A REPORT from the

Cooperative Institute for Meteorological Satellite Studies
REMOTE SENSING APPLICATIONS TO WEATHER AND CLIMATE

MAJOR PROGRAMS
REMOTE TEMPERATURE/MOISTURE SOUNDING
TRACE GAS PROFILING
WIND DETERMINATION
DATA ASSIMILATION
INSTRUMENT DEFINITION

FIELD PROGRAMS
GALE
ERICA
COHMEX
GTE/ABLE
FIRE
GAPEX
ECLIPSE

UNIVERSITY OF WISCONSIN

NOAA

NASA

CIMSS

NOAA PROGRAMS
VDUC
GOES I/M
STORM
GUFMEX

NASA PROGRAMS
EOS
GEOPLATFORM
ERBE
BOARD OF DIRECTORS REPORT

COOPERATIVE INSTITUTE FOR METEOROLOGICAL
SATELLITE STUDIES

5 JUNE 1990

1. CIMSS PERSONNEL AND FINANCIAL SUMMARY

2. CIMSS RESEARCH PROGRAMS

3. CIMSS PROPOSAL SUMMARY

4. VISITING SCIENTISTS

5. SUMMARY OF CIMSS PUBLICATIONS
CIMSS PERSONNEL 1990

TOTAL OF 45 ASSOCIATES

UW SCIENTISTS (14)

UW STAFF (10)

NOAA/NESDIS (10)

GRADUATE STUDENTS (8)

VISITING SCIENTISTS (3)
CIMSS ASSOCIATES

Board of Directors
Francis Bretherton
Christopher Hayden
John Kutzbach
Thomas Pyke
William Smith
Shelby Tilford
John Wiley

John Anderson (participant)
Robert Fox (participant)
Donald Johnson (participant)
Verner Suomi (participant)

Council Members
John Anderson
James Dodge
Robert Fox
Christopher Hayden
Paul Menzel
Donald Miller
P. Krishna Rao
Henry Revercomb
William Smith
Roland Stull

UW Scientists
Steve Ackerman
George Diak
Rob Knuteson
Robert Merrill
Chris Moeller
Bill Olson
Bill Raymond
Tony Schreiner
Chris Velden

UW Staff
Thomas Achtor
Laura Beckett
Felicia Chen
Ralph Dedecker
Richard Frey
Scott Lindstrom
Barry Rowe
Tim Schmit
Kathy Strabala
Mark Whipple

NOAA NESDIS
Bob Aune
Geary Callan
Leroy Herman
Ben Howell
Fred Nagle
Cecil Paris
Gary Wade
Hal Woolf

Post Doctors
Allan Huang
Lynn McMurdie

Visiting Scientists
Elen Cutrim
Xia-Lin Ma
Bob Rabin

CIMSS Associates
Ed Eloranta
Dave Martin
Don Wylie

Graduate Students
Arlindo Arriaga
Murthy Divakarla
Peter Keehn
Szu Chia Lee
Walt McKeown
Yanni Qu
Xiangquan Wu
Hai Yan Zhang
VISITING SCIENTISTS TO CIMSS: 1989-90

Marilena Perrone
EUMETSAT
Darmstadt, FRG
February 13-17, 1989
March 5-7, 1990

Elen M. Cutrim
Department of Meteorology
University of Belem
Brazil
September 1988/September 1989

H. J. Lutz
Universitat zu Koln
Koln, FRG
April 17-21, 1989

Mr. Luigi De Leonibus
Italian Meteorological Service
Rome, Italy
May 30-June 2, 1989

Tom Lachlan-Cope
UK Met Office
British Antarctic Survey
Bracknell, UK
June 5-9, 1989

Merv Lynch
Curtin University of Technology
Perth, Australia
July 11-22, 1989

Tony Hollingsworth
ECMWF
Reading, England
October 5-6, 1989

Rolando Rizzi
Department of Physics
Bologna, Italy
October 12-13, 1989

Akiyoshi Mita
Meteorological Satellite Center
Tokyo, Japan
January 22-26, 1990

Robert Rabin
NOAA/NSSL
Norman, OK
January 17, 1989 to present

L.V.G. Rao
National Institute of Oceanography
Goa, India
March 12-13, 1990

Klaus Schaefer
Heinrich-Hertz Institute
Berlin, FRG
March 19-April 1, 1990

Johannes Schmetz
Kenneth Holmlund
Meteosat Exploitation Project
European Space Agency
Darmstadt, FRG
March 26-30, 1990

