ILRS Network and Station Assessment Software: Overview

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Subjects to be Discussed

- Goals and Motivations

- Existing Tools

- Software and Parameter Development

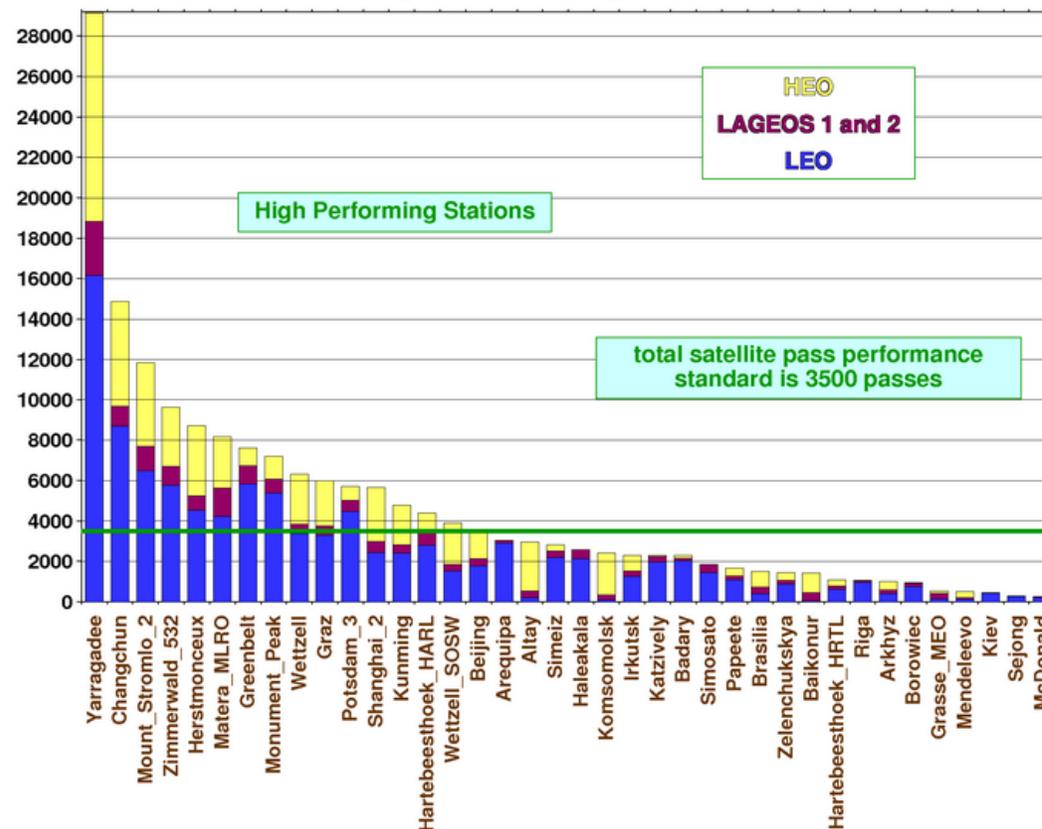- Examples: For Analysts and For Stations

Goals and Motivation

- Determine network capabilities for altimetry, geodetic, and GNSS satellites
  - Current System Performance Standards were set in 2015

    https://ilrs.cddis.eosdis.nasa.gov/network/system_performance/index.html

- Assessment of individual station performance and steps for improvement to support network goals

Table 1

Site Information		Data Volume									Data Quality		
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Location	Station Number	LEO pass Tot	LAGEOS pass Tot	High pass Tot	Total passes	LEO NP Total	LAGEOS NP Total	High NP Total	Total NP	Minutes of Data	Cal. RMS	Star RMS	LAG RMS
Baseline		2300	600	3000	3500								
Yarragadee	7090	16160	2688	10310	29158	276915	23766	39515	340196	188294	3.1	4.7	4.9
Changchun	7237	8711	967	5199	14877	81781	6454	15116	103351	53195	5.0	9.2	9.9
Mount_Stromlo_2	7825	6497	1202	4127	11826	94208	9860	14373	118441	80459	3.2	4.9	7.0
Zimmerwald_532	7810	5786	914	2943	9643	95062	11605	9338	116005	78491	7.0	9.2	11.9
Herstmonceux	7840	4536	714	3477	8727	64643	8306	10906	83855	52115	3.4	9.2	13.3
Matera_MLRO	7941	4220	1413	2545	8178	50368	11601	11561	73530	61487	.9	2.5	2.9
Greenbelt	7105	5839	893	895	7627	112827	9156	3757	125740	74180	2.1	6.7	9.1
Monument_Peak	7110	5400	670	1142	7212	96206	5009	3024	104239	55668	4.6	7.5	11.4
Wettzell	8834	3377	466	2491	6334	30413	2717	9358	42488	25125	7.4	8.6	11.9
Graz	7839	3313	448	2240	6001	66945	2953	11427	81325	40823	2.1	6.1	5.2
Potsdam_3	7841	4490	544	681	5715	75518	4938	3083	83539	45602	6.9	10.8	12.8
Shanghai_2	7821	2446	553	2656	5655	21980	5973	11338	39291	30339	7.9	9.9	9.1
Kunming	7819	2405	418	1961	4784	32574	1902	5337	39813	20153	5.5	12.1	12.0
Hartebeesthoek_HARL	7501	2790	716	889	4395	39342	5028	4278	48648	33572	4.0	10.2	10.6
Wettzell_SOSW	7827	1532	335	2026	3893	18588	1641	5918	26147	12980	7.9	11.4	11.7
Beijing	7249	1779	372	1283	3434	14994	2595	4729	22318	16077	8.3	13.7	19.6
Arequipa	7403	2916	134		3050	34097	725		34822	20500	6.2	8.4	8.9
Altay	1879	206	338	2430	2974	3886	1919	8430	14235	7011			35.8
Simeiz	1873	2191	326	313	2830	25098	1923	1419	28440	16348	20.3	10.5	11.5
Haleakala	7119	2139	448	1	2588	33678	3301	3	36982	25250	2.9	5.8	8.2
Komsomolsk	1868	101	240	2060	2401	1856	1395	7601	10852	4828			30.6
Irkutsk	1891	1273	277	769	2319	10815	2277	1618	14710	12203	39.8	29.7	33.1
Katzively	1893	1975	278	43	2296	22187	2123	256	24566	17129	26.6	11.3	11.0
Badary	1890	2012	153	128	2293	19108	762	409	20279	11648		29.7	28.3
Simosato	7838	1459	417	5	1881	22753	6486	25	29264	34801	3.4	8.0	16.6
Papeete	7124	1092	187	391	1670	17961	1682	2002	21645	13032	6.5	8.8	10.9
Brasilia	7407	409	321	783	1513	1634	1150	2636	5420	4397	33.1	22.9	29.5
Zelenchukskya	1889	874	188	395	1457	8493	1394	1076	10963	8907		23.2	37.7
Baikonur	1887	54	404	968	1426	391	1716	3491	5598	5539			32.1
Hartebeesthoek_HRTL	7503	620	165	314	1099	6682	706	912	8300	4583	33.9	26.6	31.0
Riga	1884	951	92	24	1067	16586	728	116	17430	7687	9.0	13.6	15.0
Arkhyz	1886	402	196	420	1018	3159	951	1349	5459	4764		45.4	33.5
Borowiec	7811	756	172	20	948	12971	1682	84	14737	10567	12.7	24.1	17.8
Grasse_MEO	7845	160	257	125	542	4623	3398	1178	9199	13888	9.2		14.8
Mendeleevo	1874	127	88	306	521	2517	1383	911	4811	5136	-0.0	23.5	25.4
Kiev	1824	424	39		463	3451	207		3658	2695	12.6	22.9	26.8
Sejong	7394	261	37		298	3953	369		4322	3221	3.9		12.0
McDonald	7080	223	40	2	265	1899	270	4	2173	1948	9.1	11.0	11.5

