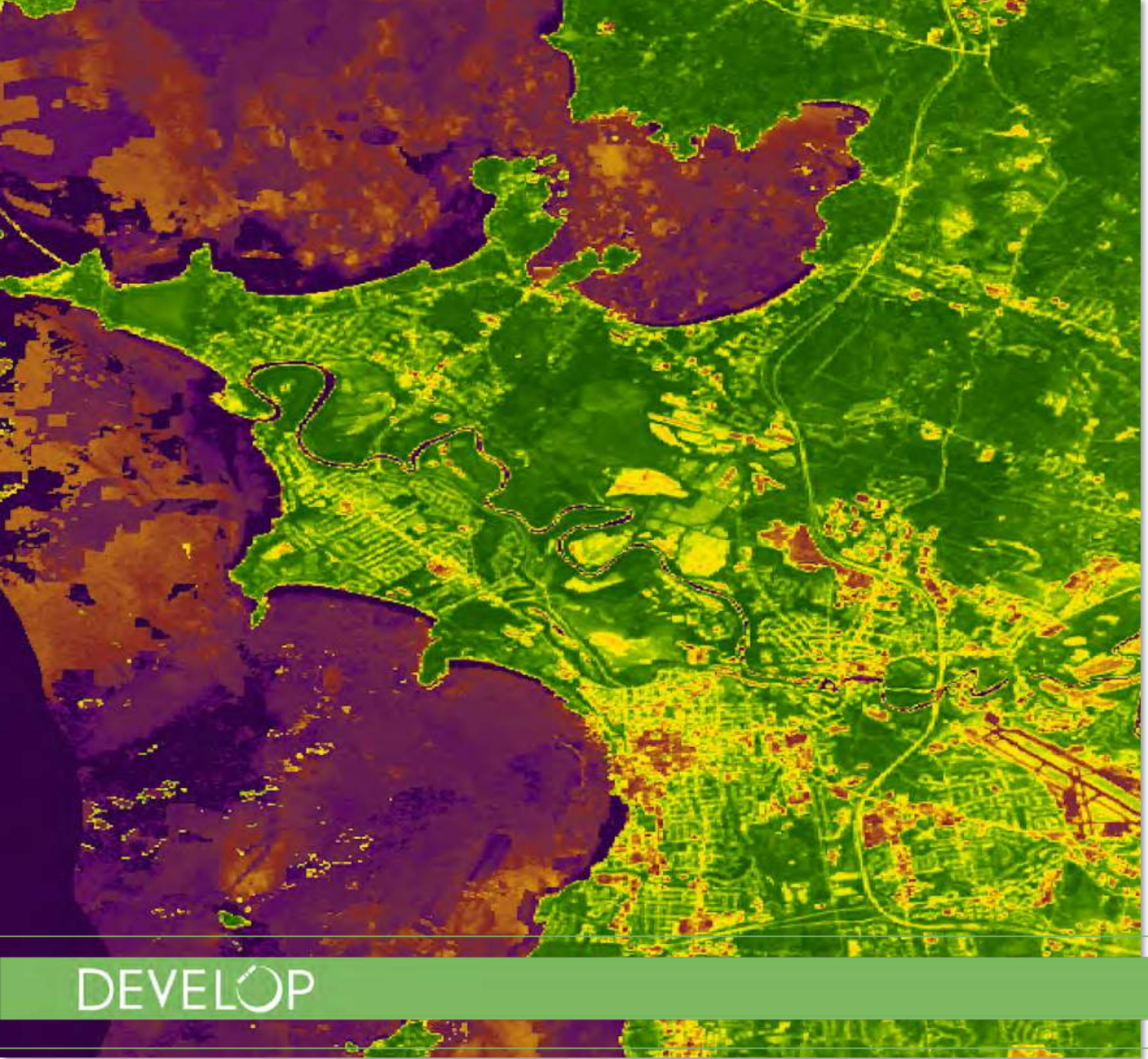


National Aeronautics and Space Administration

Identifying Environmental Stressors Impacting Sugarbush Longevity and Maple Syrup Agroforestry in Vermont

Melanie Rausch*

Brooke Bartlett

Shannon Healy

Li-Wei Lin

DEVELOP

Background Information

- **Native Americans** invented maple syrup, with the first written record dating back to 1557
- **In the 1850s**, maple syrup rose in popularity among European settlers as an inexpensive cane sugar substitute
- **Maple syrup** production began by inserting a tap into the trunk of the tree and hanging buckets to collect sap during February through April
- **The most common** maple tree to tap for sap is the sugar maple tree (*Acer saccharum)*
- **Sugar maples** are a keystone species in hardwood forests and occur from Tennessee to Canada


Credit: diapicard

Study Area

- **Vermont**, United States
- **Elevation range**
  - 100 to 4,395 feet
- **Study Period**
  - January 1987 to June 2019

Community Concerns

- **Extensive** maturation period; sugar maples must be 40 years old before being tapped
- **Sensitive** to environmental stressors such as drastic changes in temperature, degradation of soil, and defoliation
- **Decline** in sugar maple population
- **Negative** impacts to maple syrup quality

Credit: Olivia Hutcherson

Objectives

- **Utilize** Earth observations to quantify the health of Vermont Vegetation through NDVI and EVI Time Series Analysis Maps from January 1987 to June 2019
- **Produce** an EVI and Temperature Trend graph to display trends in vegetation health and temperature fluctuations from January 1987 to June 2019
- **Identify** areas that are optimal for sugarbush and maple syrup production through a Sugarbush Habitat Suitability Map
- **Provide** guidance for maple syrup producers in identifying viable maple forest stands through a PDF document

