Do atmospheric conditions and environmental hazards affect human well-being in Italy?

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Extended abstract

Most of the European urban population lives in cities where EU air quality standards for protecting human health are regularly exceeded (European Environmental Agency -EEA-, 2022). Around 90% of European cities have a pollution level harmful to health. EEA (2022) estimates that PM2.5 reduces life expectancy in the EU by more than eight months. In 2022, the Italian average of PM10, PM2.5, NO2, and O3 was above the EU27 average. Furthermore, premature death due to PM2.5, NO2, and O3 in Italy represents 21-23% of the total premature death in EU27 countries. Although the general level of emissions at the European level is decreasing, several cities continue to exceed the emission levels established by EU law. This aspect will be made more evident when the targets to be considered will be the ones of the new 2030 EU regulation (that further reduces the maximum level of pollution). According to the leading Italian environmental association (Legambiente, 2023), on a sample of 95 of the largest Italian cities, only 24% of these cities respect the PM10 limit imposed by the new EU regulation and 39% the NO2 limits. Highly populated areas require cities to build new houses, infrastructures, and general facilities, resulting in more released anthropogenic heat, a higher blockage effect against urban ventilation, and a higher absorption of solar radiation due to implementing artificial materials (Ashtiani et al., 2014). This increase in temperature triggers heat-related diseases, increases premature city deaths, and lowers citizens' well-being (Mirzaei, 2015).

Understanding how atmospheric conditions and environmental hazards affect human well-being can inform effective mitigation and adaptation strategies. Much focus has been on the psychological effects of extreme events, but little is known about the daily impacts of environmental factors on Citizens' well-being (CWB) (Wang et al., 2020). One of the main factors limiting citizens' well-being in many European cities (but also worldwide) is the intensification of heat stress episodes (Baylis et al., 2018) and pollution (Zheng et al., 2019). Summer 2023 in Italy has registered a temperature peak expected to rise further in the following years (Sabelli, 2023). This excess heat can cause cardiovascular stress, heart stroke, and other major health issues. Researchers and policymakers have increasingly used indicators as measures of life satisfaction to complement traditional objective development and economic metrics (Chai et al., 2023). Literature on citizens' well-being evaluations mainly considers survey data for a specific territory and period (i.e., Patrick et al., 2020). However, daily and specific territorial heterogeneities are not much considered.

Furthermore, using a survey would be prohibitively expensive to estimate daily sentiment across the Country. However, publicly available updates on social media (Facebook, Twitter, etc.) provide a low-cost alternative and a new and valuable complement. Every day, active social media users share and generate useful traces of their attitudes, beliefs, and feelings at every moment. Recent Natural Language Processing (NLP) has enabled extracting sentiment information from social media posts. Using expressed sentiment data can provide a high-resolution and large-scale complement to traditional survey measures of CWB. A few papers explain this relationship and focus mainly on the US or China for a shorter period. In particular, Zheng et al. (2019), using daily data for 144 Chinese cities in 2014, noted a negative relationship between PM2.5 concentration and the happiness index (based on the sentiment in the contents of 210 million geotagged tweets). People suffer more on weekends, holidays, and days characterized by extreme weather conditions. Wang et al. (2020), analyzing 121 Chinese cities, find that temperature, precipitation, cloud cover, and wind speed extremes are all correlated with more negative expressed sentiment, especially for females and individuals in poorer cities[1]. Baylis (2020), using daily Twitter data for the US (2014-2016), found a significant decline in expressed sentiment resulting from both low and high temperatures. This paper uses Twitter data (Chai et al., 2023) for the period 2012-2023 to explain how the sentiment score, defined as the probability of a post being classified as a post with a positive mood at a daily level for all the Italian provinces, is affected by urban and daily atmospheric and environmental variables (temperature, precipitation, pollution, humidity, etc.). Italy is an interesting case study because of the heterogeneous territory and the natural disasters that cross the country daily (landslides, floods, earthquakes, and droughts). To explain how citizens from different provinces react to atmospheric and environmental variables, given the nature of the dependent variable (sentiment score), the methodology used is the beta regression model fixed effects. This approach can estimate nonlinear sentiment responses to atmospheric conditions and environmental hazards considering unobserved variation across space and time and spatial and seasonal differences. We used the variable “score” as a dependent variable and PM10, humidity, precipitation, and maximum temperature as independent variables. From this preliminary analysis, it emerges that a higher level of PM10 (versus 0-10 class of PM 10 level) has a negative (and significant) effect on the “score” variable. Also, humidity negatively affects the “score”, but this effect is significant only for the larger classes (80-90 and 90-100 versus 0-60). Precipitations also negatively affect the score variable (classes 0-15 and 15-186 versus “no rain”). Last, higher temperatures positively affect the score variable (all the classes versus the lowest ones (-11, 5 Celsius degrees). Additional robustness checks will consider variables like natural disaster dummy variables, wind speed, cloudiness, and week and holidays dummy variables. Results will be used to develop specific territorial policies necessary for local and national policymakers to improve both territorial sustainability and CWB.

[1] Zheng et al. (2019) and Wang et al. (2020) used tweets data from the platform Sina Weibo.

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