Fourth meeting of the Expert Group on Disaster-related Statistics

Organized by UNESCAP in collaboration with the Philippines National Statistics Authority

3 – 6 October, 2016, Mandaluyong, Philippines

GIS for compilation and production of new statistics on disaster risk reduction by national governments

Example of assessment of human settlements (buildings and population) at risk of flood

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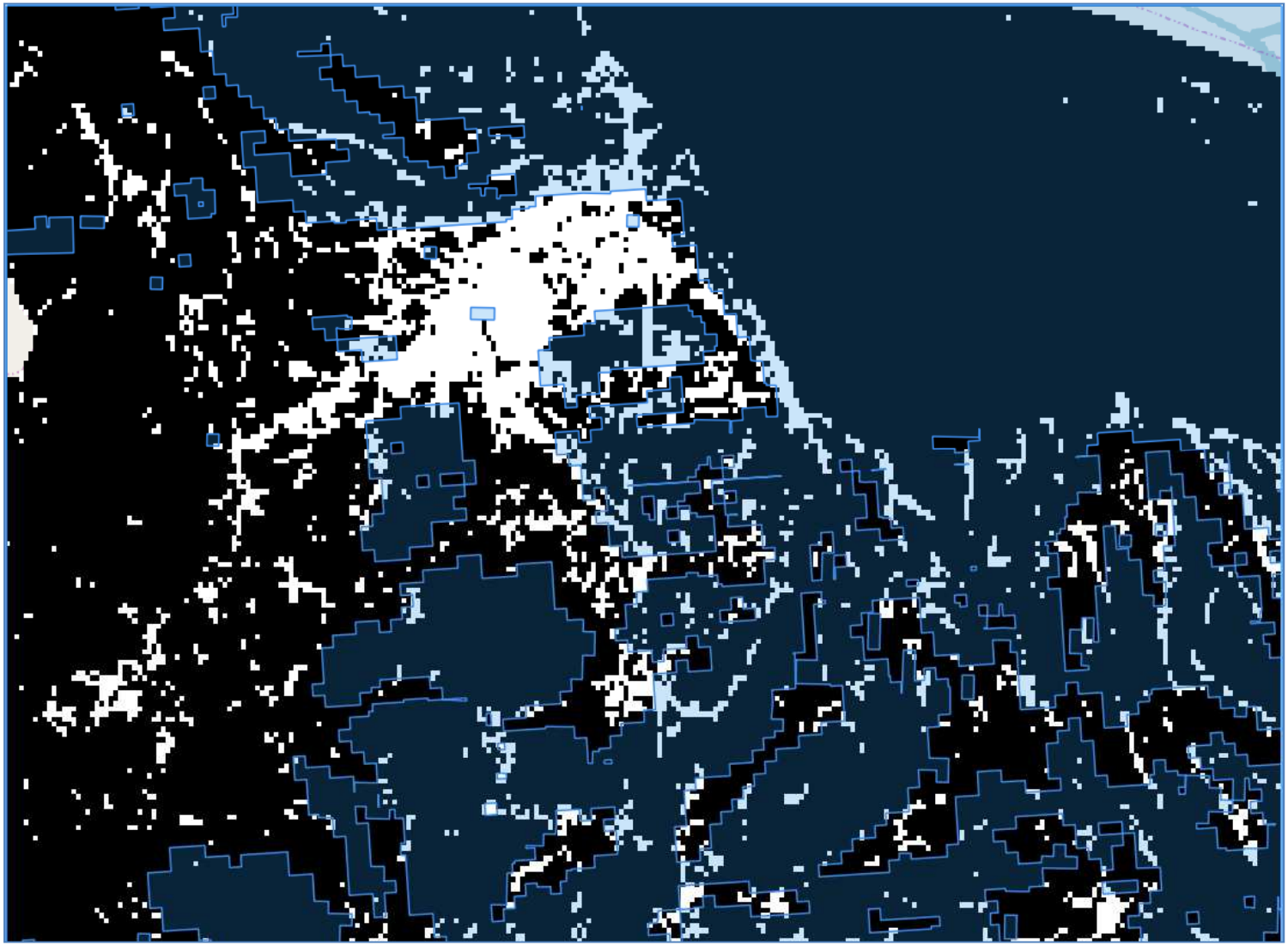
Expert Group Member and International Consultant

Assessing settlements and population spatial distribution

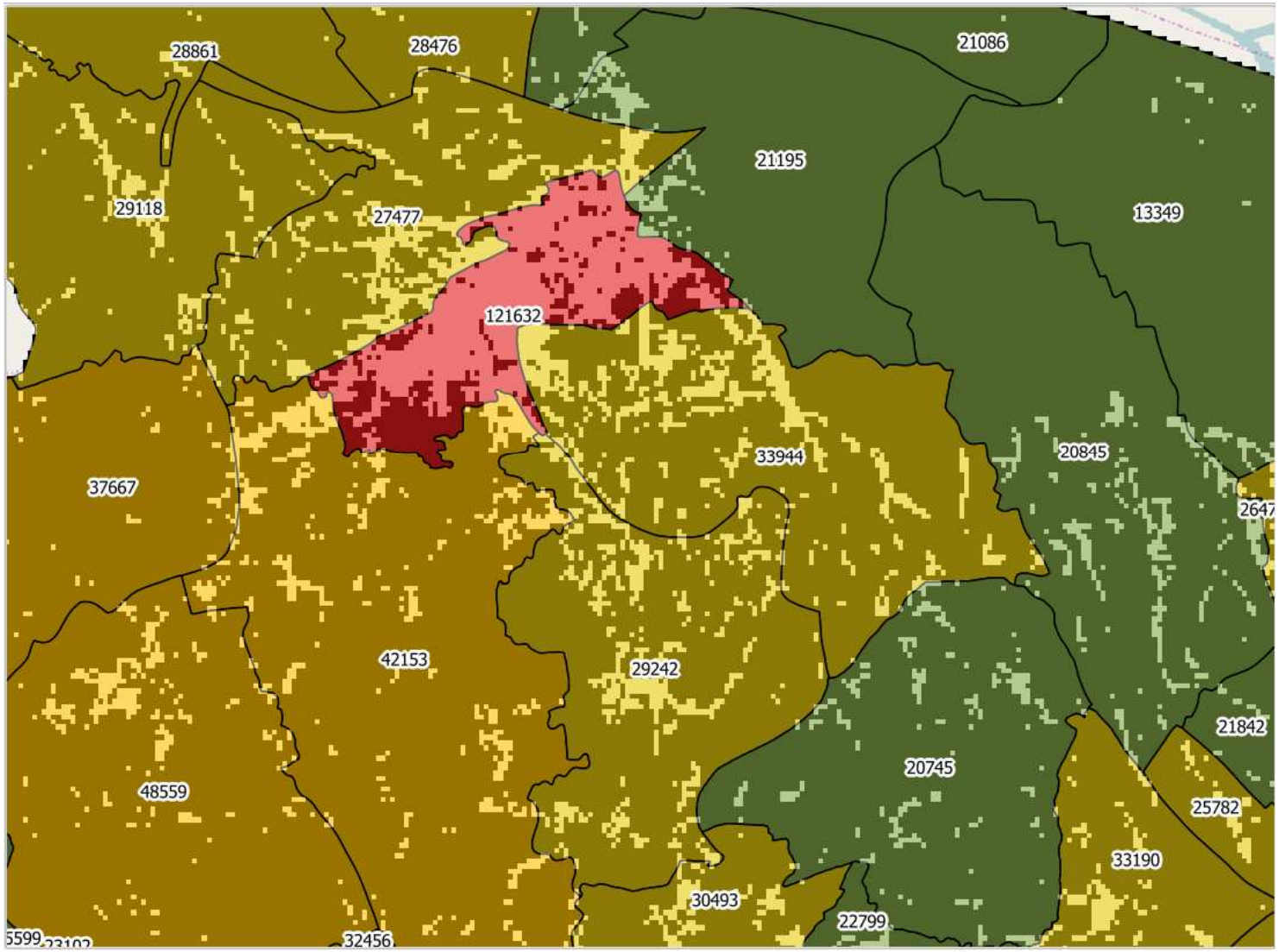
- Knowing (including mapping) settlements and spatial distribution is needed to assess exposure to risks
- Settlements and population distribution can be known from cadastre and detailed population statistics (e.g. by primary sampling units, PSU) duly georeferenced
- When such data is not easily accessible, a solution can be found using remote sensing combined with statistics (modelling distribution)
- Several products exist at the global scale; however, they are not enough precise (WorldPop at 1ha) or accurate (Landscan at 1 km2, GWP at 16 km2)
- The Global Urban Footprint (GUF) produced by the German Aerospace Agency (DLR) from radar imagery in 2012 provide a map of houses and other buildings with an accuracy of 12m x12 m. For the research, aggregated data at ~ 77m x 77m have been kindly provided by DLR of all the DRSF test countries.
- The test has been carried out on Bangladesh with the purpose of assessing the reliability of population density produced from statistics at various scales (municipal or regional).

