Wheat crop identification using Kernel Based Possibilistic c-Means Classifiers

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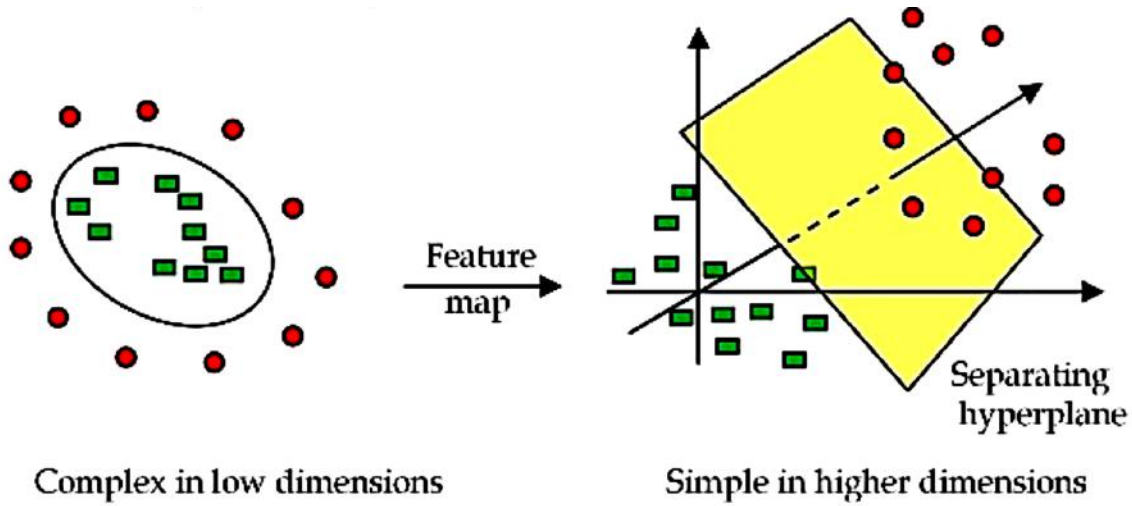
Introduction

- Accurate specific crop maps are relevant to yield estimation as well as crop cycle study.
- Mapping specific crop using single date imagery is a challenge.
- Occurrence of mixed pixels, leads to over estimation or underestimation of the target class.
- Soft classification has significant advantages over hard classification.

Classification techniques

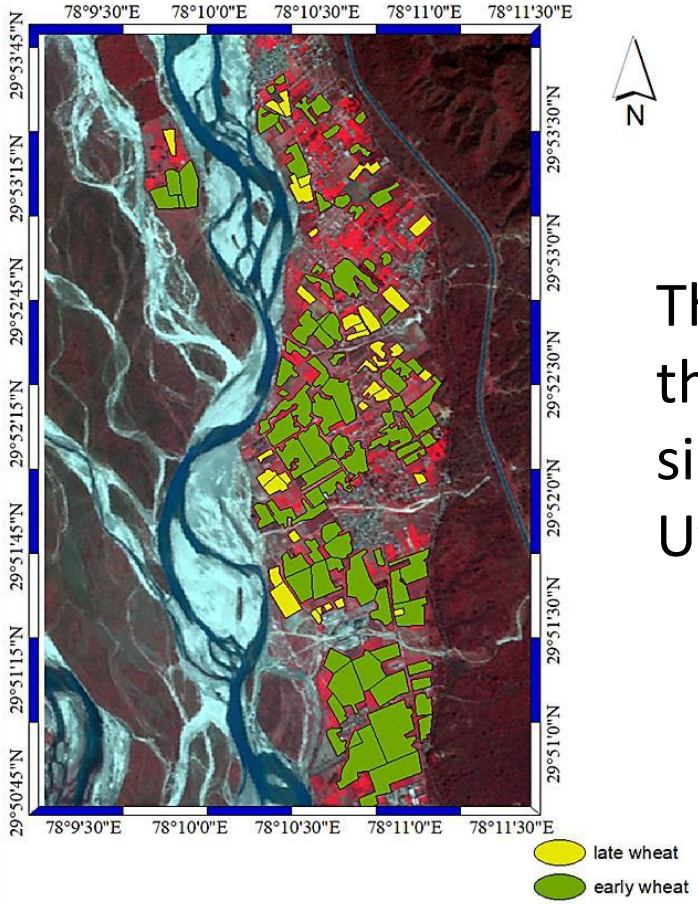
- Used PCM classifier with kernels.
- PCM is less effective to separate identical classes.



Objectives

- To evaluate number of temporal images sufficient for early and late wheat crop identification.
- To obtain best-suited kernel integrated with PCM and IPCM classifier.
- Comparison of classified results obtained by KPCM and KIPCM classifier.

Study Area



The study area under this research is East side of Haridwar, Uttarakhand, India.

