

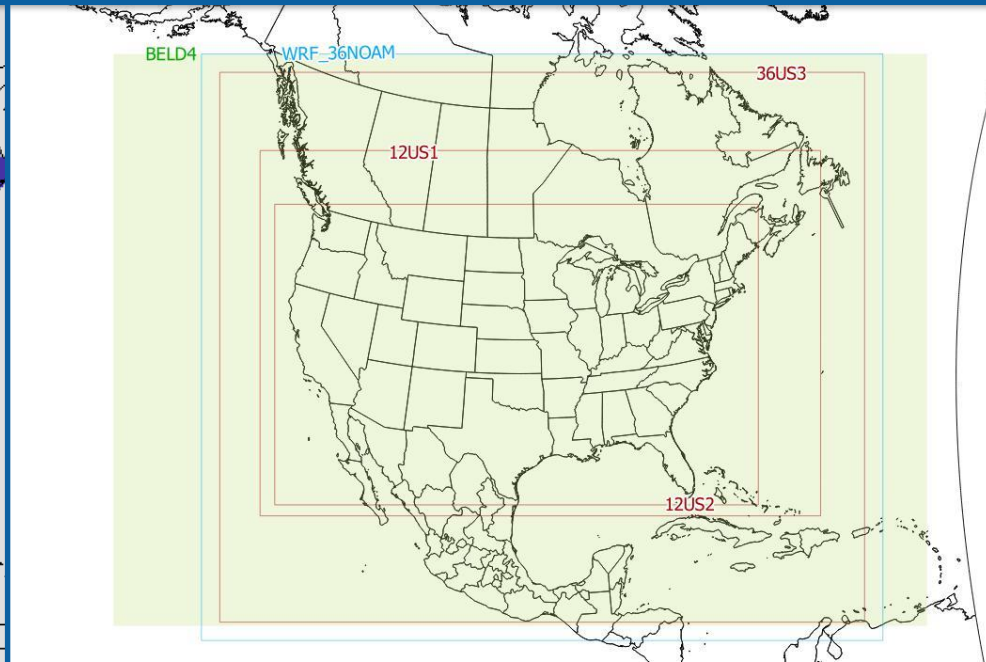
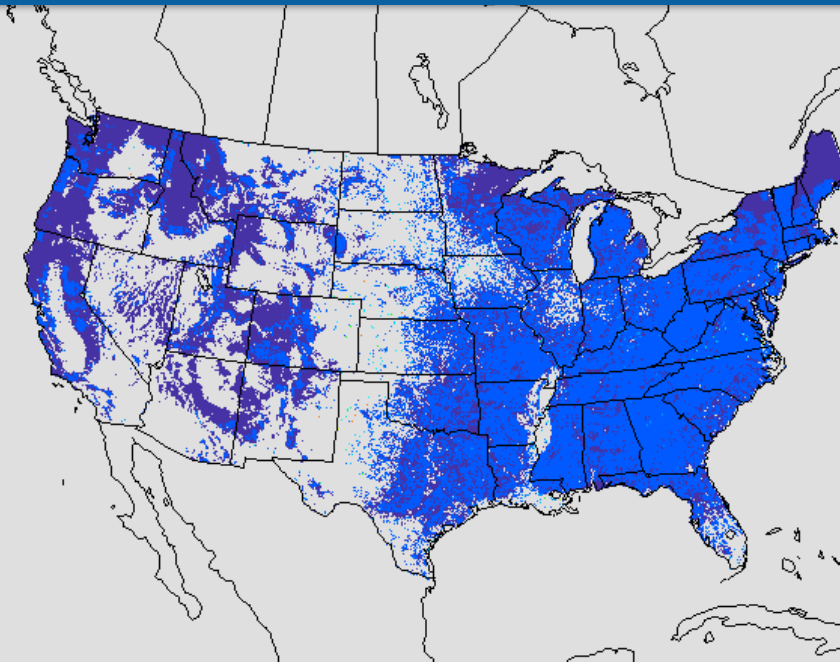
Spatial Surrogate Development for 2014 Emissions Modeling Platforms

