



Global Observation Research Initiative in Alpine Environments

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The purpose of GLORIA

The purpose of GLORIA is to establish and maintain a world-wide long-term observation network in alpine environments. Vegetation and temperature data collected at the GLORIA sites will be used for discerning trends in species diversity and temperature. The data will be used to assess and predict losses in biodiversity and other threats to these fragile alpine ecosystems which are under accelerating climate change pressures. The basic approach is aligned to alpine summit areas (Multi-Summit Approach). Within each GLORIA target region (a mountain area with consistent climate) four summit observation sites of different elevation represent an altitudinal gradient (Fig. 1).

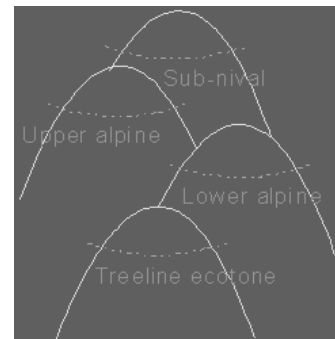


Fig. 1. GLORIA target region

The focus on summit areas

The summit observation site includes the area from the highest summit point downwards to the 10-m contour line. There are several good arguments to use such summit habitats as reference sites. First, they are well defined topographical units which can provide comparable conditions by comprising all exposures (north, east, south, west) within a small area. Thus, the summit area does not only include the very wind-exposed habitats, but also leeward and intermediate habitats. Short gradients from windward to leeward sides as well as, at least in mid and higher latitudes, gradients from northerly to southerly habitats include narrow transition zones between vegetation types. This may enable a rapid recognition of climate-induced shifts of boundaries. Secondly, on summits shading effects from neighbouring land features are minimised. It is difficult to find such comparable sites on any other topographical positions, where diurnal and seasonal variation in insolation much depends on the slope aspect and on neighbouring features. Further, summits may act as climate warming traps for cold-adapted species with weak competitive abilities due to the absence of escape routes. Finally, summits are prominent landmarks which can easily be relocated for reinvestigations.

The design and the sampling method

The sampling design is aligned along the main geographic directions around the summit and consists of permanent plot on different scales at the 0.1x0.1m, 1x1m, 10x10m and the entire summit area (Fig. 2). In each main direction a 3m x 3m plot cluster is to be established, with four 1 m² permanent quadrats in the corner positions. The detailed species cover sampling within the quadrats provides the baseline for detecting changes in species composition. Frequency counts within the same quadrats, carried out by using a grid frame divided into 100 dm²-cells, are used to detect changes in vegetation patterns. A 10x10m square in each cardinal direction that includes the 3x3m cluster is established for line-pointing with 400 points.

Eight summit area sections cover the entire summit site and are used for the detection of species immigration.

Continuous measurements of the soil temperature in 10 cm below surface in the centre of each 3m x 3m cluster are conducted to compare temperature and snow regimes. A detailed description of the design and recording methods is given in the GLORIA field

