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

VERMONT
DEPARTMENT OF HEALTH

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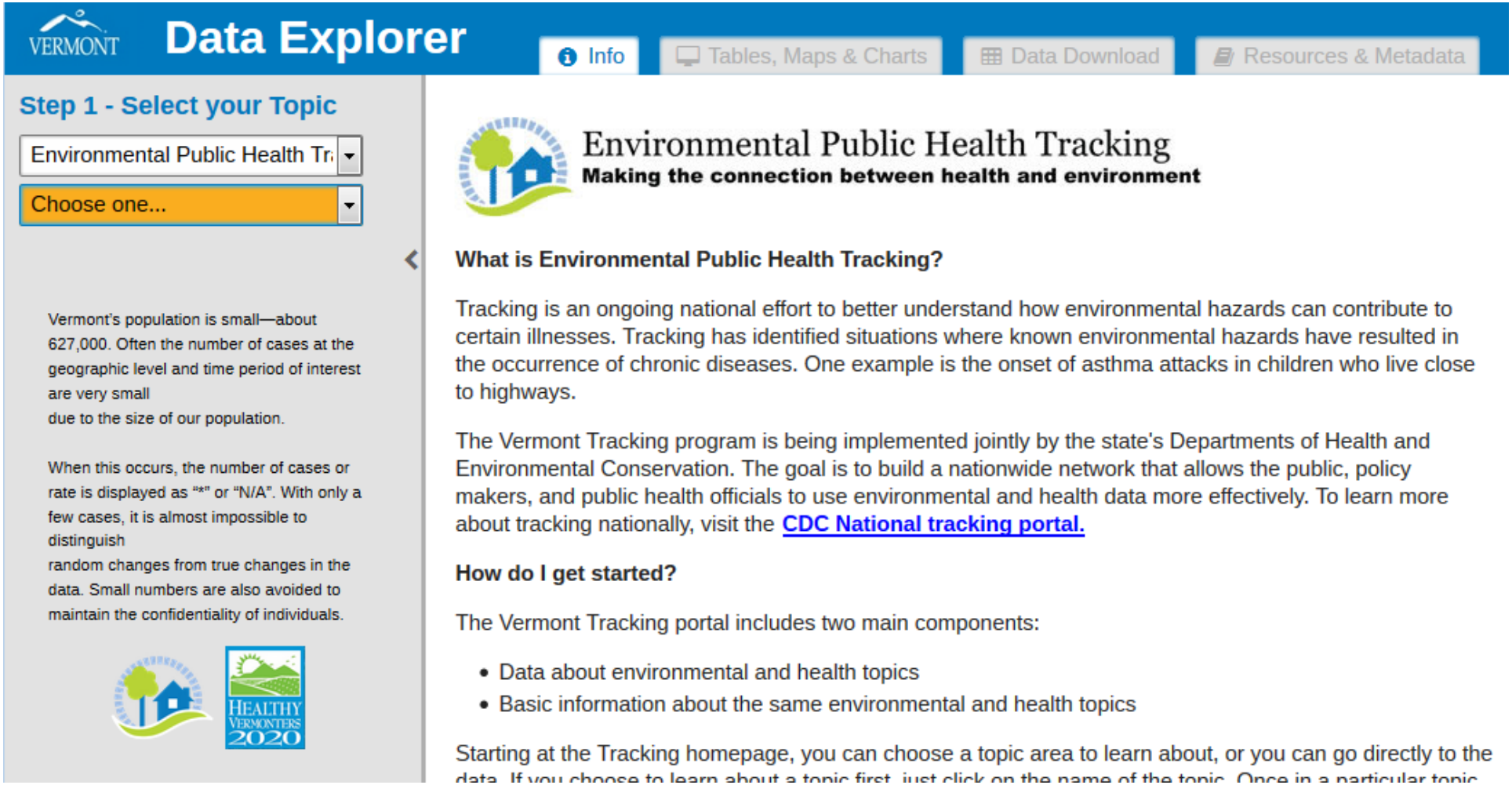
Environmental Health Surveillance Chief – Vermont Department of Health

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 Health

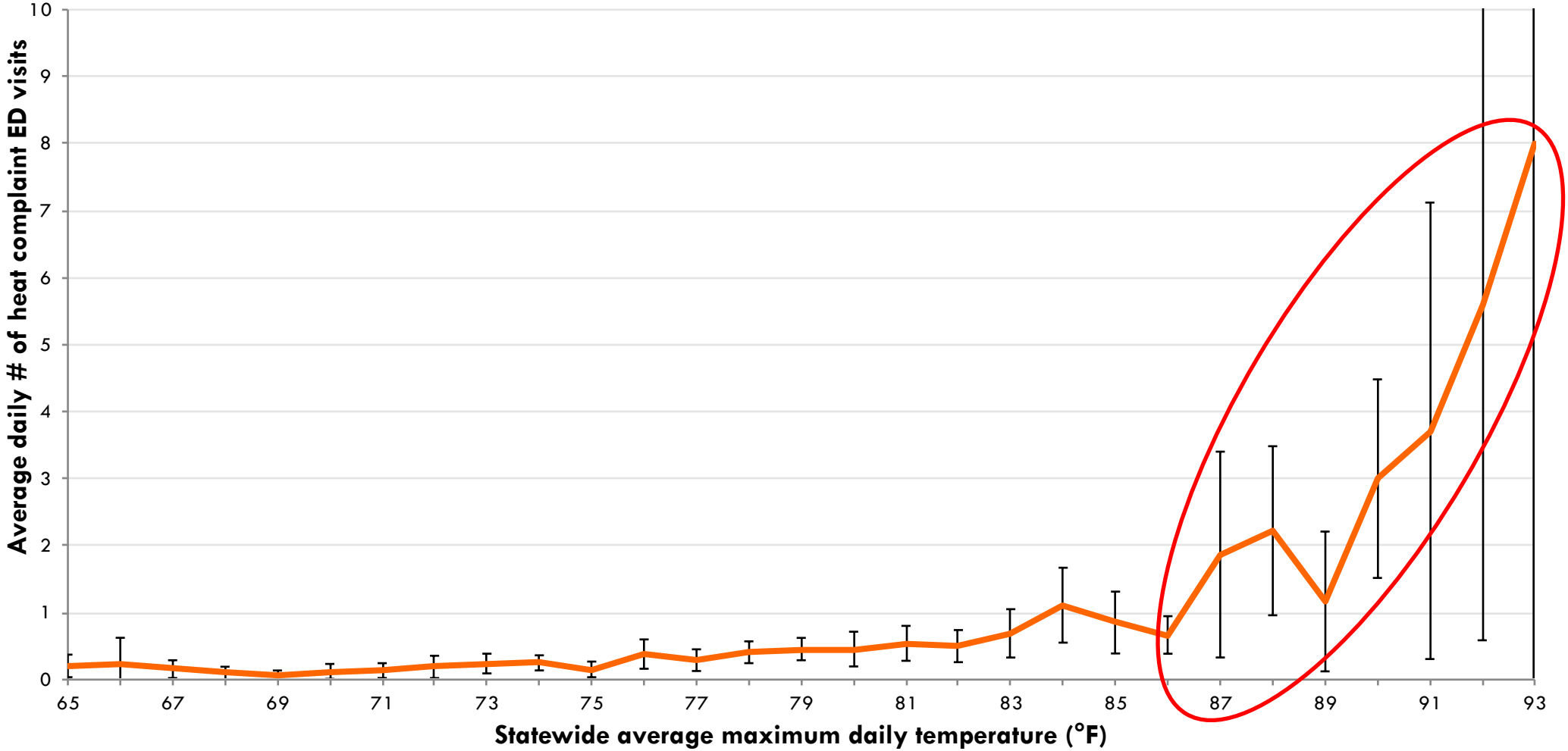


https://apps.health.vermont.gov/ias/querytool?Topic=EPHT

Heat-related Illness

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

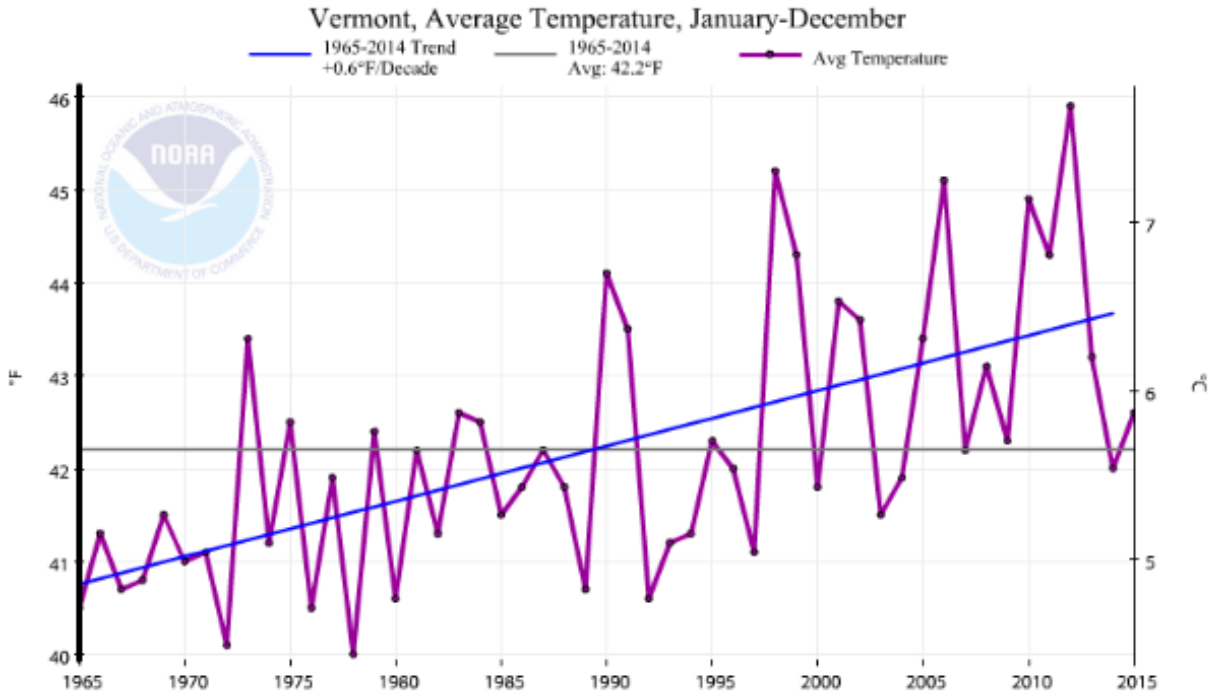
Error bars indicate 95% confidence intervals

