

# New frontiers for climate change

## Why Europe should care about climate change and air pollution in the Middle East and North Africa

**T**he Middle East and North Africa (MENA) region, largely coincident with the Arab world, covers an extended area from Morocco to Iran. The region's vast petroleum supply (two-thirds of the world's known oil and natural gas reserves), the large potential to harvest energy from the sun, and its strategic geographic position (between Asia, Africa, and Europe) are well-known attributes of the MENA.

The region faces many challenges, for example rapid population growth – currently about 500 million inhabitants – as well as political and socio-economic instabilities. The challenges are exacerbated by rapid climate change associated with extreme weather conditions in a part of the world that is already hot and dry; the number of exceptionally hot days has doubled since 1970. In the near future, heat extremes could become so intense in the MENA that human habitability is compromised (Lelieveld *et al.*, 2016). The goal of limiting global warming to less than 2°C, agreed at the 2015 Conference of Parties (COP21) of the UNFCCC in Paris, will not be sufficient to prevent highly adverse climate change impacts in the MENA region. In

combination with increasing air pollution and windblown desert dust, the environmental conditions could become intolerable and contribute to mass migration of people to more temperate and wealthier areas, such as Europe.

### Bridge between Europe and the MENA

Taking advantage of an initiative in Cyprus, as being one of its new member states with a strategic location within the Middle East, the European Union may have the great opportunity to become a leading partner in supporting the MENA in mitigating and adapting to climate change and air pollution. At the crossroads of air masses transported from three different continents, Cyprus is subject to uncontrolled transboundary air pollution from the MENA region, and dust from the two of the largest deserts in the world (Sahara, Arabian). Although this situation is very challenging for the island and its population, it can be turned into an opportunity to promote Cyprus as a regional node for climate change, dust and air pollution research activities. This could become a major asset for Cyprus (and the EU), since environmental observations in most of the MENA are critically

limited, but required to assess the extent of the rapid warming and drying conditions. Accurate information on air pollutants and greenhouse gases are scarce in the MENA, and the current initiative can support efficient air quality policies and solutions for meeting national and regional CO<sub>2</sub> emission pledges to the Paris Agreement.

### New regional centre of excellence in climate change and air pollution

Unprecedented efforts are currently underway to establish a new regional Centre of Excellence in Air Pollution and Climate Change in Cyprus; an initiative currently supported by the EMME-CARE project led by the Cyprus Institute and recently funded (in its first phase) by the EU Horizon 2020 'Spreading Excellence and Widening Participation' programme.

EMME-CARE's general objective is to take a regional leadership in advancing scientific understanding of the mechanisms underlying the MENA climate change and air pollution, through an integrated programme combining research, innovation and education, in collaboration with three internationally leading research organisations in the domain: CEA, France; Max Planck Institute, Germany; University of Helsinki, Finland.

This will involve laboratory studies, instrument development, continuous comprehensive atmospheric observations, field experiments and computer modelling of the regional climate and atmospheric environment. EMME-CARE will combine national and regional proficiency with international expertise to foster sustainable development in the MENA region, and reduce dependency on external (western world) knowhow and services.

The programme focuses on greenhouse gases, the water cycle, extreme weather, atmospheric dust, and air pollution, and will address regionally



Fig. 1 The Cyprus Atmospheric Observatory (CAO) at Agia Marina Xyliatou, Cyprus

their various impacts (health, energy and agriculture, to name just a few).

## World-class research infrastructure open to transnational access

One of the most promising developments in EMME-CARE is the establishment of atmospheric research infrastructure with a MENA view; the Cyprus Atmospheric Observatory (CAO; see Fig. 1). Representative of the regional atmosphere, CAO is providing, for the first time in this part of the world, high quality long-term observations of key climate forcers (greenhouse gases, aerosols, reactive gases) using a wide range of *in situ* and remote sensing scientific instrumentation. The governance model of CAO includes both research and governmental organisations (national air quality and meteorological networks) to ensure its compliance with (inter)national environmental directives and climate agreements. The current endorsements of CAO by strategic European and world networks (such as GAW, AERONET, EMEP, ACTRIS, ICOS, and Global SMEAR) are not only dictated by the need of open access and quality controlled atmospheric data that is currently missing in the MENA. Scientific exploitation of these data is performed through direct in house (Cyprus Institute) integration in coupled models that are used to simulate extreme weather events (droughts, flash flooding, heat waves, etc.), and to provide regional forecasting products (weather, air quality) and climate projections.

