Mercury Co-Benefits of Climate Policy in China

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The Paris Agreement on climate change and the Minamata Convention on Mercury are in the early stages of implementation.

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

UNEP
MINAMATA CONVENTION ON MERCURY

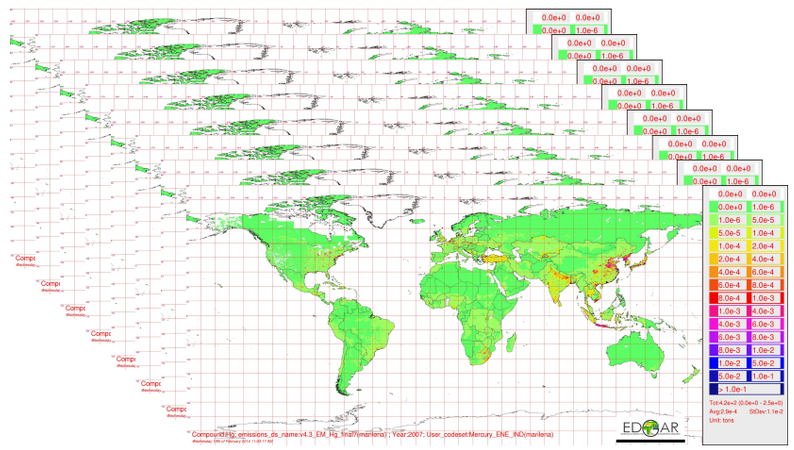
Research Question

How do mercury emissions and deposition co-benefits of climate policy in China compare to emissions reductions achieved by end-of-pipe controls designed to meet the requirements of the Minamata Convention?

Methods - Chemical Transport Modeling

2030 Policy Scenarios
BAU
Minamata Convention
3% Carbon Intensity Reduction
4% Carbon Intensity Reduction
5% Carbon Intensity Reduction

HEMCO



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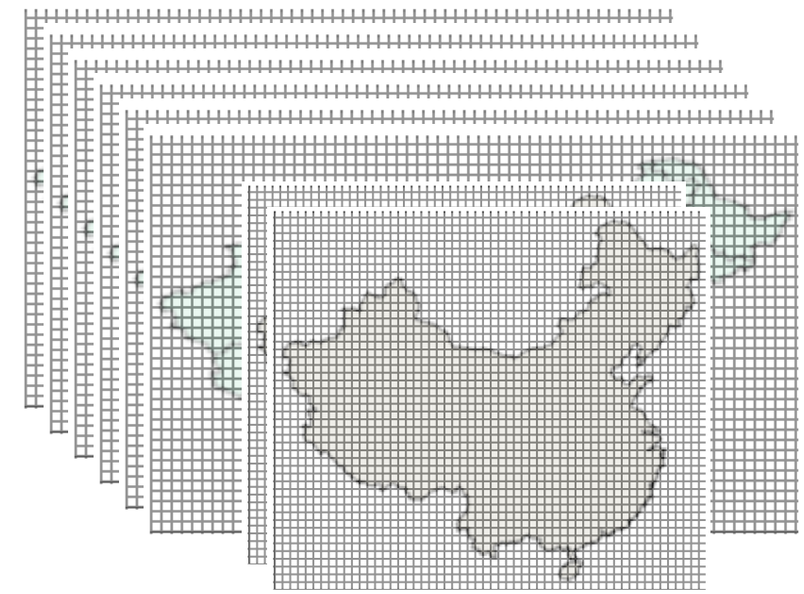
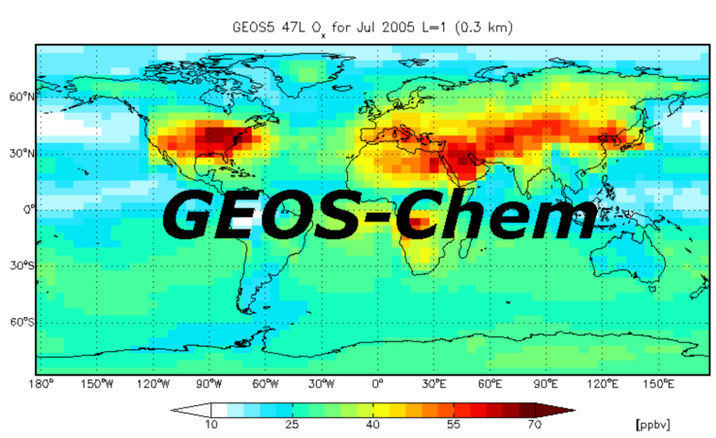


