



Laboratory of Atmospheric Physics (LAP) Aristotle University of Thessaloniki (AUTH)

Research activities

Dimitris Balis

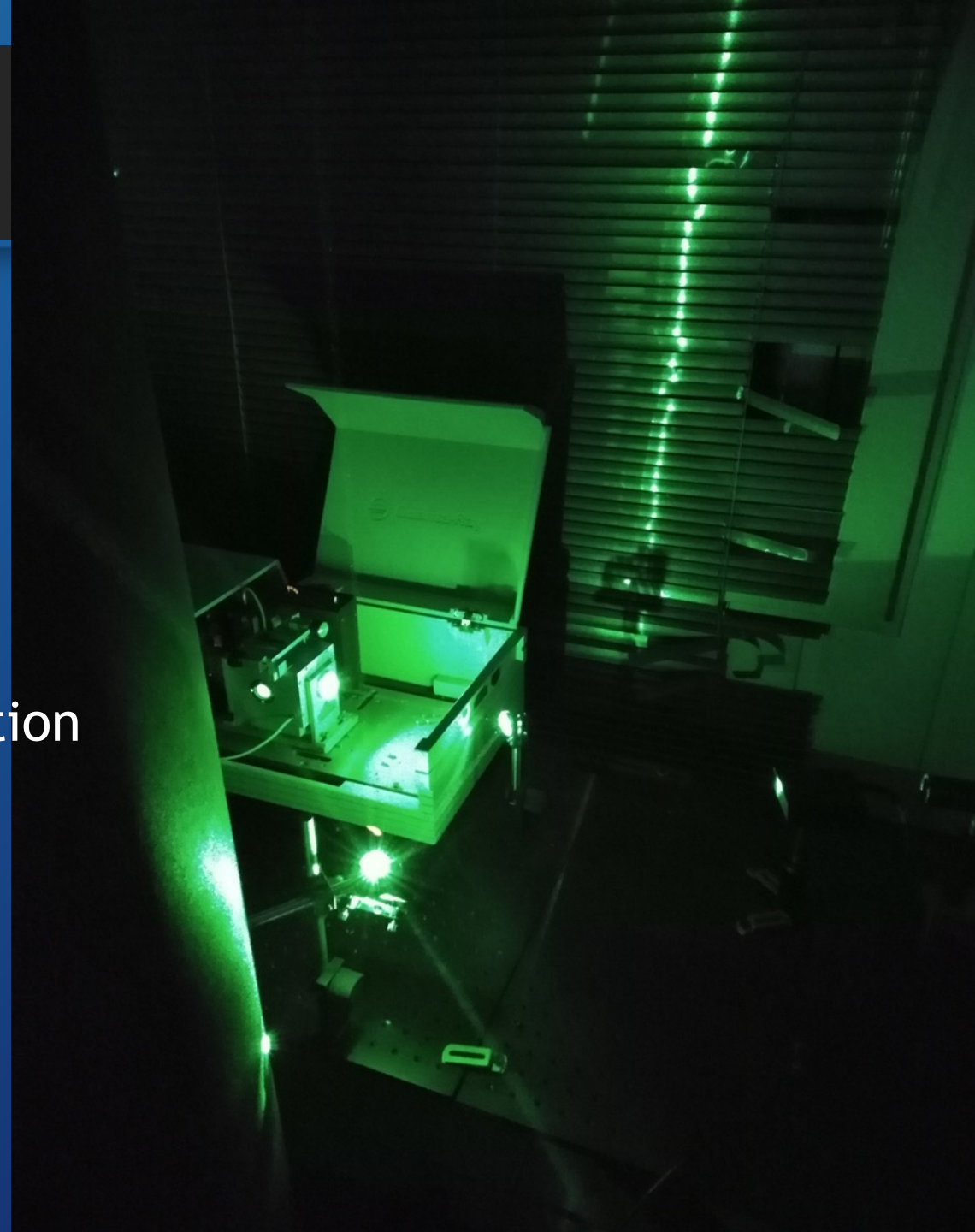
Head of LAP-AUTH

On behalf of all staff members and researchers of LAP-AUTH



Research at LAP-AUTH

- Long-term atmospheric monitoring
 - Total Ozone Column
 - Solar Radiation (spectral and broadband)
 - Aerosols
 - Trace Gases
- Experimental campaign-based studies
- Satellite validation on atmospheric composition
- Modelling studies
 - Radiation
 - Air-quality
 - Climate (global and regional)
 - Weather



