

Referee #1 (Greg Valentine)

This is a very nice and thorough manuscript. I have indicated some edits on the attached pdf, which will improve the presentation, but these are minor. Congratulations to the authors on this excellent work. Make sure to be clear at the end about your conclusion, something like: "The box model is a valuable tool for PDC modeling in situations where topography is relatively simple and smooth (such as the area south of Somma Vesuvius). On the other hand, caution must be used for cases of complex topography, where the effects of density stratification within the currents, which is not modeled with the box-model approach, plays a strong role in current behavior and deposition." This is basically the "punch line" of the paper and should be very clear both in the conclusions and in the abstract.

Thank you for your kind words and your detailed revision of our manuscript. The suggested sentence is surely appropriate, and we have inserted it in the conclusion section, with minor modifications (LINES 566-569).

We have also added one more affiliation to Giovanni Biagioli (LINE 4).

SPECIFIC COMMENTS (FROM THE ATTACHED PDF)

LINES 13 replace “In this study we” with “We”

Done (LINE 13).

LINE 16 replace “Total Grain Size Distribution” with “total grain size distribution”

Done (LINE 16).

LINE 17 delete “of Somma-Vesuvius (Italy)”

Done (LINE 17).

LINE 20 replace “that we perform with PyBox were done considering” with “consider”

Done (LINES 20-21).

LINE 22 readers will not know what ii is referring to - can more general terms be used at least in the abstract so that it is quickly readable by anyone? In the main text, these terms can be defined and used.

We have slightly modified the sentence (LINES 22-23).

LINE 26 add “simplified”

Done (LINE 27). We have also removed the following “simplified”, which was redundant.

LINE 27 replace “approaches adopted have promising” with “approach has promise for”

Done (LINE 28).

LINE 27 this sentence is confusing - can it be rewritten to be clearer?

We have added a new explicatory sentence (LINES 28-30)

LINE 33 replace “Pyroclastic Density Currents” with “pyroclastic density currents”

Done (LINE 35).

LINE 37 in this introductory material, you might refer to others who have worked on this topic, such as Dufek. I think the Neri paper was 2-D (you referred to it as 3D)?

We corrected the Neri reference and added more references of Dufek and Todesco (LINES 39-40).

LINE 45 replace “estimating” with “estimation of”.

Done (LINE 48).

LINES 49 add “the” and delete “(described in section 2.1 and in Appendix A),”

Done (LINE 52).

LINE 51 delete “remarkably” and replace “well-known” with “well-characterized”

Done (LINE 54).

LINE 52 delete “(detailed in section 2.2)” and replace “It is indeed accepted that the” with “The”

Done (LINE 55).

LINE 54 there were some problems with this application to Taupo, I believe (it was a long time since I read this, though).

We added a reference of the Wilson (1997) comment, and of the response of Dade and Huppert (LINES 57-58).

LINE 57 delete “. Similar approaches have been adopted in literature” and add “see for example”

Done (LINE 61).

LINE 60 delete “, section 5”

Done (LINE 65).

LINE 61 delete “(section 6)”.

Done (LINE 66)

LINE 65 delete “The” and “code,” and add “,”.

Done (LINE 69).

LINE 68 delete “see”

Done (LINE 72).

LINE 70 delete “or cylindrical sector,”

Done (LINE 74).

LINE 77 replace “have a leading role” with “dominate”

Done (LINE 81).

LINE 78 replace “Thus, the particle” with “Particle”

Done (LINE 82).

LINE 82 replace “differs from considering” with “does not assume” and replace “(Dade and Huppert, 1998)” with “as in Dade and Huppert (1998)”

Done (LINES 86-87).

LINE 83 delete “further”.

Done (LINE 87).

LINE 88 I'm not sure what is meant by this sentence? Can you clarify?

We added a reference to a note where we provide an explanatory example of what we mean (LINES 89-90).

LINES 90-91 and 93 these two statements completely contradict each other. Please clarify.

We apologize for this contradiction, we have removed the wrong sentence (LINES 98-99).

LINE 93 not needed in this description of your model. Could mention it in the discussion, if there is an appropriate place. Delete “The thermodynamics of cooling effects are explored in Bursik and Woods (1996).”

