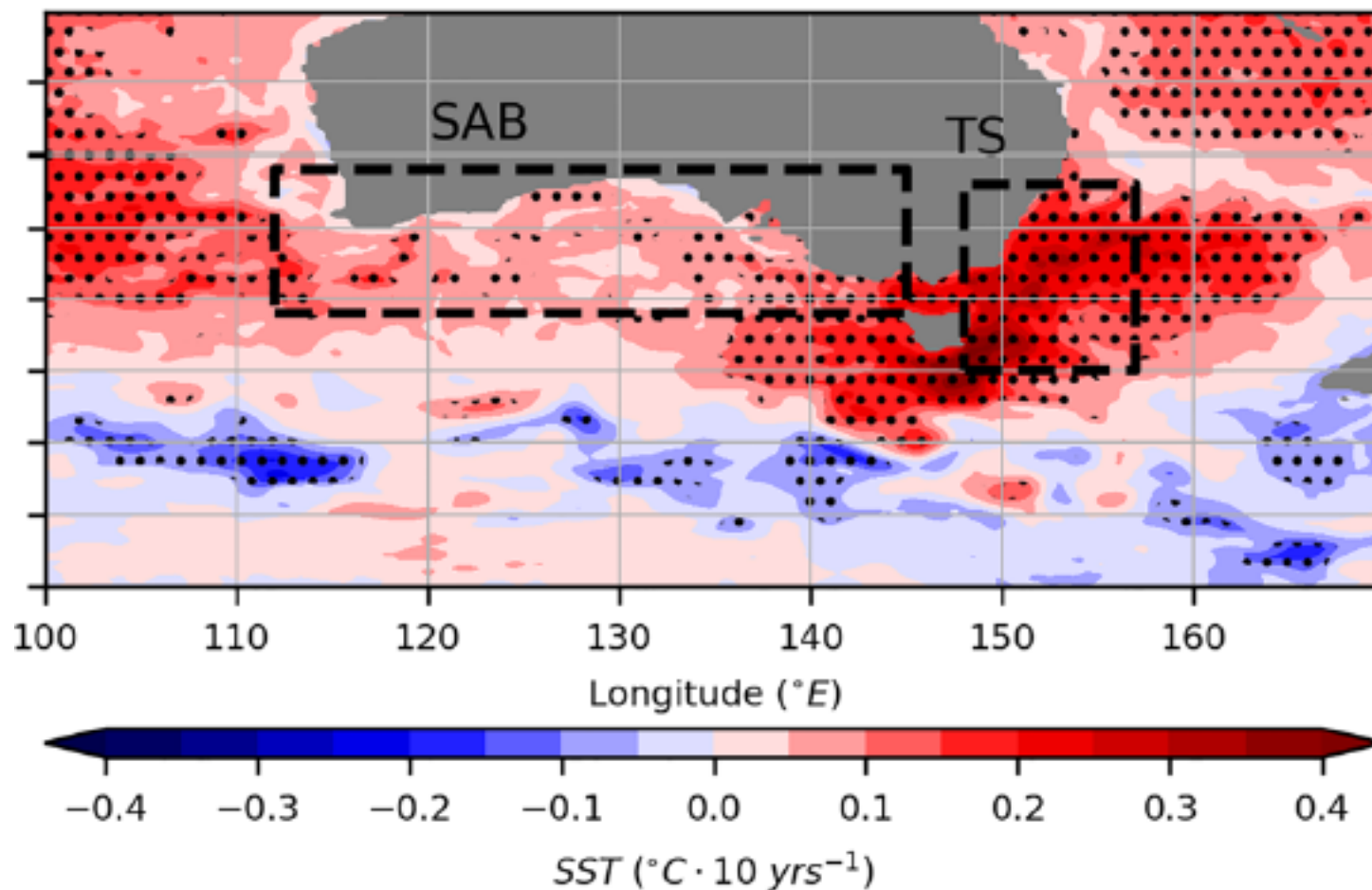


Role of wind variations in controlling ocean warming south of Australia

(b) SST 1978 to 2017 trend



Role of wind variations in controlling ocean warming south of Australia

Geophysical Research Letters




RESEARCH LETTER

10.1029/2019GL086605

Key Points:

- Interannual southward shifts in Southern Hemisphere westerlies lead to surface ocean warming events in the South Australian Basin
- Twenty-first century projected wind trends could play a role similar in magnitude to radiative warming in driving surface ocean temperature change
- Twenty-first century wind trends are responsible for around half of the projected surface ocean warming and sea level rise in the Tasman Sea

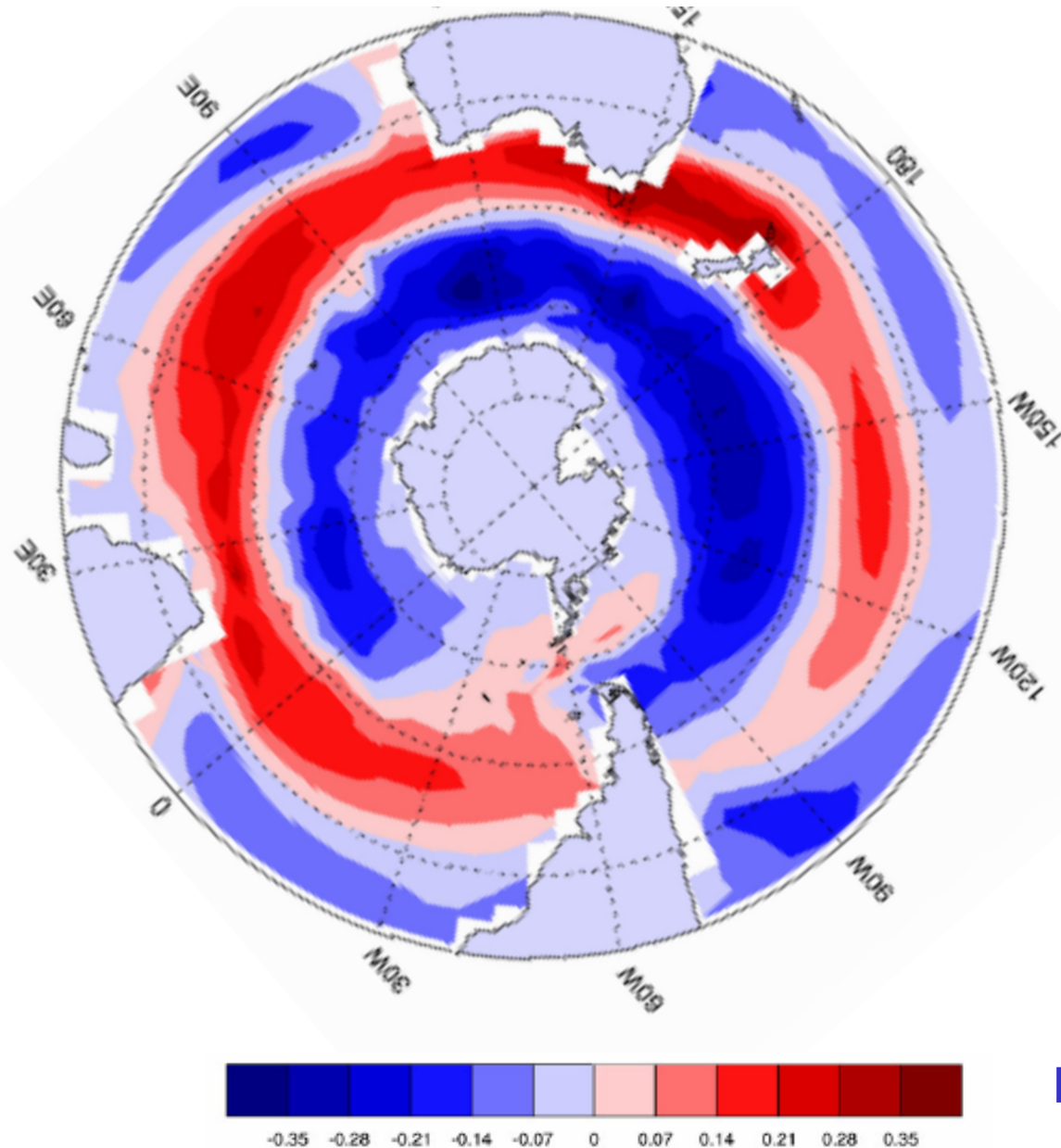
Surface Ocean Warming Around Australia Driven by Interannual Variability and Long-Term Trends in Southern Hemisphere Westerlies

E. R. Duran¹ , M. H. England^{1,2} , and P. Spence^{1,2} 

¹Climate Change Research Centre (CCRC), University of New South Wales, Sydney, New South Wales, Australia, ²ARC Centre of Excellence for Climate Extremes (CLEX), Sydney, New South Wales, Australia

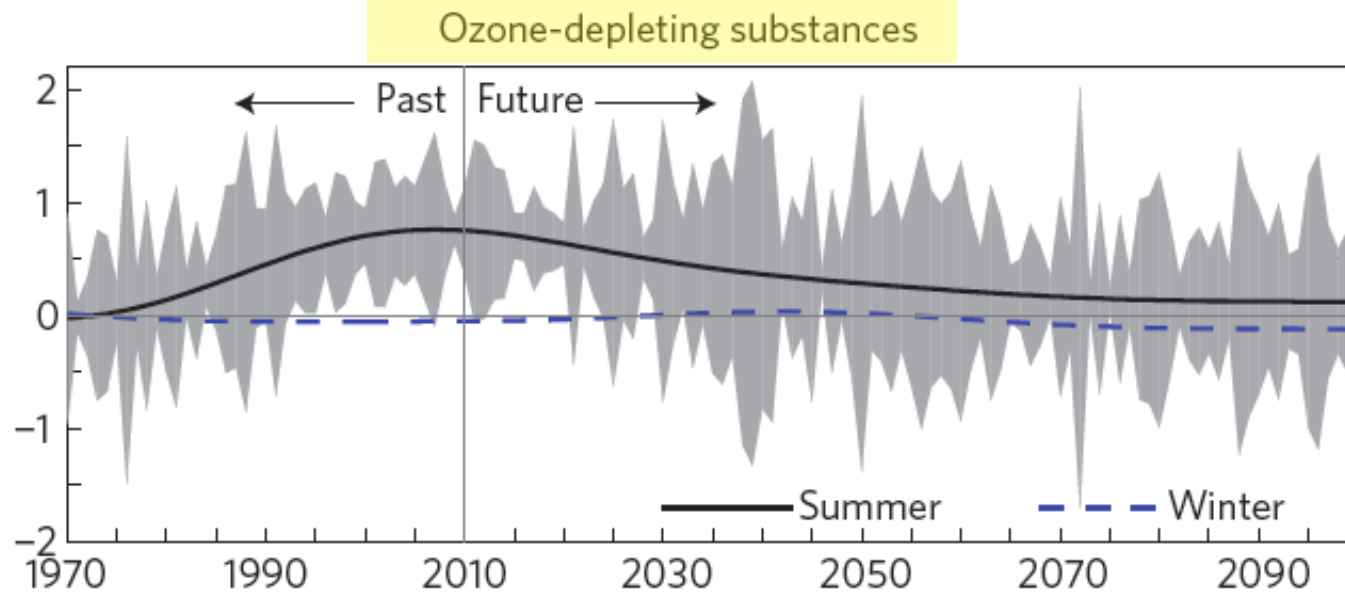
Abstract The ocean surface temperature and sea level response around Australia to both interannual variability as well as observed and projected changes in surface winds is presented. A hindcast ocean experiment shows interannual southward shifts in the Southern Hemisphere westerly winds drive ocean surface warming events in the South Australian Basin. Twenty-first century climate and ocean projections in an ensemble of the fifth Coupled Model Intercomparison Project (CMIP5) models show that wind

