

Supplementary Materials for  
**Impact-induced initiation of Snowball Earth: A model study**

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**The PDF file includes:**

Figs. S1 to S15  
Legends for movies S1 and S2

**Other Supplementary Material for this manuscript includes the following:**

Movies S1 and S2

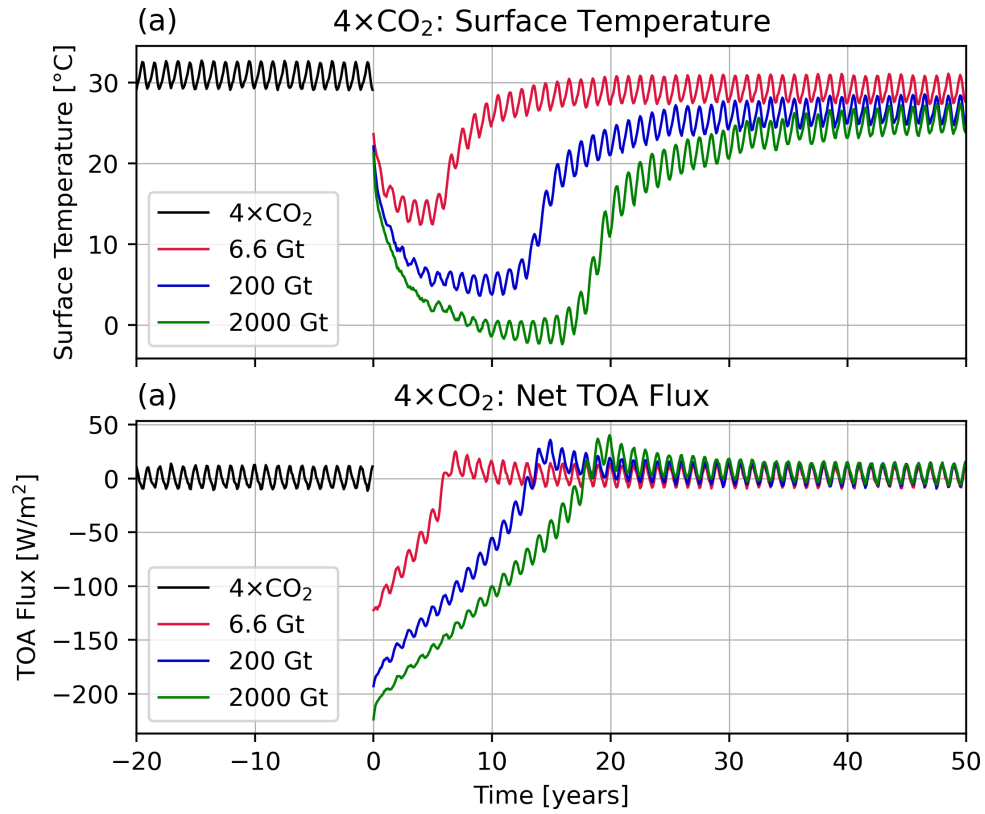


Figure S1: **Response of surface temperature and top-of-atmosphere (TOA) energy imbalance for the  $4\times\text{CO}_2$  simulations in response to 6.6, 200, and 2000 Gt sulfate aerosol injection scenarios.** (a) Global-mean surface temperature response. (b) Net TOA energy imbalance.

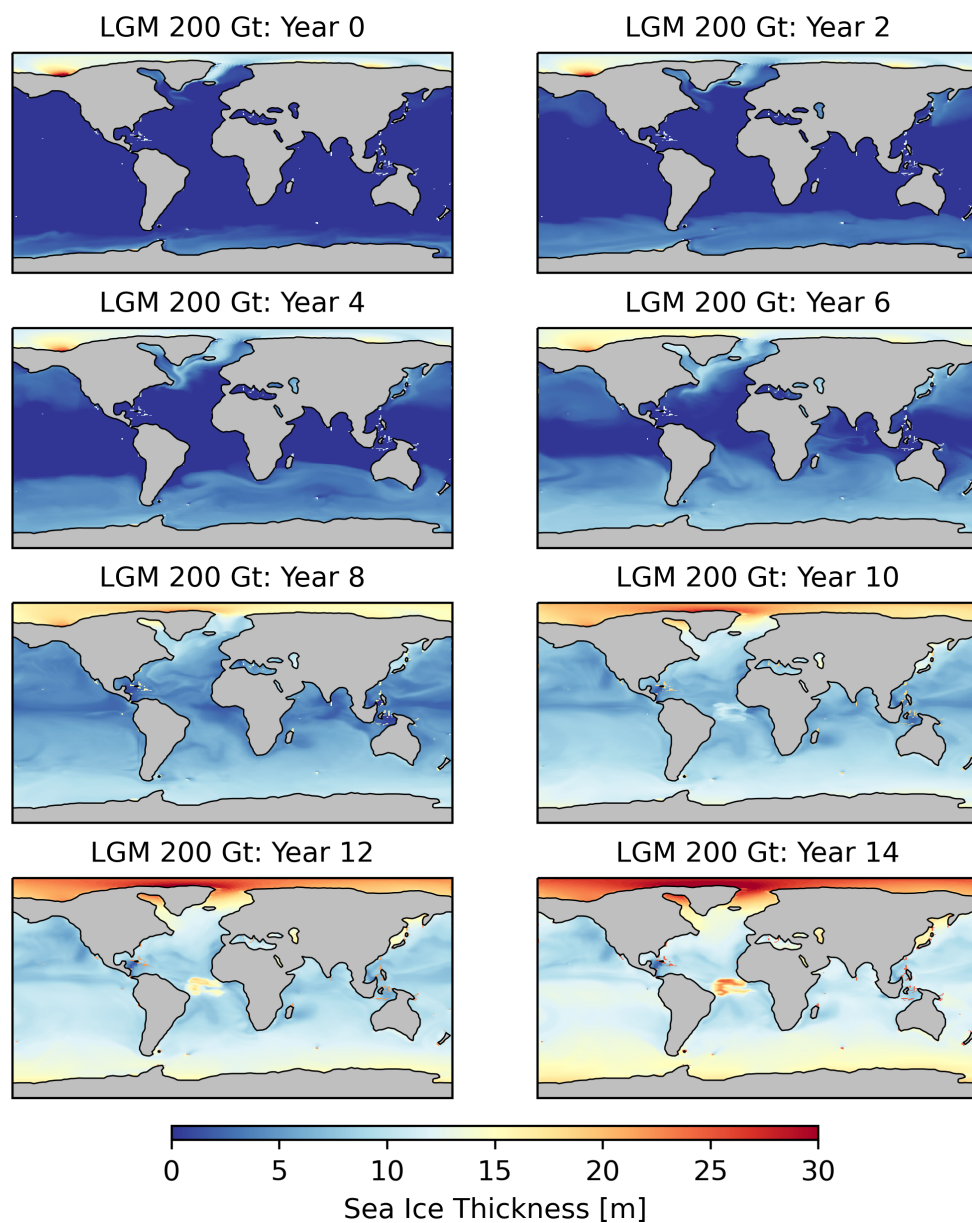


Figure S2: **Snapshots of sea ice thickness following the 200 Gt radiative forcing scenario applied to the LGM climate.**