Ma Xia-Lin
State Meteorological Center
Beijing, PRC
March 5, 1990 to present
CIMSS PROGRAM FUNDING

- Surface Energy (5.2%)
- Modeling (2.7%)
- Uplooking His (1.8%)
- TOVS (0.5%)
- Typhoon (6.3%)
- Severe WX (8.2%)
- SSM/I (0.5%)
- ERBE (9.5%)
- NOAA Base (10.9%)
- NASA Base (7.5%)
- Polar Clouds (1.1%)
- PCPN Model (4.1%)
- Goes I/M (20.2%)
- Trace Gas (4.7%)
- Fire (1.0%)
- Eumetsat (1.3%)
- MAMS/HIS (1.4%)
- Geomorphology (2.9%)
- DMSP Algorithm (3.1%)
- EOS (0.8%)
- GeoPlatform (6.2%)
# SUMMARY OF CIMSS RESEARCH PROGRAMS: 1988-1990

<table>
<thead>
<tr>
<th>Key to Program Information:</th>
</tr>
</thead>
<tbody>
<tr>
<td>G = Geostationary</td>
</tr>
<tr>
<td>P = Polar orbiter</td>
</tr>
<tr>
<td>H = HIS</td>
</tr>
<tr>
<td>M = MAMS</td>
</tr>
<tr>
<td>F = Field experiment</td>
</tr>
<tr>
<td>L = Modeling</td>
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<table>
<thead>
<tr>
<th>Investigation Title</th>
<th>Principal Scientists</th>
<th>Agency</th>
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<tbody>
<tr>
<td><strong>1. INSTITUTIONAL SUPPORT</strong></td>
<td></td>
<td></td>
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<tr>
<td>GPH L NASA Base</td>
<td>Smith, Achtor</td>
<td>NASA</td>
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<tr>
<td></td>
<td>- Institutional support for seed programs, graduate students, post doctoral positions, visiting scientists and seminars.</td>
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<tr>
<td></td>
<td>- Measurement of water vapor, methane and nitrous oxide from ground based HIS measurements (Phd thesis)</td>
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<td></td>
<td>- Support for Madison Uplooking HIS data analysis</td>
<td></td>
</tr>
<tr>
<td>GPH L NOAA Base</td>
<td>Smith, Achtor</td>
<td>NOAA</td>
</tr>
<tr>
<td></td>
<td>- Institutional support for seed programs, graduate students, post doctoral positions, visiting scientists and seminars.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Develop HIS temperature/moisture retrieval algorithm (Phd thesis)</td>
<td></td>
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<td></td>
<td>- Support for investigation of satellite signitures of explosive North Atlantic cyclogenesis (MSU, SSM/I, VAS)</td>
<td></td>
</tr>
<tr>
<td><strong>2. OPERATIONAL SUPPORT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G GOES I/M</td>
<td>Menzel, Hayden, Schmit</td>
<td>NOAA</td>
</tr>
<tr>
<td></td>
<td>- Implementation of processing system, retrieval products and algorithm development for GOES I</td>
<td></td>
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<tr>
<td></td>
<td>- Development and implementation of improved automated wind vector derivation scheme (with CO2 heights) at VDUC</td>
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<tr>
<td></td>
<td>- Develop new cloud height algorithm for GOES I (MS thesis)</td>
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<tr>
<td></td>
<td>- Cloud defination studies to supplement ASOS and ISCCLP indicate good quality of VAS CO2 cloud heights</td>
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<tr>
<td></td>
<td>- Tropical cyclone deep-layer-mean satellite wind analysis transferred to operations at VDUC</td>
<td></td>
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<tr>
<td>P TOVS-Bangladesh</td>
<td>Achtor, Schreiner</td>
<td>NASA/GSFC</td>
</tr>
<tr>
<td></td>
<td>- Installation of ITPP in Dhaka, Bangledesh; Cyclone and severe weather cases</td>
<td></td>
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<tr>
<td></td>
<td>- Taught two week course in satellite meteorology and use of ITPP</td>
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<tr>
<td></td>
<td>- In collaboration with NASA/GSFC and USAID</td>
<td></td>
</tr>
</tbody>
</table>
3. WEATHER AND CLIMATE APPLICATIONS

