Eighth workshop
on the
GEWEX water vapor assessment

Workshop summary

M. Schröder (DWD/CM SAF), Helene Brogniez (LATMOS/UVSQ) and the participants of the 8th G-VAP workshop

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1. Overview

The GEWEX Data and Assessments Panel (GDAP) has initiated the GEWEX Water Vapor Assessment (G-VAP) in 2011. The major purpose of G-VAP is to quantify the state of the art in water vapour products being constructed for climate applications, and by this supports the selection process of suitable water vapour products by GDAP for its production of globally consistent water and energy cycle products. Workshops are carried out on an annual basis to discuss recent findings, to further refine the plan and to implement new activities as well as to draft and consolidate the assessment reports. The 8th G-VAP workshop was hosted by the Agencia Estatal de Meteorologia (AEMET) Madrid, Spain and took place on 13 and 14 June 2019. Approximately 20 participants from research institutes (CNR, LMD-IPSL, KIT, MPI-C), universities (Free U. Berlin, U. of Bremen, U. of Cologne, Colorado State U., U. of Leicester, U. of Miami, U. of Michigan, U. of Paris-Saclay, Vanderbilt U.), from weather services (AEMET, DMI, DWD, NOAA) as well as from space agencies (ESA, EUMETSAT) attended the workshop. A list of participants and their affiliations are given in Appendix C. The presentations of the 8th G-VAP workshop are available at www.gewex-vap.org.

The main objectives of the 8th meeting were to

- Present updates on water vapour data records and associated retrievals.
- Present and discuss results from the analysis and characterisation of water vapour products (G-VAP science activities and wider community).
- Foster cooperation, exchange and outreach.
- Discuss the next steps of G-VAP, including potential new activities.
- Initiate a special issue in a peer-reviewed journal.
- Discuss time line changes and the G-VAP data archive.

The workshop started with a welcome address by AEMET and introductory presentations on G-VAP and on the objectives of the current meeting. After an overview talk on water vapour in the climate system, the first block of presentations focused on user needs and applications, i.e., from GEWEX and the climate modelling community. A series of presentations provided updates on retrievals, data records and related validation results. Partly, uncertainty estimates are evaluated and by this, the consistency among observing systems is analysed as well. This was followed by presentations on G-VAP activities with a focus on process studies and was introduced by a presentation on the GEWEX UTCC PROES. The last scientific talk introduced the ESA Water_Vapour_cci project and its links to G-VAP. Finally, the time line, the update of the G-VAP archive and the initiation of a special issue were discussed. The workshop concluded with a few new recommendations.

The main outcomes of the 8th workshop are summarized as follows:

- New versions and data records will comprise the G-VAP data archive version 2. It was consensus that the archive will be closed in Q1 2021.
- It was consensus to postpone the submission of the next WCRP report to fall 2021.
- It was agreed to initiate a collection of peer-reviewed publications on the analysis of atmospheric water vapour in Copernicus journals, e.g., ACP, AMT, ESSD and GMD.

- The 9th G-VAP workshop will take place at DMI, Copenhagen, Danmark in the first week of October 2020.
- The following recommendations were consensus:

> **CGMS, Space agencies: It is important to ensure that developments around 5G telecommunication links do not impact microwave observations around 23 GHz via radio-frequency interference.**
>
> **EU, Copernicus, Space agencies: The need to provide uncertainty estimates and their evaluation requires substantial resources. This is not sufficiently covered by current funding schemes. Thus, activities around uncertainty estimation and evaluation require increased funding budgets.**
>
> **GEWEX, G-VAP, Space agencies: The analysis of the global water and energy budgets requires, among others, global humidity profiles at high temporal resolution as consistent input to the various variables of the closure studies. Thus, it is needed to assess options to merge/combine the various observing systems to provide such data.**
>
> **CGMS, Space agencies, GEWEX: Given the various applications, there is a need for the sustained provision of tropospheric water vapour isotopologue data.**

The full list of previous G-VAP recommendations is given in Appendix B. The list is taken from the WCRP report on G-VAP (Schröder et al., 2017) and will be expanded by the new recommendations. The list of activities is available at http://gewex-vap.org/wp-content/uploads/2019/05/G-VAP-Plan_v2.0a.pdf. Housekeeping activities are given in Table 1.

