

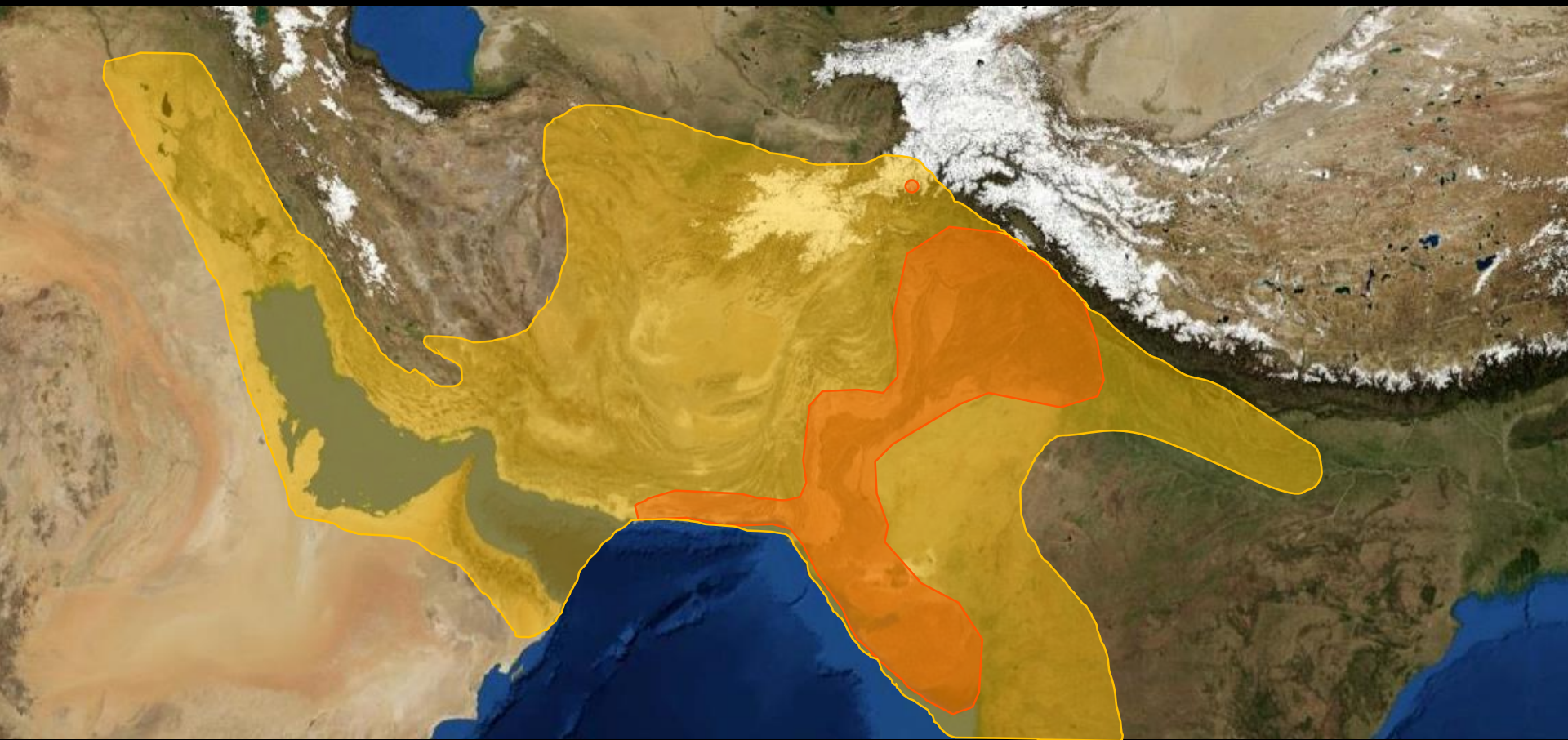
PREDICTABLY UNPREDICTABLE:

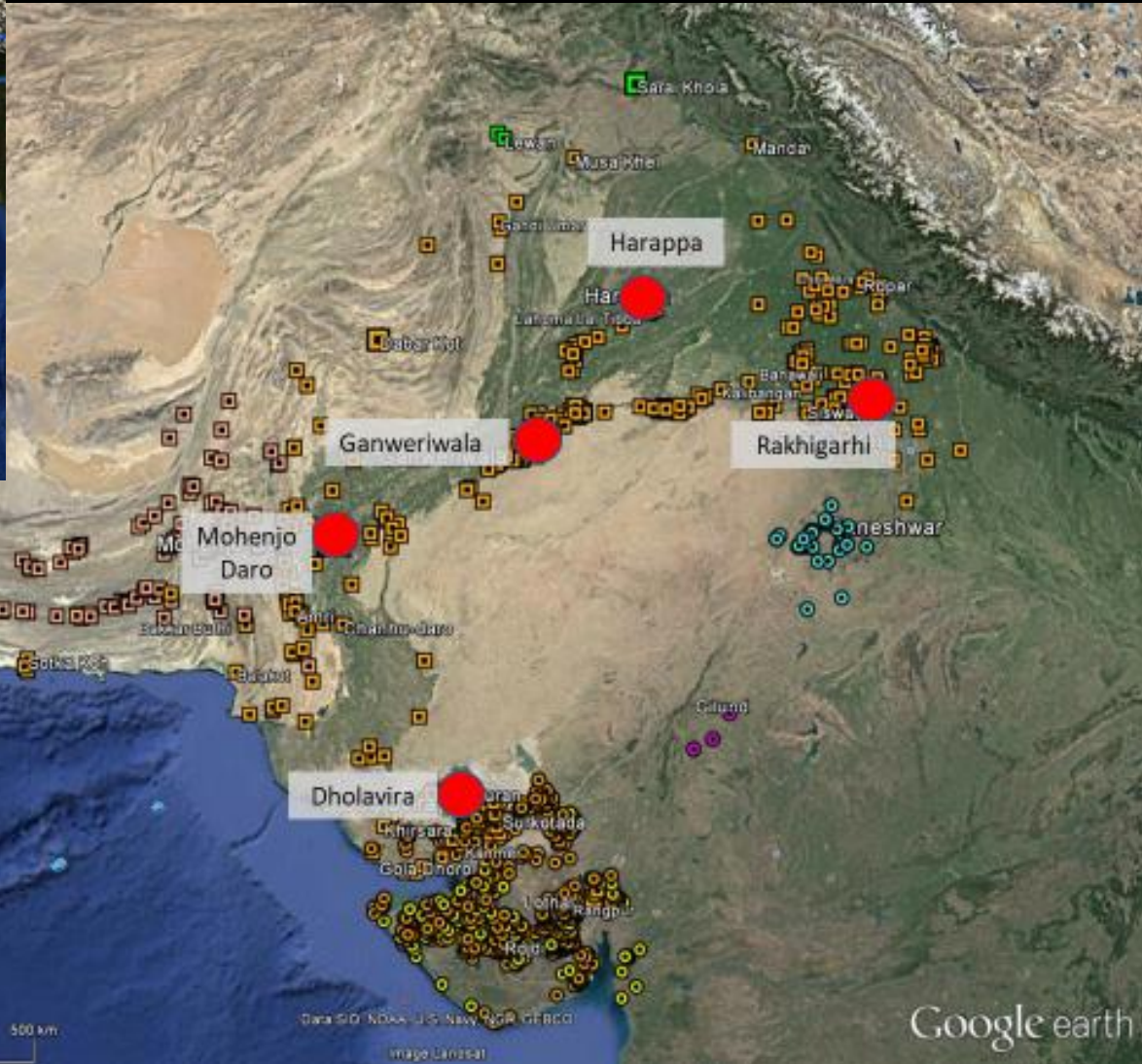
SETTING THE GEOGRAPHICAL CONTEXT

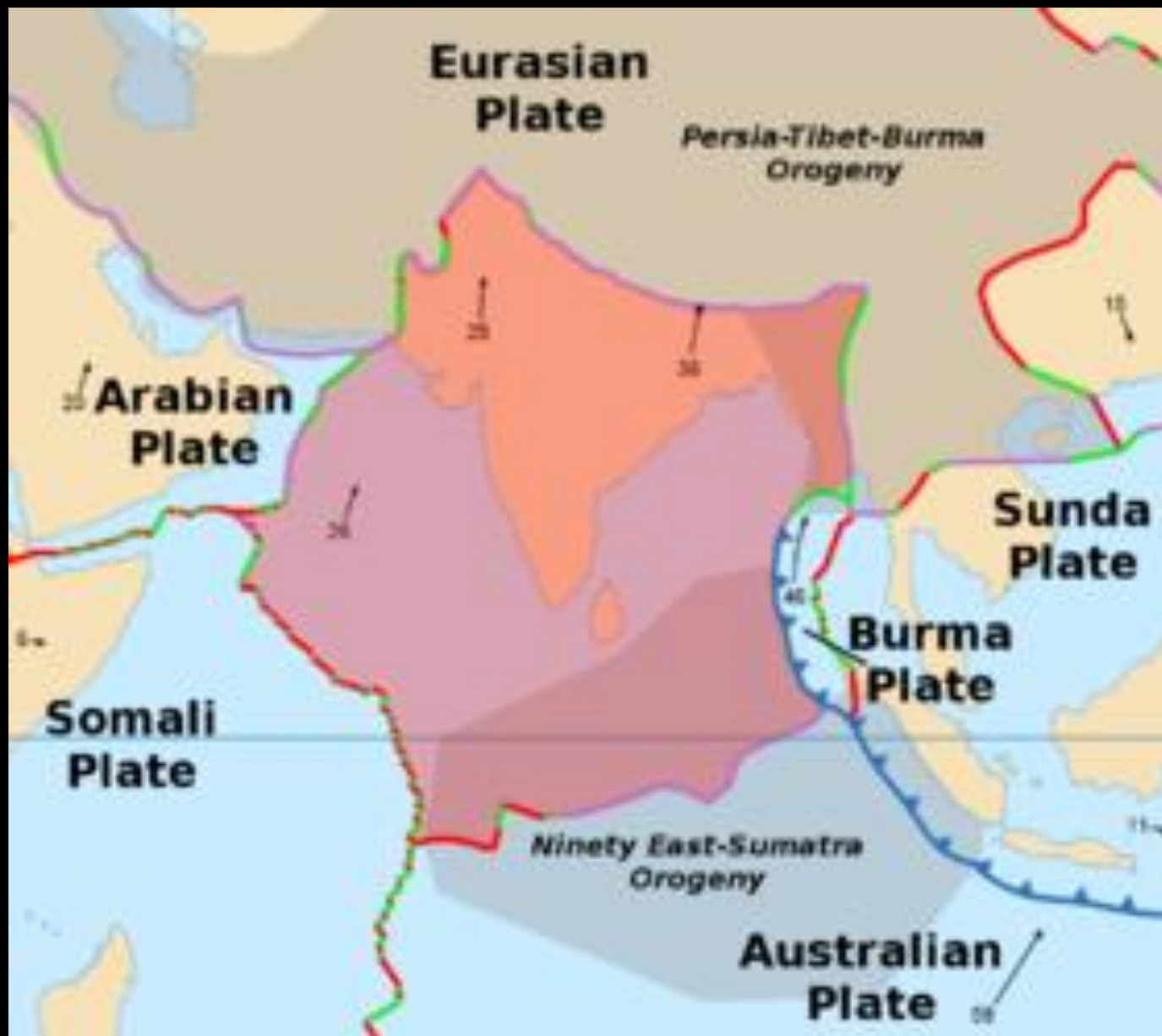


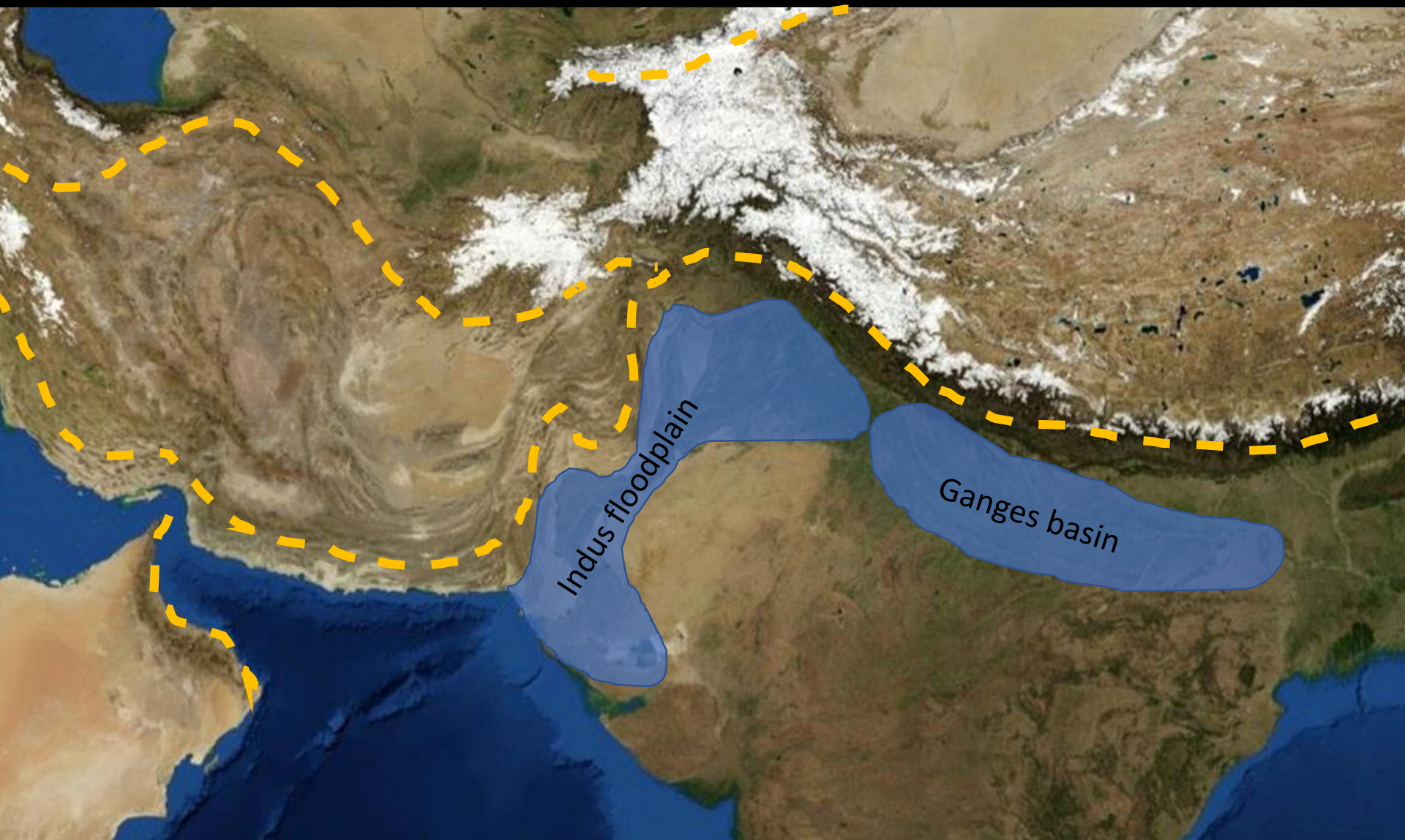
- Explore what the “Indus” zone means for these lectures
- Consider the variability of the geography of the Indus Civilization
- Think about issues of climate change
- Think about issues of hydrology
- Look at the impact of these on the Indus Civilization and models of it











