Polar Pathfinder Daily 25 km EASE-Grid Sea Ice Motion Vectors, Version 4

USER GUIDE

How to Cite These Data

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

Tschudi, M., W. N. Meier, J. S. Stewart, C. Fowler, and J. Maslanik. 2019. *Polar Pathfinder Daily 25 km EASE-Grid Sea Ice Motion Vectors, Version 4*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/INAWUWO7QH7B. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0116

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1 DATA DESCRIPTION

NOTE: A quicklook version of this data set exists to fill the time between when this data set was last updated and the present: the *Quicklook Arctic Weekly EASE-Grid Sea Ice Motion Vectors* (NSIDC-0748).

1.1 Parameters

The main parameters for this data set are daily and weekly sea ice motion (cm/s). Sea ice motion is divided into along-x (u) and along-y (v) components. Error variance (for daily data) and the number of contributing files (for weekly data) are also provided.

Additionally, the input data used to calculate daily and weekly sea ice motion vectors are included in this data set. The input data consist of sea ice motion vectors derived from specific sensors (see Table 2 for more details).

1.2 File Information

1.2.1 Format

Daily and weekly sea ice motion are provided in georeferenced netCDF (`.nc`) format. Input data are also provided in netCDF format. PNG (`.png`) browse images are also included.

1.2.2 Daily and Weekly Sea Ice Motion File Contents

Daily and weekly sea ice motion netCDF file contents are described in Table 1 and represented in Figure 1.

Table 1. Summary of Daily and Weekly Sea Ice Motion File Contents

Variable	Description	Units
`u`	Along-x component of the sea ice motion (not the eastward velocity[1]). [2]	cm/s
`v`	Along-y component of the sea ice motion (not the northward velocity[1]). [2]	cm/s
`icemotion_error_estimate`	Estimated vector error obtained from the optimal interpolation process; only included in daily data files: If the closest input vector is greater than 1250 km, then a value of 1000 is added Negative error estimates indicate the vector is near the coast. [2]	cm/s

Variable	Description	Units
`number_of_observations`	Number of contributing daily files; only included in the weekly data files	Number of daily files
`latitude`	Latitude	degrees N
`longitude`	Longitude	degrees E
`crs`	Coordinate reference system (e.g. EASE-Grid North 25 km)	N/A
`x`	X coordinate	Projected meters
`y`	Y coordinate	Projected meters
`time`	Time of measurement	Daily data: Days since 1970-01-01 Weekly data: Date range

[1] See *How to convert the horizontal and vertical components to east and north* for more details

[2] The Missing / Fill Value for `u`, `v`, and `icemotion_error_estimate` is -9999. For all other variables, fill values do not apply.

