HIGH RESOLUTION SPATIAL MAPPING OF SOIL NUTRIENTS USING K- NEAREST NEIGHBOR BASED CNN APPROACH

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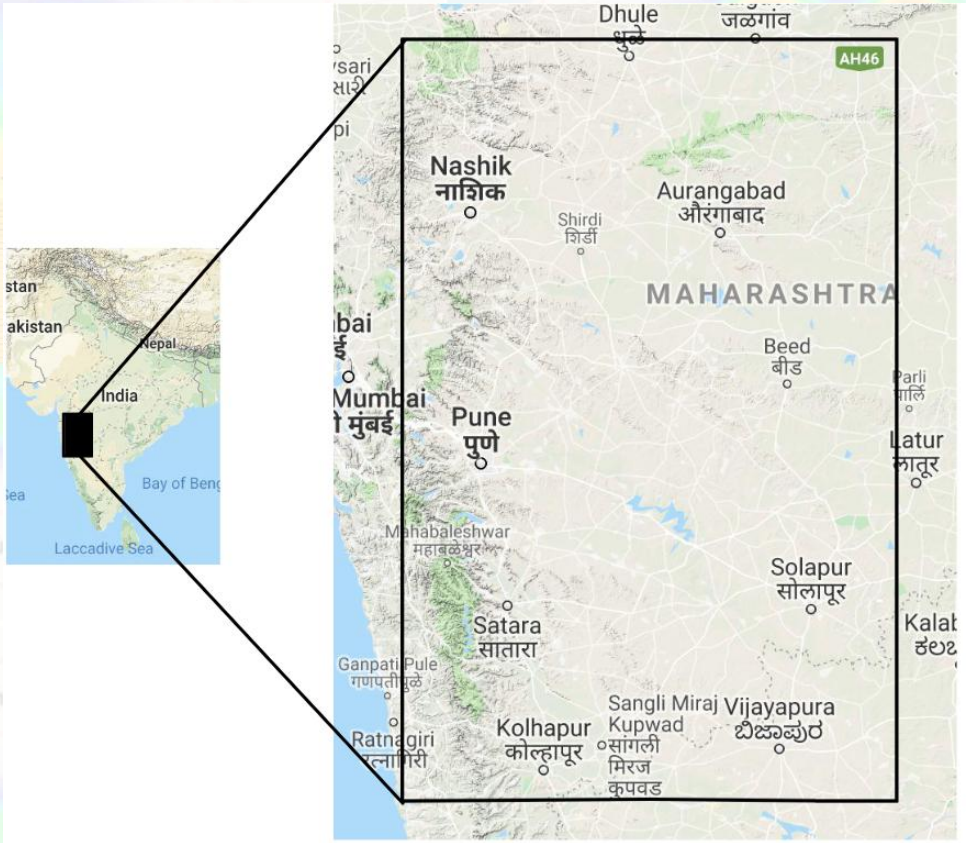


Problem statement:

Developing high resolution spatial map of soil nutrients Nitrogen(N), Potassium (K), Phosphorus(P), Organic Compounds (OC).

Study area:

- Two districts (Pune & Ahmednagar) of Maharastra state in Western India. (Latitude range 16.52 to 20.99, Longitude range 73.37 to 76.44).
- Ground truth data available from soil heath card database from Govt. of India.

Our approach and contribution

A k- nearest neighbor information based Convolutional Neural Network is developed for a fine grid estimation of soil nutrients.

