SVM based VIIRS global surface type classification map and preliminary validation

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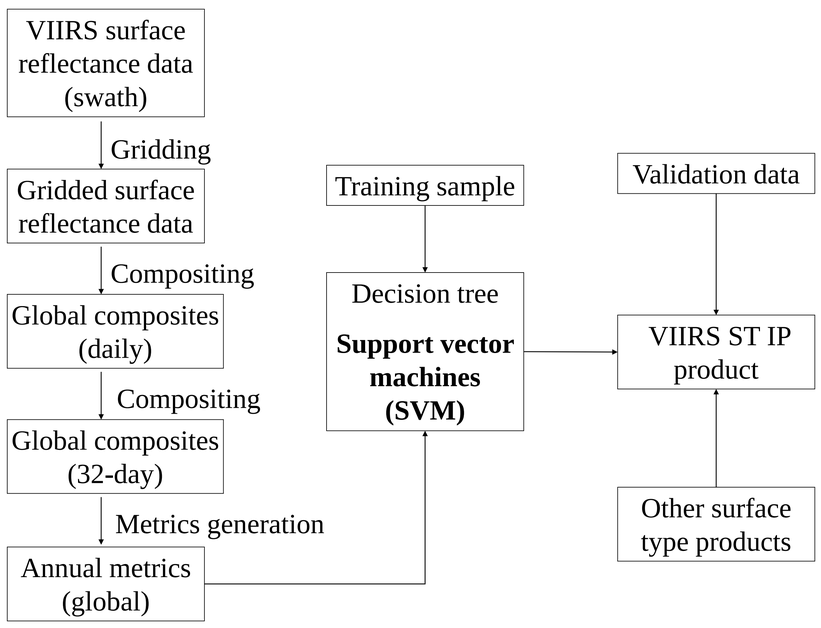
Introduction

Presently, the primary algorithm for generating global gridded surface type map is the C5.0 decision tree classification algorithm, which is inherited from the MODIS land cover products. With the advancement of the machine learning studies in recent years, new supervised classifiers are emerging with higher classification accuracy and other superior features over the traditional algorithms including the maximum likelihood and decision trees algorithm. One of the most promising classification algorithms, support vector machines (SVM), has been widely used in various scientific areas including remote sensing fields. The SVM algorithm is able to generate robust models when the size of training samples is small. It is capable of handling very high number of input variables/features while avoiding overfitting phenomenon. Therefore, it will enable us to explore more sophisticated features as input variables in annual metrics, and create a relatively light-weighted training model to speed up the classification process of the global surface type map.

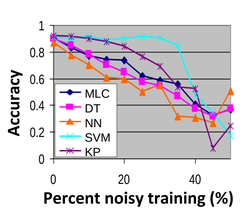
Objectives

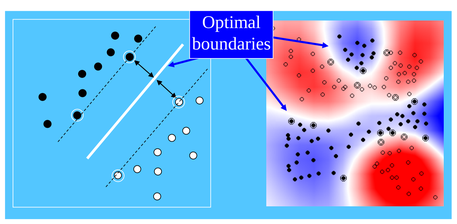
Due to the superior performances and advanced features of the SVM, we decided to replace the current C5.0 decision tree with the SVM as the primary classification algorithm for productions of S-NPP and future J-1 VIIRS surface type intermediate product and environmental data record.

Methods



Advantages of SVM: Noise resistant, more accurate. Optimal boundary (hyperplane) used, can handle very complicated classifications.



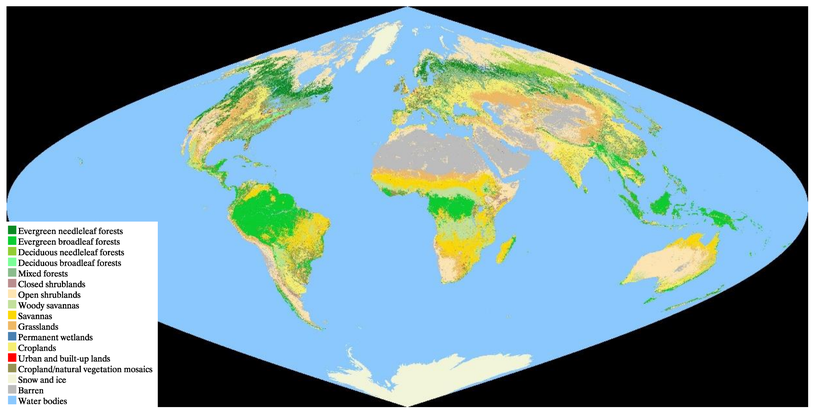


Results

We have classified 2013 and 2014 S-NPP annual metrics using the SVM algorithm in a preliminary test run. Annual metrics used in the classification are listed as below:

