



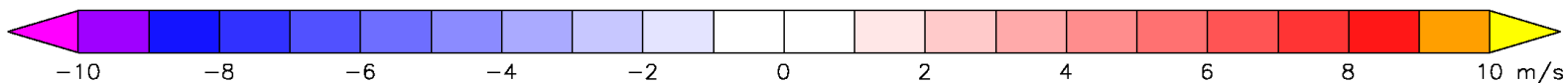
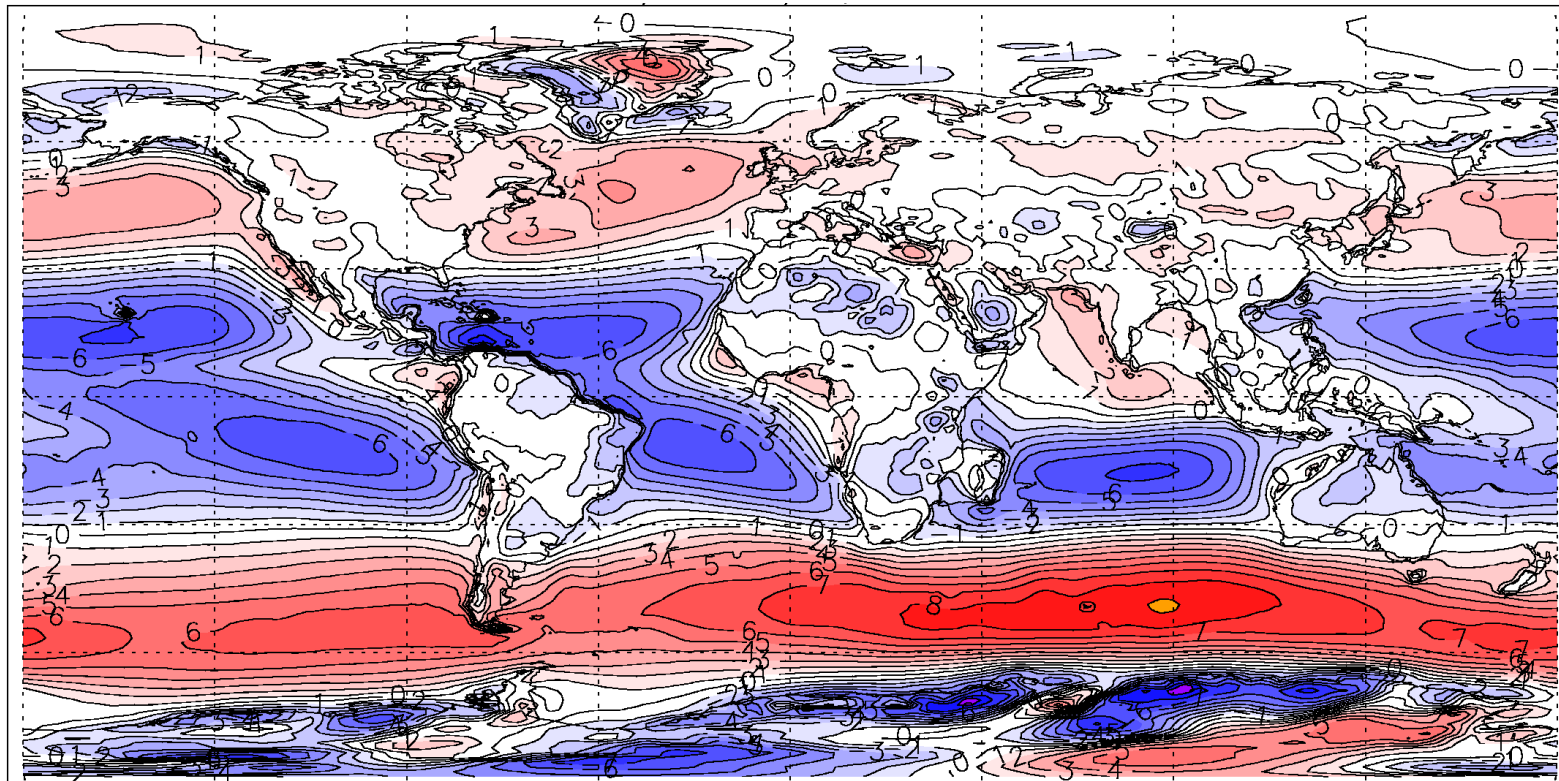
Southern Ocean wind and sea-ice in CMIP5: biases and projections

Tom Bracegirdle, John Turner



Circumpolar westerlies

Annual mean westerly wind (1979-2002) (ERA-40)



[NOAA NCEP Animation](http://earth.nullschool.net/#current/wind/surface/level/orthographic=0.52,-88.71,282) (<http://earth.nullschool.net/#current/wind/surface/level/orthographic=0.52,-88.71,282>)

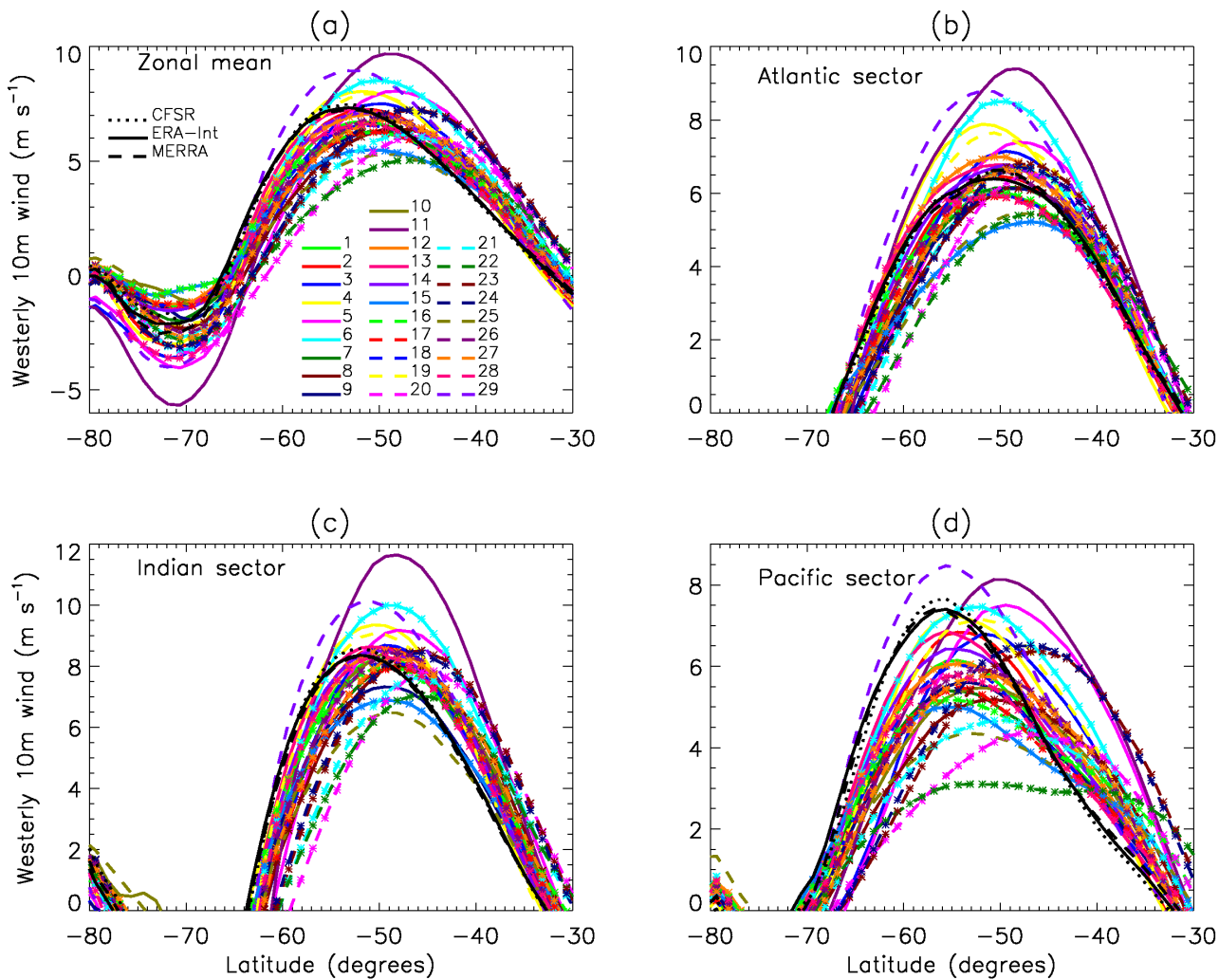


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Westerly wind bias



Bracegirdle et al. (2013)

