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THE STATE UNIVERSITY
OF NEW JERSEY

Introduction to the Geoengineering Model Intercomparison Project (GeoMIP)

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24 May 2011

Why GeoMIP?

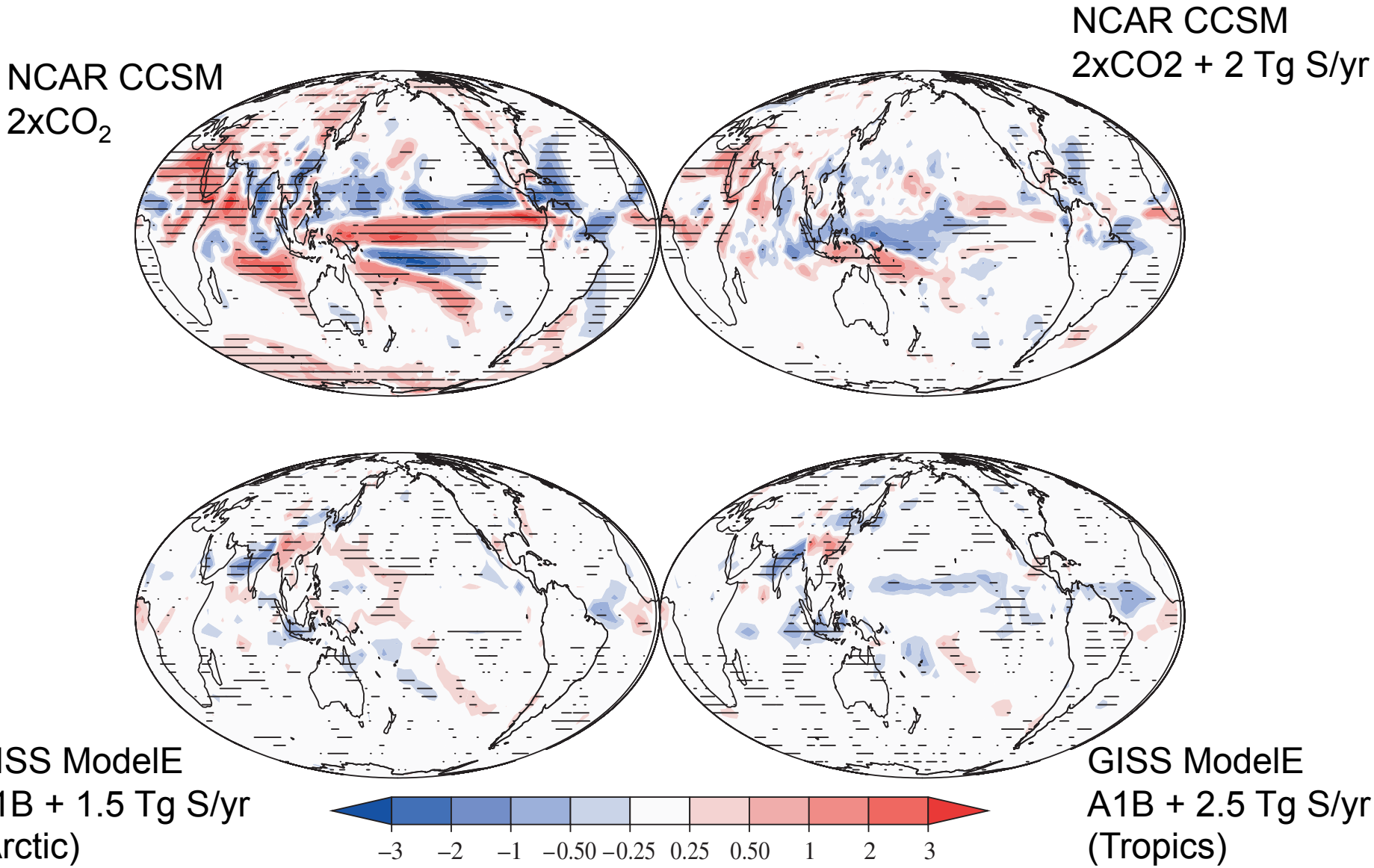
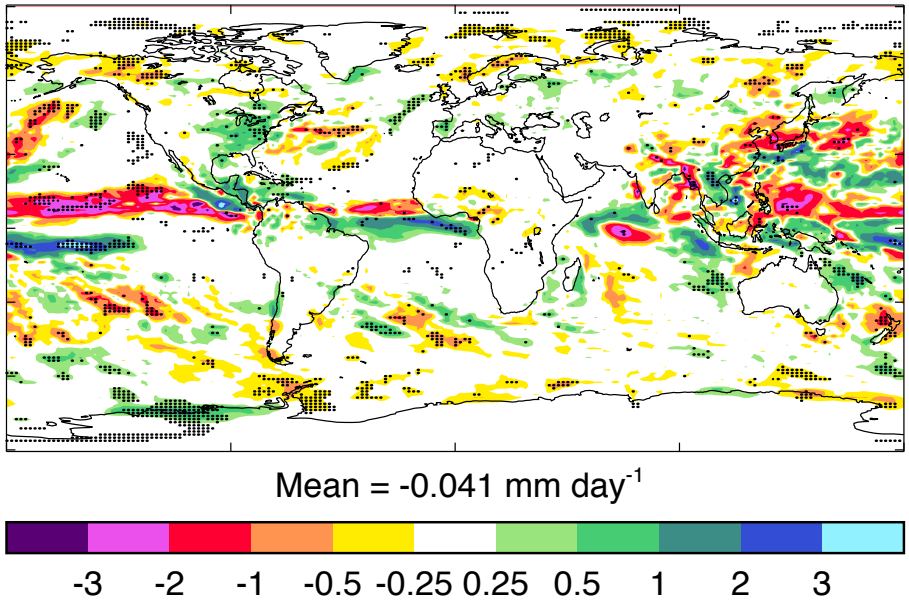


