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Carbon Budget 2010



GCP - Carbon Budget 2010 Contributors

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GCP - Carbon Budget 2010

opinion & comment

CORRESPONDENCE:

Rapid growth in CO₂ emissions after the 2008–2009 global financial crisis

To the Editor — Global carbon dioxide emissions from fossil-fuel combustion and cement production grew 5.9% in 2010, surpassed 9 Pg of carbon (Pg C) for the first time, and more than offset the 1.4% decrease in 2009. The impact of the 2008–2009 global financial crisis (GFC) on emissions has been short-lived owing to strong emissions growth in emerging economies, a return to emissions growth in developed economies, and an increase in the fossil-fuel intensity of the world economy.

Preliminary estimates of global CO₂ emissions from fossil-fuel combustion and cement production show that emissions grew by 0.51 Pg C (5.9%) in 2010 and reached a record high of 9.1±0.5 Pg C (Supplementary Methods). This is the highest total annual growth recorded, and the highest annual growth rate since 2003 (and previously 1979). The 2010 growth overcame the 1.4% drop in emissions recorded in 2009, which was due to the GFC, putting global CO₂ emissions back on the high-growth trajectory that persisted before the GFC (Fig. 1). Thus, after only one year, the GFC has had little impact on the strong growth trend of global CO₂ emissions that characterized most of the 20th C.

For the past two years (2009 and 2010), emissions growth has been dominated by the emerging economies (Supplementary Table S1). The CO₂ emissions in developed countries (which we take as the Annex B countries from the Kyoto Protocol) decreased 1.3% in 2008 and 7.6% in 2009, but increased 3.4% in 2010, and are now lower than the average emissions during 2000–2007 (Fig. 2). The CO₂ emissions in developing countries (non-Annex B countries) increased 4.4% in 2008, 3.9% in 2009 and 7.6% in 2010; the GFC only causing a 40% decrease in emissions growth in 2009 compared with the trend since 2000 (Fig. 2). The 2010 growth was due to high growth rates in a few key emerging economies (Supplementary Table S1) — for example, China 10.4% (0.212 Pg C) and India 9.4% (0.049 Pg C) — although, the contribution from some developed countries was also substantial in absolute terms: for example, United States 4.1% (0.060 Pg C), Russia Federation 5.8%

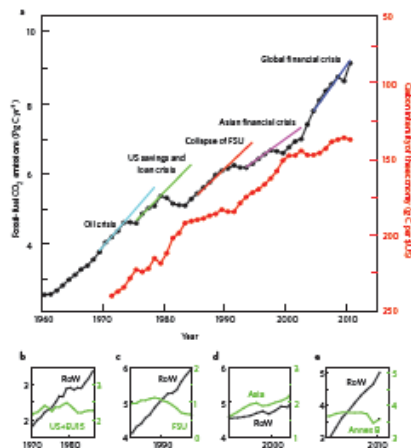


Figure 1 Global CO₂ emissions and carbon intensity. **a**, Emissions of CO₂ from fossil-fuel combustion and cement production for the world (Pg C yr⁻¹; black curve) and the carbon intensity of world GDP (Pg C per \$US (2000); red curve, inverted axis). The most important recent financial crises are highlighted with a linear trend fitted to the five years before the beginning of each crisis. **b–e**, CO₂ emissions (Pg C) for the regions most affected by each financial crisis (right axis) and the rest of the world (RoW; left axis). **b**, The oil crisis (1973) and the US savings and loans crisis (1989), where EU15 is the 15 member states of the European Union as of 1993. **c**, The collapse of the former Soviet Union (FSU; 1992). **d**, The Asian financial crisis (1997). **e**, The recent global financial crisis (2008–2009).

(0.025 Pg C) and the 27 member states of the European Union 2.3% (0.022 Pg C).

For recent decades, the growth in global CO₂ emissions can be explained mainly by the growth in economic activity corrected for decreases in the fossil-fuel carbon intensity (FFCI) of the global economy (fossil-fuel and industrial CO₂ emitted per

US dollar of economic output, that is CO₂ per unit of gross domestic product (GDP)). Using constant-price GDP measured in purchasing power parities² (real GDP), the FFCI decreased by 1.4% yr⁻¹ on average between 1980 and 2000. Since 2000 however, the FFCI has decreased by only 0.9% yr⁻¹ (Fig. 1), a sign that the positive trend of

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Peters GP, Marland G, Le Quéré C, Boden T, Canadell JG, Raupach MR (2011) Rapid growth in CO₂ emissions after the 2008–2009 global financial crisis. *Nature Climate Change*, doi: 10.1038/nclimate1332. Published online 4 December 2011.

<http://dx.doi.org/10.1038/nclimate1332>

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Carbon Budget 2010

An annual update of the global carbon budget and trends

Released in November 2011

HIGHLIGHTS

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6-page pamphlet on the Budget08

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Data Sources, files and uncertainties

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Media Information

Brief Highlights

The 'Carbon Budget 2010' is available in a compact format for the media.

Press Releases

Press releases from various research institutions that participate in this year's update.

Podcast

Interview with Pep Canadell, Executive Director of the Global Carbon Project.

Images

Images available for media coverage of the Carbon Budget.

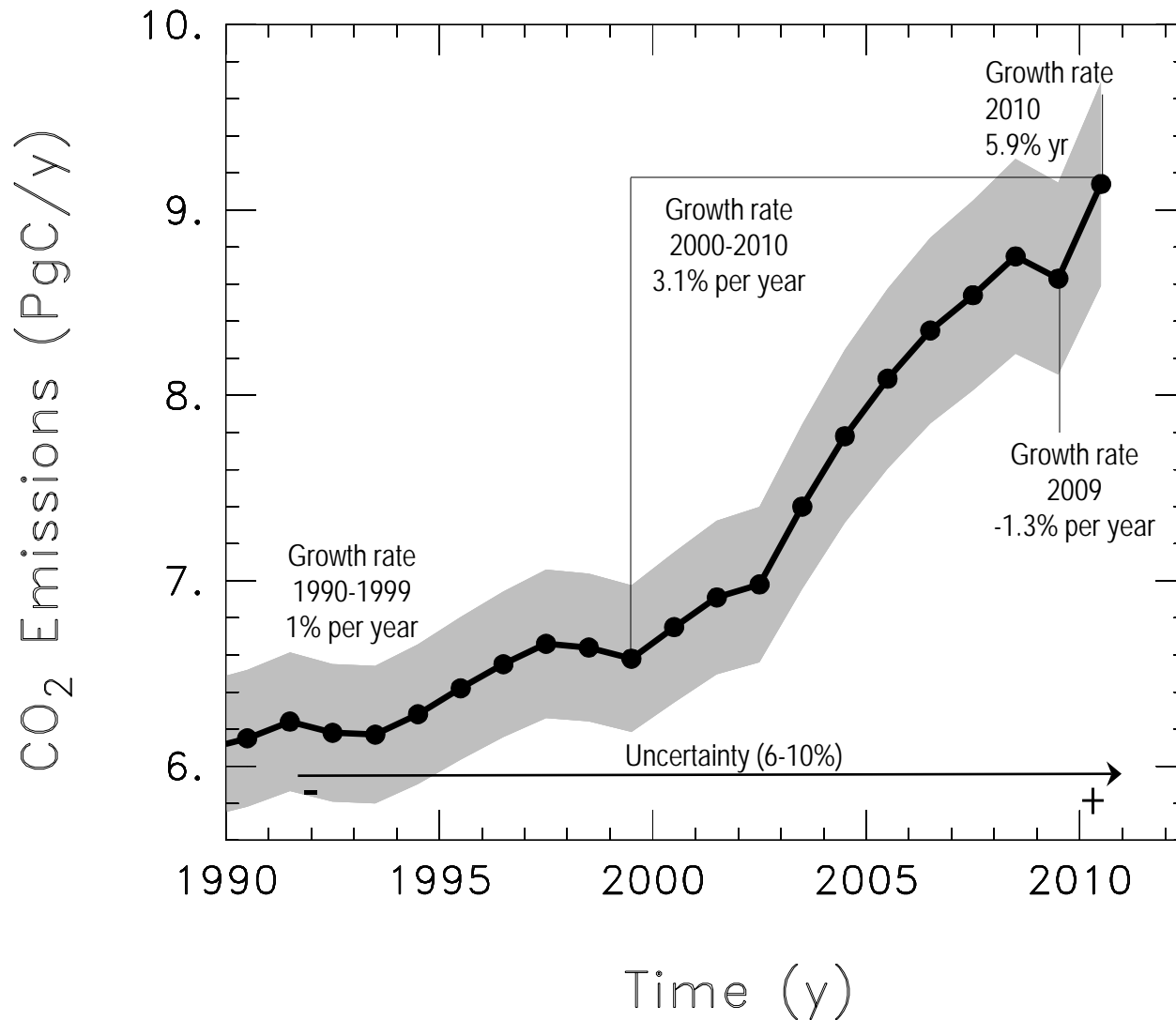
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Units