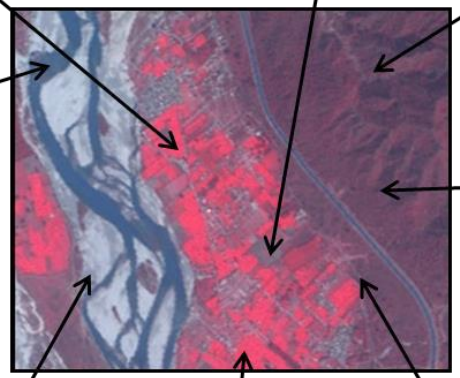
Field Photographs

Late Wheat Crop

Fallow Land

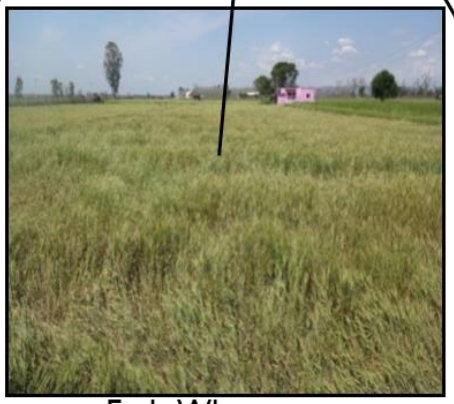
Dense Forest

Water Body



Forest

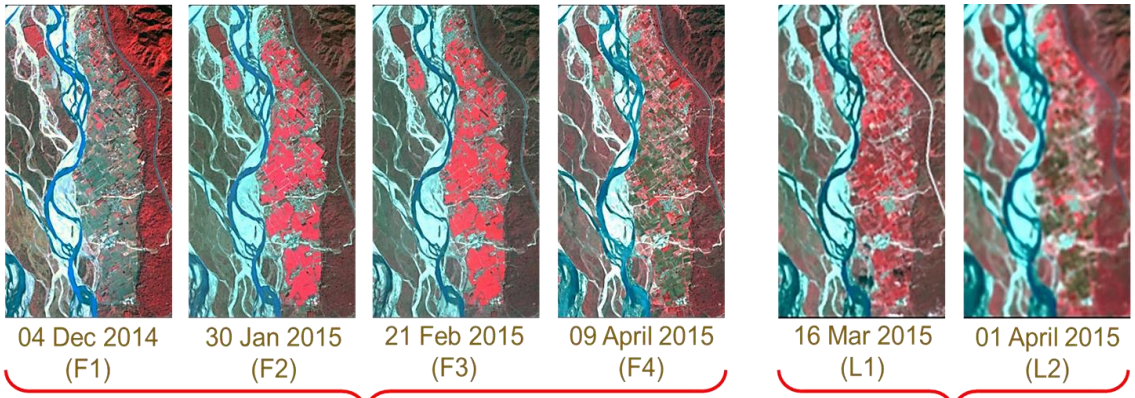
Riverine sand

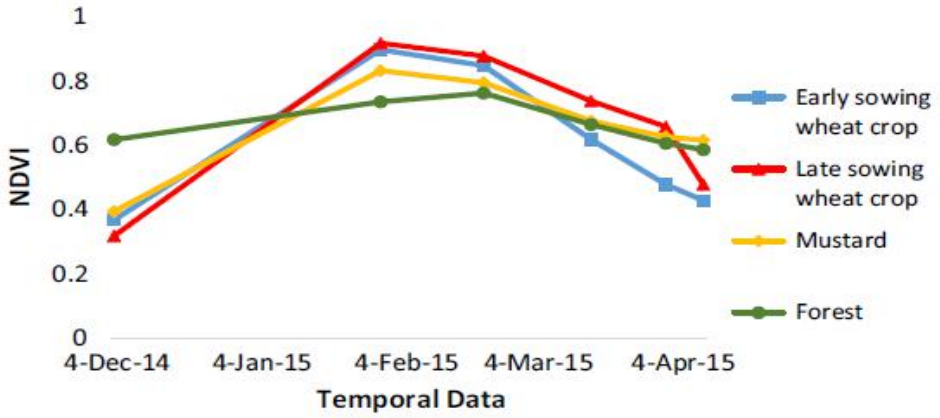


Early Wheat crop

NH 74

