Beating the Heat, Fighting the Bite, and More: Satellite Data Applications for Public Health in VT

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How can satellite data be used to protect health?

- Heat-related Illness
- Geological Risk Mapping
- Air Quality and Pollen
- Cyanobacteria (Blue-green Algae)
- Tick and Mosquito-borne Diseases
Environmental Public Health Tracking
Making the connection between health and environment

What is Environmental Public Health Tracking?

Tracking is an ongoing national effort to better understand how environmental hazards can contribute to certain illnesses. Tracking has identified situations where known environmental hazards have resulted in the occurrence of chronic diseases. One example is the onset of asthma attacks in children who live close to highways.

The Vermont Tracking program is being implemented jointly by the state’s Departments of Health and Environmental Conservation. The goal is to build a nationwide network that allows the public, policy makers, and public health officials to use environmental and health data more effectively. To learn more about tracking nationally, visit the [CDC National tracking portal](https://www.cdc.gov/nhtes/estt/about/). 

How do I get started?

The Vermont Tracking portal includes two main components:

- Data about environmental and health topics
- Basic information about the same environmental and health topics

Starting at the Tracking homepage, you can choose a topic area to learn about, or you can go directly to the data. If you choose to learn about a topic first, just click on the name of the topic. Once in a particular topic,
Hot weather already leads to increased illness & death in Vermont

Average daily emergency department visits for heat complaints in Vermont, by maximum daily temperature, 2004 - 2013

Source: Vermont Early Aberration Reporting System

Error bars indicate 95% confidence intervals
Vermont is already getting **warmer**...

- On average today, compared to 1964:
  - + 2°F in summer
  - + 4°F in winter

  4th highest rate of annual warming in U.S.

- Spring is arriving 2 weeks earlier, and winter is starting 1 week later (compared to 1960)


Change in Lake Champlain temperature, 1964-2009:
Heat Wave: NWS Burlington Station

Hourly Temperature and Heat Index Measurements, Burlington Airport
June 27 - July 9, 2018

Heat-Related Health Impacts, by Day

Estimated Heat-Related Health Impacts (6/28/18 to 7/7/18)

- **Deaths**: 4
- **ED/Urgent Care Visits**: 97*
- **EMS Calls**: 140*

* Estimate based on preliminary surveillance data.
Expect more frequent hot days in the future

Source: Vermont Department of Health
Vulnerability mapping

Social Vulnerability in Vermont - SVI

Vermont Social Vulnerability Index (SVI)

This map shows the number of vulnerability measures above the 90th percentile for Vermont census tracts. For each of the vulnerability measures, census tracts in the 90th percentile of vulnerability were assigned a flag. This Sinn exhibits the sum of all flags for each census tract. There are a total of 16 measures in the SVI.

For More Information (PDF) About the SVI...
For More Information (Video) About the SVI...

View maps showing individual SVI Measures:

Demographic Theme
Socioeconomic Theme
Housing/Transportation Theme

Vermont has 183 populated census tracts. These are divided into 6 groups by vulnerability measure flags:

- 0 flags
- 1 flag
- 2 flags
- 3 flags
- 4 flags
- 5 flags

The darker blue categories on this map are census tracts where there are more flagged socioeconomic variables, while the lighter yellow categories have fewer flags.

Important: Census tracts with a "question" symbol have either 0 or more of their SVI flags from estimates with high relative standard errors. These flags may be less accurate than the others.

The underlying population in each Vermont census tract may affect the SVI measures. For more information on Vermont's population density and college-aged population, click here.

Source: U.S. Census ACS 2009-2013
Real-time data viewable for EHRs.

For more information contact AVIS-VERGEN@vermont.gov
Heat Vulnerability Index

Factors:
- Environmental characteristics
- Climate acclimation
- Age
- Pre-existing medical conditions
- Socioeconomic status
- Isolation
- Historic heat illness

Exposures

Vulnerabilities

Bars to adaptation
Environmental
This theme indicates vulnerability based on environmental characteristics. Summer heat is exacerbated in locations with dense housing, a high proportion of paved areas and rooftops, and few trees.

Population
This theme indicates vulnerability based on the population composition of the town. Young children and older adults are age groups at higher risk for heat-related illnesses.

Acclimatization
This theme indicates vulnerability based on how acclimated residents are to hot summer temperatures. Those experiencing fewer hot days per year tend to be less adapted to the impacts of summer heat.

Socioeconomic
This theme indicates vulnerability based on social and economic resources available to town residents. Older adults living alone, those with less education, and those with fewer economic resources are often less able to find relief during summer heat.

Health
This theme indicates vulnerability based on the health status of town residents. Those with pre-existing medical conditions are more likely to suffer health impacts during summer heat events.

