Testing A Flood Mask Correction Method Of Optical Satellite Imagery Over Irrigated Agricultural Areas

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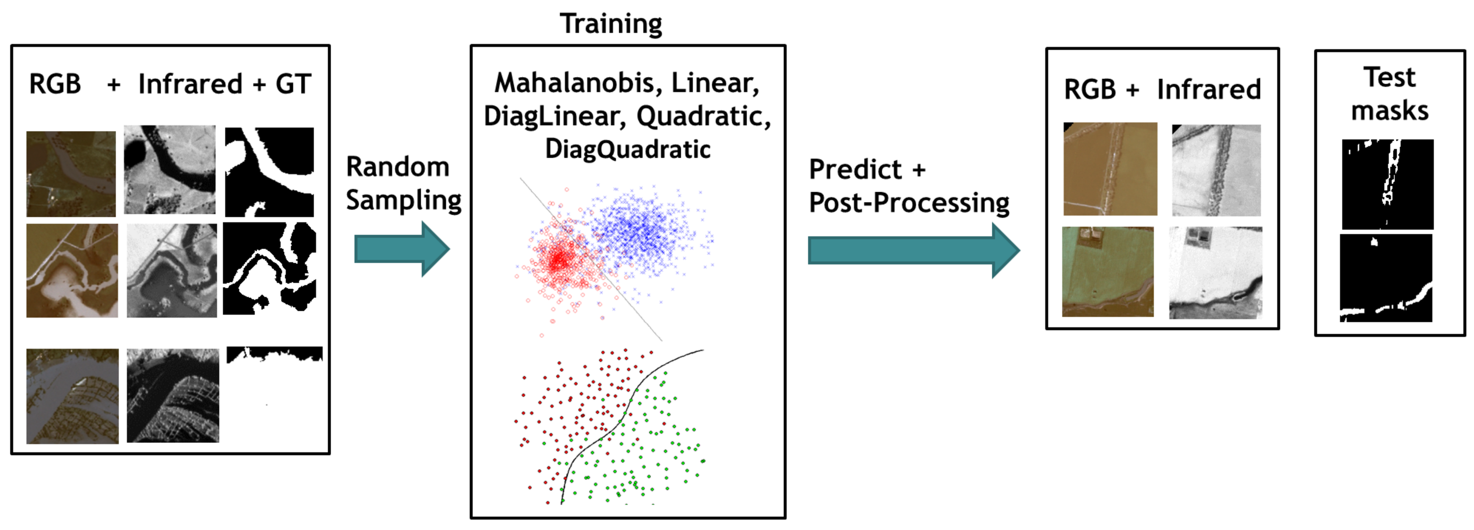
Introduction

- Disaster prediction from satellite sources have captured the interest of the computer scientific community in the last decade
- Identifying flooded areas from Earth Observation (EO) satellite images aids in:
  - damaged areas monitoring
  - effective response of civil protection agencies during disasters
- EO satellite images are valuable sources in disaster cases due to their unobtrusive and abundant nature
- Description of a method for change detection on surface water bodies that classifies satellite image pixels as a flooded area or not
- Application to the detection of changes of surface water bodies, based on water volumes data in a Moroccan Demonstration Area (H2020-MOSES)