P Typhoon Merrill/Velden NAVY/ONR
- Estimate of Typhoon intensity from TOVS Microwave radiances
- Participation in Navy Tropical Cyclone Motion Experiment (8/90)

G F GUFMEX Hayden, Wade NOAA/NSSL
- Field experiment/data analysis to better understand the role of
  return flow from the Gulf of Mexico
- Moisture fields from VAS and SSM/I have shown ability of satellite
  to accurately depict return moist flow

P ERBE Ackerman, Herman NASA/LANGLEY
- Study the radiative impact of dust on regional climate
- Scanner vs non-scanner instrument comparisons
- GOES-6 VAS observations of OLR found to be highly correlated
  with ERBE OLR measurements
- ERBE - HIS radiance comparisons in good agreement

HM HIS/MAMS-COHMEX Smith, Menzel NASA/MSFC
- HIS retrievals depict high resolution PBL moisture gradients,
  strongly correlated with cumulus cloud presence/absence
- HIS/MAMS radiance comparisons show strong agreement
- MAMS/VAS derived precipitable water matches well with cloud field

M Geomorphology Menzel, Moeller NASA
- MAMS flights over Louisiana coastline
- 100 m resolution suspended sediment and sea surface temperature maps
- Short term (<1hr) variation observed during cold frontal passage
- Comparison of 11 um with AVHRR shows additional structure in MAMS

G F Amazonia Martin, Cutrim, Menzel NSF
- Estimate evapotranspiration over Amazon during GTE/ABLE-2B
- Demonstrate ability of VAS to estimate hydrologic cycle parameters
- Results summarized in several publications and latest CIMSS View

G Biomass Burning Menzel, Cutrim NOAA-INPE
- Monitor burning and aerosol transport in Amazon region
- Demonstrate ability of VAS to estimate extent of burning
- Improved understanding of number, size and diurnal cycle of fires

P Polar Clouds Ebert NASA
- Analysis of Polar clouds using AVHRR radiances and pattern recognition
  algorithm
- Assembly of winter and summer, Arctic and Antarctic, data sets for ISLCCP
4. REMOTE SENSING TECHNIQUES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Author(s)</th>
<th>Sponsor</th>
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<tbody>
<tr>
<td>P</td>
<td>SSM/I Rainrate</td>
<td>Olson</td>
<td>NAVY/ONR</td>
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<tr>
<td></td>
<td>- Validate original rainrate algorithm</td>
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<tr>
<td></td>
<td>for SSM/I radiances</td>
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<tr>
<td></td>
<td>- Develop improved rainrate algorithms</td>
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<td></td>
<td>for operations</td>
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<tr>
<td></td>
<td>- Evaluate potential for physical</td>
<td></td>
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<tr>
<td></td>
<td>retrieval rainrate technique</td>
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<tr>
<td>P</td>
<td>DMSP Algorithm</td>
<td>Smith, Woolf, Olson</td>
<td>NAVY/NOARL</td>
</tr>
<tr>
<td></td>
<td>- Develop physical retrieval algorithm</td>
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<tr>
<td></td>
<td>using SSM/T and /I radiances</td>
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<tr>
<td></td>
<td>- Validate algorithm with case studies</td>
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<tr>
<td>GP</td>
<td>VAS plus MSU</td>
<td>Schreiner</td>
<td>NAVY/NOARL</td>
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<tr>
<td></td>
<td>- Comparison of VAS, TOVS and VAS+MSU</td>
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<td></td>
<td>retrieval algorithms with GALE</td>
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<td></td>
<td>radiosonde data set</td>
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<td></td>
<td>- VAS+MSU showed more complete coverage</td>
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<td></td>
<td>and improved temperature</td>
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<td></td>
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<td>and moisture analyses</td>
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<td>H</td>
<td>Trace Gas</td>
<td>Knuteson, Revercomb</td>
<td>NASA</td>
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<tr>
<td></td>
<td>- Quantify measurement characteristics</td>
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<td>important to retrieval</td>
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<td></td>
<td>- Develop algorithms for mixing ratio</td>
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<td></td>
<td>profile retrieval</td>
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<td></td>
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<tr>
<td></td>
<td>- Validate algorithms with real data</td>
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<tr>
<td>G</td>
<td>Surface Energy Balance</td>
<td>Diak</td>
<td>NASA</td>
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<tr>
<td>L</td>
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<tr>
<td></td>
<td>- Improved techniques for remote sensing</td>
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<td></td>
<td>of land surface energy</td>
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<td></td>
<td>balance and soil moisture</td>
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<td></td>
<td>- Determine improved skin temperature</td>
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<tr>
<td></td>
<td>method</td>
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</tr>
<tr>
<td></td>
<td>- Techniques to determine the diurnal</td>
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<tr>
<td></td>
<td>fluctuation of the PBL height</td>
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</table>

