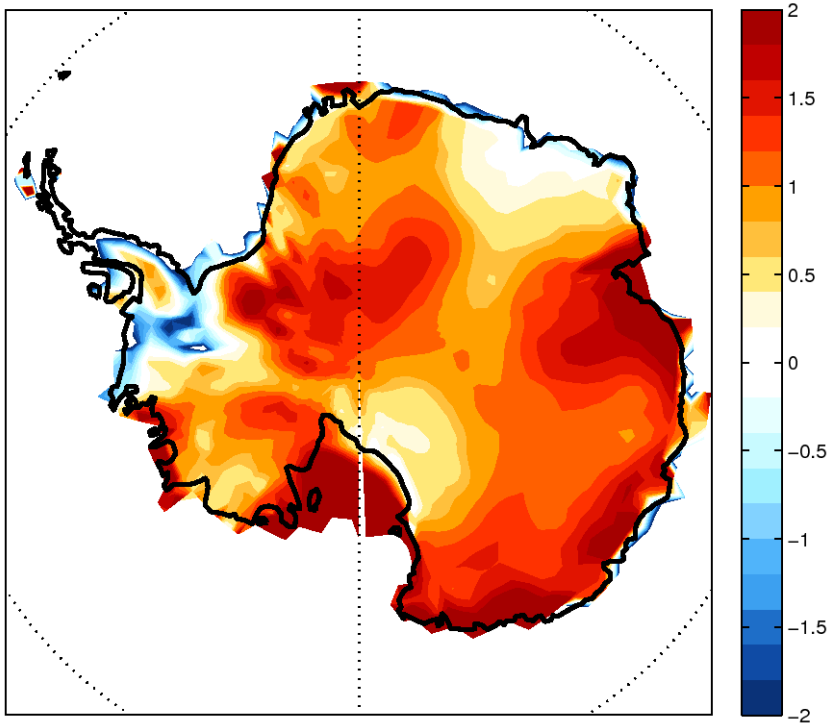
Conclusions:

- Response to ozone depletion follows « classic » pattern
- Over Antarctica, surface cooling and drying (including relative humidity)
- Response well explained by jet shift in mid-latitudes
- Additional direct radiative effects over Antarctica
- Drying: surface winds caused by radiative cooling?

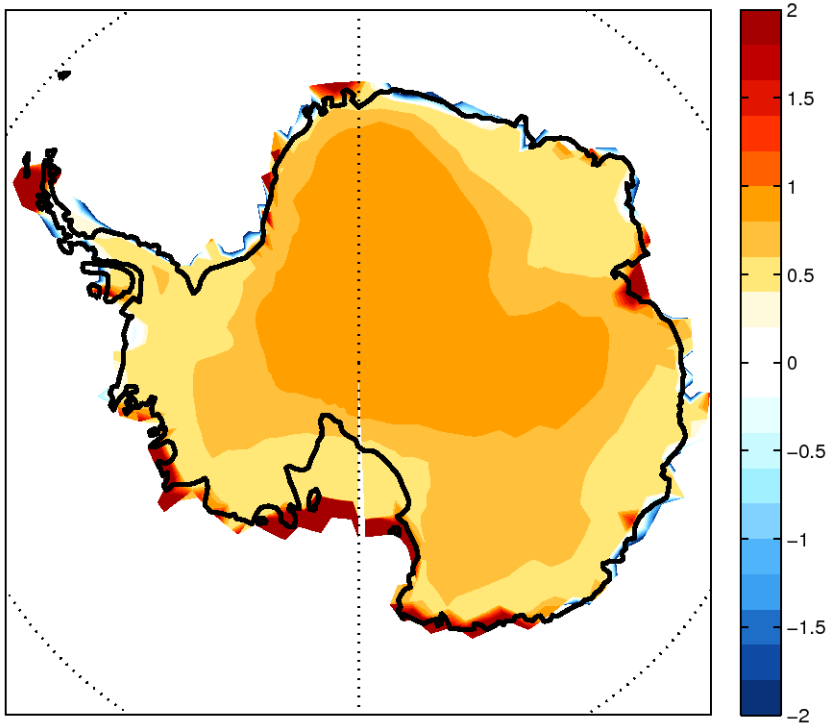
Thank You !

