Watukosek ozone after more than ten years observation as part of SHADOZ project

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ABSTRACT

Since 1998 Watukosek (-7,5ºS, 112.6ºE, East Java, Indonesia) participated in a network of 13 (thirteen) Southern Hemisphere Tropical and Subtropical stations initiated by NASA called the Southern Hemisphere Additional Ozonesondes (SHADOZ) project.

To investigate the changes of ozone mixing ratio and temperature in Watukosek after more than ten years observation, the ozone and temperature of 2010's sounding were compared with those of in 1998. The result showed that in general, Watukosek temperature at 2010 show higher compared to that in 1998. In the tropospheric region, the Ozone mixing ratio difference almost similar, but in the upper troposphere the ozone mixing ratio difference showed ~ 3 ppmv at 10 hPa in August 2010. The overpass of Watukosek total ozone from 1998 to 2010 show the average of 254.92 DU ± 8.76 DU, with the minimum of 228.6 DU and the maximum of 296.7 DU.

Keywords: Ozone, SHADOZ.

SHADOZ sites map showing Watukosek-Java as part of the network

1. INTRODUCTION

Although ozone-measuring satellites have been collecting data since 1970 (Heath et al. 1975), validation of profiles and total column measurements is still performed by relatively low technology instruments. Total column ozone is verified with spectrophotometric data from a ground-based network (Bojkov et al. 1999). Profiles measured by balloon-borne ozonesondes are used to evaluate satellite retrievals (WMO 1998). The ozonesonde is flown with a standard radiosonde. Designed to measure ozone concentrations from the surface to above the ozone concentration maximum, the combined ozonesonde–radiosonde package is flown with a 1200–1500-g balloon that usually bursts at 4–8 hPa. Presently about 50 stations send ozonesonde data to the World Ozone and Ultraviolet Data Centre in Toronto, Canada (information online at www.woudc.org), an archive operated by the Environment Canada.

In addition to provide ground truth and climatologies for satellites (Fortuin and Kelder 1998), ozone profiles are used for the evaluation of chemical models (Logan 1999; Lawrence et al. 1999; Bey et al. 2001) and the determination of ozone trends (WMO 1998; Randel et al. 1999). Most ozonesonde stations are dated from the 1960s and 1970s. The tropical station in the Southern Hemisphere that has operated ozonesondes routinely for more than a decade is at Natal, Brazil (Logan and Kirchhoff 1986; Kirchhoff et al. 1988). And recently, Watukosek become the second tropical station in Southern Hemisphere that has longest data compilation, since Watukosek has operated ozonesonde launching for more than a decade.

2. DATA AND METHOD

Compilations of the ozonesonde data launched at Watukosek as one of the SHADOZ station in the period of 1998 to 2010 are used together with Watukosek total ozone of the overpass data of OMI-AURA in the same period. These data are used to investigate the change of total ozone, ozone and temperature profiles and their variation along 1998-2010.

3. RESULT AND DISCUSSION

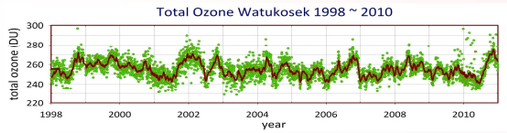


Figure 3.1 Total ozone based on overpass data of TOMS and OMI-AURA for Watukosek in 1998-2010 shows the enhancement of total ozone in the dry season of 2002, 2006 and 2010.

Figure 3.1 is constructed based on the daily OMI AURA overpass data for Watukosek in the period of 1998-2010. In Figure 3.1 Watukosek total ozone show the average of 254.92 ± 8.76 DU, with the minimum of 228.6 DU and the maximum of 296.7 DU. Ozone column amounts in the Tropics vary over a smaller range than at higher latitudes and normally fall within 225–300 DU. The reason is that there is less variability in the stratospheric ozone column in the Tropics compared to the extra tropics. (Thompson et al. 2003). Enhancement of the ozone concentration in Watukosek usually occurs in the end of the dry season (September – October) when the solar radiation is high and the water vapor and rain intensity is low. Human activities that produce ozone precursors especially in this region is very easy to reach the atmosphere and enhance the ozone concentration in troposphere and as a consequence total ozone concentration will also increase. The minimum of ozone column occurs usually in January-February when the low solar radiation and peak of rainy season is occurred at Watukosek.

