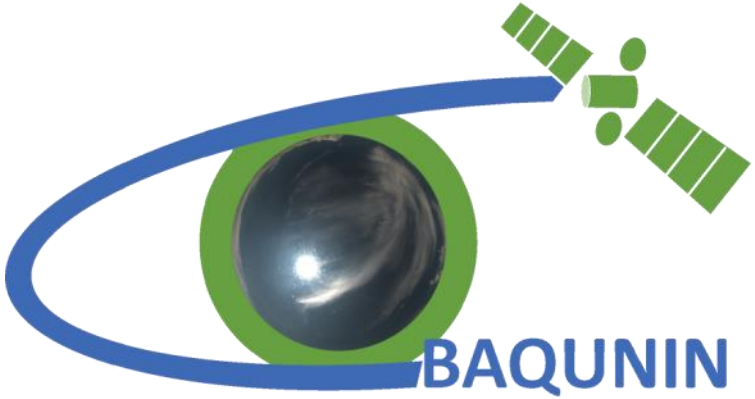

Boundary-layer Air Quality-analysis Using Network of Instruments Supersite

June 2016: WP of ESA - IDEAS+ project
March 2019: ESA - BAQUNIN Project

BAQUNIN staff:

SERCO: A.M. Iannarelli, S. Casadio, G. Mevi, M. Cardaci, E. De Grandis
Atmospheric Physics Laboratory Sapienza: M. Cacciani, A.M. Siani, A. Di Bernardino
CNR-ISAC: M. Campanelli
CNR-IIA: C. Bassani
Sardegna Clima Onlus: A. Murgia

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BAQUNIN Summary

- BAQUNIN Super Site description
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- Products examples
- Involvement in QA4EO

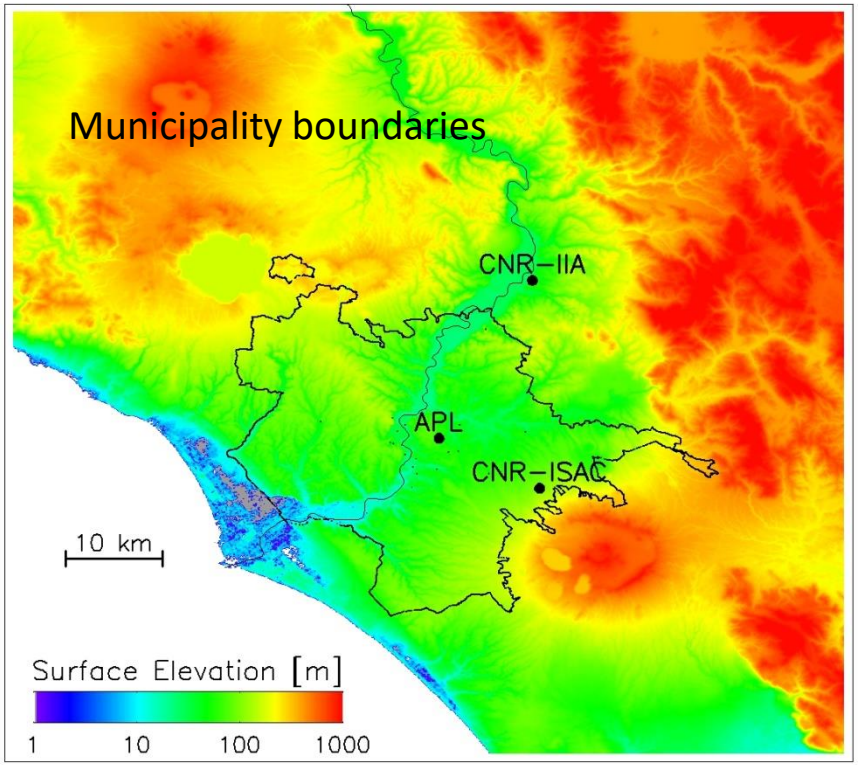
BAQUNIN Super Site Locations

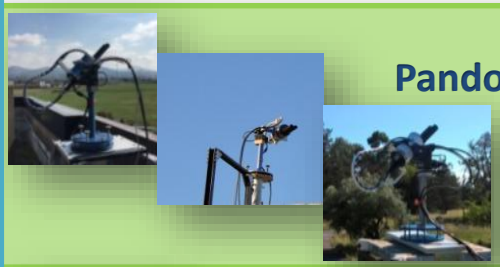
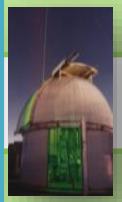
Rome is an urban site, with about **3.0 million of inhabitants**, 25 km east from the Mediterranean Sea, in the middle of an undulating plain.

