SnT 2021
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# Combining IMS and non-IMS seismic stations using CTBTO distributed software (NDC-in-a-Box)

Haijun Wang, Ronan Le Bras, Alexander Poplavskiy, Wolfgang Sommerer, Leonid Kolesnykov

Poster No. P3.5-392

IDC/CTBTO

POSTER

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## ❑ Introduction

- NDC-in-a-Box is an independent software package developed, distributed, and supported by PTS, which is intended for NDCs to establish a verification regime with a number of functions including receiving, archiving, processing and analysing data from IMS stations. To simplify installation and configuration of NDC-in-a-Box package, most software tools and applications are provided via a distributed virtual machine SeisComP3, which has a large installed base, has been integrated into NDC-in-a-Box since 2016. Automatic data processing is now possible with SeisComp3 in addition to interactive data analysis.

- The standard way to configure non-IMS seismic stations is to use SeisComp3 scripts. Station parameters are imported into the OSDB database or saved as data files within the NDC-in-a-Box virtual machine. An alternative method is introduced here for configuration of non-IMS seismic stations. Based on basic parameters and instrument response file of non-IMS seismic stations, a program developed in Matlab is used to process stations parameters including calculation of instrument response parameters and export them into the database. Standard data files of non-IMS seismic stations can be accessed by NDC-in-a-Box via the shared folder of virtual machines, which simplifies the management of parameters for non-IMS seismic stations parameters and data exchange.

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## ❑ Parameters for Configuration of non-IMS seismic stations

- In order to analyse data from non-IMS seismic stations, basic parameters of stations should be configured in Geotool. Those parameters include station code, station location of latitude and longitude and response file, etc. Response file of station are saved in specific directory and will be loaded as required for data processing.

- Basic parameters of stations are exported in five different database tables of *SITE*, *SENSOR*, *SITECHAN*, *INSTRUMENT* and *AFFILIATION*.
  Relationship between these tables is shown in Figure 1.

- Basic parameters of stations can be saved in databases integrated in Geotool, which can also be saved as data files.

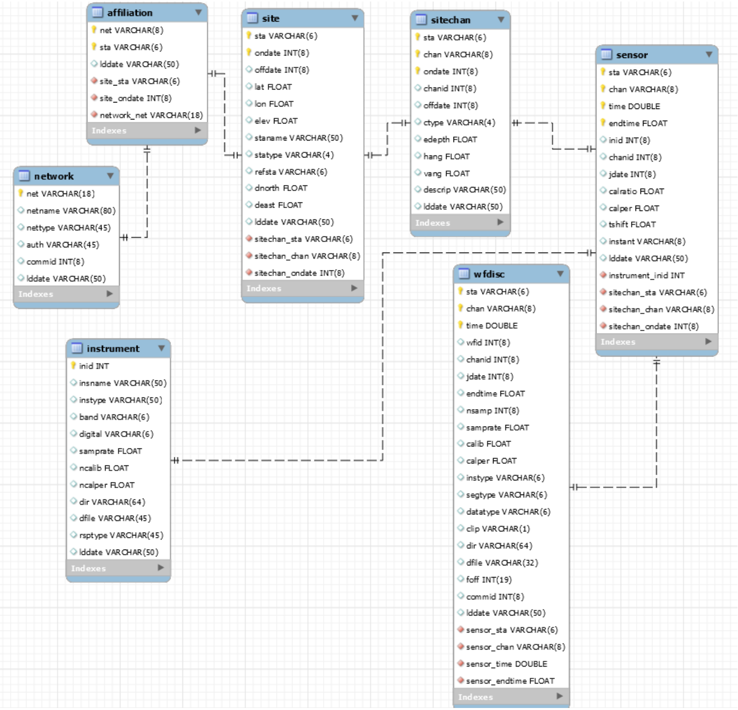


Figure 1 Database tables used for configuration of non-IMS seismic stations

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## ❑ Instrument file and nominal calibration factor

- Generally, the overall response associated with a seismometer can be described in five different stages. Particle motion detected by seismometer will be transferred to electricity signal, amplified from analog signal to digital signal with units of counts.

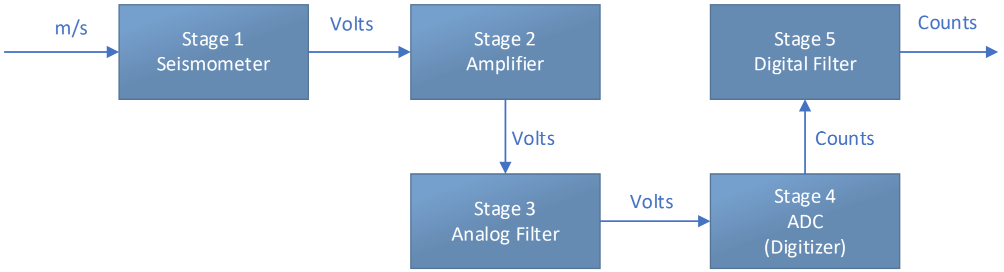


Figure 2 Stages description of overall response associated with a seismometer

- Response file and nominal calibration factor( simplified as NCALIB ) are two key parameters used in IDC system. There are three different format of response file: the Poles and Zeros Block Format( PAZ ), the Frequency,Amplitude and Phase Block Format( FAP ), and the Finite impulse Response Block Format( FIR ), in which format of PAZ is used mostly in IDC system.
- Nominal calibration factor is saved in database table of instrument, related tables include *SENSOR* and *WFDISC*. Data from stations transferred to IDC in protocol of CD1.0/CD1.1 will be saved in format of CSS for each couple of hours, basic parameters of stations will be saved in database table of *WFDISC*. Nominal calibration factor and related calibration period are included in *WFDISC*. If parameters of sensitivity is changed, many more data segments saved in format of CSS would be updated.

