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# Scientific updates on current emissions and sinks of greenhouse gases and implications for future emissions pathways

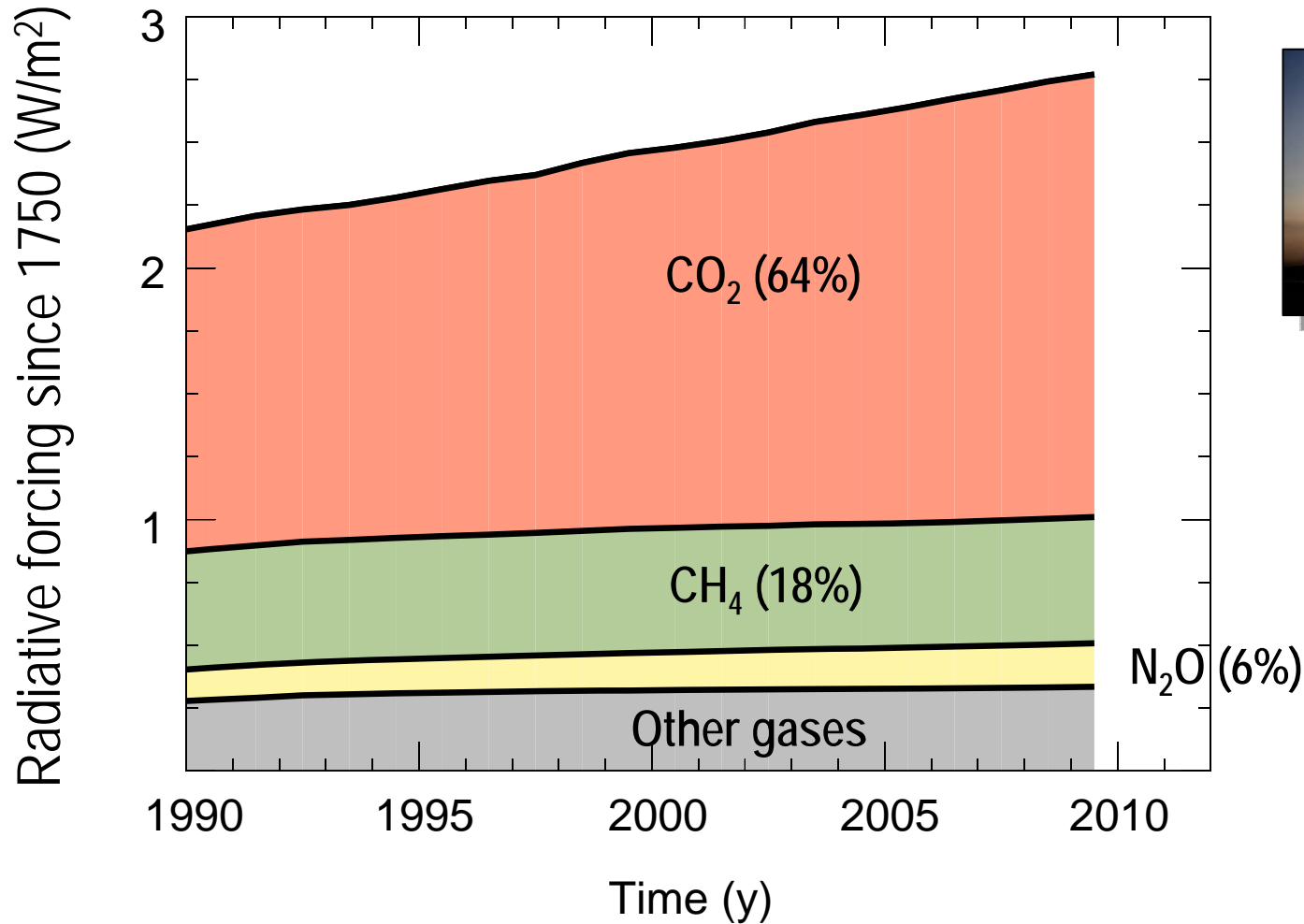
Dr Richard A. Houghton,  
Woods Hole Research Center

with contributions from the **Global Carbon Project**, C. Le Quéré,  
G. Marland, J. Hackler, T. Boden, J. Canadell, P. Friedlingstein,  
T. Conway, M. Raupach, P. Ciais and others.

slides available on [www.globalcarbonproject.org/carbonbudget](http://www.globalcarbonproject.org/carbonbudget)



# relative contribution of different greenhouse gases



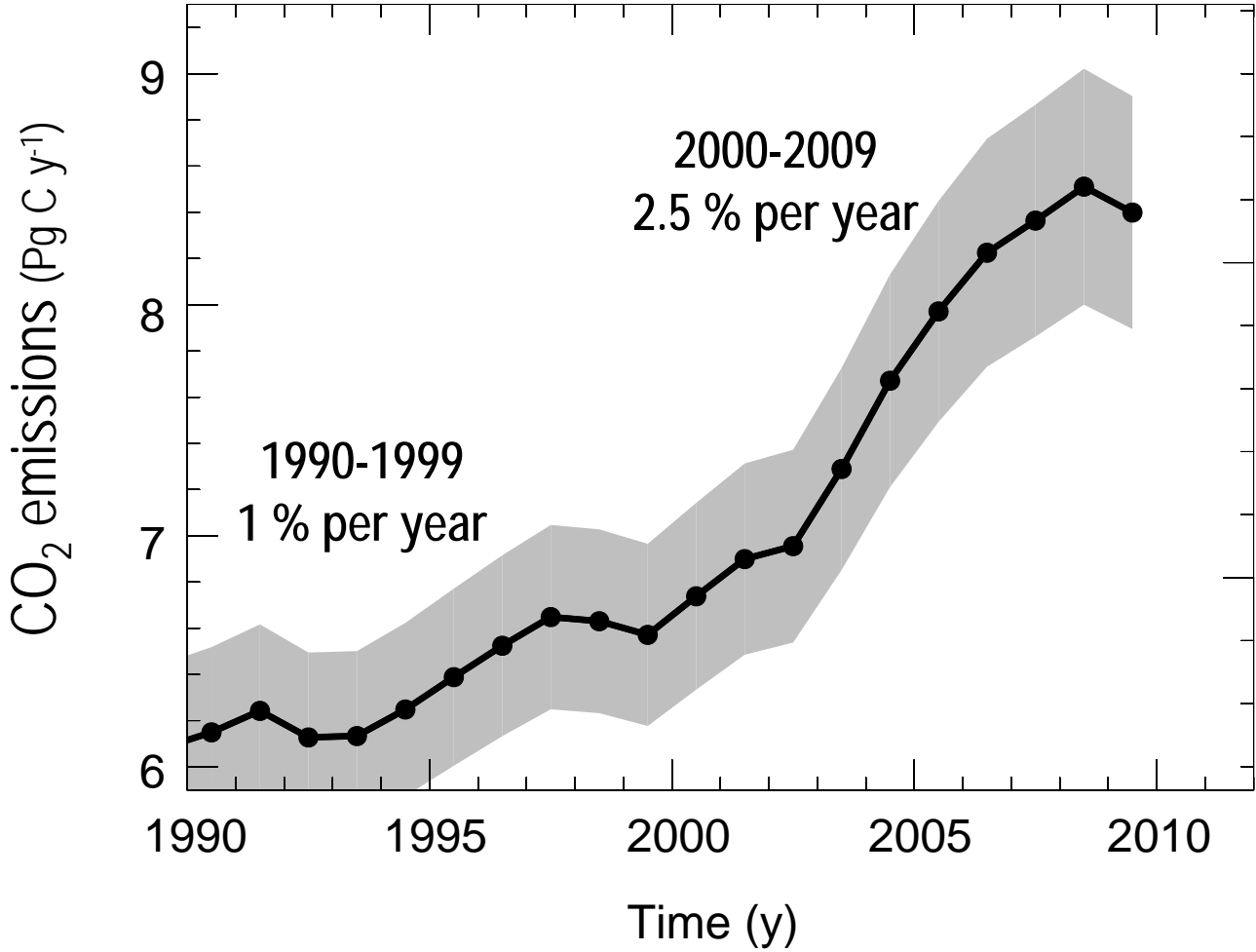
The contribution of  $\text{CO}_2$  to total anthropogenic greenhouse gases is growing