Z. Adelman, B.H. Baek, J. Brandmeyer, C. Seppanen, B. Naess, D. Yang (University of N. Carolina)

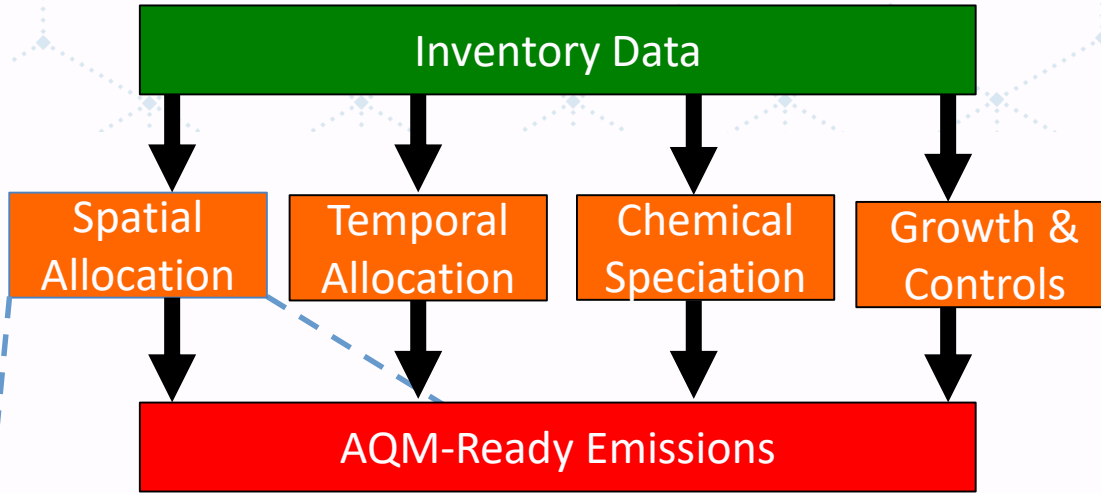
A. Eyth, J. Vukovich, M. Strum (U.S. EPA OAQPS)

Presented at the 2017 International Emissions Inventory Conference

August, 2017



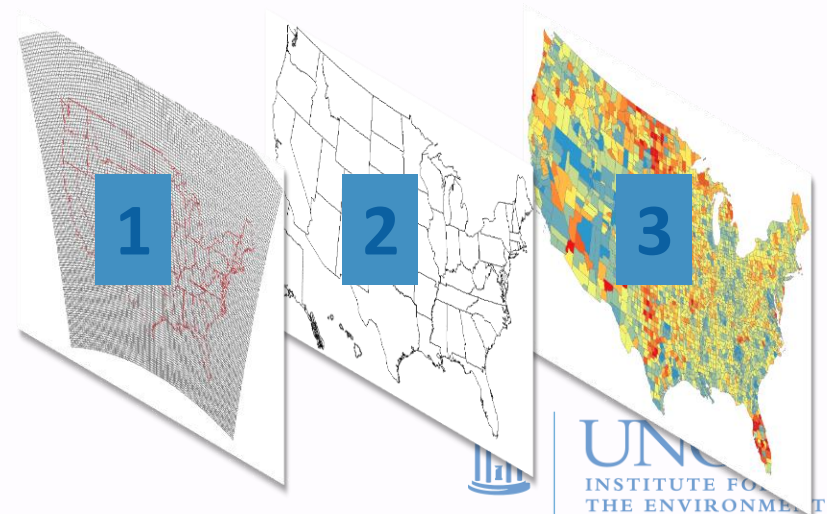
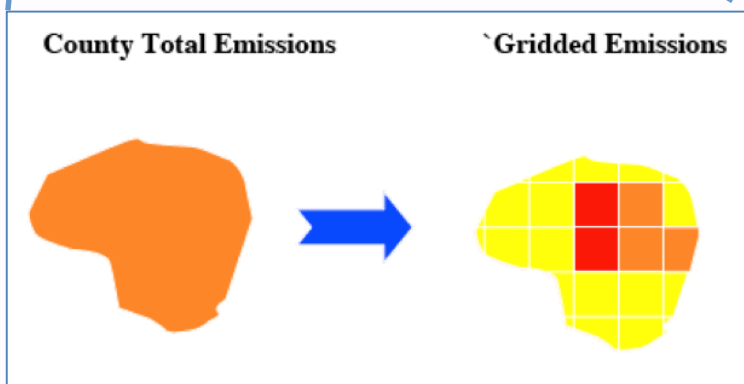
What is a Spatial Surrogate



