

# Palaeo-channel bisecting Puri town, Odisha: vestige of the lost river ‘Saradha’?

Subhamoy Jana<sup>1</sup>, William Kumar Mohanty<sup>1,\*</sup>, Saibal Gupta<sup>1</sup>,  
Chirashree Srabani Rath<sup>2</sup> and Priyadarshi Patnaik<sup>2</sup>

<sup>1</sup>Department of Geology and Geophysics, and

<sup>2</sup>Department of Humanities and Social Sciences, Indian Institute of Technology, Kharagpur 721 302, India

**Puri, an ancient town located on the Odisha (Orissa) coast in eastern India, is associated with the 12th century CE Jagannath Temple. Many ancient and historical texts mention a mythical river named Saradha that flowed across the present Grand Road (*Badadanda*) between the Jagannath and Gundicha temples in Puri, dividing the town into two parts. This study traces the trail of a palaeo-channel beyond and within the heart of Puri town through an integrated study of geology, satellite imagery and ground-penetrating radar (GPR) survey. Various satellite imagery manipulation techniques – band combination, NDVI, MNDWI, linear spectral unmixing algorithm, density slice and spatial profiling – indicate the existence of water components along with vegetation bands, and the presence of a sinusoidal palaeo-channel trace with a V-shaped topographic outline. This is interpreted to represent the remnants of an extinct river valley. GPR survey also suggests that a subsurface river valley, about 128 m wide, existed across parts of the Grand Road. A large, sinusoidal water body near the sea beach at Puri, may represent the last remains of the dried-up channel. Integration of all these features suggests that a river once existed between Jagannath and Gundicha temples in Puri town. The constructed palaeo-channel trail may be that of the lost Saradha river described in ancient texts. The study develops a sequential methodology for identifying palaeo-channels even in urbanized localities like Puri.**

**Keywords:** Ancient texts, lost river, Puri, satellite imagery.

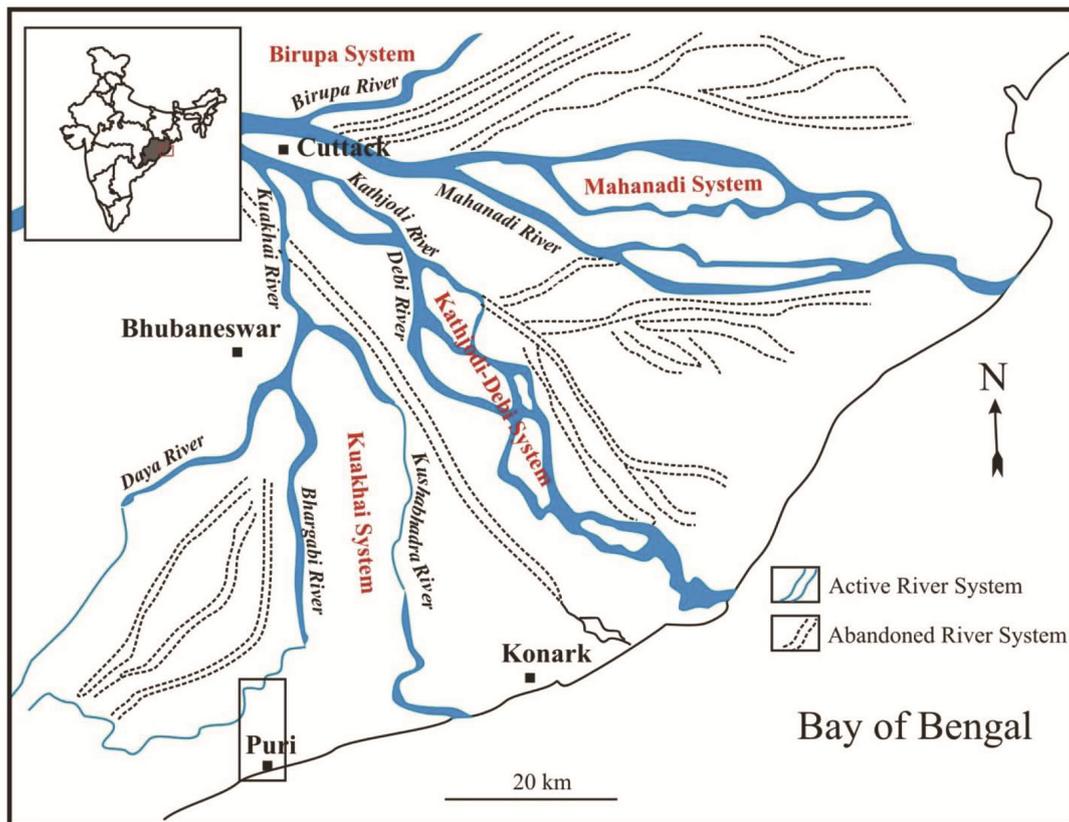
THE east coast of peninsular India formed after the separation of Greater India from Australia–Antarctica *c.* 132.5 Ma (refs 1, 2). Along this coast, a number of rivers, such as the Mahanadi, debouch into the Bay of Bengal. Although active rivers have been described from the Mahanadi delta region of Odisha in ancient literature, many do not exist at present. On account of their spatial association with various temples, these mythical ‘rivers’ are frequently mentioned in temple literature and associated folklore. The town of Puri, Odisha that hosts a number of

temples dating back to the 12th century CE, is located in the region of the Mahanadi delta, about 60 km south of Bhubaneswar (Figure 1). Two historic landmarks of the Puri town, the Jagannath and Gundicha temples, are connected by a road designated as Grand Road or *Badadanda*. It is believed that an ancient river named Saradha once flowed across the present Grand Road, dividing the town into two. In this study, we report the existence of a palaeo-channel that apparently bisected Puri town, and argue that it may correspond to the ‘lost’ Saradha river described in ancient literature. Recently, Jana *et al.*<sup>3</sup> identified the palaeo-channel of another river of possible historical significance, the Chandrabhaga, in proximity of Sun Temple at Konark. At a societal level, identification of these abandoned river channels is important as they may help in identifying freshwater pockets within the densely populated areas of the city in the coastal region; in addition, they may also show potential natural pathways for channeling of the drainage system. From a geological perspective, this study, in conjunction with that of Jana *et al.*<sup>3</sup>, highlights that a number of palaeo-channels exist in the delta region unlike in the upstream region of the River Mahanadi.

