Remote Sensing of Mangrove Deforestation – A Case Study of the Mahakam Delta
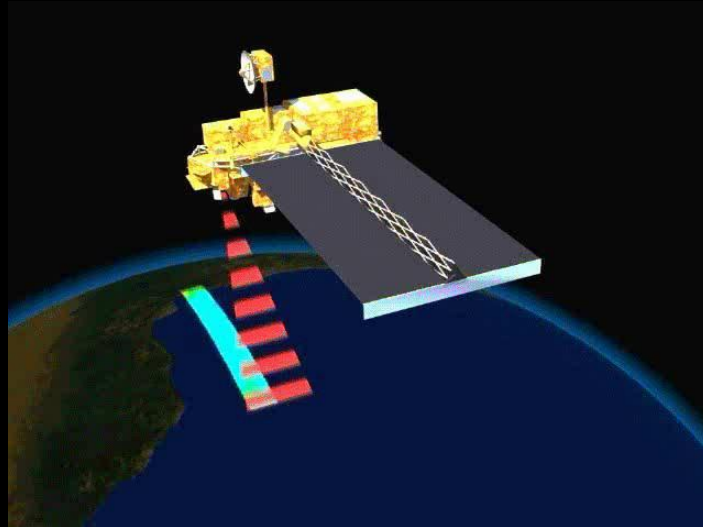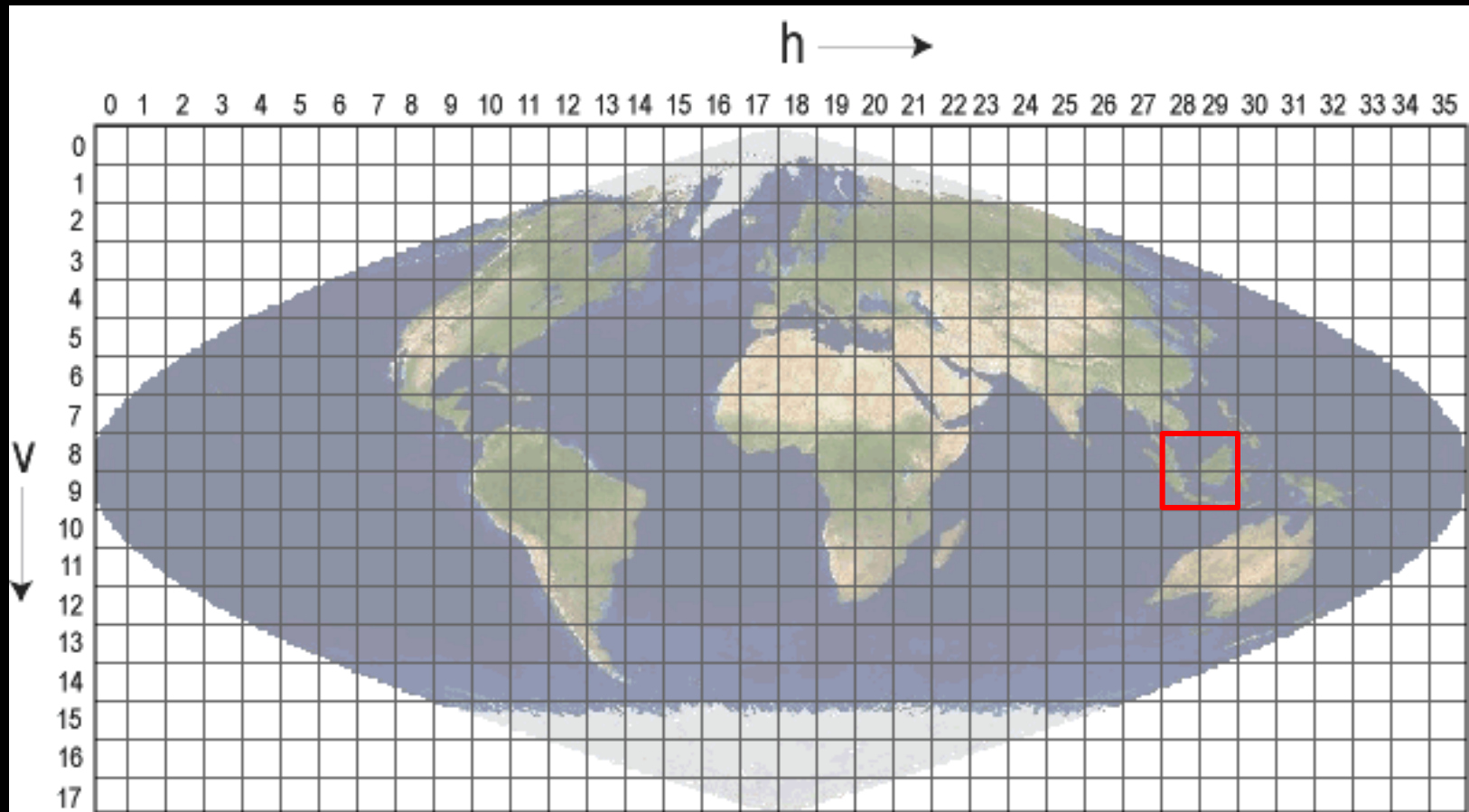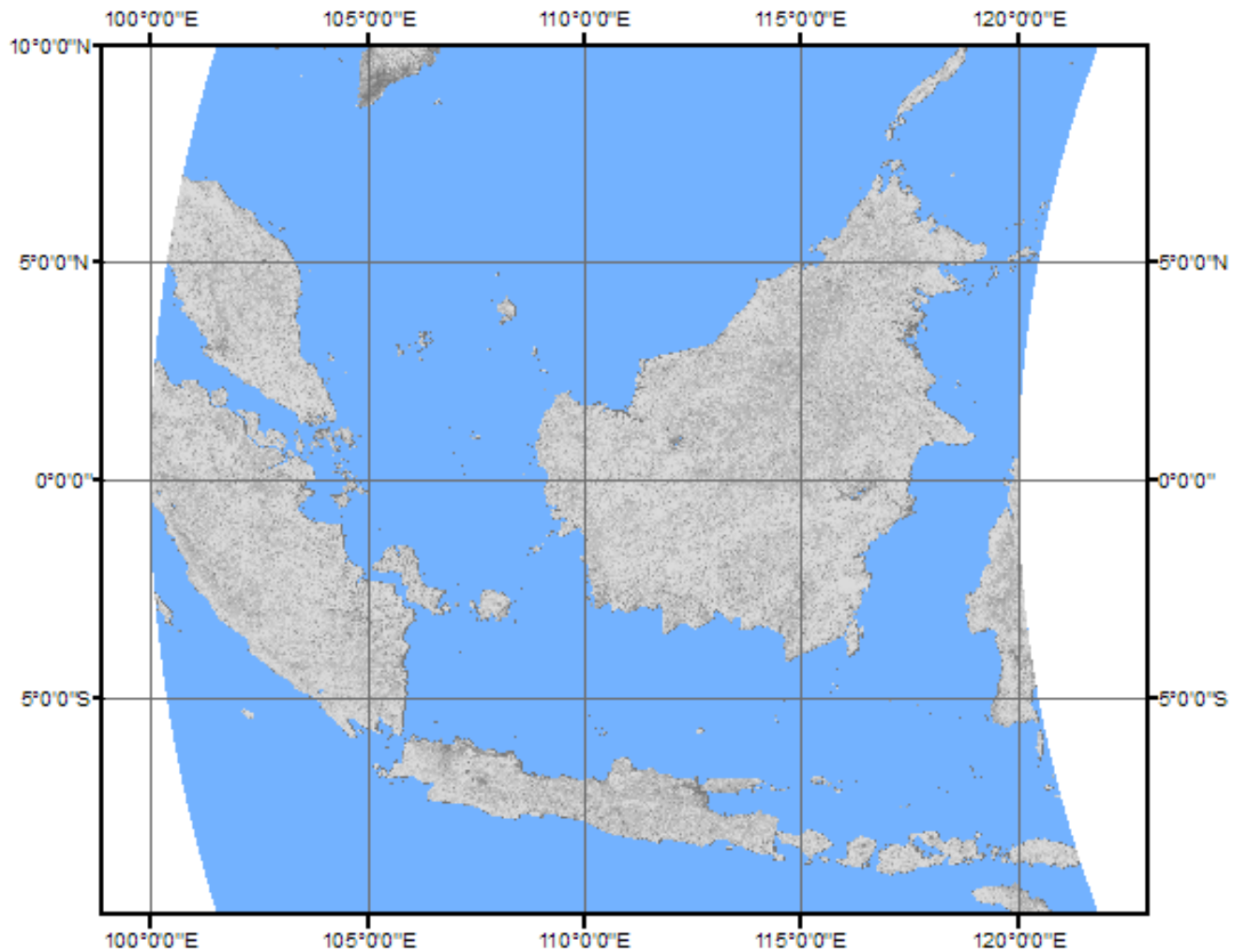