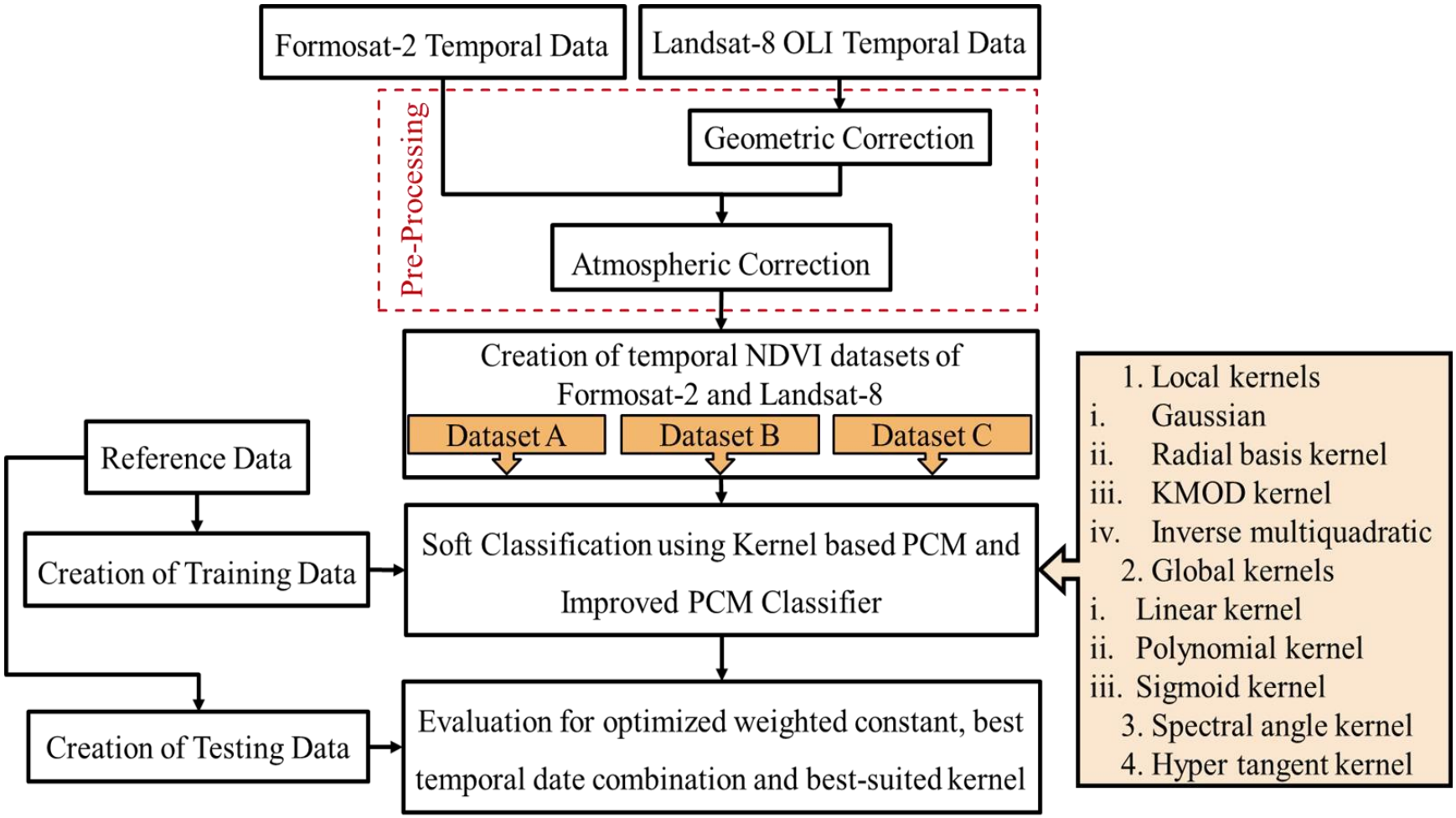
Data used





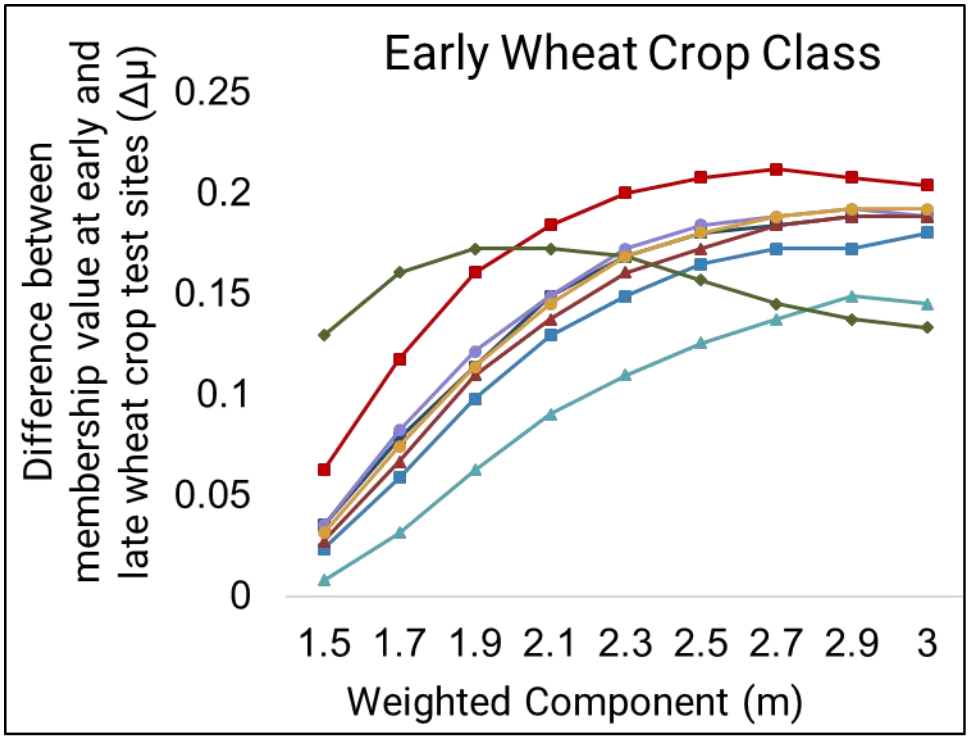
Datasets	Number of dates combined	Reference code of date combination
Dataset A	4 date combination	F1-F2-F3-L1
Dataset B	5 date combination	F1-F2-F3-L1-L2
Dataset C	6 date combination	F1-F2-F3-L1-L2-F4