Human settlements in flood prone areas (around Faridpur, Bangladesh)



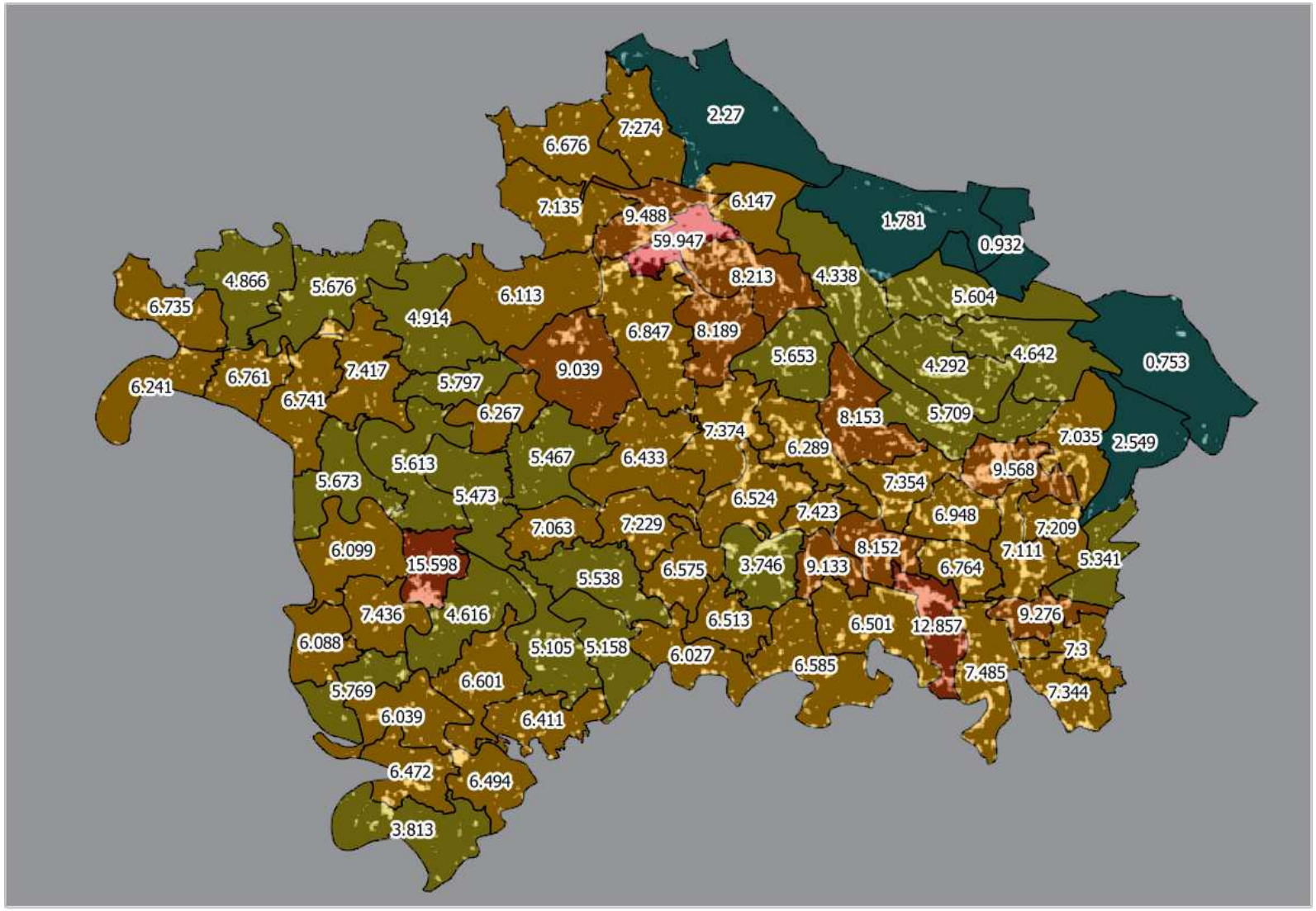
Sources: WFPGeonode (World Food Programme/ Dartmouth Flood Observatory) and DLR GUF (Global Urban Footprint) 2012

Population of municipalities and actual settlements



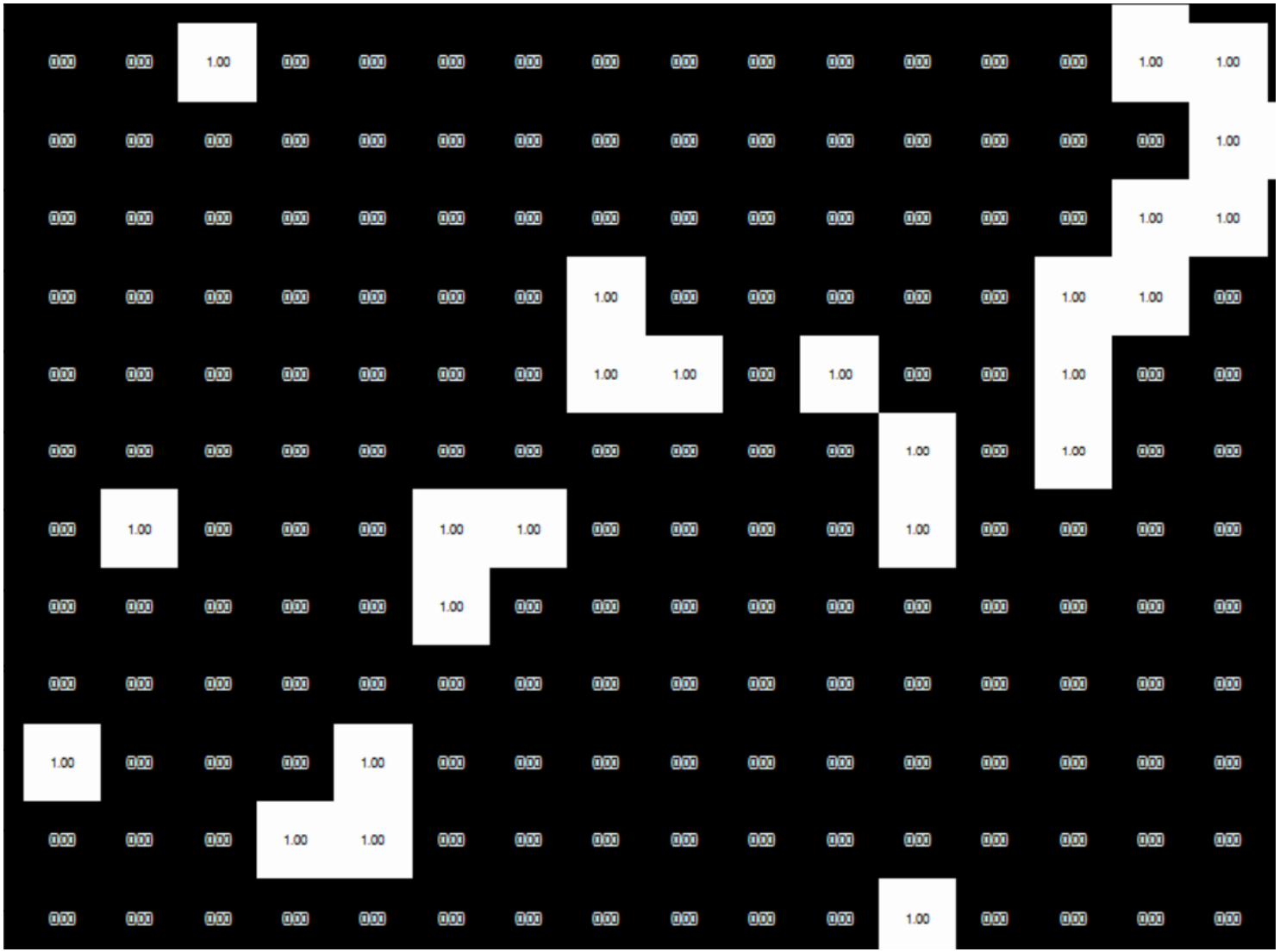
Sources: BBS Population Census 2011 and DLR GUF (Global Urban Footprint) 2012

