1st Scientific Conference PANACEA

Manassaki Amphitheater University of Crete, Heraklion

23 – 24 September 2019

Program and Book of Abstracts

European Union
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MINISTRY OF ECONOMY & DEVELOPMENT
SPECIAL SECRETARY FOR ERDF & CF
MANAGING AUTHORITY OF EPAnEK

EPAnEK 2014-2020
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ΕΣΠΑ 2014-2020
ανάπτυξη - εργασία - αλληλεγγύη
Partnership Agreement 2014 - 2020

Co-financed by Greece and the European Union

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PANACEA

PANhellenic infrastructure for Atmospheric Composition and climatE chAnge (PANACEA) is envisioned to become the high-class, integrated Research Infrastructure (RI) for atmospheric composition and climate change not only for Greece, but also for southern Europe and eastern Mediterranean, an area that is acknowledged as a hot spot for climate change. The RI is designed to be in full compliance with EU Regulation 651/26.6.2014 and act as the Greek component of ACTRIS/ESFRI (Aerosols, Clouds and Trace gases Research Infrastructure) and ICOS/ESFRI (Integrated CO2 Observation System).PANACEA addresses the need for monitoring of atmospheric composition, solar radiation variations, climate change and related natural hazards in Greece, and for providing tailored services to crucial national economy sectors that are affected by air pollution and climate change, such as public health, agriculture/food security, tourism, shipping and energy/ renewable PANACEA will act as a hub for the next generation of environmental scientists and attract promising young researchers for research and industry, bridge science with industry and entrepreneurship, induce new local jobs, new investments and market at national, EU and international level, in line with EU priorities. PANACEA is implemented under the action "Reinforcement of the Research and Innovation Infrastructure", funded by the operational program "Competitiveness, Entrepreneurship and Innovation" (NSRF 2014-2020) and co financed by Greece and the European Union (European Regional Development Fund).

PANACEA kick-off meeting, National Observatory of Athens, Penteli, 20th October 2018

Program

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First scientific conference PANACEA

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Monday 23.09.2019

8:30 Registration

9:00 Opening and Welcome from the local authorities and GSRT

9:15 Welcome from the University of Crete (rector **Panagiotis Tsakalidis**)

9:30 PANACEA & Conference Objectives (**Nikos Mihalopoulos**)

9:45 ACTRIS contribution to understanding large scale variability and trends in the European Atmosphere and challenges ahead (**Paolo Laj**)

10:15 ICOS (**Werner Kutsch**) (teleconference)

10:45 - Coffee Break

11:15 EUMETSAT (**Bojan Bojkov**)

11:45 Loss of life expectancy from air pollution compared to other risk factors (**Jos Lelieveld**)

12:15 Overview of the PANACEA Measurement Campaign Summer 2019 (**Nikos Mihalopoulos**)

12:40 Field measurements and ambient atmosphere perturbation experiments in Patra (**Spyros Pandis**)

13:00 – Light Lunch Break

14:30 Oxidative potential: Importance, results and challenges (**Athanasios Nenes**)

15:00 First results for aerosol characterization and source apportionment in Athens suburban and Volos traffic/harbour urban areas based on the NCSR Demokritos measurements during the PANACEA summer campaign (**Vasiliki Vasilatou**)

15:15 Highlights of the vertical distribution of the Aerosol Optical and Geometrical properties retrieved over the city of Volos, Greece, during the 1st PANACEA campaign (July 2019) (**Maria Mylonaki**)

15:30 Lee-Wave Cloud observed by simultaneous Lidar profiling and satellite observations during the 1st PANACEA Greek Campaign (July 2019) (**Romanos Foskinis**)

16:00 Characteristics of fine particle number size distribution at Akrotiri station (**Sofia Eirini Chatoutsidou**)

16:15 Aerosol characterization by automated typing methods over the Thessaloniki lidar station during the PANACEA campaign (**Kalliopi Artemis Voudouri**)

16:30 15 years of measurements of total ozone with a Brewer spectrophotometer in Athens, Greece (**Kostas Eleftheratos**)

16:45 - Poster Session & Coffee

18:30 End of Session

20:00 - Dinner

Tuesday 24.09.2019

09:15 Comments by the Managing Authority (EPAnEK) and GSRT

09:45 **General Comments by the Advisory Board**

10:30 Coffee Break

11:00 Remote Sensing synergies at the island of Antikythera for multi-mission CalVal (**Vasilis Amiridis**)

11:20 Multi-Instrument Validation of TROPOMI/S5P atmospheric products over Thessaloniki, Greece (**Mariliza Koukouli**)

11:35 Aerosol classification in Europe, Middle East, North Africa and Arabian Peninsula based on AERONET Version 3 (**Stavros-Andreas Logothetis**)

11:50 Hellenic Integrated Marine-Inland waters Observing Forecasting and offshore Technology System (HIMIOFoTS) (**Giorgos Petihakis**)

12:05 Measurement and monitoring of carbon dioxide parameters in the sea water by HCMR (**Aikaterini Souvermezoglou**)

12:20 Impact of dust deposition events on marine primary productivity and carbon export and sequestration in the deep basins of the Eastern Mediterranean Sea (**Alexandra Gogou**)

12:35 Light Lunch Break

14:00 Contribution of new particle formation to cloud condensation nuclei and cloud droplet number in the eastern Mediterranean (**Nikos Kalivitis**)

14:15 Cloud formation in a marine environment. A simulation approach (**Paraskevi Georgakaki-Maria Tombrou**)

14:30 Implementation and evaluation of a wave-dependent sea spray parameterization scheme in modeling system CHAOS (**Petros Katsafados**)

14:45 Air quality modelling over the Eastern Mediterranean: Seasonal sensitivity to anthropogenic emissions (**George Georgiou**)

15:00 The effect of deposition mechanisms on the Lagrangian particle dispersion model Flexpart. A case study for Black Carbon and air tracers at the Zeppelin observatory station (**Vasileios Stathopoulos**)

15:30 **General Assembly /Next steps / Futures perspectives – publications / Deliverables**

16:00 Poster Session & Coffee Break

16:30 Meeting of Steering Committee (discussion of the comments of the Advisory Board & discussion on administrative issues)

18:30 End of Conference

P#	Air Quality	First Author
1	PM10 levels at urban, suburban and background locations at the city of Chania	Chatoutsidou S. E.
2	Assessment of Aerosol Particulate Matter at the City of Ioannina, Greece, during the 1ST PANACEA CAMPAIGN (JULY-AUGUST 2019)	Hatzianasstassiou N.
3	Monitoring of atmospheric components with the Phaethon System over Thessaloniki, Greece, using MAX-DOAS and Direct-Sun observations	Karagkiozidis D.
4	Low cost sensors for measuring airborne particulate matter: field evaluation and calibration at a South-Eastern European site	Kosmopoulos G.
5	High Resolution online Aerosol Measurements during the 1st PANACEA Summer Campaign in Athens, Greece	Liakakou E.
6	Free tropospheric aerosol and trace gas observations at the Helmos Mountain (2314 m asl) Atmospheric Aerosol and Climate Change station	Eleftheriades K.
7	Airborne pollen observed by PollyXT Raman Lidar at Finokalia, Crete	Giannakaki E.
8	A new methodology for lidar-based characterization of marine particles	Tsichla M.
9	Aerosol properties at Antikythera and Finokalia during two experimental campaigns	Tsikoudi I.
P#	Remote Sensing - Modeling	First Author
10	Vertical distribution of ozone in the lower troposphere from MAX-DOAS measurements over Thessaloniki, Greece	Drosoglou T.
11	First CCN estimates from CALIOP/CALIPSO observations: a demonstration during the EUFAR-ACEMED campaign	Georgoulias A.K.
12	First assessment of AEOLUS aerosol products versus ground-based lidar measurements obtained at Antikythera island	Gkikas A.
13	Aerosol Detection in the Free Troposphere over the city of Volos, Greece, during the 1st PANACEA campaign (July 2019)	Papanikolaou C.A.
14	Vertical Profiling andf characterization of Aerosols in the planetary boundary layer retrieved over the city of Volos, Greece, during the 1st PANACEA campaign (July 2019)	Papayannis A.
15	The ESA-EVE polarization lidar for assessing the AEOLUS aerosol product performance	Paschou P.
16	Validation of TROPOMI's/S5P and GOME-2/MetOp Aerosol Height products using the elevated height obtained from Thessaloniki lidar station during PANACEA campaign	Michailidis K.
17	Towards an algorithm for near real time profiling of Aerosol Species, trace gases and clouds based on the synergy of Remote Sensing Instruments	Siomos N.
18	Spectral Solar Measurements for Atmospheric Composition at Thissio Station, Athens, Greece	Raptis I.P.
19	Estimation of Personal Dose and Health Risk Indexes for an adult male arising from Particulate Air Pollution at the Akrotiri Station (Chania, Crete)	Chalvatzaki E.
20	Global simulations of Ice Nuclei Particles of Terrestrial and Marine Origin	Chatziparaschos M.
21	Direct aerosol absorption at the Eastern Mediterranean	Methymaki G.
22	Environmental analysis in traffic-congested roads using an Integrated Modelling Tool	Melas D.
23	Atmospheric inputs of soluble N, P and Fe to the Mediterranean Sea	Kanakidou M.
24	The Extra-tropical Transition of Atlantic hurricanes in PRIMAVERA HighResMIP	Kapetanakis D.

Keynote Speakers

Bojan Bojkov

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Werner Leo Kutsch

General Director of the Integrated Carbon Observation System (ICOS), a European Research Infrastructure.
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Dr. Werner Kutsch is Director General of ICOS since March 2014. He is biologist, plant ecologist and ecosystem scientist by education and has worked on ecosystem carbon cycling for 25 years in Europe and Africa. The focus of his work has been for a long time in the comparison of ecosystems after land use change and integrating complex landscapes. He has worked at the Ecosystem Research Centre of University of Kiel, at CSIR in Pretoria, at the Max-Planck-Institute for Biogeochemistry in Jena and at Thünen, the Federal Research Institute for Rural Areas, Forestry and Fisheries in Braunschweig. ICOS is an ESFRI Landmark Research Infrastructure and a legal entity (ERIC) since November 2015. As Director General, Dr. Kutsch is the legal representative and overall coordinator of the Research Infrastructure and currently managing the final internal integration of ICOS. This work comprises internal organisation of the operations of the distributed observational networks and central facilities, on optimizing the internal data flow between the different observational programs of ICOS, on developing the data platform of ICOS ('Carbon Portal') which will also serve as an interface to COPERNICUS and GEOSS, and on deepening the cooperation with other RIs. Dr. Kutsch is experienced in data acquisition, post-processing, data analysis and modeling of ecosystem carbon budgets. Integrating ICOS-internal data streams and fostering usage of ICOS RI data for GHG modeling are some of his main goals for the next years. Furthermore, he is very interested in further developing data citation systems. He is responsible for the external representation of ICOS ERIC and currently leading the development of its future strategy. ICOS aims to be part of European and global integration initiatives that that support the usage of in-situ observations for improving the national inventories on greenhouse gases.