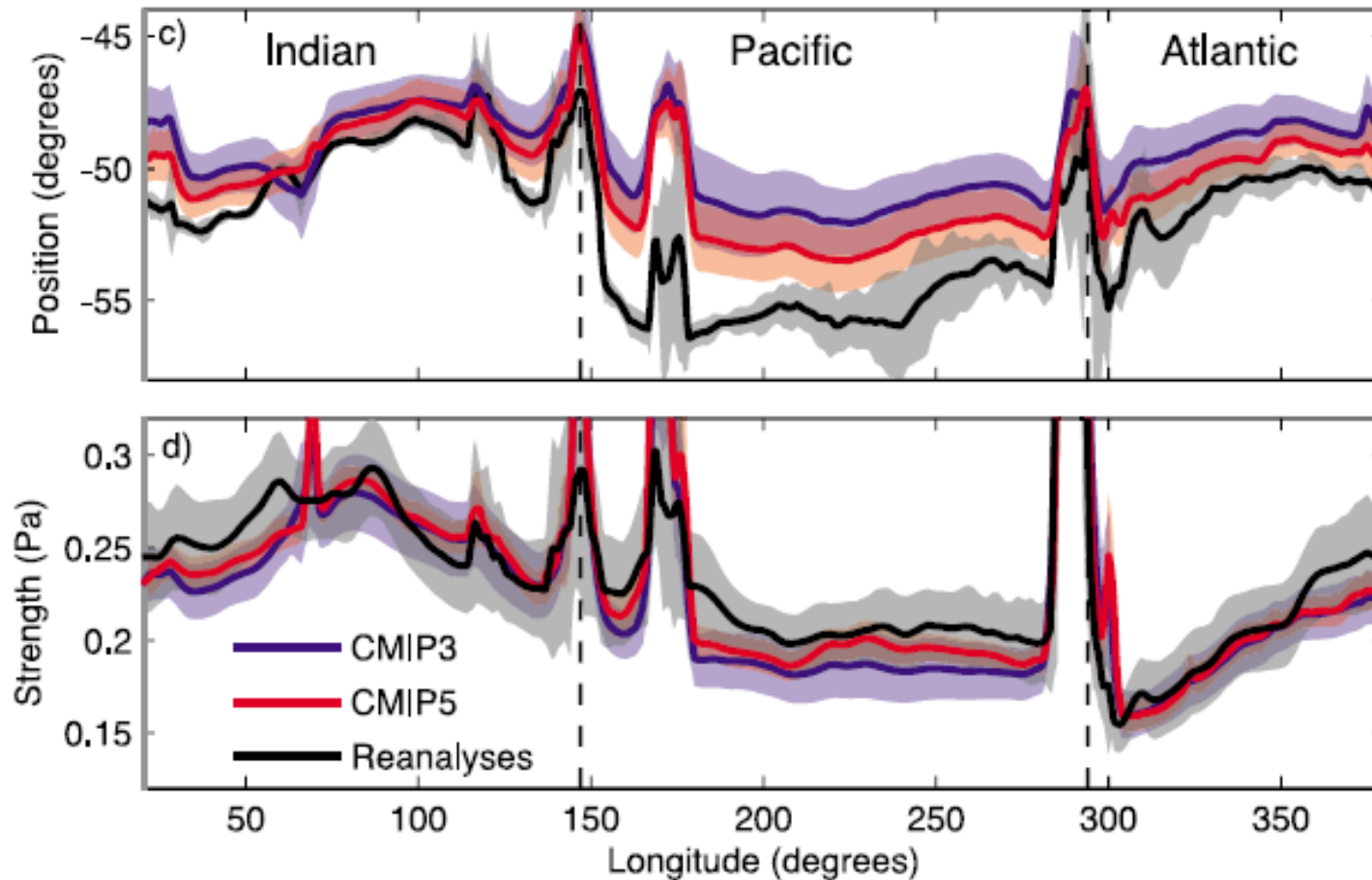


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Westerly wind stress bias



Swart and Fyfe, 2012

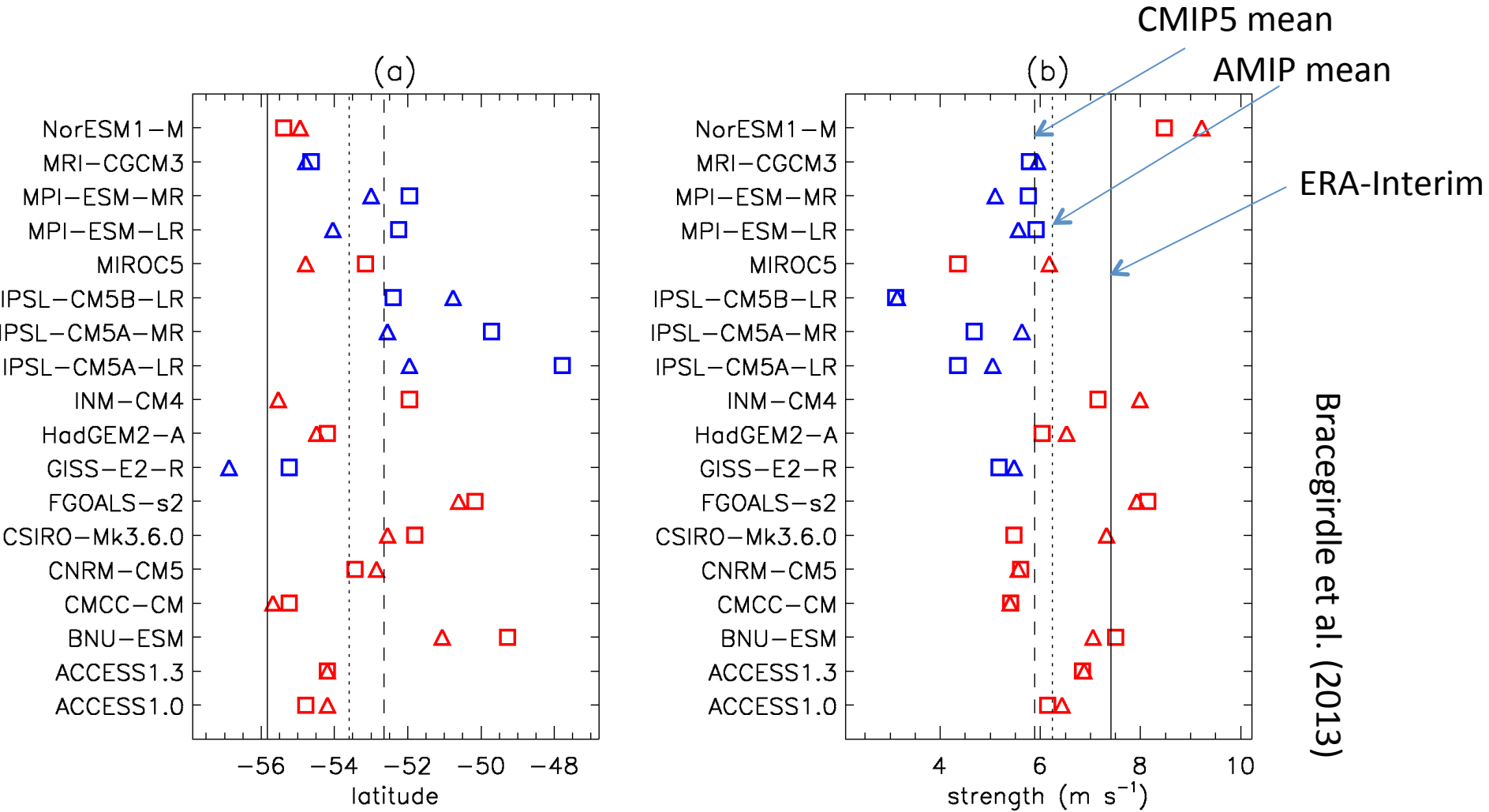


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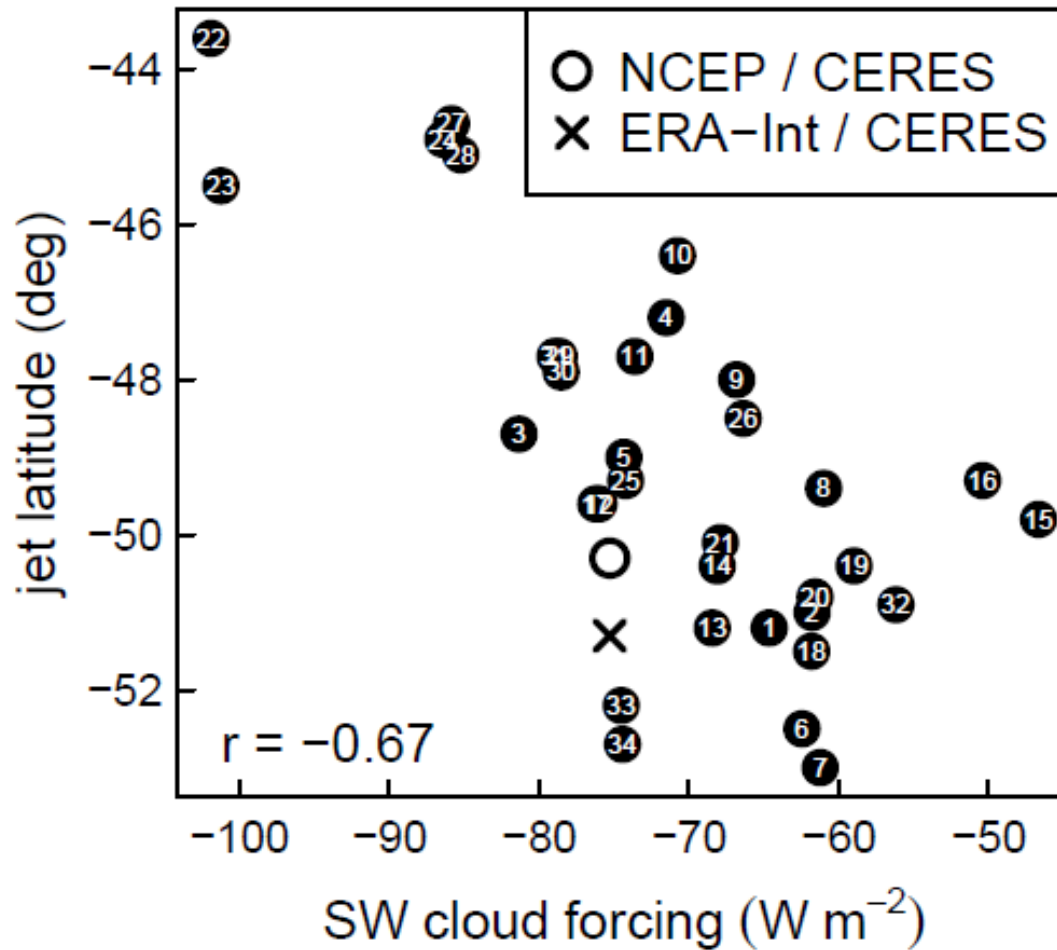