The atmosphere is affected by **traffic emission** as well as by **semi-rural particulates** and, especially during summer season, by **sea breeze and desert dust** advection from the Saharan region.

BAQUNIN Super Site Locations

APL Atmospheric Physics Laboratory Sapienza University	City center
CNR - ISAC Institute of Atmospheric Sciences and Climate	Tor Vergata Southeast of the city, 13 Km from the city center
CNR - IIA Institute for Atmospheric Pollution	Montelibretti Northeast of the city 24.6 Km from the city center.



BAQUNIN instruments	PI Affiliation	LO Affiliation	Owner
 Pandora 2S #115 #117 #138	Serco	ISAC Serco IIA	ESA
  Cimel Prede Pom 01	LOA (Laboratoire d'Optique Atmosphérique) ISAC	ISAC - Serco	LOA PNRA - ISAC
 Brewer Meteorological Sensors	Sapienza	Sapienza	Sapienza Fondazione Osservatorio Meteorologico Milano Duomo
 MFRSR	Sapienza	Serco	Sapienza
  Pyranometer Skycam	Serco	Serco	ESA
 LIDAR	Sapienza	Sapienza -Serco	Sapienza -ESA
 SODAR	Sapienza	Sapienza	Sapienza - ISAC
WRF Model	Sardegna Clima	Sardegna Clima Serco	Sardegna Clima

BAQUNIN Super-Site products & instruments

‡ Instruments present in more than one location

	BAQUNIN PRODUCTS	INSTRUMENTS
Gases	O3 surface, tropospheric and total column	PANDORA 2S ‡, BREWER
	NO2 surface, tropospheric and total column	PANDORA 2S ‡, BREWER
	SO2 surface, tropospheric and total column	PANDORA 2S ‡
	HCOH surface, tropospheric and total column	PANDORA 2S ‡
	H2O total column, profile	CIMEL, LIDAR , *PANDORA 2S* ‡, *PREDE* ‡, *MFRSR*
Aerosol	Aerosol Optical Depth (AOD)	CIMEL, PREDE ‡, MFRSR, LIDAR , *PANDORA 2S* ‡
	Aerosol backscattering and extinction profiles	LIDAR, CEILOMETER
	Ångström Exponent	CIMEL, PREDE ‡, *PANDORA 2S* ‡, LIDAR
	Single Scattering Albedo (SSA), Volume size distribution (VSD), Real and imaginary part of Refractive Index (Refr. Indx), Phase Function (PF)	CIMEL , PREDE ‡
Solar Radiation	Solar Irradiance	PYRANOMETER
	Spectral Radiance	PANDORA 2S ‡
	UV Dose, UV Index	BREWER
Clouds	Cloud top/bottom, Cloud Optical Depth (COD)	LIDAR, CEILOMETER
	Cloud mask and fraction	All Sky Camera
Wind	Turbulence, Wind Speed and Direction	SODAR
In situ/ forecating model	Surface air temperature, humidity, pressure and wind	Meteorological sensors, WRF

Networks collaborations

Pandonia Global Network
Aeronet
ESR/SKYNET
Eubrewnet
Climate Network

BAQUNIN Summary

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BAQUNIN Cal/Val Activities

- *Copernicus S5p Cal/Val project ID 42807, in collaboration with CNR, ENEA*
- *EarthCare Cal/Val project ID 38811, in collaboration with CNR and ENEA*
- *Validation of GCOM-C SGLI AOD (aerosol optical depth @500nm) using BAQUNIN AERONET and EUROSKYRAD data*
- *Validation of GOSAT TANSO-FTS IWV (Integrated Water vapour) using BAQUNIN–AERONET data*

