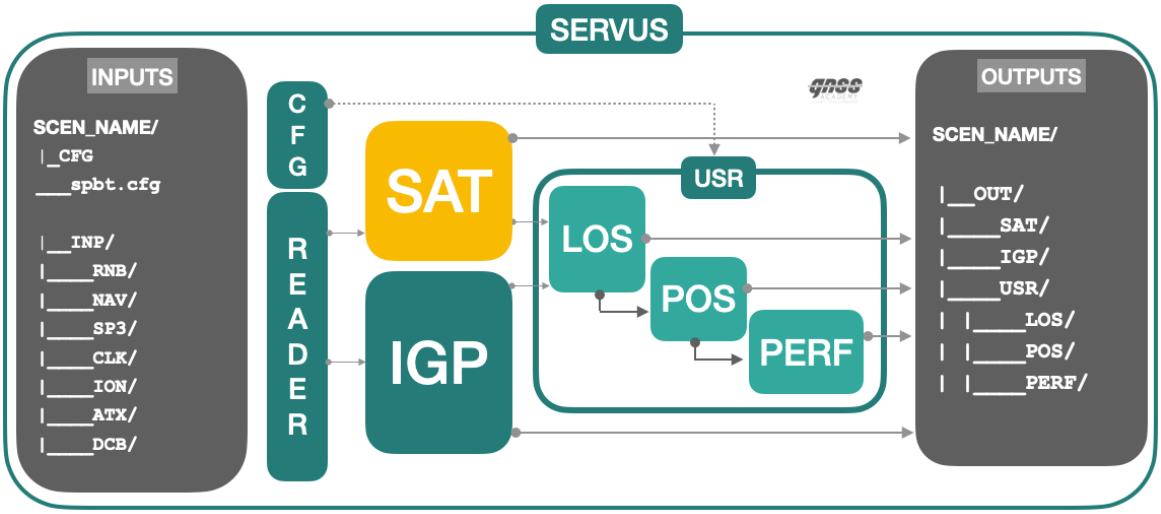
PROJECT: SERVUS		WP Number: WP-0000001
WP TITLE: WP1: Satellite Performance Characterization		**Issue**: 1.0
LEAD CONTRACTOR	GNSS Academy	
CUSTOMER	ESA	**WP LEADER**: Student
ESTIMATED EFFORT	20 hours	

OBJECTIVE

The main goal of this Work-Package is to develop the **Satellite Performance Module** of SERVUS tool by providing the daily satellite performance characterization on a EGNOS SIS real data campaign in January 2019

SCOPE

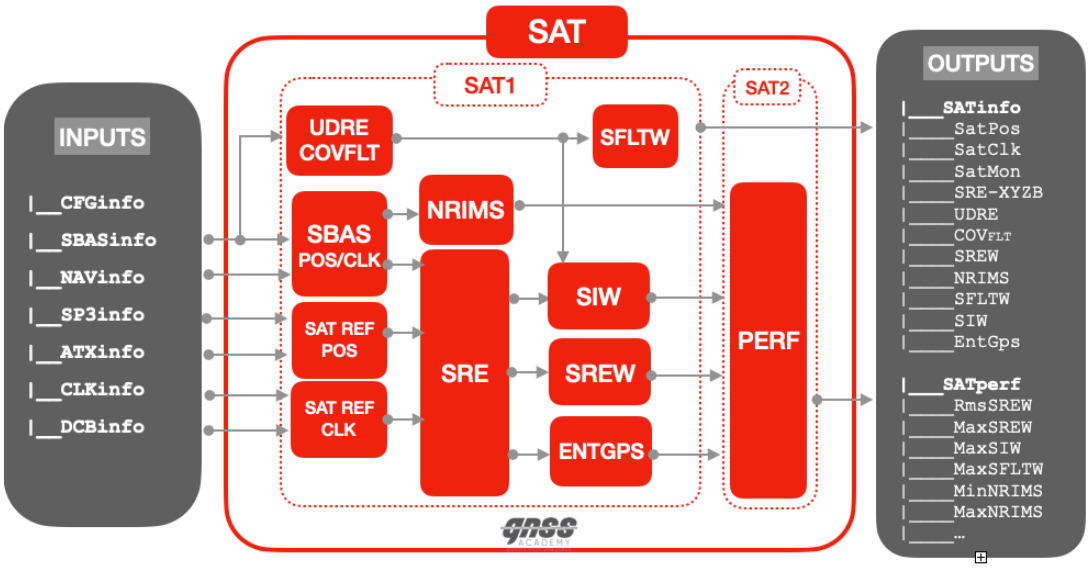
SERVUS high-level Architecture:



The **SERVUS SAT** module, the one in charge of computing SRE and the SigmaFLT as the main satellite indicators, is already implemented producing a daily file with the instantaneous information allowing to later characterize the satellite performance.

The main functions of this module are:

- Compute the Satellite Position and Clock from GPS Navigation Message
- Extract SBAS SIS satellite-related information:
  - FLT Corrections: FC (MT2-5/24), LTC (MT24-M25)
  - FLT Integrity Sigmas: UDRE (MT2-6), COV Matrix (MT27 or MT28)
  - Satellite Monitoring Flags (M/NM/DU) (MT2-6)
  - Degradation Factors (MT7-MT10)
- Compute the Satellite Corrected Position applying the corrections to the Navigation message.
- Compute True Orbit and Clock Information from reference files.
- Compute Satellite level main indicators:
  - Orbit&Clock Error: SRE-XYZ and SRE-ACR and SRE-B —> SREW (@WUL)
  - Error Variance: SigmaFLT at the WUL
  - Satellite Safety Index: SREU/5.33 SigmaFLT at WUL
  - Time Scale Offset: ENT-GPS OFFSET
- Assess the Satellite Performance in terms of accuracy (RMS SRE), Integrity (SI) and upper-bound (SigmaFLT)