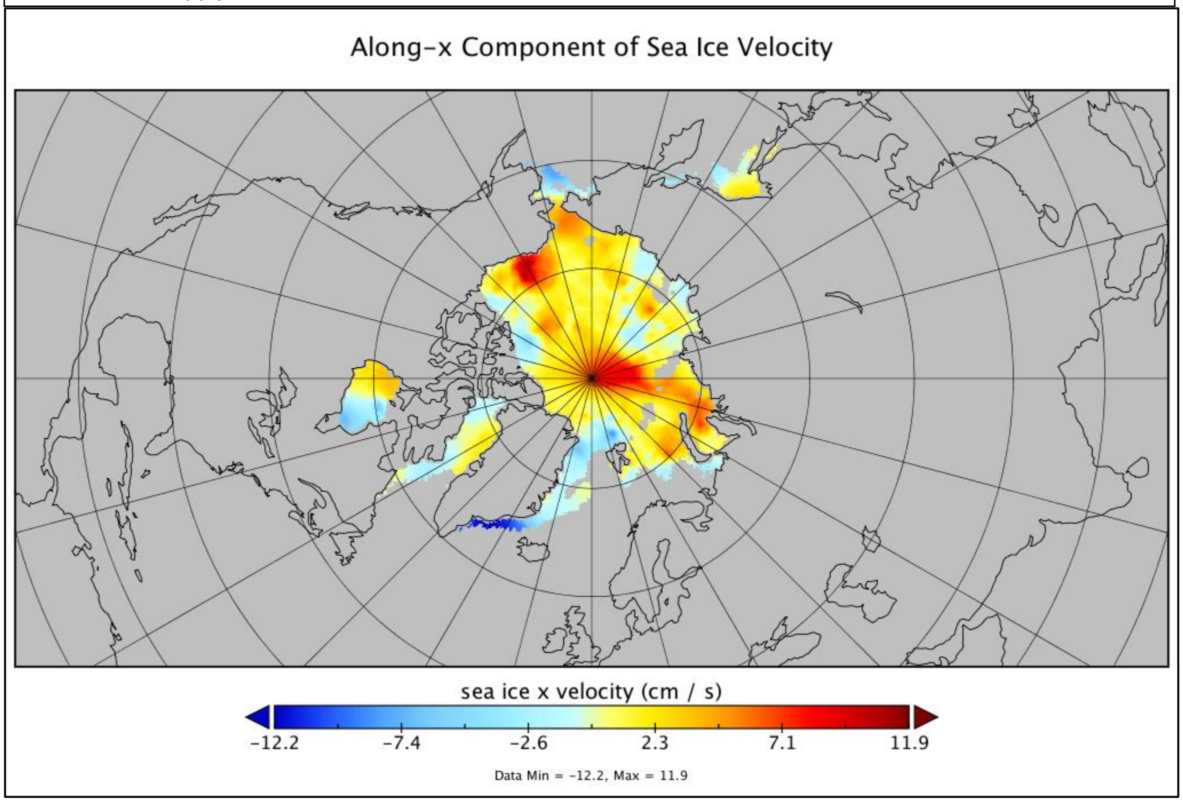

Figure 1. Sample of daily along-x component of sea ice motion from 01 January 1982. Figure produced in Panoply (software for visualization of netCDF files)

1.2.3 Browse Image File Contents

One browse image displaying weekly sea ice motion is provided for every week of data. Figure 2 contains a sample browse image.

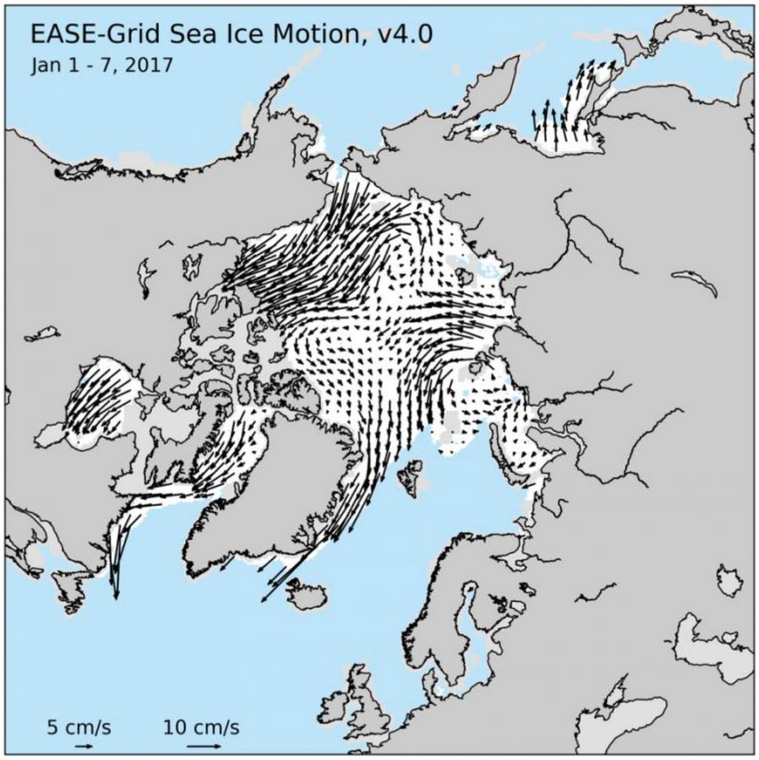

Figure 2. Sample browse image displaying sea ice motion for the week of 01 January to 01 January 2017.

1.2.4 Input Data File Contents

Input data files are described in Table 2. All input data files contain the same variables and structure, except for the IABP buoy data. Since the buoy data are point-source data, they are stored as a list, not as a georeferenced grid. Input data fields are described in more detail in Tables 3 and 4.

