Ambient Air Quality in a Low Density Territory of Continental Portugal

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Abstract

Ambient air quality (AQ) is an environmental and socio-economic issue increasingly decisive in the sustainable development of a territory. At low density territories of Continental Portugal, a good AQ can contribute to the development of various sectors of activity like health and wellness tourism and organic farming, affecting positively the socio-economic situation. The main goal of this study was to build information on ozone concentration in ambient air for the present and on a climate change scenario. The territory case study – the "cerne do Entre-Norte-e-Centro"–, consists of seven municipalities: Aguiar da Beira, Castro Daire, Moimenta da Beira, Sátão, Sernancelhe, Tarouca and Vila Nova de Paiva. Geographically it belongs to the North and Centre of Mainland Portugal (NUTS II) and the Douro and Dão-Lafões subregions (NUTS III). In this area (151.195 hectares) there is not any station of AQ monitoring. Data provided by the Portuguese Air Quality Network was analysed to determine the spatio-temporal evolution of different pollutants covered by actual Portuguese legislation, with special focus on ozone and nitrogen dioxide. This information was compared with the data provided by Copernicus Atmosphere Monitoring Service. It was build hazard and vulnerability charts as well as the chart of risk to the territory under study. This knowledge will improve the decision-making process in terms of public politics. In addition it contributes to an increased visibility and attractiveness of this area, as a tourism destination through environmental differentiation in this endogenous resource.

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Introduction

Ambient air quality (AQ) is an environmental and socio-economic issue increasingly decisive in the sustainable development of a territory. A good AQ can contribute to the development of various sectors of activity like health and wellness tourism and organic farming, affecting positively the socio-economic situation. The main goal of this study was to build information on ozone concentration in ambient air for the present and on a climate change scenario.

Study area

The territorial area case study consists of seven municipalities (Figure 1). Is a low density territory of Continental Portugal. Geographically it belongs to the North and Centre of Mainland Portugal and the Douro and Dão-Lafões subregions. In this area (151.195 hectares) there is not a station of AQ monitoring.

