Hello George,

Some coments to Your article,

I am completely agree to Your claims. And the result of other methods confirms that:, and that are good ones for advancing a COP…

Data

		R = 90-HO	GP = centre	
COP	**Body**	**Ho**	**GHA**	**Dec**
1	Body1	30	0	0
2	Body2	45	45W	1N

From point P1 to P2:
R = 0º
D = 60 nm

Zevering two solutions correcting the GP1(t1) to GP1(t2)

RhumblineFormulas: GP(t2) = 0.000000, 1.000000
CosineFormula: GP(t2) = 0.000000, 1.000000

Using Van Allen Two body fix:
P1(-43.9986, -44.6000)
P2(45.9984, -45.4290)
Lat: +N/-S
Lon: -W/+E

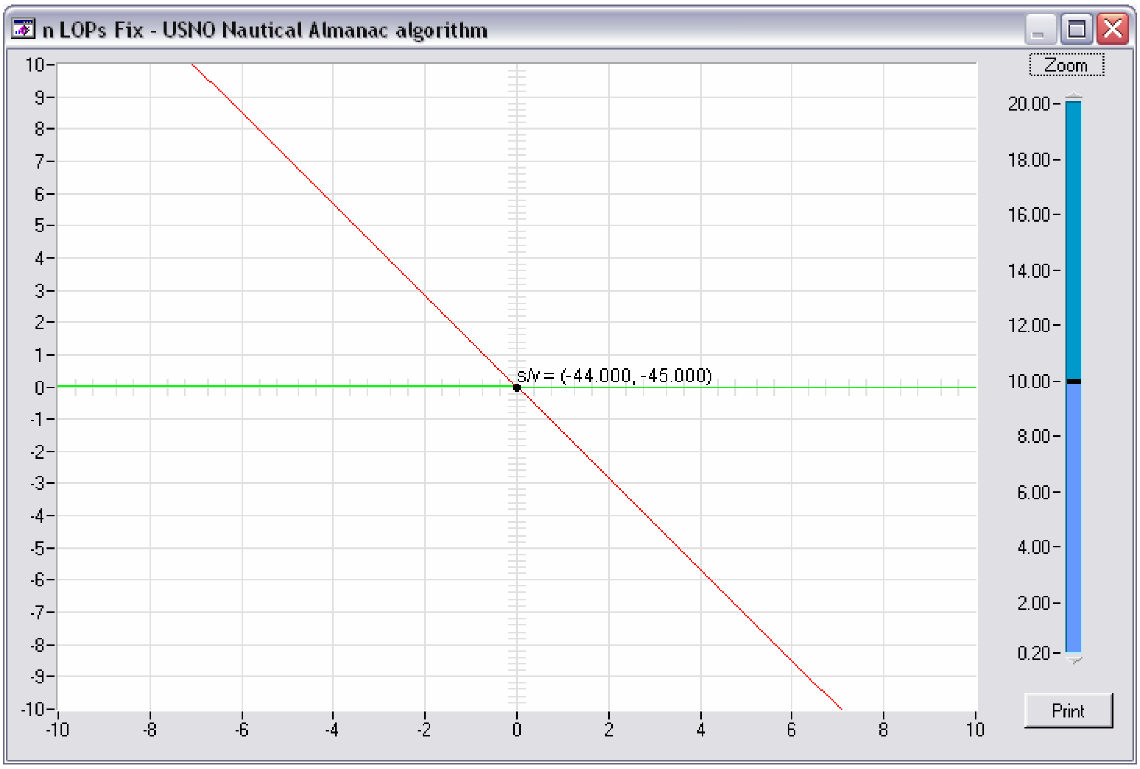
Bad output

