

# **E-GVAP Annual Meeting GNSS Processing Status @ ASI/CGS**

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- Tropospheric solutions delivered to E-GVAP:

- European NWP DA                    **ASI\_**
- NWP DA , QC                        **ASIC**
- rapid-cycle NWP DA                **ASIS**
- hourly PPP test solution        **ASIR**



- Tropospheric solutions delivered to EUREF:

- Routine                                **ASI, EUR**
- Reprocessed                        **AS0, EU0**



Tropospheric solutions delivered to EUREF:

- SINEX\_TRO v2.0

# Tropospheric solutions delivered to E-GVAP

4 solutions delivered to E-GVAP:

ASI\_

Available from June 2001  
Input: hourly RNX files/IGU  
Update cycle: hourly  
*Purpose: NWP data assimilation*

Operational

4 scores per hour every 15min  
COSTV2.2a/ZTD + gradients  
~ 225 stations

ASIC

Available from November 2008  
Input: hourly operational cost solutions  
Update cycle: hourly  
*Purpose: NWP data assimilation + QC*

Operational

4 scores per hour every 15min  
COSTV2.2a/ZTD  
~ 166 stations

ASIS

Available from January 2014  
Input: RT GNSS observation/IGS RT  
Update cycle: 15min  
*Purpose: test RT obs+prod in sub-hourly PPP for nowcasting*

Test

4 scores per hour every 15min  
COSTV2.2a/ZTD + gradients  
~ 17 stations

ASIR

Available from March 2014  
Input: Hourly RNX files/IGS RT  
Update cycle: hourly  
*Purpose: test IGS RT prod in hourly PPP for NWP*