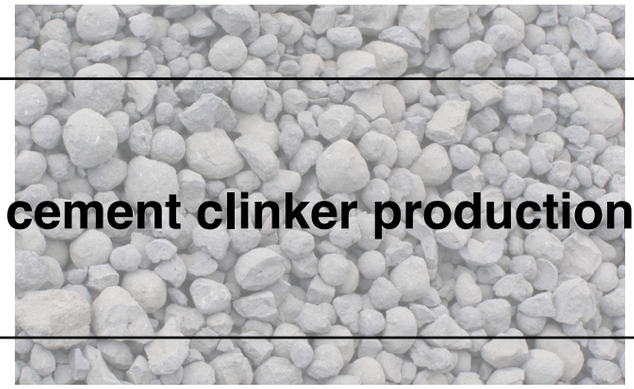


v11-01
Present-Day Meteorology (GEOS-5)
3-year spinup (2004-2006)
4x5 Degree Grid*
Deposition results averaged over 3 years (2007-2009)
Hg(0) oxidation to Hg(II) by Br
Hg(II) reduction in clouds
Unit Tester natural emissions, soil distribution, biomass burning (GFED4), ocean slab model
*future work = 2x2.5 and possibly nested grid

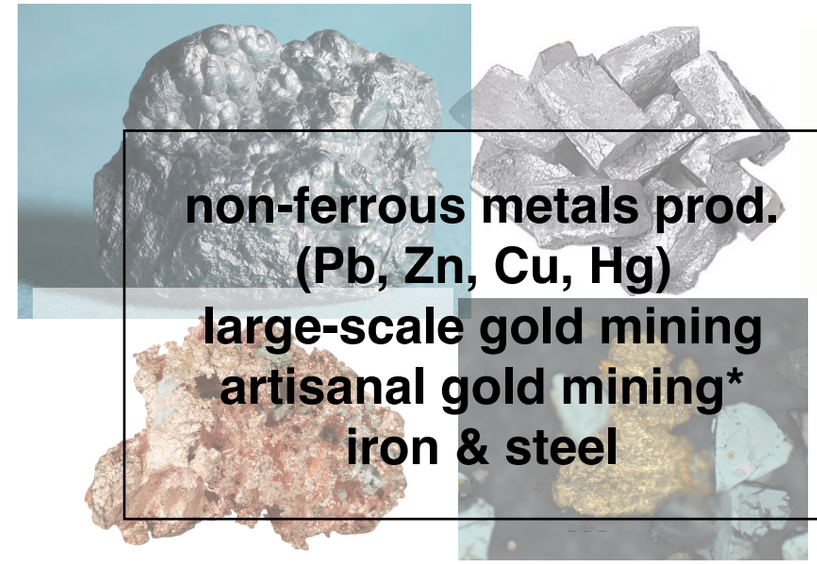
Methods - Emission Projections

EDGAR Sectors

coal-fired power plants
&
coal-fired industrial boilers
residential combustion
&
coal transformation ind.

