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

Options for Agriculture in the UNFCCC

Prof Bruce Campbell (Director) or Dr Sonja Vermeulen (Head of Research), CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

New findings demonstrate the major impacts of climate change on smallholder farmers (Erickson et al., 2011) and agricultural productivity (e.g. Lobell et al. 2011). Balancing food security, adaptation and mitigation imperatives will be a major challenge of the 21st century (Vermeulen et al., 2011). Emerging options for managing the tradeoffs, from farmer to global climate change policy, are discussed, including how agriculture can contribute to climate change mitigation.

Lobell, D.B., Banziger, M., Magorokosho, C., Vivek, B., 2011. Nonlinear heat effects on African maize as evidenced by historical yield trials. Nature Climate Change 1, 1–4.

Vermeulen, S.J., Aggarwal, P.K., Ainslie, A., Angelone, C., Campbell, B.M., Challinor, A.J., Hansen, J.W., Ingram, J.S.I., Jarvis, A., Kristjanson, P., Lau j, C., Nelson, G.C., Thornton, P.K., Wollenberg, E. 2011. Options for support to agriculture and food security under climate change. Environ. Sci. Policy (2011), doi:10.1016/j.envsci.2011.09.003

Ericksen, P., Thornton, P., Notenbaert, A., Cramer, L., Jones, P. and M. Herrero. 2011. Mapping hotspots of climate change and food insecurity in the global tropics. CCAFS Report No. 5. CGIAR Research Program on Climate Change, Agriculture and Food Security.

The Impact of Regional Climate Change on Malaria Risk

Climate change will probably alter the spread and transmission intensity of malaria in Africa. Model-based estimates for the present climate (1960 to 2000) are consistent with observed data for the spread of malaria in Africa. In the model domain, the regions where malaria is epidemic are located in the Sahel as well as in various highland territories. A decreased spread of malaria over most parts of tropical Africa is projected because of simulated increased surface temperatures and a significant reduction in annual rainfall. However, the likelihood of malaria epidemics is projected to increase in the southern part of the Sahel. In most of East Africa, the intensity of malaria transmission is expected to increase. Projections indicate that highland areas that were formerly unsuitable for malaria will become epidemic, whereas in the lower-altitude regions of the East African highlands, epidemic risk will decrease. We project that climate changes driven by greenhouse-gas and land-use changes will significantly affect the spread of malaria in tropical Africa well before 2050. The geographic distribution of areas where malaria is epidemic might have to be significantly altered in the coming decades.

Volker Ermert, Andreas H. Fink,1 Andrew P. Morse,2 and Heiko Paeth, *The Impact of Regional Climate Change on Malaria Risk due to Greenhouse Forcing and Land-Use Changes in Tropical Africa*, Environmental Health Perspectives, volume 120, number 1, 2012

Trends in CO2 emissions

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. Our estimated emissions from fossil fuel combustion and cement production of 9.1±0.5 Pg C, combined with the emissions from land-use change of 0.9±0.7 Pg C (ref. 8), led to a total emission of 10.0±0.9 Pg C in 2010. Half of the total emissions (5.0±0.2 Pg C) remained in the atmosphere, leading to one of the largest atmospheric growth rates in the past decade (2.36±0.09 ppm of CO2) and an atmospheric concentration at the end of 2010 of 389.63±0.13 ppm of CO2. Of the remainder of the total emissions (5.0±0.9 Pg C), we estimated that the ocean sink was 2.4±0.5 Pg C, and the residual attributed to the land sink was 2.6±1.0 Pg C. The land sink was more than 1 Pg C below the strength of the sink over the previous two years, but this high variability of the land sink is well known and due to natural variability.

Peters et al., Rapid growth in CO_2 emissions after the 2008–2009 global financial crisis, NATURE CLIMATE CHANGE 2011

Permafrost Carbon Emissions

Reports of tundra fires, ancient carbon release, lake methane bubbling and gigantic stores of frozen soil carbon have been emanating from the Arctic zone in recent years. Approximately 1700 Pg (billion tons) of soil carbon (C) are stored in the northern circumpolar permafrost zone, more than twice as much C than currently exists in the atmosphere. Permafrost thaw, and the microbial decomposition of previously frozen organic C, is considered one of the most likely positive feedbacks from terrestrial ecosystems to the atmosphere in a warmer world. The overall amount, rate, and form of C released are crucial for predicting the strength and timing of this C cycle feedback during this century and beyond, yet uncertainty concerning all of these dynamics is high. We used an expert survey to quantify uncertainty and measure consensus concerning the understanding of future permafrost C feedbacks to climate change. A group of international experts in this issue was asked to provide quantitative estimates of permafrost change in response to four scenarios of Arctic warming. For the highest warming scenario presented to the group, survey results indicate that C release from permafrost zone soils could be 30-46 Pg C over the next three decades, reaching 242-324 Pg C by 2100, and potentially up to 551-710 Pg C over the next several centuries (all estimates in CO2 equivalents). Most of the actual C release by weight is expected to be in the form of CO_2, with only about 2.3% of that in the form of CH_4. However, the higher global warming potential of CH_4 means that almost half of the climate forcing from permafrost C release was expected by this group to be a result of CH_4, produced by organic matter decomposition in wetlands, lakes, and other oxygen-limited environments. Experts projected that under the lowest warming scenario two-thirds of this release could be avoided. Across the dataset, the distribution of responses largely fit a lognormal distribution with a small number of experts estimating significantly higher impacts than the mean group response. These results highlight both the potential risk from permafrost thaw and serve to frame a hypothesis about the magnitude of this feedback to climate change.

Impacts of urbanization on national transport and road energy use

Few attempts have been made to investigate quantitatively and systematically the impact of urbanization on transport energy use for countries of different stages of economic development. After controlling for population size, income per capita and the share of services in the economy, the main results suggest that urbanization influences national transport and road energy use positively. However, the magnitude of its influence varies among the three income groups. Changes in urbanization appear to have a greater impact on transport and road energy use in the high income group than in the other groups. Surprisingly, the urbanization elasticities of transport and road energy use in the middle income group are smaller than those of the low income group. This insides can provide policy makers with insightful information on the link between urbanization and transport energy use at the three different stages of development.

Phetkeo Poumanyvong, Shinji Kaneko, Shobhakar Dhakal: Impacts of urbanization on national transport and road energy use:Evidence from low, middle and high income countries, 2012

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