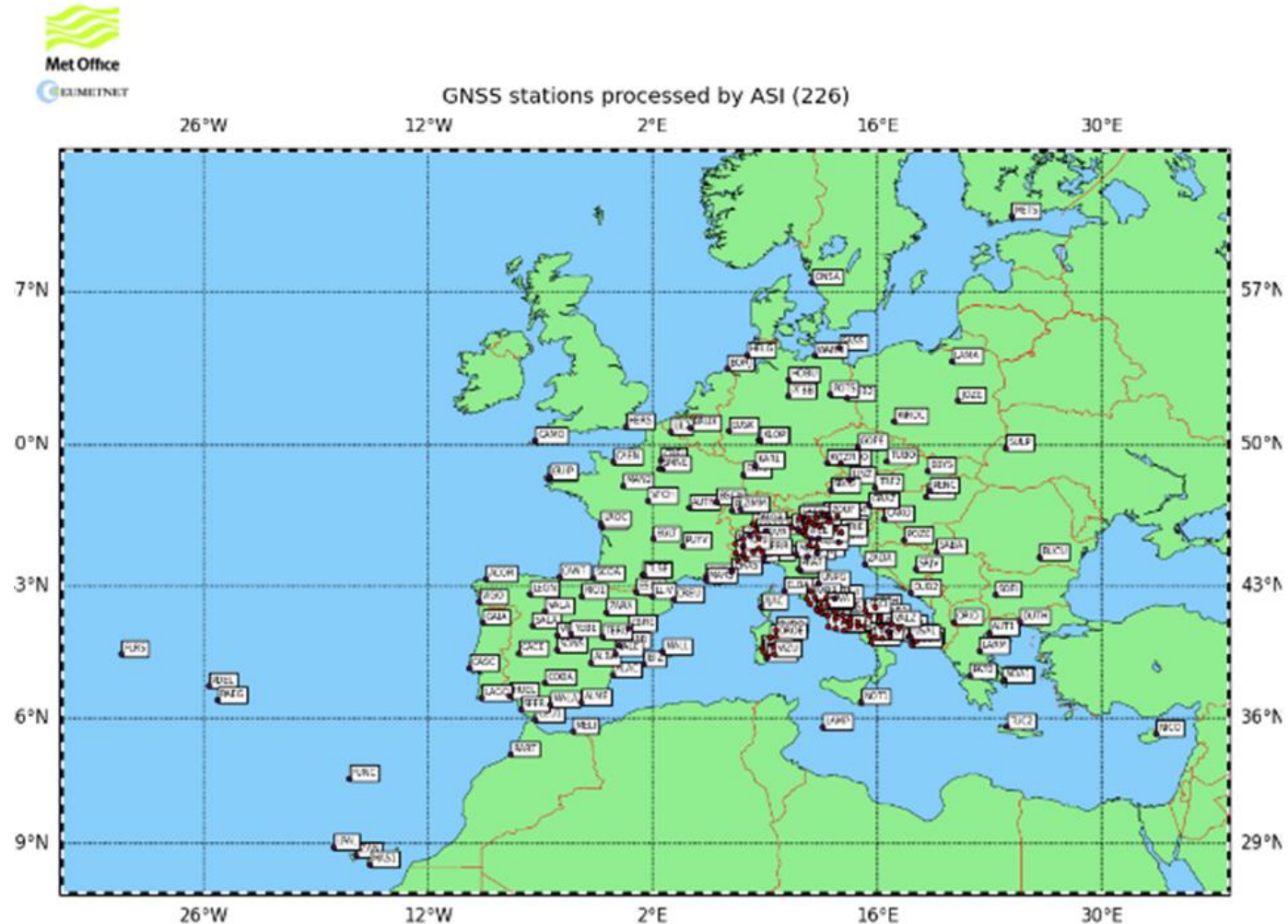
Test

4 scores per hour every 15min  
COSTV2.2a/ZTD + gradients  
~ 41 stations



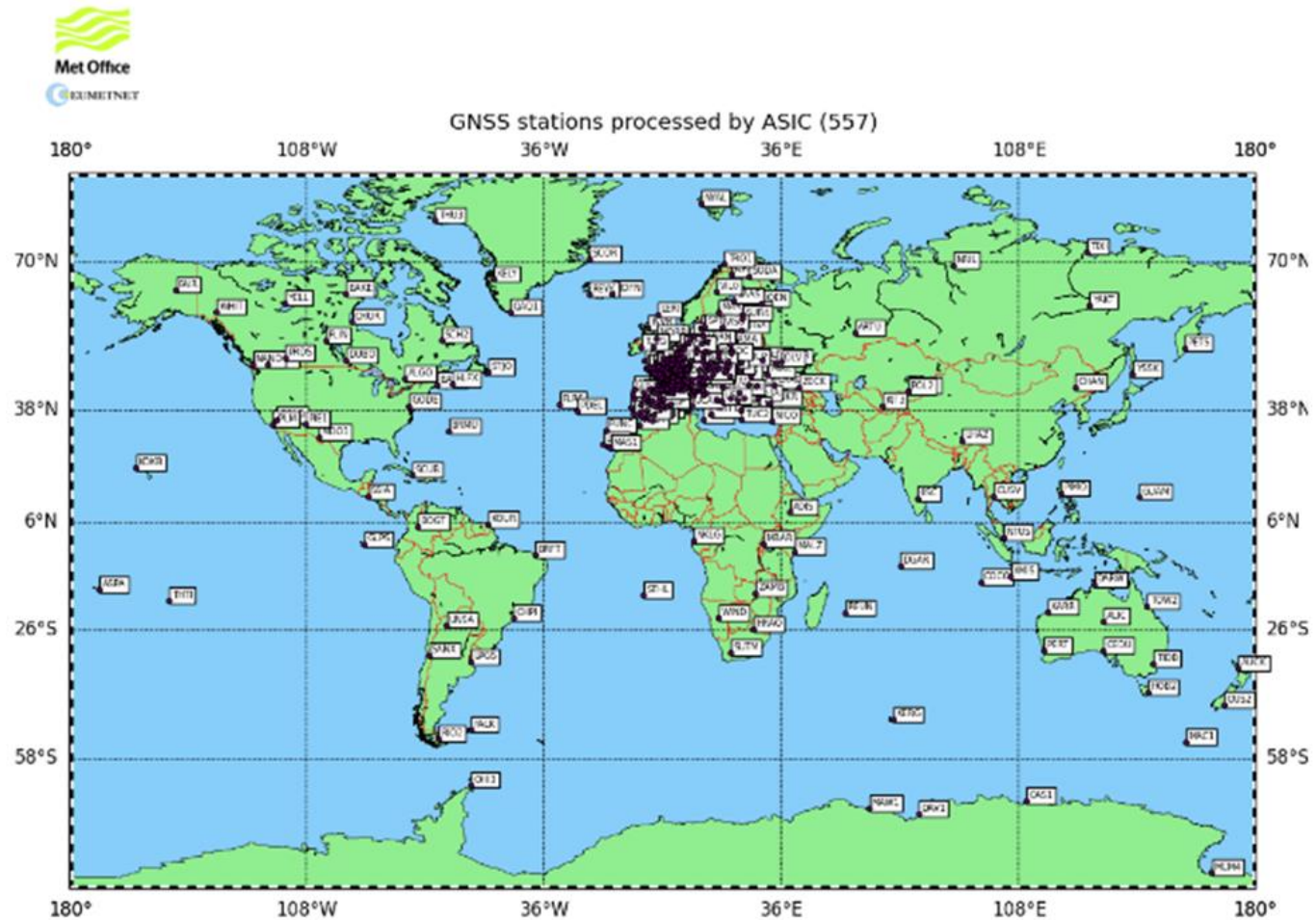
# 2017 ASI\_Developments

- Amended network of stations
- Hourly data availability of the regional Italian networks not constant
- Contacts ongoing with a commercial network



# 2017 ASIC Developments

- Global Coverage



- ASIS and ASIR: several BNC crashes

# Tropospheric solutions delivered to EUREF

## 2 solutions on routine basis

**ASI**

From 2001  
Input: daily RNX files of ASI LAC EPN sub-network/IGS final  
Update cycle: daily  
*Purpose climate monitoring*

12 scores per day every h  
SINEX\_TRO/ZTD + gradients  