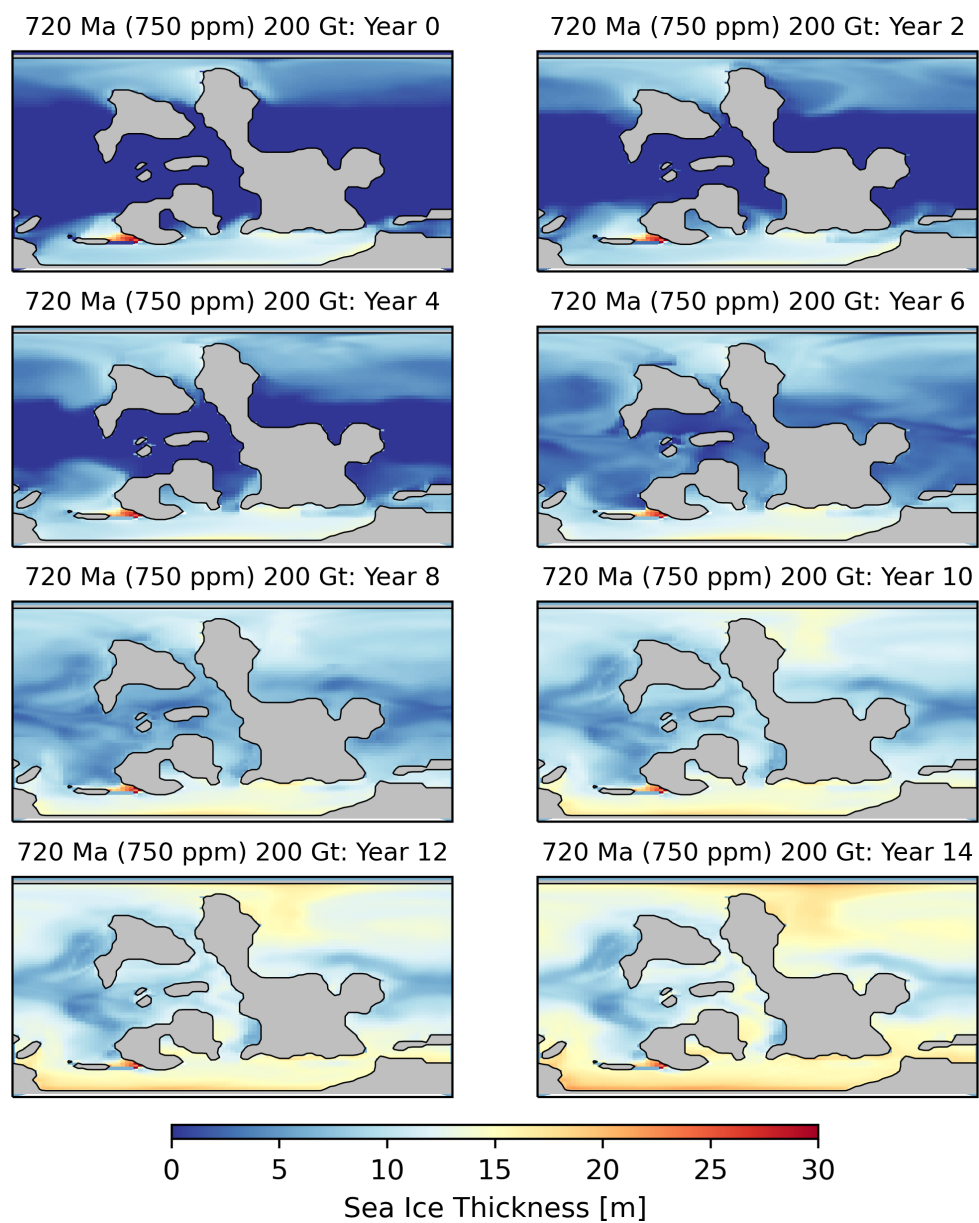


Figure S3: **Snapshots of sea ice thickness following the 200 Gt radiative forcing scenario applied to the 720 Ma (750 ppm) climate.**



