Introduction

Climate change is expected to raise average global temperatures with at least 2 degrees by 2050. However, this change in mean temperature will not be exactly the same everywhere. In some places actually cooling might occur, while at other places increases by more than two degrees are expected. Also, changes in average temperature do not reflect changes in minimum and maximum temperatures. This is especially true in extreme environments such as near tree lines (Figure 1 & 2). Global warming is expected to cause tree lines to shift to higher altitudes and latitudes. This could have important effects on alpine biodiversity because ecosystems above the tree line are often endemic and diverse. A higher position of tree lines will mean in many cases a smaller extent for areas with alpine vegetation as well as increased fragmentation of these areas.

Detecting changes in tree lines

To analyse the effects of climate on tree lines, data over long time spans are needed. Often this comes from existing field studies that were initially performed for other reasons. Analysing these studies in the light of climate change (so called meta studies) is therefore tricky because they are often based on a sampling design that is not well balanced. There is a high bias towards Europe and North America (Figure 3).

Use of historical satellite imagery

The increased availability of remote sensing imagery at relatively high spatial resolution could offer a solution to this. Sources such as Google Earth (Figure 4 A) provide information on vegetation cover at relatively high spatial resolution but coarse spectral resolution. As the spectral contrast between trees and alpine vegetation in generally high, high spatial resolution is preferred over high spectral resolution. The release of formerly restricted datasets such as from Corona spy satellites (Figure 4 B) by the USA opens up the possibility to analyse tree line positions with remote sensing over relatively long periods (several decades). Given the global coverage of this database (Figure 5), a systematic analyses of treeline positions and their dynamics (advancing or retreating) can now performed, without a bias in sampling.