


Estimation of VGOS Station Coordinates

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Structure

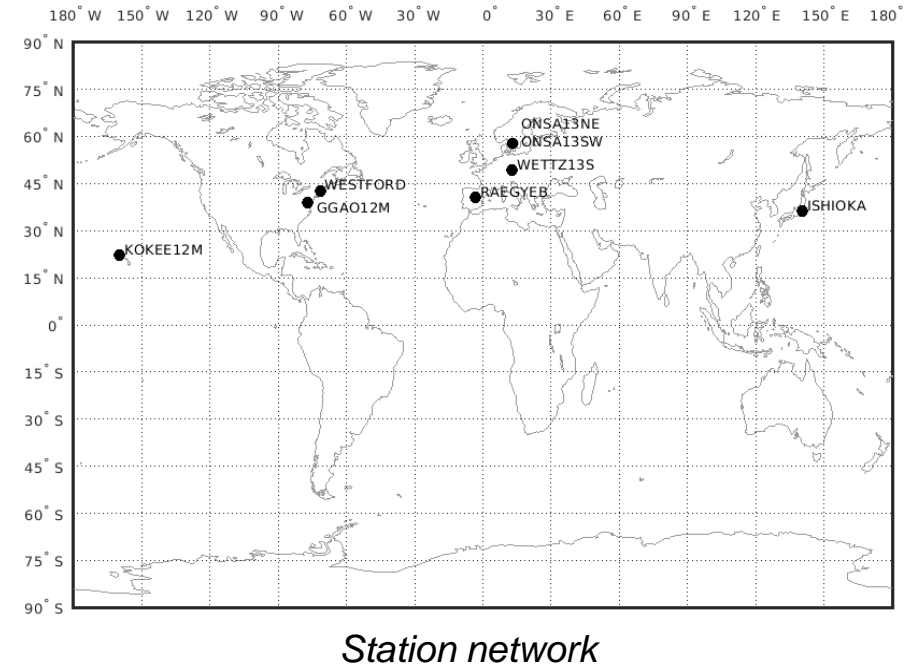
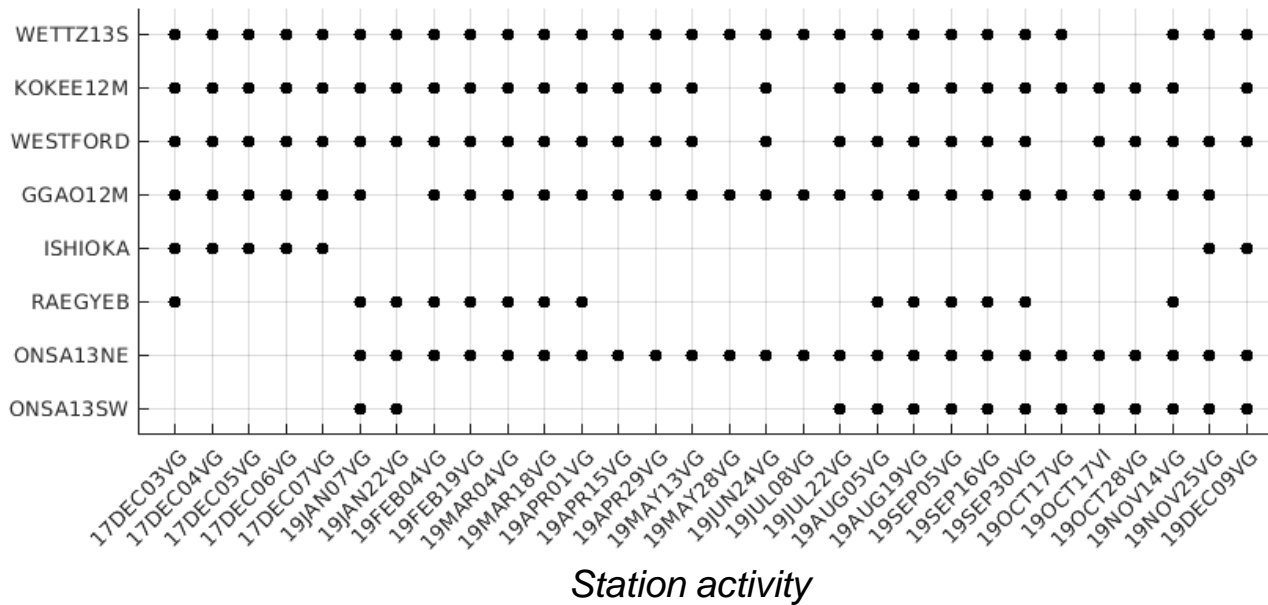
- Problem
- Data
- Geodetic datum definition in least square adjustment
- Global solution for VGOS network
- Results

