

Title:

Potential Use of ALOS/ PALSAR in Flood Hazard mapping A Case study- Hatsayphong District, LaoPDR.

Introduction:

LaoPDR has been experiencing flood over the years with different magnitude and duration. The pattern indicates that there is a general flood in every 1.4 years and a disasterous flood every 6 years. The 1994 flood of the Mekong river and the tributories damaged about 28,000 hacters of crop land. Floods are major disasters in the in the agricultural sector in the capital Vientiane and other provinces such as Borikhamxay, Khammouane, Savannakhet and Champasack. According to a report from the Government of Lao (GOL) on flood disasters, it is estimated that more than 87,300 hectares of agricultural land in 1995 and 104,000 hectares in 1996 were inundated. In these two incidences, more than 62,000 hectares of paddy field in 1995 and 76,000 hectares in 1996 were completely lost. In a recent year (2008), the flood damaged 36,000 hectares of paddy fields in Vientiane Capital. Moreover, the flood occurred in 2008 did considerable losses to other crops, livestock and fishponds while serious damage were done to irrigation works and other infrastructures.

A huge advantage of Microwave remote sensing is the capability of data acquisition in all weather day and night. It has been in use for flood extent mapping during the rainy seasons when clouds prevent the optical data to see the ground. ALOS PALSAR comes with 5 different science data modes and 3 processing levels. The proper selection of the modes and processing levels can give a clue to the actual physical process happening on the ground. In this case study, we tried to map the flooded area in a district that is often subject to flood in a province in Vientiane. We have chosen fine beam double polarization (FBD) mode to investigate the possible causes how L-band micro wave data may respond differently in different flooded conditions on the ground when there is a change in the polarization.

In Vientiane Capital, Hatxayfong District has a land area of 258 Km², has population about 82.292 people living in the 60 village, 16548 number of house using area 1988 hectare and has 36 village about 50 km nearest the Mekong river the district has a largest agricultural land it is has total area 17238 hectare, 12461 hectare, in 2008 the rainy season Rising water levels in the Mekong River floods of the paddy fields approximately 5125 hectares, agricultural land 6023 hectare. More importantly, these floods do not only damage agricultural, crops and livestock but people in Hatxayfong also experience health problems.

Sisattanak District has a land area of 163751 hectare, has population about 72227 people living in the 37 village, 10853 number of house using area 777 hectare the district has a largest agricultural land it is has total area 610 hectare, in 2008 the rainy season Rising water levels in the Mekong River floods of the paddy fields and agricultural land. More importantly, these floods do not only damage agricultural, crops and livestock but people in Sisattanak also experience health problems.

Chanthabuly District has a land area of 13244, has population about 62294 people living in the 32 village, 12623 number of house using area 9748 hectare the district has a largest agricultural land it is has total area 2280 hectare, in 2008 the rainy season Rising water levels in the Mekong River floods of the paddy fields.

Xaythany District has a land area of 80860 hectare, has population about 156739 people living in the 104 village, 28491 number of house using area 4582 hectare the district has a largest agricultural land it is has total area 16594 hectare, in 2008 the rainy season Rising water levels in the Mekong River floods of the paddy fields and agricultural land. More importantly, these floods do not only damage agricultural, crops and livestock but people in Xaythany also experience health problems.

Study Area:

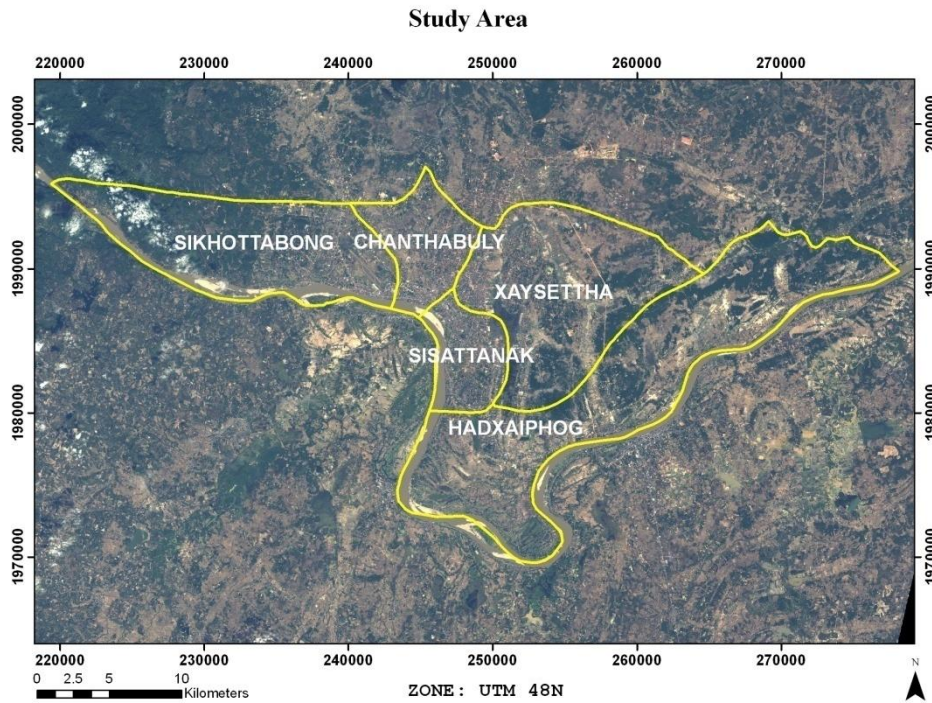


Fig. 1 Map showing the study area

The study area is parts of Hadxaiphog district in Vientiane province in LaoPDR. It is within the map extent of 17° 52' 29.26" Lat to 17° 53' 51.29" Lat and 102° 36' 47.83" Long to 102° 37' 19.23" Long. This district is bordering Thailand with the Mekong river flowing through them. In Vientiane Capital, Hadxaiphog District has the largest agricultural land but it often experiences serious impacts from the floods which are caused by the Mekong River in rainy season each year. In 2008, approximately 5.125 hectares of paddy fields in the District were damaged.

Objectives:

The main objective of this study was the the Flood extent mapping in the year 2008 using ALOS PALSAR images of the study area .

The sub objective was-

- To see Min and Max change of BS from dry to wet season in-
- Urban Built Up Area
- Forests

Marshy Lands
 Paddy
 Dry soil and sand
 Permanent Water

Data Used:

The data used in this study were-
 ALOS PALSAR dry date (June 3, 2008) - HH and HV polarization
 ALOS PALSAR wet date (September 3, 2008) - HH and HV polarization
 ALOS AVNIR2 (December 29, 2008)
 GIS data including-
 District Boundary of Vientiane Province
 DEM of the study area

Methodology:

The methodology is briefly explained by the Chart 1.