Indus floodplain

Ganges basin



Potwar Plateau

Kashmir ↑

Punjab

Cholisthan

Rajasthan

Ganges plains

Baluchistan

Sindh

Makran

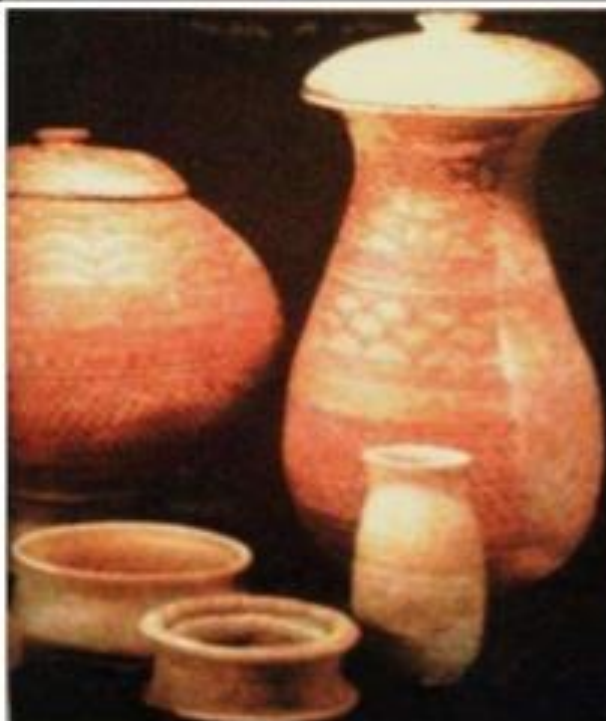
Gujarat

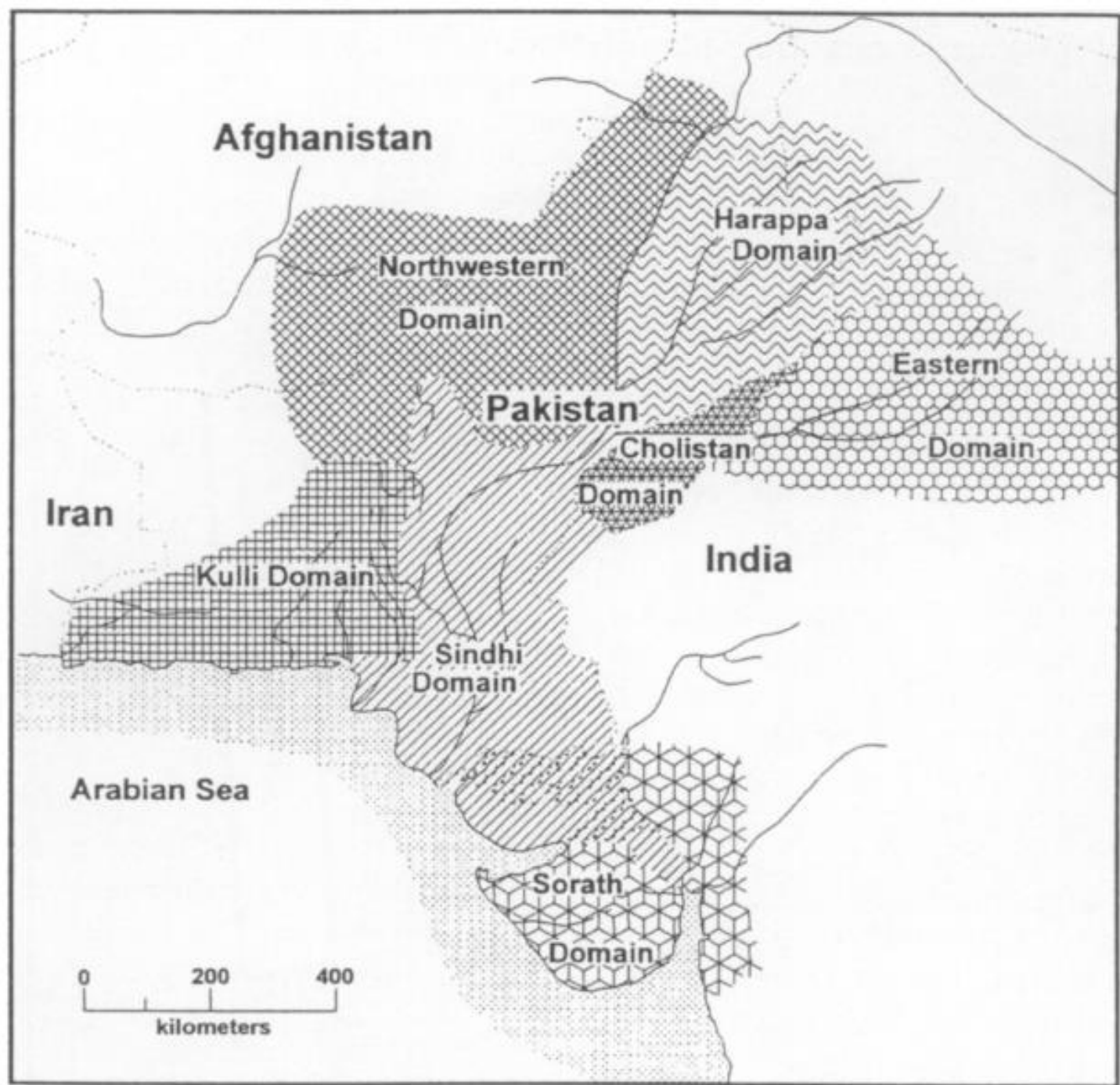
Maharashtra

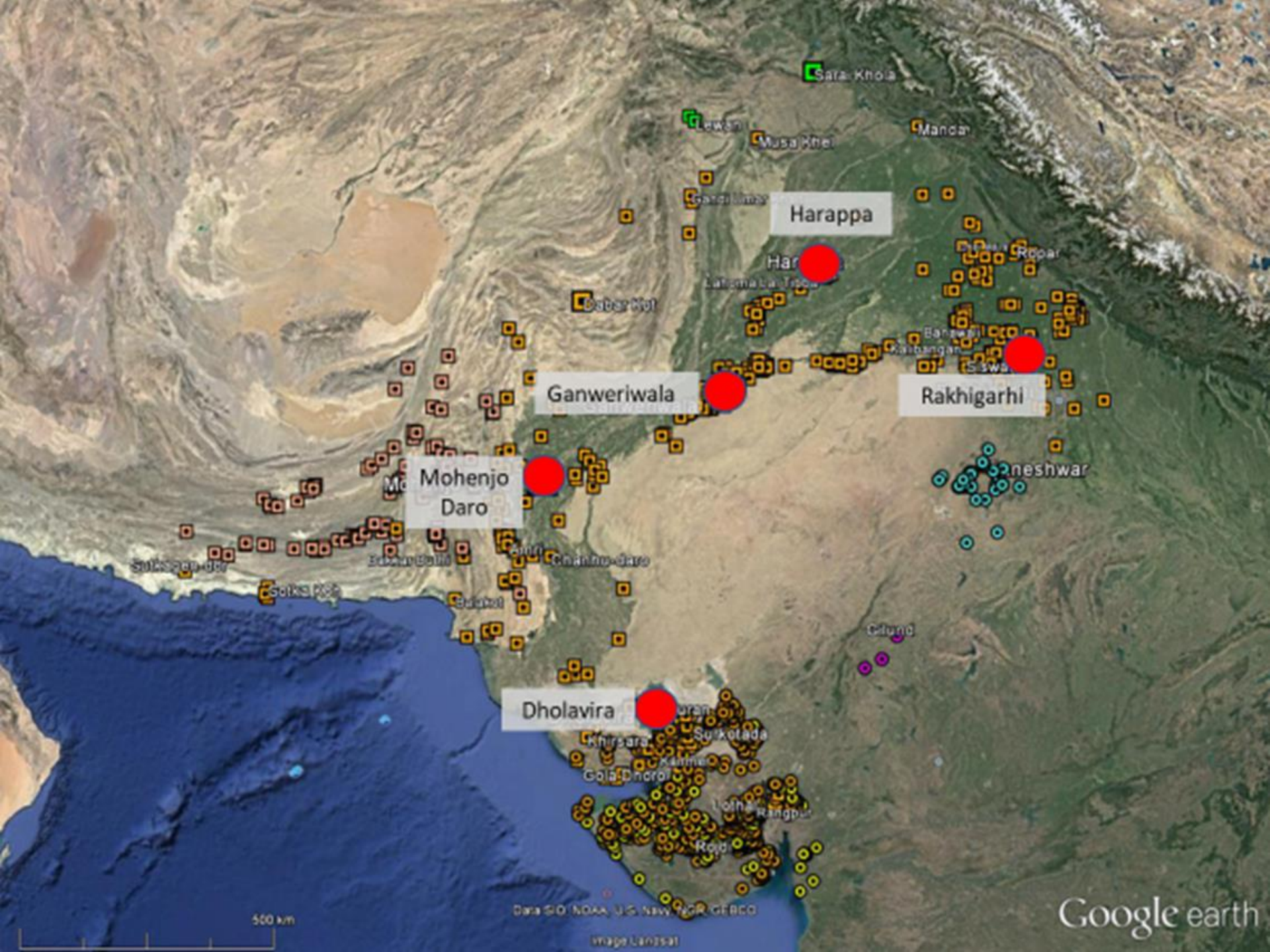
South ↓



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Satta Khola

Lewan

Musa Khel

Mandar

Harappa

Har

Ganweriwala

Rakhigarhi

Mohenjo Daro

neshwar

Dholavira

Suran

Surkotada

Khirsara

Gola Dhorai

Lotha Rangpur

Roid

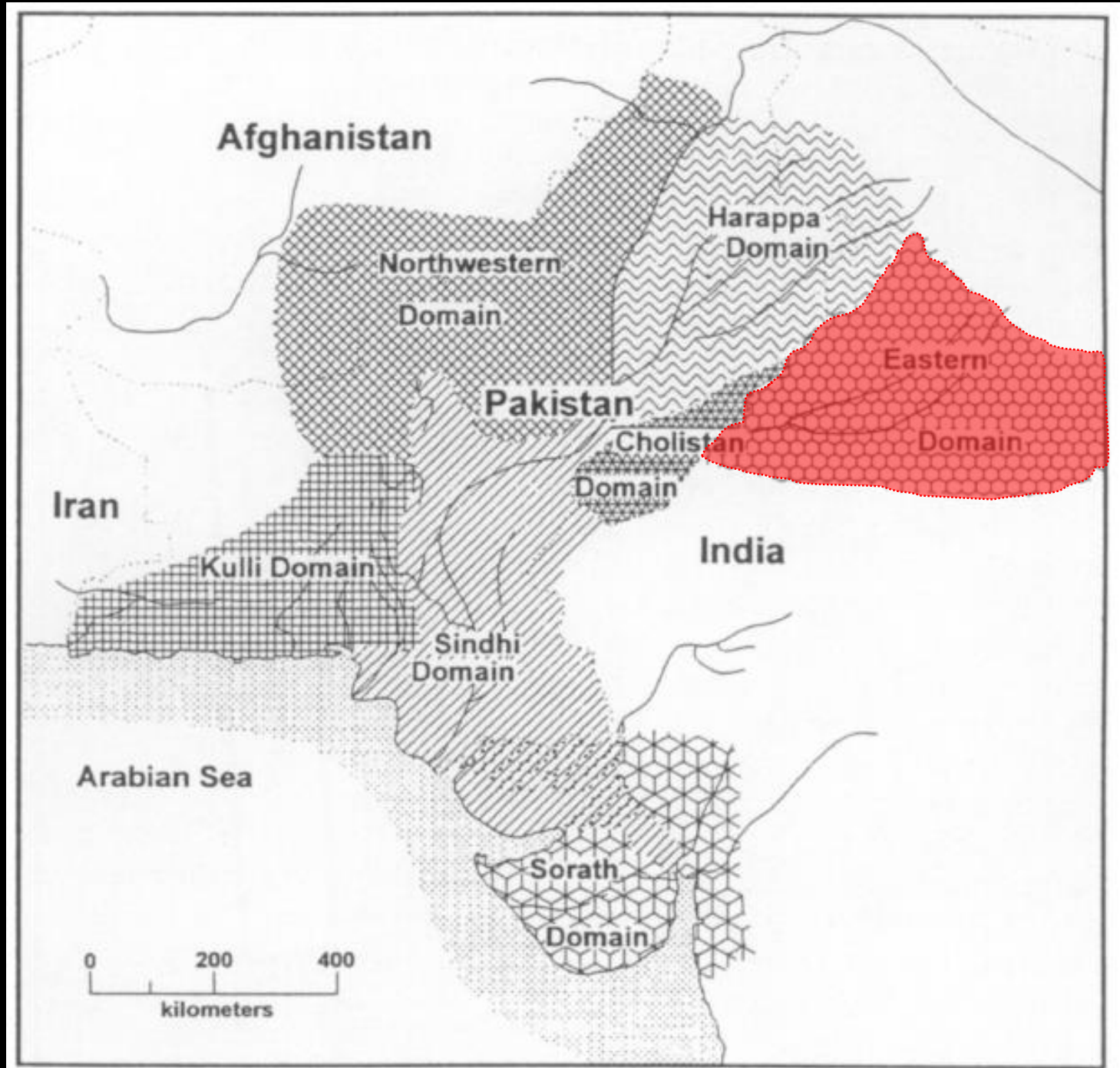
Gitund

500 km

Data SIO NOAA U.S. Navy JGR GBR

Image Landsat

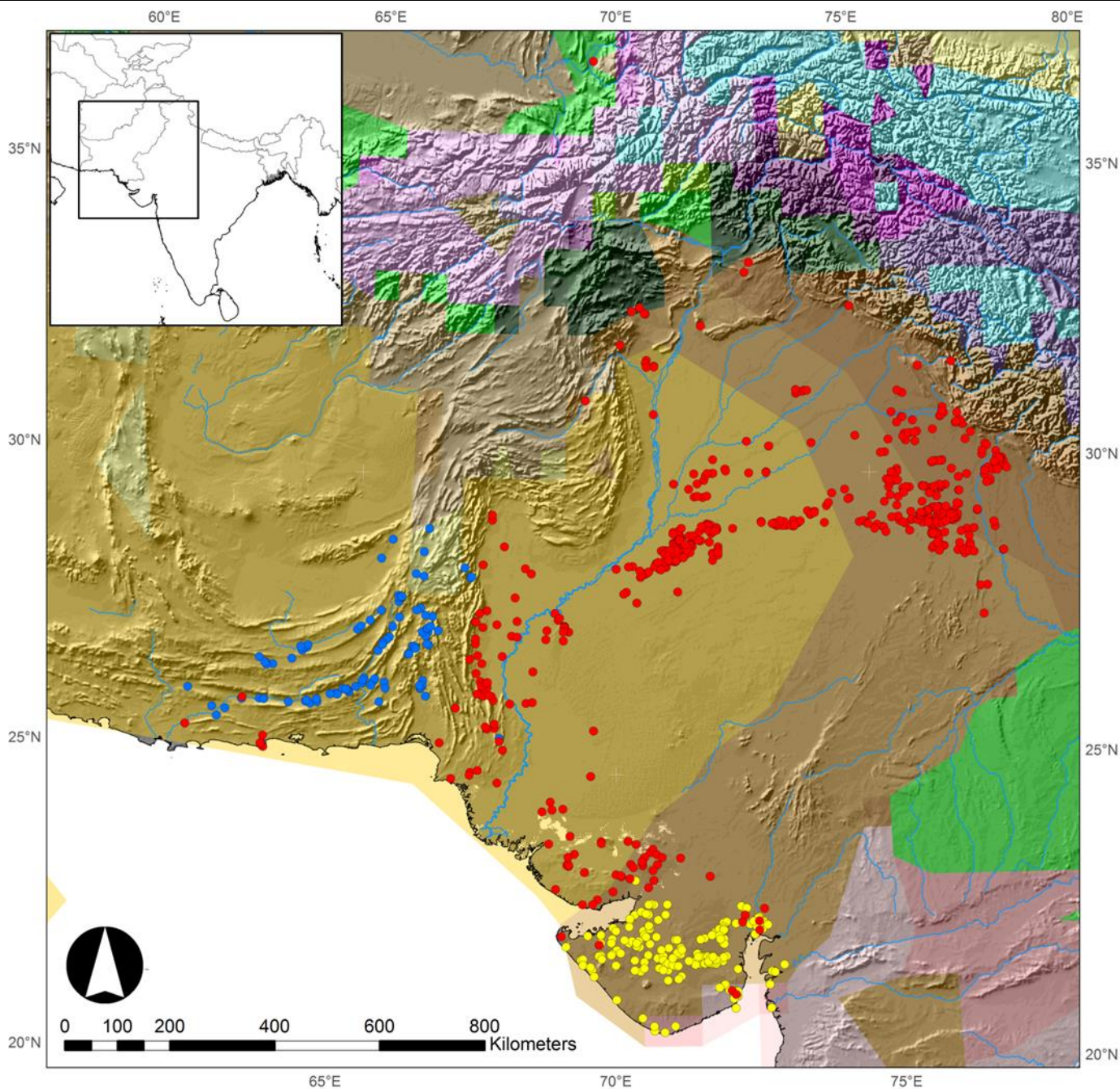
Google earth







This map is presented for information only. The Department of Foreign Affairs and Trade accepts no responsibility for errors or omission of any geographic feature. Nomenclature and territorial boundaries may not necessarily reflect Australian Government policy. For the latest travel advice visit smartraveller.gov.au. Provided by the Commonwealth of Australia under Creative Commons Attribution 3.0 Australia licence.



Legend

- urban_Harappan
- Kulli
- Sorath_Harappan

koeppen_geiger_2006

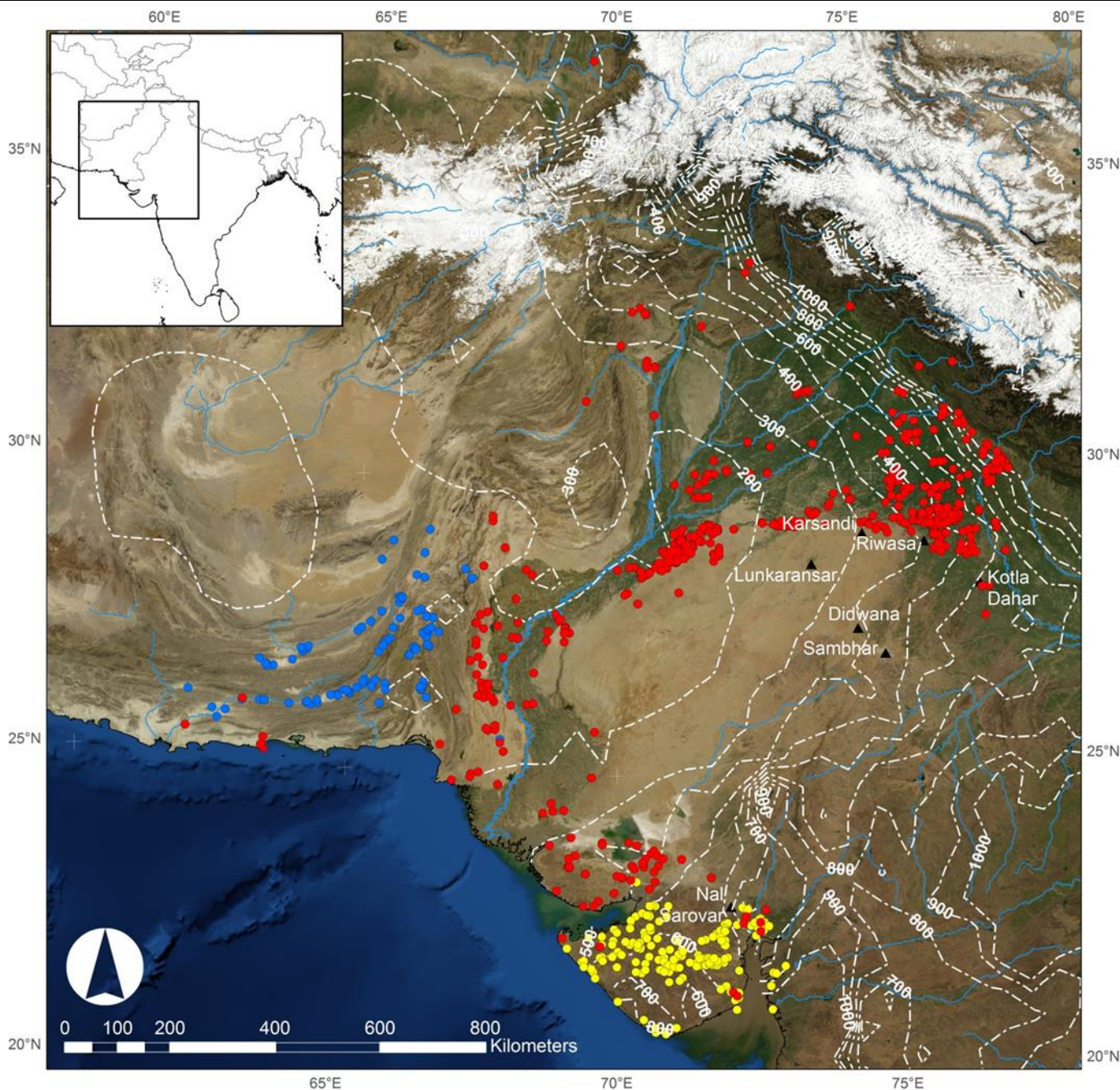
GRIDCODE

Af	Cfa	CWc	Dwa
Am	Cfb	Dfa	Dwb
As	Cfc	Dfb	Dwc
Aw	Csa	Dfc	Dwd
BWk	Csb	Dfd	EF
BWh	Csc	Dsa	ET
BSk	Cwa	Dsb	
BSh	Cwb	Dsc	

Climate classification data obtained from Kotttek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006. World Map of the Köppen-Geiger climate classification updated. Meteorol. Z., 15, 259-263. DOI: 10.1127/0941-2948/2006/0130.

See: <http://koeppen-geiger.vu-wien.ac.at/present.htm>

Maps composed by C.A. Petrie



Distribution of urban phase Indus settlements, including populations using Kulli and Sorath Harappan material, and their relationship to mean annual rainfall between 1900-2008

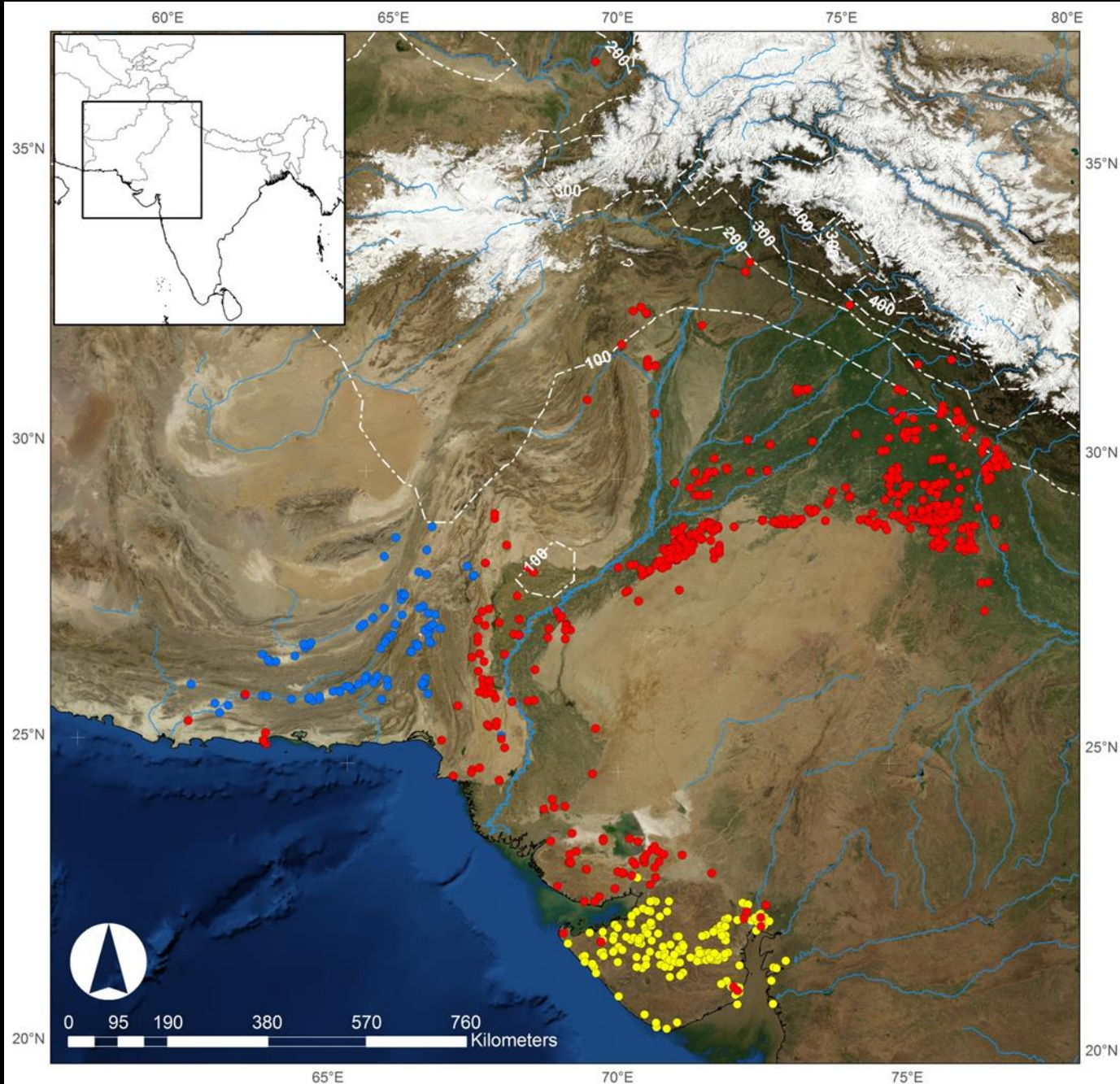
Legend

- urban_Harappan
- Kulli
- Sorath_Harappan
- Mean annual rainfall 1900-2008 mm
- Palaeo-lake_climate_proxies

NASA Blue Marble: Next Generation satellite imagery was produced by Reto Stöckli and obtained from NASA's Earth Observatory (NASA Goddard Space Flight Center)

See:
<http://earthobservatory.nasa.gov/Features/BlueMarble/>

Maps composed by C.A. Petrie



Distribution of urban phase settlements and their relationship to the mean average winter rainfall from 1900-2008

Legend

- urban_Harappan
- Kulli
- Sorath_Harappan
- mean_Q1_100

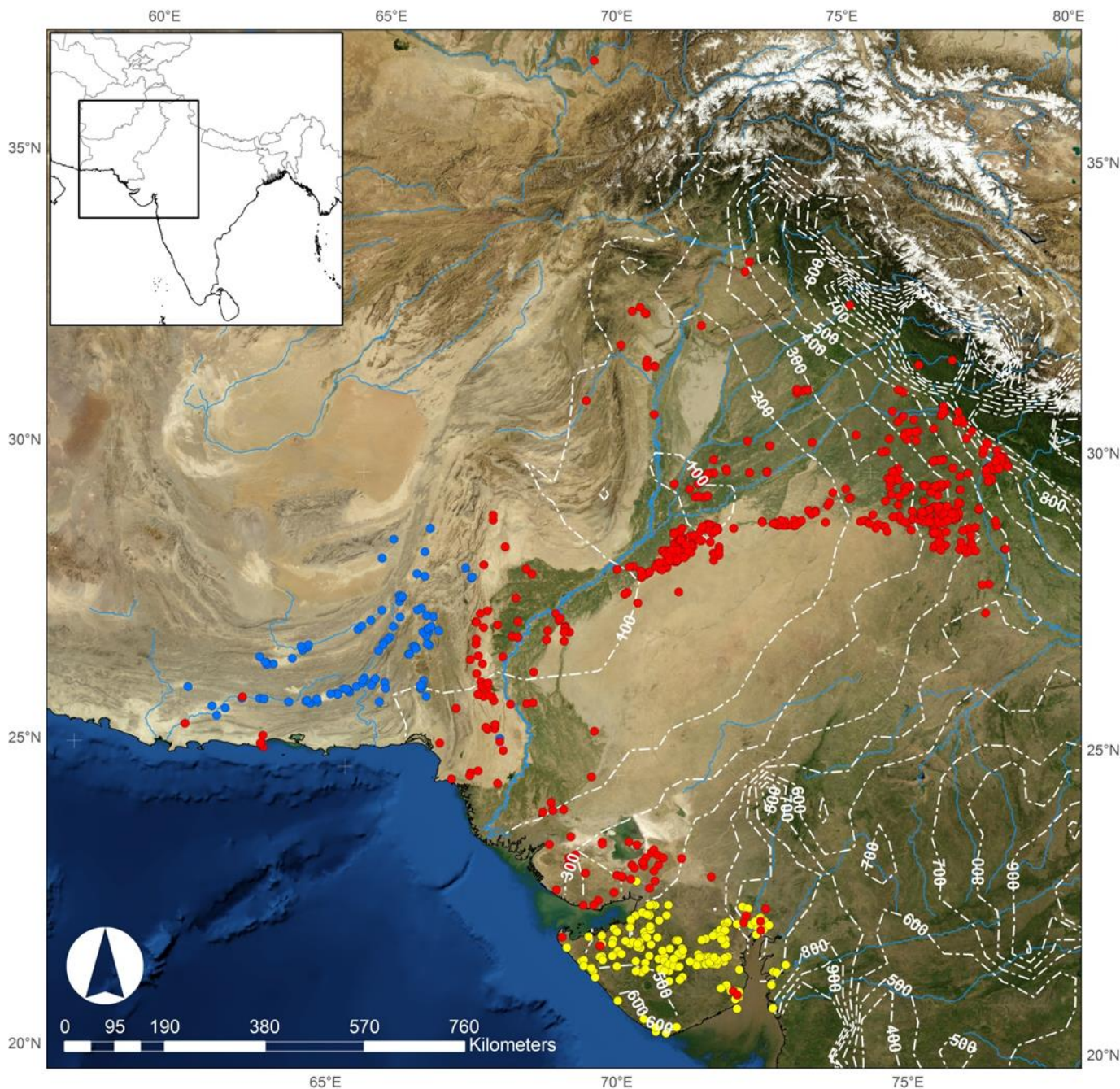
Rainfall isohyets were extracted from the Univ. of Delaware monthly global gridded high resolution station (land) data set of precipitation from 1900-2008 (v2.01) by D.I. Redhouse.