Pao Laj

Senior scientist at Université-Grenoble-Alpes and visiting professor at University of Helsinki
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Paolo Laj, born 1966, is senior scientist at Université-Grenoble-Alpes (France) and visiting professor at University of Helsinki (Finland) since 2015. Since more than 10 years, he is actively contributing to developing the in-situ component of the Earth Observation system, dedicated to the long-term observations of short-lived climate forcers, aerosol, cloud and reactive gases. He is one of the coordinators of the European Research Infrastructure ACTRIS (Aerosol, Cloud and Trace Gases Research Infrastructure) dedicated to integrating observations of short-lived species in Europe. He is currently chairing the Scientific Advisory Group on Aerosol of the Global Atmosphere Watch (GAW) of the World Meteorological Organization which overlook and coordinates the network of observing stations in the different WMo regions. One of the main tasks of his current responsibilities is to ensure sustainability of the current ground-based network for atmospheric composition, its interoperability with other networks and to promote usage of date by a wide community of users. Since 2017 he serves in the scientific advisory panel of GEO-6, Global Earth Outlook, organized by UNEP. Between 2010-2015 he served as director of the Laboratoire de Glaciologie and Geophyique de l'Environnement in Grenoble, one of the leading institutes for the studies of cold and polar regions. Paolo Laj has published more than 130 peer-reviewed scientific papers on subjects such as aerosol-cloud interactions, atmospheric composition trends and variability, aerosol formation.

Jos Lelieveld

Professor in Atmospheric Physics at Mainz University and in EEWRC,
The Cyprus Institute, Nicosia, Cyprus
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Prof. Jos Lelieveld received a PhD from the Faculty of Physics and Astronomy at Utrecht University (1990). His thesis subject was "The role of clouds in tropospheric chemistry" (supervisor Prof. Paul Crutzen). He worked at Stockholm University (1991) and the University of California, San Diego (1992), and became a Professor at Wageningen University in 1993 and at Utrecht University in 1995. In 2000 he was appointed as a Director at the Max Planck Institute for Chemistry in Mainz. Since January 2008 he is a Professor at the Cyprus Institute and leads the Atmospheric and Climate Modeling group of the EEWRC (Environment and Water Research Center). In July 2010, the Board of the Institute bestowed the title of 'Institute Professor'. He is Doctor Honoris Causa, School of Science and Engineering, University of Crete since 2016. He published more than 320 peer-reviewed articles of which many are highly cited. He is a member of the German national academy of sciences Leopoldina, of international committees and societies, and received international distinctions.

Research Interests: Atmospheric multiphase chemistry, ozone, aerosols and climate, the atmospheric cleaning mechanism (radical chemistry), global atmospheric change, air pollution and health. In Cyprus his research focuses on atmospheric and climate change in the Mediterranean, Middle East and North Africa.

Athanasios Nenes

Professor and head of the Laboratory of Atmospheric Processes and their Impacts (LAPI) at EPFL, Switzerland
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Athanasios Nenes is a Professor and head of the Laboratory of Atmospheric Processes and their Impacts (LAPI) at EPFL, Switzerland. He is affiliated with the Institute of Chemical Engineering Science of the Foundation for Research and Technology Hellas (Patras, Greece) and the National Observatory of Athens (Athens, Greece). He authored 280 manuscripts (h=63, 14000 citations), developed the ISORROPIA aerosol model, and instrumentation to measure aerosol properties and Cloud Condensation Nuclei. He serves as President of Atmospheric Sciences of the European Geophysical Union, and is member of the UN Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (WG38: Atmospheric input of chemicals to the ocean), the Committee on Nucleation and Atmospheric Aerosols. His past service includes the US National Academies Committee on the Future of Atmospheric Chemistry Research (2014-2016), Secretary of Atmospheric Sciences of the American Geophysical Union (2012-2016), the Board of Directors of the American Association for Aerosol Research (2014-2017) and Editor in Atmospheric Chemistry and Physics (2004-2019). His distinctions include an ERC Consolidator Grant (2016); Vaughan Lectureship, California Institute of Technology (2014); Ascent Award, American Geophysical Union (2012); Whitby Award, American Association for Aerosol Research (2011); Houghton Award, American Meteorological Society (2009); Sigma Xi Young Faculty Award (2007); Friedlander Award, American Association for Aerosol Research (2005); NASA New Investigator Award (2004) and a National Science Foundation CAREER Award (2004).

Oral and Poster Presentations

In first Author's Alphabetic order

Remote Sensing synergies at the island of Antikythera for multi-mission CalVal

Vassilis Amiridis[1] and the ReACT group

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The establishment of a novel and emblematic flagship activity, namely the "PANhellenic GEophysical observatory of Antikythera (PANGEA)", has been recently decided by NOA to establish a national superstation for continuous monitoring of essential Climate Variables, to stream real-time information to the State and the Society focusing in particular on the: (a) provision of continuous certified monitoring data and expertise on issues related to climate change, atmospheric pollution and chemical composition as well as seismic activity; (b) improvement of climate projections at the regional scale, for effective mitigation and adaptation; (c) scientific contribution towards the increase of the share of renewable resources in the national energy program.

PANGEA will provide the necessary research equipment at a regionally-representative site (the island of Antikythera) to establish a CalVal Center for ESA and EUMETSAT for the benefit of the targeted satellite missions, the Greek academic community and industry. NOA already represents Greece in the CalVal efforts for Aeolus and EarthCARE by coordinating the national contribution through the ASKOS campaign in Cape Verde and ACROSS national CalVal activity respectively. New lidar technologies developed to fulfil the objectives of these CalVal studies along with the appropriateness of the Antikythera island for multi-mission validation is presented here.

Estimation of Personal Dose and Health Risk Indexes for an adult male arising from Particulate Air Pollution at the Akrotiri Station (Chania, Crete)

Eleftheria Chalvatzaki, Sofia Eirini Chatoutsidou, Christina Pantelaki and Mihalis Lazaridis

School of Environmental Engineering, Technical University of Crete, Chania 73100, Crete, Greece

The objective of the current study is to estimate the personal dose received by an adult male using a dosimetry model (ExDoM2). The model considers that the exposed subject is nose breather under one activity level (light exercise) and for 24 h exposure outdoors (Akrotiri, Chania). Accordingly, the deposited dose in the human respiratory tract caused by inhalation of atmospheric particles will be calculated using number and mass concentration data. In addition, the retention in the respiratory tract, mass transferred to the esophagus and the absorption to the blood will be also estimated from mass concentration data. Finally, several human health risks associated with exposure to PM10 will be estimated such as the Relative Risk (RR) and the Attributable Fraction (AF).

PM10 levels at urban, suburban and background locations at the city of Chania

Sofia Eirini Chatoutsidou[1], Ilias Kopanakis[1], Konstantinos Lagouvardos[2], Nikolaos Mihalopoulos[2,3], Kjetil Tørseth[4] and Mihalis Lazaridis[1]

[1]School of Environmental Engineering, Technical University of Crete, Chania, Greece,

[2]National Observatory of Athens, Athens, Greece,

[3]University of Crete, Chemistry Department, Heraklion, Crete, Greece,

[4]Norwegian Institute for Air Research (NILU), Kjeller, Norway

PM_{10} levels were determined at different locations within the urban area of the city of Chania to assess the relatively contribution of local versus regional sources. Two campaigns were conducted: during the first PM_{10} was monitored at three urban locations (kerbside/traffic/background) at different sampling periods, whereas, during the second one PM_{10} was simultaneously measured at two locations (urban/suburban). Both campaigns have shown that African dust transport was a major carrier of coarse particles. The contribution from dust episodes to the measured concentration was estimated at 2 - 527 μg m^{-3} during the first campaign and 4 - 218 μg m^{-3} during the second campaign. Classification into dusty and non-dusty days has shown that local anthropogenic sources also influence ambient PM_{10} concentrations. Particularly, it was found that domestic heating during cold months was a major contributor to PM_{10} levels followed by emissions from traffic with higher contribution of the latter during summer months (high touristic season) as well as non-traffic emissions (road dust resuspension).

Characteristics of fine particle number size distribution at Akrotiri station

Sofia Eirini Chatoutsidou, Christina Pantelaki and Mihalis Lazaridis

School of Environmental Engineering, Technical University of Crete, Chania, Greece

Fine particle number size distribution is measured at Akrotiri station (Chania) from May 2019. The station is located inside the university campus (35.5N, 24.1E) where the closest distance from the sea is at 2 km and the surrounding area is a sub-urban/rural area consisted of farms and residential areas. A Scanning Mobility Particle Sizer (SMPS TSI) (CPC 3775 + EC 3082 + DMA 3081) is used to perform the measurements where the measured size distribution is in the range 14.1 – 736.5 nm sheared in 111 different size channels with a log interval of 5 min.

Higher ambient number concentration corresponds to the lower part of the size distribution thus ultrafine particles (< 100 nm) dominate (56%) over the measured size range. Average daily (24h) concentrations of the total size distribution vary between 936 – 5,518 cm-3 with most common sources for ultrafine particles being vehicular emissions and emission from aviation.

Global simulations of Ice Nuclei Particles of Terrestrial and Marine Origin

Marios Chatziparaschos[1], Stelios Myriokefalitakis[2], George Fanourgakis[1], Maria Kanakidou[1]

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Aerosol-cloud interactions consist one of the major sources of uncertainty in climate projections according to the recent IPCC report. Ice Nuclei Particles (INP) affect significantly the radiative properties and lifetime of clouds as well as precipitation rates due to their ability to form ice in mixed-phase clouds at temperatures higher than needed for homogeneous ice nucleation. The majority of studies for INP identification investigate INP from K-feldspar mineral dust particles emitted from deserts and marine organic particles released from sea surface microlayer in the atmosphere. In the present study we investigate in addition the contribution of terrestrial bioaerosols to INP concentration using the global 3-D chemistry transport model TM4-ECPL. The model simulates the available and potential INP concentrations in the atmosphere at ambient and given temperature, respectively, derived from dust, marine organics and terrestrial bacteria, fungi and pollen using experimentally-deduced parameterizations of ice-active surface site density for each type of aerosol acting as INP. INP from desert dust is found to dominate the concentration of INP over the entire Northern Hemisphere, while marine organics are important contributors to INP over remote oceans depending on marine biota, which varies seasonally. Finally, terrestrial bioaerosols contribute to INP concentration mainly close to the emission sources.

