Atmos. Meas. Tech. Discuss., 2, S63–S66, 2009
www.atmos-meas-tech-discuss.net/2/S63/2009/

Atmospheric Measurement Techniques Discussions

Interactive comment on "A new airborne tandem platform for collocated measurements of microphysical cloud and radiation properties" *by* W. Frey et al.

W. Frey et al.

Received and published: 31 March 2009

The authors would like to thank Darrel Baumgardner for his helpful comments and suggestions. The questions are answered below and changes to the manuscript have been made as stated.

Question 1: How is the horizontal position of the AIRTOSS controlled and how precisely?

Reply: The horizontal position of AIRTOSS is not actively controlled during the flight, but recorded by an INS. For guarantying the horizontal alignment, it has to be assured that the centre of gravity of the AIRTOSS is located in a specific region close to the hook. During flight AIRTOSS will put itself automatically in a horizontal position and align itself with the streamlines. To stabilise AIRTOSS, winglets are placed at the end of the drag-body. Horizontal positioning is measured by the INS with an accuracy of $< 0.3^{\circ}$ (roll/pitch).

Question 2: Has the performance of the AIRTOSS been theoretically modeled? If not are there plans to do so? I think that it is a critical component of understanding its aerodynamic behaviour to do a flow model and validate with the measurements.

Reply: Modelling certainly will be a helpful tool in this regard. Thus, this is a very good idea but it has not been realised yet.

Question 3: What were the radius of the turns and how does the radius affect its performance?

Reply: The radii of the turns have not been measured directly. A rough estimation from GPS data gives radii between about 1 km and 5 km. Since flying turns is linked with a change in heading, the radius affects the roll angle of the AIRTOSS: the smaller the radius, the higher the heading change and the higher the roll angle. Thus, a correlation of 0.96 between the reciprocal radius and the absolute value of the roll angle is found. This is the same value as for the correlation between heading change and roll angle.

Comments and Suggestions 1: Suggest "Turns" not "curves", or use "Curved Trajectories".

Reply: The term "curves" has been changed in the revised manuscript.

Comments and Suggestions 2: No need to write out the equation for the Pearson Correlation Coefficient, this is well known, more important to discuss the significance of the correlations.

Reply: The authors agree that this equation should be well known. But sometimes the denominator $(ns_x s_y)$ is used instead of $((n-1)s_x s_y)$. Therefore, we decided to write down the equation here. With the available numbers of data points (mean of 910) all correlations which are specified in the manuscript are significant with absolute values of r_{xy} ranging from 0.74 to 0.99. The respective passage has been revised as follows: "...During these phases the impact of changes in the flight parameters, such as altitude, airspeed, towing cable length, and attitude angles of AIRTOSS, named x and y in Eq. 1, are investigated. Pearson correlation coefficients of these flight parameters have been calculated according to the following equation: $r_{xy} = \frac{\mathrm{COV}_{xy}}{s_x s_y} = \frac{\sum_{i=1}^{n}(x_i-\overline{x})(y_i-\overline{y})}{(n-1)s_x s_y}$ with COV_{xy} being the covariance between x and y, s_x and s_y denoting the sample standard deviations of x and y, and $\overline{x}$ and $\overline{y}$ referring to the sample means of x and y. The number of data points recorded at 1 Hz resolution for the calculation varies with the flight phases and is given in Table 3. The minimum/mean number of data points was 169/910, respectively. With these numbers of data points all correlations which are specified in the following are significant with absolute values of r_{xy} ranging from 0.74 to 0.99. ..."

Comments and Suggestions 3: A Plan view schematic showing the relative position of the AIRTOSS to the aircraft in the horizontal would be useful. Were there any photos taken from above by the other aircraft?

Reply: We agree, to know the relative position of AIRTOSS to the Learjet is important for a good synchronisation of cloud microphysical and radiation measurements.
Pictures from the other aircraft have just been taken from aside. The exact position of AIRTOSS relative to the Learjet is unknown. So far it is just possible to estimate the relative positions due to GPS positions. Since there have been problems with the position data of the AIRTOSS, this is not incorporated in the manuscript. The improvement of our knowledge of these positions will be addressed in the upcoming experiments with AIRTOSS.

Comments and Suggestions 4: The CDP measures from 2-50 μm.

Reply: The measurement range has been corrected in the revised manuscript.

Comments and Suggestions 5: It would be a better example to show how the micro-

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physical parameters relate to the radiative flux. How about a cross correlation between radiation and drop concentration or do a frequency analysis to show spatial scales of concentration versus those of radiation?

Reply: This is an excellent suggestion. We have done some tests in that regard. For example, the correlation of upwelling radiance (at 550 nm) and drop concentration amounts to 0.6.
However, a major difficulty is to determine the exact position of AIRTOSS within the cloud, which could not be done due to problems in the GPS data. Without this knowledge the calculation of cross correlations will be prone to errors.
Nevertheless, this exercise will be important for further analysis of relations between cloud microphysical and radiation measurements. The paper presented here describes the proof-of-concept of AIRTOSS and therefore, the major attention is paid to the flight behaviour of AIRTOSS. This suggestion will be a very important task for the next AIRTOSS mission.

Comments and Suggestions 6: The final version should be edited carefully. The English is excellent but could use some final touches.

Reply: The authors will check the revised manuscript carefully.

Interactive comment on Atmos. Meas. Tech. Discuss., 2, 1, 2009.