Vermont is already getting warmer…

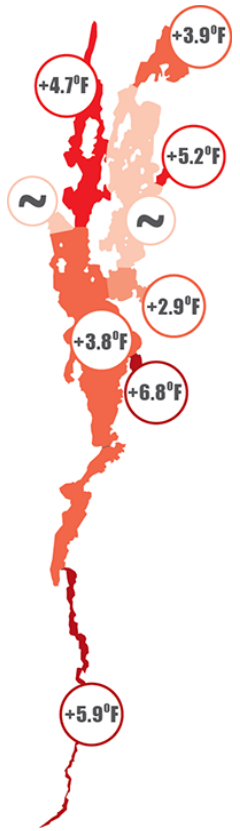
- On average today, compared to 1964:
  - + 2°F in summer
  - + 4°F in winter

  } 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)

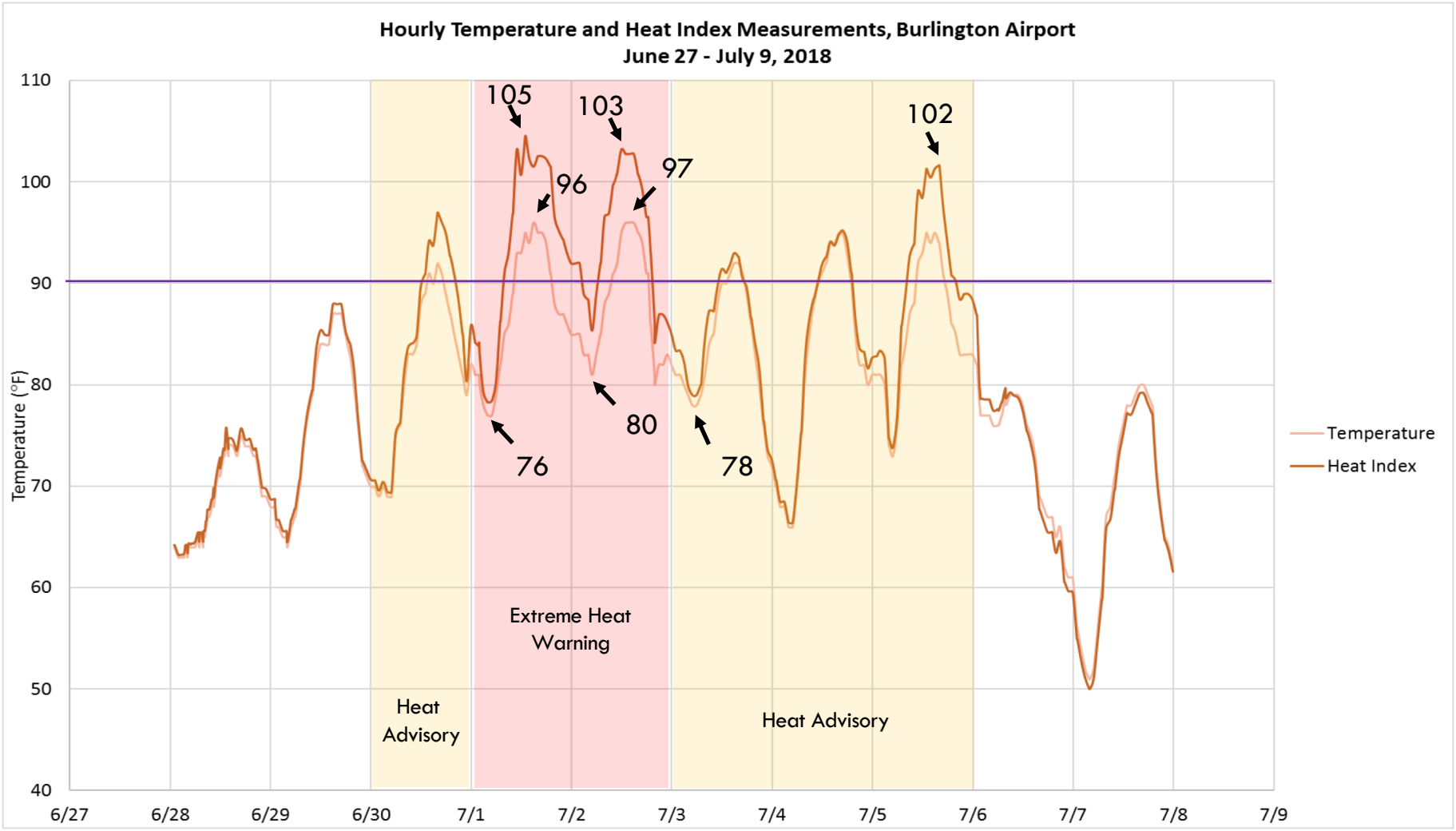


- Change in Lake Champlain temperature, 1964-2009:



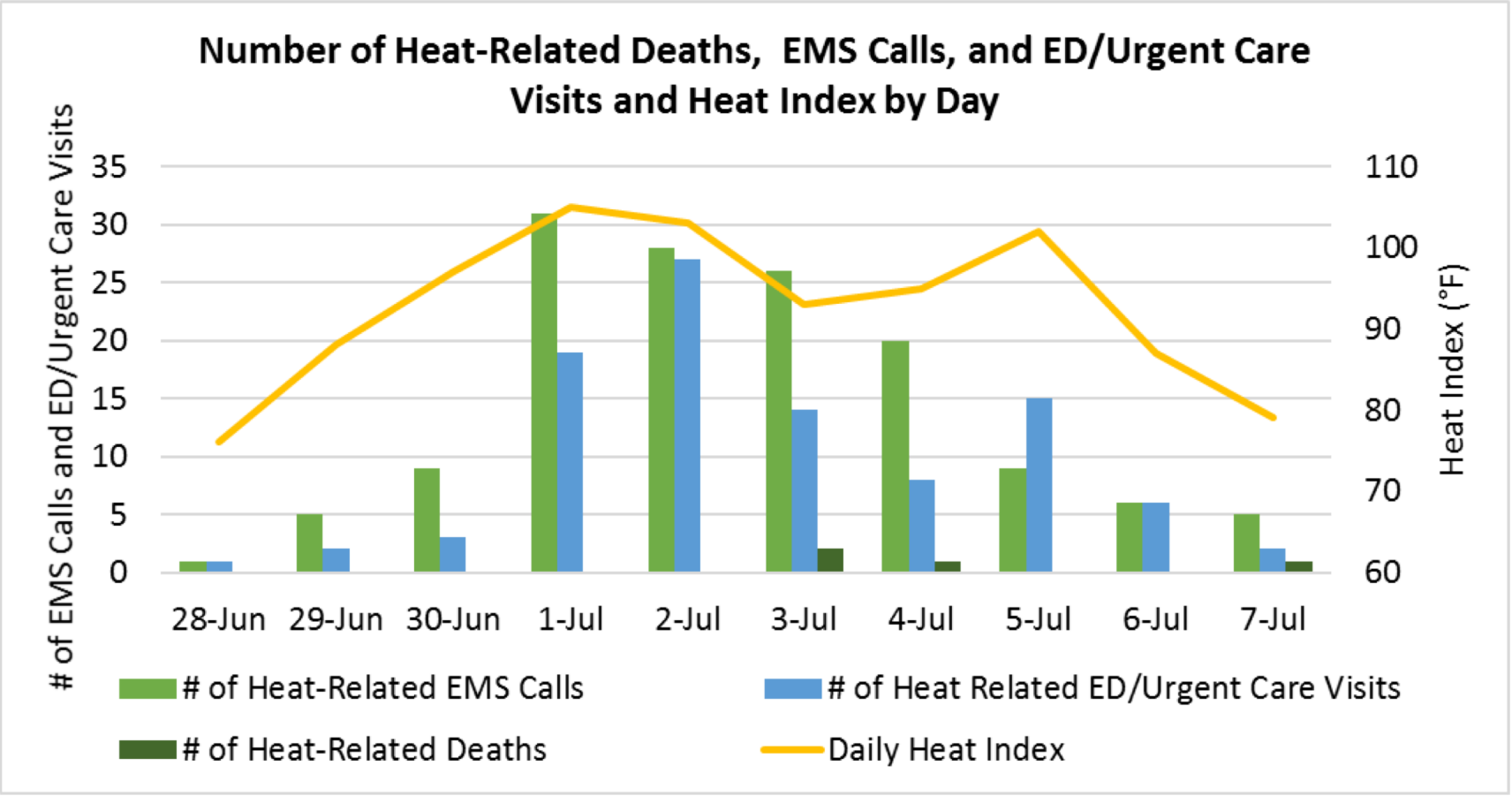
Sources: National Oceanic and Atmospheric Administration, Climate at a Glance; Betts AK. Weather, Climate & Society. 2011; Lake Champlain Basin Program, 2015 State of the Lake Report.

