Message from the Department Head

The Department of Atmospheric Science has been witness to many changes and milestones during the past year. Foremost among the changes has been the arrival or pending arrival of four new faculty members – Takamitsu Ito in 2007 and Colette Heald, Eric Maloney and Thomas Birner in 2008. We are excited about these latest additions to our faculty; information about their backgrounds can be found in this newsletter. Already, Taka Ito has had a major impact on our graduate program, as you will see in the feature article about Taka’s educational and research activities. This past year also marked the 45th anniversary of the founding of our department by Herbert Riehl.

During 2007, research by department faculty, students, and staff has led to important breakthroughs on many fronts, ranging from weather to climate to the chemical composition of the atmosphere and ocean. The Earth’s climate system itself saw major changes in 2007, with the Arctic ice pack this past summer shrinking to its lowest areal coverage by far in recorded history. Such dramatic changes have been documented in the latest IPCC report, and the IPCC panel was a co-recipient of the Nobel Peace Prize along with former Vice President Al Gore. David Randall was a Coordinating Lead Author on the climate modeling chapter in the latest report, and other faculty in the department have contributed to past reports over the years.

Both CloudSat, directed by Graeme Stephens, and CMMAP, directed by David Randall, made exceptional strides in 2007, a year after their inaugural launches. Some of their recent activities are featured in this newsletter. Plans are underway for a new building on our hill in connection with CMMAP, reflecting the continuing expansion of the department’s research activities. The Colorado Climate Center and CoCoRaHS have received recognition in 2007 for their extraordinary contributions to both Colorado and the nation, highlighted by Nolan Doesken receiving NOAA’s “Environmental Hero” award this past summer. Many others in the department have received CSU, national and international awards during the past year.

In summary, the department has had a remarkable year. The current changes in the faculty are unprecedented in the department’s history. Most importantly, we continue to enjoy the arrival of outstanding new graduate students, whose excitement about research and fresh ideas bring an environment ripe for new discovery. We invite you to send stories and news updates about yourself, and also are pleased to invite you and your guests to attend our department reception at the AMS Annual Meeting in New Orleans in January.

New Atmospheric Science Faculty Arrivals

2007

Takamitsu Ito
Education: Ph.D., 2005, Climate Physics and Chemistry, Massachusetts Institute of Technology
Recent position: 2005-06, Postdoctoral Fellow at JISAO, University of Washington
Awards: MIT’s 2005 Rossby Award for most outstanding Ph.D. Thesis
Research interests: Physical and biogeochemical processes in the oceans to study global climate and biogeochemical cycles

2008

Colette Heald
Recent position: 2006-07, NOAA Climate and Global Change Postdoctoral Fellow, University of California at Berkeley
Awards: 2006 Paul Crutzen award for best paper at Young Scientist’s Conference on Global Change
Research interests: Long-range transport of pollution; aerosol sources, composition, and chemistry; biogenic and anthropogenic influences on chemistry and climate

Eric Maloney
Education: Ph.D., 2000, Atmospheric Sciences, University of Washington
Recent position: 2002-07, Assistant Professor, College of Oceanic and Atmospheric Sciences, Oregon State University
Awards: 2006 COAS Patullo Award for Excellence in Teaching
Research interests: Tropical weather and climate variability, intraseasonal variations in the tropics

Thomas Birner
Education: Ph.D., 2003, Ludwig-Maximilians-Universität München, Germany
Recent position: 2004-07, Postdoctoral Fellow, Department of Physics, University of Toronto, Canada
Awards: 2006 Roger Daley Postdoctoral Publication Award
Research interests: Thermal and dynamical properties of the tropical and extratropical tropopause regions, dehydration in the tropical tropopause layer, stratospheric gravity waves
Today, oceans, which cover approximately 70 percent of Earth’s surface, contain 1000 times the heat and 50 times the carbon dioxide of the atmosphere. Ocean circulation has a long memory, containing climate information for decades and centuries, and plays important roles in long-term climate change. Dedicated to understanding the ocean carbon cycle and its role in Earth’s climate system, Dr. Taka Ito, the newest member of the Department of Atmospheric Science, joined Colorado State University last January.

