



Adaptation Strategies to Global Environmental Change in the Mediterranean City and the Role of Global Earth Observations

BOOK OF ABSTRACTS



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European Cities under a Changing Climate: the Challenges of Urban Planning Following the Use of the Climate Twins Approach

Guillaume Rohat

University of Geneva - Institute for Environmental Sciences (guillaume.rohat@etu.unige.ch)

Despite our scientific knowledge about the future impacts of climate change, only a limited number of European cities have started to establish a climate adaptation plan. This lack of commitment can be mostly explained by the difficulty for stakeholders to envision what climate change and its future implications actually mean at a city scale. Therefore, we believe that there is a need to develop innovative methods and tools to convert climatic models outputs into easily understandable, useful and meaningful data.

The Climate Twins approach aims to match the future climate – end of the 21st century – of a number of European cities with the current climate of some others. We have reasonably matched seventeen Twins from which we can say that the future climate of a city “A” will be significantly similar to the current climate of a city “B”. As an example, we have linked the future climate of Hamburg with the actual climate of Toulouse, which means that by the end of the 21st century, Hamburg will be challenged by the same climate as Toulouse today.

By linking these actual and future climates, this approach allows a better understanding of the forthcoming impacts of a changing climate. Through the comparative analysis of the Climate Twins, we believe that stakeholders from a city “A” could clearly envision the requirements for a future adaptation to climate change. Moreover, they could get inspired from the current climate resilient practices promoted in a city “B” and hence, could take those ideas and actions on board for the implementation of a future climate adaptation plan in their own city. As an illustration, we investigated how and to what extent the city of Hamburg could learn from the city of Toulouse in terms of climate resilient urban agriculture and green spaces.

The Surface Urban Heat Island in Large Mediterranean Cities during the Last Decade: Annual Characteristics and Trends based on EO data

Nikolaos Benas, Nektarios Chrysoulakis, Dimitris Poursanidis

Institute of Applied and Computational Mathematics, Foundation for Research and Technology – Hellas (benas@iacm.forth.gr)

The Surface Urban Heat Island (SUHI), defined as the Land Surface Temperature (LST) difference between urban and suburban areas, is among the major effects of the built environment, with consequences to local climate conditions, human health and well – being. The day and night time SUHI at 25 cities around the Mediterranean, with over 1,000,000 population each, was studied based on LST measurements from the Moderate Resolution Imaging Spectroradiometer (MODIS). Annual average LSTs were computed based on the 8 – day mean MODIS LST product, at 1 km × 1 km spatial resolution, covering all the Mediterranean countries from 2001 to 2012. In each city, an appropriate buffer zone was created including both the main urban and suburban areas. The urban environment was separated from the suburban based on the MODIS Land Cover Type product, available on an annual basis. Results include time series of the annual average urban LST, suburban LST and SUHI, and the corresponding changes (in degrees Celsius per decade) during the studied period. The SUHI intensity can reach several degrees Celsius, while

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its sign depends on the city location and the surrounding land cover types; positive signs are observed in Southern European cities, while negative ones dominate in Northern Africa. Signs and intensities of changes are also mixed, highlighting the importance of involving high spatial resolution satellite observations in the study of SUHI.

An Integrated Climate Change Impact Assessment for the City of Athens

Christos Giannakopoulos, Anna Karali, Maria Hatzaki, Konstantinos V. Varotsos, Basil Psililoglou
Institute for Environmental Research and Sustainable Development, National Observatory of Athens, Athens, Greece (cgiannak@meteo.noa.gr)

An integrated assessment of climate change impacts for the urban site of Athens in Greece is presented. A multi-sector approach to future climate change impacts is adopted and the impacts on air pollution, fire risk, energy demand and health are examined with the aid of selected indicators. The future ozone exceedance days for Athens are estimated, based on the concept that daily maximum temperature is closely associated with the average 8-h maximum ozone concentrations and it is found that the likelihood of future ozone pollution episodes may increase. Energy consumption increases with the increase (due to air conditioning demands) or decrease (due to extra heating demands) of air temperature. The predicted future gradual warming will be associated with a fall (rise) in energy demand during future milder (hotter) winters (summers). The peri-urban forest fire risk due to extreme meteorological conditions is assessed using the Canadian Fire Weather Index (FWI). It is found that vulnerable areas to forest fire in the present climate will experience the greatest increases in fire risk in the future climate (20 more days of extreme risk). Regarding human health, significantly increased rates of mortality due to heat stress and heat waves are projected for the future climate.

Climate Change Impact Assessment for Selected Urban Areas in Cyprus

Christos Giannakopoulos¹, Giannis Lemesios¹, Nikos Roukounakis¹, Basil Psiloglou¹, Christina Papadaskalopoulou², Michael Petrakis¹, Maria Loizidou²

¹ *National Observatory of Athens, Institute for Environmental Research and Sustainable Development, Athens, Greece (cgiannak@meteo.noa.gr, jlemesios@noa.gr)*

² *National Technical University of Athens, School of Chemical Engineering*

This study examines the potential future climate change impacts on selected urban areas in Cyprus using several projections derived by Regional Climate Models' (RCM) simulations. More specifically, reference values of mean and extreme climatic parameters are presented for different cities of Cyprus for the period 1960-1990 (control period) as well as their projected values for the near future period 2021-2050. Also, time series plots of temperature and precipitation parameters are shown for selective representative urban locations of Cyprus for the entire period 1951-2100. Observational data up to 2010 are also overplotted for comparison with the model results. Additionally, the impacts of climate change on energy requirements, public health and tourism industry for the near future period 2021 – 2050 are also investigated. As for energy requirements, using daily energy consumption data for the present climate, we

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construct an impact model linking consumption and temperature and assuming the same technology use we project this relationship to the future climate using the RCMs data. For the examination of the relationship between hot weather conditions and mortality in Cyprus, a statistical model is constructed assuming linear increase of mortality with increasing temperature and projected to the future climate. Finally, for the assessment of climate change impacts on tourism sector, Beach Climate Index" (BCI) is studied for specific coastal site of Cyprus. All simulations concerning future predictions are driven by the A1B emission scenario.

