Revision Suggestions:

* I think this paper could do a better job at providing context to the study system, being more descriptive about how/when/how much precipitation falls, etc.
  + We added a discussion of the precipitation and temperature patterns at the study site to the introduction. We also produced a new figure showing precipitation patterns over the different seasons to give context to the study (Figure 1).
* the study misses an opportunity to compare FFD in the more recent period of data collection (2012-2020) to the earlier period of data collection

(1942-1961)

* + if FFD is significantly earlier in the more recent period compared to the earlier period. If you pair that with changes to temperature and changes to 3 snowpack/snow totals, you could see whether a shift to earlier flowering over 50 years is more closely tied to rising temperatures or changes in snowpack (or both).
    - The suggestion of using these data as an opportunity to examine shifting flowering date associated with climate change is a good one. So we have explicitly added a before and after comparison of both flowering time by species and environmental variables by calculating averages for the first sampling period and the second sampling period. Our approach was to include a further discussion of how these two sets of variables have both changed between periods as a launching point for examining the covariation of FFD and both temperature and precipitation variables. We now include a table with averages for the different sampling periods and measurements of shift to emphasize that indeed flowering is earlier for many but not all species in the recent sampling period. We have also referenced a more thorough comparison done for FFD done by our lab where the results were essentially the same (Dunnell and Travers, ?). Correspondingly we show there were also shifts in both temperature and precipitation means in the predicted direction.

However, we would argue that the path analysis is the best approach to assessing the relationships between first flowering date and spring temperature, total snowfall and snowpack because it explicitly accounts for direct effects of each environmental variable on FFD as well as the indirect effects that occur through correlations with other environmental variables. The power of path analysis is that it simultaneously accounts for covariance among the variables and describes the strength of relationships between them and our dependent variable FFD. Thus, we conclude that yes there have been shifts either forward or backward in flowering time depending on the species and that temperature by and large explains the majority of that variation as opposed to the timing of bare ground or amount of precipitation.

* I wonder if the SPDX value is a little biased, since there was a model selection procedure used to determine what that value should be.
  + We chose to use a model selection procedure to select which day in March to use as an estimate of spring snowpack because the alternative of choosing say March 15 is both arbitrary and results in a large number of zeros as part of the dataset. As such, March 15 decreases rather than increases the explanatory value of March snowpack. In contrast, even when we use model selection to choose which day provides the greatest explanatory value (SPDX) we still found no significant relationship between snow pack and FFD relative to temperature. We are thus confident that changes in snowpack do not seem to play a role even with a liberal test.
* Why use this somewhat convoluted variable (AGDU) to represent temperature instead of just using some actual metric of temperature?
  + This point is well taken as AGDU is an abstraction that is negatively related to temperature and probably decreases understanding of the relationship between temperature and FFD. So we instead substituted the annual average temperature for the three crucial spring months: February, March and April and referred to this as spring temperature (ST) We have re-analyzed the complete set of species and their path models using the new variable in the place of AGDU.
* You probably need to include some sort of correlation table to show how much collinearity there is among predictor variables in the SEM regressions
  + We agree completely that there should be collinearity among the environmental variables. Snow pack and date of bare ground in particular should be strongly related to winter temperatures. This is why we chose path analysis as the best approach to analyzing explanatory relationships between the environmental variables and FFD. This type of analysis explicitly calculates both direct and indirect effects of each environmental variable and the dependent variable while accounting for relationships among the environmental variable. The standardized regression coefficient values in Table 1,2 reflect the strength of particular relationships after you standardize for collinearity. As suggested by the reviewer we have now emphasize how the environmental variables are related to each other with a correlation matrix depicting the covariation among 4 variables (Figure X).
  + Table 1 is pretty confusing the way it is currently structured. I’m not sure you really need columns A-D, since

those values are provided in Figure 3. So maybe this table could just be showing the indirect effects (columns AD and BD), and these column headers could be renamed to identify more easily what they are.

Line-by-line Comments:

* 18: “populations in northern latitudes” is relative. Minnesota is really not THAT far north in the grand scheme

of the globe.

* Changed to “temperate”
* 48-50: Reed et al. manuscript found advancement due to experimental warming, not due to recent temperature

increases.

* Changed to experimental warming
* 54-60: Is the increase in precipitation in this region really expected to fall as more snow? I would expect that

there would maybe be more rain and less snow. I think there needs to be more justification for these lines.

* ?????????????????
* 72: I think you need to be more specific about “prairie species.” Specifically, prairies in the Great Plains region

of the US? Lowland prairies? Provide more context to your system.

* Changed to “plant species growing in lowland grasslands.”
* 74: Define northern tallgrass prairies. Give some context to the region/system. The intro could use a lot more

background information to paint the picture a little better.

