Supporting Information. Herreros-Cantis, P., and T. McPhearson. 2021. Mapping supply of and demand for ecosystem services to assess environmental justice in New York City. Ecological Applications.

Appendix S1

Section S1: Mapping ecosystem services supply based on Kremer et al (2016).

In this section, we explain the methodology for mapping ecosystem services (ES) in detail. These methods mimic those used in Kremer et al. (2016) and are hence presented as an appendix. This methodology combines land cover data with a range of additional indicators to provide a raster with a normalized supply index that represents the potential benefits generated at each cell within the land cover dataset. The land cover data used was generated by MacFaden et al. (2012) for NYC in 2010 and has a resolution of 1x1m. Land cover data is considered key in ES mapping, since it provides an overview on the distribution of different types of ecosystems, and it can be combined with other indicators that reflect the ecosystem´s properties that define the ecosystem´s capacity to provide ES (e.g. soil types, slope… etc.) (Burkhard and Maes 2017). As specified in Kremer et al. (2016), this mapping required auxiliary data to be resampled to the land cover's resolution. It is important to consider that the resampling of data to match the land cover dataset is a source of inaccuracy, and that the results will reflect the accuracy of the coarsest dataset (Gotway and Young 2002). The ecosystem services mapped are local temperature regulation, runoff mitigation, and air purification.

For temperature regulation, a 'local climate indicator' was calculated as in Schwarz *et al.* (2011). This index expresses the local climate regulation effect as the ratio between the local land surface temperature and the mean surface temperature of the green areas in the city (Equation S1).

$$Local\ Climate\ Indicator\ (i) = \left(\frac{temp(i)}{temp(m)}\right)^{-1} \qquad \text{Equation S1}$$

Where *temp(m)* is the mean surface temperature of pixels covered by tree canopy, grass\shrub, water and bare earth.

The ‘average summer day’ data generated in the demand assessment (Table 5 in the main text) was resampled to a 1x1m grid using bilinear interpolation in order to match the resolution of the land cover data while remaining within the maximum and minimum values of the temperature dataset. Thermal values of areas covered by tree canopy, grass\shrub, water, and bare earth were retrieved and used to calculate the mean value (*Temp(m))*. This mean value was then used to calculate the indicator for each cell of the areas covered by natural land cover categories. Once the index had been calculated, it was normalized in order to limit its values to the range from 0 to 1.

For runoff mitigation, We used the technical release by USDA coded TR-55 and titled “Urban Hydrology for Small Watersheds” (Cronshey 1986). This methodology uses curve numbers (CN) to estimate the runoff for a given rain event, allowing the calculation of infiltrated water. This procedure requires information related to the hydrologic soil groups (HSGs) and land cover type to generate a curve number map. Data related to HSGs was retrieved from the NYC Reconnaissance Soil Survey Report (New York City Soil Survey Staff 2005) (Figure S1). Table S1 shows the CN defined by the different land cover categories and HSGs. Using the formula indicated in TR-55 (Cronshey 1986:p.2-1) (Equation S2) we calculated the runoff generated (Q) by a 5 inches (127mm) storm:

$$Q = \frac{(P-0.2S)^2}{(P+0.8S)} \qquad \text{Equation S2}$$

Where *P* is the rain event in inches and *S* the potential maximum runoff, dependent on the CN (Equation S3).

$$S = \frac{1000}{CN} - 10 \qquad \text{Equation S3}$$

Finally, a stormwater absorption index (X) was calculated by dividing the runoff generated by the total precipitation (Equation S4). This index was used as the supply indicator for runoff mitigation.

$$X = 1 - \frac{Q}{P} \qquad \text{Equation S4}$$

For air purification, data on air pollution removal capacity by different types of land cover was retrieved from Yang (2008) (Table S2). These numbers, which have been considered in other ES mapping research (Gómez-Baggethun et al. 2013, McPhearson et al. 2013), were then used in the land cover map of NYC.

References

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Table S1: Curve numbers per Hydrologic Soil Group and land cover category.

Land cover category	**Source (description used in TR-55)**	**A**	**B**	**C**	**D**
Tree canopy	other agricultural areas - woods - fair conditions (trees are managed, non-grazed, but litter is collected)	36	60	73	79
Grass/shrub	urban areas - open space - fair condition	49	69	79	84
Bare earth	urban areas - impervious areas - dirt	72	82	87	89
Buildings, roads and other paved surfaces	urban areas - impervious areas - paved parking lots, roofs, driveways	98	98	98	98

Table S2: Pollutant removal rate for trees and shrubs based on Yang (2008).