2. Background

The 8th GVAP workshop builds upon seven previous workshops held on an annual basis since 2011. The 1st workshop was hosted by the European Space Agency's European Space Research Institute (ESA-ESRIN) with support from the ESA DUE GlobVapour project in March 2011. This workshop set the general framework for the assessment by agreeing on variables, data records and general procedures to be considered. The workshop summary was published in the GEWEX Newsletter[1]. The 2nd workshop, hosted by Deutscher Wetterdienst and EUMETSAT's Satellite Application Facility on Climate Monitoring (CM SAF) in September 2012 aimed at the consolidation of the G-VAP strategy and the technical implementation. The results of the 2nd G-VAP workshop were presented to the first GDAP meeting in Paris, October 2012, where further recommendations were received. The major outcomes of the 2nd workshop and feedback from the first GDAP meeting have also been summarized in the GEWEX Newsletter[2]. Results

[1] http://www.gewex.org/resources/gewex-news/
[2] http://www.gewex.org/resources/gewex-news/

from these workshops and feedback from GDAP were used for setting up the G-VAP assessment plan.
Additionally, the following workshops have been carried out:

- 3rd workshop, CSU, Fort Collins, CO, USA
- 4th workshop, FU Berlin, Berlin, Germany
- 5th workshop, U Wisconsin, Madison, WI, USA
- 6th workshop, EUMETSAT, Darmstadt, Germany
- 7th workshop, Univ. Leicester, Leicester, UK
- 8th workshop, AEMET, Madrid, Spain

It was consensus at the 5th and the 6th workshop to continue G-VAP beyond the finalisation of the WCRP report on G-VAP. GDAP supports this continuation as confirmed at the GDAP meeting in Washington, D.C., USA on 29 November – 01 December 2016.
The 7th workshop was hosted by NCEO at the U Leicester. Based on discussions and results from the 7th workshop the assessment plan will be updated. However, scope, objectives and general procedures will not be changed. The assessment plans are, and will be available at the G-VAP webpage (www.gewex-vap.org).

G-VAP is a community effort. In order to continue to be successful the community is encouraged to participate. Please contact the co-chairs or activity leaders if you want to take responsibility, to carry out dedicated analysis or to provide data.

3. Major results

After Jose Antonio Fernandez Monistrol, director of AEMET, welcomed the participants of the 8th workshop, M. Schröder gave an overview on G-VAP and summarised results from G-VAP's first phase. Among others, the scope, objective, science questions, variables, and overall procedures of G-VAP have been recalled. The overview on available water vapour data records, the G-VAP data archive, the G-VAP recommendations, the WCRP report on G-VAP and the new activities which are summarised in the new assessment plan have been introduced briefly. The main feedback from the GDAP meeting in November 2018 concerns the need to (i) focus on climate and process analysis, (ii) link to science questions and PROES and (iii) inform users on issues in data. It was emphasised again that the science activities as stated in the plan are linked to science questions and that it is the goal of each activity to publish results as soon as the study is finished and prior to publication of WCRP report.

B. Soden recalled the importance of the water vapour feedback in the climate system and to accurately constrain it. Such a quantification requires long-term data records of water vapor. The example of the HIRS measurements in the 6.7 µm absorption band (Ch. 12) was discussed in terms of impact of diurnal drifts and discontinuities with the successive HIRS-2/HIRS-3. Efforts to correct these effects were described as well as the results of analysis of trends and comparisons with CMIP5. Those latter results clearly showed the added value of maintaining data records of high quality. Finally, he concluded that an extension of a HIRS/2 like CDR

using hyperspectral data is needed and that exploiting/maintaining redundancy of narrow-band IR, spectral IR, and microwave sensors is important for establishing stability of climate records.

C. Kummerow described the "GEWEX Integrated Product" which includes, among others, clouds, radiation, sea and land fluxes, moisture, and precipitation unified as best as possible. The available product covers the period 1998 - 2015, with a 1°/3-hourly resolution, and, among others, combines ISCCP (with nnHIRS), GPCP, Sea Flux, Land Flux from the GLEAM model, and SRB. The instantaneous clear-sky HIRS atmospheric profile and surface temperature fields are combined with a PCA analysis to obtain 3-hourly maps which then comprise the nnHIRS product. Such a product is essential input to various variables relevant for closure analysis of the global water and energy budgets. Thus, it is needed to approach the merging/combination of the data from the various observing systems to provide high temporal resolution water vapour data. A water budget closure experiment was also discussed and highlighted the problem of products not totally independent from each other. A workshop on integrated land-surface / atmosphere process studies was announced and will take place in March 2020 in Toledo, Spain.

