The core of the Mapflow is the AI-Mapping Models. Mapflow enables the detection and extraction of features in satellite and aerial images powered by semantic segmentation and other deep learning techniques.

AI-Mapping Models

 Buildings

Extracting of roofprints of buildings from the imagery of high resolution.

Additional options:

> *Classification by types of buildings* – typology of buildings is represented by the main classes (see reference).
> *Building heights* - building height estimation by the length of the shadow and the visible part of the wall. Shift to the building footprint.
> *Simplification* - The algorithm allows you to correct the irregularities of the contours of our model.
> *Merge with OSM* - This option allows you to replace the obtained data of our model with data from the Openstreetmap, if the polygons of the OSM buildings and the model overlap significantly (Jaccard coefficients - more than 0.7).

 High-density housing

Our “high-density housing” AI model is designed for areas with terraced or otherwise densely built buildings, common in the Middle East, parts of Africa, etc.

Buildings (Aerial imagery)

This model is designed to detect not only big buildings but also small buildings like garages and sheds in very high-resolution aerial data.

Forest

Extracting the forest masks from RGB images of high resolution (2 meters) without classification by type, density, or height.

Additional options:

Classification by heights – classification of the areas of vegetation and shrub by height classes according to the specified thresholds: 0-4 m, 4-10 m, 10+ m, and division of classes in 4+ m according to the density of vegetation into dense and sparse. Forest areas of each height class are polygonized in separate features. The height class and density of vegetation are specified in the polygon properties.

Roads

Extracting the road mask from satellite images of high spatial resolution.

Construction

Detection of the construction sites by classification of les of hi-resoluon satellite images.

Agriculture fields

Extraction and instance separation of agriculture fileds from high-resoluon satellite imagery.

Models reference

Buildings

Model	Description	Channel composition, GSD m/px	Model input, zoom	Model input, data type

Segmentation	Extract roof contours (roofprints) from high-resolution satellite imagery	RGB *, 0.5	18	Unsigned integer, 8 bit
Classification	Here are the types that we currently recognize: apartment buildings; single-household dwellings; industrial; commercial; other non-residential	RGB *, 0.5	18	Unsigned integer, 8 bit
Building heights	For each building, model estimates its height using its wall's and shadow's lengths. If height detection option is selected, all roof contours are shifted accordingly, i.e. converted to building footprints	RGB *, 0.5	18	Unsigned integer, 8 bit

Buildings (Aerial imagery)

Model	Description	Channel composion, GSD m/px	Model input, zoom	Model input, data type
Segmentaon	Extract roof contours (roofprints) from very high-resoluon aerial imagery	RGB *, 0.1	20	Unsigned integer, 8 bit

Forest

Model	Description	Channel composion, GSD m/px	Model input, zoom	Model input, data type
Segmentaon	Extract segmentaon masks of forested areas from high resoluon RGB images	RGB *, 2	16	Unsigned integer, 8 bit
Classificaon	Classify the areas of vegetation and shrub vegetation by height and vegetation density	RGB *, 0.5	18	Unsigned integer, 8 bit

Roads

Model	Description	Channel composion, GSD m/px	Model input, zoom	Model input, data type

Segmentation	Extract road mask from high resoluon satellite imagery	RGB *, 1	17	Unsigned integer, 8 bit

High-density housing

Model	Description	Channel composion, GSD m/px	Model input, zoom	Model input, data type
Segmentation	Extraction and instance detection of the building roofprints in the areas of high density housing	RGB *, 0.5	18	Unsigned integer, 8 bit
Building heights	For each building instance, model predicts its height. If height detection option is selected, all roof contours are shifted accordingly, i.e. converted to building footprints	RGB *, 0.5	18	Unsigned integer, 8 bit

Construction

Model Model	Description	Channel, composition, GSD m/px	Model input, zoom	Model input, data, type
Segmentation	The model highlights areas in the satellite image that contain construction sites and buildings under construction	RGB *, 0.5	18	Unsigned integer, 8 bit

Agriculture fields ¶

Model	Description	Channel composition, GSD m/px	Model input, zoom	Model input, data type
Segmentation	Extraction and instance separation of agriculture fields from high-resolution satellite imagery	RGB *, 1.2	17	Unsigned integer, 8 bit

* Mapflow.ai can also process single-band (panchromatic) imagery, but the NN models are not tuned for such kind of data, so the quality of the result may be worse than expected.

