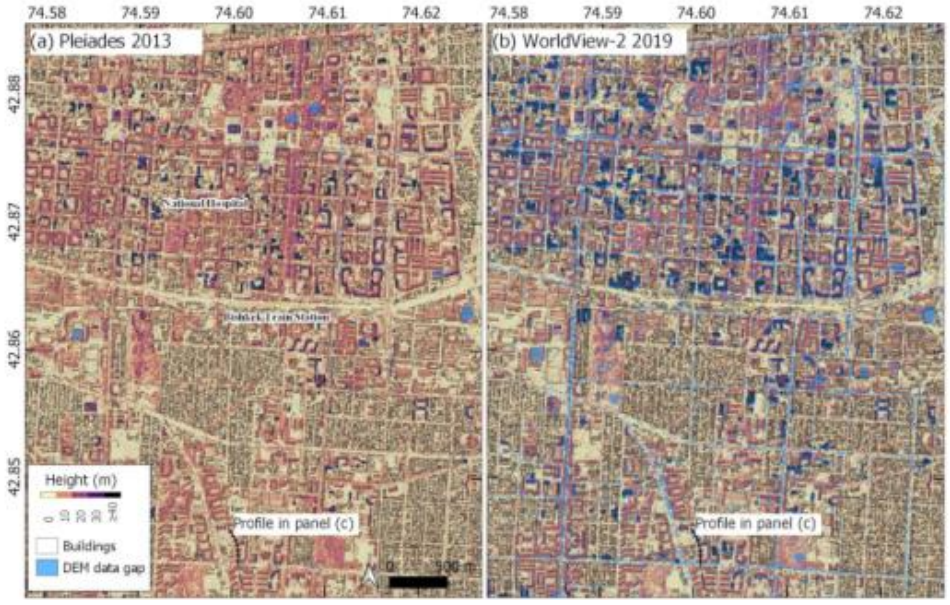
EO-FIN

## Building Inventory




Example hillshaded DSMs for Pleiades (a) and WorldView-2 (b) over central Bishkek, Kyrgyzstan (Source: Watson, C.S., Elliott, J.R., Amey, R.M. and Abdrakhmatov, K.E., 2022. Analyzing Satellite-Derived 3D Building Inventories and Quantifying Urban Growth towards Active Faults: A Case Study of Bishkek, Kyrgyzstan. Remote Sensing, 14(22), p.5790.).

### Product Category

| | | | |
|---|---|---|---|
| ■ Land Use | ☐ Natural Disaster | ☐ Coast Management | ☐ Earth's Surface Motion |
| ☐ Land Cover | ☐ Climate Change | ☐ Marine | |

### Financial Domain(s)

| | | | |
|---|---|---|---|
| ☐ **Investment management** | ■ **Risk analysis** | ☐ **Insurance management** | ☐ **Green finance** |

### User requirements

UN47: Need up-to-date geospatial data on residential and industrial infrastructures' locations

### Description

Detecting structures and associated details like their heights can provide insights into urban population density and enable the tracking of construction activities. Such data is valuable for formulating investment strategies and overseeing construction advancements, facilitating both investment planning and project monitoring. Due to the progress in sophisticated deep learning methods, it is now possible to identify buildings from VHR optical satellite pictures. Additionally, stereo and tri-stereo satellite visuals can be employed to gauge building heights through the creation of digital surface and terrain models (DSM and DTM). These techniques can be utilised to generate various maps about building footprint, building count, building area, building density, and even an approximate count of stories and floor area. These insights are instrumental in deducing details about the density of the population.

### Spatial Coverage Target

Building Level

### Data Throughput

| | | |
|---|---|---|
| Rapid tasking | ☐ High | ■ Low |
| Data availability | ☐ High | ■ Low |

| Product specifications | |
|---|---|
| **Main processing steps** | Built-up areas can be identified using high-resolution land cover data such as the world settlement footprint (WSF) (10 m resolution). Alternatively, we can classify cloud-free Sentinel-2 images into Corine 2018 land-cover classes using a pre-trained U-net deep learning. Subsequently, VHR stereo images (such as Worldview-2&3) and tri-stereo images (such as Pleiades) can be orthorectified and pansharpened, then fed to a deep learning based semantic segmentation model for building extraction, by using available building datasets. The stereo and tri stereo image would also be used to derive point cloud and DSM using software such as Agisoft Metashape. All DSMs should be coregistered to TanDEM-X DSM. In addition, DTM which represents the surface features after the removal of vegetation and building can be generated using LAStools. By clipping the DSMs and DTMs to the building footprint, building heights can be calculated by subtracting DTMs from DSMs. |
| **Input data sources** | Optical: VHR stereo and tri-stereo images from commercial sources such as Worldview-2&3 and Pleiades, Sentinel-2 (for built-up regions identifying)<br>Radar: N.A<br>Supporting data: high resolution land cover data such as WSF, building detection training datasets for deep learning models |
| **Accessibility** | Sentinel-2: freely and publicly available from ESA.<br>Stereo and tri-stereo VHR imagery: commercially available on demand from EO service providers. |
| **Spatial resolution** | Optical VHR: <1m<br>Sentinel-2: 10m |
| **Frequency (Temporal resolution)** | Optical VHR: Daily<br>Sentinel-2: 6 days |
| **Latency** | ≤ 1 day |
| **Geographical scale coverage** | Globally |
| **Delivery/ output format** | Data type: Raster<br>File format: GeoTIFF |
| **Accuracies** | Thematic accuracy: 60-70%<br>Spatial accuracy: 1.5-2 pixels of input data |
| **Constraints and limitations** | ■ Cloud presence<br>■ Urban areas across the world can have different building styles, densities, and layouts, which can make creating universally applicable methods challenging.<br>■ Tall buildings or structures can cast shadows making it challenging to accurately identify their characteristics, and occlusion might hinder the detection of buildings behind vegetation or other structures.<br>■ Estimating precise building heights from satellite imagery can be complex due to variations in terrain, building shapes, and local conditions.<br>■ Cost of VHR images<br>■ Using satellite imagery for building inventory might raise legal and privacy concerns, especially when dealing with sensitive areas or personal property. |
| **User's level of knowledge and skills to extract information and perform further analysis on the EO products.** | Skills: Ample<br>Knowledge: Ample |