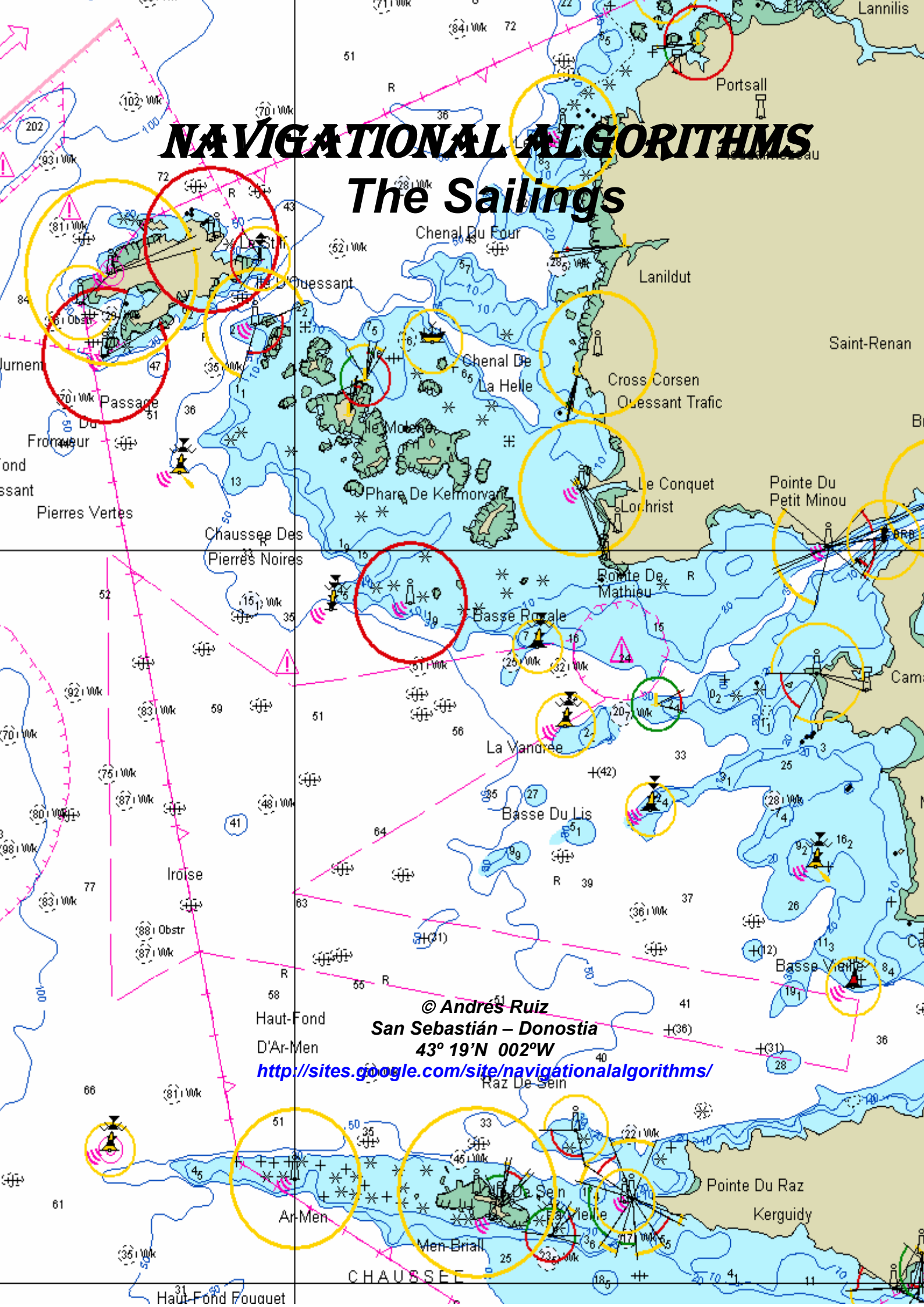
NAVIGATIONAL ALGORITHMS
The Sailings
Portsall
Chenal Du Four
Lanildut
Ouessant
Chenal De
La Helle
Cross Corsen
Ouessant Trafic
Saint-Renan
Passage
Du
Fromveur
Pierres Vertes
Chaussee Des
Pierres Noires
Phare De Kermorvan
Le Conquet
Lochrist
Pointe Du
Petit Minou
Pointe De
Mathieu
Basse Royale
La Vandree
Basse Du Lis
Iroise
Haut-Fond
D'Ar-Men
Raz De Sein
Pointe Du Raz
Kerguidy
Ar-Men
Men-Briall
CHAUSSEE
Haut-Fond Fouquet
© Andrés Ruiz
San Sebastián – Donostia
43º 19'N 002ºW
http://sites.google.com/site/navigationalalgorithms/