Buildings

Extracting of roofs of buildings from the imagery of high resolution. High performance deep learning model is trained to detect the roofs of the buildings. It is trained primarily on the territory of Asia, including cities, small towns and rural territories and performs good enough on them.

However, the results for the territories with significantly different landscape and urbanizaon patterns (like dense building blocks, skyscrapers or mountain areas) can be not so impressive.

Note: The building candidates with an area less than 25 sq.m. are removed to avoid clutter

The model does not extract the footprints directly, because they are not clearly visible in the images, but we can obtain them, just like human cartographers, by moving the roof to the boom of the wall (see Additional options).

Additional options:

Classification by types of buildings – typology of buildings is represented by the main classes (see reference).
Building heights - building height estimation by the length of the shadow and the visible part of the wall. This option also provides building footprints instead of roofs. See our article for some details on the technology.
Simplification - the algorithm corrects the irregularities of the contours of our model. The irregular geometries are replaced with rectangles, circles or arbitrary polygons with 90-degree angles, which fits better the original shape. Also, the corrected buildings are

rotated to align with the nearest roads. This option produces much more map-friendly shapes which look beer and are easier to edit, but some shape accuracy can be lost. See our blog post for more information and some visuals.

Merge with OSM - some of the areas have great coverage of OpenStreetMap data, and if you prefer human-annotated data, you can select this option. In this case, we check for each building whether it has a good corresponding object in OSM (Jaccard index more than 0.7) and if there is one, we replace our result with OSM contour. This makes the result not based on the image, so the buildings can be shifted from actual positions, and some changes that have occurred after OSM mapping may be lost.

Processing results samples

A sample of processing results with different options for Prague, Chech Republic.

Result without postprocessing: irregular building shapes, but best fit to the actual rooftop contour seen in the image.

Result with simplification: most of the buildings become rectangular.

Results merged with OSM: some of the buildings imported from OSM have more accurate shape, but can be shifted from the image position. ¶

Buildings (Aerial imagery)

This model is specifically designed to make use of very high-resolution aerial imagery (10 cm per pixel) for the Extraction of small buildings and structures. It is best suited for rural and suburban residential areas.

We do not recommend using this model in areas with high urban residential or commercial buildings. Use the Buildings model instead, even for aerial imagery.

Processing results samples

Processing example a rural residential area with a Building model (Aerial photo)

High-density housing

Our “high-density housing” AI model is designed for areas with terraced or otherwise densely built buildings, common in the Middle East, parts of Africa, etc. This model, just like the regular building model, detects the building roofs.

Firstly, the building blocks are segmented as a whole, and then each block is divided into individual houses with a rectangular grid or Voronoi diagram, based on the detected individual roof markers.

Processing results samples

Processing result sample for dense urban development area (Tunisia, Africa):

The standard model for buildings segmentation, with polygon simplification

High density buildings model

! » Forest

Forest

Forest Segmentation. The model is trained on high-resolution data (2m) for central and boreal Russia in the summer period.

The result includes areas covered with tree and shrub vegetation, including sparse forest and shrublands. The model resolution does not allow it to detect individual trees and narrow tree

lines, and draw a strict border for the forested areas, but suits well for building a general analysis map.

The model is robust to region change and performs well not only for Russia but also in other countries and continents. The image should be taken in active vegetation period, because leafless trees or vegetation covered with snow are not the target class. Postprocessing:

Additionally we use models for density and height estimation, dividing the forested area into the following classes:

Shrubs lower than 4 meters high(sparse or dense);
Forest from 4 to 10 meters high, sparse;
Forest from 4 to 10 meters high, dense;
Forest more than 10 meters high, sparse;
Forest more than 10 meters high, dense.

This model can be used as decision support for the forest growth clearing.