5. MODEL APPLICATIONS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Author(s)</th>
<th>Sponsor</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Precipitation Modeling</td>
<td>Raymond, Olson</td>
<td>NASA</td>
</tr>
<tr>
<td>L</td>
<td>- Improvements to initialization fields in mesoscale forecast models</td>
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<tr>
<td></td>
<td>using rainrate estimates from SSM/I</td>
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<tr>
<td></td>
<td>- Study model sensitivity to initial moisture fields</td>
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</tr>
<tr>
<td>L</td>
<td>Data Assimilation</td>
<td>Diak, Aune</td>
<td>NASA/MSFC</td>
</tr>
<tr>
<td></td>
<td>- Examine the potential of new satellite data sources for NWP (AMSU, HIS)</td>
<td></td>
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<tr>
<td></td>
<td>- Develop techniques for incorporating satellite-measured parameters</td>
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<tr>
<td></td>
<td>into and their impact upon short-term mesoscale forecasts</td>
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</tr>
<tr>
<td></td>
<td>- Wind impact tests with NMC and ECMWF</td>
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</tbody>
</table>
GP L Severe Weather Hayden, Schreiner, Aune NOAA/ERL
- Participation in STORM program
- Definition of improved sounding instruments and techniques
- 4 dimensional data assimilation experiments
- Performance evaluation of HIRS - HIS spectral channels (MS thesis)
- Support for GUFMEX involvement

6. INSTRUMENT STUDIES

G H Geoplatform Smith/Bretherton/Menzel NASA/MSFC
- Provide thermal and atmospheric constituent profiles in the lower troposphere
- Investigate the radiative effects of Greenhouse gasses
- Study the complimentarity of GOES-N and Geoplatform
- Study the data system requirements for Geoplatform

G H GOES/N Smith, Revercomb NOAA
- Offers improved vertical temperature and moisture soundings
- Completed Phase A study of GOES L/M modification
- Primary candidate for GOES-N advanced sounder

H EUMETSAT/HIS Smith, Knuteson EUMETSAT
- Interferometer sounder feasibility study

7. FIELD PROGRAMS

HMFL COHMEX Velden, Diak NASA/MSFC
- Participationat with HIS and MAMS data gathering flights
- Collect and assemble satellite data set
- Data assimilation experiments with CIMSS model

H F FIRE Smith, Ackerman NASA
- HIS aircraft observations over Wisconsin in fall 1987
- Study cirrus cloud microphysical properties with HIS data set
- Effects of cirrus upon satellite temperature retrieval techniques

H F GAPEX Smith, Revercomb NOAA/WPL-SSEC
- Field experiment at Denver, CO in November 1988
- Low-cost interferometer compares closely to aircraft HIS in measurement accuracy
- Acquire and analyze atmospheric temperature and moisture profiles
- Demonstrated high quality HIS data as ground based profiler

