

## Temperature and precipitation in large Italian cities

Years 2002-2016

In recent decades the interest for climate variability and extreme climate events has increased. The assessment of meteo-climatic impacts on environment, human health, socio-economic and urban systems is of great importance. Higher information needs on the issue has favored the development of statistical frameworks by international institutions to provide standardized and harmonized methodologies for producing data and indicators.

Climatic variability and extreme events of temperature and precipitation have visible consequences also in urban context, characterized by concentration of population and infrastructures. In the last two decades many Italian cities recorded relevant impacts due to climatic variability and extreme events occurrence. An increasing variability is forecast by climatic model (IPPC). Climatic extreme events as heavy rains, floods, long periods without rains, temperature that remains high for days and nights, heat waves, decrease in the number of cold days pose a threat to human health and safety of Italian cities. In fact, such events may damage infrastructures as well as artistic and cultural heritage, may also hamper economic activities and provision of public utilities (water, energy, transport).

The Istat Meteo-climatic and hydrological data survey (edition 2017) has the aim to update the existing database on meteorological and hydrological data (time series 1971-2016). The survey is included in the National Statistical Program (cod. IST-02190) and is regularly conducted. Statistical information provided by this survey can be put in relation with other official statistics regularly produced by Istat on thematic areas such as environment, human health, urban systems, public utilities, to multidimensional analyses.

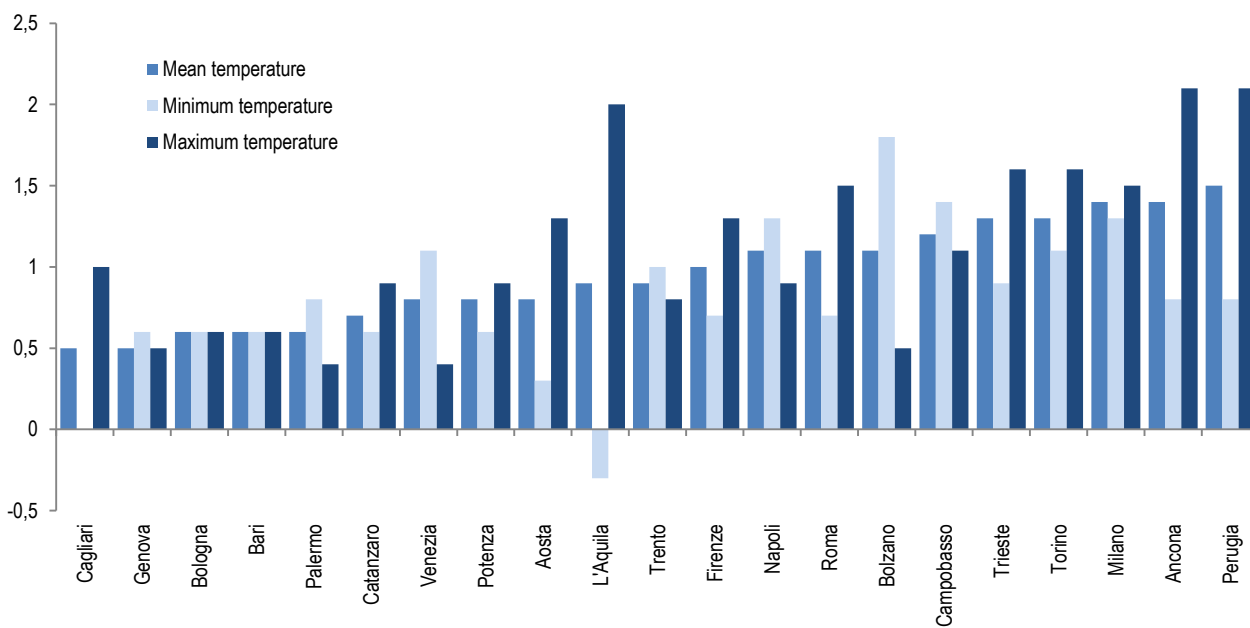
Meteo-climatic variables collected include daily observations of precipitation (mm), minimum temperature (Celsius degree), maximum temperature, mean temperature, and humidity. As far as 21 Italian Regional Capital Municipalities are concerned - where 38.9% of Italian population lives - measurements come from 122 meteorological gauging stations (units of analysis) located within the territory of such cities. Survey units are represented by 65 institutions (public and private) and agencies officially managing national networks of georeferenced meteorological stations. Quality controls, considering the long time series of daily data, lead to a reduced sample of 43 stations, located in all Regional Capital Municipalities. Based on this data collection, meteo-climatic conditions in the main cities are analyzed.

