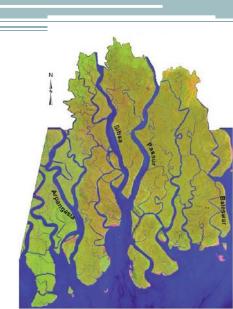# Damage and post-cyclone regeneration assessment of the Sundarbans botanic biodiversity caused by the Cyclone Sidr
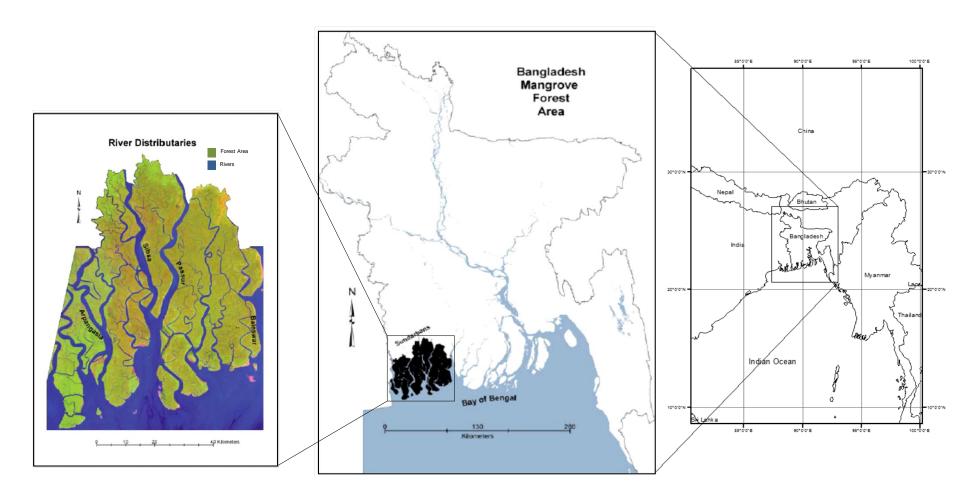
Presented by:

Avit Kumar Bhowmik
Pedro Cabral

UNIVERSIDADE NOVA
ISEGI
mundus
GEOSPATIAL TECHNOLOGIES
Supported by:
Education and Culture
Erasmus Mundus

1st World
Sustainability Forum
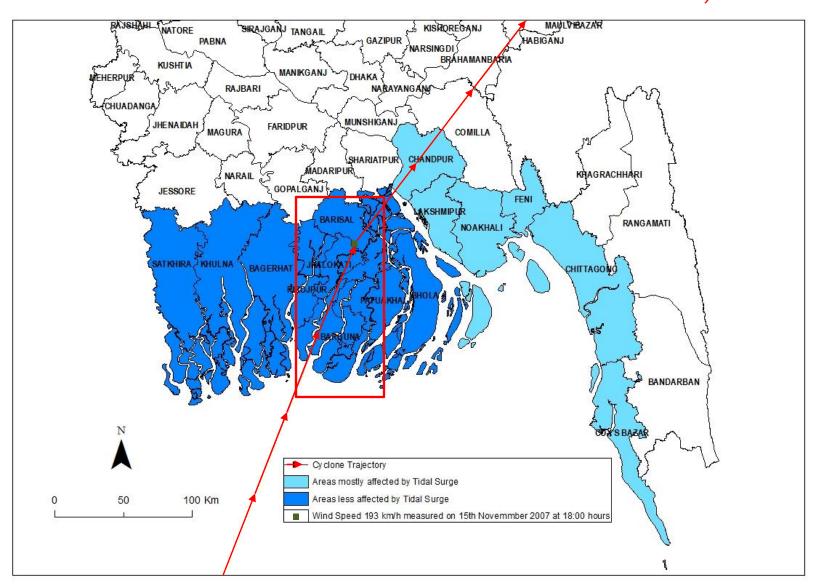1-30 November 2011

