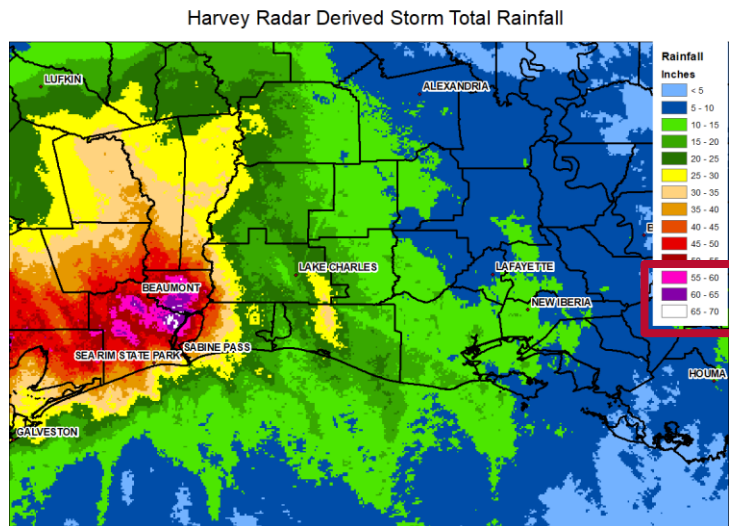


Measures from Space, Solutions on the Ground

Leticia M. Nogueira, PhD MPH

Climate Change and Cancer

Climate change alters the behavior of extreme weather events



Rainfall over Houston during Hurricane Harvey
National Oceanic and Atmospheric Administration (NOAA)

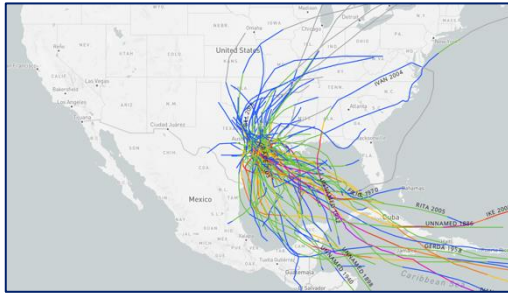


Extreme Weather Events

Warmer air holds more water vapor, which increases the water capacity of hurricanes

Disruptions in Access to Care

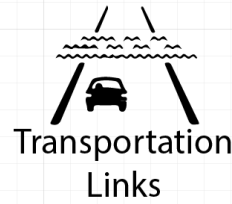
Climate-driven disasters



Historical Hurricane Paths, Houston TX
<https://coast.noaa.gov/hurricanes/#map=4/32/-80>



Extreme Weather Events



Hurricane Harvey

Changing frequency and behavior of extreme weather events makes it harder for communities to prepare and respond to increasingly unpredictable circumstances



Especially concerning for medically vulnerable populations

Impact of Hurricanes on Access to Care

Among individuals who have been diagnosed with cancer



Don't be discouraged from leaning on your lived experiences when proposing research on climate change and health outcomes

Expertise gained from lived experiences is exactly the type of knowledge we need to tackle such a rapidly evolving crisis

National Cancer Database

American Cancer Society

American College of Surgeons

- Hospital-based
- ~70% of cancer cases in the US



Federal Emergency Management Agency (FEMA)

Presidential Disaster Declarations

Facilities Impacted by a Hurricane



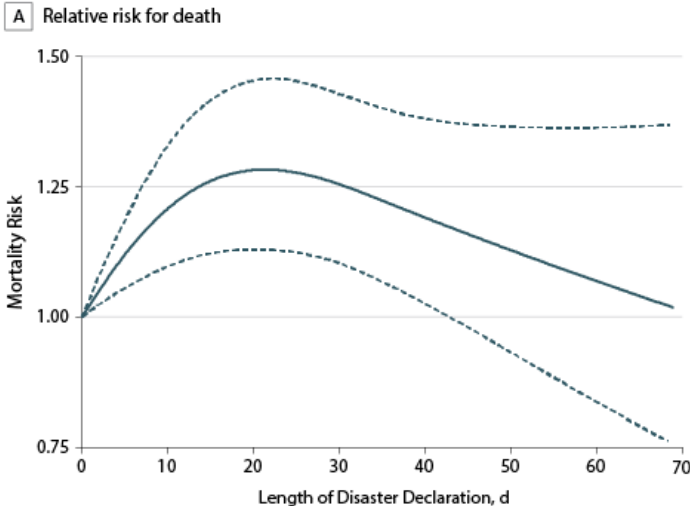
Nogueira LM, Sahar L, Efstathiou JA, Jemal A, Yabroff KR. *Association Between Declared Hurricane Disasters and Survival of Patients With Lung Cancer Undergoing Radiation Treatment.* JAMA. 2019;322: 269-271.

