16 March 2022

METEOCLIMATIC PHENOMENA, AIR QUALITY TRENDS AND PRESSURE FACTORS IN THREE MAJOR CITIES IN ITALY (2011-2020)

Angela Ferruzza, Domenico Adamo, Luigi Costanzo, Giovanna Tagliacozzo and Donatella Vignani, Directorate of Environmental and Territorial Statistics Production, ISTAT, Italy
tagliaco@istat.it, vignani@istat.it

Country	**Italy**
Short description	Focusing on the three major Italian Cities (Milan, Rome and Naples), meteoclimatic indicators (temperature, precipitations and their extremes) are linked with indicators on pressure at local scale, calculated for each urban context: data on atmospheric pollution, on the final consumption of natural gas and electricity, rate of motorisation and characteristics of the vehicle fleet and data on the coverage of green areas. Analysed in an integrated perspective.
Keywords	
Thematic area	• **Energy** • **Human settlements and housing** • **Transport** • **Meteoclimatic indicators, atmospheric pollution, green areas**
Characteristics of the reference area	• **Urban**
Type of statistical product or activity	• **Indicator(s)** • **Linking data from several sources** • **Data analysis** • **Interlinkages between phenomena**
Adaptation approaches	• **"Grey" adaptation – technological and engineering solutions** • **"Green" adaptation – nature-based or ecosystem-based solutions** • **"Soft" adaptation – policy, legal, social, management and financial measures**
Concepts covered/measured	• **Exposure to hazard** • **Vulnerability** • **Adaptation measures** • **Impacts**
Hazard type covered	• **Multiple hazards** • **Drought** • **Heatwave** • **Urban heat island effect** • **Air pollution**

Description of the activity

The output of the activity is an integrated analysis of the indicators that makes it possible to evaluate the main drivers of the pollution in the cities considered in the context of urban warming and change of precipitation patterns.

Through the Survey Meteoclimatic and Hydrological Data (inserted in the National Statistical Program) Istat yearly provided official statistics and indices of extremes at local scale, used also in the context of Sustainable Development indicators (SDGs Goal 11). Concerning Italian regional capital cities, since 1971 annual average temperature shows a positive trend, with the highest values exceeding 16°C in several years since 2014.

Anomalies of annual average temperature from CLINO 1971-2000 became ever positive and significant after 1996. Annual anomalies grow in recent years, recording an average value in the decade 2011-2020 of about +1,3°C on CLINO value.
(FIGURE 1)

Concerning annual total precipitation, data 2020 show an anomaly on average of - 91 mm with respect to CLINO 1971-2000 value (763,8 mm). Negative anomalies seem to be increasing and are recorded in 18 cities in the last year observed. The highest negative anomalies 2020 with respect to CLINO concern Naples, Genoa, Catanzaro, Florence, Bologna, Milan.

Positive anomalies of annual average temperature occur for Italian regional capital cities. Data 2020 record an annual average temperature on average among cities of 15,8°C with +1,2°C on CLINO 1971-2000 value. Positive anomalies are registered for all cities, due to rises in both minimum and maximum temperature. The highest positive anomalies 2020 with respect to CLINO concern Perugia, Rome, Milan, Bologna, Turin.
(FIGURE 2)

In urban context, meteoclimatic indicators can be linked with those describing pressure or mitigation factors (air pollution, proportion of green areas, road traffic pressure). By using statistical indicators spanning from 2011 to 2020 for three major italian Cities, the analysis show how meteoclimatic conditions can interact with other environmental variables and favour the Urban Heat Island effect and air pollution.

Meteoclimatic data highlight:

- **MILAN**: annual medium temperature grows on average of +2°C with respect to CLINO value; since 2011, annual anomalies are always positive in the period examined, reaching +2,7°C in 2014 and 2015. Total annual precipitation shows annual anomalies are mostly negative, with and average value of -163 mm on CLINO value.
- **ROME**: since 2011 annual anomalies of average temperature are always positive, with an average value equal to +2°C on CLINO value. Annual total precipitation anomalies are mostly negative with respect to CLINO value and since 2015 positive anomalies of consecutive dry days prevail. Despite fluctuations, Index Consecutive dray days show positive anomalies in 7 years of 2011-2020 period.
- **NAPLES**: annual average temperature anomalies are always positive in each year of the period examined, with an average value higher than CLINO by +1,5°C. Annual precipitation anomalies are negative for all the years considered, recording an average value of -301 mm on CLINO value. Index Consecutive dray days show positive anomalies in 8 years of 2011-2020 period.

