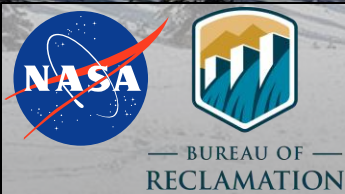


Snow Today: 2026 snow drought in the Western United States as measured by NASA satellite observations

 University of Colorado **Boulder**



Karl Rittger, Ross Palomaki, Noah Molotch,
Logan Stephenson, Mark Raleigh, Mark Serreze



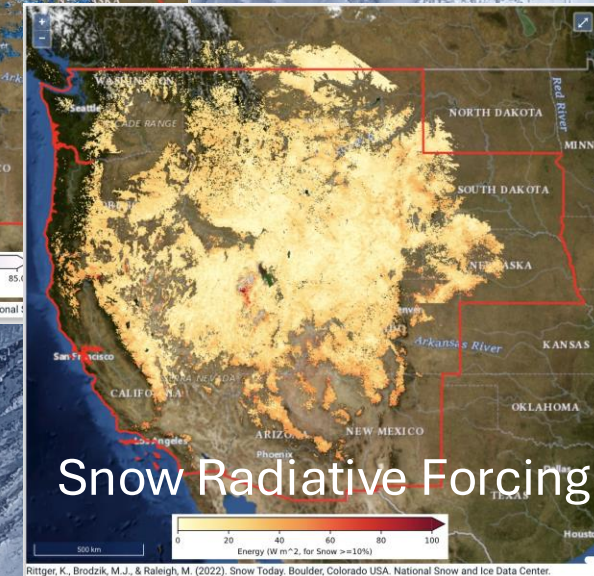
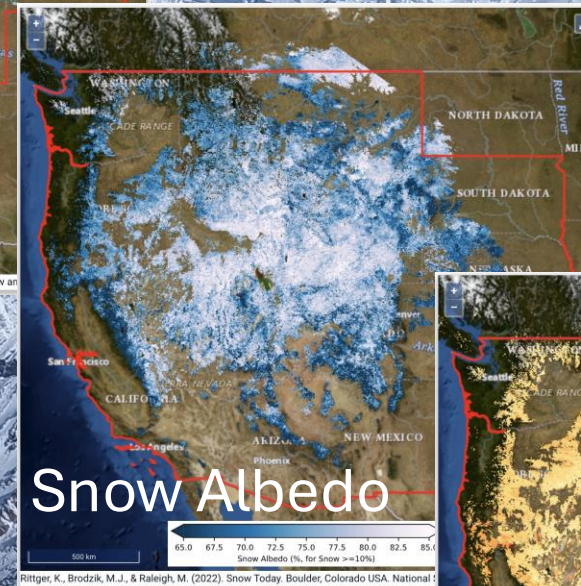
Satellite remote sensing of snow cover, snow albedo, and snow darkening

Target audience:

1. Water managers
2. Researchers
3. Public

Water supply forecasting requirements:

1. Accurate
2. Daily
3. Gap filled
4. < 24-hour lag from observation
5. Spatial resolution to resolve mountainous terrain
6. > 30-year record





[Home](#) > [Snow Today](#)

Snow Today

Daily images of snow data and seasonal analyses



WHAT'S NEW



Landing page

MONTHLY INSIGHTS



Monthly articles with analysis on western US snow conditions

DAILY SNOW VIEWER



Interactive visualization and analysis tool

GET DATA



FTP and data publication records

SNOW VIEWER GUIDE



Manual for using Daily Snow Viewer

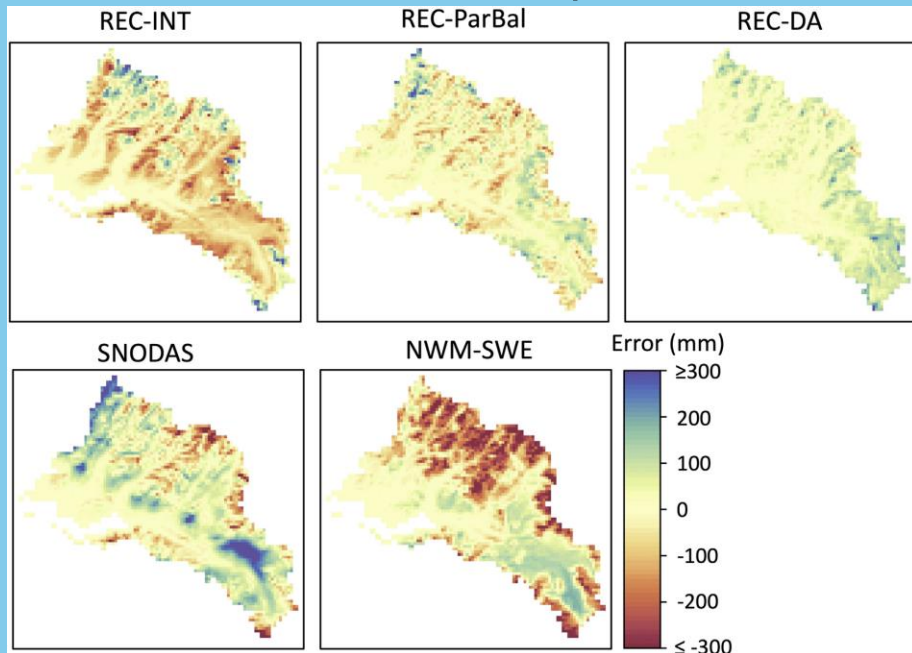
ABOUT



Variables and glossary, regions, algorithms, references, ...

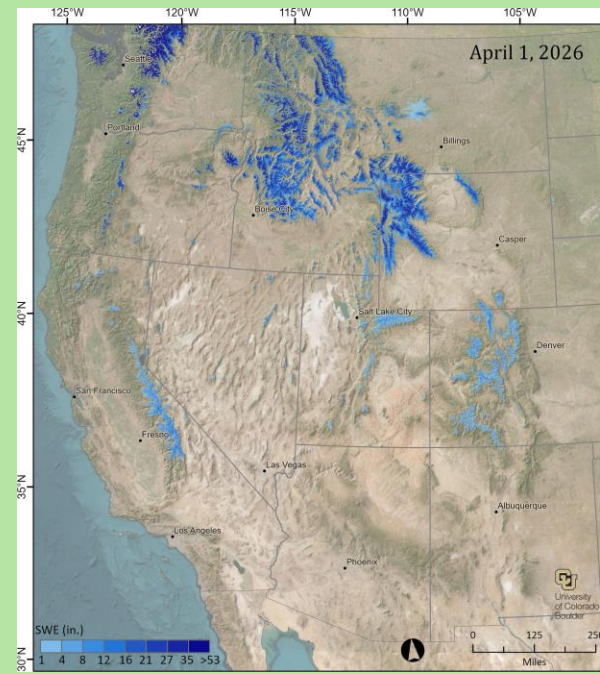
Optical satellite applications for snow water equivalent

SWE inter-comparison



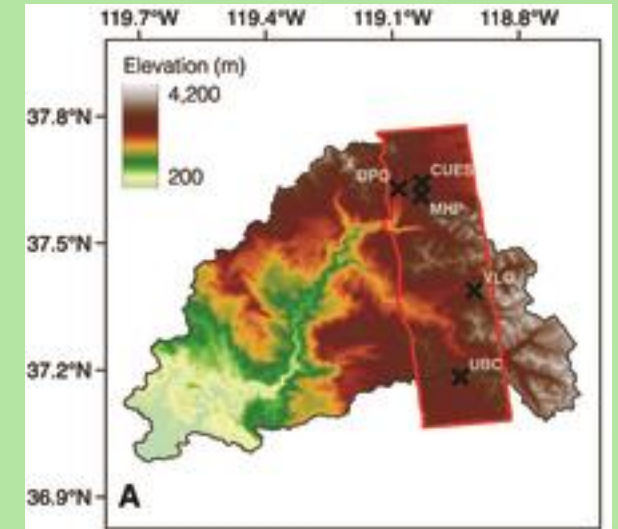
Yang et al 2023 Frontiers

Near real time SWE

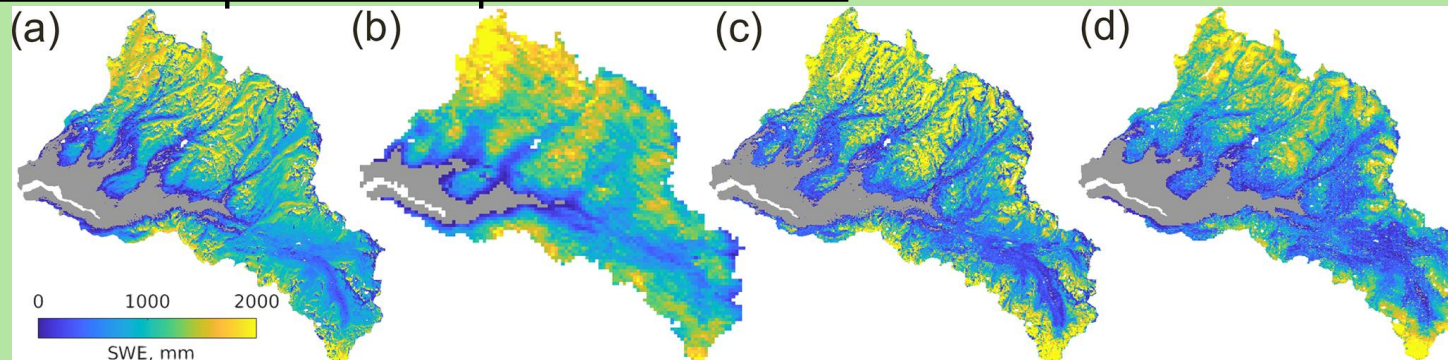


Molotch et al 2026

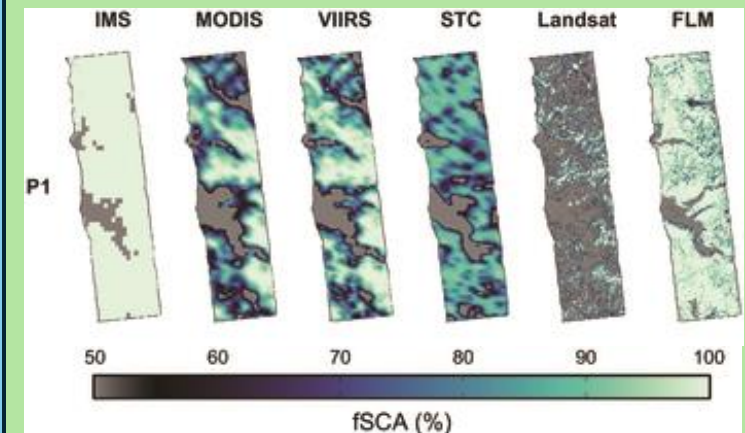
Snow cover for NISAR SWE



SWE – temporal and spatial resolution



Bair et al 2023 Cryosphere

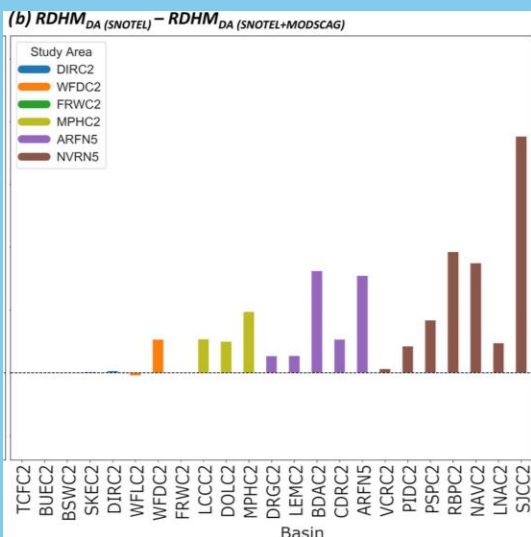
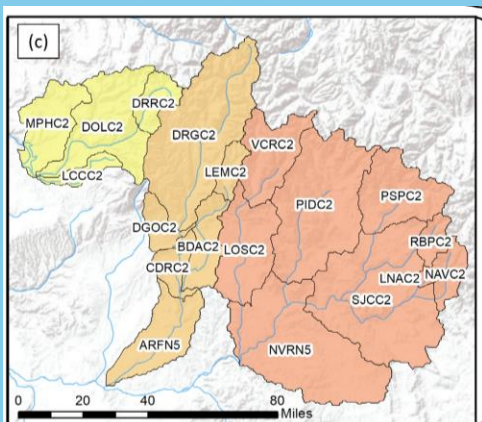


Tarricone et al 2025 Remote Sensing

Optical Satellite applications for water supply forecasting

RTI - Research Distributed Hydrologic Model

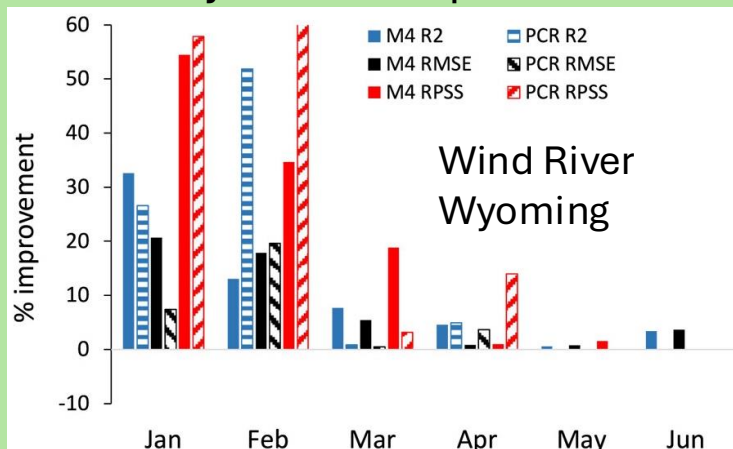
Improvement over use of SNOTEL



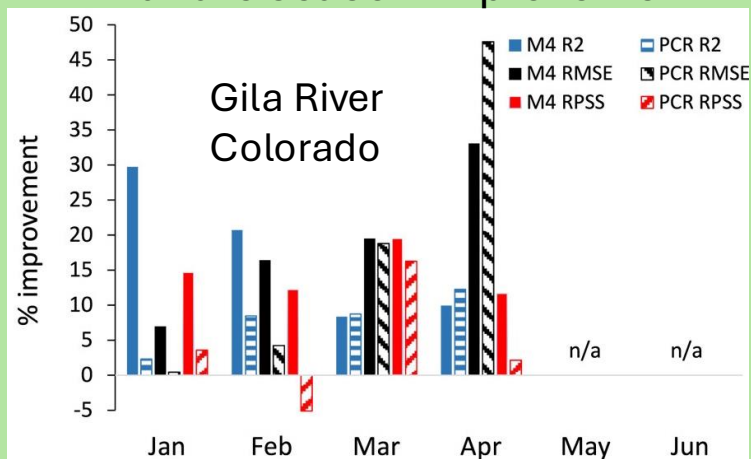
Micheletty et al, 2021 JARWA

NRCS – M4 application

Early season improvement

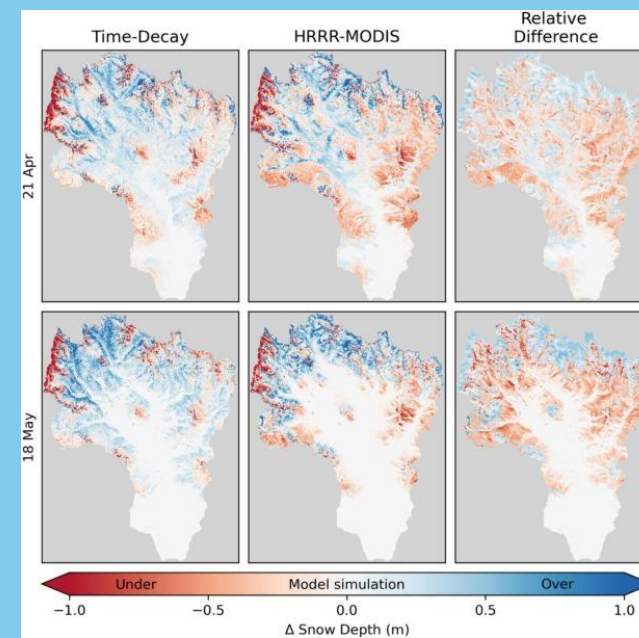
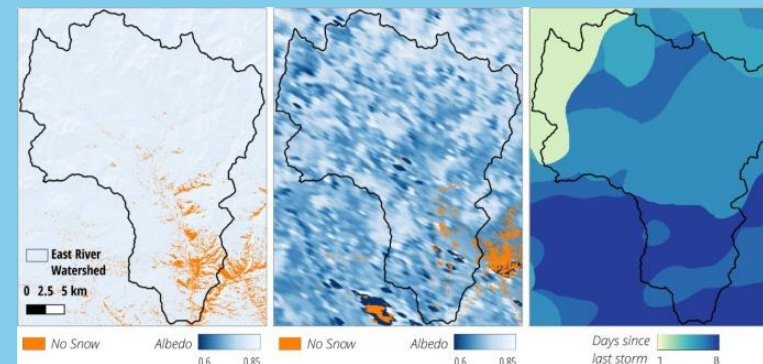


Mid-late season improvement



Fleming et al, 2024 WWR

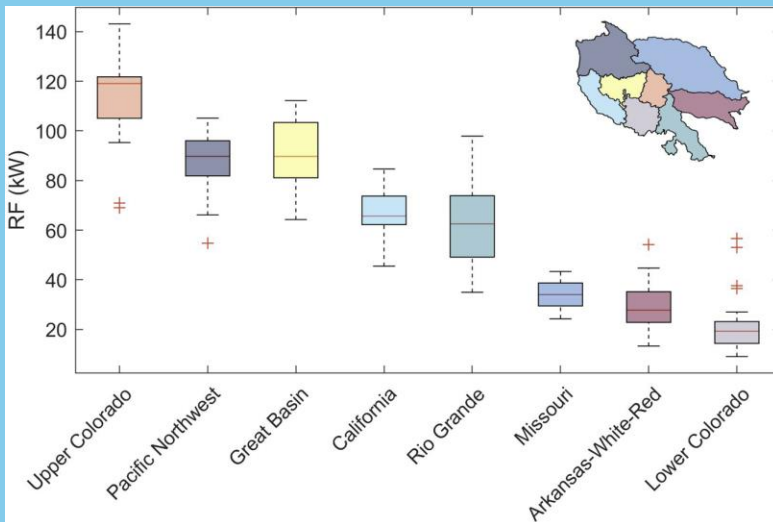
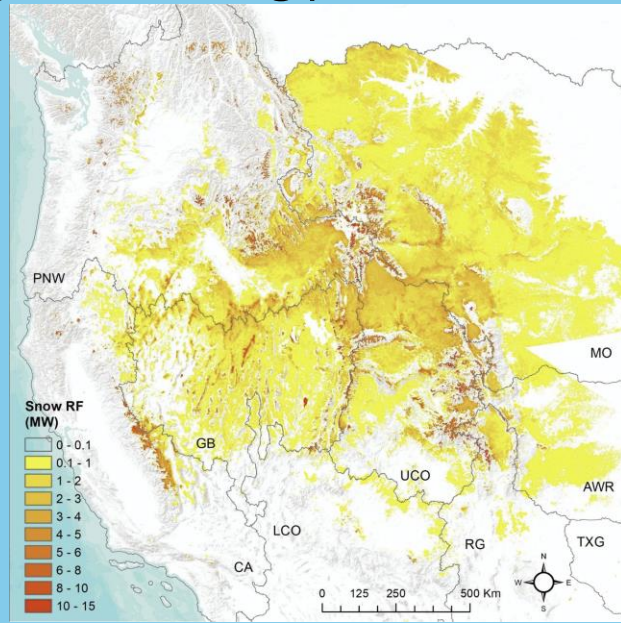
ISNOBAL Hydrologic Model



Meyer et al, 2024 Hydrology

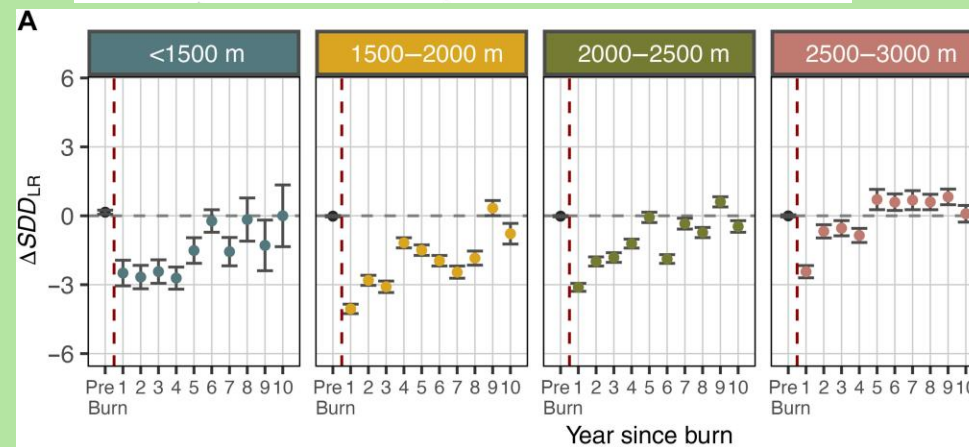
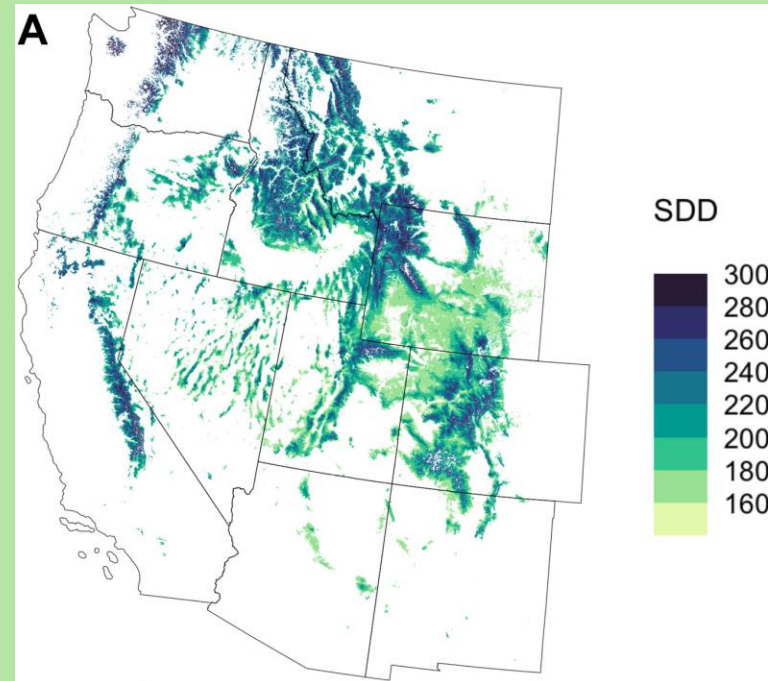
Optical satellite applications for light absorbing particles & wildlife

Light absorbing particles in snow



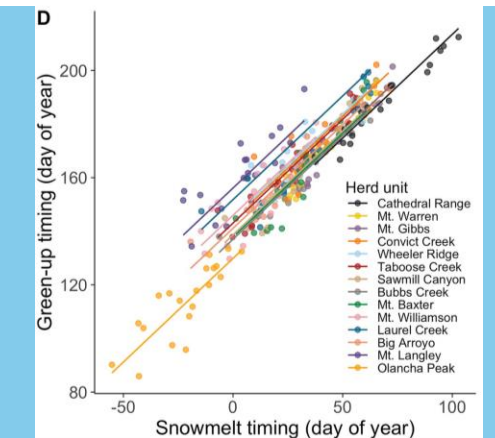
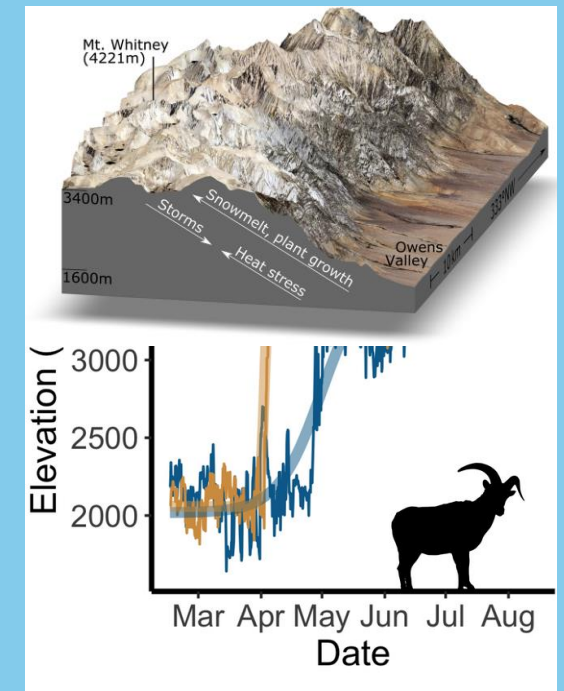
Jensen et al, 2024, *Env. Research*