A brief description of the "Tool for Intercomparison of Gridded Data Sets", developed at DWD was done by M. Schröder on behalf of the development team. This tool has been designed to analyse the spread in an ensemble of data records in order to support model evaluation. This analysis has been tailored towards the needs from a single climate modelling group. It was discussed to gather additional feedback from other climate modelling groups and approach the ESA CMUG_cci group. First results of the evaluation of 11 CMIP5 models (AMIP configurations) using the G-VAP archive of TCWV (ensemble median) as well as the ARSA data record were presented by T. Trent. Using vertical velocities as proxy for large-scale dynamics, the comparisons highlight the clear-sky sampling bias in the HIRS and NVAP datasets. This work will pursue with CMIP6 models and a focus on the recycling rates (e.g. Li et al, 2011; Kao et al, 2018).

After these presentations on user applications a series of presentations on retrievals, data records and validation activities followed. The activities of EUMETSAT on the production of water vapor products, long-term records and their validation were presented by T. August and L. Spezzi. Long-term records focus on the EPS program. The L2 product (IASI L2 v6) is an almost all-skies retrieval (except in presence of precipitation) based on the synergy between IASI/AMSU/MHS and AVHRR. The retrieval scheme estimates T, q, surface T, O3, land emissivity and CO2 through a Piece-Wise Linear Retrieval. A reprocessed data record will be released in Q1 2020. The validation is done with the IGRA radiosonde data within the MONA LISA project, and shows a bias of ~0 g/kg at 500hPa for the combined IR+MW retrieval (<0.5 g/kg for the IR-only retrieval). The results highlight the need for a realistic CO_2 concentration, as was also shown in the CIRS cloud retrieval (Stubenrauch et al., 2017). Among others, the need of synchronised satellite/GRUAN observations was mentioned and the value of a multi-hyperspectral profile product was discussed and emphasised. The following discussions about uncertainty estimation and validation lead to the consensus conclusions that the estimation and validation of uncertainties requires substantially increased funding. Linked to this, traceability to S.I. standards is also necessary. The risk of 5G telecommunication link radio-frequency interference impacting microwave observations at frequencies around 23 GHz was also discussed. G-VAP results show that trend estimates based on a subset of microwave-based

TCWV data records agree within uncertainty estimates. These data records further exhibit an increase in TCWV within the expected range estimated from Clausius-Clapeyron. Thus, it was consensus that the impact of 5G on observations around 23 GHz need to be avoided in order to ensure continuation of heritage climate data records in support to climate monitoring and climate analysis. The new generation of instruments are OLCI (NIR, similar to MERIS), SLSTR (TIR + dual view), FCI (VIS+NIR+TIR), and 3MI (NIR, similar to POLDER). They provide integrated products as well as Layer Precipitable Water (surf-850hPa; 850hPa-500hPa; 500hPa-TOA). The validation approach relies on IGRA, GRUAN and ARSA profiles. EUMETSAT is particularly looking for discussion and collaboration with G-VAP during the commissioning phase of EPS-SG and MTG (0-6 months after launch). Questions on the need for operational products were raised. Among others, there was general agreement that the need for observations at 0.9 nm is beneficial as it allows high quality and high-resolution observations of TCWV over land. Also, it was general consensus that model dependency should be minimised, if not avoided completely, because forecasters typically want to compare a model-free observation with their own model.

