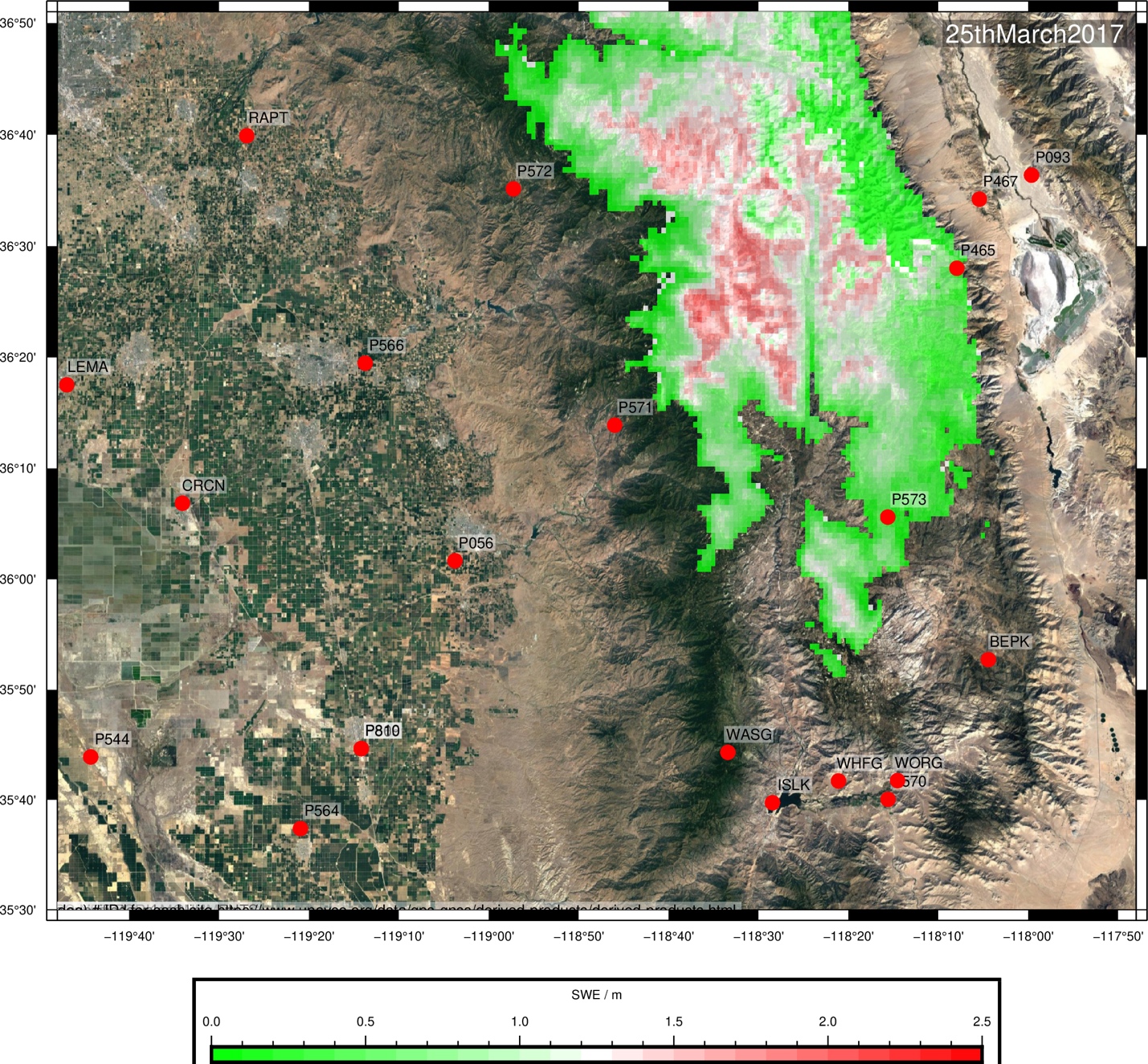
**Proposed Initial “Proof of Concept” Inversion**

We want to invert geodetic data for hydrologic loads. Our study area for this Proof of Concept inversion is approximately Sequoia National Park, as surrounded by GPS stations P572, P571, P573 and P465 in the map below. We expect the major seasonal hydrologic loading affecting the GPS stations in this area to be from snowpack and soil moisture. For Proof of Concept, we will assume the soil moisture content to be known, and our aim is to invert for the mass of snow in the study area. The time period of interest is hydrologic year 2017.

