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# Decreasing misclassified precipitation in conceptual models through the use of physiography, cloud base heights, relative humidity, and sea surface temperatures

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Precipitation phase uncertainty is a known source of error in conceptual models used for many hydrological, climatological, and environmental applications. These conceptual models often use the simple approach of calibrating an air temperature threshold (Trs) over a large area irrespective of physiographic characteristics. Simplifications are a fact of life in conceptual modeling, however there is a plethora of literature against this approach in cold regions. The magnitude of uncertainty caused by the use of a set Trs is greatest in areas such as Scandinavia where 40% or more of annual precipitation occurs within the air temperature (AT) range of -3 to 5°C.

Meteorological data from 169 observing stations was used to determine percent misclassified precipitation when air temperature (AT), dew-point temperature (DP), and Wet-bulb temperature (WB) thresholds were applied. The data set incorporates roughly 600,000 precipitation events between AT -3 and 5°C. When analyzed by country, Norwegian stations had average misclasified precipitation of 11.64% (-0.2°C) for DP, 11.21% (1.2°C) for AT, and 8.42% (0.3°C) for WB. In comparison, Swedish stations had misclassified precipitation totals of 11.25% (0.1°C) for DP, 10.67% (0.9°C) for AT, and 9.05% (0.2°C) for WB. WB resulted in the least misclassified precipitation for both countries, however relative humidity (RH) and other parameters required to calculate WB are often not reported by hydrological, or meteorological stations. Therefore it is important to find methods to decrease misclassified precipitation in models using the much more commonly reported parameter AT.

One argument for the use of set threshold temperatures in conceptual models was the reduction of computational load, but this came at the cost of accuracy. To compound this error, surface conditions only have a minor role in precipitation phase. Instead microphysics (air-hydrometer energy exchanges) and properties of the air in the lower atmosphere are major influences on precipitation phase reaching the ground. However, without adding atmospheric data, improvements to surface based conceptual model precipitation phase determination schemes (PPDS) can still be achieved through the creative use of other reported surface data. For example, adding cloud base heights or relative humidity to the PPDS as a proxy for atmospheric moisture reduced misclassified precipitation by 5% over a set Trs. Using basic knowledge of air ground interactions in the planetary boundary layer led to the finding of optimum AT thresholds of 1.0°C in flatlands compared to 1.6°C in mountains. Finally, using collocated sea surface temperature (SST) observations, a proxy for higher atmospheric lapse rates caused by surface heating, reduced misclassified precipitation by 27%.