



# Small « préambule »

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This software is free of use. But you can give us some Us\$ or €.

This software was wrote, in first idea, for the need of the C.C.A.E ( European Collins Collector Association ) and his manager.

The idea was not to " ré-inventer la roue "- not to write a new Log- Software, but the idea to have a free and confortable computer screen for help and easy trafic. Seems to be our boatanchor Collins KWM-2, S'Lines or Gold Dust Twins : pleasant to use, hear and smell .... and which can be just near a new transceiver with late technologies .

Ham-Radio is this, also.

This "easy-of-use " is to see all QSO in permanent link with QRZ.COM or GOOGLE-MAPS or a simple map where one can see exact location or the ham in QSO. So, "chemin faisant", many complemental functions have been added .

Now you can publish your log on the Net (CCAIE\_WEB). We ask a little contribution for this last software plug-in (CCAIE\_WEB) because, to do this, we need fast transfers and good security . We use three hosted computers : one in France, one in Germany and last in Spain.

Other functions are and will be available time to time to drive.. a.s.w a transceiver, antenna and-so-on... We need some time...and we have only 24 hours in a day...

This software has been developped in Microsoft Visual and only for Windows. We are not at top for Apple or Linux languages, but we think, perhaps, to be OK...in some years. We hope so... if Ham-radio is always alive in next decades...

Our setup don't put any bad things or "gremlins", bugs or so on.. in your computer but using windows components installed. Only one OBDC is created. In 2014, we don't need to do all again and collaboration is fine to go faster and further...

And for those who want to know more, this software is coming from other software very very more expensives from my professionnal occupation and validated by 1.200.000 records with 400 simultaneous users with Oracle, SQLServer, DB2 and MySQL database... Find 400 users in a shack with 400 computers and all what you want... If you want, you are autorized to transfert the database to play and enjoy ...

Join us for any suggestion, idea or if you need help.

We use radio only for our pleasure and this software in a good part for your and our pleasure...

Enjoy HAM-RADIO.. and .....Don't scrap your Old Rigs, repair them ..

# 1 How to install de CCAE :

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CCAЕ needs 2 setup :

- A setup for the the software
- A setup for an empty database

Let the setup going in the same folder or choose another.

You will receive emails with news about a new version. Download the setup and install in the same folder than last version.

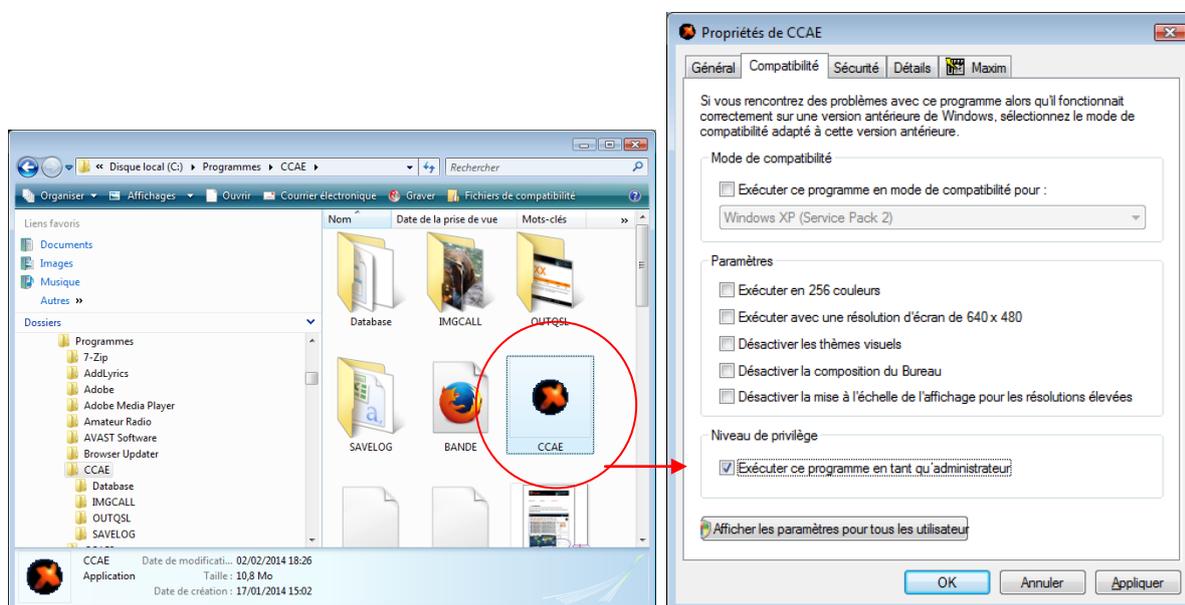
## 2 How to launch CCAE :

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It is recommanded to launch as Administrator.

You can change manually right. Go in the CCAE folder and right click on CCAE.EXE and go to Properties.

Go in compatibility and change as Administrator.



**CCAЕ needs to use INTERNET !**

# 3 The first time

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CCAЕ is provided for French and English language.

Two small buttons are used to change and save the language.

## 3.1 First register

The first time, CCAЕ ask you some informations.

It is important.

Welcome !

**COLLINS C.C.A.E**

Welcome aboard CCAE software

You are using CCAE for the first time or your are using version above 1.2

Please send us your name, call and email  
Donnez-nous votre call, nom et adresse email...

Your CALL ?  
F6HOY

Your NAME ?  
Jean-Luc

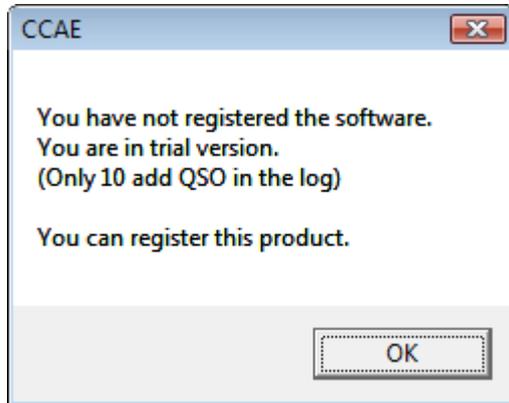
Your email ?  
jlcoutarel@yahoo.fr

First register Later

Best 73's from F6HOY - Jean-Luc - CCAE # 10003 and F6FMT - Gérard - CCAE # 10001

An email is sent to CCAE.

CCAIE invite you to register the software. You can do this later.



With a registered software you can have more than the 10 QSO in the log.

You have to write a serial number. This serial number is unique and just for this computer.

CCAIE.EXE give you a Code Key.

Send this Code Key to CCAIE and you will receive the Serial number.

But you can do this later....



Welcome aboard CCAE software

Send us an email with this Code Key and your call. We will send you back a serial number.

Code Key to send us

FFFDECC0209

Without a serial number you are limited to 100 QSO in the log.  
Sans Serial Number vous êtes limités à 100 QSO.

Your CALL ?

F6HOY

Your NAME ?

JEAN-LUC

Your email ?

jlcoutarel@yahoo.fr



Send to CCAE to get the serial number

The Serial number that receive by email ?