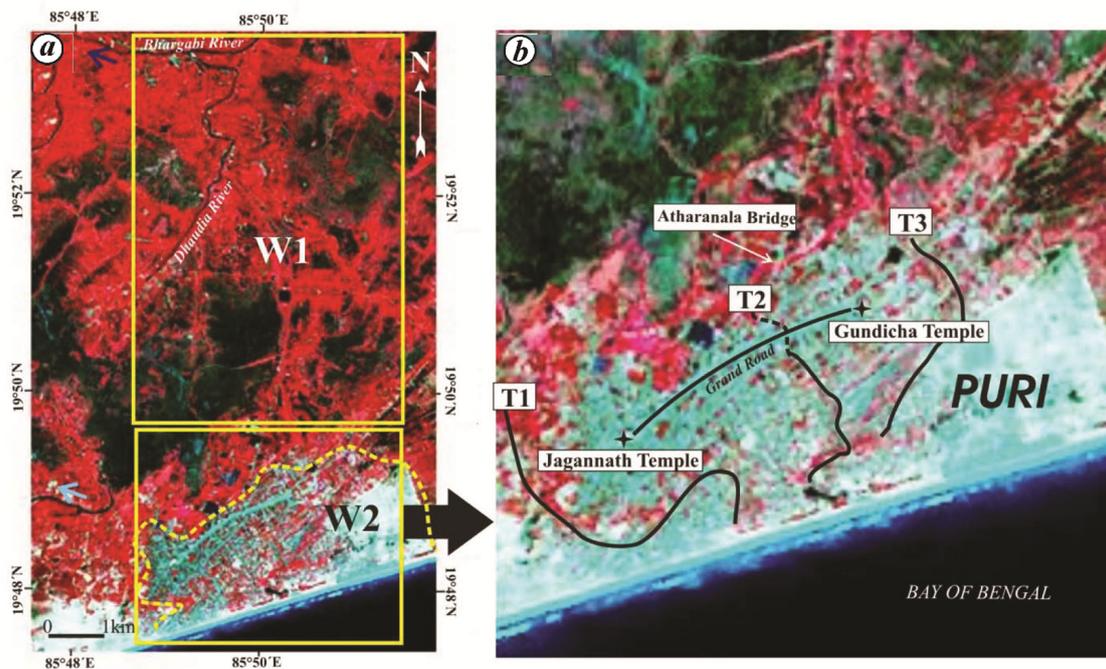
## Study area

The area selected is located in and around Puri town between lat 19°47'26"N and 19°53'44"N, and long 85°47'32"E and 85°51'53"E. The region (marked by a rectangle in Figure 1) is located within the Mahanadi delta and is covered by recent alluvium. For the purpose of this study, the area is divided into two parts. The northern part is designated as window 1 (W1), and covers an area that is largely composed of cultivated land and scattered rural settlements; the southern part, that includes the urban domain comprising Puri town, is referred to henceforth as window 2 (W2) (Figure 2 *a*). This division was made as the challenges of locating palaeo-channels within the two windows are significantly different, and would require discrete investigation strategies. Basement rocks exposed west of the delta region consist of the granulite facies rock types of the Eastern Ghats Belt<sup>4</sup>, as well as lower Gondwana sandstones and shales.

\*For correspondence. (e-mail: wkmohanty@gg.iitkgp.ernet.in)



**Figure 1.** Location map of the Mahanadi delta region (after Mahalik *et al.*<sup>7</sup>) showing active (in blue) and abandoned (black dashed lines) river channels. River systems mentioned in the text are marked in red. The location of the study area, including the town of Puri, is marked with a rectangular box.



**Figure 2.** *a*, False colour composite (FCC) of the Landsat image of the study region. The two sectors, W1 and W2, described in the text are shown in the boxes. *b*, Enlarged image of W2, encompassing most of Puri town. Note the three curvilinear vegetation traces represented by T1, T2 and T3.

The basement includes alternating ridges and depressions that are parallel to the present coast line<sup>5,6</sup>. The major part of the area is traversed by the river Mahanadi and its distributaries. Two types of fluvial geomorphic features can be observed in the delta region<sup>7</sup>. The first is an active distributary channel system that includes the Birupa, Mahanadi, Kathjodi–Debi and Kuakhai channels, while the second is represented by a number of abandoned channels within the delta region (Figure 1). The northern part of the study area (W1) is traversed by the Bhargabi River of the Kuakhai channel system, one of the distributaries of the R. Mahanadi. This bifurcates into another river called Dhaudia which flows southward past Puri town (Figure 2 a).

## Methodology

Aim of this study is to verify if there was any scientific basis for the existence of an ancient river bisecting Puri town. Initially, information from ancient literature that indicates the existence of such a river was compiled, and an attempt was made to locate the possible position of the palaeo-channel within the town. The locations based on the inferred palaeo-channel constitute the point of initiation of field surveys. However, identifying such a palaeo-channel through field survey alone, within the limits of a dense human settlement in the heart of Puri town (i.e. within W2; Figure 2 b), is practically impossible. Therefore, satellite imagery, Google Earth imagery and GPR surveys were used to find evidence for discrete traces of any past palaeo-channel within the precincts of the town. In the past, satellite imagery and aerial photography techniques have been applied by different workers to find the trace of the mythical ‘Vedic Saraswati’ river that is supposed to have existed in the Thar Desert region in western India<sup>8–11</sup>. These latter workers used different geophysical and geochemical techniques to link the lost river with existing rivers in the region. In all their studies, satellite imageries were used as the base maps. In this study, satellite imagery like Landsat ETM+, ETM + Pan-sharpened Mosaic, LISS-III and SRTM data have been used to obtain a synoptic view of an ancient channel that divided Puri town into two parts. The methodology involved acquisition of satellite data, application of various image processing techniques like band combination, normalized difference vegetation index (NDVI), modified normalized difference water index (MNDWI), linear spectral unmixing algorithm and spatial profiling for interpreting the presence of a palaeo-channel.

