2018 IVS Network Performance

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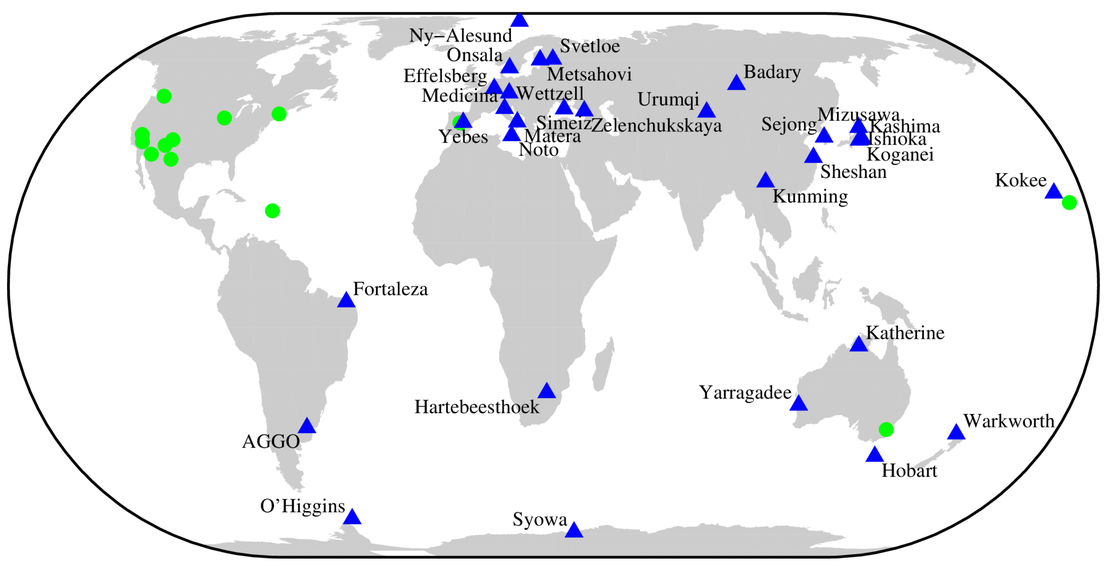
Introduction

In 2018, the International VLBI Service for Geodesy and Astrometry (IVS) scheduled over 193 VLBI sessions for geodesy and astronomy. These 24-hour sessions involved 50 VLBI antenna operating in networks of 4 to 20 stations. As of today, 154 sessions have been correlated and analyzed. These sessions required 1455 stations-days and 494823 recorded scans. In 2018, over 85% of data recorded at VLBI stations made it to the correlators and over 68% were used by analysts. This is consistent with previous years. Understanding the reasons for data loss is critical in maintaining a high performance IVS network.

2018 S/X Observing Network

The 2018 S/X observing network consists of 50 stations. This includes the 37 IVS Network Stations as official member components of the IVS as well as several cooperating sites that contribute to the IVS observing program, in particular the 10 stations of the VLBA and 3 NASA DSN stations.

