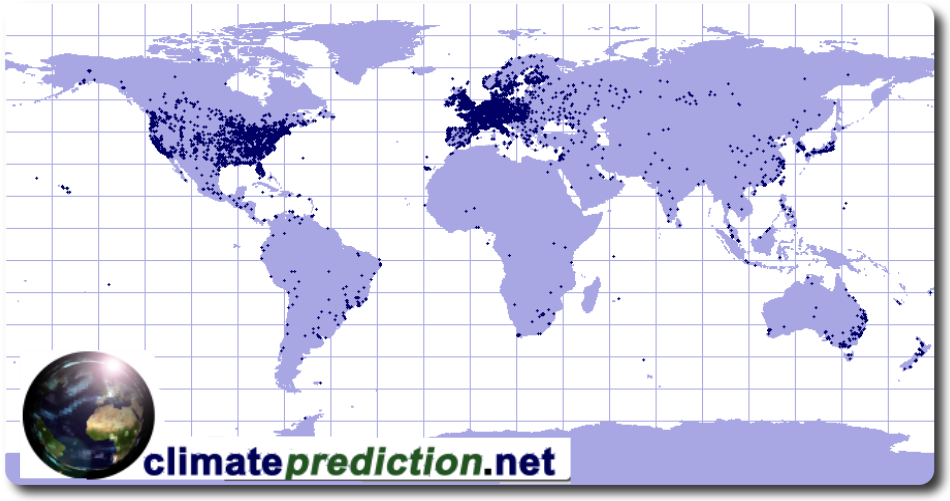
climate*prediction*.net SRM Experiment

We used the climate*prediction*.net (cpdn) version of the Hadley Centre Coupled Model, version 3 (HadCM3) to investigate climate response to SRM forcings



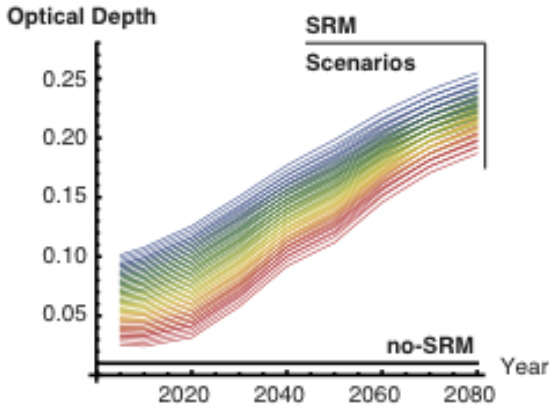
Project is based out of the Department of Physics at Oxford University

Uses volunteer PCs around the world to run large ensembles using the Berkeley Open Infrastructure for Network Computing (BOINC) client, originally developed for running the SETI@home project.

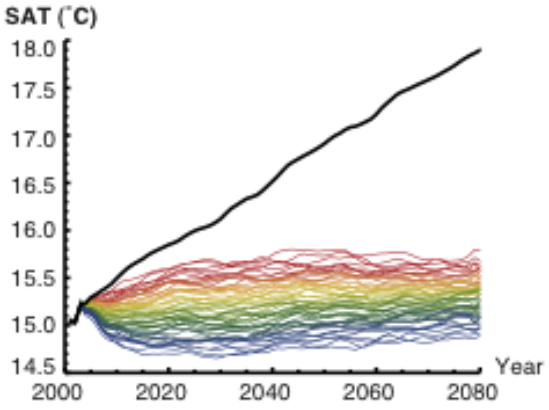
Modeling Solar Radiation Management with climate*prediction*.net/HadCM3L

- 80 year simulations, starting in 2000, SRM starting in 2005
- Used emissions scenario, SRES A1B
  - "rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies "
  - SRM forcings were designed to counter balance A1B GHGs, tropospheric ozone & tropospheric sulphur aerosols
- 10-member initial condition ensembles to improve signal-to-noise
- Simulated SRM using natural volcanic forcing module:
  - set stratospheric aerosol optical depth at 0.55 microns
  - the aerosol mass is distributed proportional to the air mass in top five levels of atmosphere

