AVHRR Leads-ARI Polar Gridded Brightness Temperatures, Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Fetterer, F., and J. Hawkins 2003. *AVHRR Leads-ARI Polar Gridded Brightness Temperatures, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/UEMKN8TUNYKI. [Date Accessed].

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National Snow and Ice Data Center

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1 INTRODUCTION

Although leads comprise only one percent of the surface area of the arctic ice pack, they contribute as much as half of the heat and moisture exchange at the surface during the winter. Formed as a result of ice pack deformation, leads grow anywhere from a few meters to a few kilometers wide. The fluxes generated by leads influence the atmosphere by:

- Increasing sensible heat, thus raising the mean air temperature
- Contributing water vapor, thus encouraging fog and cloud formation that may perturb the net radiation balance in precipitation
- Providing buoyancy, thus producing turbulent kinetic energy for mixing

Refer to Wolfe et al. (1993) for more information.

Using hard copies of AVHRR images provided by the Joint Ice Center (now the National Ice Center), the investigators evaluated image data for a given satellite pass, ranked each image for areal and cloud coverage, and compiled the image evaluations in monthly spreadsheets. The investigators then used the image evaluation spreadsheets to select digital imagery from the Satellite Data Services Division (SDSD) of NOAA's National Environmental Satellite Data and Information Service (NESDIS).

To facilitate comparisons of SSM/I and AVHRR data, the selected imagery was warped to the same projection and aligned with the same grid as that used by NSIDC for arctic SSM/I brightness temperature data. The projection is polar stereographic with the map plane at 70 degrees north. Two grids were used to cover most of the Arctic. The raw data were converted to albedo and brightness temperature following procedures similar to those outlined in Kidwell (1986) and Lauritson et al. (1979).

The AVHRR Leads-ARI Polar Gridded Brightness Temperatures data set consists of imagery for 1988, 1989 and 1992. The grids completely cover the Beaufort, Chukchi, East Siberian, Barents, and Kara Seas, and partially covers the East Greenland and Laptev Seas. The data set consists of image files containing the satellite data, graphics files containing the coastline overlays used with the satellite data, browse images containing subsampled images, and data files with nadir track positions.

2 DETAILED DATA DESCRIPTION

The AVHRR Leads-ARI Polar Gridded Brightness Temperatures data set contains Advanced Very High Resolution Radiometer images for use by scientists interested in lead dynamics and global climate change. The data set consists of AVHRR images compiled as part of the Arctic Leads Accelerated Research Initiative (Arctic Leads ARI). The data set includes images for three years for the Beaufort, Chukchi, East Siberian, Barents, Kara, East Greenland, and Laptev Seas.

Quick-look, hard copies provided by the National Ice Center of AVHRR images were used to select images for inclusion in the data set. Raw digital data for the selected images were converted to albedo and brightness temperature, and the compiled data were gridded to a stereographic projection. The data set primarily consists of image files and graphics files. It also includes browse images and files with satellite nadir track positions. Data are available via HTTPS.

The Arctic Leads ARI data set project was supported by the Office of Naval Research (ONR) under Program Element No. 61153N with Dr. Thomas Curtin as Program Manager. Distribution of the data set is supported by NASA under its Earth Observing System Data and Information System (EOSDIS) program. For more information about the data set, please contact NSIDC User Services.

For more information, please refer to the Arctic Leads ARI Project Description section and Instrument and Platform sections below.

2.1 Format

2.1.1 Data Granularity

A data granule is the smallest aggregation of data that can be independently described, inventoried, or retrieved. An individual image constitutes a granule in the AVHRR Leads-ARI Polar Gridded Brightness Temperatures data set.

2.1.2 Data Format

The data set consists of both image files and graphics files, plus files with satellite nadir track positions.

The data are provided as compressed UNIX files including image files, graphics files, binary nadir track files, orbital element ASCII data files, and browse images.

The image files contain the AVHRR satellite data. Each displayable file created on the I2S system has the extension .img. The images are raw binary files of short integer data and are 2250 x 2800 pixels in size. Image files were written in sample, line, and band format, although each band of the AVHRR data is given a separate file. At NSIDC, a VAX system and VAX DIGITAL Command Language backup command were used to write files from the NOARL system to 6250 bpi tapes for NSIDC.

2.2 File Naming Convention

Please refer to the list of graphics files and sample image files in Appendix A. The file naming convention is illustrated by file p13jan89_2124_c1s.img as follows:

channel 1 of an image taken	(p13jan89_2124_c1s.img)
January 13, 1989 at 2124 GMT	(p13jan89_2124_c1s.img)
and mapped to the Pacific Grid	(p13jan89_2124_c1s.img)
for short integer data	(p13jan89_2124_c1s.img)

The graphics files contain the WDB and WVS coastline overlays. The graphics files are full resolution (2250 x 2800 pixels) and are named as follows:

Contents	European grid	Pacific grid
latitude/longitude	egrid.img	pgrid.img
coastline overlays	emap.img	pmap.img
land masks	emask.img	pmask.img

For most image files, there are corresponding nadir track files (for example, e06jan89_0913_trk.image) that contain a plot of the nadir track for the given image. An orbital element data file contains tracking information about the satellite pass during which the imagery was acquired, along with nadir track positions every ten seconds. Refer to the sample orbital element data file in Appendix B for more information.

The data set also includes selected browse image files for selected 1989 AVHRR scenes. The browse images, which are in Hierarchical Data Format (HDF), are intended to provide potential data set users with information about AVHRR scenes prior to making a data request. The browse images illustrate each scene's area of coverage, highlight leads within the scene, and provide initial estimates of geophysical parameters (e.g., albedo or brightness temperature). Each browse image provides an easily-distributed scene derived from the image data and requires minimal manipulation of the raw sensor values.

The browse images are derived from original data from 1989. All browse images are 450 x 560 pixels and 8-bit per pixel. Except for the summer season when melt degrades the ability of the thermal channel to discriminate leads, the browse images are from channel 4 of the AVHRR. For the summer season, the images are from channel 2 (near-infrared). The "summer" set includes images from May, June, July, and August. Browse images from all other months are referred to as "winter" images. The archive consists of four subsets of the original data:

- Pacific grid - summer
- Pacific grid - winter
- European grid - summer

- European grid - winter

The data processing used to derive the browse images is described in Appendix C. See Appendix D for an alphabetical list of all data set files.

2.3 Spatial Coverage

The data set covers the Beaufort, Chukchi, East Siberian, Barents, and Kara Seas, and some of the East Greenland and Laptev Seas.

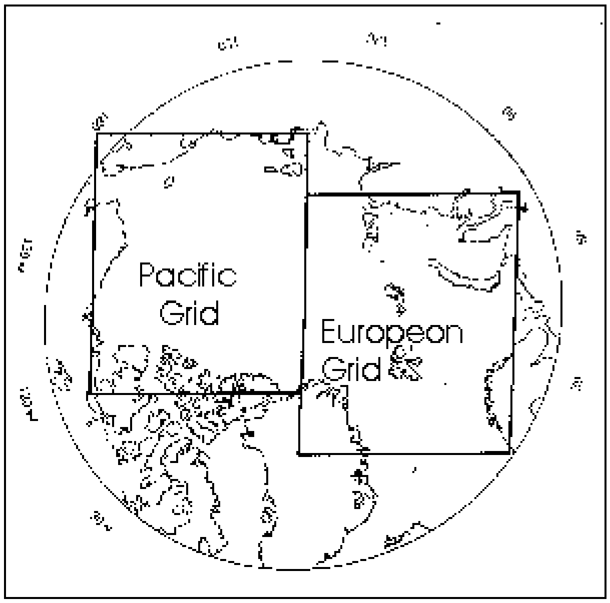

Figure 1. Pacific European Grids, approximate apatial coverage

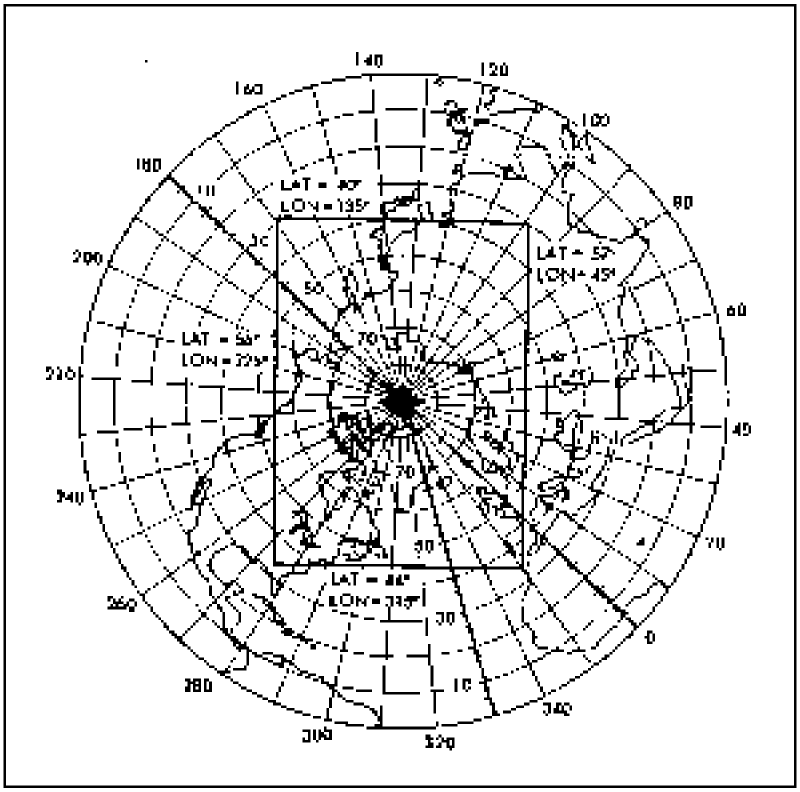

Figure 2. North Polar SSM/I Grid. The Polar Gridded AVHRR Brightness Temperatures data set uses the same projection and grid as that used by NSIDC for the Arctic SSM/I data. The north polar SSM/I grid is aligned with the 135 degrees west 45 degrees east meridian. The Pacific and European Grids Map shows the two grids used to match this grid alignment. Adapted from Fetterer et. al., (1993).

2.3.1 Spatial Resolution

Because the sensor response is not linear with temperature, its resolution varies with channel and the temperature of the observed scene. At an altitude of 833 km and with an IFOV of 1.4 milliradians, the nominal AVHRR sensor resolution is 1.1 km at nadir and about four km at the scan limbs (at a satellite scan angle of 55.4 degrees from nadir). There are 2048 samples from each channel across each scan. The sensor swath width is about 2900 km, or 26 degrees of latitude. Data are recorded with 10-bit precision. The radiometer is operable between approximately -80 degrees C to 40 degrees C. The brightness temperature resolution of the instrument varies with temperature and is about .12 degrees C.

2.3.2 Projection

Imagery was warped to a ground-plane projection using position tie points embedded in the scan lines of the Level 1B data. Tie points were calculated using Brouwer mean orbital elements from orbital information provided by the North American Air Defense Command (NORAD). Tie point accuracy depended on factors such as satellite tracking accuracy, length of time since an update, and the satellite clock accuracy. To improve the navigational accuracy given by the NESDIS tie points, each image was displayed with a graphic overlay of the coastline. For the images from 1988 and 1989, the overlay from the World Data Bank (WDB) II was used. For the 1992 images, the World Vector Shoreline (WVS) data base was used. If any coastline visible in the image did not match the graphic display, the image was shifted to make the best possible match. Often a perfect match was not possible everywhere. This was especially true along the north coast of Greenland, where the WVS is itself in error by several kilometers.

2.3.3 Grid Description

To facilitate comparisons of SSM/I and AVHRR data, the Arctic Leads ARI imagery was warped to the same projection and aligned with the same grid as that used by NSIDC for arctic SSM/I brightness temperature data. The investigators considered grids with other projections including the Fleet Numerical Meteorology and Oceanography Center (FNMOC) atmospheric fields and Polar Ice Prediction System (PIPS) ice forecasts, which are available on grids with a polar projection true at 60 degrees north. They decided, however, that these and other grids were relatively coarse in comparison with the SSM/I grid.

The projection is polar stereographic with the map plane at 70 degrees north. Distortion at the pole is three percent. The north polar SSM/I grid is aligned with the SSM/I grid and covers most of the Arctic with AVHRR data. Of the two grids depicted in the Pacific and European Grids Map. Figure 1, the Pacific grid covers the Beaufort, Chukchi, and East Siberian Seas while the European grid covers the Barents, Kara, and some of the East Greenland and Laptev Seas. The investigators decided that increasing the coverage of the Barents Sea was preferable to covering all of the Laptev. Because very few Laptev Sea images were available and the grid size was already cumbersome in terms of data storage requirements, the investigators rejected the option of enlarging the grid to cover Laptev.

The Pacific and European grids are each 2250 x 2800 pixels. The pixel size is one km. There is a pixel border at 135 degrees west on the Pacific grid and one at 45 degrees east on the European grid. These correspond to the alignment of cells in the SSM/I grid. Therefore, 25 x 25 AVHRR pixels will fit within each of the 25-km SSM/I grid cells. Refer to the figure that depicts the relationship between SSM/I grid coordinates and Arctic Lead ARI grid sample, line indexes.

Two coordinates conversion programs are available in the appendix section of this document:

- Program I converts from pixel sample and line indexes to polar stereographic SSM/I grid coordinates to latitude and longitude coordinates.
- Program II converts from latitude and longitude coordinates to polar stereographic SSM/I grid coordinates to pixel sample and indexes.

2.4 Temporal Coverage

The data set consists of imagery for all months of 1989 and 1992, and all months of 1988 except February, March and May. For 1988, coverage is limited and there are no images for February, March or May. For 1989, Beaufort Sea and Chukchi Sea coverage is good except in the cloudiest month of August when Kara Sea and Barents Sea coverage is scant. For 1992, coverage in March, August, September and October is scant, with four or fewer images each month.

2.4.1 Temporal Resolution

The data set includes approximately 10 to 20 images per month. For 1988 and 1992, the data set includes approximately 10 images per month while for 1989, there are about 20 images per month. However, some months have many more than the average, and some have many fewer.