Regression of the SAM index onto SST

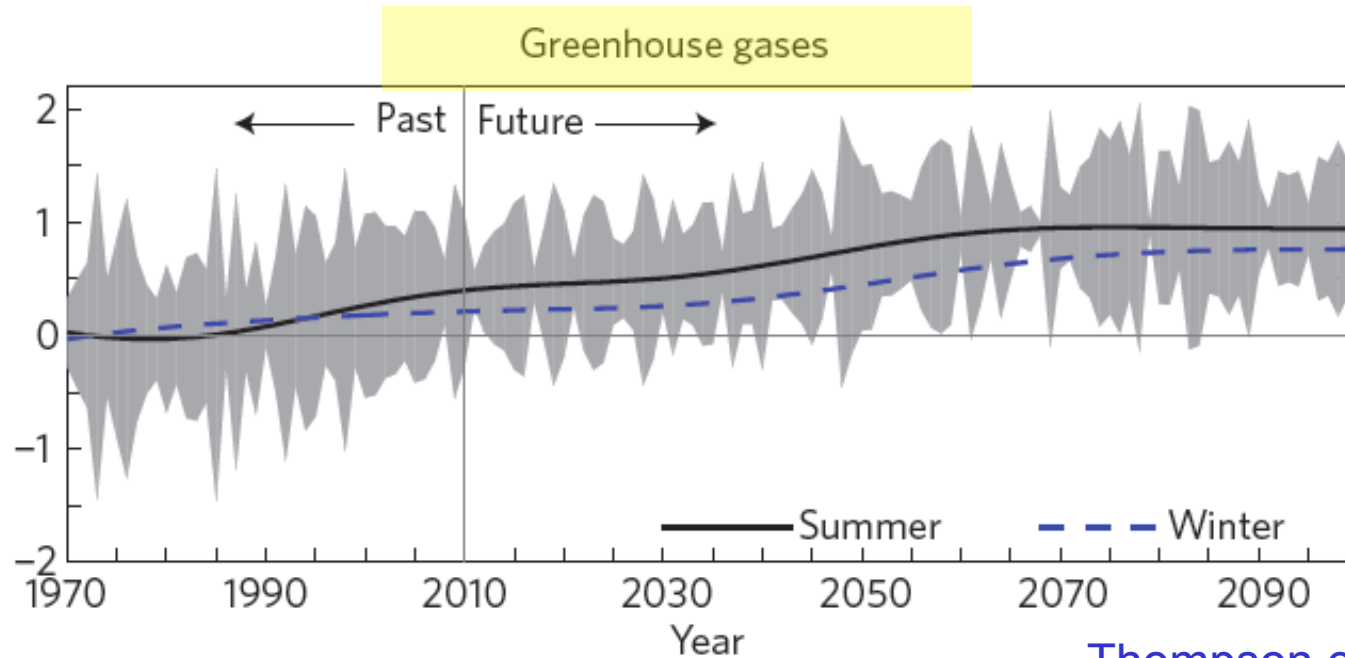


Sen Gupta &
England (2006)

SAM

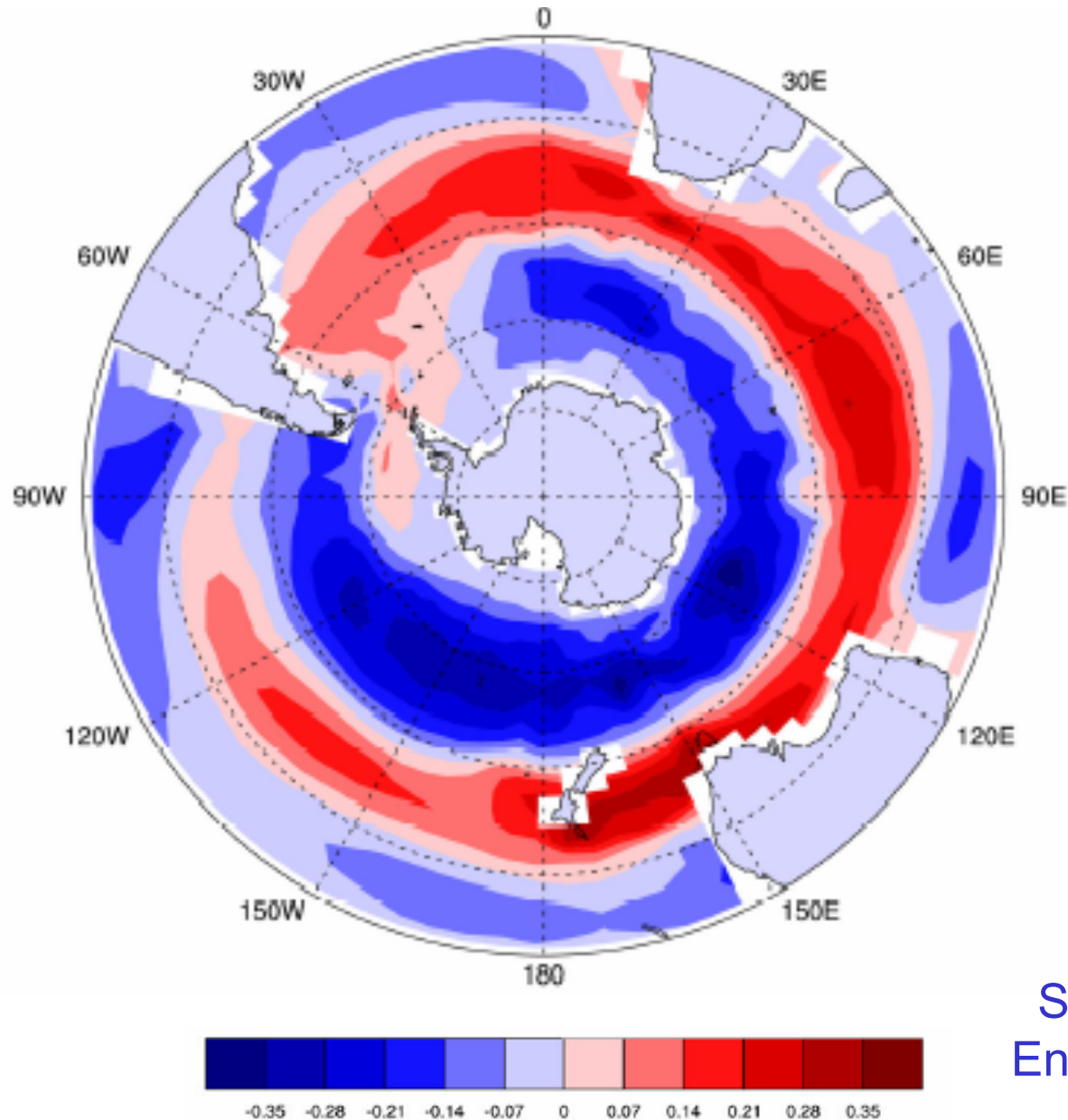


SAM



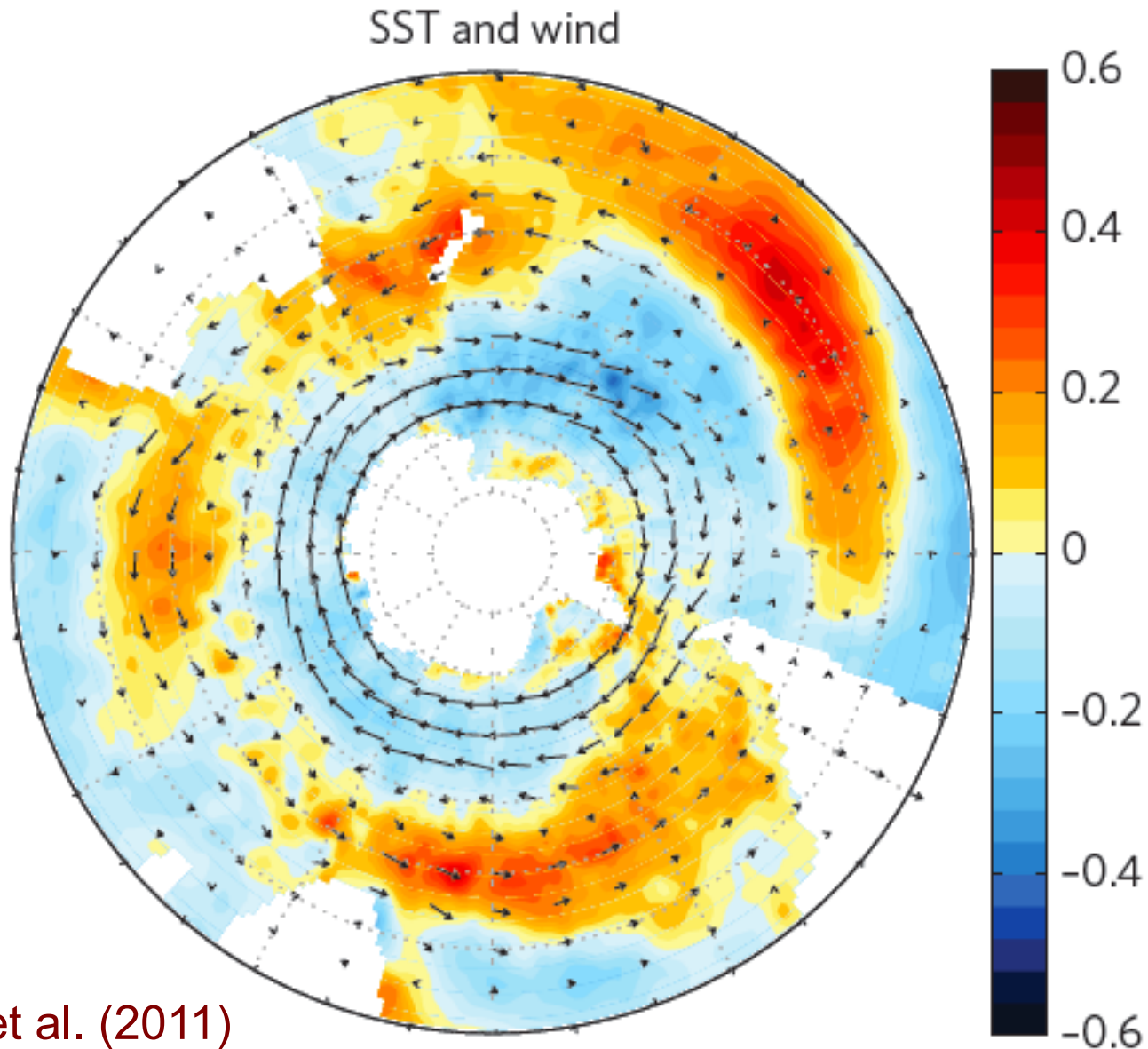
Thompson et al. (2011)
Nature Geosciences