Faiz Rahman
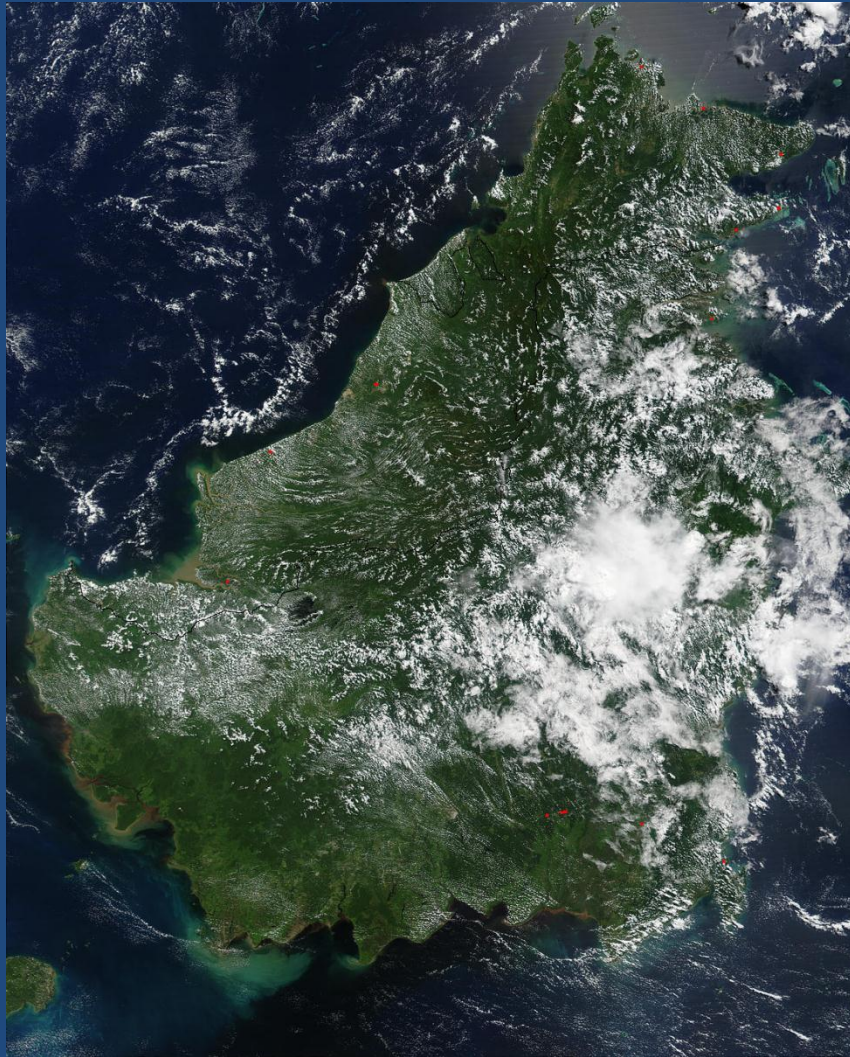
MODIS Sinusoidal Tiles Grid

Tiles are 10 degrees by 10 degrees at the equator
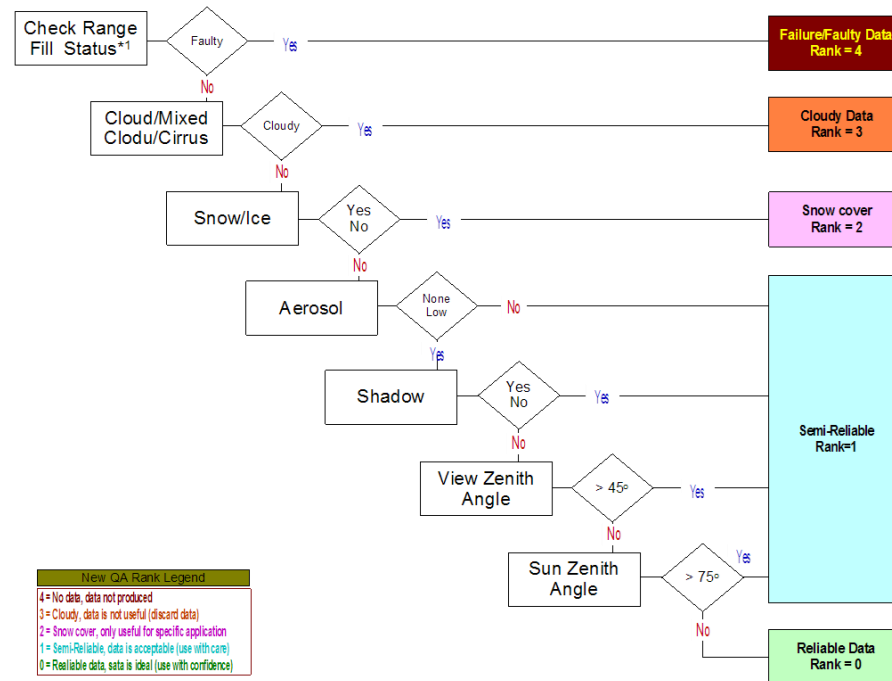Each tile for each band of data = 16 MB

Geographic Coordinate

On A Given Day, From Space
Kalimantan Looks Like:

But Ideal
If It Looked Like :

A New Quality-Assurance Metric

| Jan-Feb-Mar	Apr-May-Jun	Jul-Aug-Sep	Oct-Nov-Dec

Vegetation Index (VI)

- VI is a measure of greenness
- Two or more bands of reflectance are used to calculate a VI
- NDVI – most used, uses Red and NIR bands, but has limitations
- EVI – developed to overcome those limitations, it uses Blue band (but scattering and absence are problems)
- A recent development is EVI2 (Huete et al., 2008). It uses R and NIR, but is robust and does not saturate.