Data available from:
http://www.esrl.noaa.gov/psd/data/gridded/data.UDel_AirT_Precip.html

NASA Blue Marble: Next Generation satellite imagery was produced by Reto Stöckli and obtained from NASA's Earth Observatory (NASA Goddard Space Flight Center)

See:
<http://earthobservatory.nasa.gov/Features/BlueMarble/>

Maps composed by C.A. Petrie



Distribution of urban phase settlements and their relationship to the mean average summer rainfall from 1900-2008

Legend

- urban_Harappan
- Kulli
- Sorath_Harappan
- mean_Q3_100

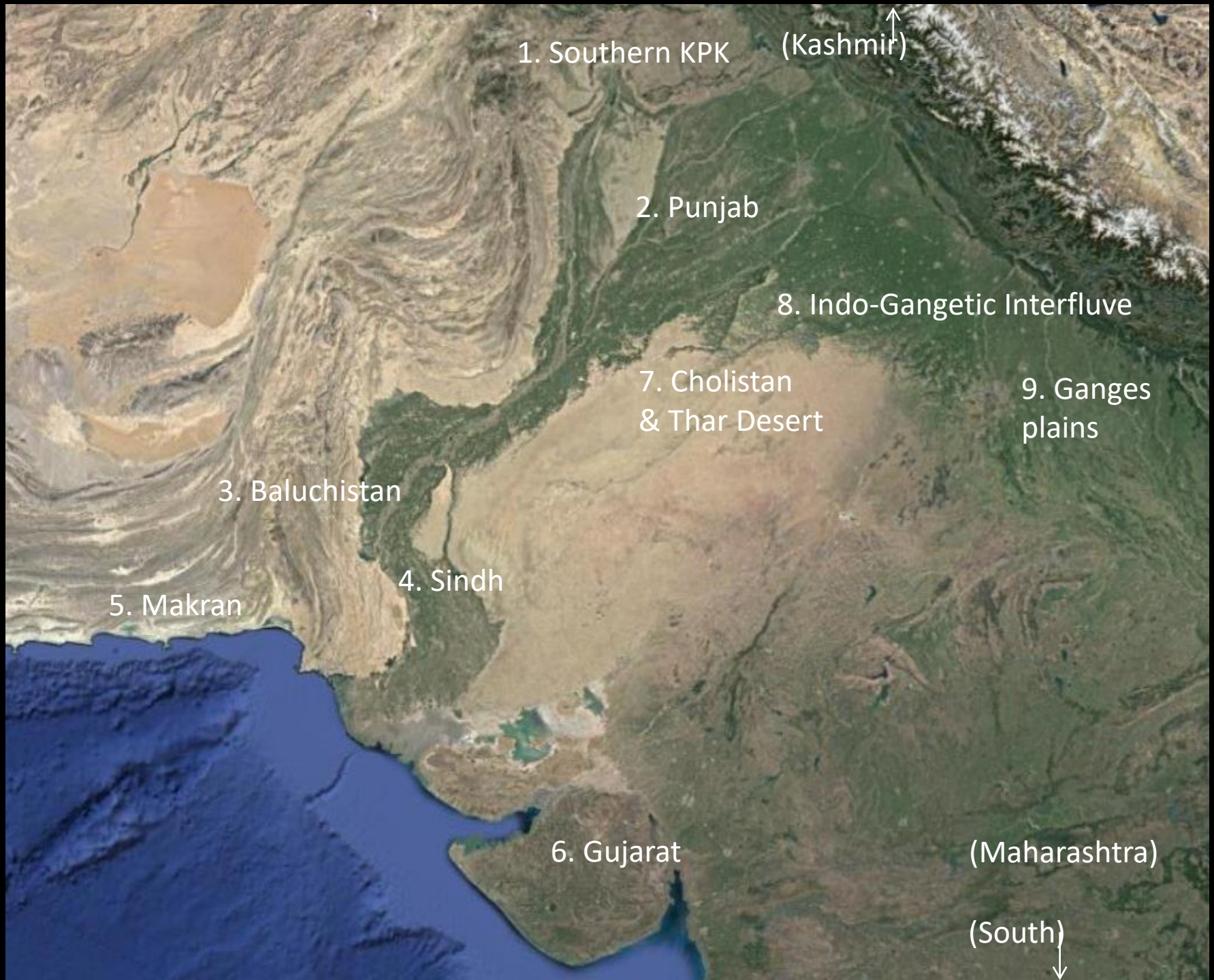
Rainfall isohyets were extracted from the Univ. of Delaware monthly global gridded high resolution station (land) data set of precipitation from 1900-2008 (v2.01) by D.I. Redhouse.

Data available from:
http://www.esrl.noaa.gov/psd/data/gridded/data.UDeI_AirT_Precip.html

NASA Blue Marble: Next Generation satellite imagery was produced by Reto Stöckli and obtained from NASA's Earth Observatory (NASA Goddard Space Flight Center)

See:
<http://earthobservatory.nasa.gov/Features/BlueMarble/>

Maps composed by C.A. Petrie



1. Southern KPK

(Kashmir)

2. Punjab

8. Indo-Gangetic Interfluve

7. Cholistan
& Thar Desert

9. Ganges
plains

3. Baluchistan

4. Sindh

5. Makran

6. Gujarat

(Maharashtra)

(South)