(FIGURE 3)

In the meteoclimatic context described, air quality trends and pressure/mitigation factors in the three major cities highlight:

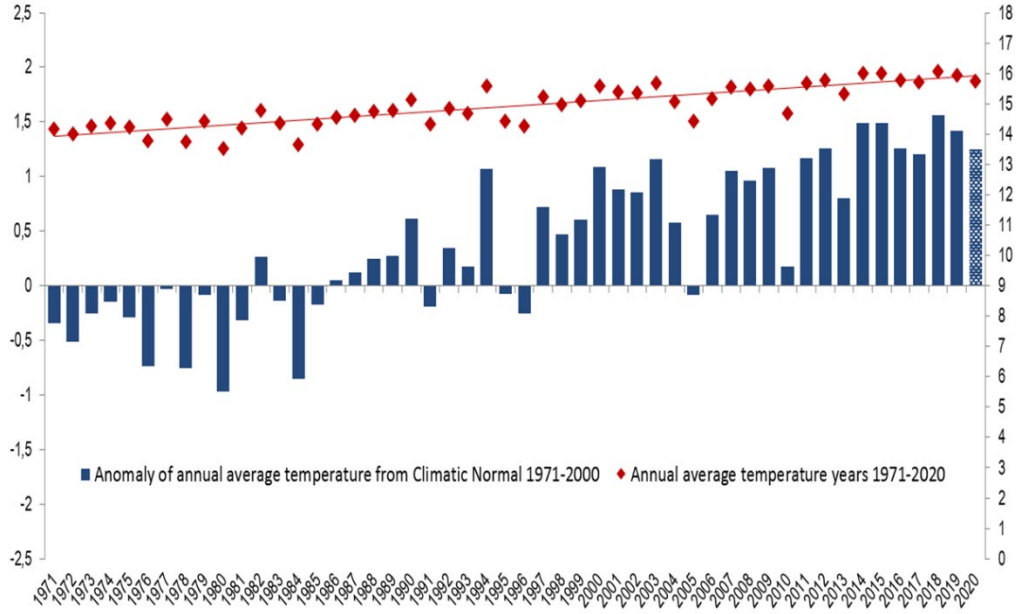
- **MILAN**: in spite of the improvement after 2015, in 2020 Milan maintains levels of pollution well above the average of the capitals and which can be associated with a higher energy consumption and higher risk of suffering from the Urban Heat Island effect (Ozone exceeding on the rise), which can be linked to the low proportion of green areas.

- **ROME:** Rome has better pollution levels, in line with the average of the capitals, thanks also to the strong presence of urban green areas in the city, but the high rate of motorisation seems to be holding back a greater improvement.
- **NAPLES:** The situation is similar to that in the capital city, but the persistence of significant levels of pollution seems to be due mainly to the age of the vehicle fleet.

(FIGURE 4)

