Local Ties at IVS Sites

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Abstract. At various VLBI sites, but not at all of them, other space geodetic observing platforms are co-located with VLBI telescopes. In this paper we summarize the status of co-locations and of availability of local tie measurements at the time when the ITRF2000 was compiled.

1 Overview of Co-locations at VLBI Sites

The basis of this summary are the ITRF2000 data files without inclusion of installations or local tie measurements carried out since then. Co-locations of DORIS beacons at radio telescopes are not considered ideal. The reason is that the active DORIS beacons often generate radio frequency interference which disturbs radio astronomy observations but also saturates VLBI observing channels at S band which is critical for ionospheric calibration. In a few cases DORIS beacons are located at a larger distance from a VLBI telescope. However, this creates the drawback that the accuracy of the local tie measurements is unsatisfactory. Co-locations of VLBI telescopes and DORIS beacons are, therefore, not considered here. Due to the importance of co-locations of VLBI telescopes and GPS receivers the emphasis of this paper is placed on the GPS equipment at radio telescopes.

32 VLBI sites are listed in ITRF2000 as being co-located with SLR telescopes. However, quite a number of them are older mobile occupations which cannot be considered as usable in the future. 29 fixed VLBI sites are co-located with permanent GPS equipment while 65 VLBI sites, listed in ITRF2000, are not equipped with any other space geodetic technique. However, 42 of these VLBI sites are mobile sites which were only occupied with transportable VLBI telescopes in the early 1980s.

It would be ideal if at least a permanent GPS receiver would be operated at each IVS VLBI site. A great number of the remaining 23 locations without permanent GPS installations are fixed VLBI sites of the Japanese national network (Table 1). It should not be that difficult to establish co-locations within the Japanese GeoNet. The other eleven are distributed all over the world and co-location are partially realized already. If not, the responsible agencies should be made aware of the importance of co-located GPS equipment.

Table 1: List of permanent VLBI sites without co-location of any other space geodetic technique.

Station	DOMES No.	Station	DOMES No.
KASHIMA	21701S001	GOLDSTONE	40405S014
MIZUSAWA	21702S009	GREENBANK	40441S007
KOGANEI	21704S004	LOS ALAMOS, NM	40463S001
MIYAZAKI	21718S001	KITT PEAK	40466S001
NOBEYAMA	21725S001	HANCOCK	40471S001
SHINTOTSUKAWA	21731S001	BREWSTER	40473S001
CHICHIJIMA	21732S001	PARKES	50108S001
MINAMI TORI SIMA	21733S002	SIMEIS	12337S008
SAGARA	21737S001	YEBES	13420S001
MIURA	21739S001	EFFELSBERG	14209S001
TATEYAMA	21740S001	URUMQI	21612S001
AIRA	21742S002		

2 Detailed Information

Although radio telescopes may generate multipath effects or mask a considerable part of the sky for the GPS antenna, both antennas should be located as close together as possible. The reason is that the quality of any local tie measurement and its results strongly depend on the distance between the different observing platforms. Less than 150 m should be considered as optimal while more than 300 m should be avoided. Table 2 gives an overview over the distribution of current separations of the GPS antennas from the radio telescopes at the 29 VLBI/GPS co-location sites.

Table 2: Distances of VLBI and GPS antennas at co-location sites

Distance [m]	**# of ties**
0 – 50	4
50 – 100	13
100 – 200	7
200 – 500	5

Table 3: Detailed list of the GPS receiver IDs at VLBI telescopes

DOMES No.	Site name		GPS Identifier	Distance [m]	Local Tie available	Formal error available
10317M003	NY-ALESUND	GPS	NYA1	106.343	Yes	Yes
10402M004	ONSALA	GPS	ONSA	22.008	Yes	No
12711M003	MEDICINA	GPS	MEDI	62.765	Yes	Yes
12717M003	NOTO	GPS	NOTO	70.207	Yes	No
12734M008	MATERA	GPS	MATE	58.004	Yes	No
13407S012	MADRID-ROBLEDO	GPS	MADR	265.513	not used	
14201M010	WETTZELL	GPS	WTZR	139.438	Yes	No
21605M002	SHANGHAI	GPS	SHAO	92.044	No	No
21729S007	USUDA	GPS	USUD	104.749	No	No
21730S005	TSUKUBA	GPS	TSKB	303.037	No	No
23903M001	SUWON-SHI	GPS	SUWN	10.221	No	No
30302M004	HARTEBEESTHOEK	GPS	HRAO	163.785	Yes	No
40104M002	ALGONQUIN	GPS	ALGO	112.908	Yes	No
40105M002	PENTICTON	GPS	DRAO	370.040	Yes	No
40405S031	GOLDSTONE	GPS	GOLD	411.520	??	??
40408M001	FAIRBANKS	GPS	FAIR	94.343	Yes	Yes
40424M004	KAUAI	GPS	KOKB	46.480	Yes	Yes
40440S020	WESTFORD	GPS	WES2	57.703	Yes	Yes
40451M123	WASHINGTON	GPS	GODE	33.231	Yes	No
40456M001	PIETOWN	GPS	PIE1	61.800	Yes	No
40465M001	NORTH LIBERTY	GPS	NLIB	67.303	Yes	No
40477M001	MAUNA KEA	GPS	MKEA	87.769	Yes	Yes
40499M005	RICHMOND	GPS	RCM4	142.300	Yes	No
41602M001	FORTALEZA	GPS	FORT	53.344	Yes	No
43201M001	SAINTE CROIX	GPS	CRO1	82.630	Yes	No
50103M108	CANBERRA	GPS	TIDB	375.774	No	No
50116M003	HOBART	GPS	HOB1	60.952	No	No
66006S002	SYOWA	GPS	SYOG	123.787	Yes	Yes
66008M001	O'HIGGINS	GPS	OHIG	51.730	Yes	No

Table 3 contains a detailed list of the GPS receiver IDs at VLBI telescopes together with the distances between the two observing platforms. Often, formal errors are not available from the documentation. This is a severe deficiency of quite a number of existing local ties. No information is available on the quality of the vectors between the observing platforms and it is difficult to decide whether the respective co-location serves its purpose as a proper link between the different reference frames.