Increase of boreal forest fire in the last 50 years: inferred from ice core dehydroabietic acid record

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Biomass burning and its emissions have significant impacts on ecosystems, climate, atmospheric chemistry, and carbon cycling. The circumpolar boreal forest contains about one-third of the world’s forest, with half of the world’s forest carbon. Thus, the boreal forest fire is an important source of atmospheric pollutant over the Arctic. To better understand a link between boreal forest fire and climate, it is necessary to reconstruct long-term variability of boreal forest fire associated with climate change. Among the different proxies of biomass burning, dehydroabietic acid is a specific tracer of the pyrolysis of conifer resin and has been used as a tracer of the burning of conifer tree. Here we present the ice core record of dehydroabietic acid in three ice cores, i.e. Southeast Dome ice core in Greenland, Ushkovsky ice core in Kamchatka peninsula and Aurora peak ice core in southern Alaska. Dehydroabietic acid record in Ushkovsky ice core covers 1693 to 1997 and ice core from Alaska covers 1761 to 2004. In contrast to these two ice cores, Southeast Dome ice core covers only from 1958 to 2014 but has high resolution. Air mass backward trajectory analyses indicate that eastern Canada is likely the main source region of the conifer tree burning aerosols for Southeast Dome ice core, whereas the western part of Canada is considered to be the main source region of the conifer tree burning aerosols for Aurora peak ice core. On the other hand, boreal forest fire in Siberia is thought to be the main source of dehydroabietic acid in Ushkovsky ice core. Dehydroabietic acid record in Ushkovsky ice core shows an increasing trend from 1970 to 1997. Dehydroabietic acid record in Aurora peak ice core shows several high peaks of dehydroabietic acid in the 17th century and further shows increasing trend from 1989 to 2004. As for Southeast Dome ice core, the linear trend of dehydroabietic acid also showing an increasing trend from 1958 to present. These results show that fires of boreal conifer forest in circumpolar regions have increased in the last 50 years.

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