Heterogeneity in Outdoor Water Demand

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February 9, 2015
Urban Water Demand Roundtable
Arizona State University

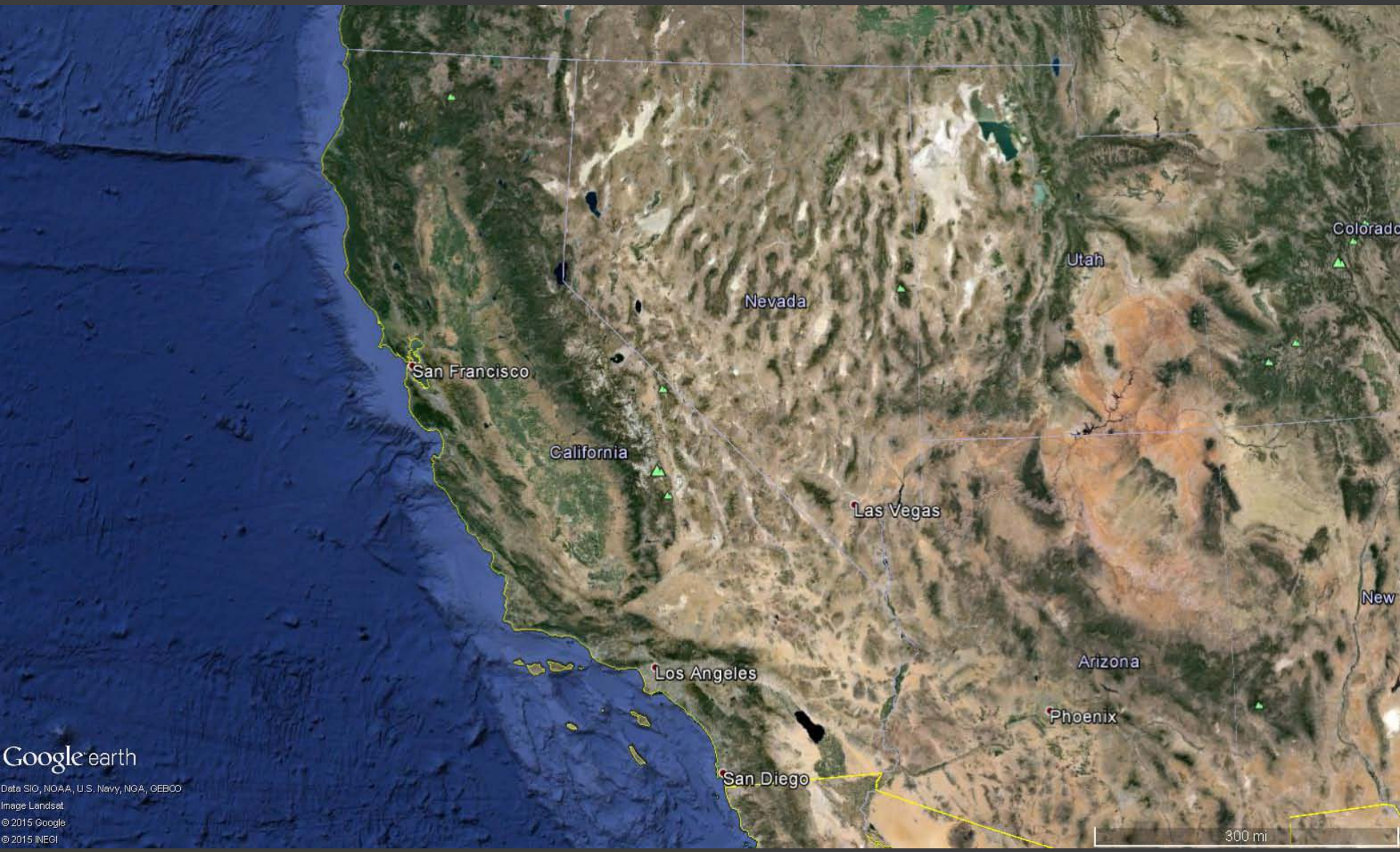
Outline

1. Study area: Easy Bay Municipal Utility District, California

2. Context: Possibilities in joint land/water management through spatial planning

3. Data challenge: Resolution in environmental data for parcel-level outdoor water analyses

STUDY AREA


Colorado
Utah
Nevada
San Francisco
California
Las Vegas
New
Arizona
Los Angeles
Phoenix
San Diego
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
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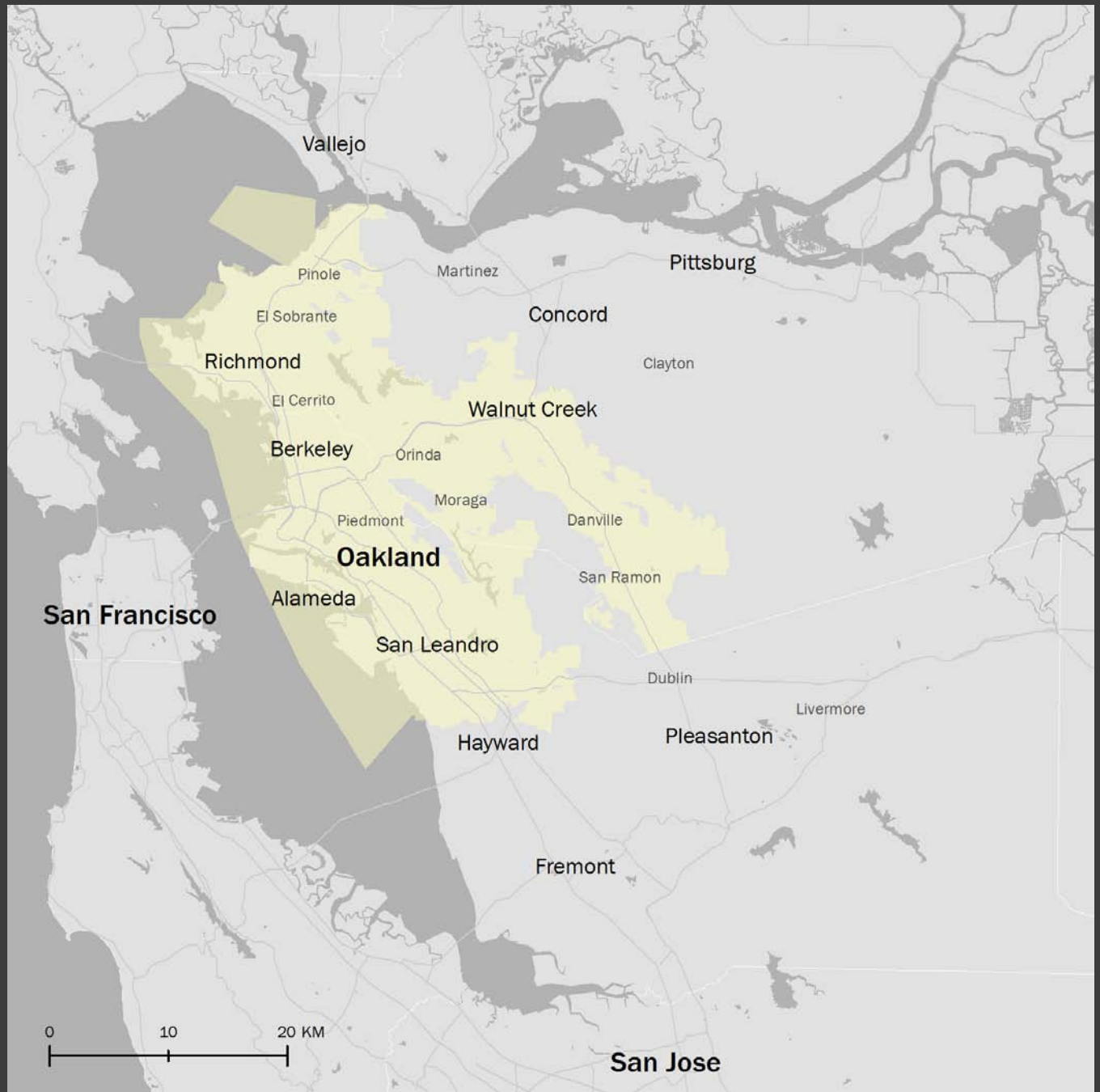
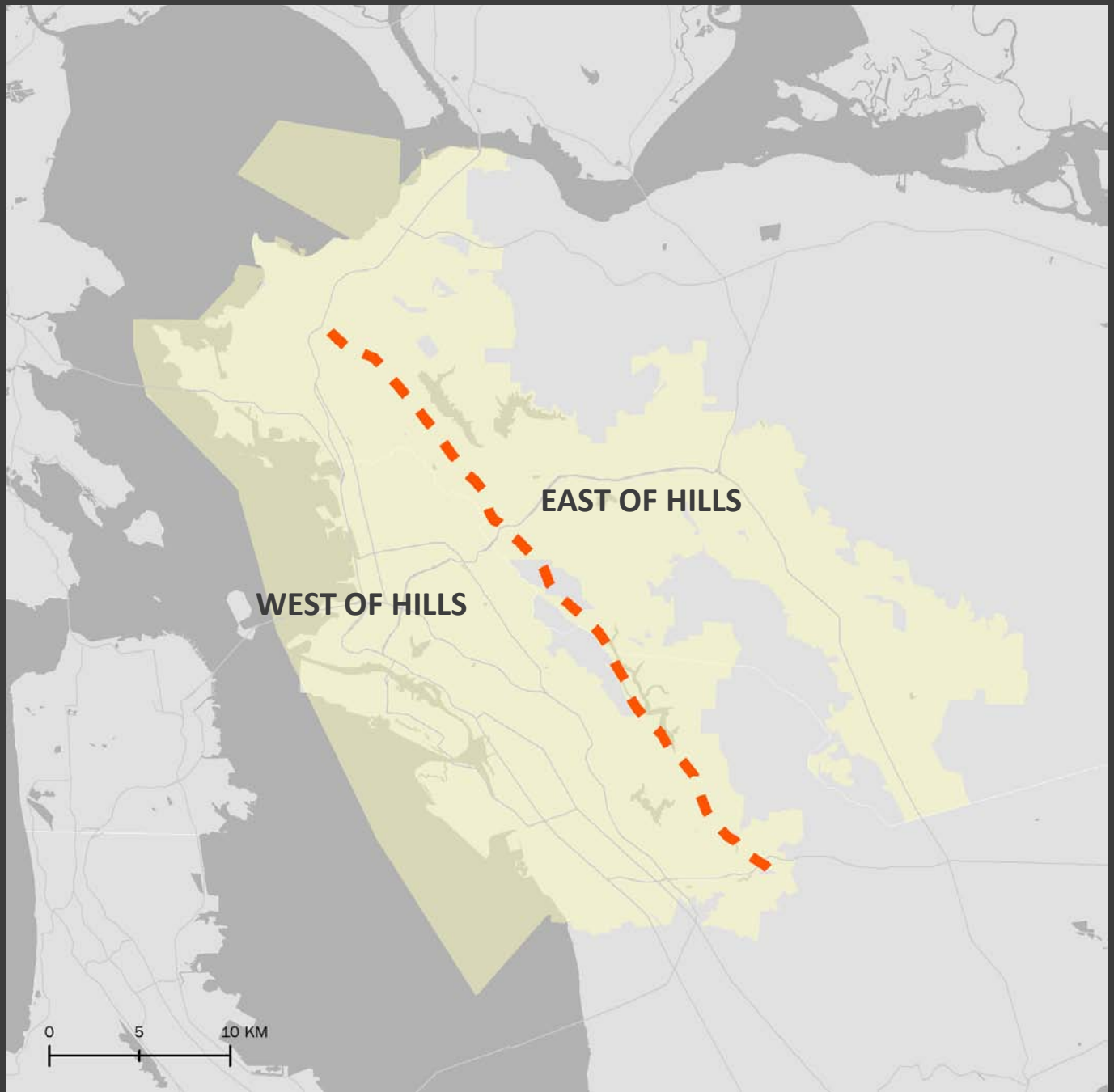
300 mi

