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New local ties at the DORIS station Wettzell in the framework of the GeoMetre project

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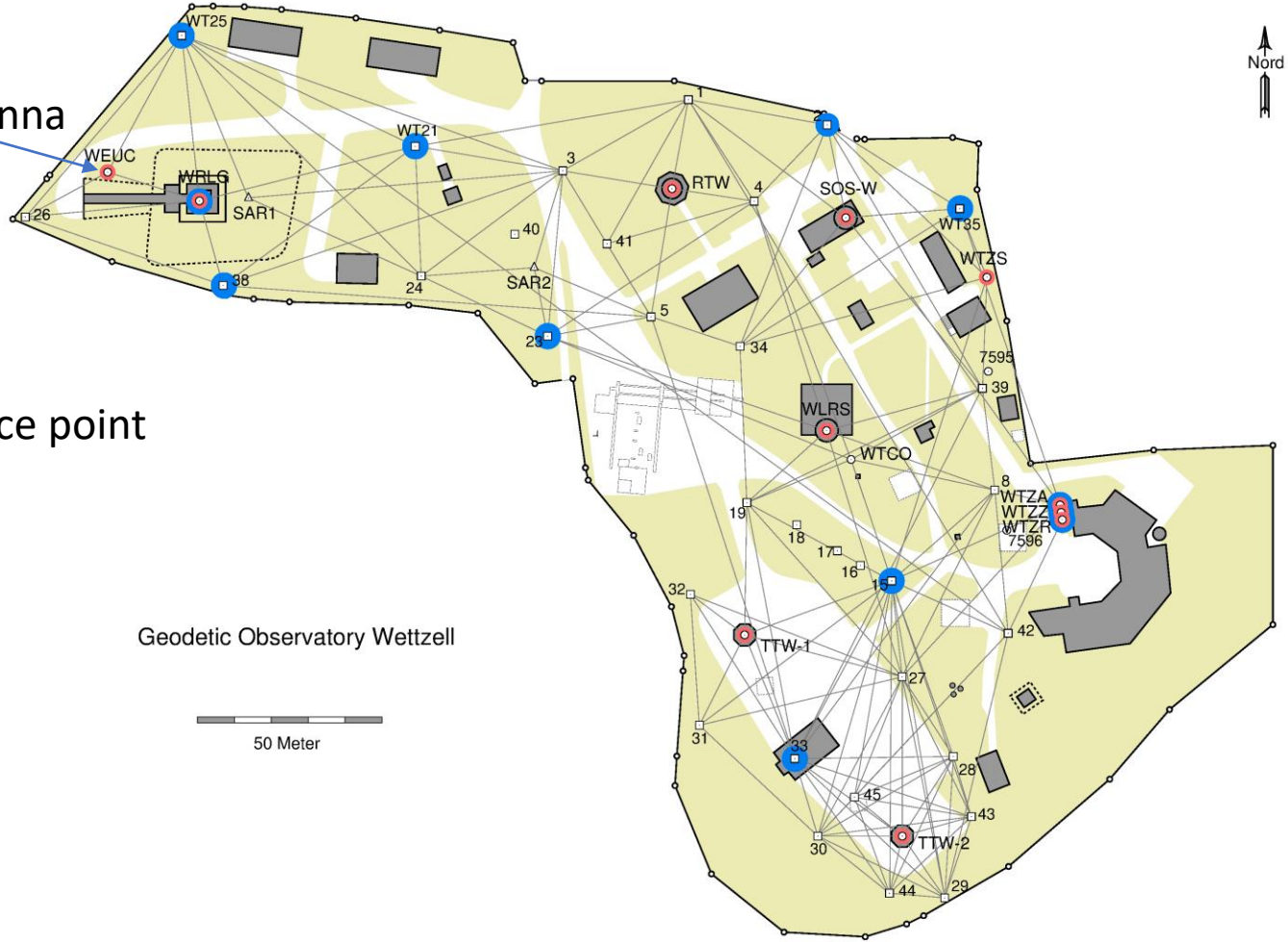
Geodetic Observatory Wettzell

DORIS Installation in Wettzell

- 2014 – 2015: Site investigation, VLBI compatibility tests
- Since 09/2016: Operation in nominal mode
- Since 10/2022: New beacon (generation 4), H-maser frequency as input