### Analysis of ancient literature and folklore

According to ancient texts, like *Skanda Purana*<sup>12</sup>, *Brahma Purana*<sup>13</sup> and *Kapila Samhita*<sup>14</sup>, King Indradumna of the Vaishnava tradition constructed a temple

on the top of the Blue Mountain (*Neelachala/Neelashaila*). According to the guidance of the Lord, he found a wooden log floating on the seashore and installed the wooden idols of Lord Jagannath, Balabhadra and Devi Subhadra in the temple at Puri. Besides reference to the Jagannath Temple in many Puranic texts, the name of an ancient river Saradha is also mentioned in the *Madala Panji*<sup>15</sup>, an official chronicle of the Jagannath Temple. The *Katakarajavamshabali*<sup>16</sup>, a compiled work from old historical records, prepared and preserved in the temple archive since the early part of 19th century CE, refers to the existence of a river in between the Jagannath Temple and Gundicha Temple, cutting across the present-day Grand Road between the two temples. According to these texts, six chariots were used during the *Rathayatra* (car festival), three on each side of the river channel, to carry the idols on either side of the river. Another folklore refers to Lord Jagannath appearing in the dream of Saradha Devi, wife of Puri Gajapati Narasingha Dev, and instructing her to close the river by filling it with sand in order to make the *Rathayatra* smoother<sup>17</sup>. The riverbed is also referred to in various poems of the 16th–18th century CE poets, which mention the sacredness and purity of the holy sand (*Saradha Bali*) of the river bed in the vicinity of the Gundicha Temple. This continues to be a sacred place of pilgrimage in Puri<sup>18</sup>.

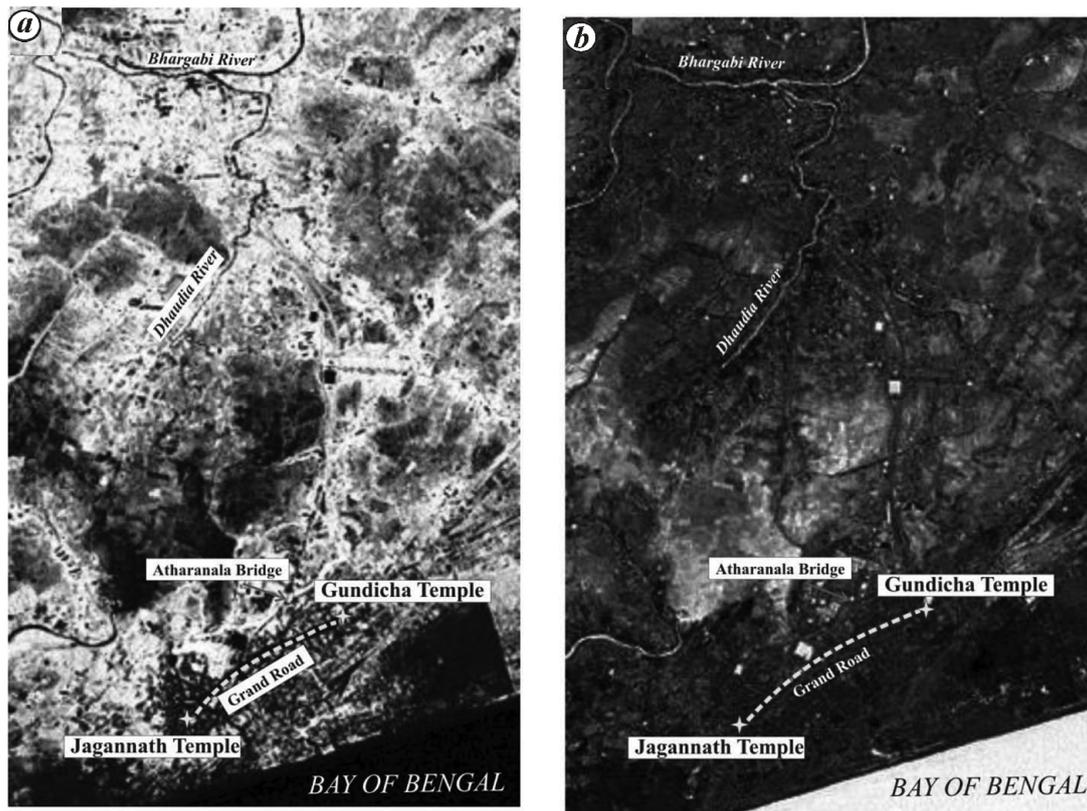
What appears to be tractable from the available ancient literature and folklore is that a river possibly existed in the ancient times, cutting across the Grand Road between the two temples. The palaeo-channel of such a river, if it did exist, must definitely be located somewhere along this Grand Road. Therefore, this is the most prospective location where the search for any palaeo-channel must be concentrated.

### Acquisition of satellite data

Landsat ETM + Pan-sharpened Mosaic, Landsat ETM+, LISS-III and SRTM data from the site global land cover facility ([www.landcover.org](http://www.landcover.org)), <http://glovis.usgs.gov> and <http://bhuvan.nrsc.gov.in> have been used in this study.

### Image manipulation techniques

The different bands of satellite imagery were atmospherically corrected and radiance was converted into reflectance using ENVI software. Band 4 (0.77–0.90  $\mu\text{m}$ ), band 3 (0.63–0.69  $\mu\text{m}$ ) and band 2 (0.52–0.6  $\mu\text{m}$ ) of Landsat ETM+, were combined to generate a false colour composite image (FCC image) (Figure 2 a and b). In the FCC image, the vegetation which is usually found along the palaeo-channel appears red, water appears black to deep blue, while swampy and moist lands appear greenish-blue in colour. Vegetation and water are characteristic features of a palaeo-channel, so NDVI and MNDWI were applied



**Figure 3.** *a*, NDVI map of the entire study area after image enhancement showing vegetation bands as brighter tones. *b*, MNDWI map of the same region showing water bodies as bright areas.

to detect vegetation and water bodies respectively (Figure 3 *a* and *b*). Vegetation may be freshwater aquatic weeds (mainly water hyacinth) or trees growing along the palaeo-channel.

