Atmos. Chem. Phys. Discuss., 10, C3316–C3318, 2010
www.atmos-chem-phys-discuss.net/10/C3316/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Measured and modeled humidification factors of fresh smoke particles from biomass burning: role of inorganic constituents" *by* J. L. Hand et al.

J. L. Hand et al.

hand@cira.colostate.edu

Received and published: 28 May 2010

Comments to Reid review:

Comment: This paper presents results from the FLAME program with regard to measurement and modeling of smoke particle hygroscopicity. Focus is on the hypothesis that the fuel dependant particle hygroscopicity characteristics can be mostly explained buy particle inorganic fraction. The paper is clean, well written and to the point. The experimental design is well described and as far as I can tell well executed. In short, this paper could be accepted immediately. However, I do have a few suggestions which could make this good clean paper much more easily applicable to the broader commu-

nity. The inorganic fraction hypothesis they present is actually very is well established in the community-although never before has it been so cleanly displayed. The authors could improve the paper by adding a bit of context. They should hit the library and look over the previous work done for the 1997 Indonesia fires, and SCAR-B, as well as further research in the SAFARI-2000 campaign. In all of these cases increases in smoke particle hygroscopicity were hypothesized to be due to be related to higher inorganic fraction.

Response: We appreciate the helpful and insightful comments of this reviewer. We did not include a wider review of measured ambient f(RH) in this paper because we had provided a summary of previous results in an earlier paper (Day et al., 2006) and referred to it here. However, we have added the following discussion to this paper [page 4247, line 6]:

"The range of f(RH) values we report (0.99 to 1.81) is consistent with previous observations, both in the laboratory and in the ambient atmosphere. Aircraft measurements of f(RH) during the dry season in Brazil were reported by Kotchenruther and Hobbs (1998) and ranged from 1.01-1.51 (humid/dry RH of 80/30%). Higher values occurred under aged conditions, suggesting the importance of atmospheric processing on aerosol hygroscopicity. However, Magi and Hobbs (2003) found similar values of f(RH) for young (∼hr old) smoke (1.42) compared to heavily aged smoke (1.44) during aircraft measurements in southern Africa. The importance of fuel composition on hygroscopic properties was suggested by Gras et al. (1999) based on aircraft measurements of smoke f(RH) from north Australian savannah fires (1.37) compared to sulfur-rich peat fires in Indonesia (1.65). Laboratory chamber measurements of f(RH) during a preliminary FLAME study ranged from 1.10 to 1.51 (humid/dry RH of 92/10%) (Day et al., 2006). Values of f(RH) for smoke from Alaskan duff were comparable between the earlier study and this one (1.10 at RH=92% compared to 1.07 at RH=80-85, respectively). However, lower estimates of f(RH) corresponding to smoke from burns of sage were reported during the earlier study compared to this one (1.30 at RH=92%

compared to 1.81 at RH=80-85%, respectively). Petters et al. (2009) also observed a wide range of hygroscopicity of sage from multiple burns, even within the same experiment. Apparently the source location of sage brush can have a significant effect on the hygroscopic response (Carrico et al., 2010). Measurements of f(RH) by Lewis et al. (2009) during the 2006 FLAME experiment were comparable to our estimates for two available fuels (chamise and ponderosa pine). Values of f(RH) for chamise varied between 1.45-1.8 as reported by Lewis et al. (2009) and 1.58 reported here. Results for ponderosa pine were f(RH)=1 for both studies."

Comment: Based on the current result, a simple parametric model could be proposed based on inorganic mass fraction. Compare that to some of the field result and see if it matches. If it does, you have something modelers will be tripping over themselves to apply.

Response: We agree that a simple parametric model would be very interesting and possibly quite useful to the broader community; unfortunately it is outside of the scope of this paper. Thanks to the suggestion, we hope to test this idea as a topic of current and future work and not just in the context of smoke.

Comment: My only other comment is the presentation in the text of f(RH) at 85 to 90% RH. 80% is more standard in the field, and more typical for the environment for people who apply these values. I suggest they present both.

Response: We have changed our presentation of f(RH) at RH=80% (80-85%) as the reviewer suggested. We present only these values in an effort to simplify the discussion. Reporting values at this RH allowed us to include two additional fuels (lignin and Puerto Rico wood) in the discussion.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 4225, 2010.