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MUT AC - Contribution to the EPN repro2 and first conclusions

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Participation in the EUREF activities

- MUT AC has been operating since 2009 and currently is processing data from 117 stations.
- Made first non-official „full” reprocessing of EPN
- Participated in the repro1 with Bernese solution and Gamit solution (test).
- Participated in the repro2 with only Gamit solutions.

- Responsible for coordinates combination (EPN ACC).

/ Karolina's talk /

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Contribution to EPN repro2

- Two full EPN solutions as a starting point

Software:	GAMIT 10.50
Period:	01.01.1996 - 31.12.2014 (19 years)
Observations:	GPS, 30 sec.
Elevation mask:	5°
Orbits:	CODE repro 2013 and routine for 2014
Antennas:	type mean (igs08_1840.atx) type mean (igs08_1840.atx) + ind. (EPN)
Troposphere:	VMF1, ZTD(1h) + grad (24h)
Ionosphere:	„iono-free" + HOI (CODE VTEC + IGRF11)
EOP:	IERS2010
Tides:	IERS2010
Loadings:	FES2004, atmospheric loadings (tidal + non-tidal)
Reference frame:	IGb08

Two aproaches for receiver antenna modelling

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Contribution to EPN repro2

- Two full EPN solutions as a starting point

MU0
(only type mean)

MU2
(type mean + individual)

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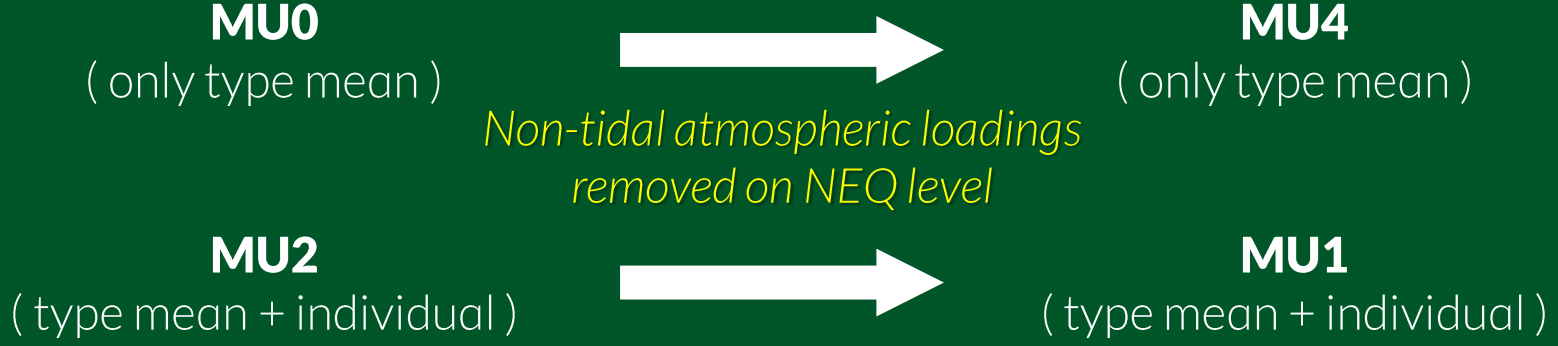
Contribution to EPN repro2

- Two full EPN solutions as a starting point



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Contribution to EPN repro2

- Two full EPN solutions as a starting point

MU0
(only type mean)
(ATML)

MU2
(type mean + individual)
(ATML)

MU4
(only type mean)
(no ATML)

MU1
(type mean + individual)
(no ATML)

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Quality of the solutions

- Total RMS after time series cleaning …

… discontinuities, outliers, postseismic, annual and semianual signals removed

	(only type mean)		(type mean + indiv.)	
	MU4	**MU0**	**MU1**	**MU2**
North	1.51 mm	1.36 mm	1.50 mm	1.37 mm
East	1.45 mm	1.34 mm	1.45 mm	1.32 mm
Up	4.32 mm	3.92 mm	4.37 mm	3.87 mm

- Nice results, but still many outliers detected !

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Contribution to official EUR combination

- Total RMS after time series cleaning ...

... discontinuities, outliers, postseismic, annual and semianual signals removed

	MU4	MU0	MU1	MU2
North	1.51 mm	1.36 mm	1.50 mm	1.37 mm
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- Nice results, but too many outliers detected !

Will be used in combination by EPN ACC

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1. ZPD time series from repro1 and repro2

- Total RMS after time series cleaning ...

... discontinuities, outliers, postseismic, annual and semianual signals removed

	MU4	MU0	MU1	MU2
North	1.51 mm	1.36 mm	1.50 mm	1.37 mm
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- Nice results, but too many outliers detected !

Long term analysis of ZPD for climate monitoring

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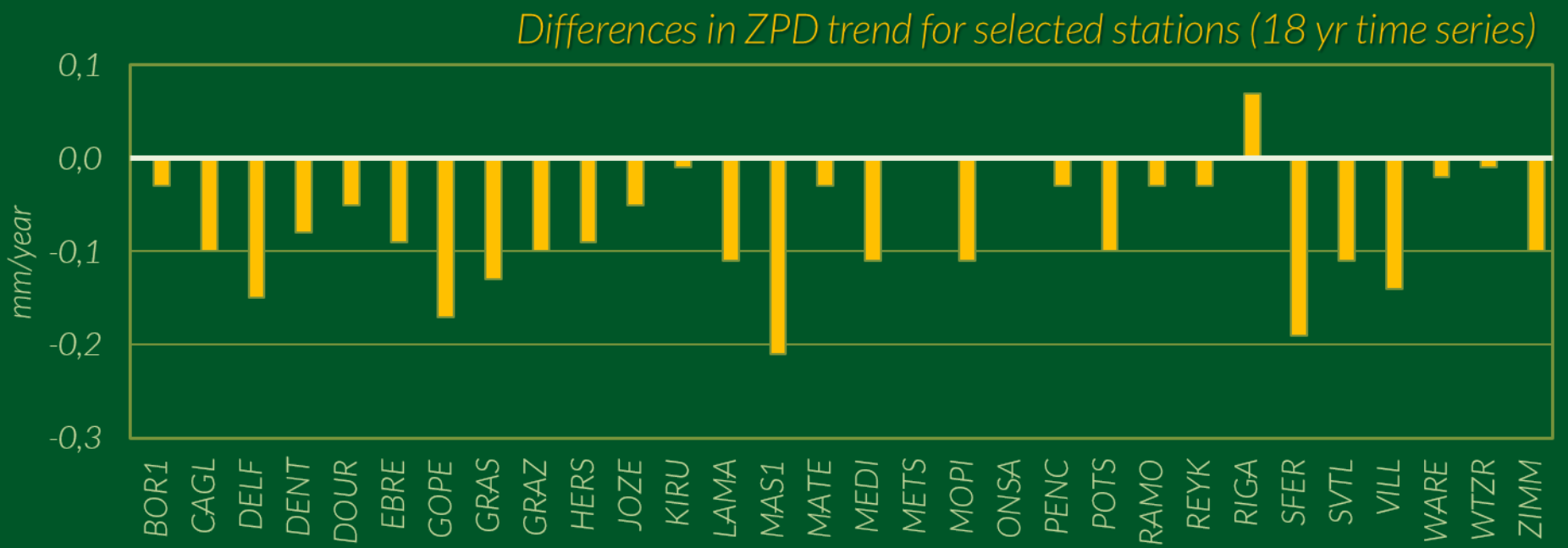
1. ZPD time series from repro1 and repro2

