Southern Ocean CO_2 fluxes: The importance of realistic representation in climate models

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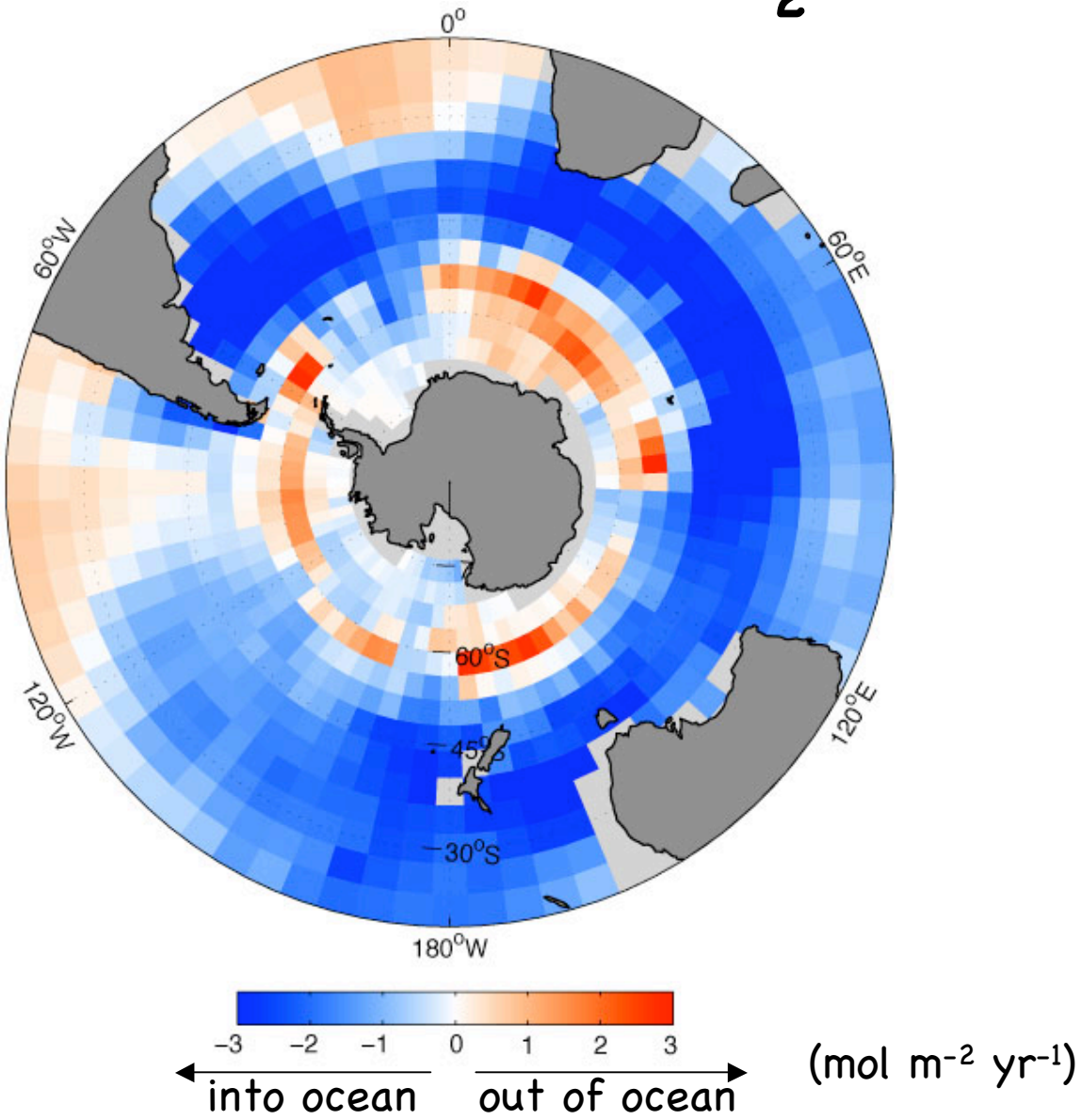
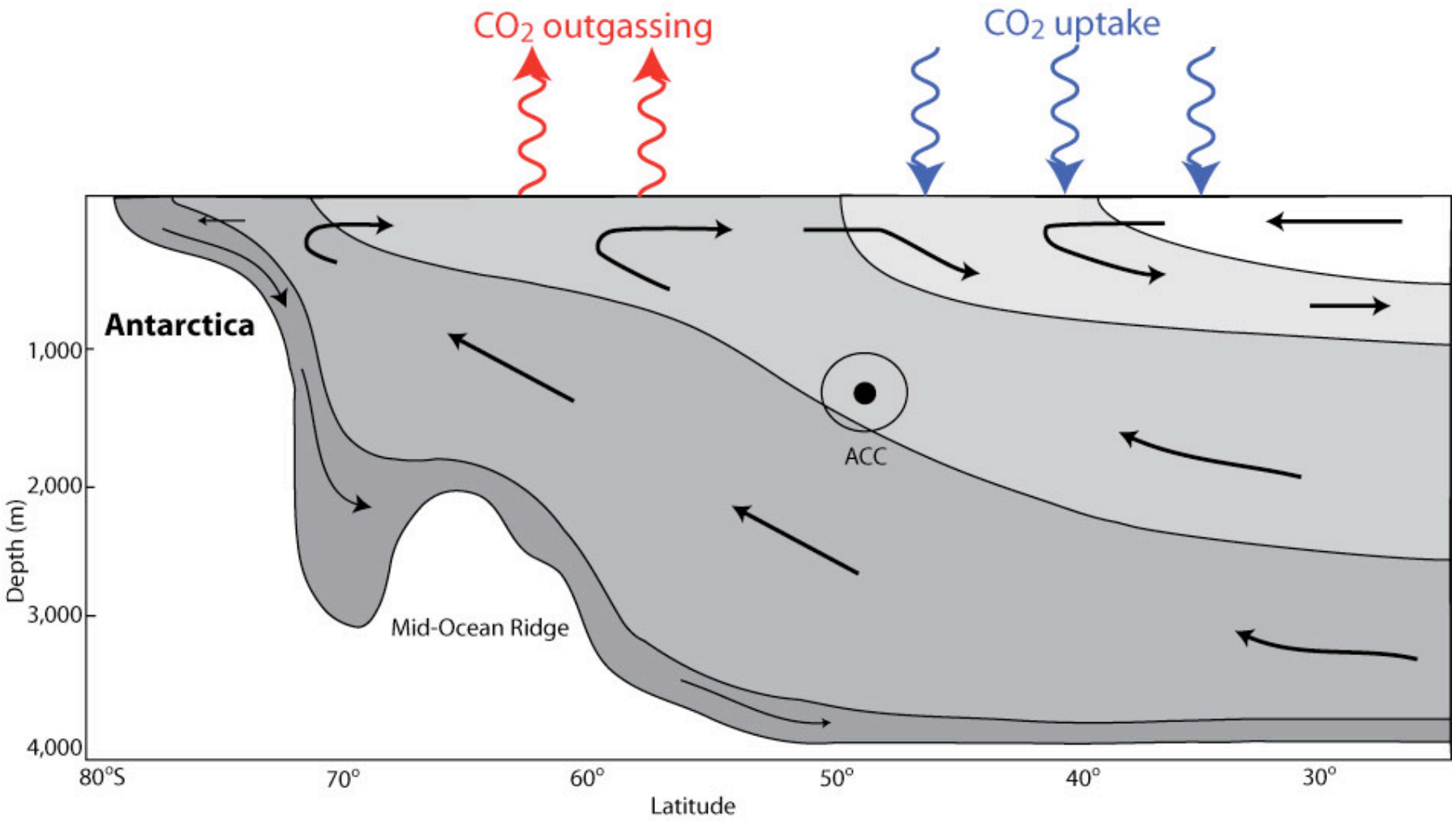
Southern Ocean air-sea CO_2 exchange



