



ASO + M3 Works Model State Update

St. Vrain & Lefthand Basins

Model date: May 21, 2023



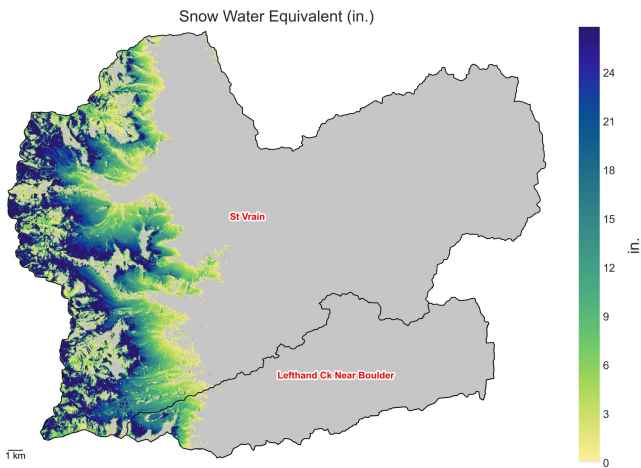
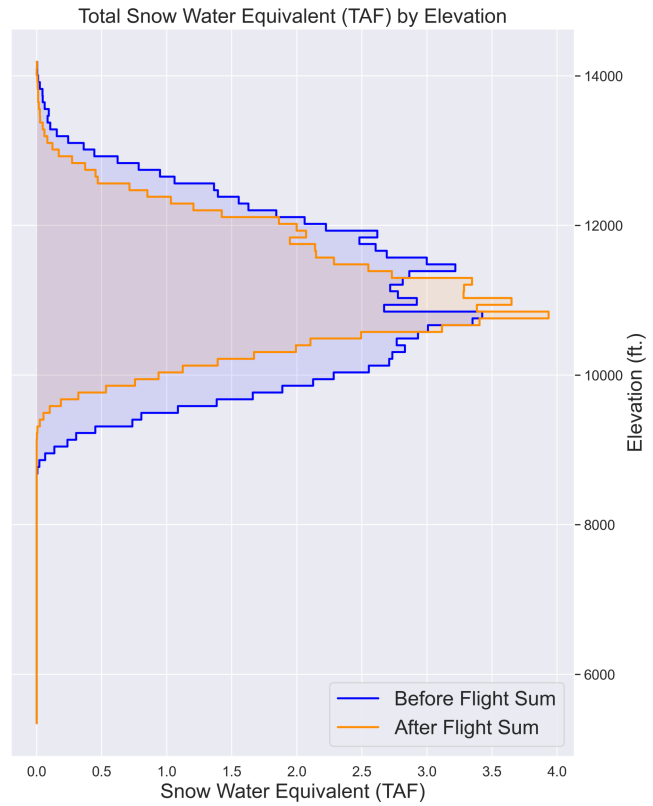
Historical data and reports can be found at:
data.airbornesnowobservatories.com

ST. VRAIN & LEFTHAND BASINS MAY 21, 2023 MODEL STATE UPDATE

The purpose of this report is to show the changes to the model during the ingestion of the ASO measured snow depth product.

Current model date: May 21, 2023
Model Total Snow Water Equivalent: 68.2 TAF
Model Mean Snow Water Equivalent: 4.8 in.
Model Mean Cold Content: -0.0 MJ/m²

Changes to model during ASO survey data ingest
Model reporting period: May 20 - May 21, 2023
Change in Total Snow Water Equivalent: -21.8 TAF
Change in Mean Snow Water Equivalent: -1.5 in.
Accumulated Total Surface Water Input: 4.4 TAF
Change in Mean Cold Content: 0.0 MJ/m²



| DESCRIPTION | TOTAL | LEFTHAND CK NEAR BOULDER | ST VRAIN |
|---------------|-------|--------------------------|----------|
| Mean SWE in. | 4.8 | 0.9 | 5.7 |
| Total SWE TAF | 68.2 | 2.3 | 65.9 |