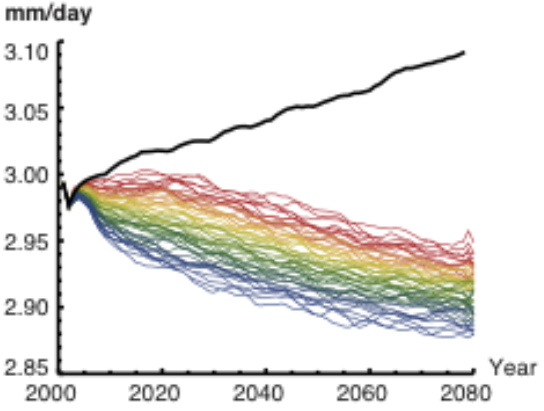
Global Response Overview



SRM SCENARIOS (INPUT)



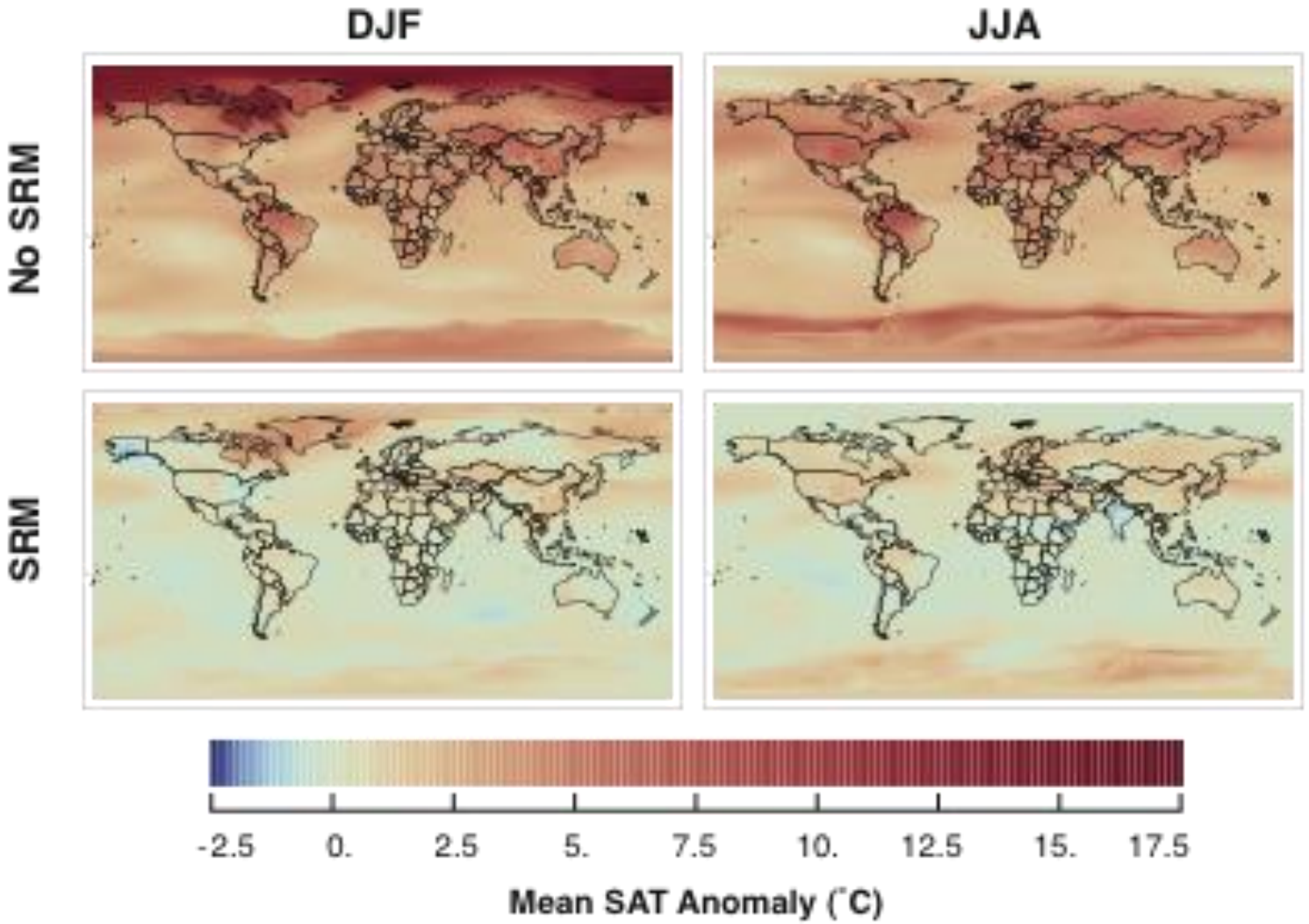
TEMPERATURE RESPONSE



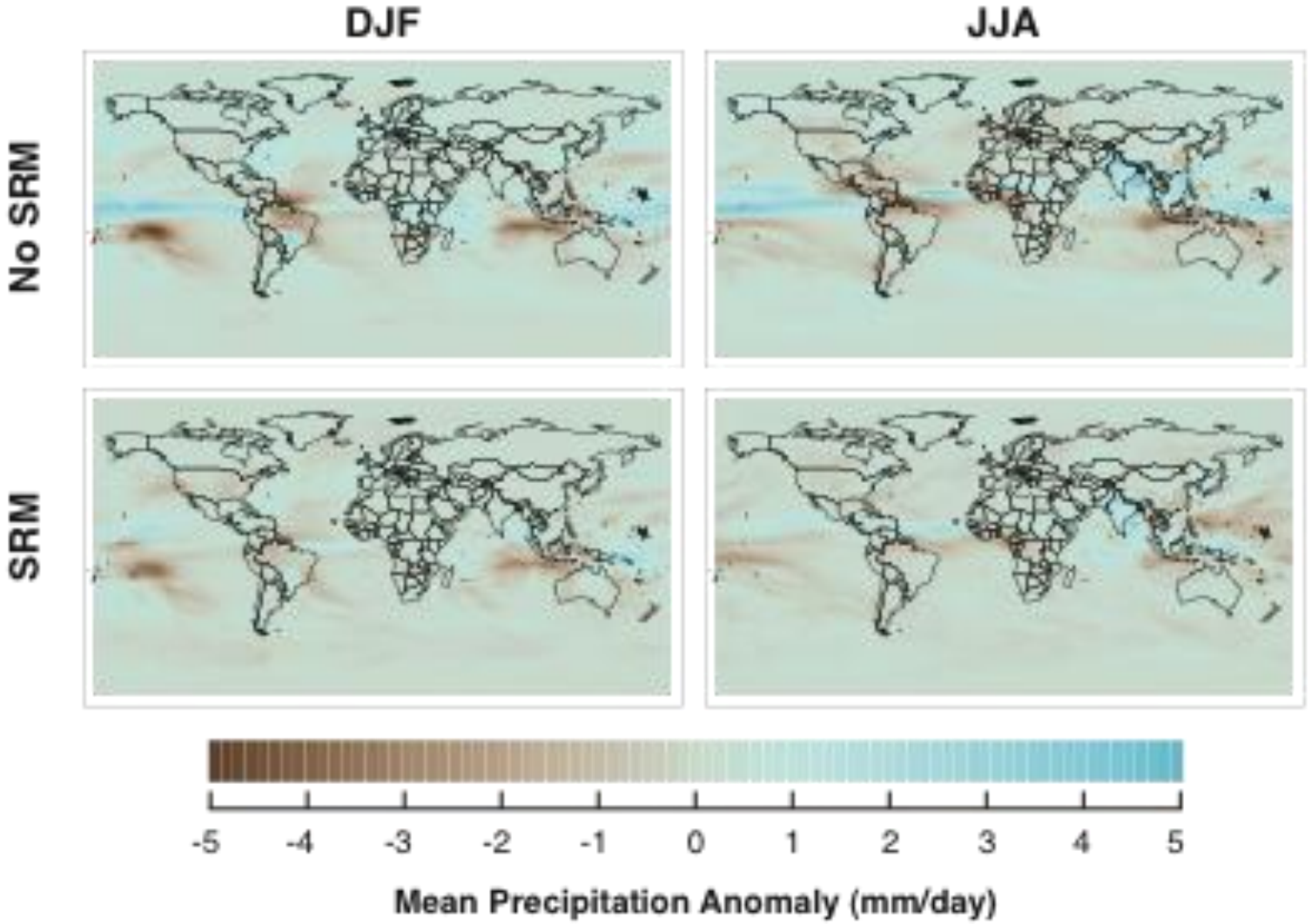
PRECIPITATION RESPONSE

Source: Ricke, K. L., Morgan, M. G. & Allen, M. R. Regional climate response to solar-radiation management. *Nature Geoscience* **3**, 537 - 541 (2010)