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Abstract

Dead reckoning involves the determination of one's present or future position by projecting the ship's course and distance run from a known position. A closely related problem is that of finding the course and distance from one known point to another. For short distances, these problems are easily solved directly on charts, but for trans-oceanic distances, a purely mathematical solution is often a better method. Collectively, these methods are called The Sailings (*Bowditch*).

This article does not intend to give an explanation of what the sailings are, but to be a compendium of the various existing mathematical methods, emphasizing the consistency of the models and their accuracy, and the precision of the calculations.

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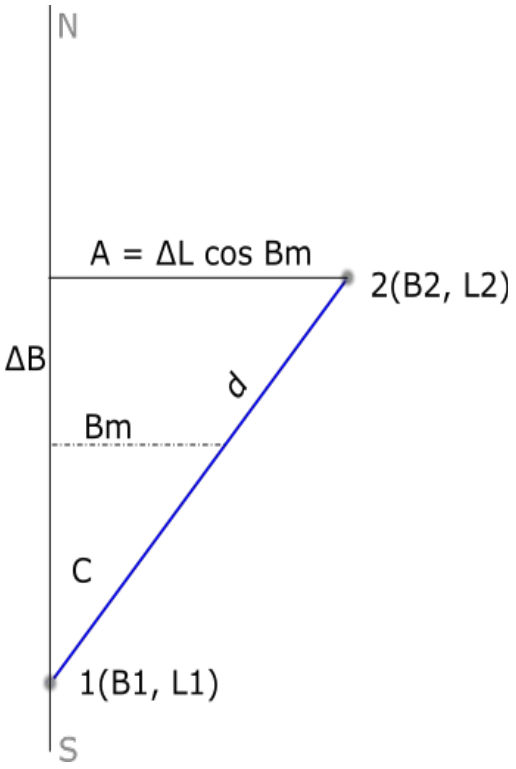
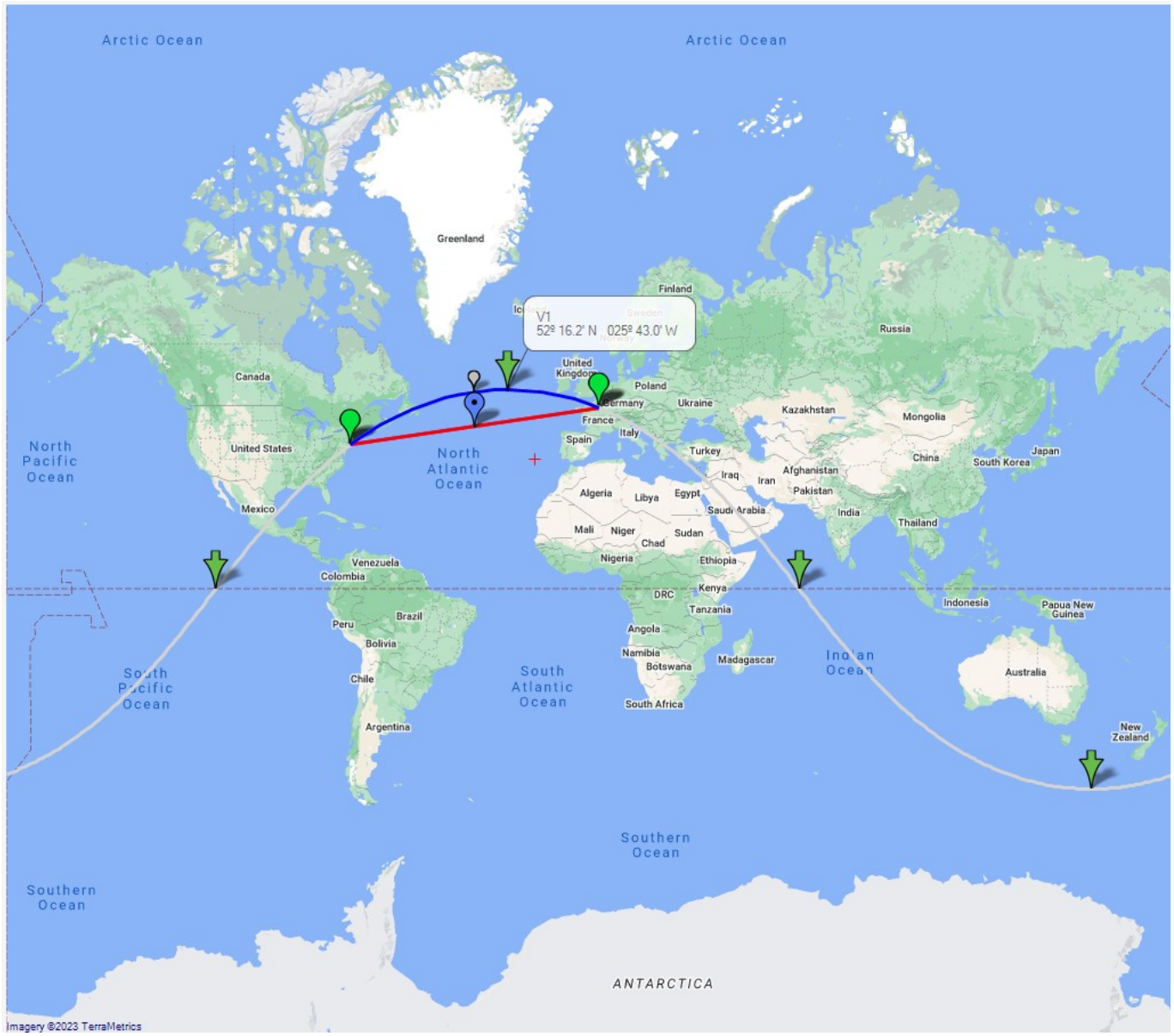
Chart approach