San Francisco Bay Area – East Bay



East Bay Municipal Utility District

Coarse environmental variation



Higher resolution environmental variation

CONTEXT

Spatial Planning & Land Capability

- Steep slopes (landslide/avalanche)
- FEMA's probabilistic risk zones
- Tahoe Regional Planning Agency
  - Development prohibited
  - Development allowed, but land cover controls
  - Development allowed, but sediment management plan

Research Questions

- Land use/land cover policies for water demand management based on environmental zones?
- To what degree does the physical environment influence demand? Can we identify high water use zones?

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Water Use Data

- 84 months of water use for 320,000 SFRs (~27 million observations)

- On analyzing the parcel:

  The choice of an appropriate scale for the study of spatial processes is an extremely important one because mechanisms vital to the spatial dynamics of a process at one scale may be unimportant or inoperative at another. Moreover, relationships between variables at one scale may be obscured or distorted when viewed from another scale. (Gotway and Young 2002)

Parcel Microclimates

- Matching covariates to spatiotemporal scale of water data (parcel/month).
- Environmental data is far coarser than water consumption data.
- Possible to quantify the unique environment surrounding a home?

TIME STEP	VARIABLE	ORIGINAL RESOLUTION	PROCESSING FOR PARCEL
Monthly	Temperature	n/a	Interpolated
	Precipitation	n/a	Interpolated
Yearly	Price	Parcel	n/a
	Vegetation (NDVI)	1m x 1m	Mean
Time invariant	Aspect	3m x 3m	Mean
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	Number of bedrooms	Parcel	n/a
	Number of bathrooms	Parcel	n/a
	Household size	Block group	Imputed from block
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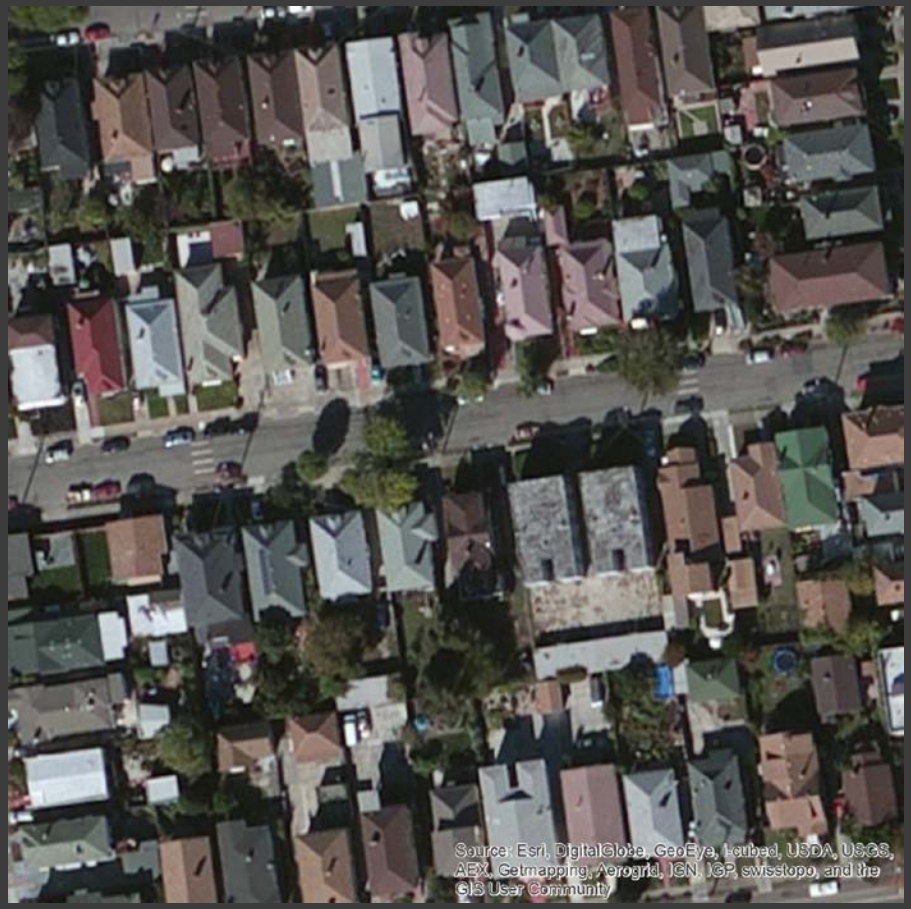
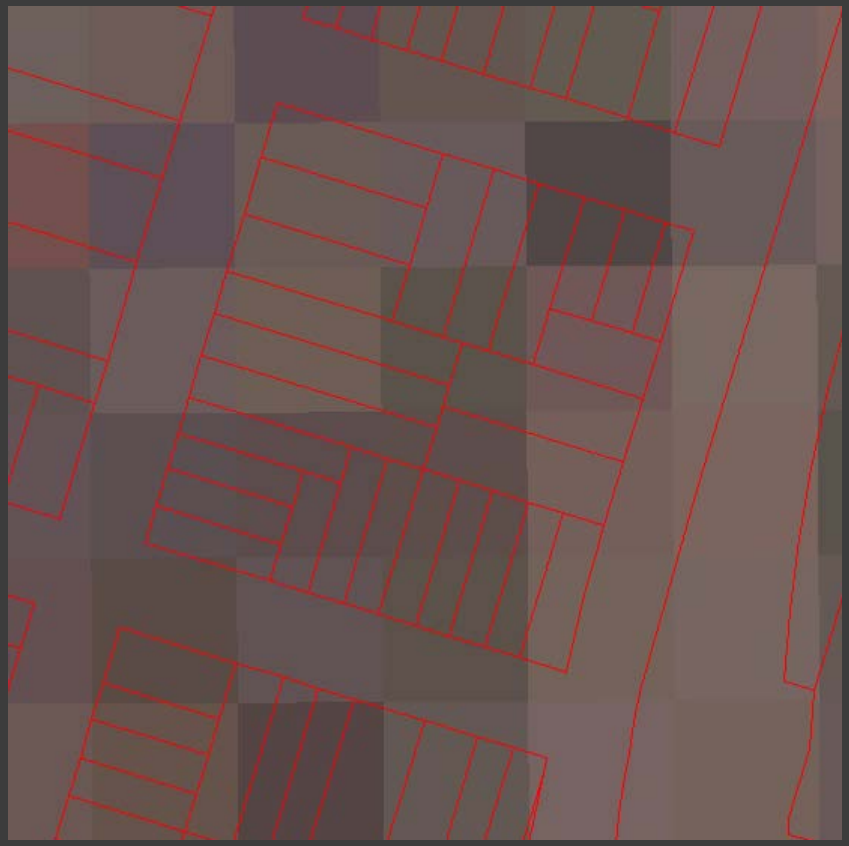
LOT CHARACTERISTICS