Southern Khyber Pakhtunkhwa



Punjab floodpains



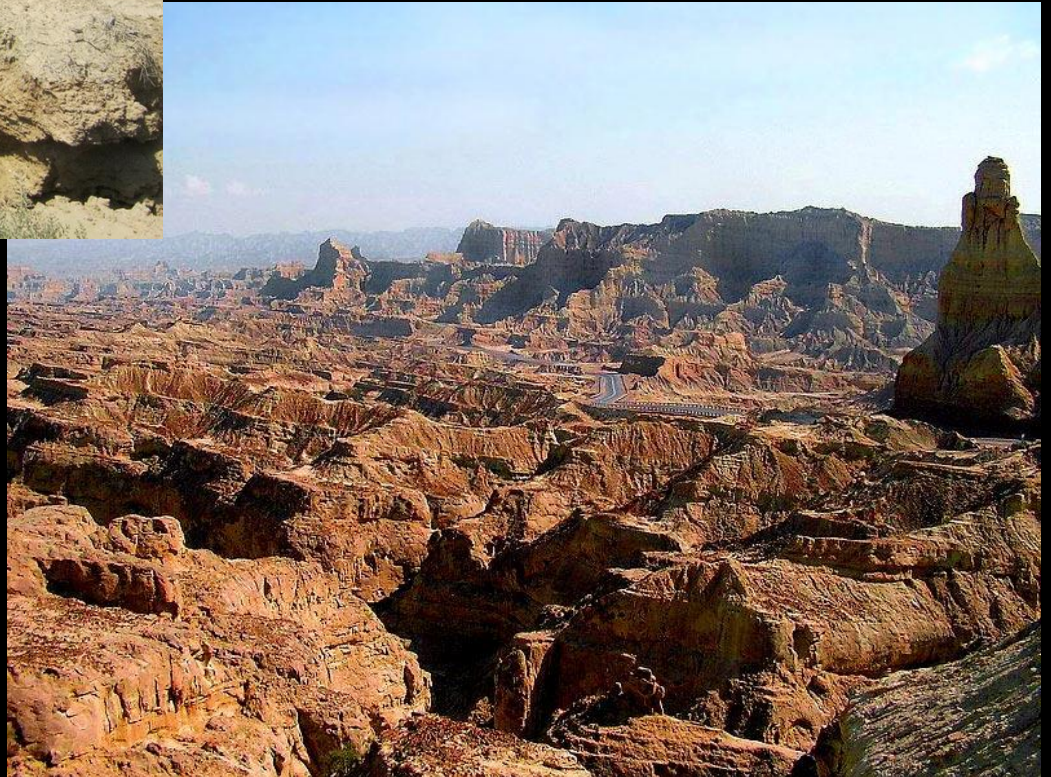
Baluchistan



Sindh and the Indus River



Makran and the Arabian Sea

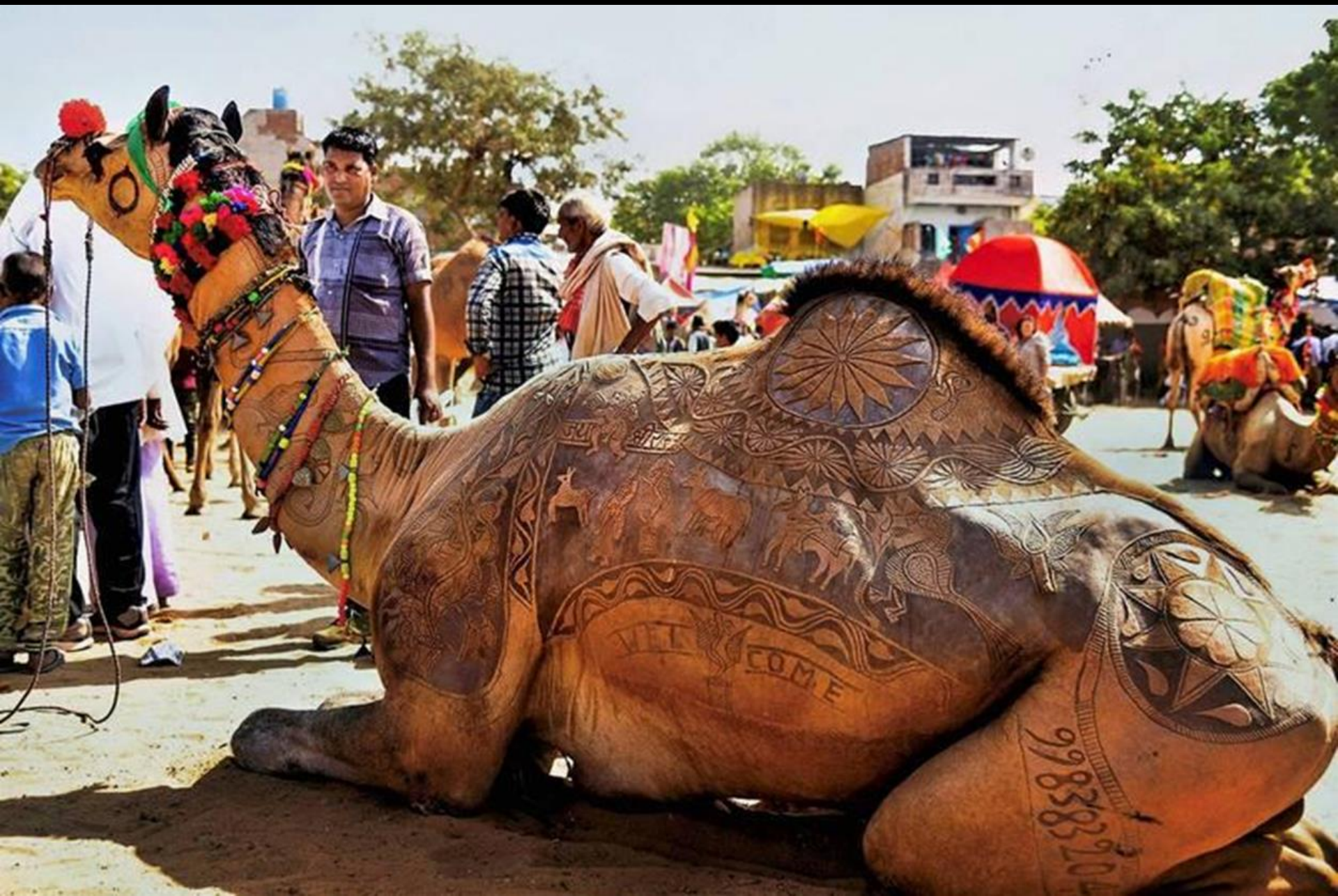


Gujarat and the Rann of Kutch



Cholistan and the deserts



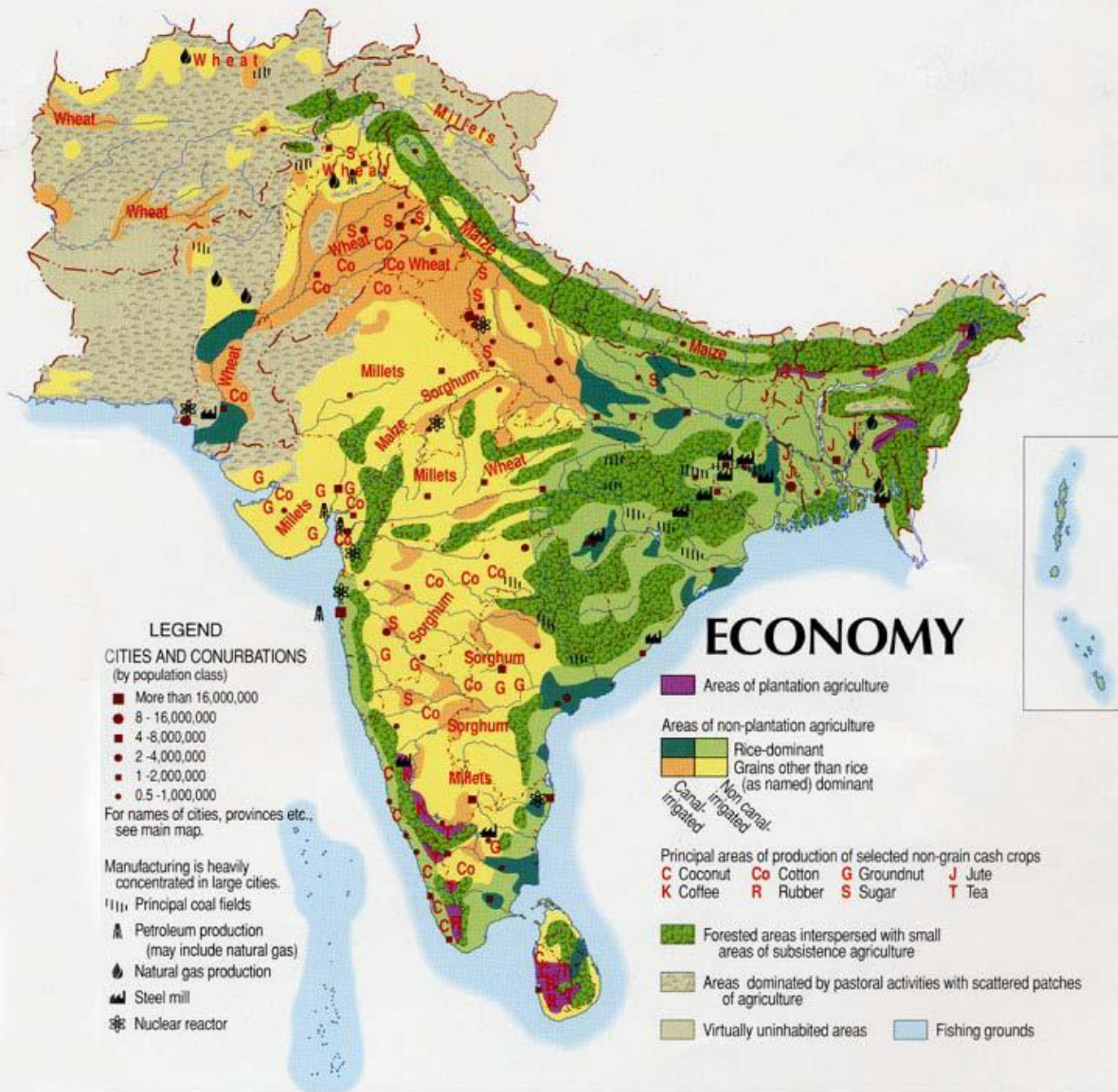


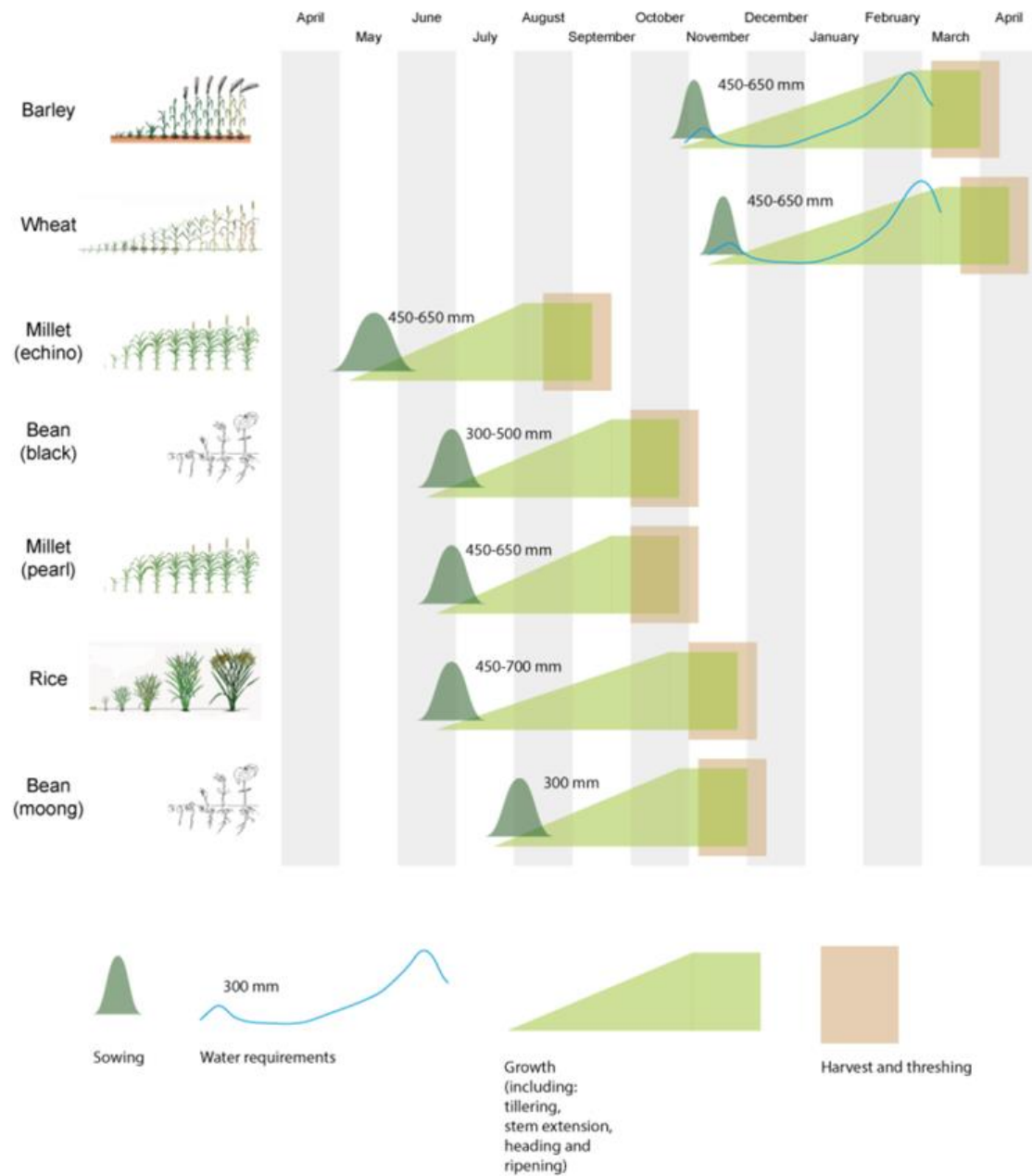
Indus-Ganges Interfluve



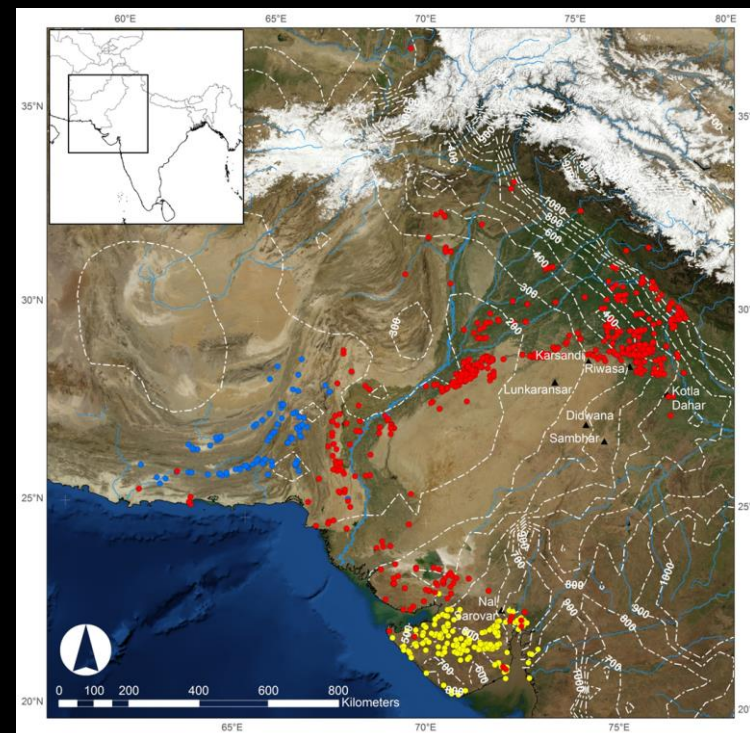
Ganges Plains

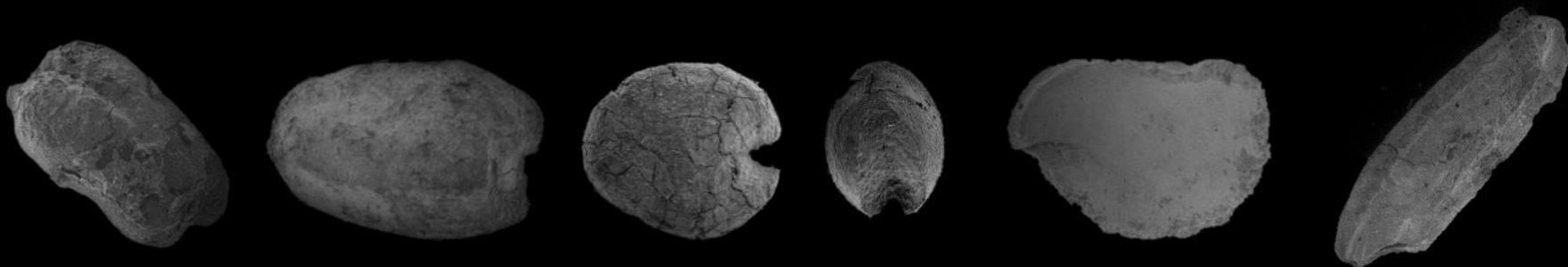
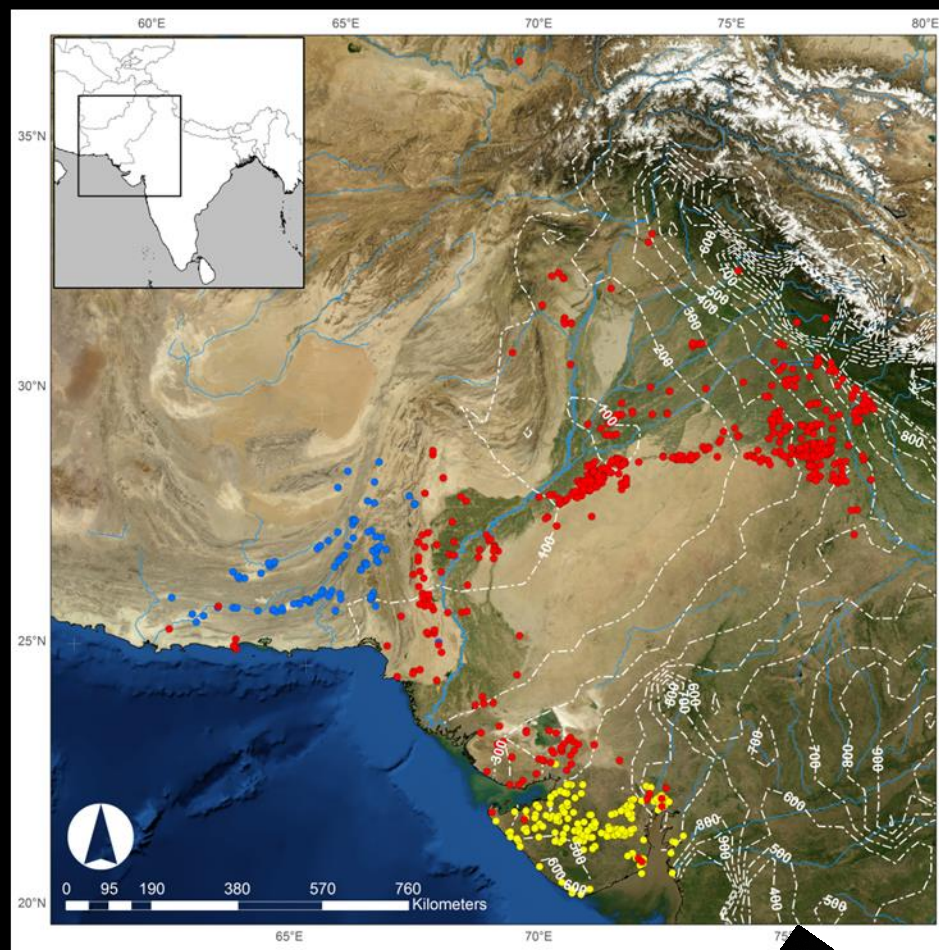
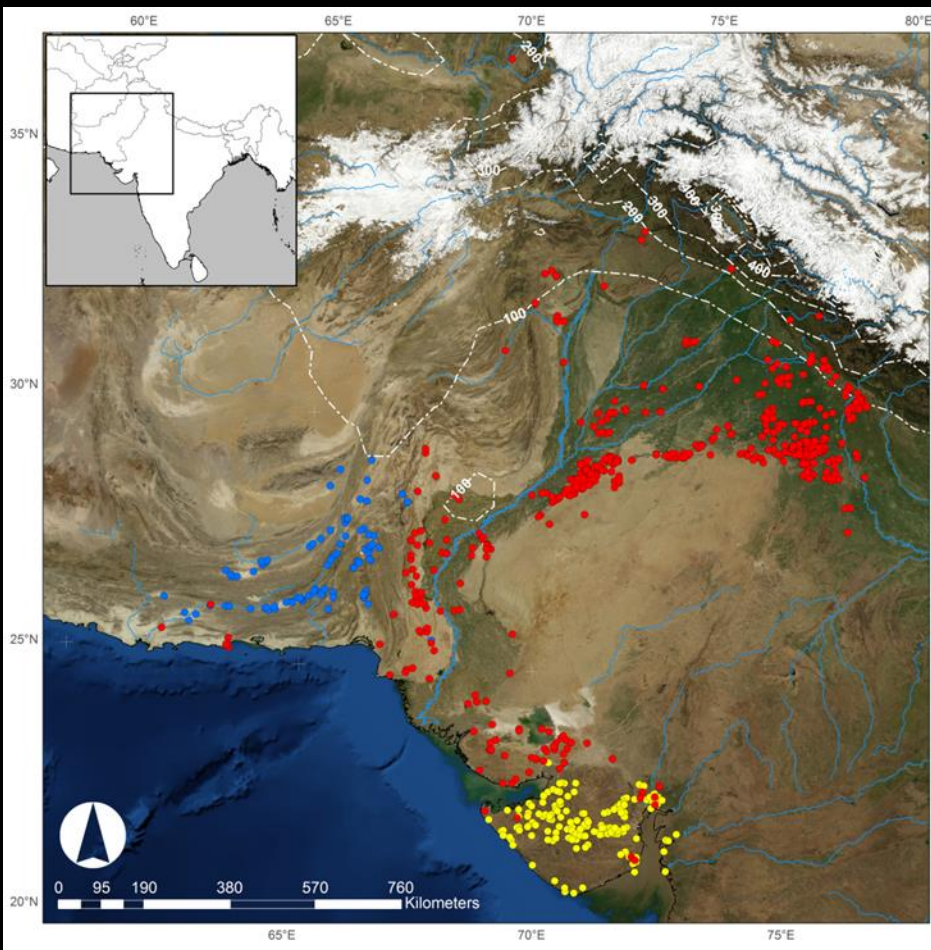






Growing season information taken from
FAO Irrigation and Drainage Paper 24
(1977): 42-3, Table 22.B

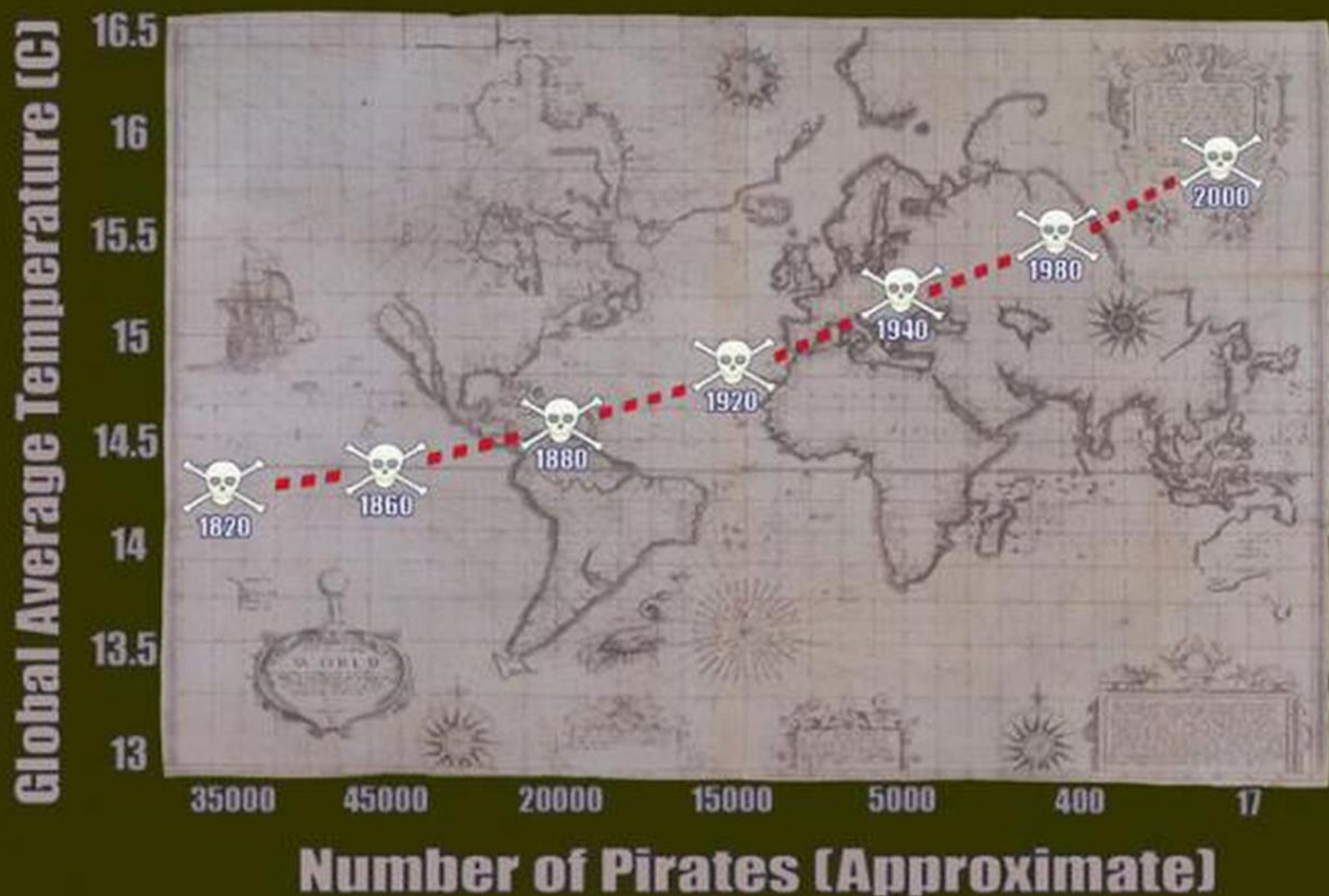


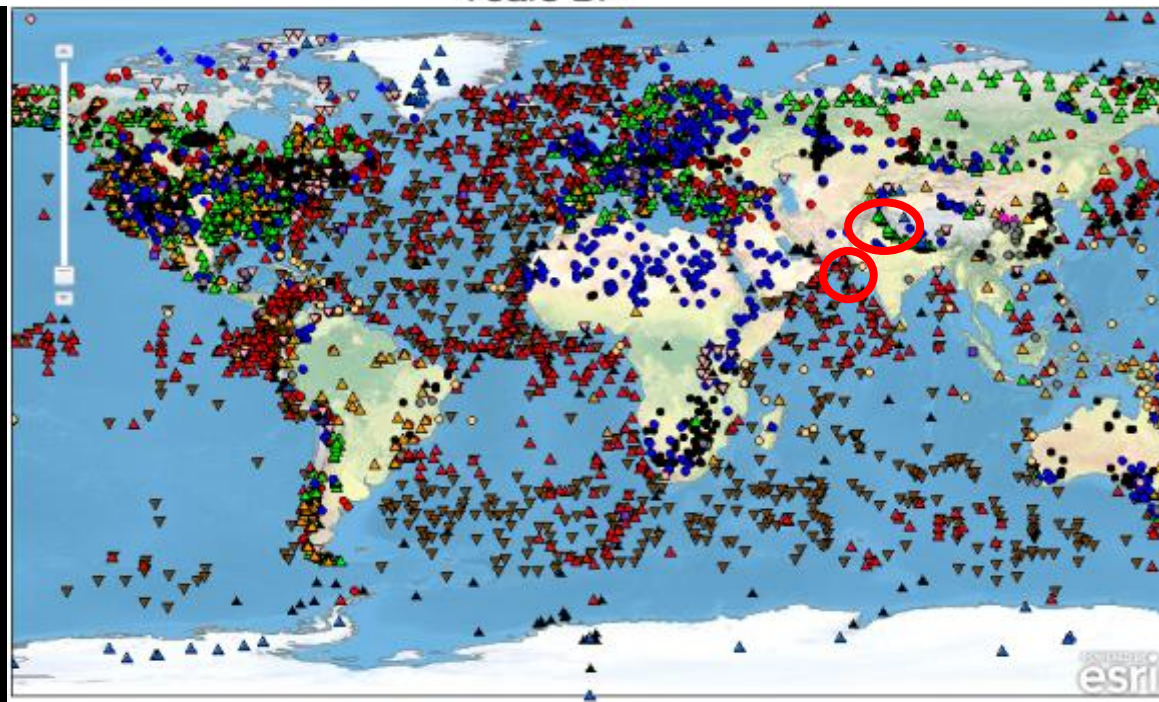
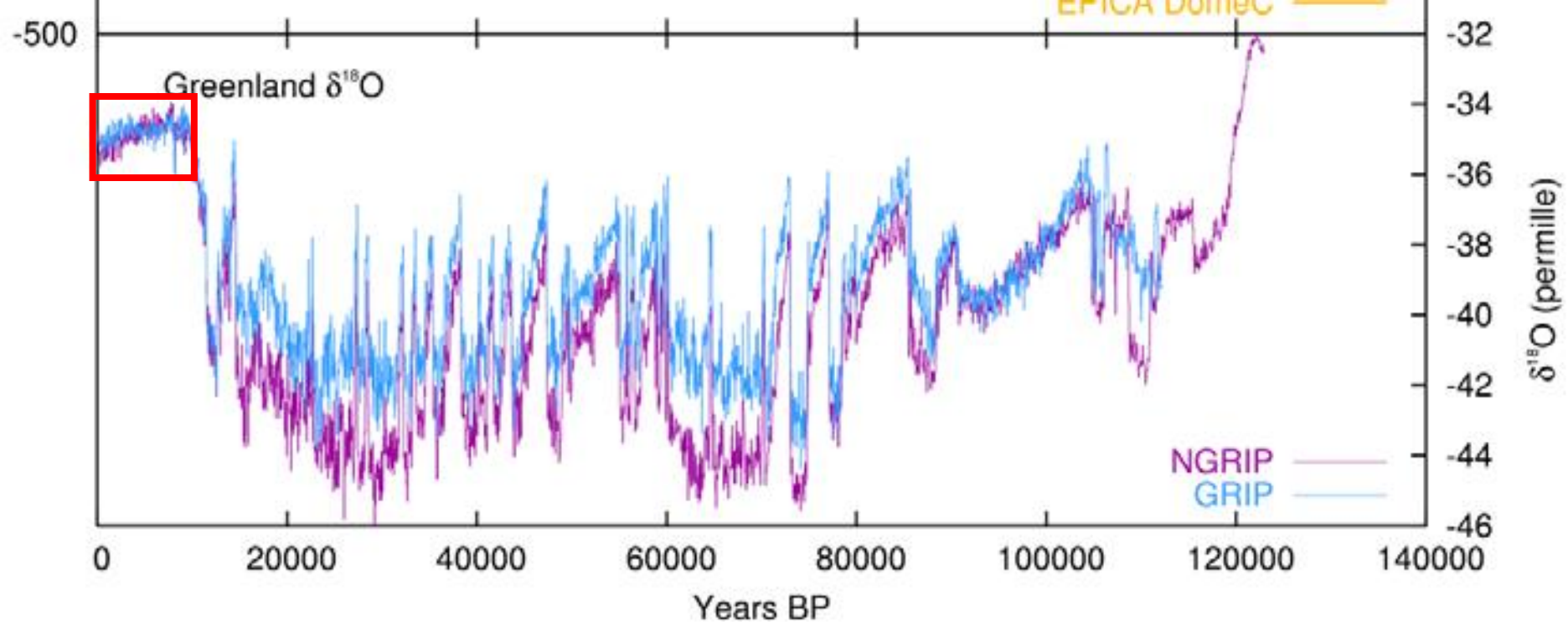


