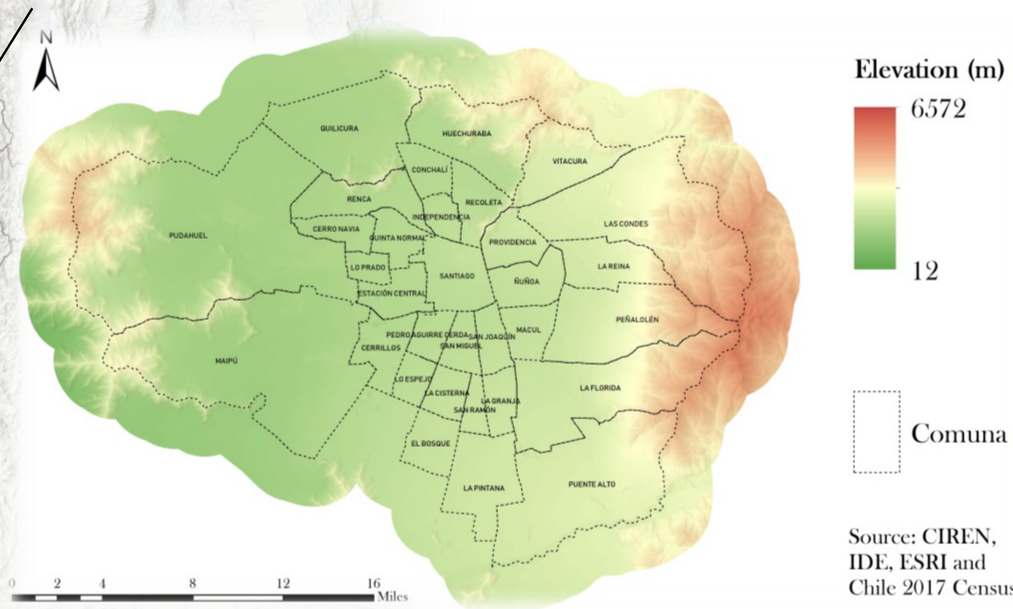
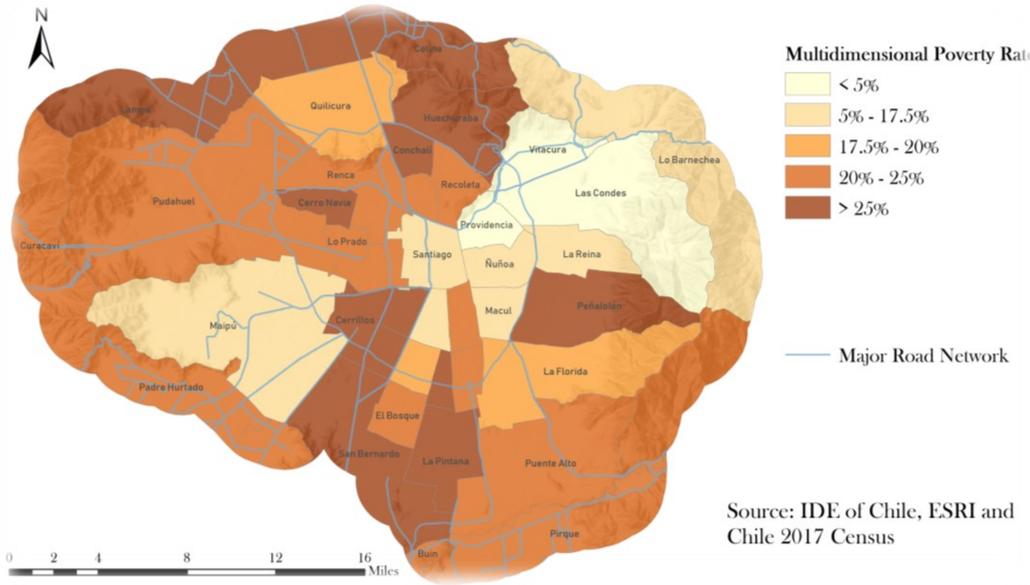
STRUGGLING TO BREATHE