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## ❑ Instrument file and nominal calibration factor

- To simplify the update procedure on sensitivity in the IDC system, the nominal calibration factor NCALIB is saved in table of *INSTRUMENT*, the ration of CALRATIO based on change of NCALIB is saved in table of sensor. If there is a sensitivity change on the seismometer, CALRATIO in the sensor table will be update, which would be applied on all related data segments in format of CSS. The *INSTRUMENT* and *SENSOR* database tables are connected via the INID key ( Figure 3 ).

| *INSTRUMENT* | |
|---|---|
| **Column** | **Description** |
| inid | instrument identifier |
| insname | instrument name |
| instype | instrument type |
| band | frequency band |
| digital | data type,digital(d),or analog(a) |
| samprate | sampling rate in samples/second |
| ncalib | nominal calibration( nanometers/digital count) |
| ncalper | nominal calibration period( seconds) |
| dir | directory |
| dfile | data file |
| resptype | response type |
| lddate | load date |

| *SENSOR* | |
|---|---|
| **Column** | **Description** |
| sta | station code |
| chan | channel code |
| time | epoch time of start of recording period |
| endtime | epoch time of end of recording period |
| inid | instrument identifier |
| chanid | channel identifier |
| jdate | Julian date |
| calratio | calibration |
| calper | calibration period |
| tshift | correction of data processing time |
| instant | (y,n) discrete/continuing snapshot |
| lddate | load date |

Figure 3 Data segments and application for response parameters

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## ❑ Instrument file and nominal calibration factor

- Pole-Zero Representation for Analog Stages of velocity seismometer
- Transfer function of seismometer in form of velocity is shown below. $S_d$ is sensitivity, $A_0$ is normalization factor. Transfer function of velocity seismometer can be converted to format of displacement or accelerator; NCALIB is nominal calibration factor. There is a little bit different for format of response file in terms of velocity, acceleration and displacement.

$$G(f) = S_d A_0 \frac{\prod_{n=1}^{N}(s - r_n)}{\prod_{m=1}^{M}(s - p_m)} = S_d A_0 H_p(s)$$

$ncalib = {}^{1\times10^9}/_{(S_d\times2\pi f)}$ for velocity seismometer

$ncalib = {}^{1\times10^9}/_{(S_d\times4\pi^2 f)}$ for accelerator seismometer

$ncalib = {}^{1\times10^9}/_{(S_d\times f)}$ for displacement seismometer

Where

$s = i2\pi$f if the reference frequency is 1 radian/second;

$S_d$ is the sensitivity;

$A_0 = {}^{1}/_{|H_p(s)|}$ is normalizing constant.

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## ❑ Instrument file and nominal calibration factor

- For instance, if the response file is in terms of PAZ.
- As shown in Figure 4. Response file used in IDC system is in terms of displacement. One zero would be added in response file for velocity seismometer, two zeros would be added for acceleration seismometer.
- To be consistent to original stations, the normalization factor $A_0$ is same as original value, but the real normalization factor would be calculated at calibration period in data processing.

| Line # | Position | Field | Format | Description |
|---|---|---|---|---|
| **Comments** | | | | |
| 1 to L | 1–80 | - | a80 | General comments preceded by a "#" |
| L+1 | 1 | 1 | a1 | # |
| | 3–80 | 2 | a78 | instrument type/description (KS36000, GS-13, and so on) |
| **Instrument Response Group Using Poles and Zeros (paz)** | | | | |
| L+2 to K | 1–80 | 1 | a80 | comments (preceded by a "#") |
| K+1 | 1–12 | 1 | a12 | response source (theoretical or measured) |
| | 14–15 | 2 | i2 | sequence number |
| | 17–28 | 3 | a12 | description (instrument, anti-alias, and so on) |
| | 30–35 | 4 | a6 | response type (fir, paz, fap) |
| | 37–80 | 5 | a44 | author or source of information |

| Line # | Position | Field | Format | Description |
|---|---|---|---|---|
| K+2 | - | 1 | f or e | normalization factor (Ao) |
| K+3 | 1–8 | 1 | i8 | number of poles |
| K+4 to N | - | 1–4 | 4(f or e) | complex pole and complex error |
| N+1 | 1–8 | 1 | i8 | number of zeros |
| N+2 to M | - | 1–4 | 4(f or e) | complex zero and complex error |

Figure 4 Format of response file ( part content )

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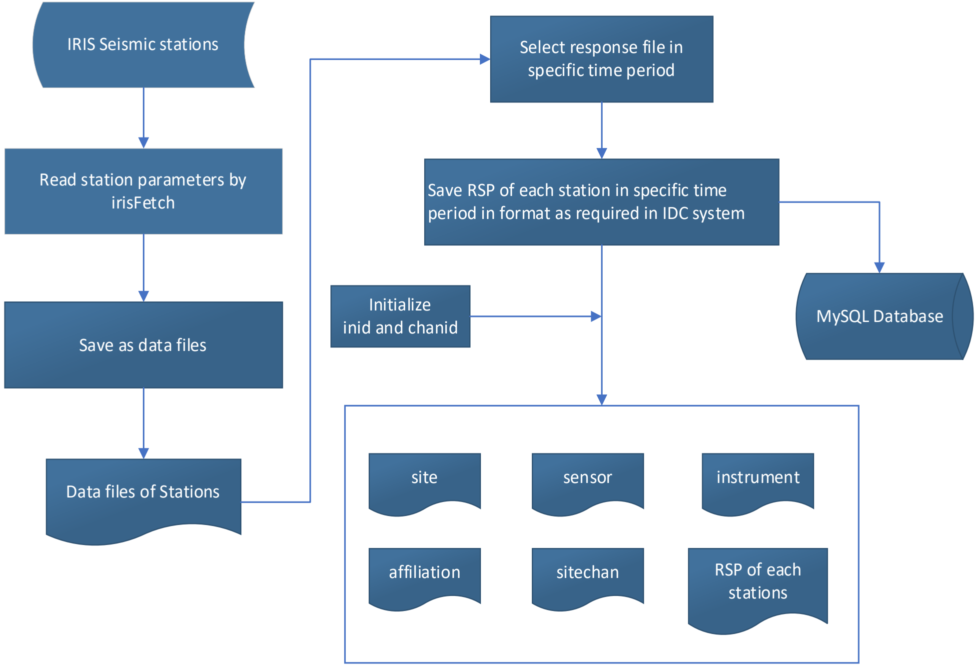
## ❑ Program developed for configuration of non-IMS seismic stations

- Figure 5 The procedure of reading and formatting parameters for non-IMS seismic stations



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## ❑ Program developed for configuration of non-IMS seismic stations

- Data files and directory needed for configuration of non-IMS seismic stations is shown in Figure 6. Basic parameters of IMS stations are saved in data files of affiliationTable, instrumentTable, sensorTable, siteTable, sitechanTable; parameters for non-IMS seismic stations are saved in data files of affiliationTable2, instrumentTable2, sensorTable2, siteTable2, sitechanTable2.

