Cooperative Institute for Research in the Atmosphere
CIRA
Colorado State University

2005-2006 Highlights

NESDIS Cooperative Institute Directors Meeting
Corvallis, Oregon
June 20-21, 2006
Professor Thomas H. Vonder Haar, Director

www.cira.colostate.edu  vonderhaar@cira.colostate.edu
CIRA HIGHLIGHTS, 2005-06

- CIRA Today
- New Research Results and Applications
- Some Future Plans
- Human Resources for Research
CIRA in 05/06 – the 26th Year

• Operates under a 5-year, renewable Cooperative Agreement (CA) with NOAA
• NOAA CI co-sponsored by NESDIS and OAR with good NWS interaction
• Complementary CAs with DOI/NPS and DoD/ARL
• 180 scientists, staff and students (144 FTE)
• Including 6 NESDIS, RAMM Team scientists on site
• Including 12 postdocs, 25 graduate students, 16 undergraduates supported by NOAA
• Including 15 academic faculty (part time)

• $12M/year in research and outreach funding
• $8M/year from NOAA
CIRA-NOAA Task II
FY 04-05 Research Activity By Theme

- Climate Studies: 28%
- Forecasting & Evaluation: 17%
- Cloud Physics: 15%
- Satellite Observations: 3%
- Air Quality & Visibility: 2%
- Societal Impacts: 1%
- Numerical Modeling: 0%
- Education, Training & Outreach: 0%
What’s New and Exciting at CIRA

• DOC Silver Medal Award to Dr. Mark DeMaria and Ms. Michelle Mainelli

• NASA CloudSat Launch on 28 April 2006 (Prof. G. Stephens et al.)
  – First Cloud Radar in Space for Climate Study and Cloud Modeling
    • CIRA hosts the CloudSat Science Data Processing Center

• NSF Science Center on Multi-scale Modeling of Atmospheric Processes
  (proposal pending at highest levels of NSF/NSB) (Prof. D. Randall et al.)

• The FAA has certified a cloud top height product after a quality assessment
  was completed. This is the first time remote sensing data was used in such an
  assessment. CIRA/GSD, ESRL

• New Project with North American Carbon Program CIRA/GMD, ESRL
UNITED STATES
DEPARTMENT of COMMERCE

SILVER MEDAL AWARD
Presented to
MARK DeMARIA  MICHELLE MAINELLI
for Meritorious Federal Service

December 2013

[Signature]
Secretary of Commerce

[Photo of an individual wearing a blue shirt]
Operational Hurricane Intensity Forecast Improvements (by DeMaria et al.)

- Satellite altimetry algorithm developed for oceanic heat content (OHC) estimation

- OHC added to the National Hurricane Center operational SHIPS intensity forecast model

- OHC input significantly improved intensity forecasts for the all four of the 2005 category 5 storms

Example of the OHC product and the track/intensity of Hurricane Katrina 2005
CloudSat Launch!

http://cloudsat.cira.colostate.edu/
CloudSat will improve our understanding of cloud processes, leading to **improved climate predictions**

The large differences in these two climate model predictions is connected to the amount of low cloud.

**Fewer low clouds = more warming**

**More low clouds = less warming**

A number of climate models with a range of global warming sensitivities
“Hidden” Precipitation / Clouds
(below a cloud shield that prevents detection by a passive system)

“Melting Level” (freezing level) …
CloudSat Sees Alberto …

NEXRAD Radar (12 June, 2006 07:37 UTC)

GOES-12 Geostationary Satellite – Infrared Image (12 June, 2006 07:32 UTC)

CloudSat Radar (12 June, 2006 07:35:56 – 07:37:33 UTC)
The Future

- Science Stewardship of Climate Data Records
- Co-op Initiatives with STAR and CI’s
- R 2 O
- Human Resources for NOAA’s Research Mission
“Science Stewardship of Thematic Climate Data Records: A Pilot Study with Global Water Vapor”

Completed at CIRA in 2005

Goal: Examine the critical water vapor CDR in light of new results from the NASA Aqua satellite and provide knowledge for interpretation and reanalysis.

