Geophysical Research Abstracts
Vol. 12, EGU2010-11381, 2010
EGU General Assembly 2010

Comparison of SVAT models for simulating and optimizing deficit irrigation systems in arid and semi-arid countries under climate variability

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The strong competition for fresh water in order to fulfill the increased demand for food worldwide has led to a renewed interest in techniques to improve water use efficiency (WUE) such as controlled deficit irrigation. Furthermore, as the implementation of crop models into complex decision support systems becomes more and more common, it is imperative to reliably predict the WUE as ratio of water consumption and yield. The objective of this paper is the assessment of the problems the crop models - such as FAO-33, DAISY, and APSIM in this study - face when maximizing the WUE. We applied these crop models for calculating the risk in yield reduction in view of different sources of uncertainty (e.g. climate) employing a stochastic framework for decision support for the planning of water supply in irrigation. The stochastic framework consists of: (i) a weather generator for simulating regional impacts of climate change; (ii) a new tailor-made evolutionary optimization algorithm for optimal irrigation scheduling with limited water supply; and (iii) the above mentioned models for simulating water transport and crop growth in a sound manner. The results present stochastic crop water production functions (SCWPF) for different crops which can be used as basic tools for assessing the impact of climate variability on the risk for the potential yield. Case studies from India, Oman, Malawi, and France are presented to assess the differences in modeling water stress and yield response for the different crop models.