Table 2. Summary of Input Sea Ice Motion Data Sets

Source	Spatial Resolution
AVHRR	50km
AMSR-E	37.5 km
SMMR	75 km
SSM/I	75 km
SSMIS	75 km
National Center for Environmental Prediction (NCEP) / National Center for Atmospheric Research (NCAR) Reanalysis U-wind and V-wind data	50 km
International Arctic Buoy Program (IABP) buoys	Point source, locations indexed to 25 km EASE-Grid

Table 3. Summary of Input Data File Contents

Variable	Description	Units
U	Along-x component of the sea ice motion (not the eastward velocity); scaled by a factor of 10	cm/s
V	Along-y component of the sea ice motion (not the northward velocity); scaled by a factor of 10	cm/s
AMSRE_quality_info[1]	Correlation coefficient; ranges from 0.0 - 1.0	N/A
S*_source[2]	Indicates the input source channel (S* = SMMR, SSMI, or SSMIS) SMMR sensor: 1 = The vector was from the 37V GHz channel 2 = The vector was from both 37 GHz channels SSM/I and SSMIS sensors: 1 = The vector was from the 37V GHz channel 2 = The vector was from both 37 GHz channels 3 = The vector was derived from the 85V GHz channel	N/A
number_of_AVHRR_observations[3]	The number of vectors averaged together at a given location, includes up to four passes and two channels (infrared and visible)	N/A
Wind_Source[4]	Indicates that the input source for this data set was the NCEP/NCAR U-wind and V-wind data set	N/A
Latitude	Latitude	degrees N
Longitude	Longitude	degrees E
CRS	Coordinate reference system (e.g. EASE-Grid North 25 km)	N/A
X	Projected x coordinate	Projected meters
Y	Projected y coordinate	Projected meters
Time	Time of measurement	Julian day

[1] only appears in the AMSRE input data files
[2] only appears in the SMMR, SSMI, and SSMI/S input data files
[3] only appears in the AVHRR input data files
[4] only appears in the NCEP/NCAR input data files

Table 4. Summary of IABP Buoy File Contents

Variable	Description	Units
U	Along-x component of the sea ice motion (not the eastward velocity); scaled by a factor of 10	cm/s
V	Along-y component of the sea ice motion (not the northward velocity); scaled by a factor of 10	cm/s
observation_date	Day of observation	Days since 1970-01-01
buoy_ID	IABP buoy number	N/A
X	Projected x coordinate on the 25 km EASE-Grid	Projected meters
Y	Projected y coordinate on the 25 km EASE-Grid	Projected meters

1.2.5 Directory Structure

Data are available for download via HTTPS; the link is accessible through the "Download Data" tab. There are two main subdirectories – north and south – pertaining to each hemisphere. Within these subdirectories, folders are subdivided by data type. Table 5 provides a listing of the subfolders.

Table 5. Data and Browse Directory Structure

Data Subdirectory	Description
/north/browse/ /south/browse/	Contains the browse images of all of the weekly sea ice motion values. Within this directory, the data are divided by year.
/north/daily/ /south/daily/	Contains the daily sea ice motion data files.
/north/input_sources/ /south/input_sources/	Contains the input data files. Within this directory, the data are subdivided into folders based on input data source (see Table 2 for more details): • amsre • avhrr • buoy • smmr • ssmi • ssmis • wind
/north/weekly/ /south/weekly/	Contains the weekly sea ice motion data files.

1.2.6 Daily and Weekly Sea Ice Motion File Naming Convention

The daily and weekly data files are named according to the following convention and as described in Table 6:

```
icemotion_<daily|weekly>_hh_rrrr_<start-date>_<end-date>_v##.nc
```

Example:

```
icemotion_daily_sh_25km_19781101_19781231_v4.1.nc
icemotion_weekly_sh_25km_19790101_19791231_v4.1.nc
```

Table 6. Daily and Weekly Sea Ice Motion File Naming Convention

<table>
<tr><th>Variable</th><th>Description</th></tr>
<tr><td><daily|weekly></td><td>Indicates whether the file contains daily or weekly sea ice motion values</td></tr>
<tr><td>hh</td><td>Hemisphere (nh = Northern, sh = Southern)</td></tr>
<tr><td>rrrr</td><td>Resolution of input data in km (e.g. 50 km)</td></tr>
<tr><td><start-date></td><td>First day of data represented in the file, written in yyyymmdd (4-digit year, 2-digit month, 2-digit day) format</td></tr>
<tr><td><end-date></td><td>Last day of data represented in the file, written in yyyymmdd (4-digit year, 2-digit month, 2-digit day) format</td></tr>
<tr><td>v##</td><td>Version number</td></tr>
</table>