The NDVI is calculated from the relation

$$\text{NDVI} = (\text{NIR} - \text{Red}) / (\text{NIR} + \text{Red}),$$

where NIR or near infrared band is band 4, and the red band is band 3 in the Landsat ETM+ image respectively.

Xu<sup>19</sup> defined MNDWI as the ratio

$$\text{MNDWI} = (\text{Green} - \text{MIR}) / (\text{Green} + \text{MIR}),$$

in order to detect water bodies. In Landsat TM and Landsat ETM+ images, the green band represents band 2, and MIR or mid infrared band represents band 5 respectively. However, each of the pixels of the palaeo-channel in satellite imagery contains vegetation and water bodies in various proportions and therefore constitutes mixed pixels. In such cases, the major component totally shields the minor component, and as a result, only one component becomes clearly visible. Shimabukuro and Smith<sup>20</sup> quantified the fraction of components present in each pixel based on the reflectance of each component in a particu-

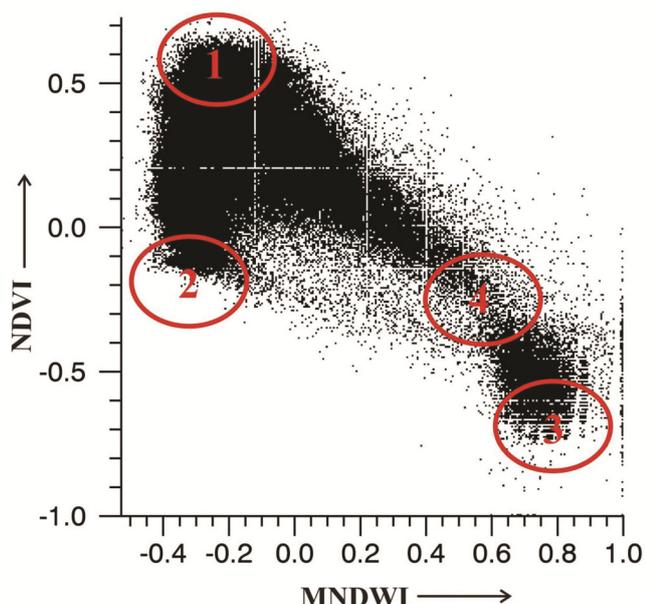
lar band. Mathematically, the spectral un-mixing model can be represented by the following simple relation

$$r_i = \sum_{j=1}^n (a_{ij} \cdot x_j) + e_i,$$

where  $r_i$  is the mean spectral reflectance for the  $i$ th spectral band of a pixel containing one or more components,  $a_{ij}$  the spectral reflectance of the  $j$ th component in the pixel for the  $i$ th band,  $x_j$  the fraction of the  $j$ th component in the pixel,  $e_i$  the error for the  $i$ th band,  $j = 1, 2, 3, \dots, n$  the number of components and  $i$  is the number spectral bands. In this case, the linear spectral un-mixing algorithm based on the above relationship is applied to the vegetation band (identified from bright pixels in the NDVI image) using ENVI version 5.1, to see if the vegetated component also contains some water bodies (Figure 3). The pure pixels/endmembers, that is those pixels predominantly composed of a single component, are selected from the 2D scatter plot of NDVI ( $y$ -axis) against MNDWI ( $x$ -axis)<sup>21</sup> in Figure 4. From the scatter plot, four endmember components can be isolated (Figure 5). Endmember 1 is characterized by pixels with the highest NDVI values that correspond to the known vegetated areas, and therefore represents vegetation. On the other

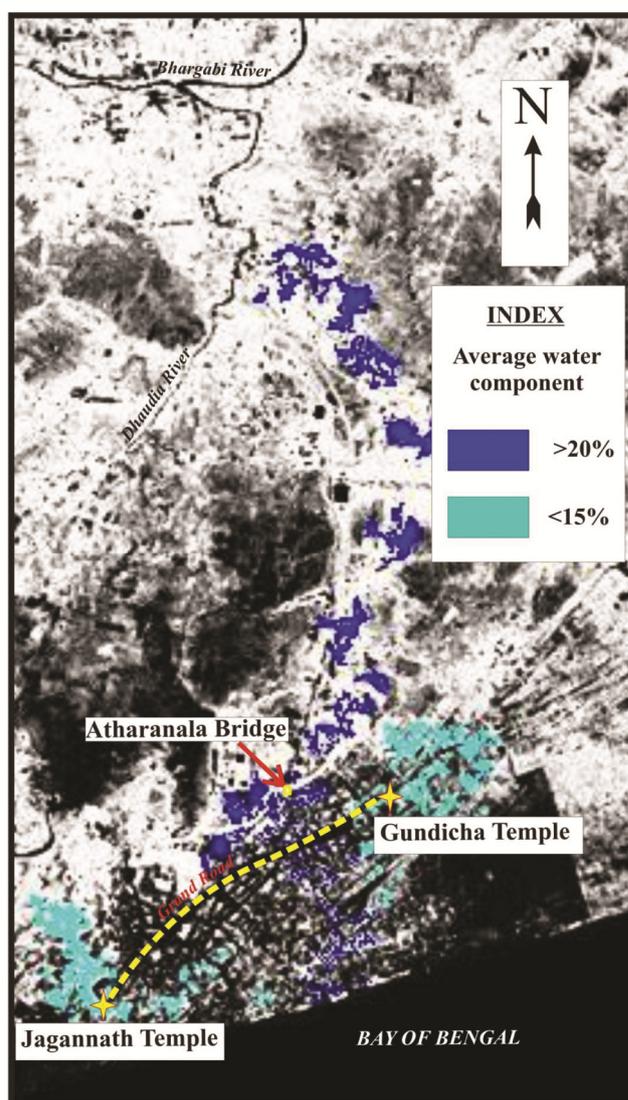
hand, pixels with the highest MNDWI values (and lowest NDVI values) are seen to lie within the Bay of Bengal in Figure 3 *a* and *b*, and are therefore considered to represent sea-water, designated as endmember 2 in Figure 4. Pixels lying within urban domains represent endmember 3, with low MNDWI and intermediate NDVI values (Figure 4). A fourth endmember component, characterized by relatively high MNDWI values (but lower than sea-water) and intermediate NDVI values corresponds to inland wetland zones and freshwater. Spectral reflectance information has then been extracted by plotting pixels from endmembers 1 and 4 onto the Landsat ETM+ imagery (i.e. Figure 2 *a*). Subsequently, the un-mixing algorithm has been used to calculate the vegetation and water component within each pixel.