Analysis of the Influence of Ground Cover and Shade on Daily Temperature Variation: a Case Study in Florence (Italy)

Luciano Massetti¹, G. Brandani^{2,3}, M. Petralli^{2,3}, M. Napoli³, S. Orlandini^{2,3}

¹ *Institute of Biometeorology, National Research Council, Florence, Italy (l.massetti@ibimet.cnr.it)*

² *Interdepartmental Centre of Bioclimatology, University of Florence, Florence, Italy*

³ *Department of Agrifood Production and Environmental Sciences, University of Florence, Florence, Italy*

As more than half of the world population live in cities, the design of liveable urban spaces is increasingly a strategic issue. Therefore, urban planners need tools allowing the evaluation of the benefits of design choices that take into account thermal comfort. Ground surface characteristics as well as shading conditions can affect spatial temperature variability of an urban area. The aim of this study was to investigate the relationship between different types of urban ground covers, sun exposure conditions and daily variation of air temperature. Our case study was based on data collected in two sites of the urban area of Florence in summer 2013. For each site, five weather stations equipped with air temperature, relative humidity and solar radiation sensors were set up at 2 meters height to analyse the thermal conditions at pedestrian level. Each station was classified according to ground cover characteristics (permeability and albedo), use of irrigation in green areas and sun exposure. The relationship between these characteristics and hourly variation of air temperature was investigated. According to our results shading conditions explained more than 70% of temperature variability during the hottest hours of the day. Air temperature over the shaded green surface was 3°C lower than temperature over sandstone exposed to the sun. On the other hand, night temperatures were significantly reduced by approximately 1°C on permeable surfaces.

Application of Measurements and Modelling in an Urban Open Space to Improve the Wellbeing

Teodoro Georgiadis

Italian National Research Council, Institute of Biometeorology IBIMET-CNR (t.georgiadis@ibimet.cnr.it)

Architectural modifications of existing urban morphology sometimes result as improvements of the aesthetic characteristics of open spaces but could produce detriment on pre-existing wellness for residential population. An example of ex-ante/ex-post study allows to assess a methodology devoted to planners for the maximisation of physiological wellness.

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Future Climate Scenarios Constructed at Local Level for Bologna as Resilient City

Piero Pelizzaro

Kyoto Club on behalf of the LIFE+ project BLUE AP partners: ARPA Emilia Romagna, Bologna Municipality, Ambiente Italia (p.pelizzaro@kyotoclub.org)

A "local tailor made" global response and a mix of real politics it is now necessary for the city to quickly adapt to climate change. The project LIFE+ BLUE AP Bologna as Resilient City led by the Municipality Bologna, Kyoto Club, ARPA E.R., Ambiente Italia aim at the definition of an adaptation plan by 2015. The Plan will be based on an analysis of vulnerability and territorial adaptive capacity, Local Climate Profile, made by ARPA. Minimum, maximum temperature, total amount of precipitation, heat wave duration index, frost days and consecutive number of dry days are the main climatic indices analysed in order to describe better the observed climate profile over Bologna city. The observed climate profile reveals significant positive trends in seasonal temperature accompanied by a reduction of the winter number of frost days and an increase in the summer heat waves. Future climate scenarios were constructed at local level, over the period 2021-2050 and 2070-2099. A statistical downscaling technique, applied to the ENSEMBLES-Stream1 global climate simulations (A1B scenario) has been developed in order to reach this objective. The future projections show that significant increases could be expected under scenario conditions in all seasons. Thus, the magnitude of projected changes at Bologna is around 2.5°C in the first period and 5.5°C in the second period, associated with a decrease in the number of frost days and an increase in the heat wave duration. The measures to be implemented will be identified through a participatory process, which aims to engage the community and to improve the existing resilient capabilities. For responding to the complex future risks a link with what has already been implemented by Bologna in the definition of its SEAP and the Metropolitan Strategic Plan will be take in consideration. This integrated approach show the "Climate-Smart" strategy in future planning.

Public Health and Climate Change in Cyprus: the CYPHEW Project

H. Tsangari¹, Z. Konsoula¹, S. Christou¹, K. E. Georgiou², K. Ioannou³, T. Mesimeris³, S. Kleanthous⁴, S. Pashiardis⁵, P. Pavlou⁶, A. Paschalidou⁷, P. Kassomenos⁸, S. Vardoulakis⁹, C.H. Heaviside⁹, E.N. Yamasaki¹

¹ *University of Nicosia Research Foundation, Nicosia, Cyprus (yamasaki.e@unic.ac.cy)*

² *Cyprus Center for European and International Affairs, University of Nicosia, Nicosia, Cyprus*

³ *Department of Environment, Ministry of Agriculture, Natural Resources & Environment, Nicosia, Cyprus*

⁴ *Section of Air Quality, Department of Labour Inspection, Nicosia, Cyprus*

⁵ *Section of Climatology and Applications in Meteorology, Meteorological Service, Nicosia, Cyprus*

⁶ *Heath Monitoring Unit, Ministry of Health Cyprus, Nicosia, Cyprus*

⁷ *Democritus University of Thrace, Greece*

⁸ *University of Ioannina, Greece*

⁹ *Centre for Radiation, Chemical and Environmental Hazards, Public Health England, UK*

Nowadays there is almost unanimous scientific consensus that climate change is the major environmental problem facing the globe, which will inevitably influence nearly all aspects of life, including public health. The CYPHEW project (ΥΓΕΙΑ/ΔΥΓΕΙΑ/0609(BIE)/20), co-financed³ by the European Regional Development Fund and the Republic of Cyprus through the Research Promotion Foundation, created data-

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bases on hospital admissions, and on deaths throughout Cyprus and by region, during the period of 2004-2009, as well as, on meteorological indices and air pollutants. Statistical analyses of the databases included the creation of air mass types, detailed analysis of the effect of temperature on mortality and morbidity, and the effect of air pollutants on mortality and hospital admissions for Cyprus as a whole island and also divided as inland and coastal areas. A threshold temperature of 34°C was defined for Cyprus, above which there was a statistically significant increase in mortality and in hospital admissions. This threshold temperature is much higher than that predicted for countries with a more temperate climate. More deaths were seen on Tuesdays, which could be interpreted as the delayed effect of a prolonged exposure during the weekend. Our analyses also showed that not only temperature was important but humidity also had an effect on mortality and morbidity, and moreover, air pollution (PM10) had an increased effect on hospital admissions specifically for cardiovascular and respiratory diseases. A report was created on the impact of thermal stress on public health, followed by a health impact assessment report, and a report on general and specific measures that should be implemented in order to mitigate and reduce the mortality and morbidity related to the extreme weather that is found in Cyprus, specifically in the warm months.

