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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Detection of dust aerosol by combining CALIPSO active lidar and passive IIR measurements" *by* B. Chen et al.

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We are very appreciative of the reviewer's thorough review of the paper and recommend to "accepting". Our point-by-point responses to the comments (italics) made by the reviewers are as following.

-This paper describes a cloud detection algorithm combining the data from CALIOP and Infrared Imaging Radiometer (IIR) both on the CALIPSO satellite. The authors demonstrated the algorithm using only CALIOP data, which is used in the CALIPSO version 2 data, often misclassify dense dust layer as cloud. The algorithm combining CALIOP data and the brightness temperature difference (BTD) data from ILL much improved the accuracy of cloud detection. The coefficients for the algorithm were determined from the CALIPSO data, and the CloudSat and MODIS data in 2007 over

Taklamakan desert, and the validation and error analysis were done with the data in 2008. The paper is very well written and may be accepted with minor revisions.

Specific comments:

-p.3430 l.8: The use of both BTD1 and BTD2 in Eq.(1) should be better explained. BTD between 8 and 11 is not mentioned here.

As Zhang et al. (2006) (Zhang et al., Identification and physical retrieval of dust storm using three MODIS thermal IR channels, Global Planet. Change, 52(1–4), 197–206, 2006) showed, "BTD2 (the brightness temperature difference between the IIR 8.65 and 11.60 μm channels) is the optimal threshold to determine the strength of dust storm." We have added above statement in the revision.

-P3431 Eq.(2) and p.3432 Eq.(3): Though it is probably common in the remote sensing community to express the cost function as a single equation, summing linear functions of sensitive parameters, it would be better to give some explanation on the method. It is different from the method considering a condition in a multi-dimensional space, and it may have some limitations in the performance.

This combined lidar and IR measurement (CLIM) method uses the IIR tri-spectral IR brightness temperatures to discriminate between ice cloud and dense dust layers, and lidar measurements alone to detect thin dust and water cloud layers. As the page 3433 line 7 to 17 explanation: These coefficients weight the various input parameters used in Eq. (3). First, the depolarization ratio can distinguish certain features (including ice clouds and dust aerosol) from all others. Second, for dense features, the dense dust parameters, β, δ, and χ, are almost the same as for the same altitude ice clouds. However, the BTD$11-12$ is always negative for dense dust and positive for ice cloud, and the dense dust can be distinguished from dense ice cloud by the CLIM method. For thin features, the BTD of dust aerosol and ice cloud may be almost the same over certain surfaces when surface infrared radiation can penetrate these features. However, for ice clouds, β is larger and the layer altitude is higher, while for dust, β

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is smaller and the layer altitude is lower; thus, based on these differences, the CLIM method can distinguish thin dust from ice cloud. The CLIM method has some limitations in the performance, i.e.: just application in single layers segments, and in a single layers segment, as error analysis showed that there were three misclassification scenarios: thinner cloud located near cloud edges, cloud mixed with dust, and dust aerosol layers above or underneath the cloud layer. This paper represents the initial development of this technique. For multi-layer dust or dust covered by cloud case, more sensor measurements may need to be integrated, such as microwave measurements. By combining all the methods, it could be possible to overcome some of the weaknesses in techniques used alone. We have clarified above points in our revision.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 3423, 2010.

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Interactive Comment

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