UNESCAP

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Regional Pilot test for Population Exposure Estimation

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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) when they are 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 Human Settlement database of JRC combines data on settlements at 30m (10 m in Europe) but final results are as well at 1 km2.

Assessing settlements and population spatial distribution

- It was decided in the context of the DRSF test to explore the possibility of more precise product relevant for assessing population exposure to risk of disaster. Tests took the advantage of a new global high resolution map of urban settlements, the Global Urban Footprint (GUF), and used a simple model to resample population census data to the built-up pixels of the map.

- GUF is produced by the German Aerospace Agency (DLR) from radar imagery in 2012. It provides a map of houses and other buildings with an accuracy of 12m x12 m. For the research, aggregated data at ~ 80m x 80m have been kindly provided by DLR of all the DRSF test countries.

- 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). They have been repeated in the Philippines, Indonesia (Java and Sumatra), Republic of Korea and Thailand.

Bangladesh: Estimation of population density by GUF pixels using statistics by sub-districts (Upzila) and municipalities (Unions and Paurashavas)
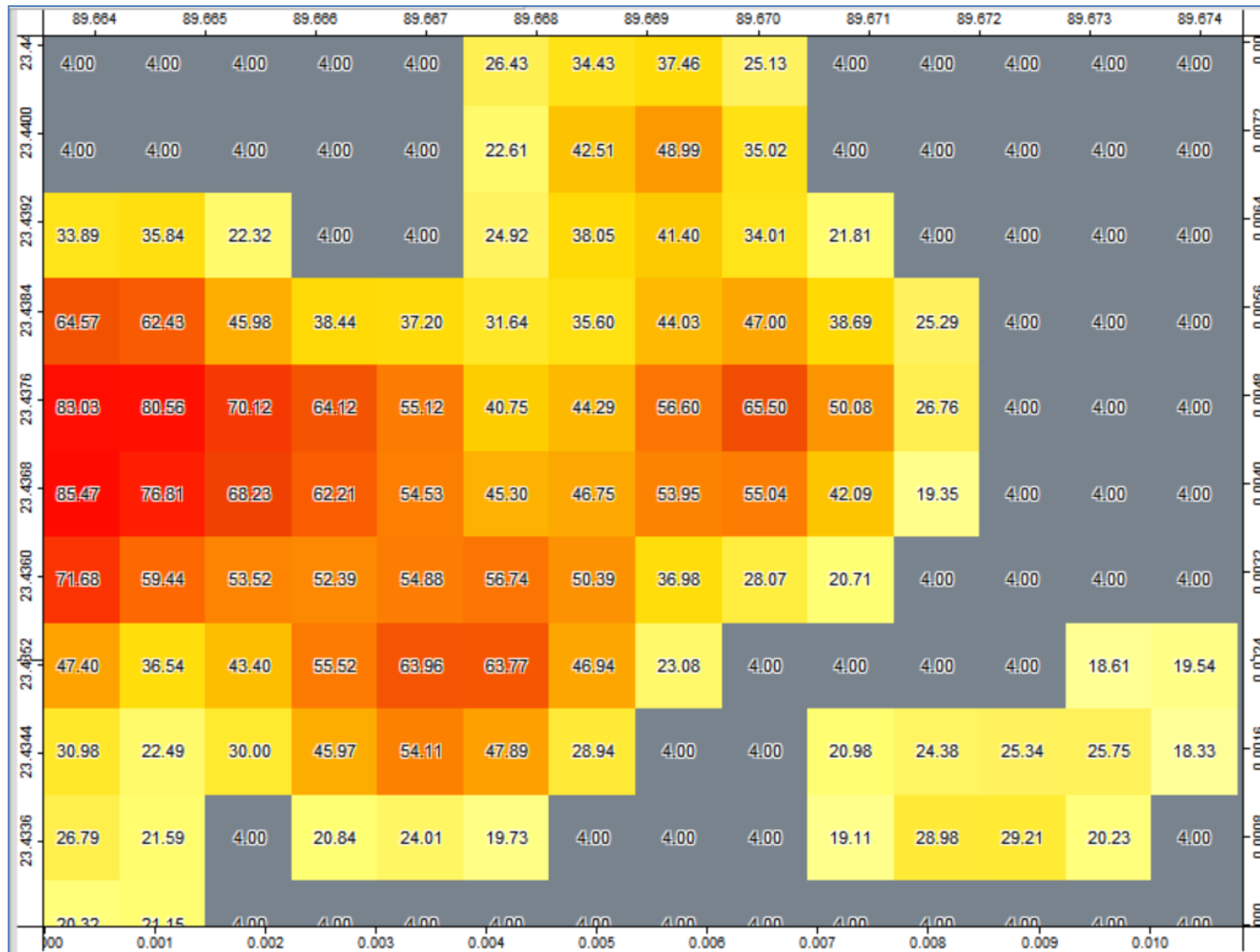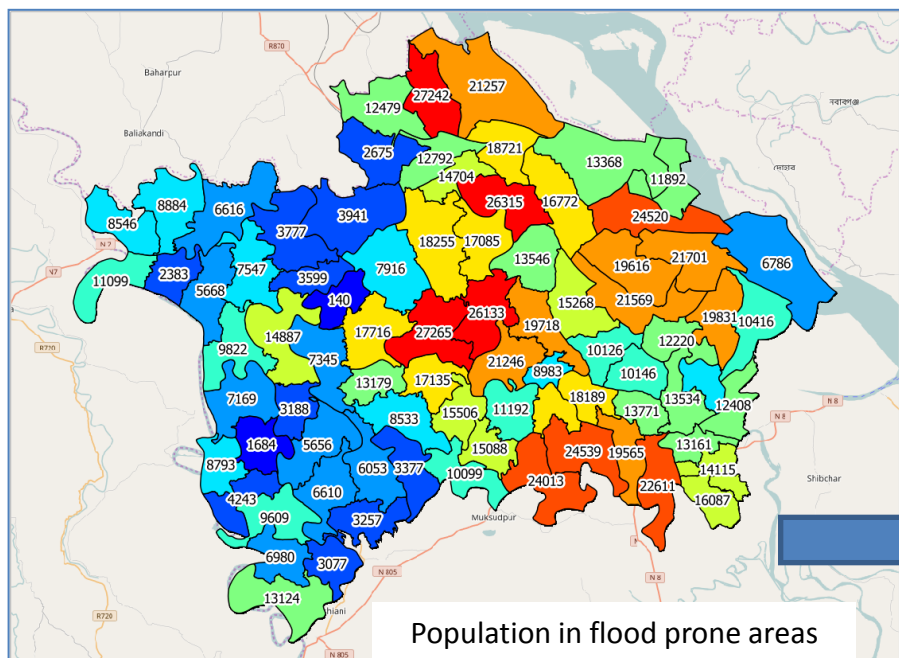
Population in flood prone areas (shade of blue)
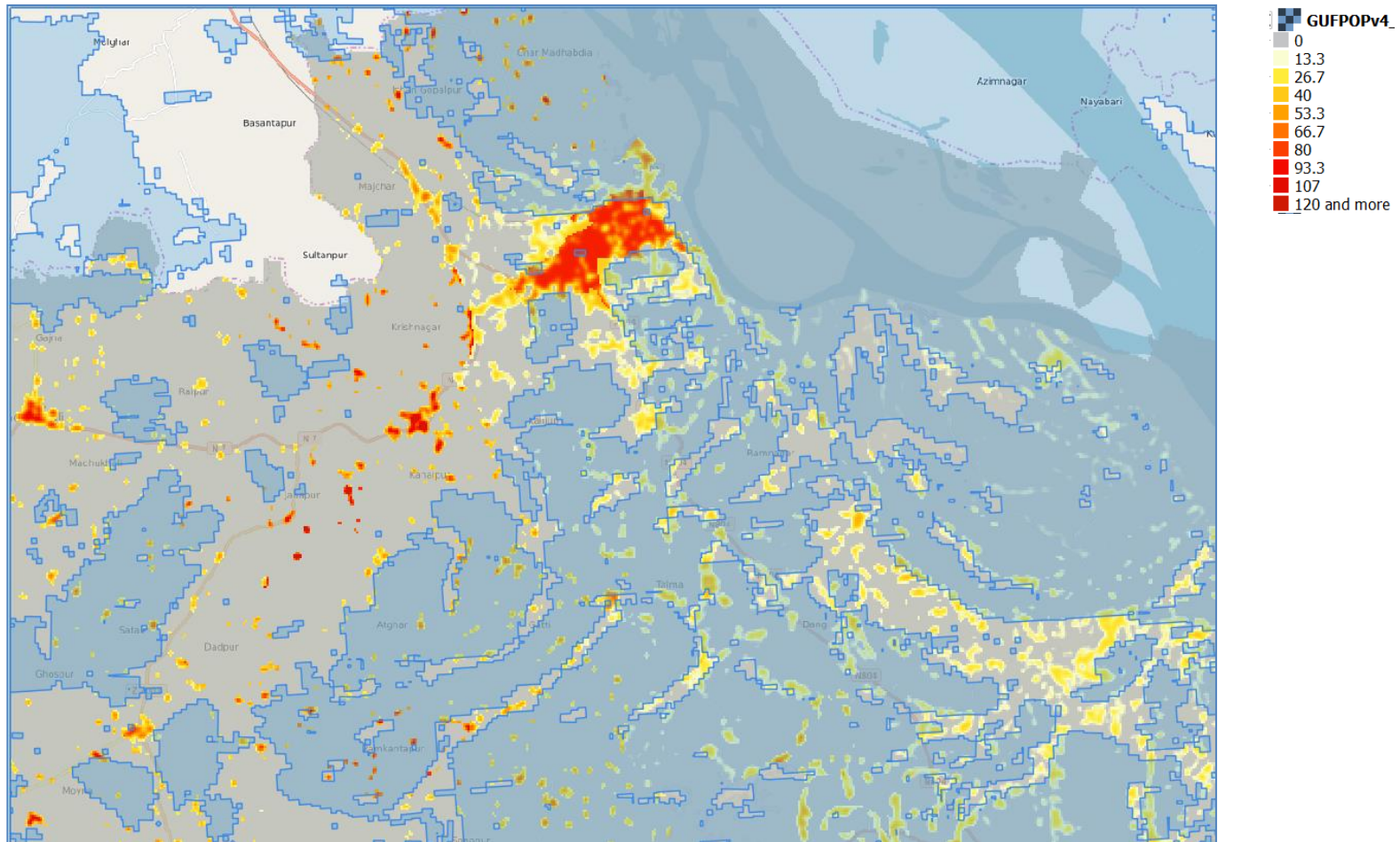
In the district of Faridpur in Bangladesh, the map shows that most population settlements (in red to yellow) are safe from the risks of floods (shaded in light transparent blue). However, we can note on the North of the regional capital city urban sprawl in the danger zone