Snow cover duration and wildfires



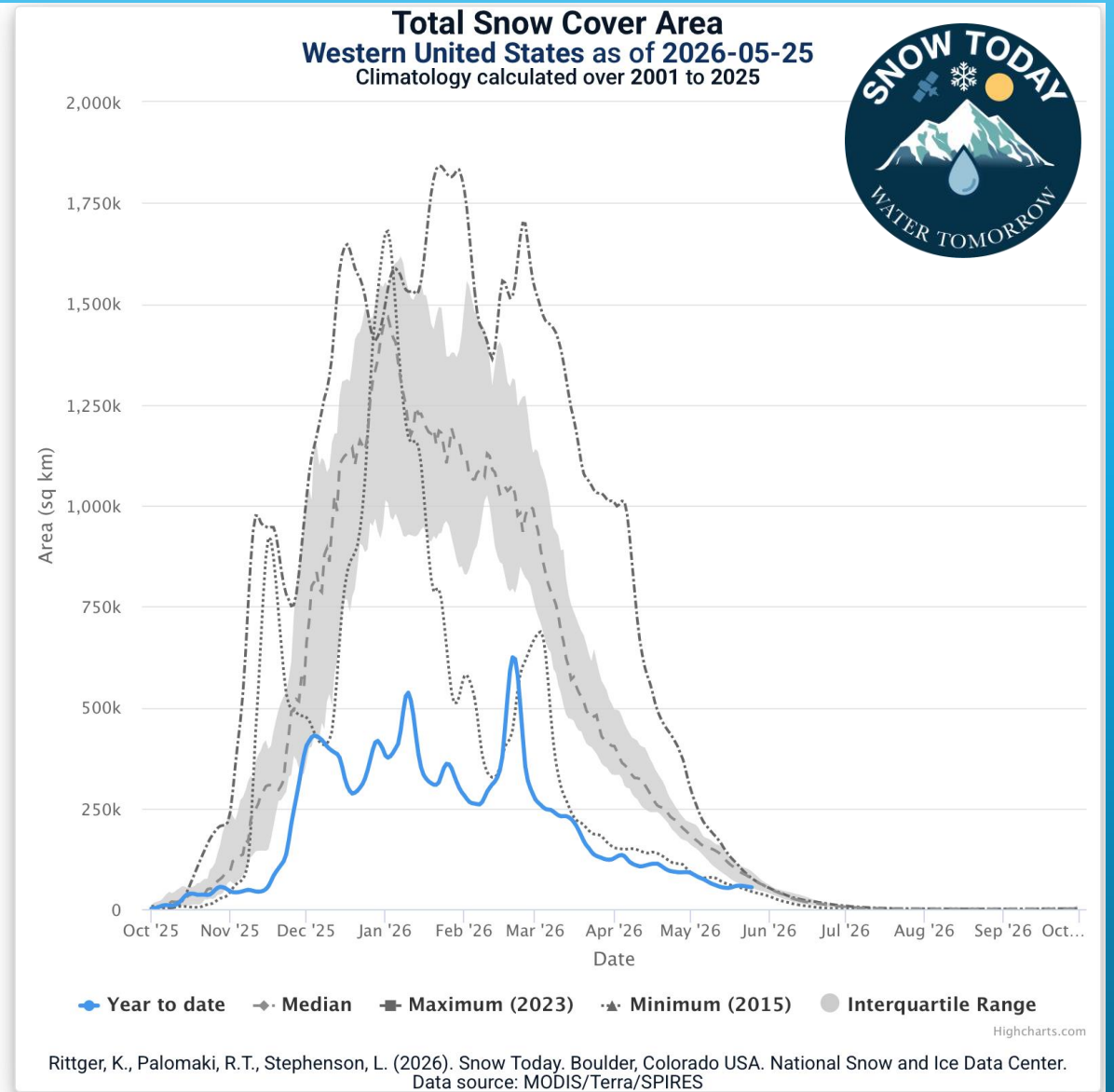
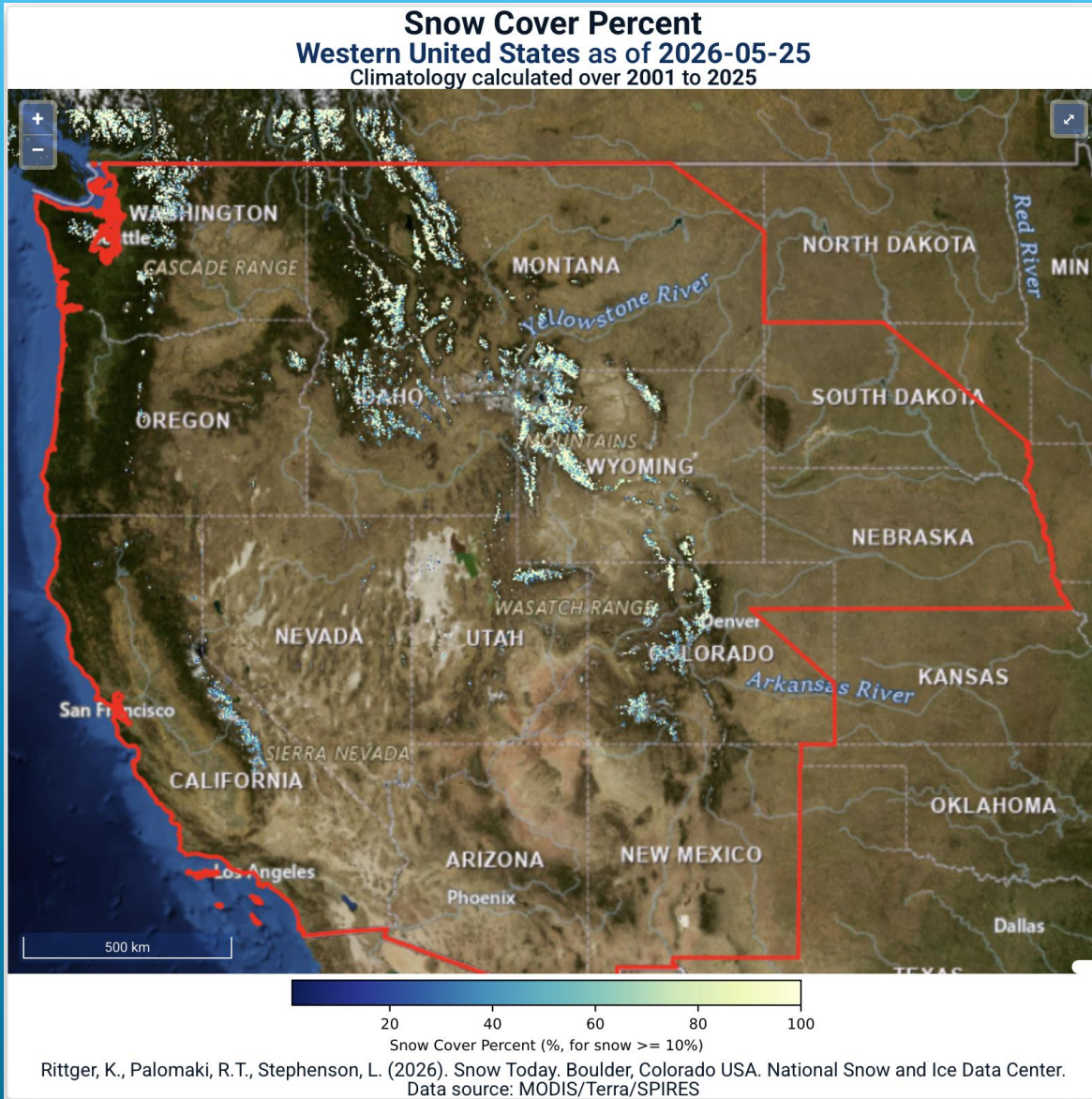
Koshkin et al, 2025, *Science Comm.*

Sierra Bighorn sheep

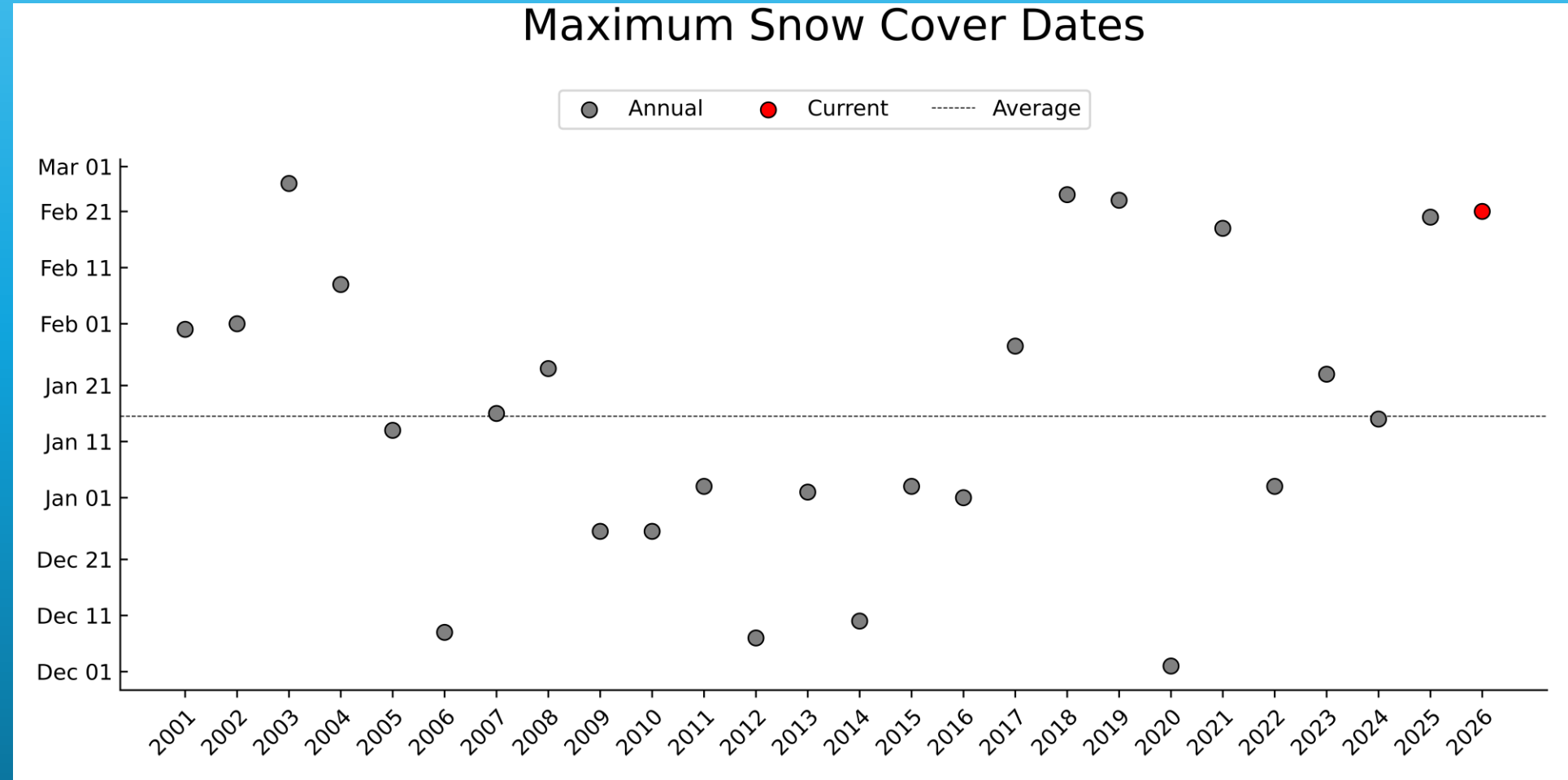
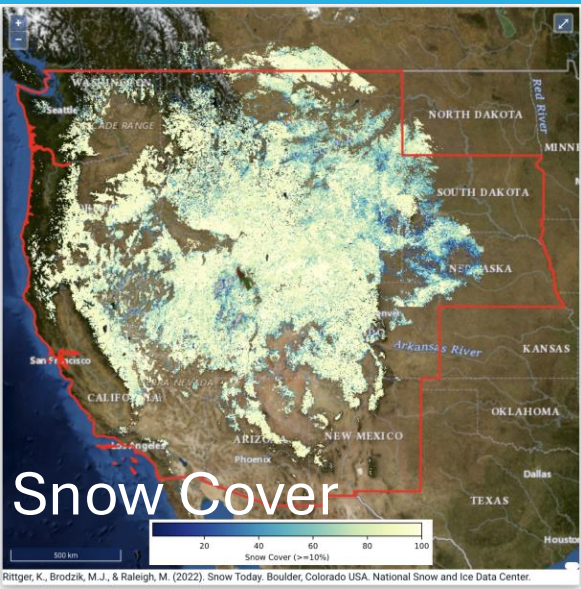


John et al, 2024, *Sci Rep*

Western U.S. current conditions: snow cover

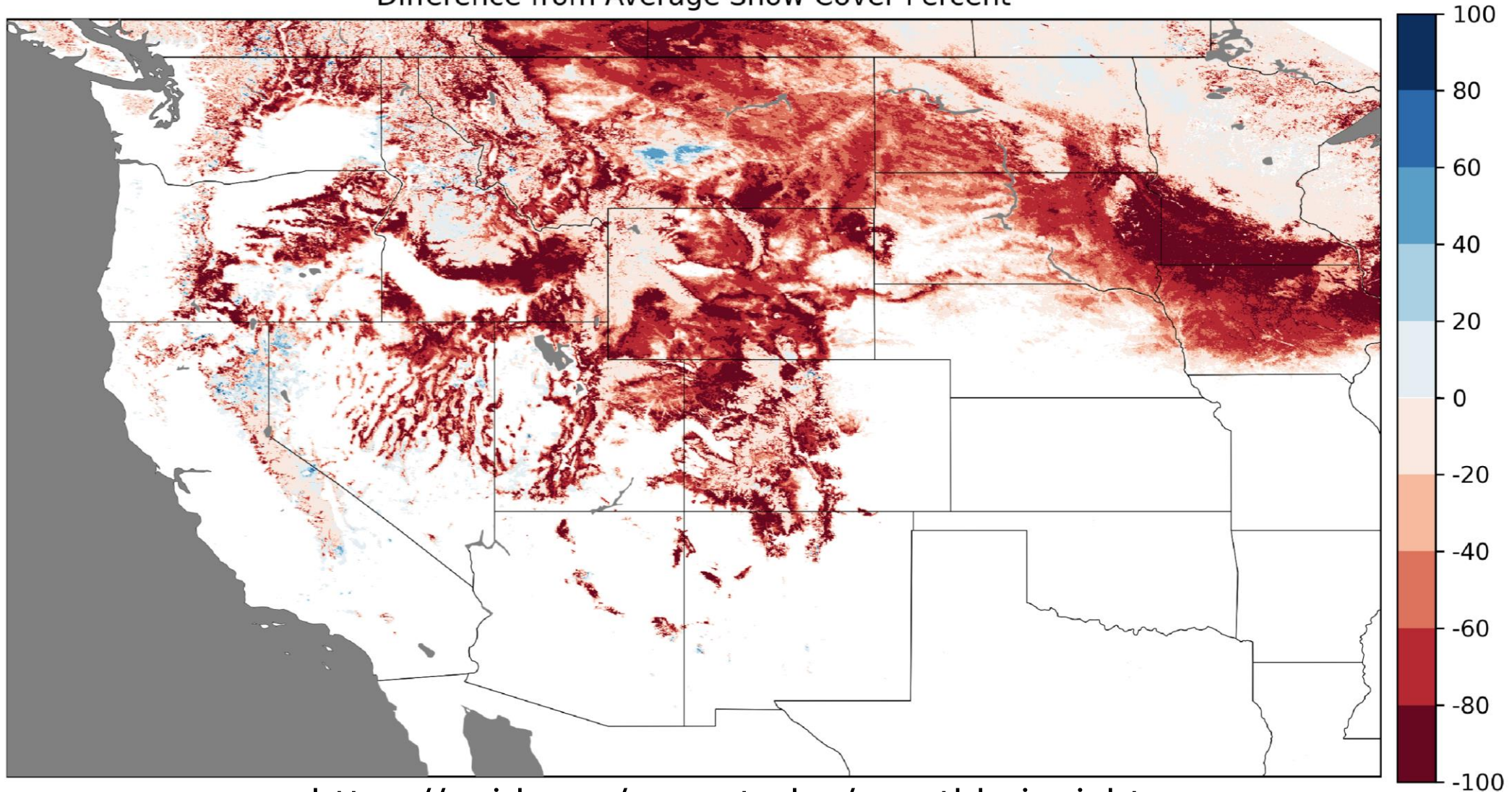


Peak snow covered area, 2001-2026



Snow cover extent difference from mean February 2026

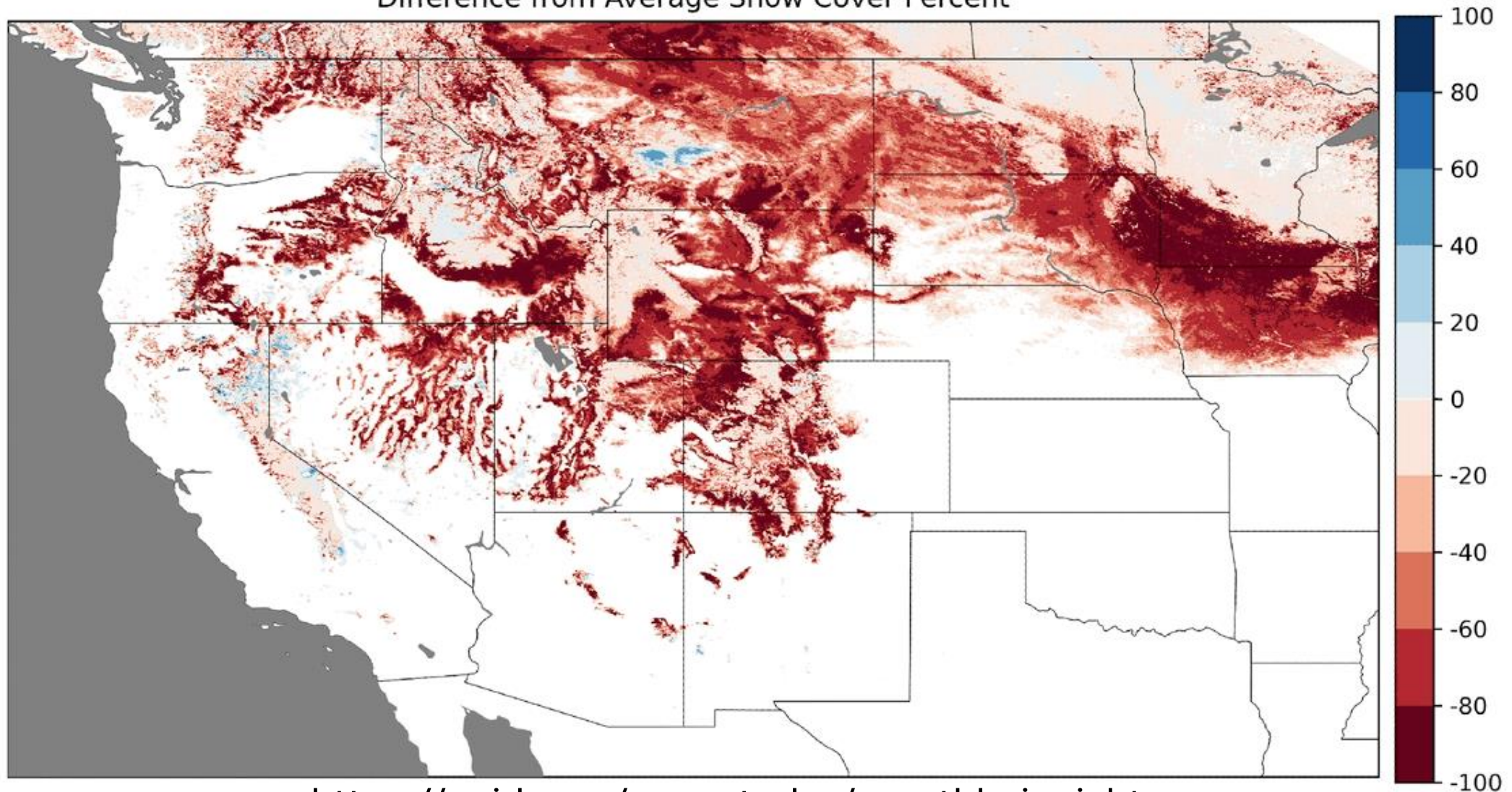
Difference from Average Snow Cover Percent



<https://nsidc.org/snow-today/monthly-insights>

Snow cover extent, February 2026

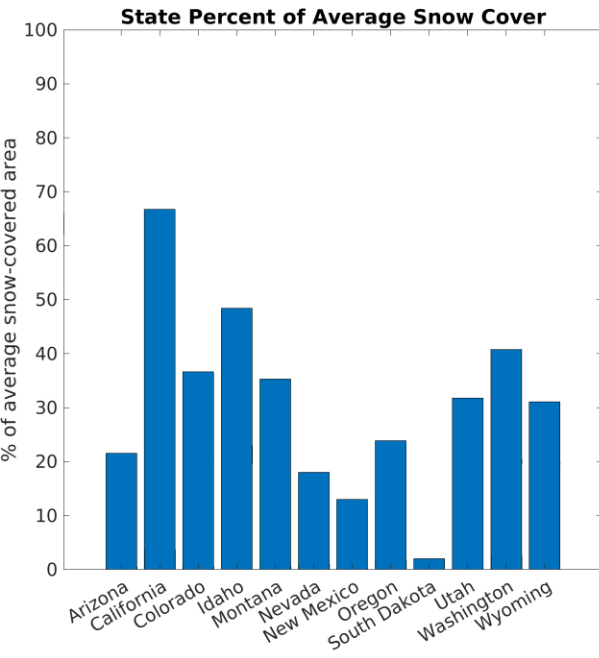
Difference from Average Snow Cover Percent



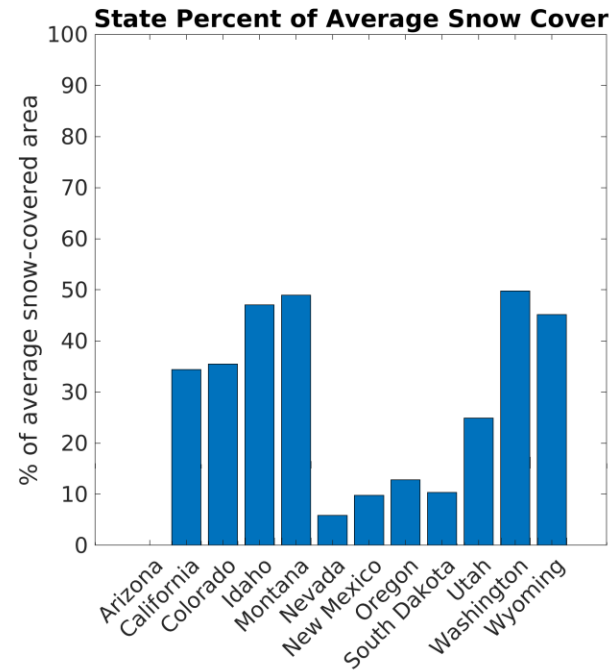
<https://nsidc.org/snow-today/monthly-insights>

