Ozone concentration studies near the ground at Poona
Part II: Short term fluctuations

C. R. SREEDHARAN and V. S. TIWARI
Meteorological Office, Poona
(Received 20 September 1972)

ABSTRACT. The paper discusses short term fluctuations, superimposed on the diurnal variation of surface ozone recorded at Poona during 1969-1970, in association with thunderstorms and the breakdown of temperature inversions near the ground.

While there is a net production of ozone during electrical discharges in a thundercloud, the surface ozone recorder at Poona often registered a decrease in surface ozone concentration. This decrease coincided with updrafts generated during the formation and movement of a thunderstorm. Similar sharp increases in ozone were observed with downdrafts. In cases of lightning without the appearance of thunderstorms over the station, an increase in ozone density was observed immediately after the first lightning discharge.

Apart from the fluctuations associated with thunderstorms in summer, sharp fluctuations in ozone density were also noticed during certain winter mornings. Rapid falls in ozone occur with the formation of a stable layer near the ground at night and sudden upward surge with the breakdown of the inversion layer in the morning. The changes in ozone are, however, much more pronounced than those in temperature and wind and this striking correlation between surface ozone, surface air temperature and wind shows that ozone provides a unique tool for the study of low level temperature inversions, their establishment and destruction.

1. Introduction

The distribution of ozone in the free troposphere in the tropics is fairly uniform with height due to the presence of strong horizontal winds and vertical mixing, and the troposphere serves as a well mixed secondary reservoir for ground ozone (Junge 1962). Near the ground, ozone is destroyed due to direct contact with organic material and aerosols. When there is strong turbulence, there is a high equilibrium density of ozone near the surface, because the ozone destroyed at the ground is rapidly replenished from above. When the regime of thermal turbulence changes to one of stable stratifications, only a small concentrations of ozone is found at the surface as the replenishment becomes weak. Apart from the regular variations of ozone near the earth's surface (Tiwari and Sreedharan 1973) short period fluctuations superimposed on the regular variations were noticed in the records of surface ozone density at Poona. These sudden changes are associated with thunderstorms and the formation and breakdown of temperature inversions. These are discussed in the present paper.

2. Method of measurement

The Brewer electrochemical bubbler sensor (Sreedharan and Tiwari 1971) was used for the continuous recording of surface ozone concentration. Measurements were made with the sensor exposed at 0, 15 and 35 m above ground and records were made on an electrical chart recorder. Temperature and wind speed and direction at the levels of the sensors were also recorded simultaneously.

3. Ozone changes associated with thunderstorms

Continuous records of surface ozone were made from October 1969 to September 1970, during which ozone changes associated with fourteen thunderstorms were recorded and analysed. Thunderstorms mostly occur at Poona in the premonsoon hot season (April, May and June) and the post monsoon season (September, October and November) and these are triggered by local heating and generally occur in the afternoons.

During all the four thunderstorms studied during the post monsoon season decreases in ozone amount were observed, associated with updrafts, followed by rapid increases during downdrafts. Fig. 1 shows the records on 13 November 1969, when a thunderstorm passed over the station. The records showed (a) a decrease in ozone concentration, from 40 to 2 \(\mu\)gm\(^{-3}\) at 1730 hr, before the commencement of the downdraft, with