50 stations ASI EPN sub-network

**EUR**

From July 2014  
Input: daily operational EPN LAC solutions  
Update cycle: daily  
*Purpose climate monitoring + QC*

12 scores per day every h  
SINEX\_TRO/ZTD  
Full EPN Network

## 2 Reprocessed solutions (1996-2014)

**ASO**

Available from 1996  
Input: daily RNX files of EPN +IGS Core network/JPL Repro  
Update cycle: daily  
*Purpose climate monitoring*

12 scores per day every h  
SINEX\_TRO/ZTD + gradients  
full EPN Network

**EUO**

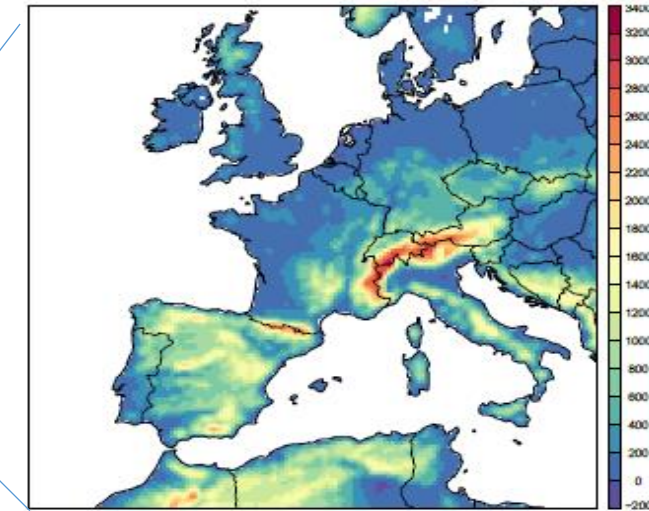
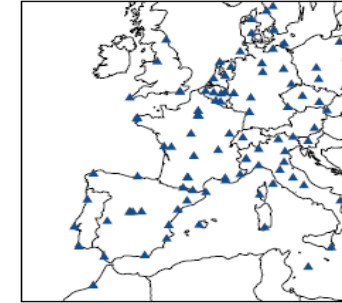
Available from 1996  
Input: daily RNX files of EPN +IGS Core network/JPL Repro  
Update cycle: daily  
*Purpose climate monitoring*

