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NRES 779- Bayesian Hierarchical Modeling

Deterministic Snow Water Equivalent Modeling

In the field of snow hydrology, it is very common to model snow water equivalent (SWE) as it is difficult to measure SWE directly with field-based methods and impossible to measure directly with remote sensing-based methods. SWE has frequently been modeled using deterministic reconstruction models, such as the one included below (Equation 1) (Molotch and Margulis, 2008).

A group of mathematical equations

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Description automatically generated This deterministic model is based on initial Snow Water Equivalent and snowmelt for a certain time step in order to evaluate SWE at a certain point in time. Mj represents the snowmelt for a given area and is calculated from a combination of incoming radiation, meteorological forcing variables, and a snow depletion curve, which is included below (Equation 2). This separate modeling of the parameters in the larger SWE model means that Equation 1 represents a simplified version of the deterministic SWE model used by many studies. The snow covered area model assumes that no precipitation inputs (such as additional snowfall) occur after the onset of snowmelt, which can potentially lead to error, but recent studies indicate this error is typically low (Molotch and Margulis, 2008). This means that the deterministic SWE model assumes a generally static system when modeling SWE.

Equation 2

Equation 1

Molotch, N. P., & Margulis, S. A. (2008). Estimating the distribution of snow water equivalent using remotely sensed snow cover data and a spatially distributed snowmelt model: A multi-resolution, multi-sensor comparison. *Advances in Water Resources*, *31*(11), 1503–1514. <https://doi.org/10.1016/j.advwatres.2008.07.017>