The Sundarbans

The Sundarbans

- Largest single block of tidal halophytic mangrove forest in the world

- Covers 10,000 sq.km. of which about 6,000 are in Bangladesh

- Inscribed as a UNESCO world heritage site in 1997

- Renown for the eponymous Royal Bengal Tiger (*Panthera tigris tigris*)

- The dominant mangrove species Heritiera fomes, locally known as Sundri or Sundari

- Numerous flora and fauna

Cyclone SIDR

November 15, 2007

Objectives

(i) Identify changes in vegetation pattern in preceding and following periods of the tropical cyclone Sidr passage using unsupervised image classification and NDVI techniques.

ii) Identify specific species damage and their regeneration until year 2010.
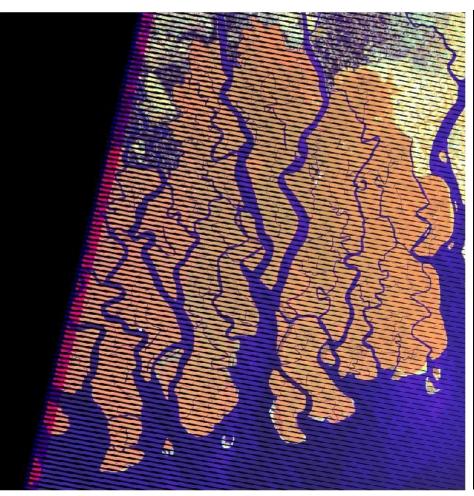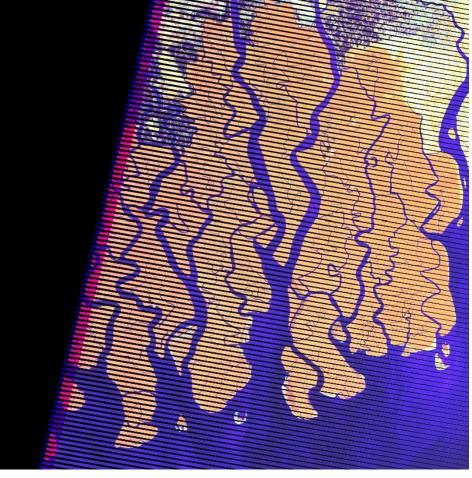
Sattelite Data

- Landsat 7 ETM+ images of Sundarban area with spatial resolution of 30 metres and records in bands 1-6 of the periods
  - 15 February 2007
  - 02 February 2008
  - 04 February 2009
  - 07 February 2010

Image Pre-processing

- Combination of Mask Bands to minimise periodic line dropout error
- Contrast Stretching - Histogram Equalization for Radiometric Enhancement