Some correlation between population density by municipalities and settlements size mapped with GUF (smoothed)

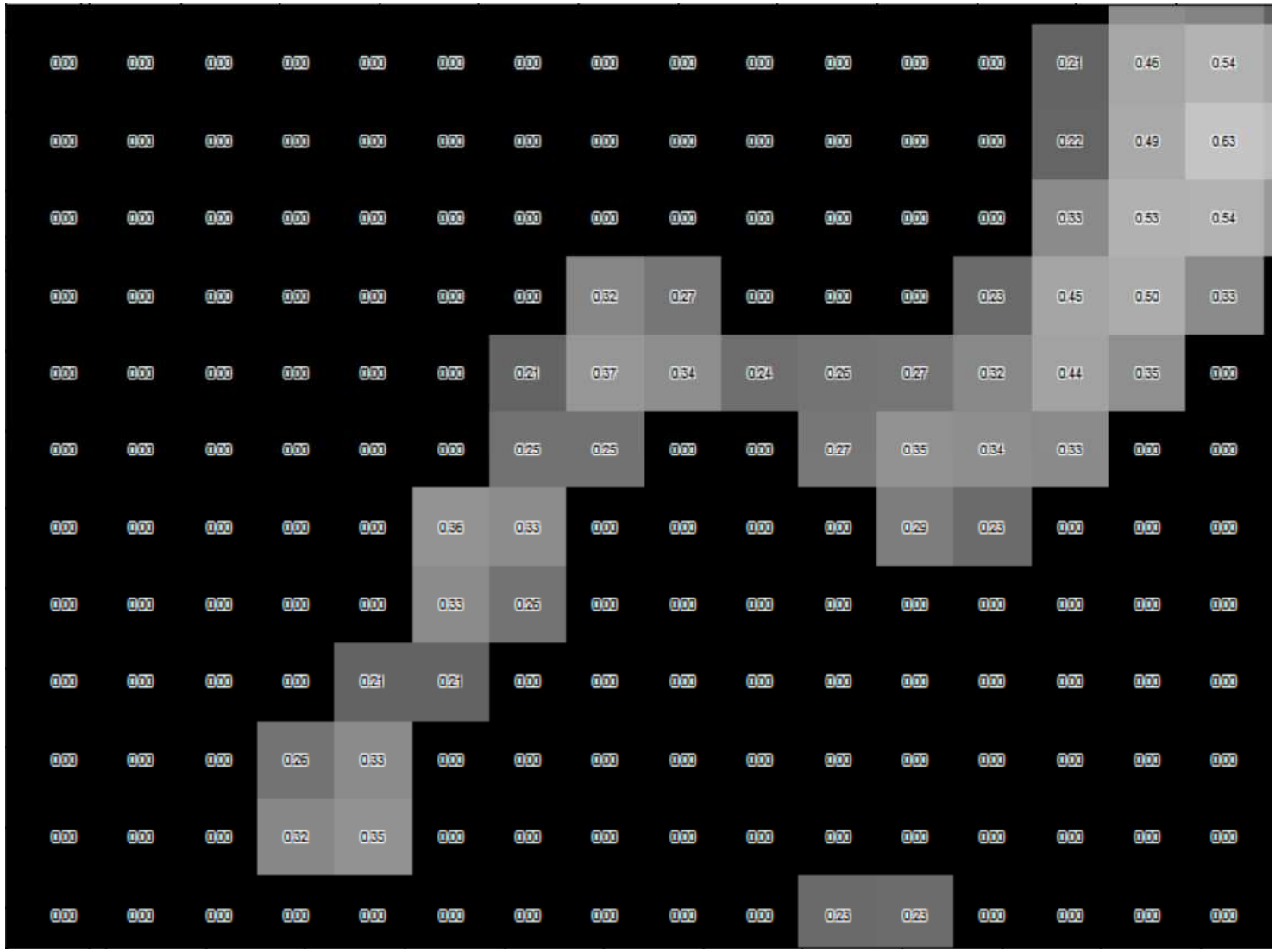


Sources: BBS Population Census 2011, and DLR GUF 2012 (smoothed)

GUF data provide a fair assessment of built-up areas but are poorly correlated to population density



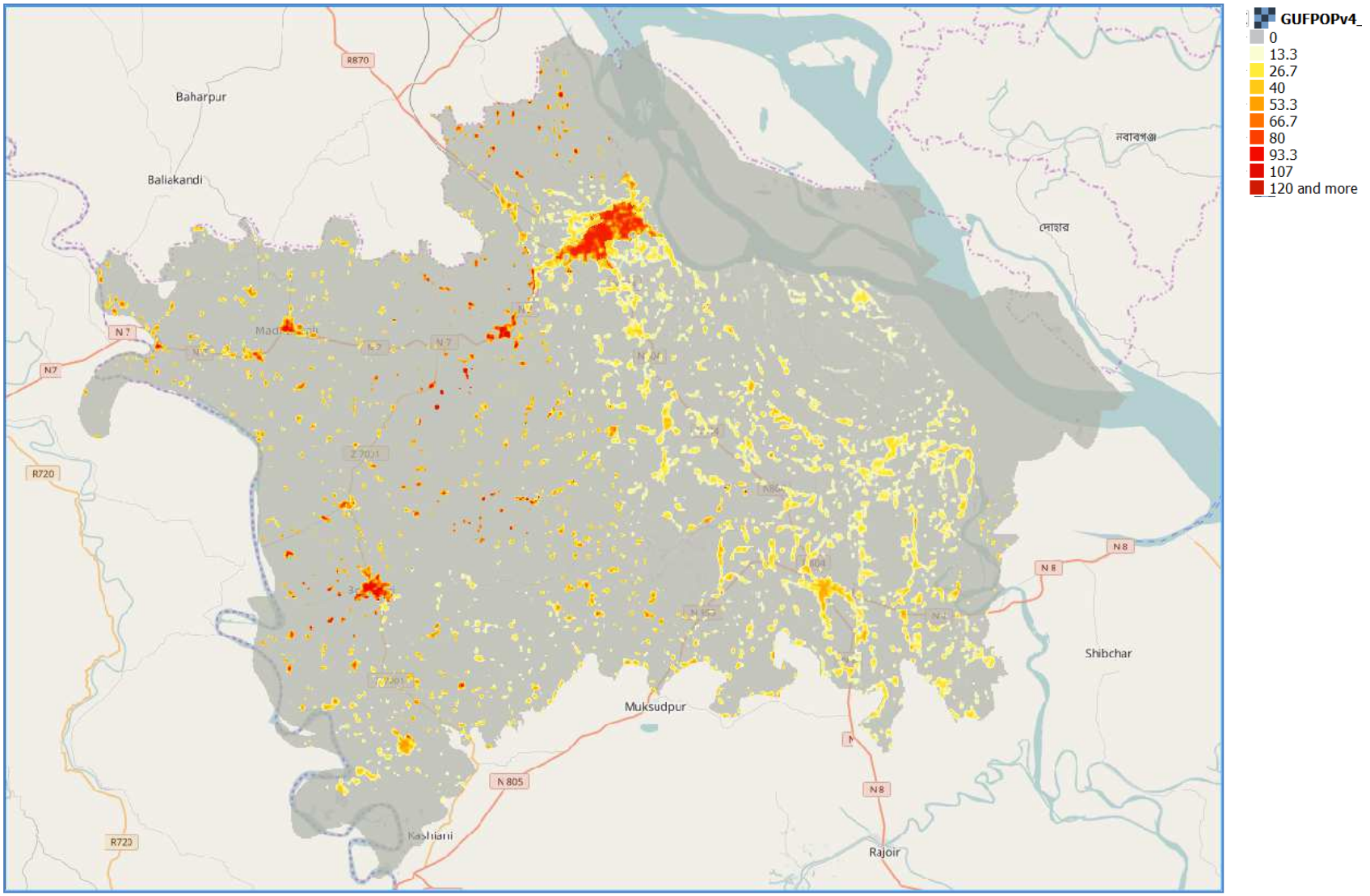
Smoothing GUF data ➔ Probability to find a human settlement in a neighbourhood of ~ 400m



Gaussian smoothing and truncating 0-1 GUF data

- ➔ Agglomerate pixels
- ➔ Truncate out low values (e.g. < 20%): eliminate isolated pixels
- ➔ Overweight large agglomerations (cities), underweight small ones (villages)
- ➔ Can be tuned up: smoothing parameters (radius, intensity – std), truncating threshold
- ➔ **Can be used to estimate density of population by GUF pixels**

