Lisboa TR and the new SOL boat

As promised, I and Jan prepared a:

- New Timed Race to be sailed with a,
- New SOL boat.

The boat is the AC72.

Picture credit: Gilles Martin-Paget

First phase

We gather the basic data for making this AC72 SOL boat Polar Data from the *AC Official Race Noticeboard* in the section dedicated to the *AC72 Penalty Polars*, in is *version #6* (for more explanations see http://noticeboard.americascup.com/ac13/).

	v1	*a1*	*v2*	*a2*	*v3*	*a3*	*v4*	*a4*	*v5*	*a5*
5	*13*	*45*	*22*	*85*	*22*	*115*	*15*	*140*	*7.5*	*180*
12	*19*	*45*	*31*	*85*	*37*	*115*	*30*	*147*	*15*	*180*
16	*21*	*45*	*37*	*85*	*47*	*120*	*37*	*150*	*18.5*	*180*
20	*23*	*45*	*40*	*85*	*49*	*120*	*41*	*152*	*20.5*	*180*
26	*24*	*46*	*41*	*85*	*51*	*125*	*44*	*154*	*22*	*180*

The values shown in the table were the ones used by the *AC Umpire* for *penalty assessment* on the AC72 boats.

The Notes on the *AC72 Polar Files* states, namely:

"*This information is used to determine the speed at which the penalty line advances when a boat is assigned a Velocity-Made-Good (VMG) penalty, where a boat must drop back a certain distance along its own course. This is in contrast to a Boat-on-Boat (BOB) penalty, where the penalized yacht must drop back to a certain distance behind another boat.*", end of quotation, (see also: http://noticeboard.americascup.com/wp-content/uploads/actv/LV13/PolarNotes.txt).

With the basic data values of (TWA; TWS; BS) we built an Excel file where, for the remaining pair of values of (TWA; TWS), the respective BS's were obtained by means of successive linear interpolations.

BS	TWA							
TWS	0	1	2	3	4	5	6	7
0	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
5	0,00	0,29	0,58	0,87	1,16	1,44	1,73	2,02
6	0,00	0,31	0,62	0,92	1,23	1,54	1,85	2,16
7	0,00	0,33	0,65	0,98	1,31	1,63	1,96	2,29
8	0,00	0,35	0,69	1,04	1,38	1,73	2,08	2,42
9	0,00	0,37	0,73	1,10	1,46	1,83	2,19	2,56
10	0,00	0,38	0,77	1,15	1,54	1,92	2,30	2,69
11	0,00	0,40	0,81	1,21	1,61	2,02	2,42	2,82
12	0,00	0,42	0,84	1,27	1,69	2,11	2,53	2,96
13	0,00	0,43	0,87	1,30	1,73	2,17	2,60	3,03
14	0,00	0,44	0,89	1,33	1,78	2,22	2,67	3,11
15	0,00	0,46	0,91	1,37	1,82	2,28	2,73	3,19
16	0,00	0,47	0,93	1,40	1,87	2,33	2,80	3,27
17	0,00	0,48	0,96	1,43	1,91	2,39	2,87	3,34
18	0,00	0,49	0,98	1,47	1,96	2,44	2,93	3,42
19	0,00	0,50	1,00	1,50	2,00	2,50	3,00	3,50
20	0,00	0,51	1,02	1,53	2,04	2,56	3,07	3,58
21	0,00	0,51	1,03	1,54	2,06	2,57	3,09	3,60
22	0,00	0,52	1,04	1,56	2,07	2,59	3,11	3,63
23	0,00	0,52	1,04	1,57	2,09	2,61	3,13	3,66
24	0,00	0,53	1,05	1,58	2,10	2,63	3,16	3,68
25	0,00	0,53	1,06	1,59	2,12	2,65	3,18	3,71
26	0,00	0,53	1,07	1,60	2,13	2,67	3,20	3,73