total passes
from July 1, 2017 through June 30, 2018

HEO
LAGEOS 1 and 2
LEO

High Performing Stations

total satellite pass performance standard is 3500 passes

20180711

https://ilrs.cddis.eosdis.nasa.gov/network/system_performance/global_report_cards/monthly/perf_201806_wLLR.html
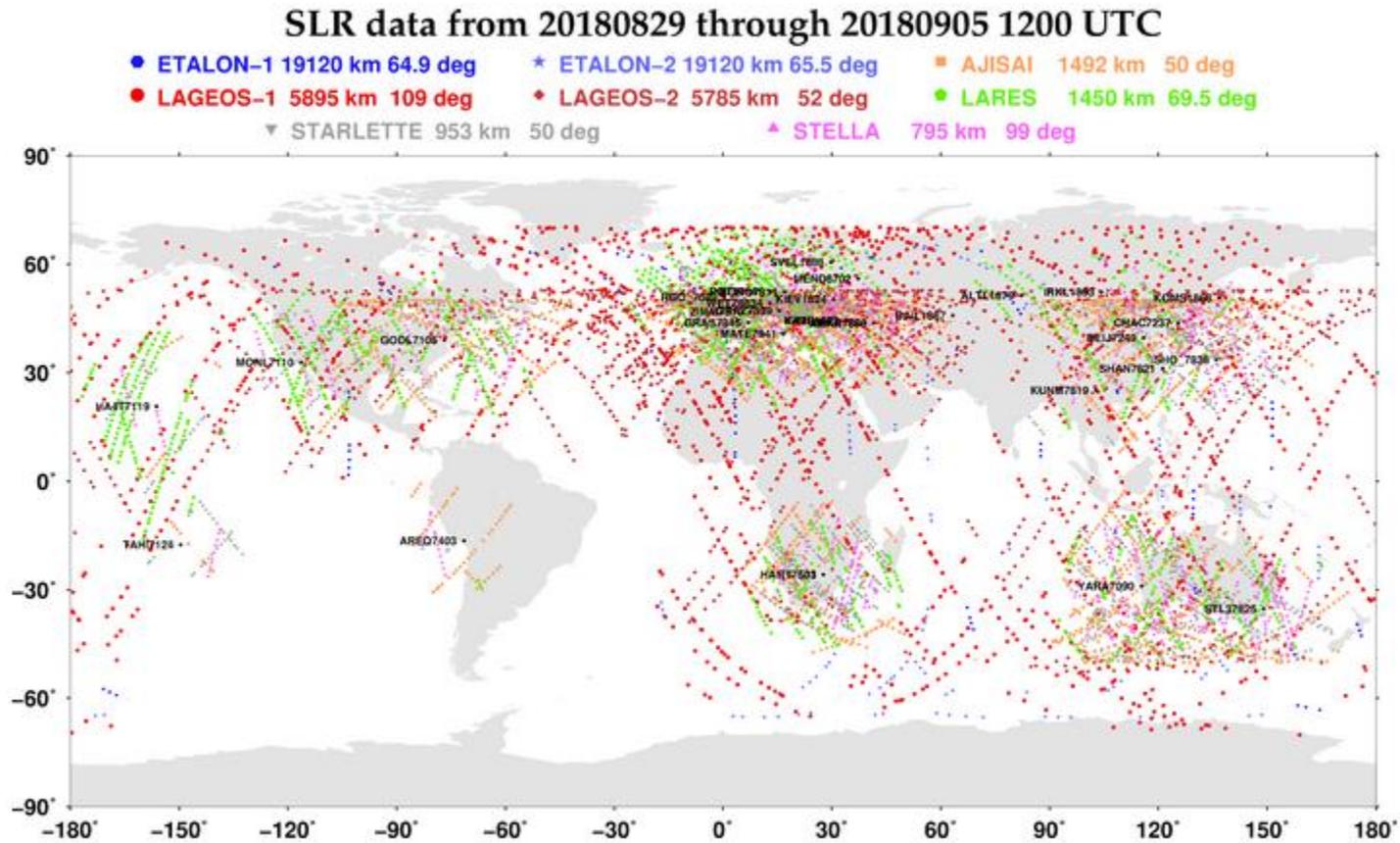
Existing Tools – Station Info Plots

LAGEOS and met information for stations for the past 12 months

Site Num	Site Name	LAG npt rms	LAG sys_dly	ave obs/npt	LAG cal rms	num of npt	num full rate	temp.	pres.	humid.
1824	GLSL									
1868	KOML									
1873	SIML									
1874	MDVS									
1879	ALTL									
1884	RIGL									
1886	ARKL									
1887	BAIL									
1888	SVEL									
1889	ZELL									

https://ilrs.cddis.eosdis.nasa.gov/network/stations/station_info_plots_past_12_months.html

Existing Tools – Ground Tracking

Groundtrack of Last Seven Days of Geodetic Satellite Data

SLR data from 20180829 through 20180905 1200 UTC

https://ilrs.cddis.eosdis.nasa.gov/network/system_performance/recent_groundtrack.html

Development Steps

- Who was Involved:
  - Evan Hoffman, Mark Torrence, Justine Woo
  - Input from CB members
- How we went about it
  - Determined existing parameters
  - New parameters explored (Riga)
  - Information from CDDIS database
  - Plot images using Python notebooks
  - Future Work: Implement as an automated process at CDDIS and incorporate into the ILRS Website