Regression of the SAM index onto SST



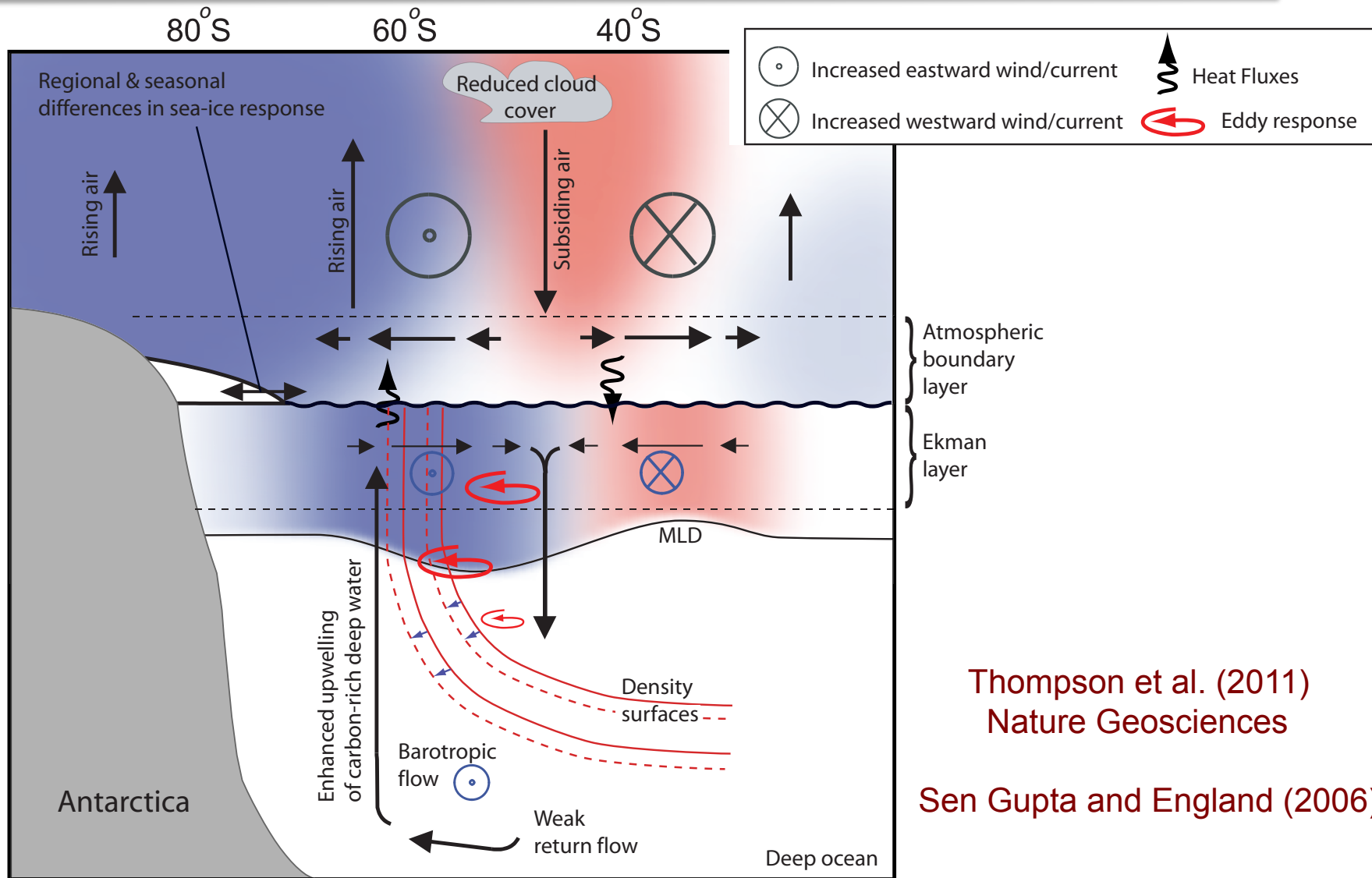
Sen Gupta &
England (2006)

