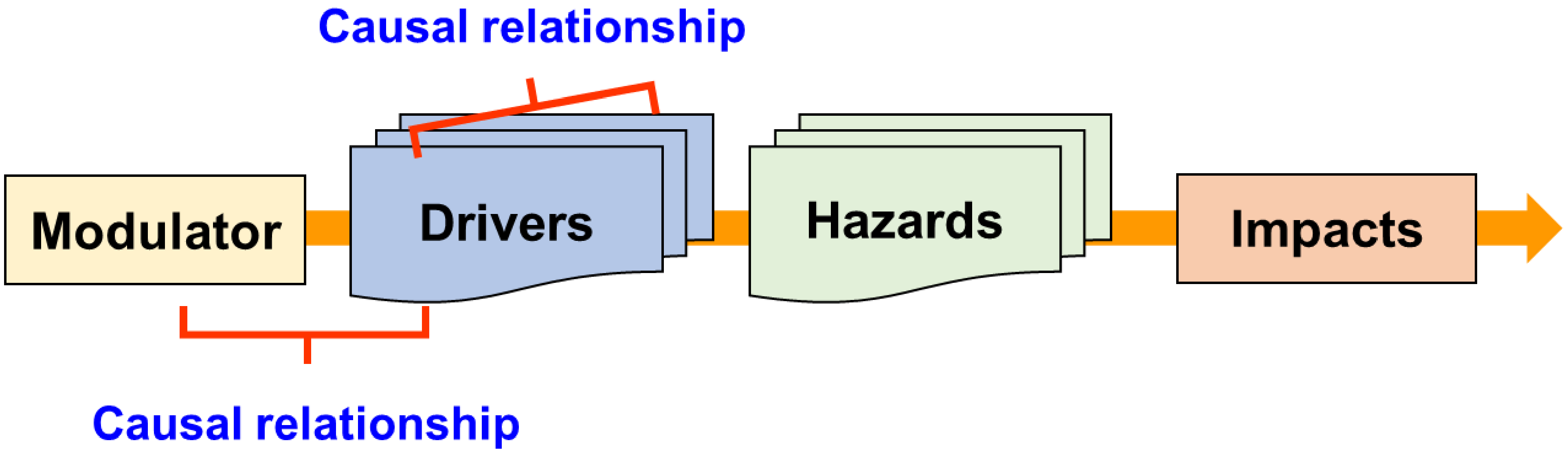
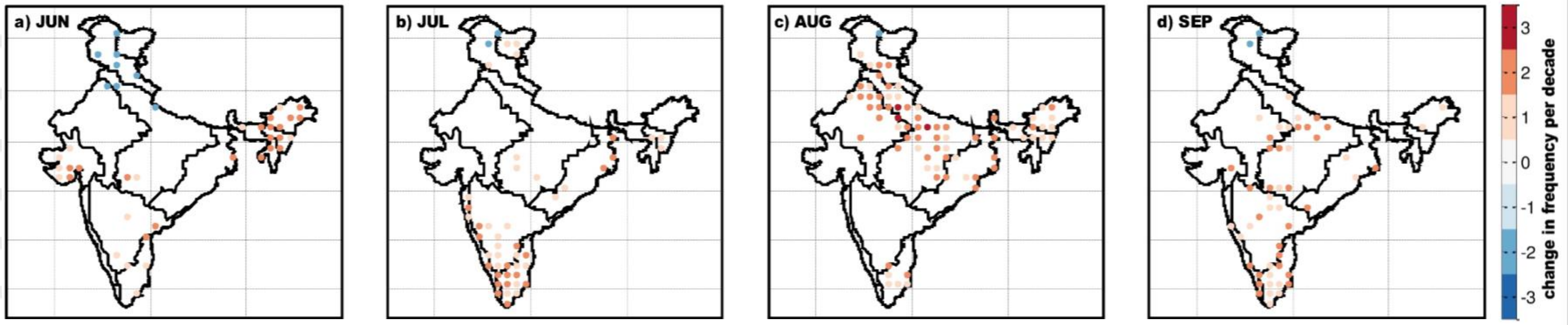
Understanding and quantifying potential modulators of compound extremes: A complex networks approach

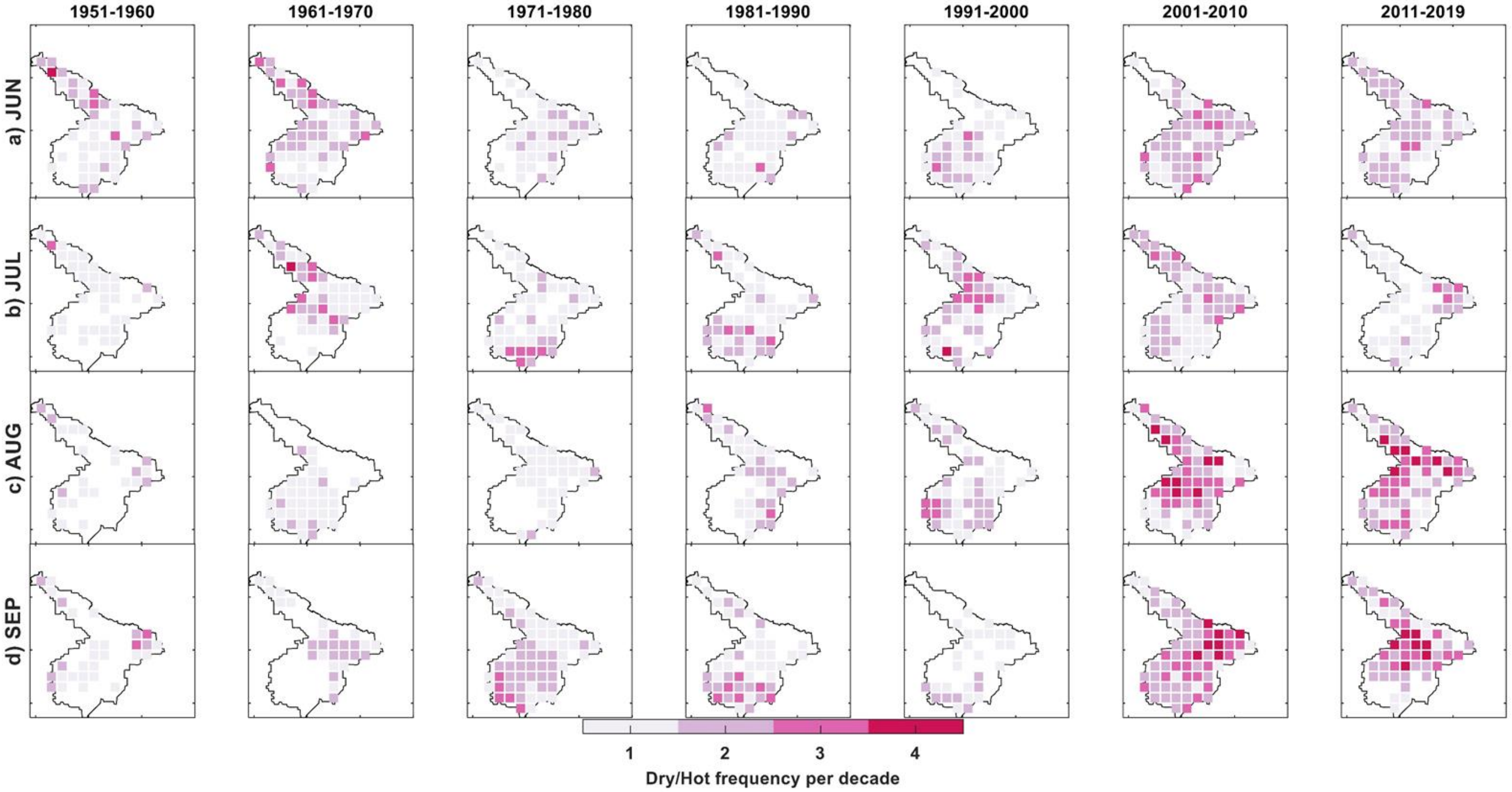
