A Domain-Change Approach to the Semantic Labelling of Remote Sensing Images

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Semantic Labelling in Remote Sensing Images

"**Semantic labeling is the process of mapping attributes in data sources to classes in an ontology** " [1]

Recent approaches in semantic labelling of remote sensing images:

Supervised : Supervised Deep Learning models, high accuracy but high cost of annotation

Semi-supervised: Transfer learning, Active learning (Human in the loop), less expensive

Unsupervised: Based on latent data structure, may require expert's validation, least expensive

Our research explores an active learning method based on a tool developed by [2] and an unsupervised method based on Latent Dirichlet Allocation (LDA) as proposed by [3]. The two approaches are combined to create semantic labels for large datasets.

[1] Pham, Minh, et al. "Semantic labeling: a domain-independent approach." International Semantic Web Conference. Springer, Cham, 2016.

[2] W. Yao, C.O. Dumitru, and M. Datcu, "An active Learning Tool for the Generation of Earth Observation Image Benchmarks", IGARSS, Brussels, Belgium, (2021): 1-4.

[3] K. Chandrabali, C.O. Dumitru, and M. Datcu, "Feature-free explainable data mining in SAR images using latent Dirichlet allocation." IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing 14 (2020): 676-689.

Workflow combining Active Learning (semi-supervised) and LDA (unsupervised)

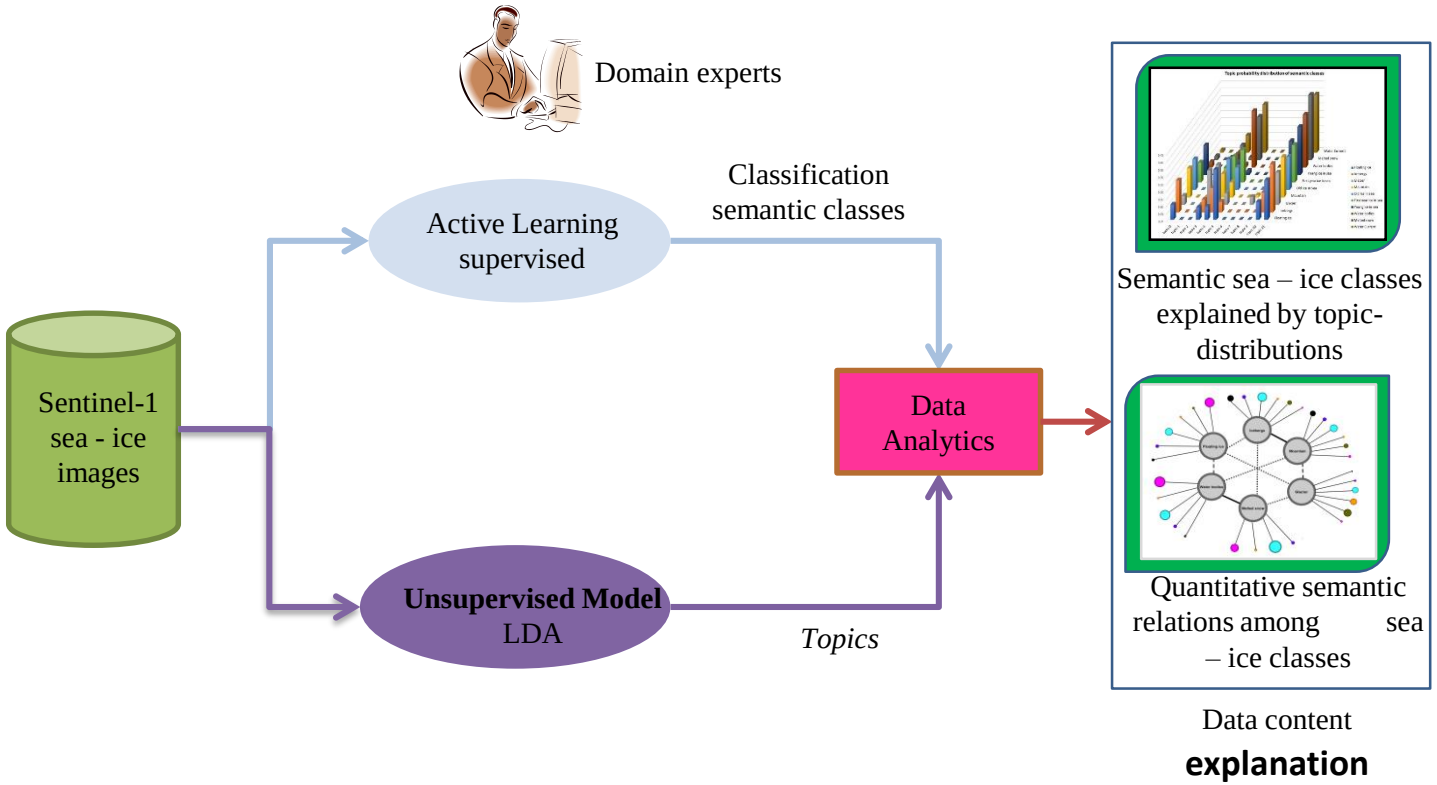
The Active Learning tool creates labelling for limited set of data

