Remote Sensing Technology
TUM Department of Civil, Geo and Environmental Engineering
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Convolutional LSTMs for Cloud-Robust Segmentation of Remote Sensing Imagery

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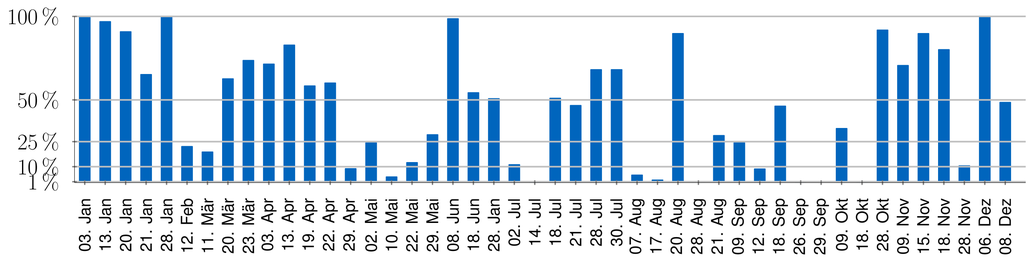
Cloud coverage: An omnipresent challenge to optical Earth observation models

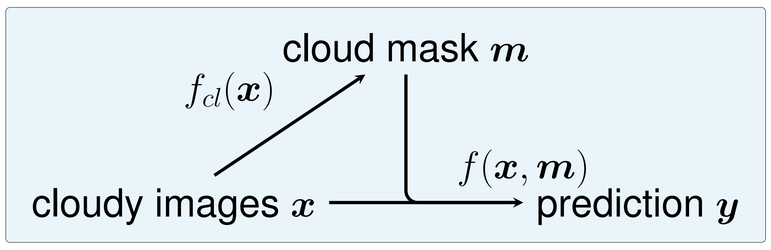
Optical Earth observation satellites
- measure the reflected sunlight
- of surface objects that are
- often covered by clouds
- in a large number of spectral bands

Cloud coverage over the 100km by 40km area of interest.



Separate cloud pre-classification

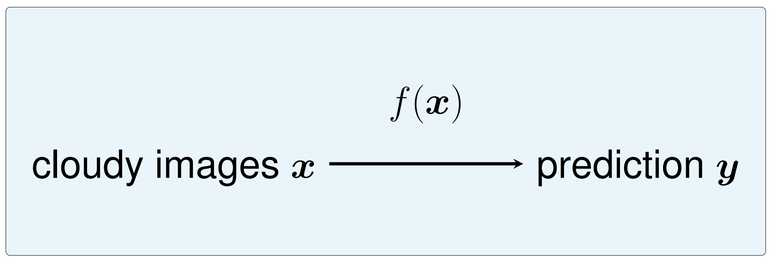
Identifying clouds in remote sensing
- is rarely the final objective
- is often performed by a separate cloud-classification model f_{cl}
- is usually a required preprocessing step for many approaches