Vertical distribution of ozone in the lower troposphere from MAX-DOAS measurements over Thessaloniki, Greece

Theano Drosoglou[1], Nikolaos Siomos[1], Ilias Fountoulakis[1], Athanasios Natsis[1], Alkiviadis Bais[1]

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Ground-based measurements of tropospheric O3 provide valuable information for studies of atmospheric photochemistry, air quality and climate change. Furthermore, observations from the ground can also be used for validation of satellite products. Multi-axis differential optical absorption spectroscopy (MAX-DOAS) provides automated and fast retrievals of total and tropospheric vertical column of trace gases and aerosol, as well as their profile shape in the lower troposphere. For the estimation of the vertical distribution, a number of well-established MAX-DOAS inversion algorithms have been developed, based either on parameterized methodologies or on optimal estimation method (OEM). However, MAX-DOAS measurements of tropospheric O3 have not been widely studied by the research community due to the significant influence of the stratospheric component, which is typically larger by about an order of magnitude compared to the tropospheric column density. This study presents preliminary estimates of the vertical distribution of ozone in the lower troposphere derived for the first time from MAX-DOAS observations over Thessaloniki, Greece. The retrievals based on a recently developed methodology. A priori ozone profiles from a climatological data set are considered in the analysis for the quantification of stratospheric influence.

15 years of measurements of total ozone with a Brewer spectrophotometer in Athens, Greece

Kostas Eleftheratos[1,2], Theodora Stavraka[2], Christos Zerefos[2,3,4]

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[2]Biomedical Research Foundation of the Academy of Athens, Greece

[3]Research Center for Atmospheric Physics and Climatology, Academy of Athens, Greece

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We have analyzed fifteen years (2003-2018) of ground-based measurements of total ozone in the urban environment of Athens, Greece. Measurements were acquired with a single Brewer monochromator operating at the roof of the Biomedical Research Foundation of the Academy of Athens since June 2003. We estimate a 15-year climatological mean of total ozone in Athens of about 320 DU with no significant change since 2003. Ozone data from the Brewer spectrophotometer have been compared with TOMS, OMI and GOME-2A satellite retrievals. The results reveal excellent correlations between the ground-based and satellite ozone measurements of about 0.9. The variability of total ozone over Athens related to the seasonal cycle, QBO, NAO, solar cycle and tropopause pressure variability is presented.

Free tropospheric aerosol and trace gas observations at the Helmos Mountain (2314 m asl) Atmospheric Aerosol and Climate Change station

Konstantinos Eleftheriadis, Prodromos Fetfatzis, Athina-Cerise Kalogridis, Maria Gini, Ekaterini Dalaka, Evaggelia Diapouli, Manousos-Ioannis Manousakas, Vasiliki Vasilatou, Stergios Vratolis

ERL, Institute of Nuclear and Radiological Sciences & Technology, Energy & Safety, NCSR "Demokritos", Ag. Paraskevi, GREECE

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Regional and global variability in the parameters affecting climate change and the variability and extent of Transboundary air pollution in Europe require the study of aerosol properties and variability of greenhouse gases in background conditions. Representative observations for the above parameters in a regional scale can be ensured at locations of high altitude (Coen et al., 2018), where crucial information of seasonal cycles and long term trends can be obtained (Nyeki et al., 1998)

The Helmos Hellenic Atmospheric Aerosol and Climate Change station (HAC)2 at Helmos Mt. is the only station at high altitude for atmospheric research in the region of the eastern Mediterranean, recently established by NCSR 'Demokritos' Environmental Radioactivity Laboratory.

Measurements started at the end of 2015. (HAC)2 station is located at 2314 m.a.s.l. on Helmos Mountain, Northern Peloponnese, Greece, 37.984 N 22.196 E. It aims to study physical-chemical characteristics of aerosols and climate gases.

Measurements of equivalent black carbon concentrations (eBC) are performed using an aethalometer (AE31 model, Magee Sci.), whereas a Picarro G2401 analyzer (Picarro Inc.) is used to monitor Greenhouse Gasses (CO_2, CO, CH_4, H_2O). A TROPOS SMPS provides the aerosol particle size distribution from 10 to 800 nm (electrical mobility diameter). The instrument provides a full size distribution every 5 minutes. An Optical Particle Counter (Grimm 11-A) acquires the particle size distribution in the size range of 250 nm to 2.5 μm (optical diameter). A TSI 3563 Nephelometer acquires the scattering and backscattering coefficients of aerosol at three wavelengths (blue, green and red). Filter samples (sampling duration of 48 or 72 h) are collected by DIGITEL Sampler DHA-80.

During wintertime, as the boundary layer gets more shallow, (HAC)2 station is exclusively in the free troposphere, thus, lower concentrations of particle number are observed (fig. 1) and eBC. However, some complexity is added by seasonal natural cycle in combination with enhancement of emissions from combustion processes.

Field measurements and ambient atmosphere perturbation experiments in Patra

Kalliopi Florou, Mauro Massiol, Jack Kodros, Christina Vasilakopoulou, Spiro Jorga, Kerrigan Cain, Charoula Baliaka, Aggeliki Matrali, Andreas Kazantzidis, Athanasios Nenes and Spyros Pandis

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The concentration and chemical composition of fine particulate matter as well as the concentrations of the major gas-phase pollutants were measured during the summer of 2019 (July 10-August 10, 2019) in the monitoring station of the Institute of Chemical Engineering Sciences. Measurements of $PM_{2.5}$ were also collected by a network of 16 low cost sensors (Purple Air) in various areas of Patras. A High Resolution-Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS) was used to measure continuously the size-resolved chemical composition of the non-refractory PM_1 aerosol species. The concentration of black carbon was measured using a MAAP and the size distribution of particles using an SMPS. Three $PM_{2.5}$ aerosol samples were collected on daily basis for analysis of ROS, OC/EC and inorganic ions and metals. The concentrations of O_3, SO_2, NO, NO_2, CO and CO_2 were also measured. A low-cost sensor (RAMP) for the measurements of gas-phase pollutants was also deployed and tested.

In parallel with the ambient measurements we conducted smog chamber experiments using ambient air as the starting point. The dual mobile smog chamber system of FORTH was deployed next to the measurement station. The hypothesis that ammonia is limiting new particle formation in Patras was tested by adding ammonia to the perturbation chamber and then following the aerosol evolution in both the control and perturbation chambers.

The results of both the field measurements and the ambient perturbation experiments will be summarised and plans for future analysis and synthesis with the measurements of other PANACEA sites will be discussed.

Lee-Wave Cloud observed by simultaneous Lidar profiling and satellite observations during the 1st PANACEA Greek Campaign (July 2019)

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We present case studies of cloud formation over the Attica (Greece), due to internal gravity waves (18-19/07/2019), as observed by synergy of instruments and tools (Multi-wavelength Raman Lidar (EOLE) and the AIAS Lidar Depolarization systems, MODIS, VIIRS and MSG4-METEOSAT satellites) in the frame of the 1st PANACEA Greek campaign. The observed internal gravity waves have been developed at the leeward side of the Penteli mountain in the northern part of the Athens Basin following N-NE synoptic winds around 850hPa pressure level. The lidar systems provided the vertical profiles of the aerosol optical and geometrical properties as well as the sphericity properties of the cloud particles. The airmass backward trajectories via the HYSPLIT model and in-situ aerosol measurements at ground level were also taken into account.

Cloud formation in a marine environment. A simulation approach

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This study investigates the cloud–aerosol interactions in the marine boundary layer (MABL) over the Aegean Sea (AS). We explore the importance of cloud condensation nuclei (CCN), MABL turbulence and surface fluxes on cloud formation, in the area between Cyclades and Crete. For this purpose, MIT/MISU Cloud-Aerosol (MIMICA) Large Eddy Simulation (LES) model, that provides fluxes and turbulence, coupled with an interactive modal description for aerosols and clouds, has been adjusted to the special conditions of the AS and applied for different atmospheric conditions over this area. Selected days from July 2013, a period that includes Etesian winds events and moderate northern surface ones, are considered. Remotely sensed data from the Moderate Resolution Imaging Spectroradiometer (MODIS) have been taken into account. The regional WRF_Chem model, has been applied to provide large scale forcing, thermodynamic and aerosol profiles, during this period. Further simulations with WRF_Chem model will provide the impact of natural and anthropogenic pollution on cloud formation.

The clouds observed offshore of the northern Crete, on 17 July, by MODIS have been successfully simulated by the MIMICA LES, despite the fact that these could be hardly produced by the regional model. According to WRF_Chem simulations, a deep MABL (~ 700 m) has been developed, with polluted air masses well mixed throughout this layer (CCN up to ~ 350 cm^{-3}) while much higher pollution is transported at higher levels. The cloud formation is apparent from the beginning of the LES simulation (6:00 UTC) and the droplet number concentration reaches up to 7 cm^{-3} with mean droplet radius ~ 20μm.

On 21 July, the concentration of CCNs (from WRF_Chem) were much higher (~ 800 cm^{-3}), confined in a very shallow stable MABL (below 500 m), without any apparent advection of polluted air masses at higher levels. After midday, a shallow cloud layer starts forming. Despite the great abundance of CCNs, LES simulations shows that their activation to cloud droplets is prevented by the prevailing strong stability, leading to reduced cloud droplet number concentration (max values ~ 3 cm^{-3}) and relatively smaller size of cloud droplets, in comparison to the 17 July. It is worth mentioning that there are no obvious signs of

cloudiness in the satellite image (nor in the WRF results). But, the infrared information over the Crete island indicates that there are appropriate conditions where if the vertical velocity increases, either due to atmospheric instability or interference of air masses with the mountains, clouds will form. The impact of aerosol-cloud interactions on longwave and shortwave cloud forcing for both days, is also examined.

After verifying that the LES reproduced observed cloud properties reasonably on 17 July, sensitivity simulations are performed and analyzed to determine the impact of CCN concentrations and hygroscopicity as well as imposed large-scale subsidence on the development and maintenance of stratocumulus cloud. The role of sea-surface temperature and stability, which play a key role in shaping the MABL structure, as well as advection conditions that transport characteristic layers of polluted air masses, are also investigated.