1.2.7 Browse Image File Naming Convention

The browse images are named according to the following convention and as described in Table 7:

```
icemotion_weekly_hh_rrrr_<start-date>_<end-date>_v##.png
```

Example:

```
icemotion_weekly_nh_25km_20000101_20000108_v4.1.png
```

Table 7. Browse Image File Naming Convention

Variable	Description
hh	Hemisphere (nh = Northern, sh = Southern)
rrrr	Resolution of input data in km (e.g. 50 km)
<start-date>	First day of the week that the image represents, written in yyyymmdd (4-digit year, 2-digit month, 2-digit day) format
<end-date>	Last day of the week that the image represents, written in yyyymmdd (4-digit year, 2-digit month, 2-digit day) format
v##	Version number

1.2.8 Input Data File Naming Convention

The input data files are named according to the following convention and as described in Table 8:

`im_from_<source>_hh_rrrr_<start-date>_<end-date>_v##.nc`

Example:

```
im_from_amsre_nh_37.5km_20020619_20021231_v4.1.nc
im_from_avhrr_nh_50km_19810724_19811231_v4.1.nc
im_from_buoy_nh_list_198790101_19791231_v4.1.nc
im_from_smmr_nh_75km_19781025_19781231_v4.1.nc
im_from_smmi_nh_75km_19870821_19871231_v4.1.nc
im_from_smmis_nh_75km_20070101_20071231_v4.1.nc
im_from_wind_nh_50km_19781025_19781231_v4.1.nc
```

Table 8. Input Data File Naming Convention

Variable	Description
im_from	Indicates that the file contains sea ice motion estimates used as input for the daily sea ice motion calculations
<source>	Input data source (amsre[1], smmr, ssmi, ssmis, buoy[1], or wind[2])
hh	Hemisphere (nh = Northern, sh = Southern)
rrrr	Resolution of input data, in km (e.g. 50 km)[3]
<start-date>	First day of data represented in the file, written in yyyymmdd (4-digit year, 2-digit month, 2-digit day) format
<end-date>	Last day of data represented in the file, written in yyyymmdd (4-digit year, 2-digit month, 2-digit day) format
v##	Version number

[1] Available for Northern Hemisphere only
[2] Indicates that the data come from the NCEP/NCAR Reanalysis U-wind and V-wind at 10 m data set
[3] The resolution is described as "list" for point-source data

1.2.9 File Size

Daily sea ice motion files range from approximately 18.0 – 22.0 MB.

Weekly sea ice motion files range from approximately 3.0 – 4.0 MB.

Input data files range from approximately 0.2 – 8.0 MB.

Browse images are approximately 0.5 – 1.5 MB.

1.3 Spatial Information

1.3.1 Coverage

Daily and weekly sea ice motion data are confined to the poles in the Northern and Southern Hemisphere, as represented in Figure 3.