- Good agreement of the annual signal in ZPD
- Notable systematic (?) differences in trend



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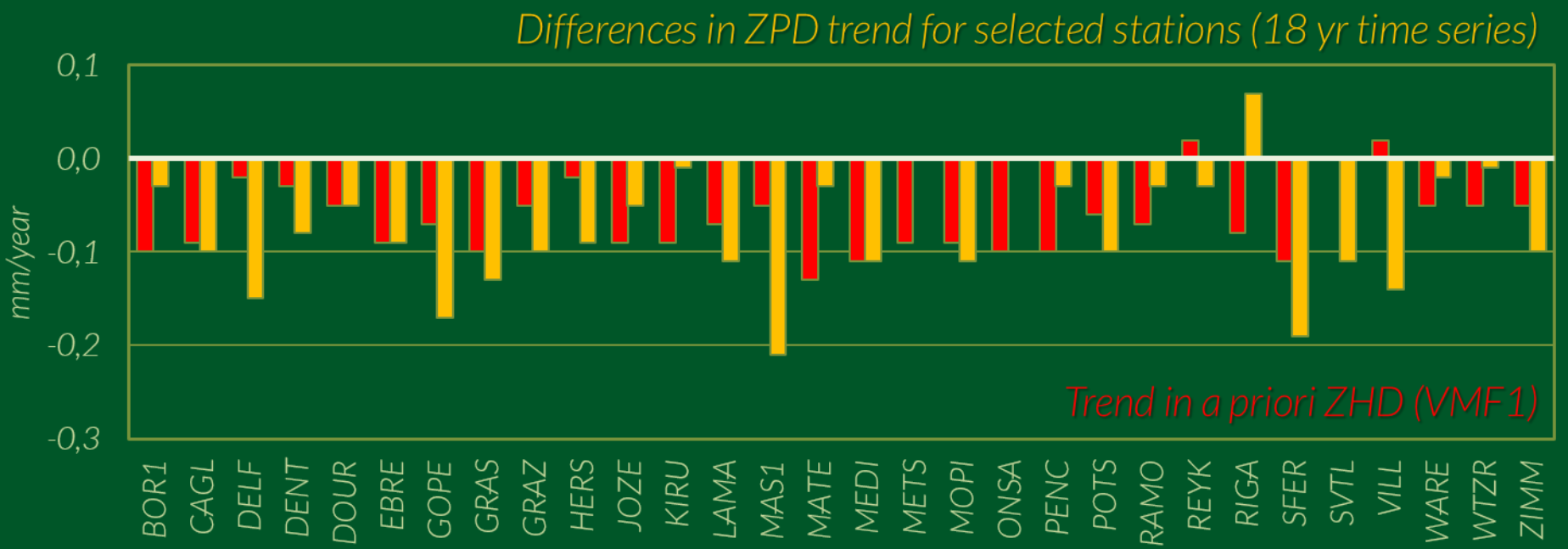

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2. Impact of atmospheric loadings on EPN

- Total RMS after time series cleaning ...

... discontinuities, outliers, postseismic, annual and semianual signals removed

	MU4	MU0	MU1	MU2
North	1.51 mm	1.36 mm	1.50 mm	1.37 mm
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Atmospheric pressure loadings

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2. Impact of atmospheric loadings on EPN

Atmospheric pressure loadings from NCEP (*Tregoning and van Dam, 2005*) and filtered to remove S1, S2 tides (*Tregoning and Watson, 2009*) were applied at observation level together with atmospheric tides (*Ponte and Ray, 2002*).

Non-tidal atmospheric loadings (ATML)

National Center for Environmental Prediction

+

Sub-daily thermal tides (ATL)

European Center for Medium-Range Weather Forecasts

MU2 – ATML and ATL applied,

MU1 – ATML removed, ATL remained.