LDA is applied to discover latent structures called *'topics'* in an unsupervised manner

A relation between the labels and topics are established

Requires less amount of annotation

Integrates domain knowledge



Active Learning work mechanism

Techniques

SVM

Relevance feedback

Active learning

Machine interactively inquires a user for new knowledge

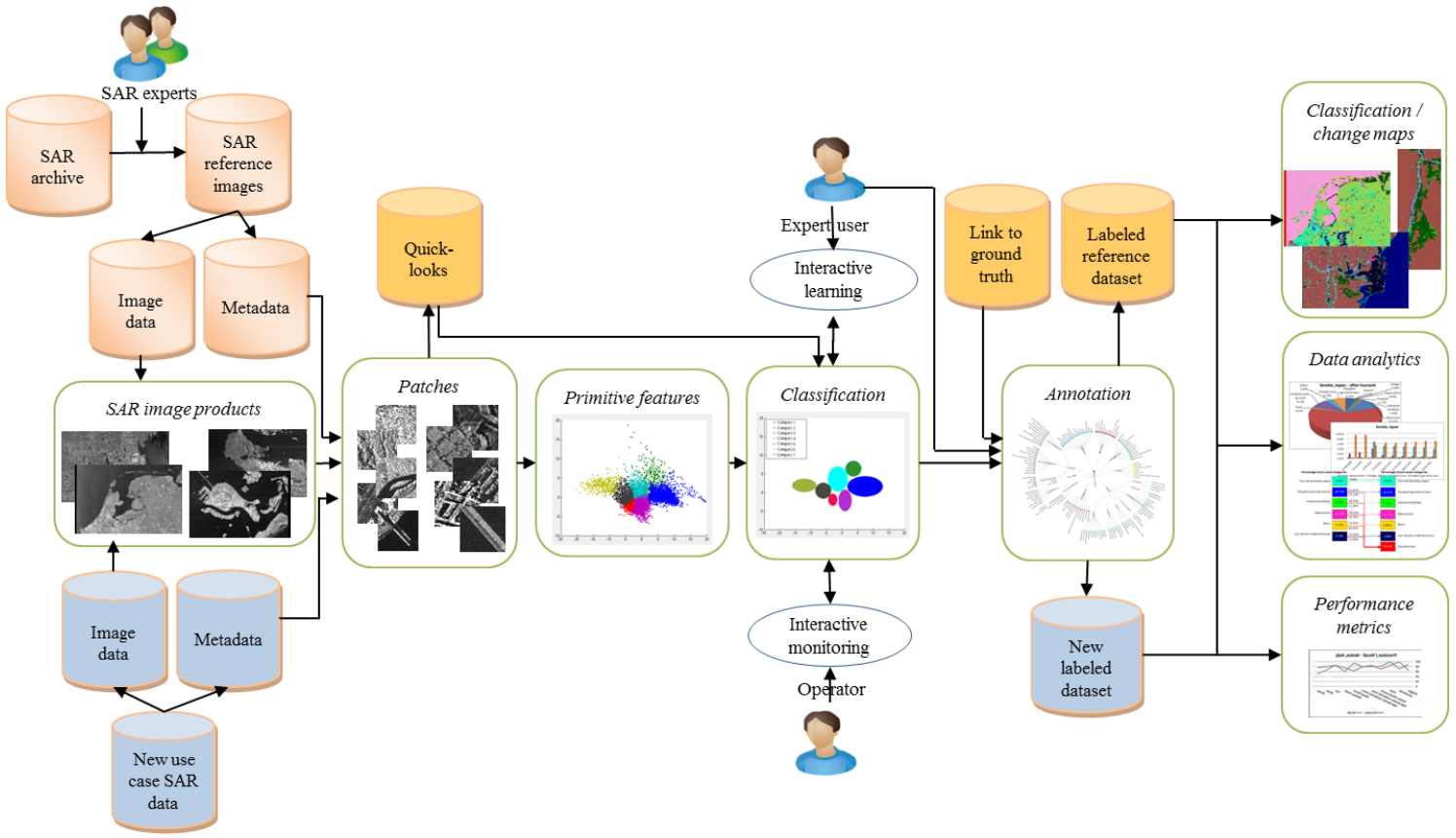
User select the semantic labels from a list or it defines itself

