Historical Remotely Sensed Snowpack Assessment of the Chena Basin in Alaska During The Snow Depletion Period

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Snow is an important driver of the hydrologic regime in Alaska. Filling gaps in surface observations with satellite retrievals is necessary for rural Alaska.

Snow Water Equivalent (**SWE**) is the water depth that would result if the snowpack instantaneously melted.

AMSR2 SWE available here

Artist's Rendition of the GCOM series of satellites [1]

Pixel Size: 5 - 10 km
Pixel Values: 0 - ~ 60 inches
SWE Basin Size: ~ 120 x 160 km

Advanced Microwave Scanning Radiometer 2 (**AMSR2**) is a microwave instrument on-board GCOM-W used to derive SWE.

Fractional Snow Cover or **Snow Fraction** (**SF**) indicate the percentage of a satellite pixel covered by snow.

Artist's Rendition of the JPSS series of satellites [2]

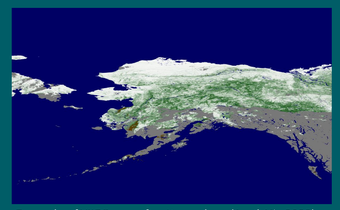
VIIRS SF data

Pixel Size: 0.01°
Pixel Values:
- 0-100 : Snow-Free and Snow Fraction (Green to White)
- 100+ Clouds, Water, Errors (Grey)

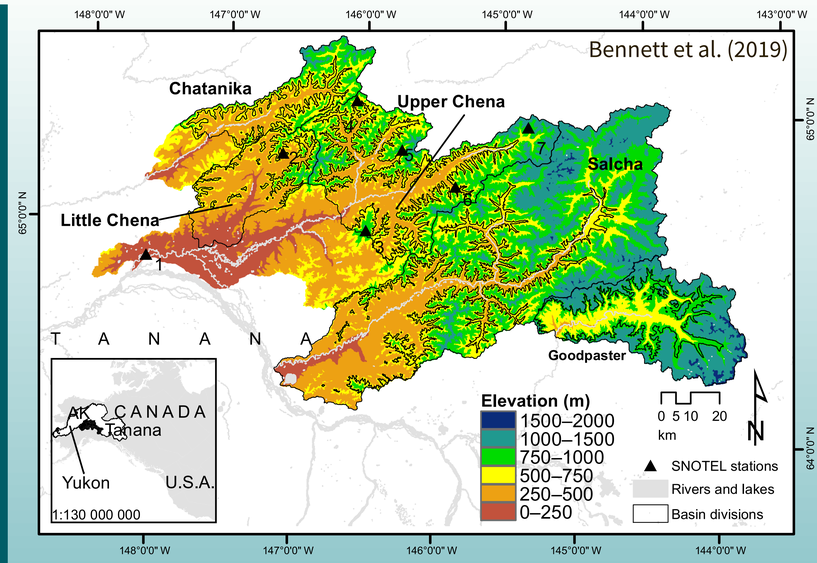
SF Basin Size: ~ 80 x 150 km

Visible Infrared Imaging Radiometer Suite (**VIIRS**) is an instrument on-board S-NPP and NOAA20 used to derive SF datasets.

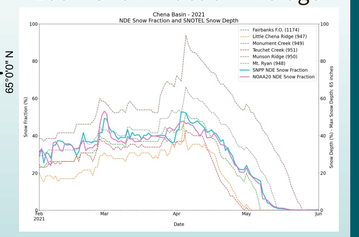
IDPS and NDE are processing systems on-board JPSS satellites.



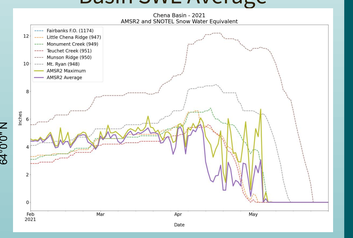
Example of VIIRS snow fraction values (April 1st , 2022).

