ANALYSES OF THE CYCLES DATA SET IN EXTRATROPICAL CYCLONES AND COMPARISONS. (U) WASHINGTON UNIV SEATTLE DEPT OF ATMOSPHERIC SCIENCES P V HOBBS 15 MAY 86
The University of Washington's CYCLonic Extratropical Storms (CYCLES) Field Project was designed to provide measurements and observations on the mesoscale organization of precipitation, and precipitation-producing mechanisms, in extratropical cyclones. A series of field studies, employing radars, aircraft, rawinsondes and ground measurements, were carried out off the coast of Washington State during the period 1973-1982. During the period covered by this contract (1981-1985) emphasis has been on analysis and interpretation of the CYCLES field data. Precipitation was found to be organized on the mesoscale into seven different types of rainbands, located in different regions of the cyclone. The air motions, cloud structure and precipitation-producing mechanisms have been documented in each of these rainbands. Numerical models for exploring cloud and precipitation physics and chemistry have been developed for several of the rainbands. Dynamical mechanisms responsible for the formation and maintenance of the rainbands have also been explored.
AFOSR. TR. 86-0914

FINAL REPORT FOR CONTRACT AFOSR-ISSA 84-00046: ANALYSES OF THE CYCLES DATA SET IN EXTRATROPICAL CYCLONES AND COMPARISONS WITH NUMERICAL MODELS

1. RESEARCH OBJECTIVES

During the period 1973-1982 the University of Washington Cloud Physics Group carried out a series of field studies to explore the mesoscale and microscale structure of clouds and precipitation in winter extratropical cyclones in the Pacific Northwest (for a review see: Hobbs, P. V., 1978, Rev. Geophys. Space Phys., 16, 741-755). This project was called CYCLES (for CYCLonic Extratropical Storms).

The principal objectives of the work carried out during the period 1981-1985, under grants from the National Science Foundation and Contract AFOSR-ISSA 84-00046, were to further analyze and interpret the CYCLES data set through diagnostic and numerical modeling studies.

2. PRINCIPAL FINDINGS

The principal accomplishments during the period 1981-1985 may be summarized as follows:

- The airflow and cloud structure associated with the narrow (but intense) rainband that is often associated with a cold front have been documented in detail on both the small mesoscale and the microscale (see P. V. Hobbs and P.O.G. Persson, 1982: J. Atmos., 39, 280-295).

2. PRINCIPAL FINDINGS (Continued):

- The formation, development, interaction and dissipation of rainbands have been documented and analyzed (see D. B. Parsons and P. V. Hobbs, 1983: *J. Atmos. Sci.*, 40, 559-579).

- The effects of orography on rainbands have been investigated (see D. B. Parsons and P. V. Hobbs, 1983: *J. Atmos. Sci.*, 40, 1930-1949).

- Various dynamical mechanisms and theories for the formation of mesoscale rainbands have been compared with CYCLES data and the most likely mechanisms identified (see D. B. Parsons and P. V. Hobbs, 1983: *J. Atmos Sci.*, 40, 2377-2397).

- The mesoscale structure of comma clouds (or polar lows) has been documented (S. Businger and P. V. Hobbs, submitted for publication to Mon. Wea. Rev.)


- A 2-dimensional, primitive equation model, with water vapor and parameterized cloud physics, is being used to see whether a cold front, with associated rainbands, can be modelled. This numerical model will also be used to diagnose the dynamical mechanisms responsible for the formation of the rainbands (This work is still in progress).
2. PRINCIPAL FINDINGS (Continued):

- Airborne data collected in CYCLES have been used to determine the size spectra of ice particles in frontal clouds and their deviations from an exponential size distribution (see P. H. Herzegh and P. V. Hobbs, 1985: *Quart. J. Roy. Meteor. Soc.*, 111, 463-477).

