

SPATIO-TEMPORAL PREDICTION OF SNOW WATER  
EQUIVALENT USING THE KALMAN FILTER

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ABSTRACT

Consider a spatio-temporal stochastic process  $\{Z(s;t) : s \in D; t = 1,2,\dots\}$  and suppose it is of interest to predict  $\{Z(s;t_0) : s \in D\}$  at some fixed time point  $t_0$ . Purely spatial methods use data  $Z(s_1;t_0), \dots, Z(s_n;t_0)$  to construct a spatial predictor (e.g., kriging). But, when data  $\{Z(s_i;t) : i = 1, \dots, n; t = 1, 2, \dots, t_0\}$  are available, it is advantageous to treat the problem as one of spatio-temporal prediction. The U.S. National Weather Service now use current snow water equivalent (SWE) data and a purely spatial model to predict SWE at sites where no observations are available. To improve SWE predictions, we introduce a spatio-temporal model that incorporates the SWE data from the past, resulting in a Kalman-filter prediction algorithm. A simple procedure for estimating the parameters in the model is developed and an example is presented for the Animas River basin in southwest Colorado.