Updates on water vapour data records were given by E. Castelli within the IR window (AIRWAVE), T. Küchler and C. Borger within the UV/VIS spectral range (GOME/SCIAMACHY/OMI/TROPOMI). The AIRWAVE v2 TCWV data are derived from (A)ASTR observations at 11 µm and 12 µm under clear-sky conditions over sea, with a 1 km resolution over 1991-2012. The evaluation is based on SSM/I and ARSA. The v2 shows a reduced bias (<0.1%) with respect to v1 (~3%). The AIRWAVE algorithm will be extended to SLSTR measurements (Sentinel-3, EUMETSAT). The UV/VIS technique based on differential optical spectroscopy allows the retrieval during daytime only over both land and sea surfaces, according to a pre-defined air-mass factor which among others depends on atmospheric conditions and viewing angle. Validation against other datasets such as SSMIS or ERA5 shows that the method is valid until a 20% cloud fraction within the field of view. It was discussed that the air mass correction factor seems to be the critical factor of the retrieval scheme. The possibility to consider NIR data records such as from OLCI or MODIS as well as the general G-VAP data archive for validation purposes was discussed. The need to consider the effect of the height of the GPS station in the comparisons and the effect of the cloud shadows in the retrieval scheme was also mentioned.

The presentations by J. Nielsen, M. Schneider and B. Sun focused on the validation of water vapour profile data. J. Nielsen introduced the reprocessed GPS RO data available from ROM SAF. Future plans may include a change to climatological profiles as a priori. The comparison to GRUAN RS92 data exhibits a positive bias in the upper troposphere and a nighttime dry bias in the middle troposphere. The validation exercise also confirms that the random errors in the middle troposphere are consistent with the independently estimated random uncertainties of the two data sets. The next IROWG will be hosted by DMI, Copenhagen, Danmark on 19-25 September 2019.
M. Schneider introduced the MUSICA IASI water vapour products and results from comparisons to GRUAN data. The presentation focused on the sound sensitivity and uncertainty estimation (averaging kernels and error covariances for various uncertainty sources). In a second part the value of analysing water vapour isotopes for process analysis was demonstrated.

The {H2O, HDO/H2O} pair distribution can identify different vapour sources (land or ocean at different temperatures), different transport processes (drying by mixing with dry air or drying by consecutive condensation and rain out) and cloud processes (e.g. large-scale rain recycling within organized convection). Furthermore, because the {H2O, HDO/H2O} pair distribution indicates latent heat release, there is potential of improving meteorological analyses when using isotoplogue measurements. In the field of paleoclimate research, investigating the linkage between current day water isotopologue distribution and atmospheric circulation is important for improved paleoclimate reconstructions. The interest in more operational data processing, e.g., in cooperation with organisations like DWD, EUMETSAT or ESA was discussed. X. Calbet, on behalf of B. Sun and A. Reale, discussed the accuracy of Vaisala RS41 and RS92 humidity observations in both radiance and geophysical spaces. He concluded that the vendor-RS41 (industry calibration, no GRUAN processing applied) appears to have a dry bias (~1.5%) in the upper troposphere during daytime but shows improvement over the GRUAN-processed RS92 (by ~1% in RH). Vendor-RS41 is consistent to IASI measurement especially for night-time data. Next, GRUAN-processed and vendor-RS41 will be analysed jointly. Here, a dry bias during day between IASI and GRUAN was observed while comparisons between GPS RO and GRUAN exhibit a wet bias during night. It was agreed that this contrast will be further analysed within the G-VAP team on the consistency activity. It was further discussed that other uncertainty sources, i.e., not related to GRUAN approaches, might explain these differences, e.g., potential issues in water vapour continuum absorption.
It was consensus that uncertainty analysis is of relevance to G-VAP (reconfirming an existing G-VAP recommendation) and results from related analysis will be summarized in the WCRP report.

C. Stubenrauch introduced the GEWEX Process Evaluation Study on Upper Tropospheric Clouds and Convection (PROES UTCC). A collection of various data records is being analysed, using a cloud system concept, to improve our understanding of the relation between the atmospheric environment, convection, cirrus anvils and radiative heating. This also provides a new observational metrics for a process-oriented assessment of climate model parameterizations. It was proposed to compare water vapour structures and cloud structures (monthly means easily available from the GEWEX Cloud Assessment database, currently being updated) as well as to use different humidity datasets in cloud process studies. It was noted that the latter is likely beyond scope while the community is invited to address the former. It followed a presentation by H. Brogniez on the variability of FTH in subsidence regions. Using wind fields from ECMWF the analysis was carried out by separating ascending and subsiding cases. The need for high temporal resolution data was emphasized. Results suggest a drying in the ascending cases but no consistent results for the subsiding cases. The temporal extension of the FTH data record is urgently needed.