Estimation of population density by GUF pixels, using statistics by municipalities (Unions and Paurashavas), Faridpur ZILA, Bangladesh



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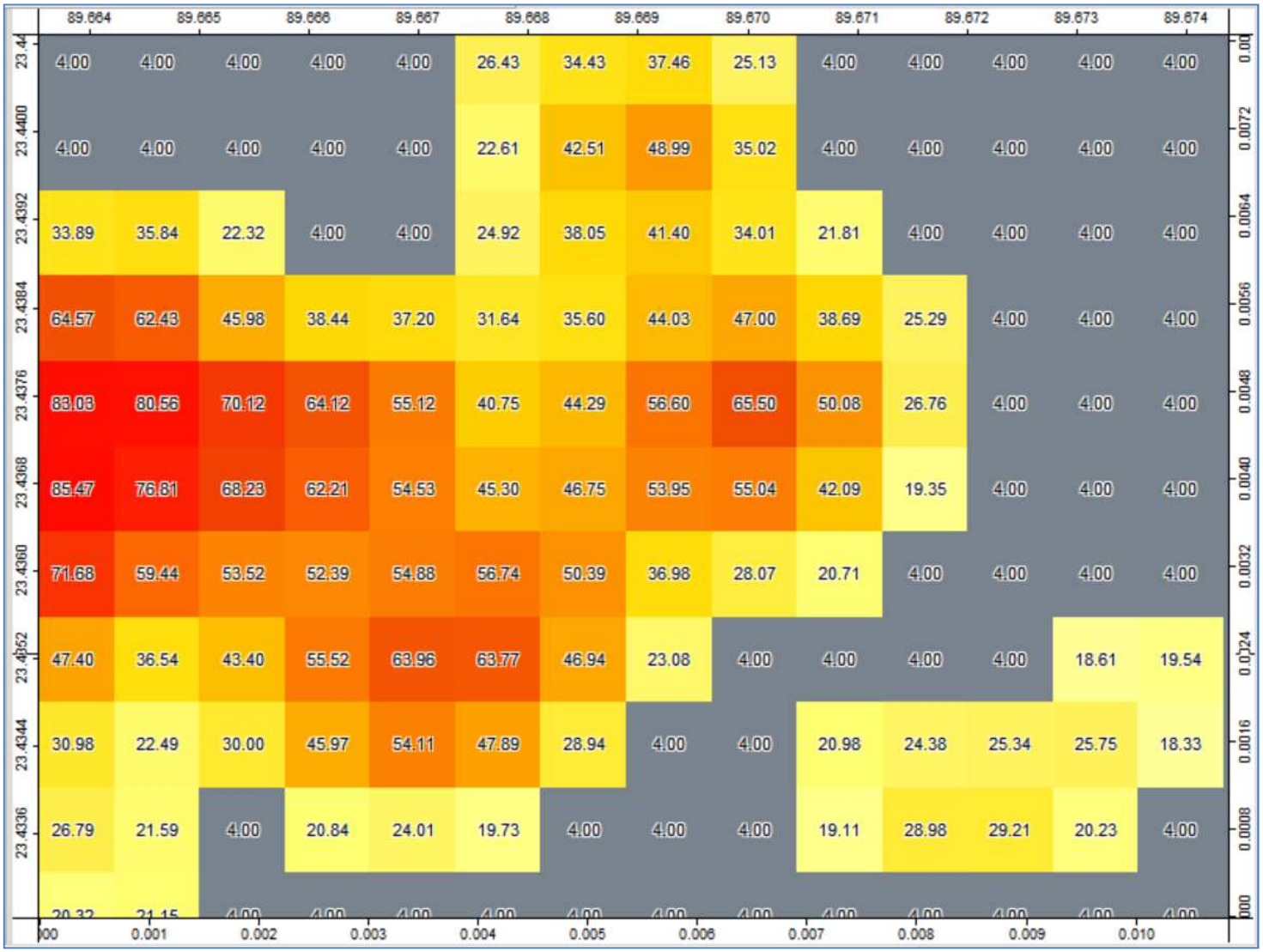
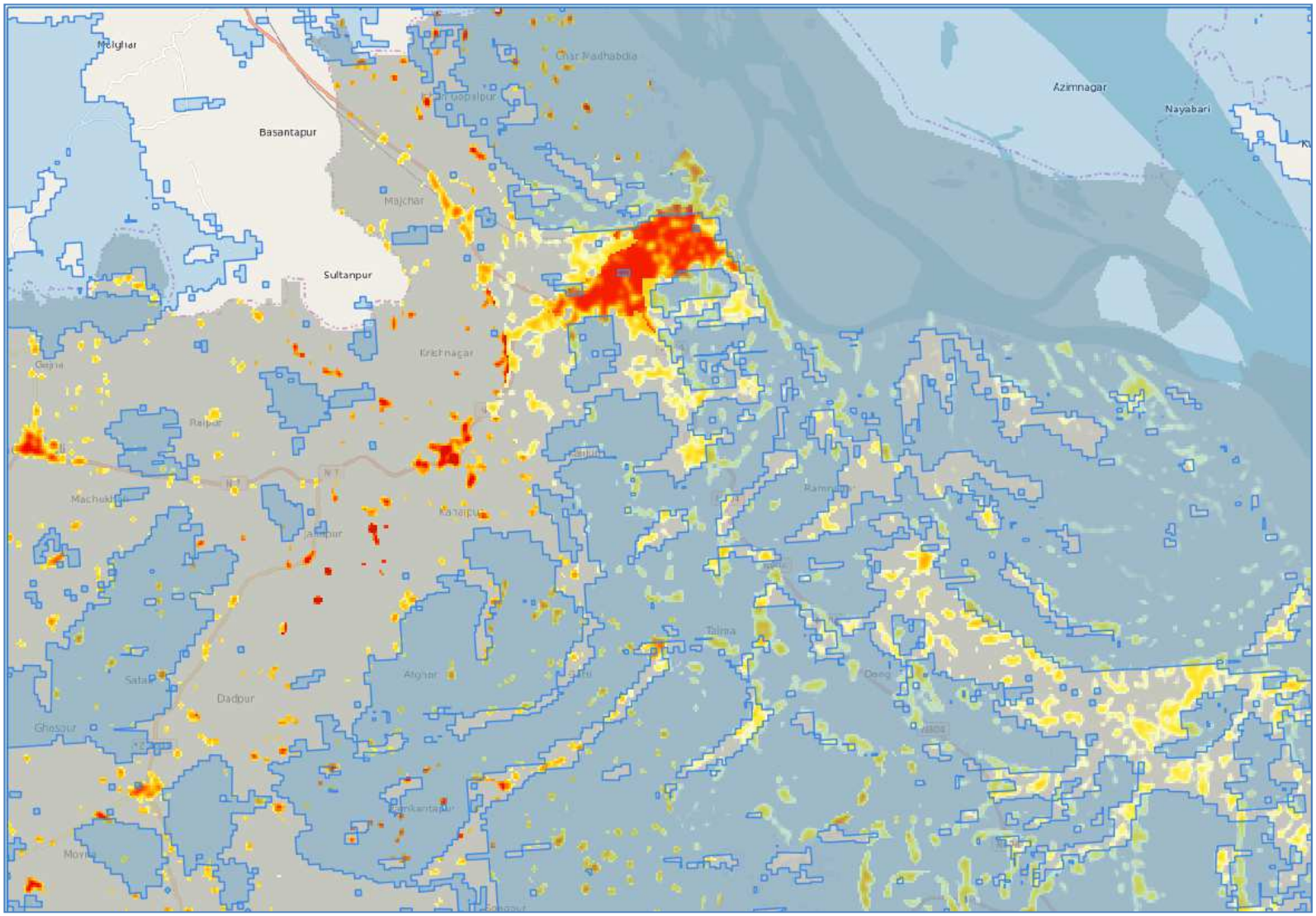
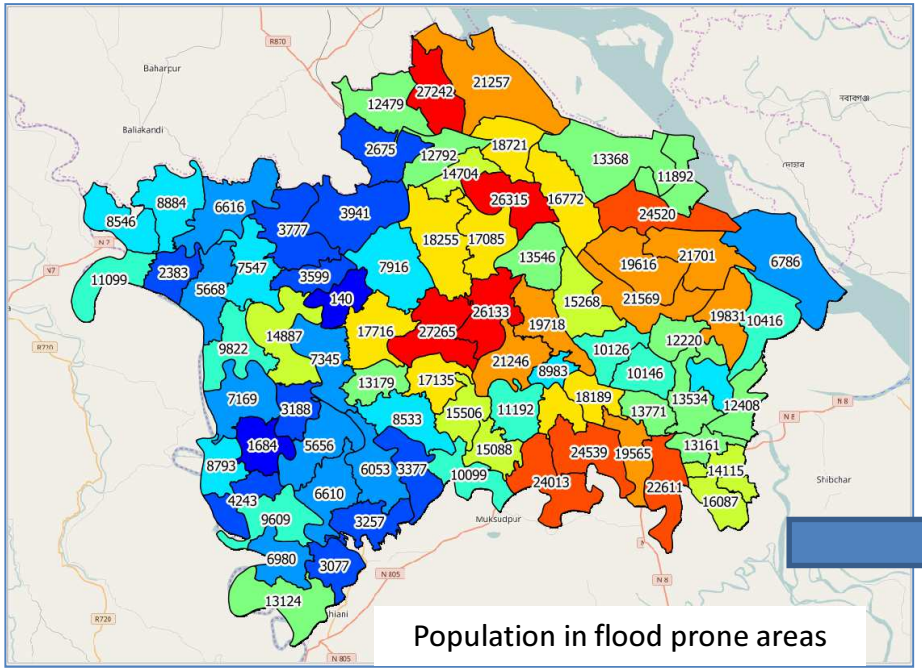