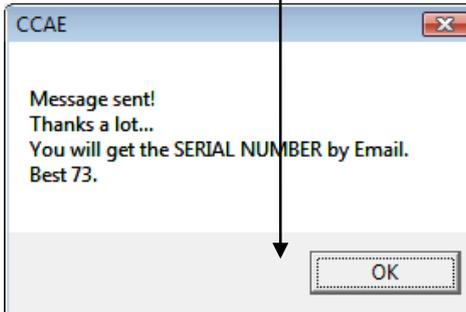
Register CCAE with serial number



Register CCAE later

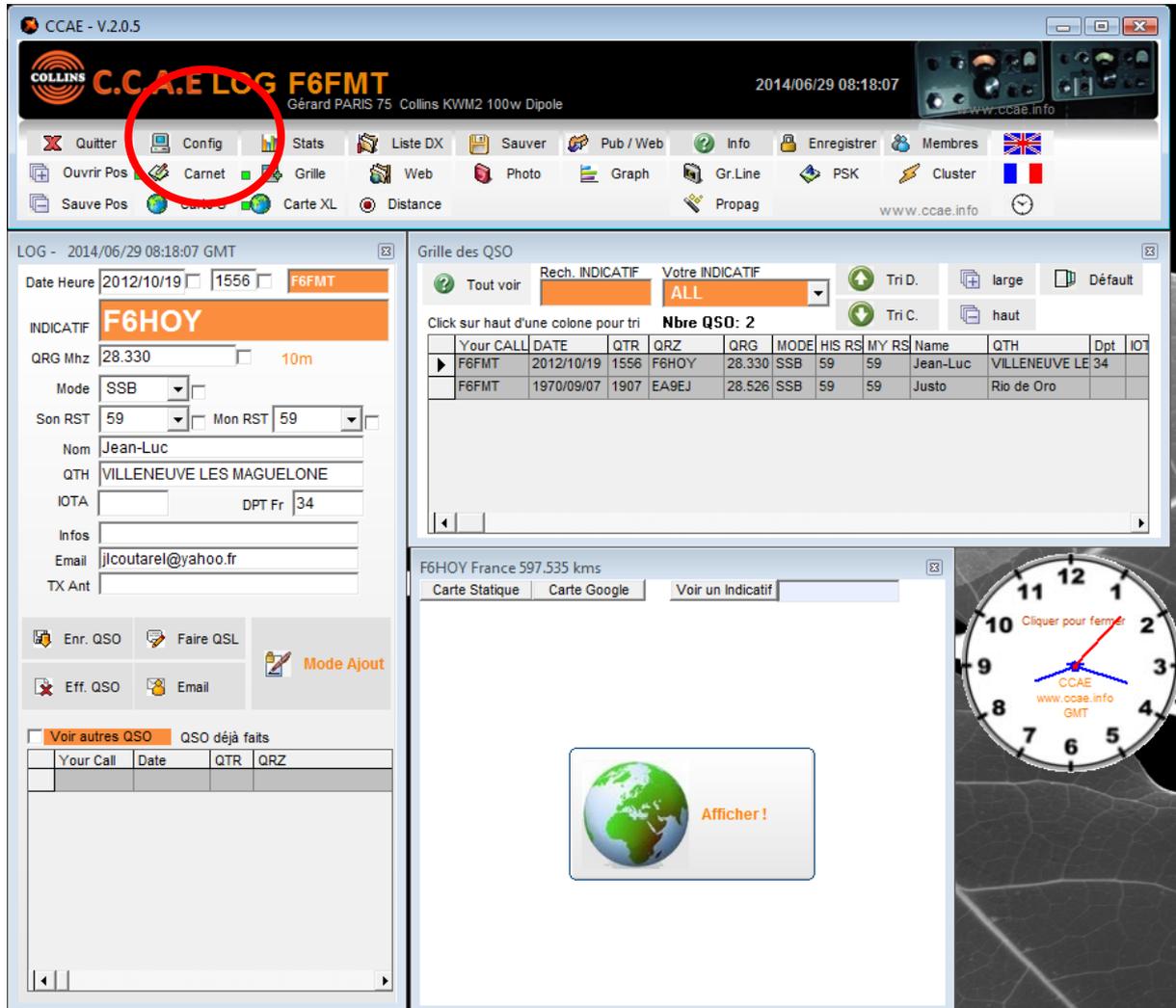


Best 73's from F6HOY - Jean-Luc - CCAE # 10003



## 3.2 Begin the configuration

The first time, go in Config



The screenshot shows the CCAE V.2.0.5 software interface. The title bar reads "CCAÉ - V.2.0.5". The main header displays the "COLLINS C.C.A.E LOG F6FMT" logo and the user information "G rard PARIS 75 Collins KVM2 100w Dipole" along with the date and time "2014/06/29 08:18:07". A red circle highlights the "Config" button in the top menu bar. Below the menu bar, there are several toolbars with icons for various functions like "Quitter", "Ouvrir Pos", "Sauve Pos", "Carnet", "Grille", "Web", "Photo", "Graph", "Gr.Line", "PSK", "Cluster", "Propag", "Liste DX", "Sauver", "Pub / Web", "Info", "Enregistrer", "Membres", "Distance", and "Carte XL".

The main interface is divided into several panels:

- LOG - 2014/06/29 08:18:07 GMT:** This panel contains fields for "Date Heure" (2012/10/19), "1556", and "F6FMT". The "INDICATIF" is set to "F6HOY". Other fields include "QRG Mhz" (28.330), "Mode" (SSB), "Son RST" (59), "Nom" (Jean-Luc), "QTH" (VILLENEUVE LES MAGUELONE), "IOTA" (DPT Fr 34), "Email" (jicoutarel@yahoo.fr), and "TX Ant".
- Grille des QSO:** This panel shows a table of QSOs. The "Rech. INDICATIF" is set to "ALL" and "Votre INDICATIF" is also "ALL". The "Nbre QSO: 2" is displayed. The table has columns for "Your CALL", "DATE", "QTR", "QRZ", "QRG", "MODE", "HIS RS", "MY RS", "Name", "QTH", "Dpt", and "IOT". Two QSOs are listed:

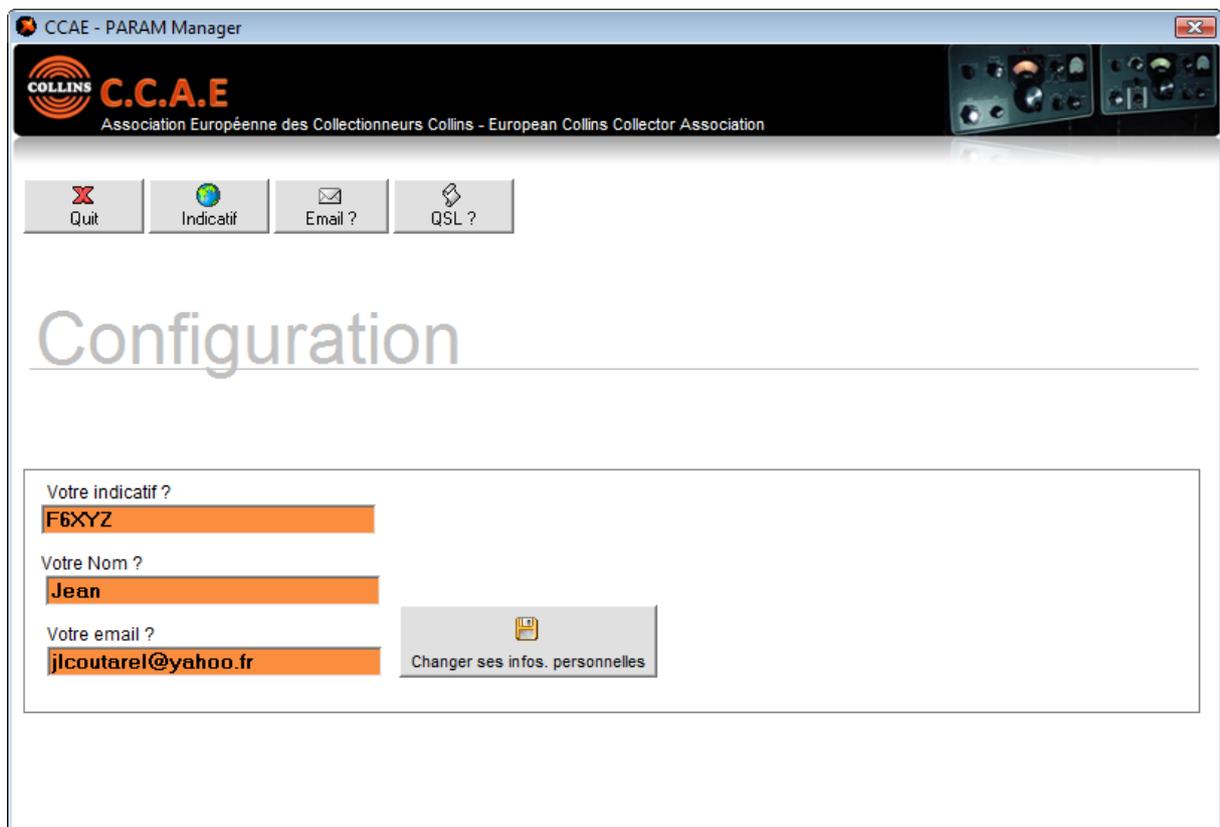
Your CALL	DATE	QTR	QRZ	QRG	MODE	HIS RS	MY RS	Name	QTH	Dpt	IOT
F6FMT	2012/10/19	1556	F6HOY	28.330	SSB	59	59	Jean-Luc	VILLENEUVE LE	34	
F6FMT	1970/09/07	1907	EA9EJ	28.526	SSB	59	59	Justo	Rio de Oro		
- F6HOY France 597.535 kms:** This panel shows a "Carte Statique" and "Carte Google" button, and a "Voir un Indicatif" button. Below these is a globe icon and an "Afficher !" button.
- Right Panel:** A clock showing the time 10:10 and the text "Cliquez pour fermer", "CCA ", "www.ccae.info", and "GMT".

# 4 Configuration

Go in Config :



You can change your personal infos if it is not correct :



## 4.1 Define your own call

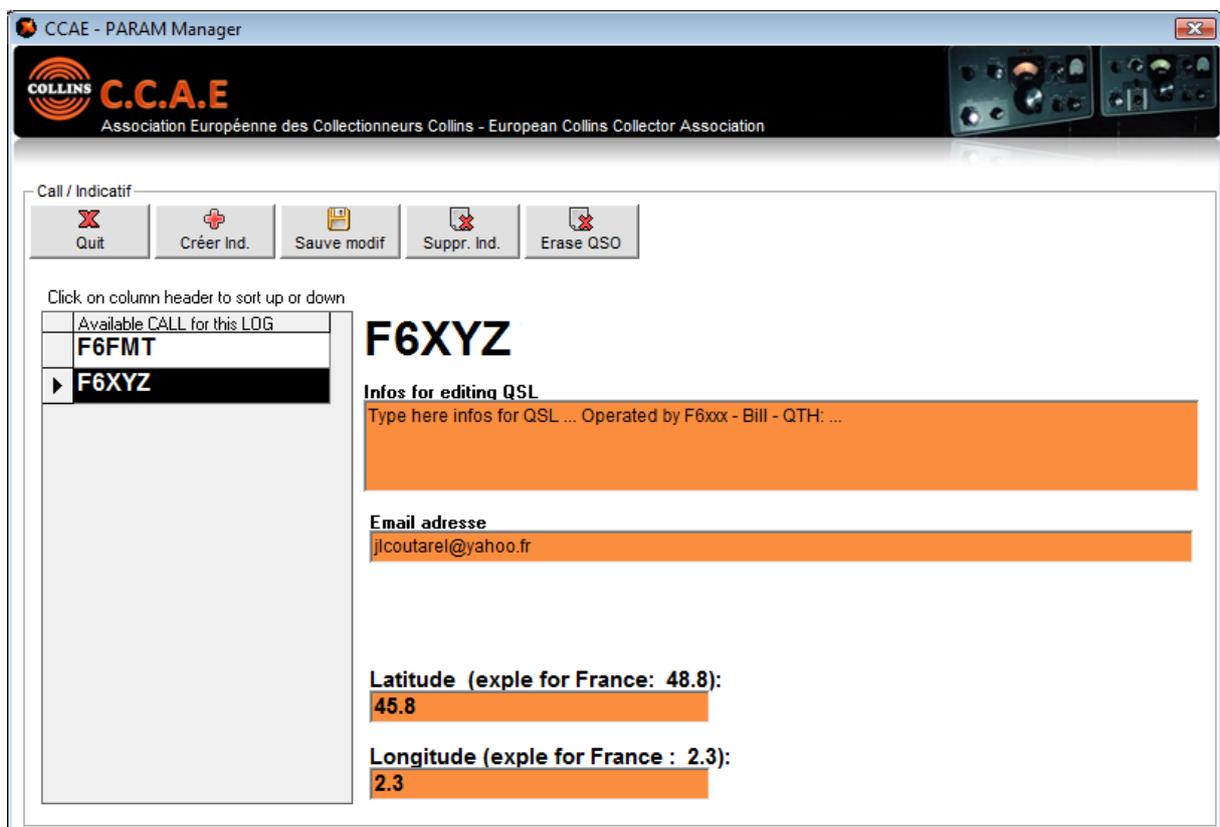
There is an example with F6FMT and the call that you have defined

With the software you can manage several CALL.

