Characterization of the Air Masses Reaching Cape Point Using ^{222}Rn as Tracer

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Air masses reaching the Cape Point, South Africa, Global Atmosphere Watch (GAW) station (34°S, 18°E) were characterized by using a combination of criteria including wind data, 10-day back trajectories (NOAA), and ^{222}Rn as a tracer for continental air. Clustering of trajectories has revealed that most of the air advected at Cape Point originates from the southwestern Atlantic Ocean, with hardly any air parcels originating from central Africa. According to ^{222}Rn levels, the air was categorized into maritime (^{222}Rn < 250 mBq m^{-3}), continental (^{222}Rn > 1200 mBq m^{-3}), and mixed conditions. With a 72-sector concentration/wind rose, high spatial resolution of the distributions of ^{222}Rn and trace gases was achieved. CO, CH_4, and CO_2 were filtered to yield baseline data, using ^{222}Rn as the indicator. This technique compares favorably with the routinely used filtering method based on two 11-day moving percentiles, for a lower and upper cutoff, respectively. The maritime (or baseline) component was further resolved by grouping back trajectories according their origin within six boxes in the southwestern Atlantic (range: 20°S to 90°S). The results indicate a small latitudinal concentration dependence for CO and ^{222}Rn, suggesting possible emissions from South America. However, no latitudinal dependence was observed for CO_2 and CH_4. Continental air reaching Cape Point can have an urban as well as a nonanthropogenic component to it, as indicated by the difference between the CO and ^{222}Rn/wind concentration roses (Figure 1). During specific events, continental air carried smoke plumes from regional veld fires, which permitted estimates to be made of emission ratios of CO and CH_4 relative to CO_2.

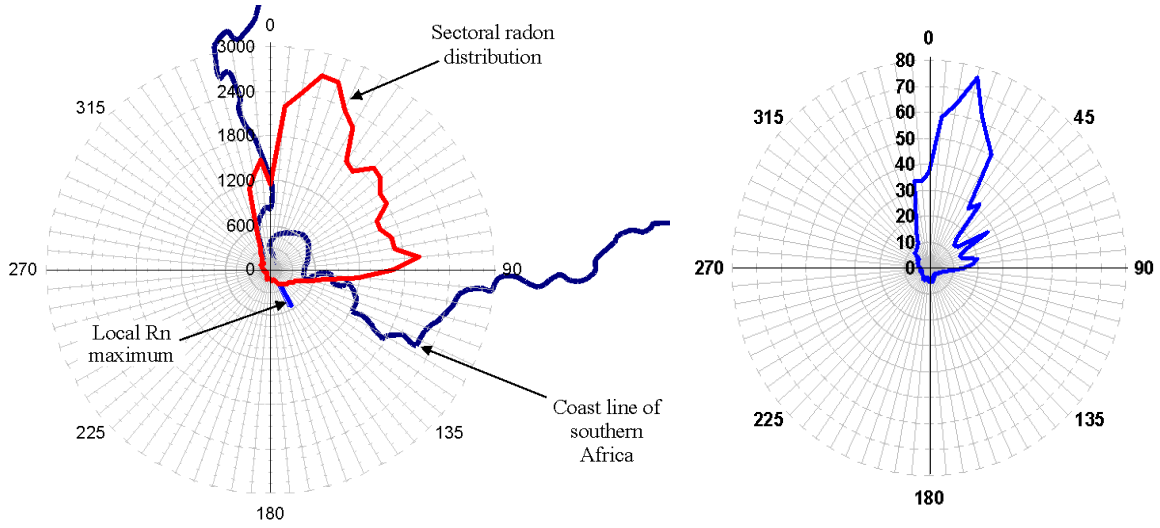

Figure 1. Left: Plot showing the coastline of southern Africa with a radon/wind rose centered on Cape Point. The ^{222}Rn distribution (based on data from 2000) is shown in terms of medians over 5-degree intervals, scaled up to 3000 mBq m^{-3}. Right: CO/wind rose showing median values for CO above background, scaled up to 80 ppb.