Local Survey Network

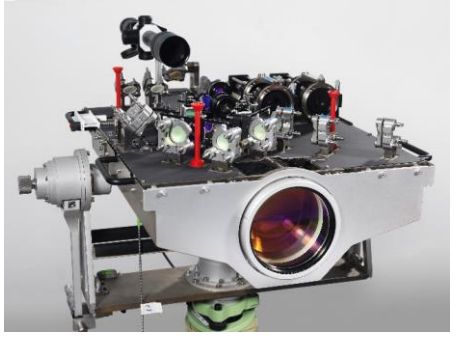


GeoMetre Project

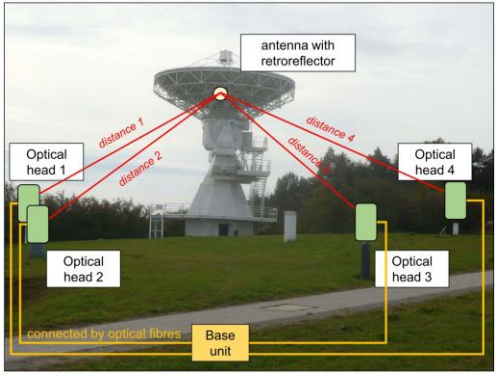
EMPIR
EURAMET
The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

The GeoMetre project brings geodesists and metrologists together to:

- Improve local tie metrology at geodetic core sites making use of innovative instrumentation for length metrology



Refraction compensated distance meters



3D multilateration systems

- Tighten the traceability of the Si definition of the metre for reference frames, using European reference baselines (WUT200, PTB600, Numella, CNAM5600, EURO5000)

