Atmospheric particulate matter and its impacts on climate

Human activities profoundly alter the composition of the atmosphere, leading to a cascade of effects on climate. Atmospheric aerosols, play a central role in all these changes, as they can directly scatter/absorb of incoming solar radiation – and also modulate clouds by providing the seeds for droplet (or ice crystal) formation. Aerosol variations have also been proposed to affect the development of precipitation, storm systems and the hydrological cycle at large. Much of the predictive uncertainty surrounding human impacts on the Earth System is related to poorly understood processes involving the emission, transformation and related impacts of atmospheric aerosol, and their complex and multi-scale coupling of aerosols and clouds. Added to this complexity is the large variability and range of aerosol types, each of which is characterized with its own ability to nucleate droplets and ice crystals.

This talk will present key advancements on the description and understanding of aerosol-climate and aerosol-cloud-climate interactions through the combination of observations, theory and modeling. We will demonstrate how instrument and remote sensing development efforts helped solve long-standing issues regarding parametric uncertainty for the description of droplet and ice crystal formation in models. We will then illustrate new approaches, based on advanced sensitivity analysis and model-observation integrations, to quantitatively understand sources of variability in model simulations, and their counterparts in the atmosphere. We conclude with perspectives on important challenges that lie ahead, and the special role that the Aerosol Science can continue have to help resolve them.

Short Bio:

Athanasios Nenes is a Professor of Atmospheric Processes and heads the Laboratory of Atmospheric Processes and their Impacts (LAPI) at the École Polytechnique Fédérale de Lausanne, Switzerland. He is an affiliate researcher of the Institute of Chemical Engineering Science at the Foundation for Research and Technology Hellas in Patras, Greece and a founding member of the Center of Studies on Air quality and Climate Change at the institute. His research focuses on the impact of atmospheric processes (especially aerosol) on clouds, climate, air quality and ecosystems. He is the prime author of the ISORROPIA aerosol thermodynamics models, open-source modules for air quality and climate models, and developer of instrumentation to measure aerosol properties and Cloud Condensation Nuclei. He is a Web of Science Highly Cited Researcher (2020-2022), having authored/co-authored 315 manuscripts (Google Scholar citations: 29000, *h*=91). He serves as President of the Atmospheric Sciences Division of the European Geophysical Union, and member of the UN Joint Group of Experts

on the Scientific Aspects of Marine Environmental Protection (WG38: Atmospheric input of chemicals to the ocean). He served on the US National Academies Committee on the Future of Atmospheric Chemistry Research, Secretary of Atmospheric Sciences of the American Geophysical Union and Editor in the Copernicus journal *Atmospheric Chemistry and Physics* (2004-2019). Prof. Nenes is an American Geophysical Union Fellow (2020); a member of the Academia Europaea (2021); a Fellow of the American Association for Aerosol Research (2022); a recipient of the Copernicus Medal (2022), a ERC Consolidator Grant (2016), the Vaughan Lectureship, Caltech (2014), the Ascent Award, American Geophysical Union AS Section (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).