586: Effect of green areas on summer air temperatures in Florence

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Abstract

In this study, the relationship between the percentage of green areas (green cover ratio - GCR) and intra-urban minimum and maximum temperature was investigated during the summer period. A network of air temperature sensors (HOBO® PRO series Temp/RH Data Logger, Onset Computer Corporation) was used to collect intra–urban thermal data in Florence (Italy). Temperature data were related to GCR calculated on areas of different size (from 10 to 250 m radius) centred on each sensor. Our results evidence a clear negative relationship between both minimum and maximum temperature values and GCR. It was correlated with maximum air temperatures only in areas of small radius, and with minimum air temperatures in all the considered areas. These results can be useful for urban planners to evaluate the effect of the increase of green areas in an urban environment.

Keywords: urban green, urban planners, temperature, urban indicators.

1. Introduction

There are several studies that analyze the effects of vegetation and green areas on the microclimate of the city (Oke, 1989; Kawashima, 1990/1991; Saito, 1990/1991; Sponken-Smith and Oke, 1998, Ren et al. , 2011). In general, the vegetation, through the shading effect and evapotranspiration is considered a factor that reduces temperature. In addition surface permeability of green areas withhold part of the water, that otherwise would be run off the city by the drainage system, and make it available to plant evapotranspiration that can further reduce temperature. In some studies, urban parks always resulted to have lower air temperature values than the surrounding urban environment (Sponken-Smith and Oke, 1998) and this mitigation also affected the neighboring urbanized area (Jauregui, 1990/91). This cooling park effect might cause a temperature reduction varying from 1 °C to 5 °C depending on the size of the park (Ca et al., 1998; Shashua-Bar and Hoffman, 2000; Robitu et al., 2006). However, other studies show that in some situations, maximum air temperature does not significantly differ between paved areas and green areas (Potcher et al, 2006). These results, in some cases, might seem to be contradictory and for this reason other studies investigated how the type of vegetation might affect the park cooling effect (Jauregui, 1990/1991; Spronken-Smith and Oke, 1998; Potchter et al., 2006; Petralli et al., 2009).

The temperature mitigation caused by vegetation can also produce positive benefits in reducing energy consumption. Tree shadow on a building wall can reduce temperature from 5 °C to 20 °C (Robitu et al, 2006; Hoyano, 1988; Papadopoulos, 2001). This effect may allow to save about 10-35% of energy consumption for cooling during Summer (Rosenfeld et al., 1995; Raeissi and Taheri, 1999).

Even though scientific research in this field produced such a huge number of studies, its achievements were scarcely used by urban planners because they did not provide information that is effectively usable in a real context. The aim of this study is to investigate and quantify the cooling effect of the percentage of a green area on minimum and maximum temperature during Summer 2009 in Florence.

2. Material and Methods

Green Cover ratio (GCR), defined as the percentage of all type of green areas above the canopy covering a fixed area (Zhao et al., 2011), was used as an urban indicator to estimate the effect of vegetation on Summer temperature in Florence. The city lies in a plain to the southwest of the Apennine mountains in the central part of Italy (Lat: 43.77; Long: 11.26; elevation 50 m asl) and it is characterized by a sub-Mediterranean climate with a hot, dry summer, a mild and quite wet winter, and a wet autumn and spring.

In this study, 20 sites were selected among those that are part of a network of air temperature and relative humidity sensors with naturally ventilated solar radiation shields (HOBO® PRO series Temp/RH Data Logger, Onset Computer Corporation, Pocassette, MA, USA; RS1-HOBO® PRO) set up in the city of Florence (Italy) since 2005 (Petralli et al., 2011). Air temperature daily extremes were calculated on data automatically collected at 15-min intervals in Summer 2009 (from the 1st of June to the 31st of August). Daily differences in maximum (DTx) and minimum (DTn) air temperature data between each single