X. Huang used multiple observations to quantify biases in reanalysis by contrasting results from comparisons to various observations from ARM and from comparisons in radiance space using data from AIRS. It was shown that, for both MERRA-2 and ERA-Interim reanalyses, the upper troposphere has a larger wet bias than the middle troposphere. The humidity biases in the reanalyses are much more prominent than the temperature biases. Future efforts will include observations from CrIS as well. The consistency between IASI observations and GRUAN data

was discussed by X. Calbet. It was demonstrated that small scale variability from turbulence contribute significantly to observed differences between observing systems, emphasizing the need for high temporal resolution water vapour data. A. Radovan showed results from a systematic assessment of water vapor products from satellite and reanalysis in the Arctic. Some satellite products underestimate TCWV at high values while reanalysis exhibit fairly large differences over sea-ice. It was concluded that sub-daily observations are needed to capture water vapour intrusions such as from atmospheric rivers.

The last scientific presentation introduced the ESA Water_Vapour_cci project and its links to G-VAP. Water_Vapour_cci will produce a NIR only TCWV product over land and, in cooperation with CM SAF, a global NIR and microwave-based product. It is foreseen that both products will be included in the updated G-VAP data archive. Within this project the clear-sky bias will be analysed which directly addresses one of the G-VAP recommendations. Finally, results from the comparisons of the Water_Vapour_cci UTLS product and ERA5 are of interest to UTCC PROES.

A potential change of the time line, the update of the G-VAP data archive and the initiation of a special issue were prepared for discussion by M. Schröder. According to current plans the new WCRP report would be due in late 2020/early 2021. In view of the current status of G-VAP activities and the time needed to prepare and submit publications prior to submission of the WCRP report, it was consensus to postpone submission of the WCRP report to fall 2021. Consequently, publications on G-VAP results need to be submitted until summer 2021 or earlier. It was recalled that all activity leads need to prepare either a report on results as (sub-) section or an „extended abstract“ based on published results (taking into account property rights). It was consensus that a new G-VAP data archive will be generated and released. This version 2 will contain updated versions and new data records, with potentially changed common spatial resolution by keeping original temporal resolution back to 1979. Multiple versions are kept as long as old versions are accessible. The archive will be closed by Q1 2021. Finally, the initiation of a special issue in Copernicus, Frontiers or J. Climate was discussed. It was agreed to initiate a collection in Copernicus journals. The collection allows publications of results as soon as they successfully passed the review in any Copernicus journal, e.g., ACP, AMT, ESSD or GMD, i.e., it is not needed to wait for the last publication. These are marked and collected as long as the collection is open for submission. The title of the collection will be ‘Analysis of atmospheric water vapour observations and their uncertainties for climate applications’. The collection is dedicated to results from G-VAP activities and open to the wider community, i.e., to UTLS and stratospheric communities, to other projects and initiatives such as SAFs, CCI, and NASA as well as JAXA projects and to retrieval development, data records, other intercomparison activities. Following first feedback from ACP the start and end date will be October 2019 - December 2021. Thus far, M. Schröder, H. Brogniez, S.-p. Ho and T. Trent agreed to be co-editors.

Table 1: List of housekeeping activities.

Activity (new)	**Responsible**	**Comment**	**Until**
Prepare MoM and provide talks	M. Schröder, H. Brogniez		June 2019
Update web page (agenda, talks, data record overview)	F. Fell, M. Schröder		August 2019
Gather user feedback, in particular from CMUG, on how to optimally intercompare an archive of data records.	Co-chairs	CMUG/Integration meeting in November 2019	November 2019
Include GPS RO in consistency analysis	X. Calbet, J. Nielsen, B. Sun, A. Reale	Linked to CGMS/WMO recommendation on consistency	Fall 2021
Discuss options to develop global humidity data with high temporal resolution	Co-chairs, all		Fall 2021
Include sessions during G-VAP workshops to discuss overarching topics	Co-chairs, all		continuous
Activity (old)	**Responsible**	**Comment**	**Until**
Assess potential to include G-VAP data archive into obs4MIPS	M. Schröder, J. Luo	via WDAC or PROES, contact PIs	April 2018

All workshop participants agreed that: CM SAF, DWD, UVSQ, NOAA and AEMET (co-chairs and local host), may store and use personal data for the purpose of organising and documenting the 8th G-VAP meeting, the agenda and the minutes (each containing name and affiliation) of this workshop will be made available publicly and that photos taking during the event may be published.