Example with F6XYZ: The small items to be printed on the QSL, and also your email, and lat and log... (comma is changed in dot)

Take time to enter a good coordinates with lot of decimal to get good results when we display map and distance.

Do not forget to do « Save Modif »



**Some tips :**

**Erase a call :**

You will do it to erase the test call F6FMT.

If there is QSO, the software ask you to delete them.

**Erase only QSO for a call :**

Use it, for example, when you have imported an ADIF file with too much mistakes.

## 4.2 Email configuration

Emails are used for :

- sending QSL
- sending an email to an OM
- sending savelog database

Write informations and do not forgot to SaveModif

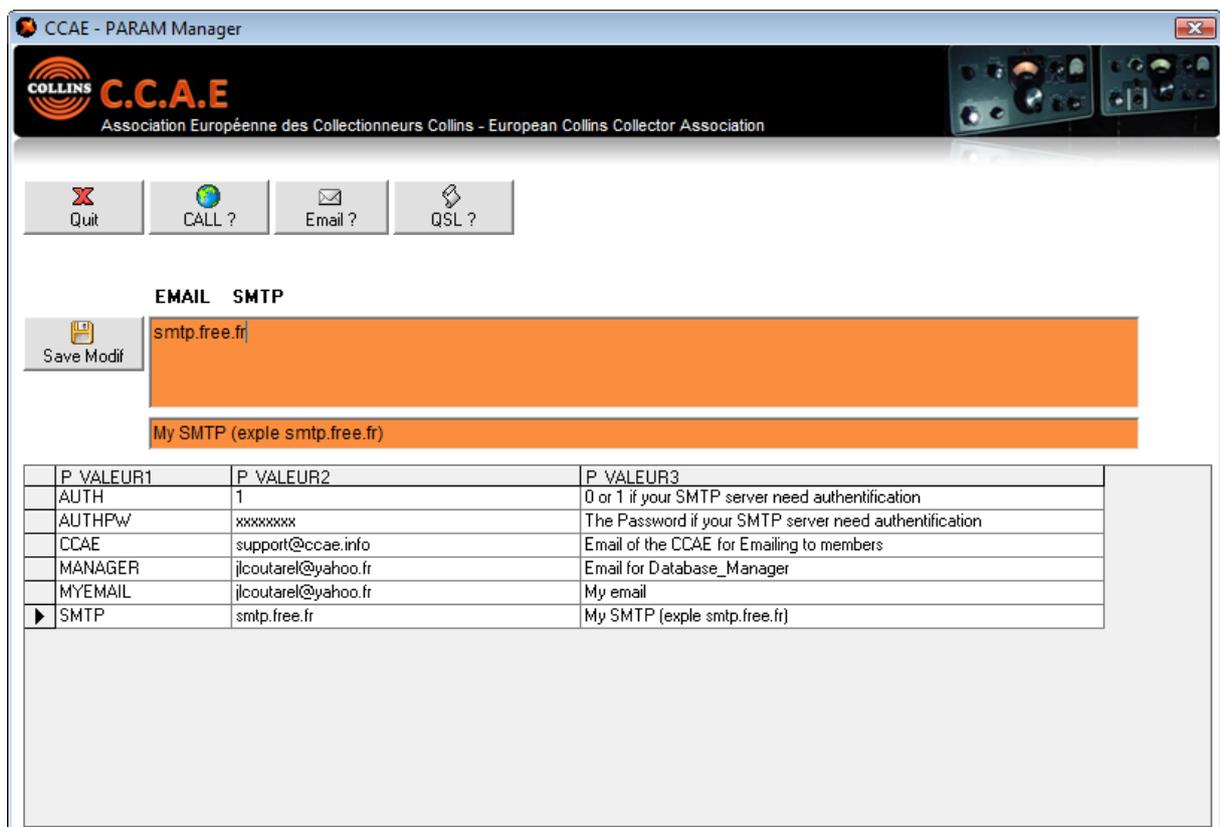
Emails are sent in SMTP

AUTH : 1 ou 0 if your SMTP provider or server needs authentification

AUTHPATH : password of your email SMTP

MYEMAIL : Your email

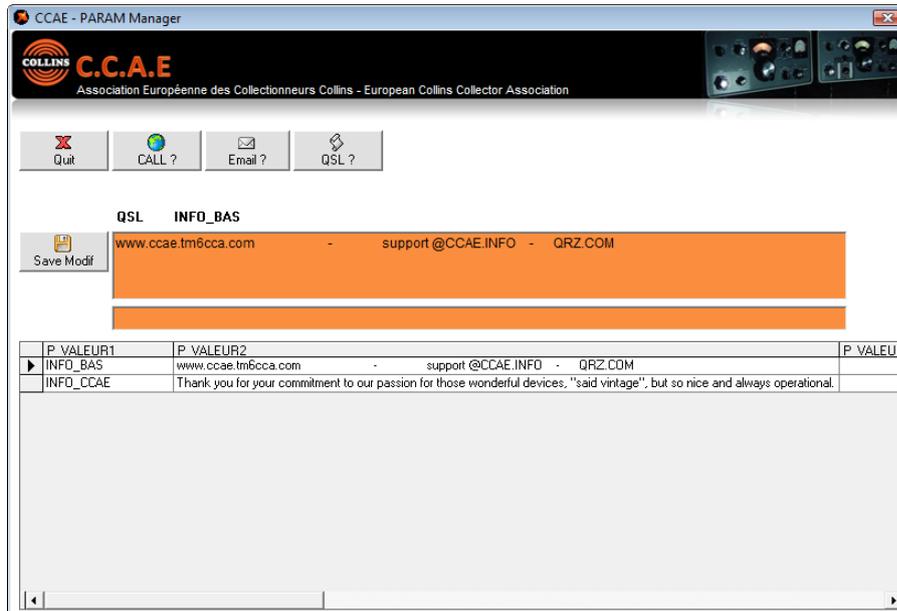
SMTP : Your SMTP server



P_VALEUR1	P_VALEUR2	P_VALEUR3
AUTH	1	0 or 1 if your SMTP server need authentication
AUTHPW	xxxxxxxx	The Password if your SMTP server need authentication
CCAЕ	support@ccae.info	Email of the CCAE for Emailing to members
MANAGER	jlcoutarel@yahoo.fr	Email for Database_Manager
MYEMAIL	jlcoutarel@yahoo.fr	My email
▶ SMTP	smtp.free.fr	My SMTP (exple smtp.free.fr)

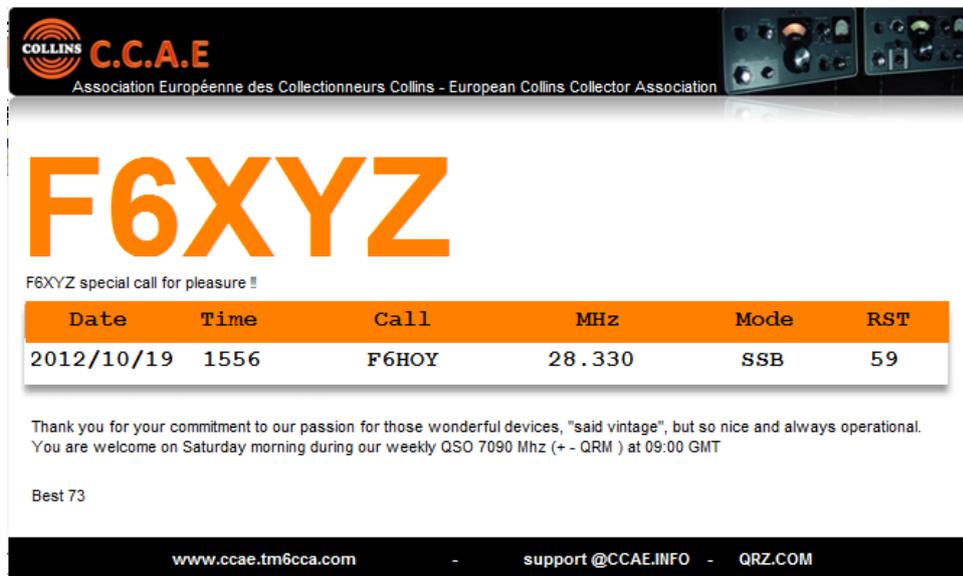
## 4.3 QSL configuration

Define 2 lines :



This is your QSL:

But you can also modify this informations later when you will create the QSL



# 5 How doe's it Works ?

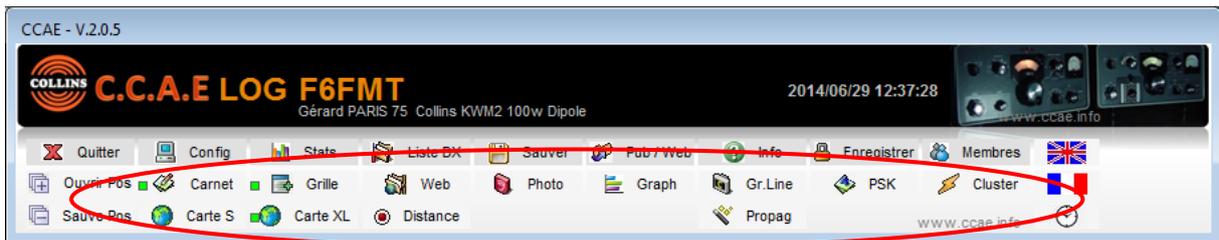
Since V2, it is possible to display some or all windows on the screen. Where you like and as you like.

