

Demonstration on how to process Galileo data with Bernese GNSS Software, version 5.2

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IGS Tutorial on the Bernese GNSS Software
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Content

- **Preparing General Files**
- **Obtaining MGEX products**
- **Running the Processing Example (RNX2SNX)**
- **Demonstration using CODE's MGEX products**
- **Additional Information**

Preparing General Files

What has to be changed?

- Receiver Information File (RECEIVER.)
indicate Galileo capability for each receiver
- Satellite Information File (SATELLITE.I14)
→ <ftp://ftp.aiub.unibe.ch/BSWUSER52/GEN/SATELLITE.I14>
- Update Phase Center Variation file (PCV)
→ <ftp://ftp.aiub.unibe.ch/BSWUSER52/GEN/I14.ATX>
- PCV file containing Galileo patterns for satellites and receiver antennas (*taken from GPS!*)
- Define RINEX 3 data selection in OBS.SEL
→ ftp://ftp.aiub.unibe.ch/BSWUSER52/GEN/OBS_GAL.SEL

Receiver Information File

The files contains the information on the supported GNSS for each receiver: **add Galileo where applicable**
→ **\$X/GEN/RECEIVER.**

```
RECEIVER INFORMATION FILE, BERNESE GNSS SOFTWARE 5.2
```

```
-----  
RECEIVER TYPE          #FREQ  CODE  FREQ  WAVE.F.  SYST  
*****  
*****                *    **   L* :    *    *****  
  
DEFAULT                2     C1   L1 :    1     GRE  
                      P2   L2 :    1  
  
TRIMBLE NETR8         2     C1   L1 :    1     GR  
                      P2   L2 :    1  
  
TRIMBLE NETR9         2     C1   L1 :    1     GRE  
                      P2   L2 :    1  
  
TRIMBLE NETRS         2     C1   L1 :    1     G  
                      P2   L2 :    1
```

PCV Update

- **Update PCV using I14.ATX**
(including Galileo, download from BSW ftp server)
- **ATX2PCV: Adapt setting considering Galileo satellite and receiver patterns**
 - Satellite pattern available from IGS ANTEX file
 - Receiver patterns usually GPS / GLONASS only
→ use GPS pattern to substitute Galileo patterns
(suboptimal, better than zero patterns)
- **Apply ATX2PCV also for individual calibrated patterns**
- **Copy updated PCV file (to \$X/GEN)**

ATX2PCV

Bernese GNSS Software Version 5.2 <@carina>

Window Menu Campaign RINEX Orbits/EOP Processing Service Conversion BPE User Help

CONVERT ANTEX TO BERNESE FORMAT - ATX2PCV 1: Input

GENERAL FILES
Show all general files

INPUT FILENAMES
External phase center offsets I14.ATX
Bernese phase center offsets file PCV.I14
Station information file EXAMPLE STA