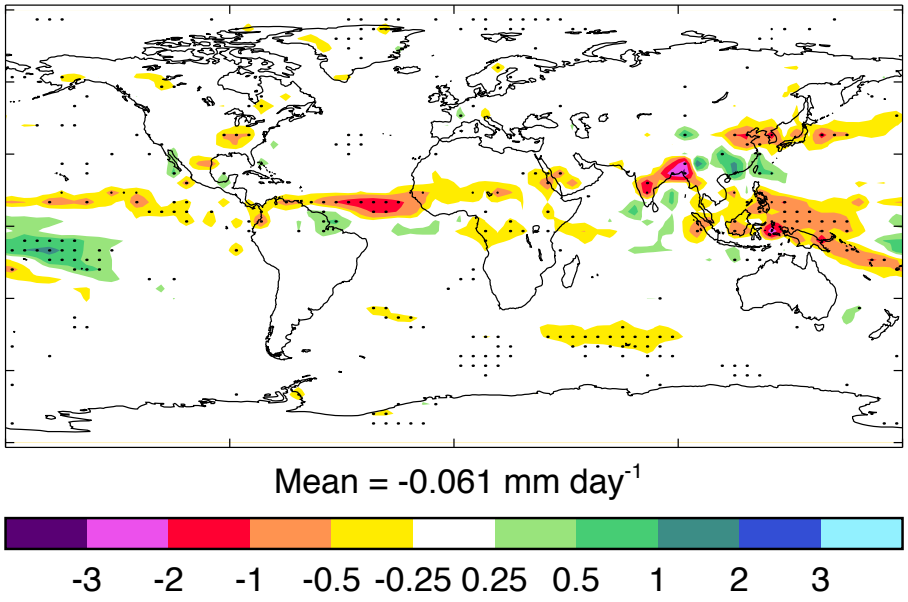
Figure 6. Change in precipitation associated with perturbations to greenhouse gases and geoengineering for two models during the June, July and August months: (a,b) shows differences

Jones et al., 2010, *ACP*

HadGEM2



GISS ModelE



Climate Effects of Stratospheric Geoengineering

- Radiation Budget
- Surface Temperature
- Precipitation (and the hydrologic cycle in general)
- Stratospheric Temperature
- Ozone
- Circulation (winds, geopotential height, Arctic Oscillation)
- Deposition
- Many more…

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Experiments G1-G4

Table I. A summary of the four experiments included in this proposal.