Istat Statistical Report describes aspects of Regional Capital Municipalities climatic variability, in particular observing anomalies of temperature and precipitation comparing the 2002-2016 mean values with the Climatic Normal (CLINO) value, defined by the 1971-2000 period. Some Indices of climatic extremes, defined by the ETCCDI (Expert Team on Climate Change Detection and Indices of WMO-UN) core set, have been calculated for Italian Regional Municipalities.

In 2002-2016 the average temperature of the city stations under observation was 15,5°C, that is 1.0°C higher than the CLINO value (14,5°C). The highest increase (+1.5°C) was measured in Perugia; the lowest (+0.5 °C) in Cagliari and Genova (Figure 1 and Table 1). With reference to climatic extremes events, all indices indicated a warming trend in the cities in 2002-2016 with respect to the 1971-2000 period. The average annual number of summer days (SU25 index) is 110 (+17 days) and the average annual number of tropical nights (TR20 index) was 45 (+14 nights). The Warm Spell Duration Index (WSDI that describe heat waves) increased by 12 days in the last period observed. Accordingly, as a confirm of a warming climate trend, the average annual number of frost days (FD0 index) reduced by 3 days; the number of cold nights (TN10p index) reduced by 9, while the number of cold days (TX10p index) reduced by 11.

The total annual average precipitation in 2002-2016 was equal to 778 mm, with an increase by 1.6% with respect to the normal value (765,8 mm). The total annual average precipitation presented a high variability by territory and time among Regional Capital Municipalities. In the period 2002-2016, Genova, ranking second about total annual average precipitation among the cities examined, presented the highest difference of total annual average precipitation (-206.2 mm) from the correspondent mean CLINO value recorded. Differently, Palermo and Campobasso registered the highest increases (+166.8 mm, +162.1 mm, respectively) (Figure 2 and Table 2). In 2002-2016 the annual number of days with precipitation (R1 index) was equal to 82, similar to the normal climatic value. The variation ranged from -5 days in Venezia to +8 in Palermo. The average annual number of days with precipitation higher than 20 mm (R20 index) also remained steady with respect to the normal value. Variation ranged from -3 days in Milan and Genova to +3 days in Campobasso, Catanzaro, Palermo and Trento. The total precipitation in very rainy days (R95p index) equaled on average 192 mm., that is 24.7% of the annual total precipitation.

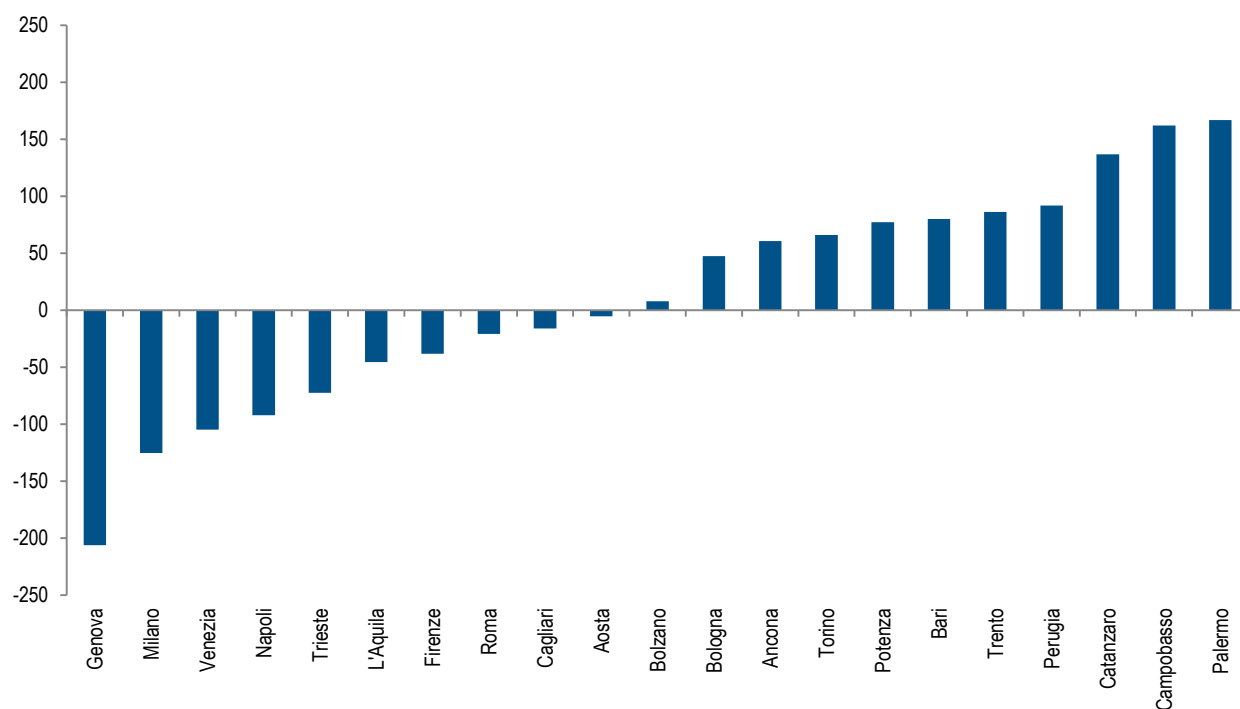
**FIGURE 1. Anomalies average of mean temperature, minimum temperature and maximum temperature of the period 2002-2016 compared to Climatic Normal 1971-2000, by Regional Capital Municipality (Celsius degrees).**