Ravi Kumar Guntu, Bruno Merz and Ankit Agarwal*



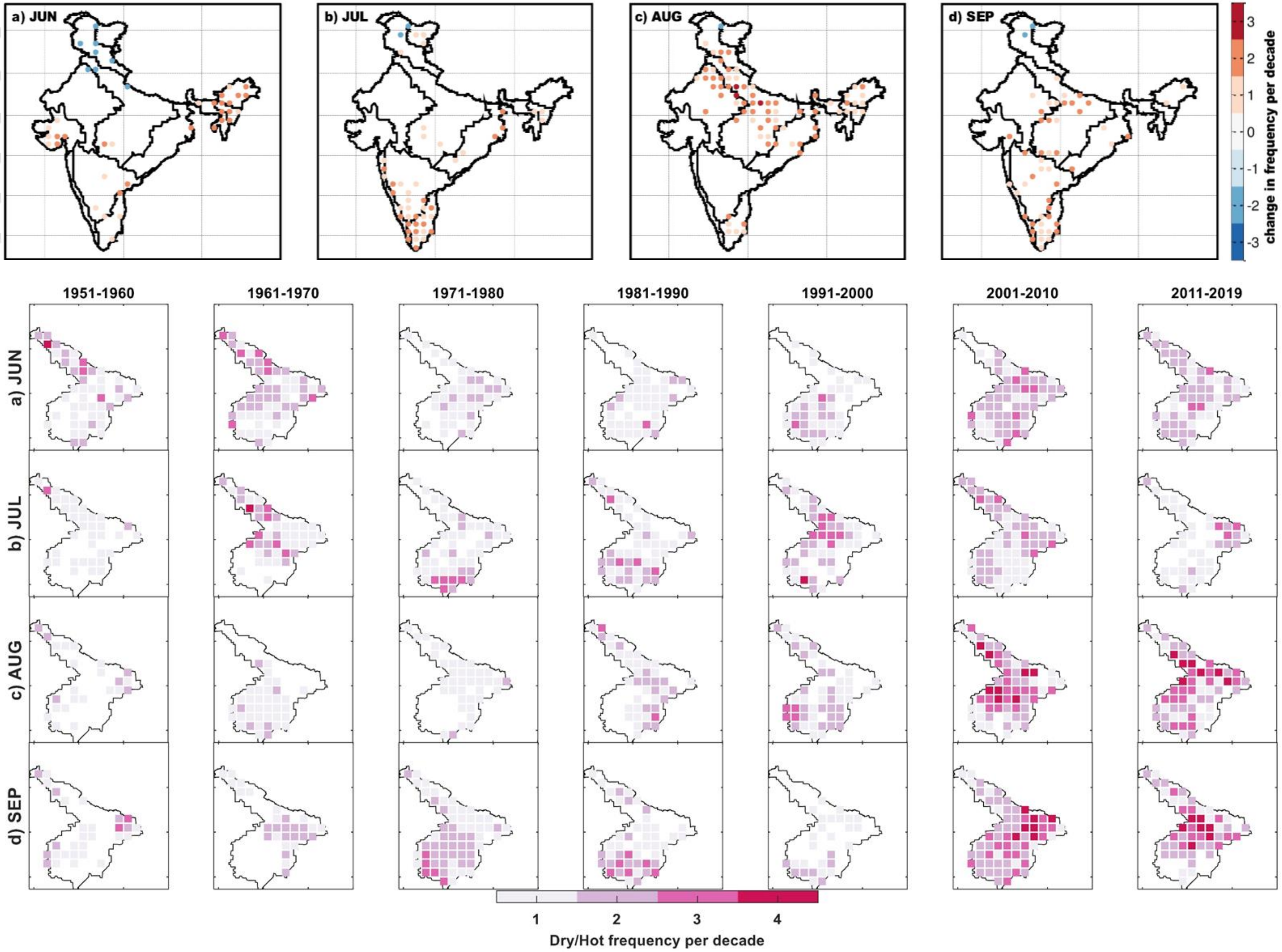
Components of a compound event adapted from J. Zscheischler et al., Nat Rev Earth Environ 1, 333 (2020)