It is also possible to save several display configurations and open one when you want.

The fonctions :



All the windows :

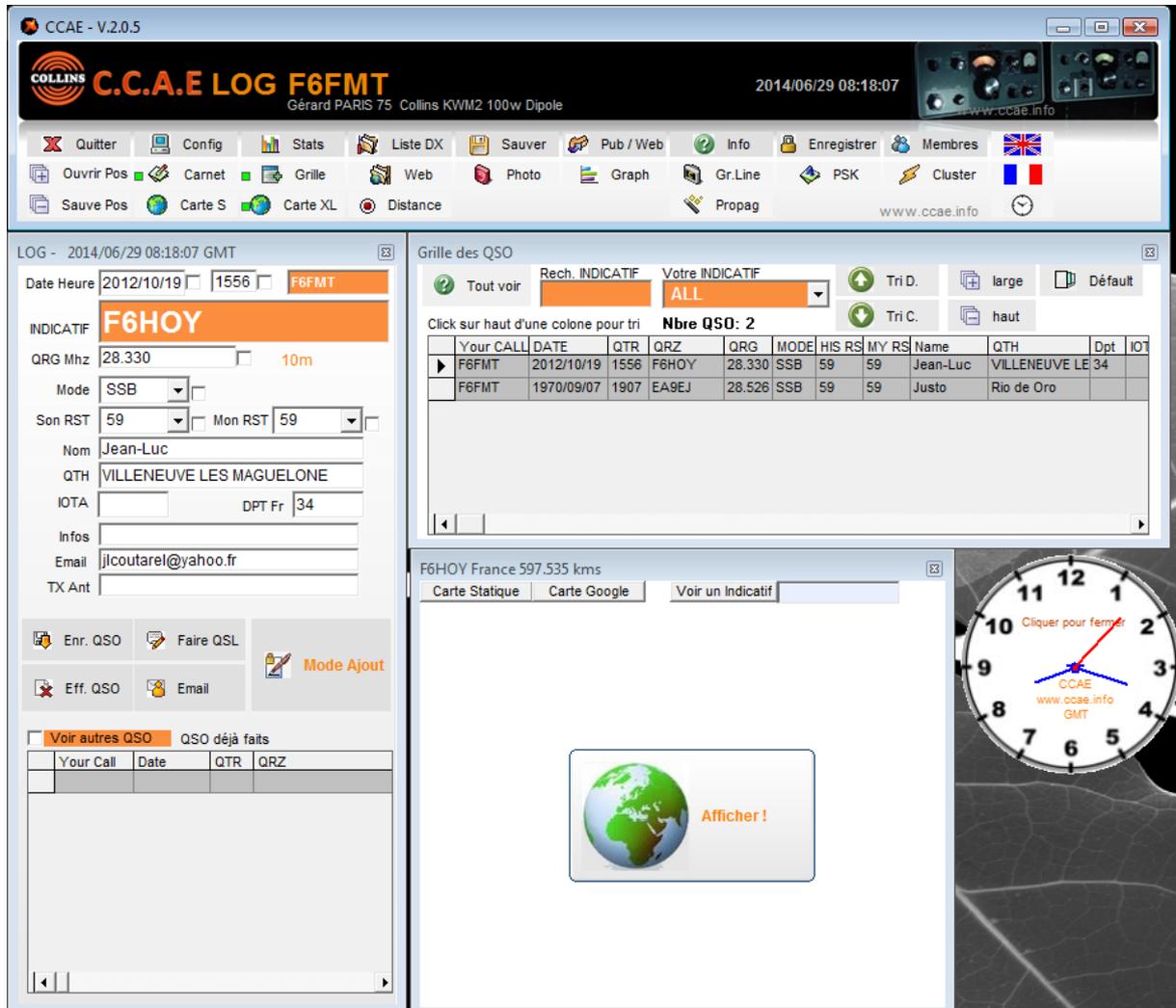


On right, a GT Clock, this manual and two flags for language.



## 5.1 Open close and display windows:

The first time CCAE software displays some few windows.

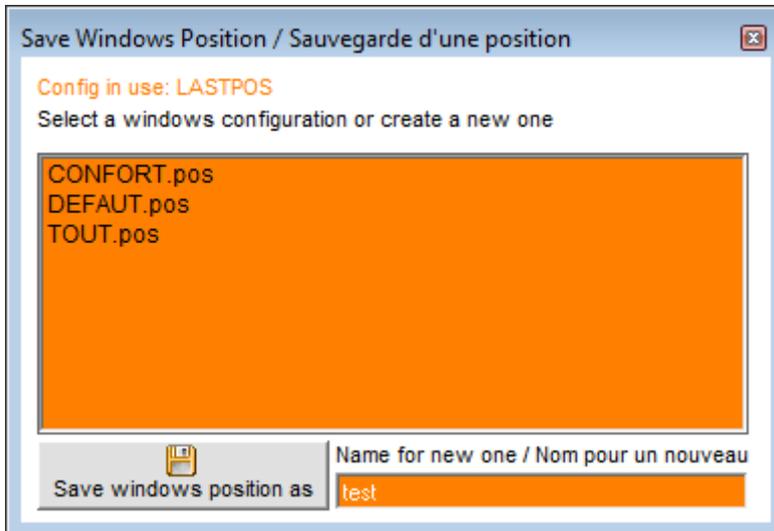


When a window is open, a small green led is « on » on the button:

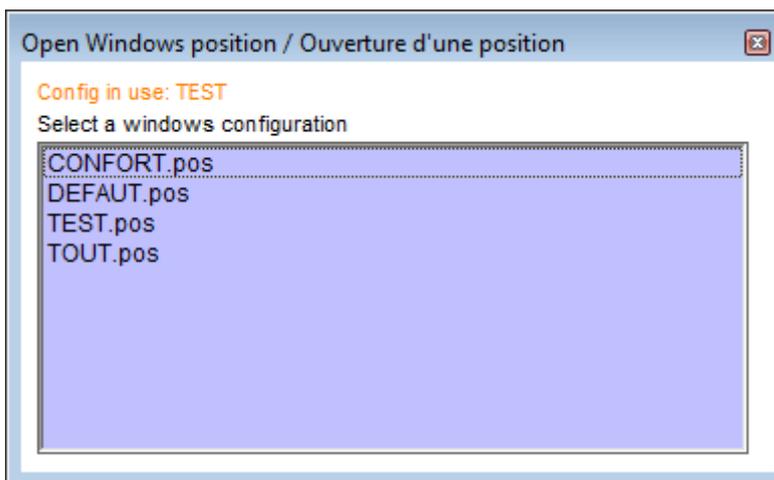
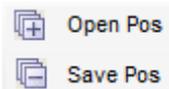


**Organize your desktop as you like.**

**Add, cancel, display windows where you like et save your configuration for next time.**



Open a configuration when you want :





## 5.2 Windows :

### DATA GRID

LOG GRID

Find a CALL: [ ] Your own CALL: ALL

Buttons: Sort Up, large, Défault, Sort Dw, haut

Click on column header to sort Nbre QSO: 23043

Your CALL	DATE	QTR	QRZ	QRG	MODE	HIS RS	MY RS	Name	QTH	Dpt	IOTA
▶ TM0CXX	2014/06/14	1806	2E1FFZ	7.147	SSB	57	59	Den	SALTBURN		
TM0CXX	2014/06/14	1755	2W0BJR	7.145	SSB	58	58	Robert	SWANSEA		
TM0CXX	2014/06/14	1748	G4OGT	7.145	SSB	58	58	Tony	SOUTHAMPTON		
TM0CXX	2014/06/14	1332	GB2NWA	7.096	SSB	59	59	Richard	NORTH WEAMD		
F6HOY	2014/06/14	0925	ON6DU	7.160	SSB	59	59	Albert	LILLOIS		
F6HOY	2014/06/14	0925	TM0CXX	7.165	SSB	57	58	Gérard	Ecouen	91	
F6HOY	2014/06/14	0920	F6CDX	7.160	SSB	56	58	Jean-Pierre	LA COQUILLE	24	

You can click on header column to sort

Two buttons are used to display the grid in full width or full height. Click to Défault to resize grid.

Find a call for your OWN call

All the log: to display all the log.

When you click on a line :

- The QSO is displayed in the window's log
- The map are enabled
- The distance and Azimuth are displayed
- The call is displayed in the QRZ.COM web site inside the software...