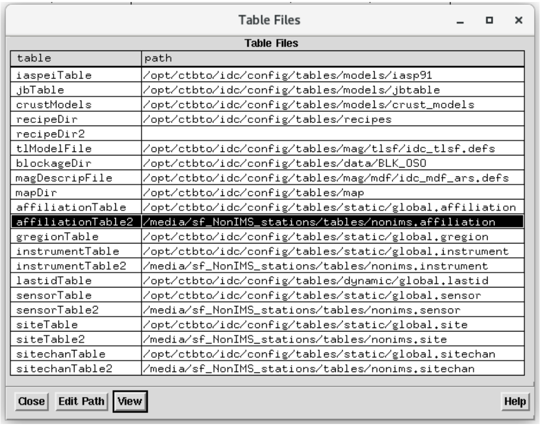

Table Files

Table Files

| table | path |
|---|---|
| iaspeiTable | /opt/ctbto/idc/config/tables/models/iasp91 |
| jbTable | /opt/ctbto/idc/config/tables/models/jbtable |
| crustModels | /opt/ctbto/idc/config/tables/models/crust_models |
| recipeDir | /opt/ctbto/idc/config/tables/recipes |
| recipeDir2 | |
| tlModelFile | /opt/ctbto/idc/config/tables/mag/tlsf/idc_tlsf.defs |
| blockageDir | /opt/ctbto/idc/config/tables/data/BLK_OSO |
| magDescripFile | /opt/ctbto/idc/config/tables/mag/mdf/idc_mdf_ars.defs |
| mapDir | /opt/ctbto/idc/config/tables/map |
| affiliationTable | /opt/ctbto/idc/config/tables/static/global.affiliation |
| affiliationTable2 | /media/sf_NonIMS_stations/tables/nonims.affiliation |
| gregionTable | /opt/ctbto/idc/config/tables/static/global.gregion |
| instrumentTable | /opt/ctbto/idc/config/tables/static/global.instrument |
| instrumentTable2 | /media/sf_NonIMS_stations/tables/nonims.instrument |
| lastidTable | /opt/ctbto/idc/config/tables/dynamic/global.lastid |
| sensorTable | /opt/ctbto/idc/config/tables/static/global.sensor |
| sensorTable2 | /media/sf_NonIMS_stations/tables/nonims.sensor |
| siteTable | /opt/ctbto/idc/config/tables/static/global.site |
| siteTable2 | /media/sf_NonIMS_stations/tables/nonims.site |
| sitechanTable | /opt/ctbto/idc/config/tables/static/global.sitechan |
| sitechanTable2 | /media/sf_NonIMS_stations/tables/nonims.sitechan |

Close Edit Path View Help

Figure 6 Data files and path for configuration of non-IMS stations

- Database for management of non-IMS seismic stations was developed in MySQL ( Figure 7 ), application interface was developed in Matlab, which can be used to load station parameters into database of MySQL.

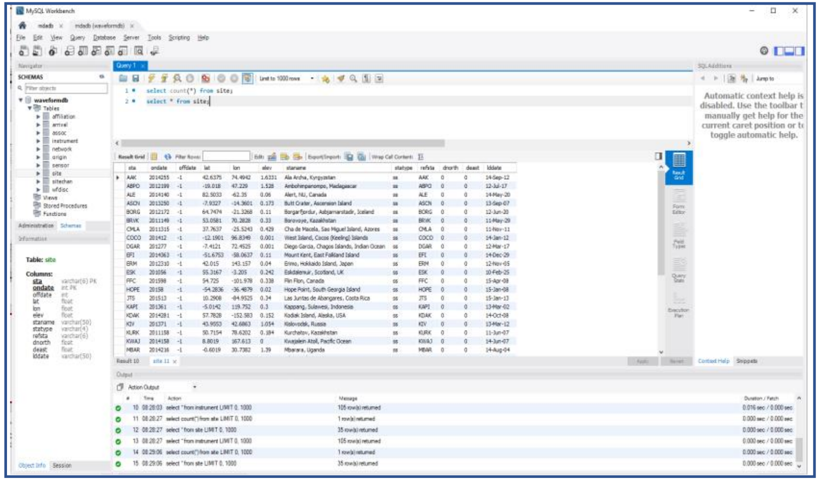

Figure 7 Database developed for management of non-IMS stations in MySQL

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## ❑ Testing on example event

| orid | Date | Time | Latitude | Longitude | mb | Ms |
|---|---|---|---|---|---|---|
| 11897223 | 4/16/2015 | 18:07:44 | 35.29 | 26.82 | 5.6 | 5.9 |

Figure 8 Example event from IDC REB

| | | | | | |
|---|---|---|---|---|---|
| II | MSEY | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | MSVF | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | NIL | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | NNA | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | NRIL | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | NVS | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | OBN | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | PALK | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | PFO | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | RAYN | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | RPN | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | SACV | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | SHEL | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | SIMI | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | SUR | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | TAU | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | TLY | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | UOSS | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | WRAB | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | XBFO | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | XPF | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | XPFO | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |

Figure 9 Station list from IRIS for example event

| | | | | | |
|---|---|---|---|---|---|
| II | AAK | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | ABKT | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | ABPO | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | ALE | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | ARTI | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | ARU | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | ASCN | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | BFO | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | BORG | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | BORK | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | BRVK | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | CMLA | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | COCO | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | DGAR | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | EFI | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | ERM | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | ESK | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | FFC | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | GAR | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | HOPE | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | IASL | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | IBFO | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | JTS | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | KAPI | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | KDAK | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | KIV | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | KURK | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | KWAJ | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | KWJN | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | LVZ | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |
| II | MBAR | 10 | BH? | 2015-04-16T18:00:00 | 2015-04-16T19:00:00 |

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## ❑ Testing on example event

- Data of 35 seismic stations from IRIS were downloaded and formatted to five different data files, response file of each station was saved in specific directory.
- Once configuration of station parameters was finished, detail information of those stations could be viewed in Geotool. Part of information in data files of *SITE*, *SITECHAN* and *INSTRUMENT* is shown in Figure 10.

