

# SNODAS Data Product Tool Update

Water Availability Task Force, April 18, 2017



openwater  
FOUNDATION

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# Open Water Foundation

Social enterprise 501(c)3 nonprofit focusing on developing open source software and open data tools to help make better decisions about water resources. Water is a public resource, and water data and software tools should also be public.



**open data | open software | open decisions**

[openwaterfoundation.org](http://openwaterfoundation.org)

# Project Overview

- CWCB Severance Tax Project - \$50k budget
- Team led by the Open Water Foundation, Brendle Group as subcontractor
- Main goals of project, from scope of work:
  - Improve water resources data access and transparency
  - Help water managers visualize their supply basins
  - Improve information for water providers and customers

# Project Need

- Some basins do not have monitoring stations (SNOTEL)
- Existing monitoring stations are not representative of snow conditions across the entire watershed
- Water managers lack late-season information because snow has melted out at observing stations

# What is SNODAS?

Secure | [https://www.nohrsc.noaa.gov/interactive/html/map.html?ql=station&zoom=&loc=37.57+N%2C+102.42+W&var=ssm\\_swe&d](https://www.nohrsc.noaa.gov/interactive/html/map.html?ql=station&zoom=&loc=37.57+N%2C+102.42+W&var=ssm_swe&d)

National Operational Hydrologic Remote Sensing Center  
**Interactive Snow Information**

Navigation Tools | 37.012 N, 107.013 W

Home Help Comments

**Redraw Map**

Select Physical Element  
Snow Water Equivalent

Select Date  
2017 April 18 07:00 UTC  
 Snap to nearest time

Select Overlays

**Hydrologic Features**

- RFC Basins  Label
- Other Basins  Label
- HUCs (6-digit)
- RFC Boundaries
- Rivers and Streams
- Lakes and Reservoirs

**Political Features**

- County Boundaries
- CWA Boundaries
- State Boundaries
- National Boundaries

**Point Features**

- Stations  Label
- Cities  Label
- Flight Lines  Label
- Climate Stns.  Label
- Skiing  Label

**Transportation Features**

- Roads and Highways

**Other features**

- NSA Disc. Regions
- NSA Disc. Subregions
- NSA Modelling Tiles

**Map Preferences**

English units

- Legend below map
- Background image
- Hill shading
- High-contrast palette
- Title on image

800 pixels map width  
450 pixels map height

**Modeled Snow Water Equivalent forecasted for 2017 April 18, 7:00 UTC**

**Inches of water equivalent**

> 30
20 to 30
18 to 20
16 to 18
14 to 16
12 to 14
10 to 12
8 to 10
6 to 8
4 to 6
2 to 4
1 to 2
trace to 1
Not Estimated

**Elevation in feet**

> 13124
8203 to 13124
3281 to 8203
3 to 3281
< 3

Created 2017 Apr 17, 13:45 Z

Gridded observed snowfall images, seasonal totals, and data downloads in several formats can now be found on the [National Snowfall Analysis](#) page.

