Physical Oceanography Distributed Active Archive Center (PO.DAAC)

Cross-Calibrated, Multi-Platform Ocean Surface Wind Velocity Product (MEaSUREs Project)

Guide Document

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Version 1.1

Jet Propulsion Laboratory
Pasadena, California

Table of Contents:

1. Abstract:

The Cross-Calibrated, Multi-Platform Ocean Surface Wind Velocity (hereafter, CCMP) project is funded under the NASA Earth Science Enterprise (ESE) Cooperative Agreement Notice, “Making Earth System Data Records for Use in a Research Environment” (formerly REASoN). Under the REASoN solicitation, a cross-calibrated multi-platform ocean surface wind data set was created using a variational analysis method (hereafter, VAM) to combine wind measurements derived from SeaWinds on QuikSCAT, SeaWinds on ADEOS-II, AMSR-E, TRMM TMI and SSM/I. By combining these measurements, a consistent data record of high resolution (25km) ocean surface winds was created for the period July 1987 through June 2009 with far reaching applications in meteorology and oceanography. Under MEaSURE, this record will be extended through 2012 incorporating data from current and future missions such as WindSat, ASCAT, DMSP (F16-F20), GMI and GCOM-W (AMSR-2) [see Table 1]. Upon completion, a consistent 25-year (1987-2012) climate data record of ocean surface winds that includes all NASA and NOAA assets will be available for atmospheric and oceanic research and for improved weather and short-term climate prediction. This will be the culmination of extensive research and development under the Pathfinder and REASoN programs.

PO.DAAC also refers to this as Product 289.

2. Investigators:

NOTE: Please refer all questions concerning the CCMP Product to PO.DAAC User Services: podaac@podaac.jpl.nasa.gov.

Principal Investigator:
Dr. Robert Atlas
NOAA/AOML
4301 Rickenbacker Causeway
Miami, FL 33149

Co-Investigators:
Mr. Joseph V. Ardizzone
Dr. Ross Hoffman
Dr. Juan Carlos Jusem
Mr. S. Mark Leidner

User Guide Authors:
Mr. David F. Moroni (Jet Propulsion Laboratory, California Institute of Technology)
Mr. Joseph V. Ardizzone (NASA/GSFC)

3. Background:

Consistent oceanic surface wind data of high quality and high temporal and spatial resolution are required to understand and predict the synoptic and mesoscale air-sea interactions which influence both the atmosphere and ocean. Such observations are needed to drive ocean models and surface wave models, calculate surface fluxes of heat, moisture and momentum, provide initial data and verification data for atmospheric models, and to construct ocean surface climatologies.

Surface wind stress provides the most important forcing of the ocean circulation, while the fluxes of heat, moisture and momentum across the air-sea boundary are important factors in the formation, movement, and modification of water masses and the intensification of storms near coasts and over the open oceans (Atlas, 1987). In addition, air-sea interaction plays a major role in theories of ENSO and the 50-day oscillation, as well as in the initiation and maintenance of heat waves and drought and other persistent anomalies (Wolfson et al., 1987; Atlas et al., 1993a).

	YEAR																									
	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
F08																										
F10																										
F11																										
ERS-1																										
ERS-2																										
F13																										
NSCAT																										
F14																										
TMI																										
F15																										
QSCAT																										
AMSRE																										
Seawinds																										
Windsat																										
F16																										
F17																										
ASCAT																										
F18																										
F19																										
AMSR-2																										
GMI																										
F20																										

Table 1: Availability of satellite ocean surface wind data sets. Shaded boxes indicate the current and projected years of operation for each observing system. Years shaded green indicate observing systems that were assimilated under REASoN. See Acronyms (section 10) for definitions of these missions.

Prior to the launch of satellites capable of determining ocean surface wind from space, observations of ocean surface wind velocity were provided primarily by ships and buoys. While these observations are extremely useful, they also have severe limitations and are generally not adequate for global applications. For example, reports of surface wind by ships are: a) often of poor accuracy, b) cover only very limited regions of the world's oceans, and c) occur at irregular intervals in time and space. Buoys, while of higher accuracy, have extremely sparse coverage. Due to these deficiencies, analyses of surface wind that do not include space-based data can misrepresent atmospheric flow over large regions of the global oceans, and this contributes to the poor calculation of wind stress and sensible and latent heat fluxes in these regions.