Numella, Finland

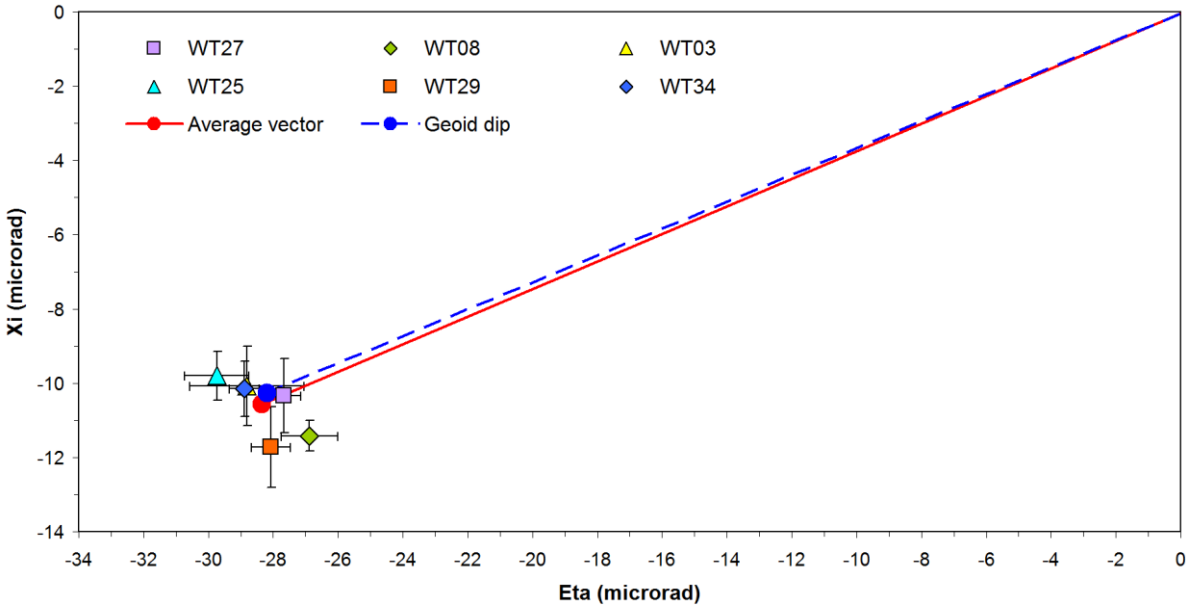
EURO5000, Poland

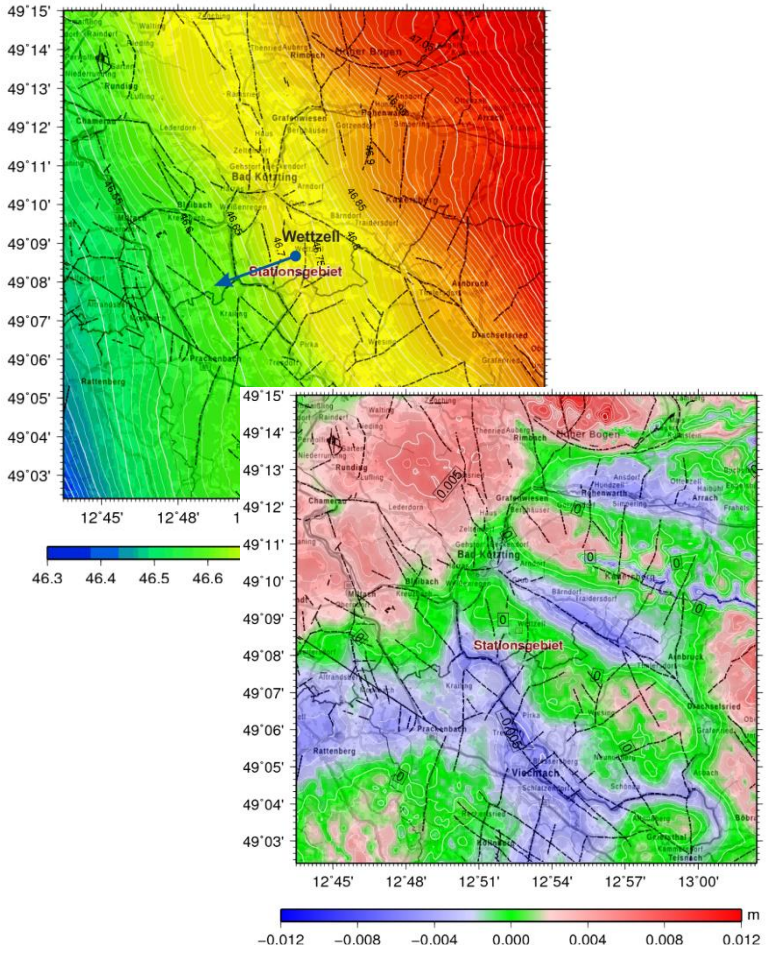
Strategy to improve Local Tie Metrology

- Improvement of the network scale
  - Use of refraction compensating distance meters (2 colors)
  - Include data from integrated thermometry
- Improvement of the network orientation
  - Use transformation-free approach
  - Include vertical deflection to improve vertical orientation
  - Include distant targets to improve horizontal orientation
- Improvement of the reference point determination (VLBI telescopes)
  - Photogrammetry
  - Multilateration

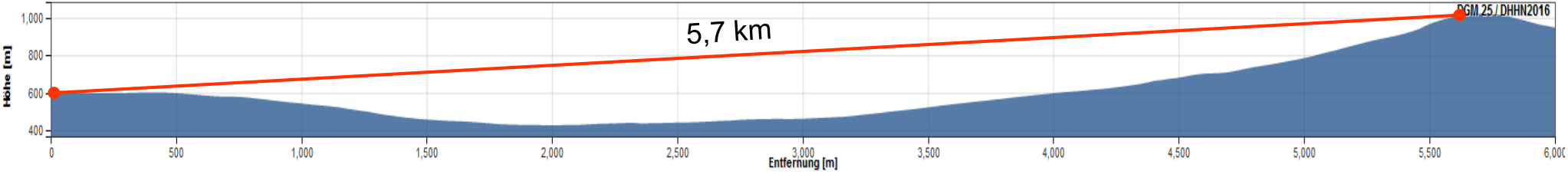
Include Deflections of the Vertical

- Gravimetric technique (computing a local fine-structure geoid)
- Astrogeodetic technique (tachymeter in combination with the QDaedalus software)





Include Distant Targets



Computation Procedure

- Network survey including targets on the moving parts of the telescopes and 3 distant targets
- Observation of permanent and temporary GNSS sites (including distant targets)
- Analysis and adjustment of GNSS observations (baselines relative to WTZR)
- Adjustment of terrestrial observations using GNSS coordinates as datum points and introducing the deflection of the vertical
- Determination of the telescope reference points from the adjusted target positions