DeWit/USNO/Compac Data, least squares algorithm for n LOPs

After four iterations: Good output

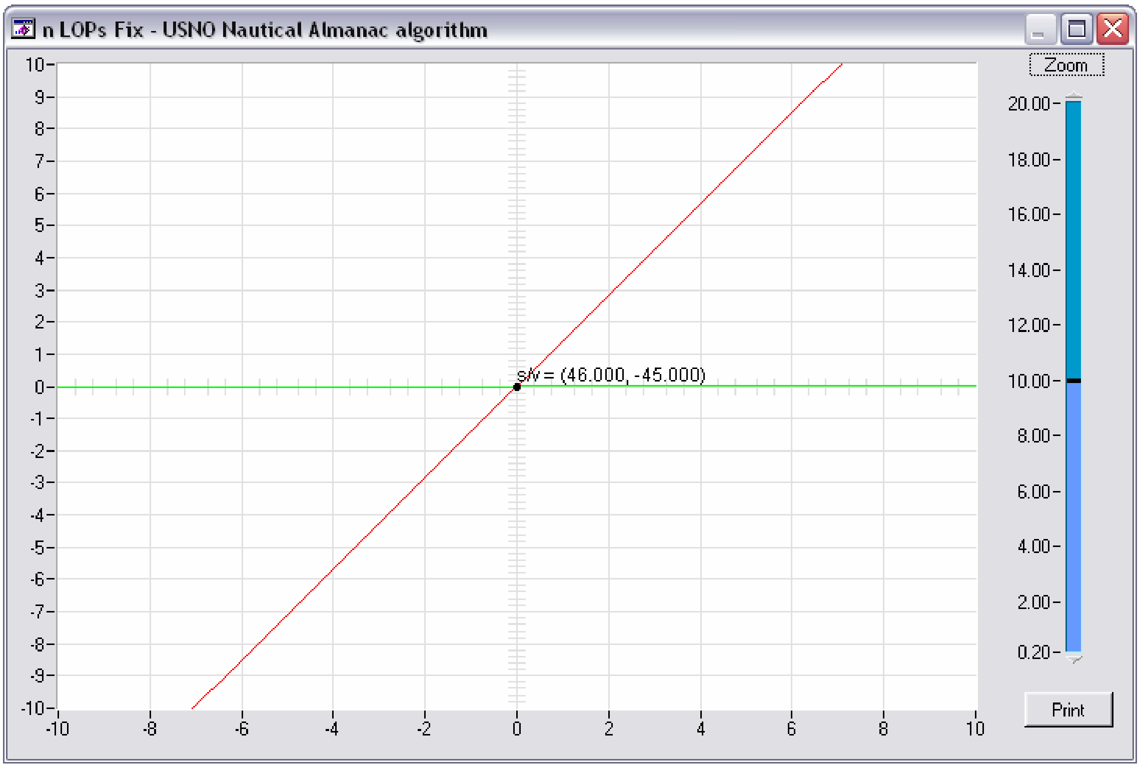
P1

BO	**LO**	**LHA**	**HC**	**Z**	**p**
-46	-44	316	29.9799	53.3176	0.0201
-45	-44	0.9999	43.9914	358.6103	1.0086
Iter	**error**	**Lat**	**Lon**		
1	73.294889	-44.008438	-45.009024		
-45.0084	-45.009	314.991	29.9899	54.7401	0.0101
-44.0084	-45.009	359.9909	44.9916	0.0129	0.0084
2	0.634706	-44.000001	-45.000152		
-45	-45.0002	314.9998	29.9999	54.7358	0.0001
-44	-45.0002	359.9997	45	0.0004	0
3	0.006447	-44	-45.000003		
-45	-45	315	30	54.7356	0
-44	-45	359.9999	45	0.0001	0
4	0.00011	-44	-45		



