C Palmer Comments 1 April 2018

Reviewer 1:
As requested, I have computed the metacentric heights for the floating alligator and *Spinosaurus*. This more traditional, naval architecture measure of floating stability confirms the findings of the two dimensional disk models that were introduced into Revision 1 to demonstrate the lateral stability/instability of the models. This added method and the new findings are documented with new paragraphs in the Materials and Methods section and in the Results section, along with the insertion of a new figure and caption (Figure 9).

With regards the calculation using the naval architects approach, there is no need to add the complication of relating values to the "keel" location. That is done by naval architects for purposes of presentation of the overall hydrostatic characteristics of ship's hulls and also because the location of the centre of mass is conventionally calculated as a distance from the keel, it is not an intrinsic requirement of the method.

The simple formula I/V gives the vertical distance from the centre of buoyancy to the metacentre (BM) (Figure 23 p70 in Comstock). The author calculates the centre of buoyancy location as an output of his well proven Henderson (2003) methodology. He also estimates the centre of mass (or centre of gravity in engineering parlance) and thus can calculate the distance between the centres of buoyancy and mass (BG). Thus it is a very simple matter to calculate the stability parameter GM:

GM=BM-BG without reference to the "keel".

Turning now to the specifics of the presentation of the results (Figure 9) I am confused. Scaling from the alligator profile in Figure 3, the centre of mass is shown as 15cm below the waterplane. In Figure 9, the distance is 20cm. Which is correct and what does the blue/green cross section represent?

I wish to keep the dynamic disk simulation sequences of stability (alligator) and instability (Spinosaurus) (Figures 7 and 8) as they provide a more intuitive sense for what is happening with the immersed models/bodies.

I disagree with this. Maybe because I am a naval architect, but I find the dynamic analysis confusing and do not see how it adds very much. I agree that the method appears to work correctly, but all it does is to calculate the stability of prismatic shapes. This could of course be achieved more simply by using the naval architecture methodology computed at the flotation level.

But more importantly, the animals are not prismatic. While the legs may be more dense than water, they displace water and create buoyancy forces, and thus it is confusing at best to say: *"As their limbs are denser than the freshwater that the models are floating in, the buoyant force arises in relation to the amount of water displaced by the less density axial body."* The legs do provide buoyancy, just not sufficient to support their weight. What matters for stability is the relative (vertical) locations of the centres of action of the total buoyancy force (the displaced weight of water) and the total weight force. In other words, the legs and tails etc matter and the prismatic models do not reflect this. Therefore they do not give a reliable estimate of the stability of the real animals.