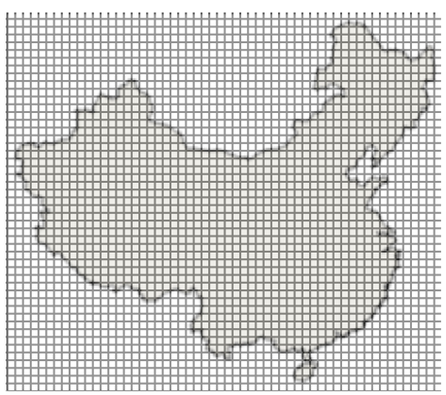


cement clinker production

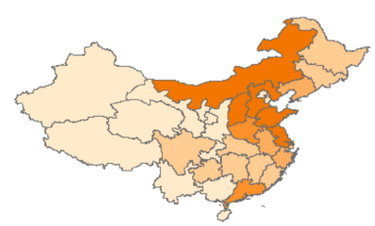


non-ferrous metals prod.
(Pb, Zn, Cu, Hg)
large-scale gold mining
artisanal gold mining*
iron & steel

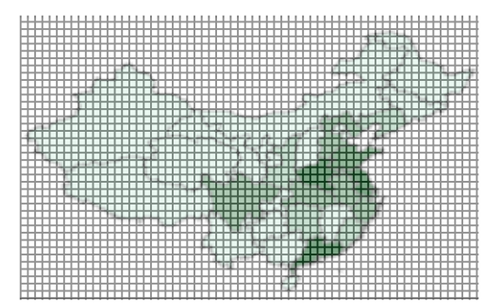
waste incineration



EDGAR v4.tox1
Muntean et al. 2014 [1]
2007 HEMCO Base Emissions
Hg(0), Hg(II), HgP



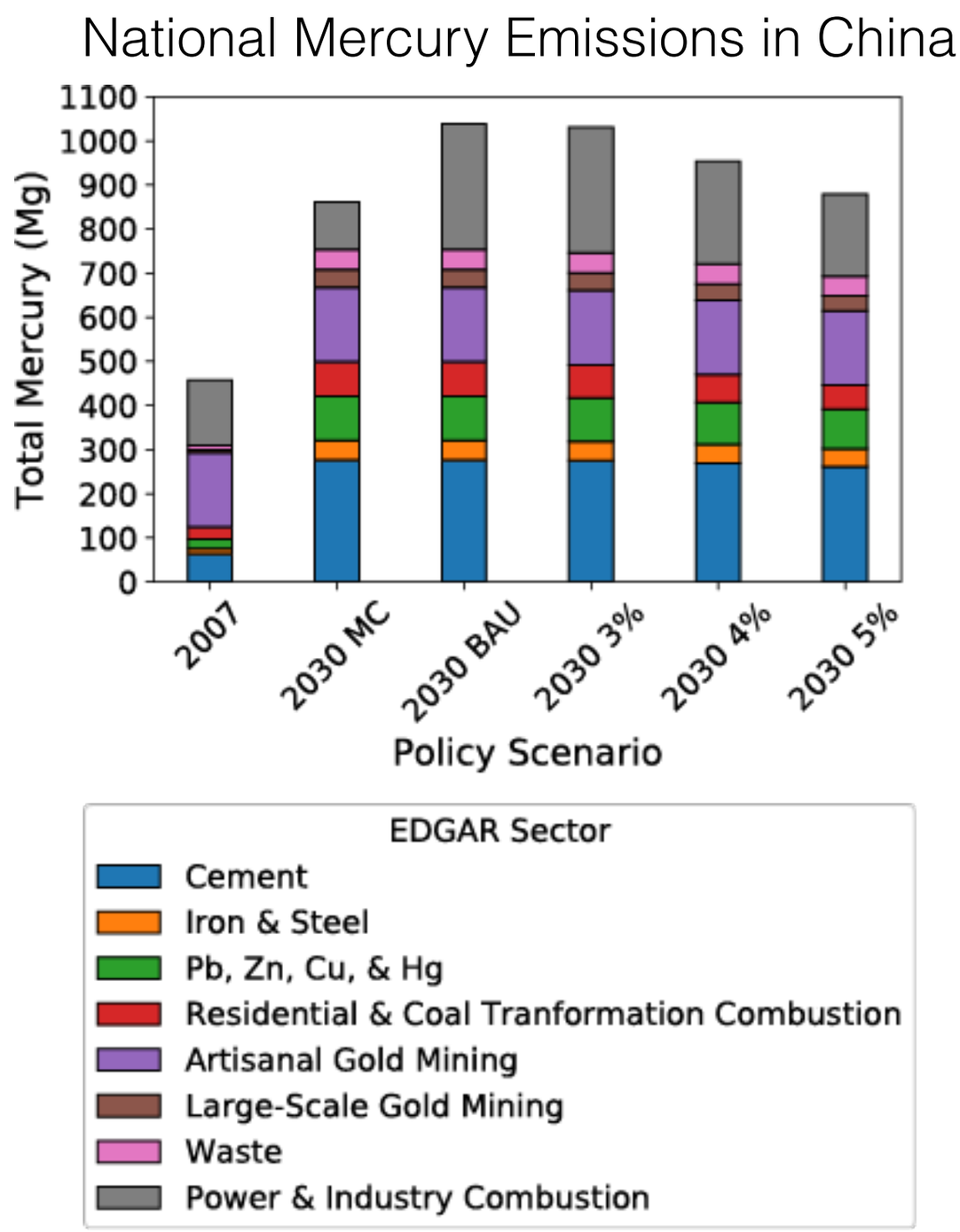
TSINGHUA - MIT
CHINA ENERGY & CLIMATE PROJECT
China Regional
Energy Model
(C-REM)
Li et al. 2017 [2]
2030
2007



