CIRA

Cooperative Institute for Research in the Atmosphere

Colorado State University
Foothills Campus
Fort Collins, Colorado 80523

Colorado State University
National Oceanic and Atmospheric Administration

CIRA

A SYNOPSIS OF ACTIVITY

JANUARY 1 - DECEMBER 31, 1982

Second Mid-year Report

March 1983

Thomas H. Vonder Haar
Director

PREFACE

This second "mid-year" report from the Cooperative Institute for Research in the Atmosphere (CIRA) is intended to communicate scientific results and information about current activities to NOAA and CSU scientists, students and staff as well as other interested parties. Each year we plan to issue this mid-year report as well as an annual report from CIRA.

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COOPERATIVE INSTITUTE FOR RESEARCH IN THE ATMOSPHERE

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Thomas H. Vonder Haar, Director
Karen S. Greiner, Research Coordinator

The Cooperative Institute for Research in the Atmosphere (CIRA) established September 1980, is jointly sponsored by Colorado State University (CSU) and the National Oceanic and Atmospheric Administration (NOAA) and has a close relationship with NOAA's Environmental Research Laboratories (ERL) and the National Environmental Satellite, Data, and Information Service (NESDIS). It was formed to increase the effectiveness of atmospheric research of mutual interest to NOAA, CSU, the state and the nation. Additional objectives are to provide a center for cooperation in specified research programs by scientists from Colorado, the nation and other countries and to hasten the training of atmospheric scientists. All Colorado State University or NOAA organizational elements are invited to participate in the Institute's atmospheric research programs.

As its research themes the Institute has concentrated on: global climate dynamics, local area weather forecasting, weather modification, application of satellite observations and air quality. Air quality, a new theme, is currently addressed through an alliance with the National Park Service. With the locating of the NOAA/NESDIS/RAMM Branch (Regional Mesoscale and Meteorology Branch) at CIRA, emphasis is placed on development of meteorological satellite data for research purposes and environmental applications. Locally CIRA is involved with satellite studies and focal point of PROFS. Internationally, the involvement is with the satellite cloud climatology project. A pending research proposal in cooperation with WMO (World Meteorological Organization) and UNEP (United Nations Environmental Programs) is to assist the Indian Meteorological Department with developing a sector processing center capability for their INSAT groundstation; this research should begin in summer 1983.

Currently the University departments engaged in CIRA research are: atmospheric science, economics, statistics, psychology, civil engineering, and electrical engineering. Twenty-six separate research projects have been funded through CIRA which includes an IPA (Intergovernmental Personnel Act) with Dr. T. Michael Carter located at the Maryland office of the National Weather Service.

CIRA personnel comprise a list of 12 fellows, 4 visiting fellows, 8 research associates and 3 visiting scientists. Since the inception of CIRA, 2 Ph.D.s and 4 Master of Science degrees have been awarded. Each year the visiting fellows program allows for at least two scientists to conduct individual research at Colorado State University.

In July of 1982 CIRA co-sponsored with NASA/Marshall Space Flight Center the "Training Workshop in Satellite Meteorology". In September of 1983 CIRA will sponsor a workshop entitled "Public Policy Toward the Support of Weather-related Research and Services: An Evaluation for Colorado".

PERSONNEL

Director

Vonder Haar, T.

Research Coordinator

Greiner, K.

Fellows

Alberty, R., NOAA/ERL
Beran, D., NOAA/ERL
Brier, G., CSU, Atmospheric Science
Brubaker, T., CSU, Electrical Engineering
Cochrane, H., CSU, Economics
Grant, L., CSU, Atmospheric Science
Gray, W., CSU, Atmospheric Science
McKee, T., CSU, Atmospheric Science
Mielke, P., CSU, Statistics
Purdom, J., NOAA/NESDIS/RAMM, CSU
Sinclair, P., CSU, Atmospheric Science

Visiting Fellows

Carter, M., in Washington on IPA
Panofsky, H., CSU

Visiting Scientists

Ashbaugh, L., UC-Davis/NPS/CSU
Campbell, G., RIC/CSU
Malm, W., NPS/CSU
Saufley, D., Houghton College, NY

Post-doctoral Fellow

Yeh, M.

Research Associates

Allen, N., CSU/CIRA--employee
Green, R., NOAA/NESDIS/RAMM, CSU
Kruidenier, M., CSU, Atmospheric Science
Lipschutz, R., located at NOAA/ERL--employee
Phillips, R., NOAA/NESDIS, CSU
Weaver, J., NOAA/NESDIS/RAMM, CSU
Winston, H., located at NOAA/ERL--employee
Zehr, R., NOAA/NESDIS/RAMM, CSU

Agency Acronyms

CSU:	Colorado State University
ERL:	Environmental Research Laboratory
NESDIS:	National Environmental Satellite, Data, and Information Service
NOAA:	National Oceanic and Atmospheric Administration
NPS:	National Park Service
RAMM:	Regional Mesoscale & Meteorology Branch
RIC:	Research Institute of Colorado
UC-Davis:	University of California, Davis

RESEARCH ACTIVITIES

September 1, 1980 - December 31, 1982

PRINCIPAL INVESTIGATOR(S)	TITLE	SPONSOR'S NUMBER	DATES
L. Grant	A Design for Assessing On-going Operational Cloud Seeding	NA80RA-C-00017*	10/1/79 - 3/30/81
P. Sinclair/ J. Purdom	Genesis and Development of Deep Convective Storms	NA80AA-D-00056*	4/15/81 - 4/14/82
T. Vonder Haar/ T. Brubaker	Satellite Data Reception and Analysis Equipment and Support	NA80AA-D-00082*	7/1/80 - 9/30/81
H. Cochrane	Estimating the Uses and Benefits Derived from PROFS	NA80RA-C-00183*	8/1/80-11/30/82
T. Vonder Haar/ E. Smith	The Development of a Daytime Multispectral Radiative Signature Technique for Estimation of Rainfall from Satellites	NA80SA-C-00746*	7/15/80-5/31/82
T. McKee	Colorado Demonstration Intergovernmental Climate Project	NA80AA-D-00118*	9/1/80-8/31/83
T. McKee	Surface Data Network Archives for PROFS	NA80RA-G-00201*	8/1/80-5/31/82
T. Vonder Haar	Cooperative Institute for Research Visiting Members Program	NA81RA-H-00001*	10/1/80-6/30/83
L. Grant	Long-range Planning for Weather Modification	NA81RA-H-00001* Amendment 1; Item 2	11/1/80-3/31/82
G. Brier	Research on Statistical Techniques for Improvement of Long Range Forecasts	NA81AA-D-00039*	2/1/81-7/31/83

*Funded by NOAA

PRINCIPAL INVESTIGATOR(S)	TITLE	SPONSOR'S NUMBER	DATES
T. Vonder Haar/ J. Purdom (T. Brubaker)	Satellite Studies & Focal Point Activities for PROFS	NA81RA-H-00001* Amendment 2; Item 4	2/1/81-9/30/83
M. Carter	The Design of Improvements in Severe Weather Warning Programs Utilizing Concepts and Products Derived from PROFS	NA81RA-H-00001* Amendment 2; Item 3	10/1/80-10/31/82
T. Vonder Haar	Pilot Studies for the International Satellite Cloud Climatology Project	NA81AA-D-00058*	3/1/81-6/30/83
P. Mielke/ G. Brier	Development of Validation and Verification Techniques for Precipitation Estimation from Satellites	NA81RA-H-00001* Amendment 3; Item 5	4/1/81-9/30/82
L. Grant	Testing and Development of Ice Nucleation Materials and Generation Calibration	NA81RA-H-00001* Amendment 5; Item 7	2/1/81-9/30/82
W. Cotton	Numerical Simulation and Observational Analysis of the Dynamics Response of Towering Cumuli to Massive Seeding	NA81RA-H-00001* Amendment 4; Item 6	4/1/81-6/30/83
T. Vonder Haar	Mesoscale Research	NA81RA-H-00001* Amendment 6	8/1/81-7/31/83
W. Gray	Hurricane-Typhoon Studies in Support of NOAA Hurricane Research and Forecasting	NA81RA-H-00001* Amendment 9; Item 9	3/1/82-2/28/83

*Funded by NOAA

PRINCIPAL INVESTIGATOR(S)	TITLE	SPONSOR'S NUMBER	DATES
P. Sinclair/ J. Purdom	The Genesis and Development of Deep Convective Storms: A New Approach to Their Prediction and Possible Modification	NA82RA-C-00103*	7/1/82-6/1/83
T. Vonder Haar/ J. Purdom	Satellite Data Reception and Analysis Equipment and Support for Research Activities	NA82AA-H-00026*	9/1/82-8/31/83
S. Cox/ T. McKee	An Investigation of the Application of Monte Carlo Method in Problems in Visibility	John Muir Inst. (National Park Service)	8/24/82-6/30/83
R. Loomis	Development of Psychological Indicators of Visual Quality Judgments	John Muir Inst. (National Park Service)	8/24/82-6/30/83
E. Reiter	Atmospheric Transport Processes Affecting Visibility in National Parks	John Muir Inst. (National Park Service)	8/24/82-6/30/83
W. Sadeh	Statistical Reduction and Analyses of Visibility-Related Data and Statistical Modeling of Visibility-Related Variables and Processes	John Muir Inst. (National Park Service)	8/24/82-6/30/83
R. Pielke	Local Transport & Dispersion in National Parks	NA81RA-H-00001* Amendment 12; Item 10	9/1/82-8/31/83
M. Carter	Federal IPA - Severe Warning Program	*	8/25/82-8/24/83
R. Pueschel/ E. Barrett	Grand Canyon Meteorology	NOAA Funding via National Park Ser.	10/1/82-3/31/84

*Funded by NOAA

PAPERS, REPORTS AND PRESENTATIONS

September 1, 1980 - December 31, 1982

Project #5-31258

A Design for Assessing On-going Operational Cloud Seeding Programs

Principal Investigators: L. Grant/P. Mielke/T. Vonder Haar

Sponsor's #NA80RA-C-00017; 10/1/79 - 3/30/81

Reports

Grant, Lewis O., and Paul W. Mielke, Jr., 1982: Final report to Weather Modification Office, NOAA, for Contract No. NA80RAC00017, Volume I, September 15, 1982.

Grant, Lewis O., and Paul W. Mielke, Jr., 1982: Final Report to Weather Modification Program Office, NOAA, for Contract No. NA80RAC00017, Volume II, September 15, 1982.

Project #5-31259

Genesis and Development of Deep Convective Storms

Principal Investigators: P.C. Sinclair/J.F.W. Purdom

Sponsor's #NA80AA-D-00056; 4/15/81 - 4/14/82

Paper

Purdom, James F.W., 1982: Integration of research aircraft data and 3 minute interval GOES data to study the genesis and development of deep convective storms. Preprint Volume: 12th Conference on Severe Local Storms, January 11-15, 1982, San Antonio, TX, AMS, Boston, MA.

Sinclair, P.C., and J.F.W. Purdom, 1983: The genesis and development of deep convective storms. Final report on Contract NA80AA-D-00056, ISSN 0737-5352, CIRA Paper No. 1. Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO.

