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Intertidal area classification with generalized extreme value distribution and Markov random field in quad-polarimetric synthetic aperture radar imagery

Key words: Intertidal classification; Polarimetric synthetic aperture radar; Finite mixture model; Markov random field; Generalized extreme value model

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Motivation

1. The intertidal areas possess a high application value and are worth to study.

2. Classification of the intertidal area in PolSAR images is not a simple task, because there are similar electromagnetic scatter mechanisms between the sea surface and the intertidal area, which are composed mainly of underwater cultivation, remnant water bodies, aquatic farms, etc. Moreover, components of the intertidal area, such as underwater cultivation and remnant water bodies, have similar scatter intensities in the SAR image, and are thus difficult to distinguish.

3. Most state-of-the-art classification methods cannot be used for classifying inter-tidal areas.

Main idea

1. The difficulty of intertidal area classification is compounded because a high proportion of this area is frequently flooded by water, making statistical modeling methods with spatial contextual information often ineffective.

2. The key point of our method is to combine the generalized extreme value (GEV) statistical model of the polarization features and the Markov random field (MRF) for contextual smoothing.

3. A goodness-of-fit test is added to determine the significance of the components of the statistical model to ensure the accuracy of the final result.

Method

1. The polarimetric feature: entropy and anisotropy;

2. Generalized extreme value distribution, finite mixture model, and Markov random field;

3. Mutli-classification result fusion.

Major results

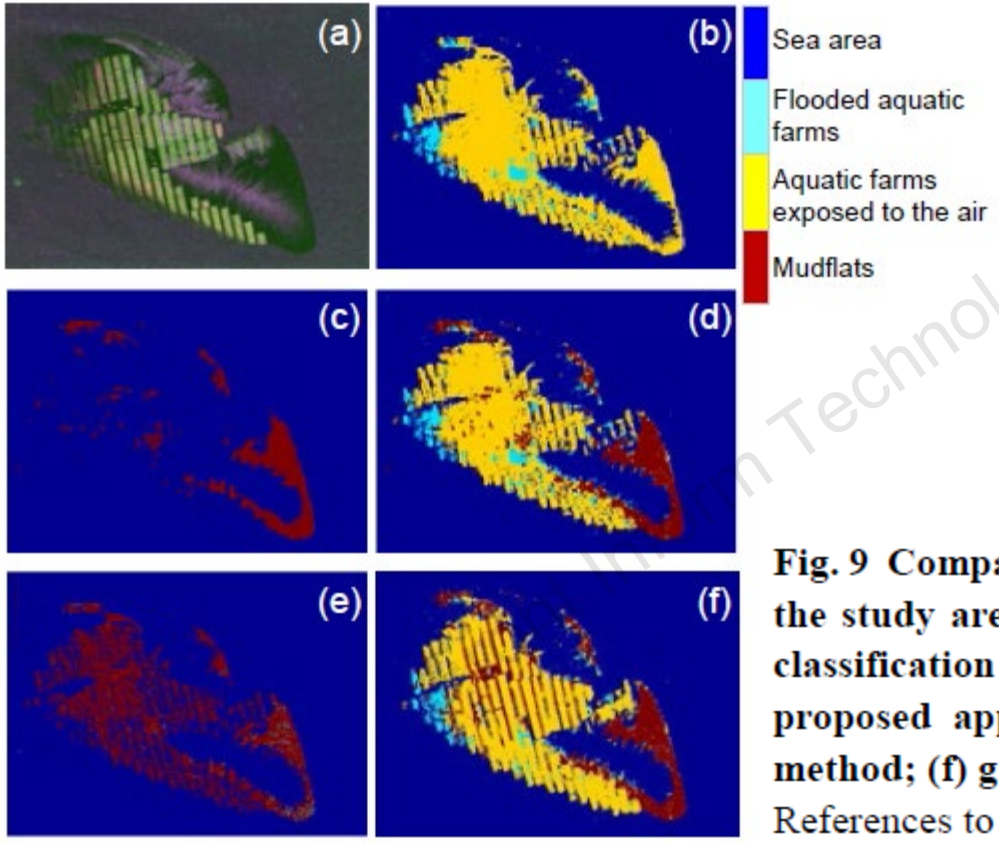

Fig. 9 Comparison of different methods: (a) Pauli image of the study area; (b) classification results with entropy; (c) classification results with anisotropy; (d) results with the proposed approach; (e) results with the Wishart-$H/A/\alpha$ method; (f) ground truth

References to color refer to the online version of this figure

Conclusions

1. We have proposed a novel classification approach for the intertidal area which combines GEV mixture models and the MRF model in PolSAR images.

2. In our study, polarimetric entropy and anisotropy were introduced to fully characterize the intertidal area.

3. The GEV distribution was proven appropriate in describing the statistical properties of the polarimetric and anisotropy images of the intertidal area.

4. The combination of FMM and MRF achieves satisfactory results for the intertidal area based on GEV distribution.