P2

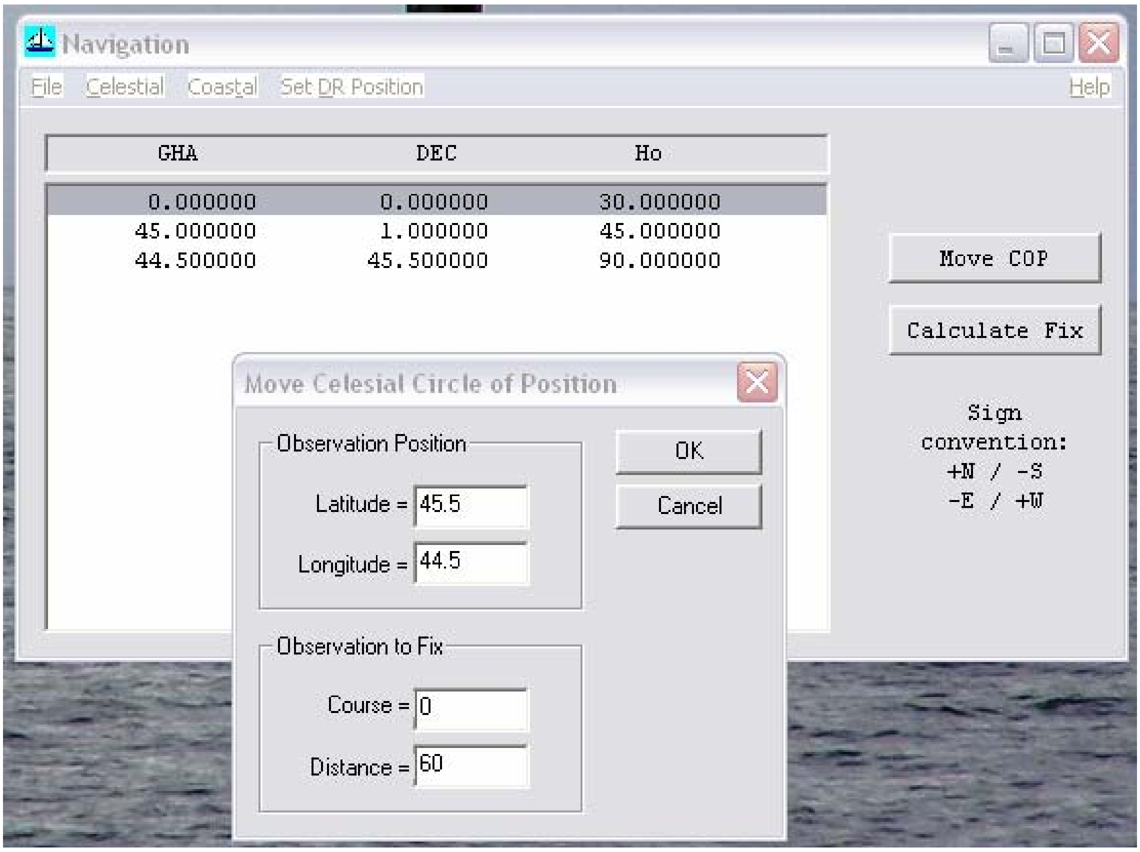
BO	LO	LHA	HC	Z	p
44	-44	316	31.1613	125.729	-1.1613
45	-44	0.9999	45.9911	181.439	-0.9911
Iter	**error**	**Lat**	**Lon**		
1	73.84961	46.00914	-44.99657		
45.0091	-44.9966	315.0034	29.9967	125.2719	0.0033
46.0091	-44.9966	0.0033	44.9909	180.0047	0.0091
2	0.567134	46	-45.00006		
45	-45.0001	314.9999	30	125.2643	0
46	-45.0001	359.9998	45	179.9998	0
3	0.002657	46	-45		
45	-45	315	30	125.2644	0
46	-45	359.9999	45	179.9999	0
4	0.000048	46	-45		