Air quality modelling over the Eastern Mediterranean: Seasonal sensitivity to anthropogenic emissions

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We employ the online coupled WRF/Chem model to study air pollution over the eastern Mediterranean during winter and summer. We utilize three nested domains with respective horizontal resolutions of 50, 10, and 2 km. Dust, sea-salt, and biogenic emissions are calculated online, while anthropogenic emissions are based on the EDGAR HTAP v2 global emission inventory. For the innermost domain covering Cyprus, an up-to-date and spatiotemporally detailed anthropogenic emission inventory is implemented to examine its impact on the model ability to accurately simulate the surface concentrations of atmospheric pollutants. The model results from three simulations with 1) EDGAR emission inventory, 2) the high-resolution emission inventory, and 3) no national emissions are compared with measurements from ground stations located in both background and urban sites. The implementation of the high-resolution national emission inventory reduced the CO normalized mean bias by 5%. Underestimation in wintertime CO mixing ratios and PM2.5 concentrations were evident in all simulations and can be attributed to missing residential heating sources from both the global and national eission inventory. The absence of a PM2.5 re-suspension mechanisms in the model can be the source of the summertime PM2.5 underestimation. The high resolution emissions reduced the NOx normalized mean bias to -29% (from 67% in the EDGAR simulation) and -10% (from 51%) for the winter and summer period, respectively. Consequently, the strong overestimation in O 3 mixing ratios seen in the EDGAR simulation (45% in winter and 25% in summer) was reduced to 28% and 19% respectively, with the remaining overestimation probably attributed to the impact of boundary conditions. Accounting for the intra-day variability in the emission inventory (hourly emission factors) strongly affected the diurnal profiles of NOx and O3 at urban sites which is important both for policy making and air quality modelling.

First CCN estimates from CALIOP/CALIPSO observations: a demonstration during the EUFAR-ACEMED campaign

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Aerosols impact the formation, the optical properties and the life cycle of clouds. Aerosol-cloud interactions (ACI) constitute one of the largest source of uncertainty in climate change studies, while, specifically for warm clouds, they depend on the cloud condensation nuclei (CCN) number concentration. Satellite-based studies focusing on ACI have utilized observations of aerosol optical depth (AOD) or Aerosol Index (AI: AOD multiplied by the Ångström exponent) considering them as a good proxy for the number of aerosols in the atmosphere and not CCN observations per se. In this work, we present a first effort to calculate CCN concentration profiles for different tropospheric aerosol types and for different supersaturation levels from CALIOP/CALIPSO satellite observations. CCN concentrations along with the corresponding uncertainties are calculated for 09/09/2011 when the ACEMED (evaluation of CALIPSO's Aerosol Classification scheme over Eastern MEDiterranean) campaign aircraft measurements were taken from the FAAM (Facility for Airborne Atmospheric Measurements) BAe-146 research aircraft. The ability of CALIOP/CALIPSO to discriminate between different types of aerosols is tested with data from the CAMS reanalysis, while, HYPSLIT back-trajectories are used to examine the origin of air masses on that day. Our data are compared against CCN retrievals from the unvalidated MODIS/Aqua satellite-based product which are available over oceanic areas only and validated against particle number concentrations at different height levels from the airborne measurements over the greater Thessaloniki area in northern Greece.

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Airborne pollen observed by Polly^{XT} Raman Lidar at Finokalia, Crete

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In order to document and study airborne pollen in the Mediterranean region, a pollen measurement campaign was performed during February-May 2018, at the Finokalia station. A ground-based multi-wavelength Raman polarization lidar Polly^{XT} performed continuous measurements, together with a Hirst-type Burkard pollen sampler. Dust-free condition is applied for pollen study, using dust models (NMMB/BSC-Dust and CAMS).

During the campaign, 30 types of pollen were measured by Burkard Sampler. The five most abundant airborne pollen types were: Olea (Olive), Cupressus (Cypress), Platanus (Sycamore), Quercus (Oak), and Ulmus (Elm). Their shapes are almost spherical, with size ranging from ~15 to ~30 μm. For these pollen types we characterized the optical properties of pollen. We found that the linear particle depolarization ratio of pollen layer was relatively small, with a maximum value of ~15%, since the shape of the majority of pollen types in this region are quasi-spherical. The difference of Ångström exponent values are found related to the pollen size information. Lidar ratios were ranged between 20 and 80 sr both at 355 and 532 nm. Optical properties of pollen found in this study are classified as "mixture" in literature. Future work will be the aerosol separation of dust, pollen and marine.

First assessment of AEOLUS aerosol products versus ground-based lidar measurements obtained at Antikythera island

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AEOLUS satellite, launched in August 2018 and operated by the European Space Agency (ESA), is carrying ALADIN, the first UV Doppler lidar, providing global wind profiles in conjunction with aerosol and cloud vertically resolved spin-off products. ALADIN, is a high spectral resolution lidar (HSRL) measuring aerosol extinction and backscatter coefficients as well as lidar ratio (extinction-to-backscatter) at 355 nm by emitting circular polarized light and receiving the co-polarized return signal. Preliminary simulation studies have shown that ALADIN underestimates backscatter coefficient, when non-spherical depolarizing particles are probed, attributed to the lack of the cross-polar component detection. Based on CALIOP depolarization ratio, converted from linear to circular and adjusted from 532 to 355 nm, it has been revealed that this deviation is magnified over areas affected by dust particles.

The overarching goal of the present work is to provide a first assessment of AEOLUS' aerosol products, emphasizing on dust, against ground-based backscatter and extinction vertical profiles acquired from the PollyXT lidar, operating by the National Observatory of Athens (NOA) at Antikythera island. The ideal location of the site, affected frequently by Saharan desert dust outbreaks, allows the validation of AEOLUS' aerosol products under conditions which are expected to affect the accuracy of the spaceborne retrievals. The performed Cal/Val activities, in the framework of the VADAM ESA-project, will serve as a preparatory study of the large-scale tropical experimental campaign ASKOS, in which NOA has a leading role, that will take place at Cape Verde on June-July 2020.

Impact of dust deposition events on marine primary productivity and carbon export/ sequestration to the deep basins of the Eastern Mediterranean Sea

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The Eastern Mediterranean Sea, as one of the most oligotrophic sites of the world ocean, displays high seasonal variability with low productivity rates and export, observed mainly during the late winter/spring convective mixing period. Sinking particulate matter is the major vehicle for exporting organic carbon produced in the sea surface during photosynthesis to the deep sea. During its transit towards the sea floor, most particulate organic carbon (POC) is returned to inorganic form and redistributed in the water column. This redistribution determines the surface concentration of dissolved CO2, and hence the rate at which the ocean can absorb CO_2 from the atmosphere. The ability to predict quantitatively the depth profile of remineralization is therefore critical to deciphering the response of the global carbon cycle to natural and human-induced environmental changes.

A mooring line of five sediment traps was deployed from 2006 to 2012 at 5 successive water column depths (700, 1200, 2000, 3200 and 4300 m) in the SE Ionian Sea, where the deepest part of the Mediterranean Sea is located ('NESTOR' site). Aiming to investigate the significant ecological and biogeochemical features and provide new insights on the sources and cycles of sinking particulate matter in the open Ionian Sea, we have examined long-term records of downward fluxes for Corg, Ntot, δ13Corg and δ15Ntot, along with the associated ballast minerals (opal, lithogenics and $CaCO_3$), selected lipid biomarkers and coccolithophores. Our ultimate goal is to identify the mechanisms governing particle transport and carbon sequestration and to explain (i) the seasonal, and (ii) the interannual variation of mass and main constituent fluxes, in relation to oceanographic conditions, regional and large scale circulation patterns and climate variability.

Our flux study proposes additional processes, potentially of high importance for fueling surface waters at the oligotrophic site with nutrients: 1) the influence of episodic dust input events, leading to enhanced fluxes of lithogenic matter and supply of nutrients to the euphotic layer, which can cause increases in primary and secondary production, as witnessed by the organic carbon, carbonate, opal, coccolithophorid and organic biomarker fluxes and 2) the upwelling of intermediate waters in late spring-early summer, causing nutrient upwelling to the euphotic zone.

Assessment of Aerosol Particulate Matter at the city of Ioannina, Greece, during the 1st PANACEA Campaign (July 2019)

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A preliminary assessment of airborne particulate matter at the city of Ioannina (Greece) during the period 11/07/2019-20/08/2019 (1stPANACEA campaign) is presented. The data encompass PM1, PM2.5 and PM10 levels, measured by a synergy of surface-based instruments (TEOM, beta gauge, OPC, Purple Air) that were located in spots with maximum distance of 1000m between each other and have been continuously and simultaneously operated. The intercomparison between the four instruments will allow to determine the background levels of particulate matter at Ioannina, and also to show the limitations and possible systematic biases of each instrument.

Contribution of new particle formation to cloud condensation nuclei and cloud droplet number in the eastern Mediterranean

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Atmospheric New Particle Formation (NPF) is a common phenomenon all over the world. NPF involves the formation of molecular clusters from precursor vapors and the subsequent growth to larger sizes. The newly formed particles may gradually grow all the way to cloud condensation nuclei (CCN), climate relevant, sizes of hundreds of nanometers in diameter and eventually impact cloud droplet number (CDN). In this study we present observations from the eastern Mediterranean region, measurements were performed at the Finokalia environmental research station on Crete. We found that NPF takes place 27% of the available days, more frequently in April and May due to the terrestrial biogenic activity and is less frequent in August when however CCN concentrations are higher. Sub-100 nm particles were found to be substantially less hygroscopic than larger particles during the period with active NPF and growth, probably due to enrichment of organic material in this size range. The aerosol hygroscopicity tended to be at minimum just before the noon and at maximum in the afternoon, which was very likely due to the higher sulfate-to-organic ratios and higher degree of oxidation of the organic material during the afternoon. NPF can increase CCN concentrations (from 0.1% to 1% supersaturation) between 29 % and 77 %, a number of hours after the NPF event began in the morning. Using the aerosol observations, and boundary later vertical velocity distributions as input to a droplet activation parameterization, we then quantify the relative impact of NPF on CDN throughout every event as it progresses. We find that CDN respond much less during NPF events, increased by a modest 13%, owing to water vapor limitations. The CDN form from CCN that activate at supersaturations below 0.1%, which defers NPF impacts on CDN to clouds to the late evening and nighttime – with important implications on what types of aerosol-cloud-can occur during NPF events. We clearly show that the numerous analyses of NPF impacts on clouds based solely on CCN concentrations using prescribed supersaturation can provide very different, even misleading, conclusions than those explicitly resolving the aerosol-cloud link such as done here. The proposed approach here offers a simple, yet highly effective way for a more realistic impact assessment of NPF events on cloud formation.