G1	Instantaneously quadruple the CO_2 concentration (as measured from pre-industrial levels) while simultaneously reducing the solar constant to counteract this forcing (Figure 1).
G2	In combination with a 1% increase in CO_2 concentration per year, gradually reduce the solar constant to balance the changing radiative forcing (Figure 2).
G3	In combination with RCP4.5 forcing, starting in 2020, gradual ramp-up the amount of SO_2 or sulphate aerosol injected, with the purpose of keeping global average temperature nearly constant (Figure 3). Injection will be done at one point on the Equator or uniformly globally. The actual amount of injection per year can be based on Hansen *et al.* (2005) but may need to be fine tuned to each model.
G4	In combination with RCP4.5 forcing, starting in 2020, daily injections of a constant amount of SO_2 at a rate of 5 Tg SO_2 per year at one point on the Equator through the lower stratosphere (~16–25 km in altitude) or the particular model's equivalent. These injections would continue at the same rate through the lifetime of the simulation (Figure 4).

Kravitz et al., 2011, *Atm. Sci. Lett.*

would be compensated by regional changes in evapotranspiration. A consensus has yet to be reached on

out the added complication of differing treatments of stratospheric aerosols in the various models. The ide-

Experiments G1-G4

- Four experiments based on CMIP5 experiments (makes doing control runs a lot easier)
- Purpose is (generally) to keep the climate “where it is”
- 50 years of geoengineering + 20 years of cessation
- Two very simple simulations (turning down the solar constant) to assess model similarities
- Two complex simulations (stratospheric sulfate aerosols) to assess model differences