Problem

- Inherent geodetic datum defect in VLBI observations:
VLBI observations define inner network geometry but not absolute position
- Not enough VGOS stations with precise ITRF2014 coordinates to define datum with NNR and NNT conditions → VGOS network is mostly independent of legacy S/X network and the ITRF2014
- Precise VGOS coordinates needed for
 - Calculation of dUT1 from VGOS intensive sessions
 - Comparison of analysis results such as Earth Orientation Parameters (EOP) to S/X
 - Combination with S/X data

Data - VGOS

- 30 VGOS sessions used: 5 during CONT17, 25 during 2019
- Westford (Wf) is a ITRF2014 defining station that was converted into a VGOS station with a receiver change



Geodetic datum definition: Unconstrained Adjustment

- Unconstrained Adjustment: some parameters fixed to a priori values
- → Definition with fixed Earth Orientation Parameters (EOP) and one Station
- Benefit: fewer/other precise a priori values necessary
- Drawbacks:
 - Fixed parameters not estimated and seen as the true values
 - Accuracy estimation for those parameters not possible
 - Cannot be done redundantly
- Common way in VLBI analysis: datum definition with a free adjustment where No-Net-Translation (NNT) and No-Net-Rotation (NNR) conditions are imposed on some/all stations **but at least three stations with precise coordinates needed**

Global solution for VGOS network

- Global solution is a combination of VLBI sessions on normal equation level
- Datum defined by fixing
 - EOP (IERS EOP 14 C04 (IAU2000A))
 - Westford (ITRF2014 coordinates)
- Station velocities not estimated but taken from neighboring ITRF2014 stations
- Exception for Ishioka (Is) due to strong inconsistency with velocity from nearest station → Velocity for Is estimated using a global solution of R1 & R4 sessions from 2017-2019
- ZWD parametrization with 30 min interval and 1.5cm relative constraint accuracy
- Source coordinates fixed
- Calculated in VieVS