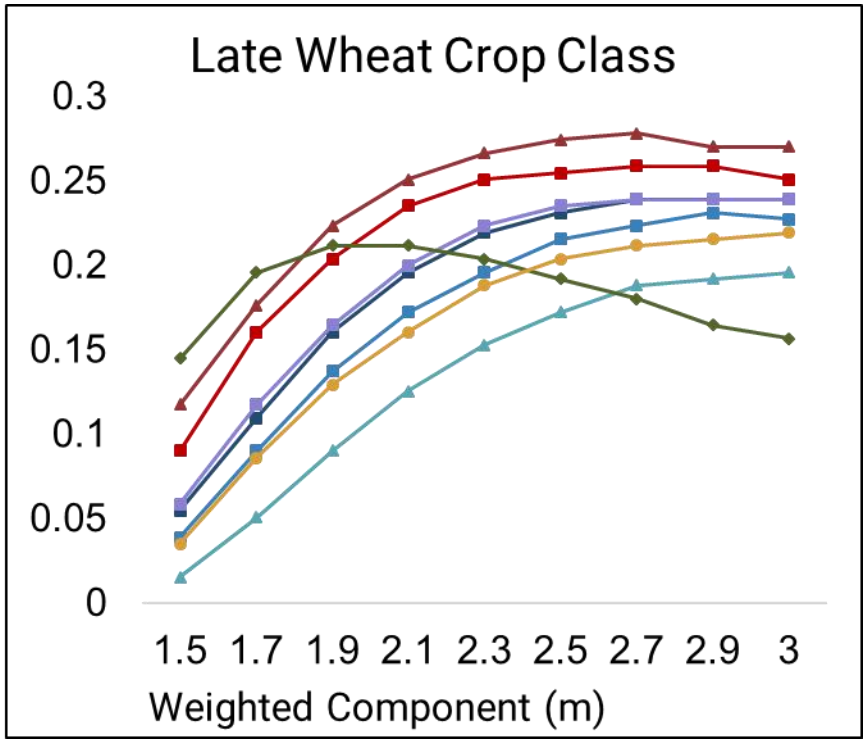
Methodology



KPCM Classified Outputs

- Weighted constant and difference between membership value at early and late wheat test sites (Δμ) for early and late wheat crop classes

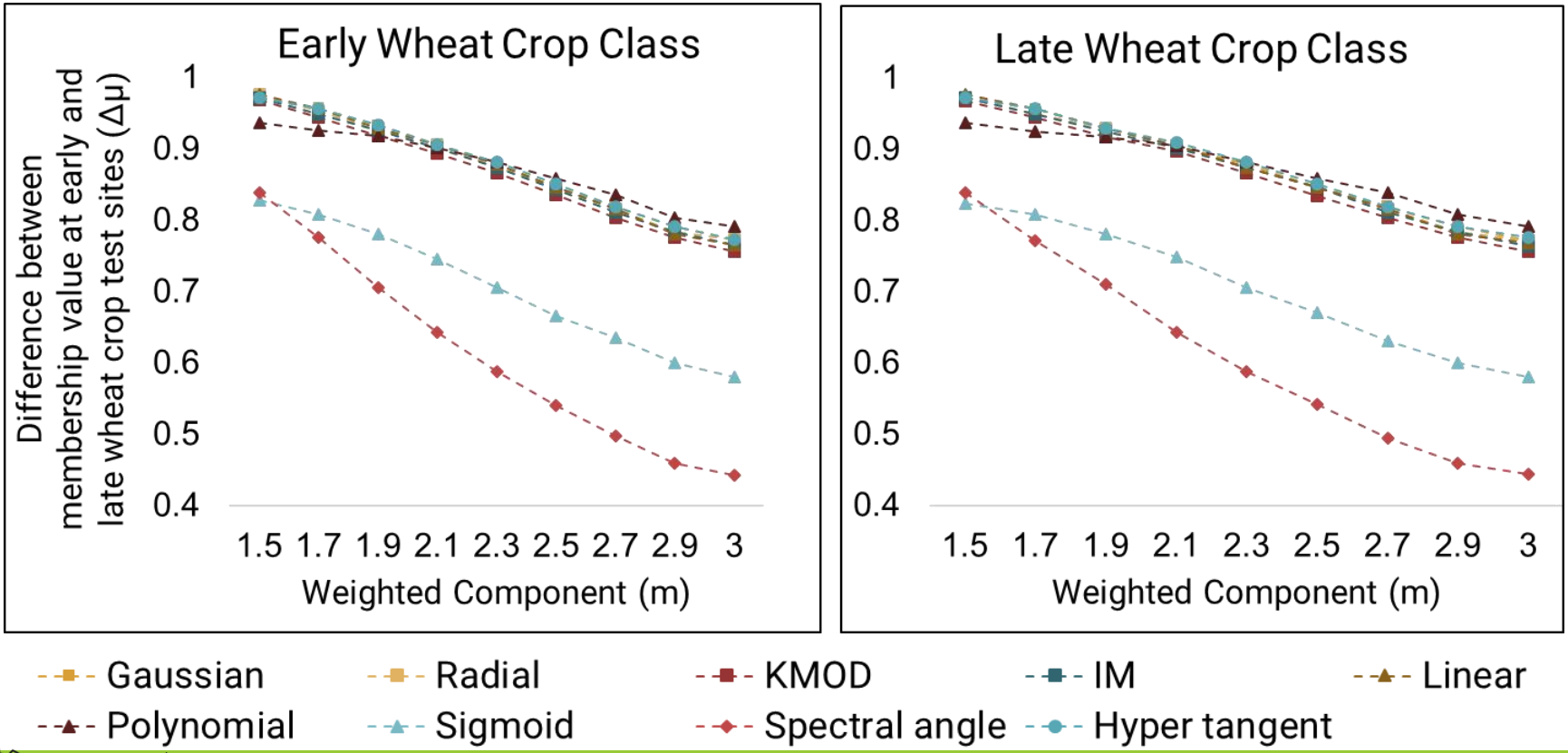




Gaussian
Radial
KMOD
IM
Linear
Polynomial
Spectral Angle
Hypertangent

KIPCM Classified Outputs

- Weighted component and difference between membership value at early and late wheat test sites (Δμ) for early and late wheat crop classes