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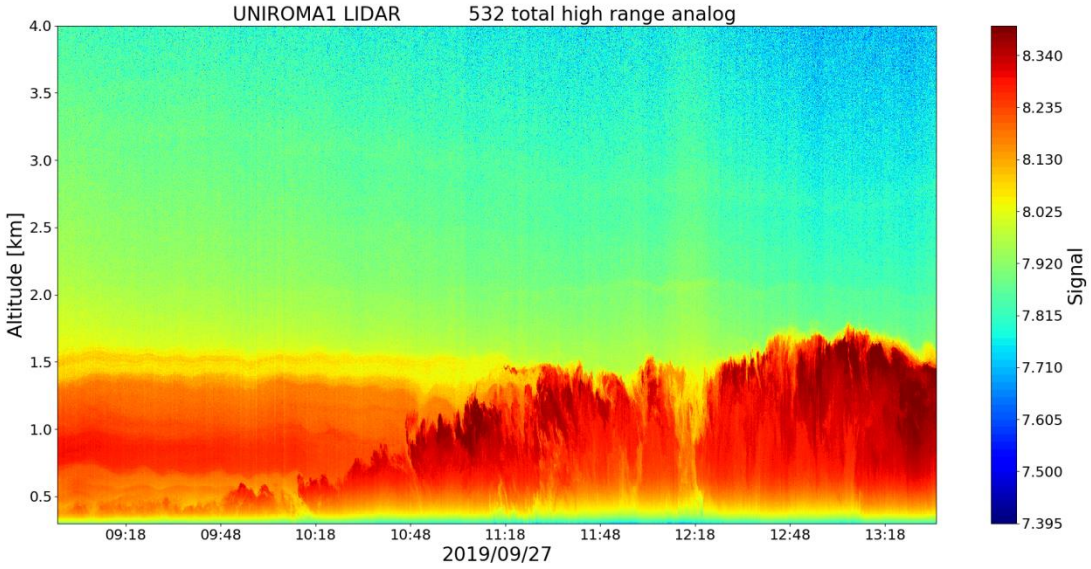
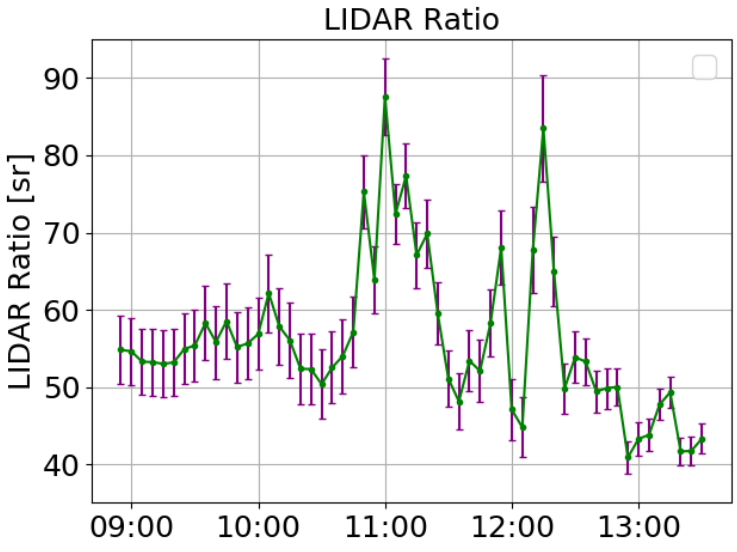
BAQUNIN Products examples

LIDAR analysis: Aerosol

The synergy between photometers and LIDAR measurements allows the estimation of aerosol LIDAR Ratio (LR) using an iterative algorithm.