Regression of the SAM index onto SST & winds



Thompson et al. (2011)
Nature Geosciences

Ocean-atmosphere imprint of the Southern Annular Mode

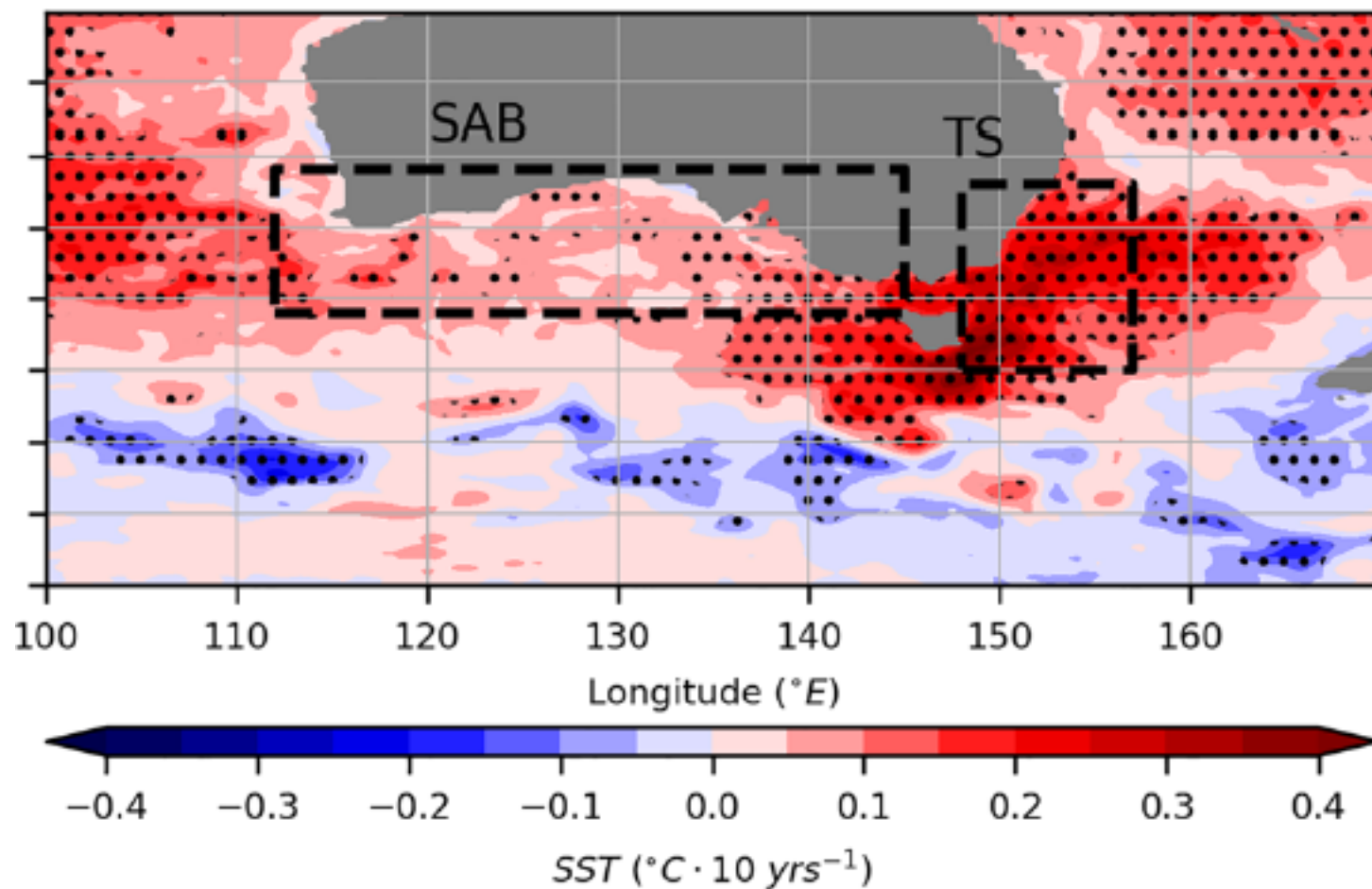


Thompson et al. (2011)
Nature Geosciences

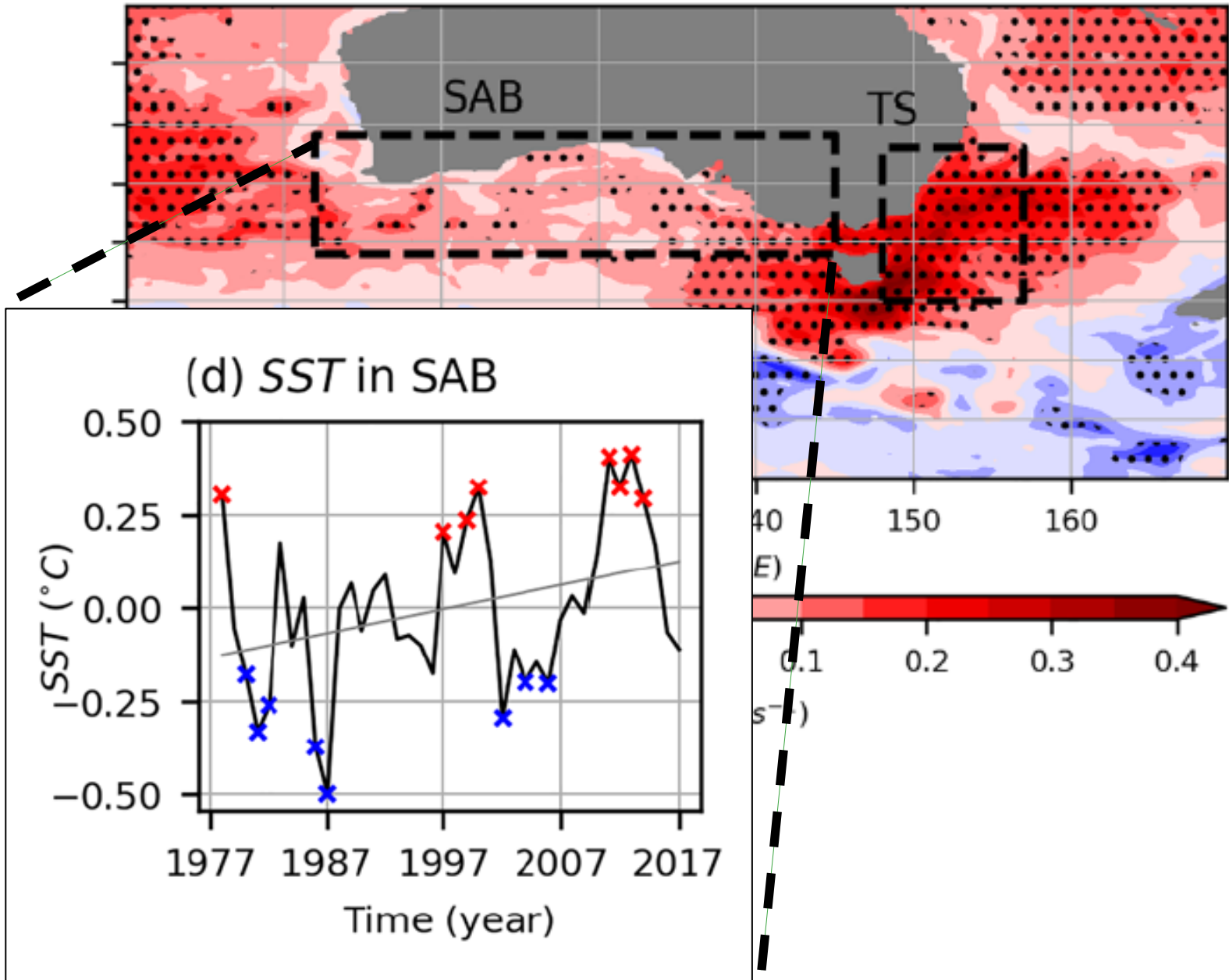
Sen Gupta and England (2006)

Surface fluxes, Ekman transport and MLD changes act in concert to produce SST response. Eddy heat fluxes act in the opposite sense

(b) SST 1978 to 2017 trend

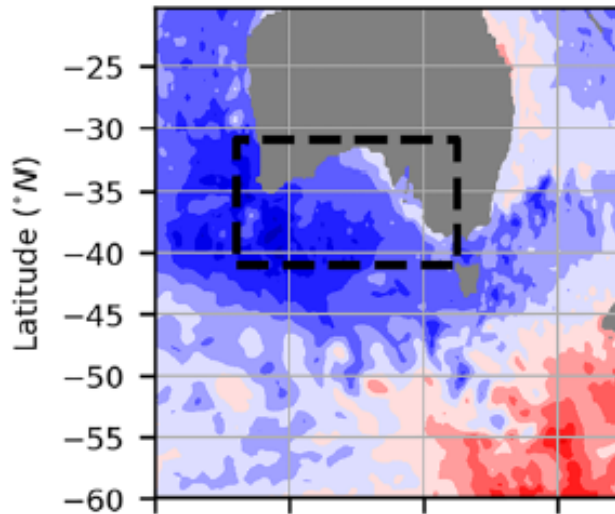


Year-to-year variability in SST

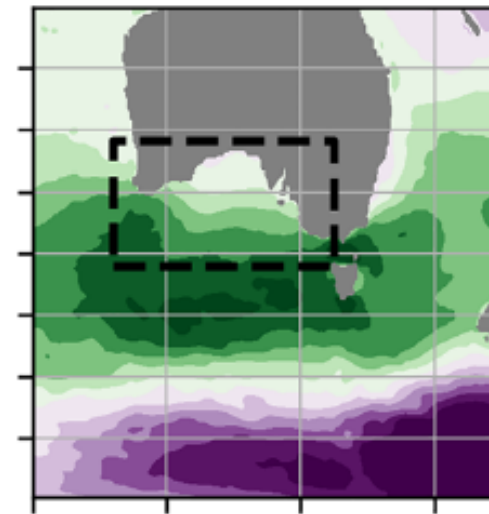


COLD
YEARS

(h) SST in cold SST years



(i) τ^x in cold SST years

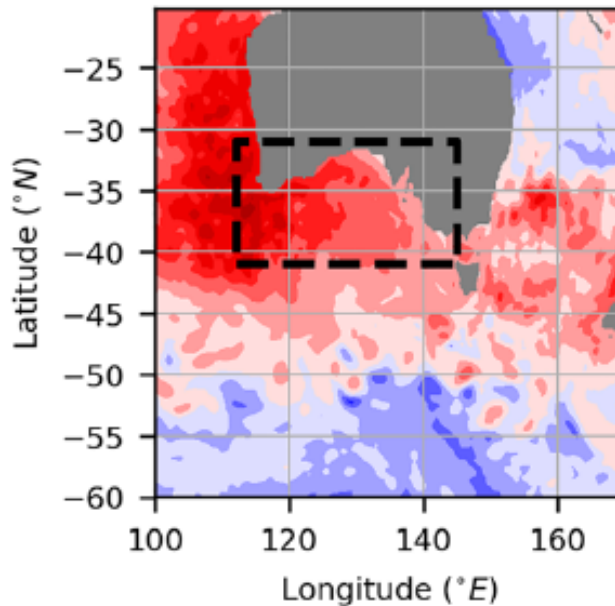


Stronger
westerlies

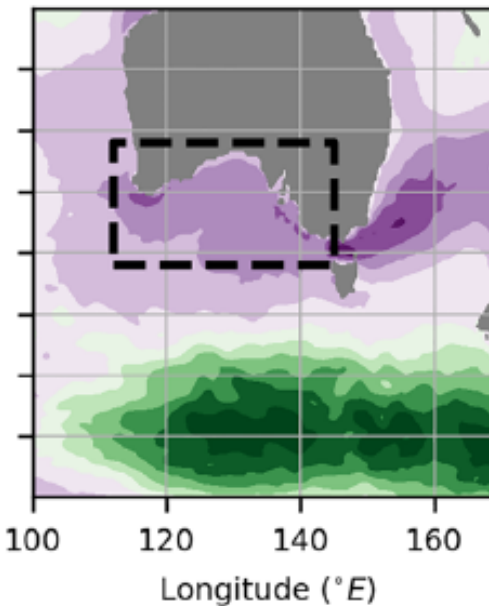
Weaker
westerlies

WARM
YEARS

(l) SST in warm SST years

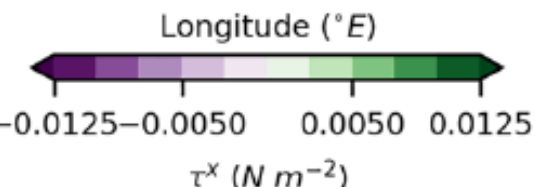
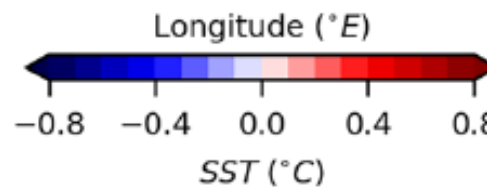


