Impact of local and remote atmospheric heating interventions on subtropical low clouds

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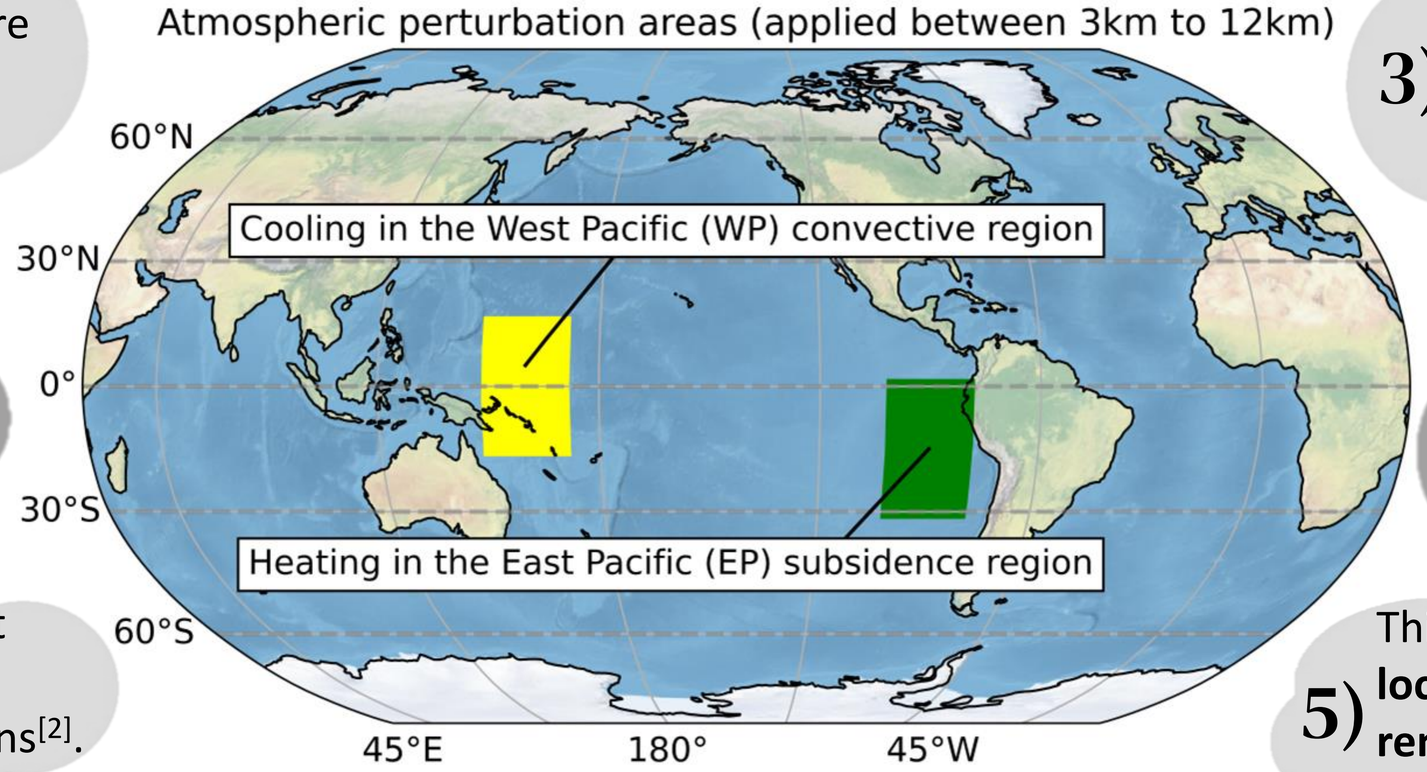
1-sentence finding: Weakening of the Pacific overturning circulation on a **regional** scale leads to **reduced** low cloud fraction in the subtropics, which is **opposite** to similar **correlative** studies that look on a global scale.

1) Marine low clouds (LC) are vital in modulating space→surface radiant energy exchange[1].

Model used:
Met Office Unified Model
GA9 AMIP scenario
20-year annual average

2) LCs are one of the largest causes of uncertainty in climate change predictions[2].

Atmospheric perturbation areas (applied between 3km to 12km)

