



Solar Radiation Management
Governance Initiative

SRM geoengineering

Gobeshona conference

10 January 2019

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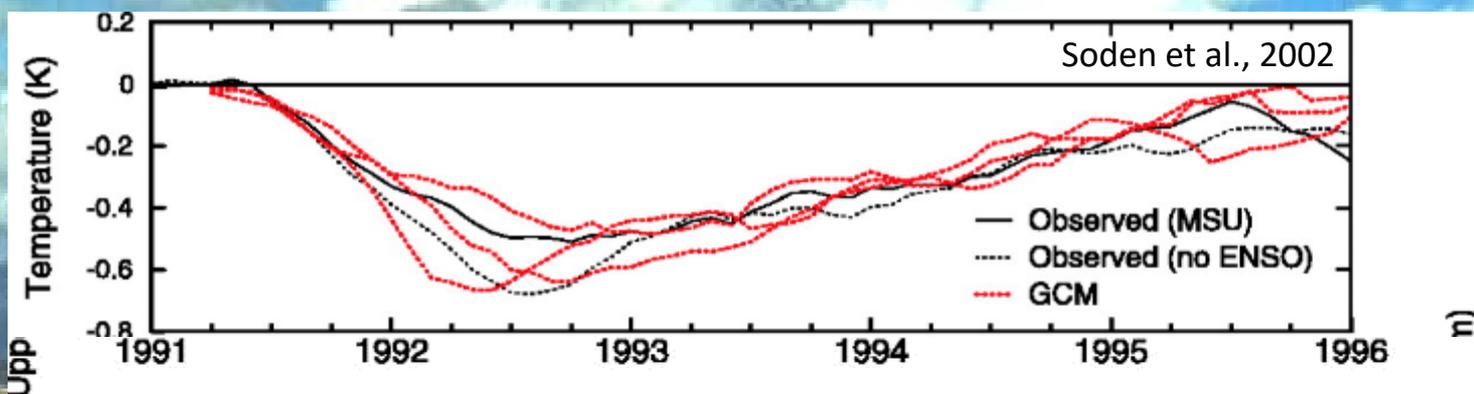




Quiz time!

What do the following have in common?

- SRM geoengineering researchers
- Malaria epidemiologists
- Donald Trump's hairdresser
- Unemployment counsellors
- WWI historians
- Volcanologists



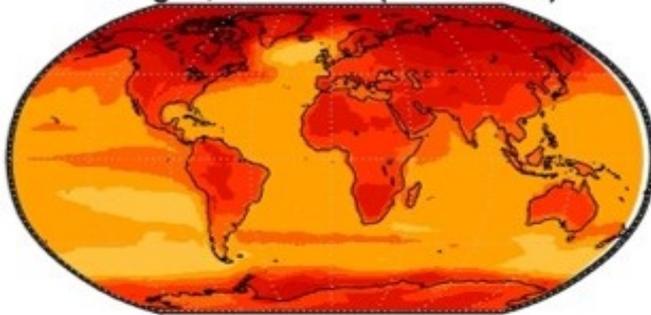


Five main messages

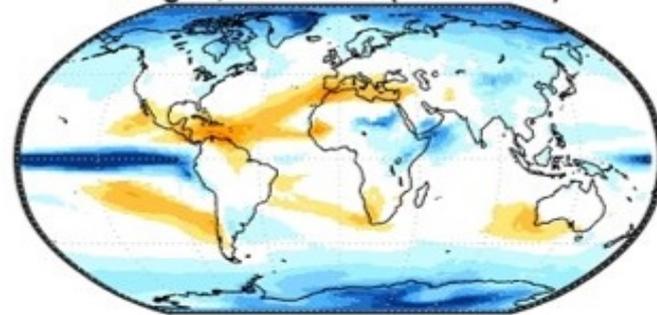
1. The world needs to be aggressive and optimistic with mitigation – **SRM is not an alternative**
2. But it is the only known way to quickly stop temperatures rising
3. Modelling consistently suggests that moderate use of SRM would significantly reduce climate risks, but the benefits would not be universal
4. The world doesn't behave exactly as models say it will, and there are many large uncertainties
5. Social and political dimensions could prove much tougher than the physical: potential for moral hazard or conflict

