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TOTAL OZONE COLUMN CORRELATION BETWEEN BREWER AND TOMS AT SOUTHERN BRAZIL (29.4°S, 53.8°W) FROM 1996 TO 2004

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ABSTRACT

The ozone layer has been monitored at INPE Southern Space Observatory, in South of Brazil (29.4°S, 53.8°W) since 1992 using three different models of Brewer Spectrophotometers. The models used in this analysis are: MKIV (1992 - 2000) and MKII (2000 - 2002) using a simple monocromator and MKIII (2002 - 2004) using a double monocromator Brewer Spectrophotometers. These equipments calculate the Total Ozone Column through incident Ultraviolet Radiation in the surface in the wavelengths: 306.3, 310.1, 313.5, 316.8 and 320.0 nm. To validate the measurements Brewer ozone data and TOMS data were compared to each other. TOMS is an instrument on board the Earth Probe satellite which infers the Total Ozone Column through the Backscatter technique in the band of 310 to 380 nm, with simple monocromator. The wavelengths used to calculate Total Ozone Column are: 317.5 and 331.2 nm, where the first one is strongly absorbed by ozone but the second one is only weakly absorbed. The data period used in this analysis ranges from August/1996 to December/2004. This period was chosen due to continuity in the data, since the previous TOMS data August/1996 are incomplete. The obtained results (correlation coefficient = 0.85) indicates that the used equipments are operating satisfactorily.

INTRODUCTION

Ozone is a trace gas with largest concentration in the stratosphere. Because of its strong absorption of harmful solar UV radiation it is essential to life on the Earth's surface. The absorption of UV and emission of infrared radiation make ozone a key variable to the radiative balance and hence to the dynamics of the troposphere and stratosphere (Slusser et al., 1999.).

METHODOLOGY

The immediate effect of decreasing stratospheric ozone is related to significant increments of the solar ultraviolet radiation. The total ozone column measurements obtained by Brewer Spectrophotometers, installed at the Southern Space Observatory, were compared with TOMS ozone data. The equipments used in this work are:

BREWER SPECTROPHOTOMETER

Brewer performs global UV Radiation measurements (286.5 – 363.0 nm) with resolution of 0.5 nm and precision of 0.006 nm.
Brewer determines ozone and sulphur dioxide total column using five specific wavelengths: 306.3, 310.1, 313.5, 316.8 and 320.1nm. In this range both molecules present high absorption spectra (Carvalho and Henriques, 2000).

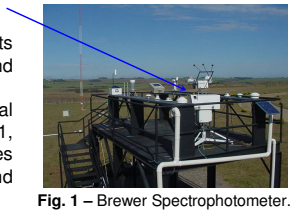

Fig. 1 – Brewer Spectrophotometer.

TOTAL OZONE MAPPING SPECTROMETER (TOMS)

TOMS instruments are carried on board the Earth Probe satellite. TOMS measures indirect ozone by the backscattered ultraviolet radiation emitted by the Sun, which is dispersed by the Earth atmosphere toward the satellite.

TOMS compares the incident solar radiation with the backscattered radiation by the Earth atmosphere, due to the interaction with ozone molecules mainly. In this analysis, strongly and weakly ozone absorbed wavelengths are used: 360.0 ± 0.2, 331.2 ± 0.1, 322.3 ± 0.1, 317.5 ± 0.1, 312.5 ± 0.1 and 308.6 ± 0.1 nm.
TOMS/EP was launched on 07/1996 and it is operating until now. It performs 35 measurements each 8 seconds in a grid from 50 to 200 km.
(http://science.hq.nasa.gov/missions/satellite_27.htm)

SOUTHERN SPACE OBSERVATORY

Fig. 2 – Map of Brazil

Fig. 3 – Map of Rio Grande do Sul state

Fig. 4 – The Southern Space Observatoy - OES/CRSPE/INPE – MCT located at São Martinho da Serra (Lat. 29.44 S; Long. 53.82 W), Rio Grande do Sul, Brazil.

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The annual distribution of total ozone column at Southern Space Observatory is represented in Figure 5. In the period from February/1999 to March/2000 there were no measurements by Brewer due to instrument change. Figure 6 shows that the correlation coefficient between TOMS and Brewer is R = 0.85.