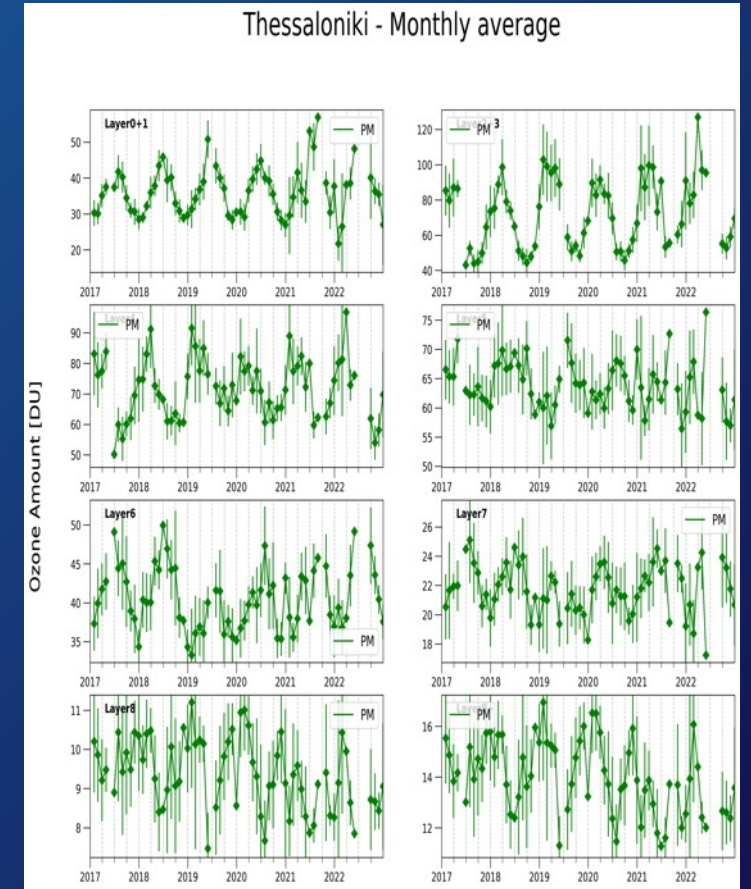
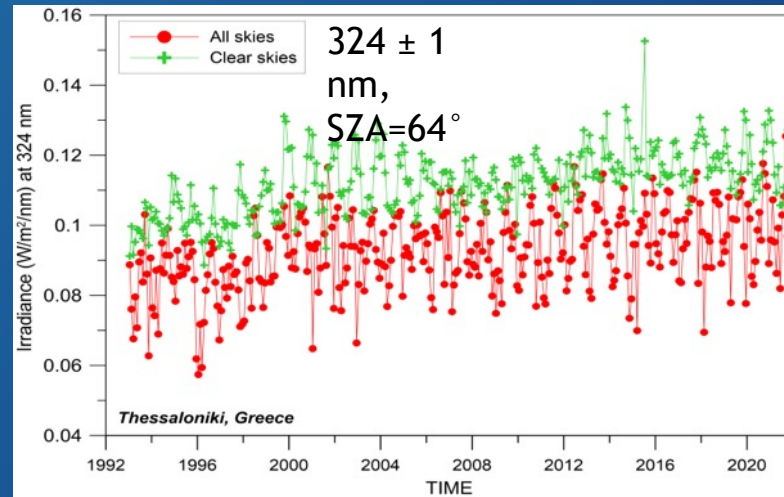
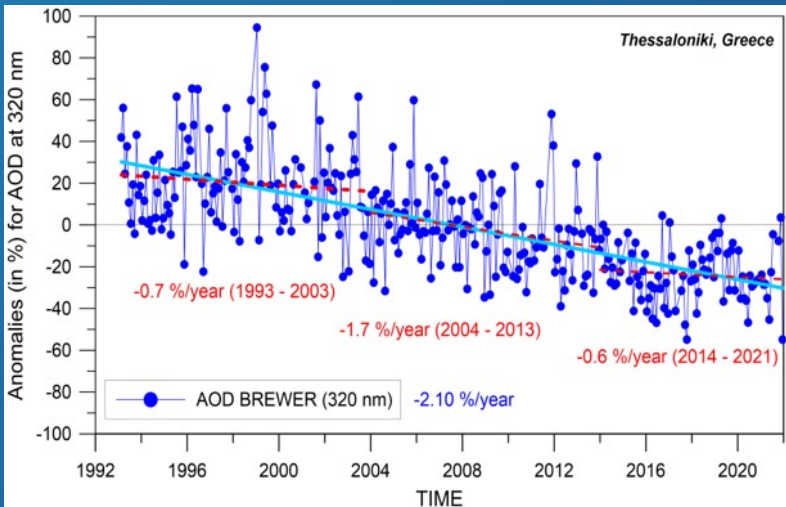
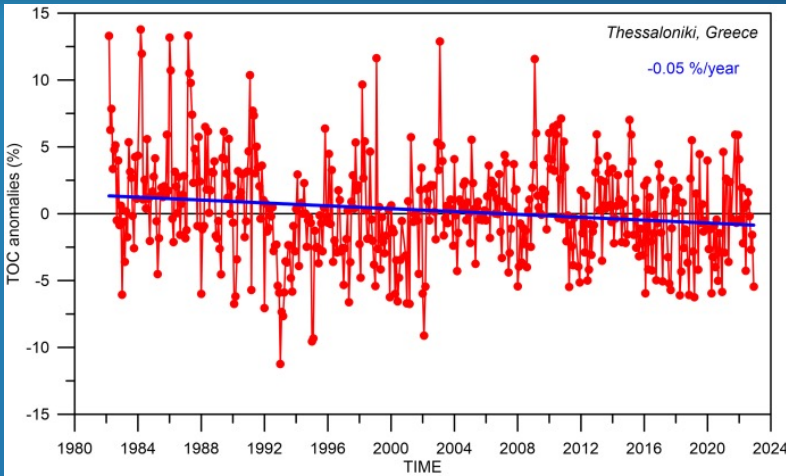
Scientific infrastructure of LAP-AUTH



- **Single Brewer** spectrophotometer #005 (1982)
- **Double Brewer** spectrophotometer #086 (1993)
- **UV and SW Radiometers** (1991, 1993 & 1998-)
- **Aerosol Lidar** (1994)
- **CIMEL** sunphotometer (2003)
- **MaxDOAS** spectrophotometers (2011)
- **Pyrheliometer** (2017)
- **FTIR** spectrometer (2019)
- **Sky Camera** (2014-)
- **Meteorological station** (2020-)



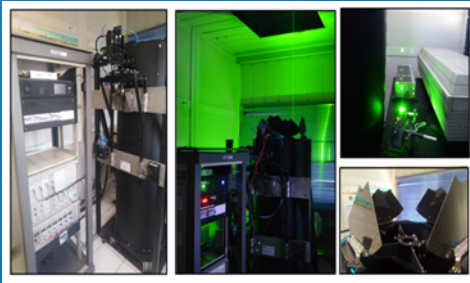
Ground-Based instruments (Brewer): Total ozone and spectral UV radiation