Population in flood prone areas



Extraction of raster data to polygons (administrative boundaries)



Population in flood prone areas

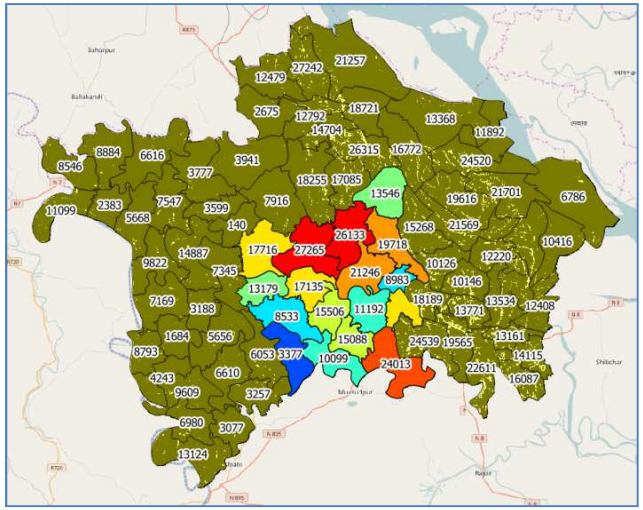
Settlements (GUF) and Population in Flood Prone Areas, Nagarkandi Upzila Faridpur Zila (District), Bangladesh

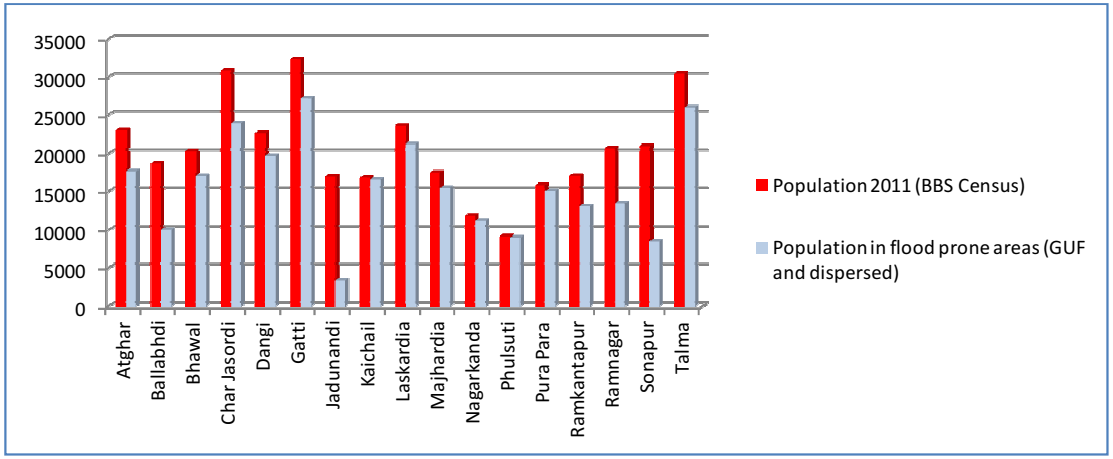
	Settlements from GUF2012 (hectares)	Settlements (GUF) in flood prone areas (hectares)	% GUF in flood prone areas	Population 2011 (BBS Census)	Population in flood prone areas (GUF and dispersed)	% population in flood prone areas (GUF and dispersed)
Nagarkandi	**2430**	**1741**	**71.7**	**349905**	**269390**	**77.0**
Atghar	77	53	69.2	23102	17716	76.7
Ballabhdi	116	46	40.0	18739	10099	53.9
Bhawal	103	82	79.3	20356	17135	84.2
Char Jasordi	208	124	59.7	30898	24013	77.7
Dangi	263	208	79.2	22799	19718	86.5
Gatti	165	127	76.7	32456	27265	84.0
Jadunandi	97	4	3.7	17058	3377	19.8
Kaichail	157	152	96.6	16951	16661	98.3
Laskardia	253	216	85.2	23694	21246	89.7
Majhardia	90	75	84.1	17563	15506	88.3
Nagarkanda	224	186	82.8	11872	11192	94.3
Phulsuti	57	49	85.4	9168	8983	98.0
Pura Para	77	72	93.8	15839	15088	95.3
Ramkantapur	50	33	65.5	17156	13179	76.8
Ramnagar	139	90	64.3	20745	13546	65.3
Sonapur	82	21	25.2	21016	8533	40.6
Talma	272	205	75.4	30493	26133	85.7

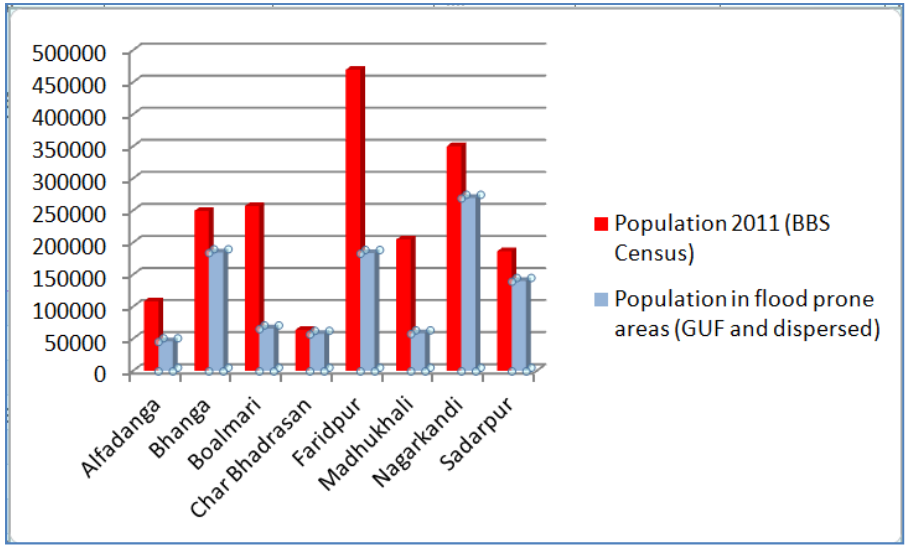
Settlements (GUF) and Population in Flood Prone Areas, Faridpur Zila (District), Bangladesh