OPTIONS FOR BERNESE INPUT FILE
Consider antennas without radome code

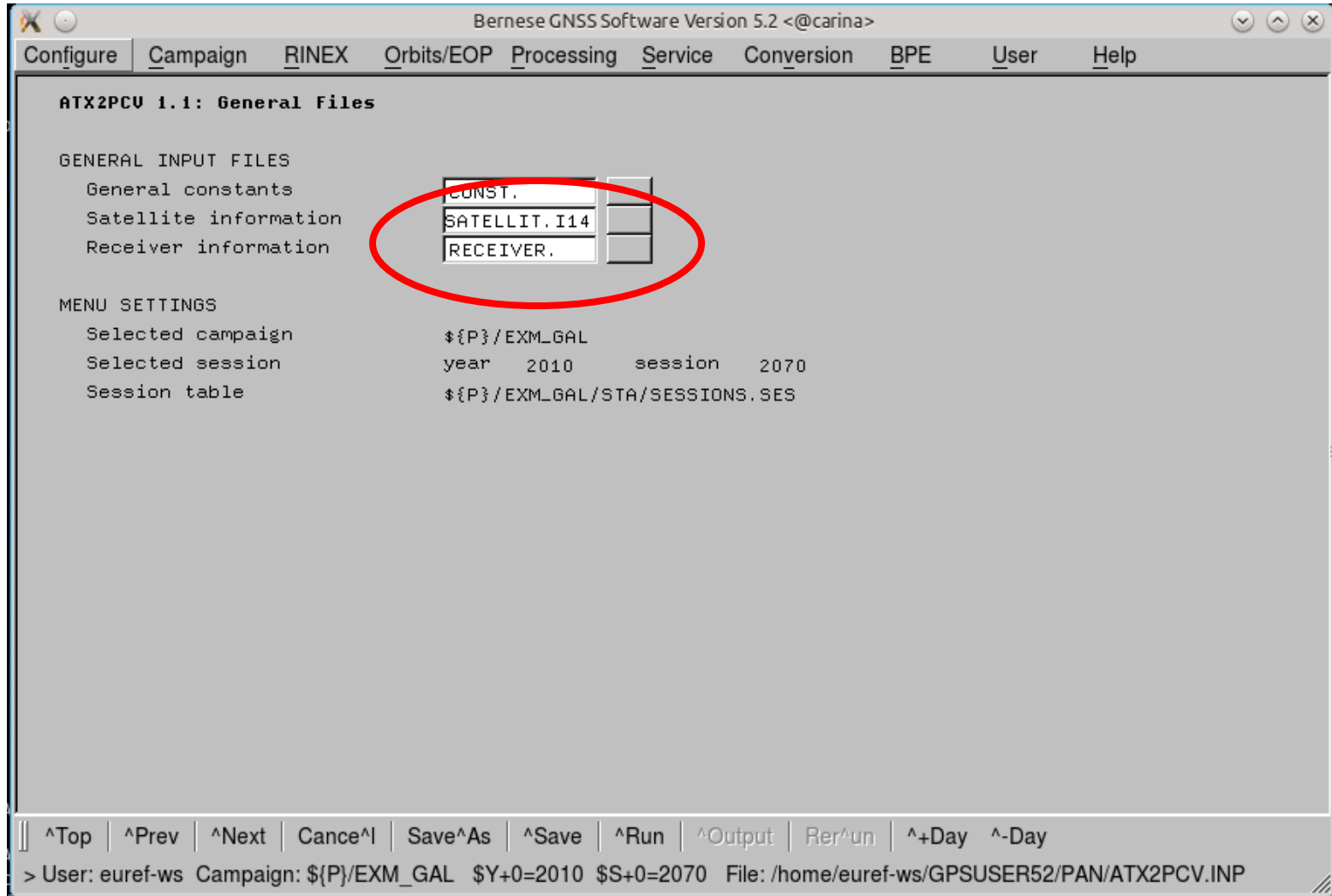
RESULT FILE
Bernese phase center offsets TEST PHG

GENERAL OUTPUT FILES
Program output use ATX2PCV.Lnn or ATX2PCV OUT
Error messages merged to program output or ERROR MSG