/media/sf_NonIMS_stations/tables/nonims.site

File Edit View Option

Edit | vi Edit Row | Sort

site

| sta | ondate | offdate | lat | lon | elev | staname | statype | refsta | dnorth | deast | lddate |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AAK | 2014255 | -1 | 42,6375 | 74,4942 | 1,6331 | Ala Archa, Kyrgyzstan | ss | AAK | 0,0000 | 0,0000 | 2014-Sep- |
| ABPO | 2012199 | -1 | -19,0180 | 47,2290 | 1,5280 | Ambohimpanompo, Madagascar | ss | ABPO | 0,0000 | 0,0000 | 2012-Jul- |
| ALE | 2014140 | -1 | 82,5033 | -62,3500 | 0,0600 | Alert, NU, Canada | ss | ALE | 0,0000 | 0,0000 | 2014-May- |
| ASCN | 2013250 | -1 | -7,9327 | -14,3601 | 0,1730 | Butt Crater, Ascension Island | ss | ASCN | 0,0000 | 0,0000 | 2013-Sep- |
| BORG | 2012172 | -1 | 64,7474 | -21,3268 | 0,1100 | Borgarfjordur, Asbjarnarstadir, Iceland | ss | BORG | 0,0000 | 0,0000 | 2012-Jun- |
| BRVK | 2011149 | -1 | 53,0581 | 70,2828 | 0,3300 | Borovoye, Kazakhstan | ss | BRVK | 0,0000 | 0,0000 | 2011-May- |
| CMLA | 2011315 | -1 | 37,7637 | -25,5243 | 0,4290 | Cha de Macela, Sao Miguel Island, Azores | ss | CMLA | 0,0000 | 0,0000 | 2011-Nov- |
| COCO | 201412 | -1 | -12,1901 | 96,8349 | 0,0010 | West Island, Cocos (Keeling) Islands | ss | COCO | 0,0000 | 0,0000 | 2014-Jan- |
| DGAR | 201277 | -1 | -7,4121 | 72,4525 | 0,0010 | Diego Garcia, Chagos Islands, Indian Ocean | ss | DGAR | 0,0000 | 0,0000 | 2012-Mar- |
| EFI | 2014363 | -1 | -51,6753 | -58,0637 | 0,1100 | Mount Kent, East Falkland Island | ss | EFI | 0,0000 | 0,0000 | 2014-Dec- |
| ERM | 2012310 | -1 | 42,0150 | 143,1572 | 0,0400 | Erimo, Hokkaido Island, Japan | ss | ERM | 0,0000 | 0,0000 | 2012-Nov- |
| ESK | 201056 | -1 | 55,3167 | -3,2050 | 0,2420 | Eskdalemuir, Scotland, UK | ss | ESK | 0,0000 | 0,0000 | 2010-Feb- |
| FFC | 201598 | -1 | 54,7250 | -101,9780 | 0,3380 | Flin Flon, Canada | ss | FFC | 0,0000 | 0,0000 | 2015-Apr- |
| HOPE | 20158 | -1 | -54,2836 | -36,4879 | 0,0200 | Hope Point, South Georgia Island | ss | HOPE | 0,0000 | 0,0000 | 2015-Jan- |
| JTS | 201513 | -1 | 10,2908 | -84,9525 | 0,3400 | Las Juntas de Abangares, Costa Rica | ss | JTS | 0,0000 | 0,0000 | 2015-Jan- |
| KAPI | 201361 | -1 | -5,0142 | 119,7517 | 0,3000 | Kappang, Sulawesi, Indonesia | ss | KAPI | 0,0000 | 0,0000 | 2013-Mar- |
| KDAK | 2014281 | -1 | 57,7828 | -152,5830 | 0,1520 | Kodiak Island, Alaska, USA | ss | KDAK | 0,0000 | 0,0000 | 2014-Oct- |
| KIV | 201371 | -1 | 43,9553 | 42,6863 | 1,0540 | Kislovodsk, Russia | ss | KIV | 0,0000 | 0,0000 | 2013-Mar- |
| KURK | 2011158 | -1 | 50,7154 | 78,6202 | 0,1840 | Kurchatov, Kazakhstan | ss | KURK | 0,0000 | 0,0000 | 2011-Jun- |
| KWAJ | 2014158 | -1 | 8,8019 | 167,6130 | 0,0000 | Kwajalein Atoll, Pacific Ocean | ss | KWAJ | 0,0000 | 0,0000 | 2014-Jun- |
| MBAR | 2014216 | -1 | -0,6019 | 30,7382 | 1,3900 | Mbarara, Uganda | ss | MBAR | 0,0000 | 0,0000 | 2014-Aug- |
| NIL | 201371 | -1 | 33,6506 | 73,2686 | 0,6290 | Nilore, Pakistan | ss | NIL | 0,0000 | 0,0000 | 2013-Mar- |
| NNA | 201162 | -1 | -11,9875 | -76,8422 | 0,5750 | Nana, Peru | ss | NNA | 0,0000 | 0,0000 | 2011-Mar- |
| OBN | 2013193 | -1 | 55,1146 | 36,5674 | 0,1600 | Obninsk, Russia | ss | OBN | 0,0000 | 0,0000 | 2013-Jul- |
| PALK | 2014185 | -1 | 7,2728 | 80,7022 | 0,4600 | Pallekele, Sri Lanka | ss | PALK | 0,0000 | 0,0000 | 2014-Jul- |
| PFO | 2013304 | -1 | 33,6107 | -116,4550 | 1,2800 | Pinon Flat, California, USA | ss | PFO | 0,0000 | 0,0000 | 2013-Oct- |
| RAYN | 201020 | -1 | 23,5225 | 45,5032 | 0,6310 | Ar Rayn, Saudi Arabia | ss | RAYN | 0,0000 | 0,0000 | 2010-Jan- |
| RPN | 2014190 | -1 | -27,1267 | -109,3340 | 0,1100 | Rapanui, Easter Island, Chile | ss | RPN | 0,0000 | 0,0000 | 2014-Jul- |
| SACV | 201438 | -1 | 14,9702 | -23,6085 | 0,3870 | Santiago Island, Cape Verde | ss | SACV | 0,0000 | 0,0000 | 2014-Feb- |
| SHEL | 2013233 | -1 | -15,9594 | -5,7455 | 0,5370 | Horse Pasture, St. Helena Island | ss | SHEL | 0,0000 | 0,0000 | 2013-Aug- |
| SUR | 2012156 | -1 | -32,3797 | 20,8117 | 1,7700 | Sutherland, South Africa | ss | SUR | 0,0000 | 0,0000 | 2012-Jun- |
| TAU | 201521 | -1 | -42,9099 | 147,3204 | 0,1320 | Hobart, Tasmania, Australia | ss | TAU | 0,0000 | 0,0000 | 2015-Jan-21 |
| UOSS | 2013276 | -1 | 24,9453 | 56,2042 | 0,2844 | Univ. of Sharjah, Sharjah, United Arab Emirates | ss | UOSS | 0,0000 | 0,0000 | 2013-Oct-03 |
| WRAB | 2013308 | -1 | -19,9336 | 134,3600 | 0,3660 | Tennant Creek, NT, Australia | ss | WRAB | 0,0000 | 0,0000 | 2013-Nov-04 |
| XPFO | 201479 | -1 | 33,6107 | -116,4550 | 1,2800 | Pinon Flat, California, USA | ss | XPFO | 0,0000 | 0,0000 | 2014-Mar-20 |