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# Emissions of carbon dioxide (CO<sub>2</sub>) from fossil fuel burning

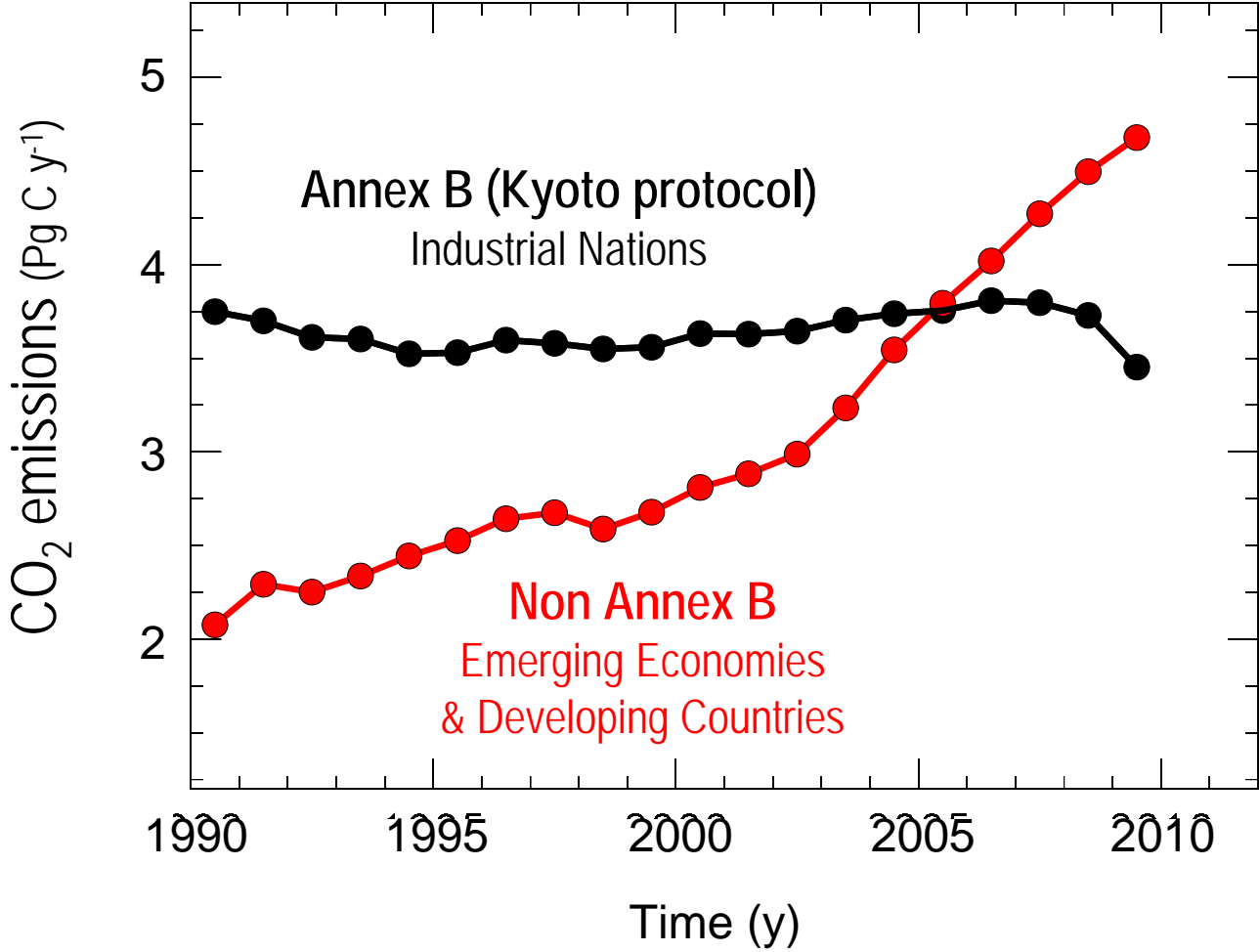


# Fossil Fuel CO<sub>2</sub> Emissions



2009:  
Emissions: 8.4 PgC  
(30.5 Gt CO<sub>2</sub>)  
Growth rate: -1.3%

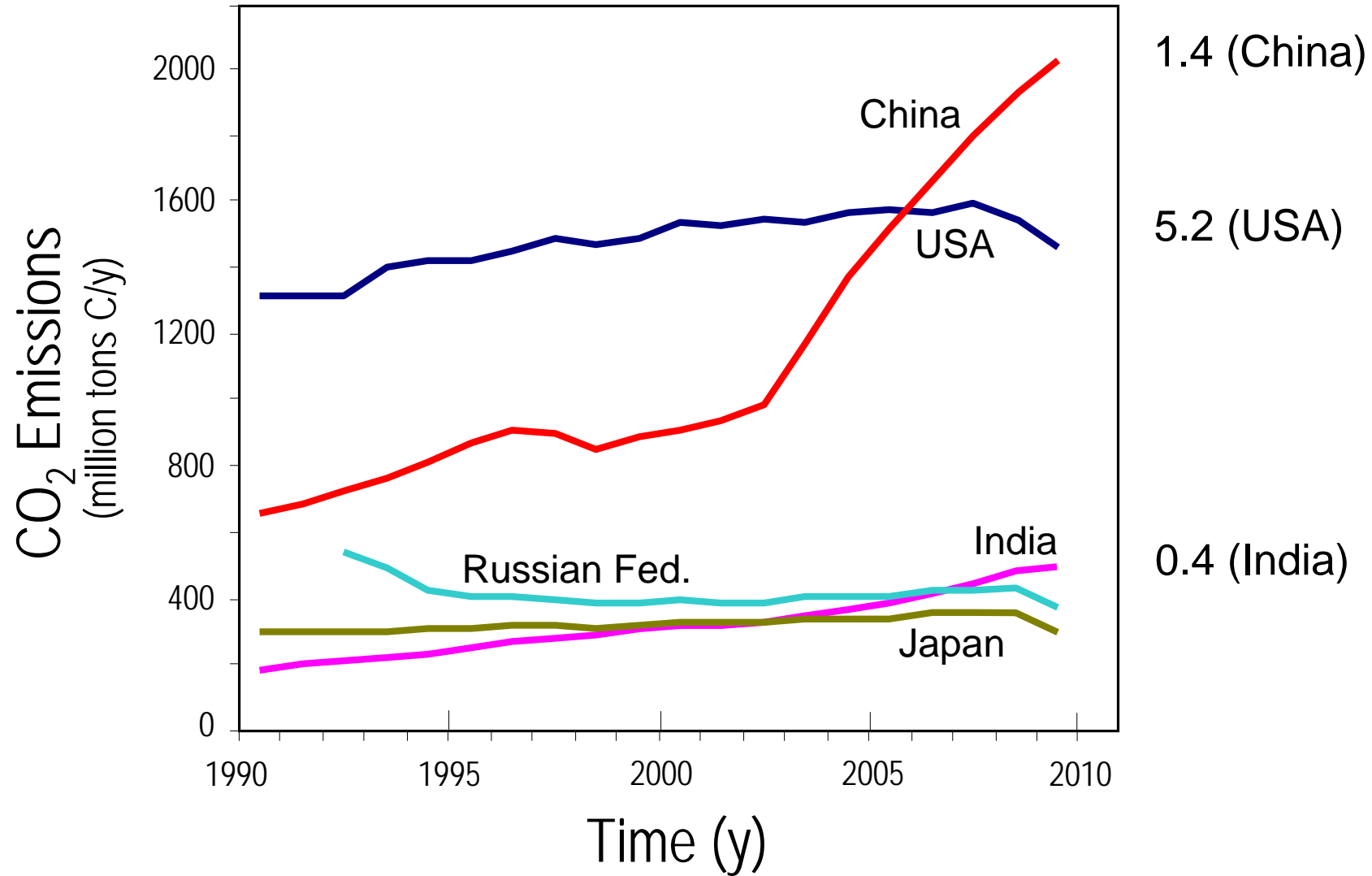
# Fossil Fuel CO<sub>2</sub> Emissions



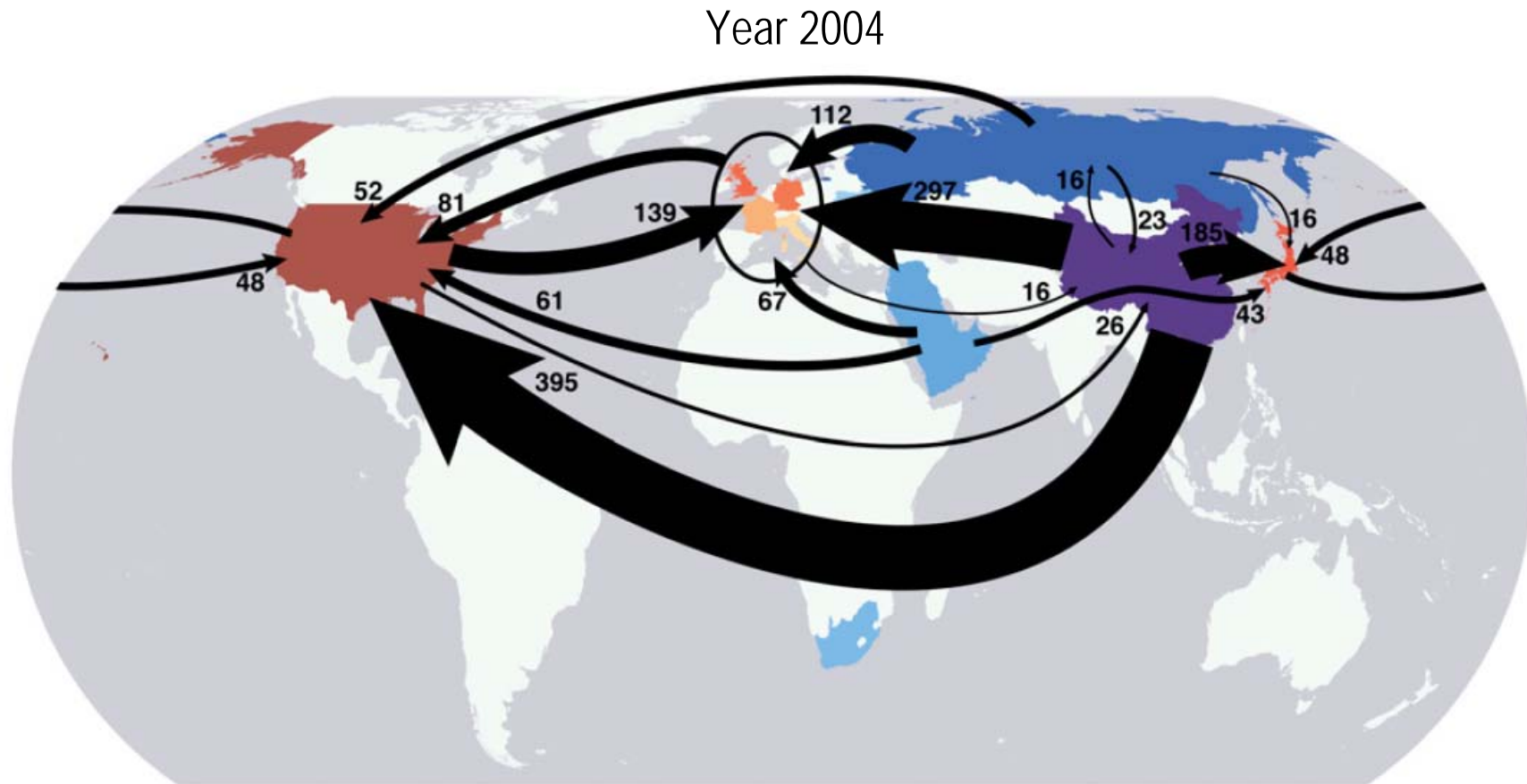