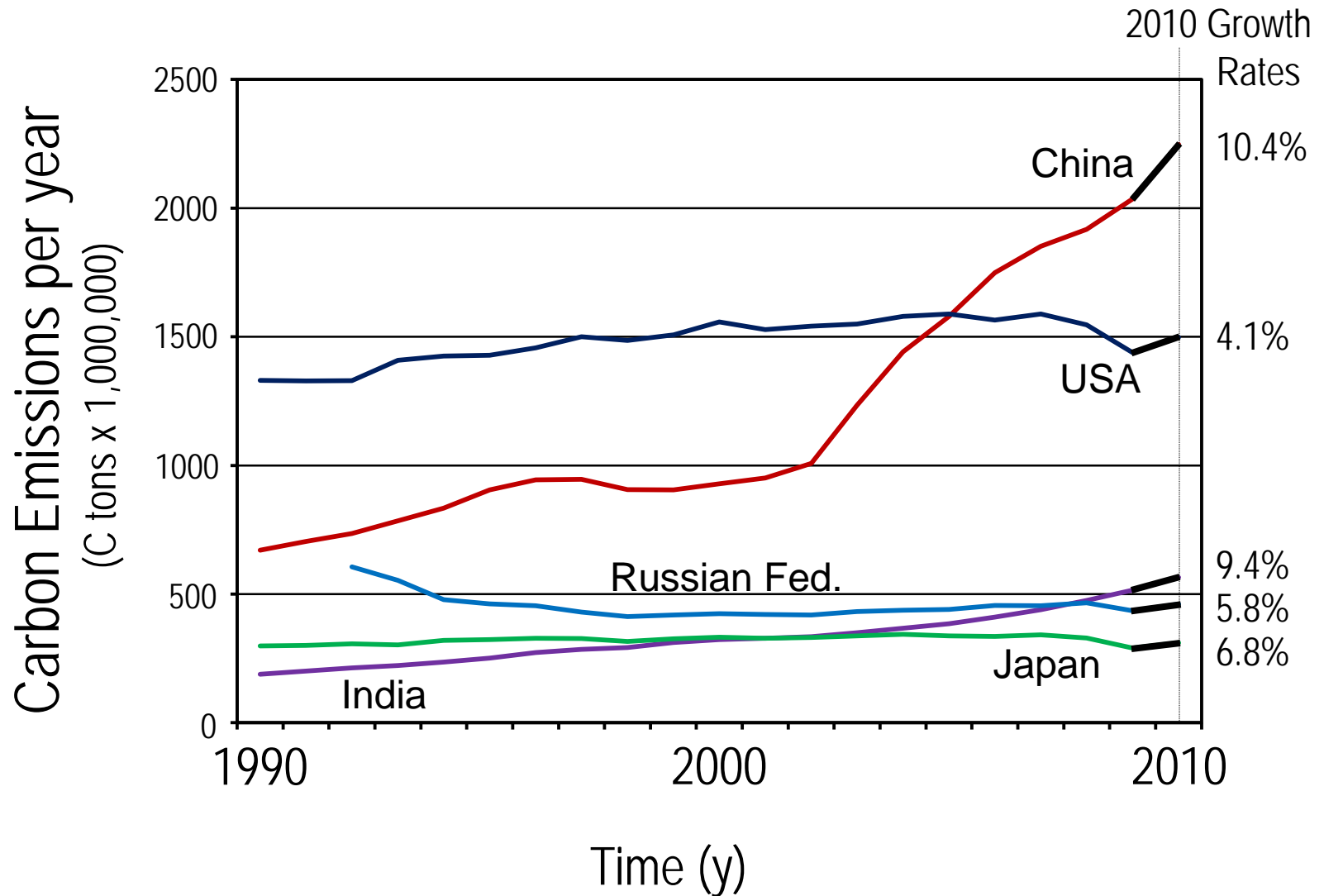
- 1 Pg = 1 Petagram = 1×10^{15} g = 1 Billion metric tons = 1 Gigaton
- 1 Tg = 1 Teragram = 1×10^{12} g = 1 Million metric tons
- 1 Kg Carbon (C) = 3.67 Kg Carbon Dioxide (CO₂)