HEMCO
2030 Scaling Factor Masks**

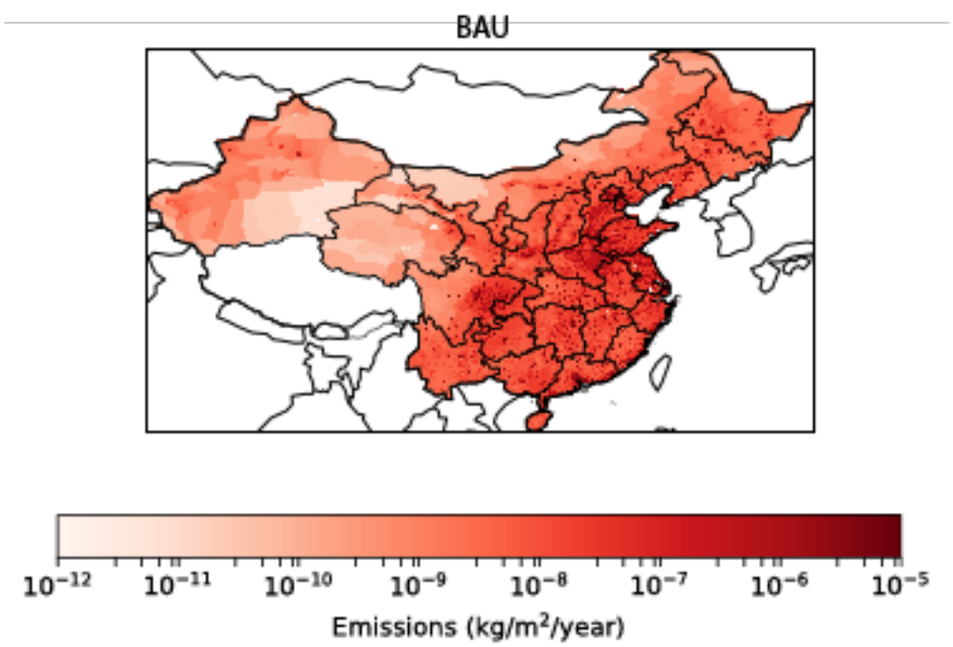
*Additional factors applied to CFPP and CFIB emissions to represent air pollution control device technology from Zhang et al. 2016 [3]
** Artisanal gold mining emissions are not scaled to 2030

