

Guide Calcul RTK

This guide explains how to retrieve data from ublox receivers and how to format them for use with the Matlab point calculation program.

I. Installation of the useful programs

Download the file **ucenter v19.02** on your PC from the section « Fichier Executable pour ucenter » of moodle. Install the program. This will allow us to:

- To configure the receiver we need
- To get the position of the initial point of the movement and that of the base station.

Download the file of section « Programme Matlab pour calcul RTK ». Unzip the archive in a Matlab folder. You should see this :

Nom	Modifié le	Type	Taille
CalculePos_quasi_RTK	24/11/2024 17:55	Dossier de fichiers	
Fichiers.xlsx	24/11/2024 17:04	Dossier de fichiers	
Recupere_Donnees_Rinex	24/11/2024 17:55	Dossier de fichiers	
Recupere_Donnees_Ublox	24/11/2024 18:11	Dossier de fichiers	

These programs should enable you to retrieve the data needed to calculate the RTK position. The following is intended to help you understand how to use them.

II. Retrieving the data

To retrieve the data, two receivers must be used, one as a base station and the other as a mobile.

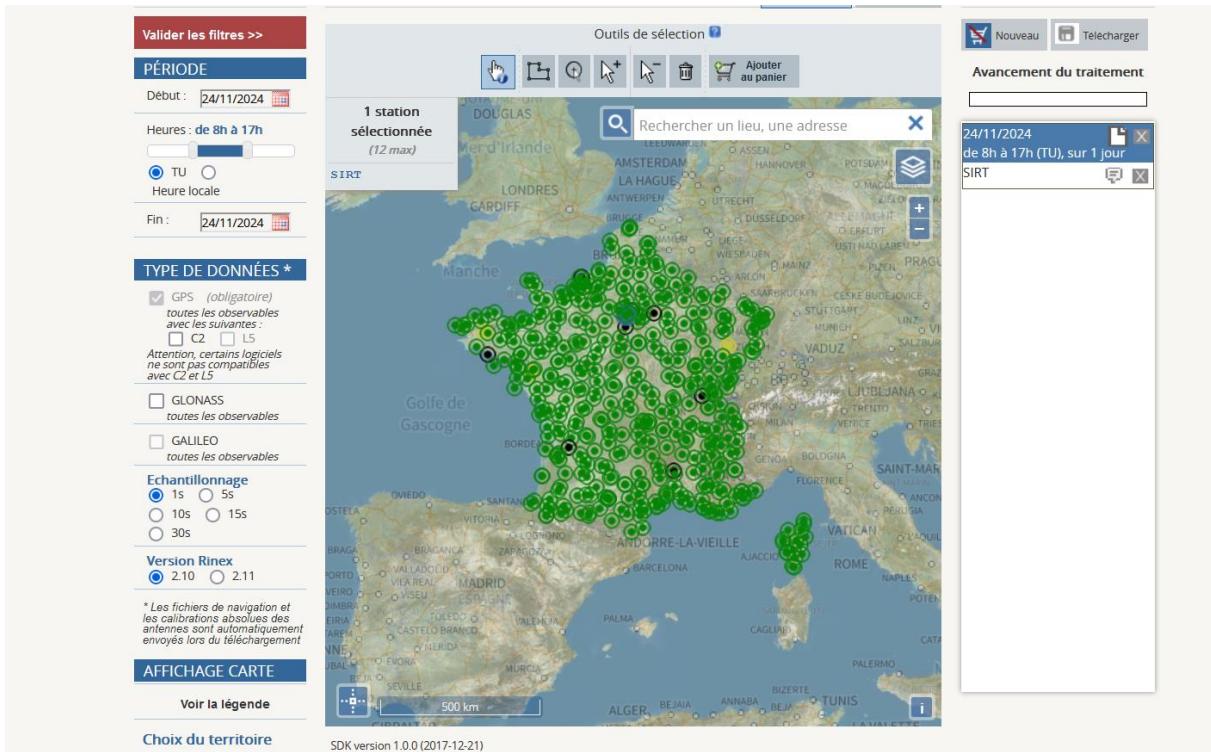
2.1. Extraction from Rinex files

Although we still have the option of using an ublox as a base station, we will be using receivers from the Institut de Géographie National (IGN) network.

