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Changing risks of resonance in extreme weather events for higher atmospheric greenhouse gas concentrations

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A recent paper by Petoukhov et al (2013) demonstrates that many of the recent major extreme events in the NH may have been caused by resonant conditions driving very high meridional winds around slowly moving centres-of-action. Besides high amplitudes of planetary wave numbers 6,7 and 8, additional features are identified through 4 further conditions that trigger system resonance. These make the potential for high amplitude waves more likely as well as the possibility of more persistent events.

A concern is that human-induced climate change could create conditions more conducive to tropospheric Rossby wave resonance, thereby forcing any periods of extreme weather to become more commonplace and longer lasting. Whilst the CMIP5 ensemble provides much information on expected changes, to fully address changing probabilities of extreme event occurrence – which by definition are relatively rare – is, though, best approached through a massive ensemble modeling framework.

The climateprediction-dot-net citizen-science massive ensemble GCM modeling framework provides order 104 simulations for sea-surface temperature, sea-ice extent and atmospheric gas composition representative of both pre-industrial and contemporary conditions. Here we present what these families of simulations imply in terms of the changing likelihood of conditions for mid-latitude resonance, and implications for amplitudes of Rossby waves