Atmos. Chem. Phys. Discuss., 12, C8374–C8376, 2012
www.atmos-chem-phys-discuss.net/12/C8374/2012/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluating MODIS cloud retrievals with in situ observations from VOCALS-REx" *by* N. J. King et al.

Anonymous Referee #1

Received and published: 19 October 2012

Comments on "Evaluating MODIS cloud retrievals with in situ observations from VOCALS-Rex", by N. J. King et al. MS No.: acp-2012-687 Special Issue: VAMOS Ocean-Cloud-Atmosphere-Land Study (VOCALS) (ACP/OS Inter-Journal SI)

Summary: The manuscript presents a comparison of cloud droplet effective radius (Re) between satellite-based retrieval from the MODIS and in situ measurements made during the VOCALS-Rex field campaign. It is found that for the eleven VOCALS-Rex flight segments compared, the MODIS Re is about 1$\sim$2μm (13%) larger than in situ values. Many potential reasons are discussed and various sensitivity tests are performed to explain this difference. However, none of the hypotheses are able to explain the size of the difference.

General comments: Satellite-based cloud droplet size retrieval products are widely

used in climate and aerosol indirect effect studies. It is important to evaluate and validate these products, which are usually done by comparing satellite retrievals with in situ measurements that are considered as the ground truth. However, because of many inherent differences it is extremely difficult to make an apple-to-apple comparison between satellite retrieval and in situ measurement. This manuscript clearly demonstrated the difficult issues involved in the comparison between satellite retrieval and in situ measurement, and made solid attempts to address them. Although a satisfying explanation about is not yet available as why MODIS retrieval of Re is generally larger than in situ values, many lessons are learned through the comparison exercise. I enjoyed reading this manuscript. It is well organized and well written. The discussion is thorough and illuminating. However, a clarification of a few minor issues/questions is necessary and may lead to improvement of the manuscript. I also have a couple of suggestions for the authors to consider. My overall recommendation is accept with minor revision.

Detailed comments: 1. How are in situ cloud optical thickness (Tau) and LWP measurement made? In section 2.1, the in situ measurements of Re and LWC are explained. However, I didn't find any discussion on Tau and LWP measurements, even though they are compared to MODIS retrieval later in Figure 3 and 4. An important point to clarify is that the Tau and LWP are column-integrated variables, whereas in situ measurements are made along aircraft track. This may not be a big issue if Tau and LWP vary slowly in horizontal. However, several papers indicate that Tau and LWP can vary rapidly within small scales (10m$\sim$100m). Therefore, it is important to clarify how Tau and LWP are derived from in situ measurements in Section 2.1

2. Why is comparison made at 5x5km? I understand that the horizontal extent of aircraft profiling is from 2$\sim$7km. But why not just choose the MODIS pixels that encompass the aircraft track?

3. Why CDP, instead of 2DS, is used to derive the width of droplet size distribution? When discussing the assumption of the width of droplet size distribution as a poten-

tial error source in Section 4, the CDP measurement is used. But isn't 2DS able to cover wider droplet size spectral? Why not use 2DS measurements to derive standard deviation of the droplet size distribution?

4. Sub-pixel variability test: It is nice to see that the authors attempt to address the effect of cloud horizontal heterogeneity on MODIS retrieval and in situ sampling. But with the continuous in situ measurements the authors should be able to go further than a simple heterogeneity index test. In fact, the authors can make a high resolution radiative transfer simulation of cloud reflectance and synthetic retrievals based on in situ measurement. Then high-resolution cloud reflectance can be aggregate to MODIS resolution to obtain MODIS-like retrievals. By comparing the statistics of the high-resolution retrievals and the MODIS like retrievals, the effect of cloud horizontal heterogeneity might be better addressed.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 23679, 2012.