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Assessing the habitat suitability of the Ganga River under anthropogenic influence

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OSPP presentation

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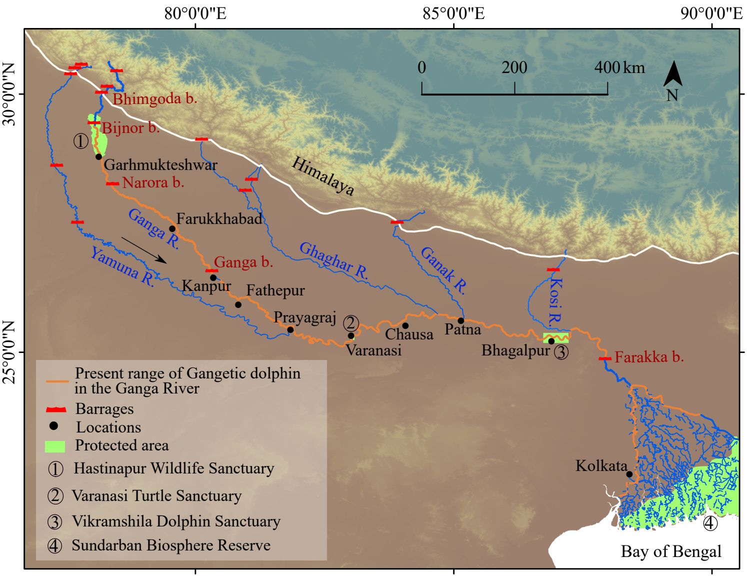
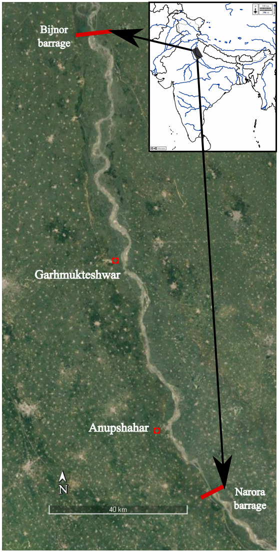
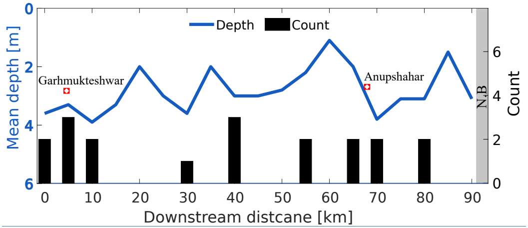
Motivation of the study