Surface net shortwave fluxes

Total

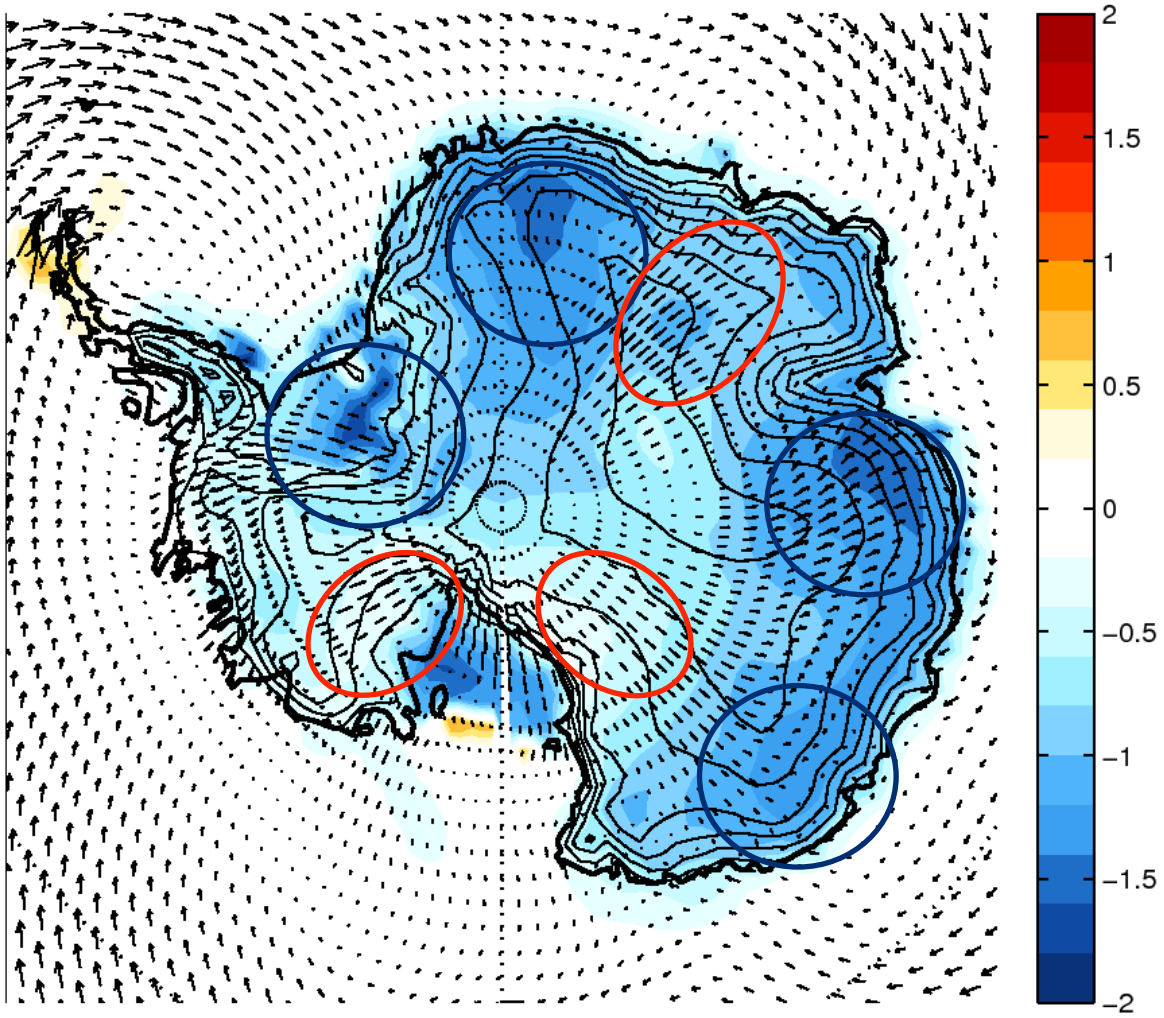


Clear sky



- Clear sky due to ozone
- Large impact of cloud cover

Surface circulation



Differences in temperature (color), 10-m wind (contours)