Atmospheric new particle formation: From chemistry to global climate

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The last 10 years has seen a transformation in our understanding of how new particles form, or 'nucleate', in Earth's atmosphere. Based on novel experimental approaches it has become feasible to observe how a very small number of special molecules like sulphuric acid, ammonia and organic compounds stick together and eventually grow into particles that can influence Earth's climate. Such measurements have enabled the development of nucleation rate expressions that can be incorporated into climate models. In this presentation I will explain what these developments mean for our understanding of global aerosol and climate. We now estimate using climate models that over half of cloud-forming aerosol particles in the atmosphere were created through nucleation, and that Earth's energy balance would be very different without it. Removing nucleation causes a global warming effect nearly twice as large as caused by all atmospheric methane. More importantly, nucleation creates a globally pervasive source of aerosol that strongly damps the response of clouds to changes in anthropogenic aerosol. Although there are gaps in our understanding of nucleation in some environments, and much still to be discovered, the big picture is that nucleation is one of the most important chemical processes in our atmosphere.