We have deleted this sentence (LINE 99).

LINE 96 replace “simplifying hypotheses” with “simplifications” and delete “of all”

Done (LINE 102).

LINE 99 add “turbulent mixing” and delete “the vertical mixing, due to turbulence, “

Done (LINE 105).

LINE 101 this also could be put in discussion instead of here, in the description of your model

We prefer to keep this small sentence here as we feel it is important for the description of the model. We have however slightly modified the previous sentence (LINES 107-108).

LINE 101 replace “is” with “was” and replace “in (see Fauria et al., 2016)” with “in Fauria et al. (2016)”

Done (LINES 107-108).

LINE 105 delete “number expressing the”.

Done (LINE 111).

LINE 117 replace “So, the” with “The”

Done (LINE 123).

LINE 120 add “ground”

Done (LINE 126).

LINE 121 add “, although not modeled, in nature”.

Done (LINE 128).

LINE 124 delete “set” and add “is set”.

Done (LINE 130).

LINES 127-128 how do you do that before comparing the KE to the PE? How do you handle obstacles that are not as high as the flow thickness?

We modified the sentence and clarified the meaning (LINES 134-139).

LINE 140 replace “was characterized by” with “involved”

Done (LINE 147).

LINE 141 delete “complex” and replace “Eruptive Units” with “eruptive units”

Done (LINE 148).

LINE 146 what do the dotted and solid lines mean?

Solid lines are the limits between EUs, dashed lines are the limits between levels (a, b and c), dotted lines are lithofacies stratifications. We have added this sentence in the caption of Figure 2 (LINES 153-154).

LINE 150 delete “PDC deposits of the” and replace “record” with “records”

Done (LINE 158).

LINE 151 replace “(up to 10 km from vent area)” with “up to 10 km from vent area,”

Done (LINE 159).

LINE 152 replace “, so resulting in a complex” with “. Variability of”, delete “variability” and replace “possibly” with “are probably”

Done (LINES 160-161).

LINE 153 delete “tends to diminish”

Done (LINE 162).

LINE 154 add “decrease” and replace “(“ with “,”

Done (LINES 162-163).

LINE 155 delete “)”, replace “pointed out that: i) in the southern part of the” with “showed that the deposits reflect different topographic situations in different sectors around the volcano. South of” and delete “area”

Done (LINES 163-165).

LINE 156 delete “controlled”, add “affected” and replace “: ii) in” with “. In”

Done (LINES 165-166).

LINE 159 replace “; iii) in the western sector of SV,” with “. To the west,”

Done (LINE 168).

LINE 161 replace “several meters thick” with “several-meters-thick”

We have modified the words into “several meters-thick” (LINE 170).

LINES 161-162 replace “-“ with “;” and replace “; iv) in the” with “. In the”

Done (LINE 171).

LINE 162 replace “(with many valleys cut on steep slopes)” with “with many radial valleys cut on steep slopes,”

Done (LINES 171-172).

LINE 166 delete “The AD 79”, replace “marks the reappraisal” with “records a subsequent phase” and delete “after the end of the Plinian phase”.

Done (LINE 175).

LINE 169 delete two ‘ ’’.

Done (LINE 177). We have furthermore deleted the ‘ ‘ ‘ at LINES 178, 179 and 180. Finally, we have replaced, at LINES 182 and 183, the words “a2”, “b” and “b” with, respectively, “EU4a2”, “EU4b” and “EU4b”.

LINE 170 replace “depositing” with “that deposited”, delete two ‘”’ and replace “is furthermore complicated” with “has additional complications”

Done (LINES 179-180).

LINE 172 replace “level” with “horizon”

Done (LINE 182).

LINE 175 replace “it was maximum toward south (up to about” with “to the south it was deposited up to ~” and replace “;” with “ (“

Done (LINES 184-185).

LINE 177 delete two ‘”’ and add “bedding”

Done (LINE 187).

LINE 187 delete “i.e.” and replace “/” with “,”

Done (LINE 197).

LINE 188 replace “TGSD” with “(TGSD)”

Done (LINE 198).