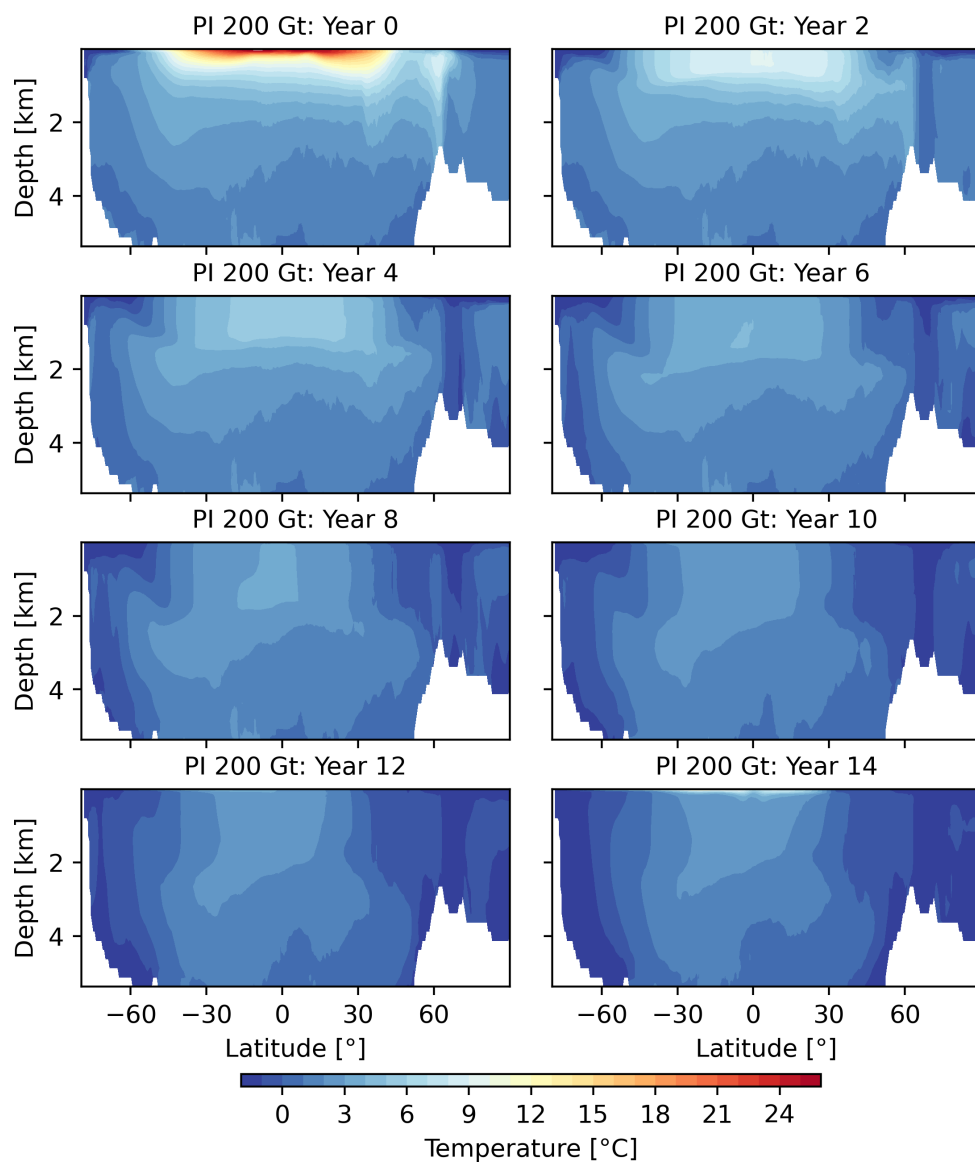


Figure S5: **Snapshots of zonal-mean ocean temperatures as a function of latitude and depth, following the 200 Gt radiative forcing scenario applied to the preindustrial climate.**

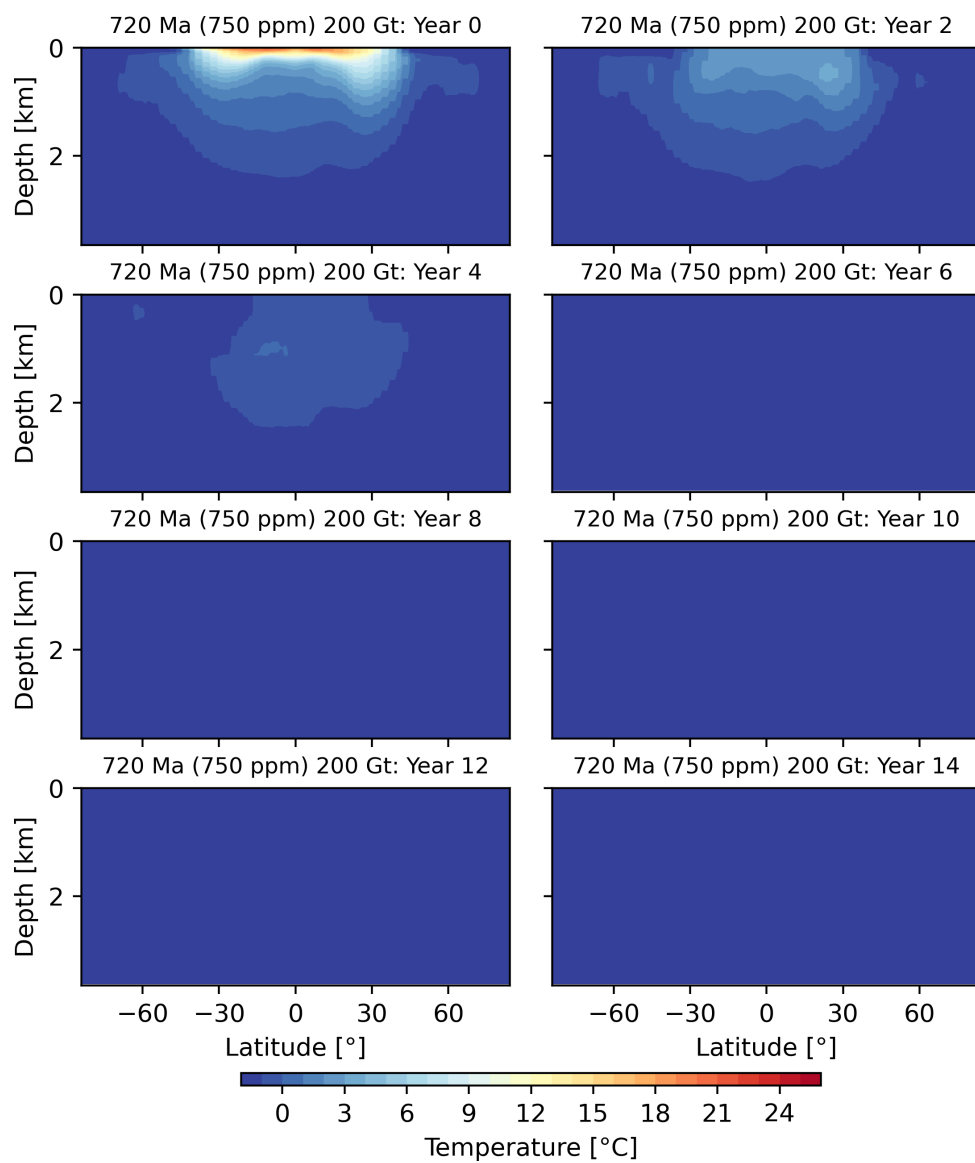


Figure S6: **Snapshots of zonal-mean ocean temperatures as a function of latitude and depth, following the 200 Gt radiative forcing scenario applied to the 720 Ma (750 ppm) climate.**