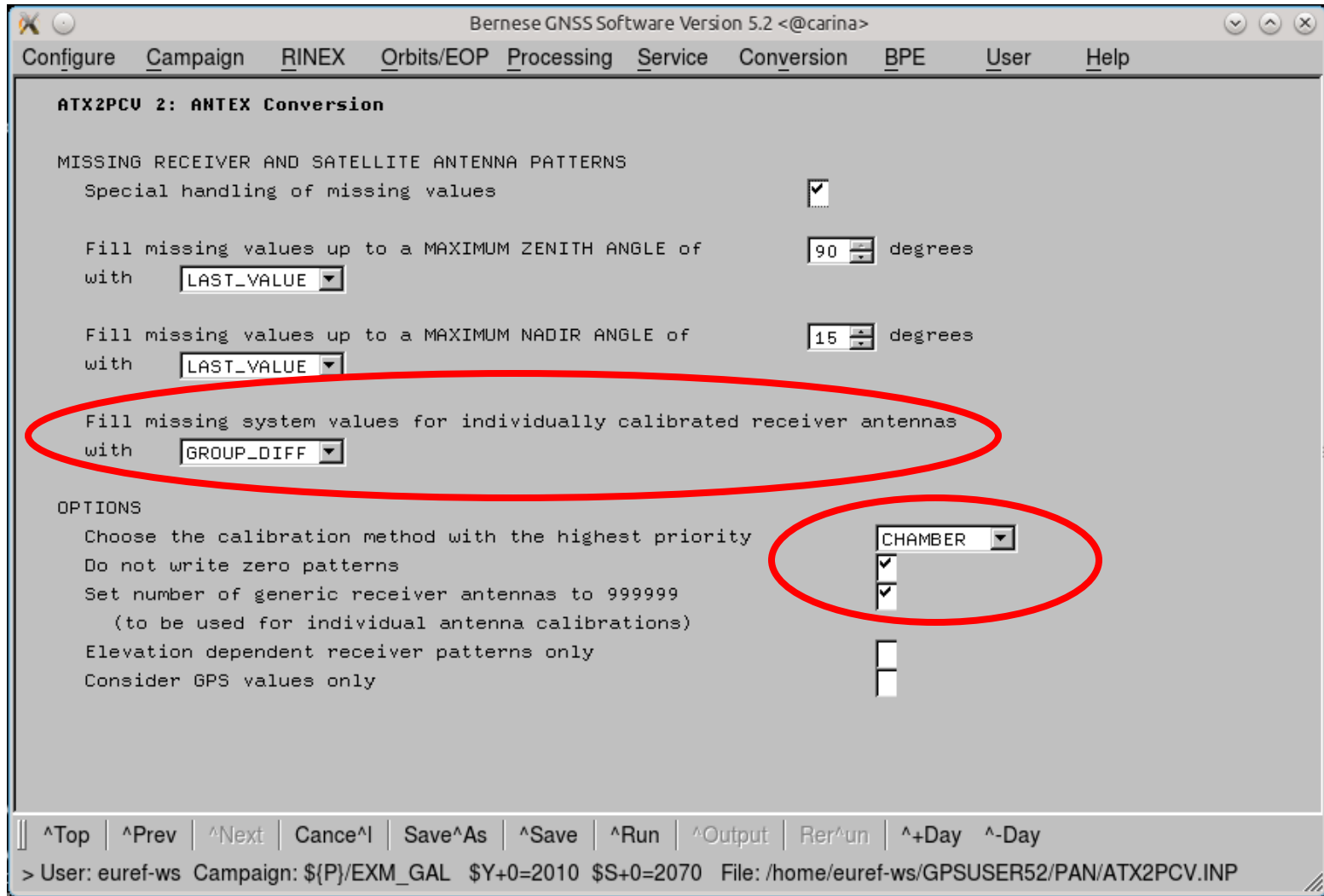
TITLE

^Top | ^Prev | ^Next | Cance^l | Save^As | ^Save | ^Run | ^Output | Rer^un | ^+Day | ^-Day
> User: euref-ws Campaign: \${P}/EXM_GAL \$Y+0=2010 \$S+0=2070 File: /home/euref-ws/GPSUSER52/PAN/ATX2PCV.INP

ATX2PCV



ATX2PCV



Observation Selection File (for RINEX 3)

Observation Selection Files is used by RNXSMT to select the observation types (\$X/GEN/OBS_GAL.SEL)

```
GNSS observation selection for Bernese GNSS Software Version 5.2      21-Aug-2012
-----
Format version:  1.00

Receiver type          S/S  O/F  RINEX observation codes and their priority
*****
DEFAULT               G    L1   L1P L1W L1C      L1X
                      G    L2   L2P L2W L2C L2D L2X
                      G    C1   C1P C1W C1C      C1X
                      G    C2   C2P C2W C2C C2D C2X
                      R    L1   L1P      L1C      L1X
                      R    L2   L2P      L2C      L2X
                      R    C1   C1P      C1C      C1X
                      R    C2   C2P      C2C      C2X
                      E    L1   L1C      L1X
                      E    L2   L5Q L5I L5X
                      E    C1   C1C      C1X
                      E    C2   C5Q C5I C5X
```

Obtaining MGEX products

Obtain GNSS orbits and clocks (MGEX)

- **Create local repository for MGEX products**
(e.g.: ~/GPSDATA/DATAPOOL/COM)
- **Choose product to be used**
(e.g. MGEX products from CODE, same schedule as IGS Final)
- **Alternative products**
(http://mgex.igs.org/IGS_MGEX_Products.html)
 - E.g. GZF (rapid products)

Obtain GNSS orbits and clocks (MGEX)

- Adapt downloader to obtain CODE MGEX products:
 - Location:
`ftp://ftp.aiub.unibe.ch/CODE_MGEX/CODE/yyyy/`
- Orbits:
 - COMWWWWD.EPH (SP3 files)
 - COMWWWWD.ERP
- Clock
 - COMWWWWD.CLK
- Bias
 - COMWWWWD.DCB
 - COMWWWWD.BIA

Adjust RNX2SNX.PCF

RNX2SNX.PCF

Adapt Options:

```
...
V_A      A priori information          APR
V_B      Orbit/ERP, DCB, CLK information COD
V_RNXDIR Directory with the RINEX files  RINEX
V_RX3DIR Directory with the RINEX files
V_OBSINF RINEX 3 observation type selection OBS.SEL
V_RESULT Directory ... for the RNX2SNX results RNX2SNX
V_SATSYS Select the GNSS (GPS, GPS/GLO)   GPS/GLO
V_GNSSAR GNSS ... used for amb. resolution ALL
...
```

RNX2SNX.PCF

Adapt Options:

...		
V_A	A priori information	APR
V_B	Orbit/ERP, DCB, CLK information	COM
V_RNXDIR	Directory with the RINEX files	RINEX
V_RX3DIR	Directory with the RINEX files	RINEX3
V_OBSINF	RINEX 3 observation typ selection	OBS_GAL.SEL
V_RESULT	Directory ... for the RNX2SNX results	R2S_GAL
V_SATSYS	Select the GNSS (GPS, GPS/GLO)	ALL
V_GNSSAR	GNSS ... used for amb. resolution	ALL
...		

