

# **A GUIDE TO USE NET\_DIFF**

Zhang Yize

Tokyo University of Marine Science and Technology

Shanghai Astronomical Observatory

[zhyize@163.com](mailto:zhyize@163.com)

# 1 General

Net\_Diff is a software for GNSS Download, Positioning and Analysis.

It supports functions of SPP/PPP/PPP-AR/DSPP/DPPP/RTK/PPP-RTK, it can also applied in SPP/PPP with BeiDou augmentation information.

It supports data analysis, including coordinate plotting, satellite number, PDOP, satellite skyview, satellite number, omc, positioning residuals and so on.

It provides IGS data and products download.

It also provides some useful tools such as time and coordinate system transfer, RINEX edit.

The software is available on GitHub: [https://github.com/YizeZhang/Net\\_Diff](https://github.com/YizeZhang/Net_Diff). You can find the latest version on the website.

## **New features of v1.1:**

1. Modify long baseline RTK;
2. More robust RTK under urban environment;
3. Add Time and Coordinate transfer tool;
4. Add RINEX editing;
5. Support command line input for better batch process;

## **New features of v1.2:**

1. Support tightly combined GNSS RTK;
2. Add .pos file output for RTKPLOT;

## **New features of v1.3:**

1. Support GLONASS AR in GNSS RTK;
2. Add Android raw data convert to RINEX;

## **New features of v1.4 :**

1. Support mix-frequency mix-observation combination on each satellite system;
2. Support PPP-AR;
3. Support un-differenced un-combined PPP

## **New features of v1.5:**

1. Support triple-frequency un-differenced un-combined PPP;
2. Support PPP-RTK(CLAS)

## **New features of v1.6:**

3. Support new signal of BDS (B1c/B2a) and GLONASS (G3), Galileo(E6), QZSS(L6)

**New features of v1.7:**

1. Support network PPP solution
2. Support loosely coupled PPP/INS and RTK/INS

**New features of v1.8:**

1. Support SSR correction in PPP
2. Support receive RTCM message from Ntrip (Adapt from goGPS)
3. Support dump RTCM SSR and conversion of various type of raw data to RINEX (Adapt from RTKLIB)

## 2 How to Install

After you download files from GitHub, please follow the steps to install Net\_Diff.

1 Click **gzip-1.3.12-1-setup.exe** and install gzip. For example, after install it, gzip.exe is under C:\Program Files (x86)\GnuWin32\bin\

2

a) If you have installed MATLAB R2017a or MATLAB Runtime version 9.2 (R2017a) in your computer.

Open /for\_redistribution\_files\_only/ and click **Net\_Diff.exe**

b) If not.

Open /for\_redistribution/ and click **Net\_Diff\_Installer\_web.exe** to install MATLAB Runtime and Net\_Diff. Please keep your computer connected to internet while installing. It will take a few minutes to download MATLAB Runtime, please be patient.

After finish installing, you can find the execute file from the installed program directory, like C:\Program Files\Net\_Diff\application\. If your Windows OS is under C:\, Net\_Diff may can't read and write files under C:\. In this case, it is recommended to copy C:\Program Files\Net\_Diff\application\ to other disk.

3 Copy C:\Program Files (x86)\GnuWin32\bin\gzip.exe to the folder of Net\_Diff.

## 3 How to Run

After install the software properly, you can start to run it.

Click **Net\_Diff.exe**, a dos-like window will appear, then after a few seconds, the main GUI of Net\_Diff will show as below.