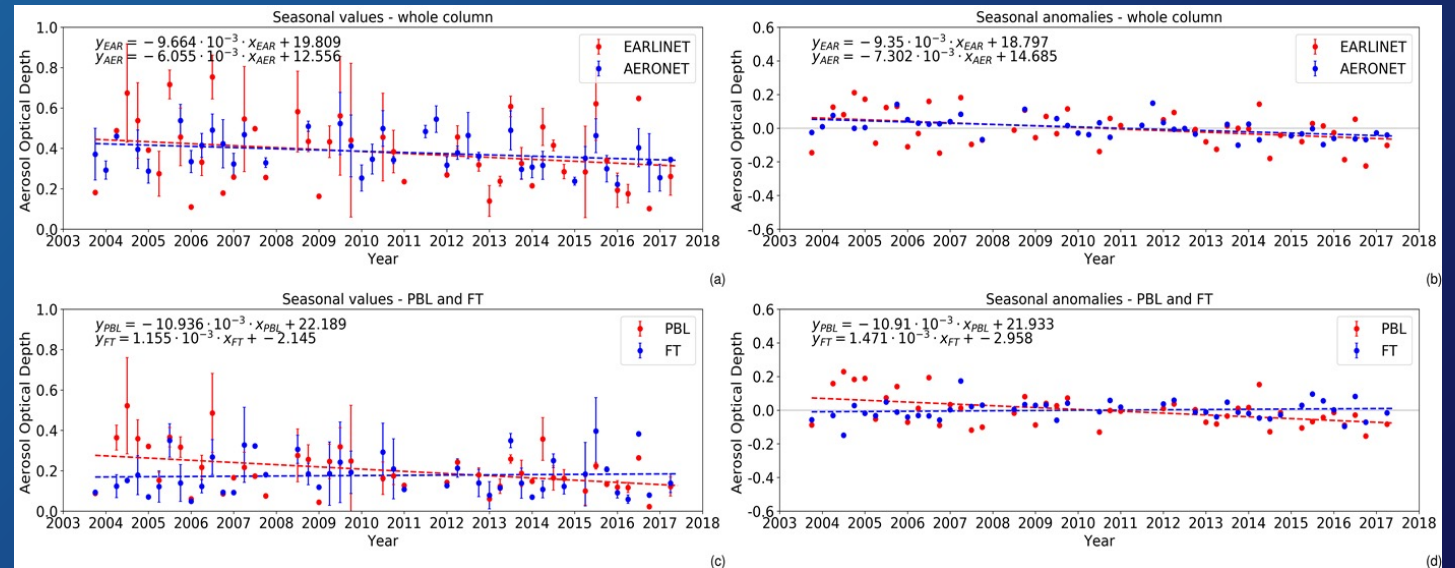
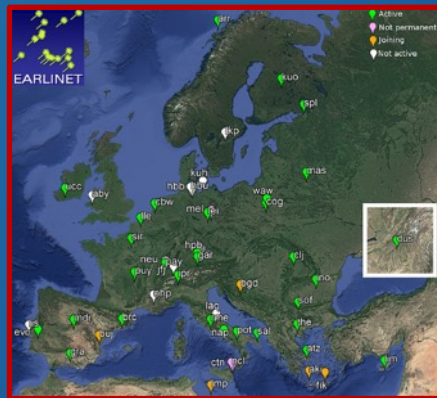
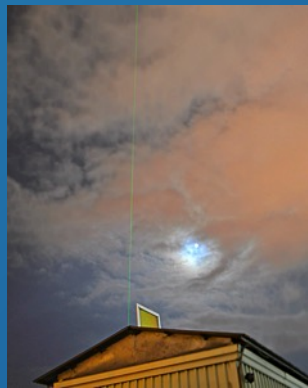
Ground-Based Instruments: Aerosol LIDAR measurements



- Multi-wavelength Raman Lidar (3b+2a+1d) since 2000
- 2023 Upgrade: Fluorescence retrievals (3β+2α+1δ + fluorescence + water vapor)



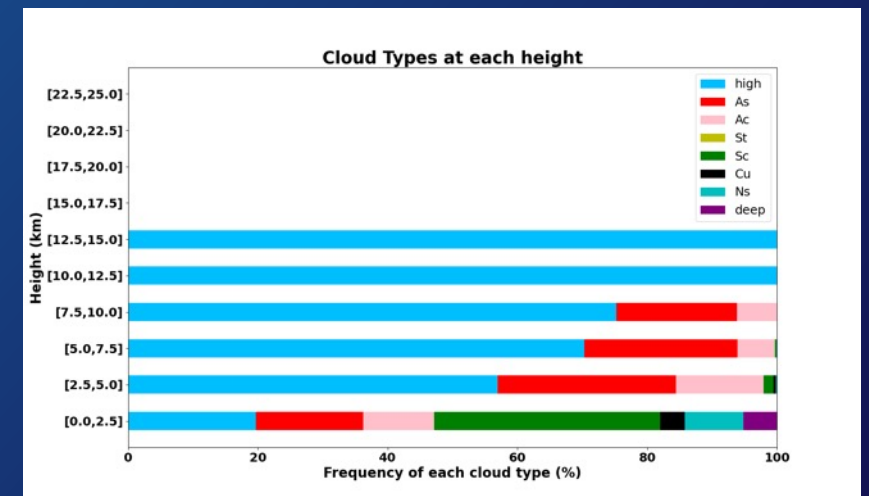
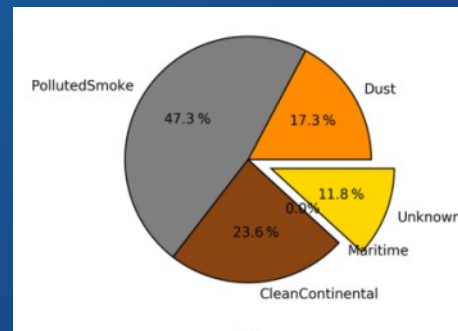
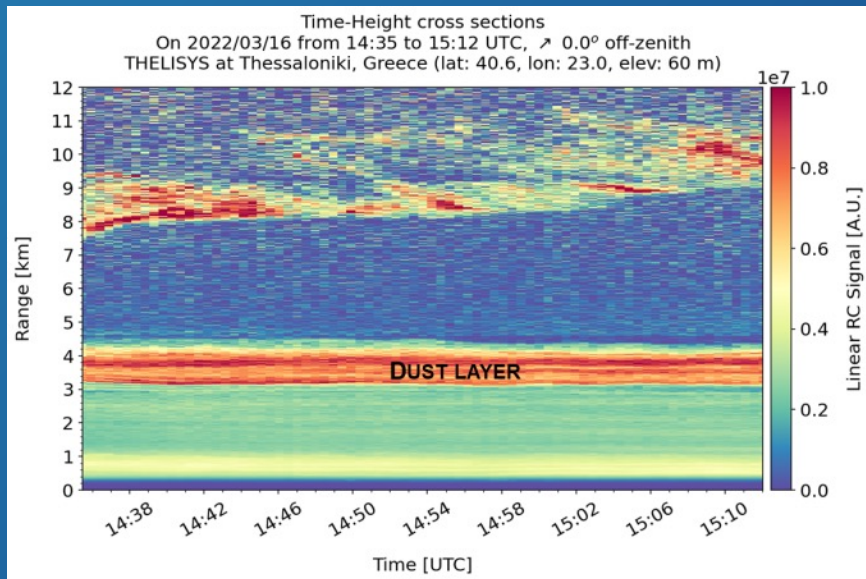
Member of EARLINET since 2000



Aerosol LIDAR activities



- Detection of special events (dust, fires)
- Aerosol typing and characterization
- CALIPSO and AEOLUS validation
- Evaluation of ESA satellite products (i.e., aerosol layer height)
- Validation of volcanic ash products from passive sensors



DOAS / MAX-DOAS systems



Instruments:

- Phaethon (home made - since 2006)
- Delta (research grade - since 2022)
- Pandora (Pandonia network) - since 2022)

Measurements:

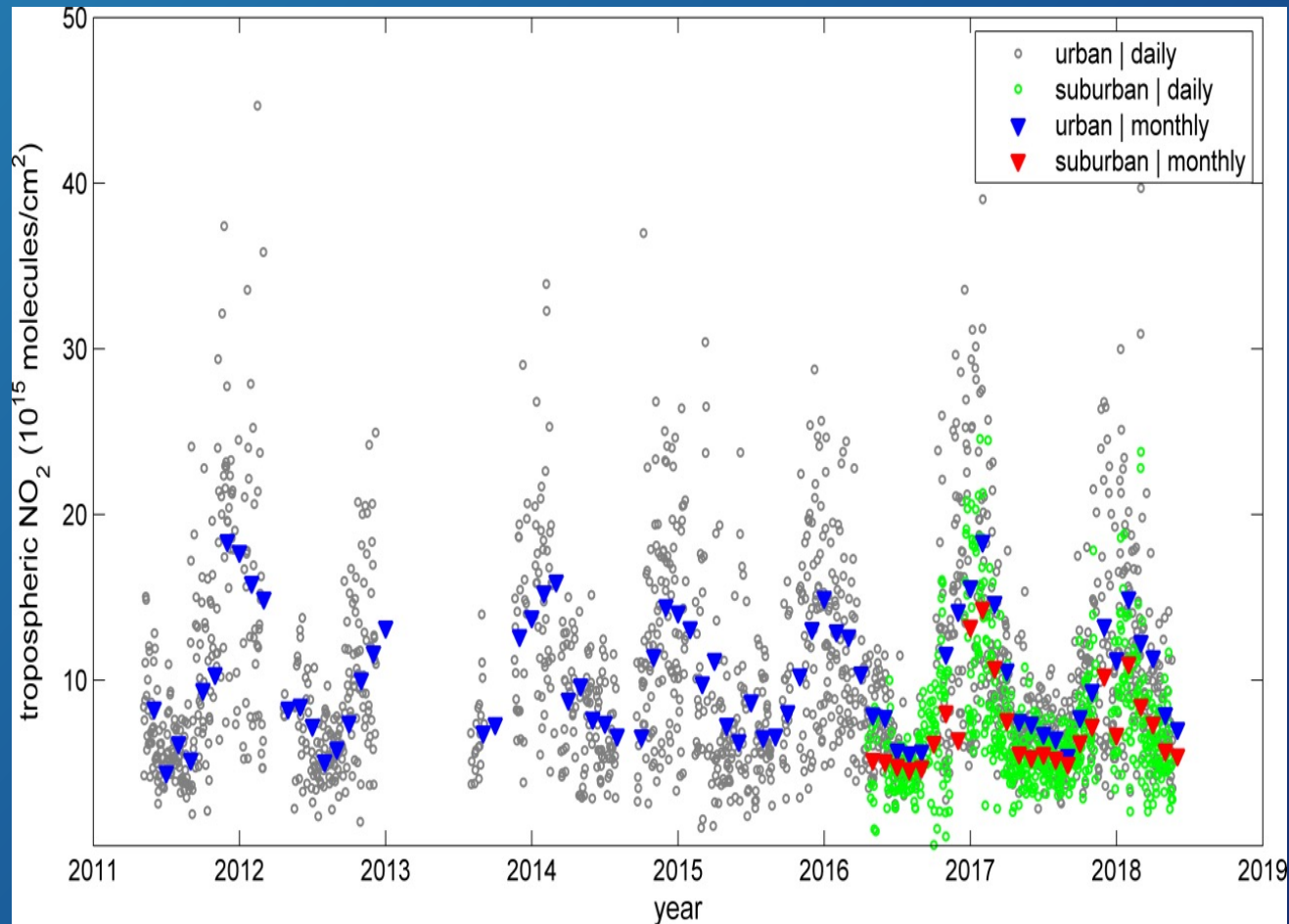
- Direct-sun/sky-radiance spectra (UV / VIS ranges)
- 2-axis trackers (3D observations elevation/azimuth)
- CCD-based spectrographs

Products:

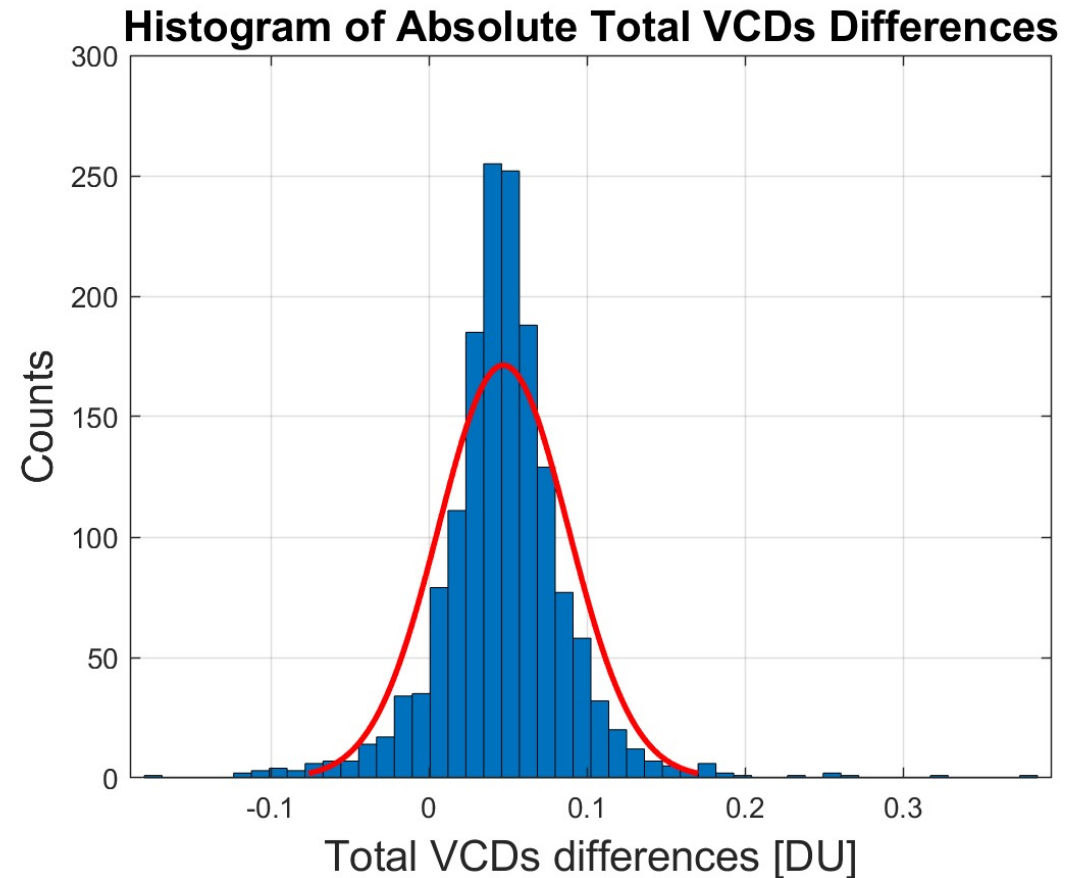
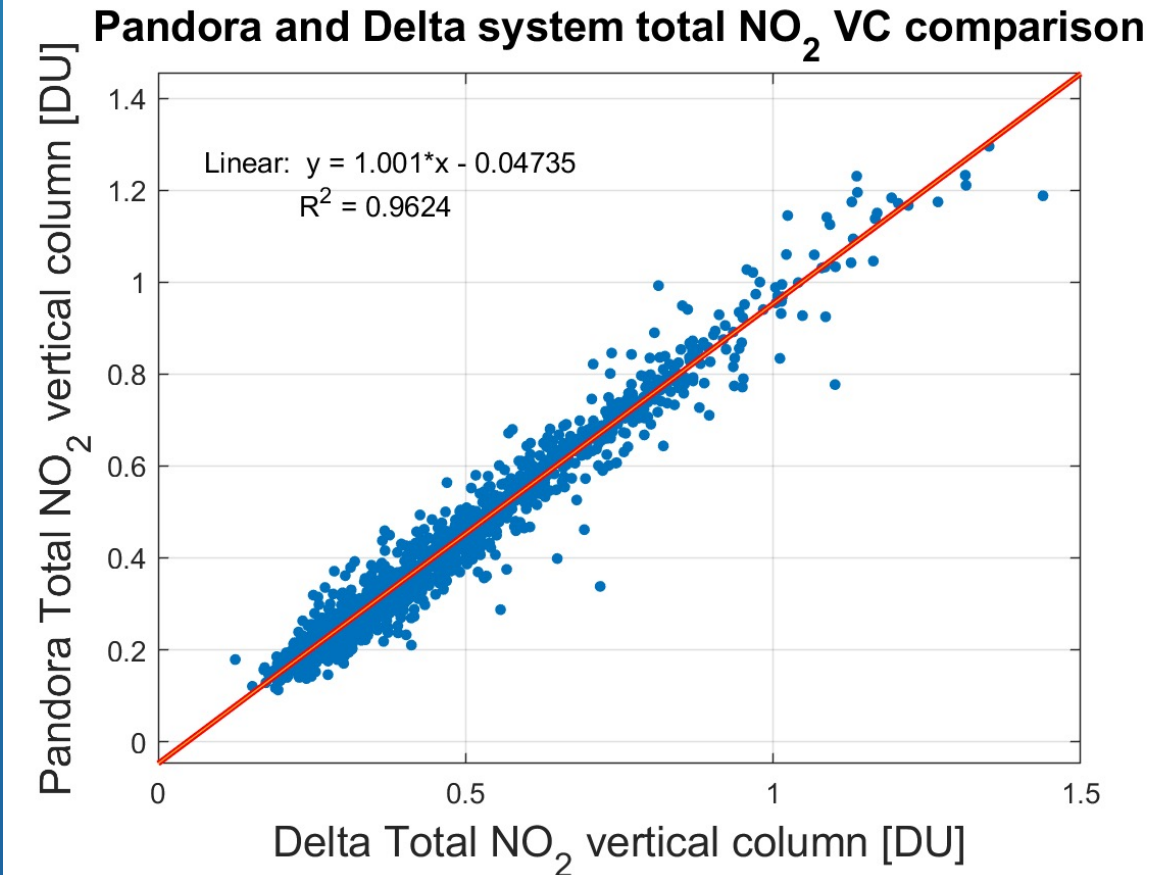
- Total and tropospheric columns
- Vertical profiles - surface concentrations
- Species NO_2 , O_3 , HCHO, SO_2
- O_4 - proxy for aerosol extinction profiles & optical depth



Medium-term Tropospheric NO₂ VCD



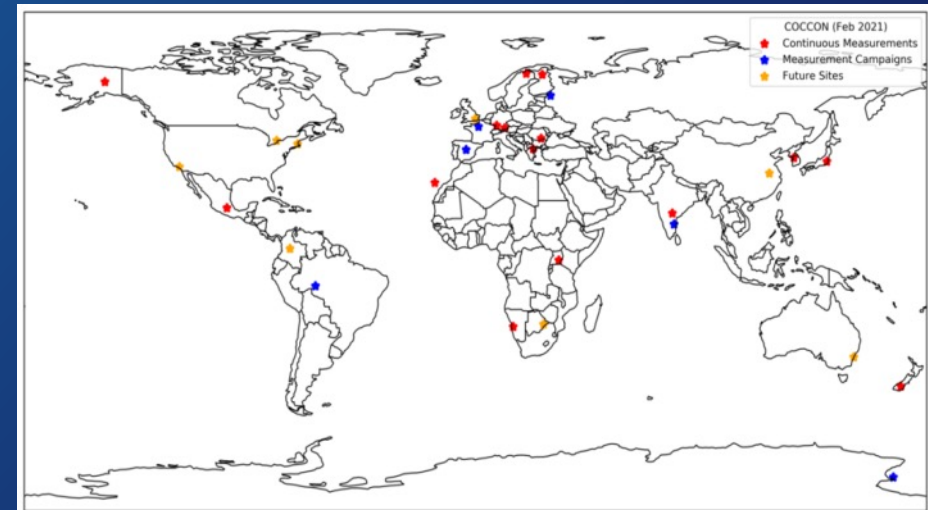
Total NO₂ vertical column comparison between Delta and Pandora system