Ambiguity resolution

File	Length (km)	Before #Amb (mm)	After #Amb (mm)	Res (%)	Sys	Max/RMS L1 (L1 Cycles)							
Tot:	10	691.611	558	0.1	219	0.2	60.8	G	0.180	0.081	#AR_WL		
Tot:	10	691.611	617	1.3	313	1.3	49.3	G	0.143	0.058	#AR_NL		
File	Length (km)	Before #Amb (mm)	After #Amb (mm)	Res (%)	Sys	Max/RMS L5 (L5 Cycles)	Max/RMS L3 (L3 Cycles)						
Tot:	10	691.611	626	1.4	564	1.4	9.9	G	0.422	0.135	0.098	0.034	#AR_QIF
Tot:	8	717.291	890	1.4	436	1.5	51.0	R	0.478	0.117	0.100	0.033	#AR_QIF
Tot:	4	657.525	180	1.6	112	1.6	37.8	E	0.169	0.039	0.094	0.025	#AR_QIF
Tot:	10	691.611	1696	1.4	1112	1.4	34.4	GRE	0.478	0.113	0.100	0.033	#AR_QIF
File	Length (km)	Before #Amb (mm)	After #Amb (mm)	Res (%)	Sys	Max/RMS L1 (L1 Cycles)							
Tot:	2	0.010	216	1.2	38	1.3	82.4	G	0.053	0.010	#AR_L12		
Tot:	1	0.002	110	1.2	22	1.2	80.0	R	0.027	0.009	#AR_L12		
Tot:	1	0.002	48	1.2	0	1.2	100.0	E	0.021	0.006	#AR_L12		
Tot:	2	0.010	374	1.2	60	1.3	84.0	GRE	0.053	0.009	#AR_L12		

Comparison with IGS14

Solution: GPS only

NUM	NAME	FLG	RESIDUALS IN MILLIMETERS			
75	GANP 11515M001	I W	2.70	0.12	-17.45	
92	HERT 13212M010	I W	0.55	-0.81	7.39	
107	JOZ2 12204M002	P A	-17.92	7.93	8.04	M
122	LAMA 12209M001	P A	-21.96	8.46	17.68	M
136	MATE 12734M008	I W	6.00	-3.43	2.10	
176	ONSA 10402M004	I W	-0.90	0.98	11.99	
192	PTBB 14234M001	P A	-17.36	8.34	9.34	M
236	TLSE 10003M009	I W	-1.02	-1.73	-6.38	
262	WSRT 13506M005	I W	-3.34	-1.15	4.59	
263	WTZR 14201M010	I W	-0.60	1.12	-8.35	
264	WTZZ 14201M014	P A	-2.15	1.73	-3.94	M
276	ZIM2 14001M008	I W	-2.60	1.67	1.37	
278	ZIMM 14001M004	I W	-0.81	3.22	4.73	

PARAMETERS :

TRANSLATION IN	N	:	0.00	+-	1.88	MM
TRANSLATION IN	E	:	0.00	+-	1.88	MM
TRANSLATION IN	U	:	-0.00	+-	1.88	MM

Comparison with IGS14

Solution: GPS/GLO

NUM	NAME	FLG	RESIDUALS IN MILLIMETERS			
75	GANP 11515M001	I W	2.15	-0.50	-20.95	
92	HERT 13212M010	I W	0.60	-0.38	8.14	
107	JOZ2 12204M002	P A	-18.14	7.60	7.70	M
122	LAMA 12209M001	P A	-22.58	8.48	17.11	M
136	MATE 12734M008	I W	5.74	-3.85	2.83	
176	ONSA 10402M004	I W	-0.57	1.28	11.22	
192	PTBB 14234M001	P A	-17.34	8.41	8.95	M
236	TLSE 10003M009	I W	-1.07	-0.96	-2.91	
262	WSRT 13506M005	I W	-3.42	-1.09	3.45	
263	WTZR 14201M010	I W	-0.65	0.82	-7.06	
264	WTZZ 14201M014	P A	-1.92	2.29	-3.69	M
276	ZIM2 14001M008	I W	-1.88	1.39	0.55	
278	ZIMM 14001M004	I W	-0.89	3.30	4.73	