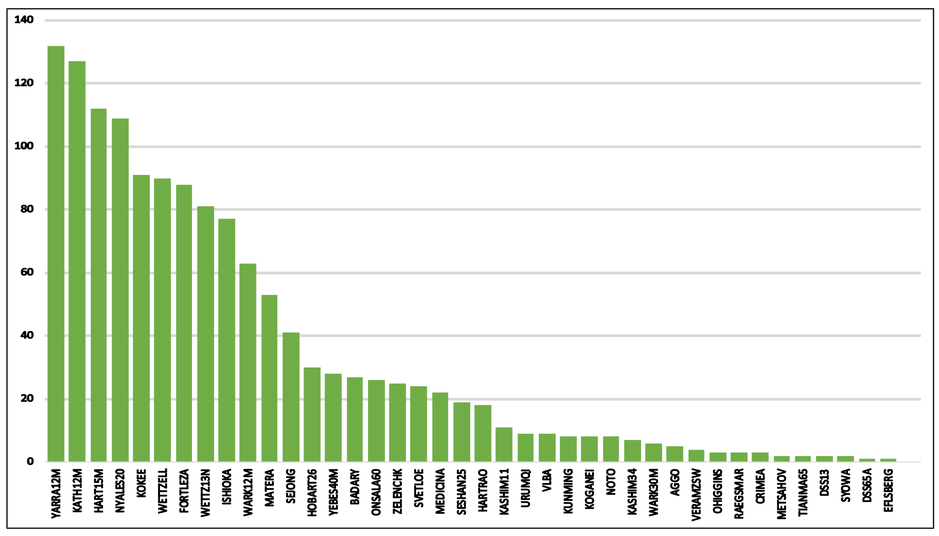


▲ *IVS Network Station* ● *Cooperating VLBI Site*

Distribution plot of the VLBI stations that contributed to the 2018 IVS Master Schedule

Network Performance

The network performance is based on correlator and analysis reports from all 24-hours experiments correlated as of February 28, 2019. Experiments correlated at VLBA were also included since available reports provided relevant information on reasons for data loss. The average number of stations per session is 9.4. The following graphic shows the number of sessions that have been correlated for each station. Some stations have observed more than shown since 39 additional sessions are not correlated yet.



Number of 24-hour sessions correlated for participating stations

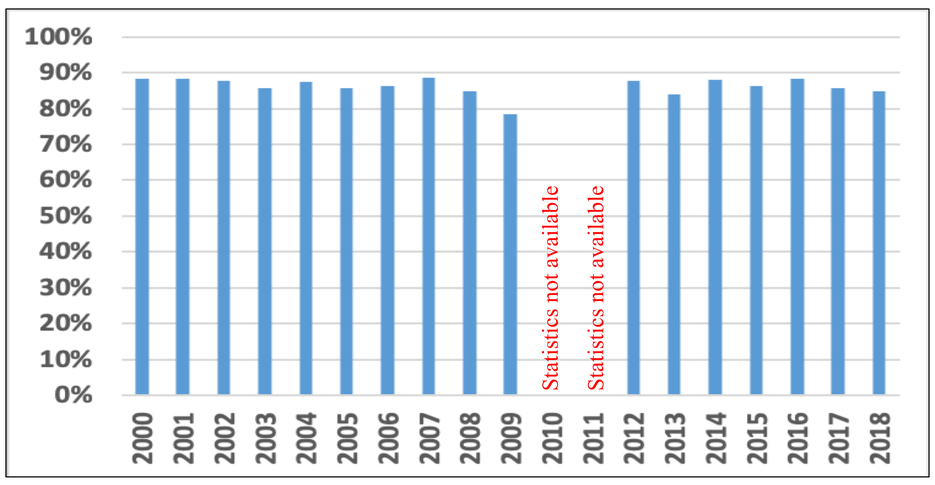
In 2018, the 50 stations delivered an average of 85% of their data. To better understand this global performance, the network has been analyzed by groups based on the station usage. The distinction between these groups was made on the assumption that results will be more meaningful for the stations with more sessions. The Large N group account for 88% of the station-days and is dominant in determining the overall performance as shown in the following table. The last two columns of the group analysis table indicate the number of stations that yield more than 90% and less than 70% of their data.