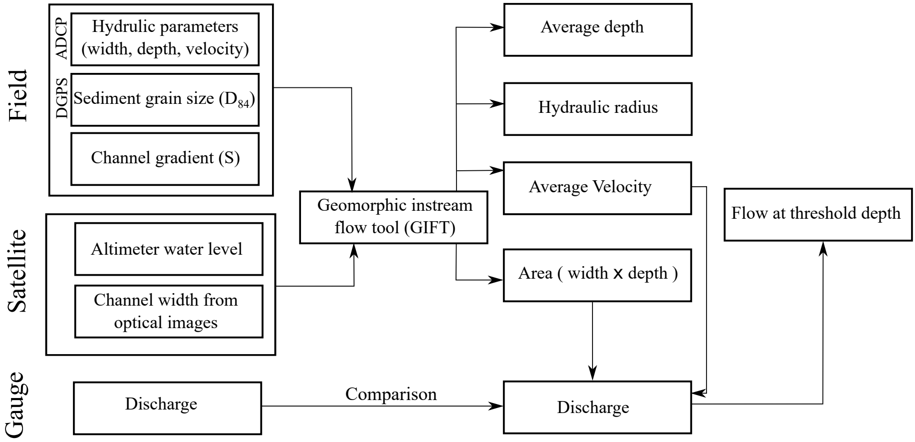
Depth influence on distribution



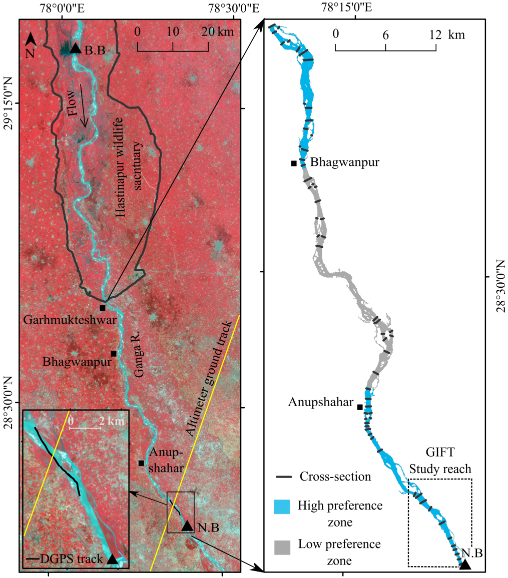


River	Minimum depth [m]	Period of measurement	Reference
Karnali/Nepal	2 - 3.5	December to May	Paudel etal ., 2021
Gandak	2.2 - 5	January	Chaudhory 2012
Ganga	3 - 9	January to June	Joshi 2008
Brahmaputra	4.1 - 6	February to April	Wakid 2009

Method of hydraulic habitat estimation



Study site



78°0'0"E
78°30'0"E
78°15'0"E
29°15'0"N
28°30'0"N
N
B.B
Flow
Hastinapur wildlife sacntuary
0 10 20 km
Garhmukteshwar
Bhagwanpur
Ganga R.
Altimeter ground track
Anup-shahar
N.B
0 2 km
DGPS track
0 6 12 km
Bhagwanpur
Anupshahar
GIFT
Study reach
Cross-section
High preference zone
Low preference zone
N.B

Channel hydraulics

Reach.	Mean depth [m]	Maximum depth [m]	Mean velocity [m/s]	Width [m]	Discharge [m^3/s]
		Pre-monsoon			
Garhmukteshwar	1.6 ±0.3	3.07 ±1.32	0.6 ±0.0	276 ±70	281 ±92
Anupshahar	1.6 ±0.3	3.25 ±0.96	0.6 ±0.11	245 ±82	264 ±93
Narora	2.0 ±0.8	4.60 ±2.89	0.5 ±0.19	294 ±116	294 ±54
		Monsoon			
Garhmukteshwar	2.1 ±0.3	5.1 ±0.5	1 ±0.13	489 ±98	1107 ±174
Bhagwanpur	2.5 ±1.0	6.0 ±2.0	1 ±0.28	527 ±112	1143 ±181
Anupshahar	2.7 ±0.3	6.1 ±0.8	1 ±0.14	506 ±140	1398 ±135
Narora	2.8 ±0.5	6.4 ±2.7	1 ±0.13	459 ±127	1388 ±140

Hydraulic habitat simulation

RIVER RESEARCH AND APPLICATIONS

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AT-A-STATION HYDRAULIC GEOMETRY SIMULATOR

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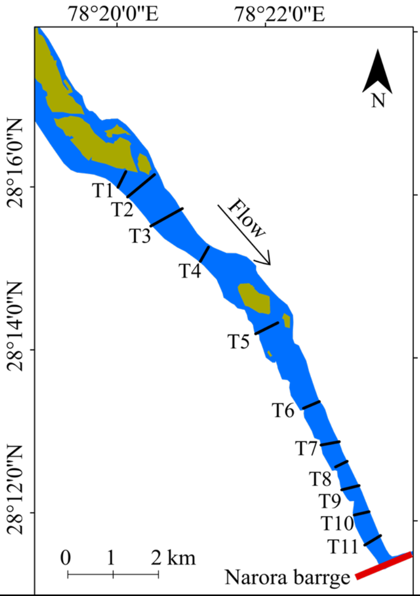
RESEARCH ARTICLE

WILEY

Evaluation of a geomorphic instream flow tool for conducting hydraulic-habitat modelling

