SINEX_TRO - Solution (Software/Technique) INdependent EXchange Format for TROpospheric and meteorological parameters

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Document History

Date	Notes/Changes
July 2017	Format officially presented and discussed at the IGS Workshop in Paris
October 2017	Add 'TIME SYSTEM' in the TROP/DESCRIPTION Block

1. INTRODUCTION

This document describes the Solution (Software/Technique) Independent Exchange (SINEX) format for TROpospheric and meteorological parameters.

The effort to standardize the exchange format for tropospheric products has started in early 1997 by a number of IGS participants [Gendt, 1997]. In November 2010 [IGSMAIL-6298] SINEX_TRO format was slightly expanded to accommodate the addition of gradients. This expanded format has never been officially accepted and adopted. Due to the lack of the standardization, different software packages and organizations have started to use different field names referring to the same variables ad-hoc supporting optional and mandatory metadata, output files with different naming conventions and overall data contents. As a result, the format cannot be handled with a unique decoder.

According to further developments, new demands arose on the format for exchanging tropospheric parameters, in particular supporting:

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

This was the driver to develop a unique format to be adopted within all the IAG services and by all the techniques dealing with tropospheric parameters. However, because of difficulties in supporting all legacy and new features, it was decided to revise the format without keeping a full compatibility with any previous SINEX_TRO unofficial version. In this way new features, such as long station names or time series data support, could be introduced much easier while simplifying the format definition and usage.

Previously, the tropospheric products were provided in SINEX_TRO files [Gendt, 1997] along with the standard SINEX files using the corresponding filename. All common blocks (SITE/ID, SITE/ANTENNA, SITE/RECEIVER, SITE/ECCENTRICITY, SITE/COORDINATES etc.) could be then taken from the SINEX product. When tropospheric results were provided only in the SINEX_TRO format, a single file should contain mandatory all the metadata concerning the SITE specification. Newly revised SINEX_TRO format is de-coupled from the official SINEX as it is impossible to implement important changes, e.g. such as long station names, different timestamp definition and others.

Originally, the SINEX_TRO format was tightly linked to the SINEX developed by the IERS (http://www.iers.org). Because of difficulties of maintaining the SINEX_TRO format along with the SINEX and because of limitations in necessary developments (e.g. a support of long station names, variable length of data lines), the SINEX_TRO format V2.0 is decoupled from the SINEX while keeping a basic philosophy and a similar metadata format description. The most of metadata blocks thus became mandatory in the SINEX_TRO format in order to support a stand-alone and non-ambiguous metadata description in the same way for any file using the format.

2. PHILOSOPHY

The SINEX_TRO has as much as a simple and flexible design following the philosophy of the SINEX format (http://www.iers.org/IERS/EN/Organization/AnalysisCoordinator/SinexFormat/sinex.html) with regards to metadata description and overall data structure. It is aimed at supporting site-specific and time series data stemming from various observing techniques or analyses, such as various space geodetic techniques (DORIS, GNSS, and VLBI), numerical weather prediction models, radiosondes, microwave radiometers, or others. All data and metadata refers to the time period or timestamp in order to support site-specific long-term data storage suitable for a time series analysis or climate research. Specific parameters, such as slant delays, are supported through the introduction of a new dedicated data block. The format supports all the necessary information for the conversion to the COST-716 format (http://egvap.dmi.dk/support/formats/egvap_cost_v22.pdf), so far widely used within GNSS-meteorology applications.

The format is able to accommodate data or products in the following scenarios:

- Parameters at a single site estimated, observed or interpolated in time,
- Parameters at a single site calculated from a vertical profile, using ray tracing or interpolating in space,
- Parameters for more sites coming from a unique source (analysis, method, provider etc.),
- Parameters from a combined solution including additional information from the combination process,
- Parameters from a long period including a full history of metadata,
- Parameters with a consistent temporal resolution (i.e. sampling rate) and representations (interpolation, modelling approach, etc.) while missing values are allowed when reported. Data representation and, optionally, interpolation should be described in the metadata section.

3. STRUCTURE

There is no limitation on the number of characters in data lines in SINEX_TRO. The SINEX_TRO file is subdivided into groups of data called blocks. A header and footer line encloses each block. The header and footer line are of 80 ASCII characters. Each block has a fixed format. The metadata blocks contain information on the file, the solution, its inputs and all the sites. Elements within each line are defined and separated by a blank character, at least. A character field without information will have "-" within its field and a missing numerical element will have an undefined value represented by number –999 (integer) or -999.000 (float) used always without scaling applied.

Important note: The undefined value should be **written/tested without the parameter scaling** (see TROPO PARAMETER UNITS and SLANT PARAMETER UNITS).

Therefore, the SINEX_TRO file is readable in both forms "column-wise" and "line-wise". Character fields should be left-hand justified whenever applicable.

The first character of each line identifies the type of information that the line contains. Five characters are reserved. They have the following meaning when they are at the beginning of a line, they identify:

- ’%’ header and footer line,

- ’*’ comment line within the header and footer line,
- ’+’ title at the start of a block
- ’-’ title at the end of a block
- ’ ’ (empty space) data line within a block

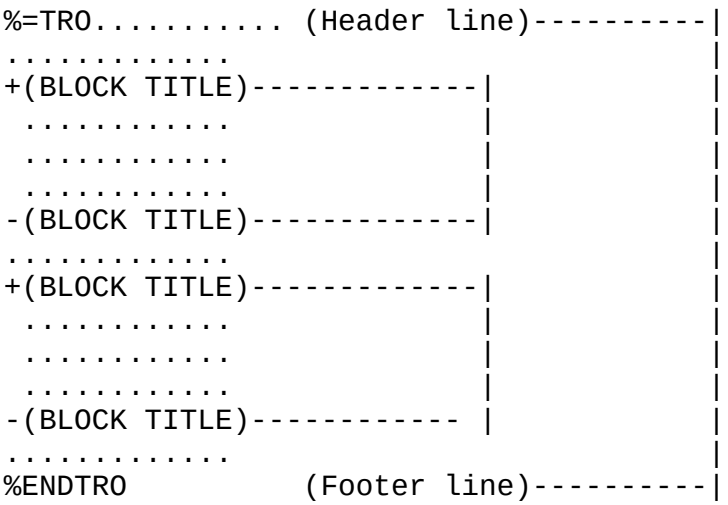
No other character is allowed at the beginning of a line!

A SINEX_TRO file must start with a header line and end with a footer line.

The following blocks are defined:

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)
SLANT/SOLUTION	(Mandatory for values in slant directions)

These block titles are immediately preceded by a "+" or a "-" as they mark the beginning or the end of a block. The block titles must be in capital letters. After a block has started (+) it must be ended (-) before another block can begin. The general structure is as follows:



Most fields within a SINEX_TRO line are separated by a single space or a sequence of spaces. In the following sections, each SINEX_TRO line is defined by its field name, a general description and format using FORTRAN notations.

A comment line (not to be confused with the FILE/COMMENT Block) can be written anywhere between the header and the footer line. All comment lines must start with a "*" in the first column. With the use of this character,

information can be hidden from the software reading the file without deleting it from the file. A comment line format definition is provided in the Appendix 1.

4. DISSEMINATION

Three specific products are foreseen (and distinguished) in various dissemination scenarios supported by the SINEX_TRO format:

1) Individual analysis centre products,
2) Products from the combination centres,
3) Site-specific data time series.

4.1 File names

For file naming, it is recommended to use new format convention according to IGS products:

AAAV_PPP_TTT_YYYYDOYHHMM_LEN_SMP.TRO

or

AAAV_PPP_TTT_YYYYDOYHHMM_LEN_SMP_SITENAME.TRO

With:

- '_' used as a separator between all the filename fields except the file extension,
- **AAA** (3-char) –analysis centre acronym,
- **V** (1-char) – version / solution identifier, see VERSION NUMBER (File Reference Block),
- **PPP** (3-char) – project/campaign identification: operational (OPS), demonstration (DEM), testing (TST), re-processing (REP), undefined [1](UNK),
- **TTT** (3-char) – solution type: final (FIN), rapid (RAP), near real-time (NRT), real-time (RTM), sub-hourly (SUB), unknown (UNK)[2],
- **YYYYDOYHHMM** (11-char) – string representing beginning time of nominal data interval. '00000000000' can be used in case of a long time series storage,
- **LEN** (2-digits+1-char) – file frequency for specifying intended collection period of the file. Three characters are allowed for the format while the last character provides units minutes (xxM), hours (xxH), days (xxD), weeks (xxW), months (xxB), years (xxY), unspecified (00U). The last (00U) should be used if the file is used to store cumulative data,
- **SMP** (2-digits+1-char) – frequency for specifying data sampling rate. Three characters are allowed for the format with the last character providing the units: 100 Hertz (xxC), Hertz (xxZ), seconds (xxS), minutes (xxM), hours (xxH), days (xxD), weeks (xxW), months (xxB), years (xxY), unspecified (00U),
- **SITENAME** (4-char/9-char, optional) – site name consisting of variable length of 4 (old) or 9 (new) characters. New site conventional names according to the RINEX 3 convention are recommended. If a multi-station file is provided, the site name is omitted.