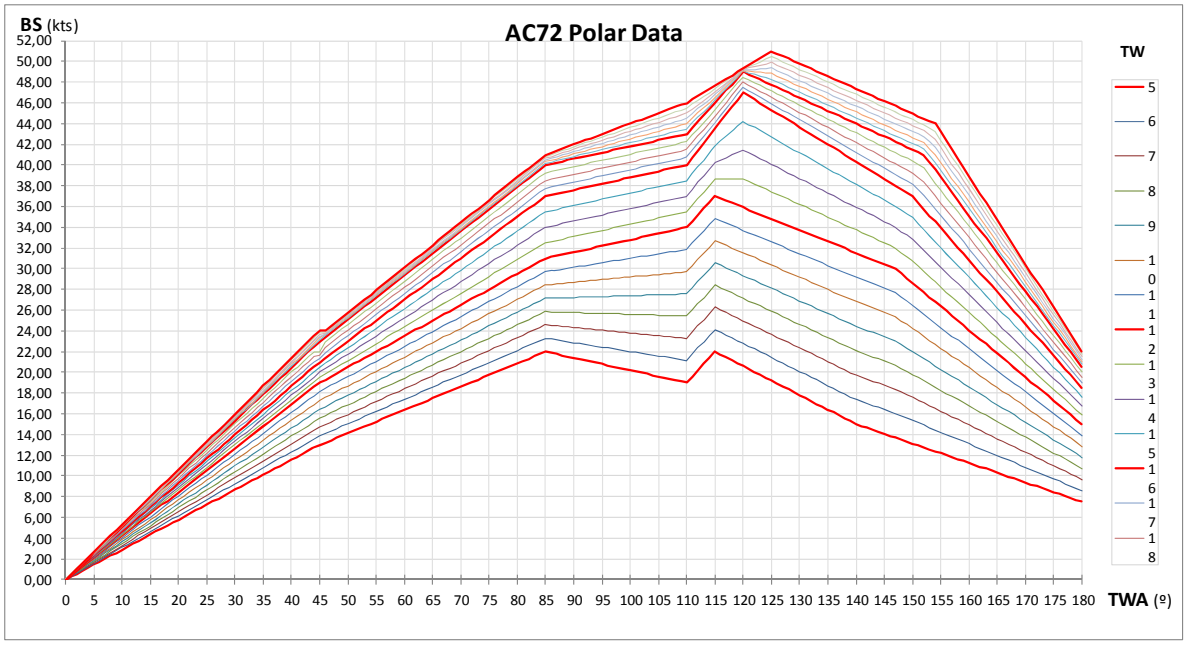
Extract from the Excel file

The initial Polar Data for the AC72 SOL boat had the following range:

- 0º ≤ TWA ≤ 180º [Degrees];
- 0 ≤ TWS ≤ 26 [Knots],

and the obtained BS range:

- 0 ≤ BS ≤ 51 [Knots].



AC72 SOL Cartesian graphic Boat Data - Phase 1, 0 ≤ TWS ≤ 26 [Knots]