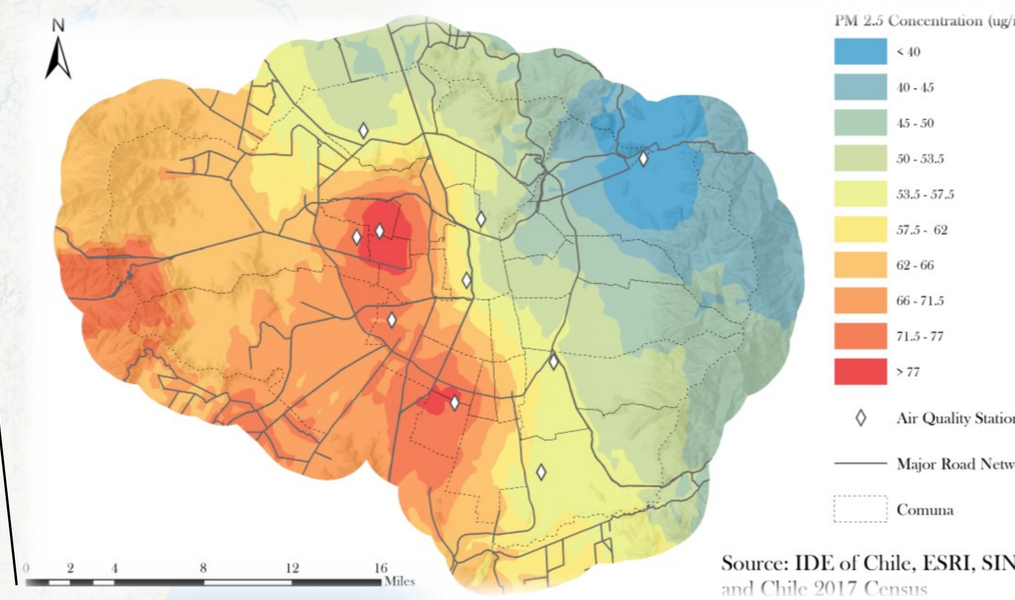
Air Quality, Socio-economic Status and Elevation in Santiago, Chile

