

A Multi-faceted Evaluation of National Water Model Snow Processes in Complex Terrain

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1. INTRODUCTION:

The goal of this work is to understand how snow processes are represented by NOAA's National Water Model and its underlying land surface model, Noah MP, through a process-based study focused in California, on the Tuolumne river basin.

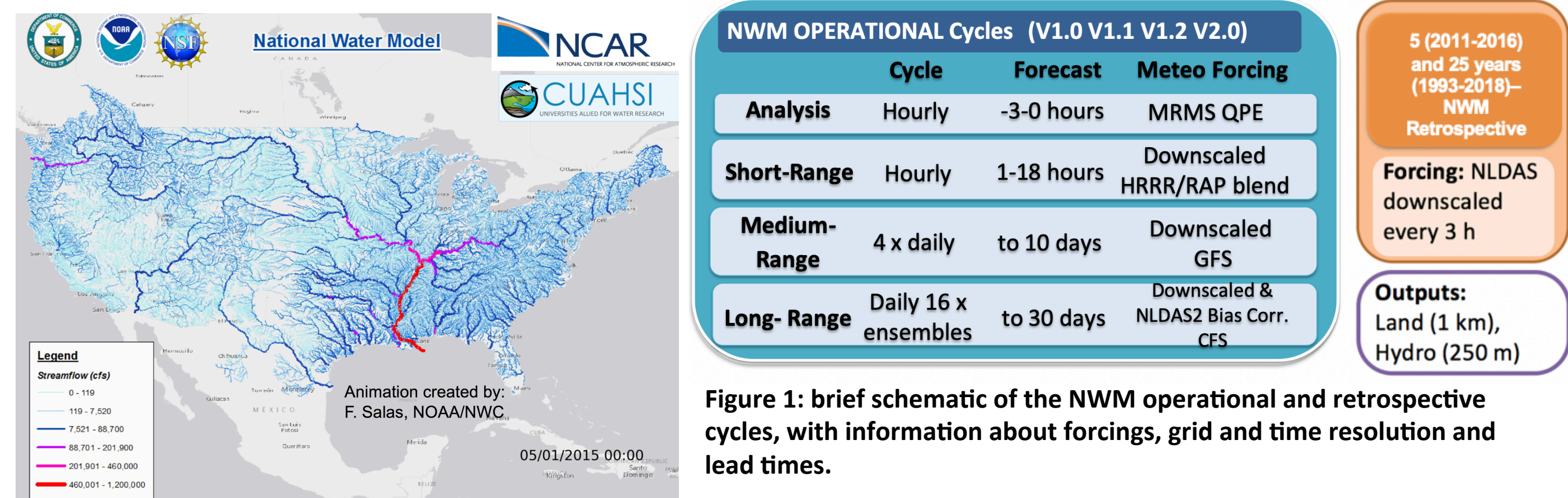


Figure 1: brief schematic of the NWM operational and retrospective cycles, with information about forcings, grid and time resolution and lead times.