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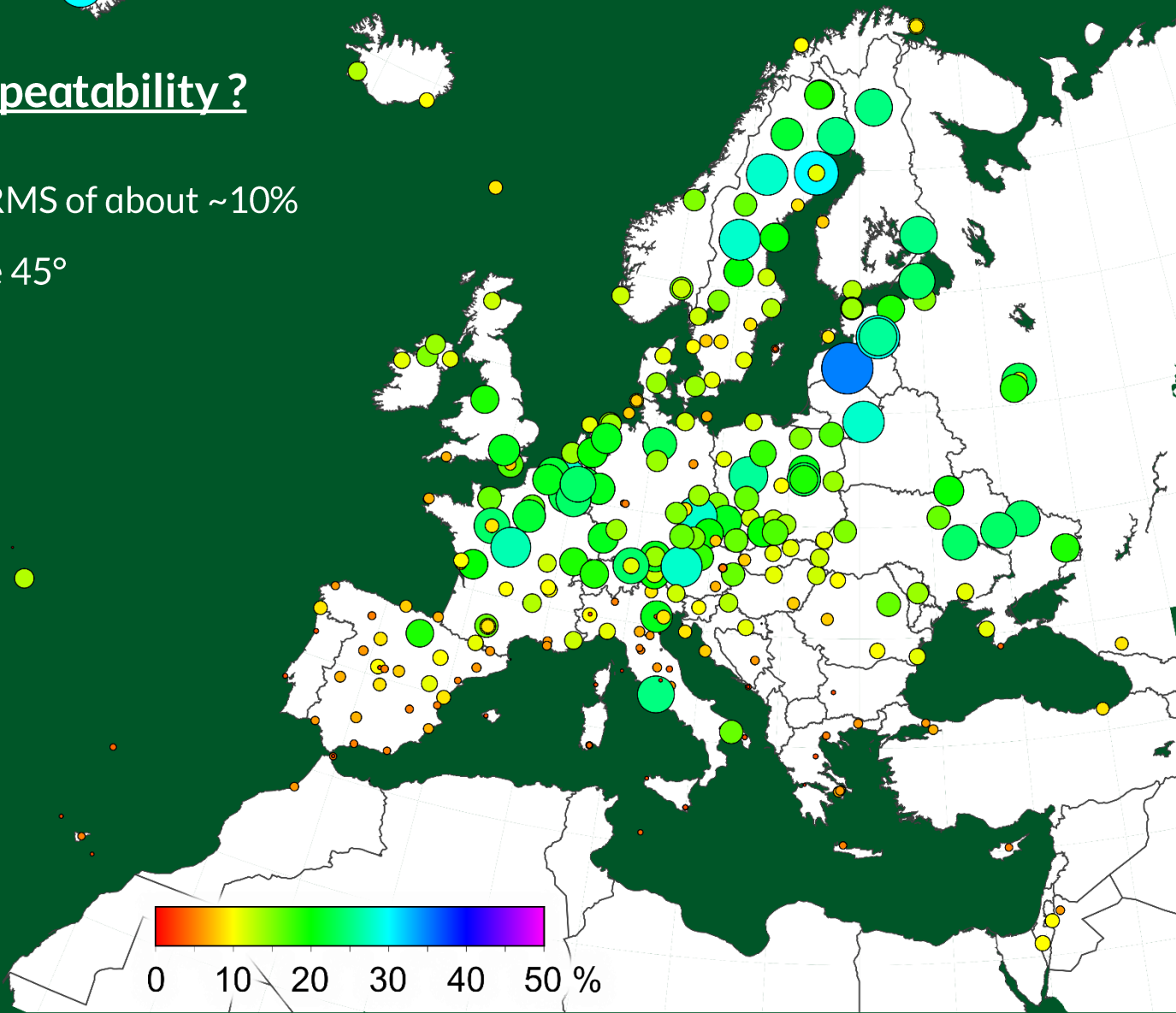
2. Impact of atmospheric loadings on EPN

Impact on position repeatability ?

- Total improvement of RMS of about ~10%
- Stations above latitude 45°
- Mostly Up component



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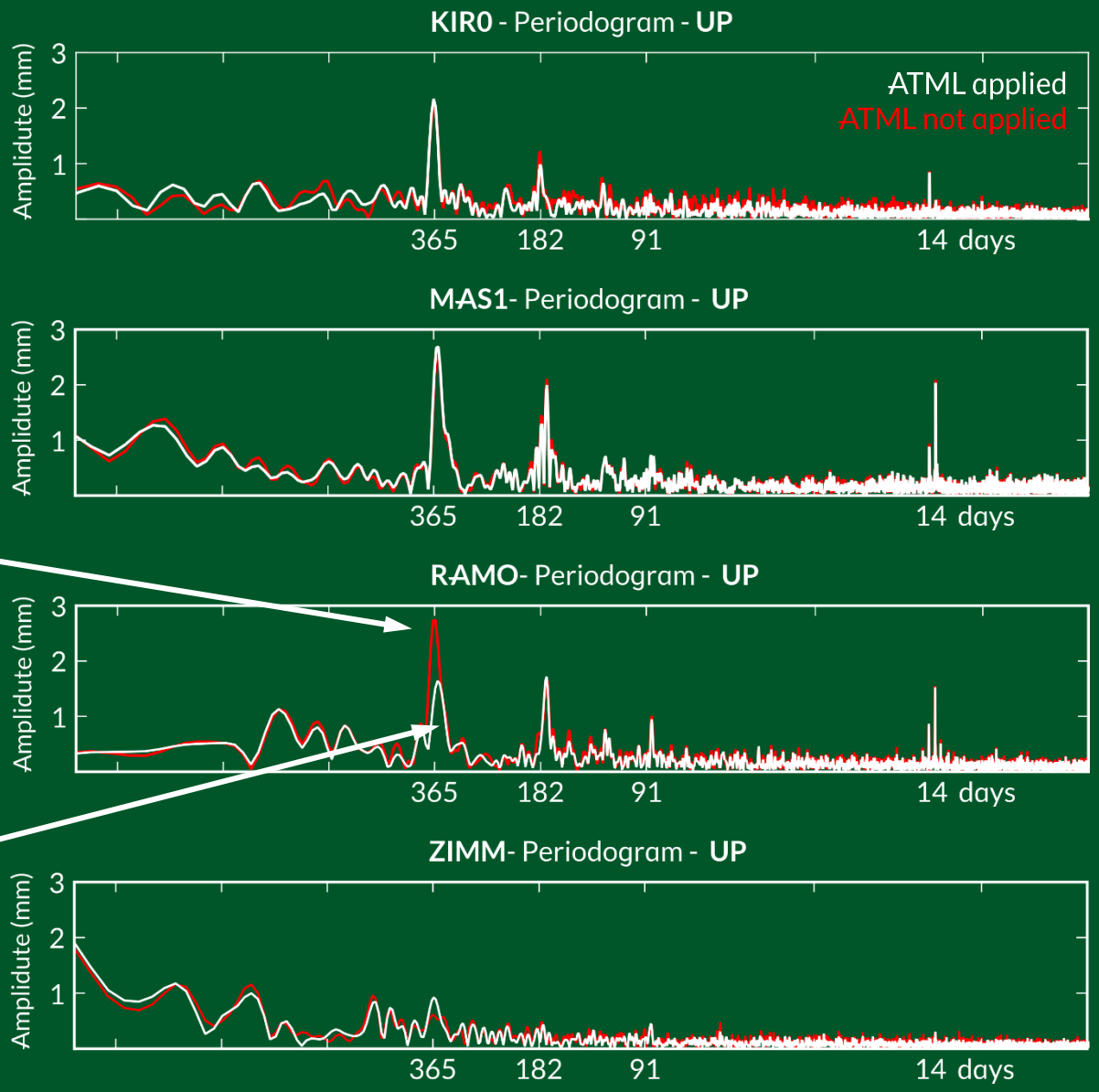
2. Impact of atmospheric loadings on EPN

Impact on annual signal ?