Middle-Latitude Sailing

A method that combines plane sailing and parallel sailing. Plane sailing is used to find difference of latitude and departure when course and distance are known, or vice versa. Parallel sailing is used to inter-convert departure and difference of longitude. The mean latitude is normally used for want of a practicable means of determining the middle latitude, the latitude at which the arc length of the parallel separating the meridians passing through two specific points is exactly equal to the departure in proceeding from one point to the other (*Bowditch*).

Difference in latitude and departure	Equations
 A: Departure Bm: Middle latitude	$\Delta L = \frac{A}{\cos B_m}$ $B_m = \frac{B_1 + B_2}{2}$ *From the triangle it follows that:* $\Delta B = d \cos C$ $A = d \sin C$ hence $\tan C = \frac{A}{\Delta B}$ $d = \sqrt{\Delta B^2 + A^2}$ Constraints: • $B_m < 60°$ • d < 200 nm *(d < 375 nm Vultaggio)* • $\Delta B < 5°$



GC: nodes and vertices (green arrows).

Great Ellipse Sailing

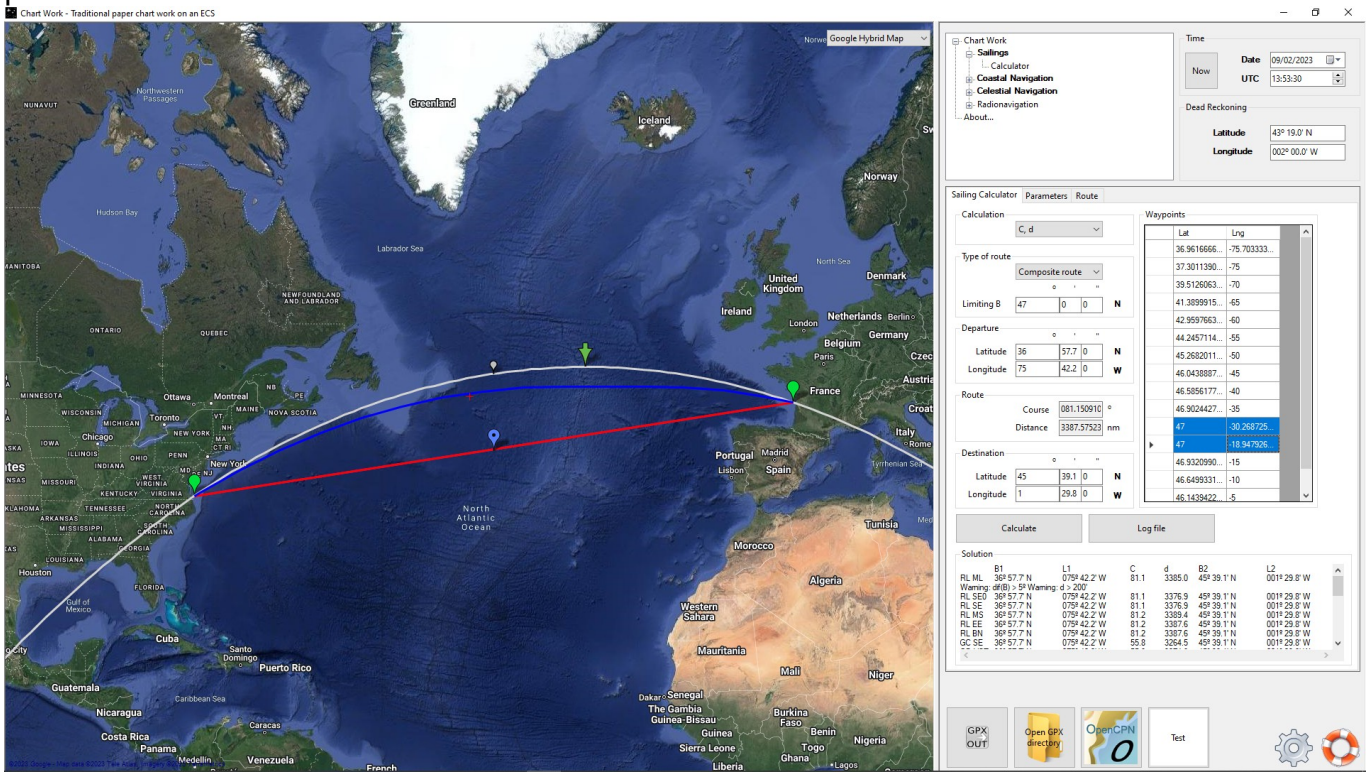
Composite sailing

Composite sailing is a modification of great-circle sailing to limit the maximum latitude, generally to avoid ice or severe weather near the poles.

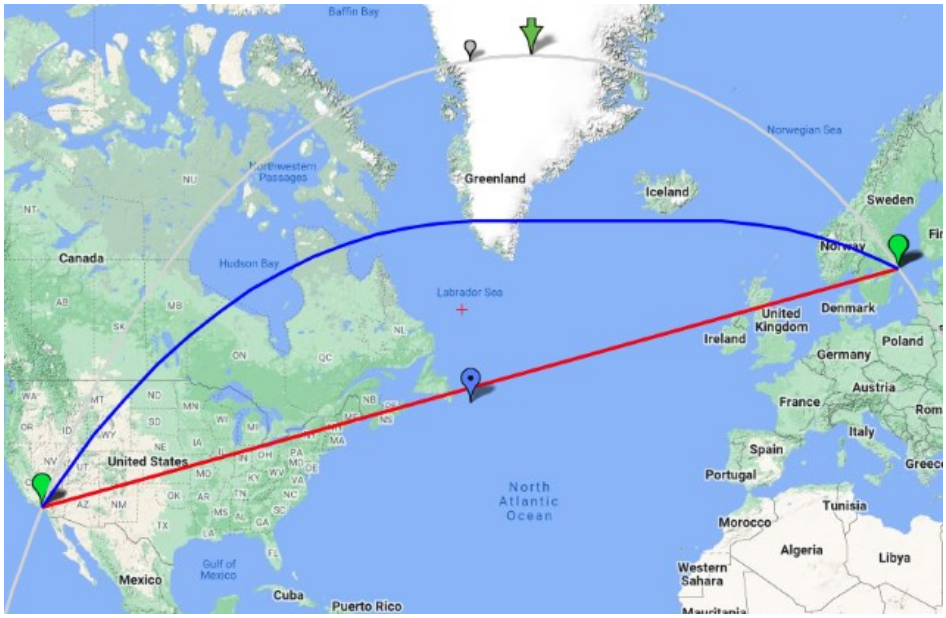
If Bv is the latitude of the limiting parallel, the longitude of the GC at that Bv is:

$$\cos L_{vx} = \frac{\tan(B_x)}{\tan(B_v)} \text{ for x = 1,2}$$

The point of departure and the destination are used successively as point X. Solve the two great circles at each end of the limiting parallel, and use parallel sailing along the limiting parallel.