12 scores per day every h  
SINEX\_TRO/ZTD  
full EPN Network

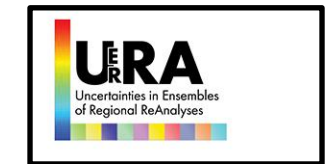
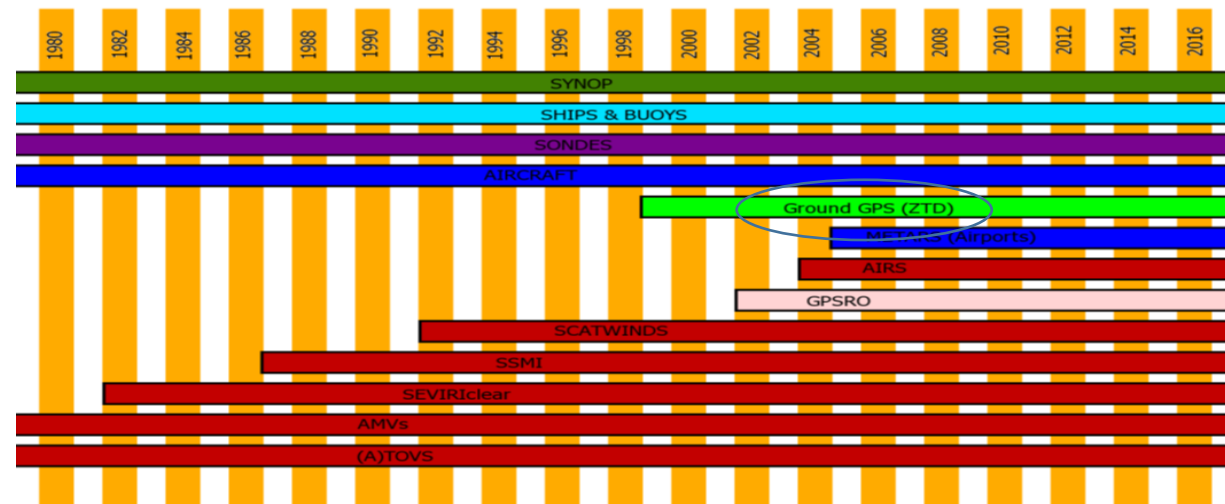
# Exploitation of EPN Repro2 dataset

Pacione, R., Araszkiwicz, A., Brockmann, E., and Dousa, J.: EPN Repro2: A reference GNSS tropospheric dataset over Europe, *Atmos. Meas. Tech.*, 10, 1689-1705, <https://doi.org/10.5194/amt-10-1689-2017>, 2017

## Climate Model Simulation **ALARO Climate Model**



Berckmans J., Van Malderen R., Pottiaux E., and Pacione R.: Evaluation of the atmospheric water vapor content in the regional climate model ALARO-0 using GNSS observations from EPN Repro2, *EMS Annual Meeting*, 4–8 September 2017, Dublin, Ireland



European ReAnalyses

Ground-Based  
GNSS

*Courtesy G.Halloran,  
UK MetOffice*

- Format description finalized and soon available at the IGS Tropo web site

- Format officially presented at:

IGS Workshop (July 3-7, 2017, Paris),

Unified Analysis Workshop in Paris (July 10-12, 2017, Paris),

EPN Analysis Center Workshop (October, 25-26, 2017 Brussels).

- Already used in the framework of a NASA Project:

[https://cddis.nasa.gov/Data\\_and\\_Derived\\_Products/GNSS/SESES\\_time\\_series\\_products.html](https://cddis.nasa.gov/Data_and_Derived_Products/GNSS/SESES_time_series_products.html)

(link to tropospheric zenith total delay products near the middle of the page)