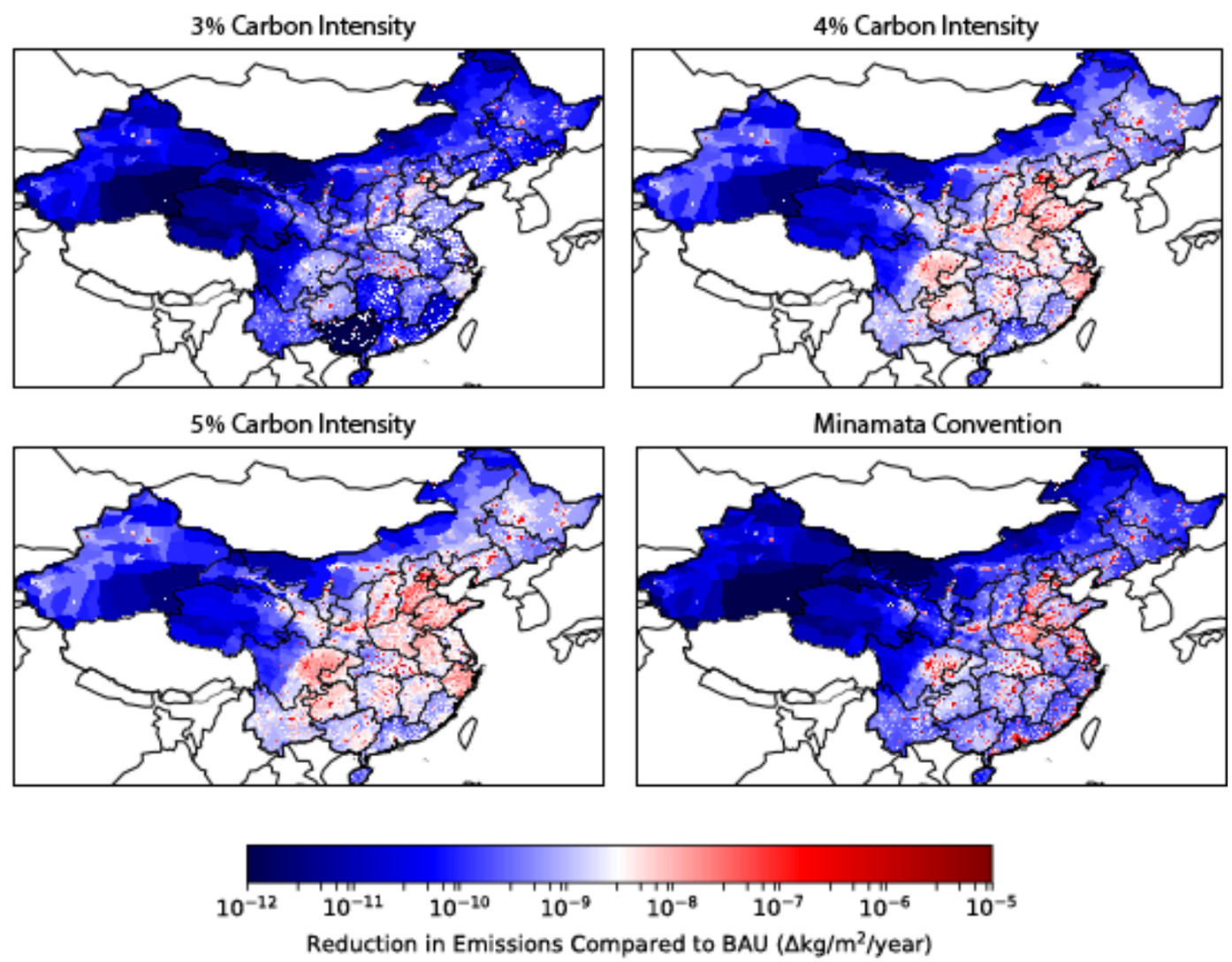
Results - Emissions



Results - Emissions