The Unmanned Systems Research Laboratory (USRL) is another highly competitive research infrastructure of EMME-CARE. This facility encompasses a private runway and airspace granted permanently by the civil aviation authorities (see Fig. 2) and exclusively dedicated to a fleet of research unmanned aerial vehicles (UAVs). Supported by an instrumentation laboratory specialised in lightweight miniaturised sensors, USRL is the first facility of its kind worldwide dedicated to analyse on a continuous (weekly) basis the vertical distribution of air pollutants in the lower 10km of the atmosphere and fill the gap between ground-based and satellite observations.

To challenge the difficulties inherent to the physical (human) access of the MENA atmospheric environment by international research teams, recent efforts have been put to provide transnational access of the EMME-CARE flagship facilities (CAO and USRL) in the framework of several European research infrastructures. With more than 400 accessed days, performed over the past three years by international teams from Europe, the MENA and the USA, these competitive infrastructures have clearly demonstrated their strong potential, and are now attracting the attention of an even larger environmental research



Fig. 2 The Unmanned Systems Research Laboratory (USRL) private runway, hangar and airspace at Orounta, Cyprus

community, as well as industrial partners, targeting new UAV applications.

## Innovation and education for sustainability

In an effort to further develop its scientific objectives in the most sustainable way and promote innovation, the ambition of EMME-CARE is to also serve as an attractive platform to develop/adapt services and products for the Middle East, such as: weather/air quality/dust forecasting, wind/solar forecasting/nowcasting, early warning systems, cost-effective environmental sensors, and UAV environmental technologies. Taking advantage of its competitive infrastructures, state-of-the-art scientific instrumentation, and seeding funds (boost projects), potential investors may also benefit from the numerous assets and investment climate of Cyprus (e.g. location and accessibility as well as being an EU member state with a sound, progressive fast-recovering economy with very competitive corporate taxes), so as to competitively develop their business.

In fact, Cyprus is currently attracting growing foreign investments in its tertiary education sector as it makes strides to becoming a regional (English speaking) education hub. The number of foreign students studying in the country has doubled since it joined the EU in 2004, and today 30% of students are from overseas. EMME-CARE will take advantage of this national attractiveness and further provide regional capacity building through education (master's/doctorate programmes), accredited training, and specialist skills development programmes in the domains of meteorology, climate and air quality. It will develop further excellence by building on a critical mass of top scientists and engineers, and by promoting innovation via regular exchanges of staff and students with strategic partners, regional networking, technology transfer, entrepreneurship and spin-offs.

Overall, through the establishment of the EMME-CARE Centre of Excellence, it is envisioned that Europe will encompass challenges and

opportunities in the area of climate change and air pollution in the MENA, while potentially generating new revenues from the green and blue economies, to name just a few.

## Glossary

ACTRIS: Aerosols, Clouds and Reactive Gases European Research Infrastructure

AERONET: Aerosol Robotic Network

CAO: Cyprus Atmospheric Observatory (<http://www.cyi.ac.cy/index.php/cao.html>)

EMEP: European Monitoring and Evaluation Programme

EMME-CARE: Eastern Mediterranean and Middle East Climate and Atmosphere REsearch Centre (<http://emme-care.cyi.ac.cy/>)

GAW: Global Atmospheric Watch from the World Meteorological Organization (WMO)

MENA: Middle East and North Africa

SMEAR: Station for Measuring Forest Ecosystem Atmosphere Relations

UNFCCC: United Nations Framework Convention on Climate Change

USRL: Unmanned Systems Research Laboratory (<http://www.cyi.ac.cy/index.php/usrl.html>)

## Reference

Lelieveld, J, *et al.* Strongly increasing heat extremes in the Middle East and North Africa (MENA) in the 21st century. *Climatic Change*, doi:10.1007/s10584-016-1665-6, 2016



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