This data is available **the day after** it was captured, so you will need to retrieve the data one day after your own experiments.

Go to the website : <https://rgp.ign.fr/DONNEES/diffusion/>

You should see this page:



Choose the following options:

- **GPS**
- **Echantillonnage : 1s**
- **Version Rinex : 2.10**

Do not select anything else

TYPE DE DONNÉES *

GPS (obligatoire)
toutes les observables avec les suivantes :
 C2 L5
Attention, certains logiciels ne sont pas compatibles avec C2 et L5

GLONASS toutes les observables
 GALILEO toutes les observables

Echantillonnage

1s 5s
 10s 15s
 30s

Version Rinex

2.10 2.11

* Les fichiers de navigation et les calibrations absolues des antennes sont automatiquement envoyés lors du téléchargement

Choose a time slot that includes the one during which you took your own measurements (choose short time slots to avoid having files that are too large):

PÉRIODE

Début : 24/11/2024

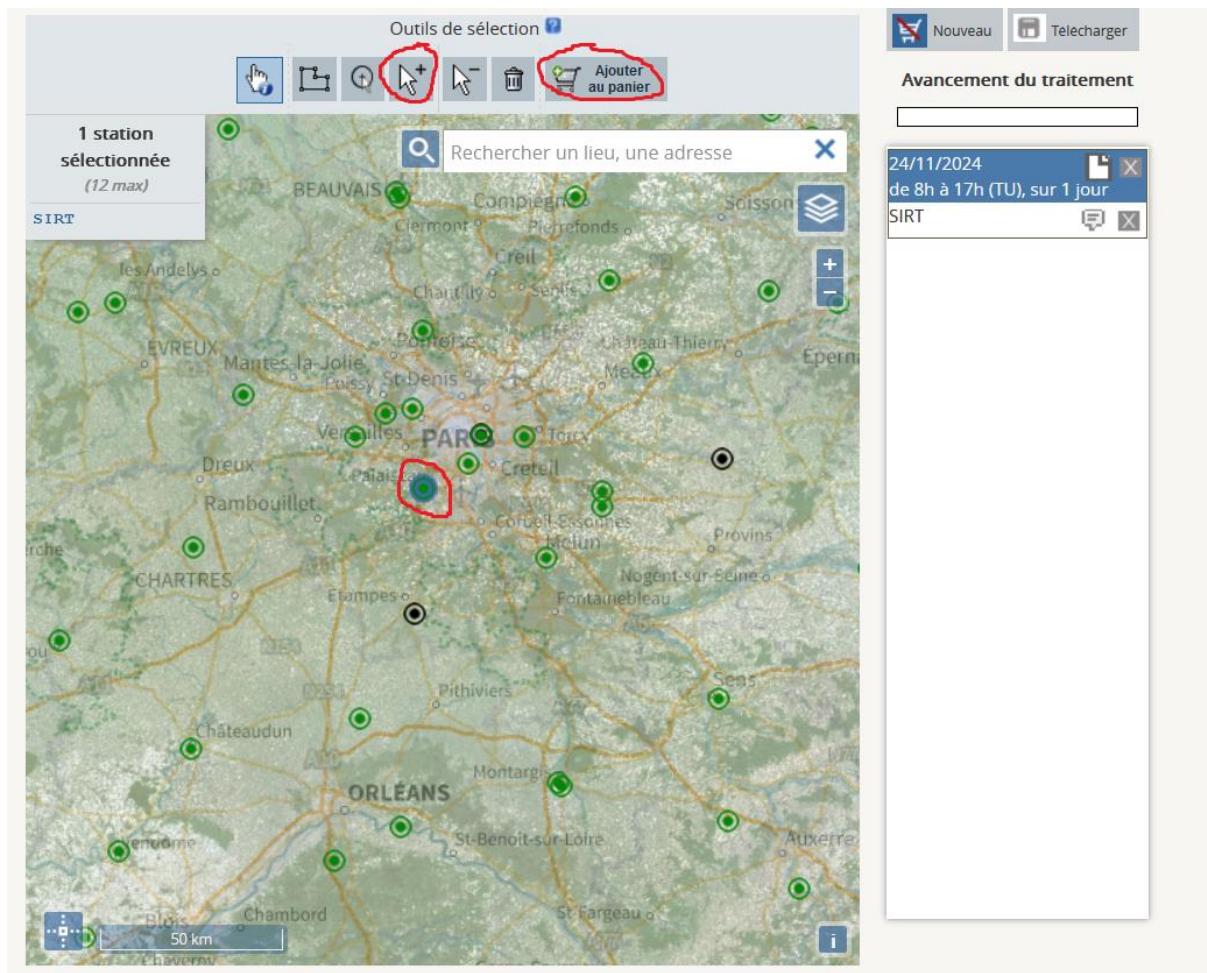
Heures : de 11h15 à 15h15

TU Heure locale

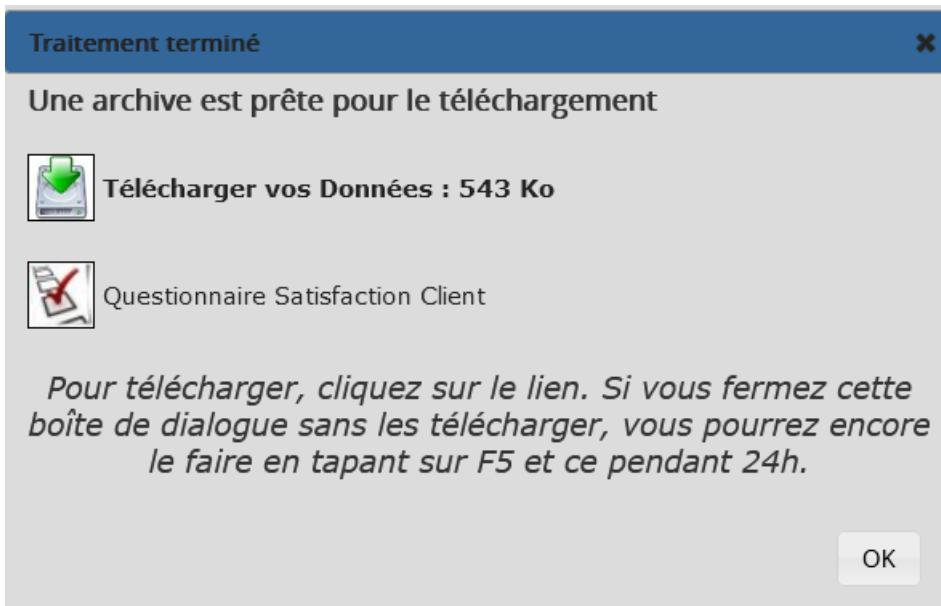
Fin : 24/11/2024

Here we have for example on 24 November 2024, with a time slot from 11.15 a.m. to 3.15 p.m. in **Universal Time (TU)**, Daylight saving time in France is GMT+1, so when it's 11:15 in Universal Time, it's 12:15 in France.

