

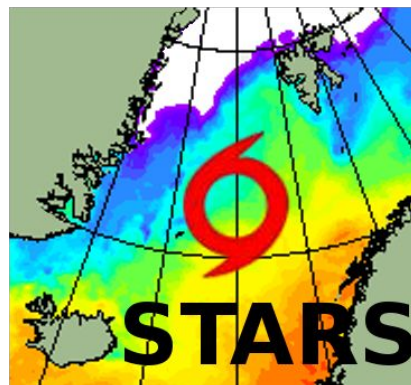
# STARS-DAT

## User Manual

Version 1.0

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# 1. Introduction

## 1.1 Purpose of this document

This document is the User Manual for the STARS project data set (STARS-DAT) and the corresponding data base (STARS-DAT-DB). The purpose of this document is to provide the user with all necessary information to be able to explore and use the STARS-DAT and STARS-DAT-DB.

## 1.2 Background

Background for the STARS project.

## 1.3 Structure of this documentation

- Chapter 1 is this chapter with the purpose and structure of the document.
- Chapter 2 describes the format and content of the STARS-DAT data set.
- Chapter 3 describes the format and content of the STARS-DAT meta data database, also called STARS-DAT-DB.
- Chapter 4 gives an identification of all the polar low events within the STARS-DAT data set.
- Chapter 5 describes all the different data sources included in the STARS-DAT data set.
- Chapter 6 gives an example of how to query and access the STARS-DAT data set using the STARS-DAT-DB for a particular polar low event.
- Chapter 7 gives recommendations for the future development of the STARS-DAT data set.
- Chapter 8 describes how the user can update the STARS-DAT data set by adding new data sources or extending the period covered.

## 1.4 Glossary

AATSR	Advanced Along-Track Scanning Radiometer
AMSR-E	Advanced Microwave Scanning Radiometer – Earth Observation System
AVHRR	Advanced Very High Resolution Radiometer
AVISO	Archiving, Validation and Interpretation of Satellite Oceanographic data
ASCAT	Advanced Scatterometer
ASCII	American Standard Code for Information Interchange
CF	Climate and Forecast
DUACS	Data Unification and Altimeter Combination System
ECMWF	European Center for Medium Weather Forecast
EOS	Earth Observation System
ESA	European Space Agency
GAC	Global Area Coverage
GFO	Geosat Follow-On
GHRSSST	Group for High Resolution Sea Surface Temperature

GTS	Global Telecommunication System
HIRLAM	High Resolution Limited Area Model
LAC	Local Area Coverage
LTSRF	Long Term Stewardship and Reanalysis Facility
LWE	Liquid Water Equivalent
METOP	Meteorological Operational Satellite
MODIS	Moderate Resolution Imaging Spectroradiometer
NASA	National Space Agency
NAVO	National Oceanographic Office
NetCDF	Network Common Data Form
NOAA	National Oceanic and Atmospheric Administration
NWP	Numerical Weather Prediction
OSI SAF	Ocean and Sea Ice Satellite Application Facility
PO.DAAC	NASA Physical Oceanography Distributed Active Archive Center
SAP	Science Application Plan
SSALTO	Segment Sol Multi mission Altimetry and Orbitography
STARS	Sea Surface Temperature and AltimeterR Synergy
RSS	Remote Sensing Systems
UTC	Universal Time Coordinate
WMO	World Meteorological Organization

### ***1.5 Reference Documents***

[RD-1] Statement of Work, STSE – Sea Surface Temperature and Altimeter Synergy. ESA project EOP-SM/1900/CD-cd. Issue:1, Revision: 2. 23-02-2009.

[RD-2] Breivik, Ø (2010): Scientific and technical review of polar lows in the Nordic Seas. STARS REP-1 report.

[RD-3] Breivik, Ø et al. (2010): STARS Scientific Analysis Plan. STARS SAP report.

[RD-4] Donlon, C et al (2005): GHRSSST-PP Product User Guide v1.1.

[RD-5] Dibarboure et al. (2010): SSALTO/DUACS User Handbook : (M)SLA and (M)ADT Near-Real Time and Delayed Time Products v2.1.

[RD-6] OSI SAF Wind team (2010): ASCAT Wind Product User Manual, v1.8.

[RD-7] OSI SAF Wind team (2009): SeaWinds Product User Manual, v1.6.

[RD-8] WMO (1995): Manual on codes. International codes. Volume I.1, Part-A. WMO-No.306.

## 2. STARS-DAT Data Model

This chapter describes the format, organization and content of the STARS-DAT data set.

### 2.1 Format

The STARS-DAT data set is given in NetCDF format, version 3.6 (except the in situ data). The CF-1.0 standard is used for the meta data. All data (except in situ) has been gridded to one common grid and projection, that is a 2km grid in polar stereographic projection on a spherical earth. In Proj4 terminology, this projection is defined as:

```
+proj=stere +lat_0=90 +lon_0=0 +lat_ts=60 +elips=sphere +a=6371000 +e=0 (1)
```

The area covered by this grid is shown in Figure 1.

The in situ data are given in ASCII format and these data has not been gridded to the common grid.