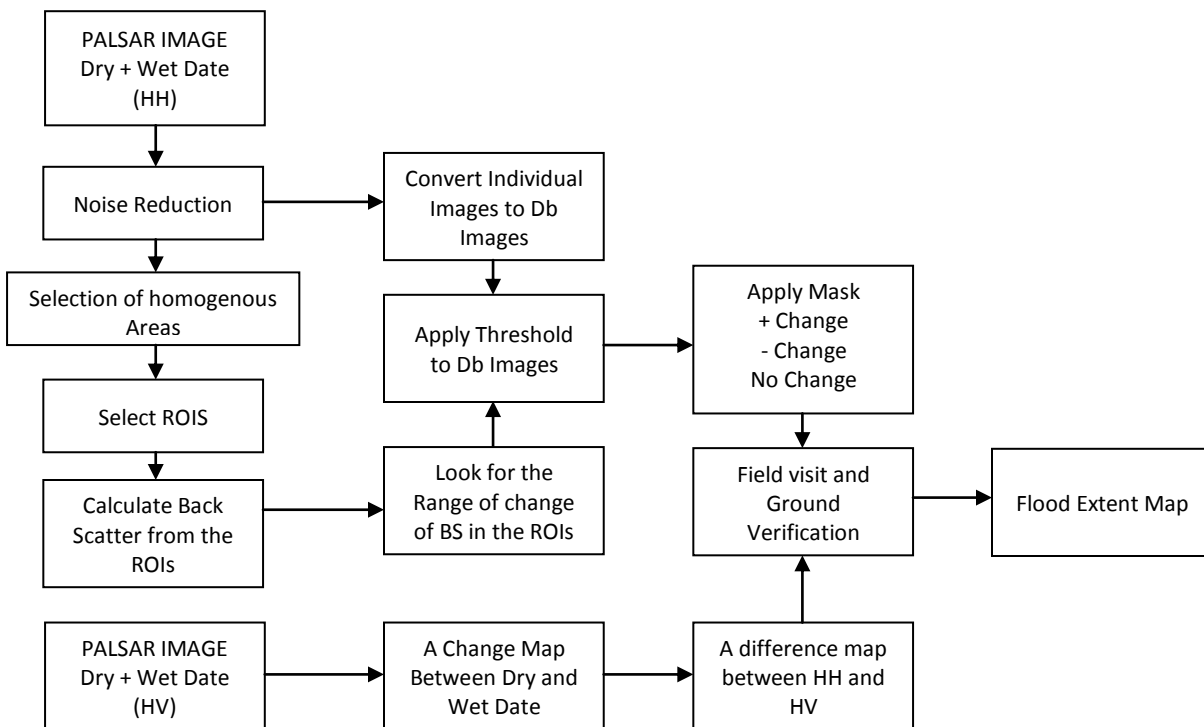


Chart 1: The Methodology in a brief

The theory behind the study is when there is a change of 3Db in backscatter there is a twice the change in brightness and a significant change in the physical property on the ground. First a meta file of dry and wet date of the PALSAR HH polarization images was created. Lee filter was applied on the individual

images in order to reduce the noise. The individual images were converted to Db images and geocoded. Third step was the selection of homogenous areas in the filtered images and record the backscatter in the ROIs. After studying a number of ROIs, the Db range was fixed for the threshold to be applied. Here for this study the applied threshold was 3Db. In the end three maps of change of decibel were achieved from dry to wet season each for the HH and HV pairs. After comparing these maps, the areas of interest were selected where there is significant difference of backscatter between HH and HV and field visit was conducted to some of these points. The step followed was the analysis of the cause of change of backscatter in these points. This analysis is linked to the Landuse and Landcover in the area and finally a map of increased backscatter that is most likely to be the flood map was produced.

Results and Discussion:

After analyzing the causes of change of backscatter in the field visit points the results were tabulated in the Tab 1.

Tab. 1 Field Visit points analyzing the cause of change of BS between HV to HH

Sl. No.	Landcover type	Flood in 2008 wet period	Change of BS from HV to HH	Point No	Conclusion
1	Rice field	flood occurred	Increase in +ve BS	1,2,9,13,14,16,30	Flood under paddy, detected by HH polarization.
2	Dense shrubs with medium tall trees	did not occur	Increase in +ve BS	5,10	Increase of overall level of BS in wet season, not flood
3	Rubber plantation	did not occur	Increase in +ve BS	6	Increase of overall level of BS in wet season, not flood
4	Rubber plantation in combination with Bamboo and other shrubs	did not occur	Increase in +ve BS	7,22	Increase of overall level of BS in wet season, not flood
5	Marshy Land	flood occurred	Increase in +ve BS	12	Open water flood, detected by HH polarization.
6	Mixed rice with grasslands	flood occurred	Decrease in -ve BS	15	Flood under paddy, detected by HH polarization. Also volume scattering, more prominent in HV polarization
7	Open grasslands with dominant banana trees	flood occurred	Increase in +ve BS	17	Open water flood, detected by HH polarization, banana leaves adds up to the BS in HH
8	Rice fields and a mixture of patches of small/dense forests	flood occurred	Decrease in -ve BS, Increase in +ve BS	19, 26, 29	Flood under paddy, detected by HH polarization. Also volume scattering, more prominent in HV polarization
9	rice fields surrounded by a big forest	flood occurred	No change -ve BS, Increase in +ve BS	20, 21, 25, 28	Flood under paddy possible, but not detected by HH polarization due to the initial moisture condition of the ground in dry