On the map, zoom in and then select the station closest to where you are doing your experiments (SIRT if you are in the Télécom building) using the + arrow. Select « Ajouter au panier » to save your choice:



Then click on 'Download'. After a while, this window should appear:



Click on 'Download your Data', and an archive file should download to your computer.

Open it and retrieve the files with a .24o and .24n extension, whose name corresponds to the name of the station, for example sirt329z.24o and sirt329z.24n.

Nom	Type	Taille compressée	Protégé pa...	Taille	Ratio	Modifié le
calibrations_absolues_des_antennes	Dossier de fichiers					25/11/2024 13:06
sirt329z.24n	Fichier 24N	62 Ko	Non	253 Ko	76 %	25/11/2024 13:06
sirt329z.24o	Fichier 24O	470 Ko	Non	1594 Ko	71 %	25/11/2024 13:06

Copy these files and put them in the folder « RinexfilestoRead » of the folder « Recupere Donnees Rinex ».

Make sure that these two files are the only ones in the directory. You can use an archive folder to store previous files, but the program will not do this on its own.

Then run the program **ReadDataRinex2p10** from the folder « « Recupere Donnees Rinex » and follow the instructions.

The program will need an initial instant in GPS time; you can either let it retrieve it from the last ublox data processed, or type it in directly at the program prompt. If you do nothing, the program will default to the first time available in the observation file.

