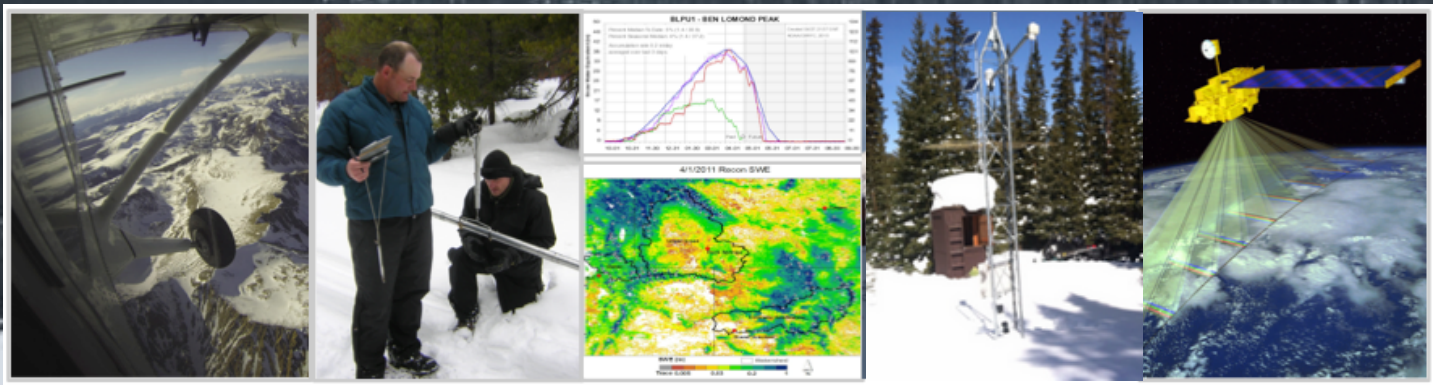
Snowpack monitoring for drought planning and streamflow forecasting



Lander, Wyoming
August 27, 2015

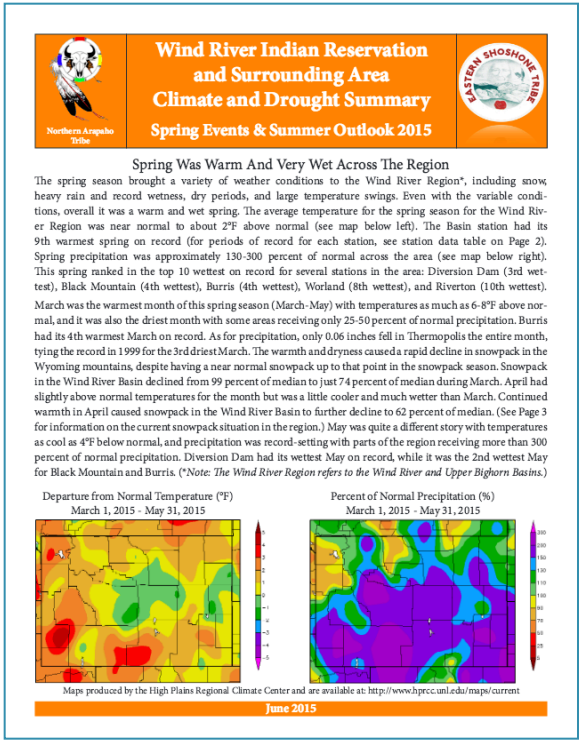
Background Photo: WY SEO

Partners/Sponsors

- CIRES Western Water Assessment
- National Integrated Drought Information System
- Wyoming State Engineer's Office
- Wyoming Water Association
- WY Water Resources Data System
- NRCS Snow Survey - Wyoming and Colorado
- NOAA Colorado Basin River Forecast Center

Wind River Indian Reservation Drought Vulnerability Project

- Northern Arapaho & Eastern Shoshone Office of Tribal Water Engineer, U. Nebraska Lincoln/NDMC, Colorado State U./North Central Climate Science Center, U. Wyo/EPSCOR, WWA