Snow Covered area by State

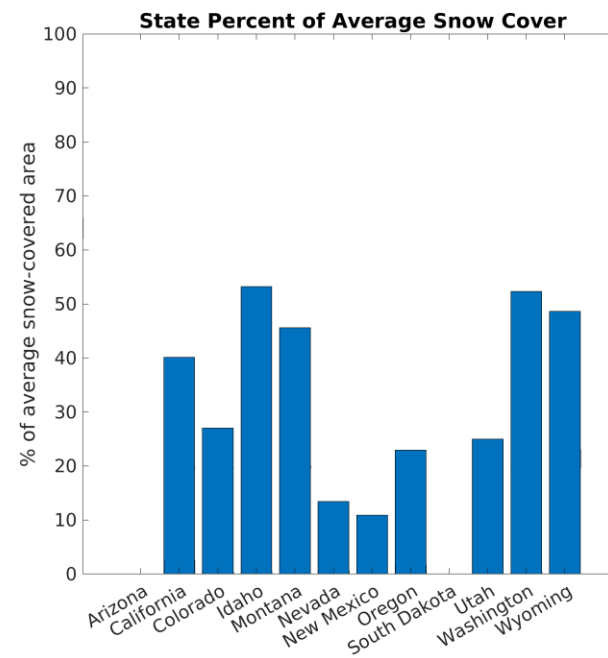
February



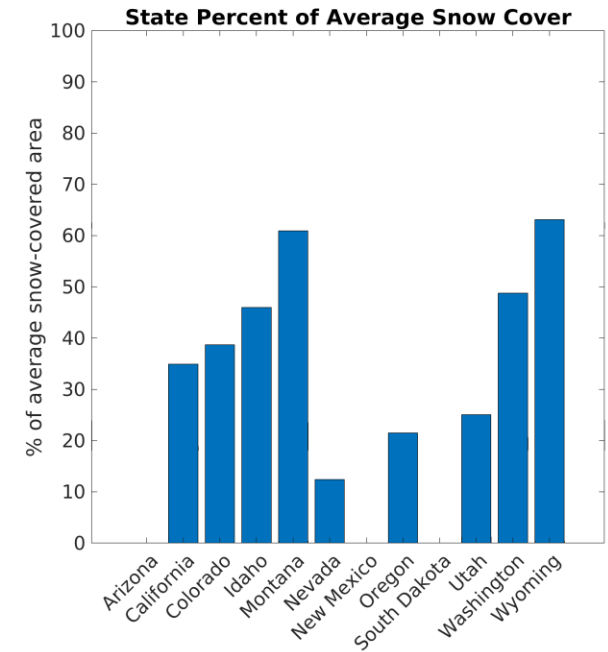
March



April

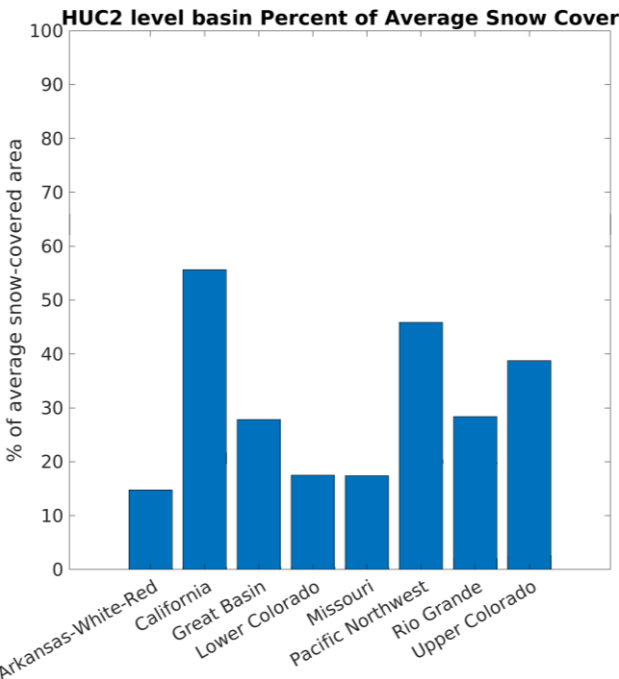


May

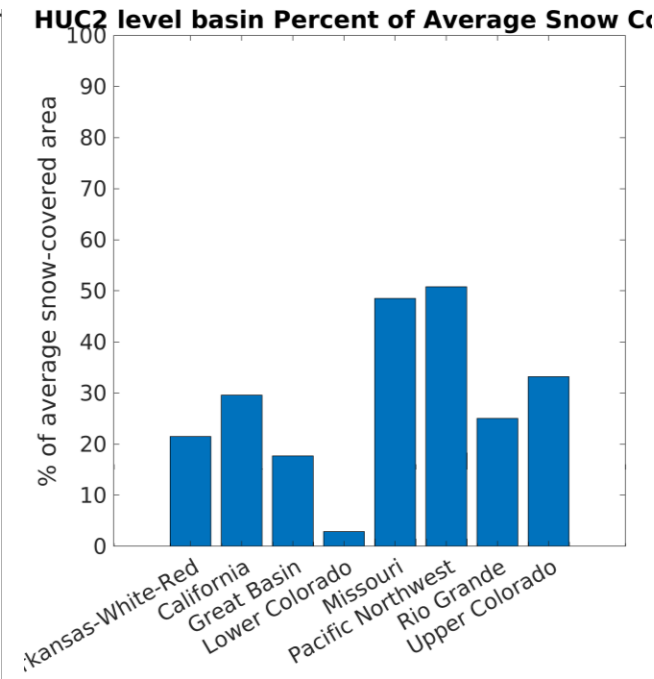


Snow Covered area by HUC2 basin

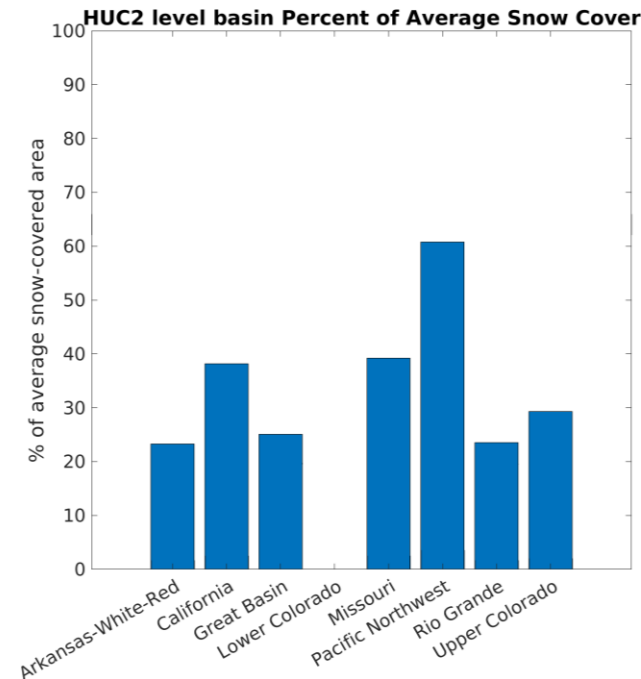
February



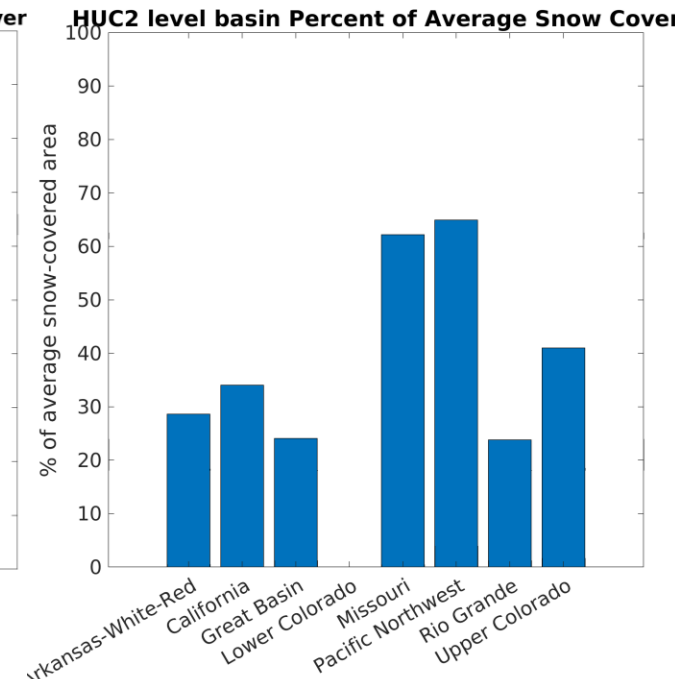
March



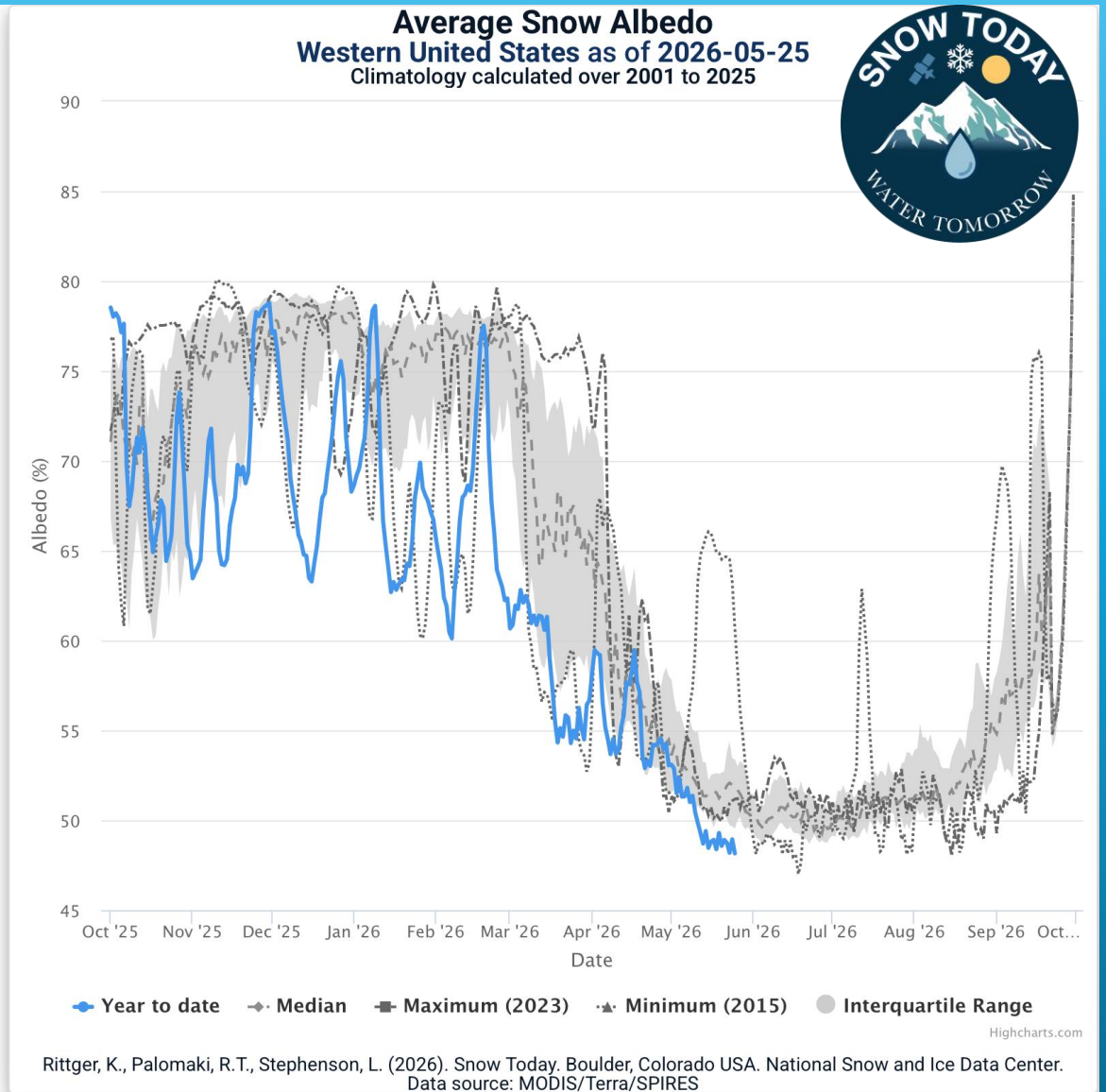
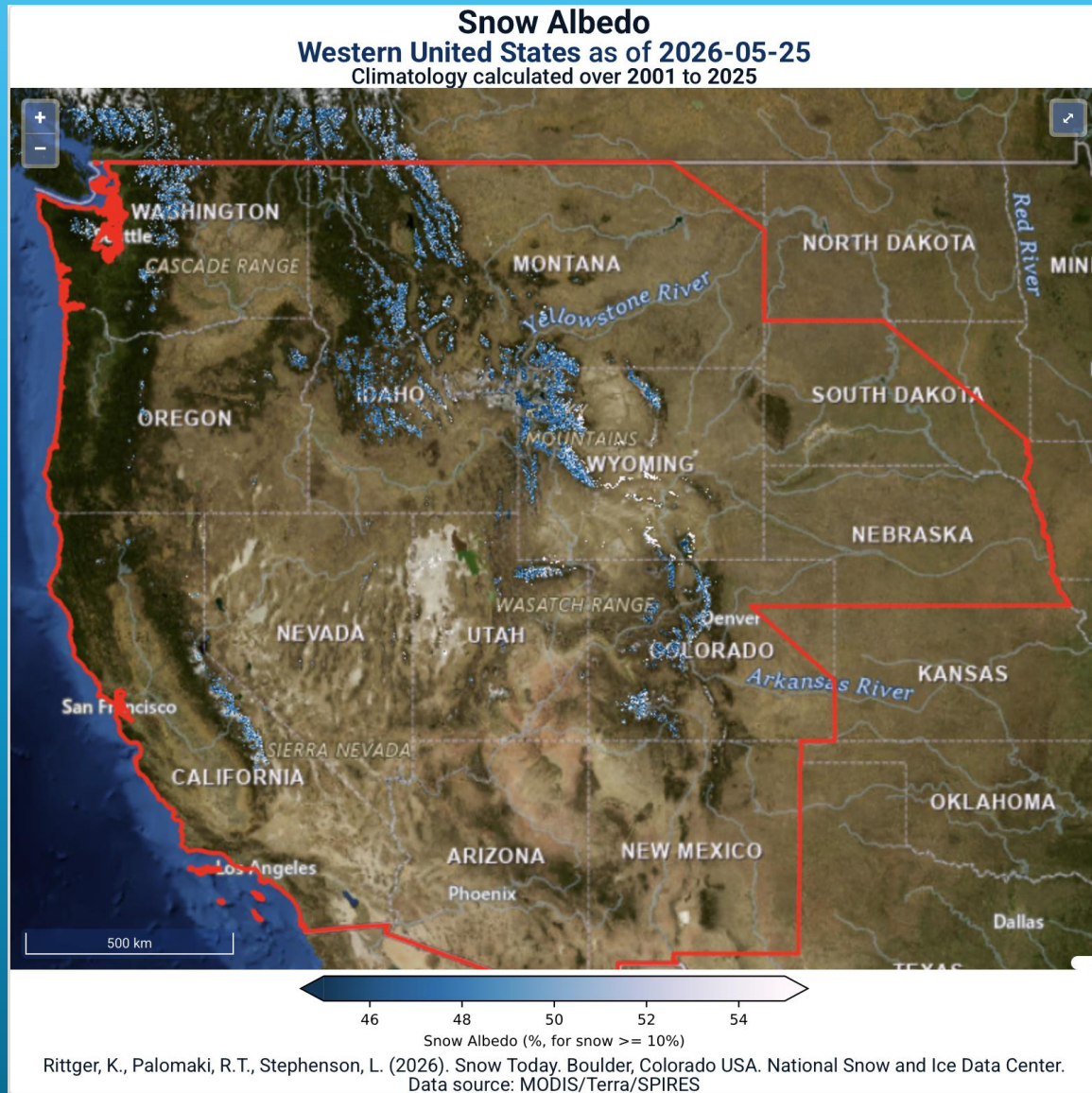
April



