## Climate Change: Changes, Challenges and Outlook

Over the last 10,000 years (known as the Holocene period) Earth’s climate has been remarkably mild and stable, enabling the development of human civilization and its remarkable accomplishments. The accumulating byproducts of human activities however – greenhouse gases and suspended atmospheric particles (“aerosols”) – have caused changes that are changing the climate system at an alarming and accelerating rate. So much in fact, that the planet has been driven out of the Holocene into a new climate period - the Anthropocene, with a myriad of changes and challenges for humanity and ecosystems worldwide that are amplified with time.

A major problem and challenge is the poor understanding of many climate change drivers – especially related to the effect of suspended particulate matter (“aerosols”) from pollution. Some aerosols cool climate by reflecting sunlight back to space, and other particles absorb light and warm. Aerosols also impact clouds – by providing the “seeds” upon which cloud particles form - so aerosol changes eventually modulate the amount of sunlight reflected by clouds back to space, the structure of cloud fields and precipitation, and eventually the hydrological cycle and climate. Although altogether these aerosol impacts are thought to collectively cool climate, model simulations give a wide range of estimates. Furthermore, it is unclear how the Earth system will respond to the above climate drivers, especially as large and irreversible changes begin to set in (e.g., melting of land ice and permafrost). As a result, there are considerable uncertainties in predictions of climate change, especially when considering possible outcomes associated with potential climate policies. Even more uncertainty exists for predictions of regional climate change – especially in “climate hotspots”, such as the Arctic and the Mediterranean.

This talk will present an overview of the key drivers of climate change, both globally and regionally for the Mediterranean, and the expected changes that are expected to occur in the near future. We present advances being made in climate models to address key sources of prediction uncertainty, focusing on European modeling frameworks and aerosol-related effects. We conclude with perspectives on challenges that lie ahead, and the impact that Chemical Engineering Science can have to help address them.