COMPARISON BETWEEN MEASUREMENTS AND MODEL SIMULATIONS OF SOLAR RADIATION AT A HIGH ALTITUDE SITE: CASE STUDIES FOR THE IZAÑA BSRN STATION

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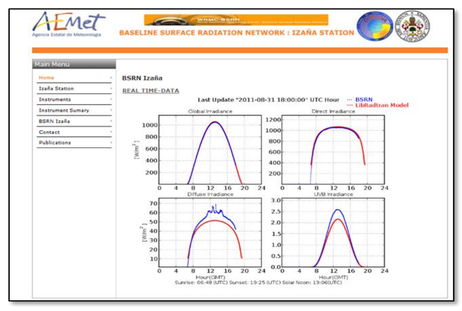
In this work we have carried out a comparative study between radiation observations for the global, direct and diffuse component of the radiation and simulations obtained with the LibRadtran model at the Izaña BSRN station. One of the main objectives is to study the capabilities of this model for modeling the solar radiation field at a high altitude (2.367 m s.a.s.l), in order to apply it in the quality control protocol. Particularly, we selected cases corresponding to the most common atmospheric conditions at the Izaña station, we analyzed: (1) cloud free conditions with the presence of a stratocumulus layer below the station level and (2) African dust intrusions.

IZAÑA BSRN STATION

The Izaña Atmospheric Observatory (IZA) is part of the Global Atmospheric Watch (GAW) programme and is managed by the Izaña Atmospheric Research Center (IARC) belonging to the Meteorological State Agency of Spain (AEMET). It is located in the Tenerife Island (Canary Island) at 28º18'N, 16º29'W, 2.367 m a.s.l. The radiation site in Izaña is part of BSRN since 2009.

Pyranometer CM-21 Kipp & Zonen
Global - Diffuse Radiation
Spectral Range: 285 to 2600 nm

Pyrheliometer CH-1 Kipp & Zonen
Direct Radiation
Spectral Range: 200 to 4000 nm



Homepage "Baseline Surface Radiation Network Izaña Station" (Quality Control)
http://www.izana.org/bsrn_iza