2448 rows, 12 columns | top row: 2414 cursor:

/media/sf_NonIMS_stations/tables/nonims.sitechan

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sitechan

| sta | chan | ondate | chanid | offdate | ctype | edepth | hang | vang | descrip | lddate |
|---|---|---|---|---|---|---|---|---|---|---|
| uc201 | shn | 2001043 | 1005 | -1 | n | 0,000000 | 0,000000 | 0,000000 | test-channel | 2001-Feb-12 |
| uc201 | shz | 2001043 | 1004 | -1 | n | 0,000000 | 0,000000 | 0,000000 | test-channel | 2001-Feb-12 |
| uc48 | she | 2001043 | 1003 | -1 | n | 0,000000 | 0,000000 | 0,000000 | test-channel | 2001-Feb-12 |
| uc48 | shn | 2001043 | 1002 | -1 | n | 0,000000 | 0,000000 | 0,000000 | test-channel | 2001-Feb-12 |
| uc48 | shz | 2001043 | 1001 | -1 | n | 0,000000 | 0,000000 | 0,000000 | test-channel | 2001-Feb-12 |
| AAK | BH1 | 2014255 | 1 | 2017170 | n | 0,030000 | 354,800000 | 90,000000 | BH1-10 | 2014-Sep-12 |
| AAK | BH2 | 2014255 | 2 | 2017170 | n | 0,030000 | 85,200000 | 90,000000 | BH2-10 | 2014-Sep-12 |
| AAK | BHZ | 2014255 | 3 | 2017170 | n | 0,030000 | 0,000000 | 0,000000 | BHZ-10 | 2014-Sep-12 |
| ABPO | BH1 | 2012199 | 4 | 2019295 | n | 0,005300 | 0,000000 | 90,000000 | BH1-10 | 2012-Jul-17 |
| ABPO | BH2 | 2012199 | 5 | 2019295 | n | 0,005300 | 90,000000 | 90,000000 | BH2-10 | 2012-Jul-17 |
| ABPO | BHZ | 2012199 | 6 | 2019295 | n | 0,005300 | 0,000000 | 0,000000 | BHZ-10 | 2012-Jul-17 |
| ALE | BH1 | 2014140 | 7 | 2015225 | n | 0,000000 | 358,300000 | 90,000000 | BH1-10 | 2014-May-20 |
| ALE | BH2 | 2014140 | 8 | 2015225 | n | 0,000000 | 88,600000 | 90,000000 | BH2-10 | 2014-May-20 |
| ALE | BHZ | 2014140 | 9 | 2015225 | n | 0,000000 | 0,000000 | 0,000000 | BHZ-10 | 2014-May-20 |
| ASCN | BH1 | 2013250 | 10 | 2016132 | n | 0,006000 | 328,600000 | 90,000000 | BH1-10 | 2013-Sep-07 |
| ASCN | BH2 | 2013250 | 11 | 2016132 | n | 0,006000 | 58,500000 | 90,000000 | BH2-10 | 2013-Sep-07 |
| ASCN | BHZ | 2013250 | 12 | 2016132 | n | 0,006000 | 0,000000 | 0,000000 | BHZ-10 | 2013-Sep-07 |
| BORG | BH1 | 2012172 | 13 | 2016290 | n | 0,005000 | 358,100000 | 90,000000 | BH1-10 | 2012-Jun-20 |

