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# Improving lidar-based mixing height measurements with radon-222

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We have found that near-surface hourly atmospheric radon-222 measurements can be combined with elastic backscatter lidar data to obtain a higher quality time-series of mixing height than is currently possible with lidar data alone.

The standard method of determining mixing heights from lidar observations relies on algorithms which detect the contrast between relatively turbid aerosol-laden air within the boundary layer and clear air above. However, this approach can be confounded by meteorological conditions that lead to the formation of multiple aerosol layers within or above the boundary layer, or when the contrast between boundary layer air and the overlying air is weak. In such ambiguous circumstances, extra information would be helpful to choose the appropriate mixing height.

Radon-222 has the properties—almost—of an ideal passive tracer emitted at a constant rate from the surface. Assuming horizontal homogeneity, the near-surface concentration time-series can be inverted to determine an effective mixing height, which is equal to the true mixing height if the tracer is mixed uniformly throughout the boundary layer. A time-series of effective mixing heights derived in this manner can then be used to choose between lidar-derived candidates for mixing height in ambiguous meteorological conditions.

This approach has the potential to extend the usefulness of lidar observations to conditions where, at present, it is only marginally applicable, and to improve the performance of automatic PBL height detection procedures. A time-series of mixing heights derived from a combination of lidar and radon observations would have fewer gaps, and therefore be more useful for applications such as model validation or pollution studies under a wider range of meteorological conditions.