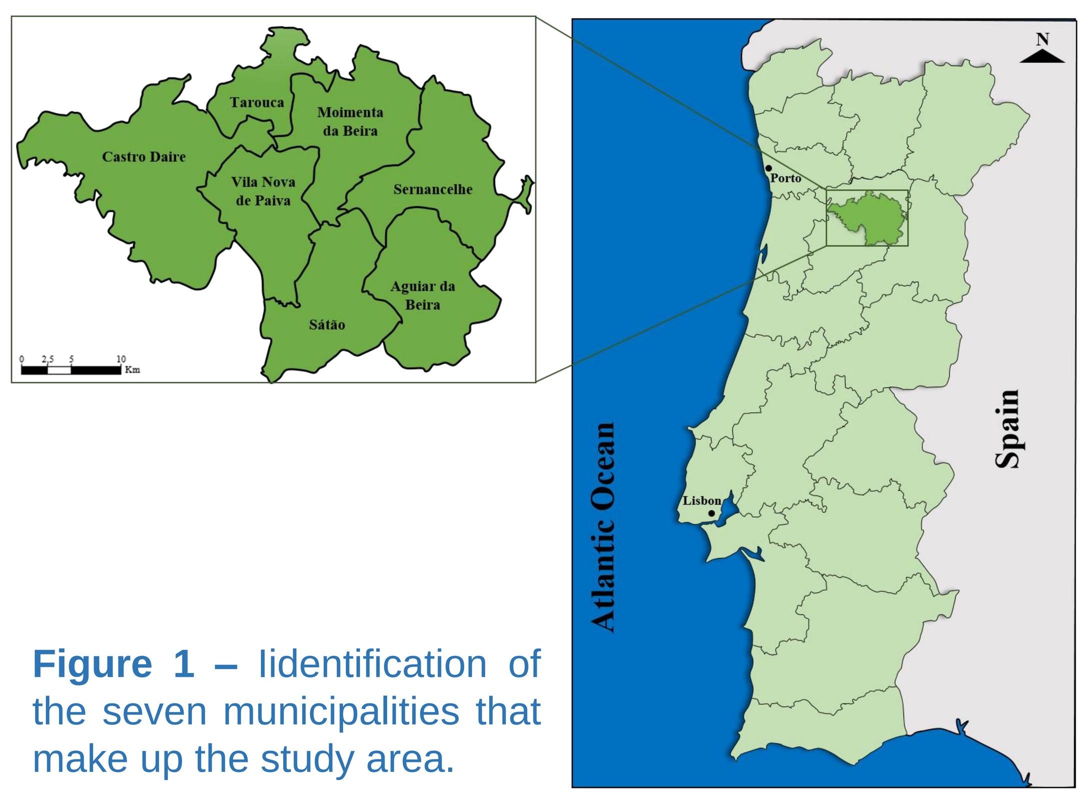

Figure 1 – Iidentification of the seven municipalities that make up the study area.

Methodology

Data provided by the Portuguese Air Quality Network was analysed to determine the spatio-temporal evolution of different pollutants covered by actual Portuguese legislation, with special focus on ozone (O_3) and nitrogen dioxide (NO_2). This information was compared with the data provided by ECMWF through the Copernicus Atmosphere Monitoring Service. Models HYSPLIT and GFS were used for the assessment of atmospheric circulation during a case study is on May 18, 2014. The cases of exceedances in the Douro Norte AQ monitoring station (DN station), were identified by the target value of 120 µg/m³ was exceeded eight consecutive times.

Air quality in the study area

The number of surpluses has been decreasing as shown in Table 1.

Results suggest that ambient air quality has improved over recent years in this territory.

Year	Douro Norte station
2004	75
2005	400
2006	94
2007	25
2008	30
2009	37
2010	76
2011	30
2012	16
2013	18
2014	-
2015	-
2016	6

Table 1 - Number of annual threshold information exceedances in the DN station.

Air quality modeling

Using an ensemble of regional models simulations for RCP4.5 and RCP 8.5 emission scenarios for the study territory, projections of maximum temperatures suggest an increase up to 3 ºC, on 2041-2070, for RCP 8.5 emission scenario (Figures 2 and 3).