* 74-80: The goals of the study seem to come out of nowhere a bit. There needs to be more build up in the

introduction for why you were trying to address these specific goals with this study. Why is it important to use

path analysis to differentiate direct/indirect effects? Provide more information of the role that bare ground might

play. Bare ground was only briefly mentioned in one citation in the previous paragraph, but it’s unclear why it

is part of Goal 2 here. Goal 3: How can precipitation take on the form of temperature? This should be reworded.

* 83: Type out name rather than abbreviating to SET.
* 100: when I read “bare ground,” I imagine exposed soil with no vegetation cover. Based on what is stated here

“snowpack (0 was considered bare ground),” I think you mean bare ground to mean just no snow on the ground

(but that vegetation could be there). This is a little confusing. Perhaps reword this or use another term other than

bare ground to refer to no snow?

* 107-113: I think the explanation for AGDU needs to be reworded and clearer. For example, 300 units is the

cutoff for what? Why is there a cutoff? And I think more detail could be added to lines 112-113. For example,

years with warmer spring months would have lower AGDU because the growing units would have been reached

earlier in the season (and AGDU is actually a day-of-year value)??

* 161: convert DOY to actual date, or at least follow up DOY value with the calendar date in parentheses.
* 167: negligent should be negligible.
* 168: provide goodness-of-fit test statistics somewhere.
* 201: “Only a few of the species...” How many??
* 214-215: You mention these results differ from other areas that receive substantial amounts of snow, but you

give no context for this study system as to how much snow it actually receives.

* 225: Give some context for how much snow there is on day X. Figure 4 shows no units!!
* 240: I have a hard time believing that growth and flowering begin regardless of snow cover. What if there is a

foot of snow on the ground for the majority of the month of March? I imagine flowering would most certainly

be delayed in that case, since the plants themselves would be buried. But perhaps the amount of snow being

received is relatively minimal (i.e., much less than there being a foot of snow on the ground), so then the

presence of that minimal snow might not matter so much for when flowering begins. But this is why it is

important to provide some context for how much snowfall there is, discuss more about the context of the

system, etc.

Figure 1 legend: Include the full names of all the abbreviated variables.

* Figure 2: Since there is such a large gap between the two data collection periods (1942-1961 and 2012-2020), I

recommend faceting this boxplot figure by time period so that we can easily observe if there is a clear, earlier

FFD trend overall in the more recent time period relative to the earlier period. I don’t think this current

arrangement for this figure makes the most sense, since we don’t really care about comparing FFD dates among

species (which is what this currently emphasizes). You have a really long term dataset. Take advantage of that!

If you facet by time period, you might unveil a climate change signal, which would add something very

interesting to the paper. If there is an interesting signal, then do further analyses to highlight this. Also, change

the y-axis to calendar dates.

* Figure 4: What are the units for SPDX?? And for TSNOW.
* L 32 Here are three more recent relevant publications on changing flowering phenology:

Park, I.W., 2014. Impacts of differing community composition on flowering phenology throughout warm

temperate, cool temperate and xeric environments. Global Ecology and Biogeography, 23(7), pp.789-801.

Park, I.W., 2016. Timing the bloom season: a novel approach to evaluating reproductive phenology across

distinct regional flora. Landscape Ecology, 31(7), pp.1567-1579.

Park, I.W., Ramirez‐Parada, T. and Mazer, S.J., 2021. Advancing frost dates have reduced frost risk among

most North American angiosperms since 1980. Global Change Biology, 27(1), pp.165-176.

* L 44 Need more recent references, too. Such as two different book chapters:

Henebry, G.M., 2003. Grasslands of the North American Great Plains. In Phenology: An Integrative

Environmental Science (pp. 157-174). Springer, Dordrecht.

Henebry, G.M., 2013. Phenologies of North American grasslands and grasses. In Phenology: An Integrative

Environmental Science 2nd edition. (pp. 197-210). Springer, Dordrecht.

* L 48 Those references relevant here, too.
* L 55 and elsewhere “northern plains” is too generic; use instead “Northern Great Plains”
* L 60 Don’t neglect the seasonal regulatory effect of nitrogen mineralization in grasslands!
* L 63 “SET” is rather cryptic here. Decode or refer explicitly to “the corresponding author”. Perhaps provide the

annual bounds of this historic data in parentheses following Stevens and SET?

* L 108f metric equivalents?
* L 166, 192, 211 Eschew the use of the isolated relative pronoun “This”. What “this” is pointing to here and

elsewhere may be self-evident for the authors, but not the readers. Help those readers by inserting the noun (or

phrase) between “this” and the verb. We read at L 192 “The is consistent” – assuming this typo was meant to be

“This is consistent”, here is another ambiguity to resolve with the fitting subject.

* L 237 it seems a stretch to draw this conclusion for all “Midwestern prairies” of which the soils, community,

and climate of Fargo approaches a northwestern range limit.