Estimating Changes in Surface Water Loading in the Colorado Rockies Using GPS and SWE data

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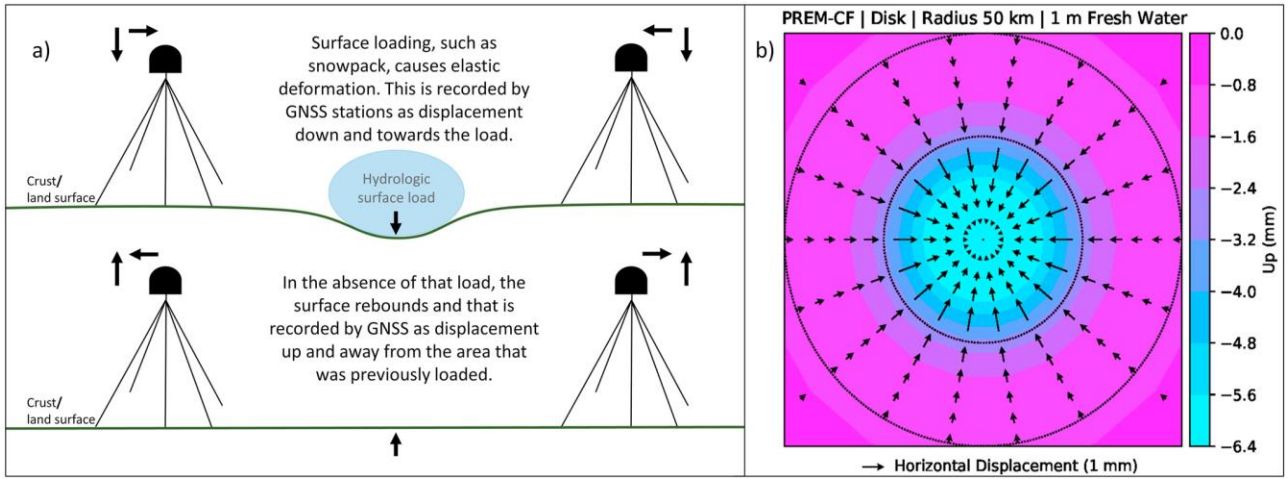
Can we use Horizontal movement from GPS stations to learn about precipitation?

- What is Hydrogeodesy?
  - A new earth science, which concerns itself with the storage and movement of water at or near the Earth's surface using the Earth's shape, orientation, and gravitational field.