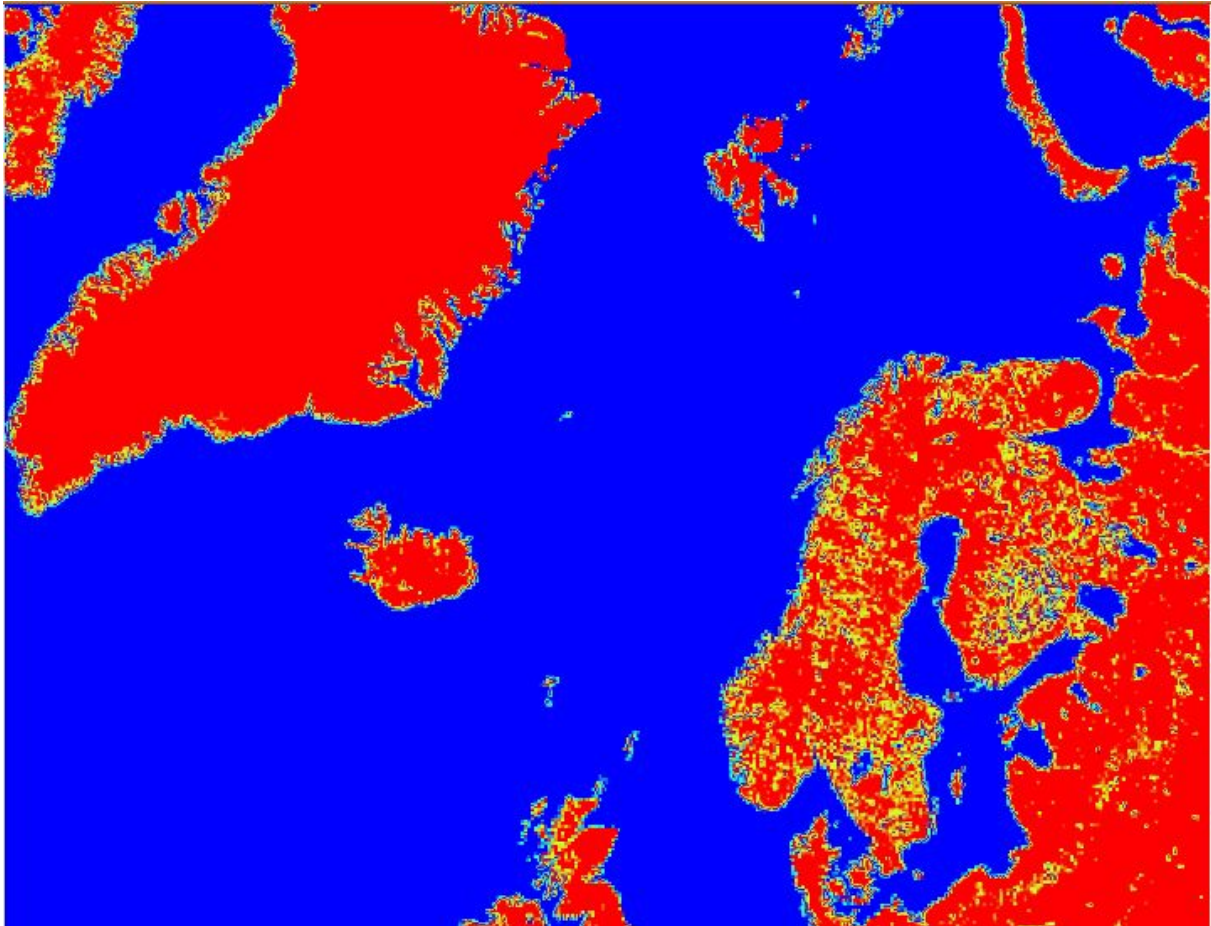


Figure 1: The area covered by the STARS-DAT data set.

## 2.2 Organization

The STARS-DAT data set contains data from the winter months during 5 years from 2006-2010. The data are organized in year and year day directories, so that each year in the data set is in one directory, with one directory for each year day within that year. The range of year days for each year is 1-120 and 274-366, so covering the months of January-April and October to December. This directory structure is illustrated in Figure 2. For 2010 only January-April is present. Each of these year day directory contains all the data set for this day (defined by UTC), defining daily sub data sets.

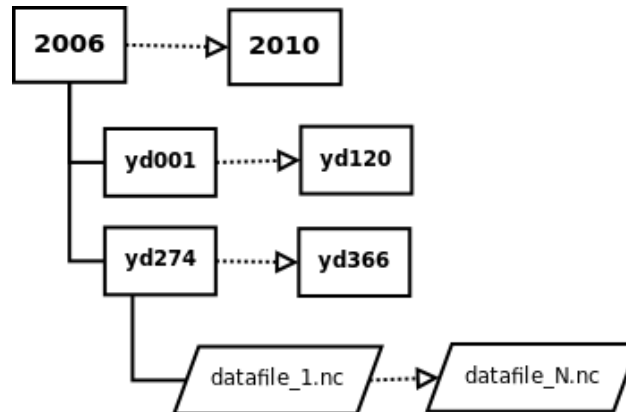


Figure 2: Directory structure of STARS-DAT data set.

## 2.3 Content

Each of the daily sub data sets contains satellite, NWP and in situ data covering the following parameters:

- Satellite
  - SST
  - SLA
  - surface wind
- NWP
  - air potential temperature at different pressure levels
- In situ
  - SST
  - surface wind
  - ++

The sources for the different data sources are listed in Table 1.



<b>Parameter</b>	<b>Data source</b>	<b>Data provider</b>
Satellite SST	Aqua EOS AMSR-E SST	RSS/GHRSST
	METOP AVHRR SST	OSI SAF
	AATSR SST	ESA/GHRSST
	Aqua/Terra EOS MODIS SST	NASA/GHRSST
	NOAA-17/18 AVHRR LAC/GAC SST	NAVO/GHRSST
Satellite SLA	Envisat along-track SLA	AVISO
	GFO along-track SLA	AVISO
Satellite Wind	METOP ASCAT wind vector	OSI SAF
	QuikSCAT Seawinds wind vector	OSI SAF
	Aqua EOS AMSR-E wind speed	RSS/GHRSST
Satellite radiometer imagery	NOAA AVHRR VIS/IR images	met.no
In situ data	GTS synop, buoy and ship	met.no
NWP model layer temperature	HIRLAM	met.no