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Atmosphere-only (AMIP) biases



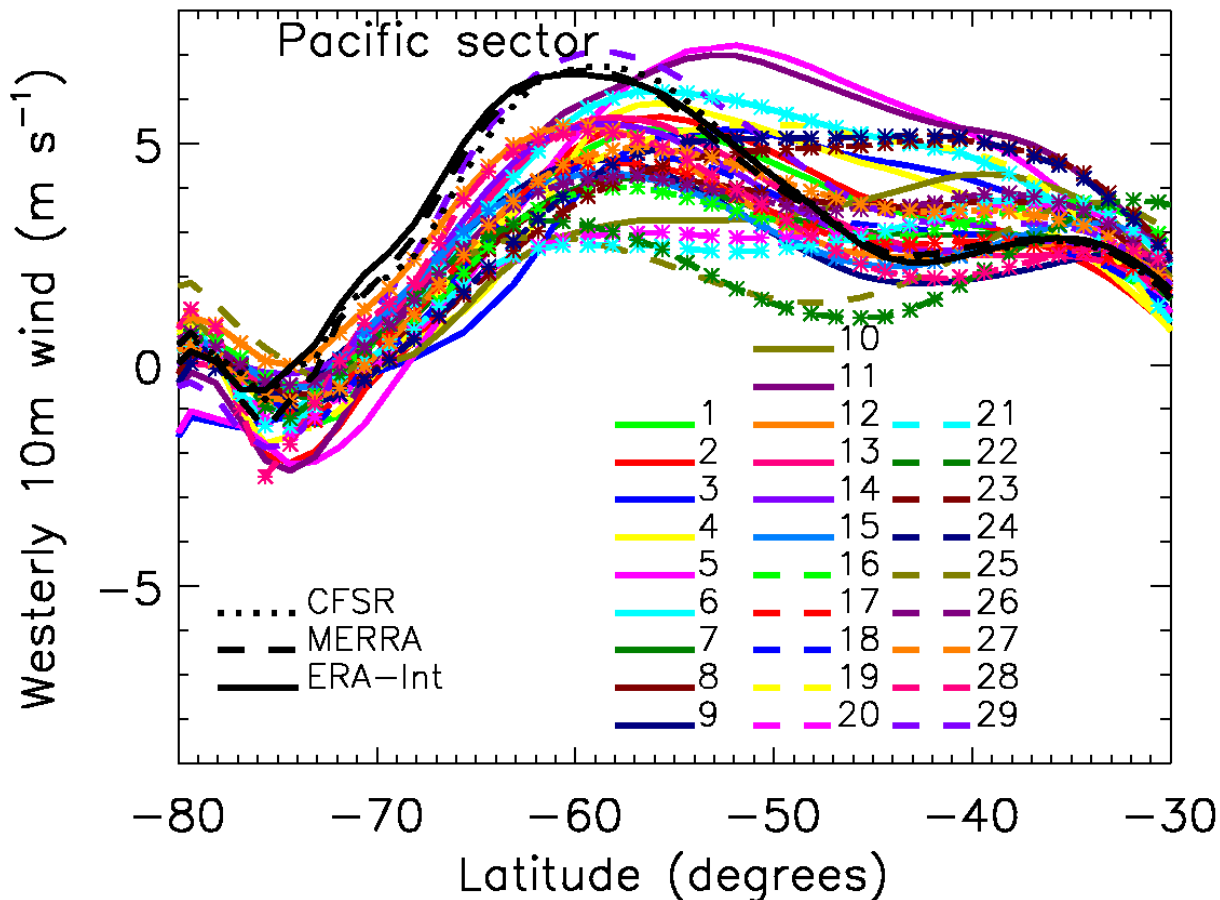
Cloud biases



Ceppi et al. (2012)



Pacific sector winds



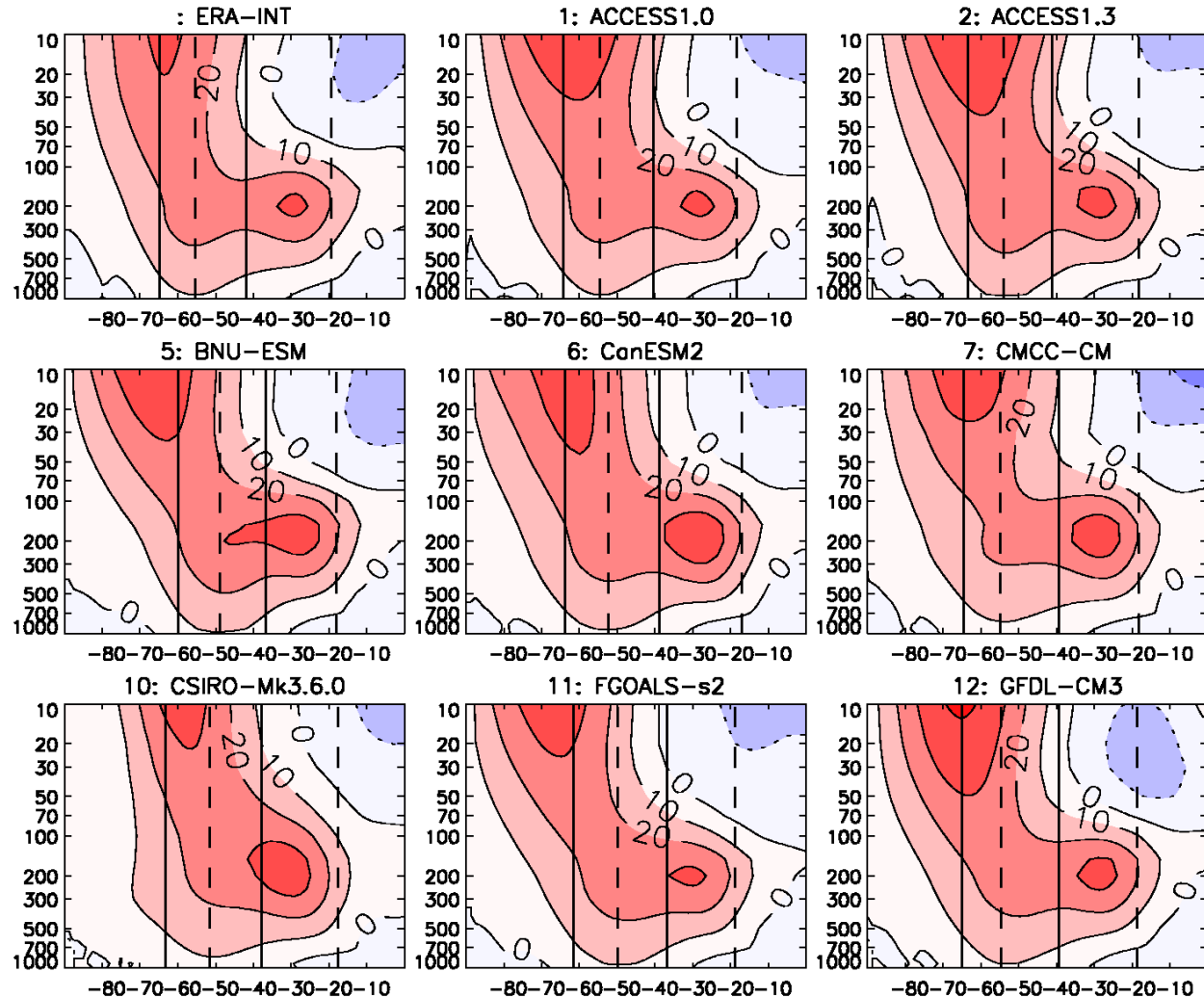
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Pacific sector upper atmosphere