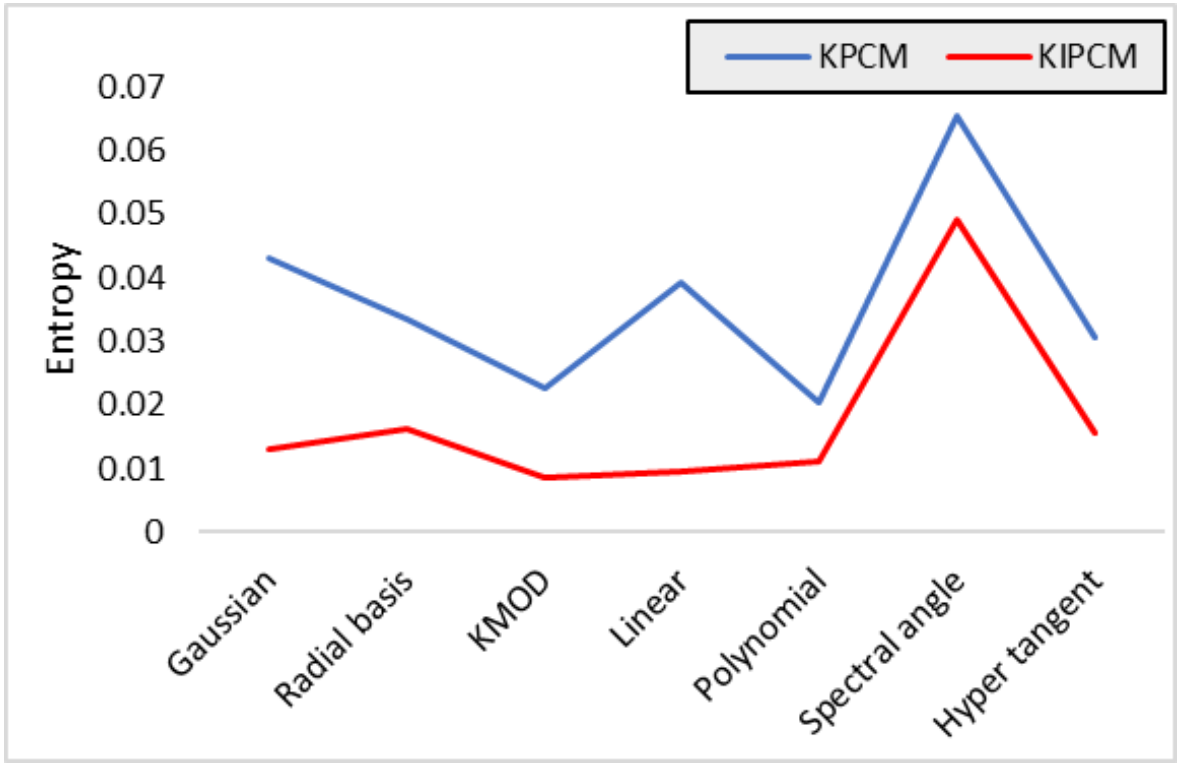


Comparison of KPCM and KIPCM

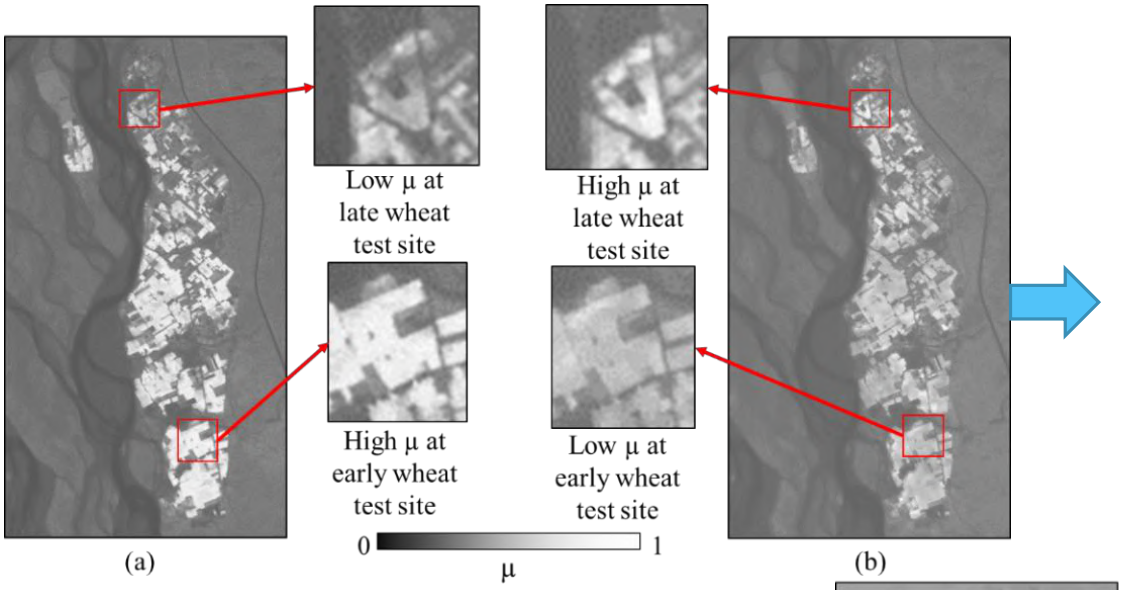
Entropy: an indirect absolute classification accuracy indicator has been used.

