

Interactive comment on “Spatial heterogeneity in mangroves assessed by GeoEye-1 satellite data: a case-study in Zhanjiang Mangrove National Nature Reserve (ZMNR), China” by K. Leempoel et al.

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Page: 3 (= 2593) Line: 6 – Sentence too long, to be condensed to one and half line

Line: 8 – lapse remote sensing data of

Line: 8 – delete using

Response: We have modified the sentence as below - In this paper, mangrove cover dynamics at Gaoqiao (P.R. China) were assessed through time using 1967, 2000 and 2009 satellite imageries (sensors: Corona KH-4B, Landsat ETM+ and GeoEye-1, re-

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spectively).

Line: 8 - replace important by major

Response: Suggestion followed.

Line: 11- replace word agriculture by pisciculture, delete paddy and aquaculture

Response: We do not understand the reasoning behind this suggestion because it completely contradicts our observations. Since we have clearly identified a shift from rice culture to aquaculture (mainly, but not exclusively, of shrimps) around the mangrove stands of Gaoqiao, we believe that using 'pisciculture' is not appropriate.

Line: 13- replace the culture by cultivation

Response: Suggestion followed

Line: 17- Grammer?

Response: We have modified the sentence as -

In the land-use/cover map based on ground-truth data (5×5 m plot-based tree measurements) (August–September, 2009) and spectral reflectance values (obtained from pansharpened GeoEye-1), both *Bruguiera gymnorrhiza* and small *Aegiceras corniculatum* are distinguishable at 73–100% accuracy, whereas tall *A. corniculatum* was only at 53% due to its mixed vegetation stands close to *B. gymnorrhiza* (classification accuracy: 85 %).

Line: 24 - provide scale or quantum of resolution??

Response: Suggestion followed (0.5 m)

Page: 4 (= 2594)

Line: 6 - replace 'but are now' by 'however, presently'

Response: Suggestion followed and we have rephrased the sentence as below -

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Mangroves provide a wide array of ecological and economic benefits (Dahdouh-Guebas and Koedam, 2006a; Dahdouh-Guebas et al., 2006a; Nagelkerken et al., 2008; Walters et al., 2008), however, they are presently considered as one of the most threatened ecosystems in the world (Duke et al., 2007).

Line: 9 - Complete the sentence and start new

Response: ... (Rönnbäck, 1999). Recent estimates on global mangrove cover indicate between 137 760 and 152 000 km² of mangrove forest remaining in 123 countries and territories.

Line: 13 – delete persisting and add constant

Response: Suggestion followed

Line: 15 – replace ‘or’ by ‘and’

Response: Suggestion followed

Line: 20 – rewrite sentence to bring out more clarity

Response: Sorry, we do not understand the problem.

Line: 20 – provide quantum in bracket?

Response: Suggestion followed. We have indicated the spatial resolution of IKONOS (1 m), QuickBird (2.4 m), and GeoEye-1 (0.5 m).

Page: 5 (= 2595)

Line: 3 – replace ‘this’ by ‘present’ & replace ‘is’ by ‘was’

Response: Suggestions followed.

Line: 3 – As stated by authors remote sensing and GIS techniques have been widely applied for mangrove and other tropical forest ecosystems from management point of views for quite long. The technique has been accepted to be precise, economic and

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rapid, and very effective in the resource mapping and management. May be source of remote sensing data was different and on larger scale in the present study. Authors must indicate what is novice about their techniques/in their methodology

Response: The novelty is the evaluation of high resolution images to discriminate of small size as stated in the following sentence - The main objective of the present study was to analyze the spatial heterogeneity of different mangrove species in Gao-qiao (Leizhou Peninsula, China) using high resolution ground-truth and high resolution satellite imagery (GeoEye-1 data). As far as we could judge from peer-reviewed literature, GeoEye-1 imagery has never been applied in tropical ecology, let along mangrove ecology.

Line: 6 – What was the basis for selecting location for the present observations?? Was it just because of Nature reserve site?