Processing results samples

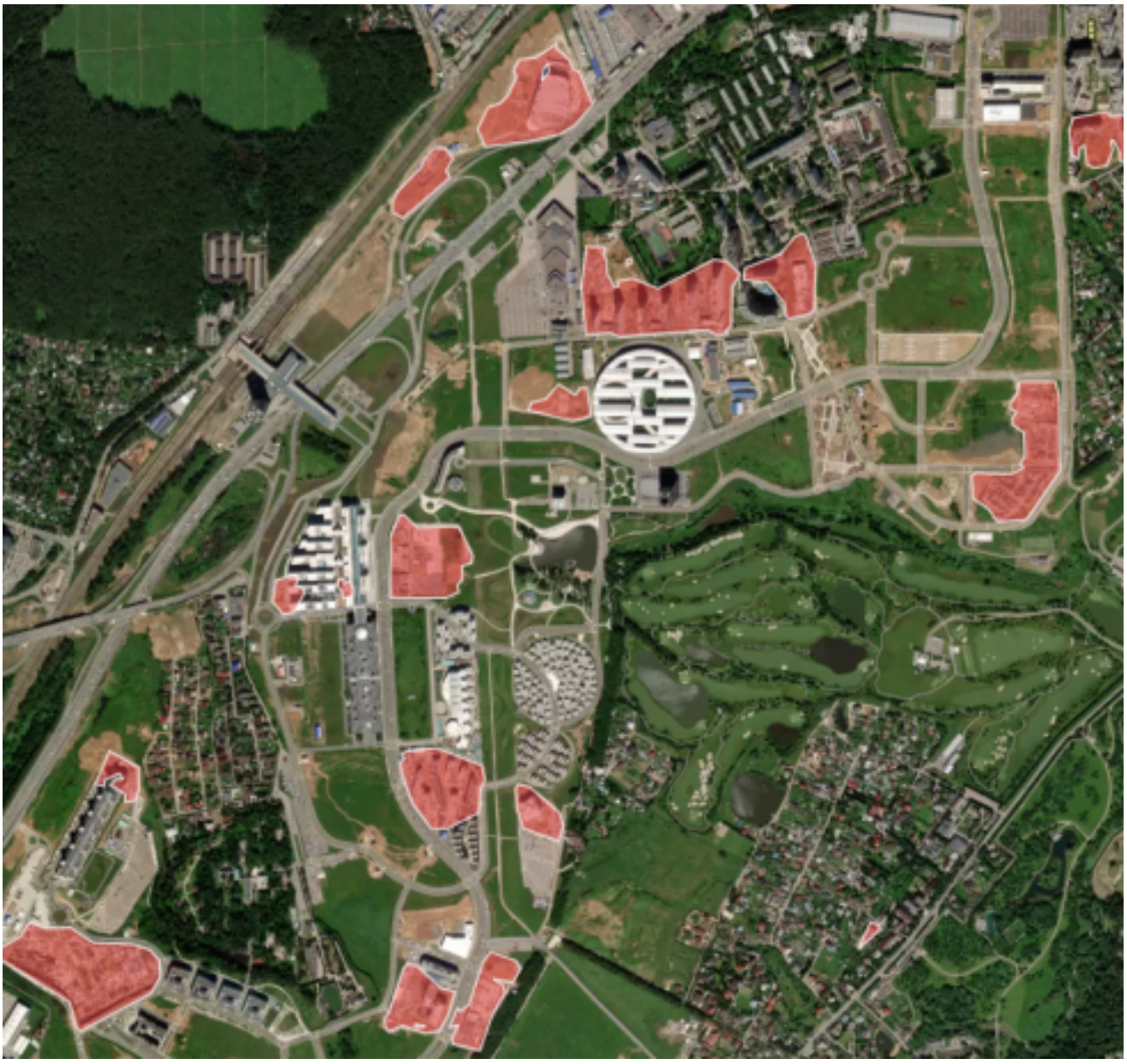
Processing results for central Russia (Tatarstan)

! » Construction

Constructions

This model outlines the areas in the satellite image that contain construction sites and buildings under construction. Very high-resolution imagery (0.3-0.5 m) for the territory of Russia is used. See our blog post on model development and motivation.

Processing results samples



Processing results for a rapidly developing area with a lot of construction sites.

Cropland Fields

Model for fields segmentation allows detection the agricultural fields and delineates the nearby fields from each other, if there is a visual boundary (forest line, road, different crop stage). The model is trained on the high-resolution data (1-1.2 m), primarily for Europe, and Russia. It performs beer with larger fields with active vegetation. Smaller and terrace fields (typical for Asia) are delineated not so well. Fields without vegetation, especially in the winter period, are not the target class.

Processing results samples

Processing result sample for Asia (Northern India)