Assessing the DNI from the HelioClim databases

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The HelioClim databases HC-2 and HC-3 delivers hourly values of irradiance (W/m²) on a horizontal plane.

The method used to derive the direct normal irradiance from global irradiance on a horizontal plane consists in 1) assessing the diffuse fraction on the horizontal, 2) compute the direct by removing the diffuse from the global irradiance, and 3) compute the direct on the plane facing the sun.

The algorithm for the assessment of the diffuse fraction from the global irradiance is that used in the European Solar Radiation Atlas (2000). Underlying algorithms are those from Liu and Jordan (1960), Klein, Erbs and Duffie (1982), Collares-Pereira and Rabl (1979) and Muneer (1990).

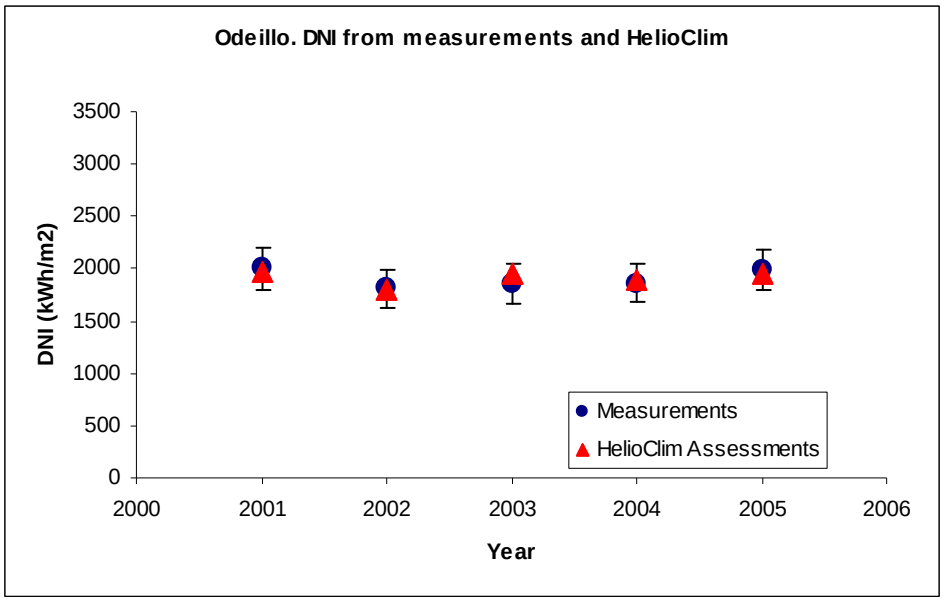
For assessing the quality of the retrieval of the annual sum of DNI, we have assembled series of measurements of DNI for several sites of the BSRN network. The BSRN (baseline surface radiation network) network is the reference in measuring solar radiation. It has several sites in the world.

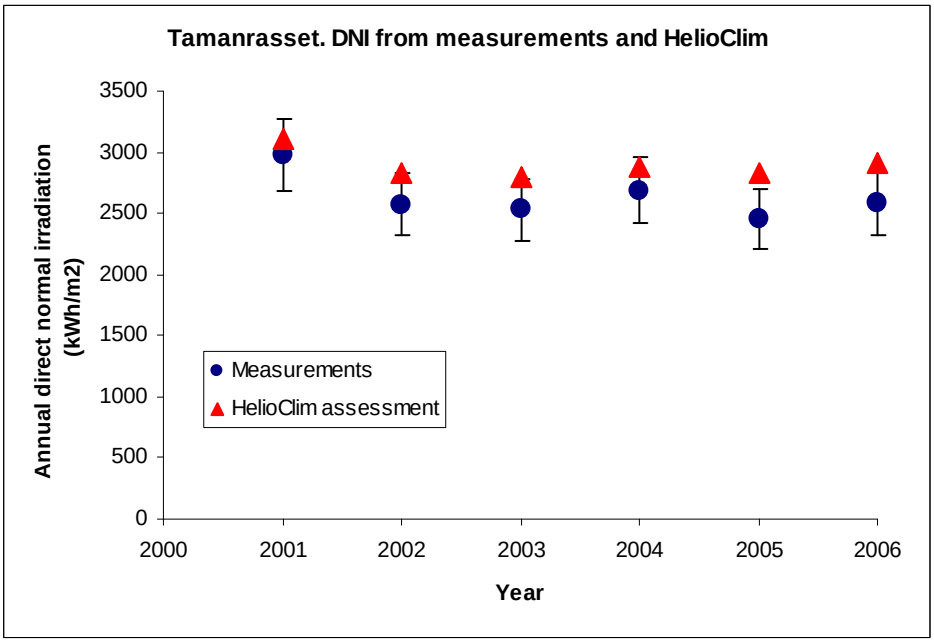
Our first task was to compute annual DNI from the time-series of observations. It was not an easy task because time-series are incomplete. It may happen that a large portion of a month is missing. The partial lack of data as a strong impact on the quality of the annual DNI. We made several trials that show that the relative error in assessing the annual DNI from ground observations amounts to 10%.

