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NASA Sea Ice and Snow Validation Program for the DMSP SSM/I

NASA DC-8 Flight Report

D. J. Cavalieri

September 1988
NASA Sea Ice and Snow Validation Program for the DMSP SSM/I

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D. J. Cavalieri
Laboratory for Oceans
Goddard Space Flight Center
Greenbelt, Maryland
Frontispiece

Photo of the NASA DC-8-72 over NASA Ames Research Center.
PREFACE

In June 1987 a new microwave sensor called the Special Sensor Microwave Imager (SSM/I) was launched as part of the Defense Meteorological Satellite Program (DMSP). In recognition of the importance of this sensor to the polar research community, NASA developed a program to acquire the data, to convert the data into sea ice parameters, and finally to validate and archive both the SSM/I radiances and the derived sea ice parameters. Because the determination of the accuracy of these parameters is critical to the development of a scientifically useful data set, NASA also formed a team of specialists to validate the sea ice products. A key component of the NASA sea ice validation program was a series of SSM/I aircraft underflights with the NASA DC-8 Airborne Laboratory. The mission (dubbed the Arctic '88 Sea Ice Mission) was completed in March 1988. This report summarizes the mission, includes a summary of aircraft instrumentation, coordination with participating Navy aircraft, flight objectives, flight plans, type of data collected, SSM/I orbits for each day during the mission, and lists several piggyback experiments supported during this mission.
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I. Introduction

In March 1988 the NASA DC-8 Airborne Laboratory completed a series of seven flights in coordination with two Navy research aircraft in support of NASA's Sea Ice and Snow Validation Program (Cavalieri and Swift, 1987). A total of fifteen flights with the three aircraft all based in Fairbanks, Alaska were made over portions of the Bering, Chukchi, and Beaufort seas. The overall goal of this mission was to collect aircraft data coincident with satellite overpasses in different regions of the Arctic for the purpose of assessing the accuracy of the SSM/I-derived ice-edge position, total and multiyear ice concentrations. A secondary objective of the mission was to acquire the requisite data to determine the potential of the new SSM/I 85 GHz channels for polar research.

II. NASA DC-8 Aircraft Instrumentation

The NASA D-8 aircraft was equipped with both active and passive microwave sensors. The complement of fixed-beam, dual-polarized radiometers supplied by the Goddard Space Flight Center (GSFC) has frequencies and polarizations closely matching those of the SSM/I. The development, integration, operation, and calibration of the system called the Aircraft Multichannel Microwave Radiometer (AMMR) was carried out under the direction of Tom Wilheit of the Microwave Sensors and Data Communications Branch at Goddard. The active sensors supplied by the Jet Propulsion Laboratory (JPL) of the California Institute of Technology and operated under the direction of Walt Brown included fully polarimetric C-, L-, and P-band synthetic aperture radars (SAR). The operating characteristics of these microwave sensors are summarized in Table 1.

In addition to the microwave sensors other instruments were flown in a support capacity. These included two Global Positioning System (GPS) receivers operated by Bill Krabill of the Wallops Flight Facility, GSFC. These receivers provided real-time information on the aircraft's position serving as a check on the DC-8 inertial navigation systems. These data will be used in a post-flight capacity to insure accurate determination of the horizontal position of the DC-8. Aerial cameras which included a 35mm Giannini, a 70mm Vinton and a video camera provided information on the sea ice and snow cover when light levels and atmospheric conditions permitted. The audio channel on the video recorder was used for recording the comments from the ice observers during each flight. Other support instruments included two and three stage hygrometers for recording the dew-point temperature of the ambient air, a radar altimeter for providing altitude above terrain, and inertial navigation systems for providing basic navigation and aircraft attitude information. The navigation, aircraft attitude, and radar altimetry data were provided to each experiment onboard the aircraft through the Data Acquisition and Distribution System (DADS). A summary of the NASA DC-8 instrumentation is given in Table 2. The participants
Table 1. NASA DC-8 Microwave Sensors

**PASSIVE MICROWAVE**

Goddard Aircraft Multichannel Microwave Radiometer (AMMR)

<table>
<thead>
<tr>
<th>Freq (GHz)</th>
<th>Polarization</th>
<th>Beam Width (degrees)</th>
<th>Resolution</th>
<th>Look angle (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.0</td>
<td>H &amp; V</td>
<td>6</td>
<td>1/7 alt.</td>
<td>45 L</td>
</tr>
<tr>
<td>21.0</td>
<td>V only</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>37.0</td>
<td>H &amp; V</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>92.0</td>
<td>H &amp; V</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>21.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>skyward</td>
</tr>
<tr>
<td>37.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

**ACTIVE MICROWAVE**

JPL Synthetic Aperture Radar (SAR): Left side imaging (30 - 70°)

<table>
<thead>
<tr>
<th>Band</th>
<th>Wavelength</th>
<th>Polarization</th>
<th>Resolution (Azim/Slant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>67 cm</td>
<td>H &amp; V alt. trans.</td>
<td>10.7/7.5 meter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H &amp; V simult. rec.</td>
<td>&quot;</td>
</tr>
<tr>
<td>L</td>
<td>24 cm</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>C</td>
<td>5.6 cm</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
</tbody>
</table>
Table 2. NASA DC-8 Instrumentation

<table>
<thead>
<tr>
<th>SENSOR</th>
<th>EXPERIMENTERS</th>
<th>MEASUREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRIMARY EXPERIMENTS:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Aircraft Multichannel Microwave Radiometer</td>
<td>Donald J. Cavalieri/NASA GSFC</td>
<td>Microwave signatures of sea ice &amp; snow (see Table 1)</td>
</tr>
<tr>
<td>(AMMR)</td>
<td>Thomas T. Wilheit/NASA GSFC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Donald A. Williams/SciTech Inc.</td>
<td></td>
</tr>
<tr>
<td>2. Synthetic Aperture Radar (SAR)</td>
<td>Walter E. Brown/JPL</td>
<td>Microwave signatures of sea ice &amp; snow (see Table 1)</td>
</tr>
<tr>
<td></td>
<td>Timothy H. Miller/JPL</td>
<td></td>
</tr>
<tr>
<td>SUPPORT SYSTEMS:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Motorola Eagle)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Data Acquisition and Distribution System</td>
<td>Russell Burns/Sterl.Software</td>
<td>Distributed day, time, latitude, longitude, pitch, roll, wind speed, wind direction, air speed, ground speed, true heading, pressure, altitude, radar altitude, dew-frost point, static and total air temp, cabin alt., sun elevation and azimuth relative to both ground and aircraft mach number, way-point info., and cross-track dist.</td>
</tr>
<tr>
<td>(DADS)</td>
<td>Sarah Young/Sterl.Software</td>
<td></td>
</tr>
</tbody>
</table>
Table 2. NASA DC-8 Instrumentation (continued)

<table>
<thead>
<tr>
<th>SENSOR</th>
<th>EXPERIMENTERS</th>
<th>MEASUREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. 2-stage and 3-stage hygrometers (G.E. 1011 and E.G. &amp; G. 300)</td>
<td>Carl Berg/Northrup Serv.Inc.</td>
<td>Provides dew-point temp of the ambient air.</td>
</tr>
<tr>
<td>9. Aerial photography</td>
<td>Bernardo Ponsegg/NASA ARC</td>
<td>a) 35mm Giannini, left viewing, 45 degrees from nadir.</td>
</tr>
<tr>
<td></td>
<td>Eric James/NASA ARC</td>
<td>b) 70mm Vinton, nadir viewing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c) video camera, left viewing, 45 degrees from nadir.</td>
</tr>
</tbody>
</table>
on the NASA DC-8 flights are listed in Table 3.

III. NASA/Navy Aircraft Coordination

The NASA DC-8 flights were coordinated with two Navy research aircraft also supporting NASA's validation program. An NRL P-3 provided high-resolution (100 meter) passive microwave imagery with the NORDA Ka-band Radiometer Mapping System (KRMS) operating at 33.3 GHz and the NADC P-3 provided wide-swath SAR coverage at C-, L-, and X-bands. Both aircraft flew mosaic patterns measuring approximately 100 km by 200 km in area. These mosaics covered several SSM/I footprints. Ice parameters derived from the aircraft mosaics will be compared with the SSM/I derived parameters, thus providing a direct check on the accuracy of the SSM/I-derived sea ice parameters. Further, an intercomparison of data from the three aircraft will provide additional checks on the validity of the sea ice products and will also serve to identify algorithm improvements. The relative positions of the NASA and Navy aircraft during these flights are illustrated in Figure 1. Participants on the NRL P-3 flights are listed in Table 4 and those on the NADC P-3 flights are listed in Table 5.

IV. Aircraft/Satellite Coordination

A key requirement for planning aircraft flights which provide the optimum opportunity to obtain the requisite data needed for meeting the scientific objectives of the mission was having access to near real-time SSM/I data. Through the cooperation of Capt. Otto Steffin, Chief of NOAA's Ocean Applications Group in Monterey, and his programmer Warren Yogi who provided technical support, we were able to access directly SSM/I radiance data in Monterey. Per Gloersen at Goddard explored various data links and was able ultimately to route the near real-time data to Goddard. Once the data were acquired at Goddard, Steve Schweinfurth gridded the radiances and applied the NASA SSM/I sea ice algorithm. The derived sea ice parameters in the form of total sea ice and multiyear ice concentration computer character maps were then transmitted to our flight operations center in Fairbanks (all within 12 hours!). An example of a Bering Sea ice concentration map for March 21 is shown in Figure 2. Maps similar to these were received in Fairbanks almost every day during the mission. Three DMSP SSM/I orbits providing coverage of the Bering, Beaufort, and Chukchi seas also for March 21, 1988 is shown in Figure 3.

