



# Warming up down south: reviews of Mayewski et al. 2015 and Arblaster et al. 2011

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In this month's journal club at University Rovira i Virgili's Centre for Climate Change we explored the topic of Southern Hemisphere climate change through two short papers: a multi-model study from 2011 (Arblaster et al.) and a 2015 mini-review focussing on palaeoclimatological analysis (Mayewski et al.).

## 1. THE SCIENCE

One key feature of the climate of the Southern Hemisphere is the band of westerly winds across the mid-latitudes. Observations and models indicate that these winds are moving further south, and strengthening, in response to climate change. This change is causing warmer air to encroach on Antarctica, more carbon dioxide to be taken up from the atmosphere into the ocean, and more frequent droughts in many countries, as the weather systems that normally bring rain occur further south.

Some studies suggest that the recovery of the ozone hole will counteract this impact for the next few decades, while others find that the greenhouse gas impact will continue to dominate. Arblaster et al. (2011) used a suite of climate models to examine this, and determine why climate projections give different estimates of the competing influences on Southern Hemisphere mid-latitude westerly winds.

They compared a model run that did not include any ozone changes with a model run that did, to identify how much of the change was due to the ozone hole recovery, and how much was due to increased carbon dioxide. Interpolating the relationship to several other models, Arblaster et al. showed that some models are more "climate sensitive" than others, which might be the reason for the differing results.

More recently, Mayewski et al. (2015) presented a "mini-review" of Southern Hemisphere mid- and high-latitude circulation research, focussing mainly on what can be learnt from past climate variability. The aim of the paper was to provide an overview for researchers outside the direct field, and to align future efforts in researching the potentially devastating impacts that can occur as a result of Southern Hemisphere climate change.

The authors discussed rapid changes in sea level that have occurred in the past in conjunction with a poleward shift in the westerly winds. They then explained some preliminary work suggesting that similar circulation changes are already occurring.

## 1. THE VERDICT

Both studies were well written and concise, with good figures to communicate their arguments. Mayewski et al. in particular provided a useful schematic of the key features of mid- to high-latitude Southern Hemisphere circulation.

However, we felt that both articles assumed slightly too much knowledge from their readership. Arblaster et al. did not really define what they meant by model "climate sensitivity", even though the term means different things to different research communities. There were no details about the various models used, or how they had been validated. This made it hard for us to really grasp the importance of their findings, apart from the general idea that climate models created in different ways give different results.

The "mini-review", which we assumed would be ideal for scientists from our diverse range of fields, also referred to several terms and geographical features that would not be familiar to those outside the specific areas of Antarctic science or palaeoclimatology. They also neglected to discuss the observed increase in Antarctic sea ice extent, a surprising phenomenon that seemed relevant to the article's aim (and title!). These aspects are probably due to the focus and word restrictions of the respective journals, but could have been easily fixed with some short descriptions.

The methods used in both studies were neat, using simple comparisons rather than complicated techniques that were hard to follow. In the case of Mayewski et al., this actually seems a bit dangerous, as a lot of weight was placed on results obtained by comparing two years of reanalysis (an estimate of the complete atmosphere based on weather observations). While the authors explained that a single case study like this is not enough to identify real climatic change, they failed to mention that reanalysis products over the Antarctic region are notoriously unreliable because of sparse observations.

Despite these shortcomings, both papers gave us some insight into two different approaches for understanding the dominant factors of Southern Hemisphere atmospheric circulation change, and showed us how much knowledge in the field has progressed in four short years.

## 1. ARTICLES REVIEWED

Arblaster JM, Meehl G, Karoly DJ. 2011. Future climate change in the Southern Hemisphere: Competing effects of ozone and greenhouse gases. *Geophysical Research Letters* 38(January): 1–6. DOI: [10.1029/2010GL045384](https://doi.org/10.1029/2010GL045384).

Mayewski PA, Bracegirdle T, Goodwin I, Schneider D, Bertler NAN, Birkel S, Carleton A, England MH, Kang J-H, Khan A, Russell J, Turner J, Velicogna I. 2015. Potential for Southern Hemisphere climate surprises. *Journal of Quaternary Science* 30(5): 391–395. DOI: [10.1002/jqs.2794](https://doi.org/10.1002/jqs.2794).

## 1. AUTHOR CONTRIBUTIONS

LA selected the articles and drafted the review, based on discussions with all present members of the journal club. All other members revised the review before submission.