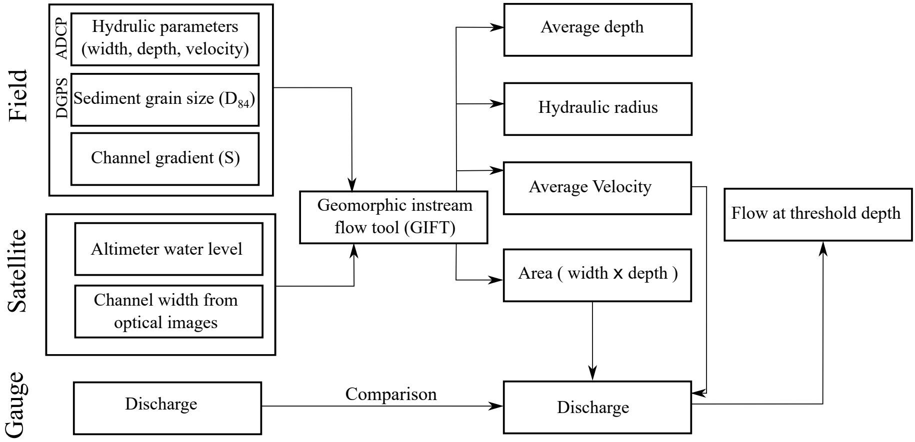
Stefan Gronsdahl[1] | Dan McParland[1] | Brett Eaton[2] | R. Dan Moore[2] | Jordan Rosenfeld[3]

GIFT Study reach



Transect no.	Mean bankfull depth (m)	Maximum bankfull depth (m)	Bankfull width (m)
T1	2.9	6.7	460
T2	2.3	5.1	761
T3	2.2	8.1	587
T4	2.9	6.6	476
T5	2.3	4.1	520
T6	3.5	7.8	405
T7	2.8	5.5	407
T8	4	14.5	306
T9	2.7	4.9	393
T10	2.9	4.8	343
T11	2.8	6.2	400
Mean	2.9	6.7	459
Standard deviation	0.5	2.8	127

Method of hydraulic habitat estimation



GIFT Work flow

Depth distribution → Bankfull water level superimposed → Benchmark bankfull bed elevation → Reach averaged depth at varying water level →

- Calculating Hydraulic radius (R): $R = W_b \times d_b / P$

  Where W_b is the bankfull width and d_b is the calculated depth at different water level

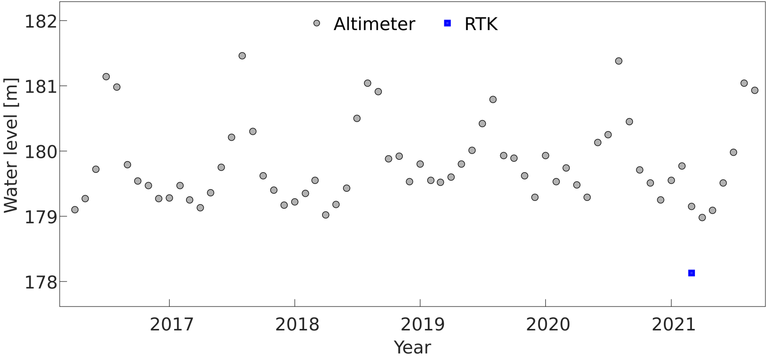
- Calculating Mean velocity (v_{mean}): $V = R^{(2/3)} \times S^{(1/2)} / n$

  where n is manning's coefficient for sand bed (0.017) and S is the channel gradient (m/m)

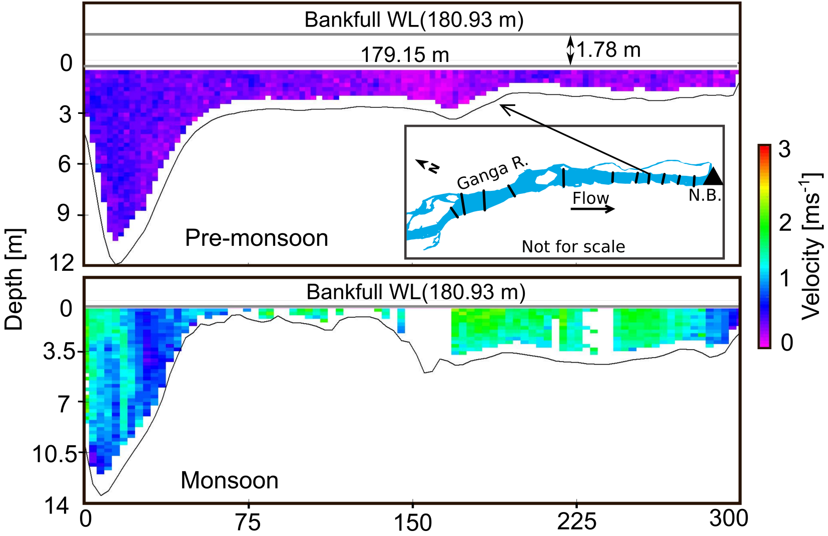
- Calculating the associated discharge (Q): $Q = v_{mean} \times W \times d_{mean}$

  Where W is the width which is the bankfull constant width or satellite derived width for each timestep.