Atmospheric inputs of soluble N, P and Fe to the Mediterranean Sea

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The oligotrophic semi-closed environment of the Mediterranean Sea is characterized by anomalous high nitrogen-to-phosphorus ratio that has been tentatively attributed to the atmospheric inputs of nutrients to the sea. A 3-dimensional atmospheric chemistry transport model to evaluate the atmospheric deposition fluxes of soluble N, P and Fe to the Mediterranean Sea. The study considers both the inorganic and organic fractions of them and compares them to other external to the ocean sources of these nutrients. These deposition fluxes provide an integrated spatially complete picture of the atmospheric inputs to the Mediterranean Sea than constructed from point measurements. The estimated fluxes of soluble nutrients are much lower when anthropogenic and biomass burning emissions of the year 1850 are considered; while for future emissions N deposition hardly increases and soluble P and Fe fluxes are drastically reduced compared to current estimates. Comparison of model results with observations in the region indicate important underestimate of organic phosphorus sources. While simple calculations reveal the importance of atmospheric deposition for C fixation, use of ocean biogeochemical model is needed to investigate the importance of these atmospheric inputs to this marine ecosystem and the ocean carbon cycle.

The Extra-tropical Transition of Atlantic hurricanes in PRIMAVERA HighResMIP

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We have analyzed the HighResMIP simulations performed by the PRIMAVERA partners with respect to the extratropical transition of tropical cyclones. We have focused on the North Atlantic and extra-tropical cyclones that reach Europe. For those storms we have analyzed their characteristics and compared them with observations and reanalyses products. Specifically, we addressed the role of warm-seclusion mechanism in the extra-tropical transition using Hart diagrams. Most PRIMAVERA models are able to represent reasonably well the observed characteristics of extra-tropical transition. In agreement with the study of Dekker et al. (2018) about 50% of the storms that reach Europe are warm-seclusion storms.

Monitoring of atmospheric components with the Phaethon System over Thessaloniki, Greece, using MAX-DOAS and Direct-Sun observations

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Multi Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) is a measurement technique that has been used for monitoring the atmospheric composition sine the 1980's but it has received considerable attention during the past two decades. MAX-DOAS utilizes scattered sunlight received from multiple viewing directions and the recorded spectra are analyzed using the DOAS technique in order to acquire slant column densities (SCDs) of several trace-gases with narrow band absorption structures in the near UV and visible wavelengths. The retrieval approach does not require radiometric calibration and the trace gases are measured relative to a reference spectrum, typically recorded in the zenith. Therefore, MAX-DOAS is recognized as a "self-calibrating" technique, so the impact of possible instrumental degradations can be largely removed by using appropriate reference spectra. The advantages of MAX-DOAS are: the ability to detect weak absorption signals, the unambiguous and absolute identification of trace-gas amounts, as well as the fact that trace-gas concentrations are determined solely from the absorption cross sections of these gases. Here, we present the retrieval methodology of five atmospheric components over Thessaloniki, Greece, from measurements with the Phaethon System. Phaethon is a ground-based mini MAX-DOAS system that performs fast, spectrally resolved measurements in the wavelength range of 300–450 nm which are used for the retrieval of total and tropospheric columns of atmospheric trace gases and aerosol optical properties. The retrieved atmospheric components are the tropospheric Vertical Column Densities (VCDs) of NO_2, HCHO and SO_2, the Total Ozone Column (TOC) and the spectral Aerosol Optical Depth (AOD). We deploy MAX-DOAS measurements at several elevation angles, defined between the horizon and zenith, for the calculation of the tropospheric VCDs, and Direct-Sun observations in order to measure the TOC and the AODs. The MAX-DOAS measurements are performed at different azimuth angles, in order to investigate the spatial distribution of the trace gases and their variability around the measurement site. This study presents the retrieval strategy, results from the analysis of the products, their time series since the beginning of the Phaethon operation in 2013 and comparisons with other co-located instruments.

Low cost sensors for measuring airborne particulate matter: field evaluation and calibration at a South-Eastern European site

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Low-cost sensors are useful tools for the collection of air quality data, augmenting the existing regulatory monitoring network and providing an unprecedented opportunity to increase dramatically the spatial coverage. A variety of commercial and low-cost sensors for particulate matter (PM) monitory are available and have been implemented in measuring networks. However, the evaluation of the performance of these devices -is still in the first stages.

This study presents the results of the evaluation and a proposed calibration technique of 2 low-cost Purple Air sensors (PAir) in ambient conditions at two sites located in the city of Patras, Greece during 2017-2018. The PM1 and PM2.5 measurements were well correlated with the reference instrument (GRIMM Environmental Dust Monitor 365) However, for PMcoarse (particles with diameters between 2.5 and 10 μm) their performance was poor. The response of the sensor for PM1 and PM2.5 at University changed significantly during periods for which the site was affected by severe dust events. For this scope, a dust detection method was developed to identify the observations that were not affected by the dust events. The effect of relative humidity (RH) on PAir sensor measurements was examined using regression-based calibration models and varied among the examined PM fractions. The implementation of the RH calibration factor in the calibration procedure improved significantly all the statistical metrics.

The final (calibrated) PAir measurements were very well correlated with the GRIMM ones for PM1 and PM2.5 and the scatter is quite small at both sites. The calculated statistic metrics, RMSE and MAE were minimal with values ranging from 0.37-0.64 μg/m3 and 0.17-0.39 μg/m3 for both sites and fractions while MBE=0 μg/m3 reveling a satisfactory performance of Pair sensors compared to GRIMM.

Multi-Instrument Validation of TROPOMI/S5P atmospheric products over Thessaloniki, Greece

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Operational monitoring of atmospheric gaseous and particular species of both tropospheric as well as stratospheric provenance sensed by satellite instruments are performed routinely in the Laboratory of Atmospheric Physics, Thessaloniki, Greece, using a suite of different ground based instruments. These include both a single and double Brewer spectrophotometer, multiple MAX-DOAS instruments, a Raman aerosol Lidar as well as a NILU-UV sun photometer, an FTIR spectrometer, a CIMEL photometer, among others. These instruments operate on the rooftop of the Physics Department in the Aristotle University of Thessaloniki at the Laboratory of Atmospheric Physics (LAP), which is located in the city center of Thessaloniki, Greece. Most of the data records provided by these instruments span the better part of two decades. In the following we will focus on validating TROPOMI/S5P total ozone columns, total, stratospheric and tropospheric NO_2 , total HCHO, CO and CH_4 columns, cloud fraction and cloud height as well as the absorbing aerosol height. The high spatial resolution of the TROPOMI/S5P measurement routine will permit the investigation on the effect of the temporal difference between the measurements, as well as other contributing factors.

The Laboratory of Atmospheric Physics of the Aristotle University of Thessaloniki, Greece, is the co-ordinator of the TROPOMI's Total Ozone Column Validation (VALTOZ) team and in this work the validation of the main atmospheric parameters of TROPOMI, ozone, will be presented via its comparison to the ground-based observations by the well-established Thessaloniki Brewer instrument.

A MAX-DOAS system has been operating since 2011 on campus while a second MAX-DOAS system is operating since 2016 at the Center of Interdisciplinary Research and Innovation (CIRI) of AUTH located at the suburbs of the city, about 10 km to the South-East. The combined monitoring ability at both an urban and suburban location can prove to be extremely informative in identifying urban gradients in NO_2 and HCHO loading and thus allowing their verification from high spatial resolution space-born observations, as well as possible features in the daily variability of the total ozone content over the city.

A multi-wavelength depolarization Raman Lidar system is co-located in LAP, operating since 2000 as part of the European Aerosol Research Lidar Network (EARLINET) and is employed to examine the variability of the aerosol load via its verification to the TROPOMI/S5P Absorbing Layer Height for cases of elevated aerosol layers such as Saharan dust events, volcanic eruptions and biomass burning episodes. Routine,

dedicated lidar measurements during such episodes, like those performed in EARLINET, are important to study the sensitivity of the newly developed S5P/ALH product for different aerosol types.

A recently acquired FTIR instrument, in collaboration with KIT, Germany, is providing dedicated observations of the Carbon Monoxide, CO and Methane, CH4, content over the city. EM27/SUN is a mobile analyzer dedicated for atmospheric studies at high performance measuring the direct solar radiation in the near infrared (NIR) spectral range. Observations performed on clear days since January 2019 will be compared to the TROPOMI/S5P measurements.

Furthermore, Synoptic Observations of the cloudiness over Thessaloniki, performed in the international Airport of Thessaloniki some 20km from the University location, will be compared to the cloud parameters provided by the dedicated TROPOMI algorithm. Cloud fraction as well as cloud top/bottom height estimates are inter-compared and useful deductions made.

Overall, all operational TROPOMI/S5P products are covered by temporal and spatial collocated observations performed, or ingested, by the Laboratory of Atmospheric Physics providing a comprehensive synergistic data center for dedicated validation purposes.

ACTRIS contribution to understanding large scale variability and trends in the European Atmosphere and challenges ahead

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Changing atmospheric composition is the driver of climate change acting both on the global scale (i.e. warming related to long-lived greenhouse gases such as CO2) and on a regional dimension where atmospheric compounds with shorter lifetime will enhance or slightly reduce warming from long-lived greenhouse gases. Atmospheric pollutants are also responsible for poor air quality which causes 7 million premature deaths every year. Even very small amounts of air pollutants can have serious impacts on human health. Fine particles are particularly harmful due to their ability to penetrate deep into the lungs and blood streams. The measured decrease in atmospheric pollutant concentrations is the ultimate indicator of a successful policy to reduce emissions. Yet, developing a sustainable framework for observing short-lived pollutants variability is a challenging endeavor.

ACTRIS (Aerosol, cloud and Trace Gases Research Infrastructure) was initiated a decade ago and is now entering its implementation phase. ACTRIS data serve a number of purposes and have been used to better characterize properties and impact of aerosol and clouds in the European atmosphere.

Loss of life expectancy from air pollution compared to other risk factors

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Air pollution enhances the risk of cardiovascular and respiratory diseases. A novel Global Exposure – Mortality Model (GEMM) has been derived from many cohort studies, providing much-improved coverage of the exposure to fine particulate matter (PM2.5). The GEMM improves estimates of mortality attributable to ambient air pollution, which can be compared to other risk factors.

We used a data-informed atmospheric model to calculate worldwide exposure to PM2.5 and ozone pollution, which was combined with the GEMM to estimate disease-specific excess mortality and loss of life expectancy (LLE) in 2015. Using this model, we investigated the effects of different pollution sources, distinguishing between natural and anthropogenic emissions, including fossil fuel use.

Global excess mortality from ambient air pollution is estimated at 8.8 (7.11–10.41) million/year, with an LLE of 2.9 (2.3–3.5) years, being a factor of two higher than earlier estimates, and exceeding that of tobacco smoking. The global mean mortality rate of about 120 per 100,000 people/year is much exceeded in East Asia (196 per 100,000/year) and Europe (133 per 100,000/year). Without fossil fuel emissions the global mean life expectancy would increase by 1.1 (0.9–1.2) years, and 1.7 (1.4 –2.0) years by removing all potentially controllable anthropogenic emissions. Because aeolian dust and wildfire emission control is impracticable, significant LLE is unavoidable.