Pollutant	**Trees**	**Shrubs/grass**
NO_2	3.57 (g/m2/yr)	2.33 (g/m2/yr)
O_3	7.17 (g/m2/yr)	4.49 (g/m2/yr)

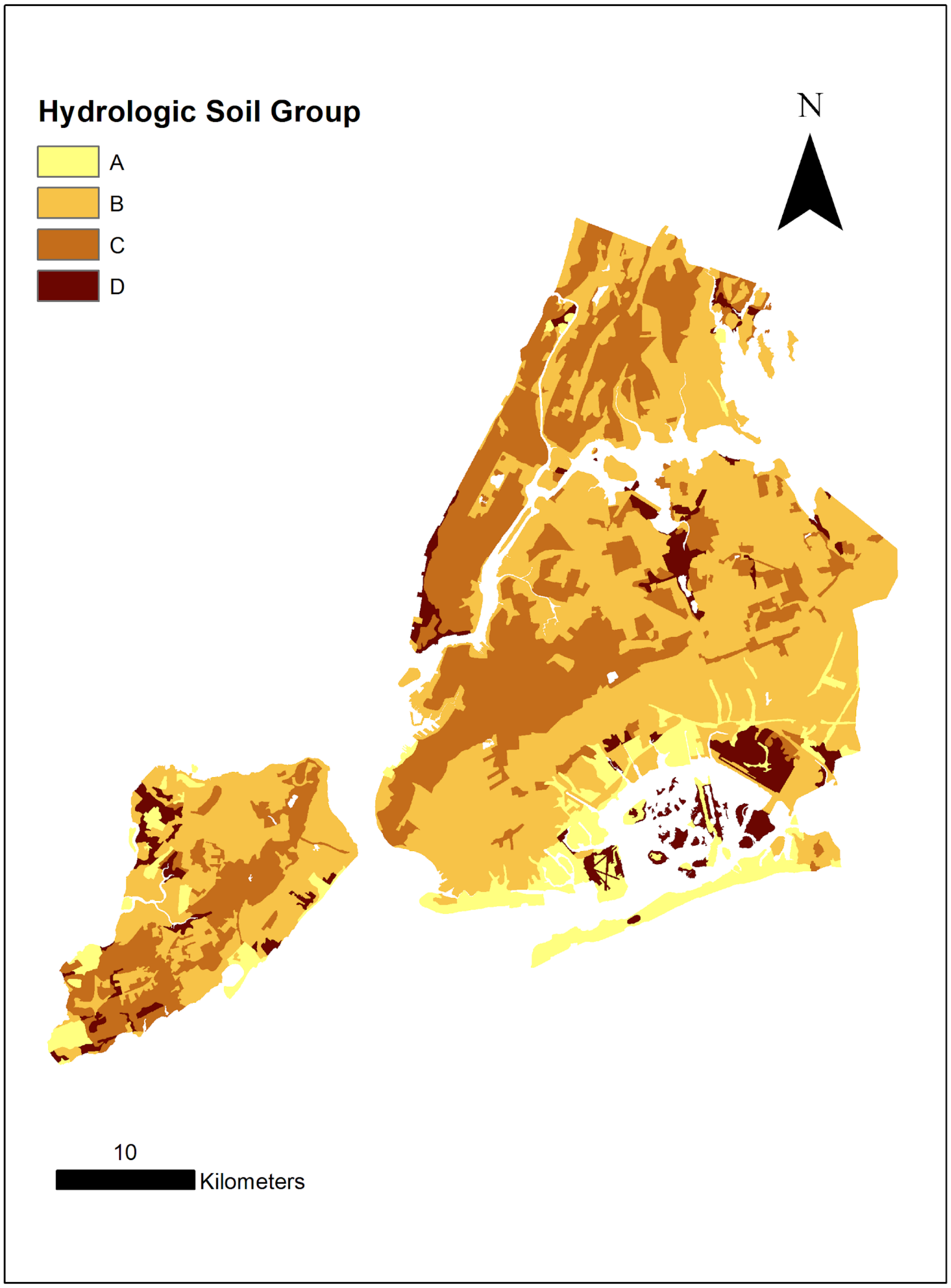

Figure S1: Map of Hydrologic Soil Groups in New York City based on the NYC Reconnaissance Soil Survey Report (New York City Soil Survey Staff 2005).