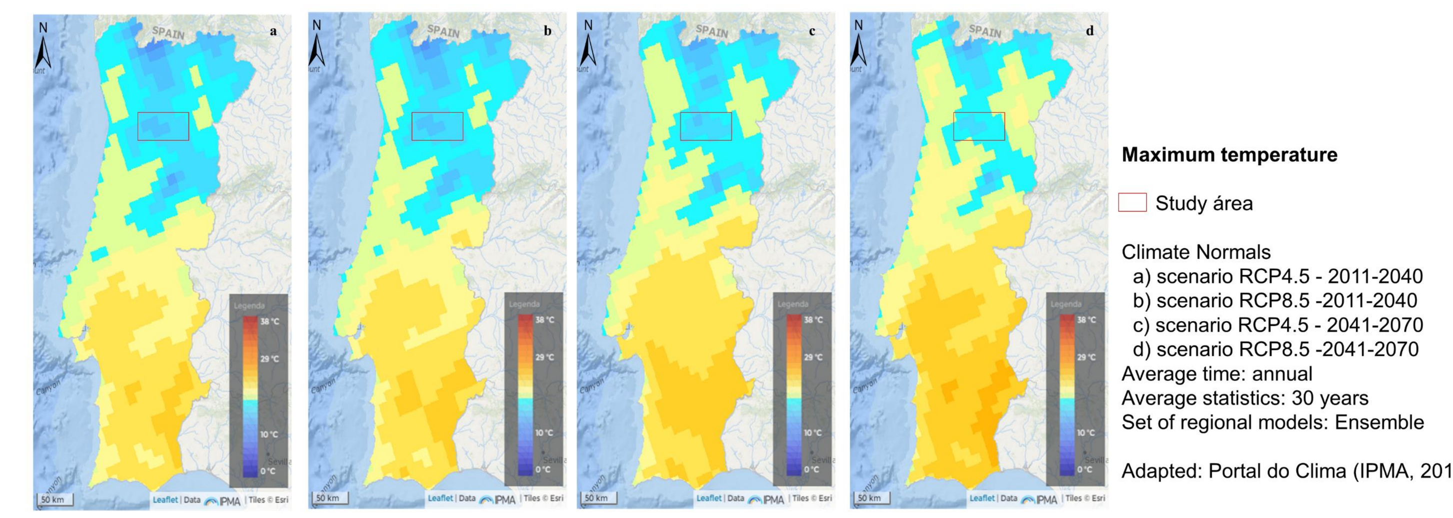

Figure 2 – Maximum temperature for the near future scenario: 2011-2040 (RCP4.5 (a); RCP8.5 (b)) and for the mid-21st century scenario: 2041-2070 (RCP4.5 (c); RCP8.5 (d).

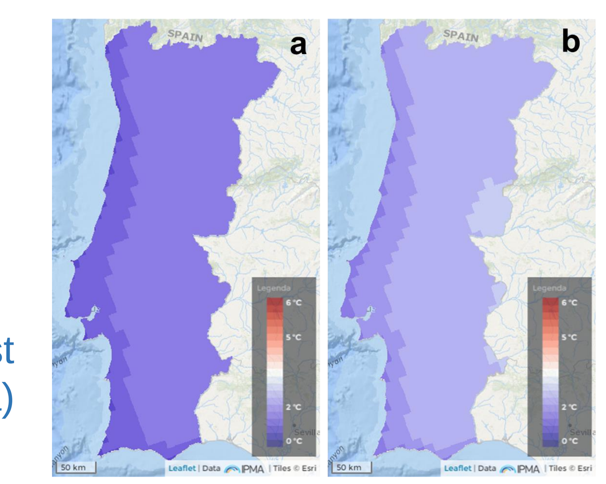

Figure 3 – Anomalies for the mid-21st century scenario: 2041-2070 RCP4.5 (a) and RCP8.5 (b).

Figure 4 shows that the O_3 concentrations exceeded the mean value DU having a TCO of 4 mm.

