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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Physical properties of iodate solutions and the deliquescence of crystalline I_2O_5 and HIO_3" *by* R. Kumar et al.

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Authors Response to Anonymous Referee 2

1. Hygroscopic nature of particles

Response: Whilst in hindsight, it is most likely that these particles were of iodine oxide composition, as far as I'm aware, the authors of the cited paper measured the hygroscopic growth but did not analyse the particles for composition and give no indication of the chemical nature of the particles – indeed there is no mention of iodine in the paper. This makes any direct comparison with our findings or related

discussion somewhat speculative. However, at the referee's request, we will add a sentence to highlight that the nucleation mode particles sampled during characteristic low-tide 'bursts' in the Väkevä et al. study showed little, if no growth (HGF = 1.0-1.1), when subsequently exposed to RH = 90%, which is consistent with our comments (supported by evidence from our earlier cited work; Saunders et al., 2010) in section 4.

2. Amorphous/glassy particles – implications

Response: Yes, we agree that this is a potentially important finding. We caveat the conclusion at present because optical microscopy is not an ideal method for distinguishing between glassy and crystalline solids. We considered using X-ray diffraction, but the mass of the material is just too small to obtain a diffraction pattern. We are at present constructing a temperature and humidity controlled flow cell which will be coupled to a Raman microscope system which we plan to use to distinguish between crystalline and amorphous solids. This work will appear in a future publication.
We have modified the pertinent paragraph to highlight the potential importance of glass formation in atmospheric aerosol on p20835 to read: 'This result is intriguing given that sub-saturated iodate solutions become increasingly viscous at higher concentrations. This trend is likely to continue as the iodate solutions become supersaturated as the RH is lowered below DRH. It is known that many aqueous solutions can become glassy at high concentration (Zobrist et al., 2008; Murray, 2008a; Murray and Bertram, 2008; Mikhailov et al., 2009; Murray et al., 2010c) and it was recently suggested that secondary organic aerosol can exist in a glassy state (Virtanen et al., 2010). This may have important implications for partitioning of semi-volatiles to the aerosol phase, heterogeneous reaction rates and may influence a particles' ability to act as a cloud condensation or ice nucleus. Further work is required to see if iodate solutions become glassy under atmospherically relevant conditions.

Technical comments/corrections:
a) Error calculations
Response:
1. Error in water activity is a standard error of the water activity meter.
2. Error in density is propagated from the standard error in weighing balance and volumetric flasks.
3. Error in viscosity is propagated from error in density and standard deviation of descent time.
4. Error in solubility of I_2O_5 is propagated from the polynomial fit of water activity as DRH data since error in DRH is $\pm$1%
5. Error in DRH is standard error of instrument which is propagated from the error in temperature in cold stage and temperature of bath.
6. Error in enthalpy of solution is propagated from the error in slope of figures 7 and 8.
7. Errors in viscosity coefficient A and activation energy in table 2 are propagated from the intercept and slope of the figure 5 for each molality.

b) Paragraph merging
Response: These will be merged as suggested.

c) Parameter definition
Response: As p was defined on page 20827, the repetition on page 20833 will be removed.

d) Clarity of figure scales
Response: We don't understand this point – the axis scale in each of these figures seems perfectly readable.

e) Figure clarity
Response: We will amend this figure for clarification.

f) Error bars
Response: See point 6 in our previous response to error determinations.

g) Figure quality
Response: Figure format will be changed.

h) Derivation of data in figure
Response: The ice saturation line is determined from the ratio (multiplied by 100 to convert to a %) of p_{ice} to p_{liq} using the expressions for each given in Murphy and Koop, 2005 (now cited) – see equations 7 and 10 in this paper. This will be added to the figure caption.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 20823, 2010.