Impact of Hurricanes on Cancer Patients

Disruptions in access to care and worse survival



Figure. Association Between Length of Hurricane Disaster Declaration and Risk of Death in Patients With Lung Cancer Undergoing Radiation



Climate-driven disasters disrupt access to potentially life-saving care



Nogueira LM, Sahar L, Efstathiou JA, Jemal A, Yabroff KR. Association Between Declared Hurricane Disasters and Survival of Patients With Lung Cancer Undergoing Radiation Treatment. *JAMA*. 2019;322: 269-271.



EARTH FLEET

Satellite data already revolutionized the type of research we do at the American Cancer Society



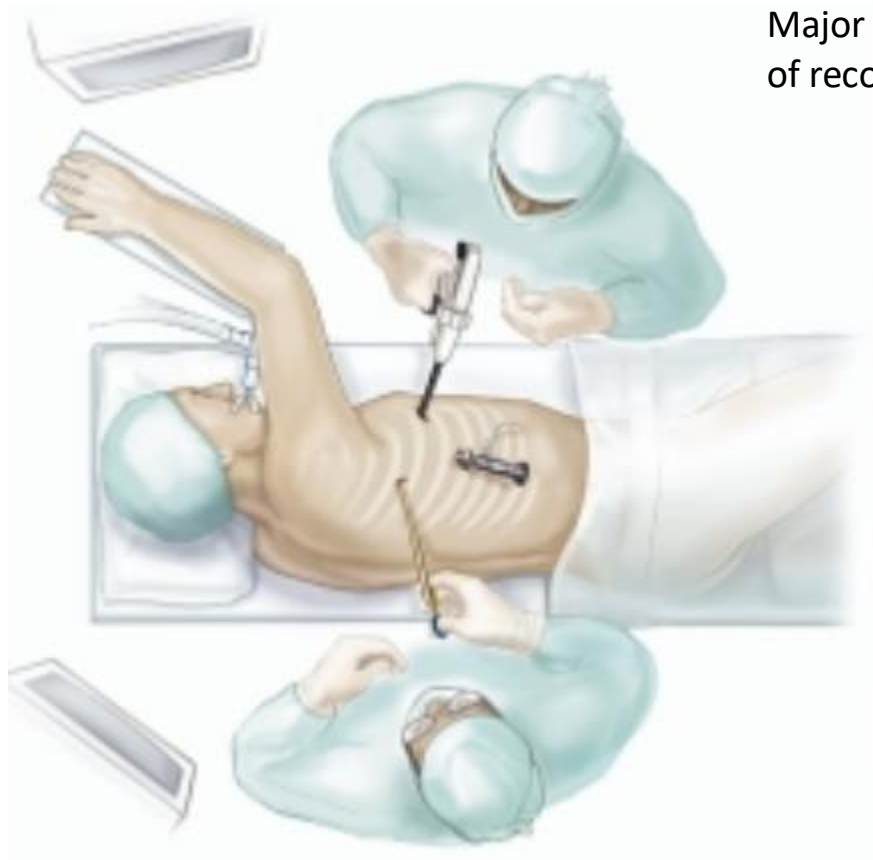
ISS INSTRUMENTS

MISSIONS

Camp Fire, Paradise CA



Lung Cancer Surgery



Major operation requiring months of recovery

Measuring Exposure to Wildfires



The screenshot shows the EPA website's 'AirData' page. The header features the EPA logo, a search icon, and a 'MENU' button. The main heading is 'AirData: Air Quality Data Collected at Outdoor Monitors Across the US'. Below this is a large image of a mountain landscape with a dark blue overlay box containing the text: 'Outdoor Air Quality Data', 'Use the tools on this site to access recent and historical data.', 'For current air quality, visit [AirNow.gov](https://www.airnow.gov).', and 'During fire events, use the [Fire and Smoke map](#).'

Use air quality monitors data to measure $PM_{2.5}$ around the date when patients were discharged from the hospital after lung cancer surgery

Exposure to Wildfires

This block contains three overlapping browser windows. The top-left window shows the CAL FIRE website with a map of California and a search bar. The top-right window displays 'Air Pollution in World: Real-time' with a world map showing pollution hotspots. The bottom window shows a map of the United States with a color-coded AQI overlay for January 20, 2020.

This screenshot shows the EPA website's 'Current AQI (Combined PM and O₃)' for Monday, January 20, 2020, at 10:00 PM EST. It features a map of the United States with color-coded AQI regions. To the right, there are sections for 'Announcements' regarding wildfires and 'Air Quality Basics'.

