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Interactive Comment

Interactive comment on "Effects of lightning and other meteorological factors on fire activity in the North American boreal forest: implications for fire weather forecasting" *by* D. Peterson et al.

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We would like to thank the reviewer for the thorough review and constructive comments. Several changes were made to the manuscript in accordance with the reviewer's suggestions.

(A) NARR data reliability The primary concern of the reviewer was the uncertainty that arises from comparing the various data sources used in the manuscript. For example, the comparison between NARR precipitation and observed lightning strikes was highlighted. We have done a detailed literature search to see if anyone has investigated the reliability of NARR precipitation in the remote areas in Canada. Several such studies (mainly based on hydrologic analysis) do exist and section 3.4 (Data Integration) was modified according to the reviewer's suggestions. Many technicalities were removed and a discussion on data comparability was added. Several key sentences follow:

"When generating precipitation fields, the NARR assimilates surface rain gauge observations (Mesinger, 2006). Therefore, the data quality is highest in regions where there are many observations and lower in regions with sparse observations. Despite sparse observations in boreal North America, results from Solaiman and Simonovic (2009) show a strong correlation (R = 0.77-0.97) between observed precipitation and NARR-generated precipitation in Ontario. Similarly, Choi et al. (2009) calculated a correlation coefficient of 0.74 using observations in Manitoba. Based on these studies, the NARR was chosen as the best source of precipitation data for the remote boreal forest. Any deviations from observations are usually negative simply because the NARR is on an aerial (model) grid box rather than a single point location (Kim et al., 2008; Choi et al., 2009)."

(B) Cloud cover issue Another important concern raised by the reviewer was the potential impact of cloud cover on MODIS fire observations. We recognized that this is an important point, and indeed we tried several ways to tackle and address this issue in the paper.

(1) We have attempted to remove the cloud cover issue in the holdover-effect analysis. We assume that a thick, stratiform cloud deck will not obscure observations for more than three days (except in extreme circumstances). Based on the strong correlation between 500 hPa heights and fire activity, we further assume the thick clouds are less likely in fire-conducive patterns (large-scale subsidence) and any new fire should be observed by MODIS during the holdover temporal window. In most cases, cloud cover will be fair-weather cumulous occasionally producing updrafts strong enough to produce isolated thunderstorms, especially in regions of elevated topography. This increases the likelihood that MODIS will observe a fire within 2-3 days of ignition. A quick analysis shows that cloud cover in our study domain (western and eastern domains)

is about 54% in active fire seasons based upon MODIS observations, and large daily variability.

(2) Unless we have ground-monitoring sites everywhere in our study domain, the exact fire start time will always remain a mystery. In addition to the holdover-effect analysis, we also conducted the hits-and-misses analysis in which a hit is considered as long as there is a fire pixel in a NARR grid box. Considering that a NARR grid box has a size of 32x32 km2, we believe that the likelihood to have total cloud cover in a NARR grid box is small, and hence the chance for MODIS to provide missing information on fires in a NARR grid box is slim. Hits-and-misses analysis therefore provides a further step to evaluate the fire weather in cloudy conditions.

Considering the above two factors, we have added the following in the last paragraph of this paper: "One caveat pertaining to the data integration is the lack of fire information in cloudy conditions from MODIS. However, the uncertainties associated with this issue are likely taken into account through the holdover effect and the hits-and-misses analysis (section 5.2) because: (a) the likelihood of having total cloud cover over a NARR grid box (32x32 km2) is small, which favors the hits-and-misses analysis; and (b) the likelihood of a large cloud deck to persist over a NARR grid box during the holdover time window (2-3 days) is rare, especially in the summer months. It is expected that within the next decade, spatiotemporally collocated half-hourly fire, lightning, and cloud cover data obtained from future geostationary satellite observations (such as GOES-R, http://www.goes-r.gov/) could provide valuable constraints in analyzing the timing and localized mechanisms for lightning-induced fires."

We also believe that the multiple observations per day capability offered by the GOES satellite can help to tackle this issue, and that is why we added the above discussion before we elaborate on GOES applications in the last paragraph.

(C) Other concerns As for shortening the results section, we have decided to shorten section 4. (Large-scale analysis) by removing many of the tiny details of correlations

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(see replies to the first reviewer).

“FRP flux” has been replaced by “regional FRP flux”

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 8297, 2010.