

Forest Fire Smoke Screens Arctic Warming

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Aerosols in the atmosphere affect the Earth's radiation budget in complicated ways, depending on their physical and optical characteristics and how they affect cloud nucleation. While the Arctic atmosphere is generally very clean, spring incursions of haze and dust from Eurasia perturb the surface radiation balance. During summer time boreal forest fires emit plumes of combustion gases and carbonaceous particles into the atmosphere as smoke. From mid-June through July 2004 hundreds of fires burned across eastern Alaska and the Yukon and smoke was advected across the Arctic into Europe. The comprehensive measuring systems in place near Barrow (NOAA/GMD and DoE/ARM) present a unique opportunity to characterize the smoke aerosol physically and optically permitting quantification of its direct radiative forcing. Using photometric measurements of aerosol optical depth (AOD), smoke particle size spectra are inferred. Applying Mie scattering theory, the critical optical properties of smoke are estimated and ported into the AFRL-MODTRAN5TM radiative transfer code. Initialized on this basis, MODTRAN can simulate with reasonable consistency what is observed empirically. Because measured and analytic calculations of the direct aerosol radiative forcing are comparable, results give a reliable indication that smoke plumes significantly cool the surface during summer. Should Boreal forests expand in area and/or dry due to global warming, natural fires may become more frequent, widespread and intense in the future. Annually, the fire season may also be prolonged. Thus, enhanced cooling by smoke in the atmosphere constitutes a potential negative feedback in the climate system that must be given consideration when making future climate assessments.

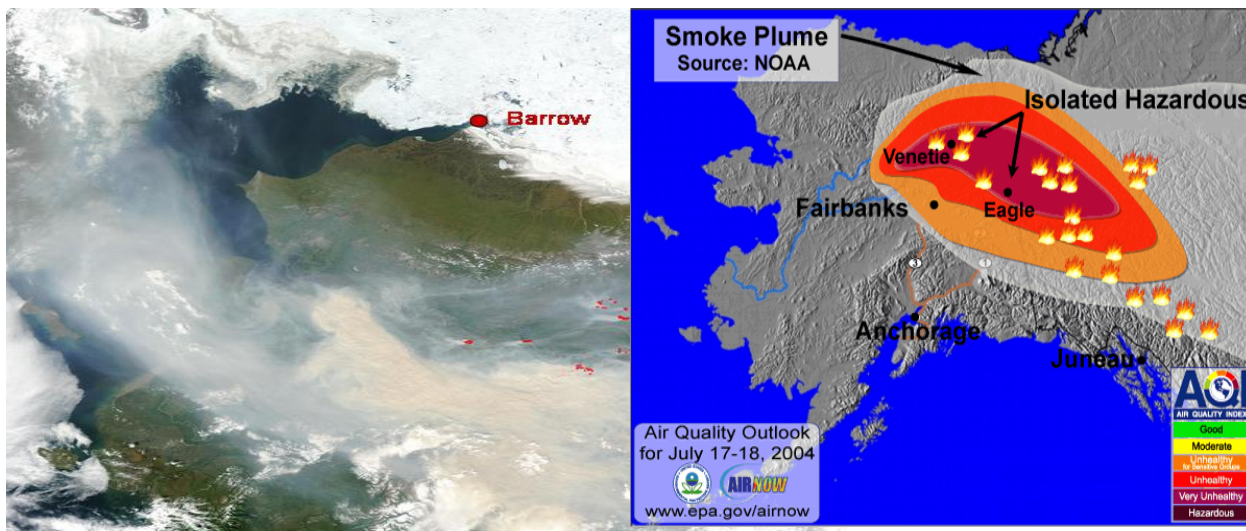


Figure 1. *Left*, MODIS image for 30 June 2004 showing fire locations and smoke plumes across Alaska. *Right*, Air quality into late July 2004 was still ‘very unhealthy’ to ‘hazardous’ over the Alaskan source region as smoke advected eastward as far as Europe.