Second phase

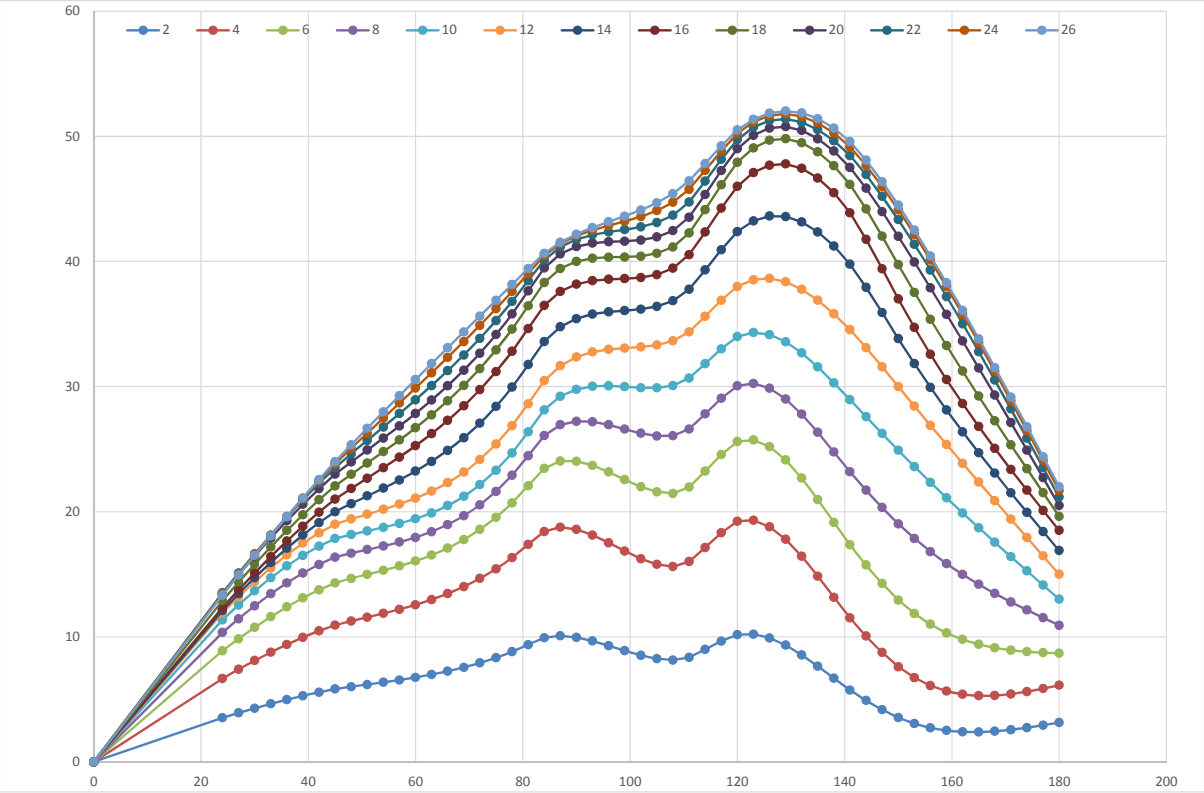
The boat Polar Data obtained in Phase 1 was subjected to a *"5-point spline*" adjustment for the initial data range:

- 0º ≤ TWA ≤ 180º [Degrees];
- 0 ≤ TWS ≤ 26 [Knots],

After, we also extended the TWS range to:

- 28 ≤ TWS ≤ 42 [Knots],

to obtain the remaining BS curves (note: we know the risks of making data extrapolation).



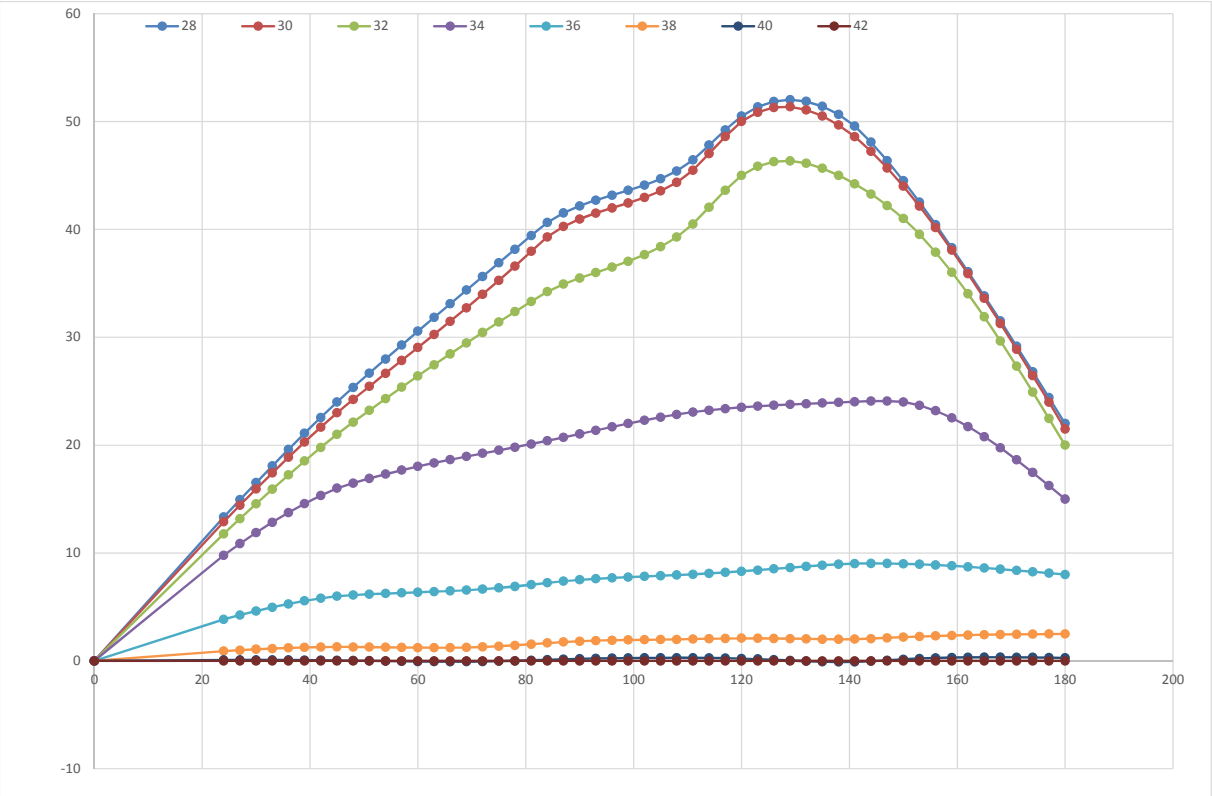
AC72 SOL Cartesian graphic Boat Data - Phase 2, 0 ≤ TWS ≤ 26 [Knots]

