

The International Radiation Symposium 2016

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1. Overview

The 2016 International Radiation Symposium, a joint venture between the IRC (International Radiation Commission) and IAMAS (International Association of Meteorology and Atmospheric Sciences), took place at the University of Auckland from April 16th to 22nd. The wide scope of atmospheric radiation research was apparent, with focuses ranging from the planetary to the particulate, and from the hourly to the millennial. The symposium, which was attended by 268 scientists from 28 countries, provided an excellent forum for the exchange of knowledge between modelers and experimentalists. (Fig. 1)

Two awards were presented by the IRC: the Young Scientist Award, to Zhibo ZHANG (Fig. 2), and the Gold Medal

Award, to Teruyuki NAKAJIMA (Fig. 3). Both gave well-received keynote talks after accepting their awards at the conference dinner at the Auckland Museum.

2. Plenary sessions

The four keynote talks, in addition to the award winners' presentations, were the highlight of the conference. Each speaker summarized an important area of radiation research, generating several questions and a great deal of discussion afterwards.

David DINER talked about the unique advantages of multi-angle imaging, such as the ability to detect thin hazes by looking through a larger airmass, and reported that MISR winds can significantly improve weather forecasting. He



Fig. 1. IRS 2016 group photo.

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also discussed the MAIA (Multi-Angle Imager for Aerosols) project, which aims to determine the impact of aerosols on human health by linking satellite and epidemiological data.

Martin WILD reported several advances in the understanding of the global energy balance. He noted that the multimodel mean of the clear-sky energy budget in CMIP5 agrees well with observations, but the variations between individual models are large. Separate energy balances were calculated for the land and ocean, and these brought the value for latent heat to within the error bars of the observations of the precipitation community, going some way toward solving a long-standing discrepancy.

Richard McKENZIE gave a comprehensive review of all the relevant aspects of current research in the field of solar UV radiation. He highlighted the work done at Lauder on ozone measurement and noted that New Zealand has the highest rates of skin cancer in the world.

Lesley GRAY also gave a talk covering solar UV, in which she described how the surface response to changes in solar radiation is a complicated mix of “top-down” and “bottom-up” effects. The effects of the 11-year cycle are reasonably clear in the middle atmosphere, but their potential influence on the circulation of the lower atmosphere, affecting surface climate, is much harder to understand.



Fig. 2. Young Scientist winner Dr. Zhibo ZHANG.

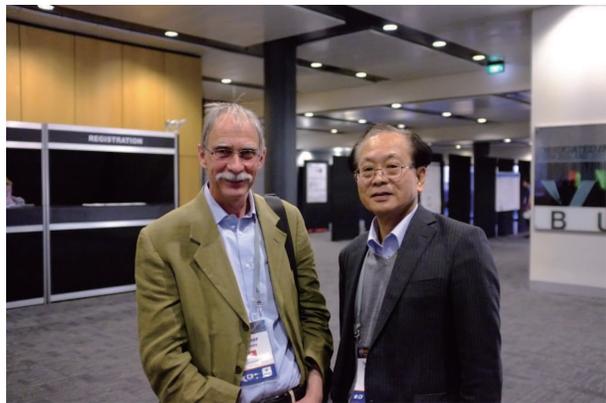


Fig. 3. IRS Gold Medal winner Prof. Teruyuki NAKAJIMA and IRC president Prof. Werner SCHMUTZ.

3. General remote sensing

At present, the radiative transfer model is usually the bottleneck in a physical retrieval algorithm. Xu LIU presented a model, PCTRM (Principal Component-based Radiative Transfer Model), which allows spectral data to be compressed through eigenvector representation, allowing for improved speed.

Bing LIN presented a method to determine the surface pressure remotely using the differential absorption of oxygen.

Marwan KATURJI showed results on the remote infrared sensing of eddies.

4. Understanding climate using satellite data

The phenomenon of brightening in Europe is widely observed, but, as Arturo Sanchez-LORENZO reported, it is still not captured fully by satellites. It was suggested that this may be due to temporally varying aerosols.

B. J. SOHN showed that including a representation of atmospheric stability allows better modeling of the Pacific Walker Circulation and El Niño-like events.

Dominique BOUNIOL documented the contribution of the mesoscale convective system to the energy and water budgets of the tropics.

The negative feedback between cloud-top height and surface temperature was investigated by Abhnil PRASAD using measurements from CALIPSO.

5. Southern Ocean and Antarctica: Radiation, clouds, aerosols and sea-ice

Looking downwards from satellites and upwards from the surface of the ocean, a network of observations is helping to improve our understanding of the Southern Ocean and Antarctica.

On the sea-borne side, Makoto KUJI used observations from shipboard whole-sky cameras and ceilometers to produce maps of cloud fraction for the region between Japan and the Antarctic.

Yuekui YANG found that snow blowing in the Antarctic can have an appreciable radiative effect — about 5 W m^{-2} .

Luca PALCHETTI noted the lack of observations in the far infrared spectrum of surface longwave radiation over the east Antarctic plateau.