2.5 Parameter or Variable

The data set consists of brightness temperature and albedo data. The parameters measured during the Arctic Leads ARI field experiment (LeadEx) in the Beaufort Sea in the spring of 1992 are described in "Appendix E | LeadEx Instruments and Parameters."

2.5.1 Units

Brightness temperature data are presented in degrees Celsius, and albedo is presented as percent albedo.

2.5.2 Data Source

AVHRR data in the data set were retrieved from digital tape archived by Satellite Data Services Division (SDSD) of the NOAA National Environmental Satellite Data and Information Service (NESDIS) in Camp Springs, Maryland.

2.5.3 Sample Data Record

A sample data record of raw binary data is too large to present here. Please refer to the data format section for information about the contents of the image files and the availability of browse images. The following is a very small subsample of an AVHRR image from the data set showing a large lead off Banks Island.

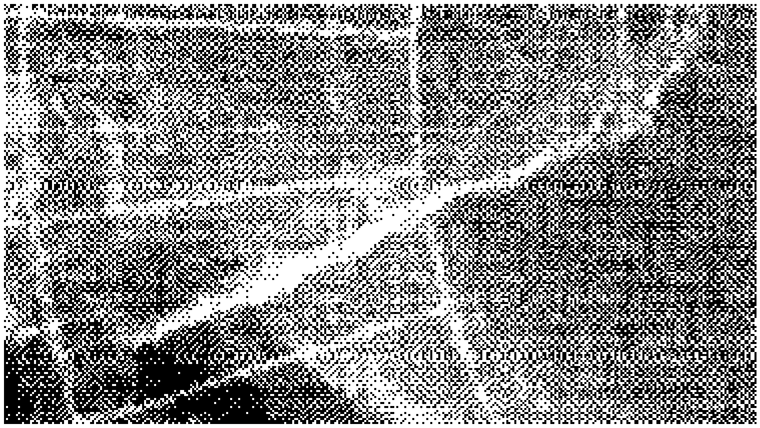

Figure 3. Subsample from a Channel 4 Image Acquired December 14, 1989.

3 PROJECT OVERVIEW

3.1 Project Name

Office of Naval Research Arctic Leads Accelerated Research Initiative (ARI)

3.2 Project Introduction

The objective of the Arctic Leads ARI was to gain a better understanding of lead dynamics. As part of the project, the Arctic Leads ARI Data Set was created to encourage the assembly of an arctic leads climatology. The ARI was sponsored by the Office of Naval Research (ONR) and included the LeadEx field experiment in the spring of 1992.

The Arctic Leads ARI project was supported by ONR under Program Element No. 61153N with Dr. Thomas Curtin as Program Manager. Distribution of the data set is supported by NASA under its Earth Observing System Data and Information System (EOSDIS) program. See the Contacts and Acknowledgments section below for additional details.

3.3 Project Mission Objectives

The goal of the five year Arctic Leads ARI was a more thorough understanding of the oceanography, meteorology, and ice dynamics surrounding lead formation and evolution.

3.3.1 Disciplines

The data set is of use to scientists investigating global climate change as well as oceanographers and meteorologists studying the Arctic region. Specifically, it has applications in the following areas:

- arctic lead statistics and climatology
- arctic energy budget
- heat flux and surface flux
- ice dynamics, leads rheology, and leads mapping
- studies of lead parameters and measurements
- surface temperature and albedo computations

3.3.2 Geographic Region

Images available for the Arctic area outlined on the Arctic Leads ARI Grid Map including the Beaufort, Chukchi, East Siberian, Barents, Kara, East Greenland, and Laptev Seas.

3.3.3 Detailed Project Description

In January 1989, a workshop was held at the University of Washington's Applied Physics Laboratory (UW/APL) to plan the Office of Naval Research (ONR) Arctic Leads Accelerated Research Initiative (Arctic Leads ARI). At this meeting, a Remote Sensing Working Group was formed to focus on leads issues including:

- the relationship of lead patterns to the wind field
- the regional distribution of lead width, orientation, and fractional area over time
- the computation of surface fluxes over large areas

The Remote Sensing Working Group determined that a satellite data set was needed to support the science objectives outlined in their workshop report. The AVHRR was selected for its ability to acquire data with Arctic-wide views at a resolution useful for leads statistics retrieval. In September 1989, a discussion about the type of data set needed took place at the Cooperative Institute for Research in Environmental Sciences (CIRES). This discussion resulted in a successful Naval Oceanographic and Atmospheric Research Laboratory (NOARL, now a part of the Naval Research Laboratory) proposal to ONR for the creation of an AVHRR Arctic leads data set.

In April 1990, the Remote Sensing Branch of NOARL began selecting AVHRR data from NOAA archives. Using hard copy prints from the Navy/NOAA Joint Ice Center, the investigators selected imagery in an attempt to cover most of the Arctic every three days. The selected imagery was processed on a scale that allows for the observation of regional, seasonal, and annual variability in lead patterns. The raw data for the selected images were converted to albedo and brightness temperature, and the compiled data were gridded to a stereographic projection identical to that used for Special Sensor Microwave Imager (SSM/I) data by the National Snow and Ice Data Center. The data set includes imagery for 1989 through 1991 that covers the Arctic in two grids of 1km pixels.

The LeadEx field component of ONR's Arctic Leads ARI was carried out in March and April of 1992 in the Beaufort Sea. The effect of open leads on the polar ocean and atmosphere was studied using data collected from a base camp northeast of Prudhoe Bay, Alaska and at several nearby leads using remote and in situ, surface-based sensors.

4 SOFTWARE AND TOOLS

Copies of the following coordinates conversion programs are available in the appendix:

- Program I converts from pixel sample and line indexes to polar stereographic SSM/I grid coordinates to latitude and longitude coordinates.
- Program II converts from latitude and longitude coordinates to polar stereographic SSM/I grid coordinates to pixel sample and indexes.

The Cloud and Surface Parameter Retrieval (CASPR) system is a toolkit that can be used to retrieve a variety of surface and cloud parameters from AVHRR data.

5 DATA ACQUISITION AND PROCESSING

5.1 Theory of Measurements

The AVHRR is a radiometer carried aboard polar orbiting satellites. It senses and measures the intensity of passive radiant energy emitted and reflected by the Earth and its atmosphere. Hastings and Emery (1992) summarize the historical development of the AVHRR sensor hardware and provide an overview of its data collection capabilities. For more information on the theory of AVHRR measurements, please refer to the Arctic Leads ARI Instrument section below.

5.2 Data Acquisition Methods

The following description of the Arctic Leads ARI data acquisition methods are summarized from Fetterer and Hawkins (1991).

5.2.1 AVHRR Data Availability

AVHRR data formerly archived by the Satellite Data Services Division (SDSD) of NOAA's National Environmental Satellite Data and Information Service (NESDIS) are now archived by the Climate Services Division (CSD) of the National Climatic Data Center (NCDC) at NESDIS in Asheville, North Carolina:

NOAA National Environmental Satellite Data and Information Service (NESDIS)
National Climatic Data Center
Climate Services Division

Federal Building, 151 Patton Ave., Asheville, NC 28801-5001 USA
Telephone: (704) 271-4800
Fax: (704)271-4876
Satellite data orders: satorder@ncdc.noaa.gov
In situ data orders: orders@ncdc.noaa.gov
All Researcher orders: research@ncdc.noaa.gov

In addition to unprocessed imagery, the Satellite Data Services Division can also provide the NOAA Polar Orbiter Data User's Guide and information on how to order data electronically.

The data can be obtained in three forms:

- HRPT (High Resolution Picture Transmission)
- LAC (Local Area Coverage)
- GAC (Global Area Coverage)

HRPT direct readout data are continuously broadcast from the satellite and are available for areas within a ground station mask. For instance, the Gilmore Creek, Alaska ground station receives HRPT data covering the Beaufort, Bering, Chukchi, and East Siberian Seas. LAC data are HRPT data that have been recorded on board the satellite for playback when the satellite is within range of a Command and Data Acquisition (CDA) station. Up to ten minutes of LAC data can be recorded during each orbit. GAC data are reduced resolution data acquired during an entire orbit and stored for playback on command. A resolution cell size of about four km at nadir makes GAC unsuitable for most Arctic Leads ARI purposes.

5.2.2 Image Evaluation and Selection

Hard copy prints of the AVHRR imagery were usually made using channel 4 (IR) during the arctic winter and channel 2 (visible) in summer. When the investigators visited SDSD in March 1990, they found the hard copy archive to be of limited use because it contained very few LAC and HRPT hard copies and no latitude/longitude grids. As an alternative to the SDSD archive, the investigators used an archive of hard copy AVHRR images at the Navy/NOAA Joint Ice Center (now the National Ice Center), which uses AVHRR as a primary tool for ice analysis and forecasting and makes a hard copy of almost every HRPT and LAC pass.

Images are from one to three frames long. Each frame includes about three minutes of data covering about nine degrees of latitude. An ascending pass starting at 70 degrees over Alaska would cover just the Beaufort Sea if the resulting image were only one frame long. If the image were three frames in length, the same pass would cover the Beaufort, Chukchi, East Siberian, Laptev, and some of the central Arctic.

Using the hard copies provided by the Joint Ice Center, image data for a given satellite pass were evaluated to determine how much of each sea was covered by the pass and how much of the image was covered by clouds. The investigators examined all images but eliminated from consideration images that were clearly of no value to the Arctic Leads ARI. The investigators noted the time and orbit printed on each hard copy as well as the seas covered by the image. They then ranked each image on a scale of one to five for degree of cloud cover and areal coverage. For example, a rank of "5-2" for the Beaufort Sea would mean that 100 percent of the image is cloud-free but only about 40 percent of the Beaufort is covered by the image.

The investigators then compiled their image evaluations in monthly spreadsheets (see Appendix F), which they used to select imagery for inclusion in the data set. Early evaluations revealed a need to change the original data selection goals of 20 images per month and complete coverage of the Arctic every three days. Limited areal coverage outside the Beaufort Sea and extensive cloud cover as well as budgetary limitations mandated the change. Initially, the investigators selected images in an attempt to cover the entire Arctic with evenly spaced temporal intervals. After recognizing the extent of could cover in the images, they elected to take advantage of the available data by selecting approximately 10 images of leads per month representing several sequential cloud free days. Unless shorter passes were part of time sequences in which leads could clearly be seen, the investigators generally favored passes covering large areas over shorter, relatively cloud free passes.

5.3 Observations

5.3.1 Field Notes

The Arctic Leads ARI included a field experiment (LeadEx) in the Beaufort Sea to study the effect of open leads on the polar ocean and atmosphere. During March and April of 1992, data were collected from a base camp northeast of Prudhoe Bay, Alaska and at several nearby leads using remote and surface based sensors. Appendix E lists the meteorological instruments used and parameters measured during the LeadEx field operations.

5.4 Derivation Techniques and Algorithms

For the full resolution images, the raw data were converted to albedo and brightness temperature following procedures similar to those outlined in Kidwell (1986) and Lauritson et al. (1979).

5.4.1 Processing Steps

Data from channels 1 and 2 were processed by converting raw counts to albedo using a straight line approximation based on pre-launch calibration. Albedo was expressed as a percentage of that for a perfectly reflecting Lambertian surface illuminated by an overhead sun. Each output count in the processed data was 0.1 percent. For example, a count of 500 would equal 50 percent albedo.

Raw count values for channels 3, 4, and 5 were converted to radiances using a straight line approximation to calibration from onboard observations of space and an internal blackbody. Each possible raw count value of zero to 1023 on the NOAA Level-1B data tape was matched with a radiant energy value in a look-up table. Energy was then converted to brightness temperature based on the inverse of Plank's function.

Data processing steps are described in detail in Fetterer and Hawkins (1993).

5.4.2 Calculations

Brightness temperatures were converted to output counts (N) using the equation:

$$N = (10(K-273.16)) + 500,$$

where K = brightness temperature (degrees Kelvin)

Output count values are stored in short integer (16-bit) form. Count values can be converted to Kelvins using:

$$K = ((N-500)/10) + 273.16$$

or to degrees Celsius using:

$$°C = (N-500)/10$$

The result is 0.1 degree per count, with a count of 500 equal to 0 degrees C. If the temperature observed is less than -50 degrees C, the count value will be negative.

NOTE: If the count values of 16-bit processed imagery are to be displayed using hardware with an 8-bit deep image plane, the 16-bit images must be scaled to 8-bit images.

5.4.2.1 Special Corrections/Adjustments

For channels 1 and 2, no corrections were made for sun angle or atmospheric effects. A nonlinear correction to temperature was applied to channels 3, 4, and 5 using the coefficients for each channel given in periodic NOAA updates and Lauritson et al. (1979).

The program that created the nadir track listings was modified so that a nadir track could be created even if it fell outside the image.

5.4.2.2 Calculated Variables

The raw data were converted to albedo and brightness temperature using the methods described above.

5.4.2.3 Graphs and Plots

A detailed description of the data processing involved in the derivation of the browse images is available in Appendix C.

5.4.2.4 Error Sources

More information about the quality of the data set imagery is available in Fetterer and Hawkins (1993).

5.4.2.5 Notes

Because relatively cloud free images were selected for the data set, it is not particularly well suited for cloud studies. For 1988, coverage is limited and there are no images for February, March or May.

5.5 Sensor or Instrument Description

The AVHRR sensor is a broad band, cross-track scanning instrument that senses in the visible, near-infrared, and thermal infrared portions of the electromagnetic spectrum. Depending on the model, the AVHRR is a four or five channel scanner. It has flown continuously on the NOAA polar orbiting series of satellites since 1978 and provides pole-to-pole on board collection of data from all channels. The satellite orbits the Earth approximately 14 times per day at an orbital inclination of about nine degrees. Each pass covers a 2399-km wide swath. The average instantaneous field of view (IFOV) of 1.4 milliradians yields a LAC/HRPT ground resolution of approximately 1.1 km at the satellite nadir from the nominal orbit altitude of 833 km.

A table listing the wavelengths of each of the AVHRR channels is available. Another table identifies the NOAA satellites that carried the AVHRR during the period of interest to the Leads ARI.

5.5.1 Platform Description

In TIROS-N Source/Platform Document (NOAA POES), the NOAA Satellite Active Archive DAAC describes the NOAA Polar Orbiting Environmental Satellites (POES) that carried the AVHRR instrument.