The obtained extended TWS/BS data range can be summed up to the other one, or, in alternative, practice the same process used on the other SOL boat Polars: above a certain level of WP (TWS), the corresponding BS's remain equal.

That last process has drawbacks, mainly a substantial deviation from reality.
In a full blown storm it's not credible that the BS is the same as, let's say, when it's blowing 15-20 kts of wind.
But, we all know that, with this AC72 boat, above (and under) a predefined TWS limit, the races were postponed.

Maybe in SOL it's possible, or better saying, desirable, to not postpone a race but, at the same time, to introduce a BS penalty (via the second set of extrapolated data), in order to reach a compromise.

We are sure that this will give some debate. And it won't stop here.



AC72 SOL Cartesian graphic Boat Data - Phase 2, 28 ≤ TWS ≤ 42 [Knots]

AC72 loss of performance vs. SOL Performance Loss function

From the site http://www.cupinfo.com/cupstats/index.php we can get real race data and use it to assess the estimated loss of performance for the AC72 boats during **tacking** - measured in loss of BS in a certain period of time.

States the "*Tacking Efficiency Explanation:*

The Tacking graphs show the ability of each boat to maintain boatspeed as they change from one tack to another. The timeframe shown is from ten seconds before to ten seconds after the boat is directly into the wind.

Entry speed for the maneuver is taken as boat speed recorded 10 seconds before head-to-wind (100% value), with the first graph shows speed through the tack as a percentage of that amount.

An additional graph shows the actual boat speeds in knots, rather than as a percentage.

