Authors' Response to Referee Comment #1

General Comments:

Overall, this seems like a very useful paper for anyone interested in the controls on plant phenology. It also provides some very interesting ideas for future research. I particularly like the notes about how the control over green-up can switch between temperature and water from year to year, since it gives good insight into how plants respond to various combinations of factors. The organization of the paper is also very clear and logical. One area that I believe needs improvement, however, is that some of the reasoning for the authors' decisions about which indices work better than others could be explained in more detail (see specific comments).

Thank the Referee very much for the comments, we sincerely appreciate the insightful suggestions and detailed technical corrections. Here we give some explanation corresponding to the specific comments.

Specific Comments:

Comment #1: There are many statements on page 11649 (such as "thermal and water conditions have been of most concern" and "it has been common to accumulate the indicator variables over a certain, fixed time span": : :) that do not include citations. This is not necessarily a problem, but it might be good to include some examples and/or sources to back up these claims.

Response: *Yes, we agree with the Referee, and include references in the revised version, i.e., "thermal and water conditions have been of most concern to large scale vegetation phenology researchers (Yu et al., 2003; Jolly and Running., 2004)." and " it has been common to accumulate the indicator variables over a certain, fixed time span (Yu et al., 2003) ".*

Comment #2: On page 11654, lines 4-7, I don't quite understand why stations 6-9 were excluded from the study. Was it because of the unusually high aridity index (as suggested by the use of the word "therefore") or because of their unusual life cycle (as suggested by the end of the last sentence)?

Response: *HAI is an index describing the water availability of the station, the higher the drier. If the HAI is quite high, drought will be likely to happen, and the grass may not green up. In stations with high HAI, green-up onset date usually could not be detected by the logistic function in dry years, so these stations are excluded in this study.*

Comment #3: In page 11655, you say that the most important factor other than the thermal condition is the water condition (line 9). What is your evidence for this?

Response: *Thermal and water conditions are usually of most concern in the recent regional phenology study (Yu et al., 2003; Jolly and Running, 2004). In fact, the grass green-up are actually influenced by many factors including water, thermal, radiation,*

nutrition, and oxygen. For the large scale study, the factors like radiation, nutrition and oxygen do not fluctuate too much from year to year, or at least they don't fluctuate as much as water/thermal condition in the arid/semi-arid area. Therefore, besides thermal condition, water condition could be a more important factor when discussing the control of factors on grass green-up in arid/semi-arid area.

Comment #4: The reasoning in the first paragraph of page 11656 is not clear. Why is it important that the PSO and GUD values have very little overlap? Isn't it just important that they be correlated, not that they actually match? The second paragraph of the same page could also use more explanation. You seem to imply that the coefficient of determination value of 0.52 shows that SMSO is superior to PSO in predicting GUD in general. I think that what you really mean, however, is that SMSO is superior to PSO for capturing the variation of GUD with respect to HAI. If I am correct, then you might be able to clear this up simply by changing the last sentence (line 23) to say ": : : capturing observed GUD variations with respect to aridity".

Response: *Let us suppose that the PSO line is totally above the GUD line with good correlation, in this situation we may say PSO captures the green-up onset date variation very good, but all the PSO happen later than the GUD, which means that precipitation is always a limiting factor for grass green up for all the years. This is not true according to our analysis in Figure 9 (see Section 3.2). When we check the line of SMSO, we could see that when SMSO is above the GUD line, the corresponding TSO is usually under it, i.e., SMSO and TSO are on the different sides of the GUD line, this reflects the of dominant factor between water and thermal conditions from year to year attributing to the varied climate condition. So PSO may be not a good index as it could not capture the shifting of dominant factors, although its correlation with GUD is good.*
Your understanding about the second paragraph is quite correct, we accept your suggestion in the revised manuscript.

Comment #5: How is "best regression" (p. 11657, line 9) defined? Do you mean the regression with the highest correlation coefficient?

Response: *Yes, you are right. In the revised version we replaced the "the best regression" by " the regression with highest regression coefficient ".*

Comment #6: Do you have any ideas about why all three indices give such a good fit at station 20? That seems worth looking into.

Response: *We checked the data and climatic characteristics of station #20, but we could not give any interesting discovery to explain this result well so far. It might happen to have such 'excellent' behavior.*

Reference

[1] Jolly, W.M., and Running, S.W.: Effects of precipitation and soil water potential on drought

deciduous phenology in the Kalahari. Global Change Biol., 10(3): 303-308, 2004.

[2] Yu, F., Price, K.P., Ellis, J., and Shi, P.: Response of seasonal vegetation development to climatic variations in eastern central Asia. Remote Sens. Environ., 87(1): 42-54, 2003.