- Just for selected stations

reduction of the annual tropical signal

remained only 1st draconitic ?



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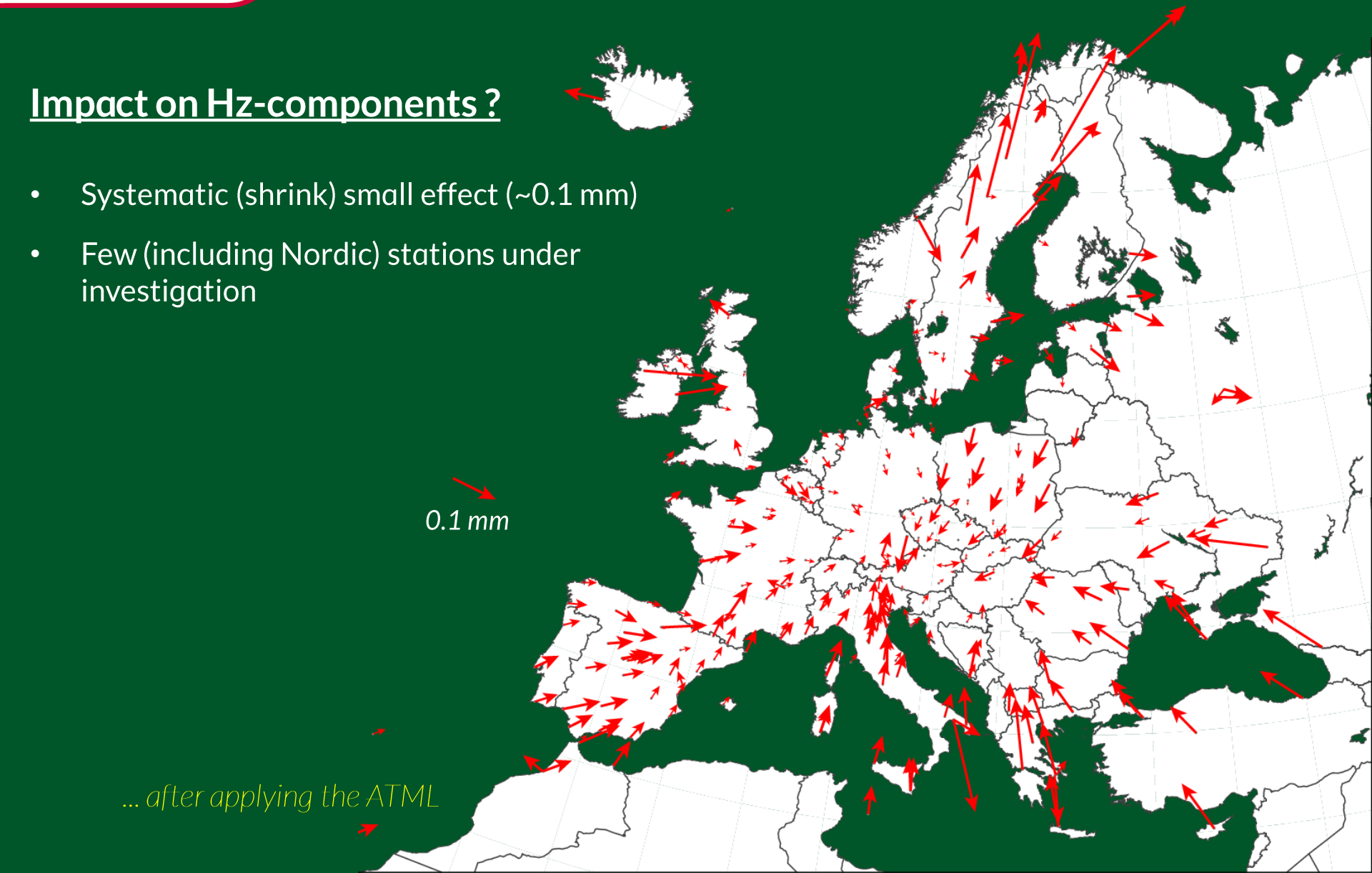
2. Impact of atmospheric loadings on EPN

Impact on Hz-components ?

- Systematic (shrink) small effect (~0.1 mm)
- Few (including Nordic) stations under investigation



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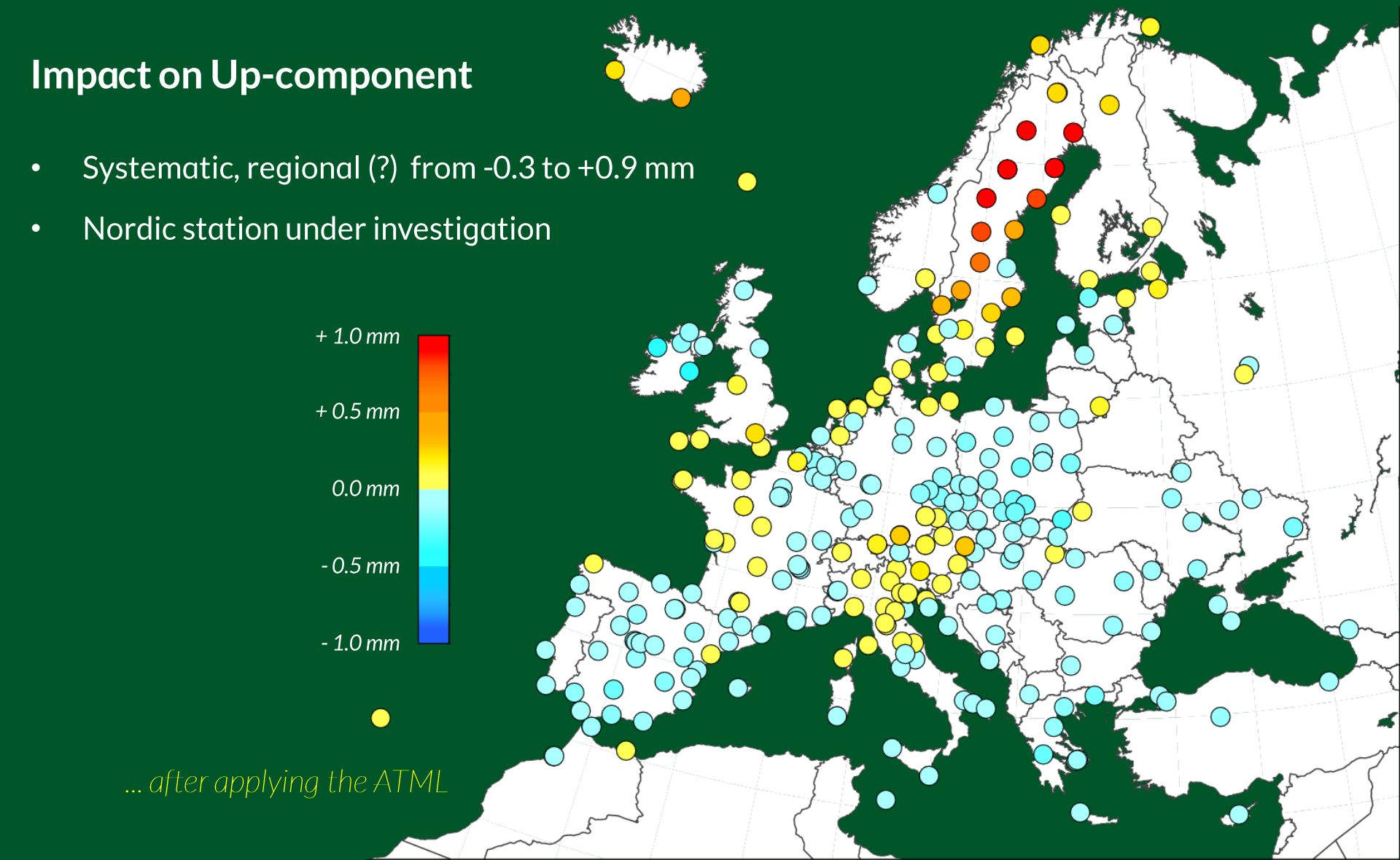
2. Impact of atmospheric loadings on EPN