The model has been updated with ASO survey data, a brief summary of the changes to the model are provided:
 May 21 update summary: removed 21.8 TAF of Snow Water Equivalent

Model changes during ASO survey data ingest

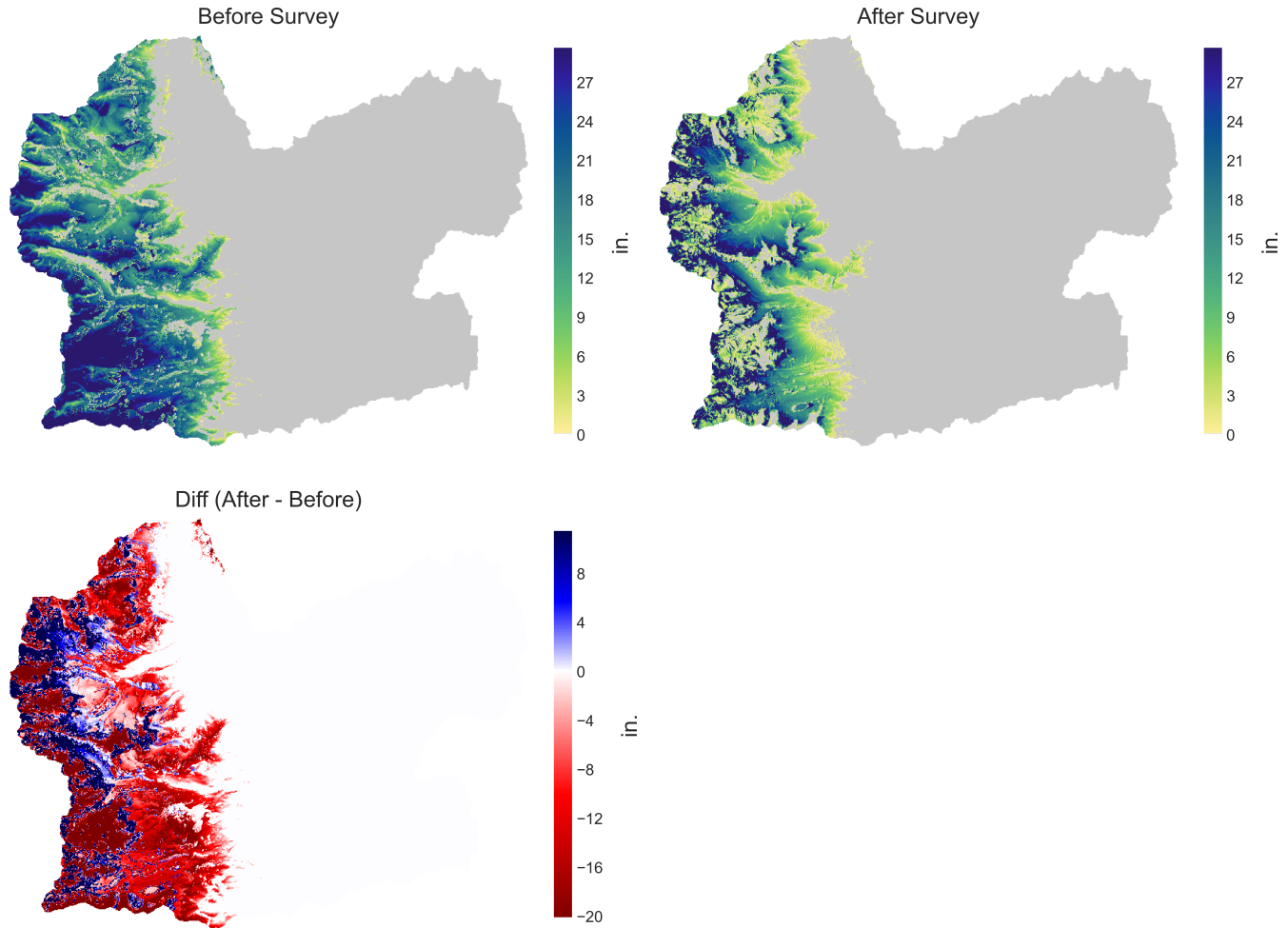


Fig.3 Change in Snow Water Equivalent from 2023-05-20 to 2023-05-21

The acquisition on 05/21 had a negligible change in the total snow-covered-area in the model, and the basin total SWE in the model decreased by 21.8 TAF.