After spectral un-mixing, mixed pixels with a high probability of containing these two endmember components (identified as regions having low root mean square error (RMSE)) are selected from the vegetation bands in both W1 and W2, to distinguish the proportion of water bodies (Figure 5). While a single high NDVI zone was observed and investigated in W1, three such high NDVI zones form curvilinear traces in W2–T1 in the west, T2 in the middle and T3 in the east were investigated as possible palaeo-channels (Figure 2 *b*). As a palaeo-channel is also expected to be characterized by high river banks and a low river floor, it can be visualized using the density slice method. Density slice is an image processing technique that involves partitioning of a continuous gray tone monochromatic image into several discrete slices or classes, each having a specific range of pixel values. This technique easily enhances the feature confined within a

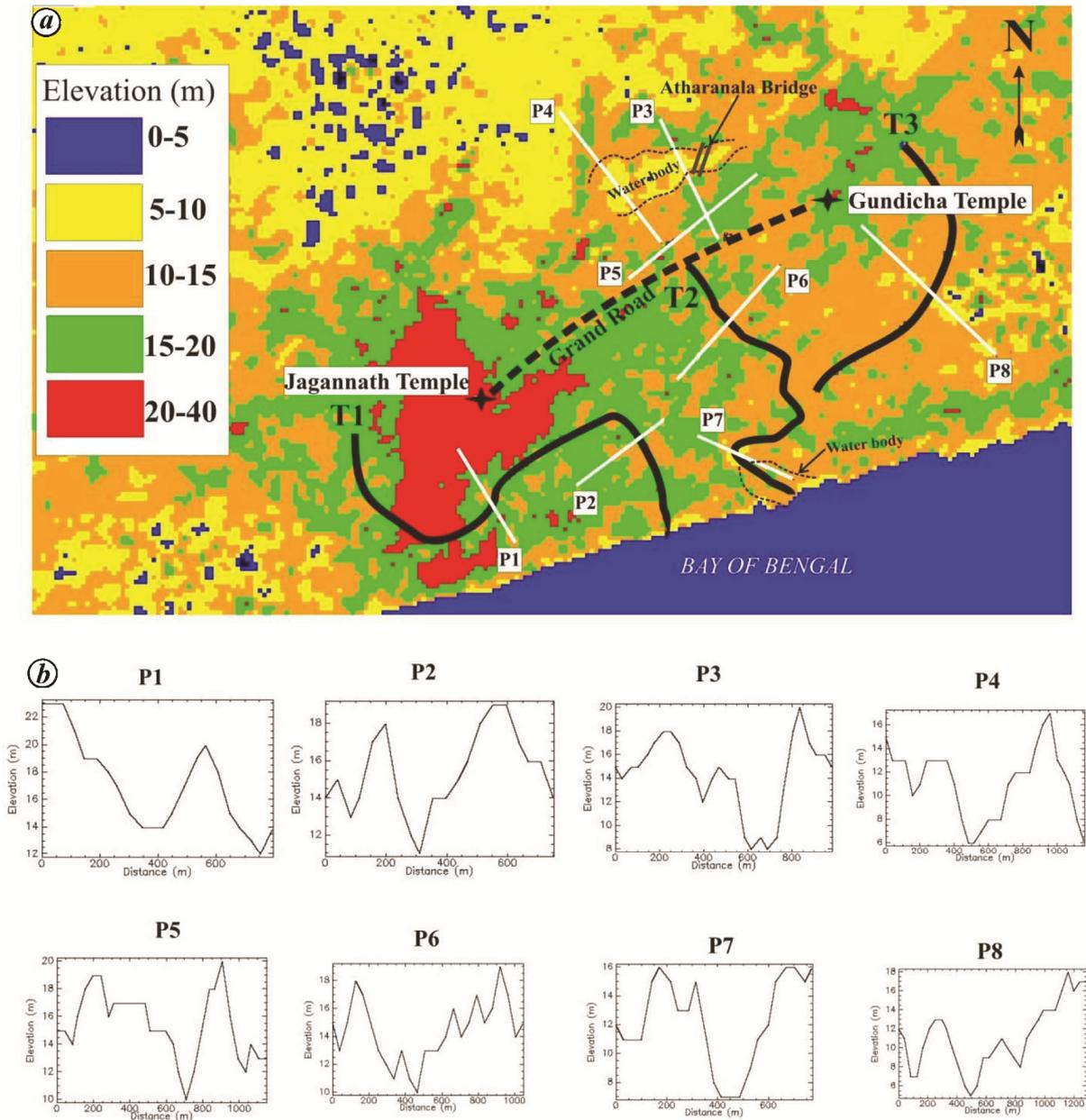


**Figure 4.** 2D scatter plot of NDVI against MNDWI. The four zones marked are – 1, Vegetation; 2, Urban area; 3, Sea-water; 4, Freshwater/wetland. For further details, see text.

particular slice. Bhaskar and Binoj Kumar<sup>22</sup> have applied the density slice method to SRTM data to demarcate uplands from lowlands while studying fluvial systems in South India. In the present study, the density slice method has been applied to five elevation classes, each class representing a particular range of elevation data (Figure 6 *a*). With the passage of time, palaeo-channels of extinct rivers are unevenly filled up with younger sediments, leaving discrete shallow depressions along the channel. Aligned depressions along a channel trace may thus help to identify a remnant river valley, which can be detected in spatial profile, i.e. plot of elevation against distance<sup>3,23</sup> across the suspected channel. In the present study, spatial profiles have been drawn across the three transects



**Figure 5.** Average water component in pixels of vegetated zones in the area, superposed onto the NDVI map. Note that the vegetation trace leading southward from Dhaudia River, and the trace coinciding with T2 contain greater than 20% water content (marked in blue). Vegetated trails to the west and east of this trail show lower water content (less than 15%, marked in cyan) and correspond to T1 and T3 respectively.