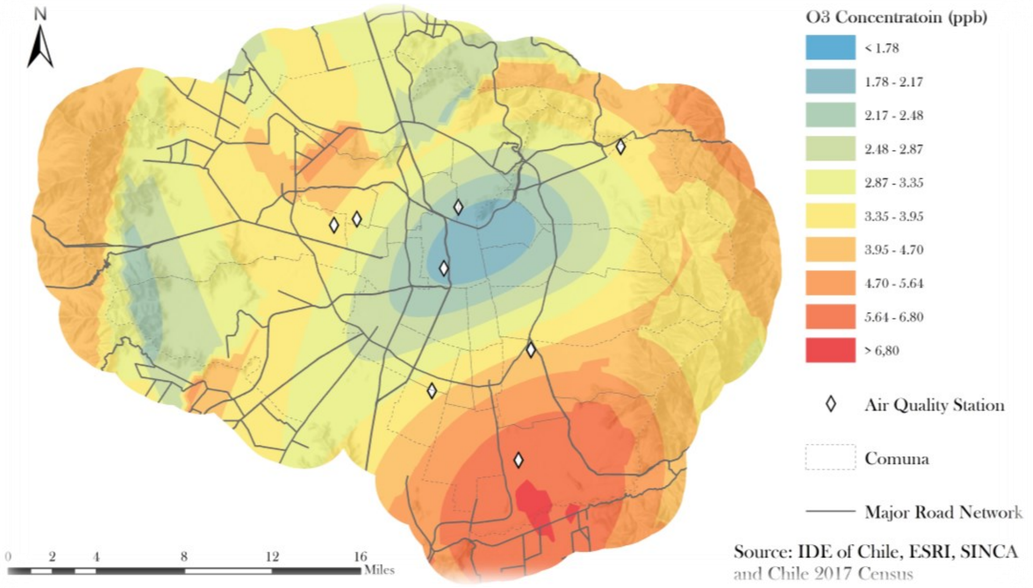
BACKGROUND

This project focuses on the relationship between social vulnerability, elevation and air pollution in Santiago, Chile. Chile suffered for seventeen years under a repressive free-market dictatorship which supported the socioeconomic elite- as a result Chile, like many Latin American countries, is a notoriously unequal country socioeconomically with the income of the highest decile larger than that of the lowest eight (López & Miller, 2008). Santiago, the country's economic and social capital and home to more than a third of its citizens (over 5.5 million), is located in a deep basin between the Andes mountains and the Chilean Coastal Range. Its location and a lack of environmental oversight has led to severe air quality problems. An estimated 2,500 inhabitants die annually from respiratory illnesses directly associated with air contamination (Romero et. al., 2010). This project will examine the social segregation of Santiago and seek to determine whether those who are most socioeconomically vulnerable are also located in the areas of lowest air quality. In addition, it will discover whether neighborhoods at higher elevation- those rhetorically perceived to be above the pollution and (not-coincidentally) the wealthiest- truly see less air contamination in a given month of high air pollution in the city.









METHODOLOGY

This project made use of data made publicly available by the Chilean government. Elevation data was gathered by the Centro de Información de Recursos Naturales (CIREN) and poverty data by the 2017 Chilean census and Ministerio de Desarrollo Social 2017 report. Both were accessed through the Chilean Infraestructura de Datos Geoespaciales (IDG) website. Elevation was clipped to the extent of the Santiago metro area and shows the drastic elevation increase from sea level to over 6,500 m (~21,000 ft) at the peaks of the nearby Andes mountains. Poverty data was aggregated to the *comuna* (municipal) level and shows the multidimensional poverty rate, an index developed by the Chilean government, which makes use of education, health, job/social security, housing and social cohesion levels to provide a more nuanced view of poverty. Multidimensional poverty rates vary from around 3% to more than 35% depending on the comuna.

Air quality data made use of PM 2.5 (µg/m3) and O3 (ppb) readings from air quality monitoring stations in the greater Región Metropolitana de Santiago (n = 11; n = 9) on the SEREMI Ministerio de Salud website. PM 2.5 levels reflect the mean of 24-hour averages and O3 levels the mean of 8-hour averages taken in the month of June 2016 (the winter months are often the most polluted). In order to interpret the data, a co-kriging interpolation was used to estimate the PM 2.5 and O3 levels. The co-kriging approach incorporated both PM 2.5 and O3 readings gathered and distance from major roads, as both PM 2.5 and O3 are pollutants associated with internal combustion and which present high health and ecological risks (Romero et. al., 2010). Co-kriging resulted in a prediction map of PM 2.5 and O3 levels throughout greater Santiago. metropolitan region.

Comuna	Poverty Rate	Elevation (m)	PM 2.5 Estimate (µg/m³)	O_3 Estimate (ppb)
Providencia	3.38%	620.82	48.61	2.08
Vitacura	3.48%	789.46	41.38	3.07
Las Condes	4.23%	1081.19	40.73	3.40
Ñuñoa	5.76%	590.99	50.16	2.26
La Reina	6.94%	792.13	45.43	2.90
Huechuraba	28.84%	710.26	49.33	3.12
Conchalí	29.37%	512.77	57.26	3.02
La Pintana	32.74%	627.85	64.34	5.43
Cerro Navia	34.64%	494.68	76.38	3.85
Lo Espejo	37.50%	543.03	72.93	2.84

CONCLUSION

Examining the results listed in the table in stata, we find that the relationship between multidimensional poverty rate and elevation along with the relationship between poverty rate and PM 2.5 levels present the strongest relationships in a two-tailed test (p = .074; p = .077). The relationship is statistically significant at the 10% level. The relationship between poverty rate and O3 levels presented a weaker relationship in a two-tailed test (p = .129), meaning the relationship is not significant at the 10% level and it cannot be said that ozone rates are significantly higher in areas of higher poverty rates. The results are limited by the lack of air quality stations in the Santiago region consistently reporting air quality data. This and the limited amount of data available to accurately perform co-kriging interpolation limited the extent of the data and created relatively high standard error rates. Still, given the paucity of the data, the model makes a strong case that poverty level, elevation and air quality are all significantly linked in the greater Santiago area. I hope this project can inform policymakers and encourage us all to consider more the relationships between poverty, air pollution and its related health problems in our own cities.

Source: IDE of Chile, ESRI, SINCA and Chile 2017 Census

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