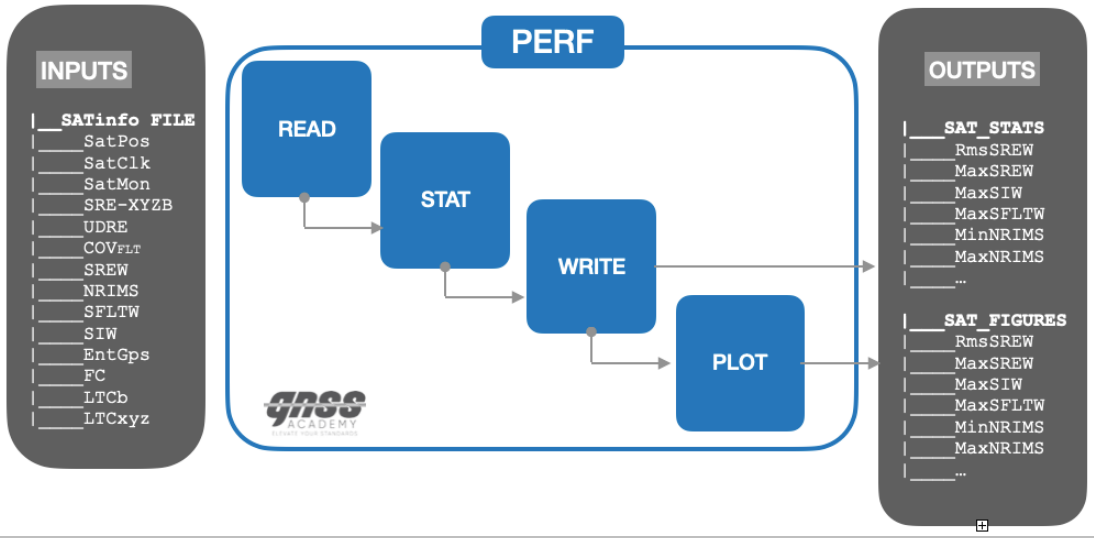


This first Work-package is related to the satellite-level characterization performances in terms of accuracy, integrity, and upper-bound.

- **Satellite Accuracy** is given by different statistics of the SRE (Satellite Residual Error) including the satellite orbit and clock errors.
- **Satellite Upper-bounding** and **Continuity** characterization is given by some statistics related to the SigmaFLT (equivalent to UDRE or SigmaUDRE)
- **Satellite Integrity** is given by the safety index SREU/5.33SigmaFLT at the Worst User location of the service are in order to ensure that the provided SigmaFLT correctly bounds the Error up to the required confidence levels.

This Work-package aims at developing the SAT2 Module corresponding to SAT PERF.

1. Read Satellite Instantaneous Information file.
2. Compute Satellite Statistics.
3. Write a Satellites Statistics file.
4. Plot Satellite Statistics.



INPUTS

This Work-package uses daily input files as the output of the SAT module.

1. **SAT_INFO_Y19D014_G123.dat** (See Description Below)

FILENAME: SAT_INFO_Y19D014_G123_50s.dat

Column	Content	Format	Units	Description
C1	SOD	%5d	SEC	Second of Day
C2	DOY	%03d	DAYS	Day of the Year
C3	PRN	%s%02d	No Units	Satellite PRN for GPS, Galileo or GEO
C4	SAT-X	%f	KMS	Satellite Navigation Position (CURRENT) X-Component
C5	SAT-Y	%f	KMS	Satellite Navigation Position (CURRENT) Y-Component
C6	SAT-Z	%f	KMS	Satellite Navigation Position (CURRENT) Z-Component
C7	MONSTAT	%d	No Units	Satellite Monitoring Status (0: NM; 1:M; -1; DU)
C8	SRESTAT	%d	No Units	Satellite SRE Status (0: NOK 1:OK)
C9	SREx	%f	METER	Satellite Residual Error X-Component
C10	SREy	%f	METER	Satellite Residual Error Y-Component
C11	SREz	%f	METER	Satellite Residual Error Z-Component
C12	SREb1	%f	METER	Preliminary Satellite Residual Error Clock Bias Component (containing the ENT-GPS Offset)
C13	SREW	%f	METER	Satellite Residual Error projected at the Worst User Location (WUL)
C14	SFLT-W	%f	METER	SigmaFLT/DFC projected at the Worst User Location (WUL)
C15	UDREI	%d		Satellite UDREI/DFREI Indicator
C16	FC	%f	METER	Satellite Clock Fast Corrections
C17	AF0	%f	METER	Satellite Clock Long Term Corrections Offset(LTCb=AF0+AF1(t-t0))=AF0 in EGNOS V2
C18	AF1	%f	METER	Satellite Clock Long Term Corrections drift This term is NULL in EGNOS V2
C19	LTCx	%f	METER	Satellite Orbit Long Term Corrections X-Component
C20	LTCy	%f	METER	Satellite Orbit Long Term Corrections Y-Component
C21	LTCz	%f	METER	Satellite Orbit Long Term Corrections Z-Component
C22	NRIMS	%d	-	Number of RIMS inside the ECAC that are in view from the satellite over a mask angle for, at least, 10min
C23	RDOP	%f	-	Radial DOP is the inverse DOP as seen from the Satellite to RIMS projected into the Radial direction

2. **RIMS_REF_POSITIONS_2019.dat** (See Description Below)

FILENAME: RIMS_REF_POSITIONS_2019.dat

Column	Content	Format	Units	Description
C1	$RIMS_{FLAG}$	%4d	none	Selection flag to activate or deactivate this RIMS from the PAN processing
C2	$RIMS_{ACRONYM}$	%8s	none	RIMS Acronym with 4 characters (e.g: ACRA)