This block shows the NASA Scientific Visualization Studio website. The main article is 'The Complex Chemistry of Surface Ozone Depicted in a New GEOS Simulation', released on December 9, 2019. It features a video player showing six panels of atmospheric simulations. The video description states: '96 chemical species are shown from a GEOS atmospheric simulation'. On the right, there is a 'Browse Stories' section with links to other articles like 'Global Temperature Anomalies from 1880 to 2019' and 'Annual Arctic Sea Ice Minimum 1979-2019 with Area Graph'. The bottom of the page shows a navigation menu with categories like 'GMAO MISSION', 'REANALYSIS & PREDICTION', and 'REANALYSIS'.



Wildfire Exposure and Lung Cancer Survival

Among individuals discharged from the hospital following lung cancer surgery



NASA HEALTH AND AIR QUALITY
APPLIED SCIENCES TEAM
Connecting NASA Data and Tools with Health and Air Quality Stakeholders



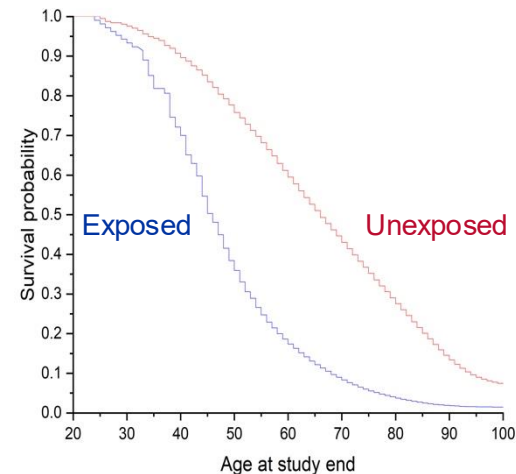
National Aeronautic and Space Agency (NASA)
<https://appliedsciences.nasa.gov/what-we-do/disasters/fires>

Exposure to wildfire goes beyond
inhaling wildfire smoke

Stress associated with potentially having to
evacuate, threat to property and life, water
and soil contamination



<https://pubmed.ncbi.nlm.nih.gov/33189165/>



Environmental Pollutants

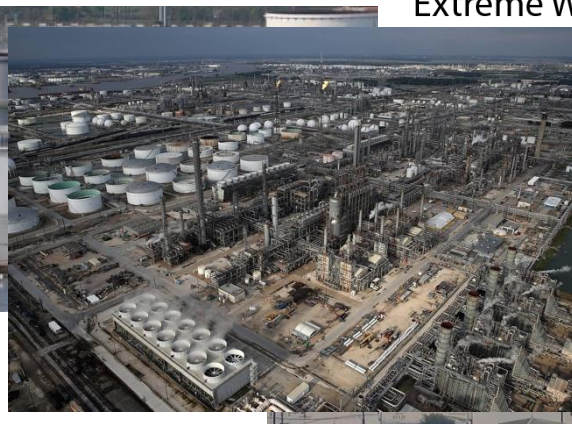
Exposure to carcinogens



Houston Ship Channel



Hurricane Harvey flooded several chemical plants, oil refineries, and Superfund sites in Houston



Arkema Chemical Plant



Climate Change



Extreme Weather Events

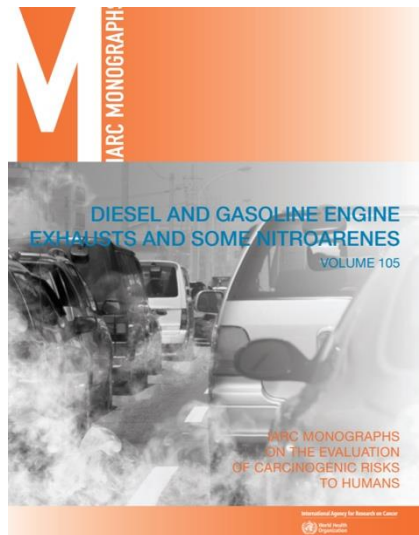
3.5 times more likely



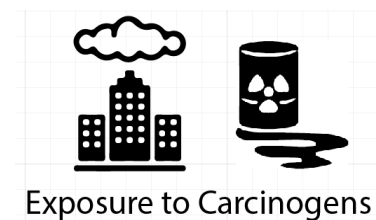
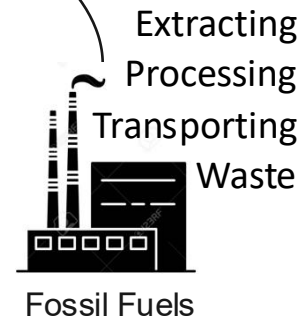
Houston, the self-declared oil capital of the world, has a high concentration of petrochemical infrastructure