### DISTANCES

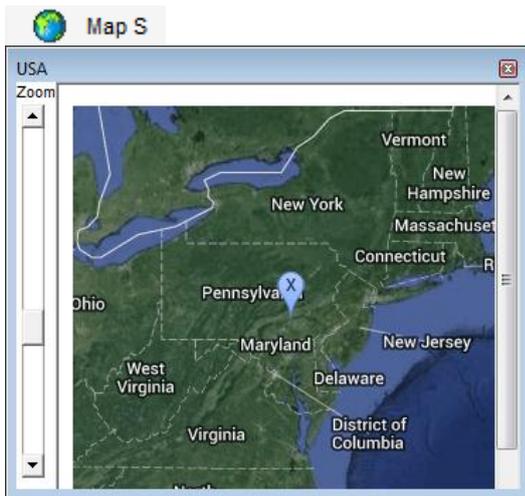
F6HOY - 43.5323 / 3.86084

**F4HEF**  
**France**  
Position : 43.4339 6.73611  
Distance : 232.078 kms  
Azimut : 91.710

Gérer la liste des pays

# MAPS

Two maps :



■ ● **Map XL**

Grille des QSO

Tout voir Rech. INDICATIF Votre INDICATIF F6HOY ↑ Tri D. large Défaut

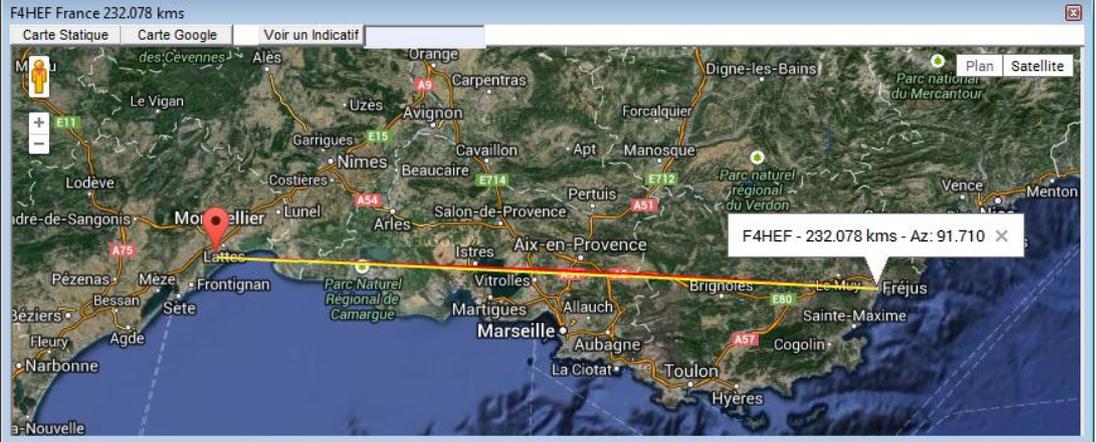
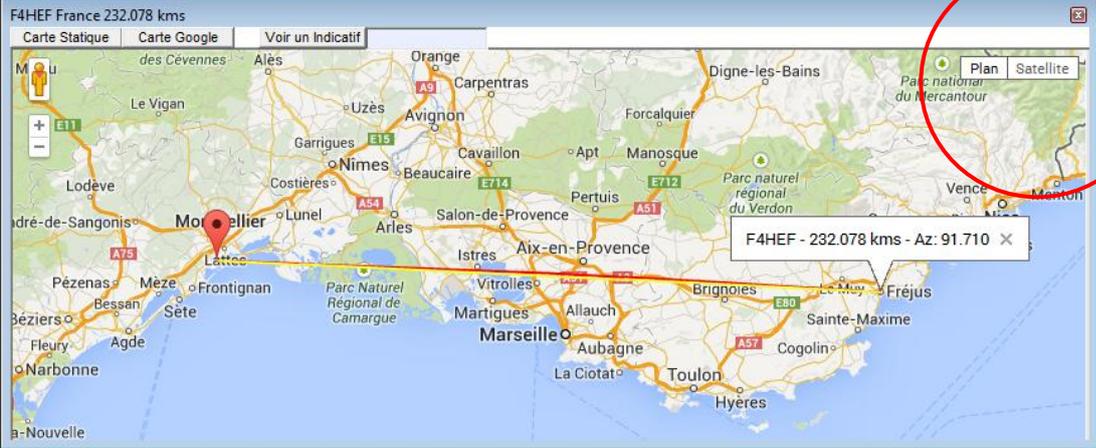
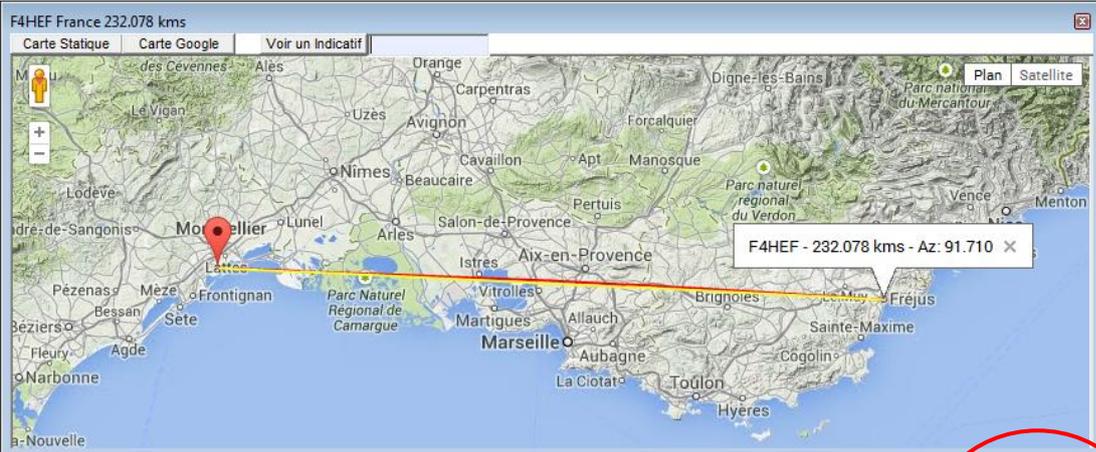
↓ Tri C. haut

Click sur haut d'une colonne pour tri **Nbre QSO: 1912**

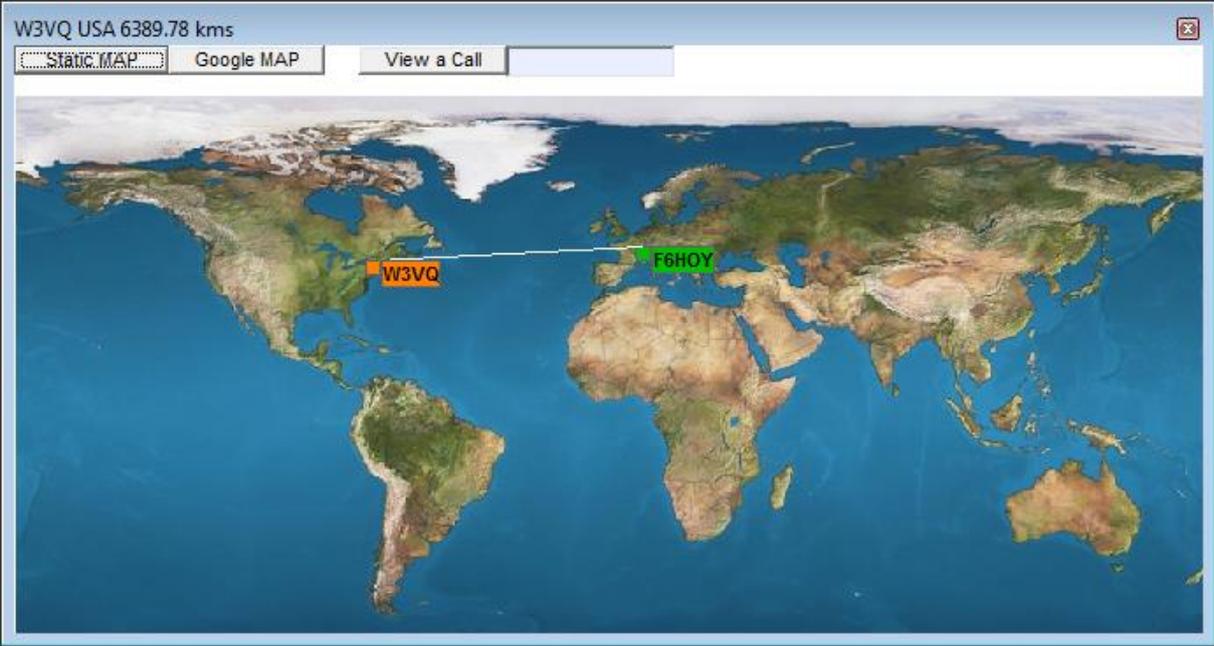
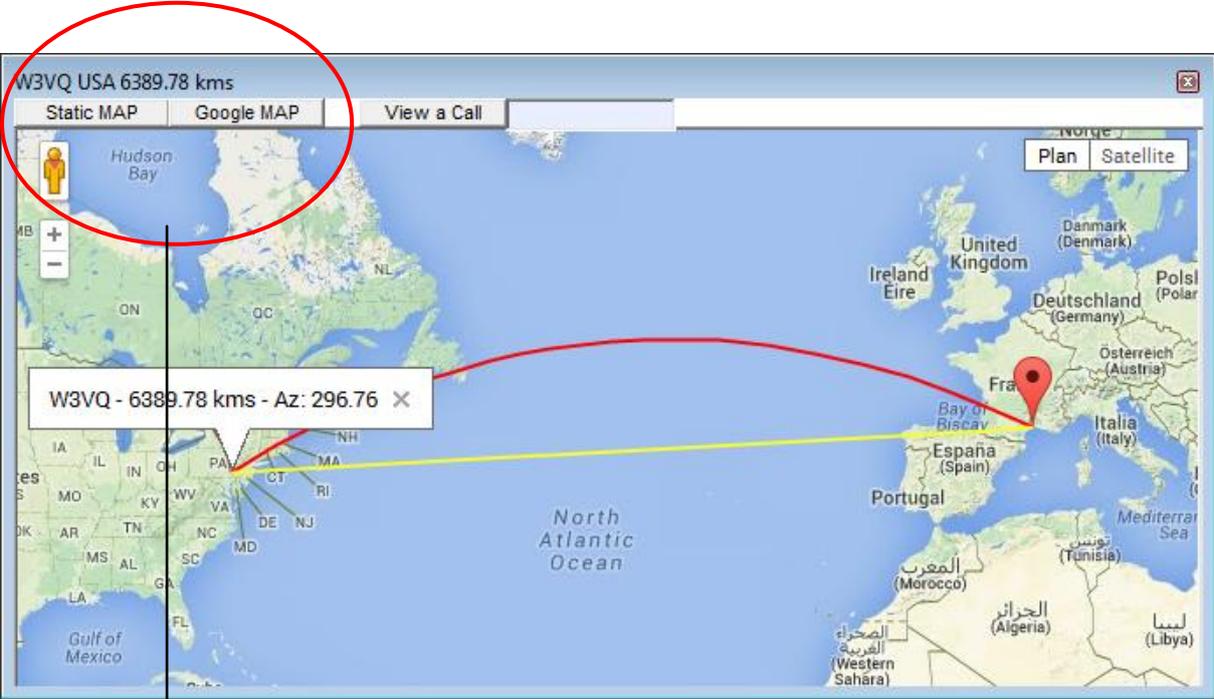
Your CALL	DATE	QTR	QRZ	QRG	MODE	HIS	RS	MY	RS	Name	QTH	Dpt	IOTA	TX-ANT	INFOS	LOCATOR	QSL VIA
F6HOY	1982/07/11	2338	4X6DF	14	SSB	59	59										
F6HOY	1982/07/11	2330	4X6BZ	14	SSB	59	59										
F6HOY	1982/07/11	2242	KZ1Z	14	SSB	59	59										
F6HOY	1982/07/11	2221	VE1CER/1	21	SSB	59	59										
F6HOY	1982/07/11	2218	CT1LN	14	SSB	59	59										
F6HOY	1982/07/11	2214	LZ2DB	14	SSB	59	59										
F6HOY	1982/07/11	2208	GM4HQF	14	SSB	59	59										
F6HOY	1982/07/11	2038	LZ1KDP	7	SSB	59	59										

