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Specification and Evaluation of Present Weather Sensors

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Specification and Evaluation of Present Weather Sensors

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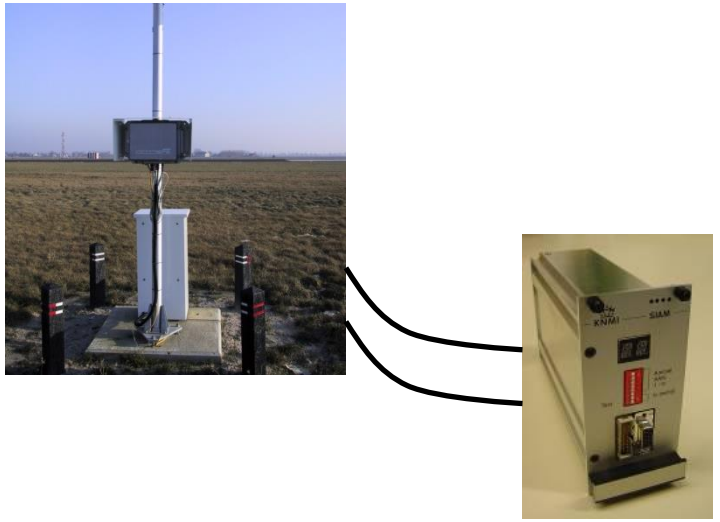
Introduction

- Replacement for Vaisala FD12P (1997-current)
- Out of production (mid 2010), support stops (end 2019)
- Visibility (MOR), precipitation type (PW), but also precipitation intensity and – duration
- Background luminance (BL) for determination VIS and RVR for aviation using LM21
- Part of AUTO SYNOP and AUTO METAR system
- Field test various PW sensors 2016-2017
  - Results Feb. 2016 – July 2016 during TECO-2016 (Wauben et al.)
  - Results Aug. 2016 – Feb. 2017 update prior to Tender (Knoop et al.)

EU Tender - Procedure

- Request for Proposals (ITT) issued March 2017
- Acquisition of PWSs including costs of 3rd line maintenance
- Best price-quality ratio using Total Cost of Ownership over 10 years period
- Mandatory requirements (Y/N) and Desirable features (score 0-10)
- Substantiation required, incl. in evaluation/score
- Mandatory: average Desirable features ≥ 7
- One PWS or separate VIS and PRECIP sensors and BL

Category	Weight
Quality	35
Maintainability	30
Implementation	10
Total costs	25
Overall Score	**100**



EU Tender - Requirements

- MOR and BL must meet WMO / ICAO requirements
  ...substantiation of the measurement uncertainty ... GUM
  & range at least 10 m – 50 km
- PW must have been verified in field evaluation
  & reports at least DZ, RA, SN, IP and GR/GS
- PRECIP detection
- Offered solution will be examined on the largest range, best quality of the measurements and level of substantiation
- Mutual agreement between 2 units of offered PWS shall be within WMO and ICAO requirements for entire MOR range
- Flying insects and cobwebs / spider silk

