NVAP-MEaSUREs (NVAP-M) ReadMe

1.0 Introduction

The National Aeronautics and Space Administration (NASA) Water Vapor Project –MEaSUREs (NVAP-M) global water vapor dataset represents the first total reprocessing of the NVAP dataset under the Making Earth Science Data Records for Use in Research Environments (MEaSUREs) program. It features combined observations of both column integrated and layered global water vapor from a variety of surface and spaceborne sensors from 1988-2009. This user guide describes the products of the dataset and is organized as follows:

- Section 2.0 - Dataset Description
- Section 3.0 - Data format
- Section 4.0 - Description of Sample Read and Display Software
- Section 5.0 - Additional Information

2.0 Dataset Description

NVAP-M includes a reprocessing of all previously existing NVAP data, as well as an extension of the dataset to include 22 years (1988-2009) of total column and layered water vapor over both ocean and land.

NVAP-M will include three separate data streams described in Table 1 below.

Table 1. Description of the production streams available as part of the NVAP-M dataset.

Product Stream	Description	Spatial Resolution	Temporal Resolution	Vertical structure information
NVAP-M Climate	Uses consistent input data and algorithms through time at the expense of spatial and temporal resolution. Ideal for studies of interannual variability and climate.	1 degree	Daily	Yes
NVAP-M Weather	Uses additional inputs as they become available but maintains consistent algorithm use for each input. Higher spatial and temporal resolution. Ideal for weather case studies.	0.5 degree	6-hourly (4 times a day)	Yes
NVAP-M Ocean	Similar to NVAP-M Climate, but using only SSM/I data inputs. Ideal for comparison to similar ocean-only passive microwave water vapor datasets.	1 degree	Daily	No

Each data stream except the Ocean will include information regarding the total precipitable water (TPW) as well as the vertical distribution of water vapor over 4 broad atmospheric layers: Surface - 700 hPa, 700 - 500 hPa, 500 - 300 hPa, and <300 hPa. NVAP-M Ocean will include TPW only.

3.0 Data Format

The data format for NVAP-M products is netCDF 4.0.

3.1 File Naming Convention

All files are currently named with the following convention:

yyyy.**jjj**.NVAP**p**.**ttt**.**d**xdaily.dat   where

yyyy = year
jjj = Julian day
p = product, either C for climate, S for weather (synoptic), or O for Ocean only
ttt = type, either tpw for total column water vapor, or lpw for the layered product
d = number of times per day, either 1 for NVAP-M Climate and NVAP-M Ocean, or 4 for NVAP-M Weather

3.2 File format

All NVAP-M files are in NetCDF 4.0 format. Each file contains several grids of data, depending on product, including one array of floating point numbers describing the total or layered water vapor, and several "data source code" (DSC) 1-byte arrays indicating a given instrument's contribution to each grid box. All product grids are formatted 90N – 90S, 180W – 180E, such that point (1,1) corresponds to the grid box centered at 89.5N, 179.5W (89.75N, 179.75W) for 1° (0.5°) data. A value of -9999.0 is assigned to missing data. Table 2 describes the contents of each type of file.

All water vapor information is in units of mm. Data source code arrays assume a value of either 0 or 1, where a 0 indicates that the given instrument was not merged into a given grid box, and a value of 1 indicates that it has.

The layered PW product contains the total water vapor contained in broad atmospheric layers from the surface – 700 hPa, 700 – 500 hPa, 500 – 300 hPa, and 300 – 100 hPa. In the LPW arrays, layers are output from the top of the atmosphere down to the surface.

The NVAP-M Weather product contains the total or layered water vapor averaged over 6-hourly time periods, with the first grid corresponding to 0000-0559 UTC, and subsequent grids corresponding to 0600 – 1159 UTC, 1200-1759 UTC, and 1800-2359 UTC.

