Particle characterisation during biomass burning events in Tasmania, Australia

F. Reisen[1], C.P. Meyer[1], M.D. Keywood[1] and S. Crumeyrolle[2]

[1]Centre for Australian Weather and Climate Research, CSIRO Marine and Atmospheric Research, Aspendale, Victoria 3195, Australia
[2]NASA Langley Research Centre, Hampton, Virginia, 23681, USA
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Presenting author email: Fabienne.Reisen@csiro.au

Regional pollution from biomass burning has become an issue of public concern in Tasmania. Smoke plumes are frequently visible at large distance, and when ground-level smoke concentrations cause discomfort or trigger acute health responses, the events are vividly remembered. Current public perception is that smoke produced by regeneration burning is the principal cause of pollution events and a significant risk to health. To date there are few data on these events.

In order to assess the seasonal air quality in the Huon Valley in southern Tasmania, we monitored fine ($PM_{2.5}$) and coarse (PM_{10}) particle concentrations and their chemical composition between March 2009 and September 2010 at two locations, Geeveston, an urban site and Grove, a rural site. Additionally an intensive campaign was carried out during the regeneration burning season in March and April 2010 during which microphysical and chemical properties of the aerosol were measured at Geeveston.

PM concentrations were substantially elevated both in autumn and winter at Geeveston compared to Grove, indicating that PM concentrations were primarily influenced by localised sources rather than by regional pollution. The measured elevated concentrations of levoglucosan, a unique tracer for wood smoke, confirmed that biomass burning was a significant source of $PM_{2.5}$ concentrations. Although the intensity of emissions from prescribed burns and residential woodheaters was similar, emissions from residential woodheaters were the largest source of $PM_{2.5}$, with a contribution of 80% to the ambient $PM_{2.5}$ load compared to an 11% contribution from prescribed burns.

In background air, the size-resolved mass distributions were typical of a non-polluted atmosphere in which sea-salt was the major source of coarse mode particles, and secondary particles (represented here by non-sea salt sulphate), were the major components of the fine particle mode (Figure 1, left). During the main smoke plume event, we observed high content of levoglucosan and organic carbon and the size distribution spectrum was dominated by a single mode around 1.5 µm (Figure 1, right).

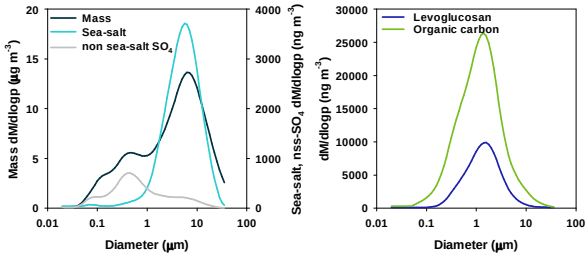

Figure 1. Size resolved chemical composition of background air (left) and smoke event (right)

We also observed contrasting characteristics of clean and smoke impacted air in the size-resolved particle concentrations. In clean background air, particle number concentrations were low, with size mode ranging between 20 and 100 nm. During the severe smoke event, the mode was substantially larger and particle growth was clearly evident increasing from 93 nm to about 157 nm in 12 h at a growth rate of 5.3 nm h^{-1} (Figure 2) Particle growth can be caused by condensation of either organic gases or water onto particles, however, because the condensation sink for water vapour during this event is extremely high (40 s^{-1}) compared to the monthly average (2 s^{-1}), we can conclude that the growth observed here is due mainly to humidity and that the smoke in this event was relatively fresh.

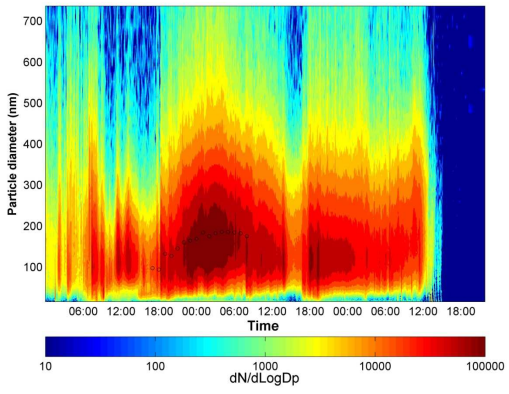

Figure 2. Size distribution of aerosol particles measured with the SMPS during severe smoke event.

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