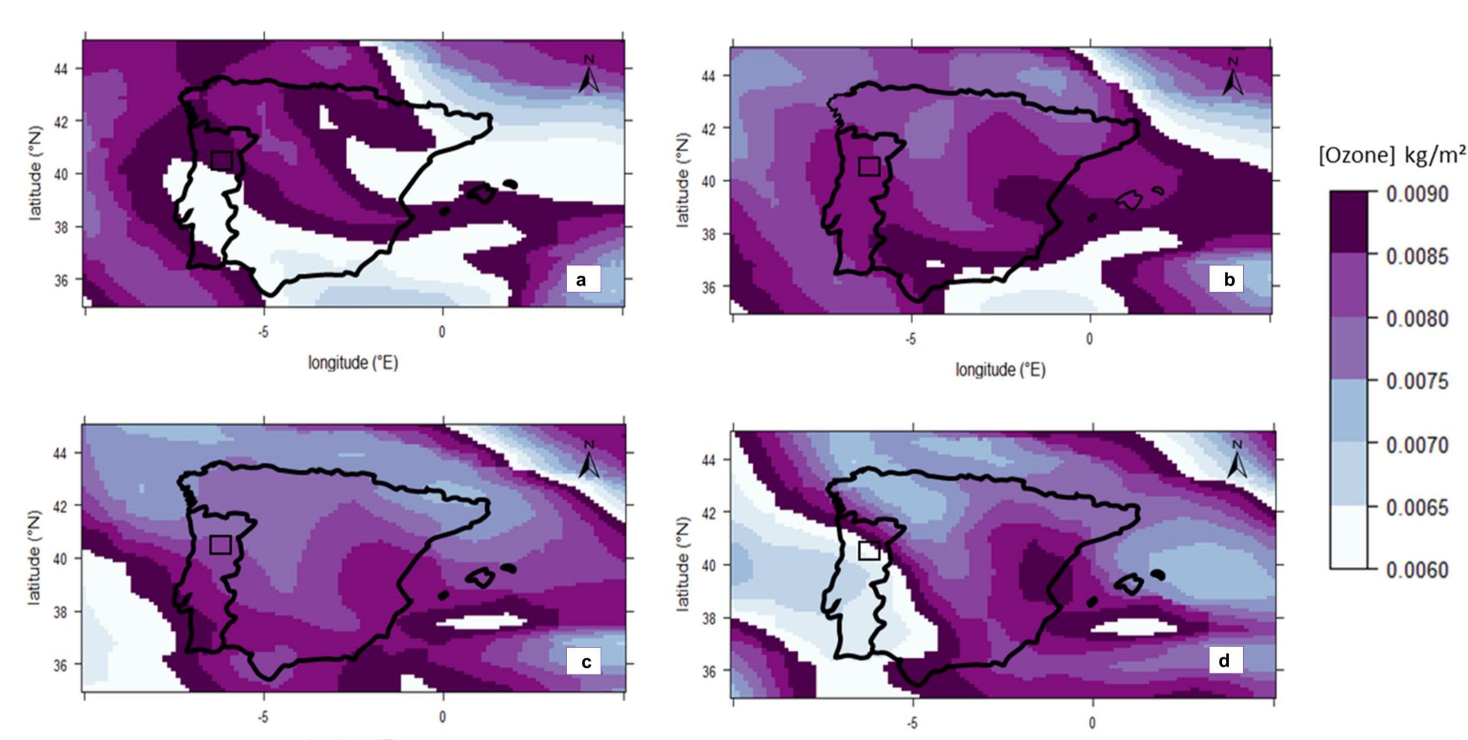

Figure 4 – Distribution of O_3 (kg/m²) in the Iberian Peninsula with ECMWF reanalysis data on May 18, 2014 at 00h (a), 06h (b), 12h (c) and 18h (d).

Simulations using HYSPLIT model suggest air masses originating from Northern Europe are associated with this episode (Figure 5a, b).

