Solid Earth
Discussions

Open Access

SED

Interactive
comment

Interactive comment on "Distinct Element geomechanical modelling of the formation of sinkhole cluster within large-scale karstic depressions" *by* Djamil Al-Halbouni et al.

Nestor Cardozo (Referee)

nestor.cardozo@uis.no

Received and published: 25 April 2019

I find the manuscript very interesting, well supported by extensive and integrated field work and numerical modelling (some published), and well written. As such, I consider the manuscript should be accepted after minor revision. These are my main comments:

1. Assembly calibration: Presumably the tests mentioned in Table 2 were run in a sub-sample of the assembly in Figure 3. Please state the size and number of particles in the samples used for assembly calibration.

2. Material behaviour: Salt may be affected by viscous forces. To what extent disre-

Printer-friendly version

Discussion paper

garding these forces in the models, may have affected the analysis? e.g. models B and D in Figures 4 and 5. For salt as a host of cavity-hosting material (Figure 5D), wouldn't viscous forces prevent the formation of strong, open cavities in mature stages of the model?

3. To what extent element/particle size may affect the estimation of the modified Poisson ratio and shear modulus? The two equations below line 25 in page 8 are very reasonable, but to what extent, for example, reducing the particle radii by half (increasing the number of particles twice) would affect the estimation of these modified values?

4. Figure 9 is a nice summary of the processes observed in the models. But wouldn't it be better to complement this figure with plots of total and incremental strain (e.g. shear strain) evolution in the models? These plots will clearly illustrate the total and active deformation at any stage, and in my opinion will truly show the evolution of the different mechanical components introduced in Figure 10. Incremental strain can further support the observations made in Figure 7 using shear stress.

5. Figure 12 can be taken forward by adding another column containing the modelled shear wave velocity (Figure 8D), and a forward seismic model (since the distribution of acoustic parameters in the model is known) of the DEM model. This will allow comparing actual to modelled seismic. It may be beyond the scope of the manuscript but it would certainly make the manuscript more appealing.

Below are minor comments:

Page 1: "a feedback loop": Unclear

Page 1: "same level" change to "same depth level"

Page 1: "individual growth rate": Unclear

Page 1: "stress interaction": Unclear

Page 2: "The relatively straightforward tectonic setting": Unclear

Page 3: Remove "compositions"

Page 5: "uniform distribution between a minimum and maximum particle radius in a 2D box": Unclear, can this be illustrated in a small figure/inset in figure 3?

Page 6: Change "same level" to "same depth level"

Page 6: "Same depth of 40 m": Why? This is explained latter in the Appendix but at this stage it is not clear why the cavities are placed close to the basement top.

Page 7: "bond-healing procedure" and "recombination behaviour": Unclear

Page 9: "Sec. 0" change to "Sec. 1"

Page 13: Define maximum shear stress in terms of principal stresses

Page 13: Change "constant subrosion" to "the constant subrosion"

Page 14: "All derived parameters must be regarded as apparent": Unclear

Figure 12: Please show the location of the line of section

Page 18: "observe similar features there": Unclear, what do you mean by "there"?

Page 17, line 26: Change "ae" to "a"

Page 17: "Stable immediate surrounding": Unclear

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2019-20, 2019.