Response: Yes, the site was selected because it is a nature reserve, one of the biggest in the region. We decided to draw our main transect along the longest distance within the patch and other transects branching from the main one. An additional transect was made to evaluate species at the limit of the mangrove/terrestrial limit.

Line: 9 – replace 'in addition' by 'besides'

Response: Since both these terms are synonyms, we would like to stick on to the same.

Line: 13 – delete 'present'

Response: Sorry, we do not see its importance.

Line: 15 – replace 'is' by 'has been'

Response: Suggestion followed.

Line: 17 – replace 'suitable' by 'potential'

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Response: Suggestion followed.

Line: 18 – replace ‘at’ by ‘to be’

Response: Suggestion followed.

Line: 18 – replace ‘is’ by ‘occurred in discontinuous patches and fringes’

Response: Suggestion followed.

Line: 21 – replace ‘its’ by ‘it represent’

Response: Suggestion followed.

Line: 21 – replace ‘was indicated’ by ‘comprising’

Response: We prefer to keep the sentence as it was for clarity reasons.

Line: 23 – Start sentence with Gaoqiao

Response: Suggestion followed.

Line: 24 - the repetition of species word can be avoided. Rewrite the sentence. Species can be written as spp.

Response: Sorry, we do not understand this query!

Line: 24 - add ‘and’

Response: Suggestion followed.

Page: 6 (= 2596) Line: 6 - Does not read correct; rewrite sentence

Response: We have rephrased the sentence as below -

The rainfall, lasts from May to September with a mean annual precipitation of 1500 mm (Gao et al., 2009).

Line: 9 – replace ‘is’ by ‘range from’

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Response: Suggestion followed.

Line: 9 – better give range as well

Response: Suggestion followed.

Line: 17 – replace ‘along the stem’ by ‘of trunk’

Response: No, we have measured it on stems, not on trunk because it was not easy to differentiate stems from trunks. Therefore we have included a statement about this measurement in the revised manuscript.

Line: 19 – provide tools used for height and girth measurements. Provide more details as how many trees/plants were taken for measurements: and how the ecological data was presented

Response: We have used a measuring tape for acquiring the tree structural measurements. All trees in 5x5 m plot were measured.

Line: 20 – replace ‘small’ by ‘dwarf’

Response: Since there were no previous records on the tree structural measurements (to compare the vegetation growth), we would prefer to use ‘small’ for this part of investigation. Dwarf is often used to emphasize plants able to grow much larger, but stressed (in mangroves often by salt) in such a way that they do not develop further. This was most probably not the case in our study site because salinities did not exceed 15 ‰ and *Aegiceras* had the habit it usually has elsewhere in the world.

Line: 22 – no plants instead stem?

Response: Please find the response above (Line: 17)

Line: 27 – This is crude way of collecting water samples for salinity measurements?

Response: Sorry, we do not agree with this comment. In fact, we based our methodology on references in the field and on expert knowledge.

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Line: 1 – contents?

Response: We did not understand the comment. The soil samples were analyzed for sediment composition and organic matter content. However, we did not use the organic matter values in this paper due to unforeseen methodological errors.

Line: 2 – ‘Soil’ change to ‘sediments’

Response: Suggestion followed (The sediment samples were analyzed)

Line: 4 – Table No.?

Response: The position of transects have already been indicated in Fig. 1. So we have referred to the same in our revised manuscript.

Line: 7 – Mapping spatial heterogeneity with LANDSAT and CORONA images raises doubts. It is surprising how authors could compare the mangrove extent with respect to different species?

Response: We mapped the distribution of mangrove species with only GeoEye imagery. Landsat and Corona images were used only to evaluate the size of the mangrove stand in 1967 and 2000, as stated in the objectives.

Lines: 7-9 – add ‘,

Response: Suggestion followed

Lines: 14 – change ‘are’ to ‘were’

Response: Suggestion followed

Lines: 19 – NDVI techniques used are very old

Response: We would like to say that NDVI is still considered as the best index demonstrating greenness/biomass of the vegetation (witnessed through several 2011-2012

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publications). In the present case, the NDVI layer has helped us for a better classification of the area.

