ESA DUE GlobVapour SSM/I+MERIS Data Set Description

TCWV (prw) version 1.0

Doi: 10.5676/DFE/WV_COMB/FP (parent file)

1. Intent of This Document and POC

1a) This document is intended for users who wish to compare satellite derived observations with climate model output in the context of the CMIP5/IPCC historical experiments. Users are not expected to be experts in satellite derived Earth system observational data. This document summarizes essential information needed for comparing this dataset to climate model output. References are provided at the end of this document to additional information.

Dataset File Name (as it appears on the ESGF):

prw_SSMI-MERIS_l3_v1-00_200301-200812.nc	(variables prw, prwNobs, prwStderr)
prwFlag_SSMI-MERIS_l3_v1-00_200301-200812.nc	(area types)
prwErr_SSMI-MERIS_l3_v1-00_200301-200812.nc	(retrieval error)
prwStddev_SSMI-MERIS_l3_v1-00_200301-200812.nc	(standard deviation)

The standard_error and Number_of_observations is included in the first file.

1b) Technical point of contact for this dataset:

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2. Data Field Description

CF variable name, units:	*Atmosphere_water_vapor_content in kg m^{-2}*
Spatial resolution:	*0.5° x 0.5°*
Temporal resolution and extent:	*monthly averages using data from early morning orbits (approximately at 10 am local time) from 01/2003 to 12/2008*
Coverage:	*global*

3. Data Origin

The combined SSM/I+MERIS total column water vapour (TCWV) data record was derived on a global grid over all-sky ocean and cloud free land, with a spatial resolution of 0.5° over ice-free ocean (SSM/I) and 0.05° over land and coastal ocean (MERIS) (Lindstrot et al., 2014). An area flag is provided which allows separating between land, ocean, and sea ice, among others. The

area flag also indirectly indicates which of the two instruments has been used. In order to ease utilisation the SSM/I+MERIS product is distributed on a 0.5°x0.5° grid, with the MERIS product being averaged to match the lower spatial resolution. The product is available as monthly mean and an example of a monthly mean is given in Figure 1. By sending a request via email to the point of contact, the product can be provided as a daily composite and with 0.05°x0.05° spatial resolution by oversampling the SSM/I product over ocean. Also on request, the product can be provided with a cloud mask applied to the SSM/I data (see also prwFlag_SSMI-MERIS_L3_v1-00_200301-200812.nc). The water vapour of the atmosphere is vertically integrated in a column from surface to 200 hPa, and given in units of kg/m². Both, the SSM/I and MERIS data streams are processed independently and combined afterwards by not changing the individual TCWV values and their uncertainties. The final product utilises SSM/I data onboard two satellites from the Defense Meteorological Satellite Program (DMSP), namely F13 and F14, for the period 2003 to 2008. The SSM/I L2 data set contains descending data which is closer to the overpass times of ENVISAT with MERIS on board (10 am local time). The SSM/I retrieval is based on an adapted 1D-Var retrieval (Deblonde, 2001, provided by NWP SAF) which uses water vapour climatology and temperature profiles from ERA-Interim as background. The MERIS TCWV retrieval is applied to swath-based, normalized radiances in MERIS bands 13, 14 and 15 at 865 nm, 885 nm and 900 nm, respectively, in daylight conditions while the cloud screening procedure utilises the full set of MERIS radiances between 400 and 900 nm (Lindstrot et al., 2012).

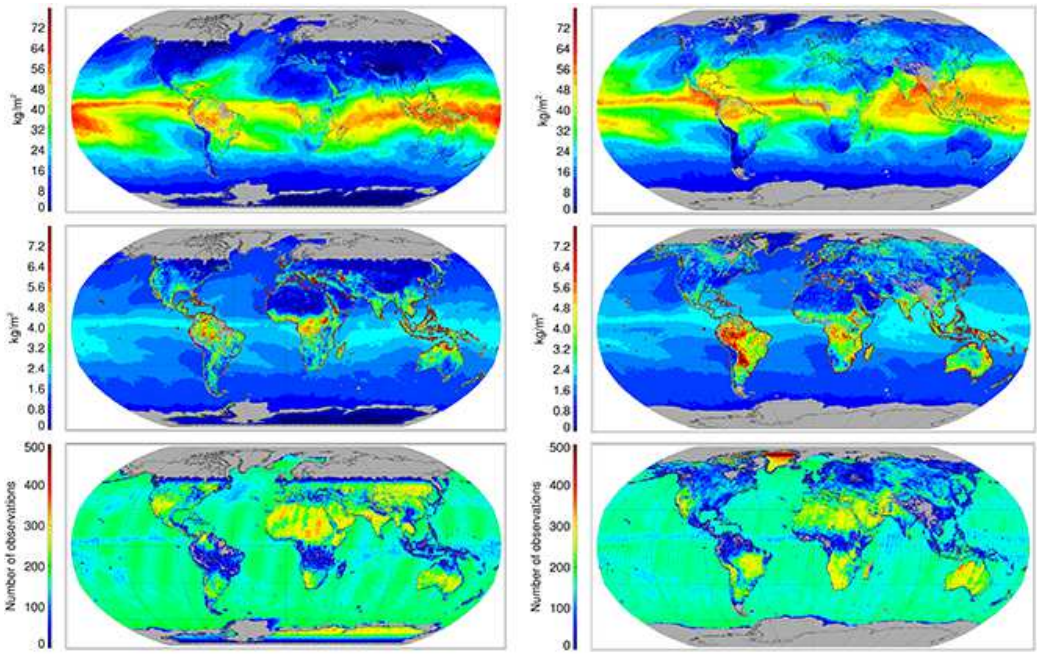

Figure 1: Exemplary monthly mean of the combined SSM/I+MERIS: TCWV (top panel), associated uncertainty (“retrieval error”, middle panel) and number of observations (lower panel) for January (left) and June 2003 (right, taken from Lindstrot et al., 2014).

