General comments

Principal criteria	Excellent (1)	Good (2)	Fair (3)	Poor (4)
Scientific significance: Does the manuscript represent a substantial contribution to scientific progress within the scope of Atmospheric Measurement Techniques (substantial new concepts, ideas, methods, or data)?	*			
Scientific quality: Are the scientific approach and applied methods valid? Are the results discussed in an appropriate and balanced way (consideration of related work, including appropriate references)? Note that papers do not necessarily need to be long to be scientifically sound.		*		
Presentation quality: Are the scientific results and conclusions presented in a clear, concise, and well-structured way (number and quality of figures/tables, appropriate use of English language)?		*		

Retrievals of aerosols properties is important for climate, weather, air quality and visibility analyses and forecast. Measurements of atmospheric aerosols during nighttime hours, at large scale from visible satellite data, is a very difficult task because of the low intensity of moon light. The VIIRS Day–Night Band (DNB) onboard the Suomi-NPP satellite is a first-of-its-kind calibrated sensor capable of collecting visible and near-infrared observations during both day and night. In recent studies, both VIIRS DNB observed nighttime light from reflected moon light and from artificial light source emissions were utilized for nighttime aerosol retrieved, by solving 1D radiative transfer (RT) equation. But surface artificial lights have complex properties (3D spatial distribution, non-Lambertian emission,). Therefore, retrieval of aerosol properties under this context can be seen as a true 3D RT problem.

The paper of J. Zhang et al., entitled "Sensitivity studies of nighttime TOA radiances from artificial light sources using a 3-D radiative transfer model for nighttime aerosol retrievals » presents for the first time in my knowledge, a study that investigates the 3D RT problem, in visible wavelength, for atmosphere with (dust) aerosols, with 2D surface artificial light, during the night.

The authors modified the 3D TR model SHDOM (Evans, 1998), included moon light and 2D surface artificial light emission. To my knowledge, this difficult technical work with SHDOM is new. And I don't think this work has ever been done with a Monte Carlo code. But the authors do not explain how they validate their modifications into SHDOM (see may major remarks).

In their work, authors focused over Dakar, used AERONET product (AOD) and the NASA's Black Marble product (surface light source). By doing 3D TR simulations under different conditions of simulations (zenithal an azimuthal viewing angle, vertical profile of aerosol optical depth), they did sensibility studies for the direct problem (TOA radiances, light dome) and for the inverse problem (aerosol optical depth (AOD)).

They concluded that the STD of TOA radiances is a more stable quantity than mean of TOA radiances for retrieved AOD, that light dome is strong function of aerosol vertical profiles and that light data from NASA's Black Marble product could serve as a primary input into estimation of surface light sources emission. Throughout the text, the authors suggest directions for research (use of light dome, TOA radiances are stronger function of the peak aerosol layer height than of specific shape of aerosol vertical distribution, Black Marble data may need to be revised to better account for viewing zenithal angle dependency,…).

The work of this paper is fundamentally new, and the possibilities of new results is enormous. Globally, I think that results of studies presented in section 3 and 4 are sufficient and represent a good starting point for future research in this topic. Nevertheless, as this new study is based on 3D RT problem, some comparisons with 1D RT problem should be presented (see my major remarks). Otherwise, the text is well written, figures are clear (see my minor remarks).

Major remarks

1) Authors have modified SHDOM and included 2D surface artificial light emission. For example, in annex, it should be nice to see a small study to validate this new code. In 1D it is possible to compare the new code in 1D (IPA – independent pixel approximation, i.e. plane parallel approximation in each column) and a other RT 1D code. By the way, authors could highlight differences between IPA computation and 3D computations with the new code.

2) In section 3 (except for the “light domes” problem), differences between results computed in 1D (IPA approximation that do not take account of “photon horizontal transport”) and 3D are not presented. We can ask ourselves the question of the importance of taking into account (or not) the 3D aspect of the RT. It would be good if the authors evaluate a little the differences between calculations of TR in 1D and in 3D.

Minor remarks

1) Line 36 : Cited references do not deal with the climatic aspect.
2) Line 40 : *« For daytime scenarios, where operational aerosol retrievals from reflective solar channels are routinely available from sensors such as Moderate Resolution Imaging Spectroradiometer (MODIS), Multi-angle Imaging SpectroRadiometer (MISR) and Visible Infrared Imaging Radiometer Suite (VIIRS) (e.g. Levy et al., 2013; Hsu et al., 2013; Kahn et al., 2010) ».* This sentence is not clear.
3) Line 65 : a reference is needed.
4) Line 173 : remove semicolon ?
5) Line 190 : what is the model of the Rayleigh scattering. Is there a reference?
6) Line 225 : is it allow to write "Normalized radiance" in a equation ?
7) Line 305 and Fig 7 and 9 : Wouldn't it be better to express the abscissa in length (m) rather than in number of pixels ?
8) Line 318 : « As it is difficult for 2-D RTMs to accurately account for scattered lights originated outside the targeted 2-D domain ». This sentence is incomplete ?
9) Line 378 : I don’t understand why the paper of Jakel et al. (2013) is relevant of the value of 0.1 ?
10) Line 583 : « showing sources »
11) Figure 8a : Wouldn't it be better to express the abscissa in extinction (m-1) rather concentration ?
12) Figure 9 : Please give explanation about the red and blue color.