Response to Referee #1

I would like to thank the referee for the appraisal of the discussion paper and the useful comments. My reply (in black) to the comments (in blue) is given below.

P4027L15: The second term of the left hand of equation (27) must be c dδ/dt.

This is correct. Thank you for pointing out this error, which was introduced during typesetting.

P4028L11: It should be necessary to describe that this equation (31) is derived from equation (28), which is under the consecutive situation with production and respiration only, because it is written in a different section.

Yes, it can be derived from Eq. (28).

P4032L1012: In equations (42) and (43), concentration term c must be multiplied to both right hands.

This is correct. Thank you pointing out this error, which was also mentioned by the other referee and which I failed to see in the galley proofs.

P4035L14: It might be better for readers to describe that this equation (51) is derived from equation (47).

Eq. (51) can indeed be derived by rearranging Eq. (47). It can also be derived (perhaps more easily) from Eq. (37).

P4036L14: Likewise, seems better to describe that this equation (52) is derived from equation (46). These two are not essential but better to avoid from reader-in-maze.

I agree.

P4059 (Figure 2): As far as my understanding, tests with variable $^{17}\Delta_P$ and $^{17}\Delta_{sat}$ use equation (1), whereas those with all other parameters use equation (48). Distinct separation between them, for instance, use warm and cool colors, change label order, etc., may help readers to understand more. Additionally, the figure caption should be revised accordingly.

There has been a misunderstanding. All sensitivity tests have been performed using Eq. (48) and the corresponding $^{17}\delta_P$, $^{18}\delta_P$, etc. values in Table 3. $^{17}\Delta_P$ and $^{17}\Delta_{sat}$ are merely listed for the reader's convenience.

P4044L13-15 P4059 (Figure 2): Unlike other parameters, θ and $^{17}\Delta_{sat}$ are dependent each other. Taking the θ values of 0.501 and 0.531 with fixed $^{18}\varepsilon_I$, $^{18}\delta_{sat}$, θ_E (same as θ but for gas evasion) values of -3.0, 0.690 and 0.516, respectively, $^{17}\Delta_{sat}$ values would then correspond to 44 and 103, respectively. It is 6 times larger than that from 17Δsat itself (assumed from 8 to 18), so that it seems to be reasonable to find remarkable errors of θ in Figure 2a relative to $^{17}\Delta_{sat}$. In other words, the range of θ uncertainty may be much unrealistic setting relative to other all parameters. I think this may be pointed out somewhere in the text if you would agree.

The parameter θ as used in the present paper only refers to gas invasion, i.e. $\theta = \ln(1+{}^{17}\varepsilon_I) / \ln(1+{}^{18}\varepsilon_I)$ (see Table 2). It is independent of $^{17}\Delta_{sat}$. There are no values reported in the literature for θ, which is why I have chosen $\theta = 0.516 \pm 0.015$, covering the theoretically predicted range for mass-dependent isotope effects (p. 4040, l. 13). $^{18}\delta_{sat}$ and $^{17}\Delta_{sat}$ have been measured, as discussed in Sect. 5.3, and are used to calculate the fractionation during gas evasion via $\varepsilon_E = (\varepsilon_I - \delta_{sat}) / (1 + \delta_{sat})$ (p. 4040, l. 16). Therefore, the uncertainty in g due to θ is indeed as high as shown in Figure 2.