Understanding the Individual Impacts of Land Use Land Cover (LULC) and Climate Change on Hydrologic Variables in India

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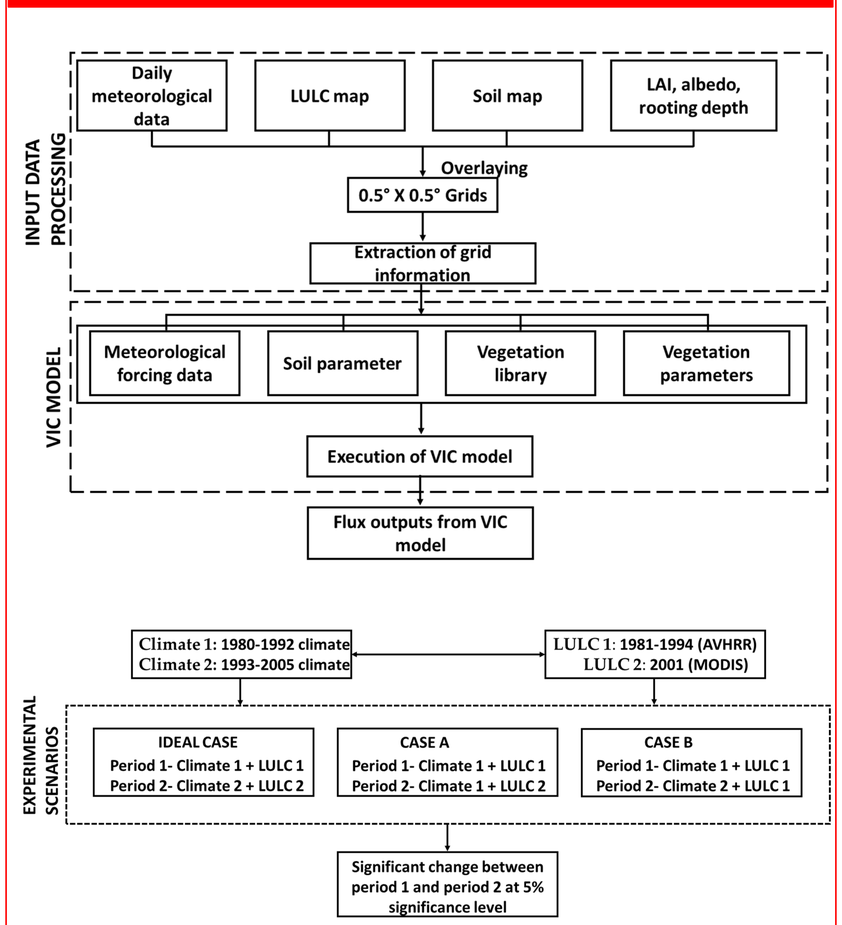
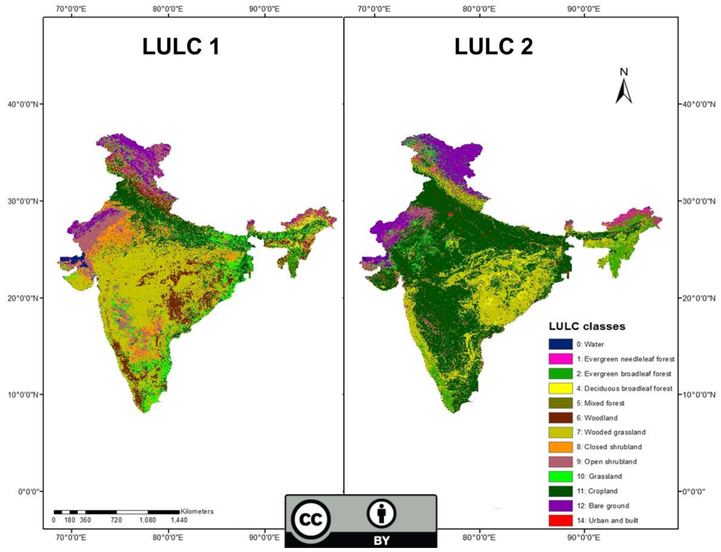
INTRODUCTION