Although most of the flights were at night to obtain coincident observations with the SSM/I, some of the flights were made during daylight coincident with NOAA-9 and -10 and LANDSAT-4 and -5 overpasses. Under clear atmospheric conditions NOAA AVHRR and LANDSAT MSS sensors provided visible and infrared sea ice imagery at spatial resolutions of 1 kilometer and 80-meters respectively. Ice concentrations derived from the high resolution LANDSAT data will be compared with the Goddard AMMR, the JPL and NADC SAR, and the NORDA KRMS ice products.
### Table 3. NASA DC-8 Participants

**NASA Ames Research Center**
- Bruce A. Barney, DC-Pilot
- Gordon H. Hardy, Co-Pilot
- D. Nielsen, Flight Engineer
- Leo H. Degroof, Mission Manager
- Earl V. Petersen, Mission Manager
- Dean N. Jaynes, Mission Manager
- Bernardo G. Ponseggia
- Eric James

**NASA Goddard Space Flight Center**
- Donald J. Cavalieri
- William B. Krabill
- Thomas T. Wilheit

**Jet Propulsion Laboratory**
- Walter E. Brown
- John Crawford
- JoBea Cimino
- Ben Holt
- William R. Fiechter
- Abel G. Guerra
- Johnny Y. Kao
- Duc D. Le
- Timothy W. Miller
- Stephen Smith

**Navy/NOAA Joint Ice Center**
- Gary Wohl

**Northrup Services/ARC**
- Douglas McKinnon
- Paul Alvarez
- Steven G. Davis
- Glen Harner
- James Horvat
- Micheal Lakowski
- Eugene Moniz
- Paul Ristrim
- Ken Thomas
- Henry Zuberer

**Scientific Technology, Inc.**
- Donald A. Williams

**Sterling Software/ARC**
- Russell Burns

**University of Colorado**
- Konrad Steffen
a) NASA DC-8/NRL P-3 PLAN

b) NASA DC-8/NADC P-3 PLAN

Figure 1. NASA/Navy flight patterns.
Table 4. NRL P-3 Participants

**NAVAL RESEARCH LABORATORY**

CDR H. J. Enuk  
LCDR C. C. Schoulda  
LCDR D. W. Thornburg  
LT D. G. Seybold  
LT R. J. Miller  
AMSC F. J. Peretto  
AD1 M. J. Peschl  
AT1 W. E. Sears  
AD1 F. A. Jones  
AT2 T. P. Rizan  
AT2 D. V. MacCormack  
AMS3 T. F. Anderson

**NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY**

D. T. Eppler  
D. Farmer

Table 5. NADC P-3 Participants

**NAVAL AIR DEVELOPMENT CENTER**

CDR R. Feierabend  
LCDR P. Letarte  
LT J. Hovland  
LT E. Sugai  
AD1 R. Rock  
AE1 E. Seaman  
AT2 B. Levault  
ADCS J. Snow  
AX1 D. Jernigan  
AE2 R. Strain  
ADZ W. Ragan  
AMEZ T. Higgins  
AMEZ T. Derricott  
A. Carreras  
K. Birney  
S. Lyness  
S. Krazsney  
A. Ochadlick

**ENVIRONMENTAL RESEARCH INSTITUTE OF MICHIGAN**

E. Kasischke  
J. Lyden
Figure 2. Bering Sea ice concentration derived from near real-time DMSP SSM/I data for March 21, 1988.
Figure 3. Three DMSP SSM/I orbits providing coverage of the Bering, Beaufort, and Chukchi seas on March 21, 1988.
V. NASA DC-8 Flight Summary

A summary of each of the 17 flights made by the three aircraft including date, aircraft, region flown, flight objective and satellite coverage is given in Table 6. For each of the nine NASA DC-8 flights, a computer generated map of the flight lines, the mission director's flight log, and output from DADS including most of the parameters listed in Table 2 are given in Appendix A. A log of the aerial photography obtained is given in Appendix B.

Gary Wohl of the Navy/NOAA Joint Ice Center provided daily weather briefings for flight planning while in Fairbanks. A summary of the overall weather conditions during our two-week deployment provided by Gary is presented in Appendix C. Gary also kindly provided a set of Navy/NOAA JIC ice charts which appear in Appendix D.

In addition to the SSM/I sea ice and snow validation flight program other experiments were supported as time permitted. These are summarized in Table 7. We were also glad to have visiting scientists from the University of Alaska and from the Fish and Wildlife Service, Department of Interior join us on selected flights. These visitors are listed in Table 8.

VI. Concluding Remarks

This report was written almost six months after the completion of the flights. During this time a preliminary examination of the aircraft microwave data was undertaken and all indications are that the mission was a success. Preliminary results from the NASA DC-8 flights indicate that sea ice signatures obtained with the new dual-polarized 92 GHz aircraft radiometer appear to provide information on surface roughness, variations in snow depth, and on new ice types. These signatures in combination with the lower frequency dual-polarized channels may lead to the development of a new generation of sea ice algorithms. The excellent imagery from the KRMS on the NRL P-3 promises to be extremely useful for comparisons with not only the SSM/I, but also with the DC-8 AMMR and SAR data. In addition, the early results from the JPL and NADC aircraft radars suggest that C-band provides good discrimination between multiyear and first-year sea ice types, while the longer wavelength P- and L-bands from the JPL SAR highlight ridges, but not ice types. This result is particularly promising for the development of C-band SAR algorithms for use with upcoming spacecraft including the Canadian Radarsat and ESA's ERS-1 and SAR-C.

Finally, the coincident satellite/aircraft data set acquired during this Arctic aircraft mission is the best combined active/passive microwave data set collected to date and is expected to serve as the basis for developing new multisensor techniques for monitoring the polar regions with the planned Eos polar orbiting platforms scheduled for the 1990s.
Table 6. NASA/Navy Aircraft Flight Summary

<table>
<thead>
<tr>
<th>DATE</th>
<th>AIRCRAFT</th>
<th>REGION</th>
<th>OBJECTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 8*</td>
<td>NRL P-3</td>
<td>Chukchi</td>
<td>Underfly SSM/I; thin &amp; thick FY ice; MY/FY transition</td>
</tr>
<tr>
<td>Mar 9</td>
<td>NASA DC-8</td>
<td>Transit</td>
<td>Colorado/Wyoming snow basins</td>
</tr>
<tr>
<td>Mar 11</td>
<td>NASA DC-8</td>
<td>Beaufort</td>
<td>Ice camp; sharp MY/FY trans.; MY ice edge definition &amp; variability</td>
</tr>
<tr>
<td></td>
<td>NRL P-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 13*</td>
<td>NASA DC-8</td>
<td>Bering</td>
<td>Overfly polynya; new ice formation; ice concentration variability</td>
</tr>
<tr>
<td></td>
<td>NRL P-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 14</td>
<td>NASA DC-8</td>
<td>Chukchi</td>
<td>Coastal polynya; gradual FY/MY transition; shear zone</td>
</tr>
<tr>
<td></td>
<td>NRL P-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 17</td>
<td>NASA DC-8</td>
<td>Prudhoe/Bay</td>
<td>Locate and verify MY variability observed in SSMI sea iceimagery</td>
</tr>
<tr>
<td></td>
<td>Harrison</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 18</td>
<td>NASA DC-8</td>
<td>Beaufort</td>
<td>Underfly SSM/I; overfly ice camp.</td>
</tr>
<tr>
<td></td>
<td>NADC P-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 19*</td>
<td>NASA DC-8</td>
<td>Beaufort</td>
<td>Underfly SSM/I; variability of FY/MY ice concentration</td>
</tr>
<tr>
<td></td>
<td>NADC P-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 21*</td>
<td>NASA DC-8</td>
<td>Bering</td>
<td>Underfly SSM/I; definition of ice edge; effectiveness of weather filter; ice concentration variability</td>
</tr>
<tr>
<td></td>
<td>NADC P-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 22</td>
<td>NADC P-3</td>
<td>Chukchi</td>
<td>Ice type variability</td>
</tr>
<tr>
<td>Mar 23</td>
<td>NASA DC-8</td>
<td>Transit</td>
<td>Alaskan glaciers</td>
</tr>
</tbody>
</table>

* LANDSAT coverage
LANDSAT coverage also for 3/12 and 3/16
DMSP SSM/I each day and DMSP OLS coverage 3/12 through 3/22
<table>
<thead>
<tr>
<th><strong>Experiment</strong></th>
<th><strong>Investigator</strong></th>
<th><strong>Comments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Super-Swath</td>
<td>Cimino/JPL</td>
<td>SAR calibration</td>
</tr>
<tr>
<td>Bonanza Creek</td>
<td>Cimino/JPL</td>
<td>Forestry and Snow Studies</td>
</tr>
<tr>
<td>Colorado/Wyoming Snow Basins</td>
<td>Campbell/USGS, Josburger/USGS</td>
<td>Microwave study of snow</td>
</tr>
<tr>
<td>Tanana</td>
<td>Gatto/CRREL</td>
<td>Microwave study of free water</td>
</tr>
<tr>
<td>Glacier Bay</td>
<td>Smith, Ranson &amp; Hall/GSFC</td>
<td>Forestry &amp; Glaciology studies with SAR</td>
</tr>
<tr>
<td>UAF Tunnel</td>
<td>Farr/JPL, Wall/JPL</td>
<td>Microwave penetration of permafrost</td>
</tr>
<tr>
<td>Katmai</td>
<td>Mougnis-Mark/UH</td>
<td>Volcanic studies</td>
</tr>
<tr>
<td>West Fork, Black Rapids &amp; Fels Glaciers</td>
<td>Cavalieri/GSFC, Harrison/UAF, Shapiro/UAF</td>
<td>Microwave study of glaciers.</td>
</tr>
<tr>
<td>Atigun Gorge &amp; Anwar Line</td>
<td>Shapiro/UAF, Benson/UAF</td>
<td>Microwave study of snow</td>
</tr>
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</table>
Table 8. Visiting Scientists

<table>
<thead>
<tr>
<th>Scientist</th>
<th>Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Vera Alexander</td>
<td>Physical and biological processes associated with Arctic polynyas.</td>
</tr>
<tr>
<td>Professor and Director,</td>
<td></td>
</tr>
<tr>
<td>Institute of Marine Science</td>
<td></td>
</tr>
<tr>
<td>Acting Dean, School of Fisheries and Ocean Sciences</td>
<td></td>
</tr>
<tr>
<td>University of Alaska at Fairbanks</td>
<td></td>
</tr>
<tr>
<td>Dr. Susan Hills</td>
<td>Arctic marine mammal studies.</td>
</tr>
<tr>
<td>Fish and Wildlife Service</td>
<td></td>
</tr>
<tr>
<td>Arctic National Wildlife Refuge</td>
<td></td>
</tr>
<tr>
<td>U.S. Department of Interior</td>
<td></td>
</tr>
<tr>
<td>Dr. Martin O. Jeffries</td>
<td>Glaciers, ice bergs and sea ice studies.</td>
</tr>
<tr>
<td>Research Fellow</td>
<td></td>
</tr>
<tr>
<td>Geophysical Institute</td>
<td></td>
</tr>
<tr>
<td>University of Alaska at Fairbanks</td>
<td></td>
</tr>
<tr>
<td>Mrs. Cindy Wilson</td>
<td>Alaskan SAR Facility</td>
</tr>
<tr>
<td>Geophysical Institute</td>
<td></td>
</tr>
<tr>
<td>University of Alaska at Fairbanks</td>
<td></td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENTS

The planning and successful completion of this mission resulted from the support received from a number of key individuals. In particular Tom Wilheit, Tom Dod, Dick Kutz, and John Fuchs of the Microwave Sensors and Data Communication Branch at Goddard, and Don Williams of Scientific Technology, Inc., are all responsible for the successful operation of the passive microwave radiometers during each of the flights.