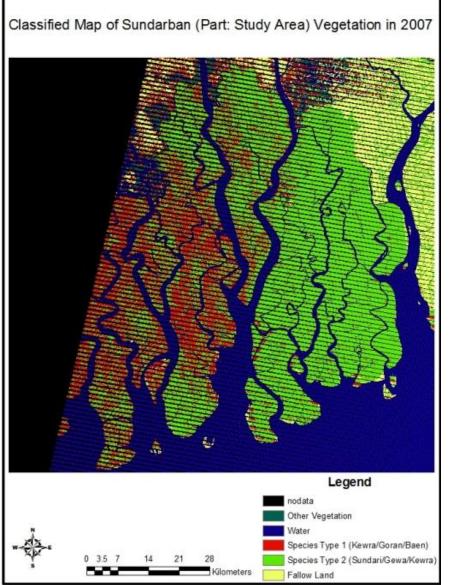# Image Pre-processing

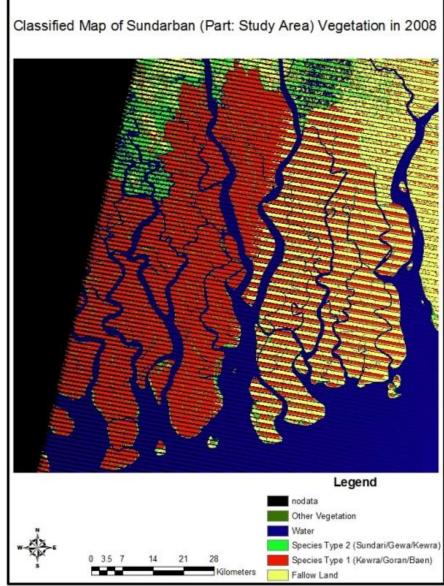Raw Image of February 2007

Pre-processed Image of February 2007

Unsupervised Classification

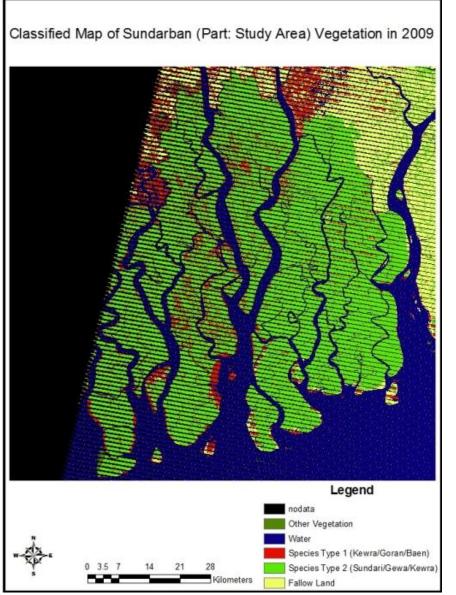- Iterative Self-Organizing Data Analysis Technique (ISODATA)
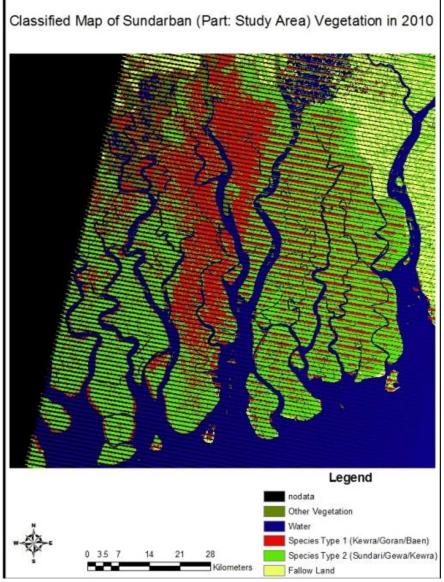
$$SS_{\text{distances}} = \sum_{\forall x} [x - C(x)]^2$$
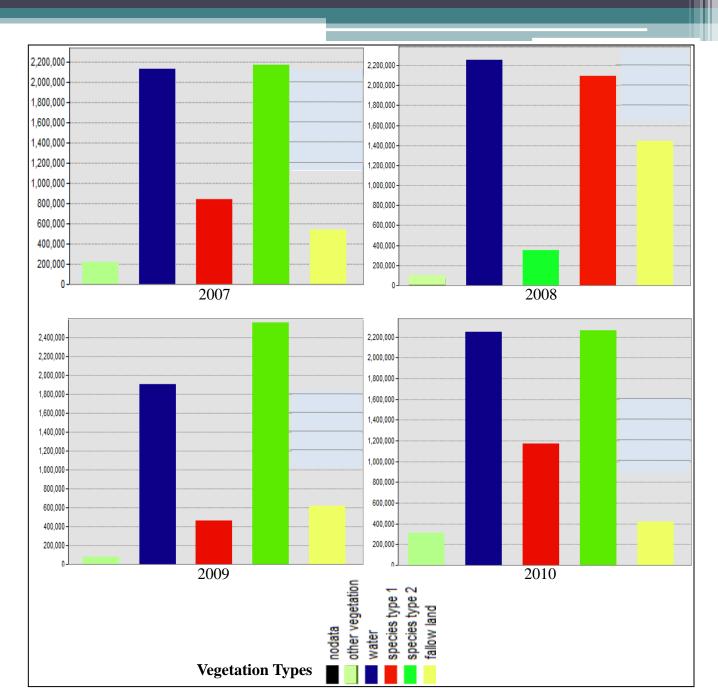
Unsupervised Classification