Examples:

[1] The 'undefined' status should only be used when converting other format to this one where the status is not defined or obvious; newly generated files should always have a known and defined status.

[2] Solution type REP, FIN, RAP, NRT, RTM are related to the GNSS product type used in the processing. Generally REP, FIN, RAP are delivered on daily basis, NRT on hourly basis, while RTM in real time. SUB is similar to NRT but delivered on sub-hourly basis.

GOPG_OPS_NRT_20150301000_01H_05M.TRO
GOP1_DEM_RTM_20150301000_05M_05M_GOPE.TRO
GOP2_TST_SUB_20150301000_15M_05M_GOPE00CZE.TRO
GOP2_OPS_FIN_20150300000_01D_01H.TRO
ASI2_REP_FIN_20150301030_07D_01H.TRO
EUR2_REP_FIN_20150300030_07D_01H.TRO

For the file dissemination, GZIP (.gz) format is recommended. There is no recommendation for using upper or lower cases in filenames. Never mix lower case and upper case.

In case of a very large number of stations, it is recommended to deliver one SINEX_TRO file per station.

4.2 Analysis Centre Product

The Analysis Centres of the different IAG services submit, usually on daily or weekly basis, files containing estimated tropospheric parameters from specific site or network processed consistently. Only that information should be given which is directly related to the troposphere estimates. Additional data from other sources are allowed (similar like in time series outputs) until these are homogeneous and properly described in the header. These could be made available in support of information equivalent to the COST-716 format. The corresponding data blocks are:

FILE/REFERENCE	(Mandatory)
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 for GNSS)
TROP/SOLUTION	(Mandatory for values in zenith directions)
SLANT/SOLUTION	(Mandatory for values in slant directions)

It is possible that a SINEX_TRO file contains data stemming from more sources, e.g. GNSS analysis completed with meteorological parameters observed in situ or derived from a numerical weather model. In such case, it should be however properly described in the file metadata sections.

4.3 Combination Product

It is necessary to define a combined product in case an IAG service, or any other service, delivers it for a single site or for a network. Besides blocks defined for the Analysis Centre products, the following blocks are added to support information from the combination process:

INPUT/FILES	(Mandatory)
CENTERS/INFO_MODEL	(Mandatory)
CENTERS/INFO_SOLUTION	(Mandatory)

4.4 Station Time Series

For the customer, who is interested in time series of tropospheric or other meteorological parameters for a specific location, it is convenient to have a product with separate files for each site.

The Station Time Series products aim at supporting application for which time series analysis is required (e.g. climate research, temporal modelling). A detailed description of a full history of metadata information has to be provided and is supported in the metadata definition since SINEX_TRO V2.0 can handle all metadata including site coordinates defined along with the time period specification.

5. TROPOSPHERIC MODELS AND OTHER RELATIONS

For the format definition, we need to define basic tropospheric models and other relations useful to exploit the format parameters.

5.1 Tropospheric models

The tropospheric path delay using the standard model and considering a symmetrical troposphere is expressed as follows:

$$d_{trop\_symmetry} = m_h(E)ZHD + m_w(E)ZWD \quad (1)$$

where ZHD and ZWD are zenith hydrostatic and wet delays, E is the elevation angle, m_h and m_w are hydrostatic and wet mapping function.

The tropospheric path delay applying the extended model and considering the first-order asymmetry of the troposphere is defined as:

$$d_{trop\_asymmetry} = m_h(E)ZHD + m_w(E)ZWD + m_g(E)[G_N cos\varphi + G_E sin\varphi] \quad (2)$$

with G_N and G_E horizontal tropospheric gradients in the North and East directions, ϕ azimuth angle, m_g gradient mapping function.

The zenith total delay (ZTD) is always defined as a sum of hydrostatic and wet delays in zenith (ZHD and ZWD), i.e. independently whether the troposphere asymmetry is modelled or not

$$ZTD = ZHD + ZWD \; . \quad (3)$$

Total slant tropospheric delay (STD) is then defined as the delay along the signal path and includes residuals (*res*) to the extended model and excludes potential multipath and other systematic effects (*mpt*). It is expressed with the following relation:

$$STD = mf_h ZHD + mf_w ZWD + mf_g[G_N cos\varphi + G_E sin\varphi] + res - mpt \quad (4)$$

where mf_h, mf_w and mf_g are mapping factors necessary for an unambiguous reconstruction of all individual model parameters. The mapping factors are float numbers corresponding to the actual observation elevation angles, and they can be calculated from specified mapping function or using a method of meteorological model data ray-tracing.

It is common to consider an approximation that the dry (or hydrostatic) zenith path delay represents the a priori troposphere model in the analysis of data of space geodetic techniques while model parameters estimated in the adjustments corresponds roughly to the wet (non-hydrostatic part).

$$d_{trop\_symmetry} = m_{approx}(E)ZTD_{apriori} + m_{estim}(E)\Delta ZTD_{estim} \; . \quad (5)$$

5.2 Conversion between ZTD and IWV

The conversion of ZTD estimates to Integrated Water Vapour (IWV) is done in two steps.

Firstly, following the IERS Conventions (2010), ZHD can be estimated by means of the Saastamoinen (1972) model if the surface air pressure P_s is known. Then, ZHD is subtracted from ZTD to form ZWD:

$$ZWD = ZTD - ZHD \ . \tag{6}$$

Secondly, ZWD is converted to IWV as:

$$IWV = \frac{10^6}{R_v\left(k_2^{'} + \frac{k_3}{T_m}\right)} ZWD \tag{7}$$

where R_v is the specific gas constant of water vapour, k'_2 *[K/hPa]* and k_3 *[K²/hPa]* are the refractivity coefficients (Bevis et al., 1994) and T_m is the weighted mean temperature of the atmosphere (Davis et al, 1985)

$$T_m = \frac{\int_H^\infty \frac{e}{T} dh}{\int_H^\infty \frac{e}{T^2} dh} \ . \tag{8}$$

T_m can be either numerically integrated from the numerical weather/climate model levels, or calculated from the analytical formula given by Askne and Nordius (1987).

5.3 Vertical parameter scaling

The temperature vertical scaling is usually approximated with the temperature lapse rate *β [K/km]*

$$T = T_0 - \beta(h - h_0) \tag{9}$$

where T and T_0 [K] are the temperature at height h and h_0 [m], respectively. Notice that the positive sign of the lapse rate is opposite to the U.S. Standard Atmosphere (1976). Similarly, the mean temperature vertical scaling is approximated with the mean temperature lapse rate β_m *[K/km]*

$$T_m = T_{m0} - \beta_m(h - h_0) \tag{10}$$

where T_m and T_{m0} [K] are the mean temperature at height h and h_0 [m].

The partial water vapour pressure vertical scaling is approximated using the parameter λ *[–]* and the formula introduced by Smith (1966) for a vertical approximation of the mixing ratio

$$e = e_0\left(\frac{P}{P_0}\right)^{\lambda+1} = e_0\left[1 - \frac{\beta(h - h_0)}{T_0}\right]^{\frac{(\lambda+1)g_m}{R_d\beta}} \tag{11}$$

where *P, e* and P_0, e_0 *[hPa]* are the atmospheric pressure and partial water vapour pressure at geopotential height *h* and h_0 *[km]*, respectively, and g_m is the standard gravitational acceleration *9.80665 [m.s-2]* defined in the U.S. Standard Atmosphere (1976).

The zenith wet delay is approximated using the ZWD decay parameter, Υ *[-]* and the formula introduced by Dousa and Elias (2014)

$$ZWD = ZWD_0 \left(\frac{P}{P_0} \right)^{\gamma+1} = ZWD_0 \left[1 - \frac{\beta(h-h_0)}{T_0} \right]^{\frac{(\gamma+1)g_m}{R_d\beta}} \quad (12)$$

where *P [hPa]* and P_0 *[hPa]* are the atmospheric pressure at geopotential height *h* and h_0 *[km]*.

6. LIST OF PARAMETER TYPES

Parameter types are defined specifically for each SINEX_TRO data block.

6.1 Parameter types in zenith direction (TROP/SOLUTION)

Different tropospheric parameter types, according to the tropospheric models described in Section 5, are summarized in **Table 1.** Parameters can be provided as a product of 1) data analysis, e.g. from data of space geodetic technique, 2) data processing, e.g. from numerical weather model data fields, or radiosounding, or 3) direct observation method, e.g. from water vapour radiometer.

