Atmos. Meas. Tech. Discuss., 3, C152–C155, 2010
www.atmos-meas-tech-discuss.net/3/C152/2010/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Automatic cloud classification of whole sky images" *by* A. Heinle et al.

A. Heinle et al.

sunshane@web.de

Received and published: 9 April 2010

We thank R. Scheirer for taking time to review our manuscript. His comments and suggestions were very helpful.

RC: It would be nice to learn something on the limitations of the algorithm. For example, it is based on an analysis of visible light. So it is certainly not working during night (which is actually a pity). What are the limits in terms of solar zenith angle? Are there more restrictive conditions (aerosols, rain, fog)?

AC: As noted, the algorithm is based on the RGB-information given by the camera and therefore only senisble during the day. Limits with respect to the zenith angle, however, are not given in particular. Due to an enhanced scattering in the atmosphere the color composition of an image certainly changes at high zenith angles. For this reason, our training sample comprises images at different zenith angles, from very high to very low, making a classification of such images feasible as well. The second question, if there are more restrictive conditions, has to be answered with yes. In chapter 4.1 and 4.2 we pointed out, that rain drops or aerosols can yield to some more missclassifications. Avoiding errors caused by these factors will be part of further research.

RC: Within the introduction (page 271, line 2), the authors mention, that satellite data come 'in a low resolution'. This gives the impression, that the spatial resolution (guessing it don't refer to the temporal resolution) of the cloud classification, proposed here, is somewhat higher. Since the written scheme provides one cloud class for a whole image, I doubt that the reached footprint is smaller than the 1 by 1 km, achieved by common products, derived on the base of space born instruments.

AC: It's true that the algorithm presented determines only one cloud class per image which corresponds to an area of more than 1 by 1 km. The resolution of the all-sky imagers, however, is much higher than the resolution of common satellite data. Whereas satellite imagenery can detect only cloud fields greater than 1 square kilometer, it is possible to identify individual and much smaller cloudlets using our ground based cameras. In combination with the cloud type information, this is very useful in radiation research.

RC: Chapter 2.2 (page 273, line 10). Here it is written, that the acquired data-set 'covers a wide range of possible sky conditions'. This is questionable. The sample is certainly dominated by marine-type air compositions. At different conditions (downwind of urban or industrial areas) with different aerosol types (e.g. black carbon with spectral characteristics, which hamper the color-difference tests) a different algorithm may work better. This should be addressed.

AC: For the development and to investigate the main architecture of the algorithm, it was important to consider data as unbiased and universal as possible. Therefore, the presented data, in fact containing not all but a broad range of common sky conditions, has been chosen. Since the success of the algorithm is highly dependent on the training sample used, we highlighted its importance in chapter 3.2.

RC: Chapter 3.3 (page 276, line 17ff). The introduction of a spectral difference to replace the spectral ratio: I would expect the threshold to be dependent on the total brightness (e.g. if R < threshold, than the threshold will never be exceeded). The misclassification of pixels close to the sun is probably due to a change in color-composition with viewing angle in relation to the sun. This means, the excess-blue seen away from the sun, is scattered out of the direct beam. If you look more towards the sun you'll see more parts of the unscattered spectrum (the longer wavelengths). Maybe one can get rid of this effect by a threshold, adapted to the difference angle relative to the sun.

AC: In chapter 5 (page 285, line 11ff) we made an appropriate suggestion. Knowledge of the sun position could be helpful to avoid misclassifications caused by the circumsolar area of the sky and should definitely be considered in future approaches.

RC: Chapter 4.2 (page 284, line 7ff). If it is difficult to separate two classes, which are on the other hand, similar in respect to their properties, then these classes should probably be merged.

AC: The classes stratocumulus, altocumulus and stratus can be distinguished by the features presented. Since generally no clear delimitations exist between different cloud types, "misclassifications“ by the algorithm in respect to another, manual classification can occure, both being accurate (see also chapter 4.1 (page 282, line 6ff) "...All three classes occur frequently as transitional forms from one in the other and the automatic classification of such images could differ from the manual preclassification.“).

RC: Chapter 5 (page 286, line 7). Miss-classifications due to multiple cloud types in FOV: A different approach to the proposed sectioning of the FOV (which not necessarily solves the problem) would be to generate a new class 'multiple types' or something like that.

AMTD
3, C152–C155, 2010

AC: We performed such an approach. Unfortunately, due to the high variability of "multiple cloudtypes“, the additional class caused more confusions instead of avoiding errors.

RC: Chapter 3.4 (page 280, equation 11). . . .

AC: We have simplified the equation.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 269, 2010.