4.1 Fine scale global mapping of human settlements

Recent years have seen a proliferation of global maps describing human settlements. The most recent datasets include the Global Urban Footprint (GUF) with its 12 m cell or pixel size product derived from TerraSAR-X imagery acquired in 2011-2013 (Esch et al. 2017); the World Settlement Footprint (WSF) with the 10 m resolution datasets based on Landsat-8 and Sentinel-1 sensors for reference year 2015 (Marconcini et al. 2019) and the FROM-GLC10 landcover map which includes a dedicated class for artificial surfaces derived from Sentinel-2 data acquired in 2017 (Gong et al. 2019). Unlike the GUF, which was generated from commercial imagery, all the other products were derived from free and open-access satellite image datasets, primarily from Landsat and the European Copernicus Sentinel missions. These products are freely available (absence of restrictions on their use for multiple types of applications) and can be updated at relatively low cost. Although these datasets have been widely used in different application areas, they present a certain number of limitations. These limitations are mostly related to accuracy, sensor-scale dependency, quantitative surface measurements in the extrema of the settlement density range, and the continuous monitoring of urban land cover changes. Compelling challenges and opportunities still lie ahead in high-resolution mapping and accurate classification of built-up areas over large areas. Several initiatives are targeting the fine scale delineation of human settlements from commercial, very high resolution satellite data. As an example, Facebook has recently made available for public use high resolution settlement grids (aggregated at a spatial resolution of 30 meters) in the frame of "Data for Good" Facebook program that supports international humanitarian efforts ('Facebook's Data for Good Program' 2020). While the delineation of sparse settlements in particular in rural Africa was remarkably accurate, the mapping of large urban areas shows systematic omission errors.

Within the GHSL project, considerable effort has been invested in the development of a deep-learning based framework (GHS-S2Net) for large-scale mapping of human settlements from Sentinel-2 Copernicus data. The deployment of the model on the global Sentinel-2 image composite provided the most detailed and complete map reporting about built-up areas for reference year 2018 (Figure 96). The results are validated with an independent reference dataset of building footprints covering 277 sites across the world. The most noticeable achievement of the GHSL approach is the capacity of the model to classify built-up areas in remote areas (e.g. in Africa and in Asia), reported in none of the global products (i.e. GUF, WSF, FROM GLC10). The resulting dataset will be used as a baseline for the production of the GHSL 2020 data package (see Box 1 p. 119). This work contributes to cutting-edge research in the field of automated built-up areas mapping from remote sensing data and establishes a new reference layer[26] for the analysis of the spatial distribution of human settlements across the rural-urban continuum (Corbane, Syrris, et al. 2020).

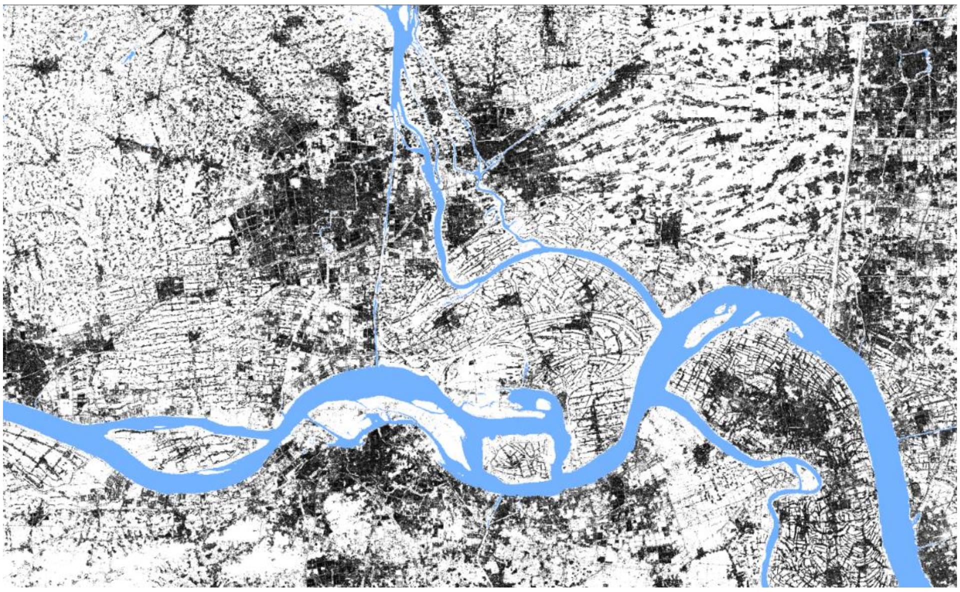

Figure 96. The most detailed and up-to-date map of built-up areas derived from Sentinel-2 Copernicus data in the framework of GHSL. The example here is taken from China.

[26] Corbane, Christina; Sabo, Filip; Politis, Panagiotis; Syrris Vasileos (2020): GHS-BUILT-S2 R2020A - built-up grid derived from Sentinel-2 global image composite for reference year 2018 using Convolutional Neural Networks (GHS-S2Net). European Commission, Joint Research Centre (JRC) PID: http://data.europa.eu/89h/016d1a34-b184-42dc-b586-e10b915dd863, doi:10.2905/016D1A34-B184-42DC-B586-E10B915DD863