Methodology

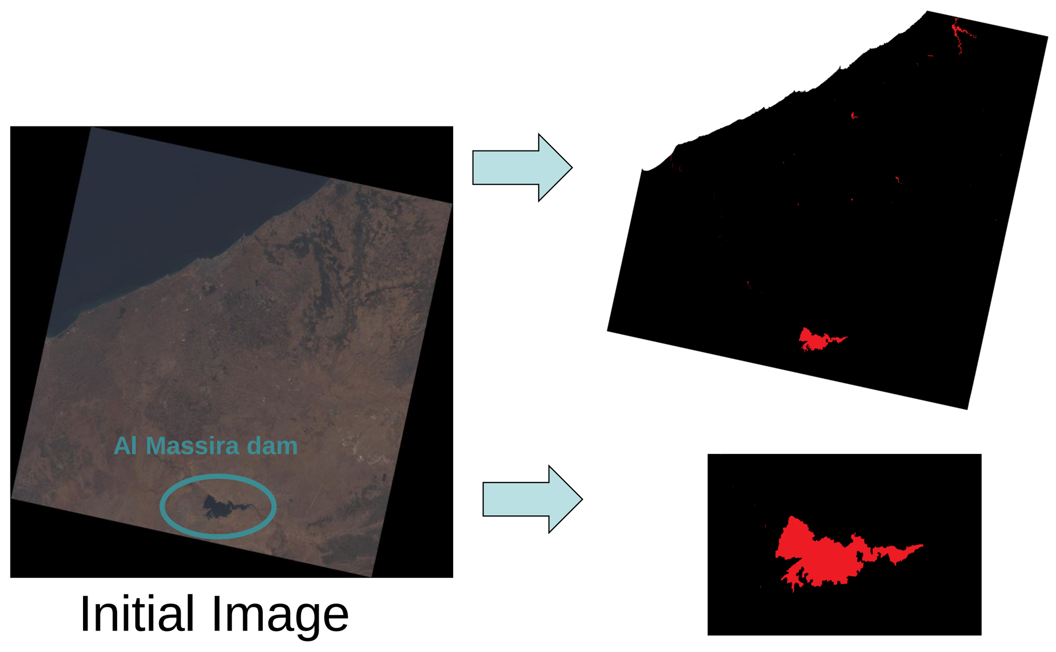
Overview: Combination of Mahalanobis distance-based classification for flood mask creation and morphological post-processing for flood mask correction so as to separate flood from non-flood areas inside satellite image by utilizing the discriminative ability of the variance of the color and the infrared values of the satellite image pixels.



- **Data**: Satellite images of 4 colour-channels, (R, G, B, Near-Infrared (NI))
- **Procedure**:
  - Random selection of pixels from training dataset
  - Representation of each pixel with 4-dimensional feature vector (R, G, B, NI)
  - Classification framework using discriminant analysis technique
    - Input: 4-dimensional feature vector and label (0,1) signifying water existence
    - Training using different discriminant functions (e.g. linear, Mahalanobis)
    - Output: binary mask with 1 for flooded pixels and 0 for non-flooded.
  - Evaluate classification framework on testing set of images
- Apply post-processing morphological operations on masks to remove erroneous areas:
  - Global filter eliminating flood-denoted pixels that as a whole did not surpass the 5% of the image size (considered as misclassified)
  - Local filter eliminating small flooded areas (10 pixels).
  - Application of image dilation and erosion around pixel and surrounding area to eliminate small non-flooded areas inside flooded area & preserve larger.

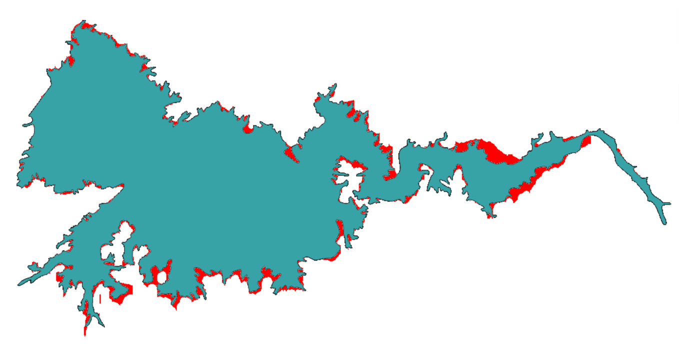
Experiments

- Training dataset:
  - MediaEval 2017 Training Annotated Dataset (http://www.multimediaeval.org/mediaeval2017/multimediasatellite/)
- Testing dataset:
  - 1 LandSat7 image and 4 LandSat8 images
  - Water volumes data refer to the Al Massira dam located in Morocco
- Discriminant functions evaluated for training model:
  - linear, diagonal linear, quadratic, diagonal quadratic, Mahalanobis
- Evaluation measure: $accuracy = \frac{number\ of\ pixels\ recognized\ correctly}{total\ number\ of\ pixels}$
- Accuracy measured on 1) full image and 2) on dam and surrounding area



Mean Accuracy

		Linear	Diagonal Linear	Quadratic	Diagonal Quadratic	Mahalanobis
Full Image	Mask before post-processing	56.268	45.846	50.179	34.846	51.156
	Mask after post-processing	56.178	45.699	51.817	36.931	53.057
Dam Region	Mask before post-processing	73.460	73.843	87.435	59.513	87.758
	Mask after post-processing	73.254	73.336	88.961	62.206	89.087



- normal dam limits
- water overflow detected using the proposed method

Alert: Dam overflown!

Outcome

- Generally post-processing operations improve the mean accuracy
- Mean accuracy of full image is low as annotation refers to dam area
- Mahalanobis outperforms other methods

Future work

Build and evaluate a deep representation scheme that leverages both texture and deep features in an effort to detect water bodies from space.

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