



The Varsom Regobs System: Enhancing Hazard Forecasting, Community Preparedness and Outdoor Activities through Crowd-Sourcing

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1. The Varsom Regobs system

Varsom Regobs (Registering of Observations) aids decision-making for the warning services at the Norwegian Water Resources and Energy Directorate (NVE). Additionally, the Varsom platform has users from organizations and the public. It fosters a participatory approach encompassing recreational activities, hazard assessments, emergency preparedness, search and rescue, and forecasting. Varsom Regobs is an innovative crowd-sourced system enabling registration, sharing, querying, and real-time storage and publication of field observations (Figure 1).



Figure 1. Varsom Regobs timeline. The system consists of a mobile app "Varsom" (available on App Store and Google Play), a website regobs.no (beta.regobs.no) and The Regobs API v.5.0 (<https://api.regobs.no/v5/>).

2. User engagement

The app has gained widespread recognition within the community, boasting over 600 000 unique visitors between Oct. 2023 and April 2024 (Number of observations in figure 2).

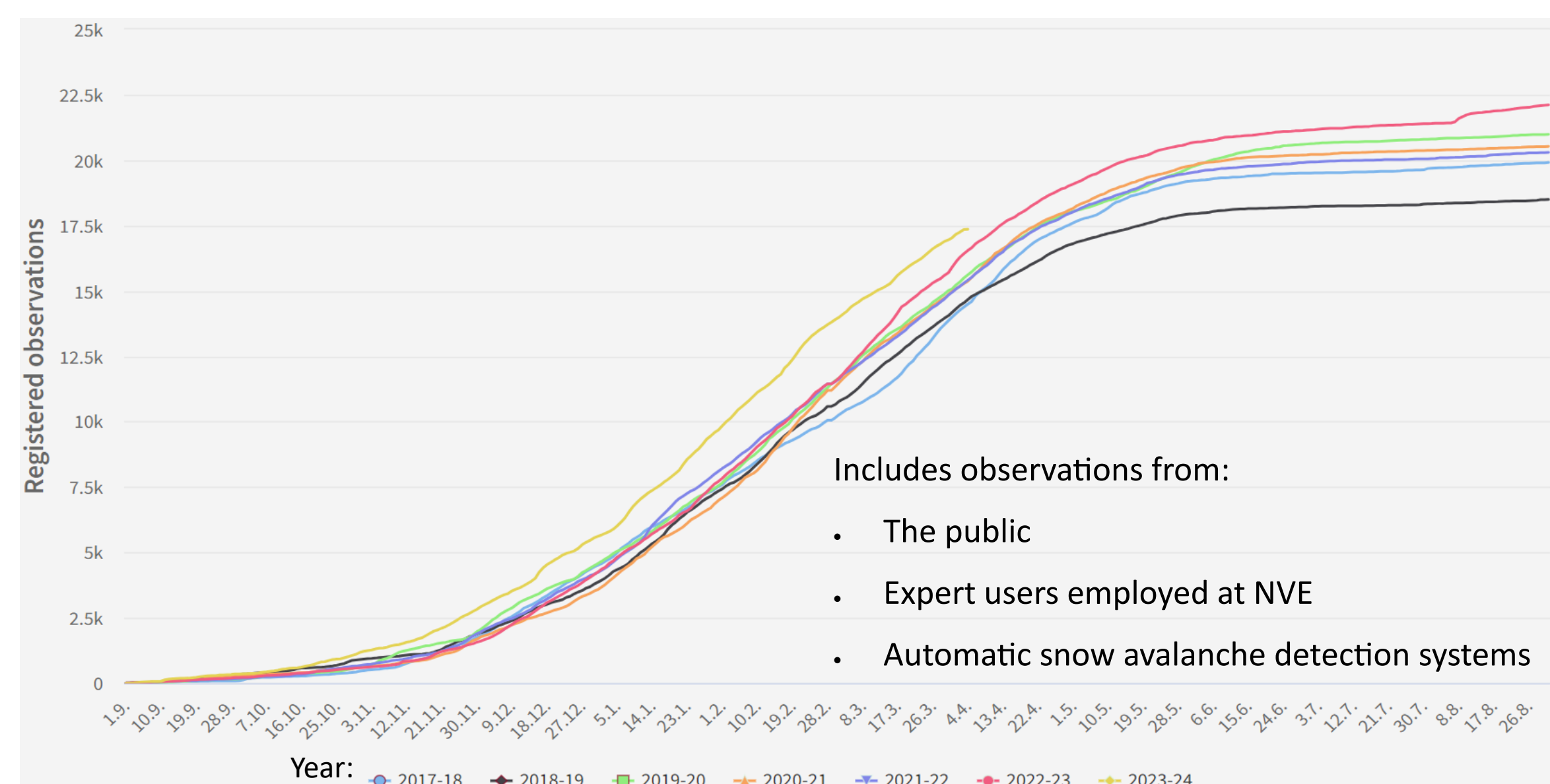


Figure 2. Number of registered observations from all categories ice, soil, water and snow for seven seasons since 2017.