2. TUOLUMNE STUDY AREA:

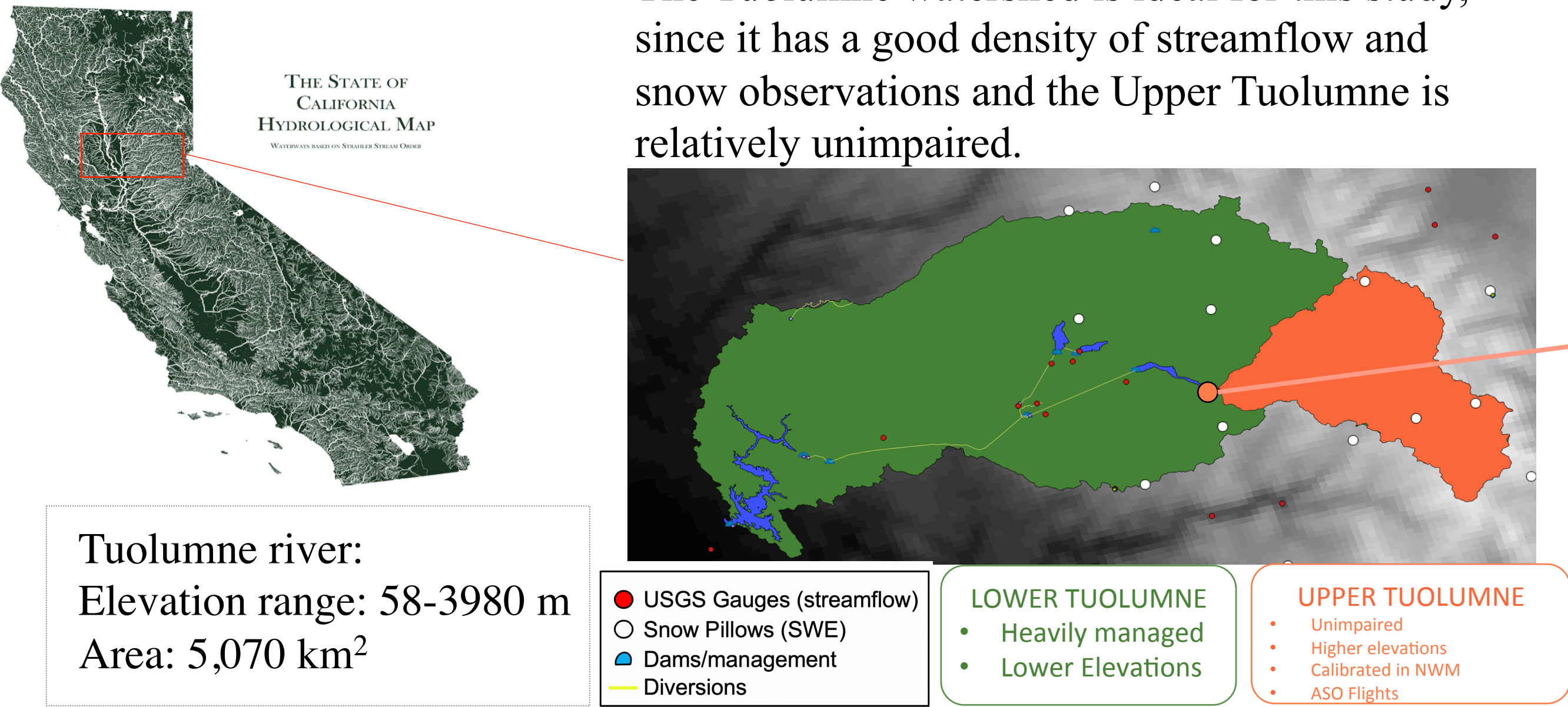


Figure 2: Map and location of the Tuolumne river basin. Illustration of the mail characteristics of the watershed and conceptual division between the Upper and Lower Tuolumne.