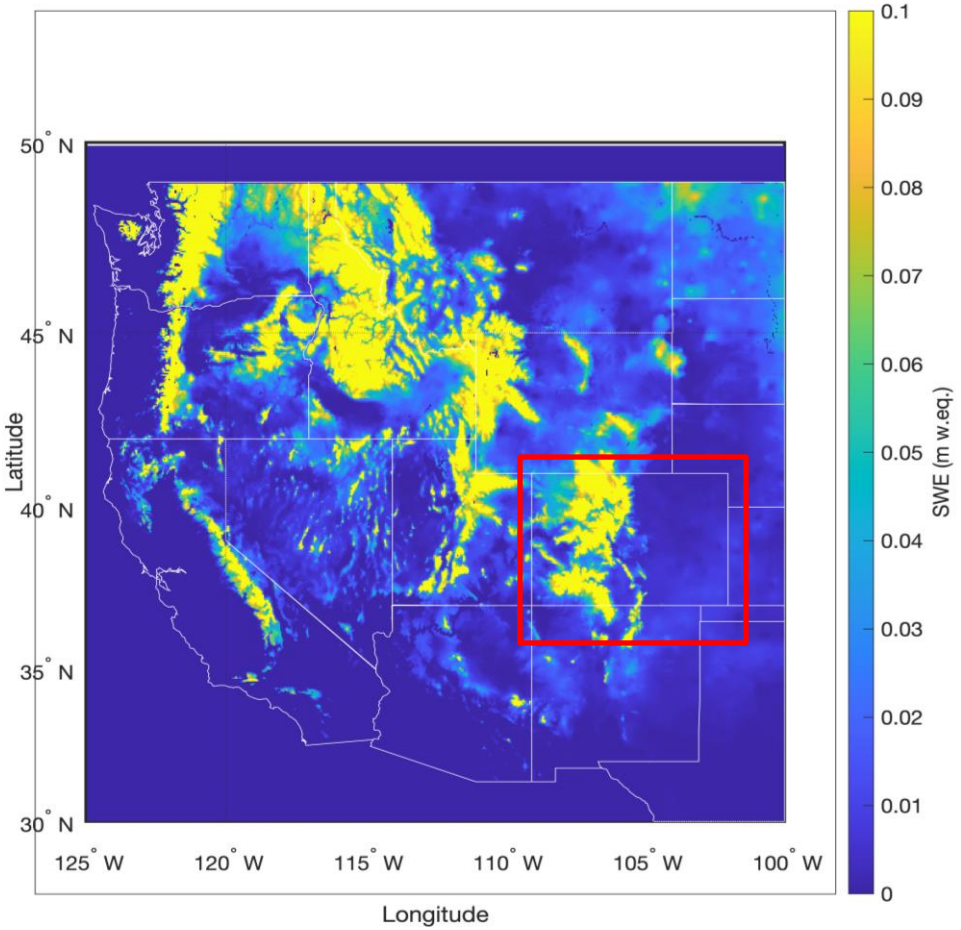


White, A. M., Et Al, 2022, *Water Resources Research*.

Why is it Important?

- North and East movements not looked at as much as Vertical movements.
  - These movements are mainly looked at in California because of how many stations there are.
  - We are looking for something new, possibly seasonal or any correlation between GPS and the SWE data.
- Importance of looking at precipitation
  - Snowmelt is a huge part of our water resource
  - Predicting water availability
  - Water management
  - Drought monitoring

