Conference Volume | 5th Symposium for Research in Protected Areas | 10 to 12 June 2013, Mittersill | pages 721 - 724

Glaciological Monitoring, Venedigerkees, Hohe Tauern, Austria

Bernd Seiser[1], Andrea Fischer[1], Hans Wiesenegger[2]

[1] Institute for Interdisciplinary Mountain Research (IGF), Austrian Academy of Sciences, Innsbruck
[2] Hydrological Service (HD), Salzburg

Abstract

Glacier mass balance is a sensitive indicator of climate change. Changes in glacier mass result from ablation and accumulation and are directly related to prevailing atmospheric conditions. Since glacier mass balance also governs glacier runoff, it is a valuable parameter for glaciological modelling and has various climatological and hydrological applications.

The spatial and temporal storage of water as snow and ice has a significant impact on stream flow of Alpine head waters. Glacier mass balances are vital for gauging the extent of changes in ice firn and snow in different areas for different glaciers. In our case study we will carry out a direct mass balance, particularly a winter and a summer balance.Direct glacier mass balance monitoring is an opportunity to see and measure changes directly on the object of interest in a cautious manner in protected areas.

Keywords

Mass balance, glacier, monitoring, runoff, Venedigerkees

Introduction

Temporal glacier variations are among the clearest natural indicators of ongoing climate change (IPCC 2007).

A sound knowledge of the response of glaciers to climate change is of crucial importance for the assessment of water resources, sea level rise and natural hazards (Haeberli & Hoelzle 1995)

Climate change causes variations in temperature and snowfall, changing mass balance. Changes in mass balance control a glacier's long term behaviour.Since glacier mass balance also governs glacier runoff, it is a valuable parameter for glaciological modelling with various climatological and hydrological applications.

The mass balance could be determined by applying the direct glaciological or the geodetic method (Hoinkes 1970). To reach a general estimate of the past and current reactions of the cryosphere to climate change, both methods are necessary, but the direct method can lead to better understanding of glacier melt (Fischer 2011).
The purpose of this study, commissioned by the Hydrological Service Salzburg is to investigate how the Venedigerkeeswill react to climate change in future years.

Methods

We applied direct mass balance measurements to Venedigerkees. The direct mass balance is based on direct measurements in different areas on the glacier. The time frame for the measurements is the hydrological year, which runs from 1 October to 30September. In this time period ablation and accumulation were measured and will be continued annually.

Mass balance is measured by determining the amount of snow accumulated, and later measuring the amount of snow and ice removed by melting and sublimation. Mass balance is reported in water equivalent (SWE). This represents the average thickness gained (positive balance) or lost (negative balance) from the glacier during that particular year.

The mass change of the whole glacier area within a hydrological year is calculated by integrating point measurements. Ablation stakes are used to measure mass loss directly. We currently use 16 ablationstakes, which are drilled between 8 m and 10 m into the ice.

For mass gain several snow pits are used. These snow pits have to be in the same place every year and have to be characteristical for particular surroundings. The snow pits have to be as deep as last year's glacier surface was. The density of the measured snow weight lets us know the snow water equivalent (SWE) for each snowpit.

The results from these two kinds of measurements, plus additional probings, will be drawn as SWE value isolines in maps. Mass balance values derived from these maps are displayed in tables. The calculated difference of annual mass balance and winter mass balance is the summer balance.

S=Sc+Sa B=Bc+Ba

S= whole glacier area
Sc= accumulation area
Sa= ablation area

B= entire mass balance
Bc= entire mass balance in the accumulation area
Ba= entire mass balance in the ablation area

