Facilitating atmospheric chemistry research towards a sustainable world

14th IGAC Science Conference

One Atmosphere: Building a Collective Knowledge

Report to the International Global Atmospheric Chemistry Project

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IGAC Conference Report

Breckenridge 2016

26-30 September
Colorado USA

Report: DOE-IGAC2016-SC0016041

Contents

1. General Information

We are pleased to report on the success of the 14th International Global Atmospheric Chemistry (IGAC) Project Science Conference in Breckenridge, Colorado, USA, 26-30 September 2016. The IGAC 2016 conference, with the theme “One Atmosphere: Building a Collective Knowledge”, provided a platform for information exchange and new ideas on the current scientific knowledge on atmospheric chemistry and its connections to climate change, policy, and other important interdisciplinary work.

IGAC 2016 marked the first time the event has been hosted in the U.S. since 1998. Nearly 500 of the world's top research scientists from the atmospheric chemistry community attended the weeklong conference with 494 participants representing 36 different countries. Early career scientists represented 40% of the conference attendees, highlighting vibrant and active research.

In 2016 IGAC had the following goals for its bi-annual conference:

- Highlight cutting edge scientific research on atmospheric chemistry.
- Foster international collaborations to address the most pressing global change and sustainability issues through scientific research.
- Engage early career scientists to cultivate the next generation of international researchers.
- Highlight scientists and scientific research from developing and emerging economies.
- Promote networking between scientists, policy makers, and industry leaders.

Specific themes of IGAC 2016 included the impacts of urbanization, agriculture, and energy systems on atmospheric chemistry, as well as the relationships between atmospheric gases, particles, and climate change. Keynote talks highlighted the important connection between basic science and policy, a review of the recent National Academies report on the Future of Atmospheric Chemistry, Atmospheric chemistry and biogeochemistry, and the use of atmospheric chemistry research for decision making.

The biennial conference was relevant not only to the research community, but also to the private sector, and nearly a dozen businesses contributed funding and in-kind donations to help defray conference costs. These contributions helped support a great conference, and afforded attendees the opportunity to learn from and interact with representatives from companies developing the technology commonly used by the community.

The gorgeous fall weather in Breckenridge gave conference attendees opportunities to experience world-class research, while also enjoying exceptional scenery and wildlife in a beautiful Colorado mountain town.

The full scientific program with abstracts can be found as a PDF file here:

http://www.igac2016.org/2016IGAC_ConferneceProgram.pdf

2. Participants

A total of 494 participants attended the IGAC 2016 Conference, representing 36 countries. About 200 participants, or 40%, were early career or student scientists.

Conference Statistics:

494 Total Participants

290 General Registrants

204 Student/Early Career

367 Poster Presentations

66 Oral Presentations including:

Guest Speaker

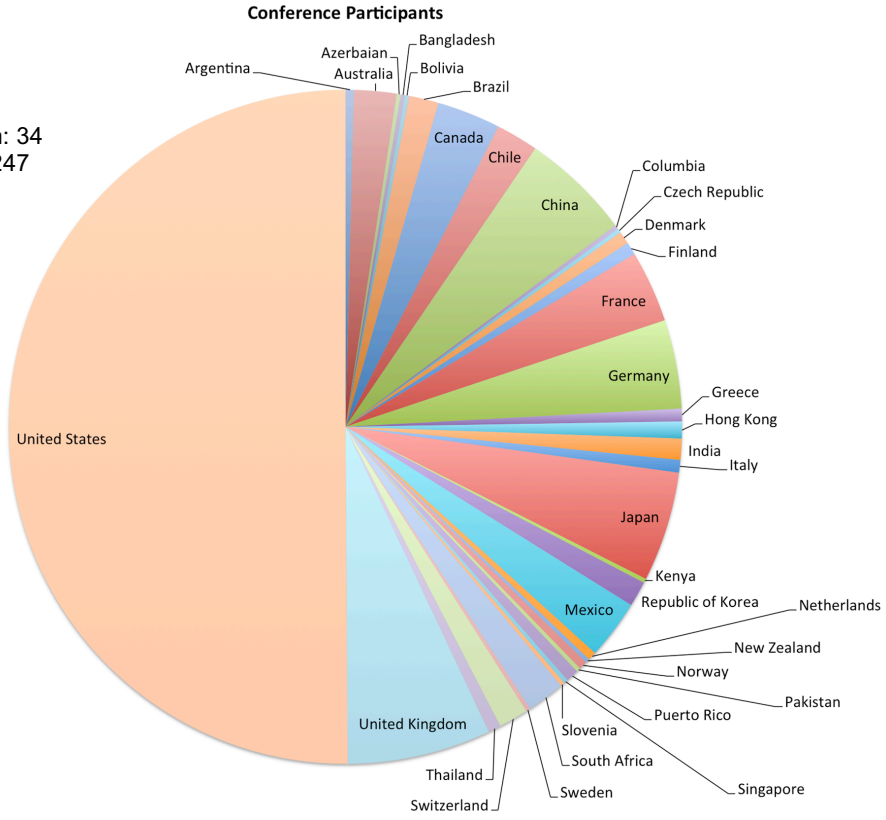
Dr. Marcelo Mena Carrasco (Vice Minister of Environment, Chile)