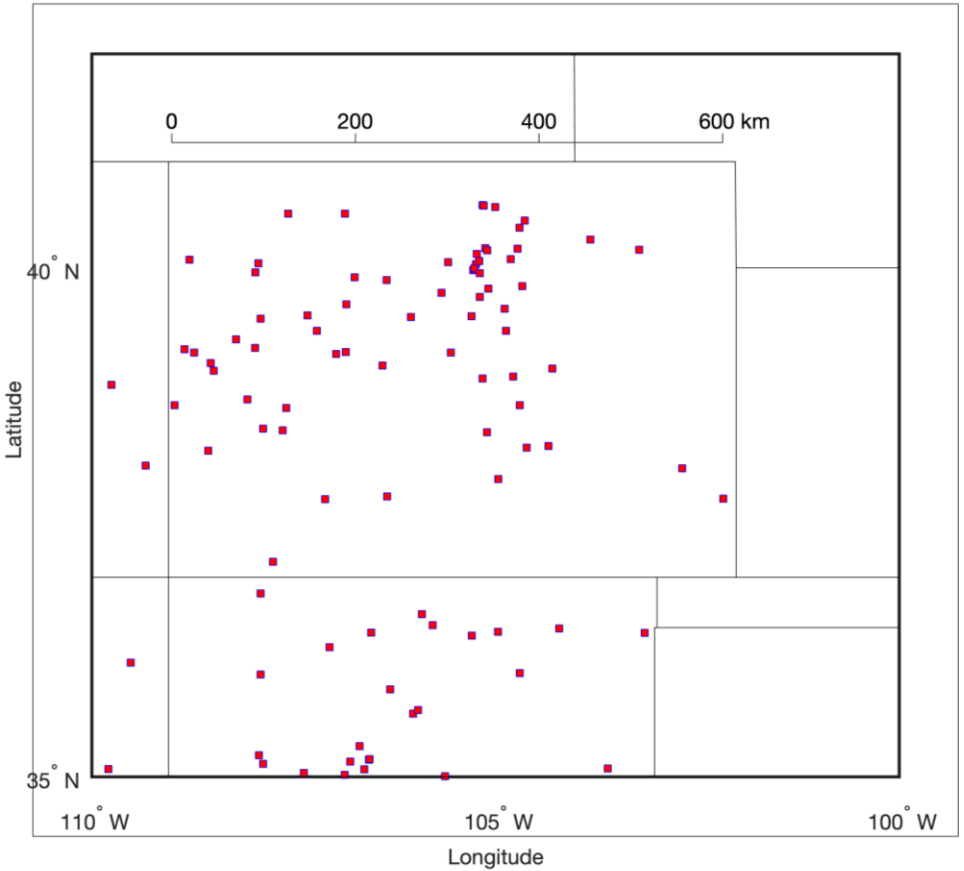
SWE Data January 2001



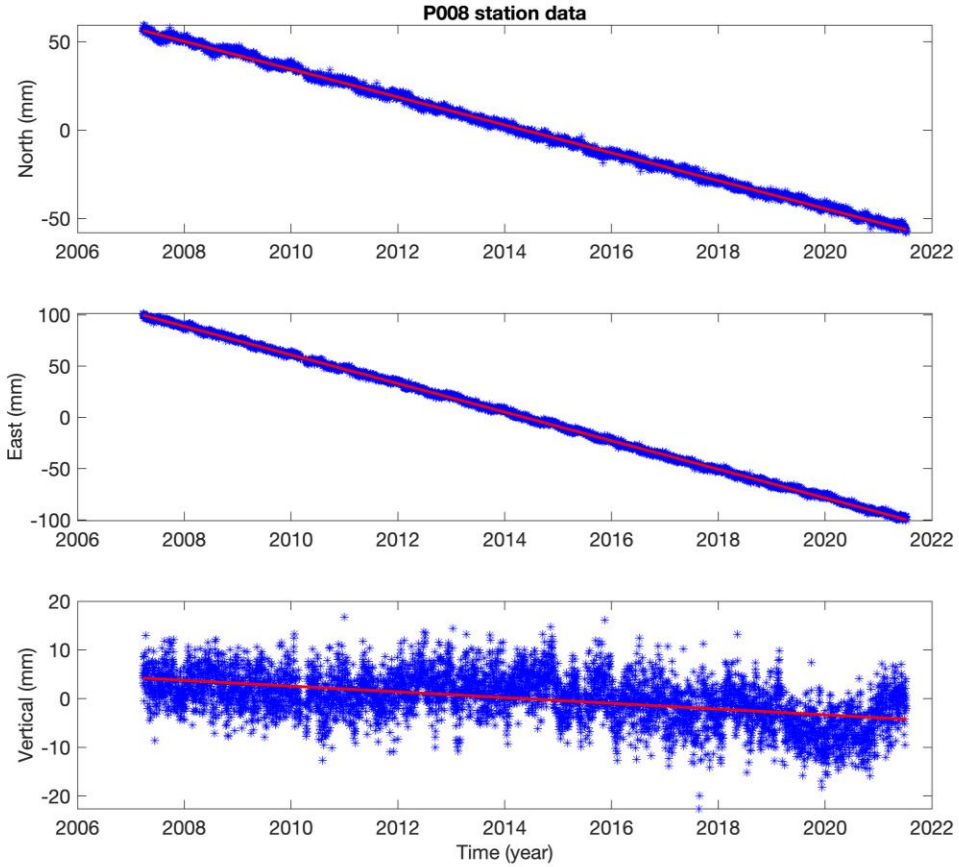
- SWE dataset made from a combination of satellite measurements
- From the Zeng group from the Hydrology and Atmospheric Sciences at University of Arizona

GPS Stations in the Colorado Rockies

- Stations had to have at least 2 years of continuous data
- There is 259 stations total, with a wide variety of settings(urban, rural, mountainous, etc.)