Walt Brown and Tim Miller of JPL were responsible for the successful operation of the JPL SAR and John Crawford and Ben Holt of the JPL Oceanography Group provided expert assistance in defining optimum times of SAR sea ice coverage on each flight.

John Reller, NASA DC-8 Aircraft Manager at NASA ARC, was responsible for early mission planning, for overall logistics support, and for coordinating the integration of the sensors on this new NASA aircraft. The successful completion of the NASA aircraft operations phase of the mission is due largely to the mission managers Leo DeGreef, Earl Petersen and Dean Jaynes through their excellent coordination and skillful integration of aircraft system requirements with scientific objectives. A great deal of credit is also given both the ground and flight crew of the DC-8 and in particular Bruce Barney, pilot, Gordon Hardy, co-pilot, and Gene Moniz, navigator, for their support and full cooperation in the planning and execution of each of the flights.

Per Gloersen and Steve Schweinfurth at Goddard and Otto Steffin and Warren Yogi at NOAA's Ocean Applications Group, were responsible for providing the near real-time SSM/I sea ice data. While in Fairbanks, the help of Cindy Wilson, administrative assistant to Gunter Weller of the Geophysical Institute, in setting up the communications to receive the SSM/I data is also greatly appreciated.

The cooperation of the Navy P-3 commanders and crews is also gratefully acknowledged; in particular CDR Enuk, LCDR Schoulda, and LCDR Thornburg with the Naval Research Laboratory aircraft and CDR Feierabend and LCDR Letarte with the Naval Air Development Center aircraft. Helpful discussions during flight coordination planning sessions were held with Duane Eppler and Dennis Farmer of NORDA and with Jim Lyden and Erik Kasischka of ERIM.

Special thanks are due Koni Steffen of the University of Colorado for his help in flight planning and for serving as an ice and snow observer and to Gary Wohl of the Navy/NOAA Joint Ice Center who served both as weather forecaster and ice observer during each of the flights.

Finally, the support of NASA's Oceanic Processes Branch, the Office of Naval Research, the Navy/NOAA Joint Ice Center, the Naval Ocean Research and Development Activity and the Naval Air Development Center is gratefully acknowledged.
REFERENCE

Appendix A
NASA DC-8 Aircraft Flight Logs
DC-8 Mission Director Log

Mission Name: Sea Ice
Flight Number: 3

17:36:26 | Take off time 17-28-30
17:37:35 | We had ATC delay, also had to re-align JPS INS before take off
17:43:19 | checked first 8 waypoints

18:06:11 | >>>> Start of run: practice run
| Altitude: 33091
| Latitude: +38 48.5
| Longitude: ??? ??

18:07:40 | >>>> Start of run: practice run
| Altitude: 33123
| Latitude: +38 48.5
| Longitude: ??? ??

18:09:42 | INS 2 has been selected for EU conversions.

18:10:12 | >>>> Start of run:
| Altitude: 33084
| Latitude: +38 47.9
| Longitude: ??? ??

18:10:26 | INS 1 has been selected for EU conversions.
18:27:20 | Lat - long froze
18:27:47 | Russ said avionics froze

18:28:00 | >>>> Start of run: practice
| Altitude: 33114
| Latitude: +39 17.2
| Longitude: ??? ??

18:28:36 | still a problem in the start run

19:10:43 | >>>> Start of run: Colorado snow basin
| Altitude: 35116
| Latitude: +38 54.7
| Longitude: ??? ??
<table>
<thead>
<tr>
<th>Time</th>
<th>Longitude</th>
<th>Note</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>19:11:05</td>
<td>long 105-57.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19:30:28</td>
<td>&gt;&gt;&gt;&gt; End of run: Colorado snow basin</td>
<td>Altitude: 35127</td>
<td>+41 0.2</td>
<td>??? ?.?</td>
</tr>
<tr>
<td>19:30:57</td>
<td>long 106-57.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19:48:55</td>
<td>&gt;&gt;&gt;&gt; Start of run: Wind river</td>
<td>Altitude: 38935</td>
<td>+42 35.2</td>
<td>??? ?.?</td>
</tr>
<tr>
<td>19:49:22</td>
<td>long 108-58.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19:59:44</td>
<td>&gt;&gt;&gt;&gt; End of run: Wind river</td>
<td>Altitude: 39108</td>
<td>+43 23.4</td>
<td>??? ?.?</td>
</tr>
<tr>
<td>20:00:57</td>
<td>long 110-25.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20:09:50</td>
<td>Jackson Hole, WY. SFC Temp = 38F.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21:07:35</td>
<td>radar altitude of the wind river run was 30,000 ft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21:23:00</td>
<td>&gt;&gt;&gt;&gt; Start of run:</td>
<td>Altitude: 39157</td>
<td>+49 3.8</td>
<td>??? ?.?</td>
</tr>
<tr>
<td>21:24:08</td>
<td>Wp 5'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21:33:41</td>
<td>aircraft vectored to Wp2'' from 5'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23:32:06</td>
<td>&gt;&gt;&gt;&gt; Start of run: Seward 342 run</td>
<td>Altitude: 39068</td>
<td>+60 6.6</td>
<td>??? ?.?</td>
</tr>
<tr>
<td>23:32:34</td>
<td>long 140-21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23:38:15</td>
<td>&gt;&gt;&gt;&gt; End of run: Seward 342 run</td>
<td>Altitude: 39130</td>
<td>+60 51.1</td>
<td>??? ?.?</td>
</tr>
</tbody>
</table>
23:38:33 | long 140-50.4

23:56:49 | military exec in area - unable to do runs around
 | Fairbanks
<table>
<thead>
<tr>
<th>TIME</th>
<th>LAT</th>
<th>LONG</th>
<th>GRD</th>
<th>TRUE</th>
<th>WIND</th>
<th>AIR</th>
<th>DRIFT</th>
<th>ALTITUDE</th>
<th>PITCH</th>
<th>ROLL</th>
<th>TEMP</th>
<th>DEP</th>
<th>PT</th>
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<tbody>
<tr>
<td></td>
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</tbody>
</table>

OF POOR QUALITY
CRITICAL PAGE IS OF POOR QUALITY
DC-8 Mission Director Log  

Mission Name: Sea Ice  
Flight Number: 4 (#Mar 88)

16:13:43 | take off at 16-09-15

16:31:33 | This flight is the Beaufort sea flight

16:45:52 | time sink was done GPS is 4 sec ahead of aircraft and JPL time

16:54:30 | >>>> Start of run: Ice point station r

   Altitude: 31045  
   Latitude: +70 5.4  
   Longitude: -146 7.8

17:00:00 | >>>> Start of run: INS test

   Altitude: 31049  
   Latitude: +70 26.9  
   Longitude: -145 43.4

17:04:09 | >>>> Start of run: INS check

   Altitude: 31039  
   Latitude: +71 13.6  
   Longitude: -144 47.0

17:05:53 | avionics system was frozen during the INS check

17:15:00 | >>>> Start of run: #2 INS check

   Altitude: 31042  
   Latitude: +72 28.9  
   Longitude: -143 5.0

17:28:24 | at 17-24 the following was recorded

17:28:50 | GPS altitude = 29,242 feet

17:29:55 | Radar altitude = 29,240 feet

17:30:23 | Baro Altitude = 31,040 feet

17:31:33 | the above alt. data was the result of the INS check at 17-15-00

17:41:59 | pitch attitude of the aircraft at level flight is + 2.7
17:45:00 | >>> Start of run: INS check #3

Altitude: 31047
Latitude: +75 54.8
Longitude: -136 57.5

17:53:05 | The P-3 is now 60 miles behind us

17:54:27 | They climbed to FL 200 to 220 and their SAR pathwidth is 13 miles

18:15:01 | >>> Start of run: INS check

Altitude: 31042
Latitude: +79 4.7
Longitude: -127 16.2

18:22:33 | estimated cloud tops FL 280 to 300, cld top temp = -35.7 deg centg.

18:24:23 | P3 dropped back to FL 200, they tried Fl 240 but wx was bad.

18:27:03 | GPS now has acquired 4 satellites.

18:30:00 | >>> Start of run: INS check

Altitude: 31029
Latitude: +80 27.7
Longitude: -120 19.5

18:37:08 | >>> Start of run:

Altitude: 31041
Latitude: +81 3.9
Longitude: -116 16.4

18:37:37 | >>> Start of run: position check

Altitude: 31036
Latitude: +81 6.2
Longitude: -115 58.9

18:42:53 | Both GPS units are tracking 4 satellites, and are in agreement.

18:44:39 | At 1835 GMT GPS alt = 29,795; Radar alt = 29,730; Baro alt = 31,040.

18:49:28 | Laying down contrail, which is being observer on LHS of AC.