# Statistics: Extraction of raster data to 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**
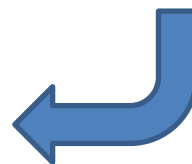
A try with statistics at the regional level BGD ADM3 (Upzila)
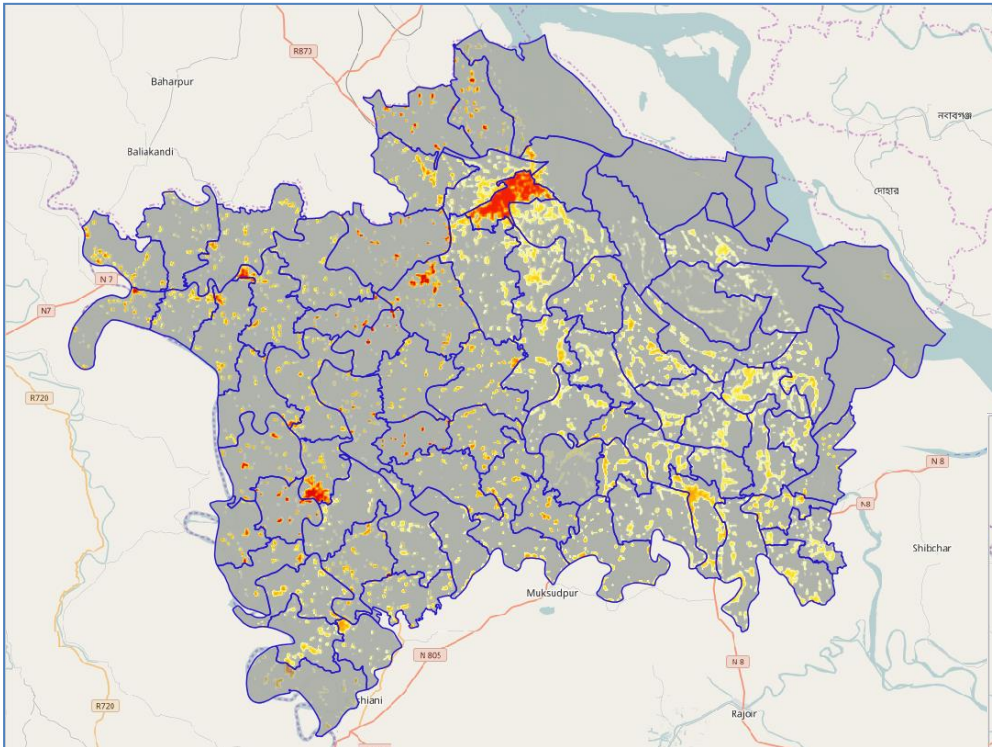
← With municipalities/
unions population statistics