Annual mean westerly
component



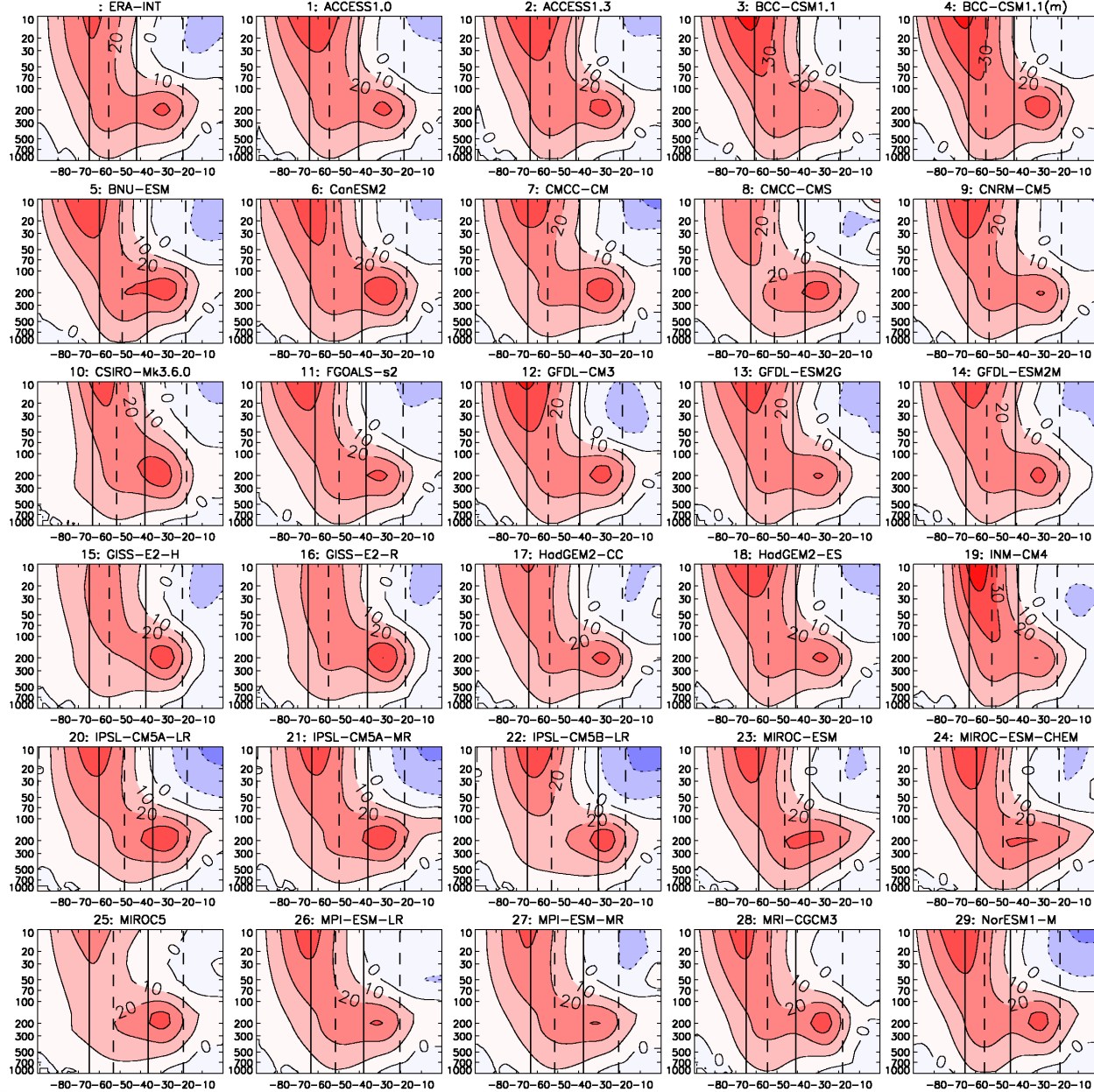
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Pacific sector upper atmosphere

