

Products and Projects in South America

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The talk will cover a review about products developed in the past 20 years with emphasis on the currently available products derived either from ground station data or satellite images. Monthly means of incoming global radiation derived from satellite is compared with the estimates derived from the Angström method, as published by OLADE Organización Latinoamericana de Energía.

An illustrative analysis is presented to show that the uncertainty of the monthly means of global radiation data available for South

America is too large, for the purpose of feasibility analysis of photovoltaic plants.

A brief report concerning the projects underway in South America is also presented. Very few countries have devoted significant effort in research to assess solar radiation data, in spite of the fact solar energy market is growing.

Special effort should be addressed to bring together the national capabilities in order to undertake a project to assess solar radiation over South America.

PRODUCTS FOR SOLAR ENERGY USERS

1. Solar radiation atlas of OLADE - Organización Latinoamericana de Energía

The distribution of global irradiation is derived from data collected from meteorological ground stations of all South American countries. These data were measured by pyranometers (P) and sunshine duration recorders (SDR) or actinographs. The global and direct irradiation are estimated by the empirical equations of Angström. A single equation is fitted for all South America. The period of measurements and the type of instruments used is given in Table 1. The quality of the data as well as the traceability of the radiometers are not reported. The data is presented graphically and numerically for the station locations.

Table 1

COUNTRY	Max Years	P	H	U	TOTAL
Argentina	22	37	96	106	239
Bolivia	7	17	25	0	42
Brazil	18	17	336	0	353
Chile	24	59	1	0	60
Columbia	9	0	90	0	90
Ecuador	25	0	63	47	110
El Salvador	24	13	8	0	21
Falkland Islands	3	1	0	0	1
Guyana	8	0	15	1	16
Paraguay	9	0	16	0	16
Peru	3	5	61	0	66
Surinam	5	0	19	0	19
Uruguay	5	5	0	0	5
Venezuela	29	29	63	0	92

Max Years: Maximum number of years of data.

P: Irradiance measured using pyranometer.

H: Data calculated from cloud cover information or bright sunshine hours.

U: Data from source lacking information on instrumentation.

2. Atlas of Solar Radiation of Brazil

Edited by the University of Pernambuco, Recife

Authors: Prof. Naum Fraidenreich and Shigueru Tiba

The work reports data obtained from Angström technique derived from ground truth collected by actinographs and pyranometers installed in the meteorological stations of INMET - Brazilian Weather Service. The accuracy of the estimated data is not carried out. Data is presented in graphical form obtained by linear interpolation from station locations.

3. Atlas of Global Solar Irradiation in Brazil - 1st Version Derived from Satellites

Edited by INMET - Brazilian Weather Service, November 1998

Authors: Prof. S. Colle and Dr. E. B. Pereira

The data is presented in graphical images as well as in multimedia form. The description of the physical model used to compute the incoming global radiation on the surface as well as the validation procedure and results are reported by E. B. Pereira in the present workshop. The numerical data for three hour, daily and monthly basis for spatial resolution of 0,5° x 0,5° is available in optical disk archives at LABSOLAR. The comparison between the present version and OLADE version was carried out over Brazilian territory. The OLADE data is interpolated from data of station locations by the kriging technique before the comparison is made. The relative deviation for each pixel is obtained by the following equation:

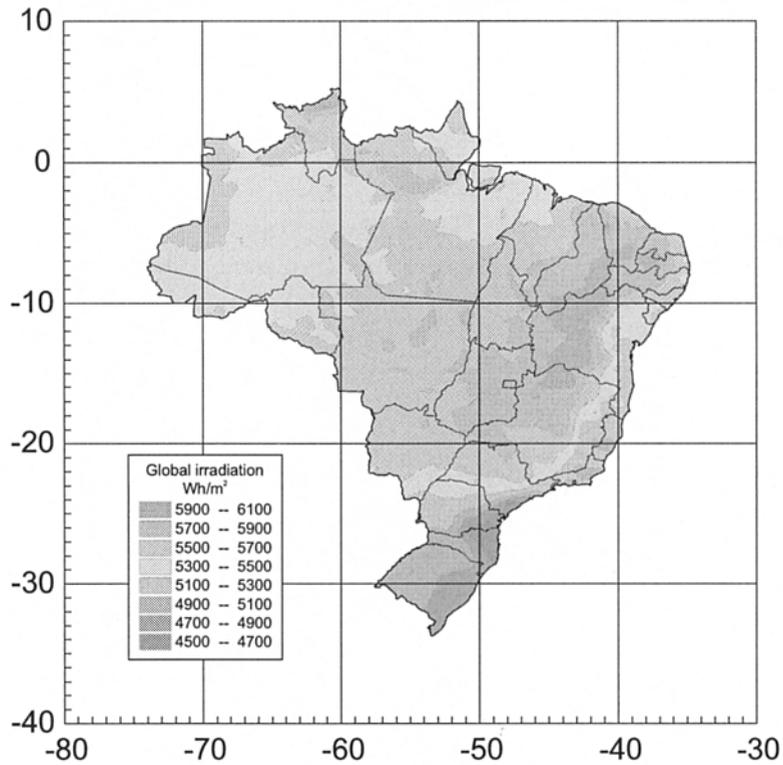
$$D(\%) = (R_{\text{SAT}} - R_{\text{OLADE}}) \times 100 / R_{\text{SAT}}$$