Heat Wave: NWS Burlington Station



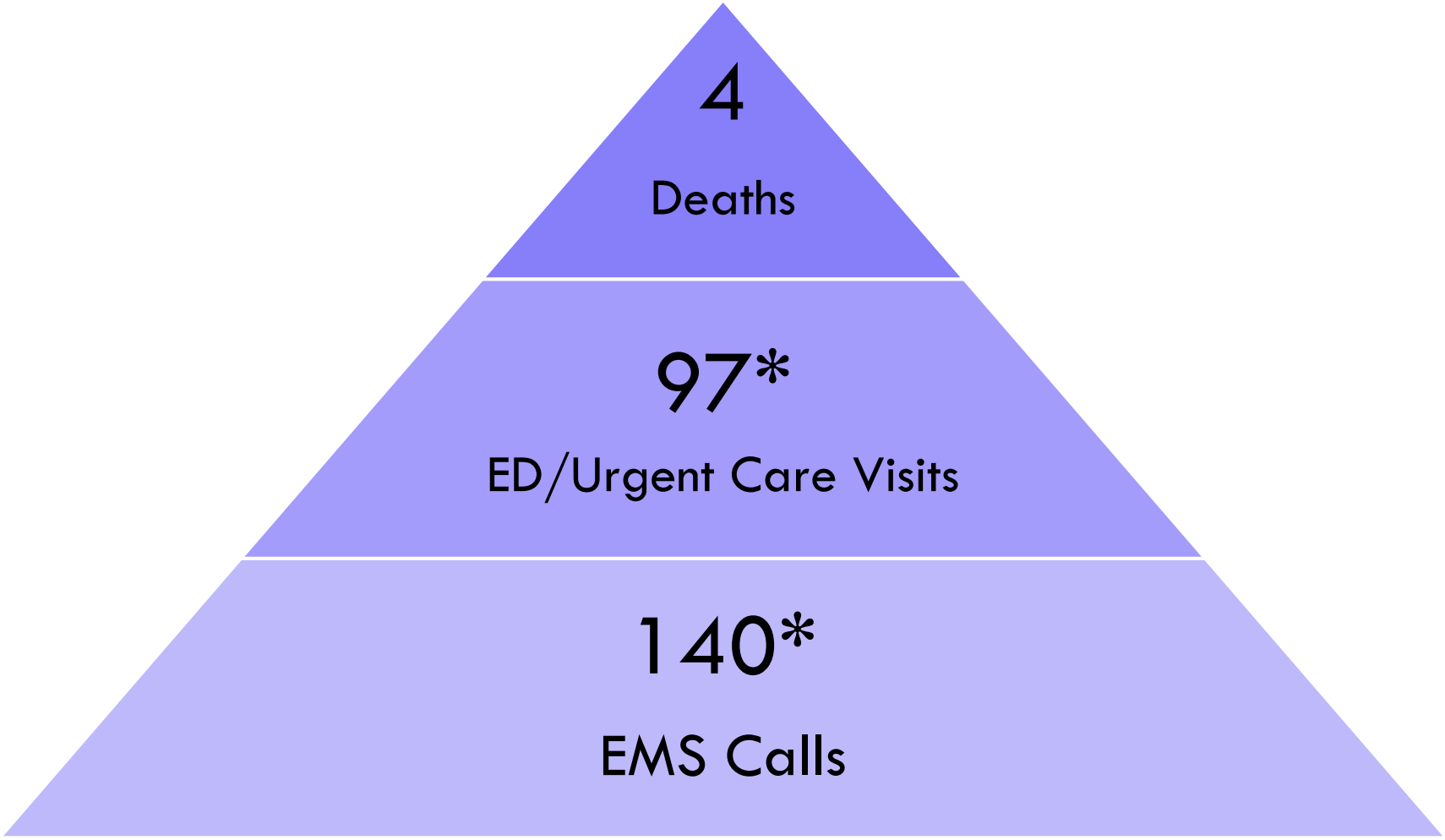
Data source: National Weather Service, 2018.

Heat-Related Health Impacts, by Day



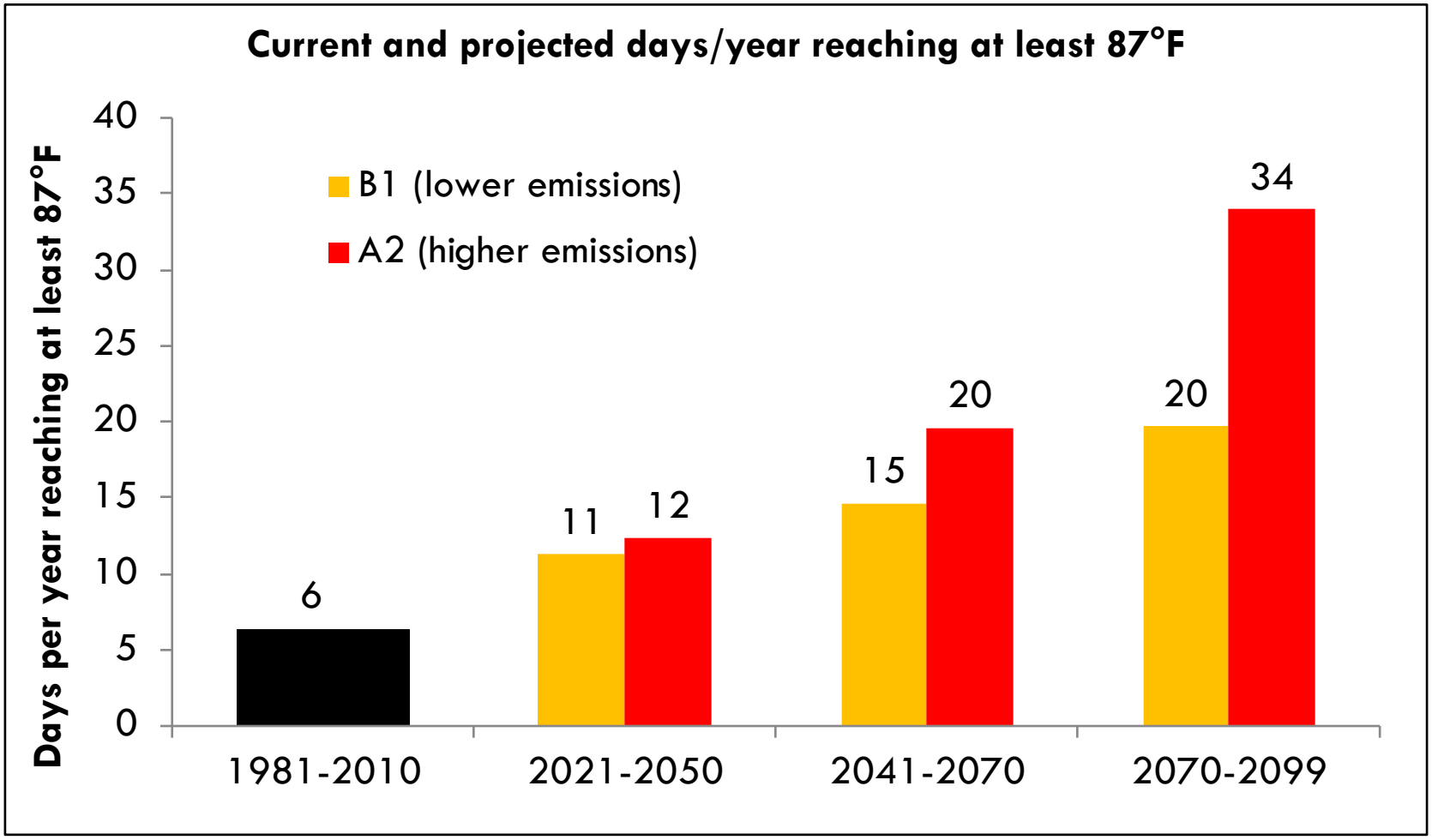
Data sources: The Statewide Incident Reporting Network (SIREN), 2018. The Electronic Surveillance System for the Early Notification of Community-Based Epidemics (ESSENCE), 2018. The National Weather Service, 2018.