5.5.2 Instrument Descriptions

The Goddard Space Flight Center DAAC describes the AVHRR instrument in the equipment section of the NOAA/NASA Pathfinder Data Set Guide Document for the AVHRR Land Data Sets

Additionally, the United States Geological Survey (USGS) describes the AVHRR instrument in the following:

- Advanced Very High Resolution Radiometer document
- AVHRR Sensor Characteristics section of its Global Land 1-KM AVHRR Data Set Project Guide Document.

5.6 Application of the Data Set

The relevance of ice lead width and width distribution to flux calculations in sea ice and climate models has been addressed (Maslanik and Key 1995) and AVHRR imagery has been used to study lead pattern formation in the Beaufort Sea in response to wind forcing (Walter and Overland 1993). Lindsay and Rothrock (1994) used the AVHRR Leads-ARI Polar Gridded Brightness Temperatures data set to estimate the surface temperature of arctic sea ice. Lindsay and Rothrock (1995) derived lead orientation and width statistics with the data set. The data set could also be used to:

- Develop algorithms for the automatic derivation of lead statistics.
- Assemble an arctic leads climatology using the lead statistics algorithms.
- Study the relationship between the arctic energy budget and heat flux through leads.
- Estimate the importance of leads in humidifying polar air masses.
- Study the effect of lead opening and closing on ice dynamics and the upper ocean.
- Map leads and reveal ice rheology through lead patterns.
- Calculate lead widths, width distributions, lead lengths, lead orientations, and open water areas and fractions.
- Calculate surface fluxes using lead width, density, orientation and other lead parameters.

- Summarize surface temperature and albedo.
- Make navigation plans for ships and submarines.

Hastings and Emery (1992) provide an overview of general AVHRR data applications.

6 REFERENCES AND RELATED PUBLICATIONS

Note: Information in this document was derived from (Fetterer et al. 1991) and (Fetterer et al. 1993).

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Wolfe D. E., D. Ruffieux, C. W. Fairall. 1993. The 1992 arctic leads experiment: an overview of the meteorology. *Arctic research of the United States* 7:24-28.

6.1 Related Data Collections

- The Global Land 1-KM AVHRR Data Set Project, maintained by the Land Processes Distributed Active Archive Center (LP DAAC), contains 1-km AVHRR land surface data for the entire globe.
- The Sea Ice Data: Overview page provides access to all of NSIDC's sea ice-related data sets, as well as links to tools for working with these data.

7 CONTACTS AND ACKNOWLEDGMENTS

7.1 Investigators

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Jeffrey D. Hawkins

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Prediction Systems Branch

U.S. Naval Research Laboratory

7.2 Acknowledgments

The Principal Investigators would like to acknowledge:

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8 DOCUMENT INFORMATION

8.1 Publication Date

31 August 1995

8.2 Date Last Updated

24 May 2021

9 APPENDIX A – GRAPHICS FILES AND SAMPLE IMAGE FILES ARCTIC LEADS ACCELERATED

The first list identifies the graphics files containing the coastline overlays used with the image data. The second list is of sample image file names.

9.1 Graphics Files

9.1.1 Grid Files

Name	Description	Data Type	Size (pixels)
pgrid.img	Lat,Lon grid for Pacific side	byte	2250 x 2800
pmap.img	Coastline for Pacific side	byte	2250 x 2800
pmask.img	Landmask for Pacific side	byte	2250 x 2800
egrid.img	Lat,Lon grid for European side	byte	2250 x 2800
emap.img	Coastline for European side	byte	2250 x 2800
emask.img	Landmask for European side	byte	2250 x 2800

9.1.2 Nadir Track Files

p13jan89_2124trk.img	binary nadir track file containing a plot of the nadir track for the given image	byte	512 x 512

9.1.3 Images Subsampled By Six

pgrid512.img	512 x 512
pmap512.img	375 x 467
pmask512.img	375 x 467
egrid512.img	512 x 512
emap512.img	375 x 467
emask512.img	375 x 467

9.2 Sample Image and Data Files

SAMPLE NAME	DESCRIPTION	DATA TYPE	SIZE (pixels)
p13jan89_2124_c1s.img	Channels 1 to 5	short integer	2250 x 2800
p13jan89_2124_c2s.img	of a January 13,	short integer	2250 x 2800
p13jan89_2124_c3s.img	1989 2124 GMT	short integer	2250 x 2800
p13jan89_2124_c4s.img	image mapped to	short integer	2250 x 2800
p13jan89_2124_c5s.img	the Pacific Grid	short integer	2250 x 2800
p13jan89_2124.dat	orbital element data file containing the orbital elements for the satellite pass during which the imagery was acquired and the nadir track positions every 10 seconds	ASCII	
p13jan89_2124_ch4.brws	browse images	Hierarchical Data Format (HDF)	

These lists were adapted from:

Fetterer and Hawkins. 1991. An AVHRR data set for the Arctic leads ARI. Naval Oceanographic and Atmospheric Research Laboratory, Technical Note 118.

10 APPENDIX B – SAMPLE ORBITAL ELEMENT DATA FILE

The following is sample orbital element data file for image file pl0jan89_1519_trk.img. The file indicates the orbital elements for the imagery acquired and the nadir track positions every 10 seconds during the pass. In cases where the nadir track is outside the grid, the file contains only the orbital elements. Satellite number 19531 is NOAA-11. Other satellites are identified as follows:

- NOAA-8: 13923
- NOAA-9: 15427
- NOAA-10: 16969

```
PLOT'TRACK    11-FEB-1991     09:31:29.33

LISTING FILE  pl0jan89_1519.dat
IMAGE FILE    pl0jan89_1519_trk.img

SATELLITE NUMBER             19531
REVOLUTION NUMBER            1526
MEAN ANOMALY                 .3717761
MEAN MOTION                  .8277287
MODIFIED DECAY COEFFICIENT   .0007100
ECCENTRICITY                 .0012072
ARGUMENT OF PERIGEE          .8827872
LONGITUDE OF ASCENDING NODE  .5707038
INCLINATION                  .2747912
EPOCH (Y/M/D)                890111

START TIME     89/01/10   15:19:55
STOP TIME      89/01/10   15:31:12
TIME INTERVAL  00:00:10

PROJECTION    POLAR STEREOGRAPHIC

CENTER LATITUDE   78.33
CENTER LONGITUDE  197.93

DEGREES/PIXEL LATITUDE   .054000
DEGREES/PIXEL LONGITUDE  .054000

SAMPLES      375
LINES        467

               LAT         LONG   YR JDAY    SECS   REVN

               79.803   273.315   89   10   55645   1526
               80.077   270.315   89   10   55655   1526
               80.322   267.158   89   10   55665   1526
               80.539   263.851   89   10   55675   1526
               80.724   260.403   89   10   55685   1526
               80.875   256.830   89   10   55695   1526
               80.992   253.154   89   10   55705   1526
               81.072   249.398   89   10   55715   1526
               81.114   245.592   89   10   55725   1526
```

81.119	241.766	89	10	55735	1526
81.085	237.952	89	10	55745	L526
81.014	234.182	89	10	55755	1526
80.906	230.486	89	10	55765	1526
80.762	226.888	89	10	55775	1526
80.585	223.410	89	10	55785	1526
80.375	220.070	89	10	55795	1526
80.136	216.878	89	10	55805	1526
79.869	213.843	89	10	55815	1526
79.576	210.966	89	10	55825	1526

The document is adapted from:

Fetterer and Hawkins. 1991. An AVHRR data set for the Arctic leads ARI. Naval Oceanographic and Atmospheric Research Laboratory, Technical Note 118. 61 p.

11 APPENDIX C – BROWSE IMAGE PROCESSING

The browse images for AVHRR scenes in the Polar Gridded AVHRR Brightness Temperatures data set are intended to provide potential data set users with information about AVHRR scenes prior to making data requests. The browse images illustrate each scene's area of coverage, highlight leads within the scene, and provide initial estimates of geophysical parameters (e.g., albedo, brightness temperatures). Each browse image provides an easily-distributed scene derived from the archived data and requires minimal manipulation of the raw sensor values.

The browse images are derived from original data from 1989. All browse images are 450 x 560 pixels and 8-bit per pixel, and are in hierarchical data format (HDF). Except for the summer season when melt degrades the ability of the thermal channel to discriminate leads, the browse images are from channel 4 of the AVHRR. For the summer season, the images are from channel 2 (near-infrared). The "summer" set includes images from May, June, July, and August. Browse images from all other months are referred to as "winter" images. The archive consists of four subsets of the original data:

- Pacific grid - summer
- Pacific grid - winter
- European grid - summer
- European grid - winter

The browse images were created by subsampling every fifth line and sample from the original 10-bit, full resolution (2250 x 2800) data. This resulted in 450 x 560 pixel images. The original data values were in counts. These smaller 10-bit images were stretched over a range of counts that best shows the leads to 8-bit values (0-255) in order to create the browse images. Each subset had a consistent stretch applied to each corresponding image; however, stretches vary among the four subsets. The linear stretches applied to the images are as follows:

- PACIFIC SUMMER:
    - 0 to 410 counts
    - 0 to 41% albedo
- PACIFIC WINTER:
    - 10 to 530 counts
    - -49 to +3 degrees C
- EUROPEAN SUMMER:
    - 0 to 340 counts
    - 0 to 34% albedo
- EUROPEAN WINTER:
    - -30 to 530 counts
    - -53 to +3 degrees C

The 8-bit values or digital numbers (DN) in the browse images can be backed out of the browse images by using the following equations. First, DN is first converted to counts from DN. Counts are then converted to either percent albedo or brightness temperature in degrees Kelvin:

- PACIFIC SUMMER:
  - Counts = (DN/249)x410
  - % Albedo = Counts x 0.1%
- PACIFIC WINTER:
  - Counts = (DN/249)x 520 + 10
  - Tb = (Counts-500)/10 + 273.16 (Kelvin)
- EUROPEAN SUMMER:
  - Counts = (DN/249)x340
  - % Albedo = Counts x 0.1%
- EUROPEAN WINTER:
  - Counts = (DN/249)x560 – 30
  - Tb = (Counts-500)/10 + 273.16 (Kelvin)

The stretches are applicable over the DN range 0 to 249. Thus, the actual value may be calculated directly from the browse image DN value according to the following equations:

- PACIFIC SUMMER:
  - % Albedo = (41/249) x DN
- PACIFIC WINTER:
  - Degrees Celsius = (52/249) x DN -49
- EUROPEAN SUMMER:
  - % Albedo = (34/249) x DN
- EUROPEAN WINTER:
  - Degrees Celsius = (56/249) x DN -53

Each image has a latitude/longitude grid and land overlaid mask. The DN value of the grid is 254 and the land mask is 255. The browse images are in HDF format with a specified palette and included annotation.

12 APPENDIX D – IMDATA SET FILES

The following is an alphabetical list of all files in the Polar Gridded AVHRR Brightness Temperatures data set. It includes:

- image files (.img files)
- graphics files (.gpg files)
- binary nadir track files - contain plots of the nadir tracks for given images
- (for example, e06jan89_0913_trk.image)
- orbital element ASCII data files (.dat) - contain the orbital elements for the satellite pass during which the imagery was acquired and the nadir track positions every ten seconds
- browse image files (.brws)

The file naming convention is illustrated by file "p13jan89_2124_c1s.img" as follows:

13jan89_2124:	13 January 1989 at 2124 GMT
c1:	channel 1
p:	mapped to the Pacific Grid
s:	short integer data

For more information about the current data set files available, please contact NSIDC User Services.