Figure S2: Supply, demand and mismatch maps for each of the ES assessed, at the census block level.

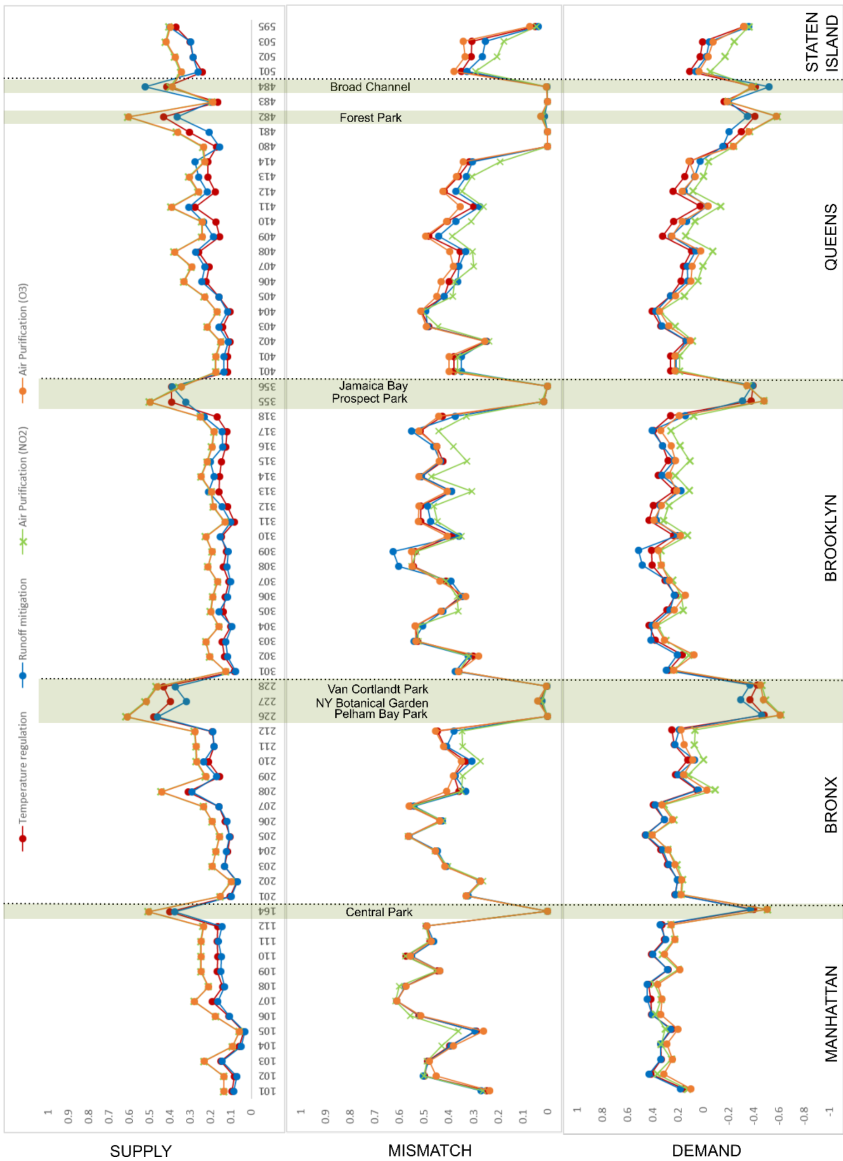

Figure S3: Variation in the supply, demand and mismatch per Community District (CD). CDs with relatively high supply values are highlighted so that their demand and mismatch can be easily compared. As it can be seen, higher supply values correspond to areas with low or no demand due to low population densities within the CDs boundaries, which leads to negative mismatch values.