Sinclair, P.C., and J.F.W. Purdom, 1983: Shuttle recovery requirements and the development of arc cloud lines from thunderstorm outflows. Preprint Volume, Ninth Conference on Aerospace and Aeronautical Meteorology, June 6-9, 1983, Omaha, NE, AMS, Boston, MA.

Presentation

Sinclair, P.C., and James F.W. Purdom, 1982: Integration of research aircraft data and 3 minute interval GOES data to study the genesis and development of deep convective storms. Presented at the 12th Conference on Severe Local Storms, January 11-15, 1982, San Antonio, TX.

Project #5-31260

Satellite Data Reception and Analysis Equipment and Support

Principal Investigators: T. Vonder Haar/T. Brubaker

Sponsor's #NA80AA-D-00082; 7/1/80 - 9/30/81

Papers

Green, Robert N., and Melanie A. Kruidenier, 1982: Interactive data processing for mesoscale forecasting applications. Prepared for the 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Kruidenier, Melanie A., 1983: Application of GOES satellite soundings to forest fire management. Preprint Volume: 7th Conference on Fire & Forest Meteorology, April 25-29, 1983, Fort Collins, CO, AMS, Boston, MA.

Plomondon, Brian L., 1982: Suomi-Sony Video Cassette Archive - EMR 822-02 Interface, March 26.

Report

Vonder Haar, Thomas H., Thomas A. Brubaker, 1982: Final Report on Satellite Data Reception and Analysis Equipment and Support, Contract NA80AA-D-00082, September 19, 1982.

Project #5-31261

Estimating the Uses and Benefits Derived from PROFS

Principal Investigator: H. Cochrane

Sponsor's #NA80RA-C-00183; 8/1/80 - 11/30/82

Papers

George, D.H., and T.M. Carter, 1983: An automated warning data management system (AWADS). NOAA/ERL, Boulder, CO and Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO.

Reiter, E., J.D. Sheaffer, H. Cochrane, J. Cook, G.R. Johnson, H. Leong, T. Nakagawa, 1982: The effects of atmospheric variability on energy utilization and conservation. Environmental Research Paper No. 32, Colorado State University, March.

Nakagawa, T., 1982: Measuring the value of short-term weather forecasts: Electric power generation, a case study. Ph.D. Dissertation, Department of Economics, Colorado State University, Ft. Collins, CO, December.

Reports

Cochrane, H.C., T. Nakagawa and A. Harney, 1982: The value of weather information in the power generation industry: A case study. Final Report for NOAA Contract NA80RA-C-00183. Colorado State University, Ft. Collins, CO.

Presentations

Cochrane, H.: Determining the economic value of short-term weather forecasts. 3rd Conference on the Meteorology of the Upper Atmosphere, AMS, San Diego, CA, January 20-22, 1981.

Cochrane, H.: PROFS and power plant scheduling: A case study of the Public Service Company of Colorado. Presented to Public Service Company.

Cochrane, H.: PROFS and power plant scheduling: A case study of the Public Service Company of Colorado. Presented to professional staff (3 presentations), Boulder, CO.

Project #5-31262

The Development of a Daytime Multispectral Radiative Signature Technique for Estimation of Rainfall from Satellites

Principal Investigators: T. Vonder Haar/E. Smith

Sponsor's #NA80SA-C-00746; 7/15/80 - 5/31/82

Reports

Smith, E.A. and T.H. Vonder Haar, 1980: Atmospheric environments and the complex indices of refraction for water and ice. Report 1--NOAA Contract NA-80-SAC-00746, Department of Atmospheric Science, Colorado State University, Ft. Collins, CO, 49 pp.

Smith, E.A. and T.H. Vonder Haar, 1980: Water cloud microphysics. Report 2--NOAA Contract NA-80-SAC-00746, Department of Atmospheric Science, Colorado State University, Ft. Collins, CO, 85 pp.

Smith, E.A. and T.H. Vonder Haar, 1980: Ice cloud microphysics. Report 3--NOAA Contract NA-80-SAC-00746, Department of Atmospheric Science, Colorado State University, Ft. Collins, CO, 50 pp.

Smith, E.A. and T.H. Vonder Haar, 1980: Single scattering models for distributions of spherical and cylindrical hydrometeors. Report 4--NOAA Contract NA-80-SAC-00746, Department of Atmospheric Science, Colorado State University, Ft. Collins, CO, 111 pp.

Smith, E.A. and T.H. Vonder Haar, 1980: The microwave radiative transfer model. Report 5--NOAA Contract NA-80-SAC-00746, Department of Atmospheric Science, Colorado State University, Ft. Collins, CO, 14 pp.

Smith, E.A. and T.H. Vonder Haar, 1981: The shortwave radiative transfer models. Report 6--NOAA Contract NA-80-SAC-00746, Department of Atmospheric Science, Colorado State University, Ft. Collins, CO, 97 pp.

Smith, E.A. and T.H. Vonder Haar, 1981: The infrared radiative transfer models. Report 7--NOAA Contract NA-80-SAC-00746, Department of Atmospheric Science, Colorado State University, Ft. Collins, CO, 44 pp.

Smith, E.A. and T.H. Vonder Haar, 1982: First year project summary of a daytime multispectral radiative signature technique for estimation of rainfall from satellites. Cooperative Institute for Research in the Atmosphere, Colorado State University/National Oceanic and Atmospheric Administration, Ft. Collins, CO, 4 pp.

Smith, E.A. and T.H. Vonder Haar, 1982: The development of a multispectral radiative signature technique for estimation of rainfall from satellites. Final Report, NOAA Contract NA-80-SAC-00746, Department of Atmospheric Science, Colorado State University, Ft. Collins, CO, 77 pp.

Vonder Haar, T.H. and E.A. Smith, 1982: Combined spaceborne and conventional measurements for precipitation estimation. Precipitation measurements from space. Workshop Report (Atlas and Thiele Editors), NASA/Goddard Space Flight Center, Greenbelt, MD, D176-D183.

Presentations

Vonder Haar, T.H. and E.A. Smith, 1981: Combined spaceborne and conventional measurements for precipitation estimation. Workshop on Precipitation Measurements from Space, NASA/Goddard Space Flight Center, April 28-May 1, Greenbelt, MD.

Smith, E.A., T.H. Vonder Haar, R. Welch and W. Wiscombe, 1981: Contractor´s Report. AgRISTARS Precipitation Contractors´ Workshop, NOAA/NESS, June 16-19, Washington, DC.

Smith, E.A. and T.H. Vonder Haar, 1982: Contractor´s Report. AgRISTARS Precipitation Contractors´ Workshop, NOAA/NESS, August 23-25, Washington, DC.

Project #5-31263

Colorado Demonstration - Intergovernmental Climate Program

Principal Investigator: T. McKee

Sponsor's #NA80AA-D-00118; 9/1/80 - 8/31/83.

Reports

Crow, Loren W., Consultants, Inc., 1982: Report on methods of estimating precipitation in mountainous areas of Colorado. Subcontract LWC #276, August 1982.

Doesken, Nolan J., Thomas B. McKee and David M. Ebel, 1982: Colorado solar radiation data with supplemental climatic data. Climatology Report 82-2, Department of Atmospheric Science, Colorado State University, Ft. Collins, CO, 99 pp.

McKee, T., N. Doesken and H. Cochrane, 1982: Final report - Colorado intergovernmental climate program - May 1982. Climatology Report 82-1, Department of Atmospheric Science, Colorado State University, Ft. Collins, CO, 103 pp.

Project #5-31264

Surface Data Network Archives for PROFS

Principal Investigator: T. McKee

Sponsor's #NA80RA-G-00201; 8/1/80 - 9/30/82.

Papers

Smith, Jeffrey Ken, 1982: Undisturbed clear day diurnal winds and temperature pattern in northeastern Colorado. M.S. Thesis, Colorado State University, Ft. Collins, CO.

Reports

McKee, T., W. Cotton, N. Doesken and G. Tripoli, 1981: Report of the PROFS mesoscale network workshop, November 18-19, 1980.

McKee, T., 1981: Surface data network archives for PROFS - Summary of Program 5-31264, October 1981.

McKee, T., and J. Kleist, 1983: Final technical report - PROFS surface data archive. Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO.

Project #5-31265

Cooperative Institute for Research Visiting Members Program

Principal Investigator: T. Vonder Haar

Sponsor's #NA81RA-H-00001; 10/1/80 - 6/30/83.

Papers

Saufley, D., 1982: Navigation of geosynchronous satellite images. Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO.

Saufley, D., 1982: Navigation of VAS data. Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO.

Workshop on Satellite Meteorology, 1982: Part I: Satellite and their data. Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO and Committee on Meteorological Aspects of Aerospace Systems, AMS, Boston, MA.

Workshop on Satellite Meteorology, 1982: Part II: Satellite image analysis and interpretation. Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO and Committee on Meteorological Aspects of Aerospace Systems, AMS, Boston, MA.

Workshop on Satellite Meteorology, 1982: Part III: Satellite soundings and their uses. Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO and Committee on Meteorological Aspects of Aerospace Systems, AMS, Boston, MA.

Yeh, Hwa-Young, and Kuo-Nan Liou, 1982: Remote sounding of cloud parameters from a combination of infrared & microwave channels. J. of Clim. & App. Meteor., 22(2), 201-213.

Yeh, Hwa-Young, and Thomas H. Vonder Haar, 1983: On the temperature field and cloud parameters inversion in cirrus cloudy atmospheres. Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO.

Reports

Bausch, Walter, 1983: Final Report - Development of an urban lawn irrigation scheduling program. Department of Agricultural and Chemical Engineering, Colorado State University, Ft. Collins, CO.

Vonder Haar, T., K. Greiner, 1982: Annual report to the Advisory Board, September 1980 - June 1981. Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO.

Project #5-31265 (cont'd.)

Vonder Haar, T., 1982: CIRA, a synopsis of activity, September 1980 - December 1981, 1st mid-year report (February). Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO.

Vonder Haar, T., K.S. Greiner, 1982: Annual report on Cooperative Institute for Research Visiting Members Program, November 1982. Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO.

Presentations

Ashbaugh, Lowell, 1982: Transport of fine particle sulfur in the western United States. Seminar at Colorado State University, Ft. Collins, CO (November 11th).

Johnson, Donald R., 1982: The seasonal variation of the planetary scale heat sources and sinks and the thermally-forced planetary scale response. Guest lecturer. Colorado State University, Ft. Collins, CO (June 14th).

Johnson, Donald R., 1982: The forcing and maintenance of the planetary scale circulation of the atmosphere. Guest lecturer. Colorado State University, Ft. Collins, CO (June 15th).

Johnson, Donald, R., 1982: The forcing of the extratropical cyclone within an angular momentum perspective. Guest lecturer. Colorado State University, Ft. Collins, CO (June 16th).

Johnson, Donald R., 1982: Diagnostics of observed and numerically simulated extratropical cyclones. Guest lecturer. Colorado State University, Ft. Collins, CO (June 17th).

Johnson, Donald R., 1982: An isentropic perspective of atmospheric jet streaks and scale interaction. Guest lecturer. Colorado State University, Ft. Collins, CO (June 22nd).

Panofsky, H.A., 1982: Meteorology in the last half century - A personal perspective. Guest lecturer. Colorado State University, Ft. Collins, CO (December 10th).