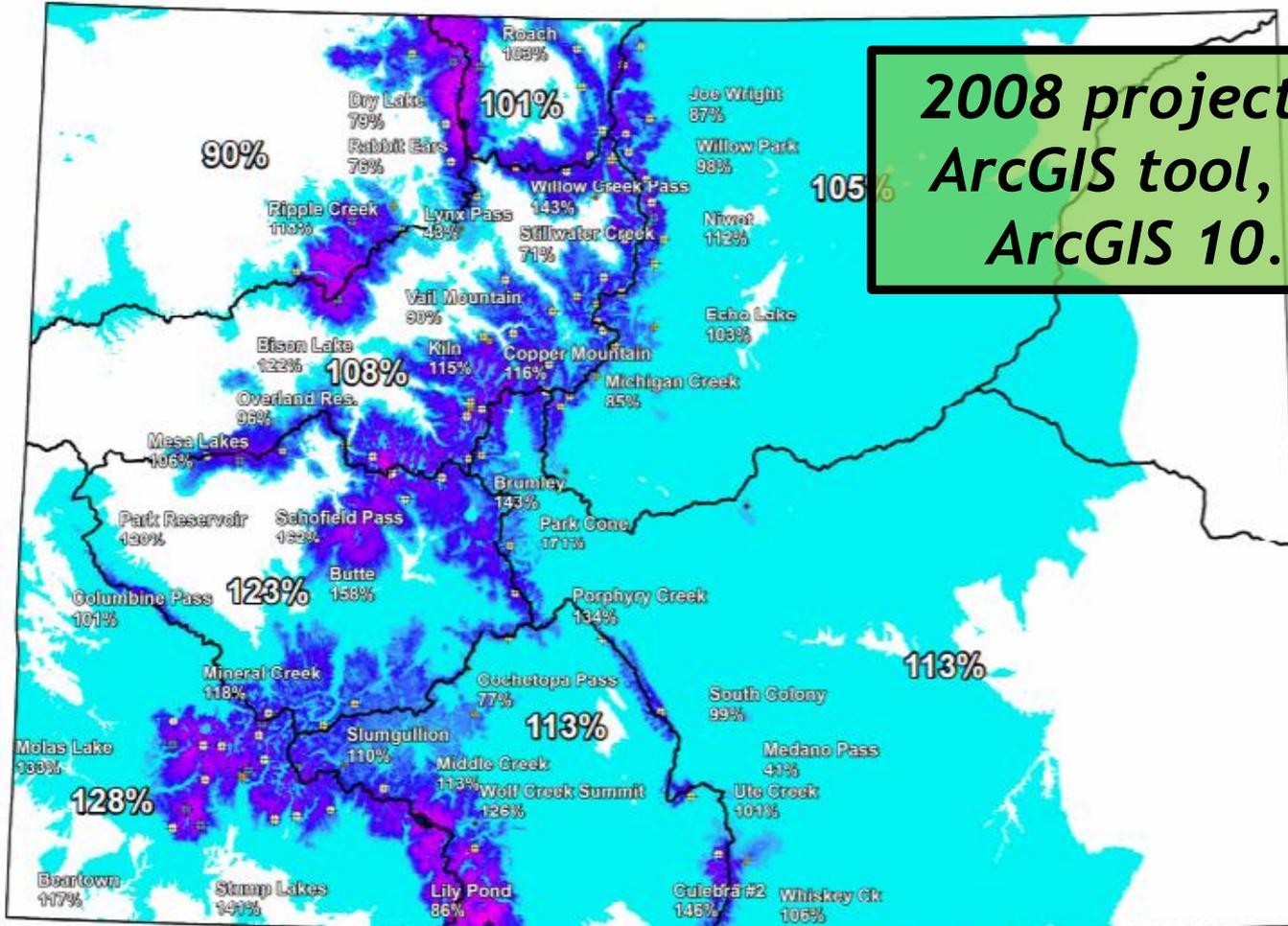
Directions: <https://www.nohrsc.noaa.gov/interactive/html/map.html>

- Select a physical element to view, select a date, select overlays, and click "Redraw Map."
- Clicking on the map while the Recenter button is selected (red) will recenter the map on that point.
- Clicking on the Zoom Control slider will zoom into or out of the map.
- Clicking on the map and dragging with the button held down while the Recenter button is selected (red) will zoom to a rectangle when the button is released.
- Stations and regions can be queried using the Query button and menu.

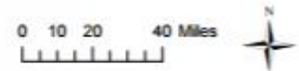
Vector GIS Datasets used by this page  
Raster GIS Datasets used by this page

# Previous CWCB Projects

Colorado - 2017 SNOTEL and SNODAS Snow Water Equivalent (SWE) 4/1/2017



2008 project to develop ArcGIS tool, updated to ArcGIS 10.1 in 2014



SNODAS Snow Water Equivalent data courtesy of the National Snow and Ice Data Center (NSIDC). SNOTEL data courtesy of the National Resources Conservation Service (NRCS). Data is provisional and subject to revision. The CWCB and USBR provide SNODAS data at the following link: <http://www.usbr.gov/pn/research/snodas/index.html>



<http://cwcb.state.co.us/water-management/flood/pages/snodassnowpackmaps.aspx>

# Previous CWCB Projects

- 2008-2009 - SNODAS map products for Rio Grande Water Conservation District
- 2012-2013 - SNODAS map products for Dolores Water Conservancy District
- 2015 - Open Water Foundation updated Colorado Surface Water Supply Index (SWSI) process.

# Enhanced Snowpack Products

projects.openwaterfoundation.org/owf-proj-co-cwcb-2016-snodas/prototype/index.html#

## Colorado's Decision Support Systems (CDSS) SNODAS Tools

About Data Analysis

### Daily SNODAS Snowpack Products for Colorado Water Supply Basins

This website provides access to a historical archive of SNODAS data products for Colorado water supply basins. Snow Data Assimilation System (SNODAS) data are processed daily to calculate Snow Water Equivalent (SWE) and Snow Coverage statistics for water supply basins in Colorado. Snow Water Equivalent is the estimate of the depth of liquid water contained within the snowpack. Snow coverage is a percent of the basin land surface covered by snow (water bodies in the basin are ignored). The national SNODAS gridded dataset has been processed to provide data products for Colorado. Mean SWE is displayed in the map using a legend similar to the National Weather Service. The SNODAS Tools website provides access to an archive of daily products.