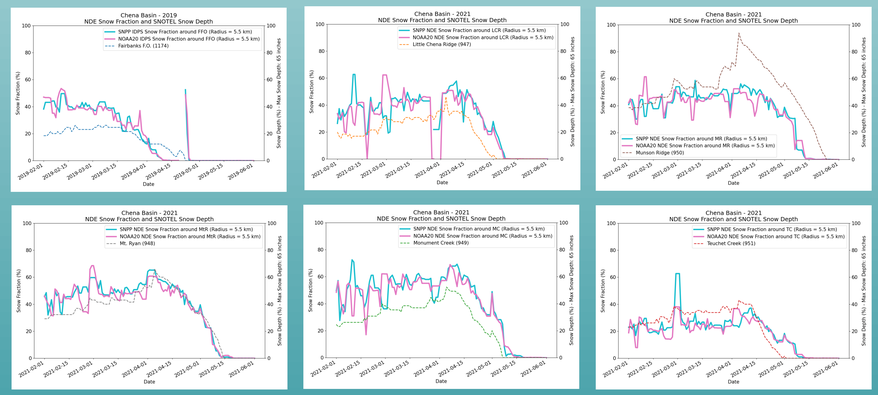


Basin Snow Fraction Average

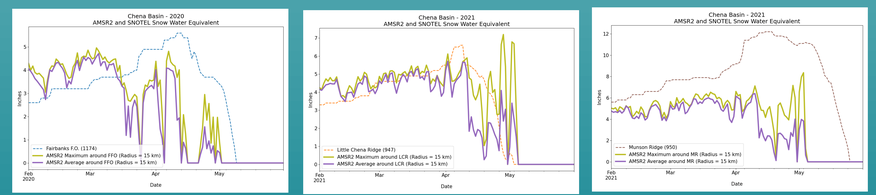


Basin SWE Average





Satellite Snow Fraction vs SNOTEL Site's Snow Depth



SWE comparisons between GCOM-W (AMSR2) and SNOTEL sites

Snowpack Telemetry (**SNOTEL**) is an automated network of snowpack assessment sites located across the western U.S. These USDA NRCS sites monitor snowpack, precipitation, temperature, and other climate parameters.

Photo of a SNOTEL site and its instruments. [QR code below]

SNOTEL data available here

SNOTEL SWE and snow depth measurements are key to assessing satellite products in the Chena River Basin.

SNOTEL station name	Station code	Map ID	Record length	Average Feb. SWE (in)	Average Mar. SWE (in)	Average Apr. SWE (in)	Average May SWE (in)	Height (ft)
Fairbanks F.O.	47P03 (1174)	1	1991–2020	N/A	N/A	N/A	N/A	450
Little Chena Ridge	46Q02 (947)	2	1991–2020	4.17	4.98	4.71	0.86	2000
Munson Ridge	46P01 (950)	3	1991–2020	6.56	7.77	8.73	5.06	3100
Mt. Ryan	46Q01 (948)	4	1991–2020	4.46	5.49	6.00	1.83	2800
Monument Creek	45Q02 (949)	5	1991–2020	4.35	5.26	4.99	0.91	1850
Teuchet Creek	45P03 (951)	6	1991–2020	3.36	4.05	3.91	0.40	1640
Upper Chena	44Q07 (952)	7	N/A	N/A	N/A	N/A	N/A	N/A

Linear Regression Analysis by Site:

Snow Fraction and Snow Depth:		
SNOTEL Site and Season	R-Squared (S-NPP)	R-Squared (NOAA20)
Fairbanks F.O. (2019)	0.763	0.723
Little Chena Ridge (2021)	0.656	0.641
Munson Ridge (2021)	0.684	0.575
Mt. Ryan (2021)	0.87	0.821
Monument Creek (2021)	0.806	0.858
Teuchet Creek (2021)	0.655	0.708

Python and the Pandas library were used to parse through the satellite and SNOTEL data and generate the figures. This allowed ease of interpreting, manipulating and visualizing the data.

This NOAA-supported work builds upon Dr. K. Bennett et al. (2019)'s publication and current efforts by Dr. Bennett (LANL) and Dr. V. Alexeev (UAF/IARC). Publication available here.

Figure Credit: [1] - https://global.jaxa.jp/projects/sat/gcom_w/ [2] - https://spaceflight101.com/jpss-1/jpss-1/