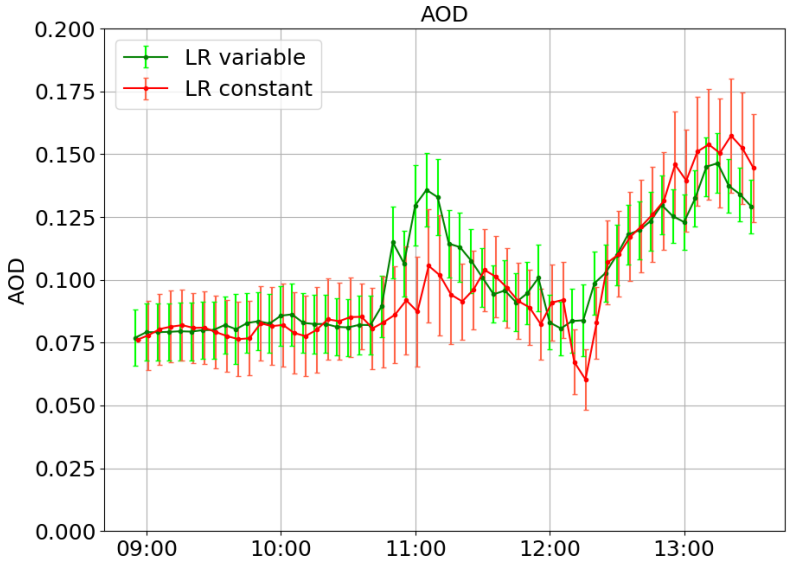


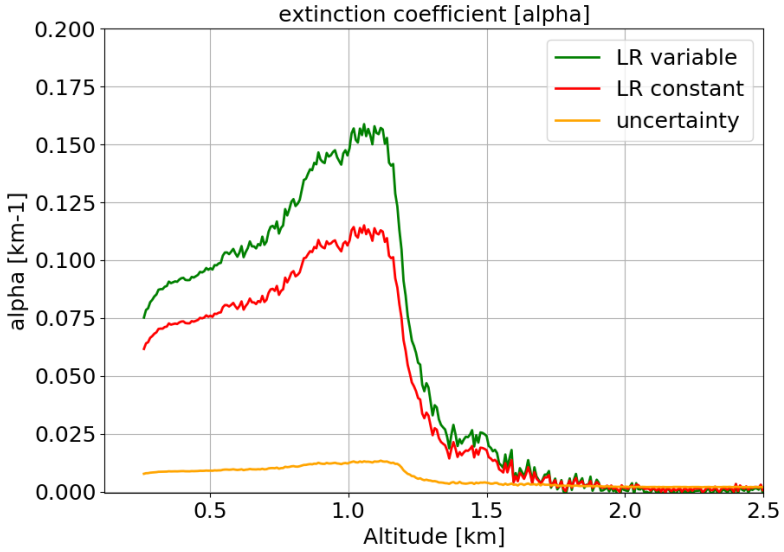
LR obtained from Aeronet AOD value at 500 nm, converted to 532 nm using AAE from Aeronet (Giles et al., 2019)

BAQUNIN Products examples

LIDAR analysis: Aerosol

Comparison of retrieved AOD and extinction profiles using fixed/variable LR





AOD values retrieved using Fixed and Variable LR measurements are represented with their uncertainty.

Extinction coefficient of the acquired profile at 11.00 utc
Fixed LR
Variable LR

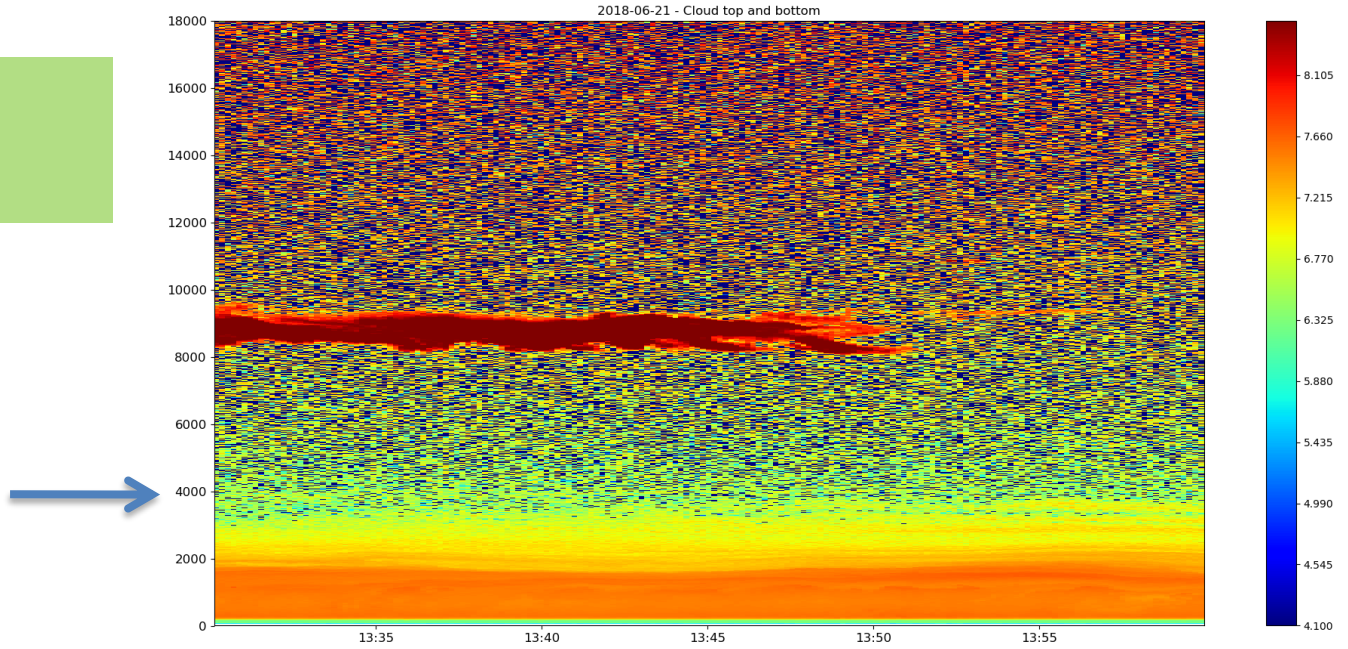
BAQUNIN Products examples

LIDAR analysis: Cloud

Algorithm for the identification of BL height and cloud top and bottom heights, using a signal threshold approach. The algorithm considers the Range Corrected Signal (RCS) and its spatial and temporal variations. (Z.Wang e al., 2001)

Steps description:

1) PBL height detection exploiting the vertical variability of the signal



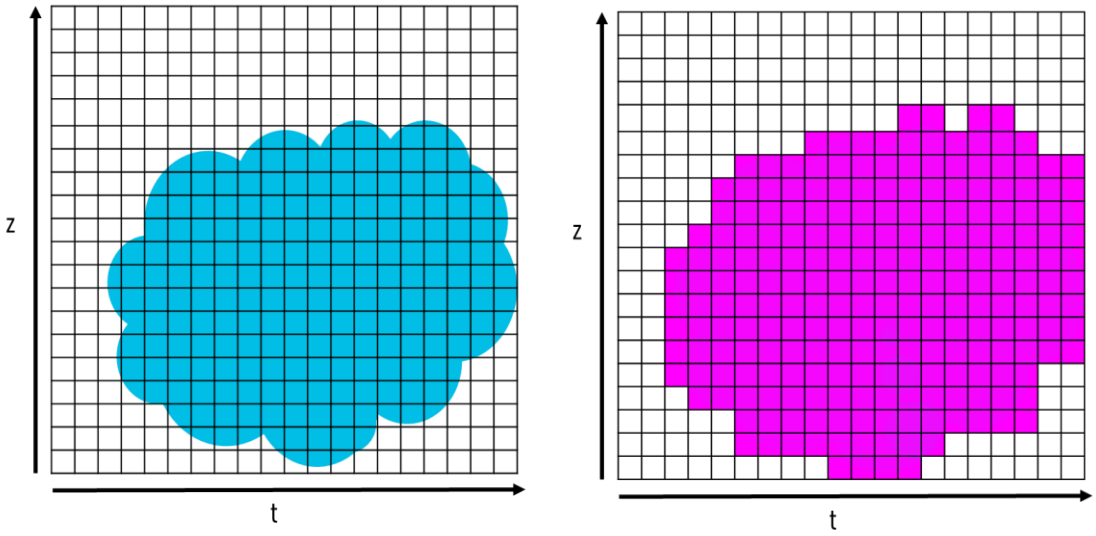
BAQUNIN Products examples

LIDAR analysis: Cloud

Algorithm for the identification of BL height and cloud top and bottom heights, using a signal threshold approach. The algorithm considers the Range Corrected Signal (RCS) and its spatial and temporal variations.

Steps description:

1) PBL height detection exploiting the vertical variability of the signal
2) Selection of the pixels with signal above a pre-defined threshold



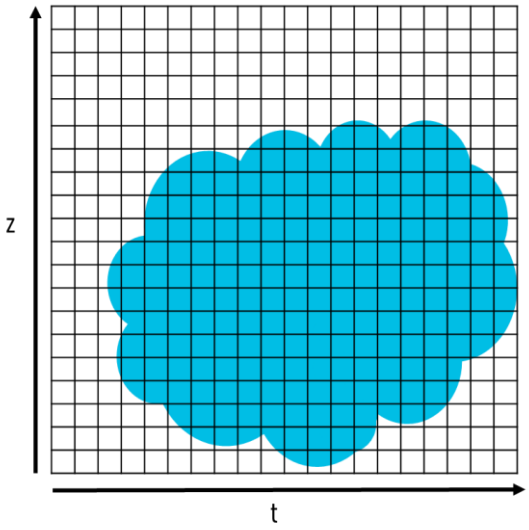
BAQUNIN Products examples

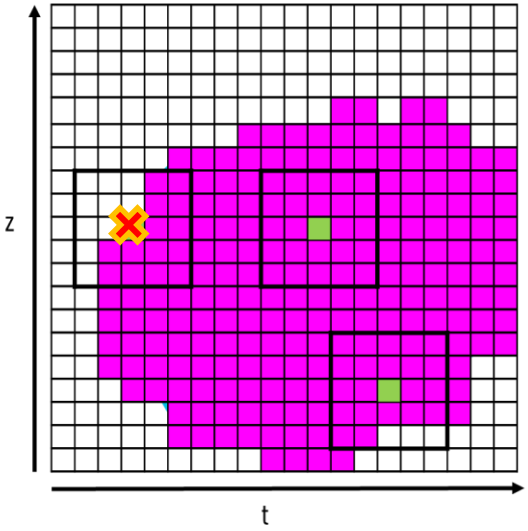
LIDAR analysis: Cloud

Algorithm for the identification of BL height and cloud top and bottom heights, using a signal threshold approach. The algorithm considers the Range Corrected Signal (RCS) and its spatial and temporal variations.

