GLIMPSE

Simultaneously achieving climate change mitigation, ecosystem protection, and air quality goals

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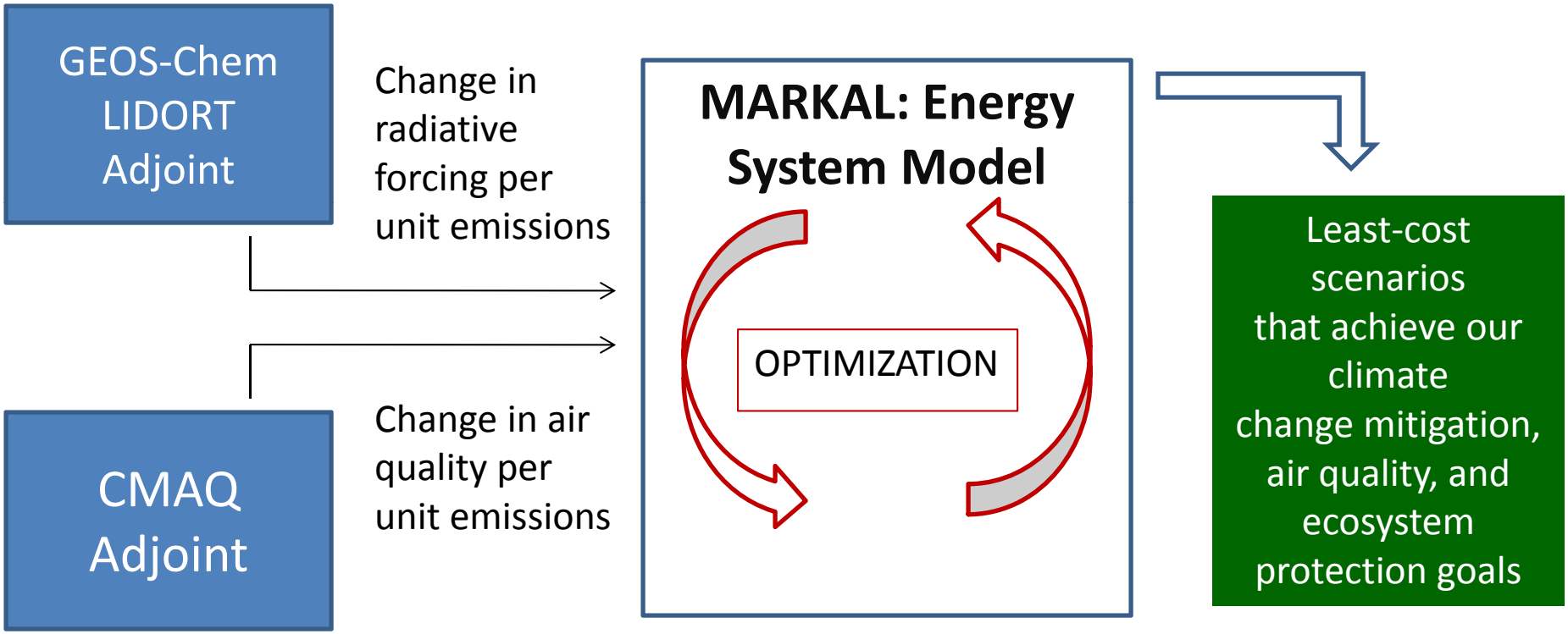
Challenge:

Energy and the environment are interconnected:

- Common pollution sources
- Co-emitted pollutants
- Competing technologies

Design

Connect energy system and atmosphere



Three metrics

Air quality and human health

Short-lived climate forcers

Long-term climate change

How it works

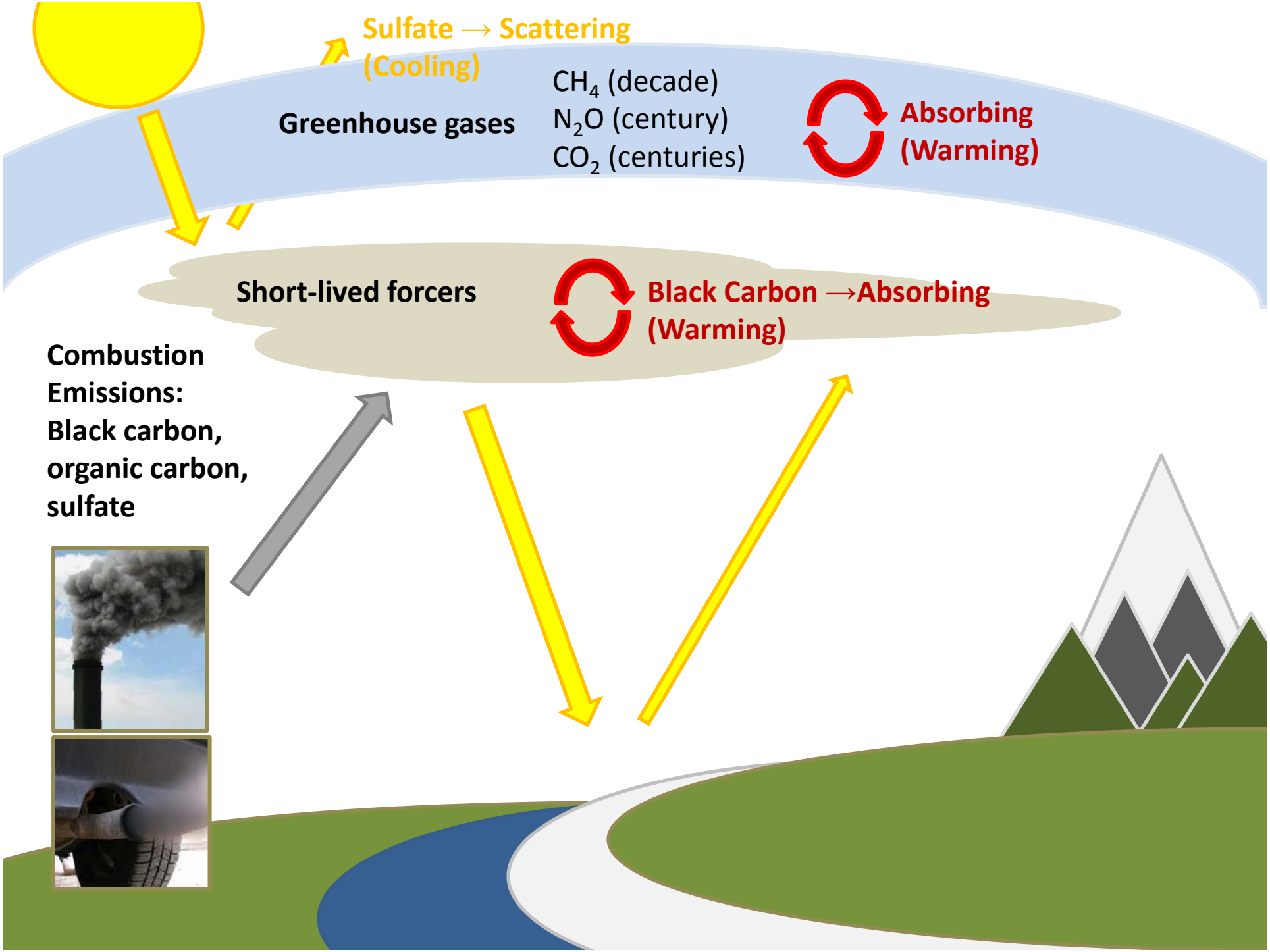
Near-term Radiative Forcing

Sulfate

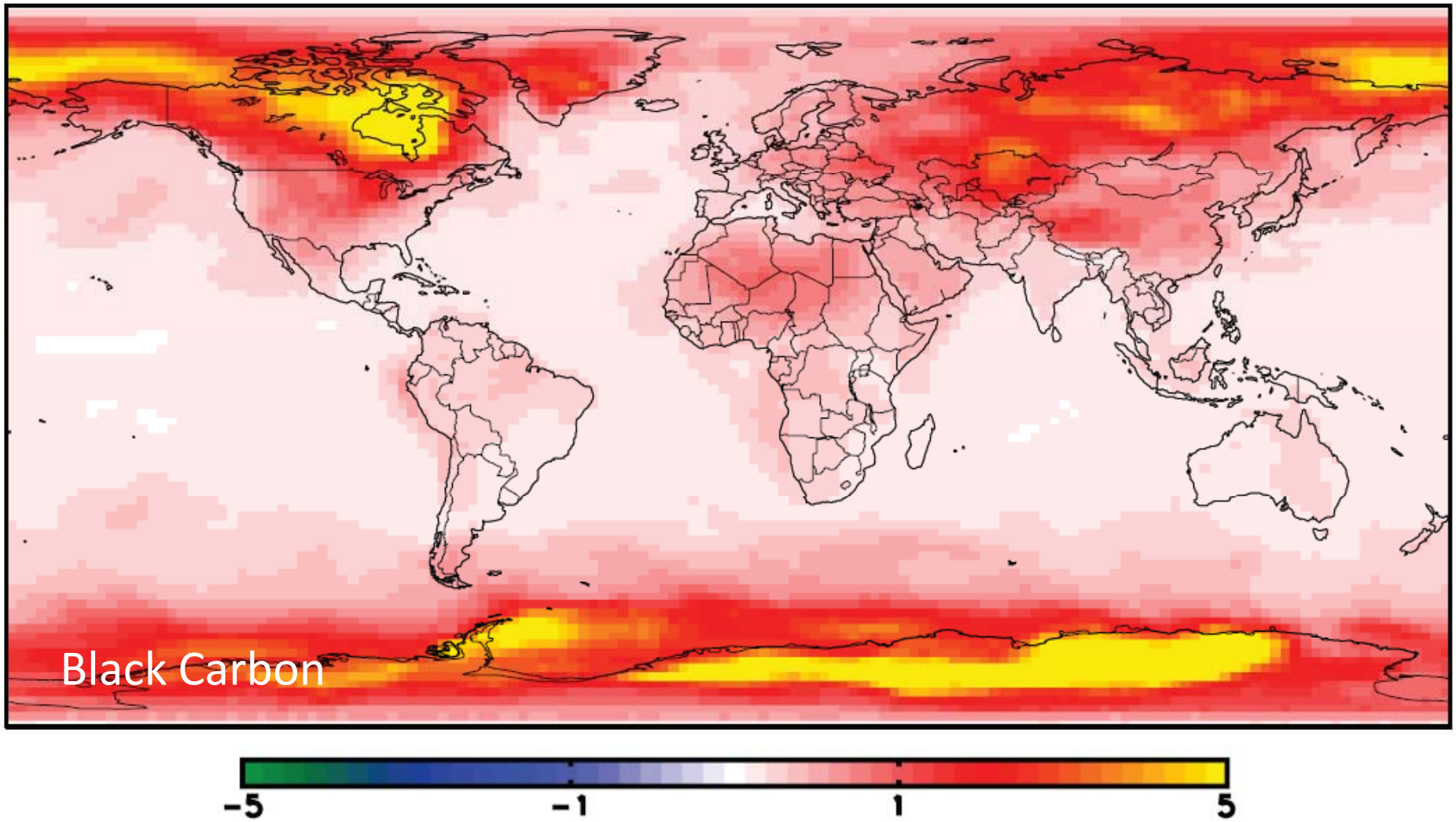
Light in color
Contributes to cooling
Primarily from coal-fired power plants

