Southern Annular Mode (SAM) also known as Antarctic Oscillation (AAO) describes a major pattern of climate variability in the Southern Hemisphere. SAM is defined as the north south shift of the westerly wind belts that surround Antarctica. SAM influences the latitudinal rainfall distribution and temperatures from the subtropics to Antarctica. This mode of variability is depended on the phases of SAM. During the positive phase of SAM, the westerly wind belt shifts toward Antarctica. During the negative phase of SAM, the westerly wind belt shifts toward the Equator.

Currently, we are in a positive phase of SAM and the proxies record suggests that the current positive phase of SAM is stronger than ever. This positive trend of SAM can be attributed to increase in greenhouse gas levels and stratospheric ozone depletion. By reconstructing the annual mean changes in the SAM using proxy records, Abram et al., (2014) determines that the SAM has undergone a progressive shift towards its positive phase since the fifteenth century. However, the reconstruction also indicates that the transition towards the positive phase starting from the fifteenth’s century occurred in two stages. First, there is a progressive increase in SAM between the sixteenth and eighteenth centuries. Then this trend reversed in the nineteenth century and resumed in the twenties century. Through discovering the inverse relationship between Nino3.4 reconstruction and the JRI ice core temperature record, Abram et al., (2014) suggest that the association between el Nino with negative SAM exit on interannual timescales. The paper shows that the positive trend of SAM during the sixteenth to eighteenth century is reflected on the mean Nino 3.4 SST. However, we also need to notice that the tropical Pacific climate variability seems to have a reduced influence on SAM trends during the twentieth century. The paper suggests that the tropical Pacific SST could be in a way muting the effect of greenhouse gases and stratospheric ozone depletion on SAM during the twentieth century. With the long-term mean of the SAM index reaching the highest value for at least the past 1000 years, SAM are predicted to be pushed more towards its positive phase with the forcing of increasing greenhouse gases. The increase of GHG driven SAM may also limit the warming over continental Antarctica and the southward expansion of the dry subtropical climate belts.

Barnes and Polvani (2004) looks at how the midlatitude, eddy-driven jets respond to increase of greenhouse gas using model output from phase 5 of the Coupled Model Intercomparison Project (CMIP5). The eddy-driven jets have generated a clear response to increase of greenhouse gas in the CMIP5 multimodal mean ensemble. The eddy driven jets were categorized into three regions---Southern Hemisphere, North Atlantic and North Pacific. The models predict jets from all three regions to have a 1-2 degrees shift toward the pole by the end of the twenty-first century. However, the paper found that the jet variability in the North Atlantic and Southern Hemisphere will become more of a change in jet speed and less of a meridional jet wobble and the jet variability in the North Pacific will become more of a wobble and less of a pulse. The paper also suggests that the response of all the jets to increase in greenhouse gas can be linked directly to the mean latitude of the jet through the mechanism called wave-breaking by Barnes and Hartmann (2011).