Ranges from 0 (low uncertainty to 1 (high uncertainty)

$$E(S) = \sum_{i=1}^{c} - p_i \log_2 p_i$$

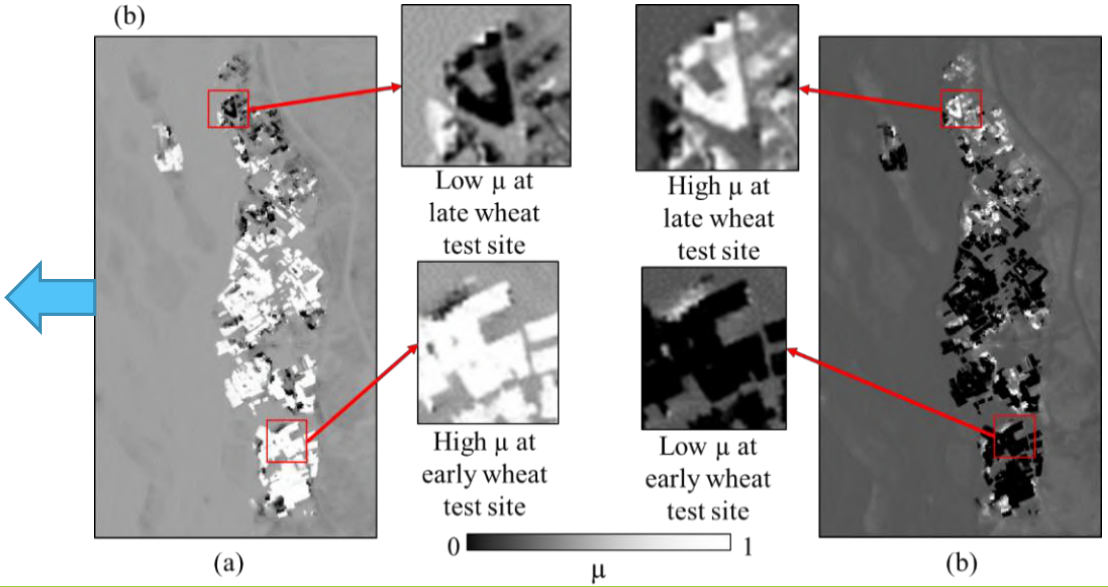


KMOD KPCM and KIPCM

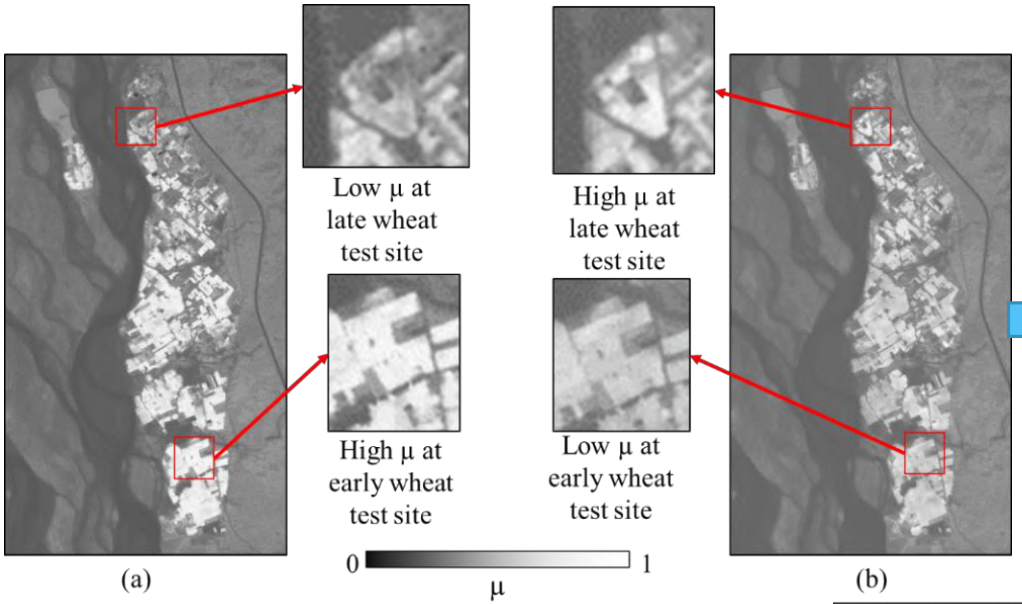


KPCM classifier (entropy: 0.0225) (a) Class1: Early wheat crop (Six date; optimized m= 2.3); (b) Class2: Late wheat crop (Five date; optimized m= 2.3)

KIPCM classifier (entropy: 0.00846) (a) Class1: Early wheat crop class, (b) Class2: Late wheat crop class

