

## ***Interactive comment on “Cloud Photogrammetry with Dense Stereo for Fisheye Cameras” by C. Beekmans et al.***

### **Anonymous Referee #1**

Received and published: 9 June 2016

#### General Comments:

This manuscript presents a method to obtain dense stereo reconstruction on clouds by using a pair of cameras with fisheye lenses. Fisheye lenses provide a larger field of view but their projection model is different from pinhole models, hence they require a different calibration and rectification solution. The main contribution of this work is to combine dense stereo reconstruction methods with a stereo setup using fisheye lenses and exploit dense matching to derive 3D geometry of clouds. It presents the potential of stereo photogrammetry in providing 3D cloud geometry that is not easy to achieve with other atmospheric measurement devices. Considering that calibration is a crucial part of stereophotogrammetry, the methods described in this manuscript to achieve reliable camera calibration with a fisheye lens are of significant value. I recommend that this manuscript should be published but after carefully addressing the issues I detail below.

### Specific Comments:

In many parts of the manuscript, rectification is referred as the method that allows dense stereo matching. I find this misleading, because rectification is merely a transformation to translate the epipoles to infinity so that the epipolar lines are parallel in both images, hence matching algorithm is less time consuming and more straightforward to design.

Page 3, Line 3, Romps and Oktem also studied convective clouds in the following two references Romps and Oktem, Stereo photogrammetry reveals substantial drag on cloud thermals, GRL, 2015 Oktem and Romps, Observing atmospheric clouds through stereo reconstruction, Proceedings of SPIE - The International Society for Optical Engineering, March 2015

In Section 3, the parameters such as theta and phi angles are only displayed in figures but are not introduced in the text nor in the captions. There are many parameters used in the equations, it maybe a good idea to list and define them in a separate table or introduce/explain them in the text.

In Section 3.3, it is claimed that rectification allows to use the complete image content of a fisheye image. It is not clear to me why the whole content of rectified image can be used but the whole content of the non-rectified image cannot. Besides, the distortion (stretching) introduced by the rectification is likely to severely limit the use of data beyond a certain theta.

Section 4, Line 14, "Dense stereo is advantageous when dealing with complex geometries but also effectively delivers reasonable results for image regions with low-contrast". I believe that this statement needs revision to clarify the point being made. I understand the clouds are considered as complex geometries but it is not clear to me how dense stereo is advantageous for these cases.

### Technical Corrections:

[Printer-friendly version](#)[Discussion paper](#)

Abstract, Line 8, “..of the a cloud ...”, “the” should be omitted.

Abstract, Line 10, there appears to be tense mismatch.

Introduction, Page 1, Line 22, “...cloud observation..” should be “observations”

Introduction, Page 2, Line 9, “..which both need to be”, correct as “..both of which need to be..”

Page 3, Line 27, “..orientation consist of..”, correct as “..orientation consists of..”

Page 4, equations with phi uses lowercase phi in one equation, and uppercase phi in another, do they refer to different parameters?

Page 6, the last equation which is below Line 30, Is this the intended notation for e.g. “atan2(z\_v,y\_v)”? I believe that the notation should be revised to clearly state the formula.

Page 9, the first equation on the top, what is “sin(delta)”?

Page 10, Line 2, “..on the both..”, I recommend “...on both of the..”

Page 10, Line 10, better separate the last statement into two sentences to make it more readable.

Page 11, Line 32, “...mounted in a box with ...”, is “with” redundant in this statement?

Page 12, Line 3, “..(IDS, 2013).”, remove “.”

Page 12, Line 8, “..an reduced..”, correct as “..a reduced..”

Page 12, Line 17, “Further, the solid angle..”, correct as “Furthermore, ..”

Page 13, Line 9, correct “citeblender”

Page 13, Line 26, is “..0.15 seconds...” supposed to be “... 15 seconds ...”?

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Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-319, 2016.