Air quality in Croatia

This is one of a series of reports by Commission VI.2 on air quality in the member countries of IUPAC.

Air quality in settlements has been improving in the last 10 years. The reasons for this improvement could be found in the introduction of natural gas, introduction of heating facilities operated from heating plants, substitution of coal with other fuel types and gradual reconstruction of the Croatian economy towards environmentally cleaner technologies. In 1995 the air protection law came into force, and the problem of air pollution has been put under more systematic control.

Emissions inventories for eight pollutants (SO_2, NO_x, NMVOC, CH_4, CO, CO_2, NH_3 and N_2O) have been established for Croatia in accordance to the European programme for such emissions inventories. Emissions have been determined for the time period 1990–95. In addition, for the years 1990 and 1995 emissions of Hg, Cd and Pb have been determined as well as emissions of stable organic compound for 1990 (Fig. 1).

Due to the war in Croatia, the standard of living and economic activity were reduced, resulting in a reduced emission of pollutants (Table 1).

The emission of sulfur dioxide has been reduced by 65% mainly due to the reduction of the sulfur content in petrol fuels, and the closing of some large industrial sources of SO_2. NO_x emissions come from road traffic (41%), other traffic (28%), combustion power plants (12.8%). Non-methane volatile organic compounds (NMVOC), very important compounds for photooxidant production and global warming, are mainly emitted from natural sources (49.2%), usage of solvents (15.1%), road traffic (20.3%) and nonenergetic industrial processes (5.9%)[1].

Surface ozone measurements in Zagreb, the capital of Croatia, were performed as early as the end of the 19th century, but the first ozone measurements using automatic monitoring equipment took place in the centre of Zagreb in the spring and summer of 1975.

Continuous measurements of photochemical air pollution in the atmospheric boundary layer above Zagreb (8 years mean ozone value 25 p.p.b., but with very pronounced diurnal variation due to local effects) and the nearby elevated Puntijarka site (980 m a.s.l.)(8 years mean ozone value 40 p.p.b.)[2] were supplemented by summer season measurement campaigns along the Adriatic coast[3,4], which has greater insolation and Mediterranean flora with many different sources of NMVOC.

Locations along the Adriatic coast were chosen so as to be representative of tourist resorts at different distances from larger pollution sources. Starting from the north, one site was on Krk island in Malinska, relatively

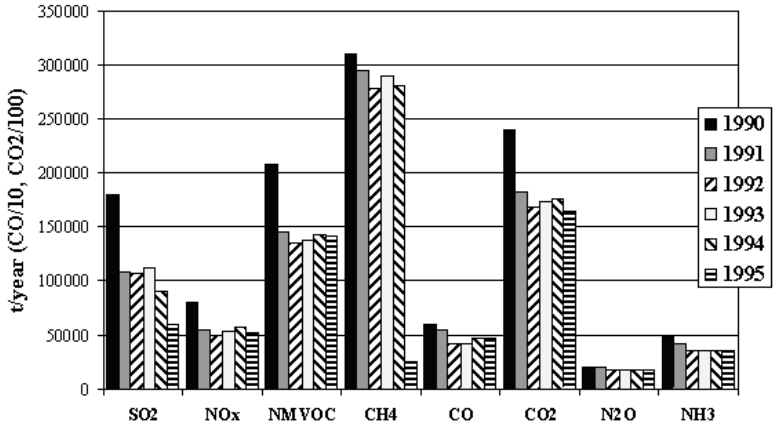

Fig. 1. Emissions of pollutants for the period 1990–1995 in Croatia.

Table 1. Reduction of emission in 1995 in relation to 1990

Pollutant	SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	NH_3
Reduction (%)	65	34	32	21	26	35	18	27

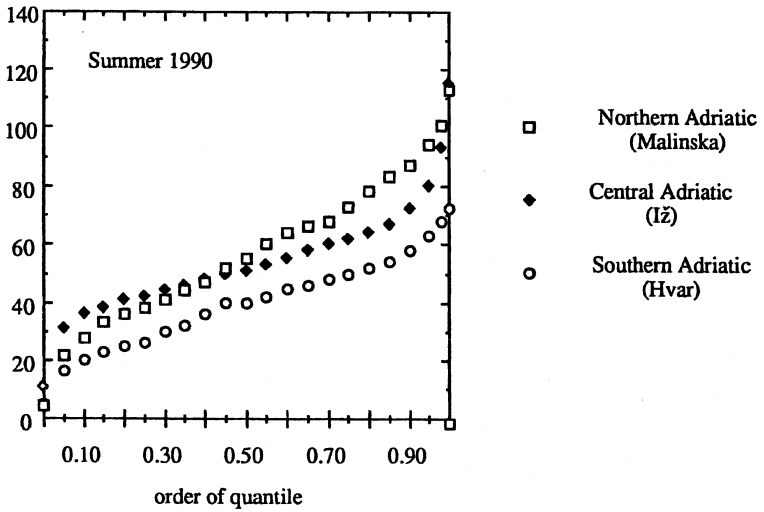

Fig. 2 Distribution of hourly average ozone volume fractions obtained at different sites along the adriatic coast in Croatia

close (25 km SSE) to the city of Rijeka. The second monitoring site was on the island of Iž in the central Adriatic, which can be considered to be isolated from larger pollution sources. The third site was in the southern Adriatic in Hvar on the island of Hvar, an important tourist resort (Fig. 2.).

To characterize a measurement site, an index defined as the average ratio between the maximum and minimum daily hourly average ozone volume fraction was introduced[3,4]. Zero values for hourly averages were assigned the value 0.4 p.p.b. in order to avoid division by zero. For urban sites with strong photochemical pollution, this index has a value of over 10, in the upper boundary layer and above, where there are no sources of precursor molecules which act also as sinks during night-time, it is less than 2. In less polluted urban and suburban sites as well as in some rural locations, where some photochemistry takes place, it will be of the order of 2 to 5 reflecting formation around noon and destruction during the night[4]. The corresponding values for five measurement sites in Croatia are compared in Table 2.

Table 2. Index of photochemical pollution for five different sites in Croatia

Location	Time period	Index
RBI (Zagreb)	Apr–Sep 1991	16.0
Puntijarka	Apr–Sep 1991	1.6
Rovinj (northern Adriatic)	Jun–Aug 1991	4.8
Iž (central Adriatic)	Jun–Jul 1991	1.9
Hvar (southern Adriatic)	Jul–Aug 1990	2.7

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