Reprocessing of Nitrogen Dioxide Total Column Densities Recorded with a Brewer Spectrophotometer in Athens

H. Diémoz^{1,2}, K. Eleftheratos^{3,4}, C. S. Zerefos^{3,4}, M. Vrekoussis⁵, A. M. Siani², J. P. Burrows⁶, A. Richter⁶ and A. Hilboll⁶

¹ *Environmental Protection Agency of Valle d'Aosta, Italy*

² *University of Rome Sapienza, Italy*

³ *Faculty of Geology and Geoenvironment, University of Athens, Greece (kelef@geol.uoa.gr)*

⁴ *Biomedical Research Foundation, Academy of Athens, Greece*

⁵ *Energy, Environment and Water Research Center, The Cyprus Institute, Cyprus*

⁶ *University of Bremen, Germany*

Despite its low concentration, nitrogen dioxide (NO₂) drives several atmospheric processes, such as both destruction and preservation of ozone (O₃) in the stratosphere and photochemical smog formation in the troposphere. Furthermore, NO₂ absorbs solar radiation, thus impacting on the radiative balance on localised areas and interfering with sun photometric measurements, such as the aerosol optical depth. In 1985, an automated Brewer ozone spectrophotometer was modified to add the capability to measure solar visible radiation and to retrieve atmospheric nitrogen dioxide from the ground. Since then, a worldwide network of MKIV Brewer spectrophotometers has been put in operation and long-term nitrogen dioxide records have been collected at the respective stations, including Athens. Unfortunately, the original algorithm has never been officially updated and exhibits several limitations (noise, overestimations, interferences, etc.) that prevent the users from confidently employing the measured data for accurate analyses. A new method to retrieve nitrogen dioxide from MKIV Brewers has been proposed by the authors allowing more accurate estimations. The algorithm is backward-compatible and may be employed to reprocess long records of historical datasets. This work presents the application of the algorithm to the NO₂ dataset recorded in Athens. An empirical bootstrap method to find the extraterrestrial calibration constant through statistical analysis was used. The results were compared with satellite total column data retrieved from the SCIAMACHY, GOME-2 and OMI instruments and with in-situ measurements of tropospheric concentrations to assess the impact of anthropogenic emissions.

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Ecological Effect of Long-Term Land Use Changes and other Pressures on a Peri-Urban Wetland

Vassiliki Markogianni

Institute of Marine Biological Resources and Inland Waters, Hellenic Centre for Marine Research, Anavyssos, Greece (vmarkogianni@hcmr.gr)

Coastal urban and industrial sprawl has had a profound impact on urban and peri-urban natural resources, particularly impacting the ecological integrity of wetlands and other water bodies. Koumoundourou Lake is a shallow, brackish lagoon that lies on the east shore of Elefsina Bay on the edge of Thriassion plain in western Attica. During the last century Thriassion plain has undergone significant changes from rural to heavily industrialized and Koumoundourou Lake has suffered multiple pressures, while the construction of an artificial weir on the canal outlet towards Elefsina Bay has changed the hydrological conditions of the wetland. In order to estimate the impacts of urbanization and industrialization of the surrounding area of Koumoundourou lake, land use maps of 1984, 1998 and 2011 of the lake's watershed were produced from supervised classification of Landsat 5 and 7 satellite images and were compared to the temporal ecological condition of Koumoundourou Lake. Based on the results, despite the heavy industrial development of the area, after the construction of the weir which increased the water level of the lake, so as to prevent the inflow of polluted groundwater through the submerged springs, the water quality has improved and a short term decrease of heavy metal concentrations in sediments was noted. Nevertheless, the weir inevitably blocked marine fish movement and extirpated several fish species. Based on the above, even though the pollution pressures on Koumoundourou Lake increased due to the land use changes and industrialization of the wider area, a slow amelioration during recent years was noted after the construction of the weir. It is evident that with appropriate management practices it is possible to improve the ecological status of a wetland even in a heavily industrialized peri-urban area.

The Etesian Wind System - Classification and Climatology

Stella Dafka¹, Elena Xoplaki¹, Andrea Toreti^{1,2}, Prodromos Zanis³, Fidel González-Rouco⁴, Christos Zerefos⁵, Jürg Luterbacher¹

¹ *Climatology, Climate Dynamics and Climate Change, Department of Geography, Justus-Liebig-University of Giessen, Giessen, Germany (elena.xoplaki@geogr.uni-giessen.de)*

² *Institute for Environment and Sustainability, Joint Research Centre, European Commission, Ispra, Italy*

³ *Department of Meteorology and Climatology, School of Geology, Aristotle University of Thessaloniki, Greece*

⁴ *Department of Physics of the Earth, Astronomy and Astrophysics I, Complutense University of Madrid, Spain*

⁵ *Research Centre for Atmospheric Physics and Climatology, Academy of Athens, Athens, Greece*

The Etesian winds are among the most persistent regional scale systems around the globe. We present an analysis of the Etesians in the past and present time, for the extended summer season covering the periods 1971-2000 and 1780-1970. The analysis is based on instrumental station series, ERA-40 and Twentieth Century Reanalysis datasets. One aim of the study is to objectively classify Etesian days and to

