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The Institute of Photonic Sciences

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euro **PHOTONICS POESII**
International Master in Photonics

MASTER IN PHOTONICS – "PHOTONICS BCN"
ERASMUS+ "EUROPHOTONICS"

MASTER THESIS PROPOSAL

Dates: April - September 2019

Laboratory: CommSensLab (Communications and Sensing Lab),
http://www.tsc.upc.edu/en/research/commsenslab , http://www.tsc.upc.edu/en/research/rslab
Institution: Universitat Politècnica de Catalunya (UPC)
City, Country: Barcelona, Spain

Title of the master thesis: *Remote Sensing for atmospheric observation: Atmospheric Boundary-Layer monitoring in the context of severe storm hazards*

Name of the master thesis supervisor: Prof. Francesc Rocadenbosch (UPC)
                                                                            Prof. Robin Tanamachi (Purdue University)

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Keywords: *Remote Sensing, optical sensing, microwave sensing, data processing, adaptive filtering, classification, boundary layer, aerosols, clouds.*
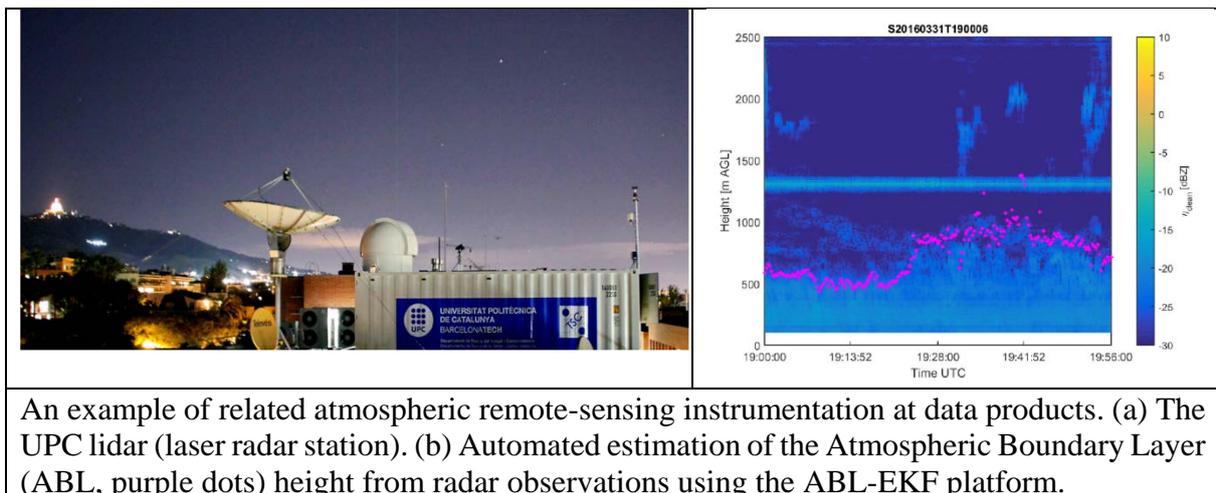
Summary of the subject (maximum 1 page):
MSc thesis on the *Remote Sensing and Data Processing* at the CommSensLab, an Excellence Unit of the UPC in collaboration with Purdue University (co-advisor).

Synergetic remote sensing of the atmosphere, combined with adaptive/data-fusion techniques, offers unprecedented opportunities to characterise the evolution of *key atmospheric parameters* such as the Atmospheric Boundary Layer (ABL; i.e., the particle height distribution directly affected by the changes on the surface of the Earth on a time scale of an hour or so) and its critical role in the development of severe storms and associated hazards. Using long-duration, high-resolution, vertically pointing observations from active and passive ground-based remote sensing systems including, e.g., ceilometers, Doppler lidar (laser radar), weather radar, and new technologies of microwave radiometers, it is expected to characterise ABL development over distinct regions that are well known for their relatively high tornado frequency.

The candidate, working at UPC, will address data-fusion techniques based on adaptive estimation and/or machine learning that are to provide automated or semi-supervised identification of ABL top in non-precipitation observations, as well as classification metrics. Verification of ABL heights against independent observations from a wealth of remote-sensing instruments across collaborating U.S. research institutions (including e.g., Purdue University, NOAA and Univ. of Massachusetts) will also be a goal.

Proposed tasks:
- *Operation, test and refinement* of ABL-EKF, an existing data-processing platform for automated identification of the ABL height, by using radar and lidar observations. Tentative refinements include "batch" and "massive processing". *Test and verification* will resort on cross-examination with co-operative radiosonde launches.
- *Compilation of a database* to study the ABL evolution during VORTEX-SE 2016 and 2017 measurement campaign. Ancillary data exist from both Purdue and UPC partners.

An example of related atmospheric remote-sensing instrumentation at data products. (a) The UPC lidar (laser radar station). (b) Automated estimation of the Atmospheric Boundary Layer (ABL, purple dots) height from radar observations using the ABL-EKF platform.

Additional information:
* Required skills: *Matlab software*. Telecommunications, electrical/mechanical engineering, or physics with clear motivation to study atmospheric remote sensing and data processing. Computer and programming skills would be beneficial. Good English speaking and writing skills are preferred.

* Miscellaneous:
VORTEX-SE: Verification of the Origins of Rotation in Tornadoes Experiment - Southeast,
https://www.nssl.noaa.gov/projects/vortexse/