May

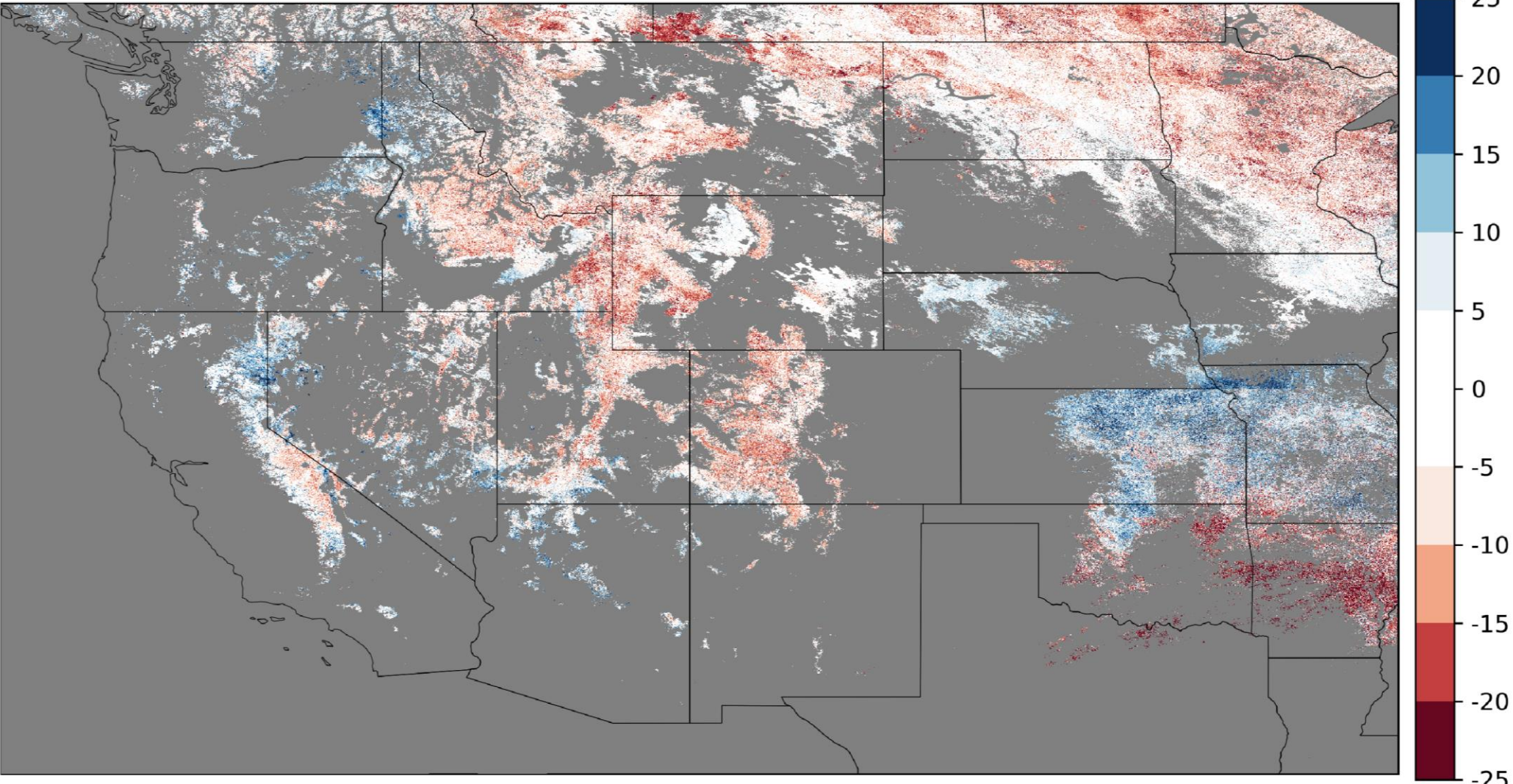


Western U.S. current conditions: snow albedo



Snow albedo, February 2026

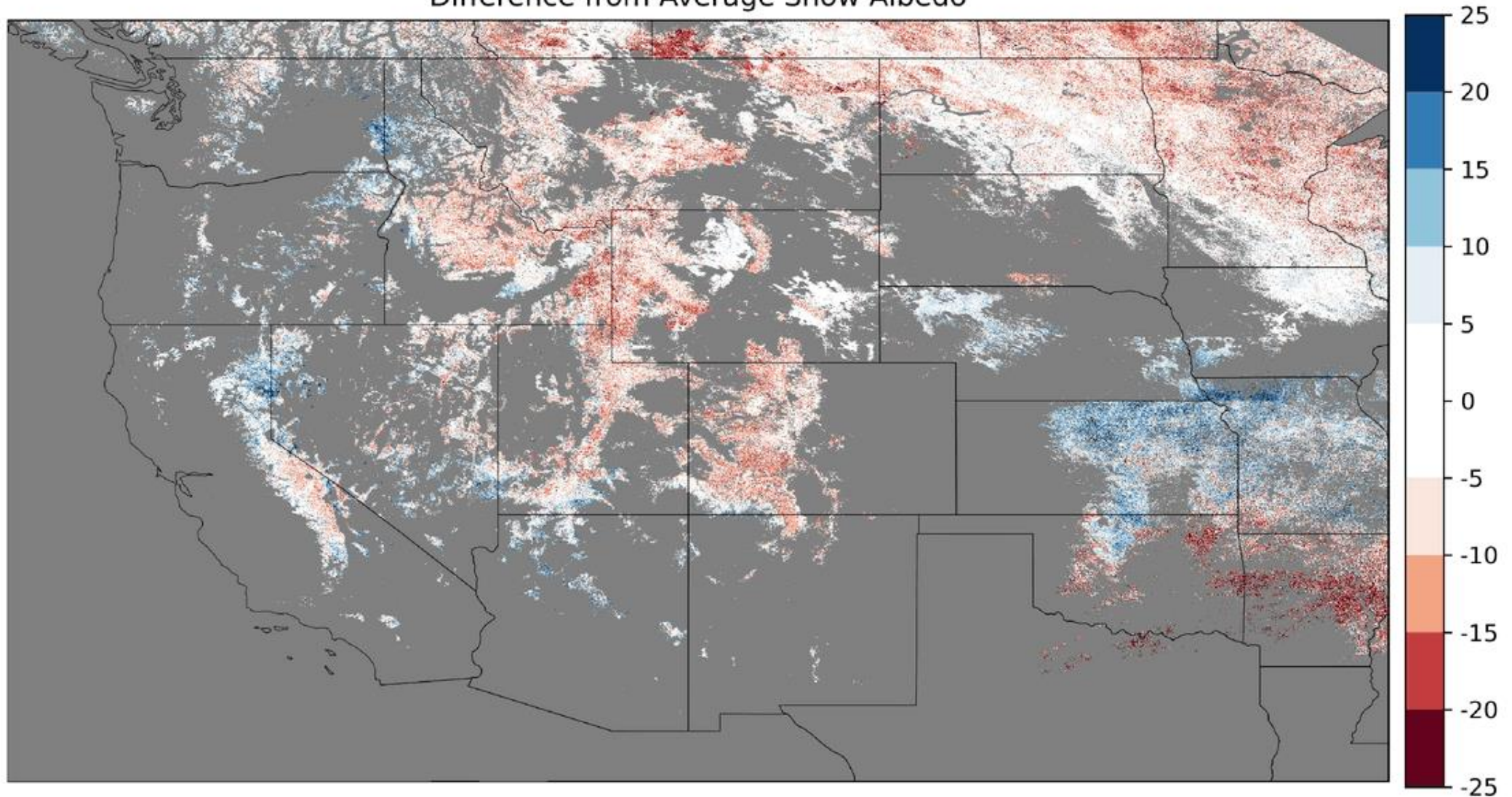
Difference from Average Snow Albedo



<https://nsidc.org/snow-today/monthly-insights>

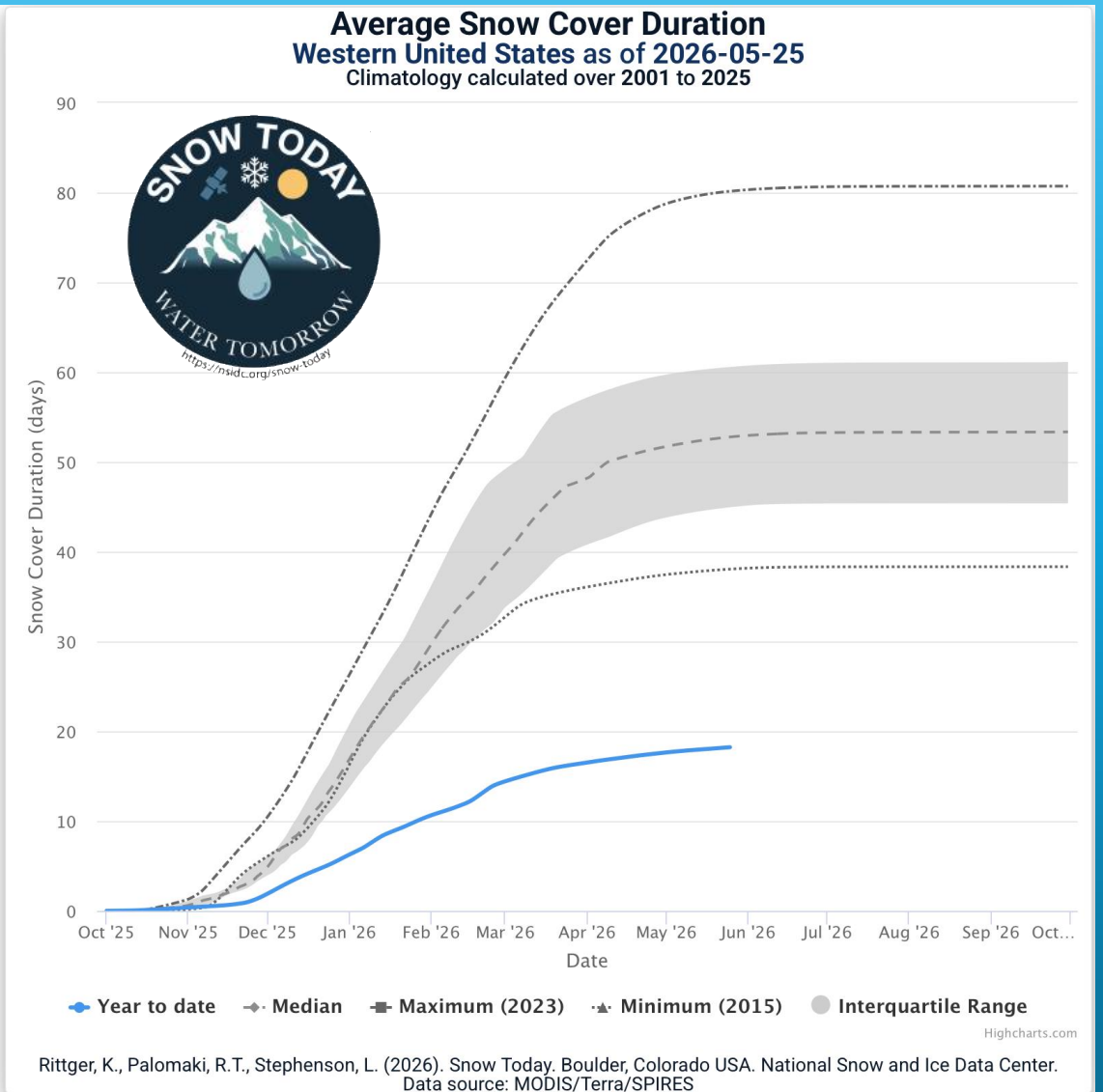
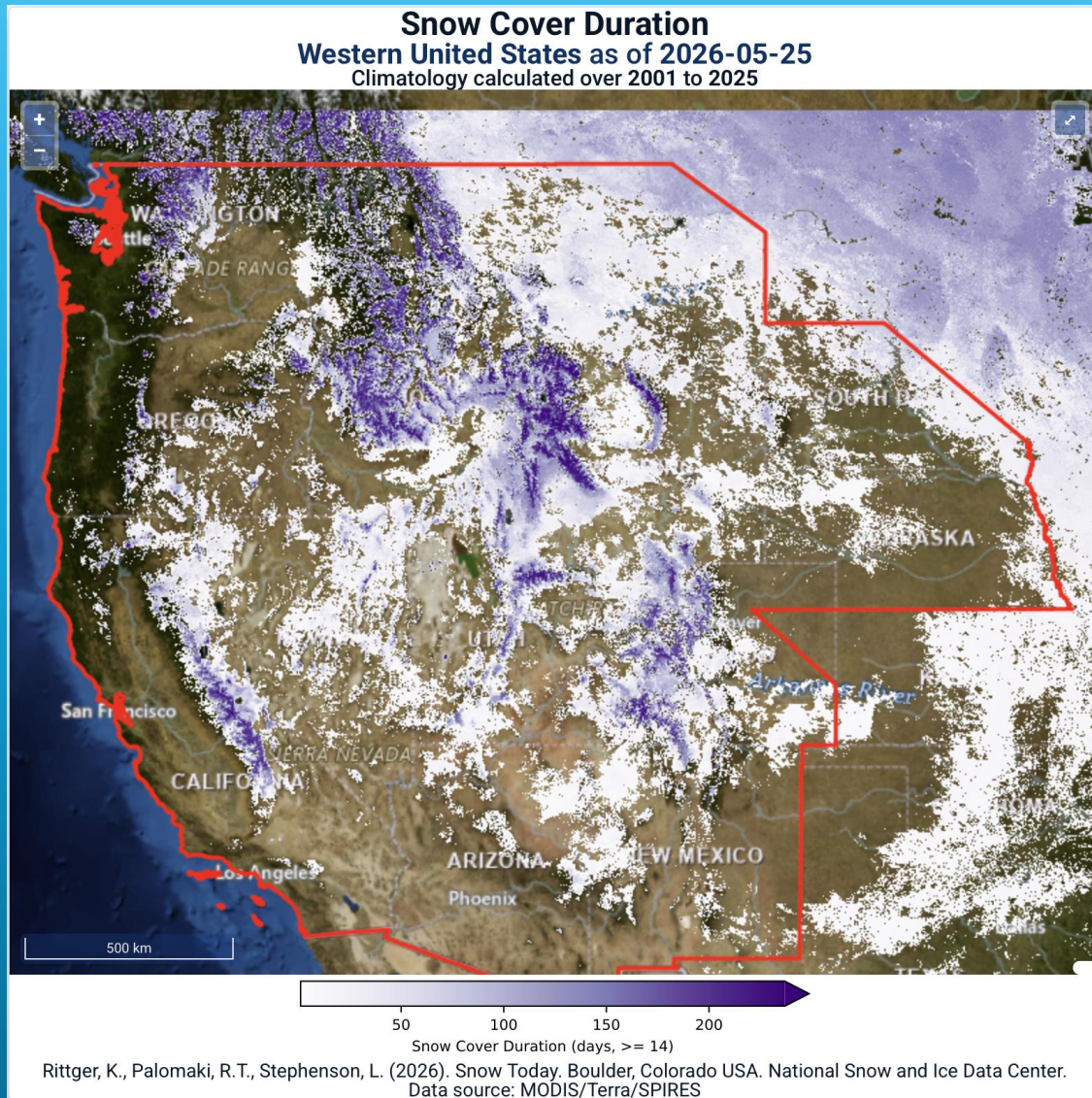
Snow albedo, February 2026

Difference from Average Snow Albedo



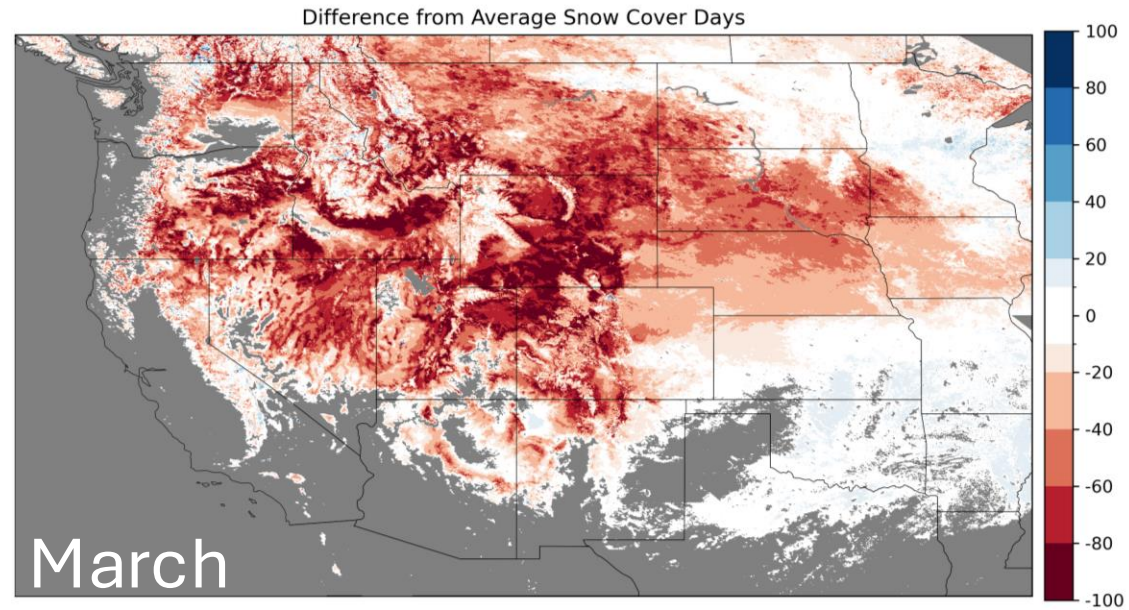
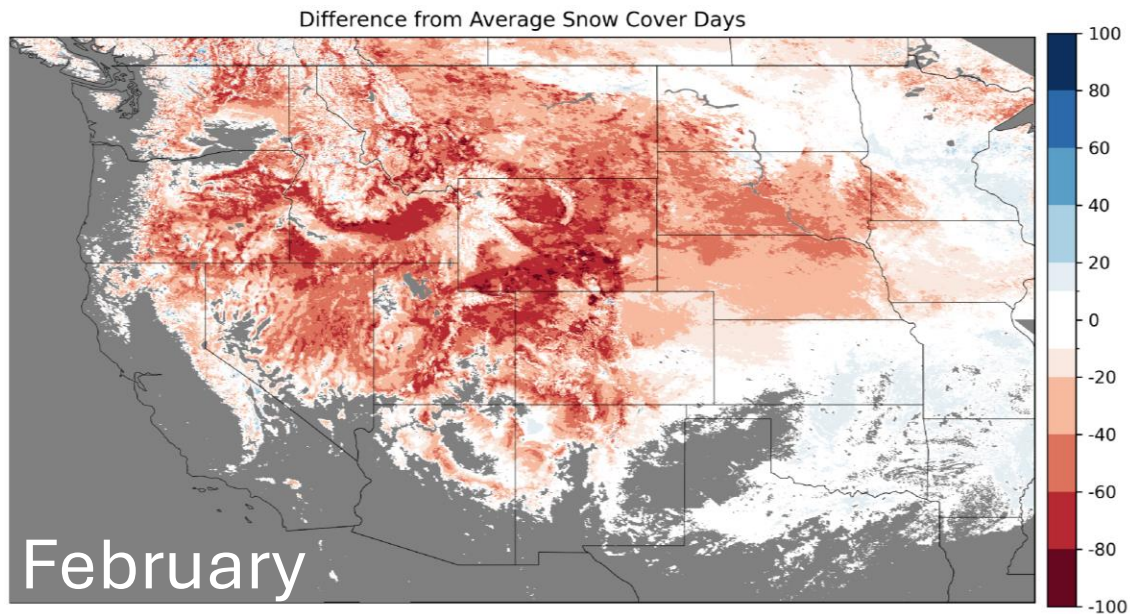
<https://nsidc.org/snow-today/monthly-insights>

Western U.S. current conditions: snow covered duration

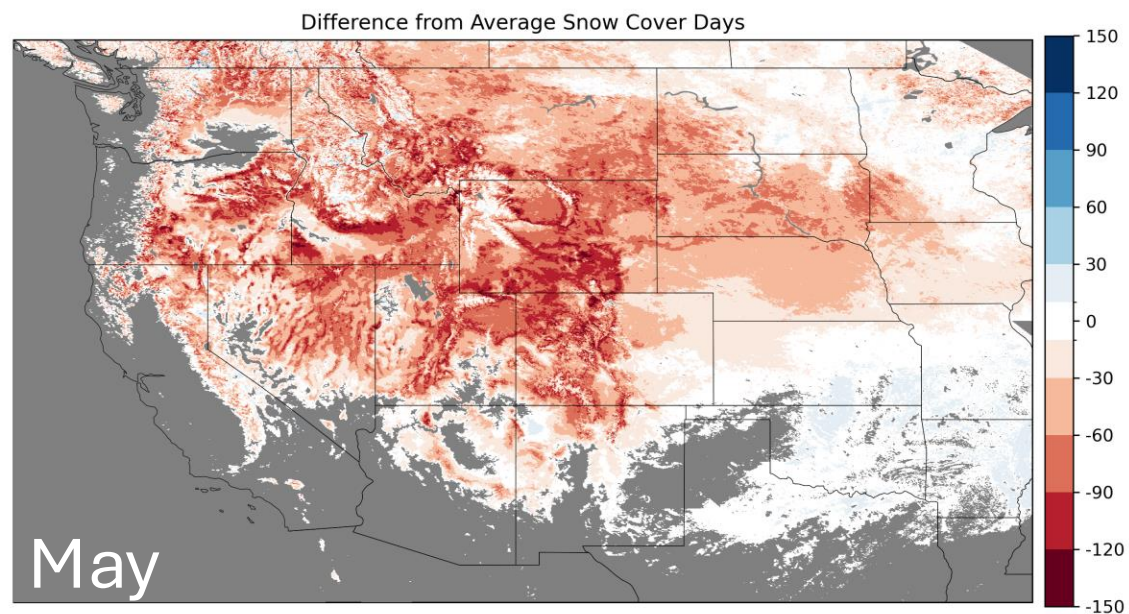
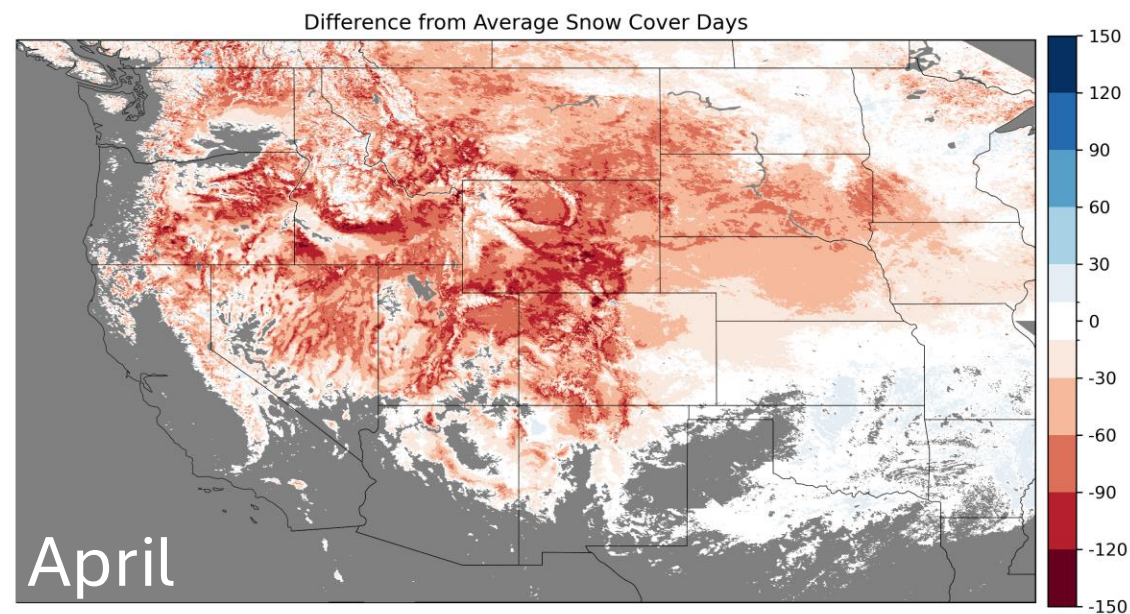


Snow cover duration

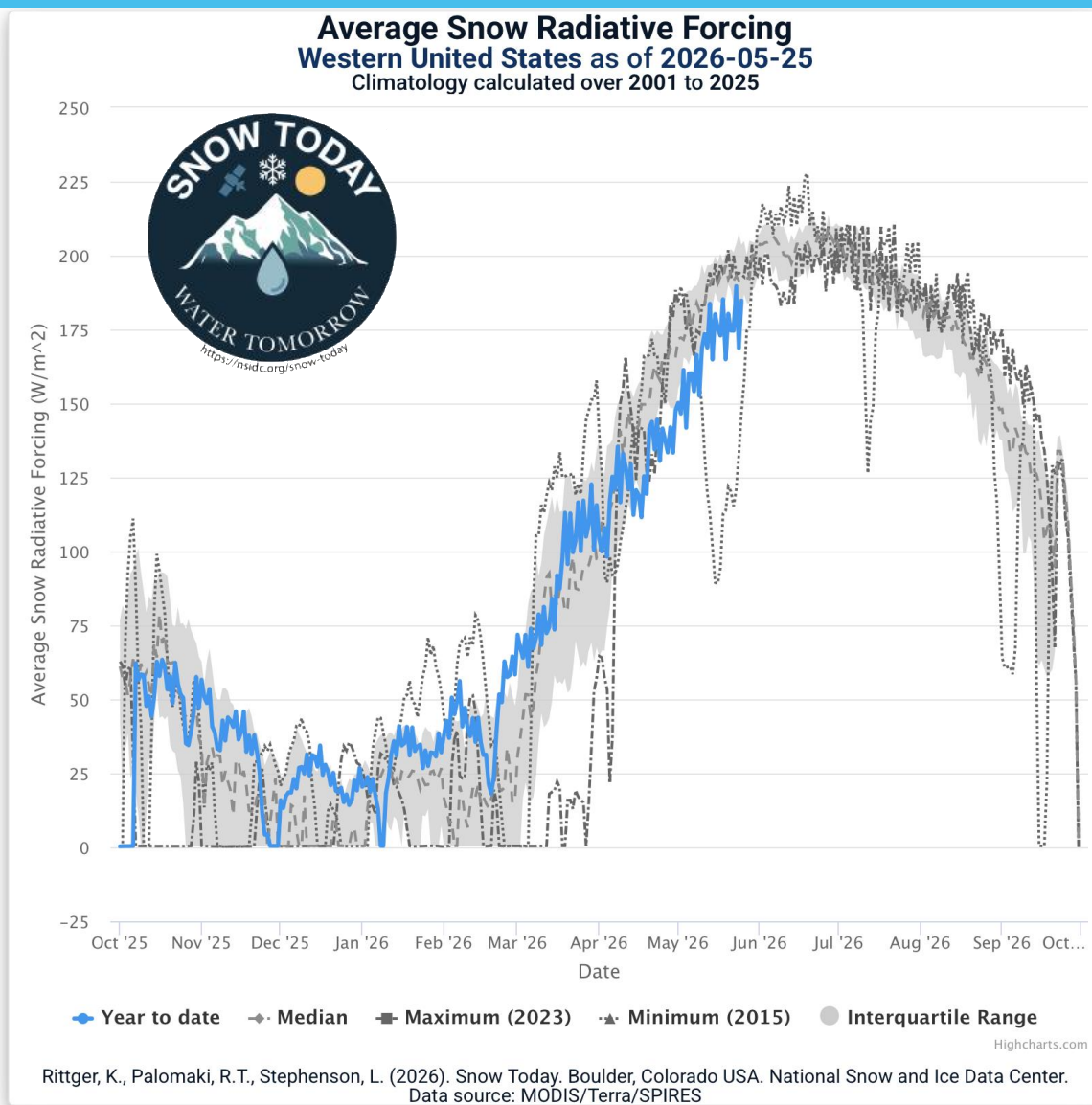
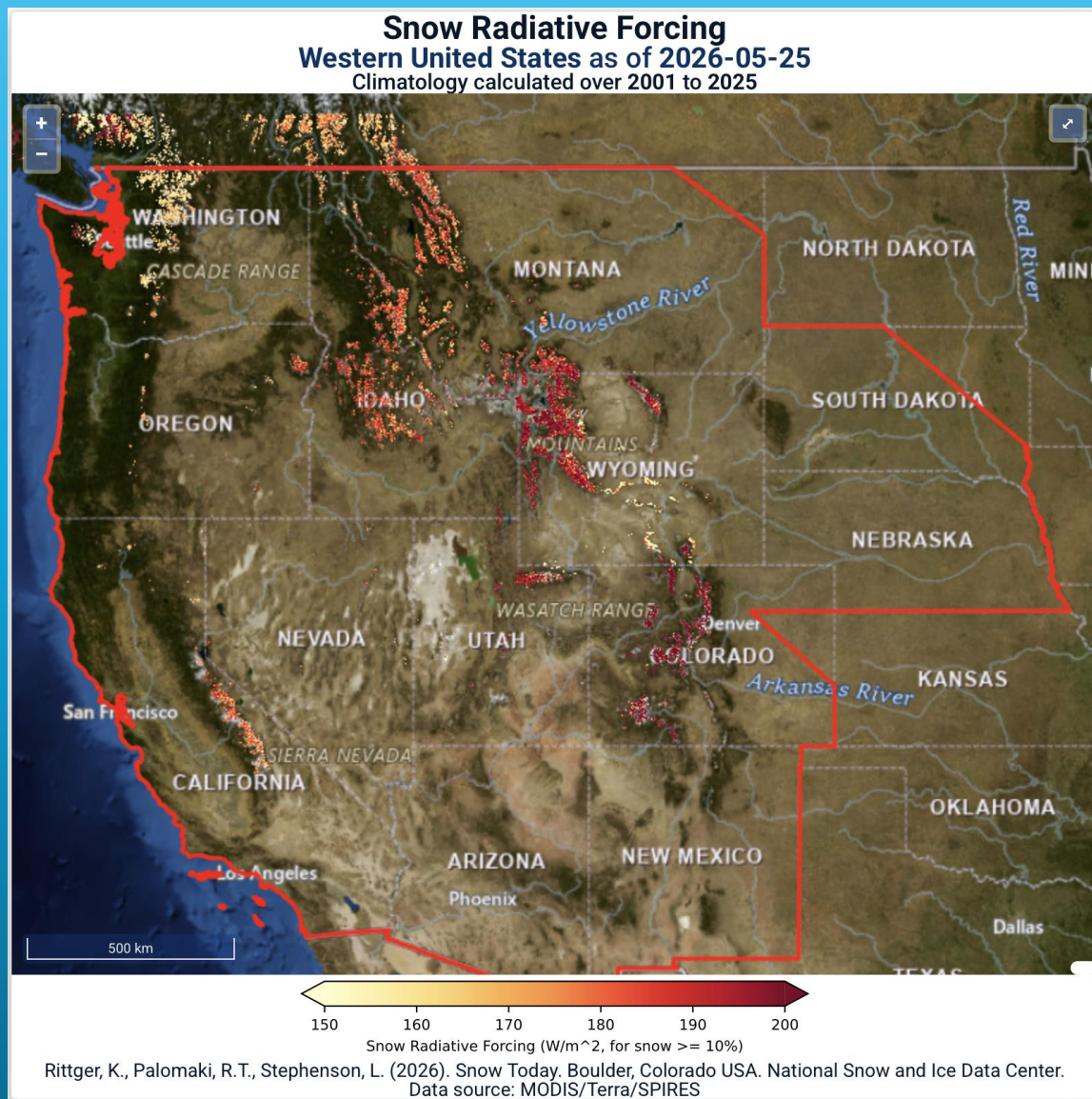
Scale 0-100 days



