We appreciate the comments and suggestions of the reviewer and have revised the paper accordingly. Below, the reviewer #1 comments are in blue, and our responses are in black.

The manuscript describes 3D cloud effects in OCO-2 XCO2 retrievals. This is done using both measurements (TCCON, OCO-2 and MODIS) and 3D radiative transfer simulations. The presence of such effects are clearly demonstrated and their importance discussed. Various mitigation methods are presented and discussed. The manuscript is well-organized and include detailed description of the results. It is recommended for publication after consideration of the minor comments below.

Comments

Table of acronyms: The manuscript contains numerous acronyms. Some are self-explanatory, some common and some rather unusual in this context (like DWS which made this reviewer think about deep water soloing). To help the reader, please include a table of all acronyms and their explanations.

A table of acronyms is included in the revised paper (lines 909-965, revised paper line numbers).

Page 2, line 47: Rayner and O'Brien (2001) is missing in the References.

The Rayner and O'Brien reference is now included in the revised paper.

Page 4, lines 140-183: Please specify the OCO-2 pixels size. And please provide a rough number of how many MODIS pixels cover one OCO-2 pixels.

On lines 166-172 of the revised paper, these sentences were added:

For nadir view geometry, the OCO-2 footprint is approximately 1.3 km x 2.3 km at the Earth's surface (OCO-2 L2 ATBD, 2019). Eight adjacent footprints are arranged in a row (see Figure 2.2 of OCO-2 L2 ATBD, 2019), and these footprints in conjunction with the observation mode (ocean glint, land nadir, and target mode) determine the footprint scan patterns. Since the MODIS CSU radiances are archived at 500 m resolution, approximately 10 MODIS 500 m pixels fit within one OCO-2 footprint.

Page 6, lines 249-251: This sentence is hard to read. Please rephrase.

On lines 265-268 of the revised paper the revised sentences are:

Several 3D metrics are calculated from MODIS and OCO-2 data files. Nearest cloud distance (abbreviated as Distkm), the sun-cloud-footprint scattering angle, and the H(3D) metrics (discussed below) are calculated from MODIS data files. The CSNoiseRatio and the H(Continuum) metrics (discussed below) are calculated from *stand-alone* OCO-2 data.

The line has been revised to (lines 277-281):

The Distkm metric frequently refers to clouds that are *outside* of the geospatial scan pattern defined by the OCO-2 observation footprints. A representative scan pattern is illustrated in Figure 9, for glint (ocean) scene. There are clouds within and outside of the geospatial scan pattern marked by the asterisks.

On lines 394-403 the following paragraph was added to the revised paper:

A separate computer program calculates the three dimensional distribution of water droplets and aerosol particles in the x-y-z grid, writing to an offline data file. This file specifies the liquid water contents and effective radii of the water droplets, and the aerosol mass densities and effective radii. We specified water droplets to have an effective radius of 10 μm, and aerosol particles an effective radius of 0.1 μm. SHDOM uses a Mie calculation to write to a particle scattering table for a range of water droplet effective radii (for a gamma size distribution), and a similar table for the aerosol particles (for a lognormal size distribution). These two tables, and the offline input file, are used by SHDOM to specify the particle absorption, scattering, and phase function particle characteristics in the x-y-z grid.