Wind River Indian Reservation and Surrounding Area Climate and Drought Summary

Spring Events & Summer Outlook 2015

Spring Was Warm And Very Wet Across The Region

The spring season brought a variety of weather conditions to the Wind River Region*, including snow, heavy rain and record wetness, dry periods, and large temperature swings. Even with the variable conditions, overall it was a warm and wet spring. The average temperature for the spring season for the Wind River Region was near normal to about 2°F above normal (see map below left). The Basin station had its 9th warmest spring on record (for periods of record for each station, see station data table on Page 2). Spring precipitation was approximately 130-300 percent of normal across the area (see map below right). This spring ranked in the top 10 wettest on record for several stations in the area: Diversion Dam (3rd wettest), Black Mountain (4th wettest), Burris (4th wettest), Worland (8th wettest), and Riverton (10th wettest).

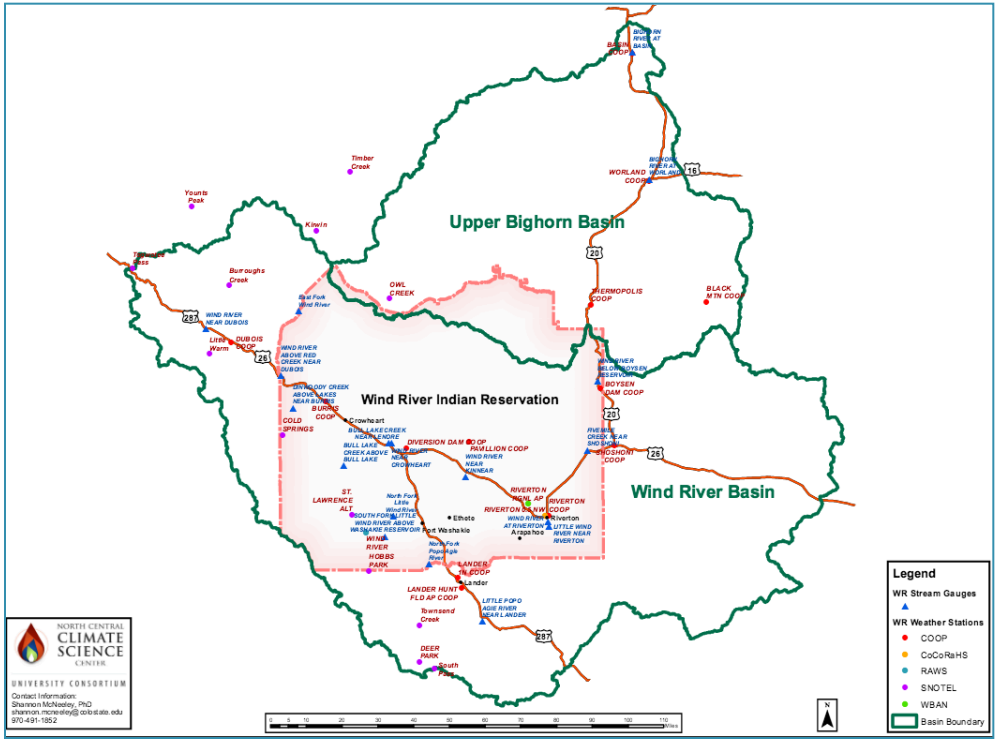
March was the warmest month of this spring season (March-May) with temperatures as much as 6-8°F above normal, and it was also the driest month with some areas receiving only 25-50 percent of normal precipitation. Burris had its 4th warmest March on record. As for precipitation, only 0.06 inches fell in Thermopolis the entire month, tying the record in 1999 for the 3rd driest March. The warmth and dryness caused a rapid decline in snowpack in the Wyoming mountains, despite having a near normal snowpack up to that point in the snowpack season. Snowpack in the Wind River Basin declined from 99 percent of median to just 74 percent of median during March. April had slightly above normal temperatures for the month but was a little cooler and much wetter than March. Continued warmth in April caused snowpack in the Wind River Basin to further decline to 62 percent of median. (See Page 3 for information on the current snowpack situation in the region.) May was quite a different story with temperatures as cool as 4°F below normal, and precipitation was record-setting with parts of the region receiving more than 300 percent of normal precipitation. Diversion Dam had its wettest May on record, while it was the 2nd wettest May for Black Mountain and Burris. (*Note: The Wind River Region refers to the Wind River and Upper Bighorn Basins.)