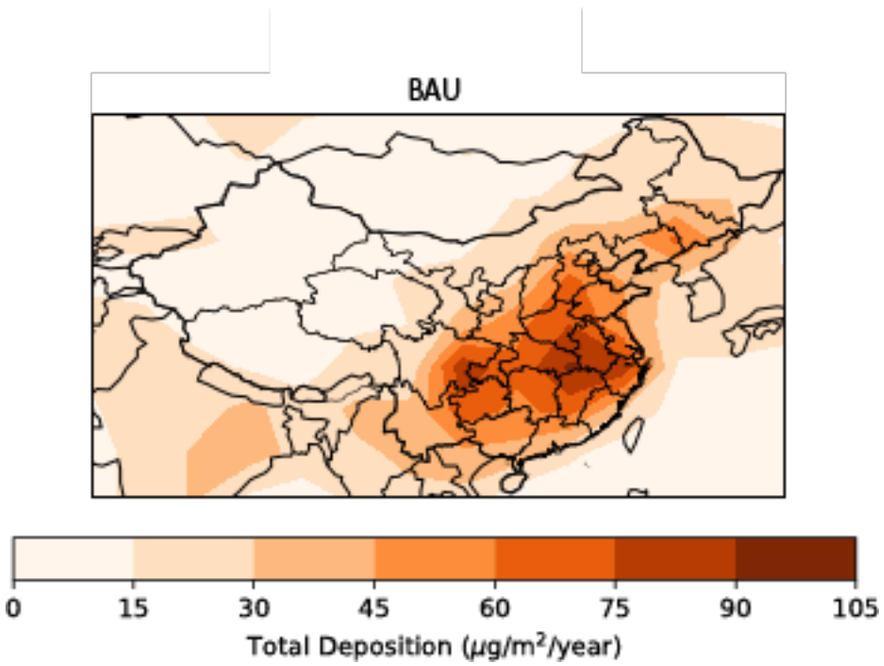
Reduction in Total Emissions for 2030 Policy Cases Compared to BAU

