Global-scale climate model sea surface temperature biases traced to cloud errors

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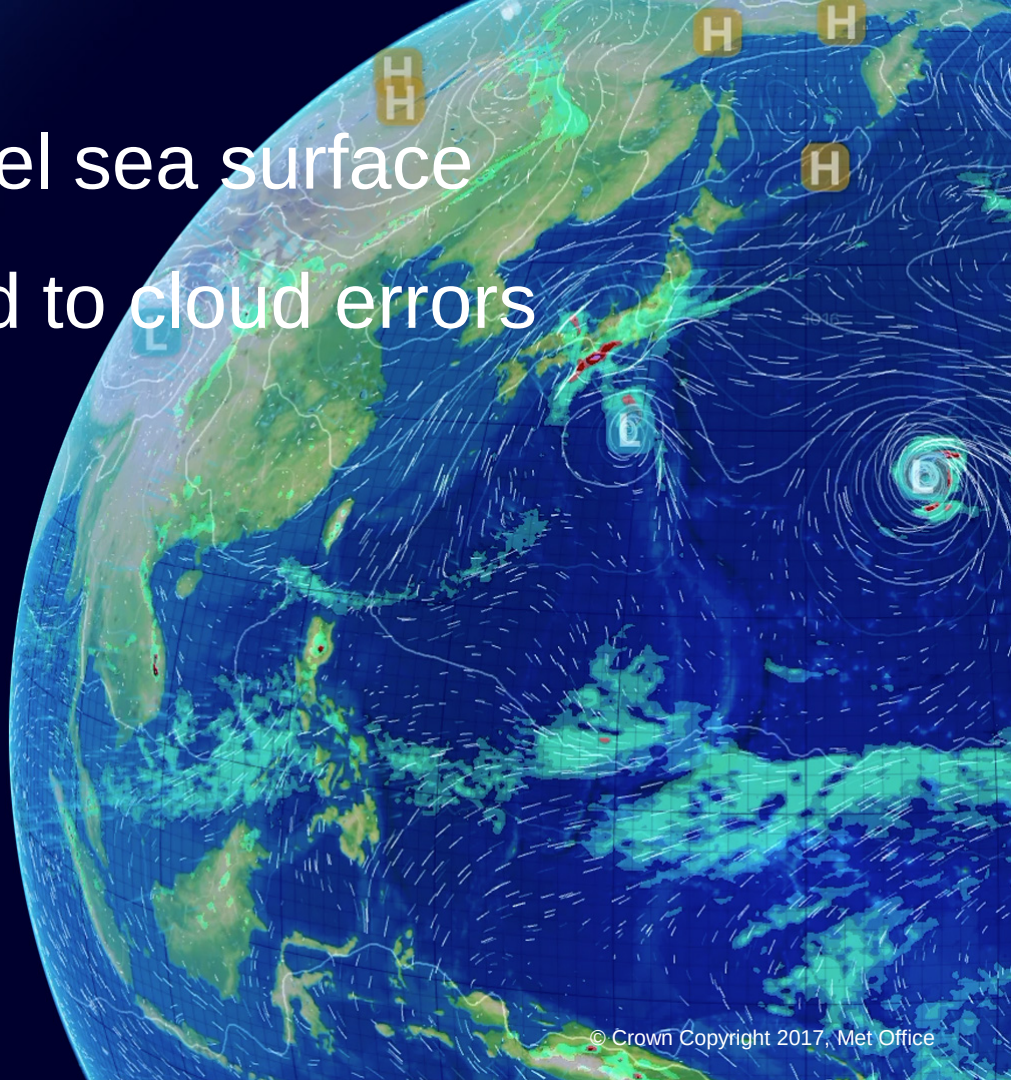


