Fractional Snow Cover Retrieval from Sentinel-3 Data Using Deep Convolutional Neural Networks

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Challenge

Estimating fractional snow cover (FSC), snow grain size (SGS) and snow surface wetness (SSW) from Sentinel-3 data is challenging due to factors like terrain, sun elevation, cloud shadows and limited resolution.
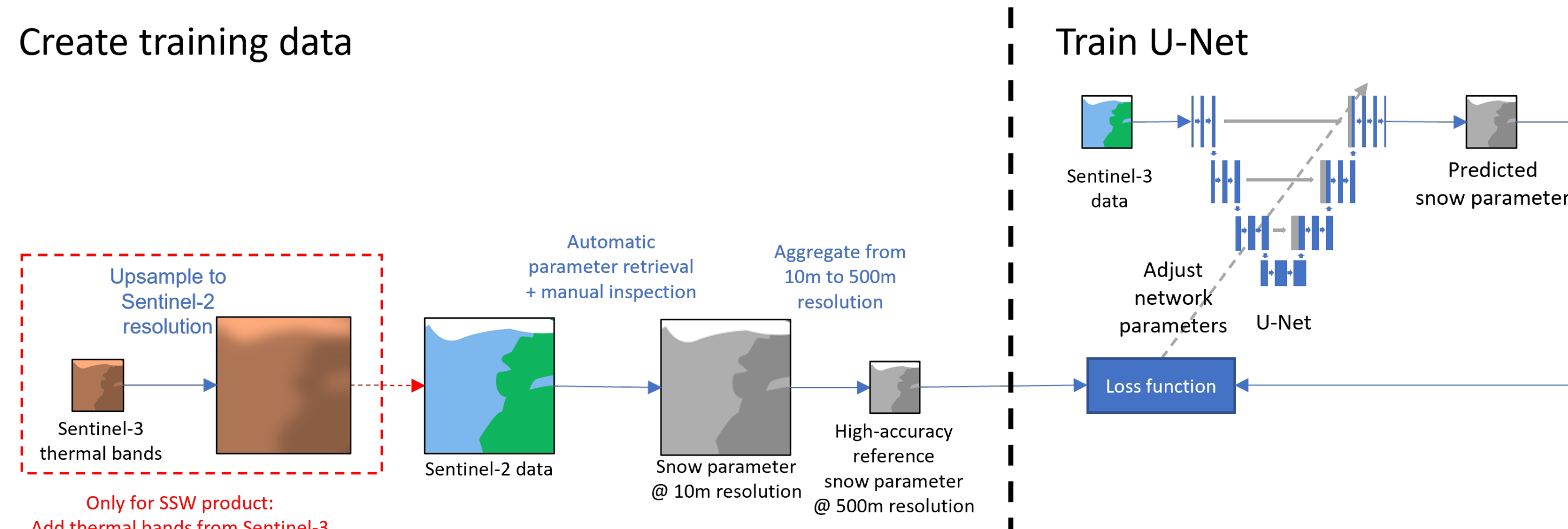
Our solution

We propose to train a deep convolutional neural network for pixel-wise mapping to estimate the snow parameters.