Focusing primarily on the ocean carbon cycle, Ito’s research aims to accurately model and predict the carbon cycle in the relatively unknown, yet very important region of the Southern Ocean. Oceans, particularly in the high latitude Southern Hemisphere, are major sinks of carbon dioxide produced from the burning of fossil fuels. During the 1990s, approximately 40 percent of carbon dioxide emitted from human activities was absorbed into ocean systems. By understanding what controls the rate at which carbon dioxide enters ocean circulation, Ito hopes to gain an understanding of how this process may change in the future as newly industrialized nations expand their use of fossil fuels.

Since directly measuring the air-sea exchange of carbon dioxide is very difficult, we must rely primarily on computer models to estimate the pattern and magnitude of oceanic carbon dioxide uptake. Ito uses a combination of simple, and very complex general circulation models to study oceanic carbon dioxide levels. Through these studies, he discovered three critical parameters that control carbon dioxide uptake: surface winds, ocean eddies and turbulent mixing. Ito and his students are now expanding their investigations to develop a better understanding of how these parameters impact the carbon cycle. Recent advances in ocean modeling made it possible to simulate “ocean eddies,” which are the oceanic counterpart of weather systems in the atmosphere (See Figure 1). The models may lead to improved understanding and more accurate forecasting of the carbon cycle and its impact on global climate change.

In addition to his research, Ito is adding oceanography into the curriculum, broadening and deepening the department’s core educational program. This fall Ito is teaching physical oceanography at the graduate level, and is developing a rotating fluid laboratory in collaboration with students and faculty members in the department (See Figure 2). The atmosphere and ocean share common characteristics of stratified fluid on a rapidly rotating planet. Various aspects of atmospheric and oceanic currents can be demonstrated using a tank on a rotating platform. The tank is also helpful in conveying difficult concepts to students in the classroom. For example, we can reproduce the “gulf stream” in the tank, which helps to explain why major ocean basins commonly contain western boundary currents and how they are related to the prevailing surface wind patterns in the middle latitude climate (See Figure 3). Other rotating tank experiments include inertial circles, wind-driven ocean circulation, deep sea currents, and weather systems.

Dr. Ito earned his Ph.D. in climate physics and chemistry from MIT and has a background in physical and chemical oceanography. He came to Colorado State from the University of Washington, where he served as a postdoctoral fellow at the Joint Institute for the Study of the Atmosphere and the Ocean (JISAO).

“This department is an ideal place for my research because we have expertise and an active research program in global carbon cycles and climate change,” said Ito.
Recognizing our Faculty and Staff for Their Dedication and Years of Service

5 years:
Timothy Lang
Erandathie Lokupitiya
Sarah Finn
Tristan L’Ecuyer
Barbara Ervens
Susan van den Heever
Stephanie Rosso

10 years:
Richard Austin
Charlotte DeMott

15 years:
Terry Flint

20 years:
Mark Branson
Ross Heikes
Paul Hein

25 years:
Rebecca Burke
Gail Cordova

30 years:
Nolan Doesken
Paul Ciesielski

Thank You to the Following 2006/2007 Benefactors

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Dr. David S. Renne
Ms. Cynthia L. Combs
Dr. J. Owen Rhea
Mr. Donald A. Dazlich
Mr. Rob Rosswurm
Ms. Ronni Delance
Mr. David Ruland
Ms. Richard W. Dellenbach
St. Cloud University, Aero Club, Inc.
Major Roger T. Edson and Ms. Sangre De Cristo RC&D
JunSook Kim
Dr. and Mrs. Richard H. Johnson