Project #5-31268

Long-range Planning for Weather Modification

Principal Investigator: L. Grant

Sponsor's #NA81RA-H-00001, Amendment 1, Item 2; 11/1/80 - 3/31/82

Report

Grant, L., 1981: Progress report on "Long-range planning for weather modification". October 1981.

Project #5-31269

Research on Statistical Techniques for Improvement on Long Range Forecasts

Principal Investigator: G. Brier

Sponsor's #NA81AA-D-00039; 2/1/81- 7/31/83.

Report

Brier, G., and M.M. Siddiqui, 1982: Research on statistical techniques for improvement on long range forecasts. Progress Report - October 1, 1982.

Presentations

Brier, G., 1981: Brown bag forum on large-scale fluctuations in the climate system. Led CSU discussion portion, July 20th, Colorado State University, Ft. Collins, CO.

Brier, G., 1982: Teleconnections and statistical analysis. Seminar presented on May 25, 1982, NOAA, Washington, DC.

Project #5-31270

Satellite Studies & Focal Point Activities for PROFS

Principal Investigators: T. Vonder Haar/J.F.W. Purdom (T. Brubaker)

Sponsor's #NA81RA-H-00001; Amendment 2; Item 4; 2/1/81 - 10/31/83

Papers

Green, R., and M. Kruidenier, 1982: Interactive data processing for mesoscale forecasting applications. Preprints, 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Johnson, R., and J. Toth, 1982: Topographic effects and weather forecasting in the Colorado PROFS mesonetwork area. Preprints, 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Johnson, R., and J. Toth, 1982: A climatology of the July 1981 surface flow over northeast Colorado. Atmospheric Science Paper No. 342, Colorado State University, Ft. Collins, CO.

Kruidenier, M., 1981: Realtime processing and transmission of digital satellite imagery for use at a remote forecasting facility. Submitted to National Weather Digest (July).

Kruidenier, M., 1983: Application of GOES satellite soundings to forest fire management. Preprint Volume, 7th Conference on Fire & Forest Meteorology, April 25-29, 1983, Ft. Collins, CO, AMS, Boston, MA.

Purdom, J., R. Green and H. Parker, 1982: Integration of satellite and radar data for short range forecasting and diagnostic studies. Preprints, 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Purdom, J.F.W., J.F. Weaver and R.N. Green, 1983: Analysis of rapid interval GOES data for the 9 July 1982 New Orleans Airliner Crash. Preprint Volume, Ninth Conference on Aerospace and Aeronautical Meteorology, June 6-9, 1983, Omaha, NE, AMS, Boston,"MA.

Weaver, J., and F. Kelly, 1982: A mesoscale, climatologically-based forecast technique for Colorado. Preprints, 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Weaver, J., and J.F.W. Purdom, 1983: Some unusual aspects of thunderstorm cloud top behavior on May 11, 1982. Preprints 13th Conf. on Severe Local Storms, Tulsa, Amer. Meteor. Soc.

Zehr, R., 1982: Thunderstorm motion analyses. Preprints, 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Project #5-31270 (cont'd.)

Zehr, R., 1983: Case studies of three severe thunderstorm events in eastern Colorado. Preprints 13th Conf. on Severe Local Storms, Tulsa, Amer. Meteor. Soc.

Reports

Brubaker, T., J. Purdom and T. Vonder Haar, 1981: Quarterly report: February 1 - March 31, 1981.

Brubaker, T., J. Purdom and T. Vonder Haar, 1981: Quarterly report: April 1 - June 30, 1981.

Brubaker, T., J. Purdom and T. Vonder Haar, 1981: Final report on Contract NA79-RA-C00152, July 1981.

Brubaker, T., J. Purdom and T. Vonder Haar, 1981: Annual report for FY81, October 1981.

Brubaker, T., J. Purdom and T. Vonder Haar, 1982: Quarterly report: October 1 - December 31. 1981.

Brubaker, T., J. Purdom and T. Vonder Haar, 1982: Quarterly report: January 1 - March 31, 1982.

Brubaker, T., J. Purdom and T. Vonder Haar, 1982: Quarterly report: April 1 - June 30, 1982.

Brubaker, T., J. Purdom and T. Vonder Haar, 1982: Annual report for FY82, October 1982.

Kruidenier, M., J. Purdom and T. Vonder Haar, 1983: Quarterly report: October 1 - December 31, 1982.

Kruidenier, M., J. Purdom and T. Vonder Haar, 1983: Quarterly report: January 1, 1983 - March 31, 1983.

Presentations

Chorowski, Larry R., 1981: Detection of mesoscale pollution in Denver using geostationary satellite data. Presented at AMS/APCA Third Joint Conference on Applications of Air Pollution Meteorology, Philadelphia, PA.

Johnson, R., 1982: Topographic effects and weather forecasting in the Colorado PROFS mesonetwork area. Presented at the 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Kruidenier, M., 1982: Satellite data processing for PROFS at CSU. Presented at University of Wisconsin, January 7, 1982.

Project #5-31270 (cont'd.)

Kruidenier, M., 1982: Interactive data processing for mesoscale forecasting applications. Presented at the 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Purdom, J., 1982: Integration of satellite and radar data for short range forecasting and diagnostic studies. Presented at 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Purdom, J., 1982: A mesoscale, climatologically-based forecast technique for Colorado. Presented at the 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Vonder Haar, T., et al, 1981: Image processing for mesoscale applications. Seminar with several speakers from the project, Colorado State University, Ft. Collins, CO, October 8, 1981.

Zehr, R., 1982: Thunderstorm motion analyses. Presented at the 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Project #5-31271

The Design of Improvements in Severe Weather Warning Programs Utilizing Concepts and Products Derived from PROFS

Principal Investigators: T.M. Carter

Sponsor's #NA81RA-H-00001; Amendment 1; Item 3; 10/1/80 - 10/31/82

Paper

Carter, T.M., 1982: Public response to natural hazard warnings. A chapter in the Value and Uses of Short-Range Mesoscale Weather Information, NOAA/ERL/PROFS - NOAA Technical Memorandum, January 1982.

Reports

Carter, T.M., 1981: Monthly progress report - October 1981.

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Presentations

Carter, T.M., 1981: Response of local emergency service agencies and the public to flash flood warnings. Presented at the National Weather Service's Working Conference on Flash Floods, November 1981, Silver Springs, MD.

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Project #5-31272

Pilot Studies for the International Satellite Cloud Climatology Project

Principal Investigator: T. Vonder Haar

Sponsor's #NA81AA-D-00058; 3/1/81 - 2/28/83.

Papers

Campbell, G.G., 1981: Diurnal radiation budget--Four months assembled into an annual mean. Preprint Volume of the Fourth Conference on Atmospheric Radiation. AMA, Boston, MA, 120-123.

Smith, E.A., 1981: Review of cloud climatologies. Clouds in climate-modeling and satellite observational studies. Report of Workshop held at NASA Goddard Institute for Space Studies, NASA/GISS, New York, NY, 113-149.

Smith, E.A., T.H. Vonder Haar and J. Graffy, 1981: The impact of GOES satellite data compaction on the estimates of cloud parameters. Clouds in climate-modeling and satellite observational studies. Report of Workshop held at NASA Goddard Institute for Space Studies, NASA/GISS, New York, NY, 192-196.

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Vonder Haar, T.H., 1982: Climate studies from satellite observations: Special problems in the verification of earth radiation balance, cloud climatology, and related climate experiments. Invited Paper at the XXIV Plenary Meeting of COSPAR (Committee on Space Research), May 1, 1982, Ottawa, Canada.

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Campbell, G.G., 1983: ISCCP system test summary. Cooperative Institute for Research in the Atmosphere, Colorado State University/National Oceanic and Atmospheric Administration, Ft. Collins, CO, 4 pp.

Project #5-31272 (cont'd.)

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Vonder Haar, T.H., 1983: The ISCCP fact sheet. Cooperative Institute for Research in the Atmosphere, Colorado State University/National Oceanic and Atmospheric Administration, Ft. Collins, CO, 6 pp.

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Ackerman, S.A., and S.K. Cox, 1980: Report on a comparison of satellite and all-sky camera estimates of cloud cover during GATE. NOAA Workshop of Satellite Derived Cloud Data Sets, National Earth Satellite Service, U.S. Department of Commerce, December 4-5, Washington, DC.

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Project #5-31273

Development of Validation and Verification Techniques for Precipitation Estimation from Satellites

Principal Investigators: P. Mielke/G. Brier

Sponsor's #NA81RA-H-00001, Amendment 3; Item 5; 4/1/81 - 9/30/82.

No Papers, Reports or Presentations to date.

Project #5-31274

Testing and Development of Ice Nucleation Materials and Generation Calibration

Principal Investigator: L. Grant

Sponsor's #NA1RA-H-00001, Amendment 5; Item 7; 2/1/81 - 9/30/82.

Paper

Horn, Randy D., William G. Finnegan and Paul J. DeMott, 1982: Experimental studies of nucleation by dry ice. J. of App. Meteor., 21(10), October.

Project #5-31275

Numerical Simulation and Observational Analysis of the Dynamic Response of Towering Cumuli to Massive Seeding

Principal Investigator: W. Cotton

Sponsor's #NA81RA-H-00001, Amendment 4; Item 6; 4/1/81 - 6/30/83.

Papers

Cotton, William R., Gregory Tripoli and Gad Levy, 1982: The three-dimensional simulation of Florida convective clouds - Sensitivity to cloud microphysical processes. Preprints Cloud Physics Conference, November 15-18, 1982 (Chicago, IL), AMS, Boston MA.

Cotton, William R., Mark A. Stephens, Thomas Nehrkorn and Gregory J. Tripoli, 1982: The Colorado State University cloud/mesoscale model - 1982. Part II - An ice phase parameterization. To be published in J. de Rech. Atmos.

Levy, Gad, 1982: Communication mechanisms in dynamically seeded cumulus clouds. M.S. Thesis, Colorado State University, Department of Atmospheric Science, Ft. Collins, CO, Atmospheric Science Paper No. 357, 142 pp.

Project #5-31276

Mesoscale Research

Principal Investigator: T. Vonder Haar

Sponsor's #NA81RA-H-00001, Amendment 6; 8/1/81 - 7/31/83.

Paper

Birkenheuer, Daniel, 1983: Advanced technologies impact on short-term forecasts. 9th Conference on Aerospace and Aeronautical Meteorology, June 6-9, Omaha, NE, AMS, Boston, MA.

Haugen, D., and Robert Lipschutz: A verification program for severe convective storm forecasts.

Winston, H., 1983: Real time processing of volume scan radar reflectivity data. 13th Conf. on Severe Local Storms, Tulsa, Amer. Meteor. Soc.

Reports

Lipschutz, R., 1982: Monthly project report, December 1981.

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Project #5-31278

Hurricane-Typhoon Studies in Support of NOAA Hurricane Research and Forecasting

Principal Investigator: W. Gray

Sponsor's #NA81RA-H-00001; Amendment 9; Item 9; 3/1/82 - 2/28/83.

Reports

Chan, J.C.L., 1982: On the physical processes responsible for tropical cyclone motion. Ph.D. Thesis, Colorado State University, Department of Atmospheric Science, Ft. Collins, CO.