The ocean surface responds to wind forcing on many wavelengths. This response provides a mechanism for the microwave remote sensing of ocean surface wind from space. The active sensing of the radar backscatter of centimeter-scale capillary waves allows the retrieval of ocean surface wind vectors with some directional ambiguity. Seasat, ERS (1&2), and NSCAT were designed to take advantage of this phenomenon, but the time periods for which scatterometer data are available are very limited, and not sufficient for studies of inter-annual variability and climate change. Seasat data are available for only the third quarter of 1978 (Atlas et al., 1987). ERS, with more limited coverage, provided data from 1992 to 2002. NSCAT provided data from September 1996 through June 1997. SeaWinds on Quikscat was launched in June 1999 and was joined by SeaWinds on ADEOS-II in December of 2002 until the unexpected power loss aboard ADEOS-II on October 24, 2003. ASCAT data is available beginning in March 2007.

Passive microwave remote sensing of the ocean surface also has the capability of retrieving ocean surface wind speed (i.e., not the vector) through the response of the microwave emissivity to the surface roughness (Wentz et al., 1986). Four passive instruments, SMMR, SSM/I, TRMM Microwave Imager (TMI), and AMSR-E have provided ocean surface wind speed data. SSM/I provides the longest and most continuous record of satellite surface wind observations over the oceans. The major limitation of the SSM/I, as well as TMI and AMSR-E, is the inability to extract directional ambiguities (i.e., a wind vector) from the passive retrievals. In an effort to make the SSM/I data more generally useful, Atlas et al. (1996) developed several different approaches, ranging from simple direction assignment methods to a variational analysis method (VAM), to convert the SSM/I speeds to vector winds and assimilate them into global atmospheric models (Atlas et al., 1983, 1987, 1991). These approaches were tested using simulated data, Seasat winds (with the directional information withheld), and finally with actual SSM/I observations. This evaluation (Atlas and Bloom, 1989) showed the VAM to be the most accurate, which was the method chosen by Atlas et al. (1996) for the processing of all ocean surface wind data sets under SSM/I Pathfinder (http://www.ssmi.com/ssmi/ssmi_description.html) and REASoN (http://reason-projects.gsfc.nasa.gov/). Future missions under the current CCMP project will continue to utilize the VAM assimilation method. Using this approach, different types of data have been assimilated in a filtering procedure. The resulting analysis is used to assign directions to the passive microwave winds. Seventeen years of SSM/I data were processed in this manner under the Pathfinder program beginning with the operational phase of the F8 DMSP SSM/I in July 1987. Under the REASoN project, this method was optimized for the assimilation of all available satellite surface wind data sets at high resolution (25km) up to and including present day missions (see Table 1).

4. Processing Methodology:

The processing methodology is described by Atlas et al. (1996) and is similar to that originally described by Hoffman (1984) with modifications to accommodate the special attributes of satellite surface wind data (Hoffman et al., 2003) as well as some additional tuning of the data quality checking and filter weights. The VAM generates a gridded surface wind analysis which minimizes an objective function **J** measuring the misfit of the analysis to the background, the data and certain a priori constraints.

Lambda weights are used to control the amount of influence each constraint has on the final analysis. Table 2 describes each term:

$$J = \lambda_{\mathrm{CONV}} J_{\mathrm{CONV}} + \lambda_{\mathrm{SCAT}} J_{\mathrm{SCAT}} + \lambda_{\mathrm{SPD}} J_{\mathrm{SPD}} + \lambda_{\mathrm{VWM}} J_{\mathrm{VWM}} + \lambda_{\mathrm{LAP}} J_{\mathrm{LAP}} + \lambda_{\mathrm{DIV}} J_{\mathrm{DIV}} + \lambda_{\mathrm{VOR}} J_{\mathrm{VOR}} + \lambda_{\mathrm{DYN}} J_{\mathrm{DYN}}$$

