## Introduction to CBRFC Soil Moisture Data

When developing both seasonal and shorter term hydrologic forecasts, antecedent soil moisture conditions are an important consideration, particularly in fall and continuing to early spring. To this end, the Colorado Basin River Forecast Center (CBRFC) utilizes ***modeled*** soil moisture data derived using the Sacramento Soil Moisture Accounting model (Sac-SMA) (Burnash et. al., 1973)[1], which is the primary component of the CBRFC's hydrologic modeling paradigm. Soil moisture parameters used by the CBRFC are developed as part of the CBRFC's calibration of its hydrologic model. During the Fall, after most irrigation operations have ceased and before streamflow gages begin to freeze, the CBRFC places additional emphasis on the assessment of the hydrologic model's current soil moisture states. On or approximately November 15th of each year, the CBRFC publishes a map illustrating the initial soil moisture conditions for the water year. These maps, both those representing soil moisture data utilized within the CBRFC's calibrated hydrologic dataset and more recent historical data, are available here.[2] Fall soil moisture is important, as it provides an insight as to the efficiency of future snowmelt driven runoff. A recent sensitivity analysis by the CBRFC found that a 1% increase in fall soil moisture conditions (i.e., soil moisture states that are more wet by 1%) can increase seasonal runoff volumes by approximately 0.5%. So, for a watershed that produces approximately a million acre feet of water under completely average conditions, soil moisture conditions that are 1% wetter than average could yield an additional 5,000 acre feet of water. Of course, there are many factors that influence seasonal water supply volumes, and soil moisture is just one component of greater overall hydroclimatic interactions. More information can be found here[3].

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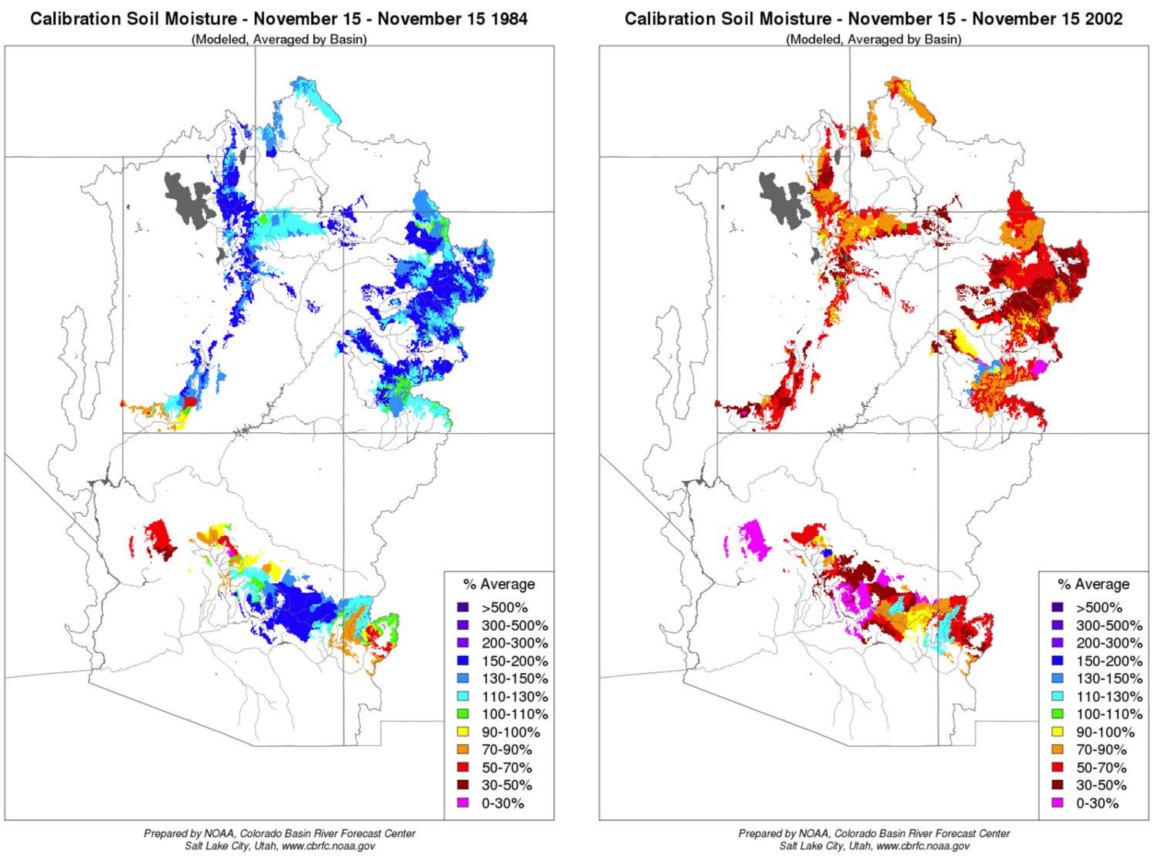
[1] Burnash, R. J., R. L. Ferral, and R. A. McGuire (1973), A generalized streamflow simulation system conceptual modeling for digital computers, U.S. Department of Commerce National Weather Service and State of California Department of Water Resources.