18:52:59 | Over flying alto stratus, cld top temp = -14 deg C.
19:00:02 | >>>> Start of run: ins check

Altitude: 31039

Latitude: +82 36.5
Longitude: - 99 25.2

19:20:00 | >>>> Start of run: INS check

Altitude: 31044

Latitude: +83 14.6
Longitude: - 79 57.6

19:24:56 | >>>> Start of run: End of WPT 5, 45 de

Altitude: 31054

Latitude: +83 16.1
Longitude: - 74 41.5

19:26:31 | >>>> Start of run: END of turn

Altitude: 31277

Latitude: +83 20.0
Longitude: - 74 41.9

19:30:33 | started return track at 19 30 00

19:31:17 | >>>> End of run: END of turn

Altitude: 31053

Latitude: +83 26.9
Longitude: - 78 57.6

19:34:32 | the last end of run was a "show Earl " the commands

19:35:02 | the printer shut itself off at 19-31

19:37:50 | time check with P3

19:39:34 | P3 reports they are 3 seconds faster

19:41:30 | time check between JPL and GPS shows GPS ahead by 3 seconds now

19:54:36 | P3 is turning around now

19:56:32 | P3 reported seeing us on right side they were out bound and we were in bound

19:58:49 | correction the P3 reported " look out your right window and you will see us "

31
20:00:00 | >>>> Start of run: INS check #5
Altitude: 31054

20:32:48 | P3 and 171 just time sinked

20:33:25 | they were 3 sec faster

20:35:00 | >>>> Start of run: INS check
Altitude: 31022

21:04:08 | >>>> Start of run: SAR recording
Altitude: 31053

21:46:35 | >>>> Start of run: Wp #8 Ice point sta
Altitude: 31053

22:09:27 | >>>> End of run: Wp #1' Coast line
Altitude: 31055

22:34:01 | 3 stage hydrometer reading off

22:34:37 | re-cycled now working

22:48:48 | 3 stage has been turned off -- the pump not working

22:50:00 | >>>> Start of run: INS check
Altitude: 31047

23:00:51 | >>>> Start of run: super swath
Altitude: 31066

23:05:36 | >>>> End of run: super swath Wp #4'

Latitude: +82 25.1
Longitude: -105 59.8

Latitude: +79 40.3
Longitude: -126 24.3

Latitude: +76 58.8
Longitude: -135 36.5

Latitude: +72 37.6
Longitude: -143 47.4

Latitude: +70 3.5
Longitude: -146 57.7

Latitude: +65 10.5
Longitude: -148 53.4

Latitude: +64 32.8
Longitude: -148 29.6
Altitude: 31100  
Latitude: +64 54.9  
Longitude: -147 15.9

| 23:20:12 | >>>>> Start of run: Farr run Wp #5' |
| Altitude: 30991 | Latitude: +64 40.5  
| Longitude: -148 2.0 |

| 23:24:46 | >>>>> End of run: Farr run Wp #6' |
| Altitude: 31040 | Latitude: +65 5.2  
| Longitude: -147 1.5 |

| 23:37:19 | AMMr worked 90 Gh down 2 hours |
DC-8 Mission Director Log

Mission Name: Sea Ice
Flight Number: 5 (13 Mar 88)

16:11:51 | Today's date is March 13, 1988

16:12:17 | take off at 16-05-36

16:13:52 | Flight title is "Bering Sea / Polinia"

16:22:28 | when the intercom is in the emergency position there is a lot of noise on the system

16:44:25 | balance of 3 stage is difficult ---reading alot different than 2 stage

16:56:27 | >>>> Start of run: coast line

| Altitude: 29023 | Latitude: +64 56.4
| Longitude: -160 55.7 |

17:07:00 | >>>> Start of run:

| Altitude: 29009 | Latitude: +64 10.4
| Longitude: -163 2.7 |

17:07:34 | the above was an INS check

17:08:50 | >>>> End of run: coast run

| Altitude: 29031 | Latitude: +64 2.2
| Longitude: -163 24.4 |

17:10:56 | >>>> Start of run: Bering sea

| Altitude: 29034 | Latitude: +64 0.5
| Longitude: -163 57.2 |

17:13:34 | GPS 4 sec ahead of JPL and aircraft time

17:16:39 | hydrometers seem to be working

17:24:51 | >>>> Start of run: time check

| Altitude: 29020 | Latitude: +64 1.9
| Longitude: -167 45.5 |
17:25:35 | >>>> Start of run: time check

    Altitude: 29013
    Latitude: +64 1.9
    Longitude: -167 57.5

17:29:59 | >>>> Start of run: INS check #2

    Altitude: 29011
    Latitude: +64 1.0
    Longitude: -169 8.3

17:32:19 | >>>> End of run: Bering Sea

    Altitude: 29012
    Latitude: +64 0.3
    Longitude: -169 45.4

17:35:03 | >>>> Start of run: St. Law #1

    Altitude: 29020
    Latitude: +63 47.5
    Longitude: -170 13.1

17:39:10 | the time that the ice observers quote is from the DADS display which appears to be 3 sec later than aircraft time

18:10:36 | P3 visable

18:11:17 | Dino turned off camera / video recording

18:11:43 | recording on now

18:20:01 | >>>> End of run: ST Law

    Altitude: 29027
    Latitude: +59 0.3
    Longitude: -174 29.8

18:30:42 | >>>> Start of run: St. Law #2 Wp 5

    Altitude: 28981
    Latitude: +59 18.3
    Longitude: -173 23.6

18:32:55 | we missed the Wp capture point, capture was late

18:33:52 | >>>> Start of run: INS check
Altitude: 28992  
Latitude: +59 37.7  
Longitude: -173 4.0

18:37:00 >>>> Start of run: INS check

Altitude: 28990

19:11:56 >>>> End of run: St. Law #2 Wp 6

Altitude: 28999

19:17:30 >>>> Start of run: St. Law #3 Wp 7

Altitude: 28979

19:46:52 >>>> Start of run: P3 observed on LHS

Altitude: 28990

20:05:14 >>>> End of run: St. Law #3 Wp 8

Altitude: 28997

20:10:05 radar alt. stopped in the 45 degree turn

20:12:49 >>>> Start of run: St. Law #4 Wp 1

Altitude: 29025

20:22:24 JPL said their SAR can now see the bottom and top of the ice with P-band

20:58:33 >>>> End of run: St. Law. #4 Wp 2

Altitude: 29031

Latitude: +59 56.8  
Longitude: -172 44.2

Latitude: +63 36.7  
Longitude: -168 19.3

Latitude: +63 50.4  
Longitude: -168 56.6

Latitude: +60 52.1  
Longitude: -172 29.8

Latitude: +58 56.8  
Longitude: -174 24.9

Latitude: +58 53.0  
Longitude: -173 58.0

Latitude: +63 38.5  
Longitude: -168 32.0
21:00:19 | the aircraft will descend with 60 degree bank

21:30:37 | >>>> Start of run: #1 low level Wp 4'
            Altitude: 1691
            Latitude: +62 52.2
            Longitude: -169 9.3

21:31:45 | >>>> Start of run: low level again
            Altitude: 1685
            Latitude: +62 54.4
            Longitude: -169 17.8

21:50:35 | >>>> End of run: low level #1
            Altitude: 1744
            Latitude: +63 33.9
            Longitude: -171 58.1

21:54:48 | >>>> Start of run: low level #2
            Altitude: 1612
            Latitude: +63 18.9
            Longitude: -171 48.2

21:58:10 | the first low level pass was too far north, so on the
         return is parallel to the original track with a 1.6
         mile off set

22:12:18 | >>>> End of run: low level #2
            Altitude: 1620
            Latitude: +62 50.9
            Longitude: -168 55.9

22:16:07 | radar alt problems

22:28:32 | >>>> Start of run: line #7
            Altitude: 29069
            Latitude: +63 47.6
            Longitude: -165 52.7

22:36:50 | >>>> End of run: line #7
            Altitude: 29051
            Latitude: +63 45.5
            Longitude: -163 38.9
Longitude: -147 15.6

00:18:00 | touchdown at 00-24-45

00:18:47 | INS #1 at TD 64-50.7 n 147 55.4 w

00:20:03 | INS #2 at TD 64-48.1 n 147 51.7 w
<table>
<thead>
<tr>
<th>DAY 73</th>
<th>TIME</th>
<th>LAT</th>
<th>LONG</th>
<th>GBH</th>
<th>TRUE</th>
<th>SPH</th>
<th>SPD</th>
<th>DIR</th>
<th>SPD</th>
<th>DRIFT</th>
<th>ALTITUDE</th>
<th>PRESS</th>
<th>RADAR</th>
<th>PITCH</th>
<th>ROLL</th>
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<tr>
<td>73</td>
<td>18</td>
<td>55.39</td>
<td>-170</td>
<td>34.7</td>
<td>440</td>
<td>54</td>
<td>45</td>
<td>279</td>
<td>424</td>
<td>42</td>
<td>279</td>
<td>424</td>
<td>54</td>
<td>45</td>
<td>279</td>
</tr>
<tr>
<td>74</td>
<td>18</td>
<td>55.39</td>
<td>-170</td>
<td>34.7</td>
<td>440</td>
<td>54</td>
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<td>279</td>
<td>424</td>
<td>42</td>
<td>279</td>
<td>424</td>
<td>54</td>
<td>45</td>
<td>279</td>
</tr>
<tr>
<td>75</td>
<td>18</td>
<td>55.39</td>
<td>-170</td>
<td>34.7</td>
<td>440</td>
<td>54</td>
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<td>279</td>
<td>424</td>
<td>42</td>
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<td>424</td>
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<td>279</td>
</tr>
<tr>
<td>76</td>
<td>18</td>
<td>55.39</td>
<td>-170</td>
<td>34.7</td>
<td>440</td>
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<td>77</td>
<td>18</td>
<td>55.39</td>
<td>-170</td>
<td>34.7</td>
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<td>424</td>
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</tr>
<tr>
<td>78</td>
<td>18</td>
<td>55.39</td>
<td>-170</td>
<td>34.7</td>
<td>440</td>
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<td>424</td>
<td>54</td>
<td>45</td>
<td>279</td>
</tr>
</tbody>
</table>

The table above contains data for the period from the 73rd to the 79th day, with columns for time, latitude, longitude, wind speed, true bearing, ground speed, true speed, direction, true speed, altitude, pressure, radar, and pitch and roll. The data is presented in a tabular format, with each column representing a different parameter.
DC-8 Mission Director Log

Mission Name: Sea Ice
Flight Number: 6 (14 Mar 88)

18:16:36 | today is march 14,1988

18:17:44 | INS at ramp was 64-48.6 n and 147-52.7 w

18:18:03 | take off was at 18-12-04

19:11:39 | >>>> Start of run: Chukchi sea trans

| Altitude: 31080 | Latitude: +67 10.6
| Longitude: -163 48.5 |

19:21:19 | >>>> End of run: Chukchi sea trans

| Altitude: 31105 | Latitude: +68 4.4
| Longitude: -165 36.3 |

19:40:59 | >>>> Start of run: INS check

| Altitude: 31078 | Latitude: +70 30.3
| Longitude: -166 36.4 |

20:01:02 | >>>> Start of run: Chukchi sea #2 Wp 4

| Altitude: 31067 | Latitude: +73 3.7
| Longitude: -167 51.5 |

20:19:14 | >>>> Start of run:

| Altitude: 31087 | Latitude: +75 13.6
| Longitude: -167 51.4 |

20:47:55 | >>>> End of run: Chukchi sea #2 Wp 5

| Altitude: 31082 | Latitude: +78 37.9
| Longitude: -167 51.3 |

20:56:18 | >>>> Start of run: Chukchi sea #3 Wp 6
Altitude: 31053

21:28:10 | P3 under DC8

21:29:24 | INS 2 has been selected for EU conversions.

