



PEEX Seminar at the ACCC Impact Week (April 2025) Tuesday, 22 April 2025

# **ARIANET research activities**

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(together with Alessandro D'Ausilio, Umberto Giuriato, Camillo Silibello and Giuseppe Calori)

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## A consulting company operating since 2001

https://www.aria-net.it/

## Atmosperic Modelling from regional to local scale







Supporting public bodies, research institutions and private clients





### **ARIANET** aims to bridge research to applications

*implement best available knowledge to support air quality management, forecast and environmental protection* 



#### **Cooperation with research institutions:**







FINNISH METEOROLOGICAL INSTITUTE

## ENEN 🗧





#### **Research projects:**

- EC Framework programs
- EC LIFE programs

#### **COST Actions**

#### International initiatives:

- FAIRMODE
- EURODELTA

#### National projects



### Non-CO<sub>2</sub> Forcers and their Climate, Weather, Air Quality and Health Impacts



Regional scale climate and atm. composition: historical period (WP4) 120 SSP 3.7.0 & SSP 3.7.0 low-NTCF (WP6) Abstract submitted at the **EMS** Annual meeting 7–12 September 2025, Ljubljana 2000 -0.18 -0.16 -0.14

300000

250000

#### https://www.project-foci.eu/



Co-funded by the European Union

Euro-CORDEX domain



Gidden et al., 2019, https://doi.org/10.5194/gmd-12-1443-2019, 2019.

#### WRF results: T trend (deg/year) during the historical period (2005-2019)



#### Effect of species-specific emission modelling on BVOC emission estimate (WP5)



#### Plant Specific Emission Model (PSEM)

Ciccioli et al., 2023,

https://doi.org/10.1016/j.agrformet.2022.109255

#### Forest cover mapping:

- EFI: 1 km, 20 tree species distribution over Europe (Brus et al. 2011)
- ESA-CCI: 300m, global annual land cover



#### Isoprene annual mean trend (2000-2019)

### **CALLIOPE: Convolution of PMSS dispersion kernels at microscale**

- Methodology to compute fast and efficiently mean concentration maps
  - over a full city domain 100 km sq
  - At microscale horizontal resolution **5** *m*
- Suitable for emission scenario evaluations
  How it works
- A database of dispersion kernels is built running PMSS (steady-state and normalized emission) for a set of classified met conditions for each source (eg road segment)
- Hour by hour, kernels are selected from the database for each source on the basis of the driving meteorology, and rescaled according to emissions
- Convolution and following time average give rise to the final concentration field.
- Regional background concentration from CTM downscaled by ML technique

#### NO2 ANNUAL MEAN FROM TRAFFIC EMI (Taranto)



suez

µg/m<sup>3</sup>

2500 - 1.0000

10,0000

15,0000

### Natural based solutions modelling in an urban environment





- Both effects are parametrized with a direct dependence on **Leaf Area Index**
- Deposition is studied with **PMSS** classifying the sources on the basis of the buildings morphology around them
- The NBS effects are applied by «selection and rescaling» in the kernel convolution framework

\*Outside the polygon boundary, the deposition is constant and keeping the value on the boundary.

# suez

**MINNI** is one of

contributing to

CAMS Regional

the CTMs

Ensemble

### CAMs EvOlution (CAMEO) – Sentinel 5P TROPOMI assimilation



#### **Enhancement of Satellite Data** Assimilation in CAMS models

"As shown in this image acquired by one of the Copernicus Sentinel-3 satellites at 09:23 UTC of 14 August, less than 8 hours after the beginning of the eruption, the ash reached the centre of the Mediterranean Sea and travelled 300 km southeast of Malta"



**Credit: European Union, Copernicus** Sentinel-3 imagery



Main challenges EO data:

- Sparse data
- Noisy
- Vertical locations not defined

"The CAMEO project (grant agreement No101082125) is funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Commission. Neither the European Union nor the granting authority can be held responsible for them."

#### Ensemble Data Assimilation – Earth Observations



The study examines the use of Data Assimilation (DA) by incorporating sulfur dioxide  $(SO_2)$  column data from the Sentinel-5p L2 COBRA retrieval (5.5 km x 3.5 km resolution and 2660 km swath) in MINNI (0.15° x 0.1°, 14 vertical levels), a model member of the CAMS regional air quality ensemble and based on the Chemical Transport Model (CTM) FARM[2]

	Description
DA Method	Ensemble Adjustment Kalman Filter (EnAKF) via DART
Coupled Model	MINNI + DART
Ensemble Setup	20 members, hourly assimilation window
Perturbations	Emissions & boundary conditions
Forward Operator	Copernicus Satellite Operator (CSO), uses averaging kernels
Localization	Vertical, 5th-order Gaspari- Cohn function
Inflation	Applied to reduce filter divergence
QC Filter Method	Quantile Conserving Ensemble Filter Framework



[2] D'Ausilio, A., De Moliner, G., Silibello, C., Bolignano, A., Briganti, G., Russo, F., and Mircea, M.: Assessing the impacts of assimilating SO2 TROPOMI retrievals with MINNI and D. the Mount Etna eruption, EGU General Assembly 2025, Vienna, Austria, 27 Apr–2 May 2025, EGU25-16042, https://doi.org/10.5194/egusphere-egu25-16042, 2025.

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## Thank you for your attention!

## **Greetings from Milan**



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