*Table 1: Sources of data for the STARS-DAT data set.*

### **3. STARS-DAT meta data database**

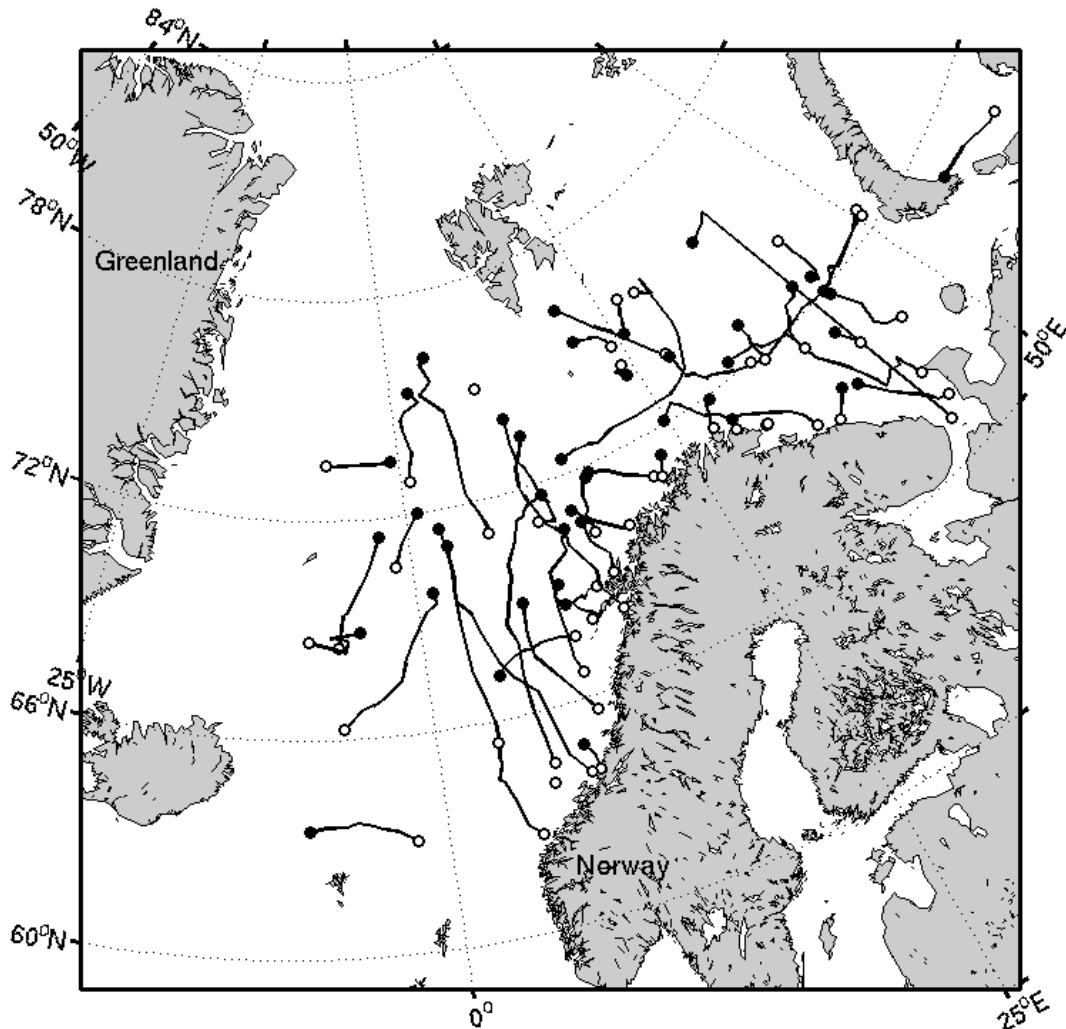
This chapter describes the format, organization and content of the STARS-DAT meta data database, also called STARS-DAT-DB.

## 4. Polar low events

This chapter gives an identification of all the polar low events within the STARS-DAT data set. This chapter will be completed in version 2 of this User Manual.

### 4.1 Tracks of polar low events

The STARS-DAT AVHRR image data set has been used to track polar low events in the North Atlantic for the period covered by the STARS-DAT data set, 2006.01-2010.04. The method used for tracking polar low events is described in the Science Analysis Plan (SAP) [RD-3]. The polar lows that were tracked, have been split in two subsets (as described in the SAP). The first subset contains polar lows in the Norwegian Sea and Barents Sea. The second subset contains polar lows in the area between South-Greenland and United Kingdom. Plots of the tracks for each of these two subsets are shown in Figure 1 and Figure 2. A more detailed list identifying each polar low is in Appendix A.



*Figure 3: Tracks of polar low events in the period 2006.01-2010.04 in the Norwegian Sea and Barents Sea. Filled circle indicates first observation and open circle indicates last observation of polar low.*