Table 1. Tropospheric parameter types in zenith direction

Acronyms	Description	Base unit[1]
TROTOT	tropospheric zenith total delay (ZTD)	m
TROWET	tropospheric zenith wet delay (ZWD)	m
TRODRY	tropospheric zenith dry/hydrostatic delay (ZHD)	m
TGNTOT	tropospheric total gradient – North component (wet + dry parts)	m
TGNWET	tropospheric dry gradient – North direction	m
TGNDRY	tropospheric wet gradient – North direction	m
TGETOT	tropospheric total gradient – East component (wet + dry parts)	m
TGEWET	tropospheric wet gradient – East component	m
TGEDRY	tropospheric dry gradient – East component	m
STDDEV	standard deviation for each estimated value reported in preceding column	
IWV	integrated water vapour	kg/m^2

[1]Base unit is the reference unit for individual parameter scaling (see TROP/DESCRIPTION block).

Meteorological parameter types are summarized in Table 2. Parameters can be derived from 1) in situ observations, e.g. meteorological sensor, water vapour radiometer, or 2) data processing, e.g. from numerical weather model data fields or radiosounding.

Table 2. Meteorological parameter types

Acronyms	Description	Base unit[1]
PRESS	atmospheric pressure	hPa
EPRESS	partial water vapour pressure	hPa
TEMDRY	dry temperature	K
HUMREL	relative humidity	%

[1]Base unit is the reference unit for individual parameter scaling (see TROP/DESCRIPTION block).

Auxiliary parameter types in zenith direction including parameters for the vertical approximations are summarized in **Table 3**. These could provide 1) additional information about the product quality based on data analysis or, optionally, the differences in height to the reference position, e.g. for long-time series, to enable filtering of GNSS products etc. 2) necessary information for computing tropospheric ties needed for the comparisons at collocated stations.

Table 3. Auxiliary parameter types in zenith direction including parameters for the vertical approximations

Acronyms	Description	Base unit[1]
ACOK	number of ACs taken into account for given epoch	-
ACDL	number of ACs deleted for given epoch	-
NSAT	number of satellites	-
GDOP	geometric dilution of precision	-
SCLHGT	pressure scale height	m
TEMLPS	temperature lapse rate	K/m
WVPDEC	water vapour pressure exponential decay	-
ZWDDEC	zenith wet delay exponential decay	-
WMTEMP	weighted mean temperature	K
WMTLPS	weighted mean temperature lapse rate	K/m

[1]Base unit is the reference unit for individual parameter scaling (see TROP/DESCRIPTION block).

6.2 Parameter types in slant direction (SLANT/SOLUTION)

Slant tropospheric delay parameter types are supported since SINEX_TRO V2.0. The parameters are summarized in **Table 4**. In addition, the following parameter of the TROP/SOLUTION block (see **Table 1**) TROWET, TROHYD, TGNTOT, TGETOT should be provided as well.

Table 4. Tropospheric parameter types in slant directions

Acronyms	Description	Base unit[1]
SLTTOT	tropospheric slant total delay (STD)	m
SLTDRY	tropospheric slant dry delay (SHD), i.e. mf_h*ZHD	m
SLTWET	tropospheric slant wet delay (SWD), i.e. mf_w*ZWD	m
SLTGRD	tropospheric slant total delay due to the first-order horizontal gradient	m
SLTTGD	tropospheric slant dry delay due to the first-order horizontal gradient	m
SLTTGW	tropospheric slant wet delay due to the first-order horizontal gradient	m
STDDEV	standard deviation for each estimated value reported in the column preceding	
SLTIWV	tropospheric slant integrated water vapour	kg/m^2

[1]Base unit is the reference unit for individual parameter scaling (see TROP/DESCRIPTION block).

Auxiliary parameters for slant directions are supported in order to enable an optimal use of the slant parameters including a full reconstruction of any component of the tropospheric models defined in Section 5.

Table 5. Auxiliary parameter types in slant direction

Acronyms	Description	Base unit[1]
SAT	satellite code: Satellite System Satellite Number Satellite System: G=GPS R=GLONASS E=Galileo C=BeiDou	-
SAT__X	Satellite X-coordinate (Mandatory for Data Assimilation)	m
SAT__Y	Satellite Y-coordinate (Mandatory for Data Assimilation)	m
SAT__Z	Satellite Z-coordinate (Mandatory for Data Assimilation)	m
SATELE	elevation angle	deg
SATAZI	azimuth angle	deg
SATRES	satellite phase residuals	m
SATMPT	satellite multipath	m
FACDRY	dry mapping factor	-
FACWET	wet mapping factor	-
FACGRD	gradient mapping factor	-
FACTGD	gradient mapping factor for dry component	-
FACTGW	gradient mapping factor for wet component	-

[1]Base unit is the reference unit for individual parameter scaling (see TROP/DESCRIPTION block).

7. YYYY:DDD:SSSSS Time Tags

Time tags are given in a YYYY:DDD:SSSSS formatted representation:

- YYYY = 4- digit year;
- DDD = 3- digit day in year;
- SSSSS = 5- digit seconds in day.

No spaces are allowed within this string.

APPENDIX I

SINEX_TRO File VERSION 2.00

DETAILED FORMAT DESCRIPTION

In this appendix, the following blocks are described:

1. **Header and Footer Lines (Mandatory)**
2. **Comment line (Optional)**
3. **FILE/REFERENCE Block (Mandatory)**
4. **INPUT/FILES (for combined product only)**
5. **CENTERS/INFO_MODEL Block (for combined product only)**
6. **CENTERS/INFO_SOLUTION (for combined product only)**
7. **TROP/DESCRIPTION Block (Mandatory)**
8. **SITE/ID Block (Mandatory)**
9. **SITE/RECEIVER Block (Mandatory for GNSS)**
10. **SITE/ANTENNA Block (Mandatory for GNSS)**
11. **SITE/COORDINATES Block (Mandatory for GNSS)**
12. **SITE/ECCENTRICITY Block (Mandatory for GNSS)**
13. **TROP/SOLUTION Block (Mandatory for values in zenith directions)**
14. **SLANT/SOLUTION Block (Mandatory for values in slant directions)**

Many blocks described in this appendix are in common with SINEX.
Others (as SITE/ID, SITE/RECEIVER, SITE/ECCENTRICITY, SITE/COORDINATES etc.) have a slightly different description/format with respect to what reported in SINEX 2.02.

The last row of each table describing the blocks contains the sum of the characters.

1. Header and Footer Lines (Mandatory)

The Header line must be the first line in a SINEX_TRO file.
The Footer line must be the last line in a SINEX_TRO file.

Header Line		
Field	Description	Format
File Identifier	%=TRO	A5
Format Version	Four digits indicating the version of SINEX_TRO format used	1X,F4.2
File Agency Code	Identify the agency creating the file	1X,A3
Time	Creation time of this SINEX_TRO file defined as year:day_of_the_year:sec_of_the_day.	1X,I4.2,':',I3.3,':',I5.5
Agency Code	Identify the agency providing the data in the SINEX_TRO file	1X,A3
Start Time	Start time of solution in the this SINEX_TRO file defined as year:day_of_the_year:sec_of_the_day.	1X,I4.2,':',I3.3,':',I5.5
End Time	End time of the solution in the this SINEX_TRO file defined as year:day_of_the_year:sec_of_the_day.	1X,I4.2,':',I3.3,':',I5.5
Observation Code	Technique(s)/Source used to generate the SINEX_TRO. In case of a space geodetic technique, the code should be consistent with the IERS convention. C – Combined techniques used D – DORIS P – GNSS	1X,A1

	R – VLBI For non-space geodetic techniques the following code are defined: W – water vapour radiometer S – radiosounding F – numerical weather forecast N – numerical weather re-analysis M – climate model	
Solution Contents	Marker name if this is a combined solution file and contains only one site or 'MIX' if it is a submission file containing more than one site	1X,A4
		58

Footer Line		
Field	Description	Format
File Identifier	%=ENDTRO	A8
		8

2. Comment line (Optional)

A comment line can be placed anywhere, i.e. within or out from any block, as long as it is between the Header and Footer lines.
It is limited to 80 characters in total with the starting '*' character of the line. The definition is following:

Field	Description	Format
Comment	Any general comment relevant to the SINEX_TRO file.	1H*,A79

3. FILE/REFERENCE Block (Mandatory)

This block provides information on the Organization, point of contact, software and hardware involved in the generation of the estimates.