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



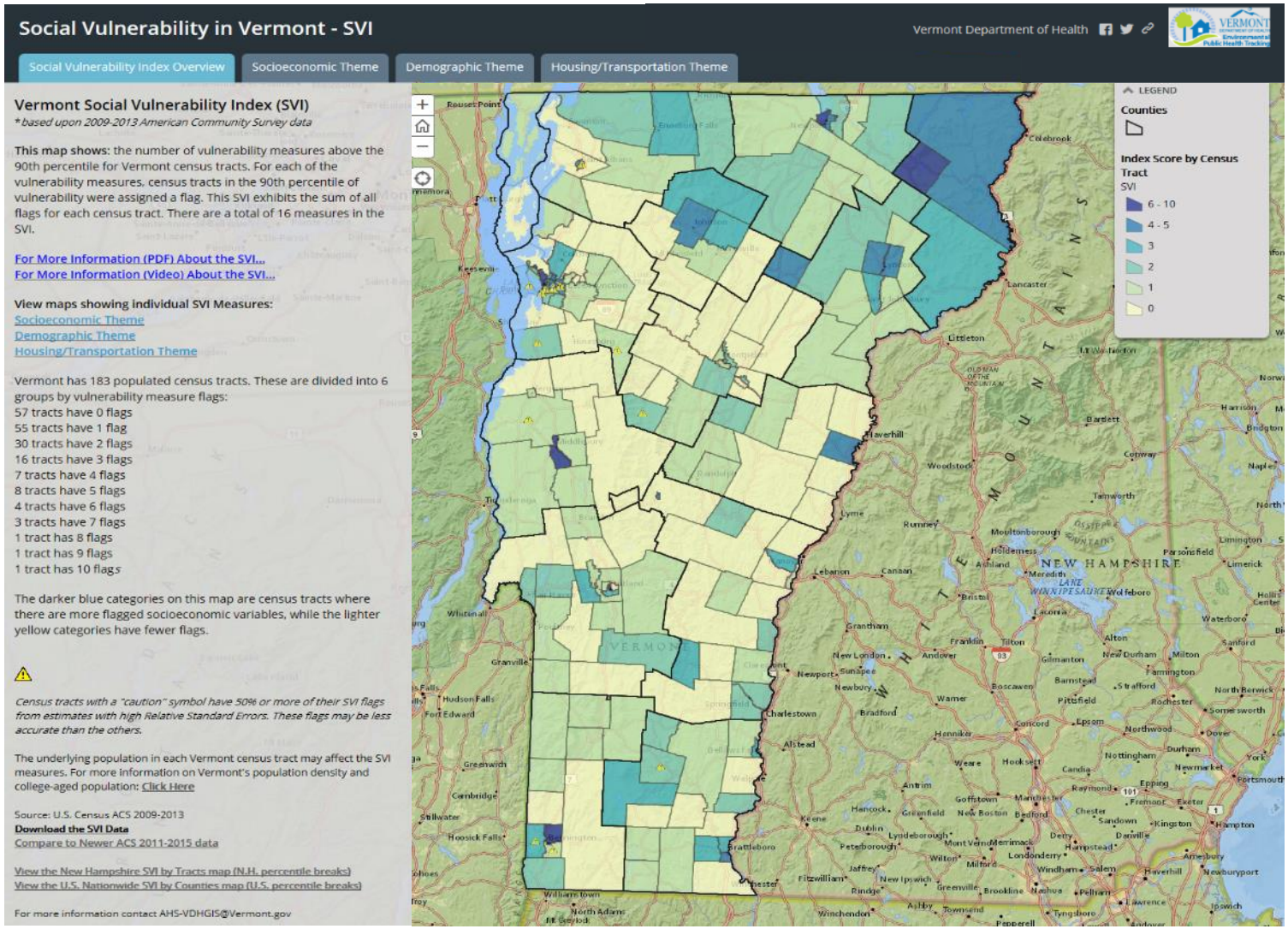
* Estimate based on preliminary surveillance data.

Expect more frequent hot days in the future

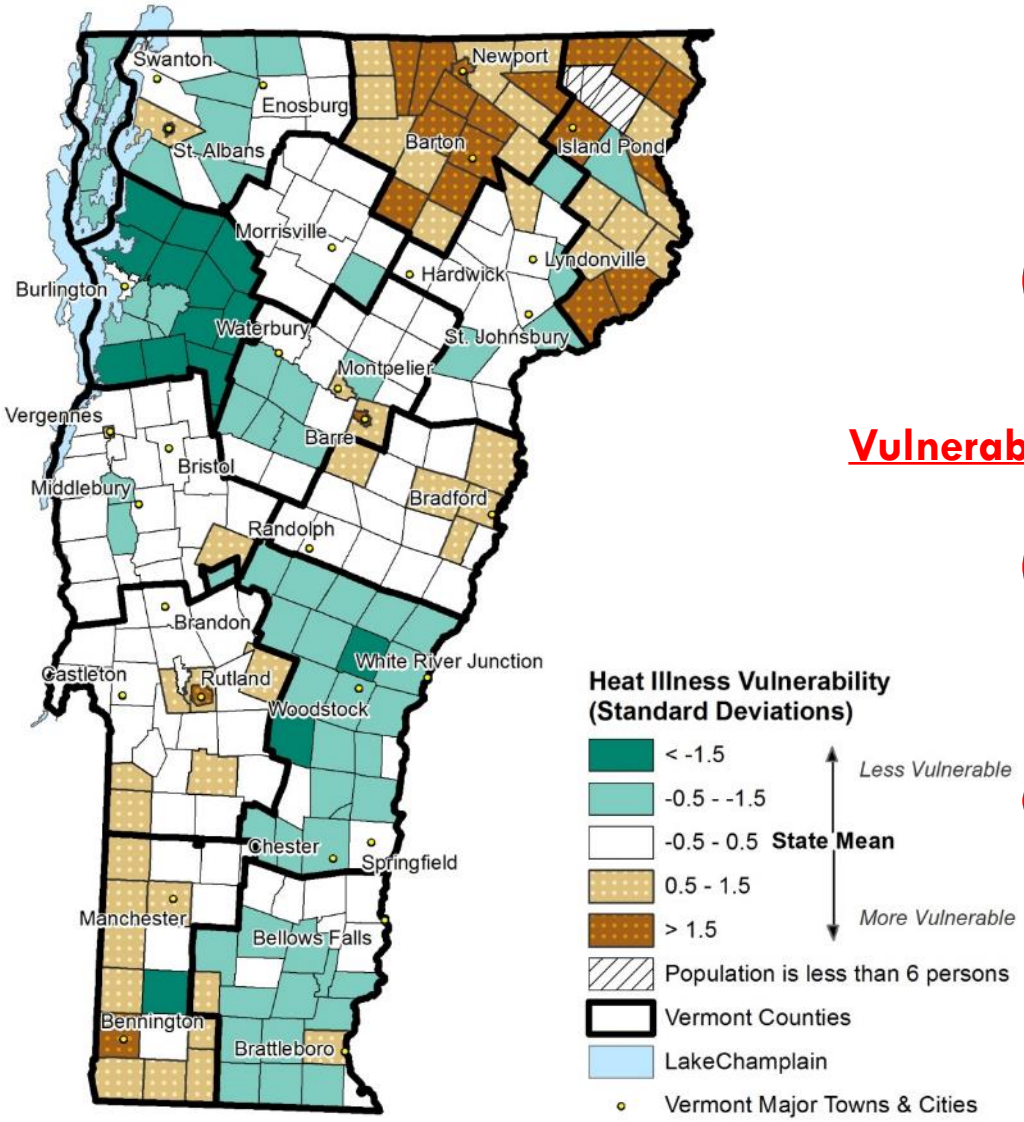


Source: Vermont Department of Health

Vulnerability mapping



Heat Vulnerability Index



- Factors:

Exposures

- Environmental characteristics
- Climate acclimation

Vulnerabilities

- Age
- Pre-existing medical conditions

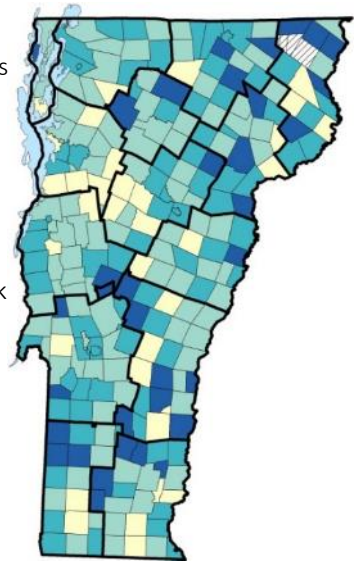
- Socioeconomic status
- Isolation

Barriers to adaptation

- Historic heat illness

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.



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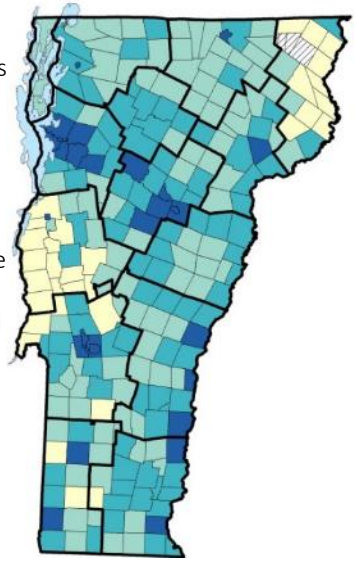

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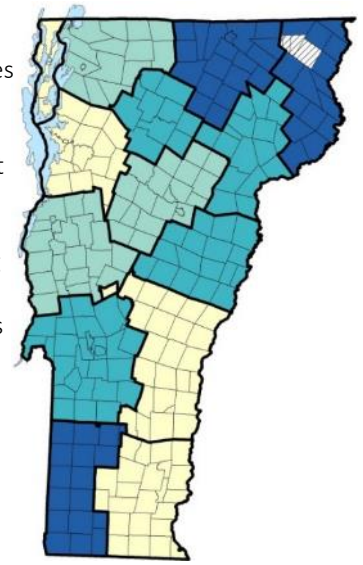

Socioeconomic

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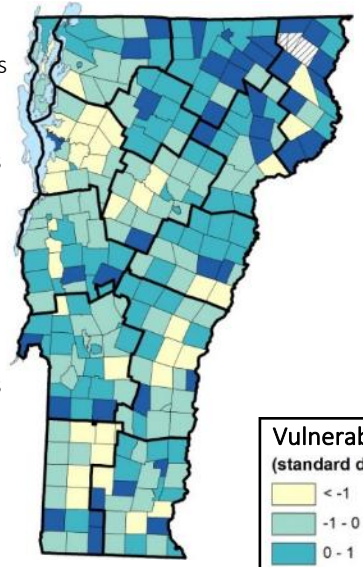