Credit: Mike Petrucci

Project Partners

University of Vermont Extension Maple Program

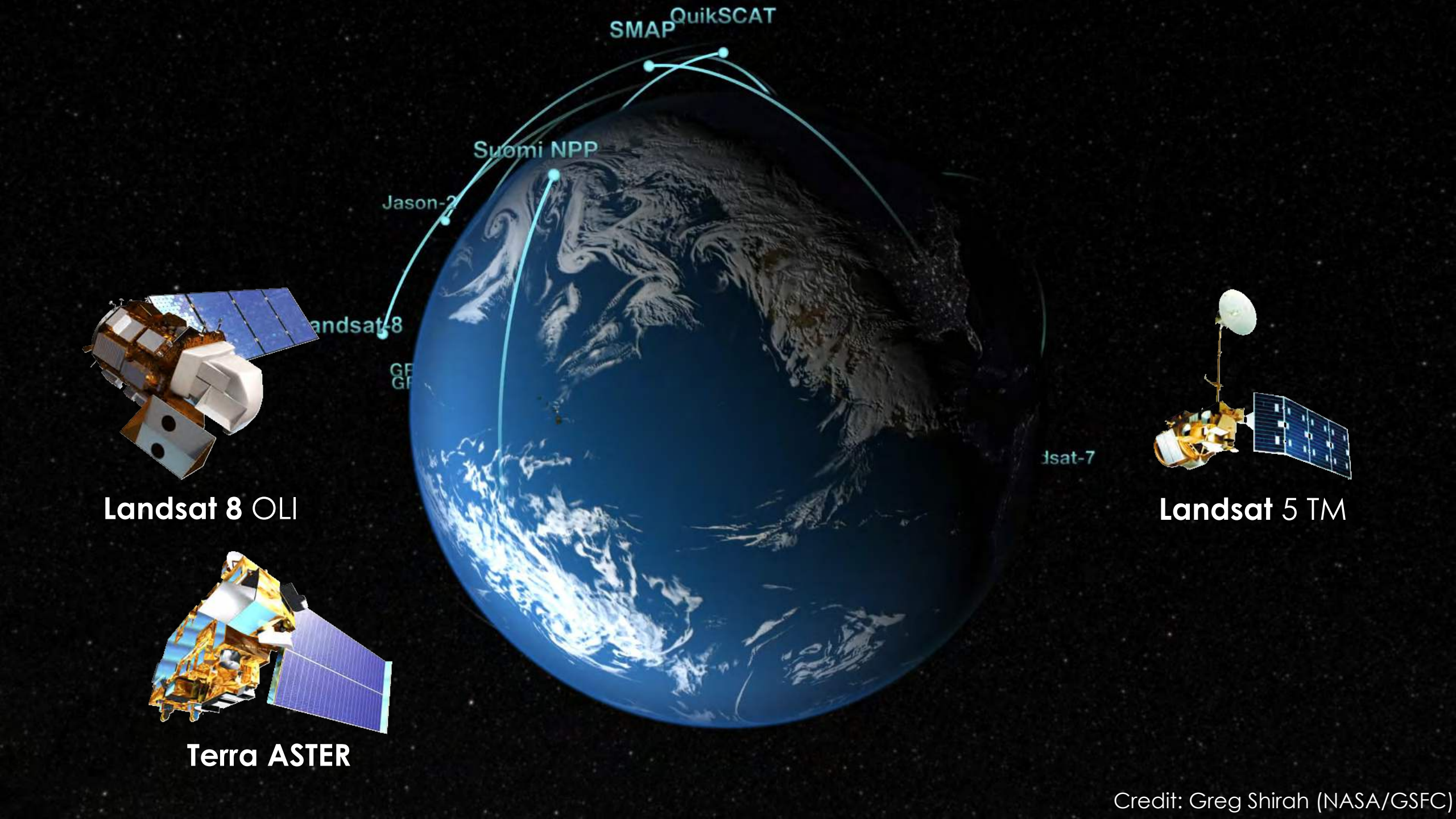
- End User – Mr. Mark Isselhardt, Extension Maple Specialist

University of Vermont Spatial Analysis Laboratory

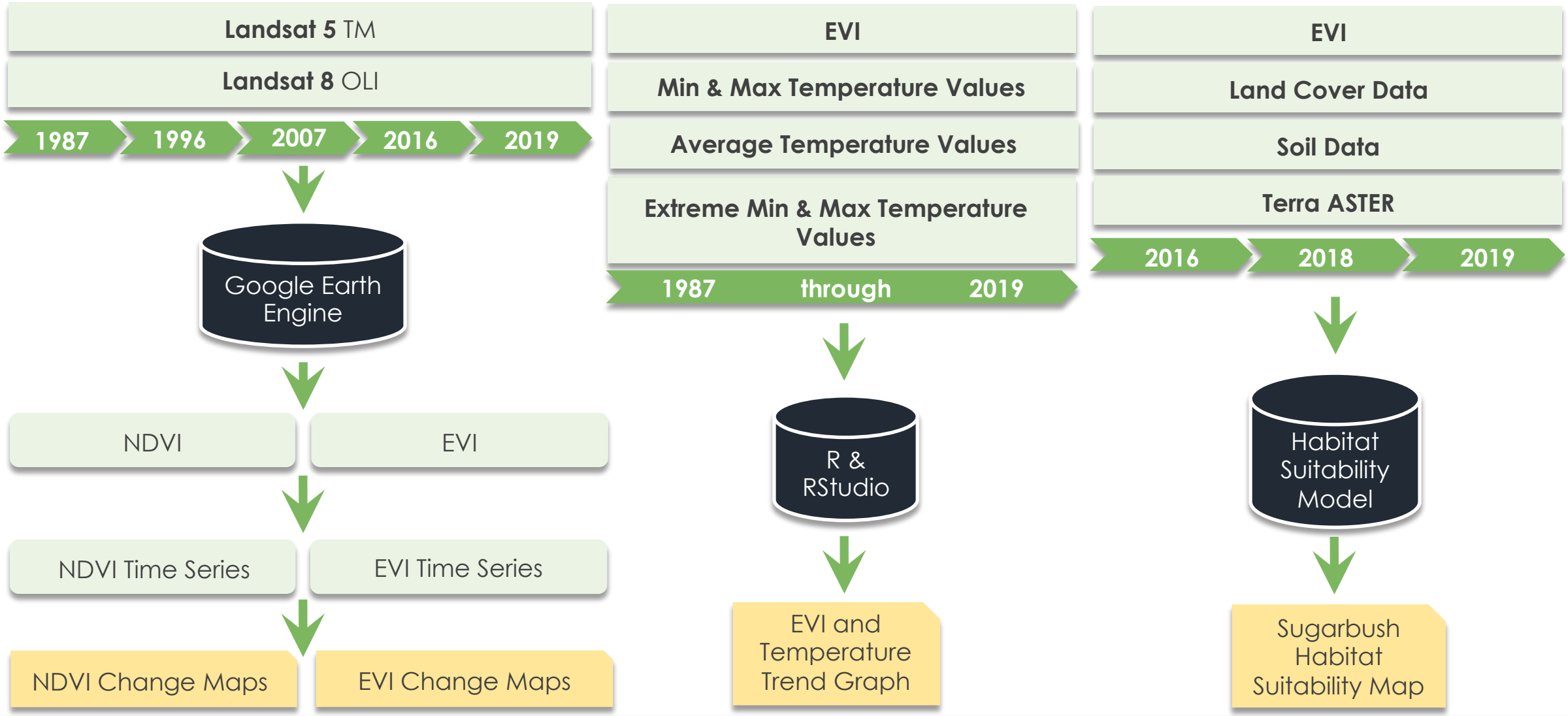
- Collaborator – Dr. Jarlath O'Neil-Dunne, Director