most of the growth in global emissions originates from emerging economies

# Top Emitters

per capita (2007)  
ton C per person

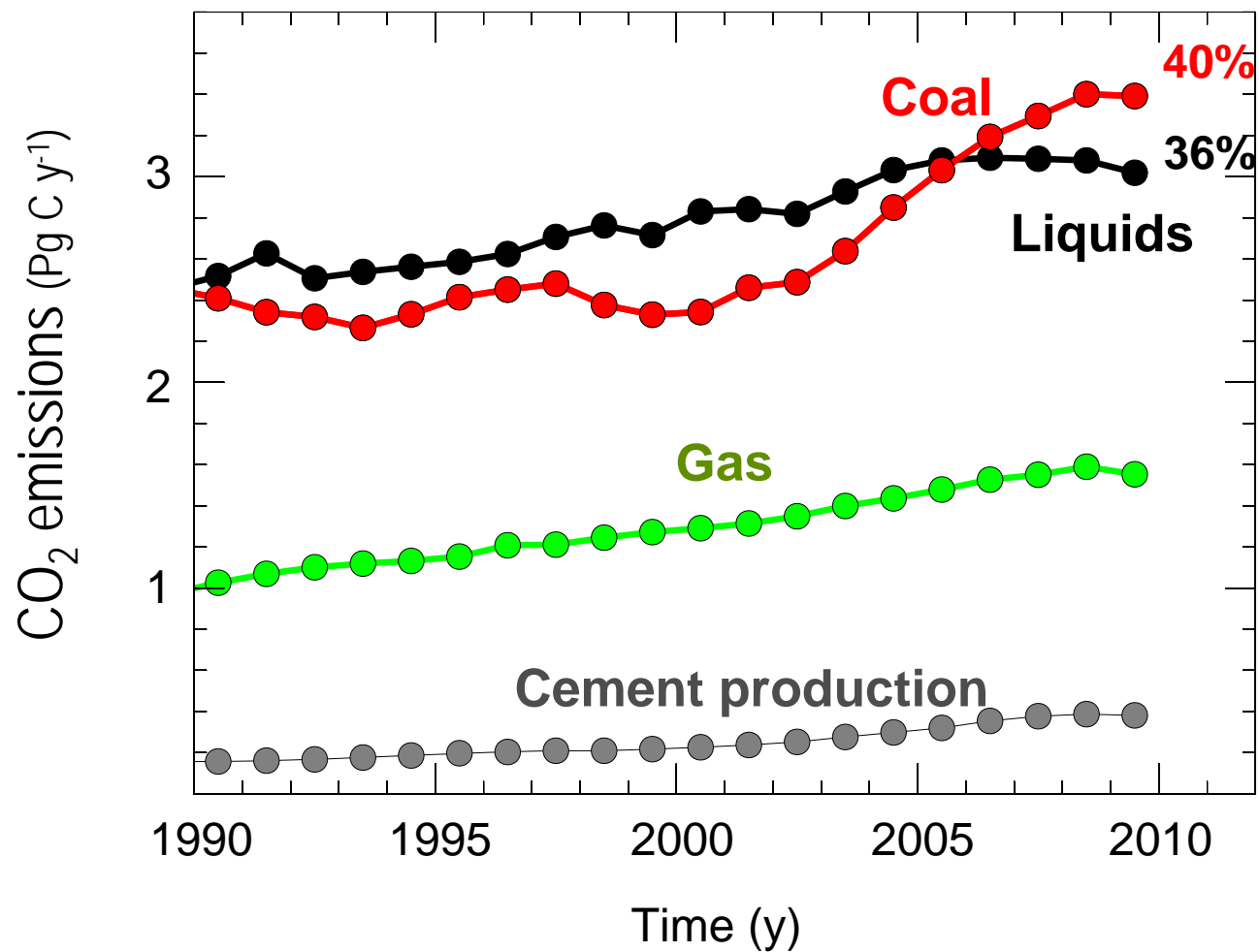


# Fluxes of Emissions Embodied in Trade (Mt CO<sub>2</sub> y<sup>-1</sup>)



From dominant net exporting countries (blue) to dominant net importing countries (red).