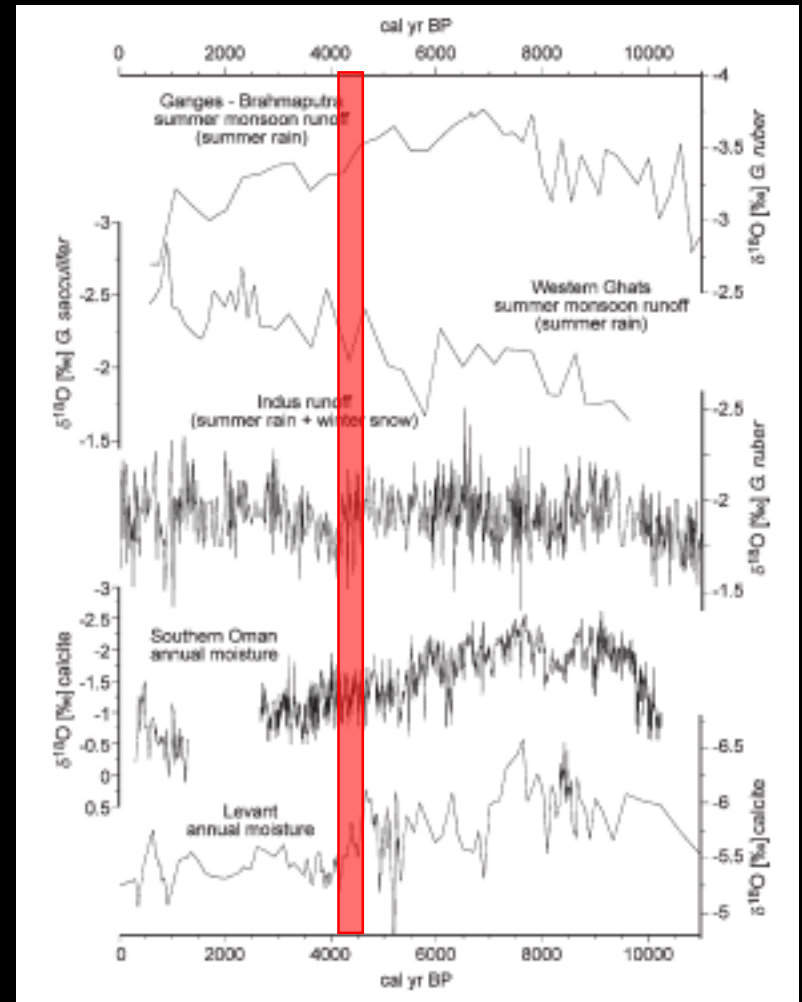
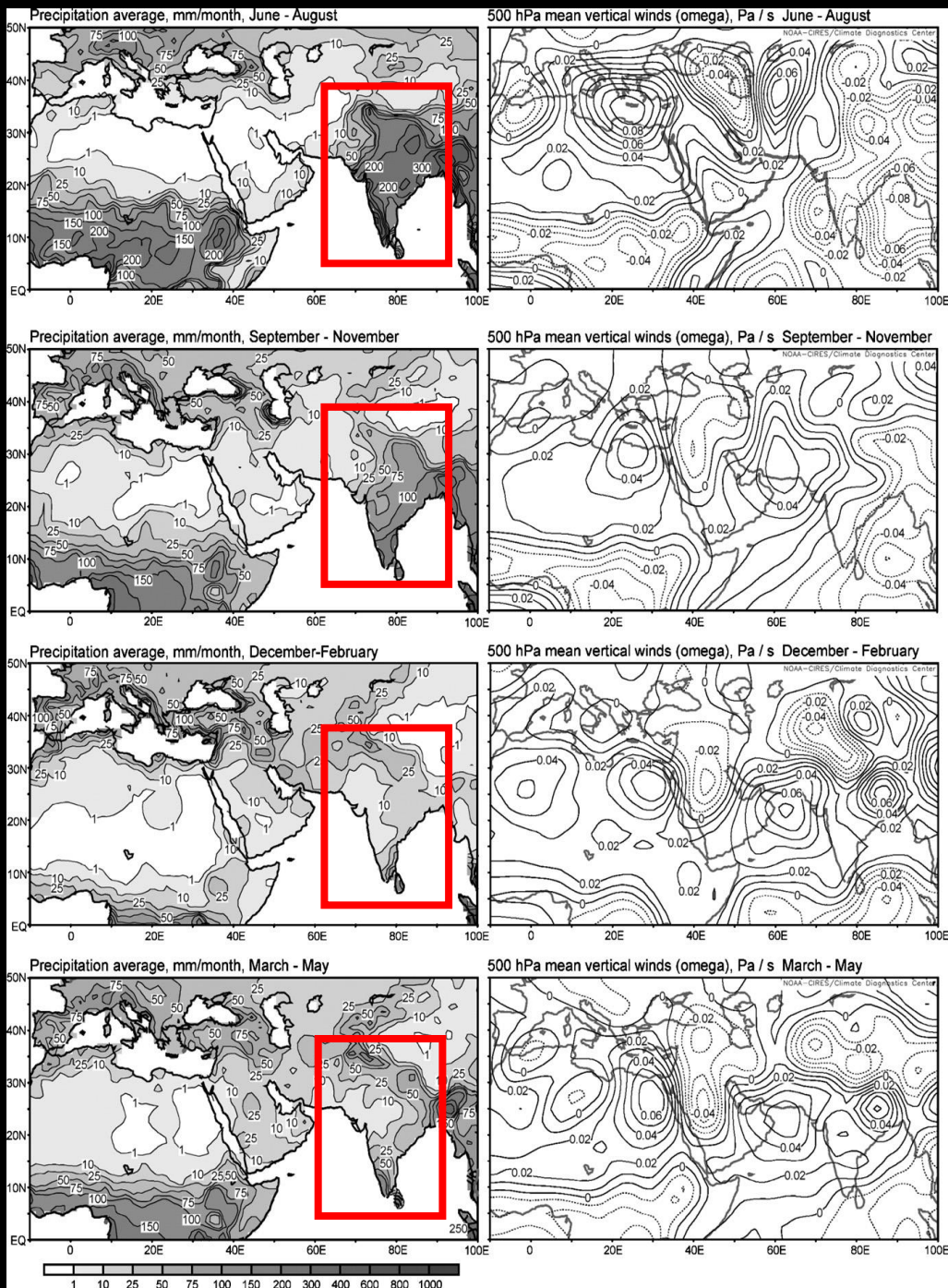




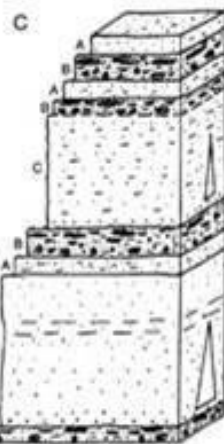
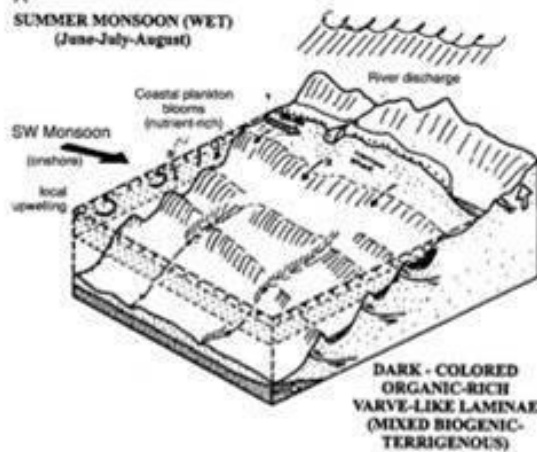
Global Temperature Vs. Number of Pirates



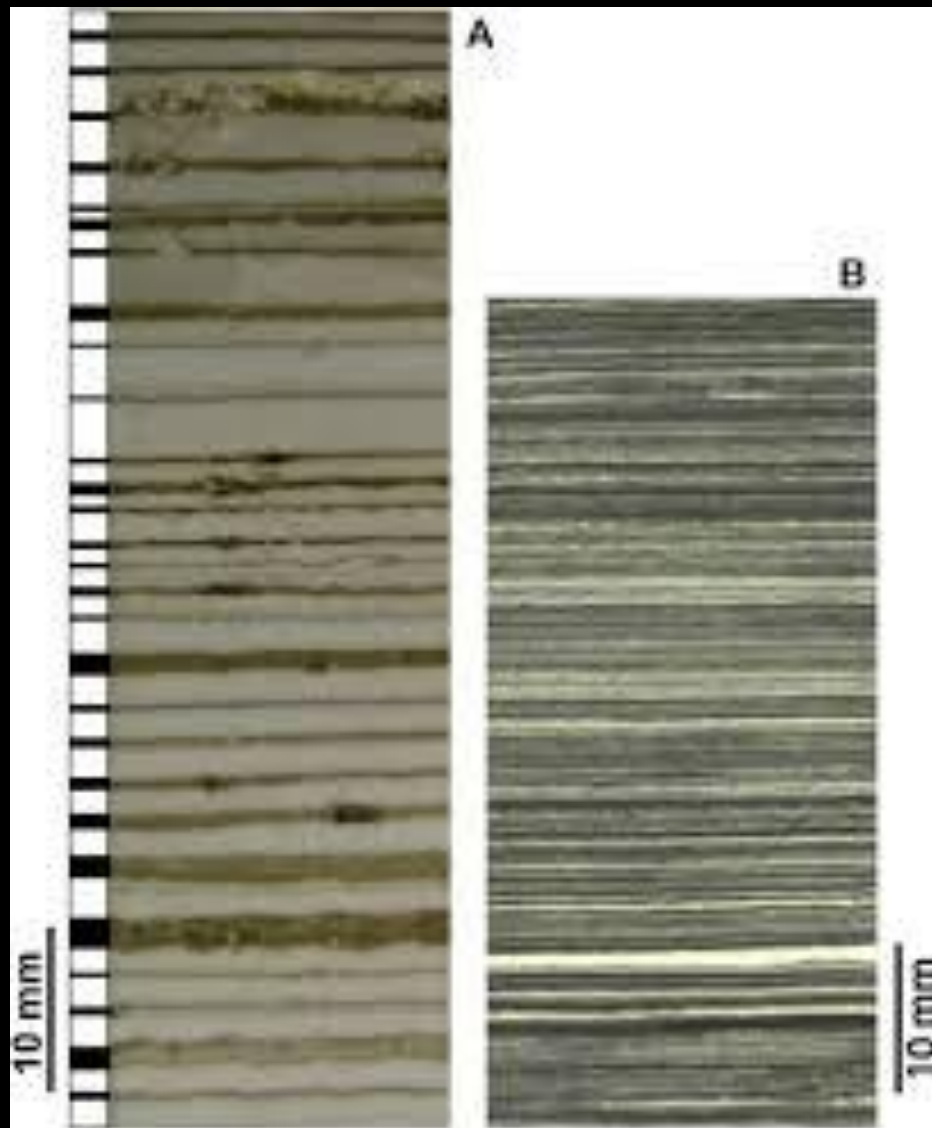
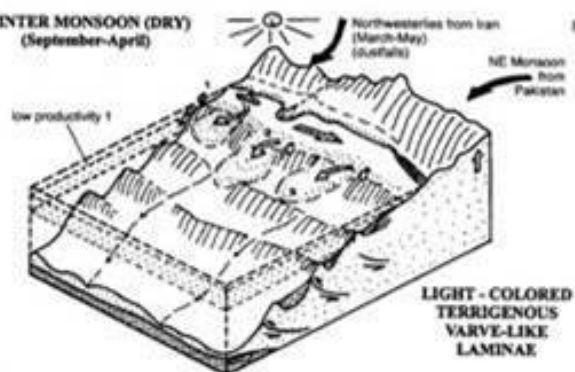


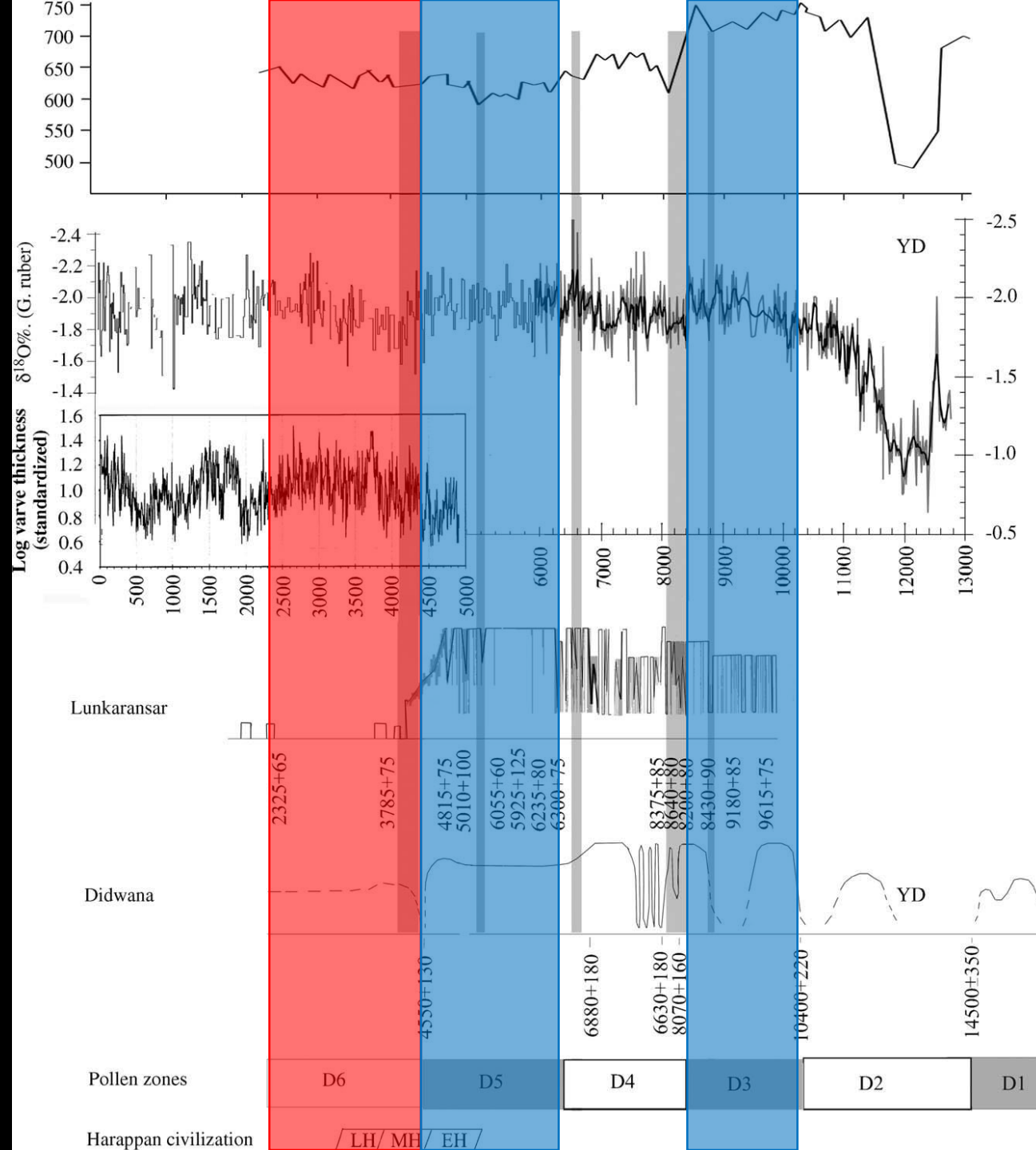


A
SUMMER MONSOON (WET)
 (June-July-August)



B
WINTER MONSOON (DRY)
 (September-April)





approx. calibrated age	Paleoclimatic phases (based on North African sequence)	Didwana DIA1	Didwana DIA2	Lunkaransar pollen	Lunkaransar sediments	site counts	settled area (ha)	average size (ha)
1500 BC								
2000 BC								
2500 BC								
3000 BC		D6		LK-4	Zone 4	Early Harappan		
4000 BC	drying	D6	Dw2	LK-3	Zone 3	KGM/Hakra/Ravi		
5000 BC	Mid-Holocene Wet					Kachi (Burj) Baskot Markot		
6000 BC	Mid Holocene (Dry)	D4	Dw1b	LK-2b	Zone 2	Mergharh IA		
7000 BC	Early							
8000 BC	Holocene			LK-2a	Zone 1			
9000 BC	Wet	D3	Dw1a	LK-1				
11-10,000 BC	(Younger Dryas)	D2						
12,500 BC								
19,500 BC	hyper-arid/ glacial maximum	D1						
		Singh et al. 1000	Singh et al. 1074	Singh et al. 1074	Enzel et al. 1000			

Archaeological Periods	Site counts	Settled area (ha)	Average size (ha)
Late Harappan	1281	4484	3.5
Mature Harappan	1022	7358	7.2
Early Harappan	477	2146	4.5
KGM/Hakra/Ravi	340	1625	4.8
Kachi(Burj)	33	86	2.6
Mergharh IA	20	52	2.6



Zeribar

Mirabad

Qunf

Lunkaransar

Karsandi

Didwana

Nal Sarovar

Riwasa

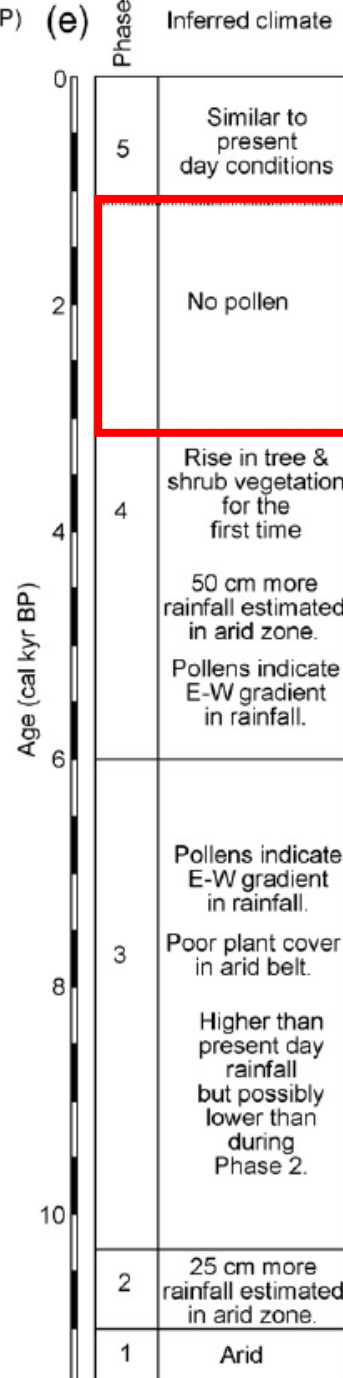
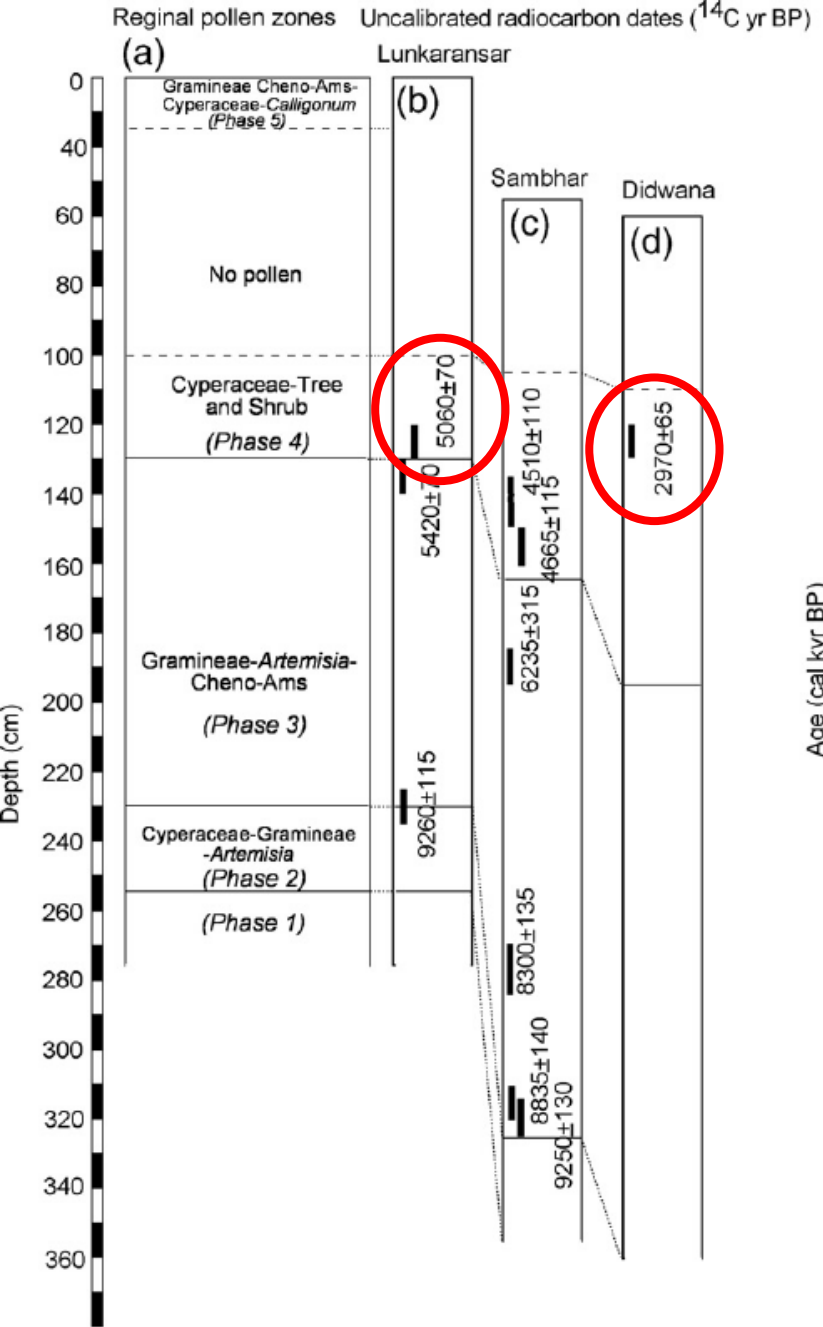
Kotla Dahar