data from Takahashi et al. (2009)

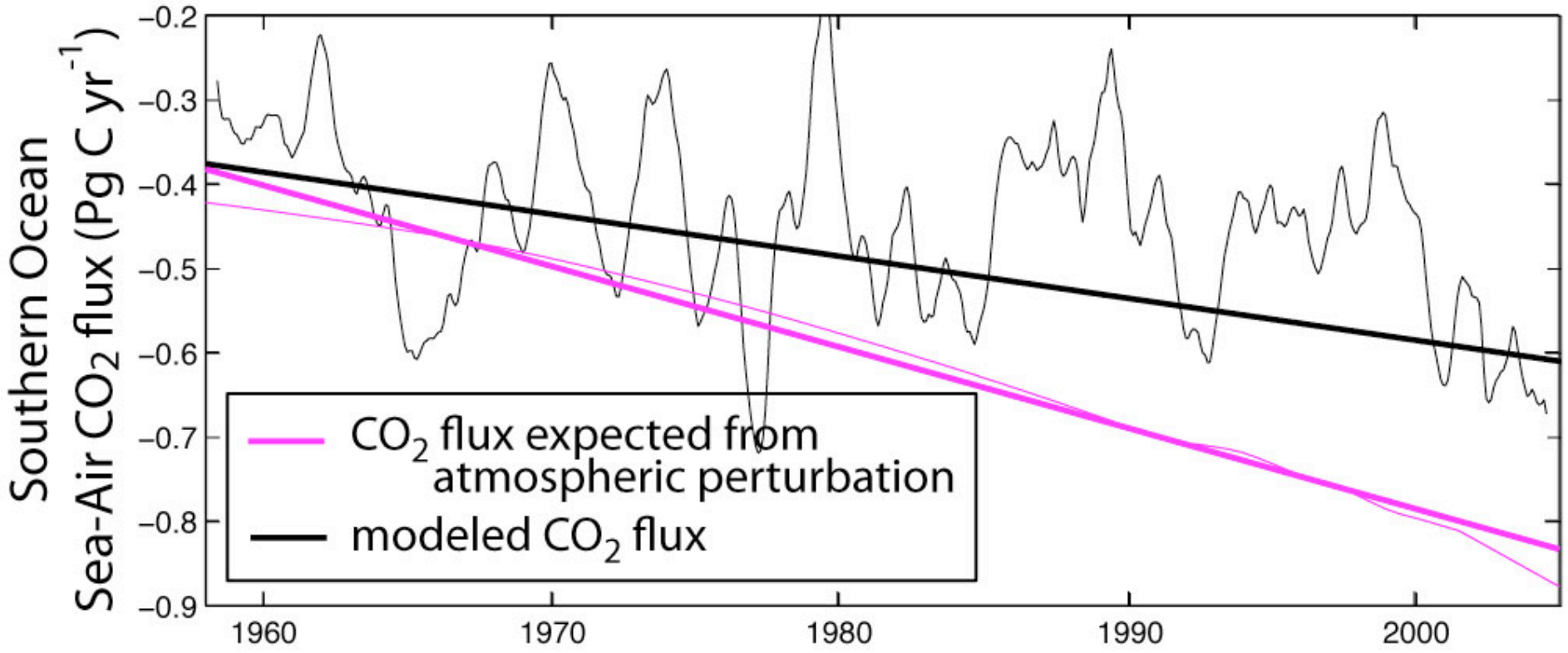
What controls the CO_2 exchange?