$$EVI2 = 2.5 \frac{NIR - R}{NIR + 2.4R + 1}$$

RePPProT, 1990
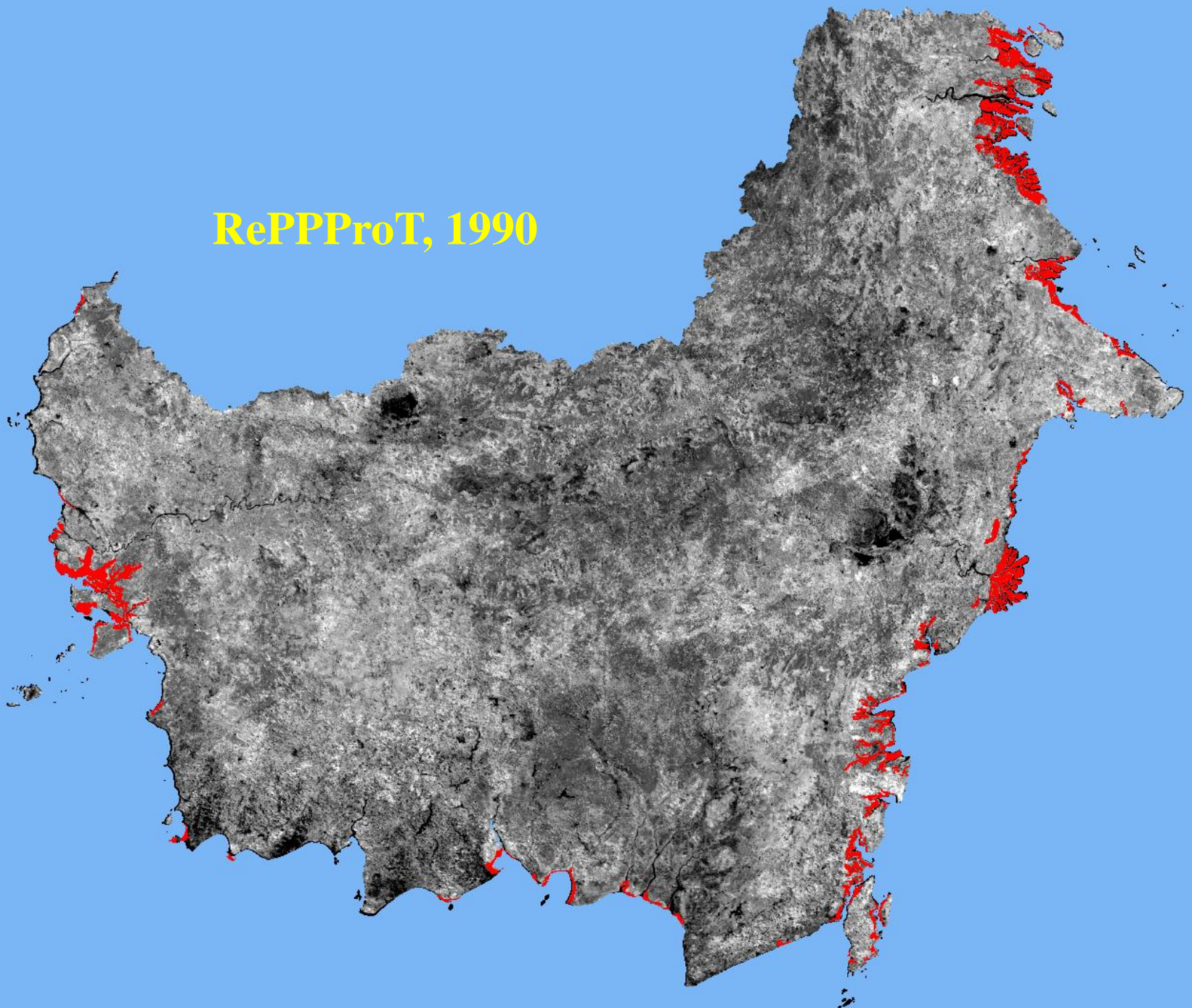
EVI2 in a 3-month Period

0.05   0.65
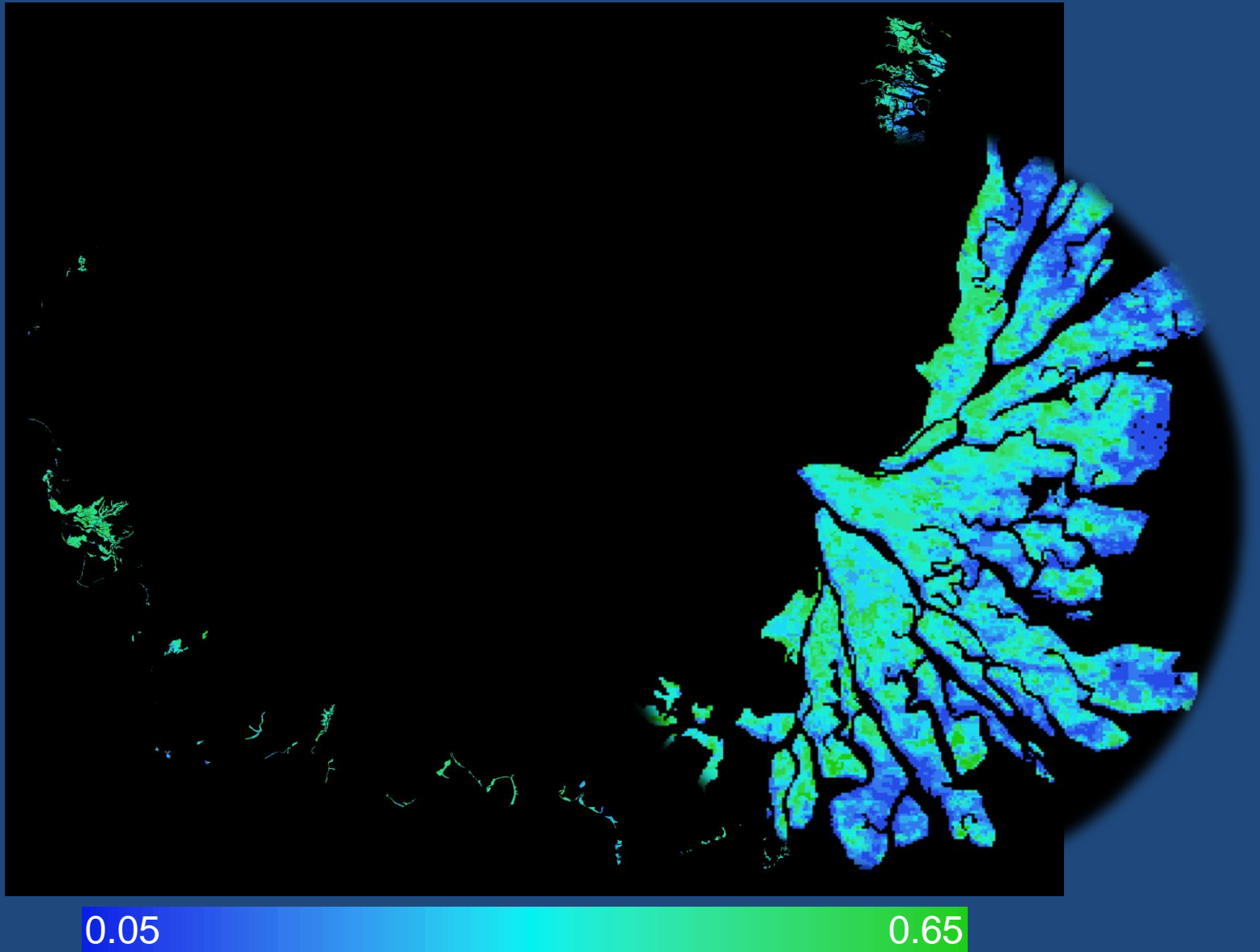
Change Point Analysis

A combined methods of cumulative sum (CUSUM) and bootstrapping

If X_1, X_2,…, X_{44} represented the consecutive EVI2 values of any pixel, the CUSUM values S_0, S_1,…, S_{44} were calculated as:

Bootstrapping: the EVI2 time-series (actual dataset) of a pixel was used to generate 1000 synthetic time-series datasets by sampling without replacement, and the CUSUM magnitude of the change was calculated for each of these synthetic datasets.
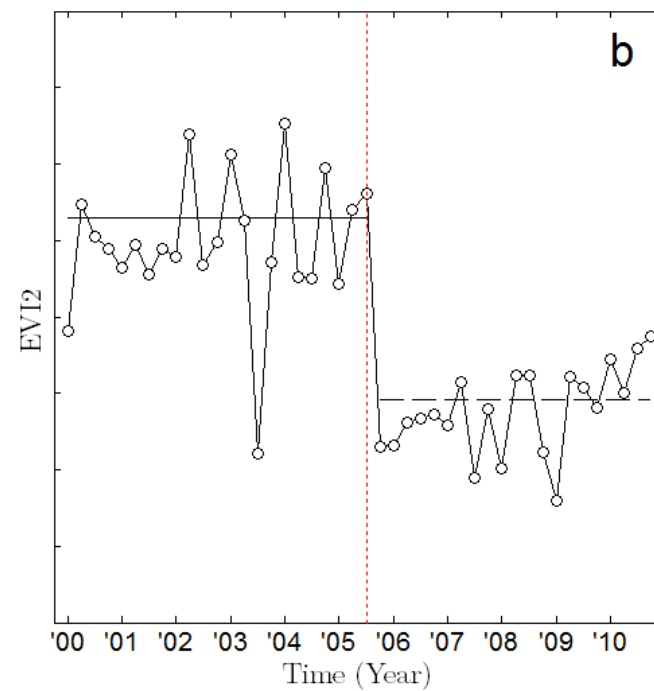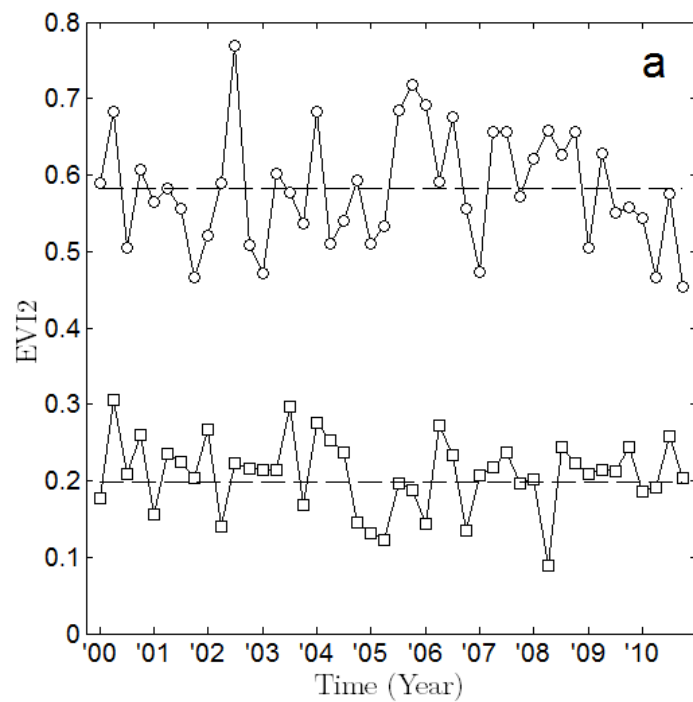
Step 1: Calculate the EVI2 average:

$$\bar{X} = \frac{X_1 + X_2 + \cdots + X_{44}}{44}$$

Step 2: Set the CUSUM at zero time-period as $S_0 = 0$

Step 3: Calculate S_i recursively:
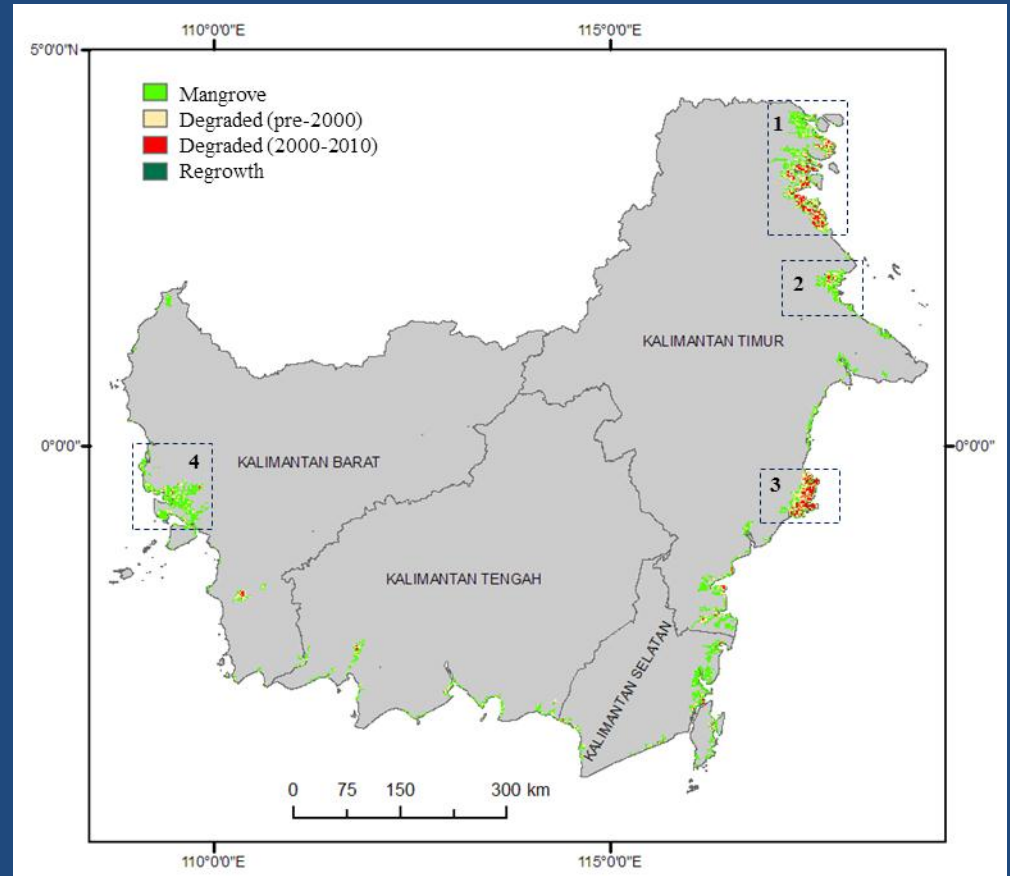
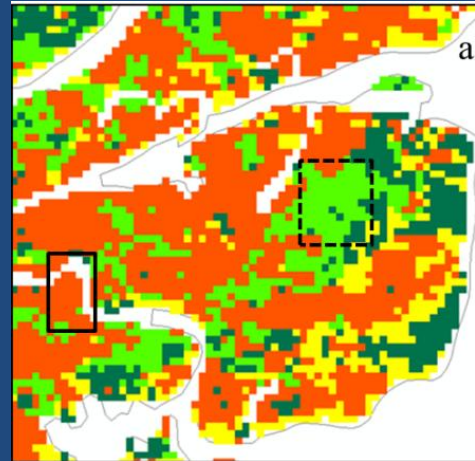$$S_i = S_{i-1} + (X_i - \bar{X}), \qquad i = 1,2,...,44$$
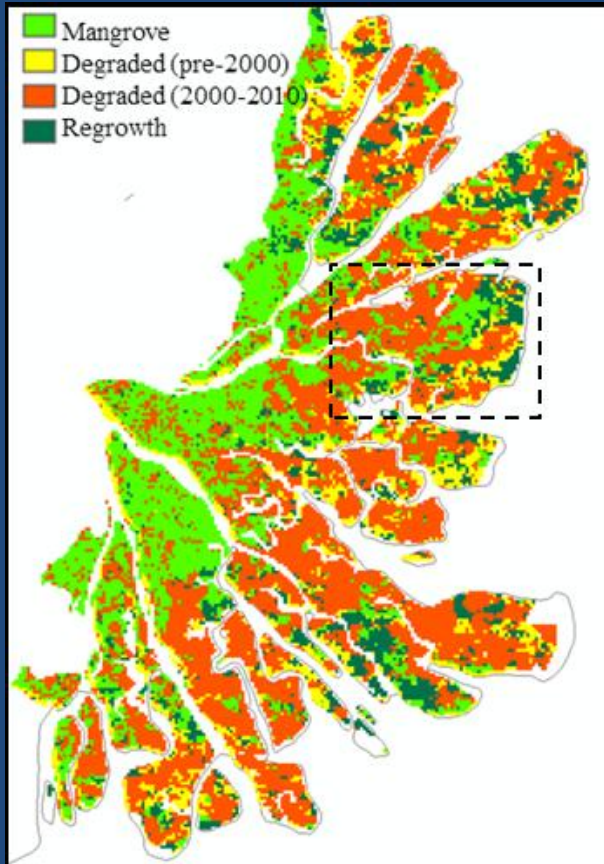
Outputs of Change Point Analysis