Steps description:

1) PBL height detection exploiting the vertical variability of the signal
2) Selection of the pixels with signal above a pre-defined threshold
3) Screening of selected pixels to exclude signal spikes [considering a grid 5x5]





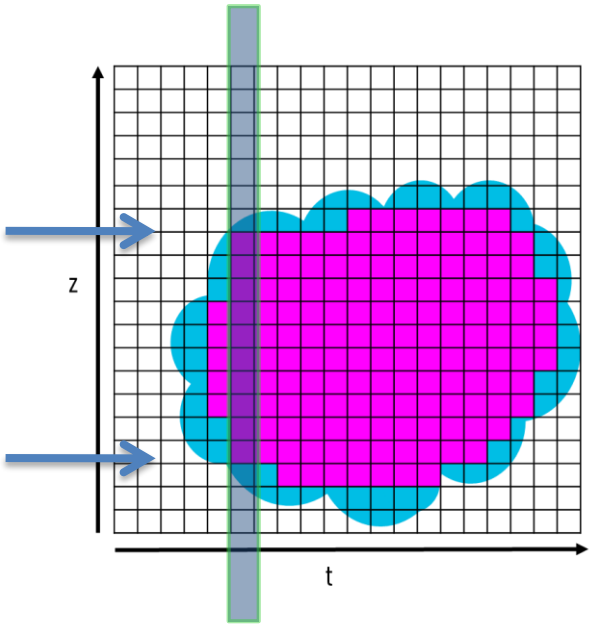
BAQUNIN Products examples

LIDAR analysis: Cloud

Algorithm for the identification of BL height and cloud top and bottom heights, using a signal threshold approach. The algorithm considers the Range Corrected Signal (RCS) and its spatial and temporal variations.

Steps description:

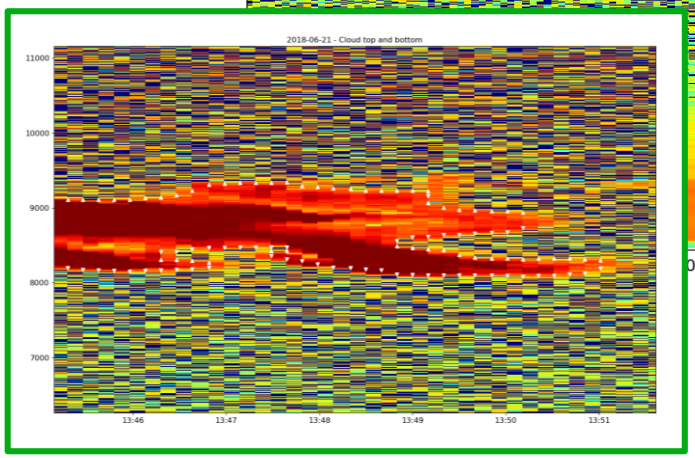
1) PBL height detection exploiting the vertical variability of the signal
2) Selection of the pixels with signal above a pre-defined threshold
3) Screening of selected pixels to exclude signal spikes [considering a grid 5x5]
4) Bottom and top of cloud heights retrieval



BAQUNIN Products examples

LIDAR analysis: Cloud

Cloud top/bottom product resolution:
Time/ Height= 3 x original profile resolution [30 sec / 22.5 m]



BAQUNIN Products examples

SBAM Seagull Borne Atmospheric Monitoring

Last year: first seagull ***Hope***

Set-up of instrumentation

Installation on the platform

Take off count down

Take off successful! (almost)

Development

On going

SBAM project approved by Sapienza university.

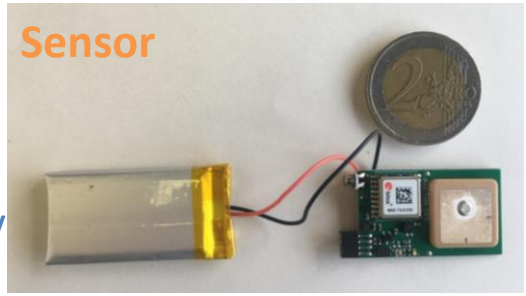
Phase 1 Placement of nests on the roof of 3 Departments building