ocean circulation



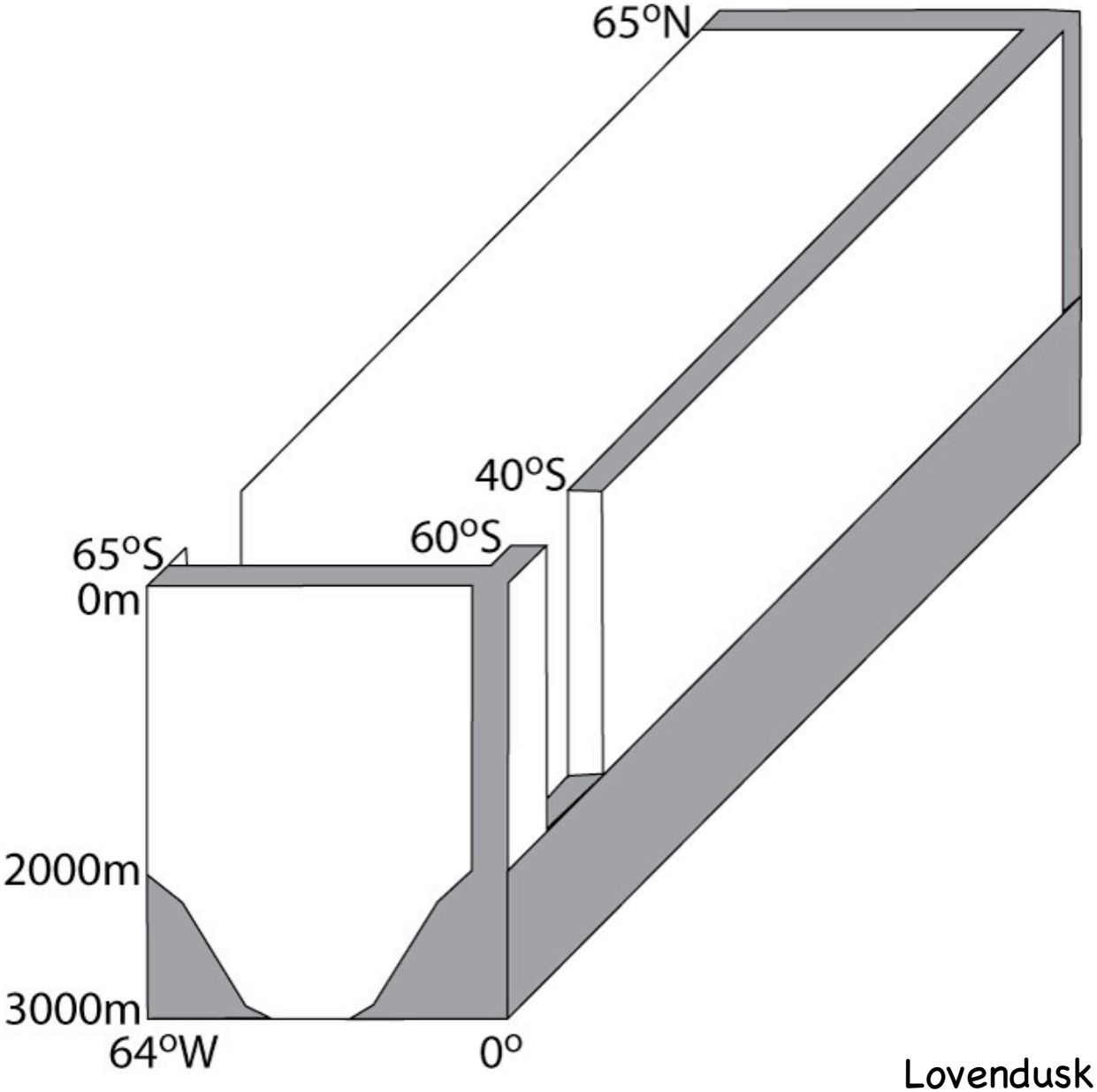
modified from Speer et al. (2000)

A recent change in the CO_2 sink?



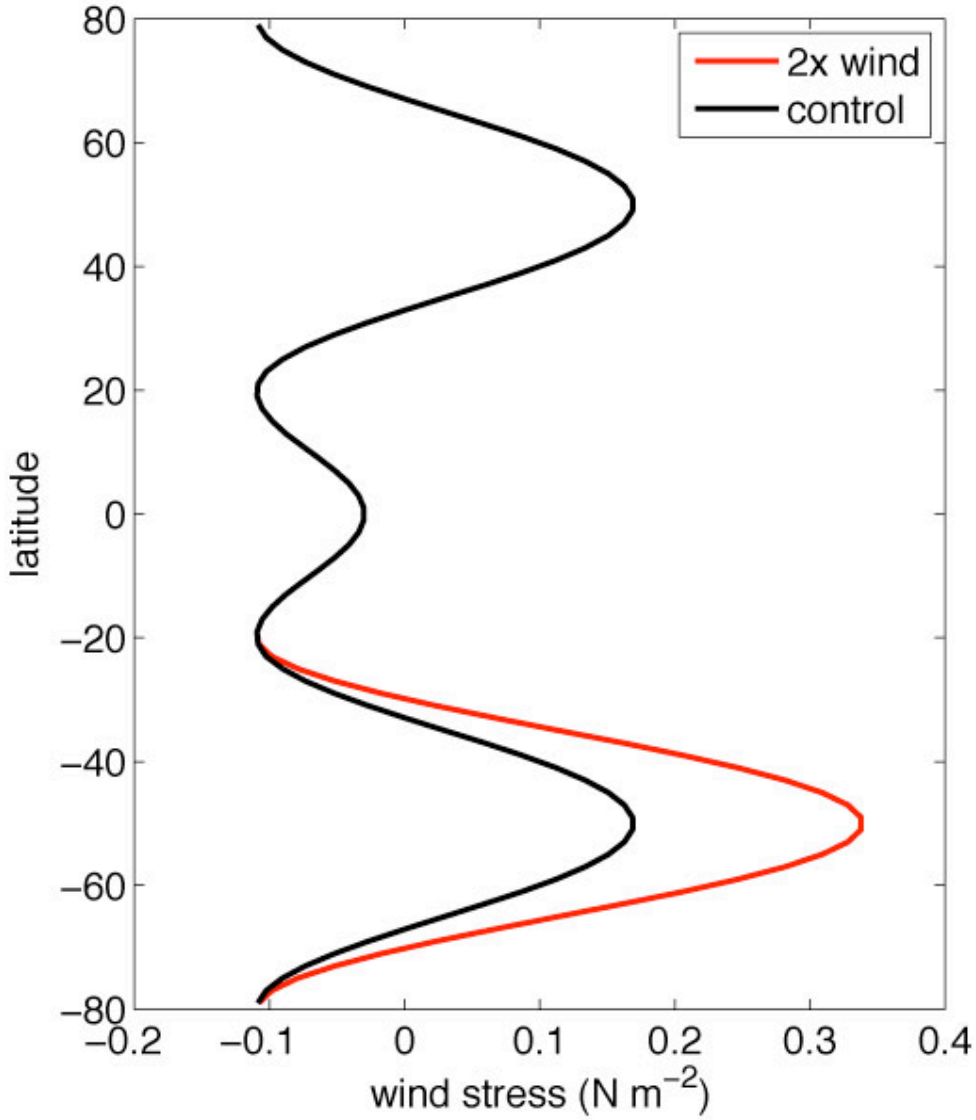
Lovenduski et al. (2008)