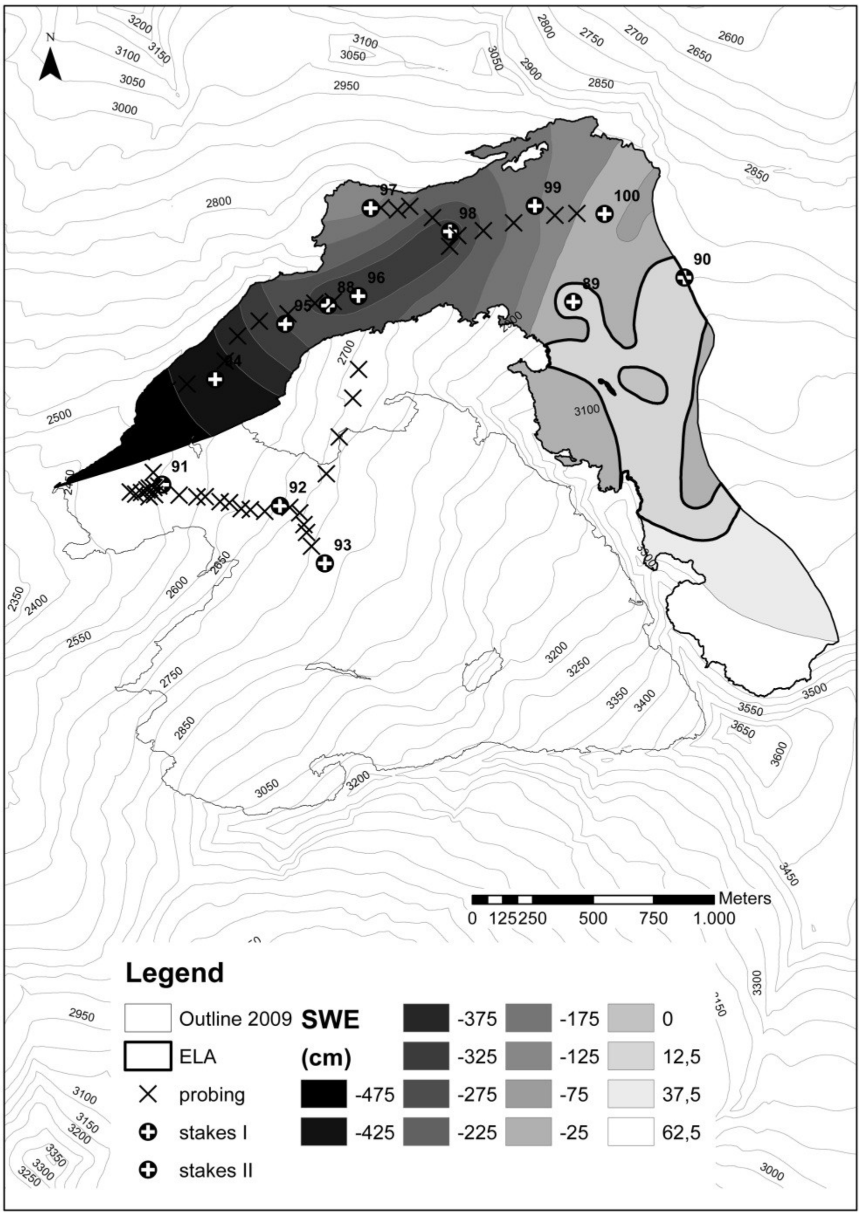

Figure 1: Mass balance Venedigerkees for the hydrological year 2011/12.

Study site

The Venedigerkees is located in the Venediger range in the core zone of Hohe Tauern National Park, Austria. The upper part of Venedigerkees is north-exposed while the lower part, and especially the tongue, is exposed to the south-west.

The area of Venedigerkees in 2009 was 2.17 km².

The elevation range of this typical valley glacier is from about 2480 m up to 3400 m, with Großvenediger the highest summit in the area at 3662 m.

Results

Winter mass balance

To arrive at the winter mass balance, the SWE is calculated from the depth and density of the snowpits. Snow heights from probing with mean density from all snow pits are also included.