Spatial surrogates define the mapping between inventory spatial units (e.g. counties) and air quality model grids

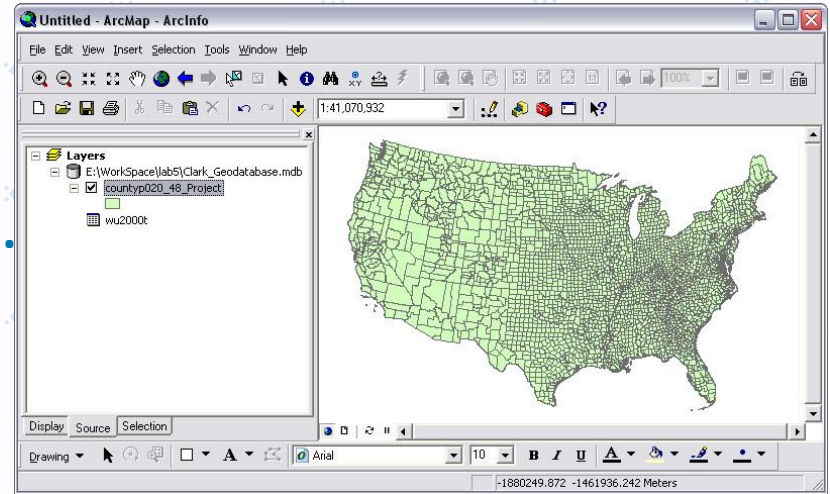
Surrogate Components:

1. Model grid definition
2. Data GIS Shapefile
3. Weight GIS Shapefile



GIS Shapefiles

- Common format (ESRI) of geospatial vector data
- For surrogates, data collected from public domain
 - U.S. Census Bureau, USGS, DOT, FEMA, Environment Canada
 - Avoid or mask proprietary data to support public access
- Some shapefiles generated in-house
 - Upstream oil and gas, extended idle locations, commercial shipping lanes



North American Surrogates

- ❑ Shapefiles for emission source-related features: US x 53, Mexico x 18, Canada x 63
- ❑ Produced surrogates: US x 109, Mexico x 23, Canada x 64
- ❑ Domains: 12km CONUS, 36km CONUS, 108km N. Hemisphere
- ❑ All surrogates gap-filled and normalized
- ❑ Processing done with Spatial Allocator: srgcreate.exe and PostgreSQL (pg_srgtool)
- ❑ Surrogate Classes
 - Population/Housing
 - Home Heating
 - Transportation
 - Shipping and Ports
 - Building Square Footage
 - Land cover/Land Use
 - Energy Production
 - Industrial/Commercial



