



DIVERSITAS IGBP IHDP WCRP

Earth System Science Partnership (ESSP)

Community building for new insights in climate science and global environmental change research

Introduction

The ESSP is a science partnership of the four international global environmental change research programmes – an international programme of biodiversity science (DIVERSITAS), International Geosphere-Biosphere Programme (IGBP), International Human Dimensions Programme on Global Environmental Change (IHDP), and the World Climate Research Programme (WCRP) - for the integrated study of the Earth system, the ways that it is changing, and the implications for global and regional sustainability.

Science highlights

Agriculture as a driver for deforestation

REDD+ has now got considerable impetus, and a work program on REDD+ will be initiated in Bonn. A key issue is “agriculture as a driver of deforestation”. The majority of deforestation is caused by agriculture, but given the role of agriculture in meeting global food security targets, it is not simply a case of restricting agriculture to ensure the success of REDD+. *Climate Change, Agriculture and Food Security (CCAFS)* a coordinated effort of Consultative Group on International Agricultural Research (CGIAR) and the ESSP, shows that countries involved in REDD+ are not yet taking agriculture seriously in their REDD+ strategies and early actions, and much more integration of the agriculture and forestry sectors is needed. Research has also shown the gains that can be achieved by intensifying agriculture and thus reducing the pressure on forests. Yet other work shows how forest governance approaches have to be combined with agricultural incentives to meet both mitigation and food security goals.

Observed impacts of climate change and resulting impacts for society

A two degree rise in temperature (and changes in rainfall patterns) is predicted to have major changes on farming and food systems. For agriculture, a four degree world is beyond the bounds of both local and global knowledge. Africa-wide, a massive 1.2 million km² may be forced to flip from typical mixed farms, with both crops and livestock, into pure rangeland. But this only considers long term averages - for agriculture, it is often the extremes that count. And these have repercussions throughout the food system and throughout society (e.g. price volatility, export bans, food riots). Farmers are already observing changes in weather patterns and in pests and diseases, and have linked the changes to climate change. They are responding by changing crop varieties, switching to completely different crops and, in some cases, migrating. In a number of cases the local adaptation strategies have increased greenhouse gas emissions. Key questions relate to how to enhance the capacity for accelerated adaptation, how to improve climate risk management and how to manage trade-offs between adaptation and mitigation. New tools, technologies and institutional options are available for driving early action in “climate-smart” food systems.

Emissions of carbon dioxide

Global Carbon Project (GCP) launched the *Carbon Budget 2009* in November 2010. It confirms the earlier findings that the fossil fuel CO₂ emissions continue to grow strongly and despite the global financial crisis. The annual growth rate of atmospheric CO₂ was 1.6 ppm in 2009, below the average for the period 2000-2008 of 1.9 ppm per year (ppm = parts per million). The mean growth rate for the previous 20 years was about 1.5 ppm per year. This increase brought the atmospheric CO₂ concentration by 39% above the concentration at the start of the industrial revolution. The present concentration is the highest during at least the last 2 million years. Fossil fuel CO₂ emissions decreased by 1.3% in 2009. These emissions were second highest in human history, just below 2008 emissions, and 37% higher than in 1990 (Kyoto reference year). Coal is now the largest fossil-fuel source of CO₂ emissions. About 92% of the growth in coal emissions for the period 2007-2009 resulted from increased coal use in China and India

Global Carbon Project (2010) Carbon budget and trends 2009.
[www.globalcarbonproject.org/carbonbudget] released on 21 November 2010

Financial crisis and emissions

The abrupt decline in fossil fuel emissions by 1.3% in 2009 is indisputably the result of the global financial crisis (GFC). However, the decline was smaller than anticipated because: 1) the contraction of the Global World Product (GWP) was only -0.6%, as opposed to the forecasted -1.1%; and 2) the impact of the GFC was largely in developed economies which led more carbon-intense economies to take a larger share of the production of global wealth (with associated higher emissions). Emissions in 2010 are expected to have increased by at least 3%, already back to the high growth rate observed since 2000. There is evidence that CO₂ emissions from land use change could have been lower in 2000-2010 compared to the previous decade, though the uncertainty is large.