West of Hills

East of Hills

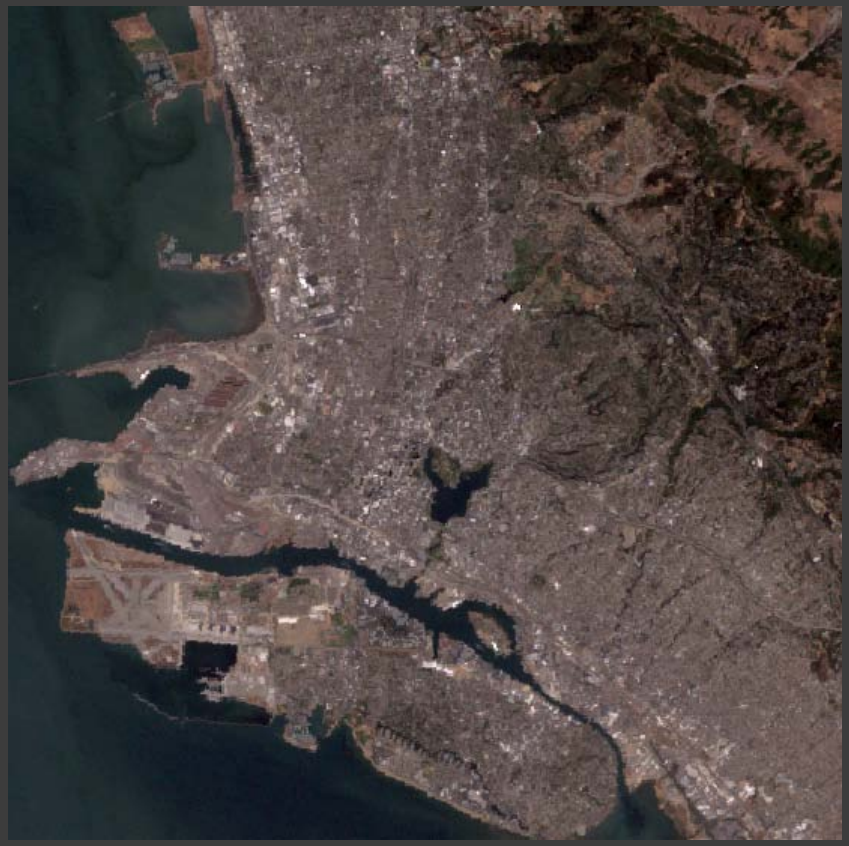
Vegetation: Landsat vs. National Agriculture Imagery Program (NAIP)