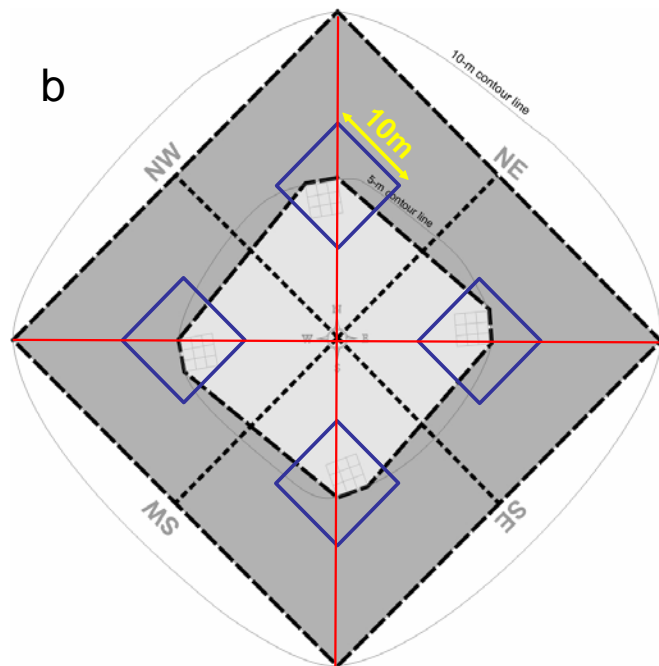
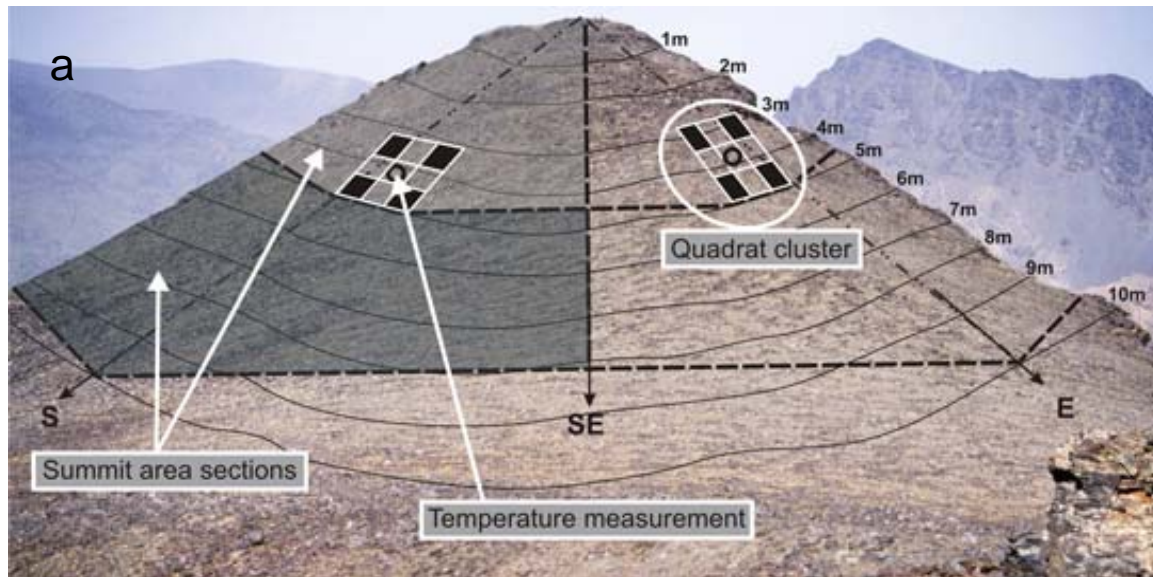


Fig. 2. The summit design;
a: side view with 3x3m clusters and summit area sections;
b: top view showing the 10x10m squares for point recording along lines.

manual (www.gloria.ac.at).

Implementation of the network

Active GLORIA target regions (Nov. 2008)

Europe	N-America	S-America	Asia	Australasia	Africa
30	14	8	6	3	0

Europe

The first main implementation step of GLORIA was reached through a European Union FP-5 project (GLORIA-Europe) with the setup of 70 summit sites in 18 target regions across Europe in 2001. Since, the European network has grown to active 30 regions. The additional sites were funded by local or national grants. A method testing campaign in 2007 and the first resurvey of the 2001-sites carried out in 2008 was mainly financed by the Swiss MAVA Foundation for Nature Conservation. The Austrian GLORIA master site Schrankogel/Tyrol and the central GLORIA co-ordination is mainly funded by national institutions.

North America

The first sites were setup in Montana (Glacier National Park) and California in 2003 and 2004. Currently 14 sites (target regions) are active in the USA including Alaska and Canada. All funding came from N-American sources. More sites are planned for 2009. GLORIA Master sites are operating in California (White Mountains) and Montana.

South America

GLORIA experienced a rapid growth in the Andes, where first sites in two target regions were setup with support from UNESCO MAB in 2005. Now 8 target regions are active and further 11 are planned for 2008/2009. Funding and support came from various sources such as Proyecto Paramo Andino/CONDESAN, Herbario Nacional de Bolivia, Conservation Internacional and the EU FP-6 project ALARM. More recently, support came from the Comunidad Andina de Naciones (CAN). The second inter-Andean GLORIA workshop will be held in Ecuador in November-December 2008.

Asia

Compared to the vast high mountain regions on the continent, GLORIA is still underrepresented. Among the first target regions were Altai (Katunskiy Biosphere Reserve; UNESCO MAB; 2005) and 3 regions in Hengduan Shan, Yunnan (Missouri Botanical Garden, The Nature Conservancy and Zhongdian Botanical Garden; 2005-2006). This year sites were setup in Alborz, Iran (Alborz) and Taiwan (Taiwanese Ministry of Forestry). A Japanese team has concrete plans for 2009. About some ongoing GLORIA activities in the Himalaya region will be reported at the conference.

Australasia

Sites in New Zealand and in the Snowy Mountains, Australia already were setup in 2004.

Africa

Sites not yet established, but several expressions of interest exist.