Health

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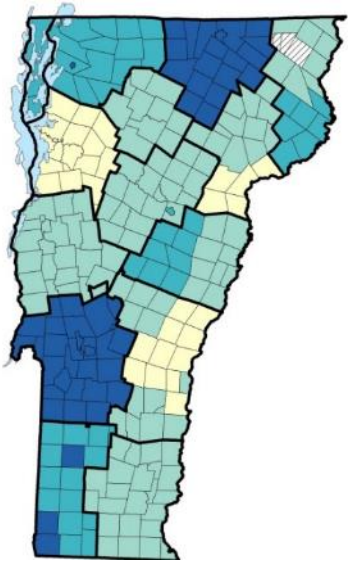

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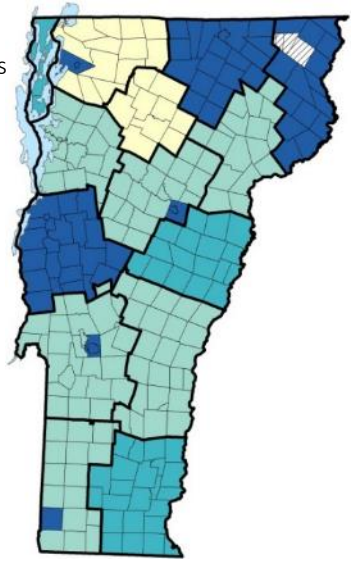
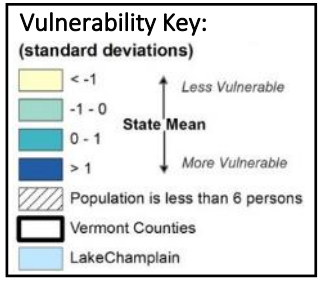
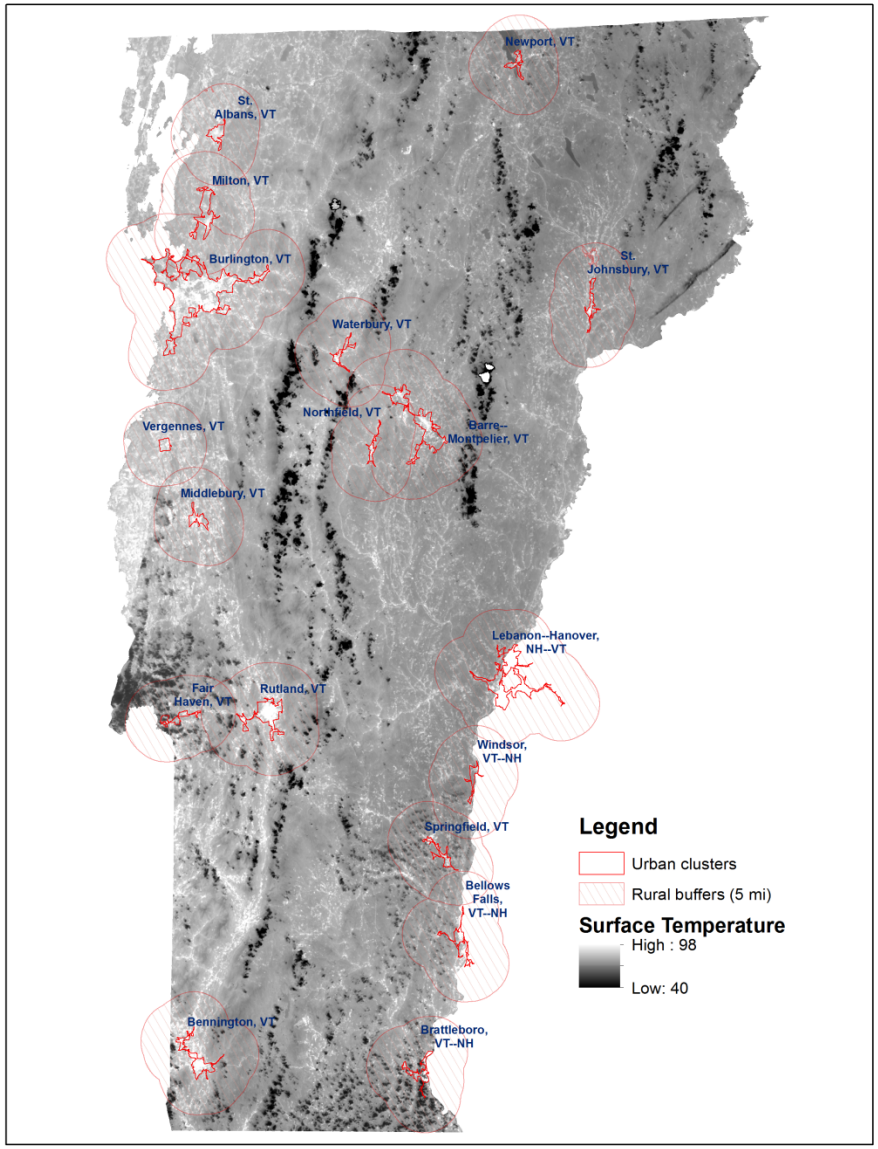




DRAFT, preliminary findings – please do not cite or circulate

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

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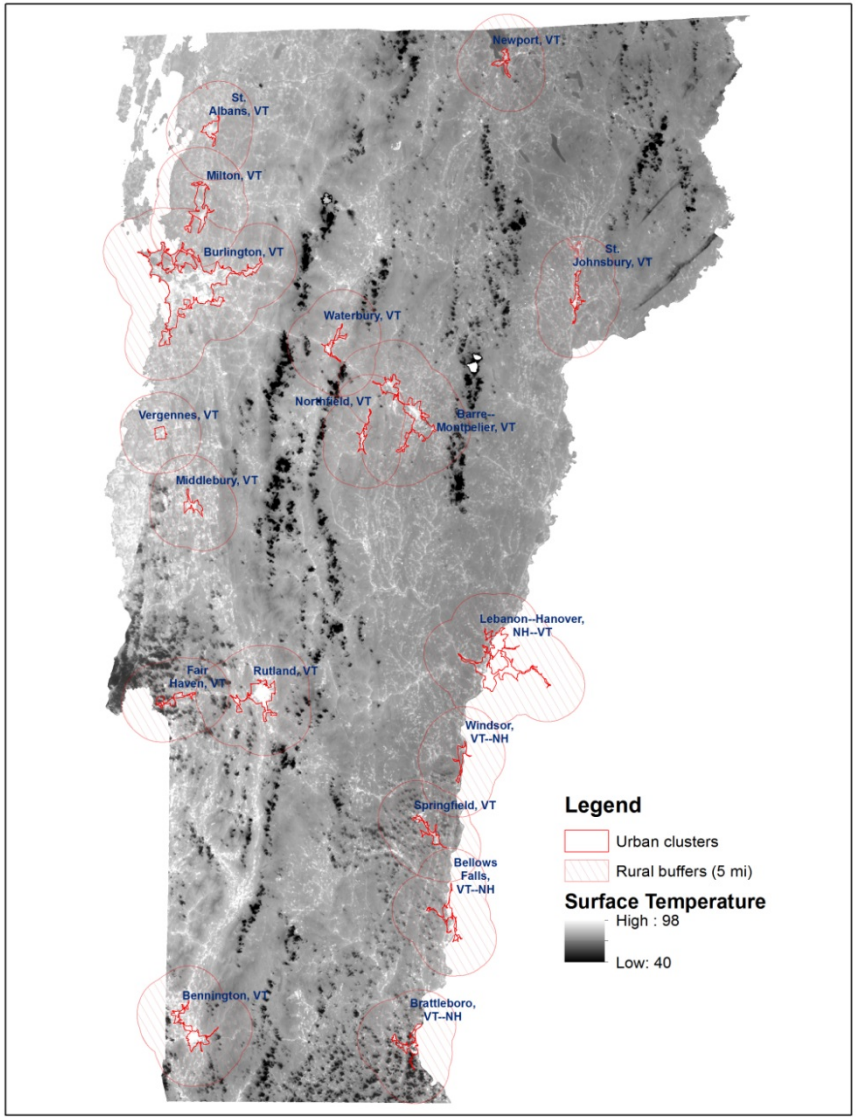
Vermont urban heat island analysis



- 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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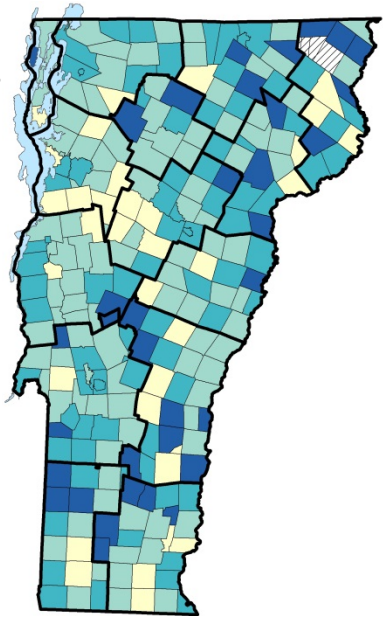