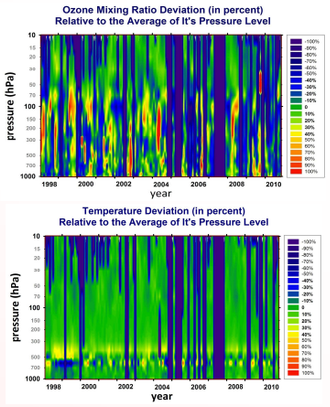


Table 1

OMR (ppmv)	Press (mbar)	temp (ºC)
0.0373	1000	29.004
0.0392	925	22.746
0.0305	850	18.118
0.0272	700	9.691
0.0318	600	3.084
0.0323	500	-4.882
0.0342	400	-12.375
0.0318	300	-27.910
0.0290	250	-38.614
0.0277	200	-51.371
0.0292	150	-66.340
0.0641	100	-79.841
0.3588	70	-73.618
1.2652	50	-66.002
3.8407	30	-56.772
6.9949	20	-49.906
8.7845	15	-46.352
9.8254	10	-41.056

Figure 3.2 : The variability at Watukosek indicated in pressure (hPa) vs. time graphs of the ozone mixing ratio profiles (ppmv) (upper graph) and temperature (ºC) (lower graph) for 1998-2010 periods.

To investigate the change of ozone mixing ratio and temperature in Watukosek, the variability at Watukosek indicated in pressure (hPa) vs. time graphs of the (a) ozone mixing ratio profiles (ppmv) and (b) temperature (ºC) for 1998-2010 periods are constructed. The average of ozone mixing ratio and temperature for the period of 1998-2010 as shown in Table 1 is used as standard for comparison. The deviation of each profiles of ozone and temperature in the period of 1998-2010 are shown in the Figure 3.2. Table 1 showing the ozone mixing ratio and temperature averaged from the 1998-2010 data.

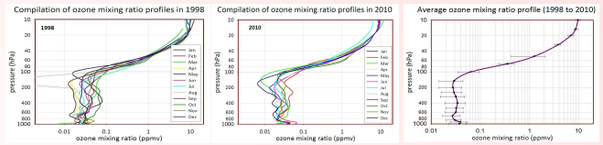
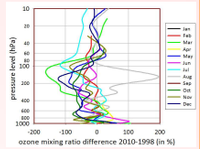


Figure 3.3 : Comparison of the ozone mixing ratio profiles of 1998 and 2010 and its deviation.

The direct comparison of the 1998 toward 2010 show that in the tropospheric region, the ozone mixing ratio deviation almost similar (deviation showed only in ppbv, but in the upper troposphere the ozone mixing ratio maximum deviation showed ~ 3 ppmv at 10 hPa in August 2010).

The comparison of 1998 and 2010 data toward the average of 1998-2010 of the mixing ratio shows the variation as: 2010 data show larger variation of ozone mixing ratio at surface to 850 hPa indicating the enhancement of ozone in the lower troposphere as of the increase of the ozone precursor.



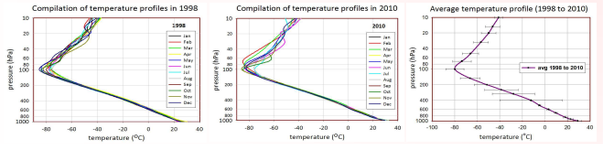
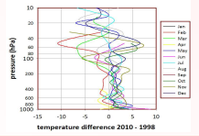


Figure 3.4 : Comparison of the temperature profiles of 1998 and 2010 and its deviation.

The direct comparison of 1998's temperature data towards the 2010's show that in general, Watukosek lower troposphere temperature at 2010 show higher compared to that in 1998, except February 2010 that shows lower than the same month in 1998.

The maximum difference occurred in October 2010 at 50 hPa.

The higher temperature in 2010 can be assumed as the occurrence of local warming in Watukosek.



4. CONCLUSION

Watukosek total ozone show the average of 254.92 ± 8.76 DU, with the minimum of 228.6 DU and the maximum of 296.7 DU.

The direct comparison of the 2010 toward 1998 show that in the tropospheric region, the ozone mixing ratio deviation almost similar (deviation showed only in ppbv, but in the upper troposphere the ozone mixing ratio maximum deviation showed ~ 3 ppmv at 10 hPa in August 2010).

In general, Watukosek lower troposphere temperature at 2010 show higher compared to that in 1998, except February 2010 that shows lower than the same month in 1998. The maximum difference occurred in October 2010 at 50 hPa.

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