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The new ENSEMBLES E1 mitigation scenario for future climate simulations

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Climate simulations with state-of-the-art earth-system models are required to study the potential impacts of climate change, and possible solutions for avoiding, or reducing, some of its undesirable consequences. Though several emission scenarios have been applied for the IPCC AR4 assessments, the differences in the SRES scenarios result mainly from varying degrees of globalization, the role of environmental and social policy, economic and population growth and the rate of technology development. It seems then necessary to consider also more stringent mitigation pathways which aim eventually to implement a climate mitigation policy. In particular it appears particularly useful to implement and analyse climate scenarios for stabilising the additional anthropogenic radiative forcing to that equivalent to a carbon dioxide concentration at around 450 ppm during the 22nd Century for attempting to match the European Union target of keeping global anthropogenic warming below 2°C above pre-industrial levels. A new set of climate simulations over the 21st century with improved earth-system models has thus been designed by the European modelling groups participating to the European FP6 project ENSEMBLES, as a contribution to the second phase ("Stream 2") of the project. The set-up of the new simulations, though basically similar to that used in the CMIP3 simulations for the IPCC AR4, has been improved by taking into account land-use changes. The simulations cover the recent historical period (1860-2000) and are extended over the the 21st century by two scenarios based on the A1B development path. The A1B scenario has been chosen as the baseline scenario for the ENSEMBLES stream 2 simulations because the strong increase in emissions is consistent with real emissions growth, and in order provide overlap with earlier climate modelling work. Besides the standard A1B SRES scenario, a new stabilisation scenario has been developed so as to limit the long-term radiative forcing to that equivalent to 450-ppm of CO2 concentration. This new stabilisation scenario (E1) has been developed with the latest version of the integrated impact assessment model IMAGE at Netherlands Environmental Assessment Agency (MNP), with improvements in the land use representation of the A1B scenario. Though the coupled climate models are directly forced by the concentrations of the well-mixed greenhouse gases (CO2, CH4, N2O, CFCs and other minor species) produced by the IMAGE model, it has however been necessary to make further adaptations, by using additional modelling tools, in order to produce the other forcing data needed by the GCMs. The 3-dimensional atmospheric fields for anthropogenic sulphate aerosols concentrations have been computed by a chemistry-transport model using the emissions from the IMAGE scenarios. The ozone concentrations have been computed by the chemistry-transport model from the University of Oslo. The land use maps over the period 1850-2000 have been derived from the LUCID project based on a combination of the crop dataset of Ramankutty and Foley and pasture from the HYDE dataset. They have been then merged with the land-use maps produced by the IMAGE scenarios in order to derive adapted land-use maps over the 21st century. The different forcings and some results of the "stream 2" ENSEMBLES scenarios are described and illustrated in this presentation.