Taylor et al., 2008

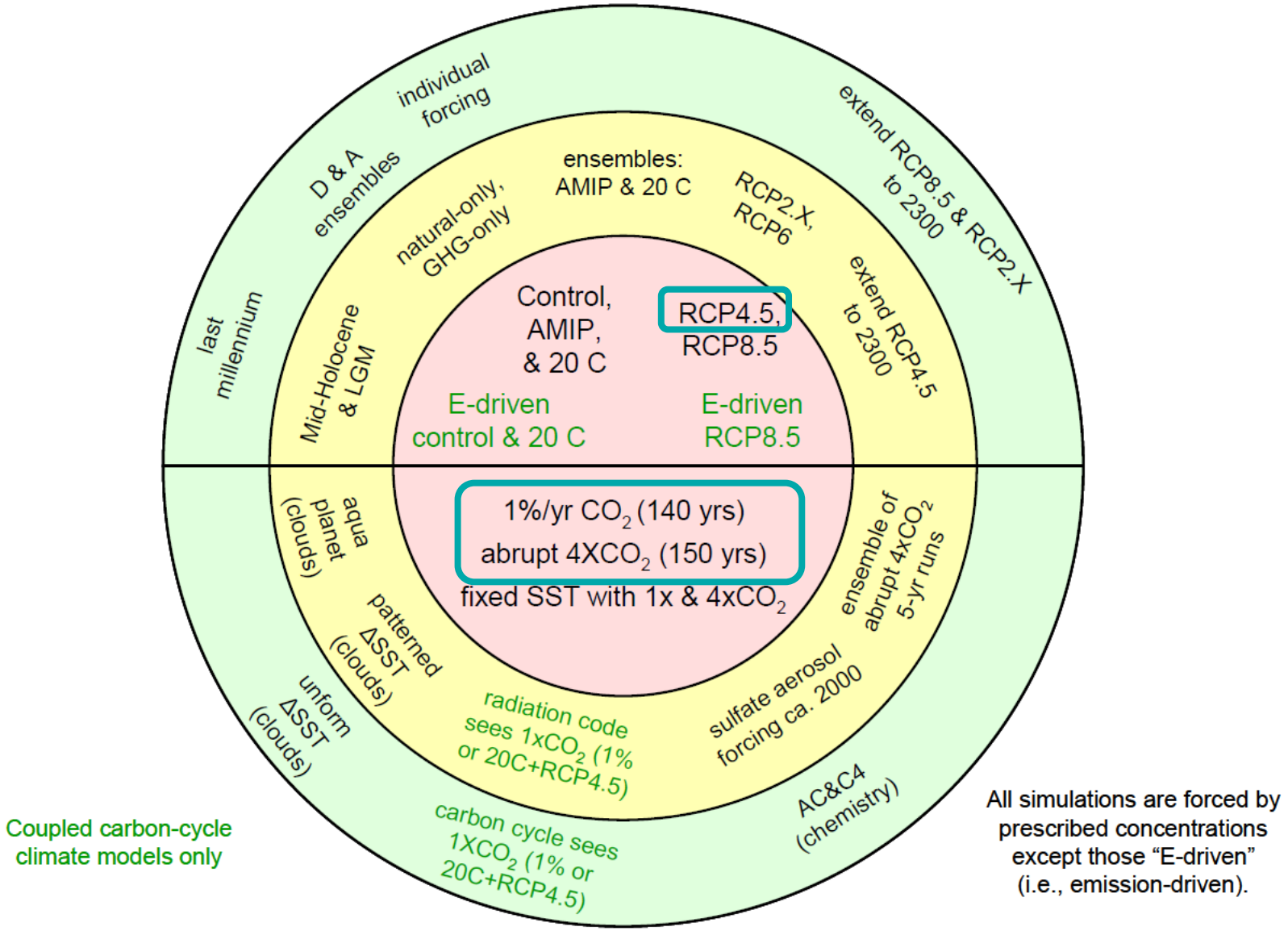
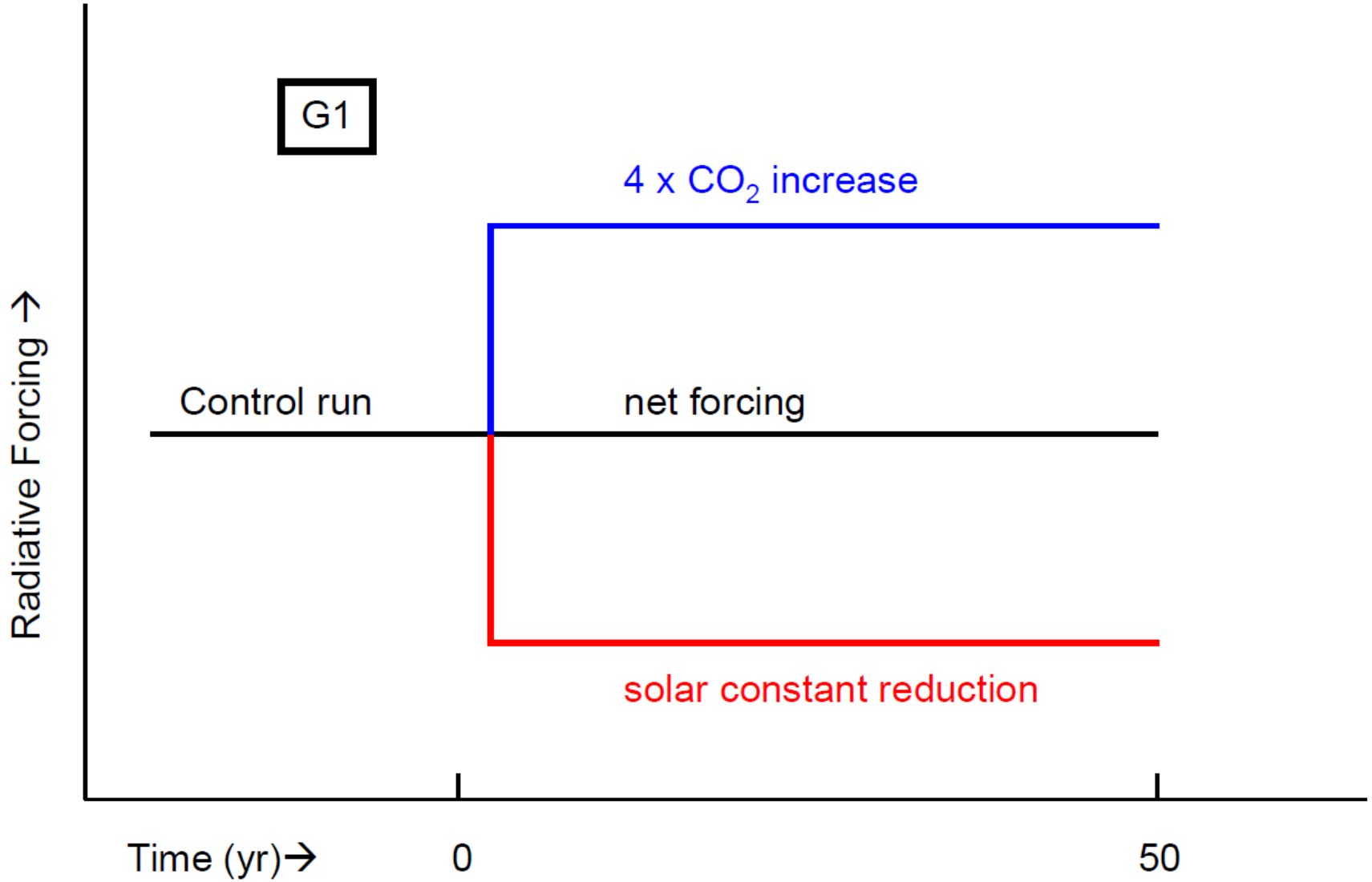
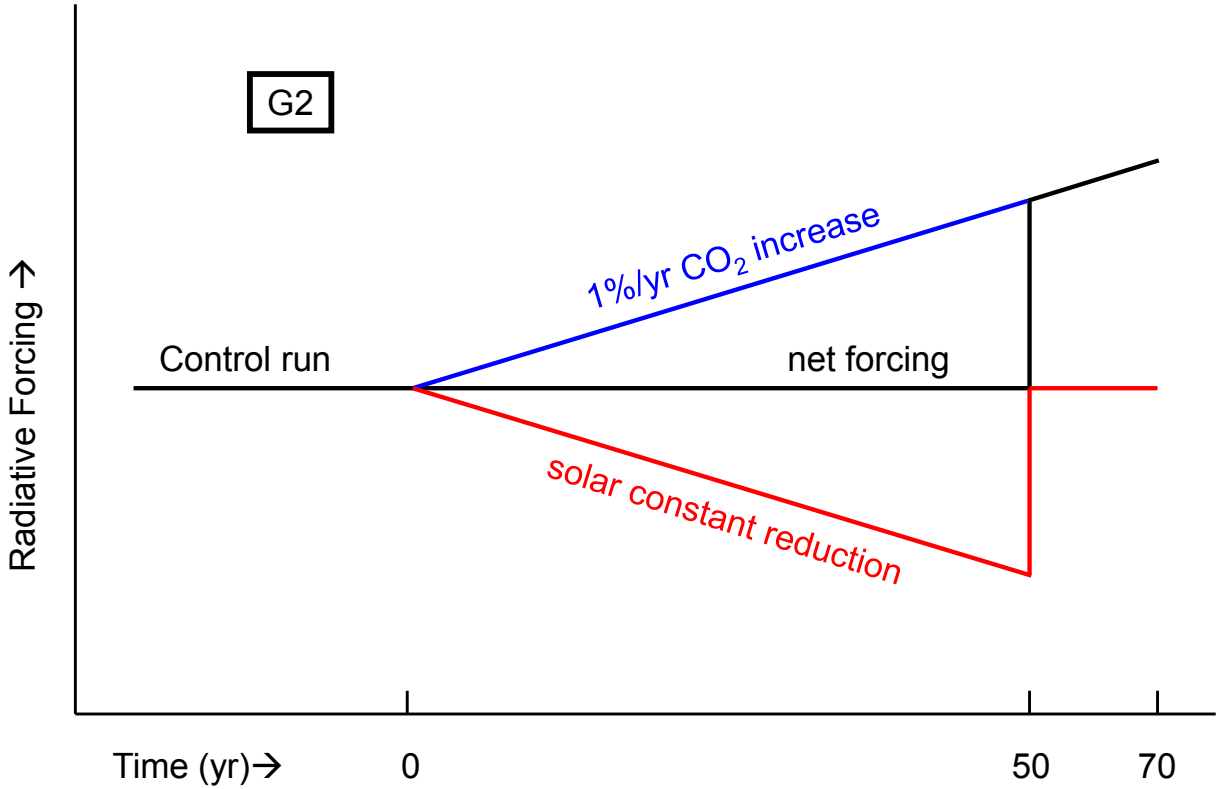