Category	Number stations	Station-days	Average	Median	>92%	<70%
Big Large N (>40)	12	1064	86.9%	91.6%	6	1
Large N (>=17)	21	1283	86.1%	84.6%	8	3
Small N (<17)	29	172	76.2%	72.4%	7	12
Full network	50	1455	84.9%	79.4%	15	15

Group analysis of data yield

Historical Performance

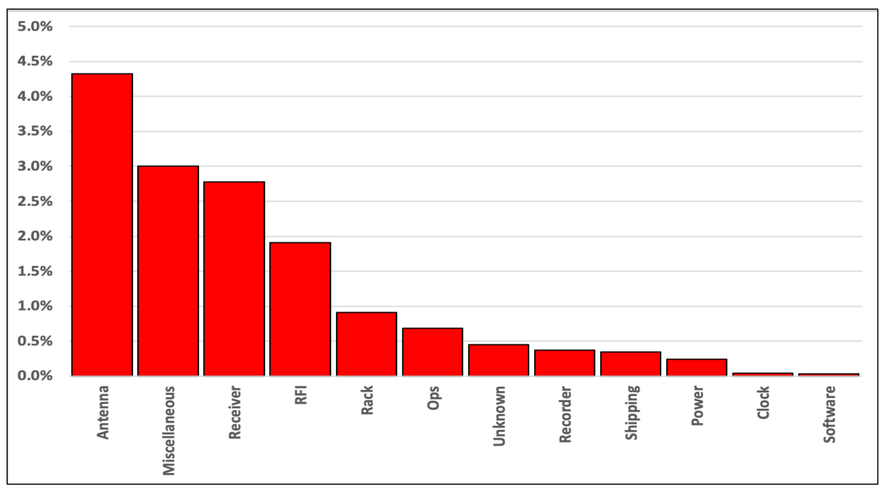
The 2018 performance is in line with historical data yield (85%-88%) as shown in the following graph.



Historical data yield since 2000

Data Loss

The data losses were also analyzed by sub-systems for each station but only network results are presented. Computing data loss is not always straightforward. In some cases, down time is used to compute data loss but for certain problems (warm receiver, pointing, RFI) the data loss is estimated from an approximate equivalent number of recorded bits lost.



Percentage of data loss for each sub-systems

The **antenna** problems have been the major cause of data lost for almost 10 years. This is probably due to aging antennas. The **miscellaneous** category includes problems that do not fit the other categories. These are mainly problems beyond the control of the station and is dominated by bad weather and scheduling conflicts. The **receiver** data losses were due to three stations that observed with warm receivers for a total of 67 stations-days.

Stations can receive their own results by contacting the authors.

RFI

This category includes all losses directly attributable to interference. RFI is mainly evaluated from dropped channels at correlation but there are some difficulties in distinguishing BBC and RFI problems. Some stations were contacted to confirm RFI presence at site. RFI due to commercial systems continues to be an important factor of data loss, mostly in S band.

Station	Data loss	Most affected channels (frequencies in MHz)
Sejong	18.0%	SR4U (2295MHz), SR5U (2345MHz), SR6U (2365MHz)
Kunming	13.9%	SR5U (2345MHz), SR6U (2365MHz), SR1U (2225MHz)
Zelenchukskaya	13.0%	SR2U (2245MHz), SR3U(2265MHz), SR4U(2295MHz)
Koganei11	12.5%	No fringes in some sessions due to weak S band signal affected by RFI
Yebes 40m	8.7%	SR2U (2245MHz), SR4U (2295MHz)
Medicina	6.0%	SR6U (2365MHz)
Hobart26	5.1%	SR5U (2272MHz) SR6U (2288MHz) – AOV sessions SR5U (2281MHz) SR6U (2297MHz) – CRDS sessions SR5U (2345MHz) SR6U (2365MHz) – CRF, RD sessions
Matera	4.1%	SR6U (2365MHz)
Wark12m	3.8%	SR5U (2345MHz), SR6U (2365MHz) – Intermittent
Fortaleza	3.1%	SR4U (2295MHz) – Mostly in September-December

Channels: SR1U = band|polarization|BBC#|sideband

Most affected stations by RFI

Summary

Estimating station data losses could be subjective and some times approximative but is a useful tool for evaluating the health of the IVS network over the years. A station yielding over 80% of data is considered very good and the statistics of the Large N group are showing that stations have been doing pretty well in 2018.

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