Proctor Maple Research Center

- Collaborator – Dr. Abby van den Berg, Associate Professor


SMAP
QuikSCAT
Suomi NPP
Jason-2
andsat-8
lsat-7
Landsat 8 OLI
Landsat 5 TM
Terra ASTER
Credit: Greg Shirah (NASA/GSFC)

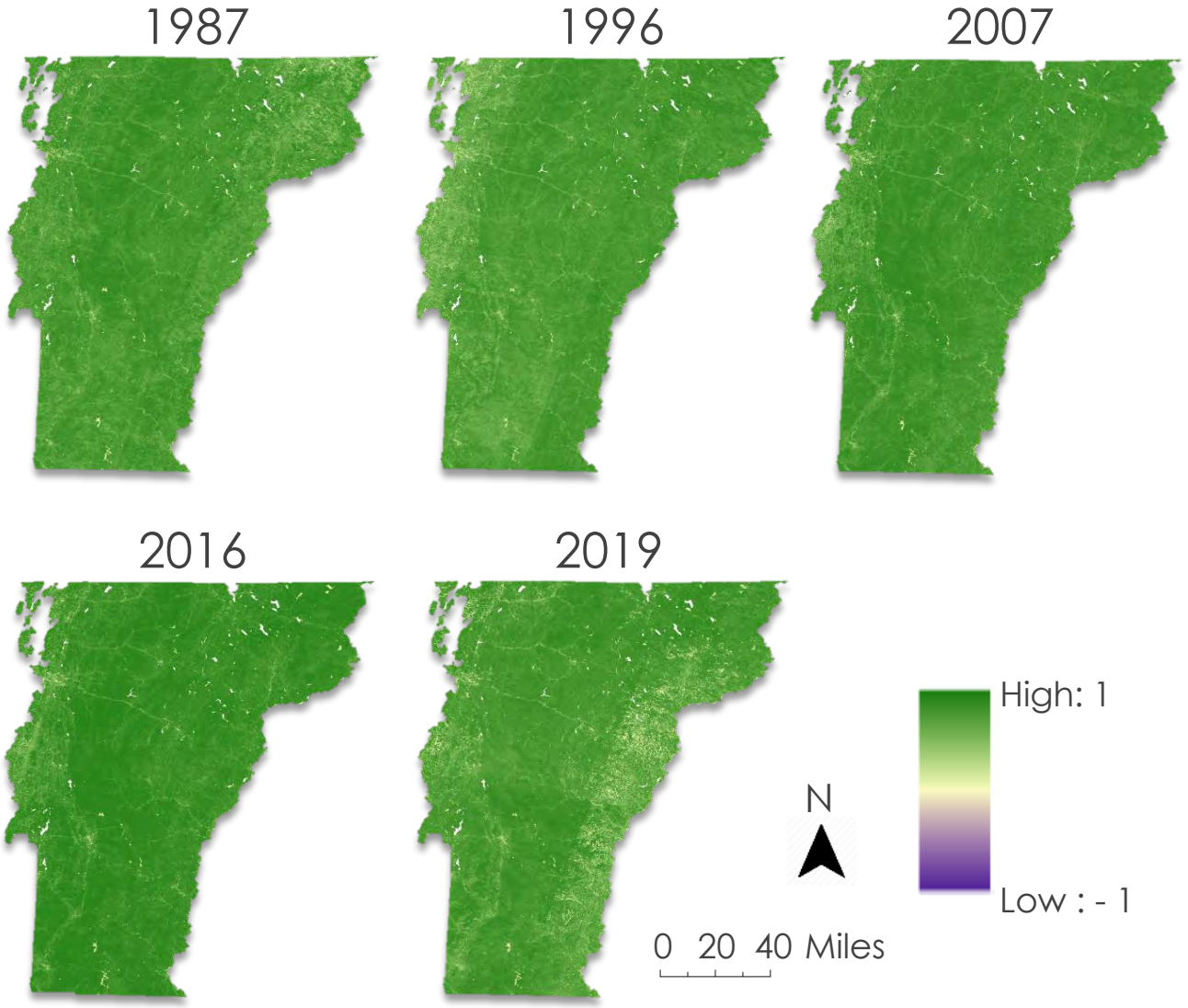
Methodology



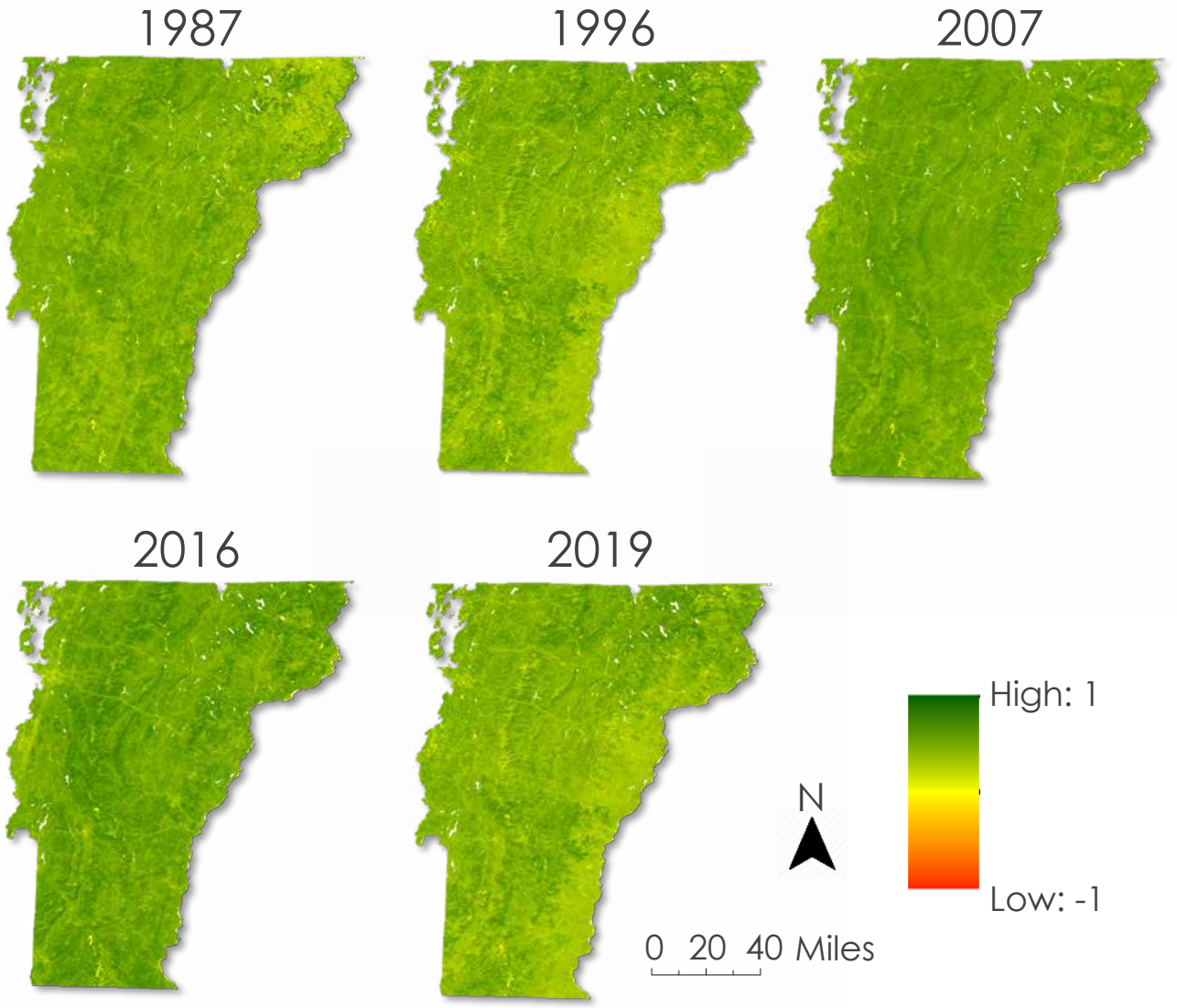
Results

- **NDVI and EVI of Vermont**
  - Time Series
  - Change maps
- **Vegetation Health and Temperature Trends**
  - Relationships and interrelationships
- **Habitat Suitability Analysis**
  - Habitat suitability model
  - Suitable areas of sugar bush