Scale 0-150 days



Western U.S. current conditions: snow radiative forcing



Current and Future Plans for VIIRS



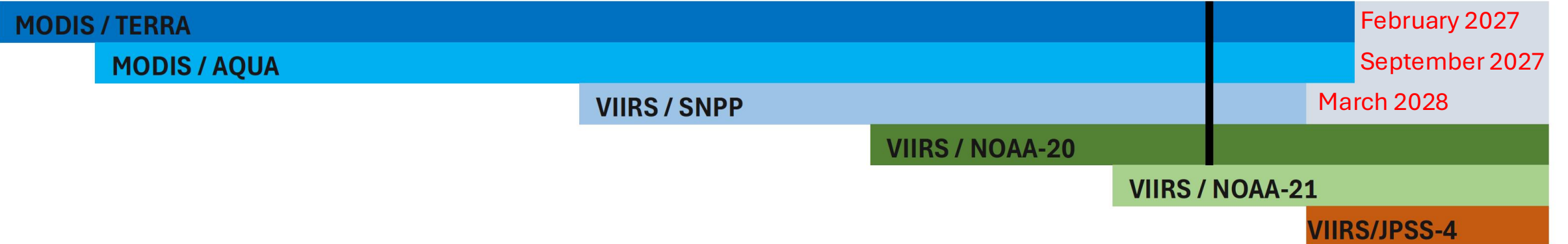
VIIRS – Visible Infrared Imaging Suite

- NOAA / NASA Collaboration
- Sensors boarded on:
 - Suomi National Polar-orbiting Partnership Suomi-NPP (2012 – proj. late 2026)
 - Joint Polar Satellite Systems (JPSS)
 - JPSS-1 / NOAA-20 (2017 - ongoing)
 - JPSS-2 / NOAA-21 (2022 - ongoing)
 - JPSS-4 / NOAA-22 (proj. 2027)
 - JPSS-3 / NOAA-23 (proj. 2032)

All JPSS will have an PM overpass



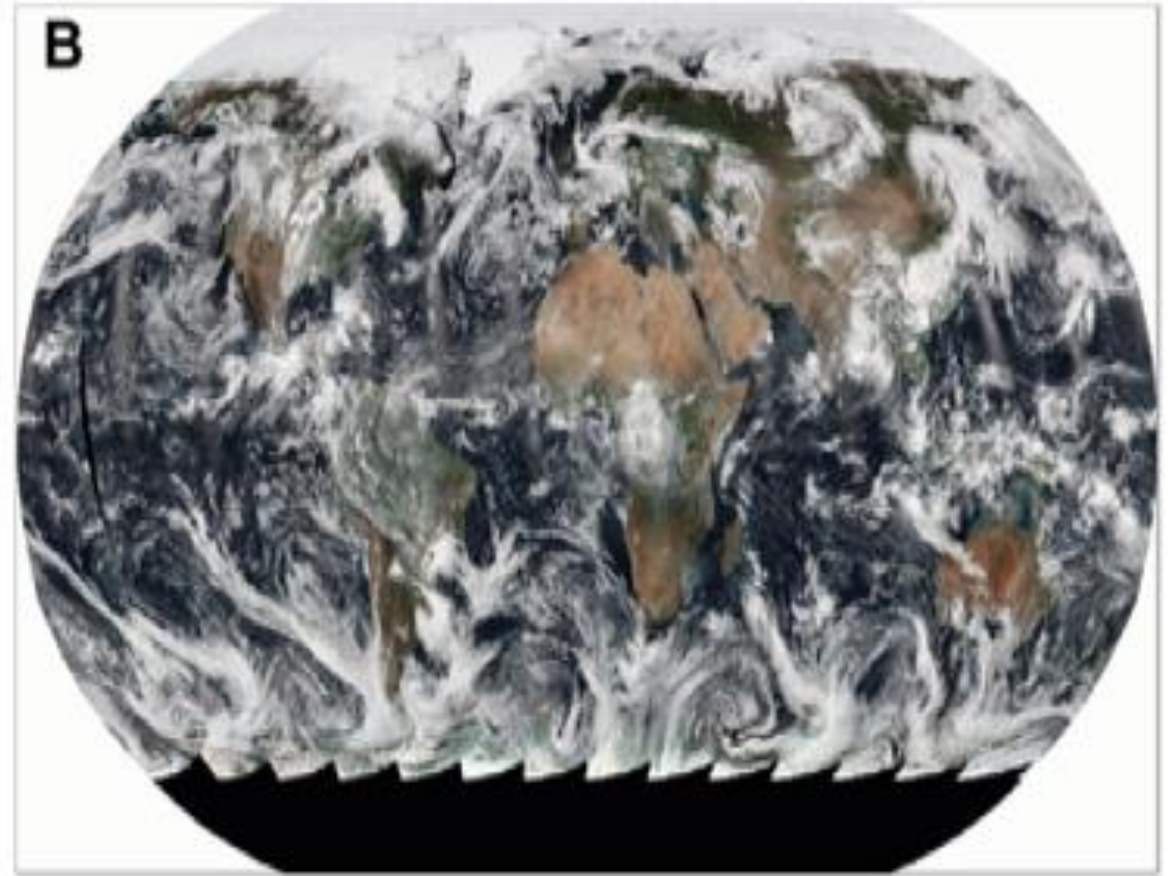
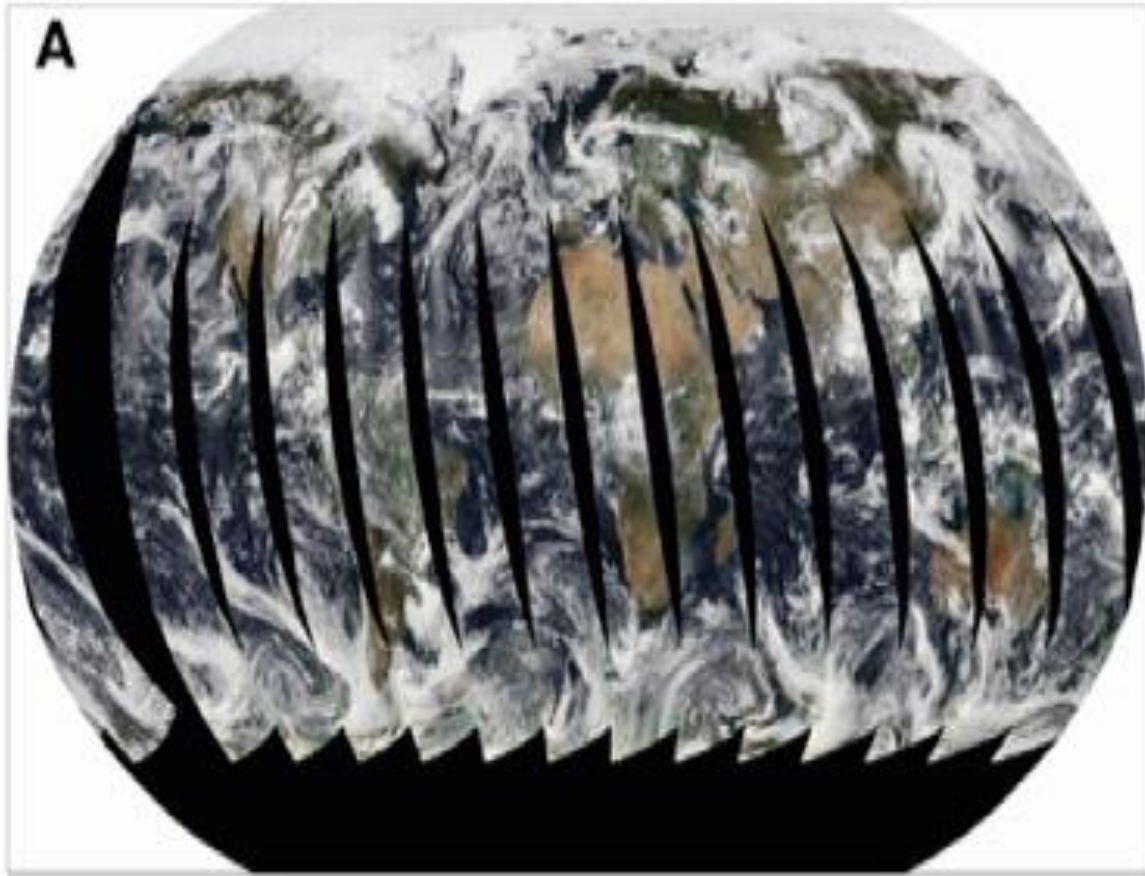
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031



VIIRS: improved sensor characteristics

MODIS Terra: May 29, 2013

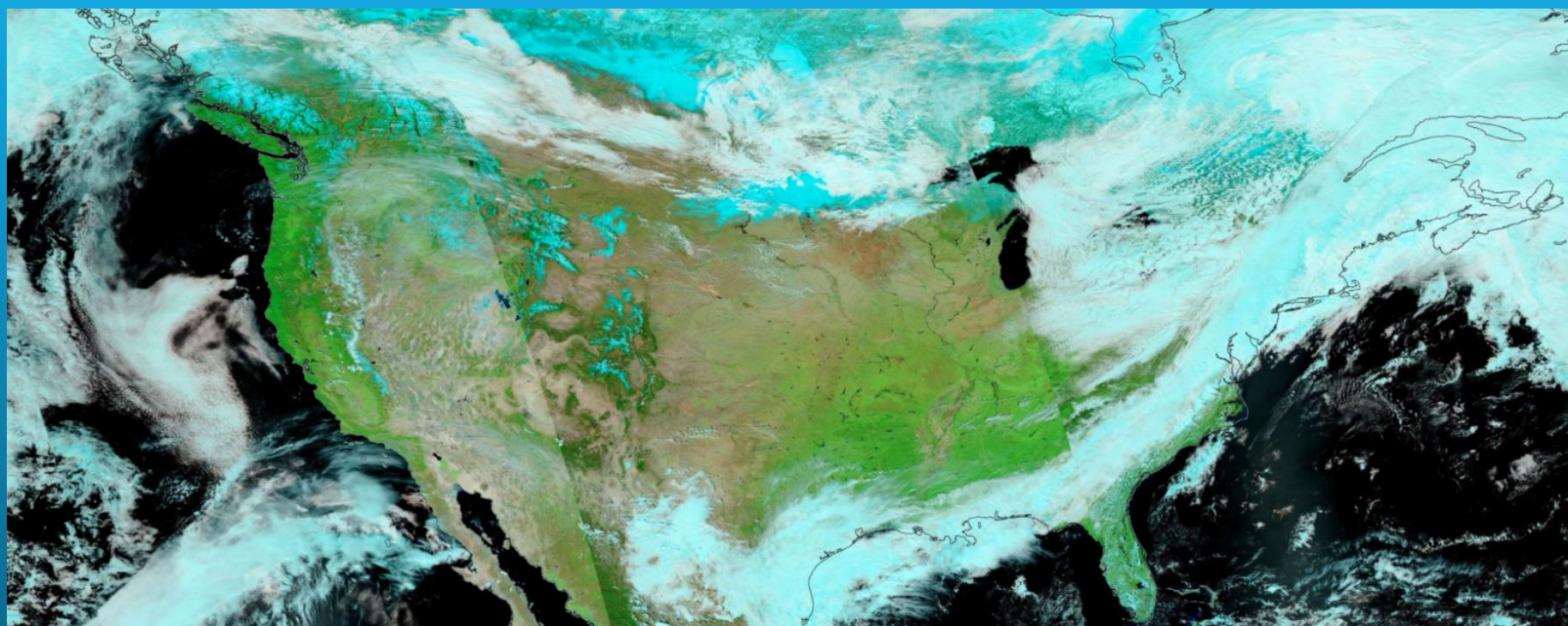
VIIRS Suomi: May 29, 2013



MODIS Terra



VIIRS Suomi

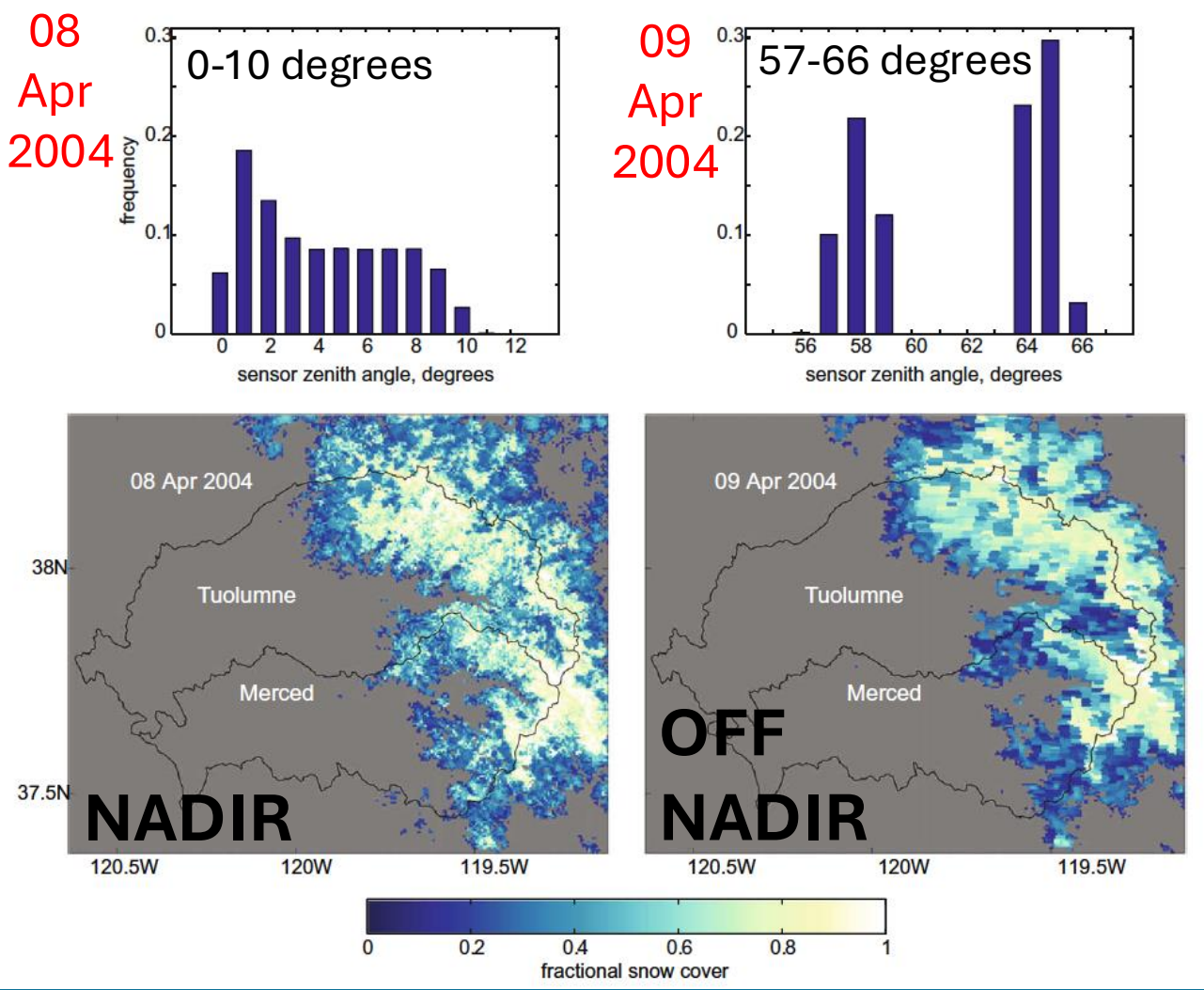


April 4, 2026

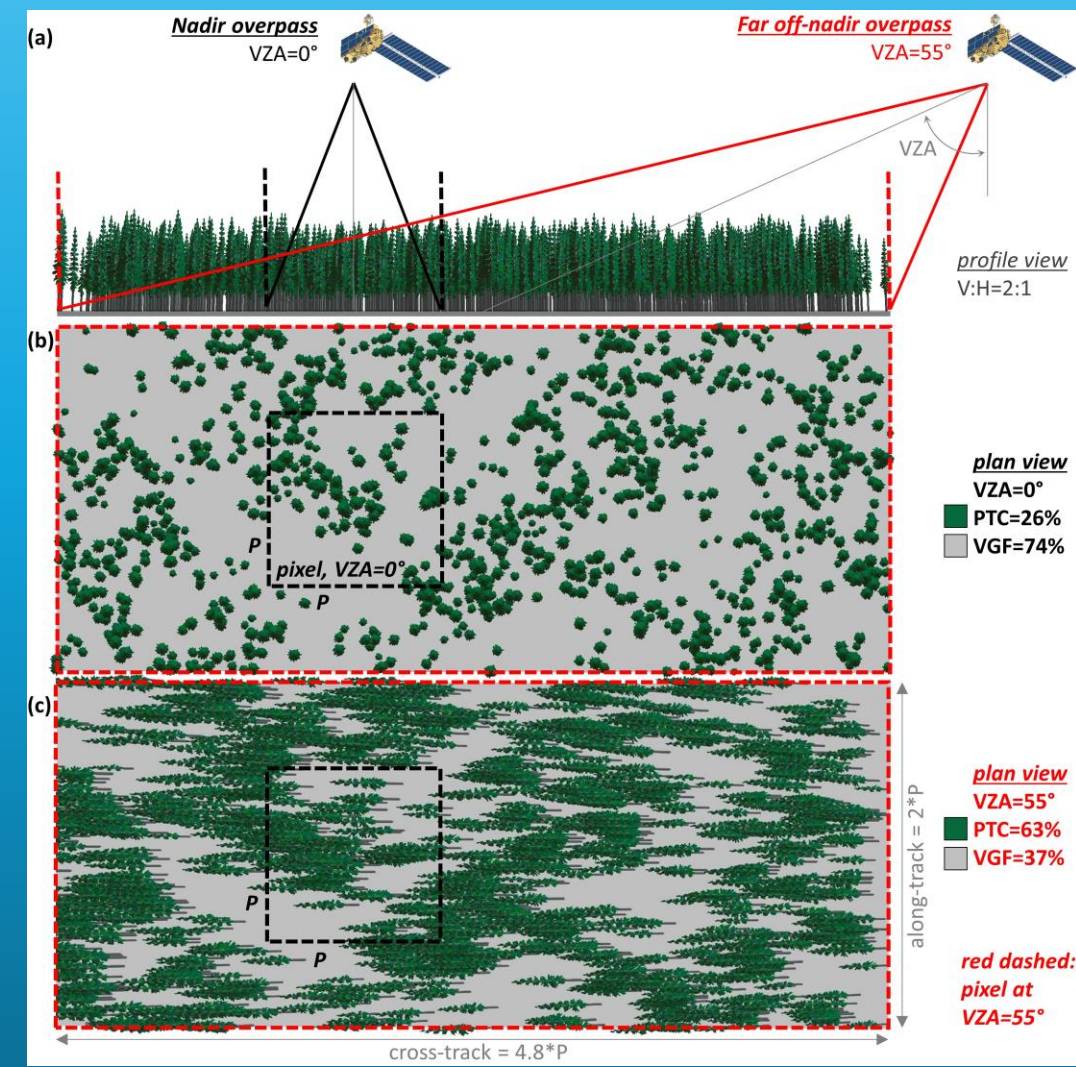
Nadir and off nadir views (MODIS Terra)

