

# ***Interactive comment on “Glacier shrinkage in the Alps continues unabated as revealed by a new glacier inventory from Sentinel-2” by Frank Paul et al.***

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The article “Glacier shrinkage in the Alps continues unabated as revealed by a new glacier inventory from Sentinel-2” presents a new compilation of glacier boundaries for the European Alps. The improved resolution of Sentinel data allows a more accurate delineation of glacier boundaries as the Landsat based inventory of 2003. The new inventory is based on remote sensing data acquired during 2 years only, and was based on past national inventories, corrected for inconsistencies at the national borders. Extensive error assessments ensure high data quality, even in shaded and debris covered areas. The data and methods presented are new, and the data will be used for lot of

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different applications, for example hydrological modelling. Methods and materials are described in sufficient detail. Reference and citation to other data sets are correct and appropriate. A minor side remark concern the climate data cited, see details below (1) with a suggestion to add a data reference. The article is supporting the data set and contains also valuable information on accuracy and limitations. The data set is under review at Pangaea.de, which is the normal process at this platform, I am confident that the data will be available once the ESSD paper is published. I consider the examples given in the Figures sufficient to judge general data quality. I cannot check the completeness of the data, but the total area given seems to support the idea that all glaciers have been mapped. Data processing and format is state of the art. I consider the data to be of highest quality. Regarding the problem of inclusion of small glaciers and the comparison to the 2003 data, I suggest some rephrasing to better distinguish between real area changes and mapping artefacts (2), which is described somehow misleading in the current version (but understandable though knowing the problem, confusing for researcher being data users only). The data set is useful in the current format and size, with appropriate metadata. Length and structure of the article is appropriate, wording is clear. Figures and Tables have high quality and show relevant items. Finally, I understand the data set by reading the article, and will potentially use and recommend it. How well do the respective data sets presented by an article and the article itself meet the following criteria (rated 1–4, excellent–poor): Significance 1 The data is useful fulfilling the criteria of - Uniqueness: Much effort has been taken to compile a unique data set of glacier boundaries in the European Alps. Mapping methods have been improved substantially in contrast to earlier data sets. - Usefulness: The data so far available for the glacier boundaries in European Alps have been either spatially very detailed but temporally inhomogeneous or spatially coarse with an accurate time stamp. In addition to that, inconsistencies at national borders have not been corrected so far at a larger scale. The new Alpine inventory is an excellent basis for all types of glaciological, hydrological and climatological studies and will be used quite frequently.

- Completeness: The data set is the completest inventory of European Alps possible

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and available. Data quality 1 As the data described in the article has been compared to our LiDAR based data set of the same area in cooperation with our staff, I can confirm the data quality although the full data set can not be downloaded right now from Pangaea. Presentation quality 1 The article is very clear and concise and describes strength as well as weaknesses of the data set.

Detailed comments: (1) line 114: The Histalp instrumental data (Auer et al., 2007) confirms the Alpine ridge as a climate trend divide in terms of precipitation. This is not necessarily a contradiction to the results of Casty et al., as the resolution and accuracy of the data set is very different. For completeness, I would recommend to cite both articles, as the HISTALP result can be used as valid hypothesis for explaining different mass balance responses North and South of the main Alpine ridge conformed by respective mass balance monitoring.

Line 416: I can confirm that small glaciers are found at all elevations, but I can not confirm that this means that they are independent of climatic parameters. Abermann et al found that the altitudinal distribution of glaciers depends on precipitation rates also, thus the distribution alone without having a look on the type of snow accumulation and radiative setting must fail. I recommend to add a deeper discussion on climate sensitivity of small glaciers or just skip that very shortened remark. This would also resolve the contradiction to lines 428 ff. (2) lines 466 and 480 I presume that the 125 very small glaciers do not really increase their size as a result of the mapping procedure as written here. I recommend to rephrase like that: The area mapped for 125 glaciers increased by XXX %, but in reality we expect that these glaciers shrunk. Also for the Suldenferner in line 470 it is not clear if the authors consider the mapping to create reliable numbers or artefacts which they want to discuss here. If the paragraph intends to warn people on working with the inventory analyzing very small samples or single glaciers, this is not entirely clear. Also the remark on the larger (compared to 2003??) glaciers 2015/16 as result of seasonal snow included leaves open if the authors consider this as an artefact or a glacier advance. In the last sentence, it is not

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entirely clear what is meant by ‘real’ area loss: The area loss corrected for mapping artefacts? Maybe it would be easier to understand if we read here that the authors think that their estimate of area loss is rather a lower threshold considering mapping uncertainties tend to diminish the area change?

Line 561: Missing debris cover in 2003: Have the glaciers been free of debris in 2003, or were debris covered areas not mapped in 2003?

References: Abermann, J., Kuhn, M., Fischer, A., Climatic controls of glacier distribution and glacier changes in Austria. *Annals of Glaciology*, 52(59), 83-90, (2011).

Auer I, Böhm R, Jurkovic A, Lipa W, Orlik A, Potzmann R, Schöner W, Ungersböck M, Matulla C, Briffa K, Jones PD, Efthymiadis D, Brunetti M, Nanni T, Maugeri M, Mercalli L, Mestre O, Moisselin J-M, Begert M, Müller-Westermeier G, Kveton V, Bochnicek O, Stastny P, Lapin M, Szalai S, Szentimrey T, Cegnar T, Dolinar M, Gajic-Capka M, Zaninovic K, Majstorovic Z, Nieplova E, 2007. HISTALP – Historical instrumental climatological surface time series of the greater Alpine region 1760-2003. *International Journal of Climatology* 27: 17-46

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