Black carbon

Dark in color
Contributes to warming
Primarily from diesel


Sulfate → Scattering
(Cooling)
Greenhouse gases
CH_4 (decade)
N_2O (century)
CO_2 (centuries)
Absorbing
(Warming)
Short-lived forcers
Black Carbon →Absorbing
(Warming)
Combustion
Emissions:
Black carbon,
organic carbon,
sulfate

Direct Radiative Forcing Efficiencies

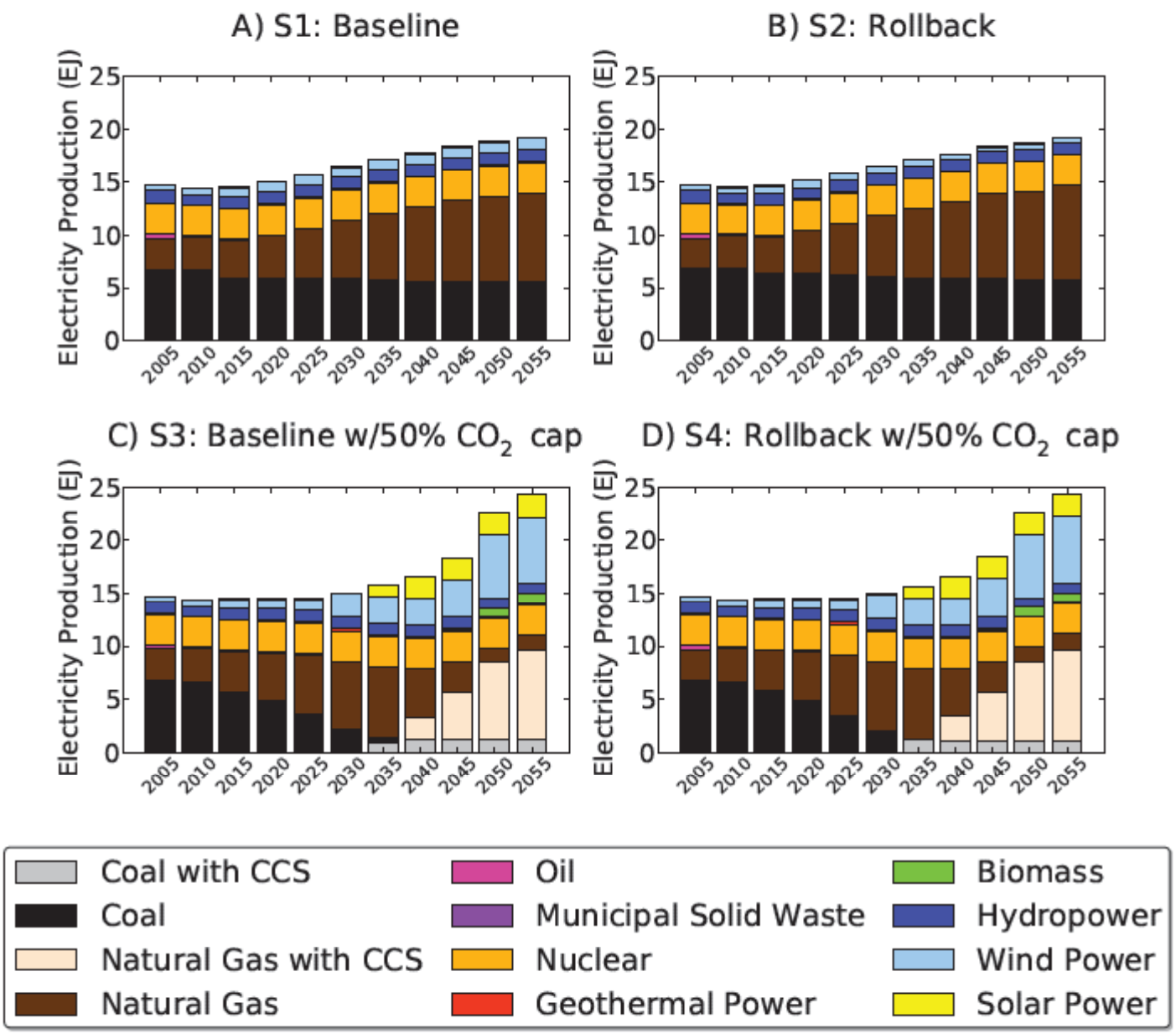


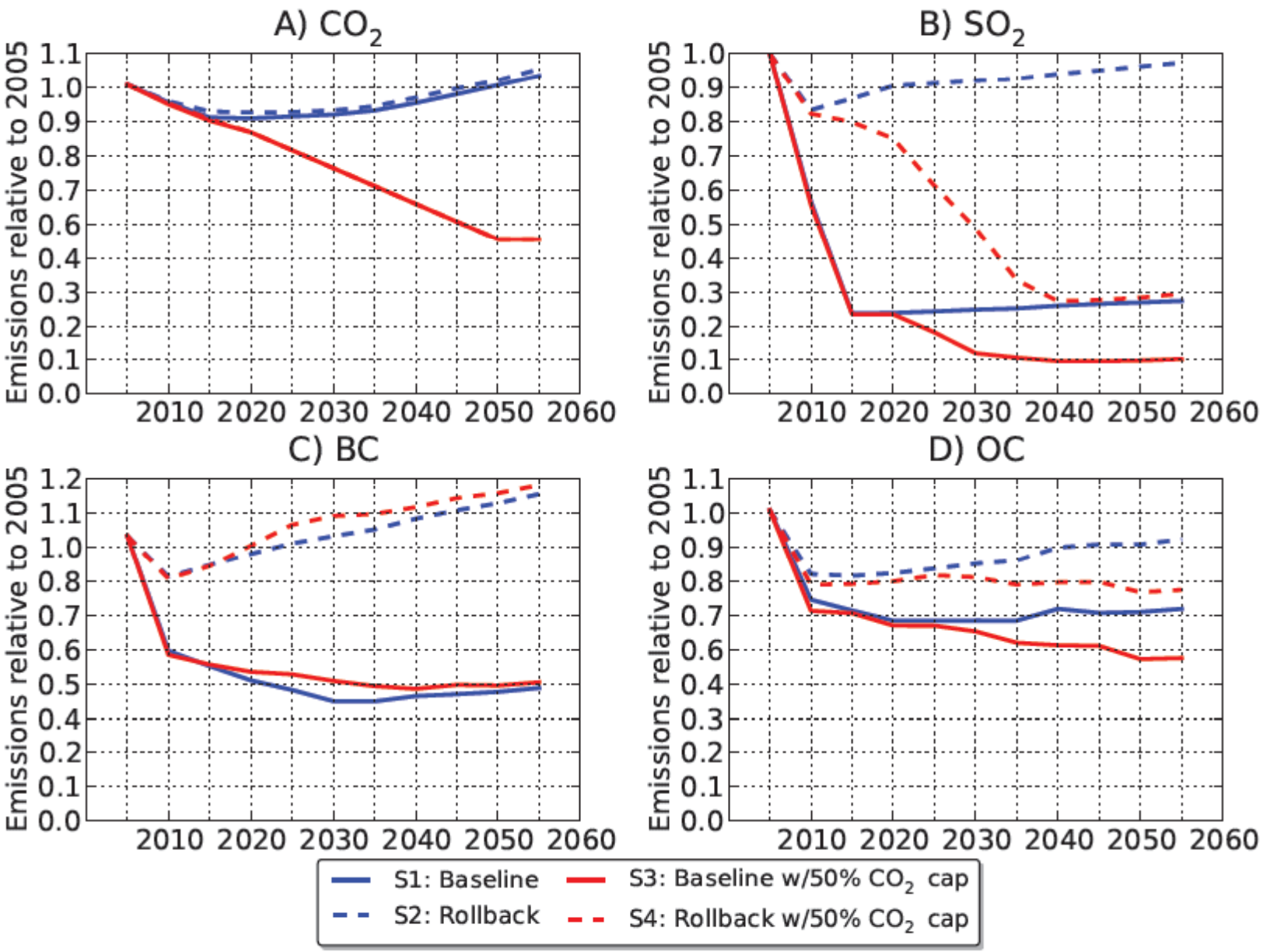
Change in radiative forcing per change in emission: W m^{-2} / (kg m^{-2} yr^{-1})