Sector model



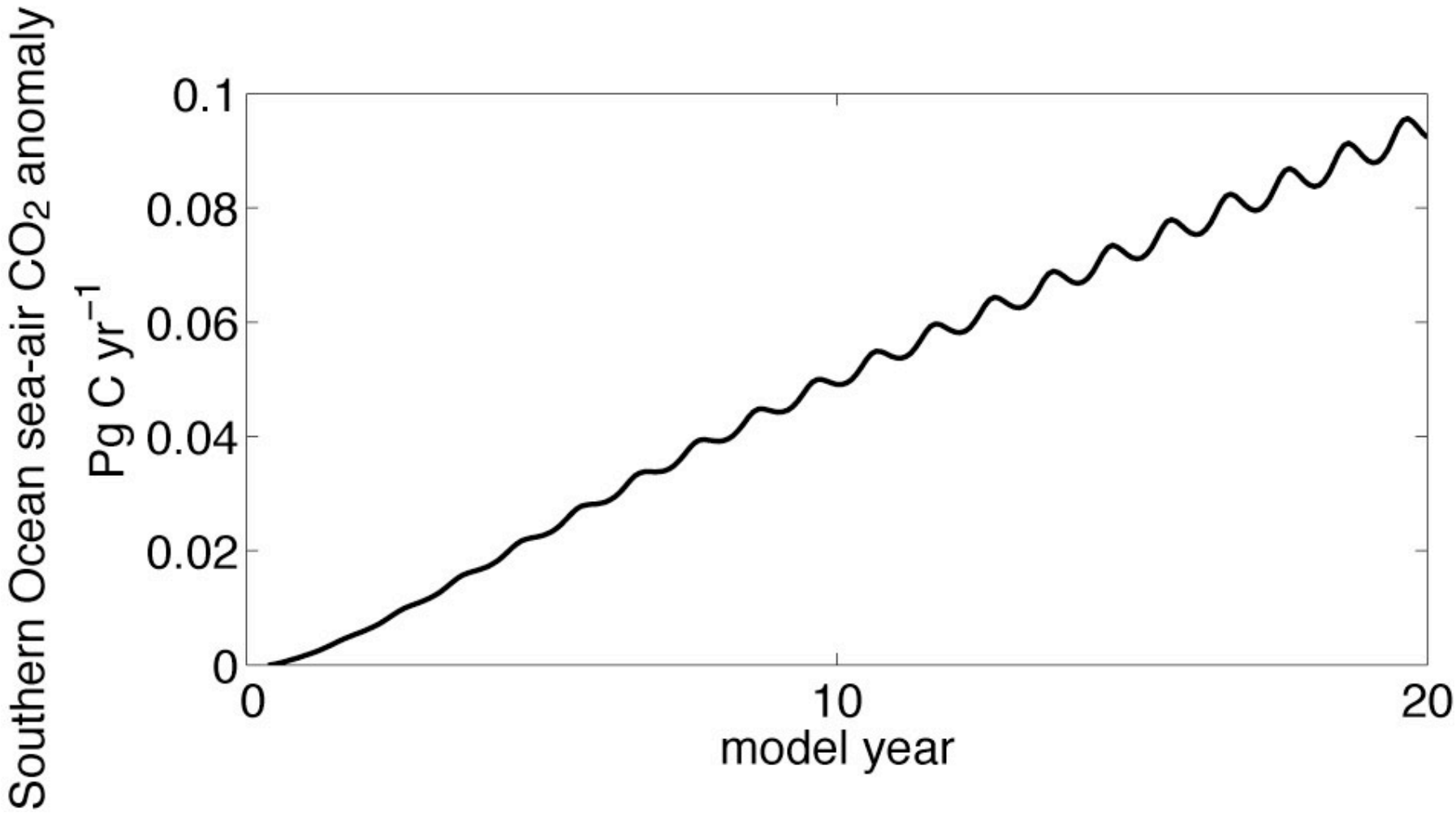
Lovenduski and Ito (2009)