The network we have applied, is the popular U-Net, which can be applied for both regression (FSC and SGS) and classification (SSW).
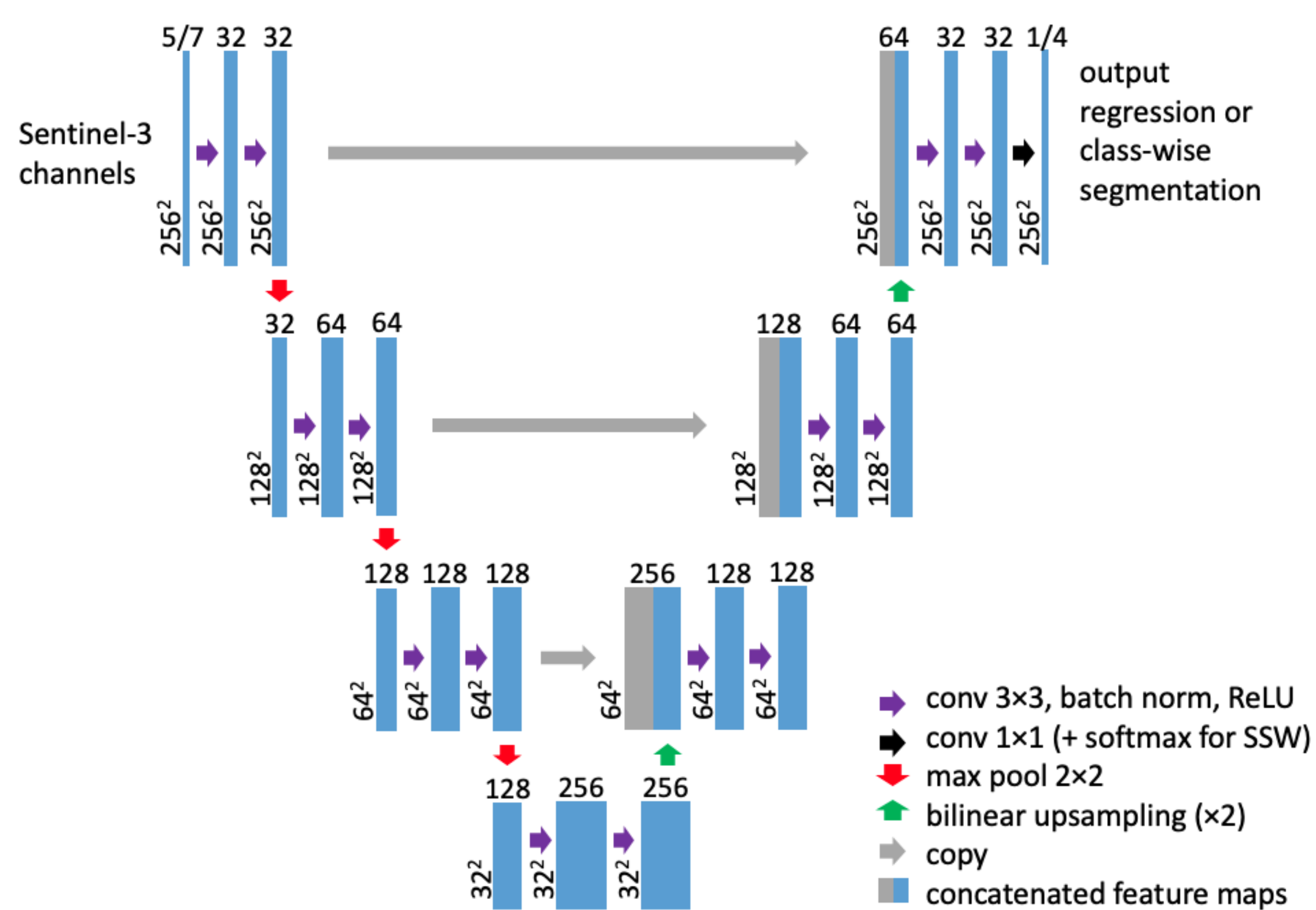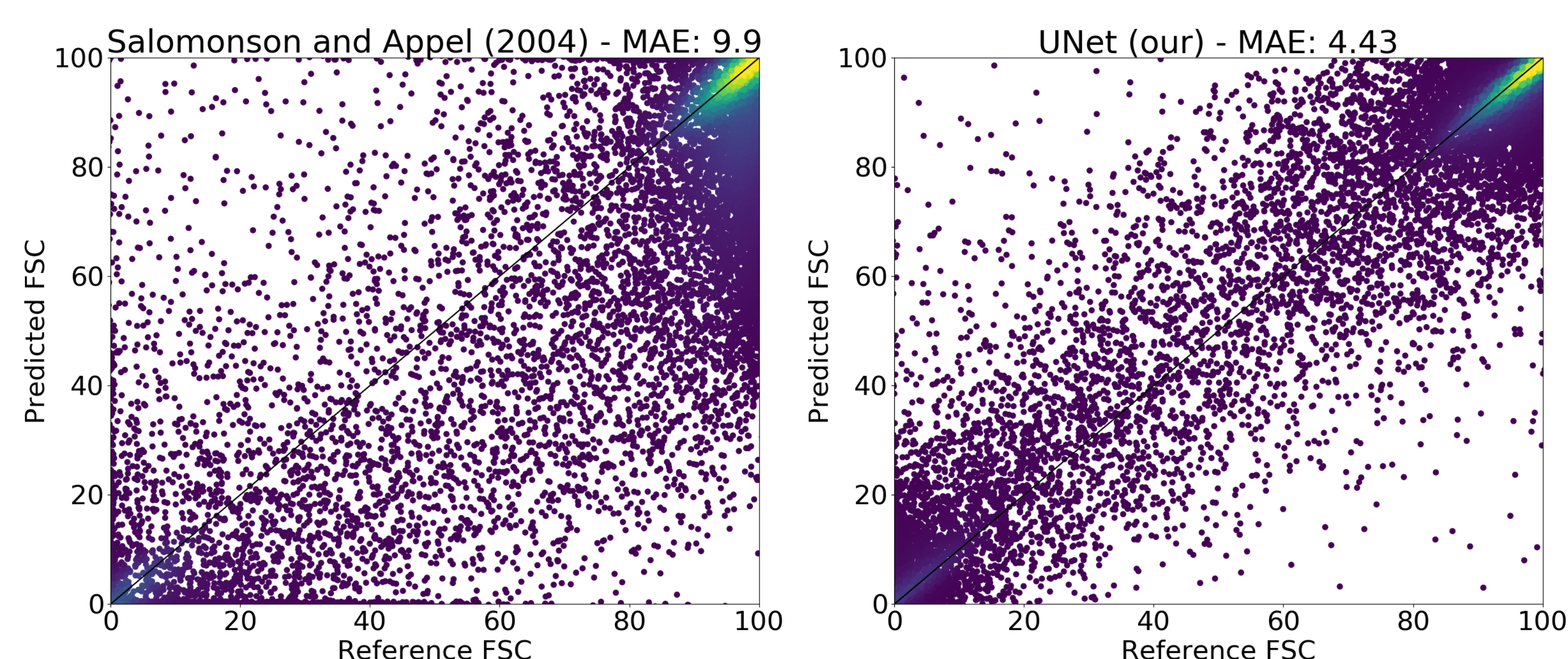

