Geophysical Research Abstracts
Vol. 15, EGU2013-12754, 2013
EGU General Assembly 2013

Estimating the impacts of extreme events from coincidences between tree ring widths, climate and simulated net primary productivity

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Here we propose a method to evaluate Dynamic Global Vegetation Models (DGVMs) such as LPJmL for their capability to simulate the response of the European carbon cycle to extreme climatic events. Observed tree ring widths are contrasted with simulated net primary productivity (NPP) from LPJmL and the climatic forcing variables in order to evaluate ecosystem responses to extreme heat and drought events. Our basic data sets are measured tree ring widths, climatic forcing variables (e.g. temperature and precipitation) and simulated NPP from LPJmL at 363 locations throughout Europe. Our goal is to find coincidences between extreme events in climate, NPP and tree ring width time series that are very unlikely to arise by chance alone and, hence, point towards a possible causal relationship. One main advantage of our method is that by determining a window of potential overlaps of coincidences we can also account for lag effects, e.g. a delayed response to an extreme event that occurs in the year after the event. Our method allows for a scale-independent model evaluation, i.e. simulated NPP and tree ring widths can be directly compared. Our results will help to improve simulations of the European carbon cycle and thus lead to a deeper understanding of potential impacts of extreme events on ecosystem productivity.