**Reviewer3-Question 6: What has been done previously in terms of gas chemistry for biomass studies?**

**There is not much literature directly cited for that.**

Only few studies have developed skeletal chemical kinetic gas-phase models of lignocellulosic biomass for the use in CFD simulations. For example, the skeletal kinetic model for biomass gasification developed by Goyal and Pepiot includes 39 species, based on the volatile species released from the CRECK-S-B model, and Lovas et al. developed a skeletal kinetic model for biomass combustion that considers less than 40 species, including only species up to C2. However, both models are not applicable in the present study due to the need to model the evolution of heavy hydrocarbons and aromatic species.

The literature indicates a lack of a skeletal kinetic model capable of accurately predicting the gas-phase kinetics of volatile species released from biomass particles over a wide range of conditions.

Based on feedback from Pooria:

We acknowledge the reviewer's question. Since only few studies have developed skeletal chemical kinetic gas-phase models of lignocellulosic biomass combustion for the use in CFD simulations, we had to develop our own kinetic model tailored to our application case. The skeletal kinetic models published by Goyal and Pepiot~\cite{Goyal2017} and Lovas et al.~\cite{Lovas2013} are not applicable in the present study due to the need to model the evolution of heavy hydrocarbons and aromatic species. We have added these references to the paper.

?? goyal and pepiot can be used or??

Debiagi reduced? Yes, but ITV soot base chemistry + cell + anisole

**Reviewer3-Question11: Figs 5, 6. What are the conditions (gas state) corresponding to the figure, e.g., stoichiometry and temperature? Are these representative of conditions throughout the flame and/or in the formation regions of interest? What is the sensitivity of the results to variations in the gas state?**

%%%%%%%%%

% reviewer refers to the initial conditions (????)

%%%%%%%%%

We acknowledge the review’s questions. Figures 5 and 6 analyze the NOx formation and destruction pathways for the group particle simulation of the torrefied miscanthus particles in air conditions (Tgas =1400K, XO2=0.21, XN2=0.79). An overview of the initial flame conditions is given in Table 3 (Case B: Fuel Effect - tMIS). The stoichiometric mixture fraction (Zst=0.15) and a visualization of the propagating flame are given in Figure 3. The sensitivity of the results to variations in the gas state can be seen from the ROPA of different gas states in Figure 10.

We modified the manuscript based on the review’s comment and clarified the statement.

%%%%%%%%%

% reviewer refers to the volumetric average conditions

%%%%%%%%%

We acknowledge the reviewer’s questions. The RPA and ROPA in the manuscript use time- and volume-integrated (averaged) nitrogen element fluxes over the entire numerical domain and total simulation time to provide a global view of the NOx formation and destruction pathways. The time- and volume-integrated (averaged) temperature for the torrefied miscanthus flame, shown in Fig. 5 and 6, is 1591.28K. For variations in gas state, this temperature changes due to the different gas properties (OXY-21: T=1534.93K and OXY-31: T=1563.47K). The sensitivity of the nitrogen element flux to variations in the gas state can be seen from the ROPA of these different gas states in Figure 10 in the manuscript.

Zst is const, or?

%%%%%%%%%%%

tMIS AIR-21: Tgas,averaged,totalDomain=1591.28K

tMIS OXY-21: Tgas,averaged,totalDomain=1534.93K

tMIS OXY-31: Tgas,averaged,totalDomain=1563.47K

Gas phase velocity?

They know that it is tMIS-AIR21???