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## Reversibility of historical and future climate change with a complex earth system model

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The reversibility of a wide range of components of the earth system was investigated by comparing forward and time-reversed historical and future simulations of a coupled earth system model known as the Beijing Normal University earth system

model. Many characteristics of the climate system, including the surface temperature, ocean heat content (OHC), convective precipitation, total runoff, ground evaporation, soil moisture, sea ice extent, and Atlantic Meridional Overturning Circulation,

did not fully return to their initial values when the historical or future natural and anthropogenic forcing agents were reversed.

The surface temperature and OHC declines lagged behind the decline in greenhouse gases (GHGs). Reverses in other variables occurred in direct response to the decline in GHGs. The sea level increased, even after all of the forces returned to the original values. Furthermore, most of the climate variables did not return to their original values because of thermal inertial.

The end states of variables, other than those related to thermal storage, mainly depended on the original state of the natural

and anthropogenic forces, and were unaffected by the future growth rate of the GHGs. The climate policy implication of this

study is that climate change cannot be completely reversed even if all the external forces are returned to their initial values