Simulated by GEOS-Chem Adjoint

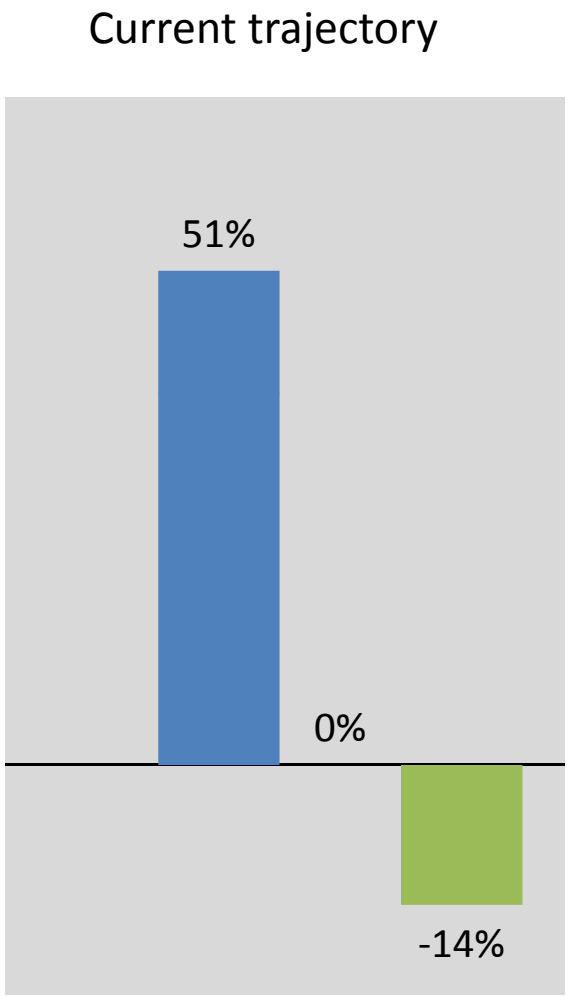
Future benefits relative to 2005

Current Trajectory	CO_2 50% lower by 2050	Both
Current air quality rules go into effect and continue to reduce emissions	All air quality rules are rolled-back to 2005 levels	Current air quality rules go into effect and continue to reduce emissions
No new requirements	A 50% cut in CO_2 emissions is achieved by 2050	A 50% cut in CO_2 emissions is achieved by 2050


A) S1: Baseline
B) S2: Rollback
C) S3: Baseline w/50% CO_2 cap
D) S4: Rollback w/50% CO_2 cap
Electricity Production (EJ)
0
5
10
15
20
25
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
Coal with CCS
Coal
Natural Gas with CCS
Natural Gas
Oil
Municipal Solid Waste
Nuclear
Geothermal Power
Biomass
Hydropower
Wind Power
Solar Power


A) CO_2
B) SO_2
C) BC
D) OC
Emissions relative to 2005
2010 2020 2030 2040 2050 2060
S1: Baseline
S2: Rollback
S3: Baseline w/50% CO_2 cap
S4: Rollback w/50% CO_2 cap

