Decadal analysis of ammonia emission levels in the lowlands of eastern Germany using remote sensing data

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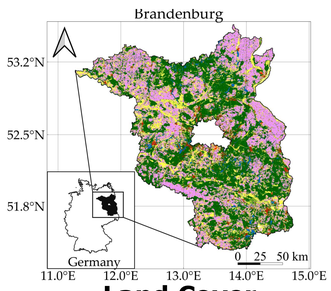
1. Introduction

- Ammonia (NH_3) is a very reactive & important gas, has a widespread impact related to air pollution, visibility, climate change, acid deposition and eutrophication. The primary source of global emission are agriculture, urban activities, and wildfires.

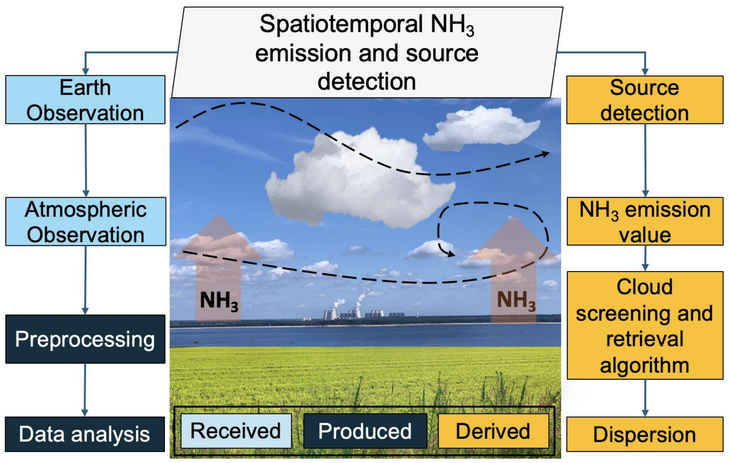


Land Cover Classification

Tree cover | Grassland | Water | Built-up | Cropland | Study area

- The study area shows the distribution of the land cover classification located in Brandenburg, Germany with five major land cover classification.
- Brandenburg is a majorly agricultural state, around 45% of its area compromising agricultural land, and surrounds the metropolitan area Berlin.

2. Methods



Sharing is encouraged

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References

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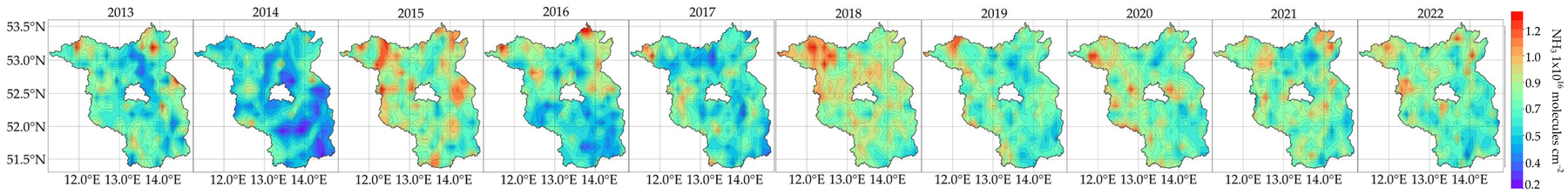
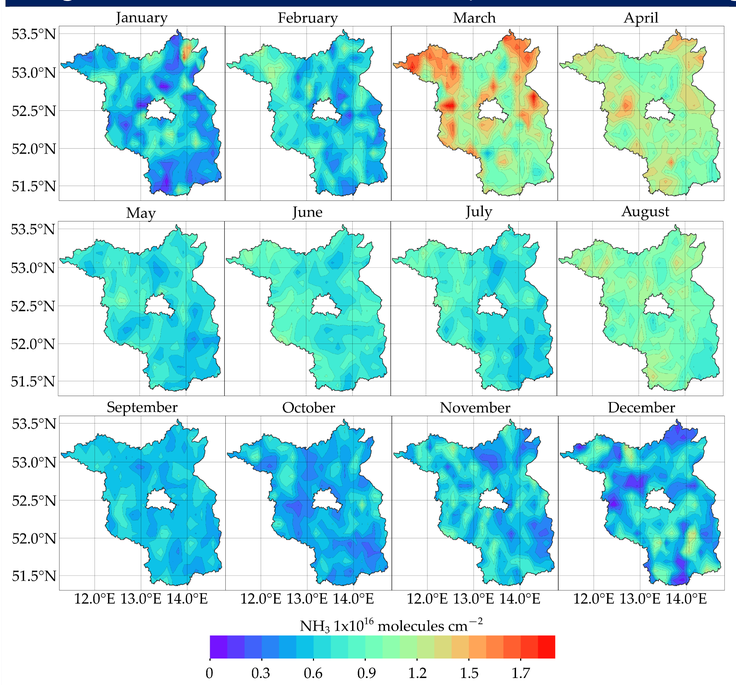
3. Results