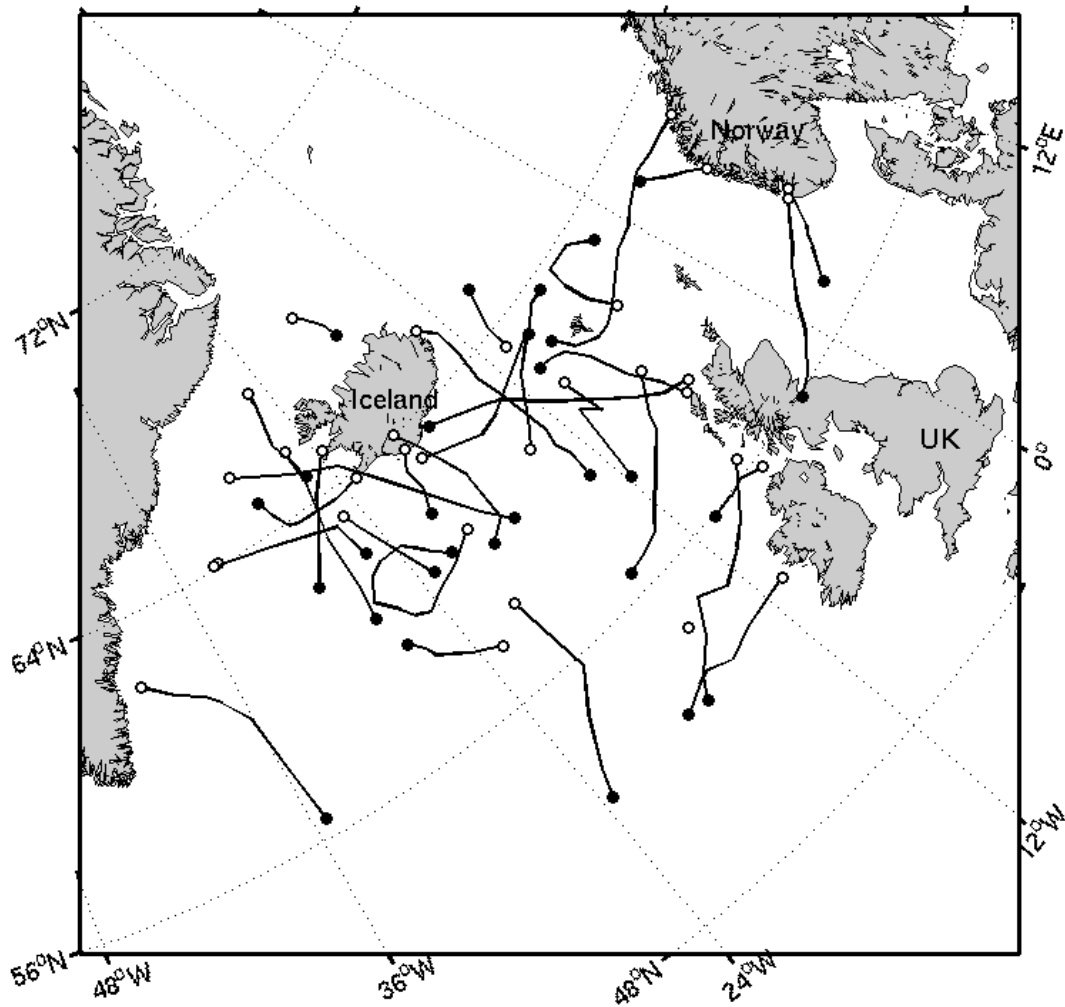


Figure 4: Tracks of polar low events in the period 2006.01-2010.04 in the area between South-Greenland and United Kingdom. Filled circle indicates first observation and open circle indicates last observation of polar low.

## 5. Data set description

This chapter describes all the different data sources included in STARS-DAT. Most of the needed details of the data file parameters and contents are available within the NetCDF files, and by using the program `ncdump` these details can be listed. This chapter therefore gives a more overall description of the data set.

### 5.1 Satellite SST

All the satellite SST data have been collected from the GHR SST LTSRF archive at <http://ghrsst.nodc.noaa.gov>. All these files are provided in the same NetCDF format and structure, thanks to the efforts of GHR SST. The original format of the files are described in the GHR SST product user guide [RD-4]. The fields in the original SST files have been regridded to the STARS-DAT grid described in Chapter 2. Most of the parameters in the original files have been kept on the regridded files, such as:

- sea surface temperature
- SSES bias
- proximity confidence level

The regridding implies that the resolution of some of the products has been degraded with respect to the original resolution. This is the case for the METOP AVHRR, NOAA AVHRR LAC, AATSR and MODIS products. The other products have been oversampled and are presented in a higher resolution with respect to the original resolution. This is the case for the AMSR-E and NOAA AVHRR GAC SST products.

The original file name convention for each data type has been kept, as described in Table 3. More details on the content of the GHR SST SST data set are given in the GHR SST product user guide [RD-4], and more details are therefore not given here.

### 5.2 Satellite SLA

The satellite SLA data have all been collected from the AVISO SSALTO/DUACS archive at AVISO (<http://www.aviso.oceanobs.com>), in NetCDF format. AVISO provides along-track and gridded SLA data from all available altimeter missions, in real-time, near real-time and delayed time mode. In STARS-DAT the along-track data from Envisat and GFO have been used. The delayed time mode data have been used for the period 2006-01-01 to 2009-10-28. For the period 2009-10-29 the near real-time data have been used. This is because the delayed time data were not available for the last period when STARS-DAT was built. The files that have been collected are validated, filtered, sub-sampled and LWE-corrected (see [RD-X] chapter 5.3.1), which is indicated by “`vfec`” in the file names.

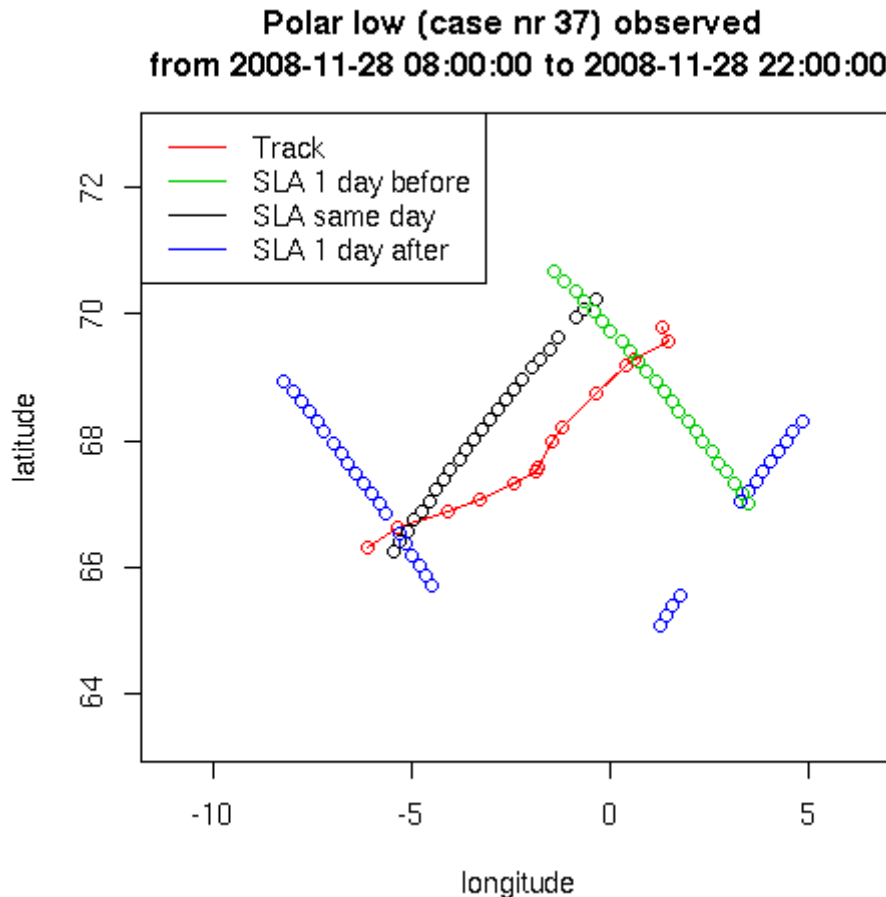
The along-track data have been re-gridded to the 2km STARS-DAT grid. Each SLA observation have bin placed in the nearest neighbor grid cell, and no filling has been applied. The following parameters are provided in the regridding SLA files:

- SLA
- reference time (for each file)
- `dtime`, time difference between reference time and observation time, in seconds (for each observation)
- latitude and longitude
- grid x and y-coordinates
- land mask

The file name convention for the SLA files is described in Table 3. This file name convention is very similar to the original file names. There is one SLA file for each day, with all SLA

observation within that day, one for GFO and one for Envisat. The original SLA along-track files which contain observations from 7-days periods, have been split in daily files. More details SLA parameter are given in the AVISO user handbook [RD-5], and more details are therefore not given here.