VE1CER/1 Canada, Pr.Edward Is. Nova Scotia 5136.20 kms
Canada, Pr.Edward Is. Nova Scotia

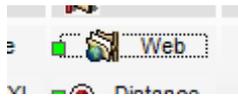
Carte Statique Carte Google Voir un Indicatif



Map with Google map (needs internet) or static (without internet)



## WEB Browser



Some web sites are shown.  
You can define your favorites.

If you check the ACTIVE AUTOMATIC SEARCH IN QRZ.COM you will get automatically the own page of your correspondents.

www - Internet

QRZ  Active automatic search in QRZ.com on a call.

CCAIE QRZ Clust WEBsdr Google DxScape Favorite WWW ?

Search Database News Forums Swapmeet Resources Contact

by Callsign OM Random DNS PRODUCTS Sale \$44.75

12:34:27 UTC 1 Jul 2014

**KENWOOD TS-9903**  
HUGE SAVINGS!  
GigaParts

**TMOCXX** France

Login is required for additional detail.

QSL: F6FMT

Email: Login required to view

Page managed by F6FMT Lookups: 7465

Label

Biography Detail Logbook

Log a NEW contact with TMOCXX...

AssociatedRadio 800.497.1457

New and Used Equipment

American Radio Supply

COMET & ORLIK ANTENNAS

**COLLINS C.C.A.E**  
Association Européenne des Collectionneurs Collins

**TMOCXX**

## Picture



Get in your log the picture of a QSO and show it next time...

Add a picture or drag and drop from external software or from the internal web Browser.

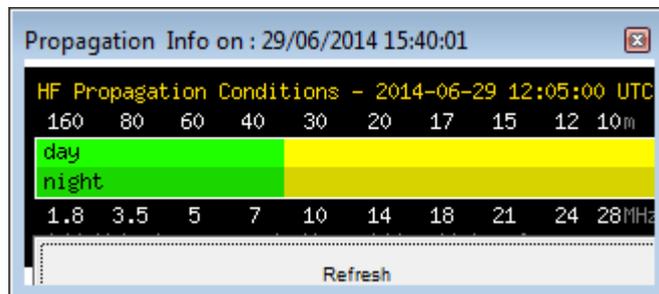
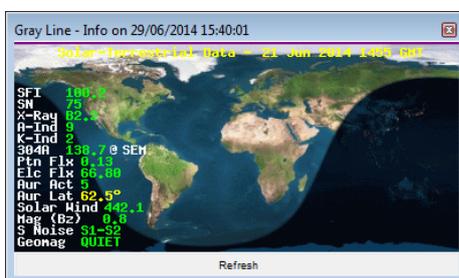
For example, from the own page of QRZ.com

Only JPG, GIF and BMP pictures.

## PROPAGATION AND GRAY LINE

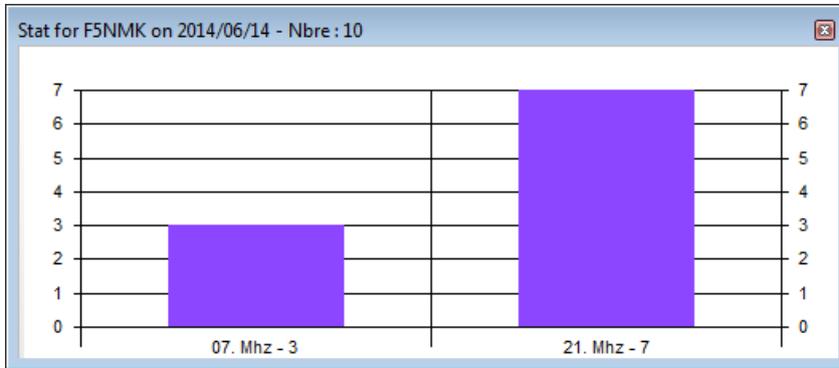


Two small tips



## GRAPHICS

 Graph



Display graph when you click on the dgrid or when you add a call in the log.

It shows stats for the day of the QSO.

Use it during pile ups or contest !

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## DXCLUSTER

 Cluster

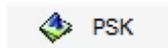


The DXCluster window has a title bar 'DXCluster' and a close button. It contains a 'Refresh' button, radio buttons for 'DxScope' (selected) and 'World DXCluster', and a status line 'List refresh at 29/06/2014 16:12:59'. Below is a list of call signs and frequencies:

40/YO6SEP/P	1341Z	14245.C
40/YO6SEP/P	1349Z	14245.C
40/YO6SEP/P	1355Z	14245.C
40/YO8SEP/P	1342Z	14245.C
40/YO8SEP/P	1345Z	14245.C
40/YO8SEP/P	1346Z	14245.C
40/YO8SEP/P	1357Z	14245.C
40/YO8SEP/P	1358Z	14245.C
4Z5AD	1316Z	18070.C
4Z5AD	1325Z	18086.S
4Z5AD	1340Z	18070.C
4Z5AD	1348Z	18070.C
4Z5AD	1408Z	18070.C
4Z5AD	1409Z	18070.C
5P2X	1410Z	18071.C
9A14P	1341Z	7021.C
9A2AJ	1310Z	14011.C