3. RETROSPECTIVE ASSESSMENT: STREAMFLOW EVALUATION

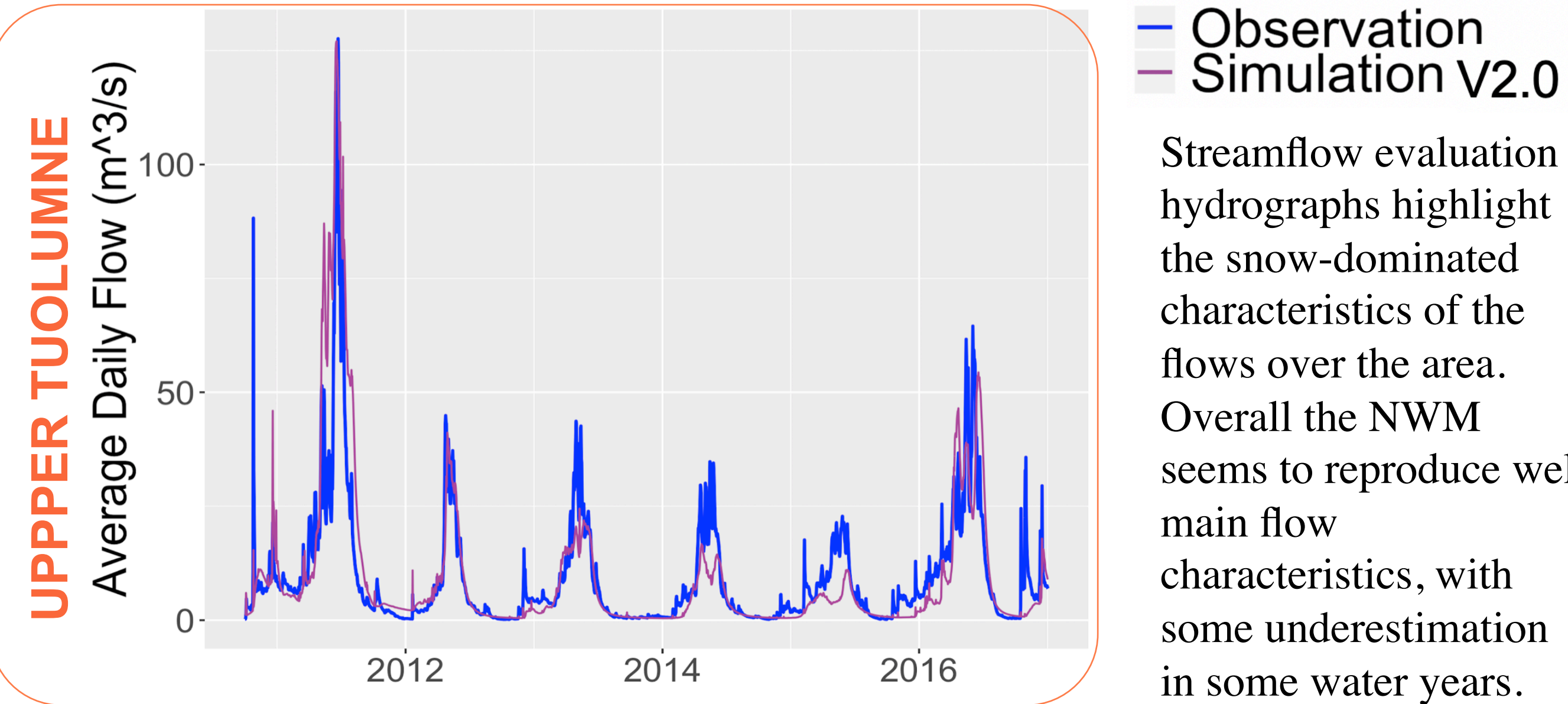


Figure 3: Streamflow comparison of NWM V2.0 retrospective run (violet line) with the USGS streamflow observations at the closing section of the Upper Tuolumne.