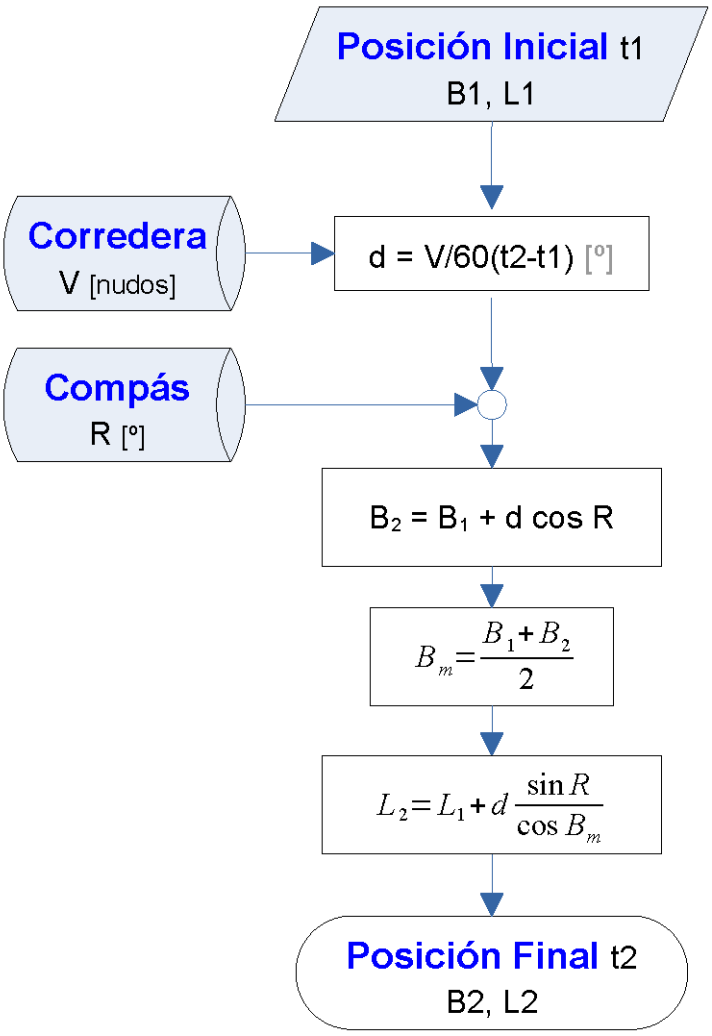


Bowditch 2019 - 1213. Composite Sailing Example 1:

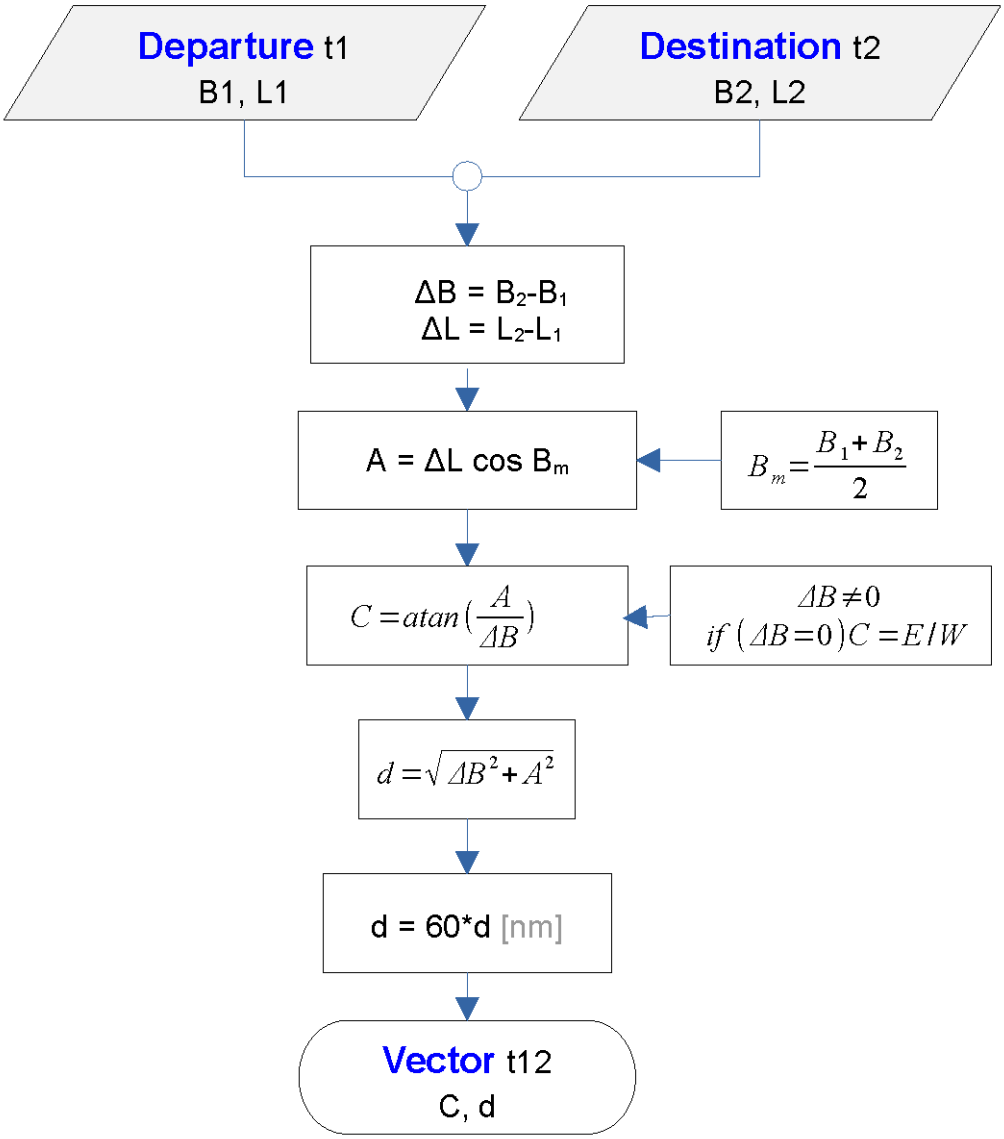


Rhumb line (red), GC (grey) and composite sailing (blue).