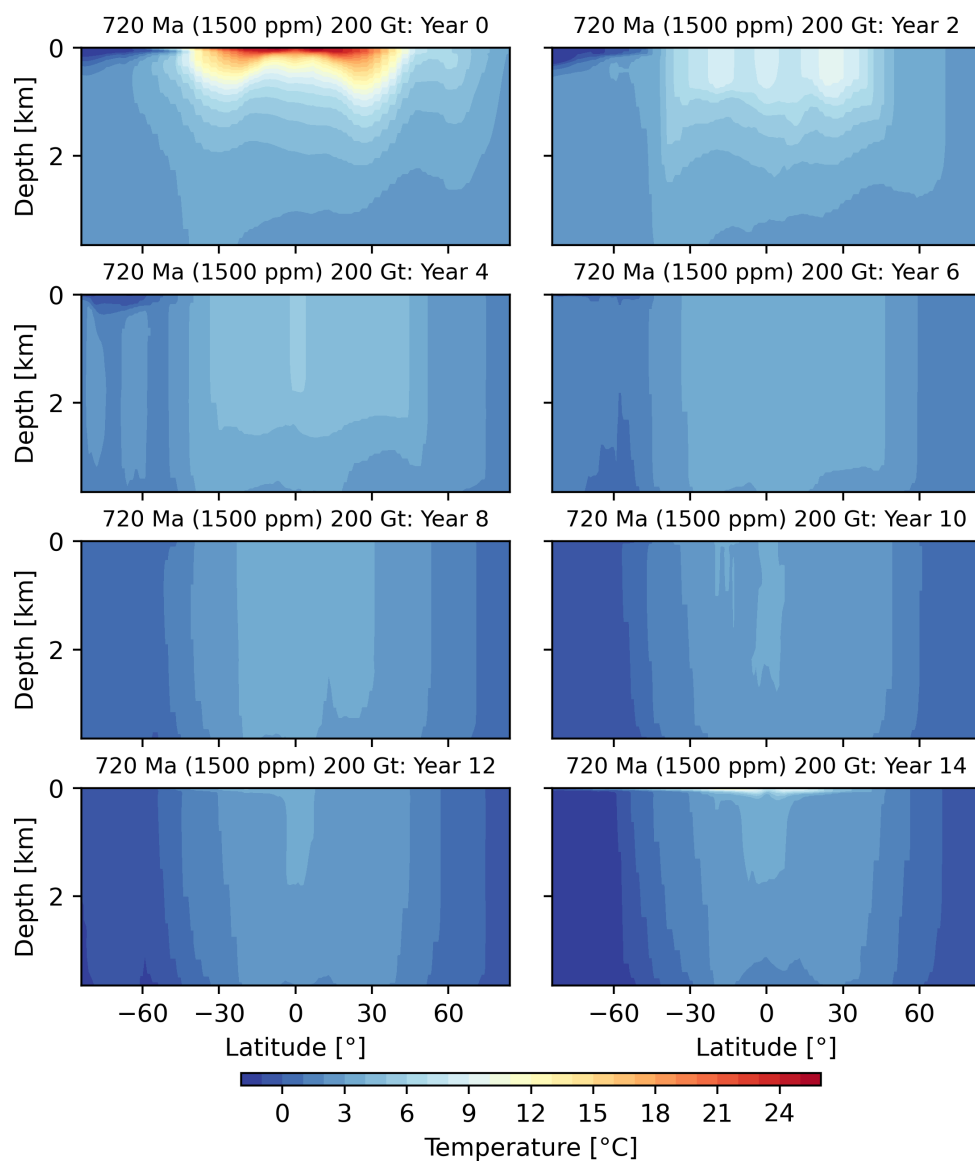


Figure S7: **Snapshots of zonal-mean ocean temperatures as a function of latitude and depth, following the 200 Gt radiative forcing scenario applied to the 720 Ma (1500 ppm) climate.**