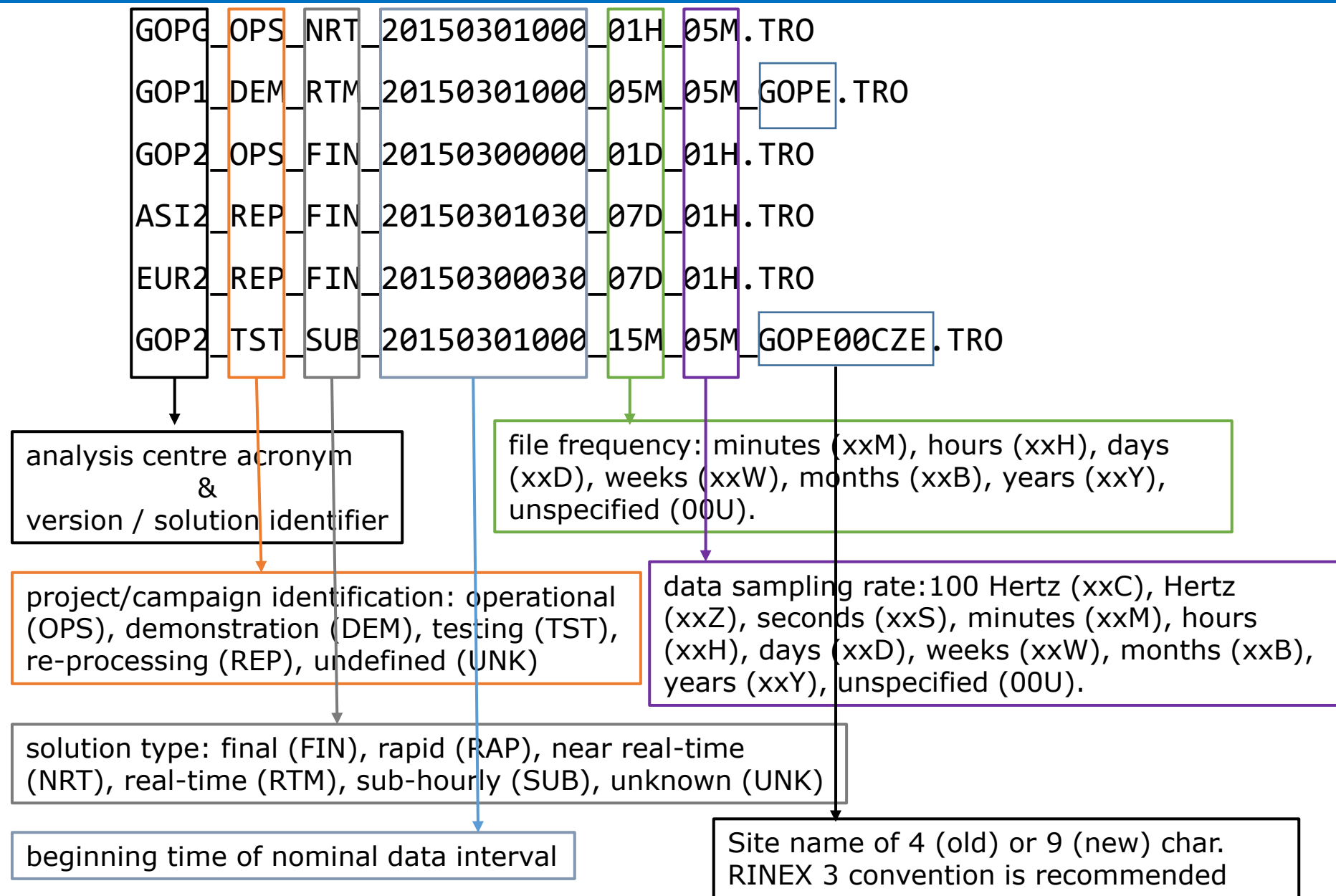
Unique format to be adopted within all the IAG services and by all the techniques dealing with tropospheric parameters and able to support:

- Parameters from different sources than space geodetic techniques such as numerical weather prediction models and re-analyses, radiosondes and water vapour radiometers;
- Long station names (9 characters) in concordance with RINEX 3 data format;
- Products including slant tropospheric delays;
- Parameters corresponding to long-term time series of individual stations.

# SINEX\_TRO v2.0: Philosophy

- Simple and flexible design following the philosophy of the SINEX format with regards to metadata description and overall data structure;
- Decoupled from the SINEX, it means that the most of metadata blocks are mandatory in the SINEX\_TRO format in order to support a stand-alone and non-ambiguous metadata description;
- Supporting all the necessary information for the conversion to the COST-716 format, so far widely used within GNSS-meteorology applications ([http://egvap.dmi.dk/support/formats/egvap\\_cost\\_v22.pdf](http://egvap.dmi.dk/support/formats/egvap_cost_v22.pdf)).

# SINEX TRO v2.0: File Naming Convention



# SINEX\_TRO v2.0: Blocks

FILE/REFERENCE	(Mandatory)
INPUT/FILES	(Combined product only)
CENTERS/INFO_MODEL	(Combined product only)
CENTERS/INFO_SOLUTION	(Combined product only)
SITE/ID	(Mandatory)
SITE/RECEIVER	(Mandatory for GNSS)
SITE/ANTENNA	(Mandatory for GNSS)
SITE/COORDINATES	(Mandatory for GNSS)
SITE/ECCENTRICITY	(Mandatory for GNSS)
TROP/DESCRIPTION	(Mandatory)
TROP/SOLUTION	(Mandatory for values in zenith directions)
NEW ← SLANT/SOLUTION	(Mandatory for values in slant directions)