3. JOURNAL PUBLICATIONS


3. JOURNAL PUBLICATIONS (Continued)


4. INTERACTIONS

(a) Conference Presentations

<table>
<thead>
<tr>
<th>Title of Paper</th>
<th>Authors</th>
<th>Conference</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Origins, Behaviors, and Interactions of Mesoscale Rainbands in Extratropical Cyclones&quot;</td>
<td>D. B. Parsons, P. V. Hobbs</td>
<td>20th AMS Conf. on Radar Meteorology, Boston, 1981</td>
</tr>
</tbody>
</table>
(a) Conferences Presentations (Continued)

<table>
<thead>
<tr>
<th>Title of Paper</th>
<th>Authors</th>
<th>Conference</th>
</tr>
</thead>
<tbody>
<tr>
<td>(iv) &quot;A Case Study of Wavelike Rainbands in a Midlatitude Cyclone&quot;</td>
<td>P.-Y. Wang, P. V. Hobbs, D. B. Parsons</td>
<td>AMS Conf. on Cloud Physics, Chicago, 1982</td>
</tr>
<tr>
<td>(v) &quot;Banded Cloud and Precipitation Structures in Extratropical Cyclones: Observations and Theories&quot;</td>
<td>P. V. Hobbs</td>
<td>1st Conf. on Mesoscale Meteorology, Norman, OK, 1983</td>
</tr>
<tr>
<td>(vii) &quot;Modelling Cloud and Mesoscale Processes&quot;</td>
<td>P. V. Hobbs</td>
<td>19th Annual Congress of the Canadian Meteorology and Oceanographic Society (CMOS), Montreal, 1984</td>
</tr>
<tr>
<td>(viii) &quot;The Synoptic Climatology of Polar Low Outbreaks&quot;</td>
<td>S. Businger</td>
<td>5th Extratropical Cyclone Project Workshop, Port Deposit, MD, 1985</td>
</tr>
<tr>
<td>(ix) &quot;Mesoscale Structures of Two Coma Clouds over the Pacific Ocean&quot;</td>
<td>P. V. Hobbs, S. Businger</td>
<td>2nd Conf. on Mesoscale Processes, Pennsylvania State University, University Park, PA, 1985</td>
</tr>
</tbody>
</table>

(b) Seminars Related to the Contract Given by Professor Peter V. Hobbs between 1981 and September 1985

(b) Seminars (Continued)

(ii) "Mesoscale Studies of Midlatitude Cyclones," University of California at Los Angeles (UCLA), February 17, 1982.

(iii) "Observational and Theoretical Aspects of Rainbands in Extratropical Cyclones", University of Reading, England, December 1983.


(b) **Seminars (Continued)**

(ix) "Observational and Theoretical Studies of the Mesoscale and Microscale Structures of Extratropical Cyclones", Department of Meteorology, University of Helsinki, Finland, August 29, 1984.

(c) **Committees**

(i) **Professor Peter V. Hobbs**

International Commission on Cloud Physics, IAMAP (President)
Executive Committee, International Association of Meteorology and Atmospheric Physics (IAMAP)
Mesoscale Working Group, IAMAP Commission on Dynamic Meteorology
Genesis of Atlantic Lows Experiment (GALE), Steering Committee
Experimental Design Panel (GALE) Chairman

(ii) **Professor Lawrence F. Radke**

Cloud Physics Committee of the American Meteorological Society
Committee on Measurements of the American Meteorological Society
GLOBE Working Group of the National Aeronautical and Space Administration
Basic Research Committee of the U.S. Army
Moving and Remote Monitoring Committee of the Air Pollution Control Association

5. **PARTICIPATING PROFESSIONALS**

(a) **Faculty**

Professor Peter V. Hobbs
Professor Lawrence F. Radke
Professor Richard R. Weiss
Research Associate John D. Locatelli
5. PARTICIPATING PROFESSIONALS (Continued)

(b) Staff
Kumud R. Biswas

(c) Students
David B. Parsons
Steven A. Rutledge
Nathan T. Funk
Paul H. Herzegh
Owen Hertzman
David Knight
Steven Businger

(d) Visiting Scientists
Peng-Yun Wang - 2 Years (People's Republic of China)
Yin-Mo Zhuang - 1 Year (People's Republic of China)
Professor J. Eggers - 2 months (Federal Republic of Germany)
Dr. Yutaka Ishizaka - 1 Year (Japan)
END

/2-86

DTTC