



HELLENIC REPUBLIC  
National and Kapodistrian  
University of Athens  
— EST. 1837 —

## Research Group

### Atmospheric Physics and Chemistry – Numerical Applications

#### Short description

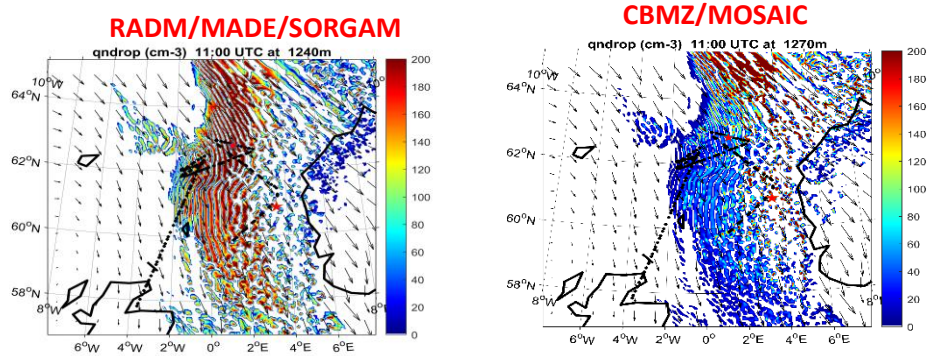
The Research Group 'Atmospheric Physics and Chemistry – Numerical Applications' operates within the Department of Physics at the National and Kapodistrian University of Athens, Greece. The group addresses topics in the field of Atmospheric Physics and Chemistry through numerical modeling. The group is led by Assistant Professor Elissavet Bossioli.

#### Research Topics

The main aim of the group is the investigation of the physical and chemical processes in the atmosphere (troposphere), the atmospheric composition, and the air pollution, in combination with the investigation of the structure of the Atmospheric Boundary Layer. To address these topics prognostic atmospheric models fully coupled with chemistry and aerosols are used. The specific Research activities of the Group are:

#### Physical processes in the atmosphere

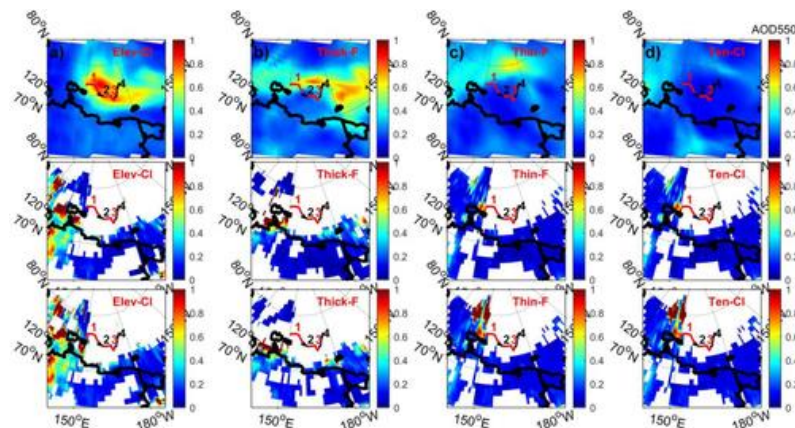
- Atmospheric Boundary Layer structure - Surface fluxes.
- Aerosol-Radiation Interactions.
- Aerosol-Cloud Interactions.



Predicted cloud droplet concentrations during a cold outbreak north of the UK. The aerosols' number concentrations are estimated by using different chemical mechanisms (RADM and CBMZ) and aerosol schemes (MADE/SORGAM and MOSAIC) (Bossioli *et al.*, in preparation).

## Chemical processes in the atmosphere

- Atmospheric composition - Numerical simulations of gases and aerosols concentration levels in mesoscale and local scale.
- Air pollution.
- Sources contribution (anthropogenic, natural, biogenic, biomass burning) in urban and pristine environments.
- Effect of atmospheric parameters on atmospheric composition.
- Effect of Chemical mechanisms on atmospheric composition.