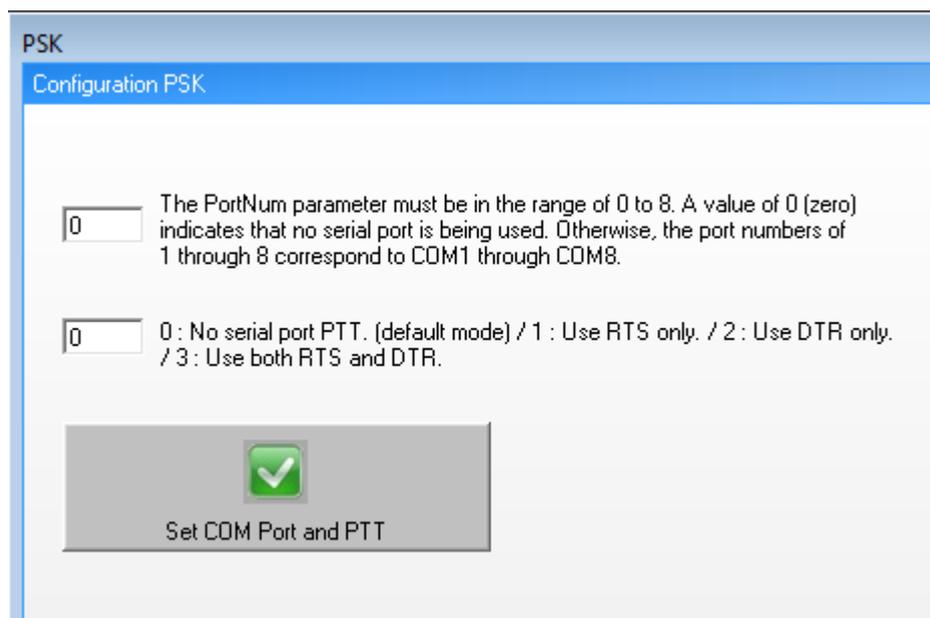
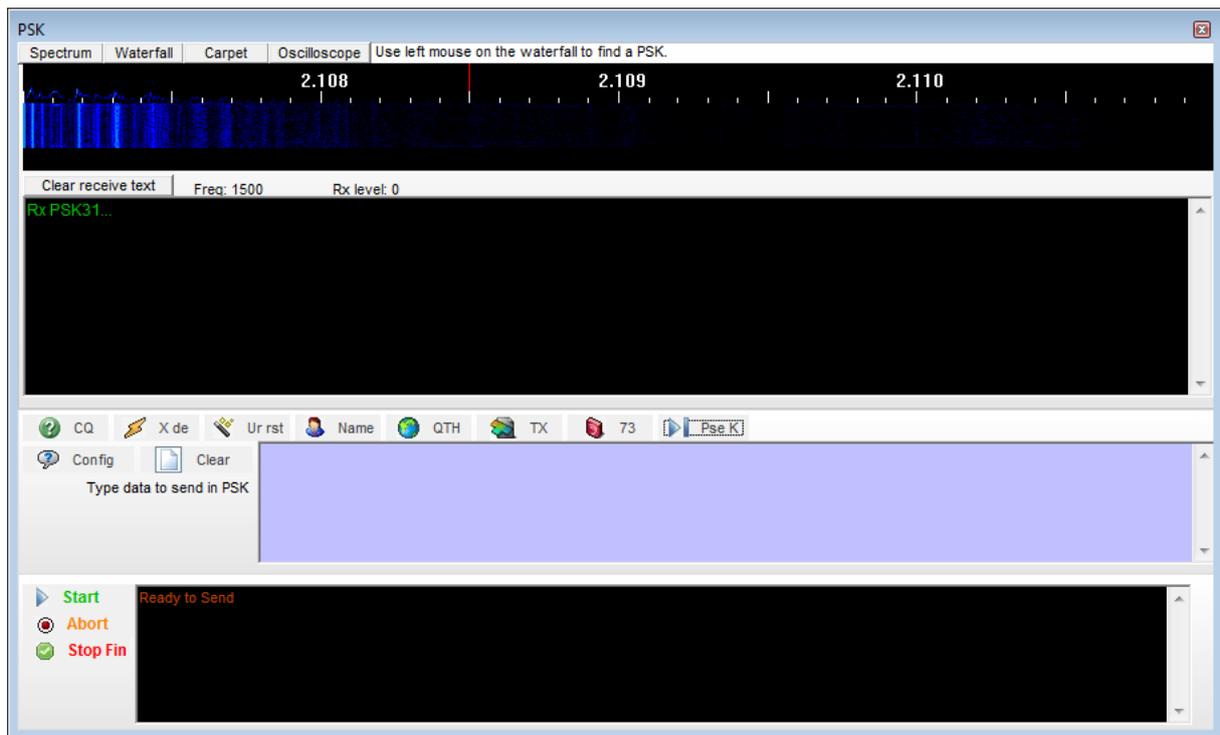
Display DX from DXscape or World DX Cluster. Refresh to get infos every 1 sec. When you click on a call all is linked: log, map, distance, QRZ.com,....)

## PSK31



Some others PSK software are great.

But here you can listen and transmit too.



Configuration :

## THE LOG



LOG - 2014/07/01 12:51:33 GMT

Date Time 2010/05/20 1812 TM0CXX

CALL **F6HOY**

QRG Mhz 7.079 40m

Mode SSB

His RST 59 My RST 59

Name Jean-Luc

QTH Cabris

IOTA DPT Fr 06

Infos

Email

TX Ant KWM/2+811+DIPLOE

Save QSO Make QSL Mode Log

Erase QSO Email

View others QSO: F6HOY in the log : 53

Your Call	Date	QTR	QRZ
▶ TM9CCAE	2010/04/03	0836	F6HOY
TM9CCAE	2010/05/01	0734	F6HOY
TM0CXX	2010/05/10	1924	F6HOY
TM0CXX	2010/05/12	1629	F6HOY
TM0CXX	2010/05/12	2040	F6HOY
TM0CXX	2010/05/15	0903	F6HOY
TM0CXX	2010/05/16	1630	F6HOY
TM0CXX	2010/05/17	2030	F6HOY
TM0CXX	2010/05/20	1812	F6HOY

You can add a new QSO or view a QSO by clicking on a line of the DATAGRID.

- Save. QSO : if you have done changes on the QSO
- Erase. QSO : Erase QSO (See also in config part to erase all the QSOs from a call)
- MakeQSL : write and send a QSL
- Email : Send an email.

View others QSO : check to see others QSO with this OM

Add QSO ?

Clock on :

Your Call	Date	QTR	QRZ
F0DIA	2007/07/21	1839	PY2KC

Define your infos of the day and..

Your Call	Date	QTR	QRZ
-----------	------	-----	-----

QUIT this mode : quit Add in the log or click on a line in the DataGrid

Time is in GMT

The small Checks box are used to keep the information for the next add in the log.

Use **ENTER** to go from one zone to another... It is easy.

If you enter a French station you can use a datalist to get the good QTH. In this case the localization on the map will be great !

Informations from last QSO with an OM are displayed (name, QTH,...)

3 modes :

QSO, PileUp and Contest with automations.

## When all is linked !...

Try this :

Open LOG, GRID, MAP XL and MAP SML, DXCLUSTER, DISTANCE, PHOTO, WEB with the small Check box.

- Click on a call in the datagrid
- Also if you click on a line in DXCLUSTER
- Also if you enter a call in the log

All is linked !!

The screenshot displays a multi-window desktop environment. The main window is 'C.C.A.E LOG F6FMT' (version 2.0.5) showing a log entry for 'F6HOY' on 2014/06/29 at 13:45:14. The log entry includes call sign, date, time, mode (SSB), and name (Jean-Luc). A map window shows the location of F6HOY in France, with coordinates 43.5323, 3.86084 and a distance of 597.535 kms. A browser window shows the QRZ.COM website for F6HOY, displaying a profile picture and a bio: 'I like to use my Elecraft K2 transceiver with the Pal...'. A DXCluster window shows a list of stations and a compass. A clock window shows the time as 11:12.

Your CALL	DATE	GRID	MODE	HS	RT	DT	NAME	QTH	
FFRMT	2014/06/23	1725	F6HOY	14	SSB	53	52	JOA'L	ATTONAT 01
FFRMT	2012/10/19	1556	F6HOY	14	SSB	59	59	jean-luc	VILLENEUVE LE 34
FFRMT	1970/09/07	1907	EASEJ	28	SSB	59	59	Justo	Ro de Oro

Call	Grid	Dist
4353D	1317E	3307.0
425AD	1226Z	1808.6
453AD	1240Q	1807.0
5B4CZ/B	1250Q	50019.0
5P7XZ	1300Q	14189.0
9A/9517A	1328E	14603.9
9A3A7	1310Q	14911.0
9A30E	1330Q	144292.0
9A30S	1317E	144292.0
9A470E	1317E	144292.0
9A792E	1328E	146291.0

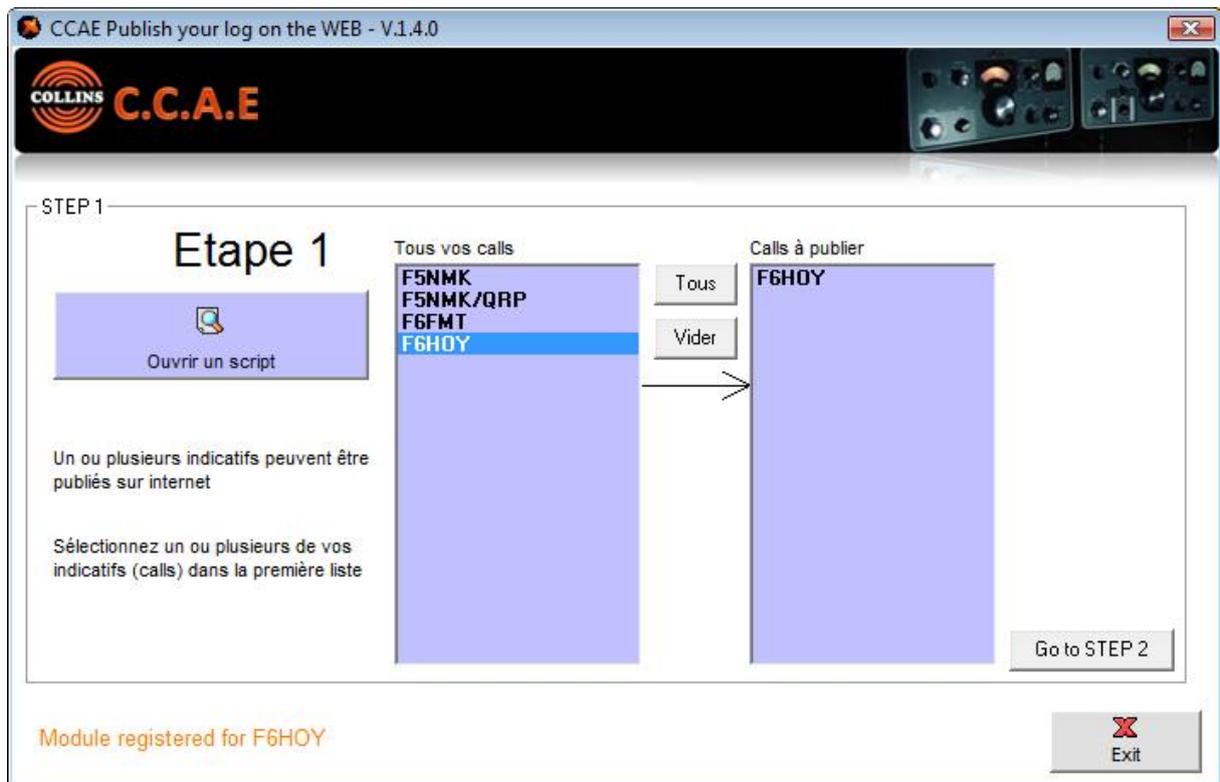
## PUBLISH on THE NET



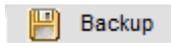
This function use CCAE\_WEB module.