- The website is best viewed on a widescreen display. If the layout seems out of order, try maximizing to fill the display. **Ctrl and minus** can be used to zoom out until the layout seems to be in correct order.
- Hover over a basin to see the daily mean SWE value and other daily statistics.
- Use the **Select Date** button to display historical data for a specified day.
- Enter animation start and end dates, press **Submit**, and then press the play button to view the animation of daily SWE data.
- Click on a basin in the map to select the basin or use the **Select Basin** to select from the basin list. Then click on buttons in the lower right to display graphs.
- Once a graph has been opened, click anywhere on the screen to close the graph view and return to the main screen.
- Reposition the map by holding the mouse button down and dragging.
- Zoom in and out of the map using the control in the upper left, or use the mouse wheel.
- Use the **Data** tab on the left to access data files.

Mean SWE (in)

0-0.02
0.02-0.04
0.04-0.2
0.2-0.4
0.4-1
1-2
2-4
4-6
6-10
10-20
20-30
30-40
40-80
80+

Daily Basin Statistics

Local Name: SOUTH FORK RIO GRANDE AT SOUTH FORK, CO  
Local ID: SRGC2

SWE (millimeters | inches)  
Mean: 453 mm | 17.8 in  
Effective Area: 210.5 sqmi  
Volume: 200155 acft  
Volume 1 Week Change: -12428 acft

Snow Cover: 89.02%

Select Date: SNODAS Date: 2017-04-17

### SNODAS Animation

Starting Date: (earliest available date: 2003-09-30)  
YYYY-MM-DD

Ending Date: (latest available date: 2017-04-17)  
YYYY-MM-DD

Increment (days): (Default is set to 1)  
value between 1 and 10

Submit

Select Basin

- SNODAS Snow Cover Graph
- SNODAS SWE Graph
- SNODAS SWE Volume Graph
- SNODAS SWE 1 Week Change Graph
- SNODAS SWE Volume Gain, Cumulative Graph

Created by the Open Water Foundation for the Colorado Water Conservation Board

<http://projects.openwaterfoundation.org/owf-proj-co-cwcb-2016-snodas/prototype>

# Approach

1. Download daily SNODAS SWE grid
2. Clip to Colorado basins
3. Calculate statistics for basins
4. Output to CSV, GeoJSON, Shapefile.
5. Process CSV files into time series graph products.
6. Publish to the web (80 GB total for 2003-2017)

## *Software:*

- *QGIS, PyQGIS, GDAL for spatial processing*
- *Leaflet for web mapping*
- *TSTool for time series products*

# Downloadable Data Files

About **Data** Analysis

[The national SNODAS data are available from the Snow Data Assimilation System \(SNODAS\)](#). The SNODAS data are processed into statistical data products by the CDSS SNODAS Tools. The output consists of comma-separated-value (CSV) files **ByDate** (basin data for each day) and **ByBasin** (historical period for each basin). Data files can be downloaded by accessing the following URL resources. The zip file contains a shapefile with daily statistics in the attribute table (attribute names have been truncated to adhere to shapefile limit).

<http://projects.openwaterfoundation.org/owf-proj-co-cwcb-2016-snodas/prototype/SnowpackStatisticsByBasin/Snowpack>

<http://projects.openwaterfoundation.org/owf-proj-co-cwcb-2016-snodas/prototype/SnowpackStatisticsByDate/Snowpack>

<http://projects.openwaterfoundation.org/owf-proj-co-cwcb-2016-snodas/prototype/SnowpackStatisticsByDate/Snowpack>

<http://projects.openwaterfoundation.org/owf-proj-co-cwcb-2016-snodas/prototype/SnowpackStatisticsByDate/Snowpack>

The following static resources are also available:

[http://projects.openwaterfoundation.org/owf-proj-co-cwcb-2016-snodas/prototype/json/CO\\_boundary.geojson](http://projects.openwaterfoundation.org/owf-proj-co-cwcb-2016-snodas/prototype/json/CO_boundary.geojson) (State of Colorado rectangular boundary)

[json/SNODAS\\_CO\\_BasinBoundaries.geojson](#) (basin boundaries, same as daily boundaries)

[StaticData/SNODAS\\_CO\\_BasinBoundaries.zip](#) (input basin boundary layer shapefile)

[StaticData/Watershed\\_Connectivity\\_v3.xlsx](#) (input basin

- *Comma-separated-value (CSV)*
- *Shapefile*
- *GeoJSON*
  
- *Static data for basins*

# Developer and User Documentation

software.openwaterfoundation.org/cdss-app-snodas-tools-doc-user/process/processing-steps/

## SNODAS Tools (User Manual)

Search docs

Home

SNODAS Tools Data

Overview

Input Data

SNODAS Tools Process

Overview

### Processing Steps

Table of Contents

1. Download SNODAS Data

Download SNODAS Data  
(Historical)

Download SNODAS Data  
(Each New Day)

2. Clip National SNODAS Grid  
to Colorado

3. Intersect SNODAS Colorado  
Grid with Colorado Basins and  
Calculate Statistics

Snowpack Statistics Exported  
as Tabular Data

Snowpack Statistics Exported  
as Spatial Data

4. Generate Time Series  
Snowpack Products

### Additional Details

SNODAS Tools Products

Overview

CDSS SNODAS Tools Web  
Application

Products and Downloads

## 1. Download SNODAS Data

National SNODAS grids are downloaded to the SNODAS Tools computer for processing into products that are relevant to Colorado.