File Reference		
Field	Description	Format
Information Type	Describes the type of information present in the next field. May take on the following values 'DESCRIPTION' - Organization(s) gathering/altering the file contents 'OUTPUT' - Description of the file contents 'CONTACT - Address of the relevant contact e-mail 'SOFTWARE' - Software used to generate the file 'HARDWARE' - Computer hardware on which above software was run 'INPUT' - Brief description of the input used to generate this solution 'VERSION NUMBER' – Unique (3-digits) identifier of the product specific to a certain processing strategy which	1X,A18 1X, 3I

	matches that as seen in the V in the filename. It must be updated, and never reused, if the processing is modified in a way that might lead to a different error characteristics of the product. Mandatory for space geodetic techniques.	
Information	Relevant information for the type indicated by the previous field	1X,A60
		84

4. INPUT/FILES (for combined product only)

This block contains the list of the contributing solutions used in the combined product.

INPUT/FILES		
Field	Description	Format
Files	Name of contributing solutions	1X,A79

5. CENTERS/INFO_MODEL Block (for combined product only)

This block contains the information about the parameters used by the contributing Analysis Centers.

Center/Info_Model		
Field	Description	Format
Analysis Center	Name of Analysis Center	1X,A3
Observation Code	Observation technique used	1X,A1
Cut-off angle	Elevation cut-off angle used (degrees)	1X,I3
Data rate	Sampling rate for used data	1X,I4
Trop rate	Sampling rate for ALL trop estimates	1X,I4
Trop. Mapping function	TROP Hydrostatic and Wet Mapping functions used	1X,A29
Grad. Mapping function	GRAD Mapping functions used	1X,A29
		80

6. CENTERS/INFO_SOLUTION (for combined product only)

This block contains for the site in the combined product file the information about the data and biases for the contributing Analysis Centers.

Center/Info_Solution		
Field	Description	Format
Site Code	Call sign for a site	1X,A9
Analysis Center	Name of Analysis Center	1X,A3
# of days	Number of days used by the AC	1X,I2
Day Code	Flag for each day (0 if not available, 1 otherwise)	1X,7I1
# of bias	Number of biases for the interval (1=weekly; 7=daily)	1X,I2
Biases	Biases for each day in [mm]	7(1X,F6.1)
		77

7. TROP/DESCRIPTION Block (Mandatory)

This block gives important parameters from the analysis and defines the fields in the block 'TROP/SOLUTION' and in the block 'SLANT/SOLUTION'.

TROP/DESCRIPTION		
Field	Description	Format
Information Type	Describes the type of information present in the next field. May take one of the following values:	1X,A29
	'**TROPO PARAMETER NAMES**': Names of fields in trop solution (see Tables 6, 2 and 3) – mandatory with TROP/SOLUTION	n(1X,A6)
	'**TROPO PARAMETER UNITS**': Units applied for individual fields in trop solution (see Table 1, 2 and 3). Values reported in TROP/SOLUTION Block should be divided by the related TROPO UNITS to get the base units – mandatory with TROP/SOLUTION	n(1X,A6)
	'**TROPO PARAMETER WIDTH**': Width of fields in trop solution (see Tables 7, 2 and 3) – mandatory with TROP/SOLUTION	n(1X,A6)
	'**SLANT PARAMETERS** ': Names of fields in slant solution (see Tables 4 and 5) – mandatory with SLANT/SOLUTION	n(1X,A6)
	'**SLANT PARAMETER UNITS**': Units applied for individual fields in slant solution (see Tables 4 and 5) – mandatory with SLANT/SOLUTION. Values reported in SLANT/SOLUTION Block should be divided by the related SLANT UNITS to get the base units.	n(1X,A6)
	'**SLANT PARAMETER WIDTH**': Width of fields in slant solution (see Tables 4 and 5) – mandatory with SLANT/SOLUTION	n(1X,A6)
	'DATA SAMPLING INTERVAL': GNSS data Sampling Rate [sec]	1X,I22
	'**TROPO MODELING METHOD**': (For GNSS only) Tropospheric estimation method: Filter, Smoother, Least Square, Piece Wise Linear Interpolation	1X,A22
	'**GNSS SYSTEMS**': (For GNSS only) Observation from GNSS system used (string concatenating system characters (G=GPS, R=GLONASS, E=Galileo, C=BeiDou)	1X,A22
	'TIME SYSTEM': The time tags specified in the TROP/SOLUTION and in the SLANT/SOLUTION blocks have to be given in a common time system. Possible time systems are : • RINEX GNSS system (flag 'G ') • Coordinated Universal Time (flag 'UTC ') Mandatory information.	1X,A22

	'**REFRACTIVITY COEFFICIENTS**': Factors used during conversion from ZPD into IWV.	1X, F5.2, 1X, F5.2, 1X, F8.1
	'**SOURCE OF MET/DATA**': source of the surface meteorological observations used, it can be: • OBS/LOCAL for on-site (local) meteo sensor • OBS/NEARBY for nearby meteo data is used (with pressure adjusted for any GNSS site height difference) • OBS/INTERPOLATED: meteo data has been interpolated from a network of nearby stations • NWP/cccctt data is from an NWP model where cccc is the (3-10 character) ID code for the NWP centre (e.g. ECMWF for ECMWF, METO for the Met Office, KNMI for KNMI, DWD for DWD, etc) and tt is the forecast lead time, e.g. 06 for a T+6hr forecast, 00 for an analysis). • NONE: not available	1X,A22
	'**OCEAN TIDE LOADING MODEL**': (For GNSS only) Ocean tide loading model applied	1X,A22
	'**ATMOSPH TIDE LOADING MODEL**': (For GNSS only) Atmospheric tide loading model applied	1X,A22
	'**GEOID MODEL**': Geoid model name for undulation values	1X,A22
	<u>Only for individual analysis centre submissions:</u> '**TROPO SAMPLING INTERVAL**': Tropospheric parameter sampling interval [sec] – mandatory with TROP/SOLUTION	1X,I22
	'**SLANT SAMPLING INTERVAL**': Slant data sampling interval [sec] – mandatory with SLANT/SOLUTION	1X,I22
	'**A PRIORI TROPOSPHERE**': A priori tropospheric model used	1X,A22
	'**TROPO MAPPING FUNCTION**': Name of mapping function used for mapping hydrostatic and wet delay	1X,A22
	'**GRADS MAPPING FUNCTION**': Name of mapping function used for mapping horizontal gradients.	1X,A22
	'**ELEVATION CUTOFF ANGLE**': Elevation cut-off [deg]	1X,F22
	<u>Only for combined solution:</u> '**BIAS FROM INTERVAL**': Begin and end of interval for bias computation [yyddd]	12X,I5,X,I5
	'**DELETE FACTOR**': Limit (factor*sigma) for editing of trop estimates	1X,F22
	The above fields may be in any order	
Information	Relevant information for the type indicated by the previous field	format is type-dependent
		Variable

8. SITE/ID Block (Mandatory)

This block provides general information for each site containing estimated parameters.

For **NWP Data Assimilation it is mandatory** to provide the coordinates of the observing site used to estimate the tropospheric parameters reported in the TROP/SOLUTION and/or in the SLANT/SOLUTION Block. The reported ellipsoid height and geoid height shall contain the antenna height in the SITE/ECCENTRICITY Block. These are the coordinates to be used for BUFR (Binary Universal Format for the Representation of data (WMO)) [12].

SITE/ID		
Field	Description	Format
Site Code	Call sign for a site	1X,A9
Point Code	Physical monument used at a site	1X,A2
Unique Monument Identification	Unique alpha-numeric monument identification. For ITRF purposes it is a nine character DOMES/DOMEX number (five/six digits, followed by the single letter 'M' or 'S', followed by four/three digits)	1X,A9
Observation Code	Observation technique used.	1X,A1
Station Description	Free-format description of the site, typically the town and/or country	1X,A22
Longitude	Longitude of the site in degrees (-90° to 90°N), decimals	1X,F10.6
Latitude	Latitude of the site in degrees (0° to 360°E), decimals	1X,F10.6
Ellipsoidal Height	Height above ellipsoid of the site in metres	1X,F9.3
Geoidal Height	Height above geoid of the site in metres	1X,F9.3
		92

9. SITE/RECEIVER Block (Mandatory for GNSS)

List the receiver used at each site during the observation period of interest.