Annual mean westerly
component



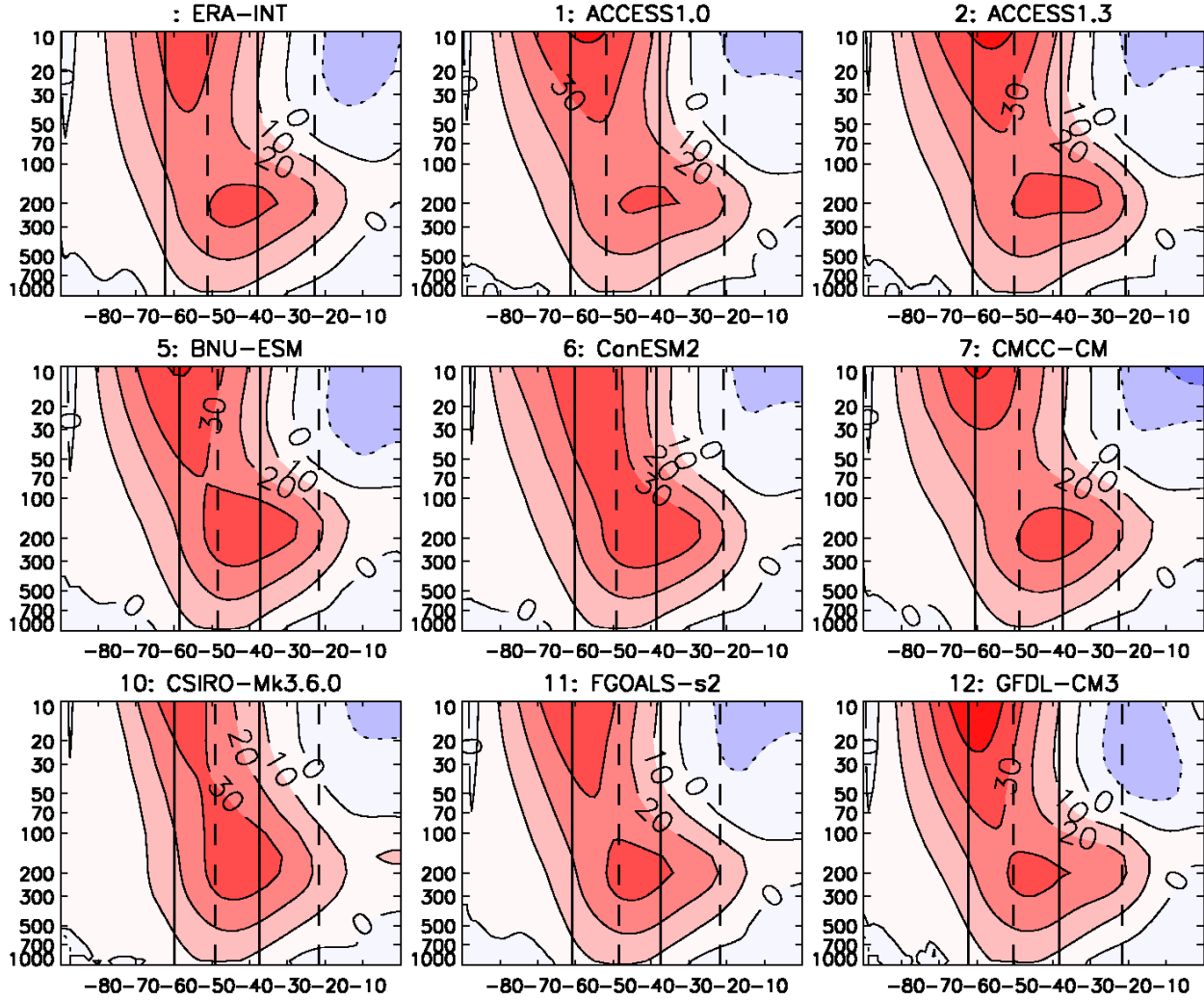
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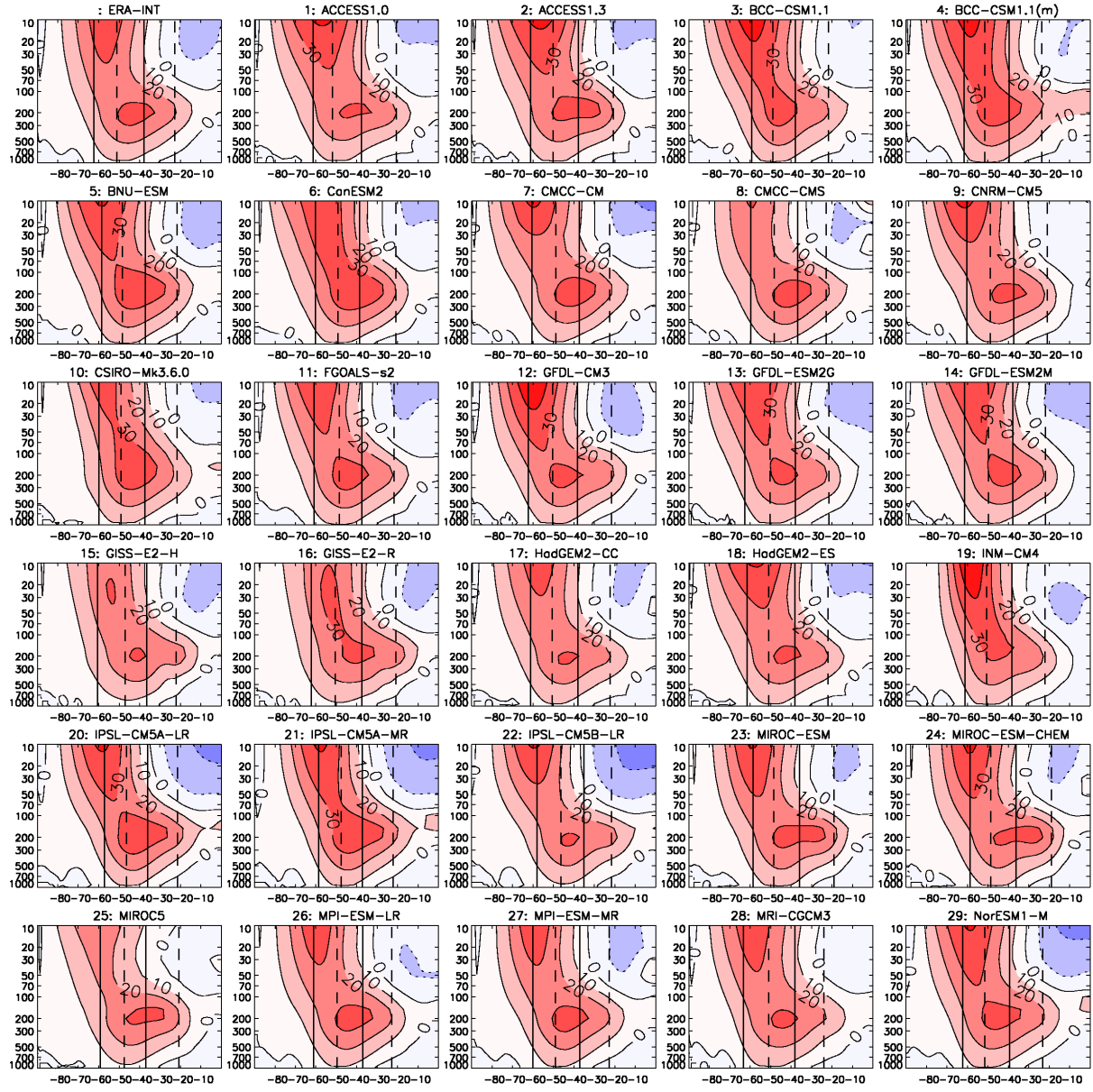
Atlantic sector upper atmosphere

Annual mean westerly
component



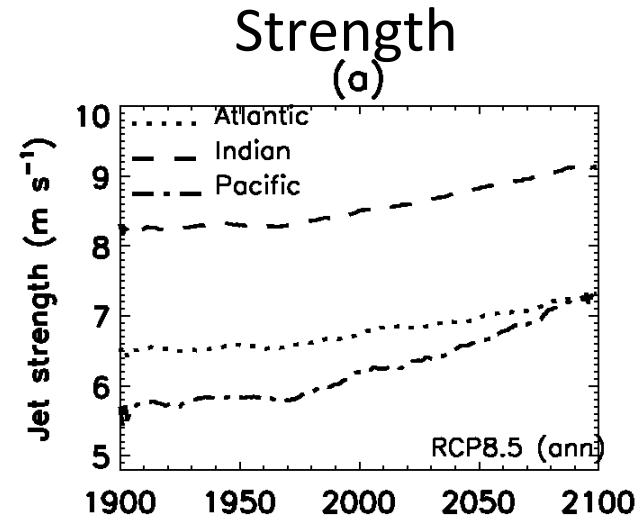
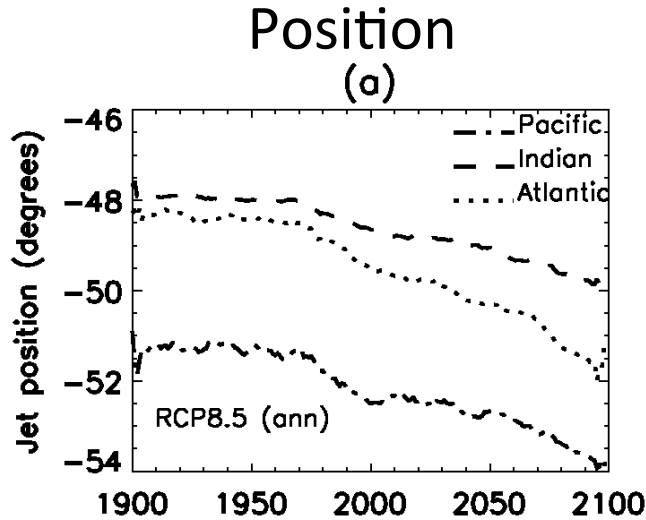
Atlantic sector upper atmosphere

Annual mean westerly
component

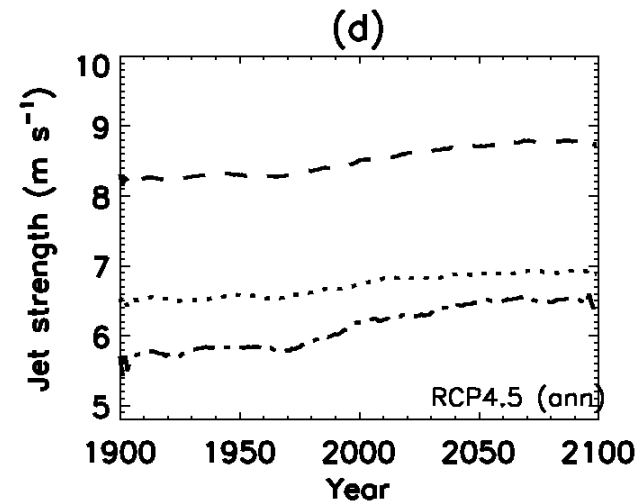
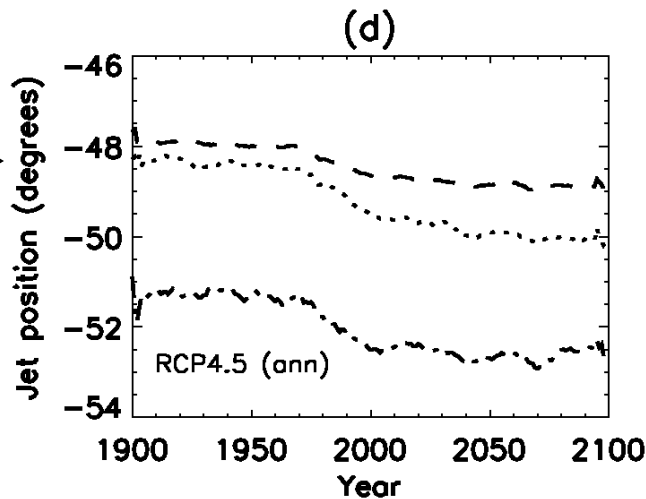