**TABLE 1. Mean temperature, period 2002-2016, CLINO 1971-2000, Celsius degrees and percentage values, by Regional Capital Municipality**

REGIONAL CAPITAL MUNICIPALITY	Mean temperature		
	2002-2016	Climatic normal 1971-2000	% variation with respect to Climatic normal
Torino (Piemonte)	14,8	13,4	9,7
Aosta (Valle d'Aosta)	11,8	10,9	7,4
Genova (Liguria)	16,5	16,0	3,2
Milano (Lombardia)	15,4	14,0	10,1
Bolzano/Bozen (Trentino-Alto Adige)	13,3	12,1	9,3
Trento (Trentino-Alto Adige)	13,2	12,3	7,1
Venezia (Veneto)	14,9	14,1	5,4
Trieste (Friuli-Venezia Giulia)	15,9	14,6	8,5
Bologna (Emilia-Romagna)	15,2	14,6	3,9
Firenze (Toscana)	16,4	15,4	6,3
Perugia (Umbria)	14,9	13,5	10,8
Ancona (Marche)	17,0	15,6	9,2
Roma (Lazio)	16,9	15,8	7,1
L'Aquila (Abruzzo)	12,8	11,9	7,3
Campobasso (Molise)	13,5	12,2	10,2
Napoli (Campania)	17,0	15,9	7,0
Bari (Puglia)	17,6	17,0	3,5
Potenza (Basilicata)	13,5	12,7	6,1
Catanzaro (Calabria)	17,0	16,3	4,4
Palermo (Sicilia)	19,1	18,5	3,3
Cagliari (Sardegna)	18,3	17,8	2,8

**FIGURE 2. Average of anomalies in total annual average precipitation of 2002-2016 period compared to Climatic Normal 1971-2000, by Regional Capital Municipality (millimeters)**



**TABLE 2. Total mean precipitation and anomalies compared to Climatic Normal. Years 2002-2016, 1971-2000, millimeters and percentage variation**

REGIONAL CAPITAL MUNICIPALITY	Total mean precipitation		
	2002-2016	Climatic Normal 1971-2000	% variation with respect to Climatic Normal
Torino (Piemonte)	938,1	872,1	7,6
Aosta (Valle d'Aosta)	521,3	526,8	-1,0
Genova (Liguria)	1064,5	1270,7	-16,2
Milano (Lombardia)	830,4	955,8	-13,1
Bolzano/Bozen (Trentino-Alto Adige)	699,9	692,1	1,1
Trento (Trentino-Alto Adige)	987,7	901,5	9,6
Venezia (Veneto)	700,0	804,8	-13,0
Trieste (Friuli-Venezia Giulia)	914,0	986,4	-7,3
Bologna (Emilia-Romagna)	802,4	755,0	6,3
Firenze (Toscana)	776,6	815,0	-4,7
Perugia (Umbria)	875,6	783,8	11,7
Ancona (Marche)	736,1	675,4	9,0
Roma (Lazio)	768,2	789,3	-2,7
L'Aquila (Abruzzo)	640,6	686,1	-6,6
Campobasso (Molise)	713,8	551,8	29,4
Napoli (Campania)	883,7	976,1	-9,5
Bari (Puglia)	609,5	529,7	15,1
Potenza (Basilicata)	754,3	677,2	11,4
Catanzaro (Calabria)	1096,9	960,1	14,3
Palermo (Sicilia)	636,5	469,7	35,5
Cagliari (Sardegna)	387,6	403,5	-4,0

**For more details please refer to the Italian version**

---

Contact persons:

**Donatella Vignani** ([vignani@istat.it](mailto:vignani@istat.it)).

Directorate for environmental and territorial statistics

Istat – National Institute of Statistics

Viale Oceano Pacifico– Rome 00100 Italy

phone +39 06 4673.4936