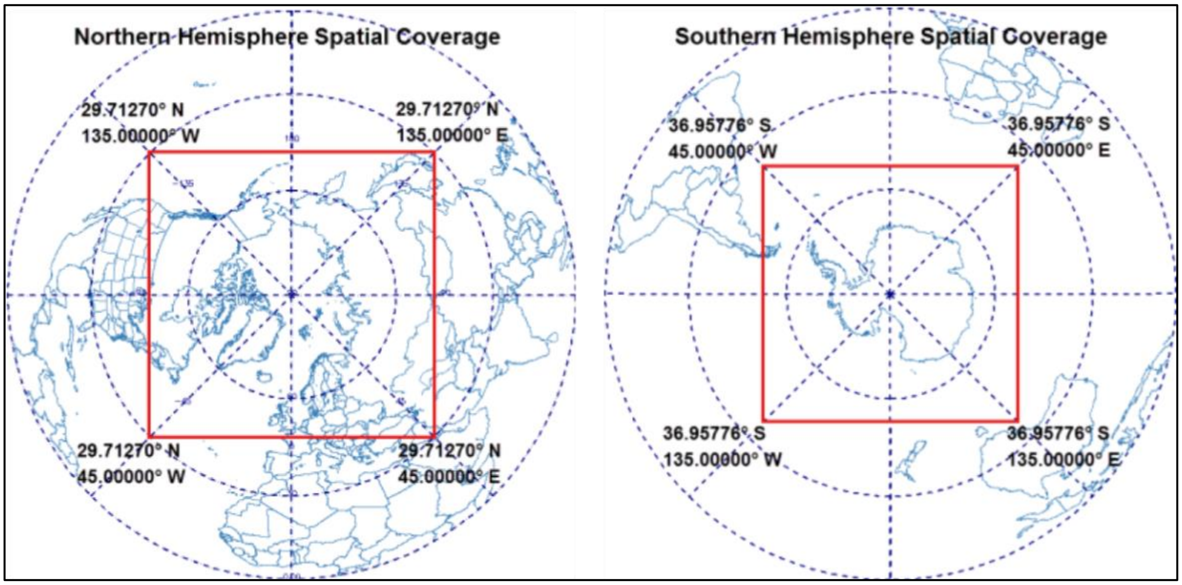

Figure 3. Spatial coverage map for the Northern Hemisphere (left) and Southern Hemisphere (right)

1.3.2 Resolution

The final daily and weekly sea ice motion data are provided at a resolution of 25 km. Input data have different spatial resolutions (see Table 2).

1.3.3 Geolocation

Daily and weekly sea ice motion data are georeferenced to the Northern and Southern 25 km original EASE-Grid projections. More details on these projections and grids are provided in Table 9 and Table 10 below. More details on EASE-Grid can be found on the EASE Grids website.

Table 9. Geolocation Details for the Northern and Southern EASE-Grids

	Northern EASE-Grid	Southern EASE-Grid
Geographic coordinate system	N/A	N/A
Projected coordinate system	NSIDC EASE-Grid North	NSIDC EASE-Grid South
Longitude of true origin	0	0

Latitude of true origin	90	-90
Scale factor at longitude of true origin	N/A	N/A
Datum	N/A	N/A
Ellipsoid/spheroid	International 1924 Authalic Sphere	International 1924 Authalic Sphere
Units	meter	meter
False easting	0	0
False northing	0	0
EPSG code	3408	3409
PROJ4 string	+proj=laea +lat_0=90 +lon_0=0 +x_0=0 +y_0=0 +a=6371228 +b=6371228 +units=m +no_defs	+proj=laea +lat_0=-90 +lon_0=0 +x_0=0 +y_0=0 +a=6371228 +b=6371228 +units=m +no_defs
Reference	http://epsg.io/3408	http://epsg.io/3409

Table 10. Grid Details for the Northern and Southern EASE-Grids

	Northern EASE-Grid	**Southern EASE-Grid**
Grid cell size (x, y pixel dimensions)	25067.5 projected meters (x) 25067.5 projected meters (y)	25067.5 projected meters (x) 25067.5 projected meters (y)
Number of rows	361	321
Number of columns	361	321
Geolocated lower left point in grid	29.71270° S, 45.00000° W	36.95776° S, 135.00000° W
Nominal gridded resolution	25 km by 25 km	25 km by 25 km
Grid rotation	N/A	N/A
ulxmap – x-axis map coordinate of the outer edge of the upper-left pixel	-4524683.8 m	-4023333.8 m
ulymap – y-axis map coordinate of the outer edge of the upper-left pixel	+4524683.8 m	+4023333.8 m

1.4 Temporal Information

1.4.1 Coverage and Resolution

The overall temporal coverage for this data set is 25 October 1978 through 31 December 2020. However, the temporal coverage and resolution vary by data type and sensor (Table 11). For more recent data, see the Quicklook Arctic Weekly EASE-Grid Sea Ice Motion Vectors data set.