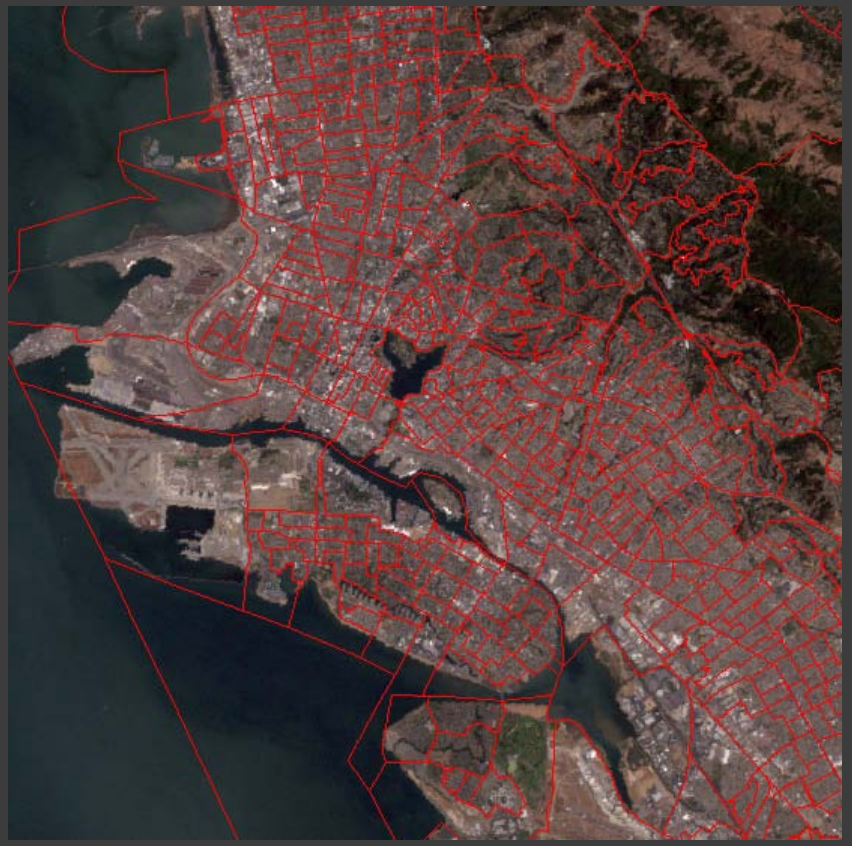
Landsat

NAIP

Landsat: Coarser spatial resolution, higher temporal resolution



Landsat



Landsat + Block Groups

NAIP: Finer spatial resolution, coarser temporal resolution

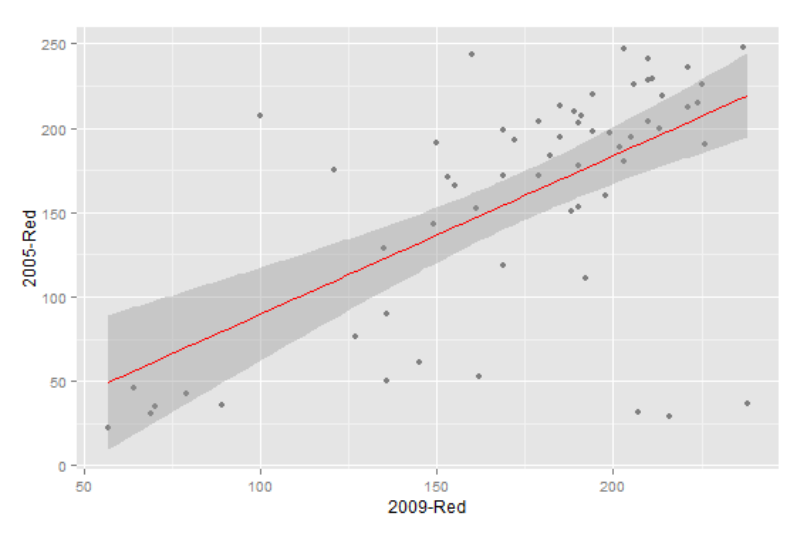
2005

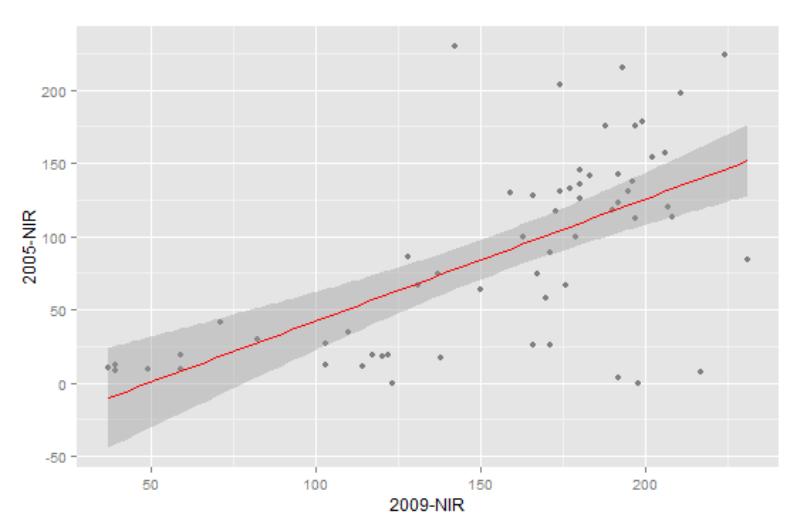
2009

2010

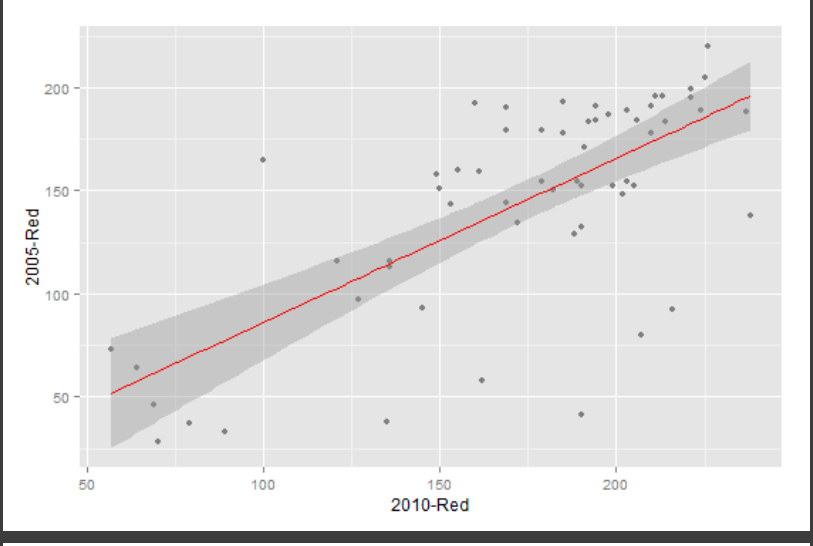
Calibrating NAIP Imagery

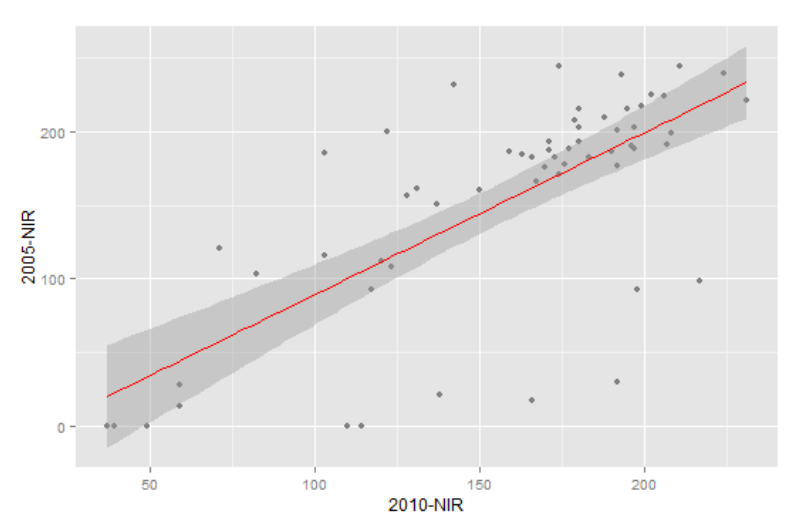
2005 v 2009





2005 v 2010





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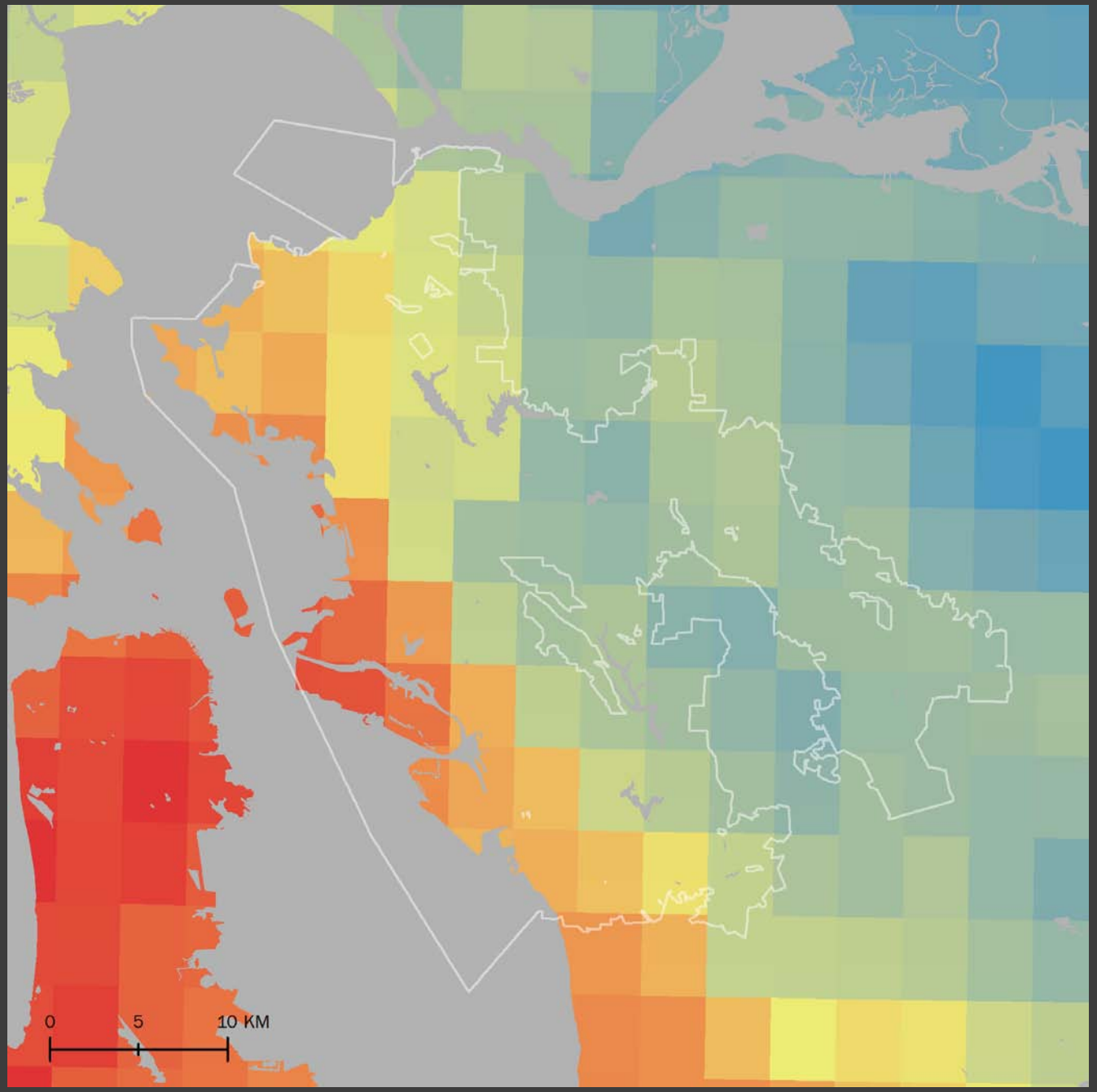
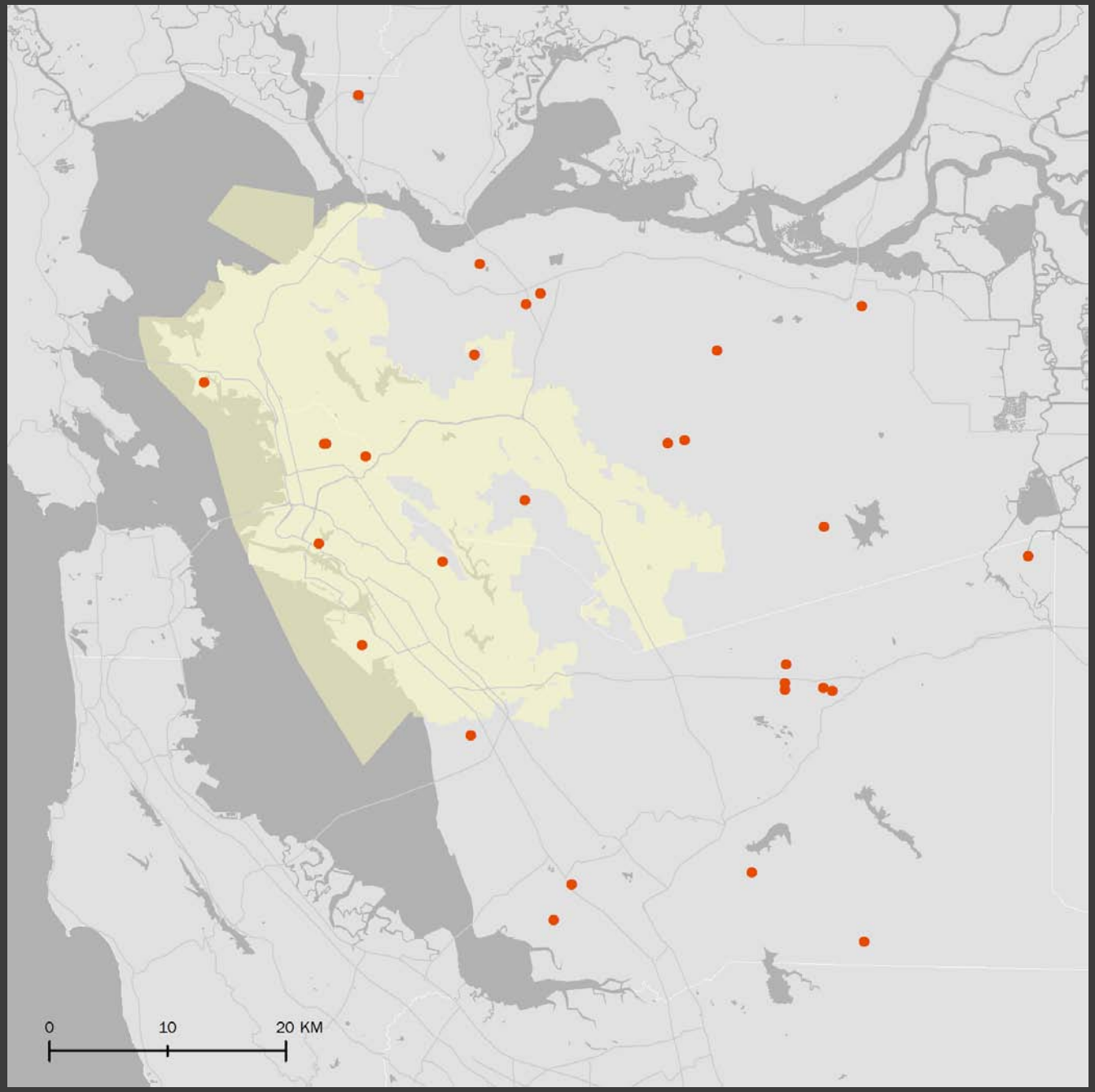
CLIMATE CHARACTERISTICS