Departure from Normal Temperature (°F)
March 1, 2015 - May 31, 2015

Percent of Normal Precipitation (%)
March 1, 2015 - May 31, 2015

Maps produced by the High Plains Regional Climate Center and are available at: http://www.hprcc.unl.edu/maps/current

June 2015



About the Western Water Assessment

Climate information and research

Resource management & decision-making

Today's objectives

- **Help improve the *usability* and *use* of snowpack monitoring information for runoff forecasting, drought early warning and planning, and other applications.**
- Provide background information on snow hydrology and snow measurement to get us on the same page
- Describe operational snow-monitoring products and how they are used in runoff forecasts
- Provide guidance for accessing and interpreting these data
- Introduce and demonstrate new snow-monitoring products using satellite and airborne sensors
- Hear your ideas on how to better meet the needs for snowpack monitoring in Wyoming

Agenda

About NIDIS and the DEWS; Results of workshop pre-survey

Fundamentals of snow hydrology and measurement

Current operational snowpack measurements and their use

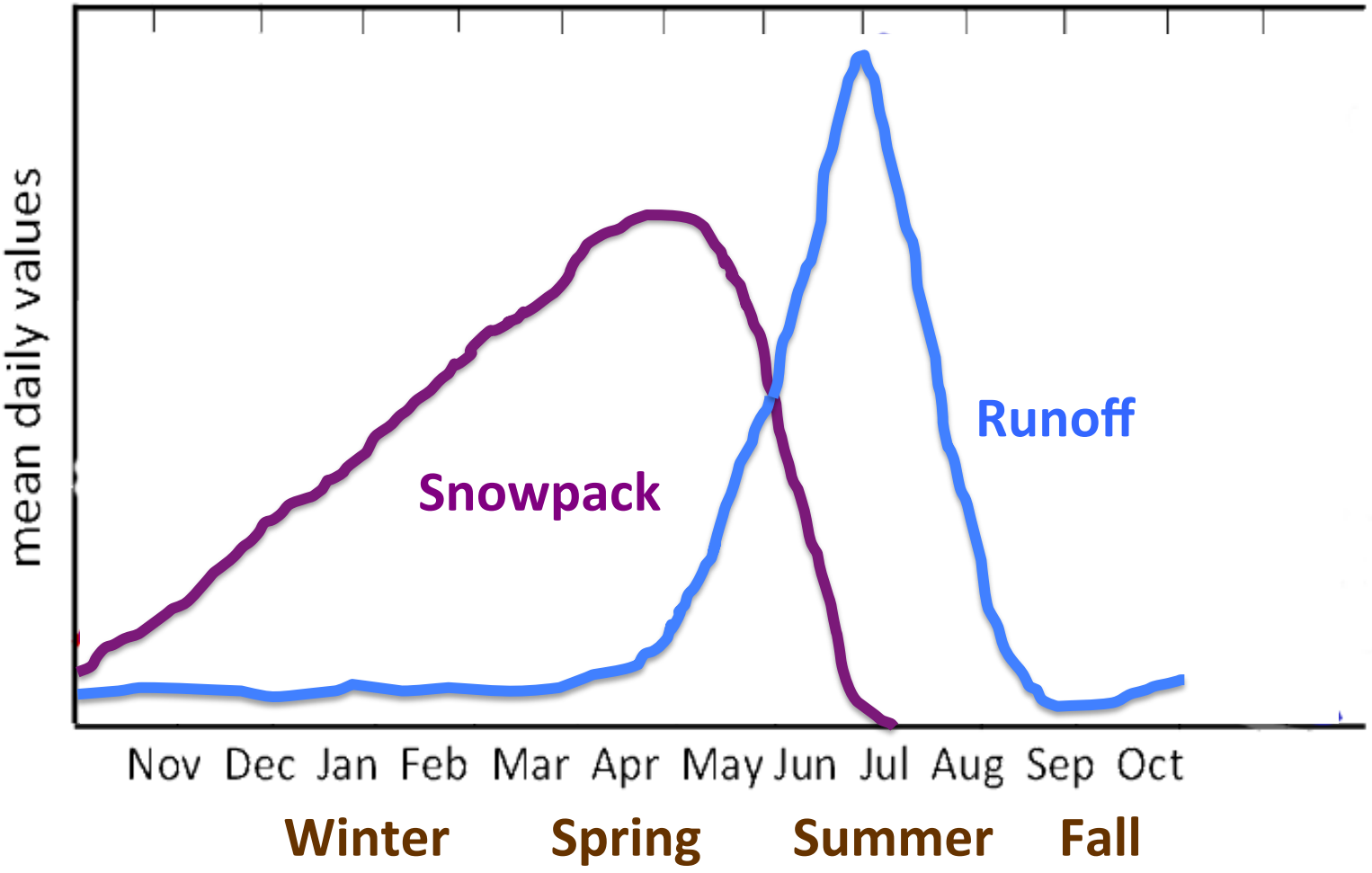
- NRCS SNOTEL/snowcourse and runoff forecasts
- CBRFC runoff forecasts
- User perspectives on operational snow data and needs
- Group discussion