- Annual means area-wide NH_3 emission (× 10^{16} molecules cm^{-2}) over Brandenburg from 2013 to 2022. The spatial analysis revealed persistent hotspots in the northwestern region of Brandenburg, especially with the average during 2015 (8.6 × 10^{15} molecules cm^{-2}), 2018 (8.5 × 10^{15} molecules cm^{-2}), and 2022 (7.5 × 10^{15} molecules cm^{-2}). The northwestern and northeastern area of Brandenburg consistently showed the highest concentrations. In contrast, the southeastern region showed a decline in emissions from 2015 to 2022.

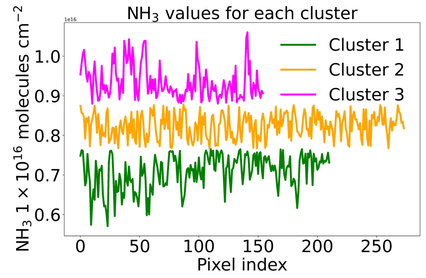


- Monthly means area-wide NH_3 emission (× 10^{16} molecules cm^{-2}), show clear seasonal patterns, with low emissions in winter (DJF) and peaks in spring (MAM) and late summer (JJA). Highest concentrations occurred in March (1.18 × 10^{16} molecules cm^{-2}), April (1.1 × 10^{16} molecules cm^{-2}), and August (9.6 × 10^{15} molecules cm^{-2}), especially in the northeastern and northwestern regions. These hotspots reflect agricultural activity, with emissions declining in autumn.

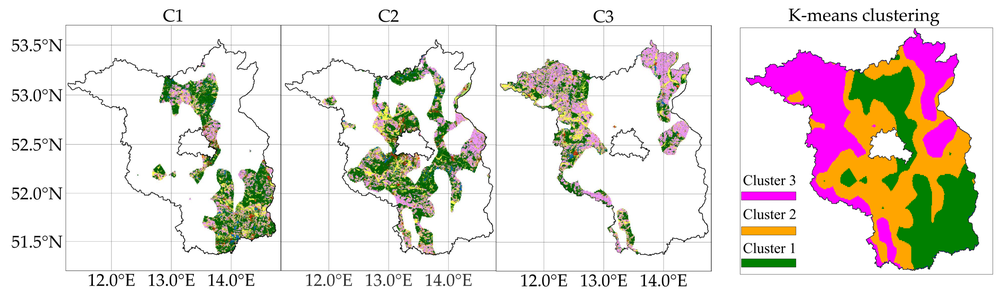
4. Cluster analysis k-means

(a)

	Cluster 1		Cluster 2		Cluster 3	
LCC	%	km^2	%	km^2	%	km^2
Trees	13.1	4531.8	22.5	5544.9	5.8	3060.4
Grass	4.7	1631	10.2	2237.9	3.9	2047.7
Crops	5.1	1760.7	15.5	3050.1	8.0	4172.6
Built-up	0.8	282.1	1.4	357.8	0.4	197.7
Water	0.7	265.9	1.3	317.7	0.4	187.2



(b)



(a) K-means cluster timeseries of monthly average NH_3 emissions related to the pixel index for three clusters identified by each coloured line corresponds to a different clusters. Distribution regions of k-means clustering show the areas with green representing with the lowest concentrations, orange cover regions with moderate concentrations and magenta with the highest concentrations.

(b) Land cover classification filtered by the clusters; Cluster 1 includes areas characterized by tree cover, grassland and water bodies. Cluster 2 has mixed land over types with grassland, and cropland. Cluster 3 is associated with cropland and built-up areas and shows the highest NH3 emissions.