where R is the irradiation in Wh/m².

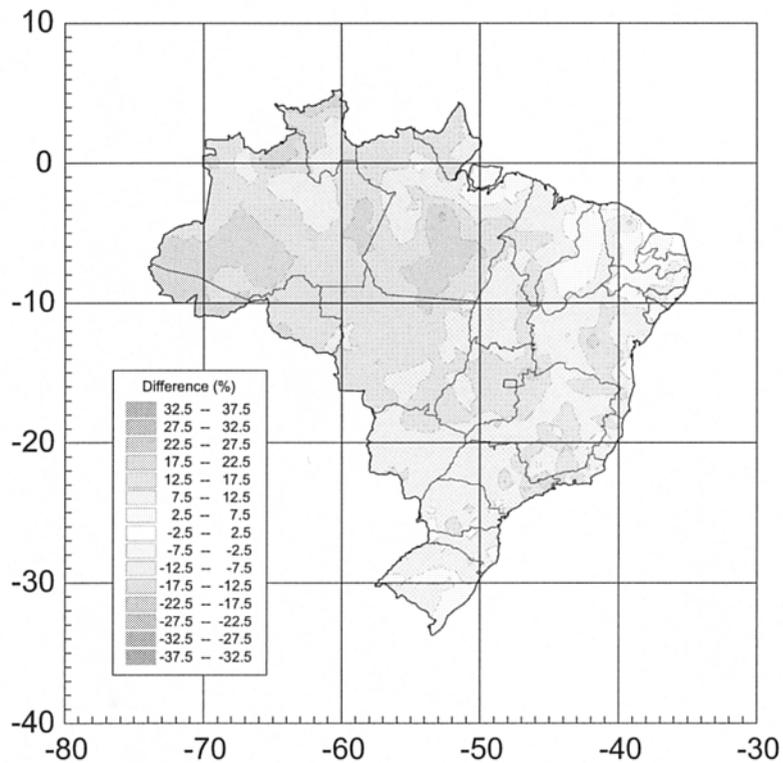
The best agreement between OLADE and satellite versions is verified for the winter season. The greatest deviations are observed in the Amazon region and Southern regions. Smaller deviations are observed in the Northeastern region. MBE and RMSE are shown in Table 2. The next figures shows the graphical images of deviations as well as the corresponding frequency histograms, for the yearly and monthly basis.

Table 2

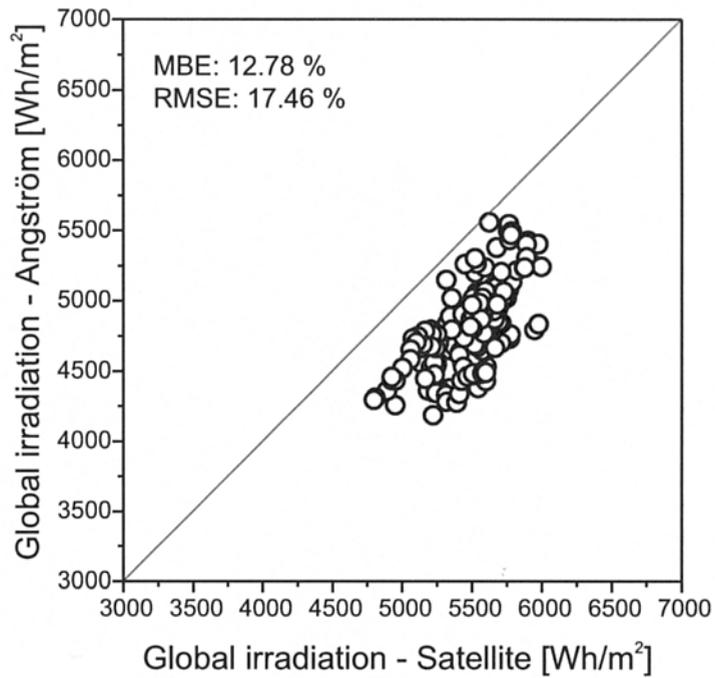
Period	MBE	RMSE
Yearly	12,78	17,46
Jan	19,54	26,26
Feb	20,30	27,26
Mar	14,17	19,32
Apr	16,27	23,08
May	5,66	11,68
Jun	9,06	14,93
Jul	-2,35	12,86
Aug	5,07	12,04
Sep	15,72	22,91
Oct	13,53	20,63
Nov	13,71	20,48
Dec	16,40	22,71