C3	**$RIMS_{ID}$**	%02d	none	RIMS identifier as an integer between 00 and 99.
C4	**$RIMS_{LON}$**	%15.7f	deg	RIMS geographical longitude positon
C5	**$RIMS_{LAT}$**	%15.7f	deg	RIMS geographical latitude
C6	**$RIMS_{ALT}$**	%12.3f	m	RIMS height in meters
C7	**$RIMS_{MASK}$**	%10.2f	deg	RIMS Mask angle
C8	**$RIMS_{ACQ}$**	%5d	s	RIMS Receiver Acquisition time
C9	**$RIMS_{SITE}$**	%20s	none	RIMS site location as the representative name of the city
C10	**$RIMS_{COUNT}$**	%20s	none	RIMS Country location

```
# RIMS Parameters
#-----------------------------------------
# p1:  Selection flag [0:OFF/1:ON]
# p2:  Station Name Acronym [%4s]
# p3:  Station Number ID [%2d]
# p4:  Longitude [deg]
# p5:  Latitude [deg]
# p6:  Height [meters]
# p7:  Mask Angle [deg]
# p8:  Acquisition Time [minutes]
# p9:  Site [%s]
# p10: Country [%s]
#-------------------------------------------------------------------------------------------------------------------
# p1 |   p2   | p3 |        p4        |        p5        |    p6    |   p7   |  p8  |        p9          |      p10
#-------------------------------------------------------------------------------------------------------------------
   1     ABSA   01      31.6168738      22.3584909      199.489      10.00     5          Abu-Simbel              Egypt
   1     ACRA   02     -28.6228066      38.5186833      198.582      10.00     5              Azores           Portugal
   1     ALBA   03       9.8831919      57.0963560       42.678      10.00     5             Alborg            Denmark
   1     ALYA   04      29.9557435      31.1829123       12.531      10.00     5          Alexandria              Egypt
   1     ATHA   05      23.7911121      37.8612226      368.684      10.00     5              Athens            Greece
   1     BRNA   06      13.5410936      52.3569463       83.432      10.00     5               Berna       Switzerland
   1     CNRA   07     -15.3793852      27.9454109       51.123      10.00     5              Canary             Spain
   1     CRKA   08      -8.4962089      51.8446852      201.929      10.00     5                Cork           Ireland
   1     CTNA   09      15.0619850      37.4636507       47.297      10.00     5             Catania             Italy
   1     DJAA   10      10.7717472      33.8801909       36.873      10.00     5              Djerba           Tunisia
   1     EGIA   11     -14.4007338      65.2800856       89.528      10.00     5          Egilsstadir            Island
   1     GLGA   12      -4.4456436      55.8706262       64.261      10.00     5             Glasgow           Ireland
   1     GOLA   13      32.8035793      39.6381446     1088.564      10.00     5             Golbasi            Turkey
   1     GVLA   14      17.1331590      60.6663660       53.299      10.00     5               Gavle           Sweeden
   1     JMEA   15      -8.4915201      70.9728644       63.463      10.00     5           Jan-Mayen            Norway
   1     KIRA   16      29.9313365      69.7311459      119.770      10.00     5            Kirkenes            Norway
   1     LAPA   17      27.5553483      60.5388860       35.773      10.00     5         Lappeenranta           Finland
   1     LPIA   18     -17.7603716      28.6196424      137.719      10.00     5            LaPalma             Spain
   1     LSBA   19      -9.1298707      38.7887635      157.600      10.00     5             Lisbon          Portugal
   1     LYRA   20      15.3965961      78.2285265      496.566      10.00     5           Svalbard            Norway
   1     MADA   21     -16.7056705      32.7474268      192.855      10.00     5            Madeira          Portugal
   1     MLGA   22      -4.5144494      36.6846957       60.881      10.00     5             Malaga             Spain
   1     PARA   23       2.3349038      48.8359007      123.380      10.00     5              Paris            France
   1     PDMA   24       2.7387532      39.5636956       51.540      10.00     5            Mallorca             Spain
   1     RKKA   25     -21.9315020      64.1292866       83.945      10.00     5           Reykjavik            Island
   1     ROMA   26      12.5837594      41.8039468      172.877      10.00     5               Rome             Italy
   1     SDCA   27      -8.4248159      42.9264046      437.005      10.00     5            Santiago             Spain
   1     SOFA   28      23.4101179      42.6848906      611.360      10.00     5              Sofia          Bulgaria
   1     SWAA   29      -1.2869796      50.8871205       76.428      10.00     5            Swanwich           England
   1     TLSA   30       1.4970244      43.4285678      253.477      10.00     5            Toulouse            France
   1     TRDA   31      10.8993146      63.4568329       43.875      10.00     5           Trondheim            Norway
   1     TROA   32      18.9390987      69.6631570      136.126      10.00     5             Tromsoe            Norway
   1     WRSA   33      21.0676369      52.2147521      125.452      10.00     5              Warsaw            Poland
   1     ZURA   34       8.5648888      47.4537484      514.795      10.00     5              Zurich       Switzerland
   1     NOUA   35     -15.9544648      18.0818926       35.278      10.00     5           Nouakchott        Mauritania
   1     HFAA   36      35.0220640      32.7789087      239.597      10.00     5               Haifa            Israel
   1     AGAA   37      -9.4115837      30.3185120      119.179      10.00     5              Agadir           Morocco
   1     HBKA   38      27.7071958     -25.8833373     1548.973      10.00     5       Hartebeesthoek        SouthAfrica
   1     MONA   39     -64.7692785      46.0711908       31.816      10.00     5             Moncton            Canada
```

OUTPUTS

Two main kind of outputs for this Work Package are required:

- A Daily file with per satellite performance Statistics with the following format and content: **SAT_STAT_Y19D014_G123_50s.dat**

Column	Content	Format	Units	Description
C1	**PRN**	%s	No Units	Satellite PRN for GPS (e.g: G01)
C2	**MON**	%6.2f	%	Satellite Monitoring Percentage along the day
C3	**RIMS-MIN**	%4d	No Units	Minimum Number of RIMS in view during the day
C4	**RIMS-MAX**	%6d	No Units	Maximum Number of RIMS in view during the day
C5	**SREaRMS**	%10.3f	METER	RMS of the SRE-A along the day, the Satellite Orbit Residual Error Along-Track component

C6	**SREcRMS**	%8.3f	METER	RMS of the SRE-C along the day, the Satellite Orbit Residual Error Cross-Track component
C7	**SRErRMS**	%8.3f	METER	RMS of the SRE-R along the day, the Satellite Orbit Residual Error Radial component
C8	**SREbRMS**	%8.3f	METER	RMS of the SRE-B along the day: the Satellite Residual Error Clock component **SRE-B is computed subtracting the ENT-GPS Offset from the SREb1**
C9	**SREWRMS**	%8.3f	METER	RMS of SREW along the day
C10	**SREWMAX**	%8.3f	METER	Maximum SREW reached along the day
C11	**SFLTMAX**	%8.3f	METER	Maximum SigmaFLT@WUL reached along the day
C12	**SFLTMIN**	%8.3f	METER	Minium SigmaFLT@WUL reached along the day
C13	**SIMAX**	%8.3f	No Units	Maximum SI_{SAT} reached along the day $$SI_{SAT} = \frac{SREW}{5.33 \cdot SFLT_W}$$
C14	**FCMAX**	%8.3f	METER	Maximum Satellite Clock Fast reached along the day.
C15	**LTCbMAX**	%8.3f	METER	Maximum Clock Long Term Corrections (LTCb) reached along the day
C16	**LTCxMAX**	%8.3f	METER	Maximum Satellite Long Term Corrections X-Component (LTCx) reached along the day
C17	**LTCyMAX**	%8.3f	METER	Maximum Satellite Long Term Corrections Y-Component (LTCy) reached along the day
C19	**LTCzMAX**	%8.3f	METER	Maximum Satellite Long Term Corrections Z-Component (LTCz) reached along the day
C20	**NMI**	%8.3f	No Units	Number of Misleading Information (MI). Number of times SIW > 1
C21	**NTRANS**	%4d	No Units	Number of Transitions from M to NM and M to DU