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identify the Etesian episodes where an episode is defined as a series of consecutive Etesian days that are exceeding the duration threshold of 1 day. The proposed classification is based exclusively on atmospheric circulation parameters and more specifically on the sea level pressure difference among Athens and Rhodes Island (3hr series) during the period 1971-2000. Then, a climatological analysis of the classified Etesian days over the Aegean is provided. The relationship between the Etesians and the large-scale atmospheric circulation is investigated by applying a classification procedure to the associated 500 hPa geopotential height field. A comparative study between results based on instrumental station time series and on Reanalyses was held considering the vertical structure of the atmosphere. First results show that the proposed classification method capture satisfactorily the Etesian pattern. Further, a good agreement has been found for the wind field between Reanalyses and station series. During 1971-2000, two clusters have been selected for the Z500 field associated with the Etesian days indicating the controlling role of the large scale circulation on the Etesian wind pattern. Finally, since the Etesian wind system shows great stability over time it would be of great importance to provide a comprehensive assessment of the wind field, its variability and evolution from past to the future, an evaluation of wind power resources over the Aegean with the goal to identify suitable areas for wind energy generation in the frame of future climate change in the area.

Evaluating Adaptation to Climate Change in Mediterranean Cities: The Case Study of Madrid, Spain

Pedro Iglesias

Technical University of Madrid, Spain (pedro.iglesias@upm.es)

Cities are facing increasing threats from climate extremes, development, and lifestyle change. Mediterranean cities provide examples of the social capacity to adapt to multiple stressors. However, future risks may be beyond their adaptive capacity threshold. The BASE project (<http://base-adaptation.eu/>) is evaluating co-benefits of a range of adaptation strategies in the city of Madrid. The case study evaluates the co-benefits of adaptation of the health, water, and energy sectors. The approach is a participatory evaluation of measures, linked to a cost benefit analysis, and provides information for policy development.

Climate Adaptation Plans of Cities and Regions with Mediterranean Climates

Laurel Hunt, Bowman Cutter, Jenny Griffin

Mediterranean City Climate Change Consortium, Council for Watershed Health; Luskin School of Public Affairs at the University of California, Los Angeles (laurelhunt@ucla.edu)

We surveyed 28 cities in 18 countries across all of the world's Mediterranean climate regions. Our purpose was to bring together, in one document, the major strategies that Mediterranean cities are pursuing to adapt to climate change. We also wished to see if there were any trends behind what types of cities have pursued climate adaptation strategies. We examined adaptation strategies for sea level rise, increased temperatures, flooding, reduced water supply and drought, wildfires, extreme weather events, and increased air pollution. We examined the cities' adaptation plans and categorized them into four

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stages: training, assessment, recommendations, and implementation. We found that a wide variety of cities have completed assessments in one or more of the climate adaptation areas. However, Australian cities are notably ahead in the implementation stages, though other cities such as Barcelona are in the implementation stage in some areas. We think the matrix of adaptation stage and climate impact area, though of course a simplification of cities' planning processes, is useful for evaluating cities' adaptation strategies. In addition, the work can begin to identify planning gaps, recommend where additional planning efforts can be most effective, and suggest city-to-city partnerships that leverage existing programs and policies.

Towards Energy Independence for Skyros: The Social Dimension

Fontina Petrakopoulou, Maria Loizidou, Christopher Koroneos

*Unit of Environmental Science and Technology, National Technical University of Athens
(f.petrakopoulou@chemeng.ntua.gr)*

Public awareness and acceptance is a very important factor when the implementation of new policies in important fields is required in a society. Green Energy for Islands (GENERGIS) is a Marie---Curie IEF project that will propose a concrete energy plan for achieving 100% sustainable living on an island in the Mediterranean and will create the first guide to sustainable development based on social, environmental, and economic data. This poster presents the results of a social survey realized in the framework of the project GENERGIS, created and addressed to the residents of the island of Skyros in Greece. The analysis of the survey results reveals the public's awareness and attitude towards renewable energy technologies, energy costs and current energy policy on the island. The results show that most people are positive towards renewable energy sources and believe that their wider use can reduce the environmental impact caused by the use of conventional fuels.

Further analysis suggests high levels of awareness that energy consumption measures can result in environmental benefits, while environmental protection is found to be by far the most important criterion when evaluating an energy technology. Secondary criteria are the economic expenditure and the energy efficiency of an energy technology.

We also find high levels of awareness when it comes to technologies widely used in the country and on the island (such as solar heaters) but less so when it comes to technologies still unknown to the society (wave energy, fuel cells, and more).

At the same time, people tend to be more open to the new installations of solar, wind and geothermal energy, while they directly reject nuclear power and coal plants. Lastly, the majority of people believe that local policies on energy issues should change, while they also perceive the lack of political will as one of the most important obstacles in the implementation of renewable technologies.

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The Impact of Future Climate Change on Urban Microclimate: Micro-scale Simulations in the city of Athens

Athina I. Samiou, Simon Charles Lannon

Cardiff University-The Welsh School of Architecture (athena_s83@hotmail.com)

Cities are the centres of human activities, where half of the world's population lives. Due to their artificial landscapes, urban areas appear different climatic conditions from neighbouring rural areas, mostly expressed through elevated temperature levels, known as "Heat Islands". Urbanized areas are also significant contributors to global warming and direct receivers of its negative effects. Estimating the effects of global warming on local urban microclimates in the future and ways to mitigate them is a crucial field of open scientific research. The present Thesis deals with the case of Athens, capital of Greece. It focuses on the scale of an existing neighbourhood in the city's core. It aimed to study and model the likely impacts of a changing climate on its microclimatic conditions until the end of the 21st century (for 2020, 2050 and 2080) under two extreme IPCC emissions scenarios (B1 and A2). An additional goal was to estimate the contribution of Vegetation as a mitigation strategy to an improved outdoor environment for the specific neighbourhood within the same timeframe and emissions scenarios. With the help of Meteonorm V.07 Weather Generator, future weather files for both scenarios were produced, which were then used for microclimatic simulations with the software ENVI-met V.3.1, of the coldest, a midseason and the hottest day of the year under clear sky conditions. A preliminary set of trial simulations revealed inconsistent results for overcast days. Air temperature levels for almost all examined days appeared uplifting trends. Vegetative covering offered a cooling effect for the hottest days with the highest temperatures, unfolding its positive contribution to the neighbourhood's future microclimatic conditions. Simulation results showed reduced temperatures for these days with higher wind speed levels. Overall, the project mirrors the need to take measures within densely parts of the city in order to maintain its future liveability.