4. Validation and Uncertainty Estimate

The combined SSM/I+MERIS data set contains the following uncertainty estimates:

- err (retrieval error): Arithmetical average of the uncertainty estimates of the daily values,
- stddev (standard deviation): Standard deviation of the daily values,
- stderr (standard error): standard deviation normalised with the square root of the number of valid contributions,

and describe the random part of uncertainty. The uncertainty of the daily composite is the arithmetic average of the retrieval error of all valid instantaneous contributions. It is an upper boundary to the random component of the uncertainty of the daily composite.

The combined SSM/I+MERIS product has been compared to GUAN radiosonde, Aeronet sun photometer, German GPS station, ARM microwave radiometer and ARM radiosonde observations as well as to the AIRS AST version 5 and the CM SAF ATOVS data record (Lindstrot et al., 2012; Schneider et al., 2012; Lindstrot et al., 2014). The average difference (or bias) is ≤ 1 kgm^{-2} (0.7 kgm^{-2} against GUAN radiosondes) and the root mean square difference varies between 1.3 kgm^{-2} (ARM microwave radiometer) and 4.4 kgm^{-2} (GUAN radiosondes). These values are averages based on full time series monthly means of global differences.

5. Considerations for Model-Observation Comparisons

The following points are relevant when this record is compared to model output:

- Diurnal cycle sampling biases may affect the comparison due to ENVISAT and SSM/I morning orbit configuration (i.e., the observations are taken at constant local time of day).
- MERIS and SSM/I carry out observations in the visible/near infrared and in the microwave spectral range. This causes fundamental differences in the capability of observing water vapour: a) MERIS observations over land are valid under clear sky conditions. When monthly averages are used without cloud filtering in model output the clear sky bias might impact the comparison, b) SSM/I and MERIS observations are not available in presence of strong precipitation.
- Observations over mountains, ice and coastal areas, that is, within 50 km off the coast, have limited quality, mainly evident in enhanced standard deviations. The uncertainty in mountainous and ice-covered areas is mainly determined by cloud detection.

Keeping this in mind and when using monthly means the standard error might be considered as uncertainty estimate for model-observation comparisons.

6. Instrument Overview

The combined SSM/I+MERIS data set utilises SSM/I data onboard two polar-orbiting satellites from the Defense Meteorological Satellite Program (DMSP), namely F13 and F14, for the period 2003 to 2008. The SSM/I L2 data set contains descending data which is closer to the overpass times of ENVISAT with MERIS on board (10 am local time). It is based on homogenised L1 data for four frequencies and for horizontal and vertical polarization (Anderson et al., 2010; a precurcor of the SSM/I FCDR from CM SAF, Fennig, 2013). The MERIS instrument is onboard the polar-orbiting satellite ENVISAT. The MERIS data stems from ESA's 3rd reprocessing of

the MERIS L1 archive (Bourg et al., 2011). The TCWV retrieval is applied to swath-based, normalized radiances in MERIS bands 13, 14 and 15 at 865 nm, 885 nm and 900 nm, respectively, while the cloud screening procedure utilises the full set of MERIS radiances between 400 and 900 nm.

7. References

This data record is referenced under DOI: 10.5676/DFE/WV_COMB/FP (http://dx.doi.org/10.5676/DFE/WV_COMB/FP). Access to the data record is given via the project homepage: http://www.globvapour.info.

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Deblonde, G., 2001: NWP SAF User's Guide: Standalone 1D-var scheme for the SSM/I, SSMIS and AMSU. NWPSAF-MO-UD-001 Version 1.0, 22 August 2001.

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Lindstrot, R., Preusker, R., Diedrich, H., Doppler, L., Bennartz, R., and Fischer, J.: 1D-Var retrieval of daytime total columnar water vapour from MERIS measurements, Atmospheric Measurement Techniques, 5, 631–646, doi:10.5194/amt-5-631-2012, http://www.atmos-meas-tech.net/5/631/2012/, 2012.

R. Lindstrot, M. Stengel, M. Schröder, J. Fischer, R. Preusker, N. Schneider, T. Steenbergen, and B. Bojkov, 2014: A global climatology of total columnar water vapour from SSM/I and MERIS. Earth Syst. Sci. Data, 6, 221–233, 2014, www.earth-syst-sci-data.net/6/221/2014/, doi:10.5194/essd-6-221-2014.

Schneider, N., M. Schröder, M. Stengel, T. Steenbergen, 2012: Product Validation Report - Combined SSMI + MERIS. ESA DUE GlobVapour report, issue 3, revision 1, 21 August 2012.

8. Dataset and Document Revision History

Rev 0 – 21 05 2014 - This is a new document/dataset.

Rev 1 – 24 10 2014 – Updates received from R. Saunders (UKMO) implemented.

Rev 2 – 06 11 2014 – Updates received from D. Waliser (JPL) implemented.