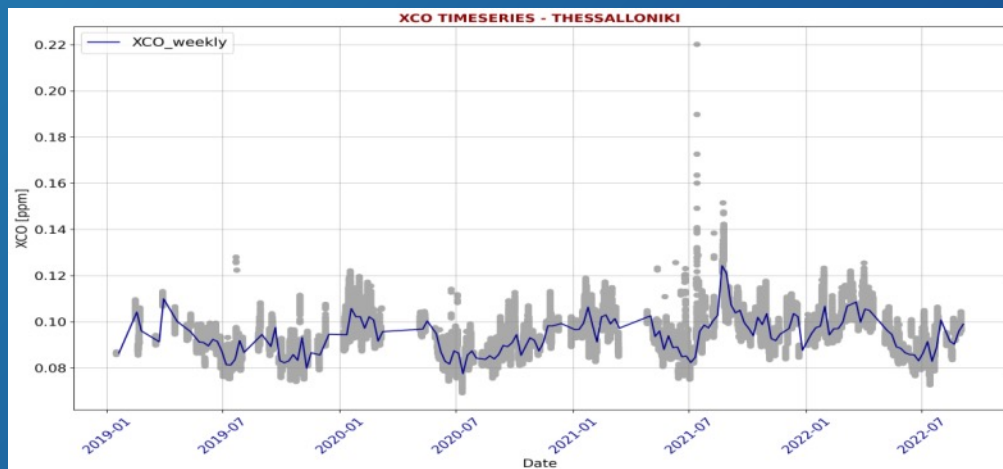
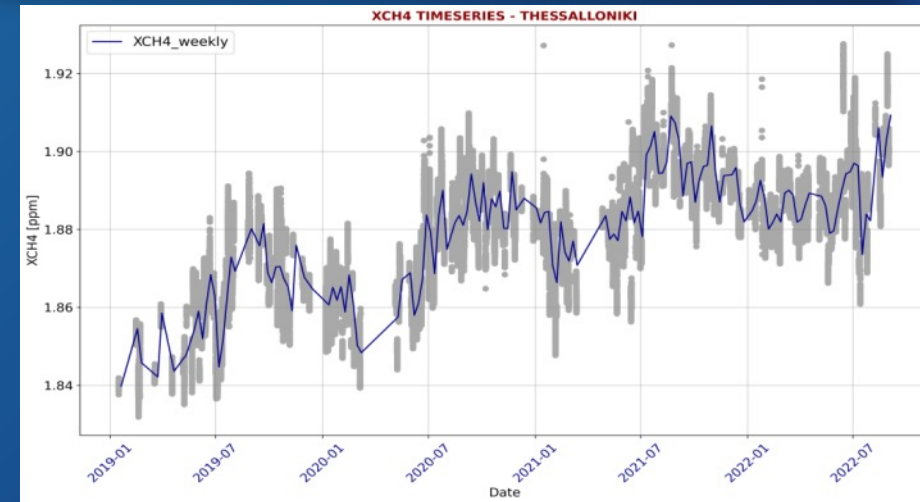
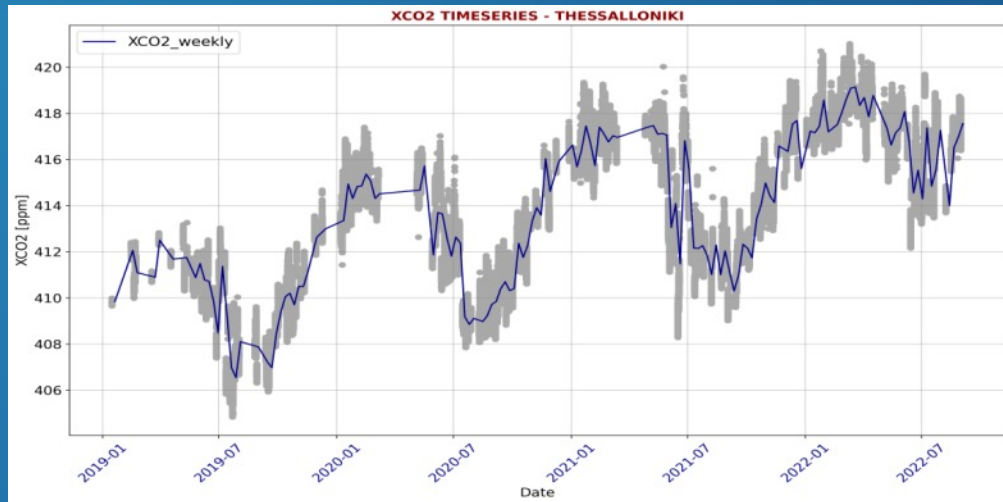
EM27/SUN FTIR spectrometer



- Developed in Karlsruhe Institute of Technology (KIT) in collaboration with Bruker Optics.
- Measures direct solar irradiance spectra in the near infrared (NIR).
- Products: Column-averaged dry air mole fraction of greenhouse gases [CO_2 , CO , CH_4 , H_2O].
- Part of the COllaborative Carbon Column Observing Network (COCCON) infrastructure

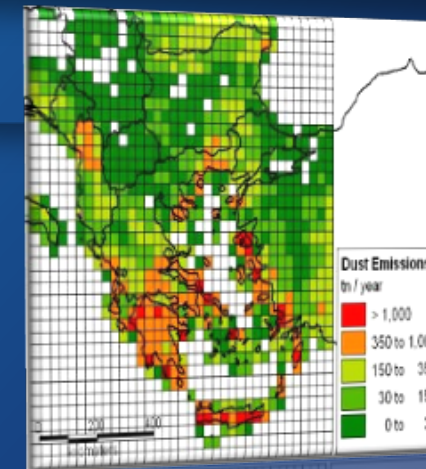
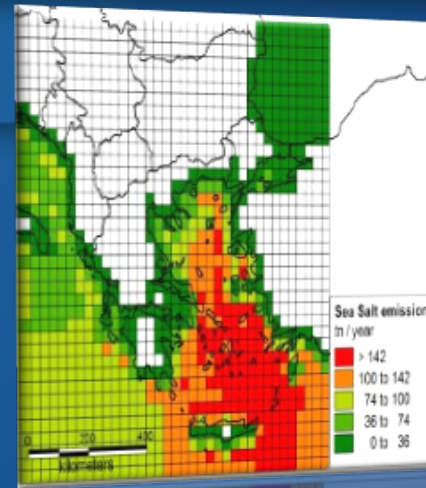
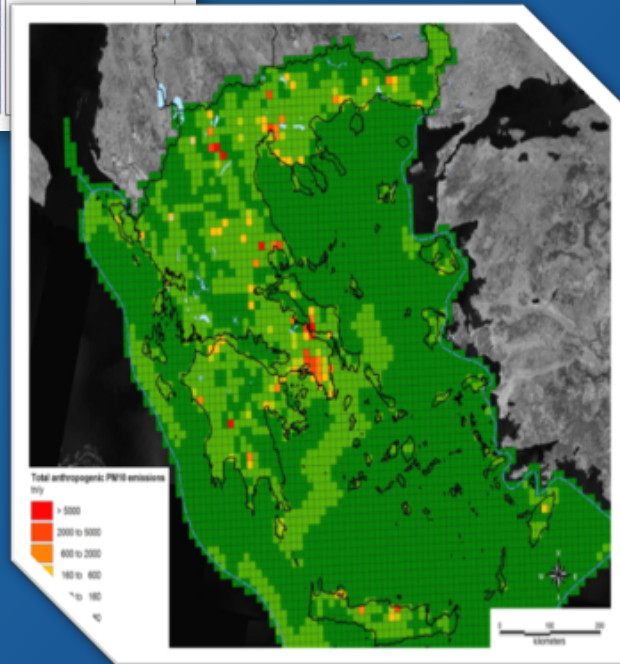
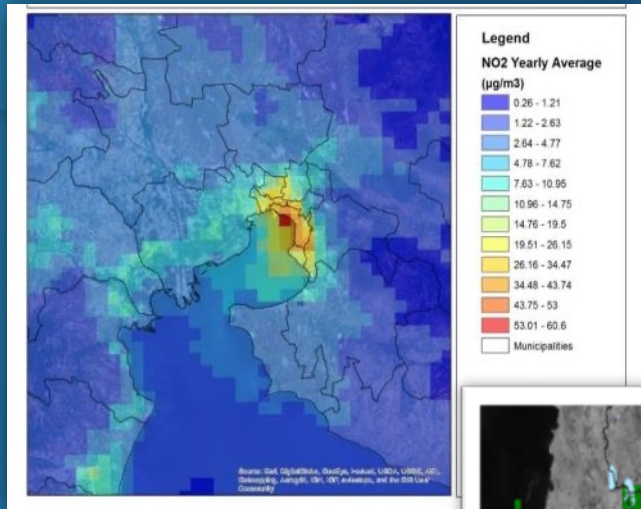


