Field Measurements of spatial and temporal turbulence statistics: testing ergodicity with a Raman Lidar.

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Spatial and temporal statistics of atmospheric turbulence are often assumed to be equal for many turbulent analyses or comparisons made between theory and measurement. This is normally done as theoretical developments often involve spatial arguments, while measurements are often taken at a stationary point. Monin-Obukhov theory would be a well known example; the theoretical framework is done for spatial statistics, while in practice it is almost universally applied to time series. Such an assumption implies that atmospheric turbulence would be Ergodic. In this work, a high spatial/temporal resolution Lidar is used to take horizontal measurements of humidity over a small lake in Switzerland. The experimental setup allows for the simultaneous measurement of both temporal and spatial statistics of humidity in the lower atmosphere, allowing for a direct comparison of low level statistics (mean and variance) and high level statistics (PDF distributions). Potential differences are conditionally sampled on atmospheric stability, and a Kolmogorov-Smirnoff test is used to determine statistical significance.