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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Creating long term gridded fields of reference evapotranspiration in Alpine terrain based on a re-calibrated Hargreaves method" *by* K. Haslinger and A. Bartsch

Anonymous Referee #2

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General comments: This study is interesting since not too many data and knowledge exists about evapotranspiration in Alpine environments. The authors worked hard and made a good job to generate new results from few available data. However, I do not see sufficient novelty and innovative potential in the analysis in order that it should be published in an international, highly ranked journal. The main drawbacks of this study are: (a) There already exist evapotranspiration maps for Austria and other countries in the European Alps, some of them including greater detail than the study presented here (b) Applications of the Hargreaves method and its adjustment with respect to accepted, physically based methods already exist (c) The physical background of the presented

methodology does not exist or is questionable

Questions and comments to item (a): Why was a new mapping of evapotranspiration necessary for Austria? Why didn't the authors compare their results with data from existing studies? There are evapotranspiration maps available for Austria: - Hydrological Atlas of Austria: Plate 3.2 (Mean annual potential evapotranspiration) and Plate 3.3 (Mean annual areal actual evapotranspiration using water balance data) Besides, there is an evaporation map for Switzerland which is based on the Penman-Monteith equation (reference period 1973-1992): - Hydrological Atlas of Switzerland: Plate 4.1 (Mean annual actual evaporation)

It is strongly recommended to analyse and to explain existing agreements or differences with the Austrian and possibly the Swiss map (e.g., different elevation gradients, mean annual data of evapotranspiration for different elevation zones etc.). Based on these analyses the authors should explain why a new product was necessary for Austria. What is the real novelty and in which fields was new knowledge generated with regard to the existing products? Why was a modified version of the Hargreaves equation applied when products exist which are based on more accepted methods?

Comments to items (b) and (c): The authors apply the simple Hargreaves method (HM) with a standard correction factor C (0.0023) to 42 stations in Austria. They compare the performance of the HM method with the modified Penman-Monteith method (PM) to express the reference evapotranspiration ET0. Then, "in order to achieve a meaningful representation of ET0 by HM" (page 5061, line 25) they adjust the calibration parameter Cadj to optimize the agreement between HM-derived ET0 estimates with those calculated with PM. The authors apply a simple method which was developed earlier, thus this step is not new. The results show that Cadj at individual stations varies over the time. Finally, the monthly Cadj parameters are first linearly interpolated to daily data which are then interpolated on a daily 1x1 km grid over Austria. The interpolation from 42 stations to the individual grid cells is carried out through monthly fitting of a third-order polynomial curve against altitude (the monthly shapes of the curves greatly

differ). Result is a gridded dataset of Cadj for every day of a year. In a final step, ET0 is computed for the individual grid cells by use of the HM method and the Cadj values. All the steps described above lack conceptual clarity, the procedure just consists of a number of optimization steps which introduce fuzziness regarding any physical meaning. Therefore, any physically-based explanation regarding the temporal and spatial variation (including altitude dependencies) of Cadj or the HM-derived ET0 estimates is not given. Hence, analysis given in section 4 (results) remains obscure. Moreover, time series analysis with respect to climate change impacts on evapotranspiration seems not trustworthy and should be avoided.

As ET0 refers to the evapotranspiration from a well-watered grass cover neglecting the impact of soil properties how would you rate the applicability of this concept to high alpine areas? What is the meaningfulness of the ET0 concept for such conditions? Is ET0 a realistic approach for e.g. dwarf shrub communities on shallow initial soils, bare rock or snow/ice cover? Don't you think that ET0 overestimates evapotranspiration for such conditions?

Specific comments:

The article requires English language editing. There occur quite a number of spelling and grammatical errors and there are ways to say things more clearly or using fewer words. Some sections, including the abstract, read complicated

Confusing notations: In the first sections of their article, the authors term the reference evaporation as ET0. In section 3.1 they term the ET0 following the (modified) PM method as E (equation 1) which they also define as reference evapotranspiration. Then, in the same section they apply the terms ET0_p for the reference evapotranspiration based on the (modified) PM equation and ET0_h for the ET0 derived from the original HM equation. In section 3.2 (equation 3) EH is "the original ET0 from HM" and EP "is the ET0 from PM" (page 5062, lines 3/4). This change in terminology is really confusing

There are several repetitions in the text regarding the statement that the modified PM method is seen as the reference (see e.g., page 5058, line 6 or page 5061, line 6)

Repetitions of ET0 definition: There are at least two definitions of ET0, and they seem quite different which confuses the reader. See for example page 5057, lines 6/7 and page 5059, lines 21/22

Page 5060: line 2 says that the PM method requires global radiation. In equation (1) however and on line 6 net radiation is mentioned as necessary input

Regarding the formulation of the PM equation on page 5060 please mention that this is a modified version of PM, with the original form (to calculate actual evapotranspiration) including a resistance network

Page 5060, lines 11/12: It is simply not practicable / physically allowable to set the soil heat flux to zero on a daily time step! Please see standard textbooks on micrometeorology about the radiation balance. Or would you set the change in daily soil water storage to zero as well?

Page 5060: please explain how you calculated Ra for the Austrian stations / the individual grid cells from extra-terrestrial radiation and give an example (in water equivalent). Don't you think that this involves high uncertainty in the whole calculation process?

Why are there separate Discussion and Conclusion sections? In the Discussion, any critical analysis is missing, while the Conclusion is just another summary of the work.

Figure 5: They grey shaded area as well as the black line in Fig. 5a seems to be identical with the ones in Fig. 3b. Please avoid redundancy

Page 5057, line 10: why "also recommended by FAO"?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 5055, 2015.