With sub-districts/upzilas population statistics
↓
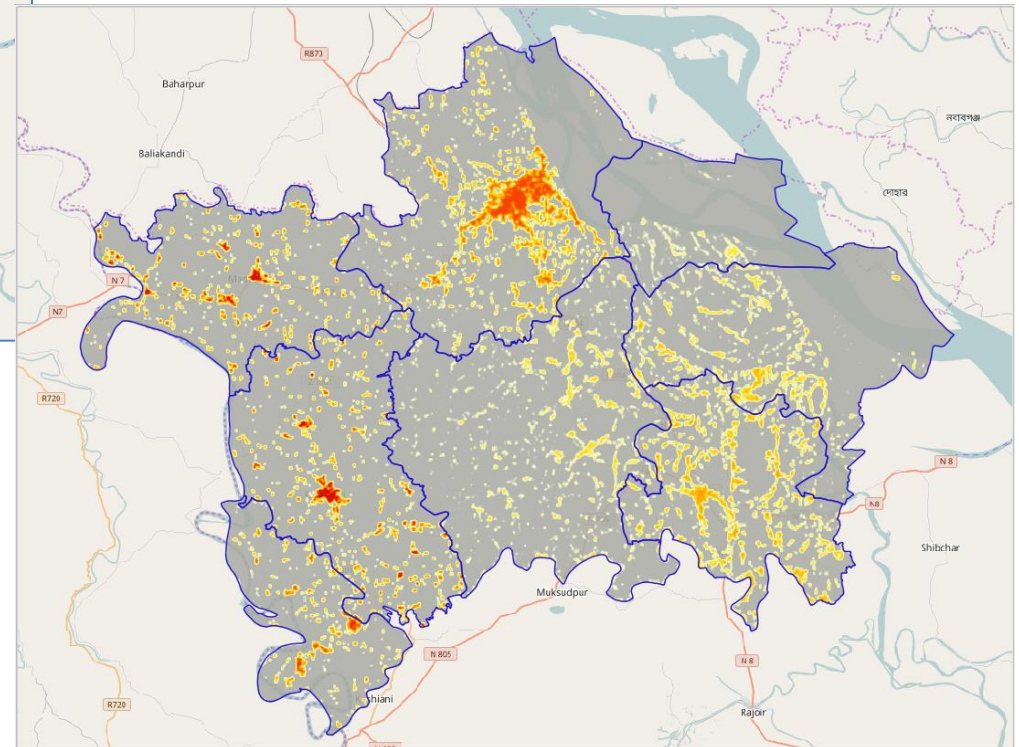
The two maps/datasets look a bit the same but there are differences. Comparisons by municipalities show:

- 50% of unions have fairly similar results
- 40% unions have gaps of around 30%
- 10% with more serious issues...

Estimation of population exposed to flood and landslide risks (density by GUF pixel) South of Manila, the Philippines
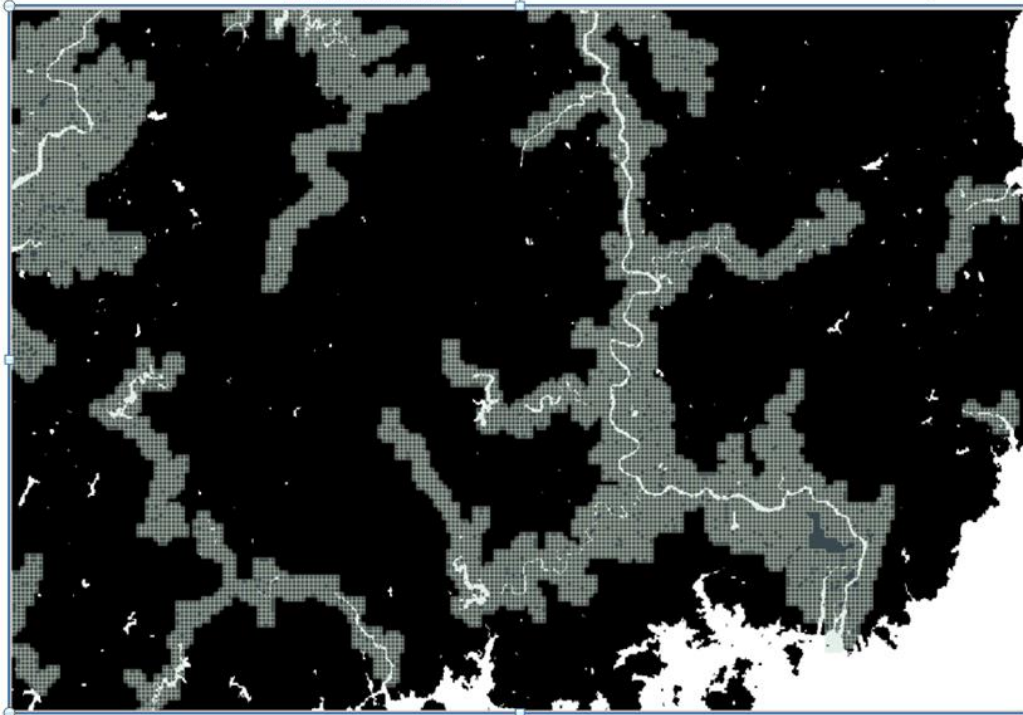