Daily SNODAS data grids are national grids representing a variety of snowpack parameters. They are developed by NOAA National Weather Service's National Operational Hydrologic Remote Sensing Center (NOHRSC) and hosted by the National Snow and Ice Data Center (NSIDC). NSIDC stores the daily grids, dating back to September 30th, 2003, in a public [FTP site](#) that is updated every day. Although, as mentioned before, the SNODAS products contain many grids of snowpack parameters, the SNODAS Tools are designed to specifically calculate snowpack statistics in regards to the Snow Water Equivalent (SWE) grid. Below is an image of a daily SNODAS grid representing SWE values across the nation. The areas of higher SWE are represented by blue while the areas with lower, or no SWE values, are represented by brown.



SNODAS Snow Water Equivalent Masked Grid for January 16th, 2017

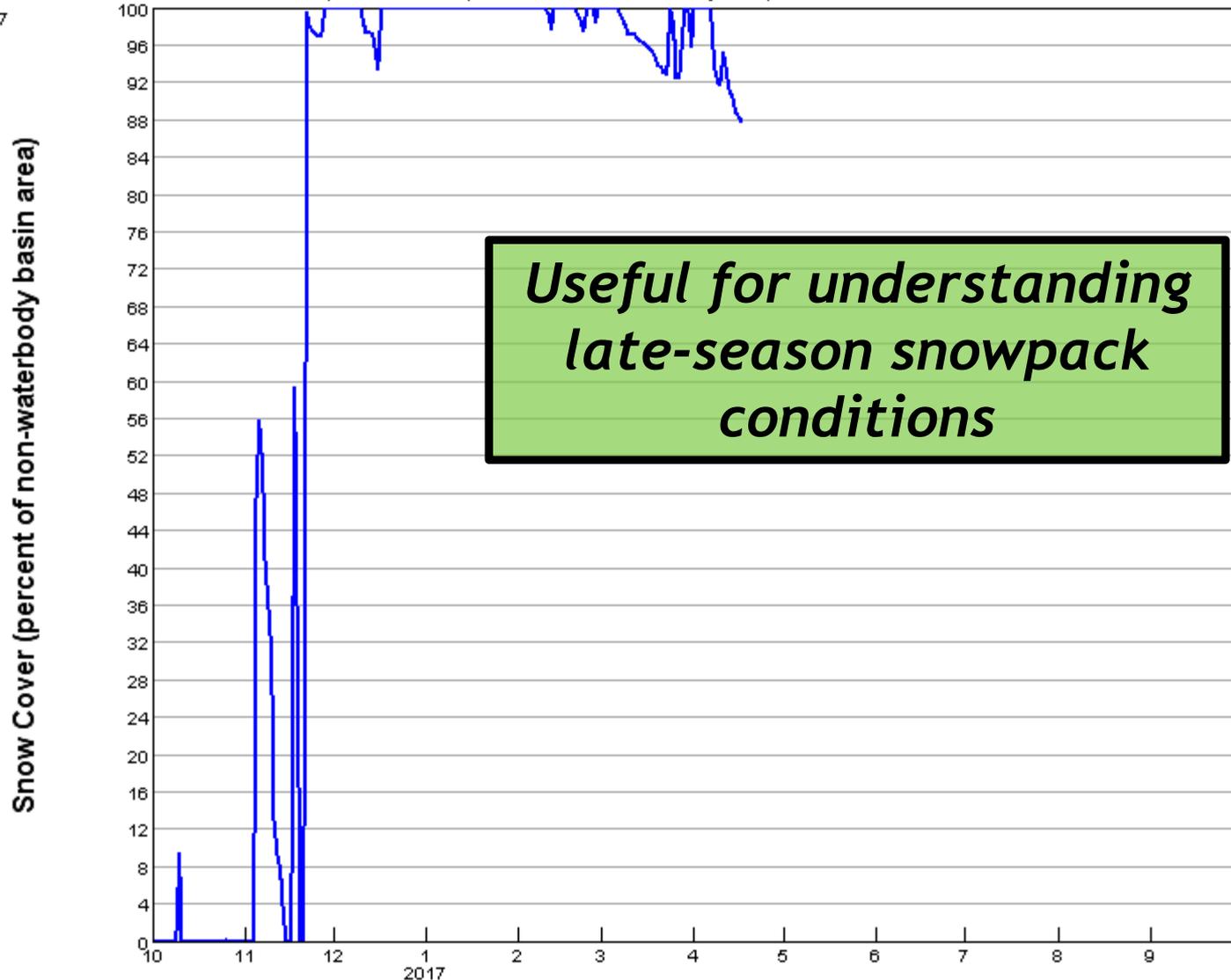
The SNODAS Tools are designed to process all available daily SNODAS SWE grids from September 30th, 2003 to the current date. A full historical repository of daily snowpack statistics gives insight