Middle-Latitude Sailing



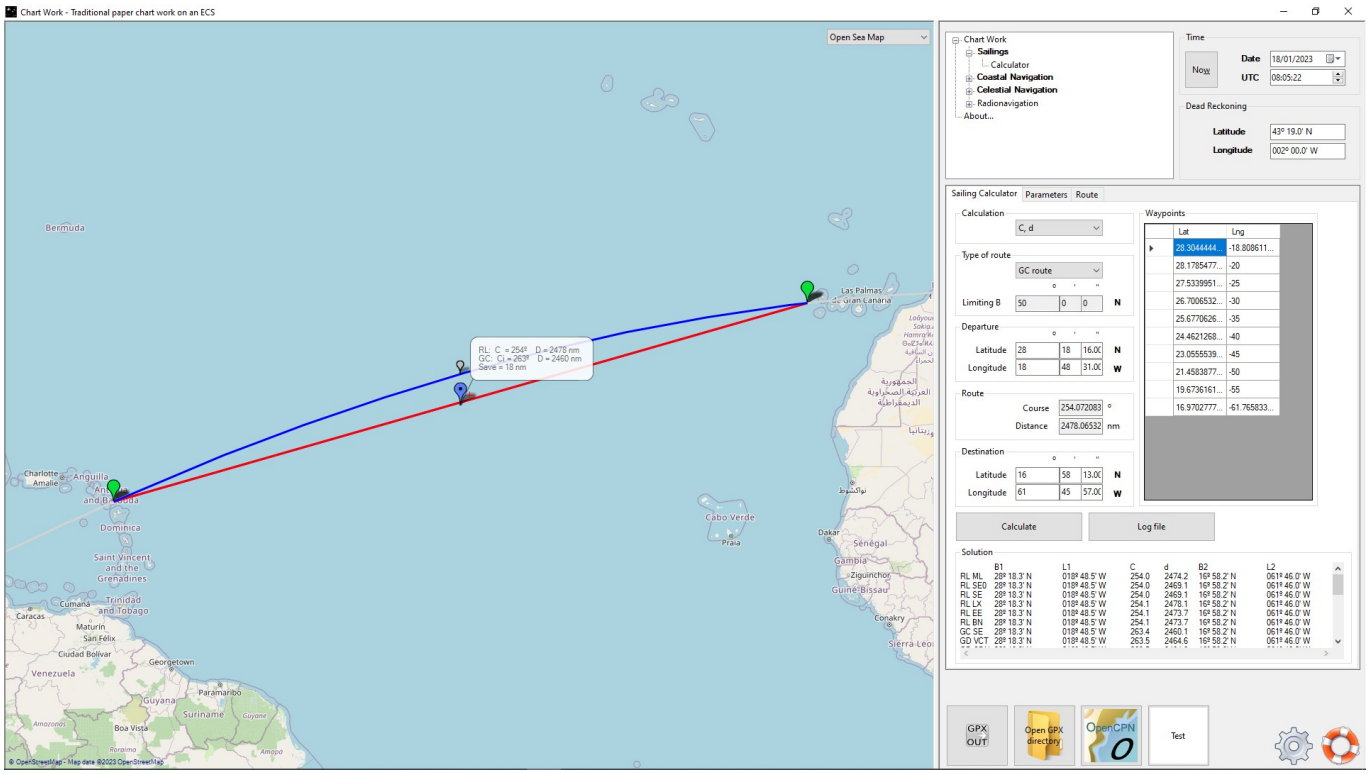
Middle-Latitude Sailing



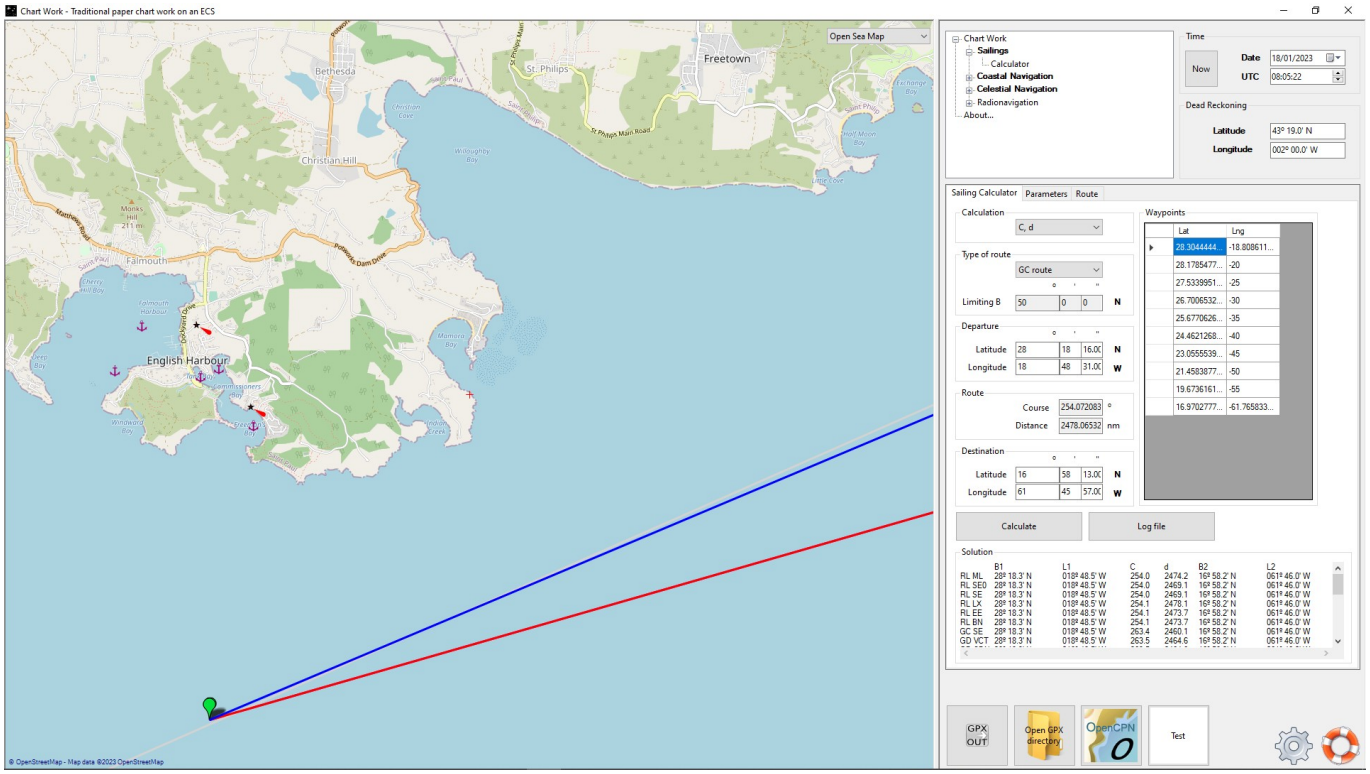
A3. Software

Chart Work / Sailings

Available at the author's web site.



Route



Destination