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Project #5-31279

The Genesis and Development of Deep Convective Storms: A New Approach to Their Prediction and Possible Modification

Principal Investigators: P. Sinclair/J. Purdom

Sponsor's #NA82RA-C-00103; 7/1/82 - 6/1/83

Papers

Purdom, J.F.W., J.F. Weaver and R.N. Green, 1983: Analysis of rapid interval GOES data for the 9 July 1982 New Orleans airline crash. Preprint Volume, Ninth Conference on Aerospace and Aeronautical Meteorology, June 6-9, 1983, Omaha, NE, AMS, Boston, MA.

Sinclair, P.C., and J.F.W. Purdom, 1983: Shuttle recovery requirements and the development of arc cloud lines from thunderstorm outflows. Preprint Volume, Ninth Conference on Aerospace and Aeronautical Meteorology, June 6-9, 1983, Omaha, NE, AMS, Boston MA.

Project #5-31280

Satellite Data Reception and Analysis Equipment and Support for Research Activities

Principal Investigators: T. Vonder Haar/J. Purdom

Sponsor's #NA82AA-H-00026; 9/1/82 - 8/31/83

Papers

Green, R.N., and H.A. Parker, 1983: Application of satellite and radar data to severe thunderstorm analysis. Preprints 13th Conf. on Severe Local Storms, Tulsa, Amer. Meter. Soc.

Reports

Vonder Haar, T., J. Purdom, 1982: Quarterly report #1 for the period September 1, 1982 - November 30, 1982.

Project #5-31281

Local Transport and Dispersion in National Parks

Principal Investigator: R. Pielke

Sponsor's #NA81RA-H-00001, Amendment 12; Item 10

No Papers, Reports or Presentations to date.

Project #5-31284

Intergovernmental Personnel Act -- NOAA, National Weather Service

Principal Investigator: M. Carter

Dates: 8/25/82 - 8/24/83

Presentations

Carter, T.M., 1983: Results of the Minnesota Study relating to (a) emergency service agencies and (b) the general public. Presented at NWS Disaster Preparedness Conference, January 10-14, Fort Worth, TX.

Carter, T.M., 1983: Results of the Minnesota study relating to (a) emergency service agencies and (b) the general public. Presented to the Fort Worth Chapter of the AMS. (January 13)

Carter, T.M., 1983: Hallgren briefing. Presented to Southern and Eastern Region attendees of NWS Disaster Preparedness Conference (January 12).

Project #5-31285

A Study of Park Visitors' Visibility, Related Behaviors and Their Relationship to Air Quality.

Principal Investigator: G. Haas

Sponsor's #NA81RA-H-00001, Amendment 13; 1/1/83 - 12/31/83.

Report

Ross, David M., Glenn E. Haas, and Ross J. Loomis, 1983: Study plan for a project entitled assessment of visibility impairment on visitor enjoyment and utilization of park resources. Submitted to Air Quality Division, National Park Service. Colorado State University, Ft. Collins, CO.

Project #5-36090

An Investigation of the Application of Monte Carlo Method to Problems in Visibility

Principal Investigators: S. Cox/T. McKee

Sponsor: John Muir Institute; 8/24/82 - 6/30/83

No Papers, Reports or Presentations to date.

Project #5-36091

Development of Psychological Indicators of Visual Quality Judgments

Principal Investigator: R. Loomis

Sponsor: John Muir Institute; 8/24/82 - 6/30/83

No Papers, Reports or Presentations to date.

Project #5-36092

Atmospheric Transport Processes Affecting Visibility in National Parks

Principal Investigator: E. Reiter

Sponsor: John Muir Institute; 8/24/82 - 6/30/83

No Papers, Reports or Presentations to date.

Project #5-36093

Statistical Reduction and Analysis of Visibility-Related Data and Statistical Modeling of Visibility-Related Variables and Processes

Principal Investigator: W. Sadeh

Sponsor: John Muir Institute; 8/24/82 - 6/30/83

No Papers, Reports or Presentations to date.

NOAA/NESDIS/RAMM Branch

Papers

Caracena, F., R.A. Maddox, J.F.W. Purdom, J.F. Weaver, and R.N. Green, 1983: Multi-scale analyses of meteorological conditions affecting Pan American World Airways Flight 759. NOAA/ERL, Boulder, CO and NOAA/NESDIS, Ft. Collins, CO, 53 pp.

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Green, Robert N., and Melanie A. Kruidenier, 1982: Interactive data processing for mesoscale forecasting applications. Preprints, 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Green, R.N., and H.A. Parker, 1983: Application of satellite and radar data to severe thunderstorm analysis. Preprints 13th Conf. on Severe Local Storms, Tulsa, Amer. Meteor. Soc.

McBride, John L., and Raymond Zehr, 1981: Observational analysis of tropical cyclone formation. Part II: Comparison of non-developing versus development systems. J. of Atmos Sc., 38(6), June 1981.

Purdom, J., 1981: Combining satellite and conventional data for very short range forecasting purposes. Proceedings, IAMAP Symposium, August 25-28, 1981, Hamburg.

Purdom, James F.W., 1982: Subjective interpretation of geostationary satellite data for nowcasting. Chapter 3.1 from Nowcasting (K.A. Browning, Ed.), Academic Press Inc. (London) Limited.

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Purdom, James F.W., and John F. Weaver, 1982: Nowcasting during the 10 April 1979 tornado outbreak: A satellite perspective. Preprints, 12th Conference on Severe Local Storms, January 11-15, 1982, San Antonio, TX, AMS, Boston, MA.

Purdom, James F.W., and Kevin Marcus, 1982: Thunderstorm trigger mechanisms over the southeast United States. Preprints, 12th Conference on Severe Local Storms, January 11-15, 1982, San Antonio, TX, AMS, Boston, MA.

Purdom, James F.W., Robert N. Green and Hugh A. Parker, 1982: Integration of satellite and radar data for short range forecasting and storm diagnostic studies. Preprints, 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

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Sinclair, P.C., and J.F.W. Purdom, 1983: The genesis and development of deep convective storms. Final report on Contract NA80AA-D-00056, ISSN 0737-5352, CIRA Paper No. 1. Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO.

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Weaver, John F., and Frank P. Kelly, 1982: A mesoscale, climatologically-based forecast technique for Colorado. Preprints, 9th Conference on Weather Forecasting and Analysis, June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

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Zehr, Raymond M., 1982: Thunderstorm motion analyses. Preprints, 9th Conference on Weather Forecasting and Analysis, June 28-July 1,1982, Seattle, WA, AMS, Boston, MA.

Zehr. R.M., 1983: Case studies of three severe thunderstorm events in eastern Colorado. Preprints 13th Conf. on Severe Local Storms, Tulsa, Amer. Meteor. Soc.

Zehr, Raymond M., and James F.W. Purdom, 1982: Examples of a wide variety of thunderstorm propagation mechanisms. Preprints, 12th Conference on Severe Local Storms, January 11-15, 1982, San Antonio, TX, AMS, Boston, MA.

Films

Purdom, James F.W., 1981: The importance of thunderstorm outflow boundaries in the development of deep convection. WAB 456, 29 minutes (sound film), The Walter A. Bohan Company, Park Ridge, IL.

Presentations

Green, Robert N., and Melanie A. Kruidenier, 1982: Interactive data processing for mesoscale forecasting applications. Presented at the 9th Conference on Weather Forecasting and Analysis (by M. Kruidenier), June 28-July 1, 1982, Seattle, WA, AMS, Boston, MA.

Green, Robert N., 1982: Image processing systems as tools for atmospheric research. Presented at the Department of Atmospheric Science (by R. Green), Colorado State University, Ft. Collins, CO, September 2.

Purdom, James F.W., 1981: Possible uses of rapid scan satellite data in the CCOPE experiment. Presented at NCAR (by J. Purdom), January 6, Boulder, CO.

Purdom, James F.W., 1981: Forecasting severe storms using satellite image data. Presented at the National Weather Service Central Region (by J. Purdom), February 6, Kansas City, MO.

Purdom, James F.W., 1981: Training seminars on using satellite data for severe storm forecasting and isolation of tornado threat areas. Presented to U.S.A.F. Offutt AFB (by J. Purdom), 2 sessions: February 9-11; February 11-13, Offutt AFB, NE.

Purdom, James F.W., 1981: Satellite systems, orbits and how satellite data fits into short range forecast programs. Presented to Environmental Research Laboratories (by J. Purdom), February 26, Boulder, CO.

Purdom, James F.W., 1981: Satellite image analysis for meteorological understanding. Presented to Northern Illinois University (by J. Purdom), March 19, DeKalb, IL.

Purdom, James F.W., 1981: Satellite observations of tornadic storms. Presented at Joint Meteorology and SSEC Colloquium (by J. Purdom), June 5, University of Wisconsin, Madison, WI.

Purdom, James F.W., 1981: New thoughts on tornado genesis from combining satellite and conventional radar data. Presented at IGRSS Conference (by J. Purdom), June 9, Washington, DC.

Purdom, James F.W., 1981: Using satellite and radar data to understand the mechanisms of tornado genesis. Presented at NASA/GSFC/Goddard Laboratory for Atmospheric Science (by J. Purdom), June 10, Greenbelt, MD.

Purdom, James F.W., 1981: Understanding thunderstorm development and tornado genesis using satellite data. Presented to NESS (by J. Purdom), June 11, Washington, DC.

Purdom, James F.W., 1981: Uses of satellite imagery for mesoscale analysis and nowcasting. Training sessions presented to PROFS/ERL (by J. Purdom), July 27-29, Boulder, CO.

Purdom, James F.W., 1981: Uses of rapid scan satellite data for downburst analyses. Presented to NCAR (by J. Purdom), November 17, Boulder, CO.

Purdom, James F.W., 1981: Using satellite and radar data to better understand and nowcast tornadic storms. Presented at Joint Meteorology and SSEC Coloquium (by J. Purdom), December 6, University of Wisconsin, Madison, MI.

Purdom, James F.W., 1981: What has been learned from rapid scan satellite data analysis and what the future holds. Presented to NESS (by J. Purdom), December 10, Washington, DC.

Purdom, James F.W., 1982: Current satellite systems and uses of the data. Presented to ERL (by J. Purdom), February 25, Boulder, CO.

Purdom, James F.W., 1982: Using satellite data to forecast convective development and evolution. Presented to U.S.A.F. (by J. Purdom), two sessions: February 8, 9; February 10, 11, Scott AFB, IL.

Purdom, James F.W., 1982: The development and evolution of deep convection--Using satellite data to nowcast tornadoes. Presented to U.S.A.F. (by J. Purdom), two sessions: April 5-7; April 7-9, Offutt AFB, NE.

Purdom, James F.W., 1982: Convective scale interaction and its implications for weather modification. Presented to North Dakota Weather Modification Board (by J. Purdom), May 11, Bismarck, ND.

Purdom, James F.W., 1982: Satellite data and NWS operational needs. Presented to ERL/NWS Technical Exchange Conference (by J. Purdom), May 13, Estes Park, CO.

Purdom, James F.W., 1982: The development and evolution of deep convection. Presented in Atmospheric Science Seminar Series (by J. Purdom), May 27, Colorado State University, Ft. Collins, CO.