NDVI Time Series Maps

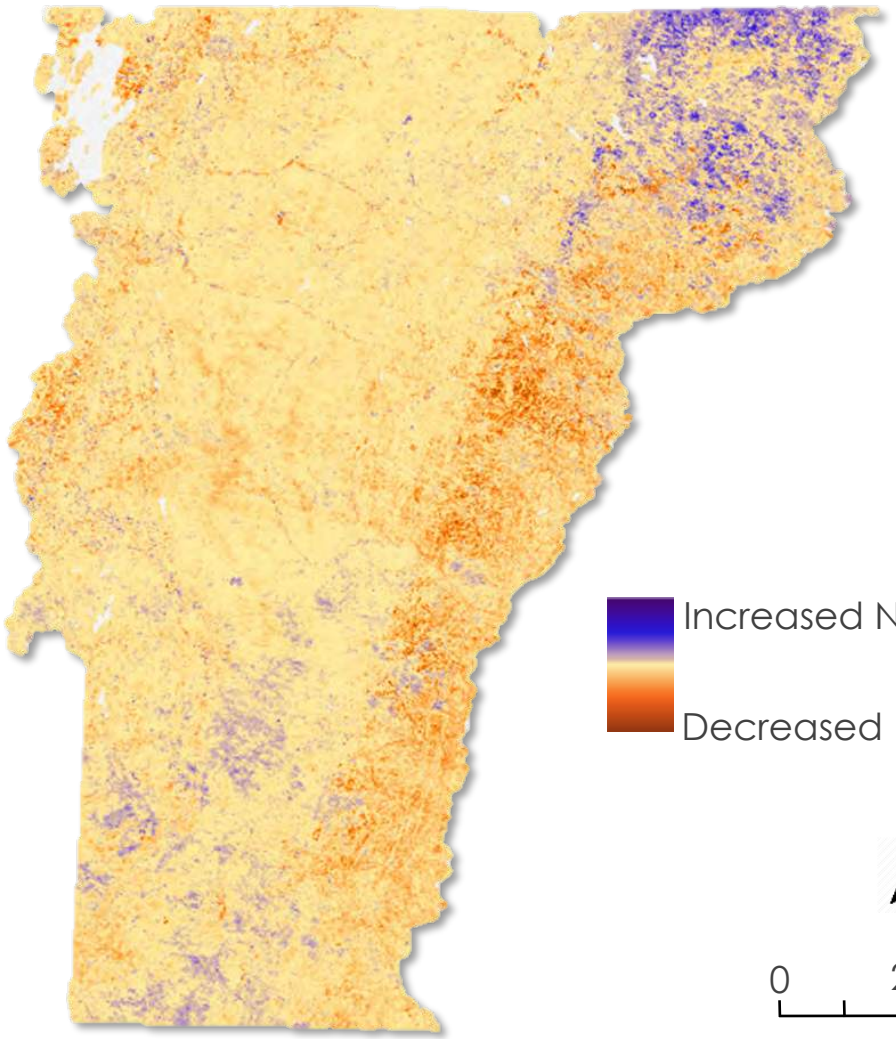


EVI Time Series Maps



NDVI and EVI Change Maps

NDVI



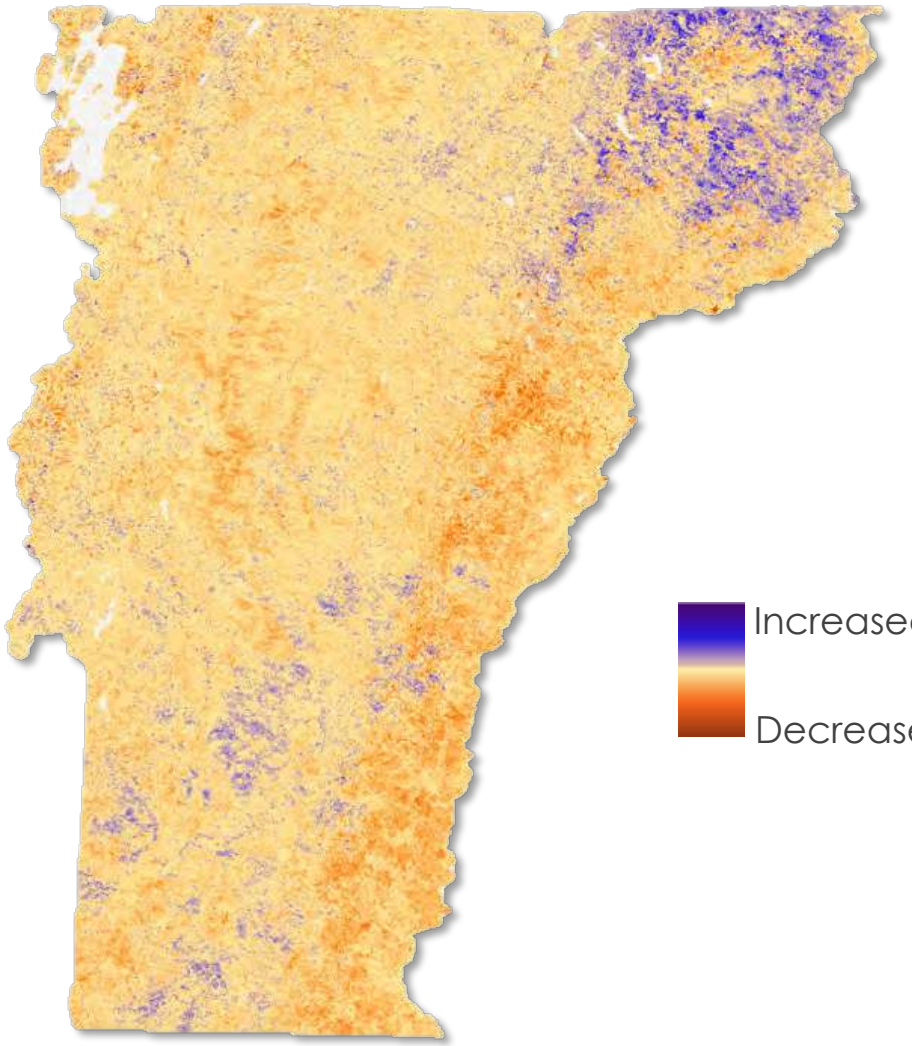