An example of coverage of SLA data in the vicinity of a polar low track is shown in Figure 5.



*Figure 5: Coverage of SLA data in the vicinity of a polar low event. All SLA data from Envisat +/- 1 day from the duration of the polar low event is shown.*

### 5.3 Satellite Wind

Three sets of satellite derived wind products are included in STARS-DAT:

- ASCAT scatterometer wind speed and direction from OSI SAF.
- Seawinds scatterometer wind speed and direction from OSI SAF.
- AMSR-E passive microwave wind speed from RSS.

The original OSI SAF ASCAT and Seawinds swath NetCDF files have all been regridded to the STARS-DAT grid, implying a oversampling from the original 25km field-of-view. The original filename convention have been kept and is listed in Table 3. The main parameters in the ASCAT and Seawinds files are wind speed and wind direction. All the other parameters from the original files have been regridded. More details about the content on the ASCAT and Seawinds files are given in the OSI SAF Product Manuals [RD-6] and [RD-7].

The AMSR-E passive microwave derived wind speed data are provided in the AMSR-E SST files as an auxiliary parameter. This parameter has been regridded as part of the SST regridding procedures. These AMSR-E wind speed data are also provided on swath format, and the regridding implies that the data are oversampled. The file name convention for these files are listed in Table 3.

#### 5.4 Satellite radiometer imagery

The NOAA AVHRR satellite radiometer imagery data files from the local receiving station at met.no are separate part of STARS-DAT. These files are only used for tracking polar low events and are therefor separated from the other files for convenience. There is one file for each satellite passage, and the files are multi-layered TIFF files, one layer for each channel. The AVHRR data have two fixed visible channels (0.6 and 0.9  $\mu\text{m}$ ) and two fixed infrared channels (10.5 and 11.5 $\mu\text{m}$ ). There is one “flexible” channel that depends from the different missions. This channel is either 1.6 $\mu\text{m}$  or 3.7 $\mu\text{m}$ , and for some satellites there is a switch between the two channels so that 1.6 $\mu\text{m}$  is used at daytime and 3.7 $\mu\text{m}$  at nighttime.

The file name convention for these files are listed in Table 3.

#### 5.5 In situ data

The available in situ synops, drifting and moored buoys and ships observation received at met.no through GTS have been collected from the met.no archive. These files are stored on a local met.no format, and have been converted to ASCII format. The synoptical land stations, ship observation and moored buoy observations are kept in the files called “syno”, while the drifting buoy observations are kept the the files called “drau” (see Table 3). The syno files are hourly files, while the drau files are 3 hourly files.

In Table 2 are listed the parameters given in the in situ data files, organized in columns separated by blanks. More details about the observed parameters are given in WMO documentation [RD-8] or at <http://wxp.unisys.com/Appendices/Formats/SYNOP.html> .

<b>Column</b>	<b>Description</b>	<b>Fillvalue</b>
1	Station ID, WMO code	Always present
2	Station type, not used	NA
3	Latitude in decimal degrees	Always present
4	Longitude in decimal degrees	Always present
5	Year	Always present
6	Month	Always present
7	Day	Always present
8	Hour	Always present
9	Minute	Always present
10	Air temperature (TTT)	-99.99
11	Dew point temperature (TdTdTd)	-99.99
12	Sea surface temperature (TwTwTw)	-99.99
13	Air pressure (PPPP)	-999.9
14	Wind speed (ff)	-9
15	Wind direction (dd)	-99

16	Precipitation (RRR)	-99.9
17	State of surface (E)	-9
18	Snow depth (sss)	-99
19	Cloud cover of all clouds (N)	-9
20	Cloud cover of high clouds (Nd)	-9
21	Cloud type low layer clouds (Cl)	-9
22	Cloud type medium layer clouds (Cm)	-9
23	Cloud type high layer clouds (Ch)	-9
24	Visibility (VV)	-99
25	Weather at observation time (ww)	-99
26	Weather since last observation time (W1)	-9
27	Weather since last observation time (W2)	-9

*Table 2: Content of in situ data files. WMO codes for the observed parameters are given in parentheses.*

## 5.6 NWP data

The NWP model chosen for STAR-DAT is HIRLAM, the operational forecast model run at met.no. More detail about this model is available from <http://www.hirlam.org>. This model has been run in 20km horizontal resolution until March 2008 and 12km since then. The HIRLAM files have all bin regridded to the 2km STARS-DAT grid. For the regridding of the HIRLAM files the Fimex software has been used, using nearest neighbor interpolation (more details on Fimex is available at <https://wiki.met.no/fimex/start>), and the resulting files are produced in NetCDF format.

From the HIRLAM forecast products only the air potential temperature in pressure levels has been collected for STARS-DAT. The air potential temperature are given for pressure levels at 1000, 925, 850, 700 and 500 hPa. The temperature is given for every third hour; at 00, 03, 06, 09, 12, 15, 18, 21 and 24 UTC. There are two files for each day, one with 00-12UTC from the forecast run at 00UTC and one with 12-24UTC from the forecast run at 12UTC. The file name convention for these two files are given in Table 3.

## 5.7 File name conventions

In Table 3 is given the file name convention for all the data types in STARS-DAT.