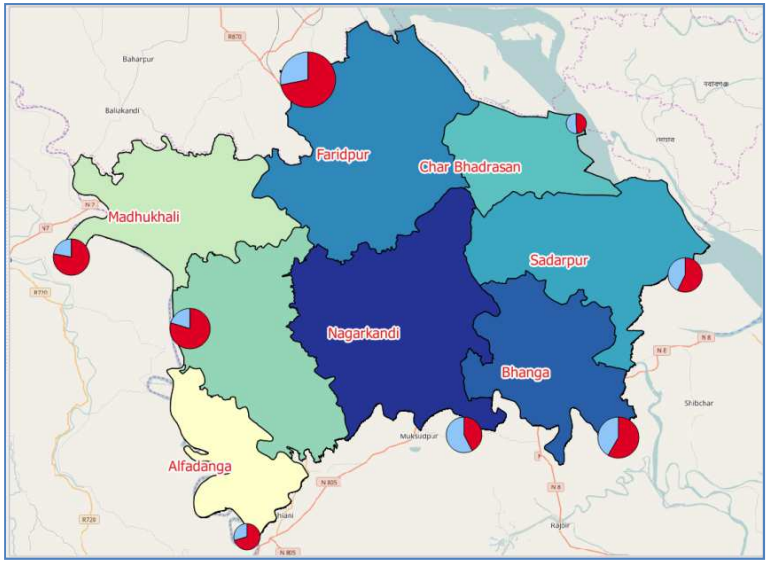
	GUF2012 (hectares)	GUF in flood prone areas (hectares)	% GUF in flood prone areas	Population 2011 (BBS Census)	Population in flood prone areas (GUF and dispersed)	% population in flood prone areas
Alfadanga	**602**	**149**	**24.7**	**108302**	**45827**	**42.3**
Bhanga	**2752**	**1908**	**69.3**	**249343**	**184518**	**74.0**
Boalmari	**1022**	**160**	**15.7**	**256658**	**65811**	**25.6**
Char Bhadrasan	**528**	**414**	**78.5**	**63477**	**57445**	**90.5**
Faridpur	**3091**	**1111**	**35.9**	**469410**	**183383**	**39.1**
Madhukhali	**790**	**142**	**18.0**	**204492**	**58120**	**28.4**
Nagarkandi	**2430**	**1741**	**71.7**	**349905**	**269390**	**77.0**
Sadarpur	**1770**	**1120**	**63.3**	**186254**	**139814**	**75.1**
Grand Total	**12986**	**6745**	**51.9**	**1887841**	**1013415**	**53.7**

Statistics and maps









Gaussian smoothing and truncating 0-1 GUF data

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- Truncate out low values (e.g. < 20%): eliminate isolated pixels
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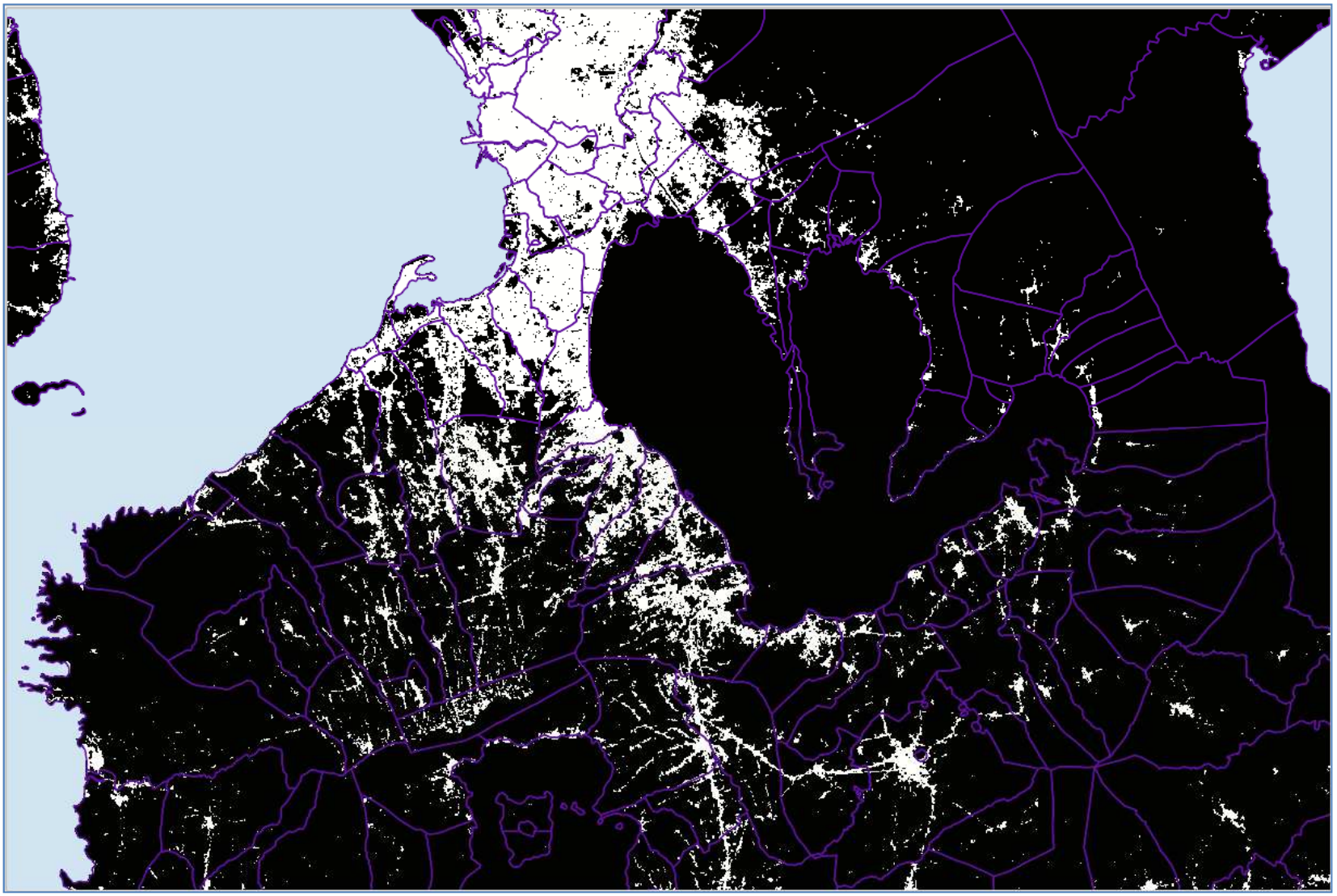
- Can be tuned up: smoothing parameters (radius, intensity – std), truncating threshold
- **Can be used to estimate density of population by GUF pixels**

- **Issues:**
  - GUF is good for urban areas, but more fragile in the countryside (isolated pixels...)
  - Research carried out with generalized GUF data (77m x 77m); probably better results with native GUF (12m x 12 m)

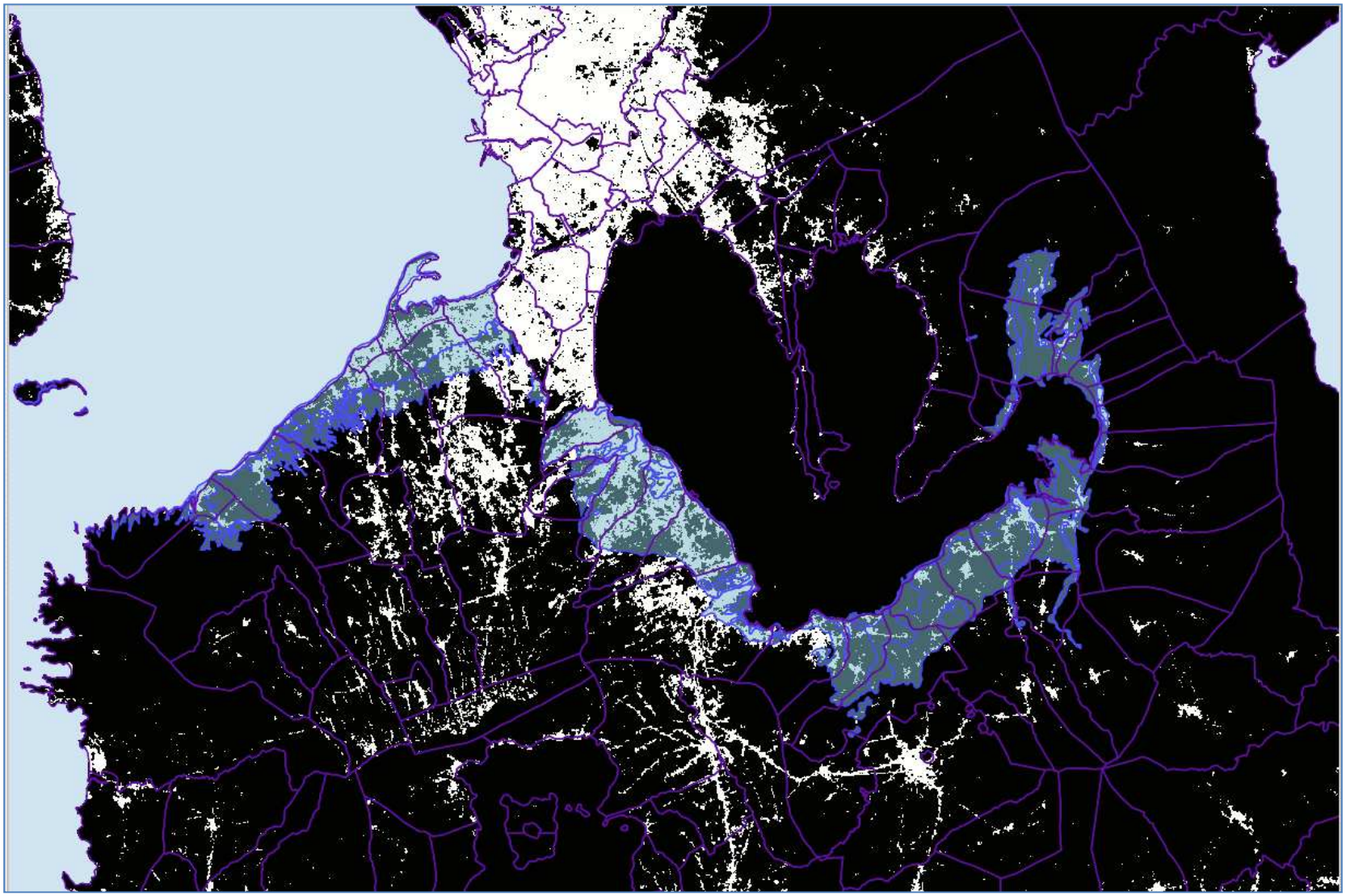
  Calibration of the model with regional data : requires estimation of non agglomerated population