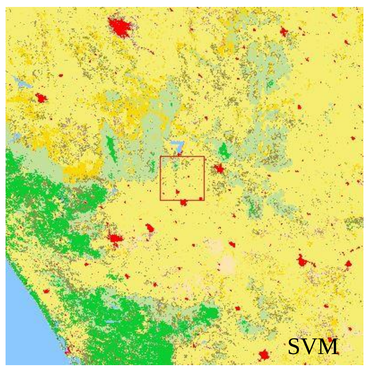
x is the band in annual metrics, : m1, m2, m3, m4, m5, m7, m8, m10, m11

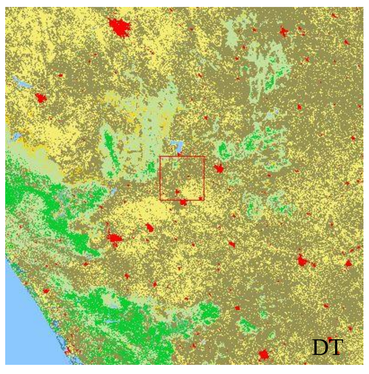
Metrics number (s)	Description
1	Maximum NDVI value
2	Minimum NDVI value of 8 greenest months
3	Mean NDVI value of 8 greenest months
4	Amplitude of NDVI over 8 greenest months
5	Mean NDVI value of 4 warmest months
6	NDVI value of warmest month
7,14,21,28,35,42,49,56,63	Maximum band x value of 8 greenest months.
8,15,22,29,36,43,50,57,64	Minimum band x value of 8 greenest months.
9,16,23,30,37,44,51,58,65	Mean band x value of 8 greenest months.
10,17,24,31,38,45,52,59,66	Amplitude of band x value over 8 greenest months.
11,18,25,32,39,46,53,60,67	Band x value from month of maximum NDVI.
12,19,26,33,40,47,54,61,68	Mean band x value of 4 warmest months.
13,20,27,34,41,48,55,62,69	Band x value of warmest month.

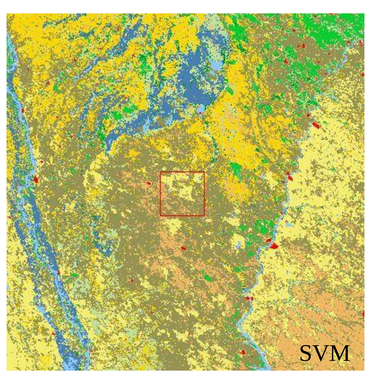


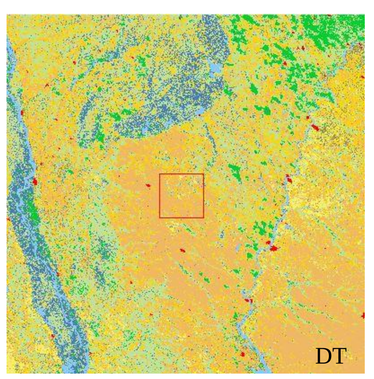
2014 S-NPP GST SVM classification preliminary result

The SVM based 2013 and 2014 gridded surface type preliminary results have been visually compared to the current 2012 C5.0 decision tree map. The comparison showed fewer speckle noises and better cropland separation are observed in the SVM result.