Wind perturbation

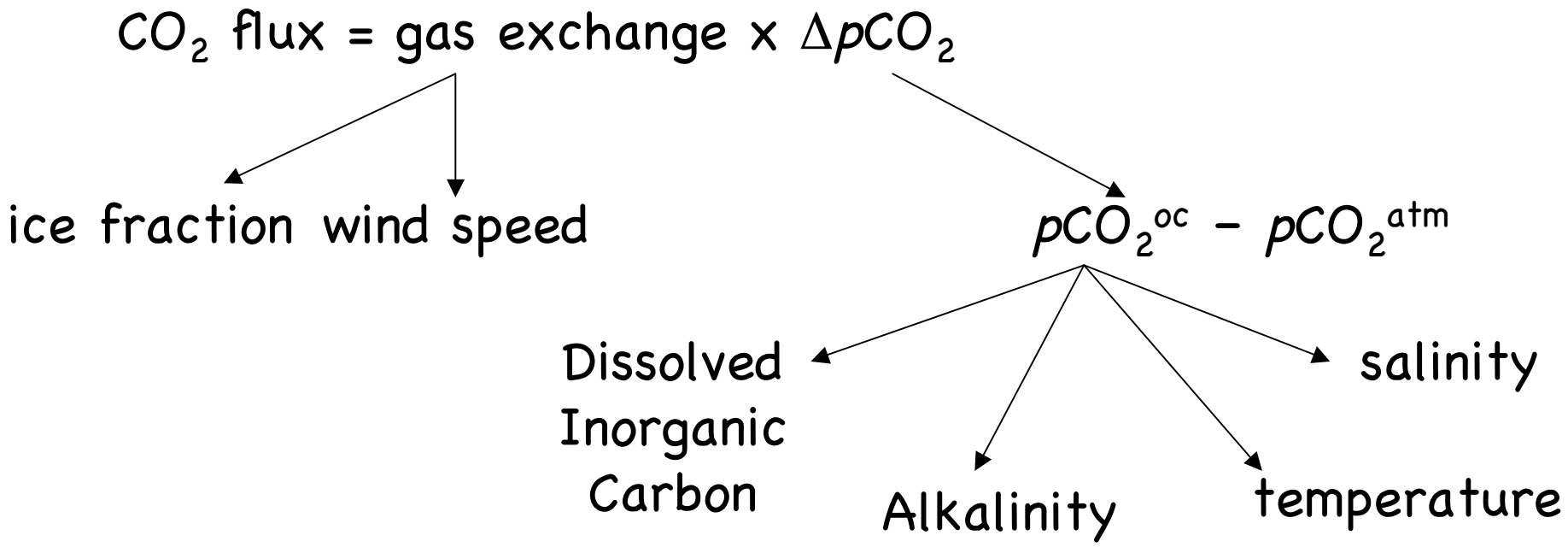


Southern Ocean sea-air CO_2 flux anomaly

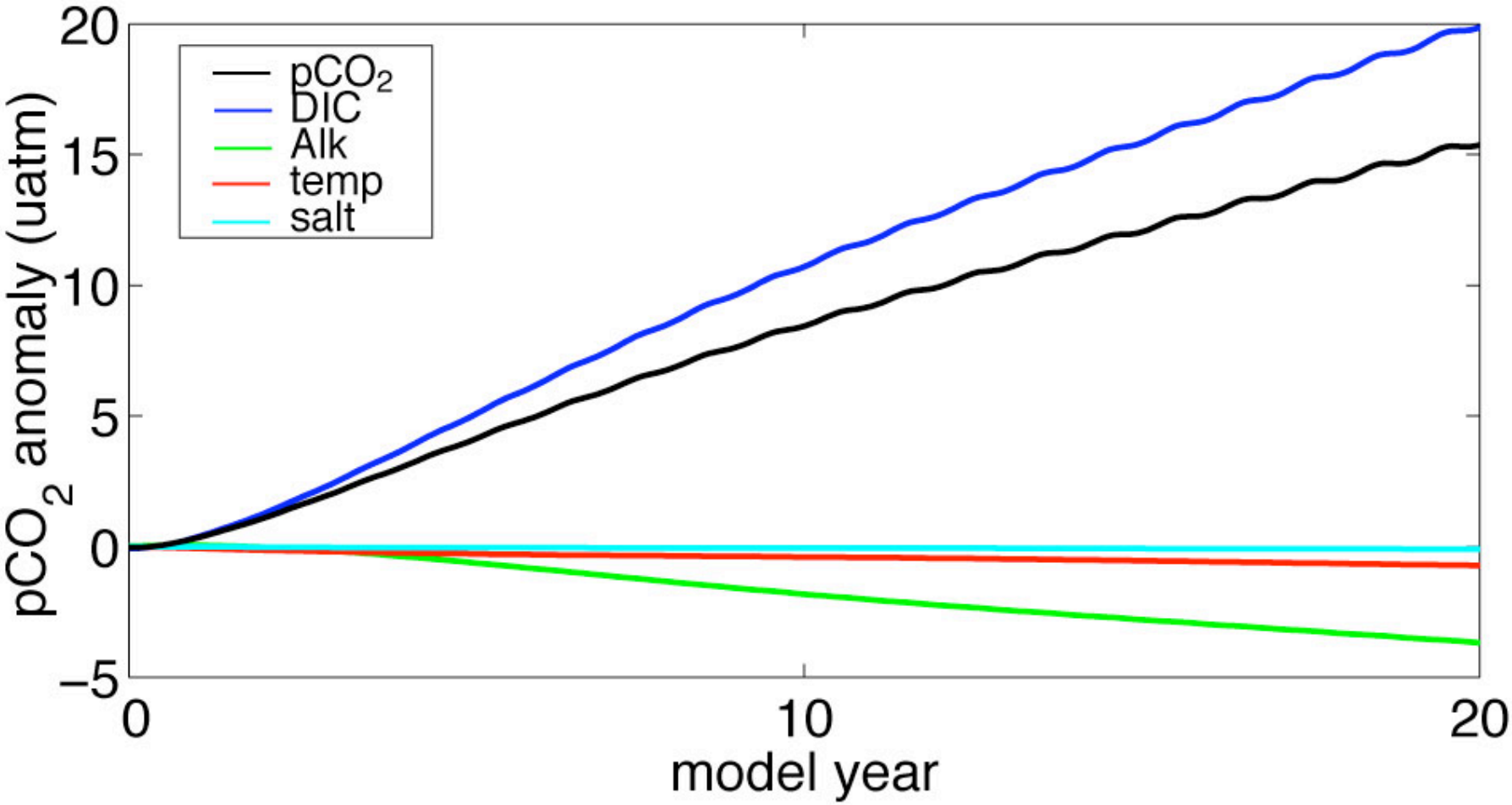
wind stress increase, constant gas exchange