A try of the methodology for the Philippines

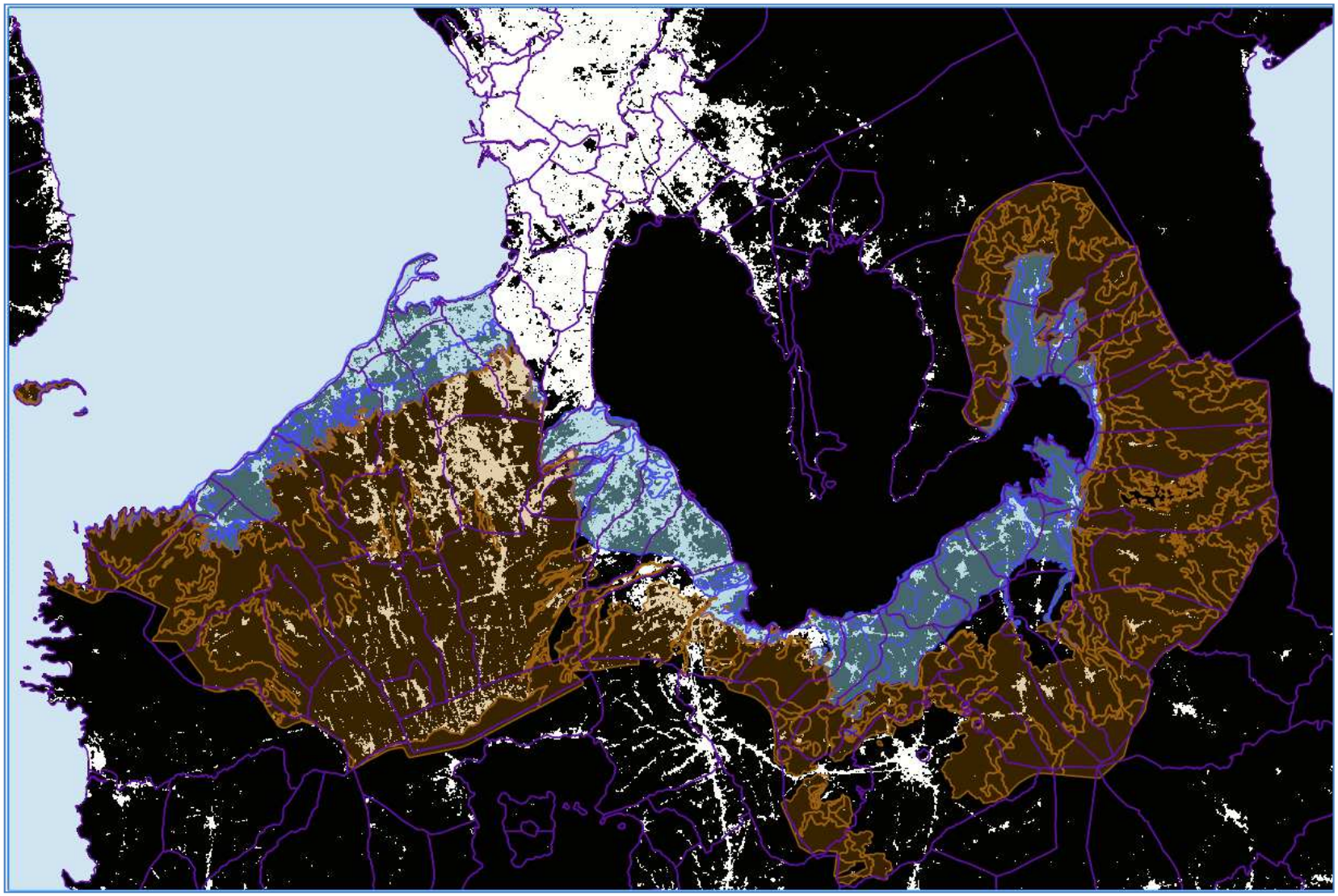
GUF and municipality boundaries (ADM2)



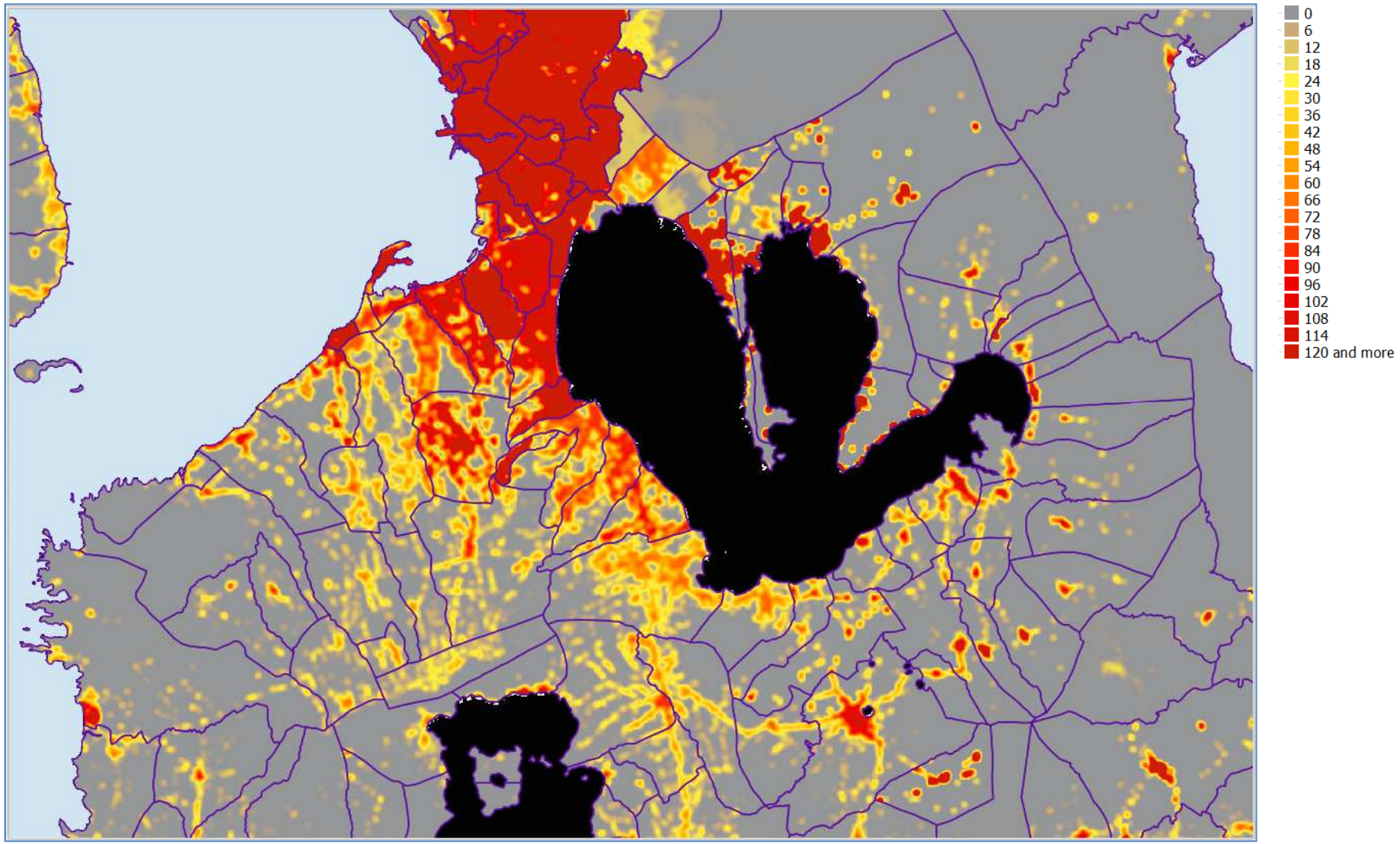
GUF and ADM2 boundaries + Flood risk exposure