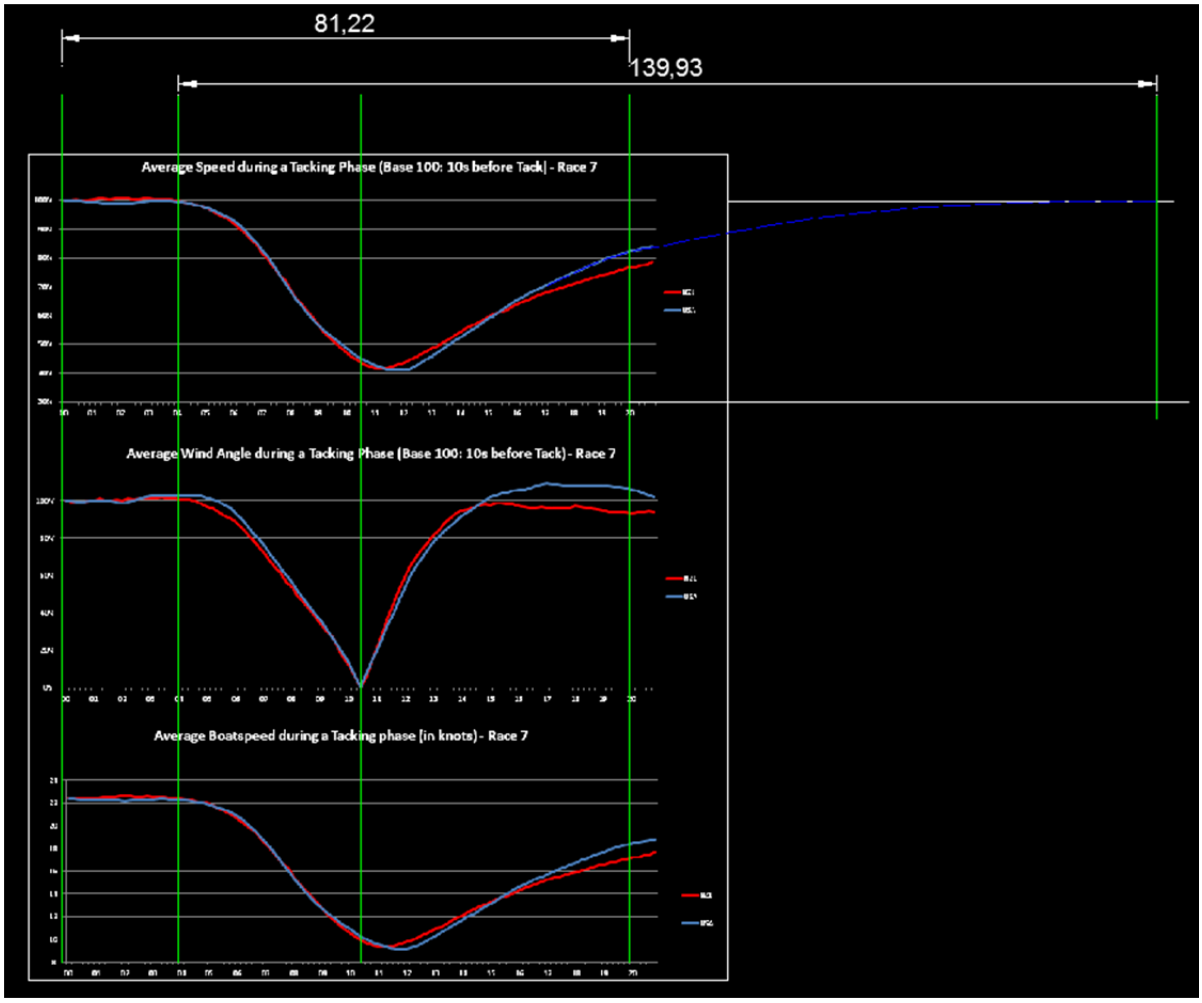
A third graph for some of the races shows the change in wind angle, a measure of how quickly the boat is turning, over the same period of time. The steeper the sides of the "V" in this plot the faster the boat is turning.", (end of quotation).

We extracted the graphs illustrated in this page from race #7 of the AC Finals
(http://www.cupinfo.com/cupstats/cupstats-americas-cup-2013-tacking-07.php) .

Extending the BS line of the OTUSA boat (light blue color) to the 100% BS level, we get an estimation of the period of time between the moment the boat starts to lose speed (above 100% of the tack entry BS) till she recovers the 100% BS entry for the tack.

In this case, the estimation is 34.21 seconds.

81,22	lenght units ->	t =	20	sec
138,93	lenght units ->	t1 =	34,21	sec



AC72 Lose of BS during tacks, race #7, AC Finals

What we think and suggest:

For the **gybes**, we don't consider relevant the loss of BS during the maneuver, so the correspondent Loss of Performance should be zero.
If you saw those boats gybing full speed while foiling, we are you sure you'll understand it.

