Interactive comment on "Avalanche risk in backcountry terrain based on usage frequency and accident data" *by* F. Techel et al.

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We greatly appreciate the valuable feedback of the two reviewers which address important issues on how to improve our article.

The reviewers agree that the research questions are of interest to the scientific (and mountaineering) community. However, they also point out several short-comings in the general structure, presentation and clarity of the paper. The reviewers suggest improving the sections on what data was used how and why, and to clearly explain when and how the different statistical methods were applied. Further, they recommend a clearer structure in the results and discussion section for a better understanding. - These points will be improved in the revised version of the paper.

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Following, we discuss in more detail some of the main points addressed by the reviewers.

Using user-generated web content as a data source
The reviewers question the scientific value of the user-generated web content, and due to this reviewer 2 considers this data not suitable for a scientific paper, but rather to be published in a more practically-oriented magazine like *Bergundsteigen*.

In this point, we disagree with the reviewers. Following, we will highlight why we consider that a scientific investigation of this data is important and warrants scientific publication, and why it should not only be published in a popular magazine like *Bergundsteigen* (which we recently did: Techel and Winkler, 2015) but should also be presented in a scientific way.

Most avalanche risk studies are limited by the fact that the exposure of the elements at risk (in our case the number of backcountry users) is unknown. Studies counting backcountry users so far, are either limited to a small region (Zweifel and Wäger, 2008; study area Davos/Sitzerland), or to a specific backcountry user group (Grimsdottir and McClung, 2006; heli-skiing in Canada), or in a larger region but on (a) single day(s) (Brugger et al., 2010; Procter et al. 2013; study area: Südtirol/Italy).

The analysis of the user-generated content (UGC), in this case the volunteered geographic information (VGI), of these two web-portals provides for a first time the chance to gain a comprehensive picture when and where users recreate in the Swiss backcountry and thus to assess the relative risk in certain weather, avalanche and snowpack conditions. However, we agree with the reviewers, that a careful scientific approach is required analyzing this kind of data, dealing with uncertainties and addressing limitations of using VGI as a data-source. We propose to considerably improve this part of our analysis.

We will use primarily two parameters of the UGC data: date of the tour and geographical location (summit coordinates). Volunteered geographic information, although not from these web-platforms, has been analyzed in numerous scientific papers

showing possibilities and weaknesses of such data (e.g. in Goodchild and Li, 2012; Grossenbacher, 2014). In public avalanche forecasting, UGC data-sources are used to complement field observations from "traditional" observational networks, as for instance in Colorado/USA [Diegel and Tremper, 2012; Tremper and Diegel, 2014] or in the European Alps where the Swiss and some of the Austrian avalanche warning services regularly check condition reports posted on bergportal.ch and camptocamp.org. We propose reanalyzing the UGC data addressing uncertainties by testing for and presenting possible biases of sub-groups of users. Based on these results, we will construct a statistically more robust data-set. In the reanalysis, we will focus primarily on the exploration of the spatiotemporal data (location and date) of the backcountry tour. Thus, we follow the recommendation of reviewer 2 and investigate other parameters (like route difficulty) in a more descriptive manner to describe the UGC data sources and refrain from a more in-depth analysis.

We are glad reviewer 2 shares our opinion that the results are important to communicate to the mountaineering community. Reviewer 2 will hopefully also agree with us, that it is important to show how we analyzed the data, and that a magazine like *Bergundsteigen* is not the appropriate medium to do so, since the majority of readers of this journal are practically-orientated mountaineers and not interested in specifications of scientific approaches.

Avalanche accidents
In the paper, we used 10 years of accidents and compared these with 5 years of usage. As accident numbers are relatively small, we used a longer time-period to have a larger data-set per region and thus reduce the influence of noise in the data. However, we agree with reviewer 1 and will reanalyze the data using the same 5-year time-period for accidents and activity. Additionally, we will present the geographical distribution of accidents for a longer time-period.

Snowpack
To describe the regional snowpack structure, we derived one index value per region based on all observations during the five-year period. Reviewer 1 questions this approach. To describe snowpack structure patterns in a very general way, this approach may be valid. However, for the reanalysis, we now also consider it as being insufficiently correct. Thus, we will re-analyze this data and use bi-monthly values per region for the subsequent analysis instead.

Definitions, Terminology
Some terms – for instance risk – were not or insufficiently defined. We will include these definitions in the revised paper.

Differences between title and paper content
We will change the title to show that the paper focuses on analyzing risk factors rather than absolute risk.

Following the recommendations and the above-mentioned improvements, we believe that the resulting paper will be more focused, easier to understand and clearer in the way how we investigated the data.

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