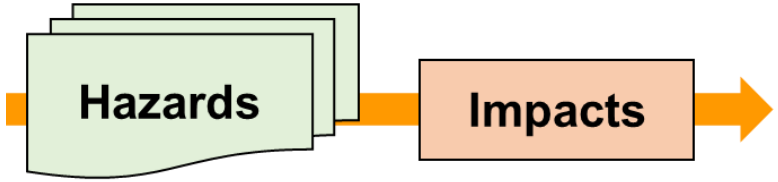
Hazards

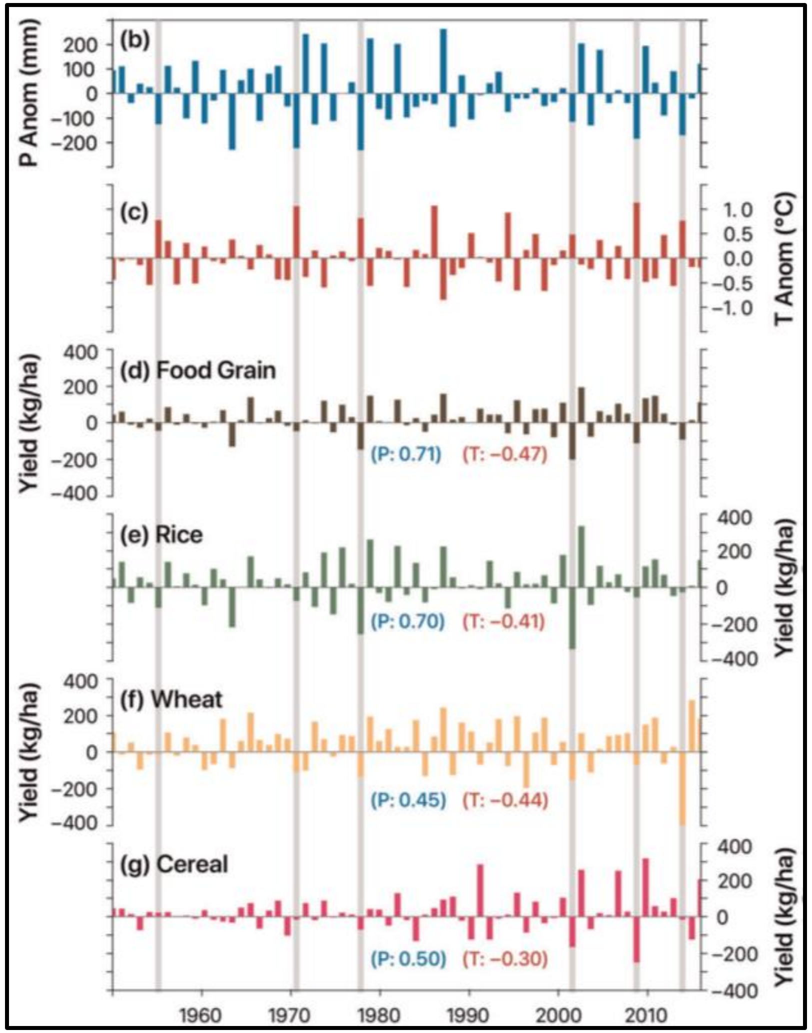




R.K. Guntu and A. Agarwal, Sci Rep 11, 16447 (2021)

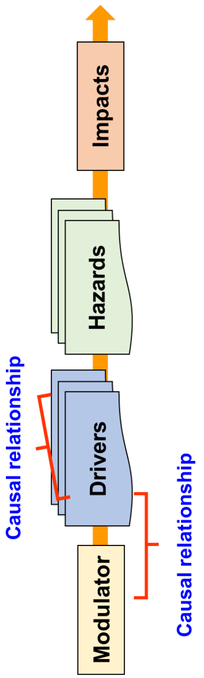


