Continental Outflow Events at Mauna Loa Observatory; a Review 1997-2006

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We report on an analysis of atmospheric radon concentrations measured at the Mauna Loa Observatory, Hawaii (MLO). Our analysis covers the period 1997-2006 and focuses on Asian continental outflow events, in particular, the continental fetch regions responsible for the greatest terrestrial influence on air masses thus characterized at MLO.

Sampling at the station is clearly affected by anabatic/katabatic air flows on the face of the Mauna Loa volcano. Based on an analysis of composite diurnal radon concentrations we defined a nocturnal sampling window of 2200-0700 local time during which observations were considered to be most representative of the lower troposphere. We arbitrarily defined the threshold for events which experienced the greatest terrestrial influence as the seasonal 90^{th} percentile radon concentration (as derived from de-seasoned radon concentration time-series). The resulting multi-year radon dataset was then corrected for radon decay during the time the air masses spent over the ocean.

We found that a subset of the selected events could be grouped in two latitudinal bands according to where the events crossed the Asian coastline: 20^{o}-30^{o} N or 30^{o}-40^{o} N (Fig. 1). The seasonal distributions of radon concentration of these outflow events show latitudinal differences which suggest changes in the radon source function and or strength vertical transport over the Asian continent. In winter and autumn, an increase in the observed radon concentrations from south to north was usually observed, whilst in spring the opposite was true (Fig. 2). There were not a sufficient number of events originating from the Asian coastline during summer of any of the ten years to enable a detailed analysis for this season.

The observed change in radon concentration range in winter and autumn (increasing to the north) is opposite to the latitudinal gradient in radon source function that is commonly assumed to exist. Also, snow cover would increase to the north in the winter months, effectively strengthening the source function gradient. The apparent disparity between the strength of the radon source function in the fetch regions and observed radon concentrations in tropospheric air masses in winter and autumn could be explained by assuming a concurrent latitudinal gradient in the frequency or strength of events that inject boundary layer air to the free troposphere over central China.

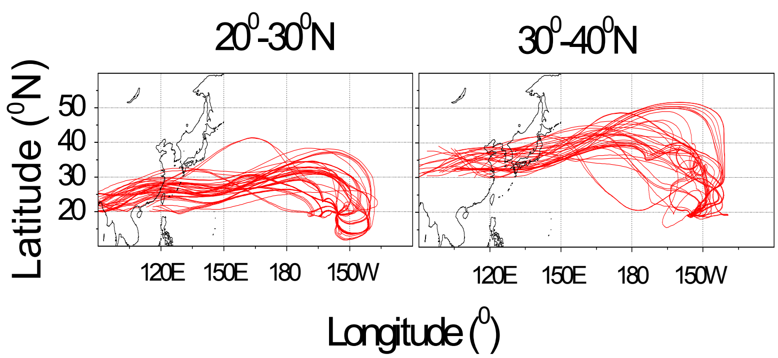

Figure 1. Example of high radon events at MLO originating from a specified latitudinal band in Asia (Spring 2003)

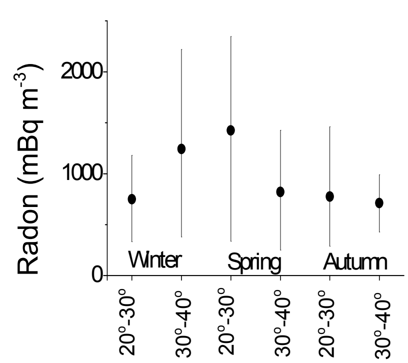

Figure 2. Radon distributions (median, 10^{th} and 90^{th} percentiles) by season and latitude in air masses greatly affected by terrestrial emissions.