Future benefits relative to 2005



Health Benefits

Long-term warming

Near-term climate change

Health Benefits

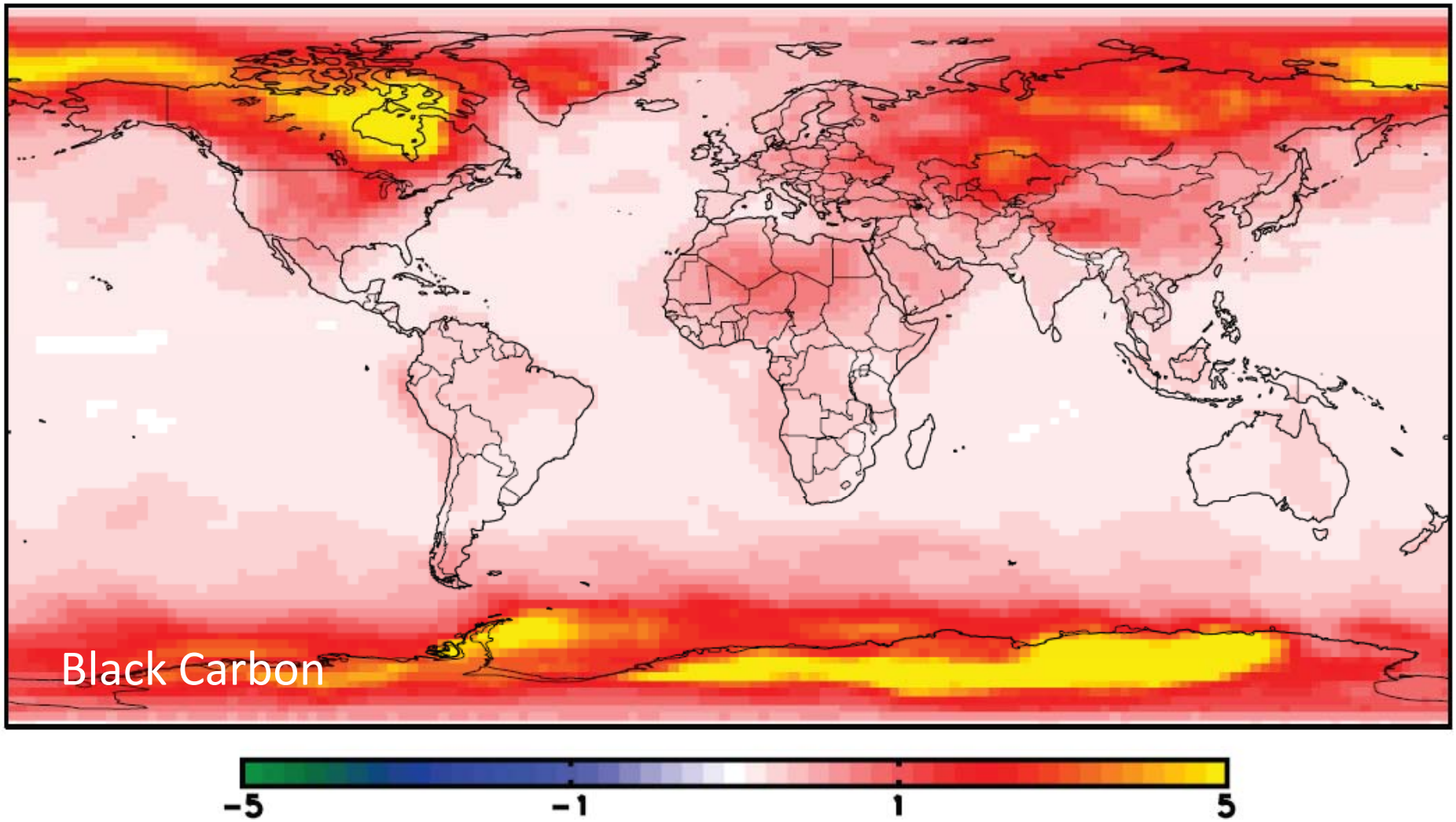
Long-term warming

Near-term climate change

Need to find ways to offset near-term warming from sulfate reduction

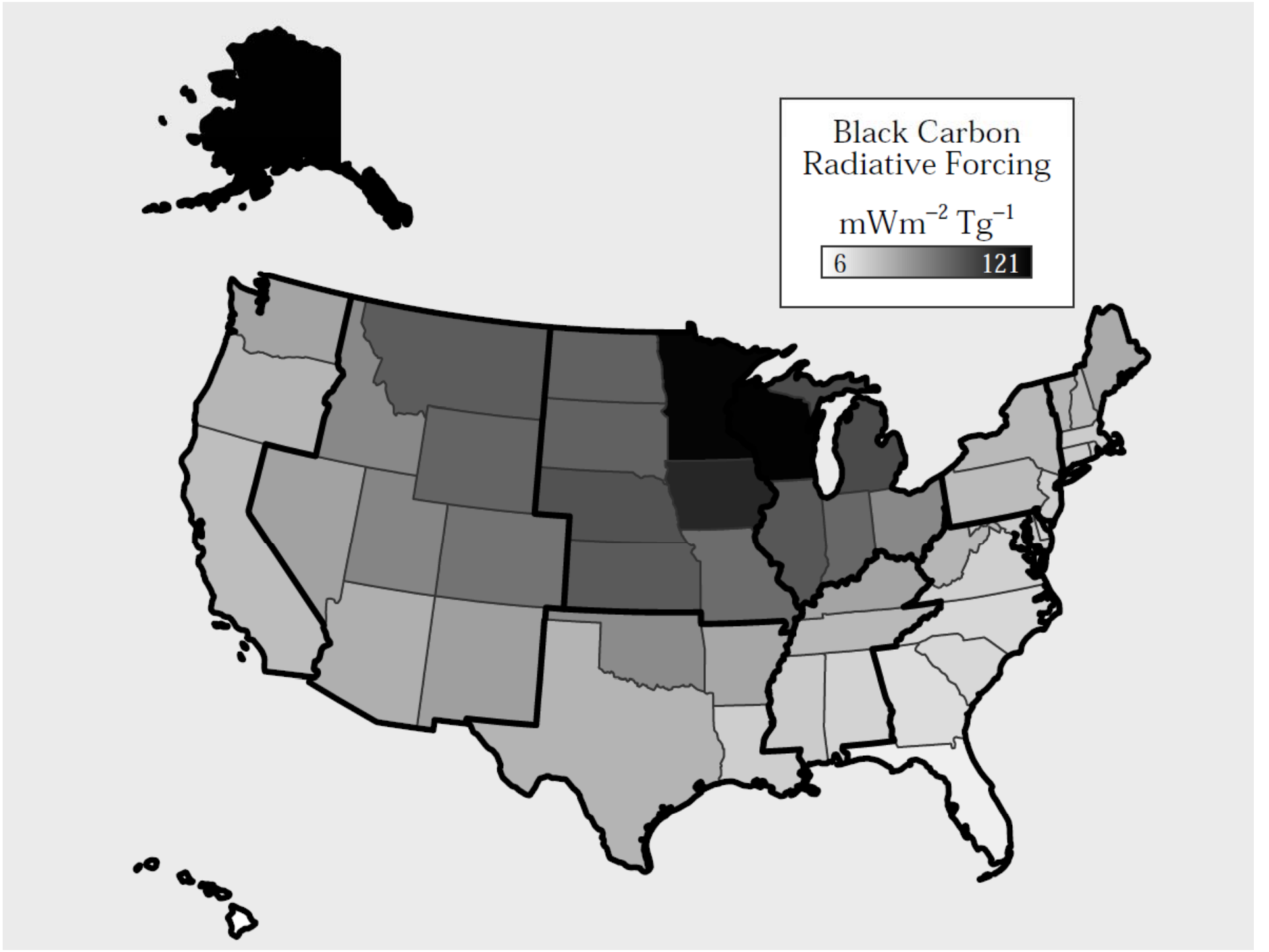
Second Report to Congress:
Highlights of the Diesel Emissions Reduction Program

