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MONITORING FUZZY COASTLINES

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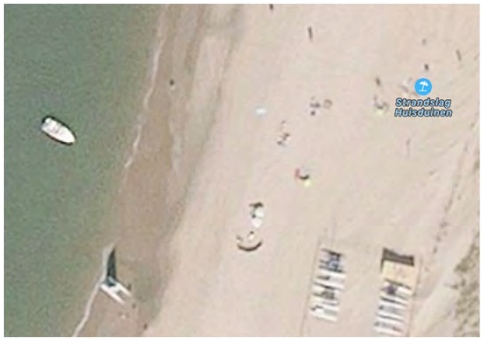
COASTLINES: GRADUAL BOUNDARIES, GRADUAL CHANGES

- Boundary between land and water (shoreline) is gradual
- Changes in shoreline are gradual
- Hard classification assigns a pixel to one class only
- Subpixel changes remain long unnoticed



Fuzzy	Hard
0.3 water 0.7 land	Land
0.45 water 0.55 land	Land
0.55 water 0.45 land	Water
0.70 water 0.30 land	Water

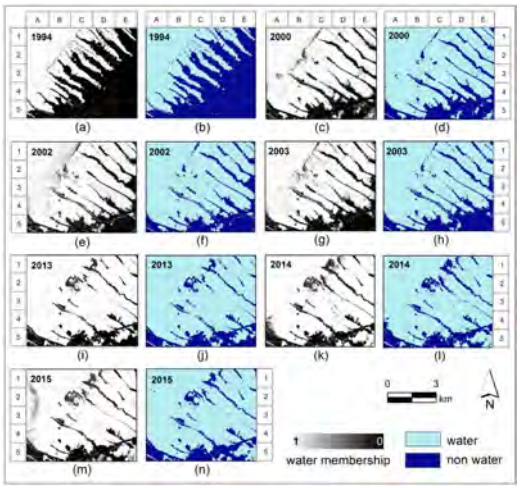
ITC UNIVERSITY OF TWENTE. Image courtesy Apple maps

FUZZY CLASSIFICATION FOR SHORELINE CHANGE MONITORING IN INDONESIA (SEMARANG)

- Fuzzy C-means classification with 2 classes: water & non-water
- Shoreline as a line versus shoreline as a margin
- Change detection
- Uncertainty of changes

Image courtesy Apple maps

SHORELINE AS A LINE



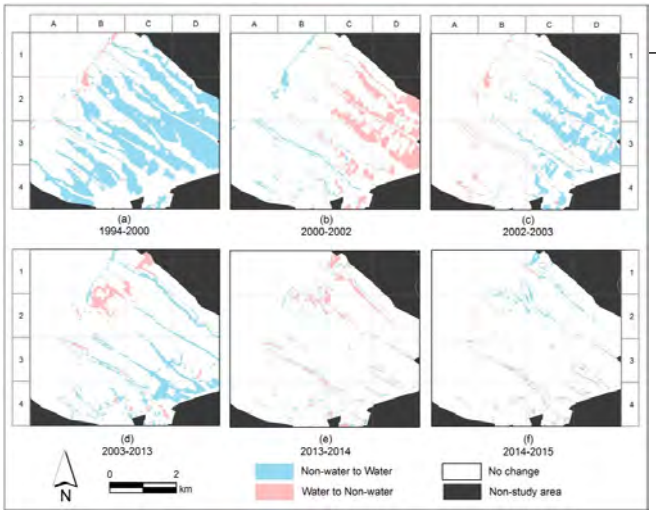
Membership of *water* class (grey)

Classified images of *water* class (blue)