Total Number of Passes (All Satellites)
(2017-10-01 to 2018-10-01)
ILRS Standard: 3500
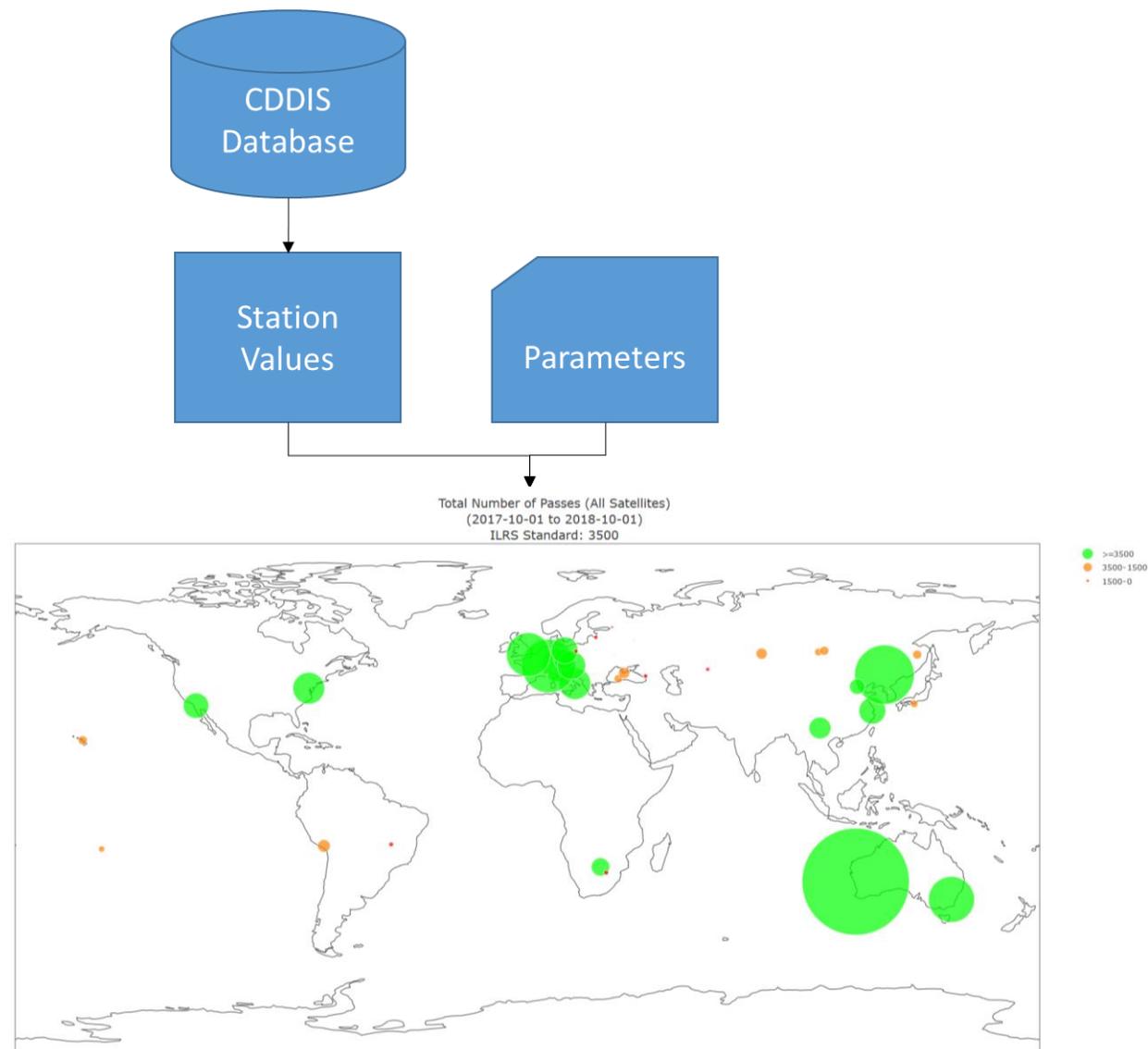
Parameters

General
- **Total Pass: 3500**
- **Avg NPT/Pass: 3**

LEO
- **Total Pass: 2300**
- Avg NPT/Pass: 8

Geodetic
- **Tracked all LAGEOS and LARES**
- **Total Pass: 600**
- **Even Spread of Passes: 200 for LAGEOS-1, LAGEOS-2, LARES**
- NPT/Pass: 6-9

GNSS*
- Track Primary GNSS Constellations: 1 Compass, 1 Galileo, 1 GLONASS
- **Total Pass: 3000**
- Avg. NPT/Pass: 3

Etalon*
- Tracked all Etalon
- Total Pass: 80
- Avg NPT/Pass: 3

Interleaving*
- % Passes that Interleave Out of Total Tracked: 10%
- % LAGEOS Passes that Interleave Out of Total Tracked: 5%
- % GNSS Passes that Interleave Out of Total Tracked: 5%

Priority List Adherence*
- % Passes from Top 10 Satellites: 1%
- % Passes from Top 20 Satellites: 15%
- % of Satellites Tracked not on the Priority List: 35% (Max)
- % Distinct Satellites on Priority List Tracked: 25%

BOLD: Existing parameter

*Not rated for stations that are not GNSS capable

Interleaving

For each pass:
  Get the startTime
  Get the endTime
  If the startTime < lastEndTime:
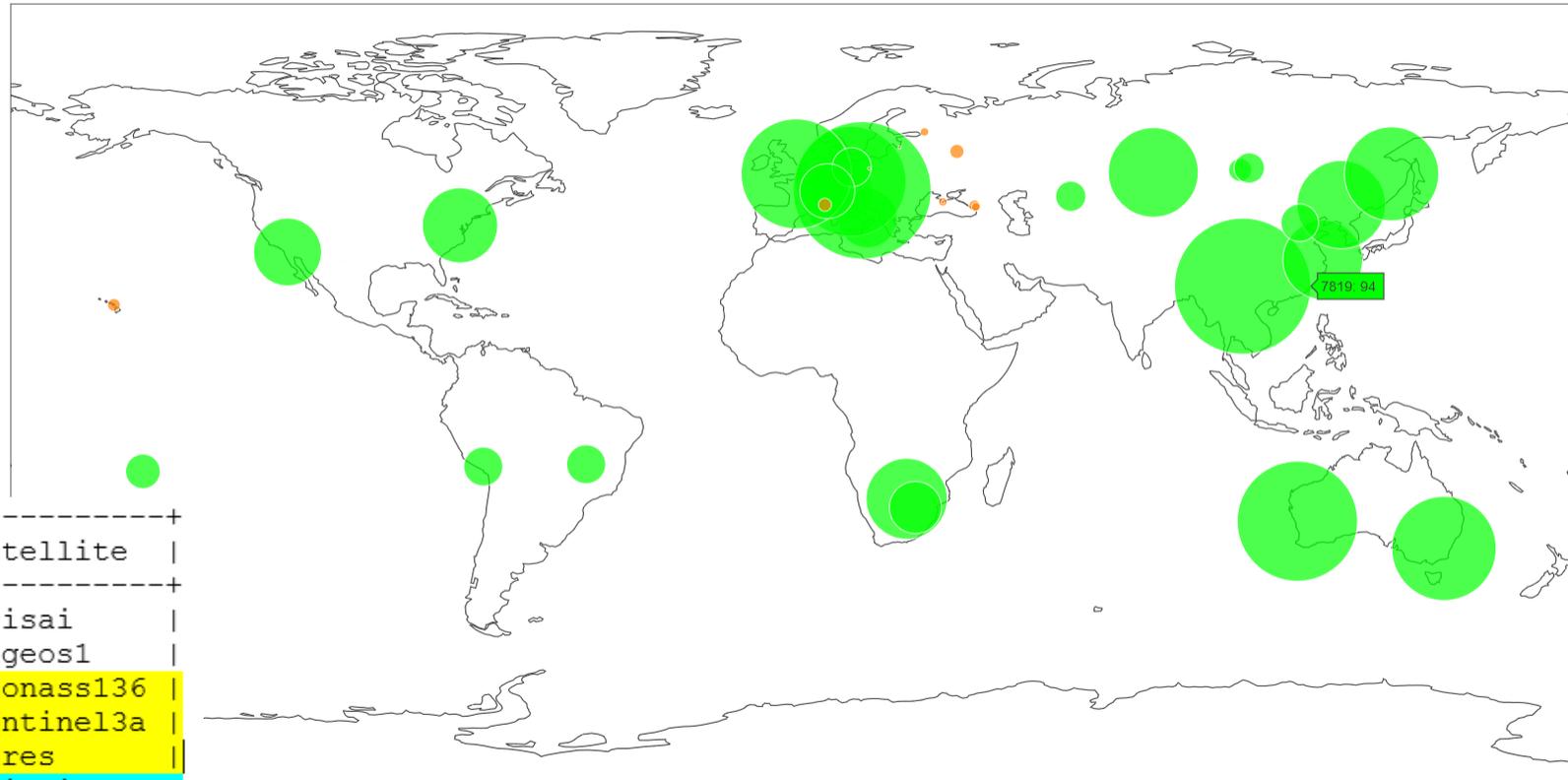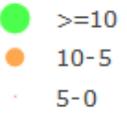   **Interleave is counted**
   **If the endTime > lastEndTime:**
     lastEndTime = endTime
  Else:
   **lastEndTime = endTime**