21:29:32 | INS 1 has been selected for EU conversions.

21:31:07 | >>>> Start of run: practice

21:31:24 | >>>> End of run: practice

21:44:07 | >>>> End of run: Chukchi #2

22:50:10 | >>>> Start of run: Chukchi Sea #4

22:20:43 | JPL switched their #10 taperecorder from 400 Hz to 60 Hz because the recorder was getting hot.

22:21:58 | The switch was made 20 min ago. So far no heating problem

22:36:16 | >>>> End of run:

22:44:18 | >>>> Start of run: Chukchi Sea #5 Wp 5

23:32:10 | >>>> End of run: Chukchi Sea #5 Wp 4
23:42:16 | Cavalieri decided to count a run between Wp 4 and Wp 4'

23:42:48 | >>>> Start of run: Cavalieri run

23:49:03 | heading on this course is 117.7

00:01:38 | >>>> End of run: Cavalieri run

00:02:37 | >>>> End of run: Cavalieri run

00:03:42 | >>>> Start of run: Pt. Barrow

00:19:28 | >>>> End of run: Pt. Barrow Wp 5'

00:21:24 | >>>> Start of run: Wp 5'

00:33:00 | >>>> End of run: Wp 6'

56
00:34:28 | >>>>> Start of run: Wp 6'
      Altitude: 31104
      Latitude: +69 0.0
      Longitude: -149 17.2

00:54:24 | >>>>> End of run: Wp 7'
      Altitude: 31084
      Latitude: +66 42.4
      Longitude: -150 48.0

??:???:?? | touchdown at 01-27-09

00:11:41 | INS #1 at ramp 64-47.0 n 147-52.0 w

??:???:?? | INS #2 at ramp 64-50.9 n 147-46.5 w

00:19:59 |
<p>| DAY | TIME   | LAT  | LONG  | SPD | TRUE SPD | HEAD SPD | SPD DIR | AIR SPD | DRIFT SPD | ANGLE DTG | ALTITUDE | PRESS | RADIUS | RADAR | PITCH | ROLL | STA | TOT | IRS | GE | EGG |
|-----|--------|------|-------|-----|----------|----------|---------|--------|-----------|-----------|-----------|---------|--------|--------|-------|-------|-----|-----|-----|-----|-----|-----|
| 75  | 1:10   | 65   | 10.7  | -148| 35.9     | 365      | 220     | 420    | -12.5     | 6.9       | 360       | 2970    | 2927   | 0      | 45    | -46 | -25 | -5  | 59  | 61  |
| 75  | 1:11:59| 65   | 10.6  | -148| 20.6     | 334      | 25      | 75     | 243       | 384       | 0         | 2074    | 1020   | 0      | 44    | -46 | -25 | -5  | 59  | 60  |</p>
<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>18:07:23</td>
<td>Today is 3-17-88</td>
</tr>
<tr>
<td>18:07:47</td>
<td>Take off was 18-01-14</td>
</tr>
<tr>
<td>18:08:25</td>
<td>The PRT-5 was turned off - not working right</td>
</tr>
<tr>
<td>18:11:28</td>
<td>New radio alt. R/T unit installed this flight</td>
</tr>
<tr>
<td>18:11:48</td>
<td>Radio alt not</td>
</tr>
<tr>
<td>18:12:51</td>
<td>Radio alt on MD console not bouncing around like last flight</td>
</tr>
<tr>
<td>18:15:00</td>
<td>&gt;&gt;&gt;&gt; Start of run: INS check</td>
</tr>
</tbody>
</table>
|             | Altitude: 28132  
|             | Latitude: +66 3.0  
|             | Longitude: -148 10.2                                                              |
| 18:49:52    | >>>> Start of run: cameras                                                         |
|             | Altitude: 31065  
|             | Latitude: +70 17.7  
|             | Longitude: -148 49.1                                                              |
| 18:58:00    | >>>> Start of run: Prudhoe Bay coast W                                             |
|             | Altitude: 31050  
|             | Latitude: +70 54.4  
|             | Longitude: -150 54.2                                                              |
| 19:04:50    | GPS reported he has 4 sat. He did a altitude check and reported agreement between his altitude and our radio altitude to within 50 ft |
| 19:47:01    | >>>> Start of run: INS check                                                       |
|             | Altitude: 31063  
|             | Latitude: +76 37.7  
|             | Longitude: -153 40.6                                                              |
| 19:55:19    | GPS is +4 sec faster than aircraft or JPL                                          |
| 20:40:39    | >>>> End of run: Prudhoe Bay #1 Wp4                                               |
|             | Altitude: 31064  
|             | Latitude: +82 39.8  
|             | Longitude: -161 17.3                                                              |
20:47:23 | >>>> Start of run: Prudhoe Bay #2 Wp4
Altitude: 31062
Latitude: +82 9.2
Longitude: -162 57.1

20:51:21 | JPL just turned P band transmitter off

21:10:00 | >>>> End of run: Prudhoe Bay #2 Wp5
Altitude: 31071
Latitude: +79 27.5
Longitude: -166 58.8

21:13:31 | >>>> Start of run: Prudhoe Bay #3 Wp5
Altitude: 31075
Latitude: +79 3.7
Longitude: -166 14.0

21:36:10 | The following 60 Hz power is recorded
21:36:44 | sta 1 ESMR = 2.5amps
21:37:19 | sta 2 photo = 2.5 amps
21:37:56 | sta 8 JPL (recorder) = 2.5 amps
21:38:24 | sta 9 test eq. = 0
21:39:14 | sta 10 JPL (opt. rec.) = 3 amps
21:39:31 | MD = 0
21:40:30 | sta 11 printer/AMMR = 2.5 amps
21:40:57 | sta 12 AMMR = 2 amps
21:41:27 | sta 14 Nav < 0
21:41:47 | sta 18 GPS 2 amps
21:42:15 | sta 19 test eq = 0
21:42:31 | sta 20 test eq = 0
21:42:49 | sta 21 test eq = 0
21:43:12 | sta 22 JPL computer = 7.5 amps
21:43:39 | sta F1 photo < 0
21:44:14 | sta F2 JPL preamp. < 0
21:44:44 | HSKP = 5 amps
21:45:01 | DADS = 6 amps
21:45:48 | total converter #1 = 15 amps
21:46:17 | total converter #2 = 22 amps
21:46:36 | The following is 400 Hz power
21:46:59 | left A phase = 12 amps
21:47:21 | left B phase = 12 amps
21:47:39 | left C phase = 8 amps
21:47:56 | right a phase = 9 amps
21:48:20 | right B phase = 7 amps
21:48:37 | right C phase = 10 amps
22:03:50 | temps in forward cargo ;  #1=54.8 , #2 = 57.0  #3 =
          | 53.9  #4 =64.8 , #5 = 52.2
22:26:36 | >>>> End of run: Prudhoe Bay #3 Wp3
          | Altitude: 31078  Latitude: +70 48.0
          |                            Longitude: -150 54.0
22:42:32 | JPL is transmitting on H polarization on P band
23:13:39 | >>>> End of run: FAI #1
          | Altitude: 31067  Latitude: +64 53.9
          |                            Longitude: -148 50.0
23:14:32 | cancell above
23:20:07 | >>>> Start of run: FAI #1
          | Altitude: 31054  Latitude: +64 33.7
          |                            Longitude: -148 38.5
23:26:40 | >>>> End of run: FAI #1
          | Altitude: 31066  Latitude: +65 1.2
          |                            Longitude: -147 9.7
23:35:09 | >>>> Start of run: FAI #2 Gatto
    Altitude: 31068
    Latitude: +65 1.0
    Longitude: -147 13.2

23:43:20 | >>>> End of run: FAI #2 Gatto
    Altitude: 31068
    Latitude: +64 29.4
    Longitude: -148 55.3

23:51:44 | >>>> Start of run: FAI #3 Cimino
    Altitude: 31066
    Latitude: +64 26.1
    Longitude: -148 40.3

23:58:39 | >>>> End of run: FAI #3 Cimino
    Altitude: 31069
    Latitude: +64 55.7
    Longitude: -147 3.9

00:09:18 | >>>> Start of run: FAI #4 Gatto
    Altitude: 31070
    Latitude: +64 41.8
    Longitude: -147 29.8

00:13:20 | >>>> End of run: FAI #4 Gatto
    Altitude: 31049
    Latitude: +64 20.0
    Longitude: -146 49.3

05:26:12 | touchdown at 00-45-10

05:26:48 | INS #1 at TD 64 48.5 n 147 44.1 w

??:??:?? | INS #2 at TD 64 48.7 n 147 48.5 w

??:??:?? | JPL at TD 64.50.7 n 147 48.0 w
DC-8 Mission Director Log

Mission Name: Sea Ice 88
Flight Number: 8 (18Mar88)

01:20:39 | Today is 3-18-88
01:21:05 | This is the first night flight
01:22:11 | INS #1 and 2 at ramp are 64-48.6 n and 147-52.7 w
02:07:50 | take off at 02-03-50