# CO<sub>2</sub> Emissions by Fossil Fuel Type

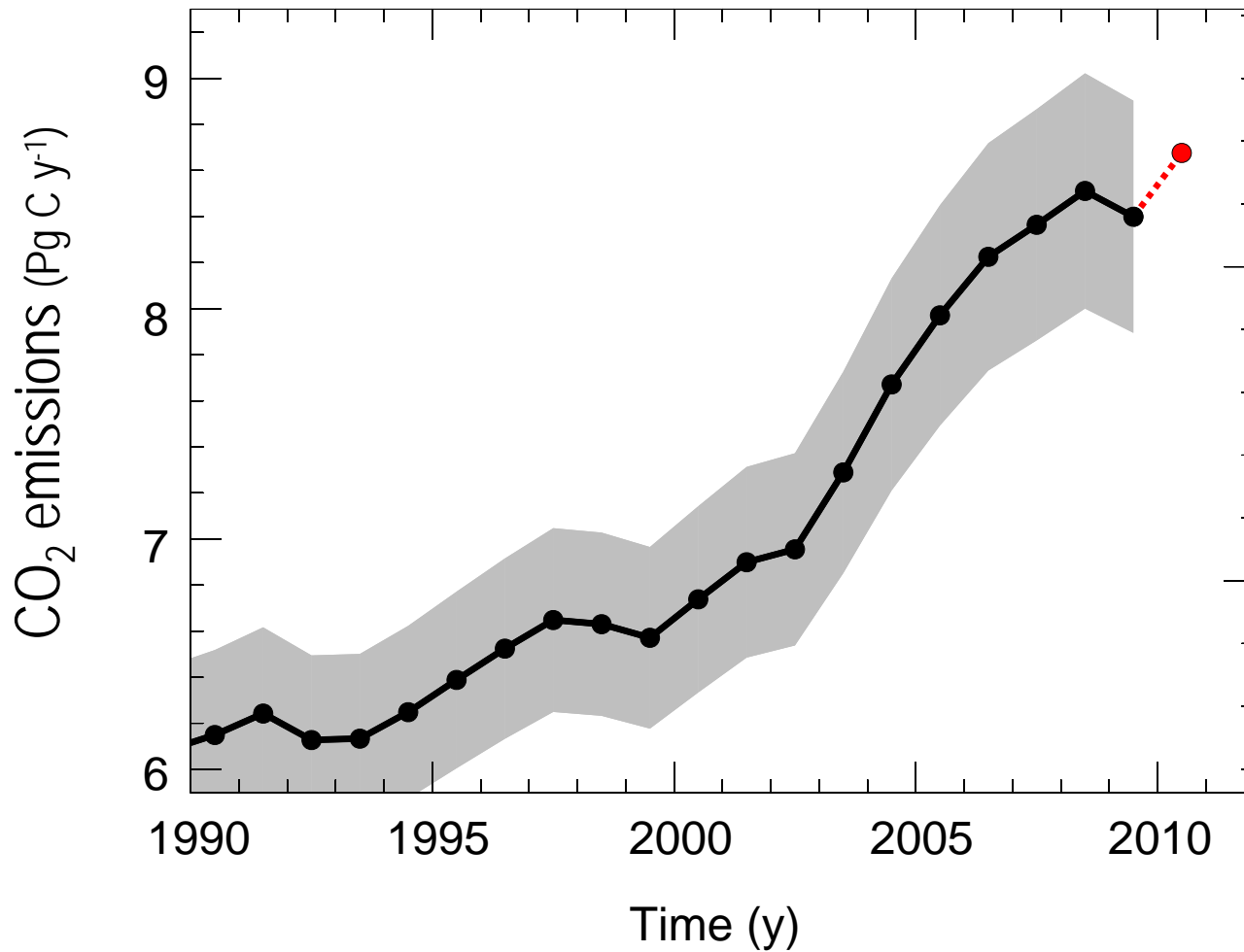


Global CO<sub>2</sub> emissions  
now dominated by coal

Coal emits more CO<sub>2</sub>  
than liquids or gas



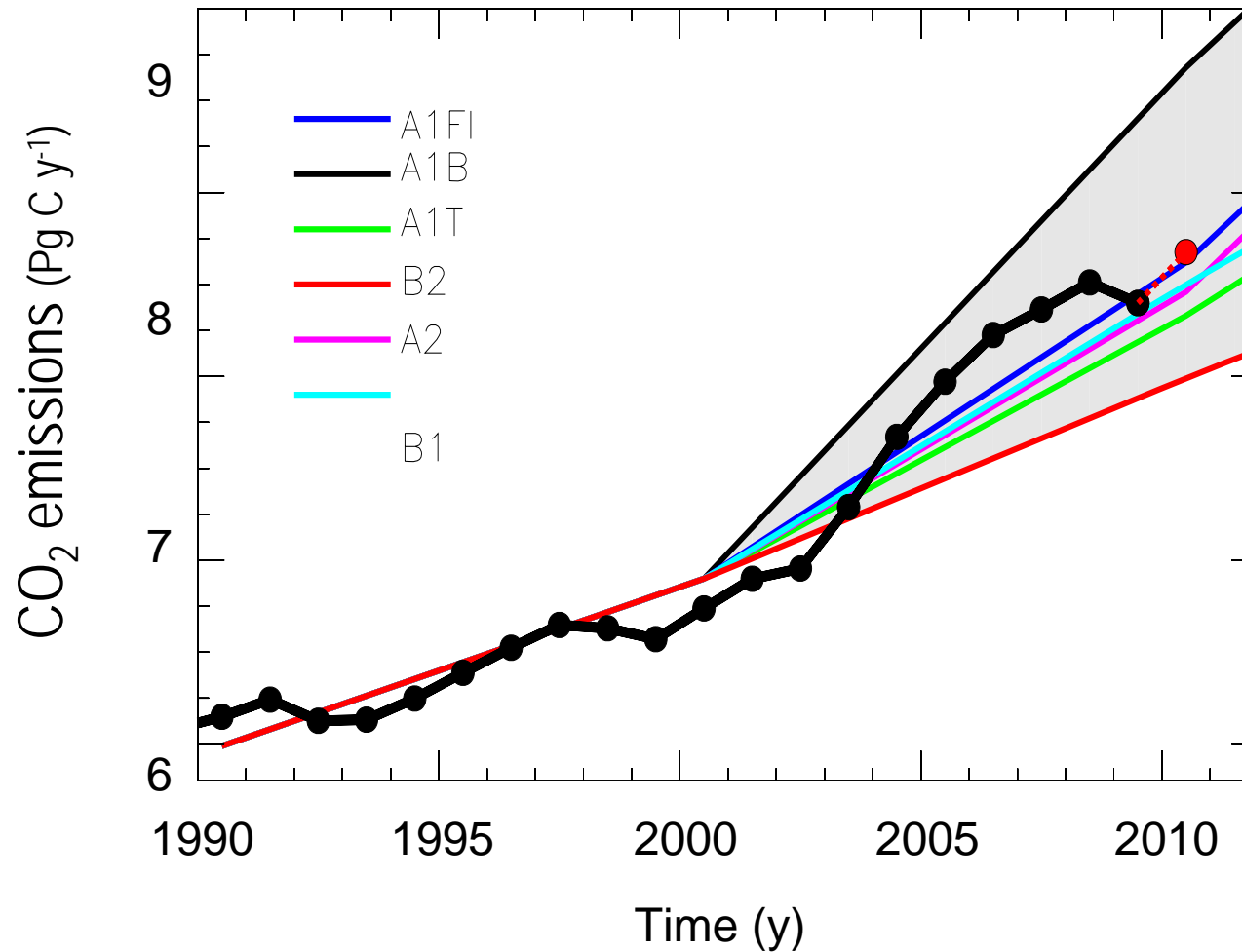
# Fossil Fuel CO<sub>2</sub> Emissions



2010:  
Projected  
growth rate: >3 %

Based on 4.8 %  
projected growth in  
GDP by the IMF,  
and -1.7 % improvement  
in carbon intensity  
of the economy.