**Figure 6.** *a*, Density slice of the SRTM 30 data of W2 shows land with low elevation between the two temples. The locations of the spatial profiles across T1, T2 and T3 (P1–P8) are shown. *b*, Results of the spatial profiles P1–P8. Note that each profile contains a depressed area that may follow a palaeo-valley.

T1–T3 (suspected to be palaeo-channels) on SRTM data with spatial resolution of 30 m (Figure 6 *b*).

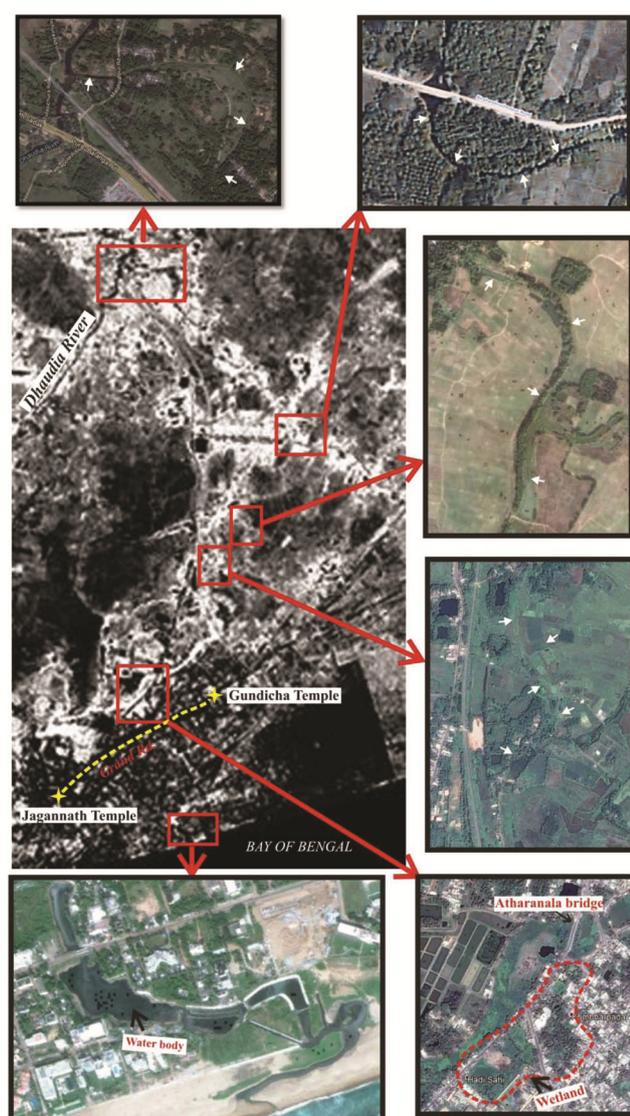
In addition, the vegetation band (brighter region of the NDVI map) (Figure 3 *a*) in both W1 and W2 has also been analysed in the high resolution Google Earth image to assess the evidence for a palaeo-channel (Figure 7).

#### Field validation and GPR survey

Field validation was conducted along the Puri sea beach, as well as north and south of the Grand Road, to detect

any elongate water bodies that might represent remnants of an earlier palaeo-channel (Figure 8). Two such water bodies are present along transect T2, which is oriented almost perpendicular to the Grand Road. Therefore, a GPR survey was carried out across the suspected palaeo-channel location on the Grand Road; thus, the GPR profile is effectively aligned parallel to the Grand Road itself (Figure 9). GPR captures images of litho-layers by transmitting electromagnetic waves through the subsurface; these waves are reflected back at points of dielectric differences, in this case between the river bed and loose sediments that fill up the palaeo-channel. GPR survey

was carried out in the present study over a distance of 600 m along the Grand Road (Figure 9 a). The survey was accomplished using bistatic fixed T/R offset in static stacking mode (point mode), taking central frequency of 40 MHz and time range 700 ns which images a profile with a vertical depth of around 37 m (Figure 9 b). An initial dielectric constant value of 8 (characteristic of soil) was used as input; this enables effective discrimination between sandy and clay-bearing horizons. The collected raw data were processed and filtered from noise using the Radon 7 software provided by Geophysical Survey Systems, Inc., USA. During processing, vertical low-pass filter, vertical high-pass filter, background removal tool and deconvolution were used to obtain a clear image<sup>3,24</sup>.



**Figure 7.** High resolution Google Earth images from the suspected palaeo-channel trail, with locations shown on the NDVI map. The sinuous bends at various places of the trail are indicated with white arrows, while the water bodies near Atharanala and Puri sea beach are labelled on the respective images.

**Results and discussion**

Google Earth, FCC of Landsat ETM+ as well as of LISS-III and Landsat ETM + Pan-sharpened Mosaic satellite images show a distinct vegetation trail (one of the characteristic features of a palaeo-channel) branching off from the Dhaudiga river, a distributary of the Bhargabi (Figure 2 a). In the FCC images of Figure 2, vegetation appears red, while in the NDVI map (Figure 3 a), vegetated areas show a brighter tone. MNDWI map (Figure 3 b) shows some bright pixels in both sectors W1 and W2, which are suspected to be water bodies and wetlands. However, the water bodies are not clearly visible within the vegetation band identified from NDVI map. In order to analyse the water content in suspected palaeo-channels in this area, four separate zones are identified, as shown in Figure 4. The linear spectral unmixing algorithm shows that in W1, vegetated areas in W1 have around 80% vegetation and 20% water bodies. In W2, the algorithm shows that mean pixels for the three curvilinear traces (shown in Figure 2 b) have contrasting proportions of vegetation and water