12.1 Alphabetical File List

```
e01feb89_0954.dat
e01feb89_0954_c1s.img
e01feb89_0954_c2s.img
e01feb89_0954_c3s.img
e01feb89_0954_c4s.img
e01feb89_0954_c5s.img
e01feb89_0954_ch4.brws
e01feb89_0954_trk.img
e01jan88_0332.dat
e01mar89_1014.dat
e01mar89_1014_c1s.img
e01mar89_1014_c2s.img
e01mar89_1014_c3s.img
e01mar89_1014_c4s.img
e01mar89_1014_c5s.img
e01mar89_1014_ch4.brws
e01mar89_1014_trk.img
e02dec89_0934.dat
e02dec89_0934_c1s.img
e02dec89_0934_c2s.img
e02dec89_0934_c3s.img
e02dec89_0934_c4s.img
e02dec89_0934_c5s.img
e02dec89_0934_ch4.brws
e02dec89_0934_trk.img
e02nov89_0941.dat
e02nov89_0941_c1s.img
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e02nov89_0941_c2s.img
e02nov89_0941_c3s.img
e02nov89_0941_c4s.img
e02nov89_0941_c5s.img
e02nov89_0941_ch4.brws
e02nov89_0941_trk.img
e03dec89_0923.dat
e03dec89_0923_c1s.img
e03dec89_0923_c2s.img
e03dec89_0923_c3s.img
e03dec89_0923_c4s.img
e03dec89_0923_c5s.img
e03dec89_0923_ch4.brws
e03dec89_0923_trk.img
e03feb89_0934.dat
e03feb89_0934_c1s.img
e03feb89_0934_c2s.img
e03feb89_0934_c3s.img
e03feb89_0934_c4s.img
e03feb89_0934_c5s.img
e03feb89_0934_ch4.brws
e03feb89_0934_trk.img
e03jul89_1414.dat
e03jul89_1414_c1s.img
e03jul89_1414_c2s.img
e03jul89_1414_c3s.img
e03jul89_1414_c4s.img
e03jul89_1414_c5s.img
e03jul89_1414_ch2.brws
e04dec89_1416.dat
e04dec89_1416_c1s.img
e04dec89_1416_c2s.img
e04dec89_1416_c3s.img
e04dec89_1416_c4s.img
e04dec89_1416_c5s.img
e04dec89_1416_ch4.brws
e04mar89_1447.dat
e04mar89_1447_c1.img
e04mar89_1447_c2.img
e04mar89_1447_c3.img
e04mar89_1447_c4.img
e04mar89_1447_c5.img
e04mar89_1447_ch4.brws
e05apr89_0919.dat
e05apr89_0919_c1s.img
e05apr89_0919_c2s.img
e05apr89_0919_c3s.img
e05apr89_0919_c4s.img
e05apr89_0919_c5s.img
e05apr89_0919_ch4.brws
e05apr89_0919_trk.img
e05jan88_1144.dat
e05nov88_1143.dat
e05nov88_1143_sat.gpg
e06dec88_0921.dat
e06dec88_0921_sat.gpg
e06feb89_0903.dat
e06feb89_0903_c1s.img
e06feb89_0903_c2s.img
e06feb89_0903_c3s.img
e06feb89_0903_c4s.img
e06feb89_0903_c5s.img
e06feb89_0903_ch4.brws
e06jan89_0913.dat
e06jan89_0913_c1s.img
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e06jan89_0913_c2s.img
e06jan89_0913_c3s.img
e06jan89_0913_c4s.img
e06jan89_0913_c5s.img
e06jan89_0913_ch4.brws
e06jan89_0913_trk.img
e06jul89_1022.dat
e06jul89_1022_c1s.img
e06jul89_1022_c2s.img
e06jul89_1022_c3s.img
e06jul89_1022_c4s.img
e06jul89_1022_c5s.img
e06jul89_1022_ch2.brws
e06jul89_1022_trk.img
e07dec88_0911.dat
e07dec88_0911_sat.gpg
e07jan89_1408.dat
e07jan89_1408_c1.img
e07jan89_1408_c2.img
e07jan89_1408_c3.img
e07jan89_1408_c4.img
e07jan89_1408_c5.img
e07jan89_1408_ch4.brws
e08apr89_0317.dat
e08apr89_0317_c1s.img
e08apr89_0317_c2s.img
e08apr89_0317_c3s.img
e08apr89_0317_c4s.img
e08apr89_0317_ch4.brws
e08apr89_0317_trk.img
e08dec88_1219.dat
e08dec88_1219_sat.gpg
e08dec89_1515.dat
e08dec89_1515_c1s.img
e08dec89_1515_c2s.img
e08dec89_1515_c3s.img
e08dec89_1515_c4s.img
e08dec89_1515_c5s.img
e08dec89_1515_ch4.brws
e08jul89_1322.dat
e08jul89_1322_c1s.img
e08jul89_1322_c2s.img
e08jul89_1322_c3s.img
e08jul89_1322_c4s.img
e08jul89_1322_c5s.img
e08jul89_1322_ch2.brws
e08jul89_1322_trk.img
e08nov88_0336.dat
e08nov88_0336_sat.gpg
e08nov89_0347.dat
e08nov89_0347_c1s.img
e08nov89_0347_c2s.img
e08nov89_0347_c3s.img
e08nov89_0347_c4s.img
e08nov89_0347_ch4.brws
e08nov89_0347_trk.img
e08nov89_1027.dat
e08nov89_1027_c1s.img
e08nov89_1027_c2s.img
e08nov89_1027_c3s.img
e08nov89_1027_c4s.img
e08nov89_1027_c5s.img
e08nov89_1027_ch4.brws
e08nov89_1531.dat
e08nov89_1531_c1s.img
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e08nov89_1531_c2s.img
e08nov89_1531_c3s.img
e08nov89_1531_c4s.img
e08nov89_1531_c5s.img
e08nov89_1531_ch4.brws
e08oct88_1149.dat
e08oct89_1412.dat
e08oct89_1412_c1s.img
e08oct89_1412_c2s.img
e08oct89_1412_c3s.img
e08oct89_1412_c4s.img
e08oct89_1412_c5s.img
e08oct89_1412_ch4.brws
e09aug89_0243.dat
e09aug89_0243_c1s.img
e09aug89_0243_c2s.img
e09aug89_0243_c3s.img
e09aug89_0243_c4s.img
e09aug89_0243_ch2.brws
e09aug89_0243_trk.img
e09dec89_1000.dat
e09dec89_1000_c1s.img
e09dec89_1000_c2s.img
e09dec89_1000_c3s.img
e09dec89_1000_c4s.img
e09dec89_1000_c5s.img
e09dec89_1000_ch4.brws
e09dec89_1000_trk.img
e09jan88_1100.dat
e10jan89_1015.dat
e10jan89_1015_c1s.img
e10jan89_1015_c2s.img
e10jan89_1015_c3s.img
e10jan89_1015_c4s.img
e10jan89_1015_c5s.img
e10jan89_1015_ch4.brws
e10jan89_1015_trk.img
e10jul89_0940.dat
e10jul89_0940_c1s.img
e10jul89_0940_c2s.img
e10jul89_0940_c3s.img
e10jul89_0940_c4s.img
e10jul89_0940_c5s.img
e10jul89_0940_ch2.brws
e10jul89_0940_trk.img
e10nov89_1509.dat
e10nov89_1509_c1s.img
e10nov89_1509_c2s.img
e10nov89_1509_c3s.img
e10nov89_1509_c4s.img
e10nov89_1509_c5s.img
e10nov89_1509_ch4.brws
e11aug89_0339.dat
e11aug89_0339_c1s.img
e11aug89_0339_c2s.img
e11aug89_0339_c3s.img
e11aug89_0339_c4s.img
e11aug89_0339_ch2.brws
e11aug89_0339_trk.img
e11nov89_0955.dat
e11nov89_0955_c1s.img
e11nov89_0955_c2s.img
e11nov89_0955_c3s.img
e11nov89_0955_c4s.img
e11nov89_0955_c5s.img
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e11nov89_0955_ch4.brws
e11nov89_0955_trk.img
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e12aug89_0316_c1s.img
e12aug89_0316_c2s.img
e12aug89_0316_c3s.img
e12aug89_0316_c4s.img
e12aug89_0316_ch2.brws
e12aug89_0316_trk.img
e13dec88_0953.dat
e13dec88_0953_sat.gpg
e13dec89_0917.dat
e13dec89_0917_c1s.img
e13dec89_0917_c2s.img
e13dec89_0917_c3s.img
e13dec89_0917_c4s.img
e13dec89_0917_c5s.img
e13dec89_0917_ch4.brws
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e13dec89_1421.dat
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e13dec89_1421_c2s.img
e13dec89_1421_c3s.img
e13dec89_1421_c4s.img
e13dec89_1421_c5s.img
e13dec89_1421_ch4.brws
e13jan89_0944.dat
e13jan89_0944_c1s.img
e13jan89_0944_c2s.img
e13jan89_0944_c3s.img
e13jan89_0944_c4s.img
e13jan89_0944_c5s.img
e13jan89_0944_ch4.brws
e13jan89_0944_trk.img
e14dec89_0337.dat
e14dec89_0337_c1s.img
e14dec89_0337_c2s.img
e14dec89_0337_c3s.img
e14dec89_0337_c4s.img
e14dec89_0337_ch4.brws
e14dec89_0337_trk.img
e14jan89_0046.dat
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e14jan89_0046_c2s.img
e14jan89_0046_c3s.img
e14jan89_0046_c4s.img
e14jan89_0046_ch4.brws
e14mar89_0229.dat
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e14mar89_0229_c2s.img
e14mar89_0229_c3s.img
e14mar89_0229_c4s.img
e14mar89_0229_c5s.img
e14mar89_0229_ch4.brws
e14mar89_0229_trk.img
e14mar89_1447.dat
e14mar89_1447_c1s.img
e14mar89_1447_c2s.img
e14mar89_1447_c3s.img
e14mar89_1447_c4s.img
e14mar89_1447_c5s.img
e14mar89_1447_ch4.brws
e14nov88_0940.dat
e14nov88_0940_sat.gpg
e15jan89_1428.dat
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e15jan89_1428_c3s.img
e15jan89_1428_c4s.img
e15jan89_1428_c5s.img
e15jan89_1428_ch4.brws
e15jul89_1533.dat
e15jul89_1533_c1s.img
e15jul89_1533_c2s.img
e15jul89_1533_c3s.img
e15jul89_1533_c4s.img
e15jul89_1533_c5s.img
e15jul89_1533_ch2.brws
e15nov89_1416.dat
e15nov89_1416_c1.img
e15nov89_1416_c2.img
e15nov89_1416_c3.img
e15nov89_1416_c4.img
e15nov89_1416_c5.img
e15nov89_1416_ch4.brws
e16jul89_0319.dat
e16jul89_0319_c1s.img
e16jul89_0319_c2s.img
e16jul89_0319_c3s.img
e16jul89_0319_c4s.img
e16jul89_0319_ch2.brws
e16jul89_0319_trk.img
e16mar89_0913.dat
e16mar89_0913_c1s.img
e16mar89_0913_c2s.img
e16mar89_0913_c3s.img
e16mar89_0913_c4s.img
e16mar89_0913_c5s.img
e16mar89_0913_ch4.brws
e16mar89_0913_trk.img
e16mar89_1426.dat
e16mar89_1426_c1s.img
e16mar89_1426_c2s.img
e16mar89_1426_c3s.img
e16mar89_1426_c4s.img
e16mar89_1426_c5s.img
e16mar89_1426_ch4.brws
e16nov88_1242.dat
e16nov88_1242_sat.gpg
e16nov89_0227.dat
e16nov89_0227_c1s.img
e16nov89_0227_c2s.img
e16nov89_0227_c3s.img
e16nov89_0227_c4s.img
e16nov89_0227_ch4.brws
e16nov89_0227_trk.img
e16sep89_1442.dat
e16sep89_1442_c1s.img
e16sep89_1442_c2s.img
e16sep89_1442_c3s.img
e16sep89_1442_c4s.img
e16sep89_1442_c5s.img
e16sep89_1442_ch4.brws
e17dec88_0912.dat
e17dec88_0912_sat.gpg
e17jan89_0903.dat
e17jan89_0903_c1s.img
e17jan89_0903_c2s.img
e17jan89_0903_c3s.img
e17jan89_0903_c4s.img
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e17jan89_0903_c5s.img
e17jan89_0903_ch4.brws
e17jan89_0903_trk.img
e17oct89_1419.dat
e17oct89_1419_c1s.img
e17oct89_1419_c2s.img
e17oct89_1419_c3s.img
e17oct89_1419_c4s.img
e17oct89_1419_c5s.img
e17oct89_1419_ch4.brws
e18nov89_0323.dat
e18nov89_0323_c1s.img
e18nov89_0323_c2s.img
e18nov89_0323_c3s.img
e18nov89_0323_c4s.img
e18nov89_0323_ch4.brws
e18nov89_0323_trk.img
e18nov89_1344.dat
e18nov89_1344_c1s.img
e18nov89_1344_c2s.img
e18nov89_1344_c3s.img
e18nov89_1344_c4s.img
e18nov89_1344_c5s.img
e18nov89_1344_ch4.brws
e18nov89_1344_trk.img
e18oct88_1140.dat
e19apr88_1112.dat
e19apr89_1340.dat
e19apr89_1340_c1s.img
e19apr89_1340_c2s.img
e19apr89_1340_c3s.img
e19apr89_1340_c4s.img
e19apr89_1340_c5s.img
e19apr89_1340_ch4.brws
e19dec89_0958.dat
e19dec89_0958_c1s.img
e19dec89_0958_c2s.img
e19dec89_0958_c3s.img
e19dec89_0958_c4s.img
e19dec89_0958_c5s.img
e19dec89_0958_ch4.brws
e19dec89_0958_trk.img
e19feb89_1014.dat
e19feb89_1014_c1s.img
e19feb89_1014_c2s.img
e19feb89_1014_c3s.img
e19feb89_1014_c4s.img
e19feb89_1014_c5s.img
e19feb89_1014_ch4.brws
e19feb89_1014_trk.img
e19jul89_1309.dat
e19jul89_1309_c1s.img
e19jul89_1309_c2s.img
e19jul89_1309_c3s.img
e19jul89_1309_c4s.img
e19jul89_1309_c5s.img
e19jul89_1309_ch2.brws
e19jul89_1309_trk.img
e19oct89_1540.dat
e19oct89_1540_c1.img
e19oct89_1540_c2.img
e19oct89_1540_c3.img
e19oct89_1540_c4.img
e19oct89_1540_c5.img
e19oct89_1540_ch4.brws
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e20nov88_0232.dat
e20nov88_0232_sat.gpg
e21dec89_0238.dat
e21dec89_0238_c1s.img
e21dec89_0238_c2s.img
e21dec89_0238_c3s.img
e21dec89_0238_c4s.img
e21dec89_0238_ch4.brws
e21dec89_0238_trk.img
e21jan88_1212.dat
e21jan89_1005.dat
e21jan89_1005_c1s.img
e21jan89_1005_c2s.img
e21jan89_1005_c3s.img
e21jan89_1005_c4s.img
e21jan89_1005_c5s.img
e21jan89_1005_ch4.brws
e21jan89_1005_trk.img
e21sep89_1027.dat
e21sep89_1027_c1s.img
e21sep89_1027_c2s.img
e21sep89_1027_c3s.img
e21sep89_1027_c4s.img
e21sep89_1027_c5s.img
e21sep89_1027_ch4.brws
e21sep89_1027_trk.img
e22apr89_0947.dat
e22apr89_0947_c1s.img
e22apr89_0947_c2s.img
e22apr89_0947_c3s.img
e22apr89_0947_c4s.img
e22apr89_0947_c5s.img
e22apr89_0947_ch4.brws
e22apr89_0947_trk.img
e22apr89_1451.dat
e22apr89_1451_c1s.img
e22apr89_1451_c2s.img
e22apr89_1451_c3s.img
e22apr89_1451_c4s.img
e22apr89_1451_c5s.img
e22apr89_1451_ch4.brws
e22apr89_1451_trk.img
e22dec89_1245.dat
e22dec89_1245_c1s.img
e22dec89_1245_c2s.img
e22dec89_1245_c3s.img
e22dec89_1245_c4s.img
e22dec89_1245_c5s.img
e22dec89_1245_ch4.brws
e22dec89_1245_trk.img
e22dec89_1426.dat
e22dec89_1426_c1s.img
e22dec89_1426_c2s.img
e22dec89_1426_c3s.img
e22dec89_1426_c4s.img
e22dec89_1426_c5s.img
e22dec89_1426_ch4.brws
e22feb89_0944.dat
e22feb89_0944_c1s.img
e22feb89_0944_c2s.img
e22feb89_0944_c3s.img
e22feb89_0944_c4s.img
e22feb89_0944_c5s.img
e22feb89_0944_ch4.brws
e22feb89_0944_trk.img
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e22feb89_1448.dat
e22feb89_1448_c1s.img
e22feb89_1448_c2s.img
e22feb89_1448_c3s.img
e22feb89_1448_c4s.img
e22feb89_1448_c5s.img
e22feb89_1448_ch4.brws
e22nov89_0333.dat
e22nov89_0333_c1s.img
e22nov89_0333_c2s.img
e22nov89_0333_c3s.img
e22nov89_0333_c4s.img
e22nov89_0333_ch4.brws
e22nov89_0333_trk.img
e22nov89_0939.dat
e22nov89_0939_c1s.img
e22nov89_0939_c2s.img
e22nov89_0939_c3s.img
e22nov89_0939_c4s.img
e22nov89_0939_c5s.img
e22nov89_0939_ch4.brws
e22nov89_0939_trk.img
e22oct89_0329.dat
e22oct89_0329_c1s.img
e22oct89_0329_c2s.img
e22oct89_0329_c3s.img
e22oct89_0329_c4s.img
e22oct89_0329_ch4.brws
e22oct89_0329_trk.img
e23apr88_1210.dat
e23jan88_1512.dat
e23jan89_0944.dat
e23jan89_0944_c1s.img
e23jan89_0944_c2s.img
e23jan89_0944_c3s.img
e23jan89_0944_c4s.img
e23jan89_0944_c5s.img
e23jan89_0944_ch4.brws
e23jan89_0944_trk.img
e23mar89_0952.dat
e23mar89_0952_c1s.img