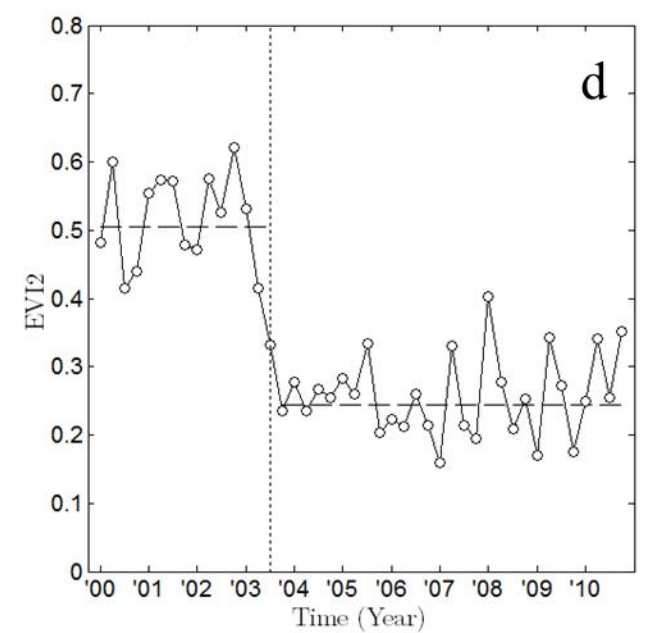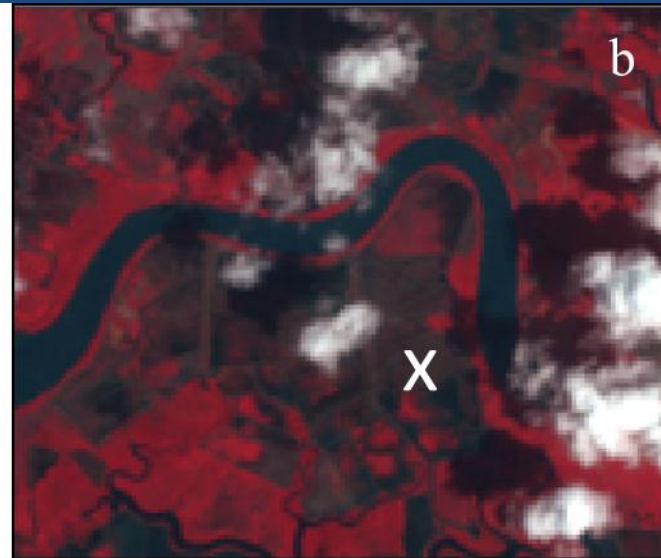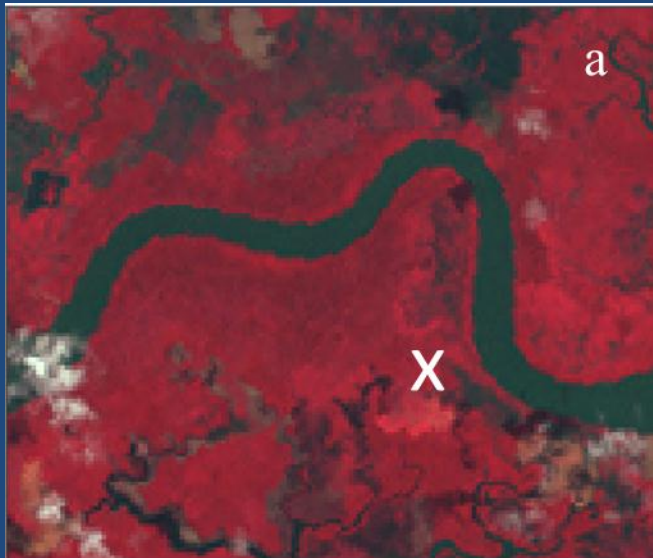# Some Initial Results

For 2000-2010:

- Unchanged mangrove: 711,981 ha (~61% of the study area)

- Deforested pre-2000: 86,087 ha (~ 7% of the study area)

- Deforested since 2000: 279,090 ha (~24% of the study area)