# Snow Cover (Percent)

CONEJOS RIVER NEAR MOGOTE, CO. (MOGC2) SNODAS Snow Cover

(Each line corresponds to a Water Year starting Oct 1)

— SNODAS WY 2017



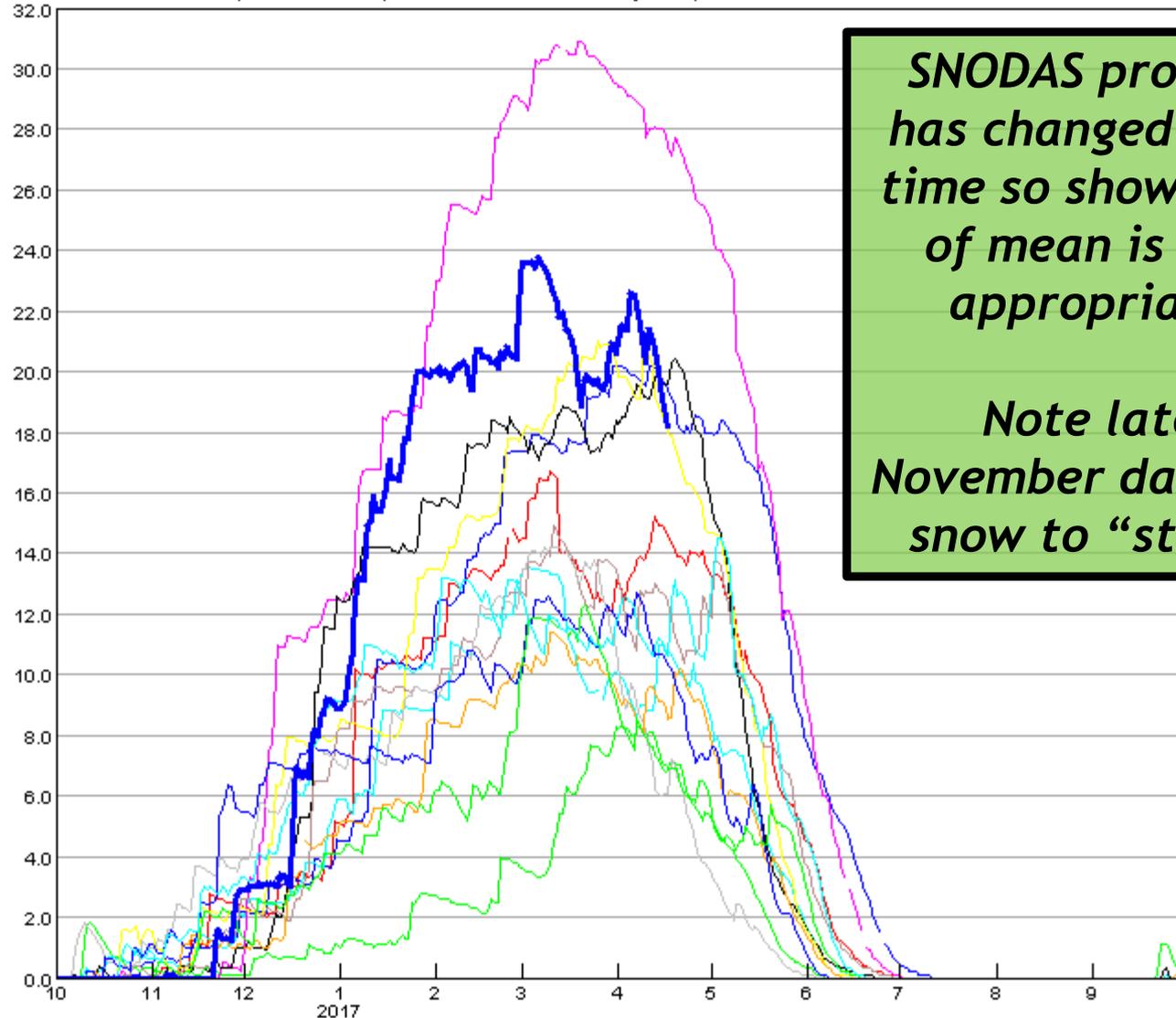
*Useful for understanding  
late-season snowpack  
conditions*

# SNODAS Snow Water Equivalent

CONEJOS RIVER NEAR MOGOTE, CO. (MOGC2) SNODAS SWE  
(Each line corresponds to a Water Year starting Oct 1)