Student Fellowships and Awards 2007/2008

ALUMNI AWARD: Kirsten Koehler
BALL: Eric Stoner
AMS: Stephen Holcomb
Leigh Patterson
CEAS: Nick Parazoo
Kelley Wells
EPA: Amy Butler
DOE GLOBAL CHANGE EDUCATION PROGRAM (GCEP): Gavin McMeeking
HERB RIEHL AWARD: Amy Butler
NASA FELLOWSHIP: Matt Lebsock
Stephen (Joe) Munchak
NCAR FELLOWSHIP: Michelle Harrold
NSF FELLOWSHIP: Kevin Grise
PRSE: Amanda Anderson
Zachary Finch
Molly Ragsdale
Stephen Holcomb
COLORADO STATE GRADUATE FELLOWSHIP: Kathryn Argo
Stephen Holcomb
Andrew Newman
Leigh Patterson
Heather Quantz
Robert Seigel
Darren VanCleave
SHRAKE – CULLER SCHOLARSHIP: Jim Benedict
Luke Van Roekel
Amy Butler

Alumni Reception

Join us for the Atmospheric Science Alumni Reception to take place in New Orleans, Louisiana, January 22, during the AMS Annual Meeting. See old friends, catch up with faculty members, and have a great time during an evening of hors d’oeuvres and drinks from 5:30 p.m. to 8:30 p.m. at the Hilton New Orleans Riverside Melrose Room.

www.atmos.colostate.edu

Editors: Lana Hoff, Kim Dail and Danielle Knapic
Faculty Awards

Dave Thompson –
2008 AMS Meisinger Award
The Clarence Leroy Meisinger Award is given to an individual in recognition of research achievement that is, at least in part, aerological in character and concerns the observation, theory, and modeling of atmospheric motions on all scales. Dave has received this award for “imaginative and insightful analysis of observations of the circumpolar vortices of both hemispheres and elucidation of the linkages of these phenomena to stratospheric ozone variability, tropospheric circulations, weather, and climate.”

Chris Kummerow –
2007 Professor of the Year Award
Professor Christian D. Kummerow is the 2007 recipient of the Department of Atmospheric Science Outstanding Professor of the Year Award. Chris has been at CSU since 2000 and conducts research and teaches in the areas of radiative transfer, remote sensing, global hydrologic cycle, climate change, and satellite meteorology.

Wayne Schubert –
Jack E. Cermak Award
Professor Wayne Schubert won the Jack E. Cermak Outstanding Advisor Award, endowed in 1984, to honor excellence in academic advising. Wayne was recognized for his extraordinary commitment to advising in the department for over thirty years. His students all express praise for his guidance and mentorship, and fully half of his fourteen Ph.D. graduates are now serving in academic faculty positions at universities throughout the world.

David Randall –
IPCC-Nobel Peace Prize
Thousands of scientists from across the globe were involved in the IPCC. At Colorado State University, David Randall, Atmospheric Science professor, served as a Coordinating Lead Author on a chapter on climate modeling in the final report issued earlier this year by the IPCC.

Randall is director of the $19 million NSF Science and Technology Center for Multi-Scale Modeling of Atmospheric Processes to build climate models that will more accurately depict cloud processes and improve climate and weather forecasting for scientists around the world. Randall is a previous recipient of the Scholarship Impact Award, one of the University’s top honors for research accomplishments.

George T. Abell Outstanding Faculty Research Award
David Randall won the 2007 Abell Outstanding Faculty Research Award for his sustained and exceptional contributions to research in the atmospheric sciences since his arrival at CSU. Notable among his recent achievements are the NSF STC award of CMMAP in 2006 and the 2006 NASA Distinguished Public Service Medal.
Graduates of Atmospheric Science

Spring 2007 Graduates

Name                  Advisor       Degree
Kyoko Ikeda           S. Rutledge    M.S.
Matthew Masarik       W. Schubert    M.S.
Rebecca Mazur         T. Vonder Haar M.S.
Kevin Donofrio        T. Vonder Haar M.S.
Levi Silvers          W. Schubert    M.S.
Taehyoung Lee         J. Collett     Ph.D.
Toshi Matsui          R. Pielke      Ph.D.
Elizabeth Page        W. Cotton      Ph.D.
Christopher Rozoff    W. Schubert    Ph.D.