(m) τ^x in warm SST years

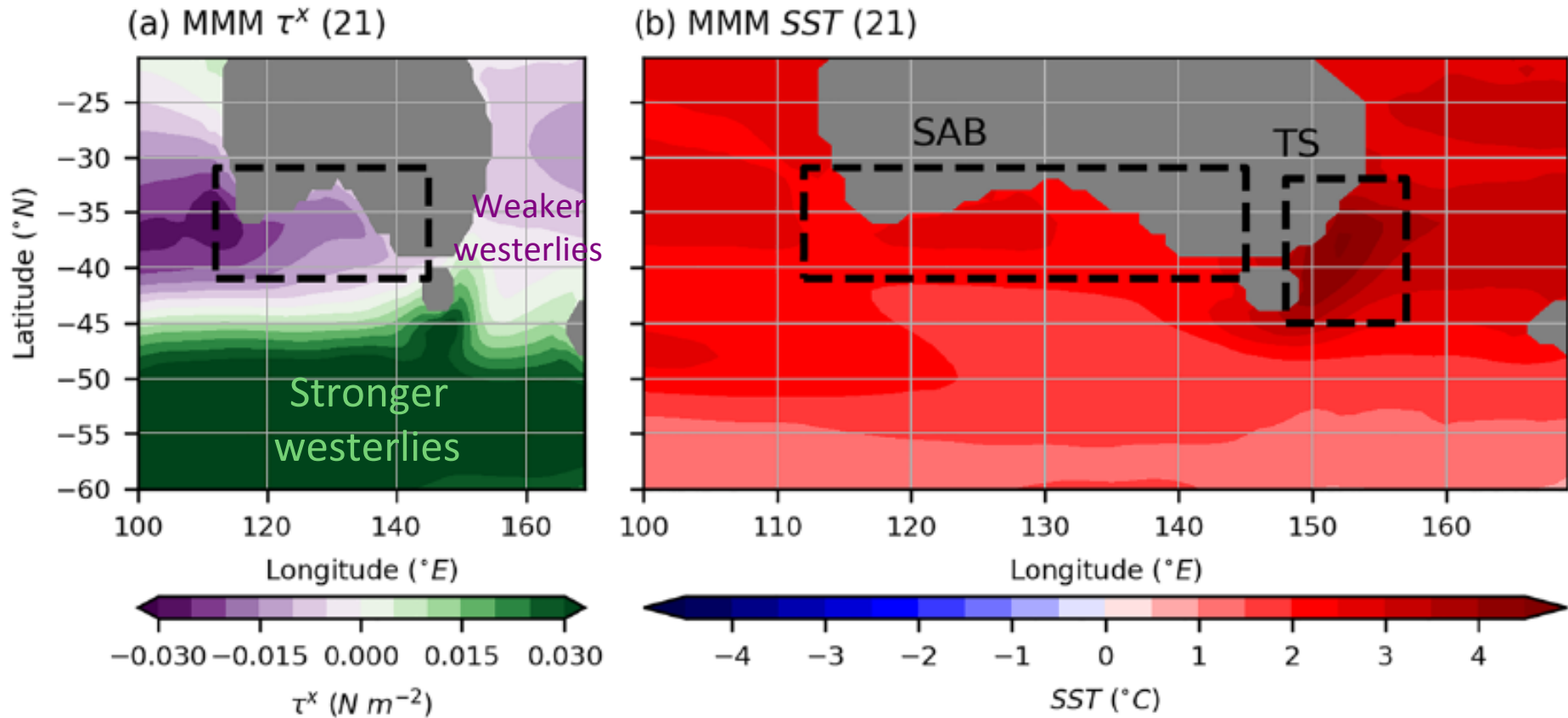


Weaker
westerlies

Stronger
westerlies



Projected warming and wind shifts to 2100

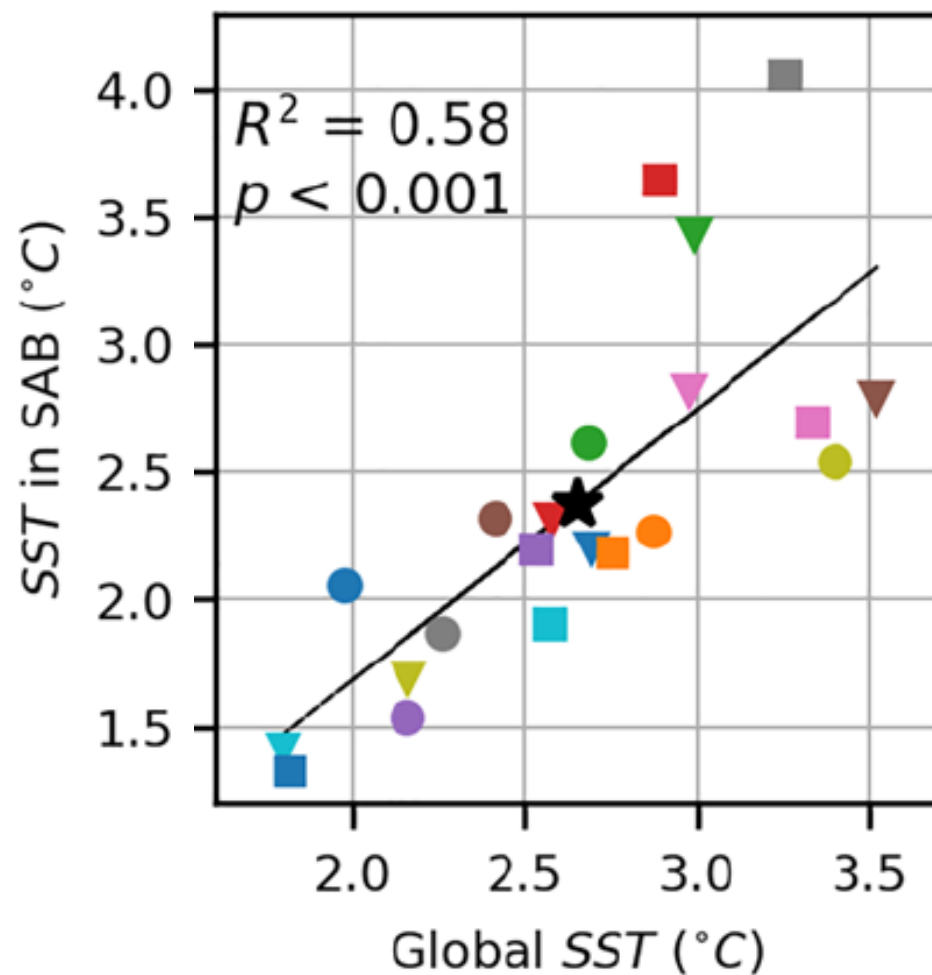


CMIP5 models

CMIP5 models

South Australian Basin (SAB)

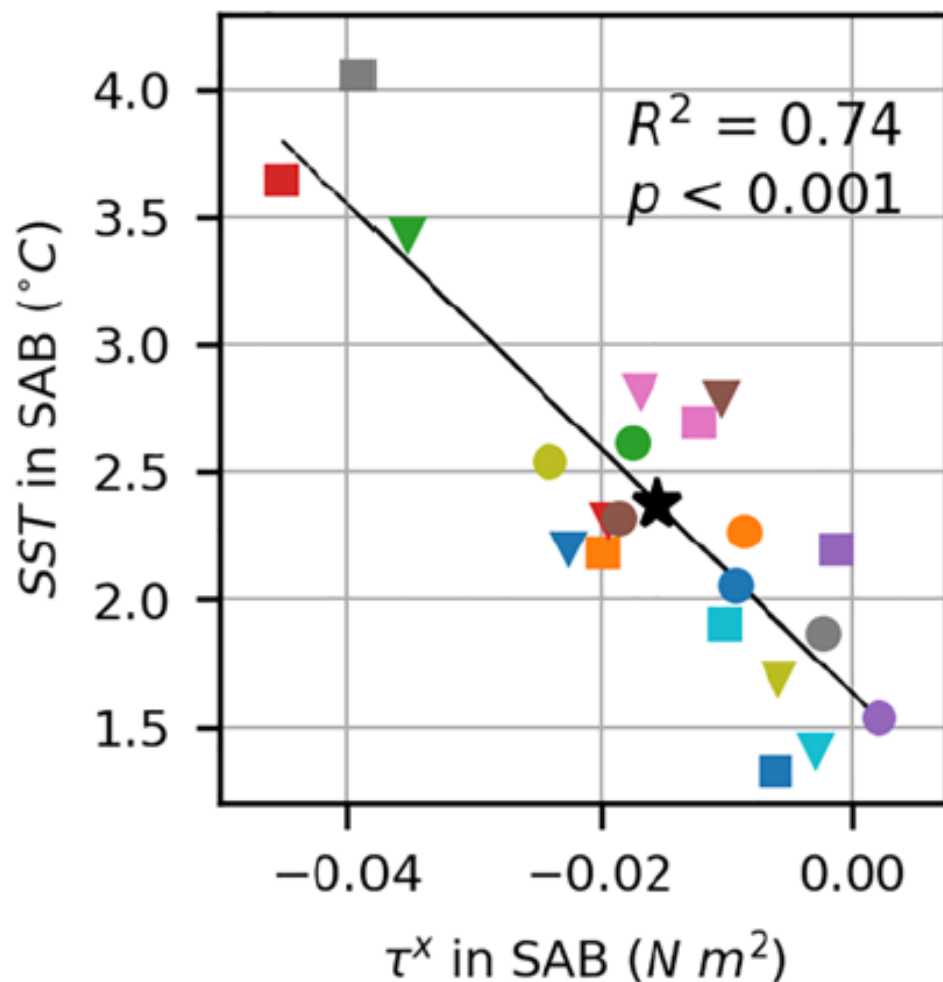
(e) SAB vs. Global SST (21)



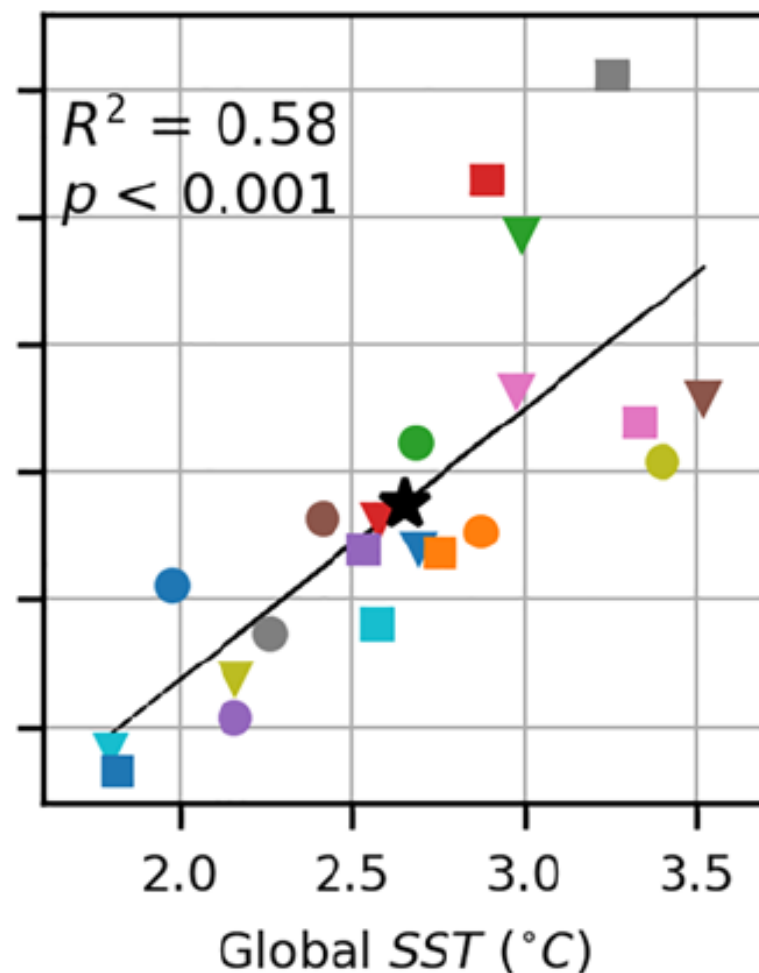
CMIP5 models

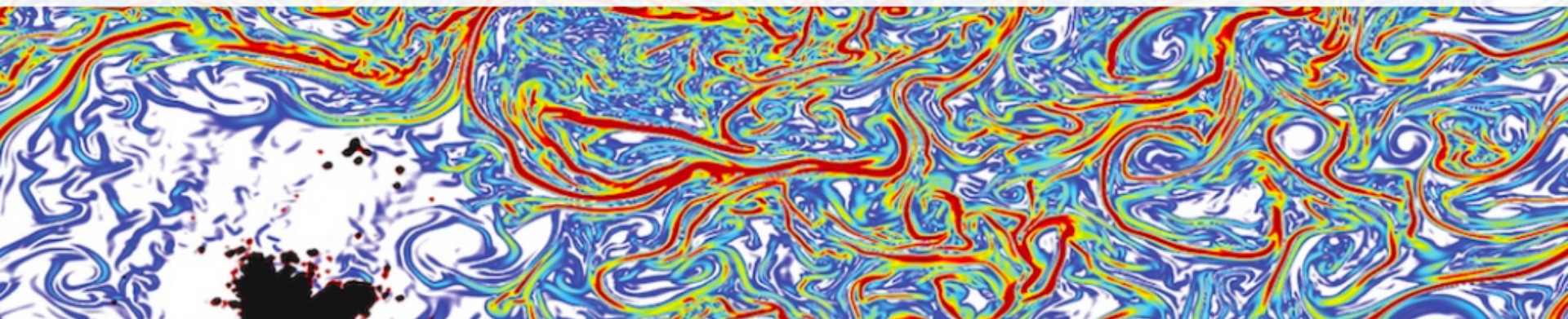
South Australian Basin (SAB)