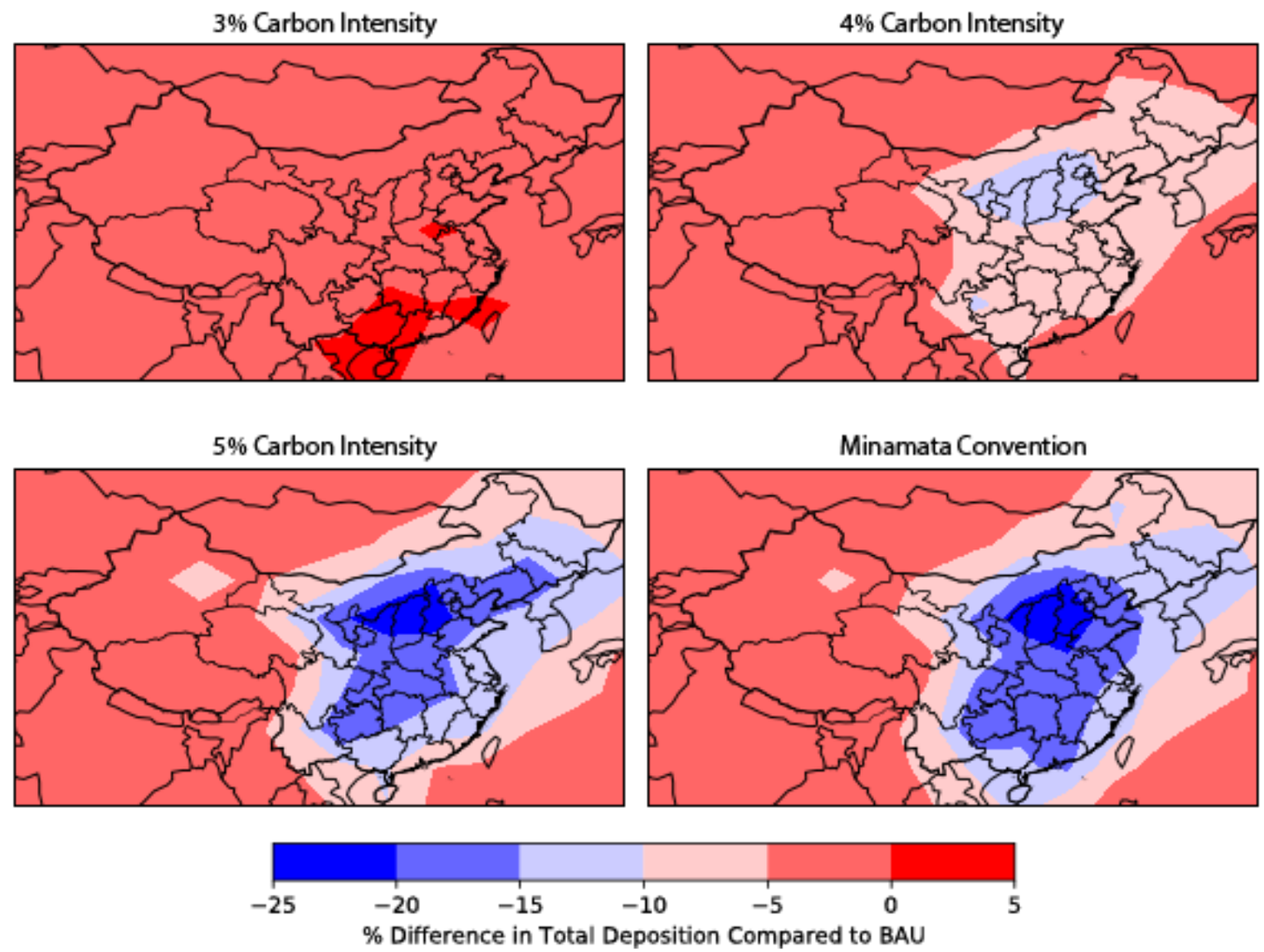




Results - Total Deposition

2030 BAU Total Deposition (Wet Hg(II), HgP + Dry Hg(0), Hg(II), HgP)
2030 Policy Cases, Percent Difference in Total Deposition Compared to BAU





Conclusions

At the national level in China, climate policy can provide substantial reductions in total mercury emissions and deposition comparable to end-of-pipe control policies adherent to the Minamata Convention. Benefits increase with more stringent climate policy.

Reductions in total mercury emissions occur mostly in the combustion in power generation and industry sector (with the exception of the 3% carbon intensity reduction climate policy scenario).

The climate policy emissions reductions translate to substantial reductions in total mercury deposition in China in 2030, comparable to the Minamata Convention case. The 5% carbon intensity reduction climate policy scenario exhibits similar deposition reduction magnitude and spatial pattern compared to the Minamata Convention case.

The highest levels of mercury deposition reductions are slightly north of the areas with highest total deposition and emissions.

References

[1] Muntean, M. et al. (2014). "Trend analysis from 1970 to 2008 and model evaluation of EDGARv4 global gridded anthropogenic mercury emissions." *Science of the Total Environment*. 494-495, pg. 337-350.

[2] Li, M. et al. (2017). "Air quality co-benefits of climate policy in China." *Submitted to Nature Climate Change.*

[3] Zhang, L. et al. (2016). "Potential of co-benefit mercury control for coal-fired power plants and industrial boilers in China." Natural Resources Defense Council Report. https://www.nrdc.org/sites/default/files/co-benefit-mercury-control-report.pdf.