Increased NDVI: 1

Decreased NDVI: -1

N

0 20 40 Miles

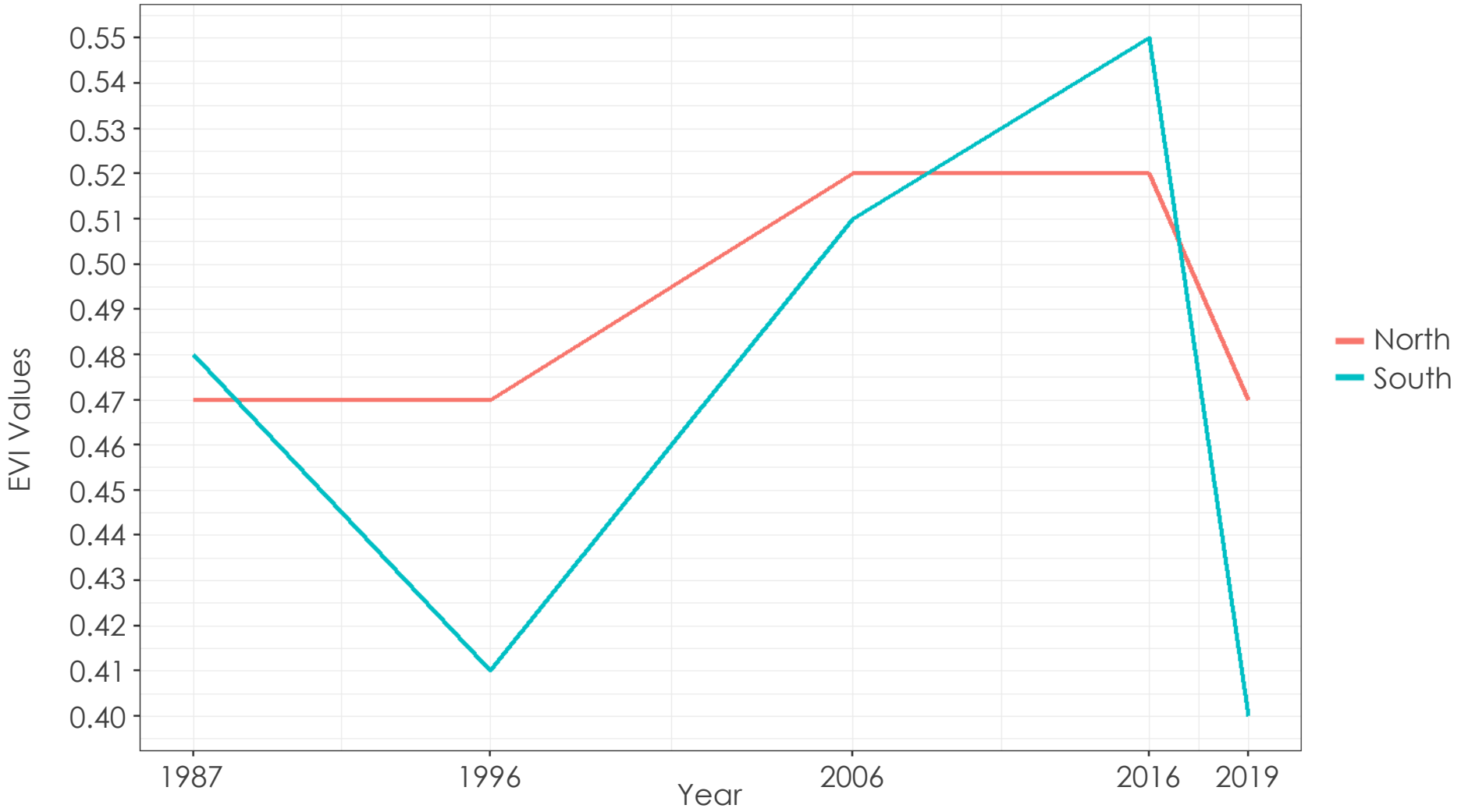
EVI



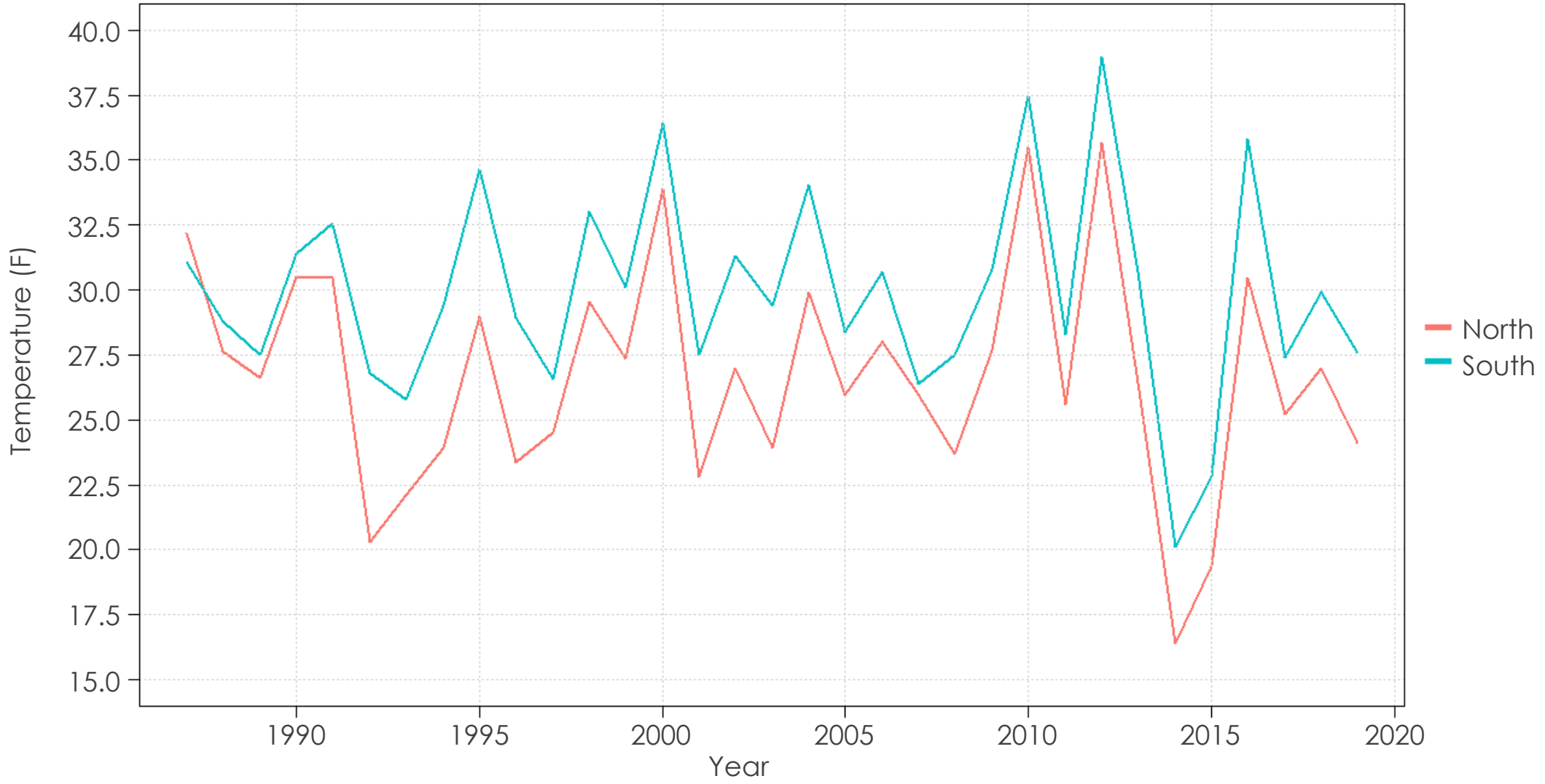
Increased EVI: 1

Decreased EVI: -1

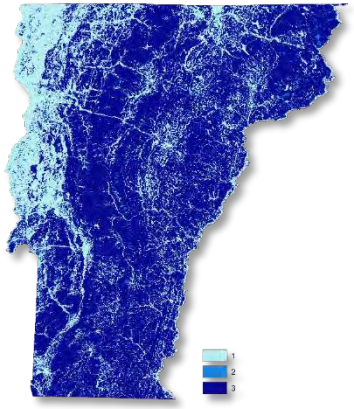
Average EVI Values (1987 – 2019)



Average Temperature for Sugaring Season (1987 – 2019)