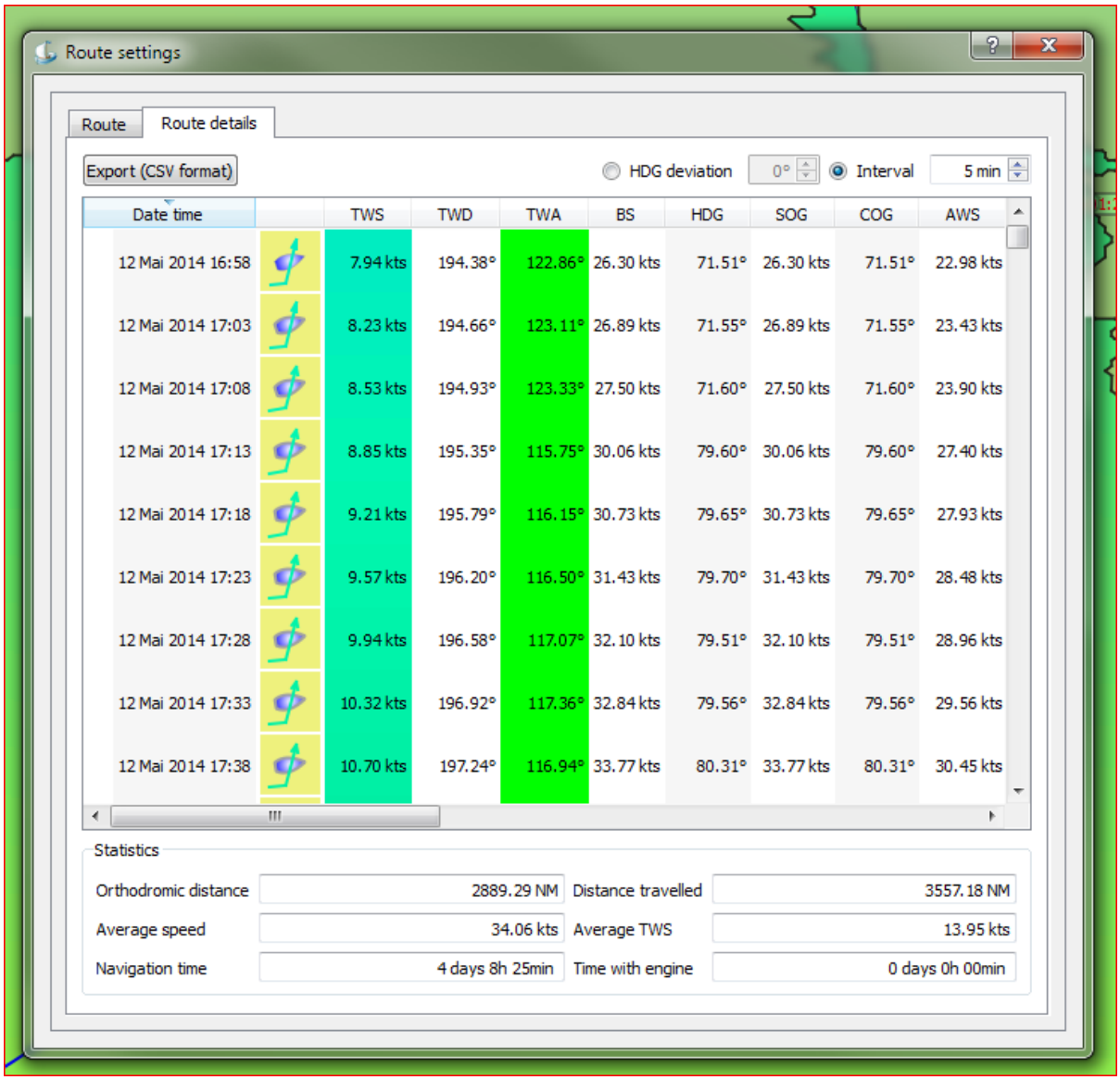
For the **tacks** we suggest a **constant** 40% Loss of Performance during a minute.

One of the conclusions is obvious: the actual SOL "Loss of Performance function" is inappropriate for this boat, namely.

Simple example

As a mere exercise of routing using *qtVlm* (grib file "*GFS20140512164904522.grb*"), and without any special waypoint optimization, from NY (USA) to Plymouth (UK), a boat with the AC72 Polar Data **characteristics** (Phase 1) makes the destination in 4 days 8 hrs 25 minutes.

You heard, 4 days!
For covering the routed path of 3.557 nm with an average BS = 34,06 Kts and an average TWS = 13,95 Kts!