Heat Emergencies
This theme indicates vulnerability based on emergency department visits for heat illness in recent years. Towns that currently experience a high rate of heat-related emergencies are expected to continue experiencing a high rate in the near future.
Urban cluster thermal analysis

- **Data:** LandSat 8
  - 2 mid-summer images
  - 2 similarly warm, non-summer images
  - All were taken mid-day

- Converted thermal band data to surface temperature

- Aggregate temperature to urban clusters and surrounding rural areas
Vermont urban heat island analysis

- Strongest associations with temps:
  - Tree cover
  - Impervious surface
  - Housing density

- Comparing urbanized areas to surrounding 5-mile buffers
  - Average temperature difference: +3.9°F in urbanized areas
  - Heat-related EMS incident rate difference: +50% in urbanized areas
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Vulnerability Key:
(standard deviations)
- Less Vulnerable
- > 1
Less Vulnerable
State Mean
More Vulnerable
Population is less than 6 persons
Vermont Counties
LakeChamplain
Using trees to save energy and protect health

- **2017:** 200 trees to Bennington & Newport
- **2018:** 300 trees to Barre & Rutland
  - High historic rate of heat illnesses
  - Lacking urban tree canopy

- Expected benefits include:
  - Increased shade & cooling
  - Reduced energy costs
  - Many other health & environmental benefits!

Partners:

- Vermont Urban & Community Forestry
- Vermont Department of Health
- Arbor Day Foundation
- ENERGY-SAVING TREES
Radon Geological Risk Mapping

Radon Risk in Vermont
A series of maps showing long-term residential in-air radon test results from 1994-2016.

Rates of Radon Testing (by Town)

Elevated Radon Results (by Town)

Radon in Relation to Geology

Radon is a naturally occurring radioactive gas that is estimated to kill 50 Vermonter's a year due to lung cancer. Radon can only be detected by testing, and buildings with elevated radon levels are found throughout the state. All Vermont homes should be tested.

Naturally occurring radon gas is released during radioactive decay in the earth's crust. Different combinations of surface and bedrock geology allow different rates of gas to discharge through them. Once the gas rises to the earth’s surface, radon can move into the air and seep into buildings through foundation cracks. For more information: USGS: Geology of Radon
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Air Pollution Vulnerability Index (in development with VT DEC)

- **Purpose:** Support decisions related to:
  - Transportation emissions reductions strategies
  - Biomass combustion policies and programs
- **Proposed data themes:**
  - Demographics
  - Socioeconomic status
  - Health characteristics
  - Ambient pollution and emissions
  - Population exposure to pollution

Sample data from: Global Annual PM2.5 Grids from MODIS, MISR and SeaWiFS Aerosol Optical Depth (AOD) with GWR, v1 (1998–2016)
Cyanobacteria Monitoring
Cyanobacteria monitoring & preparedness

Source: Seven Days, Nov 8th, 2017, Lake Carmi Pollution Triggers Call for Stricter Regulation of Dairy Farms

Source: Lake Champlain Committee
Cyanobacteria Monitoring

Cyanobacteria Assessment Network (CyAN)
An EPA, NASA, NOAA, and USGS Project
Vector-borne Disease
Lyme Disease in Vermont

Number of Confirmed & Probable Lyme Disease Cases Reported to the Vermont Department of Health, 1990-2017

- Confirmed
- Probable

* First year that probable cases were counted

Year:
- 1990: 13 cases
- 1991: 7 cases
- 1992: 8 cases
- 1993: 12 cases
- 1994: 17 cases
- 1995: 9 cases
- 1996: 26 cases
- 1997: 9 cases
- 1998: 26 cases
- 1999: 8 cases
- 2000: 18 cases
- 2001: 40 cases
- 2002: 37 cases
- 2003: 43 cases
- 2004: 50 cases
- 2005: 54 cases
- 2006: 105 cases
- 2007: 138 cases
- 2008: 404 cases
- 2009: 408 cases
- 2010: 356 cases
- 2011: 623 cases
- 2012: 893 cases
- 2013: 599 cases
- 2014: 710 cases
- 2015: 763 cases
- 2016: 1,092 cases
Anaplasmosis

Number of Confirmed & Probable Anaplasmosis Cases Reported to the Vermont Department of Health, 2008-2016

- Confirmed
- Probable


- 2008: 3 Confirmed, 2 Probable
- 2009: 3 Confirmed, 2 Probable
- 2010: 3 Confirmed, 1 Probable
- 2011: 10 Confirmed, 1 Probable
- 2012: 17 Confirmed, 1 Probable
- 2013: 37 Confirmed, 2 Probable
- 2014: 67 Confirmed, 2 Probable
- 2015: 139 Confirmed, 7 Probable
- 2016: 201 Confirmed, 7 Probable
Other possibilities

- Vector host habitat/dynamics
- Emerald Ash Borer – Forecast and mitigate impacts
- Emergency Preparedness: Have RGB data prepped for use during an emergency event
- Land use mapping for nutrient pollution planning for water quality/cyanobacteria (VT DEC)
- Poison Parsnip?
Key Takeaway

- Public health is a data and evidence-driven field
- Our understanding of some infectious and environmental health issues in Vermont can be advanced through application of remotely sensed data.
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