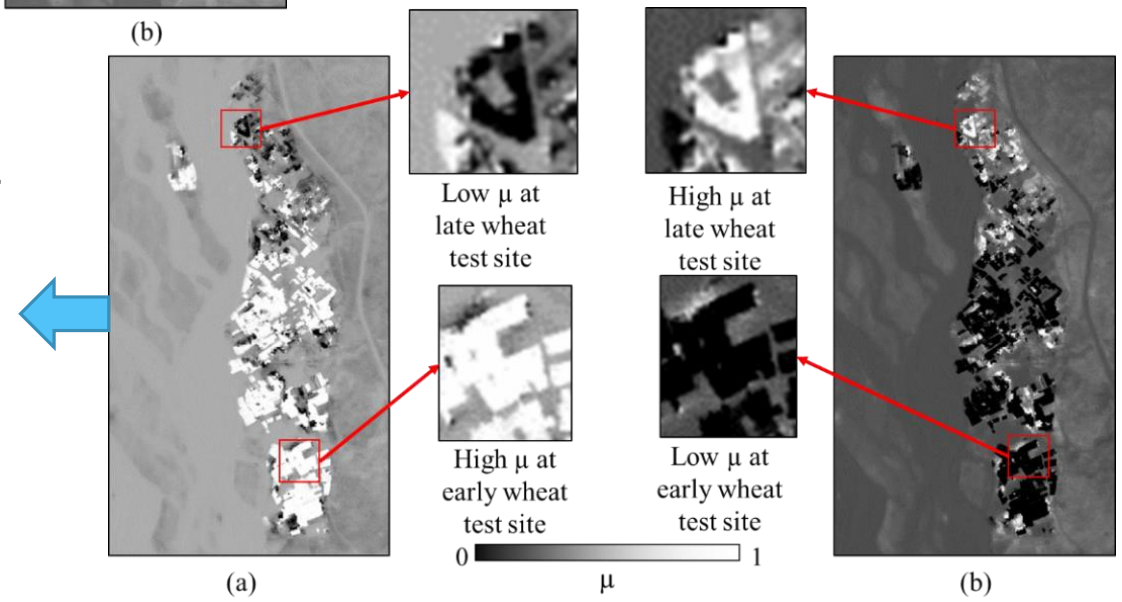


Polynomial KPCM and Linear KIPCM



Polynomial KPCM classifier (entropy= 0.0205) (a) Class1: Early wheat crop (Six date; optimized m= 2.3); (b) Class2: Late wheat crop (Six date; optimized m= 2.3)

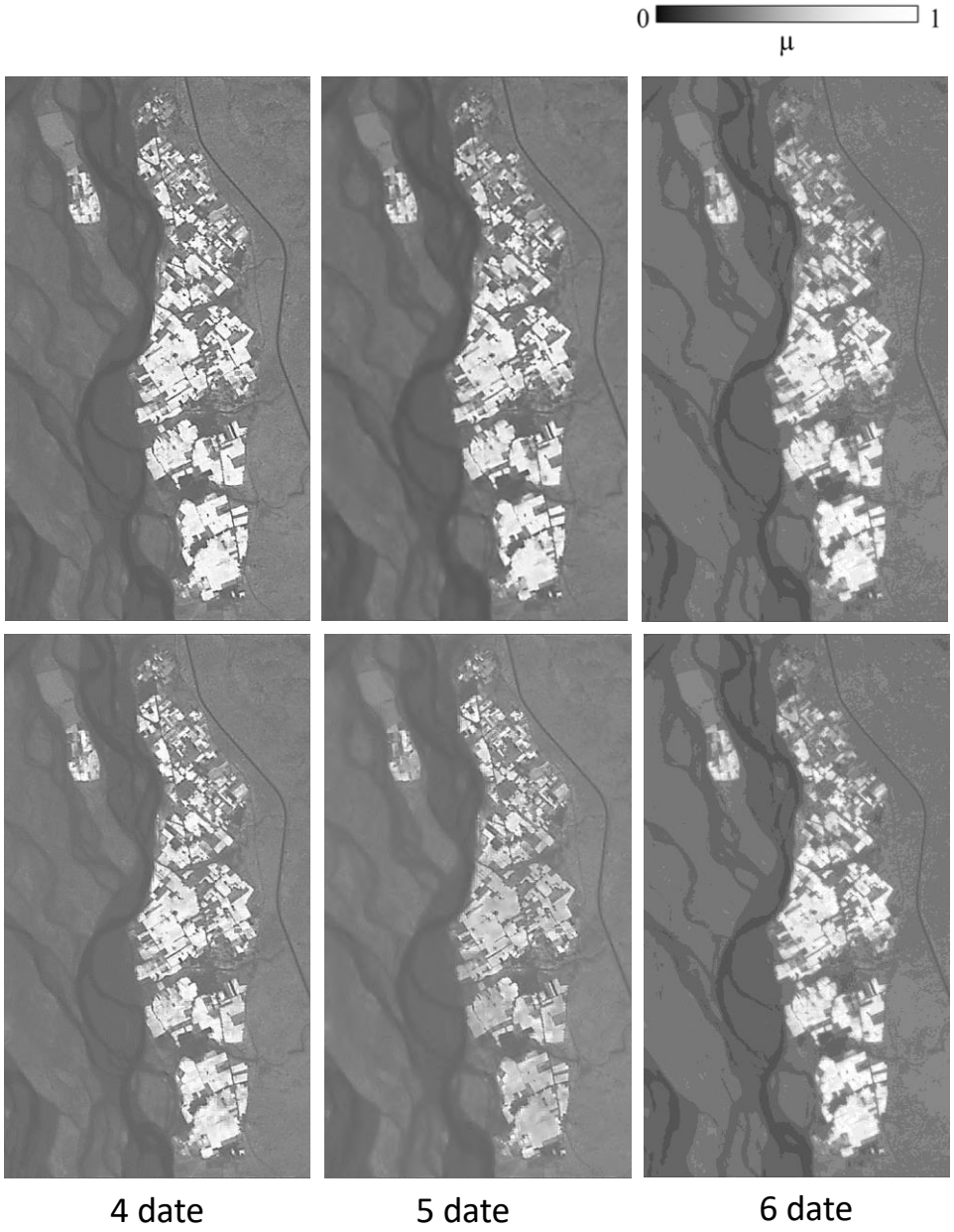
Linear KIPCM classifier (entropy= 0.00965) (a) Class1: Early wheat crop class, (b) Class2: Late wheat crop class