(d) SST vs. τ^x in SAB (21)



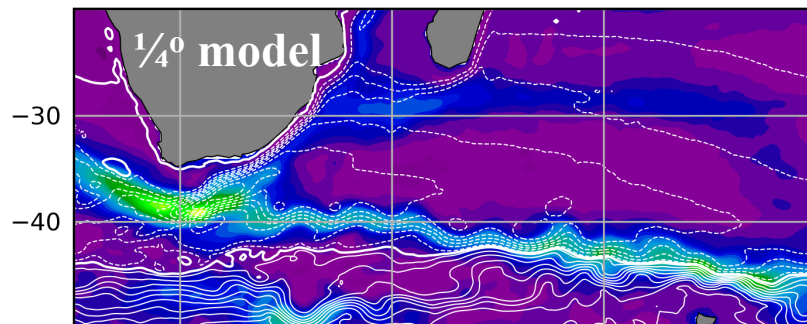
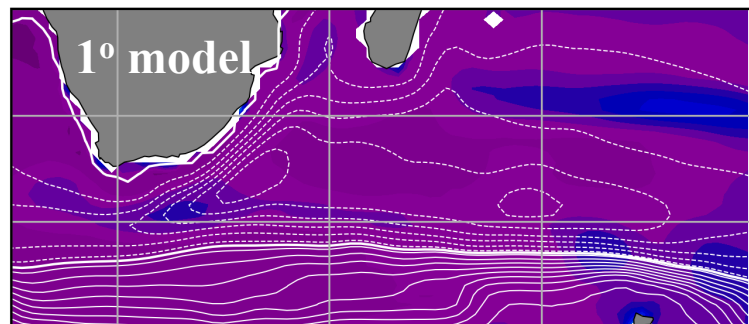
(e) SAB vs. Global SST (21)





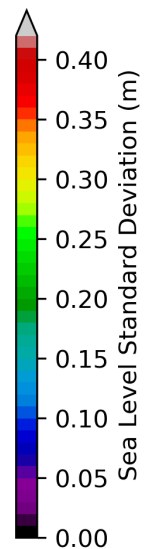
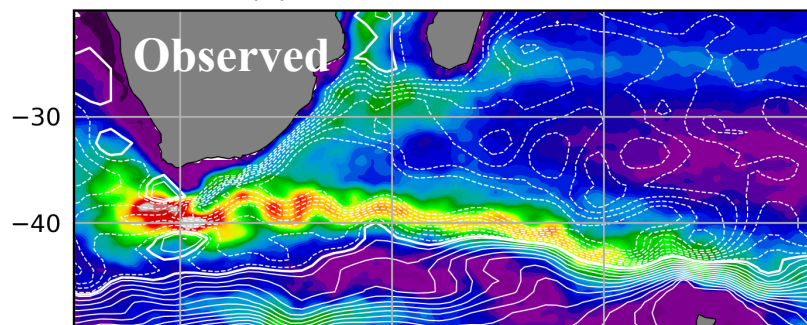
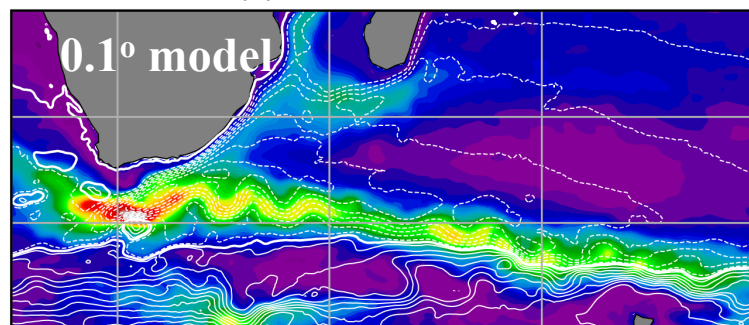
(a) ACCESS-OM2

(b) ACCESS-OM2-025



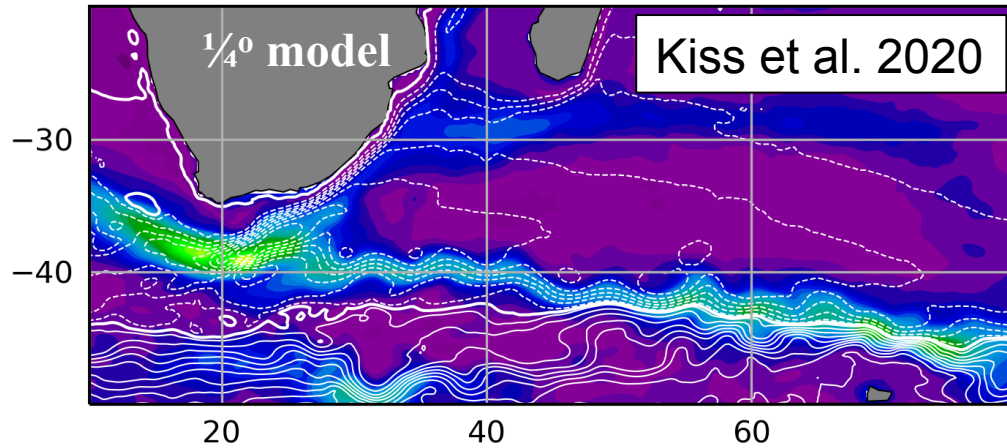
(c) ACCESS-OM2-01

(d) Observational estimate

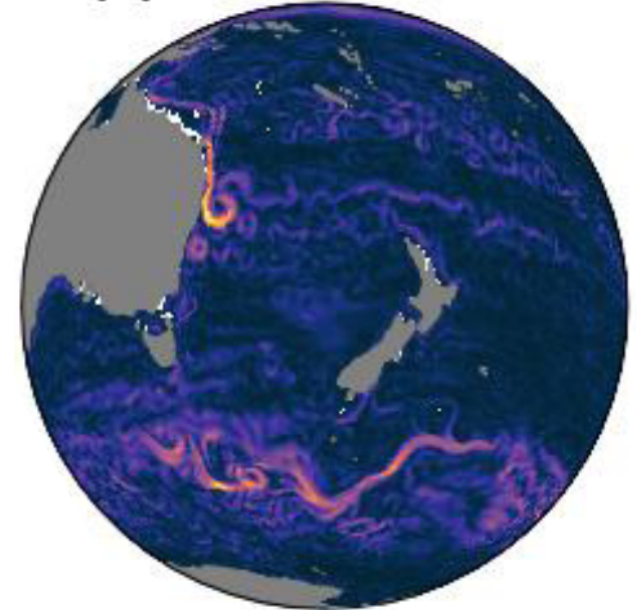


Projected impacts of wind shifts to 2100

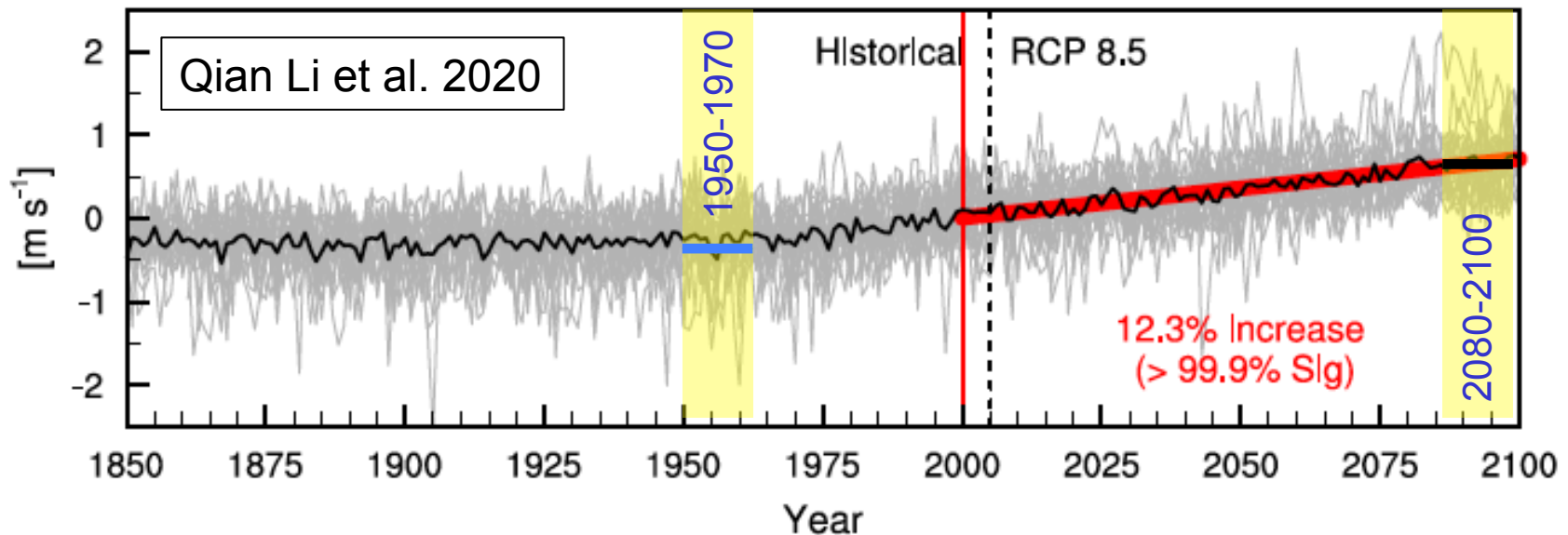
(b) ACCESS-OM2-025



(b) 0.25° Resolution

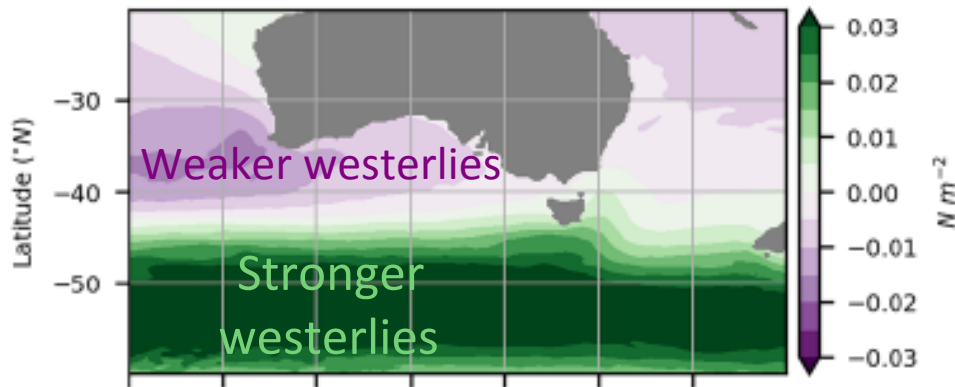


c) 10m U-Component of Wind [40°S - 60°S -mean]