Sanbhar

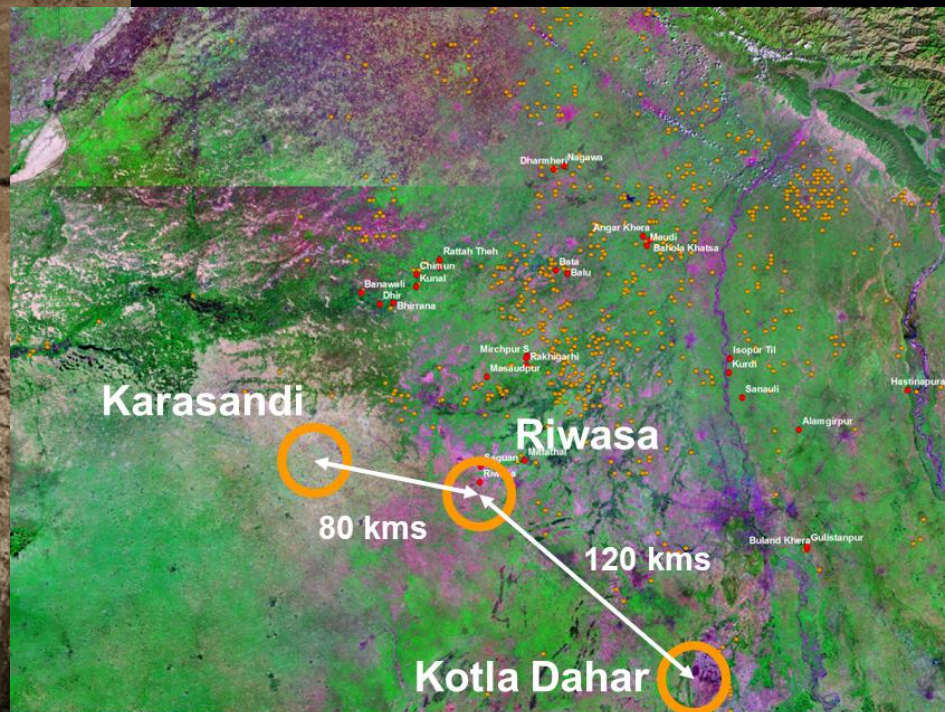
Mawmluh

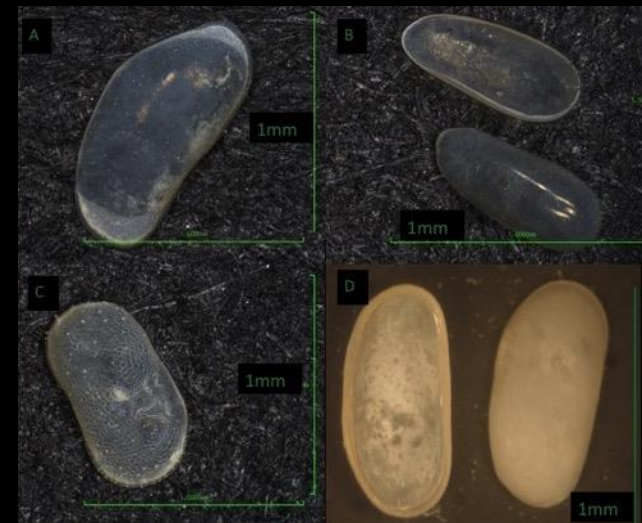
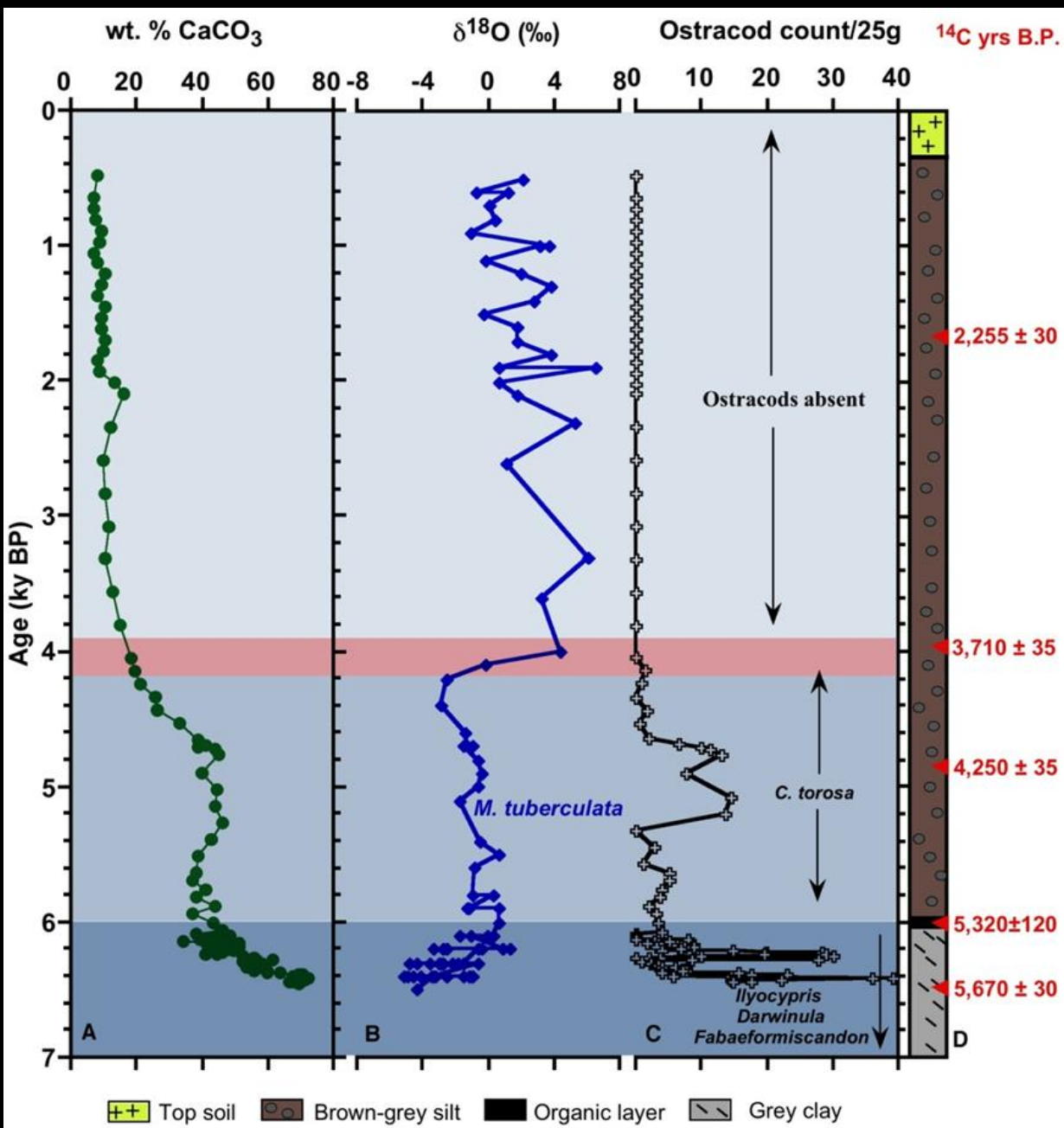
Lonar

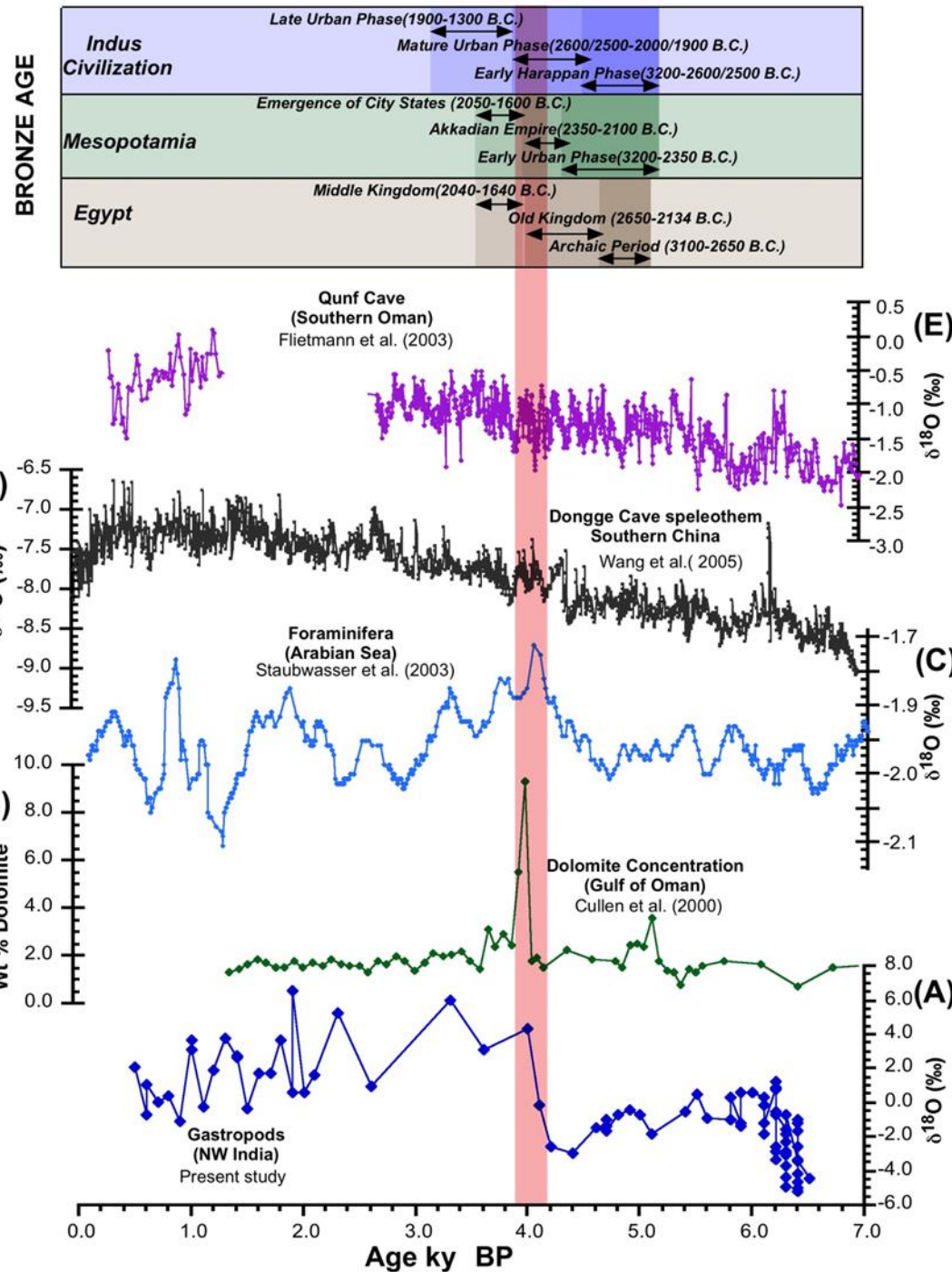


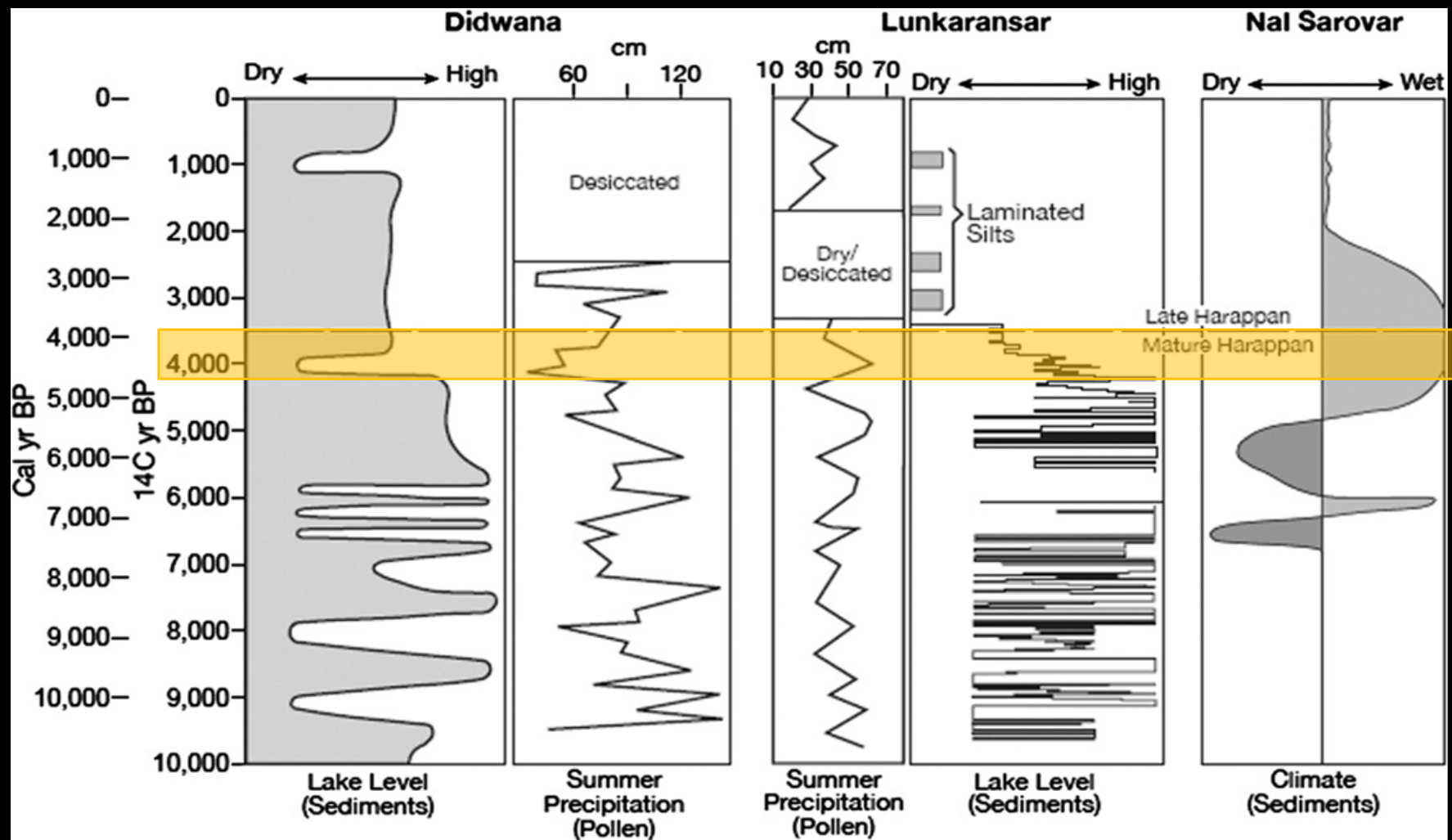








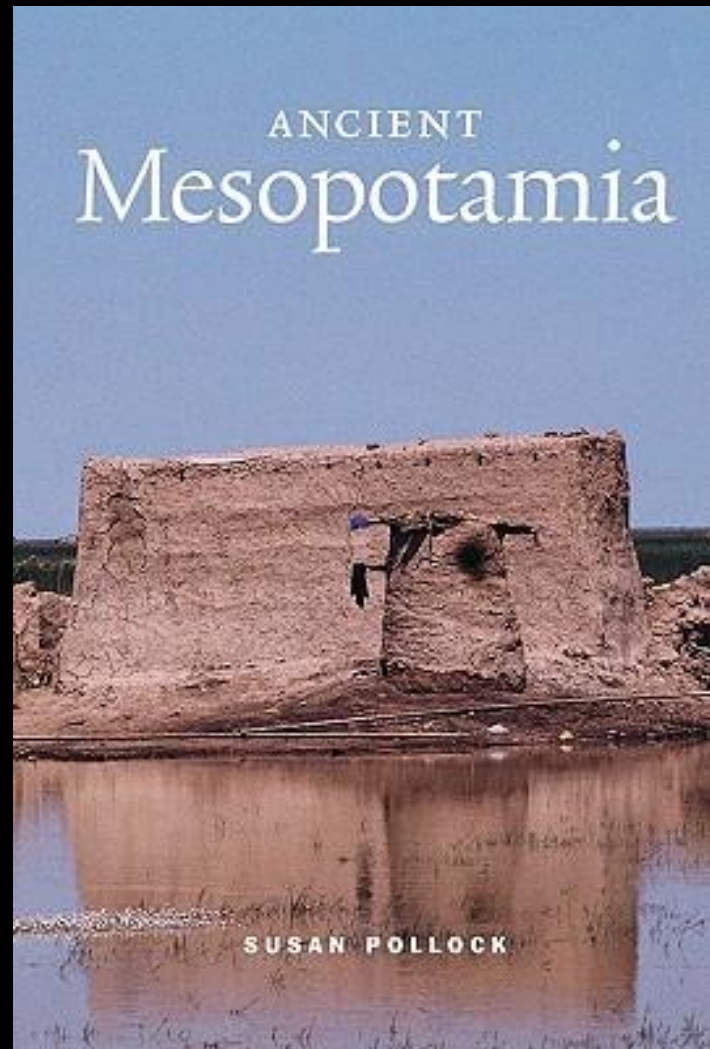






Indus/Punjab River system

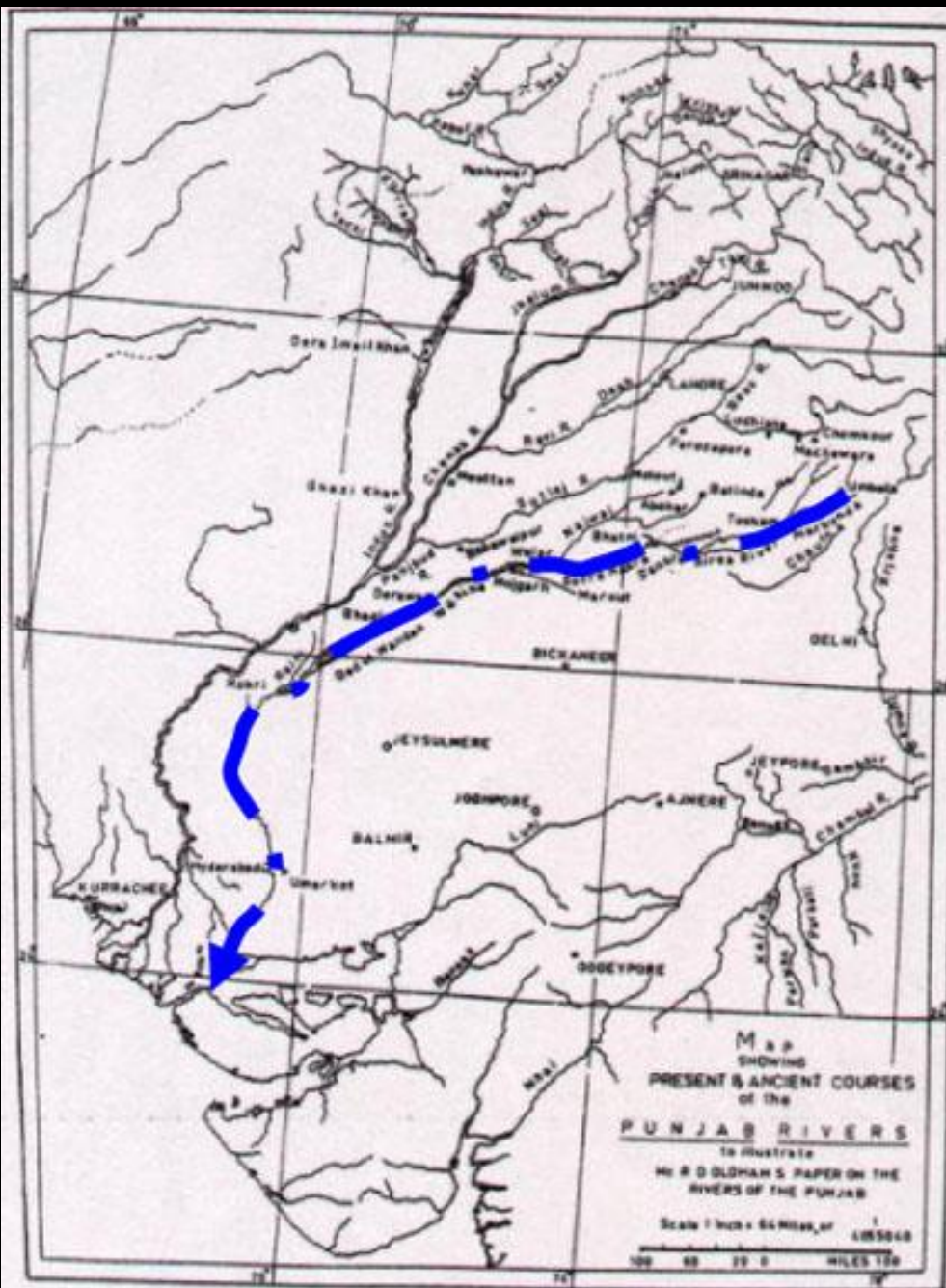
Yamuna & Ganges
River system





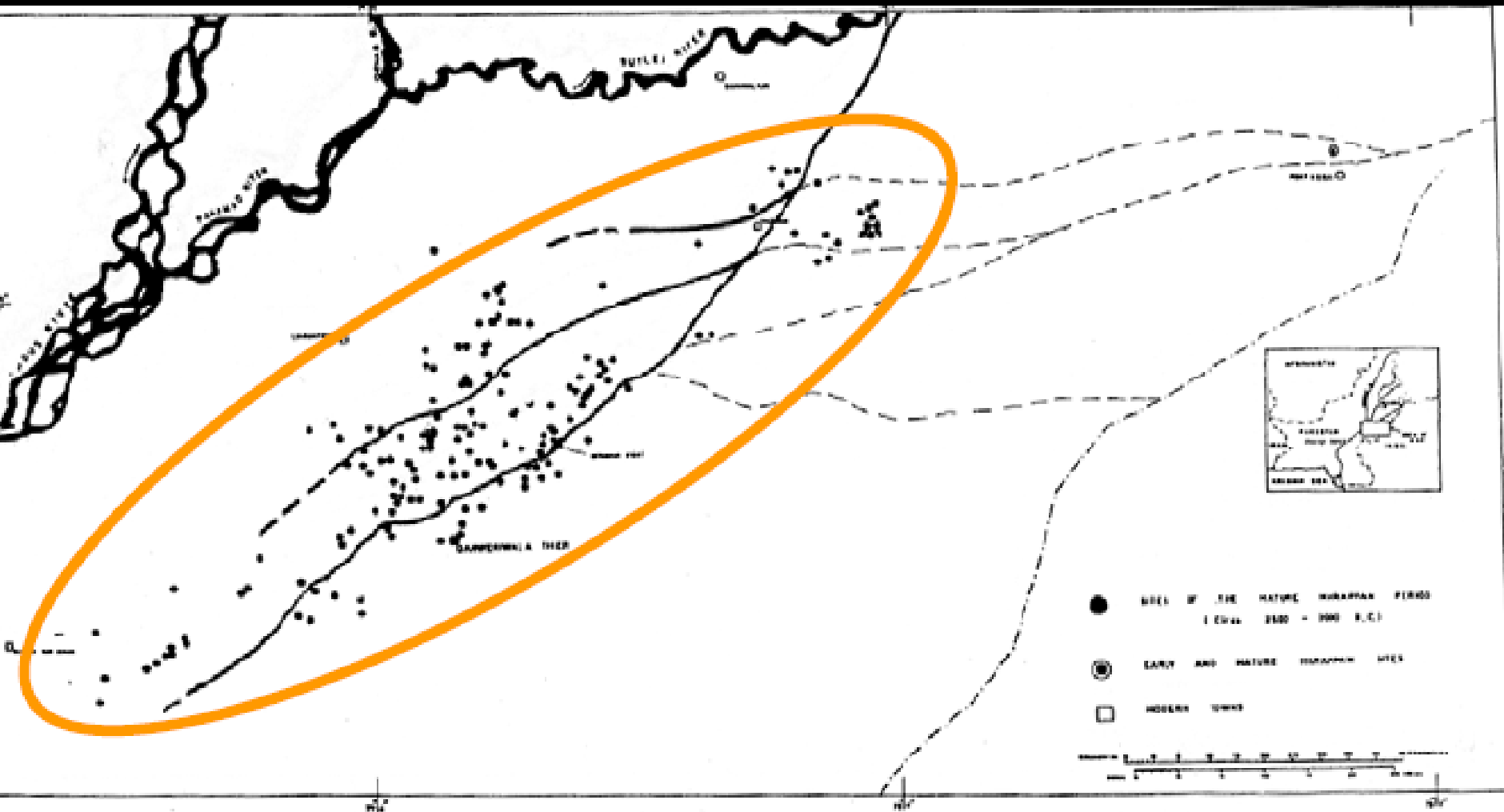
Hunt for mythical Saraswati river a test of history and science

