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Influence of biomass burning events on surface solar irradiation in Southern Brazil

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Introduction

The solar and wind energy resources are presented as alternative clean, not harmful to the environment and renewable character. However, the attraction of investments and realization of effective actions to technological and scientific development of new energy sources require to make estimates of the availability and distribution of resources throughout the country, besides the establishment of a database accessible and reliable (Pereira et. al., 2006).

During the process of burning biomass, emits into the atmosphere aerosol particles, that possess the property of absorbing and/or reflecting sunlight, changing thus the terrestrial radiation budget.

The total amount present in the aerosol atmospheric integrated column is given the name optical thickness of aerosols.

Objective: To study the relationship between the occurrence of outbreaks of fires and reduced radiation that reaches the surface of the central region of the state of Rio Grande do Sul, measured by sensors installed at stations solarimetric Project PROBE (National Organization System Environmental Data facing the energy sector) on a clear day.

Methodology

The solar radiation data used in this study were collected using a CM21 pyranometer (Kipp & Zonen), the SONDA Reference Station - SMS, located in the Southern Space Observatory - SSO/CRS/CCR/INPE - MCTI.

The selection was made of a clear day, needed to minimize the uncertainties arising from the influence of clouds on solar radiation.
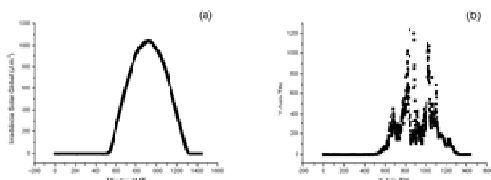

Figure 1: The SSO' cycle daily solar radiation observed at (a) 01/11/09 and (b) 05/11/09.

The days of clear skies had selected their respective indices of atmospheric transparency (Kt) calculated according to Iqbal (1983), using equation 1,

$$K_t = \frac{H}{H_0} \qquad (1)$$

where H is the integral of daily global solar radiation, H_d is integral to daily diffuse solar radiation, and H_0 is the full daily radiation incident at the top of the atmosphere (TOA).

The data of aerosol optical thickness (AOT) were obtained at the same station using the sun photometer data. AOT data collected on the network are available in the SONDA database through the AERONET email address NASA's Goddard Space Flight Center, http://aeronet.gsfc.nasa.gov.

Temporal evolution studies were made of the daily averages of AOT in the period July 2009 to December 2011. It also investigated the relationship of AOT with outbreaks of fire observed in the period. The data obtained were burned in http://www.dpi.inpe.br/proarco/bdqueimadas, the CPTEC/INPE database.

We also obtained the retro trajectories of air masses, using the HYSPLIT model (Hybrid Single-Particle Lagrangian Integrated Trajectory), developed by NOAA in conjunction with Australia's Bureau of Meteorology, (http://ready.arl.noaa.gov/ HYSPLIT.php).

Results

Table 1: The clear skies days information selected from SONDA – SMS station at Southern Space Observatory,São Martinho da Serra – RS, Brazil.

Month/Year	Days of clear sky	Month/Year	Days of clear sky	Month/Year	Days of clear sky
Jul/09	3	May/10	1	Mar/11	5
Aug/09	7	Jun/10	0	Apr/11	4
Sep/09	2	Jul/10	5	May/11	4
Oct/09	1	Aug/10	4	Jun/11	1
Nov/09	1	Sep/10	5	Jul/11	0
Dec/09	2	Oct/10	6	Aug/11	4
Jan/10	0	Nov/10	6	Sep/11	6
Feb/10	0	Dec/10	10	Oct/11	12
Mar/10	0	Jan/11	0	Nov/11	14
Apr/10	2	Feb/11	2	Dec/11	3
Total				**110 Days**	

Figure 3. (a) Time series of daily averages of AOT recorded in station SMS to the wavelength of 500 nm, (b) fire focuses registered during the period from 10 to 17 August 2010 in the database CPTEC/INPE, and (c) retroactive trajectories of air masses for the same period.
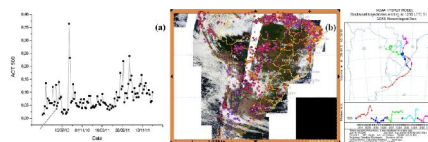

Figure 4. (a) Time series of daily averages of AOT recorded at station SMS to a wavelength of 500 nm, (b) fire focuses recorded during the period 25 to 31 December 2009 in the database CPTEC/INPE and (c) retroactive trajectories of air masses for the same period.

Table 2. Modelos de regressão linear e indices estatísticos obtidos neste estudo.

Wave-length (nm)	Equation	Linear correlation	RMSE (%)
440	$K_t = 0.7751 - 0.22149$ AOT	-0.54761	5,168324813
500	$K_t = 0.77513 - 0.31405$ AOT	-0.65323	4,98582677
675	$K_t = 0.77379 - 0.43846$ AOT	-0.64249	4,743326571

Conclusion

✓ The increase in the optical thickness of atmospheric aerosols (AOT) results in a decrease in atmospheric transparency index (Kt).
✓ Through the case study, it was found that the peak probably worth AOT determined on 17/08/2010 relates to the occurrence of fires.
✓ In continuation of this work will be expanded database, towards greater reliability of the models developed and developing new models.

References

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