# Fossil Fuel CO<sub>2</sub> Emissions compared to IPCC Marker scenarios used for climate projections



2000-2009 growth rates are at the high end of the emissions scenarios used by the IPCC to project climate change

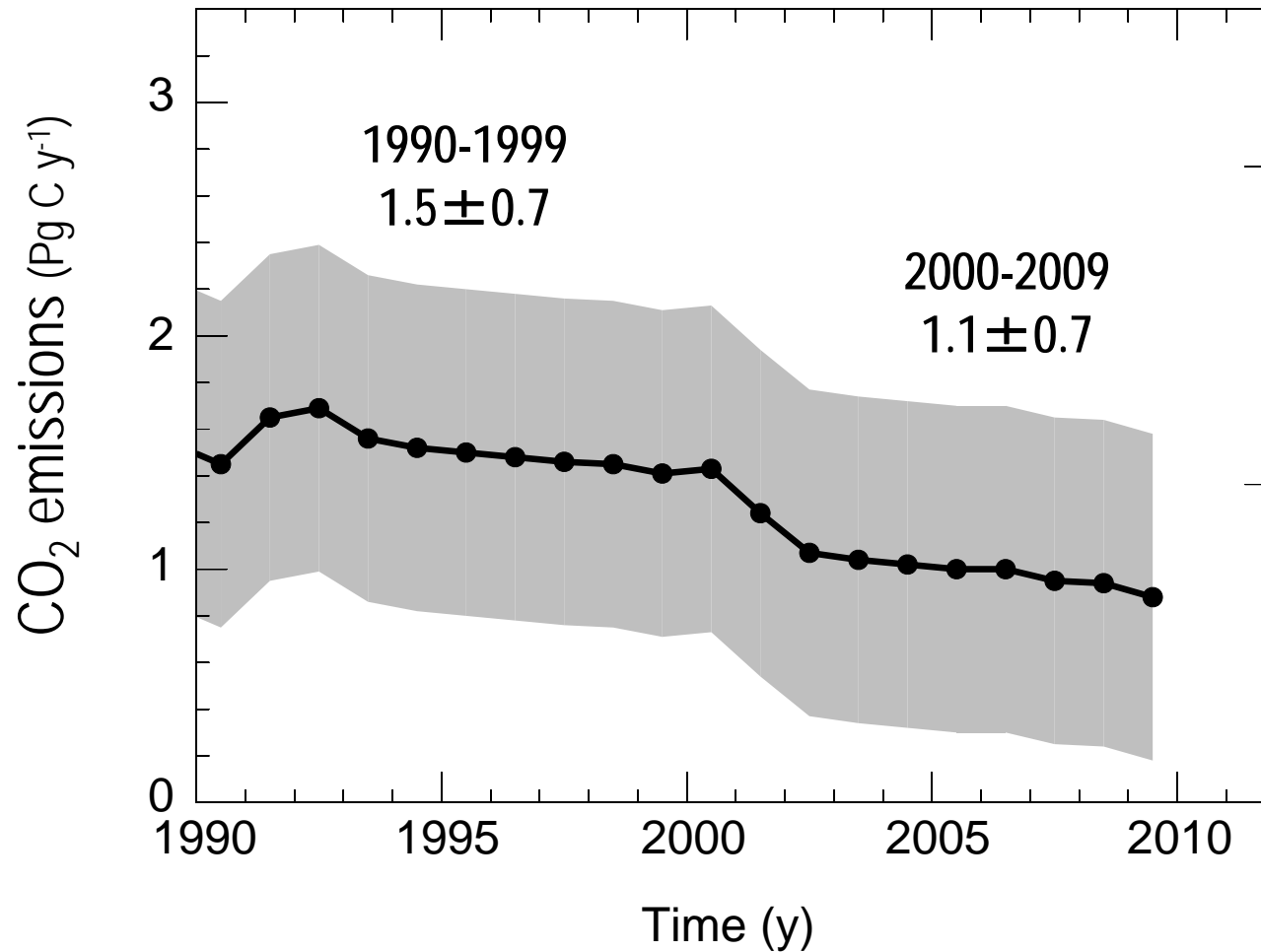
IPCC range: 1.6 - 6.9 ° C above pre-industrial in 2100

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# Emissions of CO<sub>2</sub> from deforestation and other Land Use Change (LUC)