Keynote Speakers

Dr. Allen Goldstein (University of California-Berkeley)
Dr. Maria Kanakidou (University of Crete)
Dr. David Fahey (NOAA ESRL Chemical Sciences Division)

Of the nearly 500 participants, 36 countries were represented:

Argentina: 2
Australia: 10
Azerbaijan: 1
Bangladesh: 1
Bolivia: 1
Brazil: 7
Canada: 15
Chile: 10
China: 26
Columbia: 1
Czech Republic: 1
Denmark: 3
Finland: 3
France: 17
Germany: 21
Greece: 3
Hong Kong: 4
India: 5
Italy: 3
Japan: 26
Kenya: 1
Republic of Korea: 6
Mexico: 14
Netherlands: 2
New Zealand: 1
Norway: 2
Pakistan: 1
Puerto Rico: 3
Singapore: 1
Slovenia: 1
South Africa: 9
Sweden: 1
Switzerland: 7
Thailand: 3
United Kingdom: 34
United States: 247



3. Scientific Program

Six scientific sessions were designed to foster discussions and inspire participants on future endeavors pertaining to important fundamental atmospheric chemistry research as well as impacts and connections with other components of the Earth system:

- Session 1: Atmosphere chemistry and urbanization
- Session 2: Atmospheric chemistry, ecosystems and agriculture
- Session 3: Atmosphere chemistry and energy
- Session 4: Atmospheric chemistry and fundamental studies
- Session 5: Atmospheric chemistry and climate change
- Session 6: Atmospheric chemistry: Observing composition and variability

In addition to the 12 invited speakers and 50 oral presentations within the session topics, three keynote addresses by Dr. Allen Goldstein, Dr. Maria Kanakidou, and Dr. David Fahey describing the future of atmospheric chemistry, aerosols in atmospheric chemistry and biogeochemical cycles, and earth observations and modeling for decision making, respectively. Dr. Marcelo Mena, Vice Minister of Environment, Chile, gave an exciting presentation highlighting real-world intersections between atmospheric chemistry science and policy.

Oral presentation topics spanned the breadth of Atmospheric Chemistry research, from highlights in satellite observations, to exciting model applications, to results from field campaigns and fundamental laboratory experiments. Each session included two invited speakers. Session chairs moderated active discussions after the presentations.

A total of 367 posters gave the conference attendees the chance to see a diverse representation of work being done in all six session topic areas. The posters were available throughout the week, with primary sessions on Tuesday and Thursday mornings.

4. Social and Special Events

A Colorado themed welcome reception hosted by the National Center for Atmospheric Research (NCAR) and the University Corporation for Atmospheric Research (UCAR) kicked off an exciting week of science.

The following night, The University of Colorado Cooperative Institute for Research in Environmental Sciences (CIRES) sponsored a networking and social hour that encouraged young scientists to get to know future colleagues and other early career participants from across the globe. Light food and drinks were provided and poster rooms were open.

Later in the week, during the pre-banquet cocktail hour participants took time to chat with colleagues and to visit the exhibit tables and a few posters while enjoying a pre-dinner beverage courtesy of the IGAC Local Organizing Committee.

The conference banquet and after party, sponsored by New Belgium Brewery (Ft. Collins, CO), featured three types of beer donated by this employee owned brewery known for craft beer and an award winning sustainability program.

Special banquet speaker, Jenn Vervier, the Director or Strategy &Sustainability at New Belgium Brewery, shared the amazing story of how a local microbrewery started in a Colorado basement became an industry leader in environmental awareness and sustainability.