Data in Varsom Regobs are regulated according to the Norwegian License for Open Government Data (NLOD), compatible with CC BY 4.0. Varsom Regobs feature global maps and support eight languages, making the tool available for international users.

Download the Varsom app on App Store/Google Play using QR-codes, or visit www.regobs.no.



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Algorithms for lake ice were developed by the Norwegian Computing Center (nr.no), and snow avalanche detection algorithms were developed by NORCE (norceresearch.no), both in collaboration with NVE (Kjetil Melvold and Karsten Müller).

3. Examples of successful aspects of use

A successful aspect of enhancing natural hazard monitoring has been the mutual engagement with users. They use the app to plan recreational activities with available supporting maps, regional warning levels and observations (Figure 3).

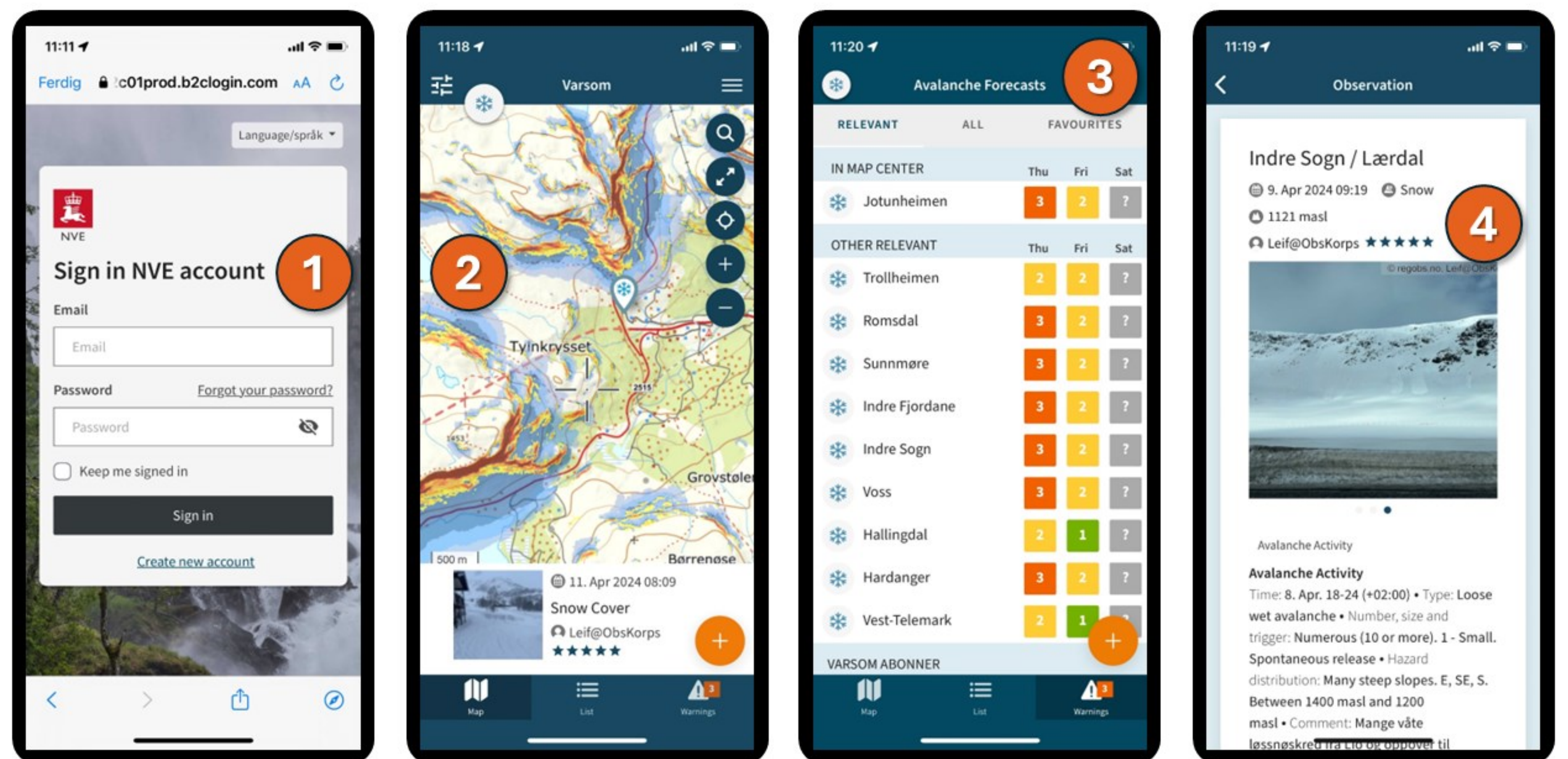


Figure 3. 1) Login NVE account, 2) Supporting maps for trip planning (Avalanche terrain, weak lake ice etc.), 3) Available regional warning levels from [Varsom.no](https://varsom.no), 4) Star based system.