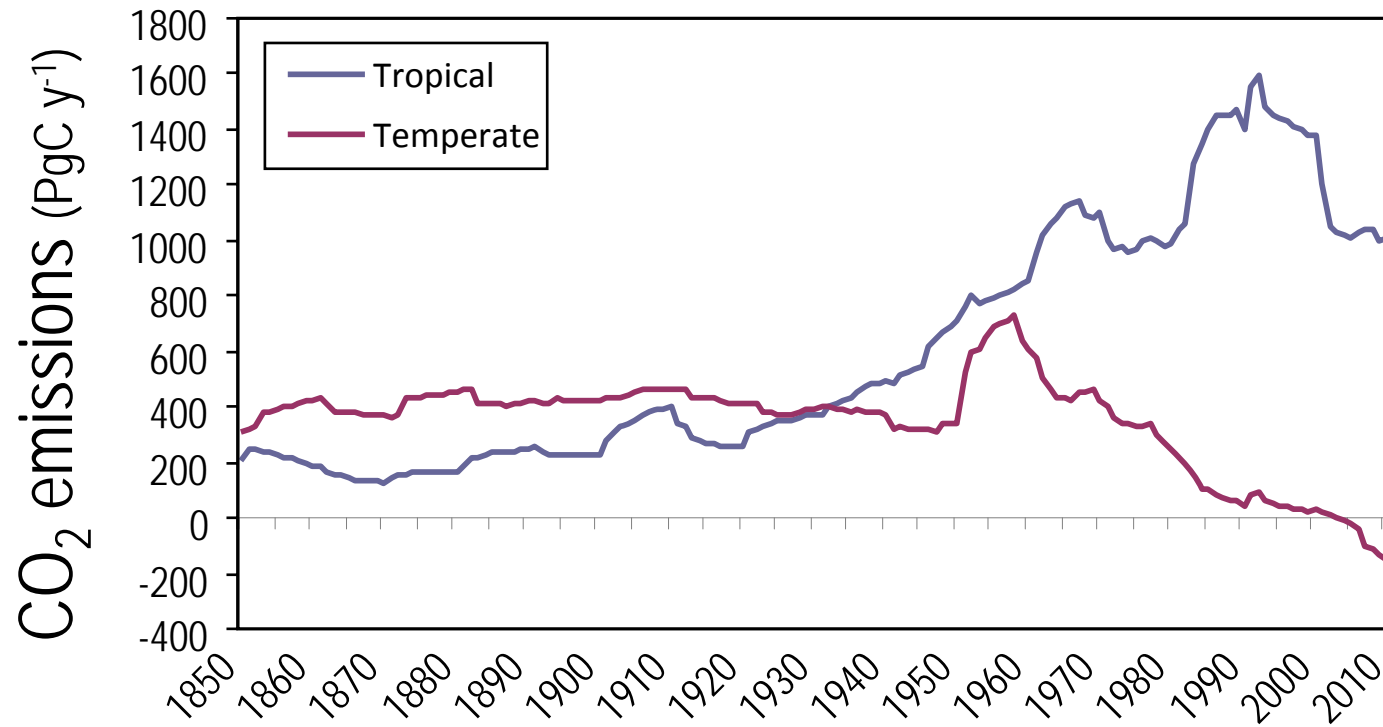


# CO<sub>2</sub> Emissions from deforestation and other Land Use Change



Estimated ~25% decrease between the two decades with large uncertainty

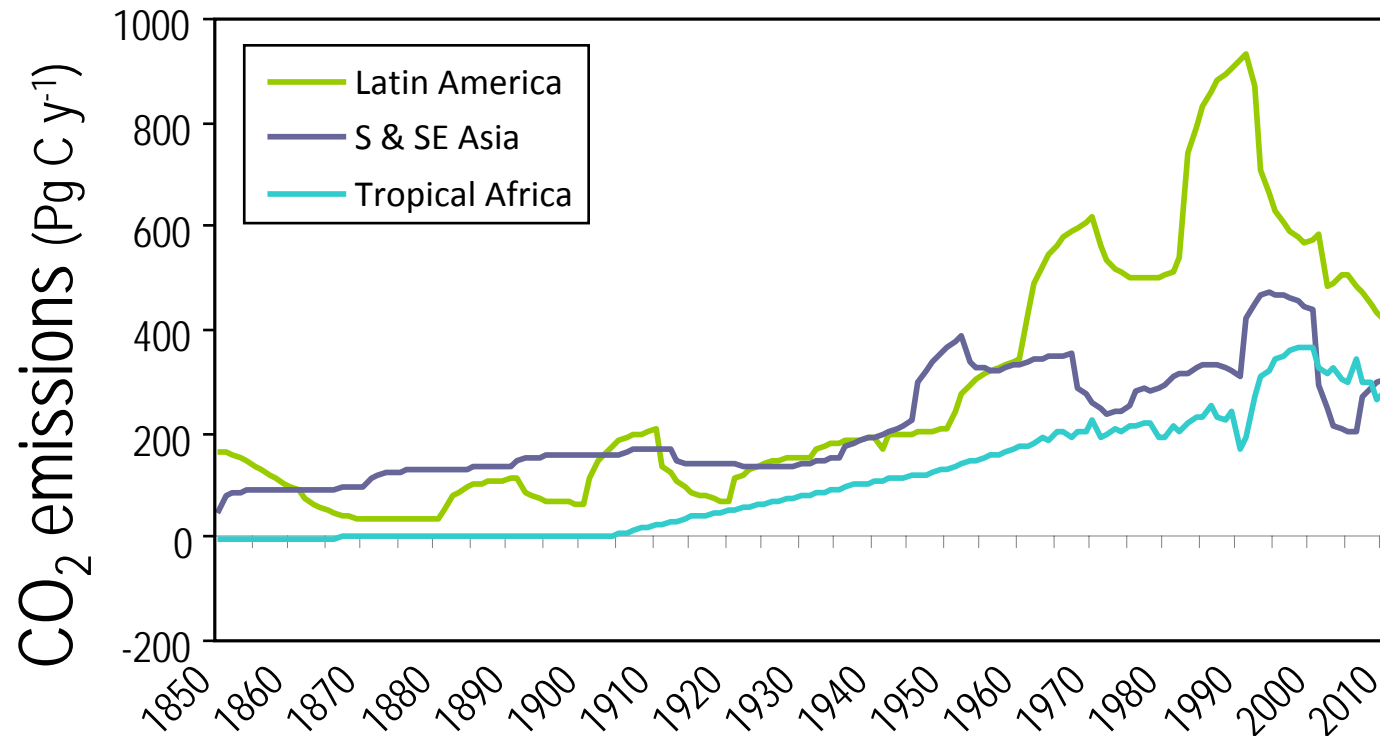
# Regional Emissions from Land Use Change



Both tropical and temperate LUC recently decreasing

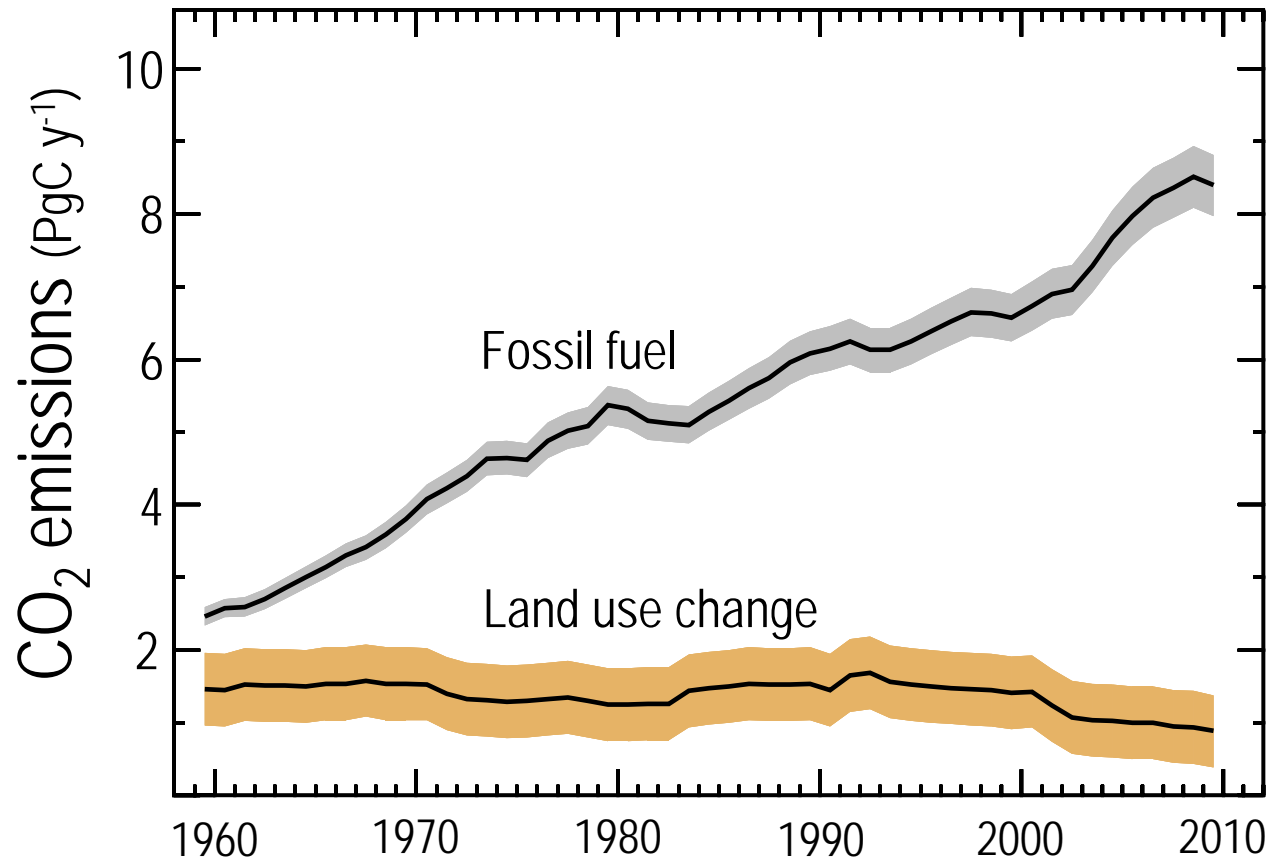
Temperate LUC could now be a small CO<sub>2</sub> sink

# Regional Emissions from Land Use Change



Satellite data for Brazil and Indonesia support recent LUC trends

# Total CO<sub>2</sub> Emissions (1960-2009)



LUC emissions now  
~10% of total CO<sub>2</sub> emissions

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# Fate of CO<sub>2</sub> emissions