Summer 2007 Graduates

Name                  Advisor       Degree
Dustin Rapp           T. Vonder Haar M.S.
Nicholas Parazoo      S. Denning     M.S.
Christina Kalb        S. Rutledge    M.S.
Marc Hidalgo          M. Montgomery Ph.D.
Phil Klotzbach        W. Gray        Ph.D.

Fall 2007 Graduates

Name                  Advisor       Degree
Michael Smith         W. Cotton      M.S.
Kevin Grise           D. Thompson    M.S.
Elinor Martin         R. Johnson     M.S.
Brad Hammerschmidt    C. Kummerow   M.S.
Wesley Terwey         M. Montgomery Ph.D.
Kirsten Koehler       S. Kreidenweis Ph.D.

Hung-Chi Kuo Receives Major Award in Taiwan

Hung-Chi Kuo, a 1987 Ph.D. graduate of our department, received Taiwan’s 2006 National Chair Professorship Award in Natural Sciences. This award is one of the highest academic awards given in Taiwan. Recipients are among six fields – literature, social science, bio-related, engineering, economics, and natural science. Hung-Chi is probably the youngest ever to receive the natural science award.

Hung-Chi’s advisor was Wayne Schubert, who earlier this year won CSU’s Jack E. Cermak Outstanding Advisor Award.

Upon receiving the award, Hung-Chi Kuo stated, “I owe the award very much to the great education I received from CSU, and appreciate all the support, encouragement and scientific interactions from you in all these years.”

CMMAP Outreach

Scientists have struggled for decades to improve the way the clouds are represented in global atmospheric models. In July 2006 the National Science Foundation awarded Colorado State University and its partners a $19 million Science and Technology Center to build a radically new kind of global atmospheric model that will more realistically depict cloud processes. The NSF Science and Technology Center for Multi-Scale Modeling of Atmospheric Processes (CMMAP) is based at Colorado State University and directed by Prof. David Randall.

One third of CMMAP’s budget has been dedicated to education, outreach and diversity. Now in its second year, CMMAP has made great strides in fulfilling this mission:

- Upper-grade elementary, junior high/middle school and high school teachers from the Poudre, Thompson, Weld County and Eaton School Districts attended a week-long CMMAP course that provided a comprehensive overview of the latest research related to weather and climate, including tools to transfer that knowledge to their students in an effective, engaging manner. CMMAP plans to conduct a similar course each summer.
- CMMAP will sponsor the 2008 Colorado Global Climate Conference at Rocky Mountain High School next April. The goal of the conference is to educate, inspire and empower students to be informed citizens on global climate issues.
- CMMAP will contribute to Focus the Nation, an educational initiative that creates a dialogue between local, state and federal political leaders and decision-makers with students and faculty in a non-partisan, round-table discussion of global warming solutions.

Read more about CMMAP on their website: http://www.cmmap.org. To learn about future summer teacher workshops and view photos of these outreach activities, go to http://littleshop.physics.colostate.edu/docs/CMMAP/tenthings/.
Celebrating ten years of data collection, the Community Collaborative Rain, Hail and Snow network, CoCoRaHS, has grown from a small local group of dedicated Fort Collins citizens, to a nationwide network of volunteers of all ages and backgrounds. Committed to reporting precipitation measurements from their own backyards, volunteers of the CoCoRaHS community have the unique opportunity to help scientists at Colorado State University create a more detailed picture of weather patterns through daily monitoring and reporting.

CoCoRaHS, the brainchild of Colorado State University State Climatologist and senior research associate Nolan Doesken, was developed following the devastating flood in the summer of 1997 when five Fort Collins residents lost their lives and damages exceeded $200 million. The non-profit network equips and trains local citizens to accurately measure and record precipitation using a simple rain gauge and foil-wrapped Styrofoam pads.