# SINEX TRO v2.0: Example for Submission of Trop & Slant Estimates

%=TRO 2.00 GOP 2017:157:61799 GOP 2013:168:64500 2013:168:86100 P MIX

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+FILE/REFERENCE

*INFO_TYPE	INFO
DESCRIPTION	GOP - Geodetic Observatory Pecny, RIGTC
OUTPUT	Solution parameters
CONTACT	gnss@pecny.cz
SOFTWARE	G-Nut/Geb
INPUT	GNSS/NWM/RAO/OTH data
VERSION NUMBER	001

-FILE/REFERENCE

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+TROP/DESCRIPTION

*KEYWORD	VALUE (S)
TROPO SAMPLING INTERVAL	300
SLANT SAMPLING INTERVAL	300
DATA SAMPLING INTERVAL	300
GNSS SYSTEMS	G
TIME SYSTEM	G
TROPO MODELING METHOD	KALMAN FILTER
GEOID MODEL	VMF1/EGM96
OCEAN TIDE LOADING MODEL	FES2004
ATMOSPH TIDE LOADING MODEL	NOT APPLIED
ELEVATION CUTOFF ANGLE	7
OBSERVATION WEIGHTING	SINEL
A PRIORI TROPOSPHERE	EXTERN
TROPO MAPPING FUNCTION	GMF
GRADS MAPPING FUNCTION	CHEN_HERRING
REFRACTIVITY COEFFICIENTS	77.60 70.40 373900.0
SOURCE OF MET/DATA	NWP
TROPO PARAMETER NAMES	TROTOT STDDEV TRODRY TROWET TGNTOT STDDEV TGETOT STDDEV
TROPO PARAMETER UNITS	1e+03 1e+03 1e+03 1e+03 1e+03 1e+03 1e+03 1e+03
TROPO PARAMETER WIDTH	6 6 6 6 6 6 6 6
SLANT PARAMETER NAMES	SLTTOT STDDEV SLTDRY SLTWET SLTIWV SLTGRD SATRES SATMPT
SLANT PARAMETER UNITS	1e+03 1e+03 1e+03 1e+03 1 1e+03 1e+03 1e+03
SLANT PARAMETER WIDTH	8 6 8 6 6 6 6 6

-TROP/DESCRIPTION

NSAT	GDOP	IWV	PRESS	TEMDRY	WMTEMP	TEMLPS	WMTLPS	ZWDDEC
1	1	1	1	1	1	1e+03	1e+03	1
4	4	6	7	6	6	6	6	6
SAT	SATELE	SATAZI	FACDRY	FACWET	FACGRD			
1	1	1	1	1	1			
4	7	7	9	9	9			

