Machine learning for boulder detection in acoustic data

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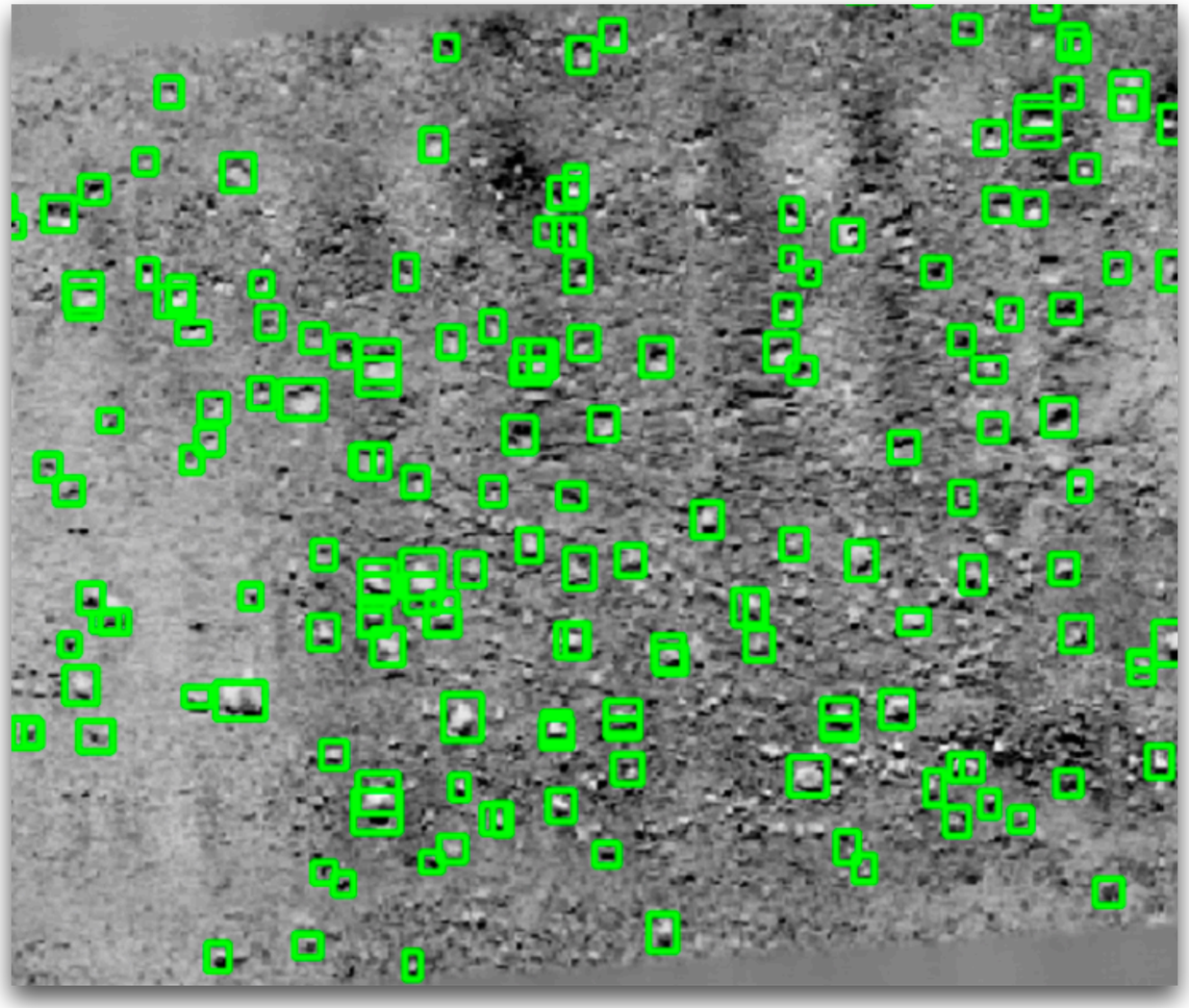
Boulder field are ecologically important hard grounds