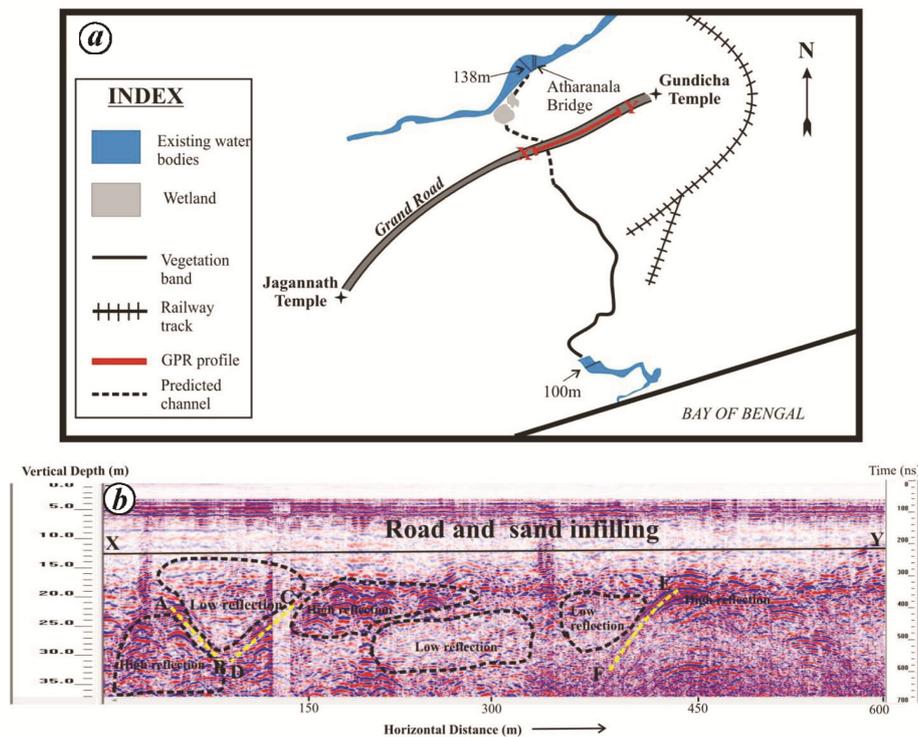


**Figure 8.** Results of field validation. *a*, Large water body near Atharanala covered with water hyacinth plants. *b*, Elongated curvilinear water body near Puri sea-beach that finally opens into the sea.

**Table 1.** Average percentage of vegetation and water components along the suspected palaeo-channel trails

W1			W2								
			T1			T2			T3		
V	W	RMSE	V	W	RMSE	V	W	RMSE	V	W	RMSE
79.9	20.1	0.005	93.2	6.8	0.006	79.2	20.8	0.007	88.1	11.9	0.006

V, Vegetation; W, Water component; W1 and W2 are rectangles marked in Figure 2. T1, T2 and T3 are three palaeo-channel traces marked in Figure 2.



**Figure 9.** *a*, Location of the GPR profile (in red) on the Grand Road (marked in grey). The trace of the suspected palaeo-channel is marked, and the railway track is also shown for locational reference. *b*, Result of GPR profiling. Note subsurface V-shaped valley (bound by reflectors A–B and C–D) on the western side of the profile, and the reflector E–F in the east. For further details, see text.

bodies – around 93% and 7% (in T1); 79% and 21% (in T2), and 88% and 12% in T3 (Table 1). Thus, the water body proportion in T2 (within W2) is comparable to that in W1, that is, the trail leading south from Dhaudia River, with both containing over 20% water proportion (Figure 5).

Density slice of the SRTM data around Puri town (Figure 6*a*) shows that the southern part is higher (elevation around 10–15 m) than the northern part (5–10 m), possibly due to the presence of a sand dune. Jagannath and Gundicha temples lie on relatively higher lands (15–40 m), and they are separated by a region of low elevation (Figure 6*a*). The eight spatial profiles drawn across the three traces, two across T1, five across T2 and one across T3 all show topographic depressions (Figure 6*b*), indicating that all three traces may represent palaeo-channels. The high resolution Google Earth image shows sinusoidal river bends in the vegetated trace of W1, while elongated water bodies are more prominent in W2 (Figure

7). One elongated water body with some adjacent wetlands is found in the northern part of W2 near Atharanala, while another is found to the south, near Puri Sea beach (Figure 7); the existence of both has been confirmed through field validation (Figure 8*a* and *b*). Both the water bodies have variable width (Figure 9); the northern water body is wider (around 138 m) in the middle than in the northeast (about 70 m) or southwest (50 m). The southern water body is wider in the north (around 100 m) and is connected to sea.

The northern and southern water bodies are not connected by any perceptible channel as the Grand Road passes through the region between the two trails. To examine the possible existence of a palaeo-channel connecting the northern and southern water bodies, a GPR survey was conducted along the Grand Road, 1.66 km northeast of the Jagannath temple (Figure 9*a*). The upper part of the survey profile (Figure 9*b*) depicts a horizontal zone,

