

## ***Interactive comment on “Transmissivity of solar radiation within a *Picea sitchensis* stand under various sky conditions” by S. Dengel et al.***

**Anonymous Referee #3**

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Dengel et al. describe a study on light extinction in a managed *Picea sitchensis* stand in Central Scotland, addressing changes in the spectral distribution of light, which has a potential impact on photosynthesis. They present a comprehensive set of measurements quantifying the horizontal and vertical variations in spectral distribution, and focus on the role that sky conditions play in determining this distribution.

Overall, the study is concise and clearly written, and the topic is relevant for publication in Biogeosciences. Relatively few data sets exist that discuss spectral changes both horizontally and vertically, and I consider this paper suitable for publications once a few remarks have been addressed.

Major comments:

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- p. 3828, l. 8: Here, three objectives of the study are listed, but for (b) and (c), it is unclear how "importance" is defined: The authors do not measure the importance for photosynthesis in the study. Rather, the study determines whether spectral differences exist (b), and how gaps affect the spectral distribution (c).

- The discussions paper addresses light distributions in great detail, but does not show the impact of these changes on photosynthesis from measurements. This is not a flaw as such, but the authors seem to try and compensate for that by adding Fig. 7 in the last sentence of the paper, which comes a bit out of the blue. Also, the figure is referred to as "taken from Dengel and Grace, 2010" (p. 3839, l. 25), but, although the data probably originate from there, the figure as such is not given in there. If the authors want to address the impact of sky conditions on photosynthesis, I think this figure should be placed in the results section and should be described and discussed properly, and the measurements for this should be described (briefly) in the methods section (with reference to Dengel and Grace, 2010).

- p. 3833, l. 20: The extinction plot in Fig. 4, used to determine Beer-Lambert extinction coefficients, is interesting, but I have some doubts about the discussion of the clear sky curve. The light extinction as described by Beer-Lambert law should be considered a canopy-integrated description representative for a somewhat larger area, where beams of light can get absorbed in the canopy at different heights (depending on the LAI distribution). Determining the extinction coefficients from the observations in this study works reasonably well for conditions with diffuse light only, because of the absence of a direct beam. However, for the clear sky case, the beam is intercepted relatively high up in the canopy, after which there is no direct radiation left (except for the observed sun fleck at app. 11 m height). The slope in Fig. 4 observed for the remainder of the curve is hence representative for the diffuse fraction of the radiation occurring on a clear sky day. This binary behaviour for an individual measurement is not captured by Beer-Lambert's law, but when integrated over a larger area (where interception can happen at any height, and some beams can penetrate deeper), it still holds. Hence, the

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extinction coefficient could be determined properly only if a larger set of measurements would exist.

Minor comments and technical corrections:

- p. 3826, l. 7: replace "an" with "a"
- p. 3827, l. 26: It is unclear what "this" refers to, I presume it is the occurrence of sunflecks?
- p. 3828, l. 9: Please add the unit to LAI for consistency (you do so in l. 23).
- p. 3828, l. 23: Replace "are" with "were"
- p. 3829, l. 10/19: "All spectral measurements": How many measurements were performed, and how were these distributed over clear days, cloudy days and overcast days?
- p. 3829, l. 23: Please add that the normalization was done relative to the above-canopy measurement.
- p. 3830, Eq. 1: You use  $E_\lambda$  rather than  $E$  in Eq. 2, it would be more correct to do so here as well.
- p. 3832, l. 1: I am unsure what "frame" refers to here. Do you mean within the same period?
- Fig. 2: It is unclear to me why panel (c) is displayed. I guess the top of panel (d) should resemble (a) (and the bottom of (d) should resemble (b))? If right, panel (c) is not necessary.
- p. 3832, l. 24: The term "shifts" is somewhat misleading here: There is not more infrared radiation - rather, there is less absorption in this band than in the others, which makes the infrared relatively more important. Energy is not shifting from one wavelength to another.

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- Fig. 3: Are the clear/cloudy/overcast measurements shown here all one-day measurements? And do more measurements exist? In the latter case, it may be interesting to show how these curves vary between days with comparable sky conditions.
- p. 3834, l. 2: If lateral illumination occurs, as the authors suggest, it should be visible in the PPFD near the surface as well. This seems to be the case for clear sky, but the scale of Fig 3b does not allow to determine this for the other conditions.
- p. 3835, l. 2: "...closely resembling the "background" values shown in Fig. 6a, although 50% higher.": Would it be possible to plot the background (diffuse) part from Fig. 6a also in Fig. 6b to illustrate this?
- p. 3837, l. 17: check the spelling of "branches"
- p. 3838, l. 17: replace "which" with "with"
- p. 3839, l. 15: Closing brackets are missing

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