We thank the reviewer for the insightful comments and will modify the manuscript to incorporate responses to them.

The comment regarding the model (page 2, section 2) and the comment concerning the treatment of clouds (page 6, section 3) are related since the only unusual aspect of the radiative transfer calculation centers on the treatment of cloudiness. An attempt to treat the effect of fractional cloudiness in the context of a one-dimensional model must be based on some rather extreme approximations since the true radiative transfer problem is three-dimensional. The model operates as described below.

First, consider a sky that is 100% covered by a horizontally homogeneous cloud. We treat this cloud as a diffuser plate with albedo "A" and transmission "1-A". All of the radiation that is transmitted through or reflected from the cloud is assumed to be hemispherically isotropic. Define the following quantities (that are computed as part of the solution to the one-dimensional radiative transfer equation):

E(dn,abv) = downward diffuse irradiance incident on the cloud top from above.

E(dir,abv) = downward direct irradiance incident on the cloud top from above.

E(up,blw) = upward diffuse irradiance incident on the cloud base from below.

Given these quantities, the model computes the following:

E(dn,blw) = downward diffuse irradiance at the cloud base.

E(up,abv) = upward diffuse irradiance at the cloud top.

Conservation of energy requires the following (assuming no absorption within the cloud):

E(dn,blw) = (1-A)[E(dir,abv)+E(dn,abv)] + A[E(up,blw)]

E(up,abv) = (1-A)[E(up,blw)] + A[E(dir,abv)+E(dn,abv)]

The above formulation can be extended to the case of fractional cloud cover. Let "f" be the fraction of the sky covered by clouds of albedo "A". Conservation of energy leads to the following relationships:

[1] E(dn,blw) = f (1-A)[E(dir,abv)+E(dn,abv)] + fA[E(up,blw)] + (1-f)[E(dn,abv)]

[2] E(up,abv) = f(1-A)[E(up,blw)] + fA[E(dir,abv)+E(dn,abv)] + (1-f)[E(up,blw)]

[3] E(dir,blw) = (1-f)[E(dir,abv)]

The expressions for the diffuse irradiances, E(dn,blw) and E(up,abv), require no further modification. However, the expression for the direct irradiance that comes though the clear fraction of the sky is problematic. Averaged over a substantial horizontal area, the above three equations must be true to ensure energy conservation. But at any specific location at the ground, the solar disk is likely to be totally visible or totally obscured by clouds. It is as if “f” in Eq. [3] takes on only the values f=0 or f=1 regardless of the actual value of fractional cloudiness used in the calculation of diffuse irradiances.

The calculation allows the solar disk to be either (1) entirely visible, which leads to irradiances in excess of the clear-sky value when clouds are present, or (2) entirely obscured by clouds, which leads to irradiances less than the clear sky value. The computed diffuse irradiance can be interpreted as an average over the horizontal area to which the fractional cloud cover refers, while the computed direct irradiance refers to the specific location of the sensor.

Over the South Pole, the surface albedo is horizontally homogeneous, which is consistent with a one-dimensional calculation. Also, the clouds, particularly when fractional cloudiness prevails, are likely to be thin, so that complications from the sides of clouds are minimized. Still, we are trying to capture the physics of a three-dimensional situation in a one-dimensional model. While we are comfortable in using the model to illustrate the mechanisms at work, we would never seek to use the radiative transfer model to infer properties of the clouds from the measurements

Finally, we will make the format changes in the figures as suggested by the referee in assembling the revised manuscript.