Fossil Fuel & Cement CO₂ Emissions

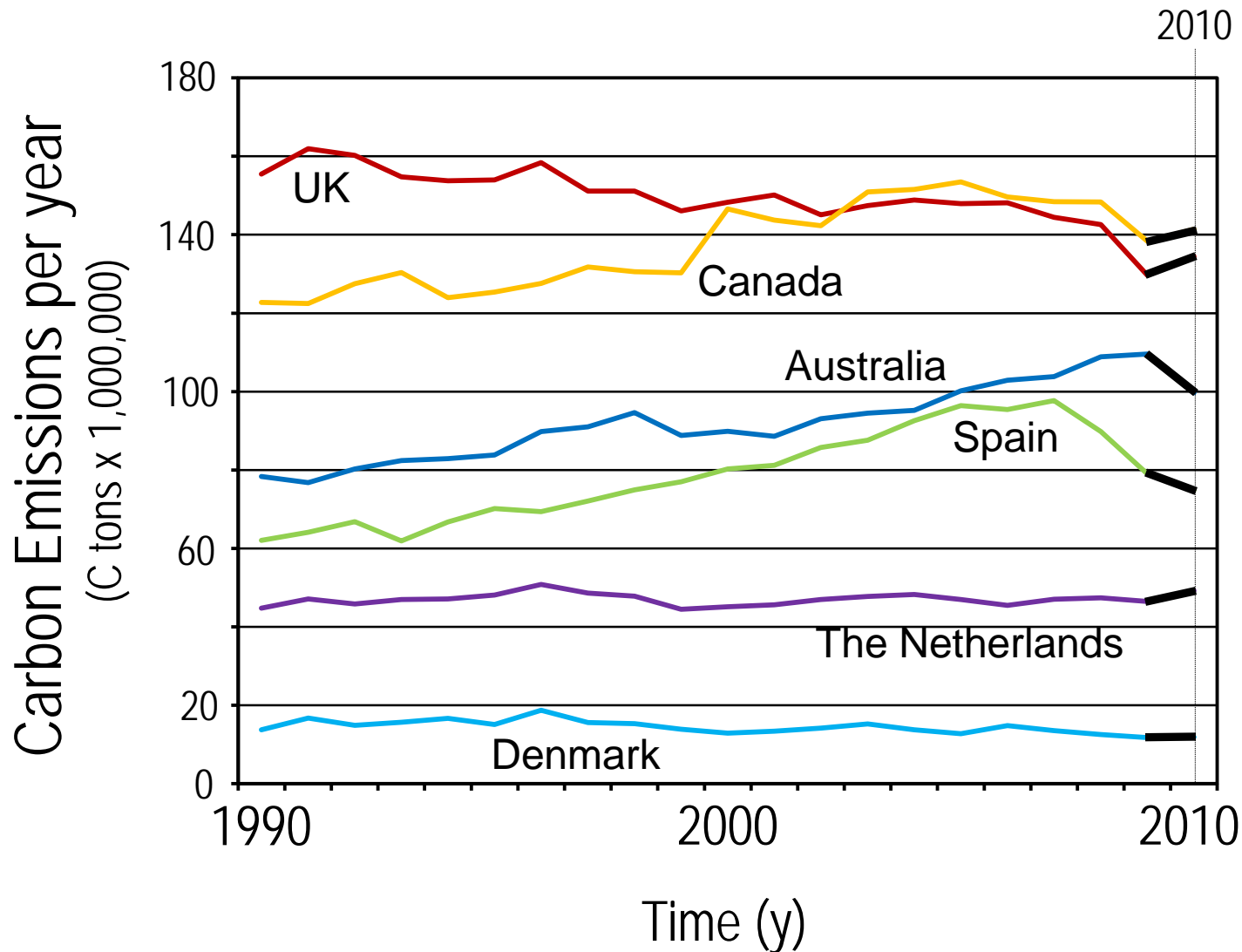


Peters et al. 2011, Nature CC; Data: Boden, Marland, Andres-CDIAC 2011; Marland et al. 2009

Fossil Fuel CO₂ Emissions: Top Emitters



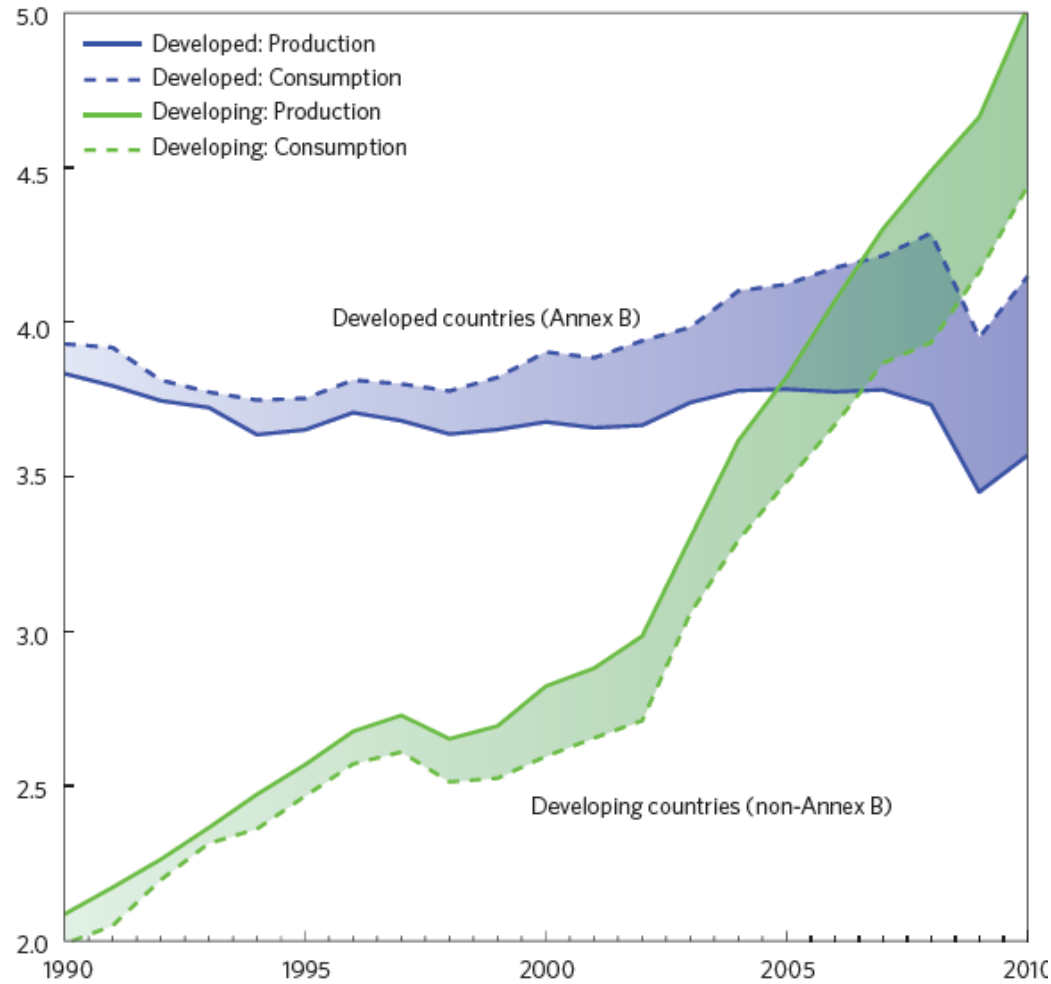
Fossil Fuel CO₂ Emissions: Profile Examples



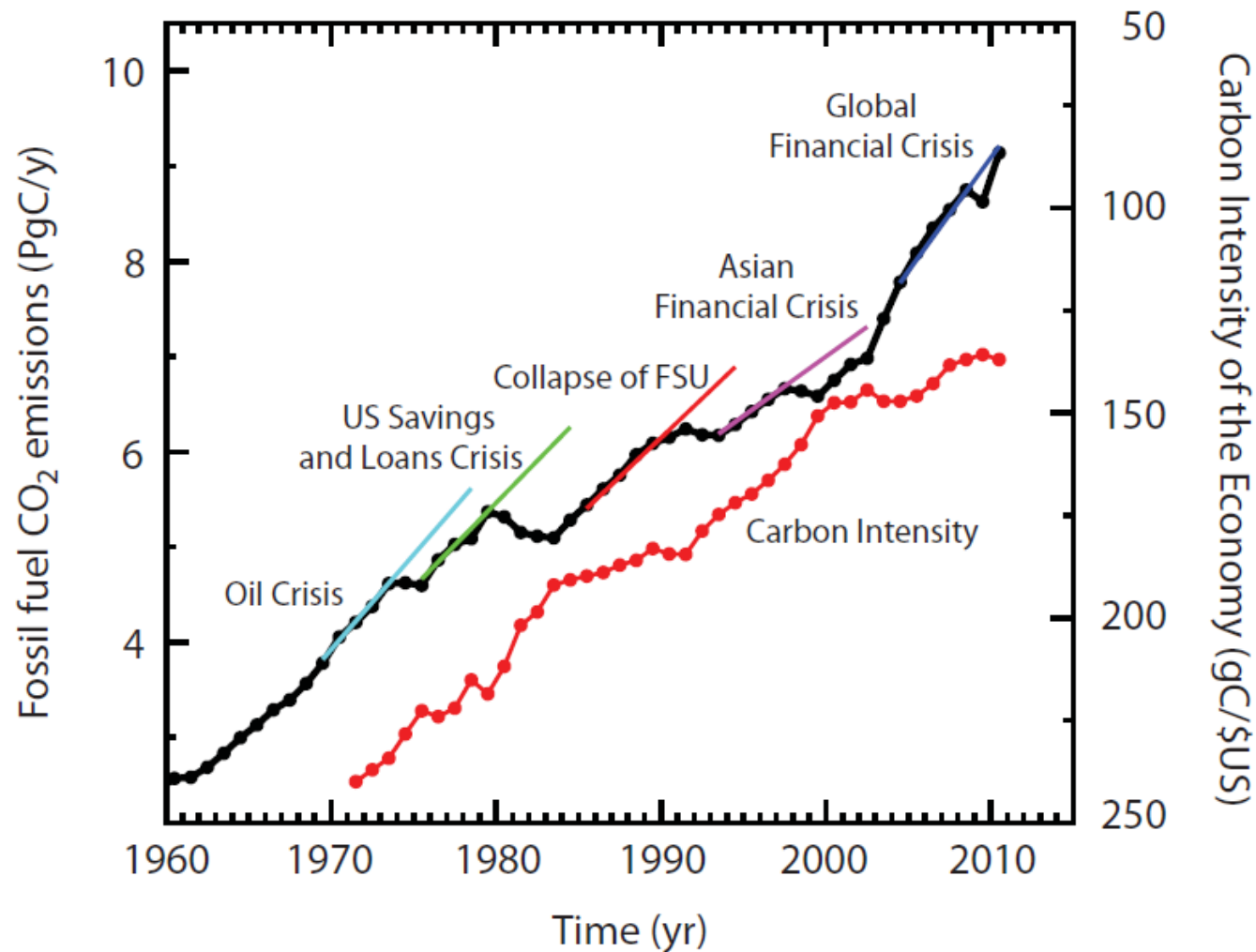
Fossil Fuel CO₂ Emissions Growth in 2010

