Response to *Associated Editor Simon Mudd*

General response

I've now read the revised manuscript and the comments from reviewers. I am satisfied that the authors have responded to reviewer comment or explained where they did not answer queries.

Dear Simon Mudd, thank you for your editing work. We are sorry for the late submission due to the end of my PhD thesis writing and the beginning of a time-consuming teaching job. We have revised our manuscript according to your comment in the pdf an in the decision letter. We respond bellow to your main points.

I have highlighted some additional typos and grammatical queries in my commented manuscript (attached).
Most of these are rather simple to change and should not trouble the authors. The main comments revolve around the calculation of volumes and fitting of the presumed initial surface. Figure 5 I think makes clear how the method works, but that comes later in the paper and below the description of the method. Figure 2 shows that one could estimate the local volume eroded in a wedge of the island, so it is somewhat counterintuitive to me to then assume radial symmetry and calculate the entire volume of erosion from the radially symmetric initial fit. It only becomes clear that this is an appropriate assumption by figure 5. I think there should be one additional schematic drawing emphasizing that you calculate the volume only after fitting the entire component of the island that is radially symmetric.

In the Method section we added some text to explain more clearly that we collapse all the points around the calculated center into a radial profile, then we fit this profile with exponential models, we rotate then this profile around the center to define an initial surface. Then the eroded volume is mapped by subtracting this surface to the DEM in different sectors.
I have also improved Figure 2 by making it more readable and adding an illustration (D) to better visualize where and how the eroded volume is calculated.

There is some discussion of the errors introduced by assuming radial symmetry starting on page 17, it seems this error analysis could have been included in the paper. I will let the authors decide if they want to include this in the paper or argue that it is not worth putting in. Basically, all my concerns revolve around the assumption of radial symmetry and what do you do if the condition is not met. Or indeed how do you know when an island is not symmetric enough? I think this deserves more discussion. I'm happy to clarify my position over email.

We understand your concern. Strictly speaking our method can still be applied if only part of the island only has a radial symmetry associated with one particular center (crater) in the case of island shaped by different lava centers. You are right that the uncertainty on the volume estimation depends on the degree of radial symmetry. As we mentioned in paragraph 415, one way to characterize the asymmetry could be to divide the island in different sectors, to apply our method to find the different associated centers, and then quantity their location difference. We leave this for future applications of our approach. But note that the uncertainty on volume is already taken into account by the mismatch between the onshore and offshore topography in

each selected sector and the exponential models. We can define a criterion for « enough » symmetry but the most important is probably that the relative uncertainty on eroded volumes remains small enough for correlation with erosion factors to be evidenced. We added paragraph 260 in the method:

"This uncertainty takes into account the imperfection of radial symmetry; a deviation from radial symmetry results in a greater vertical dispersion of points in the radial profile. Radial symmetry can be considered sufficient if the uncertainty domain of the IE position remains above the insular shelf, i.e. constrained between the horizontal position of the CCT and the depth of the ESB. We will see that these assumptions are confirmed in the case of Corvo Island (section 5.2)."

And we modified paragraph 405 in the discussion as:

"Our method requires that the initial shape of the volcanic edifice, or part of it associated with a given center, has radial symmetry. This hypothesis can be easily tested, for example by dividing the island into different sectors and by comparing the predicted center (by applying our method) of each sector with the others. In the case that the symmetry does not hold for the whole island, or in case of multiple volcanic edifices, or if it is not circular, our approach can be still applied independently for some selected sectors. Note that the uncertainty on eroded volume associated with a deviation from a perfect radial symmetry is taken into account by the uncertainty computed between the topography and the exponential model defined from the calculated center of the island."

I did enjoy this paper and think this is a very nice approach that could be used widely, and so I look forward to revisions from the authors.

Thank you very much and again, sorry for the late response.

Rémi Bossis, for the co-authors.

Point-by-point response

Line 8: Fixed

Line 9: Fixed

Line 31: Fixed

Line 50: *Is there a reference you can cite here that shows these islands are in fact conical when they first erupt? You say this later but just add one of the citations that establish the initial geometry of the volcano here.*

I have clarified this point and by citing Ramalho et al. (2013) and Karátson et al. (2010).