Motivation for Updates

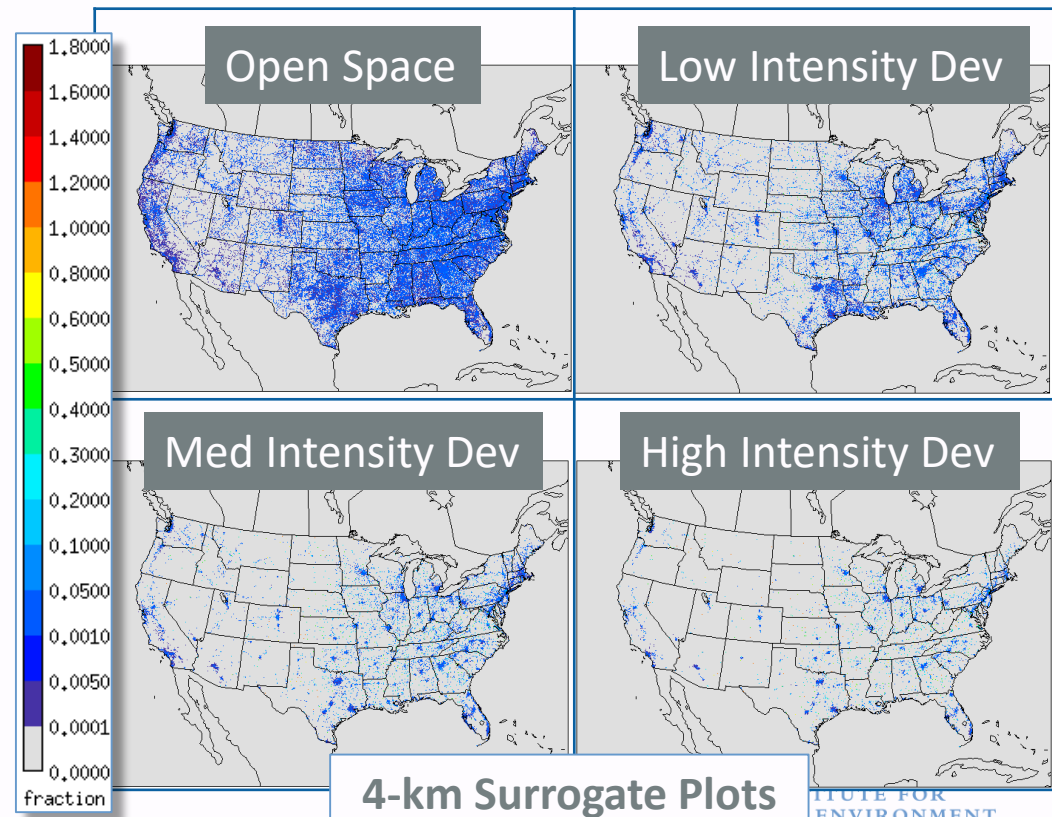
- Last major overhaul of U.S. EPA OAQPS emissions modeling platform surrogates 2012/13 following U.S. 2010 Census
- New data and processing techniques motivated recent updates:
 - Highway Performance Modeling System (HPMS) with activity weights
 - Commercial marine vessel 2013 density in U.S. waters
 - Refinement to extended idle locations
 - 2011 NLCD landcover/landuse-based development intensity surrogates
 - Canada 2006 Shapefiles
 - Gridded Population of the World v4 for 2015 Mexico population counts
 - PostgreSQL calculations for memory and speed optimizations



National Land Cover Database (NLCD)

- 2011 NLCD data raster → polygon → PostgreSQL database
- NLCD categories combined to create new mobile surrogates

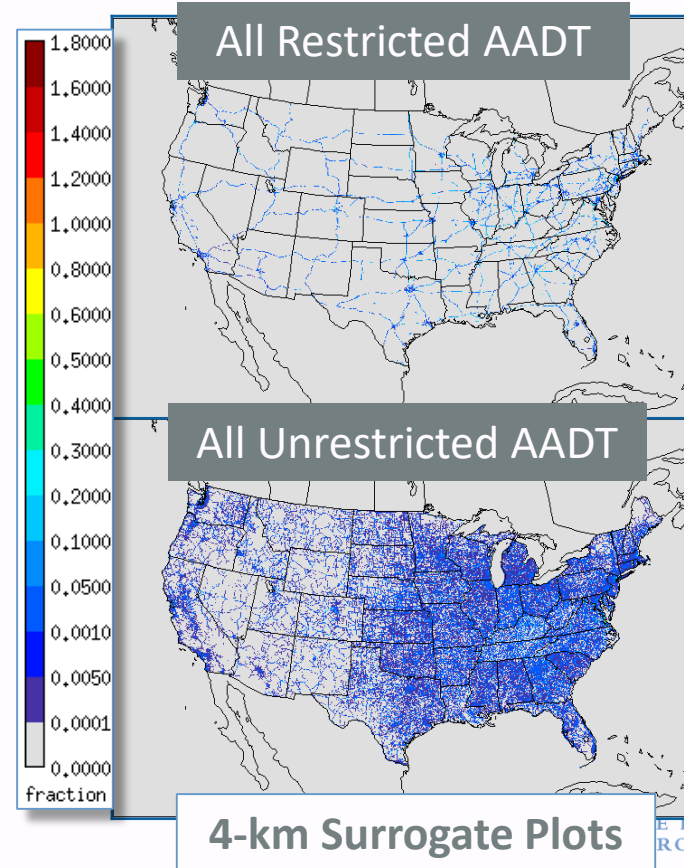
Surrogate	Description
304	NLCD Open + Low
305	NLCD Low + Med
306	NLCD Med + High
307	NLCD All Development
308	NLCD Low + Med + High
309	NLCD Open + Low + Med
310	NLCD Total Agriculture
320	NLCD Forest Land
321	NLCD Recreational Land