e23mar89_0952_c2s.img
e23mar89_0952_c3s.img
e23mar89_0952_c4s.img
e23mar89_0952_c5s.img
e23mar89_0952_ch4.brws
e23mar89_0952_trk.img
e23nov88_1455.dat
e23nov88_1455_sat.gpg
e23oct89_0954.dat
e23oct89_0954_c1s.img
e23oct89_0954_c2s.img
e23oct89_0954_c3s.img
e23oct89_0954_c4s.img
e23oct89_0954_c5s.img
e23oct89_0954_ch4.brws
e23oct89_0954_trk.img
e24dec88_0943.dat
e24dec88_0943_sat.gpg
e24mar89_0941.dat
e24mar89_0941_c1s.img
e24mar89_0941_c2s.img
e24mar89_0941_c3s.img
e24mar89_0941_c4s.img
e24mar89_0941_c5s.img
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e24mar89_0941_ch4.brws
e24mar89_0941_trk.img
e24nov88_0941.dat
e24nov88_0941_sat.gpg
e24oct89_1446.dat
e24oct89_1446_c1s.img
e24oct89_1446_c2s.img
e24oct89_1446_c3s.img
e24oct89_1446_c4s.img
e24oct89_1446_c5s.img
e24oct89_1446_ch4.brws
e25apr88_1148.dat
e25apr89_0916.dat
e25apr89_0916_c1s.img
e25apr89_0916_c2s.img
e25apr89_0916_c3s.img
e25apr89_0916_c4s.img
e25apr89_0916_c5s.img
e25apr89_0916_ch4.brws
e25apr89_0916_trk.img
e25feb89_0913.dat
e25feb89_0913_c1s.img
e25feb89_0913_c2s.img
e25feb89_0913_c3s.img
e25feb89_0913_c4s.img
e25feb89_0913_c5s.img
e25feb89_0913_ch4.brws
e25feb89_0913_trk.img
e25mar89_0931.dat
e25mar89_0931_c1s.img
e25mar89_0931_c2s.img
e25mar89_0931_c3s.img
e25mar89_0931_c4s.img
e25mar89_0931_c5s.img
e25mar89_0931_ch4.brws
e25mar89_0931_trk.img
e25oct88_1204.dat
e26apr89_0318.dat
e26apr89_0318_c1s.img
e26apr89_0318_c2s.img
e26apr89_0318_c3s.img
e26apr89_0318_c4s.img
e26apr89_0318_ch4.brws
e26apr89_0318_trk.img
e26dec88_0923.dat
e26dec88_0923_sat.gpg
e26jan88_1439.dat
e26jul89_0255.dat
e26jul89_0255_c1s.img
e26jul89_0255_c2s.img
e26jul89_0255_c3s.img
e26jul89_0255_c4s.img
e26jul89_0255_ch2.brws
e26jul89_0255_trk.img
e26mar89_0924.dat
e26mar89_0924_c1s.img
e26mar89_0924_c2s.img
e26mar89_0924_c3s.img
e26mar89_0924_c4s.img
e26mar89_0924_c5s.img
e26mar89_0924_ch4.brws
e26mar89_0924_trk.img
e26oct89_0339.dat
e26oct89_0339_c1s.img
e26oct89_0339_c2s.img
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e26oct89_0339_c3s.img
e26oct89_0339_c4s.img
e26oct89_0339_ch4.brws
e26oct89_0339_trk.img
e26oct89_0921.dat
e26oct89_0921_c1s.img
e26oct89_0921_c2s.img
e26oct89_0921_c3s.img
e26oct89_0921_c4s.img
e26oct89_0921_c5s.img
e26oct89_0921_ch4.brws
e26oct89_0921_trk.img
e27mar89_1228.dat
e27mar89_1228_c1s.img
e27mar89_1228_c2s.img
e27mar89_1228_c3s.img
e27mar89_1228_c4s.img
e27mar89_1228_c5s.img
e27mar89_1228_ch4.brws
e27mar89_1228_trk.img
e27oct88_1142.dat
e27oct89_0316.dat
e27oct89_0316_c1s.img
e27oct89_0316_c2s.img
e27oct89_0316_c3s.img
e27oct89_0316_c4s.img
e27oct89_0316_ch4.brws
e27oct89_0316_trk.img
e28feb89_1024.dat
e28feb89_1024_c1s.img
e28feb89_1024_c2s.img
e28feb89_1024_c3s.img
e28feb89_1024_c4s.img
e28feb89_1024_c5s.img
e28feb89_1024_ch4.brws
e28feb89_1024_trk.img
e28feb89_1529.dat
e28feb89_1529_c1s.img
e28feb89_1529_c2s.img
e28feb89_1529_c3s.img
e28feb89_1529_c4s.img
e28feb89_1529_c5s.img
e28feb89_1529_ch4.brws
e28mar89_1404.dat
e28mar89_1404_c1s.img
e28mar89_1404_c2s.img
e28mar89_1404_c3s.img
e28mar89_1404_c4s.img
e28mar89_1404_c5s.img
e28mar89_1404_ch4.brws
e28nov89_1521.dat
e28nov89_1521_c2s.img
e28nov89_1521_c3s.img
e28nov89_1521_c4s.img
e28nov89_1521_c5s.img
e28nov89_1521_ch4.brws
e28oct88_1131.dat
e29dec89_1452.dat
e29dec89_1452_c1s.img
e29dec89_1452_c2s.img
e29dec89_1452_c3s.img
e29dec89_1452_c4s.img
e29dec89_1452_c5s.img
e29dec89_1452_ch4.brws
e29oct88_0354.dat
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e29oct89_1536.dat
e29oct89_1536_c1s.img
e29oct89_1536_c2s.img
e29oct89_1536_c3s.img
e29oct89_1536_c4s.img
e29oct89_1536_c5s.img
e29oct89_1536_ch4.brws
e30nov89_0948.dat
e30nov89_0948_c1s.img
e30nov89_0948_c2s.img
e30nov89_0948_c3s.img
e30nov89_0948_c4s.img
e30nov89_0948_c5s.img
e30nov89_0948_ch4.brws
e31jan89_1005.dat
e31jan89_1005_c1s.img
e31jan89_1005_c2s.img
e31jan89_1005_c3s.img
e31jan89_1005_c4s.img
e31jan89_1005_c5s.img
e31jan89_1005_ch4.brws
e31jan89_1005_trk.img
e31jul89_1427.dat
e31jul89_1427_c1s.img
e31jul89_1427_c2s.img
e31jul89_1427_c3s.img
e31jul89_1427_c4s.img
e31jul89_1427_c5s.img
e31jul89_1427_ch2.brws
e31mar89_1011.dat
e31mar89_1011_c1s.img
e31mar89_1011_c2s.img
e31mar89_1011_c3s.img
e31mar89_1011_c4s.img
e31mar89_1011_c5s.img
e31mar89_1011_ch4.brws
e31mar89_1011_trk.img
egrid.img
emap.img
emask.img
p01aug89_0100.dat
p01aug89_0100_c1s.img
p01aug89_0100_c2s.img
p01aug89_0100_c3s.img
p01aug89_0100_c4s.img
p01aug89_0100_c5s.img
p01aug89_0100_ch2.brws
p01aug89_0100_trk.img
p01aug89_2244.dat
p01aug89_2244_c1s.img
p01aug89_2244_c2s.img
p01aug89_2244_c3s.img
p01aug89_2244_c4s.img
p01aug89_2244_c5s.img
p01aug89_2244_ch2.brws
p01dec89_0459.dat
p01dec89_0459_c1s.img
p01dec89_0459_c2s.img
p01dec89_0459_c3s.img
p01dec89_0459_c4s.img
p01dec89_0459_ch4.brws
p01dec89_0459_trk.img
p01dec89_2315.dat
p01dec89_2315_c1s.img
p01dec89_2315_c2s.img
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p01dec89_2315_c3s.img
p01dec89_2315_c4s.img
p01dec89_2315_c5s.img
p01dec89_2315_ch4.brws
p01dec89_2315_trk.img
p01feb89_1145.dat
p01feb89_1145_c1s.img
p01feb89_1145_c2s.img
p01feb89_1145_c3s.img
p01feb89_1145_c4s.img
p01feb89_1145_c5s.img
p01feb89_1145_ch4.brws
p01feb89_1145_trk.img
p01jul89_0057.dat
p01jul89_0057_c1s.img
p01jul89_0057_c2s.img
p01jul89_0057_c3s.img
p01jul89_0057_c4s.img
p01jul89_0057_c5s.img
p01jul89_0057_ch2.brws
p01jul89_0057_trk.img
p01jul89_2047.dat
p01jul89_2047_c1s.img
p01jul89_2047_c2s.img
p01jul89_2047_c3s.img
p01jul89_2047_c4s.img
p01jul89_2047_ch2.brws
p01jul89_2047_trk.img
p01jun88_2019.dat
p01mar89_1518.dat
p01mar89_1518_c1s.img
p01mar89_1518_c2s.img
p01mar89_1518_c3s.img
p01mar89_1518_c4s.img
p01mar89_1518_c5s.img
p01mar89_1518_ch4.brws
p01mar89_1518_trk.img
p01sep88_2159.dat
p02apr89_0209.dat
p02apr89_0209_c1s.img
p02apr89_0209_c2s.img
p02apr89_0209_c3s.img
p02apr89_0209_c4s.img
p02apr89_0209_ch4.brws
p02apr89_0209_trk.img
p02apr89_2043.dat
p02apr89_2043_c1s.img
p02apr89_2043_c2s.img
p02apr89_2043_c3s.img
p02apr89_2043_c4s.img
p02apr89_2043_c5s.img
p02apr89_2043_ch4.brws
p02apr89_2043_trk.img
p02dec88_2334.dat
p02dec88_2334_sat.gpg
p02dec89_2304.dat
p02dec89_2304_c1s.img
p02dec89_2304_c2s.img
p02dec89_2304_c3s.img
p02dec89_2304_c4s.img
p02dec89_2304_c5s.img
p02dec89_2304_ch4.brws
p02dec89_2304_trk.img
p02jul88_2045.dat
p02mar89_1508.dat
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p02mar89_1508_c1s.img
p02mar89_1508_c2s.img
p02mar89_1508_c3s.img
p02mar89_1508_c4s.img
p02mar89_1508_c5s.img
p02mar89_1508_ch4.brws
p02mar89_1508_trk.img
p02mar89_2336.dat
p02mar89_2336_c1s.img
p02mar89_2336_c2s.img
p02mar89_2336_c3s.img
p02mar89_2336_c4s.img
p02mar89_2336_c5s.img
p02mar89_2336_ch4.brws
p02mar89_2336_trk.img
p02sep89_2355.dat
p02sep89_2355_c1s.img
p02sep89_2355_c2s.img
p02sep89_2355_c3s.img
p02sep89_2355_c4s.img
p02sep89_2355_c5s.img
p02sep89_2355_ch4.brws
p02sep89_2355_trk.img
p03apr89_2312.dat
p03apr89_2312_c1s.img
p03apr89_2312_c2s.img
p03apr89_2312_c3s.img
p03apr89_2312_c4s.img
p03apr89_2312_c5s.img
p03apr89_2312_ch4.brws
p03apr89_2312_trk.img
p03aug89_0016.dat
p03aug89_0016_c1s.img
p03aug89_0016_c2s.img
p03aug89_0016_c3s.img
p03aug89_0016_c4s.img
p03aug89_0016_c5s.img
p03aug89_0016_ch2.brws
p03aug89_0016_trk.img
p03dec88_2142.dat
p03dec88_2142_sat.gpg
p03dec89_2113.dat
p03dec89_2113_c1s.img
p03dec89_2113_c2s.img
p03dec89_2113_c3s.img
p03dec89_2113_c4s.img
p03dec89_2113_c5s.img
p03dec89_2113_ch4.brws
p03dec89_2113_trk.img
p03jul88_2022.dat
p03jul89_0035.dat
p03jul89_0035_c1s.img
p03jul89_0035_c2s.img
p03jul89_0035_c3s.img
p03jul89_0035_c4s.img
p03jul89_0035_c5s.img
p03jul89_0035_ch2.brws
p03jul89_0035_trk.img
p03jul89_1822.dat
p03jul89_1822_c1s.img
p03jul89_1822_c2s.img
p03jul89_1822_c3s.img
p03jul89_1822_c4s.img
p03jul89_1822_ch2.brws
p03jul89_1822_trk.img
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p03jun89_2110.dat
p03jun89_2110_c1s.img
p03jun89_2110_c2s.img
p03jun89_2110_ch2.brws
p03jun89_2110_trk.img
p03nov88_1713.dat
p03sep89_1839.dat
p03sep89_1839_c1s.img
p03sep89_1839_c2s.img
p03sep89_1839_c3s.img
p03sep89_1839_c4s.img
p03sep89_1839_ch4.brws
p03sep89_1839_trk.img
p04jun88_2055.dat
p04nov88_1659.dat
p04sep88_2049.dat
p05aug89_2202.dat
p05aug89_2202_c1s.img
p05aug89_2202_c2s.img
p05aug89_2202_c3s.img
p05aug89_2202_c4s.img
p05aug89_2202_c5s.img
p05aug89_2202_ch2.brws
p05aug89_2202_trk.img
p05jul86_2129.dat
p05jul86_2129_c1s.img
p05jul86_2129_c2s.img
p05jul86_2129_c3s.img
p05jul86_2129_c4s.img
p05jul86_2129_c5s.img
p05jul86_2129_trk.img
p05jul88_0202.dat
p06aug88_1941.dat
p06aug89_0210.dat
p06aug89_0210_c1s.img
p06aug89_0210_c2s.img
p06aug89_0210_c3s.img
p06aug89_0210_c4s.img
p06aug89_0210_ch2.brws
p06aug89_0210_trk.img
p06dec88_2255.dat
p06dec88_2255_sat.gpg
p06dec89_0136.dat
p06dec89_0136_c1s.img
p06dec89_0136_c2s.img
p06dec89_0136_c3s.img
p06dec89_0136_c4s.img
p06dec89_0136_ch4.brws
p06dec89_0136_trk.img
p06jul89_2353.dat
p06jul89_2353_c1s.img
p06jul89_2353_c2s.img
p06jul89_2353_c3s.img
p06jul89_2353_c4s.img
p06jul89_2353_c5s.img
p06jul89_2353_ch2.brws
p06jul89_2353_trk.img
p06nov88_1636.dat
p06nov88_1636_sat.gpg
p06nov89_0030.dat
p06nov89_0030_c1s.img
p06nov89_0030_c2s.img
p06nov89_0030_c3s.img
p06nov89_0030_c4s.img
p06nov89_0030_c5s.img
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p06nov89_0030_ch4.brws
p06nov89_0030_trk.img
p07aug89_2141.dat
p07aug89_2141_c1s.img
p07aug89_2141_c2s.img
p07aug89_2141_c3s.img
p07aug89_2141_c4s.img
p07aug89_2141_ch2.brws
p07aug89_2141_trk.img
p07dec89_2211.dat
p07dec89_2211_c1s.img
p07dec89_2211_c2s.img
p07dec89_2211_c3s.img
p07dec89_2211_c4s.img
p07dec89_2211_c5s.img
p07dec89_2211_ch4.brws
p07dec89_2211_trk.img
p07jul88_2037.dat
p07jul89_2013.dat
p07jul89_2013_c1s.img
p07jul89_2013_c2s.img
p07jul89_2013_c3s.img
p07jul89_2013_c4s.img
p07jul89_2013_ch2.brws
p07jul89_2013_trk.img
p07sep89_0326.dat
p07sep89_0326_c1s.img
p07sep89_0326_c2s.img
p07sep89_0326_c3s.img
p07sep89_0326_c4s.img
p07sep89_0326_ch4.brws
p07sep89_0326_trk.img
p08apr89_1402.dat
p08apr89_1402_c1s.img
p08apr89_1402_c2s.img
p08apr89_1402_c3s.img
p08apr89_1402_c4s.img
p08apr89_1402_c5s.img
p08apr89_1402_ch4.brws
p08apr89_1402_trk.img
p08apr89_1543.dat
p08apr89_1543_c1s.img
p08apr89_1543_c2s.img
p08apr89_1543_c3s.img
p08apr89_1543_c4s.img
p08apr89_1543_c5s.img
p08apr89_1543_ch4.brws
p08apr89_1543_trk.img
p08dec88_2237.dat
p08dec88_2237_sat.gpg
p08nov89_0158.dat
p08nov89_0158_c1s.img
p08nov89_0158_c2s.img
p08nov89_0158_c3s.img
p08nov89_0158_c4s.img
p08nov89_0158_ch4.brws
p08nov89_0158_trk.img
p08nov89_2036.dat
p08nov89_2036_c1s.img
p08nov89_2036_c2s.img
p08nov89_2036_c3s.img
p08nov89_2036_c4s.img
p08nov89_2036_c5s.img
p08nov89_2036_ch4.brws
p08nov89_2036_trk.img
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p08nov89_2358.dat
p08nov89_2358_c1s.img
p08nov89_2358_c2s.img
p08nov89_2358_c3s.img
p08nov89_2358_c4s.img
p08nov89_2358_c5s.img
p08nov89_2358_ch4.brws
p09feb89_1520.dat
p09feb89_1520_c1s.img
p09feb89_1520_c2s.img
p09feb89_1520_c3s.img
p09feb89_1520_c4s.img
p09feb89_1520_c5s.img
p09feb89_1520_ch4.brws
p09feb89_1520_trk.img
p09feb89_2347.dat
p09feb89_2347_c1s.img
p09feb89_2347_c2s.img
p09feb89_2347_c3s.img
p09feb89_2347_c4s.img
p09feb89_2347_c5s.img
p09feb89_2347_ch4.brws
p09feb89_2347_trk.img
p09jul88_0119.dat
p09jul89_2109.dat
p09jul89_2109_c1s.img
p09jul89_2109_c2s.img
p09jul89_2109_c3s.img
p09jul89_2109_c4s.img
p09jul89_2109_ch2.brws
p09jul89_2109_trk.img
p09mar89_0230.dat
p09mar89_0230_c1s.img
p09mar89_0230_c2s.img
p09mar89_0230_c3s.img
p09mar89_0230_c4s.img
p09mar89_0230_ch4.brws
p09mar89_0230_trk.img
p09nov88_1535.dat
p09nov88_1535_sat.gpg
p10aug88_1954.dat
p10aug89_0220.dat
p10aug89_0220_c1s.img
p10aug89_0220_c2s.img
p10aug89_0220_c3s.img
p10aug89_0220_c4s.img
p10aug89_0220_ch2.brws
p10aug89_0220_trk.img
p10dec88_2213.dat
p10dec88_2213_sat.gpg
p10dec89_2320.dat
p10dec89_2320_c1s.img
p10dec89_2320_c2s.img
p10dec89_2320_c3s.img