- A Daily file containing the estimated ENT-GPS per epoch:

ENTGPS_Y19D014_G123_50s.dat

Column	Content	Format	Units	Description
C1	**SOD**	%5d	SEC	Second of Day
C2	**ENT-GPS**	%10.4f	SEC	ENT to GPS Offset computed as follows: $$ENTGPS = median(\{SREb1 - SREr\}_{SRE_{STATUS}==1})$$ Where SREr is the projection of (SREx, SREy, SREz) into the satellite radial direction And SREb1 is the preliminary Satellite Clock Error including the time scales offset

- Daily Satellite performance plots

TASKS		
ID	**DESCRIPTION**	
T0. PRELIMINARY	Downloading and Understanding	
T0.1 FOLDER TREE	Download following TAR file: **STEP1. Download SERVUS-TOOL folder tree and files** → **SBPT-SERVUS_WP1.tgz** **STEP2. Place it somewhere in the GNSS Academy working directory** **STEP3 untar the file.**	

	tar xvfz SBPT-SERVUS_WP1.tgz Check that all the following information is available: **SBPT/SERVUS/SERVUS_V1.0/SERVUS_WP1_SAT/** **|____SRC** | |____SatPerformances.py | |____SatFunctions.py | |____COMMON | | |____PlotsConstants.py | | |____Plots.py | | |____Coordinates.py | | |____GnssConstants.py | | |____Dates.py **|____SCN** | |____SCEN-EGNOS-SIS-GEO123-JAN19 **| | |____CFG** | | | |____satperformances.cfg **| | |____INP** | | | |____**NAV**/brdc0140.19n | | | |____**RNB**/M1230140.19b | | | |____**EMS**/GEO123/2019/DOY014/h*.ems | | | |____**SP3**/igs20361.sp3 | | | |____**DCB**/P1C11901.DCB & P1P21901.DCB | | | |____**ATX**/igs14.atx | | | |____**ION**/igsg0140.19i | | | |____**CLK**/igs20361.clk_30s | | | |____**RIMS**/RIMS_REF_POSITIONS_2019.dat **| | |____OUT** **| | | |____SAT** | | | | |____SAT_INFO_Y19D014_G123_50s.dat | | | | |____SAT_INFO_Y19D015_G123_50s.dat | | | | |____SAT_INFO_Y19D016_G123_50s.dat Note that there are 3 SAT_INFO files already sampled at 50 seconds in order to speed-up the execution process. Output Files will be generated in: **OUT/SAT/SAT_STAT_Y19D014_G123_50s.dat** **OUT/SAT/SAT_STAT_Y19D015_G123_50s.dat** **OUT/SAT/SAT_STAT_Y19D016_G123_50s.dat** Output Figures shall be generated in: **OUT/SAT/figures/*.png**	
T1. IMPLEMENTATION	Functions Implementation: Open/Reading/Loading	
T1.1 Configuration	Check configuration file. 3 configuration parameters, INI_DATE, END_DATE (in order to run only one day, both shall be the same) and TSTEP. **CFG/satperformances.cfg**	
T1.2 Execution	Execute SatPerformance Module Call Main function from the SRC directory and check that you generate	

	`python SatPerformances.py ../SCN/`SCEN-EGNOS-SIS-GEO123-JAN19 Check that this runs properly and that already generates the following files: **OUT/SAT/SAT_STAT_Y19D014_G123_50s.dat** **OUT/SAT/ENTGPS_Y19D014_G123_50s.dat** These files are partial files that have to be completed with the remaining columns.	
T1.3 Implementation	Implement the necessary Python functions to create the satellite statistics file with all the different columns, in line with following tasks.	
T2. ENTGPS	Create a file including the instantaneous ENT-GPS Offset	
SOD	Seconds of Day	
ENTGPS	ENT-GPS Offset: estimated from the SRE of the monitored satellites with SRE_STATUS OK, as follows: $$ENTGPS = median(\{SREb1 - SREr\}_{SRE_{STATUS}==1})$$ Where SREr is the projection of (SREx, SREy, SREz) into the satellite radial direction	
T3. STATISTICS	Create a file including all satellite Statistics with the following information per columns. SAT_STATISTICS_	
PRN	PRN: Satellite PRN	
MON	Satellite Monitoring Percentage in the day. Count the number of epochs the satellite has been monitored during the day divided by the total number of seconds in the day.	
MIN RIMS	Minimum number of RIMS in view by the satellite during the day Note that the satellite is monitored by EGNOS when the satellite is seen at least by 3 RIMS.	
MAX RIMS	Maximum number of RIMS in view by the satellite during the day	
RMS-SRE$_R$	Root Mean Square of Satellite Orbit Error - Radial Component Note that SRE$_R$ is not in the input file. It has to be computed by projecting the SRE$_{XYZ}$ along the orbit radial component. Radial Direction $U_R = r_s / \lvert r_s \rvert$	
RMS-SRE$_C$	Root Mean Square of Satellite Orbit Error - Cross Track Component Note that SRE$_C$ is not in the input file. It has to be computed by projecting the SRE$_{XYZ}$ along the orbit cross track component. **$U_C = U_R \times U_V$** where $U_R = r_s / \lvert r_s \rvert$ in the direction of the satellite position (r_s) $U_V = v_s / \lvert v_s \rvert$ in the direction of the satellite velocity (v_s) Note that Velocity is obtained by deriving the Satellite Position during the monitoring periods. Care shall be taken for the first epoch of the satellite monitoring pass since	

	no previous position to compute the velocity. First sample will be discarded from the statistics.
	
	Do not forget that it is a non-inertial reference frame and you need to add the Earth's Rotation in order to get the absolute velocity.
	