$Bwi = 2861.9*10^3\ m^3$
$bwi = 1323\ mm$

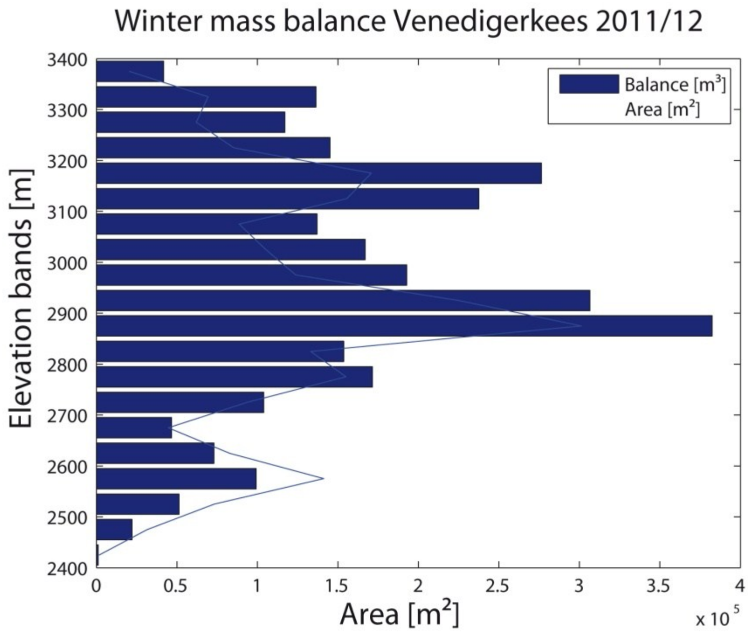

Figure 2: Netto mass balance [10^5 m3] and Area [10^5 m2] per altitutinal belt [mm ww] for winter 2011/12 on Venedigerkees.

<u>Annual mass balance</u>

The annual mass balance includes all mass loss and mass gain within one hydrological year. To calculate the SWE of the measured ablation, we assume a density of 900 kg/m³. Also mass gain is converted into SWE with the measured density from snow pits. The additional snow heights from probing are also included as SWE value with an average density of the snow pits.

B=-2847.7*10³
b=-1229 mm

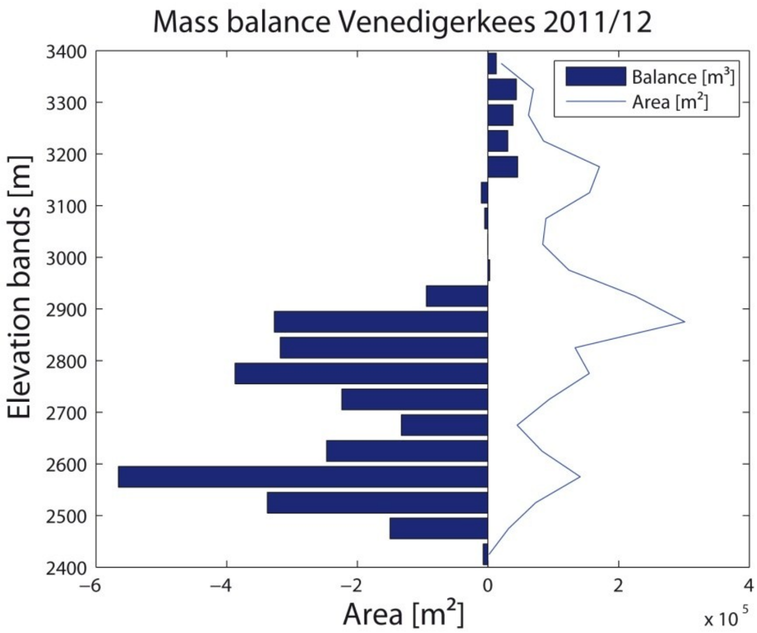

Figure 3: Netto mass balance [10^5 m³] and area [10^5 m²] per altitudinal belt [mm ww] for the hydrologic year 2011/12 on Venedigerkees.

Conclusion

The year 2011/12 was the first monitoring year for Venedigerkees, this year the mass balance was negative with a value of -1229 mm SWE. It is important to get long data series to learn how this glacier reactsto meteorological changes and to get an idea of the trend for the mass balances.

For many hydrological departments, sound knowledge about stored water in the catchment and changesin this storage are necessary for planning current and future water supply.

References

FISCHER, A. 2011. Comparison of direct and geodetic mass balances on a multi-annual time scale The Cryosphere, 5, 107–124.

HAEBERLI, W. & M. HOELZLE 1995. Application of inventory data for estimating characteristics of and regional climate-change effects on mountain glaciers: a pilot study with the European Alps. *Ann. Glaciol.*, 21, 206–212.

HOINKES, H. 1970. Methoden und Möglichkeiten von Massenhaushaltsstudien auf Gletschern, Zeitschrift für Gletscherkunde und Glazialgeologie, 6, 37–90.

IPCC 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III for the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC: Geneva, Switzerland, 104 pp. ISBN: 92-9169-122-4.

Contact

Bernd Seiser
Bernd.Seiser@oeaw.ac.at

Institut für interdisziplinäre Gebirgsforschung
Forschungsstelle der Österreichischen Akademie der Wissenschaften
Technikerstraße 21a
6020 Innsbruck
Austria