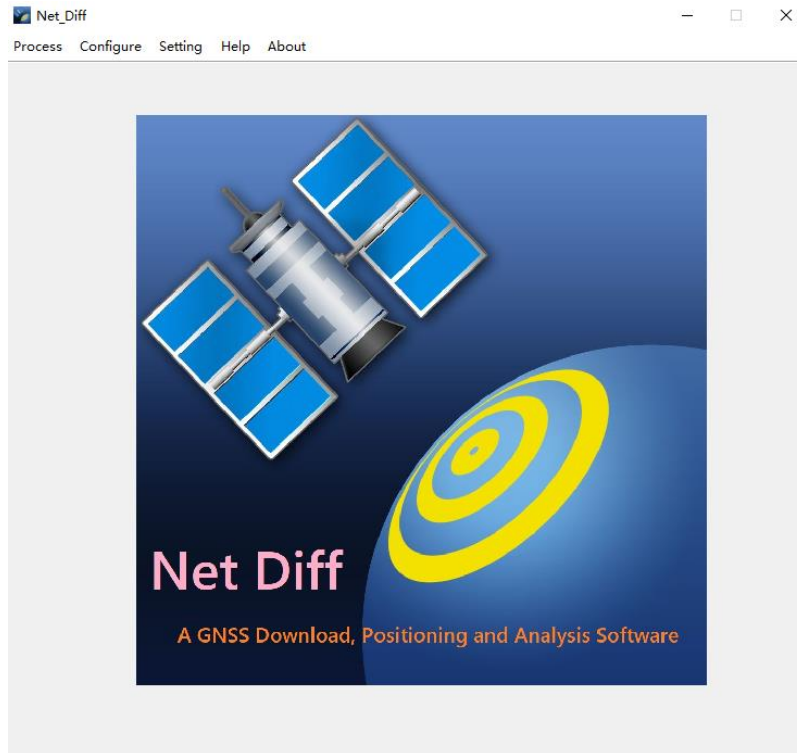


Fig. 1 Main GUI of Net\_Diff

The dos-like widow is also the processing status window. It gives you the information of the software processing status information.

Generally, the information can be divided into 3 kinds, i.e. INFO, WARN, ERROR. INFO just tells you the action you did in the software. WARN is a warning information of the when you use this software. It is not a severe problem. ERROR is the error information, which is a big issue and will certainly affect your positioning result if you don't handle it properly. Only after you solve the errors, you can get best positioning results.

```

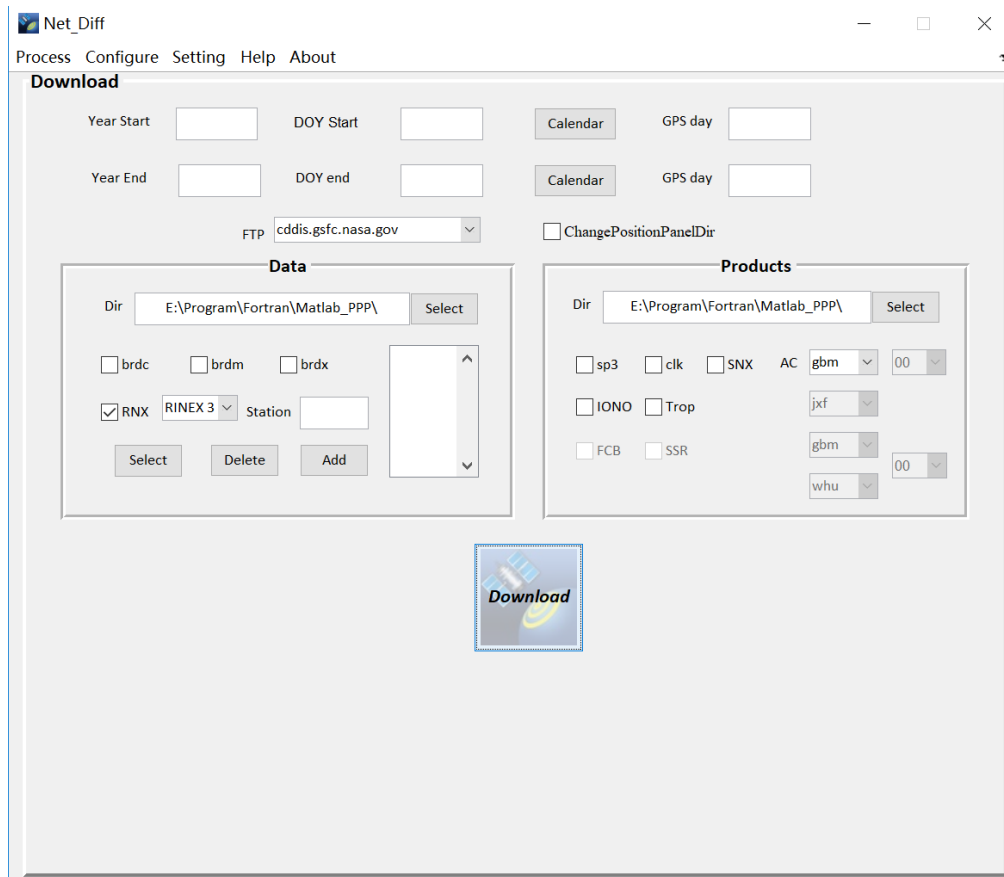
net_diff
===== Welcome to Net_Diff =====
Net_Diff, v1.0
A software for GNSS Download, Positioning and Analysis
https://github.com/YizeZhang/Net_Diff/
Author: Yize Zhang, zhyize@163.com
Tokyo University of Marine Science and Technology
Shanghai Astronomical Observatory
(c) 2018. TUMSAT & SHAO. All rights reserved.
=====
-----INFO-----: 23:12:57 Load configuration file done.
-----ERROR-----: 23:13:16 Incorrect year and doy, please check!
-----INFO-----: 23:13:44 Writing configuration file...
-----INFO-----: 23:13:47 Finish writing Control File!
-----WARN-----: 23:14:08 No DCB file. DCB will set as 0
-----INFO-----: 23:14:08 Writing configuration file...
-----INFO-----: 23:14:12 Start processing...