State of the Snowpack

Interpretation Notes

Elevation bands are in increments of 1000 ft, e.g., 4000 is 4000 - 5000 ft.

Mean SWE is calculated over the total basin area. Mean cold content is calculated over the snow covered area to reflect the ripeness of the existing snowpack.

Surface Water Input (SWI) includes liquid water leaving the bottom of the snowpack and rain on bare ground.

Forcing data is created with the Spatial Modeling for Resources Framework (SMRF) using the High Resolution Rapid Refresh (HRRR) output fields as inputs. The HRRR data is locally optimized for mass input to the basin.

Model changes during ASO survey updates include both changes due to the depth update and model state changes from running the model over the period containing the depth update.

Model Results

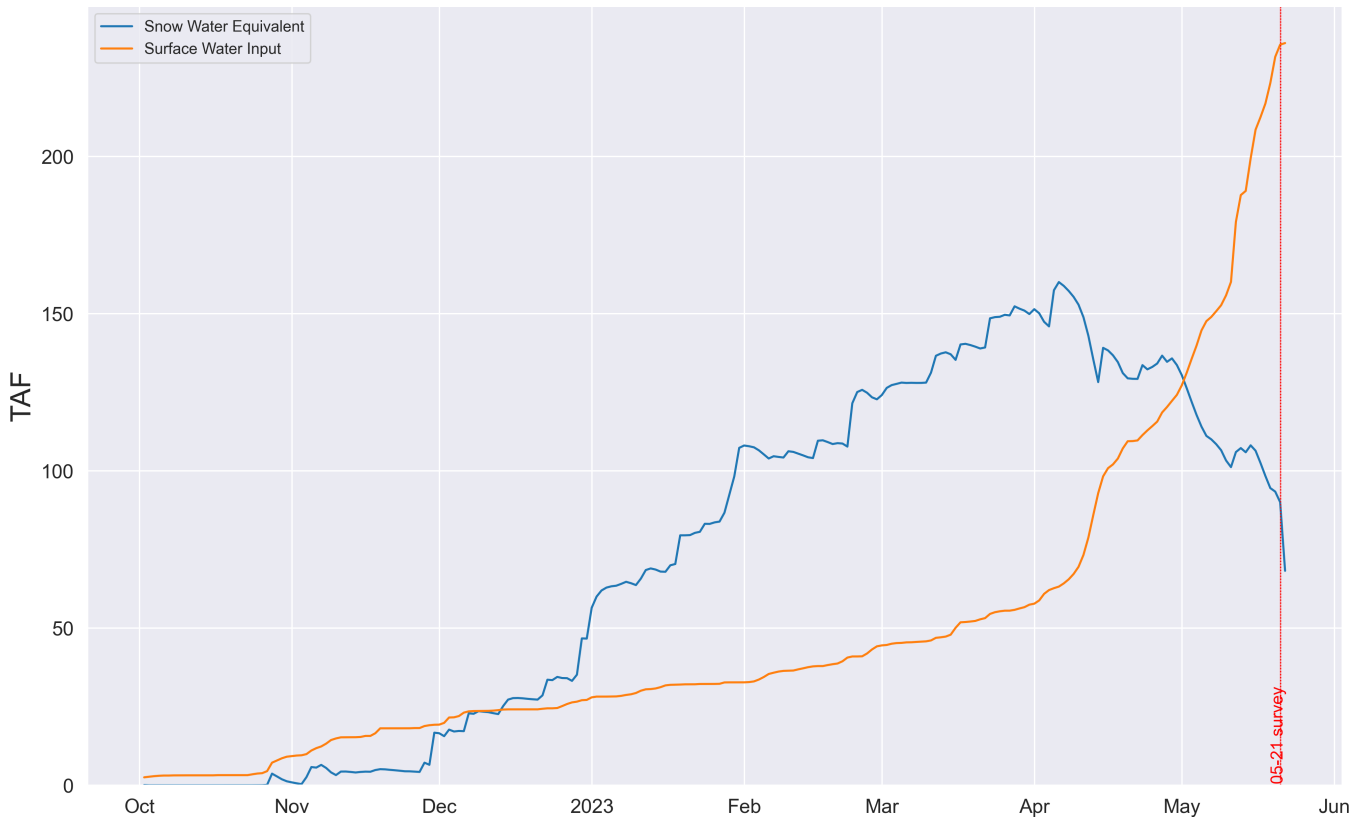


Fig.4 Water Year timeseries. Vertical lines indicated ASO survey dates.

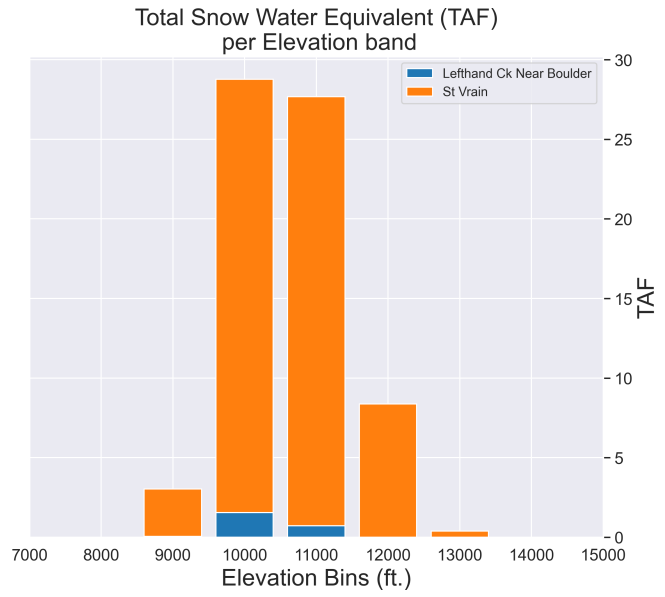
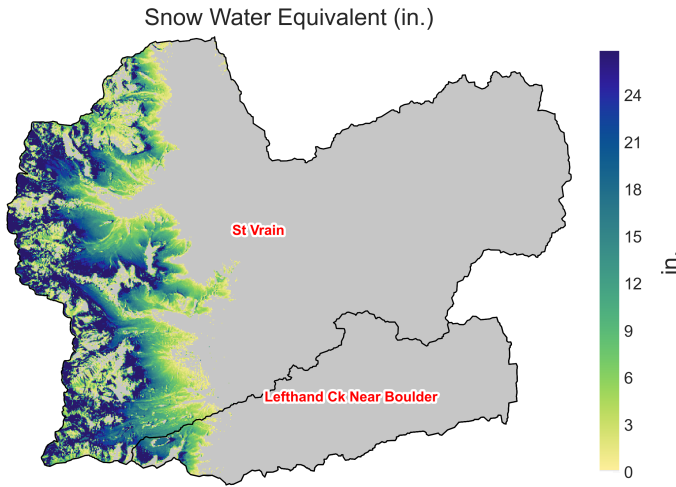