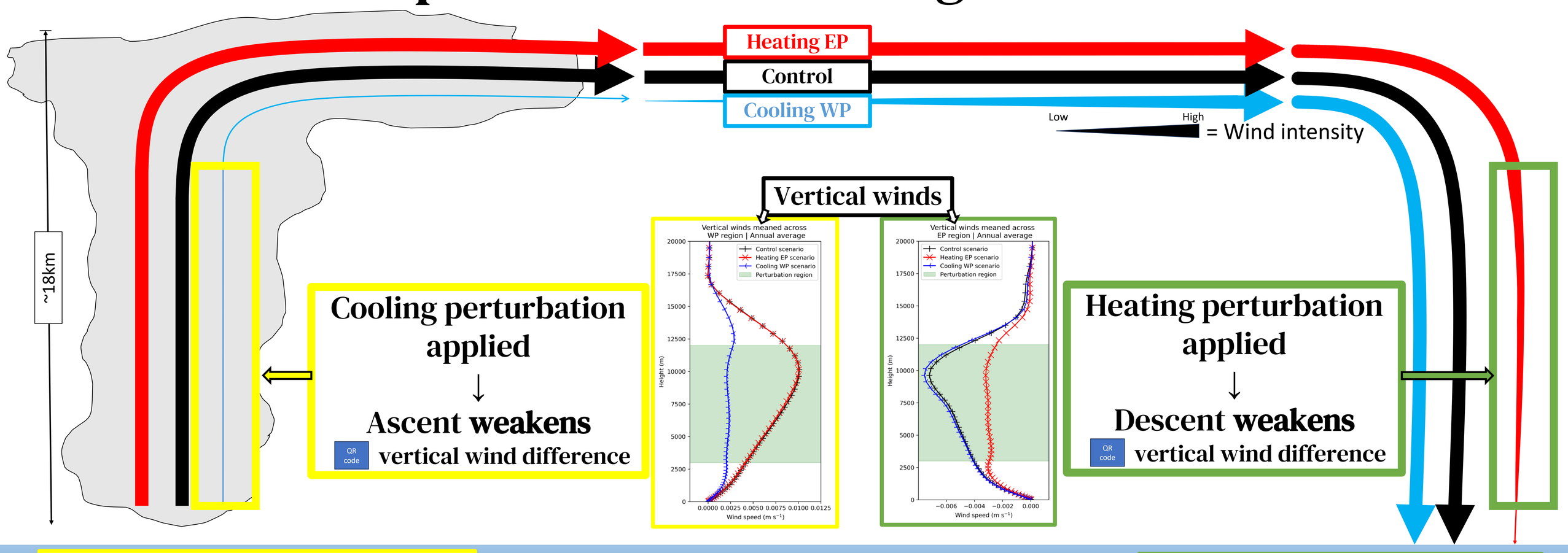


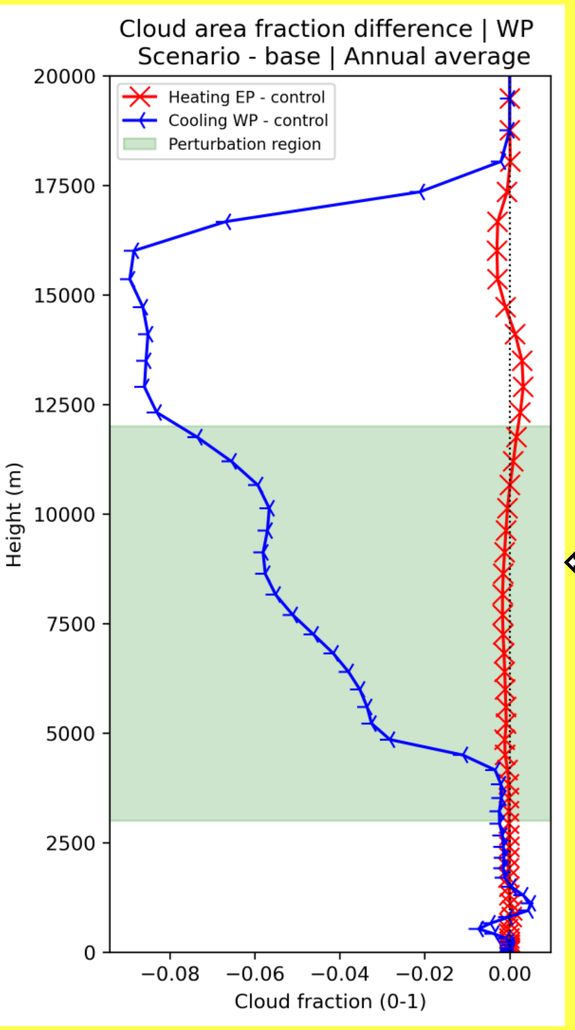
3) **Correlative** studies find a net global **increase** in subsidence leads to **less** subtropical LC [1,2,3,4].

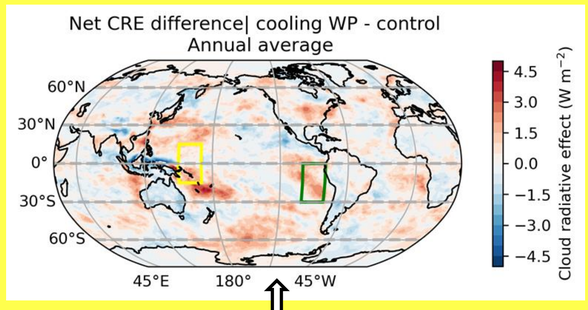
4) We conduct 2 **separate** heating & cooling experiments to **causally weaken** large-scale circulation

5) This then induces a prognostic **local** (from the subtropical perturbation) **or remote** (from the tropical perturbation) change on subtropical LC

Effects of *T* perturbations on large-scale circulation:







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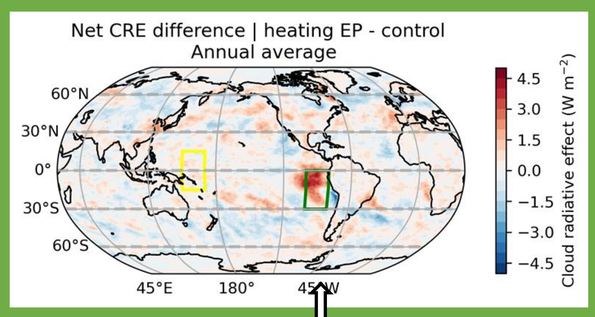

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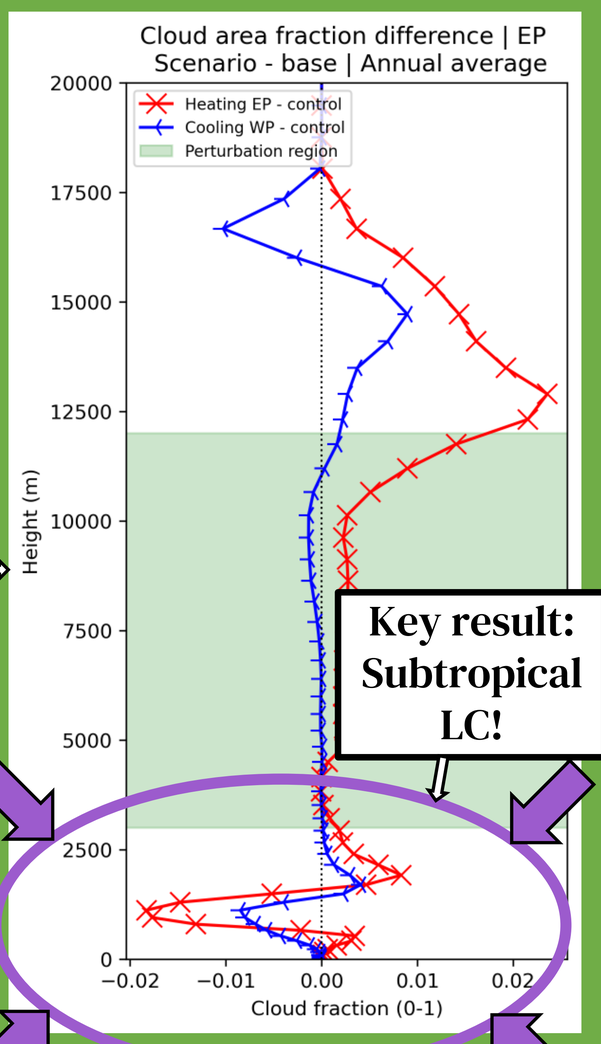

Vertical cloud fraction

Results

Main finding bottom-right!

Vertical cloud fraction

Key result: Subtropical LC!

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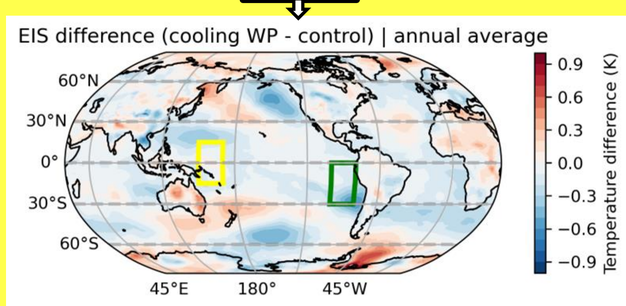

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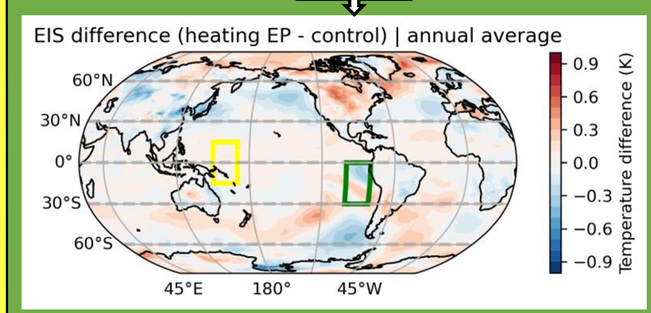

References:
1: Myers, T. A. and Norris, J. R. (2013) 'Observational evidence that enhanced subsidence reduces subtropical marine boundary layer cloudiness', *Journal of Climate*, 26(19), pp. 7507–7524. doi: 10.1175/JCLI-D-12-00736.1.
2: Schiro, K. A. *et al.* (2022) 'Model spread in tropical low cloud feedback tied to overturning circulation response to warming', *Nature Communications*, 13(1), p. 7119. doi: 10.1038/s41467-022-34787-4.
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4: Andrews, T. and Webb, M. J. (2018) 'The dependence of global cloud and lapse rate feedbacks on the spatial structure of tropical pacific warming', *Journal of Climate*, 31(2), pp. 641–654. doi: 10.1175/JCLI-D-17-0087.1.

Supplementary material
QR code