	0
	6
	12
	18
	24
	30
	36
	42
	48
	54
	60
	66
	72
	78
	84
	90
	96
	102
	108
	114
	120 and more
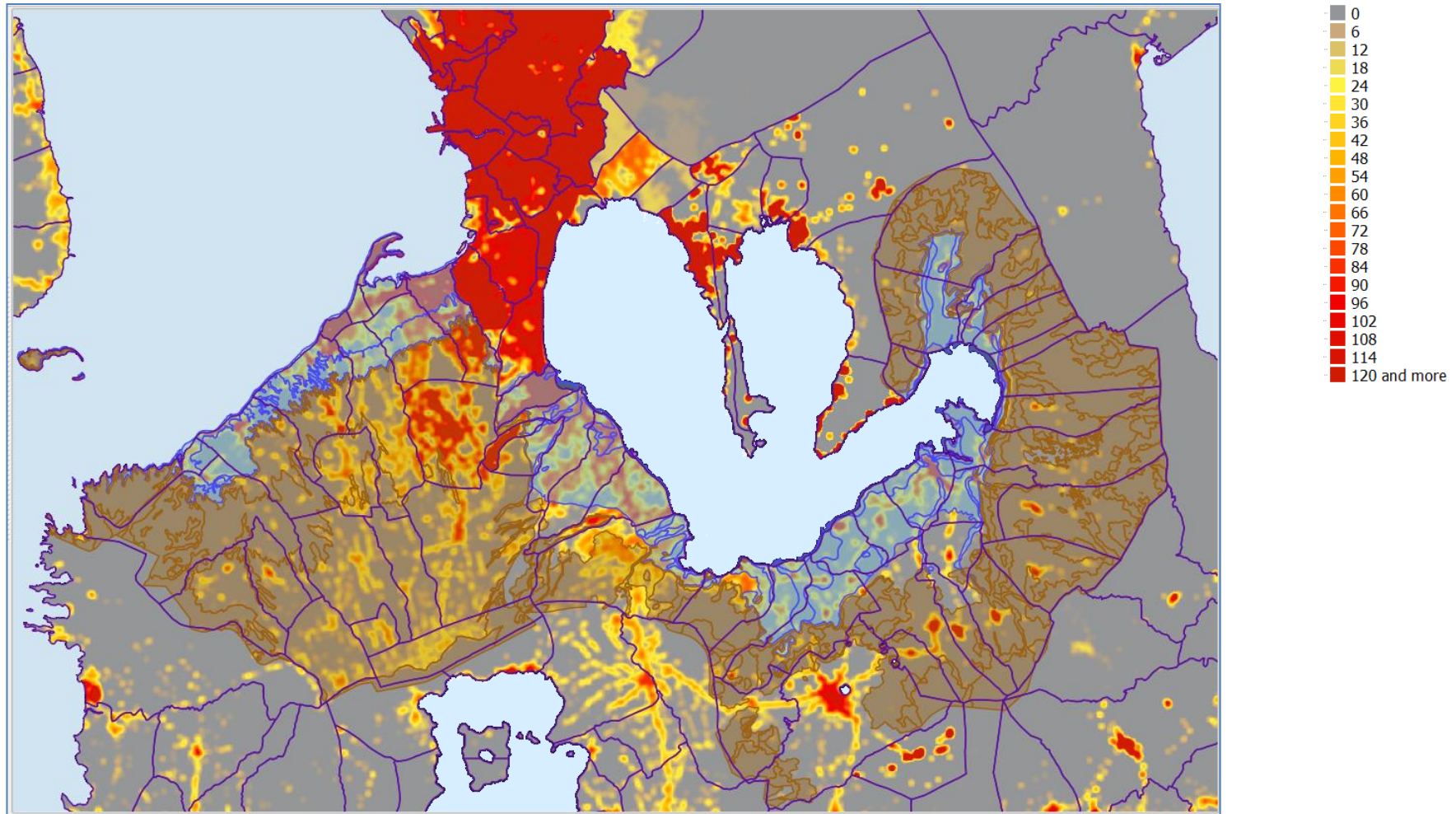
Zones at risk of flood are shaded in blue, zones at risks of landslide in brown