Fig.5 Snow Water Equivalent as of 2023-05-21

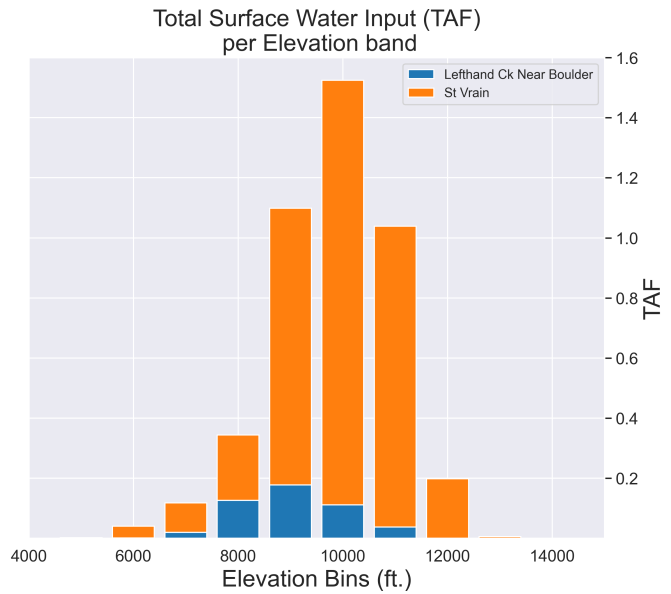
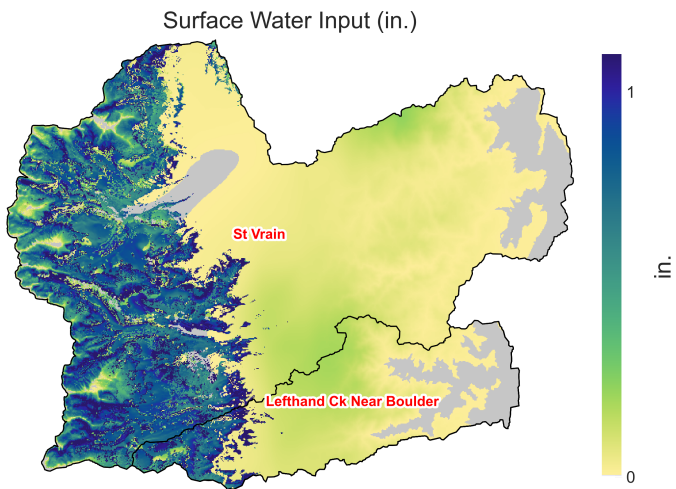