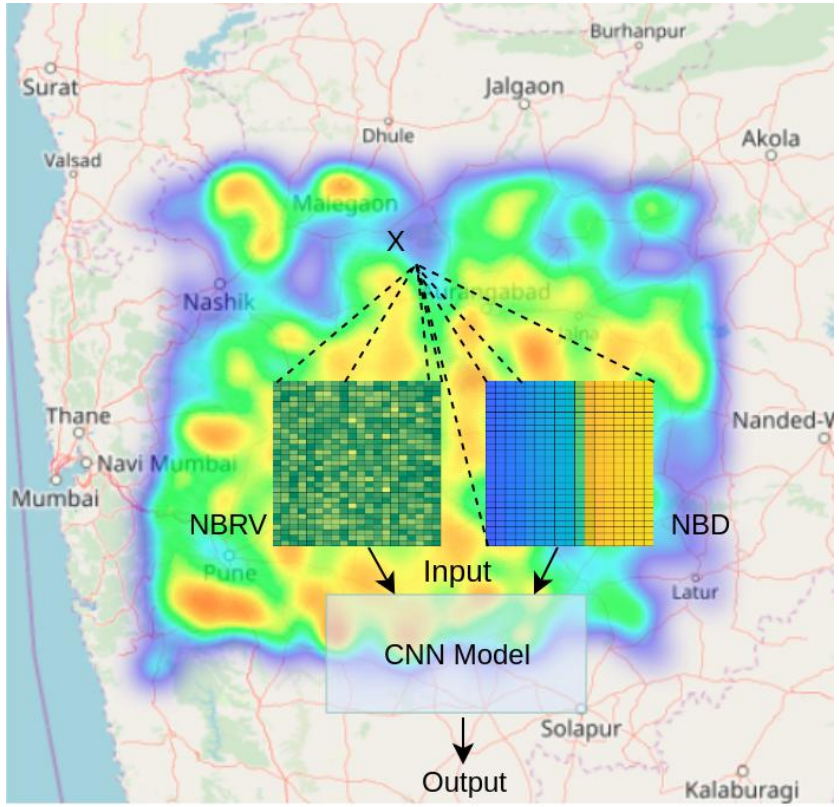


Fig:1 A location point x is shown in the map, whose k-nearest neighbourhood information is extracted and fed through a CNN model

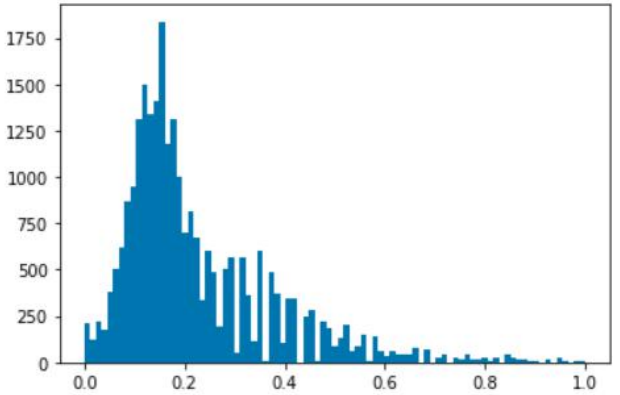
Data Description

- Laboratory tested samples from individual location in study area.

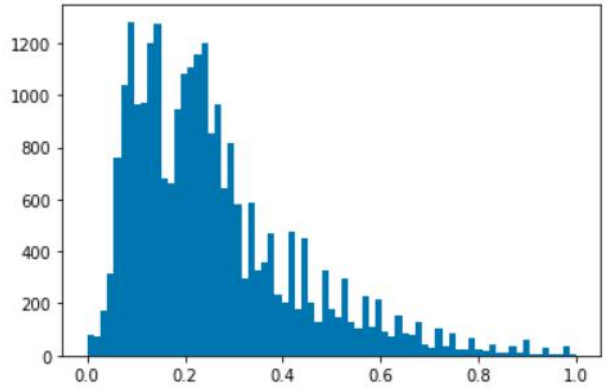
- Units for Nitrogen, Potassium, Phosphorus in kg/ha.
(Organic compund data given in %)