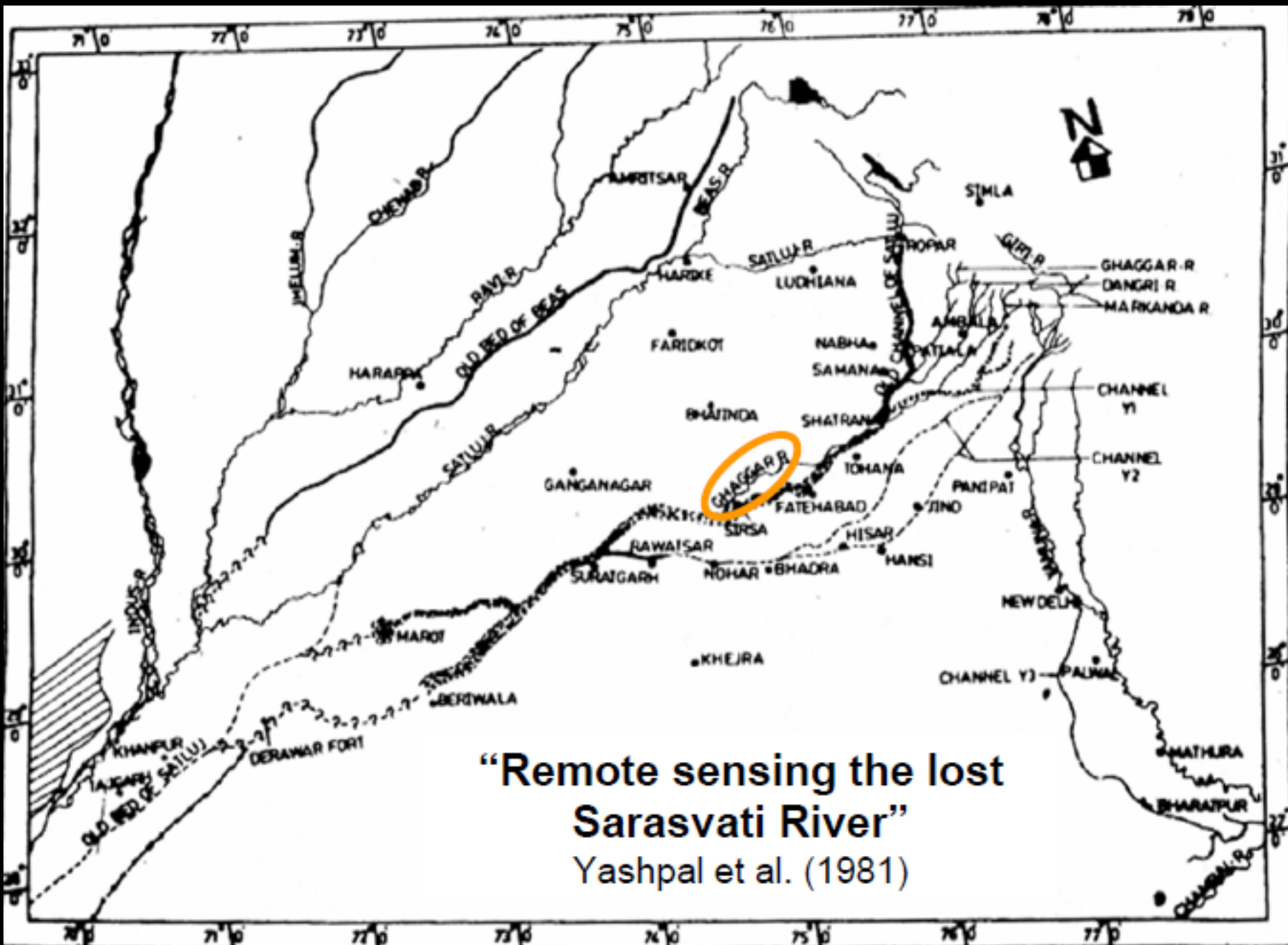
According to scientists, the Saraswati flowed from its origin at Adi Badri in Haryana to its meeting point with the Chautang river in the plains. This is said to be the course the river followed in the Vedic era.

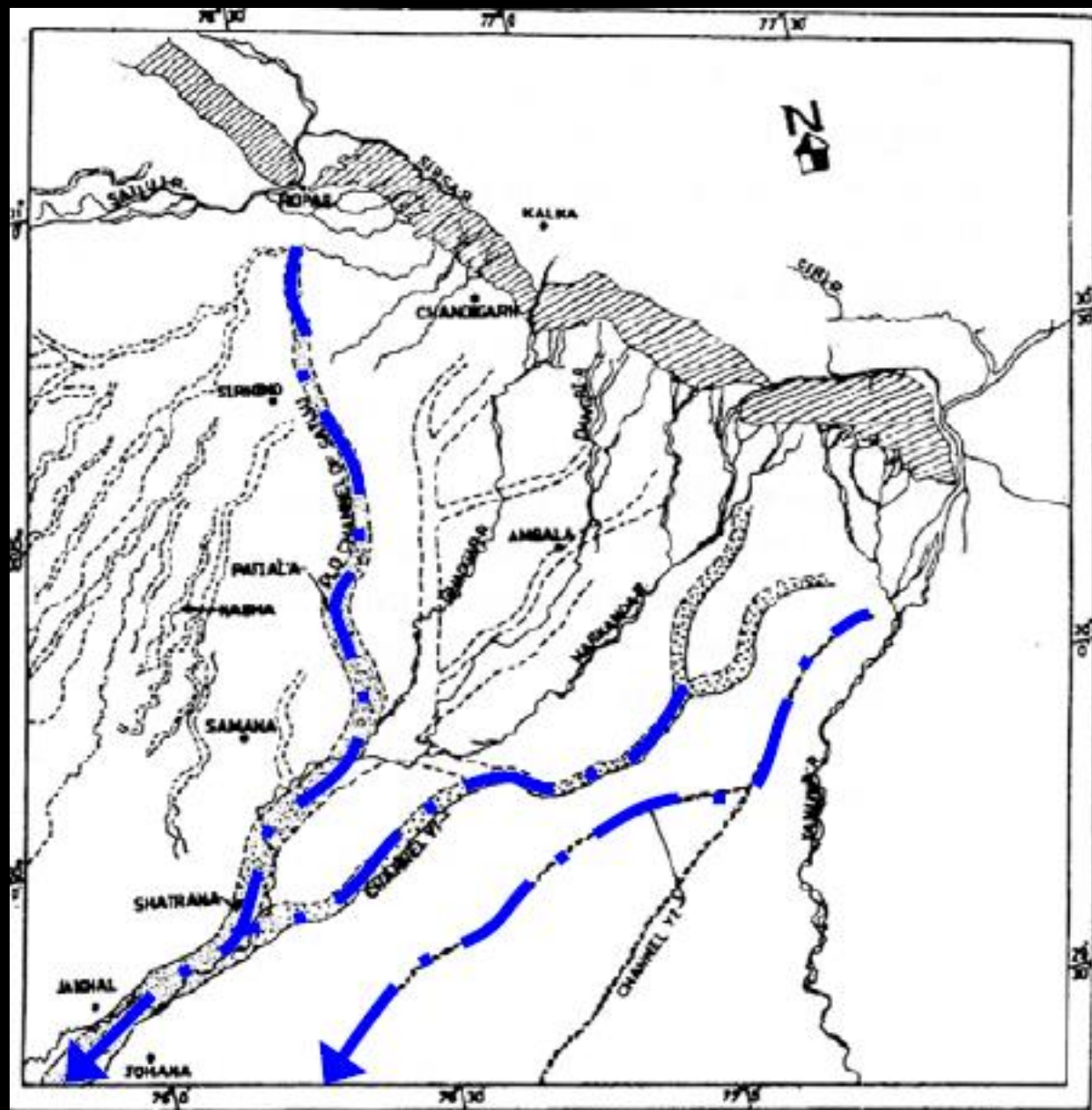


Early Exploration in Bikaner and Bahawalpur

Ancient river courses
 discovered by
 C.F. Oldham (1874, 1893) &
 R.D. Oldham (1887)