Roger DAVIES, who is also a Local Organizer (Fig. 4), presented observations from MISR of the cloud morphology over the South Pacific, and discussed the microphysics that could be inferred from these. The aim was to determine whether there were observable differences between the hemispheres, which was found to be the case.

6. Particle radiative properties

Michael KAHNERT, the invited speaker, presented a novel particle model for the light scattering properties of heterogeneous aerosols with complex shapes. The performance



Fig. 4. Local organizer Prof. Roger DAVIES.

of this “core-grey-shell” model in predicting scattering properties was investigated.

Another highlight was the talk given by Konrad KANDLER, who presented 3D images, obtained through scanning electron microscopy, of mineral dust in which several different minerals were aggregated.

7. Radiation budget and forcing

The radiation budget and radiative forcing session addressed the principle of the greenhouse effect and global warming. In particular, the specific contributions of energy input and output in the Earth’s atmosphere on a global scale were presented. Martin WILD estimated the amount of long-wave radiation with high accuracy and with comparison to ground-based measurements.

Norman LOEB described the failure of land surface models that do not allow for divergence from the mean climatology of a region to account for droughts, with reference to the millennium drought recently experienced by Australia.

Two papers were presented on the brightening and dimming effects of air pollution over China and Japan.

8. Weather, climate and environment applications

As Allen HUANG noted, satellites provide most of the forecast skill for current weather predictions. He outlined the use of a hyperspectral environmental sounder for nearcasting severe weather events, and described the process of forecasting volcanic ash for aviation applications. An overview of the state of hyperspectral IR observations was given by David Tobin.

Yunfei FU investigated aerosol–cirrus interactions, and found that the distance to the nearest cirrus cloud can have a 20 W m^{-2} effect on the upward radiative forcing.

Steven PLATNICK presented a suite of common algorithms for MODIS and VIIRS observations, which were produced in order to ensure continuity in the cloud climate data record.

Hua ZHANG presented a calculation of the total effective radiative forcing of anthropogenic aerosols, while Toshihiko TAKEMURA examined the SO_2 aerosol effect, specifically in Asia. Talks were also given on cloud–radiation feedbacks in monsoon conditions and a coupled convection–cloud fraction parameterization.

9. Radiative transfer theory and modeling

A focus of this session was the new techniques and algorithms developed for the retrieval of optical properties from cloudy scenes, a task which presents many unique problems.

Eli MLAWER introduced an updated version of RRTM, which makes use of advances in computing architecture to improve the speed of radiation calculations in GCMs. Improved radiative transfer models were also presented by Anthony DAVIS and Jerome VIDOT.

Sheng-Hsiang WANG highlighted shortcomings in the assumption of uniform aerosol optical properties. A transport with two layers was observed and a two-layer aerosol model was developed to explain this.

10. Ice clouds: Light scattering, radiometric polarimetric remote sensing, and radiation

The invited speaker, Dr. Brian KAHN, spoke about retrieving ice-cloud properties from hyperspectral infrared observations. Observations from AIRS were found to be very useful in characterizing ice clouds, and multi-sensor approaches show a lot of promise.

While observations have been successful, there is plenty of work to be done on the theory of light scattering by ice crystals, particularly in the resonance region (where the size of the scattering particle is similar to the incident wavelength), and effects such as photon tunneling need to be further explored. This may require a novel physical–geometric optics approach.

11. Surface measurements and field experiments

Von WALDEN presented the results of the ICECAPS (Integrated Characterization of Energy, Clouds, Atmospheric state, and Precipitation at Summit) experiment, which aimed to determine the effect of clouds on Greenland’s surface energy budget.

A lively discussion was sparked by invited speaker Julian GRÖBNER’s talk, in which he described an effort to measure cloud fractions 24 hours a day, using an infrared camera and a gold-coated spherical mirror observing 180° of the sky during day and night.

Mikhail KRINITSKIY described another method for determining cloud fraction, which distinguishes between cloudy and clear sky using only color saturation.

Improved measurements of aerosol–cloud interaction, aerosol optical depths, and the solar spectrum were also reported, and updates were given on several ongoing calibration and intercomparison projects for radiometers.

12. Ocean optics

Knut STAMNES, Jacek CHOWDHARY and Jürgen FISCHER all spoke on the topic of the retrieval of optical properties using satellite measurements of ocean color.

Neural networks were used to train the algorithms presented in several talks at the conference. In this session, success was reported in their use for merging data collected simultaneously by different instruments, and for retrieving parameters from SeaWiFS (Sea-Viewing Wide Field-of-View Sensor), greatly improving the speed of the retrieval.

13. Solar UV radiation

Several authors presented the results of UV measurements over a period of about 20 years, in both oral presentations and posters, including overviews by invited speakers

Germar BERNHARD and Ben LILEY. The measurements of broadband radiometers in general show no significant trend in recent decades. However, a strong daily and annual variability of UV exposure caused by clouds and aerosols has become apparent, and the research focus has shifted to this area.

Finally, the consequences of UV exposure for both humans and materials were discussed. For humans, a balance between the positive (vitamin D production) and the negative (skin cancer) needs to be struck, and the research from this session will aid in this.

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