COMPARISON LIBRADTRAN MODEL: CASE STUDIES CLOUD FREE AND DUST INTRUSION

CLOUD FREE: 2010-05-16
AOD (550 nm) 0.024

CLOUD FREE: 2010-10-26
AOD (550 nm) 0.005

DUST INTRUSION: 2009-07-22
AOD (550 nm) 0.3922

DUST INTRUSION: 2010-07-10
AOD (550 nm) 0.415

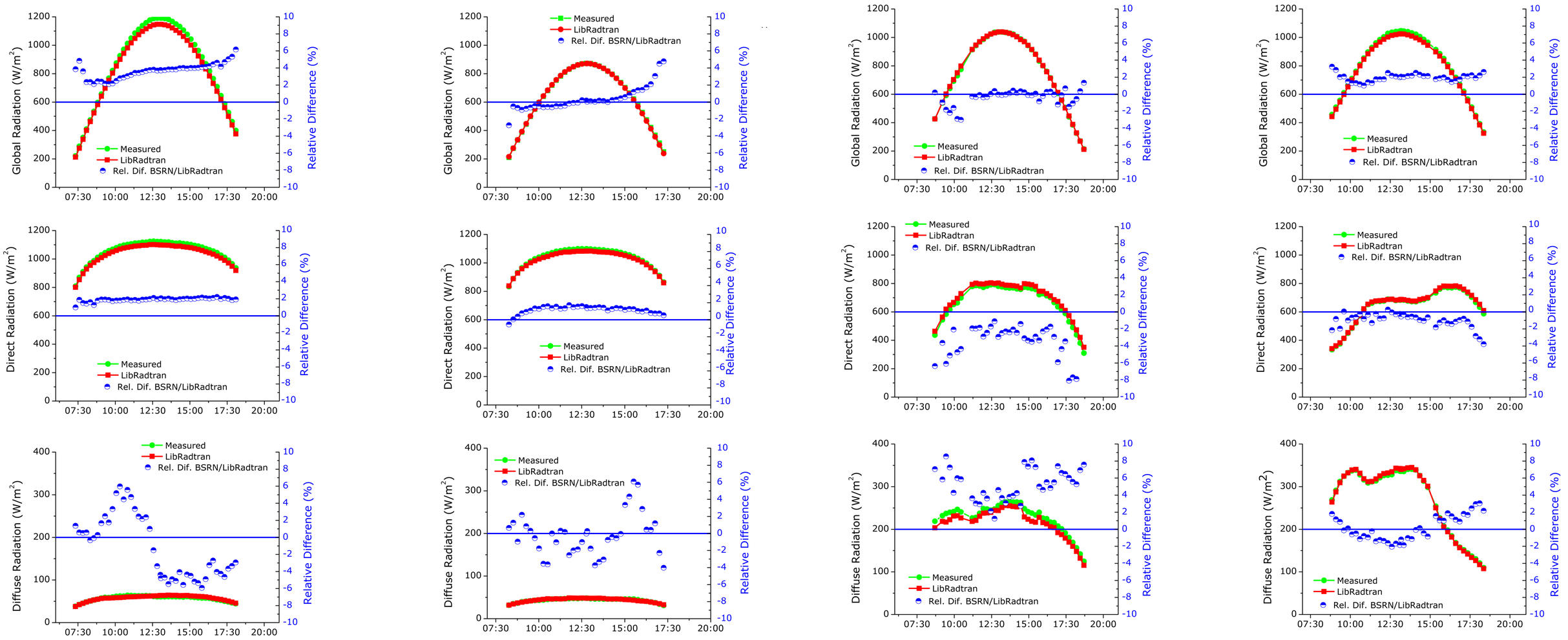


Figure 1.- Comparison between global, direct and diffuse radiation measurements (the green line) and simulations performed with LibRadtran model (the red line) in cloud free and dust intrusion conditions. The blue dots show relative difference (measurement-simulate/measurement).

Measured/LibRadtran Model (SZA≤70°)

CLOUD FREE

The relative difference were at most of 7%, 2% and 6% for the global, direct and diffuse radiation, respectively, with corresponding RMSE of 3%, 10% and 4%.

DUST INTRUSION

The relative difference were at most of 2%, 4% and 8% for the global, direct and diffuse radiation, respectively, with corresponding RMSE of 2%, 3% and 5%.

Table 1.- Mean and standard deviation values of input parameters in the study days.

	Date	Column Water Vapour (mm)	Ozone Column (D.U.)	Surface Albedo
CLOUD FREE	2010-05-16	1.147 ± 0.142	340 ± 5	0.12 ± 0.01
	2010-10-26	4.122 ± 0.191	258 ± 1	0.10 ± 0.01
DUST INTRUSION	2009-07-22	9.081 ± 0.525	289 ± 1	0.11 ± 0.01
	2010-07-10	8.533 ± 0.911	291 ± 2	0.13 ± 0.02

Figure 2.- Values of AOD (550 nm) in the study days (AERONET Network).

For SZA≤70° and cloud free days the differences between measurements and simulations are always within the instrumental error for the global and direct components, but not for the diffuse component. The discrepancies found for diffuse component are due to the uncertainties of observations and input parameters. One of the most important parameter is the atmospheric turbidity, in our case is AOD whose AOD uncertainty is ± 0.02 (Holben et al., 1998). In cloud free days the AOD value is lower than instrumental error. However for dust intrusion days the difference for the three components are within the instrumental error. The model results agree with the observations within the measurement uncertainty. This model shows high capabilities for using it in radiation data quality control protocols (Garcia, 2011).

References

Holben, B.N., Eck, T.F., Slutsker,I., Buis,J.P., Setzer, A., Vermote, E.F., Reagan, J.A., Kaufman, Y., Nakajima, T., Lavenu, F., Jankowiak, I., and Smirnov, A.: AERONET– a federated instrument network and data archive for aerosol Characterization. Remote Sensing of Environment, 66, pp 1-16, 1998.

García, R.D.: Aplicación de modelos de transferencia radiativa para el control operativo del programa BSRN (Baseline Surface Radiation Network) del Centro de Investigación Atmosférica de Izaña, Ph.D. thesis, Valladolid University, Spain, 2011.

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