```

Fig. 2 INFO, WARN and ERROR information in processing status window

### 3.1 Download

Click **Process** → **Download** or **Ctrl+D** to change to download page.



The screenshot shows the 'Net\_Diff' software window with the 'Download' panel selected. The window has a menu bar with 'Process', 'Configure', 'Setting', 'Help', and 'About'. The 'Download' panel contains several input fields and buttons. At the top, there are fields for 'Year Start', 'DOY Start', 'Calendar', 'GPS day', 'Year End', 'DOY end', 'Calendar', and 'GPS day'. Below these is an 'FTP' dropdown menu set to 'cddis.gsfc.nasa.gov' and a checkbox for 'ChangePositionPanelDir'. The panel is divided into two main sections: 'Data' and 'Products'. The 'Data' section has a 'Dir' field set to 'E:\Program\Fortran\Matlab\_PPP\' and a 'Select' button. It also has checkboxes for 'brdc', 'brdm', 'brdx', and 'RNX' (which is checked). There is a 'RINEX 3' dropdown, a 'Station' field, and buttons for 'Select', 'Delete', and 'Add'. The 'Products' section has a 'Dir' field set to 'E:\Program\Fortran\Matlab\_PPP\' and a 'Select' button. It has checkboxes for 'sp3', 'clk', 'SNX', 'IONO', 'Trop', 'FCB', and 'SSR'. There are also dropdown menus for 'AC' (set to 'gbm'), 'jxf', 'gbm', and 'whu', and a '00' dropdown. At the bottom center of the panel is a 'Download' button with a satellite icon.

Fig. 3 Download Page

In this page, you can download the IGS data and products you want.

Please check the hint information on each uicontrol to know their functions.

What should be noticed is that:

- (1) When download IGS observation data, the station name is a four-character name. Although the file name of RINEX 3 has adopts the long name format, the software will transform it into a RINEX 2-like file name.
- (2) When download IGS final clock, although the clock file name is end up with .clk\_30s, the software will delete \_30s and rename it as .clk. This is to unify the file name of all clock products.
- (3) Please keep in mind that you have install gzip and have copy gzip.exe to the same folder of Net\_Diff.exe, otherwise Net\_Diff would not uncompress the downloaded file.
- (4) If you check **ChangePositionPanelDir**, and change to **Positioning panel** from **Download panel**, the directory of observation data, orbit, clock and output would also change to the same directory of products and data in **Download panel**.