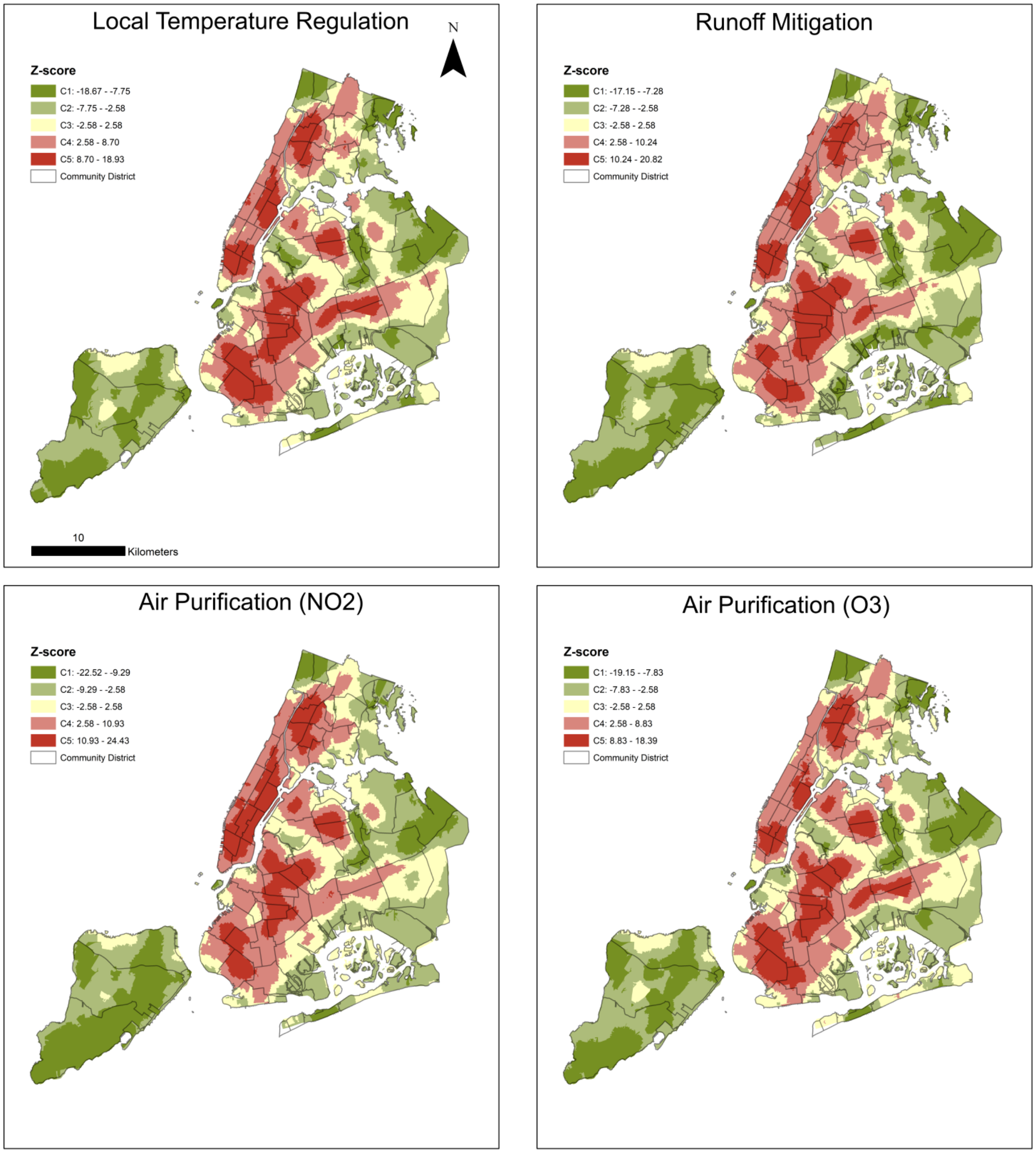

Figure S4: Census blocks classified into hotspots and coldspots according to the Z-score obtained in the cluster analysis. Coldspots (clusters of low mismatch value) correspond to low Z-scores, while larger scores correspond to hotspots (high mismatch). Even though break values between different categories were set using a Jenks distribution, values 2.58 and -2.58 were set manually in order to keep a minimum degree of significance ($p<0.01$). C3 corresponds to those census blocks that obtained a Z-score between 2.58 and -2.58, meaning that their p-value is > 0.01.