LUNCH

New spatially-distributed snowpack estimates

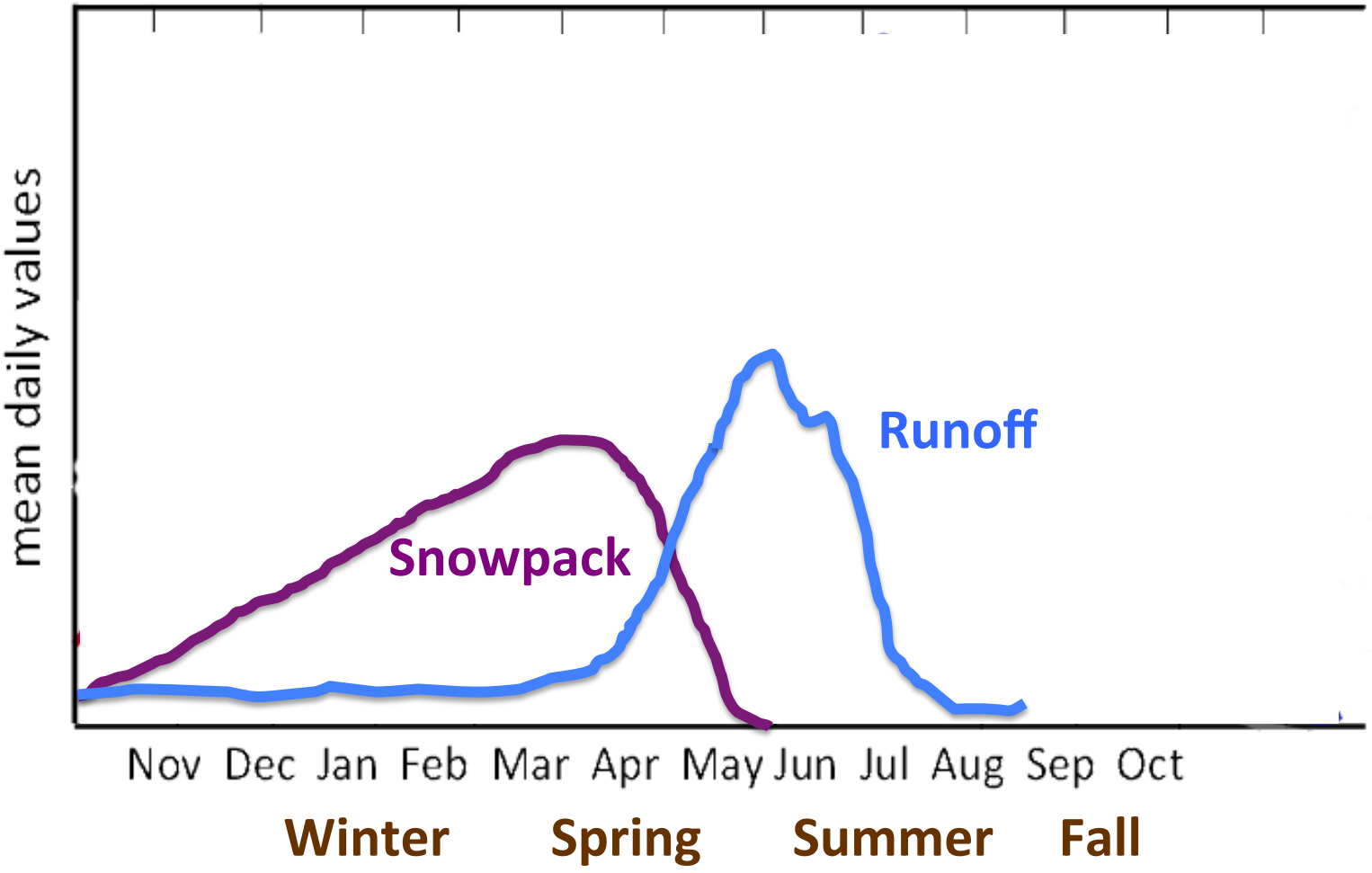
- MODIS-modeled snowpack estimates
- LIDAR- and hyperspectral-based SWE and albedo estimates from the Airborne Snow Observatory
- Group discussion