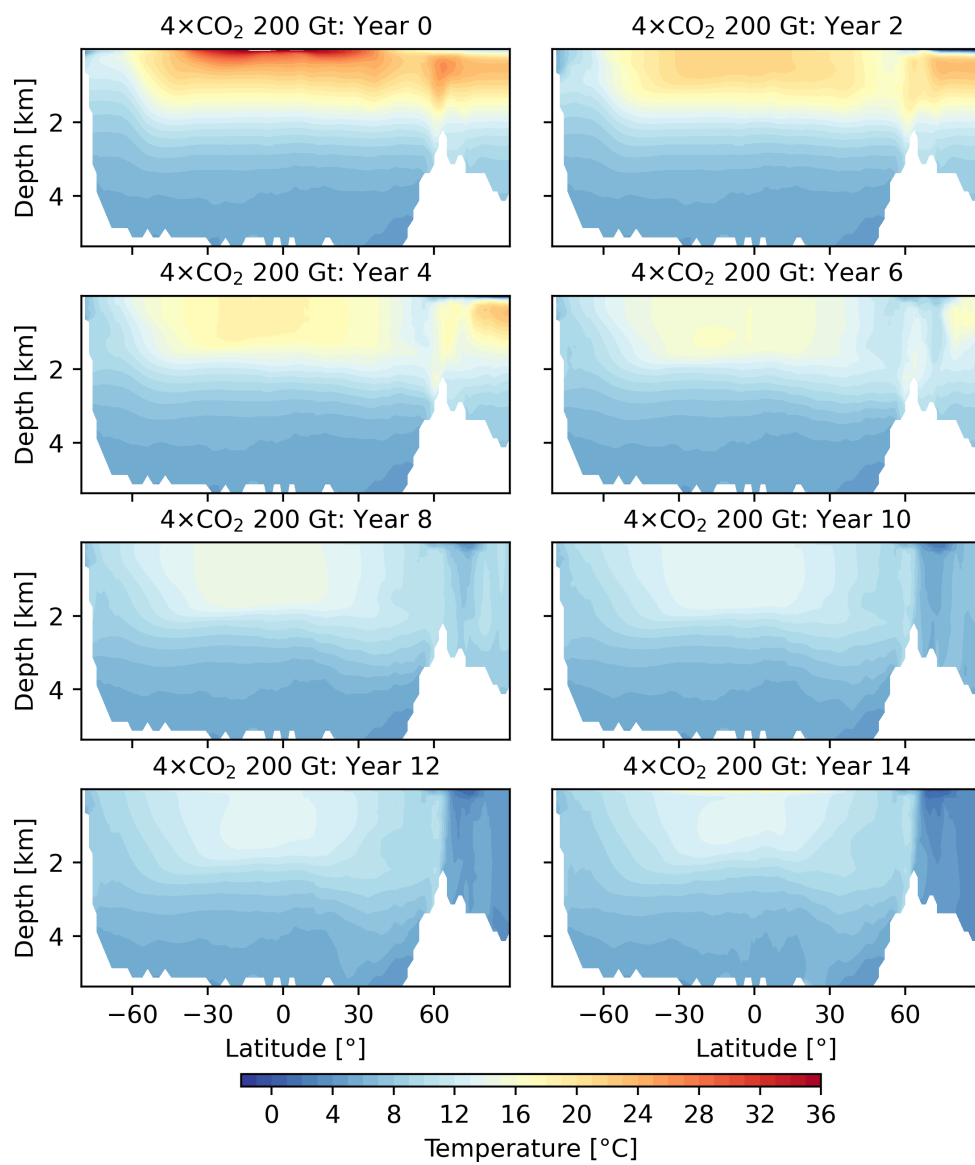
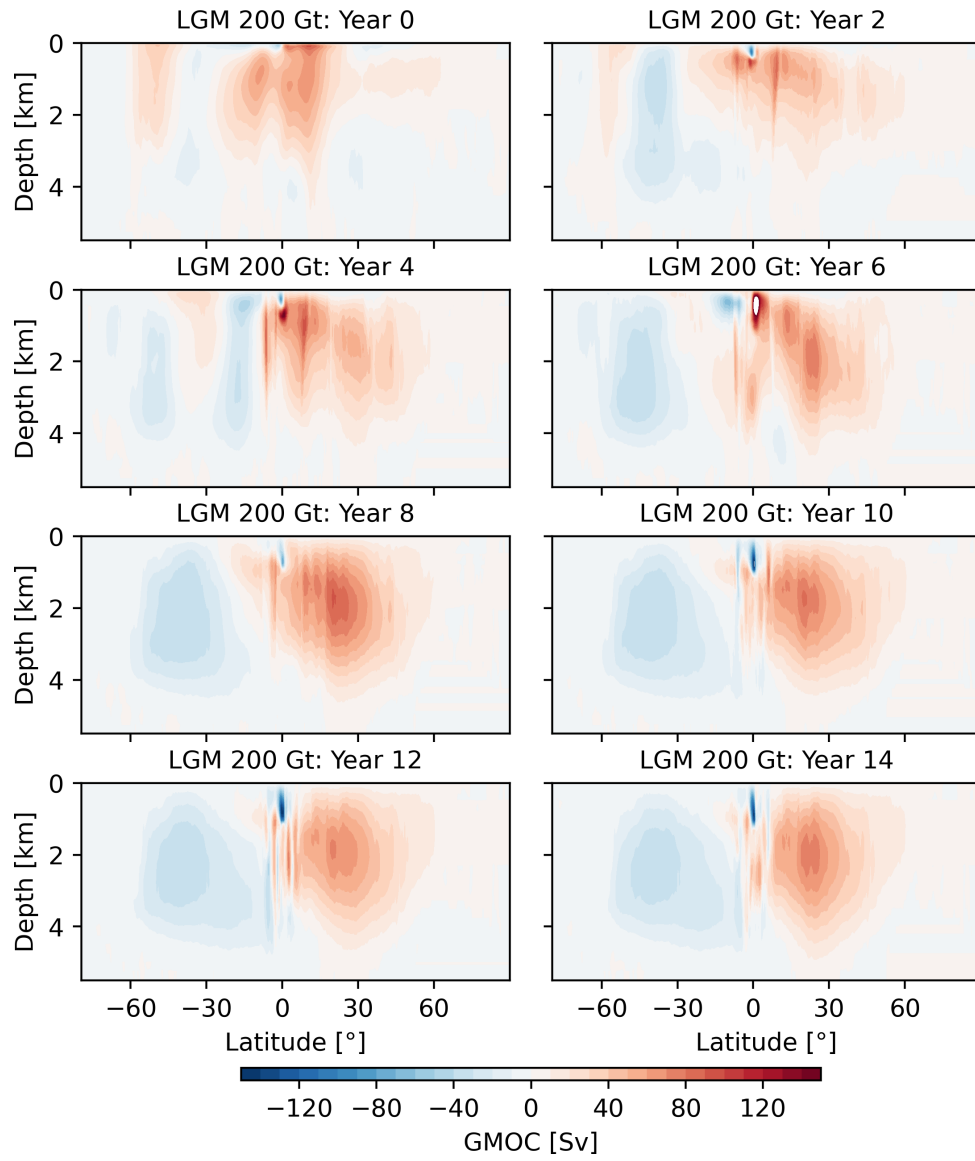
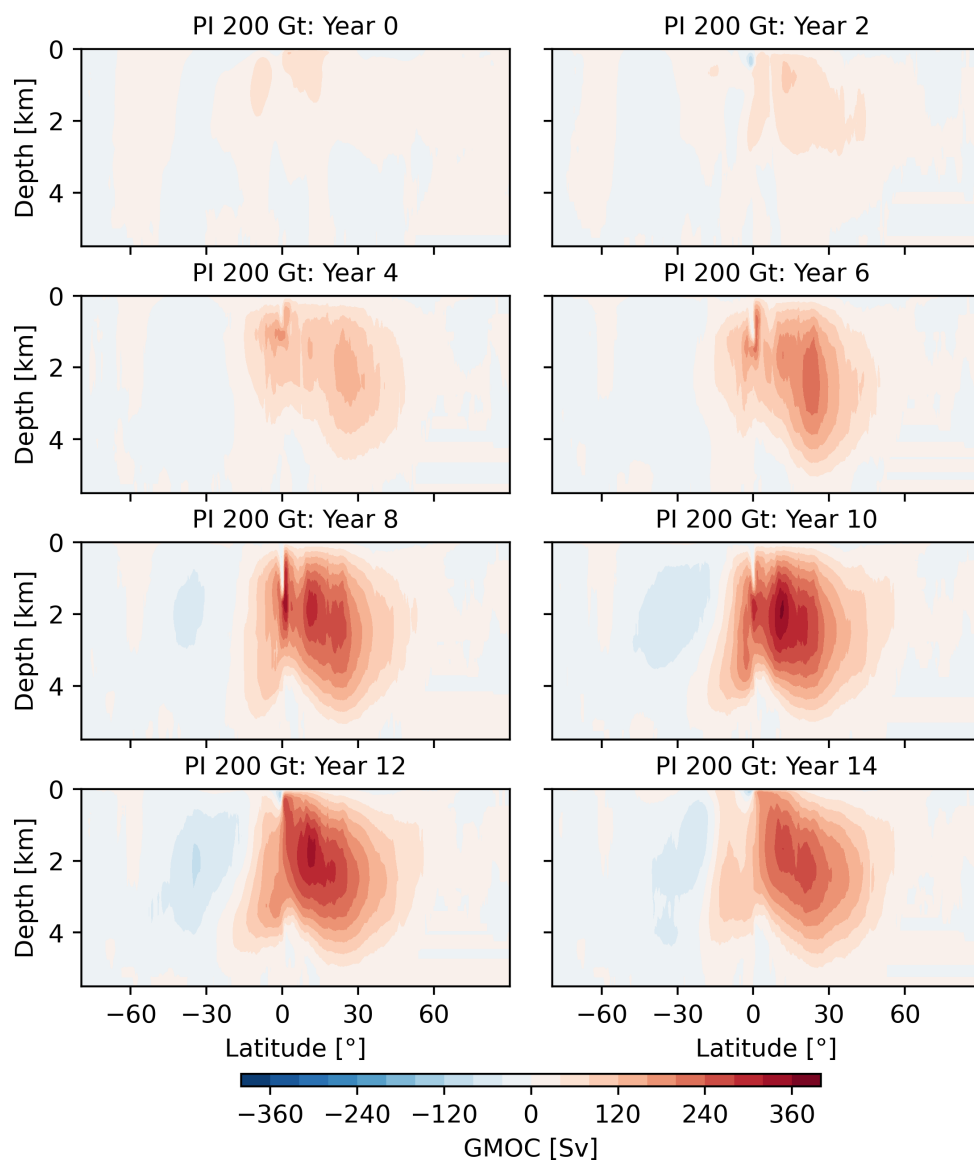


