

Observing the Northern Hemisphere snow mass with Sentinel-1



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Snow covers $\pm 20\%$ of the Northern Hemisphere

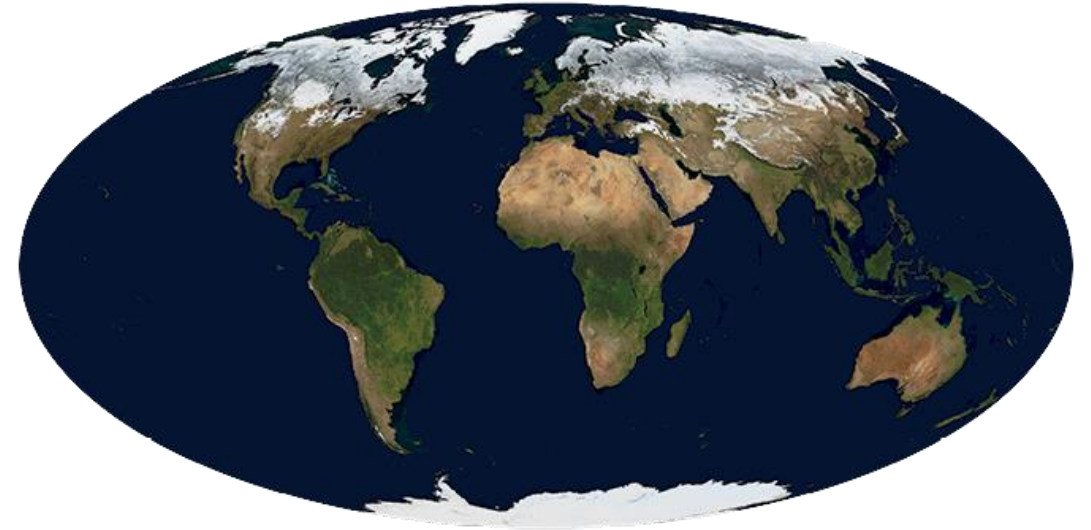
Global cooling effect

- Reflects $\pm 90\%$ of incoming solar radiation, vegetation only 10-20%
- Reduces ground heat exchange with the atmosphere

Critical water resource

- Drinking water for >1 billion people
- 75% of the agricultural water use in western US
- Hydropower generation, industry, ...

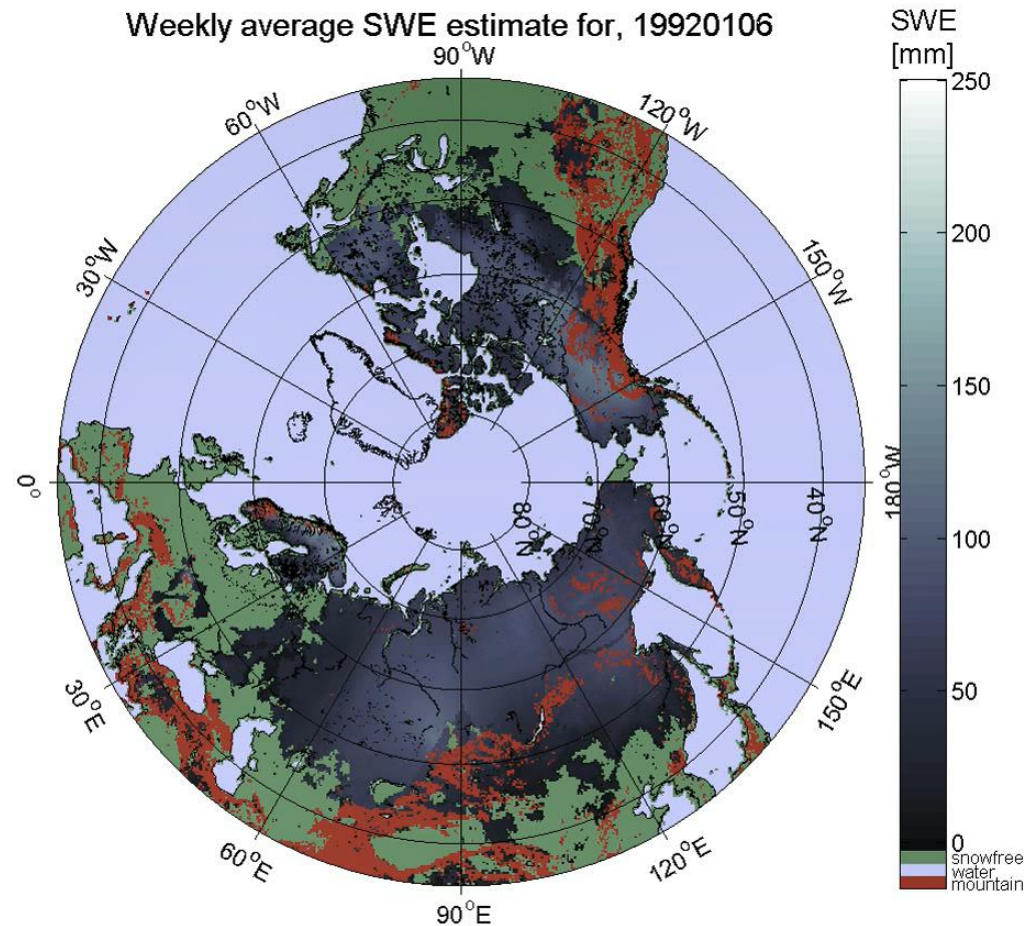
Flood and avalanche prediction, wildlife migration, tourism, ...