Population in flood hazard areas in the region of Busan, Republic of Korea

Flood hazard reprojected shapefile, overlaid on rivers map

Flood hazard reprojected shapefile, overlaid on POPtoGUF
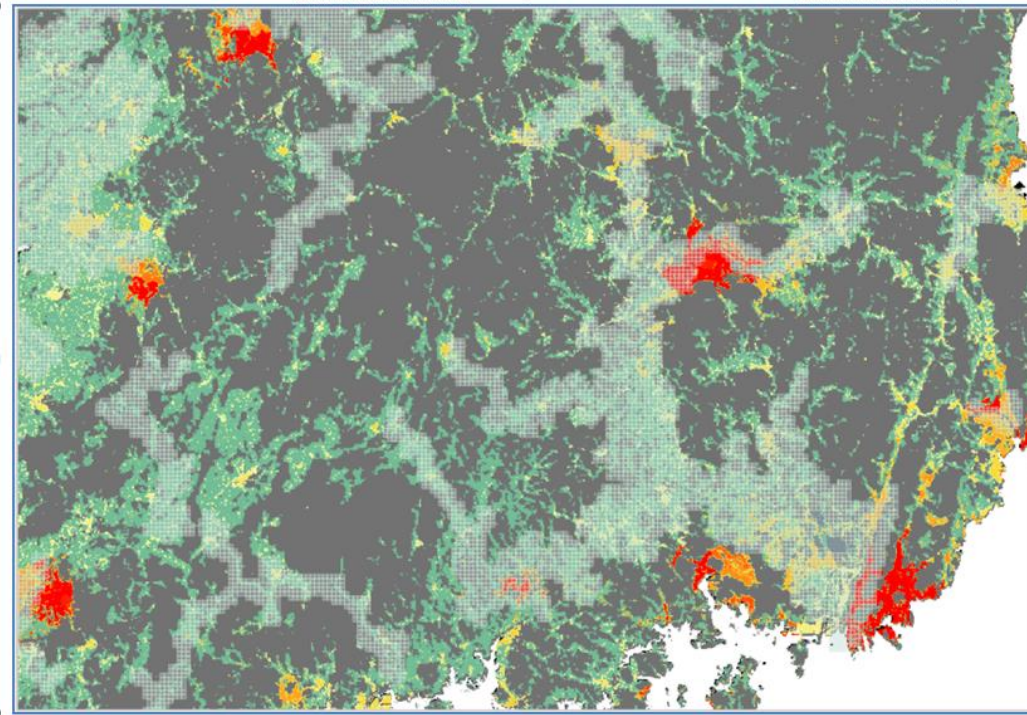
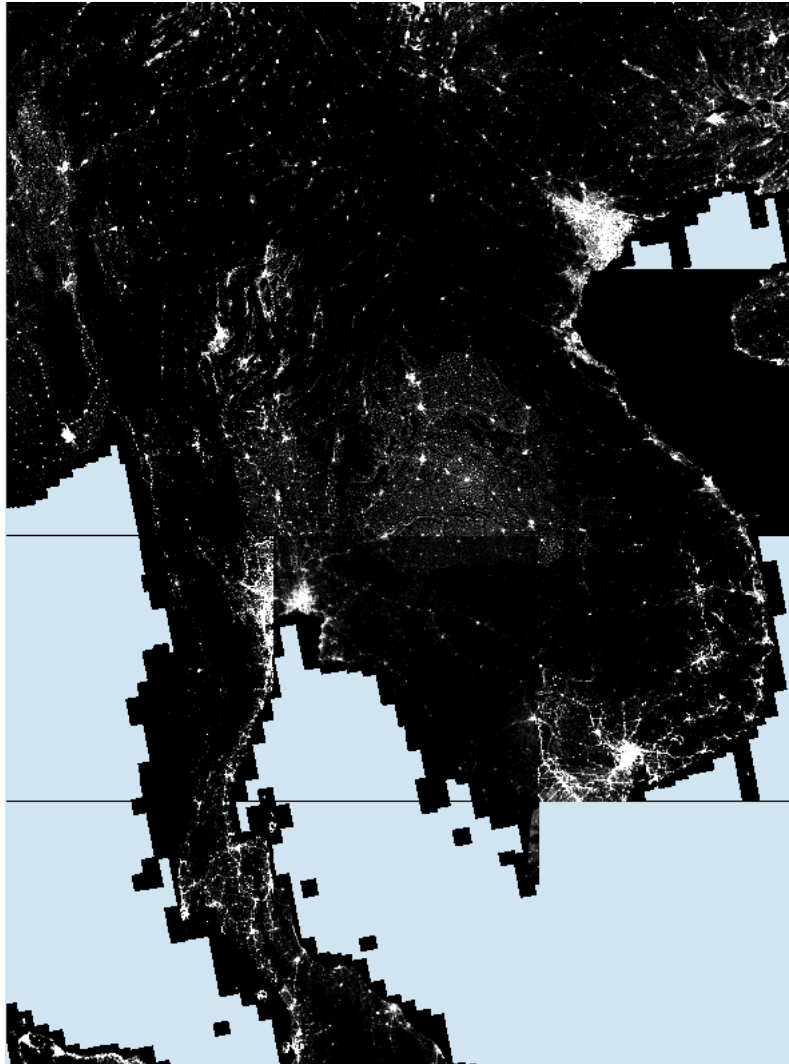The flood hazard map used here is that of UNEP GRID Global Risk Data Platform
http://preview.grid.unep.ch/index.php?preview=map&lang=eng