Training data created using aligned Sentinel-2 data.
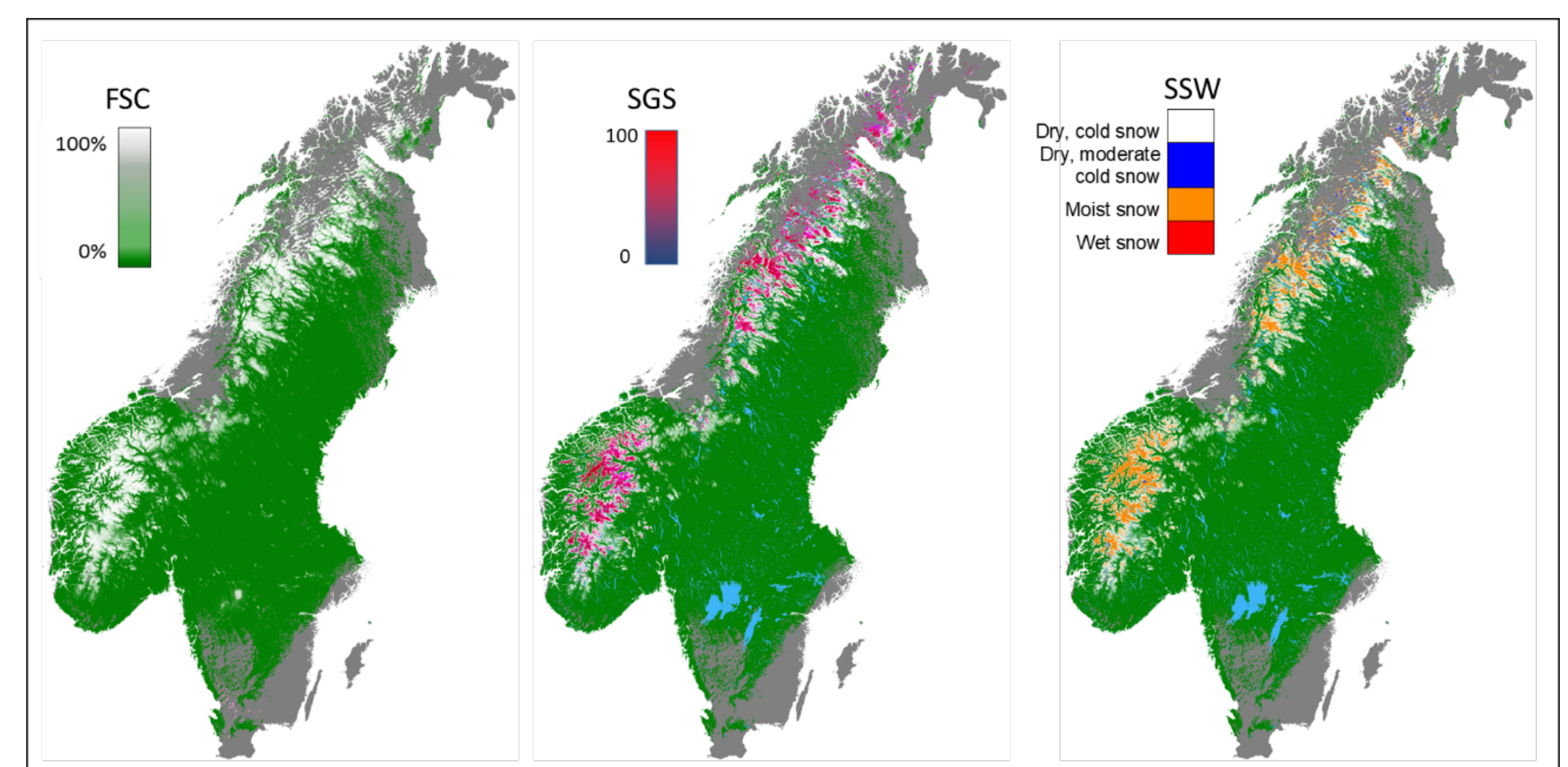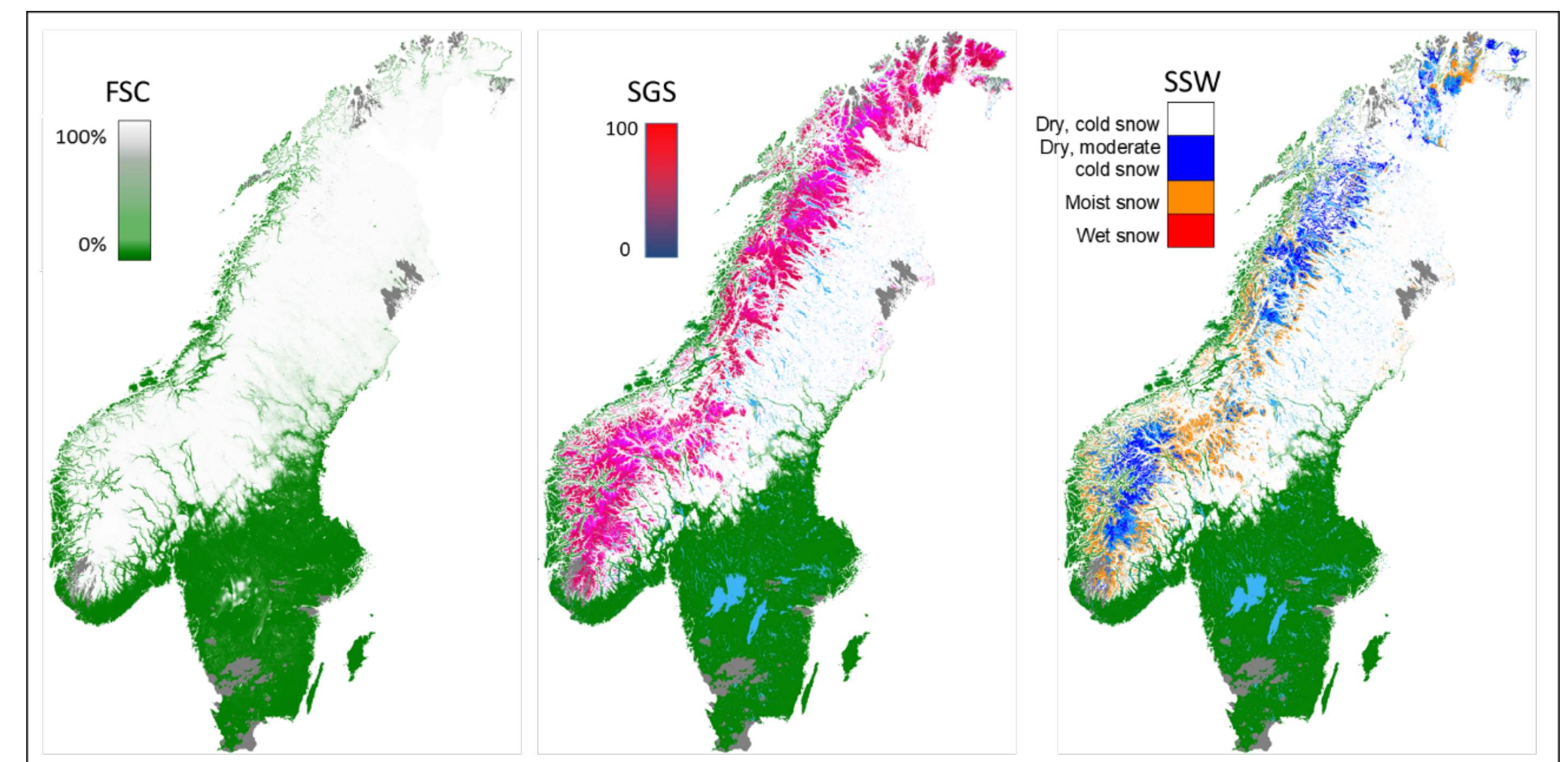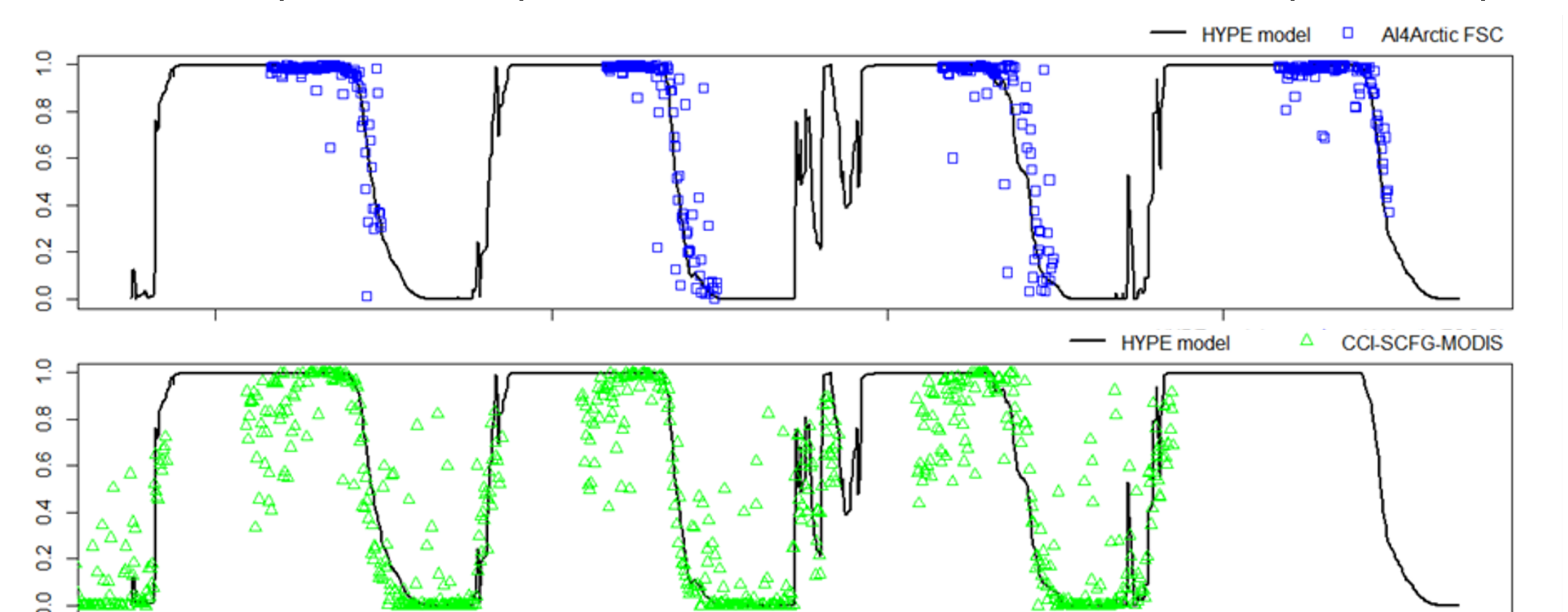

Results

Comparison of the reference FSC versus the predicted FSC for the S&A algorithm (left) and proposed method (right).

Snow parameter maps for April 18th, 2021 (top) and May 28th, 2021 (bottom).

FSC in Lake Överuman catchment, HYPE-model (solid lines), proposed (top panel) and Modis CCI FSC product (bottom).

Conclusions

The U-Net provides very good results for estimating FSC and SGS. The results for SSW were in general good, however, the performance for the dry – moderate cold snow and moist snow was not satisfactory. As in other machine-learning projects, we experience that the performance is very much depending of the quality of the training data.

Further improvements

► Get more training data from patchy snow and forests.
► Increase the SSW dataset with more samples from the moderate cold and moist snow classes.
► Apply a similar approach to segment clouds.