The user obtains a labelled dataset learned with few samples

Cascaded learning

Multi-grid layer classification

Multi-product image mining



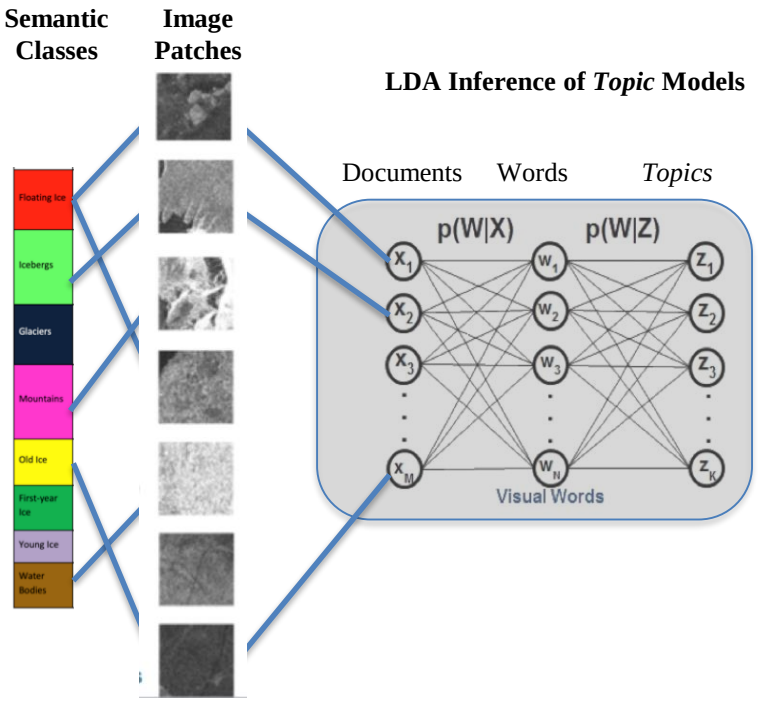
LDA work mechanism

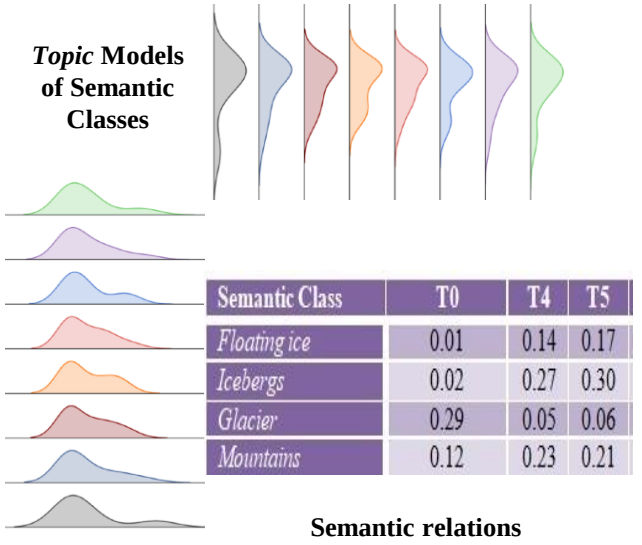
Works on top a **bag-of-words** representation of the images

Finds **latent structures** (*topics*) in the data by observing distribution of words