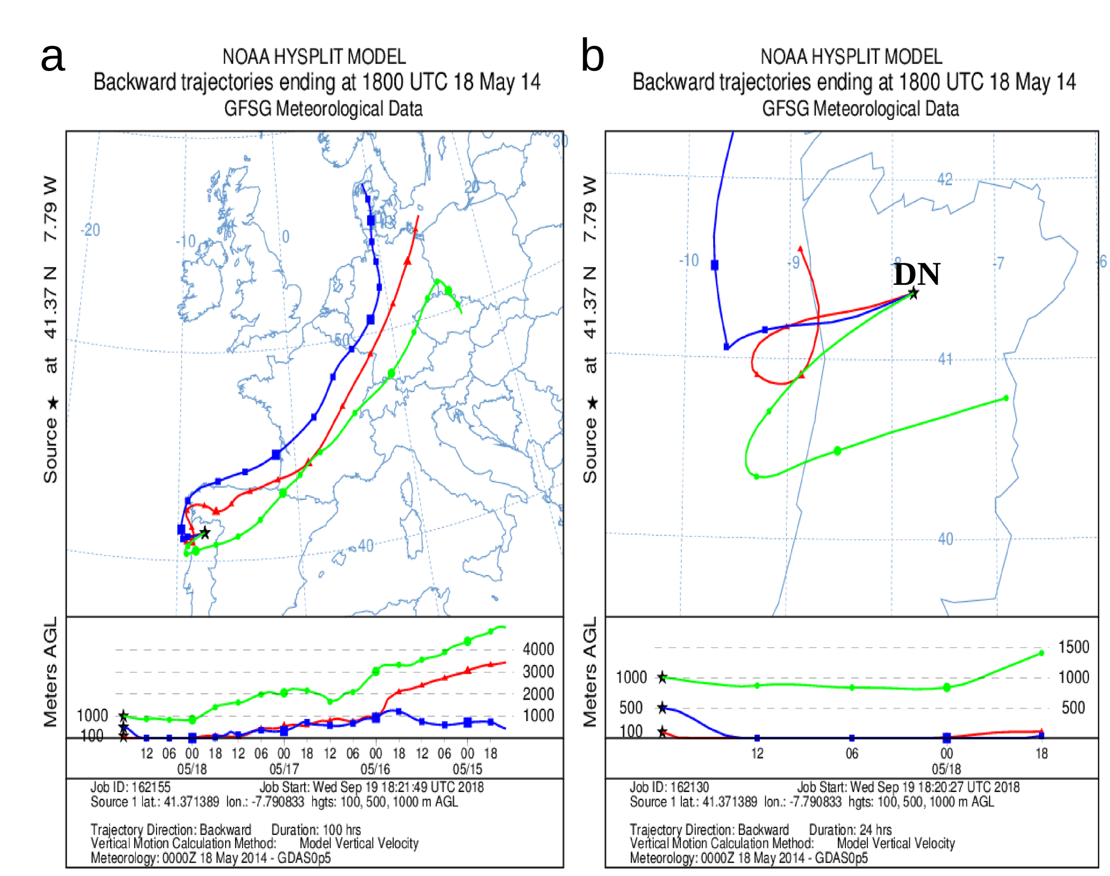

Figure 5 – Backward trajectories of the HYSPLIT model for the period of 100h (a) and 24h (b) of May 18, 2014, at the station AQ Douro Norte.

Figure 6 and 7 show the synoptic patterns developed during the period 15 to 18 May, 2014, corresponding to a stationary depression in Central Europe and the development of an intrusion of dry, cold air mass northwest of the Iberian Peninsula.

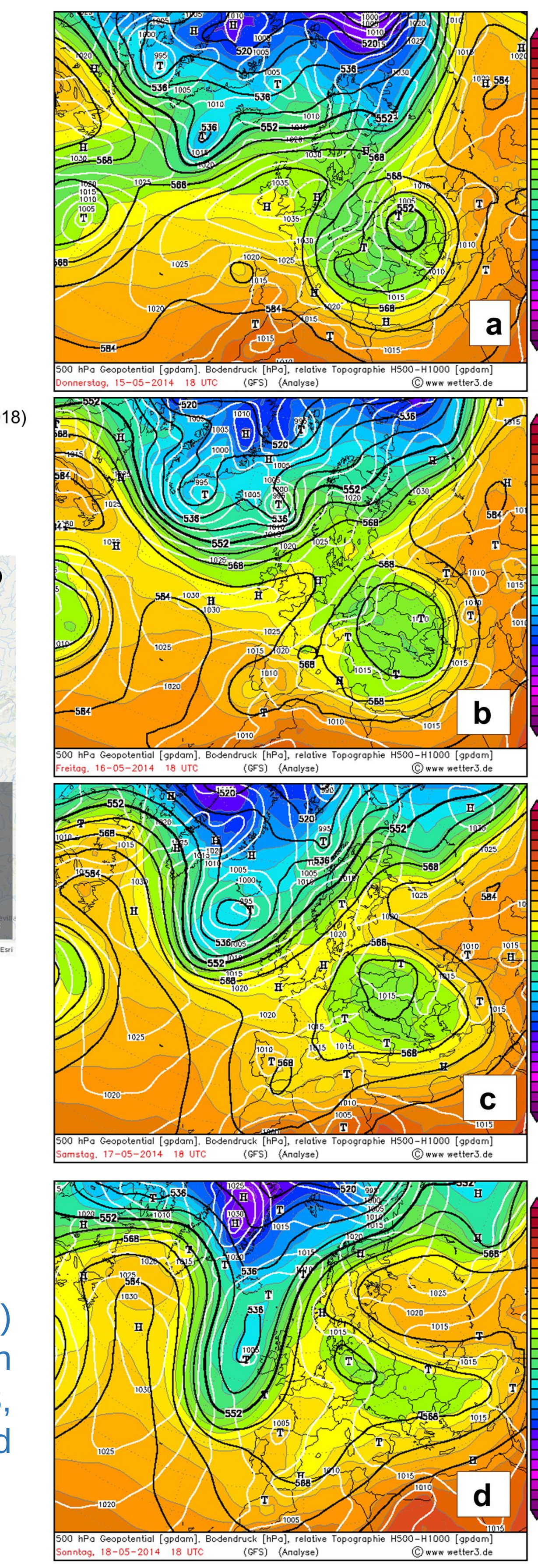

Figure 6 – Geopotential height at 500 hPa and mean sea level pressure at 18 UTC on May 15 (a), 16 (b), 17 (c) and 18 (d) 2014.

