

Interactive comment on “Identification of high risk zones for geological origin hazards using PALSAR-2 remote sensing data: Kelantan river basin, Peninsular Malaysia” by A. Beiranvand Pour and M. Hashim

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Identification of high-risk zones for geological origin hazards using PALSAR-2 remote sensing data: Kelantan river basin, Peninsular, Malaysia

The authors conducted a study using SAR data to map high-risk zones in a river basin in Malaysia. The information was compiled by visual interpretation.

General comments

Large parts of the manuscript have already been published in a conference paper from

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which the authors copied text word by word. Even the figures and maps are taken from this publication: [1] A. Beiranvand Pour and M. Hashim, "Application of PALSAR-2 remote sensing data for landslide hazard mapping in Kelantan river basin, Peninsular Malaysia," *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, vol. XLI-B8, pp. 413-416, 2016. The authors should at least take the effort to re-formulate the text. In addition it should be clear what distinguishes the new manuscript from the already published work (novelty aspect).

In general the manuscript needs some re-structuring to provide a logical information flow. Some redundant text should be removed (repetitive). The references used are overly outdated. In addition the manuscript needs English editing (use of article, grammar). See also detailed comments.

The study focused on landslides, which should be mentioned in the title in order to point out the content of the paper. This is also valid for the description of risk zoning within the text.

Self-citations (lines 47-48; lines 77-78): What is the sense of mentioning 5 (!) own papers in this sentence. Throughout the document the authors keep referring to their own papers. They should pick the most relevant publication or reason why all these publications are relevant. For example the reference Hashim et al. 2013 in line 52 is obsolete. There is plenty of literature before that referring to the limitations of optical remote sensing in the tropics due to cloud cover, e.g.: [1] R. Eckardt, C. Berger, C. Thiel, and C. Schmullius, "Removal of Optically Thick Clouds from Multi-Spectral Satellite Images Using Multi-Frequency SAR Data," *Remote Sensing*, vol. 5, p. 2973, 2013. [2] J. Ju and D. P. Roy, "The availability of cloud-free Landsat ETM+ data over the conterminous United States and globally," *Remote Sensing of Environment*, vol. 112, pp. 1196-1211, 3/18/ 2008. [3] F. Melgani, "Contextual reconstruction of cloud-contaminated multitemporal multispectral images," *Geoscience and Remote Sensing, IEEE Transactions on*, vol. 44, pp. 442-455, 2006.

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Important scientific achievements in the mapping and analysis of landslides, hazards and disasters using SAR were omitted. The present manuscript uses RGB displays and filtering followed by visual interpretation. Other important information contained in SAR data, i.e. phase, coherence, InSAR, etc. were neglected. Relevant recent literature is not considered, e.g.: [1] S. Abuzied, S. Ibrahim, M. Kaiser, and T. Saleem, "Geospatial susceptibility mapping of earthquake-induced landslides in Nuweiba area, Gulf of Aqaba, Egypt," *Journal of Mountain Science*, vol. 13, pp. 1286-1303, 2016. [2] A. Barra, O. Monserrat, P. Mazzanti, C. Esposito, M. Crosetto, and G. Scarascia Mugnozza, "First insights on the potential of Sentinel-1 for landslides detection," *Geomatics, Natural Hazards and Risk*, pp. 1-10, 2016. [3] A. Bhattacharya, K. Mukherjee, M. Kuri, M. Vöge, M. L. Sharma, M. K. Arora, et al., "Potential of SAR intensity tracking technique to estimate displacement rate in a landslide-prone area in Haridwar region, India," *Natural Hazards*, vol. 79, pp. 2101-2121, 2015. [4] S. Bianchini, F. Raspini, A. Ciampalini, D. Lagomarsino, M. Bianchi, F. Bellotti, et al., "Mapping landslide phenomena in landlocked developing countries by means of satellite remote sensing data: the case of Dilijan (Armenia) area," *Geomatics, Natural Hazards and Risk*, pp. 1-17, 2016. [5] S. Plank, A. Twele, and S. Martinis, "Landslide mapping in vegetated areas using change detection based on optical and polarimetric SAR data," *Remote Sensing*, vol. 8, 2016. [6] F. Raspini, A. Ciampalini, S. Del Conte, L. Lombardi, M. Nocentini, G. Gigli, et al., "Exploitation of amplitude and phase of satellite SAR images for landslide mapping: The case of Montescaglioso (South Italy)," *Remote Sensing*, vol. 7, pp. 14576-14596, 2015. [7] R. Schlögel, J. P. Malet, P. Reichenbach, A. Remaitre, and C. Doubre, "Analysis of a landslide multi-date inventory in a complex mountain landscape: The Ubaye valley case study," *Natural Hazards and Earth System Sciences*, vol. 15, pp. 2369-2389, 2015. [8] M. Vöge, R. Frauenfelder, K. Ekseth, M. K. Arora, A. Bhattacharya, and R. K. Bhasin, "The use of SAR interferometry for landslide mapping in the Indian Himalayas," in *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives*, 2015, pp. 857-863. The authors should at least mention why these information were not used in the manuscript.

