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Total ozone variability and trend estimates from ground-based and satellite observations in the southern subtropics

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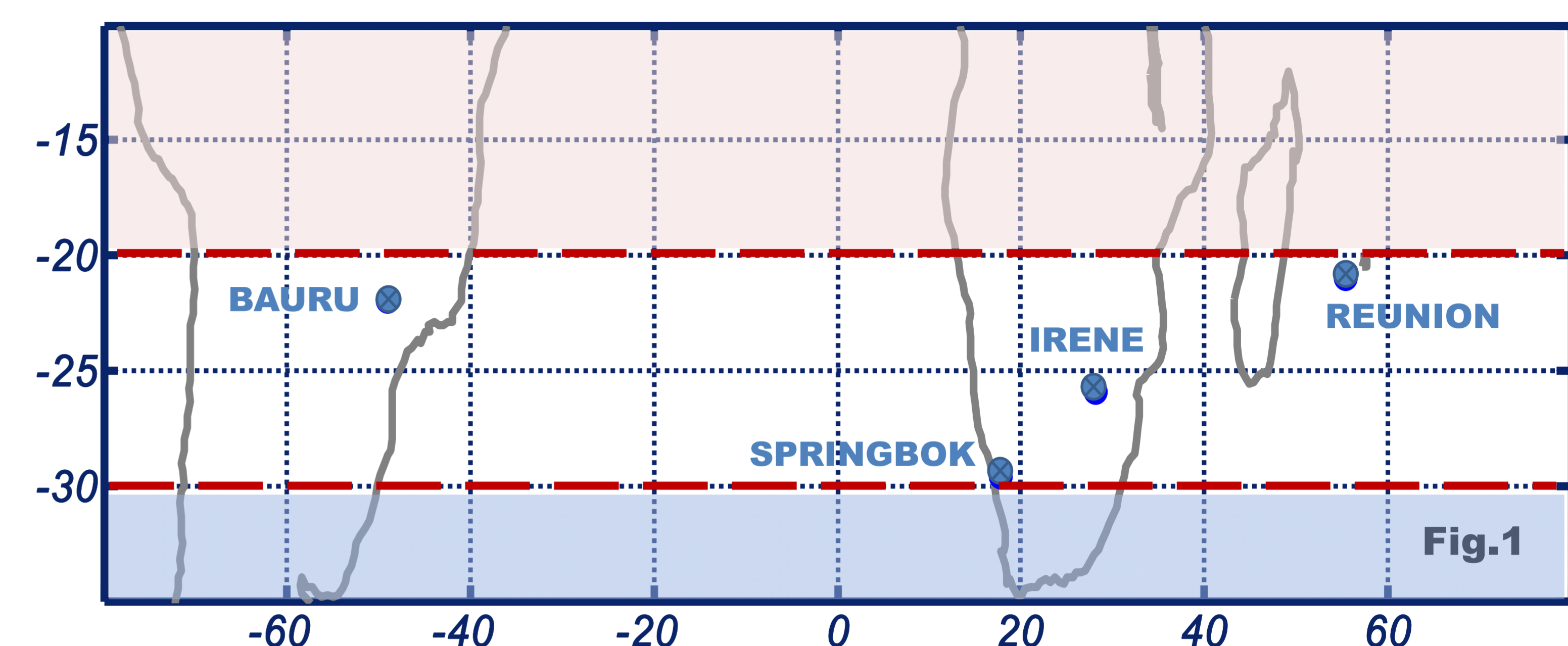
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The present poster aims to report on analyses of total ozone (O_3) observations obtained from ground-based and satellite measurements over subtropical sites, within the 20°S – 30°S latitudinal belt. The study examines the climatology, variability and trends of total ozone. It is respectively based on 19, 17, 22 and 17 years of continuous observations at four sites: Reunion Island (21°S, 55.5°E), Bauru (22°S, 49°O), Irene (25.5°S, 28.1°E) and Springbok (29.6°S, 17.9°E), see Fig.1.

Depending on the observational period of each instrument, ground-based total O_3 measurements are compared with satellite datasets. The study focuses on comparisons with total O_3 values measured from space by TOMS (Total Ozone Mapping Spectrometer) from 1995 to 2004, completed by OMI (Ozone Monitoring Spectrometer) observations from 2004 to 2011 and by IASI (Infrared Atmospheric Sounding Interferometer) on the MetOp satellite from 2007 to 2011. Plot (a) of Fig.3 (face-to-right) illustrates the time-evolutions of monthly total O_3 values derived from Dobson, TOMS, OMI and IASI observations over Irene site. Except for some discrepancies, especially with the IASI sensor, the plot shows that Dobson ground-based observations are in agreement with satellite ones. Similarly for the other sites (Reunion, Bauru and Springbok), we observe the same variations of total O_3 and agreement between ground-based and satellites records.

