DETECTION OF SNOW POLLUTION IN THE CHILEAN ANDES USING DESIS HYPERSPECTRAL DATA

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The winter snow cover plays an important role worldwide, since both the incident radiation is reflected by the high albedo and (drinking) water is stored in it and is gradually released as it thaws. Snow impurities, such as black carbon, are introduced into the snow cover and lead to a reduction in the albedo. This results in earlier melting, and there can also be health issues associated with drinking water. Together with the Universidad Técnica Federico Santa María in Valparaíso (Chile), snow pollution is being investigated at two locations near the capital Santiago. Two observatories (NUNATAK-1 and 2) were set up in the area of the central Chilean Andes and both the atmosphere (aerosols) and the deposition of impurities in the snow were examined there. The NUNATAK-1 test station is located in Portillo (at Lake Laguna del Inca) on the busy road from Santiago de Chile to Mendoza (Argentina), so it serves as a "dirty" area in the experiment. NUNATAK-2 serves as the "clean" area and is located south-east of Santiago at the El Yeso reservoir (Figure 1).

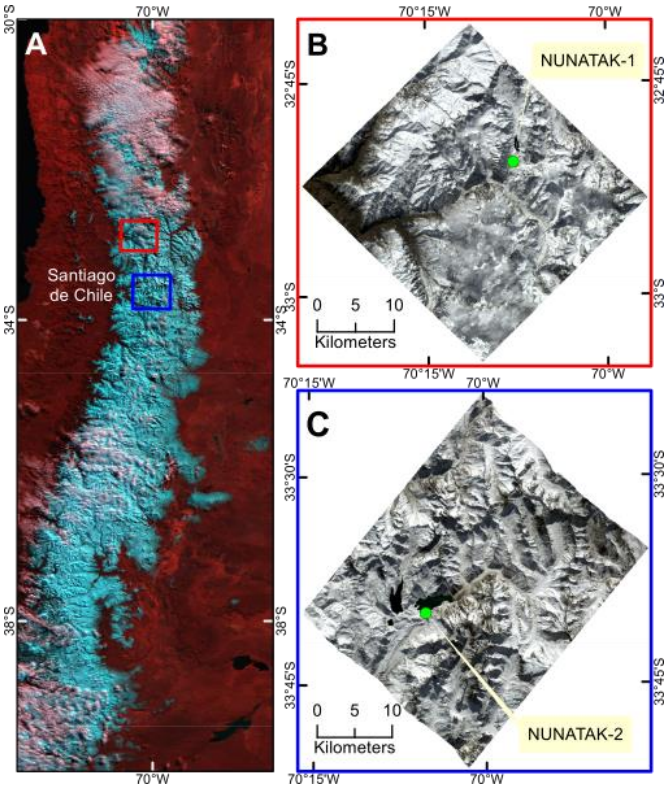

Figure 1: Location of the test sites (A: MODIS scene; B, C: DESIS scenes)

Central Chile is of interest because a so-called super drought has been occurring since 2010, accompanied by decreasing winter precipitation, massive retreat of glaciers, rising snow line and shortened duration of the snow season. Therefore, it is essential to get extensive information about the (avoidable) snow pollution in order to be able to take countermeasures. Due to the spectral properties of e.g. black carbon, it should be possible to detect them with hyperspectral remote sensing. In the austral winter of 2022, DESIS images were therefore requested from the beginning of July to the end of September to monitor the transition from winter to spring. We hoped for a stronger signal from the accumulation of contamination due to snowmelt. During this period, the direct test areas were covered by 5 DESIS scenes, the somewhat larger ROIs were covered by a total of 20 scenes. The data was downloaded and analyzed as a Level 2A product.

The optical properties of snow contamination show an exponentially increasing absorption with decreasing wavelength, of which black carbon has a smaller slope but proportionally the largest contribution to the signal attenuation. We therefore focus on this component. Increased pollution, however, leads to aging of the snow (increased grain size). These two components show up in the hyperspectral spectrum in the visible through a reduction in reflection due to black carbon, and in the near-infrared through a larger snow grain size. Using the Snow, Ice and Aerosol Radiative Model (SNICAR), a large number of possible spectra were simulated and used to classify the cut snow areas of the scenes. This is intended to test general suitability. The first results will be presented at the conference. The next step is to integrate the information collected on site.