Metcalf - Least squares algorithm for n COPs

OutPut: OK

P1



GHA	DEC	Ho
0.000000	0.000000	30.000000
45.000000	1.000000	45.000000
44.500000	45.500000	90.000000

Sign convention: +N / -S -E / +W

Observation Position

Latitude = 45.5

Longitude = 44.5

Observation to Fix

Course = 0

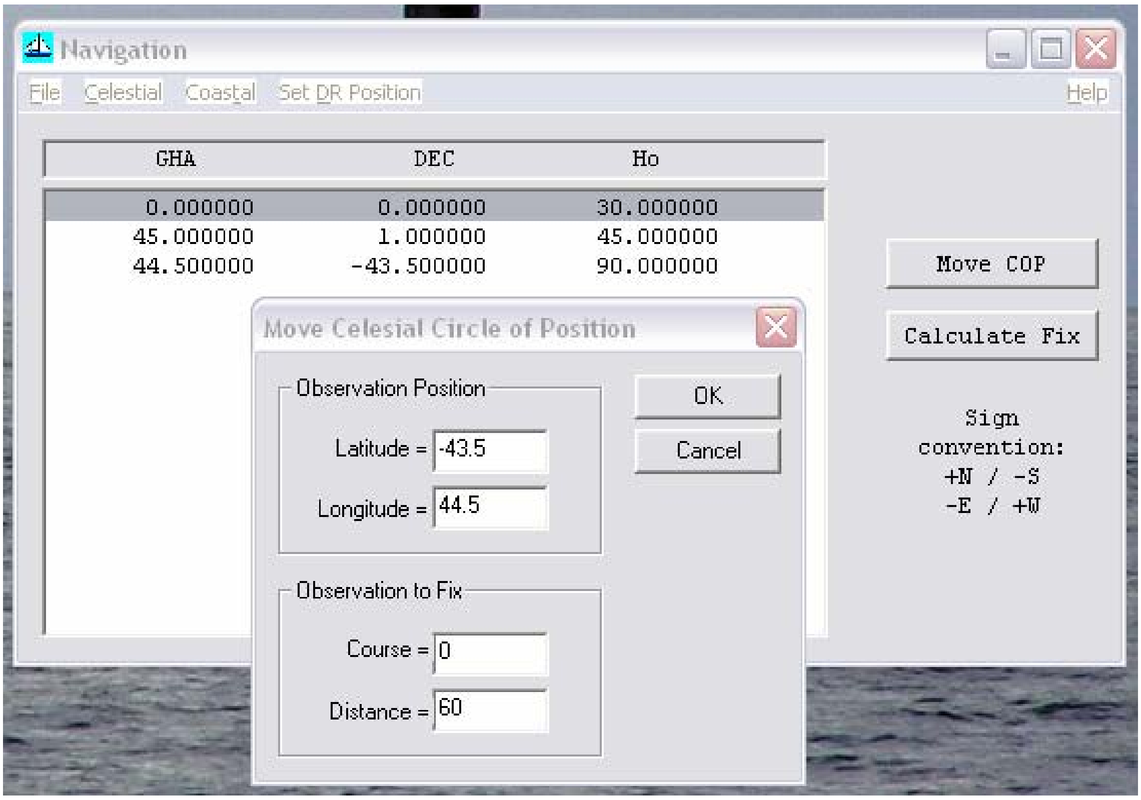
Distance = 60

```
  GHA     DEC     ALT   ITER   LAT      LONG
==============================================

359.9956   0.7132  30.0000
 45.0000   1.0000  45.0000
 44.5000  45.5000  90.0000   2  46.0000   45.0089
```

Position: Latitude = 46.0000, Longitude =   45.0089

P2



GHA	DEC	Ho
0.000000	0.000000	30.000000
45.000000	1.000000	45.000000
44.500000	-43.500000	90.000000

Observation Position

Latitude = -43.5

Longitude = 44.5

Observation to Fix

Course = 0

Distance = 60

Sign
convention:
+N / -S
-E / +W

```
   GHA      DEC      ALT   ITER   LAT      LONG
==================================================

359.9956   0.7132  30.0000
 45.0000   1.0000  45.0000
 44.5000 -43.5000  90.0000   2 -44.0000   44.9915

Position: Latitude = -44.0000, Longitude =   44.9915
```

Note that Zevering do the GP as a function of R, d

GHA(t2) = f(GHA(t1), Dec(t1), R, d)
Dec(t2) = f(GHA(t1), Dec(t1), R, d)

