wacmos
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Deutscher Wetterdienst
Wetter und Klima aus einer Hand

DWD

Use of the PGE13 SEVIRI Physical Retrieval within the WACMOS Project

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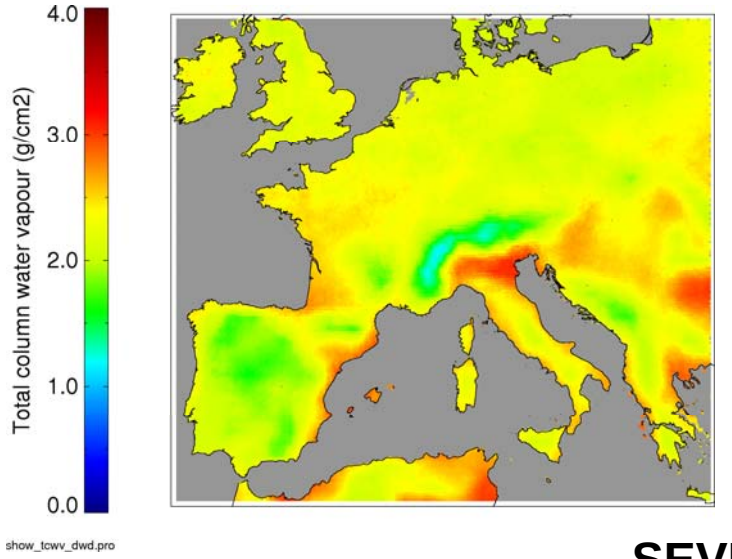
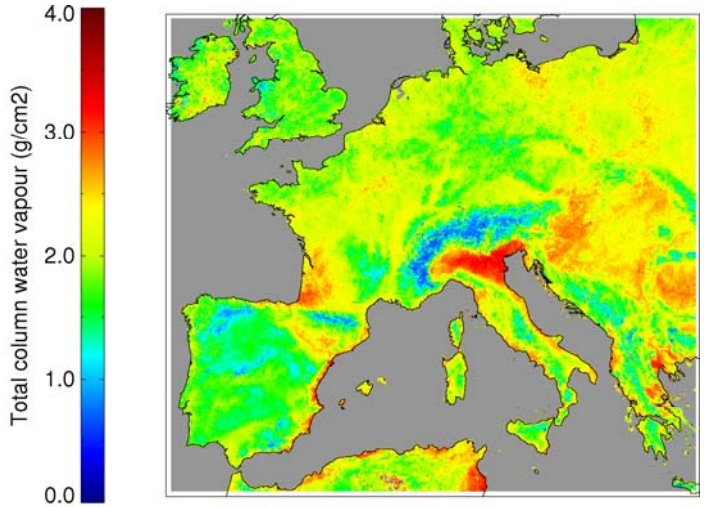
Monthly mean TCWV for August 2008

