Regional Climate Expected to Continue to Change Significantly After Net-Zero CO\textsubscript{2} Emissions Reached

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The Zero Emissions Commitment (ZEC) is the expected temperature change following the cessation of anthropogenic emissions of climate altering gases and aerosols. Recent model intercomparison work has suggested that global average ZEC for CO\textsubscript{2} is close to zero. However there has thus far been no effort to explore how temperature is expected to change at spatial scales smaller than the global average. Here we analyze the output of nine full complexity Earth System Models which carried out standardized ZEC experiments to quantify the ZEC from CO\textsubscript{2}. The models suggest that substantial temperature change following cessation of emissions of CO\textsubscript{2} can be expected at large and regional spatial scales. Large scale patterns of change closely follow long established patterns seen during modern climate change, while at the regional scale patterns of change are far more complex and show little consistency between different models. Analysis of model output suggest that for most models these changes far exceed pre-industrial internal variability, suggesting either higher climate variability, continuing changes to climate dynamics or both. Thus it appears likely that at the regional scale, where climate change is directly experienced, climate disruption will not end even as global temperature stabilizes. Such indefinite continued climate changes will test the resilience of local ecosystem and human societies long after economic decarbonization is complete. Overall substantial regional changes in climate are expected following cessation of CO\textsubscript{2} emissions but the pattern, magnitude and sign of these changes remains highly uncertain.