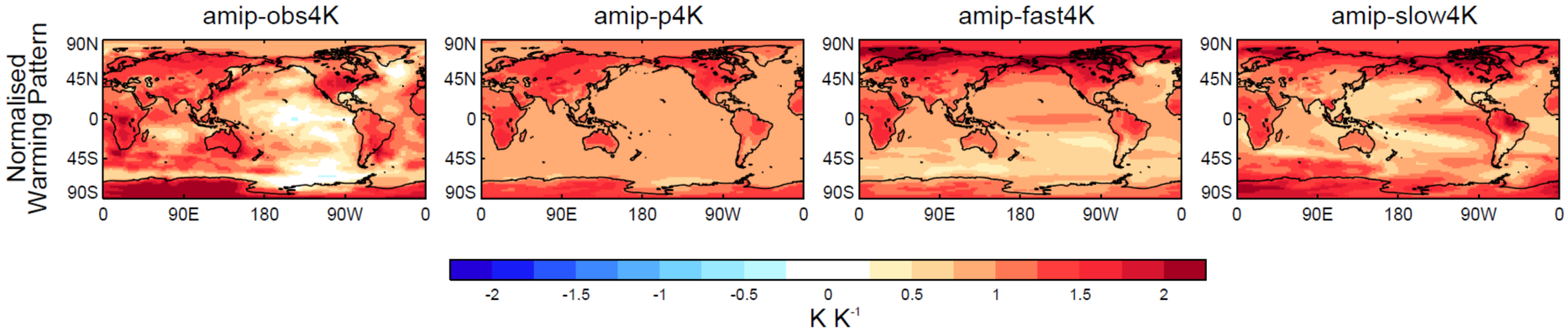
amip-fast/slow/obs4K: dependence of feedback on pattern of warming

Aim: to gain a detailed process understanding of the dependence of climate feedbacks (particularly cloud and lapse-rate feedbacks) on the spatial structure of surface warming, including why some models are more sensitive than others.

(a) Suface warming pattern



Experiments: extend the *amip-p4K* and *amip-future4K* suite of experiments with three new patterns of warming, derived from (i) the first 20yrs of abrupt4xCO_2 (*amip-fast4K*), (ii) years 21-150 of abrupt4xCO2 (*amip-slow4K*), and (iii) 20th century observations.

Experiment	Warming pattern	Key feature
amip-obs4K	1900-2012 linear trend of observed SSTs	Lack of warming in east Pacific
amip-p4K	Uniform warming of +4K	Uniform warming
amip-future4K	End of 1%CO2 simulation	Relatively small warming in southeast tropical Pacific & Southern Ocean
amip-fast4K	First 20 years of abrupt4xCO2 simulation	Relatively small warming in southeast tropical Pacific & Southern Ocean
amip-slow4K	Years 21-150 of abrupt4xCO2 simulation	Relatively large warming in east Pacific, Southern Ocean & high latitudes

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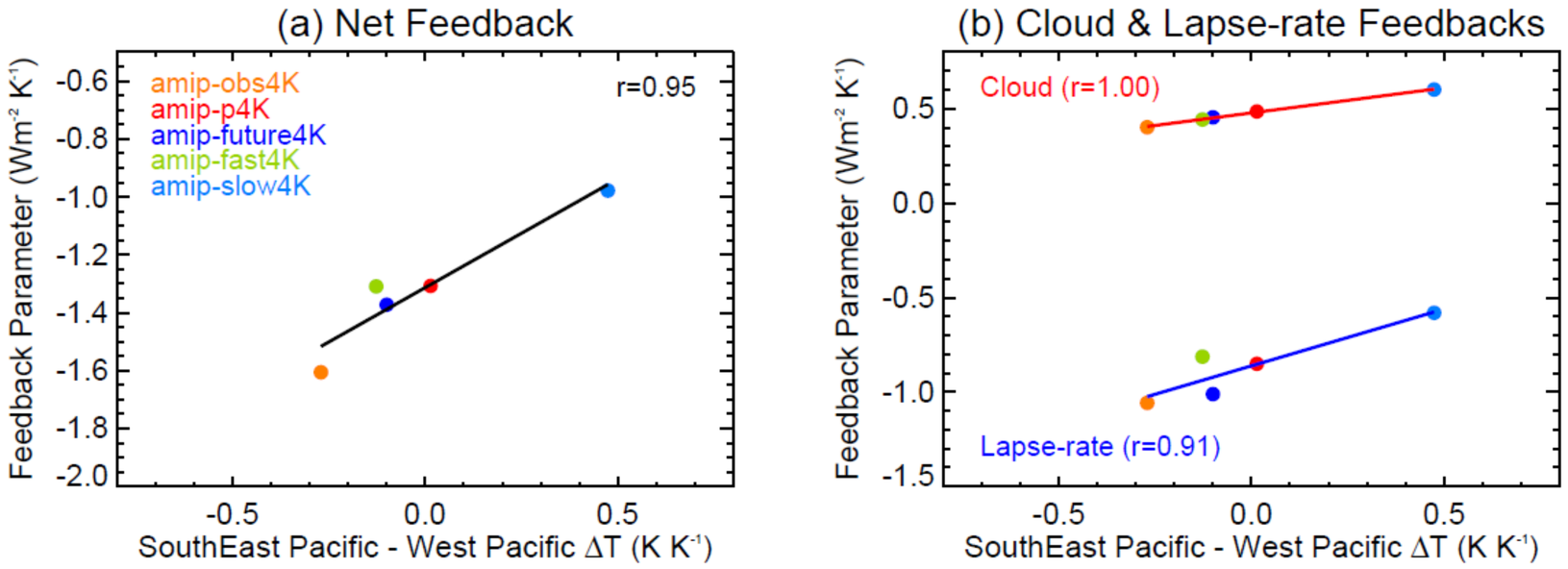

- In HadGEM2 the effective climate sensitivity of the model varies from 2.6 to 5K, simply as a result of changing the warming pattern applied to the model.

- The 30yr amip-4K design gives clear regional and process information, revealing that cloud and lapse feedbacks vary significantly on the warming contrast between the east and west Pacific (see also Zhou et al. 2016) due to competing effects from local boundary layer warming in the stratocumulus regions and remote upper tropospheric warming from the warm pool.

- Only a single model study, it is imperative to quantify and understand the processes more widely across models to gain a better understanding of the robustness of the response and inform the link between observed estimates of cloud and lapse-rate feedback processes on various timescales to those simulated.

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