SEVIRI



MERIS



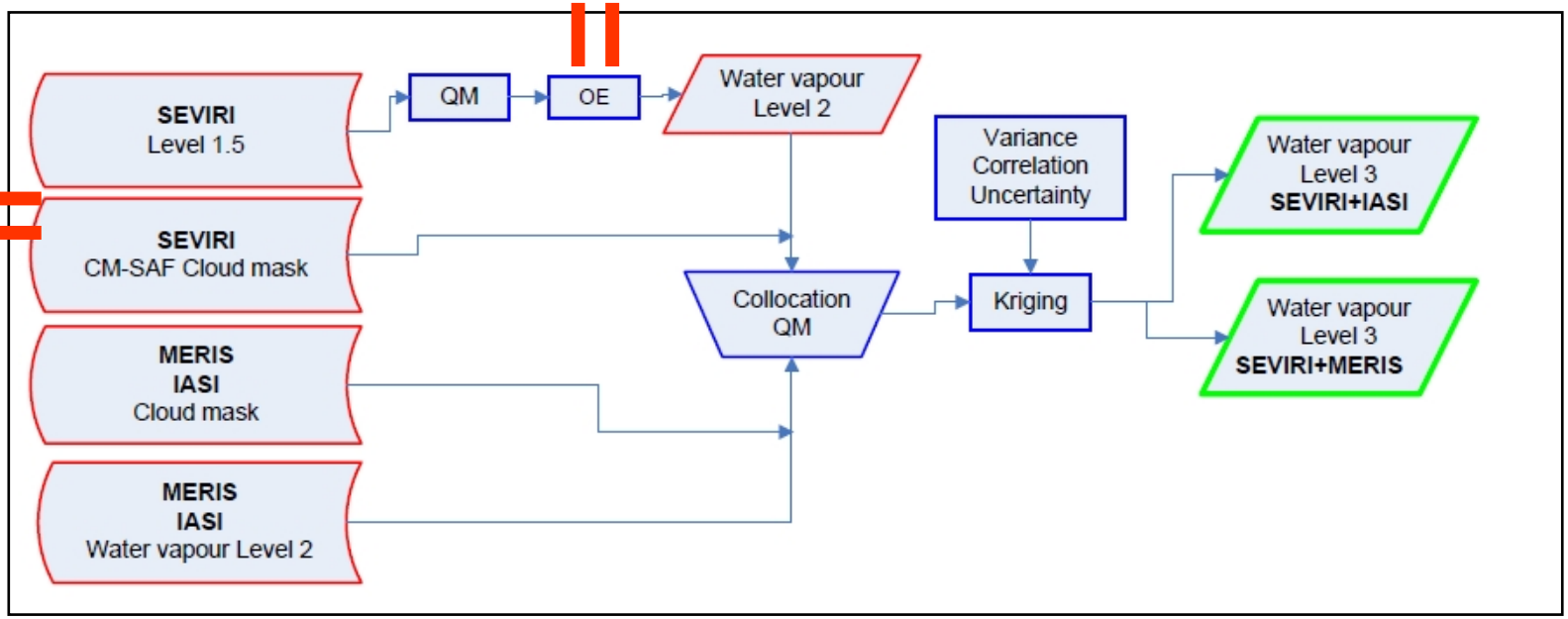
SEVIRI + MERIS

?

Flowchart for WACMOS Water Vapour Products

NWC SAF MSGv2009 Product Generator Element (PGE) 13 SEVIRI Physical Retrieval (SPhR)

NWC SAF MSG PGE01 CMa



Kriging of SEVIRI and MERIS TCWV

The integrated total water vapour column $x(p_0,t_S)$ at location p_0 and time t_S is estimated as a linear combination of SEVIRI observations, $x_S(p_i,t_S)$, made at n different locations (p_i) at time t_s and one MERIS observation $x_M(p_0,t_M)$ at location p_0, obtained at time t_M.

$$x(p_0,t_S) = \sum_{i=1}^{n} \lambda_i \left[x_S(p_i,t_S) + \Delta x_S(p_i,t_S) \right] + \nu \left[x_M(p_0,t_M) + \Delta x_M(p_0,t_M) \right]$$

Δx_S and Δx_M denote the SEVIRI and MERIS retrieval error, respectively

The SEVIRI water vapour profiles and the retrieval errors are needed for the kriging of SEVIRI + MERIS and SEVIRI + IASI, respectively.

NWC SAF MSG PGE 13 SEVIRI Physical Retrieval:

PGE 13 SPhR		
	Step 1:	Non-linear regression to build a first-guess
	Step 2:	Non-linear iterative physical retrieval

Minimize the cost function (*Rodgers*, 2000):

$$J(X) = \left[Y^m - F(X)\right]^T E^{-1} \left[Y^m - F(X)\right] + \left[X - X^b\right]^T \gamma B^{-1} \left[X - X^b\right]$$

to obtain the **atm. temperature and moisture profiles** that best reproduce the SEVIRI observations.

The **retrieval error S** is determined by $S = \left(F^T \cdot E^{-1} \cdot F + B^{-1}\right)^{-1}$

The final, **retrieved profiles** (T and q at 43 levels) are stored in binary files

The **errors of the retrieved profiles** (clear-sky pixels) are stored in binary files

Current SAFNWC/MSG Setup Used

Software:

- July 2009: Distribution of the PGE13 prototype version for beta users by the NWC SAF team.
- March 2010: Update to write the errors of the temperature and moisture profiles provided by Jun Li and Miguel A. Martinez. Output at clear sky pixels only to reduce disk space needed.