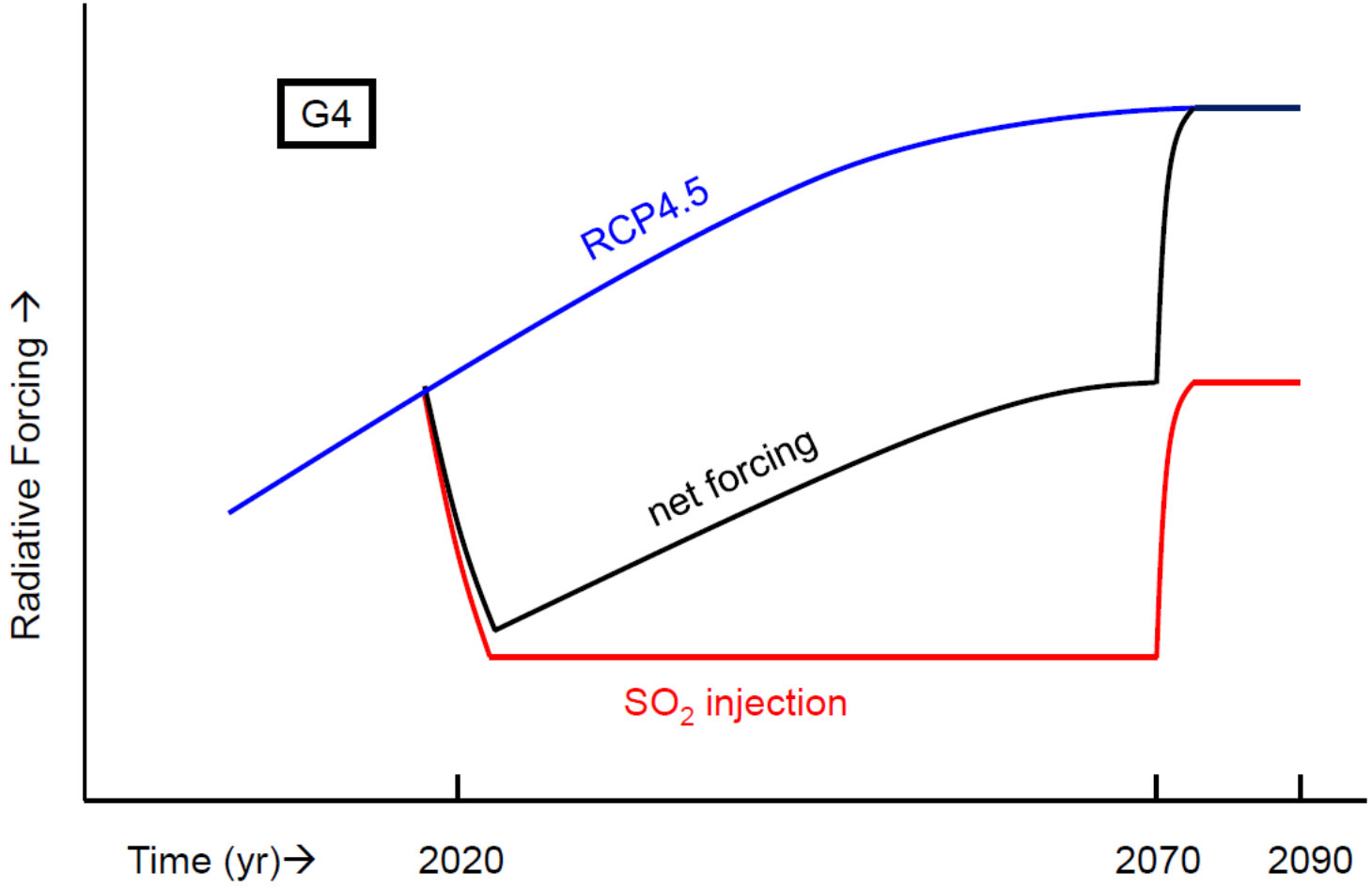
Figure 3: Schematic summary of CMIP5 long-term experiments.