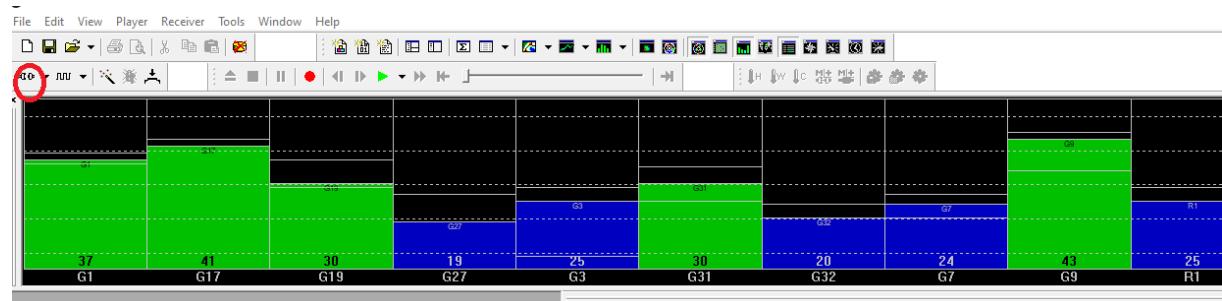
This will result in the creation of a data file corresponding to the measurements from the base station "Donnees_PR_Base.xlsx", as well as a file "Donnees_Ephem.xlsx", containing the satellite ephemerides, both in the "Filesxlsx" directory.

2.2.Extraction from ublox M8T

Before retrieving the data, you must first configure the receiver.

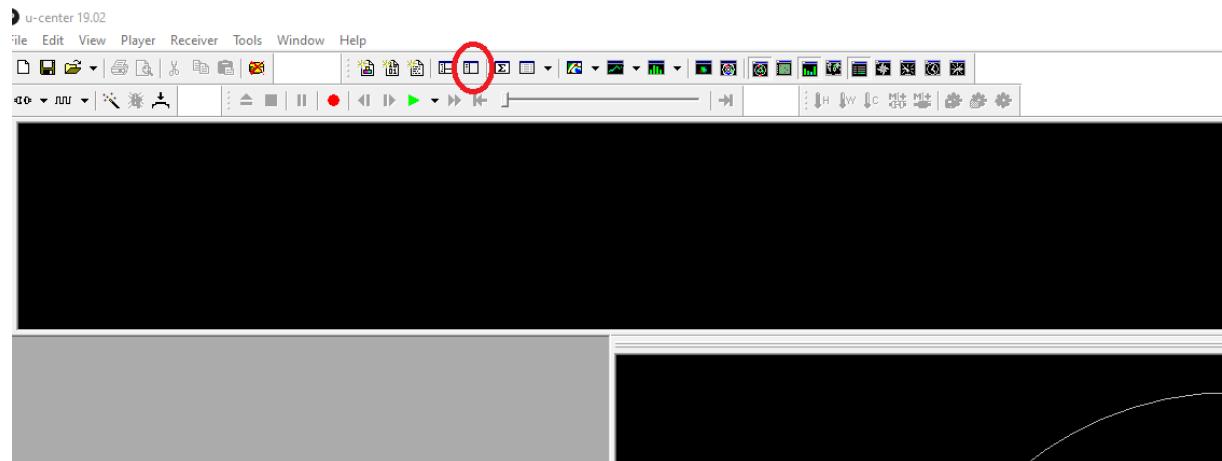
Run **ucenter**.

Once the program window is open, connect the receiver by clicking on ‘connect’. You will need to choose the com port - there is usually only one - and the speed is set correctly by default.:



Make a careful note of the port number (here COM4, it will be different on your computer and depends on the USB port to which you connect the receiver). You will be asked for this com port number when you launch the Matlab program.

Once the receiver is connected, click on « configuration view »



In the control panel, go to the GNSS line (GNSSconfig)

Configure - GNSS Configuration

- ANT (Antenna Settings)
- BATCH (Batch mode output)
- CFG (Configuration)
- DAT (Datum)
- DGNSS (Differential GNSS configuration)
- DOSC (Disciplined Oscillator)
- DYNSEED (Dynamic Seed)
- EKF (EKF Settings)
- ESFGWT (Gyro+Wheeltick)
- ESRC (External Source Config)
- FIXSEED (Fixed Seed)
- FXN (Fix Now Mode)
- GEOFENCE (Geofence Config)
- GNSS (GNSS Config)**
- HNR (High Nav Rate)
- INF (Inf Messages)
- ITFM (Jamming/Interference Monitor)
- LOGFILTER (Log Settings)
- MSG (Messages)
- NAV5 (Navigation 5)
- NAVX5 (Navigation Expert 5)
- NMEA (NMEA Protocol)