4. RETROSPECTIVE ASSESSMENT: SNOW EVALUATION

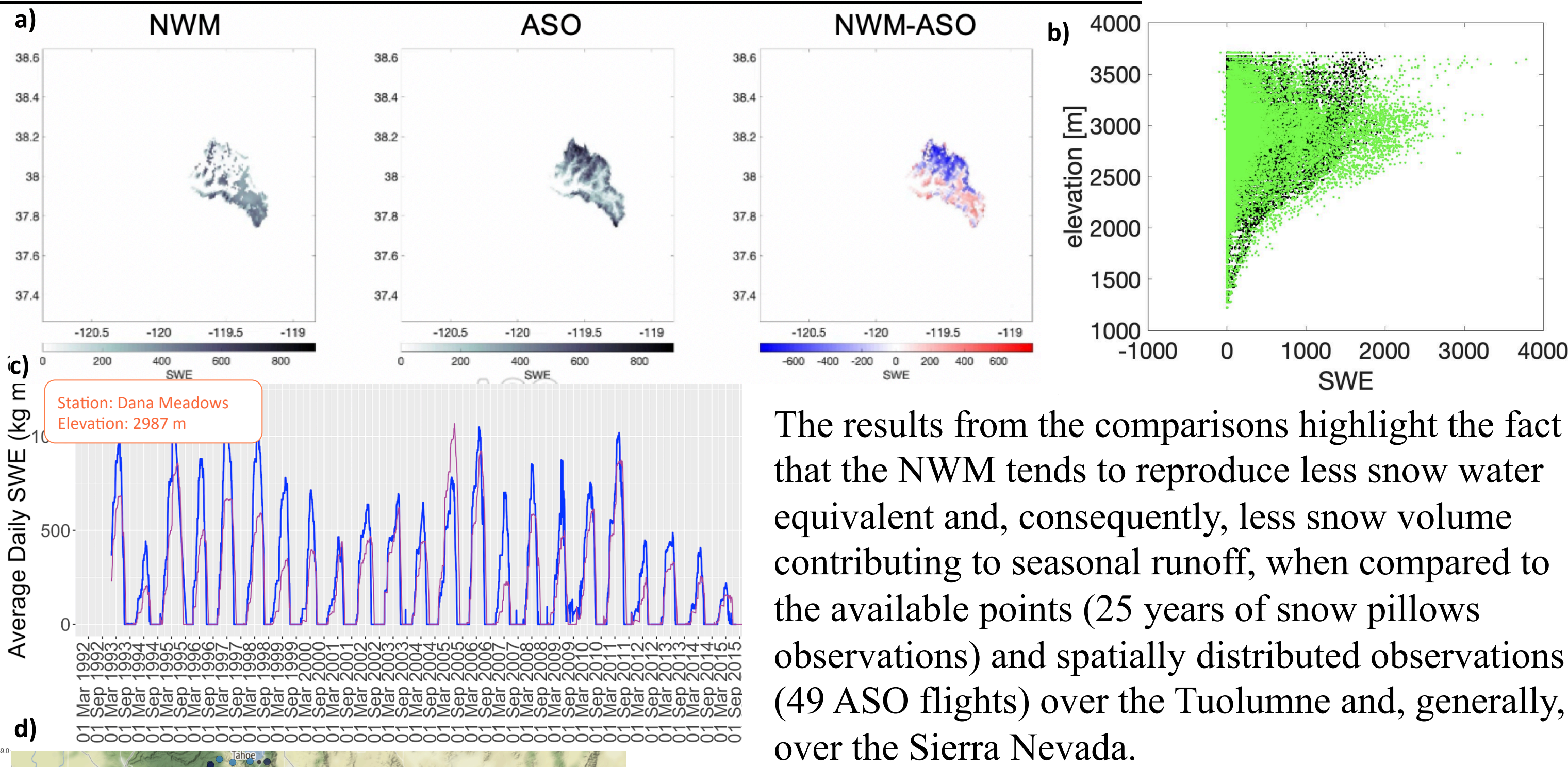


Figure 4: Point based and distributed snow evaluation of the NWM. Panel a shows the typical pattern of distributed SWE in the Upper Tuolumne from the NWM, ASO and the difference between the two (NWM-ASO). Panel b illustrates the SWE values distribution from all the 49 ASO flights from 2012 to 2018 (black dots) and corresponding NWM SWE (green dots) function of elevation. The NWM underestimates at higher elevations. Panel c shows point based observations over 25 years of retrospective evaluation at Dana Meadows and panel d represents the BIAS scores of same retrospective evaluation over the Sierra Nevada.

5. SINGLE COLUMN EXPERIMENT: DANA MEADOWS

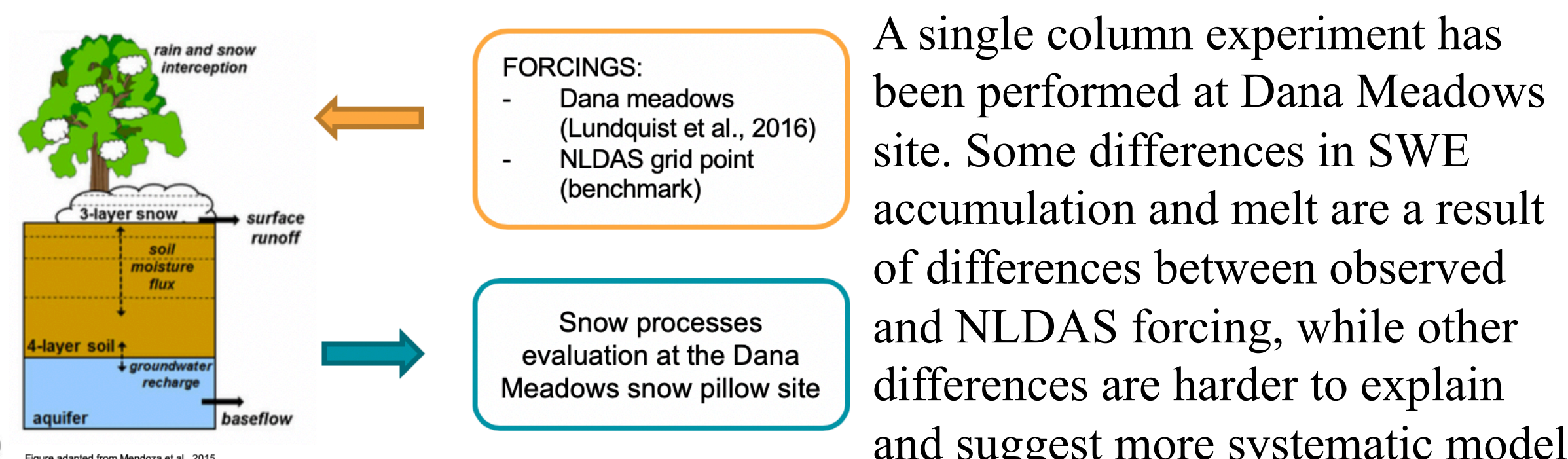


Figure 5: Schematic of the single column experiment, using the Noah-MP LSM, as used in the NWM.

A single column experiment has been performed at Dana Meadows site. Some differences in SWE accumulation and melt are a result of differences between observed and NLDAS forcing, while other differences are harder to explain and suggest more systematic model deficiencies on the process side.