Impact on Up-component

- Systematic, regional (?) from -0.3 to +0.9 mm
- Nordic station under investigation



... after applying the ATML

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3. Impact of receiver antenna modelling

- Total RMS after time series cleaning ...

... discontinuities, outliers, postseismic, annual and semianual signals removed

	MU4	MU0	MU1	MU2
North	1.51 mm	1.36 mm	1.50 mm	1.37 mm
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- Nice results, but too many outliers detected !

Receiver antenna PCC modeling

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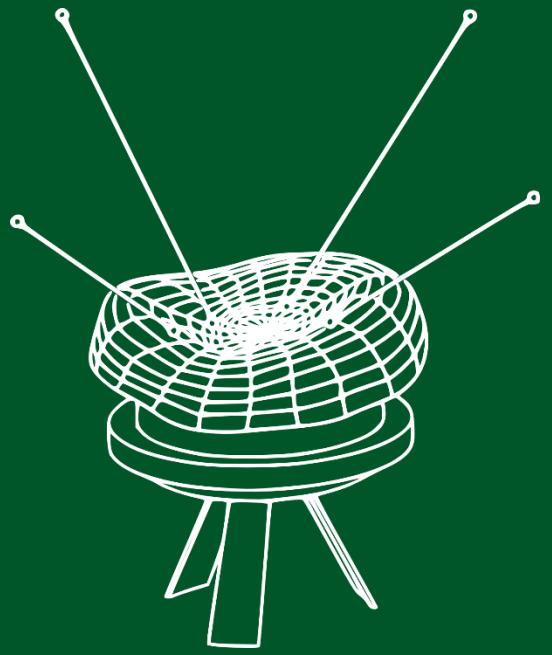
3. Impact of receiver antenna modelling

First individual calibrated antenna appeared in 2002 at HOBU00DEU. By the end of 2014 number of such antennas reached 110. Two „quasi" identical solutions were prepared. First solution based only on type mean IGS model (igs08_1780.atx and for 2014 igs08_1840.atx), second one also on EPN individual calibrations (epn08_1840.atx).

MU4 – IGS type mean only

MU1 – IGS type mean + EPN individual



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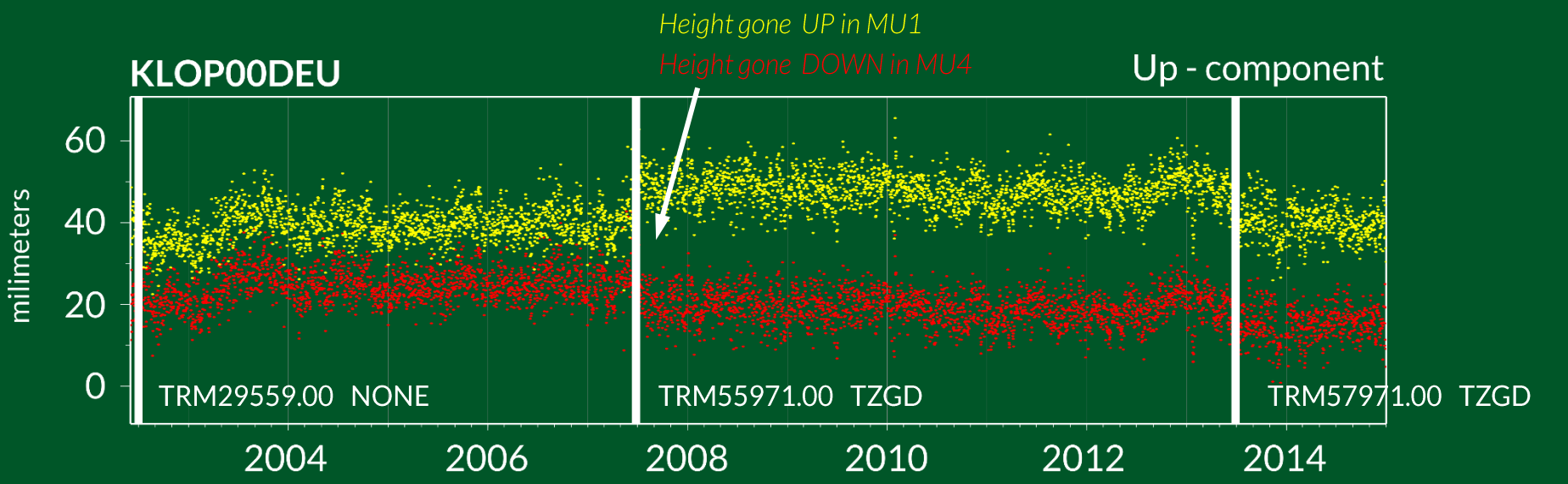
3. Impact of receiver antenna modelling