Data source	File name convention
Aqua EOS AMSR-E SST	<YYYYMMDD>-AMSRE-REMSS-L2P-amsr_l2b_v05_rXXXXX.dat-v01.nc 20070410-AMSRE-REMSS-L2P-amsr_l2b_v05_r26239.dat-v01.nc



METOP AVHRR SST	<YYYYMMDD>-EUR-L2P_GHRSSST-SSTsubskin-AVHRR_METOP_A-eumetsat_sstmgr_metop02_<YYYYMMDD>_<HHMISS>-v01.7-fv01.0.nc  20090410-EUR-L2P_GHRSSST-SSTsubskin-AVHRR_METOP_A-eumetsat_sstmgr_metop02_20090410_100103-v01.7-fv01.0.nc
AATSR SST	<YYYYMMDD>-ATS_NR_2P-EUR-L2P-ATS_NR_2PNPDE<YYYYMMDD>_<HHMISS>_XXXXXXXXXX_XXX_XXXXX_XXXXX_XXXX.N1-v01.nc  20070410-ATS_NR_2P-EUR-L2P-ATS_NR_2PNPDE20070410_204758_000066812057_00114_26721_6738.N1-v01.nc
Aqua/Terra EOS MODIS SST	<YYYYMMDD>-MODIS_A-JPL-L2P-A<YYYYMMDDHHMI>.L2_LAC_GHRSSST-v01.nc  20070410-MODIS_A-JPL-L2P-A2007100010000.L2_LAC_GHRSSST-v01.nc
NOAA-17/18 AVHRR LAC/GAC SST	<YYYYMMDD>-AVHRR17_G-NAVO-L2P-SST_s<HHMI1>_e<HHMI2>-v01.nc  eg. 20070410-AVHRR17_G-NAVO-L2P-SST_s0838_e1033-v01.nc
Envisat along-track SLA	gridded_dt_upd_global_en_sla_vfec_<YYYYMMDDHHMI1>-<YYYYMMDDHHMI2>.nc  eg. gridded_dt_upd_global_en_sla_vfec_200704100000-200704102359.nc
GFO along-track SLA	gridded_dt_upd_global_g2_sla_vfec_<YYYYMMDDHHMI1>-<YYYYMMDDHHMI2>.nc  eg. gridded_dt_upd_global_g2_sla_vfec_200704100000-200704102359.nc
METOP ASCAT wind vector	ascat_<YYYYMMDD>_<HHMISS>_metopa_XXXXX_eps_t_250_0100_ovw.l2.nc  eg. ascat_20070410_063602_metopa_02452_eps_t_250_0100_ovw.l2.nc
QuikSCAT Seawinds wind vector	QS025_D<YYJJJ>_S<HHMI1>_E<HHMI2>_BXXXXXXXX.nc  eg. QS025_D09087_S0032_E0210_B5107475.nc
Aqua EOS AMSR-E wind speed	<YYYYMMDD>-AMSRE-REMSS-L2P-amsr_l2b_v05_rXXXXX.dat-v01.nc  20070410-AMSRE-REMSS-L2P-amsr_l2b_v05_r26239.dat-v01.
NOAA AVHRR VIS/IR images	noaa<YYYYMMDDHHMI>mne.mitiff  eg. noaa200611051546mne.mitiff
GTS synop, buoy and ship	syno_<YYYYMMDDHHMI>.txt drau_<YYYYMMDDHHMI>.txt  eg. syno_200910281200.txt, drau_200910281200.txt
HIRLAM	h12pl00_<YYYYMMDD>.nc for 00UTC forecast 00-12UTC. h12pl12_<YYYYMMDD>.nc for 12UTC forecast 12-24UTC.

Table 3: File name convention for the different data types in STARS-DAT. Dates in file names are indicated in <>-brackets, using <YYYYMMDD> for date, <HHMISS>

*for time, and <JJJ> for day of year. Some file names contains start and end hours, which are indicated by <HHM1> for start and <HHM2> for end. Example file names are given in smaller font size.*

## 6. Example of use

This chapter gives an example of how to query and access the STARS-DAT data set using the STARS-DAT-DB for a particular polar low event. This chapter will be completed in version 2 of this User Manual.

## **7. Recommended future developments**

This chapter gives recommendations for the future development of the STARS-DAT data set.

### ***7.1 Add new polar low events to list***

A natural development of the STARS-DAT data set will be to update the list of polar low events with future polar lows. The forecasting section for Arctic weather at met.no are continuously tracking polar lows as a part of the operational weather forecasting service. The list of polar low events in the STARS-DAT area could be updated by contacting the forecasting section for Arctic weather at met.no.

## 8. Procedures for updating STARS-DAT

The STARS-DAT and STARS-DAT-DB is designed so that they can be archived and re-located in a manner that can be easily updated and extended if required in the future. The easiest way to extend with future data will of course be to apply the software used in the STARS project, but since this software is plainly performing nearest neighbor interpolation, it could be done with any regridding software. The following sections shortly describes where to get the needed data.

### 8.1 Adding new polar low events

Contact Øyvind Sætra ([oyvinds@met.no](mailto:oyvinds@met.no)) or Gunnar Noer ([g.noer@met.no](mailto:g.noer@met.no)) to get an updated list of polar low events.

### 8.2 Adding satellite SST data

Collect the GHRSSST L2P SST data from the GHRSSST LTSRF at <http://ghrsst.nodc.noaa.gov> in delayed mode, with open data access.

### 8.3 Adding satellite SLA data

Collect data from the AVISO SLA archive at <http://www.aviso.oceanobs.com>. User registration is requested for accessing the data archives.

### 8.4 Adding satellite wind data

The OSI SAF ASCAT wind products are available through the EUMETSAT Data Center (<http://www.eumetsat.int>) or through PO.DAAC (<http://podaac.jpl.nasa.gov>). User registration is requested for accessing the data archives.

The RSS AMSR-E wind speed data products are available in GHRSSST L2P format through the AMSR-E SST files at the GHRSSST LTSRF (<http://ghrsst.nodc.noaa.gov>) in delayed mode, with open data access.

### 8.5 Satellite radiometer imagery

The AVHRR data were only used to track the polar low events. So if an updated list of polar lows is collected as described in Chapter 8.1, there is no need to update the AVHRR radiometer imagery data.