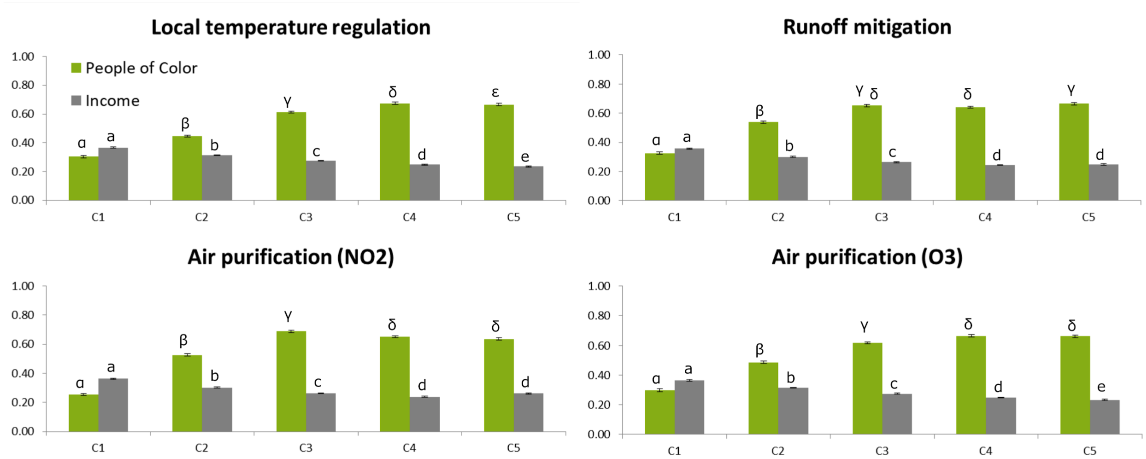

Figure S5: Average proportion of people of color over the total population and relative income per mismatch cluster. Clusters range from extreme lows to extreme highs (coldspots to hotspots, from lower to higher z-scores). C3 refers to census blocks that do not belong to a high or low cluster based on statistical significance at $p>0.01$. Latin and greek letters indicate statistical significance across the clusters as per the ANOVA tests carried out. All the statistical significance tests returned p-values below 0.001 except for the comparison of people of color C4-C5 in the service runoff mitigation ($p<0.05$).

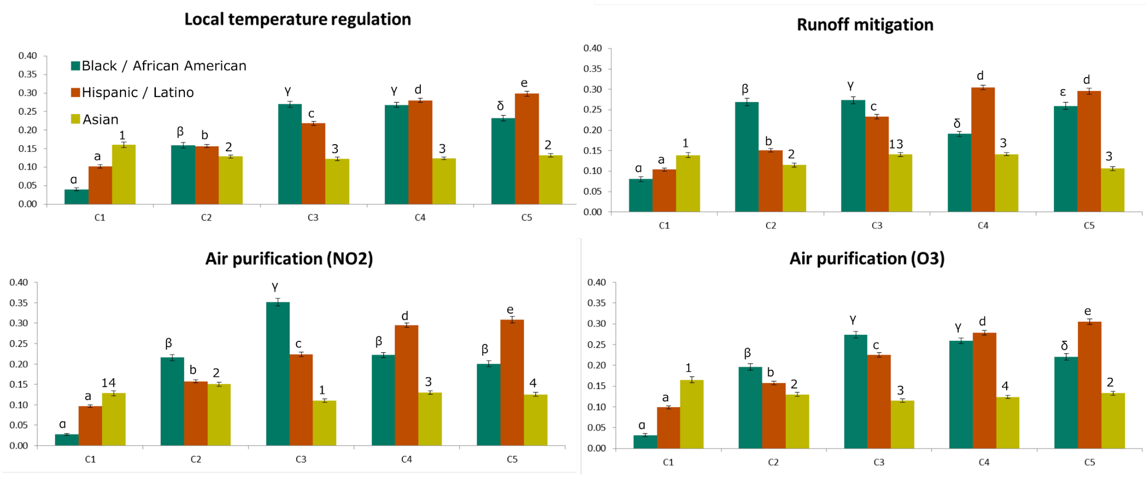

Figure S6: Average proportion of disaggregated people of color, per mismatch cluster for the service local temperature regulation. Latin and greek letters and numbers indicate statistical significance across the clusters as per the ANOVA tests carried out. All the statistical significance tests returned p-values below 0.001, except for the following comparisons in which $p<0.05$: In local temperature regulation, Asian in comparisons C2-C3, C2-C4, C4-C5, and C4-C3. In Runoff mitigation, Black/African American in comparison C3-C5. In air purification (NO_2), Hispanic/Latino in comparison C4-C5; Asian in C4-C1, C5-C3, and C5-C4. In air purification (O_3), Asian in comparison C4-C3.