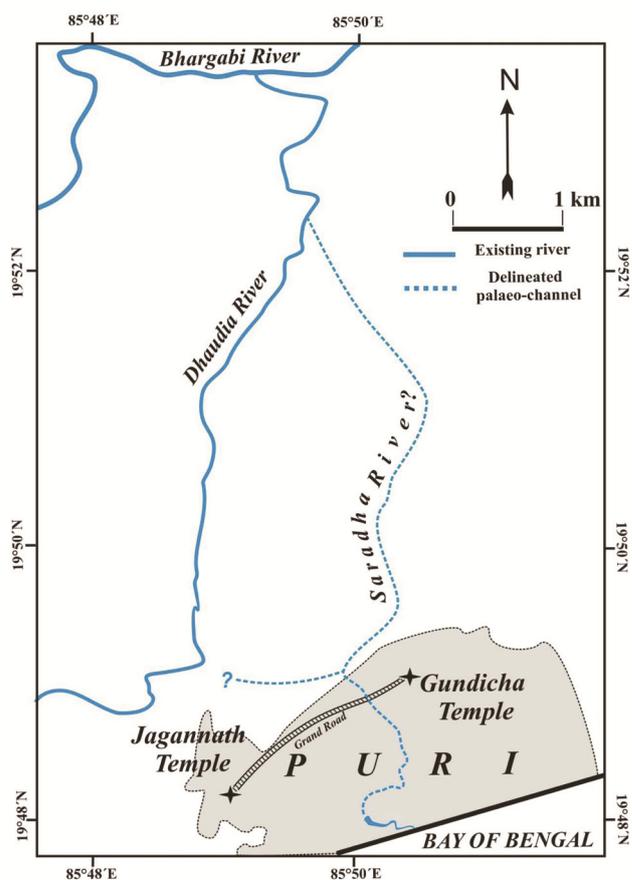
with high reflection zones (possibly representing road material) underlain by a horizontal low reflection zone (at depths of 5–15 m) characteristic of sand layers. This lower sand-bearing zone may either be interpreted as natural dune sands, or as infilling material used during construction of the Grand Road. Below this zone, the horizontal nature of the reflectors is gradually replaced by more undulating horizons, and zones of high reflectance, interpreted as clay layers; they are seen to be intermixed with sandy horizons of low reflectance<sup>24</sup>. The most prominent feature is observed near the western end of the profile, where two clay reflectors (A–B and C–D) dip toward each other, enclosing a V-shaped valley that contains material with low reflection characteristic (sand). This 128 m wide V-shaped feature, most likely represents a sub-surface river valley (Figure 9 b). Another prominent dipping clay layer (E–F) is observed at the eastern end of the profile, and may well represent an older channel bank. However, the middle of the profile shows no dipping layers, although zones of low reflection (sand) underlie high reflection clay zones. This may indicate the existence of an earlier, wider channel that subsequently shrunk and migrated westward.

Thus, in W1, the vegetation band identified from NDVI contains water and vegetation as two components, and sinusoidal river bends (identified from Google Earth) at various places. All the foregoing evidences suggest that the identified feature is a palaeo-channel. This palaeo-channel can be traced southward up to the precincts of Puri town (i.e. sector W2). In the urbanized area within Puri town lying within W2, three traces are suspected to be palaeo-channels, based on the presence of curvilinear vegetation bands and embedded water components, and may represent continuations of the palaeo-channel identified in W1. In the context of this study, the focus is on T2, which cuts across the Grand Road and is close to the southern end of the palaeo-channel identified in W1; the other two traces lie west of the Jagannath (T1) and east of the Gundicha (T3) temples respectively, and therefore do not cut across the Grand Road. T2 has water bodies at its northern and southern ends, with more than 20% water component. Thus, T2 is most likely to represent the palaeo-channel continuous with the one identified in W1.

The gap between the postulated northern and southern ends of T2 coincides precisely with the location of the Grand Road, where the GPR profile indicates that an earlier existing palaeo-channel is filled up. Interestingly, this can be explained from the writings in ancient texts that describe how the river channel was filled up with sand in the 14th century to pave way for construction of the Grand Road across the river. This part of the Grand Road is still called ‘Saradha bali’ (bali in Oriya (Odia) is sand). Remnants of the original river, in the form of water body and wet lands, still exist to the north of the Grand Road. The northern trail leading southward from Dhaudia River is suspected to be the main trunk of the earlier existing

river, with T2 probably being a distributary channel that flowed southward from the main trunk towards the sea, bisecting Puri town (Figure 10). The southern elongated sinusoidal water body near Puri sea-beach is also suspected to be a remnant of the earlier channel that finally flowed into the sea.

Summarizing, it can be stated from the above observations that an ancient river used to flow through a channel that originated from the existing Dhaudia river, which is itself a distributary of the Bhargabi. This river, or a distributary channel emanating from Dhaudia river flowed through Puri town and ultimately reached the Bay of Bengal (Figure 10). This channel can be correlated with the mythical river Saradha described in ancient texts. Thus, Saradha river was a part of the Mahanadi distributary system and may have dried up simply on account of sand dune migration. Artificial filling of the Saradha channel with sand in the late 14th century, in order to smoothen the journey of Lord Jagannath’s chariot from the Jagannath to the Gundicha temple, removed the last remaining surficial evidence of the river that once flowed southward through the present Grand Road.



**Figure 10.** Delineated palaeo-channel of the Saradha River shown as a blue dashed line, leading south from the Dhaudia River and flowing through Puri town (shaded in grey). Note that the palaeo-channel cuts across the Grand Road between the Jagannath Temple and Gundicha Temple.

## Conclusion

The present study is yet another demonstration of the potential of satellite images in identifying palaeo-channels. Examples in the Mahanadi delta region, Saradha and Chandrabhaga, are mentioned in ancient texts. The palaeo-channels have been recognized using a combination of satellite imageries and field geological and geophysical studies. In the present study, identifying the Saradha palaeo-river channel involved the following steps. Initially, a suspected palaeo-channel branching off from the existing river Dhaudia was identified from curvilinear vegetation bands embedded with water components, after matching the band with high resolution Google Earth images. Further south, the strategy for identifying the palaeo-channel was necessarily more complex, as the area fell within the precincts of Puri town. The southern end of the palaeo-channel is in the proximity of an elongate natural water body along with wetland that is present to the north of the Grand Road. South of the Grand Road, another curvilinear vegetation band terminates in another elongated water body at its southern end, which ultimately opens into the sea. Along the Grand Road itself, GPR profiling across the suspected trace of the palaeo-channel reveals the presence of a 128 m wide, V-shaped river valley in the subsurface. Thus, an ancient river channel could be identified. It branched off from the present Dhaudia River, and flowed southward along a distributary channel that passed through the present town of Puri before debouching into the Bay of Bengal. The palaeo-channel identified in the present study cuts across the Grand Road, or *Badadanda*, between the Jagannath and Gundicha temples. Our studies suggest that this palaeo-channel may well represent the mythical river Saradha mentioned in ancient texts and temple chronicles.

The present study demonstrates a sequential methodology for identifying palaeo-channels even in urbanized localities like Puri.

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