complex processing pipeline

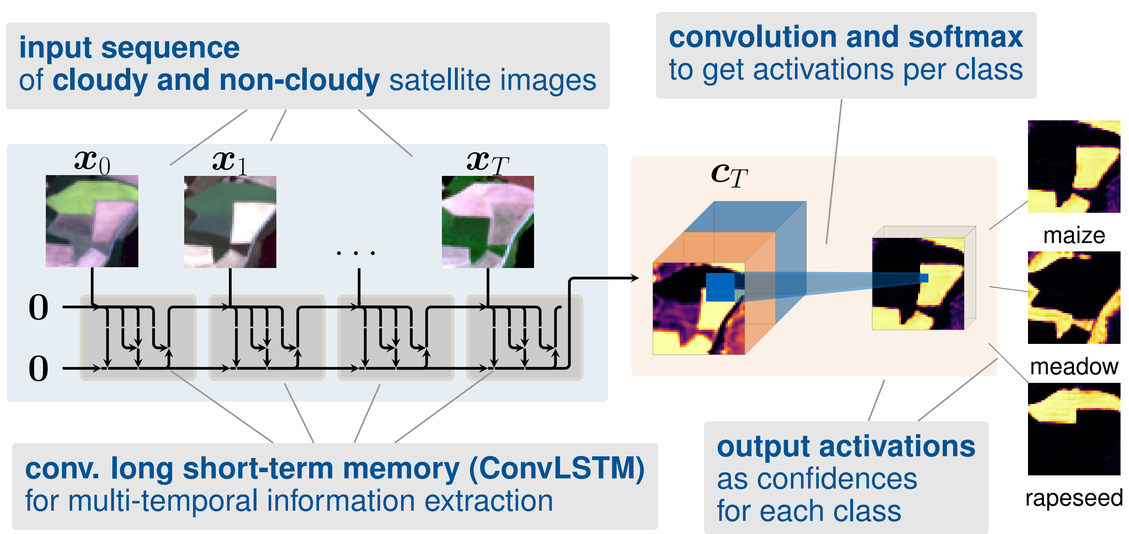
Learn to ignore clouds in one model

In this work
- We treat clouds as data-inherent noise
- by employing ConvLSTMs to learn cloud masking
- and classification in **one model end-to-end**.



our straightforward end-to-end trainable model

The cloud-robust ConvLSTM model for vegetation classification



Our ConvLSTM model $f(\boldsymbol{x})$
- encodes sequence of images $\boldsymbol{x}$ is by a ConvLSTM
- produces class activations $\boldsymbol{y}$ by final conv+softmax.

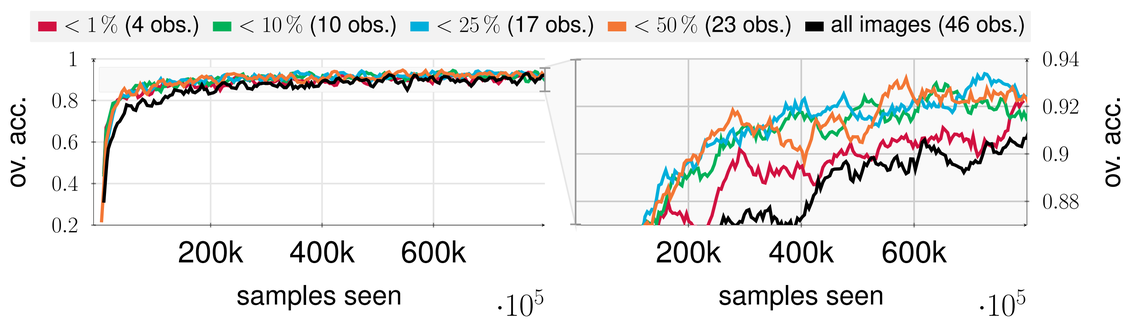
Trained to
- classify the vegetation type (maize, wheat, barley etc.)
- using 80k image sequences of 46 observations.

We achieved
- state-of-the-art accuracies in crop classification
- without prior cloud filtering
- published results in a remote sensing related journal[1].

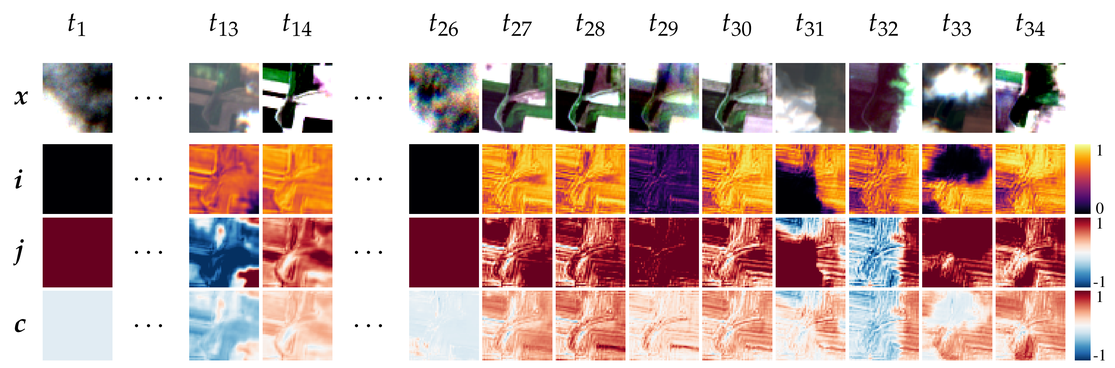
[1]Marc Rußwurm and Marco Körner. Multi-temporal land cover classification with sequential recurrent encoders. ISPRS International Journal of Geo-Information, 2018.

Did the ConvLSTM learn to ignore clouds?

We **trained** the network on **cloudy** and **non-cloudy** datasets observing the validation accuracy:



We **visualized** some **hidden LSTM states**



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