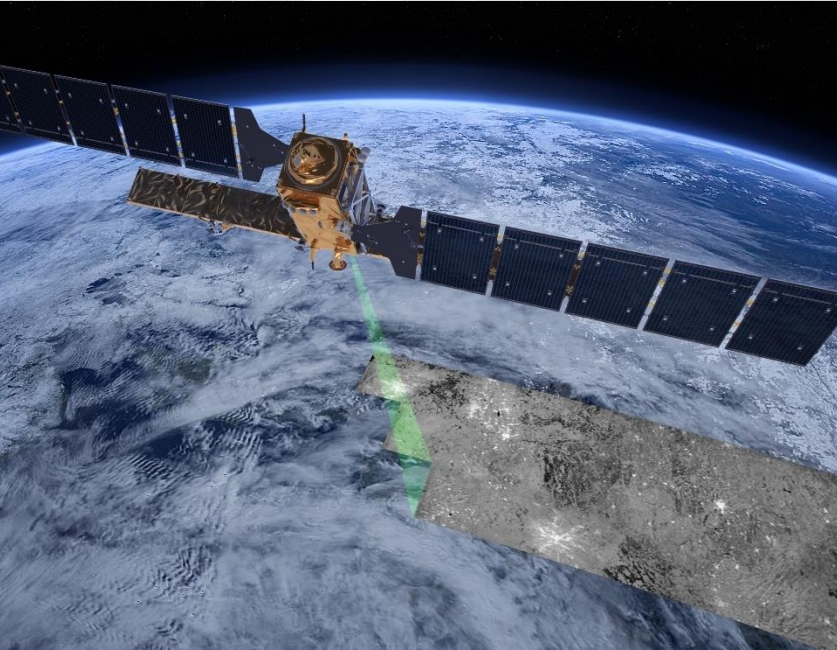


Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

We lack basic understanding of how much snow we have on Earth, particularly in mountain areas

- Measurements: sparse
- Models: poor snowfall
- Passive microwave: coarse
- Airborne observations: local





Sentinel-1

- Snow depth and snow water equivalent
- Northern Hemisphere mountain areas
- \pm weekly 1-km² resolution
- Target accuracy:
 - Error < 20% of the range
 - Spatial correlation > 0.7
 - Temporal correlation > 0.7