[2] For those unable to access the hyperlink: https://www.cbrfc.noaa.gov/rmap/grid800/index_soil.php

[3] For those unable to access the hyperlink: https://www.cbrfc.noaa.gov/report/CBRFC_Model_Sensitivity_Analysis_2020.pdf

Figure 1 provides two examples of the CBRFC's Fall Soil Moisture maps. These maps highlight areas that significantly contribute to seasonal (April through July) snowmelt driven runoff and are typically high elevation areas. Values are presented as a percent of average over the 1981 through 2010 time period. The magnitude of these soil moisture values is not presented, as the values are developed during the CBRFC's calibration process and have little applicability outside of the CBRFC's modeling paradigm.

It is important to understand that the CBRFC's fall soil moisture states are not based on




physical measurements such as those recorded at some SNOwpack TELemetry (SNOTEL) stations maintained by the Natural Resources Conservation Service (NRCS) and are instead developed utilizing fall baseflow conditions; this is because soil moisture measurements made at SNOTEL sites are typically not deep enough to correlate well with the CBRFC's soil moisture states. Future research efforts may look at the correlation of this modeled soil moisture information with deep soil moisture sensors, or exploring the use of remotely sensed soil moisture to make soil moisture assessments that could be used within the CBRFC's hydrologic modeling framework, or the next generation of hydrologic models.

The CBRFC also produces a daily soil moisture graphic illustrating the inches to saturation over major contributing areas. These graphics are available here[4]. The primary audience for this product are users in the Lower Colorado River Basin that are often affected by localized, intense, convective rainfall events over areas where soil saturation conditions are typically low. These rainfall events may not yield significant prolonged runoff after an initial event; however, after successive events, soil may become saturated enough that additional rainfall events over the area could produce significant, prolonged runoff.

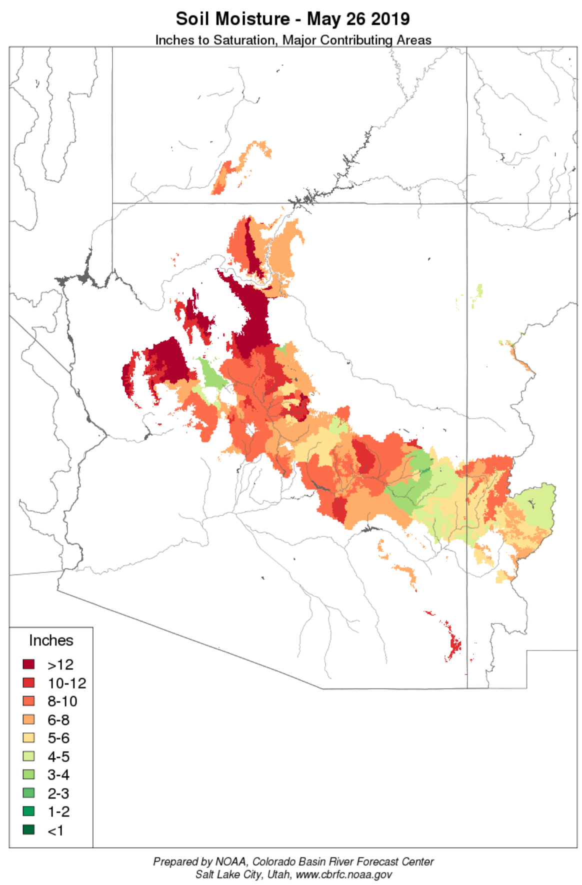



Figure 2 illustrates an example of the daily soil saturation maps produced by the CBRFC. In these maps, green colors indicate areas that are nearing saturation and could potentially yield significant runoff from a rainfall event in the near future. Conversely, red areas indicate areas that are less likely to yield significant runoff following a rainfall event. It is important to note that convective, localized rainfall events in the Lower Colorado River Basin often produce flash floods, and these maps are not meant to provide guidance regarding flash flood events; rather, these maps

[4] For those unable to access the hyperlink: https://www.cbrfc.noaa.gov/rmap/grid800/index.php?type=monthly

provide guidance where more significant surface water runoff may occur after a rainfall event, which may or may not include flooding.