Purdom, James F.W., 1982: Satellite data and convective weather modification. Presented to North Dakota Weather Modification Advisory Board (by J. Purdom), June 15, Bowman, ND.

Purdom, James F.W., 1982: Mesoscale interpretation of satellite imagery. Presented at Workshop in Satellite Meteorology (by J. Purdom), July 21, Colorado State University, Ft. Collins, CO.

Purdom, James F.W., and Kevin Marcus, 1982: Thunderstorm trigger mechanisms over the southeast United States. Presented at the 12th Conference on Severe Local Storms (by J. Purdom), January 11-15, San Antonio, TX, AMS, Boston, MA.

Purdom, James F.W., and John F. Weaver, 1982: Nowcasting during the 10 April 1979 tornado outbreak: A satellite perspective. Presented at the 12th Conference on Severe Local Storms (by J. Purdom), January 11-15, San Antonio, TX, AMS, Boston, MA.

Purdom, James F.W., Robert N. Green and Hugh H. Parker, 1982: Integration of satellite and radar data for short range forecasting and storm diagnostic studies. Presented at the 9th Conference on Weather Forecasting and Analysis (by J. Purdom), June 28-July 1, Seattle, WA, AMS, Boston, MA.

Purdom, James F.W., 1982: Satellite data applications for short range forecasting. Presented to NESS (by J. Purdom), September 13, Washington, DC.

Purdom, James F.W., 1982: Uses of rapid scan satellite data in understanding and forecasting storm development presented to NESS (by J. Purdom), September 14, Wallops Island, VA.

Purdom, James F.W., 1982: Satellite data as a tool in understanding thunderstorm development and evolution. Presented to Office of the Federal Coordinator for Meteorological Services (by J. Purdom), September 16, Rockville, MD.

Purdom, James F.W., 1982: Using satellite data to understand the development and evolution of deep convection. Presented at the Headquarters NOAA/RD Seminar (by J. Purdom), September 16, Rockville, MD.

Sinclair, P.C., and James F.W. Purdom, 1982: Integration of research aircraft and 3 minute interval GOES data to study the genesis and development of deep convective storms. Presented at the 12th Conference on Severe Local Storms (by J. Purdom), January 11-15, San Antonio, TX, AMS, Boston, MA.

Weaver, John F., 1981: Using satellite and conventional data for severe storm environment forecasting. Presented to PROFS/ERL (by J. Weaver), July 29, Boulder, CO.

Weaver, John F., 1982: Severe weather spotting. Presented to University of Northern Colorado (by J. Weaver), April 23, Greeley, CO.

Weaver, John F., 1982: How to recognize severe weather from the ground. C.S.U. Campus Police Training Lecture (by J. Weaver), June 9, Colorado State University, Ft. Collins, CO.

Weaver, John F., 1982: Satellite orbits. Presented at Workshop in Satellite Meteorology (by J. Weaver), July 19, Colorado State University, Ft. Collins, CO.

Weaver, John F., 1983: Results from the 1982 satellite compositing study (by J. Weaver), May 3, Colorado State University, Ft. Collins, CO.

Weaver, John F., and Frank P. Kelly, 1982: A mesoscale, climatologically-based forecast technique for Colorado. Presented at the 9th Conference on Weather Forecasting and Analysis (by J. Purdom), June 28-July 1, Seattle, WA, AMS, Boston, MA.

Zehr, Raymond M., 1982: Combining satellite radar and conventional data to observe mesoscale features pertinent to thunderstorm development. Presented at 1981 International Geoscience and Remote Sensing Symposium (by J. Purdom), June 9, Washington, DC.

Zehr, Raymond M., 1982: Thunderstorm motion analyses. Presented at the 9th Conference on Weather Forecasting and Analysis (by R. Zehr), June 28-July 1, Seattle, WA, AMS, Boston, MA.

Zehr, Raymond M., and James F.W. Purdom, 1982: Examples of a wide variety of thunderstorm propagation mechanisms. Presented at the 12th Conference on Severe Local Storms (by J. Purdom), January 11-15, San Antonio, TX, AMS, Boston, MA.

TRAINING WORKSHOP IN SATELLITE METEOROLOGY--A REVIEW

A Training Workshop in Satellite Meteorology was held July 19-23, 1982 on the campus of Colorado State University in Fort Collins, Colorado. The workshop was co-sponsored by CIRA at Colorado State University, The American Meteorological Society via its Committee on Meteorological Aspects of Aerospace Systems, and NASA/Marshall Space Flight Center. James F.W. Purdom of CIRA and NOAA/NESDIS chaired the workshop which was attended by over 80 scientists from across the country.

The workshop covered uses of satellite data in atmospheric science and provided state-of-the-art information on uses of satellite data as well as information concerning the "how to and where to" portions of getting the data. Another of the workshop's primary functions was to provide source material to university personnel for developing and augmenting courses in satellite meteorology and atmospheric science that would also be of considerable value to those involved in various aspects of meteorological research outside of the university community. A special preprint volume was prepared for the participants.

The workshop was divided into four sections. Each section was presented by experts in that field and ended with an open discussion of the state-of-the-art and promising areas for future development. The first section "Meteorological Satellites and Their Data," was presented by W. Vaughan of NASA/MSFC, D. Miller of NOAA/NESDIS, J. Scoggins of Texas A&M, and E. Hoppe of NOAA/NESDIS. The second section, "Satellite Image Analysis and Interpretation," was presented by V. Oliver of NOAA/NESDIS, J. Purdom of NOAA/NESDIS/CIRA, G. Wilson of NASA/MSFC, R. Adler of NASA/GSFC, T. Fujita of the University of Chicago, S. Kidder of the University of Illinois at Urbana, and C. Griffith of NOAA/ERL. The third section, "Satellite Soundings and Their Uses," was presented by M. Chahine of JPL, California Institute of Technology, W. Smith of NOAA/NESDIS, and R. Atlas of NASA/GSFC. T. Vonder Haar of CSU/CIRA presented the fourth section, "Satellite Data for Climate Studies. The banquet speaker was Dr. J. McElroy, NOAA's Associate Administrator for Satellites, who spoke on "Meteorological Satellites in the Future."

The set of volumes (3) are available for purchase from CIRA.

EXPANDED REPORTS - A SELECTION

ESTIMATING THE USES AND BENEFITS DERIVED FROM PROFS

Harold C. Cochrane, Principal Investigator

NA80RA-C-00183

8/1/80 - 11/30/82

The Value of Weather Information in the Power Generation Industry: A Case Study

Background

In October of 1979 NOAA (ERL) initiated a new research program designed to facilitate the transfer of forecasting technology to practicing meteorologists. As originally conceived, the project encompassed more than the development of new sophisticated sensing networks and data displays. A series of studies were earmarked to determine the extent to which improved forecasts would benefit households, businesses and governmental operations. Specifically, these studies were intended to uncover user's needs and dissemination requirements. Findings regarding the type, timing and accuracy of weather forecasts were to help shape the nature of the weather displays as well as the raw data requirements.

The valuation of weather forecasts in the electric generation industry is but one of these studies. A public utility was selected after screening activities which have often been mentioned in the literature as being highly sensitive to weather. The criteria which were used to narrow the field of potential studies centered on: weather sensitivity, available options to mitigate losses; the magnitude of potential savings, the degree to which decisions could be captured by an economic framework, and the extent of cooperation and interest expressed by industry representatives.

To keep the research within manageable proportions, the project had to be further delineated. Focus was placed on a single utility. As a result, those aspects of power management which entail the interaction of utilities were simplified. Contractual arrangements between companies were represented as a firm commitment to purchase specified amounts of energy per month.

The task of measuring the value of improving weather forecasts clearly revolves around the type and quality of information received. Most utilities currently utilize the Weather Service's 24-hour forecast sometimes modified by the judgment of private meteorological consultants. At the time the project was initiated, the specific nature of forecast improvements was not specified. All that was known was NOAA's intent to increase accuracy, shorten the lead time, and insure area specificity. The details regarding the extent of improvements anticipated, the number of updates, or the format of the forecast could only be imagined.

The value of either currently available forecasts or potential improvements was scaled against the generating company's next best alternative. That is, it could simply use a form of persistence to guide their operating strategy. Certain cues such as yesterday's maximum temperature and the previous four-hour generating pattern provide a useful means of projecting future loads. These data would be available and independent of weather forecasts.

Objective and Approach

The object of the research was to determine the extent to which a generating company's fuel costs could be reduced as a result of better weather information. Experiments were performed varying the timing and accuracy of forecasts. Decision theory has been traditionally applied to such problems. However, in this instance it had to be abandoned due to the complexity of the choices facing typical utilities. Computer simulations of observed operating rules were utilized instead.

The benefits of improving load forecasts were anticipated to fall into two categories. When demand is underforecast, more costly generators and expensive external sources of power are required. When demand is overestimated, an unnecessarily large generating capacity must be maintained.

The tie between weather forecasts and the subsequent value to users is displayed symbolically in Figure 1. A statistical analysis of Denver's daily electric load profile indicated that most of the variation could be predicted. The result was a series of equations demonstrating the influence of weather and nonweather factors on the city's demand for power. Three different models (each with 48 equations) were proposed. The first was based on the receipt of a single weather forecast, the succeeding day's high and low temperatures. The other two reflected short-term forecasts, one of which included weather variables the other did not. The latter utilized information about preceding hour's generation only. Separate equations were constructed for the weekdays in order to capture the effects of normal commercial activities. The resulting models were exercised to forecast loads and thereby determine the influence of any improvements on operating costs. This was done by feeding the load forecasts to a generation algorithm.