- (5) If you can't download data or product from FTP, check your internet connecting or try another FTP.

## 3.2 Positioning

Click **Process** → **Positioning** or **Ctrl+P** to change to positioning page.

Fig. 4 Positioning Page

In this page, you can set your settings for positioning.

An easier way to start positioning is use positioning template firstly. When click pushbutton **SPP Temp**, it provides a basic SPP template. When click pushbutton **PPP Temp**, it provides a basic PPP template. When click pushbutton **RTK Temp**, it provides a basic RTK template. Based on the template, you can change the settings according to your own requirement.

There are some regulations or points when you change the settings:

- (1) The **Start time** and **End time** should strictly follow the format like: 2017-06-07 00:00:00. It is a 19-character string.
- (2) You can name you observation file as you like or following the IGS RINEX2 format. If the file name is same as IGS RINEX2 format, when input file name of the rover or base station, you can just input the four-character of the station. For example, if your observation file name is abcd001.19o, then you can just input abcd in the text box in coordinate panel. Nevertheless, a simpler way is to just click on **Rover** or **Base**, then select the observation file. But

remember that you have already select the corresponding directory in observation file directory.

- (3) When processing RTK or DSPP/DPPP, the file of rover station and base station should under the same observation file directory.
- (4) The default **observation file type** is RINEX. If you choose X71\_I, X71\_Q, or X11, you should have these types of data. If you don't have, please ignore them and don't choose these types.
- (5) When the **Orbit** or **Clock** type is SP3 or CLK, you can add IGS ACs name after the file directory or choose the AC name in the popupmenu. As gbm provides most satellites products, the default precise orbit and clock product is from gbm.
- (6) Similarly, for **ION Type**, when you choose **GIM** model, please add IGS ACs name after the file directory. For example, your GIM file is E:\products\igsg0010.18i, please make sure that the file directory is E:\products\igsg. In fact, when you change **Iono Type** from others to GIM, or then select a directory using **Select** pushbutton, the directory will automatically add codg. Considering update latency and precision, the default GIM product is from cod.

If you choose **Klobuchar** or **GIM** model, you can **download** the GIM file.

If you choose **Klobuchar** model, the software will find brdm file in orbit directory if the Orbit type is broadcast ephemeris. If it is SP3, then the software will find brdm file in Ionosphere file directory. Otherwise, please download it.

If you choose **BeiDou 14** or **BeiDou Grid** model, you should have a standard BeiDou 14 parameter or grid file. If you don't have, please ignore it and don't use this model.

- (7) Please update **EOP file** and **Antenna File** when you are processing PPP/DPPP/Long Baseline RTK. If you use GLONASS data, please **update GLONASS Frequency & Leap second file**. Although most of time, these files doesn't update frequently or don't have so much influence on the result.
- (8) If you are processing PPP/DPPP/Long Baseline RTK, please check that if you have **Ocean Load Coefficient** of the station in Tide.txt. The Tide.txt is under the folder of Input and not shown in GUI, you have to update it by hand. Although most of time, ocean load tide doesn't have so much influence on the result.
- (9) **P1C1 DCB** file only provide the P1C1 DCB of GPS. As its value is very stable, you can **Update** it even once a year.
- (10) **GNSS BSX** file contains not only GPS P1C1 DCB, but also Multi-GNSS and Multi-frequency DCB. If you are processing single frequency or other combinations except L1L2 combination and not use broadcast file(As DCB/TDG contains in broadcast file), you can **Update** GNSS BSX file
- (11) When you set **Wet delay** as 0, it means the software will not estimate troposphere parameter. If it is greater than 0, troposphere parameter will be estimated. If the estimation mode is LS(Least Square), the troposphere will be estimated every wet delay time. If it is KF(Kalman Filter), it will be estimated as a random walk model, with a 1cm/sqrt(hour) walk step.