Term	Expression	Description of constraint
		Observation Function for the
J_{CONV}	$\sum(\mathbf{V}_{\mathrm{A}} - \mathbf{V}_{\mathrm{O}})^2$	• wind vectors
J_{SCAT}	$\sum(\mathbf{V}_{\mathrm{A}} - \mathbf{V}_{\mathrm{O}})^2$	• wind vectors
J_{SPD}	$\sum(\lvert\mathbf{V}_{\mathrm{A}}\rvert - \lvert\mathbf{V}_{\mathrm{O}}\rvert)^2$	• wind speeds
		Background Constraints on the
J_{VWM}	$\int(\mathbf{V}_{\mathrm{A}} - \mathbf{V}_{\mathrm{B}})^2$	• vector wind magnitude
J_{LAP}	$\int[\nabla^2(u_{\mathrm{A}} - u_{\mathrm{B}})]^2 + \int[\nabla^2(v_{\mathrm{A}} - v_{\mathrm{B}})]^2$	• Laplacian of the wind components
J_{DIV}	$\int[\nabla^2(\chi_{\mathrm{A}} - \chi_{\mathrm{B}})]^2$	• divergence
J_{VOR}	$\int[\nabla^2(\psi_{\mathrm{A}} - \psi_{\mathrm{B}})]^2$	• vorticity
J_{DYN}	$\int(\partial\zeta_{\mathrm{A}}/\partial t - \partial\zeta_{\mathrm{B}}/\partial t)^2$	• vorticity tendency

$$\mathbf{V}_{\mathrm{A}} = \alpha \mathbf{V}_{\mathrm{A}} + \mathbf{V}_{\delta}$$

Table 2 VAM penalty terms. V_A is the VAM analysis at the observation time. V_B is the background wind analysis. V_O is the observation.

The a priori constraints are: (1) the analysis should be "close" to the background field, (2) the differences between the analyzed and background wind, vorticity, and divergence should be smooth, and (3) the estimated time rate of change of the vorticity of the analysis should be small. These constraints control the degree to which the analysis can use the data to modify the background field. The analysis procedures also include a simple quality control; initially, data far from the background are withheld , but after an initial analysis the withheld data are then reconsidered in a second pass using tighter acceptance criteria. For further details see Hoffman (2003) and Atlas et al. (1993, 1996).

Under the REASoN project, the VAM was optimized for the assimilation of multiple observing systems at high resolution. As the spatial resolution increases, it becomes more important to account for the asynopticity (departure from the analysis time) of the observations being assimilated. With many overlapping observations spanning a 6-hour window, it is critical to have an accurate assessment of the background field at the actual observing times to derive an accurate analysis increment. The VAM FGAT algorithm was enhanced to better estimate this asynoptic increment and to appropriately de-weight the influence of observations made at times far from the synoptic time where gross estimates of the background are likely to misrepresent the actual wind field.

The penalty term, requiring that the time rate of change of the vorticity of the analysis be small, was also modified since this constraint may not apply at high spatial resolution. The dynamical constraint was reformulated to be the integral of the squared difference between the analysis and background time rate of change of vorticity at the surface. This adjustment helps to avoid the elimination of small scale features in the analysis where the time rate of change of vorticity might be large.

5. Assimilated Data Products:

5.1 Satellite Surface Winds

Satellite surface wind data are obtained from Remote Sensing Systems under the DISCOVER project (http://www.discover-earth.org/). RSS uses a more accurate sea-surface emissivity model resulting in much better consistency between wind speed retrievals from microwave radiometers (SSM/I, AMSR, TMI) and those from scatterometers (NSCAT and SeaWinds). All observations are referenced to a height of 10 meters assuming that the boundary layer over the ocean is neutrally stable.