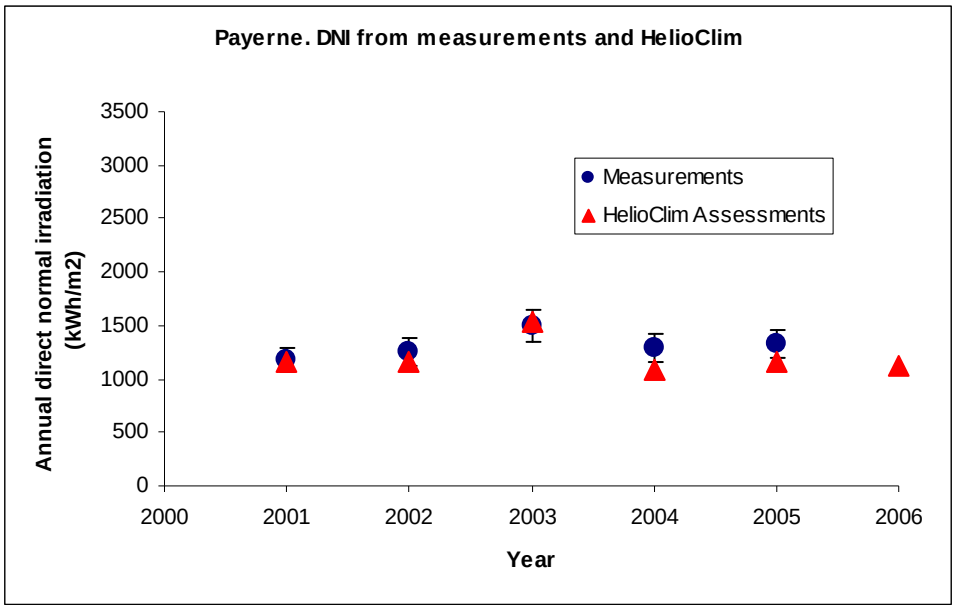
Taken this into account, we have compared the annual DNI from the ground measurements and that delivered by the SoDa Service exploiting the HelioClim databases. Two stations have been studied here. One is Tamanrasset in Algeria (latitude: 22.783; longitude: 5.514; elevation: 1385 m) because it exhibits large values in irradiation. Period is 2001 to 2006. The other is Payerne in Switzerland (latitude: 46.8167; longitude: 6.95; elevation: 491 m) because this where are the headquarters of the BSRN and that the quality of the measurements should be the best. The annual DNI is low in this site. Period is 2001 to 2005. The site Sede Boqer in Israel would also offer a nice opportunity to check the quality of the HelioClim assessments but it suffers from long missing gaps in data that render the computation of the annual DNI inaccurate.

In this document, we also use the annual DNI that we have read from a curve for the site of Odeillo in France (latitude: 42.48; longitude: 2.12; elevation: 1590 m) for years 2001 to 2005. We assume that the relative error is also 10%.

The following graphs show the annual DNI assessed from the ground measurements and from HelioClim databases.


Odeillo. DNI from measurements and HelioClim
DNI (kWh/m2)
3500
3000
2500
2000
1500
1000
500
0
2000
2001
2002
2003
2004
2005
2006
Year
Measurements
HelioClim Assessments


Tamanrasset. DNI from measurements and HelioClim
Annual direct normal irradiation (kWh/m2)
3500
3000
2500
2000
1500
1000
500
0
2000
2001
2002
2003
2004
2005
2006
Year
Measurements
HelioClim assessment



	Mean DNI (kWh/m²)	Bias (kWh/m²)	RMSD (kWh/m²)
Tamanrasset	2 634	291 (11%)	302 (11%)
Odeillo	1 906	6 (0%)	47 (2%)
Payerne	1 309	-103 (-8%)	184 (14%)