Earth Observation Techniques for Monitoring Inland Water Quality in the Mediterranean Region: A Case Study of Lake Karla

Ioanna Theologou

School of Rural and Surveying Engineering, National Technical University of Athens

(ioan.theologou@gmail.com)

Nowadays, the need for monitoring and protection of natural environment is greater than ever. Thus, reliable and low cost monitoring methods and techniques are becoming more essential. To this end, cutting-edge technologies from Geo-Informatics and Earth Observation fields form a valuable tool towards effective remote sensing monitoring of aquatic environment. The main objective of this study was to standardize the process of monitoring key water quality parameters in lake ecosystems. Therefore, multiple in-situ, analytical and satellite multispectral data were acquired, processed and fused in the study area Lake Karla, Greece. In particular, Landsat 8 satellite images, hyperspectral data from a field spectrometer, physico-chemical and other monitoring parameters from water samples served as the ground truth data, formed the multi-modal dataset. Radiometric and atmospheric corrections were performed to the satellite and hyperspectral data. The experimental results indicated highly correlations between the

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remote sensing observations and the in-situ data for key water quality parameters like the concentrations of chlorophyll-a, ammonium and dissolved oxygen. In particular, for the hyperspectral data the highest rates were for chl-a ($r^2=97.6\%$), ammonium ($r^2=88.5\%$), nitrates ($r^2=85.7\%$), conductivity ($r^2=81.7\%$) and dissolved oxygen ($r^2=81.9\%$). Total phosphorus and pH didn't provide stable correlations. For the satellite multispectral data, the highest rates were for chl-a ($r^2=93.2\%$), dissolved oxygen ($r^2=90\%$), nitrates ($r^2=82.7\%$), ammonium ($r^2=87.2\%$), total phosphorus ($r^2=78.9\%$) and pH ($r^2=79.3\%$), while the conductivity ($r^2=57.5\%$) stayed in lower correlation rates. In all cases, the temperature estimation based on Landsat TIRS data established strong relationships at 95% (r^2). These preliminary results demonstrate that remote sensing technology can significantly contribute towards the development of a reliable and low-cost off-situ water quality monitoring system for sensitive aquatic ecosystems.

Strategic Environmental Impact Assessment in the Framework of Climate Change Adaptation

Eirini Skrimizea¹, Dimitris Papakonstantinou², Maria Papadopoulou²

¹ *Urban and Regional Planning, National Technical University of Athens, Greece (eskrimi@yahoo.com)*

² *School of Rural and Surveying Engineering, National Technical University of Athens, Greece*

The urgent need to adapt to climate change raised the discussion concerning whether this should be more strongly reflected in the methodology and expected results of the Strategic Environmental Impact Assessments (SEA). Recently, the European Commission (EC) drafted the Guidance on Integrating Climate Change and Biodiversity into Strategic Environmental Impact Assessment (EC, 2013), a conceptually rich document, which includes guidelines for the integration of climate change into SEA, proposing the restructuring of the SEA's functional basis, in the framework of "resilience" and by using the "adaptive management" methodology. Considering the latest developments in scientific research relating to spatial planning and environmental management, the concept of this document can be only regarded as a very significant contribution to the development of new strategies for adapting to climate change, but also to the appropriate reconfiguration of methodologies, such as the Integrated Coastal Zone Management (ICZM), already implemented in vulnerable to climate change areas. Nevertheless, it should be recognized that the main terms used, "complexity", "resilience" and "adaptive management", along with the content they represent, are highly complicated and not very accustomed to up to now scientific outcomes, let alone operational practices. Further dialogue, scientific investigations and clarifications on the respected terms, descriptions and recommendations are therefore needed, in order to be better clarified and efficiently used. This paper seeks to contribute towards this direction, by examining resilience's and adaptive management's scientific basis and by forming their connection with the climate change issue. In the aforementioned process, the complex systems' concept is used as common language of reference and is finally proved catalytic, adding new dimensions to the proposed methodological framework of the EU.

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Biogeochemical Characteristics in the Saronikos Gulf (Aegean Sea, Eastern Mediterranean) in Relation to Athens Metropolitan Sewage Outfall and Climate Change

S. Zervoudaki, A. Pavlidou, N. Sympoura, G. Assimakopoulou, P. Panayotidis, H. Kontoyannis

Hellenic Centre for Marine Research, Institute of Oceanography, Anavyssos, Greece (tanya@hcmr.gr)

Human activity is producing changes at global scale that might be causing important unbalances in the structure (biodiversity) and functioning (energy and matter fluxes) of marine ecosystems. Discharges of domestic sewage «produced» by large cities are among the major pollution problems in the Mediterranean Sea, since they affect considerably the marine ecosystems stability. Saronikos Gulf, located in the oligotrophic South Aegean Sea, receives the sewage effluents of Athens metropolitan area (about 4 million inhabitants). Waste waters are primarily treated since 1994 and secondary-tertiary treated since 2005. The monitoring study of Saronikos Gulf has been performed by HCMR during the last 20 years. Spatial and temporal variability of the following parameters were studied: temperature, salinity, turbidity, currents, dissolved oxygen, nutrients, particulate organic carbon, chlorophyll-a, phytoplankton species composition, mesozooplankton biomass and species composition, phytobenthic communities of the upper infralittoral zone and soft bottom macro-invertebrates communities. Nutrient values had an increasing trend in the period 1987-2004, due to the increment of the effluents volume. However, after the secondary-tertiary treated (2005) nutrients values decreased whereas autotrophic biomass did not vary considerably after 2000. Zooplankton biomass revealed a clear increasing trend from 1987 to 2003, followed by an almost gradual decrease trend till 2009. Zooplankton biomass seems to recover in 2010. The inter-annual evolution of the ecological quality revealed significant changes. The ecological quality of the phytobenthic communities improved since 1994 (primary treatment) and even more after 2004 (secondary-tertiary treatment). An evaluation of the current status of the soft bottom macro-invertebrates communities based on the indices applied, showed a gradient from moderate ecological status at stations up to a distance of 8000 m from the outfalls to good environmental and ecological status at more remote stations. At shallower stations (4000 m from the outfall) benthic communities also present good environmental status.