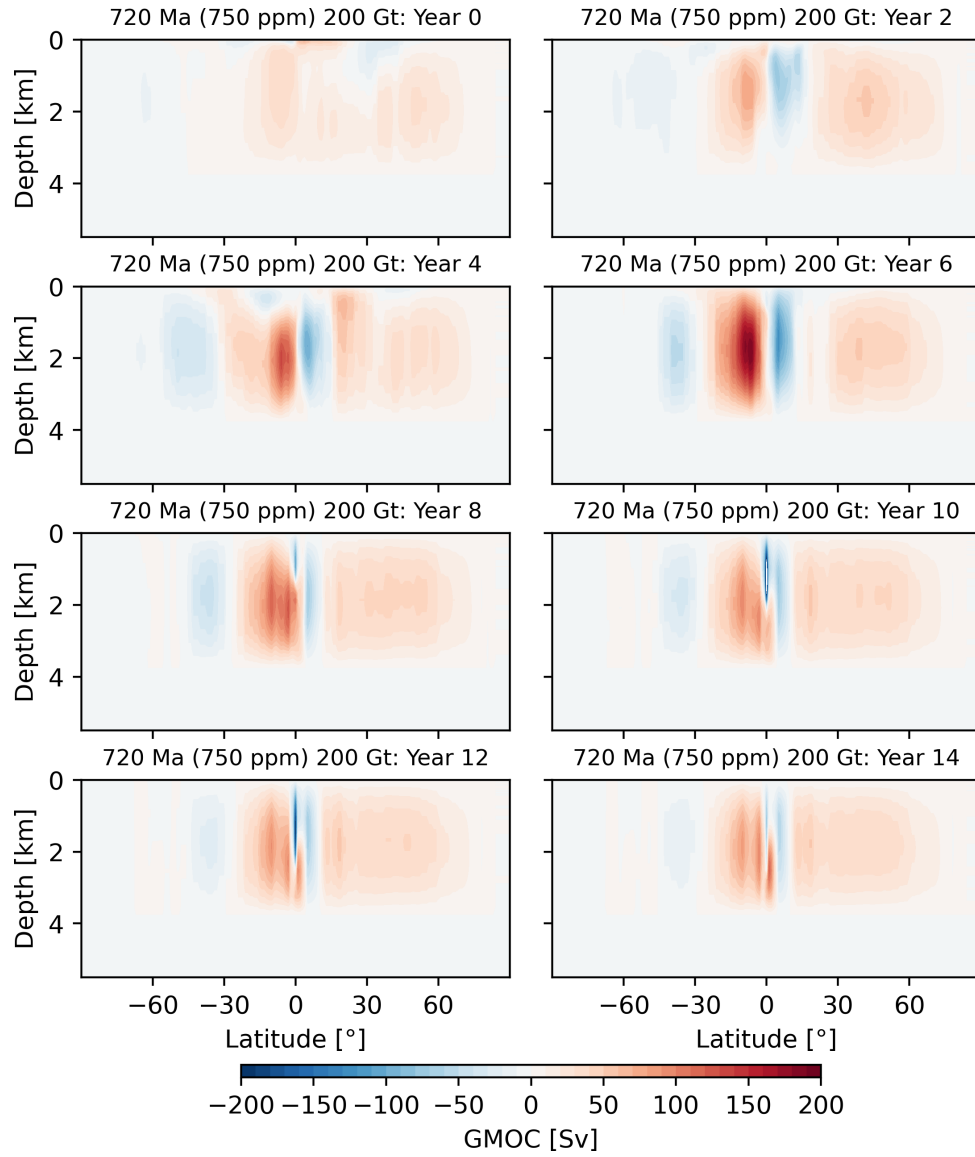
Figure S8: Snapshots of zonal-mean ocean temperatures as a function of latitude and depth, following the 200 Gt radiative forcing scenario applied to the  $4\times\text{CO}_2$  climate.



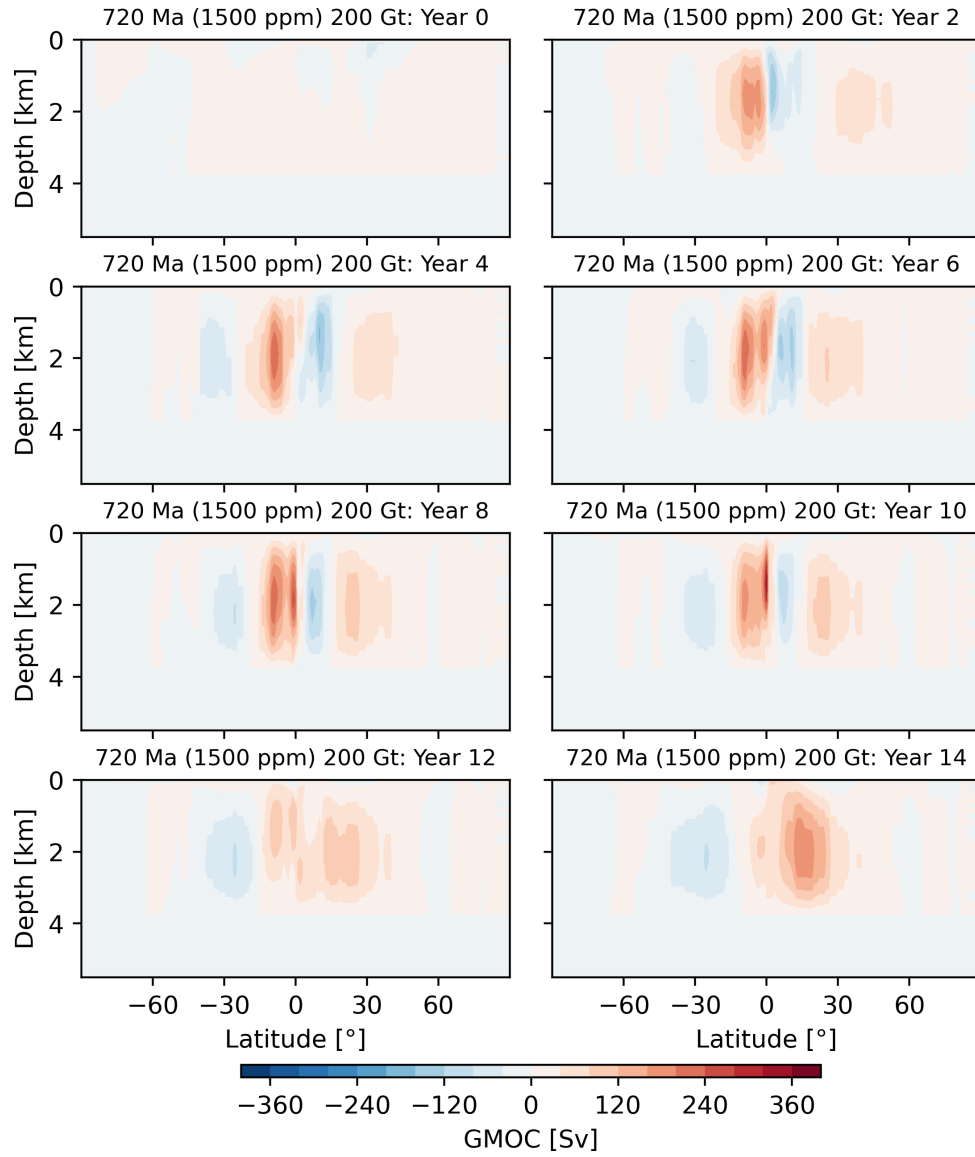
**Figure S9: Eulerian streamfunction for the global meridional overturning circulation, shown as a function of latitude and depth, following the 200 Gt radiative forcing scenario applied to the LGM climate.**