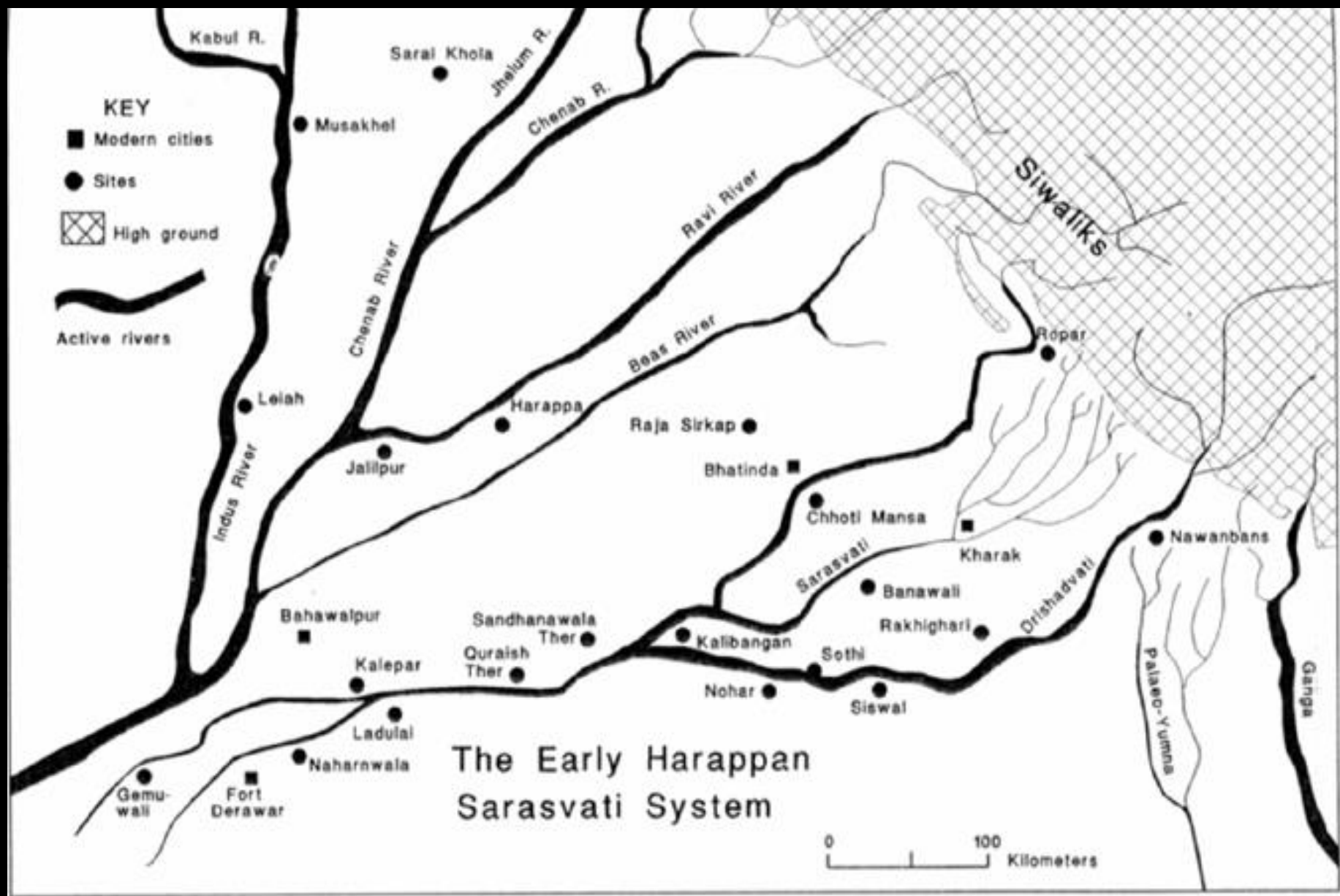


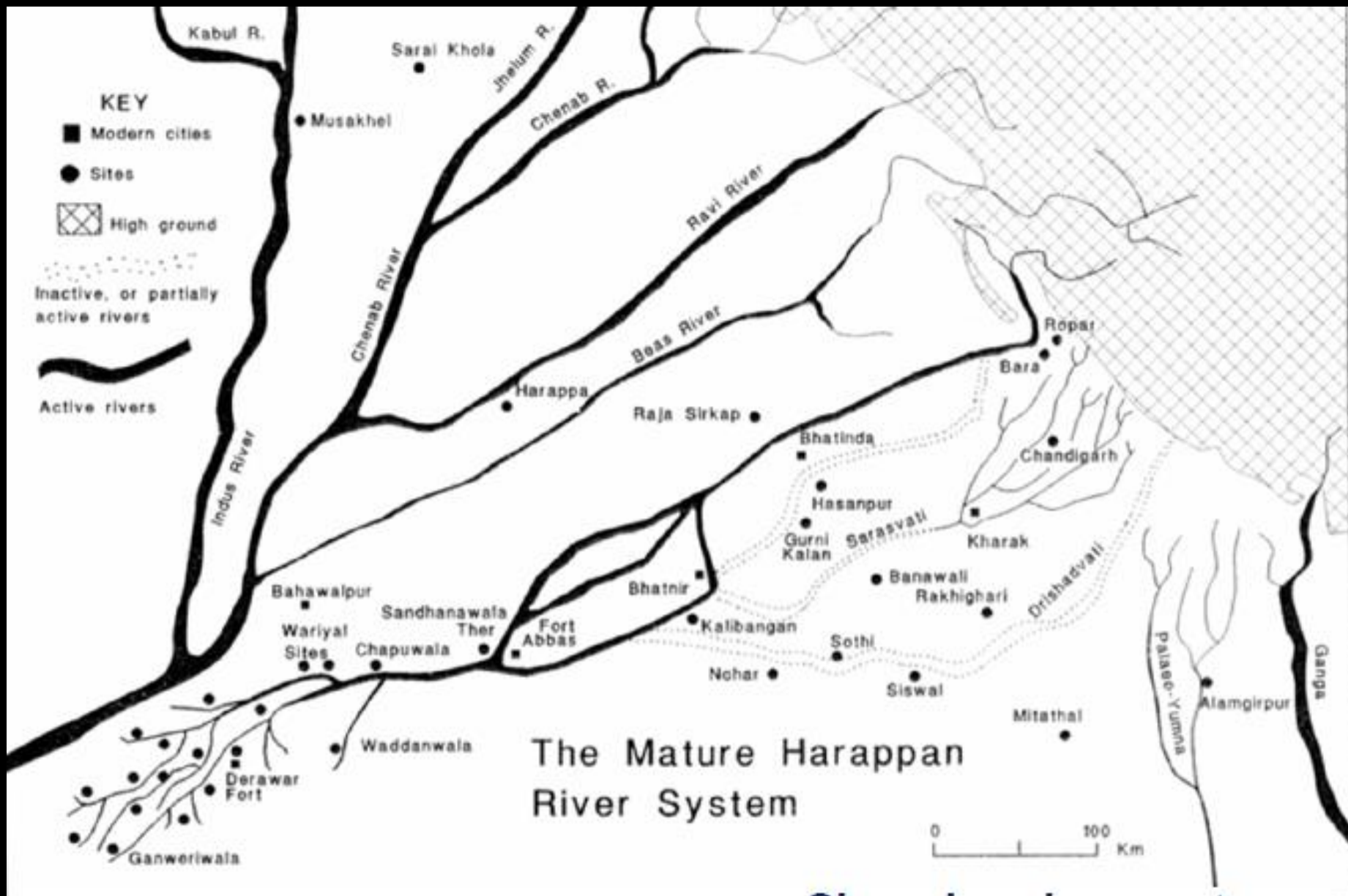


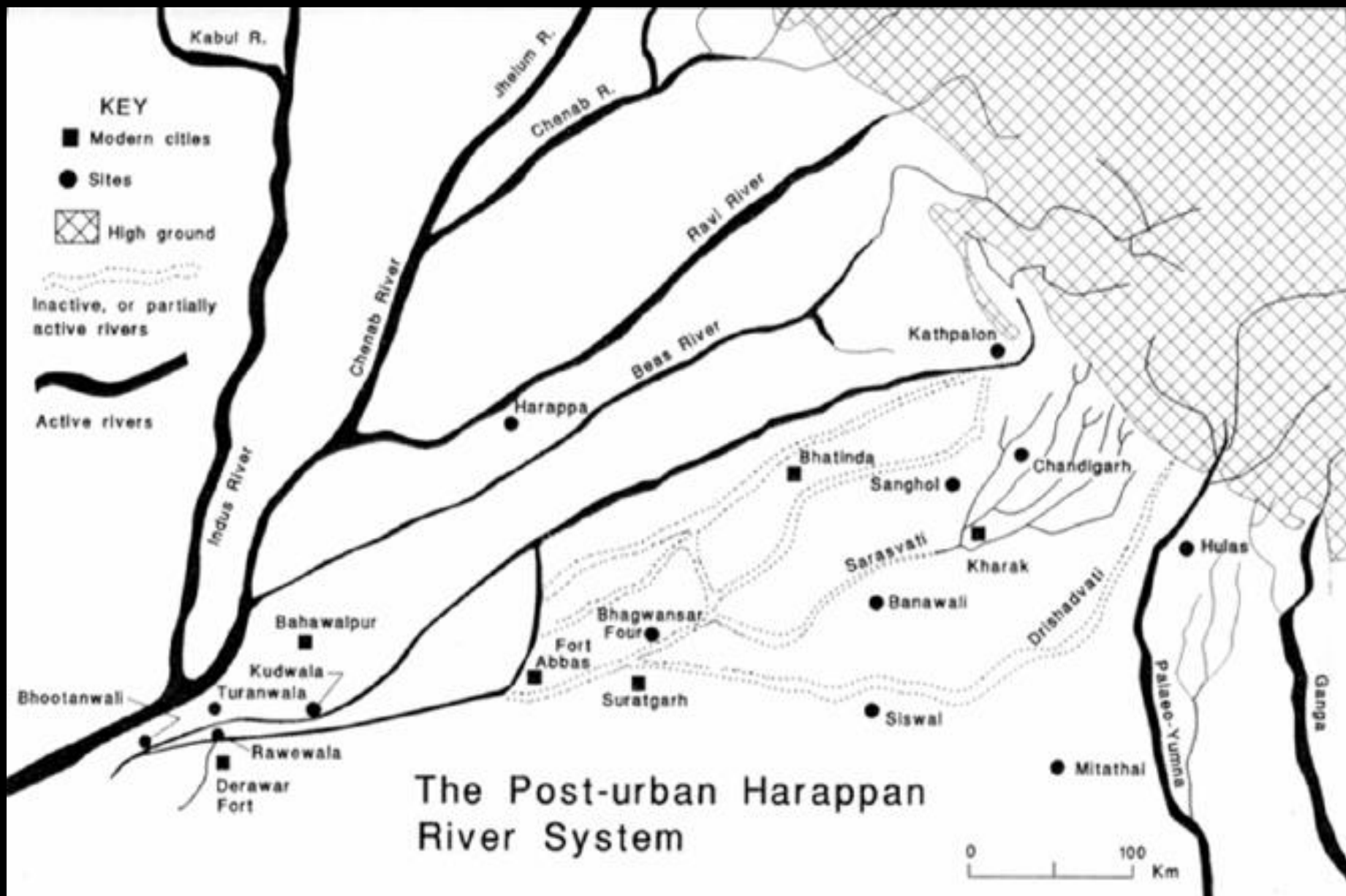


LEGEND
 --- PALAEDRAINAGE
 --- PRESENT DRAINAGE
 --- CANALS
 --- HILLS

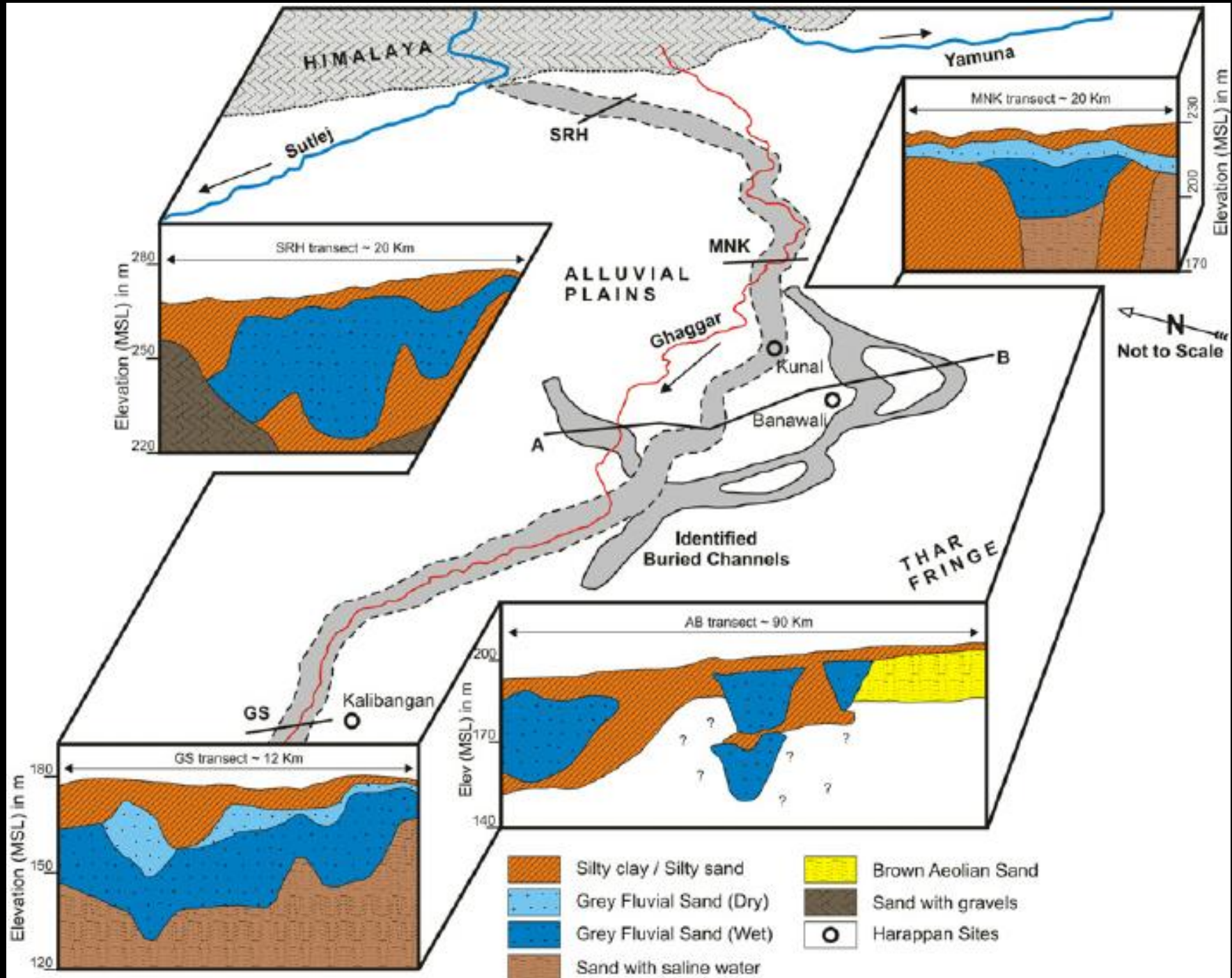
0 1 2 3 4 5 6 7 8 9 10
 SCALE
 MILES

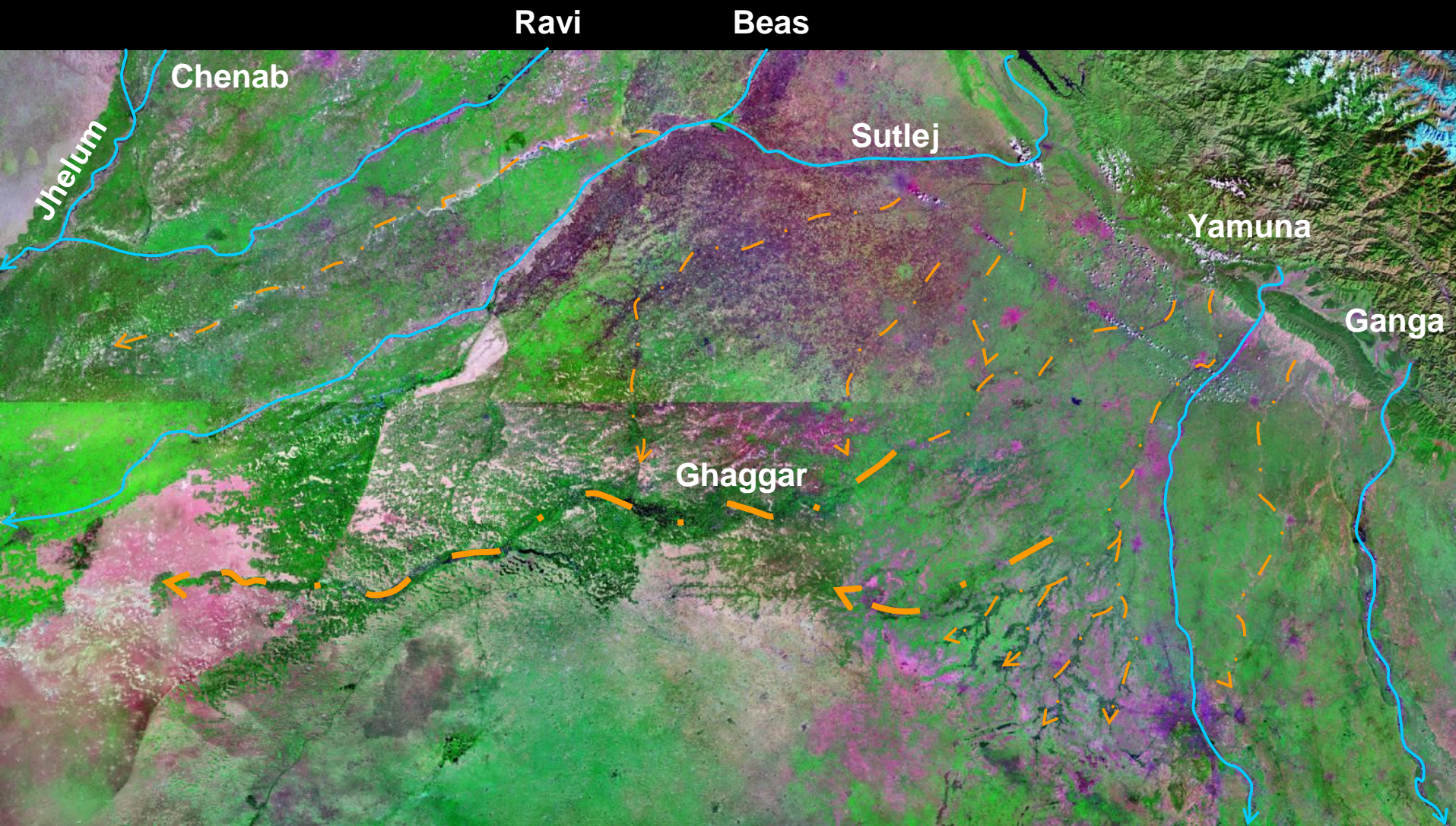






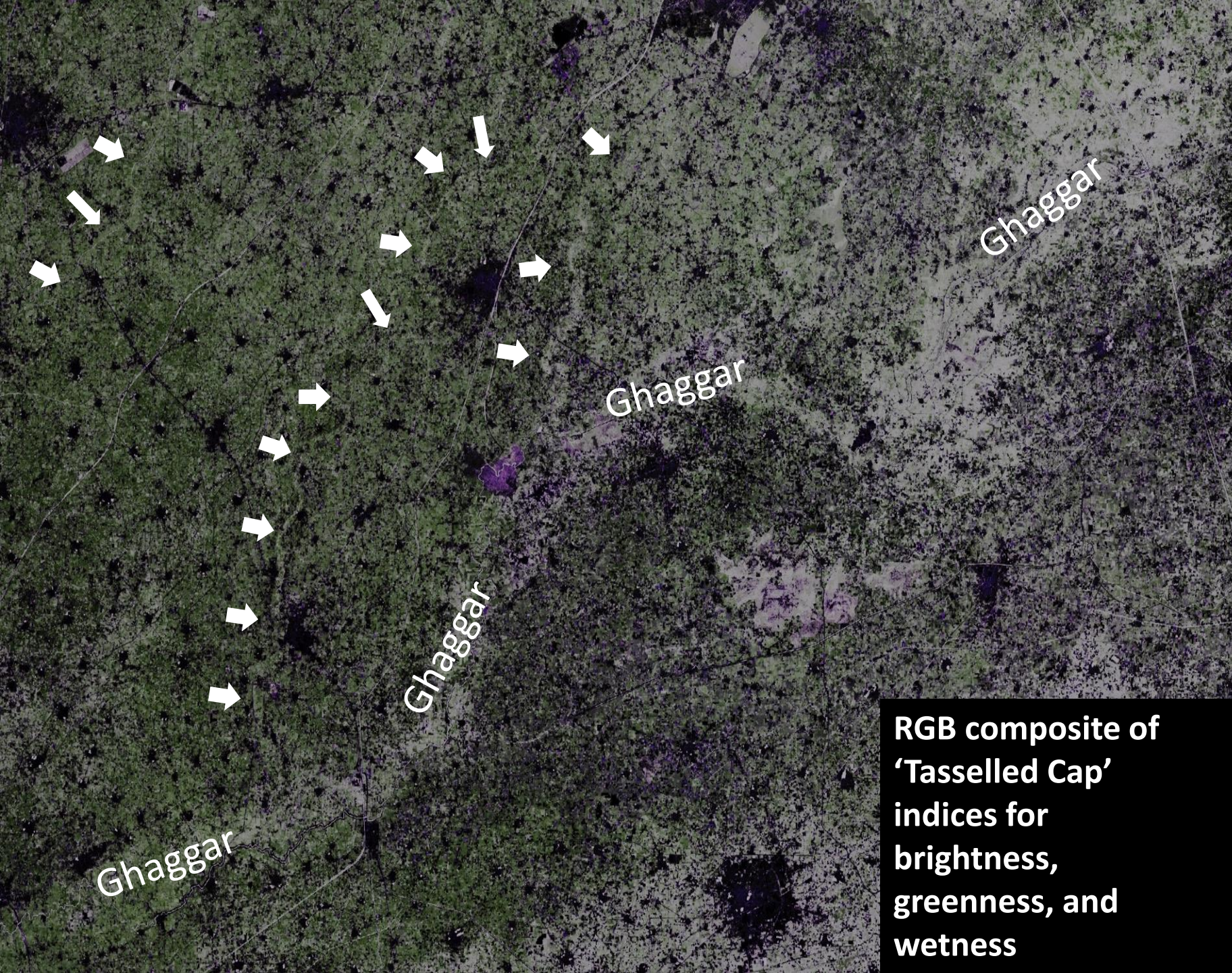




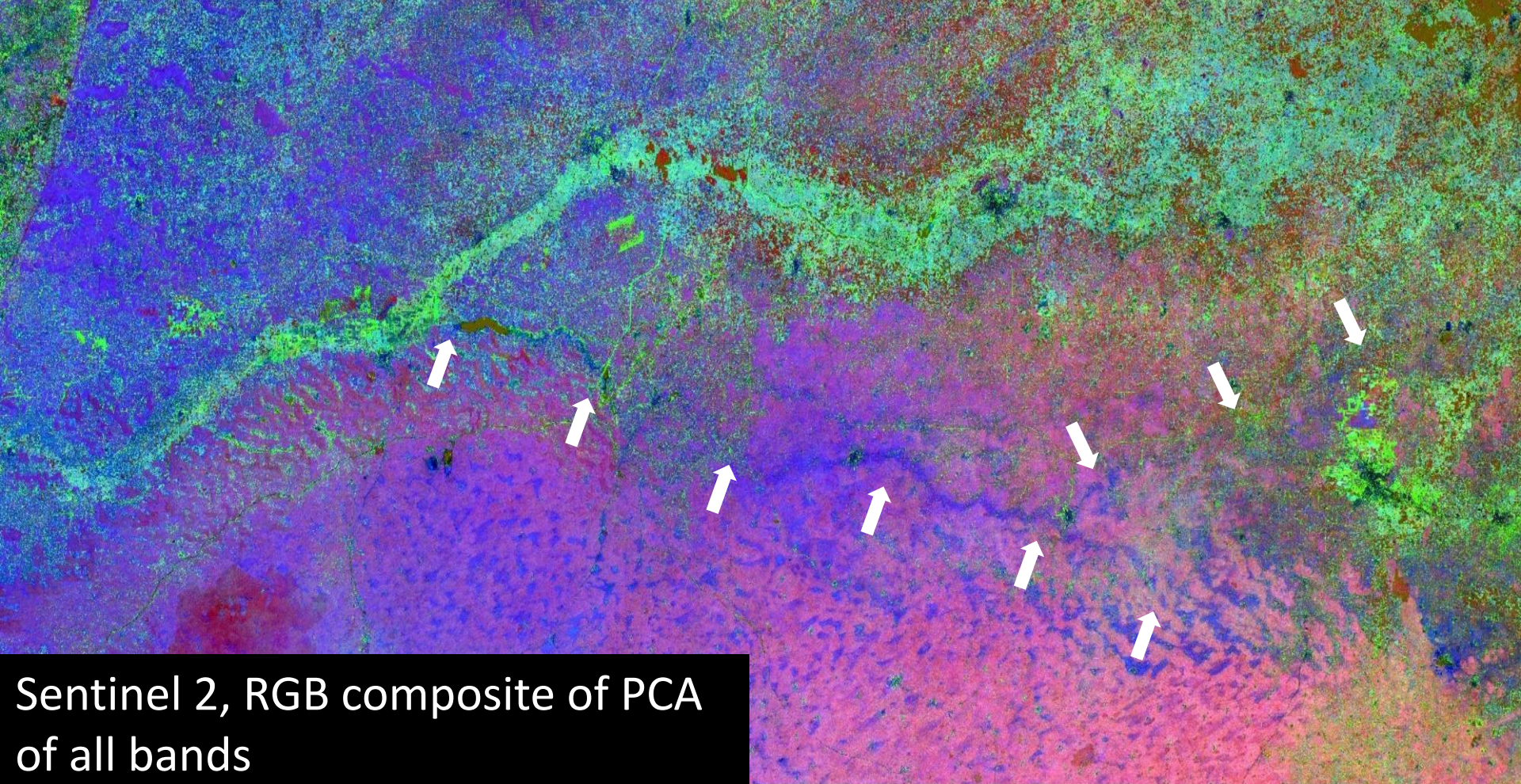


Yamuna/Indus Interfluvium – plains of Haryana and Punjab
Landsat 7 artificially coloured imagery (NASA ZULU)

Traces of river shift (avulsion)? – dating is the key

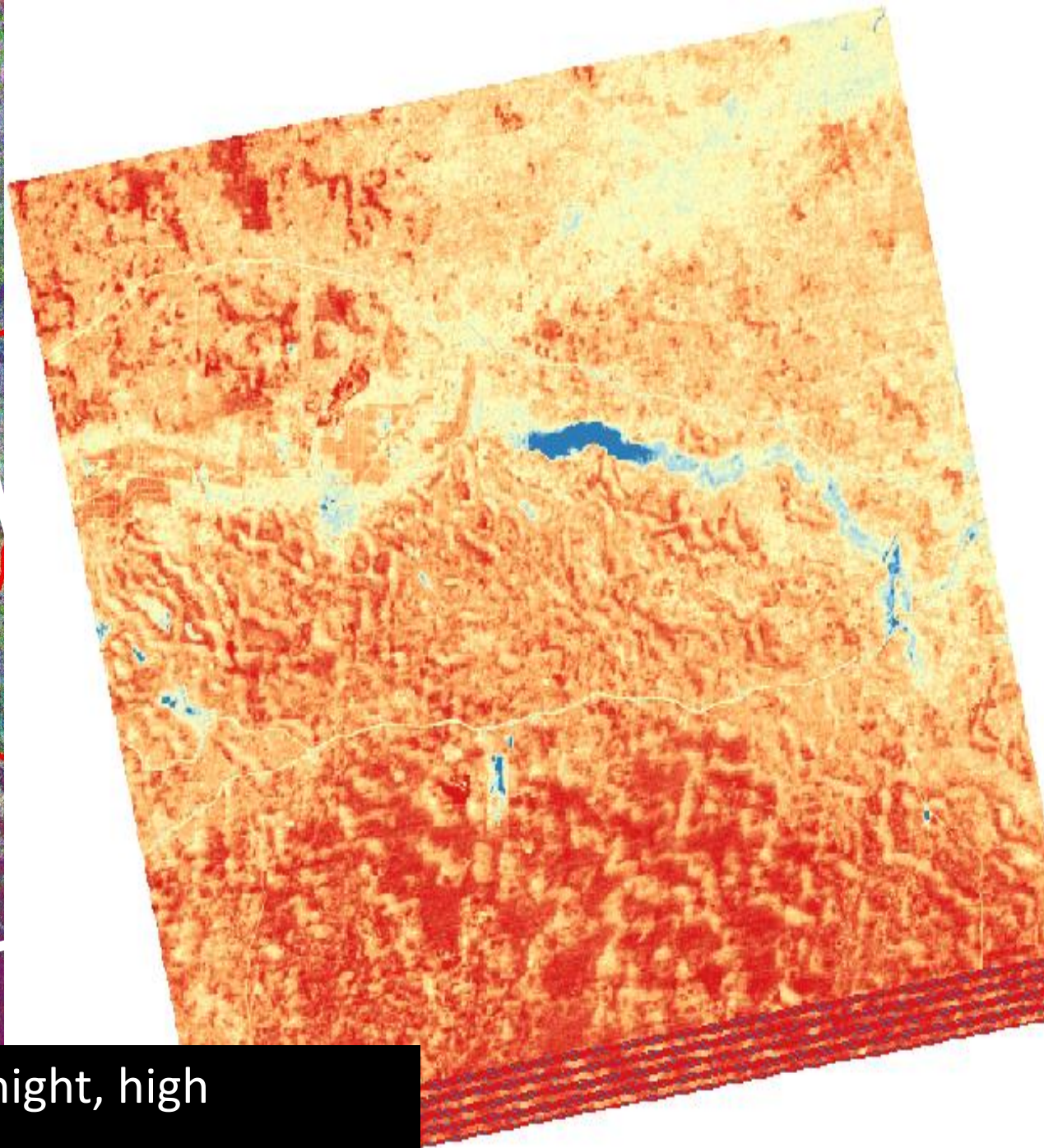
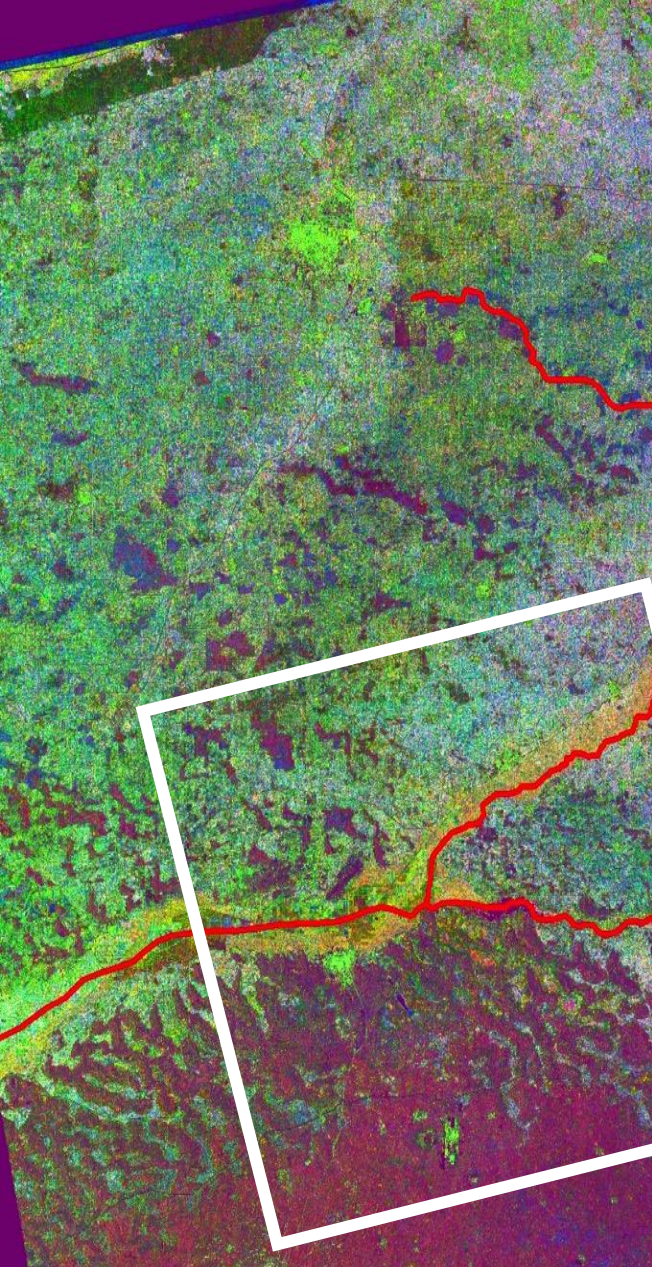


RGB composite of
'Tasselled Cap'
indices for
brightness,
greenness, and
wetness



The middle palaeo-Ghaggar





ASTER thermal band at night, high temperature contrast

Digital Surface Model (DSM) topographic analysis

The topography of the area preserves ancient palaeorivers and associated palaeochannels that can be visualised through the DSM

The middle course of rivers in the study area also present a high degree of braiding and migration given the flat topography and their strong seasonality