High Resolution online Aerosol Measurements during the 1st PANACEA Summer Campaign in Athens, Greece

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Aerosol chemical speciation, optical and physical properties were monitored by means of automated high resolution equipment, at the urban background Atmospheric Monitoring Station of the National Observatory of Athens (NOA) at Thissio (37.973°N, 23.718°E, 105 m a.s.l) in the center of the Athens Basin, during the 1st PANACEA summer campaign (11/07/2019-25/08/2019). Ancillary measurements of major gaseous species and meteorological parameters were also available, whereas offline sampling for further chemical analysis was simultaneously conducted. The first results of the levels and the factors driving the species' variability are presented. Emphasis is given on the contribution of the online techniques and Purple Air II sensors to determine the fast changes of the atmospheric composition during natural or manmade hazards that deteriorate the air quality and affects the population. The case of the Evia forest fire plumes that affected Athens is further elaborated, as there has been specific and intense mass media coverage on the degradation of air quality during the event.

Aerosol classification in Europe, Middle East, North Africa and Arabian Peninsula based on AERONET Version 3

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The aerosol optical properties from Version 3 (V3) of AERONET were used to classify the aerosol types in Europe, Middle East/North Africa (MENA) and Arabian Peninsula, during the 2008-2017 period. The hourly Level 2.0 quality-assured data at all 41 stations were used in order to apply a modified version of the classification method by Zheng et al. 2017. The latter is using the Single Scattering Albedo (SSA), Fine Mode Fraction (FMF) and Angstrom Exponent (AE) in order to the categorize aerosol type.

The method performance relies on the determination on threshold limits of these optical properties. The aerosol type depends on the location and the sources of each region of study; for example, in Atlantic, Arabian Peninsula and MENA, clearly the predominant aerosol type is the coarse absorbing due to dust from Sahara and Arabian deserts. However, in Arabian Peninsula, fine particles are observed mainly in autumn and winter. In addition, the lower percentages of coarse absorbing particles across MENA are observed in the East because of fine particle emissions from human activities. In South-East Europe, a bimodal size distribution is found and the predominant aerosol types are the fine-slightly absorbing and non-absorbing, followed by coarse absorbing due to Sahara dust outbreaks. In South-West areas, primarily fine slightly absorbing and non-absorbing particles are observed since the stations are located in urban/industrial regions. In Central and East Europe, the prevailing aerosol type is the fine-non absorbing which is followed by the fine slightly absorbing aerosols due to urban/industrial sites.

The results of the aerosol type characterization are presumed to give a better assessment of regional climate and local air pollution. They will also be useful for the validation of satellite data and the improved performance of models and remote sensing algorithms in the future.

Environmental analysis in traffic-congested roads using an Integrated Modelling Tool

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A novel Integrated Modelling Tool (IMT) has been developed as a tool for mobility decision making within the REMEDIO project (REgenerating mixed-use MED urban communities congested by traffic through Innovative low carbon mobility sOlutions), co-founded by the Interreg Med Programme. IMT is implemented through FIWARE platform and it is composed of several individual modules aiming to assess the main impacts of traffic on pollutant emissions and carbon footprint, air pollution dispersion, energy efficiency, noise, cost and health effects. In particular this tool links the traffic model 'Simulation of Urban Mobility' (SUMO), the emission model 'Passenger Car and Heavy Duty Emission Model (Light)' (PHEMLight), the model 'Pollutant dispersion in the atmosphere under variable wind conditions' (VADIS) (coupling a boundary layer flow module with a Lagrangian dispersion module) and a noise module based on the EU 'Common Noise Assessment Methods' methodology (CNOSSOS-EU). The implementation of IMT requires the introduction by the user of the zone definition and the traffic data (road definition, special lanes, traffic lights, vehicle technologies, flows). In the current study, a description of the IMT is presented as well as an application in a main road axis of Thessaloniki, Greece.

Direct aerosol absorption at the Eastern Mediterranean

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The absorption influence on radiation, apart from scattering, is studied above the Aegean Sea (Eastern Mediterranean) under a typical warm period with Etesian and non-Etesian days. During this period mixed anthropogenic and biomass burning polluted air masses from eastern and central Europe were transported to the region. The mesoscale Weather Research and Forecasting model fully coupled with chemistry and aerosols (WRF-Chem) is applied. The forcing caused by total absorption is estimated along with black carbon (BC), dust, and sea salt contributions, 1.3, 1.2, 0.1 and nearly zero W m-2, accordingly. As dust and sea salt influence is negligible due to the low dust concertation and sea salt absorptivity, the main focus is on BC. BC absorption reduces downward shortwave irradiance reaching the ground by 5.9 W m-2 and the upward part by up to 1.7 W m-2. The downward and the upward longwave irradiances influenced more by the temperature increase (up to 0.3 K) than the actual absorption are augmented by up to 2.0 and 1.2 W m-2, accordingly. Low level clouds are dissipated by 10% (the semi-direct effect), as the temperature increases with height due to BC absorption and stabilizes the planetary boundary layer (PBL). In order to examine the physical mechanisms below this temperature increase, all modeled heating rates are analyzed. At the layers above ~0.5 km, the heating rate is attributed only to the absorption of shortwave radiation since advection tends to bring colder air masses at these layers. On the other hand, between the 0.5 km and the atmospheric surface layer, the advection and shortwave radiation act positively on the heating of the atmosphere where the vertical diffusion and mixing produce cooling in the layers with an overall small positive outcome. At the atmospheric surface layer, where the highest BC concentration is located, the longwave cooling unexpectedly prevails over the shortwave heating and therefore the heating of the layer is mainly attributed to the advection process as more heated air masses are transported over the Aegean Sea.

Validation of TROPOMI's/S5P and GOME-2/MetOp Aerosol Height products using the elevated height obtained from Thessaloniki lidar station during PANACEA campaign

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In this study, Aerosol Height products from GOME-2 and TROPOMI's satellite sensors are validated using ground-based lidar measurements from Thessaloniki lidar station. Aerosol height information is an important parameter when estimating radiative forcings and climate impacts of aerosol, for aviation safety and it helps in understanding atmospheric transport mechanisms. Measurements have been performed within the period 10 July to 10 August 2019, at the Laboratory of Atmospheric Physics (LAP) at Thessaloniki, Greece (40.630N, 22.960E), in the framework of PANACEA summer campaign. THELISYS is the lidar system that belongs to the LAP and is operational since 2000 in the framework of the EARLINET. The validation products are the Absorbing Aerosol Height (AAH) and Aerosol Layer Height (ALH), provided by GOME-2 (on board MetOpA/B) and TROPOMI's (on board Sentinel-5 Precursor) instruments respectively. These products have been analysed by the Royal Netherlands Meteorological Institute (KNMI) and focus on retrieval of vertically localized aerosol layers in the free troposphere, such as desert dust, biomass burning aerosol, or volcanic ash plumes. In the future, other lidar stations that are part of the EARLINET network will be included in the comparison for further validation of the satellite products on continental scale.

The 1st PANACEA Summer Campaign (An overview)

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Air pollution has been reported as responsible for about 4.5 million premature deaths worldwide per year and about 10000 in Greece. Sources of aerosols as well as the processes that cause mortality present high spatial and temporal variability and require thorough investigation. One of the three main scientific activities of PANACEA is to elucidate sources of aerosol pollution and population exposure, in 6 cities along Greece. For this purpose, spatial- temporal mapping of atmospheric pollution in Athens, Thessaloniki, Patras, Volos, Ioannina and Xanthi and the quantification of the variability of the most important sources of pollution will be studied in two seasons (summer and winter), periods with well distinguished aerosol sources and meteorology. Additionally measurements of oxidation potential (ROS) will be performed and will be used as an indicator of human exposure to the pollution sources. Finally similar type measurements will be conducted at Finokalia during the same period and will be used as a reference for the regional background atmosphere.

In the frame of this presentation, an overview of the measurements performed in summer 2019, during the first PANACEA campaign, in the 6 cities and at Finokalia background station will be presented. The first results will be discussed and some interesting case studies will be highlighted.

Highlights of the vertical distribution of the Aerosol Optical and Geometrical properties retrieved over the city of Volos, Greece, during the 1st PANACEA campaign (July 2019)

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We present preliminary results of the profiles of the aerosol optical and geometrical properties retrieved by a synergy of instruments (depolarization lidar, MAX-DOAS sun photometer, etc…) and tools (HYSPLIT model, MODIS satellite sensor, etc.), as observed over the industrial city of Volos (Greece) during the period (11/07/2019-31/07/2019) in the frame of the 1st PANACEA campaign. Specific case studies will be devoted to study of the aerosol diurnal variability during specific events (Saharan dust transport, industrial emissions, forest fires, etc.).

Oxidative potential: Importance, results and challenges

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It is well established that air pollution is classified as a mild carcinogen and increased particulate matter concentrations are linked to increased rates of cardiovascular diseases, acute respiratory disorders, mitochondrial damage and oxidative stress. Although a direct mechanism linking particulate matter (PM) exposure to health outcomes is not yet well established, it is thought that reactive oxygen species (ROS), generated from photochemical reactions in polluted air or in vivo by redox cycling (all together called oxidative potential, OP) degrades health by inducing oxidative stress to exposed populations and ecosystems. The development of numerous acellular OP assays techniques routinely measuring ROS activity has led to a rapidly growing global dataset of OP that carries significant potential for unraveling the relationship between emissions, chemical constituents of PM and their health outcomes. Here we present an overview of the work done to date, including the challenges and potential breakthroughs that OP measurements can offer in linking PM to health outcomes.

Aerosol Detection in the Free Troposphere over the city of Volos, Greece, during the 1st PANACEA campaign (July 2019)

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In this contribution, we present the results of the profiles of the aerosol optical (backscatter coefficient and linear particle depolarization ratio-LPDR) and geometrical properties retrieved by the AIAS depolarization lidar system, during the 1st PANACEA campaign, in July 2019, in the city of Volos. The aerosol layers were detected in the free troposphere in altitudes ranging from the top of the PBL, at 1500 m (during nighttime) to 3500 m (during daytime). The LPDR values ranged from 1.7 to 5.7 (%). The airmass back-trajectories provided by the HYSPLIT model, the satellite active fire data (fire maps by MODIS and VIIRS), as long as the LPDR values indicate biomass burning particles from local sources and from long-range ones (Europe).