SITE/RECEIVER		
Field	Description	Format
Site Code	Call sign for a site	1X,A9
Point Code	Physical monument used at a site	1X,A2
Solution ID	Solution Number at a Site/Point code for which some parameters are estimated	1X,A4
Observation Code	Observation technique used.	1X,A1
Start Time	Time since the receiver has been operating at the Site/Point defined as year:day_of_the_year:sec_of_the_day. Value 00:000:00000 indicates that the receiver has been operating at least since the "File Epoch Start Time"	1X,I4.2,':',I3.3,':',I5.5
End Time	Time since the receiver has been operating at the Site/Point defined as year:day_of_the_year:sec_of_the_day.	1X,I4.2,':',I3.3,':',I5.5

	Value 00:000:00000 indicates that the receiver has been operating at least since the "File Epoch End Time"	
Receiver Type	Receiver Name & model	1X,A20
Receiver Serial Number	Serial number of the receiver. Takes on value '-----' if unknown	1X,A20
Receiver Firmware	Firmware used by this receiver during the epoch specified above. Takes on value '-----' if unknown	1X,A11
		100

10. SITE/ANTENNA Block (Mandatory for GNSS)

List of antennas used at each site used in the SINEX_TRO file including the reference to the antenna phase center model used.

SITE/ANTENNA		
Field	Description	Format
Site Code	Call sign for a site	1X,A9
Point Code	Physical monument used at a site	1X,A2
Solution ID	Solution Number at a Site/Point code for which some parameters are estimated	1X,A4
Observation Code	Observation technique used.	1X,A1
Start Time	Time since the antenna has been installed at the Site/Point defined as year:day_of_the_year:sec_of_the_day. Value 00:000:00000 indicates that the receiver has been operating at least since the "File Epoch Start Time"	1X,I4.2,':',I3.3,':',I5.5
End Time	Time since the antenna has been installed at the Site/Point defined as year:day_of_the_year:sec_of_the_day. Value 00:000:00000 indicates that the receiver has been operating at least since the "File Epoch End Time"	1X,I4.2,':',I3.3,':',I5.5
Antenna Type	Antenna Name & model	1X,A20
Antenna Serial Number	Serial number of the antenna. Takes on value '-----' if unknown	1X,A20
Antenna Calibration Model	Name of the antenna model used in the correction of the observations for phase center variations	1X,A10
		98

Comments:

- For IGS, the antenna calibration model refers to the ANTEX file provided by the IGS Central Bureau Information System:
  directory: ftp://igscb.jpl.nasa.gov/igscb/station/general
  atx ('wwww' for GPS week of the last update)

- For IGS, standard antenna names please refer to ftp://igscb.jpl.nasa.gov/igscb/station/general/rcvr_ant.tab

- If a receiver antenna is given in this block with a serial number to indicate individual antenna calibration model it has to be assigned in the SITE/ANTENNA Block to a specific station.

11. SITE/COORDINATES Block (Mandatory for GNSS)

This block provides the coordinates of the sites. The eccentricities of section "SITE/ECCENTRICITIES should be applied to these precise coordinates. The coordinates should be related to SITE point and only if ECCENTRICITIES are zero, then it is the ARP point. For the combination result, it also gives some statistical information.

SITE/COORDINATES		
Field	Description	Format
Site Code	Call sign for a site	1X,A9
Point Code	Physical monument used at a site	1X,A2
Solution ID	Solution number to which the input in this data line is referred to	1X,A4
Observation Code	Observation technique used	1X,A1
Data Start	Start Time since the site coordinates are valid, defined as year:day_of_the_year:sec_of_the_day. Value 00:000:00000 indicates the validity since the "File Epoch Start Time"	1X,I4.2,':',I3.3,':',I5.5
Data End	End Time since the site coordinates are valid, defined as year:day_of_the_year:sec_of_the_day. Value 00:000:00000 indicates the validity till the "File Epoch End Time"	1X,I4.2,':',I3.3,':',I5.5
Coordinates	x,y,z-coordinate of a site of SINEX_TRO format used.	3(1X,F12.3)
System	Terrestrial Reference System Code	1X,A6
Remark	A remark used to identify the origin of the coordinates (AC acronym or 'Mean')	1X,A5
Standard Deviation	Standard deviation for x,y,z in [mm] (Used only for Mean)	3(1X,I2)
Counter	Number of ACs used for Mean(Used only for Mean)	1X,I2
		110

12. SITE/ECCENTRICITY Block (Mandatory for GNSS)

List of antenna eccentricities from the Marker to the Antenna Reference Point (ARP) or to the intersection of axis.

SITE/ECCENTRICITIES		
Field	Description	Format
Site Code	Call sign for a site	1X,A9
Point Code	Physical monument used at a site	1X,A2
Solution ID	Solution Number at a Site/Point code for which some parameters are estimated	1X,A4
Observation Code	Observation technique used.	1X,A1
Start Time	Time since the antenna has been installed at the Site/Point defined as year:day_of_the_year:sec_of_the_day. Value 00:000:00000 indicates that the receiver has been operating at least since the "File Epoch Start Time"	1X,I4.2,':',I3.3,':',I5.5

End Time	Time since the antenna has been installed at the Site/Point defined as year:day_of_the_year:sec_of_the_day. Value 00:000:00000 indicates that the receiver has been operating at least since the "File Epoch End Time"	1X,I4.2,':',I3.3,':',I5.5
Eccentricity Reference System	Reference system used to describe vector distance from monument benchmark to the antenna reference point or intersection of axis: 'UNE' - Local reference system: Up, North, East 'XYZ' - Cartesian Reference System X, Y, Z. All units are in meters	1X,A3
Up / X Eccentricity	Up / X offset from the marker to the Antenna reference point (ARP)	1X,F8.4
North / Y Eccentricity	North/Y offset from the marker to the Antenna reference point (ARP)	1X,F8.4
East / Z Eccentricity	East / Z offset from the marker to the Antenna reference point (ARP)	1X,F8.4
		77

13. TROP/SOLUTION Block (Mandatory for values in zenith directions)

This block contains the solution for all epochs.

TROP/SOLUTION		
Field	Description	Format
Marker	Name of the marker NOTE : For backward compatibility left - aligned 4-character station codes are also permitted	1X,A9
Time	Time epoch of the solution: Middle of data Interval, defined as year:day_of_the_year:sec_of_the_day.	1X,I4.2,':',I3.3,':',I5.5
Values	Space separated fields of variable length. Number and order of fields are given in the block TROP/DESCRIPTION. Readable by: read(line(20:),*)(val(i),i=1,n)	no format
		variable

14. SLANT/SOLUTION Block (Mandatory for values in slant directions)

This block contains the slant solution for all epochs.

SLANT/SOLUTION		
Field	Description	Format
Marker	Name of the marker NOTE : For backward compatibility left - aligned 4-character station codes are also permitted	1X,A9
Time	Time epoch of the solution: Middle of data Interval defined as year:day_of_the_year:sec_of_the_day.	1X,I4.2,':',I3.3,':',I5.5
Values	Space separated fields of variable length. Number and order of fields are given in the block TROP/DESCRIPTION. Readable by: read(line(20:),*)(val(i),i=1,n)	no format
		variable

APPENDIX II

1. Example for Submissions of Trop & Slant Estimates

```
%=TRO 2.00 GOP 2017:157:61799 GOP 2013:168:64500 2013:168:86100 P  MIX
*-------------------------------------------------------------------------------
+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
*-------------------------------------------------------------------------------
+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        GMFH/GMFW
 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   NSAT   GDOP    IWV  PRESS TEMDRY WMTEMP TEMLPS WMTLPS ZWDDEC
 TROPO PARAMETER UNITS          1e+03  1e+03  1e+03  1e+03  1e+03  1e+03  1e+03  1e+03      1      1      1      1      1      1  1e+03  1e+03      1
 TROPO PARAMETER WIDTH              6      6      6      6      6      6      6      6      4      4      6      7      6      6      6      6      6
 SLANT PARAMETER NAMES         SLTTOT STDDEV SLTDRY SLTWET SLTIWV SLTGRD SATRES SATMPT    SAT SATELE SATAZI FACDRY FACWET FACGRD
 SLANT PARAMETER UNITS          1e+03  1e+03  1e+03  1e+03      1  1e+03  1e+03  1e+03      1      1      1      1      1      1
 SLANT PARAMETER WIDTH              8      6      8      6      6      6      6      6      4      7      7      9      9      9
-TROP/DESCRIPTION
*-------------------------------------------------------------------------------
+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
*-------------------------------------------------------------------------------
+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
*-------------------------------------------------------------------------------
+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
```