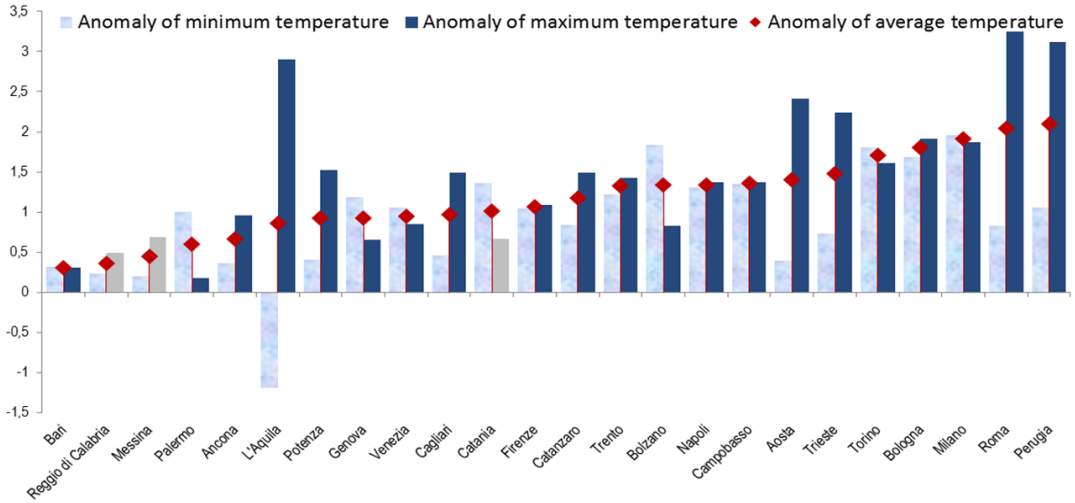
Example of the statistical output

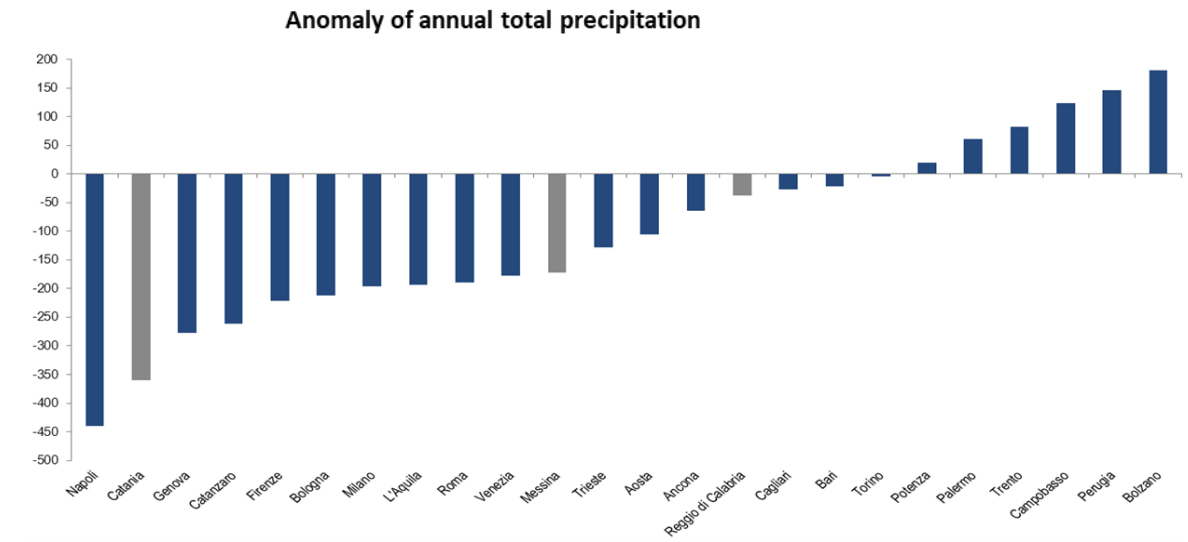
FIGURE 1. ANOMALIES OF ANNUAL AVERAGE TEMPERATURE AND ANNUAL AVERAGE TEMPERATURE OF ITALIAN REGIONAL CAPITAL CITIES WITH RESPECT TO CLIMATIC NORMAL 1971-2000 - Years 1971-2020, absolute values in °C



Source: Istat, Meteoclimatic and Hydrological data

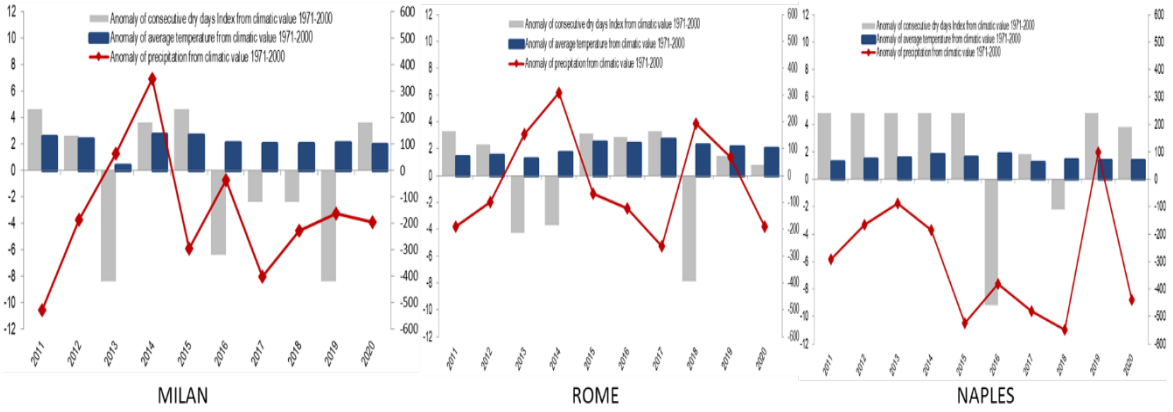
FIGURE 2. ANOMALIES OF 2020 MINIMUM, AVERAGE, MAXIMUM TEMPERATURE AND ANOMALIES OF 2020 TOTAL PRECIPITATION WITH RESPECT TO CLIMATIC NORMAL 1971-2000 BY REGIONAL CAPITAL AND METROPOLITAN CITY - Year 2020, absolute values in mm and °C