Unsupervised Classification

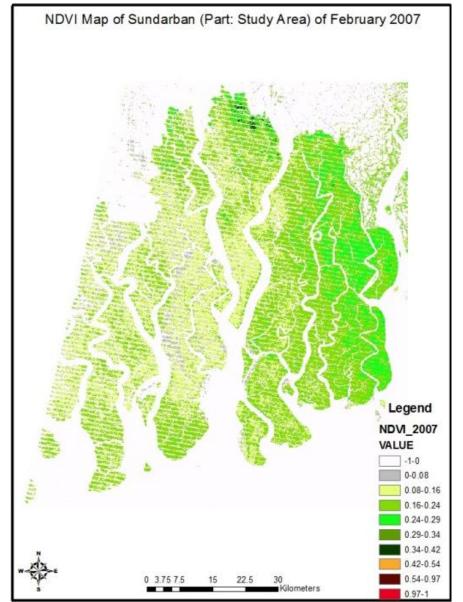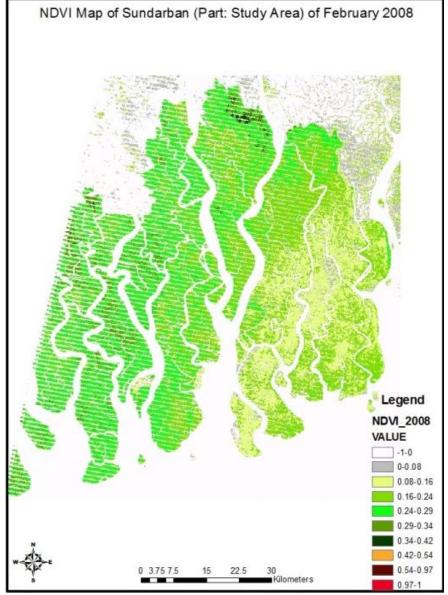Analysis and Results from Unsupervised Classification

Normalized Difference Vegetation Index (NDVI)
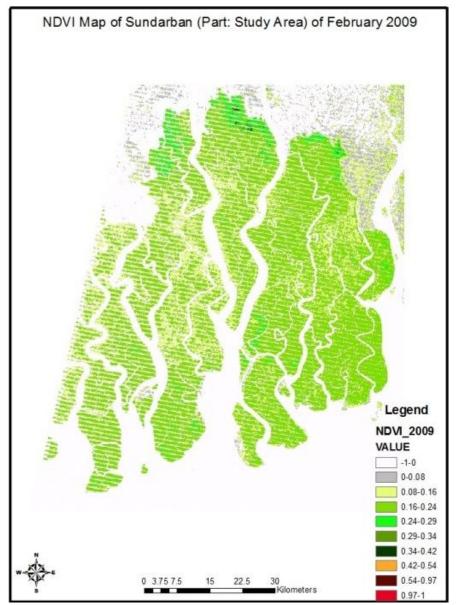
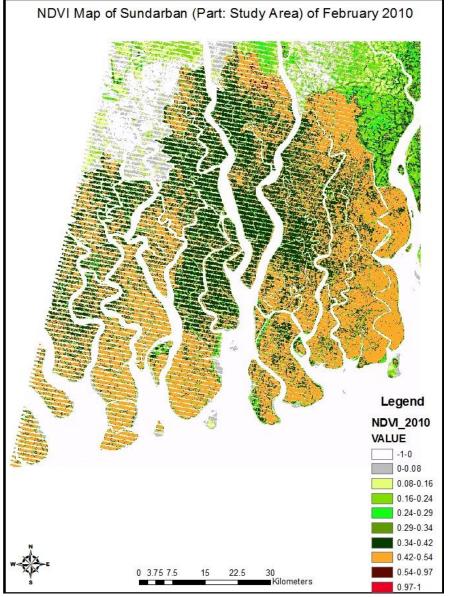$$NDVI = \frac{NIR - PAR}{NIR + PAR}$$

