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Atmospheric Chemistry and Physics Discussions

Interactive comment on "13-month climatology of the aerosol hygroscopicity at the free tropospheric site Jungfraujoch (3580 m a.s.l.)" *by* L. Kammermann et al.

Anonymous Referee #3

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Overall this is a very good paper that addresses hygroscopic properties of atmospheric aerosol. This is a property that is of consequence to global modeling and radiation transfer and climate science. The results presented are representative of the regional scale of Western Europe. They include seasonal and synoptic variability as well as shorter term variability and quantitative presentation of this variability in addition to the central values of hygroscopcity.

More emphasis should be placed on the variability and its importance as input to models.

Page 13577

"Thereafter, a monodisperse size cut with dry diameter $D0$ is

selected using a differential mobility analyzer (DMA) and subsequently humidified by

transferring water vapor through a Gore-Tex™ tube into the sample flow."

Suggest, "size increment" or rather than " size cut".

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"All data measured at lower or higher RH were ignored."

Suggest, "All data acquired at lower or higher RH were ignored."

"Different integral properties . . . "

I would call these central values of the PDF rather than integral properties.

Page 13579

"Two particles of different size but identical chemical composition will

have the same because the influence of the Kelvin effect is filtered."

Suggest, ". . . .because the influence of the Kelvin effect is removed according to equation 2, below".

"We assumed surface tension of pure water in our calculations."

What error is associated with this assumption?

Page 13580

"During winter this effect is hardly found, and the air masses present are usually representative of the free tropospheric background conditions (FT)."

Suggest, "During winter this effect is found infrequently,. . . ."

If this can be quantified by percentage of time observed then all the better.

Page 13581

"A total of 10 408, 10 575, 10 626, 10 596, 10 532, and 10 115 valid GF-PDFs were obtained for D0=35, 50, 75, 110, 165, and 265 nm, respectively, during the 13 months of measurement on the JFJ."

Simplify to "Approximately 10,000 ..... were obtained at each Do value during ....."

Explain why the N for the largest Do is significantly different if this is of importance with respect to your results and aerosol properties, and continue with the next paragraph.

"Seasonal mean GF-PDFs were calculated by averaging these individual GF-PDFs separately for each season and dry size (Fig. 2a–f). It has to be emphasized that mean GF-PDFs just represent. . . "

"Separately" and "just" not needed.

Page 13582

". . . of small non-hygroscopic particles are too low to show up as a distinct non-hygroscopic . . . "

Are the emissions to low or the concentration of gas or particulate phase hygroscopic mass too large and accumulation of hygroscopic mass too fast (efficient) as in previous sentence?

"They are characterized by a dominant contribution of more hygroscopic particles with growth factors between 1.25–1.7, as well as a minor contribution of less hygroscopic particles with growth factors .1.25."

As stated earlier, the averaging precludes that there were ever two separate modes in the GF PDF. Were there significant occurrences of two modes simultaneously? To

show this would require a different statistic.

"The annual cycle and the size dependence of integral properties of the GF-PDF are discussed in the following."

This does not add much to the discussion; it is basically the section heading repeated.

Page 13583

"Monthly mean -values, determined from the observed hygroscopic growth according to Eqs. (1) and (2), varied in the narrow range between 0.17 and 0.31 . . . "

To say that the range is narrow requires some reference either internal from your own data set or some other set, atmospheric or otherwise.

Similarly, in connection with this and results in related paragraphs, to state that

". . . no pronounced seasonal trend was found for GF. . . "

one should discuss the importance of variation and standard deviations for the average monthly values or the uncertainty in the g(RH) and κgalues.

While a constant k value is convenient and maybe OK for a simple description of hygroscopicity most models can handle seasonal and synoptic variability. I would not want modelers to take this as regionally and seasonally constant. Thus, the inter and intraseasonal distribution of GF as presented in Table 2 should be pointed out to the reader. What effect would the range or uncertainty of kappa have on say CCN potential at low supersaturations or on extinction, direct radiative effect, for a given RH?

Page 13584

"In a further analysis separated mean GF-PDF. . . ."

In a further analysis, separate mean GF-PDFs. . . .

GF-percentiles are equivalent to a simplified GF-PDF because each GFpercentile

corresponds the a single point of the cumulative distribution function.

.. corresponds to the. . . .

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. . . .can be explained by the fact that the dust particles are not very numerous

but non-hygroscopic and predominantly in the coarse mode size range (see Fig. A1),

with over-proportionally large scattering cross section.

Awkward. I suggest,

. . . can be explained by the fact that although the dust particles are not very numerous, they are non-hygroscopic and predominantly in the coarse mode size range (see Fig. A1).

Because they are larger they have a more dominant effect on scattering cross section relative to the FT or PBL accumulation mode at other times.

"Here we investigate the diurnal patterns of the hygroscopic growth factors for different weather classes. . . "

Here we investigate the diurnal patterns of the hygroscopic growth factors for routinely determined weather classes at JFJ. . .

In Fig. 5 legend, spell out the weather classes and acronyms, e.g., Convective Cyclonic, CC as in section 2.4

"The diurnal pattern of GF spans values from 0.33–0.15 and 0.27–0.20"

The diurnal pattern of GF spans values from ca. 0.33 to ca. 0.15 and 0.27 to 0.20

The summary paragraphs of section 3.3 are largely redundant with the descriptive paragraphs and should be integrated or eliminated.

Page 13590

". . . Fig. 6 did not change anything."

Fig. 6 did not change the results.

Page 13591

"Consequently a constant and size independent value of 0.24 is a good approximation in any model that needs a simple description of the Aitken and accumulation mode aerosol at the JFJ site."

Don't underrate your results to a single average number for use in models with simple hygroscopicity parameterization. The real value here is that you have measured values of kappa or GF that are regionally representative and that show seasonal and synoptic variation that is of significance when put in the context of direct radiative forcing or potential CCN activity.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 13573, 2010.