Fig.2 below depicts monthly climatological total O_3 values derived from satellite and ground-based observations at the studied locations. It comes from plot (a) that TOMS fits best Dobson values, while OMI and IASI show similar variations and do agree between each other chiefly during spring, from August to December. Plot (b) of Fig.2 superimposes monthly climatological variations of total O_3 obtained from observations of Dobson and SAOZ ground-based spectrometers at Reunion, Bauru, Irene and Springbok. As expected, total O_3 variation is driven by the annual cycle and admits a pole-ward positive gradient.

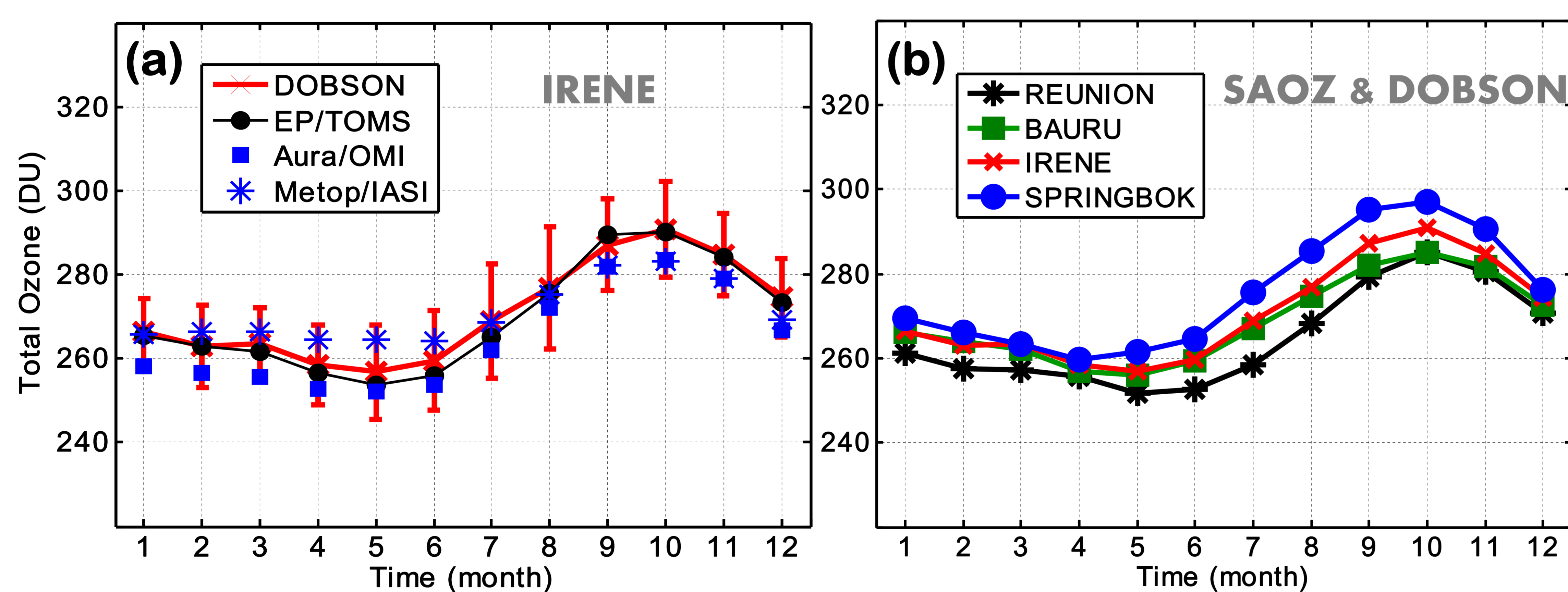


Fig.2:

(a) Seasonal variations of total ozone over Irene from Dobson spectrometer and from satellite overpasses: TOMS, OMI and IASI (see legend).

(b) Similar as plot (a), but from ground-based observations at different locations: SAOZ at Reunion and Bauru; Dobson at Irene and Springbok.

The present study reports on total ozone trend estimates derived from a multi-regression model named Trend-Run. The model is based on the principle of breaking down the variations of ozone time-series into a sum of several *forcings* (seasonal cycles, QBO, ENSO, IOD, Solar cycles, ...) that explain most of its variability. The trend values are then derived, site-by-site, from the residual terms as a linear function (Bencherif et al., 2006; Begue et al., 2010). Plots (b) and (c) of Fig.3 to the right show Irene and Reunion total O_3 monthly variations from ground-based observations (respectively from Dobson and SAOZ) and from model simulations, with the trend lines superimposed in red. As it can be seen from Table.1 below, only Irene site shows a significant negative trend, while Reunion and Bauru reveal positive significant trends.