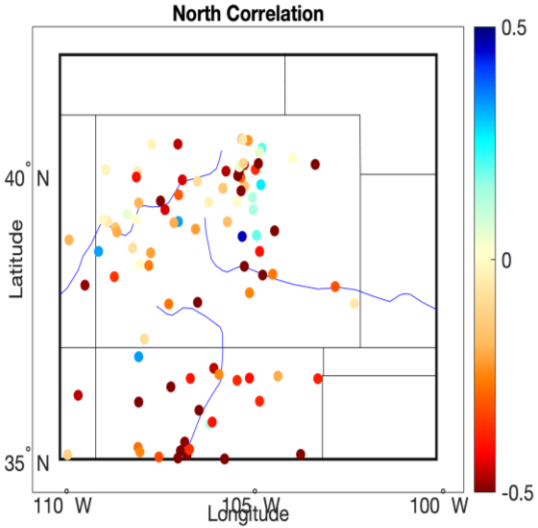
Example of GPS data

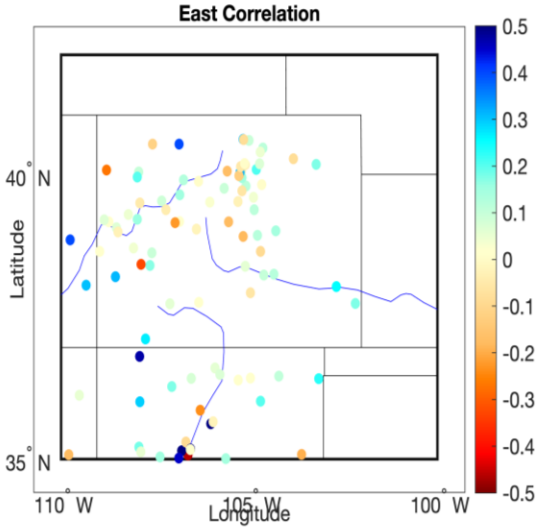


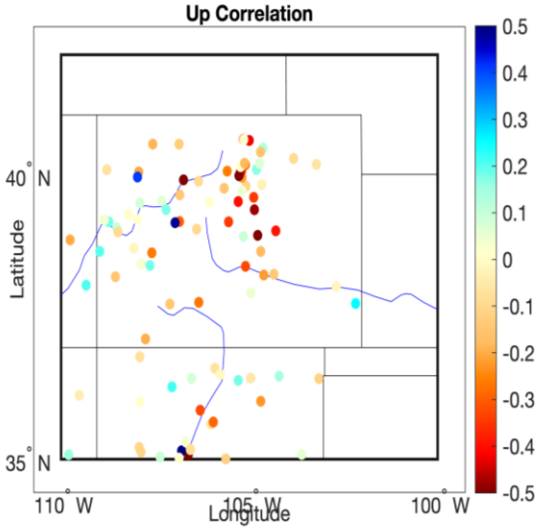
- We remove the linear trend and fit annual and semi-annual signals in GPS data
- We use the SWE data to predict surface displacement from snow changes at locations

SWE and GPS correlation

- Do the GPS and SWE data have the same motion at the same time?