Comparison of population by GUF pixels in Indonesia, using population statistics by ADM2 divisions (left) and villages (right)
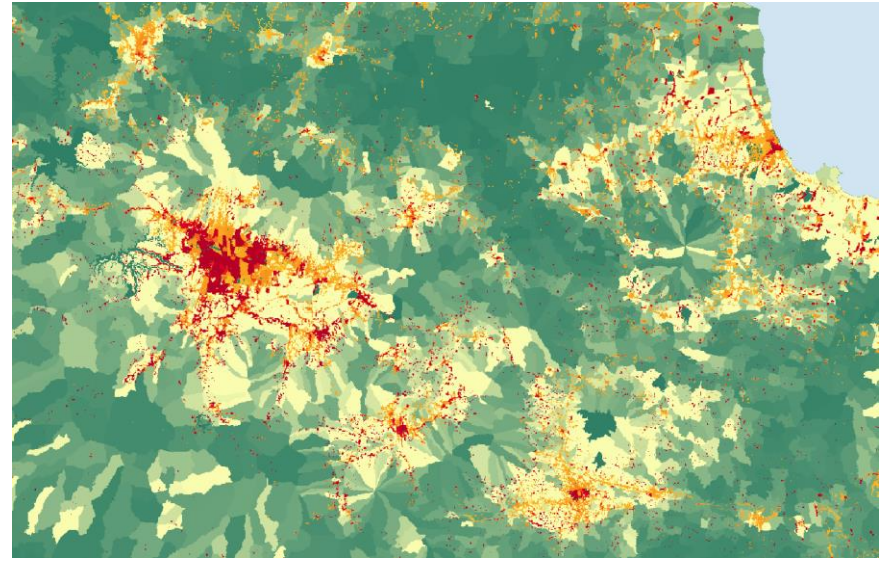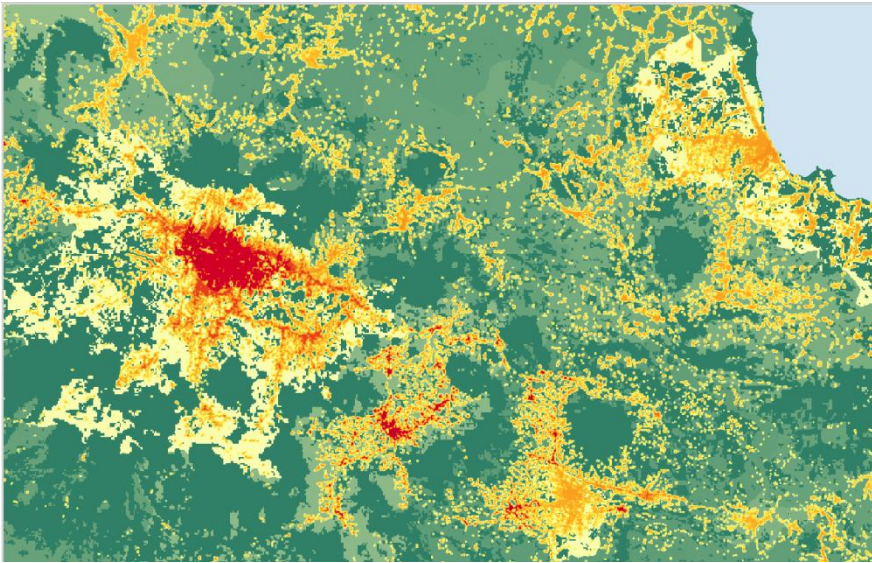
# Thailand: ongoing test carried out with GUF pixels resampled to 100m

