

## Question 3:

*Part I: Are there gaps in remotely sensed or in-situ observing or monitoring networks that, if filled, would have a demonstrable benefit in the near-term?*

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Many basins approaching full utilization → critical to anticipate fluctuations in water supply and demand. In addition to maintaining existing observing networks, improved monitoring of soil moisture, snow cover/albedo/SWE, and evapotranspiration would advance the ability of water managers to anticipate shortfalls in supply relative to changes in demand / use.

### 1) Soil Moisture

- Colorado River Basin: soil moisture is significant variable in snowpack to runoff models; limited data available to calibrate models and estimate partitioning of snow pack to runoff vs soil moisture / percolation
  - Need for a coordinated, well planned effort to expand SCAN → joint effort among states and NRCS
  - SCAN + SMAP satellite soil moisture valuable to forecasting runoff and elevation in Lake Mead
  - SCAN and SMAP are complementary, not redundant
  - Comparisons between SMAP gridded data and data from SCAN soil moisture sites → analysis of covariance to assess representativeness

## 2) Snow

- Improved measurement of snow cover / SWE above 10,000 feet would be especially valuable
  - More SNOTEL sites, e.g., 66 new sites needed for Arizona alone
  - Remote sensing products from MODIS and ASO very promising; significant potential value → snow cover, SWE, dust radiative forcing
  - Snow cover and snow albedo; e.g., 2002 in Arizona, reasonable snowpack, but runoff never showed up which impacted reservoir operations; need to reduce surprises
  - Expand SNOTEL instrumentation to include measurements of snow albedo; need to get an early start on R&D on most cost-effective way to measure snow albedo / dust radiative forcing

3) Evapotranspiration / Consumptive use: Need for standardized methods / networks; development of prototype ET monitoring network for use in validation / calibration of satellite ET models

## 4) Other needs:

- Rangeland health / forest health / insect infestations / wildland fire risk
  - Changes in greenness, vegetation stress maps; significant amount of ongoing work on this topic → need for more outreach / training?

*Part II: Are there practical monitoring efforts that the Council should be supporting that would be useful for Western states?*

- Maintenance and expansion of SCAN
- Maintenance and expansion of SNOTEL; addition of snow albedo measurements to SNOTEL sites
- Development of pilot surface ET monitoring network for validation and calibration of satellite estimates

WSWC could also support these monitoring networks by:

- Coordination of workshops and working groups to identify / quantify uses and benefits of information from these networks by state and local agencies
- Coordination of workshops to provide state input into network design and operation → e.g., development of standards and protocols for monitoring of soil moisture and evapotranspiration → more valuable if done sooner
  - Separate requirements for current operations vs future improvements to models)
- Advocating for sustaining support for networks and sustainability of network; coordination of state inputs into design
- Significant Federal role in resource management in Western U.S. and must sustain funding for monitoring networks; “you can’t manage what you can’t measure”

- Outreach and training: Water managers need clear guidance on use of different tools and selection of right tools for the purpose → water managers struggle with mixed / conflicting messages from different tools and data sources
  - Important to provide guidance on appropriate use of tools and datasets; protocols for interpreting conflicting information