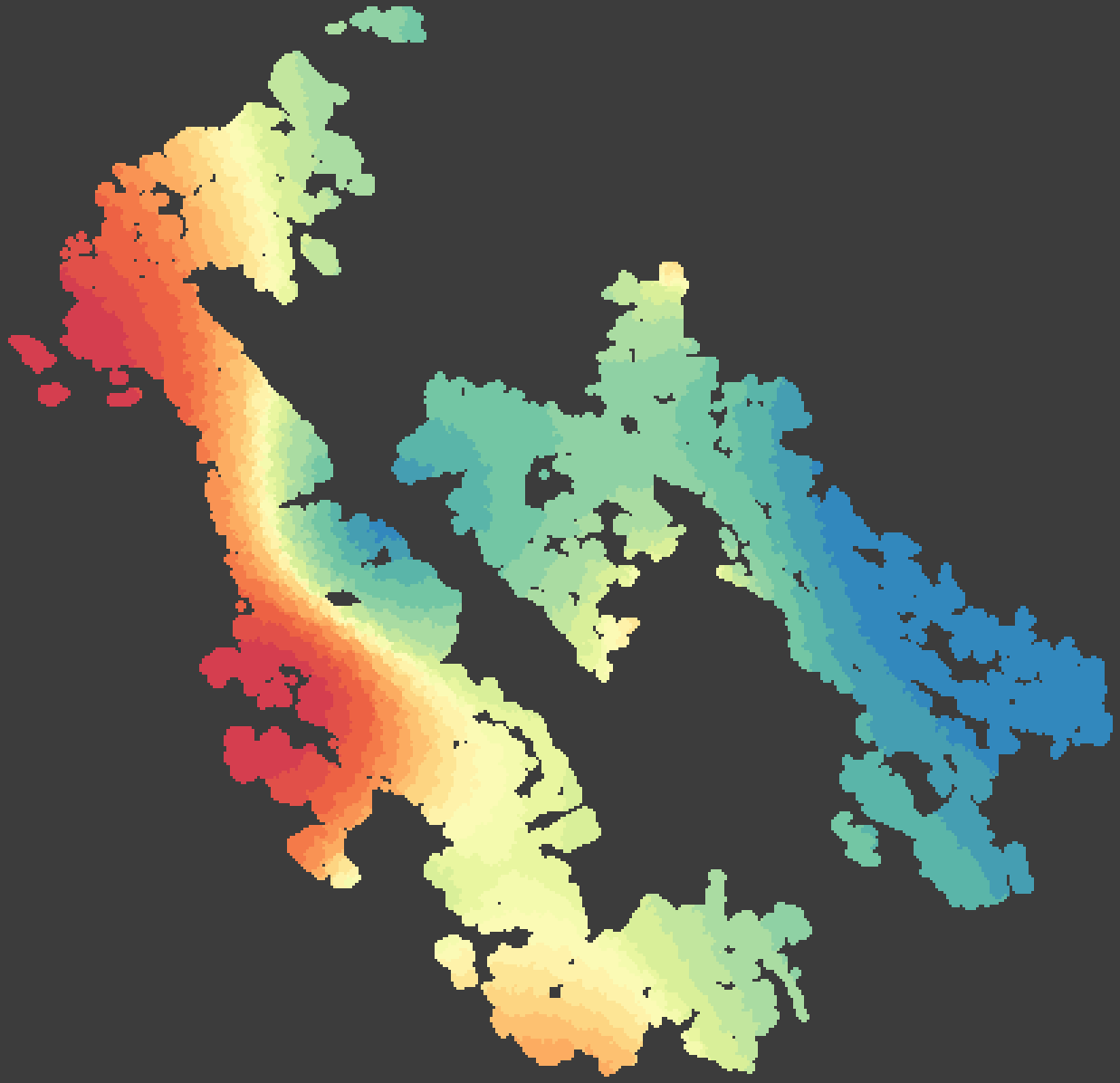
PRISM: Temperature



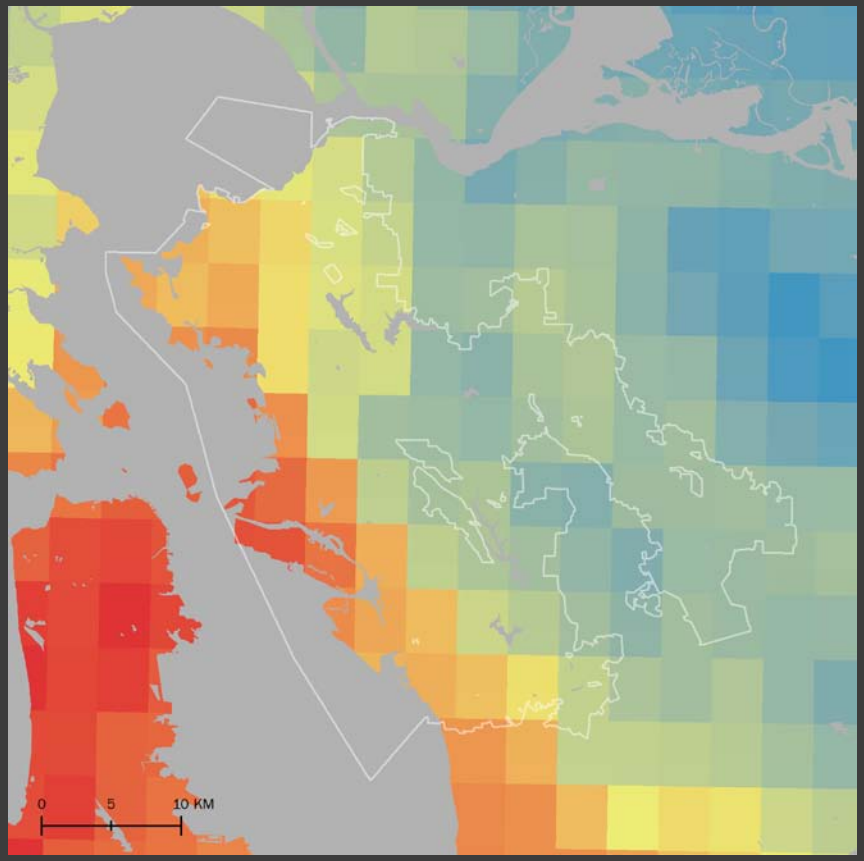
National Weather Service Monitoring Stations: Temperature