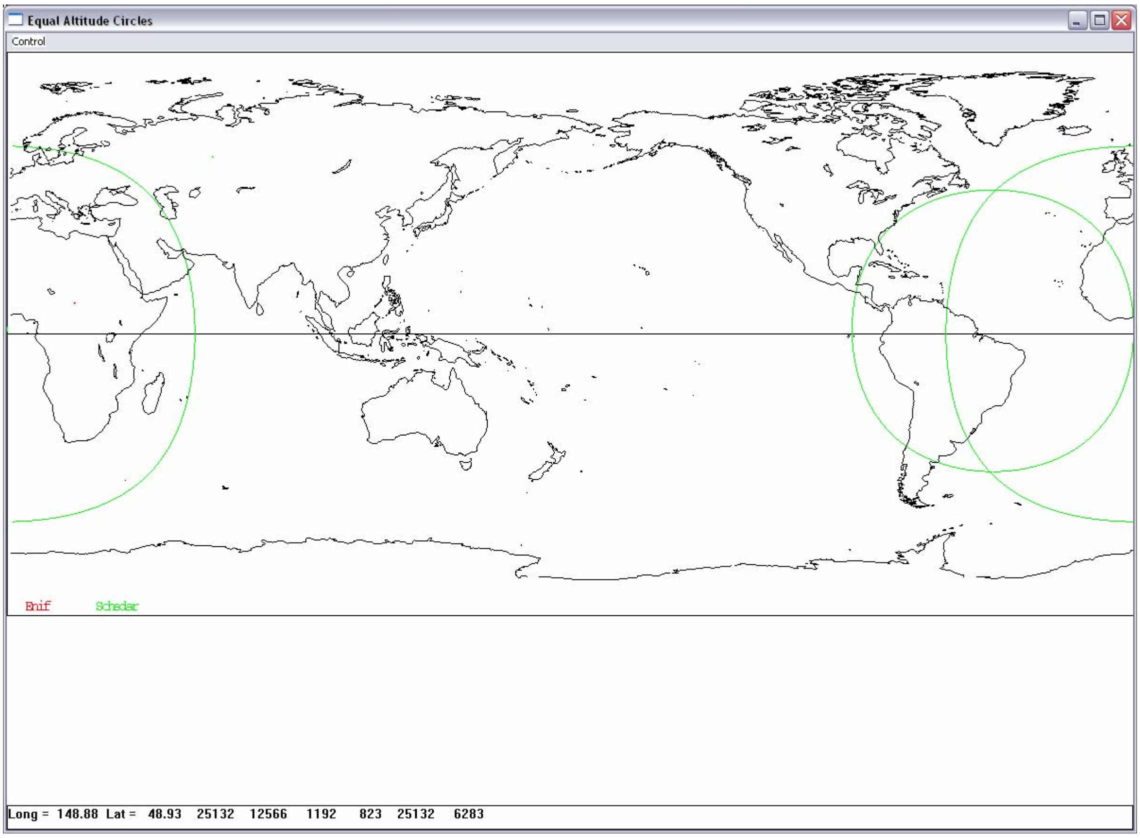
And Metcalf also include the estimated position (Be, Le):

GHA(t2) = f(GHA(t1), Dec(t1), R, d, Be, Le)
Dec(t2) = f(GHA(t1), Dec(t1), R, d, Le)

I have attached the points of the circumferences of equal altitude in a excel file, (really they aren't a circle). I also check if the fundamental equation is true for each point of the COP: $\sin \mathrm{Hc} = \sin \mathrm{Be} \sin \mathrm{Dec} + \cos \mathrm{Be} \cos \mathrm{Dec} \cos \mathrm{LHA}$

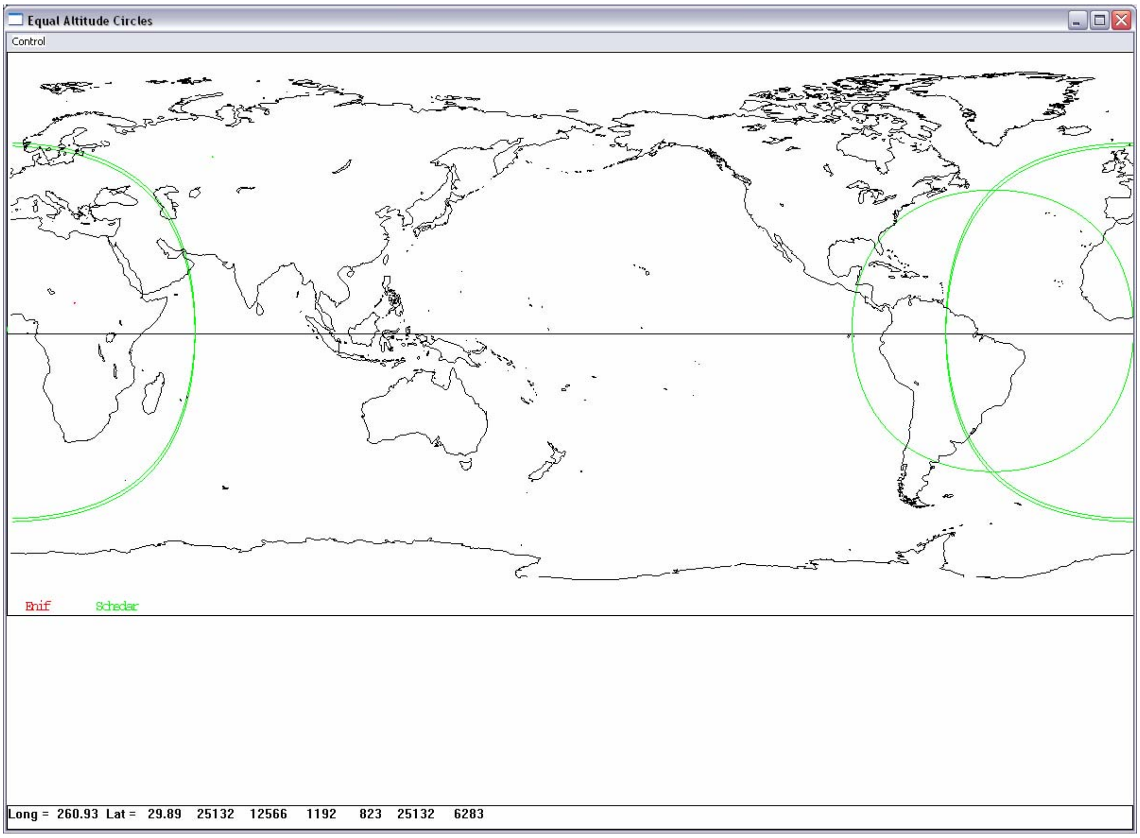
If You move the COP1(t1) to the time t2, COP1 (t2), by move all his points using the DR, you have the real shape of the new COP2.

