

Leveraging the Healthy Oregon Project (HOP) to evaluate environmental exposures during critical reproductive periods and young-onset breast cancer risk

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Introduction

- Incidence of young-onset breast cancer (**YOBC**; <50 years) is increasing in the U.S. and has ~2x the mortality of later onset cases
- YOBC diagnoses are rising more rapidly in non-metropolitan vs. metropolitan areas in western states
- **Geographic disparities** may drive exposure differences and risk
- **Environmental factors** (e.g., air pollution, pesticides) are linked to breast tissue inflammation and increased breast cancer risk
- Shifts in **critical reproductive periods** (e.g., menarche timing, delayed childbirth, parity) also affect risk and may interact with environmental exposures

Objective

To assess environmental exposures during critical reproductive periods to evaluate YOBC risk in Oregon

Methods

- We leveraged the Healthy Oregon Project (**HOP**) – a statewide cohort of adults, recruited since 2018 (**Table 1**)
- We used baseline residential addresses to link:
 - USDA Economic Research Service's Rural-Urban Commuting Area (**RUCA**) codes, which we grouped as Urban (codes 1-3), Rural (4-9), and Frontier (10)
 - CDC/ATSDR Social Vulnerability Index (**SVI**) – a composite measure of neighborhood socioeconomic deprivation based on 16 Census variables, including poverty, employment, housing, disability, insurance, race/ethnicity, vehicle access – which we divided into nationwide quartiles (Q1=low vulnerability; Q4=high vulnerability)
- We developed a supplementary **reproductive life course questionnaire** for integration into the HOP app that includes reporting of home addresses at critical reproductive times

Table 1. HOP participant characteristics (N=51,978)

Characteristic	%
Age group (years)	
18-34	15.6
35-49	42.0
50-64	24.8
≥65	16.9
Unknown	0.8
Sex at birth	
Male	25.0
Female	71.2
Unknown	3.8
Race/Ethnicity	
American Indian or Alaska Native	0.5
Asian	4.4
Black or African American	1.1
Middle Eastern or North African	0.5
Native Hawaiian or Other Pacific Islander	0.3
Other	1.5
Biracial or Multiracial	3.4
White	80.8
Unknown	3.2
Hispanic/Latino	5.3

Results

- HOP consented **51,978 individuals** (~1.5% of Oregon adults); 71.2% reported female-at-birth
- Some HOP participants reported **YOBC diagnosis** (N=615)
- Urban-rural geographic distribution of baseline addresses is representative of the Oregon population, and similar between the overall cohort and cohort participants who were diagnosed with YOBC (**Table 2**)
- Most HOP participants lived in **high social vulnerability neighborhoods** (relative to all neighborhoods across the U.S. inc. AK, HI, PR ; **Table 3**)
- Obtained **IRB approval** for HOP reproductive questionnaire integration
- Obtained **IRB approval** for geocoding HOP residential addresses (X, Y coordinates) and linking environmental exposure datasets (**Figure 1**)