Climate Change Adaptation through Non-Conventional Water Resources Management: Cases from Mediterranean Islands

Konstantina Toli¹, Michael Scoullos^{1,2}, Vangelis Constantianos¹

¹ *Global Water Partnership - Mediterranean (GWP-Med) (konstantina@gwpmed.org)*

² *Laboratory of Environmental Chemistry, Chemistry Department, University of Athens, Greece*

Access to safe water, in sufficient quantity, is fundamental for sustainable livelihoods and for economic development. Water resources are heavily exploited in most countries of the Mediterranean region, including due to rapid and often uncontrolled urban development, particularly along the coast. Many Mediterranean islands are challenged due to limited fresh water resources, further depleted as a result of climate change and human pressures. In this context, the mobilisation of Non Conventional Water Resources (NCWR), such as rainwater and stormwater harvesting, greywater as well as treated wastewater reuse, is crucial for local water security and climate change adaptation.

The *Non Conventional Water Resources Programme (NCWR) in the Mediterranean* is a multi-stakeholder

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programme in Greece, Malta, Cyprus and Italy, bringing together the Global Water Partnership Mediterranean (GWP-Med), the Coca-Cola system and national and local authorities in the respective countries. It aims at advancing the use of non conventional water resources for climate change adaptation at local level, as well as increasing water availability for urban, tourism, irrigation, and other uses, in a sustainable and cost-effective way. Through different phases and focus areas, the Programme has been on-going since 2008. Through its holistic approach, it offers demonstration applications of modern systems in islands, utilising mainly rainwater, stormwater and greywater. Applications aim at demonstrating innovative technologies, adapted to local needs in order to alleviate floods and utilise rain and storm water as additional resources adding to the local water budget for urban and other uses towards local water security. Programme activities also include tailor made educational material, hands-on activities for students and teacher trainings in order to advance youth awareness on water scarcity, utilisation of NCWR, as well as water conservation. It is also complemented by training of local technicians to advance their know-how and expertise to apply NCWR systems, local awareness raising activities as well as regional dialogue and experience sharing on NCWR management. The Programme has been already implemented in 26 Greek islands, in the Maltese islands (Gozo and Malta), in Cyprus and is currently commencing operations in the Italian islands and has been recognised as "best practice" and solution¹ for climate change adaptation at local level in the Mediterranean.

¹ 6th World Water Forum, March 2012, Marseille, France

Blue Green Dream Vision for Mediterranean

Branislav Todorovic

*Agricultural University of Athens & National Technical University of Athens, Greece
(bt.emit.group@gmail.com)*

The adverse effects of intensifying climate extremes (floods, droughts and extreme heat) combined with increasing urbanization call for a new paradigm for efficient planning and management of the urban environment: one that maximizes ecosystem services and increases the capacity to changing climate. Blue Green Dream (BGD) project brings such paradigm. BGD enhances rethinking of planning, design, construction, operation and maintenance of urban water systems (blue) and urban vegetated areas (green assets), not separately but in combination, placing emphasis on their mutual interactions. The benefits include: a) increased amenity and urban health, b) enhanced resilience to drought and flood risk, c) reduced air pollution and noise, d) mitigation of urban heat islands, e) enhanced energy efficiency of buildings and g) enhancement of biodiversity and quality of life. The Blue Green Dream main partners are four leading EU universities from Berlin, Delft, London and Paris. It also involves a number of other companies and institutes, with national BGD clusters and international centres created to bring together relevant partners interested in pursuing, promoting and participating in the BGD mission and implementation. One important area for BGD is the Mediterranean with its specific issues and necessary adjustment required for an optimised application. The Blue Green Dream project enhances the synergy of urban BG systems of multifunctional Blue Green Solutions (BGS) including an Integrated Modeling System (BGD IMS). Through the close cooperation with stakeholders from Mediterranean, BGD works to adapt and upgrade the developed system. Application in the Mediterranean would not only improve the eco-

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logical status through the introduction of advanced systems, but also further enhance the business opportunities and create new working places in the area.

Engaging Stakeholders to Formulate Strategies for 'Sustainable Tourism' and 'Clean Seas' in the Mediterranean Region: A Joint Effort of 'PERSEUS' and 'Sea for Society' FP7 Projects

Martha Papathanassiou, Christos Ioakeimidis, Nikos Streftaris, Alexandra Gogou

*Hellenic Centre for Marine Research (HCMR), Institute of Oceanography, 19103, Anavyssos, Greece
(mpapath@hcmr.gr)*

Two Interactive Stakeholder Consultations have been held on the subject of 'Tourism', in the framework of FP7 projects PERSEUS and Sea for Society respectively, based on the Collective Intelligence (CI) methodology. (CI) is defined as 'a shared or group intelligence that emerges from the collaboration and competition of many individuals', which takes participants through four stages: definition, design, choice and implementation. Participants reached a consensus on the best design options and solutions through negotiations and voting, once they had identified and agreed upon the main barriers posed by 'Tourism' to achieving 'Clean Seas' by 2020 and a sustainable marine ecosystem.

The first consultation was organized by HCMR & 'Sea for Society' in Messinia, Greece, in October 2013, where 15 stakeholders, expressed their views and ideas on how 'Tourism' threatens the marine environment. The stakeholders which participated in this event included local/regional mayors, tourism and port authorities, as well as representatives from the Greek Ministry of Tourism.