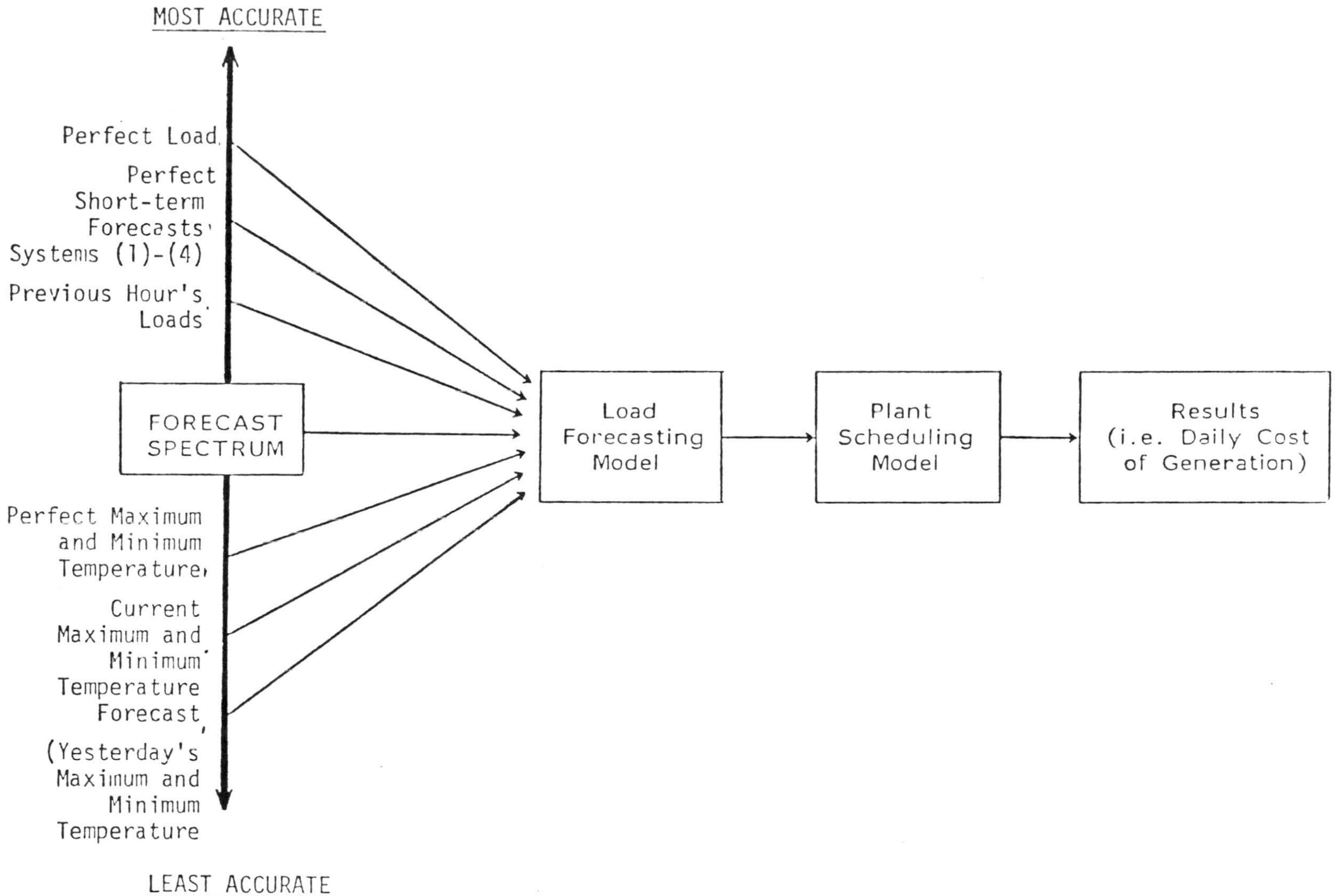

Fig. 1. Sequence of experiments performed to establish the potential economic value of improved weather forecasts to an electric generation utility.

The algorithm was designed to mimic the rules of thumb employed by a typical utility. Generating units were scheduled according to their incremental costs. Power was dispatched from the most inexpensive units first. The less efficient gas and oil units were then utilized to meet the region's peak power needs.

An example of the simulation's results is provided in Figure 2. The amount of power dispatched by unit (megawatts) is displayed in the upper portion of the Table; the lower rows summarize the hourly cost of meeting electricity demand. The daily costs are shown at the bottom of the Figure.

Summary of the Results

The scheduling model was exercised for a three-month period: June, July and August of 1980. Actual hourly weather information was utilized

Table 1. Summary results for the three-month period.

Forecast Type	Three-month Cost to Meet Demand (Assuming $500/MW Penalty)
Perfect Load	$47,561,000
Perfect High & Low Temperature Forecast	47,651,600
Perfect High & Low	47,846,600
Perfect Four-hour Forecast	47,716,200

to forecast demand and schedule units. As expected, the lowest cost solution was produced as a result of knowing the next day's loads with certainty. This sets the lower bound on cost since any other forecasting method would involve error and, consequently, a larger expense. Reliance on the previous day's observed weather yielded the least reliable load forecast.

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Fig. 2. Sample results for 6/4/80.

The resultant expense to the utility proved to be $.0335 million higher. The added expense reflected the cost of maintaining excess capacity when demand failed to materialize. This comparison is somewhat unrealistic, but it does serve to illustrate the widest possible difference in cost and, hence, sets bounds on the magnitude of savings one could anticipate as a result of forecast improvements. The extent to which these costs could be reduced through improved information was determined by first experimenting with current forecast accuracy.

Given current skills, the cost of generation proved to be $47.846 million, a slight improvement ($44 thousand) over a persistence forecast.

Succeeding experiments focused on improving accuracy and verifying the lead time with which the forecast is received. For example, it was discovered that a "perfect meteorological forecast" resulted in operating costs declining to $47.651 million. This means that the value of improving temperature forecasts of this nature is at most $0.195 million over the ninety-day period.

The extent to which such savings could be achieved hinges on the degree of forecasting improvements that can be anticipated. Obviously, a perfect temperature forecast is out of the question. However, a dramatic improvement in short-term predictions may be achieved. This potential was explored by hypothesizing a perfect four-hour forecast. Operating costs dropped to $47.716 million, implying that such an improvement would save the company nearly $0.174 million.

The savings and costs cited above were derived for the peak period of June, July and August. One can only guess how these results might vary for the other seasons of the year. It may not be unreasonable, however, to anticipated winter savings to be one-half; and fall and spring to be one-third of those realized in summer. If so, the present worth of the annual stream of fuel savings could be $5.17 million for a perfect high-low temperature forecast, and $3.77 million for a perfect short-term (four-hour) temperature forecast.*

Aside from the value estimates just provided, the models provided some useful insights into several related issues. First, it was discovered that temperature forecasts did not alter scheduling over weekends. The load profile proved to be much flatter than that of weekdays. As a result, the demands could be met utilizing base units only. Under such circumstances forecasts play a limited role in shaping operating strategies, and the value of forecasts during this period is likely to be minimal.

It is also interesting to note that the simple load models developed for the Denver region are capable of explaining 92 to 95 percent of the variation in demand throughout the peak period (2:00 p.m. to 3:00 p.m.). Despite the fact that the model's explanatory power drops during the off-peak period, the cost of meeting demands is not appreciably affected by the model's error. Apparently, it is accurate for the periods of the day when scheduling is most critical. The value of improving the model can be gleaned from the results displayed in Table 1. The cost of generation given a <u>perfect</u> load profile is $47.561 million; the equivalent cost given a perfect high-low temperature forecast is $47.651 million, only $90 thousand higher. It appears that error in the temperature forecasts is the most critical aspect of the problem. Further refinements designed to reduce error in the model is unlikely to yield significant benefits.

*These estimates were obtained by discounting the annual savings in perpetuity (10 percent).

It may be unwise to draw sweeping conclusions from the study. Utilities serving customers in other climatic zones exhibit a different sensitivity to forecasts. The Public Service Company of Colorado's (PSCC) service area is dispersed geographically, yet Denver's demand looms large relative to the rest of the state. Consequently, climate and weather information is easily incorporated into the problem. A temperature forecast for the City of Denver alone is sufficient to determine the PSCC's daily load profile. In other regions of the country where the geographical dispersion is matched by regional variability in loads, the value of more sophisticated demand models may be enhanced. It should also be noted that the results are limited to day-to-day operations, primarily commiting units and dispatching power. This is but one element of PSCC's operations. Weather forecasting may prove most value in the scheduling of maintenance of plants, line repair and/or cash flow projections (based upon anticipated electric usage).

LOCAL TRANSPORT AND DISPERSION IN NATIONAL PARKS

Roger Pielke, Principal Investigator

NA81RA-H-00001 Amend. 12; Item 10

9/1/82 - 8/31/83

This study, begun in September 1982, is directed toward developing an improved, more accurate assessment tool of potential air quality degradation in Shenendoah National Park due to the introduction of new source emissions in the vicinity of the Park. Current, operationally utilized tools are felt to be unable to realistically represent the complicated spatial and temporal variations of air quality which are likely to be present in irregular terrain, such as found in Shenendoah National Park.

One fundamental problem that needs to be addressed in mountainous terrain is: under what circumstances does a plume emitted in a valley move up and over an adjacent ridge, and when does it remain confined to the valley (e.g. see Figure 1). The answer to this question is expected to be a function of such parameters as effective stack height, local and synoptic thermodynamic stratification, and the prevailing large scale wind field (including its speed and directional shear). A goal for this component of the work is to quantify for idealized terrain, and for the specific terrain configuration of Shenendoah National Park, when will movement out of the valley adjacent to the Park occur and when it will not. The answer to this question is critical if realistic estimates of air pollution concentration within the Park are to be assessed.

One of the tools which we are using to determine the meteorology for specific terrain configuration is a mesoscale numerical mesoscale model which has been documented in the peer-reviewed literature (e.g. Segal and Pielke (1981), Segal et al (1982), Pielke and Mahrer (1978)). These studies

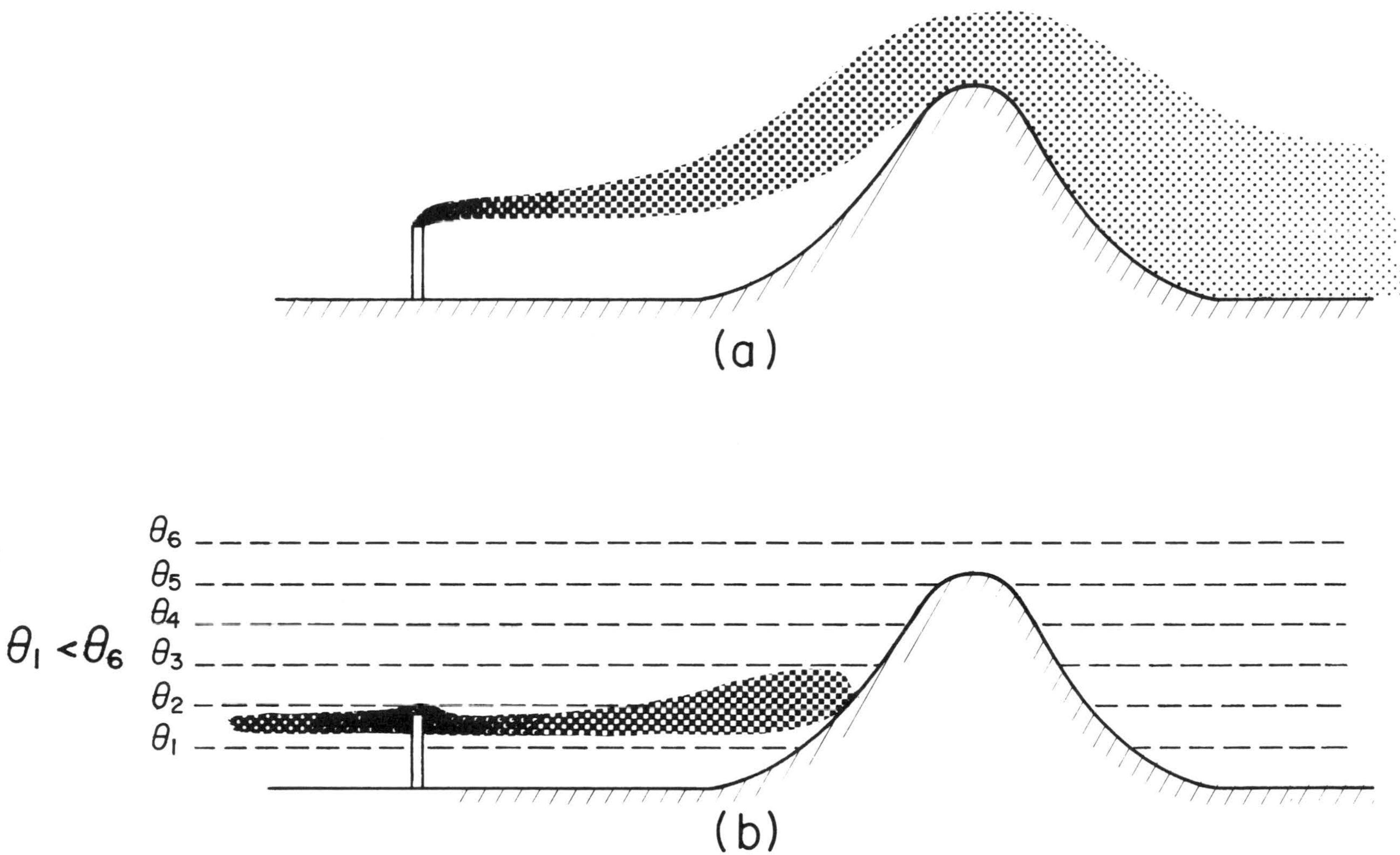

Figure 1 Schematic of plume behavior (a) in an adiabatic atmosphere where it easily moves up and over an adjacent ridge; and (b) in an atmosphere with large thermodynamic stability such that the plume is constrained to remain in the valley. A weak gradient wind flow from left to right is assumed.

