

**THE CYCLE OF ATMOSPHERIC TRACE SPECIES
CONTAINING SULPHUR, NITROGEN, CARBON AND
HALOGENS OVER EUROPE AND THE EASTERN
ATLANTIC**

Cover: Average ozone concentrations at the surface in early May, 1997
calculated by a 3-D numerical transport and chemistry model.

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The cycle of atmospheric trace species containing sulphur, nitrogen, carbon
and halogens over Europe and eastern Atlantic.

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THE CYCLE OF ATMOSPHERIC TRACE
SPECIES CONTAINING SULPHUR,
NITROGEN, CARBON AND HALOGENS
OVER EUROPE AND THE EASTERN
ATLANTIC

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DR. SCIENT DISSERTATION
at



Geophysical Institute
University of Bergen
Bergen, Norway
1998

Preface

Though writing a PhD thesis sometimes may be a lonely and troublesome task, and looking back in despair on all the work that never reached longer than the trash bin, the last 3 1/2 years have been years where I have been allowed to do essentially what I want, and it is with sadness I now see the end of my stay here at the Geophysical Institute, University of Bergen.

Studying the atmospheric cycle of trace gases involves the knowledge of several disciplines. The gases considered are subject to chemical conversion as well as long range transport depending on the meteorological conditions and surface deposition depending on biological parameters. Retriving knowledge in this different scientific areas has been a very interesting and demanding task and it has certainly broaden my view about the complexity of modeling pollution problems.

There are many people to which I owe thanks for their help and support during my thesis work. I would especially like to thank my supervisor professor Øystein Hov for excellent cooperation and invaluable support throughout the work, Dr. Frode Flatøy for assistance concerning the 3-D model and profitable discussions. Thanks to colleagues and fellow students at at the Geophysical Institute for helpful discussions and motivational contributions. A special thanks to my officemate Øyvind Breivik for brilliant coffee and endless discussions on politics which have probably delayed this thesis by several months. Thanks also to several staff members at the Geophysical Institute for solving practical problems.

A warm thanks to my family for moral support and not having any ambitions on my behalf.

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May 1998

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Paper I - Two parameterizations of the dry deposition exchange for SO_2 and NH_3 in a numerical model.

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Atmospheric Environment Vol 30 pp. 1823-1840.

Paper II - Gaseous and particulate oxidized and reduced nitrogen species in the atmospheric boundary layer in Scandinavia in spring.

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Paper III - VOC emission estimates evaluated by measurements and model calculations.

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Paper IV - The role of halogenated species in the troposphere - Model calculations.

Sorteberg A. and Hov Ø., 1998.

In preparation.