Vertical Profiling and characterization of Aerosols in the planetary boundary layer retrieved over the city of Volos, Greece, during the 1st PANACEA campaign (July 2019)

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We present preliminary results of the daytime evolution of the Planetary Boundary Layer (PBL) and the profiles of the aerosol optical properties retrieved by a the AIAS depolarization lidar, in conjunction with in situ aerosol composition data derived from filter samplings, SMPS and aetholometer in situ measurements at ground level, as observed at the industrial city of Volos (Greece) during the period (11/07/2019-31/07/2019) in the frame of the 1st PANACEA campaign. Specific case studies will be presented focusing on the diurnal variability of specific categories of aerosols from emitted local sources (industrial emissions, local transport activities, forest fires, etc.)

The ESA-EVE polarization lidar for assessing the AEOLUS aerosol product performance

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We present the EVE (Enhancement and Validation of ESA products) lidar concept, a combined linear/circular polarization system, tailored to evaluate the aerosol product of the spaceborne ALADIN (Atmospheric Laser Doppler Instrument) lidar system, on board Aeolus ESA mission. EVE, is being currently developed to be a flexible, mobile, ground-based lidar system, which aims to provide the Aeolus mission and the forthcoming EarthCARE mission with well-characterized, fiducial reference measurements of aerosol optical properties. The system design will utilize a dual-telescope/dual-laser configuration emitting linearly and circularly polarized radiation in the UV, at 355 nm. Moreover, the system will allow the adjustment of the measurement zenith angle from 3 to 35 degrees as well as full adjustment of the measurement azimuth angle in order to fulfil the requirements of both Aeolus and EarthCARE missions.

ALADIN being a High Spectral Resolution Lidar (HSRL) system, is capable of deriving aerosol optical properties such as particle backscatter and extinction coefficient profiles. An inherent weakness of ALADIN is the lack of detection of the cross-polarized return of the emitted circularly-polarized signal. This limitation has almost negligible impact when near-spherical aerosol particles are probed. However, under the presence of non-spherical particles, such as desert dust, volcanic ash, and ice crystals, the undetected portion of the received radiation leads to an underestimation of the circular depolarization ratio through the retrieved backscatter coefficient. The main focus of the new EVE lidar is to evaluate the aerosol backscatter/extinction retrievals for Aeolus and quantify their uncertainties. EVE will be also utilized for EarthCARE product validation, quality assessment and improvement. Furthermore, the capability of EVE to emit both linearly and circularly polarized radiation, may provide an additional insight on polarization related multiple scattering effects as well as particle orientation.

EVE is implemented by NOA and Raymetrics S.A. under an ESA contract. We also acknowledge the support of the project "PANhellenic infrastructure for Atmospheric Composition and climatE change" (MIS 5021516) which is implemented under the Action, funded by the Operational Programme "Competitiveness, Entrepreneurship and Innovation" (NSRF 2014-2020) and co-financed by Greece and the European Union (European Regional Development Fund); the European Research Council under the European Community's Horizon 2020 research and innovation framework program/ERC Grant Agreement 725698 (D-TECT) and the Stavros Niarchos Foundation.

Hellenic Integrated Marine-Inland waters Observing Forecasting and offshore Technology System (HIMIOFoTS)

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Processes in the aquatic environment are characterized by increased variability across multiple spatial and temporal scales, and their observation requires methods and technologies that allow the complex dynamics to be captured. Especially when it comes to the observation of multiple parameters required for the study of complex problems such as multi-annual variability and its role in climate change, the response of aquatic ecosystems to global change, the coupling between sea and atmosphere and the coastal – off shore continuum. Hellenic Integrated Marine-Inland waters Observing Forecasting and offshore Technology System (HIMIOFoTS) is a fully integrated large-scale infrastructure that comprises two distinct components: (1) the marine observation and forecasting system, including marine structure testing facilities and (2) an information system for hydro-environmental information on surface water resources. Specifically, the "Integrated Seas Monitoring and Forecasting System" consists of different marine environment observation platforms that transmit in near real-time data as well as a suite of numerical models that provide short-term atmospheric, wave and hydrodynamic forecasts; while the Open Hydrosystem Information Network (OpenHi.net) is an integrated information infrastructure for the collection, management and free dissemination of hydrological and environmental information related to the country's surface water resources.

Spectral Solar Measurements for Atmospheric Composition at Thissio Station, Athens, Greece

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Solar Spectral Measurements are widely used to retrieve atmospheric variables, through radiative transfer calculation of optical properties. Most frequent retrieved variables are the optical depths of Aerosols and trace gases (NO_2, O_3 etc). This study aims to present results of these measurements performed at Thissio station. Athens is a city of 3.7 million habitants with an estimated of 2.5 million automobiles and heavy traffic, which is the single greatest source of local emissions. The area has been heavily deindustrialized the previous decades, but there are still emissions linked to factories and fossil fuels. Athens is located in a basin, where mountainstrap most of the urban emissions in the greater area, due to poor ventilation. Thus, there is great interest in both Aerosol and Trace Gases measurements. Instruments installed at Thissio station included filter radiometer (CIMEL) and spectral photometers (PSR and PANDORA).

The CIMEL sun-photometer is a filter radiometer which performs direct sun and sky radiance measurements. Measurements are performed at eight nine bandpass filters between 340 and 1064 1640 nm (8 of them dedicated to Aerosol Optical Depth –AOD- retrieving and one used for water vapor). Direct measurements are performed usually every 10-15 minutes. These measurements are processed centrally and are widely available through Aerosol Robotic Network (AERONET). The Precision Solar Spectroradiometer (PSR) is designed to measure the solar spectrum in the 320 to 1040 nm wavelength range with a spectral resolution of about 2 nm full width at half maximum. Data from these measurements are used to study incident solar irradiance and to retrieve AOD and water vapor. The Pandora spectrometer system consists of an optical head sensor, mounted on a computer controlled sun-tracker and sky-scanner, and connected to a spectrometer. It operates in the 280–530 nm spectral range with a 0.6 nm slit function width (full width at half maximum). Data collected are used to retrieve columnar NO_2, O_3 and algorithms for other trace gases are under development. Data will be freely available through the PANDONIA network.

At this study retrieved data from these instruments will be presented. Ten years of AOD measurements provide a short climatology for the area and seasonal patterns are identified. Also, half-year retrievals of NO_2 will be shown and diurnal and weekly patterns are detected.

Towards an algorithm for near real time profiling of Aerosol Species, trace gases and clouds based on the synergy of Remote Sensing Instruments

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We present the concept of a novel algorithmic chain that aims to a dataset of unprecedented detail in the vertical distribution of multiple atmospheric components in near real time conditions. The analysis will be based on the following remote sensing instruments: a depolarization Raman lidar, a visible and a thermal all-sky camera, a Brewer spectrophotometer, and up to three mini DOAS/MAX-DOAS systems. Based on both individual and synergistic processing of the data collected, novel products will be made available in near real time conditions to the end users. Columnar aerosol information from the spectrophotometers will be combined with lidar data to retrieve vertical profiles of individual aerosol species. Cloud layers will be detected and classified based mainly on the synergy of the lidar and the sky cameras and a realistic 3D representation of cloud conditions around the measurement site will be produced. Lidar profiles will be implemented as a priori information for radiative transfer purposes, that are necessary in order to obtain high quality trace gases profiles from the DOAS/MAXDOAS spectrophotometer. Fast synergistic data processing will ensure that the algorithm can be applied for near real time public data dissemination in the future. The ability to obtain the vertical distribution of individual aerosol species and trace gases is still quite fresh in the scientific community. The atmospheric modeling community for sure would benefit the most as such information can be invaluable for the evaluation of forecasting models. The same products could be utilized in the evaluation of satellite observations as well. As cloud formation depends largely on the existing aerosol load and some aerosol species originate from trace gases, applications in the fields of aerosol and cloud interactions and aerosol formation in elevated layers are also possible. Since both aerosols and trace gases are factors that negatively affect public health, the knowledge of their concentration levels inside the boundary layer is important in preventing detrimental exposure by timely warning the public. Likewise, a near real time detection of extreme aerosol outbreaks, such as dust and volcanic ash plumes, can be critical in avoiding aviation hazards. Applications could even focus towards agriculture as there is evidence that aerosol species and trace gases could damage crops directly by being absorbed by the plants.

Measurement and monitoring of carbon dioxide parameters in the sea water by HCMR

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Humans are increasingly influencing the climate and the earth's temperature primarily by burning fossil fuel and releasing greenhouse gases in the atmosphere. Carbon dioxide, a key greenhouse gas that drives global climate change, continues to rise every year. Climate change mitigation generally involves reductions in anthropogenic emissions of greenhouse gases. The ocean constitutes a key reservoir, which mitigates the accumulation of anthropogenic CO_2 in the atmosphere. Recent estimates have calculated that 26 percent of all the carbon released as CO_2 from fossil fuel burning, cement manufacture, and land-use changes over the decade 2002–2011 was absorbed by the oceans (Le Quéré et al., 2015).

Ocean uptake of anthropogenic CO_2 (C_{ANT}) alters ocean chemistry, leading to more acidic conditions and lower chemical saturation states (Ω) for calcium carbonate minerals, a process commonly termed "ocean acidification" (e.g. Caldeira and Wickett, 2005).

The Mediterranean Sea plays an active role in the sequestration of atmospheric CO_2 because of : 1) its high, compared to the oceans, Total Alkalinity (A_T) and Total Inorganic Carbon (C_T) concentrations, 2) his calcium-carbonate supersaturation, 3) his circulation as a concentration basin and 4) the short residence time of its deep waters.

We started to determine carbonate chemistry parameters at HCMR since 1990-1991 by precise potentiometric method, measuring A_T and C_T in a closed cell. Recently the measuring system was replaced by VINDTA 3C (Versatile INstrument for the Determination of Total inorganic carbon and titration Alkalinity). This instrument combines a system of the sea water titration with acid for the A_T determination and a simplified extraction unit for coulometric analysis of the C_T (Dickson et al 2007).

Therefore, a quantitative estimation of the anthropogenic carbon dioxide and other parameters that play a role in the acidification level of the Eastern Mediterranean is of great importance. HCMR has the capacity to combine data taken from cruises and of the POSEIDON buoy network, in order to assess the role of the Eastern Mediterranean to the mitigation of the C_{ANT} in the atmosphere. The combination of our data with greenhouse data collected at Finokalia could give a more complete picture of the exchanges occurring at air –sea interface.

The effect of deposition mechanisms on the Lagrangian particle dispersion model Flexpart. A case study for Black Carbon and air tracers at the Zeppelin observatory station

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Flexpart is an offline Lagrangian particle dispersion model that simulates atmospheric transport, diffusion, dry and wet deposition, radioactive decay and first order chemical reactions. Flexpart can be run in either forward or backward mode and operates by releasing computational particles. The produced output represents the residence time of the particles in every grid cell and is termed emission sensitivity. Computational particles can be tuned either as gas or particle (aerosol) tracers. When in aerosol mode, the computational particles are represented by a log-normal diameter distribution, with a given center and variation. Flexpart applies dry removal through gravitational settling and dry deposition, taking into account the aerosol size distribution. Wet scavenging occurs in the presence of clouds and precipitation. Both large scale and convective precipitation rates are accounted.