Temperature and precipitation

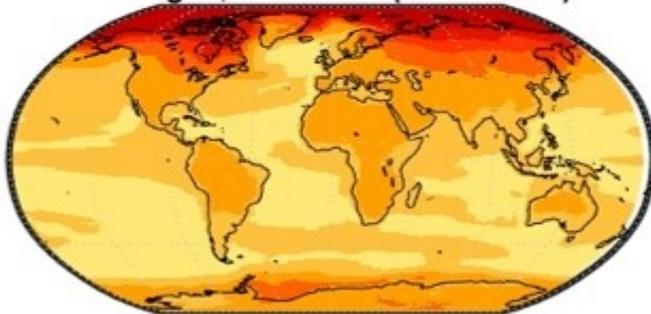
No geo, 2091-2110 ($\Delta T = 2.7^\circ\text{C}$)



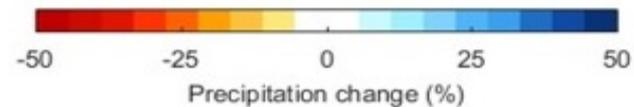
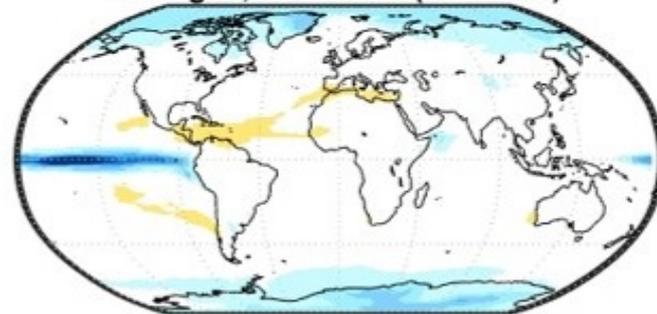
No geo, 2091-2110 ($\Delta P = 5.1\%$)



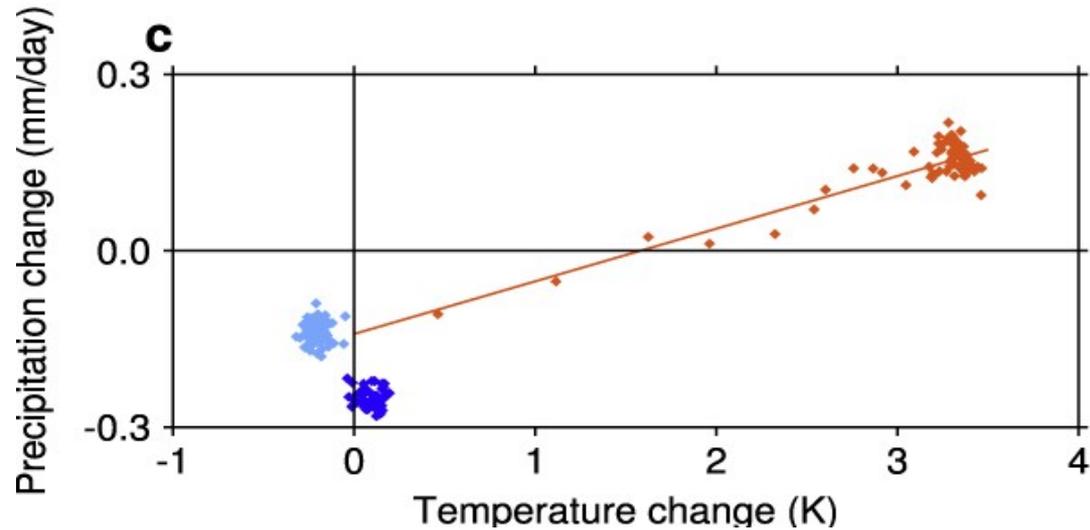
With geo, 2091-2110 ($\Delta T = 1.5^\circ\text{C}$)



With geo, 2091-2110 ($\Delta P = 2\%$)



Effects on hydrology



Ferraro et al, 2013

1. Not possible to entirely cancel both temperature & precipitation changes, but both can be significantly improved simultaneously
2. Therefore effects on global average precipitation are a choice



Sea level rise

**Projected that SRM
could significantly slow
(but not stop) rising sea
levels**



Efficacy of geoengineering to limit 21st century sea-level rise

J. C. Moore^{a,b,c,1}, S. Jevrejeva^d, and A. Grinsted^e

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Edited by Robert E. Dickinson, University of Texas, Austin, TX, and approved July 15, 2010 (received for review June 12, 2010)