# Fate of Anthropogenic CO<sub>2</sub> Emissions (2000-2009)

1.1 PgC y<sup>-1</sup>



7.7 PgC y<sup>-1</sup> +



4.1 PgC y<sup>-1</sup>  
47%



2.4 PgC y<sup>-1</sup>  
27%

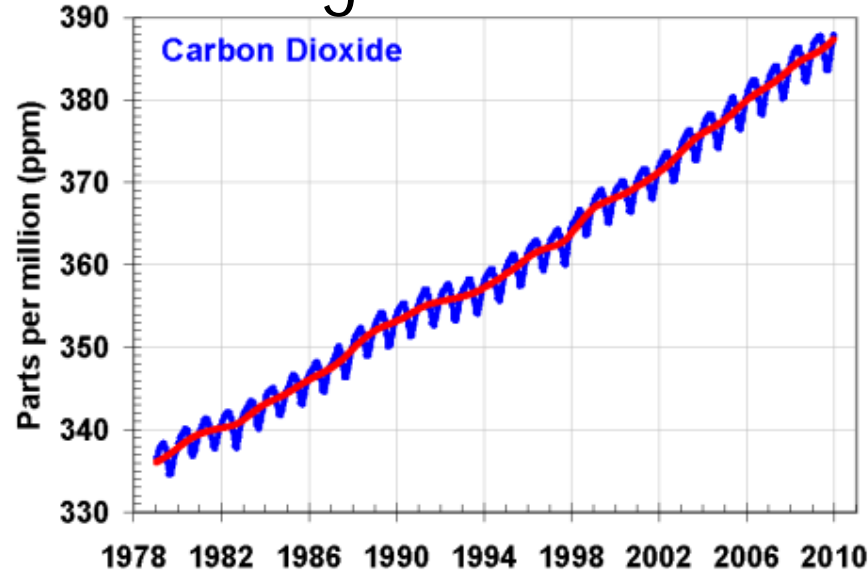


2.3 PgC y<sup>-1</sup>  
26%



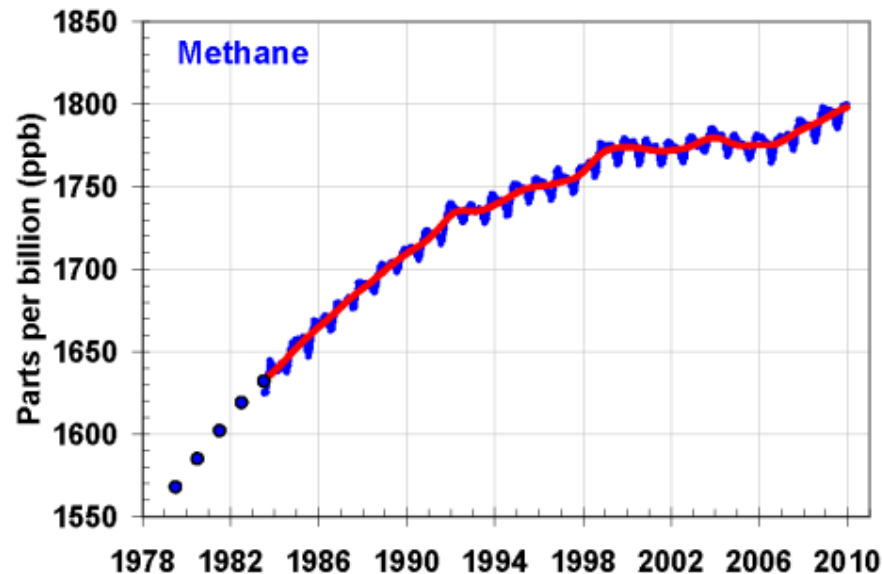
# Greenhouse gas concentration (1978-2010)

**CO<sub>2</sub>**  
**(ppm)**



Atmospheric CO<sub>2</sub>  
concentration in Sept  
2010: 389.2 ppm

**CH<sub>4</sub>**  
**(ppb)**



Atmospheric CH<sub>4</sub>  
concentration increased for  
the third year in a row after  
being stable for 10 year.

The cause of the recent  
increased is unknown.

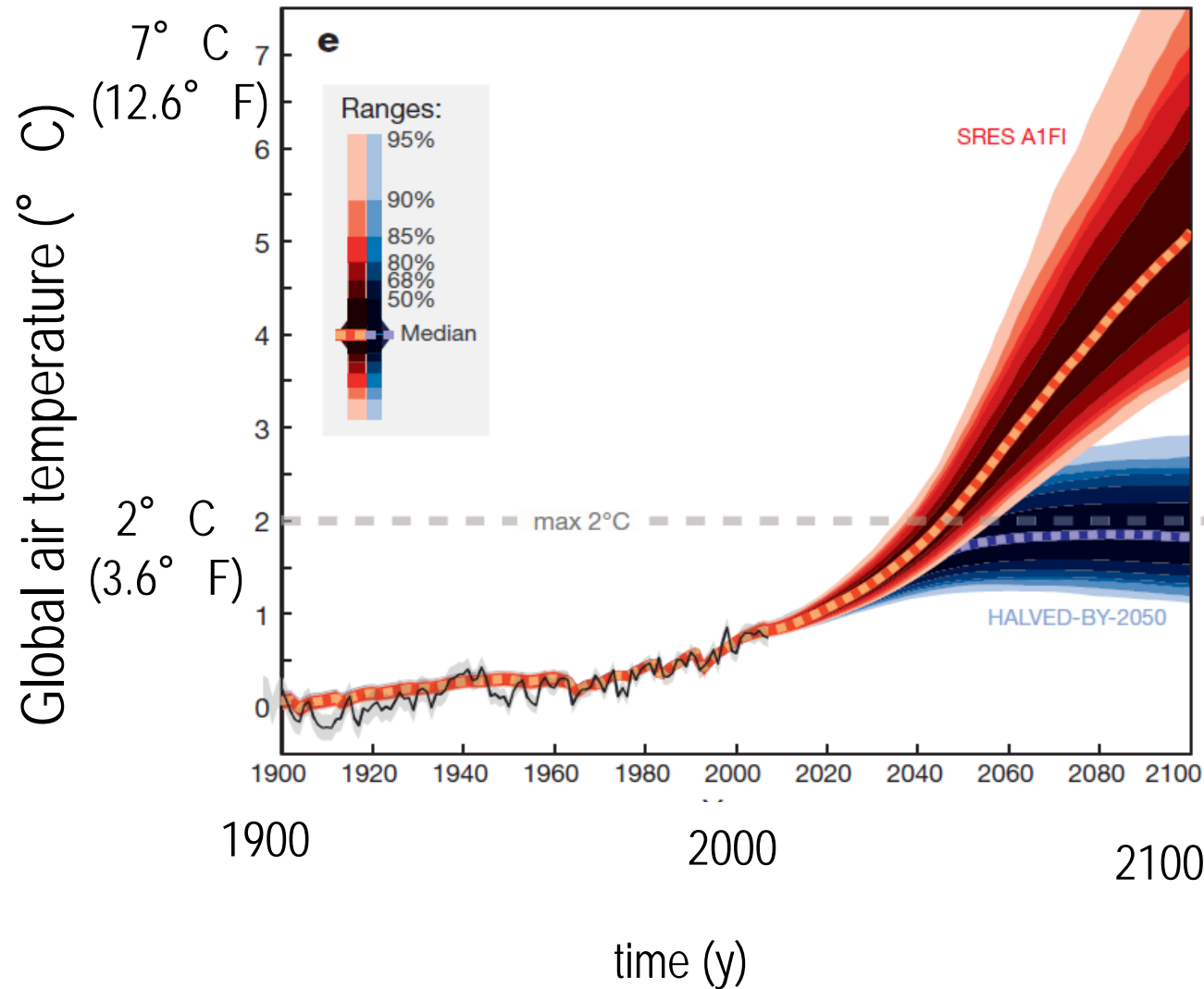
Source: NOAA Earth System Research Laboratory

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# Implications of recent trends for future emissions pathways



# Emission scenarios consistent with 2° C limit



25% probability of exceeding 2° C:

→ no more than 185 PgC (677 billion ton CO<sub>2</sub>) emitted until 2050

50% probability of exceeding 2° C:

→ no more than 305 PgC (1120 billion ton CO<sub>2</sub>) emitted until 2050

# References cited in this ppt

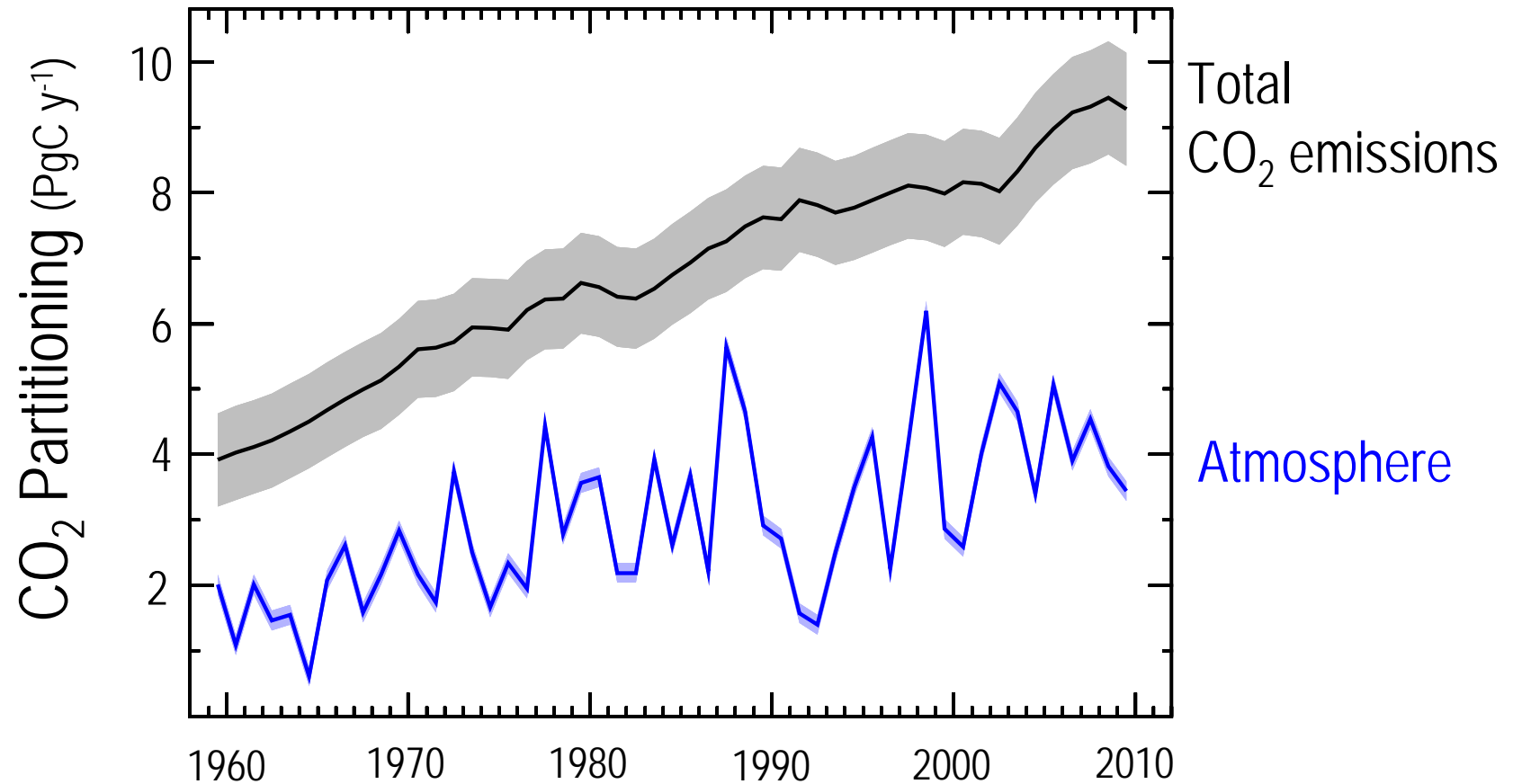
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[www.globalcarbonproject.org](http://www.globalcarbonproject.org)

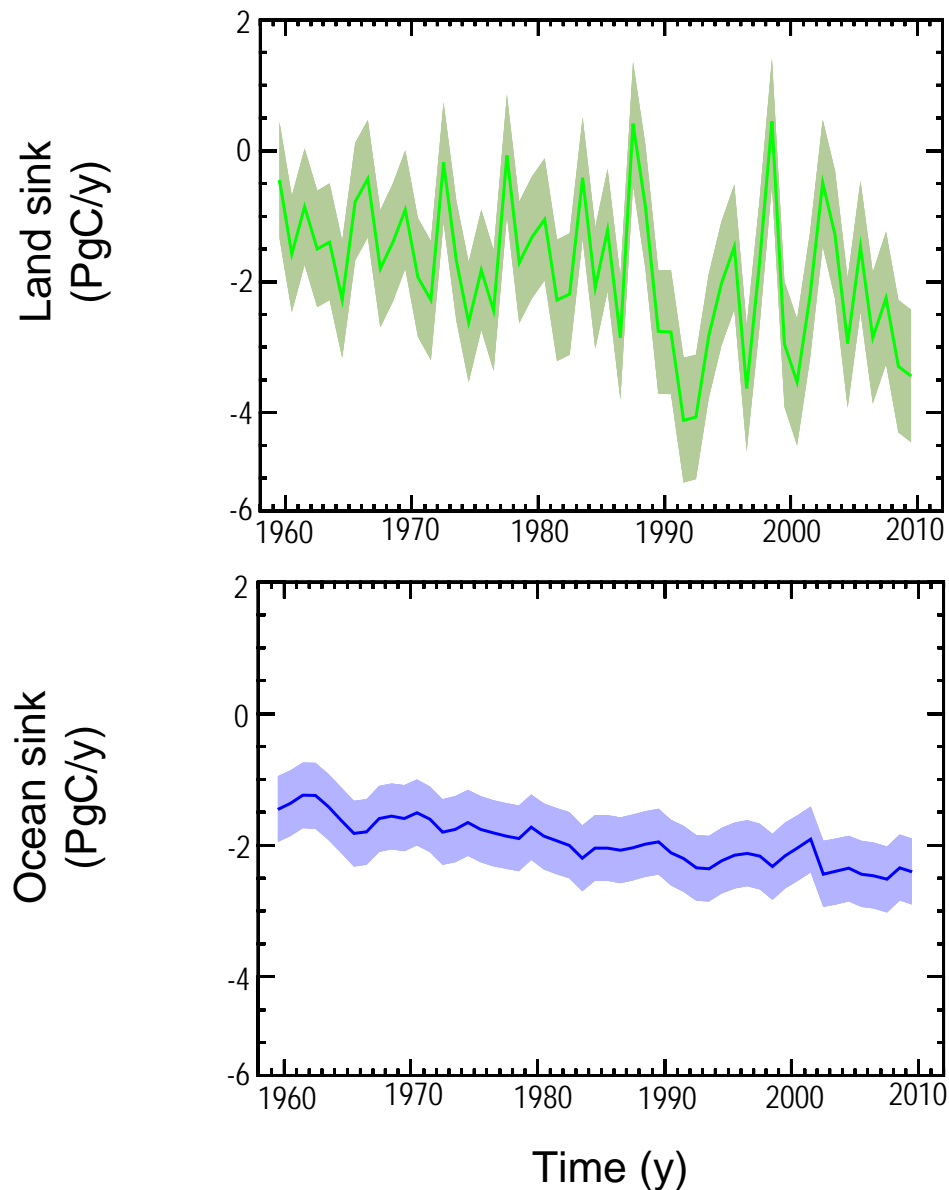


# Key Diagnostic of the Carbon Cycle





# Modelled Natural CO<sub>2</sub> Sinks





# Top 20 CO<sub>2</sub> Emitters & Per Capita Emissions 2009