include the quantitative validation of the model for specific case studies of terrain-induced local weather features. The second tool to be applied in our investigation utilizes the output from the mesoscale model in order to drive a semi-stochastic transport and diffusion model. This model simulates the spread of an effluent which is influenced by a temporally and spatially varying field of wind and turbulence. As described in Pielke, et al (1983), this approach is felt to be an effective improved mechanism to assess air quality degradation due to point sources.

Among the other related questions which will be addressed in our study are:

- is the air pollution transferred from long distance into a local region (such as Shenendoah National Park) preferentially deposited in specific locations?
- using idealized, as well as real terrain configurations, what are the mechanisms and rate of accumulation of pollution for specific synoptic situations and times of day? How is this pollution flushed from the valley (either by shear-induced turbulence at the top of an inversion or through transport up and over the adjacent ridges)?

The answers to these questions will provide an improved understanding of the meteorology in complex terrain, as well as yield a next generation air quality assessment tool.

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SATELLITE STUDIES AND FOCAL POINT ACTIVITIES FOR PROFS

Thomas Vonder Haar, Thomas Brubaker (2/1/81-9/30/82),
James Purdom (10/1/82-9/30/83), Principal Investigators

NA81RA-H-00001; Amendment 2; Item 4

2/1/81-9/30/83

ABSTRACT

The Prototype Regional Observation and Forecasting Service (PROFS) Program is designed to answer the needs of nowcasting and prediction in Colorado's front range area and has emphasized the summer convective season weather. The operational objectives to which CIRA has made contributions include forecasting, professional training and observation, realtime data processing and archiving, systems design and systems development. Investigative support has included analysis of the mesoscale convective environment and technical studies in the realm of satellite image interpretation.

Operational Support to PROFS Summer "Exercise"

During the summer of 1982, the PROFS Program Office implemented experimental forecasting workstations at their Exploratory Development Facility (EDF) and at the Denver NWS Forecast Office (WSFO), information which was accessible to forecasting teams at these sites was the result of a massive, continuing program of collection, processing and display of current regional and local weather data. Forecasters were asked to analyze summertime weather patterns daily over eastern Colorado, in order to evaluate the requirements of a regional forecasting service and the severe weather prediction capabilities of the PROFS system in use.

Data sources available to the forecast team members included GOES satellite imagery, NWS radar reflectivity imagery, standard upper-air observations, surface mesonet data, and lightning strike locations. Colorado State University (CSU) provided GOES-West visible and infrared image sectors in near realtime each half hour. A satellite receiving and processing subsystem dedicated to this task was configured, and specialized applications and systems software written. The digital imagery was used within the EDF during the winter and spring quarters for the creation and testing of PROFS software, and during the summer for the forecast exercise. GOES-West three-minute rapid scan (RRSD) image sequences were archived at CSU for 21 severe weather days during the summer then processed and delivered to the EDF at the end of the summer season. Through these activities, CSU transferred to PROFS over 11,000 realtime satellite images and almost 5,000 rapidscan images from the summer operational period alone.

The expertise of the NESDIS Regional and Mesoscale Meteorology (RAMM) Branch was utilized through CIRA to provide forecast training, evaluation of the experimental forecast exercise, and severe storm verification data. Video tapes and written training materials on the uses of satellite data for mesoscale analysis were prepared and distributed. Participation as lead forecasters involved training other forecast team members in nowcasting and severe thunderstorm watch/warning decision making. Evaluation activities of the forecasters were the monitoring of workstation performance and determining the relative usefulness of each available information display type during daily weather analysis and prediction.

Forecasts of severe weather scenarios were also made daily at CSU in order to schedule GOES rapid scan data collection periods. Also, nowcasting at CSU was used on occasions when "storm chase" vehicles left from CSU to obtain severe event observational data for PROFS forecast verification. Observers documented storm visual characteristics and provided event summaries with respect to supporting mesoscale and synoptic evidence.

Studies of Mesoscale Convective Development

Surface wind data from 20 PROFS surface mesonetwork stations have been analyzed for the month of July 1981 to determine characteristic flow patterns over northeast Colorado (Johnson and Toth, 1981a,b). It has been found that diurnal forcing by radiative heating exerts a dominant control on the flow fields with a basic pattern of drainage flow at night and upslope flow in the daytime. It is observed along the front range of eastern Colorado that rather than occurring simultaneously at all elevations, the downslope-to-upslope and upslope-to-downslope transitions begin at the foothills of the Rocky Mountains and propagate eastward toward the plains. The period of time for the transition from downslope to upslope during July mornings is $\sim$3 h and from upslope to downslope $\sim$4-5 h. During July local confluence is found at midday (Fig. 1) along major east-west ridges in the region (e.g., Cheyenne Ridge and Palmer Lake Divide); and, consequently, these ridges are preferred regions for afternoon thunderstorm activity. The late afternoon onset of downslope flow (Fig. 2) appears to be often associated with a preferred development of thunderstorms at this time just west of the upper reaches of the South Platte River Basin followed by propagation toward eastern Colorado later in the evening. The occurrence of the downslope onset well before sunset may be a consequence of downward mixing of westerly momentum by the growth of the convective boundary layer or may somehow be caused by the early afternoon development of cumulonimbus along the Continental Divide.

A preference for thunderstorm development along the Cheyenne Ridge and Palmer Lake Divide rather than the adjacent river valleys is evident in the July average precipitation pattern over the region (Fig. 3).

All convective days in Colorado for the period May 1-September 10 in 1981 were analyzed through the use of GOES imagery and 1200 GMT synoptic data, including surface dewpoints, winds, 700 mb moisture and 500 mb geostrophic winds. Satellite photos were used to stratify convective initiation patterns and favored areas according to synoptic conditions. Hourly images between 1500 and 2200 GMT for the months of June, July and August were digitally composited into image products (see Fig. 4) which typify cloud development under the various synoptic stratifications. Comparison of the composite images with realtime data can be valuable as an assessment of convective potential and cloud distribution (Kelly, 1982).

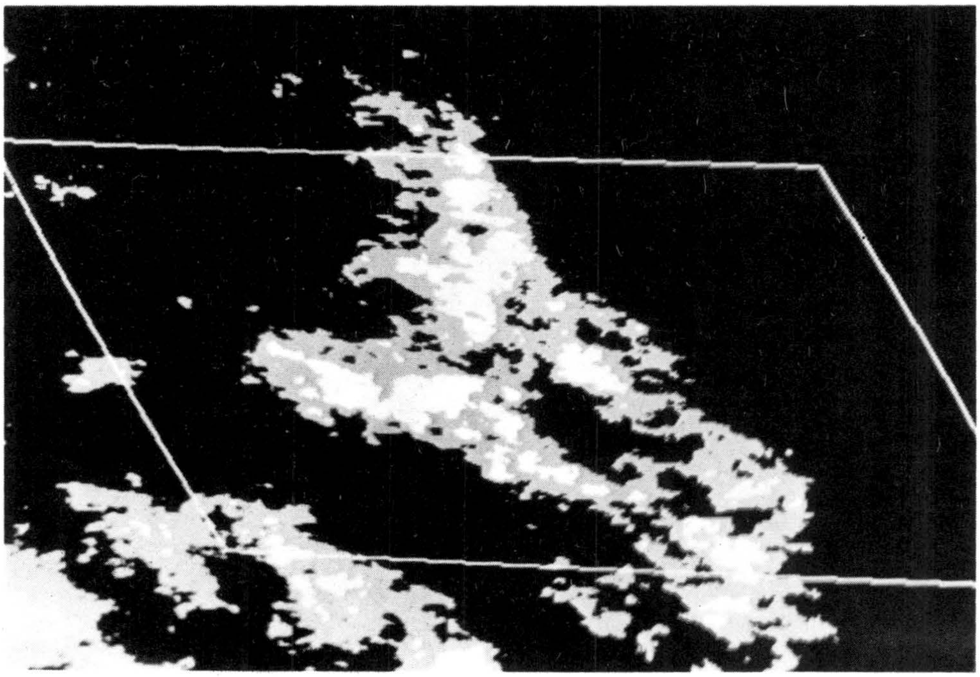

Fig. 4. Composite of visible satellite imagery for mid-morning in July over Colorado region.

Fourteen case study days from the summer 1981 were also selected to investigate and document thunderstorm propagation mechanisms in Colorado. Utilizing the 1981 RRSD data set and image display facilities at CSU, along with Limon radar film, radiosonde observations, conventional and PROFS mesonet surface data, each case was analyzed in detail. Cells which moved differently than the mean cloud layer flow were identified, and the characteristics of these were compared with other convective complexes in the vicinity. A classification scheme and conceptual model of thunderstorm motion is being pursued (Zehr, 1982).