Table 11. Temporal Coverage and Resolution for Daily and Weekly Sea Ice Motion and Input Data

Data	Source	Start Date	End Date	Resolution
Daily Sea Ice Motions	Interpolated from input data	01 Nov 1978	31 Dec 2020	Daily
Weekly Sea Ice Motions	Averaged from Daily Sea Ice Motions	05 Nov 1978	31 Dec 2020	Weekly
Input Data	AMSR-E	19 Jun 2002	08 Aug 2011	Data are available every day for any given grid cell.
	AVHRR	24 Jul 1981	31 Dec 2000	Four satellite passes are used each day when available.
	IABP buoys	18 Jan 1979	31 Dec 2020	The 12:00 Greenwich Mean Time (GMT) buoy positions were used to compute 24-hour mean velocities.
	NCEP-NCAR U-wind and V-wind	25 Oct 1978	31 Dec 2020	Data are available every day for any given grid cell.
	SMMR	25 Oct 1978	08 Jul 1987	Data are available every other day for any given grid cell.[1]
	SSM/I	09 Jul 1987	31 Dec 2006	Data are available every day for any given grid cell.
	SSMIS	01 Jan 2007	31 Dec 2020	Data are available every day for any given grid cell.

[1] See Section 1.3 of the Technical Reference on Measuring Sea Ice Motion from Various Sources for more information.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

Sea ice movement is measured using imagery acquired by frequent, repeat coverage by remote sensing instruments. Ice motion computed from satellite imagery represents the displacement between two images with the same spatial coverage taken at different acquisition times. Researchers identify a feature, such as an ice floe, on two registered images and measure its pixel displacement. Ice velocity vectors are computed based on the pixel resolution and the time span between images.

A more automated method is to measure the correlation of groups of pixels between image pairs. A small target area in one image is correlated with several areas of the same size in a search region of the second image. The displacement of the ice is then defined by the location in the second image where the correlation coefficient is the highest. This is the spatial correlation method used to produce sea ice motion vectors for this data set.

The approach used for this data set is generally valid over short distances away from the ice edge in areas where ice conditions are relatively stable from day to day. Spatial correlation methods cannot find matches between images where a complete knowledge of ice dynamics is needed, e.g. in areas where ice is deforming or in the ice margins near the open ocean where the spatial or spectral characteristics of the ice within a pixel are changing rapidly (Emery, Fowler, and Maslanik 1995).

2.2 Acquisition

2.2.1 AVHRR Input Data

This input data derived sea ice motion vectors from AVHRR channel 2 (visible band) and channel 4 (infrared) Global Area Coverage (GAC) images. These images have a 50 km gridded resolution, are available for nearly two decades, provide an intermediate spatial resolution between passive microwave and buoys, and have a finer time sampling than microwave data.

Beginning with Version 3 of this data set, misregistered AVHRR estimates were removed.

For more information on AVHRR input data, please refer to: AVHRR Polar Pathfinder Twice-Daily 5 km EASE-Grid Composites.

2.2.2 Buoy Input Data

This input data derived sea ice motion vectors from International Arctic Buoy Program (IABP) buoy position data. IABP provides buoy location information through satellite tracking of buoys placed on sea ice. Several buoy locations are determined each day and corresponding sea ice motions are calculated. Sea ice motion estimates from buoys are very accurate, but they are limited since the numbers and locations of buoys are driven by cost and logistics. In addition, buoys have not been placed on ice in the Eastern Arctic.

IABP buoy locations are generally provided every 12 hours: at noon and at midnight Greenwich Mean Time (GMT). This sea ice motion product uses 24-hour motion estimates from the IABP. For example, the IABP motion estimate for a buoy at noon on 01 January 2010 is derived by taking the difference of the buoy's location at noon on 02 January 2010 and its location at noon on 01 January 2010 and then dividing by 24 hours. The intervening midnight location value is not factored into the noon-to-noon 24-hour motion estimate. Similarly, the IABP motion estimate for midnight is calculated the same way, ignoring the intervening noon location information. Therefore, each buoy generally has two independent, 24-hour motion estimates: one for midnight and one for noon. Beginning with Version 4 of this data set, the noon-time and midnight buoy vectors were averaged together to provide one buoy-derived sea ice motion per day.

For more information the buoy input data, please refer to Brown and Kerut (1978) and the IABP website.

2.2.3 NCEP/NCAR Wind Input Data

This input data derived sea ice motion vectors from the NCEP/NCAR Reanalysis wind data set. The data, called U-wind and V-wind at 10 m, are available from the NOAA Earth System Research Laboratory (ESRL) Physical Sciences Division (PSD).

