The Cryosphere Discuss., 8, C1783–C1786, 2014
www.the-cryosphere-discuss.net/8/C1783/2014/

The Cryosphere
Discussions
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Interactive comment on "Changes in the timing and duration of the near-surface soil freeze/thaw status from 1956 to 2006 across China" *by* T. Zhang et al.

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Received and published: 10 September 2014

GENERAL COMMENTS

This paper examines the soil temperature data collected at numerous stations in China for the long-term trend of the first day and last day of soil frost, and the duration and number of soil frost days. A number of previous studies have reported the decreasing trend of soil frost in various parts of the world. This study is a useful exercise that adds another piece of evidence to the growing body of literature substantiating the common notion that the rising air temperature results in fewer days of soil frost. However, I feel that the paper in its present form does not contribute significant new knowledge to the scientific understanding of interaction between environmental changes and soil freeze-thaw status. That is partly because the paper is somewhat vague in the tech-

nical definition of frozen/unfrozen status of soil, as well as the statistical treatment of data set. The paper can be strengthened significantly by more creative and rigorous analysis of data and their discussions. Please see my comments below for specific suggestions.

SPECIFIC COMMENTS

1. P3788-3790. This section contains a large volume of texts reviewing previous literature on similar studies. I feel that the literature review is too long, and also much of the material on remote sensing is not directly relevant to this paper. On the other hand, it is fairly thin on the current understanding of the physical processes that control how the environmental changes (e.g. air temperature, precipitation, landuse, urbanization, etc.) affect soil freezing and thawing. I suggest that the introduction be re-written to sharpen the focus of the paper. I also suggest that the scientific question, hypothesis, or objective of the study be clearly stated in the introduction.

2. P3790, L5. How were these stations selected? Did all of these stations register soil temperature below freezing point? Is it meaningful to include the stations from warm regions (e.g. southeastern China) in the analysis?

3. P3790, L6. How is "near-surface" defined? Please present a precise definition.

4. P3790, L11. Did all stations have continuous hourly temperature data? If not, how was the daily minimum temperature determined? This needs to be explained carefully. Note that Henry (2008) used the data sets that had only two measurements per day.

5. P3790, L12. How was the temperature of ground surface (0 cm) measured? It is not trivial to measure the surface temperature. Accurate measurements would require an infrared thermometer. Was the same method used to measure soil temperature at all stations? What is the accuracy of measurements? This is a very important point, and should be discussed thoroughly in the paper.

6. P3790, L23. The temporal trend analysis concerning environmental changes, such

as this paper, requires rigorous statistical treatment of the data, if it is to be published in a peer-reviewed journal. The authors need to explain the statistical methods carefully and justify the assumptions used in the analysis. Why is a linear regression method used? Does the statistical distribution of data set justify the use of linear regression?

7. P3791, L14. How was this number (300 days) selected? If the missing days occur more frequently during winter than in summer, it will bias the statistics. How was this issue addressed?

8. P3791, L20-21. It took me a while to understand what is shown in Fig. 2a. Please remind the reader that you are showing the anomalies in this graph, both in the figure caption and in the texts.

9. P3791, L21. How is the range (+/- 0.03) defined?

10. P3791, L23. How is the coefficient of multiple determination defined?

11. P3791, L26. How is the p value defined? Do the data meet the assumptions for the calculation of p value (e.g. normal distribution)?

12. P3792, L1-2. A "major" increase in the early 1970's is not visible in Fig. 2a. The data seem to be more or less steady until after 1990.

13. P3792, L6. This sentence contradicts with the statement in L1-2 (see above).

14. P3792, L19-20. Is this statistically significant?

15. P3792, L26. How is "west China" defined?

16. P3792, L28. What does "dramatically" exactly mean?

17. P3794, L6. "NF varied significantly". This needs to be explained a bit more carefully, as there was a period with very little change, followed by a period of visible change. What is the statistical significance of NF during the two periods?

18. P3794, L11-12. Please indicate Qinghai-Tibet Plateau and Yangtze River on a

map.

19. P3794, L15-16. The issue of urbanization needs to be investigated much more carefully. Is the urbanization restricted to the lower reaches of the Yangtze? I imagine urbanization has been occurring in other parts of China. How many of the monitoring stations are located in rural areas? Should the analysis be conducted separately for urban and rural stations?

20. P3794, L16. Another related issue is the relocation of stations and changes in measurement methods and depth. If any station has been affected by relocation or other changes, it should be excluded from the data analysis. Also, did all stations have continuous data from 1956 to 2006 (P3790, L5)? If new stations have been added over time, how does it affect the statistical analysis? Can there be a bias in the regional distribution of new stations? These are very important issues, which should be discussed thoroughly.

21. Figure 1. This map appears to show the stations that are not likely affected by soil frost at all. For the purpose of this paper, it will be better to include only those stations that are subjected to soil freeze-thaw. Also, this map shows Taiwan and southern islands that are not relevant to this paper at all. They should be removed.

22. Figure 2. In the caption for (a), what are "composite variation" and "low-pass filter"? Please explain these in the texts. What are the units of the values shown in these figures? Please indicate. This map appears to have a smaller number of data points than in Figure 1. Why?

23. The paper presents the data in the form of anomalies, but the reader is given no information on the actual number of frost days, etc. It will be useful to include a map or histograms showing the distribution of duration of frost, or number of frost days.

Interactive comment on The Cryosphere Discuss., 8, 3785, 2014.