- SNODAS WY 2004
- SNODAS WY 2005
- SNODAS WY 2006
- SNODAS WY 2007
- SNODAS WY 2008
- SNODAS WY 2009
- SNODAS WY 2010
- SNODAS WY 2011
- SNODAS WY 2012
- SNODAS WY 2013
- SNODAS WY 2014
- SNODAS WY 2015
- SNODAS WY 2016
- SNODAS WY 2017

Snow Water Equivalent, SWE (in)



*SNODAS process has changed over time so showing % of mean is not appropriate*

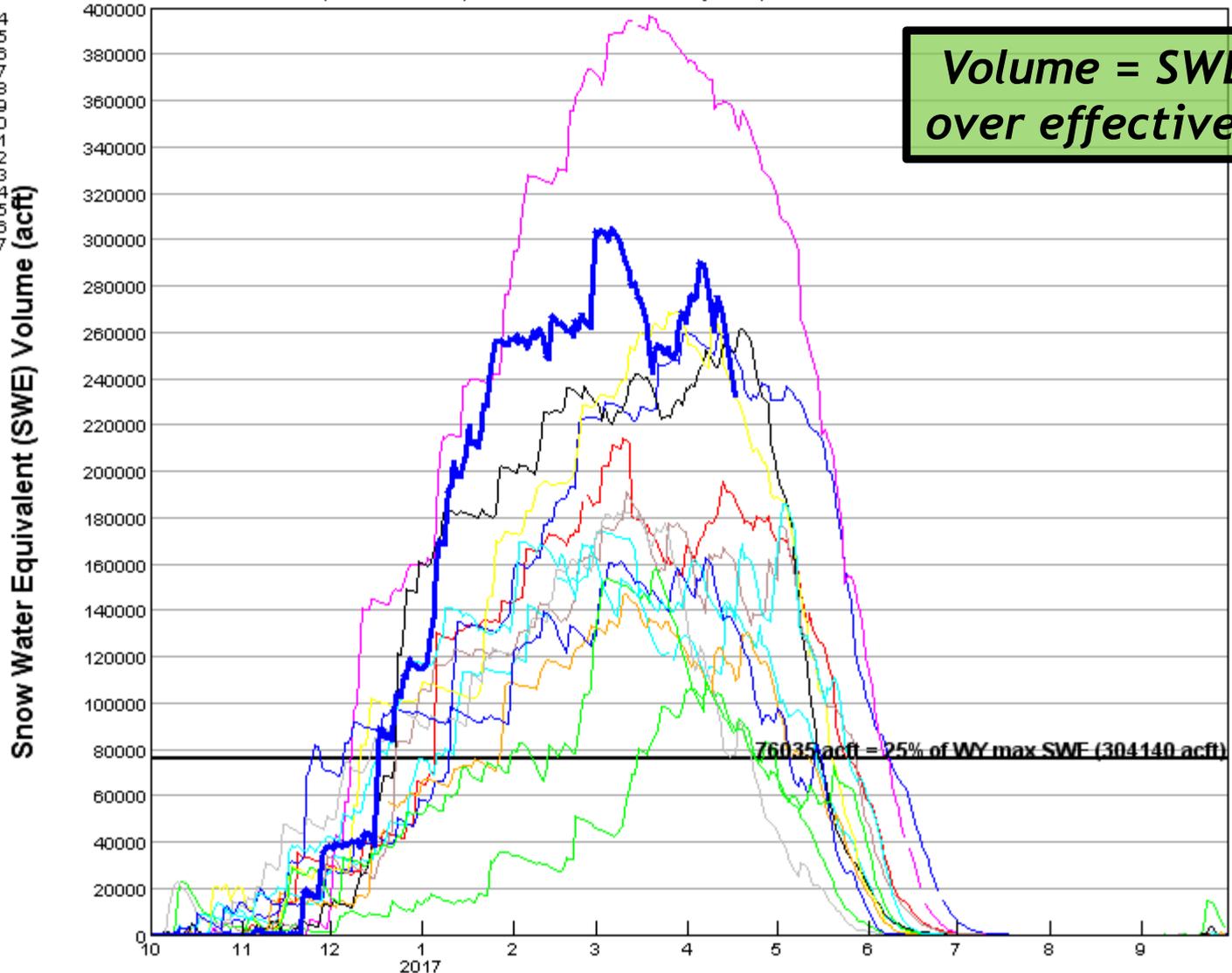
*Note late November date for snow to “stick”*

# SNODAS SWE Volume

CONEJOS RIVER NEAR MOGOTE, CO. (MOGC2) SNODAS SWE Volume

(Each line corresponds to a Water Year starting Oct 1)

- SNODAS WY 2004
- SNODAS WY 2005
- SNODAS WY 2006
- SNODAS WY 2007
- SNODAS WY 2008
- SNODAS WY 2009
- SNODAS WY 2010
- SNODAS WY 2011
- SNODAS WY 2012
- SNODAS WY 2013
- SNODAS WY 2014
- SNODAS WY 2015
- SNODAS WY 2016
- SNODAS WY 2017