After dinner attendees enjoyed coffee and dessert and then took to the dance floor with renowned Denver radio personality DJ Staxx spinning dance tunes from every decade.

5. Early Career Scientists Program

With the help of generous sponsors, IGAC supported 70 Early Career scientists from around the world to attend the 2016 conference. A total of 204 Early Career scientists attended the Conference. Special events and activities were coordinated for these participants throughout the week. This Early Career Program was developed by the Early Career Program Organizing Committee.

Early Career Program

Tuesday 27th September

09:00 – 11:00 Poster Judging – early career competition judging for sessions 1, 3 and 6.

12:40 – 14:05 Lunch with established scientists
Opportunity to take part in a networking lunch with established scientists. A buffet style lunch provided. Established scientists seated at several tables, providing opportunity to ask any questions regarding science, career, publication, etc.

19:00-21:00 Early Career Mixer
The Quandary Grille, 505 S Main St C1, Breckenridge, CO
Appetizers and drinks at local bar/grill.

Wednesday 28th September

13:00 – 17:00 Afternoon social activity
Three group hikes of different levels of difficulty.

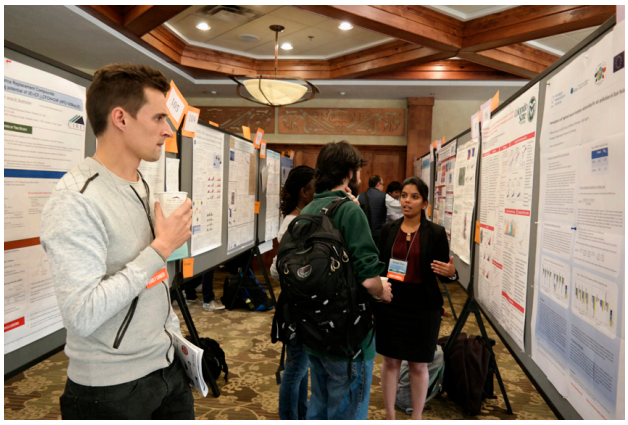
Thursday 29th September

11:55 – 12:30 Poster Judging – early career competition judging for sessions 2, 4 and 5.

12:20 – 14:00 Lunchtime talk: Opportunities to get involved in international networks
Meredith Hastings – Earth Science Women's Network (ESWN)
Fiona Tummon – YESS (Yound – Earth System – Science)
Craig Starger – Future Earth

Friday 30th September

11:55 – 12:30 Closing Ceremonies - Awards for early career oral and poster presentations.



The Early Career Program included competition in each session and an award for the best oral presentation by an Early Career Scientist.

Early Career Poster Presentation Award Winners

Session 1: Atmospheric Chemistry and Urbanization
Sara Fenech, School of GeoSciences, University of Edinburgh, UK
Quantifying uncertainties in multi-pollutants health impacts in urban/rural regions across the UK

Session 2: Atmospheric Chemistry, Ecosystems, and Agriculture
Jason Ducker, Florida State University, USA
Ozone deposition degrades water-use efficiency across multiple ecosystems

Session 3: Atmospheric Chemistry and Energy
Ingrid Mielke-Maday, University of Colorado Boulder/NOAA/CIRES, Boulder, Colorado, USA
Characterization of a Quantum Cascade Tunable Infrared Laser Differential Absorption Spectrometer (QC-TILDAS) for atmospheric ethane and methane field measurements

Session 4: Atmospheric Chemistry and Fundamental Studies
Rebecca Simpson, University of Hawaii at Manoa, USA
Revising concepts of methanesulfonic acid (MSA) formation in the remote tropical Pacific marine boundary layer using high-resolution measurements and a thermodynamic model of aerosol chemistry

Session 5: Atmospheric Chemistry and Climate Change
Erik Larson, CIRES, University of Colorado, Boulder, CO, USA / NOAA ESRL CSD, Boulder, CO, USA
CMIP5 estimate of Earth's energy budget

Session 6: Atmospheric Chemistry – Observing Composition and Variability
Jorge Luis Baylon Cardiel, Centro de Ciencias de la Atmósfera, Universidad Nacional Autónoma de México (UNAM), Mexico City, Mexico
CO2 variability and trends in Mexico

Early Career Oral Presentation Award Winner

Session 2: Atmospheric Chemistry, Ecosystems, and Agriculture
Catherine Scott, Institute for Climate and Atmospheric Science, School of Earth and Environment, University of Leeds, Leeds, UK
Including the biogeochemical impacts of deforestation increases projected warming of climate