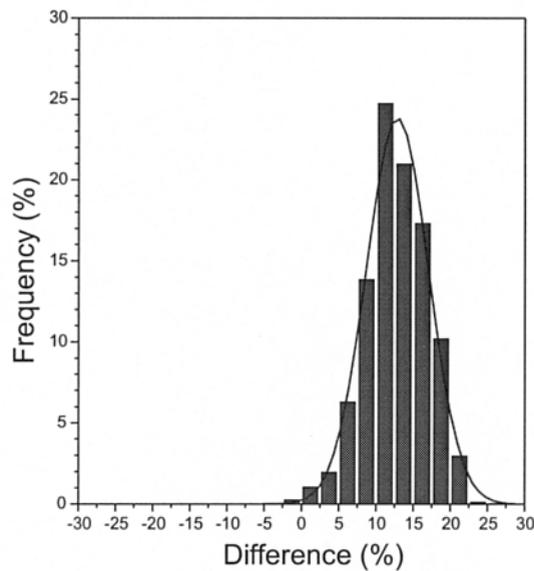
Annual mean derived from satellite data - GOES 8



Difference between satellite derived data and OLADE data (%)

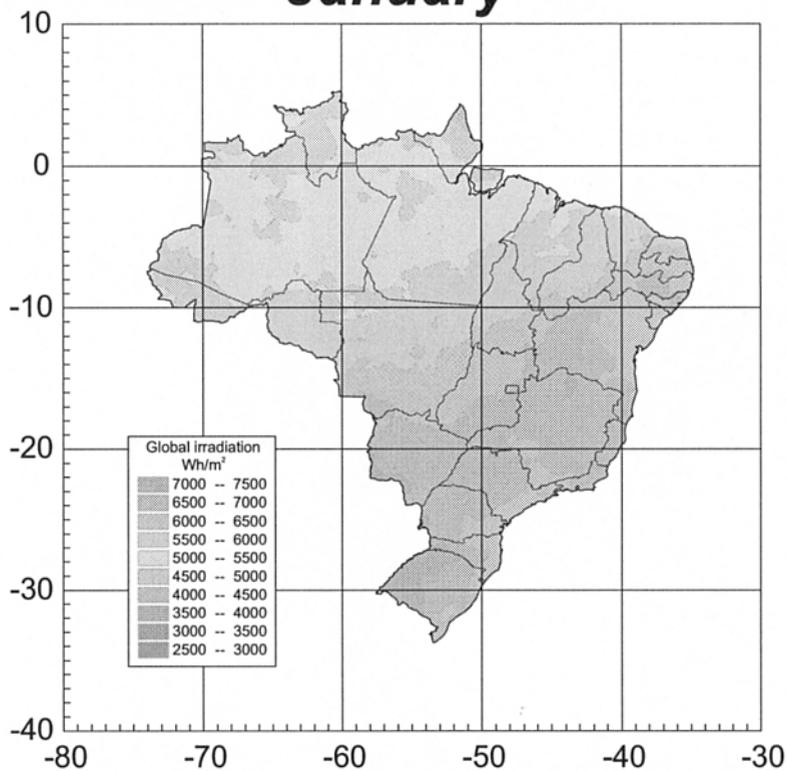


Comparison between satellite derived data and OLADE data

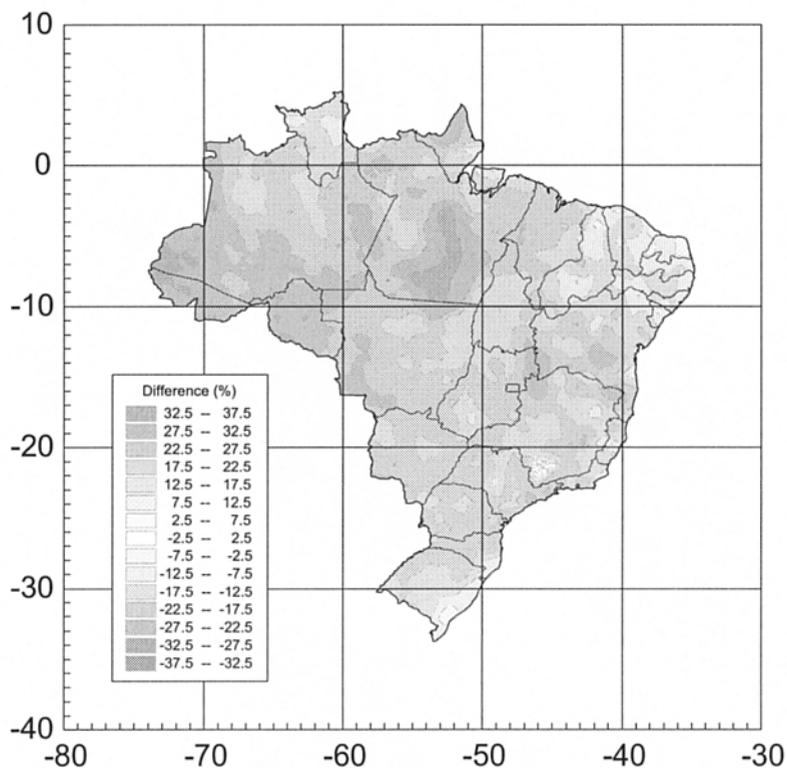