Typical snowpack and runoff seasons in Wyoming



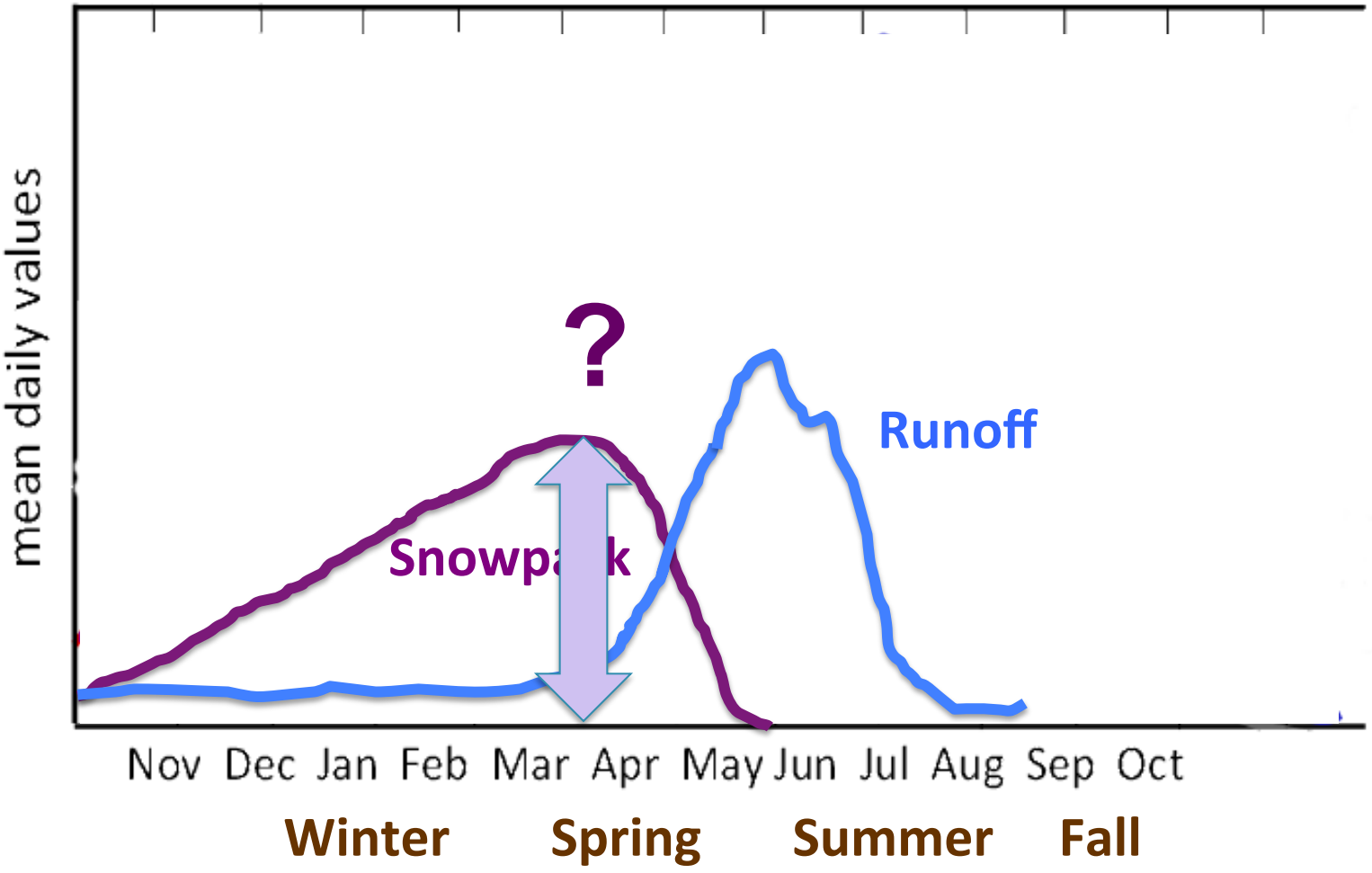
Graphic: adapted from J. Deems, after Peterson et al. (1997)