	$V_{sat} = \frac{P_{sat}(k) - P_{sat}(k-1)}{\Delta t} + \Omega_{EARTH} x P_{sat}(k)$
	
	# Earth's rotation rate (rad/sec)
	OMEGA_EARTH = 7.2921151467e-5	

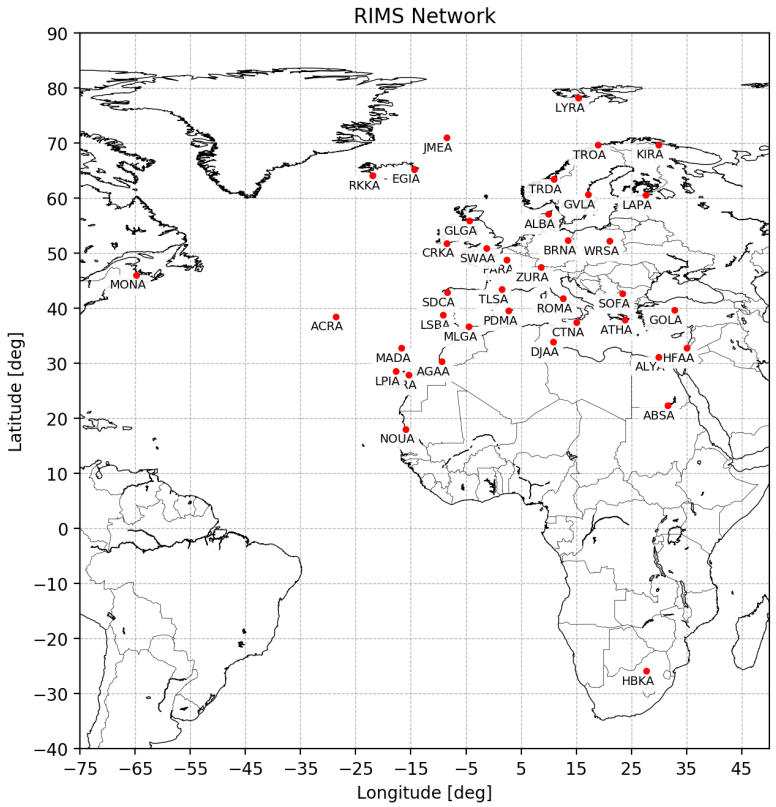
RMS-SRE$_A$	Root Mean Square of Satellite Orbit Error - Along Track Component Note that SRE$_A$ is not in the input file. It has to be computed by projecting the SRE$_{XYZ}$ along the orbit along track component. Along-Track is the cross product between Cross and Radial Track Component. **$U_A = U_C$ x U_R** $RMS = \sqrt{\frac{\Sigma(X_k)^2}{N}}$	
RMS-SRE$_B$	Root Mean Square of SRE-B Clock Component *SRE-B is computed subtracting the ENT-GPS Offset from the SREb1*	
RMS-SREW	Root Mean Square of SREW: satellite Orbit Error at the Worst User Location	
MAX-SREW	Maximum SREW Satellite Orbit Error at the Worst User Location	
MAX SFLT	Maximum Sigma FLT as the Satellite Orbit and clock Error Sigma at the Worst User Location.	
MAX SIW	Maximum Satellite Safety Index as the ratio between the SRE and the SigmaFLT at the Worst User Location The **instantaneous SI** for each satellite shall be computed as follows: $SI_{SAT} = \frac{SREW}{5.33 \cdot SFLT_W}$	
MAX LTCx	Maximum (absolute)Value of the Satellite Position LTC correction X-Component	
MAX LTCy	Maximum (absolute)Value of the Satellite Position correction LTC Y-Component	
MAX LTCz	Maximum (absolute)Value of the Satellite Position correction LTC Z-Component	
MAX LTCb	Maximum (absolute) Value of the Satellite LTC -Clock AF0	
MAX FC	Maximum (absolute)Value of the Satellite Clock Fast Corrections	
NMI	Number of Satellite MIs (Misleading Information) as the number of times SI is higher than 1. (SI>1)	
NTRANS	Number of transitions Monitored to Not Monitored (MtoNM) or to Don't USE (MtoDU)	

SAT_STAT_Y19D014_G123_50s.dat

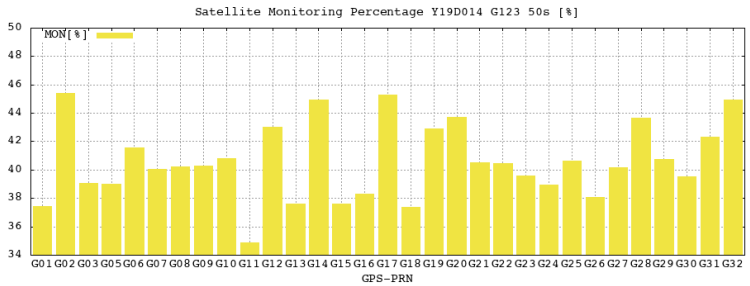
#PRN	MON	minRIMS	MaxRIMS	SREaRMS	SREcRMS	SRErRMS	SREbRMS	SREWRMS	SREWMAX	SFLTMAX	SFLTMIN	SIMAX	FCMAX	LTCbMAX	LTCxMAX	LTCyMAX	LTCzMAX	NMI	NTRANS
G01	37.44	4	39	2.663	0.591	0.488	0.470	0.562	1.235	2.384	0.938	0.228	1.750	1.675	2.375	3.625	4.500	0	3
G02	45.43	4	38	2.739	0.581	0.428	0.352	0.630	2.214	2.352	0.938	0.248	2.750	0.977	2.625	1.875	3.000	0	3
G03	39.06	4	38	3.898	0.947	0.691	0.587	0.842	1.807	4.664	0.938	0.286	2.375	2.094	3.000	4.500	4.125	0	5
G05	39.00	3	39	1.421	0.875	0.527	0.807	0.567	1.475	1.700	0.938	0.281	2.000	1.256	1.625	2.125	1.250	0	2
G06	41.55	3	39	2.587	1.160	0.411	0.470	0.671	1.859	4.632	0.938	0.249	1.750	2.094	2.000	2.250	1.625	0	3
G07	40.05	5	39	2.397	0.575	0.479	0.499	0.580	1.136	2.384	0.938	0.210	2.500	2.094	3.000	2.125	1.625	0	3
G08	40.22	3	39	4.232	0.577	1.285	1.209	0.873	2.240	2.352	0.938	0.336	2.875	2.652	5.875	6.625	6.500	0	2
G09	40.28	3	39	2.747	0.620	0.643	0.584	0.562	1.514	4.664	0.938	0.209	1.375	1.256	7.500	3.750	6.500	0	6
G10	40.80	3	38	1.427	0.776	0.241	0.592	0.619	1.706	2.422	0.938	0.315	1.625	2.234	1.250	3.500	4.000	0	7
G11	34.90	5	39	2.082	0.414	0.585	0.782	0.602	1.498	1.510	0.938	0.288	1.250	2.513	2.875	3.125	2.875	0	3
G12	43.00	1	39	4.173	0.435	0.330	0.811	0.970	2.172	1.870	0.938	0.414	2.875	1.117	1.500	2.750	4.625	0	8
G13	37.62	4	39	3.031	1.160	1.142	1.195	0.931	1.996	2.306	0.938	0.272	1.875	3.211	1.875	4.250	4.000	0	5
G14	44.91	4	38	1.675	0.983	0.531	0.589	0.505	1.366	1.896	0.938	0.241	0.875	1.256	1.750	2.250	2.750	0	3
G15	37.62	3	39	2.756	2.210	1.297	1.528	0.872	1.532	1.668	0.938	0.307	2.500	1.256	4.125	4.500	2.375	0	2