PARAMETERS :

TRANSLATION IN	N	:	-0.00	+-	1.95	MM
TRANSLATION IN	E	:	-0.00	+-	1.95	MM
TRANSLATION IN	U	:	-0.00	+-	1.95	MM

Comparison with IGS14

Solution: GPS/GLO/GAL

NUM	NAME	FLG	RESIDUALS IN MILLIMETERS			
75	GANP 11515M001	I W	1.66	-0.15	-18.77	
92	HERT 13212M010	I W	0.71	-0.36	8.44	
107	JOZ2 12204M002	P A	-18.07	7.44	8.66	M
122	LAMA 12209M001	P A	-22.73	8.32	17.35	M
136	MATE 12734M008	I W	5.41	-4.00	2.03	
176	ONSA 10402M004	I W	-0.67	1.24	12.17	
192	PTBB 14234M001	P A	-17.34	8.47	9.11	M
236	TLSE 10003M009	I W	-1.26	-1.90	-4.58	
262	WSRT 13506M005	I W	-3.36	-1.07	4.31	
263	WTZR 14201M010	I W	-0.26	1.16	-9.17	
264	WTZZ 14201M014	P A	-1.44	2.96	-6.45	M
276	ZIM2 14001M008	I W	-1.60	1.58	0.93	
278	ZIMM 14001M004	I W	-0.62	3.50	4.64	

PARAMETERS :

TRANSLATION IN	N	:	-0.00	+-	1.94	MM
TRANSLATION IN	E	:	-0.00	+-	1.94	MM
TRANSLATION IN	U	:	-0.00	+-	1.94	MM

GNSS Inter-System Translation Bias (GTRA)

Helmert: NO GTRA (GRE) <-> GTRA (GAL)

NUM	NAME	FLG	RESIDUALS IN MILLIMETERS		
75	GANP 11515M001	W W	-0.25	-0.20	-1.64
92	HERT 13212M010	W W	-0.00	-0.13	0.07
107	JOZ2 12204M002	A A	0.03	0.09	0.03
122	LAMA 12209M001	A A	0.08	0.09	0.01
136	MATE 12734M008	W W	-0.10	0.04	0.52
176	ONSA 10402M004	W W	0.13	-0.03	-0.01
192	PTBB 14234M001	A A	0.04	-0.03	0.07
236	TLSE 10003M009	W W	0.26	0.34	-0.46
262	WSRT 13506M005	W W	0.02	-0.08	0.05
263	WTZR 14201M010	W W	-0.00	0.12	0.86
264	WTZZ 14201M014	A A	-0.04	-0.24	1.47
276	ZIM2 14001M008	W W	-0.11	-0.00	-1.03
278	ZIMM 14001M004	W W	-0.04	-0.01	0.07
	RMS / COMPONENT		0.12	0.15	0.77
	MEAN		0.00	-0.00	0.00
	MIN		-0.25	-0.24	-1.64
	MAX		0.26	0.34	1.47

RMS OF TRANSFORMATION : 0.49 MM

GNSS Inter-System Translation Bias (GTRA)

Helmert: NO GTRA (GRE) <-> GTRA (GAL)

RMS / COMPONENT			
MEAN	0.12	0.15	0.77
MIN	0.00	-0.00	0.00
MAX	-0.25	-0.24	-1.64
	0.26	0.34	1.47

RMS OF TRANSFORMATION : 0.49 MM

PARAMETERS :

TRANSLATION IN X : 0.49 +- 1.59 MM
TRANSLATION IN Y : 0.28 +- 1.85 MM
TRANSLATION IN Z : 1.36 +- 1.54 MM
ROTATION AROUND X-AXIS: 0 0 0.000002 +- 0.000054 "
ROTATION AROUND Y-AXIS: - 0 0 0.000016 +- 0.000058 "
ROTATION AROUND Z-AXIS: 0 0 0.000009 +- 0.000050 "
SCALE FACTOR : -0.00019 +- 0.00020 MM/KM

Additional Information

- Bernese Example Campaign including Galileo
 - Latest version of the Bernese 5.2 Tutorial:
<http://www.bernese.unibe.ch/docs/TUTORIAL.pdf>
- Tutorial contains additional examples:
 - Section 7.5: Using RINEX 3 Data
 - Section 7.6: Processing Galileo Observations
 - Contains data for 1. Aug. 2017