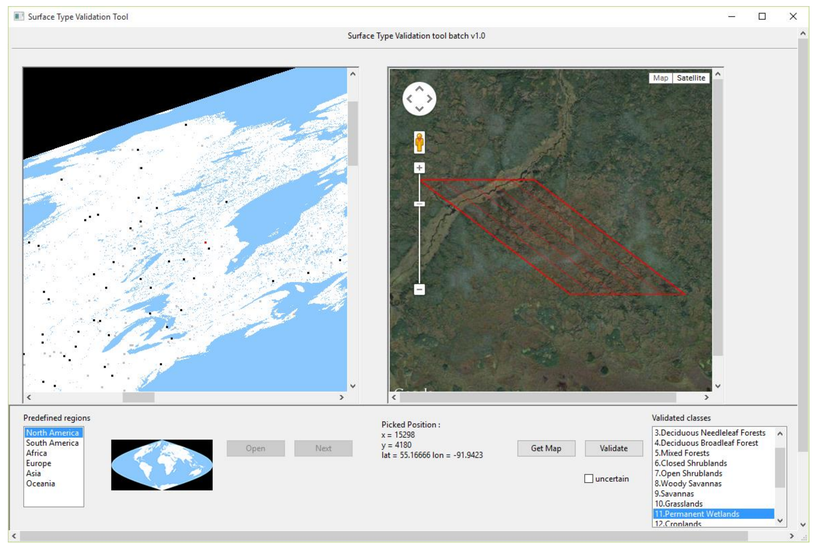


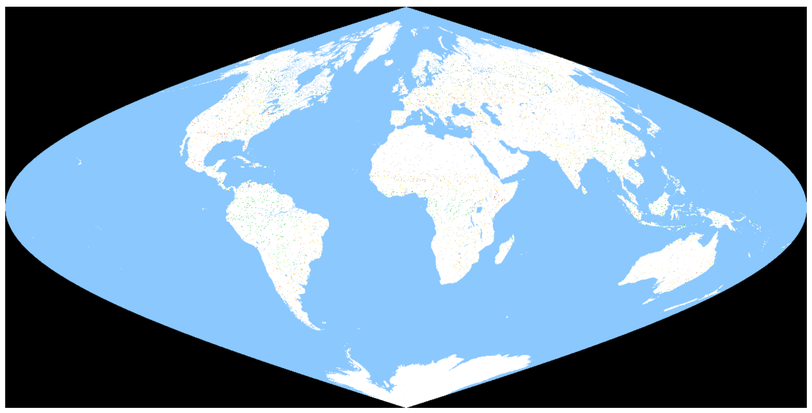
Yellow pixels are cropland, brown ones are cropland mosaic, and orange is grassland. These three classes are very similar in spectral. Visual inspections using Google Earth indicate that SVM are more accurate for scenes shown above. Post-classification steps will be applied to SVM maps in further refinements.

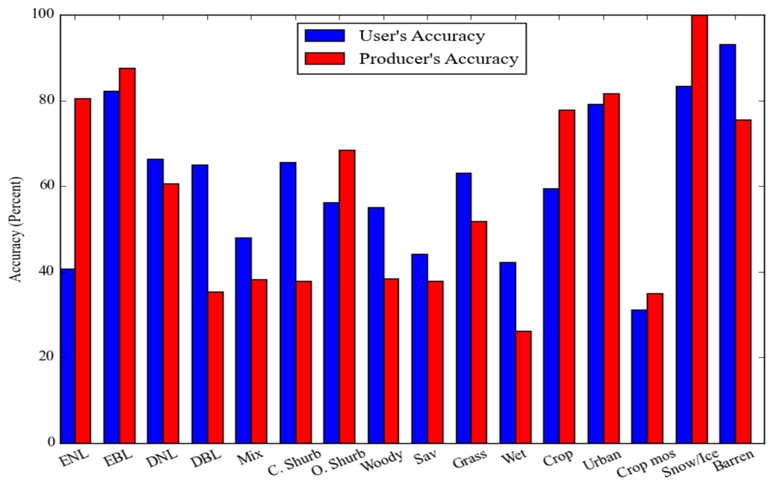
Preliminary Validations

Visual interpretation based validation against Google Map/Earth high resolution images have been used to validate the current delivered C5.0 GST and ongoing SVM GST preliminary maps. This preliminary validation will help further improve the SVM classification results before the formal product delivery.

The validation tool used to collect validation dataset, validation locations and user's and producers' accuracy are shown below.







References

Zhang, R., et al. (2015), Global Surface Type Data Product from S-NPP VIIRS, Remote Sensing Letters (In revision).

Huang, C., et al. (2002). An assessment of support vector machines for land cover classification. International Journal of Remote Sensing, 23, 725-749.