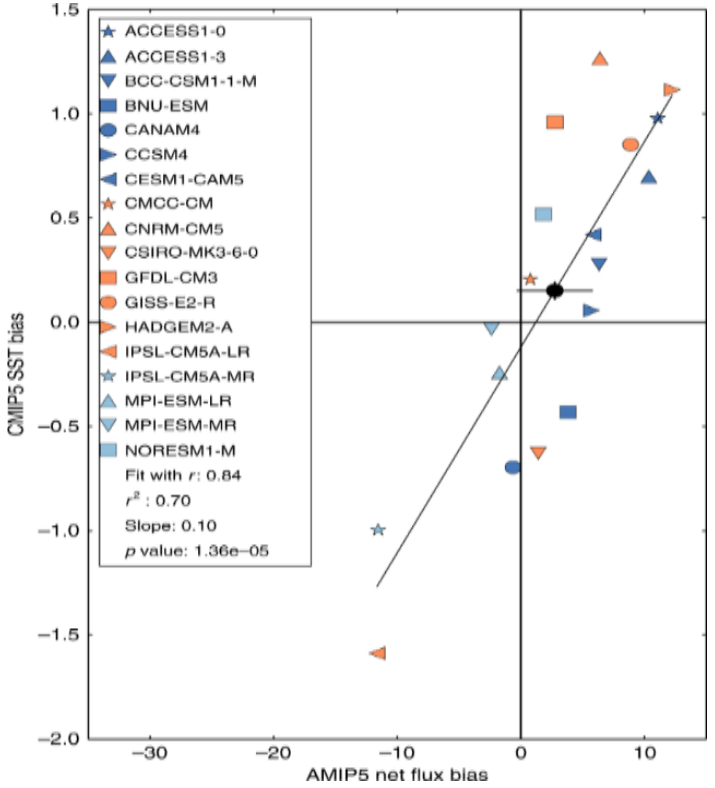
Outline

- Background
- Locally driven large-scale biases.
- Remotely driven large-scale biases – an ocean teleconnection to the tropics?
- Controls on global mean SST (from local and remotely-forced biases).
- Conclusions.

Background to methods

Southern Ocean 40-60ºS SST biases example (Hyder et al, 2018 NCOMMS)

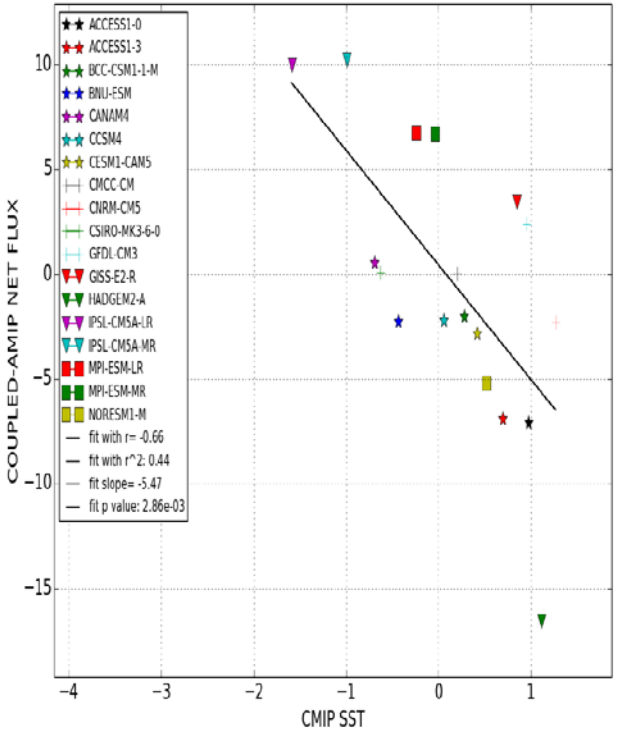
- As expected from theory SST biases are strongly related to AMIP5 fluxes (r=0.84).
- For short-wave alone the correlation is ~0.7
- SST are weakly related to coupled fluxes (r<0.4)



Southern Ocean coupled flux response

CMIP5-AMIP5 net flux bias

- Equilibration involves a linear SST-dependent surface flux response, with SST biases depending both on AMIP5 net flux and surface flux response.
- The surface flux response is mainly associated with turbulent and longwave fluxes.
- It acts as a negative feedback reducing the CMIP5 net flux biases. However, AMIP errors tend to be cloud-related SW errors whereas response is TURB&LW so this results in wrong supply of heat and moisture to atmosphere, which could explain large atmospheric Southern Ocean biases.



Locally driven global-scale biases (i.e. due to local model errors and flux feedbacks)

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An ocean teleconnection? - remotely driven SST biases in the tropics

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Controls on Global Mean SST - The combined effect of local and remotely driven biases

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Conclusions

Conclusions

- Local cloud-related AMIP5 net flux biases explain CMIP5 SST bias variations in most mid and high latitude regions and the sub-tropical eastern boundary regions but not the tropics.
- Equilibration involves a dominant local surface flux response which is strongly influenced by the atmosphere and plays a key role in climate.
- Remote AMIP5 net flux biases in the eastern boundary and strato-cumulous regions appear to drive tropical SST biases.
- Global mean SST is influenced by remotely and locally driven biases and appears to be set by the Southern Ocean eastern boundary clouds through northward surface propagation of biases, i.e. an ocean teleconnection - another key role for S. Ocean.
- Similar results in PPE

Thank You