The Cryosphere Discussions

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Comment on tc-2022-64

Roger Braithwaite (Referee)

Referee comment on "Estimating degree-day factors based on energy flux components" by Muhammad Fraz Ismail et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2022-64-RC1, 2022

SUBSTANTIVE COMMENTS.

Izmail and others (submitted) is an interesting article and is very timely as many of us are concerned about the increased melting of snow and ice and its effects on streamflow. The basic premises and ambitions of the study are well presented in the ABSTRACT and in the INTRODUCTION.

The basic idea is to explain the empirical degreeâ□□day approach in terms of energy fluxes. This was done by Braithwaite (1995a) and the present paper does something similar but with a broader array of methods and models.

Modern workers have access to detailed measurements from sophisticated monitoring systems and should use them where they can. Workers modelling historic data may have to use obsolete variables such as maximum and minimum temperatures and sunshine duration if these were measured with simple instruments. Izmail and others (submitted) address both communities.

Izmail and others (submitted) discuss the basic formulation of degreeâ□□day sums on lines 150-159. They are correct that several methods have been used in the past, but the common method of equating daily degree-day sum to the daily mean temperature if positive (or greater than the reference temperature if not 0 ° C) is open to the criticism that there may be melt in part of the day even with daily mean temperature below zero (Arnold and McKay, 1964). Workers should calculate their degree-day sums from a sum of positive temperatures throughout the whole day if they have a modern datalogger. Braithwaite and Hughes (2022) suggest a new way of calculating degree-days if you only have maximum and minimum temperatures. This takes account of the daily temperature

range, which can be quite large at lower latitudes, e.g., the Himalaya, and may cause degree-day factors to vary with latitude, as mentioned in line 146.

Izmail and others (submitted) is exceptional well-referenced, but I would like them to cite a 'senior' degree-day publication by Zinng (1951) that has stood the test of time.

USE OF ENGLISH AND RERENCING

Izmail and others (submitted) is well written, but I wish they would use active verbs more often, and they do overuse 'however'. The text may be about 25% too long and they should remove padding and re-arrange text, so any issue is only addressed once. The reference list is accurate except for leaving out names of journals in some places, which may be an artefact of citing on-line journals.

DETAILED POINTS

Line 24: define BIAS and RMSE the first time they occur.

Lines 25-26: Better to say 'cloud cover and snow albedo under clear sky'

Lines 30-32: Good point!

Line 36: 'main' is better than 'unique'

Line 41: 'more' is better than 'most'.

Line 52: add citation to Braithwaite (1995a) here

Line 88: According to Braithwaite (1995a) degree-day factors depend on mean temperatures

Lines 105-115: Good!

Table 1. Some variables should be defined in caption or in a foot note

Figure 2: Is ‘Wolfgang Bogacki, 2016’ reference to a publication?

Line 147: ‘following’ is better than ‘along’

Lines 151-159: I already mentioned this

Lines 168-169: They should not have done this! From my own thinking about the data used by Braithwaite (1995a) I am quite sure that degree-day factors are only valid for periods of many days, e.g., 10-20 days when you might expect a combination of different weather conditions and when day-to-day measurement errors may compensate.

Line 180: much better to say ‘largest’ and not ‘most important’ as this has caused lots of problems in the literature since about 1952.

Line 192: ‘although’ is better than ‘however’. This occurs in a few places.

Line 196: ‘rigorous’ is better than ‘rigid’ and ‘but’ is better than ‘however’

Line 200: ‘Day of the year’ is a modern muddle as 1 January is day 1 in the usual counting. This means that 12:00 on 1 January is day=1.5, which is obviously wrong! Sorry!

Line 209: Should ‘attenuation’ be ‘reflection’?

Line 215-218. The Prescott equation is useful for historic data but not needed for modern instruments

Line 226: ‘when’ is better than ‘that’

Lines 233-239: Very comprehensive!

Line 319: Better is ‘the sensible heat component depends mainly on high wind speed and temperature’ because it uses an active verb

Line 321: better ‘is smaller on average than…’. The point is that sensible heat flux is generally smaller than the radiation components in most snowmelt situations, but sensible heat fluxes changes by a greater amount if you change temperature by 1 °C.

Lines 352-353. Latent heat flux is generally a heat source to the ice/snow surface in South Greenland and a heat sink in North Greenland. This is explained by variations in vapour pressure and temperature.

Line 374: do you mean ‘… such events are rare…’?

Lines 392-394: Is this a small limitation?

Line 415: I was confused by the start of a new chapter here. You probably mean ‘Results from Brunnenkopfhütte’. This brings me to a small concern. I accept this paper is much more than a data report from a single location, and I applaud this, but it is difficult to keep track of what material relates to which. Location. Please consider restructuring, e.g., you could discuss ALL results from Brunnenkopfhütte either before or after discussion of the more general modelling.

Line 419: You should base your degree-day sum on hourly data (if positive) from your nice AWS in Fig. 2. See Braithwaite and Hughes (2022).

Line 430: That confusing ‘most important’ again.

Chapters 4 and 5: I am confused by all the examples given. Could you not define a few ‘typical’ cases and give energy flux values for each case? In general, I think both chapters would benefit from some smoothing. This is something you can do more easily 1-2 months after you have written the original text.

Lines 557-361: I think this is correct, but you could phrase it better!

Lie 563: I know what RMSE means but what is BIAS? You should define all acronyms first time you use them.

Figure 8: I like it. Braithwaite (1995a) should have done this for all the months in his study rather than just comparing grand-means of measured and simulate degree-day factors. I am thinking about a new paper on my old data and I will certainly make a figure like this.

Chapter 5. I like this. Braithwaite)1995b) looked in detail at the effect of stability on sensible heat flux model used by Braithwaite (1995a). The sensible (and latent heat) fluxes depend the density of air at the altitude in question so the degree-day factor should depend on altitude, and on latitude as lower latitude glaciers occur at greater altitude. There should be a greater latitude effect on degree-day factors than we have discovered so far. If not, why not?

Lines 612-617: Interesting!

Line 630-633. Walter Ambach is the master of albedo under overcast conditions. In Braithwaite (1995a) this is one factor that reduces the time-variability of the net radiation flux.

Line 654: this should be ‘breaking in’.

Line 665-19. I think you well explain here the importance of rain on snow.

Section 5.6. Ingenious!

Section 5.7: Although Braithwaite (1995a) clearly showed the change of degree-day factor with changing energy balances, he assumed constant degree-day factors for climate change projections in his later papers. (I am not going to give references here as you already have too many!)

Acknowledgements

Was there no funding? No good advice from somebody?

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