Direct Radiative Forcing Efficiencies



Change in radiative forcing per change in emission: W m^{-2} / (kg m^{-2} yr^{-1})

Simulated by GEOS-Chem Adjoint


Black Carbon
Radiative Forcing
mWm^{-2} Tg^{-1}
6
121

What is the climate change benefit from this program?

Reduction in diesel particulate matter (PM) emissions	×	Fraction of PM that is light absorbing	×	Change in Radiative forcing	×	Equivalent CO_2 emission reduction

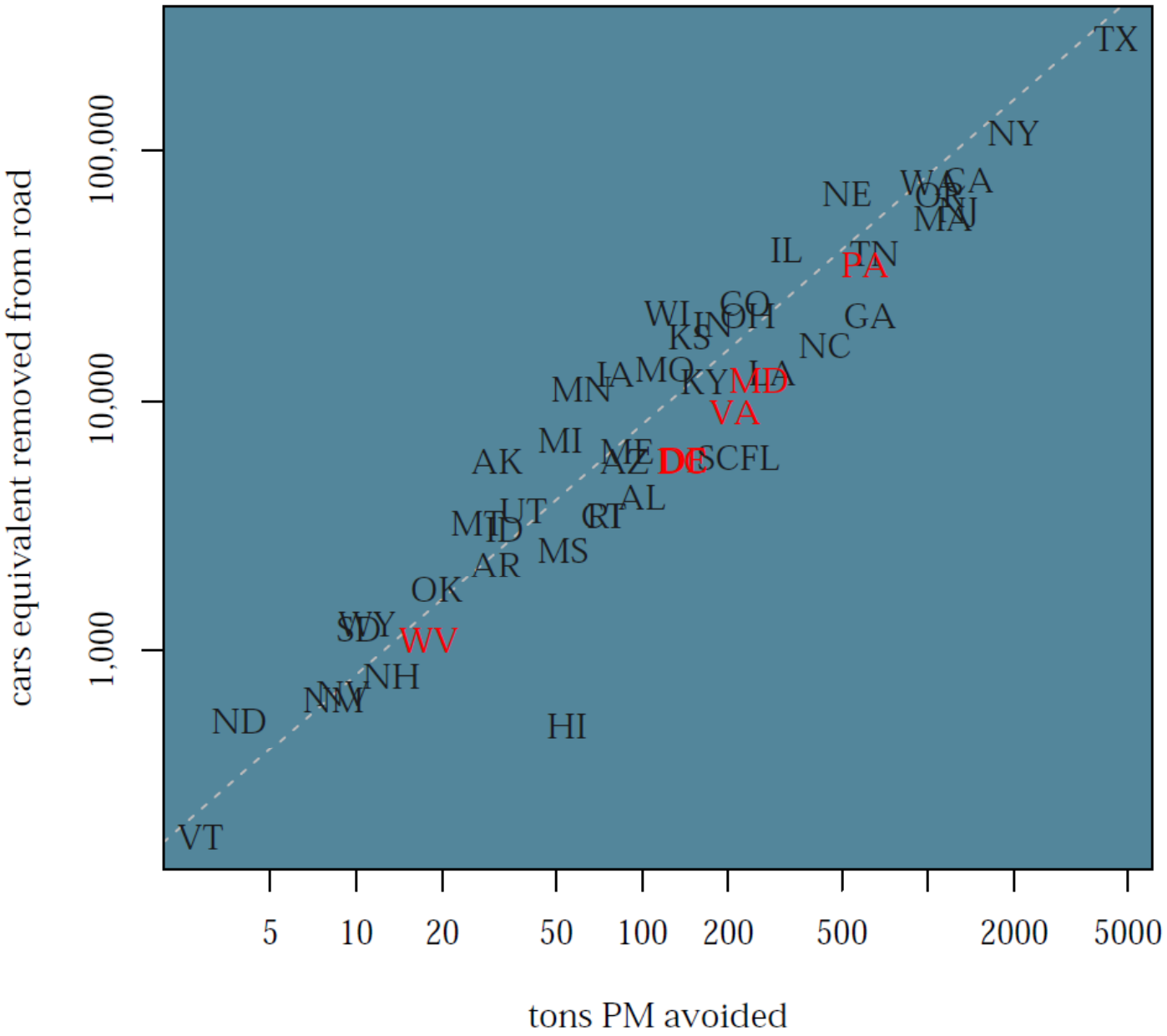
1 ton of diesel PM emissions

=

annual CO_2 emissions

from **80** passenger cars

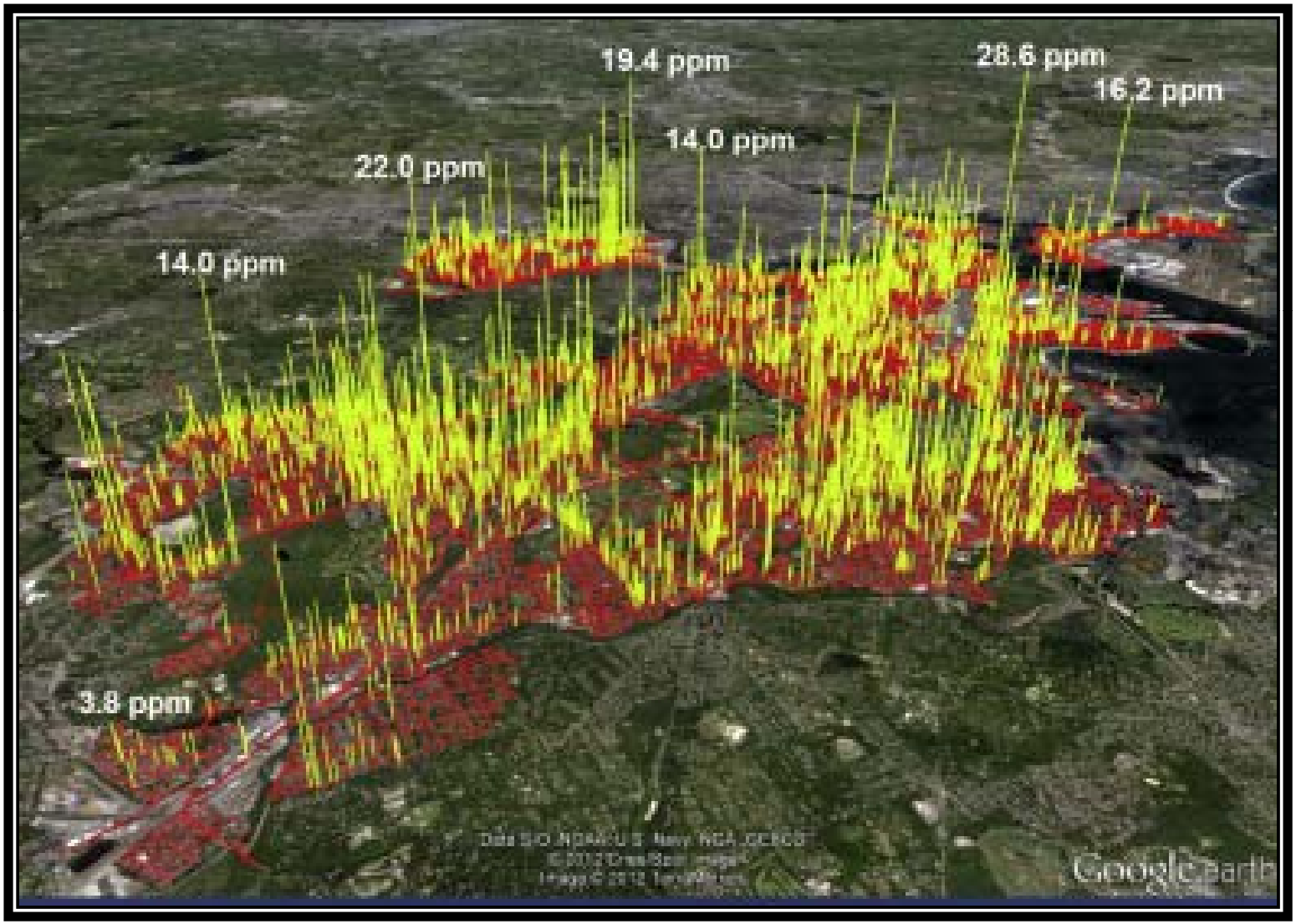
(national average)


cars equivalent removed from road
100,000
10,000
1,000
tons PM avoided
5
10
20
50
100
200
500
2000
5000
TX
NY
NE
IL
TN
PA
GA
NC
MD
VA
DE
SC
FL
AL
MS
AR
OK
WV
NH
ND
HI
VT

From a climate change mitigation perspective….

Retrofitting two diesel school buses is equivalent to the annual CO_2 emissions from a passenger car.

Methane Leaks



Question to consider:

When looking across your state's portfolio of air quality and climate change mitigation actions – are there opportunities for greater co-benefits?

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