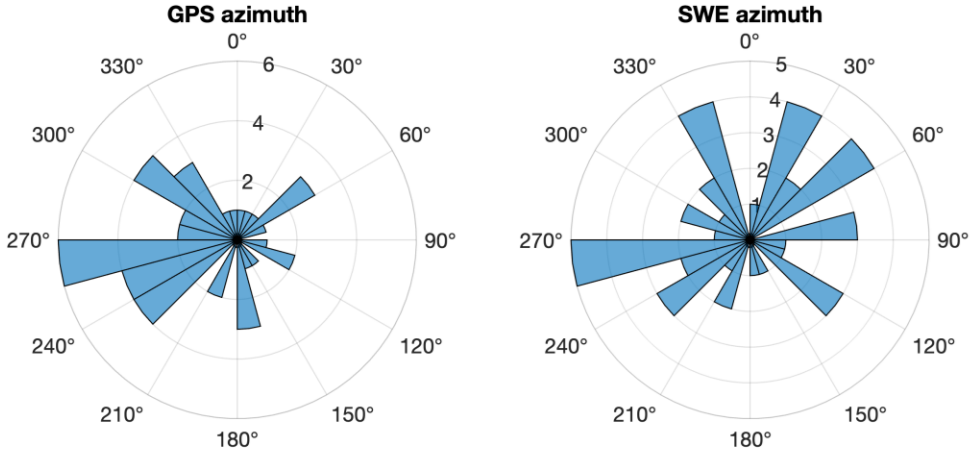


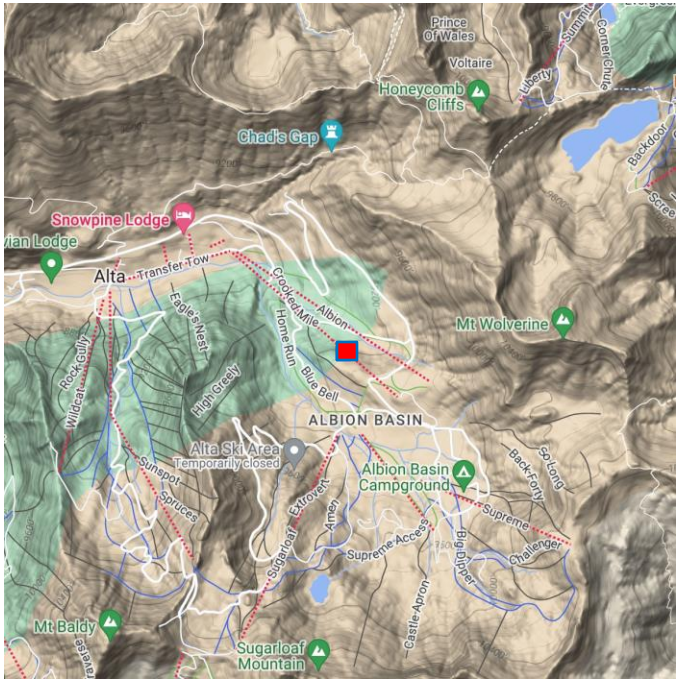




Example 1-High Positive Correlation

Station ALUT – Alta, Utah

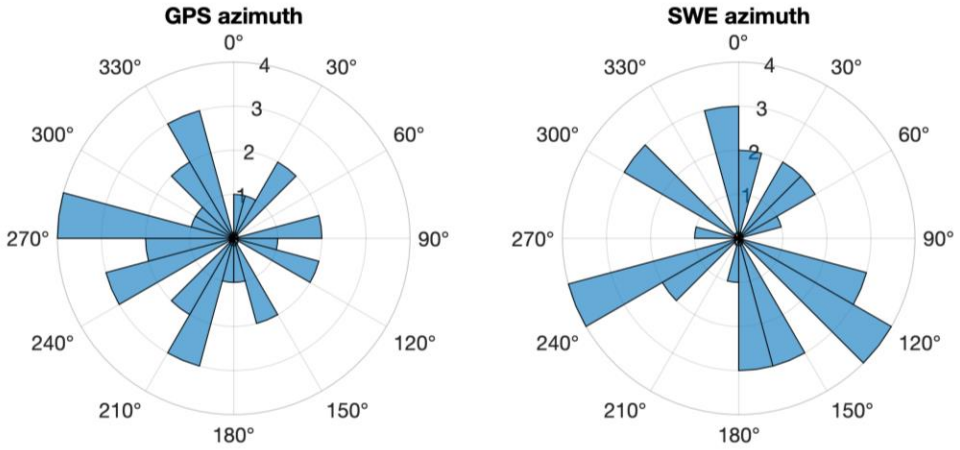


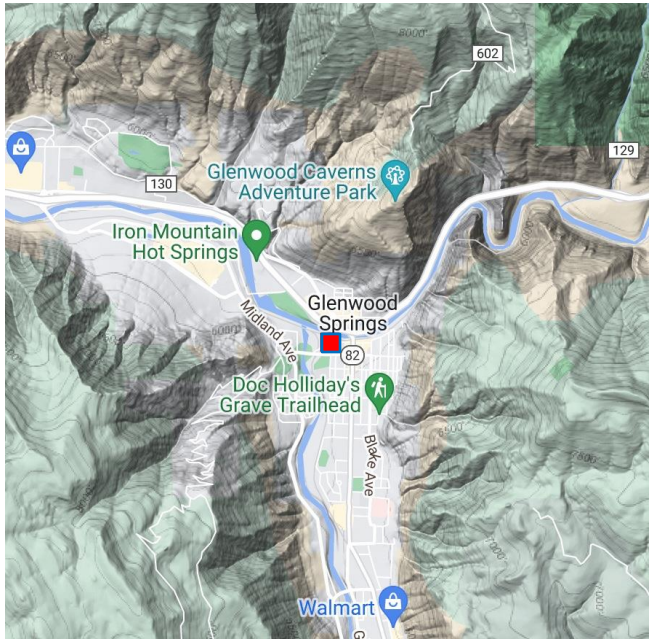


- Horizontal components combined into azimuth of motion
- Data selected for winter months (i.e. Dec-March)
- This station of high elevation near Alta Ski Area in Wasatch Mountains

Example 2- High Negative Correlation

Station GSC1 – Glenwood Springs, Colorado





- Horizontal components combined into azimuth of motion

Conclusions

- The relationship between horizontal GPS motion and snow signals is complex
- We should put more stations in the mountains close to the snow
- There is snow sensitive stations and river sensitive stations give complementary info on water resources

Future Work

- Examine the phase delay of river sensitive stations to snowpack signals