### 8.6 In situ data

The in situ data source used to build STARS-DAT was an internal binary format at met.no archive, which is not accessible outside met.no. A good alternative to this archive is the Coriolis in situ data archive available at <http://www.coriolis.eu.org>.

### 8.7 NWP

The HIRLAM NWP data used in STARS-DAT are not accessible outside met.no in general. But any NWP model covering the North Atlantic up to the Arctic can be used, either from a national weather service and the ECMWF (<http://www.ecmwf.int>).

## 9. Appendix A

Table of polar low events within the STARS-DAT period 2006.01-2010.04. The first table is for the Norwegian Sea and Barents Sea, and the second table for area between South Greenland and United Kingdom.

<b><i>Polar low ID</i></b>	<b><i>Start time</i></b>	<b><i>End time</i></b>	<b><i>Start position</i></b>	<b><i>End position</i></b>
1	2006-01-29 15UTC	2006-01-30 02UTC	76.11N 20.83E	73.63N 28.12E
2	2006-03-06 14UTC	2006-03-06 21UTC	68.60N 11.10E	68.80N 13.80E
3	2006-03-20 14UTC	2006-03-22 07UTC	71.36N 02.75E	62.75N 05.46E
4	2006-10-29 11UTC	2006-10-29 22UTC	71.70N 16.20E	70.00N 18.00E
5	2006-11-01 19UTC	2006-11-02 04UTC	75.18N 20.95E	74.60N 24.00E
6	2006-11-08 14UTC	2006-11-08 23UTC	63.53N 08.23W	63.10N 02.00W
7	2006-12-22 12UTC	2006-12-22 16UTC	71.80N 16.60E	70.90N 21.60E
8	2006-12-26 03UTC	2006-12-26-18UTC	72.40N 14.80E	75.50N 29.20E
9	2007-01-21 05UTC	2007-01-22 17UTC	72.70N 41.50E	68.57N 43.26E
10	2007-01-22 14UTC	2007-01-23 17UTC	76.20N 04.40E	71.11N 06.80E
11	2007-01-26 04UTC	2007-01-26 09UTC	70.60N 14.50E	69.07N 15.44E
12	2007-01-27 01UTC	2007-01-27 07UTC	75.54N 38.16E	75.98N 41.60E
13	2007-02-05 01UTC	2007-02-05 04UTC	64.75N 09.46E	64.03N 09.99E
14	2007-02-13 06UTC	2007-02-13 09UTC	71.25N 22.90E	70.80N 22.20E
15	2007-04-06 00UTC	2007-04-06 20UTC	73.40N 12.00E	68.00N 15.10E
16	2007-04-29 01UTC	2007-04-29 02UTC	71.10N 29.70E	70.80N 29.60E
17	2007-09-03 04UTC	2007-09-03 05UTC	64.00N 06.40E	64.00N 04.00E
18	2007-12-11 18UTC	2007-12-11 19UTC	70.40N 31.70E	70.40N 31.90E
19	2008-01-06 11UTC	2008-01-06 21UTC	51.70N 16.90W	53.77N 09.96W
20	2008-01-25 13UTC	2008-01-25 21UTC	67.28N 05.26E	67.70N 11.10E
21	2008-01-31 04UTC	2008-01-31 17UTC	73.92N 10.98E	71.00N 11.10E
22	2008-02-14 23UTC	2008-02-15 01UTC	69.80N 38.20E	69.20N 36.50E
23	2008-02-29 11UTC	2008-02-29 16UTC	73.70N 23.90E	73.98N 23.86E
24	2008-03-02 21UTC	2008-03-02 21UTC	75.00N 09.00E	75.00N 09.00E
25	2008-03-02 21UTC	2008-03-03 09UTC	69.20N 11.10E	68.00N 12.70E
26	2008-03-04 01UTC	2008-03-04 20UTC	71.00N 03.10E	64.17N 09.11E
27	2008-03-16 09UTC	2008-03-17 11UTC	71.75N 12.03E	64.50N 07.30E
28	2008-03-18 15UTC	2008-03-20 14UTC	73.50N 28.40E	72.53N 50.07E
29	2008-03-20 07UTC	2008-03-20 14UTC	72.00N 43.27E	72.40N 50.15E
30	2008-04-04 01UTC	2008-04-04 20UTC	72.00N 01.00E	70.69N 01.29W
31	2008-04-24 12UTC	2008-04-24 13UTC	71.00N 41.00E	70.30N 41.90E
32	2008-10-27 20UTC	2008-10-27 22UTC	66.70N 04.70W	65.60N 04.40W
33	2008-11-17 07UTC	2008-11-17 16UTC	74.70N 25.90E	75.60N 27.20E
34	2008-11-18 02UTC	2008-11-18 20UTC	75.30N 02.00E	73.00N 00.83E
35	2008-11-18 20UTC	2008-11-19 10UTC	71.00N 14.00E	70.20N 15.30E
36	2008-11-20 06UTC	2008-11-20 20UTC	69.00N 08.00E	65.60N 11.00E
37	2008-11-28 08UTC	2008-11-28 22UTC	69.80N 01.30E	66.30N 06.10W

38	2008-11-29 19UTC	2008-11-30 01UTC	73.50N 00.80W	73.50N 06.73W
39	2008-12-30 11UTC	2008-12-30 18UTC	72.50N 32.50E	70.50N 41.30E
40	2009-01-07 03UTC	2009-01-07 10UTC	71.90N 29.20E	71.20N 28.00E
41	2009-01-16 12UTC	2009-01-16 17UTC	71.00N 57.00E	70.50N 63.44E
42	2009-02-05 03UTC	2009-02-05 13UTC	71.44N 02.67W	68.58N 06.26W
43	2009-02-05 18UTC	2009-02-06 08UTC	69.60N 39.30E	67.60N 43.40E
44	2009-02-07 17UTC	2009-02-08 07UTC	72.50N 43.20E	73.80N 43.80E
45	2009-02-26 18UTC	2009-02-27 11UTC	70.60N 12.90E	66.72N 10.88E
46	2009-02-27 18UTC	2009-02-28 11UTC	72.40N 32.50E	71.30N 38.30E
47	2009-03-27 22UTC	2009-03-28 18UTC	68.90N 04.60W	68.70N 08.50E
48	2009-04-02 09UTC	2009-04-02 15UTC	73.00N 35.30E	71.80N 35.20E
49	2009-04-05 01UTC	2009-04-05 09UTC	71.79N 43.32E	69.90N 45.60E
50	2009-04-05 07UTC	2009-04-05 19UTC	72.10N 24.70E	69.50N 34.90E
51	2010-01-08 11UTC	2010-01-08 15UTC	80.70N 15.10E	80.80N 20.00E
52	2010-01-29 17UTC	2010-01-29 22UTC	67.95N 08.10E	67.20N 08.30E