p10dec89_2320_c4s.img
p10dec89_2320_c5s.img
p10dec89_2320_ch4.brws
p10dec89_2320_trk.img
p10jan89_1519.dat
p10jan89_1519_c1s.img
p10jan89_1519_c2s.img
p10jan89_1519_c3s.img
p10jan89_1519_c4s.img
p10jan89_1519_c5s.img
p10jan89_1519_ch4.brws
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p10jan89_1519_trk.img
p10jun88_0133.dat
p10nov88_1525.dat
p10nov88_1525_sat.gpg
p10nov88_1945.dat
p10nov88_1945_sat.gpg
p10nov89_0121.dat
p10nov89_0121_c1.img
p10nov89_0121_c2.img
p10nov89_0121_c3.img
p10nov89_0121_c4.img
p10nov89_0121_ch4.brws
p10nov89_0121_trk.img
p10nov89_2336.dat
p10nov89_2336_c1s.img
p10nov89_2336_c2s.img
p10nov89_2336_c3s.img
p10nov89_2336_c4s.img
p10nov89_2336_c5s.img
p10nov89_2336_ch4.brws
p10nov89_2336_trk.img
p10sep89_0047.dat
p10sep89_0047_c1s.img
p10sep89_0047_c2s.img
p10sep89_0047_c3s.img
p10sep89_0047_c4s.img
p10sep89_0047_ch4.brws
p10sep89_0047_trk.img
p11apr89_2331.dat
p11apr89_2331_c1s.img
p11apr89_2331_c2s.img
p11apr89_2331_c3s.img
p11apr89_2331_c4s.img
p11apr89_2331_c5s.img
p11apr89_2331_ch4.brws
p11apr89_2331_trk.img
p11nov88_1515.dat
p11nov88_1515_sat.gpg
p11sep88_0125.dat
p12dec89_0232.dat
p12dec89_0232_c1s.img
p12dec89_0232_c2s.img
p12dec89_0232_c3s.img
p12dec89_0232_c4s.img
p12dec89_0232_ch4.brws
p12dec89_0232_trk.img
p12jan89_1507.dat
p12jan89_1507_c1s.img
p12jan89_1507_c2s.img
p12jan89_1507_c3s.img
p12jan89_1507_c4s.img
p12jan89_1507_c5s.img
p12jan89_1507_ch4.brws
p12jan89_1507_trk.img
p12jan89_2327.dat
p12jan89_2327_c1s.img
p12jan89_2327_c2s.img
p12jan89_2327_c3s.img
p12jan89_2327_c4s.img
p12jan89_2327_c5s.img
p12jan89_2327_ch4.brws
p12jan89_2327_trk.img
p13apr89_0306.dat
p13apr89_0306_c1s.img
p13apr89_0306_c2s.img
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p13apr89_0306_c3s.img
p13apr89_0306_c4s.img
p13apr89_0306_ch4.brws
p13apr89_0306_trk.img
p13dec89_0037.dat
p13dec89_0037_c1s.img
p13dec89_0037_c2s.img
p13dec89_0037_c3s.img
p13dec89_0037_c4s.img
p13dec89_0037_ch4.brws
p13dec89_0037_trk.img
p13jan89_2124.dat
p13jan89_2124_c1s.img
p13jan89_2124_c2s.img
p13jan89_2124_c3s.img
p13jan89_2124_c4s.img
p13jan89_2124_ch4.brws
p13jan89_2124_trk.img
p13jun88_1918.dat
p13nov89_2304.dat
p13nov89_2304_c1s.img
p13nov89_2304_c2s.img
p13nov89_2304_c3s.img
p13nov89_2304_c4s.img
p13nov89_2304_c5s.img
p13nov89_2304_ch4.brws
p13nov89_2304_trk.img
p14dec89_0156.dat
p14dec89_0156_c1s.img
p14dec89_0156_c2s.img
p14dec89_0156_c3s.img
p14dec89_0156_c4s.img
p14dec89_0156_trk.img
p14dec89_2057.dat
p14dec89_2057_c1s.img
p14dec89_2057_c2s.img
p14dec89_2057_c3s.img
p14dec89_2057_c4s.img
p14dec89_2057_c5s.img
p14dec89_2057_ch4.brws
p14dec89_2057_trk.img
p14feb89_1256.dat
p14feb89_1256_c1s.img
p14feb89_1256_c2s.img
p14feb89_1256_c3s.img
p14feb89_1256_c4s.img
p14feb89_1256_c5s.img
p14feb89_1256_ch4.brws
p14feb89_1256_trk.img
p14jul88_0205.dat
p15apr89_2249.dat
p15apr89_2249_c1s.img
p15apr89_2249_c2s.img
p15apr89_2249_c3s.img
p15apr89_2249_c4s.img
p15apr89_2249_c5s.img
p15apr89_2249_ch4.brws
p15apr89_2249_trk.img
p15dec89_2046.dat
p15dec89_2046_c1s.img
p15dec89_2046_c2s.img
p15dec89_2046_c3s.img
p15dec89_2046_c4s.img
p15dec89_2046_c5s.img
p15dec89_2046_ch4.brws
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p15dec89_2046_trk.img
p15jul89_1533.dat
p15jul89_1533_c1s.img
p15jul89_1533_c2s.img
p15jul89_1533_c3s.img
p15jul89_1533_c4s.img
p15jul89_1533_c5s.img
p15jul89_1533_ch2.brws
p15jul89_1533_trk.img
p15mar89_2042.dat
p15mar89_2042_c1s.img
p15mar89_2042_c2s.img
p15mar89_2042_c3s.img
p15mar89_2042_c4s.img
p15mar89_2042_ch4.brws
p15mar89_2042_trk.img
p15sep89_2051.dat
p15sep89_2051_c1s.img
p15sep89_2051_c2s.img
p15sep89_2051_c3s.img
p15sep89_2051_c4s.img
p15sep89_2051_ch4.brws
p15sep89_2051_trk.img
p16jan89_2106.dat
p16jan89_2106_c1s.img
p16jan89_2106_c2s.img
p16jan89_2106_c3s.img
p16jan89_2106_c4s.img
p16jan89_2106_c5s.img
p16jan89_2106_ch4.brws
p16jan89_2106_trk.img
p16nov88_2253.dat
p16nov88_2253_sat.gpg
p16sep88_0211.dat
p17aug89_2320.dat
p17aug89_2320_c1s.img
p17aug89_2320_c2s.img
p17aug89_2320_c3s.img
p17aug89_2320_c4s.img
p17aug89_2320_c5s.img
p17aug89_2320_ch2.brws
p17aug89_2320_trk.img
p17jan88_2304.dat
p17mar89_1416.dat
p17mar89_1416_c1s.img
p17mar89_1416_c2s.img
p17mar89_1416_c3s.img
p17mar89_1416_c4s.img
p17mar89_1416_c5s.img
p17mar89_1416_ch4.brws
p17mar89_1416_trk.img
p17mar89_2245.dat
p17mar89_2245_c1s.img
p17mar89_2245_c2s.img
p17mar89_2245_c3s.img
p17mar89_2245_c4s.img
p17mar89_2245_c5s.img
p17mar89_2245_ch4.brws
p17mar89_2245_trk.img
p17nov89_0204.dat
p17nov89_0204_c1.img
p17nov89_0204_c2.img
p17nov89_0204_c3.img
p17nov89_0204_c4.img
p17nov89_0204_ch4.brws
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p17nov89_0204_trk.img
p18apr89_2038.dat
p18apr89_2038_c1s.img
p18apr89_2038_c2s.img
p18apr89_2038_c3s.img
p18apr89_2038_c4s.img
p18apr89_2038_c5s.img
p18apr89_2038_ch4.brws
p18apr89_2038_trk.img
p18aug89_1451.dat
p18aug89_1451_c1s.img
p18aug89_1451_c2s.img
p18aug89_1451_c3s.img
p18aug89_1451_c4s.img
p18aug89_1451_c5s.img
p18aug89_1451_ch2.brws
p18aug89_1451_trk.img
p18feb89_0117.dat
p18feb89_0117_c1s.img
p18feb89_0117_c2s.img
p18feb89_0117_c3s.img
p18feb89_0117_c4s.img
p18feb89_0117_ch4.brws
p18feb89_0117_trk.img
p18nov89_1534.dat
p18nov89_1534_c1s.img
p18nov89_1534_c2s.img
p18nov89_1534_c3s.img
p18nov89_1534_c4s.img
p18nov89_1534_c5s.img
p18nov89_1534_ch4.brws
p18nov89_1534_trk.img
p18nov89_2211.dat
p18nov89_2211_c1s.img
p18nov89_2211_c2s.img
p18nov89_2211_c3s.img
p18nov89_2211_c4s.img
p18nov89_2211_c5s.img
p18nov89_2211_ch4.brws
p18nov89_2211_trk.img
p18oct88_2330.dat
p19dec89_2325.dat
p19dec89_2325_c1s.img
p19dec89_2325_c2s.img
p19dec89_2325_c3s.img
p19dec89_2325_c4s.img
p19dec89_2325_c5s.img
p19dec89_2325_ch4.brws
p19dec89_2325_trk.img
p20feb89_1508.dat
p20feb89_1508_c1s.img
p20feb89_1508_c2s.img
p20feb89_1508_c3s.img
p20feb89_1508_c4s.img
p20feb89_1508_c5s.img
p20feb89_1508_ch4.brws
p20feb89_1508_trk.img
p20jan89_1520.dat
p20jan89_1520_c1s.img
p20jan89_1520_c2s.img
p20jan89_1520_c3s.img
p20jan89_1520_c4s.img
p20jan89_1520_c5s.img
p20jan89_1520_ch4.brws
p20jan89_1520_trk.img
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p20nov89_0407.dat
p20nov89_0407_c1s.img
p20nov89_0407_c2s.img
p20nov89_0407_c3s.img
p20nov89_0407_c4s.img
p20nov89_0407_ch4.brws
p20nov89_0407_trk.img
p20nov89_2331.dat
p20nov89_2331_c1s.img
p20nov89_2331_c2s.img
p20nov89_2331_c3s.img
p20nov89_2331_c4s.img
p20nov89_2331_c5s.img
p20nov89_2331_ch4.brws
p20nov89_2331_trk.img
p20sep89_0515.dat
p20sep89_0515_c1s.img
p20sep89_0515_c2s.img
p20sep89_0515_c3s.img
p20sep89_0515_c4s.img
p20sep89_0515_ch4.brws
p20sep89_0515_trk.img
p20sep89_2227.dat
p20sep89_2227_c1s.img
p20sep89_2227_c2s.img
p20sep89_2227_c3s.img
p20sep89_2227_c4s.img
p20sep89_2227_c5s.img
p20sep89_2227_ch4.brws
p20sep89_2227_trk.img
p21apr89_2008.dat
p21apr89_2008_c1s.img
p21apr89_2008_c2s.img
p21apr89_2008_c3s.img
p21apr89_2008_c4s.img
p21apr89_2008_c5s.img
p21apr89_2008_ch4.brws
p21apr89_2008_trk.img
p21dec89_0037.dat
p21dec89_0037_c1s.img
p21dec89_0037_c2s.img
p21dec89_0037_c3s.img
p21dec89_0037_c4s.img
p21jul86_2159.dat
p21jul86_2159_c1s.img
p21jul86_2159_c2s.img
p21jul86_2159_c3s.img
p21jul86_2159_c4s.img
p21jul86_2159_c5s.img
p21jul86_2159_trk.img
p21mar89_0446.dat
p21mar89_0446_c1s.img
p21mar89_0446_c2s.img
p21mar89_0446_c3s.img
p21mar89_0446_c4s.img
p21mar89_0446_c5s.img
p21mar89_0446_ch4.brws
p21mar89_0446_trk.img
p21mar89_1517.dat
p21mar89_1517_c1s.img
p21mar89_1517_c2s.img
p21mar89_1517_c3s.img
p21mar89_1517_c4s.img
p21mar89_1517_c5s.img
p21mar89_1517_ch4.brws
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p21mar89_1517_trk.img
p21sep89_2359.dat
p21sep89_2359_c1s.img
p21sep89_2359_c2s.img
p21sep89_2359_c3s.img
p21sep89_2359_c4s.img
p21sep89_2359_c5s.img
p21sep89_2359_ch4.brws
p22jan89_1459.dat
p22jan89_1459_c1s.img
p22jan89_1459_c2s.img
p22jan89_1459_c3s.img
p22jan89_1459_c4s.img
p22jan89_1459_c5s.img
p22jan89_1459_ch4.brws
p22jan89_1459_trk.img
p22jun89_2047.dat
p22jun89_2047_c1s.img
p22jun89_2047_c2s.img
p22jun89_2047_c3s.img
p22jun89_2047_c4s.img
p22jun89_2047_ch2.brws
p22jun89_2047_trk.img
p22nov88_2011.dat
p22nov88_2011_sat.gpg
p22nov89_1452.dat
p22nov89_1452_c1s.img
p22nov89_1452_c2s.img
p22nov89_1452_c3s.img
p22nov89_1452_c4s.img
p22nov89_1452_c5s.img
p22nov89_1452_ch4.brws
p22nov89_1452_trk.img
p22oct88_0307.dat
p22sep88_0106.dat
p23apr89_1450.dat
p23apr89_1450_c1s.img
p23apr89_1450_c2s.img
p23apr89_1450_c3s.img
p23apr89_1450_c4s.img
p23apr89_1450_c5s.img
p23apr89_1450_ch4.brws
p23apr89_1450_trk.img
p23feb89_1942_c2s.img
p23feb89_1942_c3s.img
p23feb89_1942_c4s.img
p23feb89_1942_trk.img
p23jan89_1457.dat
p23jan89_1457_c1s.img
p23jan89_1457_c2s.img
p23jan89_1457_c3s.img
p23jan89_1457_c4s.img
p23jan89_1457_c5s.img
p23jan89_1457_ch4.brws
p23jan89_1457_trk.img
p23mar89_1456.dat
p23mar89_1456_c1s.img
p23mar89_1456_c2s.img
p23mar89_1456_c3s.img
p23mar89_1456_c4s.img
p23mar89_1456_c5s.img
p23mar89_1456_ch4.brws
p23mar89_1456_trk.img
p23mar89_2323.dat
p23mar89_2323_c1s.img
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p23mar89_2323_c2s.img
p23mar89_2323_c3s.img
p23mar89_2323_c4s.img
p23mar89_2323_c5s.img
p23mar89_2323_ch4.brws
p23mar89_2323_trk.img
p23nov88_1504.dat
p23nov88_1504_sat.gpg
p23oct88_0209.dat
p24aug88_0121.dat
p24aug89_2206.dat
p24aug89_2206_c1s.img
p24aug89_2206_c2s.img
p24aug89_2206_c3s.img
p24aug89_2206_c4s.img
p24aug89_2206_c5s.img
p24aug89_2206_ch2.brws
p24aug89_2206_trk.img
p24dec89_1547.dat
p24dec89_1547_c1s.img
p24dec89_1547_c2s.img
p24dec89_1547_c3s.img
p24dec89_1547_c4s.img
p24dec89_1547_c5s.img
p24dec89_1547_ch4.brws
p24dec89_1547_trk.img
p24mar89_1313.dat
p24mar89_1313_c1s.img
p24mar89_1313_c2s.img
p24mar89_1313_c3s.img
p24mar89_1313_c4s.img
p24mar89_1313_c5s.img
p24mar89_1313_ch4.brws
p24mar89_1313_trk.img
p24nov88_0245.dat
p24nov88_0245_sat.gpg
p24nov89_0247.dat
p24nov89_0247_c1s.img
p24nov89_0247_c2s.img
p24nov89_0247_c3s.img
p24nov89_0247_c4s.img
p24nov89_0247_ch4.brws
p24nov89_0247_trk.img
p24nov89_2249.dat
p24nov89_2249_c1s.img
p24nov89_2249_c2s.img
p24nov89_2249_c3s.img
p24nov89_2249_c4s.img
p24nov89_2249_c5s.img
p24nov89_2249_ch4.brws
p24nov89_2249_trk.img
p24sep89_1508.dat
p24sep89_1508_c1s.img
p24sep89_1508_c2s.img
p24sep89_1508_c3s.img
p24sep89_1508_c4s.img
p24sep89_1508_c5s.img
p24sep89_1508_ch4.brws
p24sep89_1508_trk.img
p24sep89_2050.dat
p24sep89_2050_c1s.img
p24sep89_2050_c2s.img
p24sep89_2050_c3s.img
p24sep89_2050_c4s.img
p24sep89_2050_ch4.brws
```

```
p24sep89_2050_trk.img
p25aug88_0110.dat
p25dec89_0014.dat
p25dec89_0014_c1s.img
p25dec89_0014_c2s.img
p25dec89_0014_c3s.img
p25dec89_0014_c4s.img
p25dec89_0014_c5s.img
p25dec89_0014_ch4.brws
p25dec89_0014_trk.img
p25feb89_2246.dat
p25feb89_2246_c1s.img
p25feb89_2246_c2s.img
p25feb89_2246_c3s.img
p25feb89_2246_c4s.img
p25feb89_2246_c5s.img
p25feb89_2246_ch4.brws
p25feb89_2246_trk.img
p25jan89_2020.dat
p25jan89_2020_c1s.img
p25jan89_2020_c2s.img
p25jan89_2020_c3s.img
p25jan89_2020_c4s.img
p25jan89_2020_ch4.brws
p25jan89_2020_trk.img
p25jul88_2043.dat
p25mar88_1819.dat
p25mar88_1819_c1s.img
p25mar88_1819_c2s.img
p25mar88_1819_c3s.img
p25mar88_1819_c4s.img
p25mar88_1819_trk.img
p25sep89_1457.dat
p25sep89_1457_c1s.img
p25sep89_1457_c2s.img
p25sep89_1457_c3s.img
p25sep89_1457_c4s.img
p25sep89_1457_c5s.img
p25sep89_1457_ch4.brws
p25sep89_1457_trk.img
p26aug89_2138.dat
p26aug89_2138_c1s.img
p26aug89_2138_c2s.img
p26aug89_2138_c3s.img
p26aug89_2138_c4s.img
p26aug89_2138_ch2.brws
p26aug89_2138_trk.img
p26feb89_2156.dat
p26feb89_2156_c1s.img
p26feb89_2156_c2s.img
p26feb89_2156_c3s.img
p26feb89_2156_c4s.img
p26feb89_2156_ch4.brws
p26feb89_2156_trk.img
p26jul89_0114.dat
p26jul89_0114_c1s.img
p26jul89_0114_c2s.img
p26jul89_0114_c3s.img
p26jul89_0114_c4s.img
p26jul89_0114_ch2.brws
p26jul89_0114_trk.img
p26mar89_1425.dat
p26mar89_1425_c1s.img
p26mar89_1425_c2s.img
p26mar89_1425_c3s.img
```