2. Example for Combination Product

```
%=TRO 2.00 ASI 2015:352:42300 EUR 2015:298:01800 2015:304:84600 P MIX
*------------------------------------------------------------------------------
+FILE/REFERENCE
 DESCRIPTION    Weekly combination of trop estimates of EPN Analysis Centers
 OUTPUT         Combined Tropospheric Products of the EPN Network
 CONTACT        rosa.pacione@e-geos.it,ASI/CGS Italy
 Version Number 001
-FILE/REFERENCE
*------------------------------------------------------------------------------
+TROP/DESCRIPTION
*_________KEYWORD_____________ __VALUE(S)_____________________
 TROPO SAMPLING INTERVAL                      3600
 BIAS FROM INTERVAL                      15298 15304
 DELETE FACTOR                             1.0
 GEOID MODEL                             EGM2008
 TIME SYSTEM                                 G
 TROPO PARAMETER NAMES         TROTOT STDDEV #ACTAK #ACDEL
 TROPO PARAMETER UNITS         1.0e+3 1.0e+3      1      1
 TROPO PARAMETER WIDTH              8      8      2      2
-TROP/DESCRIPTION
*------------------------------------------------------------------------------
+CENTERS/INFO_MODEL
*_AC T CUT DATA TROP __TROP_MAPPING_FUNCTION______
 ASI P   3  300 3600    VMF1H/VMF1W
 BEK P   3  180 3600    GMFH/GMFW
 BKG P   3  180 3600    GMFH/GMFW
 COE P   3  180 3600    VMF1H/VMF1W
 ............................

-CENTERS/INFO_MODEL
*------------------------------------------------------------------------------
+INPUT/FILES
 ASI1_OPE_FIN_2015102500_01D_01H.TRO
 ............
 ASI1_OPE_FIN_2015103100_01D_01H.TRO
 BEK1_OPE_FIN_2015102500_01D_01H.TRO
 ............
 BEK1_OPE_FIN_2015103100_01D_01H.TRO
 ............
 COE1_OPE_FIN_2015103100_01D_01H.TRO
 ............
-INPUT/FILES
*------------------------------------------------------------------------------
+FILE/COMMENT
 Coordinates taken from EUREF weekly combined solution
-FILE/COMMENT
*------------------------------------------------------------------------------
+SITE/ID
*STATION__ PT __DOMES__ T _STATION_DESCRIPTION__ APPROX_LON_ APPROX_LAT_ _APP_HGT GEOID_HGT
 ACOR00ESP  A 13434M001 P A Coruna, ES           43.364385    -8.398930   66.900   14.821
 ...
-SITE/ID
*------------------------------------------------------------------------------
+SITE/COORDINATES
*STATION__ PT SOLN T DATA_START____ DATA_END______ ___STA_X____ ___STA_Y____ ___STA_Z____ SYSTEM REMRK SX SY SZ #N
 ACOR00ESP  A    1 P 2015:298:00000 2015:304:86370  4594489.598  -678367.524  4357066.243 ITRF08 Mean   0  0  0
 ...
-SITE/COORDINATES
*------------------------------------------------------------------------------
+SITE/RECEIVER
*STATION__ PT SOLN T DATA_START____ DATA_END______ DESCRIPTION_________ S/N_________________ FIRMWARE___
 ACOR00ESP  A    1 P 2015:298:00000 2015:304:86370 LEICA GRX1200PRO     -459187              8.20/2.125
 ...
-SITE/RECEIVER
*------------------------------------------------------------------------------
+SITE/ANTENNA
*STATION__ PT SOLN T DATA_START____ DATA_END______ DESCRIPTION_________ S/N_________________ PCV_MODEL_
 ACOR00ESP  A    1 P 2015:298:00000 2015:304:86370 LEIAT504        LEIS -103033              IGS08_1885
 ...
-SITE/ANTENNA
*------------------------------------------------------------------------------
+SITE/ECCENTRICITY
*                                              UP______ NORTH___ EAST____
*STATION__ PT SOLN T DATA_START____ DATA_END______ AXE ARP->BENCHMARK(M)_________
 ACOR00ESP  A    1 P 2015:298:00000 2015:304:86370 UNE   3.0460   0.0000   0.0000
 ...
-SITE/ECCENTRICITY
*------------------------------------------------------------------------------
+TROP/SOLUTION
*STATION__ ___EPOCH____ TROTOT _SIG #T #D
 ACOR00ESP 2015:298:01800 2461.6  5.6  4  0
 ACOR00ESP 2015:298:05400 2461.6  4.3  4  0
 ACOR00ESP 2015:298:09000 2457.8  4.6  4  0
 ...
-TROP/SOLUTION
*------------------------------------------------------------------------------
+CENTERS/INFO_SOLUTION
*STATION__ AC_ #D DAY_COD #B _BIAS_ _BIAS_ _BIAS_ _BIAS_ _BIAS_ _BIAS_ _BIAS_
 ACOR00ESP BEK  7 1111111  1    1.4    1.0    0.9    1.3    1.1    1.0    1.2
 ACOR00ESP IGE  7 1111111  1    1.9    1.9    1.9    1.9    1.9    1.9    1.9
 ACOR00ESP IGN  6 1110111  1    1.9    1.5    1.3    1.8    2.0    1.6    1.9
 ACOR00ESP ROB  4 1001101  1   -5.3   -5.0   -5.1   -5.5   -5.3   -4.9   -5.2
 ....
-CENTERS/INFO_SOLUTION
*------------------------------------------------------------------------------
%=ENDTRO
```