5.2 Conventional (Ships and Buoys)

The conventional data used in our analyses is obtained from the Scientific Division of the National Center for Atmospheric Research (NCAR). These consist of all ship and buoy observations of surface wind. In addition to the standard observations, additional buoy data are obtained from the Pacific Marine and Environmental Laboratory (PMEL) under the Tropical Atmosphere Ocean Project (TAO). These data consist of moored ocean buoys for improved detection, understanding and prediction of El Niño and La Niña (see http://www.pmel.noaa.gov/tao/ for more information). When available, buoys from the Pilot Research Moored Array in the Atlantic (PIRATA) are also used (http://www.pmel.noaa.gov/pirata/). All conventional observations are adjusted to a height of 10 meters assuming neutral stability (see Hoffman, 2005). When unavailable, instrument heights are assumed to be 19.5m and 5m for ships and buoys respectively.

5.3 Background Analyses

The VAM requires a background (first guess) analysis of gridded U and V winds as a starting estimate of the wind field. Analysis increments are added to this background to arrive at the final analysis. For this project, two data sets were used as the starting wind field. 10-meter winds from the ERA-40 Re-analysis were used as a background for the period, July 1987 to December 1998. Beginning in 1999, the benefits of 4-DVAR assimilation and increased spatial resolution make the ECMWF Operational analysis the better choice for a background. Both data sets were obtained from the

Computation and Information Systems Laboratory (CISL) at the National Center for Atmospheric Research (NCAR): http://dss.ucar.edu/datasets/ .

6. Calibration and Validation:

To be added later…

7. Data Set Description:

7.1 Product Types

The main product stream produced under this project is called First-Look (FLK). FLK products are available within 6-months of real-time. A Late-Look (LLK) product stream will be produced in response to revisions or updates to the methodology or assimilated data products. LLK will incorporate improvements resulting from research and evaluation of FLK products as well as any additional satellite surface wind products that become available under the DISCOVER project.

Each product stream contains three standard data sets designated as level 3.0, 3.5 and 2.5. The primary data set, denoted Level 3.0, contains 6-hourly gridded VAM analyses. These analyses are time averaged over 5-day and monthly periods to derive the Level 3.5 data sets. For level 3.5a data sets, only those grid points with one or more analyzed observations are used in the averages in order to more accurately approximate a satellite-only climatology. A level 3.5b data set will also be made available that uses all points. Finally, directions from the VAM analyses are assigned to the wind speed observations for each passive microwave sensor to derive the Level 2.5 data sets.

Level 3.0 and 3.5 data sets are stored in the Network Common Data Format (NetCDF) in compressed form to minimize storage requirements. NetCDF is an industry standard for managing scientific data and is freely available (see http://www.unidata.ucar.edu/software/netcdf). Applications using the Hierarchical Data Format (HDF) (see http://www.hdfgroup.org/) can also be used to read these files.

Level 2.5 products are stored in binary “bytemap” files to parallel the original satellite data files from RSS. These are easy to use files that employ maximum compression techniques to reduce storage requirements for large volumes of satellite data. All observations are mapped to a 25km grid and packed into 1-byte integers. The grid auto-navigates the data thus reducing the need to store latitudes and longitudes. In addition, bytemap files are highly compressible using GNU zip (gzip).

Each data set is archived using the following naming convention:

NAME_YYYYMMDD_*v*VV*l*LLPPP.TTT.gz
NAME = unique identifier describing the data
YYYYMMDD = date/time expressed as year, month, day
VV = product version number (in tenths)
LL = product level designation (in tenths)
PPP = product stream (flk or llk)
TTT = file type designating the data format

For example, "analysis_20040101_*v*10*l*30flk.nc.gz" designates a level 3.0 (l30) data set containing VAM analyses for January 1, 2004 from version 1.0 (v10) of the first-look (flk) product stream in NetCDF (.nc) format. The ".gz" node indicates that the file must first be de-compressed using the GNU zip (gzip) compression utility.

Values for the abovementioned nodes are described below:

NAME	analysis	VAM analyses centered at 0,6,12 and 18z. See grid-1.
	pentad	5-day means starting on the first day of each year. In leap years, the pentad starting on 2/26 will include 6-days such that the starting date for each pentad remains the same across all years. See Grid-1.
	monthly	Monthly means starting on the first day of each month. See Grid-1.
	f08,f10,f11,f13,f14,f15	DMSP SSM/I satellite wind speeds with assigned directions (stored 2x daily as AM and PM orbits). See Grid-2.
	amsre	AMSR-E wind speeds with assigned directions (stored 2x daily as AM and PM orbits). See Grid-2.
	tmi	TRMM TMI wind speeds with assigned directions (stored 2x daily as AM and PM orbits). See Grid-3.
YYYY	1987-	4-digit year.
MM	01-12	2-digit month.