Local Tie Solution for ITRF 2020

Station	Technique	Site ID	Domes No.	DX [m]	DY [m]	DZ [m]	rms DX [m]	rms DY [m]	rms DZ [m]
WTZR	GNSS	1202	14201M010	0.00000	0.00000	0.00000	0.00061	0.00026	0.00058
WTZA	GNSS	1204	14201M013	-2.18965	-1.00173	1.89096	0.00062	0.00030	0.00059
WTZZ	GNSS	1205	14201M014	-1.12239	-0.68639	0.90670	0.00060	0.00024	0.00058
WRLG	GNSS	1220	14201M024	-15.58126	-243.24712	52.52927	0.00070	0.00030	0.00133
WTZS	GNSS	1208	14201M015	-45.36698	-31.46797	40.87921	0.00058	0.00059	0.00074
WEUC	DORIS	223	14201S046	-20.86947	-273.46404	53.49741	0.00091	0.00043	0.00148
RTW	VLBI	7224	14201S004	-40.79935	-118.39787	61.31629	0.00021	0.00043	0.00086
SOSW	SLR	7827	14201S045	-49.47589	-71.95635	51.81447	0.00025	0.00042	0.00071
WLRS	SLR	8834	14201S018	-3.82402	-68.20428	15.51548	0.00031	0.00028	0.00074
TTW1	VLBI	7387	14201S043	47.23547	-79.66738	-15.84895	0.00026	0.00047	0.00079
TTW2	VLBI	7388	14201S044	78.54239	-29.16116	-51.98213	0.00052	0.00075	0.00067

ITRF 2020 Tie Residuals (Wettzell only)

Id	DOMES	Soln	Id	DOMES	Soln	East mm	North mm	Up mm	Tie Epoch	Flg	Technique Start	Technique End	Epochs Start	Epochs End	Spans	Spans	
WTZR	14201M010	1	WTZA	14201M013	1	4.9	2.3	7.2	18:344	--*	95:040	09:020	97:329	21:001	13.95	23.10	
WTZR	14201M010	1	WTZZ	14201M014	3	1.9	0.6	-3.1	18:344	---	95:040	09:020	11:036	21:001	13.95	9.90	GNSS - GNSS
WTZR	14201M010	1	WTZS	14201M015	4	-1.0	-0.4	-3.6	18:344	---	95:040	09:020	10:182	20:366	13.95	10.50	
WTZR	14201M010	1	7224	14201S004	1	0.7	-2.5	-3.6	18:344	---	95:040	09:020	83:320	20:365	13.95	37.12	
WTZR	14201M010	1	7387	14201S043	1	1.7	-2.5	-0.6	18:344	---	95:040	09:020	15:160	20:358	13.95	5.54	GNSS - VLBI
WTZR	14201M010	1	7388	14201S044	1	1.8	-1.6	0.3	18:344	---	95:040	09:020	17:337	20:191	13.95	2.60	
WTZR	14201M010	1	7827	14201S045	1	0.2	0.1	1.5	18:344	---	95:040	09:020	14:107	20:319	13.95	6.58	
WTZR	14201M010	1	8834	14201S018	1	1.1	0.3	2.3	18:344	---	95:040	09:020	90:365	20:198	13.95	29.54	GNSS - SLR
WTZR	14201M010	1	WEUC	14201S046	1	0.2	-6.2	3.8	18:344	-*-	95:040	09:020	16:268	21:003	13.95	4.27	GNSS - DORIS
7224	14201S004	1	7827	14201S045	1	-0.4	2.6	5.1	18:344	--*	83:320	20:365	14:107	20:319	37.12	6.58	
7224	14201S004	1	8834	14201S018	1	0.4	2.8	6.0	18:344	--*	83:320	20:365	90:365	20:198	37.12	29.54	VLBI - SLR
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7224	14201S004	1	7388	14201S044	1	1.1	0.9	3.9	18:344	---	83:320	20:365	17:337	20:191	37.12	2.60	VLBI - VLBI

Summary

- In the framework of the GeoMetre project, refraction compensated distance meters were developed and tested
- The impact on scale at observatory level (200 m) is small
- The transformation-free approach has successfully been tested and applied to the ITRF2020 local ties
- The tie residuals to the DORIS system are similar to those between other space techniques
- The tie residuals are significantly bigger than the uncertainties of the local ties

GeoMetre Consortium