**Response to the editor and reviewer**

We greatly appreciate the editor and the reviewer for the efforts and the valuable suggestions and hope that deficiencies pointed out in the original submission are overcome in the revised version. Our responses of the Referee’s Report are given below.

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**General comments**

*1. The terminology around taxa with sampling times in the past is confusing.*

*(1) In algorithm 2, the use of extant/extinct does not match any common usage. The definitions on page 7 line 33 for Y and O are clearer and avoid this confusion. I suggest removing extant/extinct entirely.*

*(2)* *It seems that the authors are using "sampled ancestor" to mean "a tip whose sampling time is in the past," or more compactly "a heterochronous tip." This is not the standard usage of sampled ancestor, which generally means "a sampled taxon who has descendants which are also sampled taxa."*

*(3)* *On page 6 (l 24-25), it is stated that a sampled ancestor has no descendants (is of degree 1, having only a parent). This suggests that "sampled ancestor" is being used to mean "heterochronous tip."*

*(4) Does the "Big Pulley" algorithm apply if O is a node of degree 2 (having a parent and a single child)? It seems like it should, but I do not know if it would fall under the symmetric or asymmetric case. The authors are free to leave this case to future work, so long as the terminology surrounding what O represents is made clearer.*

**Author’s Response:**

Thank you for your professional comments and suggestions.

(1) We have removed the notation of “extant/extinct” in the revised manuscript. The two child nodes of the root are simply denoted by Y () and O ().

(2) – (3) We have removed the usage of “sampled ancestor” in the revised manuscript. The tips

actually mean heterochronous tips.

(4) In the revised manuscript, we have made it clear that O is a heterochronous tip.

*2. Figure 10 and Table 7 appear contradictory about the models used to analyze RSV2 and HIV-1. In the table it is stated that there is an operator on the population size, but in the figure there are efficiencies listed for birth and death rates instead.*

**Author’s Response:**

Thank you for pointing out this mistake.

In the latest manuscript, we have corrected the inconsistent parameters in Figure 10 and Table 7. To be specific, the Anolis data set has a birth-death tree prior in our model and two corresponding parameters (birth rate and death rate) are sampled in the analysis. For RSV2 and HIV-1 data sets, we used coalescent model as the tree prior, where the parameter population size (pop.size) is sampled. Moreover, we also sampled clock mean (ucld.mean) for RSV2 and HIV-1 because we specified dates at the tips. Therefore, in Figure 7, birth.rate and death.rate are compared in Anolis data set, pop.size and ucld.mean are compared in RSV2 and HIV-1.

**Typos and other minor comments:**

*1. The comparison of ESS for the clock standard deviation between "cons" and "categories" doesn't seem exactly fair, since there is an entirely new operator for the standard deviation of the clock in "cons."-It may be useful to mention the "nocons" tests were run in previous analyses. This would assuage any concerns that the difference between "categories" and "cons" is about the change from discretized to continuous branch rates, rather than about the use of the constant distance operator.*

**Author’s Response:**

Thank you for your professional comments

In the revised manuscript, we have added a new subsection to discuss the “NoCons” configuration in Appendix 3.5.

*2. Table 7: "Substituion model"*

**Author’s Response:**

In the revised manuscript, it has been replaced by “Substitution model”.

*3. p26 l28: the simulations are not definitive proof, but rather a convincing demonstration*

**Author’s Response:**

In the revised manuscript, we

**We greatly appreciate the reviewer for the valuable suggestions. We try our best to overcome the deficiencies pointed out in the original submission. If there are any problems in the revised version, please do not hesitate to point out. We will revise the submission according to reviewer’s suggestions.**