- The changes in Land Use Land Cover (LULC) and climate affects the hydrologic and energy cycle of earth.
- Past studies show the impact of land use change on hydrology assuming constant climatic conditions within the region (Thanapakpawin et al., 2007; Gosain et al., 2011) or the impact of climate on hydrology keeping constant land use conditions (Kwadijk and Rotmans, 1995; Labat et al., 2004). Despite the several studies the relative influences of LULC and climate changes in shaping the hydrology of India are lacking.
- The present work quantifies the hydrologic implications of individual and combined climate and LULC changes over India using Variable Infiltration Capacity (VIC) mesoscale model considering databases during 1979-2005.
- This study identifies the relative contribution of climate and LULC changes which is particularly important in water management and also in nitrogen management in India under change.

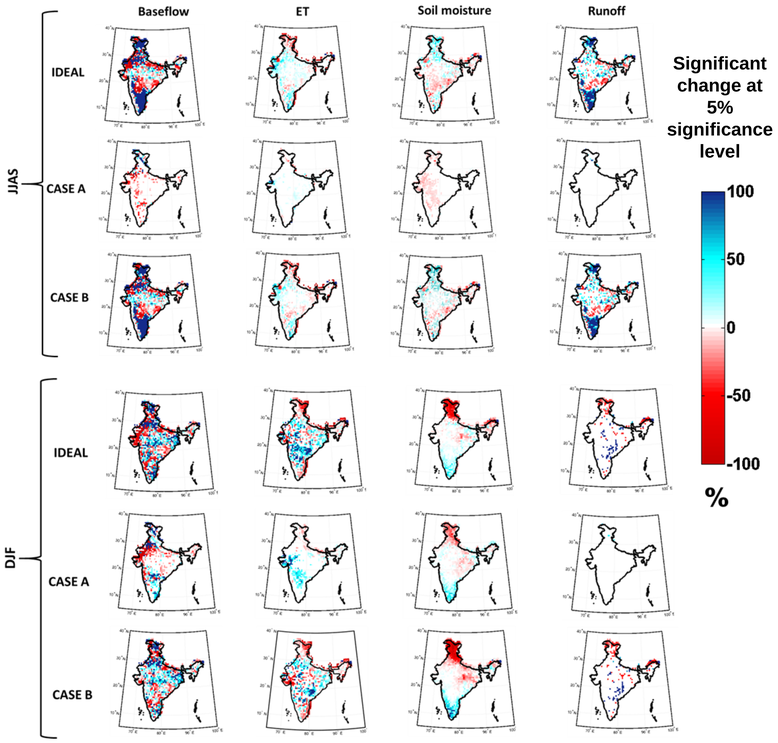
METHODOLOGY



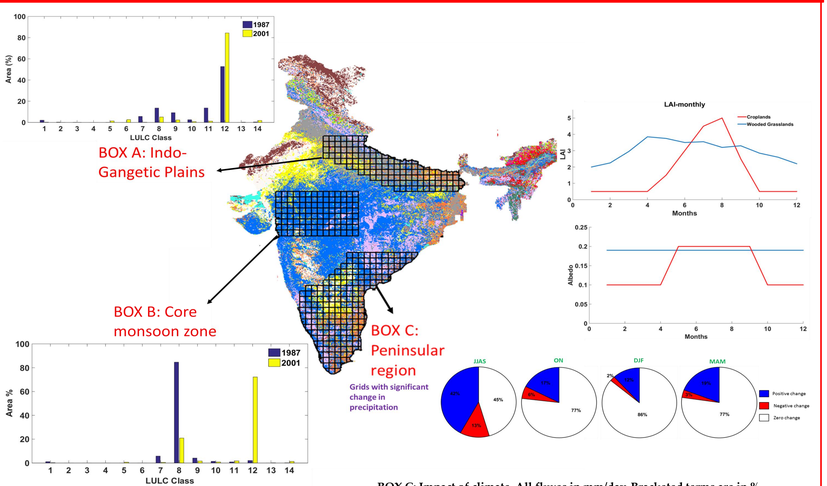
TWO SETS OF LULC USED



RESULTS AND INFERENCE



RESULTS AND INFERENCE (Contd..)