The Metcalf and the LS for n LOPs algorithms take into account this fact.



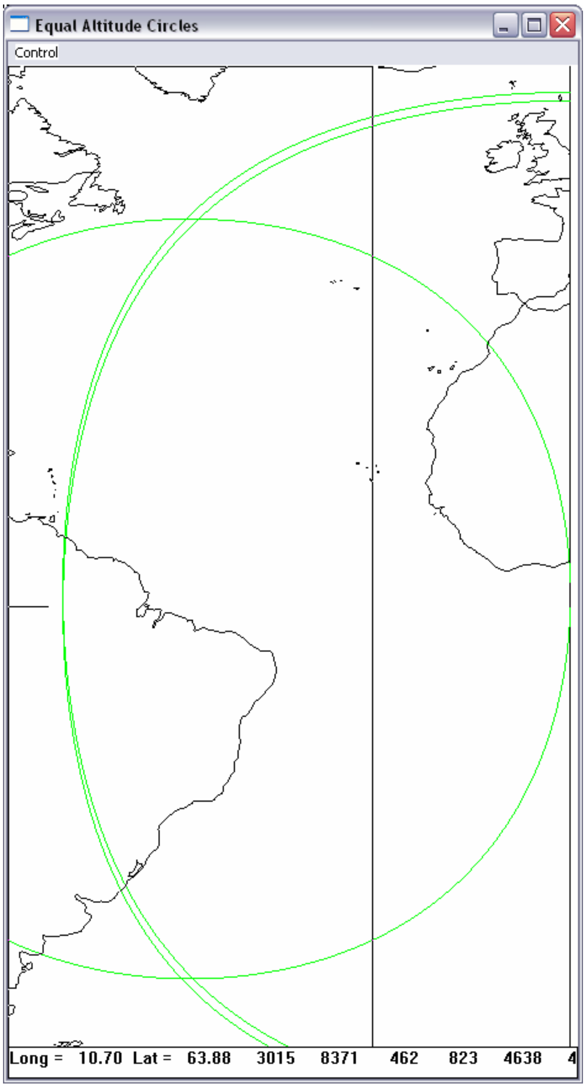
```
Long =  148.88  Lat =   48.93   25132   12566    1192     823   25132    6283
```

COP before advancing



```
Long =  260.93  Lat =   29.89   25132   12566    1192     823   25132    6283
```

COP after advancing by Zevering



```
Long =  10.70  Lat =  63.88   3015   8371   462   823   4638   4
```

zoom

Note: I have done this modifying the program Sights.exe, developed by Mike Dorl, a member of our Navigation list. It calculates the two simultaneous COP intersections and plot the COP.

Andrés
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