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Scientific questions/issues (Specific Comments)

The description of the study area (lines 48-50) belongs to section 2 and not into the introduction.

What do the authors mean by "advanced remote sensing technology" (Line 63)? Please explain. It should be pointed out that the main information extraction was performed by visual interpretation.

The description of the ALOS systems could be shortened. E.g. remove details on ALOS-1 since the study only uses ALOS-2.

The statement "This study is the first time ..." doesn't hold. Using the keywords PALSAR, geology and hazards quite a number of publications can be found: [1] A. A. M. Radhi, M. L. R. Sarker, and N. Ishak, "Monitoring of surface deformation due to earthquake using dinsar technique and PALSAR-2 data: A case study of the Gorkha Earthquake in Nepal, 2015," in *ACRS 2015 - 36th Asian Conference on Remote Sensing: Fostering Resilient Growth in Asia, Proceedings, 2015*. [2] D. Notti, F. Calò, F. Cigna, M. Manunta, G. Herrera, M. Berti, et al., "A User-Oriented Methodology for DInSAR Time Series Analysis and Interpretation: Landslides and Subsidence Case Studies," *Pure and Applied Geophysics*, vol. 172, pp. 3081-3105, 2015. [3] X. T. Nguyen and C. P. Chang, "Mapping surface deformation in Red River Fault Zone using spaceborne SAR interferometry," in *ACRS 2015 - 36th Asian Conference on Remote Sensing: Fostering Resilient Growth in Asia, Proceedings, 2015*. [4] D. Sudiana, Rokhmatuloh, M. Rizkinia, Ardiansyah, R. Arief, B. Setiadi, et al., "Analysis of land deformation on slope area using PS InSAR. Case study: Malang area," in *IOP Conference Series: Earth and Environmental Science*, 2014. [5] R. F. Putri, S. Wibirama, I. Alimuddin, H. Kuze, and J. T. S. Sumantyo, "Monitoring and analysis of landslide hazard using dinsar technique applied to ALOS PALSAR imagery: A case study in Kayangan catchment area, Yogyakarta, Indonesia," *Journal of Urban and Environmental Engineering*, vol. 7, pp. 308-323, 2013. [6] N. Mitsuhara and T. Onuma, "Geological mapping in Iraq using

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terra ASTER and ALOS PALSAR images and application to petroleum exploration," in 34th Asian Conference on Remote Sensing 2013, ACRS 2013, 2013, pp. 2051-2058. [7] Y. Yamada, "Mathematical morphology approach to detect farmland conditions from ALOS/PALSAR data after the 2011 off the pacific coast of Tohoku Japan earthquake and Tsunami," in International Geoscience and Remote Sensing Symposium (IGARSS), 2012, pp. 6118-6121. [8] K. Honda, T. Nakanishi, M. Haraguchi, N. Mushiake, T. Iwasaki, H. Satoh, et al., "Application of exterior deformation monitoring of dams by DInSAR analysis using ALOS PALSAR," in International Geoscience and Remote Sensing Symposium (IGARSS), 2012, pp. 6649-6652. [9] C. de Oliveira Andrades Filho and D. de Fáltima Rossetti, "Effectiveness of SRTM and ALOS-PALSAR data for identifying morphostructural lineaments in northeastern Brazil," International Journal of Remote Sensing, vol. 33, pp. 1058-1077, 2012. Please re-phrase.

Line 108-109 What do the authors mean by "largely lacking"? Does it mean there are no maps or only for part of the Kelantan river basin? Or are maps existing but not up-to-date?

From the text it is not clear what the objective (iii) Lines 115-116 is supposed to deliver. Please explain the purpose of objective (iii).

An overview on the manuscript is missing and should be inserted before Section 2.

