

## **Secondary ice processes: a modulator of global mixed-phase clouds**

In-situ observations of mixed-phase clouds (MPCs) regularly reveal that ice crystal number concentrations (ICNCs) are orders of magnitude higher than ice-nucleating (IN) particle concentrations. This discrepancy has often been attributed to the influence of missed IN sources and secondary ice production (SIP) processes, but only recently considerable work has been invested towards better understanding the role of SIP. Here we present an overview of the main SIP processes and impacts that have been identified for globally-important cloud types (including polar, orographic and other cloud systems), and present efforts to parameterize their impacts and include them in climate modeling frameworks for use in the upcoming CMIP. An emphasis will be placed on what has been learned and what critical knowledge gaps remain for weather-prediction and climate models.

**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, aerosol-cloud interaction parameterizations, and developer of instrumentation to measure aerosol properties and Cloud Condensation Nuclei. He is a Web of Science Highly Cited Researcher (2020-2023), having authored/co-authored more than 375 manuscripts (Google Scholar citations: 37690, h=100). He has served as President of Atmospheric Sciences of the European Geophysical Union (EGU), co-Chair of the EGU Annual Assembly (2023-2024), is an expert of the IPCC AR7 WG1, member of the UN Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (WG38: Atmospheric input of chemicals to the ocean), and served on the US National Academies Committee on the Future of Atmospheric Chemistry Research, Secretary of Atmospheric Sciences of the American Geophysical Union (AGU) and Editor in the Copernicus journal Atmospheric Chemistry and Physics. He is a Fellow of the AGU and the American Association for Aerosol Research (AAAR); he is also member of the Academia Europaea. Distinctions include the Copernicus Medal, ERC Consolidator Grant, AGU Ascent Award, AAAR Sinclair, Whitby and Friedlander Awards, American Meteorological Society Houghton Award; NASA New Investigator Award and a US National Science Foundation CAREER Award. He has mentored 25 PhD students and 28 postdocs.