Friedlingstein, P, R. A. Houghton, G. Marland, J. Hackler, T. A. Boden, T. J. Conway, J. G. Canadell, M. R. Raupach, P. Ciais and C. Le Quéré, Update on CO₂ emissions, Nature Geosciences, 2010

Carbon sinks

Natural land and ocean CO₂ sinks removed 57% of all CO₂ emitted from human activities during the 1958-2009, each sink in roughly equal proportion. During this period, the size of the natural sinks has grown almost at the same pace as the growth in emissions, although year-to-year variability is large. There is the possibility, however, that the efficiency of the natural sinks is declining, an issue currently under intense debate in the scientific community. In 2009, the CO₂ sink increased slightly in response to the end of La Nina event that perturbed the global climate system from mid 2007 to early 2009.

Global Carbon Project (2010) Carbon budget and trends 2009.
[www.globalcarbonproject.org/carbonbudget] released on 21 November 2010

Human water security and aquatic biodiversity security

Recent results of a study, prepared by *Global Water System Project (GWSP)* and *DIVERSITAS* scientists provide a worldwide joint assessment of human water security and biodiversity security. The assessment is based on 23 selected indicators. The study concluded that while the positive effects of beneficiary investments to improve water security for human use could be proven, though sometimes at the expense of aquatic biodiversity, no comprehensive data were available about direct investments to protect and rehabilitate biodiversity. The lack of consideration and safeguarding of biodiversity has a serious consequence in the context of climate change. As ecosystem service security is closely correlated with ecosystem health, and hence biodiversity, the climate change induced shifts of ecosystem boundaries will increasingly jeopardize the livelihoods of those who rely directly on ecosystem services. The over one billion subsistence farmers worldwide are among those primarily affected. While it was acknowledged that the poor would be most affected by climate change, this can be proven even through the indirect secondary effects of biodiversity loss.

It is worth to note and to emphasize that wetlands and streams, due to their biological transfer function are particularly vulnerable. Aquatic species extinction is about twice as high as that of terrestrial ones. Bad and short sighted water policies accentuate the effects of climate change and vice versa.

C. J. Vörösmarty, P. B. McIntyre, M. O. Gessner, D. Dudgeon, A. Prusevich, P. Green, S. Glidden, S. E. Bunn, C. A. Sullivan, C. Reidy Liermann, P. M. Davies (2010): *Global threats to human water security and river biodiversity*. *Nature*, Vol 467: 555-561.

Human health in changing climate

The Global Environmental Change and Human Health (GECHH) project foster international networked research, promote training and capacity-building and to enable science/policy bridges highlighting the importance of integrative and holistic approaches in addressing the linkages between climate change and human health, and also within the context of the Millennium Development Goals. Among the GECHH activities, it is important to recall the upcoming GECHH 2011 Symposium “*Global Environmental Change and Human Health: Healthy Forests for Life*” (Verbania, Italy 19-21 September 2011) organized in partnership with the Institute of Ecosystem Study (ISE) and the Water Research Institute (IRSA) of the Italian National Research Council (CNR). The Symposium and other initiatives will allow for furthering the understanding of the linkages between climate change and human health, taking into account – *inter alia* – the growing evidence that a number of mitigation and adaptation strategies result in major health co-benefits, and that the value of these health co-benefits can potentially offset the costs of implementing the strategies by varying amounts depending on the strategy and the setting. For instance, a number of greenhouse gas (GHG) mitigation strategies result in health co-benefits, including policies to promote active travel (walking and cycling) in urban centres and the reduction of private car use which can result in substantial reductions in cardiovascular disease, diabetes, depression and some cancers related to sedentary lifestyles.

Furthermore, GECHH also fosters international efforts to increase adaptation options in the health sector, through improved understanding of vulnerable populations and regions, sharing of lessons learned in modifying current and implementing new public health policies and measures to address the health risks of global change, and collaboration with international processes such as the UNFCCC Nairobi Work Programme.

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