p26mar89_1425_c4s.img
p26mar89_1425_c5s.img
p26mar89_1425_ch4.brws
p26mar89_1425_trk.img
p26nov89_0153.dat
p26nov89_0153_c1s.img
p26nov89_0153_c2s.img
p26nov89_0153_c3s.img
p26nov89_0153_c4s.img
p26nov89_0153_ch4.brws
p26nov89_0153_trk.img
p26oct88_1657.dat
p27aug88_2024.dat
p27aug89_2115.dat
p27aug89_2115_c1s.img
p27aug89_2115_c2s.img
p27aug89_2115_c3s.img
p27aug89_2115_c4s.img
p27aug89_2115_ch2.brws
p27aug89_2115_trk.img
p27feb89_1406.dat
p27feb89_1406_c1s.img
p27feb89_1406_c2s.img
p27feb89_1406_c3s.img
p27feb89_1406_c4s.img
p27feb89_1406_c5s.img
p27feb89_1406_ch4.brws
p27feb89_1406_trk.img
p27jan88_2100.dat
p27nov89_2216.dat
p27nov89_2216_c1s.img
p27nov89_2216_c2s.img
p27nov89_2216_c3s.img
p27nov89_2216_c4s.img
p27nov89_2216_c5s.img
p27nov89_2216_ch4.brws
p27nov89_2216_trk.img
p27oct88_0257.dat
p27sep89_1942.dat
p27sep89_1942_c1s.img
p27sep89_1942_c2s.img
p27sep89_1942_c3s.img
p27sep89_1942_c4s.img
p27sep89_1942_ch4.brws
p27sep89_1942_trk.img
p28apr89_2037.dat
p28apr89_2037_c1s.img
p28apr89_2037_c2s.img
p28apr89_2037_c3s.img
p28apr89_2037_c4s.img
p28apr89_2037_c5s.img
p28apr89_2037_ch4.brws
p28apr89_2037_trk.img
p28feb89_1529.dat
p28feb89_1529_c1s.img
p28feb89_1529_c2s.img
p28feb89_1529_c3s.img
p28feb89_1529_c4s.img
p28feb89_1529_c5s.img
p28feb89_1529_ch4.brws
p28feb89_1529_trk.img
p28jul89_2326.dat
p28jul89_2326_c1s.img
p28jul89_2326_c2s.img
p28jul89_2326_c3s.img

```
p28jul89_2326_c4s.img
p28jul89_2326_c5s.img
p28jul89_2326_ch2.brws
p28jul89_2326_trk.img
p28oct88_0112.dat
p29apr89_1522.dat
p29apr89_1522_c1s.img
p29apr89_1522_c2s.img
p29apr89_1522_c3s.img
p29apr89_1522_c4s.img
p29apr89_1522_c5s.img
p29apr89_1522_ch4.brws
p29apr89_1522_trk.img
p29jan89_1530.dat
p29jan89_1530_c1s.img
p29jan89_1530_c2s.img
p29jan89_1530_c3s.img
p29jan89_1530_c4s.img
p29jan89_1530_c5s.img
p29jan89_1530_ch4.brws
p29jan89_1530_trk.img
p29jul89_0148.dat
p29jul89_0148_c1s.img
p29jul89_0148_c2s.img
p29jul89_0148_c3s.img
p29jul89_0148_c4s.img
p29jul89_0148_ch2.brws
p29jul89_0148_trk.img
p29jul89_1844.dat
p29jul89_1844_c1s.img
p29jul89_1844_c2s.img
p29jul89_1844_c3s.img
p29jul89_1844_c4s.img
p29jul89_1844_ch2.brws
p29jul89_1844_trk.img
p29jun88_0127.dat
p29nov88_0054.dat
p29nov88_0054_sat.gpg
p30dec89_2309.dat
p30dec89_2309_c1s.img
p30dec89_2309_c2s.img
p30dec89_2309_c3s.img
p30dec89_2309_c4s.img
p30dec89_2309_c5s.img
p30dec89_2309_ch4.brws
p30dec89_2309_trk.img
p30jul88_2034.dat
p30mar89_1526.dat
p30mar89_1526_c1s.img
p30mar89_1526_c2s.img
p30mar89_1526_c3s.img
p30mar89_1526_c4s.img
p30mar89_1526_c5s.img
p30mar89_1526_ch4.brws
p30mar89_1526_trk.img
p30mar89_2211.dat
p30mar89_2211_c1s.img
p30mar89_2211_c2s.img
p30mar89_2211_c3s.img
p30mar89_2211_c4s.img
p30mar89_2211_c5s.img
p30mar89_2211_ch4.brws
p30mar89_2211_trk.img
p30nov88_1535.dat
p30nov88_1535_sat.gpg
```

```
p30nov89_2326.dat
p30nov89_2326_c1s.img
p30nov89_2326_c2s.img
p30nov89_2326_c3s.img
p30nov89_2326_c4s.img
p30nov89_2326_c5s.img
p30nov89_2326_ch4.brws
p30nov89_2326_trk.img
p30sep89_2015.dat
p30sep89_2015_c1s.img
p30sep89_2015_c2s.img
p30sep89_2015_c3s.img
p30sep89_2015_c4s.img
p30sep89_2015_c5s.img
p30sep89_2015_ch4.brws
p30sep89_2015_trk.img
p31aug88_0144.dat
p31dec89_0524.dat
p31dec89_0524_c1s.img
p31dec89_0524_c2s.img
p31dec89_0524_c3s.img
p31dec89_0524_c4s.img
p31dec89_0524_ch4.brws
p31dec89_0524_trk.img
p31jul89_1255_c1s.img
p31jul89_1255_c2s.img
p31jul89_1255_c3s.img
p31jul89_1255_c4s.img
p31jul89_1255_c5s.img
p31jul89_1255_trk.img
p31jul89_1427.dat
p31jul89_1427_c1s.img
p31jul89_1427_c2s.img
p31jul89_1427_c3s.img
p31jul89_1427_c4s.img
p31jul89_1427_c5s.img
p31jul89_1427_ch2.brws
pgrid.img
pmap.img
pmask.img
```