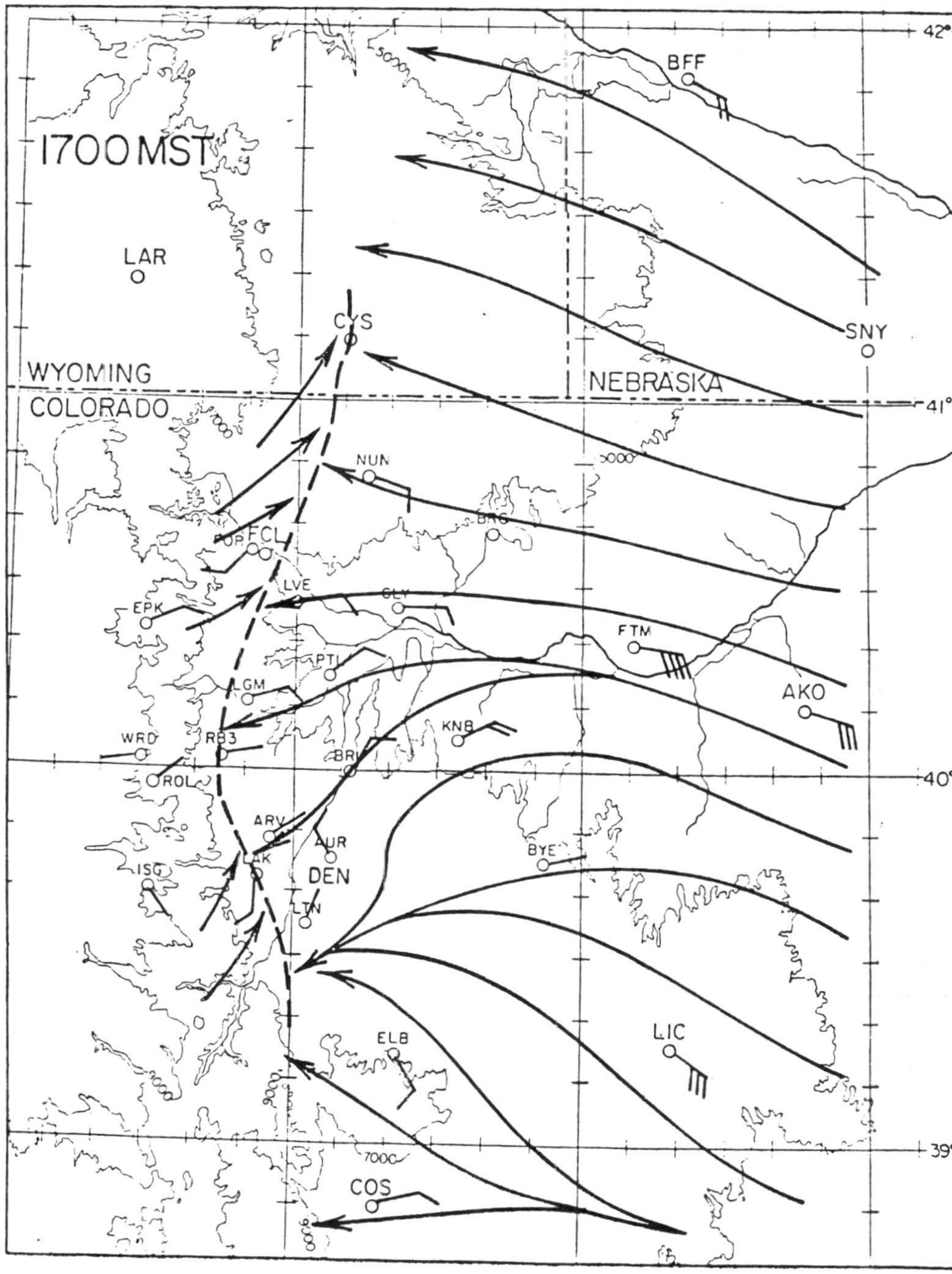

Fig. 1. Surface streamline analysis for 1700 Mountain Standard Time (MST). Plotted winds are in ms^{-1} (one full barb = 1 ms^{-1}). From Johnson and Toth (1982b).

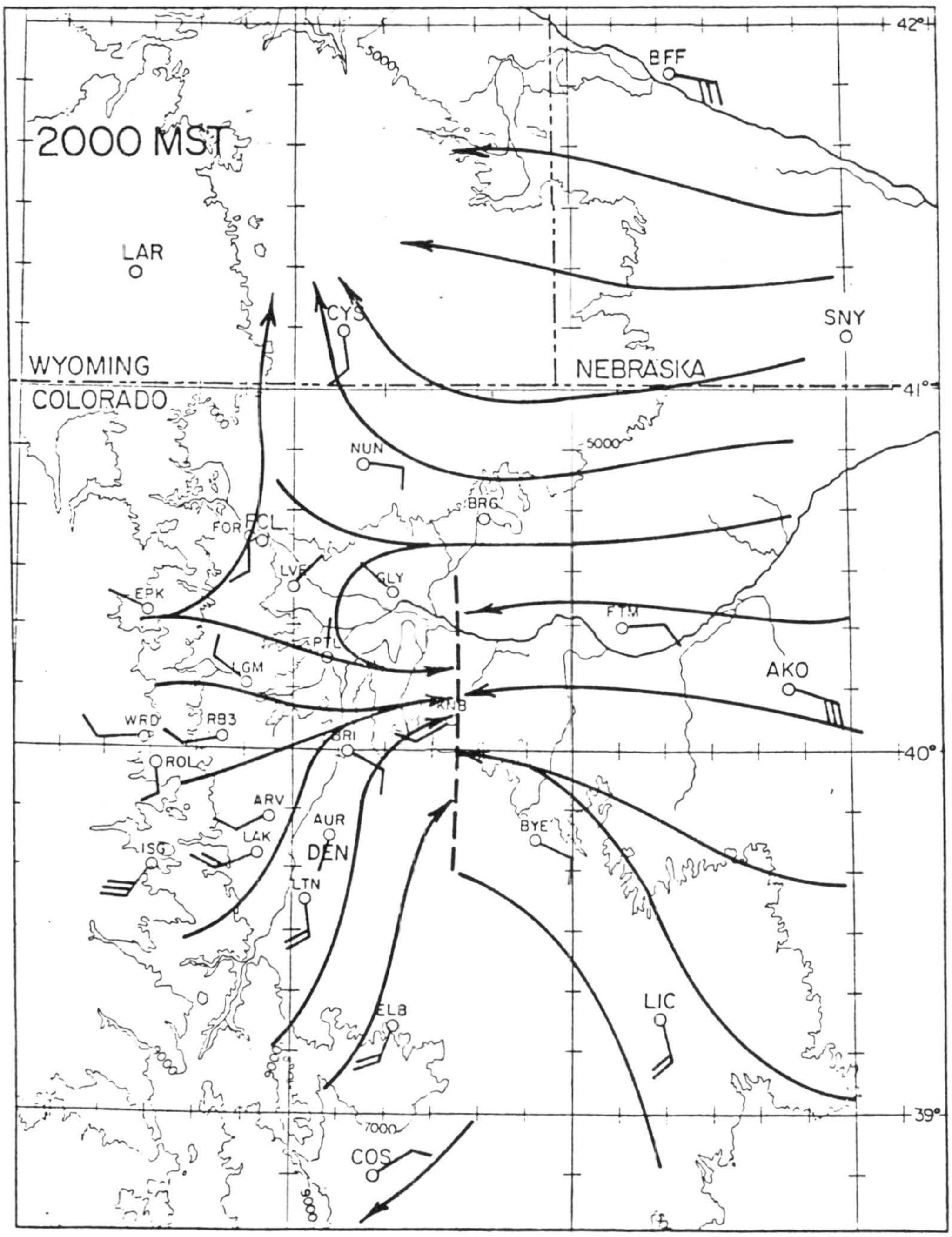

Fig. 2. Surface streamline analysis for 2000 Mountain Standard Time (MST). Plotted winds are in ms^{-1} (one full barb = 1 ms^{-1}). From Johnson and Toth (1982b).

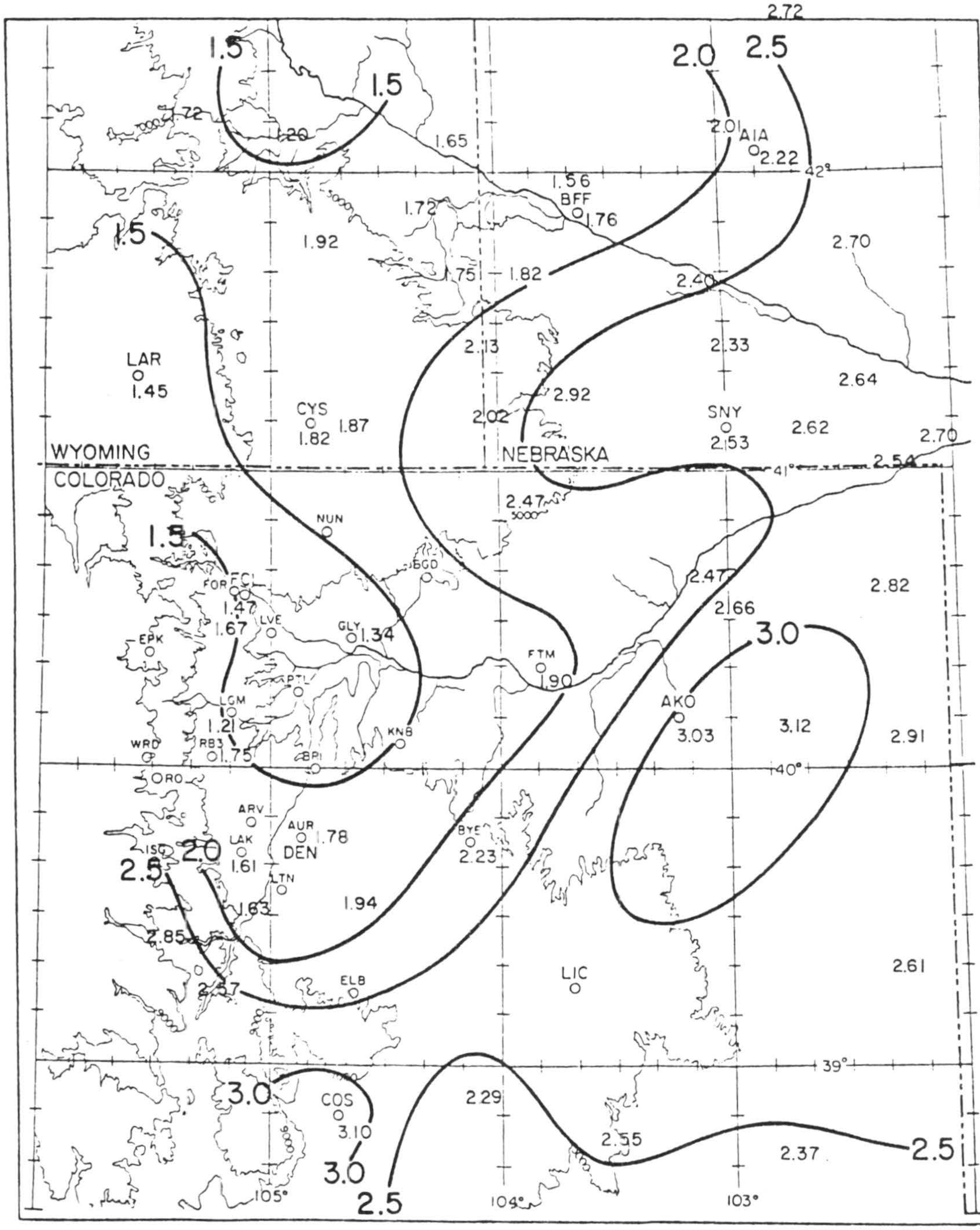

Fig. 3. July average precipitation over the region of this study (inches). From Johnson and Toth (1982b).

Other work in satellite analysis and applications has been the use of RRSD infrared imagery with interpolative image magnification and selective color enhancement of cloud top thermal gradients. This process revealed more continuity in the movement of warm and cold anvil areas. Cloud top structural evolution is being related to the underlying three-dimensional radar echo patterns. Results from these studies will be used to assess the temporal frequency requirements of satellite and radar scanning for severe storm nowcasting (Purdom, Green and Parker, 1982).

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