To address trust issues regarding non-academic observers Varsom Regobs has a star-based quality system, aligning with an observer's training courses. The login on NVE account reduces the risk for spam-like entries (Figure 3). This is a challenge, and when this happens the forecasters warn the IT-team.

4. Utilizing in situ, model, and satellite data in warning services

NVE has a successful in situ component through the Varsom Regobs, and the outlook for the future is to further utilize this data together with satellite-derived products such as lake ice (Figure 4), snow avalanches (Figure 5), and other potential natural hazards like landslides and snow-related hazards such as floods.

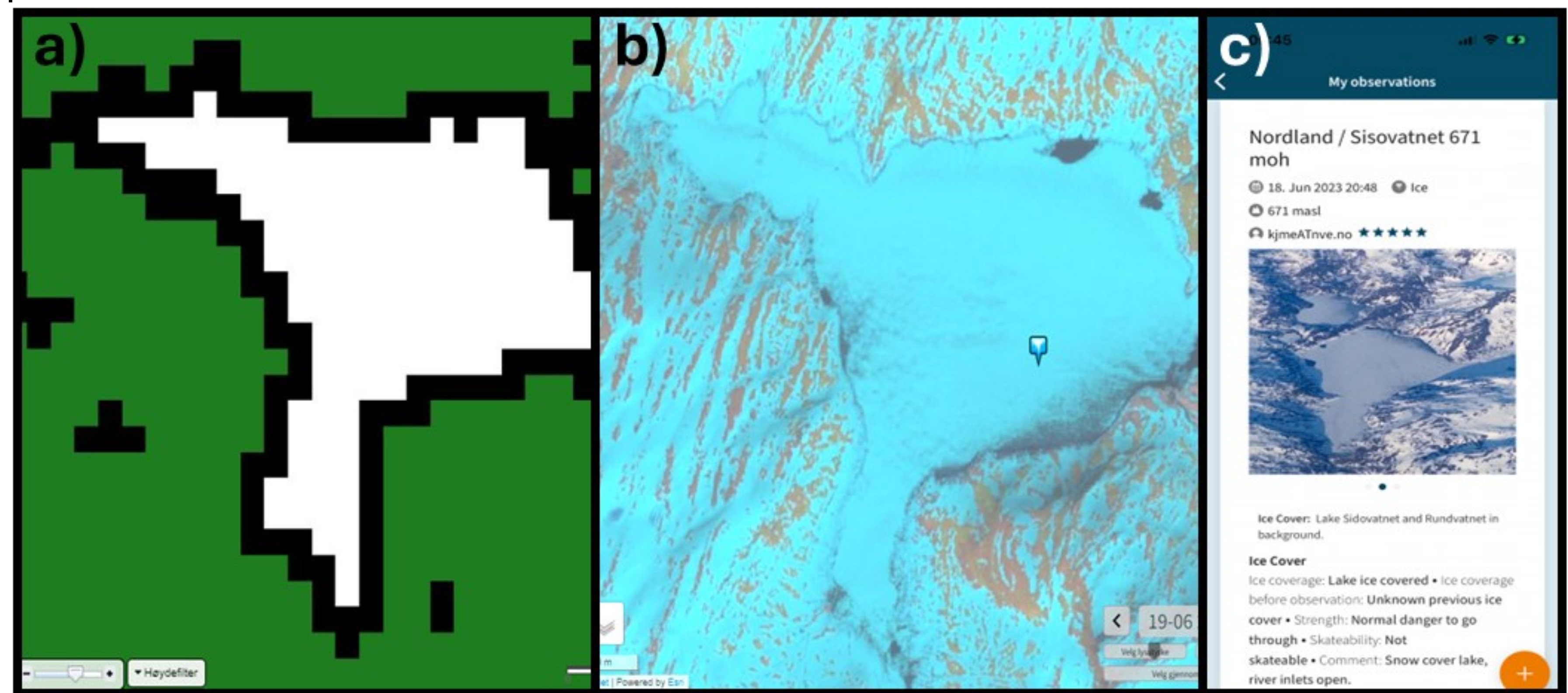
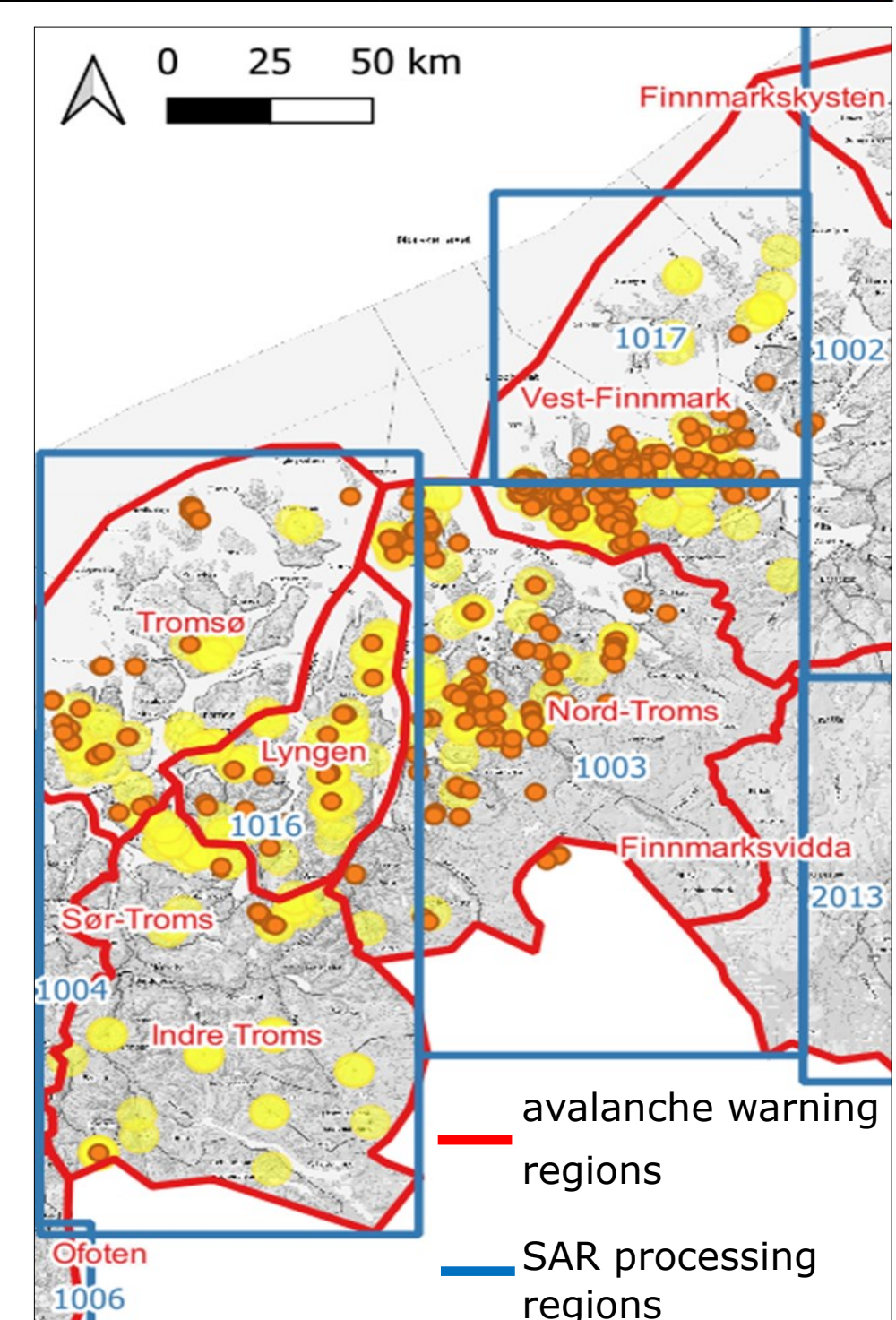


Figure 4. Lake Ice Warning Service take advantage of Copernicus data. a) A lake ice satellite derived product (Sentinel-3) from the lake Siosovatnet from the 18. June 2023, b) Copernicus Sentinel-2 false colour image from the 19. June 2023, c) In situ data obtained from the Varsom app from the 18. June 2023.

Figure 5: Satskred (satskred.nve.no) is an automated service detecting snow avalanches. It shows avalanches detected after a snowstorm in Northern Norway, April 2023. Yellow circles: 231 avalanches auto-detected by our algorithm using Copernicus Sentinel-1 data. Orange circles: 375 potential avalanches mapped by an expert in SAR images, validated with Varsom Regobs observations.



5. Conclusion

Varsom Regobs is a sustained citizen science initiative due to its integration into Norway's operational warning services, serving as an exemplary model for long-term engagement and collaboration. NVE will use Varsom Regobs observations more frequently for validation of NVE's operational services based on Copernicus satellite data in the future.