Future projections

High emissions



Medium Emissions

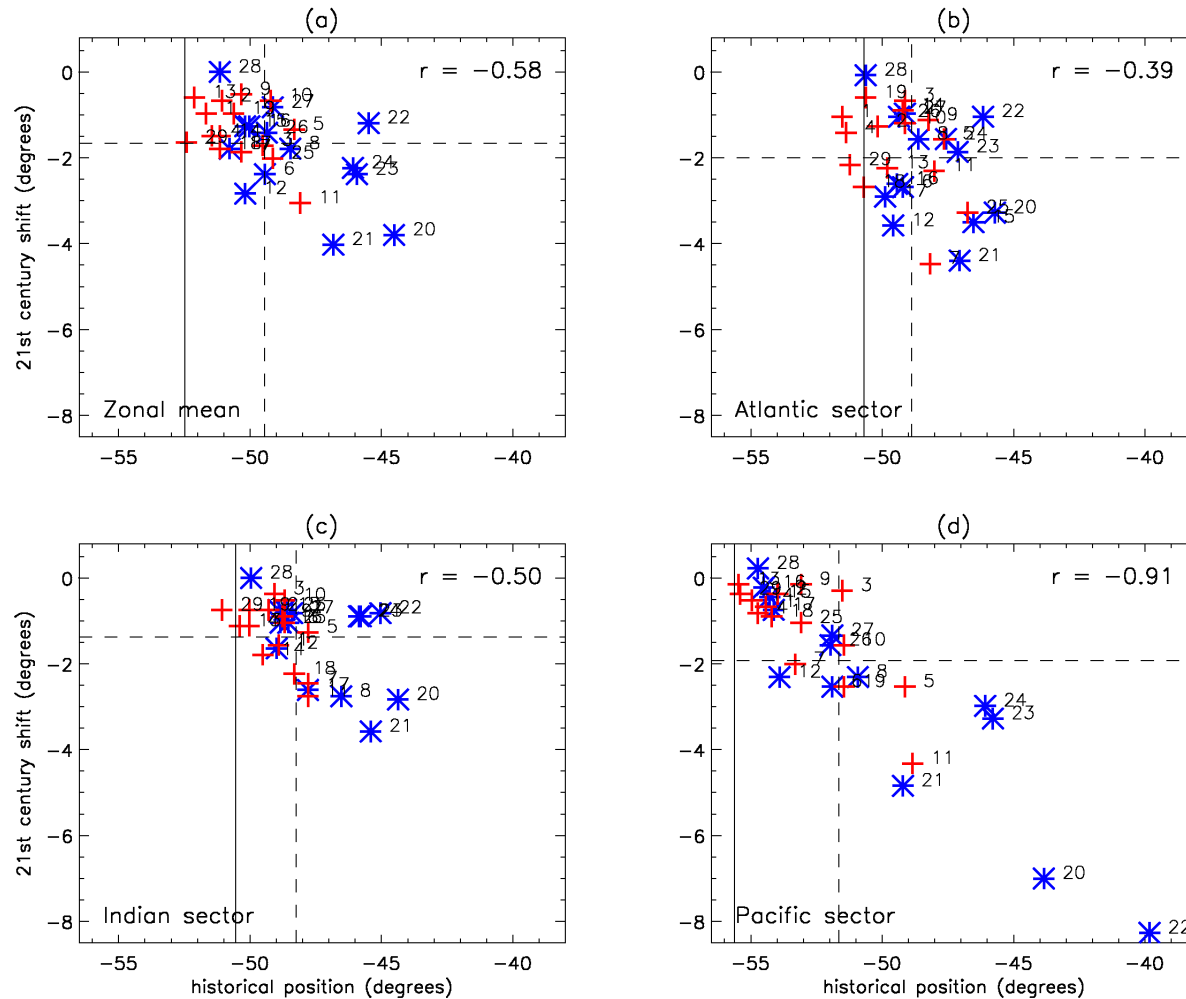


Major change has already happened!

Bracegirdle et al. (2013)