Line 65: *I would say "punctuated". "Punctual means the transition arrived at a prearranged time. Or if you only mean on specific time say the transition is abrupt. Or discreet?*

I have changed “punctual” to “abrupt” to be clearer.

Line 66: *Maybe say "and dating this moment is difficult"*

I added these words.

Line 96: *"The mechanics of the cliff collapse process are beyond..."*

I added these words.

Line 140: *"retreat of the coastal cliff"*

Fixed.

Line 153: *Explain here what you mean by "stacked".*

I have changed the two sentences with “stacked” to be clearer.

Line 158: *The logic here needs to be expanded. Add 2 sentences as to why the difference in IE and ESP characterize the mass lost due to gravity losses (or at least refer back to earlier in the paper where this is explained).*

I added one sentence to explain this point.

Line 160: *topographic*

Fixed.

Line 178: *ASTER is notoriously poor quality. Why not refer to modern 30m datasets, like the Copernicus DEM or the ALOS World3d 30?*

Because it was fitting well the EMODnet data (see response to line 298). I have cited the other GDEMs you propose.

Line 182: *What sets this minimum resolution? Or is this just a qualitative impression? If not, say what determines the minimum grid spacing.*

It is a qualitative impression. I have deleted this not relevant precision.

Line 185: *It has been some time since you defined the CCT so I suggest writing it our again here.*

I have changed “CCT” to “Coastal Cliff Top (CCT)”.

Line 187: *inflection*

Fixed.

Line 192: *Some more description of this might be useful. Presumably on a gridded dataset there are a scattering of pixels that reach 15 degrees. Is the ESB determined by the raster or in the radial transects? Also, if there are multiple >15 degree slopes along the transect, do you pick the first one? This might be straightforward on the transects but getting a threshold of 15 degree contour on the raster seems more difficult. How did you do it?*

I have clarified this point by better describing the process to select the slope.

Line 212: *In your figure not all these lines intersect. So how do you pick the point? Do you choose the three biggest catchments or something? Needs additional text.*

Sorry but as I can see, all these lines intersect on the figure… I simply specified that we consider all the intersections of all the basin directions.

Line 238: *I'm a bit confused by this suggestion of rotating the profile. Is this done around the entire island or is it done in wedges? In figure 2, the eroded volume is calculated by the difference between the CCT and ESB. But the ESB location or distance changes as a function of bearing (or direction from the edifice) so clearly you do not rotate around the entire edifice with a characteristic ESB or CCT for the entire island. Can you perhaps add a cartoon to explain how this is done?*

I have clarified this point by explaining that we can calculate the volume on all the island or on angular sectors. We take the horizontal position of the CCT and the depth of the ESB, with their respective variations around the island, as boundaries of the calculated eroded volume.

Line 247: *See previous comment. Add a schematic diagram. Are you calculating the volume in angular segments?*

See my General response. I have specified that we calculate the various net cliff position changes all around the island, not an unique mean net cliff position change.

Line 292: *Okay, so there is a complete rotation. Presumably, because the ESB changes distance as a function of bearing, you would get a "volume loss" as the exponential fit to the bathymetry would miss the radially symmetric profile. Is that right? Added comment: okay, so figure 5 is*

fairly convincing that there is radial symmetry. I still think there could be another explanatory figure in here to show readers that you really must assume radial symmetry and lack of this will degrade the method.

See my General response.

Line 298: *This is a strange choice, as it is, by far, the worst globally available DEM. On the other hand I don't think it will make much difference to these results.*

The choice of this dataset is indeed questionable, but for our study these data are sufficient and give satisfactory results, without significant changes in the uncertainties associated with the fits. We choose the ASTER data because there was a gap of several tens of meters between the SRTM data and the EMODnet data (ellipsoid problem?).

Line 330: *Are these points well above the trend clustered along one direction of the island?*

It seems so. These few points have very little weight on the calculation of the submarine fit.

Line 341: *Can you do this for the offshore component? Presumably the offshore component does not erode. So the "eroded" volume here would correspond to an uncertainty metric for the assumption of radial symmetry. Added comment: okay, you say this on page 17. How difficult would it be to actually implement this approach here?*

See my General response.

Line 445: *How likely is a long-term similar wave climate?*

That is a very good question. I looked for papers on the paleo wave climate for the last 10-100 ka in the area of the Azores, and I found nothing. So, it is very difficult to estimate this probability.