10% of Passes that Interleave

| startTime	endTime	satellite
2017-10-01 00:23:50	2017-10-01 00:30:45	ajisai
2017-10-01 01:30:35	2017-10-01 01:42:09	lageos1
2017-10-01 01:49:38	2017-10-01 03:43:15	glonass136
2017-10-01 02:16:30	2017-10-01 02:17:26	sentinel3a
2017-10-01 02:19:33	2017-10-01 02:32:10	lares
2017-10-01 02:28:33	2017-10-01 02:38:49	ajisai
2017-10-01 02:44:46	2017-10-01 04:30:25	galileo208
2017-10-01 04:29:31	2017-10-01 04:43:29	ajisai
2017-10-01 04:59:29	2017-10-01 05:39:49	lageos1
2017-10-01 06:16:39	2017-10-01 06:19:20	jason3

Priority List Adherence

Percentage of Passes that Tracked (Out of Top 10 Satellites on the Priority List)
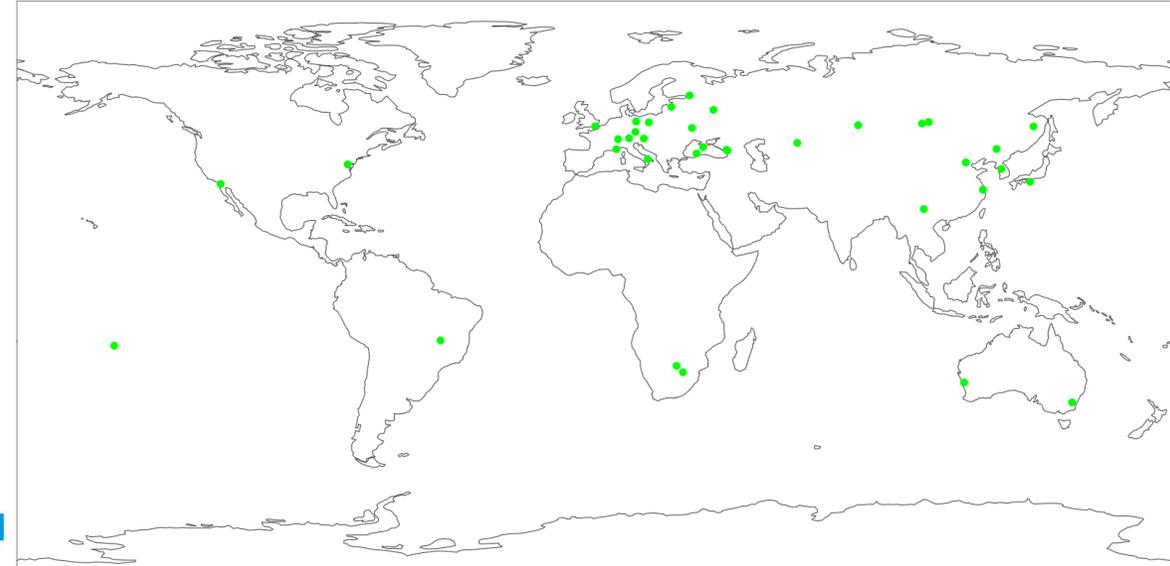(2017-10-01 to 2018-10-01)
ILRS Standard: 1%
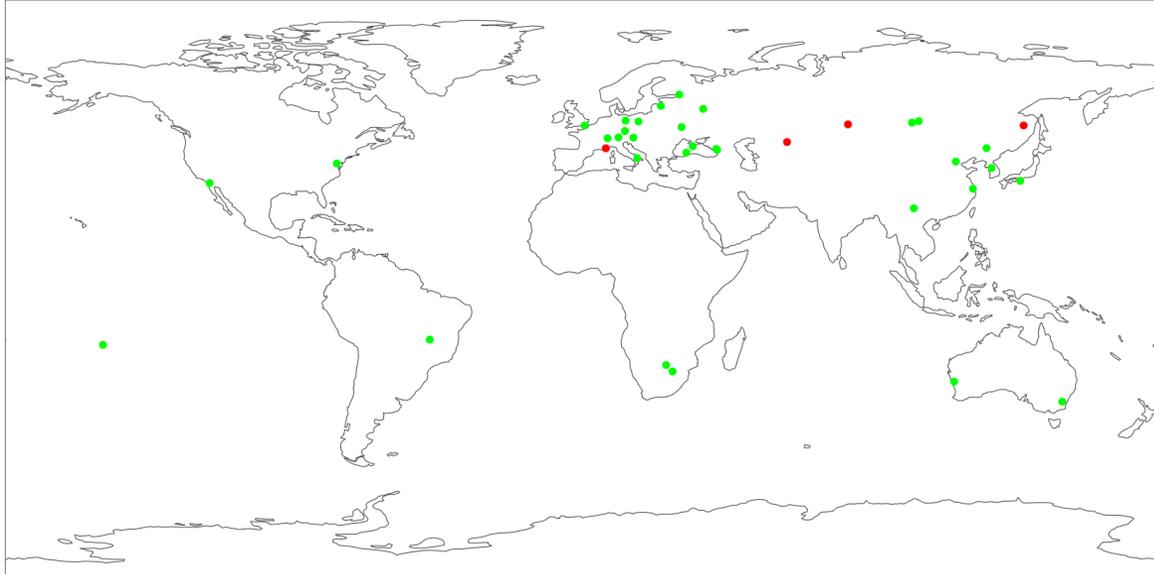
Percentage of Passes Tracked for Satellites not on Priority List
(2017-10-01 to 2018-10-01)
ILRS Standard (Maximum Allowed): 35%
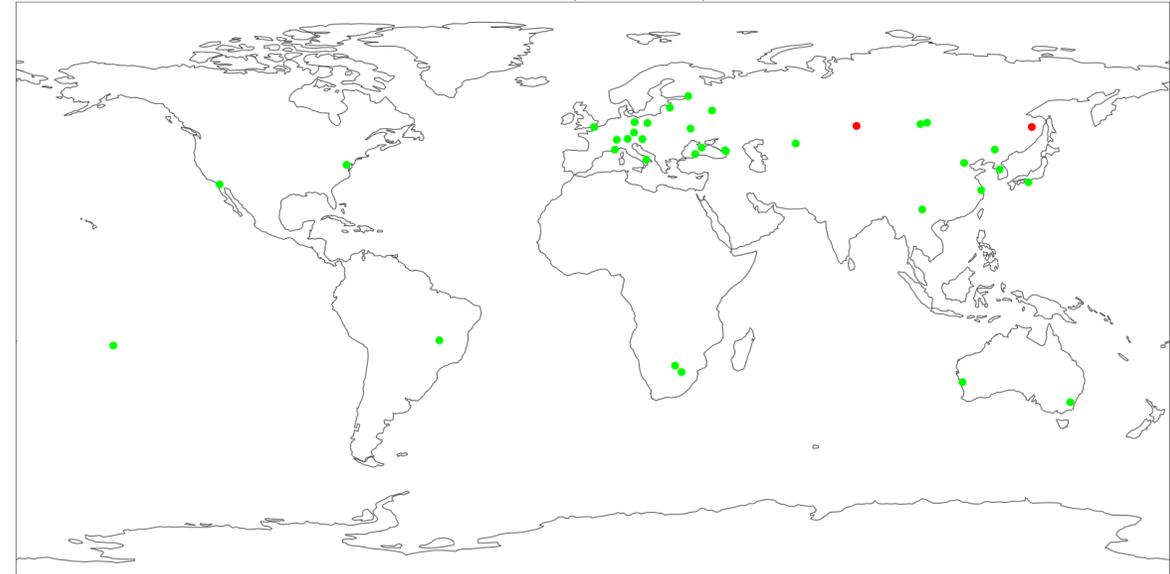
Percentage of Passes that Tracked (Out of Top 20 Satellites on the Priority List)
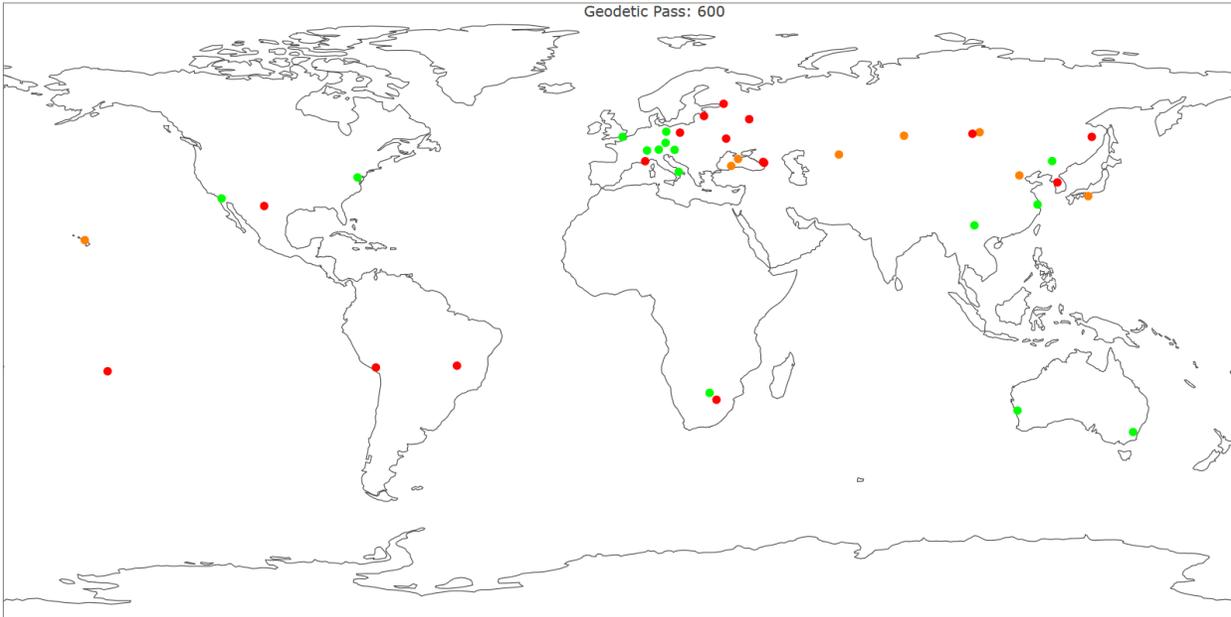(2017-10-01 to 2018-10-01)
ILRS Standard: 15%
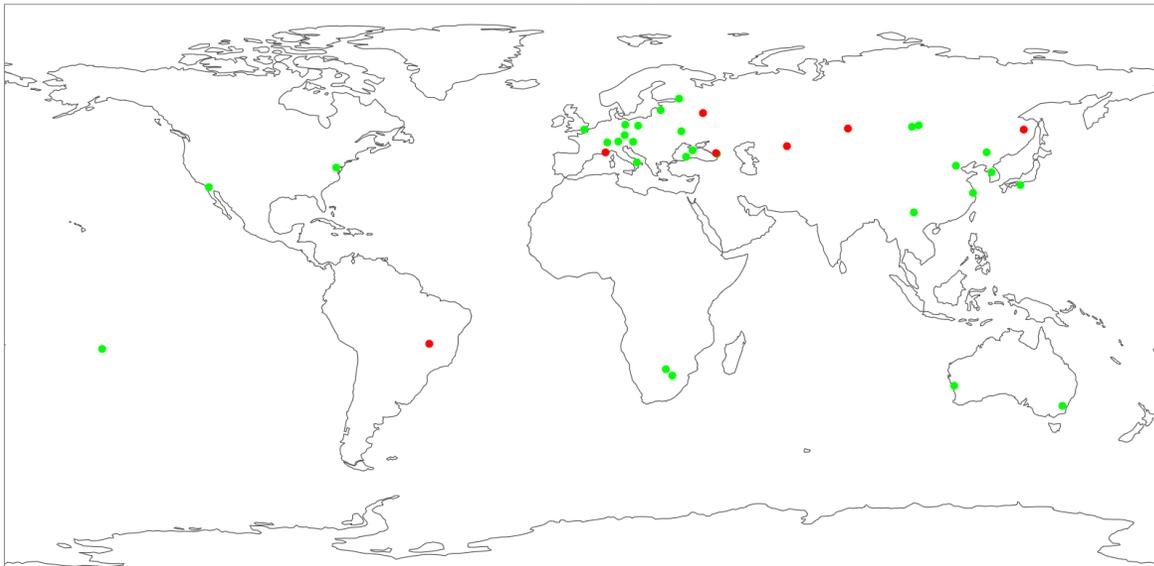
Percentage of Unique Satellites Tracked from the Priority List
(2017-10-01 to 2018-10-01)
ILRS Standard: 25%