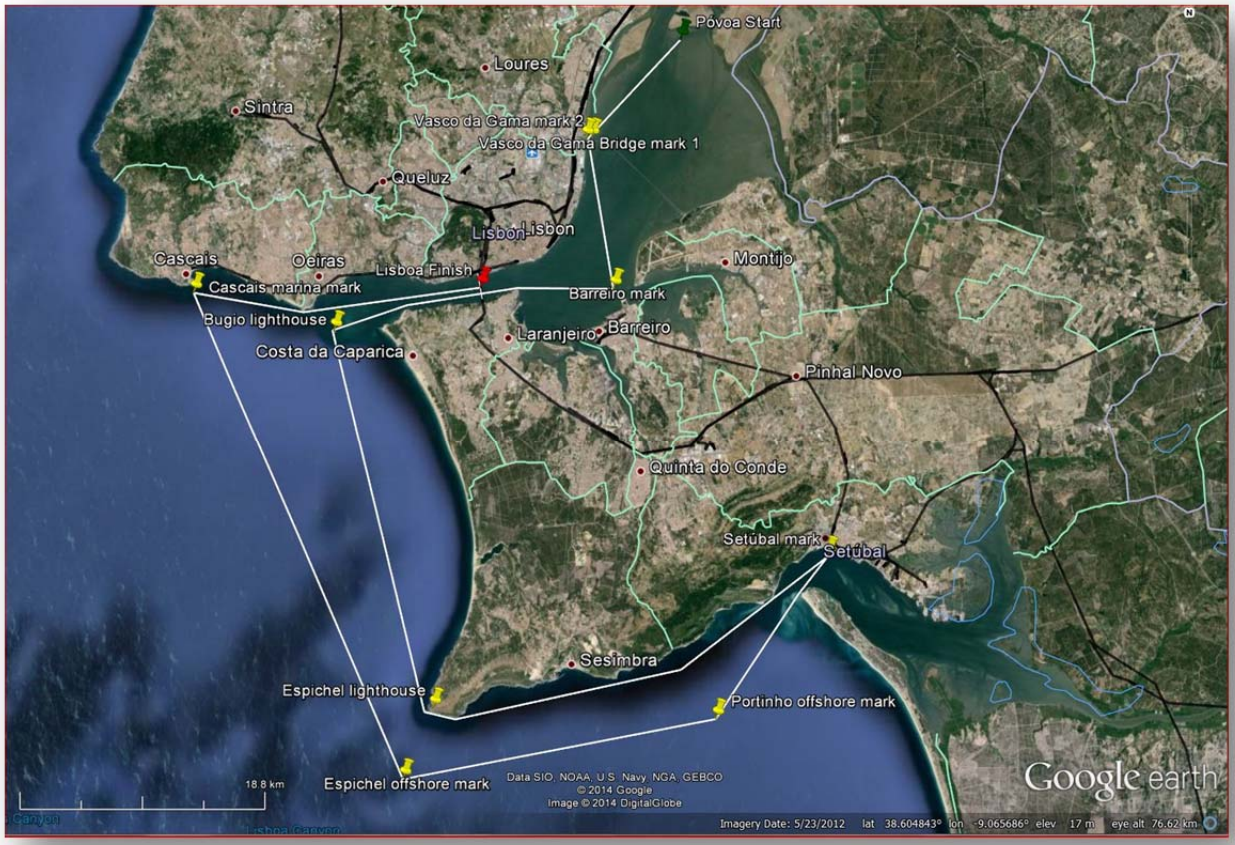
qTVlm route resume with an "AC72" from NY to Plymouth

Finally, the new TR

The new Timed Race, to be sailed with the AC72 SOL boat, starts in a point NE of Lisboa on the river Tejo, upstream in the navigable zone, goes South to Setúbal (inside river Sado) and comes back to Lisboa passing first in Cascais.

The finish line is under the *25 Abril* bridge, in Alcantara, (Lisboa) for an estimated total length of 107 nm.

The hot points will be the turning marks as you imagine by now.
Well, they always are, but with this boat they are going to be very special.



Lisboa TR path resume

We suggest that this race should be sailed in “Summer” time, between May and August, when the “North” winds start to blow with consistency along the Portugal Atlantic coast.
On normal conditions the TWS will be in the range of 15 Kts - 20 Kts+.

The full details for this TR will be published on the SOL Forum dedicated to the *Races Proposal*.

We sincerely hope that this new SOL boat and race deserves some interest from you.
If it will be the case, enjoy it SOLers!

João / *psail*, Jan / *bonknhoot*
19.May.2014