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Satellite-Based Analysis of Fire Events and Transport of Emissions in the Arctic

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Climate change is proceeding fastest in the Arctic region. During past years Arctic summers have been warmer and drier elevating the risk for extensive forest fire episodes. In fact, satellite observations show, that during past two summers (2018, 2019) an increase is seen in the number of fires occurring above the Arctic Circle, especially in Siberia. While human-induced emissions of long-lived greenhouse gases are the main driving factor of global warming, short-lived climate forcers or pollutants emitted from the forest fires are also playing an important role especially in the Arctic. Absorbing aerosols can cause direct arctic warming locally. They can also alter radiative balance when depositing onto snow/ice and decreasing the surface albedo, resulting in subsequent warming. Aerosol-cloud interaction feedbacks can also enhance warming. Forest fire emissions also affect local air quality and photochemical processes in the atmosphere. For example, CO contributes to the formation of tropospheric ozone and affects the abundance of greenhouse gases such as methane and CO_2.

This study focuses on analyzing fire episodes in the Arctic for the past 10 years, as well as investigating the transport of forest fire CO and smoke aerosols to the Arctic. Smoke plumes and their transport are analyzed using Absorbing Aerosol Index (AAI) from several satellite instruments: GOME-2 onboard Metop A and B, OMI onboard Aura, and TROPOMI onboard Copernicus Sentinel-5P satellite. Observations of CO are obtained from IASI (Metop A and B) as well as from TROPOMI, while the fire observations are obtained from MODIS instruments onboard Aqua and Terra, as well as from VIIRS onboard Suomi NPP. In addition, observations e.g. from a space-borne lidar, CALIPSO, is used to obtain vertical distribution of smoke and to estimate plume heights.