Highway Performance Monitoring System (HPMS)

- Federal Highway Administration roadway monitoring systems
- Includes Annual Average Daily Traffic (AADT) by road link

Surrogate	Description
201/202	Urban Restricted Miles/AADT
211/212	Rural Restricted Miles/AADT
221/222	Urban Unrestricted Miles/AADT
231/232	Rural Unrestricted Miles/AADT
241/242	All Restricted Miles/AADT
243/244	All Unrestricted Miles/AADT

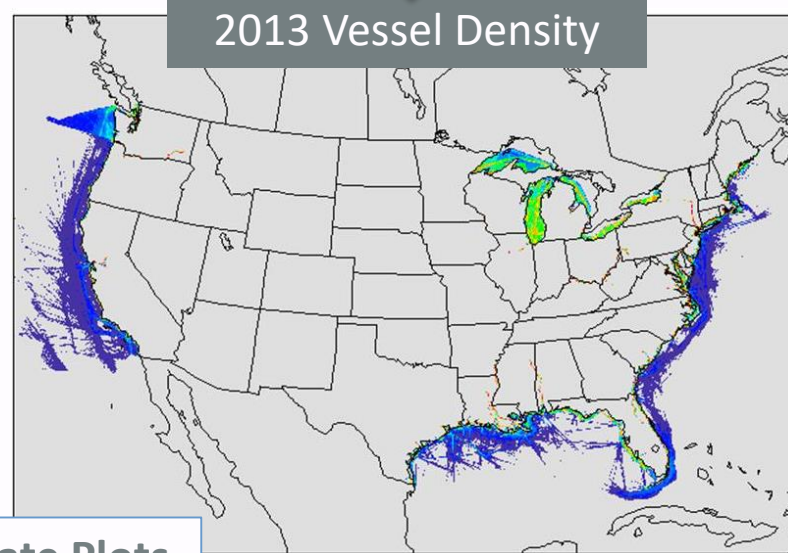
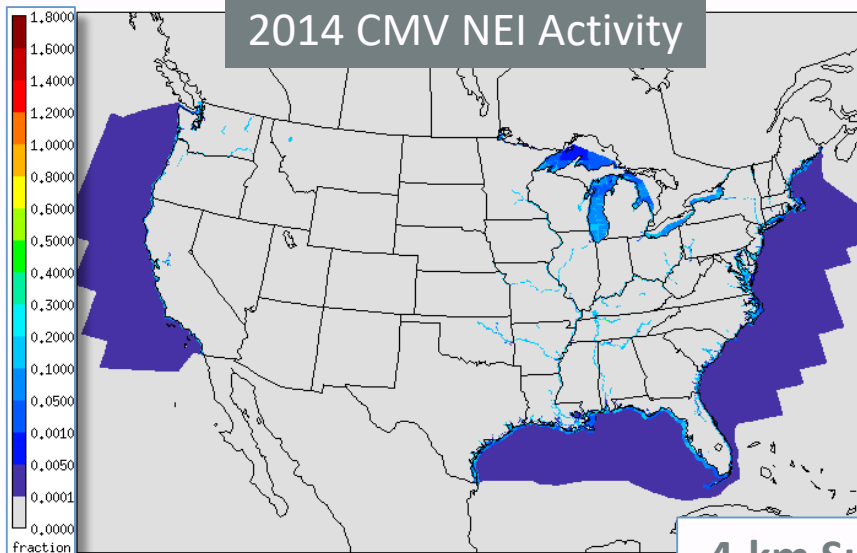
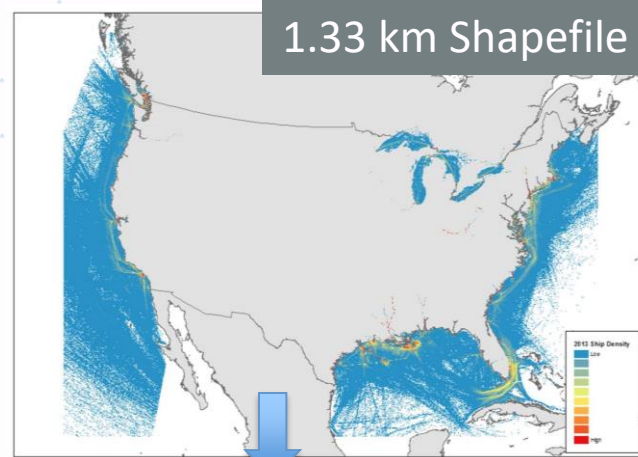