Snow

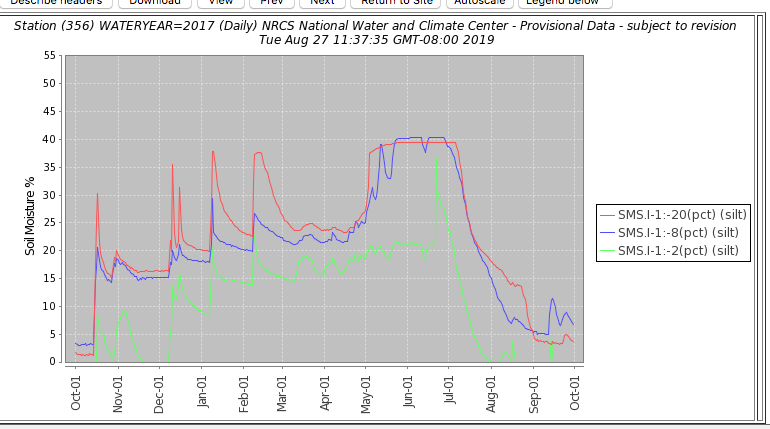
Our best estimate of the mass distribution of snow comes from the SNODAS dataset. In March 2017, it looks like this:



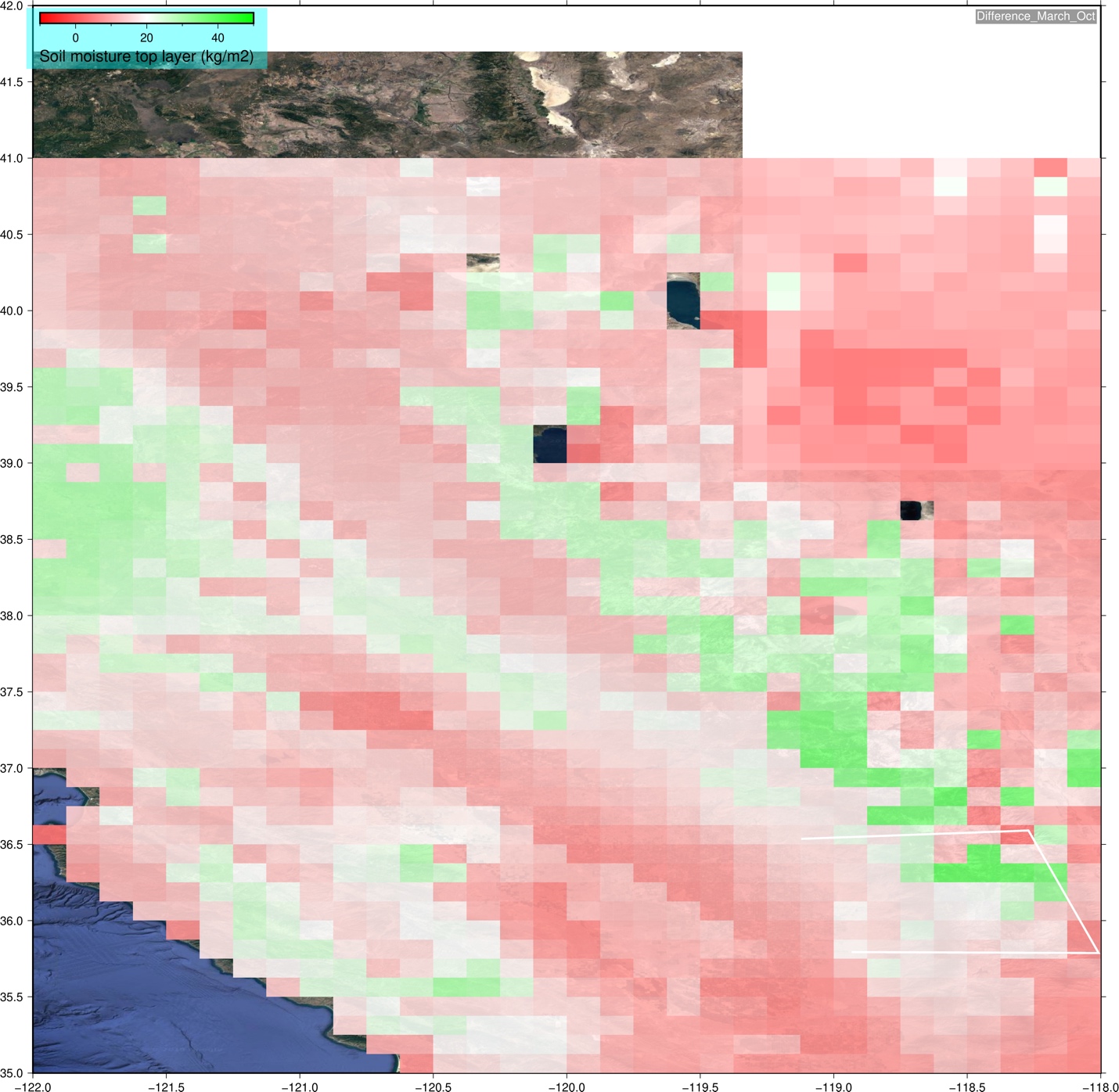
Red circles are GPS stations. The green-red coloured grid are ‘truth’ from the SNODAS SWE model. The total mass of snow, obtained by integrating the above map and multiplying by 1000 kg/m3, is 3.68 GT. There is no/negligible snow at the start of hydrologic year 2017 (October 2016).