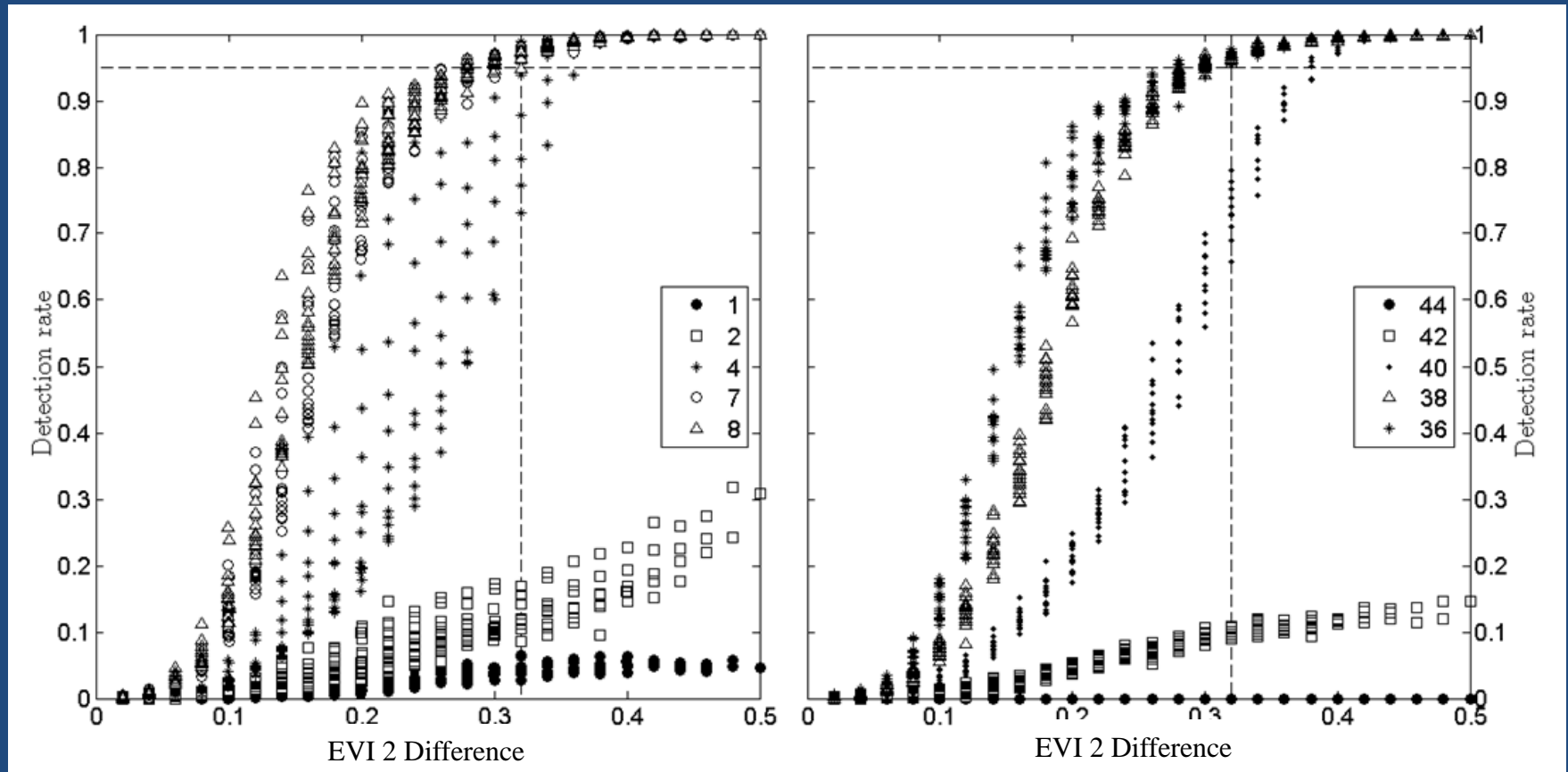- *** Regrowth? : 87,944 ha (~8% of the study area)
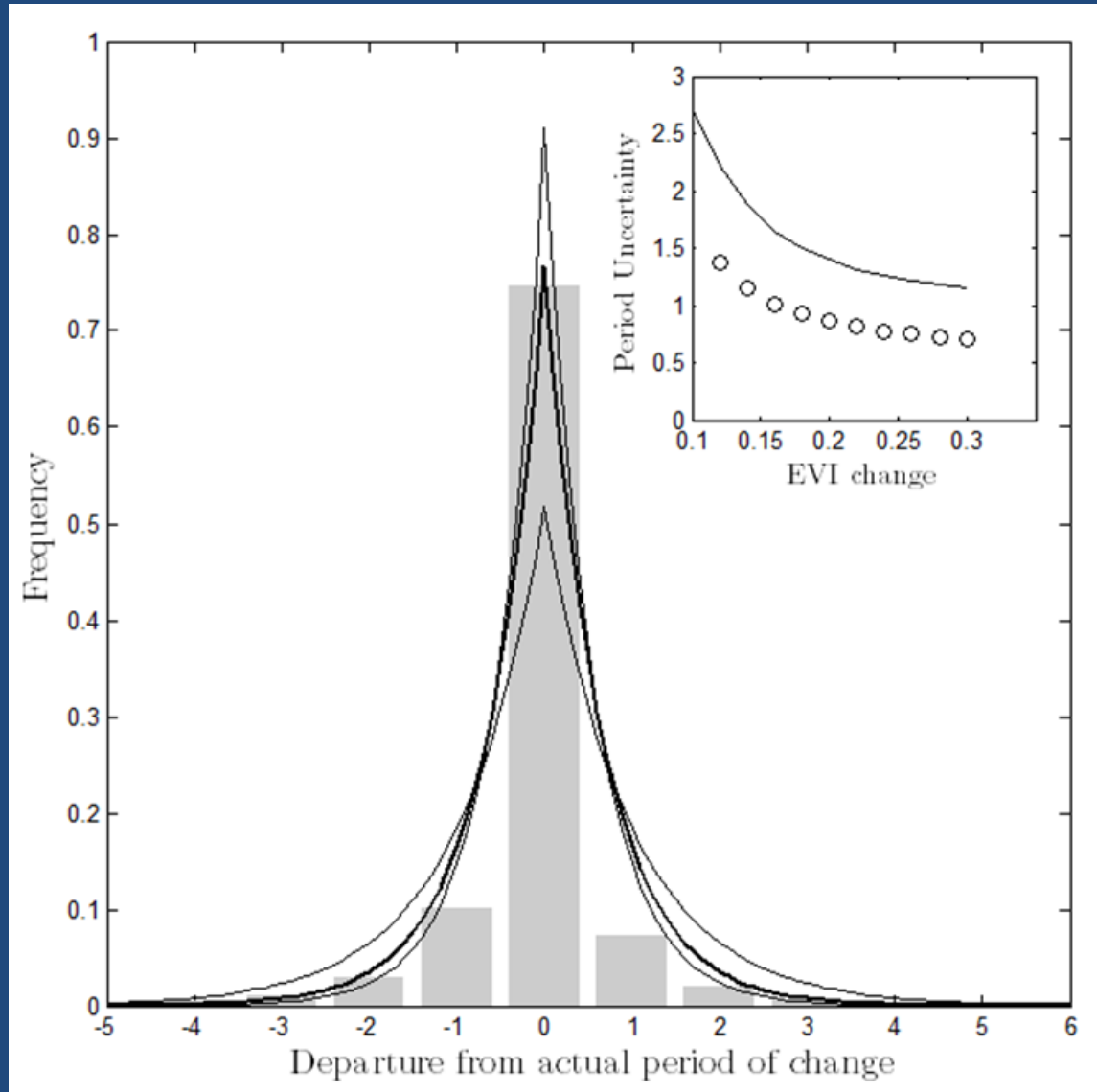
Validation (scarce ground data!)
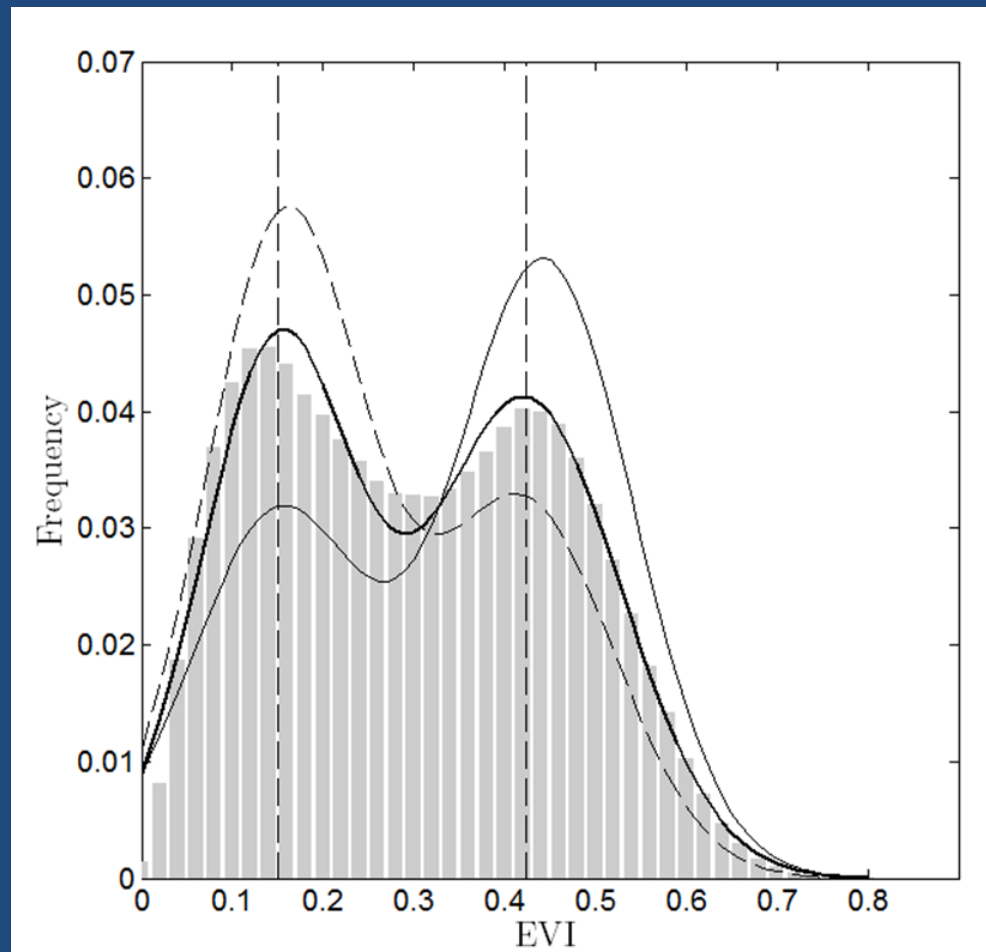
Validation (contd.)
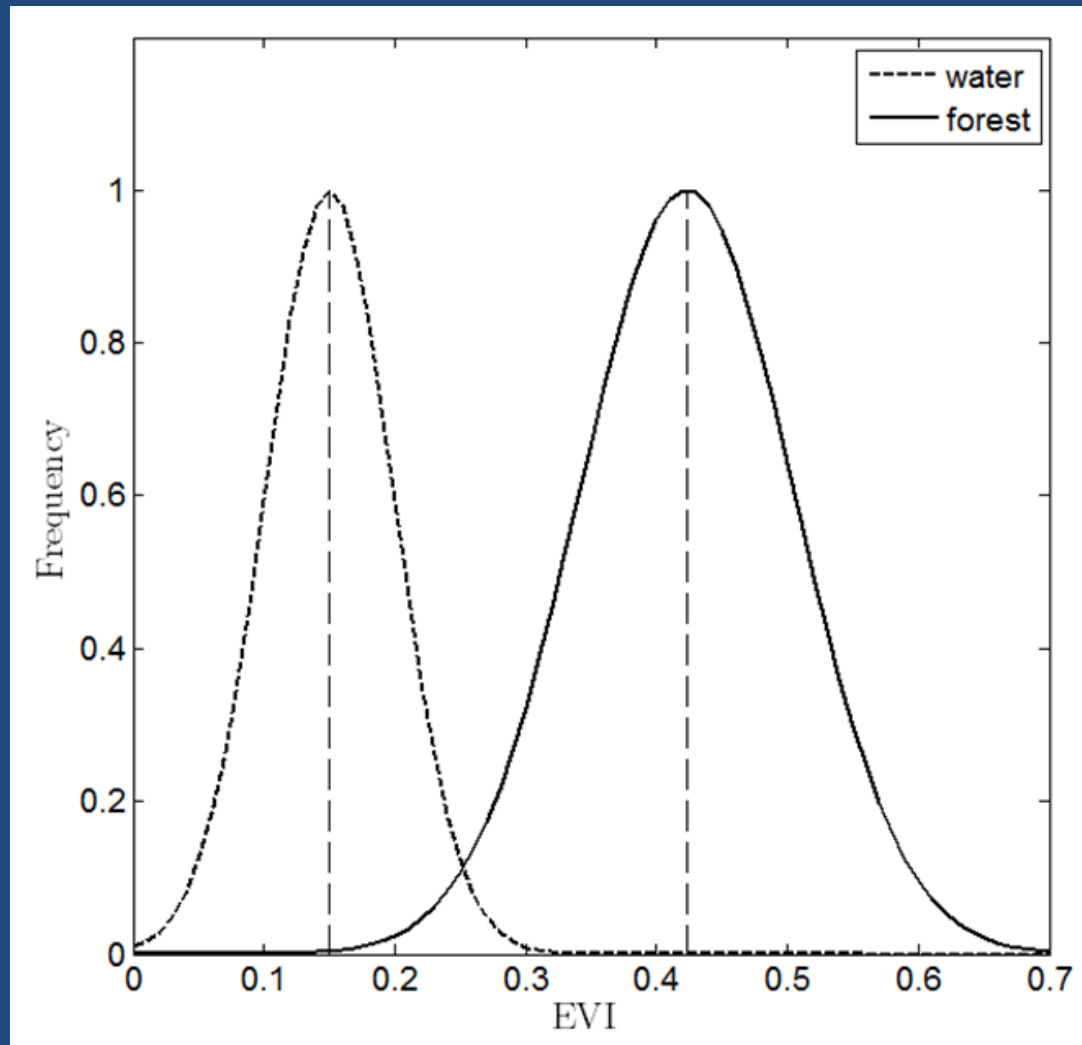
Edge Effect in Time Series

