Supplementary Information

Supplementary Methods

In this article, we provide preliminary estimates of CO_2 emissions in 2010. Collection, organization, and release of energy data by the United Nations Statistics Office requires 2 to 2½ years after the end of a calendar year[1]. Because of this time lag, and because of wide interest in having an indication of CO_2 emissions for the most recent years, we provide preliminary emissions estimates for two years more recent than the end of the UN energy data set. The formal CDIAC data set of CO_2 emissions is now current through 2008[1] and in this paper we update the global total and most of the major emitting countries for 2009 and 2010. Our experience with this process suggests that these preliminary estimates provide a good estimate of recent trends but there will be refinements in these numbers as full UN energy data become available for 2009 and 2010 and data for years up to 2008 are revised and updated[2,3]. Due to updates in both UN and BP statistics, emission estimates can change in previous years. For example, previously we found that global CO_2 emissions decreased 1.3% in 2009[3], but after updates we now estimate they decreased by 1.4%.

Estimates for 2009 and 2010 are based on energy data from the energy company BP[4]. The BP energy data are published in June of each year and cover years up to the most recently completed calendar year. We use the BP data to extrapolate two additional years beyond the end of the UN energy data set. For emissions from cement we extrapolate the USGS cement production time-series[5] for one year and for emissions from gas flaring we assume that emissions are unchanged from the 2008 values.

Not all of the countries in Annex B of the Kyoto Protocol have emission estimates in all years. We have estimated emissions for 1990 and 1991 from the republics that were formerly part of the USSR, Yugoslavia, and Czechoslovakia by taking total emissions from the USSR, Yugoslavia, and Czechoslovakia for 1990 and 1991 and distributing them among the new republics in the same ratio as emissions from those republics in 1992. Likewise, BP energy statistics used in 2009 and 2010 do not report all individual countries, but many smaller countries are allocated to regional aggregates[4]. We estimate the emissions for these countries by distributing the 2009 and 2010 aggregated regions in the same ratio as emissions in 2008. This implies that the disaggregated countries in each region have the same growth rates through 2009 and 2010. We do not allocate bunker fuels to either Annex B or non-Annex B countries.

The consumption-based estimates from 1990-2010 were based on an update and improvement of a previous study[6]. The original data was improved with a more recent version of the 1997 data (update to GTAP version 5.4 with greater country coverage), supplemented with detailed 2007 data (GTAP version 8), and the GDP data was extended to 2010 using the same data sources as the original estimates.

We use GDP data measured in purchasing power parities for the years 1971 to 2008 from the International Energy Agency[7]. We estimated the 2009 and 2010 values using the growth rates from the International Monetary Fund World Economic Outlook[8].

For the carbon budget, the ocean CO_2 sink for 2010 is an update of the 1959-2008 time-series estimate of Le Quéré et al.[2] We calculated the change in CO_2 from 2008 using the average sink anomalies of four ocean biogeochemistry models[9-12] forced by meteorological data for the specific years.

The growth rates for single year comparisons were calculated as a difference: $(v_{2010}-v_{2009})/v_{2009}$. The growth rates for multi-year comparison were calculated as the ratio of the linear regression and mean values[13]: (linear regression slope)/(mean value).

Supplementary Data

All data presented in this paper, including the full global CO_2 budget for 2010, can be accessed from:

http://www.globalcarbonproject.org/carbonbudget

References

1   Boden, T. A., Marland, G. & Andres, R. J.   (Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, 2011).

2   Le Quéré, C. *et al.* Trends in the sources and sinks of carbon dioxide. *Nature Geoscience* **2**, 831-836 (2009).

3   Friedlingstein, P. *et al.* Update on CO_2 emissions. *Nature Geoscience* **3**, 811-812 (2010).

4   BP. *BP Statistical Review of World Energy June 2011*, <bp.com/statisticalreview > (2011).

5   van Oss, H. G. 2009 Minerals Yearbook - Cement [Advanced Release]. (US Geological Survey, 2011).

6   Peters, G. P., Minx, J. C., Weber, C. L. & Edenhofer, O. Growth in emission transfers via international trade from 1990 to 2008. *Proceedings of the National Academy of Sciences* **108**, 8903-8908 (2011).

7   IEA. CO_2 emissions from fuel combustion highlights (International Energy Agency, Paris, 2011).

8   IMF. World Economic Outlook - Update June. (International Monetary Fund, Washington DC, 2011).

9   Doney, S. C. *et al.* Mechanisms governing interannual variability in upper-ocean inorganic carbon system and air–sea CO2 fluxes: Physical climate and atmospheric dust. *Deep Sea Research Part II: Topical Studies in Oceanography* **56**, 640-655, doi:10.1016/j.dsr2.2008.12.006 (2009).

10   Assmann, K. M., Bentsen, M., Segschneider, J. & Heinze, C. An isopycnic ocean carbon cycle model. *Geosci. Model Dev.* **3**, 143-167, doi:10.5194/gmd-3-143-2010 (2010).

11   Aumont, O. & Bopp, L. Globalizing results from ocean in situ iron fertilization studies. *Global Biogeochem. Cycles* **20**, GB2017, doi:10.1029/2005gb002591 (2006).

12   Buitenhuis, E. T., Rivkin, R. B., Sailley, S. & Le Quéré, C. Biogeochemical fluxes through microzooplankton. *Global Biogeochem. Cycles* **24**, GB4015, doi:10.1029/2009gb003601 (2010).

13   Raupach, M. R. *et al.* Global and regional drivers of accelerating CO_2 emissions. *Proceedings of the National Academy of Sciences* **104**, 10288-10293, doi:10.1073/pnas.0700609104 (2007).

Table SI 1: The emissions growth globally, for developed and developing countries, and for the 10 countries with the largest absolute emissions growth in 2010. The table shows the 2010 growth and the combined 2009 and 2010 growth rate based on regression (Supplementary Methods). *Country totals do not add to the global total since a) there are global imbalances in energy trade statistics, b) global totals include emissions from non-fuel hydrocarbon products (e.g., asphalt) whereas national totals do not, c) changes in fuel stocks are not reported by many countries and we assume that globally there is no change over time, and d) emissions from bunker fuel use are included in global estimates but not national totals.

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)