R. J. Yokelson - Residual Smoldering Combustion (1999)

1999-2000 Measurements of Residual Smoldering Combustion (RSC) - RSC Photo Gallery

Description - We loosely define residual smoldering combustion (RSC) as biomass combustion that produces emissions that are not lofted by strong fire-induced convection. A practical consequence is that the initial RSC emissions cannot be sampled from an aircraft. RSC emissions can be produced for up to several weeks after the passage of a flame front and they are mostly unaffected by flames. Fuels prone to RSC include downed logs, stumps, duff, and organic soils. Limited observations in the tropics and the boreal forest suggest that RSC is a globally significant source of emissions to the troposphere. This source was previously uncharacterized.

We measured the first emission factors (EF) for RSC in a series of laboratory fires in 1999 (and later in Zambia, Oregon, and Brazil). We reported EFRSC for PM 2.5, carbon dioxide, carbon monoxide, methane, ethane, ethene, acetylene, propene, formaldehyde, methanol, acetic acid, formic acid, glycolaldehyde, phenol, furan, ammonia, and hydrogen cyanide. For many compounds, the EF for RSC-prone fuels from the boreal forest and wooded savanna are very different from the EF for the same compounds measured on aircraft in fire convection columns above these ecosystems. We coupled our EFRSC with estimates of fuel consumption by RSC to refine emissions estimates for fires in the boreal forest and wooded savanna. We found some large changes in estimates of biomass fire emissions with the inclusion of RSC. For instance, the wooded savanna CH4 EF increases by a factor of 2.5, even when RSC accounts for only 10% of fuel consumption. Measurements of fuel consumption and emission factors for RSC should be included in estimates of biomass burning emissions (Bertschi et al., 2003).