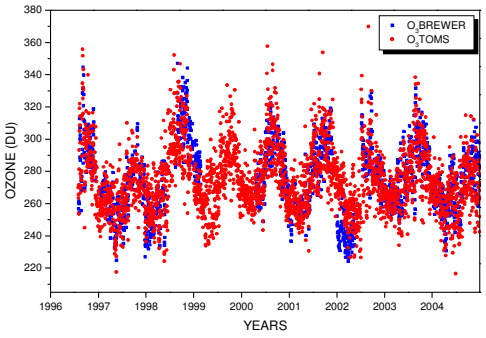


Fig. 5 – Total ozone column during the 08/1996 to 12/2004period at the Southern Space Observatory (Lat. 29.44 S; Long. 53.82 W).

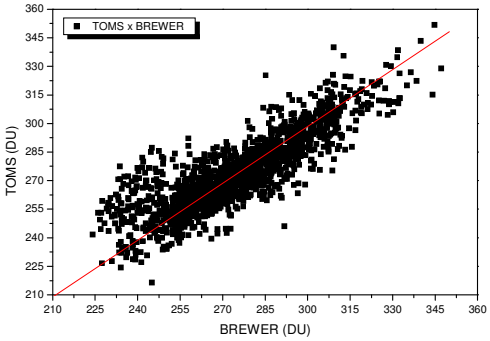


Fig. 6 – Correlation of TOMS and Brewer total ozone column for the 08/1996 to 12/2004, period (R = 0.85).

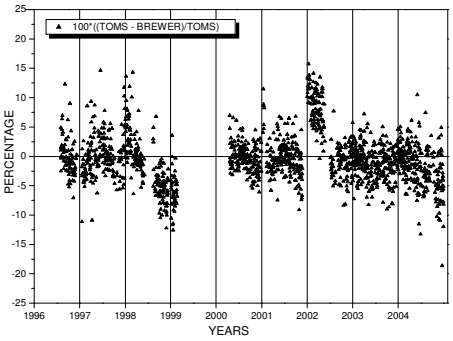


Fig. 7 – Percentage of difference of TOMS and Brewer for SSO.

The relative difference of the total ozone column between Brewer and TOMS data (see Figure 7) was calculated through the equation: 100*(TOMS – Brewer)/(TOMS). The average difference obtained in this analysis is -0,41 ± 4.22%. Comparisons between satellite data and surface station data presented similar values for latitudes as 30º S. (R D. PiacenthW, E. Crino, J. Sirur Flares and M. Ginzburg, 2002).

Another comparison made here is about only the data from Brewer MKII #167, which is now installed at Southern Space Observatory, and TOMS. The correlation between Brewer MKIII #167 and TOMS, from 2002 to 2004, was R = 0.88.

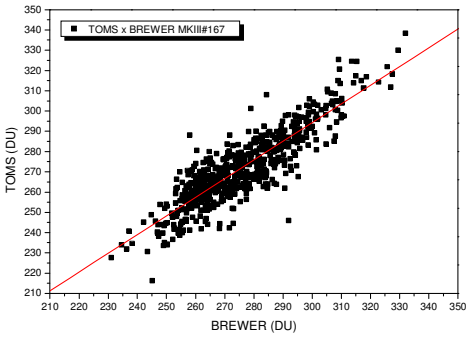
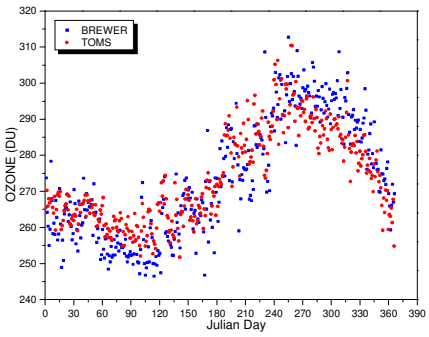


Fig. 8 – Correlation between Brewer MKIII #167 and TOMS at SSO.

Fig. 9 - Average per day Julian in the considered period.



CONCLUSIONS

➢ The correlation coefficient between Brewers and TOMS total ozone column data for the analyzed period is R=0.85. Considering the difference of methods used for each equipment the obtained results can be considered good.
➢ The relative differences between TOMS and Brewers data are -0.41 ±4.22%.
➢ The comparison between Brewer MKIII#167 and TOMS presented high correlation (R = 0.88). This results suggest that the equipment installed at the Southern Space Observatory is working properly.

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