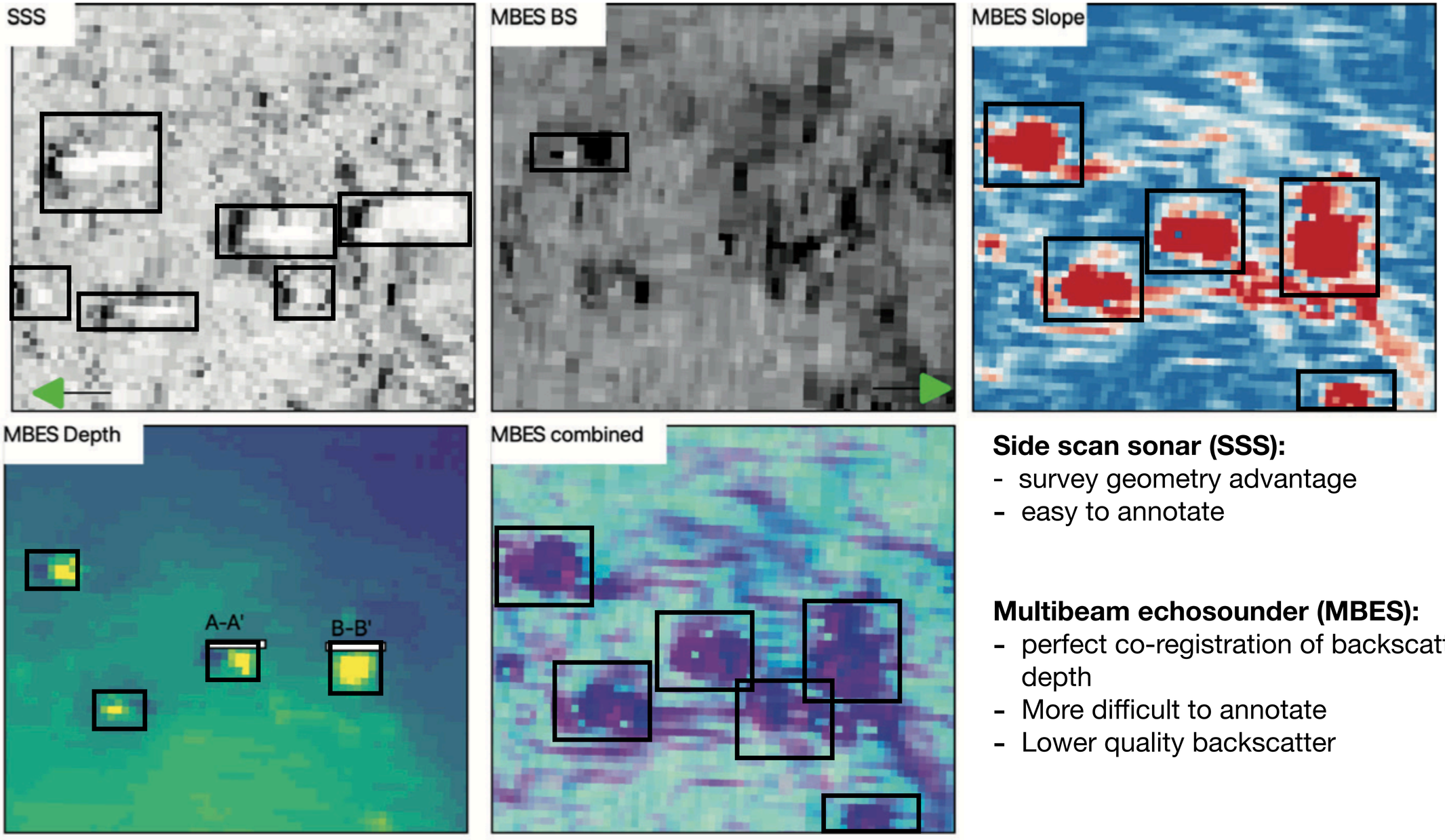


Ideally suited for AI object detection with convolutional neural networks:

- it is easy to acquire training data
- It is a very tedious problems for manual interpreters
- large areas have to mapped mandatorily for hydrographic, geological and ecological problems.