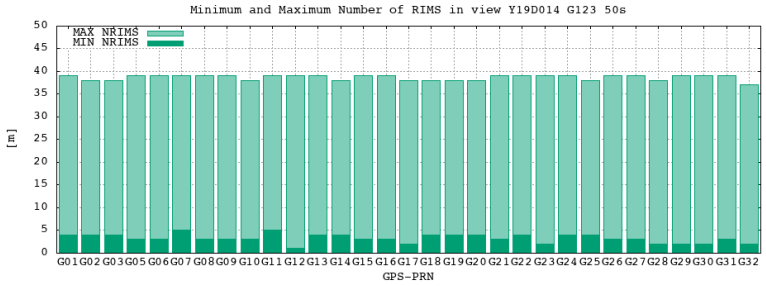
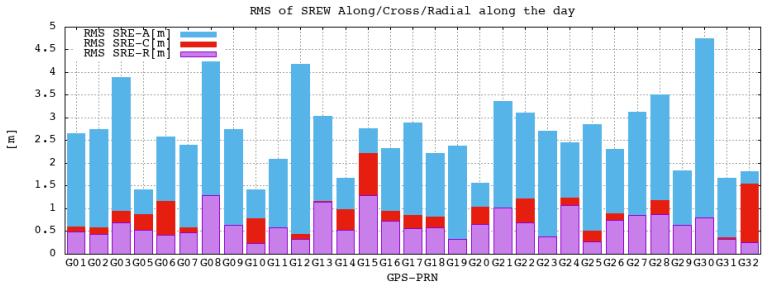
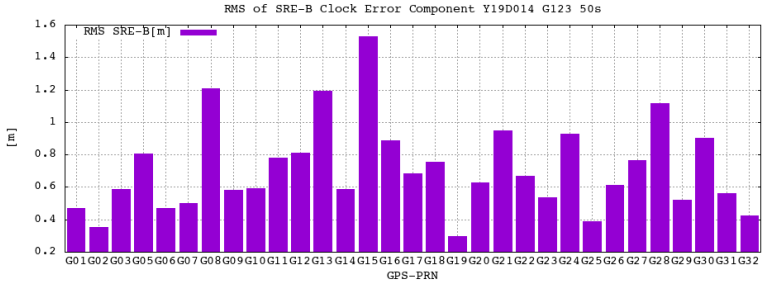
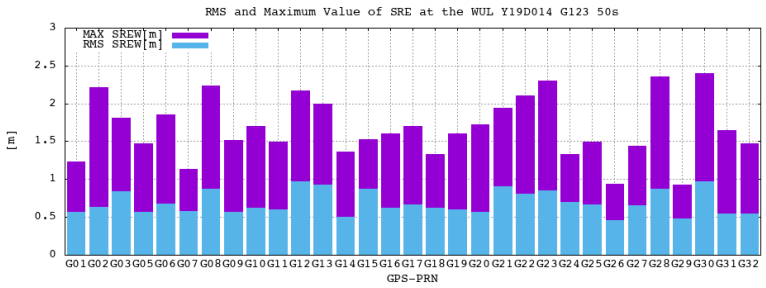
G16	38.31	3	39	2.326	0.937	0.724	0.889	0.617	1.608	1.896	0.938	0.300	1.625	1.117	2.625	1.625	3.375	0	3
G17	45.31	2	38	2.897	0.859	0.557	0.683	0.663	1.701	2.384	0.938	0.201	1.750	0.698	2.125	2.125	2.125	0	2
G18	37.38	4	38	2.216	0.818	0.578	0.754	0.624	1.331	2.352	0.938	0.206	2.375	2.094	2.250	3.000	4.375	0	3
G19	42.88	4	38	2.382	0.331	0.329	0.297	0.600	1.603	1.966	0.938	0.256	2.625	1.117	3.250	0.625	3.875	0	2
G20	43.69	4	38	1.556	1.032	0.662	0.626	0.569	1.723	1.896	0.938	0.245	1.750	1.256	2.375	1.875	1.625	0	3
G21	40.51	3	39	3.364	0.547	1.020	0.949	0.908	1.942	4.664	0.938	0.278	2.000	1.256	2.375	4.250	5.500	0	3
G22	40.45	4	39	3.118	1.214	0.699	0.669	0.806	2.100	4.632	0.938	0.340	3.000	1.675	1.625	1.750	4.000	0	4
G23	39.58	2	39	2.709	0.347	0.390	0.535	0.849	2.306	2.384	0.938	0.336	2.750	2.373	3.375	3.500	4.625	0	2
G24	38.95	4	39	2.462	1.234	1.070	0.930	0.702	1.334	1.928	0.938	0.246	2.000	2.932	1.625	4.000	3.250	0	2
G25	40.62	4	38	2.849	0.505	0.267	0.387	0.663	1.499	4.585	0.938	0.280	1.500	0.977	0.750	2.250	2.875	0	3
G26	38.08	3	39	2.303	0.884	0.747	0.614	0.458	0.941	1.668	0.938	0.184	2.625	2.234	5.375	2.500	5.625	0	3
G27	40.16	3	39	3.131	0.687	0.860	0.765	0.655	1.439	1.472	0.938	0.233	1.500	1.675	3.500	3.125	2.875	0	2
G28	43.63	2	38	3.515	1.183	0.879	1.117	0.871	2.352	4.606	0.938	0.345	1.875	2.513	2.375	2.625	4.125	0	4
G29	40.74	2	39	1.835	0.505	0.636	0.520	0.485	0.922	2.352	0.938	0.180	2.500	2.094	2.000	2.625	1.250	0	3
G30	39.53	2	39	4.745	0.769	0.806	0.905	0.975	2.398	4.632	0.938	0.355	3.750	1.954	4.125	4.875	5.250	0	3
G31	42.30	3	39	1.676	0.364	0.325	0.560	0.545	1.647	4.664	0.938	0.209	2.000	2.094	1.625	1.875	1.250	0	3
G32	44.91	2	37	1.827	1.540	0.262	0.423	0.547	1.468	4.632	0.938	0.201	1.625	1.675	4.000	1.125	2.750	0	3

