

Interactive comment on “Evaluation of Arctic cloud products from the EUMETSAT Climate Monitoring Satellite Application Facility based on CALIPSO-CALIOP observations” by K.-G. Karlsson and A. Dybbroe

K.-G. Karlsson and A. Dybbroe

karl-goran.karlsson@smhi.se

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CHANGES DURING POLAR SUMMER:

It is true that the deviation (small underestimation of cloud cover) is increasing also during the studied polar summer months with the largest deviation (-7 %) occurring in August 2007. Yes, we interpret this as being caused by increasingly unfavourable illumination conditions in the Arctic region as we go from the best illuminated month (June) towards August. It is not only the fact that nighttime conditions start to appear

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but also that we are as well facing an increasing frequency of cases with twilight conditions, i.e. conditions with sun very close to the horizon. The latter condition makes for example the use of the AVHRR 3.7 micron channel quite problematic since the cloud appearance changes drastically from day to night in this channel. At twilight conditions clouds (in particular water clouds) will for a short while (at solar zenith angles close to 85 degrees) not be distinguishable from cloud-free surfaces in this AVHRR channel. Thus, if there is not a significant temperature difference between cloud tops and surfaces (which is more or less the normal situation in the Arctic), allowing for an efficient use of other infrared channels at 11 and 12 micron, a substantial amount of these clouds will remain undetected.

We will comment this behaviour more clearly in the revised manuscript.

SITUATION OVER GREENLAND IN POLAR SUMMER:

The comment related to the situation over the Greenland ice plateau is actually not directly related to this. Here we would like to stress the fact that at the Greenland ice plateau, despite being under polar summer conditions (with good illumination), we will here face surface temperatures over the snow/ice that are much colder than the temperatures for corresponding surfaces over e.g. the Arctic ocean. Thus, we cannot here use infrared channels efficiently for cloud detection, i.e., cloud temperatures are often comparable to and not colder than the surface temperature. It means that for infrared channels conditions are not very different here compared to what would be experienced during the polar winter. As a contrast, surface temperatures are much warmer (often close to zero degree Celsius) over the Arctic ocean which leads to at least some skill in the use of infrared temperature contrasts for cloud detection. The net effect is that we will fail in detecting some of the thin ice clouds over Greenland during the polar summer since these do not reflect significantly more (especially at 3.7 micron) than snow/ice surfaces. Over the Arctic ocean these clouds may still be detected because of a discernible temperature difference compared to the surface. This explains why cloud detection over Greenland performs worse than over e.g. the Arctic ocean in the

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polar summer but still better than the corresponding detection scores over Greenland in the polar winter (thanks to the detection of strongly reflecting clouds during the polar summer).

We will discuss these additional aspects in more detail in Section 4.

THE IMPACT OF EXISTING NAVIGATION ERRORS

In principle we agree with the reviewer here (i.e., that navigation errors might lead to systematic errors) when looking at an individual collocated NOAA/CALIPSO track. For example, if the track is passing along a very long cloud edge any navigation error here will mean that we systematically overestimate or underestimate the amount of cloudy pixels. However, our point is that if we aggregate results from many collocated tracks (here about 30-40 for each month) these systematic errors will tend to be averaged out. Also, with long tracks and several tracks being compared and aggregated we will sample a very wide range of cloud situations with very different morphologies. This also supports the view that potential systematic errors will be averaged out.

BETTER BALANCE IN THE DISCUSSION OF MODIS AND PPS CLOUD MASK RESULTS IS NEEDED

Yes, we agree. This point has also been addressed in another referee comment (see our reply here).

MISSING DISCUSSION RELATED TO PREVIOUSLY REPORTED MODIS-CALIOP RESULTS + IMPROVING THE CONCLUSION PART

We do refer to these previous studies in the manuscript (Holz et al,2008 and Ackermann et al, 2008) but we admit that a more comprehensive discussion and inter-comparison of the results could be made. We will try widening the discussion and conclusion sections in the revised manuscript taking these results better into account.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 16755, 2009.