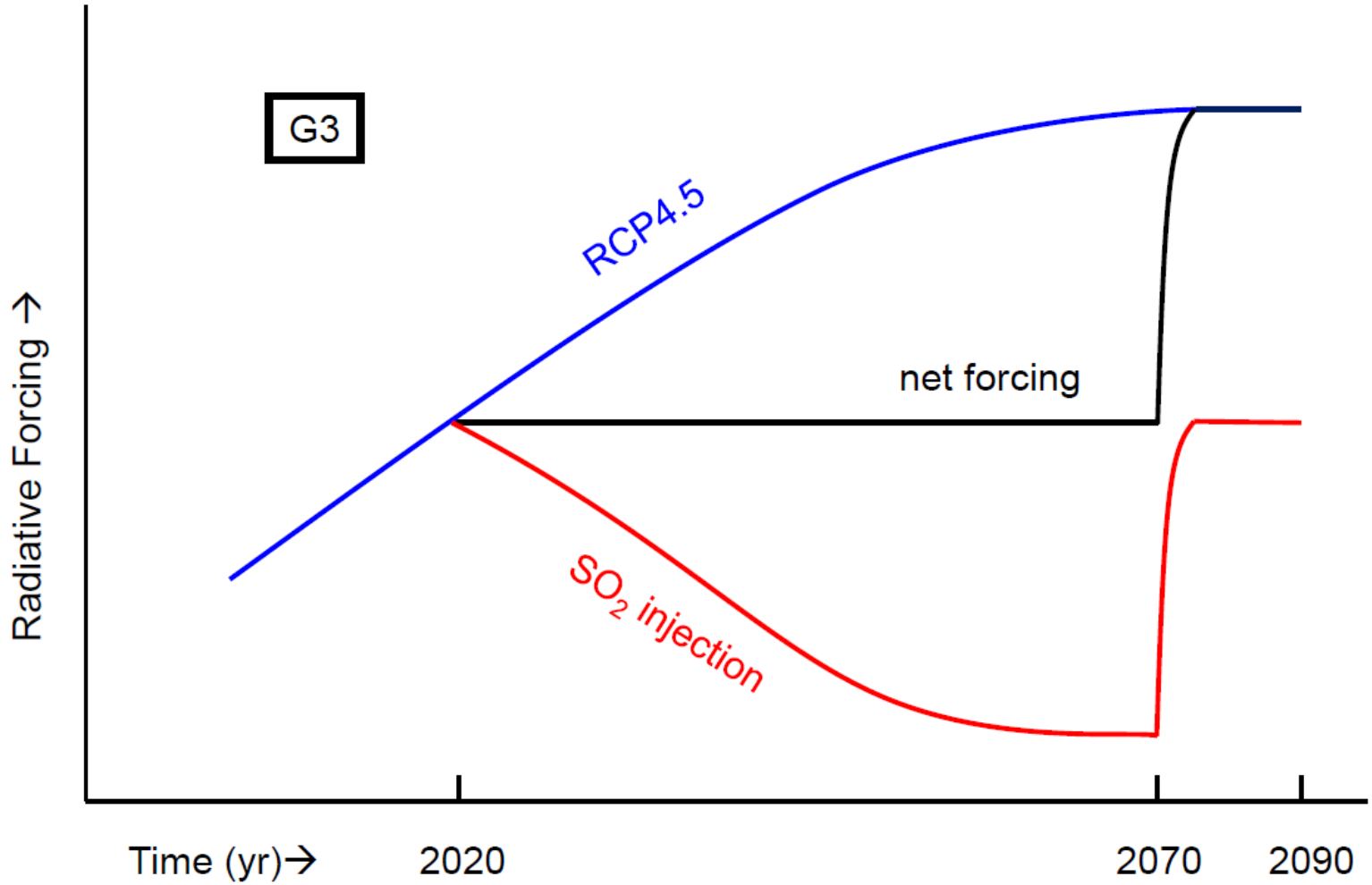
G1: Instantaneously quadruple CO_2 concentrations (as measured from preindustrial levels) while simultaneously reducing the solar constant to counteract this forcing.