With the help of FEMA, the Colorado Office of Emergency Management, the National Weather Service, Mountain States Weather Services, the Fort Collins Storm Water Utility Office, and local high school students and community members, Doesken and his colleagues officially launched CoCoRaHS in June of 1998.

Over the last ten years, CoCoRaHS has developed into a widespread nationwide community. Having begun originally as a rain and hail monitoring system, the CoCoRaHS network added snow measurement in 1999 and began training volunteers on the difficult task of snow monitoring. In 2003, the National Science Foundation (NSF) Informal Science Education program provided funds to reach out to rural communities of the western Great Plains; Wyoming, Nebraska and Kansas joined the network.

CoCoRaHS has a national coordinator, Henry Reges, and since 1998, has grown from the 200 members who attended the first public meeting to over 7200 active volunteers in 26 states and the District of Columbia. CoCoRaHS’s community is comprised of citizens from every stage of life, ranging from young school-age children and their families to college students and senior citizens. In 2006 alone, active volunteers contributed more than 60,000 hours of time monitoring precipitation.

Currently, an average of 3600 precipitation reports are accumulated daily. CoCoRaHS is generating high-quality data for natural resource, education, and research applications. Verification. In addition to weather forecasts, CoCoRaHS’s high-definition precipitation data is used by radar engineers to distinguish rain from hail and improve the estimation of rainfall, by NASA scientists to improve hail monitoring near launch pads, and by structural engineers to improve building materials. Atmospheric scientists utilize the data in combination with other weather data sources to verify and evaluate the performance of new weather prediction models, and agricultural researchers assess the variability of crop development and yield.

Growing exponentially each year, CoCoRaHS is working to encompass 40 active states by 2009 and a total of 20,000 to 30,000 participants nationwide. Future goals also include the development of state leadership and media teams to support the CoCoRaHS effort, in addition to creating a long-lived spatially dense precipitation network across the U.S. and assisting volunteers in becoming citizen scientists. Already a growing success, CoCoRaHS has accomplished its mission to increase community awareness about our weather by inspiring and encouraging citizens to participate in meteorological science, and have fun doing so!

For more information on CoCoRaHS, please visit the website at www.cocorahs.org.
CoCoRaHS Outreach and Service

- An integral component of the CoCoRaHS network, education is provided to volunteers through annual workshops, local seminars, picnics and other gatherings.
- In addition, online training materials, videos and customized lesson plans for school teachers who want to involve students are now available to all those interested.
- CoCoRaHS is now able to offer a 1-2 week paid summer internship for middle school science teachers, to enable them to develop training and outreach materials for students and adults, and to conduct small research projects for classroom use.
- In 2006, official funding from the National Oceanic and Atmospheric Administration’s (NOAA) Office of Education supplemented CoCoRaHS activities, encouraging network expansion and more participation from citizens.
- Working closely with the Colorado State University Cooperative Extension program, CoCoRaHS will have resources to expand and develop local leadership teams in several new states over a three-year period.

CloudSat Explores New Vistas

CloudSat, a satellite mission conceived by Colorado State Professor and Principal Investigator Graeme Stephens, is the world’s only cloud-profiling radar in orbit. NASA recently extended the CloudSat mission through 2011 and approved enhanced scientific products above and beyond that originally proposed – the only Earth science mission granted that permission in the current evaluation of NASA’s operating Earth satellite missions.

Launched in April 2006, the CloudSat mission is beginning to address vital issues of climate change and global warming, providing new insights into the greenhouse effects of clouds and shedding new light on the role of water vapor feedback, precipitation, and the effects of clouds on polar climate and sea ice changes.

CloudSat scientists are showing how the rate at which water vapor changes are occurring in the atmosphere outpaces the rate of change of precipitation, thus suggesting that the cycling of water through the atmosphere on the global scale is in fact slowing down in time. The extent that clouds radiatively heat the atmosphere is one of the important yet unknown factors that influence this recycling rate. With CloudSat data, researchers can now quantify how much clouds heat the atmosphere, and thus be in a better position to understand how this heating might change in the future and influence changes to global precipitation.