The Early Career Program Organizing Committee included:

Dr. Sarah Monks (co-chair)
University of Colorado
Boulder, Colorado, USA

Dr. Steven Brey (co-chair)
Colorado State University
Fort Collins, Colorado, USA

Dr. Fatima Ahamad
Universiti Kebangsaan Malaysia
Selangor, Malasisa

Dr. Julián Constantin
CNEA
Buenos Aires, Argentina

Dr. Kerneels Jaars
North-West University
South Africa

6. Technology Special Session & Exhibits

The Technology Special Session & Exhibits were a popular addition to the 2016 IGAC Conference. Seven companies working in atmospheric sensing technology made short presentations about their instruments and were available to answer questions and meet with conference attendees at tabletop exhibits. In all, twenty-one international industry and scientific community sponsors participated in the conference.

7. Sponsors

Silver Sponsors- Contributions valued at $10,000 and above

University Corporation for Atmospheric Research (UCAR)

UCAR is a consortium of more than 100 member universities that manages and operates the National Center for Atmospheric Research on behalf of the National Science Foundation. UCAR supports international science and is pleased to support this conference.

National Center for Atmospheric Research (NCAR)

The National Center for Atmospheric Research (NCAR) is a federally funded research and development center devoted to service, research and education in the atmospheric and related sciences. NCAR's mission is to understand the behavior of the atmosphere and related Earth and geospace systems; to support, enhance, and extend the capabilities of the university community and the broader scientific community, nationally and internationally; to foster the transfer of knowledge and technology for the betterment of life on Earth.

New Belgium Brewing Company

New Belgium is an employee owned craft brewery located in Fort Collins, Colorado and is a recognized leader in sustainable business practices. It was opened in 1991 by Jeff Lebesch and Kim Jordan. In 2011, it produced 712,800 barrels of its various labels. As of 2012, it was the third-largest craft brewery and eighth-largest overall brewery in the United States.

National Centre for Atmospheric Science

The National Centre for Atmospheric Science (NCAS) is one of the long-term research centres of the UK Natural Environment Research Council. The Centre increases knowledge of key environmental issues including: climate change, weather processes and atmospheric composition including air quality.

Bronze Sponsors - Contributions valued at $5,000 and above

Ball Aerospace

Ball Aerospace has played a key role in a long list of scientific “firsts”. From confirming the ozone hole, to discovering the first Earth-sized planet in the habitable zone of another star, Ball technology makes the most challenging science missions possible.

Cooperative Institute for Research in Environmental Sciences (CIRES)

At CIRES, hundreds of environmental scientists work to understand the dynamic Earth system, including people’s relationship with the planet. CIRES is a partnership of NOAA and the University of Colorado Boulder, and our areas of expertise include weather and climate, changes at Earth’s poles, air quality and atmospheric chemistry, water resources, and solid Earth sciences.

Contributing Sponsors – Contributions valued at $1000 and above

Elementa: Science of the Anthropocene

A mission-driven, nonprofit collaborative, Elementa: Science of the Anthropocene is a trans-disciplinary, open-access journal

committed to the facilitation of collaborative, peer-reviewed research. With the ultimate objective of accelerating scientific solutions to the challenges presented by this era of human impact, it is uniquely structured into six distinct knowledge domains, and gives authors the opportunity to publish in one or multiple domains, helping them to present their research and commentary to interested readers from disciplines related to their own.

2B Technologies, Inc.

2B Technologies, invents, designs, manufactures, markets and sells portable instruments for measurements of ozone, NO, NO2, NOx, mercury and other air pollutants. 2B Tech is the principal sponsor of the non-profit Global Ozone Project or "GO3 Project" where students around the world measure air pollutants and share their data online.

Handix Scientific LLC

Handix Scientific is a research firm and a manufacturer of atmospheric instruments, including the Portable Optical Particle Spectrometer (POPS) and the Open-Path Cavity Ringdown Spectrometer (OPCRDS). The POPS is a light-weight, high-performance, and low-cost particle counter that is the ideal tool for measuring aerosol size distributions from tethered and free balloons, unmanned aerial vehicles (UAV) and ground-based ambient environmental monitoring networks. The OPCRDS is the first in-situ instrument capable of measuring true ambient aerosol-induced light extinction.