Hardware:

- Currently the NWC SAF MSG v2009 software is running on a Linux work station having 6 cores and 12 GB RAM.
- At a later stage, the NWC SAF MSG v2009 software package installed at the European Centre for Medium-Range Weather Forecasts (ECMWF) might be used. This will increase computing power significantly and is a matter of particular interest for re-processing the SEVIRI physical retrieval including the error module.

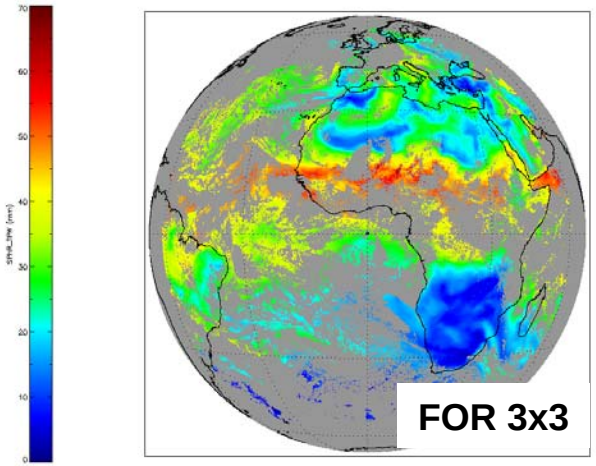
Current SAFNWC/MSG Setup used

- Region: almost whole MSG disc (~ 3600 x 3600 pixels)
- Time: One year (three-hourly)
- Field-of-Regard (FOR): 3x3 FOV
- BT_RMS Threshold = 0.001
- MAX_RESIDUAL = 0.001

The execution of the NWC SAF SEVIRI physical retrieval is time consuming with the current setup.

Total column water vapour (mm)

01.08.2008 11:45



Computing Time per slot:
~ 30 min without error
~ 120 min with error

Three iterations for every pixel and written of very huge datasets

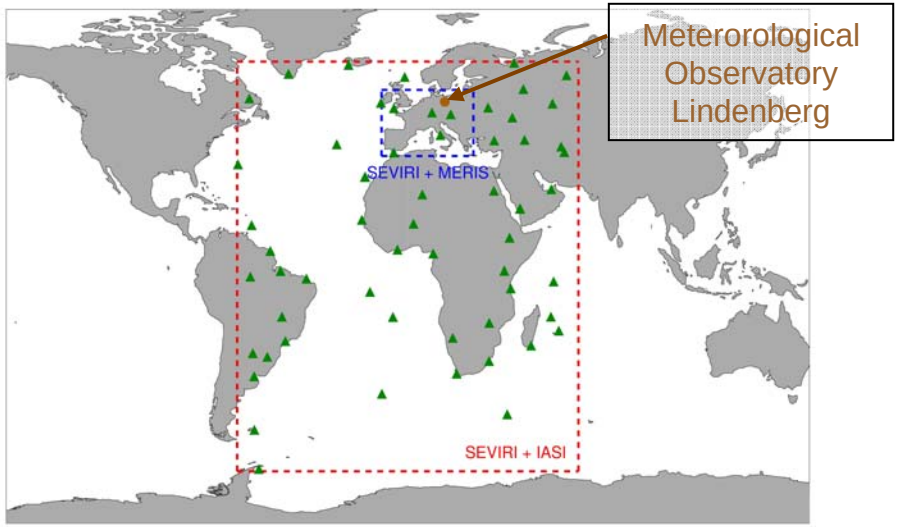
First Verification Results

Both WACMOS water vapour products will be validated with radiosonde data from the GCOS Upper Air Network (GUAN).

Done so far:

Validation of the newly produced NWC-SAF PGE13 level 2 water vapour products (instantaneous, 3-hourly, August 2008) against GUAN radiosonde observations.