/media/sf_NonIMS_stations/tables/nonims.instrument

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instrument

| inid | insname | instype | band | digital | samprate | ncalib | ncalper | dir | dfile | rsptype | lddate |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1120013 | Seismowave absolute pressure microbarometer | MB3a | b | d | 20,000000 | 0,000141 | 4,000000 | ../response | I20EC_BDF_RSP_20190923_M | pazfir | 2019-Sep-26 |
| 1120014 | Seismowave absolute pressure microbarometer | MB3a | b | d | 20,000000 | 0,000143 | 4,000000 | ../response | I20EC_BDF_RSP_20190923_M | pazfir | 2019-Sep-26 |
| 1120015 | Seismowave absolute pressure microbarometer | MB3a | b | d | 20,000000 | 0,000150 | 4,000000 | ../response | I20EC_BDF_RSP_20190923_M | pazfir | 2019-Sep-26 |
| 1120016 | Seismowave absolute pressure microbarometer | MB3a | b | d | 20,000000 | 0,000143 | 4,000000 | ../response | I20EC_BDF_RSP_20190923_M | pazfir | 2019-Sep-26 |
| 1120017 | Geotech KS5400 + Science Horizons AIM24S-3 | KS5400 | b | d | 40,000000 | 0,020000 | 1,000000 | ../response | PS15_DBIC_BB_resp_2015222 | pazfir | 2019-Sep-27 |
| 1120018 | Geotech KS5400 + Science Horizons AIM24S-3 | KS5400 | b | d | 40,000000 | 0,020000 | 1,000000 | ../response | PS15_DBIC_BB_resp_2015222 | pazfir | 2019-Sep-27 |
| 1120019 | Geotech KS5400 + Science Horizons AIM24S-3 | KS5400 | b | d | 40,000000 | 0,020000 | 1,000000 | ../response | PS15_DBIC_BB_resp_2015222 | pazfir | 2019-Sep-27 |
| 1120020 | Geotech GS-21 + Science Horizons AIM24S-1 | GS-21 | s | d | 40,000000 | 0,014270 | 1,000000 | ../response | CPUP1_sp_resp_20180524 | fap | 2019-Sep-27 |
| 1120021 | Trillium 120QA + Centaur | T120QA | b | d | 40,000000 | 0,033088 | 1,000000 | ../response | DLBC_bb_response_20190529 | pazfir | 2019-Sep-30 |
| 1120022 | Trillium 120QA + Centaur | T120QA | b | d | 40,000000 | 0,033088 | 1,000000 | ../response | DLBC_bb_response_20190529 | pazfir | 2019-Sep-30 |
| 1120023 | Trillium 120QA + Centaur | T120QA | b | d | 40,000000 | 0,033088 | 1,000000 | ../response | DLBC_bb_response_20190529 | pazfir | 2019-Sep-30 |
| 1 | Streckeisen STS-2.5 Seismometer | Veloci | b | d | 40,000000 | 0,062012 | 1,000000 | /media/sf_NonIMS_stations/response/ | AAK_10_rsp_2014255.txt | pazfir | 2014-Sep-12 |
| 2 | Streckeisen STS-2.5 Seismometer | Veloci | b | d | 40,000000 | 0,061851 | 1,000000 | /media/sf_NonIMS_stations/response/ | AAK_10_rsp_2014255.txt | pazfir | 2014-Sep-12 |
| 3 | Streckeisen STS-2.5 Seismometer | Veloci | b | d | 40,000000 | 0,061303 | 1,000000 | /media/sf_NonIMS_stations/response/ | AAK_10_rsp_2014255.txt | pazfir | 2014-Sep-12 |
| 4 | Streckeisen STS-2 Seismometer | Veloci | b | d | 40,000000 | 0,065199 | 1,000000 | /media/sf_NonIMS_stations/response/ | ABPO_10_rsp_2012199.txt | pazfir | 2012-Jul-17 |
| 5 | Streckeisen STS-2 Seismometer | Veloci | b | d | 40,000000 | 0,064889 | 1,000000 | /media/sf_NonIMS_stations/response/ | ABPO_10_rsp_2012199.txt | pazfir | 2012-Jul-17 |
| 6 | Streckeisen STS-2 Seismometer | Veloci | b | d | 40,000000 | 0,064426 | 1,000000 | /media/sf_NonIMS_stations/response/ | ABPO_10_rsp_2012199.txt | pazfir | 2012-Jul-17 |
| 7 | Streckeisen STS-2.5 Seismometer | Veloci | b | d | 40,000000 | 0,063501 | 1,000000 | /media/sf_NonIMS_stations/response/ | ALE_10_rsp_2014140.txt | pazfir | 2014-May-20 |
| 8 | Streckeisen STS-2.5 Seismometer | Veloci | b | d | 40,000000 | 0,063464 | 1,000000 | /media/sf_NonIMS_stations/response/ | ALE_10_rsp_2014140.txt | pazfir | 2014-May-20 |
| 9 | Streckeisen STS-2.5 Seismometer | Veloci | b | d | 40,000000 | 0,062859 | 1,000000 | /media/sf_NonIMS_stations/response/ | ALE_10_rsp_2014140.txt | pazfir | 2014-May-20 |