UBX - CFG (Config) - GNSS (GNSS Config)

ID	GNSS	Configure	Enable	Channels	
				min	max
0	GPS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	8	16
1	SBAS	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	3
2	Galileo	<input type="checkbox"/>	<input type="checkbox"/>	0	0
3	BeiDou	<input checked="" type="checkbox"/>	<input type="checkbox"/>	8	16
4	IMES	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	8
5	QZSS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0	3
6	GLONASS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	8	14
7	IRNSS				

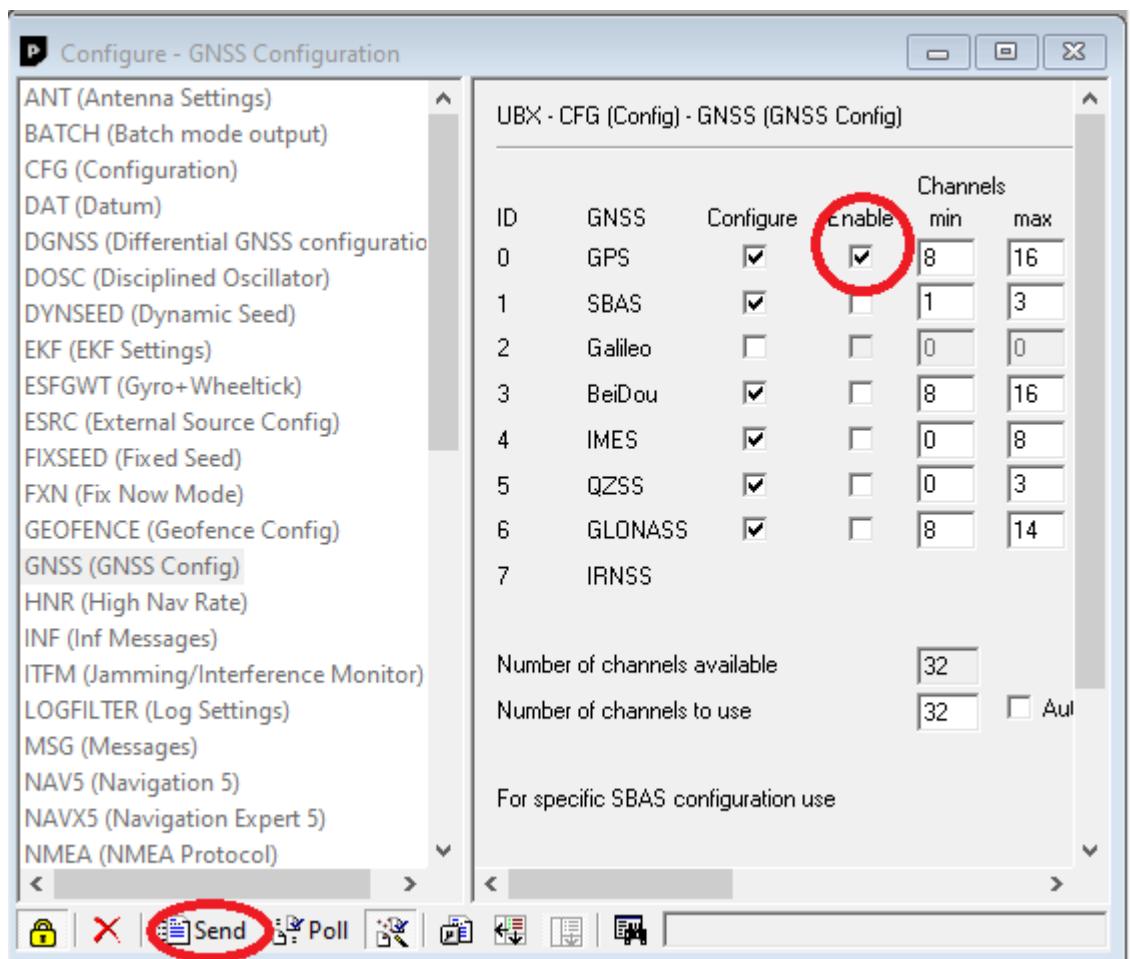
Number of channels available

Number of channels to use Aul

For specific SBAS configuration use

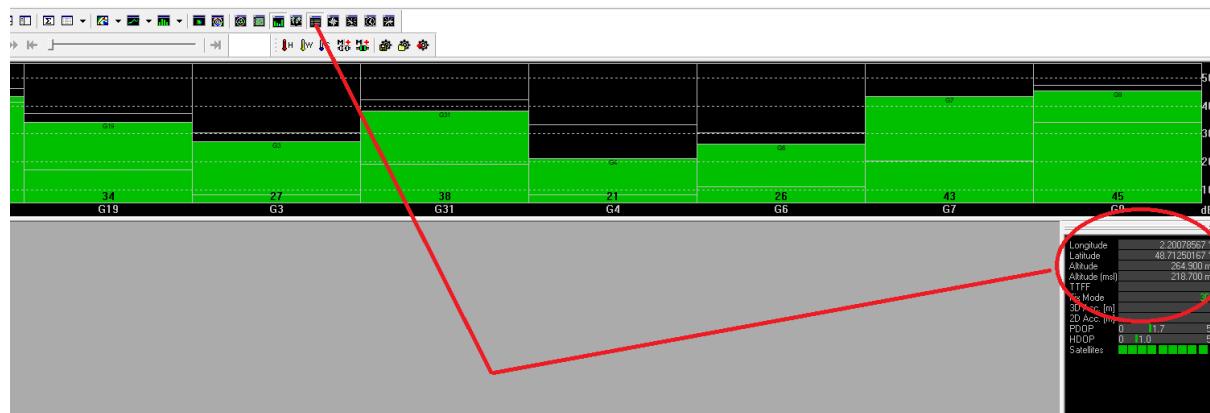
Toolbars: Lock, Close, Send, Poll, Save, Open, Print, Help, Exit.

Desirable non-GPS constellations, otherwise the data rate will not be sufficient to obtain one measurement per second.



Only the GPS must remain activated, then click on 'send' to confirm the configuration.

As long as you are stationary, or if your receiver is acting as a base station, note the position (latitude, longitude, altitude) calculated by the receiver:



Remember that accuracy of the order of a metre is given for 5 decimal in a decimal representation of degrés for latitude and longitude.