- Rescaled between [0,1] using minmax

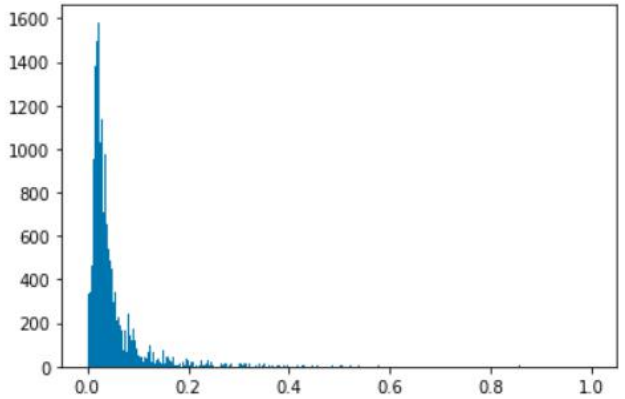
Nitrogen



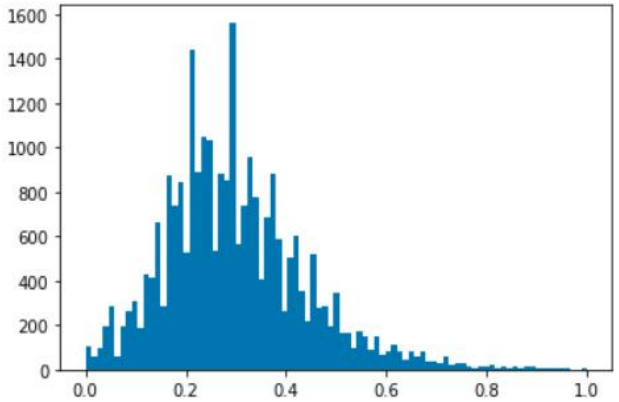
Potassium



Phosphorus



Organic Compounds



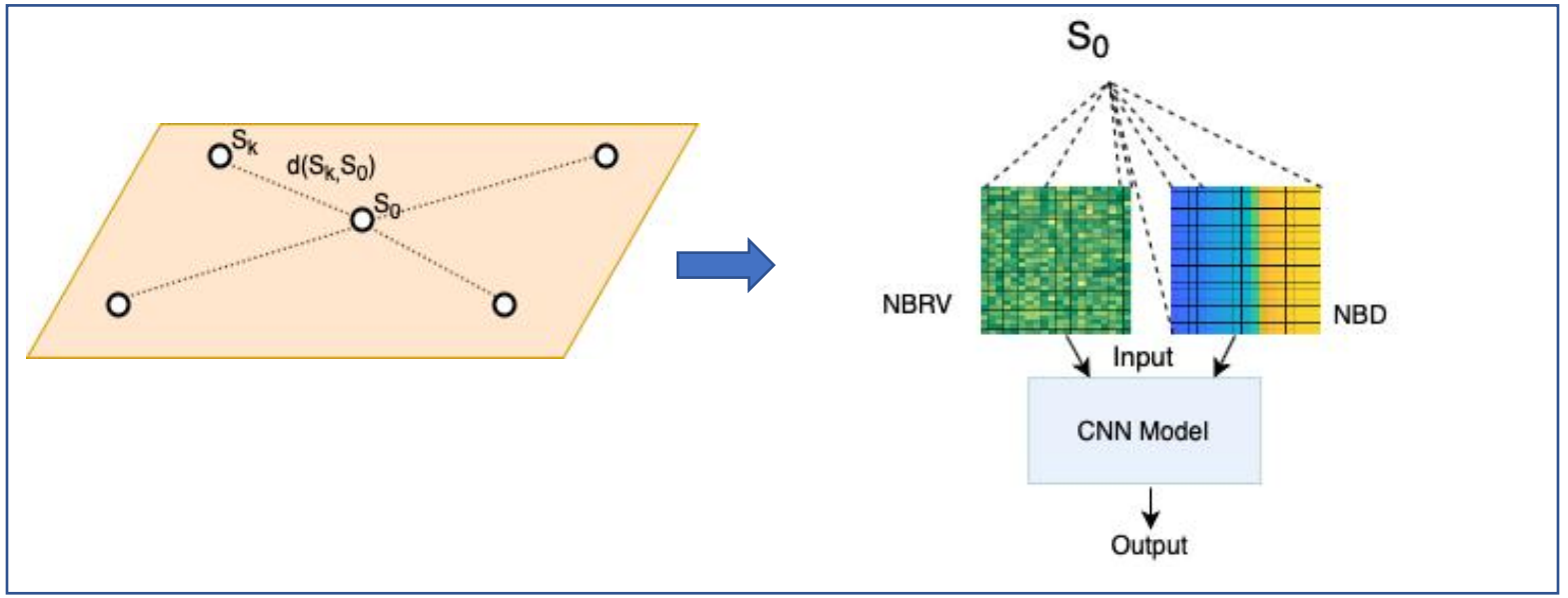
Technical details

To estimate $Y(S_0)$

Model Input data generation scheme:

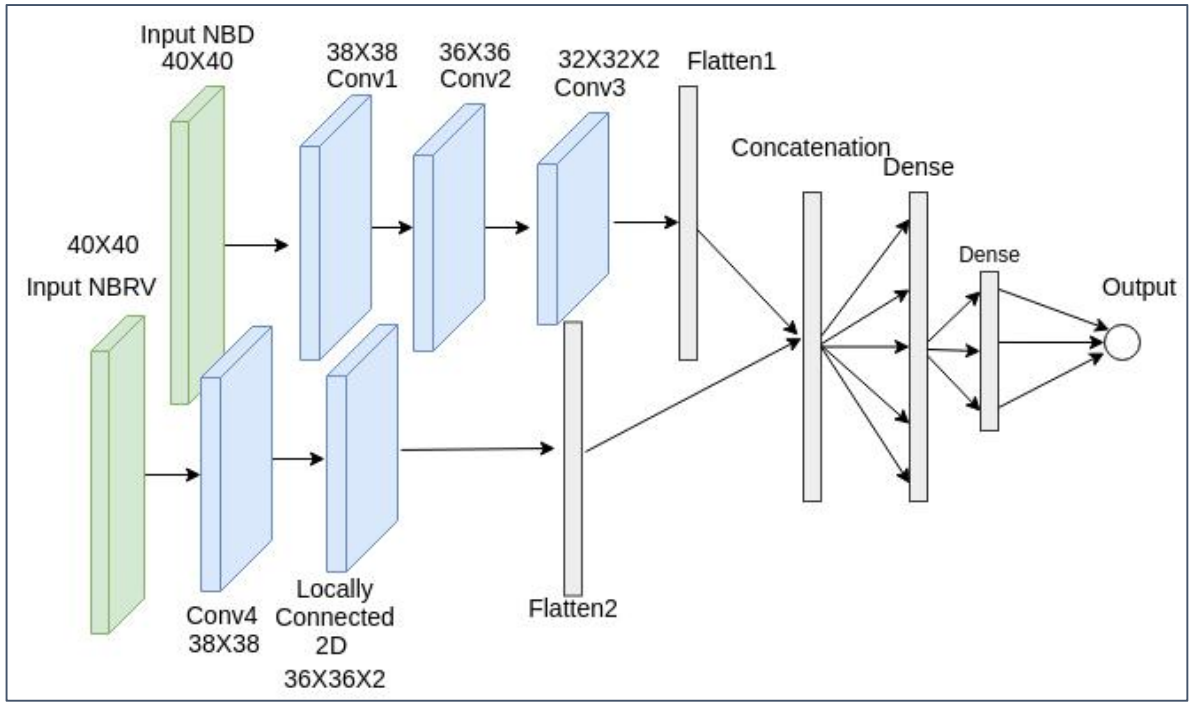
Note: K has been chosen as a positive square integer by looking at average range of the variogram

- Construct a matrix **NBRV** containing k-nearest neighbors' random variable value.
- Construct a matrix **NBD** containing corresponding distances from the point S_0.