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

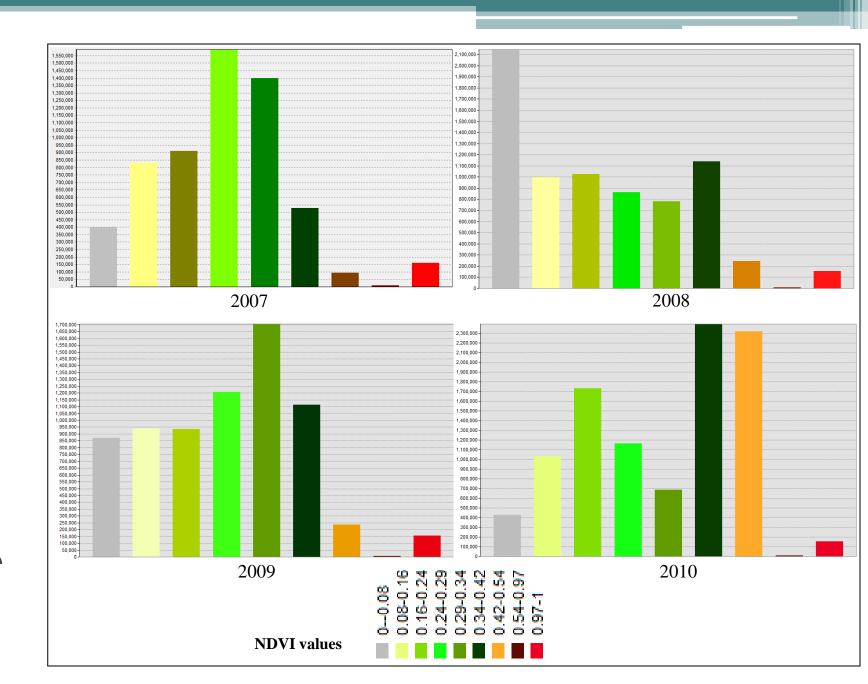# Normalized Difference Vegetation Index (NDVI)
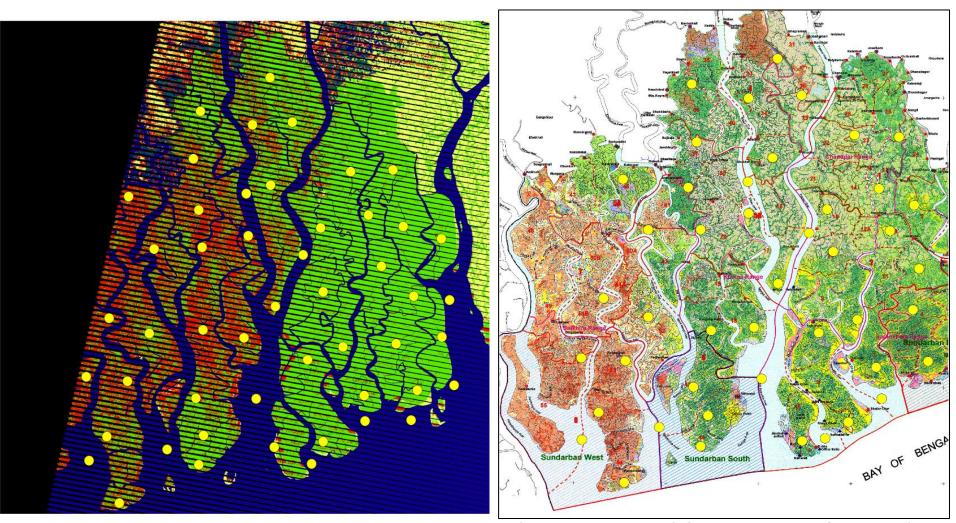
Normalized Difference Vegetation Index (NDVI)