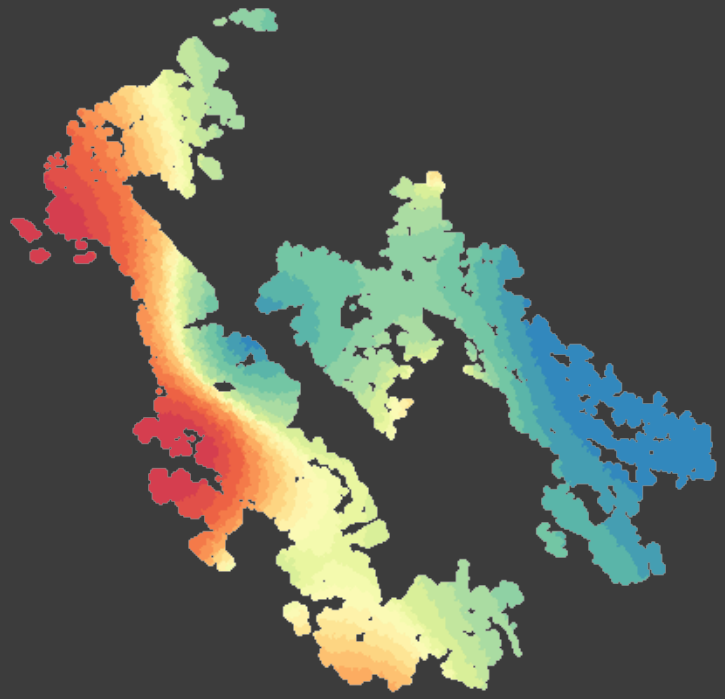
Temperature by Household, January 2005



Temperature, January 2005

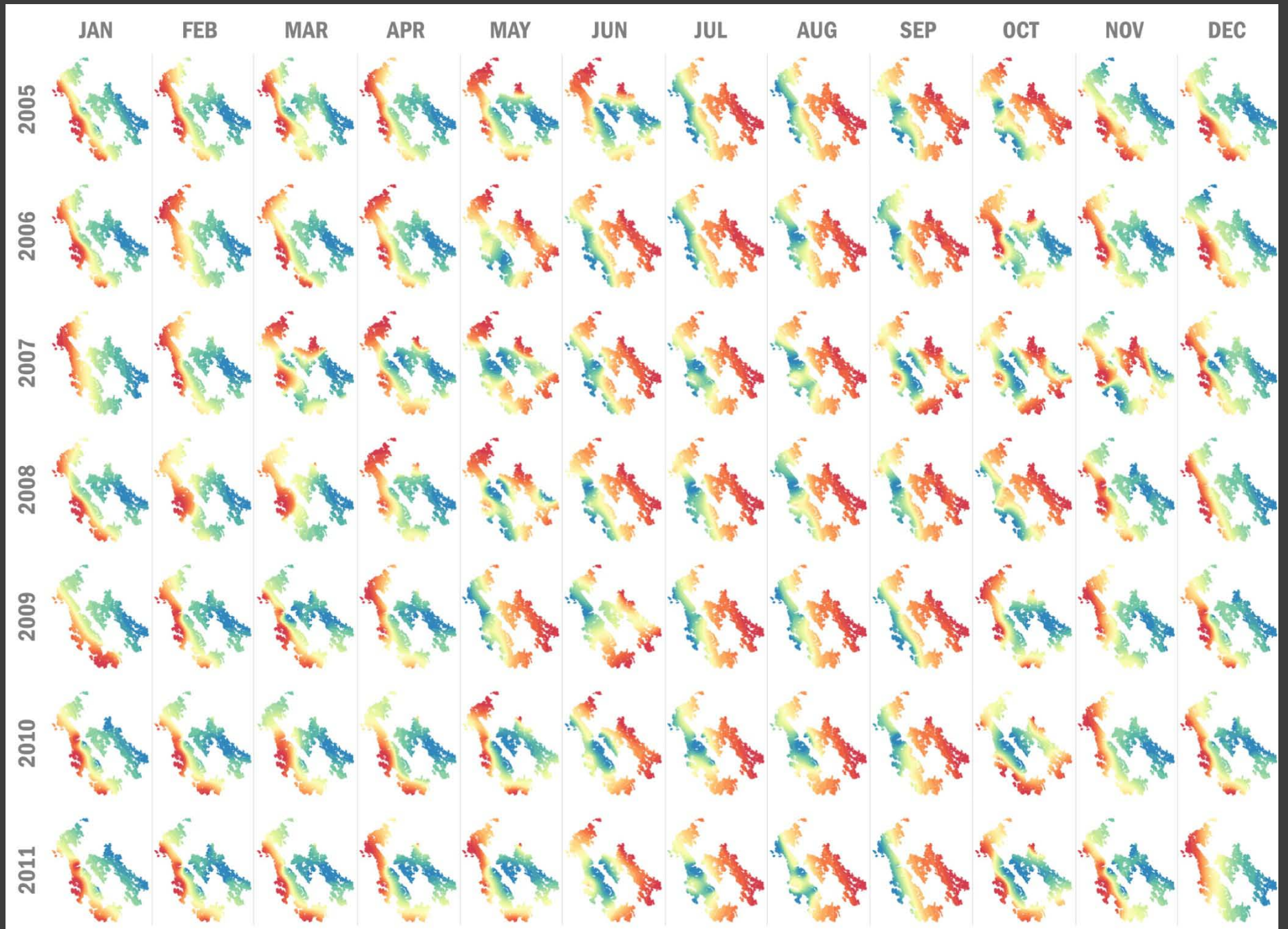


PRISM

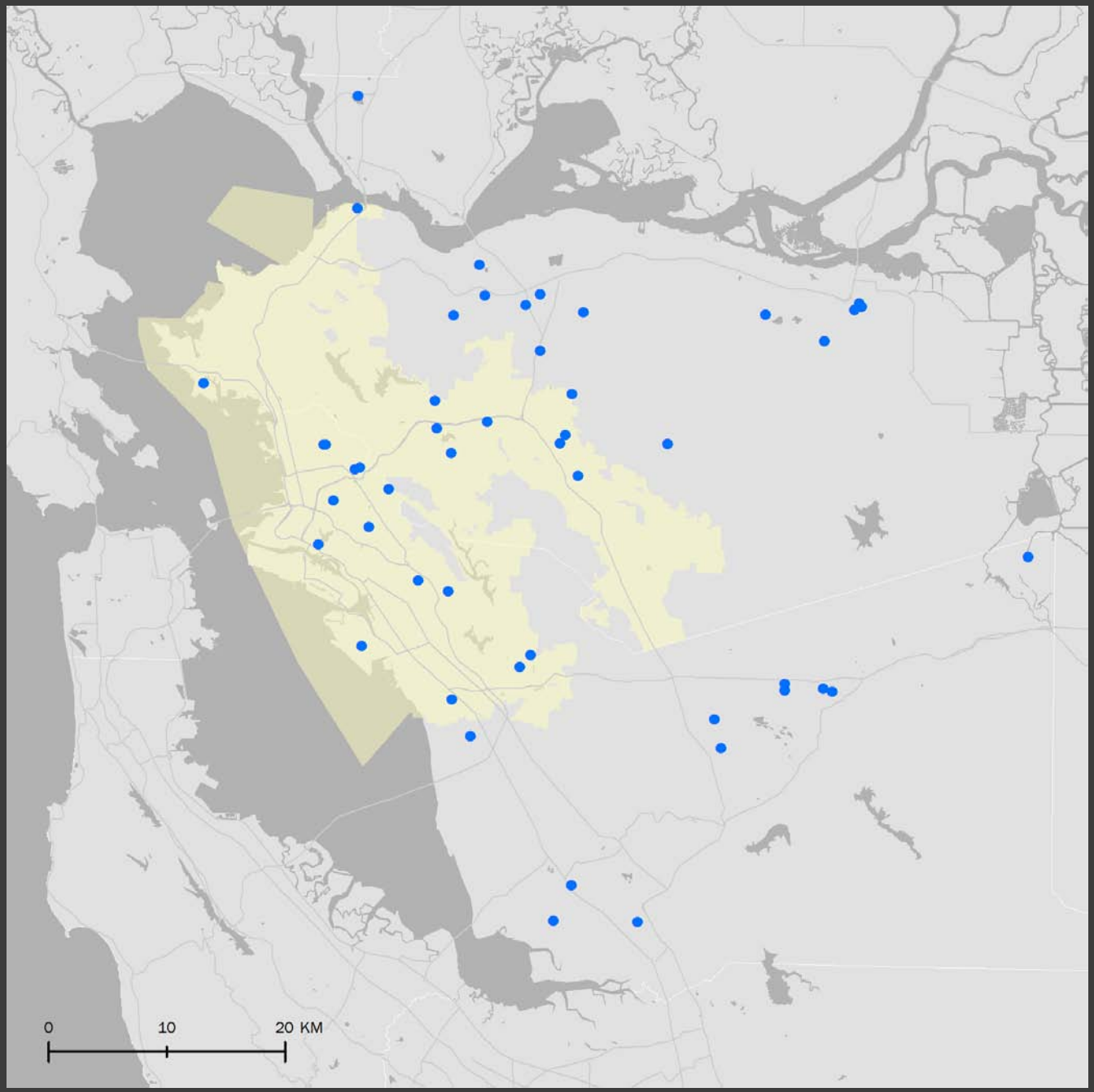


NWS Interpolation

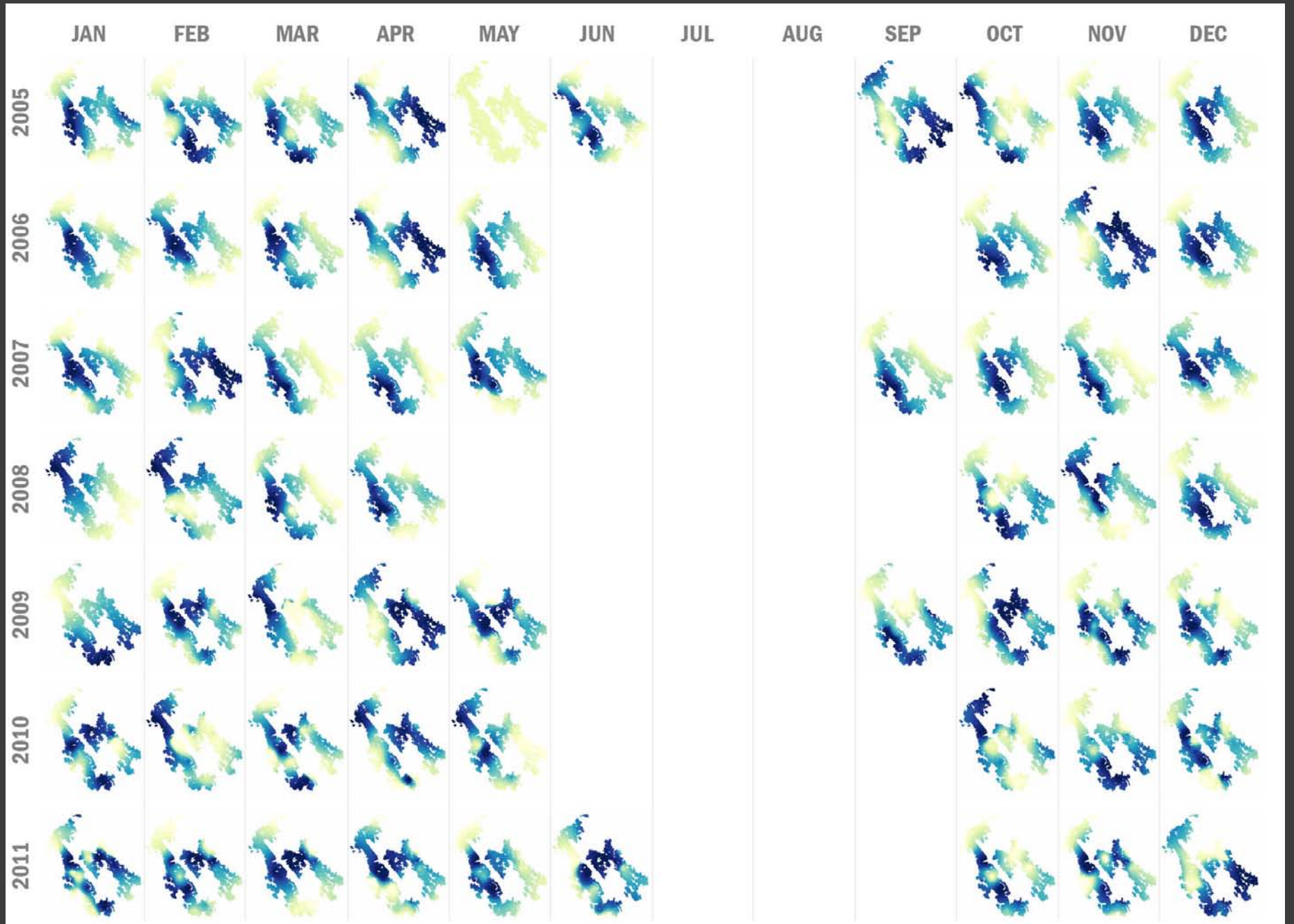