Topics are **mapped to semantic classes** retrieved with active learning

An **explainable approach** to semantic labelling of remote sensing imagery



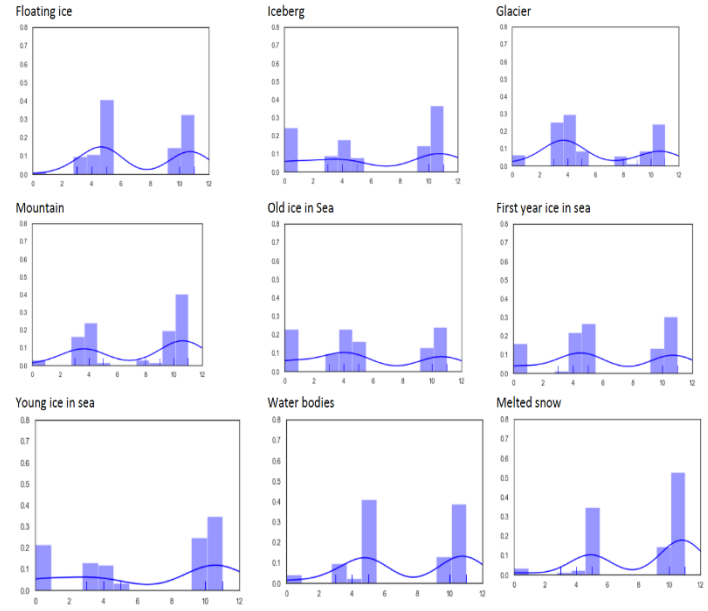


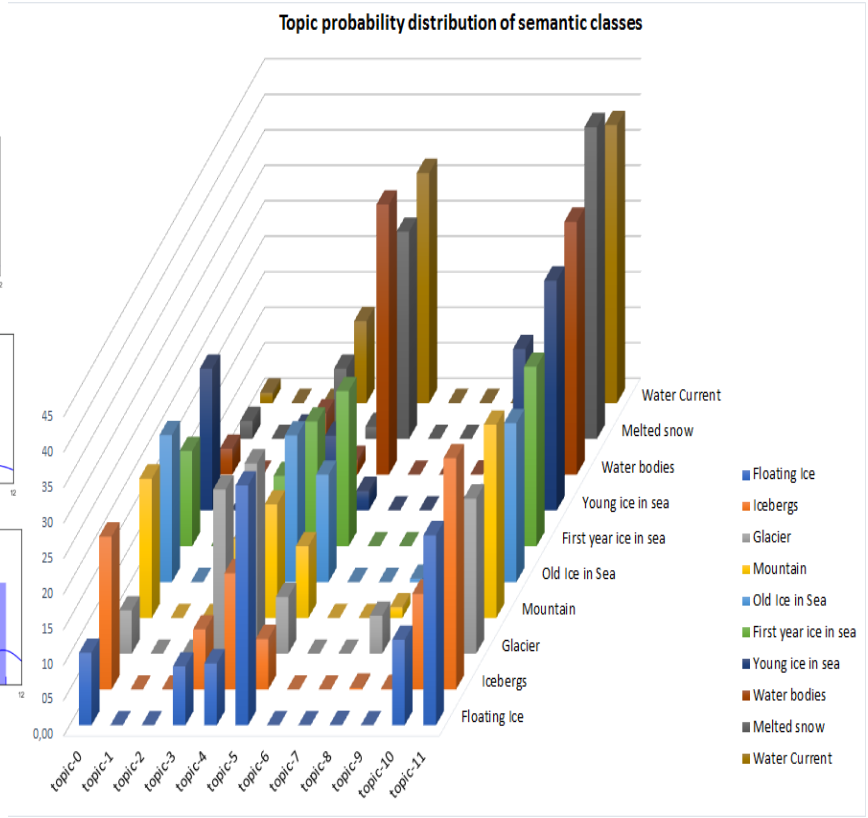
Data analytics

Semantic relations

With the **sea-ice classes** from **Active Learning**

derived by using **topic distributions**





Ref: K. Chandrabali, C.O. Dumitru, and M. Datcu, "Feature-free explainable data mining in SAR images using latent Dirichlet allocation." IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing 14 (2020): 676-689.

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Thank you!

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