Difference between satellite derived data and OLADE data (%)

January

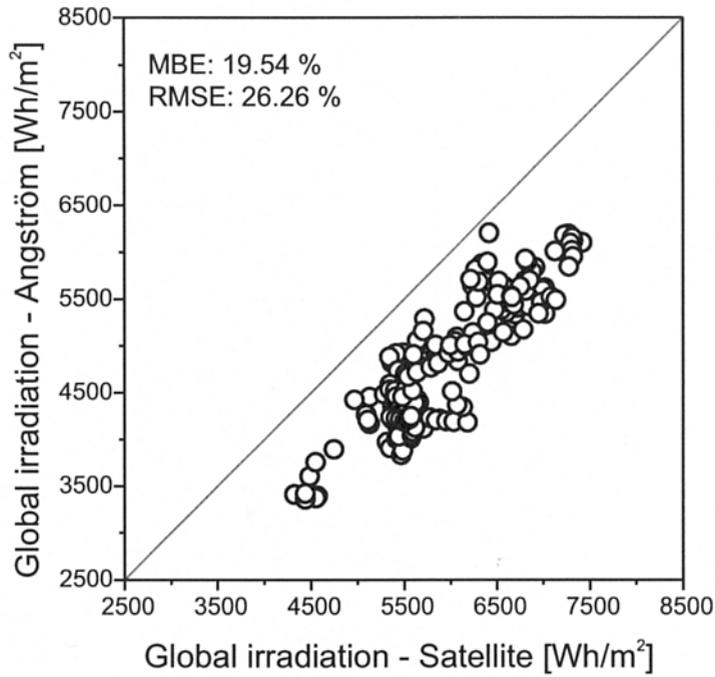


Monthly mean derived from satellite data - GOES 8

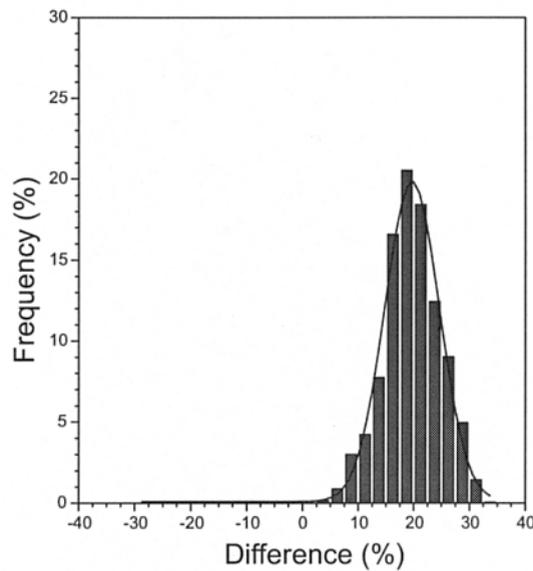


Difference between satellite derived data and OLADE data (%)

