Geophysical Research Abstracts
Vol. 17, EGU2015-5180, 2015
EGU General Assembly 2015

From site measurements to spatial modelling – multi-criteria model evaluation

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Hydrological models are traditionally evaluated at gauge stations for river runoff which is assumed to be the valid and global test for model performance. One model output is assumed to reflect the performance of all implemented processes and parameters. It neglects the complex interactions of landscape processes which are actually simulated by the model but not tested. The application of a spatial hydrological model however offers a vast potential of evaluation aspects which shall be presented here with the example of the eco-hydrological model SWIM. We present current activities to evaluate SWIM at the lysimeter site Brandis, the eddy-co-variance site Gebesee and with spatial crop yields of Germany to constrain model performance additionally to river runoff. The lysimeter site is used to evaluate actuall evapotranspiration, total runoff below the soil profile and crop yields. The eddy-covariance site Gebesee offers data to study crop growth via net-ecosystem carbon exchange and actuall evapotranspiration. The performance of the vegetation module is tested via spatial crop yields at county level of Germany. Crop yields are an indirect measure of crop growth which is an important driver of the landscape water balance and therefore eventually determines river runoff as well. First results at the lysimeter site show that simulated soil water dynamics are less sensitive to soil type than measured soil water dynamics. First results from the simulation of actuall evapotranspiration and carbon exchange at Gebesee show a satisfactorily model performance with however difficulties to capture initial vegetation growth in spring. The latter is a hint at problems capturing winter growth conditions and subsequent impacts on crop growth. This is also reflected in the performance of simulated crop yields for Germany where the model reflects crop yields of silage maize much better than of winter wheat. With the given approach we would like to highlight the advantages and importance of a multi-criteria evaluation of eco-hydrological models. This approach appreciates the complex chain of processes in eco-hydrological models which are otherwise only tested at the integrated level of river runoff.