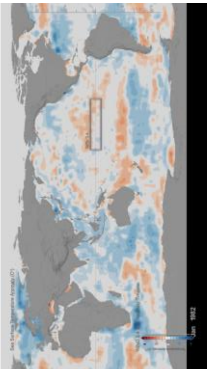




R.K. Guntu and A. Agarwal, Sci Rep 11, 16447 (2021)

V. Mishra et al., Npj Clim Atmos Sci 3, 10 (2020)





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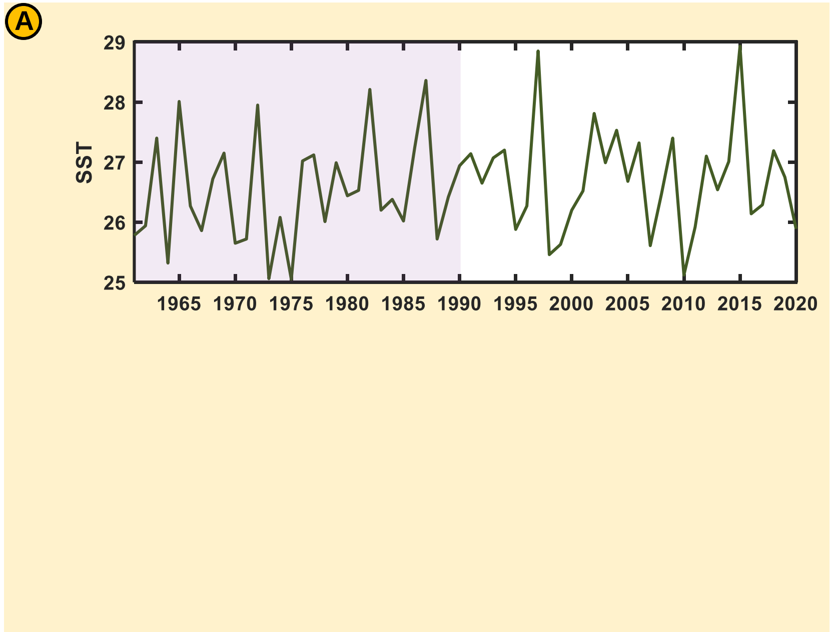

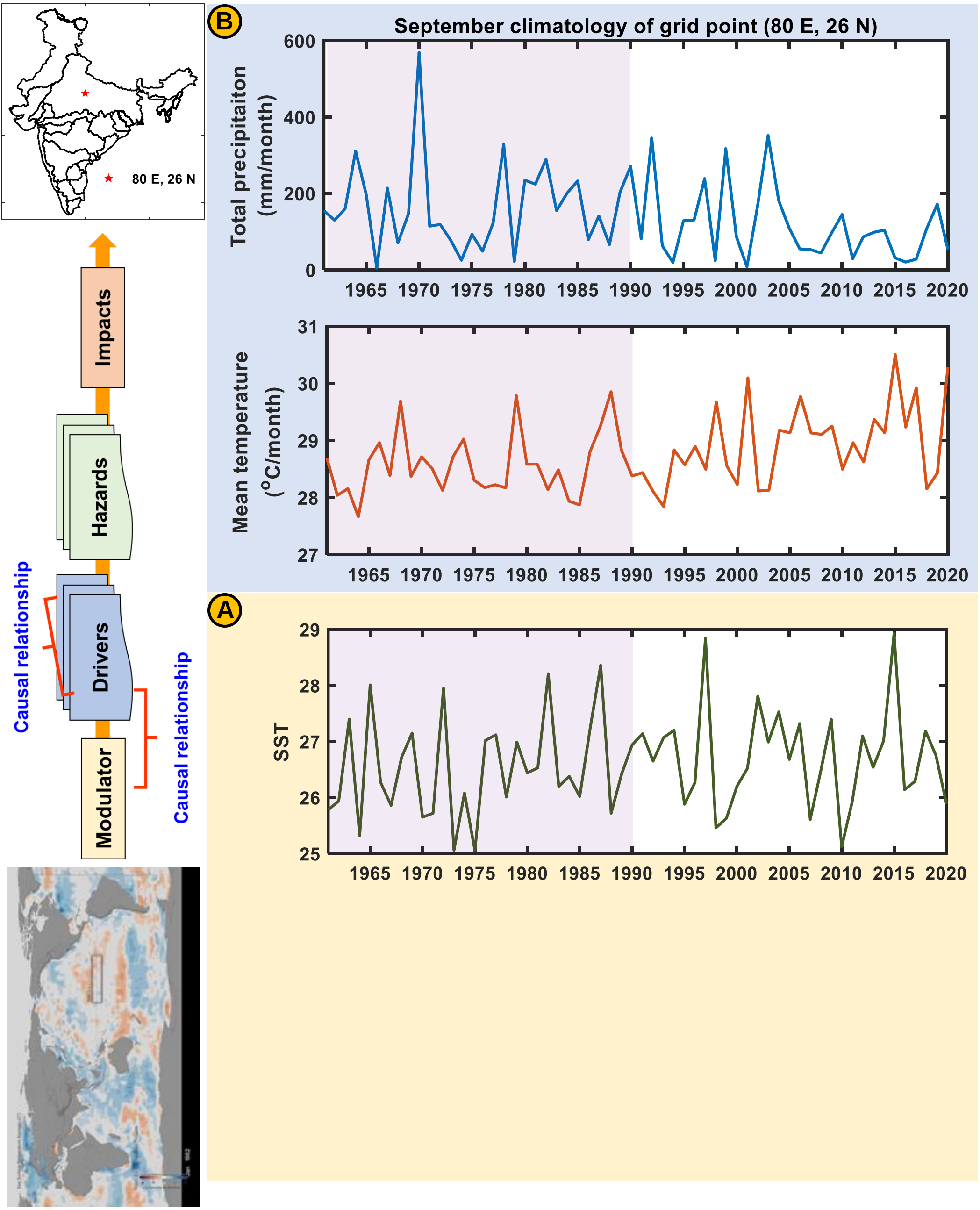

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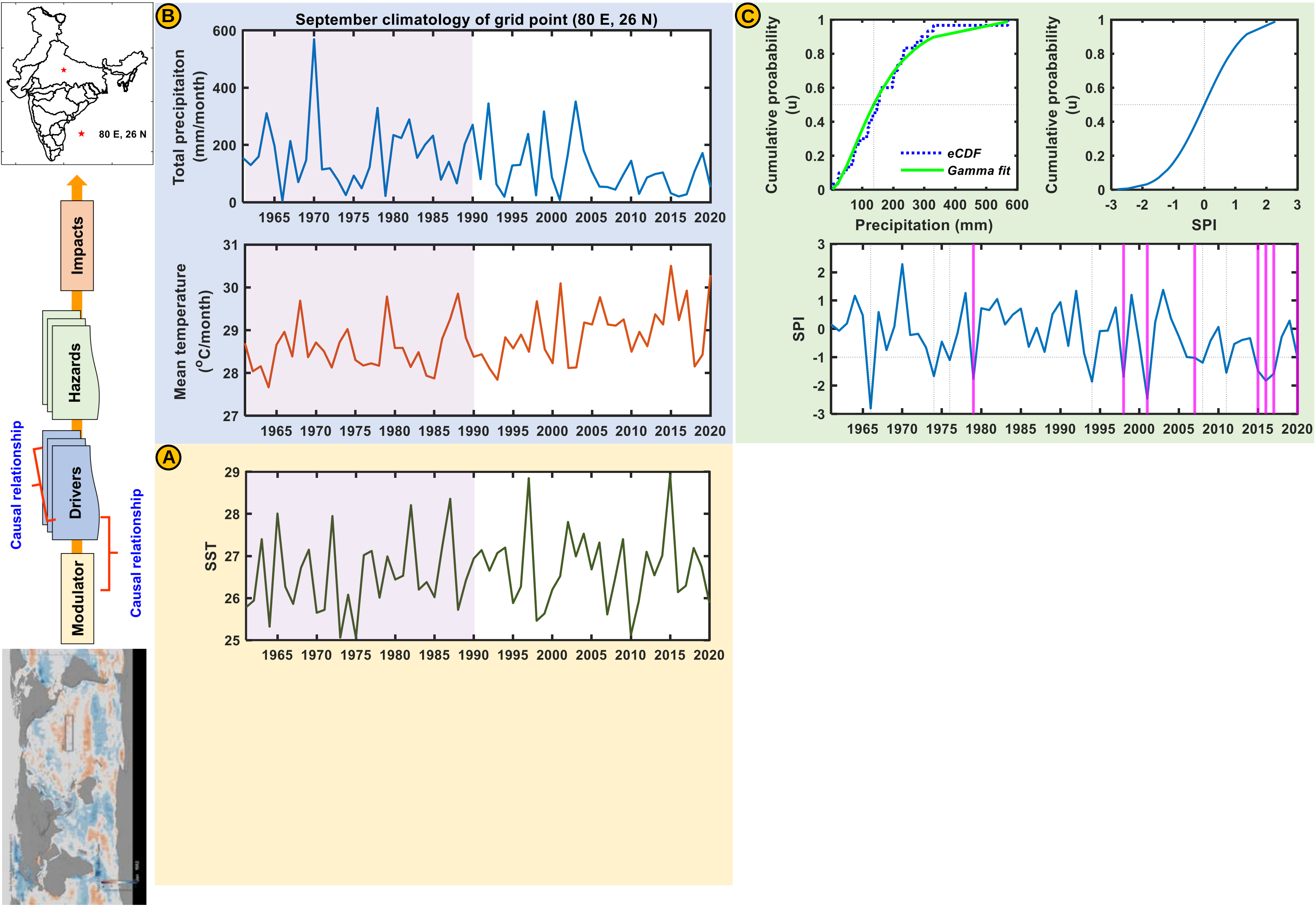
GFZ
Helmholtz-Zentrum
POTSDAM