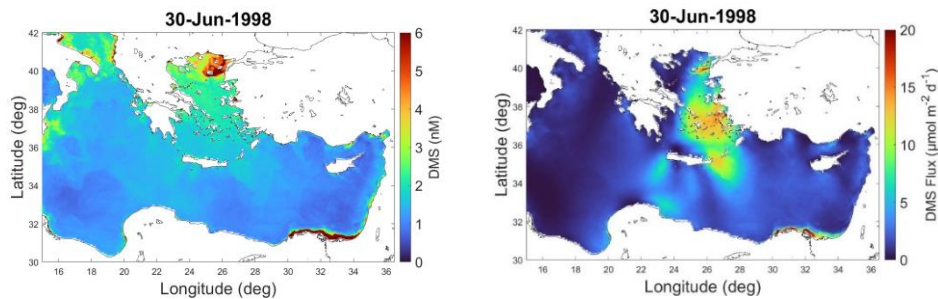


Aerosol optical depth (AOD) at 550 nm modeled (top) and satellite MODIS aqua (middle), and terra (bottom) during an extreme warm-air advection in the Arctic with varying cloud characteristics (elevated-cloud - Elev-Cl; optically thick fog - Thick-F; optically thin fog -Thin-F; tenuous-cloud -Ten-Cl) (Bossioli *et al.*, 2021).

## Air-Sea fluxes of volatile organic compounds (VOC)

- Parameterisation of sea surface biogenic VOC in the Eastern Mediterranean.
- Parameterisation of sea-to-air biogenic VOC fluxes.

- Impact of marine biogenic VOC emissions on the chemical composition, marine aerosols, radiative forcing and the marine boundary layer clouds.



Estimation of dimethylsulphide (DMS) sea water concentrations (left) based on empirical models linking remotely-sensed data of chlorophyll, sea surface temperature, and photosynthetically available radiation and DMS sea-to-air fluxes (right) in the Eastern Mediterranean (*Kourakos et al., in preparation*).

## Selected Publications

1. Bossioli, E., M. Tombrou, J. Kalogiros, J. Allan, A. Bacak, S. Bezantakos, G. Biskos, H. Coe, B.T. Jones, G. Kouvarakis, N. Mihalopoulos, C.J. Percival (2016), Atmospheric composition in the Eastern Mediterranean: Influence of biomass burning during summertime using the WRF-Chem model. *Atmos. Environ.*, Volume 132, pp. 317-331.
2. Methymaki G., E. Bossioli, Kalogiros J., Kouvarakis G., Mihalopoulos N., Nenes A., Tombrou M., (2020): Aerosol absorption over the Aegean Sea under northern summer winds, *Atmos. Environ.*, 231; <https://doi.org/10.1016/j.atmosenv.2020.117533>.
3. Bossioli, E., Sotiropoulou, G., Methymaki, G., & Tombrou, M., Modeling extreme warm-air advection in the Arctic during summer: The effect of mid-latitude pollution inflow on cloud properties, *J. Geophys. Res: Atmospheres*, 126, e2020JD033291, 2021, <https://doi.org/10.1029/2020JD033291>.
4. Karalis, M., Sotiropoulou G., Abel SJ, Bossioli E., Georgakaki P., Methymaki G., Nenes A., Tombrou M., Effects of secondary ice processes on a stratocumulus to cumulus transition during a cold-air outbreak, *Atmospheric Research*, 277, 2022, <https://doi.org/10.1016/j.atmosres.2022.106302>.
5. Methymaki G., Bossioli E., Boucouvala D., Nenes A., Tombrou M., Brown carbon absorption in the Mediterranean basin from local and

long-range transported biomass burning air masses, *Atmos. Environ.*, 306, 2023, <https://doi.org/10.1016/j.atmosenv.2023.119822>.

6. Bessagnet, B., Cuvelier, K., de Meij, A., et al., Assessment of the sensitivity of model responses to urban emission changes in support of emission reduction strategies *Air Quality, Atmosphere and Health*, 2024, 17(4), pp. 681–706.
7. Bessagnet, B., Bossioli, E., Cholakian, Vivanco, MG, Cuvelier, K., Theobald, M. R. Gil, V., Menut, L., de Meij, A., Pisoni, E., Thunis, P. Impact of air quality model settings for the evaluation of emission reduction strategies to curb air pollution, *Environmental Research*, 2024, 255, 119112.

## Members

- Elissavet Bossioli, Assistant Professor
- Dimitrios Kourakos, PhD student (supervision by E. Bossioli).
- Scientific collaboration with Dr. Georgia Methymaki and Dr. Panagiotis Portalakis.