Country	Emissions 2010 (PgC)	Growth 2010, PgC (%)	Average Growth 2009 and 2010 (PgC/yr, %/yr)
Global*	9.14	0.51 (5.9)	0.2 (2.2)
Developing countries (non-Annex B)			
non-Annex B	3.57	0.355 (7.6)	0.264 (5.6)
China	2.24	0.212 (10.4)	0.165 (8.0)
India	0.56	0.049 (9.4)	0.045 (8.6)
South Korea	0.15	0.013 (9.2)	0.007 (5.1)
Brazil	0.11	0.012 (11.6)	0.004 (3.3)
Indonesia	0.13	0.009 (7.9)	0.010 (8.0)
Saudi Arabia	0.13	0.009 (7.3)	0.008 (6.5)
Developed countries (Annex B)			
Annex B	5.02	0.118 (3.4)	-0.082 (-2.3)
United States of America	1.44	0.060 (4.1)	-0.026 (-1.8)
Russian Federation	0.46	0.025 (5.8)	-0.003 (-0.6)
European Union (EU27)	1.01	0.022 (2.2)	-0.029 (-2.9)
Japan	0.31	0.020 (6.8)	-0.009 (-3.1)
Germany	0.21	0.008 (4.0)	-0.003 (-1.6)

Fossil Fuel CO₂ Emissions (Production and Consumption)