You can also use GoogleEarth (or Maps) to determine your fixed positions, but this will be less accurate than with the ublox receiver.

Once all this is done, **close ucenter**.

At this point you have :

- The Port Com number
- The coordinates of your position

Allez dans le répertoire « Recupere Donnees_Ublox »

Run the **Read_Data_Ublox** program, which will ask you to specify the recording time **in seconds**. By default, this is 300 seconds (5 minutes) and cannot exceed 20 minutes.

The data is saved in strxx.mat files, so in the event of an interruption it can still be used. However, we recommend recording for a maximum of 5 to 10 minutes.

When the time has elapsed, the program will ask you if you want to change the port number. If you type 0, the number will remain the same as that of the last record. Otherwise, type 1 and then type the number (**just the number!**) you retrieved with **Ucenter**.

The programme should start and you will see a counter from 1 to 5 seconds scroll by, as well as a seconds counter (BC).

Carry out your experimentation.

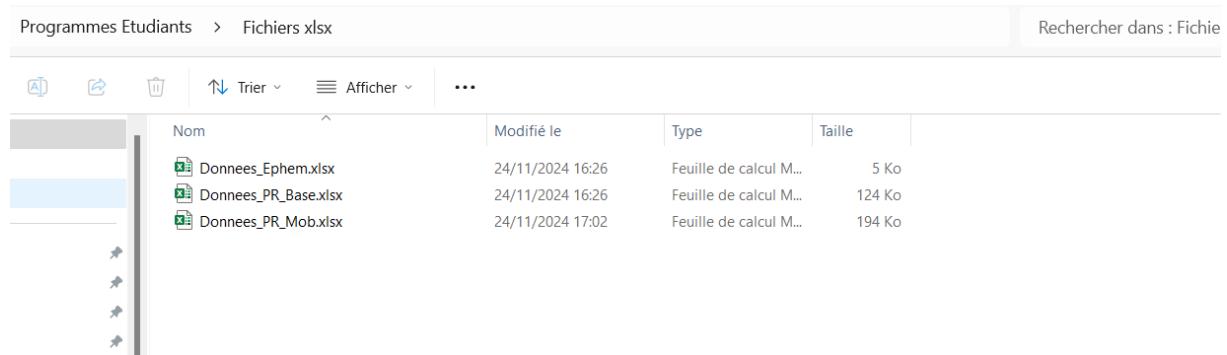
Recordings are saved in the ‘SavedRecords’ folder, in a folder whose name corresponds to the time at which they were saved.