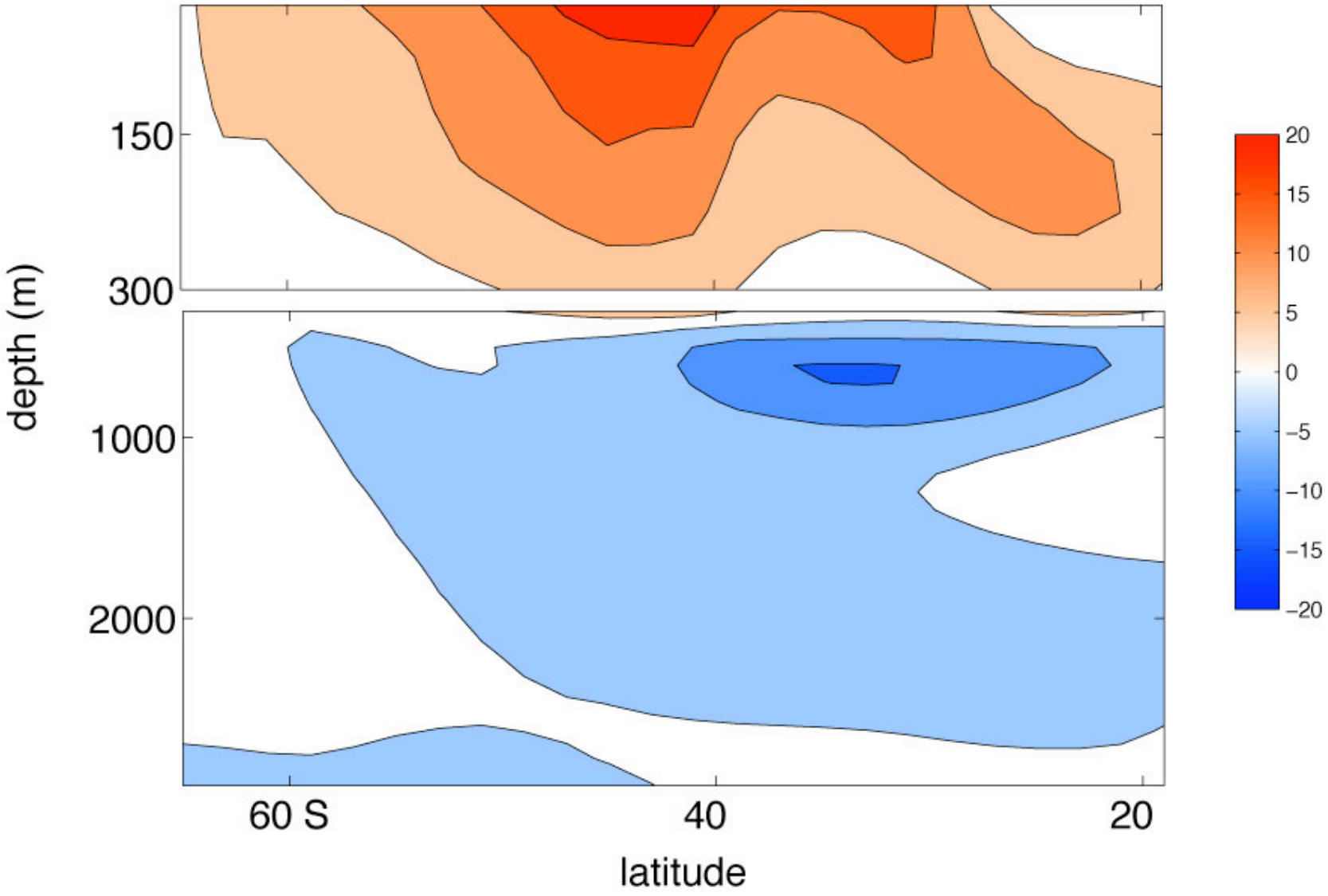
Modeled air-sea CO_2 exchange



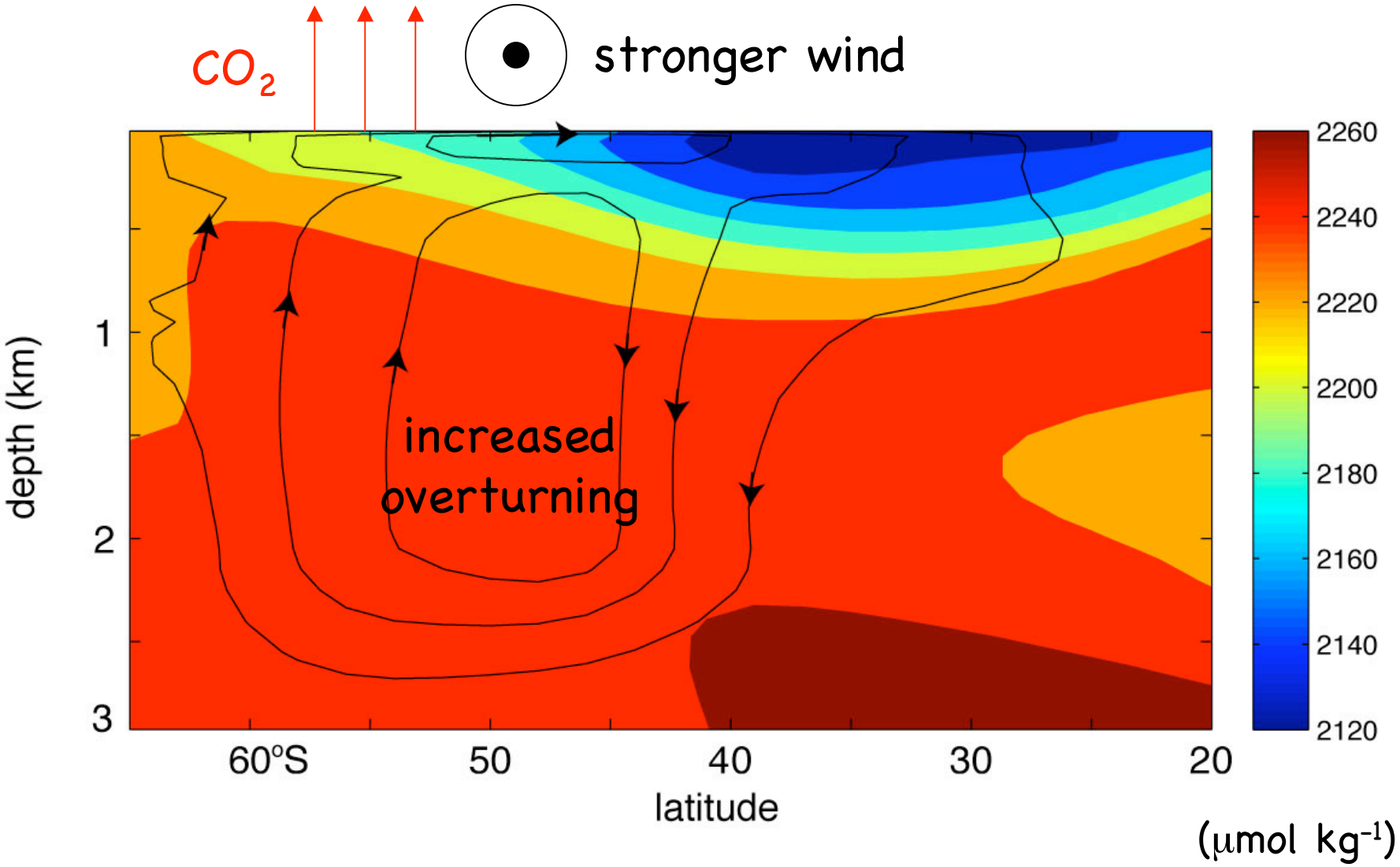
pCO_2^{oc} budget



Dissolved inorganic carbon anomaly

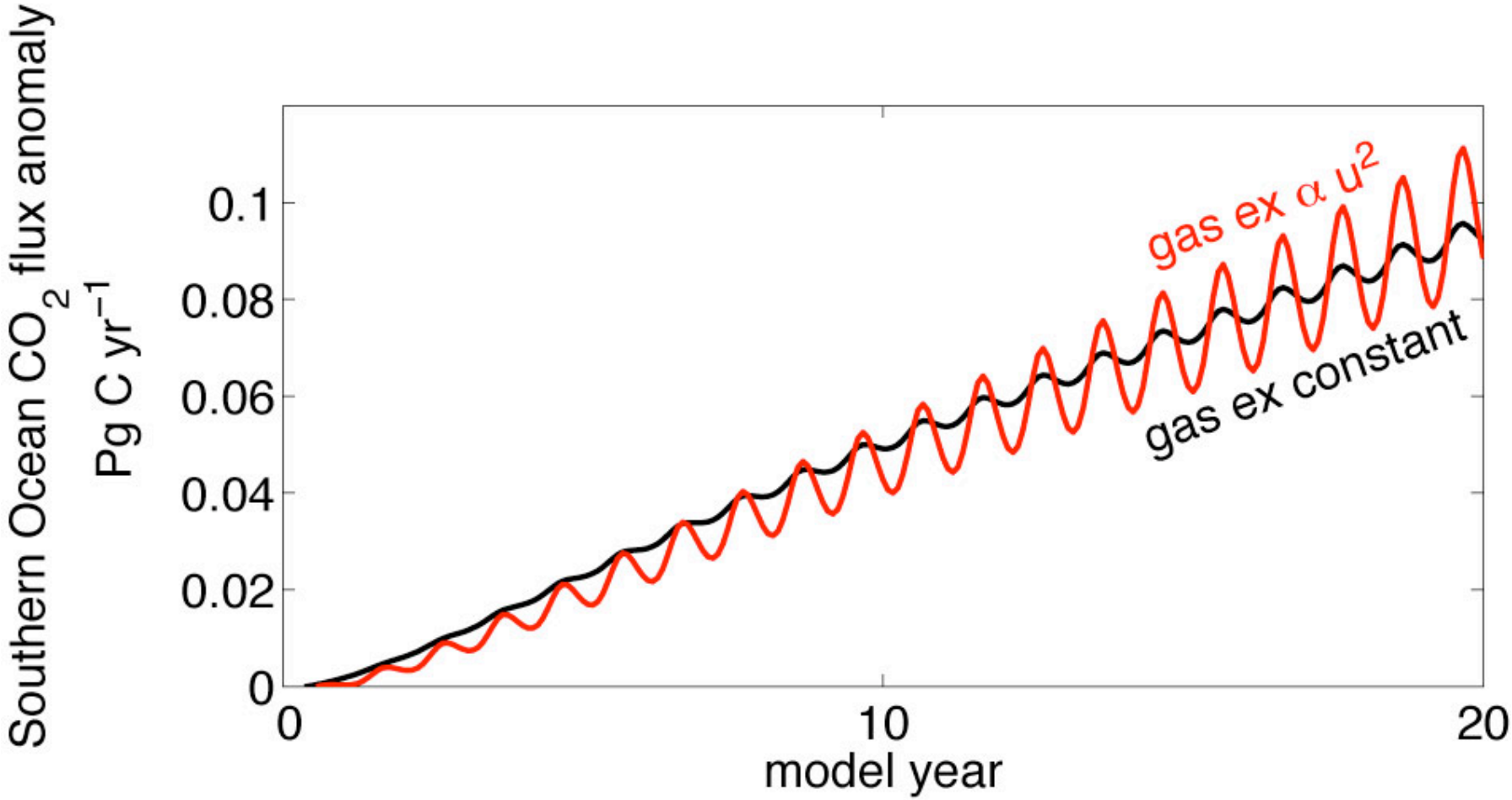