Reliance on Fossil Fuels

Shared cause of climate change and rise in exposure to carcinogens



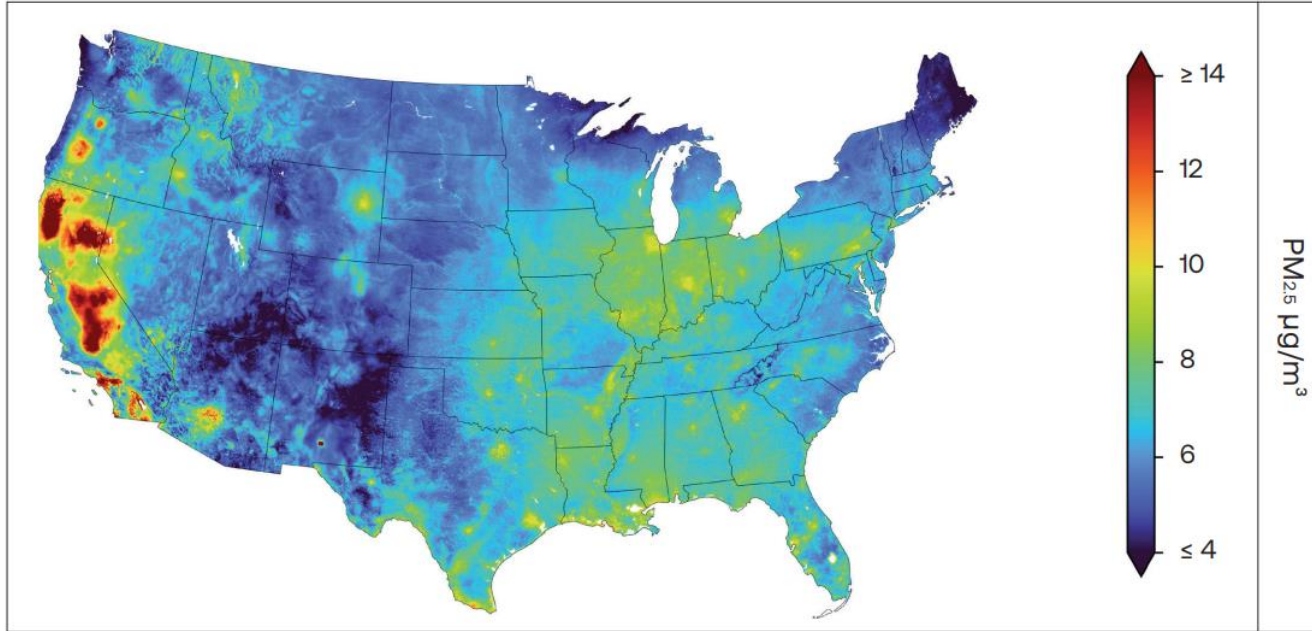
The same air pollution that is driving the greenhouse effect also increases lung cancer risk



Measuring Air Pollution Exposure

Comprehensive Spatial Coverage

Around-the-clock monitors combined with satellite data provide nationwide accurate air quality data where monitoring stations are sparse.



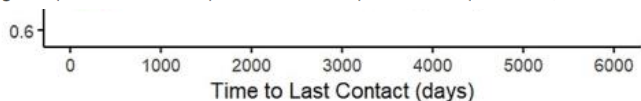
Environmental Pollutants and Cancer Survival

Pediatric cancer patients

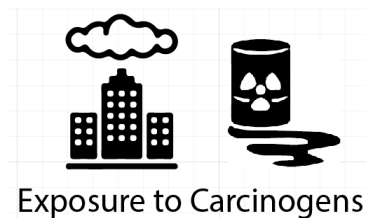
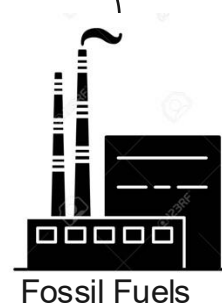


Final Reconsideration of the National Ambient Air Quality Standards for Particulate Matter (PM)

On February 7, 2024, EPA strengthened the National Ambient Air Quality Standards for Particulate Matter (PM NAAQS) to protect millions of Americans from harmful and costly health impacts, such as heart attacks and premature death. Particle or soot pollution is one of the most dangerous forms of air pollution, and an extensive body of science links it to a range of serious and sometimes deadly illnesses. EPA is setting the level of the primary (health-based) annual $PM_{2.5}$ standard at 9.0 micrograms per cubic meter to provide increased public health protection, consistent with the available health science.



