

An input tif image of arbitrary size ...

... gets dissected with a tiling window algorithm.

The extracted tiles are separately fed into LineaMapper, which outputs predictions of classified masks.

The output masks are merged together.

The above step is done for the whole input image. Finally, the merged features are georeferenced for use in a GIS software.

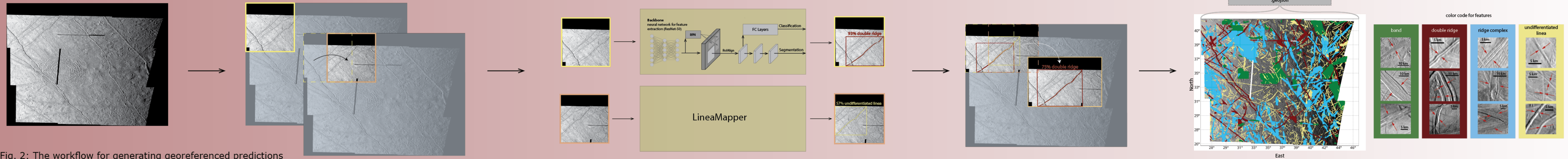


Fig. 2: The workflow for generating georeferenced predictions

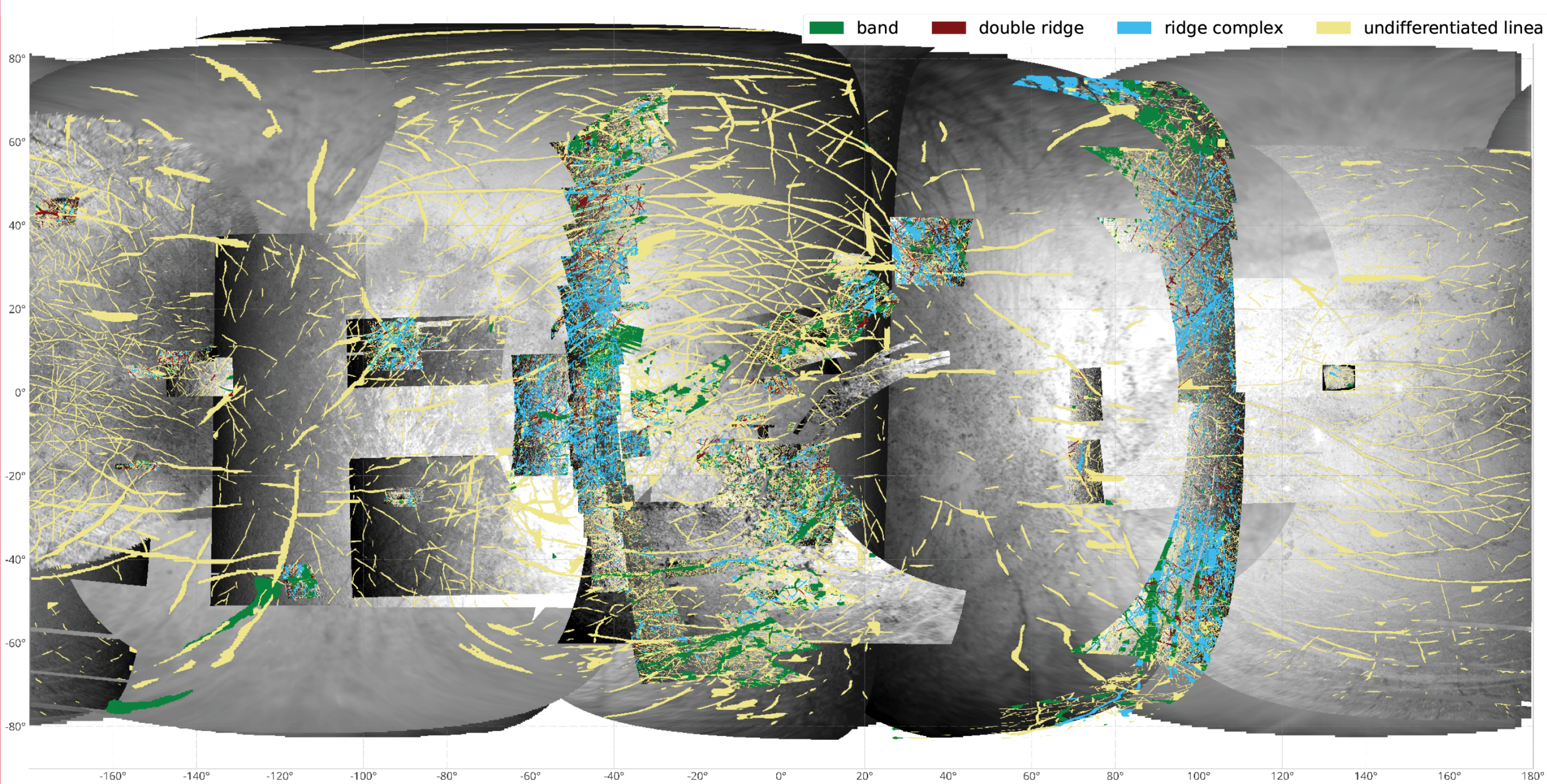


Fig. 1: A global map of lineaments produced with the workflow shown in Fig. 2.

A WHAT? A global map of lineaments

We applied a deep-learning network called LineaMapper [1] to remote sensing images of Jupiter's icy moon Europa for mapping linear surface features (bands, double ridges, ridge complexes and undifferentiated lineae).