03:06:50 | >>>> Start of run: ice camp #1 Wp3
          | Altitude: 31094
          | Latitude: +71 55.4
          | Longitude: -142 38.1

03:42:06 | GPS now tracking 4 sat
03:42:45 | GPS alt comparison with aircraft 40 ft
03:42:59 | start INS

03:44:59 | >>>> Start of run: INS
          | Altitude: 31108
          | Latitude: +76 36.7
          | Longitude: -142 35.5

03:49:59 | sar doing 4 segments per track, each segment 55 n miles long separated by 30 miles
03:51:39 | >>>> End of run: ice camp #1 Wp#5
          | Altitude: 31102
          | Latitude: +77 25.3
          | Longitude: -142 35.4

03:57:12 | >>>> Start of run: ice camp #2 Wp6
          | Altitude: 31094
          | Latitude: +77 20.7
          | Longitude: -143 48.6

04:04:33 | >>>> End of run: sar segment
          | Altitude: 31094
          | Latitude: +76 25.8
          | Longitude: -143 48.6
04:05:38 | opt recorder taking Ph and Lh data

04:08:39 | >>>> Start of run: sar segment

Altitude: 31094
Latitude: +75 55.3
Longitude: -143 48.6

04:16:14 | >>>> End of run: sar segment

Altitude: 31097
Latitude: +74 58.9
Longitude: -143 48.6

04:20:24 | >>>> Start of run: sar segment

Altitude: 31102
Latitude: +74 27.8
Longitude: -143 48.4

04:38:40 | >>>> End of run: sar segment

Altitude: 31091
Latitude: +72 11.7
Longitude: -143 46.0

04:39:53 | Time check done with the NADC P3 and they are 4 seconds ahead of our time.

04:41:34 | >>>> End of run: WP 1'

Altitude: 31098
Latitude: +71 50.2
Longitude: -143 45.7

04:43:56 | The last end of run was really at WP 8

04:49:54 | >>>> Start of run: ice camp #3 Wp

Altitude: 31100
Latitude: +71 51.9
Longitude: -143 49.3

04:52:04 | >>>> Start of run: sar

Altitude: 31101
Latitude: +72 8.1
Longitude: -143 49.2

04:59:33 | >>>> End of run: sar segment
05:02:58 | >>>> Start of run:  
Altitude: 31107
Latitude: +73 29.4
Longitude: -143 48.0

05:03:24 | >>>> Start of run: sar  
Altitude: 31097
Latitude: +73 32.6
Longitude: -143 47.9

05:07:17 | GPS units now: Top unit is GMT + 4 seconds the bottom unit is + 3.

05:14:57 | Reconfirmed the P3 time with new results. It appears that their aircraft time is exactly the same as ours and their GPS time is 4 to 4 and one half seconds ahead.

05:15:40 | >>>> Start of run: SAR run  
Altitude: 31102
Latitude: +75 3.6
Longitude: -143 46.7

05:23:01 | >>>> End of run: SAR run  
Altitude: 31101
Latitude: +75 57.9
Longitude: -143 46.7

05:27:44 | >>>> Start of run: SAR run  
Altitude: 31104
Latitude: +76 32.4
Longitude: -143 46.7

05:35:44 | >>>> End of run: ice camp #3 Wp3'  
Altitude: 31109
Latitude: +77 30.3
Longitude: -143 46.7

05:40:01 | >>>> Start of run: ice camp #4 Wp4'
05:42:00 >>>> Start of run: INS check

Altitude: 31090
Latitude: +77 9.3
Longitude: -144 59.9

05:47:01 >>>> End of run: sar segment

Altitude: 31096
Latitude: +76 31.8
Longitude: -144 59.8

05:50:00 >>>> Start of run: INS check

Altitude: 31102
Latitude: +76 9.4
Longitude: -144 59.8

05:51:14 >>>> Start of run: sar

Altitude: 31102
Latitude: +76 0.2
Longitude: -144 59.8

06:34:44 [B

06:35:30 ♦

06:37:50 ♦

06:40:10 the grid crashed

06:42:12 the ports were switched after the grid was reloaded, that seemed to work

06:55:00 >>>> Start of run: INS check

Altitude: 31091
Latitude: +67 55.7
Longitude: -145 12.2

07:02:24 >>>> Start of run:

Altitude: 31093
Latitude: +66 59.2
Longitude: -145 15.1

07:03:08 SAR start run over the Yukon River.
00:16:29 | touchdown at 07-39-46

00:17:11 | INS #1 at ramp 64-50.6 n 147-47.5

???:???:?? | INS #2 at ramp 64-47.6 n 147-53.7

???:???:?? | JPL at ramp 64-50.6 n 147-49.1

00:20:07 | GPS at ramp 64-48.59 n 147-52.79
Sea Ice Flight #9  
March 19 1988  
Fairbanks Local  
9.FLT  
1:51:50 TO 8:41:19 UT  SCALE 1:1.25E+07  TIME TIC EVERY 20.00 MINUTES
DC-8 Mission Director Log

Mission Name: Sea Ice 88
Flight Number: 9 (19Mar88)

01:23:44 | today is 3-19-88

01:24:15 | #1 INS 64-48.6 n 147.52.7 w

01:24:23 | INS #2 same

01:55:10 | take off at 01-50-06

01:59:48 | just after take off fluid was dripping out of power station box #11. The cause of the fluid was cleaning fluid in the overhead storage was not secure and spilled over.

02:01:53 | This is the Beauford Sea mosaic

02:47:30 | SAR P band is in-operative right now. Switching problem. May be related to the removal of the P-band polarization switch.

03:00:28 | SAR just got P-band up and will be taking some P-band data

03:05:51 | >>>> Start of run: Beau Sea #1

| Altitude: 31097 |
| Latitude: +72 56.8 |
| Longitude: -152 31.8 |

03:13:12 | >>>> End of run: sar segment

| Altitude: 31090 |
| Latitude: +73 42.7 |
| Longitude: -152 28.5 |

03:24:48 | SAR started another segment however we didn't catch the start time

03:26:58 | >>>> End of run: Beau Sea #1

| Altitude: 31108 |
| Latitude: +75 9.4 |
| Longitude: -152 21.5 |

03:27:57 | error in above title. should read end of SAR segment

03:28:23 | now tracking 4 GPS sat
03:29:00 | >>>> Start of run: INS check
    Altitude: 31091
    Latitude: +75 22.3
    Longitude: -152 20.3

03:33:50 | >>>> Start of run: SAR segment
    Altitude: 31098
    Latitude: +75 52.9
    Longitude: -152 18.7

03:36:40 | GPS ahead 4 sec of aircraft and JPL

03:41:54 | >>>> End of run: SAR segment
    Altitude: 31107
    Latitude: +76 44.6
    Longitude: -152 18.7

03:48:08 | >>>> Start of run: SAR segment
    Altitude: 31103
    Latitude: +77 24.9
    Longitude: -152 18.9

03:55:40 | >>>> End of run: SAR segment
    Altitude: 31094
    Latitude: +78 14.0
    Longitude: -152 18.8

04:00:00 | >>>> Start of run: INS check
    Altitude: 31101
    Latitude: +78 42.5
    Longitude: -152 18.8

04:02:41 | >>>> End of run: Beau Sea #1 Wp5
    Altitude: 31099
    Latitude: +79 0.2
    Longitude: -152 18.7

04:08:13 | >>>> Start of run: Beau Sea #2 Wp6
    Altitude: 31109
    Latitude: +78 51.3
    Longitude: -153 41.9
04:11:38 | >>>> Start of run: sar
Altitude: 31102
Latitude: +78 20.9
Longitude: -153 41.7

04:18:50 | >>>> End of run: sar
Altitude: 31100
Latitude: +77 15.7
Longitude: -153 41.8

04:23:38 | >>>> Start of run: sar segment
Altitude: 31101
Latitude: +76 32.0
Longitude: -153 41.8

04:28:12 | temps in the forward cargo bay
04:28:24 | #1 = 58.0
04:28:44 | #2 = 60.3
04:28:56 | #3 = 57.2
04:29:11 | #4 = 67.8
04:29:24 | #5 = 54.8

04:30:07 | >>>> End of run: sar segment
Altitude: 31106
Latitude: +75 33.0
Longitude: -153 41.8

04:32:32 | >>>> Start of run: sar
Altitude: 31093
Latitude: +75 10.9
Longitude: -153 41.9

04:44:59 | >>>> Start of run: INS check
Altitude: 31104
Latitude: +73 17.2
Longitude: -153 42.1

04:48:20 | >>>> End of run: Track #2 WP #8
Altitude: 31081
Latitude: +72 46.6
Longitude: -153 42.0
04:55:41 | >>>> Start of run: Beau Sea #3 Wpl'
Altitude: 31093
Latitude: +72 33.6
Longitude: -153 43.4

04:57:45 | >>>> Start of run: SAR run
Altitude: 31115
Latitude: +72 47.1
Longitude: -153 45.2

05:05:15 | >>>> End of run: sar
Altitude: 31101
Latitude: +73 35.7
Longitude: -153 50.4

05:11:54 | >>>> Start of run: SAR segment
Altitude: 31096
Latitude: +74 18.9
Longitude: -153 55.4

05:19:33 | >>>> End of run: SAR segment
Altitude: 31098
Latitude: +75 9.2
Longitude: -154 1.9

05:25:42 | >>>> Start of run: SAR segment
Altitude: 31097
Latitude: +75 50.0
Longitude: -154 6.2

05:39:51 | the terminal at the MD console died at 05-30 . Russ
patched his terminal to MD console

05:39:59 | >>>> Start of run: sar
Altitude: 31095
Latitude: +77 25.2
Longitude: -154 6.3

05:47:26 | >>>> End of run: sar
Altitude: 31099
Latitude: +78 15.6
Longitude: -154 6.4
05:49:28 | >>>> Start of run: INS
Altitude: 31105  
Latitude: +78 29.4  
Longitude: -154 6.4

05:51:14 | >>>> Start of run: ins
Altitude: 31105  
Latitude: +78 41.6  
Longitude: -154 6.4

05:52:57 | >>>> End of run: Beau Sea #3 Wp3'
Altitude: 31073  
Latitude: +78 53.4  
Longitude: -154 6.4