H F ECLIPSE Revercomb, Knuteson SSEC
- Madison experiment; Nov 1989 to acquire coincident upwelling and downwelling radiation, for data analysis with lidar measurements
- Data reduction in progress
<table>
<thead>
<tr>
<th>Date</th>
<th>Title</th>
<th>Agency</th>
<th>Amount</th>
<th>PI</th>
<th>Status</th>
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<tbody>
<tr>
<td>10/7/88</td>
<td>Continuation of CIMSS Basic Funding</td>
<td>NOAA</td>
<td>$240,229</td>
<td>Smith/ Achtor</td>
<td>Funded</td>
</tr>
<tr>
<td>10/10/88</td>
<td>Analysis of Cirrus Optical Properties with Data from the NASA ER2 High-resolution Interferometer Spectrometer (HIS)</td>
<td>NASA</td>
<td>45,760</td>
<td>Smith/ Ackerman</td>
<td>Funded @ $25K</td>
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<tr>
<td>10/28/88</td>
<td>Storm Research Program; Ground-based Atmospheric Profiling Experiment (GAPEX)</td>
<td>NOAA</td>
<td>135,166</td>
<td>Smith/ Schreiner</td>
<td>Funded @ $35K</td>
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<tr>
<td>12/13/88</td>
<td>Surface Energy Balance</td>
<td>NASA</td>
<td>411,911</td>
<td>Diak</td>
<td>Funded</td>
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<tr>
<td>12/13/88</td>
<td>Microwave (SSM/I) Estimates of the Precipitation Rate to Improve Numerical Atmospheric Model Forecasts</td>
<td>NASA</td>
<td>178,000</td>
<td>Raymond/ Olson</td>
<td>Funded</td>
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<tr>
<td>12/15/88</td>
<td>Atmospheric Trace Gas Vertical Concentration Profiling - Source, Sink and Flux Observations</td>
<td>NASA</td>
<td>480,058</td>
<td>Smith</td>
<td>Unfunded</td>
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<tr>
<td>12/15/88</td>
<td>Participation in the ONR Tropical Cyclone Motion Initiative</td>
<td>ONR</td>
<td>13,660</td>
<td>Merrill/ Velden</td>
<td>Funded</td>
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<tr>
<td>1/10/89</td>
<td>Complete Calibration/Validation Work for SSM/I Rainfall Rate Estimation</td>
<td>ONR</td>
<td>50,000</td>
<td>Smith/ Olson</td>
<td>Funded</td>
</tr>
<tr>
<td>2/15/89</td>
<td>Memorandum of Understanding Among the NOAA, NASA, and Board of Regents of the Univ. of Wisconsin</td>
<td>NOAA/ NASA/ UW-MSN</td>
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<td>Cooperative Agreement Signed</td>
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<td>5/2/89</td>
<td>Arctic Radiation and Chemistry Experiment</td>
<td>NOAA</td>
<td>14,594</td>
<td>Smith</td>
<td>Funded</td>
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<td>5/15/89</td>
<td>Environmental Influences on Tropical Cyclone Convection</td>
<td>NSF</td>
<td>367,227</td>
<td>Merrill</td>
<td>Unfunded</td>
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<tr>
<td>5/18/89</td>
<td>NASA Base</td>
<td>NASA</td>
<td>165,000</td>
<td>Smith/Achtor</td>
<td>Funded</td>
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<td>5/25/89</td>
<td>Continued Support of the Storm Research Program</td>
<td>NOAA</td>
<td>180,600</td>
<td>Smith</td>
<td>Funded</td>
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<tr>
<td>6/2/89</td>
<td>Trace Gas Retrieval Program</td>
<td>NASA</td>
<td>599,197</td>
<td>Smith</td>
<td>Funded</td>
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<tr>
<td>6/2/89</td>
<td>Investigations in Support of the Development of the NASA Geoplatform Program</td>
<td>NASA</td>
<td>999,739</td>
<td>Smith</td>
<td>Funded $269K</td>
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<tr>
<td>6/29/89</td>
<td>Participation in the FIRE Phase II Program</td>
<td>NASA</td>
<td>349,252</td>
<td>Smith</td>
<td>Funded STBD</td>
</tr>
<tr>
<td>7/17/89</td>
<td>Application of Non-local Mixing Concept to Model Initialization and Forecasting</td>
<td>NSF</td>
<td>231,846</td>
<td>Raymond</td>
<td>Pending</td>
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<tr>
<td>8/2/89</td>
<td>HIS Spectral Surface Studies</td>
<td>Univ. of MD</td>
<td>305,570</td>
<td>Smith/Revercomb</td>
<td>Funded STBD</td>
</tr>
<tr>
<td>8/22/89</td>
<td>HIS Participation in TOGA COARE</td>
<td>NSF</td>
<td>148,200</td>
<td>Smith</td>
<td>Unfunded</td>
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<tr>
<td>9/12/89</td>
<td>Continuation of CIMSS Basic Funding</td>
<td>NOAA</td>
<td>240,382</td>
<td>Smith/Achtor</td>
<td>Funded</td>
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<tr>
<td>9/15/89</td>
<td>Typhoon Monitoring Supplement</td>
<td>ONR</td>
<td>93,658</td>
<td>Merrill</td>
<td>Funded</td>
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<td>10/13/89</td>
<td>EUMETSAT-Meteosat Interferometer Sounder: Tradeoff Study</td>
<td>EUMETSAT</td>
<td>28,982</td>
<td>Smith</td>
<td>Funded</td>
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<tr>
<td>10/19/89</td>
<td>A TOVS/VHF Ground Receiving Station</td>
<td>Ahmed Jaffet Company</td>
<td>305,742</td>
<td>Smith</td>
<td>Pending</td>
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<tr>
<td>11/29/89</td>
<td>Participation in FIRE Phase II Program</td>
<td>NASA</td>
<td>50,000</td>
<td>Smith</td>
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<td>NASA</td>
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<td>McKeown/Smith</td>
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<td>Continued Participation in the ERBE Program</td>
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<td>4/11/90</td>
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<td>4/16/90</td>
<td>High Spectral Resolution Radiation Measurements for the ARM Program</td>
<td>DOE</td>
<td>1,901,662</td>
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<td>4/16/90</td>
<td>The Determination of Atmospheric Radiative Properties and Their Use in Parameterizing the Radiative Forecast in Climate Models</td>
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<td>1,363,448</td>
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<td>Synoptic Analysis of the GUFMEX Field Phase of 10-12 March 1988</td>
<td>NOAA</td>
<td>26,944</td>
<td>Merrill</td>
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<td>4/27/90</td>
<td>The Investigation of Cloud Properties, Atmospheric Stability and Total Ozone with MODIS-N</td>
<td>NASA</td>
<td>4,072,202</td>
<td>Menzel</td>
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<td>4/27/90</td>
<td>Algorithm Development with HIS Data</td>
<td>NASA</td>
<td>3,021,724</td>
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**Funding Summary: FY89-FY90**