Fig.6 Accumulated Surface Water Input from 2023-05-20 to 2023-05-21

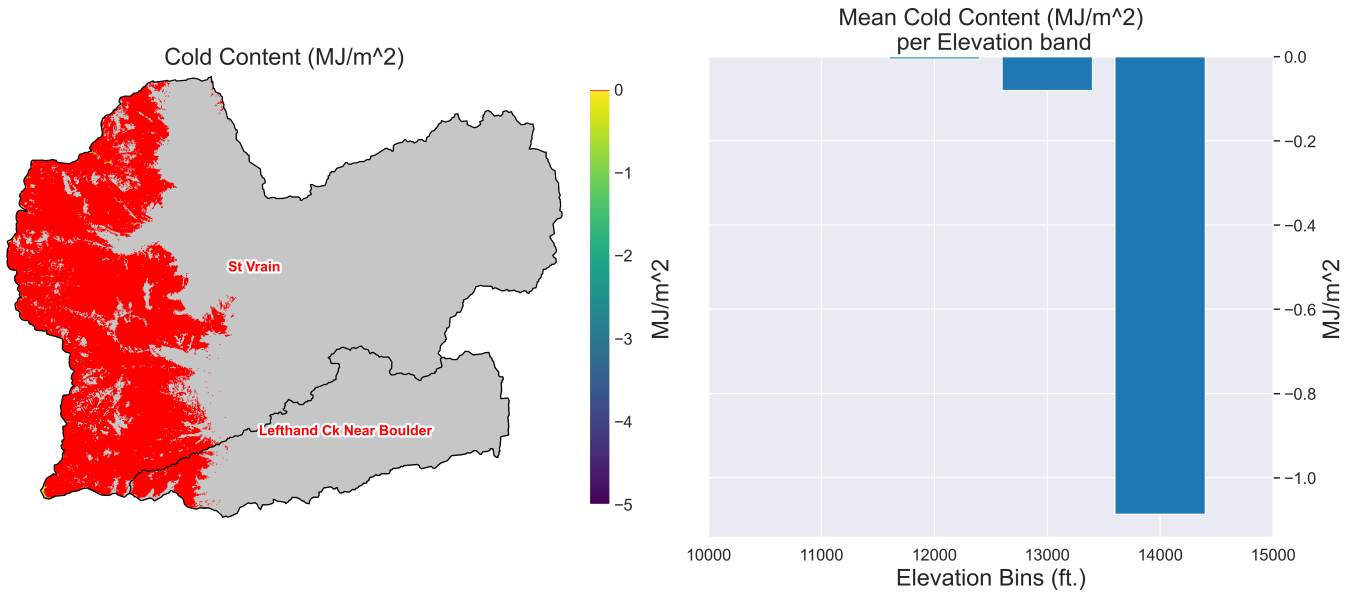


Fig.7 Cold Content as of 2023-05-21

Very little cold content remains in the St. Vrain & Lefthand basin. The remaining un-ripe snow exists only above 11759 ft., and represents approximately 0.34% of the basin SWE.

Model to station comparisons are a comparison of 50 meter cells to a point within the basin. Some differences are expected when comparing modeled and measured snowpack behavior at these different spatial scales. ASO 3m snow depth measurements at each station are indicated by the red '+' symbols. Absence of these symbols indicates that the station location or data quality are suspect, and they were not used in the ASO survey validation and report.