| 10 | Nanometrics Trillium 120 (Type A) Posthole BB Seis | Veloci | b | d | 40,000000 | 0,078550 | 1,000000 | /media/sf_NonIMS_stations/response/ | ASCN_10_rsp_2013250.txt | pazfir | 2013-Sep-07 |
| 11 | Nanometrics Trillium 120 (Type A) Posthole BB Seis | Veloci | b | d | 40,000000 | 0,078784 | 1,000000 | /media/sf_NonIMS_stations/response/ | ASCN_10_rsp_2013250.txt | pazfir | 2013-Sep-07 |
| 12 | Nanometrics Trillium 120 (Type A) Posthole BB Seis | Veloci | b | d | 40,000000 | 0,078013 | 1,000000 | /media/sf_NonIMS_stations/response/ | ASCN_10_rsp_2013250.txt | pazfir | 2013-Sep-07 |
| 13 | Streckeisen STS-2.5 Seismometer | Veloci | b | d | 40,000000 | 0,066232 | 1,000000 | /media/sf_NonIMS_stations/response/ | BORG_10_rsp_2012172.txt | pazfir | 2012-Jun-20 |
| 14 | Streckeisen STS-2.5 Seismometer | Veloci | b | d | 40,000000 | 0,068058 | 1,000000 | /media/sf_NonIMS_stations/response/ | BORG_10_rsp_2012172.txt | pazfir | 2012-Jun-20 |
| 15 | Streckeisen STS-2.5 Seismometer | Veloci | b | d | 40,000000 | 0,065723 | 1,000000 | /media/sf_NonIMS_stations/response/ | BORG_10_rsp_2012172.txt | pazfir | 2012-Jun-20 |
| 16 | Streckeisen STS-2 Seismometer | Veloci | b | d | 40,000000 | 0,063995 | 1,000000 | /media/sf_NonIMS_stations/response/ | BRVK_10_rsp_2011149.txt | pazfir | 2011-May-29 |
| 17 | Streckeisen STS-2 Seismometer | Veloci | b | d | 40,000000 | 0,064078 | 1,000000 | /media/sf_NonIMS_stations/response/ | BRVK_10_rsp_2011149.txt | pazfir | 2011-May-29 |
| 18 | Streckeisen STS-2 Seismometer | Veloci | b | d | 40,000000 | 0,063291 | 1,000000 | /media/sf_NonIMS_stations/response/ | BRVK_10_rsp_2011149.txt | pazfir | 2011-May-29 |
| 19 | Guralp CMG-3T Seismometer | Veloci | b | d | 40,000000 | 0,063145 | 1,000000 | /media/sf_NonIMS_stations/response/ | CMLA_10_rsp_2011315.txt | pazfir | 2011-Nov-11 |
| 20 | Guralp CMG-3T Seismometer | Veloci | b | d | 40,000000 | 0,064154 | 1,000000 | /media/sf_NonIMS_stations/response/ | CMLA_10_rsp_2011315.txt | pazfir | 2011-Nov-11 |
| 21 | Guralp CMG-3T Seismometer | Veloci | b | d | 40,000000 | 0,062902 | 1,000000 | /media/sf_NonIMS_stations/response/ | CMLA_10_rsp_2011315.txt | pazfir | 2011-Nov-11 |
| 22 | Nanometrics Trillium 120 (Type A) Posthole BB Seis | Veloci | b | d | 40,000000 | 0,080105 | 1,000000 | /media/sf_NonIMS_stations/response/ | COCO_10_rsp_201412.txt | pazfir | 2014-Jan-12 |
| 23 | Nanometrics Trillium 120 (Type A) Posthole BB Seis | Veloci | b | d | 40,000000 | 0,079702 | 1,000000 | /media/sf_NonIMS_stations/response/ | COCO_10_rsp_201412.txt | pazfir | 2014-Jan-12 |
| 24 | Nanometrics Trillium 120 (Type A) Posthole BB Seis | Veloci | b | d | 40,000000 | 0,079160 | 1,000000 | /media/sf_NonIMS_stations/response/ | COCO_10_rsp_201412.txt | pazfir | 2014-Jan-12 |
| 25 | Streckeisen STS-2 Seismometer | Veloci | b | d | 40,000000 | 0,064228 | 1,000000 | /media/sf_NonIMS_stations/response/ | DGAR_10_rsp_201277.txt | pazfir | 2012-Mar-17 |
| 26 | Streckeisen STS-2 Seismometer | Veloci | b | d | 40,000000 | 0,064705 | 1,000000 | /media/sf_NonIMS_stations/response/ | DGAR_10_rsp_201277.txt | pazfir | 2012-Mar-17 |
| 27 | Streckeisen STS-2 Seismometer | Veloci | b | d | 40,000000 | 0,063972 | 1,000000 | /media/sf_NonIMS_stations/response/ | DGAR_10_rsp_201277.txt | pazfir | 2012-Mar-17 |
| 28 | Nanometrics Trillium 120 (Type A) Posthole BB Seis | Veloci | b | d | 40,000000 | 0,078700 | 1,000000 | /media/sf_NonIMS_stations/response/ | EFI_10_rsp_2014363.txt | pazfir | 2014-Dec-29 |
| 29 | Nanometrics Trillium 120 (Type A) Posthole BB Seis | Veloci | b | d | 40,000000 | 0,078700 | 1,000000 | /media/sf_NonIMS_stations/response/ | EFI_10_rsp_2014363.txt | pazfir | 2014-Dec-29 |
| 30 | Nanometrics Trillium 120 (Type A) Posthole BB Seis | Veloci | b | d | 40,000000 | 0,079616 | 1,000000 | /media/sf_NonIMS_stations/response/ | EFI_10_rsp_2014363.txt | pazfir | 2014-Dec-29 |

