Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-74-RC2, 2016

Atmospheric Measurement Techniques Discussions
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Interactive comment on "Calculating direct normal irradiance from sun photometer measurements" *by* Juan Carlos Antuña-Marrero et al.

Anonymous Referee #3

Received and published: 13 June 2016

The paper deals with an interesting possibility: use of sun photometers in the AERONET network to assess all-sky broadband direct normal irradiance.

Considering the number of AERONET stations in the World and their temporal coverages this possibility is of great practical interest for DNI resource assessment.

The major concern of this study is related to the ground DNI measurements used as reference in this study to assess the potential of AERONET in measuring the broadband DNI. These DNI measurements is questionable and their uncertainties prevent authors from drawing definitive conclusion.

The same approach with AERONET stations co-located with BSRN stations (like CARPENTRAS, TAMANRASSET, etc.) would have been better for this study.

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Discussion paper

I have some additional comments (*: not important -> ***: very important):

** 29-31: I don't see the point of this antagonism: why do the authors exclude satellite-based surface solar irradiance (SSI) estimations that are operationally used, notably as a complementary source of long-term dataset to be calibrated with short-term (or incomplete) in-situ measurement.

* 34-35: many other pyranometric networks exist (SURFAD, WRDC, etc.)

*** 106-107: authors should discuss their method used to extrapolate the spectral DNI at 300 nm and 2600 nm. It seems that TOA spectral DNI has been used instead of having, for example, simply prolongated to nearest measured spectral clearness direct index. This extrapolation with full TOA should induce positive bias.

*** 109-111: I don't understand the constant contribution of 55.2 W/mˆ2 to include spectral regions [0.5 300] and [2600 10000] nm that are not in the spectral domain of the broadband DNI

** 117-124: the validation of the trapezoidal integration should have done at least with clear-sky DNI and not only with TOA DNI to account for narrow extinction that induce higher spectral variability in the ground DNI than the TOANI. The integration error assessed with the TOANI is clearly underestimated by the authors.

** 130-133: please precise the level of processing used (1.0, 1.5 or 2.0) (leve 1.0 is not cloud screened, http://aeronet.gsfc.nasa.gov/new_web/data_description_AOD_V2.html

* 139: what are the characteristics of M-3 (spectral sensitivity, angular aperture, uncertainty, etc.)

** 145-147: this is not clear. Is it hourly average values and only 10-min average values in case of precipitation and cloudly situation?

*** section 2.4

Authors should explain why they have used this model of DNI under clear sky situation? Comparison of clear-sky model is available here: Ineichen, Pierre. 2016. “Validation of Models That Estimate the Clear Sky Global and Beam Solar Irradiance.” Solar Energy 132: 332–44. doi:10.1016/j.solener.2016.03.017.

Only AOD at 550 nm is used in this model: what about spectral AOD (Angstrom coefficient ?) and aerosol species, ssa, phase function, TCWV, Ozone, ... ?

* 196-199: authors should precise where does this information about cloudiness come from?

*** Section 3 Comparisons are done between ground measurements of broadband DNI from pyrheliometer (normally the reference), integrated DNI from sun-photometers and modeled DNI. Nothing is said about the fraction of the circumsolar normal irradiance that is measured with the pyrheliometer, the different fraction of the circumsolar measured by the sun photometer (that may have not the same aperture angle) and (maybe) no circumsolar modeled.

*** 226-228:

The comparison here raises many problems and questions: 1. McClear tested in Eissa et al. (2015) is a model and in that sense, only "comparable" for the section 3.2 2. McClear is using AOD from the numerical model MACC not from AERONET 3. Why choosing this comparison in a desert region where the variability in space and in time of aersol and high albedo raise specific problems Maybe comparison (if relevant) should be done with BSRN stations like the one presented in :

Lefèvre, M., A. Oumbe, P. Blanc, B. Espinar, B. Gschwind, Z. Qu, L. Wald, et al. 2013. “McClear: A New Model Estimating Downwelling Solar Radiation at Ground Level in Clear-Sky Conditions.” Atmospheric Measurement Techniques Discussions 6 (2): 3367–3405. doi:10.5194/amtd-6-3367-2013.

I recommend to reconsider this paper after a major revision. Author should also con-

sider to use other sites to do the study (BSRN + AERONET) in order to have better broadband DNI measurements used as the reference.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-74, 2016.