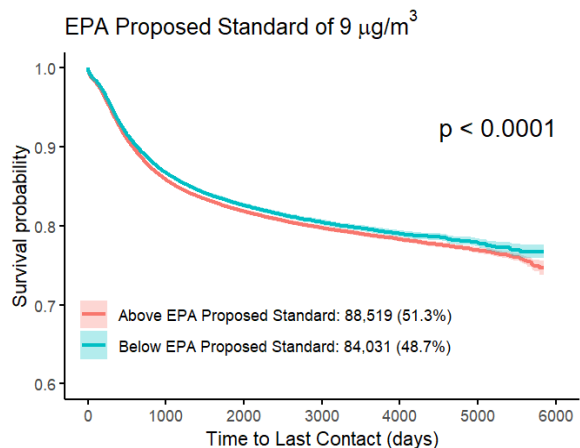
2.5 and worse
children with



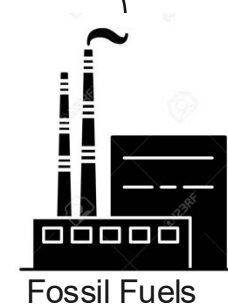
George PE, Zhao J, Liang D, Nogueira LM. *Ambient air pollution and survival in childhood cancer: A nationwide survival analysis.* Cancer. 2024, ;130(22):3870-3878

Environmental Pollutants and Cancer Survival

Pediatric cancer patients

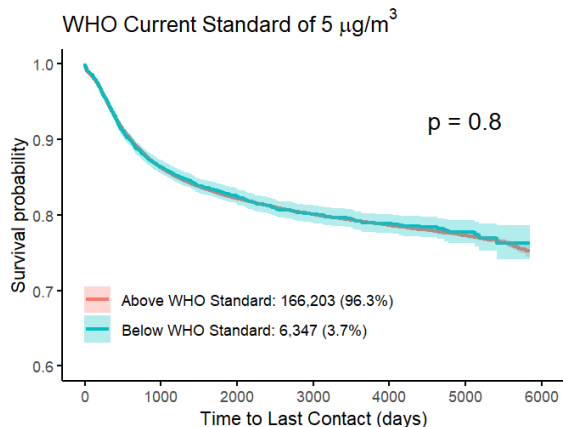


Exposure to $\text{PM}_{2.5}$ at the new EPA air quality standard was still associated with worse survival among children with cancer



Environmental Pollutants and Cancer Survival

Pediatric cancer patients



Exposure to $\text{PM}_{2.5}$ at levels recommended by the WHO was **not** associated with worse survival among children with cancer



Climate Change



Fossil Fuels



Exposure to Carcinogens

**Measuring the problem →
Identifying Solutions**



<https://www.washingtonpost.com/weather/2021/05/02/california-wildfire-season-growing/>

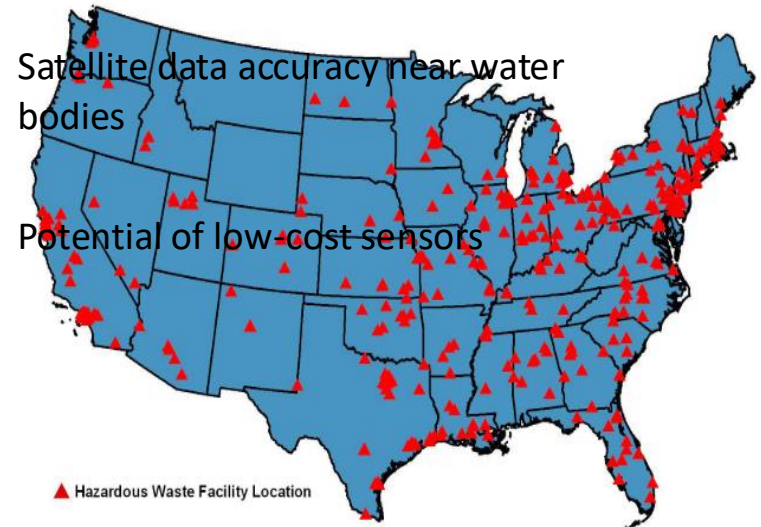
Sources of Air Pollution



<https://earthjustice.org/case/cleaning-up-power-plant-water-pollution>

Toxic Wastes and Race at Twenty: 1987-2007

*Grassroots Struggles to Dismantle
Environmental Racism in the United States*



Bullard, Robert D., Mohai, Paul, Saha, Robin, Wright, Beverly. 2007. Toxic Wastes and Race at Twenty: 1987-2007

Thank You