Geoengineering has been proposed as a feasible way of mitigating anthropogenic climate change, especially increasing global temperatures in the 21st century. The two main geoengineering

and financially reasonable—in so far as any geoengineering project may be thought of as feasible. Here we present simulations of 21st century global sea level resulting from both geoengineered reduction in solar insolation and modification of the atmospheric



Extremes of heat and precipitation



Effective at reducing temperatures in general and therefore extreme heat events

 **AGU** PUBLICATIONS

JGR

Journal of Geophysical Research: Atmospheres

RESEARCH ARTICLE

10.1002/2013JD020648

Special Section:

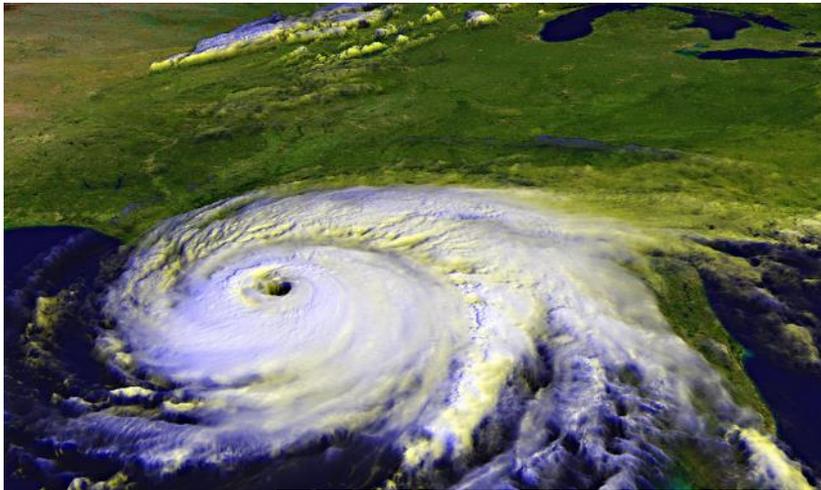
The Geoengineering Model
Intercomparison Project
(GeoMIP)

**A multimodel examination of climate extremes in an idealized
geoengineering experiment**

Charles L. Curry¹, Jana Sillmann^{1,2}, David Bronaugh³, Kari Alterskjaer², Jason N. S. Cole⁴,
Duoying Ji⁵, Ben Kravitz⁶, Jón Egill Kristjánsson², John C. Moore⁵, Helene Muri²,
Ulrike Niemeier⁷, Alan Robock⁸, Simone Tilmes⁹, and Shuting Yang¹⁰



Storm intensity



Complicated to model, but studies indicate that SRM use could ameliorate cyclones due to reduction in SST

Atlantic hurricane surge response to geoengineering

John C. Moore^{a,b,1}, Aslak Grinsted^{a,c}, Xiaoran Guo^a, Xiaoyong Yu^a, Svetlana Jevrejeva^{a,d}, Annette Rinke^{a,e}, Xuefeng Cui^a, Ben Kravitz^f, Andrew Lenton^g, Shingo Watanabe^h, and Duoying Ji^{a,1}

^aJoint Center for Global Change Studies, College of Global Change and Earth System Science, Beijing Normal University, Beijing 100875, China; ^bArctic Centre, University of Lapland, Rovaniemi 96101, Finland; ^cCentre for Ice and Climate, Niels Bohr Institute, University of Copenhagen, 2100 Copenhagen Ø, Denmark; ^dNational Oceanography Centre, Liverpool L3 5DA, United Kingdom; ^eAlfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Potsdam 14473, Germany; ^fAtmospheric Sciences and Global Change Division, Pacific Northwest National Laboratory, Richland, WA 99352; ^gCommonwealth Scientific and Industrial Research Organisation, Oceans and Atmosphere Flagship, Hobart, Tasmania, TAS 7004, Australia; and ^hJapan Agency for Marine-Earth Science and Technology, Yokohama 237-0061, Japan

Edited by Kerry A. Emanuel, Massachusetts Institute of Technology, Cambridge, MA, and approved September 29, 2015 (received for review June 12, 2015)



Effects on plant life and agriculture

Many factors,
many variables,
much more
research necessary

nature
climate change

LETTERS

PUBLISHED ONLINE: 22 JANUARY 2012 | DOI: 10.1038/NCLIMATE1373

Crop yields in a geoengineered climate

J. Pongratz^{1*}, D. B. Lobell², L. Cao¹ and K. Caldeira¹

 **AGU** PUBLICATIONS

JGR

Journal of Geophysical Research: Atmospheres

RESEARCH ARTICLE

10.1002/2013JD020630

Special Section:

The Geoengineering Model
Intercomparison Project
(GeoMIP)

Solar radiation management impacts on agriculture in China: A case study in the Geoengineering Model Intercomparison Project (GeoMIP)

Lili Xia¹, Alan Robock¹, Jason Cole², Charles L. Curry³, Duoying Ji⁴, Andy Jones⁵, Ben Kravitz⁶,
John C. Moore⁴, Helene Muri⁷, Ulrike Niemeier⁸, Balwinder Singh⁶, Simone Tilmes⁹,
Shingo Watanabe¹⁰, and Jin-Ho Yoon⁶



Health effects

Complicated picture with many potential factors

- Increase in tropospheric ozone
- Reduction in heat waves
- Increase in UV radiation
- Decrease in climate-caused disease movement
- Increase in tropospheric SO₂
- Changing patterns of infectious disease outbreaks



Biodiversity effects

Complicated picture with many potential factors

- Reduced temperatures stress / induced migration
- Increase in tropospheric ozone
- Less coral bleaching due to ocean temps
- Decreased direct radiation
- Increased diffuse radiation
- Deposition of aerosols
- Less disruption to hydrological cycles

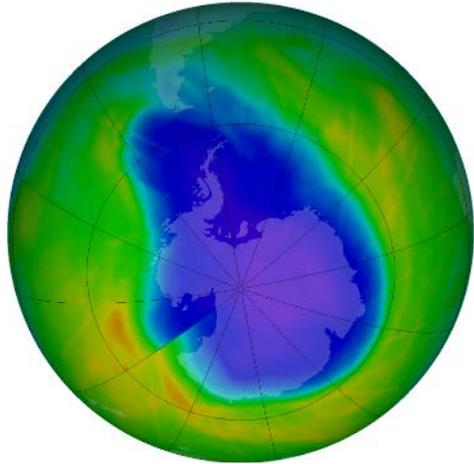


Modelled effects: summary

“Models consistently suggest that SRM would generally reduce climate differences compared to a world with elevated GHG concentrations and no SRM; however, there would also be residual regional differences in climate (e.g., temperature and rainfall) when compared to a climate without elevated GHGs.”
IPCC AR5, Working Group I, Chapter 7



Side effects?



Effects on the
ozone layer?

Acid rain?

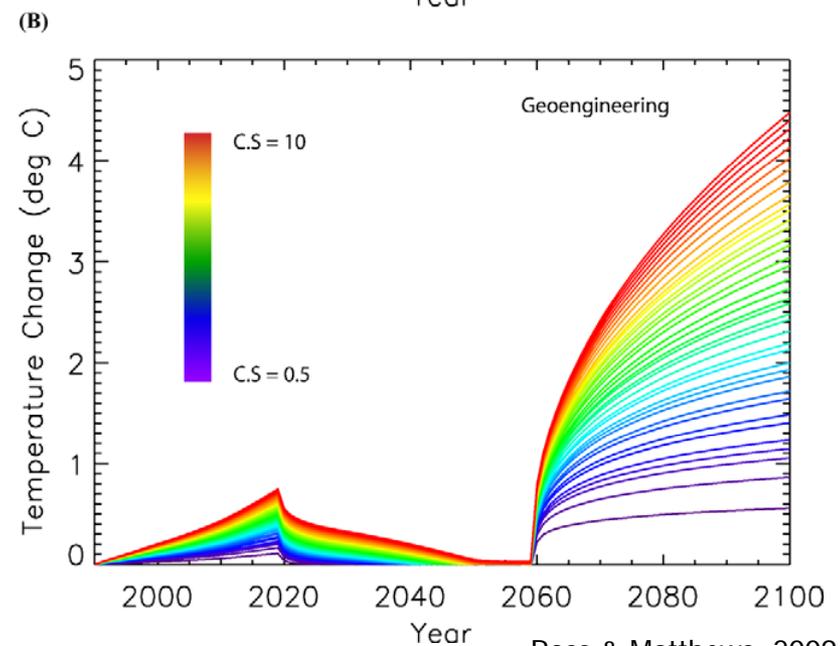
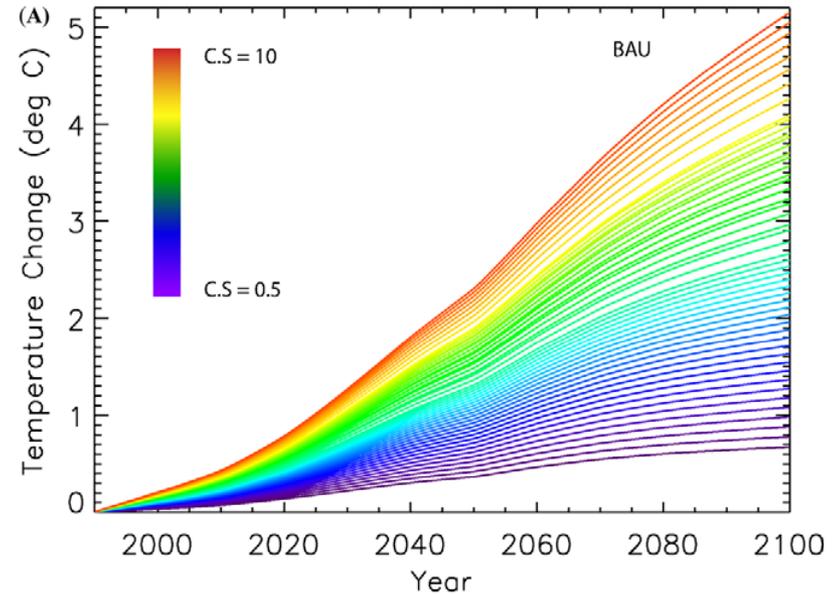