Method: Extend the NVAP dataset to 2003-2004 to match Aqua.

Conclusion: Aqua and NVAP agree well over oceans. NOAA ATOVS soundings and AIRS have large differences.

1987-1992 SSM/I data at CIRA also rescued in this effort and provided to NOAA.
“Atmospheric Rivers” Cause High Impact Weather

Bao et al. 2006
Feb. 2004 moisture plume, 10” of rain produced flooding in California
In some cases these “rivers” are a direct connection to the Tropics

- What is their vertical structure?
- How well do satellite moisture retrievals capture these rivers?
- Do forecast models represent these features?
- Crosscutting effects across atmosphere, surface, ocean (flooding, erosion, sediment and pollution transport…)

Brant Dodson (CSU M.S. student) investigating this topic.
Established New Center for Accelerating Research Results into Operations (CARRO)

- With ORA and other CI’s (other CARRO’s?)
- Lessons learned; best practices; new mechanisms
- CCARRO Algorithm Incubator Program (CAIP) for local CI and joint CI research activities interface to Satellite Products Testbed (SPT) at NESDIS

(Contacts: Andy Jones and Stan Kidder)
All NOAA's Cooperative Institutes help build Human Resources In NOAA's Mission Areas

At CIRA …
CIRA POSTDOCS

- Dr. Isidora Jankov
  - The Role of Physical Scheme Interactions on Warm Season Rainfall Forecasts
    - Iowa State (at GSD)

- Dr. Yoo-Jeong Noh
  - Observational Analysis and Retrieval of Snowfall of Microwave Frequencies
    - Florida State

- Dr. Sarah Tessendorf
    - Colorado State University

- Dr. Tarendra Lakhankar
  - Estimation of Soil Moisture Using Active Microwave Remote Sensing Data
    - New York University (CREST)
Sample of CIRA Graduate Student Research