Procedure: label training data - train a convolutional neural network - apply to datasets

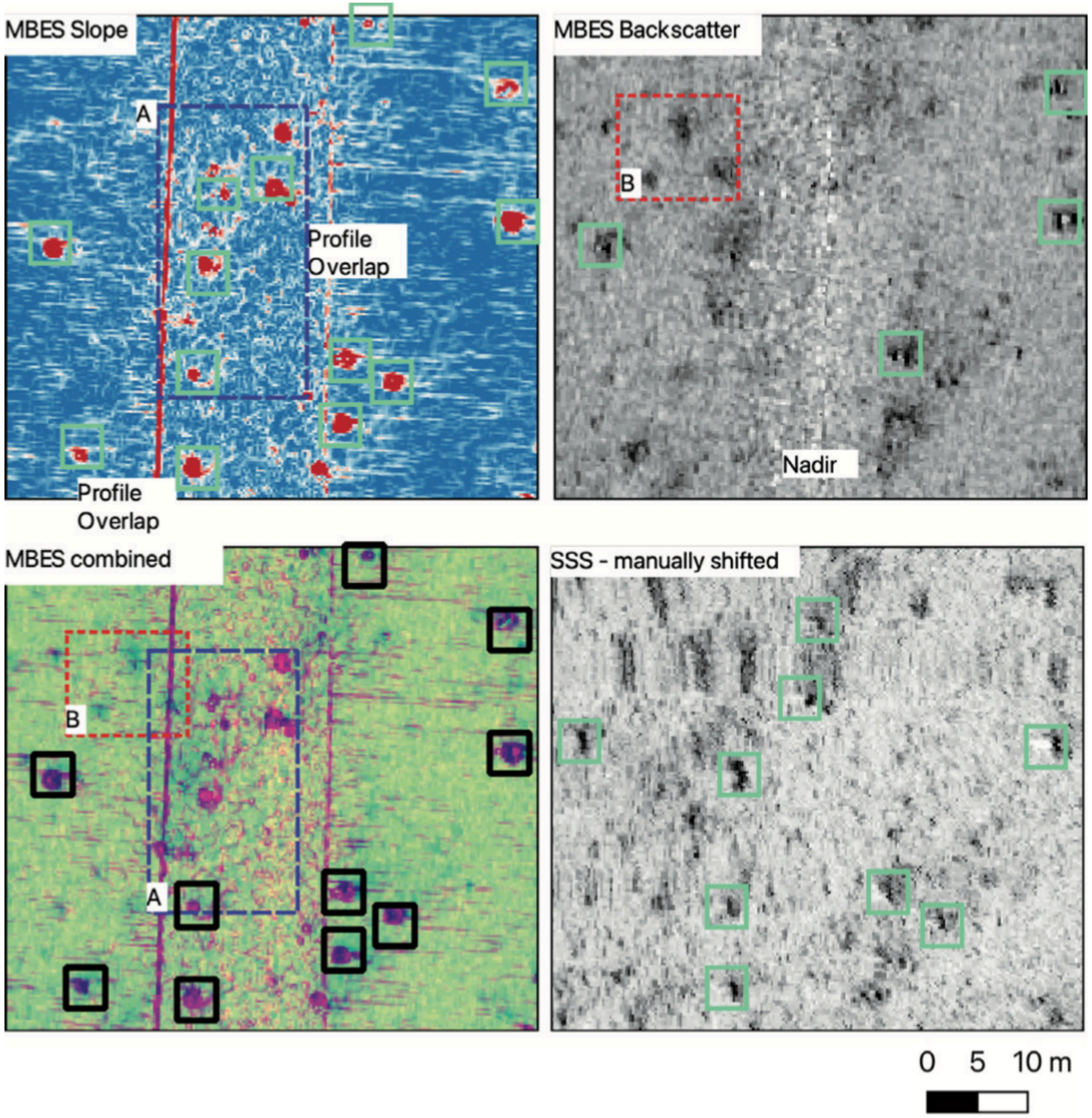
Boulder are recognised in different datasets