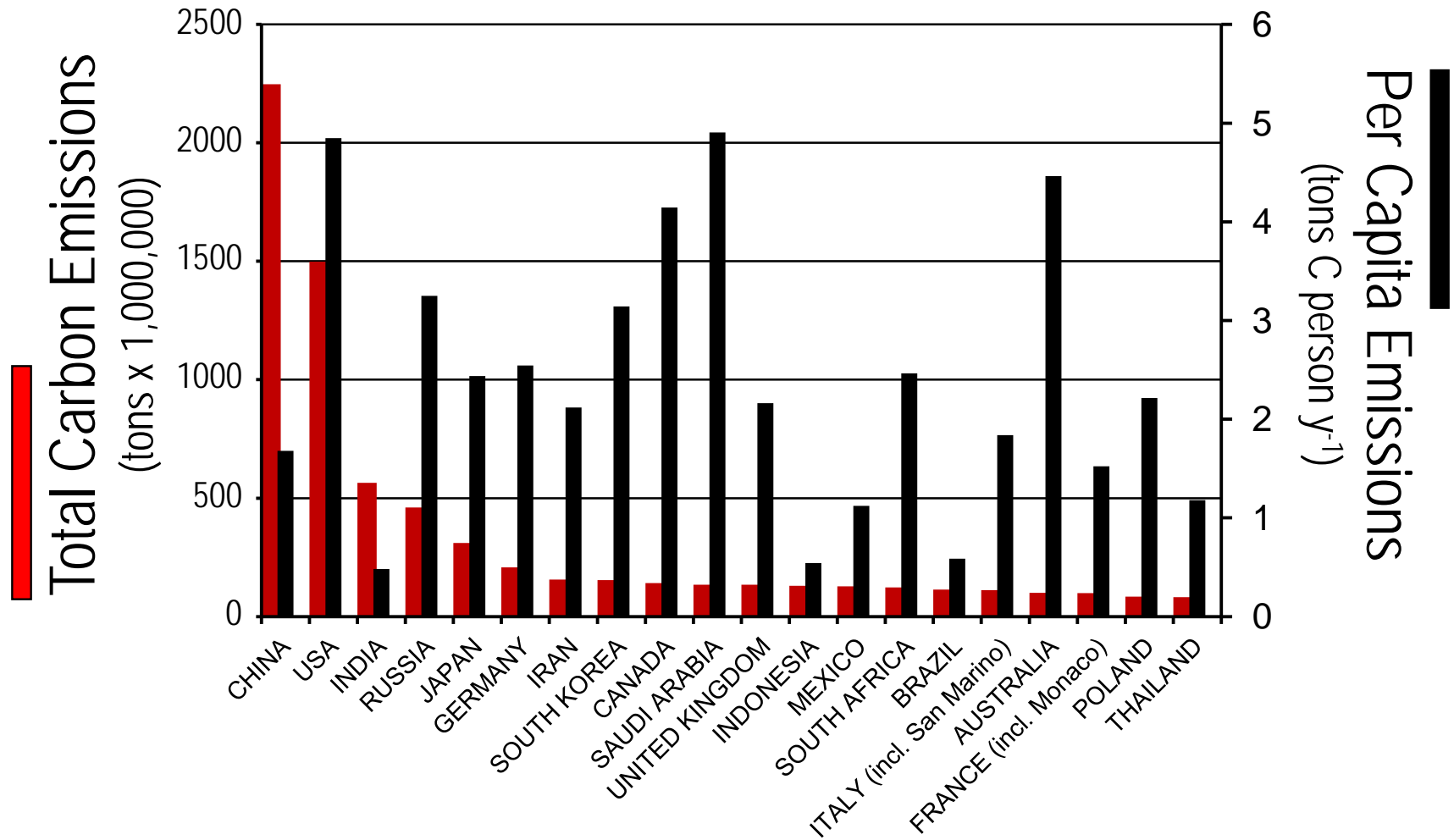


Impacts of Economic Crises on C Emissions

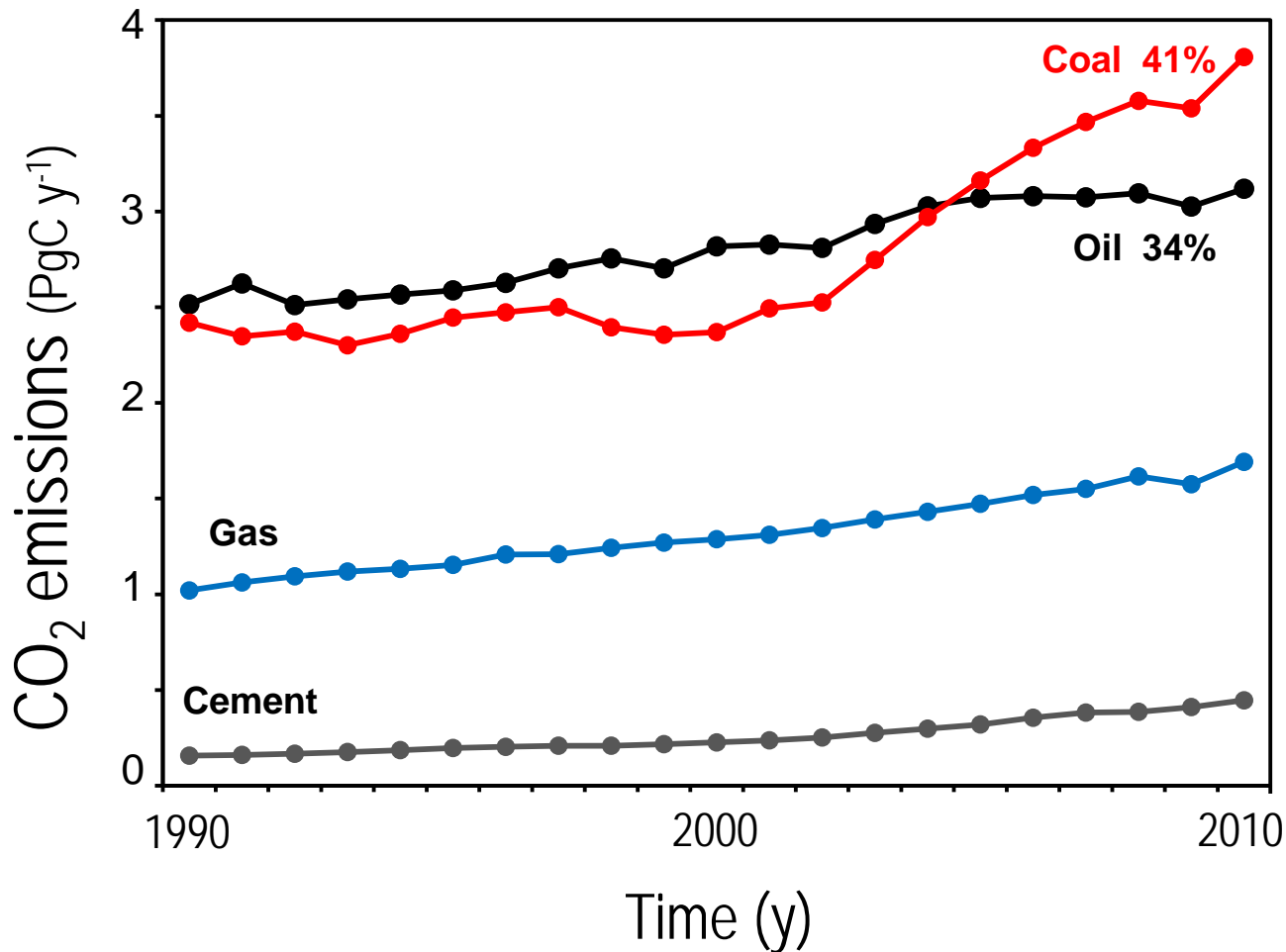


Peters et al. 2011, Nature CC

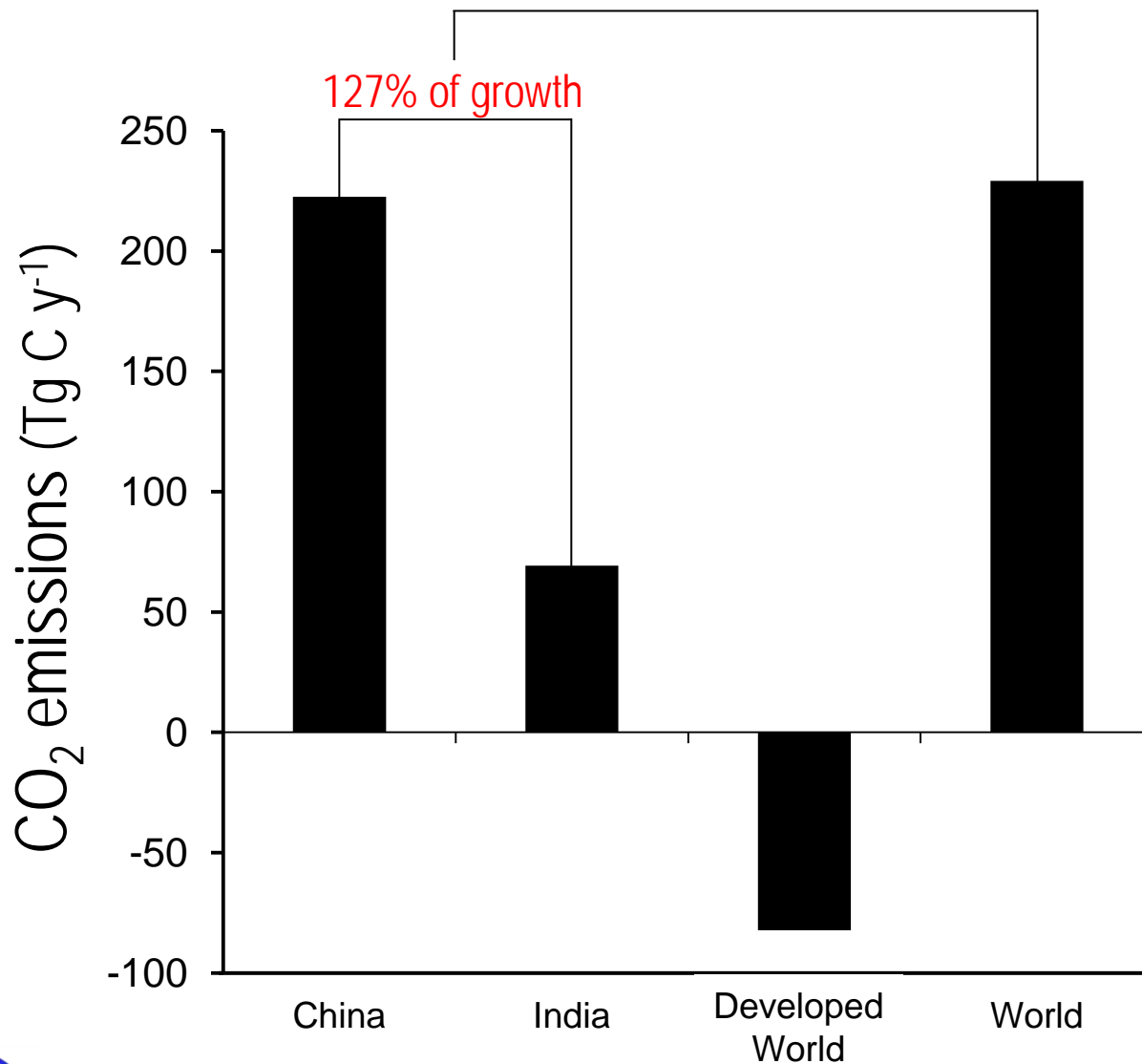
Top 20 CO₂ FF Emitters & Per Capita Emissions 2010