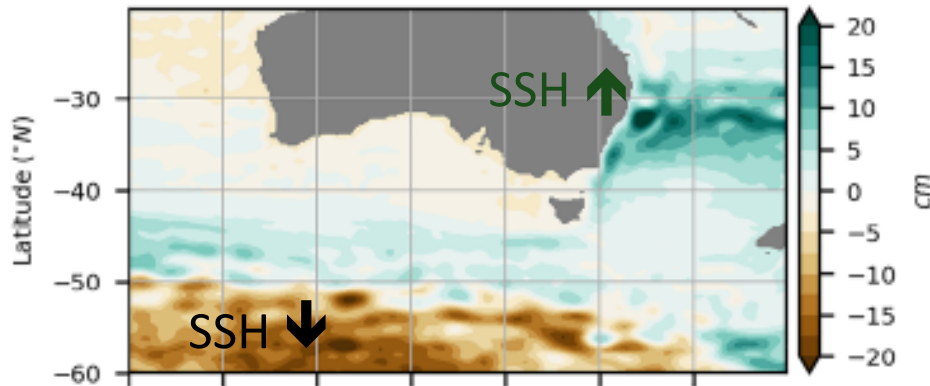


Projected 21st century changes due to winds (2080-2100 minus 1950-1970)

WINDS

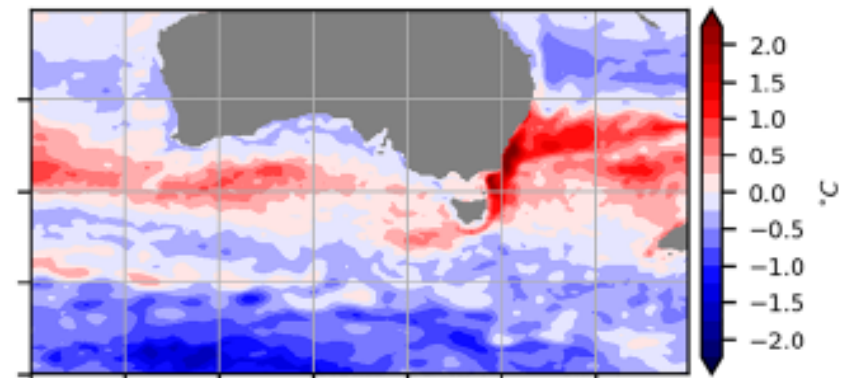


(c) Sea level

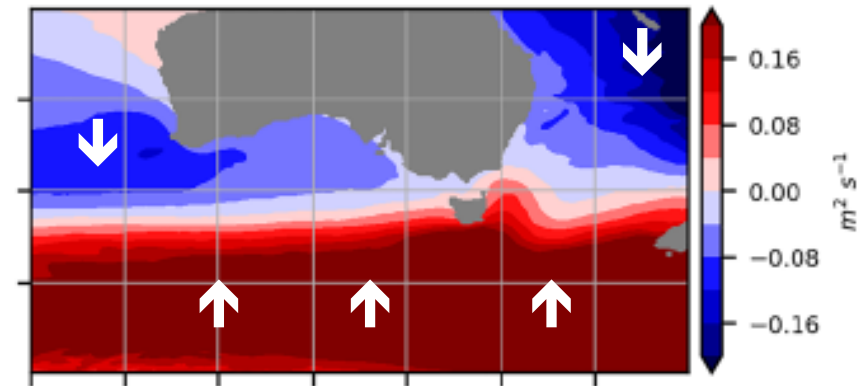


Sea level

SST

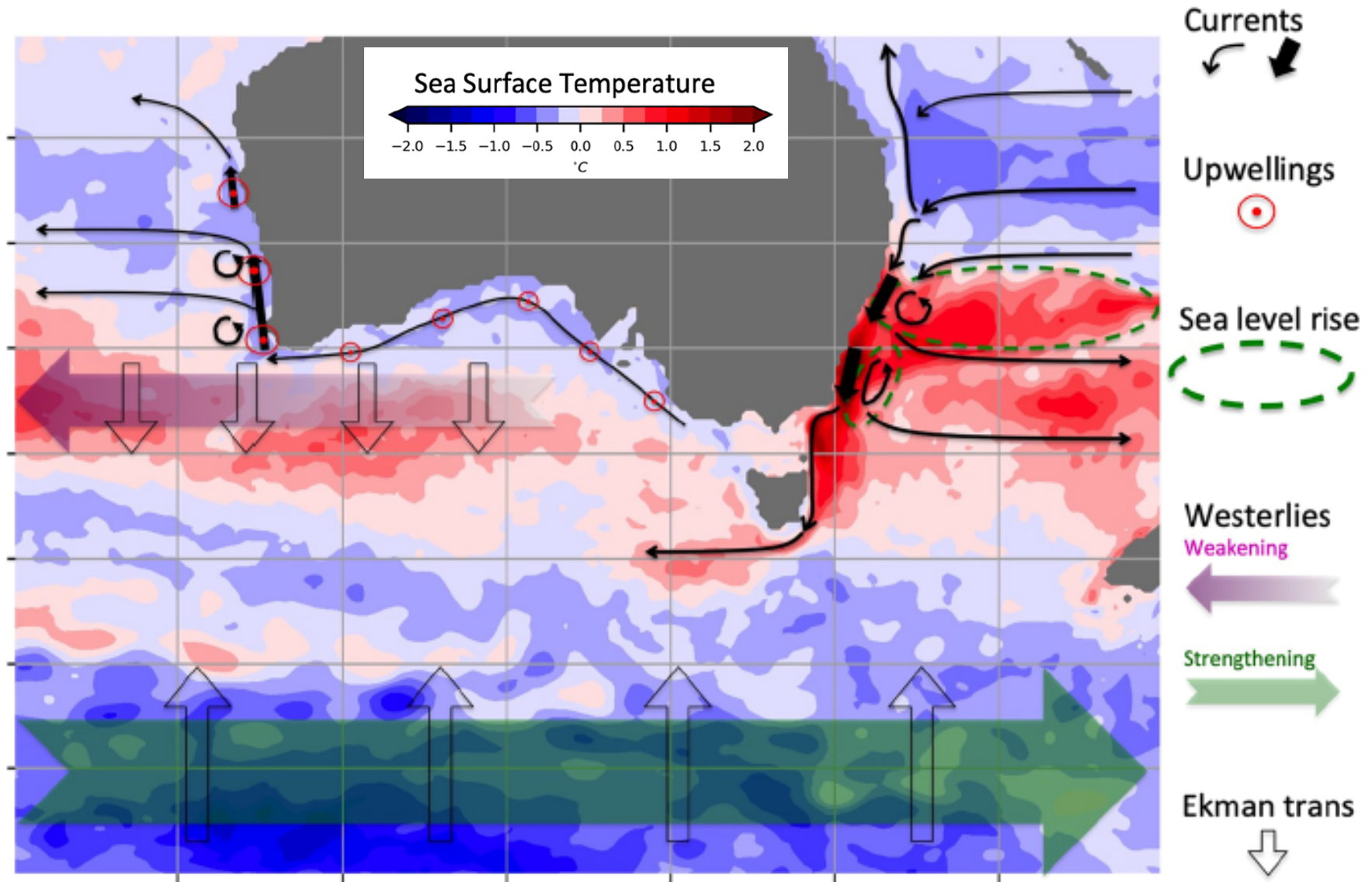


(d) Meridional Ekman transport



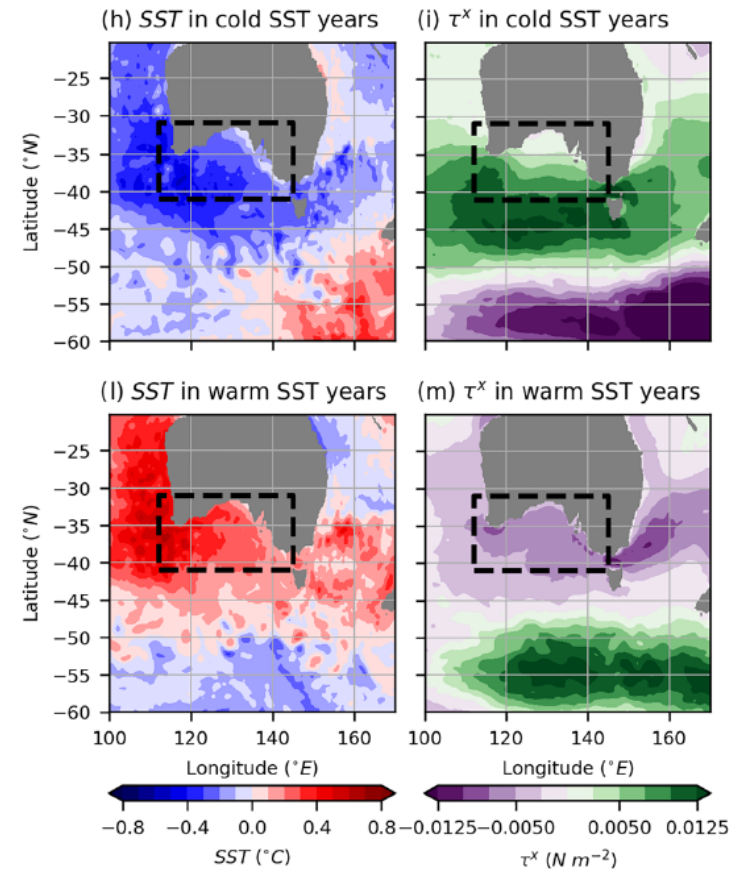
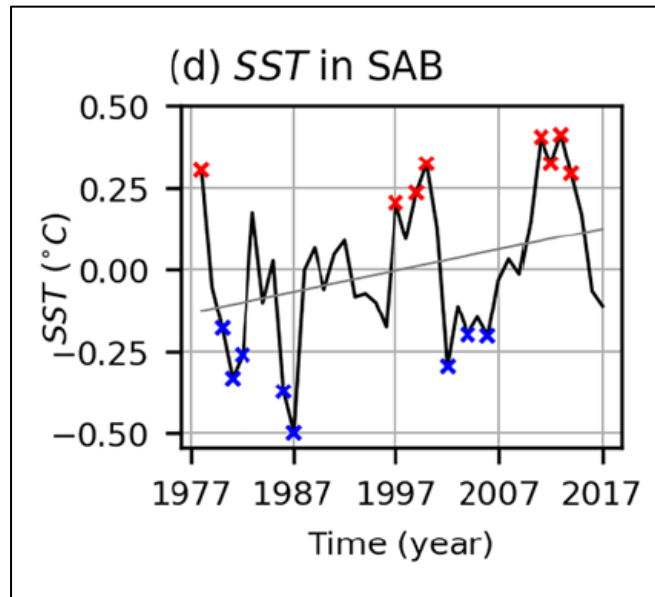
Meridional Ekman transport