06:26:00 | the start of Beau #4 Wp4' was at 06-00-01
06:26:49 | lat was 78-57.4 n 155-09.4
06:28:26 | during the run from Wp4' to 6' the aircraft rolled 8 degrees or so several times
06:32:21 | >>>> End of run: SAR segment
Altitude: 31194  
Latitude: +74 9.8  
Longitude: -155 5.6

06:34:27 | >>>> Start of run: sar
Altitude: 31189  
Latitude: +73 50.7  
Longitude: -155 3.1

06:40:54 | >>>> End of run: Beau Sea #4 Wp6'
Altitude: 31180  
Latitude: +72 51.3  
Longitude: -154 55.9

06:43:15 | >>>> Start of run: INS check
Altitude: 31200  
Latitude: +72 30.2  
Longitude: -154 40.9
06:44:59 | >>>> Start of run: INS check
Altitude: 31184
Latitude: +72 14.6
Longitude: -154 29.6

07:33:44 | >>>> Start of run: INS check
Altitude: 31172
Latitude: +65 22.2
Longitude: -149 54.5

07:46:40 | >>>> Start of run: Cimino #1 Wp1''
Altitude: 31183
Latitude: +64 42.6
Longitude: -148 0.3

07:50:23 | >>>> End of run: Cimino #1 Wp2''
Altitude: 31189
Latitude: +64 58.2
Longitude: -147 9.4

07:58:29 | >>>> Start of run: Cimino #2 Wp3''
Altitude: 31201
Latitude: +65 7.3
Longitude: -147 3.1

08:07:00 | >>>> End of run: Cimino #2 Wp4''
Altitude: 31191
Latitude: +64 33.6
Longitude: -148 52.4

08:14:41 | >>>> Start of run: Cimino #3 Wp5''
Altitude: 31184
Latitude: +64 27.0
Longitude: -148 40.3

08:21:14 | >>>> End of run: Cimino # Wp6''
Altitude: 31191
Latitude: +64 55.3
Longitude: -147 5.1

00:25:35 | touchdown at 08-46-22
00:26:25 | INS #1  64-49.3 n 147.47.9
-----------
00:27:08 | INS #2  64-50.8 n 147.50.5
-----------
00:27:57 | JPL  64-50.6 n 147.47.3
02:05:27 | today is 3-21-88

02:05:52 | Take off was at 02-00-00 z

02:06:09 | really

02:52:28 | >>>> Start of run: Norton Sound WP #2

Altitude: 27017
Latitude: +64 20.4
Longitude: -161 15.9

02:59:01 | >>>> End of run: sar segment

Altitude: 27002
Latitude: +64 23.0
Longitude: -163 9.8

02:59:47 | GPS how tracking 4 sat.

03:04:26 | >>>> Start of run: sar

Altitude: 27021
Latitude: +64 24.0
Longitude: -164 45.4

03:09:29 | >>>> End of run: sar

Altitude: 27035
Latitude: +64 24.0
Longitude: -166 14.9

03:14:00 | >>>> Start of run: sar segment

Altitude: 27030
Latitude: +64 23.2
Longitude: -167 34.1

03:18:59 | >>>> End of run: sar segment

Altitude: 27003
Latitude: +64 21.6
Longitude: -169 1.3
03:21:50 >>>> Start of run:
   Altitude: 27012
   Latitude: +64 9.4
   Longitude: -169 41.8

03:25:26 >>>> Start of run: sar segment
   Altitude: 27012
   Latitude: +63 47.1
   Longitude: -170 24.2

03:31:31 >>>> Start of run: sar interfer eff
   Altitude: 27030
   Latitude: +63 8.7
   Longitude: -171 33.5

03:40:23 >>>> End of run: sar segment
   Altitude: 27016
   Latitude: +62 12.7
   Longitude: -173 7.7

03:47:23 >>>> End of run: Wp 5
   Altitude: 26997
   Latitude: +61 27.1
   Longitude: -174 19.1

03:52:25 >>>> Start of run:
   Altitude: 27026
   Latitude: +61 14.9
   Longitude: -173 19.6

03:58:30 >>>> Start of run: INS check
   Altitude: 27003
   Latitude: +61 14.6
   Longitude: -171 42.0

04:13:28 >>>> Start of run: Bering Sea #1 Wp6
   Altitude: 26996
   Latitude: +60 50.2
   Longitude: -168 15.0

04:16:22 >>>> Start of run: INS check
<table>
<thead>
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<th>Time</th>
<th>Event</th>
<th>Altitude</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>04:18:52</td>
<td>&gt;&gt;&gt;&gt; End of run: sar</td>
<td>27022</td>
<td>+60 27.7</td>
<td>-168 14.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27015</td>
<td>+60 8.4</td>
<td>-168 14.9</td>
</tr>
<tr>
<td>04:21:36</td>
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<td>27005</td>
<td>+59 47.4</td>
<td>-168 14.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+59 13.5</td>
<td>-168 14.7</td>
</tr>
<tr>
<td>04:26:00</td>
<td>&gt;&gt;&gt;&gt; End of run: sar segment</td>
<td>27026</td>
<td>+59 13.5</td>
<td>-168 14.7</td>
</tr>
<tr>
<td>04:27:47</td>
<td>&gt;&gt;&gt;&gt; Start of run: sar</td>
<td>27019</td>
<td>+58 59.8</td>
<td>-168 14.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+58 19.7</td>
<td>-168 14.4</td>
</tr>
<tr>
<td>04:38:21</td>
<td>&gt;&gt;&gt;&gt; Start of run: SAR</td>
<td>27023</td>
<td>+57 38.7</td>
<td>-168 14.3</td>
</tr>
<tr>
<td>04:48:34</td>
<td>&gt;&gt;&gt;&gt; End of run: SAR</td>
<td>27020</td>
<td>+56 21.3</td>
<td>-168 14.1</td>
</tr>
<tr>
<td>04:50:39</td>
<td>&gt;&gt;&gt;&gt; End of run: SAR</td>
<td>27013</td>
<td>+56 5.5</td>
<td>-168 14.0</td>
</tr>
</tbody>
</table>
04:51:00 | This also ended the track

04:58:54 | Bering Sea run #2 start at 04-57-01 56-31.9n 167-36.4w

04:59:35 | start of #2 run at Wp 2'

04:59:56 | >>>> Start of run: INS check

    Altitude: 27028
    Latitude: +56 53.5
    Longitude: -167 35.9

05:07:38 | >>>> End of run: sar

    Altitude: 27025
    Latitude: +57 52.3
    Longitude: -167 35.8

05:11:51 | >>>> Start of run: SAR segment

    Altitude: 27023
    Latitude: +58 24.4
    Longitude: -167 35.7

05:17:41 | >>>> End of run: SAR segment

    Altitude: 27025
    Latitude: +59 8.8
    Longitude: -167 35.6

05:29:10 | >>>> Start of run: SAR segment

    Altitude: 27029
    Latitude: +60 35.0
    Longitude: -167 35.5

05:33:50 | >>>> End of run: Bering Sea #2 Wp 5'

    Altitude: 27049
    Latitude: +61 9.9
    Longitude: -167 35.5

05:41:33 | >>>> Start of run: Bering Sea #3 Wp 6'

    Altitude: 27007
    Latitude: +61 10.1
    Longitude: -167 35.0

05:47:31 | >>>> End of run: sar
05:51:29 >>>> Start of run: SAR segment
Altitude: 27025
Latitude: +59 54.3
Longitude: -167 34.9

05:56:31 end

05:56:35 >>>> End of run: SAR segment
Altitude: 27011
Latitude: +59 15.6
Longitude: -167 34.9

05:58:36 >>>> Start of run: SAR segment
Altitude: 27030
Latitude: +59 0.2
Longitude: -167 34.8

06:04:09 >>>> End of run: SAR segment
Altitude: 27026
Latitude: +58 17.6
Longitude: -167 34.7

06:09:02 >>>> Start of run: SAR segment
Altitude: 27024
Latitude: +57 40.3
Longitude: -167 34.7

06:18:23 >>>> End of run: SAR segment
Altitude: 27020
Latitude: +56 29.6
Longitude: -167 34.4

06:20:30 >>>> End of run: Bering sea #3
Altitude: 27007
Latitude: +56 13.6
Longitude: -167 33.8
06:24:56 | >>>> Start of run: Bering Wp''

Altitude: 27026
Latitude: +56 21.3
Longitude: -166 40.0

06:27:01 | >>>> Start of run: INS check

Altitude: 27029
Latitude: +56 27.4
Longitude: -166 12.4

06:32:14 | >>>> Start of run: SAR segment

Altitude: 27017
Latitude: +56 42.0
Longitude: -165 3.1

06:37:16 | >>>> End of run: SAR segment

Altitude: 27021
Latitude: +56 55.4
Longitude: -163 55.6

06:41:16 | >>>> Start of run: SAR segment

Altitude: 27026
Latitude: +57 5.6
Longitude: -163 1.4

06:55:12 | >>>> End of run: SAR segment

Altitude: 27013
Latitude: +57 37.6
Longitude: -159 50.3

06:57:45 | >>>> Start of run: SAR segment

Altitude: 27025
Latitude: +57 42.1
Longitude: -159 14.6

07:13:00 | >>>> End of run: SAR segment

Altitude: 27034
Latitude: +58 5.8
Longitude: -155 37.3

07:15:25 | >>>> Start of run: run #4 Wp
07:17:39 | >>>> End of run: run #4 Wp
Altitude: 27019
Latitude: +58 9.8
Longitude: -155 2.5

07:26:03 | >>>> Start of run: #5 Wp4''
Altitude: 27035
Latitude: +58 16.7
Longitude: -155 25.7

07:29:32 | >>>> End of run: #5 Wp 5''
Altitude: 27032
Latitude: +58 2.0
Longitude: -154 43.5

07:38:16 | >>>> Start of run: #4 Wp 2''
Altitude: 27011
Latitude: +58 7.2
Longitude: -155 25.3

07:42:08 | >>>> End of run: #4 Wp 3''
Altitude: 27015
Latitude: +58 13.4
Longitude: -154 29.8

07:43:19 | GPS said we were 2 miles off in latitude in the middle of that run

07:48:49 | >>>> Start of run: INS check
Altitude: 28273
Latitude: +58 59.6
Longitude: -153 51.8