Implications for 21st century projections

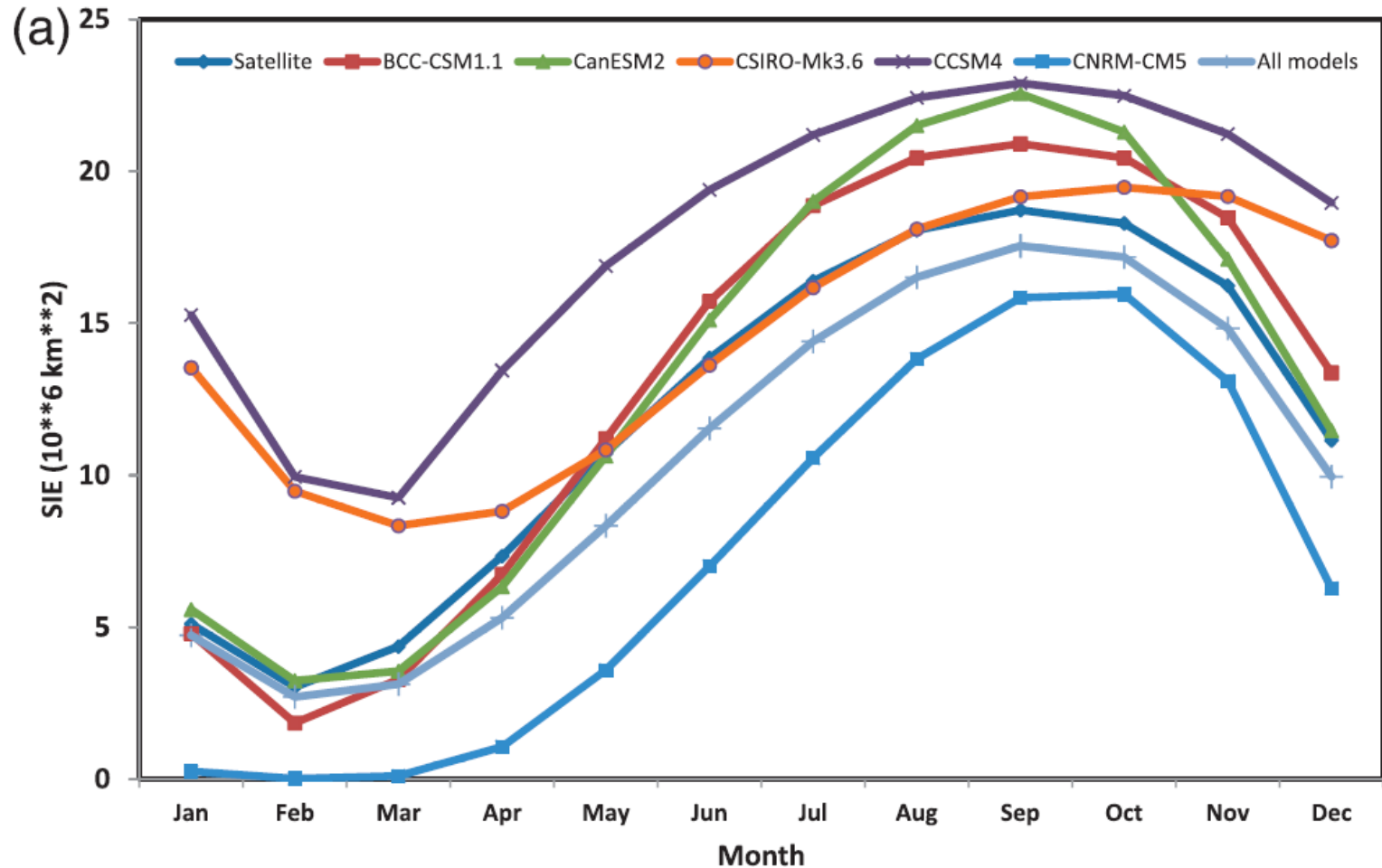


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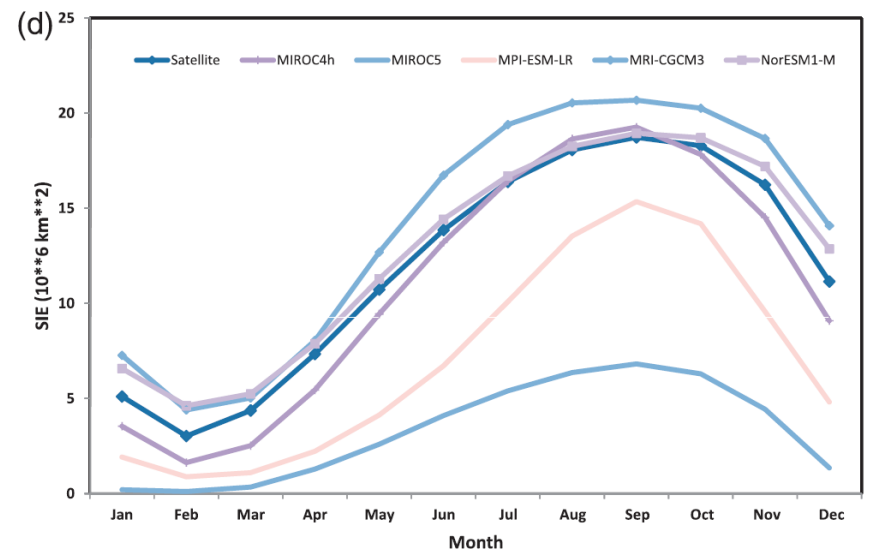
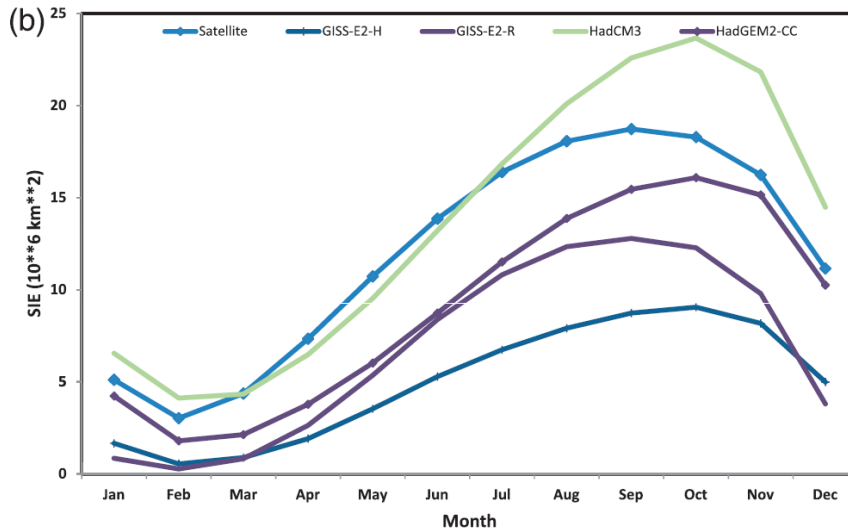
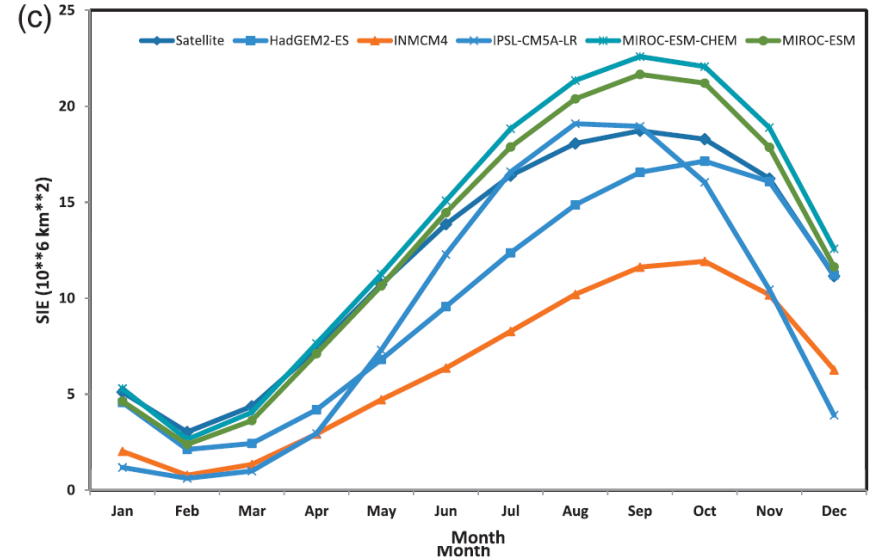
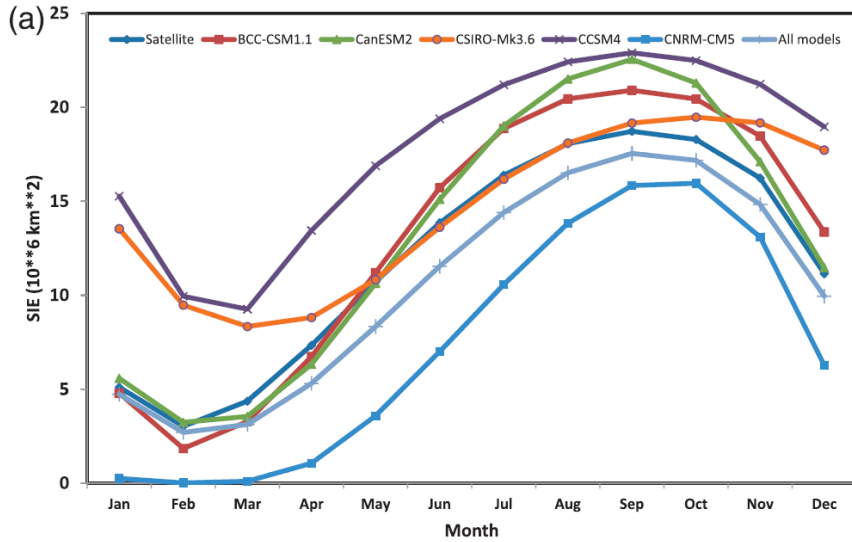
Sea ice extent biases



Turner et al. (2013)



Sea ice extent biases

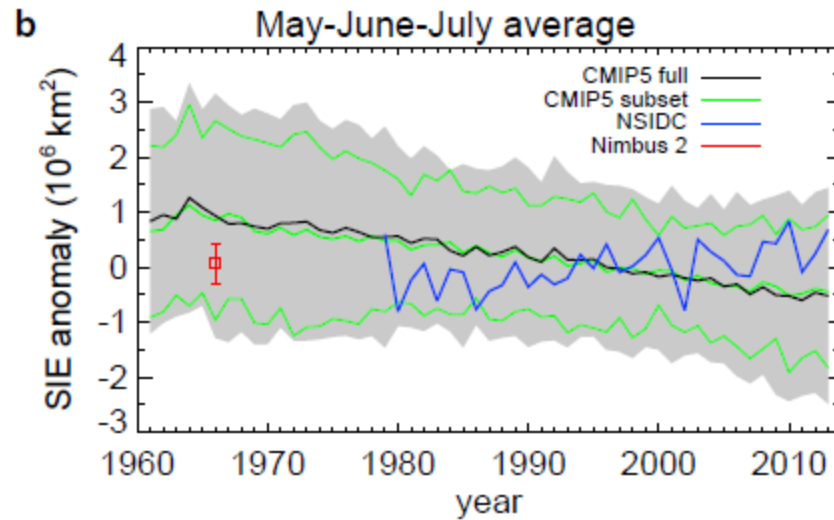
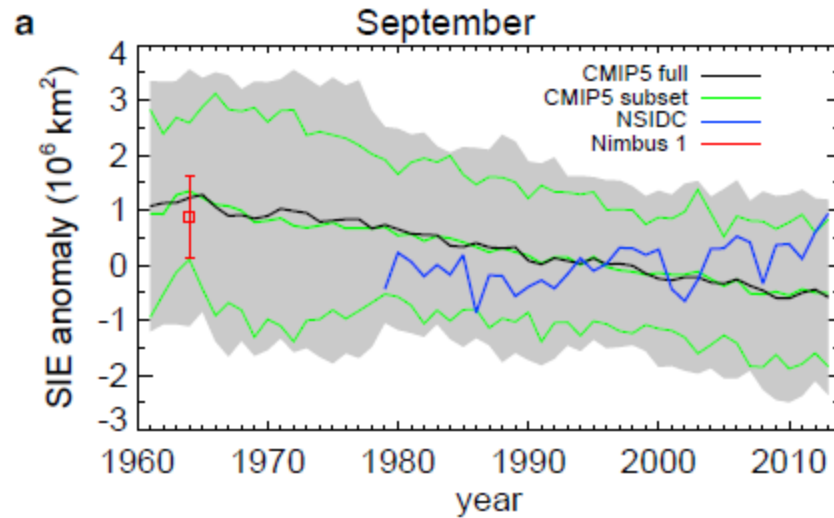


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Sea ice trends



Gagne et al. (2014)



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Summary

- Most CMIP5 models exhibit an equatorward bias in Southern Hemisphere jet position
 - Largest over the Pacific sector and smallest over the Atlantic
 - Problems capturing the ‘split jet’ structure
- Most of the bias seems to be intrinsic to the atmospheric component of the models
- Under high emissions scenarios there is a projected 21st century poleward shift in most models, but smaller in the ‘better’ models
- Many models have too little ice and most have too large year-to-year variability
- The recent trends in sea ice are difficult to separate from natural variability