Stakeholders identified a number of barriers, grouped into five different categories, following the CI procedure. The interrelationships between the barriers were structured, using the Interpretive Structural Modelling (ISM) software, while on the second day participants generated options to overcome the barriers.

In May 2014, the PERSEUS project held a Consultation on Tourism, in Izmir, Turkey. The focus of this consultation was on identifying barriers to 'Clean Seas' by 2020 in relation to 'Tourism'. The 14 participants were carefully selected, including port authorities, coastal engineering companies, NGOs, etc from the Mediterranean Region.

Top barriers in both cases seemed to be the lack of coastal and marine spatial planning and the low or lack of environmental awareness, while establishment of 'best practice' awards and innovative tools and methods for education and awareness were amongst the most popular solutions.

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Conserving the Past, Building for the Future: Chemical and Isotope Analysis of Historic Mortars

D. Kyropoulou¹, E. Dotsika^{1,2}, P. Chantzi¹, E. Heliadis¹, P. Karalis¹

¹ *Institute for Nanoscience and Nanotechnology, National Center for Scientific Research "Demokritos", I.M.S., 15310 Aghia Paraskevi Attikis, Greece (dkyropoulou@ims.demokritos.gr)*

² *Institute of Geosciences and Earth Resources CNR, Via G. Moruzzi 1, 56124 Pisa, Italy*

Climate change is currently attracting major attention both at the political and research level. However, this attention is focused mostly on sectors such as environment, industry, energy, transport and health. Until recently, it has not yet been considered as a threat towards the preservation of cultural heritage, which is a non-renewable resource that needs to be transmitted to future generations. Historic properties are exposed to the atmosphere over long periods of time; therefore they are exposed to climate changes that occur on long timescale. To study the impact of climate change on historic collections, samples of mortars were collected from Hellenistic, Roman and Byzantine architectural constructions, located in North Greece.

Compositional, morphological and stable isotope analyses were undertaken in order to determine the impact of climate change in historic mortars. Compositional analysis was achieved using energy dispersive X-ray analysis in the scanning electron microscope, while the mineralogical phases were detected using petrographic (polarised optical microscopy) analysis. Stable isotope analysis provided information on the origin of CO₂ and water during calcite formation and degradation mechanisms, which occurred overtime. Isotopic change of the initial $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ in the carbonate matrix was attributed to the primary source of CO₂ and H₂O in mortar over time. Recrystallisation of calcite with pore water, evaporated or re-condensed water and CO₂ from various atmospheric and biogenic sources affect the isotopic signatures of lime mortars. Exogenic processes are responsible for further alterations of $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ in lime mortar, showing the impact of changing climatic conditions.

Corporate Social Responsibility Meet Advanced Climate Research in the Mediterranean

Giorgos Maneas

Navarino Environmental Observatory (giorgos.maneas@natgeo.su.se)

Navarino Environmental Observatory (NEO) is a cooperation between Stockholm University, the Academy of Athens and TEMES S.A. It is dedicated to research and education on the climate and environment of the Mediterranean region. Located at Costa Navarino, NEO is developing into a dynamic hub where scientists from all over the world conduct frontline research, develop new tools and methods, as well as meet to exchange knowledge and ideas.

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New Service for Quarter-hour Monitoring of Urban Temperatures from Space

Iphigenia Keramitsoglou¹, Chris T. Kiranoudis², Panagiotis Sismanidis³

¹ *National Observatory of Athens – NOA/IAASARS (ik@noa.gr)*

² *National Observatory of Athens – NOA/IAASARS; National Technical University of Athens, School of Chemical Engineering (kyr@chemeng.ntua.gr)*

³ *National Observatory of Athens – NOA/IAASARS (panosis@noa.gr)*

A system for real time and online monitoring of the thermal urban environment using geostationary satellite images has been developed at the Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing of the National Observatory of Athens (IAASARS/NOA). The system's output is a time-series (15 min interval) of land surface temperature (LST) image data at a spatial resolution of 1 km that is adequate for studying the SUHI phenomenon and providing the base for the development of many added-value data products tailored to serve different end-users, such as urban climate modelers, health responders and energy demand suppliers. Our vision is to develop the system for all the cities with population >1M and view angle below 60° in the SEVIRI disk (117 cities in total). For further details visit BEYOND web site: <http://beyond-eocenter.eu/> and click on Urban Environment.

Offshore Wind Farms and Marine Protected Areas: Integration in the Context of the FP7 CoCoNET Project

T. Soukissian, E. Voukouvalas, F. Karathanasi

Hellenic Centre for Marine Research Institute of Oceanography (vvoukouvalas@hcmr.gr)

As the interest on harnessing the offshore wind energy in the Mediterranean basin is increasing, it is important to assess the criteria for selecting the most prominent areas for the erection of Offshore Wind Farms (OWFs) among the different marine disciplines. In this context, the FP7 CoCoNET aims to produce the guidelines for the effective management of Marine Protected Area (MPA) networks along with the clean energy production from OWFs.

The wind energy sufficiency is assessed through the collection and analysis of three different wind sources (local sea surface measurements, satellite and SAR observations and numerical data) during the past, current and future climatic conditions, while potential wind energy "hot spots" are proposed. The local wind sea surface measurements were utilized in order to calibrate both the spaceborne and the numerical data and their respective deviations have been mapped. The proposed data calibration, not only improved the wind power estimation -with respect to in-situ measurements- but also proposed alternative data sources when measurements are not available. Furthermore, an alternative and efficient probabilistic model was introduced for the stochastic modeling of the wind speed and for different areas of the Mediterranean basin.

The review of the socioeconomic impacts of OWFs case studies revealed the benefits and drawbacks of their installation on the local communities. Currently, an attempt to compile the environmental factors that may restrain the construction of the OWFs on a basin scale is in progress.