Soil Moisture

Aakash is working on soil moisture. A few prelim bits I could do easily. Soil moisture seems to be at a minimum in the late summer/early Fall and max in the Winter/Spring. Eg One SNOTEL observation station, available from [here](https://www.nrcs.usda.gov/wps/portal/wcc/home/quicklinks/imap#version=107&elements=M&networks=!&states=!&counties=!&hucs=&minElevation=&maxElevation=&elementSelectType=all&activeOnly=true&activeForecastPointsOnly=false&hucLabels=false&hucIdLabels=false&hucParameterLabels=false&stationLabels=&overlays=&hucOverlays=&basinOpacity=100&basinNoDataOpacity=100&basemapOpacity=100&maskOpacity=0&mode=stations&openSections=dataElement,parameter,date,basin,elements,location,networks&controlsOpen=true&popup=&popupMulti=&base=esriNgwm&displayType=inventory&basinType=6&dataElement=SRVO&depth=-8&parameter=PCTAVG&frequency=MONTHLY&duration=custom&customDuration=1&dayPart=E&year=2019&month=7&day=26&monthPart=E&forecastPubMonth=6&forecastPubDay=1&forecastExceedance=50&seqColor=1&divColor=3&scaleType=D&scaleMin=&scaleMax=&referencePeriodType=POR&referenceBegin=1981&referenceEnd=2010&minimumYears=20&hucAssociations=true&lat=50.26&lon=-119.99&zoom=4.0):



In terms of spatial distribution, here is an (ugly) map of the different in the topmost layer from NLDAS between October 2016 and March 2017. Study area poorly marked by white lines in bottom right corner:



Aakash is working on getting more detailed information so we can forward model the loading due to soil moisture.

Inversions

Three steps:

1. Toy problem: test whether we can invert purely synthetic data. DONE.
   1. Create a known cylinder of a given mass and calculate deformation field (synthetic data) at 3,4,5(?) GPS stations around the cylinder. Add noise and invert for the mass of the cylinder.
   2. Add a second cylinder and explore how well the inversion works.
2. Highly simplified real world problem.
   1. First, take a model of the March soil moisture as compared to minimum soil moisture in the study area. Forward model the deformation associated with Consider the minimum and maximum snow mass for the hydrologic year 2017. (Maximum is approximately shown in picture above; minimum is zero). Model the maximum snow as a single cylinder centred on the ‘centre of mass’ of the snow. Can we use stations P572, P572, P573 and P465 to invert for this mass of snow?
   2. Consider modelling the snow as two or three cylinders?
3. More realistic real world problem.
   1. Discretize the snow into a mesh?
   2. Bring in InSAR data.
   3. Full time series rather than just maximum extent?