model's historical data refer to the period 1996-2016 and climate projections are for the near future (2030-2050) and distant future (2079-2099).

III. Heatwaves identification

The heatwaves were identified using the definition given by [19], where a heatwave is defined as a period of at least three consecutive days with maximum temperatures above the threshold of the ninetieth percentile of the daily maximum temperature of the reference period. The threshold is defined as the 90th percentile of daily highs, centered on a 31-day window.

The same method described above was used to identify heat waves in the near future (2030-2050) and distant future (2079-2099). However, there were changes in the data and values of the daily thresholds. To verify the impacts of future heat waves on health, we used the same methodology first applied in [20] and later in [15]. Two assumptions about adapting to heat waves were considered here:

1) Non-adaptation: to identify heat waves in the near future (2030-2050) and distant future (2079-2099) in a non-adaptation hypothesis, the daily thresholds were calculated for the present period (1996-2016). These thresholds were used to identify heat waves in the present (1996-2016), in the near future (2030-2050) and in the distant future (2079-2099). In this condition, it is assumed that humans cannot adapt to the increase in temperature with the same response to the temperature distribution [15], [20]. This method is often used to characterize heatwaves in the future.

2) Hypothetical full adaptation: In this condition, the daily threshold is recalculated, considering reference periods of the future, such as the period from 2030 to 2050 to identify heat waves in the near future and from 2079 to 2099 to identify heat waves in the distant future. The new reference periods for the near future and the distant future are used as an indication of a complete human adaptation to heat waves in the future, through changes in human physiology and behavior, such as changes in clothing, diet, physical activity, lifestyle, housing and city planning itself (creation of parks and green areas).

IV. Historical heat-wave elderly mortality relationships

To verify the impact of heat waves on the elderly mortality from 1996 to 2016, statistical models were run for each Brazilian State capital separated by disease. The statistical model used was the Generalized Linear Model (GLM) with quasi-Poisson distribution combined with the Distributed Lagging Nonlinear Model (DLNM)[21].

According to [21] the effects of heat during heat waves can be described as the sum of two contributions: the independent effects of daily air temperature levels (known as main effects) and the added effects due to duration. heat for several consecutive days (heat wave period). These contributions were analyzed by the results of the statistical models, the first contribution (main effects) being an exposure-response function for the temperature and health (*Basis*). The second contribution (added effects) is an indicator function of days with heat waves (equal to 1) and days without heat waves (equal to zero) (*HW*). An algebraic representation is given by (1):

$$Log|E(Y_i)| = \beta_0 + \beta_1 HW + \beta_2 Basis + \beta_3 DOW + \beta_4 ns(Time, df = 10 * 14) \quad (1)$$

where Yi is the mortality count, assuming it follows a quasi-Poisson distribution for each day i.

The relative risk of the main effect is predicted between the median temperature over heatwave days versus the Minimum Mortality Temperature (MMT). MMT refers to a temperature at which little or no adverse effect of temperature on mortality is expected [15], [21]. The added effect is estimated as the exponential coefficient of the indicator variable (HW). The total effect was also estimated by adding individual contributions.

After obtaining an estimate for each specific Brazilian capital, a meta-analytic process was performed based on the constrained maximum likelihood to group the estimates and obtain a summary measure for Brazil and each administrative region [22].

V. Projection of relative risk

The relative risk was initially projected for each contribution of heat to elderly mortality during heat waves, in order to obtain the projection of the total contribution of heatwave-related elderly mortality. Therefore, the projections of the relative risk of mortality in the elderly associated with the average persistence of heat waves were made based on the value of the estimated coefficient for added effects. This coefficient is equivalent to the increase or decrease in elderly mortality (from respiratory and/or cardiovascular diseases) in one (1) heat wave day. Regarding the main effect of heat, projections were made based on the coefficient estimated for the main effects of heat on mortality by the statistical model. This coefficient is equivalent to the increase or decrease in elderly mortality every 1ºC. Therefore, the relative risk can be projected for the future period for each contribution, based on the following equations [15], [23]:

$$RR_{proj\_add} = e^{(\beta \Delta L)} \quad (2)$$

$$RR_{proj\_main} = e^{(\beta \Delta T)} \quad (3)$$

where β is the value estimated by the statistical model for the added effects and main effects, respectively. ΔL and ΔT are respectively the difference in the average duration of heat waves and the difference in the median temperature during heat waves between the present and in each of the future periods (near and distant) in the RCP4,5 and RCP8,5 scenarios of climate change.

After obtaining the projections of the relative risk of individual contributions, the projection of the relative risk of the total contribution of heatwaves in the mortality of the elderly was calculated, adding the individual contributions in each Brazilian capital. To obtain a summary measure of the