Temperature by Household, 2005 - 2011



National Weather Service Monitoring Stations: Precipitation



Rainy Days (Precip > 0.1 in) by Household, 2005 - 2011



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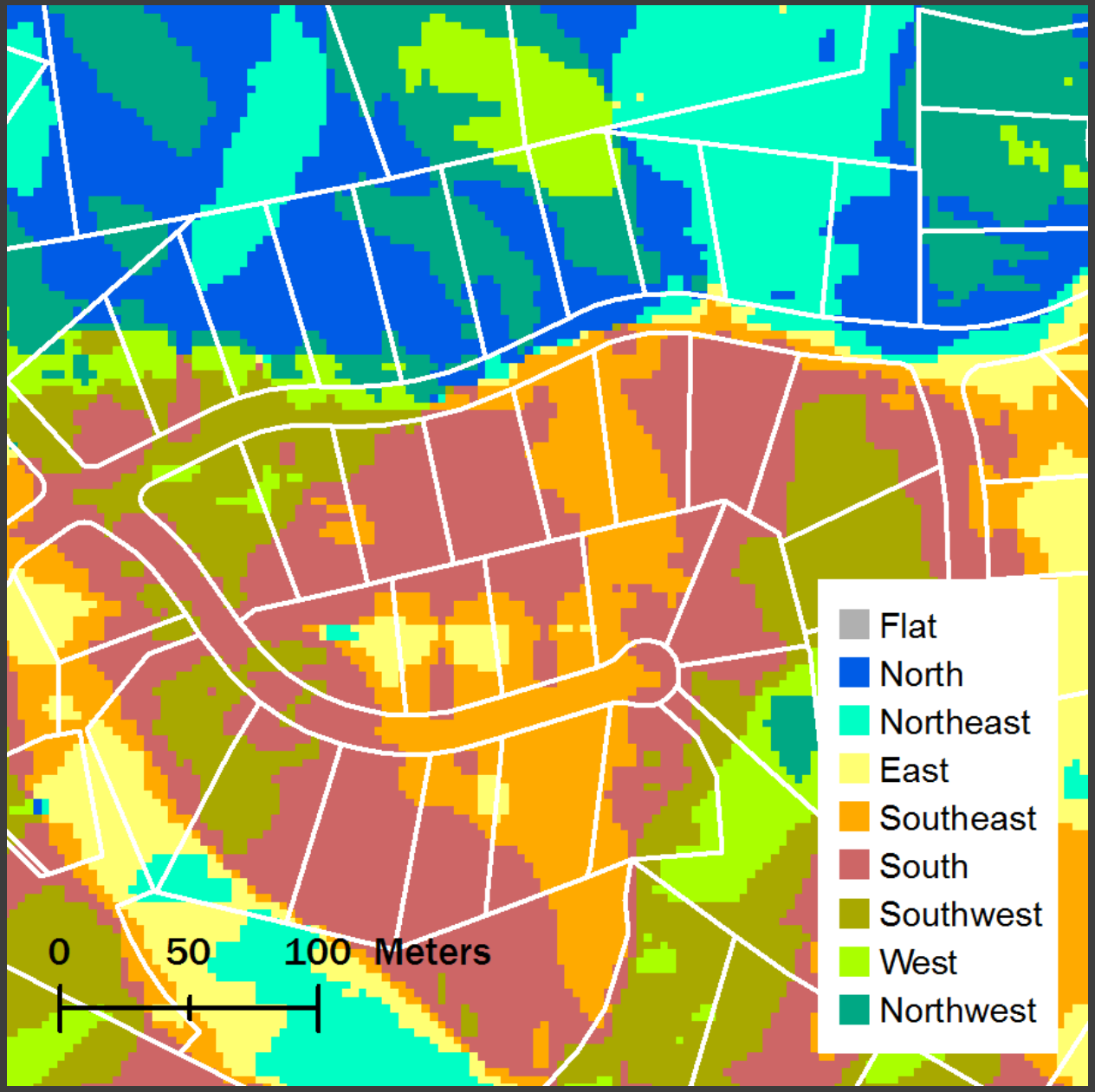
LAND CHARACTERISTICS