Unknown
unknowns?



Termination shock

- Termination of (lots of) SRM would lead to a rapid warming
- The rate of warming would be much greater than without SRM
- More rapid warming means less time for adaptation, which means more damaging impacts on ecosystems





Socio-political concerns



Moral hazard
response

Research creates a
slippery slope
towards use of SRM?





Politics





Solar Radiation Management
Governance Initiative

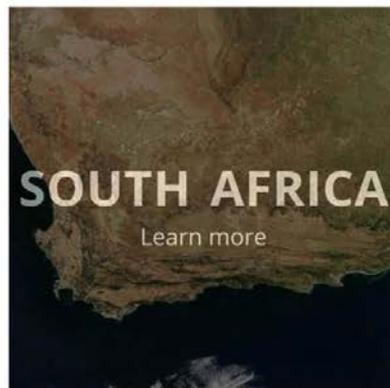
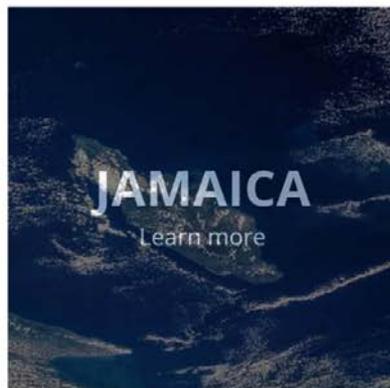
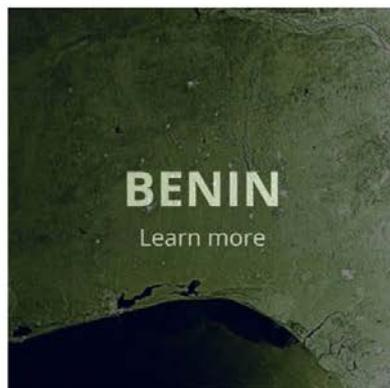
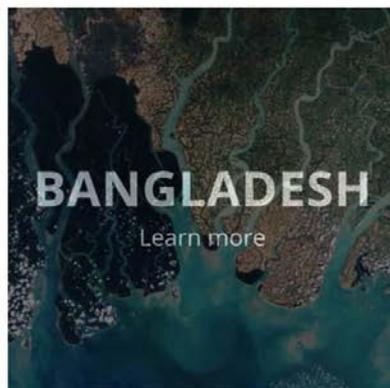
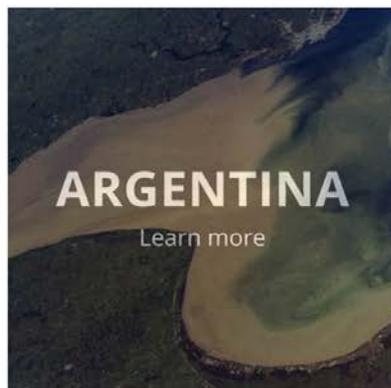
The SRM Governance Initiative