08:03:32 | >>>> Start of run: INS check
Altitude: 31087
Latitude: +60 47.1
Longitude: -152 40.6

08:13:51 | INS 2 has been selected for EU conversions.
08:17:24 | >>>> Start of run: SAR segment

Altitude: 31067
Latitude: +62 29.2
Longitude: -151 25.6

08:22:51 | >>>> End of run: SAR segment

Altitude: 31066
Latitude: +63 9.8
Longitude: -150 52.8

08:26:40 | >>>> Start of run: INS check

Altitude: 31073
Latitude: +63 38.1
Longitude: -150 29.1

08:27:40 | >>>> Start of run: INS check

Altitude: 31075
Latitude: +63 45.5
Longitude: -150 22.7

08:34:23 | >>>> Start of run: #6 Wp7''

Altitude: 31069
Latitude: +64 21.5
Longitude: -148 54.4

08:42:09 | >>>> End of run: #6 Wp8''

Altitude: 31073
Latitude: +64 56.0
Longitude: -147 5.3

08:55:33 | SAR ran h polarization on P band

00:29:27 | touchdown at 09-02-30 z

00:29:18 | INS #1 at ramp 64-52.8n 147.49.6w

00:30:06 | INS #2 at ramp 64-49.8n 147-51.6w

00:30:44 | JPL at ramp 64-49.4n 147-51.5w
DC-8 Mission Director Log

Mission Name: Sea Ice 88
Flight Number: 11 (23Mar88)

18:13:36 | today is 3-23-88
18:14:03 | This is the transit flight to Ames
18:14:48 | take off was at 18-02-58
18:19:27 | PRT -5 take off line

18:25:32 | >>>> Start of run: Black Rapids Wp3
          | Altitude: 29064
          | Latitude: +63 25.6
          | Longitude: -145 17.3

18:33:38 | >>>> End of run: Black Rapids Wp4
          | Altitude: 29052
          | Latitude: +63 40.7
          | Longitude: -147 18.0

18:41:16 | >>>> Start of run: West Fork
          | Altitude: 29065
          | Latitude: +63 34.0
          | Longitude: -147 28.4

18:43:01 | >>>> End of run: West Fork
          | Altitude: 29053
          | Latitude: +63 27.0
          | Longitude: -147 49.6

19:27:36 | >>>> Start of run: INS check
          | Altitude: 29058
          | Latitude: +59 9.3
          | Longitude: -154 30.7

19:32:29 | /c

19:41:29 | >>>> Start of run: Katmai #1 Wp7
          | Altitude: 29061
          | Latitude: +58 23.8
          | Longitude: -155 44.1
19:46:56   >>>> End of run: Katmai #1 Wp8
          Altitude: 29072
          Latitude: +58 2.3
          Longitude: -154 45.8

19:59:49   >>>> Start of run: Katmai #2 Wp1'
          Altitude: 29041
          Latitude: +58 5.0
          Longitude: -155 44.7

20:05:32   >>>> End of run: Katmai #2 Wp2''
          Altitude: 29045
          Latitude: +58 13.4
          Longitude: -154 30.1

21:29:34   >>>> Start of run: Glacier Bay #1 Wp 7
          Altitude: 29067
          Latitude: +58 36.6
          Longitude: -135 33.9

21:35:54   >>>> End of run: Glacier Bay #1 Wp8'
          Altitude: 29061
          Latitude: +59 17.2
          Longitude: -136 23.7

21:38:25   The two Glacier Bay runs are being done 5 miles right
          of the track as define by wp 7',8',5'6'

21:44:51   >>>> Start of run: Glacier Bay #2 Wp5'
          Altitude: 29060
          Latitude: +59 19.0
          Longitude: -136 23.9

21:53:21   >>>> End of run: Glacier Bay #2 Wp6'
          Altitude: 29067
          Latitude: +58 21.9
          Longitude: -135 52.0

22:43:07   climbed to 37000

23:16:18   decending to 33000 ft
23:25:51 | >>>> Start of run:
    Altitude: 33058
    Latitude: +48 53.5
    Longitude: -123 49.7

23:30:18 | >>>> End of run: Sook lake forest Wp
    Altitude: 33065
    Latitude: +48 19.1
    Longitude: -123 49.6

23:32:20 | ascend to 37000 ft

23:51:04 | >>>> Start of run: INS check
    Altitude: 37113
    Latitude: +45 25.6
    Longitude: -123 42.1

00:00:08 | >>>> Start of run: INS check
    Altitude: 37126
    Latitude: +44 6.8
    Longitude: -123 20.3

00:03:46 | >>>> Start of run: SAR segment
    Altitude: 37107
    Latitude: +43 35.2
    Longitude: -123 11.8

00:05:40 | >>>> End of run: SAR segment
    Altitude: 37103
    Latitude: +43 18.4
    Longitude: -123 7.3
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ORIGIN PAGE IS OF POOR QUALITY
Appendix B
NASA DC-8 Film and Video Logs
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<td>*Cavalieri</td>
<td>Transit from Moffett to Fairbanks. Data runs over Colorado. High cirrus obscured view. No patterns due to military exercise.</td>
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<td>*Cavalieri</td>
<td>Ice observations on one track to Ellesmere Island and back. Audio unusable.</td>
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<td>*Cavalieri</td>
<td>071 - Ice observations to Ellesmere and back 072 - Very dark due to clouds. Good audio. Tracks between St. Lawrence and St. Matthews Islands.</td>
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<td>End of St. Lawrence/St. Matthews tracks. Good audio and visual.</td>
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<td>*Cavalieri</td>
<td>End Chukchi Mosaic. Coastline near Barrow. Alaska pipeline south of Barrow.</td>
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<td>Chukchi Sea triangular pattern to investigate SSM/I anomaly.</td>
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<td>077 3/17</td>
<td>*Cavalieri, Farr, Gatto and Cimino</td>
<td>End Chukchi triangular pattern. 3 data runs near Fairbanks, (Cimino, Farr and Gatto).</td>
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<td>*Smith and Ranson, Crawford</td>
<td>Glacier Bay for Smith/Ranson. Sooke Lake for Crawford.</td>
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### SEA ICE '88 35 & 70 mm FILM LOG

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<td>End Chukchi Mosaic. Coastline near Barrow. Alaska pipeline south of Barrow.</td>
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<td>Chukchi Sea triangular pattern to investigate SSM/I anomaly.</td>
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<td>077 3/17</td>
<td>*Cavalieri</td>
<td>End Chukchi triangular pattern. 3 data runs near Fairbanks, (Cimino, Farr and Gatto).</td>
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<td>and Cimino</td>
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Appendix C
Weather Summary
SUMMARY OF ALASKAN REGION WEATHER SYSTEMS
March 9-23, 1988

During the deployment to Alaska two large scale weather patterns were observed. Early in period the entire region was much warmer than normal due to storms traversing the state. Once the storms resumed their usual track into the Gulf of Alaska cold Arctic air spread over the state including the Bering, Chukchi and Beaufort Seas.

March 9-13 A blocking ridge in the upper atmosphere caused storms to track from the Pacific Ocean into the Bering Sea and over Alaska. Record high temperatures were recorded at many locations, the greatest deviations from normal occurring over the northern half of the state. For the week of March 6-12 Fairbanks averaged 24 degrees above normal.

March 14-17 High pressure built into the Bering Sea from Siberia and moved slowly northeastward. Very cold temperatures, in the -10 to -20 degree range, were recorded in the northern Bering and southern Chukchi Seas.

March 18-19 Weakening High pressure was observed across northern Alaska and a weak disturbance crossed the Bering Sea which dissipated in northwestern Alaska.

March 20-21 A strong arctic Low pressure system and cold front swept across the North Slope leaving blowing snow and falling temperatures in its wake. Cold temperatures persisted in the Bering Sea as a cold front pushed southward.

March 22-23 High pressure built over northern Alaska and with a storm in the Gulf of Alaska maintained a cold northerly flow over the Bering Sea. For the week March 20-26 St. Paul Island (in the central Bering Sea) was 14 degrees below normal with the remainder of the Bering, Chukchi and Beaufort Sea stations reporting temperatures near 10 degrees below normal.
Appendix D
Navy/NOAA JIC Charts
SOUTHERN ICE LIMIT
NAVY/NOAA JOINT ICE CENTER
NAVIGATION CENTER, SUITLAND
CHART 584
ANALYSIS DATE: 11 MAR 88

C - Total ice concentration in the area in percent.
C, C, C - Comparison of thickness (C), 2nd best (C),
2nd thickest (C) ice.
C, C, C - State of development of thicker (C), 2nd
thicker (C), and 3rd thinnest (C) ice.
C - Concentration of ice which consists of strips
and patches.
I - State of development of a thicker than (C) but
having a concentration less than 10%.

STAGE(S) OF DEVELOPMENT (THICKNESS)
1. New ice (0 - 10 cm)
2. Young ice (10 - 30 cm)
3. First year (30 - 100 cm)
4. First year thick (100 - 120 cm)
5. Old ice (thicker than new, snow free)

Data Sources
RECONNAISSANCE...
SHIP...
SHORE...
NOAA SATELLITE...
NIMBUS SATELLITE...

Date: 09-10

Original page is of poor quality.
DATA SOURCES
RECONNAISSANCE
SHIP
SHORE
NOAA SATELLITE
NIMBUS SATELLITE
DATE
29-30
In June 1987 a new microwave sensor called the Special Sensor Microwave Imager (SSM/I) was launched as part of the Defense Meteorological Satellite Program (DMSP). In recognition of the importance of this sensor to the polar research community, NASA developed a program to acquire the data, to convert the data into sea ice parameters, and finally to validate and archive both the SSM/I radiances and the derived sea ice parameters. Central to NASA's sea ice validation program was a series of SSM/I aircraft underflights with the NASA DC-8 Airborne Laboratory. The mission (dubbed the Arctic '88 Sea Ice Mission) was completed in March 1988. This report summarizes the mission includes a summary of aircraft instrumentation, coordination with participating Navy aircraft, flight objectives, flight plans, data collected, SSM/I orbits for each day during the mission, and lists several piggyback experiments supported during this mission.