Projected wind-driven temperature and circulation changes to 2100



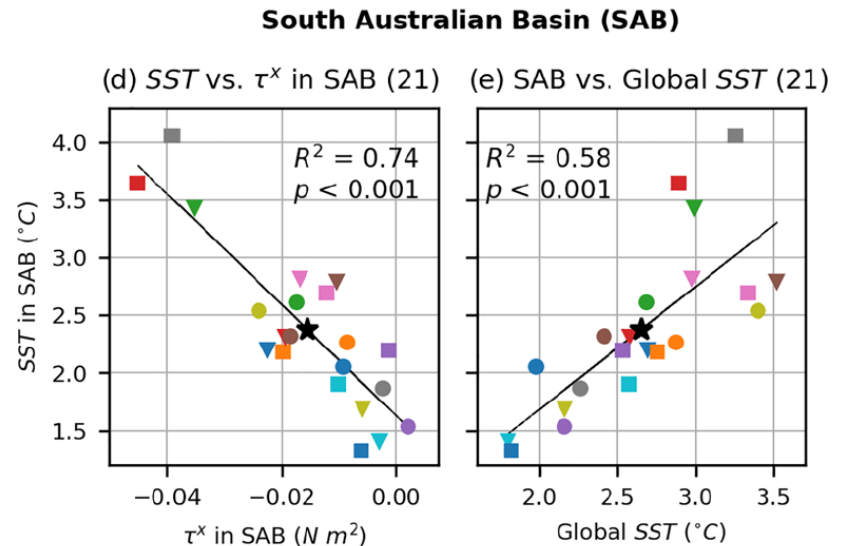
Summary

- Interannual shifts in SWW's control SST variability south of Australia



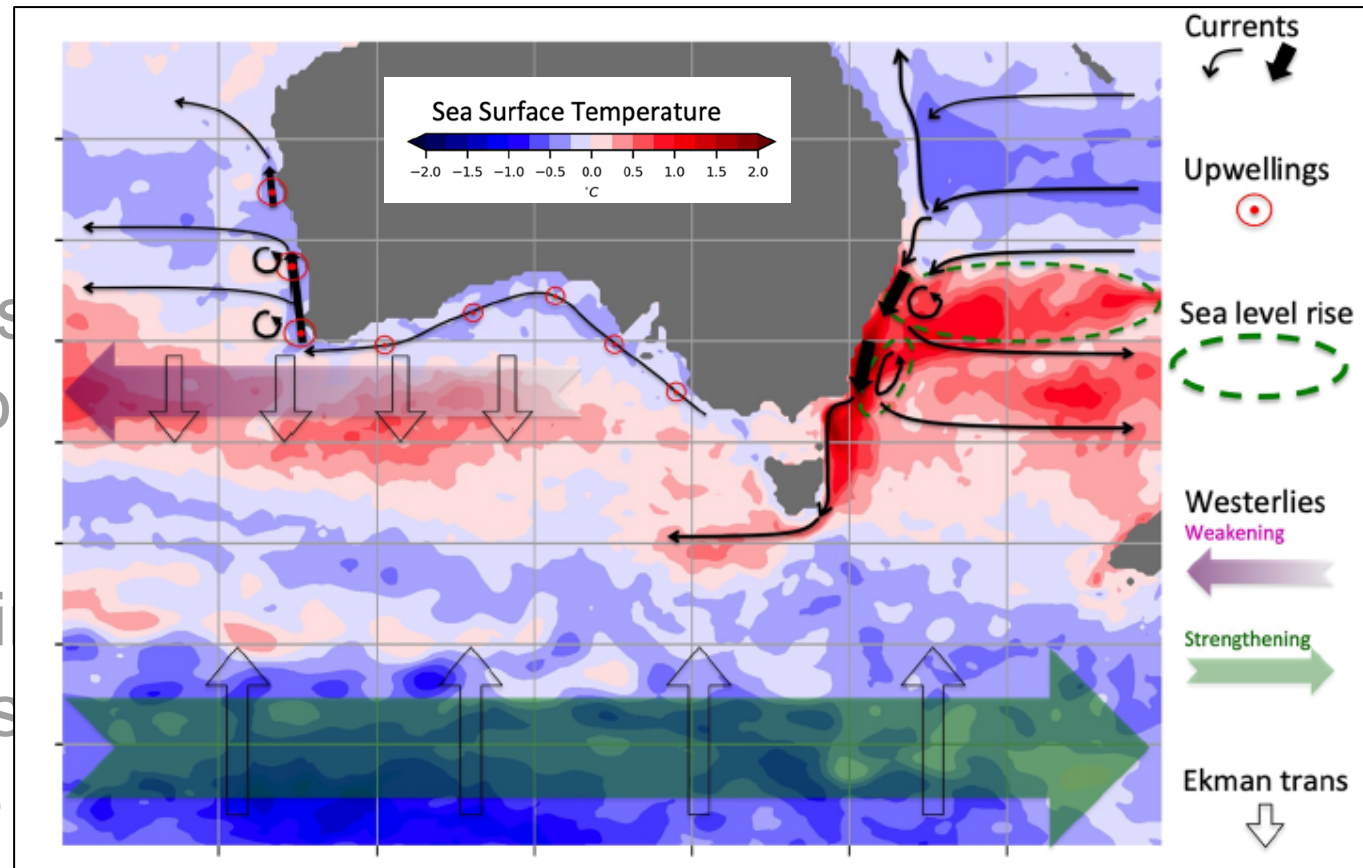
Summary

- Interannual shifts in SWW's control SST variability south of Australia
- Projected wind trends might be an even better indicator of southern Australian warming than climate sensitivity



Summary

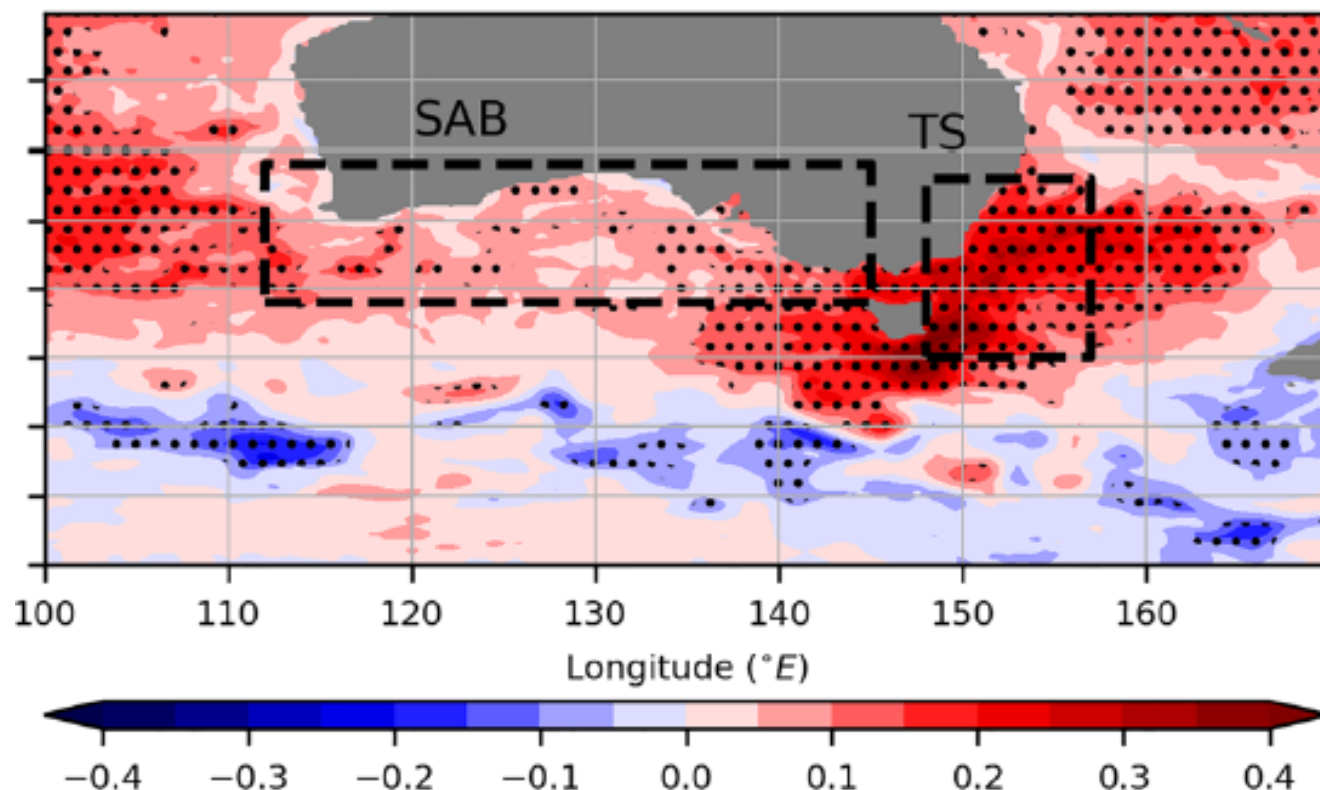
- Interannual s
variability so
- Projected wi
indicator of s
than climate



- Wind trends estimated to be responsible for ~50% of projected surface ocean warming and sea level rise in the Tasman Sea, and ~30% of warming in the GAB, by 2100

THANKS!!

(b) SST 1978 to 2017 trend



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Key Points:

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Surface Ocean Warming Around Australia Driven by Interannual Variability and Long-Term Trends in Southern Hemisphere Westerlies

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