Building developing country capacity to participate
in SRM discussion and research



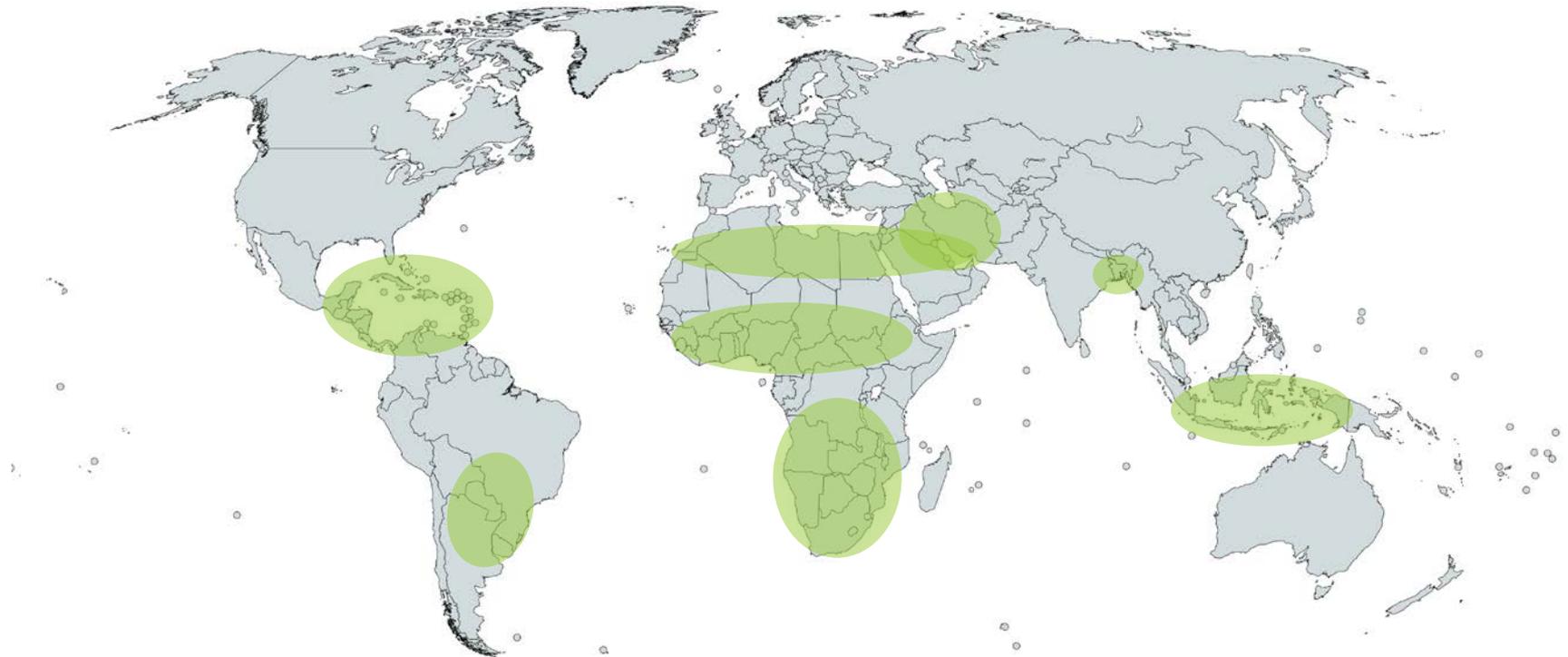


DECIMALS Fund grants: 2018





DECIMALS research coverage





A group of villagers stands beside the Jamuna River in Bangladesh, where erosion is eating into the riverbanks.

Developing countries must lead on solar geoengineering research

The nations that are most vulnerable to climate change must drive discussions of modelling, ethics and governance, argue **A. Atiq Rahman** and colleagues.



Conclusion from Nature Comment

“Solar geoengineering is fraught with risks and can never be an alternative to mitigation. But it’s unclear whether the risks of solar geoengineering are greater than the risks of breaking the 1.5C warming target. As things stand, politicians will face this dismal dilemma within a couple of decades. It is right, politically and morally, for the global south to have a central role in solar-geoengineering research, discussion and evaluation.”