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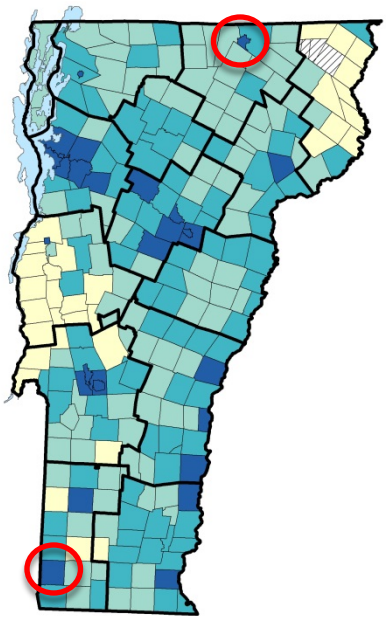

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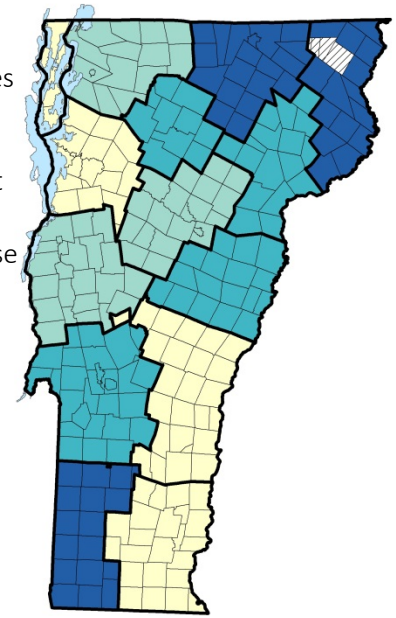

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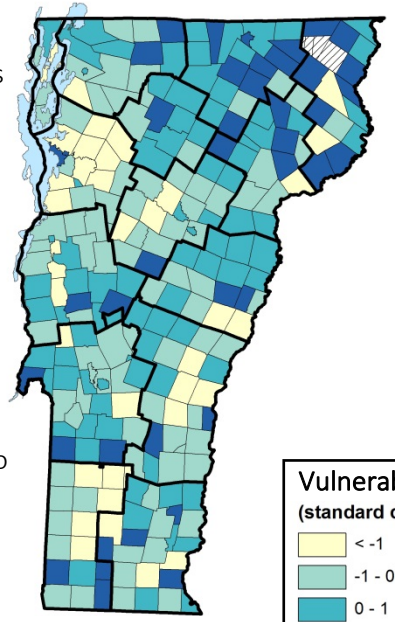

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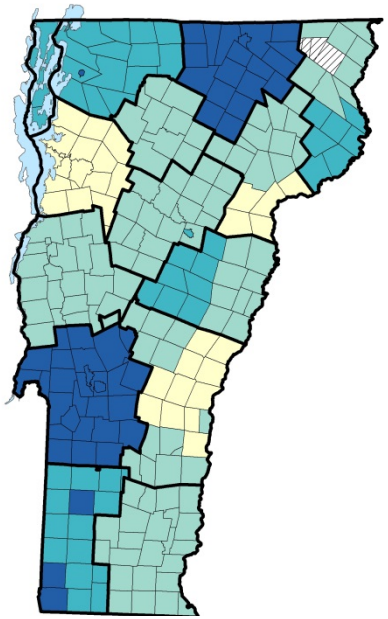

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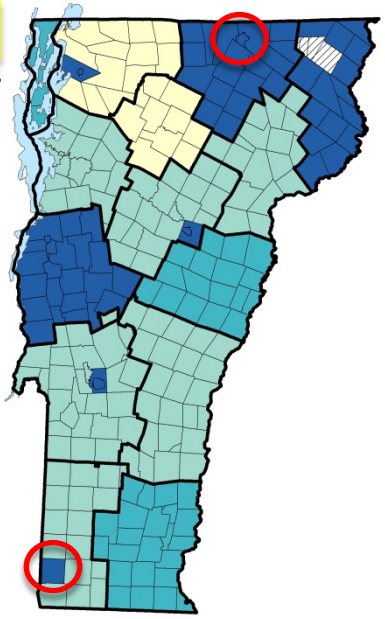
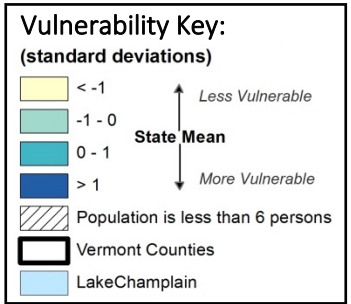




Using trees to save energy and protect health

- 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:

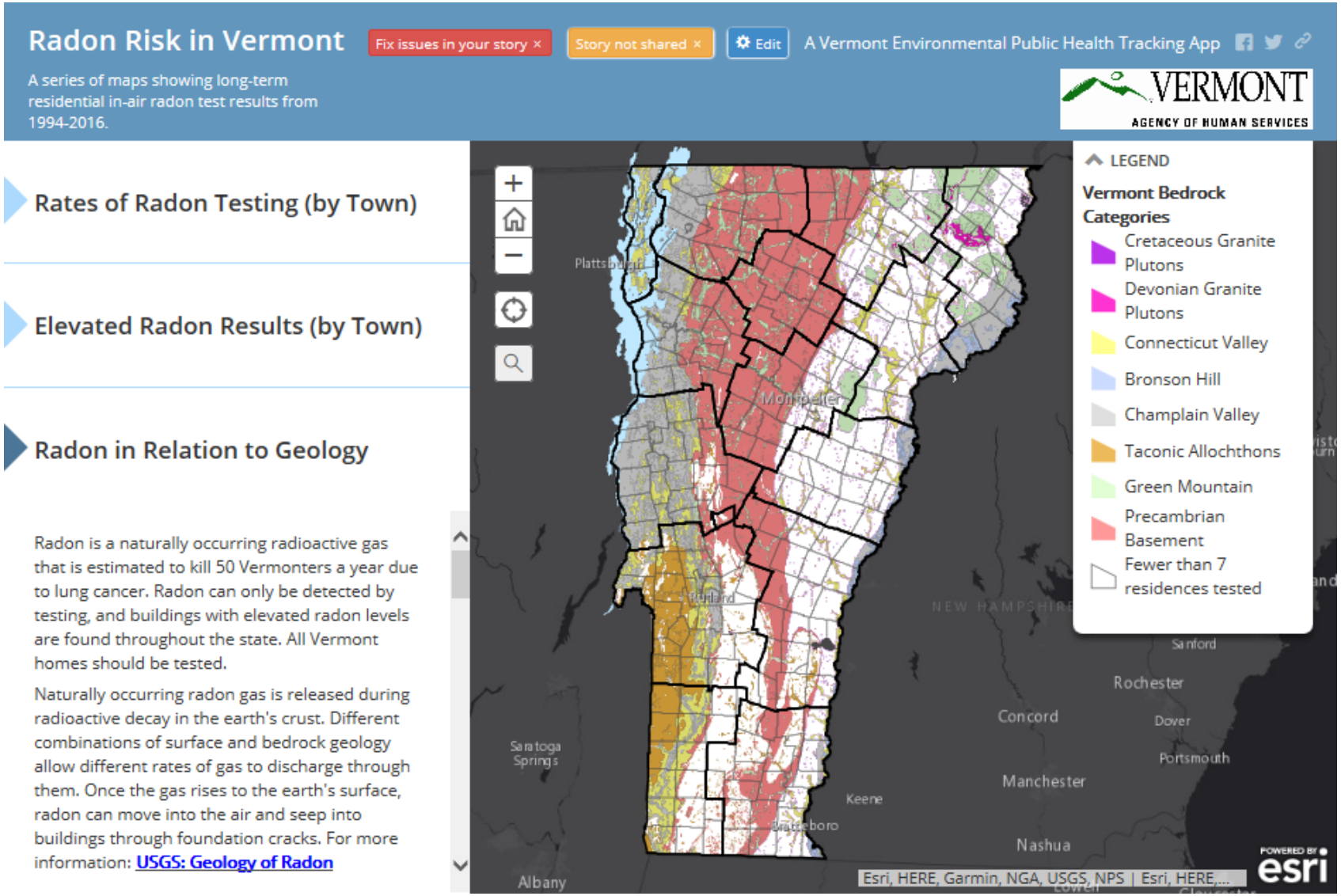
VERMONT URBAN & COMMUNITY FORESTRY
Cultivating connections to grow trees in our communities