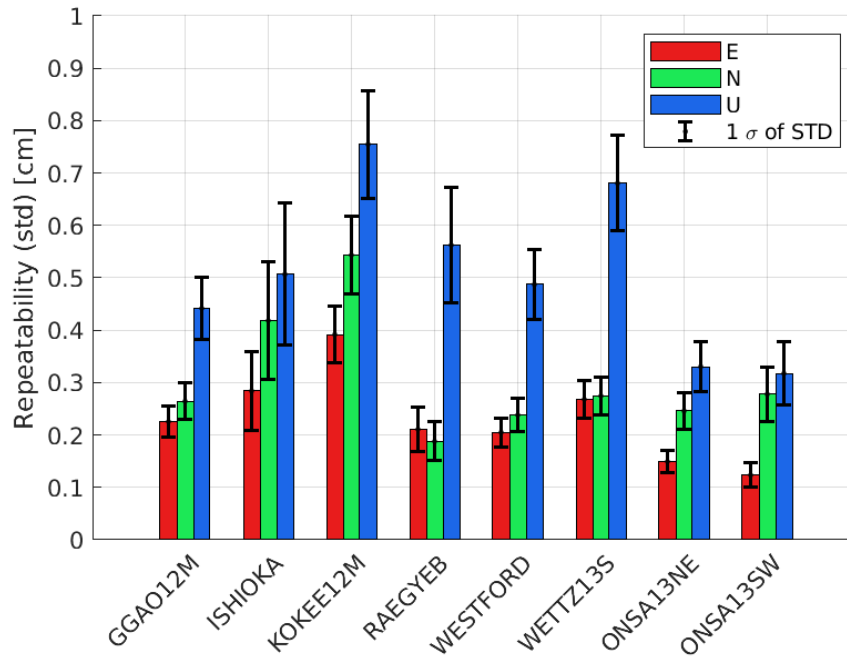
Resulting Coordinates

Station	Coordinates [m]			Formal Errors [mm]			Velocities [cm/y]			Epoch
	x	y	z	x	y	z	vx	vy	vz	
GGAO12M	1130729,8900	-4831245,9513	3994228,2859	0,13	0,27	0,28	-1,50	-0,11	0,23	2019.0
ISHIOKA	-3959636,1638	3296825,4801	3747042,5997	0,64	0,52	0,87	-2,29	-0,08	-0,65	2019.0
KOKEE12M	-5543831,7443	-2054585,6766	2387828,9139	0,65	0,50	0,57	-0,93	6,29	3,23	2019.0
ONSA13NE	3370889,1670	711571,3336	5349692,1358	0,27	0,26	0,46	-1,44	1,45	1,04	2019.0
ONSA13SW	3370946,6467	711534,6414	5349661,0127	0,30	0,27	0,51	-1,44	1,45	1,04	2019.0
RAEGYEB	4848831,0419	-261629,4098	4122976,5472	0,40	0,28	0,48	-0,49	1,90	1,65	2019.0
WETTZ13S	4075658,8759	931824,8823	4801516,2886	0,27	0,25	0,42	-1,61	1,70	1,00	2019.0
WESTFORD	1492206,3859	-4458130,5272	4296015,5872	-	-	-	-1,56	-0,13	0,41	2010.0

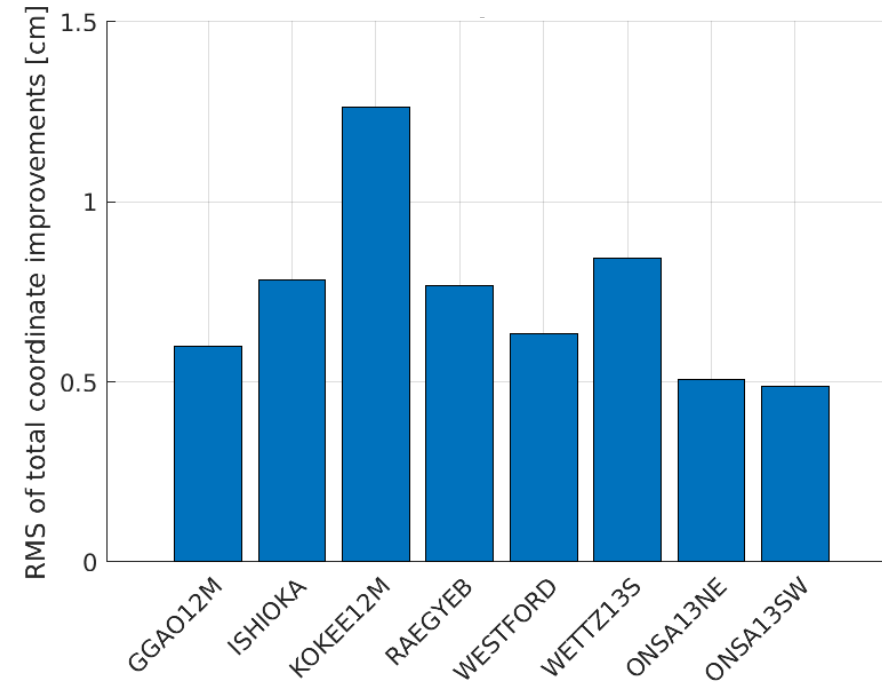
VGOS coordinates resulting from global solution

VGOS station repeatability

Station repeatability in single session analysis of the VGOS sessions using the estimated coordinates



Station repeatability as the standard deviation of coordinate improvements in East, North & Up along with one sigma uncertainty based on single analysis of 30 VGOS sessions



Root-mean-square of estimated total station position improvements based on single analysis of 30 VGOS sessions

$$\sqrt{\frac{1}{n} \sum_i^n \Delta x_i^2 + \Delta y_i^2 + \Delta z_i^2}$$