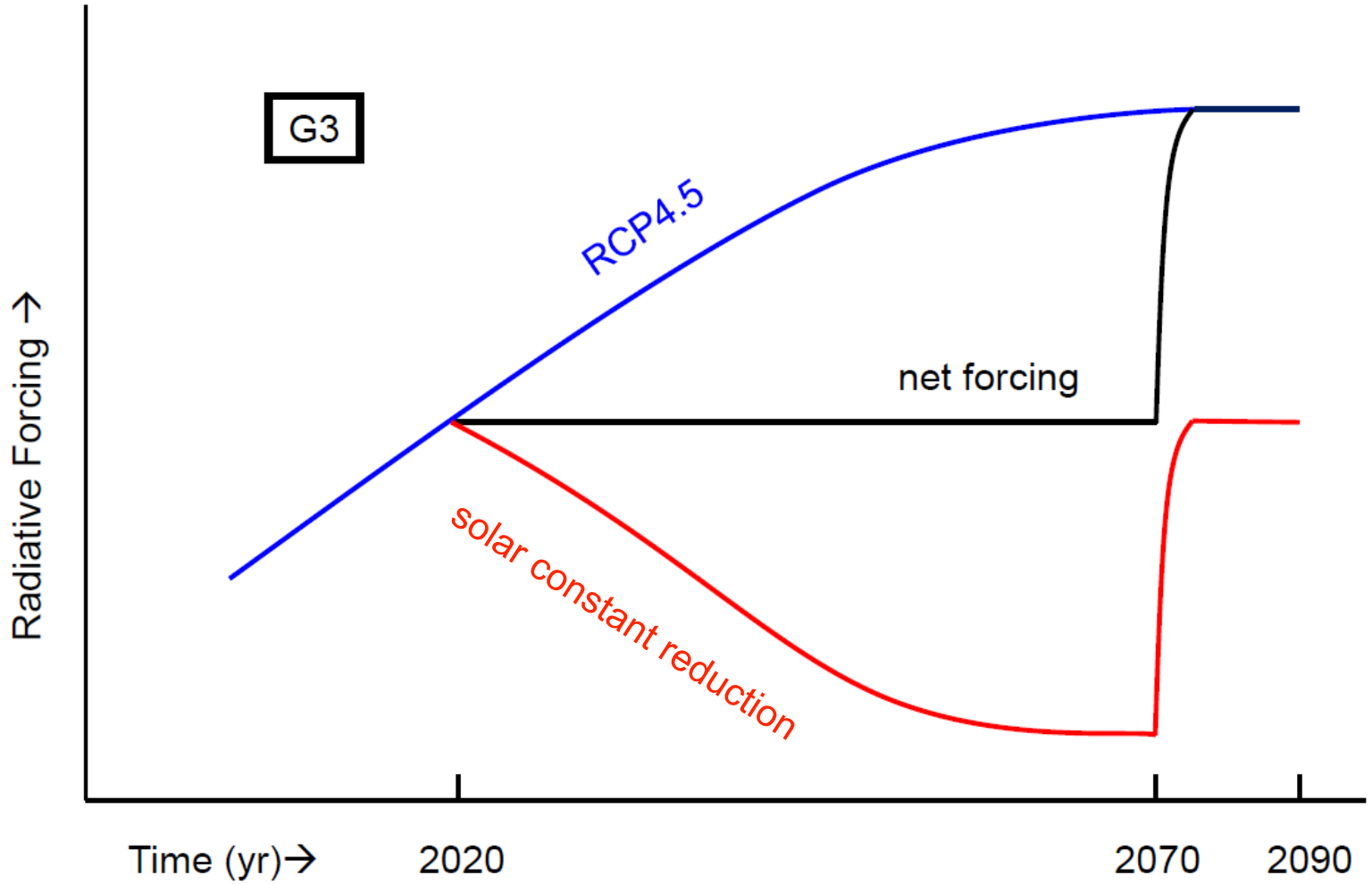
G2: In combination with 1% CO_2 increase per year, gradually reduce the solar constant to balance the changing radiative forcing.



