Spatiotemporal statistics of optical turbulence at the ground layer.

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Abstract

Taylor's frozen turbulence hypothesis (TFTH) has been extensively used in theoretical studies to model the temporal fluctuations of optical quantities affected by atmospheric turbulence. It provides temporal-frequency spectra under varying propagation conditions and different atmospheric refractive index models. However, experimental work has revealed limitations, such as systematic inaccuracies in estimating crosswinds during calm nights in scintillation measurements at astronomical sites, discrepancies in ground-layer scintillation measurements, and broad estimates of coherence time in phase fluctuation measurement techniques. This presentation discusses a controlled experiment testing TFTH on the spatiotemporal properties of image wander. Two characteristic times were observed: one associated with TFTH decorrelation and a second potentially linked to the sweeping hypothesis. These time scales correspond to different dominant turbulent sub-regimes. The results are used to reinterpret sonic anemometer campaigns at astronomical observatory sites.

Keywords: ground layer turbulence, non kolmogorov turbulence, optical turbulence profiling

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