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Figure 10 Station parameters in different data files viewed in Geotool

# Combining IMS and non-IMS seismic stations using CTBTO distributed software (NDC-in-a-Box)

Haijun Wang, Ronan Le Bras, Alexander Poplavskiy, Wolfgang Sommerer, Leonid Kolesnykov . IDC/CTBTO



## ❑ Testing on example event

- Data of those stations could be loaded in Geotool for data analysis. Data waveforms, location results, map and magnitude for example event is shown in Figure 11.

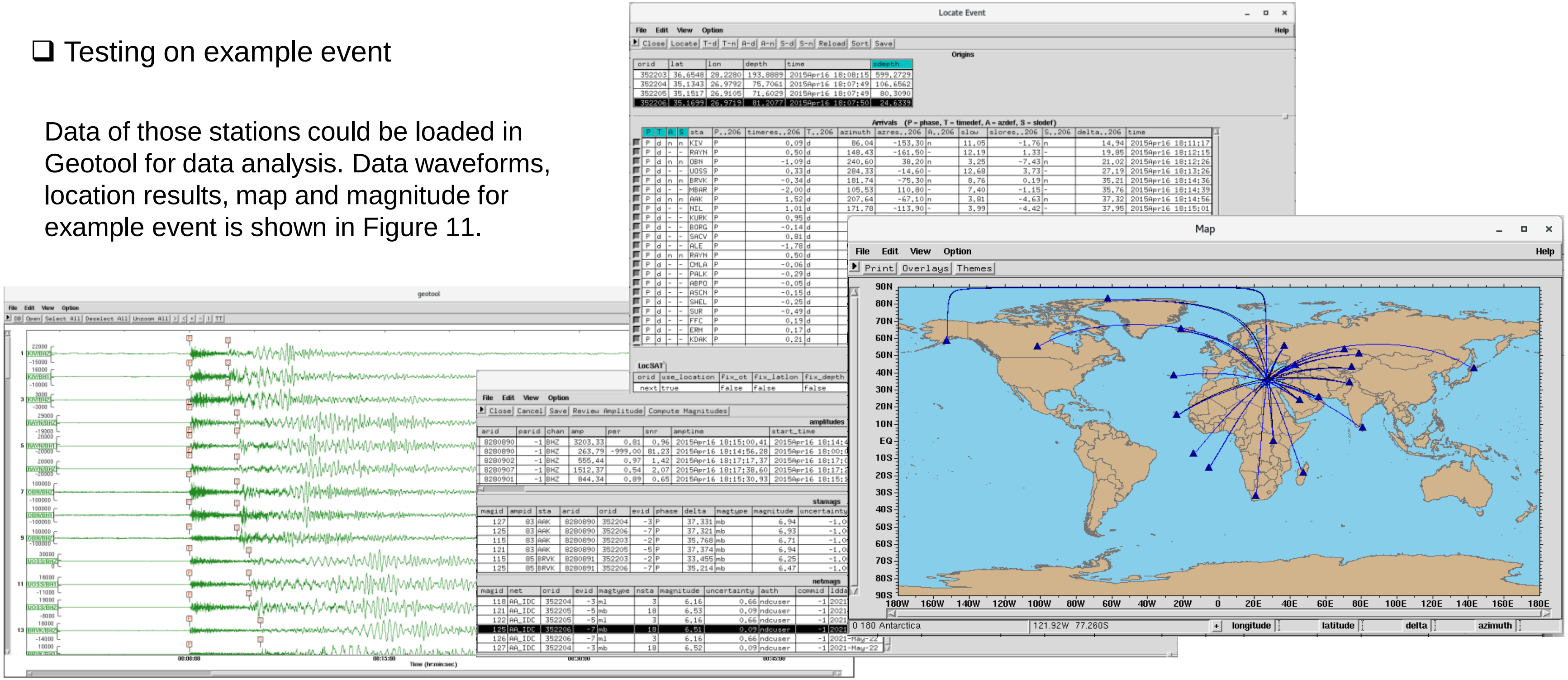


Figure 11 Data waveform and event location for example event

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CTBTO
PREPARATORY COMMISSION

## ❑ Testing on example event

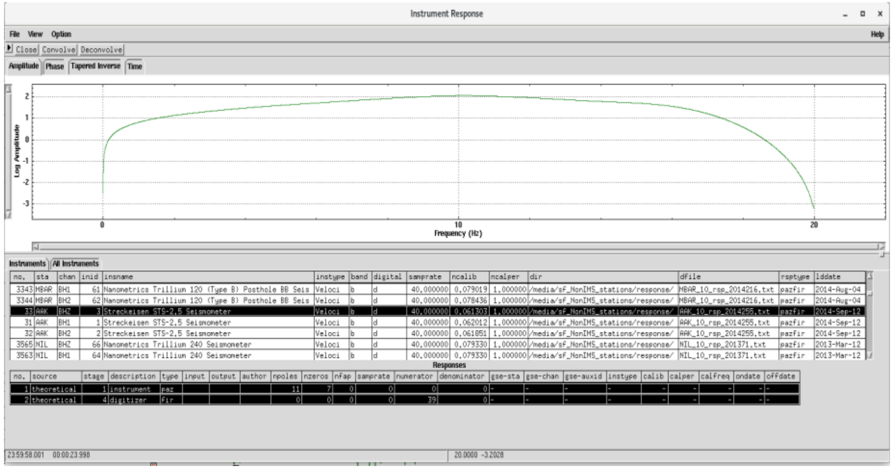


Figure 12 Response curve of station AAK in Geotool.

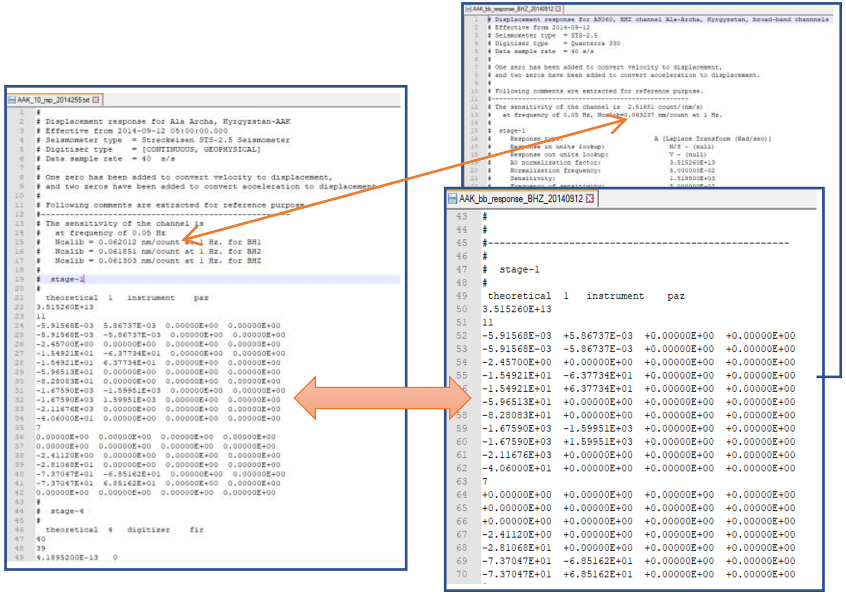


Figure 13 Comparison of response parameters for station AAK from IRIS to that from IDC system.

# Combining IMS and non-IMS seismic stations using CTBTO distributed software (NDC-in-a-Box)

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## ❑ Discussion and Conclusion

- Programs used for configuration of non-IMS seismic stations were developed in Matlab, which could be used to read parameters of seismic station from IRIS and format in data files as required in Geotool. A separate database was developed in MySQL for management of parameters of non-IMS seismic stations.
- Data files and data for non-IMS seismic stations are saved in local directory of host computer, which is connected to VM by shared folder. Path of datafiles used in Geotool is pointed to shared folder to ensure data from non-IMS seismic stations would be analysed properly in Geotool.
- The idea of analysing data in Geotool through the use of a shared folder would benefit for data management, even when the VM is not stable, there is no impact on data in shared folder. Also, the disk space available on the VM may be limited, whereas the host computer may have much more capacity.
- One example event was selected from IDC REB, available station data and parameters were request from IRIS. Testing results showed that data from non-IMS seismic stations can be loaded into Geotool properly for normal data analysis, which include adding phase, event location and magnitude calculation, etc. Location results is consistent to that of IDC REB except magnitude.
- It is quite easy to implement the application for non-IMS seismic stations. If stations parameters were request from IRIS by script of irisFetch, all parameters in different time periods is mixed in one struct file, which would be pro-processed by programs developed here and exported to specific directory in host computer. The method proposed would be convenient for data analysis for multiple non-IMS seismic stations.