DD	01-31	2-digit day.
VV	11	Version 1.1.
PPP	flk	First-Look data stream.
	llk	Late-Look data stream.
LL	30	Level 3.0 instantaneous analyses (see Variable Description for Level 3.0).
	35	Level 3.5 time averaged analyses (see **This variable will be updated to contain additional information such as land and ice flags. Updates will be posted when the installation is complete. Scale and offset factors may change. **Variable Description for Level 3.5**).
	25	Level 2.5 satellite swath wind speed observations with assigned directions (seeVariable **Description for Level 2.5**).
TTT	nc	NetCDF.
	bmap	Bytemap: flat binary data format containing 1-byte lat/lon grids.

7.2 Variable Types

The following tables describe the variables contained on the level 3.0, 3.5 and 2.5 data sets. Most variables are stored as one or two byte "packed" integers to minimize storage. A scale and offset factor is provided for each packed integer variable to retrieve the actual value as follows:

actual = integer*scale + offset

Variable Description for Level 3.0

Name	Number Type	Scale	Offset	Missing Value	Description
time	float	1.0	0.0	N/A	hours since 1987-01-01
uwnd	short	0.0030519441	0.0	-32767	u-wind at 10 meters (m/s)
vwnd	short	0.0030519441	0.0	-32767	v-wind at 10 meters (m/s)

nobs	short	1.0	32766	-32767	number of observations used in the analysis**

**This variable will be updated to contain additional information such as land and ice flags. Updates will be posted when the installation is complete. Scale and offset factors may change.

Variable Description for Level 3.5

Name	Number Type	Scale	Offset	Missing Value	Description
time	float	1.0	0.0	N/A	hours since 1987-01-01
uwnd	short	0.001525972	0.0	-32767	u-wind at 10 meters (m/s)
vwnd	short	0.001525972	0.0	-32767	v-wind at 10 meters (m/s)
upstr	short	0.030519441	0.0	-32767	u-comp of pseudostress at 10 meters (m**2/s**2)
vpstr	short	0.030519441	0.0	-32767	v-comp of pseudostress at 10 meters (m**2/s**2)
wspd	short	0.001144479	37.5	-32767	wind speed at 10 meters (m/s)
nobs	short	1.0	32766	-32767	number of times used in the average

Variable Description for Level 2.5

Name	Number Type	Scale	Offset	Missing Value	Description
time	byte	6.0	0.0	255	time of day in minutes (0-1440)
uwnd	byte	1/2.54	-50.0	255	u-wind at 10 meters (m/s)
vwnd	byte	1/2.54	-50.0	255	v-wind at 10 meters (m/s)

7.3 Grid Description

All data sets share the same grid. Latitude extent varies depending on the data type. In the tables below, dimension “1” references the innermost (fastest incrementing) dimension. The convention for C and Fortran would be array[dim2][dim1] and array(dim1,dim2) respectively.

Grid-1

Dimension	Name	Size	Range (deg)	Spacing (deg)
1	Longitude	1440	0.125 to 359.875	0.25
2	Latitude	628	-78.375 to 78.375	0.25

Grid-2

Dimension	Name	Size	Range (deg)	Spacing (deg)
1	Longitude	1440	0.125 to 359.875	0.25
2	Latitude	720	-89.875 to 89.875	0.25

Grid-3

Dimension	Name	Size	Range (deg)	Spacing (deg)
1	Longitude	1440	0.125 to 359.875	0.25
2	Latitude	320	-39.875 to 39.875	0.25

7.4 First-Look Version 1.1

First-Look (FLK) version 1.1 is the first product released under this project. Data sets are available at: http://podaac.jpl.nasa.gov/DATA_CATALOG/ccmpinfo.html . Table 3 summarizes the satellite retrieved products used in this release. The RSS product version number is listed for each observing system. Version number can vary from year to year depending on the availability of the release at the time of processing. Processing for the years 2004 and 2005 were completed before the version-5 AMSR-E product release. Version-5 corrected a rain-flagging problem that resulted in too many rejected observations in the version-4 release (see Figure 1).