Once the recording time has elapsed, the program continues and creates two xlsx files in the ‘Filexlsx’ directory, ‘Donnees_PR_Mob.xlsx’ and ‘Donnees_Ephem.xlsx’. These files are also saved in the ‘Archives’ folder, under the directory name corresponding to the date and time of day.

III. Calculation of the point

The point should be calculated using the files from the previous programs.

In the ‘xlsx files’ directory of the ‘Student Programme’ directory (if you have copied it as it is), place the xlsx files from the previous programs as shown in the following screenshot:



Nom	Modifié le	Type	Taille
Donnees_Ephem.xlsx	24/11/2024 16:26	Feuille de calcul M...	5 Ko
Donnees_PR_Base.xlsx	24/11/2024 16:26	Feuille de calcul M...	124 Ko
Donnees_PR_Mob.xlsx	24/11/2024 17:02	Feuille de calcul M...	194 Ko

The file ‘Donnees_Ephem.xlsx’ is duplicated. Choose which program you want to retrieve it from. Naturally, we would prefer to retrieve it from the Rinex file extraction program, but this is not compulsory.

Go to the “Pos_quasi_RTK” directory and run the point calculation program : **Double_Difference_NSat_DonneesUblox**.

You can manually cancel the presence of a double difference in the position calculation. The pivot satellite of the calculation will always be the satellite with the highest elevation, and the satellites will then be ordered by increasing number. The variable to be modified, ‘ChoixDD’, can be found on line 74 of the main program:

```
63
64    % On sauve les coordonnées des points dans le répertoire de config
65
66    save("./Config\Config.mat","StationBase","VraisPoints");  %VraisPoin
67
68    % Masque d'élévation (degrés)
69
70    Masque = 20;
71
72    % Choix des Double différences à retirer manuellement (0 si retiré)
73
74    Choix_DD = [1 1 0 1 1 1 1 1 1];
75
76    % Longueur d'onde
```

Here we have removed the third double difference. You can find out which satellite this corresponds to using the ‘Tab_DD_numSat’ variable, which lists the satellites involved in the double difference, as in the following example:

	1	2	3	4
1	12	10		
2	12	15		
3	12	17		
4	12	19		
5	12	24		
6	12	25		
7	12	32		
8				
9				
10				

Each line indicates the satellites that are double differenced.

Here, the third element of “DD_choix” is 0, so we won't use the double difference corresponding to satellites 12 and 17.

The minimum number of double differences required to calculate a point is 3. 4 or more will give a calculation of correct quality.

The program will show you the coordinates of the base station that it will use for the calculation. Check directly in the Rinex observation file (sirt329.24o) whether the coordinates are correct. It will then ask you if you want to change the coordinates it has. If you do (enter 1), the program will suggest that you read them directly from the file. If you say no (type 0), it will keep the coordinates it has. If you say yes (type 1), it will read them from the Rinex file.

Then it shows you the coordinates of the initial point it has for the mobile. First in Cartesian, then in WGS84 (latitude, longitude, altitude). If you want to change (type 1), you'll be asked to enter the coordinates one by one manually (in degrees for latitude and longitude, in metres for altitude). The calculation programme is then launched, with the steps indicated.

Finally you obtain ;

- the horizontal projection of the satellites
- the HDOP
- the 2D error on the base position calculation using pseudodistance code
- a 3D RTK phase position figure (using phase measurements)
- a 2D RTK phase position figure (using phase measurements)
- a 3D RTK code position figure (using code measurements)
- a 2D RTK code position figure (using code measurements)
-

In the program directory, you have two xlsx files PosWGS84_code and PosWGS84_phase which allow you to display the route on Google Earth. You can repeat the procedure seen in TD#3 with the PosMob.xsl file.