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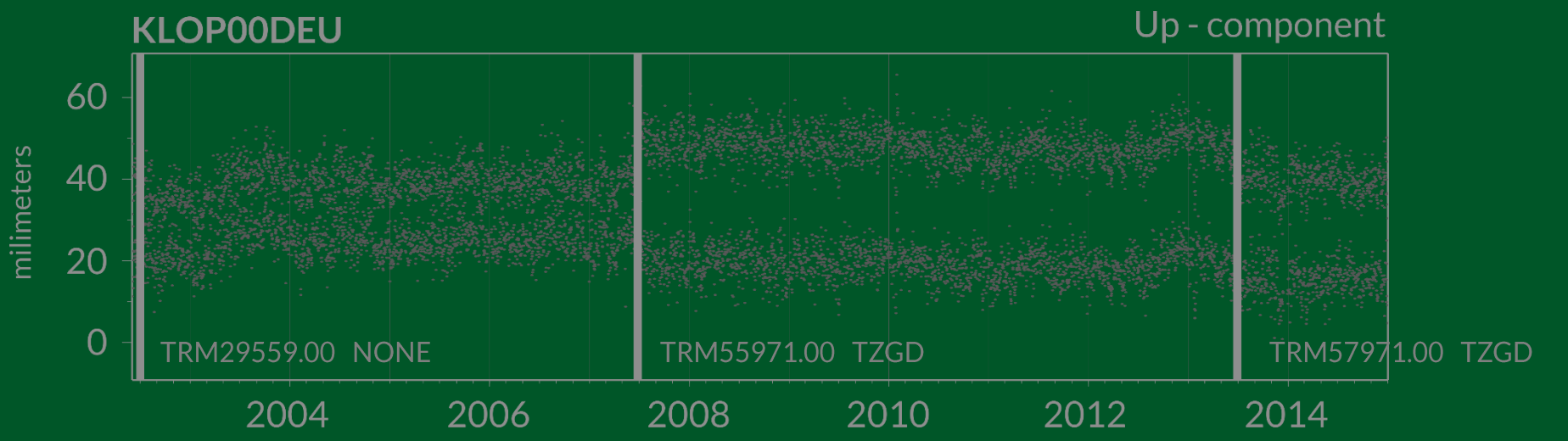
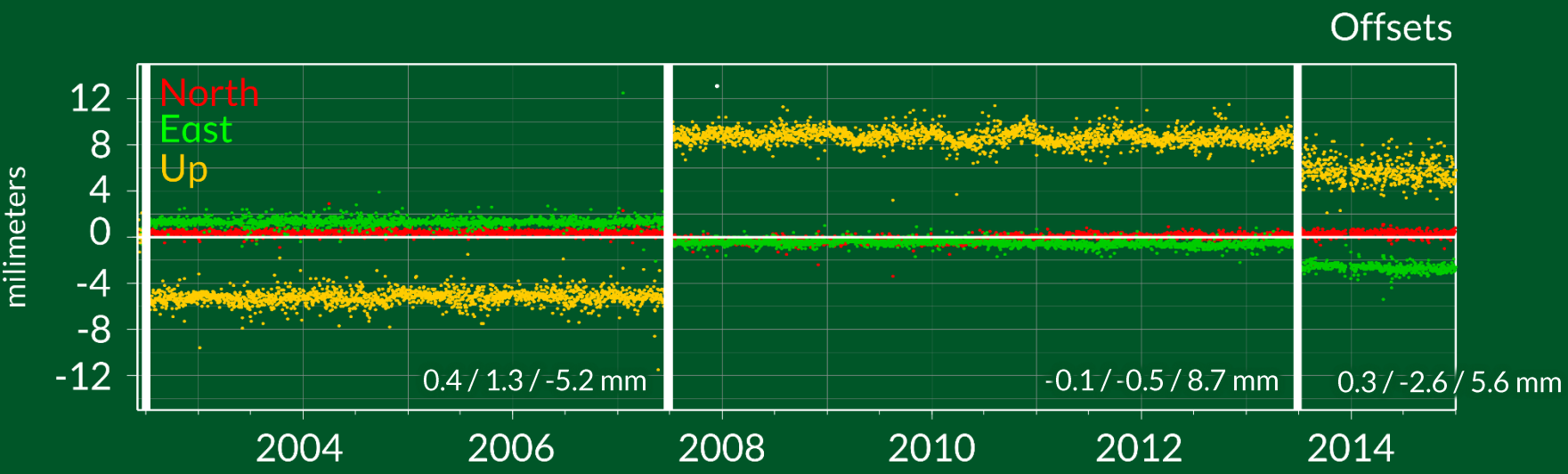
3. Impact of receiver antenna modelling





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3. Impact of receiver antenna modelling

STATION	PERIOD OF TIME [YYYY-MM-DD]:[YYYY-MM-DD]	N-offset [milimeters]	E-offset [milimeters]	U-offset [milimeters]
ALAC	2010-09-15 : 2014-12-31	-2.7 +/- 0.30	1.5 +/- 0.26	2.1 +/- 0.57
ALBA	2010-09-14 : 2014-12-31	2.7 +/- 0.28	-2.3 +/- 0.29	-0.1 +/- 0.53
ANKR	2008-05-06 : 2014-12-31	0.4 +/- 0.25	0.8 +/- 0.27	2.0 +/- 0.54
ARJ6	2011-07-29 : 2014-12-31	-4.1 +/- 0.45	-3.7 +/- 0.56	0.5 +/- 0.74
BADH	2005-01-18 : 2012-09-18	0.3 +/- 0.27	-0.2 +/- 0.28	0.7 +/- 0.62
BADH	2012-09-18 : 2014-12-31	0.5 +/- 0.28	-1.3 +/- 0.32	12.0 +/- 0.86
BORJ	2005-06-09 : 2010-09-01	1.1 +/- 0.18	-0.4 +/- 0.20	2.6 +/- 0.47
BORJ	2010-09-01 : 2014-12-31	0.3 +/- 0.22	0.2 +/- 0.28	-1.9 +/- 0.47
BORK	2003-06-02 : 2003-07-01	-0.1 +/- 0.29	0.1 +/- 0.64	0.0 +/- 0.69
BORK	2003-07-01 : 2014-12-31	0.2 +/- 0.20	2.4 +/- 0.29	2.0 +/- 0.59
BPDL	2007-12-04 : 2014-12-31	-0.5 +/- 0.27	-1.9 +/- 0.30	-5.4 +/- 0.55
BRUX	2011-03-07 : 2014-12-31	-0.2 +/- 0.19	-1.3 +/- 0.22	1.1 +/- 0.46
BUCU	2008-10-31 : 2014-12-31	1.7 +/- 0.27	-1.3 +/- 0.22	-0.8 +/- 0.49
BUTE	2007-07-31 : 2013-11-04	-1.2 +/- 0.25	-0.1 +/- 0.22	-8.3 +/- 0.58
BUTE	2013-11-04 : 2014-12-31	0.1 +/- 0.25	1.8 +/- 0.31	-1.4 +/- 0.56
BYDG	2007-12-04 : 2014-09-09	-0.2 +/- 0.26	-1.0 +/- 0.25	-1.8 +/- 0.52
BYDG	2014-09-09 : 2014-12-31	-0.2 +/- 0.17	-0.1 +/- 0.27	2.4 +/- 0.50
BZRG	2012-02-16 : 2014-12-31	1.4 +/- 0.28	1.9 +/- 0.28	[illegible]
CANT	2011-10-20 : 2014-12-31	-2.3 +/- 0.27	1.1 +/- 0.32	[illegible]
CFRM	2012-04-25 : 2014-12-31	0.1 +/- 0.25	2.4 +/- [illegible]	[illegible] 0.76
DRES	2003-01-22 : 2007-05-23	-2.6 +/- 0.21	3.4 +/- [illegible]	[illegible] +/- 0.50
DRES	2007-05-23 : 2010-09-22	0.1 +/- 0.17	-0.3 +/- 0.[illegible]	[illegible].4 +/- 0.40
DRES	2010-09-22 : 2014-12-31	0.1 +/- 0.25	1.8 +/- 0.3[illegible]	1.1 +/- 0.48