FTIR time series of CO₂, CO and CH₄



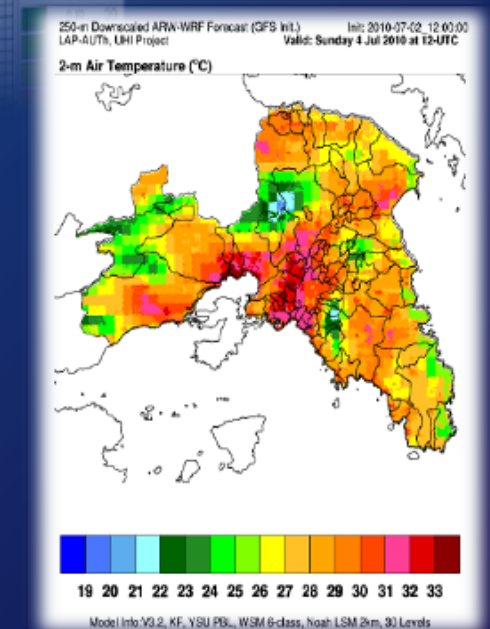
- Increase of 3 ppmv per year in XCO₂ due to anthropogenic emissions. Seasonal cycle of 14.2 ppm (peak-to-peak). Decreases of CO₂ during the local growing season due to photosynthesis.
- Increases in XCO concentrations during the cold period owing to fossil fuel combustion and heating. Increases due to transport from forest fires were detected in August 2021.
- XCH₄ is lower in spring and higher in summer (higher temperatures and more OH)

Air quality modeling system



Components:

- ✓ Anthropogenic emissions
- ✓ Natural emissions (NEMO)
- ✓ Meteorological modeling (WRF)
- ✓ Photochemical modeling (CAMx)

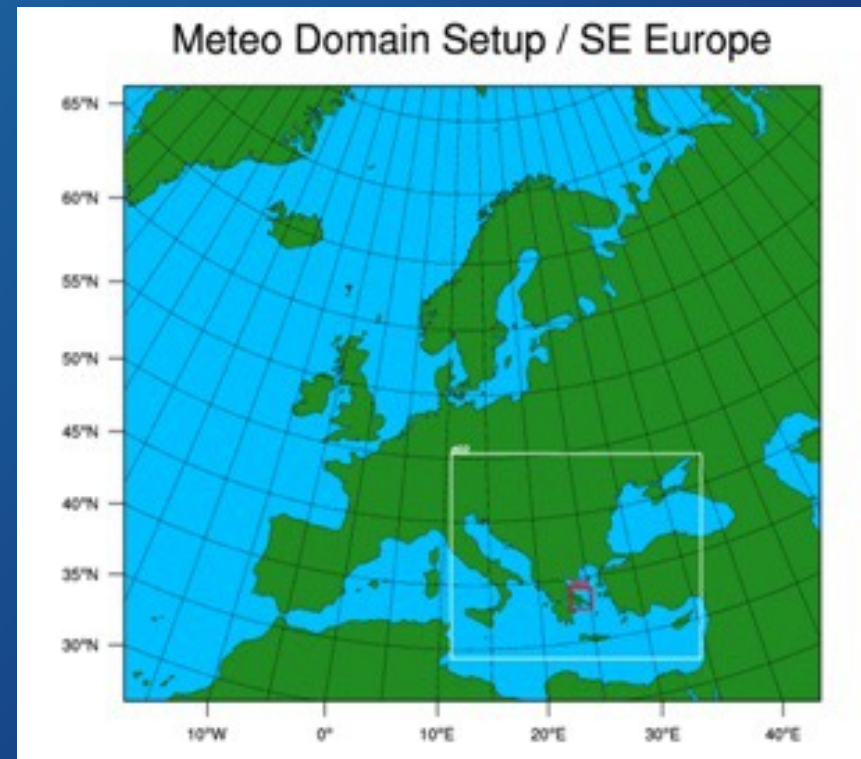
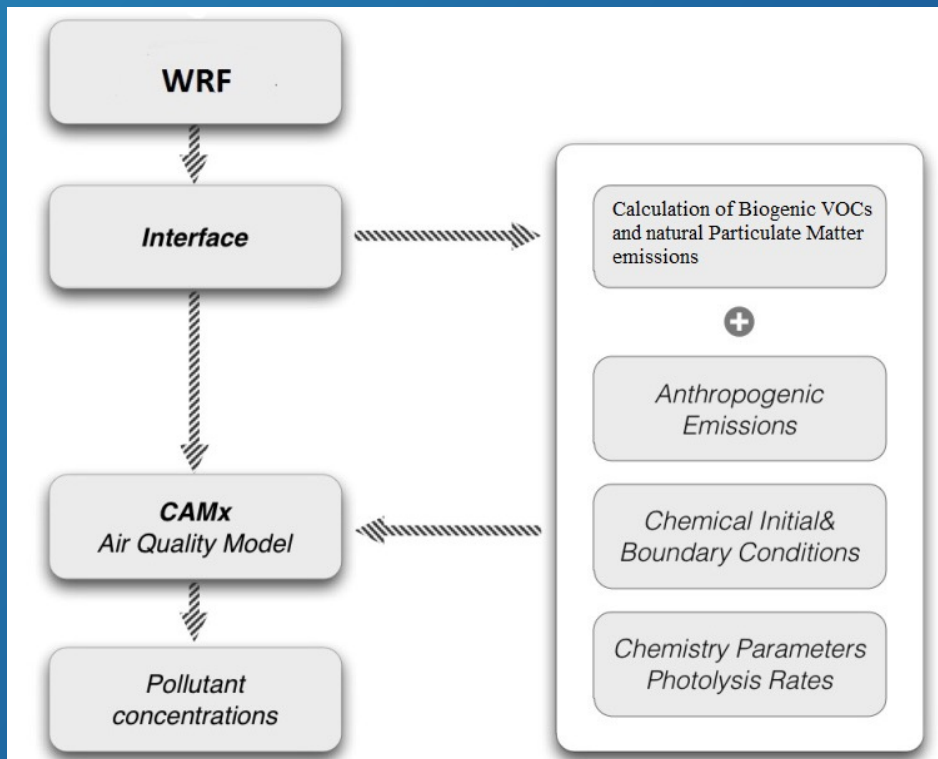