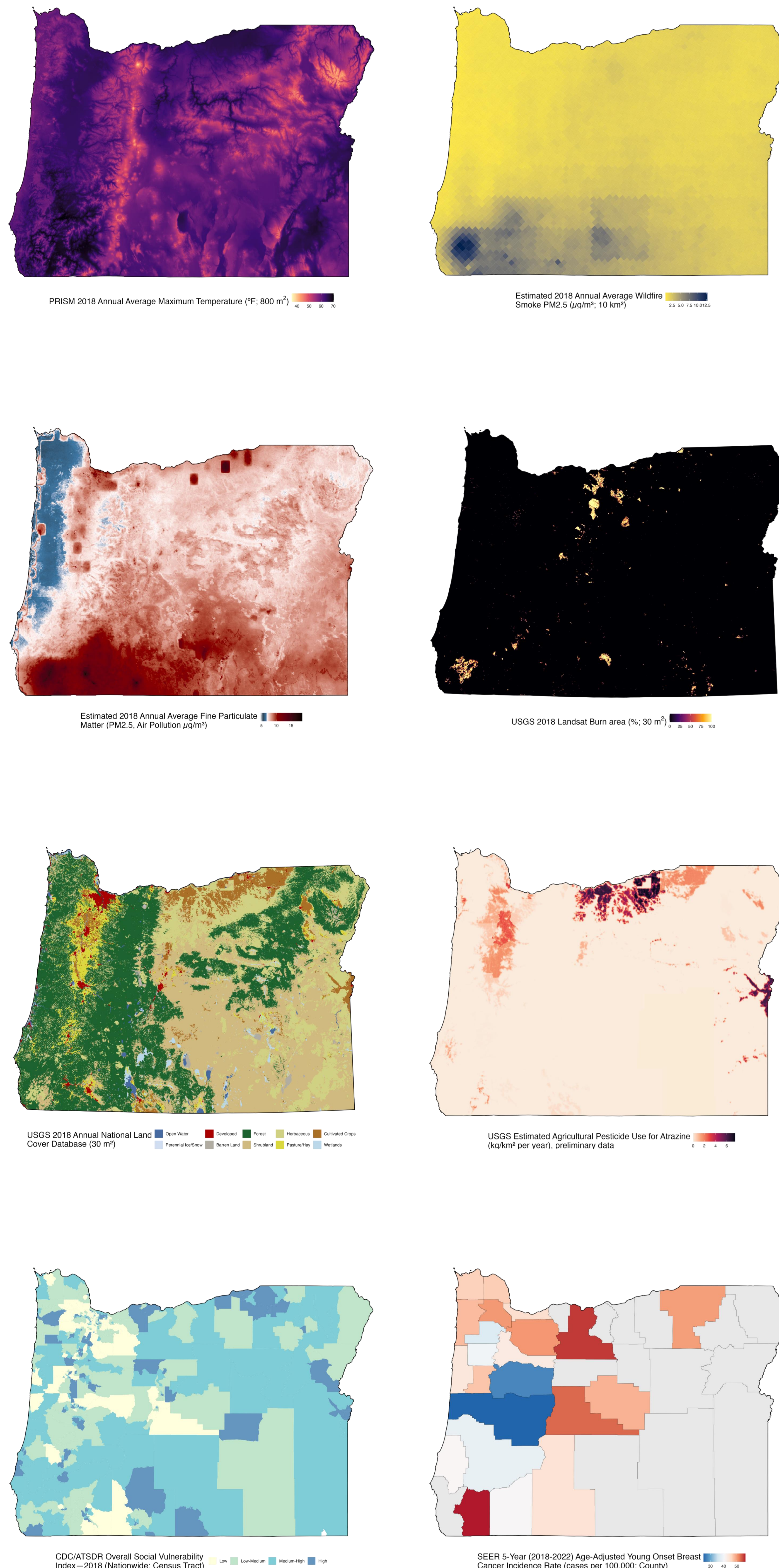


Figure 1. Sample of environmental datasets (e.g., climate-related data, air pollution, pesticides, social vulnerability) mapped across Oregon, which will be linked HOP residential address locations during critical reproductive windows. Note: SEER 5-yr age-adjusted YOBC incidence rate (cases/100,000; county-level) is provided for reference (grey counties suppressed due to low population or cases).

Results cont.

Table 2. Residential rural-urban distribution of HOP participants with Oregon-based residential address (N=44,357)

RUCA area type	Overall (%)	YOBC cases (%)
Urban	82.5	79.8
Rural	16.8	13.5
Frontier	37.6	2.3
Missing	4.7	4.4

Table 3. Social Vulnerability Index (nationwide) of HOP participants with Oregon residential address (N=44,357)

SVI Quartile	%
Q1 (lowest vulnerability)	1.0
Q2	16.8
Q3	37.6
Q4 (highest vulnerability)	44.7

Conclusion

- HOP captures diverse socioeconomic and geographic contexts
- The distribution of HOP — including those with YOBC — is representative of Oregon's urban-rural composition
- High representation in socioeconomically deprived areas supports studying social and environmental inequities
- Integration of geospatial and reproductive data will enable reproductive life-course exposure research, and future analyses of YOBC risk

Future Steps

- Continue to recruit into HOP, specifically targeting Oregon-based individuals diagnosed with YOBC via the Oregon State Cancer Registry
- Deploy HOP reproductive questionnaire to female-at-birth participants
- Acquire, geocode and link residential histories during critical reproductive windows to environmental and socioeconomic exposure data (**Figure 1**), including:
 - **Temperature:** Average Annual, Monthly, Daily PRISM (800m² res.)
 - **Wildfire Smoke:** Estimated Average Annual, Monthly, Daily Wildfire Smoke (PM2.5 µg/m³; 10km² res.; Childs et al.)
 - **Burn Area:** USGS Landsat Burn Area (30m² res.)
 - **Total Fine Particulate Matter Air Pollution:** Estimated Average Annual, Monthly, Daily PM2.5 (µg/m³; 1km²; Di et al.)
 - **Land cover:** USGS Annual National Land Cover Database (30m²)
 - **Agricultural pesticides:** USGS Estimated Agricultural Pesticide Use for multiple endocrine-disrupting agricultural chemicals (kg per county)
 - **PFAS in drinking water:** US EPA time-invariant; exceedance only
 - **Neighborhood socioeconomic deprivation:** CDC/ATSDR Overall Annual Social Vulnerability Index (Census Tract)
- Conduct a case-control study among female HOP participants aged 18–49 years to identify environmental and social risk factors of YOBC
- Assess cumulative and potentially synergistic environmental and social exposures in during critical reproductive windows in relation to YOBC risk

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