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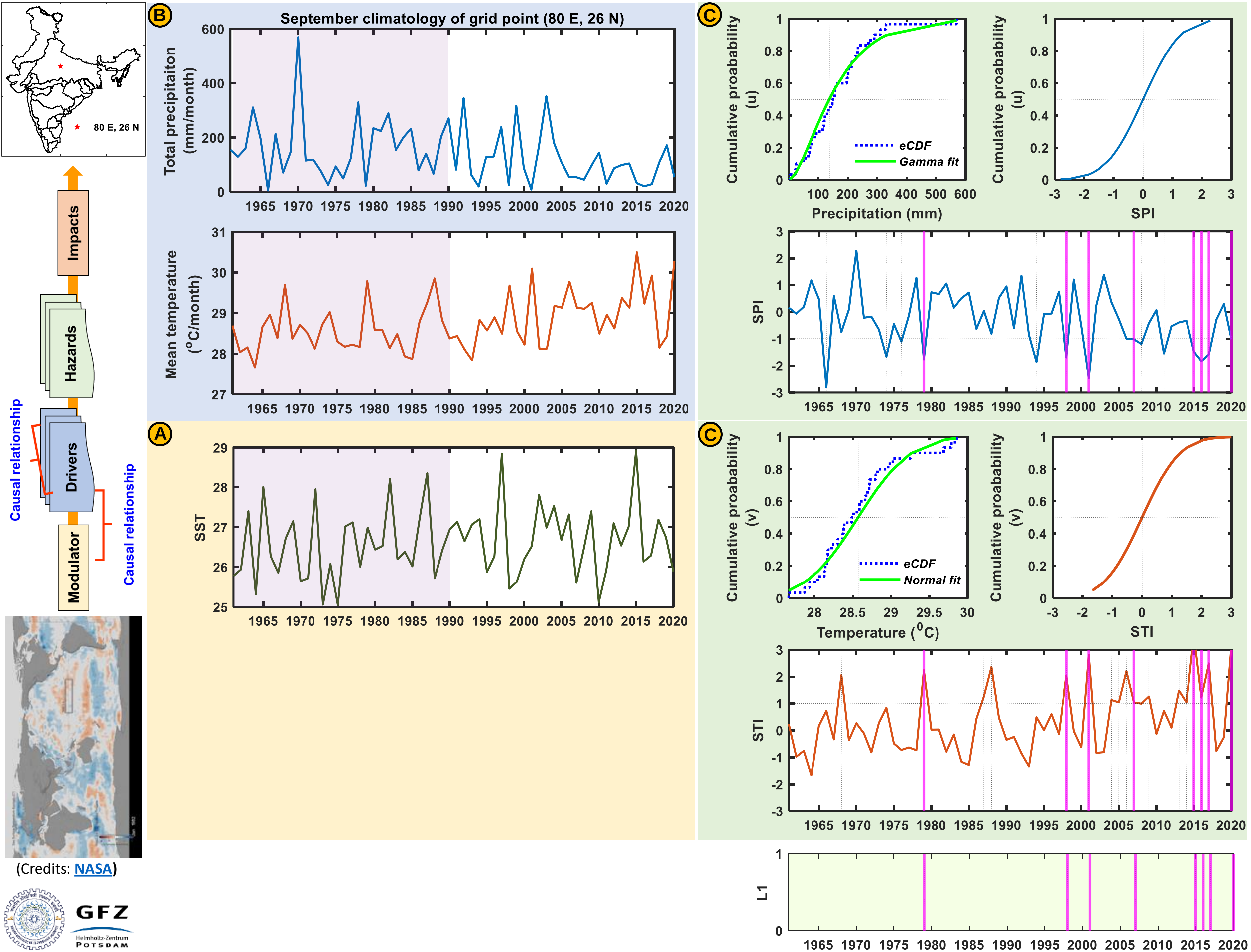
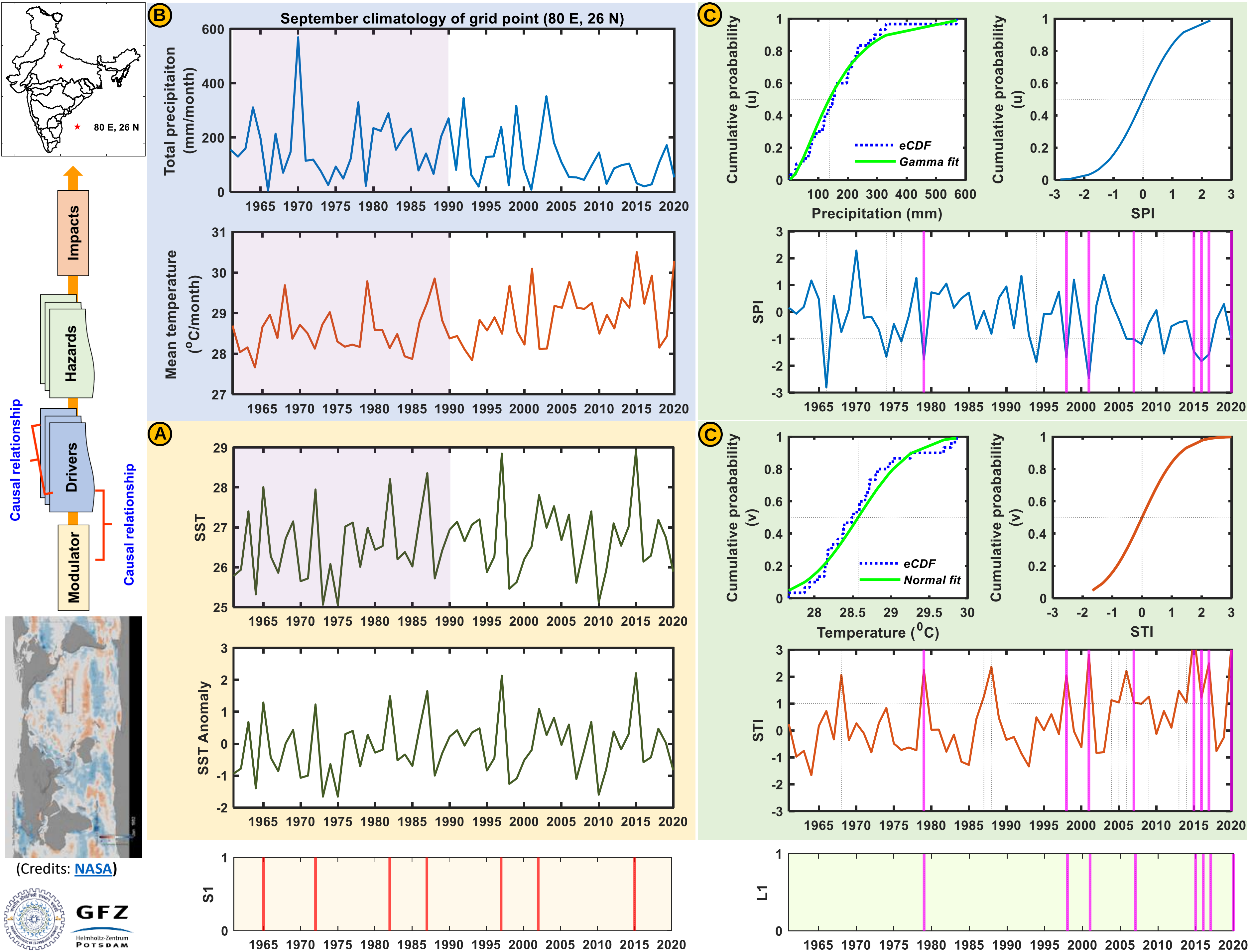

80 E, 26 N
Impacts
Hazards
Drivers
Modulator
Causal relationship