Side scan sonar (SSS):
- survey geometry advantage
- easy to annotate

Multibeam echosounder (MBES):
- perfect co-registration of backscatter and depth
- More difficult to annotate
- Lower quality backscatter

Feldens et al. 2021



There is no perfect dataset for detection.

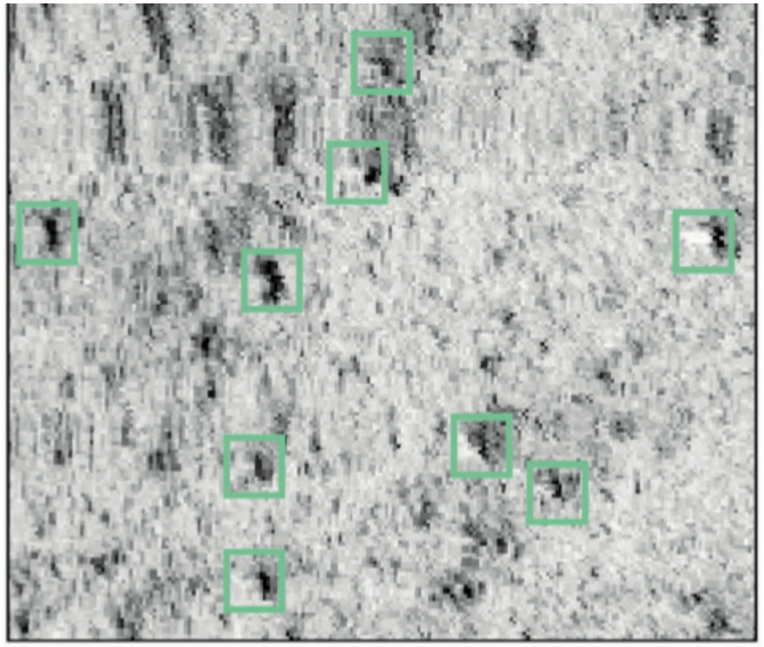
The best single-band dataset was slope.

We estimate that multi-band MBES composed of SLOPE-BACKSCATTER-(DEPTH/BPI) may be best.

For side scan sonar, including information on survey geometry and image texture may be promising.

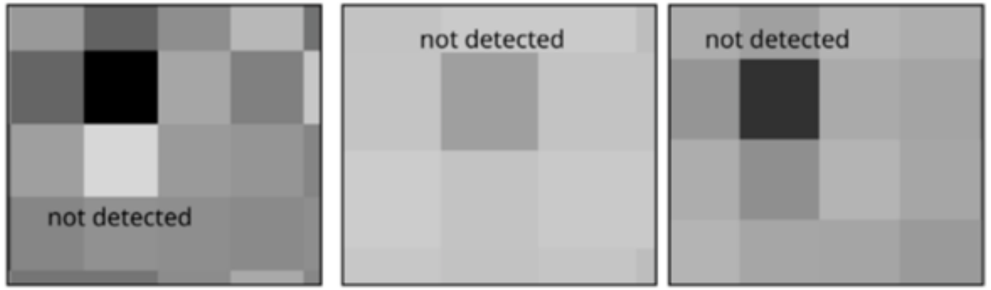
Data set	Model AP
MBES SLOPE	64 %
MBES DEPTH SLOPE BACKSCATTER	61 %
SSS BACKSCATTER large objects	43 %
SSS BACKSCATTER small objects	37 %
MBES DEPTH	36 %
MBES BACKSCATTER	18 %

Accurate detection of small objects remains problematic



Boulders start at 25 cm
1 pixel is commonly not more than that.