Error in Detecting the Time of Change
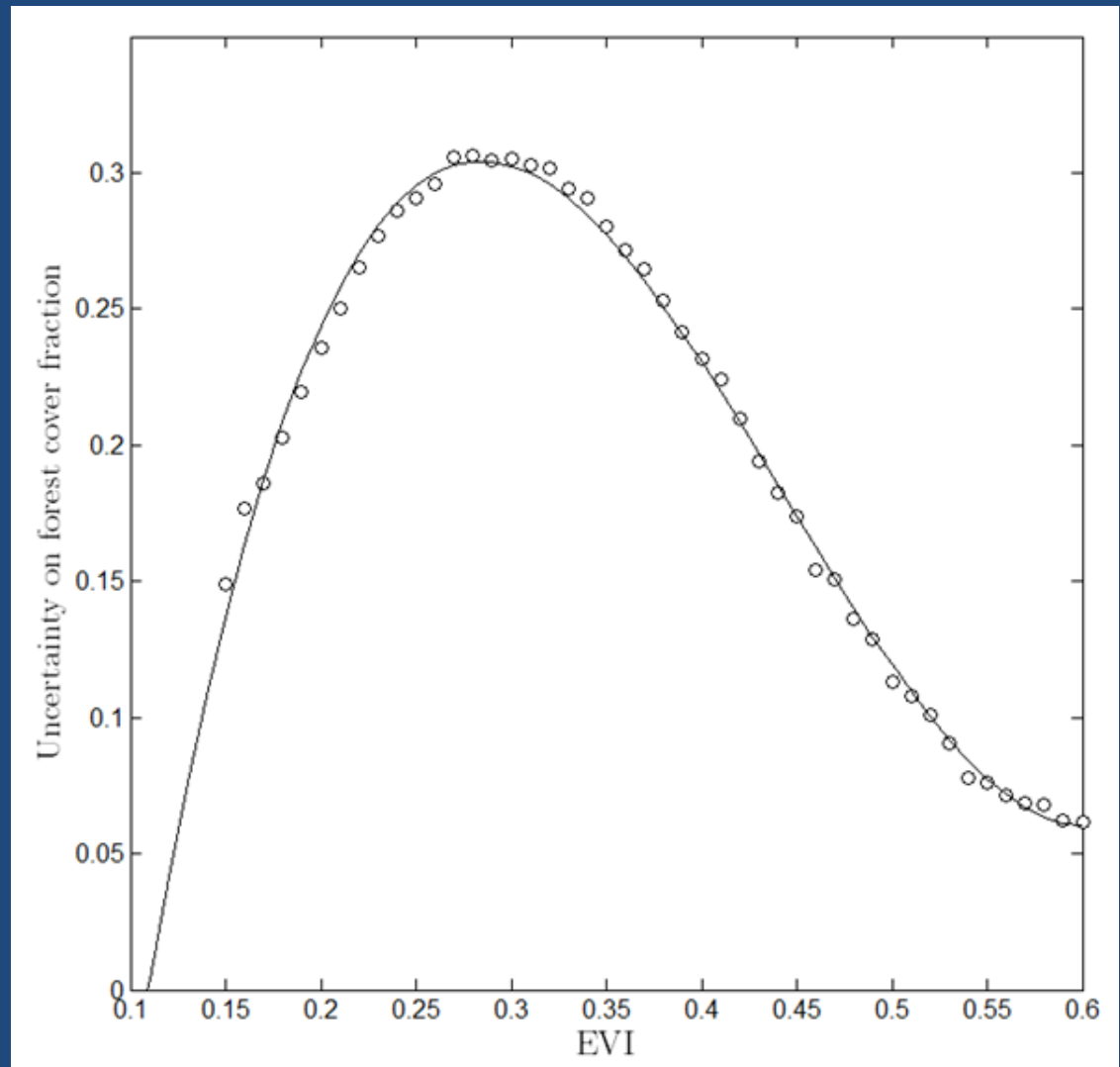
EVI2 Distribution for All Pixels All Periods