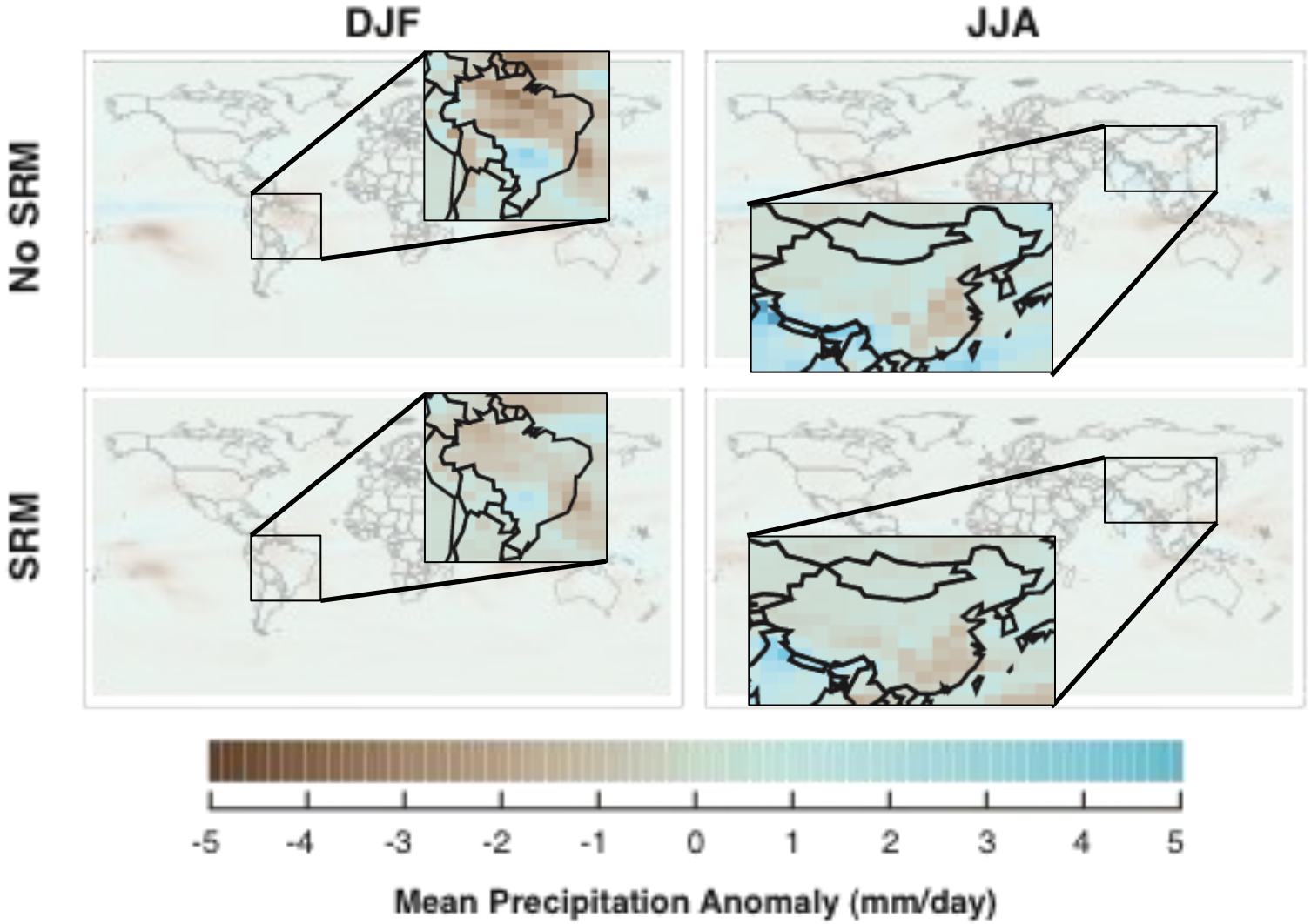
Near-surface Air Temperature Maps (2070s minus 1990s)