For more information on the NCEP/NCAR input data, please refer to Kistler et al. (2000).

2.2.4 Passive Microwave Input Data

The passive microwave input data come from four different instruments: SMMR, SSM/I, SSMIS, and AMSR-E. All the source data are available for download from the National Snow and Ice Data Center Distributed Active Archive Center (NSIDC DAAC). The SMMR input data are derived from the NIMBUS-7 SMMR Pathfinder Brightness Temperatures data set. Due to satellite limitations, full Arctic coverage is only available every two days with SMMR. The SSM/I and SSMIS input data both come from DMSP SSM/I-SSMIS Daily Polar Gridded Brightness Temperatures, while the AMSR-E input data come from the AMSR-E/Aqua L2A Global Swath Spatially-Resampled Brightness Temperatures. Passive microwave inputs also include the Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave Data data set, which is used to distinguish ice-covered and ice-free ocean.

Table 12 lists the channels used by each passive microwave sensor to derive input sea ice motion vectors. In general, the passive microwave sensors provide all-sky coverage, whereas the AVHRR visible and infrared channels are limited by cloud cover. For more information on the passive microwave instruments, please refer to:

- AMSR-E Instrument Description
- SMMR, SSM/I, and SSMIS Sensors Summary

Table 12. Channel Frequencies and Resolutions of the Passive Microwave Instruments

Instrument	Channel Frequency	Resolution
AMSR-E	89 GHz vertical	12.5 km
SMMR	37 GHz vertical and horizontal	25 km
SSM/I	37 GHz vertical and horizontal 85 GHz vertical and horizontal	25 km 12.5 km
SSMIS	37 GHz vertical and horizontal 91 GHz vertical and horizontal	25 km 12.5 km

2.3 Processing

The following steps were used to create this sea ice motion product. For more details, see Tschudi et al. 2020.

1. Compute the Sea Ice Motion Fields

   A sea ice mask, derived from Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave Data using a threshold of 15%, is used to restrict all independent sea ice motion estimates to ice-covered ocean. Detailed information about the methods used to compute sea ice motion for each input data source can be found in the Measuring Sea Ice Motion from Various Sources technical reference.

2. Grid the Input Data to the 25 km EASE-Grid

   Each of the input sea ice motion estimates are mapped to the output grid (e.g. Northern Hemisphere 25 km EASE-Grid).

3. Merge the Sea Ice Motion Fields

   Input sea ice motion estimates are combined to produce the daily sea ice motion product. Daily sea ice motion is a source- and distance-weighted average of the 15 highest-weighted input sea ice motion vectors. Each input data set is weighted according to the expected accuracy of the source data. For example, estimates derived from nearby buoys are weighted higher than NCEP/NCAR-derived estimates. Note that where data are sparse, the input data will be widely separated; when data are dense, only the very nearest estimates are considered. If the input sea ice motion estimates vary significantly from each other, this method can result in daily sea ice motion vectors that do not vary smoothly from one grid cell to the next.

4. Calculate Daily Error Values

   The input vectors from the individual input sources (NCEP/NCAR, SSM/I, SSMIS, SMMR, AMSR-E, and AVHRR) are weighted separately based upon cross-correlations with buoy vectors. The optimal interpolation uses these weights, along with their distances from the location being estimated, to obtain the final error variance. If the closest input vector was greater than 1250 km, then a value of 1000 is added to this variable. Because interpolation was applied to a surface map from passive microwave data, coastlines may contain false ice. In this case, the third variable was assigned a negative value to allow users to remove these vectors near coastlines (within 25 km). For example, a value of -1035 indicates all of the following conditions: the vector was near a coastline, the nearest sampled vector was further than 1250 km, and the vector had a standard deviation (σ) of 3.5 and an estimated error variance (σ^2) of 12.25.

5. Compute Weekly Fields

   Weekly sea ice motion was computed from the daily gridded sea ice motion data for both the northern and southern polar regions. Weekly sea ice motion is an average of all the daily sea ice motions calculated for that week. At least four out of seven days were needed to compute the weekly mean.

   Weekly means for each year begin on 01 January for consistency. The last day of each year (or last two days if in a leap year) were excluded. In other words, the first week is always 01 January through 07 January and the last week of a year is either 24 December through 30 December or 23 December through 29 December (if in a leap year).