IONICON

The world's leading producer of real-time trace gas analyzers based on Proton Transfer Reaction – Mass Spectrometry (PTR-MS) technology, offering a market-leading detection limit < 1 pptv for VOCs and a mass resolution of > 10,000. Our PTR-TOFMS instruments are used for VOC monitoring in environmental research, atmospheric chemistry, vehicle emissions testing, food & flavor science, breath analysis and many other applications. We also manufacture industrial VOC monitoring solutions and OEM time-of-flight mass spectrometers.

Droplet Measurement Technologies

Droplet Measurement Technologies is the most diversified provider of instrumentation in the world for measuring atmospheric aerosol and cloud particles. Our sensors measure refractory and equivalent black carbon, cloud condensation nuclei, and ice nuclei, bioaerosols, cloud droplets and ice crystals on ground-based or airborne platforms.

Harris Corporation

Harris Corporation is a leading technology innovator, solving customers' toughest mission-critical challenges by providing solutions that connect, inform and protect. Our scientist and engineers develop the world's most advanced atmospheric sensors technologies and analytic tools to identify, capture, and enhance data to support global weather forecasting, climate monitoring, and Earth observations.

Picarro, Inc.

Picarro is a leading provider of solutions to measure greenhouse gas (GHG) concentrations, trace gases, and stable isotopes across many scientific applications, as well as in the energy and utilities markets. Our patented Cavity Ring-Down Spectroscopy (CRDS) is the core of all Picarroinstruments and solutions, enabling fast, highly sensitive, and ultra-precise measurements. Our instruments offer unparalleled performance in a variety of field conditions and are deployed by scientists around the world to measure GHGs, trace gases and stable isotopes found in the air we breathe, water we drink and land we harvest.

Aerodyne Research, Inc.

Aerodyne Research produces state of the art instruments for measuring gases or aerosol particles with fast time response and great sensitivity. This includes aerosol and chemical ionization mass spectrometers, laser trace gas and isotope analyzers, aerosol chemical speciation monitors, particle optical extinction monitors, and ultrasensitive NO2 monitors.

Colorado State University
Department of Atmospheric Science

The top-rated Colorado State University Department of Atmospheric Science focuses on graduate education, cutting-edge research, and public service. Our diverse areas of research include Cloud Microphysics, Severe Storms and Mesoscale Meteorology, Atmospheric Chemistry and Air Quality, Radiation and Remote Sensing, Climate and Atmosphere-Ocean Dynamics, and Global Biogeochemical Cycles and Ecosystems.

Colorado State University
Department of Chemistry

The Department of Chemistry at Colorado State University has an international reputation for excellence in research across a broad array of disciplines, including analytical, biological, inorganic, organic, materials and physical chemistry. Ph.D. graduates receive world-class training, participate in cutting-edge (and often interdisciplinary) research projects, and are employed at all levels of

academia and industry around the globe. The faculty also enjoy an award-winning reputation for teaching excellence. Undergraduate students benefit both from access to this classroom expertise and from a long tradition of substantive undergraduate participation in research. The Department's research efforts are supported by a state-of-the-art Central Instrument Facility that provides 24/7 student access to shared instrumentation.

Hills-Scientific

The Fast Isoprene Sensor (FIS) is in use worldwide for the monitoring of isoprene in air. It provides continuous measurement of isoprene with an 0.4-second response to 200-pptv and is suitable for ambient, tower (eddy covariance), enclosure, chamber, and cuvette studies.

Early Career Program Sponsors:

U.S. Department of Energy

The U.S. Energy Department ensures America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions. This is achieved by building the new clean energy economy, reducing nuclear dangers & environmental risks, and expanding the frontiers of knowledge via scientific research.

U.S. National Science Foundation (NSF)

NSF's goals–discovery, learning, research infrastructure and stewardship–provide an integrated strategy to advance the frontiers of knowledge, cultivate a world-class, broadly inclusive science and engineering workforce and expand the scientific literacy of all citizens, build the nation's research capability through investments in advanced instrumentation and facilities, and support excellence in science and engineering research and education through a capable and responsive organization.

U.S. National Aeronautics Space Administration (NASA)

NASA's mission is to pioneer the future in space exploration, scientific discovery and aeronautics research. To do that, thousands of people have been working around the world and in space for more than 50 years, trying to answer some basic questions. What's out there in space? How do we get there? What will we find? What can we learn there — or learn just by trying to get there — that will make life better here on Earth?