Provisional conclusions

➔ **Application of the methodology with population data by municipalities brings useful information**

➔ **Use of regional population statistics:** allows broad scale application with easily accessible statistics; estimations are more fragile

➔ **Methodological Issues:**

  ➔ GUF is good for urban areas, but more fragile in the countryside (isolated pixels...).

  ➔ Research carried out with generalized GUF data (80m x 80m); probably better results with native GUF (12m x 12 m)

  ➔ **Calibration of the model with regional population statistics :** requires estimations of density of non agglomerated population (*Assessing dispersed population in agriculture or forest landscapes is an issue for all models...*)

➔ **A possible 3 tiers approach (?):**

  ➔ Default 1: GUF + regional statistics + international risk maps➔ international comparisons

  ➔ Default 2: GUF + municipal statistics + national risks maps ➔ national/sub-national assessments

  ➔ Reference methodology: micro statistics geo-referred to high resolution maps

An option for flexible implementation of methodology tests

- The methodology followed in the tests is easily replicable at different scales
- To facilitate the reproduction of population disaggregations by GUF pixels in various contexts and at different scales, the methodology has been documented and step-by-step operational manual produced.
- The manual targets non-professional GIS users; it is based on a free GIS package (QGIS)
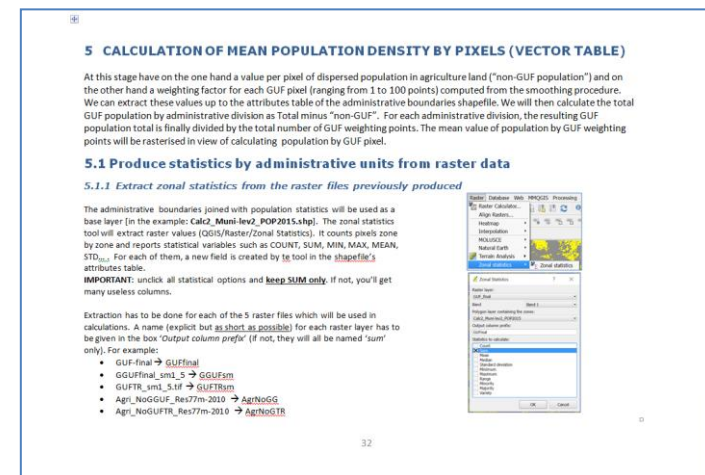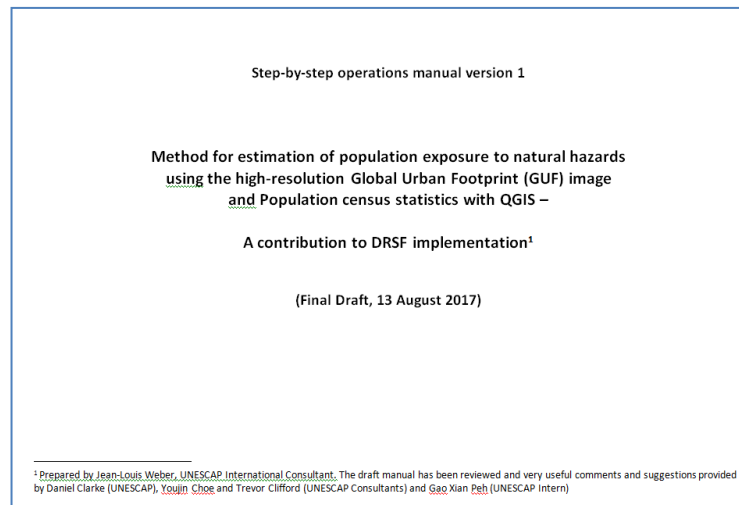
A Regional Pilot test for Population Exposure Estimation is feasible shortly. *Is it desirable?*