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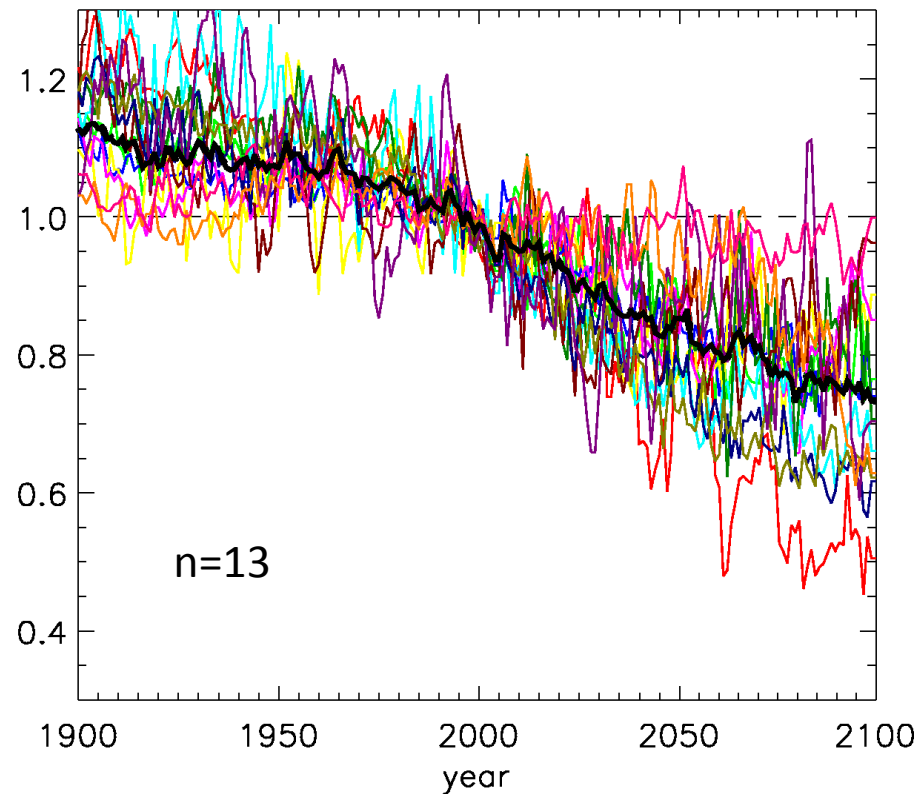
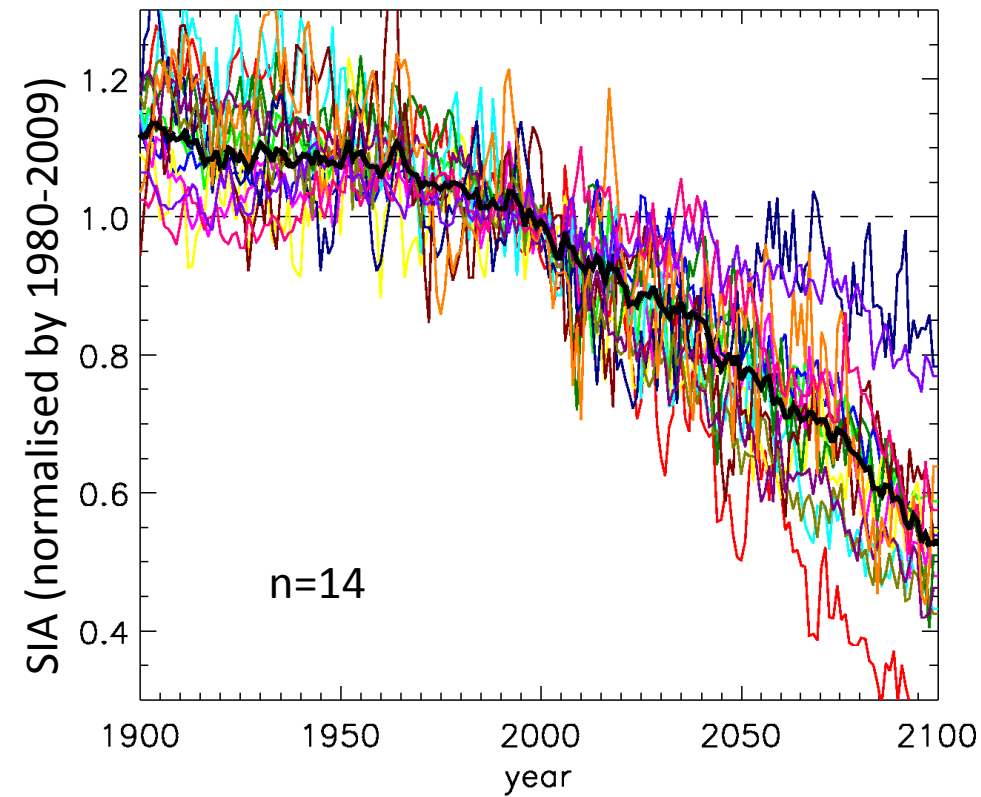
Tom Bracegirdle, John Turner



Annual mean sea ice area

CMIP5 RCP 8.5

CMIP5 RCP 4.5



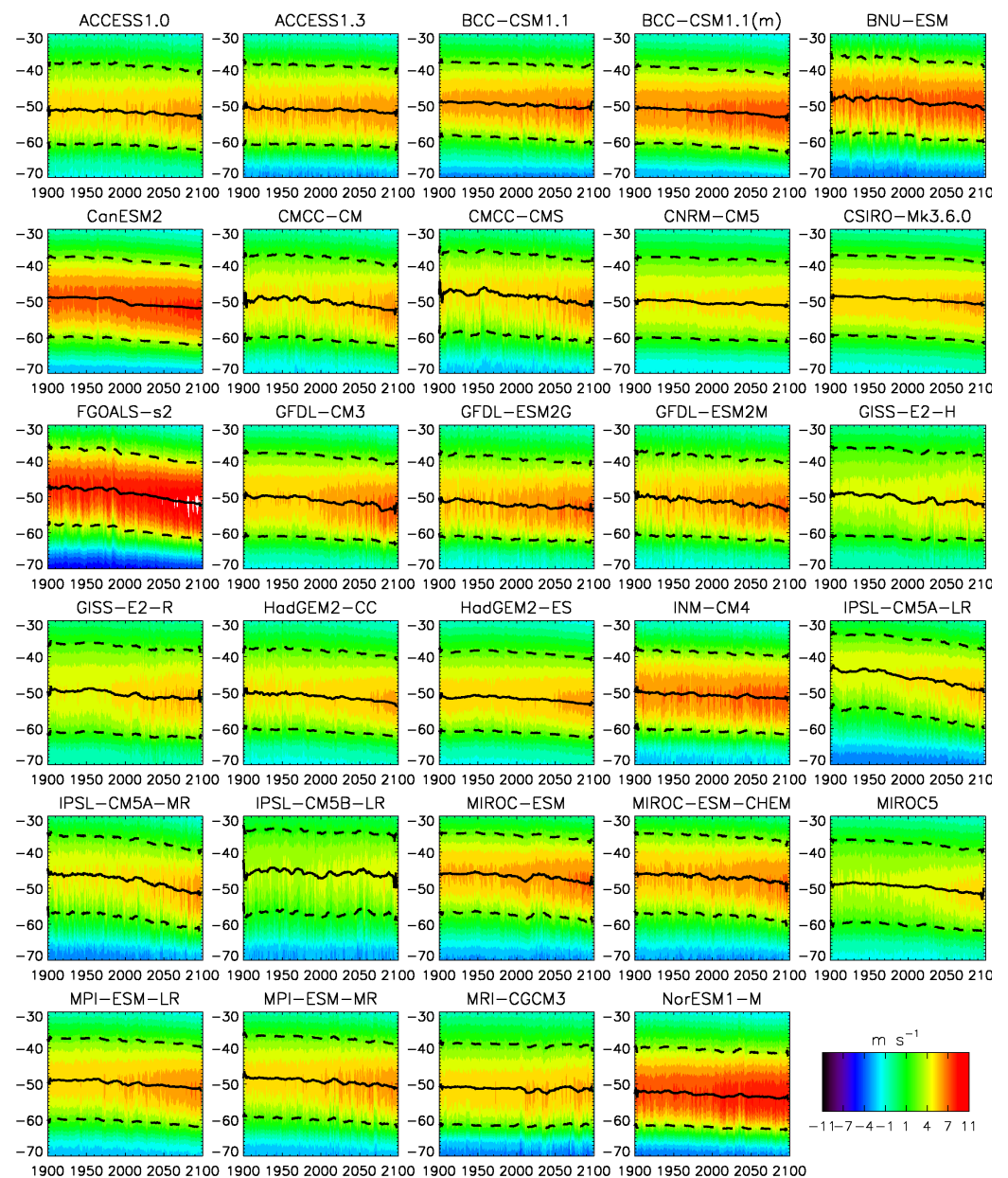
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Jet shift and strengthening

Large inter-model differences



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