The effective synergies between the technological criteria regarding the development of OWFs and the reduced local environmental impacts will be displayed in the form of a "smart wind chart". This tool is addressed to scientists and policy makers for the evaluation of maritime policy management schemes.

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Investigation of Coastal Sediment Transport in the Ierissos Gulf, Chalkidiki

P. Chantzi¹, K. Albanakis², I. Krestenitis³, K. Kombiadou³, Z. Konstadinou³

¹*Institute for Nanoscience and Nanotechnology, National Center for Scientific Research "Demokritos", I.M.S., 15310 Aghia Paraskevi Attikis, Greece (echantzi@ims.demokritos.gr)*

²*Department of Physical and Environmental Geography, School of Geology Faculty of Sciences Aristotle University of Thessaloniki GR-541 24 Thessaloniki, Greece*

³*Department of Hydraulics and Environmental Engineering, School of Civil Engineering, Aristotle University of Thessaloniki, GR 54124 Thessaloniki, Greece*

The sustainable management, considering climate change, requires scientific tools based on integrated management. Especially, the gulfs constitute a prime example as the coastal zone is obviously affected by the characteristics of the rivers that outflow and mainly by the dominant land uses at the river basins. However, climatic and morphological features of river catchments are those that determine the transmission of the polluted sediments at the marine environment. The main river that outflows in Ierissos Gulf is Kokkinolakkas followed by Karvournoskala and Argiro. The land uses that are included to their river basins related to mining activities which have been taking place to this area since the last decade of 19th century AD.

In order to identify the mechanism of the polluted sediment transposition and deposition a sediment transport model was applied. It was performed on FORTRAN environment. The inputs in the model concern wind velocity, water velocity, physical characteristics of sampled sediments from Ierissos gulf and sediment discharge based on RUSLE model.

It was arisen that Karvounoskala and Argyro rivers, with seasonal flow, mainly affect the sediment deposition for north (2% frequency) and north-east (14% frequency) wind with a northwest direction to Straton where mining activities are taking place. The transportation and deposition of sediments towards to Ierissos predominately controlled by east wind which is the most frequent (20%); the river that mainly participates is Kokkinolakas with the greatest basin and perennial flow during the year. So, it is highlighted the negative impact of circulation pattern to the coastal zone of Ierissos Gulf. Considering that climate change affects the precipitation regime to storm episodes a sediment yield increase it could be possible. Therefore the fragmentary planning of the land uses, with mining activities, it is believed to have a more negative impact to Ierissos gulf.

Evaluation of Chronomes in Greek Population and Relation with Cycles in Solar and Atmospheric Activity

Styliani A. Geronikolou

*Clinical Research Centre, Biomedical Research Foundation, Academy of Athens
(sgeronik@bioacademy.gr)*

Numerous physiological rhythms in humans and global collective behaviours are not only synchronized with solar and geomagnetic activity but disruptions in these fields can create adverse effects on human cardiovascular and respiratory health. Heliomagnetic disturbances cause an adaptive stress reaction, through the hypothalamus-pituitary-adrenal axis HPA, known in physiology as biological clock. Yet, this mechanism is not extensively investigated and certainly not for Mediterranean or Greek populations.

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Mapping time structures, named chronomes, is, nowadays, of growing importance as it contributes to better individual and population health care planning.

In this study, we compare daily morbidity data from the city of Athens, seasonal, monthly and yearly mortality census data from the city of Piraeus, with solar and atmospheric physics data in order to identify possible physical interactions and to assess environmental factors that might predict or confound the cardiovascular mortality. The study periods 1955-1962 and 1985-1989 are especially chosen to exclude three critical confounding factors: pollution and diet for the first period and genetic infusion and interactions for both periods as the immigrating flow that started in 1990.

Seasonal variations of 3 and 6 months in solar flares and cardiovascular mortality (5 year data) are observed. Strong fluctuation, higher than 35% of sunspot numbers was found to significantly contribute to the increase of cardiovascular and stroke mortality. For the first time, we identified a weekly rhythm of 6.8 days in stroke mortality indicating non-anthropogenic death causes.

Acute events such as geomagnetic storms (1-2 day observations), maximum and/or minimum solar activity, are related to an increased ozone variation, by ionizing the stratosphere, and to respiratory morbidity, while strong negative correlation has been found between cyclic variations of solar activity and ozone.

The 2-year cyclic variation of stratospheric ozone is well documented in the literature, however it is absent in cardiovascular disease mortality and solar activity (in F2800 Å distribution). Yet, while ozone variation aligns with respiratory morbidity, it is inversely correlated to cardiovascular mortality incidences.

Conclusively, this study on genetically solid Greek populations revealed seasonal, monthly annual and biannual cyclicality of many death causes being aligned or responding to periodic solar phenomena. We mapped a 6.8 days structure of mortality of strokes aligned to solar activity, suggesting an intimate rhythm of nature to renew populations. Acute events like coronal mass ejections and geomagnetic storms contribute to ionization of the atmosphere and have human health respiratory effects. This work is still in progress and the results require confirmation in other populations, periods and time scales.

Climate mitigation in urban centres through redesign of open urban areas with bioclimatic criteria

Argiro Dimoudi

Dimokriteio University (adimoudi@env.duth.gr)

The morphology of the urban centres, the urban design, the canyons geometry and the constructive materials are important factors which affect the parameters of the local microclimate. The redevelopment of array of streets and open areas in a city centre aims at the bioclimatic and qualitative aesthetic upgrade of the area, strengthen of the local market and environmental improvement of the area. The redesign of open spaces in Greek cities will be presented in this paper. The proposed interventions include increase of vegetation, of shaded open spaces and introduction of water surfaces. The surface temperatures will decrease as cool materials will replace the existing ones. Ventilation of the area will be improved through special systems at selected locations.



**Adaptation Strategies to
Global Environmental Change in the Mediterranean City
and the Role of Global Earth Observations**

**10-11 June 2014
Athens, Greece**

BOOK OF ABSTRACTS

<http://www.mariolopoulosfoundation.gr/medcity2014>

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