U.S. National Oceanic and Atmospheric Administration (NOAA)

NOAA is an agency that enriches life through science. NOAA's reach goes from the surface of the sun to the depths of the ocean floor as they work to keep citizens informed of the changing environment around them. From daily weather forecasts, severe storm warnings, and climate monitoring to fisheries management, coastal restoration and supporting marine commerce, NOAA's products and services support economic vitality and affect more than one-third of America's gross domestic product. NOAA's dedicated scientists use cutting-edge research and high-tech instrumentation to provide citizens, planners, emergency managers and other decision makers with reliable information they need when they need it.

European Space Agency

The ESA is Europe's gateway to space. Its mission is to shape the development of Europe's space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world. ESA is an international organization with 22 Member States. By coordinating the financial and intellectual resources of its members, it can undertake programs and activities far beyond the scope of any single European country.

World Meteorological Organization (WMO) Global Atmosphere Watch (GAW)

The Global Atmosphere Watch (GAW) programme of WMO is a partnership involving 80 countries, which provides reliable scientific data and information on the chemical composition of the atmosphere, its natural and anthropogenic change, and helps to improve the understanding of interactions between the atmosphere, the oceans and the biosphere. GAW focal areas are GHGs, ozone, UV, aerosols, selected reactive gases, and precipitation chemistry.

The American Geophysical Union (AGU)

AGU is an international scientific society that is home to nearly 60,000 scientists from 139 countries, AGU provides a dynamic forum for Earth and space scientists to advance research and collaboration with colleagues across disciplines. Through top-ranked scientific journals such as JGR: Atmospheres and Geophysical Research Letters, award-winning books, scientific meetings and conferences, and other programs and initiatives. AGU offers opportunities to spark innovation and freely exchange knowledge.

Thank you to our IGAC Scientific Steering Committee Sponsors:

Science Council of Japan

Science Council of Japan is the representative organization of Japanese scientist community ranging over all fields of sciences subsuming humanities, social sciences, natural sciences, and engineering.

8. Local Organizing Committee – Members and Contact

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Dr. Kim Oanh
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Dr. Gabrielle Petron
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Boulder, Colorado, USA

Dr. Andrew Rickard
University of York
Heslington, York, UK

2016 IGAC SSC Members

Allen Goldstein (Co-Chair)
University of California, Berkeley
Berkeley, California, USA

Mark Lawrence (Co-Chair)
Institute for Advanced Sustainability Studies
Potsdam, Germany

J.P. (Paul) Beukes
North-West University
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James Crawford
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10. Conference website

http://www.igac2016.org/

Appendix A

Schedule at a Glance

Monday	Tuesday	Wednesday	Thursday	Friday
9:00-10:30 Opening Ceremonies	8:00-11:00 Sessions 1, 3, and 6 Poster Presentation	8:00-9:00 Special Session New Technology	8:00-11:00 Sessions 2, 4, and 5: Poster Presentations	9:00-9:30 Keynote Speaker
		9:00-9:30 Keynote Speaker		
		9:30-10:25 Session 2 Plenary Talks		9:00-10:35 Session 6 Plenary Talks
10:30-11:00 Coffee Break		10:25-10:55 Coffee Break		10:35-11:05 Coffee Break
11:00-11:30 Guest Speaker	11:00-12:40 Session 5 Plenary Talks	10:55-12:30 Session 2 Plenary Talks	11:00-12:20 Session 4 Plenary Talks	11:05-11:55 Session 6 Plenary Talks
11:30-12:00 Keynote Speaker				
12:00-12:35 Session 1 Plenary Talks				
12:35-14:05 Lunch	12:40-14:05 Lunch	12:30-18:30 Free Afternoon	12:20-14:00 Lunch	11:55-12:30 Closing Ceremonies
14:05-15:40 Session 1 Plenary Talks	14:05-15:30 Session 5 and 3 Plenary Talks		14:00-15:30 Session 4 and 6 Plenary Talks	
15:40-16:10 Coffee Break	15:30-16:00 Coffee Break		15:30-16:00 Coffee Break	
16:10-17:40 Session 1 and 5 Plenary Talks	16:00-17:35 Session 3 Plenary Talks		16:00-17:30 Session 6 Plenary Talks	
17:40-19:00 UCAR/NCAR Welcome Reception	17:35-19:00 Networking/ Social Hour	18:30-21:00 Conference Banquet		
	19:00-21:00 Early Career Scientists Mixer	21:00-24:00 After Party		