Google earth
1 mi


Google earth
Data LDEO-Columbia, NSF, NOAA
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
1000 ft

Landform Analysis: Aspect



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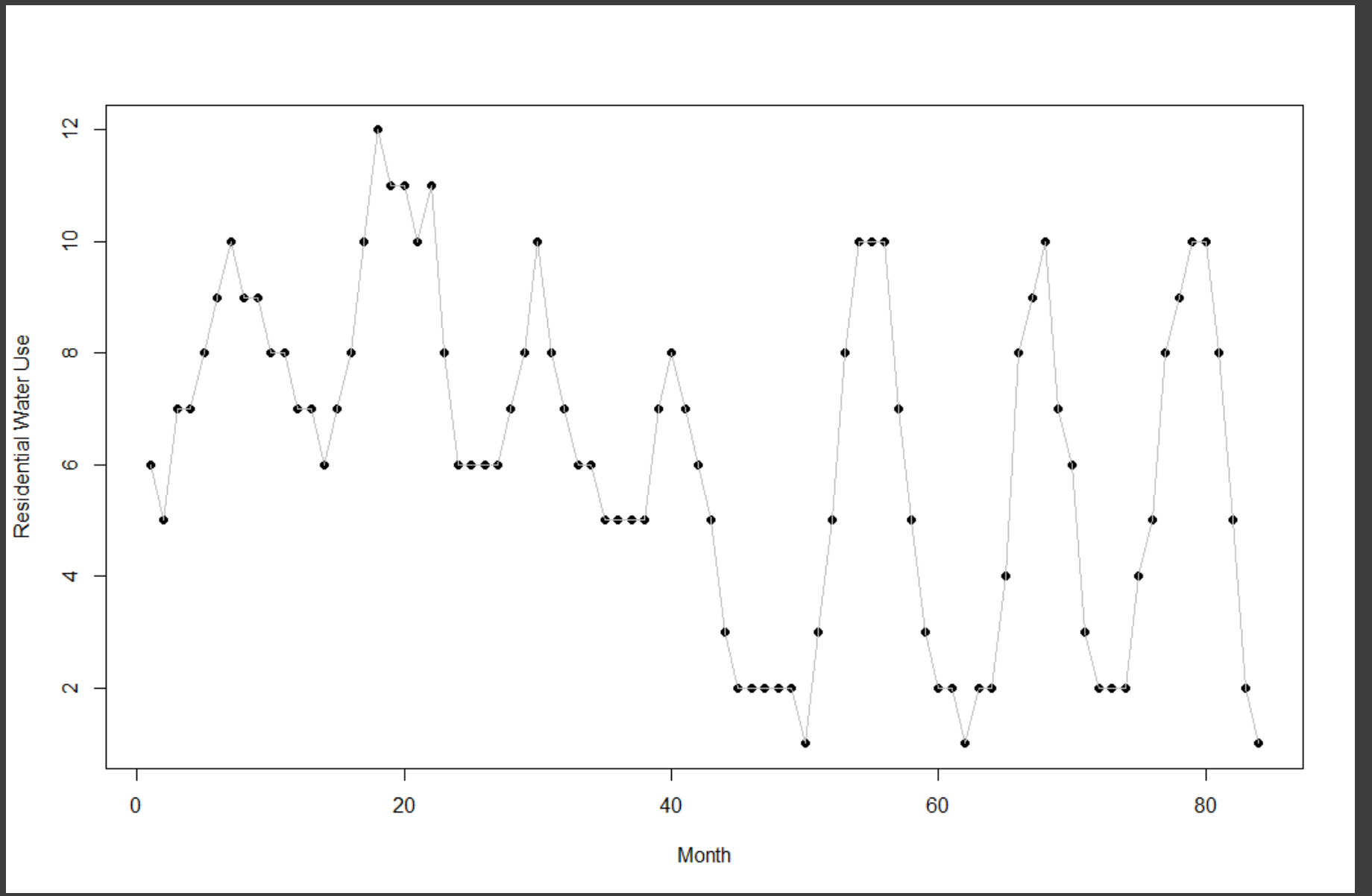
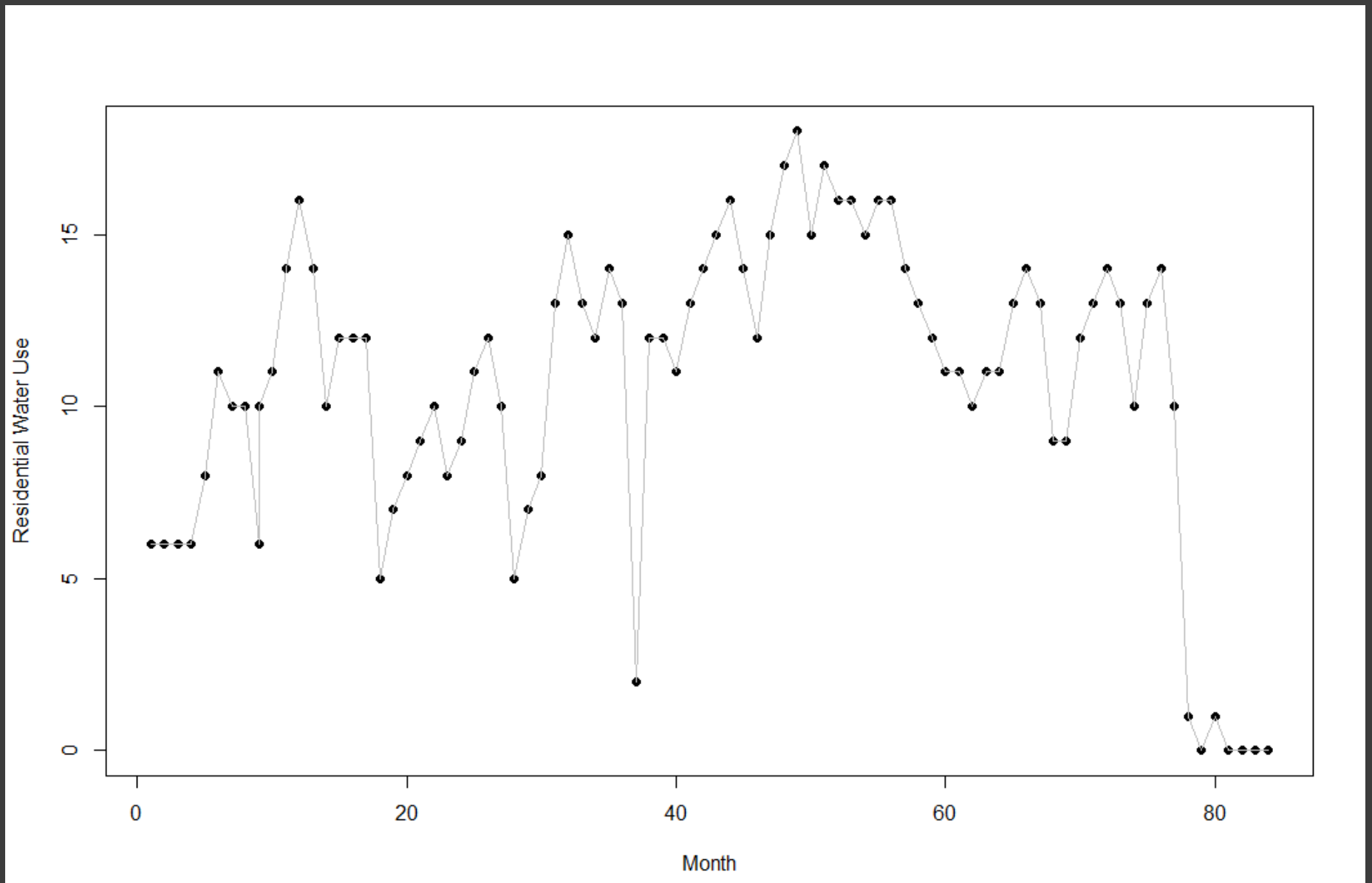
Challenges

- Integrating data at multiple temporal scales (monthly, yearly, time invariant)?
- Outdoor water use as response variable? Or total water use?


Residential Water Use
2
4
6
8
10
12
0
20
40
60
80
Month


Residential Water Use
0
5
10
15
0
20
40
60
80
Month

Next Steps

- Quantile regression
  - Do user groups show different responses?
- Comparing data sources/aggregations
  - How to do results differ?
- Identifying high water use zones?

Thank you

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