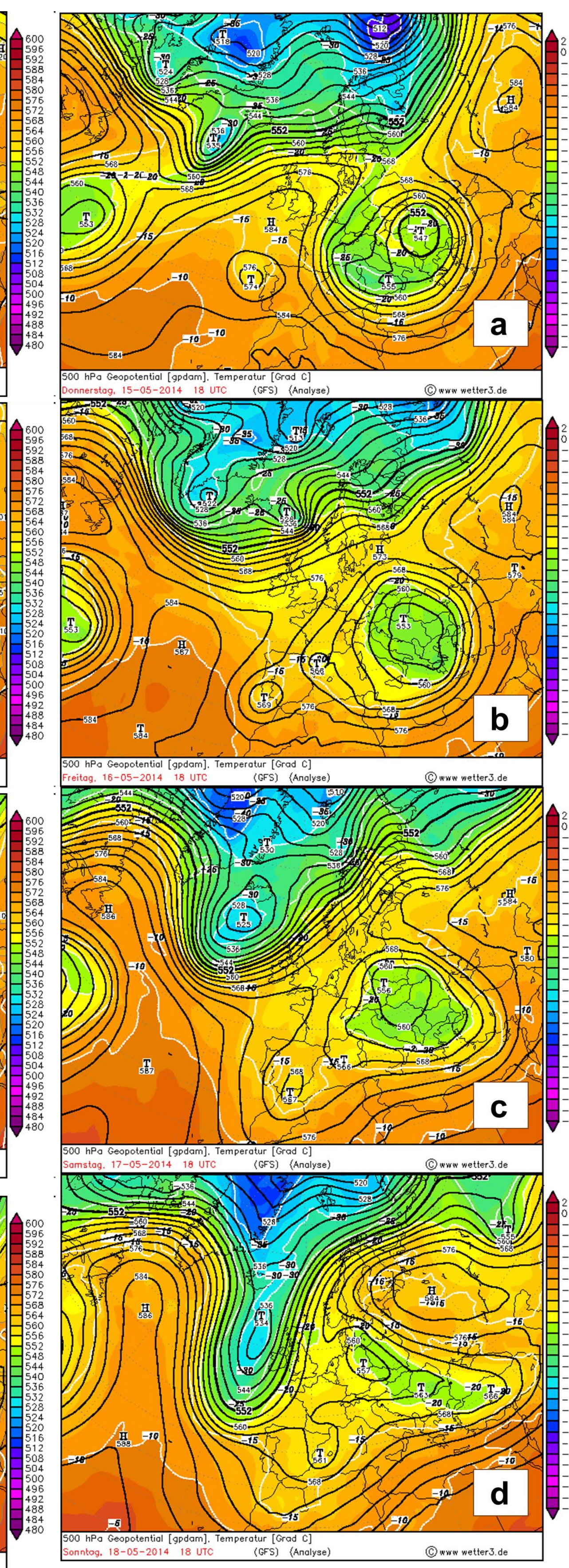

Figure 7 – Geopotential height at 500 hPa and temperature at 18 UTC on May 15 (a), 16 (b), 17 (c) and 18 (d) 2014.

Conclusion

This knowledge will improve the decision-making process in terms of public policies. In addition it contributes to an increased visibility and attractiveness of this area, as a tourism destination through environmental differentiation in this endogenous resource. In the middle of the 21st century, the maximum temperature is expected to increase by 3 °C. These changes in the climate may aggravate the ambient air quality for the territory in question.

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