Radiocarbon-based source apportionment of elemental carbon and organic carbon at a regional background site on Hainan Island, South China

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Carbonaceous particles (total carbon, TC) are major fraction of fine particles and are of worldwide concern due to their important impacts on climate and human health. TC is often operationally classified into two sub-fractions: elemental carbon (EC) and organic carbon (OC) (Pöschl, 2005). Radiocarbon (^{14}C) analysis of EC and OC separately allow a quantitative and unambiguous measurement of their contemporary and fossil contributions, thereby potentially reducing a major uncertainty in the present understanding of organic aerosols emissions (Szidat *et al*. 2006).

Both fossil-fuel emissions and biomass/biofuel burning in Southeast Asia may have an important impact on regional EC and OC emissions. Here, we present a ^{14}C-based source apportionment study at a regional background site of Jianfeng (JF) on Hainan Island, South China. This is an ideal site to study air pollutions outflows from mainland China, as well as the impact of Southeast Asian biomass burning emission.

PM2.5 samples were collected about once per week from May 2005 to August 2006 using a high volume sampler (~1 m^3/min) for 24 h. All samples were measured for the EC and OC concentrations by the thermal-optical transmittance method. The EC and OC isolation for subsequent ^{14}C measurements were prepared with an optimized thermo-optical protocol (Swiss_4S) on the selective samples (Zhang *et al*. 2012).

As shown in Figure 1, both EC and OC are characterized by the lowest abundances during the wet summer season (i.e. from the Mid-May to September) and the highest levels in winter (i.e. from mid-November to February). This is most likely due to the high wash-out effect and the prevailing clean maritime air mass origins in summer on the one hand and the anthropogenic air pollutions (biomass and fossil fuel combustions) transportation from continental China with the northeast winds on the other hand.

As an example illustrated in Figure 2, the combination of the analysis of the air mass back trajectories and fire counts on the day of the highest carbonaceous particles levels during the entire study period indicate a significant contribution from open biomass burning to the carbonaceous particles. This idea is further confirmed by ^{14}C measurements, which show the non-fossil sources account for 69% and 88% to the total EC and OC, respectively. Biofuel combustion may be another important non-fossil contributor to EC and OC in Southeast China during the heating season. ^{14}C measurements of the carbon faction of interest on other samples with different air mass origins and seasons will be present as well.

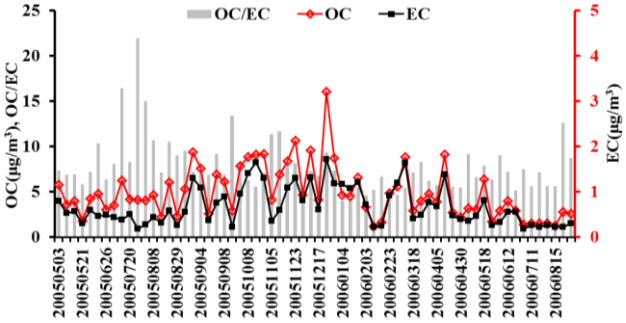

Figure 1. Temporal variations of OC, EC concentrations (μg/m^3) and the OC-EC ratios

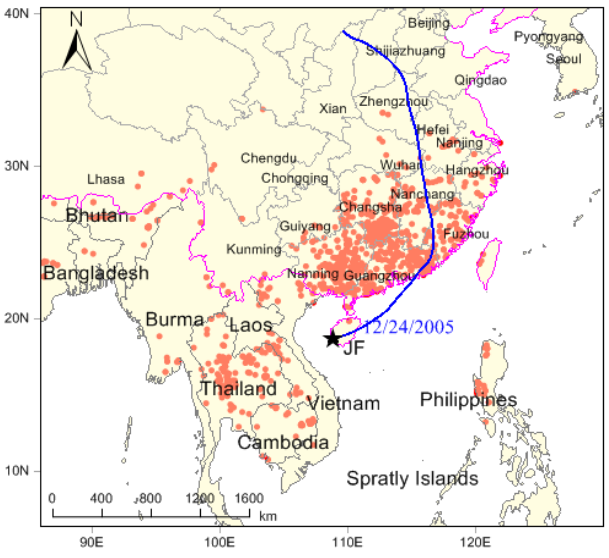

Figure 2. 5-day air mass back trajectories reaching JF and MODIS fire counts on 24 Dec 2005.

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