Analysis and Results from NDVI

2007

2008

2009

2010

NDVI values

Analysis and Results from NDVI

Area covered by NDVI Values	From February 2007 to February 2008	From February 2008 to February 2009	From February 2009 to February 2010
0-0.08	Increased by 95%	Decreased by 7%	Decreased by 77%
0.08-0.16	Increased by 14%	Increased by 8%	Decreased by 51%
0.16-0.24	Decreased by 21%	Increased by 70%	Decreased by 39%
0.24-0.29	Increased by 77%	Decreased by 80%	Increased more than 90%
0.29-0.34	Increased by 30%	Decreased by 91%	Increased more than 95%
0.34-0.42	Increased by 25%	Decreased by 25%	Increased more than 98%
0.42-0.54	No Change	No Change	Increased by 100%
0.54-0.97	No Change	No Change	Increased by 100%
0.97-1	No Change	No Change	No Change

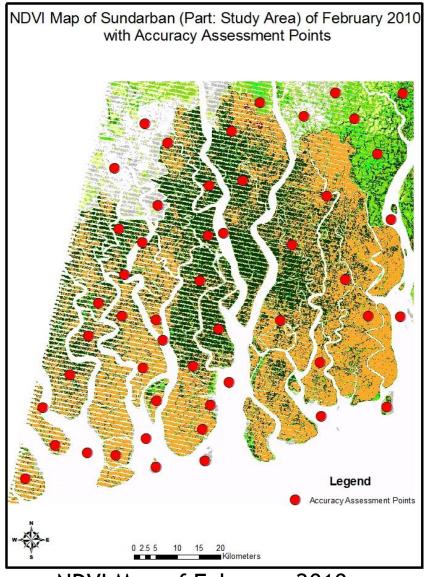# Accuracy Assessment (Classified Image)

Classified Image of February 2007

Reference Map of Species Distribution from Forest Department of Bangladesh, 2002
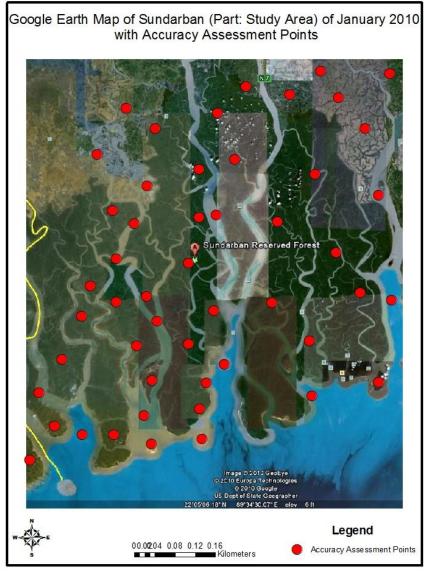
Accuracy Assessment (Classified Image)

	Species type 1	Species type 2	Water	Row total
Species type 1	9	9	0	18
Species type 2	3	19	0	22
Water	0	0	10	10
Column total	12	28	10	50

Overall accuracy = 76 %		
Class	Producer's accuracy (%)	User's accuracy (%)
Species type 1	50	75
Species type 2	86.36	67.86
Water	100	100

Accuracy Assessment (NDVI Map)

NDVI Map of February 2010

Reference Map from Google Earth of November 2010

Accuracy Assessment (NDVI Map)

	Fallow land	Sundarban Vegetation	Other Vegetation	Waterbody	Total
Fallow Land	2	0	1	0	3
Sundarban Vegetation	0	30	0	0	30
Other Vegetation	0	2	4	0	6
Waterbody	0	3	0	8	11
Total	2	35	5	8	50

Overall Accuracy = 88%		
Classes	Producer Accuracy	User Accuracy
Fallow Land	66.67%	100%
Sundarban Vegetation	100%	85.71%
Other Vegetation	66.67%	80%
Waterbody	72.73%	100%

Major Findings

- Around 45% area (2500 sq.km.) of the study region has been damaged by cyclone SIDR

- The eastern part of the region was affected largely because of closeness to cyclone trajectory

- Sundari (*Heritiera fomes*), Gewa (*Excoecaria agallocha*) and Kewra (*Sonneratia mangrove)* were the species which have been largely affected by cyclone SIDR

- The regeneration rate in 2009-2010 is 4 times higher than the regeneration rate in 2008-2009

Thank you All