Ann. Geophys., 26, 1039–1040, 2008
www.ann-geophys.net/26/1039/2008/

Annales Geophysicae

Preface

Atmospheric studies by optical methods

The 33rd Annual European Meeting on Atmospheric Studies by Optical Methods (33AM) was held in Kiruna, Sweden, 28 August–1 September 2006. This special section contains 13 invited and contributed papers that were presented at the meeting. Ten additional papers and results of an intercalibration session are published in a report from the Swedish Institute of Space Physics, IRF Scientific Report 292, 2008 (ISSN 0284-1703, ISBN 978-91-977255-1-4).

The first European Meeting on Atmospheric Studies by Optical Methods was held in 1973 in Stockholm and subsequent meetings have since then been held every year except 1989. These meetings provide a forum for exchanging experiences concerning experimental techniques, sharing scientific results, and planning and coordinating future experiments. An additional important activity is inter-calibration of light standards.

33AM was attended by 75 scientists from 11 countries, including a number of participants from outside Europe. There were 82 scientific contributions (64 oral and 18 posters) covering topics on mesosphere and stratosphere, aeronomy, auroral phenomena, lidars, instruments and facilities, calibration methods, history of auroral research, and optical studies during the International Polar Year. One full meeting day was spent at Esrange Space Center, where meeting participants had the opportunity to see the rocket and balloon launching facilities, the satellite station, and the ground-based instrumentation for support of sounding rocket and balloon experiments. Two meeting sessions were also held at Esrange. Meeting information can be found at www.irf.se/33am.

The papers in this special issue demonstrate the rich diversity and usefulness of optical methods. Four papers concern auroral phenomena. Chernouss et al. present the first results from a new all-sky CCD spectrograph being operated at Barentsburg, Spitsbergen. Spectra from both aurora and airglow were studied. During the winter season 2005–2006, close to solar minimum, the green emission at 557.7 nm dominated over the red emission at 630.0 nm, while the situation during IGY 1958–1959, near solar maximum, was the opposite. ASK (Auroral Structure and Kinetics) is a very sensitive instrument with three EMCCD-cameras operated with three different filters for studies of small-scale auroral features. Dahlgren et al. present the first results from ASK, obtained at Svalbard in the winter of 2005–2006. Using a new method to process TV-data, Kornilova et al. studied the detailed behaviour of the aurora during more than 60 breakups. With this method it was also possible to follow subvisual structures. The results support patchy tail reconnection rather than a single neutral line and indicate that breakup is a result of interaction between processes in the tail and in the near magnetosphere. Pedersen et al. review observations of both artificial and natural optical emissions measured at the High Frequency Active Auroral Research Project (HAARP) facility in Alaska and present its capabilities. Among the natural emissions are some newly recognized types of hard precipitation far equatorward of the normal auroral oval.

Many imagers around the world measure airglow. Pertsev and Perminov measured the solar cycle dependence in infrared emissions from the mesopause region at Zvenigorod near Moscow. The hydroxyl temperature decreased 5 K between solar maximum and solar minimum and emission intensities decreased 40 to 50 per cent.

Both in aurora and airglow studies, understanding of collisions between atmospheric constituents and reaction rate coefficients are essential. Kirillov presents two theoretical studies treating collisions involving nitrogen and oxygen molecules. In one study, quenching rate coefficients are calculated, and in the other the redistribution of vibrational levels of ground states is investigated.

The mesopause region is treated in four papers, one discussing a sounding rocket study and three in which lidars are used. The Arctic summer mesopause at 80–90 km is the coldest region anywhere in the Earth's atmosphere. Noctilucent clouds are found there which consist of ice particles with sizes smaller than 75 nm, but it is not known for sure if there is a tail of particles much smaller than this. Hedin et al. present a method and an instrument, SLAM (Scattered Lyman-Alpha in the Mesosphere), to investigate this small size particle tail using Lyman-α measurements. Lautenbach et al. demonstrate that there is a lack of understanding of the relationship between polar mesosphere summer echoes

Published by Copernicus Publications on behalf of the European Geosciences Union.

(PMSE) and temperatures. Like noctilucent clouds, PMSE are thought to be related to the existence of ice particles that are due to temperatures below the frost point. PMSE, measured by VLF-radar, were always found, but only below 92 km, while temperatures, measured by potassium lidar, were low enough for ice particle formation also above this altitude. Nesse et al. used the ALOMAR sodium lidar to study the creation of sudden sodium layers. They found that more than one of the proposed formation mechanisms was in agreement with their data, but concluded that conversion from sodium ions seems to be the most likely one. Heinrich et al. carried out summer measurements of sudden sodium layers. They describe the rather complicated data analysis and find a strong relation between summer sudden sodium layers and sporadic E layers.

One paper concerns the stratosphere. Grytsai et al. have analyzed ozone data obtained by TOMS (Total Ozone Mapping Spectrometer). The zonal minimum of ozone in the Antarctic spring exhibited an eastward shift of 15–20 degrees per decade.

Finally, the special issue contains one paper on the history of auroral research. In 1899–1900 a Russian-Swedish expedition to Spitsbergen carried out what was then state-of-the-art auroral measurements using optical instrumentation. An account of the results is presented by Chernouss and Sandahl.

Considerable development in optical technology during recent years is opening up new possibilities for research with optical methods. This also means new challenges in effective experiment design, instrument calibration, data analysis methods, modelling, and data interpretation. The Annual Optical Meetings will have an important role to play as a forum for the optical community for many years to come.

We would like to thank the Editor Wlodek Kofman, Topical Editors Ulf-Peter Hoppe and Mike Pinnock, Natascha Otto from the Copernicus Editorial Office, and all the reviewers as well as all the authors for their good work bringing this special issue to completion. We would also like to thank Karl Heinrich Fricke for demonstrating the lidar at Esrange, and the staff at the Swedish Institute of Space Physics and at the Esrange Space Center (Swedish Space Corporation) for their contributions to the local organization of the meeting. We gratefully acknowledge support from the International Association of Geomagnetism and Aeronomy (IAGA), the Swedish Research Council (Vetenskapsrådet), the Nordic Council of Ministers (Nordiska ministerrådet), the Municipality of Kiruna (Kiruna kommun), the Swedish Institute of Space Physics, and the Swedish Space Corporation.

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Guest Editor