EU Tender - Requirements

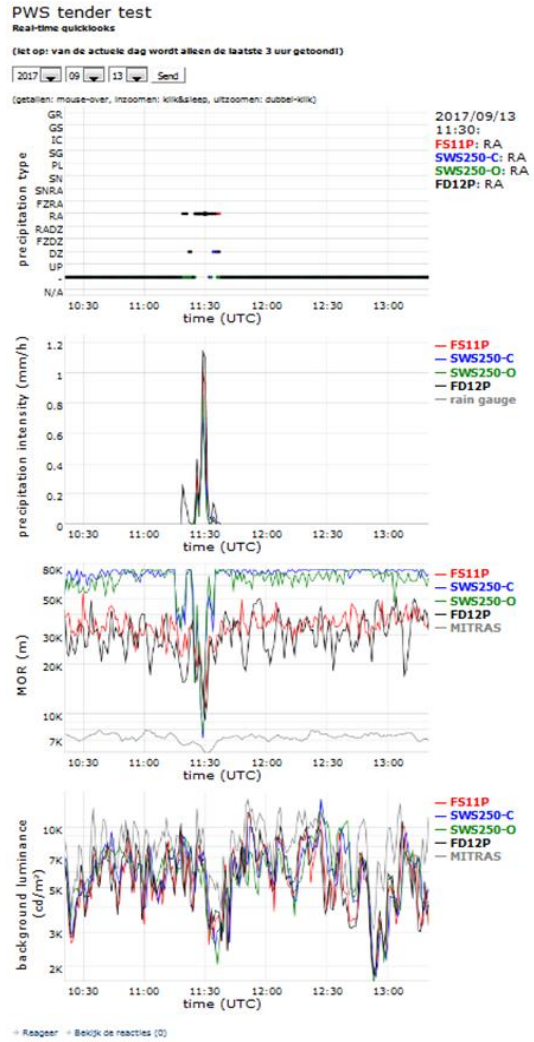
- Calibrators for MOR, BL, quantities from which PW and intensity is derived
- Requirements of PWS regarding installation site and vicinity (least restrictions)
- Raw data, reprocessing, quality information
- Network interface, service switch
- Expected new firmware releases (potential)
- Size, weight and color

Evaluation - Procedure

- 3 PWS meeting all Mandatories with highest scores
- Field evaluation of nearly 1 year (Aug 2017 – May 2018) at De Bilt + ??
- 2 units of each PWS and calibrators/mounting
- Support by Tenderer and 2 moments of interaction
- Verification after installation (setup, configuration, data)
- Verification half way field test (results without interpretation)
- Changes allowed, but may invalidate obtained results
- Description of tests and evaluation & previous results

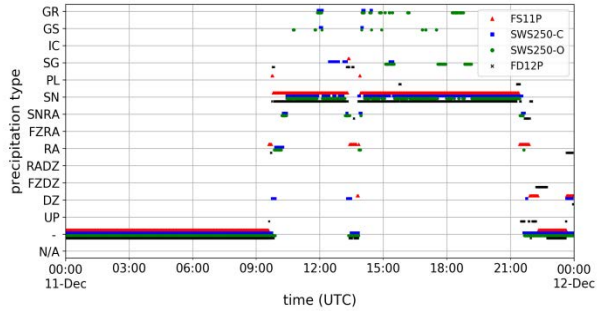
Evaluation - Procedure

- 1-minute data of PWS NRT for observers/forecasters; 10-minute data for validation staff
- MOR vs transmissometer (REF, 10’ boxplot) and FD12P
- BL vs LM21, PW vs FD12P
- Intensity vs rain gauge (REF, accumulations) and FD12P
- Scatter/density plots, statistics differences, frequency distributions, classes, … (see TECO-2016)
- Evaluation by several user groups (observers, forecasters, technicians, validation, R&D) and stakeholders (weather, climate, aviation)



Evaluation - Results PW

- All PWSs OK for detection, but default settings of one PWS adjusted
- No PWSs reported unidentified precipitation (UP), FD12P does
- All PWSs reported more rain (RA) instead of drizzle (DZ) compared to FD12P
- One PWS reported less solid precipitation, the other much more than FD12P
- No PWS reported faulty snow grain (SG) during dense fog, FD12P does
- One PWS reported less ice pellets (IP) than FD12P, and more snow grain (SG). The other PWS gave reversed results
- One PWS reported no hail (GR/GS), the other reported hail too often
- No PWS including FD12P reported hail during one of the 3 verified events
- Mutual agreement between 2 units was generally good (much better than agreement with FD12P), but deviations occurred for all PWSs