- (12) When the processing modes are **PCOR/PCOR+Orb/Zone PPP**, the BDS WADS PPP panel will show and you should have corresponding files. If you don't know these, please ignore them and don't choose these processing modes.
- (13) **DD** method in cycle slip is only valid for static station.
- (14) **IMU** is for loosely coupled PPP/INS, currently it is not open.
- (15) Please correctly set the Code/Phase/Doppler noise according to real situation.
- (16) For stochastic model, the recommendation option is Elevation Depend( $a+b/\sin(\text{Ele})$ ).
- (17) Doppler observation is only valid in RTK currently.
- (18) When the processing mode is **RTK**, the RTK panel will show and you can choose proper **RTK Mode** and **AR Mode**. As for **Partial AR**, although the software provides three options of **No Full AR, Data Driven, Model Driven**, it is always recommended that you choose Data Driven or Model Driven, although it may takes a little more time to process RTK ,but it is worthy in aspect of fix rate and precision. Model Driven is the traditional partial AR, while Data Driven is a modified partial AR in Net\_Diff. The advantage of Data Driven or Model Driven is hard to say. But as a default setting, Data Driven is applied, as it more depends on real data.
- (19) When you choose GLONASS in RTK, **GLONASS AR** is enable to apply.
- (20) When you choose QZSS in RTK, you can check **QZSS DISB**, which is to estimate QZSS code DISB (not phase). Usually, when you are using identical receivers, you don't need to estimate QZSS DISB; if you are using different receivers, it is recommended to estimate it.
- (21) If you use **Long Baseline RTK** mode, please remember to check **Est. Iono** (Estimate Ionosphere). If you don't estimate ionosphere parameter, it is very hard to fix the ambiguity for long baseline.
- (22) For AR success rate, you can set it as 0.99 (the default value is 0.68 in the software) to get a reliable fixed result. If you just need to get a more accurate result and don't consider the fixing reliability, you can set success rate as 0.
- (23) If you want to forbidden the use of some satellites, you can click **Sat. Health** (Satellite Health) and uncheck the satellites you want.
- (24) The pushbutton of **SINEX** and **Header** means reading approximate station coordinate from a SINEX file or header of observation file.

When click pushbutton **Write**, it writes preparation file of Control.txt and Coord\_Table.txt for positioning. This would be useful if you want to debug the source code of Net\_Diff. When click pushbutton **Wt.& Run**, it writes preparation file of Control.txt and Coord\_Table.txt and start positioning.

You can check the hint information on each uicontrol to know their functions. However, as there are so many combinations of positioning settings, it is recommended to have your own try using your data.



### 3.3 Analysis

Click **Process** → **Analysis** or **Ctrl+A** to change to analysis page. If you are from positioning page, the coordinate file and log file will automatically change to the results you just processed.

