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Preface to Physics, Chemistry and Biology of Atmospheric Composition and Climate Change

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The Academy of Finland funded altogether 16 national Centres of Excellence in Research (CoE's) for the period 2002–2007, one of those was the **Research Unit on Physics, Chemistry and Biology of Atmospheric Composition and Climate Change**. This Special issue of the Boreal Environment Research presents some of the highlights of the research conducted by our CoE.

The Intergovernmental Panel for Climate Change (IPCC 2007) has emphasized the need for understanding the complexity of the combined direct and indirect radiative forcings from both aerosols and greenhouse gases. Although the greenhouse gas budgets are relatively well known, uncertainty in the current estimates of radiative forcing due to aerosols is still large. Better understanding of the various effects of aerosols in the atmosphere requires detailed information on how different sources (including those of biosphere) and transformation processes modify properties of aerosol particles and trace gases. Trace gases and atmospheric aerosols are tightly connected with each other via physical, chemical, meteorological and biological processes occurring both in the atmosphere and at the atmosphere-biosphere interface. Gases and aerosol particles originating from natural and anthropogenic emissions are transported and transformed over geographically large areas. This complexity underlines the fact that there is no individual group, discipline, institute, or country that is able to solve these interlinked issues of climate change and air quality alone. Therefore inter-, multi and cross-disciplinary approaches have been the baseline in the CoE research plan, and the same idea has been implemented throughout this issue of Boreal Environment Research.

The origin of the CoE is in the close collaboration between two University of Helsinki departments, namely the Department of Physics and Department of Forest Ecology, and in the founding of two measurement stations, SMEAR I and II (Stations for Measuring Ecosystem–Atmosphere Relationships) already in the early 1990s (Hari and Kulmala 2005). Finnish Meteorological Institute and University of Kuopio joined this collaboration somewhat later, and the present CoE includes also the Department of Chemistry of University of Helsinki.

The work performed at the field stations continues to provide a solid background for the research consortium and a fertile base for interdisciplinary collaboration both in theoretical, experimental and field work. The consortium operates currently five field stations in Finland. Data and studies conducted there are presented in this Special issue. General principles for creating a comprehensive network of measuring stations to monitor climate change are presented in the paper by Hari *et al*. (2009), whereas Junninen *et al*. (2009) introduces an on-line data exploration and visualization tool for measurement data.

The CoE aimed at studying the importance of aerosol particles on climate change, and the proc-

esses governing material, energy and momentum fluxes between atmosphere and biosphere (Kulmala *et al*. 2005). The research has concentrated on revealing: (1) formation and growth mechanisms of atmospheric aerosols, aerosol dynamics and air ion and cluster dynamics (Jaatinen *et al*. 2009, Leppä *et al*. 2009, Manninen *et al*. 2009, Ortega *et al*. 2009, Paasonen *et al*. 2009, Toivola *et al*. 2009, Vaattovaara *et al*. 2009, Yli-Juuti *et al*. 2009), (2) the effect of secondary biogenic aerosols on global aerosol load (Kulmala *et al*. 2004, Spracklen *et al*. 2006, Paasonen *et al*. 2009, Yli-Juuti *et al*. 2009), (3) aerosol-cloud-climate interactions (Kivekäs *et al*. 2009, Leskinen *et al*. 2009, Portin *et al*. 2009), and (4) the relationships between the atmosphere and different ecosystems, particularly the boreal forest (Aurela *et al*. 2009, Dal Maso *et al*. 2009, Ilvesniemi *et al*. 2009, Kolari *et al*. 2009, Lallo *et al*. 2009, Laurila *et al*. 2009, Porcar-Castell *et al*. 2009, Rinne *et al*. 2009). Feedback processes between the ecosystem carbon uptake and atmospheric aerosol formation have been central in the research plan. The relevance and use of the results in the context of global scale modeling (Kyrö *et al*. 2009), as well as the development and utilisation of the newest measurement techniques (Birmili *et al*. 2009, Järvi *et al*. 2009, Laitinen *et al*. 2009, Parshintsev *et al*. 2009, Kulmala *et al*. 2009) have also been addressed.

The value and importance of inter-, multi- and cross disciplinarity in environmental and atmospheric research has been established and even proved in the work of our Centre of Excellence.

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