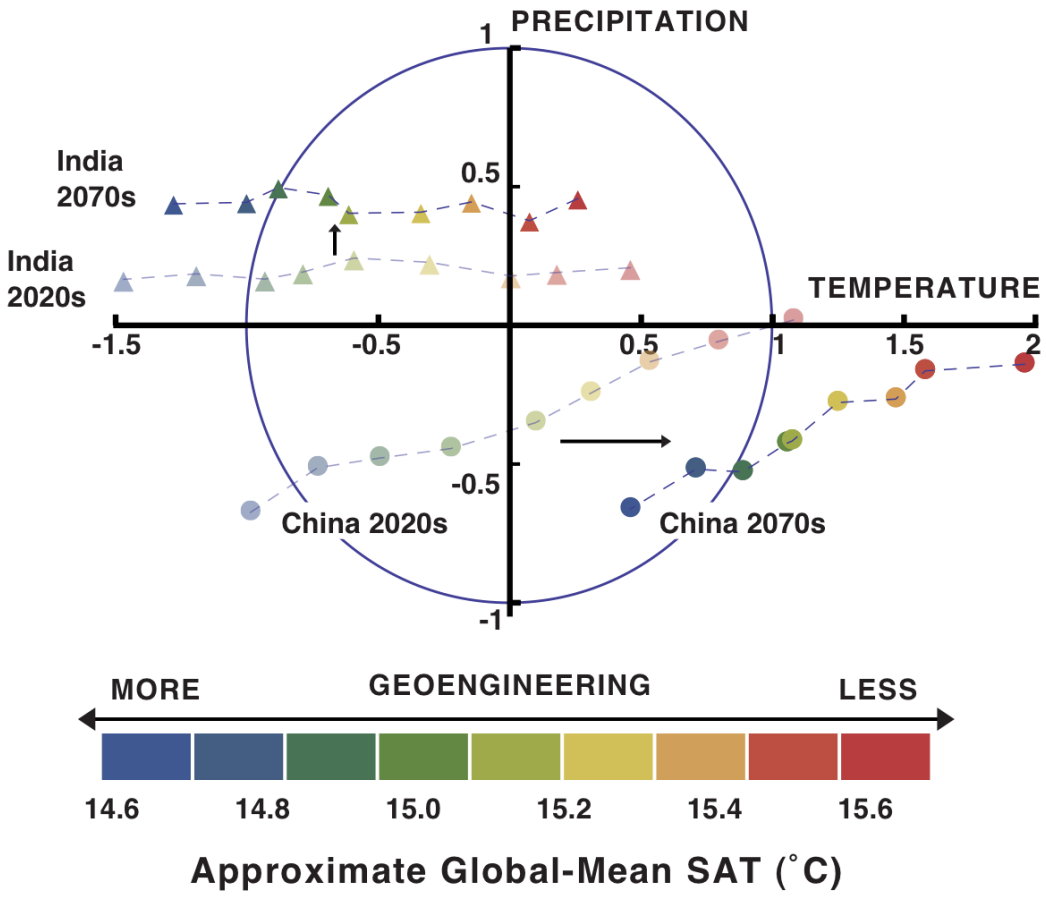
Precipitation Rate Maps (2070s minus 1990s)



Precipitation Rate Maps (2070s minus 1990s)