GUAN stations used for the validation



GUAN stations	
• global	173
• SEVIRI + IASI	59
• SEVIRI + MERIS	6

Bias and RMS between GUAN radiosondes and SEVIRI

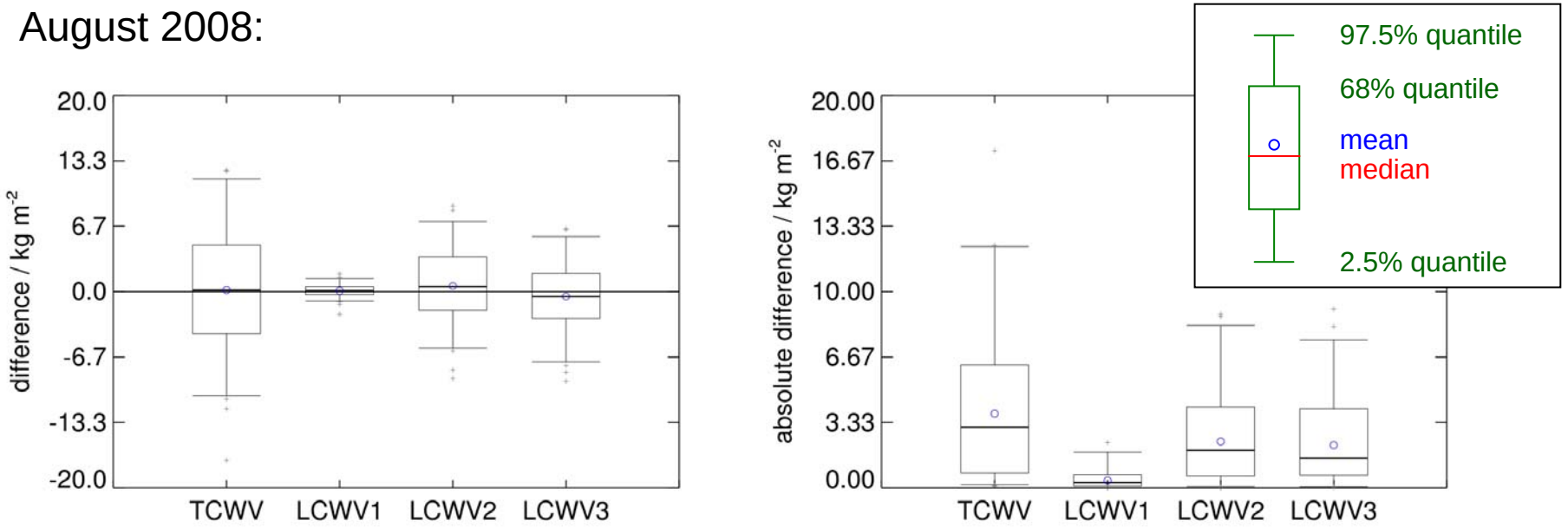
Parameter		TCWV (200 – surface)	LCWV1 (200 – 500)	LCWV2 (500-850)	LCWV3 (850-surface)
RMS / kg m^{-2}		4.9 (4.0)	0.51 (0.8)	3.0 (2.0)	2.8 (3.0)
bias / kg m^{-2}		0.17 (1.0)	0.10 (0.2)	0.58 (0.6)	-0.49 (0.8)
mean / kg m^{-2}	GUAN	24.8	0.85	10.4	13.5
σ / kg m^{-2}	GUAN	9.7	0.53	5.2	5.2
mean / kg m^{-2}	SEVIRI	24.9	0.95	10.9	13.0
σ / kg m^{-2}	SEVIRI	9.2	0.43	4.6	4.9

- ➔ Except for the LCWV2 RMS, all values are smaller than the values given in WACMOS Technical Specifications (in red).
- ➔ Because the bias of the lowest layer is with the WACMOS specifications, the preliminary conclusion is to consider all three vertical layers from SEVIRI for the generation of the WACMOS products.

The results are promising because it can be assumed that the quality of the SEVIRI product is the lower limit of the final WACMOS product quality.

Preliminary Verification Results

Box-Whisker Plots of the difference and absolute difference between collocated instantaneous GUAN radiosondes and SEVIRI water vapour products for August 2008:



Both plots reveal a large scatter of differences and absolute difference. Since no averaging was applied, extreme values are not smoothed out.