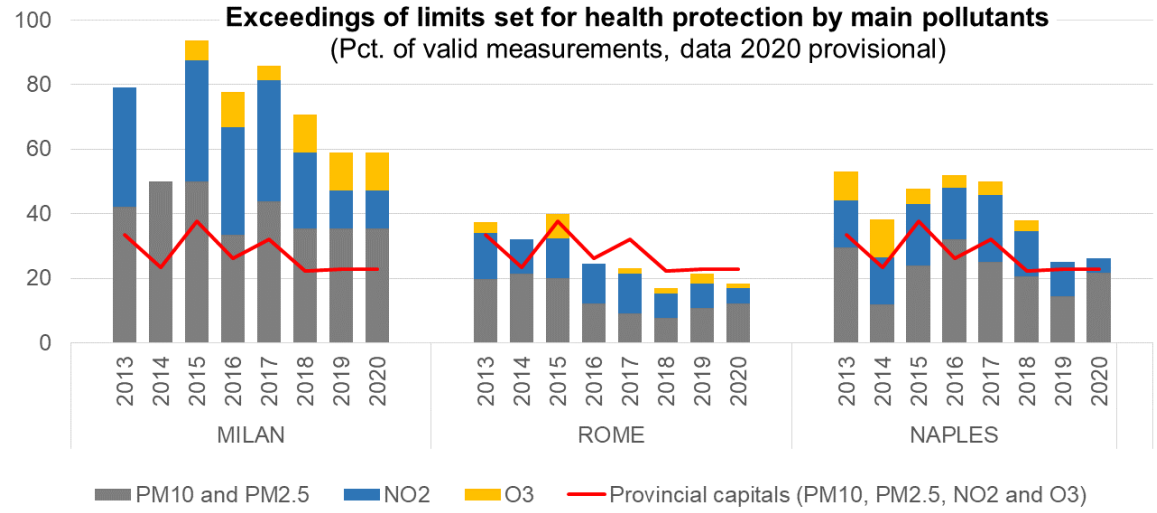
Source: Istat, Meteoclimatic and Hydrological data

FIGURE 3. ANOMALIES OF ANNUAL AVERAGE TEMPERATURE, ANNUAL TOTAL PRECIPITATION AND CONSECUTIVE DRY DAYS INDEX FROM CLIMATIC NORMAL 1971-2000 IN MILAN, ROME, NAPLES - Years 2011-2020, absolute values in °C, mm and number of days



Source: Istat, Meteoclimatic and Hydrological data

FIGURE 4.



2020 provisional data	Final consumption of natural gas+electricity (Toe per 1000 p)	Road traffic pressure (Cars per 1000 p)	(% Euro 0-3 cars)	Green areas coverage (Pct. of municipal territory)
Milan	96 ▼	491 ▼	26.0 % ▼	13.8 % ●
Rome	61 ▼	626 ●	27.2 % ▼	35.6 % ●
Naples	37 ●	586 ▲	52.7 % ▼	31.5 % ●

Source: Istat, Urban Environmental Data

More details

Data sources used	Source: Istat Survey Meteoclimatic and Hydrological Data Survey on Urban Environmental Data
Frequency	Regular data collection and statistics production are provided by the Istat Surveys; one time analysis but may have future developments
Coverage (national/subnational)	Subnational – urban scale
Link with results and more information	Istat 2021, Temperature and precipitation in Italian Capital Cities (Year 2020 and time series 2010-2020) – Tables of data https://www.istat.it/it/archivio/263811
References and bibliography	Methodology of World Meteorological Organization (WMO) of the United Nations (UN) and of Expert Team on Climate Change Detection and Indices (ETCCDI) WMO Commission for Climatology