4-km Surrogate Plots

NOAA/BOEM Commercial Marine Density

marinecadastre.gov

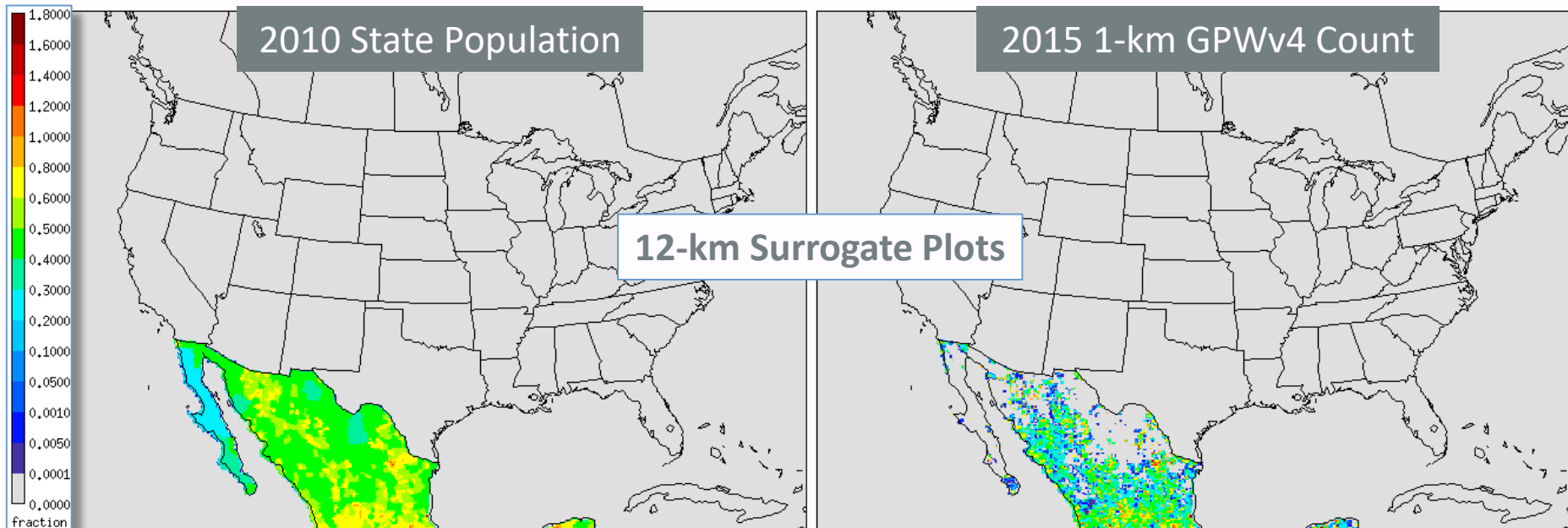
- ❑ NOAA and BOEM 100m resolution 2013 vessel density
- ❑ Rasters converted to 1.33 km resolution polygons
- ❑ Gapfill with navigable waterways, water



