

## ***Interactive comment on “Volatile organic emissions from the distillation and pyrolysis of vegetation” by J. P. Greenberg et al.***

**J. P. Greenberg et al.**

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(We paraphrase reviewer's comment.)

1. MS does not refer to much relevant previous work on pyrolysis of biomass: We will cite his suggested references and include some comparisons of results in Table 3.
2. Why were measurements made only to 300C? As noted in the last paragraph of the introductory section, this work was focused on those emissions that occur during pre-flaming stages of fires. We recognize that measurements from fires usually include contributions from all stages of combustion, including the flaming stage. We chose to restrict the experiment to a more limited stage of combustion to understand more about the physical process and emissions during the early stages of combustion and

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the application of these limited results, rather than to study the combustion process as a whole, for which numerous publications (some listed by reviewer) have presented previously.

3. The section on the flammability of emissions should be eliminated... While the physics and chemistry of combustion and flames has been the subject of almost innumerable studies, the rates at which pyrolysis gases are emitted give some insight into the process of ignition. In section 4.4 we conclude from a simple model of emissions that ignition probably does not occur in the mixed atmosphere of the forest canopy, but rather very close to the leaf surface. While the model may be crude, the implication is significant.

4. Glycolaldehyde appears as the same mass as acetic acid in PTRMS: This is true and we can adjust the text to include this observation. Our GCMS analyses showed only acetic acid present, although it is possible that glycolaldehyde may not be easily analyzed with our GCMS method. However, measurements of the emissions of fires consuming various wood fuels indicate that the acetic acid emission factor is on average 6 times that for glycolaldehyde (Christian et al., 2004). The comparison and reference will be included in the revised manuscript. Also, furan and isoprene share the common mass (69) in PTRMS. Isoprene is emitted immediately after it is produced by certain plant species when exposed to sufficient sunlight; it is not stored in the leaf or wood tissue. Since our experiments were conducted in the darkness of the oven, we expect no isoprene to be produced. Isoprene was below detection limit in our GCMS analyses, while furan was easily identified. Additionally, although isoprene has been reported as an emission from numerous fires, its emission factor is 4 to 10 times less than furan (Andreae and Merlet, 2001). We will include a discussion of common ions in the revised text.

5. Emission estimates for charcoal kilns should be calculated using reference supplied by reviewer (Bertschi et al., 2003): We have estimated VOC emissions from charcoal production by comparing results with kiln measurements of Pennise et al., 2001

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and global contributions with Yevich and Logan, 2003. Emission factors during distillation and pyrolysis for individual VOCs were measured directly in our experiments. Our manuscript was not focused on more accurately describing emissions from particular landscapes. The global emissions of VOCs from charcoal production, using results from Yevich and Logan (2003), was only included to indicate the possible magnitude of VOC emissions. We don't think a more detailed emission estimate for certain landscapes is appropriate here. However, we will, as much as possible, expand our comparison with previous results (Table 3).

6. References to emission factors are out of date: We have cited the literature review of Andreae and Merlet [2001] because this is a familiar paper to many investigators. While more recent work has extended and improved the estimate of emission factors, we only wanted to show how much work had been done on the subject by numerous investigators. We can include the more recent report suggested.

7. Previous TGA work on pyrolysis should be cited: We will review the suggested literature and include references where appropriate. Regarding the summary of biomass pyrolysis made by reviewer, we have cited his work in connection with this (section 3.1). We will make citation of his figure 7 explicit.

8. Ethylene emissions: Ethylene and formic acid could not be observed with our GCMS and PTRMS methods.

9. Charcoal kiln temperatures: While some kilns are heated to much higher temperatures than those considered in these experiments, all of the biomass in the kiln is heated at the lower temperatures at some time during the process and the VOC emissions described will occur. We discuss charcoal production because the process does not include the flaming phase of combustion.

10. Section 4.3, VOC emission weight fraction: The wording in the text should read "it is assumed, therefore, that VOC emissions measured comprise the major fraction of total VOC emissions."

11. Terpenes and pyrazine from leaf and woody tissue: We will change the reasoning for the higher terpene/pyrazine emissions from leaf versus woody tissue to recognize that leaves contain more nitrogen than woody tissue, that cellulose does not contain nitrogen, and that terpenes are stored in eucalyptus leaves, not woody tissue.

12. Emission factors for some oxygenated VOCs: The emission factors for the most abundant oxygenated VOC emissions may be read from Figure 6. As also suggested by Reviewer #1, we will expand comparison of emission factors in Table 3.

13. Figure 3 middle graph mislabeled: The middle panel should be labeled acetone, as it is in caption.

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