With LineaMapper, we produced a global map of linear surface features based on Voyager, Galileo and JUNOCAM images (see Fig. 1).

B WHY? 300 times faster

Geological mapping is a valuable, but cumbersome process [4,5]. Deep learning can reduce the mapping time while providing tunable output. The workflow described in (C) is at least 300 times faster than a geological mapper (Fig. 3).

In the light of upcoming missions to Europa [6,7], LineaMapper can be applied for an inexpensive initial analysis of incoming data.

With a detailed global lineaments map, we advance our understanding of the formation and evolution of linear surface features.

C HOW? 13 hours, LineaMapper

We fed all available photogrammetrically corrected mosaics of Europa [2] and two JUNOCAM [3] images into the workflow (Fig. 2). It took 13 hours to produce the georeferenced predictions shown in the global map with one GPU. Different output can be generated by altering preprocessing (e.g. projections, resolution) or processing parameters (e.g. score threshold, mask threshold).

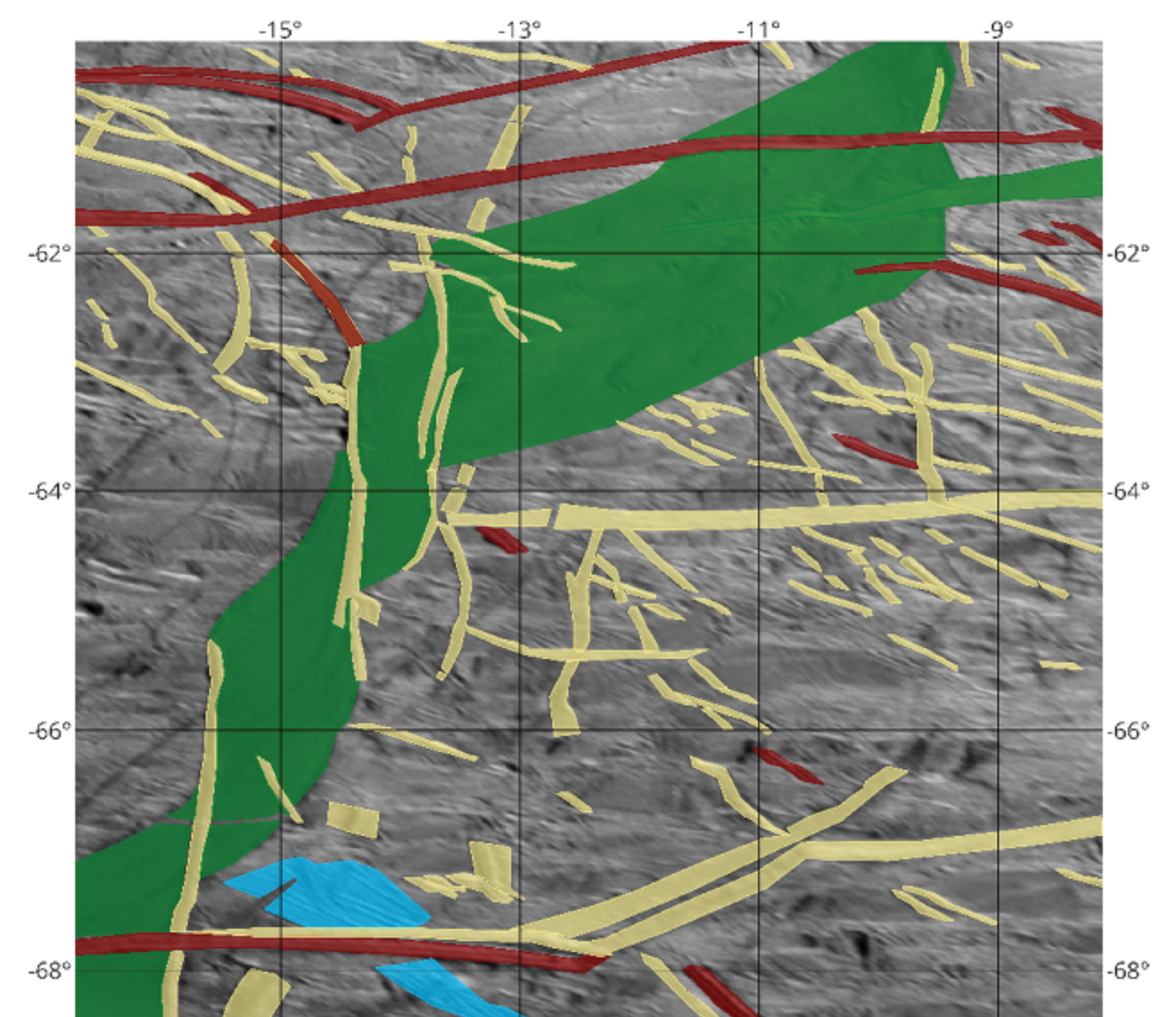


Fig. 3: A human mapper needed 100 minutes to map this excerpt of 17ESREGMAP01, while the automated algorithm with LineaMapper took 20 seconds. (In the online version, the human mapping is displayed)

D SO WHAT NOW? Faults on Venus

The global lineament map must be checked and cleansed by a geologic mapper. This step leaves behind a bigger training set for the next version of LineaMapper.

We found that LineaMapper, although trained for Europa, is applicable to fault mapping on Venus for the study of seismicity.

Do you have an application idea for LineaMapper or want to know more about this work, then CONTACT ME! caroline.haslebacher@unibe.ch