Projections of social-inequalities due to sea level rise in the Continental United States

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Climate change is one of the most pressing challenges of the 21st century and is likely to exacerbate social inequalities. Climate change impact studies typically focus on population totals or use current populations to discuss social inequalities of impacts. With the anticipated growth of minority groups in the United States, the potential inequalities that climate change is expected to exacerbate are still relatively undefined. Here, we use critical race theory coupled with detailed sociodemographic population projections to answer two primary research questions regarding social inequalities due to climate change impacts within the context of sea level rise. First, who is at the highest risk to SLR? Second, is climate change a new form of in- equality or is it simply a new avenue for current inequalities to continue to manifest? Our preliminary results suggest women, the elderly, and communities of color will likely account for most sea level rise displacement, in the absence of protective measures. Sea level rise is not simply a new avenue for current inequalities, but the magnitude of these inequalities suggest it could be considered a new form of inequality.

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INTRODUCTION

Climate change is one of the most pressing challenges of the 21ˆst century and is likely to exacerbate social inequalities. Environmental inequality (eco-inequality) and environmental racism (eco-racism) are already prevalent in the U.S. (Faber and Krieg 2001; Hurley 1995; Krieg 1998; Mitchell and Norman 2012; Mohai 1996) and climate change could disproportionately expose low-income communities and communities of color to additional environmental hazards.

Recent scholarship on the environmental inequalities typically focus on contemporary mechanisms that heighten environmental risks, such as white-flight, racially-based policies,

discriminatory zoning and lawas, and business alliances (Boone and Modarres 1999; Bullard 1990, 2000, 1996; Faber and Krieg 2001; Mitchell and Norman 2012). This scholarship tends to focus on communities already experiencing significant disadvantage, but few studies have considiered the much broader environmental issue of climate change and the disproportionate impact it could have on communities of color and low-income communities. The Environmental Justice Movement highlights the risks of environmental toxins on minority communities and workplaces, but without exploring how climate change may disproportionately push minority groups further into disadvantage we risk blindly stumbling into a future wrought with the intergenerational transmission of inequality.

Additionally, relatively few high-quality data sets containing detailed population projections of sociodemographic characteristics exist and some have called for the development of these data (Lutz and Muttarak 2017). Due to this lack of data, few studies have attempted to *quantify* the anticipated impacts of climate change on social inequalities while many have *qualitatively* discussed these impacts.

Sea level rise (SLR) impact studies have a long history within the social and physical sciences (Curtis and Schneider 2011; Mathew E. Hauer, Evans, and Mishra 2016; Martinich et al. 2013; Strauss, Kulp, and Levermann 2015) but typically focus on either the impact on the total population or on the sociodemographic characteristics of current coastal inhabitants. Here we examine SLR, a broader environemtanl issue associated with climate change, by coupling high-quality sub-national sociodemographic population projections (Hauer 2018) with high-resolution flood mapping to explore emergent inequalities in SLR exposure in the continental United States. Additionally, we use critical race theory to inform our project by rejecting the premise that racism persists soley because of poorly-educated individuals and instead consider the systematic influence of social instituions and practices that perpetuate racially-based policy and inequalities (Hardy, Milligan, and Heynen 2017).

With this methodological approach and with the guidance of critical race theory, we explore two central research objectives, one empirical and one theoretical. First, empirically,

who is at the highest risk to SLR? Second, theoretically, is climate change a new form of inequality or is it simply a new avenue for current inequalities to continue to manifest? Because most scholarship has left future environmental inequalities unexplored, policy prescriptions aimed at reducing inequalities based on present environmental conditions could inadvertently exacerbate inequalities rather than alleviate them. Similarly, preemptive adaptation that fails to incorporate social dynamism could create maladaptation and perpetuate inequality. We anticipate our results could make coastal communities more just, more equaitable, and better adapted to SLR.

DATA AND METHODS

We use two sources of data for our analysis. The first concerns the production of sociodemographic population projections. We use recently published subnational population projections by age/sex/race (Hauer 2018) as controls in a small-area population projection model (Hardy and Hauer 2018). These sociodemographic population projections use cohort-change ratios (CCRs) and cohort-change differences (CCDs) (Hamilton and Perry 1962; Swanson, Schlottmann, and Schmidt 2010) in leslie matrix projection models (Caswell 2001), controlled to the Shared Socioeconomic Pathways (O'Neill et al. 2014, 2017; Samir and Lutz 2017; Jiang 2014), to produce rigourous county-level population projections. We then further disaggregate these projections using a modified Hammer Method (Hammer et al. 2004; Mathew E Hauer, Evans, and Mishra 2016) to produce population estimates by census block group (CBG) for ther period 1940-2100, controlling the CBG's to the projected county-level projections.

