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The Cryosphere Discussions

Interactive comment on "Glacier annual balance measurement, prediction, forecasting and climate correlations, North Cascades, Washington 1984–2006" *by* M. S. Pelto

Anonymous Referee #2

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general comments

The paper describes a fairly accurate qualitative method for predicting glacier annual balance from October-April average of large-scale circulation indices PDO and ENSO. It does not clearly describe their quantitative utility, which is quite low. It mistakes the ENSO phase of El Nino as being positive.

The paper constitutes publication of annual balance values over 1984–2006 for eight glaciers and over 1990-2006 for two others. The numerous errors and inconsistencies in the paper, as shown below, however, call into question the reliability of the mass balance values presented.

Analytical methods are very weak. Equation (1) is not the correct way to determine the joint effect of two independent variables. Moreover, the data (Table 2) are eminently suitable for principal components analysis.

specific comments (correlated to the manuscript by: page-line)

It is not apparent from the paper what distinction the author is making in the title between prediction and forecasting, which are nearly exact synonyms.

18-10 The statement concerning 42 of 47 years needs to be explained here because the abstract mentions only 23 years, 1984-2006.

18-23 It is not clear what has limited utility.

19-22 Because the scope of the paper is 1984-2006, a more recent South Cascade Glacier report should be cited, namely Bidlake, et al. (2007) USGS Scientific Investigations Report 2007–5055

20-11 Annual balance is not defined as change between successive mass minima. If NCGCP uses the fixed date method, that is annual balance and correctly is denoted by subscript a.

On p. 7 of Mayo et al. (1972) subscript a denotes balance between fixed dates and subscript n denotes balance between dates of minimum mass. On p. 8 of that paper these are termed, respectively, annual balance and net balance.

21-6 The sentence implies that NCGCP finds net balance and USGS annual balance, whereas the opposite is true.

22-17 It should be clarified that winter temperature is meant, not summer temperature, and how much of effect is shift of winter precipitation from snow to rain and how much is winter melting.

22-23 Multiple linear regression should be used to obtain dependence on two independent variables, not the way Equation (1) is formed.

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23-8 Bitz and Battisti (1999) found r = -0.65 between November-April PDO and South Cascade Glacier net balance (see their Table 6), which gives 42 percent variance explained.

23-10 Sources of the PDO and ENSO data should be stated and if it was downloaded from an online site, also the date that it was.

25 Summary can be condensed: if Rule 2 holds, balance is non-negative (successful in 13 of 15 cases, 87 percent); if it does not hold, balance is non-positive (successful in 29 of 32 cases, 91 percent). The actual number of cases in each category and success rates are subject to revision, pending resolution of error in Table 4 detailed below regarding p 31.

25 Quantitative results should be given in addition to qualitative statements of the summary; that is, the two linear regressions of balance versus PDO and balance versus ENSO, as well as the multiple linear regression of balance versus PDO and ENSO. Scatter diagram Fig 8 suggests these regressions will explain very little of the variance in the balances.

31 It needs to be explained why NCGCP values were not used for 1984- 1986; moreover, the 1986 value for South Cascade Glacier was -0.61, not -0.71. Most of the balance values for 1987-2005 are incorrect; those for 1993-2002 are exactly those for South Cascade Glacier, not the combined values, and others are not consistent with values in Table 2. For 1987, for instance, Table 4 has –2.56 whereas the average of the values in Table 2 is –0.77; for 1988 they are –1.64 versus –0.10

38 Caption of Fig 7 should be revised regarding the range of years; it says 22 years 1984–2005 but 23 points are shown. Instead of citing equations on Figs 5 and 6, it should cite Equation (1), which should be revised as comment 22, 23 explains.

technical corrections

18-3 Subscript a needed on b, here and throughout the paper.

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20-3 Presumably >100 meant is meant.

21-12 The sentence should end “...the high correlation (Table 3)."

21-16 Variation from year to year is meant, not trend from year to year.

21-20 Least negative ba would be clearer than highest ba.

25 Rule 6 succeeds in 3 of 3 years.

26-2 Statement "error climbs appreciably" is unclear.

29 Headnote should say “Annual balance of the 10 North Cascade... and net balance for South Cascade...". It is net balance (not annual net balance) that is reported for South Cascade Glacier. The 1998 value for South Cascade Glacier was –1.86, not –1.60. It should be stated that South Cascade Glacier balances are in water equivalent meters, and the units for the other glaciers should also be stated.

29 Table 2 would be improved with an additional row showing multi-year mean values and an additional column showing multi-glacier means.

31 Headnote of Table 4 should say –0.2 to 0.2 for equilibrium and should cite section 5 instead of section 6. By the –0.2, 0.2 rule 1962 should be classified as e, not p.

31 Balance values for South Cascade Glacier are published to two decimal places, and should not have trailing zeros deleted in Table 4.

31 Because South Cascade Glacier values are net balance and NCGCP values are annual balances, perhaps the column headings should be labeled just b, not bn.

31 Balance value for 1962, 1984 and 1991 should be classified as e instead of p, and 1986 as n instead of e. ENSOW for 1997 should be classified as e instead of n.

32 Glacier codes should be deleted from Fig. 1 caption because their names are spelled out in the figure.

36 Caption of Fig 5 should indicate which years are represented. There are 21 points

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shown but Table 2 has 23 years. The dependent variable should be explicitly identified; is it the mean of the ten glaciers?

37 Caption of Fig 6 needs same attention as that of Fig 5.

39 Caption of Fig 8 needs same attention as that of Fig 5. It also should state the season over which the indices apply. The statement “...forecasting which demands less precision" needs to be explained.

There are many ungrammatical constructions, several involving the comma splice (also called a run-on sentence):

19-18 Change “still exist, two have disappeared" to “still exist. Two have disappeared"

20-6 Change “or avalanching, thus changes" to “or avalanching. Thus, changes"

21-24 Change "character substantially, neither glacier" to "character substantially. Neither glacier"

22-2 Temperature and precipitation are variables, not parameters.

22-7 “For accumulation season precipitation annual balance ..." is apparently garbled.

26-2 Change “SNOTEL stations, for individual" to “SNOTEL stations. For individual"

26-9 Change “indices values" to either “indices" or “index values"

Interactive comment on The Cryosphere Discuss., 1, 17, 2007.