Lines: 25 – replace ‘small’ by ‘dwarf’

Response: See answer on page 5

Page: 8 (= 2598) Line: 3 – Tabular geographical coordinates

Response: As we explained before, the position of transects have already been indicated in Fig. 1.

Line: 4 – There is no mention of the accuracy of geo-referencing . Three different resolution satellite data have been used, how confident authors are in their accuracy in georeferencing and mapping. Error matrix is not given. Authors would have restricted with GeoEye-1 data. How CORONA data added the value is not explained. Methodology used for data classification is not clear??

Response: Yes we agree with this comment and we have included a statement on Corona imagery treatment in the revised manuscript. In fact, the delimitation of mangrove extent in Corona image was done manually because the image did not support a classification due to its single band. The georeferencing accuracy was less than 6m and was also mentioned in the revised MS. Error matrix is given for Geoeye-1 but not for the LANDSAT image. Since there was no ground-truth information for the period 2000, we do consider it as not necessary. However, we checked visually if the stand considered is mangrove or not.

Line: 7 – start sentence with ANOVA. One -way—delete

Response: Suggestion followed

Line: 15 – delete mainly along the . . .

Response: ‘mainly’ can make sense as it describes that most changes occurred in the north of the study area without omitting those, of lesser extent, in the south.

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Line: 16 – change perceptible to prominent

Response: We believe that ‘perceptible’ is an appropriate word there.

Line: 16 – add ‘mainly’

Response: Suggestion followed

Line: 18 – for pisciculture activities. delete into————aquaculture ponds

Response: Sorry, we observed only shrimp and crab culture ponds, not fish.

Line: 19 – where or were?

Response: It should be were (typographic error), so we have updated it in our revised manuscript.

Line: 19 – ‘for similar’ delete rice and aquaculture

Response: Sorry, we prefer to keep the sentence same with no deletions.

Line: 25 – delete 192 ha

Response: Suggestion followed

Page: 9 (= 2599)

Line: 2 – replace present by predominant

Response: Suggestion followed

Line: 4 – replace ‘important’ by ‘more’

Response: Suggestion followed

Line: 5 – remove ‘or’ add ‘and’

Response: We believe that the sentence is meaningful and require no changes

Line: 9 – Not clear: rewrite the sentence

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Response: Suggestion followed

Line: 10 – rewrite sentence

Response: Sorry, the comment is unclear. Sentence is short and briefly mentions the potential role of 3 crab species on soil dynamic in the study zone.

Line: 12 – You mean bioturbation and nutrient recycling; give reference

Response: The RESULTS section usually does not refer to literature. If necessary please inform us to cite some applicable references. In the context of bioturbation and nutrient cycling we have referred to Kristensen (2007) and Kristensen et al. (2008) in the discussion.

Line: 12 – provide quantitative data for barnacles

Response: This is only a personal observation; we do not have any quantitative data for barnacles.

Line: 13 – large or major?

Response: We changed it into ‘major’ in the revised manuscript.

Line: 17 – sand or sediment/mudflats?

Response: We have observed large sand backshore on the field and we classified them as sand. This class also includes a dune seen in the main mangrove stand.

Lines: 20-21– provide numbers

Response: The values are already present in Fig. 3

Line: 21– replace ‘small’ by ‘dwarf’

Response: Please find our explanation in page 5.

Line: 25– add ‘a’

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Response: Suggestion followed

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Lines: 2 & 3 – replace ‘small’ by ‘dwarf’

Response: Please find our explanation in page 5.

Line: 3 – add ‘;

Response: Suggestion followed

Line: 5 – replace ‘less well’ by ‘poorly’

Response: Suggestion followed

Lines: 9-10 – provide values

Response: Since the values are already given in Table 4, we believe it as not necessary.

Line: 10 – replace ‘less’ by ‘in narrow range’

Response: Suggestion followed

Line: 14 – Two third of original mangrove extent was reduced during 1960-70 mainly due to ..