Even if you do not register this module you can publish on the web your last 5 QSO and all the statistics.

(see CCAE\_WEB documentation available in the soft)



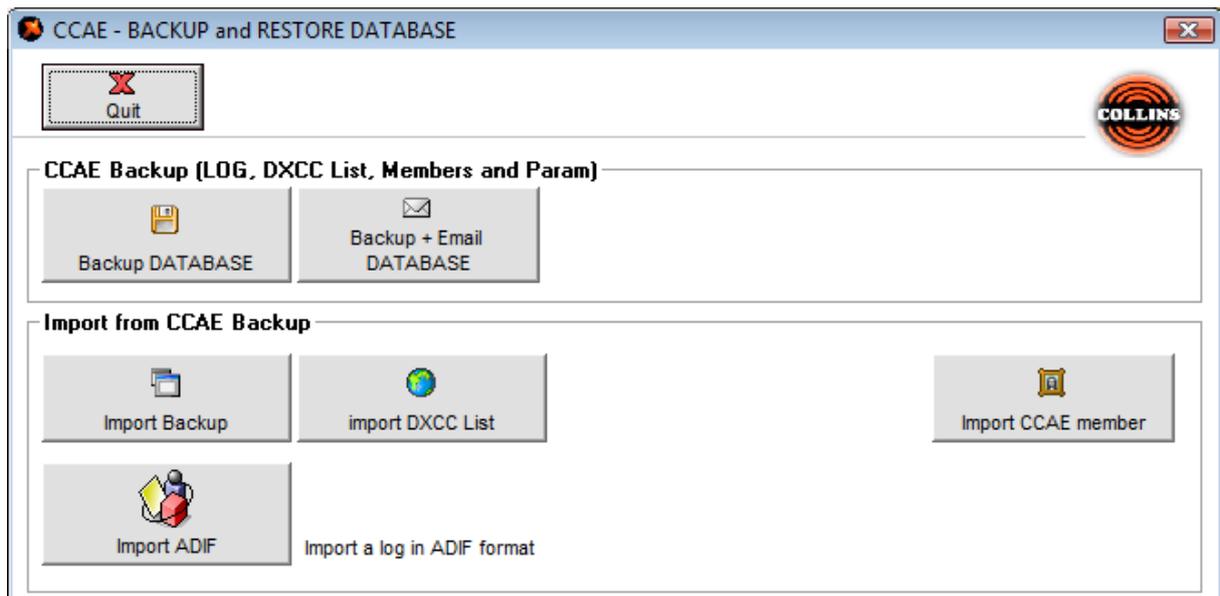
## SAVE LOG – IMPORT ADIF



Do not forget to backup your log.

- Somewhere on a hard disk
- Somewhere by email

Backup are done in CSV and ADIF files.



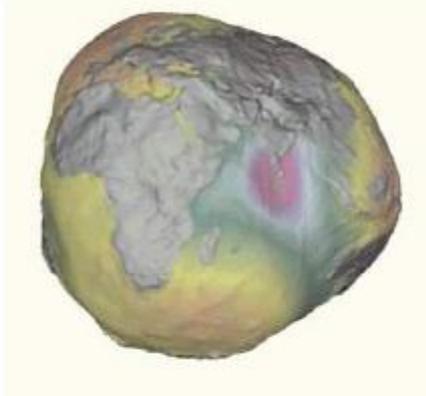


# Calcul Distance et Azimut

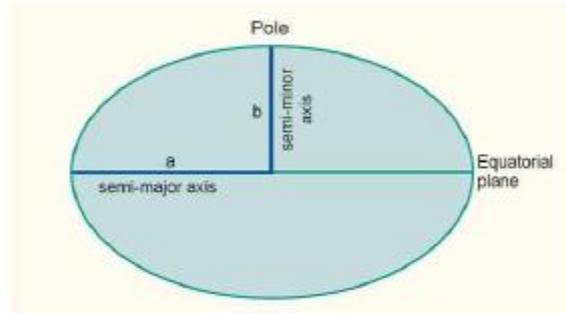
F1LAG

v1.0 – 29 Avril 2014

Le calcul de distance et d'azimut entre deux points du globe dépend évidemment de la taille et de la forme choisie pour représenter la Terre. Celle-ci n'est pas parfaitement sphérique mais plutôt d'allure patatoïde. Dans tous les calculs de cartographie, cette forme est approximée par un ellipsoïde.



The Geoid, exaggerated to illustrate the complexity of its surface.



Plusieurs ellipsoïdes ont été définis. Le plus récent et maintenant généralement utilisé est le WGS84 (quasi identique au GRS80 dans le tableau ci-dessous).

## MAP PROJECTIONS—A WORKING MANUAL

TABLE 1.—Some official ellipsoids in use throughout the world<sup>a</sup>

Name	Date	Equatorial Radius, a meters	Polar Radius b, meters	Flattening f	Use
GRS 80 <sup>b</sup>	1980	6,378,137*	6,356,752.3	1/298.257	Newly adopted
WGS 72 <sup>c</sup>	1972	6,378,135*	6,356,750.5	1/298.26	NASA; Dept. of Defense; oil companies
Australian	1965	6,378,160*	6,356,774.7	1/298.25*	Australia
Krasovsky	1940	6,378,245*	6,356,803.0	1/298.3*	Soviet Union
Internat <sup>d</sup>	1924	6,378,388*	6,356,911.9	1/297*	Remainder of the world <sup>e</sup>
Hayford	1909				
Clarke <sup>f</sup>	1880	6,378,249.1	6,356,514.9	1/293.46**	Most of Africa; France
Clarke	1866	6,378,206.4*	6,356,583.8*	1/294.98	North America; Philippines
Airy <sup>g</sup>	1830	6,377,563.4	6,356,256.9	1/299.32**	Great Britain
Bessel	1841	6,377,397.2	6,356,079.0	1/299.15**	Central Europe; Chile; Indonesia
Everest <sup>h</sup>	1830	6,377,276.3	6,356,076.4	1/300.80**	India; Burma; Pakistan; Afghan.; Thailand, etc.

Si l'on ne cherche pas une très grande précision, on peut se contenter de considérer la Terre comme une sphère. Les calculs sont alors très significativement simplifiés.

## Modèle sphérique

Tous les angles (latitude, longitude) seront d'abord convertis en radians :  $X_{rad} = X_{deg} \cdot \pi / 180$

### Notations :

$Lat_{LOC}$ ,  $Lon_{LOC}$  latitude et longitude de la station locale (en radians)

$Lat_{DX}$ , $Lon_{DX}$	latitude et longitude de la station DX (en radians)
$R$	rayon de la sphère terrestre
$D$	distance entre les deux stations
$A$	azimut – de la station locale vers la station DX (en radians)

Il faut choisir une valeur pour le rayon terrestre.

Par exemple le rayon moyen de l'ellipsoïde WGS84 :  $R = 6371.009 \text{ km}$

Les calculs :

Calculer l'écart de longitudes et divers cosinus et sinus :

$$\Delta = Lon_{DX} - Lon_{LOC} \quad ; \quad CD = \cos(\Delta) \quad ; \quad SD = \sin(\Delta)$$

$$CLAT_{LOC} = \cos(Lat_{LOC}) \quad ; \quad SLAT_{LOC} = \sin(Lat_{LOC}) \quad ; \quad CLAT_{DX} = \cos(Lat_{DX}) \quad ; \quad SLAT_{DX} = \sin(Lat_{DX})$$

En théorie il faut commencer par calculer l'écart angulaire (en radians) :

$$E = \arccos(CLAT_{LOC} \cdot CLAT_{DX} \cdot CD + SLAT_{LOC} \cdot SLAT_{DX})$$

Cette formule est mathématiquement exacte mais une fois programmée, les erreurs d'arrondis peuvent conduire à des résultats erronés. Donc, en pratique, il vaut mieux utiliser l'équivalent suivant :

$$E = \arctan\left(\frac{\sqrt{(CLAT_{DX} \cdot SD)^2 + (CLAT_{LOC} \cdot SLAT_{DX} - SLAT_{LOC} \cdot CLAT_{DX} \cdot CD)^2}}{SLAT_{LOC} \cdot SLAT_{DX} + CLAT_{LOC} \cdot CLAT_{DX} \cdot CD}\right)$$

Afin de gérer les différents quadrants, utiliser la fonction atan2 au lieu de atan (ou arctan) :  $\text{atan2}(y,x) = \arctan\left(\frac{y}{x}\right)$

Attention à bien choisir l'ordre des paramètres car pour Excel on a :  $\text{atan2}(y,x) = \arctan\left(\frac{x}{y}\right)$

Finalement calculer la distance et l'azimut de la station locale vers la station DX (en radians) :

$$D = R \cdot E$$

$$A = \arccos\left(\frac{SLAT_{DX} - SLAT_{LOC} \cdot \cos(E)}{CLAT_{LOC} \cdot \sin(E)}\right)$$

Pour finir, on peut bien sûr convertir en degrés :  $A_{deg} = 180 \cdot A / \pi$

Note :

Pour la valeur de la distance il est inutile de donner le résultat avec trop de décimales puisque la sphère n'est qu'une approximation de la Terre. Avec ce calcul et le rayon proposé, l'erreur maximale est de l'ordre de 0.5%. Donc, afficher les résultats avec une précision au km près devrait suffire, sauf éventuellement pour les petites distances où les 100m près doivent convenir. Idem pour l'azimut où le degré ou bien les 0.5 degrés près suffisent.