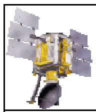	Year																				
	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
F08													--	--	--	--	--	--	--	--	--
F10													--	--	--	--	--	--	--	--	--
F11													V6	V6	--	--	--	--	--	--	--
F13													V6	V6	V6	V6	V6	V6	V6	V6	V6
F14													V6	V6	V6	V6	V6	V6	V6	V6	V6
F15													V6	V6	V6	V6	V6	V6	V6	V6	V6
AMSRE													--	--	--	V5	V5	V4	V4	V5	V5
TMI													V4	V4	V4	V4	V4	V4	V4	V4	V4
QSCAT													V3	V3	V3	V3	V3	V3	V3	V3	V3
SEA-WINDS													--	--	--	--	V3	--	--	--	--

***Table 3** RSS product version number for each year of the first-look v1.1 processing. Version numbers are listed for each year and each observing system. The most recent version of the RSS data was used at the time of processing and may vary from year to year.*

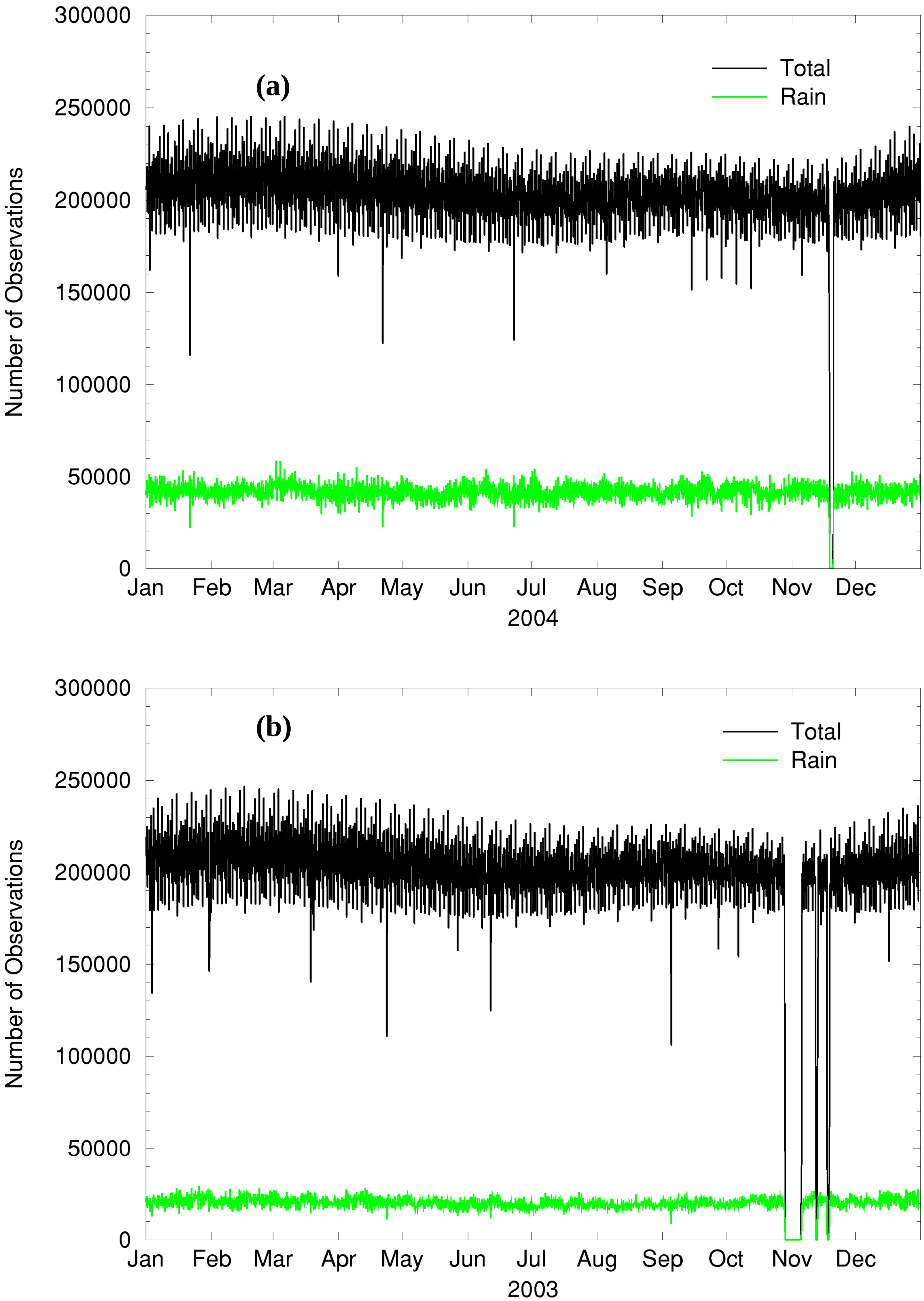

Figure 1 : AMSR-E quality control metrics for 2004 (a) and 2003 (b) in the VAM FLK v1.1 product stream. The total number of observations are shown in black. The number of observations failing quality control due to the presence of rain is shown in green. There are nearly twice the number of rain flagged reports in 2004 (a) as there are in 2003 (b) where version-5 AMSR-E from RSS replaced version-4.

8. Read Software:

Open source software tools for reading data sets are available in Fortran and C. In addition, visualization and analysis tools are available using the Grid Analysis and Display System (GrADS). GrADS is an interactive desktop tool that is used for easy access, manipulation and visualization of earth science data. Its built-in scripting language enables users to easily tailor applications for analysis and visualization, and engages the user community in the development and sharing of information technology. GrADS has an extensive user group base and is freely available on many operating systems. See http://grads.iges.org/grads/grads.html for more information.