# SINEX TRO v2.0: Example for Submission of Trop & Slant Estimates

+SITE/ID										
*STATION	PT	DOMES	T	STATION DESCRIPTION	LONGITUDE	LATITUDE	HGT_ELI	HGT_MSL		
GOPE00CZE	A	11502M002	P		14.785625	49.913706	592.716	630.502		
WTZR00DEU	A	14201M010	P		12.878912	49.144199	666.119	705.725		
ZIMM00CHE	A	14001M004	P		7.465279	46.877099	956.324	1000.057		
-SITE/ID										
*-----										
+SITE/COORDINATES										
*STATION	PT	SOLN	T	DATA_START	DATA_END	STA_X	STA_Y	STA_Z	SYSTEM	REMRK
GOPE00CZE	A	1	P	2013:168:00000	2013:168:86100	3979315.993	1050312.623	4857067.191	IGS08	GOP
WTZR00DEU	A	1	P	2013:168:00000	2013:168:03300	4075580.457	931853.932	4801568.218	IGS08	GOP
ZIMM00CHE	A	1	P	2013:168:00300	2013:168:86100	4331296.936	567556.035	4633134.023	IGS08	GOP
-SITE/COORDINATES										
*-----										
+SITE/ECCENTRICITY										
*-----										
						UP	NORTH	EAST		
*STATION	PT	SOLN	T	DATA_START	DATA_END	AXE	ARP->BENCHMARK (M)			
GOPE00CZE	A	1	P	2013:168:64500	2013:168:86100	UNE	0.1114	0.0000	0.0000	
WTZR00DEU	A	1	P	2013:168:64500	2013:168:86100	UNE	0.0710	0.0000	0.0000	
ZIMM00CHE	A	1	P	2013:168:64500	2013:168:86100	UNE	0.0000	0.0000	0.0000	
-SITE/ECCENTRICITY										
*-----										
+SITE/ANTENNA										
*STATION	PT	SOLN	T	DATA_START	DATA_END	DESCRIPTION	S/N	PCV_MODEL		
GOPE00CZE	A	1	P	2013:168:64500	2013:168:86100	TPSCR.G3	TPSH	IGS08_1664		
WTZR00DEU	A	1	P	2013:168:64500	2013:168:86100	LEIAR25.R3	LEIT	IGS08_1664		
ZIMM00CHE	A	1	P	2013:168:64500	2013:168:86100	TRM29659.00	NONE	IGS08_1664		
-SITE/ANTENNA										
*-----										
+SITE/RECEIVER										
*STATION	PT	SOLN	T	DATA_START	DATA_END	DESCRIPTION	S/N	FIRMW		
GOPE00CZE	A	1	P	2013:168:64500	2013:168:86100	TPS NETG3				
WTZR00DEU	A	1	P	2013:168:64500	2013:168:86100	LEICA GRX1200+GNSS				
ZIMM00CHE	A	1	P	2013:168:64500	2013:168:86100	TRIMBLE NETRS				
-SITE/RECEIVER										
*-----										

# SINEX TRO v2.0: Example for Submission of Trop & Slant Estimates

+TROP/SOLUTION

*STATION	EPOCH	TROTOT	STDDEV	TRODRY	TROWET	TGNTOT	STDDEV	TGETOT	STDDEV	NSAT	GDOP	IWV	PRESS	TEMDRY	WMTEMP	TEMLPS	WMTLPS	ZWDDEC
GOPE00CZE	2013:168:64500	2334.3	5.3	2166.8	167.4	0.99	0.85	0.14	0.93	7	2.2	27.26	951.92	299.6	285.7	7.20	7.21	3.32
GOPE00CZE	2013:168:64800	2334.2	5.2	2166.8	167.4	1.00	0.84	0.17	0.92	6	1.9	27.25	951.90	299.6	285.7	7.20	7.21	3.32
GOPE00CZE	2013:168:65100	2333.0	5.1	2166.8	166.2	1.00	0.83	0.29	0.91	7	2.2	27.06	951.90	299.6	285.7	7.20	7.21	3.33
...																		
ZIMM00CHE	2013:168:85800	2275.0	4.6	2081.5	193.5	-0.18	0.65	0.79	0.86	9	1.1	31.16	913.97	296.3	282.6	7.21	6.74	2.94
ZIMM00CHE	2013:168:86100	2274.7	4.7	2081.5	193.2	-0.20	0.66	0.84	0.85	8	1.4	31.11	914.01	296.2	282.5	7.20	6.74	2.94

-TROP/SOLUTION

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+SLANT/SOLUTION

*STATION	EPOCH	SLTTOT	STDDEV	SLTDRY	SLTWET	SLTIWV	SLTGRD	SATRES	SATMPT	SAT	SATELE	SATAZI	FACDRY	FACWET	FACGRD
GOPE00CZE	2013:168:64500	8363.0	9.9	7748.2	603.3	98.2	10.4	1.1	0.0	G05	16.000	39.323	3.575822	3.603292	12.159794
GOPE00CZE	2013:168:64500	5635.5	8.2	5226.3	405.1	66.0	-0.2	4.2	0.0	G06	24.340	276.596	2.411963	2.419605	5.273237
GOPE00CZE	2013:168:64500	3527.2	6.5	3266.0	252.6	41.1	0.8	7.8	0.0	G16	41.483	305.307	1.507287	1.508554	1.698072
...															
ZIMM00CHE	2013:168:86100	6721.5	8.0	6146.0	573.3	92.3	-7.0	9.3	0.0	G28	19.603	279.934	2.952592	2.967259	8.150843
ZIMM00CHE	2013:168:86100	2366.6	4.7	2156.7	200.2	32.2	-0.2	9.8	0.0	G32	74.810	235.655	1.036111	1.036160	0.281091

-SLANT/SOLUTION

%=ENDTRO