REGIONAL SCALE WATER BALANCE MODELLING FOR GLOBAL CHANGE STUDIES IN THE MOUNTAINOUS WESTERN UNITED STATES

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The effects of global change on soil moisture, vegetation, and stream flow in the western United States (US) are being studied using a series of integrated models. Spatially-explicit, coupled energy and water balance models are being developed to make these regional assessments. The western US contains many mountainous areas, as shown in figures 1 and 2, with vegetation ranging from rainforest in the northwest to desert in the south.

Air temperatures are spatially extrapolated from weather station data by adjusting them for elevation based on digital elevation models (DEM). Potential evapotranspiration is calculated using a turbulent transfer model (Marks 1990). Precipitation from weather station data is spatially extrapolated over mountainous terrain with variable lapse rates using the PRISM model (Daly et al. 1994).

The framework for linking soil infiltration and throughflow with subsurface flow is adopted from Wigmosta et al. (1994). Water is routed into two soil layers and a third groundwater/baseflow layer. Lateral subsurface flow in the third layer occurs in response to gravitational gradients and moisture gradients. Timesteps used during model development do not allow the use of detailed approaches such as the Richards' equation which requires many model iterations per minute (Šim_nek et el. 1994). Even if the computing resources were available, the required input data are not. Simplified approaches to model the soil water balance on a spatial basis are being developed. Similar to the Richards' equation, the subsurface flow model provides solutions for water flow but it is constrained by field capacity and wilting point. Despite the drawbacks of the concepts of field capacity and wilting point for modeling-specific processes such as solute transport, they are useful for broad-scale modeling with relatively long timesteps. We used the SWMS_2D model, based on the Richards' equation for saturated and unsaturated flow (Šim nek et al. 1994), to explore the relationship between soil texture and field capacity.

Soil water retention is derived from pedotransfer functions using soil texture and organic matter data. Kern (1995) found that the functions developed by Rawls et al. (1982) were effective for a wide range of soils in the US. Estimates of hydraulics are made in a similar manner. Soil water holding capacity (i.e., the difference in water content between field capacity and wilting point), corrected for rock fragment content and soil depth, is shown in the figure.

Current research is examining ways to spatially characterise soil distribution. Methods are being developed to separate soils into hydrologically-significant groups based on their water storage and hydraulic conductivity. Specifying stream channels is being explored as a way to enhance the subsurface lateral flow routing and may be particularly useful in flat areas where the subsurface flow model tends to fail.

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Figure 1. Digital elevation model and soil-water holding capacity in the 0 to 150cm depth layer for the western United States

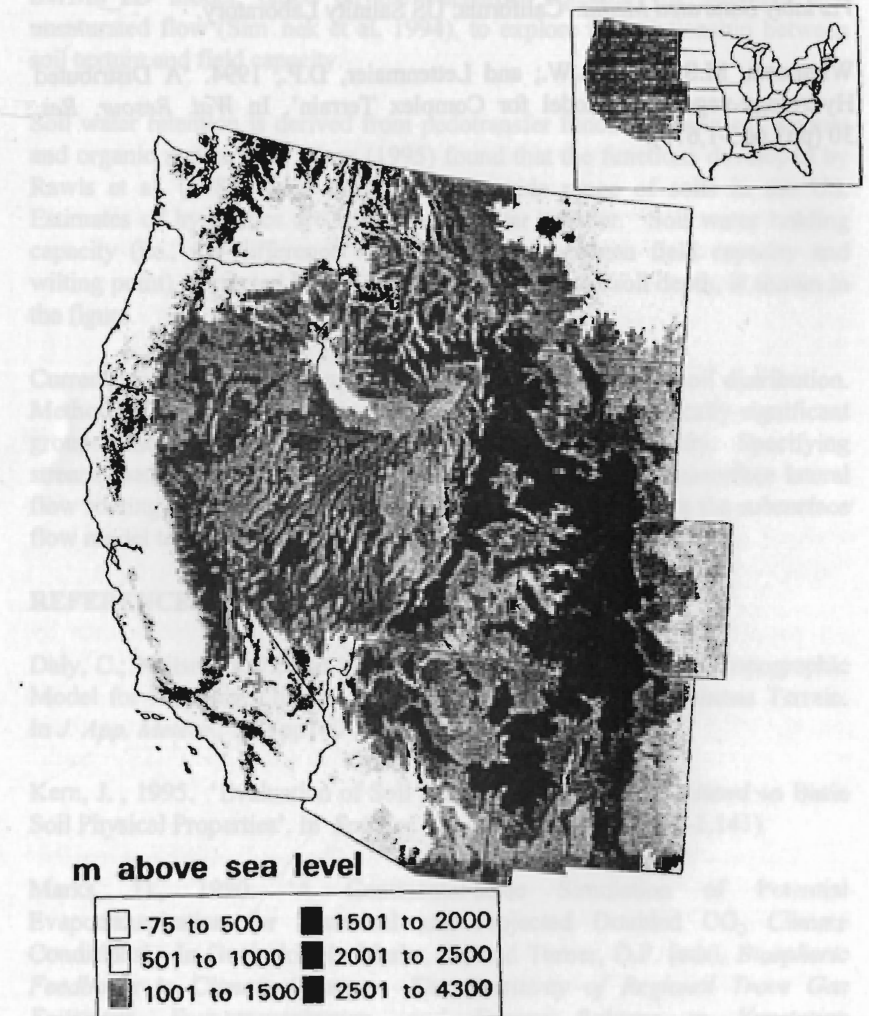

Figure 2. Digital elevation model and soil-water holding capacity in the 0 to 150cm depth layer for the western United States