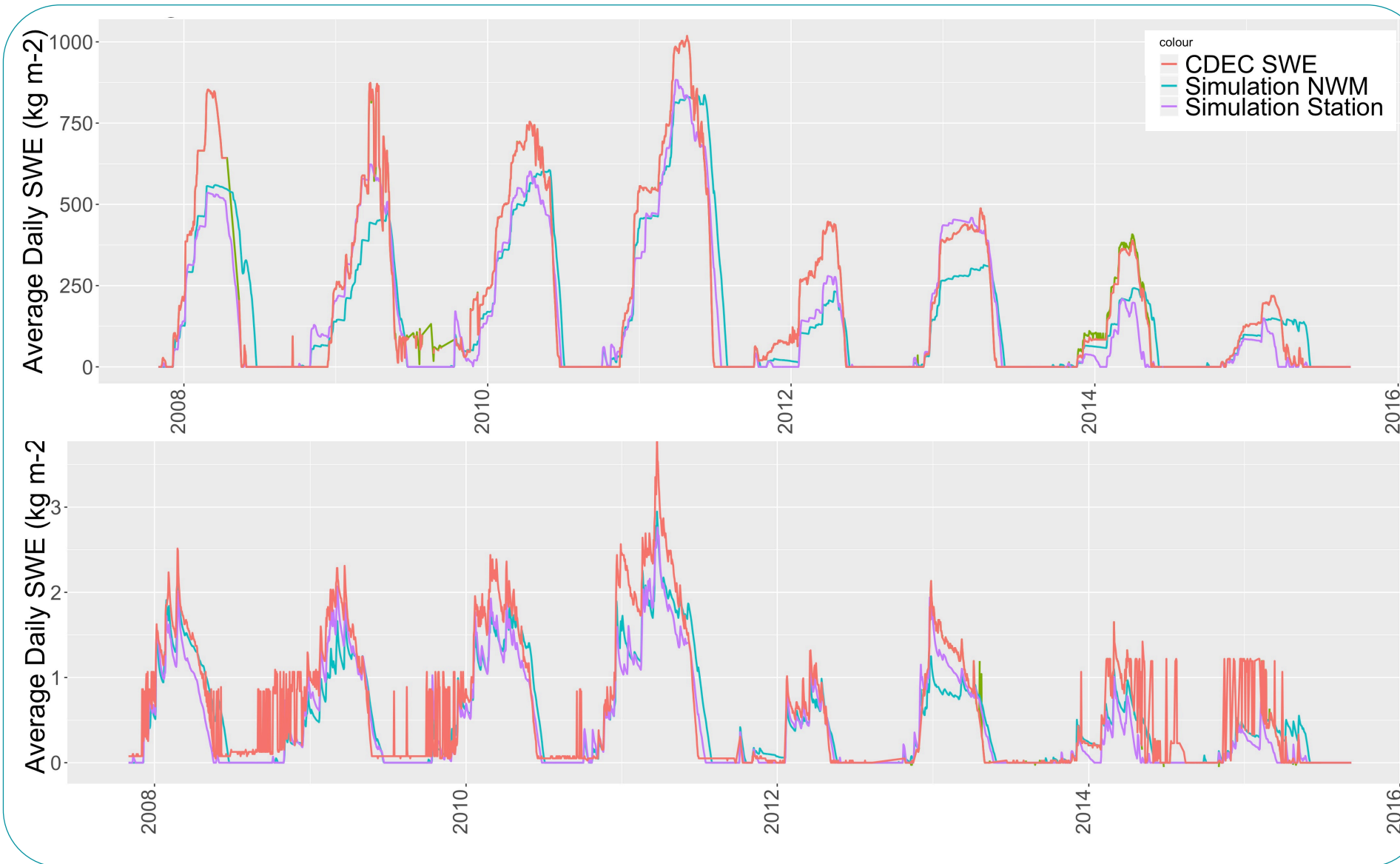


Figure 6 (on the left). SWE (upper panel) and snow depth (lower panel) from observations (rose line), NWM simulation with NLDAS forcings (light blue line) and NWM forced by station data. Figure 7 (on the right). Monthly timeseries of precipitation, temperature and long wave forcings from station observations (violet) and from NLDAS forcings (blue line).

6. FUTURE TASKS:

Continue to investigate snow physical processes in order to guide future development of the NWM snow model (Noah-MP) through:

- Sensitivity experiments on NWM/LSM parameters
- Deep investigation on the model's reproduction of key snow processes (albedo, snow density, etc.) within the three snow layers
- Explore the robustness of the results obtained here to other places in the Sierra Nevada or in similar snow-driven watersheds

ACKNOWLEDGEMENTS:

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