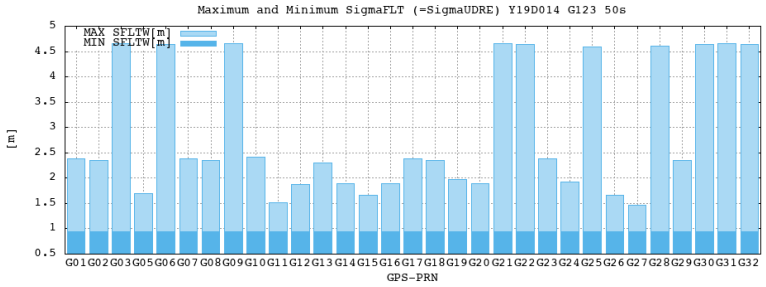
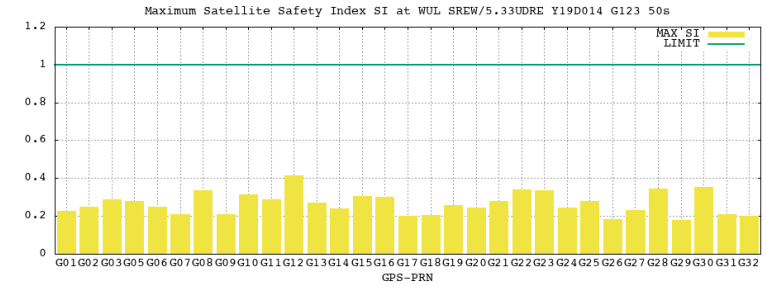
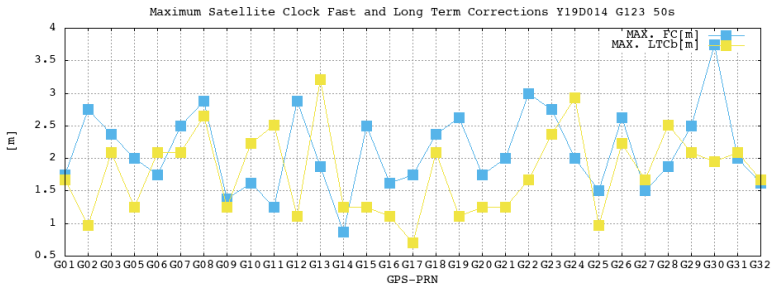
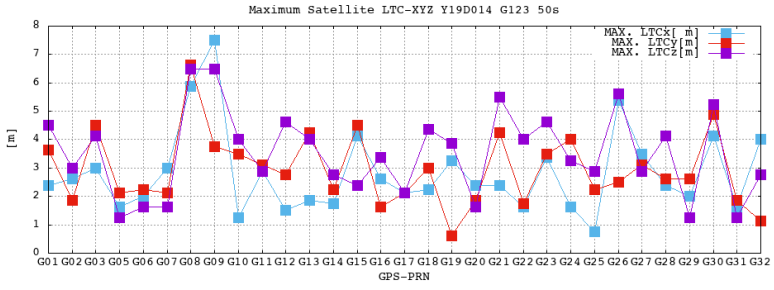
T4. PLOTS RIMS	RIMS NETWORK	
RIMS MAP	Display the network of RIMS configured in the Scenario:	

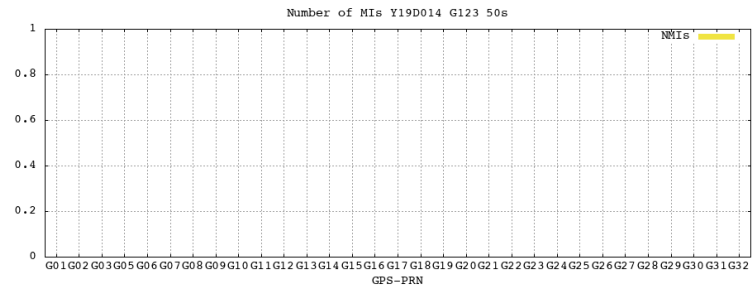
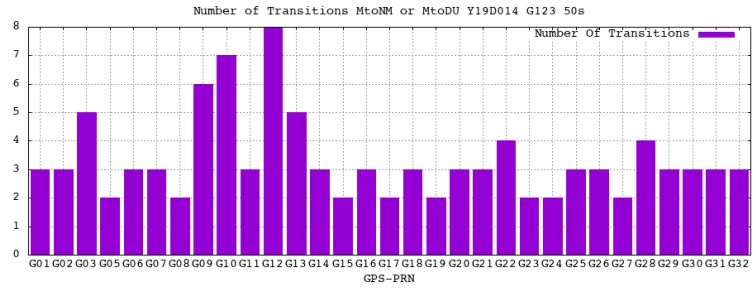
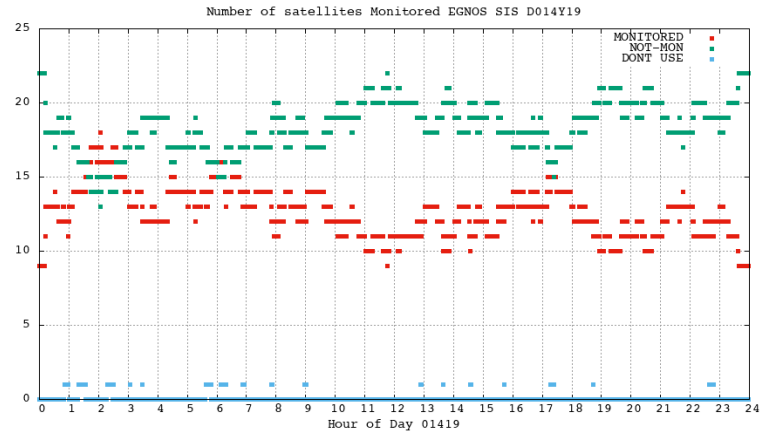