CO₂ Emissions by Fossil Fuel Type

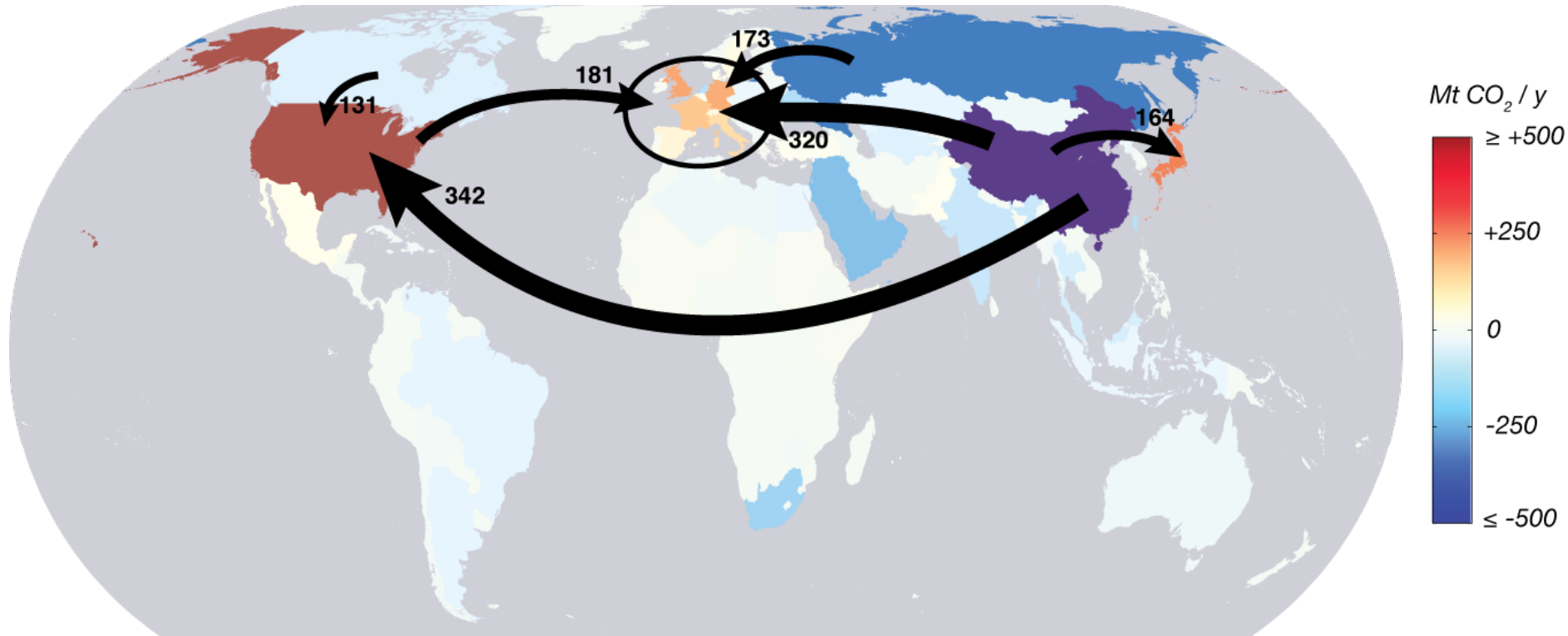


Change in CO₂ Emissions from Coal (2008 to 2010)



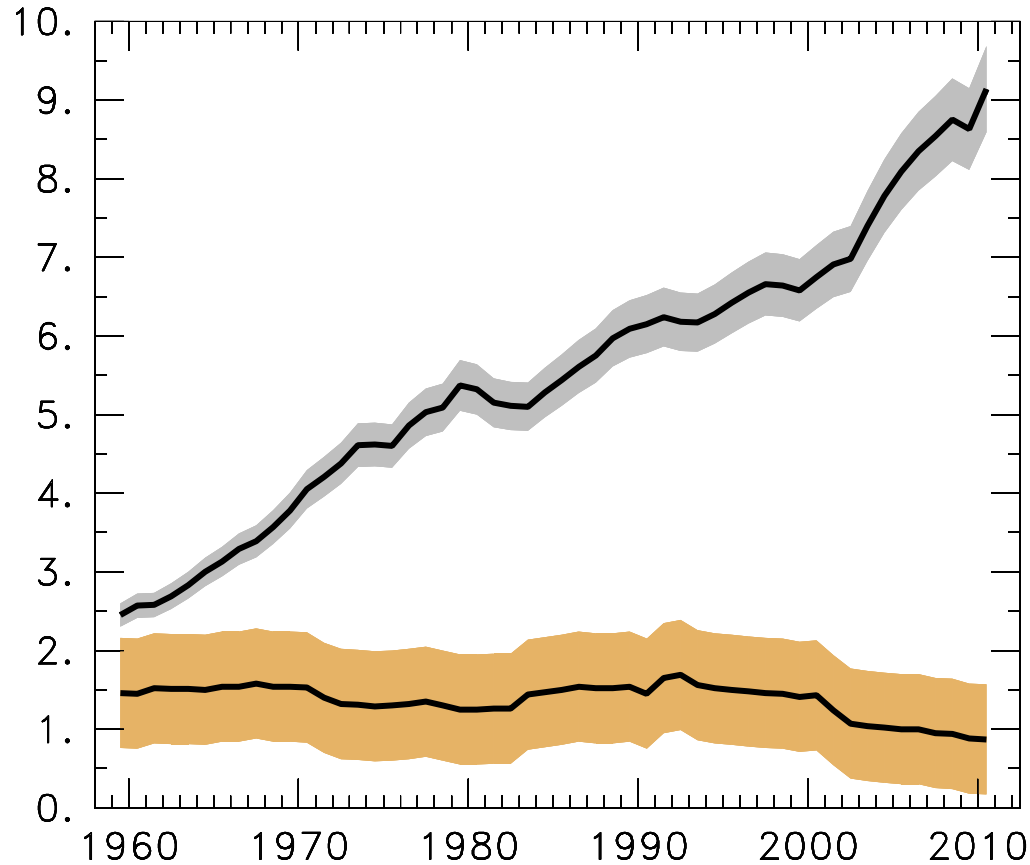
Carbon in Trade (2004):

Emissions embodied in products



Net exporting countries (blues) to net importing countries (reds)

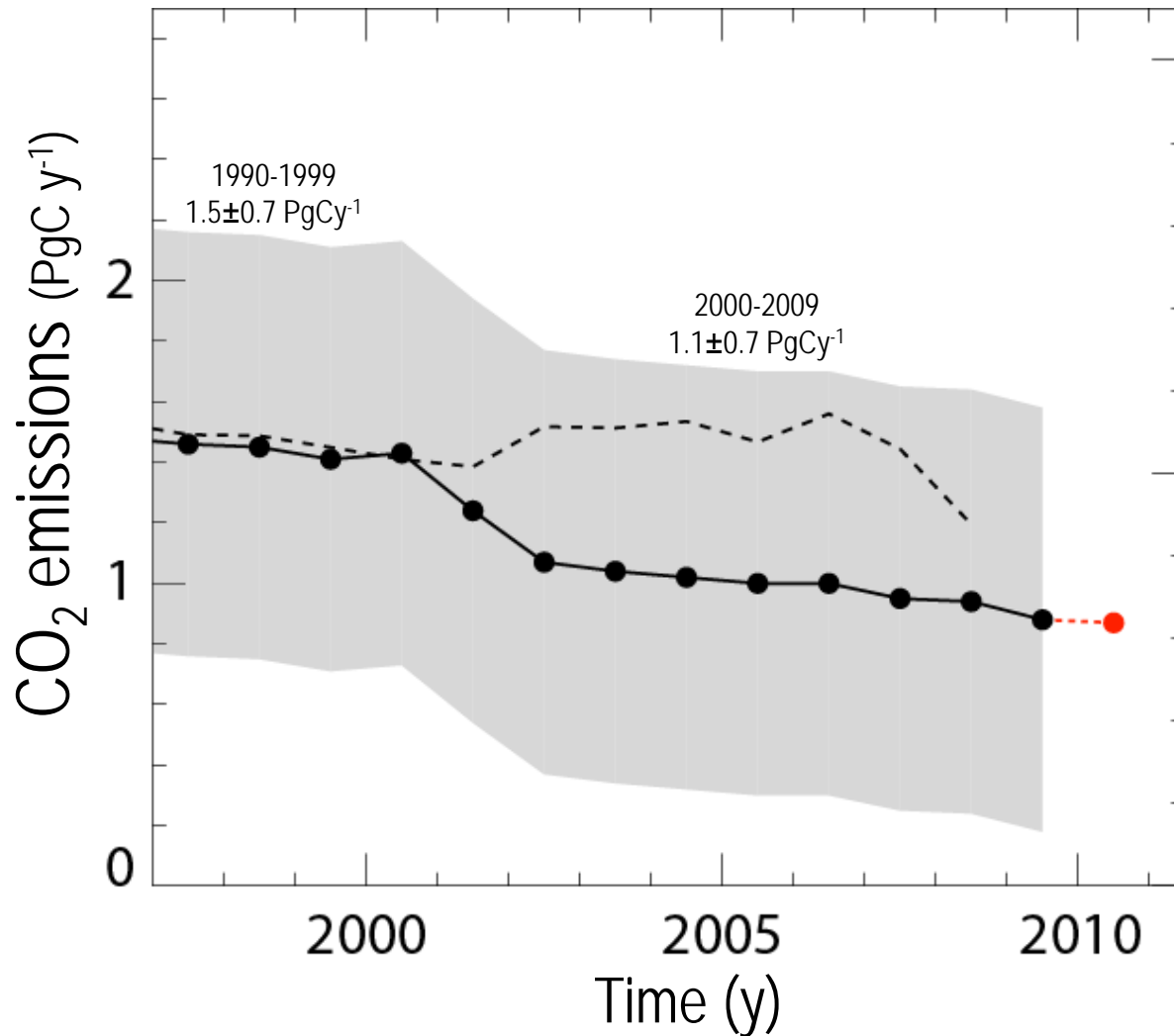
CO₂ Emissions from FF and LUC (1960-2010)