The DSC is available for every instrument. In the case of the Special Sensor Microwave Imager (SSM/I) and High Resolution Infrared Sounder (HIRS) instruments, which were flown on multiple satellite platforms, there is a DSC value given for each platform. The 6 SSM/I platforms correspond to Defense Meteorological Satellite Program (DMSP) F08, F10, F11, F13, F14, and F15, respectively. The 8 satellite platforms carrying the HIRS instrument are National Oceanic and Atmospheric Administration (NOAA) N09, N10, N12, N14, N15, N16, and N17. DSC flags are output in order from lowest-numbered platform to highest.

Table 2. Description of the information found in each type of NVAP-M file for Climate, Weather, and Ocean products, both total and layered water vapor data.

Product Type	TPW array size	Included DSC Arrays	Dimension definitions
NVAP-M Climate TPW	(nlon x nlat)	SSMI_DSC (nlon x nlat x nssmi) HIRS_DSC (nlon x nlat x nhirs) Sonde_DSC (nlon x nlat) AIRS_DSC (nlon x nlat)	nlon = 360 nlat = 180 nssmi = 6 nhirs = 8
NVAP-M Climate Layered PW	(nlon x nlat x nlayers)	HIRS_DSC (nlon x nlat x nhirs x nlayers) Sonde_DSC (nlon x nlat x nlayers) AIRS_DSC (nlon x nlat x nlayers)	nlon = 360 nlat = 180 nlayers = 4 nhirs = 8
NVAP-M Weather TPW	(nlon x nlat x ntimes)	SSMI_DSC (nlon x nlat x nssmi x ntimes) HIRS_DSC (nlon x nlat x nhirs x ntimes) Sonde_DSC (nlon x nlat x ntimes) AIRS_DSC (nlon x nlat x ntimes) GPS_DSC (nlon, nlat, ntimes)	nlon = 720 nlat = 360 ntimes = 4 nssmi =6 nhirs = 8
NVAP-M Weather Layered PW	(nlon x nlat x nlayers x ntimes)	HIRS_DSC (nlon x nlat x nhirs x ntimes x nlayers) Sonde_DSC (nlon x nlat x ntimes x nlayers) AIRS_DSC (nlon x nlat x ntimes x nlayers)	nlon = 720 nlat = 360 nlayers = 4 ntimes = 4 nhirs = 8
NVAP-M Ocean TPW	(nlon x nlat)	SSMI_DSC (nlon, nlat, nssmi)	nlon = 360 nlat = 180 nssmi = 6

4.0 Description of Sample Read and Display Software

NVAP-M is provided in netCDF 4.0 format. A variety of free software is available that can read, display, and extract data from netCDF files. Some examples include NASA's Panoply (http://www.giss.nasa.gov/tools/panoply/), Ncview (http://meteora.ucsd.edu/~pierce/ncview_home_page.html), and ncBrowse (http://www.epic.noaa.gov/java/ncBrowse/).

IDL read/display code has been provided (written in IDL version 8.0 on a Windows PC). The user needs only to enter the directory and filename of the file they wish to explore. The code will then determine, based on the file name, what NVAP-M product type is contained in the file. It will then print to the screen the names of all of the variables and their associated array sizes.

The total or layered water vapor array will be output to an ASCII file in the local directory with a header indicating the number of grid boxes in the x and y direction, number of times, and number of layers. A map of water vapor will also be displayed on the screen. In the case of NVAP-M Climate and Ocean TPW products, this is what will be displayed. For layered products, the surface – 700 hPa layer will be displayed. For NVAP-M Weather products, the 0000-0559 UTC time period will be displayed.

This code can easily be altered by the user to output files for both the water vapor and DSC information, and to create maps for different layers/time periods.

5.0 Additional Information

5.1 Science Points of Contact

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5.2 Project Website

A brief description of the NVAP-MEaSUREs project can be found at
http://nvap.stcnet.com

Previous versions of NVAP and associated documentation can be found at https://eosweb.larc.nasa.gov/project/nvap/nvap-m_table

5.3 Reference

Vonder Haar, T. M., J. L. Bytheway and J. M. Forsythe, 2012: Weather and climate analyses using improved global water vapor observations. *Geophys. Res. Lett.*, **39**, L15802. Doi:10.1029/2012GL052094