Line 159-212 Is it really relevant to describe the entire PALSAR-2 system? Is the identification of the best imaging mode for the study purpose part of the study (Lines 172-173)? It is mentioned but not explicitly researched. What is the reasoning for the selected modes? The authors should consider to shorten these paragraphs and relate to the necessary information belonging to the study. The acquisition dates of the SAR data are missing and form a relevant information in the interpretation process, in particular for the link to the collected ground truth.

Remove "for comprehensive analysis of major ... of Kelantan." (Lines 178-179) This has been said before. Repetitive.

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The description of precipitation and soil moisture and their influence on the data should be contained in the background information (introduction) and not in the description of the material section. Re-structure.

It would be useful to provide a kind of flowchart at the beginning of Section 4 to provide an overview on the image processing performed to the reader.

The authors should comment on the use of the median filter instead of considering specific speckle filters developed for polarized SAR images: [1] M. Xiaoshuang, S. Huanfeng, Z. Liangpei, Y. Jie, and Z. Hongyan, "Adaptive Anisotropic Diffusion Method for Polarimetric SAR Speckle Filtering," Selected Topics in Applied Earth Observations and Remote Sensing, IEEE Journal of, vol. 8, pp. 1041-1050, 2015. [2] S. Shitole, S. De, Y. S. Rao, B. Krishna Mohan, and A. Das, "Selection of Suitable Window Size for Speckle Reduction and Deblurring using SOFM in Polarimetric SAR Images," Journal of the Indian Society of Remote Sensing, vol. 43, pp. 739-750, 2015/12/01 2015. [3] L. Jong-Sen, T. L. Ainsworth, W. Yanting, and C. Kun-Shan, "Polarimetric SAR Speckle Filtering and the Extended Sigma Filter," Geoscience and Remote Sensing, IEEE Transactions on, vol. 53, pp. 1150-1160, 2015. [4] L. Gomez, M. E. Buemi, J. C. Jacobo-Berlles, and M. E. Mejail, "A New Image Quality Index for Objectively Evaluating Despeckling Filtering in SAR Images," Selected Topics in Applied Earth Observations and Remote Sensing, IEEE Journal of, vol. PP, pp. 1-11, 2015. [5] L. Fengkai, Y. Jie, and L. Deren, "Adaptive-Window Polarimetric SAR Image Speckle Filtering Based on a Homogeneity Measurement," Geoscience and Remote Sensing, IEEE Transactions on, vol. 53, pp. 5435-5446, 2015. In addition it is not clear if all the statements about the filtering process to enhance edges are valid for this particular case (ALOS PALSAR) or in general including optical imagery. The references regarding edge enhancement filters are very old (1995, 1996, 1997, 2000, 2008) - Lines 262-264. In the discussion of directional edge detection it is not obvious why all these references are cited: Haralick et al. 1987, Carr 1995, Sabins 1996, Vincent 1997, Jensen 2005). What are the particulars of these publications/research results? Haralick et al. 1987 is

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the most cited document, which explains texture and feature detection. If the authors like to cite all the others too, it should have a reason.

Lines 291-296 The collected ground truth should be provided in a table or map to provide an overview on the content and distribution of the collected information.

Throughout the document there is no discussion on the choice of RGB assignments of the different channels. The authors should point out if they refer to standard channel assignments as used in geology or if the assignments were particularly applied for this study only. If the latter is the case it should be reasoned.

The information contained in lines 373-378 belongs to the background information (introduction). Similarly the text of lines 391 - 395 should be moved to the introduction.

It is not clear how the analysis of the field data has been done (Lines 480-483). Please clarify. Apparently major analysis efforts were done by visual interpretation. Looking at the application and the data that went into the analysis process it would be interesting to know why the authors did not consider using a GIS analysis and tools to provide rules for computer-supported analysis.

Line 505-507 What are "advanced remote sensing satellite data"?

Line 517-520 What is a "total solution" how do the results of this study relate to flood disaster management? The manuscript does not contain any research on flood management nor tools to do so. The work provides information from SAR data that could feed into a GIS.

Technical corrections

Line 61 "... between active faults, ..."

Line 62 "Therefore, the delineation of faults ..."

Line 63 "... in any region is a necessity to ..."

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Lines 70-72 "ALOS-2 contains a Phased Array type L-band Synthetic Aperture Radar-2 (PALSAR-2) using microwaves to maximize its ability compared to ALOS-1, which contained three sensors, i.e. two optical and one microwave device."

Line 74 "... PALSAR-2 has the ability to ... due to its relatively long wavelength (..."

Lines 78-79 Repetition. Delete sentence.

