Test

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Key Points:

- In-situ measurements of microphysical cloud properties with a holographic Imager
- Influence of in-situ cloud observations at mountain top stations by ground based ice enhancement processes
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Abstract

In-situ cloud observation at mountain top research station regularly measure an ice crystal concentration orders of magnitudes higher than expected from measurements or simulations of ice nuclei. The Source of these ice crytsals still remain an enigma. How atmospheric relevant are mountain top measurments? In this study we want to assess the influence of surface based ice enhancement process on in-situ coud observations at mountain top stations. Vertical profiles within a height of 10m above the surface were observed at the Sonnblick Observatory. Results suggest that such measurements a highly influenced by surface based processes. Decrease in concentrations of a factor of 2 a frequently observed within this height interval. During a short time period when the Sonnblick Observatory was not in cloud and the origin of the observed ice crystals was the surface a decrease from ccm just above the surface and ?? ccm at the was observed.

1 Introduction

2 Field Measurements at the Sonnblick Observatory

2.1 Site description

This field campaign was conducted at the Sonnblick Observatory (SBO) situated at the summit of Mt. Sonnblick at 3106 masl (12°57′E, 47°3′N) in the Hohen Tauern National Park in the Austrian Alps. The SBO is a meteorological observatory operated all year by the ZAMG (Central Institute for Meteorology and Geodynamics). On the East and South the SBO is surrounded by large glacier fields with a moderate slope, whereas on the Northeast a steep wall of approximately 800 m descends to the valley (Fig. 1, right). Part of the SBO is a 15 m high tower used for meteorological measurements by the ZAMG. The data presented in this paper was collected during a field campaign in February 2017.

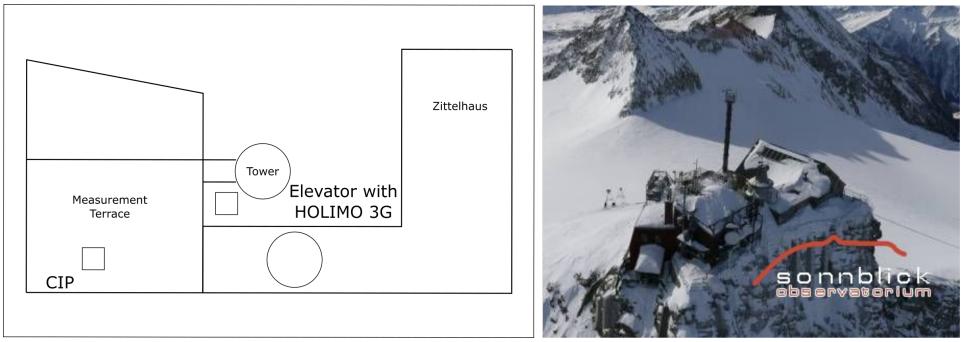

Figure 1. Short caption

2.2 Instrumentation

The microphysical properties of clouds, hydrometeors and resuspended particles from the surface were observed with the HoloGondel platform [*Beck et al.*, 2017] and the Cloud Imaging Probe (CIP) (CIP from Droplet Measurement Technologies; citation) of the Desert Research Institute, Colorado. The HoloGondel platform was mounted on an elevator that was attached to the meteorological tower of the SBO (see Fig. 2) to obtain vertical profiles with a maximum height of 12 m above the surface of the measurement platform of the SBO. Within this height the HoloGondel platform was repeatedly positioned at five locations as indicated in Figure 2. On the Elevator the HoloGondel platform had a distance of approximately 1.5 m and was oriented in a way that the holographic imager HOLIMO 3G, which is the main part of the HoloGondel platform, ... HOLIMO 3G cap-

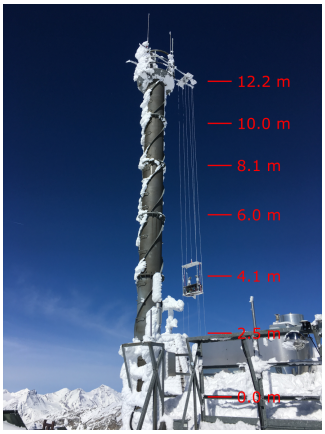

Figure 2. Short caption

tures the information of a three-dimensional volume of air containing cloud particles on a single image with a sample area of 20 mm x 13.4 mm. In this study the examined volume has a depth of 60 mm along the optical axis resulting in a sample volume of 16 cm^3. The open source software HoloSuite [*Fugal*, 2017] is used to reconstruct the in-focus images of the particles. Particles smaller than 25 µmm are classified as liquid droplets. Particles larger than larger than 25 µmm are separated in liquid droplets and ice crystals based on the shape of their 2D image. Similar to a study by *O. and J.* [2017] the ice crystals were further visually classified into three different groups: ... . Because the visual classification of several thousands of crystals is time consuming this subclassificaition of ice crystals was done only for the profiles on February 17th.

The CIP was located on the north facing side of the measurement terrace of the SBO (see Fig. 1, left). Because this location is in the wind shadow of the building of the SBO during south wind cases, the CIP data is only analysed for February 17th, when the wind direction was from North.

Meteorological data are available from the measurements by the ZAMG. At the top of the meteorological tower horizontal wind and temperature measurements are avaialbe. In Addition information about snow cover and precipitation. A ceilometer located in the valley north of the SBO information about the cloud. An additional 3D Sonic Anemometer, which is part of the HoloGondel platform was located at the top of the meteorological tower.

3 Results

The data presented was observed on 4 February and 17 February 2017. Figure (??) show an overview on the meteorological conditions on both days. The main difference is the wind direction, which was from south on February 4th and North on February 17th.

3.1 Evolution of

On February 4th a total of ... profiles were obtained between 0830 and 2200 UTC. The temperature was ... and wind was from ??. Data from the 3D Sonic Anenometer are not available, because the heating was not sufficient enough to prevent riming. Therefore, only one minute averages of wind speed and direction are available from the ZAMG measurements. Most of the profiles were obtained when the station was in cloud expect for

four profiles between ? and ? UTC. At this time the station was not in cloud, but a high cloud was present. Because south wind, no CIP data is available.

Figure ?? shows an overview on the HoloGondel data obtained on 4 February 2017. The data set is separated into four time intervals. Between

seperate day into four time intervalls

plots: meteo plot with indication of cloud profiles precip and snowcover one plot with all box plots on left and sample height profiles on right

morning: no blowing snow, "Low" wind speed, old snow cover noon: high influence, high wind speed, fresh snow afternoon: strong decrease with no cloud and low wind speeds night: decrease

interesting to look at: spectra, particle habit

3.2 February 17th

On February 17th only four profiles were obtained during the entire day. The SONIC 3D Anenometer on top of the tower was working. Because the wind was from the north also data from the CIP is available.

4 Discussion

5 Conclusion

Acronyms

SBO Sonnblick Observatory

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