Phase 2 Sensors inter-calibration: Temperature and Relative humidity

Phase 3 Development of CO2 sensors

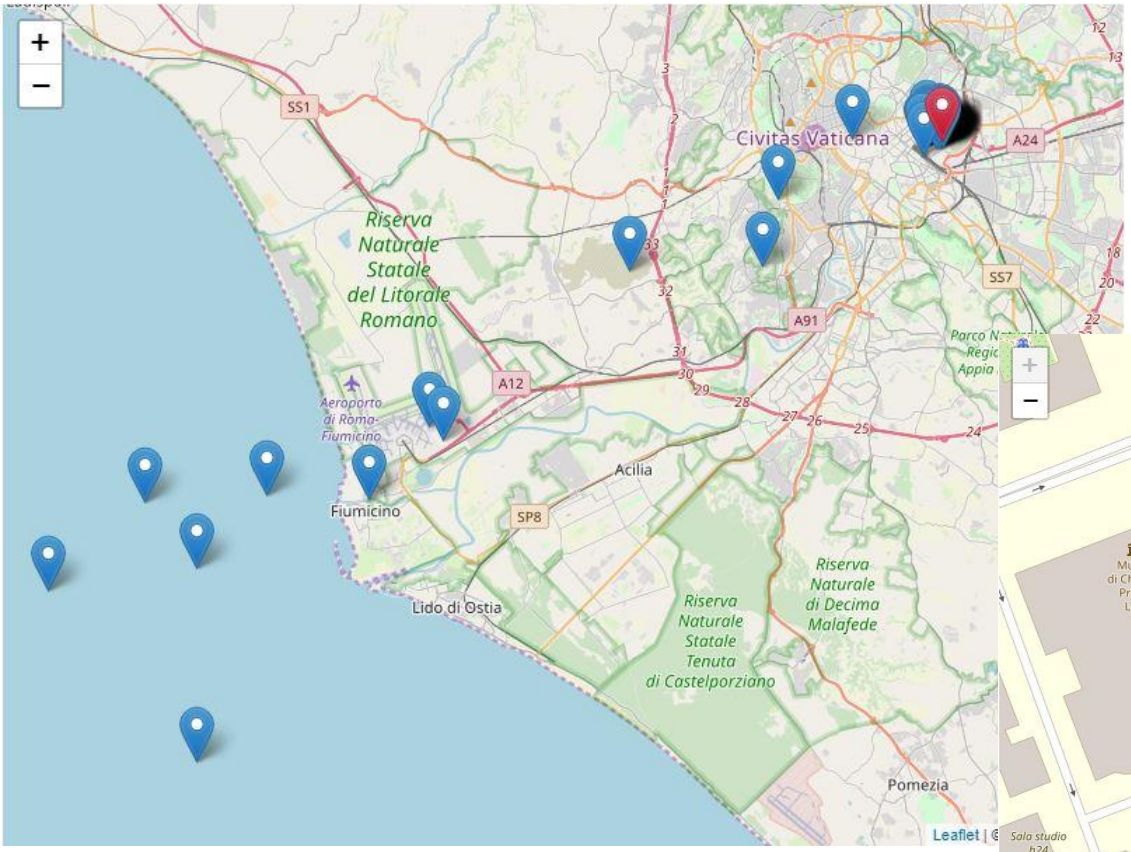
Phase 4 Installation of the instruments on seagulls

Phase 5 Seagulls monitoring



BAQUNIN Projects

SBAM Seagull Borne Atmospheric Monitoring



The seagull ***Hope*** positions during last days!

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BAQUNIN involvement in QA4EO (2020-2022)

WP #1

Use of drone and multi-spectral camera for BRDF angular and spectral measurements

The aim is to acquire know how on instrumental setup and operation in order to provide experimental data for satellite (e.g. Sentinel-2) validation purposes.

The work is performed in collaboration with Engineering Department University Tor Vergata (drone and spectral camera) and CNR-IIA (RT modelling and measurement requirements)

WP #2

Retrieval of cloud mask, cloud bottom height and, possibly, wind speed at cloud bottom, using two sky-cameras and a ceilometer

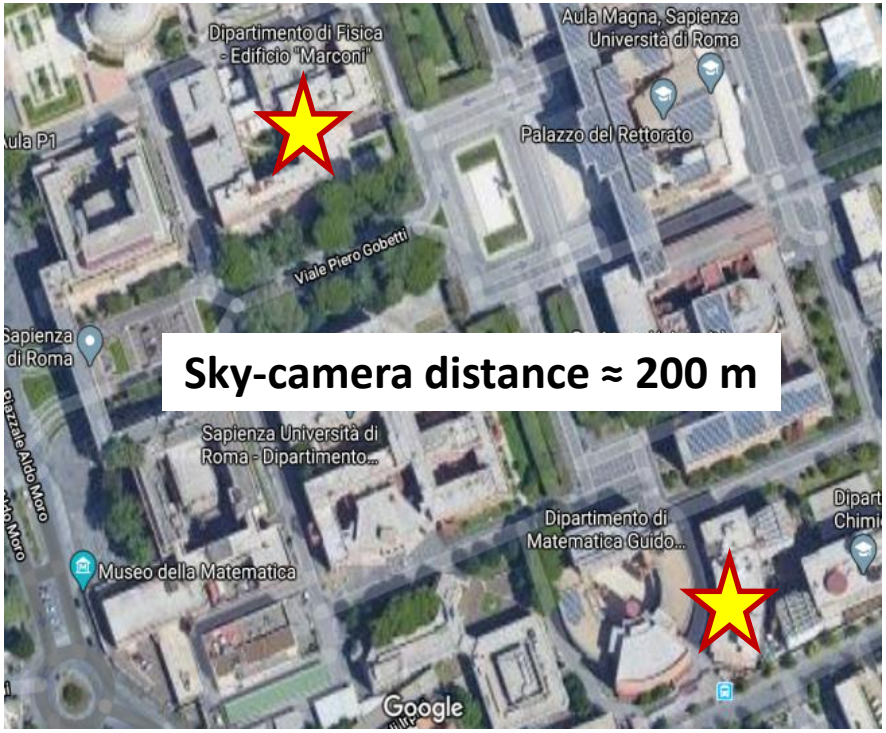
The aim is to exploit the sky-camera images acquired in “stereo mode” and to use the ceilometer data in support of the retrieval scheme developments.