The following table describes the software tools available at:
http://podaac.jpl.nasa.gov/DATA_CATALOG/ccmpinfo.html :

Name	Type	Description
ncread.f	Fortran 77	Sample program for reading NetCDF (.nc) data sets using the NetCDF F77 API: http://www.unidata.ucar.edu/software/netcdf/
ncread.F	Fortran 90	Sample program for reading NetCDF (.nc) data sets using the NetCDF F90 API: http://www.unidata.ucar.edu/software/netcdf/
bmread.F	Fortran 90	Sample program for reading Level2.5 bytemap files.
ncread.c	C	Sample program for reading NetCDF (.nc) data sets using the NetCDF C API: http://www.unidata.ucar.edu/software/netcdf/
hdfread.c	C	Sample program for reading NetCDF (.nc) data sets using the HDF4 C API: http://www.hdfgroup.org/hdf4.html
bmread.c	C	Sample program for reading Level2.5 bytemap files.
plot_l35.gs	GrADS Script	Plots streamlines and shaded vector magnitude using level3.5 data sets individually or in combination to produce new averages. See http://www.iges.org/grads/downloads.html

plot_l35_stress.gs	GrADS Script	Plots pseudo-stress vectors and shaded vector magnitude using level3.5 data sets individually or in combination to produce new averages. See http://www.iges.org/grads/downloads.html
stats_l30.gs	GrADS script	Reads level 3.0 data sets and prints statistics on global wind speed. See http://www.iges.org/grads/downloads.html
stats_l25.gs	GrADS script	Reads level 2.5 data sets and prints statistics on global wind speed. See http://www.iges.org/grads/downloads.html

9. Sources of Error:

There is some error resulting from packing the data into 2-byte and 1-byte integers. Errors from packing can be as high as 0.2 m/s. Applications requiring high accuracy should consider both the error resulting from data compression and the inherent observation errors.