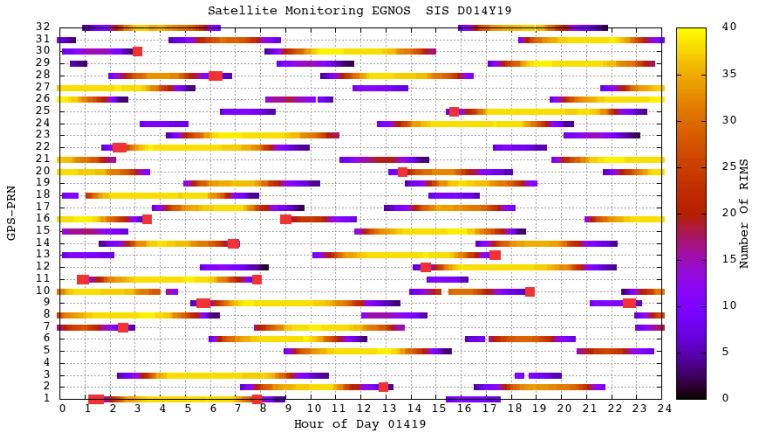
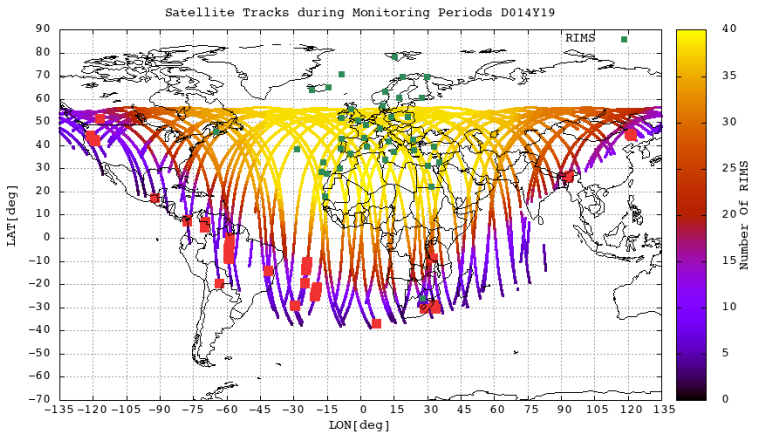
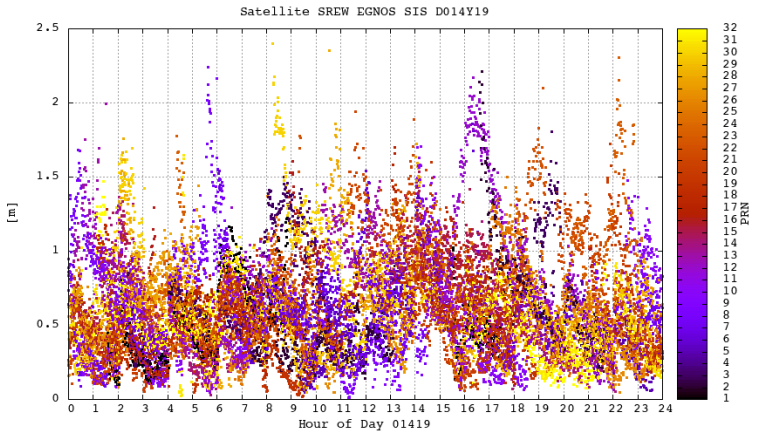
T5. PLOTS STATS	STATISTICS PLOTS	
BOX PLOTs	Create a box plot for every column on the Satellite Statistics file where the x-axis is the satellite PRN and the Y-Axis the statistic to plot.	
MON	Plot Satellite Monitoring Percentage	

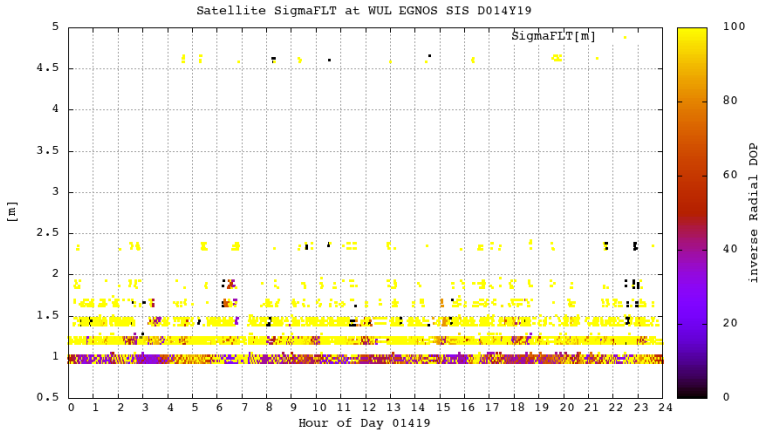
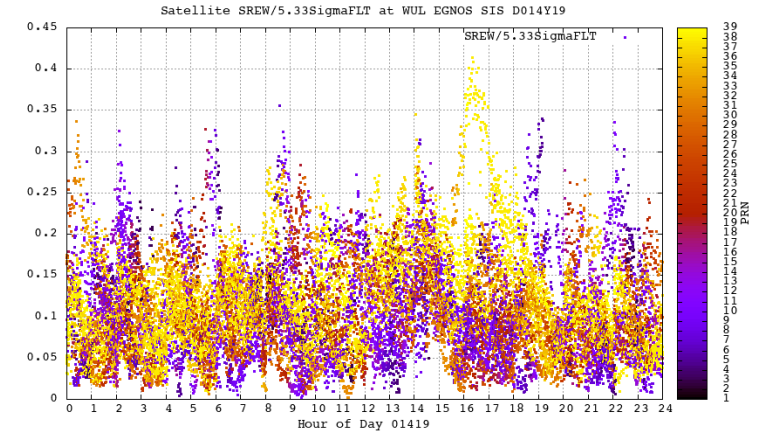


NRIMS	Plot Minimum and Max. Number of RIMS in View 	
RMS-SRE$_{ACR}$	Plot RMS SREA for all satellites as a box-plot 	
RMS-SRE$_{B}$	Plot RMS SREB for all satellites as a box-plot 	
SREW	Plot RMS and MAX SREW for all satellites as a box-plot 	
MAX and MIN SFLT	Plot MAX and MIN SigmaFLT for all satellites as a box-plot	

		
MAX SIW	Plot MAX SIW for all satellites as a box-plot 	
MAX FC and LTCb	Plot MAX Satellite Clock Fast and Long term Corrections for all satellites 	
MAX LTCxyz	Plot MAX LTC-XYZ for all satellites 	
NMI	Plot Number of MIs for all satellites as a box-plot	

		
NTRANS	Plot Number of Transitions for all satellites as a box-plot 	
T6. PLOTS Vs. TIME	**TIME PLOTS**	
MON1	Plot the instantaneous number of satellites monitored as a function of the hour of the day 	
MON2	Plot the satellites monitoring windows as a function of the hour of the day	

		
MON3	Plot the satellites ground tracks on a map during monitoring periods 	
SREW	Plot the SREW for all satellites as a function of the hour of the day. 2 plots: 1.PRN in the color bar. 2.Number of RIMS in view in the color bar. 	
SigmaFLT (PRN)	Plot the SigmaFLT for all satellites as a function of the hour of the day. 2 plots: 1.Inverse Radial DOP in the color bar. 2.Number of RIMS in view in the color bar.	

		
SI	Plot the SI for all satellites as a function of the hour of the day 1.PRN in the color bar. 	
ENT-GPS Offset	Plot the ENT-GPS Offset along the day