Input data generation scheme

Technical details



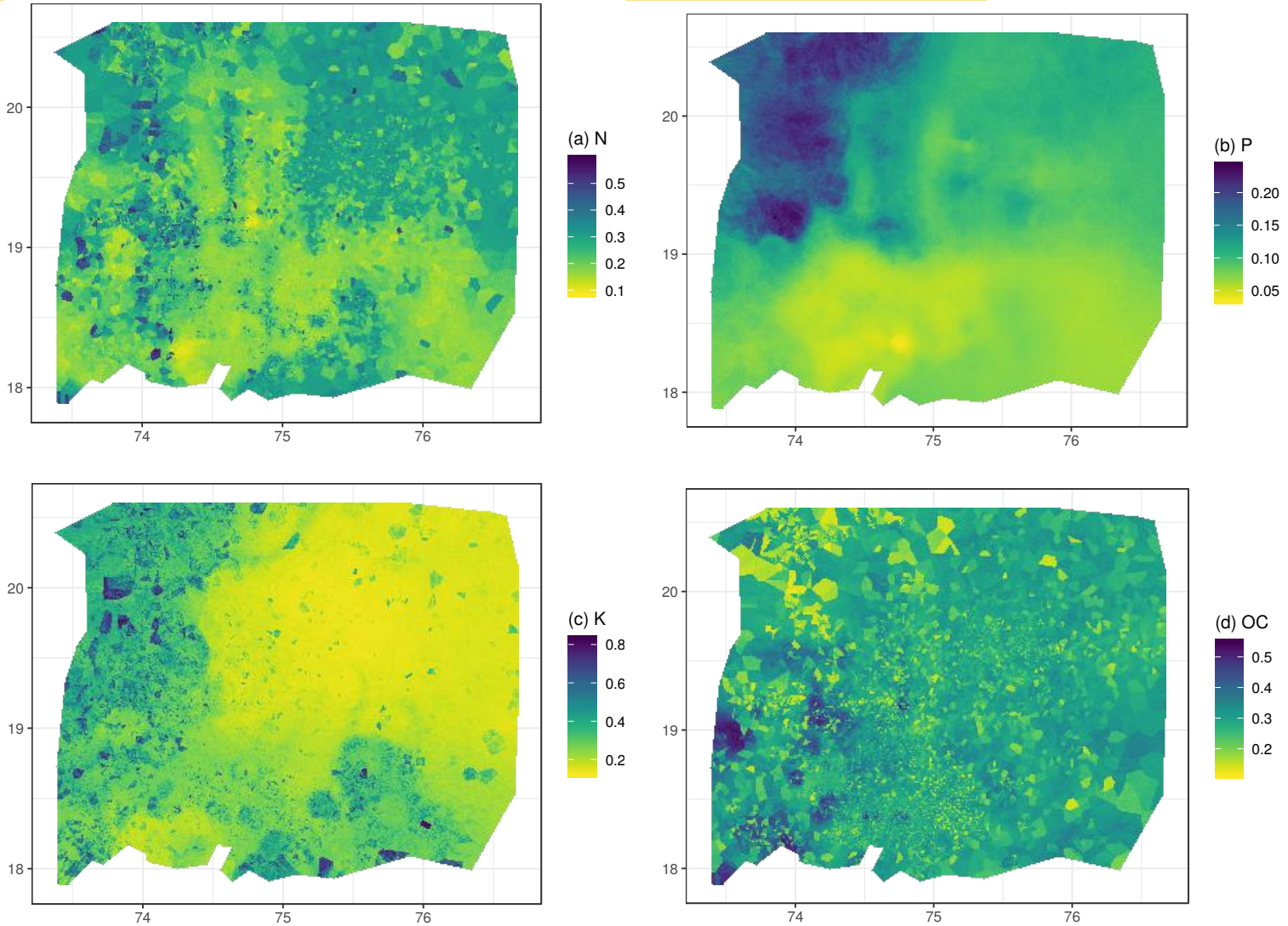
K-NN CNN model Architecture

Key factors for the Architecture

- Use of Locally connected layer
- RMSprop optimizer with learning rate 0.001
- batchsize 5, use of Dropout

Model accuracy results and generated maps

MP	Exp	N	K	P	OC
R^2	1	0.51	0.73	0.62	0.66
	2	0.76	0.82	0.66	0.63
RMSE	1	0.11	0.09	0.07	0.08
	2	0.08	0.07	0.07	0.08
MAE	1	0.07	0.06	0.04	0.06
	2	0.05	0.05	0.04	0.06
sMAPE	1	0.32	0.24	0.37	0.25
	2	0.26	0.25	0.46	0.21



Summary and Future work

- Inexpensiveness compared to traditional geostatistical techniques.
- Have potential for capturing the local spatial variability.
- Accurate than geostatistical methods.
- Tedious to find the optimal architecture of the CNN model.
- Not suitable for estimation in larger area because of varying spatial uncertainty.
- The model parameters can be optimized to get better accuracy.

Thank You