view angle

snow cover

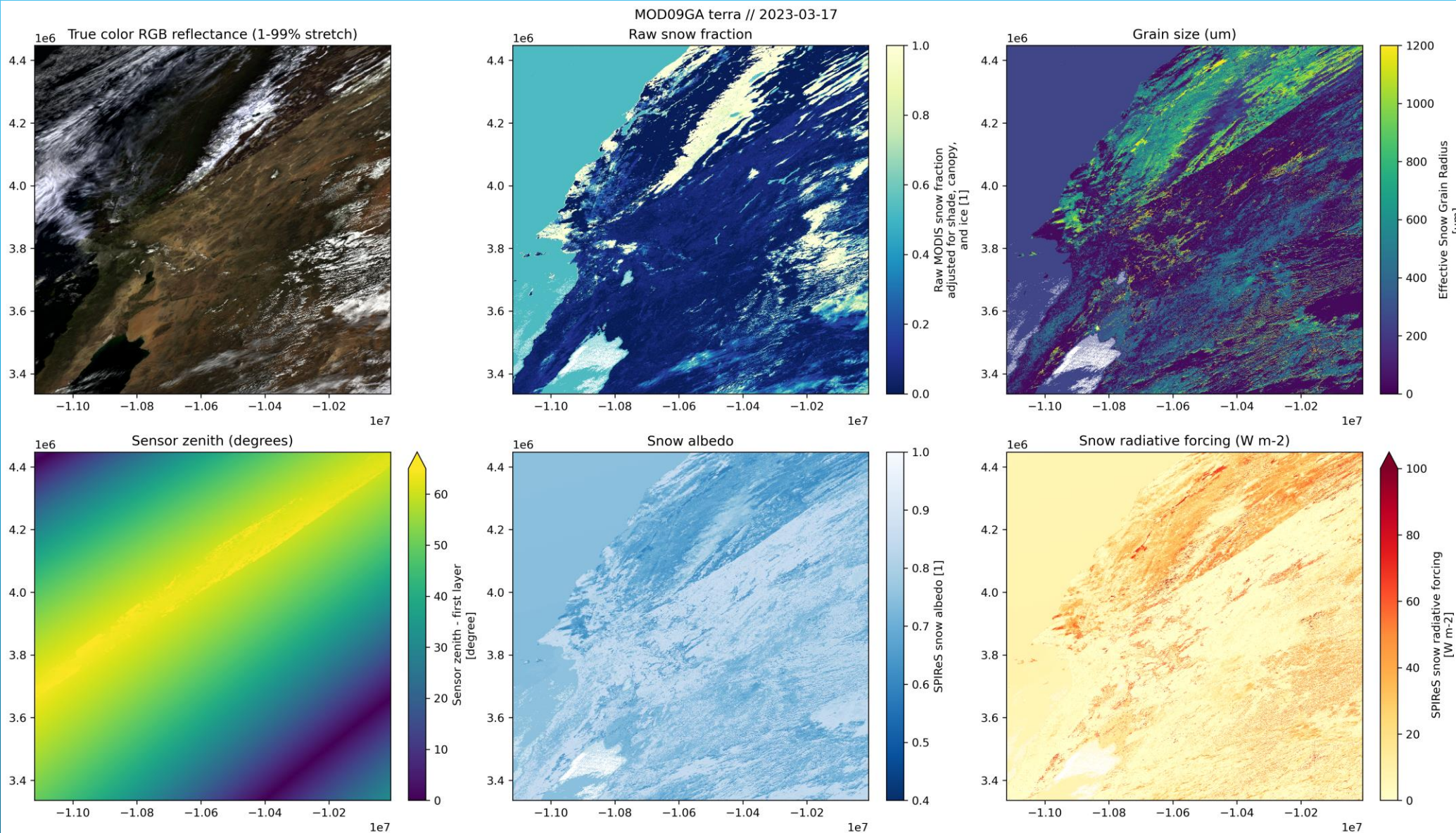


Dozier et al. 2008



Rittger et al, 2020

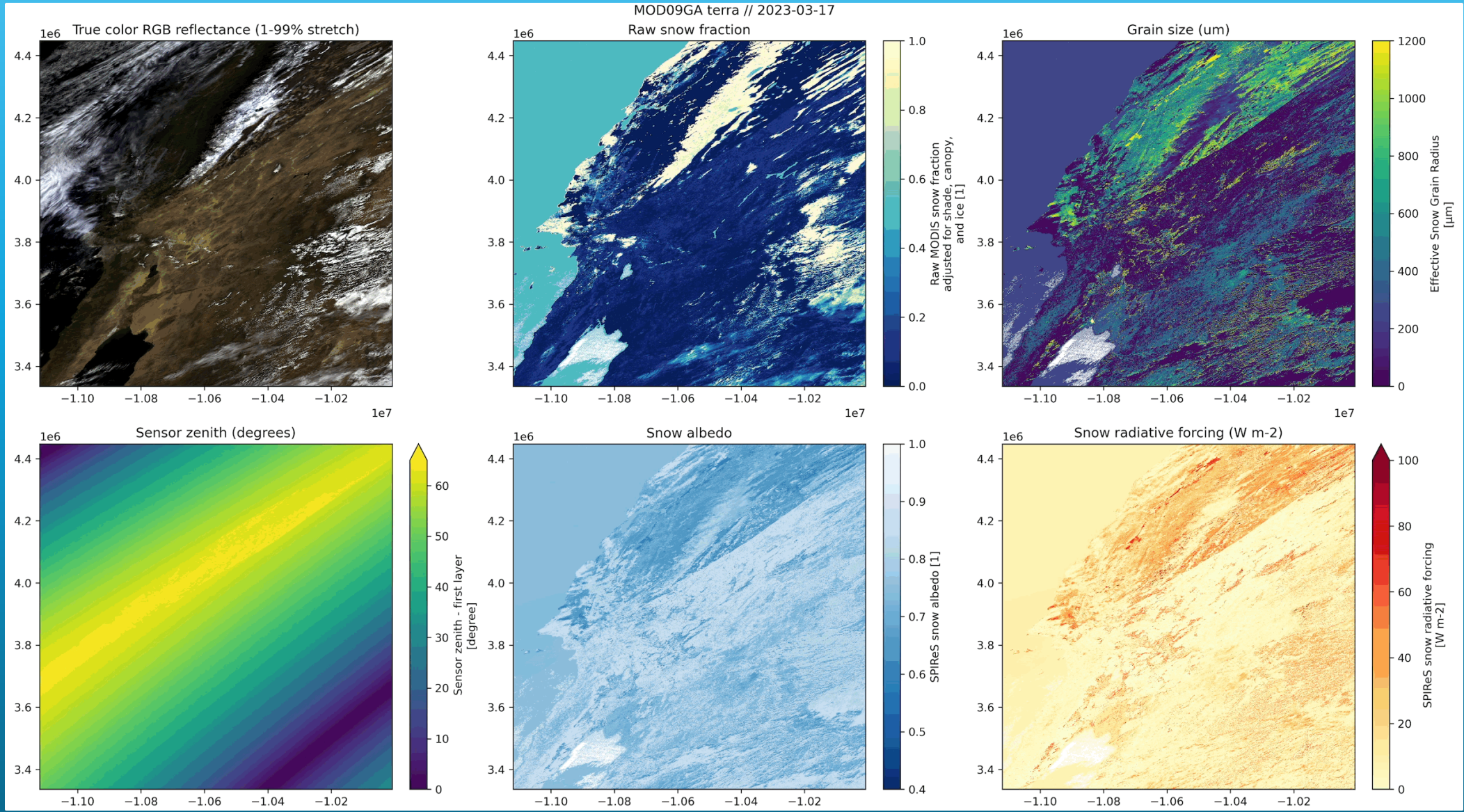
MODIS Terra: California



THIS IS A GIF

MODIS: Terra & Aqua

VIIRS: Suomi, NOAA-20, NOAA-21

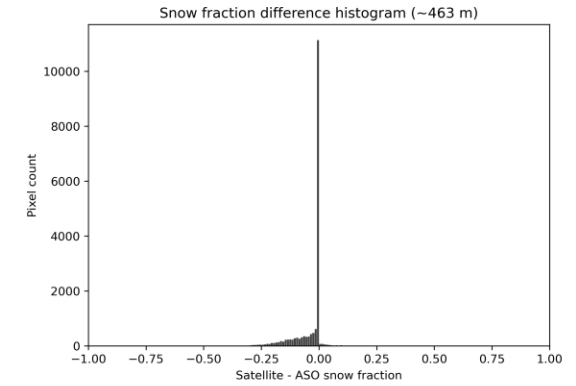
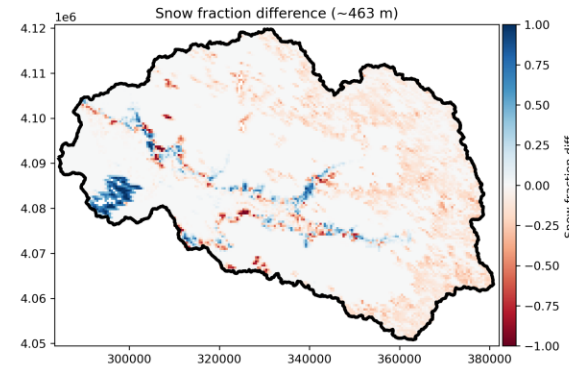
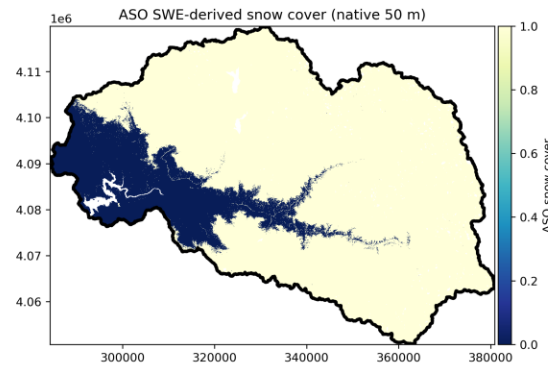
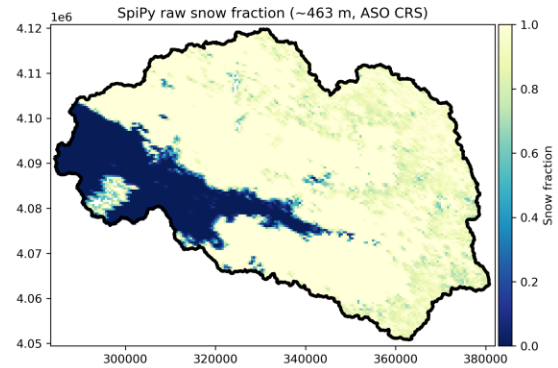




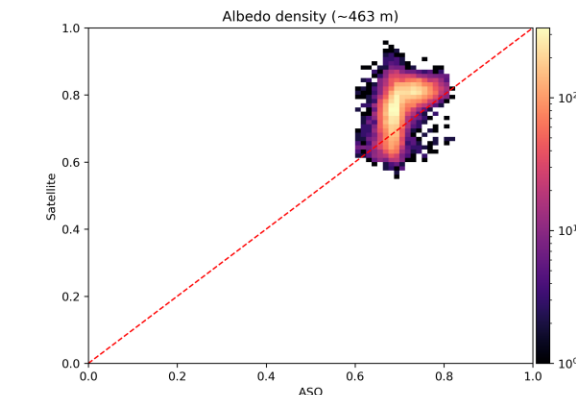
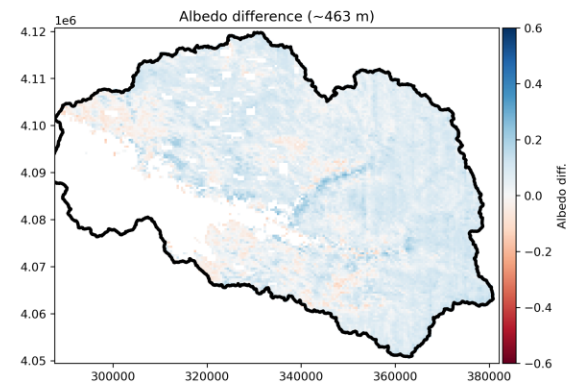
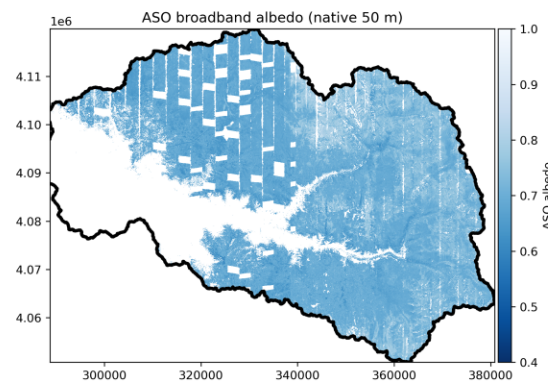
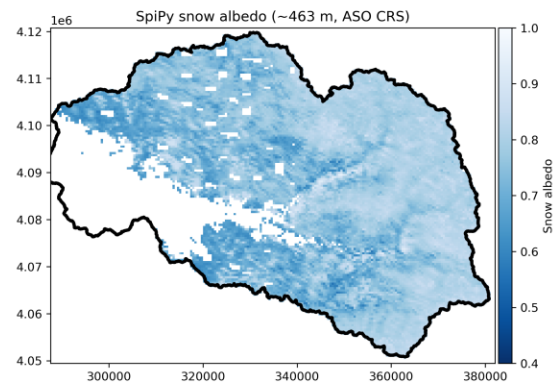
Snow cover and snow albedo validation using airborne lidar and hyperspectral observations MODIS Terra

MODIS Terra // 2023-03-17 // Kings ASO

Snow cover



Snow albedo



Satellite

Airborne

Difference

Hist/Scatter

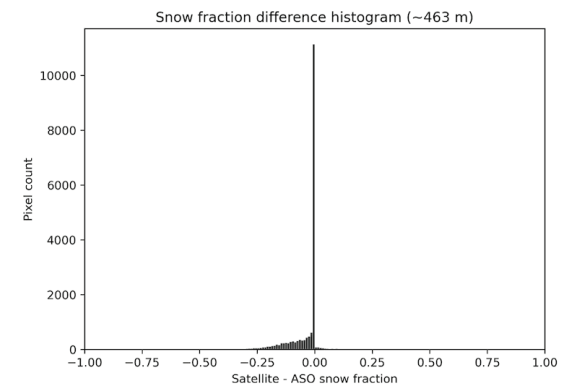
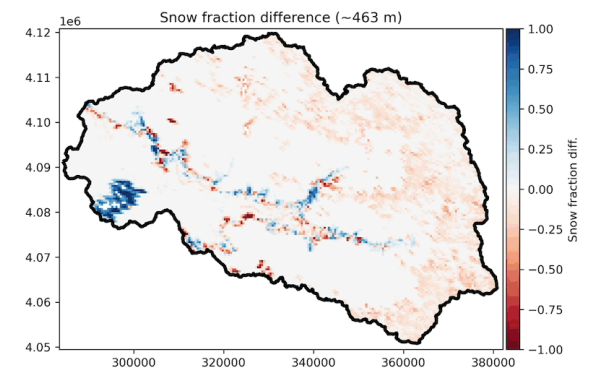
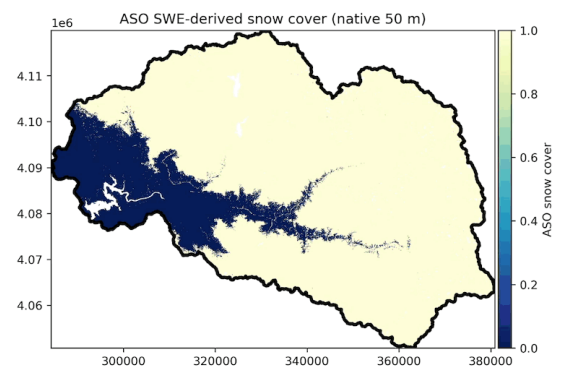
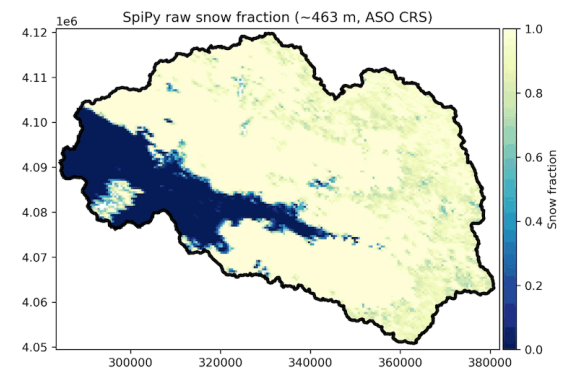


Snow cover and snow albedo validation using airborne lidar and hyperspectral observations MODIS: Terra & Aqua; VIIRS: Suomi, NOAA-20, NOAA-21

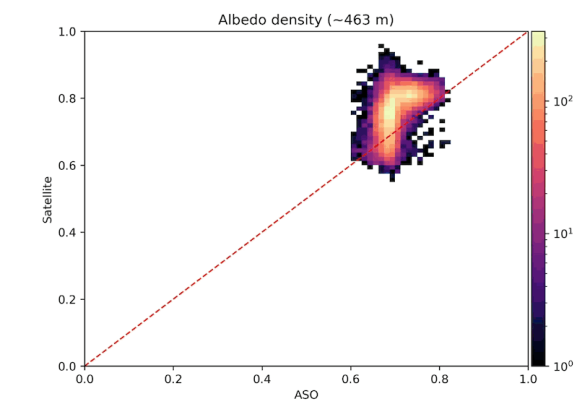
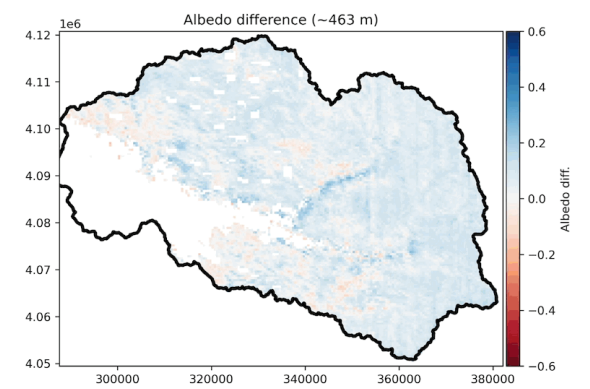
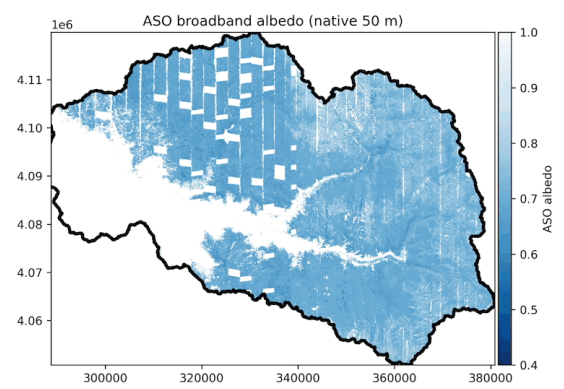
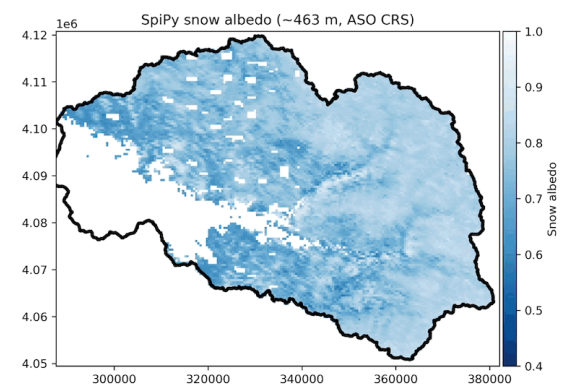
THIS IS A GIF

MODIS Terra // 2023-03-17 // Kings ASO

Snow cover



Snow albedo



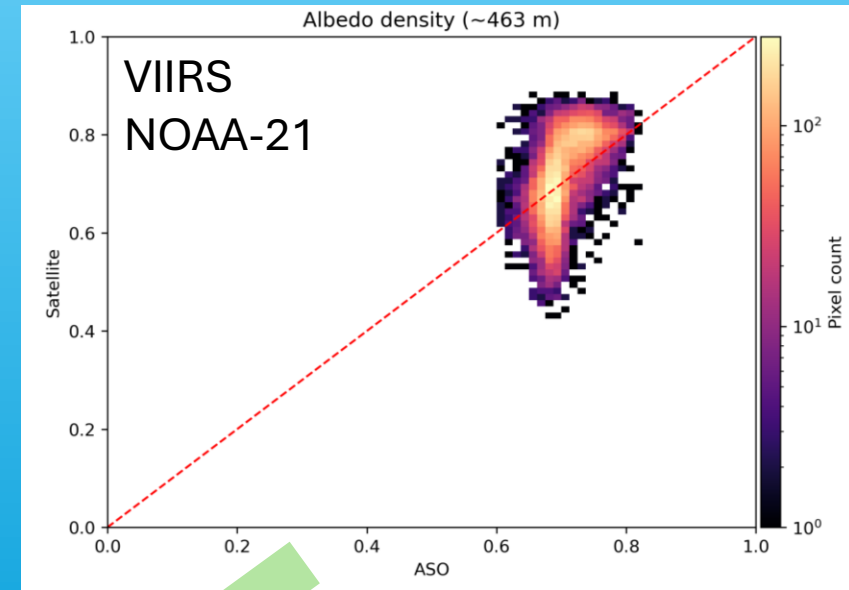
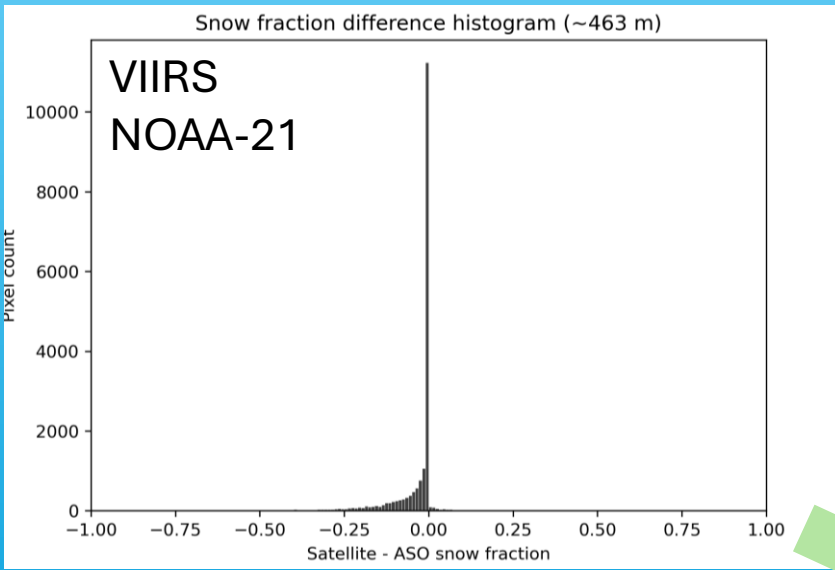
Satellite

Airborne

Difference

Hist/Scatter

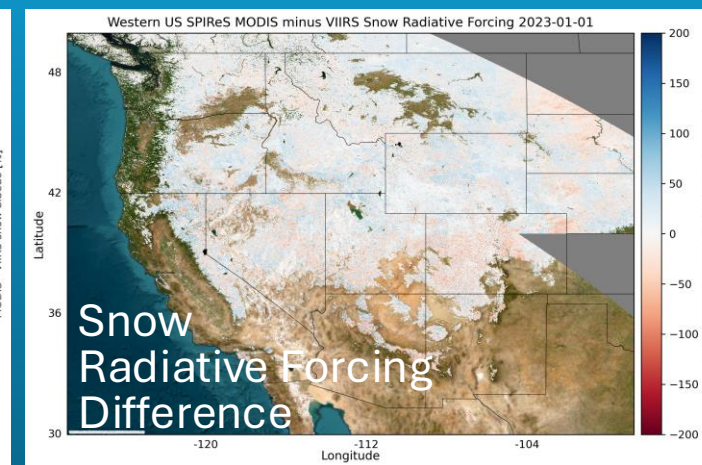
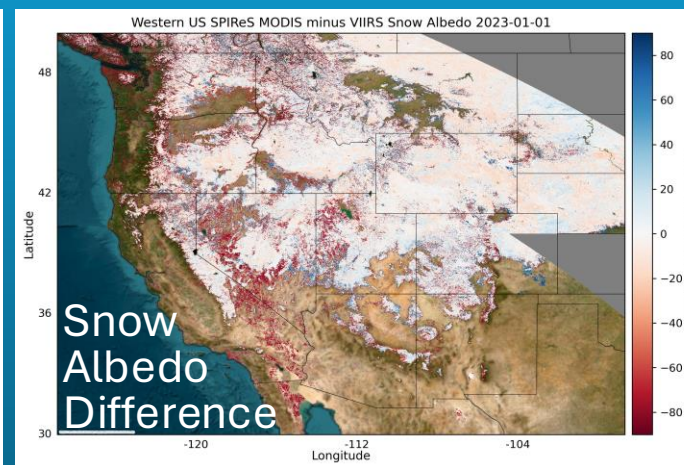
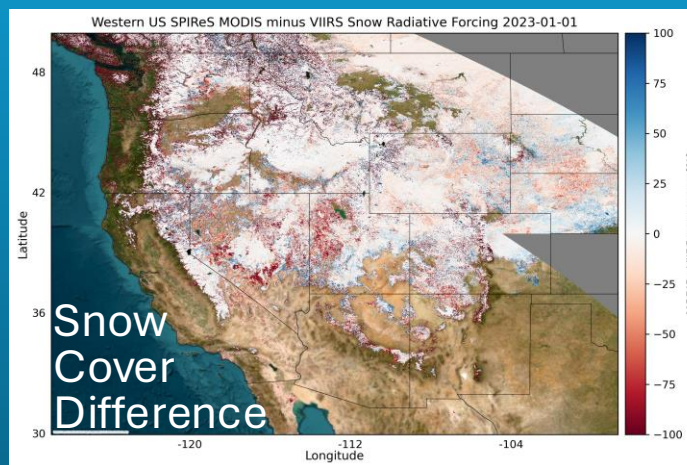
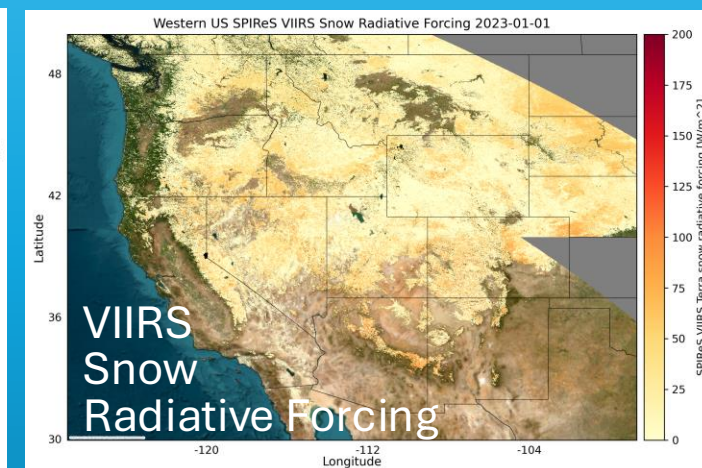
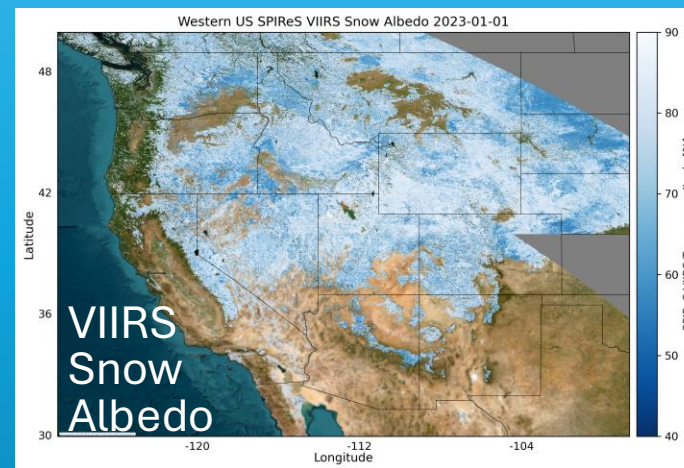
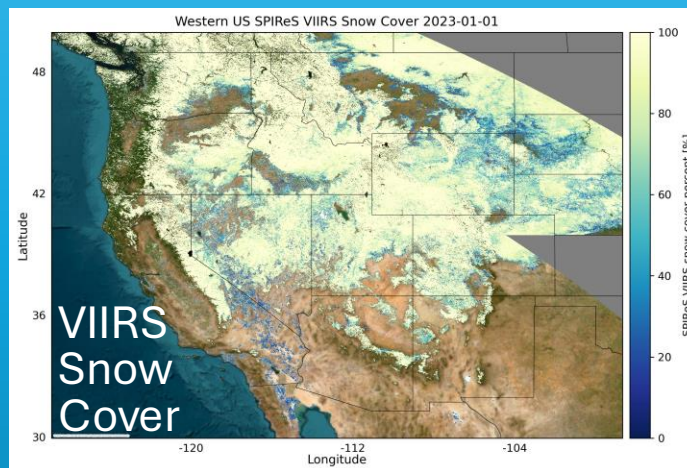
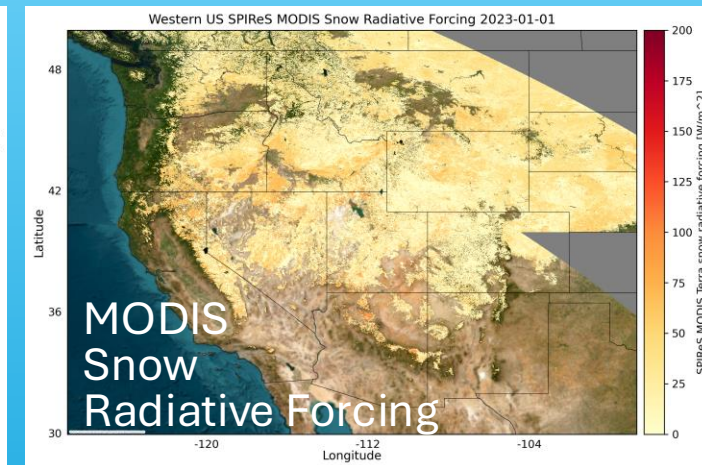
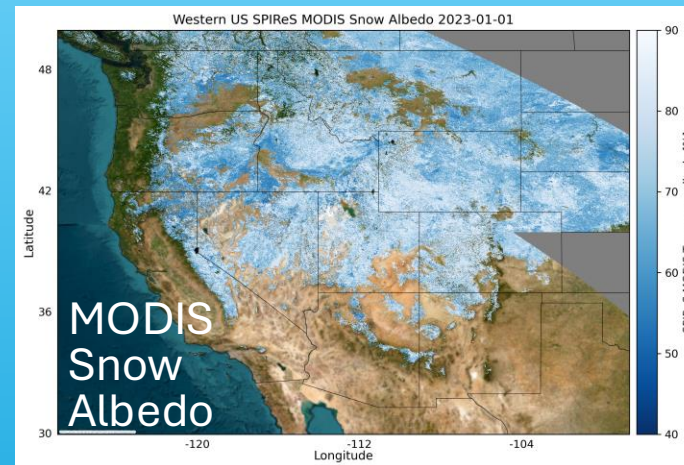
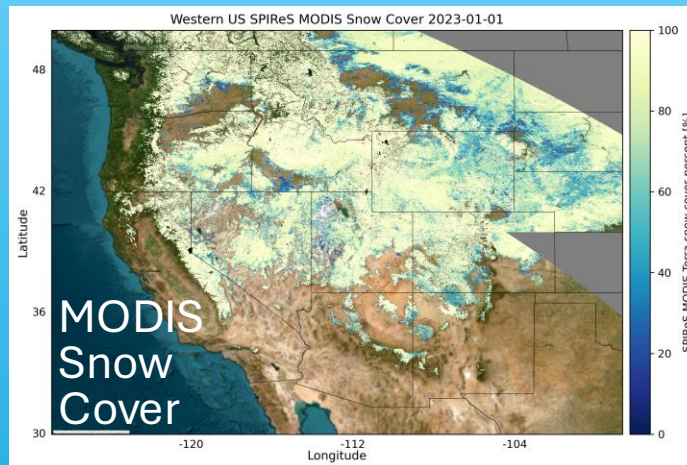
Statistical comparison for 5 sensors March 17, 2023 – Kings River basin