*Volume = SWE (in)  
over effective area*

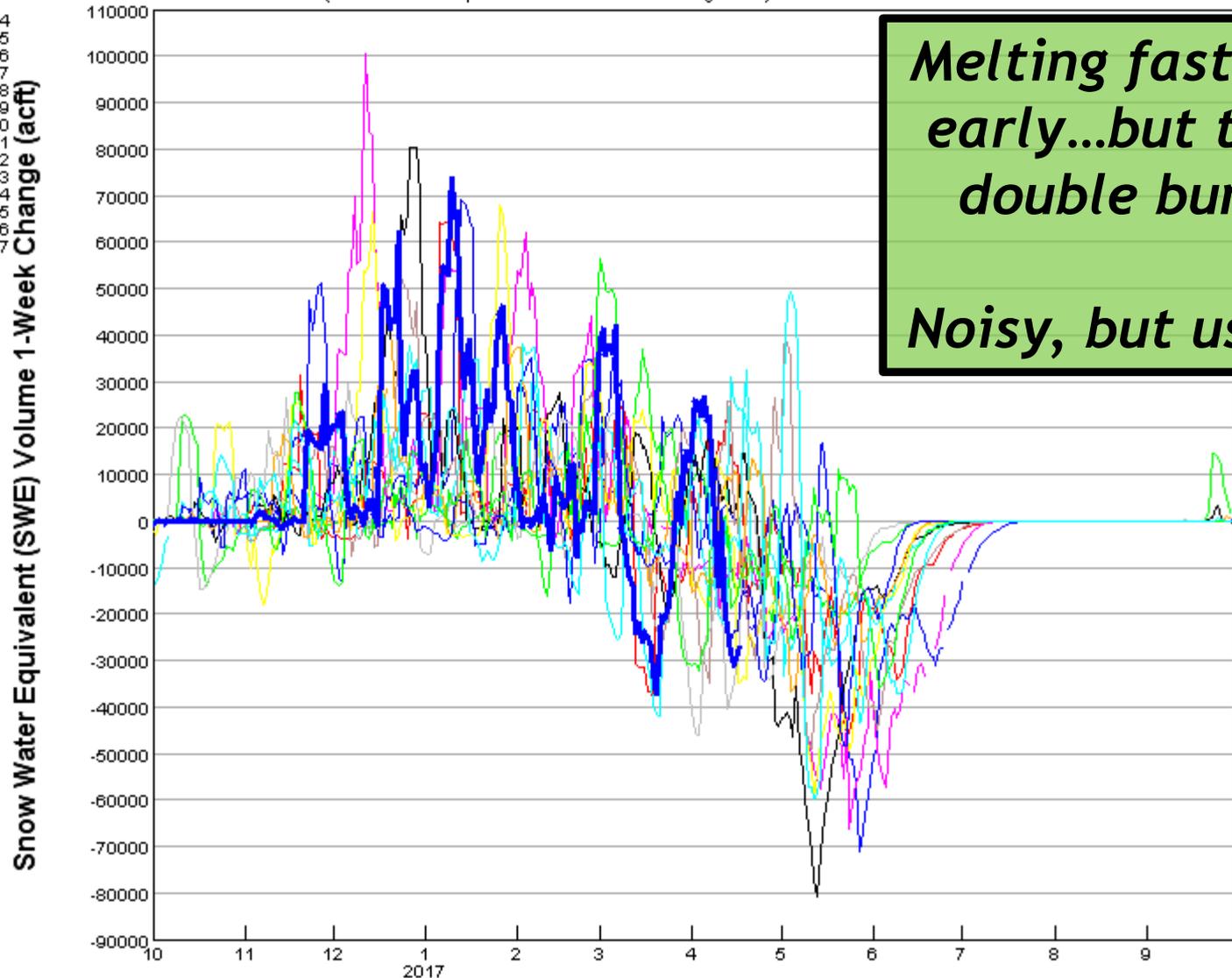
76035 acft = 25% of WY max SWE (304140 acft)

# SNODAS SWE Volume 1-Week Change

CONEJOS RIVER NEAR MOGOTE, CO. (MOGC2) SNODAS SWE Volume 1-Week Change

(Each line corresponds to a Water Year starting Oct 1)

- SNODAS WY 2004
- SNODAS WY 2005
- SNODAS WY 2006
- SNODAS WY 2007
- SNODAS WY 2008
- SNODAS WY 2009
- SNODAS WY 2010
- SNODAS WY 2011
- SNODAS WY 2012
- SNODAS WY 2013
- SNODAS WY 2014
- SNODAS WY 2015
- SNODAS WY 2016
- SNODAS WY 2017