BOX B: Conversion of wooded grasslands to croplands. All fluxes in mm/day

Seasons \ Water Fluxes		Prec	ET	Runoff	Baseflow
JJAS	1987	68.61	41.93	13.9	6.63
	2001	68.61	43.04	13.9	6.15
ON	1987	8.12	14.22	1.3	4.16
	2001	8.12	12.16	1.4	3.9
DJF	1987	1.5	1.6	0.2	0.3
	2001	1.5	2.25	0.2	0.3
MAM	1987	1.03	0.85	0.09	0.02
	2001	1.03	0.85	0.12	0.02

BOX C: Impact of climate. All fluxes in mm/day. Bracketed terms are in %

Season \ Water fluxes		Increased rainfall				Decreased rainfall			
		Prec	ET	Runoff	Baseflow	Prec	ET	Runoff	Baseflow
JJAS	1987	3.04 (100)	2.14 (70.4)	0.43 (14.1)	0.19 (6.25)	13.48 (100)	4.19 (31.08)	4.53 (33.61)	3.95 (29.3)
	2001	4.54 (100)	2.57 (56.6)	0.92 (20.2)	0.74 (16.3)	10.67 (100)	3.81 (35.71)	3.15 (29.52)	3.23 (30.27)
ON	1987	4.31 (100)	2.75 (63.8)	0.8 (18.5)	1.05 (24.4)	5.57 (100)	3.21 (57.63)	1.08 (19.39)	1.09 (19.57)
	2001	4.67 (100)	2.84 (60.8)	0.88 (18.8)	1.44 (30.8)	4.16 (100)	2.69 (64.66)	0.87 (20.91)	0.71 (17.07)
DJF	1987	0.24 (100)	0.44 (183.3)	0.03 (12.5)	0.07 (29.2)	1.57 (100)	1.48 (94.27)	0.34 (21.66)	0.54 (34.39)
	2001	0.54 (100)	0.6 (111.1)	0.08 (14.8)	0.13 (24.1)	0.87 (100)	0.98 (112.64)	0.17 (19.54)	0.41 (47.13)
MAM	1987	1.35 (100)	0.95 (70.4)	0.14 (10.4)	0.03 (2.2)	1.55 (100)	1.13 (72.9)	0.18 (11.61)	0.03 (1.94)
	2001	2.12 (100)	1.31 (61.8)	0.15 (7.1)	0.29 (13.7)	1.03 (100)	0.85 (82.52)	0.09 (8.74)	0.008 (0.78)

CONCLUSIONS

- The climate variation played a more pronounced role than land use change in influencing surface hydrology of India during the analysis period 1979-2005.
- The impact on runoff caused by land use land cover changes does not contribute much to the total changes.
- On conversion of grasslands to croplands, top soil layer moisture decreases in JJAS because of higher LAI of croplands leading to more interception. During DJF, losses due to ET, baseflow and runoff increases. ET is more in croplands because albedo of croplands is less than grasslands during winter.
- Besides the effects of land use cover, climate variability in India was a major factor, which tended to be warmer and wetter during 1993–2005 and directly led to increases in runoff, baseflow, soil moisture and evapotranspiration.
- When compared to the observed soil moisture, even the simulated soil moisture of ideal case shows discrepancies which can be due to human interventions that were not included in VIC simulations. We anticipate to consider the effects of human interventions such as controlled structures, groundwater extraction, and irrigation in studying the impacts on water resources of India.

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