Sensor, Platform	Snow cover		Snow albedo	
	MAE	Bias	MAE	Bias
MODIS, Terra	0.08	-0.02	0.07	0.05
MODIS, Aqua	0.10	0.02	0.10	0.09
VIIRS, Suomi	0.11	0.04	0.10	0.08
VIIRS, NOAA-20	0.09	0.00	0.09	0.04
VIIRS, NOAA-21	0.09	0.03	0.10	0.07

MODIS Terra & VIIRS Suomi

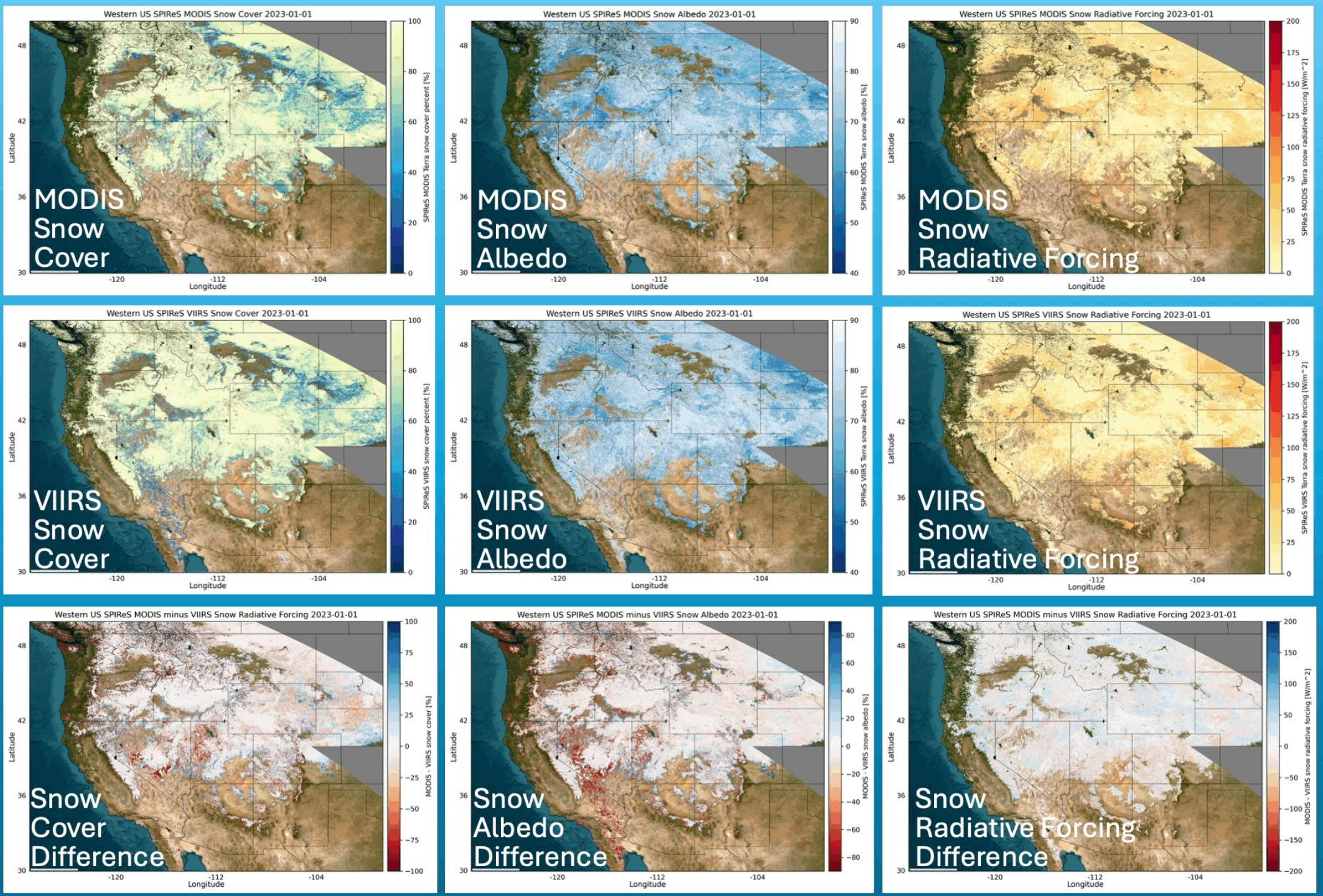
1/1/2023



MODIS Terra & VIIRS Suomi

1/1/2023

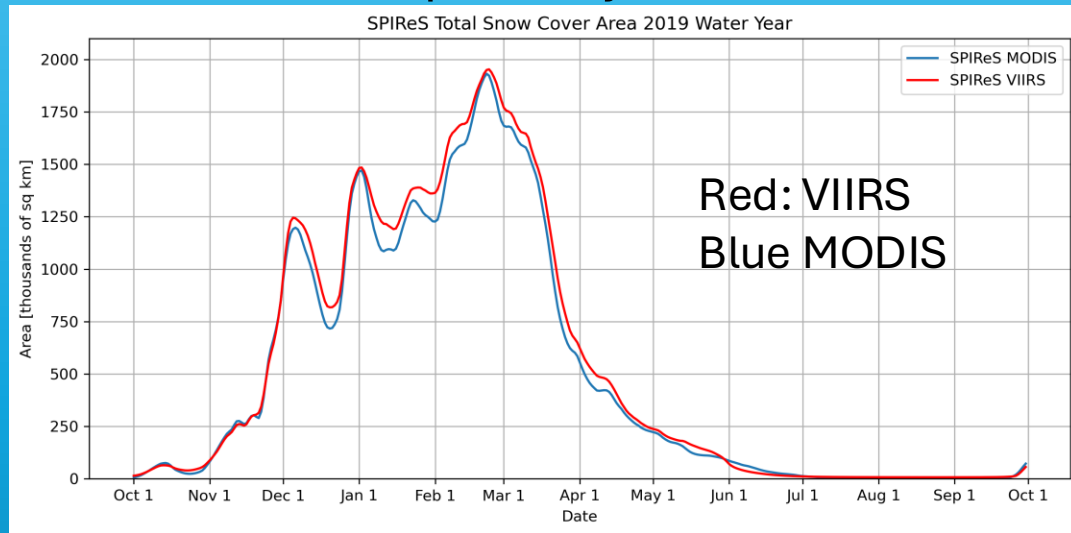
THIS IS A GIF



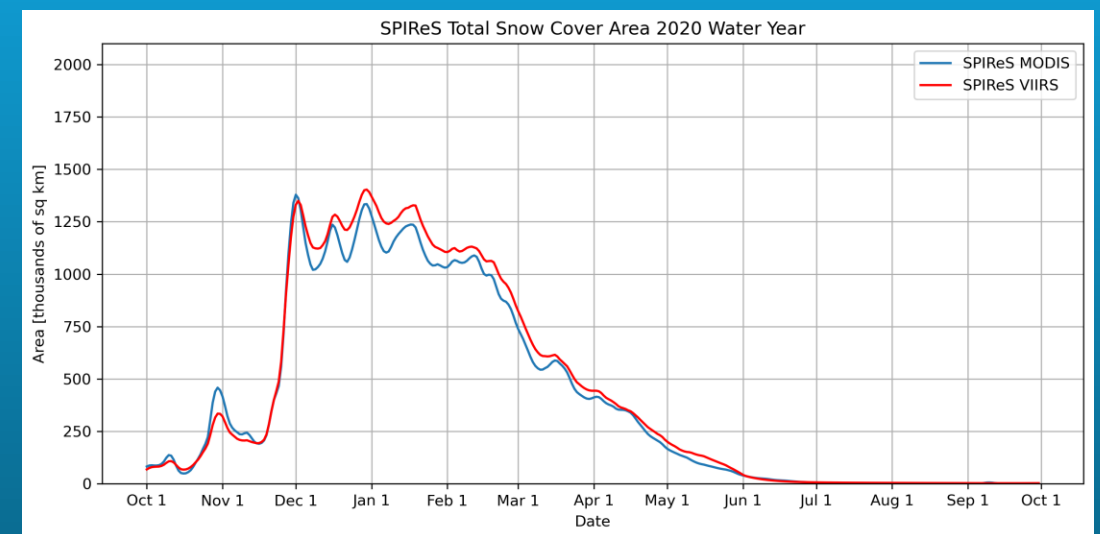
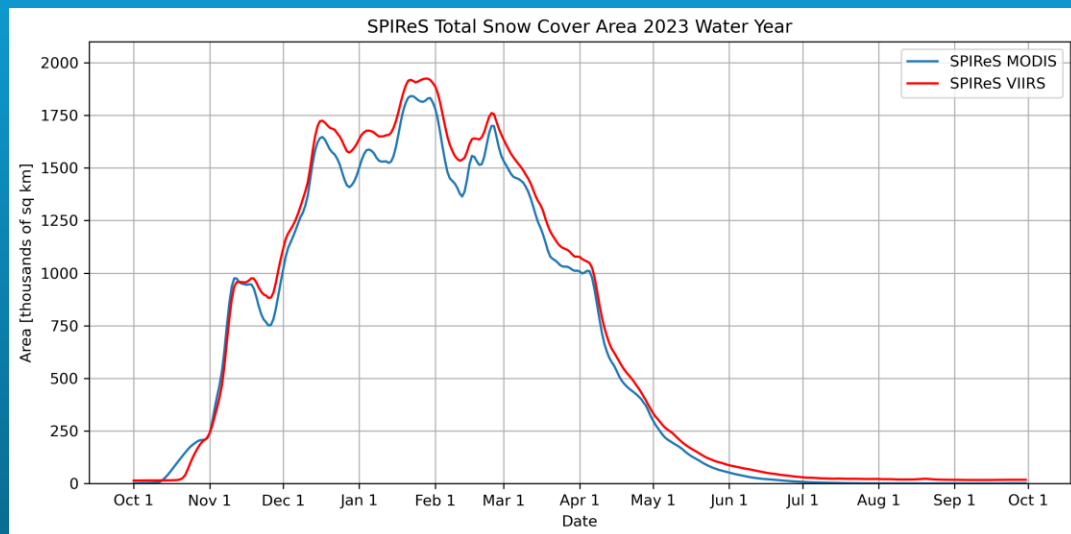
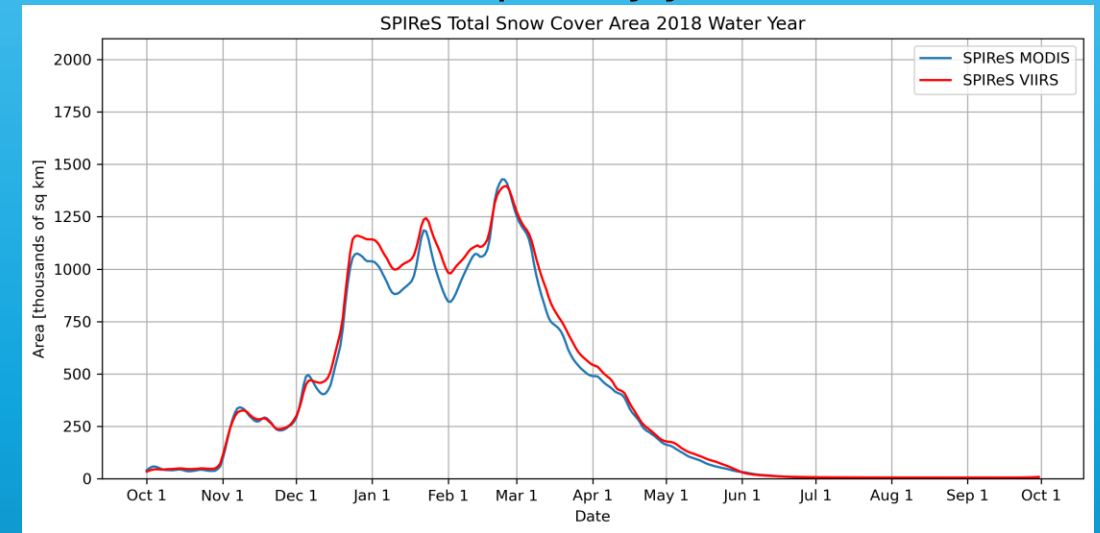
MODIS & VIIRS: Extending and integrating the record

Total snow-covered area Western United States

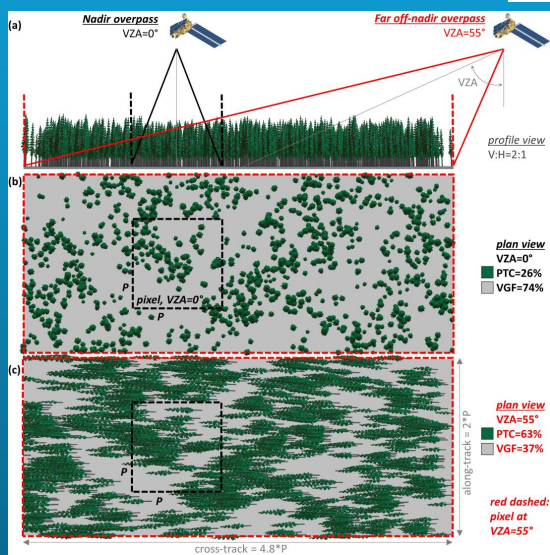
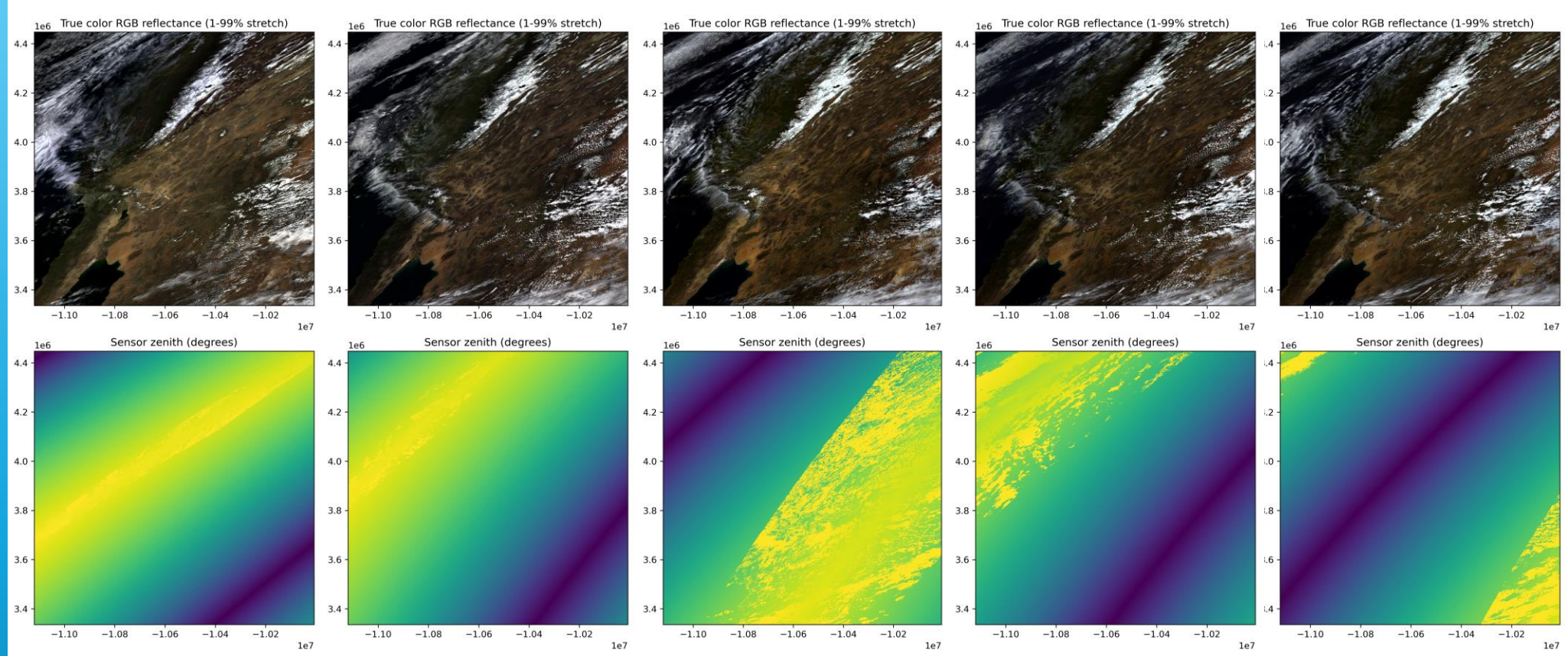
Example wet years



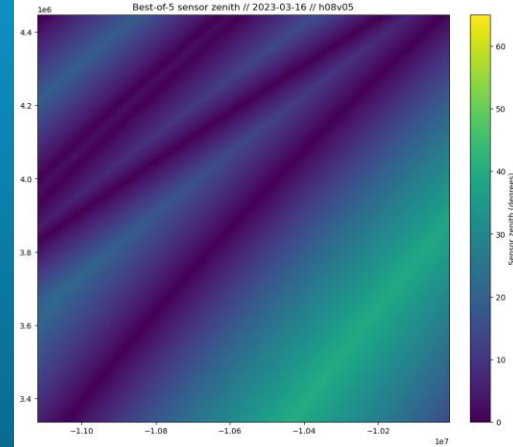
Example dry years



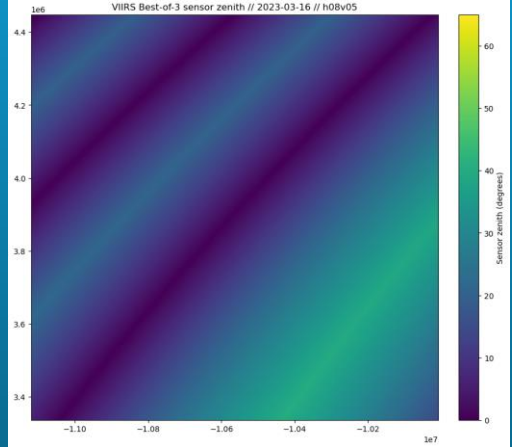
Multiple satellite observations within a day to overcome clouds and view angle