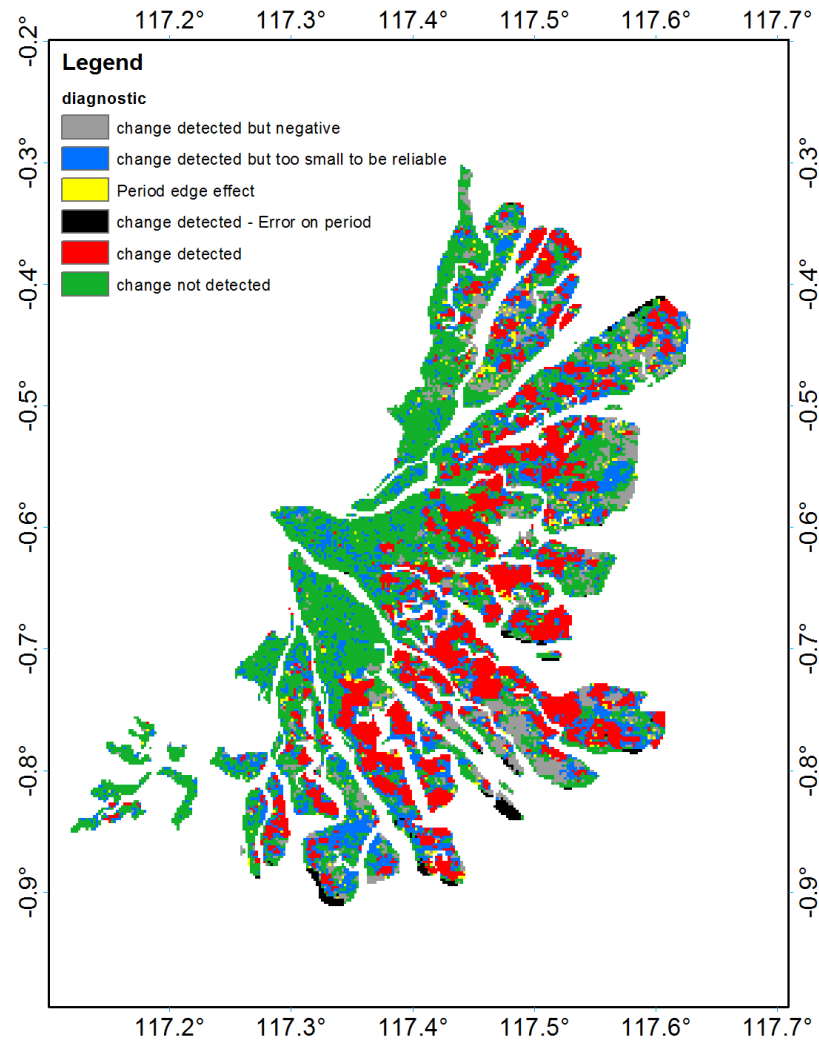# Mixed Pixel, End Members

Mixture Analysis

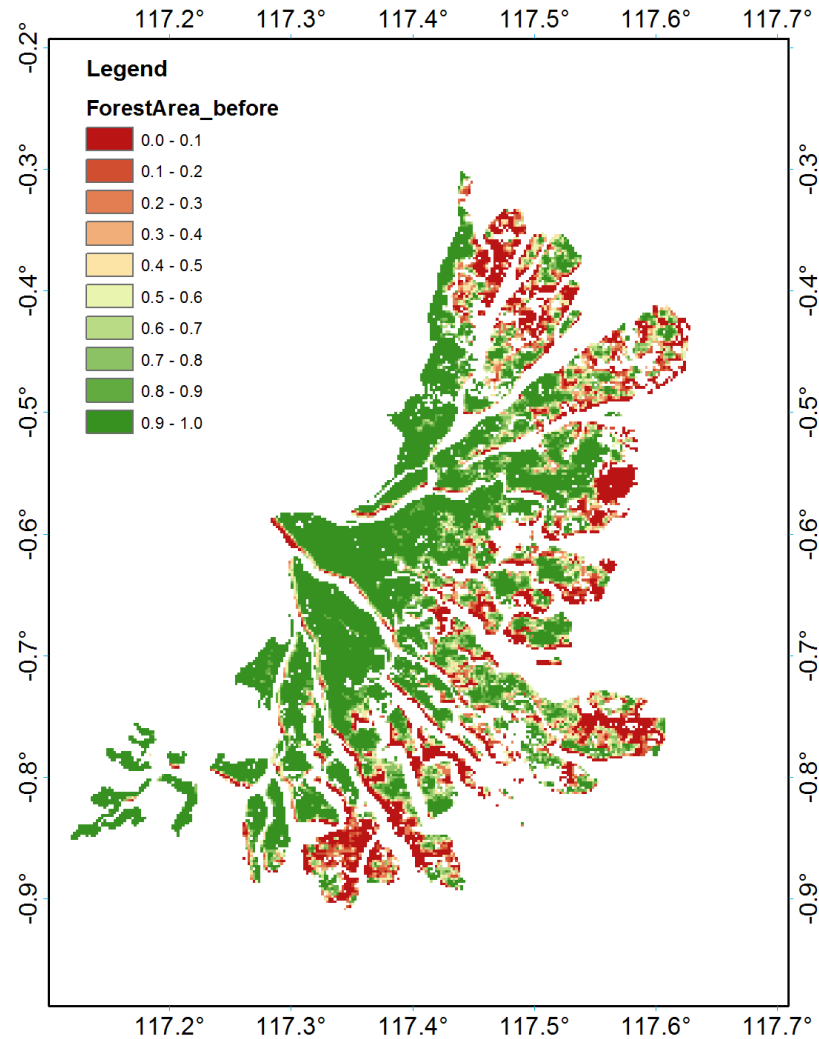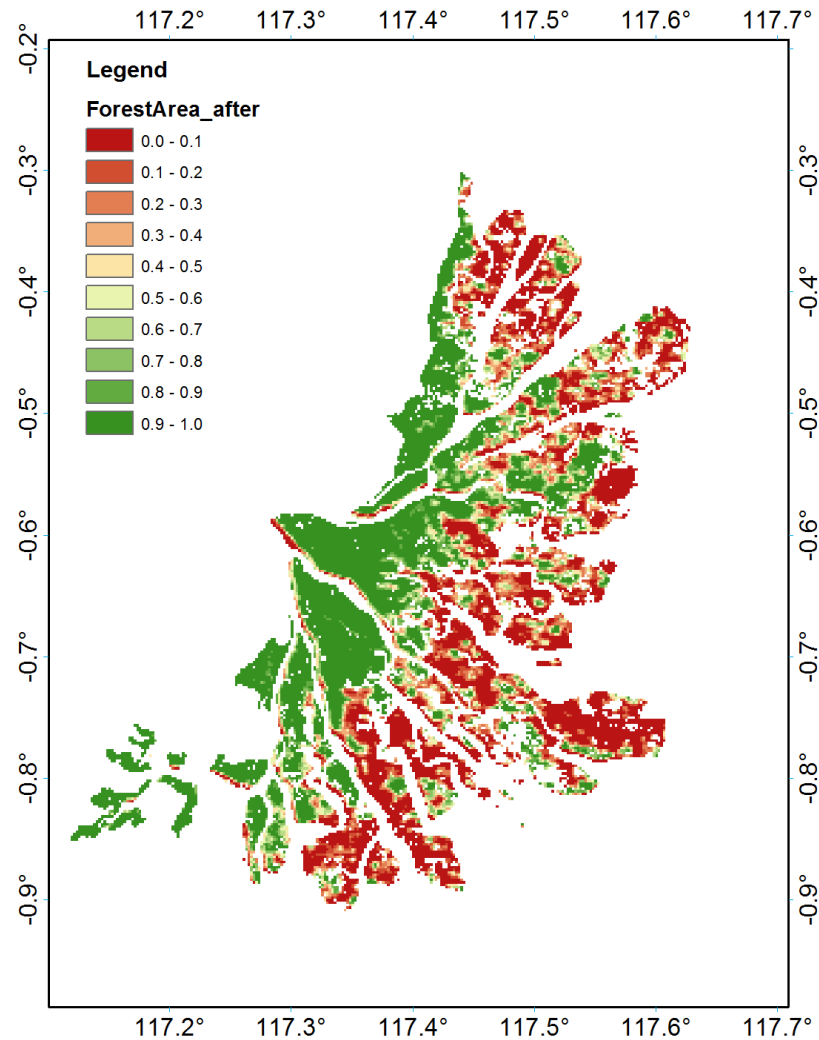$$E = E_F A_F + E_W A_W$$

$$A_F + A_W = 1$$

Results

Results

Results

MODIS Data: Dr. Kamel Didan
Data Analysis: Dr. Danilo Dragoni
GIS Data, Assistance: Joseph Hutabarat

Thank You