3. Example of Submission for Radiosonde Product

```
%=TRO 2.00 GOP 2017:157:61760 GOP 2013:169:00000 2013:181:21600 S  MIX
*-------------------------------------------------------------------------------
+FILE/REFERENCE
*INFO_TYPE_________ INFO_____________________________________________________
 DESCRIPTION        GOP - Geodetic Observatory Pecny, RIGTC
 OUTPUT             Solution parameters
 CONTACT            gnss@pecny.cz
 SOFTWARE           G-Nut/Rao
 INPUT              GNSS/NWM/RAO/OTH data
 VERSION NUMBER     001
-FILE/REFERENCE
*-------------------------------------------------------------------------------
+TROP/DESCRIPTION
*_________KEYWORD_____________ __VALUE(S)_____________________________________
 TROPO SAMPLING INTERVAL       0
 TIME SYSTEM                   UTC
 REFRACTIVITY COEFFICIENTS     77.60 70.40 373900.0
 TROPO PARAMETER NAMES         WVPDEC WMTLPS TEMLPS ZWDDEC WVPRES    IWV  PRESS HUMSPC TEMDRY WMTEMP TRODRY TROTOT TROWET
 TROPO PARAMETER UNITS              1  1e+03  1e+03      1      1      1      1      1      1      1  1e+03  1e+03  1e+03
 TROPO PARAMETER WIDTH              6      6      6      6      6      6      7      6      6      6      6      6      6
-TROP/DESCRIPTION
*-------------------------------------------------------------------------------
+SITE/ID
*STATION__ PT __DOMES__ T _STATION_DESCRIPTION__ _LONGITUDE _LATITUDE_ _HGT_ELI_ _HGT_MSL_
 EZM_11520  A XXXXXXXXX S Czech Republic: PRAHA-  14.446900  50.007800   340.003   378.007
-SITE/ID
*-------------------------------------------------------------------------------
+SITE//COORDINATES
*STATION__ PT SOLN T __DATA_START__ __DATA_END____ __STA_X_____ __STA_Y_____ __STA_Z_____ SYSTEM REMRK
 EZM_11520  A    1 S 2013:169:00000 2013:181:21600  3977538.400  1024729.503  4863607.154  IGS08   GOP
-SITE/COORDINATES
*-------------------------------------------------------------------------------
+TROP/SOLUTION
*STATION__ ____EPOCH_____ WVPDEC WMTLPS TEMLPS ZWDDEC WVPRES    IWV   PRESS HUMSPC TEMDRY WMTEMP TRODRY TROTOT TROWET
 EZM_11520 2013:169:00000   2.99   7.11   7.05   3.73  18.87  32.19  980.00 12.064  294.5  287.8 2230.6 2426.9  196.3
 EZM_11520 2013:169:21600   3.36   6.97   7.13   3.50  21.27  28.78  981.00 13.600  295.3  286.9 2232.9 2409.0  176.0
 EZM_11520 2013:169:43200   3.05   7.22   7.44   3.64  23.94  34.14  980.00 15.337  305.5  288.7 2230.7 2438.2  207.6
 EZM_11520 2013:170:00000   5.19   6.94   7.15   3.27  23.21  29.11  982.00 14.835  294.8  286.6 2235.2 2413.4  178.2
 EZM_11520 2013:170:21600   4.55   6.59   7.02   3.00  22.78  29.56  982.00 14.559  296.8  284.9 2235.2 2417.3  182.1
 EZM_11520 2013:170:43200   3.43   7.05   7.32   4.10  26.41  36.86  981.00 16.918  304.1  288.8 2232.9 2456.9  224.0
 EZM_11520 2013:171:00000   4.02   7.37   7.03   4.73  22.78  29.36  978.00 14.619  297.3  290.5 2226.1 2403.5  177.4
 EZM_11520 2013:171:21600   3.84   7.19   6.86   4.07  22.36  28.93  978.00 14.347  296.9  288.4 2226.1 2402.1  176.0
 EZM_11520 2013:171:43200   3.57   7.31   7.42   4.24  25.46  33.76  977.00 16.370  304.5  290.1 2223.8 2428.1  204.2
 EZM_11520 2013:172:00000   2.10   6.56   6.64   2.87  16.60  32.20  976.00 10.647  293.8  284.4 2221.5 2420.2  198.6
 EZM_11520 2013:172:21600   2.02   5.82   6.15   3.10  16.39  30.38  979.00 10.477  291.9  281.7 2228.3 2417.5  189.2
 EZM_11520 2013:172:43200   2.80   6.24   6.45   3.50  16.39  24.22  980.00 10.466  297.5  282.9 2230.6 2380.8  150.2
 EZM_11520 2013:173:00000   2.30   5.67   6.30   2.45  16.82  26.38  982.00 10.720  292.9  280.3 2235.2 2400.3  165.1
 EZM_11520 2013:173:21600   2.48   5.78   6.06   2.72  16.82  24.83  982.00 10.720  292.1  279.4 2235.2 2391.0  155.9
 EZM_11520 2013:173:43200   2.03   6.02   6.82   3.28  12.94  25.87  981.00  8.244  297.9  280.9 2232.9 2394.4  161.5
 EZM_11520 2013:174:00000   2.43   5.97   6.42   3.48  16.39  29.36  980.00 10.466  291.8  280.6 2230.6 2414.1  183.5
 EZM_11520 2013:174:21600   2.80   5.67   6.19   3.27  16.92  25.55  979.00 10.823  291.5  279.5 2228.3 2388.7  160.4
 EZM_11520 2013:174:43200   2.42   5.60   6.24   2.96  15.56  28.94  979.00  9.944  294.8  278.6 2228.3 2410.5  182.2
 EZM_11520 2013:175:00000   1.88   5.19   6.16   2.04  10.72  22.74  981.00  6.822  290.1  273.9 2232.8 2378.4  145.6
 EZM_11520 2013:175:21600   1.92   5.22   6.12   2.11  12.85  24.83  982.00  8.181  285.5  272.5 2235.1 2394.8  159.7
 EZM_11520 2013:175:43200   2.17   5.16   5.96   2.21  13.46  26.26  983.00  8.564  287.3  273.0 2237.4 2406.1  168.7
 EZM_11520 2013:176:00000   2.00   5.21   6.06   2.21  13.46  26.73  982.00  8.572  285.1  272.7 2235.1 2406.9  171.8
 EZM_11520 2013:176:21600   2.38   4.92   6.16   2.24  13.11  24.14  981.00  8.355  285.1  272.1 2232.8 2388.4  155.5
 EZM_11520 2013:176:43200   2.36   4.73   5.93   2.37  12.77  22.98  983.00  8.118  285.3  271.0 2237.4 2386.0  148.6
 EZM_11520 2013:177:00000   2.26   4.88   5.99   2.48  10.86  20.63  986.00  6.881  283.3  270.3 2244.2 2378.0  133.8
 EZM_11520 2013:177:21600   2.37   4.94   6.07   2.62  11.09  20.91  986.00  7.023  282.9  270.2 2244.2 2379.8  135.6
 EZM_11520 2013:177:43200   2.24   5.18   5.92   2.51  10.08  19.82  988.00  6.368  284.3  270.2 2248.7 2377.3  128.6
 EZM_11520 2013:178:00000   4.09   6.25   6.16   4.34   9.74  13.10  990.00  6.139  282.5  273.2 2253.3 2337.3   84.1
 EZM_11520 2013:178:21600   4.48   5.83   6.60   4.47  10.29  13.26  989.00  6.494  283.9  273.2 2251.0 2336.1   85.1
 EZM_11520 2013:178:43200   2.95   5.82   6.79   4.16   9.34  14.36  988.00  5.901  287.1  273.9 2248.7 2340.7   91.9
 EZM_11520 2013:179:00000   4.18   5.94   6.86   3.94  10.22  13.20  987.00  6.463  281.8  274.3 2246.4 2330.8   84.4
 EZM_11520 2013:179:21600   3.16   5.68   6.58   3.12  10.50  14.60  986.00  6.649  281.5  272.5 2244.2 2338.1   93.9
 EZM_11520 2013:179:43200   2.55   5.81   7.04   3.06   9.60  14.39  985.00  6.086  292.5  273.6 2241.9 2334.1   92.2
 EZM_11520 2013:180:00000   3.15   6.12   6.64   4.04  11.24  16.34  984.00  7.134  284.1  276.1 2239.6 2343.4  103.8
 EZM_11520 2013:180:21600   2.70   5.93   6.39   3.08  11.24  18.31  983.00  7.141  285.5  273.6 2237.4 2354.7  117.3
 EZM_11520 2013:180:43200   2.04   5.67   6.87   2.60  10.72  21.14  981.00  6.822  292.1  273.6 2232.8 2368.3  135.5
 EZM_11520 2013:181:00000   2.79   5.90   6.42   3.42  13.11  22.46  984.00  8.330  285.8  275.5 2239.6 2382.6  143.0
 EZM_11520 2013:181:21600   6.51   5.82   5.77   6.32   9.41   9.06  986.00  5.955  283.8  273.9 2244.2 2302.2   58.0
-TROP/SOLUTION
%=ENDTRO
```