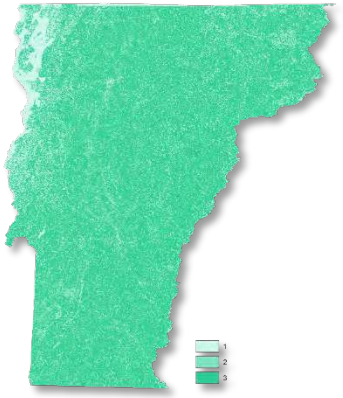


Habitat Suitability Model

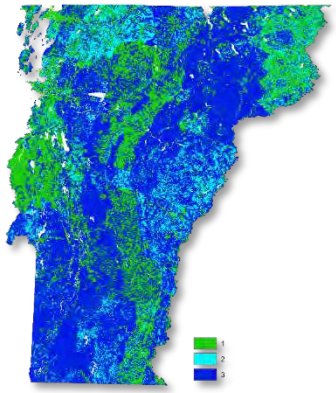


Land Use & Land Cover

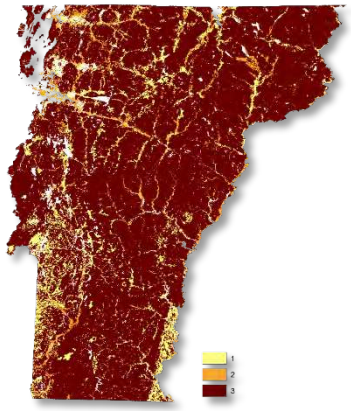
EVI



Slope



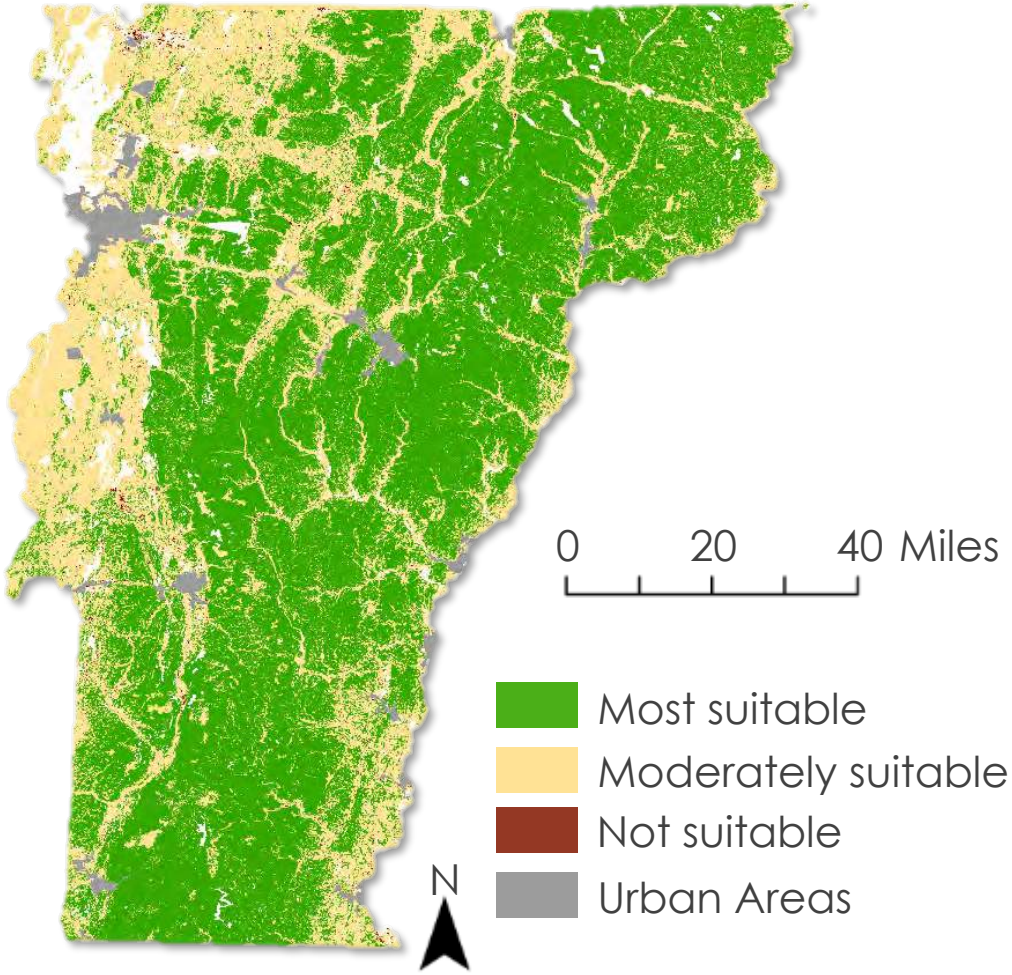
Drainage



Soil

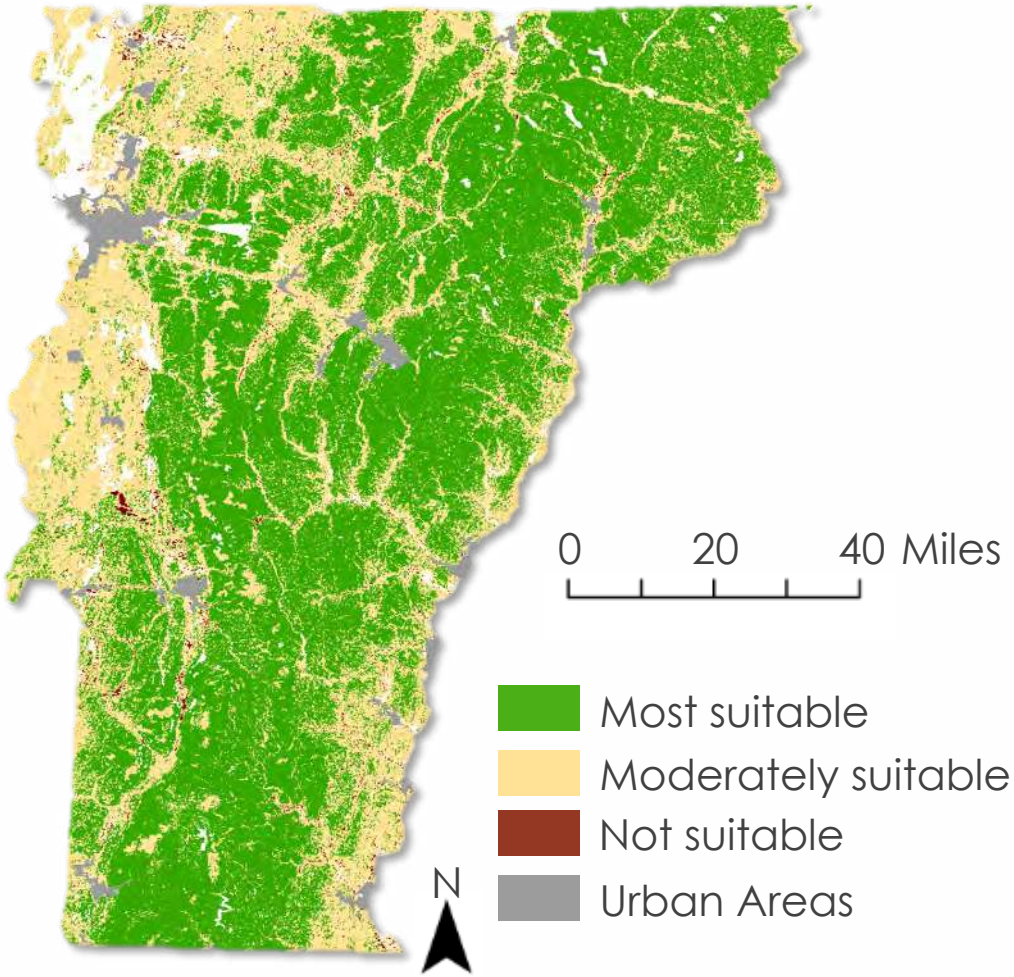
Sugar Bush Habitat Suitability Map

2007



Sugar Bush Habitat Suitability Map

2019



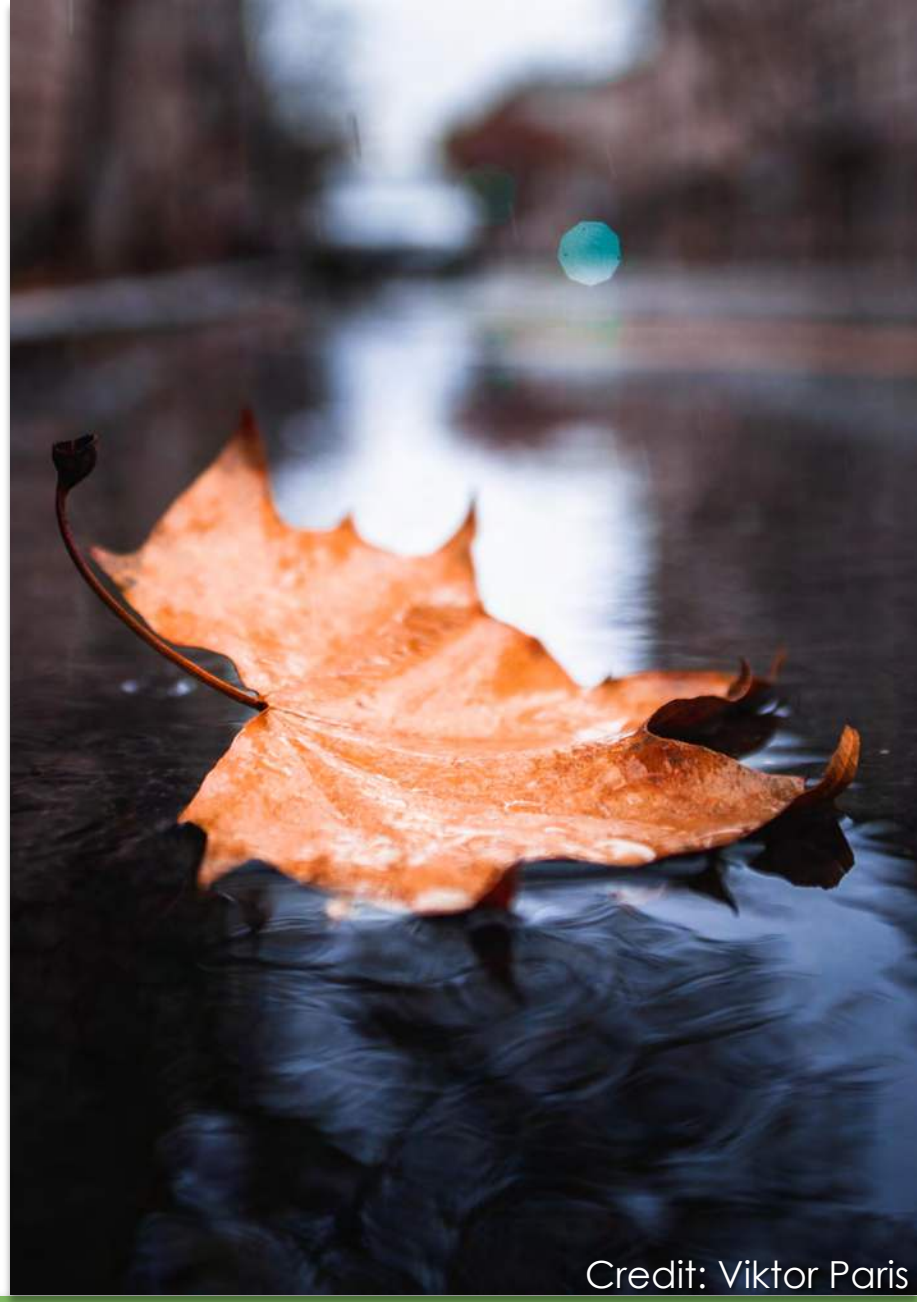
Conclusions

- **NDVI decreased** in the study area from 1987 to 2019
- **EVI decreased** in the study area from 1987 to 2019
- Between 2016 and 2019, **EVI and temperature trends observed a similar downward pattern** in both North and South focus areas
- The suitability analysis conducted for 2019 found that **59% of Vermont was most suitable** for sugarbush growth requirements

Credit: Marie Bouffard

Planning Implications

- **Land use –** by identifying optimal sugar maple forests we can plan land use around these valuable forest stands
- **Natural resource conservation –** protecting these forests from uses other than agroforestry allows for their preservation
- **Economic stability –** identifying optimal maple stands provides the maple industry stability



Credit: Viktor Paris

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- Dr. Marguerite Madden – Director of Center for Geospatial Research
- Dr. Sergio Bernardes – Assistant Director of Center for Geospatial Research

Partners

University of Vermont (UVM)

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- Dr. Abby van den Berg – Proctor Maple Research Center, Research Associate Professor
- Dr. Jarlath O'Neil-Dunne – Director of the UVM Spatial Analysis Laboratory

DEVELOP

- Shelby Ingram – Acting Center Lead
- Sam Furey – Talamanca-Osa Ecological Forecasting II Project Lead
- Marie Bouffard – Former Center Lead
- Samantha Trust – Talamanca-Osa Ecological Forecasting II Participant

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