water $if\ \mu_{water} \geq 0.5$
non- water $if\ \mu_{water} < 0.5$

Source: Dewi, 2018

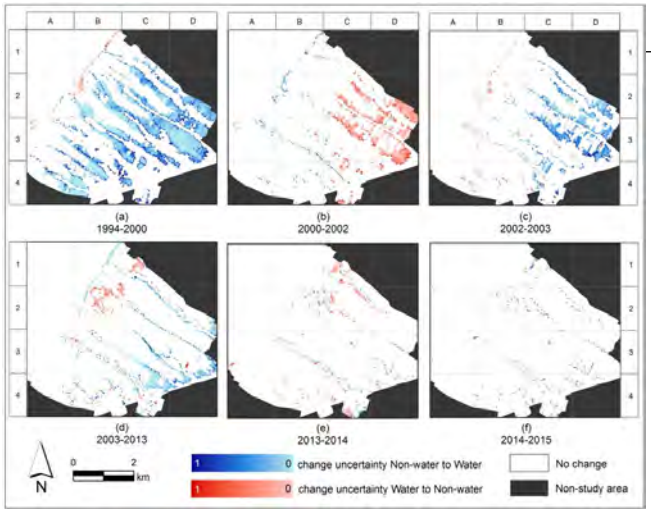
CHANGE DETECTION – SHORELINE AS A LINE



Source: Dewi, 2018

Shoreline change analysis at α = 0.5. Two changes: *non-water to water* and *water to non-water*.
(a) 1994 – 2000: large areas changed from *non-water to water* due to inundation, erosion.
(b) 2000 – 2002 large areas changed from *water to non-water*

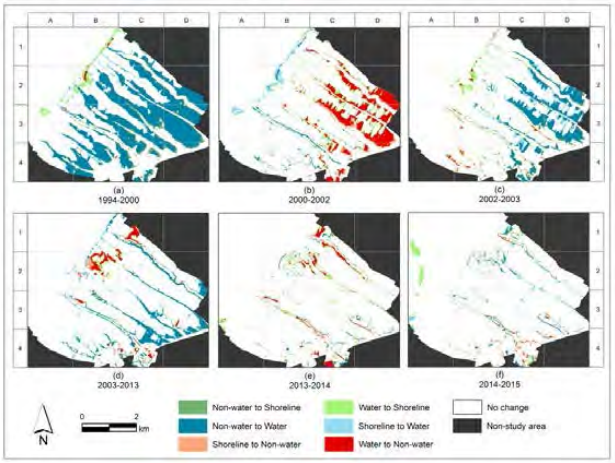
CHANGE UNCERTAINTY– SHORELINE AS A LINE



Source: Dewi, 2018

Shoreline change uncertainty at α = 0.5 and CU ≤ 0.1.
(a) 1994 – 2000: extensive inundation.
(b) 2000 – 2002: largest change from *water to non-water*

CHANGE DETECTION – SHORELINE MARGIN



water
if $\mu_{water} \geq 0.7$,

non-water
if $\mu_{water} < 0.3$

shoreline margin
if $0.3 \leq \mu_{water} < 0.7$

Changes of *shoreline* margin, *water* and *non-water* for six timespans (a-f).
(a) Extensive inundation between 1994 and 2000,
(b) Large change to *non-water* over 2000–2002.
Changes (c) 2002–2003, (d) 2003–2013, (e) 2013–2014 (f) 2014–2015.

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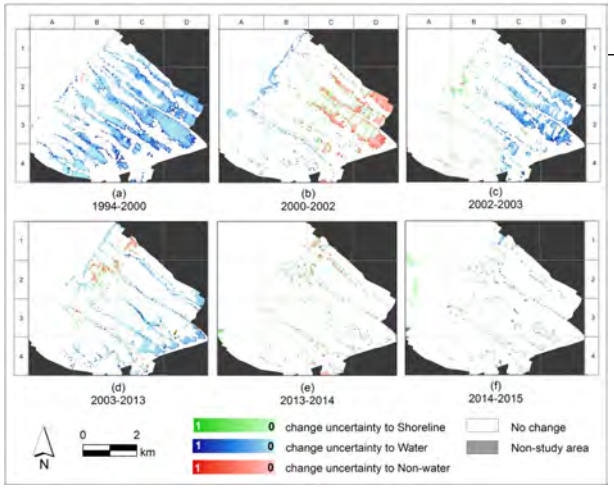
Source: Dewi, 2018

CHANGE UNCERTAINTY – SHORELINE MARGIN



Source: Dewi, 2018

Change uncertainty of shoreline margins and their associated sub-areas at CU level ≤ 0.1 in the period 1994–2015.

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SOURCES

- Dewi, R. S. (2018). Multitemporal image analysis for monitoring fuzzy shorelines. (331 ed.). Enschede: University of Twente, Faculty of Geo-Information Science and Earth Observation (ITC). PhD thesis. https://doi.org/10.3990/1.9789036546331

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