110 antennas
75 stations

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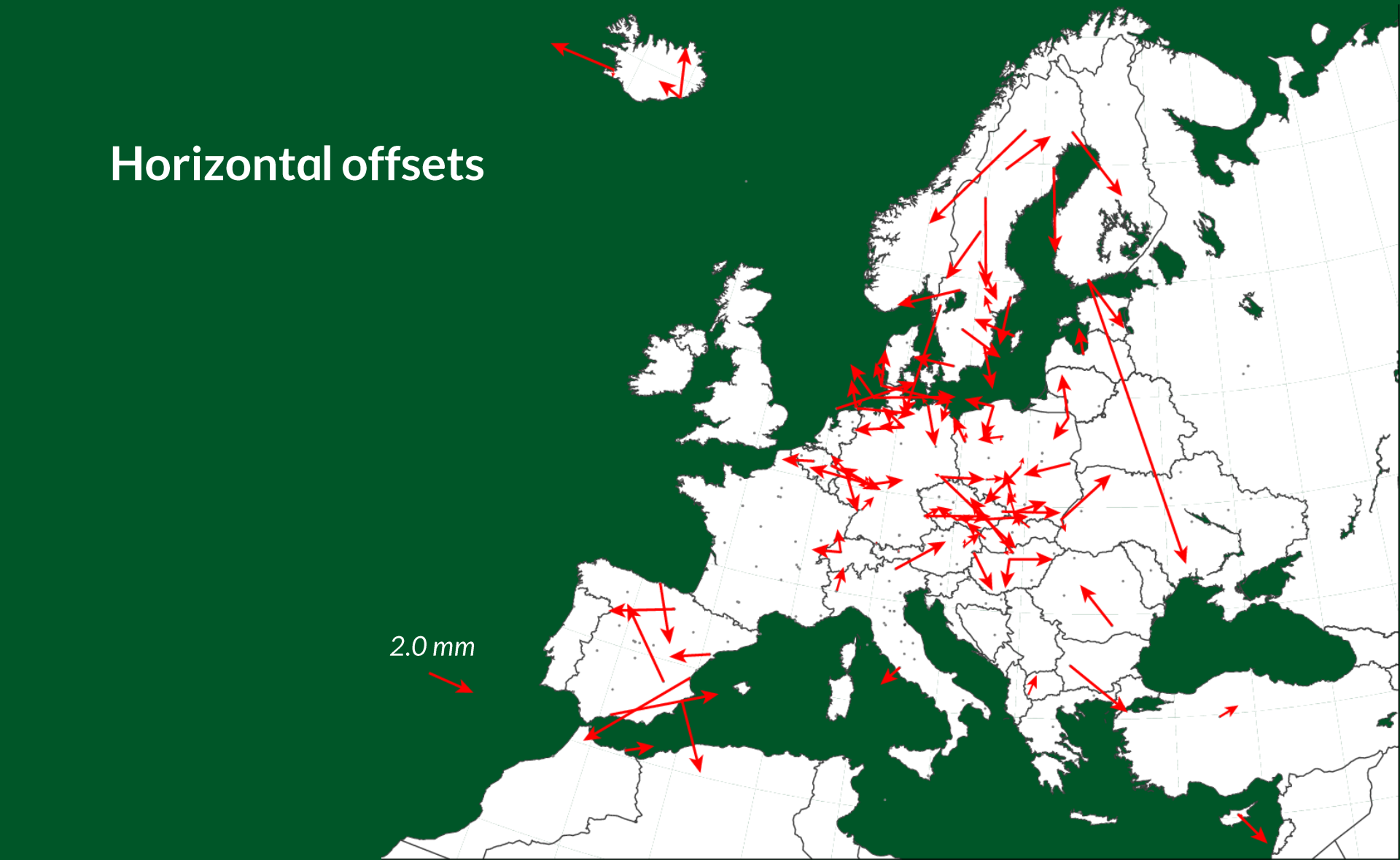
3. Impact of receiver antenna modelling