January

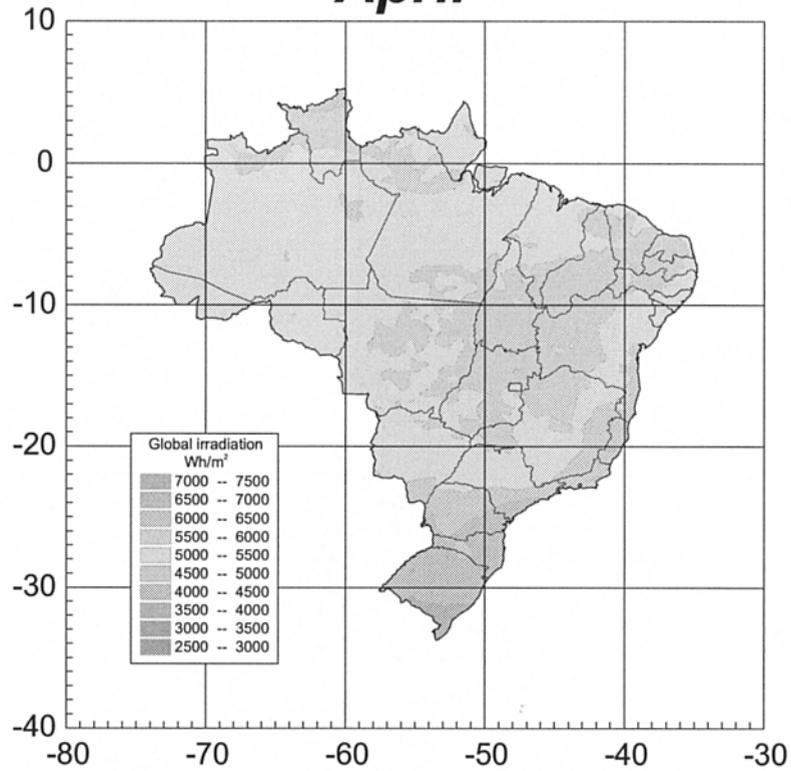


Comparison between satellite derived data and OLADE data

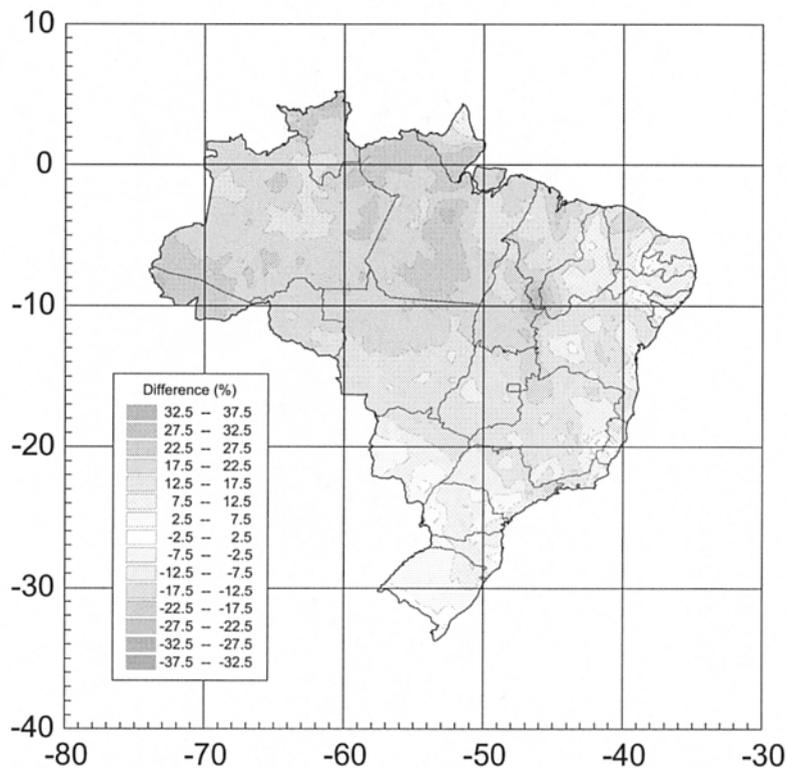


Difference between satellite derived data and OLADE data (%)

April



Monthly mean derived from satellite data - GOES 8



Difference between satellite derived data and OLADE data (%)