Sensor zenith 5 sensors

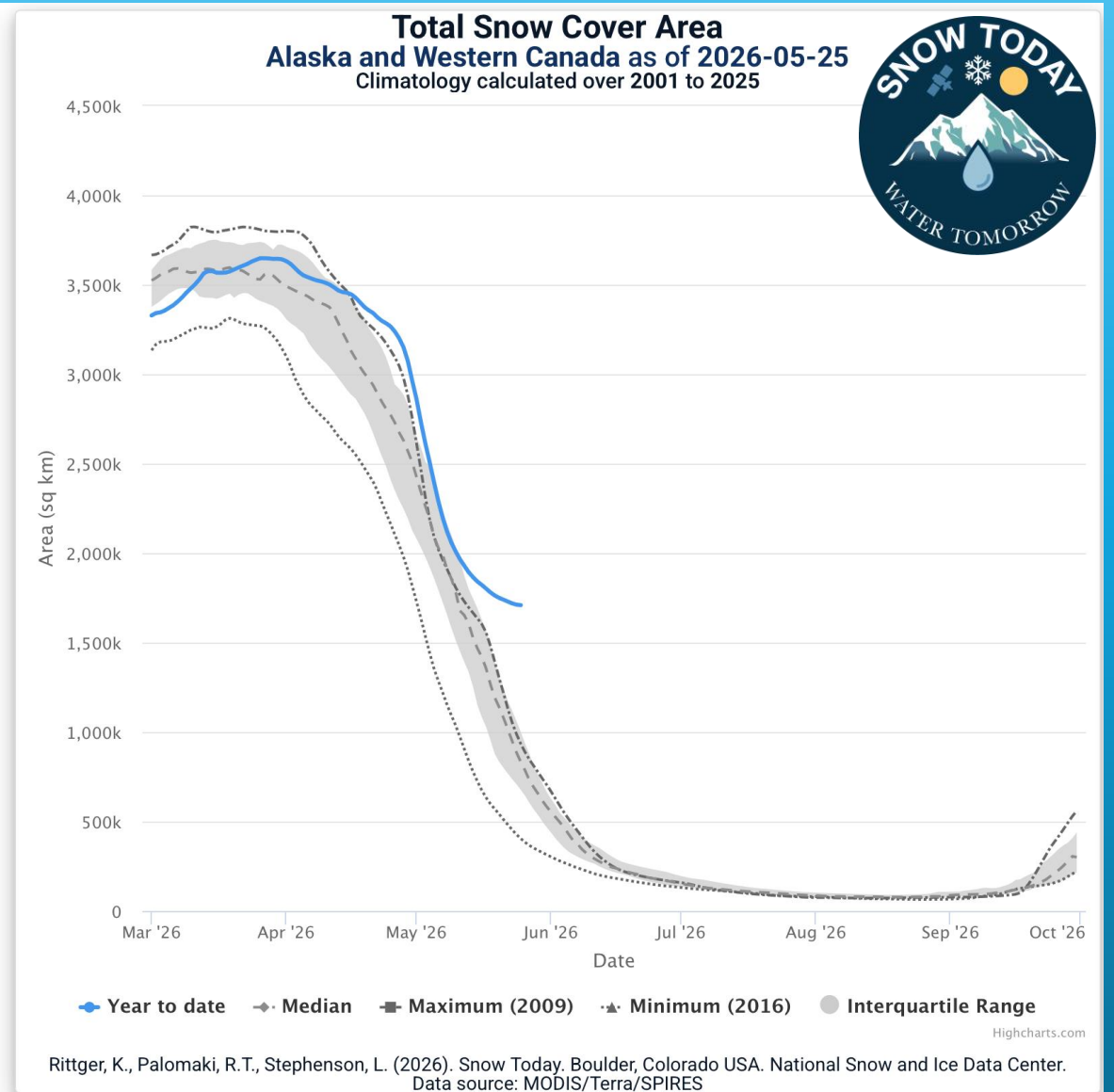
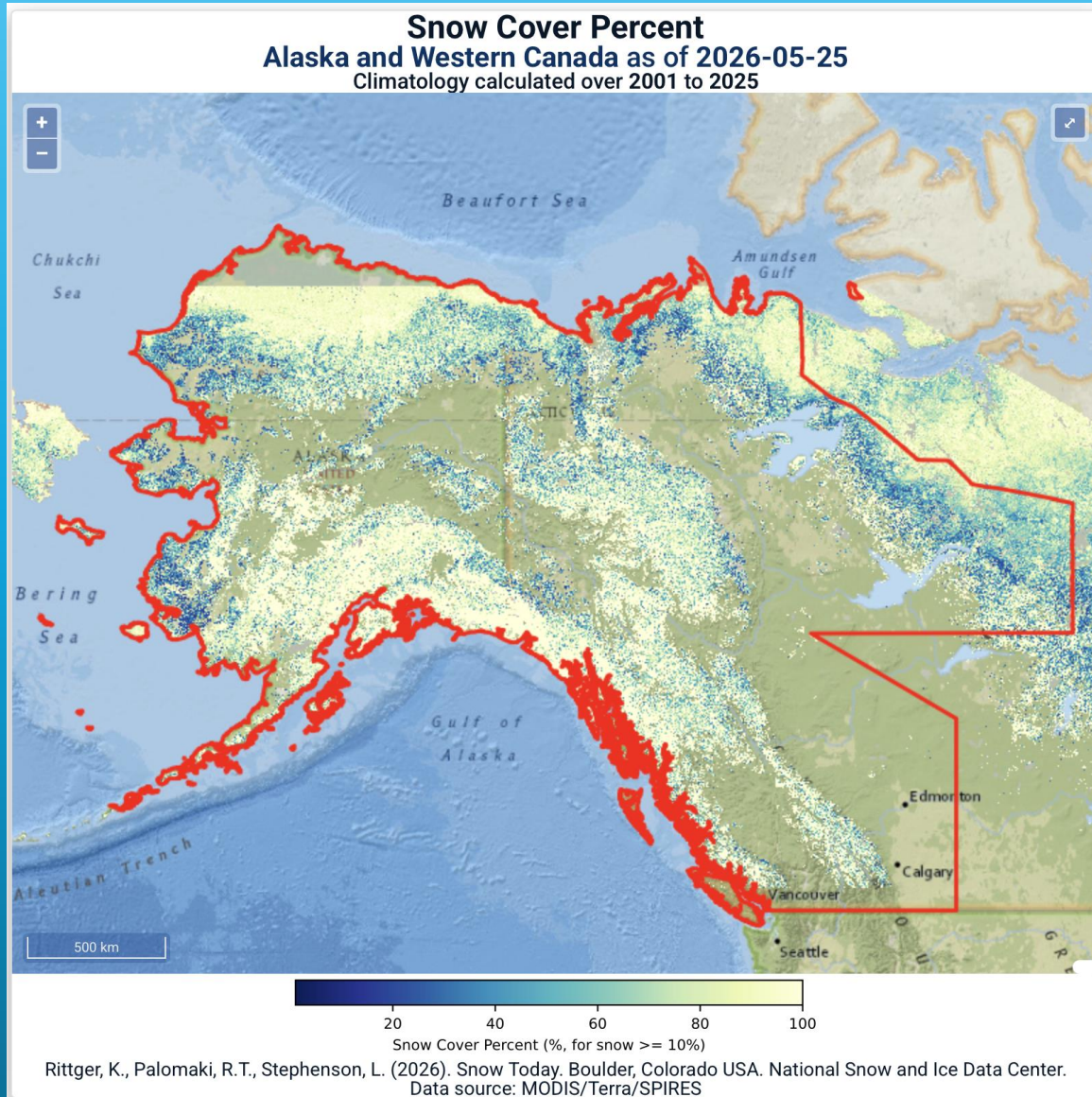


Sensor zenith 3 sensors



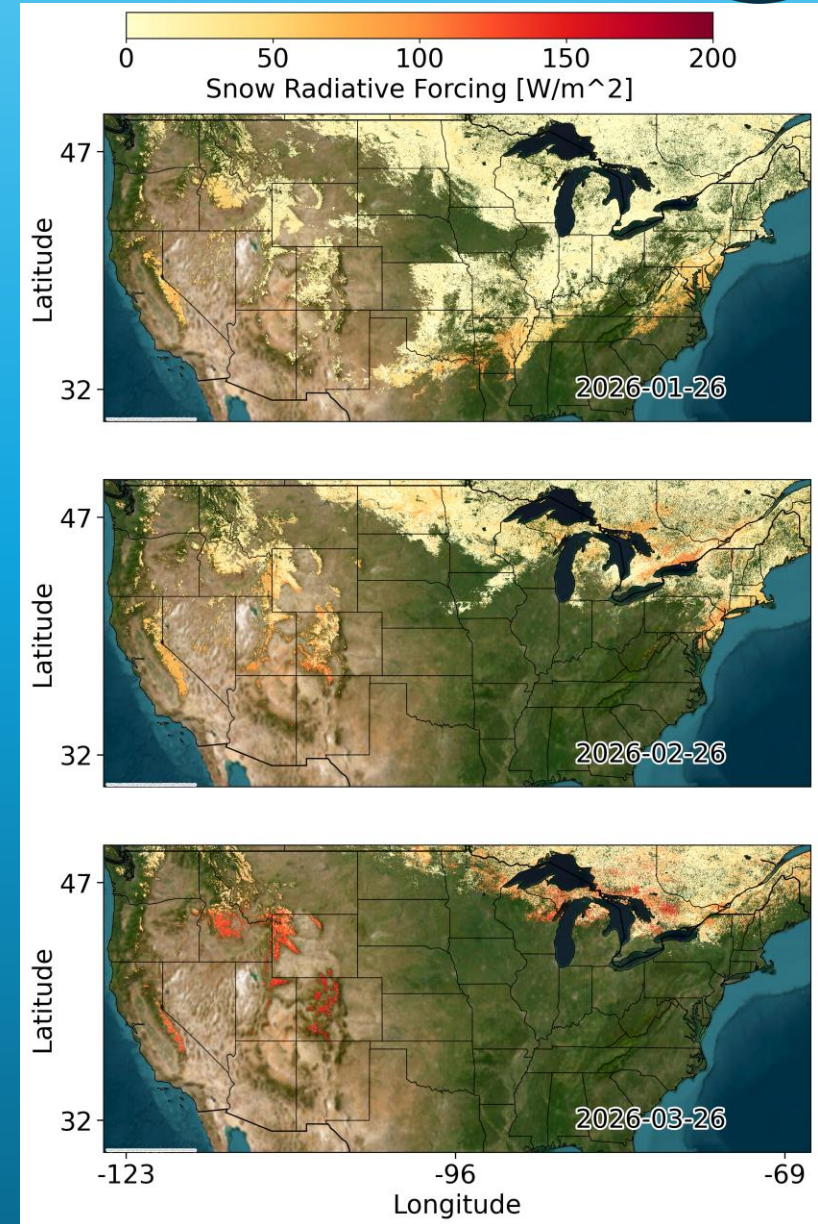
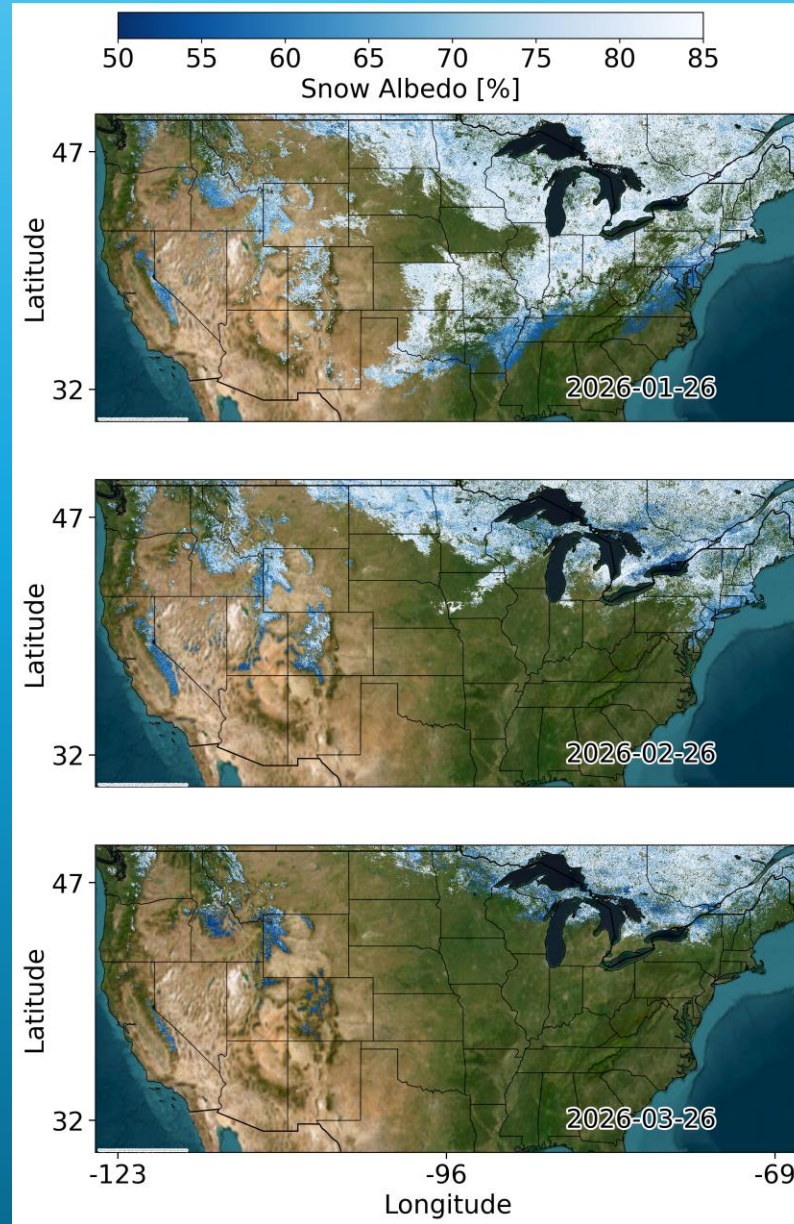
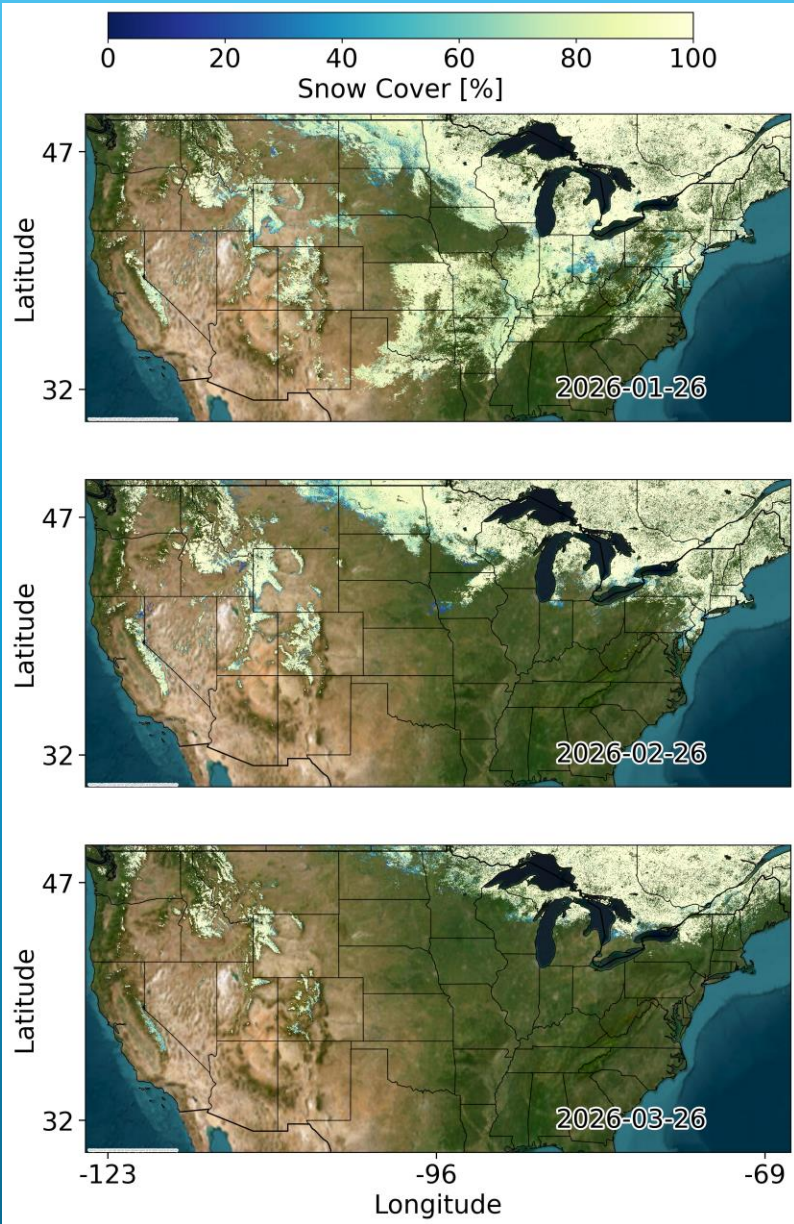
- March 2000 – October 2002: **1 sensor**
- October 2002 – October 2011: **2 sensors**
- October 2011 – November 2017: **3 sensors**
- November 2017 – November 2022: **4 sensors**
- November 2022 – present: **5 sensors**
- March 2027: (Terra retired) **4 sensors**
- September 2027: (-Aqua, +JPSS-4) **4 sensors**
- March 2028 : (-Suomi) **3 sensors**

Added this year: Alaska, and four Canadian provinces



<https://nsidc.org/snow-today>

CONUS prototype data, Water Year 2026



Future directions: Multispectral data fusion and hyperspectral data fusion

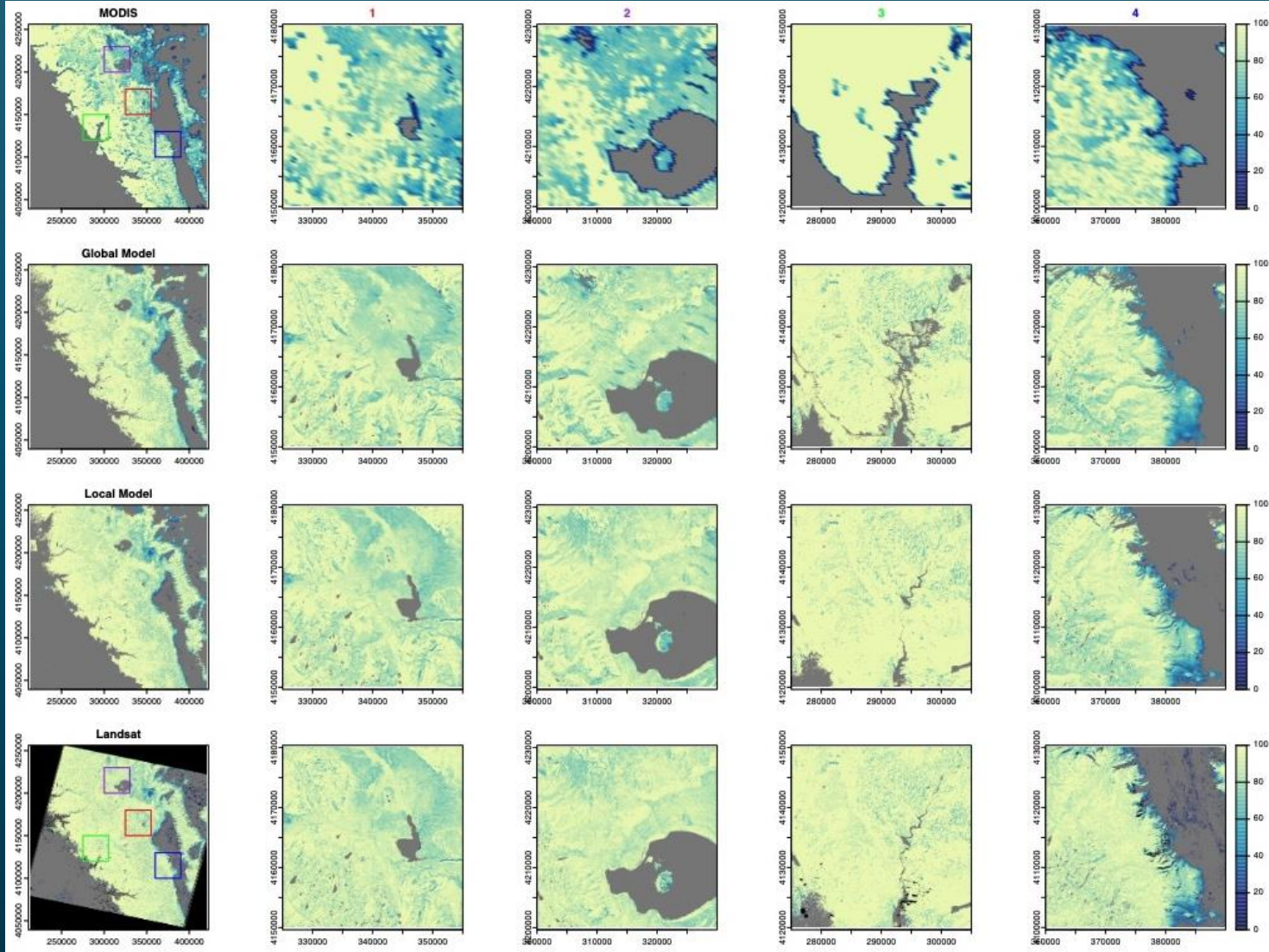
Snow cover fraction fusion MODIS, global fusion, local fusion, and Landsat

MODIS

Global model

Local model

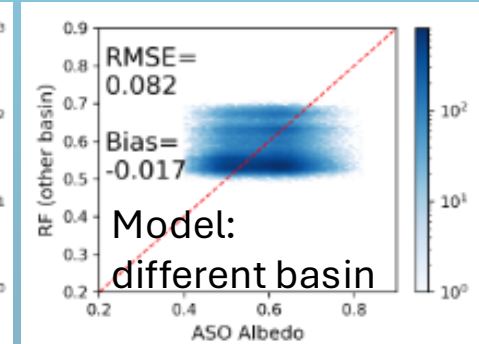
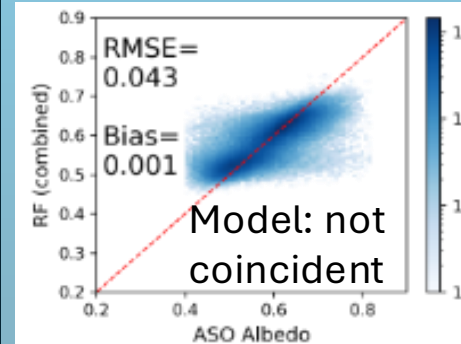
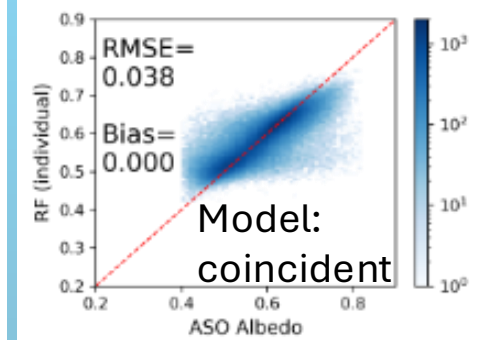
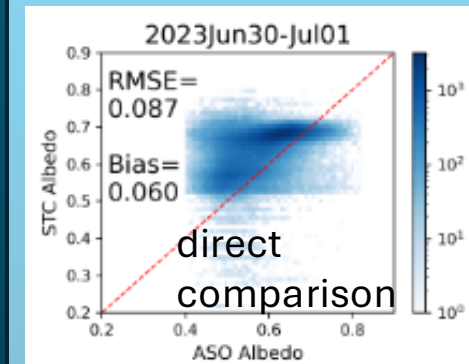
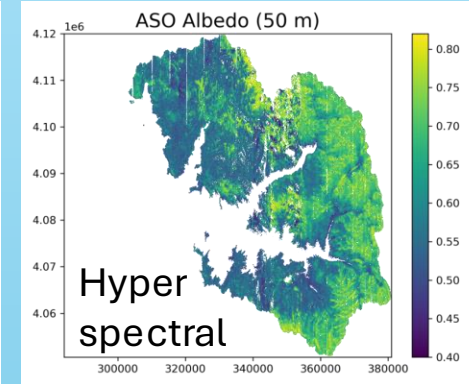
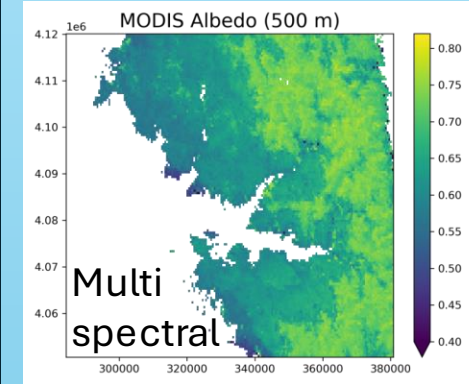
Landsat



Hyperspectral snow albedo fusion

MODIS and Airborne data

Palomaki et al,
in prep



Summary

- Water Year 2026 was had the last snow cover in the 26 year satellite record
- Visualization, analysis, and data access from Snow Today
- Widely used MODIS satellites are being decommissioned
- VIIRS and MODIS snow cover and snow albedo show comparable accuracy
- VIIRS and MODIS are consistent in overlapping periods indicating ability to extend record
- Combining multiple data streams will lead to more accurate snow mapping
- Expanded data availability in Water Year 2026 to Alaska & 4 Canadian provinces
- Expansion to North America in Water Year 2027
- Future: Fusion built on spatial, temporal, and spectral characteristics of sensors

We're hiring a postdoc! Contact Karl or Ross

<https://jobs.colorado.edu/jobs/JobDetail/?jobId=71989>

Karl.Rittger@Colorado.edu & Ross.Palomaki@Colorado.edu





Open-source code & freely downloadable data

Data: FTP

- Host Name: dtn.rc.colorado.edu
- Username: anonymous
- Password: pwd *[not required]*
- Directory: /shares/snow-today

Example download for historical data:

```
wget --ftp-user=anonymous -r --cut-dirs 3 -nH ftp://dtn.rc.colorado.edu/shares/snow-today/gridded_data/SPIRES_HIST_V02
```

Code: Github

<https://github.com/orgs/RittgerLabGroup/>

Historical

https://nsidc.org/data/spires_hist/versions/1

**Historical MODIS/Terra L3
Global Daily 500m SIN
Grid Snow Cover, Snow
Albedo, and Snow Surface
Properties, Version 1**

DATA SET ID: SPIRES_HIST
DOI: 10.7265/A3VR-C014

Mar. 2000 to Sep. 2024

Near real-time

https://nsidc.org/data/spires_nrt/versions/1

**Near Real-Time
MODIS/Terra L3 Global
Daily 500m SIN Grid Snow
Cover, Snow Albedo, and
Snow Surface Properties,
Version 1**

DATA SET ID: SPIRES_NRT
DOI: 10.7265/HS6B-ZG21

Oct. 2024 to present