LINE 189 delete “(see sections 3.1.1 and 3.1.3)” and delete “(Barberi et al., 1989; section 3.1.2)”

Done (LINE 199).

LINE 190 replace "; Cioni et al., 2004) are derived from the literature" with "are derived from Barberi et al. (1989) and Cioni et al. (2004)."

Done (LINES 200-201).

LINE 191 remove paragraph break and replace "In summary, the" with "Total"

Done. We have also removed 4 "the" (LINE 201).

LINE 192 replace "Thus, the" with "The"

Done (LINE 202).

LINE 203 replace "Maximum Runout Lines" with "maximum runout lines"

Done (LINE 213).

LINE 208 delete "i.e."

Done (LINE 218).

LINE 270 replace "Due to the lack of reliable data, we have moreover" with "We"

Done (LINE 280).

LINES 271 add "due to the lack of reliable data"

Done (LINE 281).

LINE 281 seems unnecessary, delete "The False Negative case (no deposit nor simulation) has not been obviously calculated"

Done (LINE 291).

LINE 291 replace "GSs" with "grain sizes"

Done (LINE 301).

LINE 294 replace "More in" with "In"

Done (LINE 304).

LINE 298 delete "forcedly"

Done (LINE 309).

LINE 313 replace "Particularly, the present" with "The modern"

Done (LINE 324).

LINE 318 replace “In particular,” with “We modeled”.

Done (LINE 329).

LINE 357 delete “We remind that” and delete “code”

Done (LINE 368).

LINE 358 replace “to” with “with”

Done (LINE 369).

LINE 364 replace “vare” with “value” and replace “correspondence of” with “corresponding to”.

Done (LINE 375).

LINE 377 add “, and where ~50% or more of the particles are relatively coarse,”

Done (LINES 388-389).

LINES 378-379 delete “and considering an impacting mixture consisting of at least ca. 50% coarse particles (> 1 cm diameter) relative to fines (< 1 cm diameter),”.

Done (LINES 390-391).

LINE 380 replace “PDCs” with “dense underflows”

Done (LINES 391-392).

LINE 395 remove paragraph break

Done (LINE 406).

LINES 411-412 replace “testifies the strongest interaction of the EU3pf unit with the non-homogeneous topography (see also Gurioli, 1999; Cioni et al., 2020) and” with “reflects”

Done (LINES 423-424).

LINE 413 add “in areas of complex topography (Gurioli, 1999; Cioni et al., 2020)”

Done (LINES 425-426).

LINE 447 replace “matching” with “match”, delete “tends to sensibly” and replace “overestimate” with “overestimates”

Done (LINE 459).

LINE 448 what does it mean “equilibrate”?

We have replaced “equilibrate” with “balanced” (LINE 460).

LINE 448 replace “motivated” with “related”

Done (LINE 460).

LINE 449 replace “with” with “to” and replace “acts” with “act”.

Done (LINE 461).

LINE 452 replace “overlapping” with “overlap”

Done (LINE 464).

LINE 455 replace “always reminded” with “kept in mind”

Done (LINE 467).

LINE 457 replace “We remark that, beyond” with “Beyond”

Done (LINE 469).

LINE 458 replace “Shallow” with “Thin”

Done (LINE 470).

LINE 459 replace “remark” with “note”

Done (LINE 471).

LINE 467 replace “We note that this” with “This”

Done (LINE 479).

LINE 468 delete “, that are”

Done (LINE 480).

LINE 497 remove paragraph break

Done (LINE 508).

LINE 520 replace “matching” with “match”

Done (LINE 531).

LINE 521 replace “North-West” with “north-west” and delete “sensibly”

We have used NW and we have also replaced South-East with SE (LINE 532).

LINE 524 replace “shallow” with “thin”

Done (LINE 535).

LINE 540 replace “stratified features” with “density-stratified character” and replace “make” with “made”

Done (LINES 551-552).

LINE 541 replace “In particular, results” with “Results”

Done (LINE 553).

LINE 551 replace “We” with “However, we”

Done (LINE 563).

LINE 552 replace “such” with “the”

Done (LINE 564).

LINE 553 replace “which” with “situations where”

Done (LINE 565).