Pass

Fail

Single Parameter Display Example

Total Number of Passes (Geodetic Satellites)
(2017-10-01 to 2018-10-01)
ILRS Standard: 600
Geodetic Pass: 600

Total Number of Passes (Geodetic Satellites)
(2017-10-01 to 2018-10-01)
ILRS Standard: 600
Geodetic Pass: 600
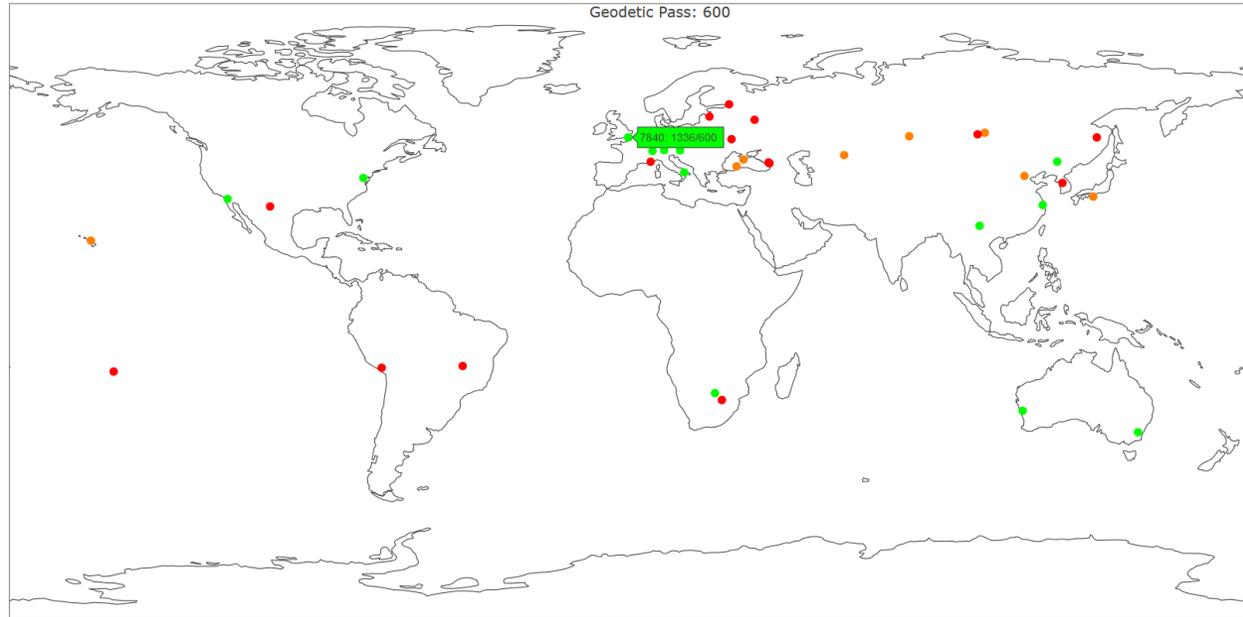
- ● >=100%
- ● 100%-50%
- ● 50%-0%

