

# Preface

Weather natural hazards, the environment and climate change are of concern to all of us. Especially, it is essential to understand how human activities might impact the nature. Hence, monitoring, research, and forecasting is of the outmost importance. Furthermore, climate change and pollution of the environment do not obey national borders; so, international collaboration on these issues is indeed extremely important.

In the future, the increasing computer power and understanding of physical processes pave the way for developing integrated models of the Earth system and gives a possibility to include interactions between atmosphere, environment, climate, ocean, cryosphere and ecosystems.

Therefore, development of integrated Numerical Weather Prediction (NWP) and Atmospheric Chemical Transport (ACT) models is an important step in this strategic direction and it is a promising way for future atmospheric simulation systems leading to a new generation of models. The EC COST Action 728 “Enhancing Mesoscale Meteorological Modelling Capabilities for Air Pollution and Dispersion Applications” (2004–2009) is aimed at identifying the requirements and propose recommendations for the European strategy for integrated mesoscale NWP-ACT modelling capability.

DMI strongly supports this development. Almost 10 years ago DMI initiated developing an on-line integrated NWP-ACT modelling system, now called Enviro-HIRLAM (Environment – High Resolution Limited Area Model), which includes two-way interactions between meteorology and air pollution for NWP applications and chemical weather forecasting. Recently we also initiated organisation of the Chemical branch in the HIRLAM international consortium (<http://hirlam.org>), where this model is considered as the baseline model. The Enviro-HIRLAM became an international community model starting January 2009 with several external European organisations joining the research and development team (e.g., from the University of Copenhagen, Denmark; University of Tartu, Estonia; University of Vilnius, Lithuania; Russian State Hydro-Meteorological University; Tomsk State University, Russia; Odessa State Environmental University, Ukraine) with new coming participants.

During 2002–2005, DMI led EC FP5 project FUMAPEX (<http://fumapex.dmi.dk>), which developed a new generation Integrated Urban Air Quality Information and Forecasting System and implemented such a system in six European cities.

The new EC FP7 project MEGAPOLI (2008–2011) (<http://megapoli.info>), coordinated by DMI, is also focusing on further developments of integrated systems and studies of interactions between atmospheric pollution from mega cities and meteorological and climatic processes.

These remarks show the importance to organise a workshop to share and analyse international experience in integrated modelling worldwide. The first workshop on “Integration of meteorological and chemical transport models” (<http://netfam.fmi.fi/Integ07>) was arranged at DMI (Copenhagen, Denmark) on 21–23 May 2007. The workshop was organised in the framework of the COST Action 728 and in cooperation with the Nordic Network on Fine-scale Atmospheric Modelling. Almost 50 participants, including invited experts in integrated modelling and young scientists, from 20 countries attended this event to discuss the experience and further perspectives of coupling air quality and meteorology in fine-scale models. The workshop was aimed at joining both NWP and air quality modellers to discuss and make recommendations on the best practice and strategy for further developments and applications of integrated and coupled modelling systems “NWP and Meso-Meteorology – Atmospheric Chemical Transport”. Main emphasis was on fine-resolution models applied for local chemical weather forecasting and considering feedback mechanisms between meteorological and atmospheric pollution (e.g. aerosols) processes. The following topics were in the focus of presentations and discussions:

- Online and offline coupling of meteorological and air quality models
- Implementation of feedback mechanisms, direct and indirect effects of aerosols
- Advanced interfaces between NWP and ACT models
- Model validation studies, including air quality-related episode cases

As a follow-up a young scientist summer school and workshop on “Integrated Modelling of Meteorological and Chemical Transport Processes / Impact of Chemical Weather on Numerical Weather Prediction and Climate Modelling” was organised by DMI and Russian State Hydrometeorological University during 7–15 July 2008 in Russia.

This book, written mostly by invited lectors/speakers of the Copenhagen workshop, is focused on above mentioned workshop topics, summarizes presentations, discussions, conclusions, and provides recommendations. The book is one of the first attempts to give an overall look on such integrated modelling approach. It reviews the current situation with the on-line and off-line coupling of mesoscale meteorological and air quality models around the world (in European countries, USA, Canada, Japan, Australia, etc.) as well as discusses advantages and disadvantages, best practice, and gives recommendations for on-line and off-line coupling of NWP and ACT models, implementation strategy for different feedback mechanisms, direct and indirect effects of aerosols and advanced interfaces between both types of models.

It is my hope that this book will be useful for first of all to those interested in the modelling of meteorology and air pollution, but also for the entire meteorology and atmospheric environment communities, including students, researchers and practical users.

Copenhagen, Denmark

DMI Director General, Peter Aakjær

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Baklanov, A.; Mahura, A.; Sokhi, R. (Eds.)

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