6. Encode Data and Associated Metadata in netCDF Files

   Beginning with Version 4, data are provided in netCDF format.

2.4 Quality, Errors, and Limitations

2.4.1 Quality Assessment – Input Data

The Measuring Sea Ice Motion from Various Sources technical reference provides information on the accuracy of sea ice motion estimates calculated from each input sensor.

Beginning with Version 3 of this data set, IABP buoy sea ice motion estimates above 70 cm/s were deemed physically unrealistic; thus, velocities that exceed this threshold were excluded from this data set. In addition, beginning with Version 4 of this data set, buoys which were outside the mask of valid sea ice motion (away from the coast, where sea ice concentration was greater than 15%) were excluded.

2.4.2 Quality Assessment – Daily and Weekly Sea Ice Motion Product

The icemotion_error_variance (daily data) and number_of_observations (weekly data) fields both provide a means of characterizing data quality. For the daily files, the error variance can indicate a "near coastline" check. For the weekly data, the more days that contributed to calculating the sea ice motion vector in a given grid cell, the higher the data quality.

2.4.3 Missing Data

Beginning with Version 3 of this data set, there are some missing data in the Southern Hemisphere because there was not enough data from SSMI and AVHRR sensors to yield sea ice motion vectors. Missing data fields are left blank.

2.4.4 Limitations

The passive-microwave-derived sea ice motion estimates are based on changes in brightness temperature over consecutive days. The methods used to generate these input vectors requires fairly large areas of open ocean. As a result, ice motion cannot be calculated in regions of mixed land and ocean coverage, such as the Canadian Archipelago. The absence of sea ice motion estimates in such locations does not imply the absence of ice in these locations.

3 VERSION HISTORY

Table 13. Summary of Version Changes

Version	Release Date	Description of Changes
V4.1	April 2019	This minor version update coincided with no science changes. Changes to this version include: • The "V" field variable type was changed from a 2-byte integer to a 4-byte floating point • Summaries of "V" and "U" fields were updated • File naming conventions were updated to include the version number and start / end dates • File level metadata was updated to reflect the current version number.

Version	Release Date	Description of Changes
V4	March 2019	• Data are provided in georeferenced netCDF format rather than ASCII and raw binary files • Merge 15 highest-weighted rather than 15 closest input vectors • Improved filtering of SSMI inputs • Each buoy provides one daily motion estimate instead of separate noon and midnight estimates • Monthly and yearly sea ice motion estimates are no longer produced
V3	February 2016	• Eliminated unrealistic AVHRR and IABP buoy velocities • Extended buoy sea ice motion estimates to the present • Improved browse images • Reprocessed SSMI fields using GDAL map transformations on the DMSP SSM/I-SSMIS Daily Polar Gridded Brightness Temperatures Data Set, NSIDC-0001. • Used ice concentration estimates greater than 15 percent from the Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave data set, NSIDC-0051, to indicate where ice extent is present.
V2	Sep 2013	Added AMSR-E and NCEP/NCAR data for the Northern Hemisphere
V1	May 2003	Original version of data. **Note:** V1 is not indicated in Version 1 file names

4 RELATED DATA SETS

Quicklook Arctic Weekly EASE-Grid Sea Ice Motion Vectors

EASE-Grid Sea Ice Age

5 RELATED WEBSITES

SMMR and SSM/I-SSMIS | Overview

6 CONTACTS AND ACKNOWLEDGMENTS

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7 REFERENCES

Brown, W. P. and E. G. Kerut. 1978. Air droppable RAMS (ADRAMS) buoys. *AIDJEX Bulletin*, 40, 21-29.

Cavalieri, D. J., C. L. Parkinson, P. Gloersen, J. C. Comiso, and H. J. Zwally. 1999. Deriving long-term time series of sea ice cover from satellite passive-microwave multisensor data sets, *Journal of Geophysical Research*, 104(C7), 15803-15814. https://doi.org/10.1029/1999JC900081

Cavalieri, D., C. Parkinson, P. Gloersen, and H. J. Zwally. 1996, updated yearly. *Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave Data, Version 1*. Boulder, Colorado USA: NASA DAAC at the National Snow and Ice Data Center. https://doi.org/10.5067/8GQ8LZQVL0VL

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8 DOCUMENT INFORMATION

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