In addition to global climate change, scientists are using CloudSat data to understand factors that affect precipitation on a much smaller scale. For the first time, scientists are getting a glimpse at the processes responsible for the formation of much of the precipitation that falls to Earth. CloudSat is also shedding new light on distribution of oceanic precipitation. Using CloudSat data, researchers are discovering that clouds over the oceans are producing more precipitation and rain more frequently than previously thought. In the Southern Ocean alone, CloudSat has shown that about one-third of all clouds are raining at any given time. “This information is basic to our understanding of how water is cycled from the Earth’s surface to the atmosphere and back,” said Stephens.

“CloudSat radar provides a unique microscope on the processes that shape our hydrological cycle. The new insights we are gathering are providing a much greater understanding of the broad-scale factors that affect the patterns and amounts of precipitation that fall to Earth, and the cloud structures that control this.”

CloudSat is beginning to reveal how recent changes in arctic sea ice extent are intimately related to changes in arctic cloudiness. This work will be highlighted in a future newsletter.

In April of this year, NOAA honored Nolan Doesken (at right) as one of 10 “Environmental Heroes” for his role in the creation of the expanding monitoring network.
Awarded the 2007 Herbert Riehl Memorial Scholarship for best technical manuscript, atmospheric science Ph.D. student **Amy Butler** is tackling the well-known issue of carbon dioxide in a region with relatively little research in the area, the Southern Ocean. Located in the Southern Hemisphere, the Southern Ocean is thought to act as a sink for human-induced carbon dioxide emissions. Using observations of carbon dioxide from the National Oceanic and Atmospheric Administration (NOAA) Global Monitoring Division based in Boulder, Butler is working to understand how climate variability affects the carbon dioxide levels circulating over the Antarctic Peninsula, and surrounding ocean.

The first study of its kind to demonstrate a relationship between observed variations in the rate of change of carbon dioxide over the peninsula, and large-scale climate variability, the study will help scientists to understand what drives fluxes of carbon dioxide from the Southern Ocean from month to month. Specifically, this study shows that an increase in the westerly winds around Antarctica is significantly related to an observed increase in carbon dioxide over the Antarctic Peninsula. Ultimately, Butler hopes that this relationship may indicate how trends in climate circulation will affect the overall ability of the Southern Ocean to take up carbon dioxide over longer time periods.

Current climate models indicate that an increase in the westerly winds near Antarctica may continue in the future due to ozone depletion and greenhouse gases. Based on Butler’s research, an increase in the westerly winds could mean more carbon dioxide outgassed from the high-latitude Southern Ocean, mitigating the ability of the Southern Ocean to take up human-induced carbon dioxide.

Butler’s work titled, “Observed Relationships between the Southern Annular Mode and Atmospheric Carbon Dioxide,” will be featured in the journal *Global Biogeochemical Cycles,* and is currently in press. A double major in physics and astrophysics at the University of Colorado in Boulder prior to joining CSU, Butler ideally would like to continue her climate research at NOAA or the National Center for Atmospheric Research (NCAR) after earning her Ph.D. under Dr. David Thompson.

Working in the opposite hemisphere, Ph.D. student **Kirsten Koehler** was recently rewarded for her work on atmospheric issues plaguing California. The byproduct of source water diversion in 1913, Owens Lake has been a dry lakebed in the arid desert of southeastern California since 1926. Today, this region is the largest contributor of particulate matter, measuring less than 10 microns in diameter, in the western hemisphere. Particulate matter or aerosols – small particles or liquid droplets suspended in our atmosphere – have been linked to poor air quality, adverse health effects and dust storms plaguing the area.

According to Koehler, aerosols have also been shown to influence cloud formation, one of the largest uncertainties in determining global climate change. By measuring interactions of aerosols with water vapor at differing temperatures and relative humidities, Koehler has shown the potential impact of dust aerosols on visibility, the development of precipitation and the lifetime of clouds. Atmospheric aerosols are also believed to disturb the radiative balance in clouds, the incoming and outgoing radiation energy that warms and cools climate systems. Koehler hopes to accurately measure changes in clouds due to climate and aerosol concentration changes in the region, in order to determine their impact on cloud formation and the climate.