Current LUC emissions
~10% of total CO₂ emissions



CO₂ Emissions from Land Use Change



1990s

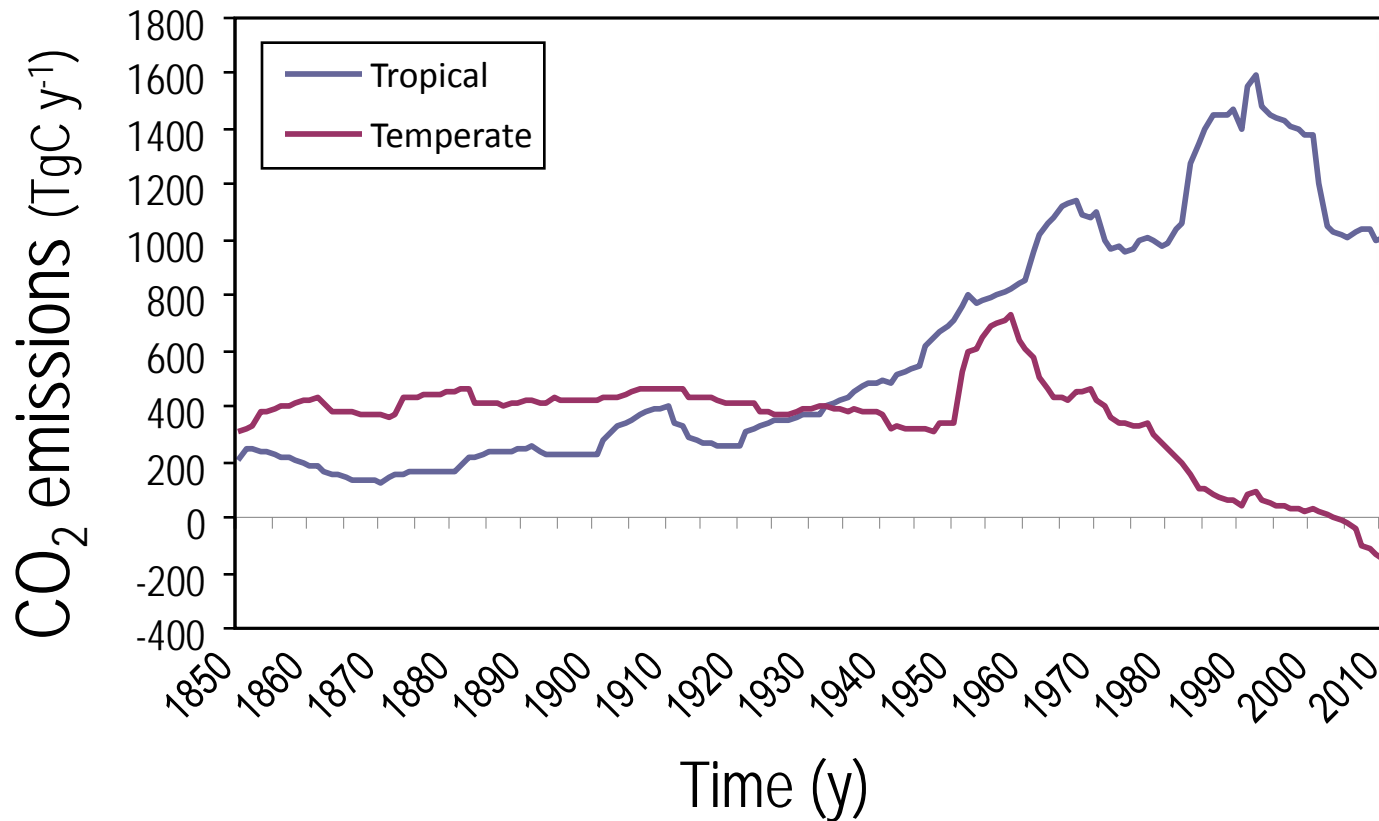
Emissions: 1.5 ± 0.7 PgC

2000-2010

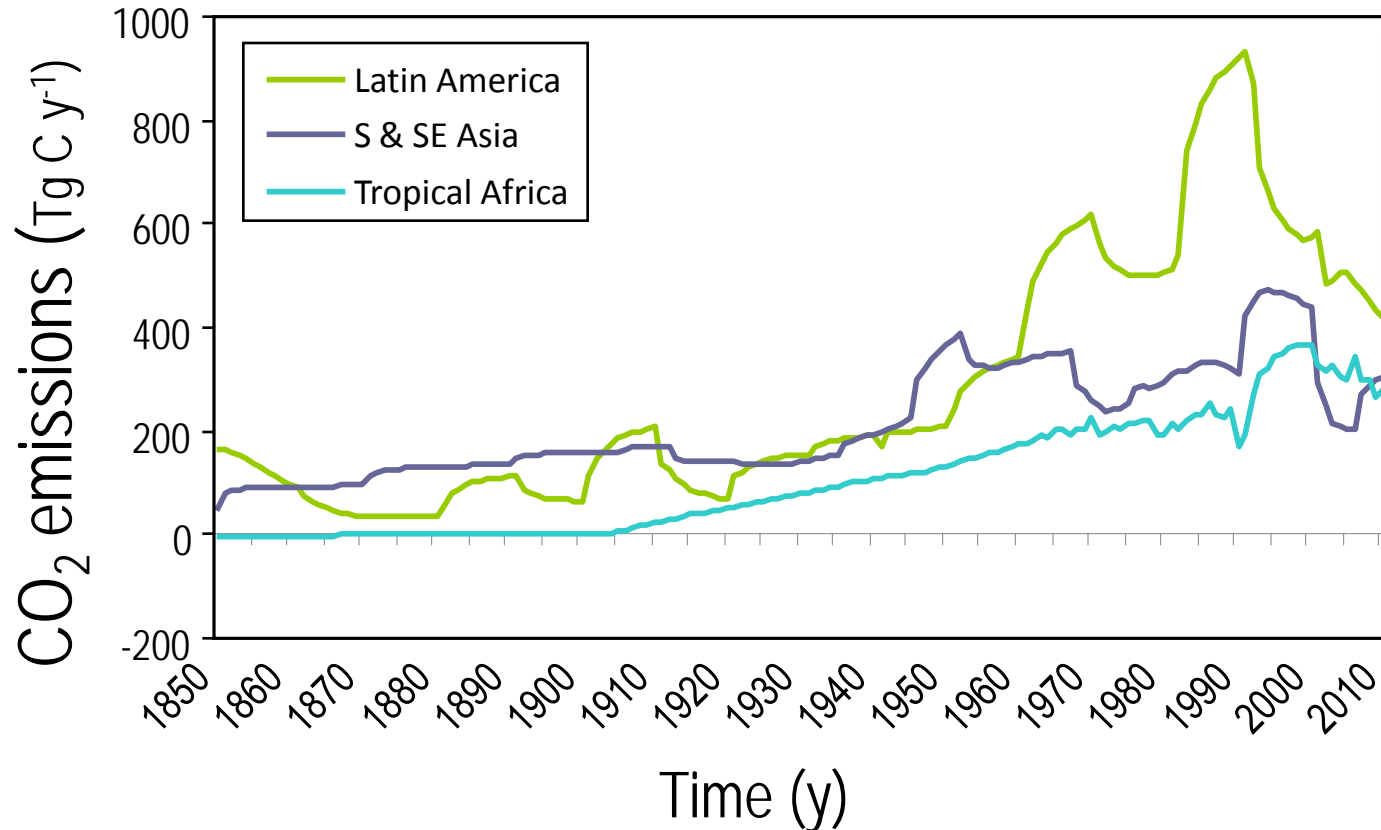
Emissions: 1.1 ± 0.7 PgC

Dashed line – previous estimate.