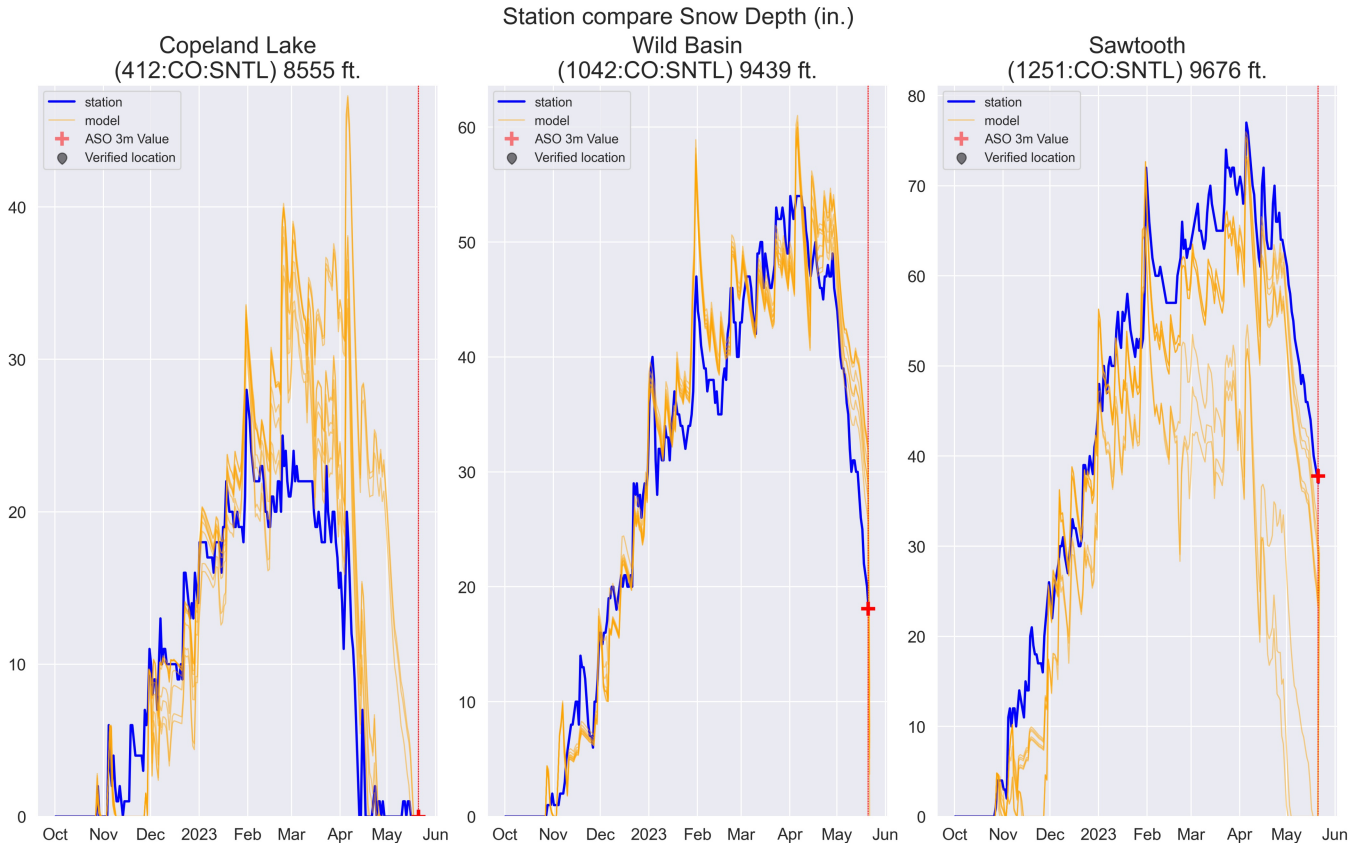


Fig.8 Comparison of modeled and measured Snow Depth. Comparisons of model pixels to measured station data are performed with the 9 nearest model pixels to give a more spatially complete view of model behavior.

Model Description

Modeled data is generated using the Automated Water Supply Model (AWSM). Underlying forcing data is sourced from the High Resolution Rapid Refresh model (HRRR). AWSM simulates the snowpack state using the physically based, distributed energy and mass balance snow model, iSnoBal.

For more information on the Airborne Snow Observatories Inc. visit airbornesnowobservatories.com.

More information about M3 Works can be found at m3works.io.

ST. VRAIN & LEFTHAND BASINS MAY 21, 2023 MODEL STATE UPDATE

Additional Details

Total Snow Water Equivalent values (TAF) on 2023-05-21

| ELEVATION RANGE | TOTAL | LEFTHAND CK NEAR BOULDER | ST VRAIN |
|-----------------|-------|--------------------------|----------|
| 8000 - 8999 | 0.0 | 0.0 | 0.0 |
| 9000 - 9999 | 3.0 | 0.1 | 3.0 |
| 10000 - 10999 | 28.8 | 1.6 | 27.2 |
| 11000 - 11999 | 27.7 | 0.7 | 27.0 |
| 12000 - 12999 | 8.4 | 0.0 | 8.4 |
| 13000 - 13999 | 0.4 | 0.0 | 0.4 |
| 14000 - 14999 | 0.0 | 0.0 | 0.0 |

Accumulated Total Surface Water Input values (TAF) from 2023-05-20 to 2023-05-21

| ELEVATION RANGE | TOTAL | LEFTHAND CK NEAR BOULDER | ST VRAIN |
|-----------------|-------|--------------------------|----------|
| 5000 - 5999 | 0.0 | 0.0 | 0.0 |
| 6000 - 6999 | 0.0 | 0.0 | 0.0 |
| 7000 - 7999 | 0.1 | 0.0 | 0.1 |
| 8000 - 8999 | 0.3 | 0.1 | 0.2 |
| 9000 - 9999 | 1.1 | 0.2 | 0.9 |
| 10000 - 10999 | 1.5 | 0.1 | 1.4 |
| 11000 - 11999 | 1.0 | 0.0 | 1.0 |
| 12000 - 12999 | 0.2 | 0.0 | 0.2 |
| 13000 - 13999 | 0.0 | 0.0 | 0.0 |