Response: Suggestion followed

Line: 18 - 39.5 % mangrove cover lost in the past four decades (1967-2009) for pisciculture practices (Fig. 2) ...change sentence

Response: Suggestion followed, but the sentence written was without ‘pisciculture’

Page: 11 (= 2601)

Line: 1 – 2:22

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Response: The values here indicate 2 to 22 ha of forested land, not ratio. So it should be 2-22

Lines: 1-2 – rewrite sentence

Response: Suggestion followed. The sentence was modified as below –

In fact, in order to filter the nitrogen and phosphorus loads within mangrove ecosystem, the minimum sustainable ratio for mangrove and aquaculture areas was proposed at 2-22 ha of forest per 1 ha of aquaculture.

Line: 3 – replace 'is below' by '>'

Response: We have indicated 'is below' with '<' in the sentence.

Line: 4 – add continue to decrease

Response: Suggestion followed

Line: 5 – replace 'we' by 'was'

Response: Suggestion followed

Line: 5 – 'much lower' instead of 'found to be less than'

Response: Suggestion followed

Line: 6 – delete brackets

Response: Suggestion followed

Line: 12 – Too long sentence; condense to bring out clear meaning

Response: Suggestion followed. We have modified the sentence as below –

However, due to its lower dominance and limited coverage, the accuracy of the classified map was poor with unrealistic species' distribution and therefore ignored.

Line: 15 – Sentence not clear?

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Response: We have modified the sentence as below –

Overall, the importance of NIR and NDVI bands for (dominant) mangrove species discrimination at Gaoqiao was evident (Fig. 3).

Line: 18 – ‘small’ - ‘dwarf’

Response: Please find our explanation in page 5.

Line: 18 – ‘is’ - ‘was’

Response: Suggestion followed.

Lines: 8-23 – Whole para to be written as does read better

Response: With the applied corrections, the paragraph is clear now.

Line: 24 – replace ‘previous observations made’ by ‘earlier records from mangrove regions close to Hong Kong, . . . bay

Response: Suggestion followed. We have modified this sentence as below –

In addition to earlier records from mangrove regions close to Hong Kong, Yingluo Bay and Leizhou Bay (Tam et al., 1997; Ye et al., 2005; He et al., 2007; Ren et al., 2008; Gao et al., 2009; Ramsar, 2009), the present study. . .

Page: 12 (= 2602)

Line: 7 – replace ‘K’ by ‘Kandelia’

Response: The species names were already defined, so we use Genus name abbreviations for the clarity.

Line: 7 – replace ‘is more’ by ‘being’

Response: Suggestion followed.

Line: 8 – delete ‘and hence was’

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Response: Suggestion followed.

Line: 8 – add of the same

Response: Sorry, the comment is unclear to us. Of the same family? If so, we will add it in the revised manuscript.

Line: 11 – replace ‘were found’ by ‘exist’

Response: Suggestion followed.

Line: 11 – add-in the upper intertidal and supralittoral zones

Response: Suggestion followed. This sentence is now as follows –

Open areas in the upper intertidal and supralittoral zones are the last to be inundated,

Line: 12 – delete ‘areas’

Response: Suggestion followed.

Line: 13 – replace ‘tot’ with ‘to’

Response: Suggestion followed.

Line: 15 – ‘small’ - ‘dwarf’

Response: Please find our explanation in page 5.

Line: 16 – add ,

Response: Suggestion followed. convex and concave creek sides, respectively (Fig. 4) is likely

Line: 18 – full stop?

Response: Yes, we have updated it in the revised manuscript.

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Line: 22 – why equal sign?

Response: We have replaced it with 'i.e.'

Line: 23 – rewrite sentence

Response: We have modified the sentence as below –

However, the salinity in mangroves close to Gaoqiao was reported to be 23‰ (Liang and Dong, 2004).

Line: 28 – barnacles are not parasite on mangroves; use correct word

Response: Yes, we have updated it in the revised manuscript.

Page: 13 (= 2603)

Line: 1 – *Heritiera* spp. are mangroves and not associate? Grow above high tide line merged with terrestrial forms. . .