LAP-AUTH Air Quality Forecasting



Operational 72-hour forecasts of
 O_3 , NO_2 , NO , CO , SO_2 , $PM_{2.5}$ and PM_{10}
Based on WRF (3.2.1) – CAMx (5.3) system

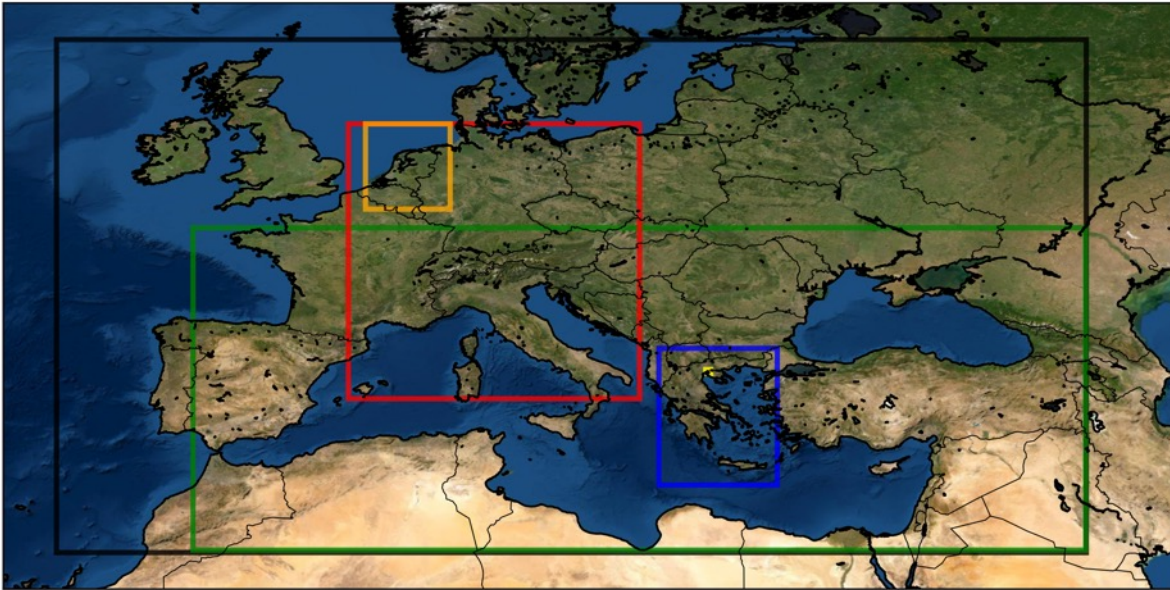
Europe (30km)
Eastern Mediterranean (10km)
Athens – Thessaloniki (2 km)



LOTOS-EUROS CTM v2.2



LOTOS-EUROS runs



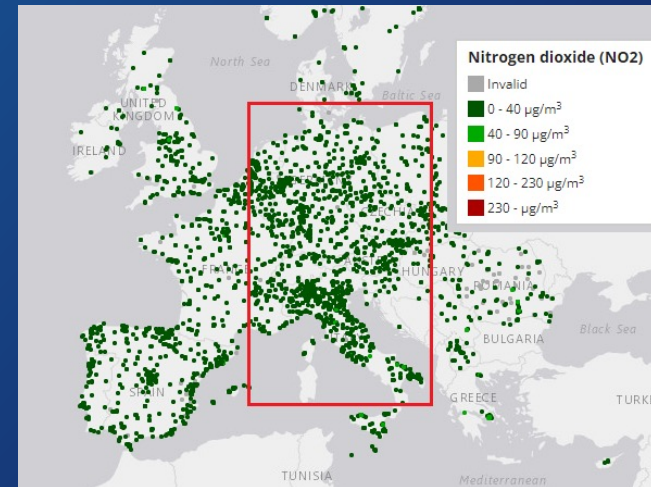
Color	Horizontal Resolution	Vertical scheme	Period
Black [Boundary]	0.25° x 0.25°	meteo12	1/2018-4/2021
Green [Mediterranean]	0.1° x 0.1°	meteo12 and meteo34	Only 2019
Red [Central Europe]	0.05° x 0.1°	meteo12 and meteo34	December 2018, January 2019, June 2019, July 2019
Orange [the Netherlands]	0.05° x 0.1°	meteo12 and meteo34	January 2019
Blue [Greece]	0.05° x 0.1°	meteo12	1/2018-4/2021
Yellow [Thessaloniki]	0.05° x 0.05° 0.01° x 0.01°	meteo12 and meteo34	1/2018-4/2021

Meteorology

ECMWF (7 km x 7 km)

Input emissions

CAMS REG AP v5.1 base year 2018



EEA ground-based measurements

We wish you a
fruitful workshop!

Sorry for the heatwave, it
was not planned...



<https://lapweb.physics.auth.gr>



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