**Figure S10: Eulerian streamfunction for the global meridional overturning circulation, shown as a function of latitude and depth, following the 200 Gt radiative forcing scenario applied to the preindustrial climate.**



**Figure S11: Eulerian streamfunction for the global meridional overturning circulation, shown as a function of latitude and depth, following the 200 Gt radiative forcing scenario applied to the 720 Ma (750 ppm) climate.**



**Figure S12: Eulerian streamfunction for the global meridional overturning circulation, shown as a function of latitude and depth, following the 200 Gt radiative forcing scenario applied to the 720 Ma (1500 ppm) climate.**

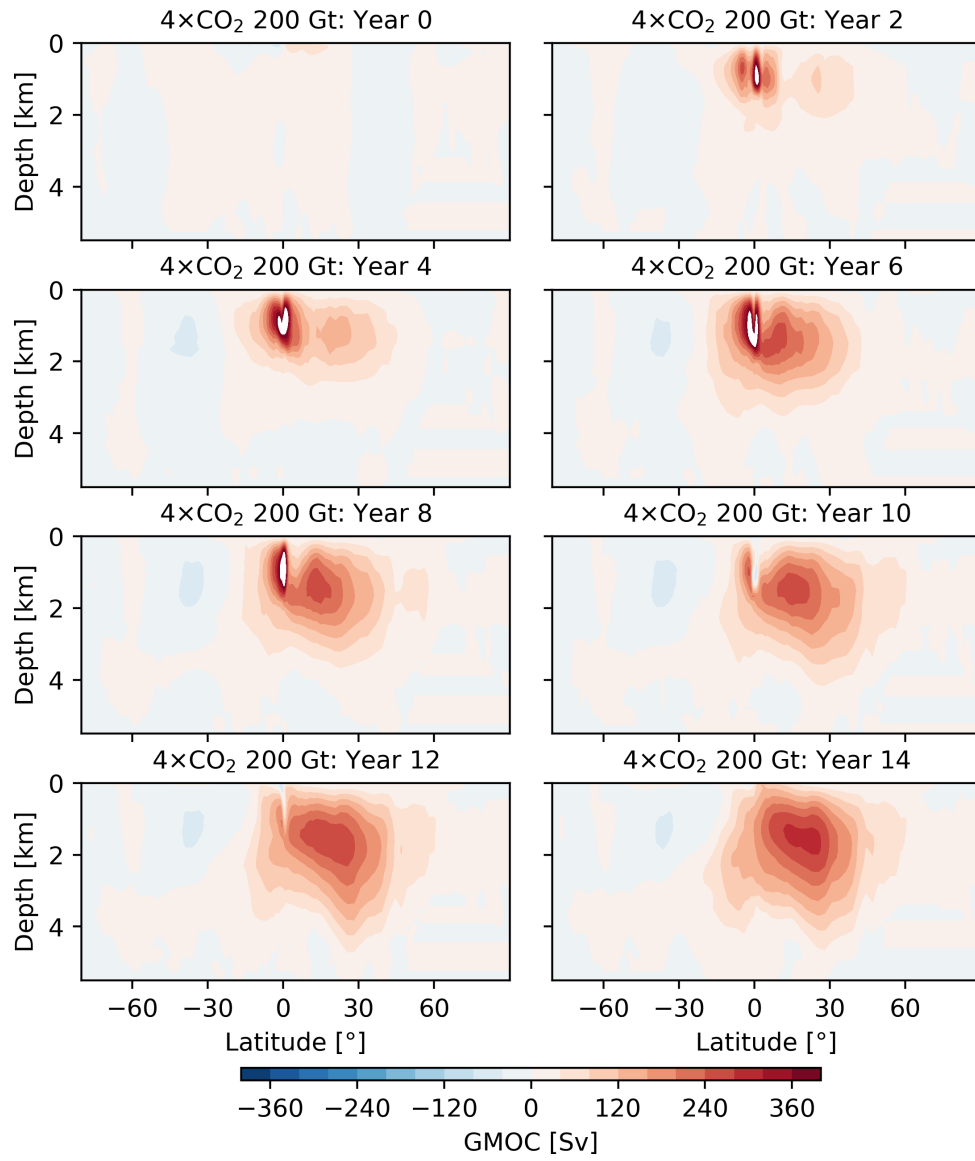


Figure S13: **Eulerian streamfunction for the global meridional overturning circulation, shown as a function of latitude and depth, following the 200 Gt radiative forcing scenario applied to the  $4\times\text{CO}_2$  climate.**