- Total funding requested: all proposals $17,163 M
- Total funding of accepted proposals $3,083 M
- Total of unfunded proposals $1,115 M
- Total funding of pending proposals $12,965 M
1988 REVIEWED LITERATURE


1988 CONFERENCE PAPERS AND REPORTS


1989 REVIEWED LITERATURE


1989 CONFERENCE PAPERS AND REPORTS


Ackerman, S. A., 1989: Maximum and minimum in the earth radiation budget. IAMAP '89 Conference: Symposium on the Earth's Radiation Budget, University of Reading, Reading, UK, August 3-4.


Smith, W. L., 1989: Recent advances in instrumentation for passive remote sensing. Fifth Scientific Assembly of IAMAP, Reading, UK, July 31-August 11.


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Diak, G. R., 1990: Combining radiosonde measurements with satellite-measured surface skin temperatures for evaluation of surface turbulent fluxes and effective surface roughness at synoptic scales. Accepted for publication in J. Agr. Forest Met.

Franklin, J. L., C. S. Velden, J. Kaplan, and C. M. Hayden, 1990: Some comparisons of VAS and dropwindsonde data over the subtropical Atlantic ocean. Accepted for publication in Mon. Wea. Rev.


*Menzel, W. P., D. P. Wylie, and K. I. Strabala, 1990: Seasonal and diurnal changes in clouds as seen in four years of observations with the VAS. Submitted to J. Geophys. Res.


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*Significant publications