4-km Surrogate Plots

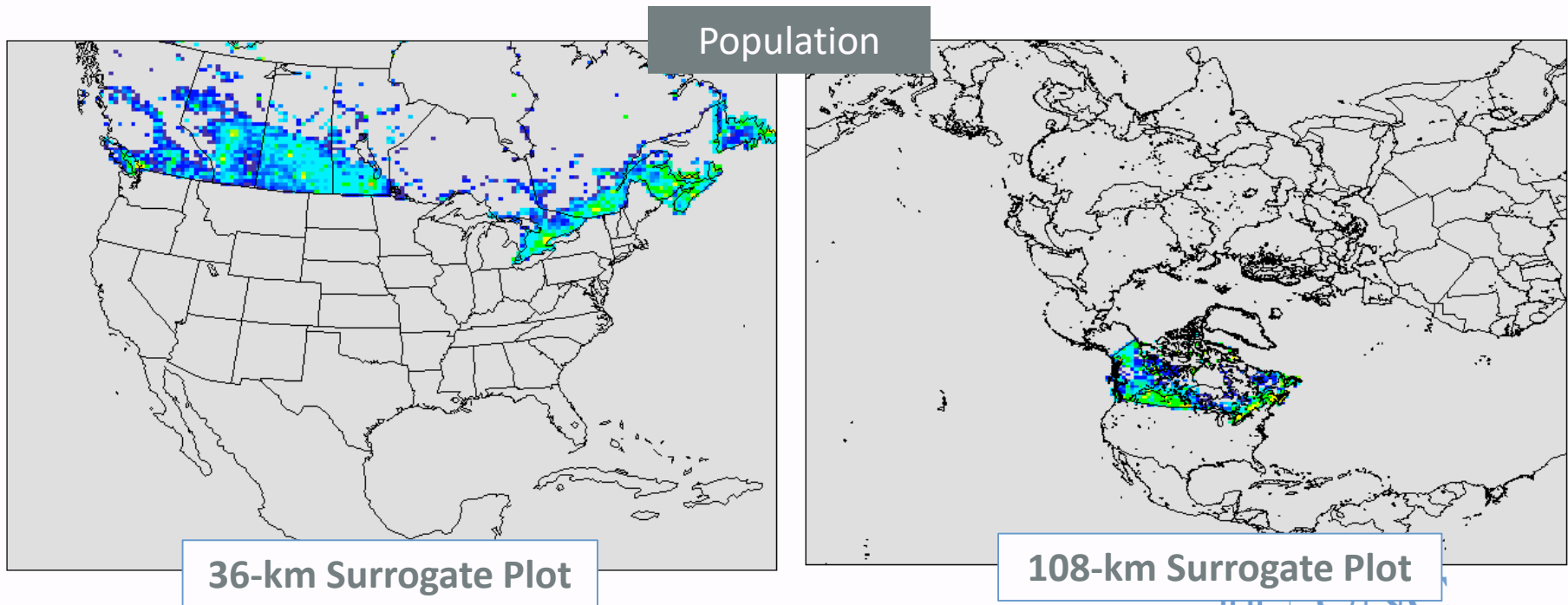
Mexico Population

- ❑ Previous Mexico surrogates using state-level weights
 - Need for surrogates at least at the municipality level to match inventory
- ❑ Gridded Population of the World v4 (GPWv4)
 - 1km resolution raster for surrogates at least at the municipality level to match inventory



Canada 2006

- Environment Canada provided shapefiles and specifications for national surrogates, ca. 2006
- Surrogate Tool processed to EPA Platform modeling domains



PostgreSQL Surrogates

- ❑ PostgreSQL + PostGIS system developed to address issues with the Spatial Allocator Surrogate Tools (speed and memory)
- ❑ General processing sequence for polygon surrogates:
 1. Load modeling domain to DB
 2. Load shapefiles to DB
 3. Cut weight features by data (counties) and compute denominator
 4. Cut again by grid and compute numerator
 5. Calculate and output surrogates



Conclusions and Future Work

- ❑ Incrementally improved the OAQPS modeling platform surrogate database with newer/better data
- ❑ All input data are in the public domain and available with the modeling platforms
- ❑ PostgreSQL tool needs to be generalized, currently too customized for each weight shapefile
- ❑ Next major update following 2020 U.S. Census