Koehler is the 2007 recipient of the Department of Atmospheric Science Alumni Award for Outstanding Research by a Senior Ph.D. After earning her doctorate under Dr. Sonia Kreidenweis, she would like to continue her research at NCAR or join academia as a professor or research scientist.

Both Koehler and Butler were honored this past spring in an annual awards ceremony, where each presented their research in a 20-minute talk. Candidates for both awards were nominated by a Department of Atmospheric Science faculty member, and were selected by a faculty committee.
Colorado State University’s Cooperative Institute for Research in the Atmosphere has earned a top award from NASA for its ongoing data processing work on the CloudSat satellite orbiting Earth.

NASA honored CIRA with a Public Service Group Achievement Award for processing data that is critical to getting CloudSat’s information on the characteristics of clouds to the international science community. In the first 18 months of the CloudSat mission, CIRA has processed and distributed more than 1 million CloudSat data products, or about 43 terabytes of data, to scientists in 18 countries.

NASA honored the CIRA and Science and Technology Corp.-METSAT division team of Ken Eis, Mike Hiatt, Phil Partain, Don Reinke, Dale Reinke and Laura Sample “for exceptional contributions to the CloudSat Mission in the design, development and implementation of the CloudSat Data Processing System.”

“I’m proud of our CIRA scientists who strive to provide the best service as they conduct research that is of mutual benefit to our federal agencies, the university, state and nation,” said Tom Vonder Haar, CIRA director. “CloudSat’s groundbreaking scientific results are truly benefiting scientists around the globe.”

Most recently, NASA’s Jet Propulsion Laboratory, Colorado State and Massachusetts Institute of Technology announced CloudSat data has helped them develop a promising new technique for estimating the intensity of tropical cyclones from space. The method could one day supplement existing techniques, assist in designing future tropical cyclone satellite observing systems and improve disaster preparedness and recovery efforts.

The technique uses NASA satellite data, including simultaneous, accurate measurements of cloud-top temperatures from the Moderate Resolution Imaging Spectroradiometer on NASA’s Aqua satellite, and cloud-top height and cloud profiling information from NASA’s CloudSat satellite. Both satellites fly in formation as part of NASA’s “A-Train” of Earth-observing satellites.

CIRA is a center for international cooperation in research and training based at Colorado State University. CIRA was first established to increase the effectiveness of atmospheric research in areas of interest between Colorado State and the National Oceanic and Atmospheric Administration and has developed into a leader in many areas of climate research.

At right: Information from CloudSat and its sister mission, CALIPSO, are combined to form a complete image of the cloud and aerosol distribution.
Aerosol particles in the atmosphere influence the Earth’s radiation balance and climate, atmospheric chemistry, visibility, and human health on scales ranging from local to global. Fires of both anthropogenic and natural origin are a major source of carbonaceous particles in the global atmosphere.

In the U.S., increased pressure to conduct prescribed burning in a variety of ecosystems and recent increases in the extent and severity of fire seasons point to the need for improved understanding of the role of fires in air quality. In particular, the characteristics of particles emitted from the combustion of wildland fuels vary with both fuel and combustion conditions, but are needed to separate the influence from smoke from other sources of particulate matter.

CSU researchers measuring smoke particle characteristics in the Fire Science Lab.

CSU researchers Sonia Kreidenweis and Jeffrey Collett, together with colleagues from the Desert Research Institute, USDA Forest Service and National Park Service, are conducting a series of experiments under controlled laboratory conditions to study the characteristics of aerosol particles freshly emitted from the combustion of individual wildland fuels. FLAME, the Fire Lab at Missoula Experiment, has included stack and chamber burns of several hundred fuels conducted in the USDA/USFS Fire Research Laboratory in Missoula, Montana. Smoke samples from each burn are being analyzed to develop databases of optical properties and emissions profiles, which can be used to apportion contributions of smoke to observed ambient visibility degradation and to total particulate matter concentrations.