<table>
<thead>
<tr>
<th>Student Name</th>
<th>Proposed Thesis Title</th>
<th>Area of Interest</th>
</tr>
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<tbody>
<tr>
<td>Gordon Wichern</td>
<td>Adaptive Methods for Rapid Acoustic Transmission Loss Prediction in the Atmosphere</td>
<td>Acoustics, Neural Networks</td>
</tr>
<tr>
<td>Guenter Engling</td>
<td>Characterizing Biomass Combustion Emission Contributions to Ambient Aerosol Concentrations</td>
<td>Aerosol Chemistry</td>
</tr>
<tr>
<td>Taeyoung Lee</td>
<td>Aerosol Chemical Characterization</td>
<td>Aerosol Chemistry</td>
</tr>
<tr>
<td>Richard Cullin</td>
<td>TBD</td>
<td>Biomass Combustion Aerosol</td>
</tr>
<tr>
<td>Courtney Gorin</td>
<td>TBD</td>
<td>Nitrogen Deposition</td>
</tr>
<tr>
<td>Xinhua Shen</td>
<td>TBD</td>
<td>Aerosol Chemistry</td>
</tr>
<tr>
<td>Mike Smith</td>
<td>TBD</td>
<td>Cloud microphysics/dust effects</td>
</tr>
<tr>
<td>James Halgren</td>
<td>Long Term, Fully-Distributed Hydrologic Model with Chemical Transport</td>
<td>Computer Modeling, Channel Hydraulics</td>
</tr>
<tr>
<td>Gavin McMeeking</td>
<td>Optical Properties of Carbonaceous Particles</td>
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<td>Kelley Johnson</td>
<td>A Comparison of the Navy Aerosol Analysis and Prediction System (NAAPS) to In-situ</td>
<td>Transport and Radiative Effects of Soil Dust Aerosol</td>
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<td></td>
<td>Aerosol Measurements in the Continental U.S.: Transport vs. Local Production of Soil Dust Aerosol</td>
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<td>Timothy Nobis</td>
<td>The Impact of an Urban Parameterization Scheme on Simulations of Washington DC</td>
<td>Urban Boundary Layers</td>
</tr>
<tr>
<td>Giovanni Leoncini</td>
<td>Improving Numerical Weather Prediction: Specialized Models and Look Up Table Approach</td>
<td>Mesoscale Dynamics</td>
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<tr>
<td>Rahul Peroor</td>
<td>Upscaling of Hydrologic Fluxes with a Physical Mechanistic and Fully Coupled Watershed Model</td>
<td>Hydrometeorology</td>
</tr>
<tr>
<td>Matt Masarik</td>
<td>Analytical Solutions to a Primitive Equation Model and Balanced Model for the MJO</td>
<td>Tropical dynamics, specifically looking at theoretical modeling of the Madden-Julian Oscillation (MJO)</td>
</tr>
<tr>
<td>Brant Dodson</td>
<td>TBD</td>
<td>Global Water Vapor Variability</td>
</tr>
<tr>
<td>Kevin Donofrio</td>
<td>Remote Sensing of Cloud Liquid Water over Land and Ocean using the Advanced Microwave Sounding Unit</td>
<td>Microwave Remote Sensing of Cloud Liquid Water</td>
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<td>Kate Maclay</td>
<td>Tropical Cyclone Inner Core Energetics and it's Relation to Storm Structural Change</td>
<td>Hurricane Energetics</td>
</tr>
<tr>
<td>Becca Mazur</td>
<td>Observations of Inflow Feeder Clouds and Their Relation to Thunderstorms</td>
<td>Observe the relationship between clouds that form in the inflow region of thunderstorms (called feeder clouds) and severe weather</td>
</tr>
<tr>
<td>Dustin Rapp</td>
<td>The Use of Windsat Passive Microwave data in Soil Moisture Monitoring</td>
<td>Analyzing Windsat data with regard to a large rain event which occurred over the Midwest in September 2003</td>
</tr>
<tr>
<td>Curtis Seaman</td>
<td>Assimilation of Satellite Humidity Information to Improve Forecasting of Mid-level, Mixed-phase Clouds</td>
<td>Cloud dynamics, cloud microphysics, radiative transfer, and assimilation of satellite data</td>
</tr>
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Back-up
First Two Weeks of CloudSat Imagery …

- Comparison with MODIS instrument (flying on-board AQUA)
- Cloud Overlap / Melting Level
- Topography mapping
- Alberto
- Level 2 products
- Unusual clouds …
“FIRST IMAGE”
This segment was the first dump of CloudSat data - 20 May 2006 12:26-12:29 UTC

Location of CloudSat data segment on a 5-minute MODIS visible data swath (approx. 25 minutes prior to CloudSat overpass)

(MODIS image downloaded from Goddard DAAC)
Location of CloudSat data segment on a 5-minute MODIS infrared (10.8 µ) data swath (approx. 25 minutes prior to CloudSat overpass) (MODIS image downloaded from Goddard DAAC)
Horizontal extent of precipitation …

This example extends over 1100km (683 miles)

MODIS 3.7 μm (Channel 20)
“Hidden” Precipitation / Clouds
(below a cloud shield that prevents detection by a passive system)

“Melting Level” (freezing level) …
CloudSat – Topography Match-up … 12 June … orbit 662

CloudSat – Topography Match-up … 14 June … orbit 683 (FirstLook)
CloudSat Sees Alberto ...

NEXRAD Radar (12 June, 2006 07:37 UTC)

GOES-12 Geostationary Satellite – Infrared Image (12 June, 2006 07:32 UTC)

CloudSat Radar (12 June, 2006 07:35:56 – 07:37:33 UTC)

B 24km SFC A
Cloud top structure of an intense frontal system east of Hokkaido Japan on 20 May.
Vertical Structure of Clouds and Precipitation In the Polar Night have never before been observed!
The vertical structure of an intense storm system during the south polar night is documented as it buffets the Antarctic Peninsula and the Weddell Sea.
Volcanic Plume?

Hokkaido
MODIS 11 µm
(Channel 31)
MODIS 3.7 µm (Channel 20)