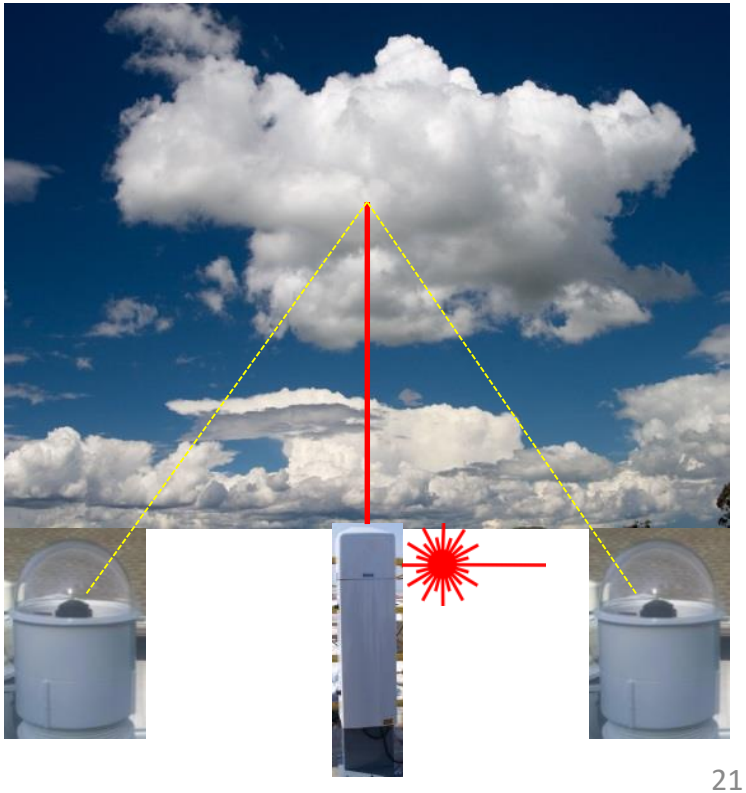
The work is performed in the context of ACIX/CIMIX activities, and involves NASA-GSFC (sky-cameras, retrieval methodology) and Brockmann Consult (data analysis)

BAQUNIN involvement in QA4EO

Retrieval of cloud mask, cloud bottom height and, possibly, wind speed at cloud bottom, using two sky-cameras and a ceilometer

Sky-cameras will be installed on the roof of Marconi and Fermi building of Physics Department
Ceilometer will be installed and operated on the roof of Fermi building





SORBETTO

SOlar Radiation Based Established Techniques for aTmospheric Observations

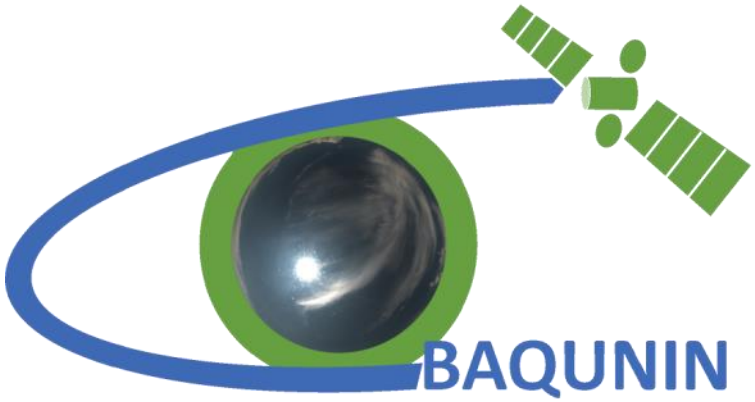
Organized by ISAC-CNR, Sapienza University of Rome, ESA. Funded by SERCO within the IDEAS project

1° SORBETTO Summer School 2-6 July 2018

NEW

2° SORBETTO Summer School September 2020

m.campanelli@isac.cnr.it



Boundary-layer Air Quality-analysis Using Network of Instruments Supersite

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Thanks for your attention!!!