VERMONT DEPARTMENT OF HEALTH

Arbor Day Foundation

ENERGY-SAVING TREES

Radon Geological Risk Mapping



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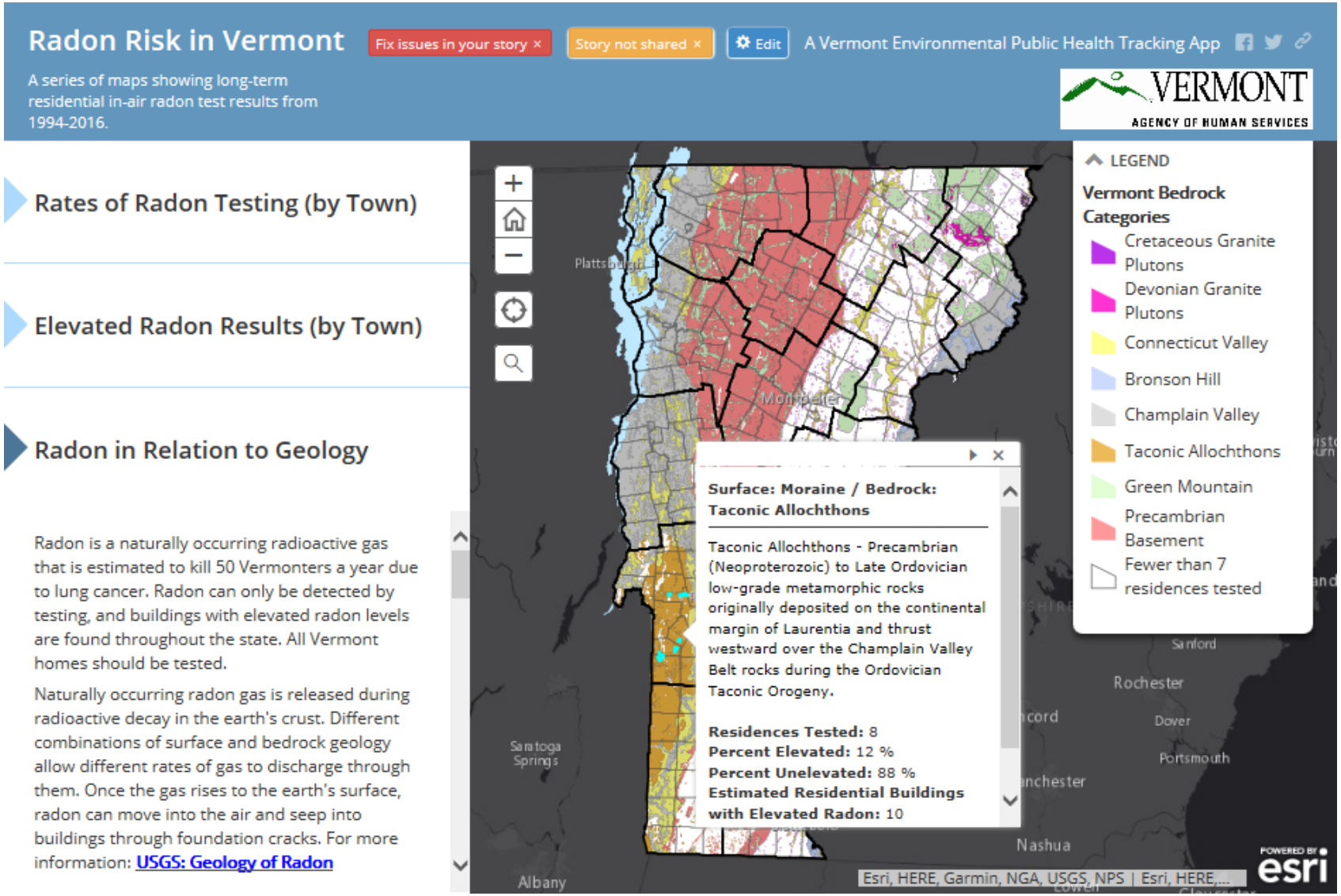
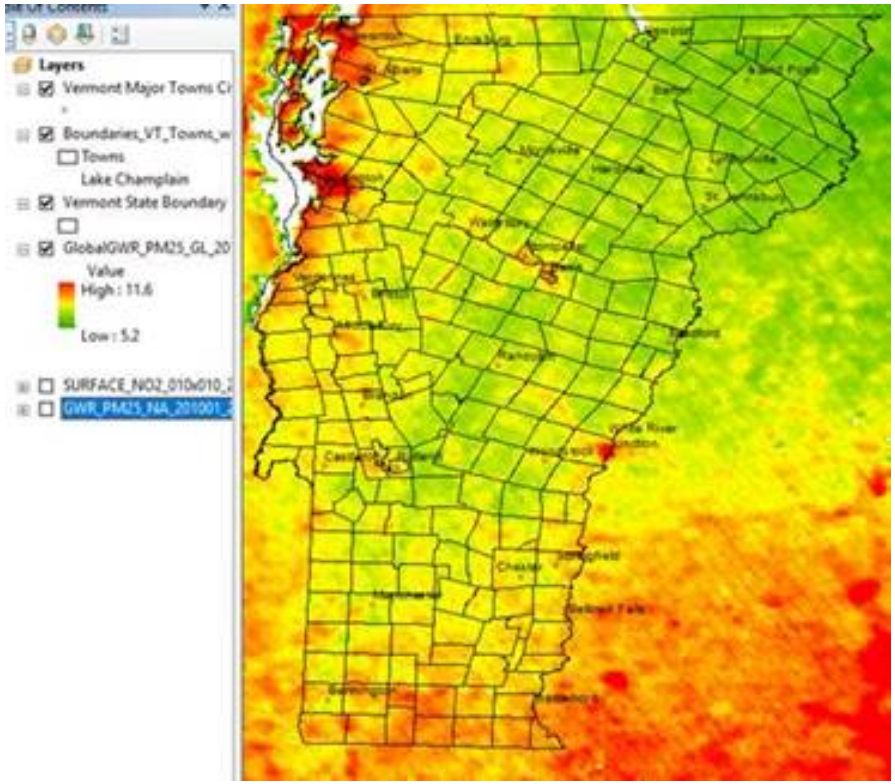


Air Pollution Vulnerability Index (in development with VT DEC)

- 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



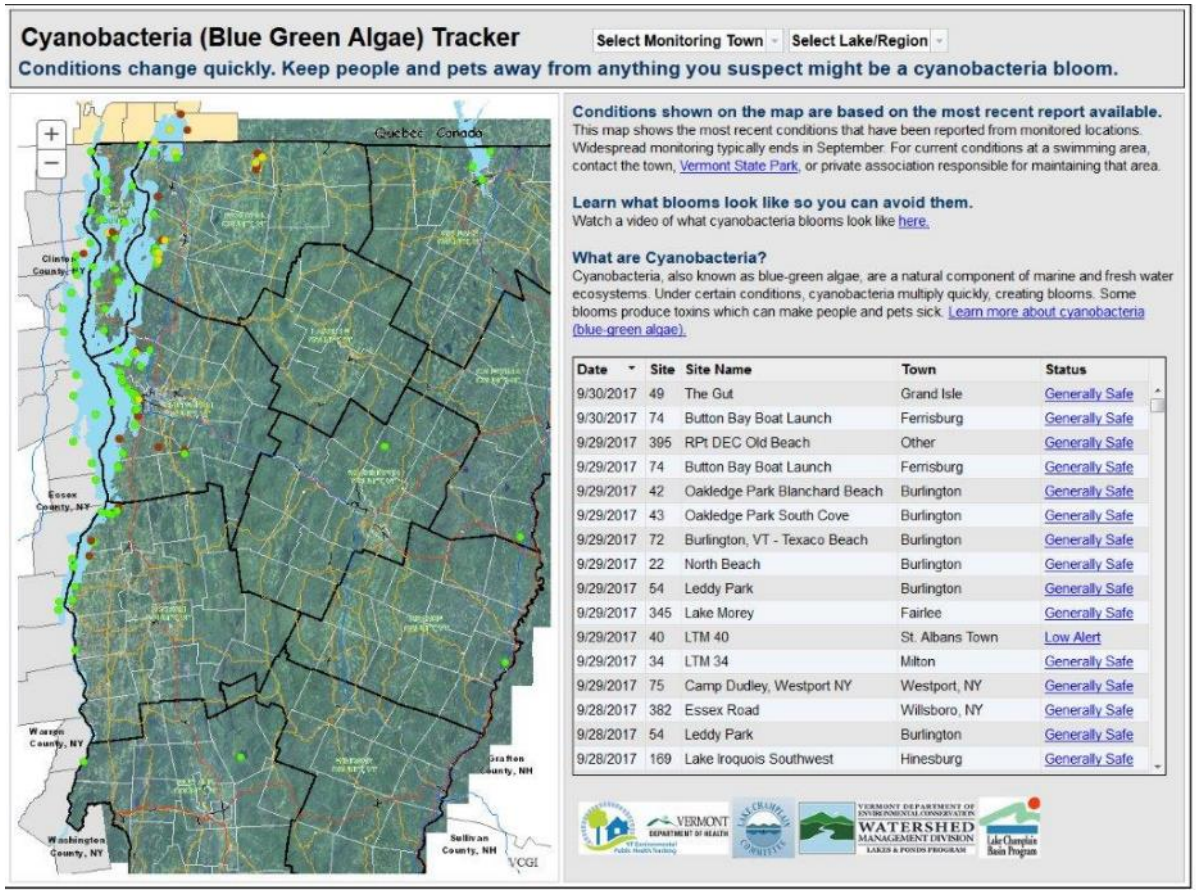
Sample data from: Global Annual PM2.5 Grids from MODIS, MISR and SeaWiFS Aerosol Optical Depth (AOD) with GWR, v1 (1998–2016)