Temporal datasets results

KMOD kernel PCM results

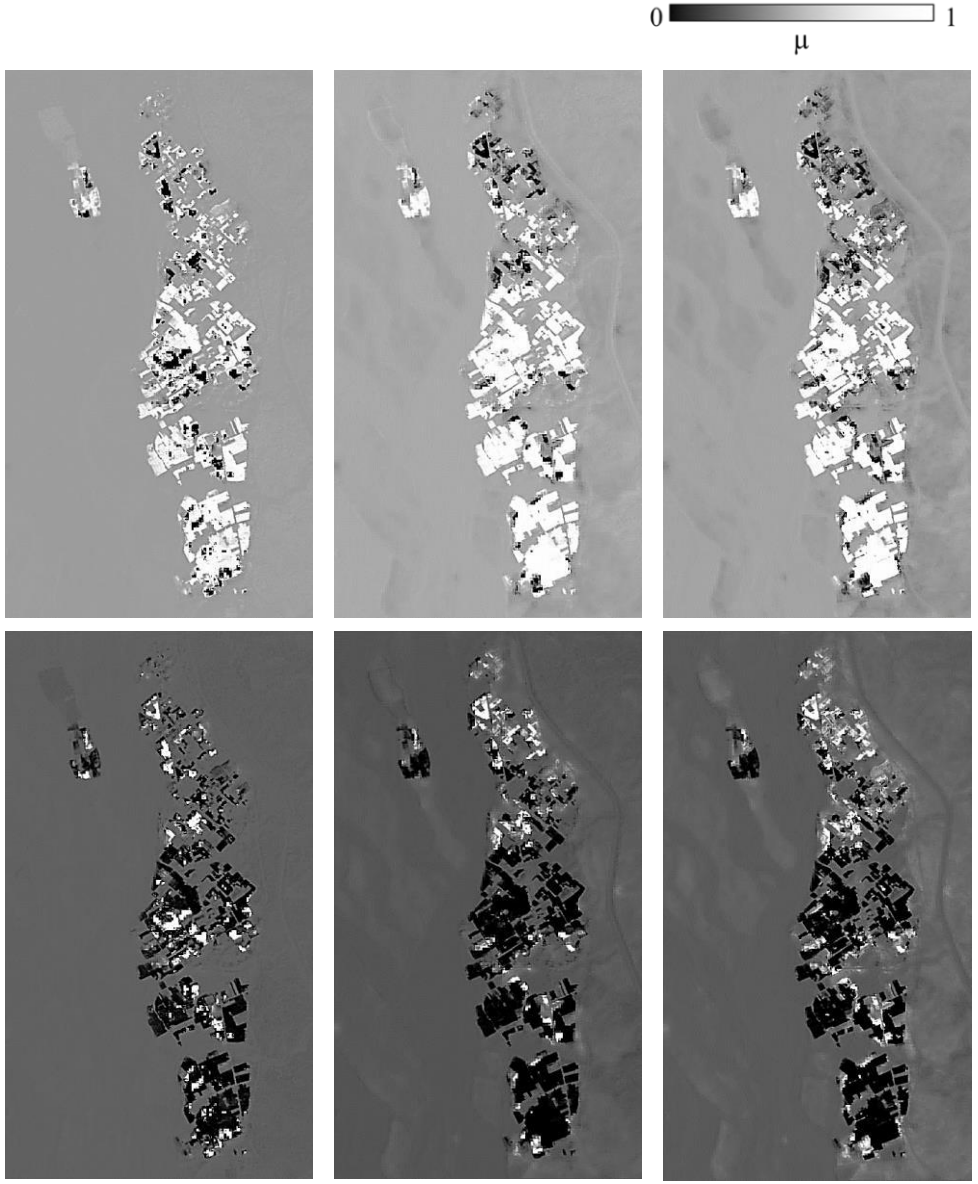
Datasets	Entropy
4 date combination	0.0624
5 date combination	0.0324
6 date combination	0.0225



Temporal datasets results

KMOD kernel IPCM results

Datasets	Entropy
4 date combination	0.0091
5 date combination	0.0096
6 date combination	0.00846



Conclusion

- More homogeneity within wheat class was observed in KIPCM results.
- Wheat pixels from background pixels were well separated in case of kernels KIPCM as compared to KPCM results.
- The best results for wheat identification, were found to be with KMOD kernel, with 6 temporal dates combination and the corresponding entropy value was 0.00846.

Thank You