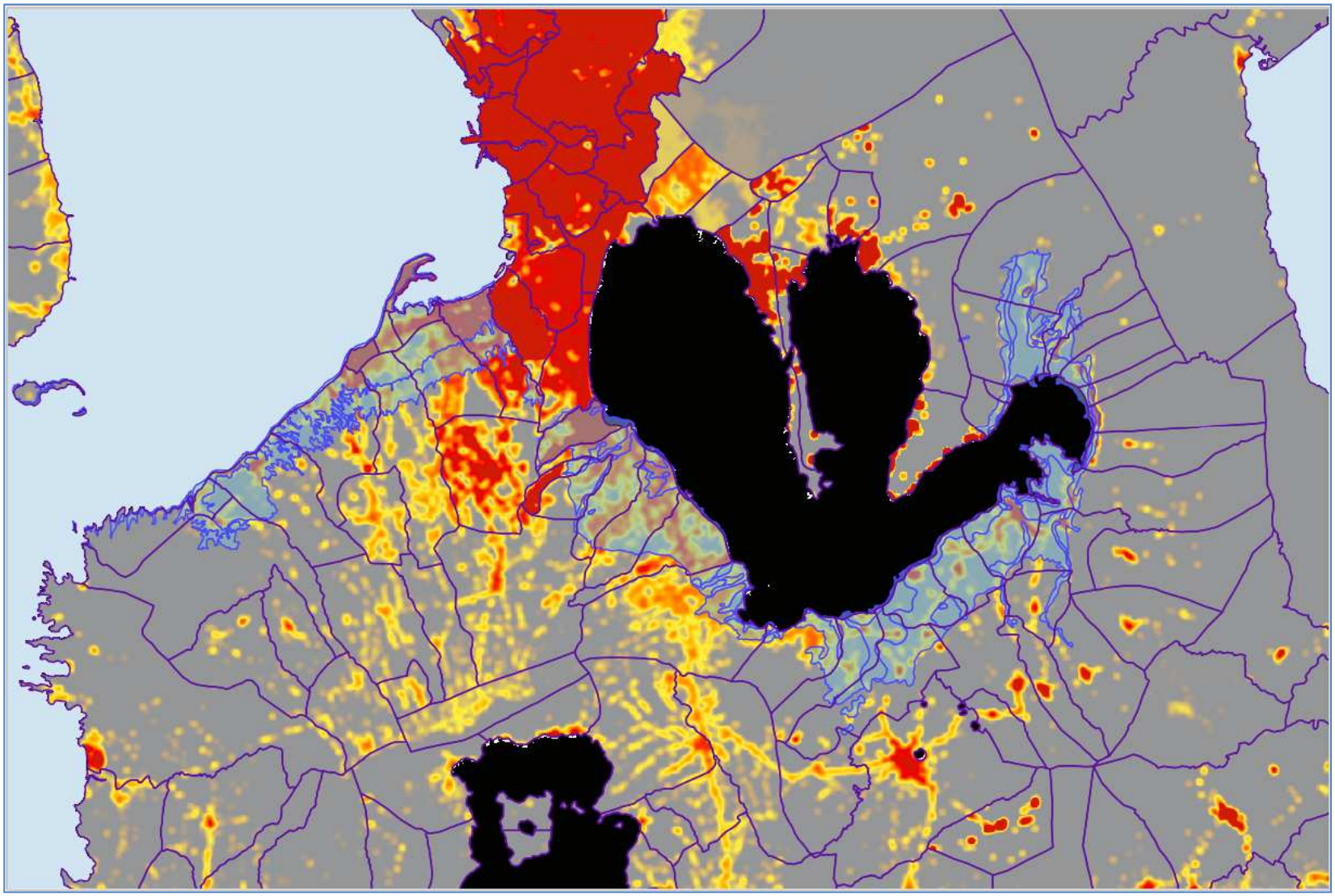
GUF and ADM2 boundaries + Flood risk and landslide exposure



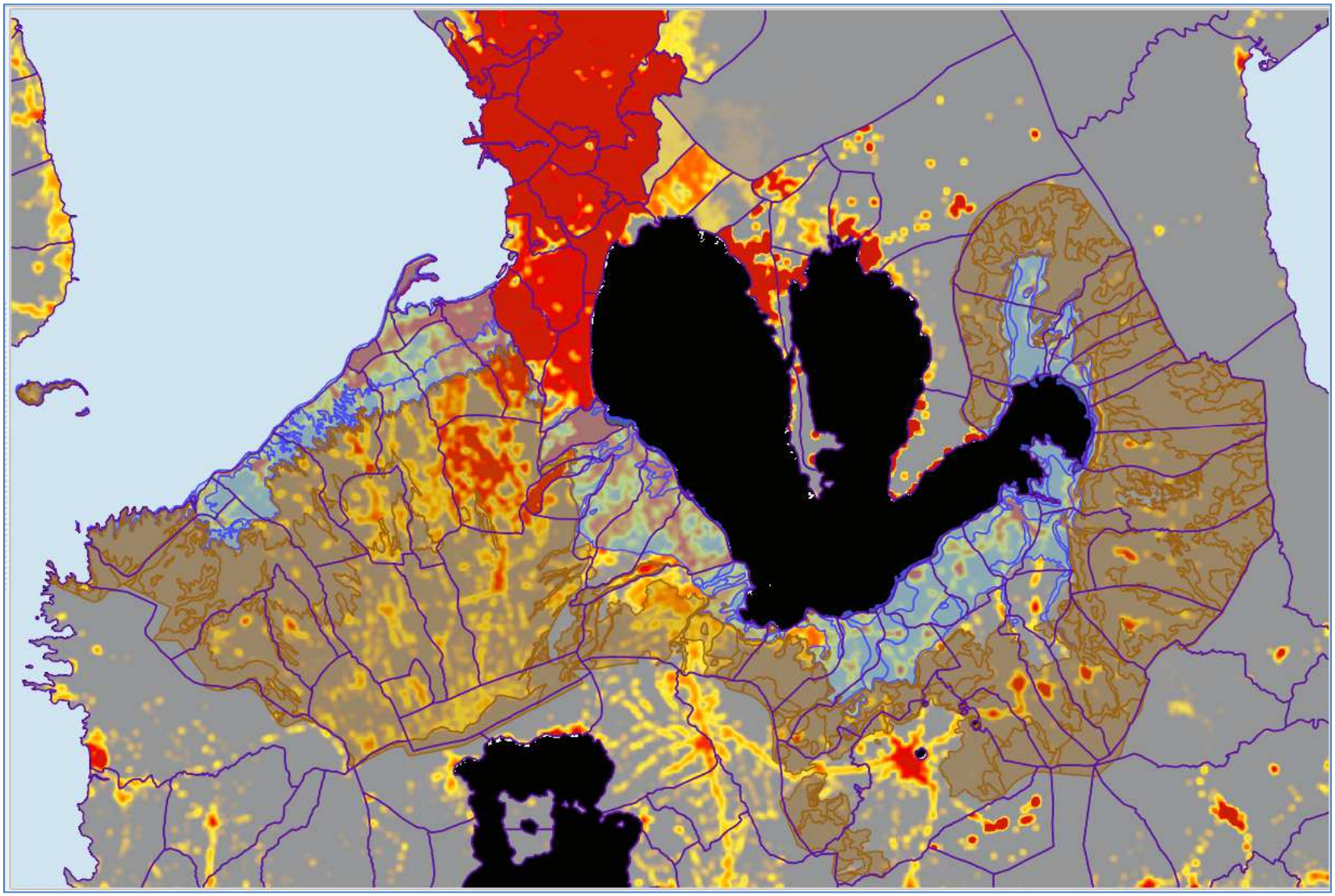
Estimation of population density per smoothed GUF pixels



Estimation of population exposed to flood risk



Estimation of population exposed to flood and landslide risks



Thank you!

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