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| Mapping Circumpolar Fire Emissions for Carbon Cycle Modeling |
| **Introduction:**  Boreal ecosystems occupy 22% of the terrestrial surface and contain more than 40% of the world's soil carbon inventory that is vulnerable to change in near-term climate conditions. Wildfire occurrence has increased in northern high latitudes in recent decades, with an increase in both fire number and burned area. In Siberia alone, the fluctuation of burned area ranged from 3 to 20 million hectares over the last two decades. Concurrently, mean global air temperatures have increased during the last century and the largest temperature increases on Earth are found in circumpolar regions.  For this paper we review development of a circumpolar burn severity product that was used to improve estimates of total carbon exchange using the Wildland Fire Emissions Inventory System (WFEIS) to map direct carbon emissions and the Terrestrial Ecosystem Model (TEM) for long-term carbon exchange. Burn severity is a significant factor for mapping immediate emissions and for improved modeling of post-fire carbon exchange.  **Methods and Results:**  To adequately quantify the role of boreal forest ecosystems in the global carbon budget, a dataset of spatially and temporally explicit fire burn area with severity was developed for all regions north of 50 deg latitude for 1986-2020 for North America and 2003-2016 for Eurasia (the Eurasia dataset being limited to the MODIS mission). Fire perimeters were compiled from existing fire databases or were derived from Landsat and MODIS and were processed to ensure that they had valid geometry, including repairing perimeter geometries and simplifying geometry to a 60 meter resolution to improve processing time. Burn severity was determined from Landsat TM/ETM+ by assigning pre- and post- Normalized Burn Ratio (NBR) values within each fire perimeter and calculating adjusted dNBR and RdNBR. Uncertainty associated with remote sensing of burn severity and fire perimeter estimation is a consideration for accounting fire emissions and post-fire carbon exchange. In this work we provide a summary of the contributing sources of error in burn severity estimation and evaluate our burn area products for this error.  This dataset was then used in evaluation of the role of severity in post-fire carbon exchange, and assessment of circumpolar fire distribution and trends in burn area, severity, and ecoregion. Results show an increase in regional burn severities during the study period and that severity is a factor in both immediate and long-term carbon exchange. |