10. Known Problems:

- The ERA-40 Reanalysis data used in the most current FLK product is at a 2.5 degree grid resolution. A 1.125 degree resolution version of ERA-40 is currently available and will be implemented in the future release of either the FLK or LLK product which will help to maintain better grid consistency and lower spatial errors in the VAM processing.
- There is currently no land or ice mask available for the Level 3.0 product, and therefore we advise caution when examining data points in close proximity to land or areas known to be populated by sea ice. There is an implicit land/sea-ice mask for the Level 2.5 and 3.5 products, which essentially coincides with the missing value flag where satellite data was either unavailable or contaminated by various factors such as rain, sea-ice, or land. A land/ice flag is currently being developed for the Level 3.0 product and is likely to be released as part of the “nobs” parameter within the Level 3.0 product (stay tuned!).
- The background wind analyses used in the FLK processing contain stability effects which were not removed before processing. Stability effects will be removed in future releases which will make the background data more compatible with the satellite observations.

11. Data Access:

Obtaining Data:

The CCMP data products, read software and documentation are freely available for public download via anonymous FTP at: ftp://podaac.jpl.nasa.gov/ocean_wind/ccmp/. All data granules are compressed using the industry standard GNU Zip compression utility. To learn more about the GNU compression utility, please visit the GZIP home page: http://www.gzip.org/.

For information on all other ocean surface wind products available at PO.DAAC, please visit our Ocean Wind data product listing: http://podaac.jpl.nasa.gov/DATA_CATALOG/ow.html

For general news, announcements, and information on all other PO.DAAC data products, please visit the PO.DAAC home page: http://podaac.jpl.nasa.gov/.

Contact Information:

Questions and comments concerning the CCMP science data products should be directed to the Physical Oceanography Distributed Active Archive Center (PO.DAAC) at the NASA Jet Propulsion Laboratory (JPL). Please note that email is always the preferred method of communication.

E-Mail: podaac@podaac.jpl.nasa.gov

WWW: http://podaac.jpl.nasa.gov/DATA_CATALOG/ccmpinfo.html

Mail: PO.DAAC User Services Office
Jet Propulsion Laboratory
M/S T1721-202
4800 Oak Grove Drive
Pasadena, CA 91109

12. References:

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13. Acronyms:

4-DVAR: Four-Dimensional Variation

ADEOS-II: Advanced Earth Observing Satellite, 2nd Generation

AMSR-E: Advanced Microwave Scanning Radiometer - Earth Observing System

ASCAT: Advanced Scatterometer

CCMP: Cross-Calibrated, Multi-Platform

CISL: Computation and Information Systems Laboratory

DISCOVER: Distributed Information Services for Climate and Ocean products and Visualizations for Earth Research

DMSP: Defense Meteorological Satellites Program

ECMWF: European Centre for Medium-Rage Weather Forecasts

ENSO: El Niño-Southern Oscillation

EOS: Earth Observing System

ERA-40: ECMWF Re-Analysis – 40km grid resolution

ERS: European Remote-Sensing Satellite

ESE: Earth Science Enterprise

FGAT: First Guess at the Approximate Time

FLK: First-Look products

FTP: File Transfer Protocol

GCOM-W: Global Change Observation Mission - Water

GMI: GPM Microwave Imager

GPM: Global Precipitation Measurement

GrADS: Grid Analysis and Display System

GSFC: Goddard Space Flight Center

HDF: Hierarchical Data Format

JPL: Jet Propulsion Laboratory

LLK: Late-Look products

MEaSURE: Making Earth System Data Records for Use in a Research Environment

NASA: National Aeronautics and Space Administration

NCAR: National Center for Atmospheric Research

NetCDF: Network Common Data Format

NOAA: National Oceanic and Atmospheric Administration

NSCAT: NASA Scatterometer

PIRATA: Pilot Research Moored Array in the Atlantic

PMEL: Pacific Marine and Environmental Laboratory

PO.DAAC: Physical Oceanography Distributed Active Archive Center

QuikSCAT: NASA Quick Scatterometer

REASoN: Research, Education and Applications Solutions Network

RSS: Remote Sensing Systems

SASS: Seasat-A Scatterometer System

SSM/I: Special Sensor Microwave Imager

SMMR: Scanning Multichannel Microwave Radiometer

TAO: Tropical Atmosphere Ocean project

TMI: TRMM Microwave Imager

TRMM: Tropical Rainfall Measuring Mission

VAM: Variational Analysis Method

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