

## ***Interactive comment on “Vapor pressure deficit controls on fire ignition and fire spread in boreal forest ecosystems” by F. Sedano and J. T. Randerson***

### **Anonymous Referee #1**

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This is a very interesting article about fire progression and weather conditions that can mitigate or exacerbate fire activity primarily through variations in VPD. It's important to begin to look at variation in fire activity throughout the season as opposed to an entire year's worth of information (such as annual area burned), and the results of this analysis look quite interesting. That said, I have a few methodological concerns regarding the way the data were handled in the course of this analysis.

First, the use of all MODIS active fire detections without consideration of confidence is very uncommon and requires proper justification. It is my understanding that those detections with a confidence rating of less than 30% are basically junk, and should not be included in the analysis. This is the most common method I know of for subsetting

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the active fire detections based on the reliability of the data.

Second, I'm concerned with the identification of the lightning strike that “began” a particular fire. After a burn is extinguished, we look at the landscape and think of the fire as a singular event that consumed the contiguous area comprising a scar. However, in examining the active fire data record, it is clear that burn scars often represent several points of ignition that converge to form the eventual ‘burn’. The methodology as described only counts the first ignition within a burn scar and ignores subsequent ignitions which are likely as important if not so in terms of the burned area. Take the progression of active fire detections in the 2004 Boundary Fire perimeter, for example. The ignition in the south occurred first, and another occurred several days later in the middle of the burn scar. Most of the burned area spread from the second ignition, not the first.

With respect to the lightning data, I'm also concerned about the problematic upgrading of the system in 2010 to a TOA system. As I understand it, the sensor improvement means that many more strikes will have been detected for the last two years of the study.

Specific comments as follows:

Page 1311 Line 11: Reference to permafrost ‘levels’ is unclear. Do you mean ‘active layer depth’?

Page 1311 Line 21: Barret should be Barrett

Page 1313 Line 25: Was there any processing of the MODIS data to remove the multiple fire detections caused by the ‘bow-tie effect’?

Page 1314 Line 9: The use of low-confidence detections is addressed in my general comments, but there is an additional problem due to the lack of Aqua data for the period prior to 2003. Active Fire Detections from Aqua are only available after mid-season 2002, so the first year of the analysis is undersampled.

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Page 1314 Line 13: It's interesting that you used the MODIS Veg Indices product for this region. Given the strong BRDF issues in high northern latitudes, especially in areas of more pronounced topography, it's common to use the MODIS NBAR product to calculate vegetation indices to avoid this problem.

Page 1318 Line 7: It is true that dNBR has been extensively tested as a proxy for fire severity in boreal forests, but you've neglected to mention that many of the analyses that evaluated the performance of NBR-family indices for detecting variations in severity have determined that it is not useful. I do think your use of the metric is justified here (NBR would be preferable to dNBR, given the issues with phenology and a short growing season in the region) because you are using dNBR to detect burned areas, not burn severity. But the citations you mention curiously avoid papers that have pointed out the shortcomings of dNBR for severity mapping, including several that were published in the same special issue of IJWF as the cited Murphy et al. 2008 paper.

Page 1319 Line 29: I'm curious why you chose the interval from 1500 to 1800 (p.m. is redundant here) for calculating the VPD. Usually indices associated with fire weather are calculated from the noon or 1300 interval, the time of maximum solar elevation.

Page 1320 Line 4: What is the spatial resolution of the VPD dataset?

Page 1320 Line 11: Which fire perimeter do you mean? The daily burned area or the entire burn perimeter. This is not clear.

Page 1320 Line 21: Replace 'was' with 'were'.

Page 1320 Line 22 to 23: The problem with this assumption is discussed in my general comments.

Page 1322 Line 17: Subterranean hotspots reference needs a citation.

Page 1322 Line 3: I would find another phrase to replace "spread rate" which foresters will insist refers to something other than what you are describing here (i.e., the rate at which the front moves in a line perpendicular to the front).

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Page 1325 Line 10: Your reference to a fire management scheme that is designed to "maintain the current fire regime in future decades" presumes a lot about fire management efforts and requires citations to support this description.

Page 1325 Line 21 to 22: I'm unclear as to how this information would benefit fire management agencies, since it's nearly impossible to assess which of these quiescent, smouldering fires represent a threat versus those that are likely to die out.

Page 1327 Line 28: Strike 'in'.

Page 1328 Line 24: Comma needs to follow 'i.e.' and replace 'melt' with 'thaw'.

Page 1329 Line 7: Twenty out of how many?

Page 1329 Line 11: This isn't actually possible given the remoteness of most fires characterized by slow initial growth, given how many of them do not become large fires. In fact, even those that do burn large areas are not a priority for suppression unless they threaten human settlements or infrastructure.

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