The next workshop will take place at DMI, Copenhagen, Denmark, tentatively in the first week of October 2020, i.e., the week after the EUMETSAT Satellite Conference which will take place in Würzburg, Germany.

References

Schröder, M., Lockhoff, M., Shi, L., August, T., Bennartz, R., Borbas, E., Brogniez, H., Calbet, X., Crewell, S., Eikenberg, S., Fell, F., Forsythe, J., Gambacorta, A., Graw, K., Ho, S.-P., Höschen, H., Kinzel, J., Kursinski, E.R., Reale, A., Roman, J., Scott, N., Steinke, S., Sun, B., Trent, T., Walther, A., Willen, U., Yang, Q., 2017: GEWEX water vapor assessment (G-VAP). WCRP Report 16/2017; World Climate Research Programme (WCRP): Geneva, Switzerland; 216 pp. Available at https://www.wcrp-climate.org/resources/wcrp-publications.

Stubenrauch, C. J., Feofilov, A. G., Protopapadaki, E.-S., and Armante, R., 2017: Cloud climatologies from the InfraRed Sounders AIRS and IASI: Strengths and Applications. Atmosph. Chem. Phys., 17, 13625-13644, doi:10.5194/acp-17-13625-2017.

Appendix A List of recommendations.

The list given below is a copy from the WCRP report on G-VAP (Schröder et al., 2017). The list of recommendations has not yet been updated with results from the 8th workshop.

- CGMS, Space Agencies: Improve upon current satellite profiling capabilities with goals of providing high precision and long-term stability, with sufficient vertical resolution, complete, unbiased global sampling and independency of models.
- CGMS, Space Agencies: Dedicated validation archive for all water vapour sensors, also including ship-based RS.
- CGMS, WMO, GRUAN: Aim at the sustained generation and development of a stable, bias corrected multi-station radiosonde archive including reprocessing of historical data.
- CGMS, WMO: Achieve consistency among reference observing systems and sustain corresponding services.
- WMO, GCOS: Oppose and balance user, scientific and product requirements with focus on climate analysis.
- Space Agencies: Need for continental high-quality satellite data records.
- Space Agencies: Need for inter-calibrated radiance/brightness temperature data records and homogeneously reprocessed instantaneous satellite data records.
- Space Agencies, GEWEX: Provide water vapour transport product in order to analyse atmospheric dynamics and to evaluate the constancy of relative humidity.
- Space Agencies, PIs: Develop and provide PDF based climatology of satellite-based radio-occultation data.
- Space Agencies, PIs: Provide averaging kernels, a priori state vectors and associated error covariance matrices together with the release of profile products.
- Space Agencies, PIs, G-VAP: Estimate and provide uncertainty information and assess uncertainty estimates, also as function of total amounts and other dependent parameters.
- Space Agencies, PIs, G-VAP: Improve stability of long-term data records and (re)assess improvement in stability.
- Space Agencies, PIs: Provide information on input to data records such as precise start and stop dates and number of observations as function of time and input data type.
- GEWEX, SPARC, G-VAP, WAVAS: Joint WAVAS and G-VAP analysis of data records covering the upper troposphere and lower stratosphere using the same methodology.
- GRUAN: Include station over tropical land.
- GRUAN: Reassess the uncertainty estimates at large humidity values.
- GRUAN: Provide estimates of the correlation uncertainty between levels or guidance on how to compute it from information already available (ideally the covariance matrix of uncertainties is provided).
- GEWEX: Continuous support to G-VAP, beyond acceptance of first report.
- G-VAP, Space Agencies, PIs: Enhance quality analysis of profile data records over open ocean, in particular over high pressure areas/subsidence areas and stratus.
- G-VAP, Space Agencies, PIs: Analyse differences between observations under all-sky as well as cloudy and clear sky conditions.
- G-VAP: Reassess the TTD of humidity profile data by taking into account the vertical resolution and sensitivity and the characteristics of the PDF at certain levels/layers.
- G-VAP: Assess the joint effect of orbital drift, clear sky sampling/bias and the diurnal cycle of clouds on biases and how this might change with climate change.
- G-VAP supports the ITSC-20 recommendation on the reinstallation of the TPW ARM station.
- G-VAP supports the ITSC-20 initiative to collect SRF data in common format.
- G-VAP supports the concluding remarks from the Joint workshop on uncertainties at 183 GHz.