Parameter Reassessment

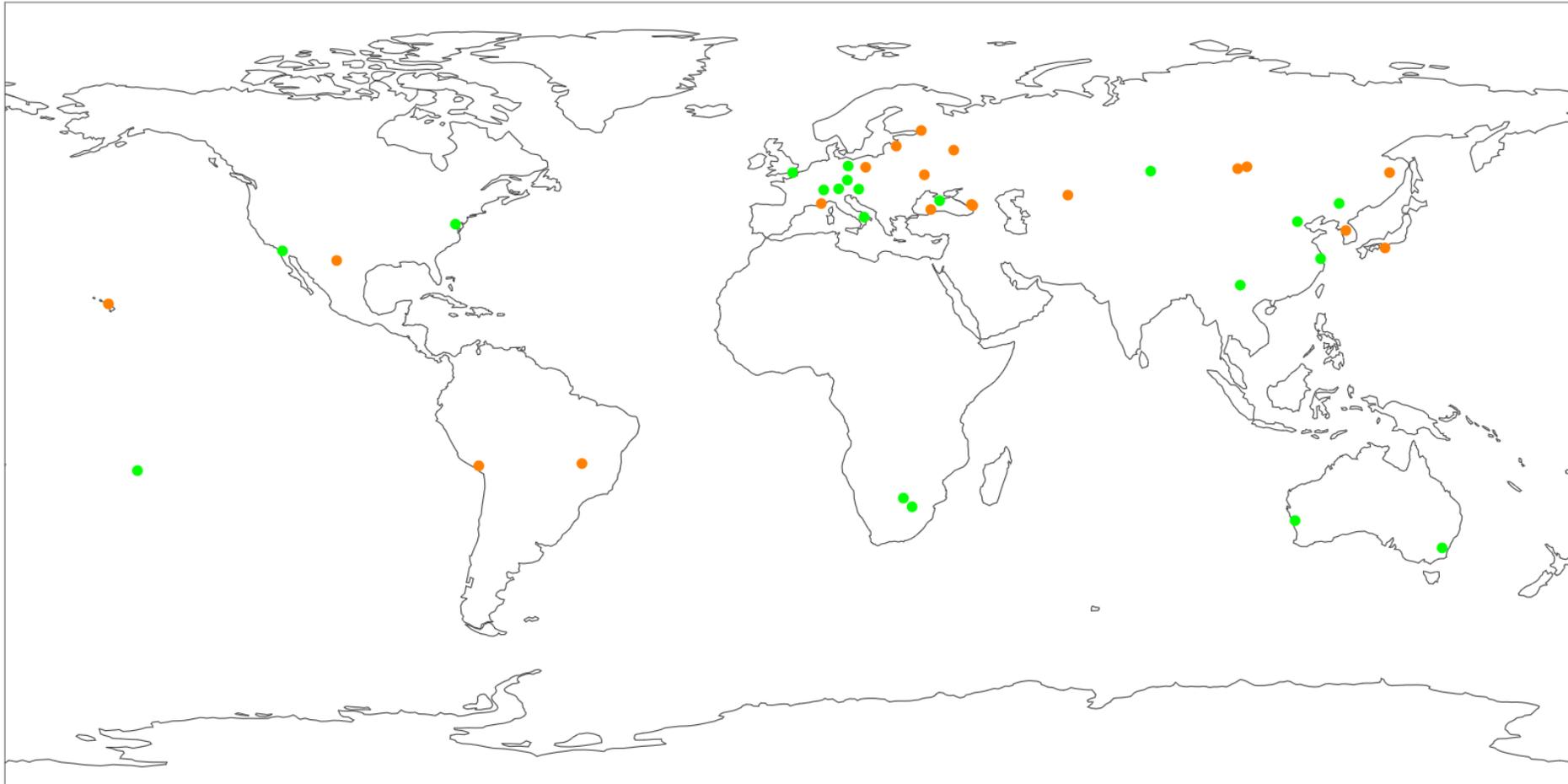Total Number of Passes (GNSS Satellites)
(2017-10-01 to 2018-10-01)
ILRS Standard: 3000
GNSS Pass: 3000
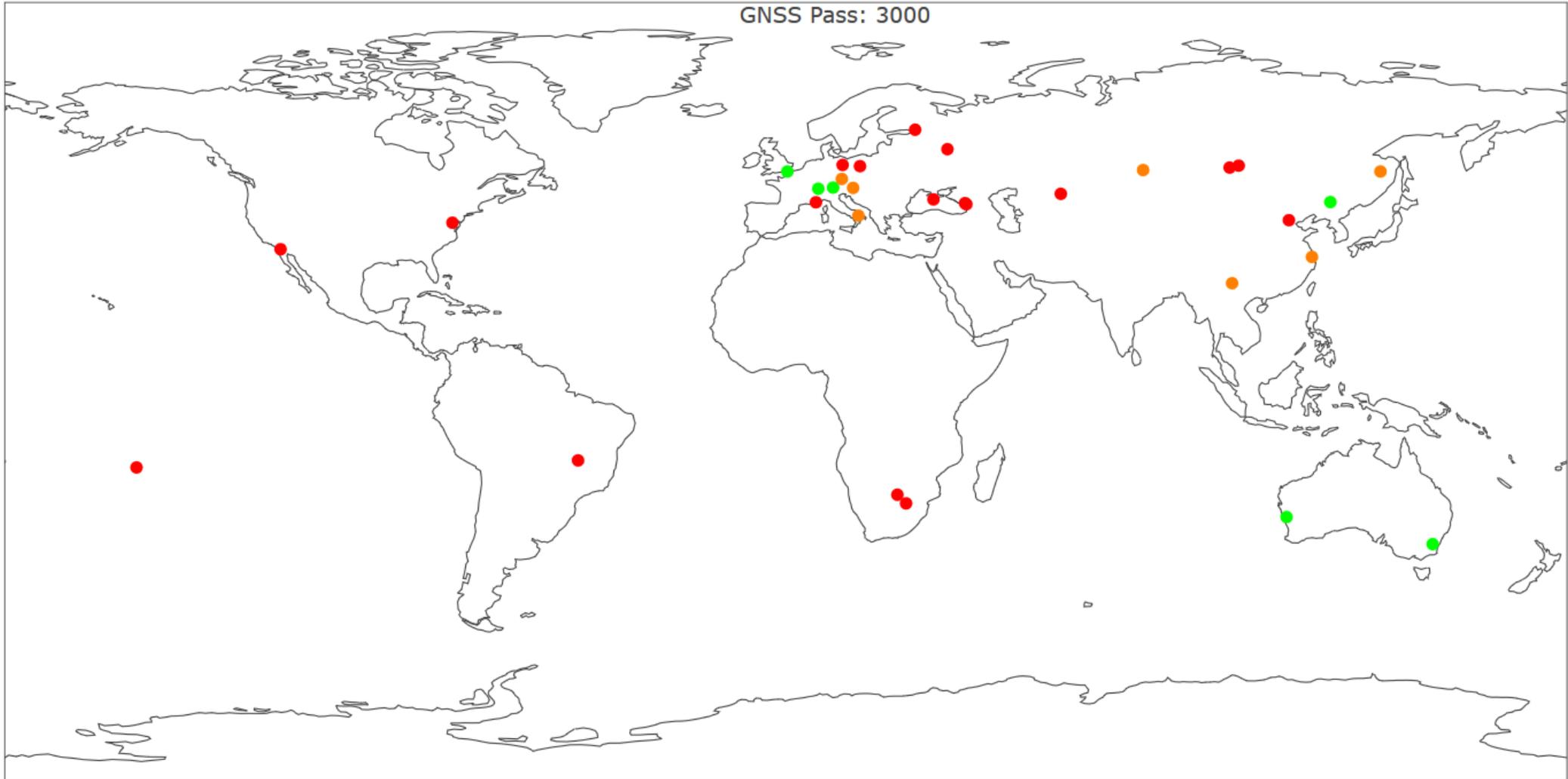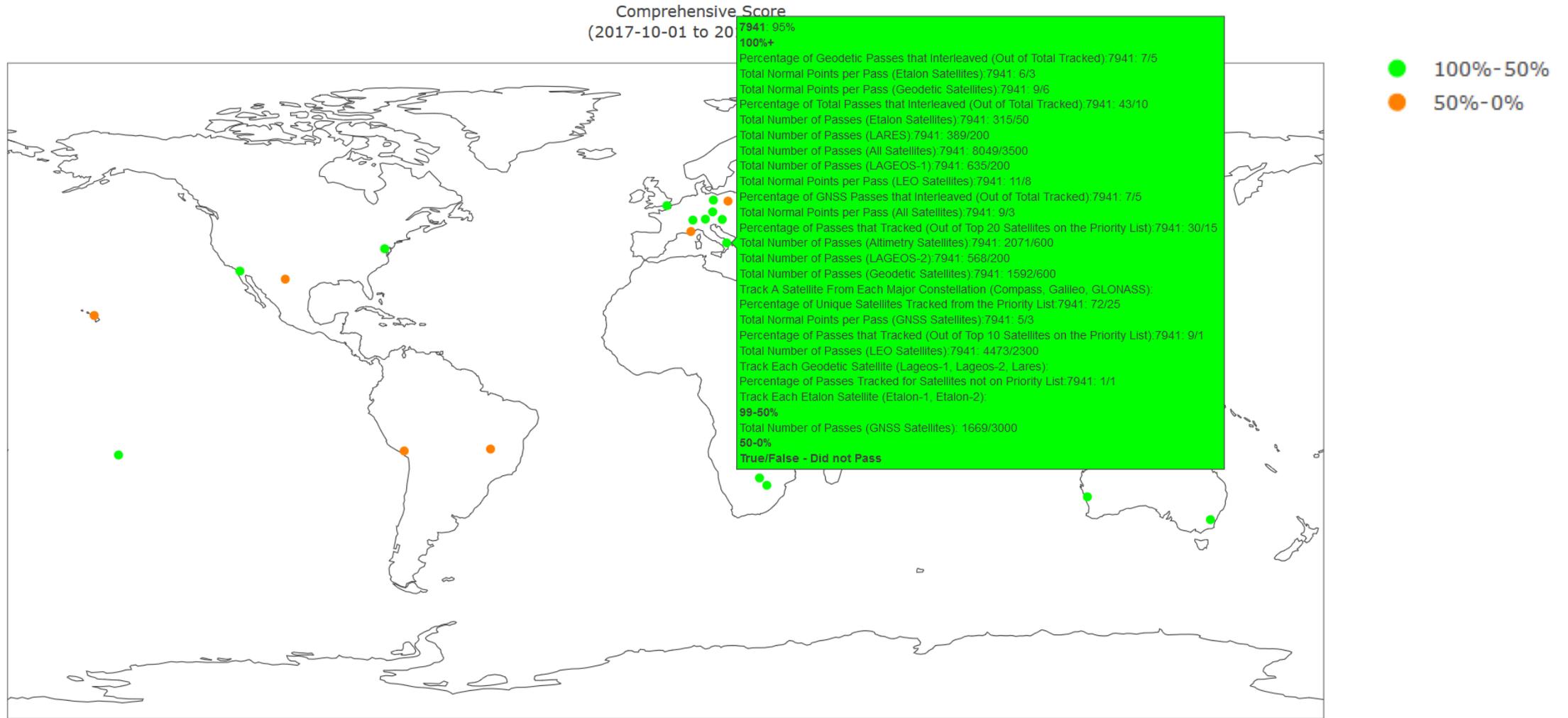
Overall Network Performance

Comprehensive Score
(2017-10-01 to 2018-10-01)

● 100%-50%
● 50%-0%

Note: Score based on all parameters weighed evenly

Overall Network Performance

Comprehensive Score
(2017-10-01 to 20...)

