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Atmospheric Measurement Techniques Discussions

Interactive comment on "Shortwave Radiative Effect of Arctic Low-Level Clouds: Evaluation of Imagery-Derived Irradiance with Aircraft Observations" *by* Hong Chen et al.

Anonymous Referee #3

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The paper presents a method to validate irradiances derived from satellite observations by aircraft irradiance observations.

The authors calculate irradiances using a radiative transfer model with cloud optical properties derived from MODIS observations as input. These modelled irradiances are compared to airborne observations of broadband irradiances (BBR) and shortwave spectral irradiances (SSFR). From aircraft observations, the spectral surface albedo is also derived, which is besides the cloud optical properties a crucial parameter for the calculation of (spectral) irradiances. On the other hand, if the surface albedo is not well-known, the retrieval of optical properties (particularly optically thin clouds) from

satellite observations is highly uncertain.

The presented results for two case studies show, that the airborne observations are consistent (i.e. BBR and SSFR yield the same broadband flux), thus the radiometric calibration of the two instruments is consistent. However, differences between airborne irradiance observations and satellite-derived irradiances are found. The main differences emerge from pixels, where clouds are not detected in the MODIS images (cloud optical thickness < 0.5). Otherwise the agreement was surprisingly good, the reason might be that different errors compensate during spectral integration.

The paper is generally well written and the results are clearly presented by appropriate figures. However, it should be stated more clearly that the paper presents a methodology rather than a thorough validation (see also comment below). The topic fits well into the scope of AMT, therefore I recommend publication after minor revisions.

General Comments:

- The title is misleading, since the cloud radiative effect of arctic low-level clouds is not discussed much in the paper. Also, the imaginary derived irradiances are not evaluated, because only two case studies are presented. In the conclusions it is stated that a statistical analysis of a large dataset would be required for evaluation but this has not yet been done. An appropriate title could be e.g. "A method to evaluate shortwave irradiances derived from satellite images of low-level arctic clouds with aircraft observations".

- Abstract: "This study suggests that passive imagery cloud detection could be improved through a multi-pixel approach, that would make it more dependable in the Arctic." -> Cloud detection methods are not discussed at all in the paper, thus is sentence should not be in the abstract.

- What is the uncertainty of the airborne observations? Please include error bars in the plots. If this is not possible, discuss the sources of errors in the text and provide a

rough estimate.

Technical corrections:

p4, l11: "radiative calculations" -> "radiative transfer calculations"

p5, l5: "satellite-based radiative transfer calculations" -> "irradiances calculated using an RTE model with input from satellite data ..."

p6 Eq.1: Reference for numbers used to convert RGB to grayscale

p11, l37: Fig. 6b -> Fig 7b

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