*Table 4: List of Polar Lows in the north-east part of the North Atlantic for 2006.01-2010.04.*

<b>Polar low ID</b>	<b>Start time</b>	<b>End time</b>	<b>Start position</b>	<b>End position</b>
1	2006-10-25 13UTC	2006-10-25 17UTC	62.90N 37.00W	62.30N 37.70W
2	2006-11-29 11UTC	2006-11-29 23UTC	69.50N 09.20W	68.10N 16.10W
3	2006-12-14 08UTC	2006-12-14 16UTC	62.30N 39.70W	61.60N 37.90W
4	2006-12-29 07UTC	2006-12-29 15UTC	67.10N 15.10W	71.56N 16.61W
5	2007-03-03 08UTC	2007-03-03 21UTC	61.60N 38.00W	59.20N 35.20W
6	2007-03-06 04UTC	2007-03-06 17UTC	56.60N 15.50W	59.99N 06.92W
7	2007-03-07 02UTC	2007-03-07 12UTC	52.70N 18.40W	53.40N 10.86W
8	2007-04-15 04UTC	2007-04-15 22UTC	64.90N 29.00W	63.80N 23.00W
9	2007-10-03 19UTC	2007-10-04 07UTC	64.00N 37.50W	61.35N 38.01W
10	2007-12-02 12UTC	2007-12-02 20UTC	59.30N 26.70W	57.70N 23.17W
11	2007-12-06 09UTC	2007-12-06 21UTC	58.80N 15.50W	60.00N 06.00W
12	2007-12-06 21UTC	2007-12-07 05UTC	55.10N 18.27W	53.70N 10.60W
13	2007-12-06 16UTC	2007-12-06 16UTC	54.40N 15.50W	54.40N 15.50W
14	2007-12-06 15UTC	2007-12-07 13UTC	64.80N 36.20W	63.30N 34.10W
15	2007-12-09 03UTC	2007-12-09 03UTC	64.10N 33.20W	64.10N 33.20W
16	2007-12-09 12UTC	2007-12-09 20UTC	61.70N 21.00W	63.50N 19.60W
17	2007-12-12 04UTC	2007-12-13 04UTC	56.50N 35.30W	62.10N 40.89W
18	2007-12-13 12UTC	2007-12-13 22UTC	60.40N 27.30W	65.60N 25.60W
19	2007-12-21 21UTC	2007-12-22 08UTC	64.80N 25.52W	67.45N 25.12W
20	2007-12-21 22UTC	2007-12-22 12UTC	62.00N 28.90W	64.96N 23.69W
21	2007-12-29 05UTC	2007-12-29 08UTC	55.90N 10.34W	55.76N 07.43W

22	2008-01-07 08UTC	2008-01-09 08UTC	60.50N 21.60W	60.69N 20.15W
23	2008-01-08 07UTC	2008-01-08 22UTC	52.69N 17.19W	56.36N 07.78W
24	2008-01-17 03UTC	2008-01-17 08UTC	66.00N 24.47W	65.80N 26.00W
25	2008-01-17 07UTC	2008-01-17 10UTC	67.10N 17.60W	68.19N 18.84W
26	2008-04-13 22UTC	2008-04-14 21UTC	63.48N 17.41W	58.85N 06.02W
27	2008-10-04 03UTC	2008-10-04 07UTC	65.13N 09.28W	63.49N 10.57W
28	2008-10-04 06UTC	2008-10-04 21UTC	63.15N 02.10W	61.70N 04.68W
29	2008-10-22 05UTC	2008-10-22 22UTC	63.82N 38.87W	59.50N 32.30W
30	2008-11-15 22UTC	2008-11-16 05UTC	62.74N 02.59E	61.32N 04.86E
31	2008-12-01 11UTC	2008-12-01 22UTC	62.30N 10.30W	58.72N 06.45W
32	2008-12-15 07UTC	2008-12-16 15UTC	63.09N 37.14W	59.81N 20.17W
33	2009-01-12 16UTC	2009-01-13 20UTC	62.33N 08.43W	62.80N 07.00E
34	2009-01-16 11UTC	2009-01-16 22UTC	60.02N 19.12W	63.96N 19.46W
35	2009-01-28 04UTC	2009-01-28 20UTC	59.30N 13.10W	65.60N 13.60W
36	2009-04-04 20UTC	2009-04-05 04UTC	60.40N 23.10W	63.13N 25.06W
37	2009-05-09 13UTC	2009-05-10 01UTC	55.90N 03.30W	58.90N 05.30E
38	2009-12-23 14UTC	2009-12-24 02UTC	57.00N 02.30E	59.00N 05.80E
39	2009-12-25 15UTC	2009-12-26 13UTC	63.60N 06.56W	61.00N 14.30W
40	2010-01-13 21UTC	2010-01-14 12UTC	52.61N 23.37W	58.29N 20.90W
41	2010-01-15 05UTC	2010-01-16 03UTC	60.00N 17.70W	65.85N 29.41W
42	2010-02-19 02UTC	2010-02-19 17UTC	63.10N 09.10W	62.95N 18.92W
43	2010-03-19 15UTC	2010-03-20 13UTC	62.00N 25.50W	64.09N 33.53W
44	2010-03-21 08UTC	2010-03-21 19UTC	58.54N 11.64W	61.47N 10.10W
45	2010-03-22 04UTC	2010-03-22 20UTC	58.41N 14.29W	61.91N 17.71W

*Table 5: List of Polar Lows in the north-west part of the North Atlantic for 2006.01-2010.04.*