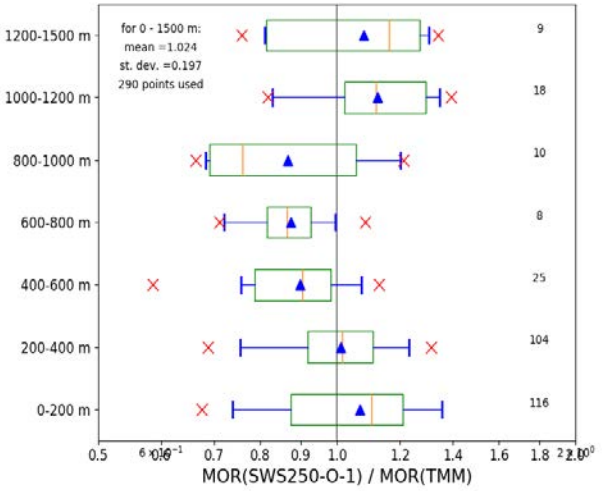


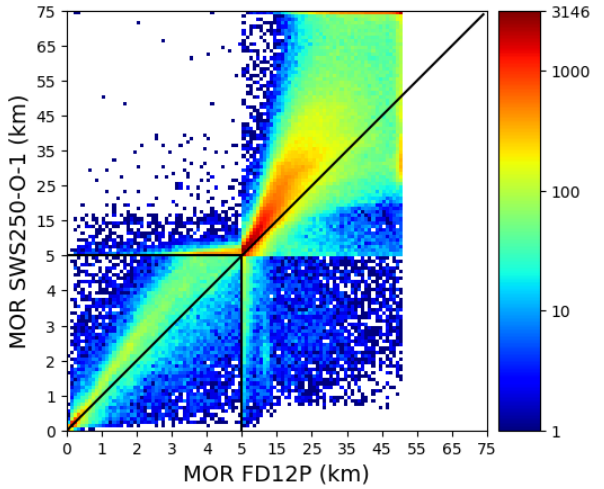
SWS250-O-1 / FD12P

NWS	C	P	L	ZL	LR	R	ZR	LRS	S	IP	SG	IC	SP	A	
C	313959	1644	9415	46	0	5952	2	71	104	10	102	0	0	0	331305
P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L	421	90	4426	7	0	2174	0	3	13	0	34	0	0	0	7168
ZL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	1600	223	3207	7	0	15279	0	569	104	28	33	0	0	0	21050
ZR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LRS	8	42	467	0	0	1651	1	161	132	42	40	0	0	0	2544
S	103	50	17	0	0	75	0	42	1601	21	118	0	0	0	2027
IP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SG	2	61	97	1	0	983	2	133	135	27	0	0	0	0	1441
IC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SP	1	0	2	0	0	30	0	1	55	0	0	0	0	0	89
A	0	0	0	0	0	19	0	8	128	0	0	0	0	0	155
	316094	2110	17631	61	0	26163	5	988	2272	128	327	0	0	0	365779

Evaluation - Results MOR

- All PWSs showed similar agreement with the transmissometer as FD12P
- All PWSs showed good agreement with FD12P
- All PWSs showed differences in linearity over 0-50 km range vs FD12P
- Mutual agreement between 2 units was generally better than vs FD12P
- All PWSs showed differences in linearity over 0-50 km between 2 units
- One PWS showed large scatter over the 0-50 km range compared to the other unit
- All PWSs applied filters to avoid visibility reduction due to flying insects. Suitability of the filter could, however, only be tested for mild events
- The MOR of each PWS was affected by spider silk. One PWS seemed more sensitive to spider silk





Conclusions

- June 2018: winner Biral SWS250 and ALS2 offered by Observator Instruments, details contract being finished
- Lessons learned requirements (e.g. identical offers)
- Lessons learned evaluation (resolved issues like undocumented BL calibration factors)

Challenges

- Performance near coast / on North Sea
- Solid precipitation (faulty GR, GS and SG)
- MOR affected by flying insects and spider silk

Outlook

- Verification phase
- Implementation project