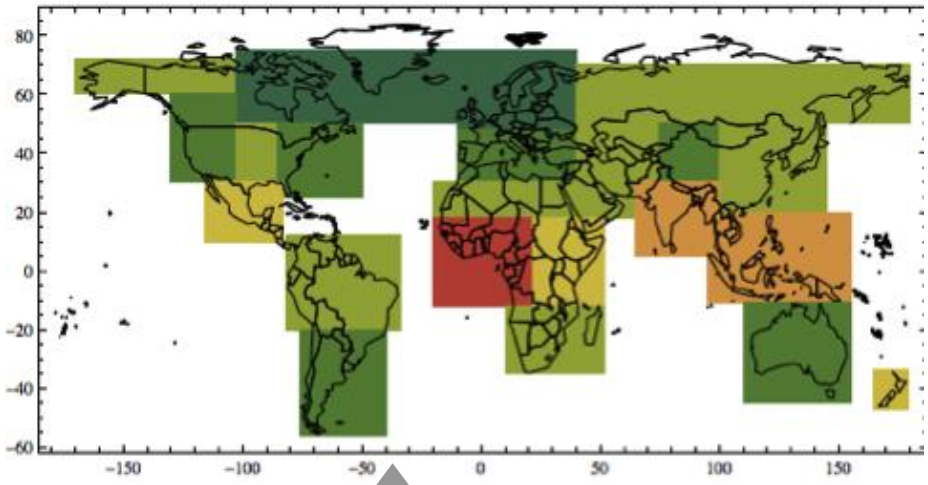
Diverging regional responses



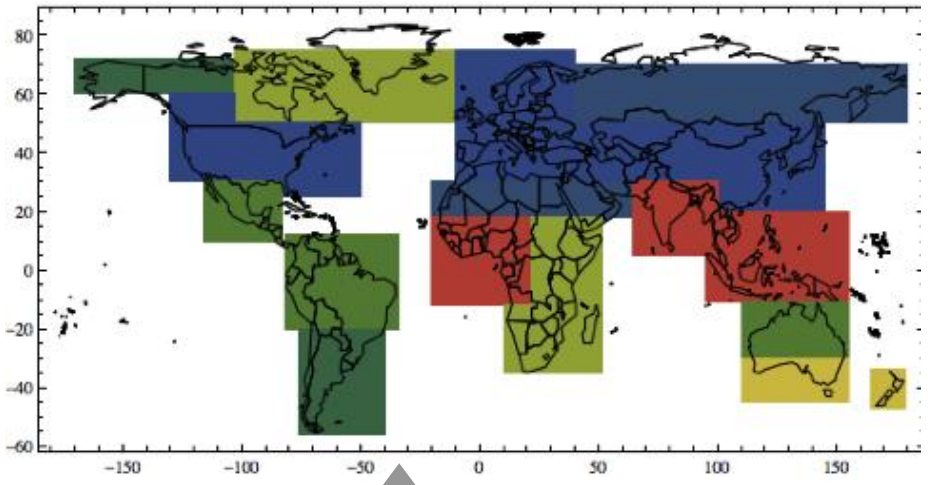
Source: Ricke, K. L., Morgan, M. G. & Allen, M. R. Regional climate response to solar-radiation management. *Nature Geoscience* **3**, 537 - 541 (2010)

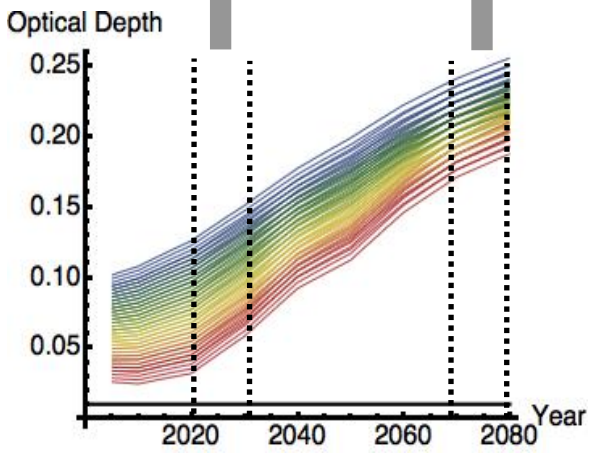
To get closest to baseline rain and precipitation during summer/rainy season…

“Optimum” by region in 2020s



“Optimum” by region in 2070s





More SRM **Less SRM**

14.6 14.8 15.0 15.2 15.4 15.6

Approximate Global-Mean SAT (°C)

Some Conclusions

- SRM generally returns regions closer to their baseline conditions especially as simulations progress
- The most desirable level of SRM varies by region and the variable that is considered, so “optimal” SRM activities imply different things for different regions
- Regional preferences for the amount of SRM diverge, so international negotiations over the amount of SRM could become inherently more difficult the longer such activities are used
- More recent work, just completed using “parametric physics,” finds essentially similar results.

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Relevant Publications:

"A simple model to account for regional inequalities in the effectiveness of solar radiation management" Moreno-Cruz, J.B., Ricke, K.L., Keith, D.W., *Climatic Change.* In press.

"Cooling the Earth Through Solar Radiation Management:The need for research and an approach to its governance" Morgan, M.G., Ricke, K.L. IRGC Opinion Piece.

"Regional climate response to solar-radiation management" Ricke, K.L., Morgan, M.G., Allen, M.R. *Nature Geoscience*. 2010. doi:10.1038/ngeo915

"The Geo-engineering Option" Victor, D., Morgan, M. G., Apt, J., Steinbruner, J., Ricke, K. *Foreign Affairs*. March/April 2009.

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