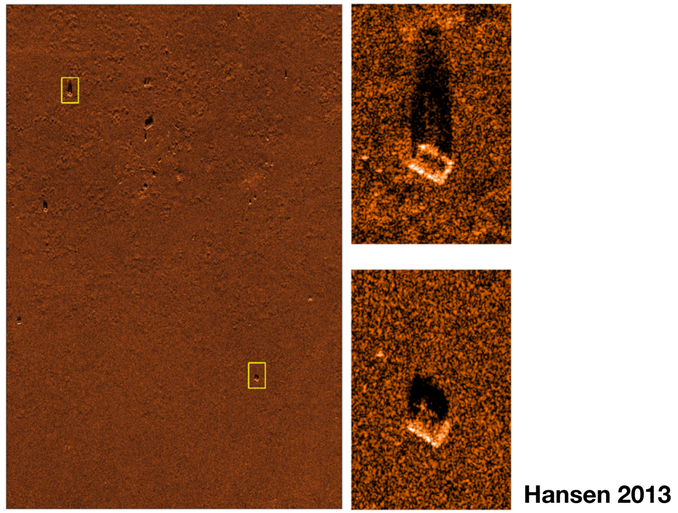
7-9 pixel are required
for our model



Feldens et al. 2019

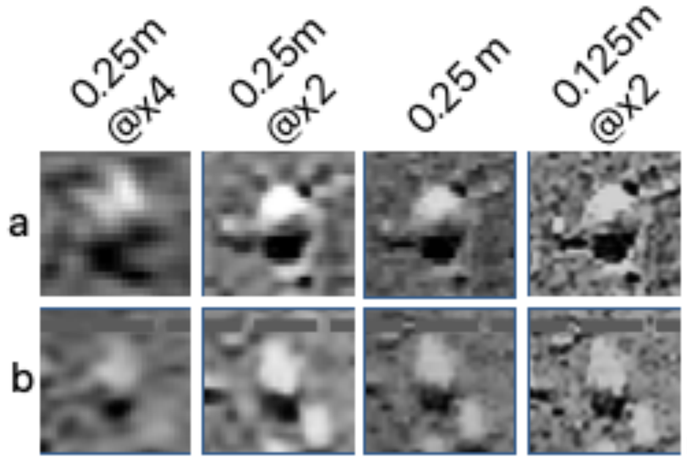
Solutions:

1. Higher resolution data (SAS)?



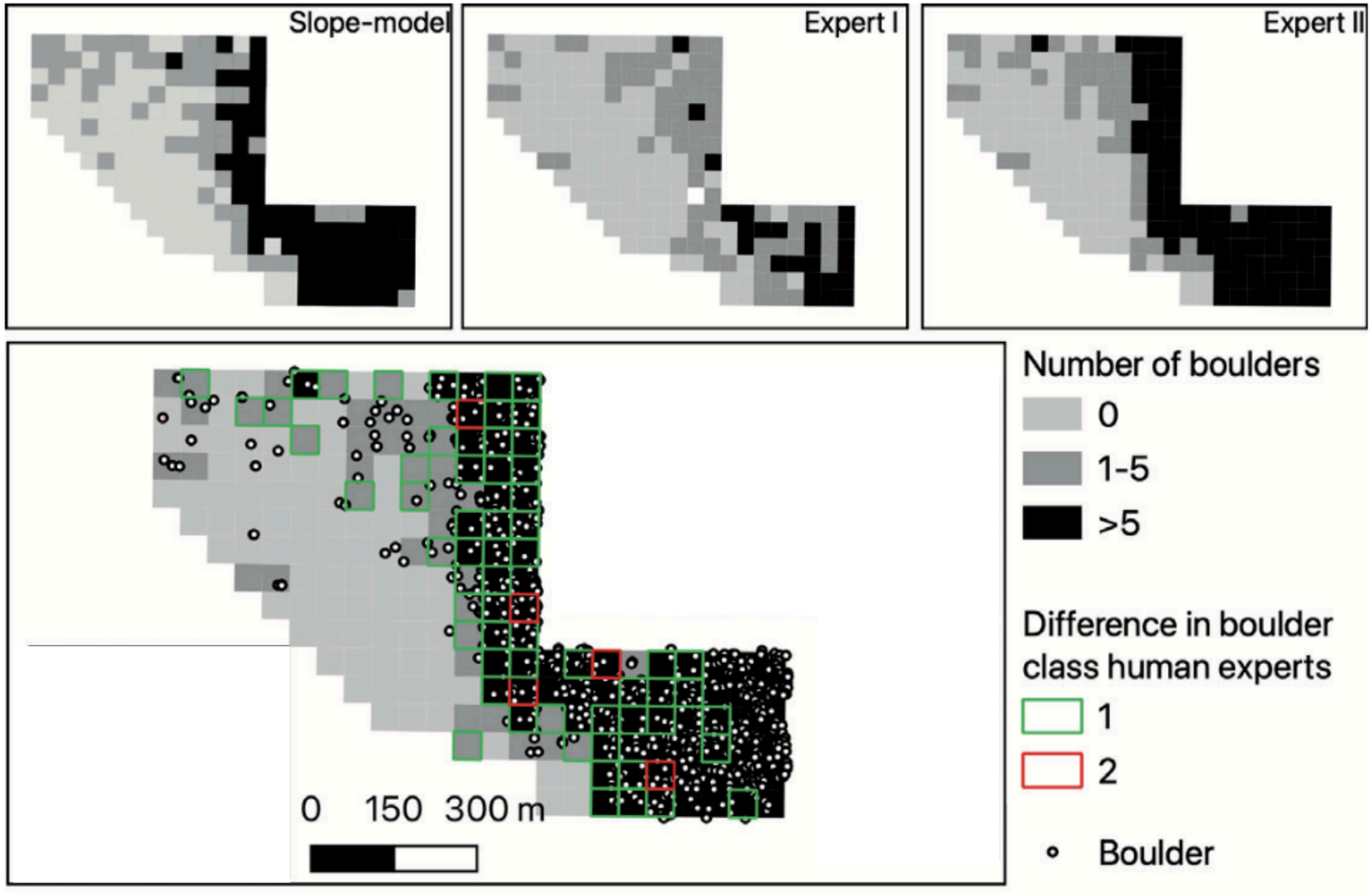
Hansen 2013

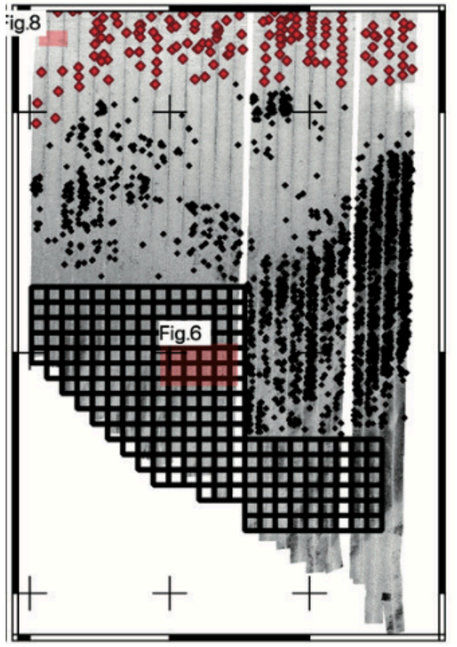
2. Super-Resolution/upscaling?



Feldens 2020

3. Improve network architecture and training detests?





Model performance difficult to judge quantitatively, because even interpretations of human expert vary extensively.

The creation of an accurate training and validation database is probably the most important step.

Thank you

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References

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