

---

# CATS: last upgrades, turbulence forecasting and additional instrumentation

Christophe Giordano<sup>\*†</sup>, Aziz Ziad<sup>1</sup>, Eric Aristidi<sup>1</sup>, Julien Chabé<sup>2</sup>, Yan Fantei-Caujolle<sup>1</sup>,  
and Christophe Bailet<sup>1</sup>

<sup>1</sup>Laboratoire J.L. Lagrange, OCA, UCA, CNRS, UMR 7293, Parc Valrose 06108 Nice Cedex 2, France –  
CNRS, Laboratoire Lagrange – France

<sup>2</sup>Université Côte d’Azur, OCA, CNRS, IRD, Géoazur, 2130 route de l’Observatoire, 06460 Caussols,  
France – Université Côte d’Azur (UCA) – France

## Abstract

The atmospheric turbulence measurement and characterization is an essential information for high- angular resolution imaging in astronomy, and for optical link (telecommunication, telemetry, time trans- fer, ...). Indeed, its impact on the light propagation decreases the resolution of astronomical images, and degrades the bit error rate of optical communication signals. In this framework, since 2015, the Calern Atmospheric Turbulence Station (CATS) monitors atmospheric conditions at the Calern observatory, during both daytime and nighttime from the ground to the top of the atmosphere. The station is fully autonomous and is equipped with a set of complementary instruments to continuously monitor optical turbulence. The Profiler of Moon Limb (PML) measures, from Sun or Moon limbs observation, the vertical profiles of the refractive index structure constant  $C_n^2$  with a high vertical resolution ( $\sim 100\text{m}$  at ground level). The Generalized Differential Image Motion Monitor (GDIMM) monitors the integrated turbulence parameters (seeing, isoplanatic angle, coherence time, scintillation, outer scale) by observing bright stars. The equipment is controlled with a ground weather station providing the ground meteorological conditions (pressure, temperature, relative humidity, wind speed, wind direction and irradiance), and the nighttime cloud coverage is given by an all-sky camera. More recently, knowing the need of turbulence forecasting, we developed a system integrated in the CATS station to daily predict daytime and nighttime meteorological and optical turbulence conditions for the next 48h. We also have designed an instrumental platform attached to a drone and allowing to measures, with a high resolution, the weather conditions between the ground and an altitude of around 500m. Since 2022, we have also added an infrared AllSky imager measuring 24/7 the cloud conditions, and a photometer measuring aerosols conditions, important for optical telecommunications. In this paper we present the CATS station and its last upgrades, the instrumented drone, and the forecasting tool developed and tested on Calern Observatory (France).

**Keywords:** Turbulence, Atmospheric effects, Forecasting, Flexible Scheduling, Modeling, Instrumentation

---

<sup>\*</sup>Speaker

<sup>†</sup>Corresponding author: cgiordano@oca.eu