Line 80 Complicated sentence: "Not only ... well." Re-phrase.

Line 86 "... increase in the amount of ..."

Line 92 "To date, only a few studies ..."

Line 96 The word 'dire' doesn't seem to be appropriate in this context. Suggestion: "There is an urgent need to apply ..."

Line 106 "A recent challenge ..."

Line 111-112 Remove explanation of PALSAR-2 "ALOS-2 Phased Array type L-band Synthetic Aperture Radar-2". The abbreviation has been defined in the beginning and should be used throughout the text. Remove "recently launched" (already explained in the beginning). Remove "remote sensing".

Line 120 "... composed of a central ... of the Southeast Asian ..."

Line 121 "... is located in the north-eastern ..."

Line 124 "The Kelantan river ..."

Line 125 "... of a flat slope ... in the northern ..." Line 137 "... Pahang states and Thailand (Fig. 2)."

Line 148 "... of Kelantan is divided into four ..."

Lines 190-193 "The HV channel ..." Avoid repetition. The information on available polarizations could be summarized in one sentence.

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Line 194 "Particularly the HV channel ... modes increases the amount ..."
Line 200 "... proportional to wavelength, and ..."
Line 201 "Therefore, the HV polarization ..."
Line 230 "This flexibility makes convolution one of the most useful tools in image processing." - only for the purpose of feature extraction, in this case lineaments!
Line 233 Is this valid for all remote sensing images or does it relate to SAR?
Line 239 What are 'systematic image processing techniques'?
Line 242 "... images reduces the detectability ..."
Line 257 "In this study, a 3x3 neighborhood ..."
Line 258 "The Image Add Back used was 60%."
Line 262 "Edge enhancing filters highlight any ..."
Lines 265-268 Repetitive text. This has been stated above.
Line 267 "The directional filtering ..."
Line 273 "The directional filter ..."
Line 278 "A 5x5 kernel was selected for the ScanSAR scene ..."
Line 280 "A 7x7 kernel was applied to the Fine scenes." What are the references Chavez and Bauer 1982 and Jensen 2005 used for? It is not obvious from the context.
Line 282 "... were adjusted to N-S ..."
Line 284 "... in counterclockwise direction." "An Image Add Back value of 60% was used."
Line 286 Please explain "systematic remote sensing techniques". It is not clear which images (polarizations) have been entered into the red, green and blue channels, re-

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spectively.

Line 304 "5.1 Lineament extraction and lithology ..."
Line 306 "The image acquired in ScanSAR mode was used ... structures. It shows mega-geomorphology ..."
Lines 308-310 "Figure 3 shows an RGB ... for the ScanSAR median filtered image."
Line 323 "... shows a ScanSAR ... by a general topography ..."
Line 326 The range '500-100 m' should be mentioned as "100-500 m". What is the meaning of differentiating 100-500 m and < 1000 m? Similarly Line 329 (range 50-500 m). This overlaps with 100-500 m. Please explain the categories.
Line 364 "Figure 6 shows the fine mode ..."
Line 365 "..., the HH polarization ..."
Line 367 "... an image map containing important ..."
Line 371-372 "Hence, the antenna did not receive a returned radar signal."
Line 374 Re-phrase: "Soil moisture/wetness information is best obtained from L-band radar because of its ground penetrating capability."
Line 379 "... distributed in the northern ..."
Line 382 "... observable in the central ..."
Line 393 "Hence the combination of ..."
Line 398 Is this really a merged image or a colour composite?
Line 403 "... with the geological map ..."
Line 411 "... images of the fine mode observations, ..."
Line 413 "... shows a structural ..."

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Line 421 "... , a few short ..."

Line 424 "The pattern of ..."

Line 456 "The pattern is characterized of ..."

Line 457 "The rectangular pattern ..."

Line 461 "Rectangular drainage patterns form a susceptible zone ..."

Line 465 "..., which consists of ..."

Line 467 "The structural and ..."

Line 477 "... and flooded areas were ..."

Line 480 "... after the 2015 flood event." "... of the field data indicates that ..."

Caption Figure 3 "... covering the northern ... The black rectangle shows the area covered by the fine mode RGB colour composite of the northern ..."

Caption Figure 5 "... filters for the northern part ..."

Caption Figure 6 "... from the fine mode images of the ..."

Caption Figure 7 "... derived from the fine mode images of the ..."

Caption Figure 8 This map was not derived from directional filtering but from visual interpretation of filtered imagery. Please correct.

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