Typical snowpack and runoff seasons in Wyoming – *drought year*



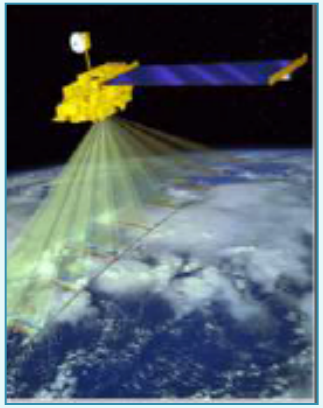
Graphic: adapted from J. Deems, after Peterson et al. (1997)

Typical snowpack and runoff seasons in Wyoming – *drought year*



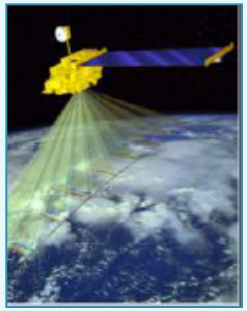
Graphic: adapted from J. Deems, after Peterson et al. (1997)

Snowpack monitoring

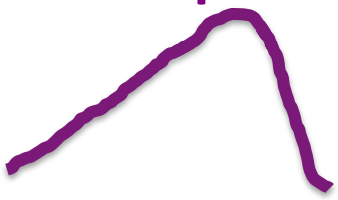
	SNOTEL	Satellite	Airborne
Snowpack 			
Grid Size	10-50 km	1 km	1 m

Snowpack monitoring, runoff forecasting, decision-making

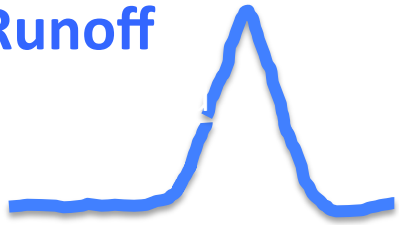
SNOTEL Satellite Airborne



Snowpack

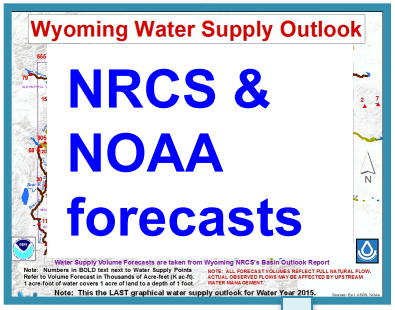


Runoff



Situational awareness of evolving snowpack conditions

Identify analog years



System-impact modeling

Operational decision-making