4. Example of Submission for NWM-derived Parameters

```
%=TRO 2.00 GOP 2017:120:63556 GOP 2013:168:00000 2013:169:00000 N  MIX
*-------------------------------------------------------------------------------
+FILE/REFERENCE
*INFO_TYPE_________ INFO_____________________________________________________
 DESCRIPTION        GOP - Geodetic Observatory Pecny, RIGTC
 OUTPUT             Solution parameters
 CONTACT            gnss@pecny.cz
 SOFTWARE           G-Nut/Shu
 INPUT              GNSS/NWM/RAO/OTH data
-FILE/REFERENCE
*-------------------------------------------------------------------------------
+TROP/DESCRIPTION
*_________KEYWORD_____________ __VALUE(S)_____________________________________
 REFRACTIVITY COEFFICIENTS     77.60 70.40 373900.0
 TROPO SAMPLING INTERVAL       3600
 TIME SYSTEM                   UTC
 TROPO PARAMETER NAMES         WVPDEC WMTLPS TEMLPS ZWDDEC WVPRES SCLHGT    IWV  PRESS HUMSPC TEMDRY WMTEMP TRODRY TROTOT TROWET
 TROPO PARAMETER UNITS              1  1e+03  1e+03      1      1  0.001      1      1      1      1      1  1e+03  1e+03  1e+03
 TROPO PARAMETER WIDTH              6      6      6      6      6      6      6      7      6      6      6      6      6      6
-TROP/DESCRIPTION
*-------------------------------------------------------------------------------
+SITE/ID
*STATION__ PT __DOMES__ T _STATION_DESCRIPTION__ _LONGITUDE _LATITUDE_ _HGT_ELI_ _HGT_MSL_
 GOPE00CZE  A 11502M002 N                        14.785625  49.913706   592.716   630.502
 WTZR00DEU  A 14201M010 N                        12.878912  49.144199   666.119   705.725
 ZIMM00CHE  A 14001M004 N                         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 N 2013:168:00000 2013:169:00000  3979316.100  1050312.600  4857067.400  IGS08   GOP
 WTZR00DEU  A    1 N 2013:168:00000 2013:169:00000  4075580.800   931853.900  4801568.800  IGS08   GOP
 ZIMM00CHE  A    1 N 2013:168:00000 2013:169:00000  4331297.300   567556.000  4633134.600  IGS08   GOP
-SITE/COORDINATES
*-------------------------------------------------------------------------------
+TROP/SOLUTION
*STATION__ ____EPOCH___ WVPDEC WMTLPS TEMLPS ZWDDEC WVPRES SCLHGT    IWV   PRESS HUMSPC TEMDRY WMTEMP TRODRY TROTOT TROWET
 GOPE00CZE 2013:168:00000   2.58   6.23   6.51   2.80  12.51  8.081  22.67  953.04  8.202  293.1  280.1 2169.4 2311.4  142.0
 GOPE00CZE 2013:168:03600   2.49   6.21   6.50   2.74  12.21  8.081  22.79  953.13  8.006  292.7  279.9 2169.6 2312.5  142.9
 GOPE00CZE 2013:168:07200   2.41   6.18   6.49   2.68  11.91  8.082  22.92  953.22  7.810  292.4  279.8 2169.8 2313.6  143.7
 GOPE00CZE 2013:168:10800   2.33   6.16   6.48   2.62  11.61  8.082  23.05  953.32  7.614  292.1  279.7 2170.0 2314.6  144.6
 GOPE00CZE 2013:168:14400   2.24   6.13   6.47   2.57  11.31  8.082  23.17  953.41  7.418  291.8  279.5 2170.2 2315.7  145.5
 GOPE00CZE 2013:168:18000   2.16   6.11   6.46   2.51  11.02  8.082  23.30  953.50  7.222  291.4  279.4 2170.5 2316.8  146.3
 GOPE00CZE 2013:168:21600   2.08   6.08   6.45   2.45  10.72  8.082  23.42  953.59  7.026  291.1  279.3 2170.7 2317.8  147.2
 GOPE00CZE 2013:168:25200   2.11   6.17   6.52   2.52  11.23  8.089  23.79  953.60  7.361  291.9  279.8 2170.7 2319.9  149.2
 GOPE00CZE 2013:168:28800   2.18   6.30   6.62   2.64  11.97  8.098  24.24  953.57  7.847  293.0  280.5 2170.6 2322.2  151.6
 GOPE00CZE 2013:168:32400   2.27   6.45   6.74   2.77  12.84  8.109  24.74  953.51  8.418  294.3  281.3 2170.5 2324.7  154.2
 GOPE00CZE 2013:168:36000   2.36   6.60   6.86   2.92  13.74  8.120  25.27  953.42  9.010  295.6  282.2 2170.3 2327.4  157.1
 GOPE00CZE 2013:168:39600   2.44   6.75   6.97   3.06  14.57  8.131  25.81  953.30  9.556  296.9  283.1 2170.0 2330.0  160.0
 GOPE00CZE 2013:168:43200   2.50   6.89   7.06   3.17  15.23  8.141  26.34  953.15  9.992  298.0  283.8 2169.7 2332.5  162.9
 GOPE00CZE 2013:168:46800   2.46   6.97   7.12   3.22  15.38  8.149  26.83  952.95 10.096  298.7  284.3 2169.2 2334.8  165.6
 GOPE00CZE 2013:168:50400   2.40   7.05   7.16   3.25  15.37  8.155  27.31  952.73 10.091  299.2  284.7 2168.7 2337.1  168.4
 GOPE00CZE 2013:168:54000   2.33   7.10   7.19   3.26  15.27  8.161  27.78  952.49 10.031  299.5  285.0 2168.2 2339.3  171.1
 GOPE00CZE 2013:168:57600   2.26   7.15   7.21   3.27  15.16  8.166  28.23  952.26  9.966  299.7  285.3 2167.7 2341.3  173.7
 GOPE00CZE 2013:168:61200   2.21   7.19   7.21   3.29  15.12  8.171  28.65  952.05  9.950  299.7  285.5 2167.2 2343.3  176.1
 GOPE00CZE 2013:168:64800   2.19   7.21   7.20   3.32  15.24  8.174  29.04  951.90 10.033  299.6  285.7 2166.8 2345.2  178.3
 GOPE00CZE 2013:168:68400   2.28   7.22   7.15   3.42  15.94  8.176  29.31  951.90 10.486  299.1  286.0 2166.8 2346.7  179.9
 GOPE00CZE 2013:168:72000   2.37   7.23   7.11   3.51  16.64  8.177  29.59  951.90 10.940  298.7  286.2 2166.8 2348.3  181.4
 GOPE00CZE 2013:168:75600   2.46   7.24   7.07   3.61  17.33  8.179  29.87  951.90 11.394  298.2  286.5 2166.8 2349.8  183.0
 GOPE00CZE 2013:168:79200   2.55   7.25   7.02   3.71  18.03  8.180  30.15  951.90 11.848  297.7  286.7 2166.8 2351.4  184.5
 GOPE00CZE 2013:168:82800   2.64   7.26   6.98   3.80  18.72  8.182  30.43  951.90 12.301  297.3  287.0 2166.8 2352.9  186.1
 GOPE00CZE 2013:169:00000   2.73   7.27   6.94   3.90  19.42  8.184  30.71  951.90 12.755  296.8  287.2 2166.8 2354.5  187.6
 ...
 ZIMM00CHE 2013:168:00000   3.02   7.12   6.87   3.86  18.78  8.106  28.07  912.71 12.261  294.8  284.1 2078.5 2253.5  175.0
 ZIMM00CHE 2013:168:03600   3.01   7.15   6.89   3.83  18.40  8.107  27.54  912.56 12.165  294.7  284.1 2078.2 2249.9  171.8
 ZIMM00CHE 2013:168:07200   3.00   7.18   6.91   3.80  18.02  8.108  27.01  912.41 12.069  294.5  284.1 2077.8 2246.3  168.5
 ZIMM00CHE 2013:168:10800   2.99   7.21   6.93   3.77  17.64  8.108  26.49  912.26 11.973  294.4  284.1 2077.5 2242.7  165.3
 ZIMM00CHE 2013:168:14400   2.98   7.24   6.95   3.74  17.26  8.109  25.96  912.11 11.877  294.3  284.1 2077.1 2239.2  162.0
 ZIMM00CHE 2013:168:18000   2.97   7.27   6.97   3.72  16.88  8.110  25.43  911.96 11.781  294.2  284.1 2076.8 2235.6  158.8
 ZIMM00CHE 2013:168:21600   2.96   7.30   6.98   3.69  16.49  8.111  24.91  911.81 11.685  294.0  284.1 2076.4 2232.0  155.5
 ZIMM00CHE 2013:168:25200   2.93   7.30   7.07   3.65  16.31  8.115  24.84  911.75 11.520  294.8  284.2 2076.3 2231.4  155.1
 ZIMM00CHE 2013:168:28800   2.90   7.28   7.18   3.62  16.20  8.120  24.94  911.71 11.347  295.8  284.3 2076.2 2231.8  155.6
 ZIMM00CHE 2013:168:32400   2.86   7.26   7.29   3.58  16.16  8.126  25.19  911.69 11.190  296.9  284.5 2076.2 2233.2  157.0
 ZIMM00CHE 2013:168:36000   2.82   7.24   7.42   3.53  16.17  8.131  25.57  911.68 11.070  298.1  284.7 2076.2 2235.4  159.3
 ZIMM00CHE 2013:168:39600   2.77   7.21   7.54   3.48  16.24  8.137  26.05  911.66 11.009  299.3  284.9 2076.1 2238.4  162.2
 ZIMM00CHE 2013:168:43200   2.71   7.19   7.65   3.42  16.34  8.143  26.63  911.63 11.031  300.2  285.0 2076.0 2241.9  165.8
 ZIMM00CHE 2013:168:46800   2.63   7.20   7.76   3.34  16.45  8.149  27.27  911.47 11.217  300.9  285.0 2075.7 2245.6  169.9
 ZIMM00CHE 2013:168:50400   2.55   7.21   7.87   3.24  16.60  8.155  28.02  911.29 11.488  301.5  285.1 2075.3 2249.9  174.7
 ZIMM00CHE 2013:168:54000   2.47   7.22   7.96   3.15  16.80  8.160  28.82  911.12 11.807  301.9  285.0 2074.9 2254.7  179.8
 ZIMM00CHE 2013:168:57600   2.39   7.22   8.02   3.06  17.01  8.164  29.64  911.01 12.138  302.1  285.0 2074.6 2259.8  185.1
 ZIMM00CHE 2013:168:61200   2.32   7.21   8.05   2.98  17.25  8.166  30.43  910.99 12.445  302.0  284.9 2074.6 2264.8  190.2
 ZIMM00CHE 2013:168:64800   2.27   7.19   8.04   2.92  17.50  8.165  31.15  911.09 12.692  301.7  284.7 2074.8 2269.7  194.9
 ZIMM00CHE 2013:168:68400   2.28   7.11   7.90   2.92  17.76  8.158  31.57  911.58 12.704  300.8  284.3 2075.9 2273.6  197.7
 ZIMM00CHE 2013:168:72000   2.29   7.04   7.75   2.93  18.01  8.150  32.00  912.08 12.716  299.9  283.9 2077.1 2277.6  200.5
 ZIMM00CHE 2013:168:75600   2.31   6.96   7.61   2.93  18.27  8.143  32.42  912.57 12.728  298.9  283.6 2078.2 2281.6  203.4
 ZIMM00CHE 2013:168:79200   2.32   6.88   7.47   2.93  18.53  8.135  32.85  913.07 12.740  298.0  283.2 2079.3 2285.5  206.2
 ZIMM00CHE 2013:168:82800   2.33   6.81   7.33   2.94  18.78  8.128  33.27  913.56 12.753  297.0  282.8 2080.4 2289.5  209.0
 ZIMM00CHE 2013:169:00000   2.34   6.73   7.19   2.94  19.04  8.120  33.70  914.05 12.765  296.1  282.5 2081.6 2293.4  211.8
-TROP/SOLUTION
%=ENDTRO
```

References

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