In 2008, field studies will be conducted to determine if lab results can be scaled to the real world. Plans include sampling of prescribed burns in the western U.S.
Atmospheric Scientist Studies Particulates, How Clouds Form in Skies above Colorado, Wyoming

The air gets a little thin at 25,000 feet above south-central Colorado, but that makes it ripe for the picking for senior research scientist Paul DeMott, a member of the Atmospheric Chemistry group at Colorado State.

Since the end of October, DeMott has been grabbing air samples out of the skies above Colorado to study how certain tiny particles form ice in clouds as far south as the New Mexico border and as far north as north-central Wyoming. He’s part of a select group of scientists flying out of Rocky Mountain Metropolitan Airport in Jefferson County in a specially equipped C-130 aircraft owned by the National Science Foundation (NSF) and operated by the National Center for Atmospheric Research (NCAR).

The National Science Foundation-funded project to study cloud formation processes ends in mid-December.

Ultimately, the research could improve climate modeling, helping scientists predict with more certainty where and how clouds and precipitation form and the impact of changing atmospheric composition on clouds. Special particles called ice nuclei result from desert dusts, from some biological processes and possibly from pollution, which are needed to form ice in clouds. Scientists have spent decades trying to understand the processes.

“If we can measure these particulates and how they make ice, can we predict exactly how ice will form in the ideal cloud?” DeMott said, noting that, for now, CSU is the only university with an instrument to take continuous air samples from in and around clouds and measure in real time the ice-forming ability of particles inside a plane. “We need to understand all the mechanisms for first forming ice. Then we can identify the nature of other processes we don’t understand that don’t have anything to do with particulates – processes that cause the amount of ice to multiply, for example.”

As part of the NSF grant, CSU and other scientists have temporarily retrofitted the C-130 with their equipment. They’ve spent two to five days a week since October flying about five hours a day to study clouds. Fall provides ideal weather for studying ice formation in clouds forming over the mountains and Front Range that contain smooth air flow, also known as wave or lenticular clouds. The field campaign, called the Ice in Clouds Experiment, is led by NCAR scientist Andrew Heymsfield.

DeMott, working with two other CSU research scientists and two postdoctoral researchers, is the principal investigator on a three-year, $650,000 NSF grant he obtained in 2006. On the NCAR plane, he and his CSU team take air samples into a small chamber through a special port on the side of the plane. A diffusion chamber cools and humidifies the air and particles between two plates of ice toward conditions where ice forms – essentially allowing DeMott to “grow” clouds by simulating the conditions in the atmosphere. He then evaluates how many particles will form ice crystals for specific cloud conditions. The C-130 then passes through the wave clouds to measure, with other instruments, how much ice really does form. DeMott and other investigators also use specialized instruments to determine the chemical makeup of the particulates forming ice.

Earlier this year, his grant took him to Japan in trans-Pacific flights on another NSF study of how dust and pollution from Asia travels as far east as the United States and beyond. While the particles are released at the planet’s surface, they ultimately move across the planet multiple times when storms loft them to higher altitudes, DeMott said. His research looked at the quantity of ice nuclei and their changes in the time and distance from their source. He expects to publish that research in a peer-reviewed journal within the next six months.
# Incoming Graduate Students Fall 2007

<table>
<thead>
<tr>
<th>Name</th>
<th>Advisor (M.S./Ph.D.)</th>
<th>Undergraduate University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amanda Anderson</td>
<td>Rutledge (M.S.)</td>
<td>Valparaiso University</td>
</tr>
<tr>
<td>Kathryn Argo</td>
<td>Thompson (M.S.)</td>
<td>University of Oregon</td>
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<tr>
<td>Zachary Finch</td>
<td>Johnson (M.S.)</td>
<td>UCLA</td>
</tr>
<tr>
<td>Walter Hannah</td>
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