Horizontal offsets



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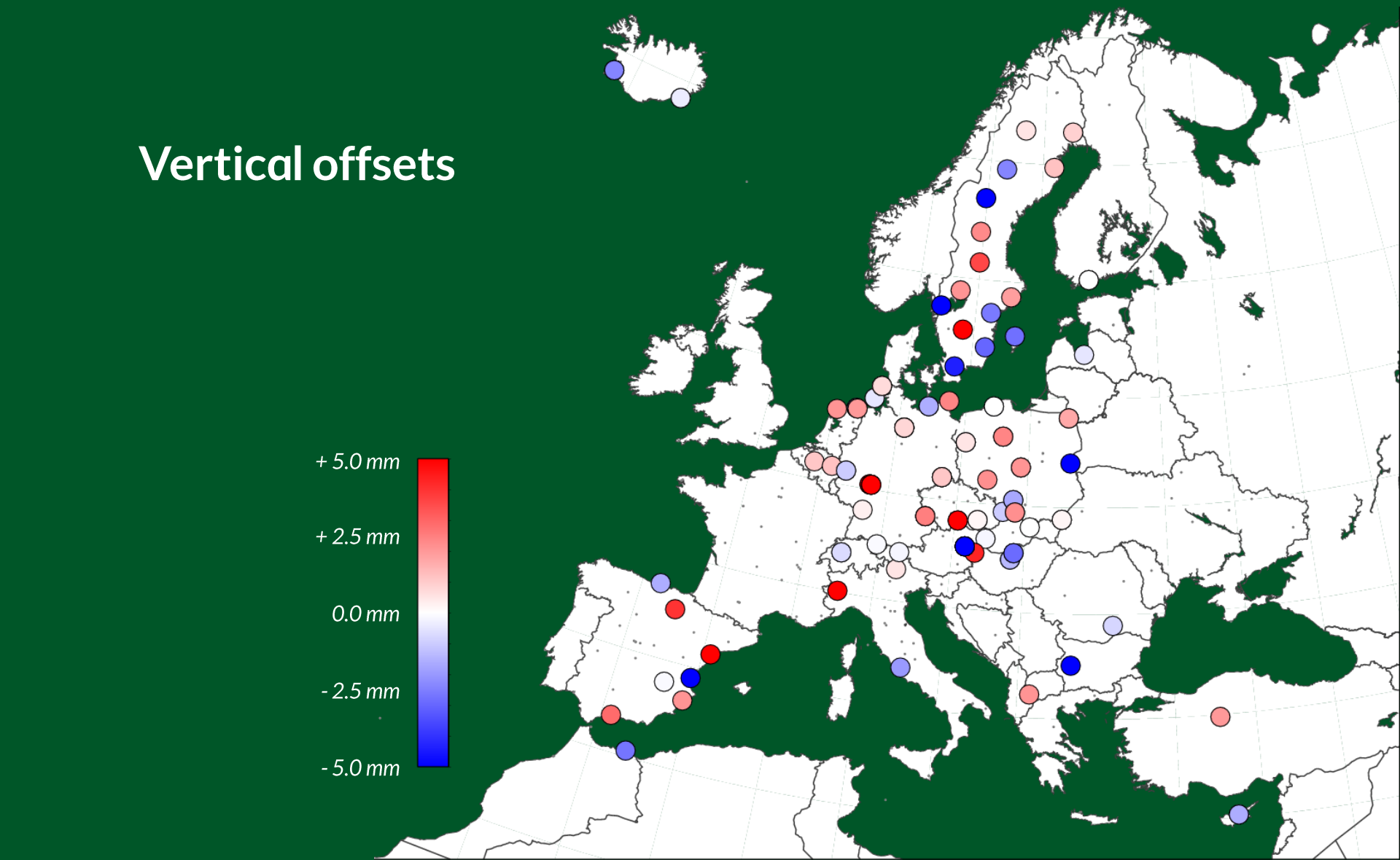
3. Impact of receiver antenna modelling

Vertical offsets



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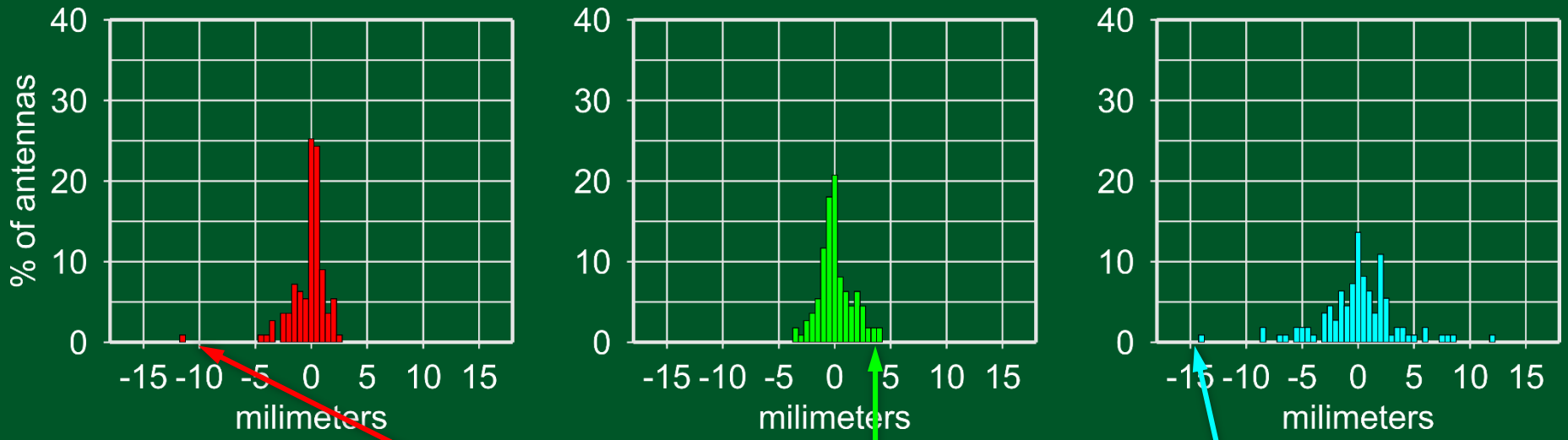
3. Impact of receiver antenna modelling

Mean std. of estimated offsets: **0.3 mm / 0.3 mm / 0.6 mm**

Distribution of estimated offsets (N, E, U) :



Greatest impact

North	- 11.7 mm	„AOAD/M_T NONE" at METS00FIN
East	4.1 mm	„AOAD/M_T NONE" at METS00FIN
Up	- 14.0 mm	„LEIAT25.R3 LEIT" at VAE600SWE

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Summary

- Four „full EPN” solutions are finished ! 
- Good results, but comparison with others finally verify their quality. Currently carried out by EPN ACC.
- GAMIT has proven to be of equivalent importance as any other software package used in the EPN analysis
- ATML correction improved solutions for EPN stations over latitude 45° (~15%) as well as rest of the stations.
- „Corrections” for position related to receiver antenna modeling are provided. Ready to verify the inconsistency between individual solution and maybe (?) improve selected.

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Acknowledgements

Thanks for attention !

All results are available on request

contact: andrzej.araszkiewicz@wat.edu.pl

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