Table.1: Total Ozone trends (in DU per decade) at Reunion, Bauru, Irene and Springbok computed by the Trend-Run model from SAOZ and Dobson ground-based observations. R^2 is the coefficient of determination. It is a statistical parameter that illustrates how well the regression fitting model describes the studied geophysical signal.

site	Coordinates	Instrument	Obs. period	R^2	Trend (DU/decade)
- REUNION, France	21.0°S, 55.5°E	SAOZ	Aug. 1993 - Dec. 2011	0.88	+3.6 ± 1.1
- BAURU, Brasil	22.0°S, 49.0°O	SAOZ	Nov. 1995 - Dec. 2011	0.81	+4.4 ± 1.4
- IRENE, South Africa	25.5°S, 28.1°E	Dobson	Jul. 1990 - Dec. 2011	0.78	-2.1 ± 1.4
- SPRINGBOK, South Africa	29.6°S, 17.9°E	Dobson	Mar. 1995 - Dec. 2011	0.79	+1.8 ± 1.6

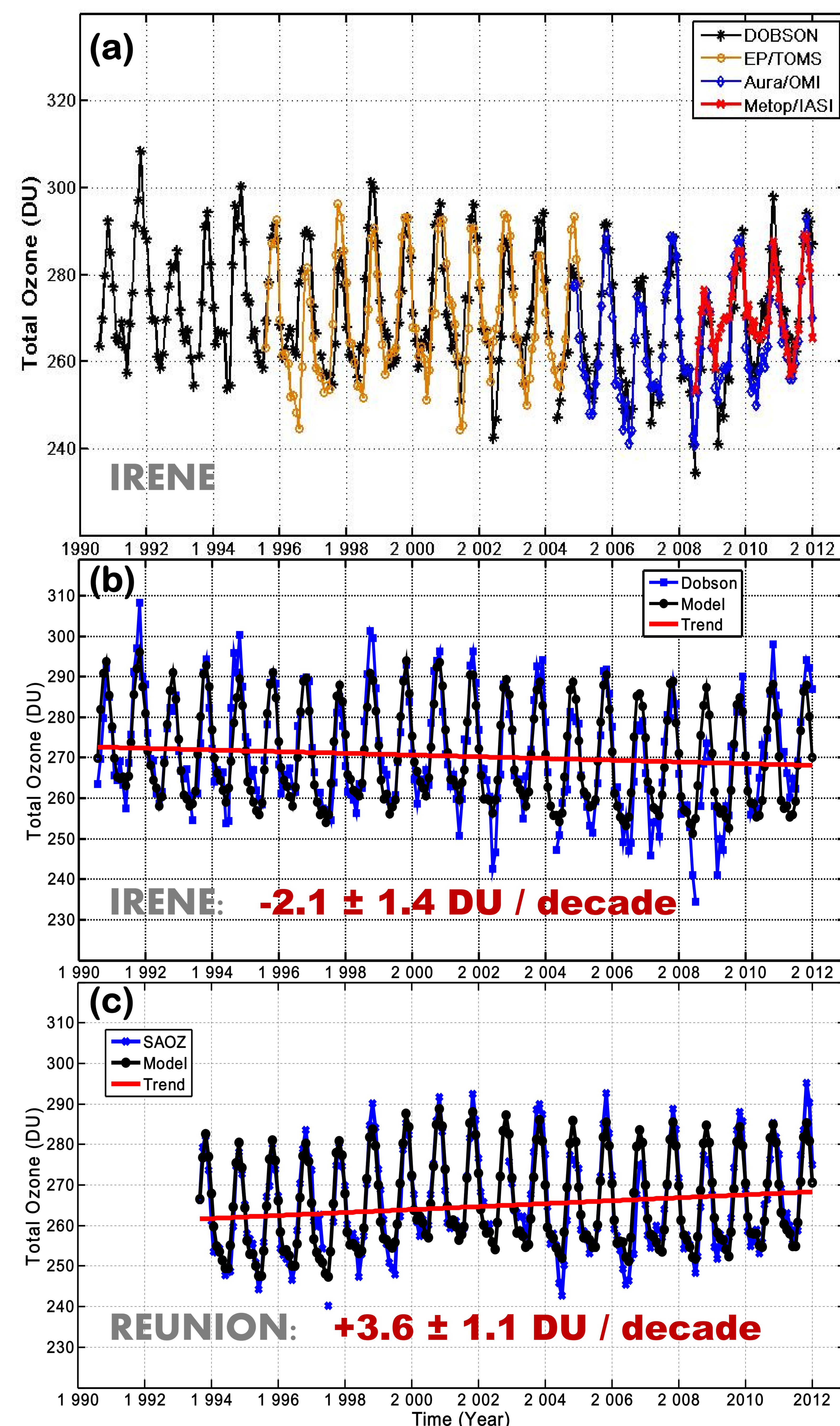


Fig.3:

(a) Time evolution of monthly total ozone values as observed by Dobson, TOMS, OMI and IASI experiments over Irene.
 (b) Time evolution of monthly total ozone values from Dobson over Irene from July 1990 to December 2011 (blue line). The superimposed black star line represents total ozone values simulated by Trend-Run regression model, while the straight red line illustrates the obtained trend.
 (c) Same as plot (b), but for Reunion site with the use of SAOZ observations from August 1993 to December 2011.