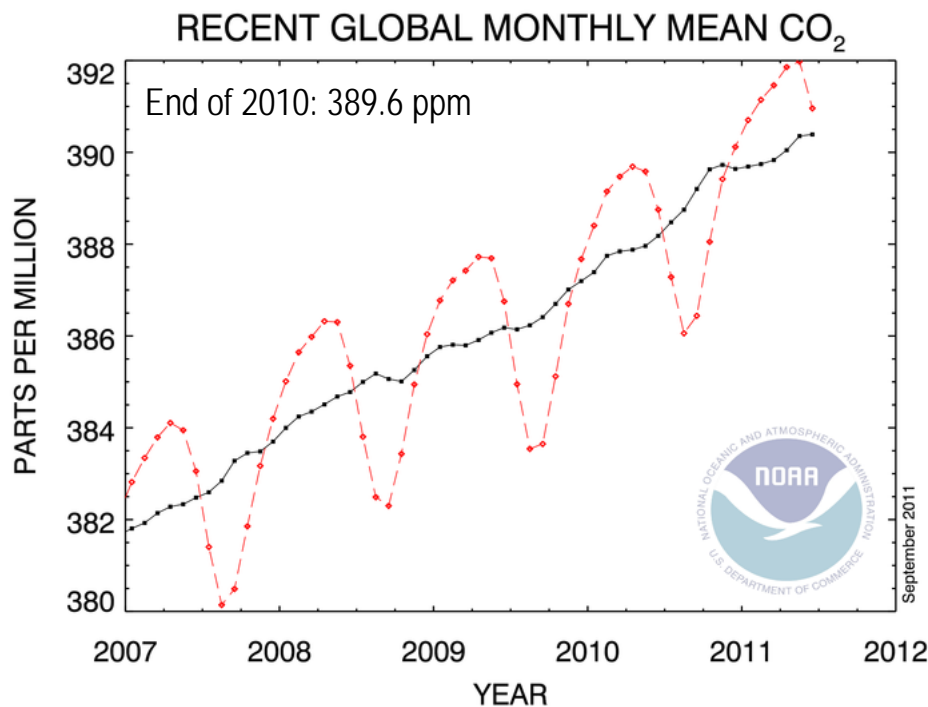
Emissions from Land Use Change (1850-2010)



Emissions from Land Use Change (1850-2010)



Atmospheric CO₂ Concentration



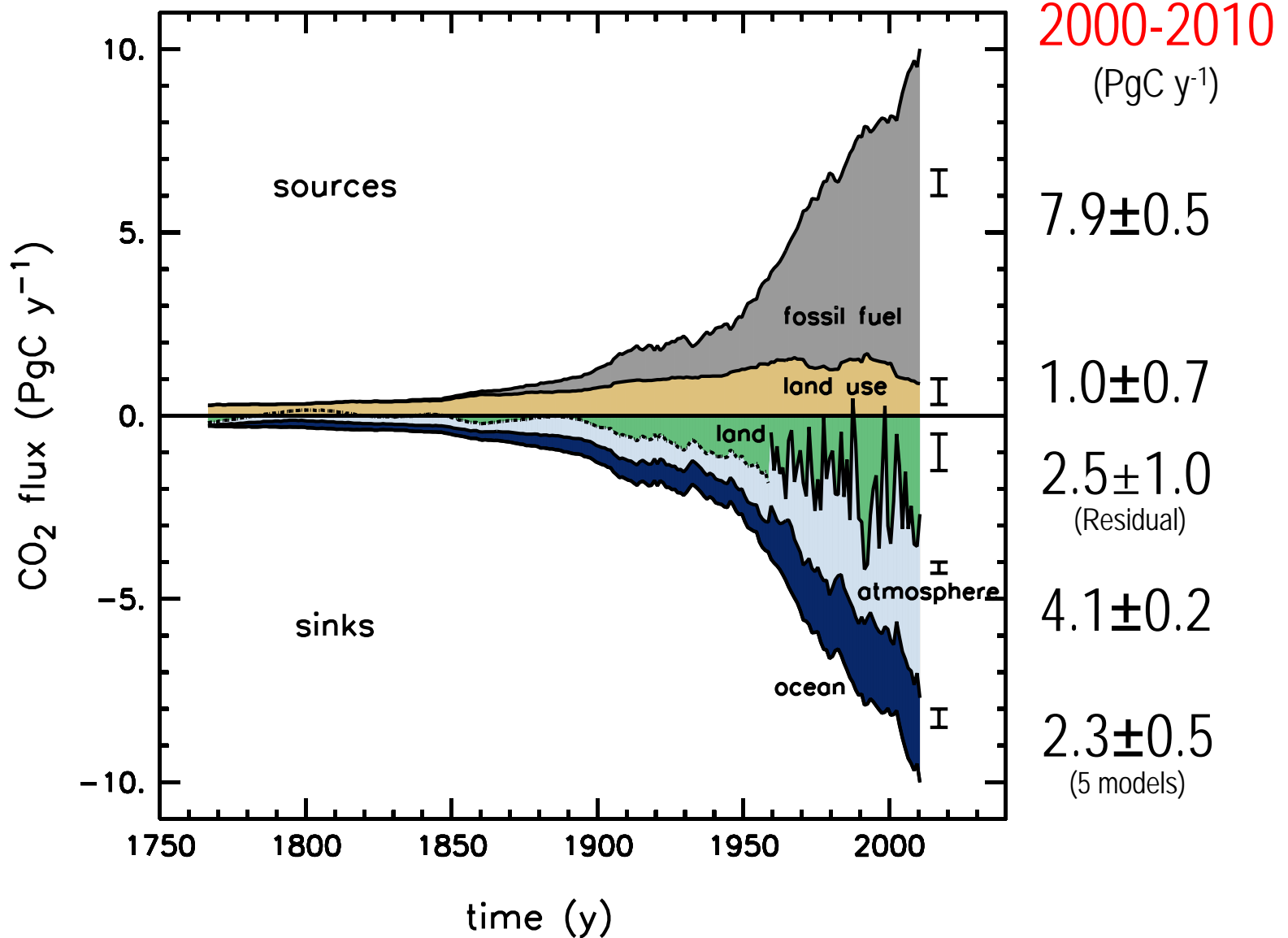
Annual Mean	Growth Rate (ppm y ⁻¹)
2010	2.36
2009	1.63
2008	1.81
2007	2.11
2006	1.83
2005	2.39
2004	1.58
2003	2.20
2002	2.40
2001	1.89
2000	1.22

Annual Growth Rates
(decadal means)

1970 – 1979: 1.3 ppm y⁻¹
 1980 – 1989: 1.6 ppm y⁻¹
 1990 – 1999: 1.5 ppm y⁻¹
 2000 – 2010: 1.9 ppm y⁻¹

Data Source: Thomas Conway, 2011, NOAA/ESRL + Scripps Institution

Human Perturbation of the Global Carbon Budget



Fate of Anthropogenic CO₂ Emissions (2010)

9.1±0.5 PgC y⁻¹



0.9±0.7 PgC y⁻¹

+



5.0±0.2 PgC y⁻¹

50%



2.6±1.0 PgC y⁻¹

26%

Calculated as the residual
of all other flux components



24%

2.4±0.5 PgC y⁻¹

Average of 5 models



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