13 APPENDIX E – LEADEX INSTRUMENTS AND PARAMETERS

The following table summarizes the instruments used and parameters measured during the Arctic Leads ARI field experiment (LeadEx) in the Beaufort Sea during March and April of 1992.

Instrument/Sensor	Location	Parameter
NOAA's 915-Mhz profiler and Radio Acoustics Sounding System (RASS)	base camp	hourly wind and temperature profiles
rawinsondes	base camp	deep wind and temperature profiles
laser celiometer	base camp	cloud base height and aerosol backscatter
single-axis Doppler minisodar	base camp	low-level profiles of temperature structure and acoustic backscatter
profiler and minisodar	leads	independent measurements of vertical velocity and inversion height
small scale, three-sensor u-pressure array	leads	pressure fluctuations
three-axis sonic anemometer	site east of base camp	wind components and virtual temperature
short- and long-wave radiation sensors	site east of base camp	standard wind, pressure, temperature, and relative humidity

This information was summarized from:

Wolfe D. E., D. Ruffieux, and C. W. Fairall. 1993. The 1992 arctic leads experiment: an overview of the meteorology. Arctic research of the United States 7:24-28.

14 APPENDIX F – IMAGE EVALUATION SPREADSHEETS

Investigators from the Remote Sensing Branch of the Naval Oceanographic and Atmospheric Research Laboratory (NOARL) selected images for inclusion in the Polar Gridded AVHRR Brightness Temperatures data set using hard copy prints from the Navy/NOAA Joint Ice Center (now the National Ice Center). The investigators evaluated the images for areal coverage and degree of cloudiness, and compiled the image evaluations in monthly spreadsheets.

For each image, the investigators noted the date, time, and orbit printed on the hard copy. They subjectively rated each image on a scale of one to five for image clarity and extent of sea coverage. For the January through April, they ranked the seas covered by an image collectively. For instance, a pass covering the Beaufort, Chukchi, and East Siberian Seas might have been given a ranking of 3-4 indicating that about 60 percent of the area covered by the image is cloud-free and that the image covers 80 percent of all three seas combined. For later months, the seas were ranked individually. For instance, an image covering the Beaufort and Chukchi Seas might have been ranked 2-5 for the Beaufort and 3-3 for the Chukchi. In this example, the pass covered 100 percent of the Beaufort and 60 percent of the Chukchi with 40 percent of the Beaufort and 60 percent Chukchi being cloud-free.

The cloud ranking, area ranking, and satellite number (NOAA 10 or 11) for each image are indicated on a spreadsheet under the sea or seas covered by the image. An asterisk denotes an image deemed especially good; two asterisks identify an excellent image. Image passes on order from NOAA and being processed at NOARL at the time of publication of Fetterer and Hawkins (1991) are indicated on the spreadsheets in italics.

Because the National Ice Center separates hard copy imagery based on whether an image is best used for their Eastern or Western Arctic Analysis, the spreadsheets were conveniently divided into eastern and western halves. These areas generally correspond to the European and Pacific Lead ARI grid areas, although the Lincoln Sea and central Arctic are bisected by the Arctic Lead ARI grids.

Monthly spreadsheets for 1989 were included in an appendix of Fetterer and Hawkins (1991) and can be used to facilitate selection of additional passes.

14.1 Sample Spreadsheet

December 1989 AVHRR Coverage From JIC LAC and HRPT Hardcopies											
Note - Every pass has its own line (within W. Arctic or E. Arctic).											
	Western Arctic (JIC designation)						Eastern Arctic (JIC designation)				
	Beaufort	Chukchi	East Siberian	Laptev	Lincoln	Central Arctic	Central Arctic	Lincoln	Kara	Barents	Green-land
Date											
1			4-5 10*			4-5 10*				4-5 11	3-5 11
1	3-3 11	3-5 11						3-5 11			
1	3-3 11*	4-5 11*	4-4 11*								
2	3-4 10	4-5 10								4-5 11*	4-5 11*
2	3-5 11	2-3 11						3-3 11			
2	4-3 11*	3-5 11*	4-5 11*								
2		4-5 11				4-5 11					
3	3-4 10	4-5 10								4-5 11	4-5 11
3	4-5 11					4-5 11					
3	3-4 11	4-5 11									
4								4-5 11*			
5	3-5 10	3-5 10						4-4 11*			
6				4-5 10*				3-4 11			
7	4-5 11	3-5 11						4-4 11*			
7	5-4 11	3-5 11	3-4 11								4-5 11
7	3-4 11	4-5 11									
7	~~4-5 10*~~					~~4-5 10*~~					
8	4-5 11	4-4 11						5-4 11*			
8	3-5 11	2-5 11									
8	4-5 10	3-5 10									
9	3-3 10	3-5 10								4-5 11	4-5 11
9								4-4 11			
10	5-5 11*	4-4 11*						3-2 11			
10	4-5 10	4-3 10								3-5 11	
10	4-3 11*	4-5 11*	4-4 11*								
11	3-3 11	4-5 11	4-3 11					4-5 11			
11		4-3 10	3-4 10							3-5 11	4-5 11
11	5-4 11	4-5 11									
12	5-5 10*					5-5 10*		3-5 11			
12	4-2 11	4-5 11	3-4 11								3-5 11
12	4-4 11	4-5 11								3-5 11	3-5 11
13	3-4 10	4-5 10	4-2 10					4-5 11*			
13	4-4 11	3-4 11									3-5 11
13										3-5 11	4-5 11
13			5-4 10*			5-4 10*					
14	5-5 11*	4-3 11*									4-3 11
14	4-5 10	4-4 10							4-4 10		
14	5-4 11	3-5 11									

F- 1. Sample Image Evaluation Spreadsheet for July 1989

15 APPENDIX G: COORDINATES CONVERSION PROGRAM I

The following program converts from pixel sample and line indexes to polar stereographic SSM/I grid coordinates to latitude and longitude coordinates. Program II converts from latitude and longitude coordinates to polar stereographic SSM/I grid coordinates to pixel sample lines and indexes.

```
c       Convert xy  11
c
c       This program  converts  from  Leads  ARI  grid sample,line
c       indexes to  polar  stereographic  SSM/I  grid coordinates
c       (in km) and to latitude and longitude.  This program is a
c       version of the program written by C.S. Morris, Jet Propulsion
c       Laboratory,  which appears in the NSIDC SSM/I User's
c       Guide, Section F, "SSMII Polar Grids".
c
c       Program adapted for Leads ARI grids by F.Fetterer,
c       NOARL Remote Sensing,Stennis  Space  Center,  March 1991

        real*4 x,y,alat,along
        real*8 e,e2,cdr,pi
        character*1 grid

c       Conversion constant, degrees to radians:
        cdr=57.29577951
c       Radius and eccentricity of earth (Hughes ellipsiod, km):
        re=6378.273
        e2=0.006693883
        e=SQRT(e2)
        pi=3.141592654
c       Standard parallel - latitude of no distortion
        slat=70.0
c       Puts 135 deg long. at the top of the grid:
        xlam=-45.

        print*, 'Type ''P'' for Pacific grid, ''E'' for European'
        accept*,grid
100     print*,'Type sample, line (9999,9999 to stop)'
        accept*,sample,rline
        if (sample.eq.9999.) goto 999
c       Transform sample, line coordinates to SSMI grid coordinates
        if(grid.eq.'P'.or.grid.eq.'p')then
         y=1975-rline
         x=-(2250-sample)
        else
         y=1300-rline
         x=sample
        end if
c       Comput latitude and longitude:
200     rho=SQRT(x**2+y**2)
        if(rho.gt.0.1)goto 250
```

```
      alat=90.
      along=0.
      goto 300
250   cm=COSD(slat)/SQRT(1.-e2*(SIND(slat)**2))
      t-TAN((pi/4.)-(slat/(2.*cdr)))/((1.-e*SIND(slat))/
    & (1.+e*SIND(slat)))**(e/2.)
      t=rho*t/(re*cm)
      chi=(pi/2.)-2.*ATAN(T)

      alat=chi+((e2/2.)+(5.*e2**2./24.)+
    & (e2**3./12.))*SIN(2*chi)+((7.*e2**2./
    & 48.)+(29.*e2**3/240.))*SIN(4.*chi)+
    & (7.*e2**3./120.)*sin(6.*chi)

      alat=alat*cdr
      along=xlam+ATAN2D(x,-y)
      if(along.1t.0.) along  = along+360.
      if(along.gt.360.)along  =   along-360.
300   print*,'   Sample    Line       SSMI x      SSMI y lat
    &    Long'
      write (6,310)sample,rline,x,y,alat,along
      print*

      goto 100
310   format 4f10.2 2f10.4
999   continue
      end
```

The program is reproduced from Fetterer and Hawkins. 1991. An AVHRR data set for the Arctic leads ARI. Naval Oceanographic and Atmospheric Research Laboratory, Technical Note 118. 61 p.

16 APPENDIX H: COORDINATES CONVERSION PROGRAM II

The following program converts from latitude and longitude coordinates to polar stereographic SSM/I grid coordinates to pixel sample lines and indexes. Program I converts from pixel sample and line indexes to polar stereographic SSM/I grid coordinates to latitude and longitude coordinates.

```
c       Convert_11_xy
c
c       This program converts from latitude and longitude
c       to polar stereographic SSM/I grid coordinates (in km)
c       and to Leads ARI grid sample,line indexes.  This program is a
c       version of the program written by C.S. Morris, Jet Propulsion
c       Laboratory,  which appears in the NSIDC SSM/I User's
c       Guide, Section F, "SSMII Polar Grids".
c
c       Program-adapted for Leads ARI grids by F.Fetterer,
c       NOARL Remote Sensing,Stennis Space Center, March 1991

        dimension t (2)
        real*4 x,y,alat,along
        real*8 e,e2,cdr,pi
        character*1 grid

c       Conversion constant, degrees to radians:
        cdr=57.29577951
c       Radius and eccentricity of earth (Hughes ellipsiod, km):
        re=6378.273
        e2=0.006693883
        e=SQRT(e2)
        pi=3.141592654
c       Standard parallel - latitude of no distortion
        slat=70.0
c       Puts 135 deg long. at the top of the grid:
        xlam=-45.

        print*,'Type ''P'' for Pacific grid, ''E'' for European'
        accept*,grid
100     print*,'Type latitude, longitude (9999,9999 to stop)'
        accept*,alat,along
        if (alat.eq.9999.) goto 999
        if(alat.lt.89.995)goto 250
        x=0.
        y=0.
        goto  300
250     rlat=alat
        do 600 II=1,2
         if(II.eq.2)rlat=slat
```

```
600     t(II)=TAN((pi/4.)-(rlat/(2.*cdr)))/((1.-e*SIND(rlat))/
     &  (1.+e*SIND(rlat)))**(e/2.)

        cm=COSD(slat)/SQRT(1.-e2*(SIND(slat)**2))
        rho-re*cm*t(1)/t(2)
        x=rho*SIND(along-xlam)
        y=rho*COSD(along-xlam)
c       Transform sample, line coordinates to SSMI grid coordinates
300     if(grid.eq.'P'.or.grid.eq.'p')then
         rline=1975-y
         sample=x+2250
        else
         rline=1300-y
         sample=x
        end if
        print*,'    Sample    Line       SSMI x      SSMI y    Lat
     &       Long'
        write (6,310)sample,rline,x,y,alat,along
        print*
        goto  100
310     format(4f1O.2,2f1O.4)
999     continue
        end
```

The program is taken from:

Fetterer and Hawkins. 1991. An AVHRR data set for the Arctic leads ARI. Naval Oceanographic and Atmospheric Research Laboratory, Technical Note 118. 61 p.