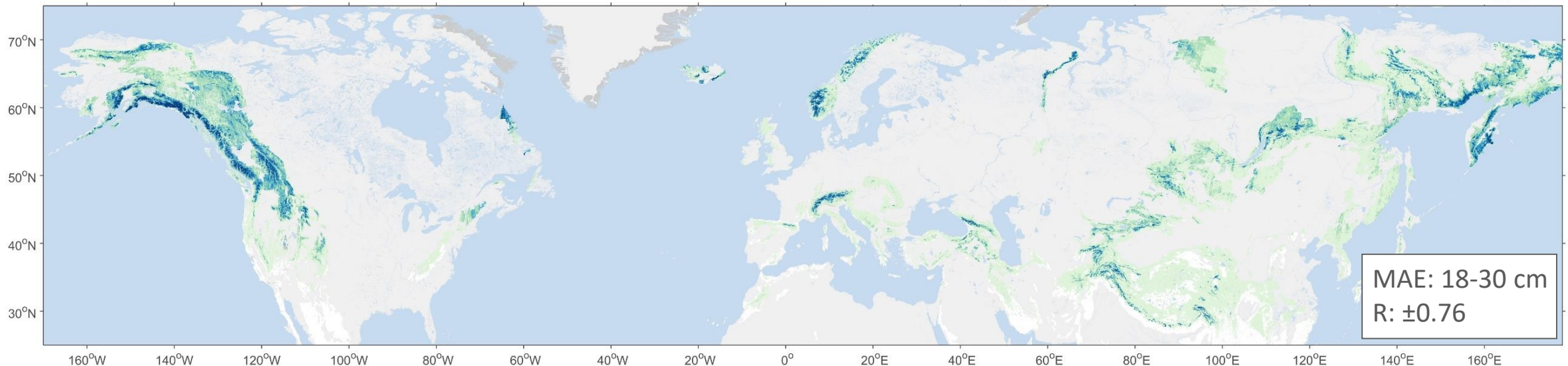
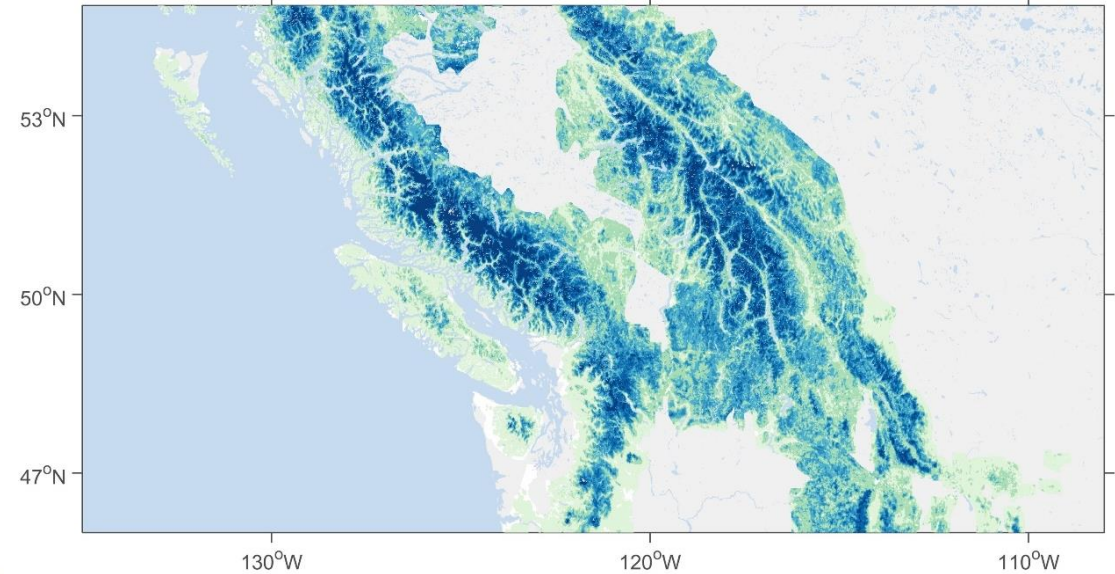
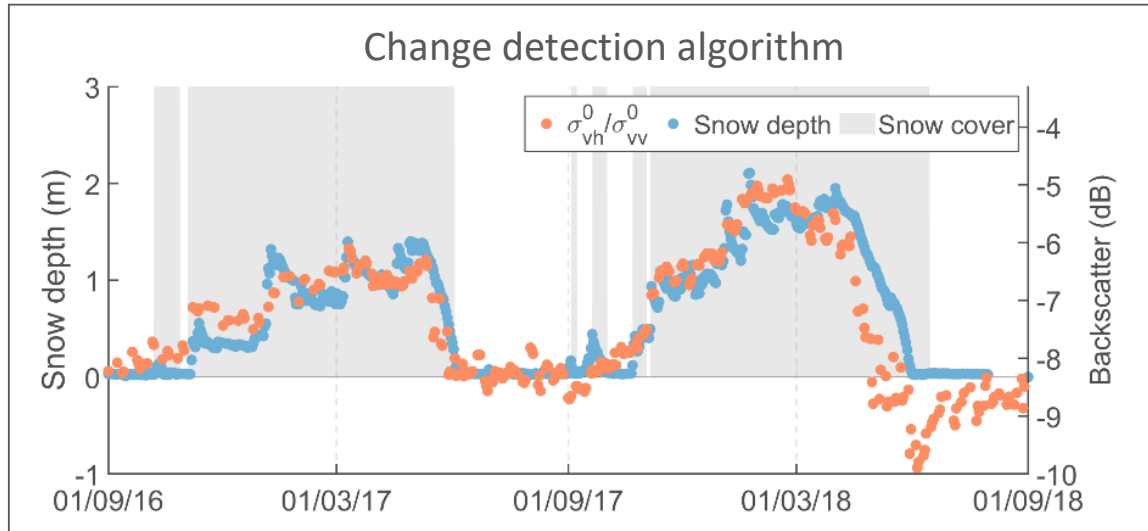
Snowmobile

- Radar measurements once per winter
- Larger-scale experiment
- Investigating spatial variability
- Bridging the scale-gap from tower to satellite



Tower

- 2 sites in Idaho, 1 in Colorado, USA
- Continuous C-band quad-pol radar
- Weekly snowpit measurements
- Understanding radar interactions with snow





- The 100 mountain ranges storing the largest volumes of snow - February 2018
- Sometimes large differences between estimates from Sentinel-1 and (scarce) local measurements
 - Coast Mountains: 100 km³ difference, but most measurements are at low elevation





Hans-Peter and C-band radar, Boise, Idaho



Preparing site 1, Banner Summit, Idaho



Installing radar at site 3, Fraser, Colorado



Snow temperature (above) and pit (below)





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