A multi-instruments campaign using scintillometry to measure the horizontal turbulence spatial distribution

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Agregated fluxes measurements with scintillometric methods rely on horizontal homogeneity assumptions (Monin-Obukov theory). If these measurements were shown valid over slightly heterogeneous terrain [1], questions still remain when spatial heterogeneity is more pronounced (leading to Bowen ratio variability) which is susceptible to generate steady turbulent structures with a large range of Cn^2 values [2].

A field experiment has been conducted near Lannemezan (France) aiming to evaluate new scintillometric methods to quantify the spatial variability of refractive index structure parameter (Cn^2) from which heat fluxes can be derived. The Cn^2 variability comes from the intrinsic topography along the path. Three devices were installed between the Centre de Recherche Atmosphérique and the Campistrous church, 2.7 km northward: The Shack-Hartmann wavefront sensor (SH) working in 3.8-4.2 μm wavelengths [3]. It consists in saving a matrix of 25 sub-pictures of a double source from which we compute cross correlations of the scintillation indices and angles of arrival. 5 to 8 Cn^2 values along the path can be extracted from these correlations. 5 scintillometers with different aperture sets measured an averaged Cn^2 for different parts along the path. Moreover 2 eddy-covariance stations (EC) measured the local structure parameters C_T^2, C_Q^2 et C_{TQ} to calculate the local Cn^2. Continuous time series of Cn^2 measurements from the scintillometers have been stored together with EC measurements from 28/08/2012 till 22/10/2012. From the 14/092012, 21 days and 5 nights data sequences have been stored with the SH. Data analysis of the SH measurements produced spatial and temporal spectra of scintillations and of angles of arrival that show a good concordance to the Kolmogorov model. We checked that both sources are embedded in the same small turbulence regime. Then inversion of the SH measurements covariances should allow us to retrieve the $Cn^2(x)$ profile along the sightline. These local estimations will be compared with the Cn^2 integrated from the scintillometers.

References

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