					date and the threshold applied.
10	Big sparse trees on dry grass lands	did not occur	Decrease in -ve BS	27	Volume scattering, more prominent in HV polarization

From the table it is seen that the flood under the paddy is shown in an increase of positive BS change from dry to wet period in the HH polarization. In the HV it is not as prominent. Same is happening when the ground had a Landcover of open dry and marshy lands. For all the forests where there is an increase of positive BS in the HH polarization, it is not because of flood under the trees but as an increase of overall increase of wetness on the three canopy volume. This phenomenon is increasing from HV to HH resulting in an increase of positive BS or decrease in negative BS. Banana trees show up an increase in BS both in HV and HH but it is more in HH when wet. Same is the phenomenon with the rubber plantation when the average tree heights are about 25-30 m and spacing between them is about 5-8m. In point number 9, when there is a big forest surrounded by paddy, the BS for the forest remains pretty unchanged when for the paddy it goes up.

In order to trace the flood with much confidence, the next step was a supervised classification of the area and overlaying it with the increase of positive BS in the HH polarization image. The result is shown in the Tab.2

Tab. 2 Table showing the area of flood in Km² for the 4 Landcover types

	Marshy Lands	Paddy	Dry soil and sand	Permanent Water	Total (km ²)	
Not Flooded	130	53	59	29	271	
Flooded	23	19	31	10	83	
Total (km ²)	153	72	90	39	353	Total (km ²)
	CHANTHABUL	SIKHOTTABO	XAYSETTHA	HADXAIPHOG	SISATTANAK	
Not Flooded	18	70	59	109	15	271
Flooded	8	14	28	26	5	82
Total (km ²)	26	84	87	136	20	353

It is seen from Tab 2. That about 23% of the area was flooded by the single day flood in September 3, 2008 in the five districts of LaoPDR. This also showed an area of 23% affected by flood where rice cultivation was practiced.

Tab 3 Table showing flood affected areas in the 5 districts

In the Tab.3, it is seen that the highest flood affected district was XAYSETTHA with 34% of the landmass under water. It is followed by HADXAIPHOG with 32%. The study also reveals that of all the area that was flooded, 39% was under an elevation of 50-60m followed by 27% under a range of 40-50m from the MSL.

Tab. 4 Table showing the Min and Max change of BS per LU types

VALUE	Max change in HH		Max change in HV	
	negative	positive	negative	positive
Urban Built Up Area	24.93	26.88	23.00	26.58
Forests	19.17	19.89	18.37	17.56
Marshy Lands	27.46	22.81	21.43	25.59
Paddy	29.35	27.62	24.17	24.10
Dry soil and sand	29.35	28.30	22.87	21.71
Permanent Water	25.33	30.36	27.00	19.79

The Tab. 4 shows the maximum change of BS in both directions from dry to wet date in the study area per Landuse type. There is maximum positive change for the HH pair in all the landuse types except in Marshy Lands. It is true for the negative change except in Permanent Water. It can be concluded that under other factors remaining same, the HH mode is more sensitive to detecting flood in open land and under paddy.

Conclusion:

The study showed that L-band PALSAR images can be very useful in delineating the flood extent. The greatest advantage being its all weather day and night capability. Specially the HH polarization of the FBD mode of ALOS PALSAR can be utilized to map open water flood and flood under the paddy. With the availability of the polimetric products of PALSAR, the difference between the HH and the VV modes would give another significant insight into the different surface and volume scattering that may hold a key to the flood delineation under the vegetation canopy and in an urban environment.