7941: 95%
100%+
Percentage of Geodetic Passes that Interleaved (Out of Total Tracked):7941: 7/5
Total Normal Points per Pass (Etalon Satellites):7941: 6/3
Total Normal Points per Pass (Geodetic Satellites):7941: 9/6
Percentage of Total Passes that Interleaved (Out of Total Tracked):7941: 43/10
Total Number of Passes (Etalon Satellites):7941: 315/50
Total Number of Passes (LARES):7941: 389/200
Total Number of Passes (All Satellites):7941: 8049/3500
Total Number of Passes (LAGEOS-1):7941: 635/200
Total Normal Points per Pass (LEO Satellites):7941: 11/8
Percentage of GNSS Passes that Interleaved (Out of Total Tracked):7941: 7/5
Total Normal Points per Pass (All Satellites):7941: 9/3
Percentage of Passes that Tracked (Out of Top 20 Satellites on the Priority List):7941: 30/15
Total Number of Passes (Altimetry Satellites):7941: 2071/600
Total Number of Passes (LAGEOS-2):7941: 568/200
Total Number of Passes (Geodetic Satellites):7941: 1592/600
Track A Satellite From Each Major Constellation (Compass, Galileo, GLONASS):
Percentage of Unique Satellites Tracked from the Priority List:7941: 72/25
Total Normal Points per Pass (GNSS Satellites):7941: 5/3
Percentage of Passes that Tracked (Out of Top 10 Satellites on the Priority List):7941: 9/1
Total Number of Passes (LEO Satellites):7941: 4473/2300
Track Each Geodetic Satellite (Lageos-1, Lageos-2, Lares):
Percentage of Passes Tracked for Satellites not on Priority List:7941: 1/1
Track Each Etalon Satellite (Etalon-1, Etalon-2):
99-50%
Total Number of Passes (GNSS Satellites): 1669/3000
50-0%
True/False - Did not Pass

- 🟢 100%-50%
- 🟠 50%-0%

Next Steps and Questions?

Track Each Geodetic Satellite (Lageos-1, Lageos-2, Lares)
(2017-10-01 to 2018-10-01)
ILRS Standard: Track each at least once
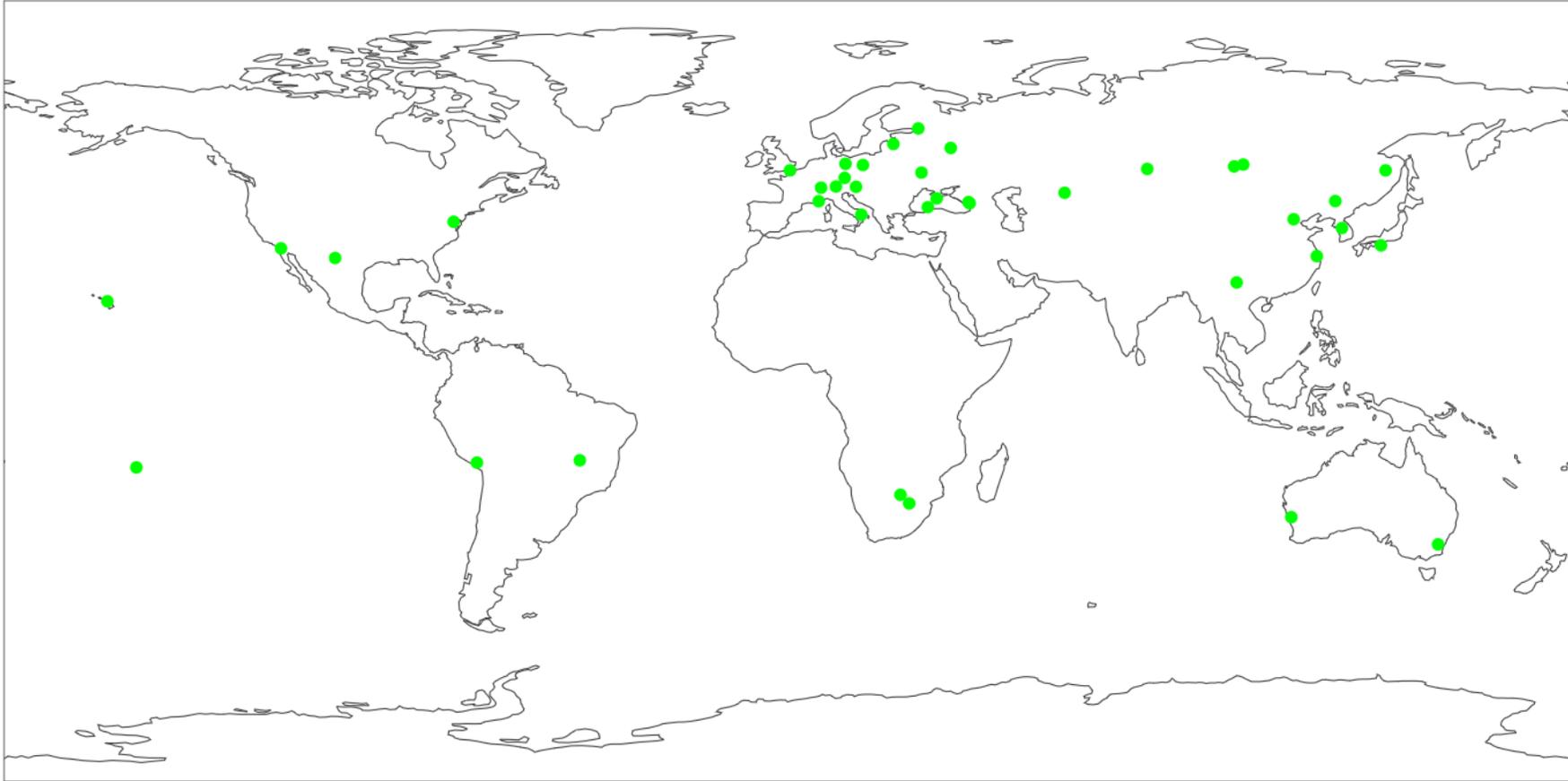
Please come see our poster "Station Assessment Software – Initial Results" where you'll be able to navigate through the program results