An A31 Aethalometer operating at Zeppelin station is used to collect Black Carbon (BC) data during the Arctic haze period, corresponding to the annual peak of measured concentrations. We simulate the backward transport of the detected Black Carbon and an air tracer at the Arctic station of Zeppelin. The simulation is driven by reanalysis meteorological inputs from the European Center for Medium-range Weather Forecasts (ECMWF) on a resolution of one degree. The version of the model is FLEXPART_9.02. Differences in emission sensitivities between the two tracers stress the importance of deposition mechanisms in aerosol transport. The Potential Source Contribution Function (PSCF) is applied on both tracers. When comparing the BC tracer and air tracer, we find that former PSCF values are larger and situated closer to the expected emission areas according to emission inventories. As an exception, there is a large BC tracer source contribution along the east Siberian transport pathway appearing over the Arctic ocean.

A new methodology for lidar-based characterization of marine particles

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We demonstrate a methodology for retrieving profiles of optical properties of marine particles. The developed methodology is tailored to the observations performed with the Polly^{XT}-NOA lidar system of the National Observatory of Athens, part of the European Aerosol Research Lidar Network (EARLINET). The dataset used has been collected at the newly established PANhellenic GEophysical observatory of Antikythera (PANGEA; 35.86°N, 23.31°E, 193 m a.s.l.) during the first experimental campaign of the ERC D-TECT project (1 – 20 September 2018). During that period, marine aerosols were constantly present above the station at altitudes close to the surface, and sea salt concentrations were measured at the surface with in situ instrumentation. The lidar-based retrievals of aerosol optical properties close to the surface are affected significantly from the incomplete overlap between the laser beam and the receiver field of view. In the case of the Polly^{XT}-NOA lidar, the full overlap is achieved between 600m and 1km above the surface for the channels acquired with the far-range telescope, and between 200m and 400m for the channels acquired with the near-range telescope (varying for different measurement setups and atmospheric conditions). This effect limits significantly the lidar capabilities to provide information of the optical and microphysical properties of marine particles close to their source. In order to improve the observations, we are using different techniques (i.e. gluing of the near-range and far-range signals, use of an overlap function to extend the near-range signals at even lower altitudes) for retrieving reliable profiles of marine properties at altitudes even lower than 200m a.s.e. (about 400m a.s.l at PANGEA station), inside the Marine Boundary Layer. Using these new techniques, we can investigate, for the first time, the vertical structure of the marine boundary layer in the Mediterranean Sea. These observations can be used in the future for the evaluation of sea salt emission schemes in modeling systems.

We acknowledge support of this work by the project "PANhellenic infrastructure for Atmospheric Composition and climatE change" (MIS 5021516) which is implemented under the Action "Reinforcement of the Research and Innovation Infrastructure", funded by the Operational Programme "Competitiveness, Entrepreneurship and Innovation" (NSRF 2014-2020) and co-financed by Greece and the European Union (European Regional Development Fund). The authors would also like to acknowledge the support of the Stavros Niarchos Foundation and the European Research Council under the European Community's Horizon 2020 research and innovation framework program / ERC Grant Agreement 725698 (D-TECT).

Aerosol properties at Antikythera and Finokalia during two experimental campaigns

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We present first results from two large-scale experimental campaigns conducted in the Eastern Mediterranean during April 2017 and September 2018. The Pre-TECT campaign (1 - 30 April 2017) took place at the Finokalia station (35.34°N, 25.67°E, 250 m a.s.l.) in the framework of ACTRIS (Aerosol Clouds and Trace gases Research Infrastructure) and the preparatory phase of the ERC D-TECT project. The second campaign (1 – 20 September 2018) took place at the newly established PANhellenic GEophysical observatory of Antikythera (PANGEA; 35.86°N, 23.31°E, 193 m a.s.l.) and is the first experimental campaign in the framework of the D-TECT project. Main goal of the two experiments was to advance the aerosol and cloud characterization in the region by using synergistic measurements from remote sensing instrumentation along with in situ methods. In the present study, we report on the 24/7 observations acquired with the Polly^{XT}-NOA lidar system of the National Observatory of Athens. We present optical and geometrical properties of selected aerosol layers observed in the lower and free troposphere. Source-receptor analysis with FLEXPART is used to identify the main sources of the layers observed. During the Pre-TECT campaign, elevated dust plumes originated from Sahara at altitudes between 2.5 to 7.5 km are found, while also cloud formation on dust layers at about 10 km was frequently observed. During the first D-TECT campaign at the PANGEA observatory, thin smoke layers were observed at altitudes of about 2.5 km. Marine particles are constantly present at both sites (at heights below 2km), while here we also extend the study of their optical properties at heights down to 400m which is made feasible for the first time in the Eastern Mediterranean due to the near-range capabilities of the Polly^{XT}-NOA lidar system and the unique location of PANGEA observatory in the Mediterranean (located at 193 m a.s.l. in a very small, remote island).

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Implementation and evaluation of a wave-dependent sea spray parameterization scheme in modeling system CHAOS

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Sea salt aerosols represent a major component of the natural aerosol mass. Sea salt aerosols affect radiation, clouds and remote sensing having also effects on human health as they may encompass harmful pollutants. Sea salt aerosols are formed by the evaporation of sea spray droplets. Wind-wave interaction leads to sea surface white-capping, creating foam which bursts injecting sea spray droplets into the atmosphere. Sea spray droplets evaporate in atmosphere forming sea salt aerosols. The last decades, there are advanced observational systems to study the lifecycle of sea salt aerosols. However, there is a need for modeling so as to cover various spatiotemporal gaps of measurements. The models traditionally parameterize the sea salt aerosol emissions through the whitecap fraction (the sea surface percentage covered by foam) which is estimated using formulas dependent only on the wind speed, ignoring the sea state. This consideration introduces errors in the estimation of emissions which are propagated in the simulation of sea salt aerosols lifecycle.

This study aims at overcoming the above weakness implementing a new parameterization in a modeling system. The new parameterization is dependent on both wind speed and sea state information. Such an effort can be feasible only using a coupled atmosphere-wave-chemistry system. Hence, the new parameterization was implemented in the fully coupled Chemical Hydrological Atmospheric Ocean wave modeling System (CHAOS) which among other mechanisms represents wind-wave interactions and sea spray production. The CHAOS system consists of the WRF atmospheric model and the WAM wave model which are two-way coupled through the OASIS3-MCT coupler. WRF model is online coupled with the WRF-Chem chemical model which estimates sea spray production and simulates the lifecycle of sea salt in the atmosphere. The new parameterization is based on a modern consideration of whitecap fraction which is dependent on the wind speed (estimated by WRF model) and the wave phase velocity (estimated by WAM model).

The simulated sea salt concentrations using either the old or the new parameterization were evaluated against LiDAR measurements at Finokalia station on 4 and 15 July 2014 and Antikythera (PANGEA) station on 15 September 2018. Preliminary results indicate that the new parameterization offers a more realistic representation of sea salt aerosol emissions which improves the simulation of sea salt concentrations in a range of 200 m to 1000 m. However, both schemes systematically underestimate the measured concentrations above that height indicating that additional case study simulations and sea salt concentration measurements should be considered in order to draw a reliable overall evaluation on these schemes.

First results for aerosol characterization and source apportionment in Athens suburban and Volos traffic/harbour urban areas based on the NCSR Demokritos measurements during the PANACEA summer campaign

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The chemical composition of atmospheric particulate matter (PM) may provide insight into their emission sources and formation processes. In this framework, a comprehensive characterization of the ambient aerosol has been performed in Athens and Volos, Greece. The obtained chemical composition database was used to assess the concentration levels of specific PM2.5 components in urban and suburban areas during the period from June the 25th , 2019 to August the 10th , 2019. The measurements were conducted at 2 different places, namely National Centre for Scientific Research "Demokritos", Agia Paraskevi, Attika, Greece, (GAW-DEM) a suburban station and at Volos, Central Greece, an urban station located near a busy street and close to the harbour. The Demokritos station is a member of the Actris network, measuring size distribution, EC/OC, PM2.5 and PM10, Black Carbon and scattering coefficient. Atmospheric aerosol samples on PM2.5 suspended particulate filters were collected at the Demokritos station using an air low volume sampler, at an operational flow rate of 2.3 m3/h, on Teflon filters in accordance with the sampling procedure standardized in EN 12341, for 24 hours. These filters will be analyzed by means of X-Ray Fluorescence for a total of 21 major and trace elements. As far as the Volos station is concern, atmospheric aerosol samples on PM2.5 suspended particulate filters were collected in quartz filters, at an operational flow of 30 l/min. These filters from Volos will be analyzed by X-Ray Fluorescence for elemental analysis and additional ROS analysis. Measurements of equivalent Black Carbon concentrations (eBC) were performed using a custom portable Aethalometer (Moscow State University) and a small, low cost smart sensor system called Air Sensis measured certified for precision and uncertainty range for gaseous and particulate pollutants (PM2.5 and PM10) in real time.

First results of the Demokritos station show that the daily concentrations of PM2.5 range from 7 to 19 μg/m3 with an average concentration of 12 ± 3 μg/m3.In the city of Volos, PM2.5 24hr concentrations range from 15 to 32 μg/m3 with an average concentration of 22 ±4 μg/m3 by gravimetric analysis.

Aerosol characterization by automated typing methods over the Thessaloniki lidar station during the PANACEA campaign

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Two automated aerosol type characterization algorithms based on the aerosol intensive properties derived from Raman lidar measurements over the Thessaloniki Lidar station are tested and evaluated. All the detected aerosol layers acquired between the 10th of July 2019 and the 10th of August 2019 in the framework of the PANACEA campaign are analyzed in terms of aerosol typing with the supervised learning techniques in their high resolution mode. The first algorithm relies on Artificial Neural Networks developed in the framework of EARLINET (European Aerosol Research Lidar Network) and validated with the EARLINET-CALIPSO database. The second algorithm, depends on a supervised learning technique and makes use of the Mahalanobis distance function, using a reference dataset of already classified EARLINET data. Both algorithms, classify observed layers into the following major aerosol types: Dust, Volcanic, Mixed Dust, Polluted Dust, Clean Continental, Mixed Marine, Polluted Continental and Smoke. The results are further compared against manually typed profiles using satellite observations, model simulations and insitu measurements. The reasons of typing agreement and disagreement with respect to the uncertainties and the threshold criteria applied, are discussed.

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