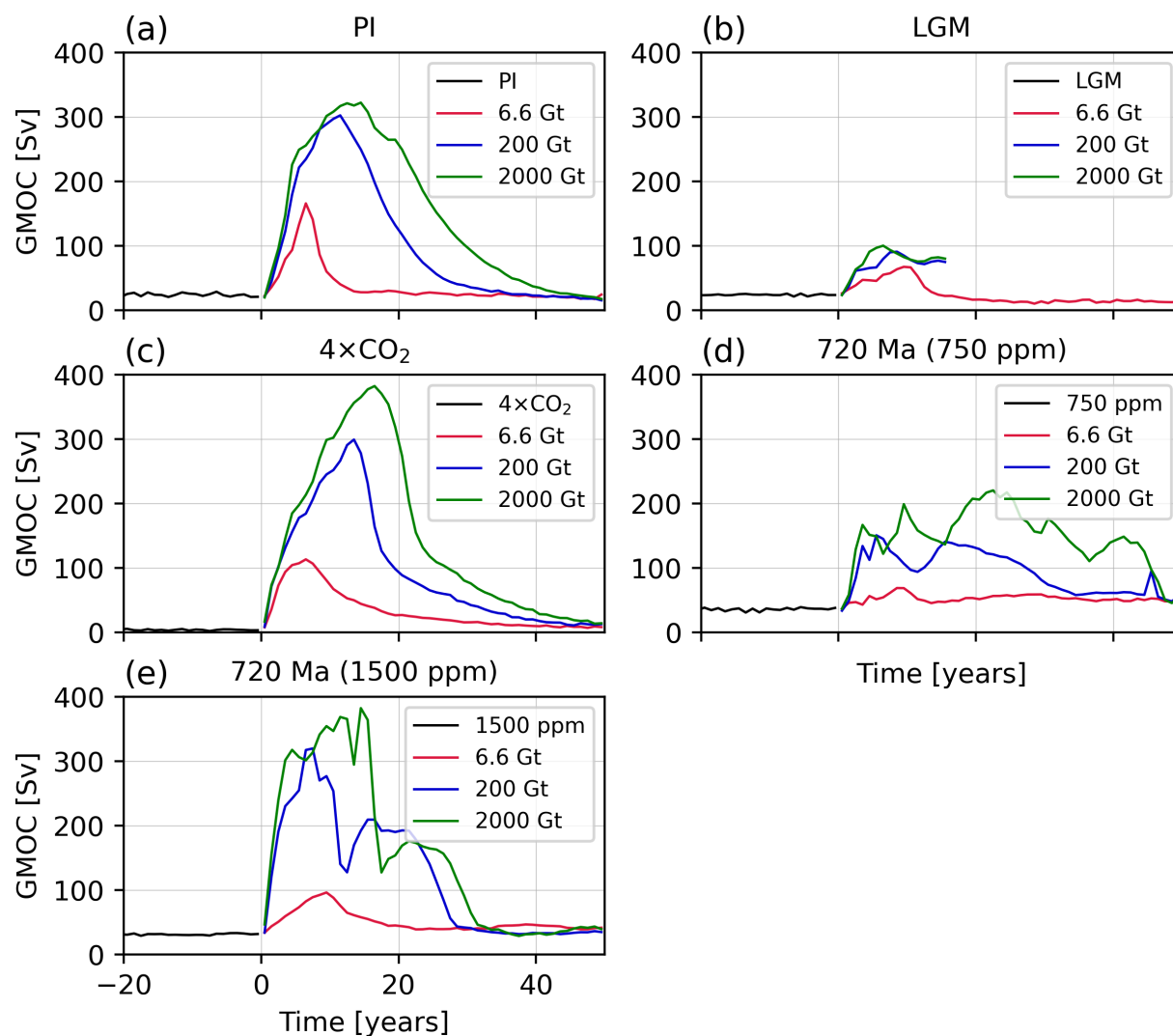


Figure S14: **Response of GMOC strength to the 6.6, 200, and 2000 Gt radiative forcing scenarios.** (a) GMOC strength in the preindustrial simulations. (b) As in (a), but for the LGM simulations. (c) As in (a), but for the 4×CO<sub>2</sub> simulations. (d) As in (a), but for the 720 Ma (750 ppm) simulations. (e) As in (a), but for the 720 Ma (1500 ppm) simulations. GMOC strength is computed as the maximum of the annual-mean Eulerian streamfunction below 750m and to the north of 20°N.

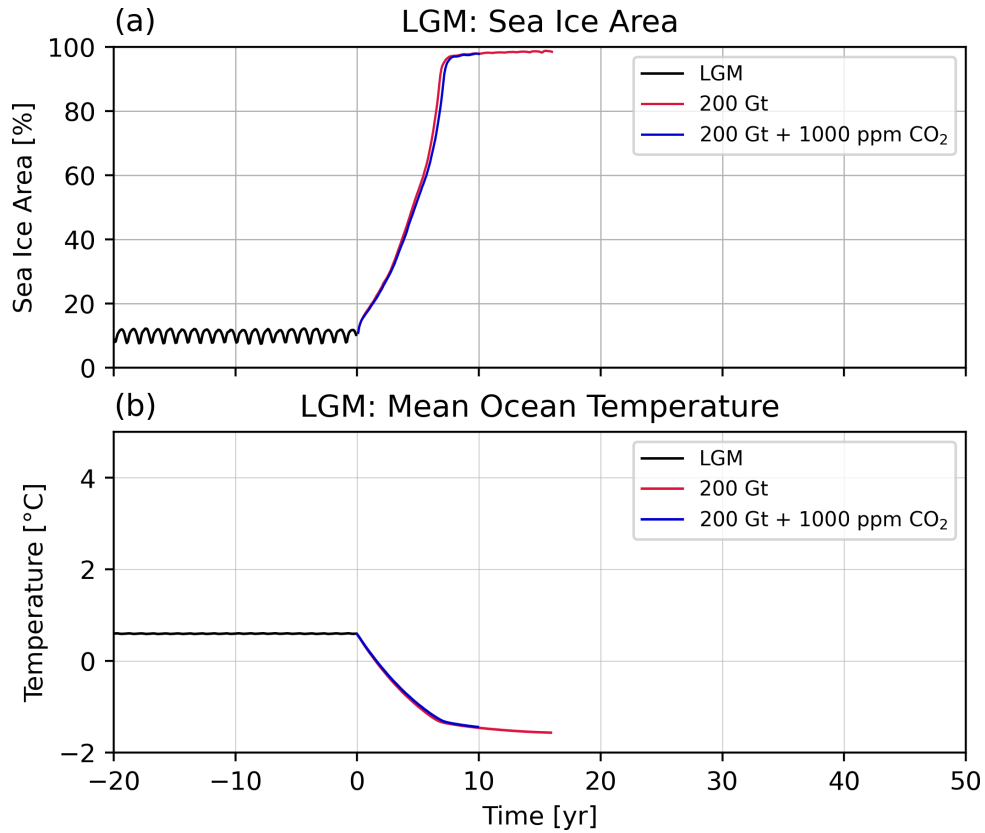


Figure S15: **Response of sea ice coverage and global mean ocean temperature to the 200 Gt sulfate aerosol radiative forcing scenario applied to the LGM climate.** (a) Sea ice coverage in the LGM simulation, with and without an abrupt 1000 ppm CO<sub>2</sub> injection. (b) Ocean temperature response in the LGM simulation, with and without an abrupt 1000 ppm CO<sub>2</sub> injection.



## **Movies**

**Movie S1:** Animation of sea ice area for the LGM simulation following the 200 Gt radiative forcing scenario.

**Movie S2:** Animation of sea ice area for the 720 Ma (750 ppm) simulation following the 200 Gt radiative forcing scenario.