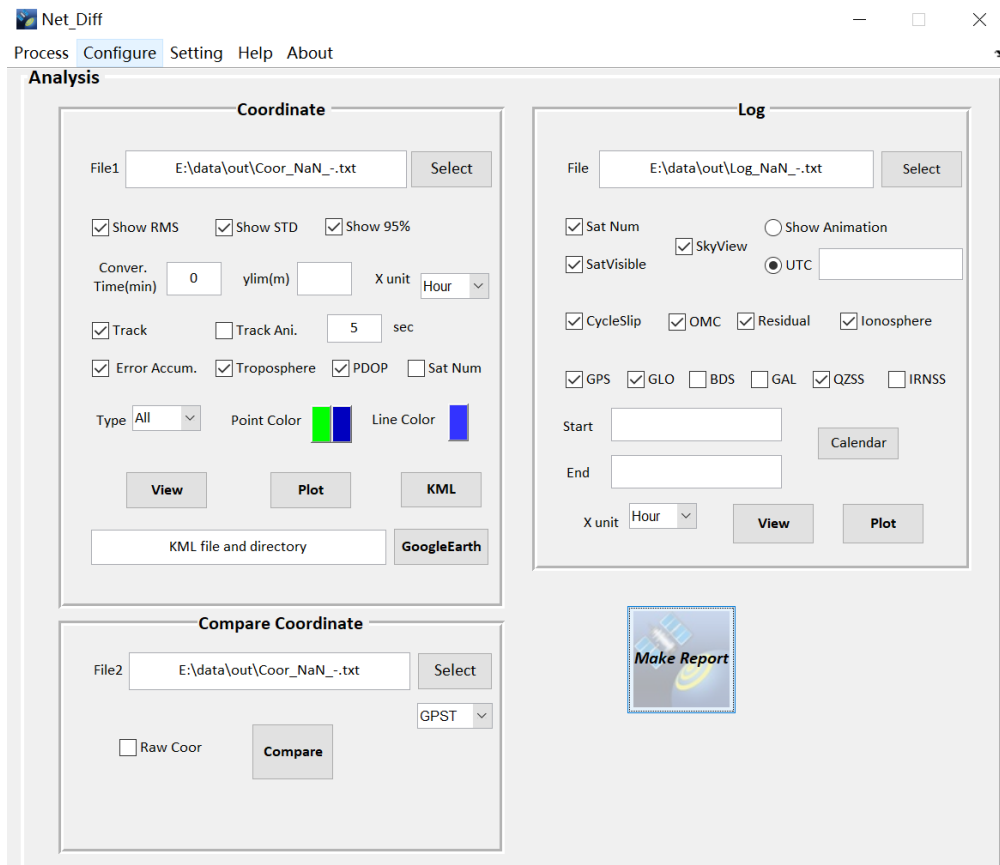


Fig. 5 Analysis Page

In this page, you can get analysis the positioning results and make positioning report through pushbutton of **Plot** and **Make Report**.

You can also make kml file in pushbutton **KML** and check the real positioning location on Google earth using pushbutton **GoogleEarth**(Make sure that you have installed Google Earth).

You can compare two positioning results in **Compare Coordinate** panel.

There are some regulations or points in Analysis page:

- (1) For coordinate type, currently we support Net\_Diff coordinate file, Net\_PPP coordinate file, pos file from RTKLIB, NMEA file, csv file from POSLV.
- (2) When plotting coordinate file, the software will also check **Start** and **End** epoch in **Log** panel. So please carefully check the time if you change another coordinate file. If you are not sure about the detailed epoch, just clear the time in Start and End epoch.
- (3) When comparing two coordinate files, you can set the time difference. If the two files are in different time system. For example, time system of NMEA is usually in UTC. Please change the time system to **UTC**, and you can set the difference between file 1 and file 2.

Please check the hint information on each uicontrol to know their functions.

### 3.4 Tool

Click **Process** → **Tool** or **Ctrl+T** to change to tool page.

The screenshot shows the 'Net\_Diff' application window with a menu bar (Process, Configure, Setting, Help, About) and a toolbar. The main area is divided into several panels:

- Time Transfer:** Includes a 'Calendar' button and input fields for Year, DOY, UTC, GPSweek, GPSday, and GPSsec.
- Coordinate Transfer (Top Right):** Input fields for X, Y, Z coordinates and Lat, Lon, Hgt.
- Coordinate Transfer (Bottom Left):** Input fields for Ref.Sta(ECEF), dX, dY, dZ, dN, dE, dU, and User Station.
- Ntrip:** Includes a dropdown for Ntrip Client (set to 'products.igs-ip.net'), Port (2101), Mount point, User ID, Password, and RTCM Dir, with 'Start' and 'Stop' buttons.
- RTCM/RINEX Convert & Edit:** Contains checkboxes for 'ConvBin', 'dumpSSR', 'RINEX3 To 2', and 'Android to RINEX'. It has 'Input File' and 'Out File' fields with 'Select' buttons, 'Start' and 'End' time fields, and an 'Interval(s)' field. A 'Calendar' button is also present. Below these are checkboxes for various data types: GPS, GLO, BDS, GAL, QZSS, IRNSS, SBAS, IODE, ORB, CLK, Code/Phase Bias, and VTEC. There is a 'RTCM3 time' field showing '2019/05/11 10:56:09'. At the bottom, there are dropdowns for 'L1+L2+L5+...', a numeric field '3.03', and a dropdown 'rtcm3'. A 'Convert' button with a satellite icon is on the right. At the very bottom, there are checkboxes for 'Nav', 'Doppler', 'SNR', and 'Scan', along with a 'Header...' button.