Response: It is true that *Heritiera* often occurs in the back mangrove and sometimes at the edge of the terrestrial vegetation, but there is no doubt that it is a mangrove species. We have not come across any papers questioning this. Quite on the contrary, as evidenced from *The Botany of Mangroves* (Tomlinson, 1986), *Australia's Mangroves* (Duke, 2006), *The Mangrove World Atlas* (Spalding et al., 2010), *The Mangrove Reference Database and Herbarium* (Massó i Alemán et al., 2010), and numerous peer-reviewed mangrove papers.

Line: 4 – to be insignificant instead of very small?

Response: Suggestion followed.

Line: 5 – if name of the genus to be mentioned remove italics

Response: In biology both genus and species names are always written in italics. So no corrections were made.

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Line: 6 – added ‘along’, and modified the sentence

Response:, along the banks of river and small streams that supply water inland to the rice fields.

Line: 9 – overall, discussion part needs a great improvement. Highlight significance of this studies in protection, conservation and sustainable management of mangrove resources at local/regional/global levels.

Response: Based on the given suggestions, we have improved our discussion part greatly and it is now conveying the information on strength of our study as well as its value for conservation and management of the mangrove ecosystems locally and elsewhere.

Line: 21 – add ‘decrease’ & delete ‘decrease’

Response: Suggestion followed. This sentence has been modified as –
. . . was also responsible for a decrease in mangrove/aquaculture ratio.

Line: 22 – replace ‘species distribution spreading’ by ‘extent’

Response: Suggestion followed.

Page: 14 (= 2604)

Line: 1 – Replace ‘we suggest’ by ‘it is suggested’

Response: In fact, we have been using this word (i.e. we) throughout the text wherever it is applicable. So we would prefer to keep it as same.

Line: 3 – replace of our study zone by present study region

Response: Suggestion followed.

Line: 5 – add significance of present studies in conservation of local/regional mangroves and relate it’s applications to mangroves in other parts of the world.

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Response: Suggestion incorporated.

Page: 18 (= 2608)

Table: 1 – Provide geographical coordinates for plots in table?

Response: Instead of showing the GPS bearing for all 70 locations (comes to a big table with low information), we will represent those three categories in Fig. 1 for easy visualization/understanding.

Table: 1 – replace ‘small’ by ‘dwarf’

Response: Please find our explanation in page 5.

Page: 20 (= 2610)

Table: 3 – replace ‘small’ by ‘dwarf’

Response: Please find our explanation in page 5.

Page: 21 (= 2611)

Table: 4 – soil–sediments?

Response: Please find the updated legend below – The sediment characteristics at three mangrove classes in ZMNRR, Gaoqiao, China. The average and standard deviation values are indicated by its significance (P value) level ($\alpha = 0.05$ with Bonferroni correction for multiple test = 0.017) ($P < 0.05$ are highlighted in bold face).

Table: 3 – replace ‘small’ by ‘dwarf’

Response: Please find our explanation in page 5.

Page: 23 (= 2613)

Figure: 2 – delete ‘extent of’

Response: Suggestion followed.

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Page: 25 (= 2615)

Figure: 4 – replace ‘small’ by ‘dwarf’

Response: Please find our explanation in page 5.

Figure: 4 – tall vegetation occur in the regularly inundation zone along the waterways, and must be old stands. the dwarf *Aegiceros* stands could be young crop and might grow tall in due course of time. Distribution pattern of mangrove species observed in the present observations could also be compared with distribution pattern of the same species in othr regions of China and some of the neighboring Asian countries. The above points need to be discussed under appropriate chapter.

Response: Exactly, this is what is in our minds as well. This is why we do not want to say it as ‘dwarf’ instead of ‘small’ for this investigation. However, we are planning to monitor this area on long-term basis and hence expect some interesting observations in the near future. Also, the distribution patterns of the mangrove species encountered in this study are well in agreement with other findings both in China and adjacent countries. So all the necessary information was updated in our revised manuscript and we did our level best to improve the quality of this paper.

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