Cyanobacteria Monitoring

Cyanobacteria monitoring & preparedness

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

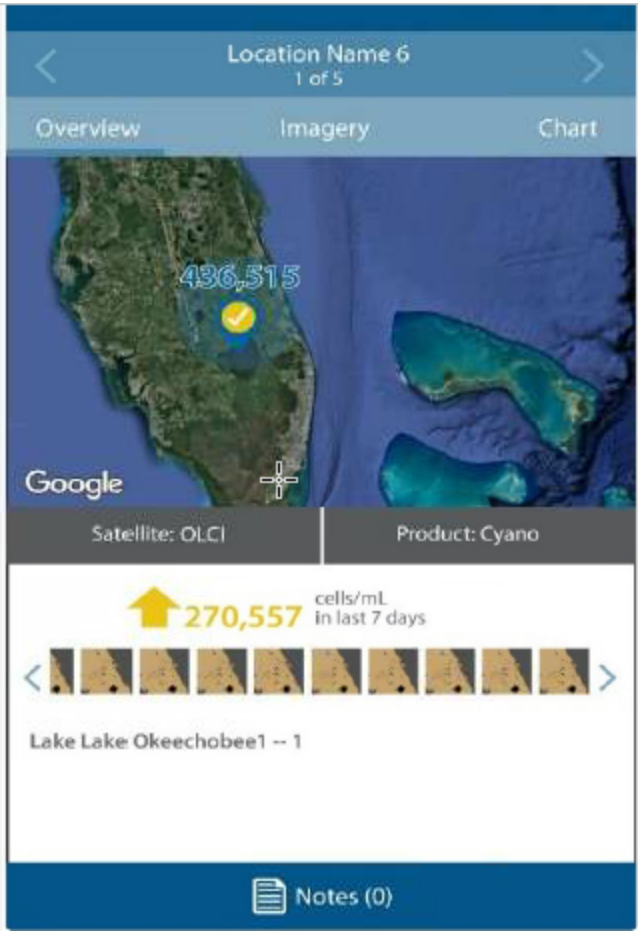
Source: Lake Champlain Committee



Cyanobacteria Monitoring

Cyanobacteria Assessment Network (CyAN)

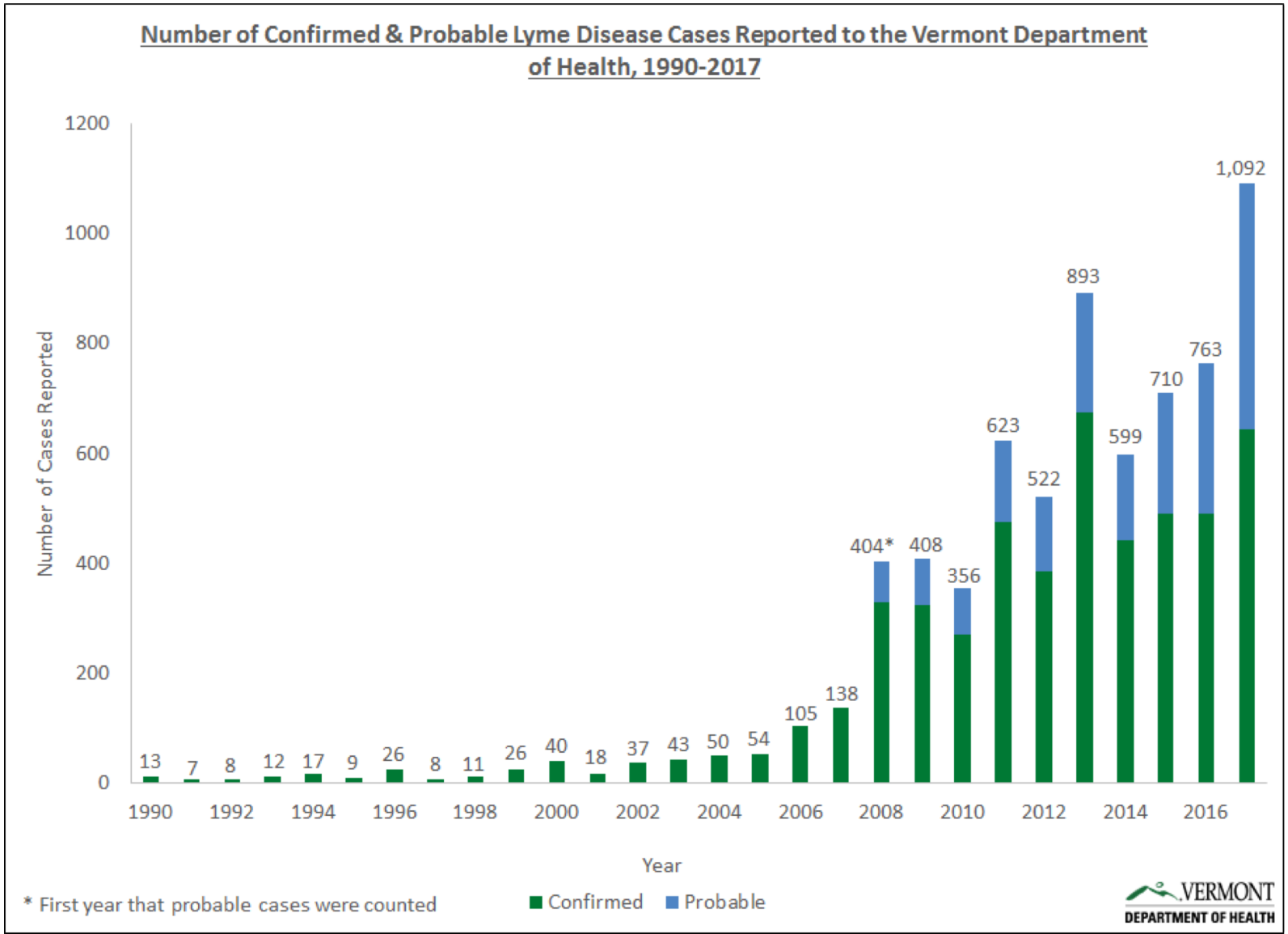
An EPA, NASA, NOAA, and USGS Project



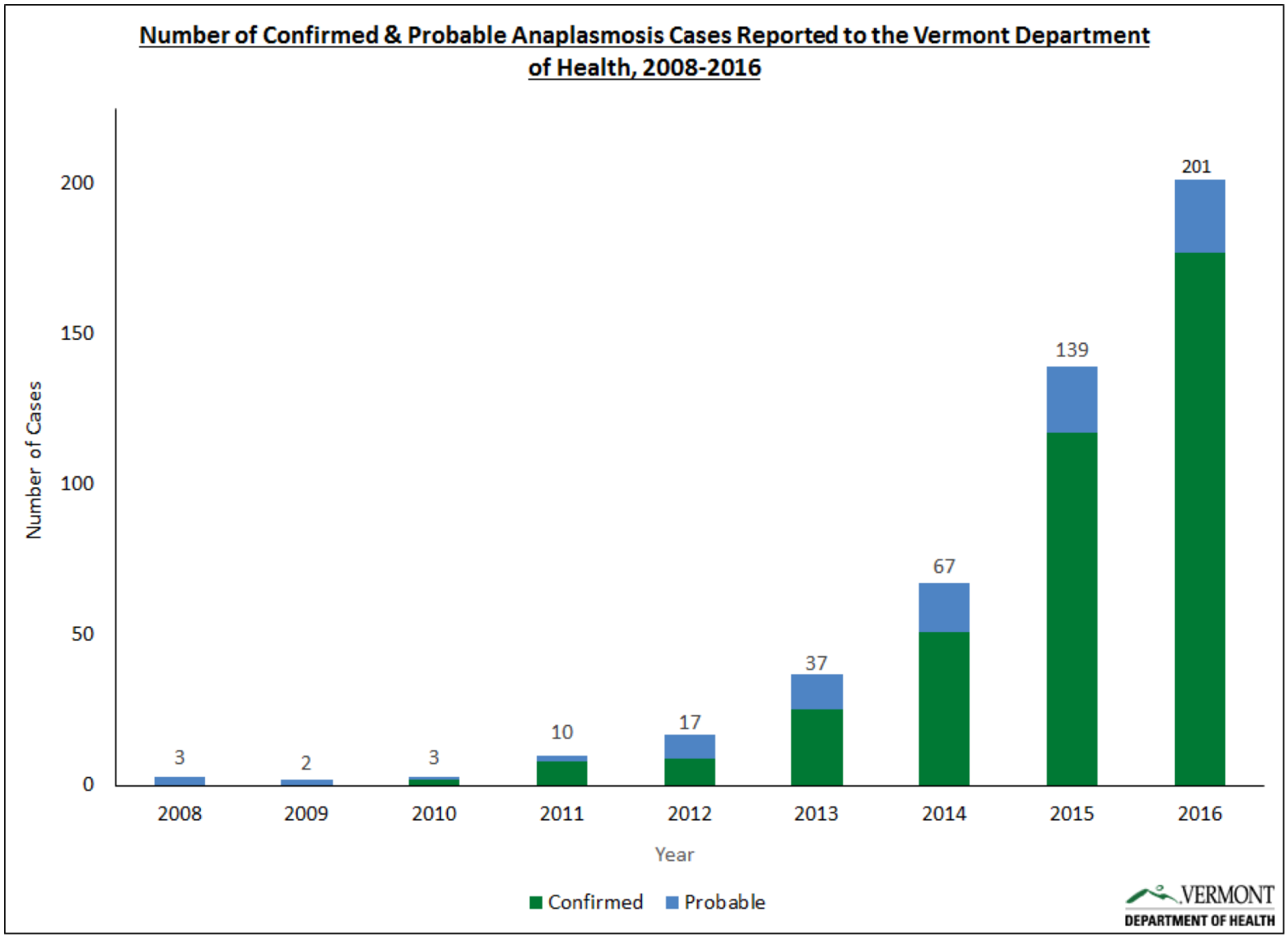
CYAN

Vector-borne Disease

Lyme Disease in Vermont



Anaplasmosis



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.

Acknowledgments

- Centers for Disease Control and Prevention
  - Environmental Public Health Tracking Program
  - Climate and Health Program
- Vermont Department of Health
  - Jared Ulmer, Climate and Health Program Manager
  - Lauren Prinzing, Tracking and Climate Epidemiologist
  - Bridget O'Brien, Radiological and Toxicological Analyst
- NASA GSFC, formerly or currently
  - Jeff Privette
  - Venkat Lakshmi
  - Mike Jasinski
  - Tucker Carlson
  - Brent Holben

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