Next, we use data from the National Oceanic and Atmospheric Administration's (NOAA) SLR datasets that simulate expected changes in the mean higher-high water (MHHW) mark on areas that are hydrologically connecetd to coastal areas. We assess the populations at-risk to SLR by detailed sociodemographic group as one minus the percentage of land lost under

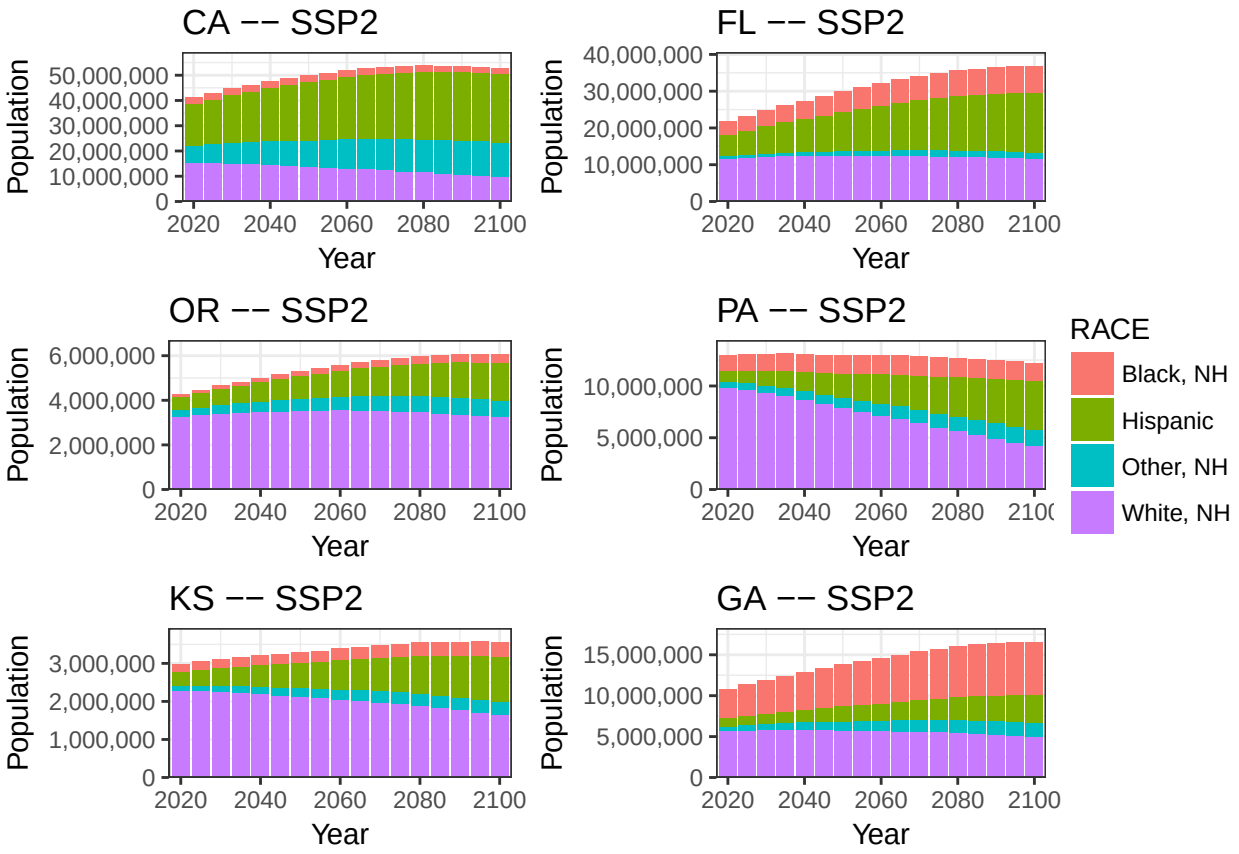

Figure 1: Projected changes in six samples tates under SSP2 (Middle of the Road). All six sample states demonstrate increasing diversity in their racial compositions.

the preceding amount of SLR using whole-foot increments. NOAA's 0m MHHW layer is our initial, dry land calculation.