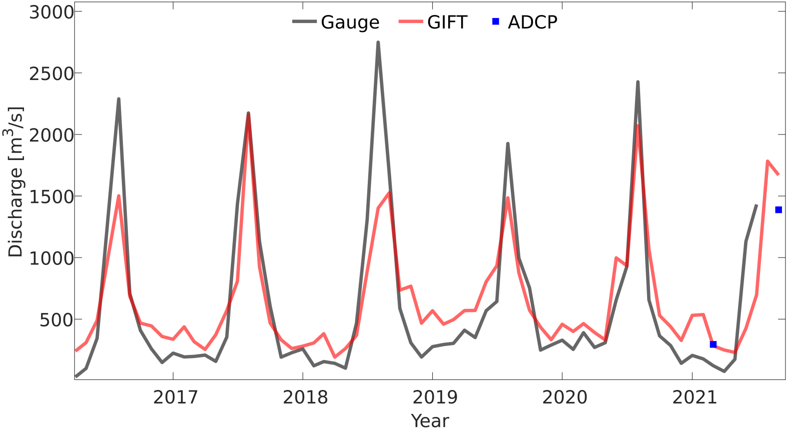
Satellite Altimeter water surface elevation



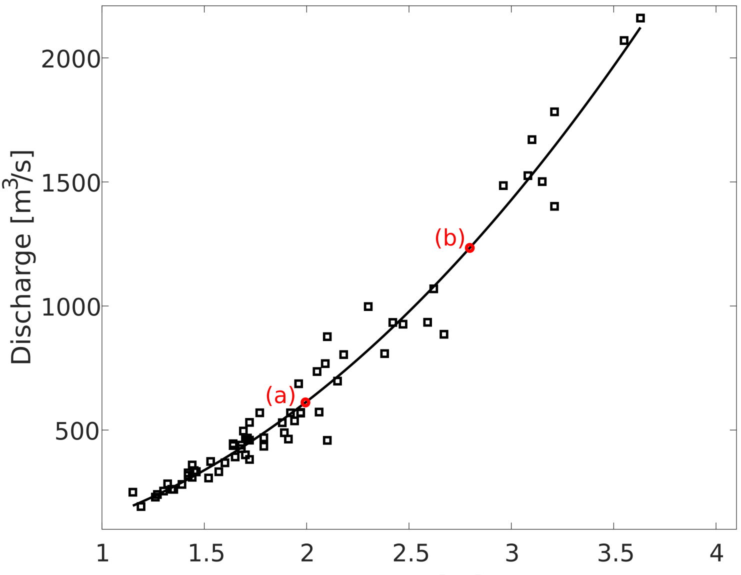
Water level variation



Rating curve



Rating curve



Conclusion

The optimal mean depth of 2 m is available in the monsoon season throughout the high and low preferred zones of GRD habitat, while in the pre-monsoon, the optimal mean depth is present only in the reach upstream of Narora barrage. The mean maximum in the pre-monsoon may provide intermittent longitudinal connectivity.

Altimetry WL superimposed on a cross-section reflects the temporal change of 1.7 m in WL is also observed in the cross-section bathymetry it is superimposed on. This suggests that the altimetry dataset can predict water surface elevation change of river cross-sections with relative ease.

Conclusion

The study assumes a fixed channel configuration; therefore 614 m3/s of discharge is required to maintain the optimal depth of 2 m. The requisite mean discharge and depth is are attained at WL of >179.8 m. The mean simulated hydraulics of the pre-monsoon and monsoon suggest that the altimetry dataset are a good precursor to check habitat suitability under varying flow conditions where data is scarce.

GIFT's ability is limited by the input measurements and the assumption of fixed channel configuration. Additionally, this study's findings are site-specific but can be in predicting a first-order estimate of reach averaged hydraulic habitat quality.