G4: In combination with RCP4.5 forcing, starting in 2020, daily injections of a constant amount of SO_2 at a rate of 5 Tg SO_2 per year at one point on the Equator through the lower stratosphere (approximately 16-25 km in altitude).



G3: In combination with RCP4.5 forcing, starting in 2020, gradual ramp-up the amount of SO_2 or sulfate aerosol injected, with the purpose of keeping global average temperature nearly constant. Injection will be done at one point on the Equator or uniformly globally.



G3solar: Same as G3, but instead of SO_2 injection, use a reduction of the solar constant.

GeoMIP Goals/Services

- A better idea of the “robust” climate impacts of geoengineering
- Highlighting areas for model improvement
- Providing output to other more specialized studies (e.g., crop models)
- Provide a framework for future geoengineering experiments

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MPI-ESM (ECHAM6)	Max Planck Institute for Meteorology	Hauke Schmidt
IPSLCM5A	Laboratoire des Sciences du Climat et de l'Environnement	Michael Schulz, Diana Boukaram
GISS ModelE	NASA GISS/Rutgers	Ben Kravitz
NORESM CESM-CAM5	PNNL	Phil Rasch
CESM-CAM4 (G1, G2, G3 solar)	NCAR	Simone Tilmes
CESM-CAM4 Chem (G3 solar, G3, G4)	NCAR	Simone Tilmes
CESM-WACCM4	NCAR	Michael Mills
MIROC-ESM (?)		
HadGEM2-ES	Hadley Centre	Andy Jones
EMAC (ECHAM5/MESSy)	Max Planck Institute for Chemistry	Mark Lawrence
HadCM3 [perturbed physics ensemble]	University of Bristol	Peter Irvine
UMUKCA (future HadGEM3-ES)?	Cambridge University	Peter Braesicke, Luke Abraham
IAPRASCM	Inst. Atmospheric Phys., Russian Acad. Sci.	Alexander Chernokulsky

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Further Information

http://climate.envsci.rutgers.edu/GeoMIP

GeoMIP mailing list

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