PRELMINARY RESULTS

In our population projections, aggregated to the state-level (Figure 1), we find the greatest increases in population among Non-White populations under SSP2 (Middle of the Road).

In our preliminary examination of the Georgia Coast (Figure 2), we found the greatest elevation in exposure among Women, Latinx, Blacks, and the elderly. Without accounting for demographic changes in many areas we are likely to misrepresent the social inequalities present in climate change.

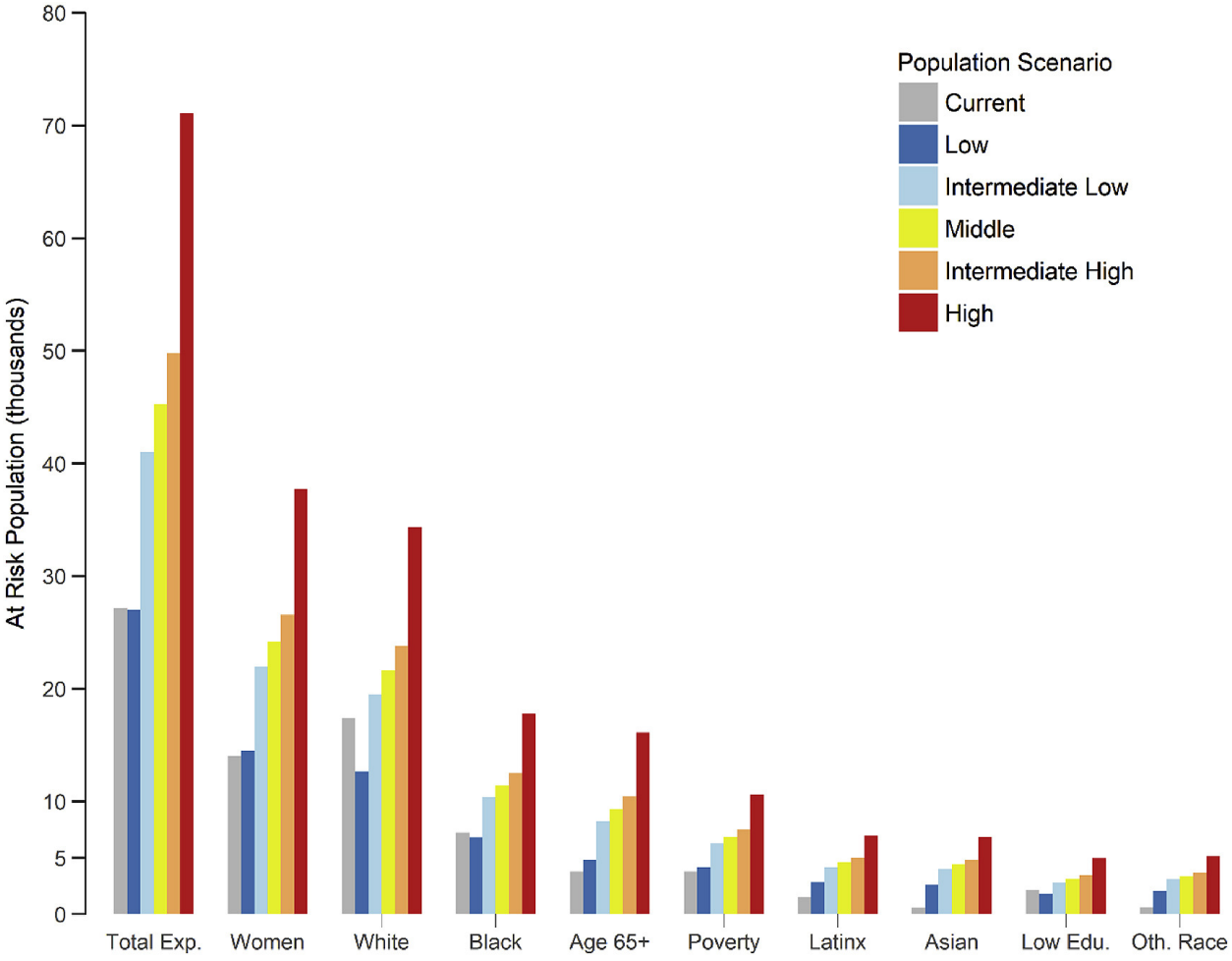

Figure 2: Absolute change in total and vulnerable sub-populations (including white sub-population) to inundation exposure under the fast sea-level rise scenario by 2050.

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