Mechanisms of change



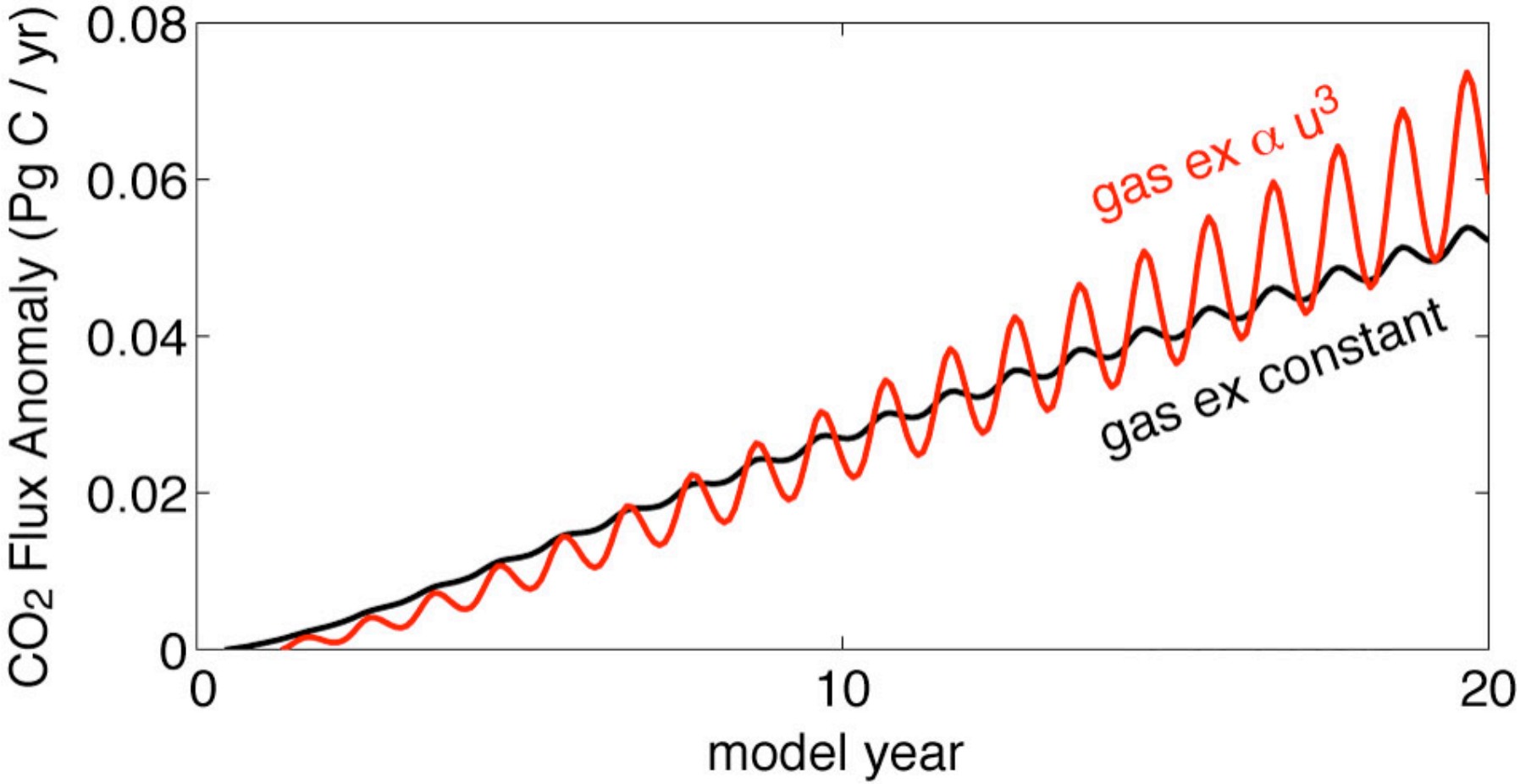
Southern Ocean sea-air CO_2 flux anomaly

wind stress increase, gas exchange α u^2



Southern Ocean sea-air CO_2 flux anomaly

wind stress increase, gas exchange α u^3



Conclusions

- Increased wind stress over the Southern Ocean causes anomalous degassing of respired CO_2
- The magnitude of the anomaly is a function of the air-sea CO_2 flux parameterization used