Fig. 6 Tool Page

In this page, you can get transfer between different time format and transfer coordinate system.

There are some regulations or points in Analysis page:

- (1) For **Ntrip** panel, you need a user ID and password. The saved file is in RTCM format.
- (2) In the **RTCM/RINEX Convert & Edit** panel, if you choose **ConvBin**, it means you can convert different types of raw observation data (including RTCM) to standard RINEX format. If you choose **dumpSSR**, this means you can dump the binary SSR file to text file. As SSR file doesn't include week information, you should select a approximate RTCM3 time that is in the same week of your SSR file. If you choose **RINEX3 To 2**, it allows you to change to RINEX3 format to RINEX2 format. If you choose **Android to RINEX**, you can change Android raw data to RINEX format. If you don't select any of the above option, you can edit your RINEX 3 file, similar as TEQC.

Please check the hint information on each uicontrol to know their functions.

## 3.5 Others

In the Configure menu, you can select **Save Configuration** or **Ctrl+S** to save your settings in positioning panel as a .cfg file. And you can select **Load Configuration** or **Ctrl+L** to load the existed .cfg file. This would be helpful if you want to do the same or similar positioning next time.

In the Setting menu, you can select voice hint in Chinese (**Voice(中文)**) or English (**Voice(English)**). If you don't want to use this function, please uncheck it.

If voice is selected, when you are doing the positioning processing or reading log file in Analysis Panel, a song will be played at the same time. It is named "We Will Change" from Komasa Mida, one of my favourite post-rock. Hope you enjoy it.

In the Setting menu, **Enable Terminate** allows to terminate the positioning processing, otherwise you can only terminate the processing through management window.

In the Setting menu, **Close All Files** is the same as the meaning. It is usually used in some occasions that the software doesn't work properly and doesn't close the opened file.

In the Help menu, you can also open this help document using **How to use** or **Ctrl+H**. You can also find some resource website on **DataSource**. Besides, you can find **Website** of Net\_Diff on GitHub, the latest version of Net\_Diff will be uploaded on it, please remember to update it.

There are some examples in the folder of test on GitHub, including data, results and .cfg file. You can load the .cfg file and test them in your Net\_Diff.

## 4 How to Debug

If you have bugs when processing Net\_Diff, you can turn to debug it.

The GUI is in fact to generate two files, Control.txt and Coord\_Table.txt. And then the core execute file **Net\_Diff.dll** in Input folder will read these two files and start processing.

To start debug Net\_Diff:

- (1) Download the src of Net\_Diff from GitHub, which is under the src branch.
- (2) Use Visual Studio to make a new solution of Net\_Diff, and then load all src into the solution. Please make sure that you have installed Visual Fortran Compiler.
- (3) Copy the Control.txt and Coord\_Table.txt to your solution directory, or set your working directory the same as Net\_Diff.
- (4) Start to debug it!

## 5 Others

Please keep an eye on processing status window when you are using Net\_Diff, which will tell you

your processing status. Or open voice hint so that you can turn to do other things while waiting.

If the processing status window doesn't refresh, try to press enter in processing status window to refresh.

If the positioning processing doesn't work, check if Net\_Diff.dll from last operation is still working in your task management window. If yes, please kill it and then retry Net\_Diff. If it still doesn't work, close Net\_Diff and restart it. So it is recommended to save the configuration every time.

If you have any questions or suggestions, please contact me: [zhyize@163.com](mailto:zhyize@163.com).

Thank you for using Net\_Diff.