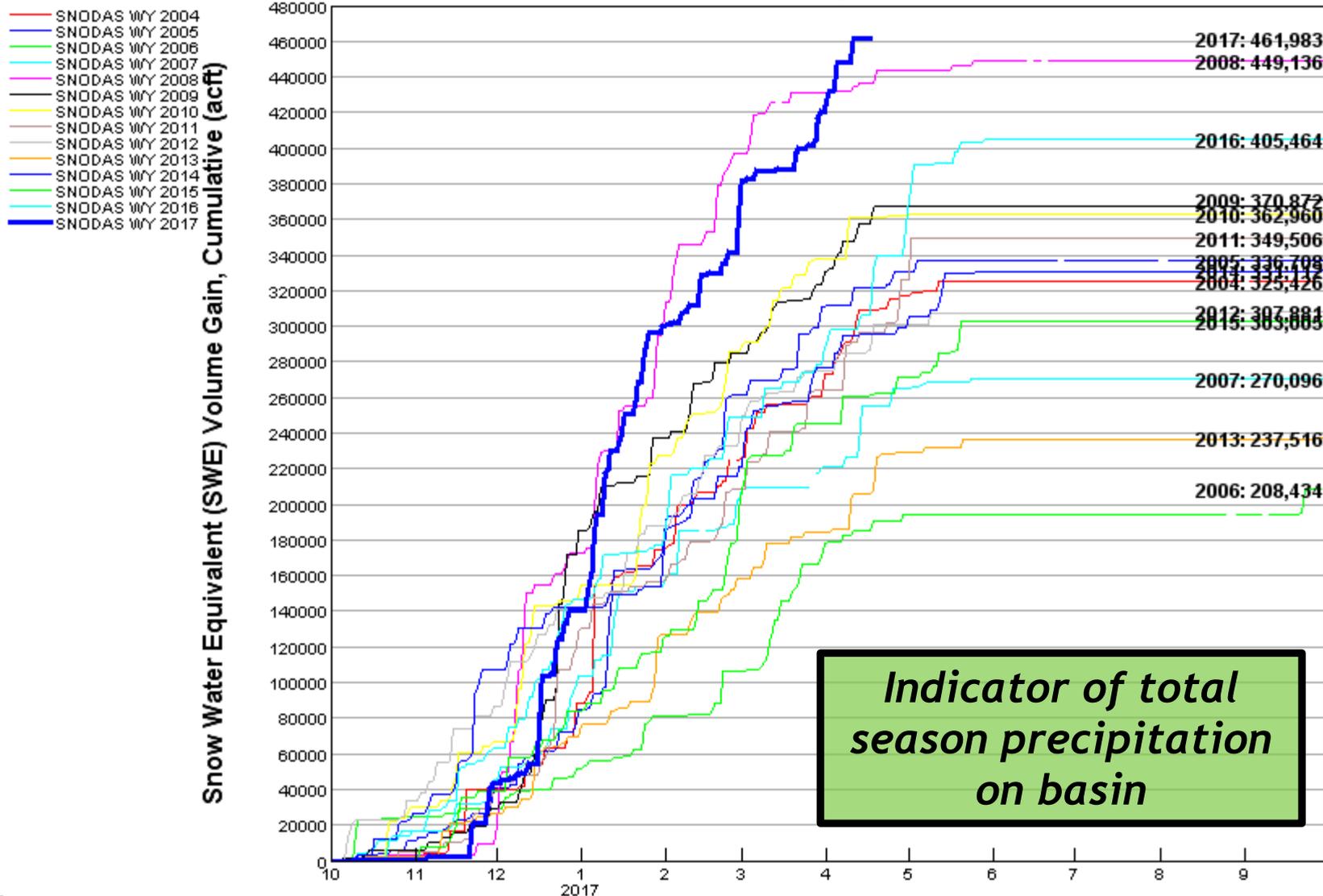
*Melting fast and early...but then double bump*

*Noisy, but useful*

# SNODAS SWE Volume Gain, Cumulative

CONEJOS RIVER NEAR MOGOTE, CO. (MOGC2) SNODAS SWE Volume Gain, Cumulative

(Each line corresponds to a Water Year starting Oct 1)



*Indicator of total season precipitation on basin*

# Daily SWE Map Animation

Select Date **SNODAS Date: 2016-10-01**

**SNODAS Animation**

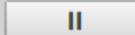
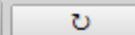
Starting Date: (earliest available date: 2003-09-30)  
2016-10-01 

Ending Date: (latest available date: 2017-04-17)  
2017-04-17 

Increment (days): (Default is set to 1)  
value between 1 and 10 

Submit

2016-10-01

- *It is pretty cool!*
- *Can see storm events*
- *Can see when snow started to accumulate and melt out*

# Next Steps

- Minor cosmetic changes to website
- Add graph products for total basin (upstream of current basin)
- Move system to State cloud-hosted server
- Get feedback from stakeholders
- Project ends June 30, 2017

# Share It

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