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Discussions

Interactive comment on "Determining stages of cirrus life-cycle evolution: A cloud classification scheme" *by* Benedikt Urbanek et al.

Anonymous Referee #1

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Review of

**Determining stages of cirrus life-cycle evolution:
A cloud classification scheme**

by Urbanek et al.

The authors present an attempt to determine the stages of cirrus life-cycle evolution based on in-cloud RHi measurements performed by the airborne Lidar WALES. Though I like the idea and also find the paper well organized and fluently written, I have a major concern with respect to the proposed cirrus life-cycle classification scheme which I explain in the following. To my opinion this point should be cleared before publishing the manuscript in ACP.

Major comment: In the introduction, the authors state:
'*In order to gain more insight into the particular role of different cirrus clouds, great efforts were made to classify cirrus by the meteorological contexts in which they occur (Jackson et al., 2015; Muhlbauer et al., 2014). Categories include "synoptic", "orographic", "lee wave" and "anvil" cirrus. Recently Krämer et al. (2016) introduced a more general classification distinguishing the groups of "liquid origin" and "in situ" clouds that describe whether the cirrus formed from a pre-existing liquid cloud or from cloud-free air. Such a classification of recorded data is a prerequisite for statistically investigating the specific properties and influences of different clouds, and to extract the governing mechanisms and parameters from remote sensing and in situ measurements.*'

However, the cirrus life-cycle classification scheme presented in the paper holds only for 'in situ' formed cirrus clouds. In the so-called 'liquid origin' cirrus, the meaning of 'SUB' will be similar, but what about the interpreation of 'DEP', HETin and HOMin in case of pre-existing ice? It is very likely that in case of further lifting of a liquid origin cirrus cloud the supersaturation rises to values of DEP, HETin or HOMin (then, a new, homogeneous nucleation event can occur on top of the liquid origin cirrus), but they are at different stages of cirrus evolution than the in situ cirrus.

In a recent publication of Wernli et al. (2016), GRL, the frequencies of occurence of in situ and liquid origin cirrus are analyzed from 12 years of ERA-Interim ice clouds in the North Atlantic region. Wernli et al. found that: 'Between 400 and 500 hPa more than 50% are liquid-origin cirrus, whereas this frequency decreases strongly with altitude (<10% at 200 hPa).'

Thus, it seems to be important that first of all these two types of cirrus can be identified by a cirrus classification scheme before going in the detail of stages of cirrus life-cycle evolution. So I would highly encourage the authors to continue their work by including an analysis of the cirrus origin prior to the investigation of the stages of evolution.

It might be an idea to first perform a trajectory analysis as done by Wernli et al. (2016) and also Luebke et al. (2016) using ECMWF wind fields and determine wether the back trajectory of an observed air parcel stemmed from temperatures warmer than -38C and carried ice when entering the cirrus temperature range. Then, the classification scheme can be applied to both types separatly.

Fig. 1.