Appendix B Workshop Agenda

G-VAP – Workshop

13 - 14 June 2019

Agenda

Venue:

Agencia Estatal de Meteorología (AEMET)
AEMET Servicios Centrales, Calle Leonardo Prieto Castro, 8 Ciudad Universitaria, Madrid, Spain

Version 1.1
14 June 2019

Thursday, 13th June 2019

09:00 – 09:10	Welcome *Monistrol*
09:10 – 09:30	Overview on G-VAP *Schröder, Brogniez*
09:30 – 09:40	Aims of meeting *Schröder, Brogniez*
09:40 – 10:10	Water vapour in the climate system *Soden*
Discussion	
10:30 – 11:00	Coffee break
11:00 – 11:30	The GEWEX Integrated Product *Kummerow*
11:30 – 11:45	Towards user driven intercomparisons *Gutenstein/Schröder*
11:45 – 12:00	Using the G-VAP archive to evaluate CMIP5 *Trent (remote)*
Discussion	
12:30 – 14:00	Lunch break
14:00 – 15:30 (15 minutes each)	IASI retrieval and validation activities at EUMETSAT: Recent updates *August* AIRWAVEv2 TCWV from ATSR series: performance improvements *Castelli* Long-term analysis of global water vapour data from satellite UV/VIS observations *Borger* Total water vapour column from Sentinel-5P derived by the AMC-DOAS method *Küchler*
Discussion	
15:30 – 16:00	Coffee break
16:00 – 17:30 (15 minutes each)	EUMETSAT water vapour products from new generation satellites: development and validation strategy *Spezzi*

Validation of ROM SAF specific humidity uncertainty using GRUAN radiosondes
Nielsen

Evaluation of MUSICA IASI tropospheric water vapour profiles using theoretical error assessments and comparisons to GRUAN Vaisala RS92 measurements
Schneider

Comparison of GRUAN and satellite data using dedicated radiosondes
Reale/Sun (remote)

Discussion

17:30 Adjourn

Dinner (own expense)

Friday, 14th June 2019

09:00 – 09:30 Process Evaluation Study on Upper Tropospheric Clouds and convection
Stubenrauch

09:30 – 09:45 On the diurnal cycle of tropospheric water vapour
Brogniez

Discussion

10:30 – 11:00 Coffee break

11:00 – 11:15 Using multiple observations to quantify moisture biases in meteorological reanalyses and climate data record: A Hyperspectral Radiance Closure Approach
Huang

11:15 – 11:30 On the importance of consistency between observing systems
Calbet

11:30 – 11:45 A systematic assessment of water vapor products from satellite and reanalysis in the Arctic
Radovan

Discussion

12:30 – 14:00 Lunch break

14:00 – 14:30	The ESA Water_Vapour_cci project: activities, products and links to G-VAP *Schröder/Hegglin*
14:30 – 15:15	Special issue on water vapour *Schröder, Brogniez, all*
15:15 – 15:45	Wrap-up, next meeting
15:45 – 16:00	AoB
16:00 – 17:00	Open, informal discussions
17:00	Expected end

Appendix C Participants

Thomas August (EUMETSAT)
Ralf Bennartz (Vanderbilt University, University of Wisconsin)
Christian Borger (MPI-C)
Helene Brogniez (LATMOS)
Xavier Calbet (AEMET)
Elisa Castelli (CNR)
Xianglei Huang (University of Michigan)
Tobias Küchler (University of Bremen)
Christian Kummerow (CSU)
Jose Antonio Fernandez Monistrol (welcome address, AEMET)
Johannes Nielsen (DMI)
Simon Pinnock (ESA)
Ana Radovan (University of Cologne)
Anthony Reale (remote, NOAA)
Matthias Schneider (KIT)
Marc Schröder (DWD)
Brian Soden (University of Miami)
Loredana Spezzi (EUMETSAT)
Claudia Stubenrauch (LMD)
Bomin Sun (remote, NOAA)
Tim Trent (remote, University of Leicester, NCEO)