Causal relationship
(Credits: NASA)
GFZ
Helmholtz-Zentrum
POTSDAM
B
September climatology of grid point (80 E, 26 N)
Total precipitaiton (mm/month)
Mean temperature (^{0}C/month)
A
SST
C
Cumulative proabability (u)
eCDF
Gamma fit
Precipitation (mm)
SPI
Cumulative proabability (v)
eCDF
Normal fit
Temperature (^{0}C)
STI
L1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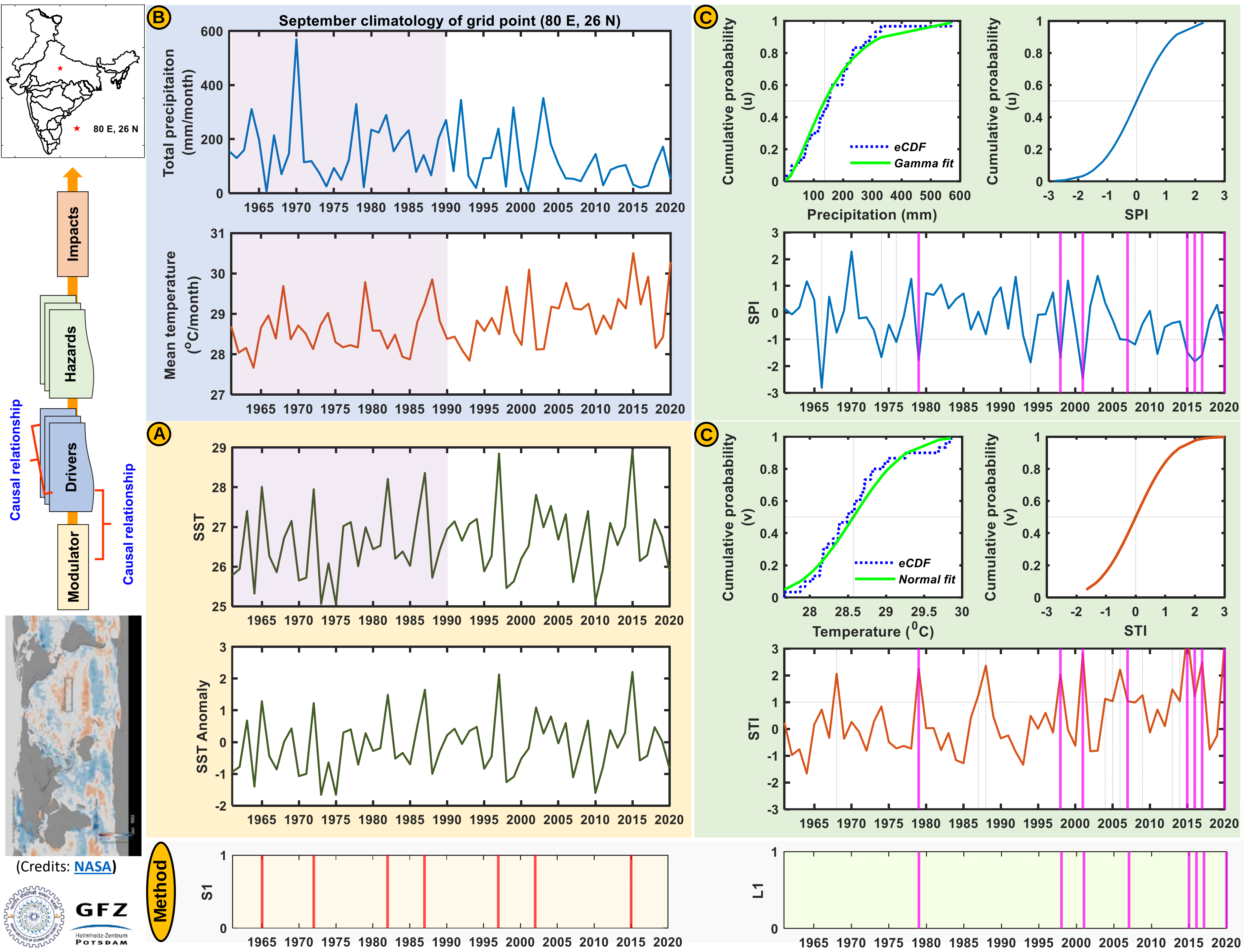
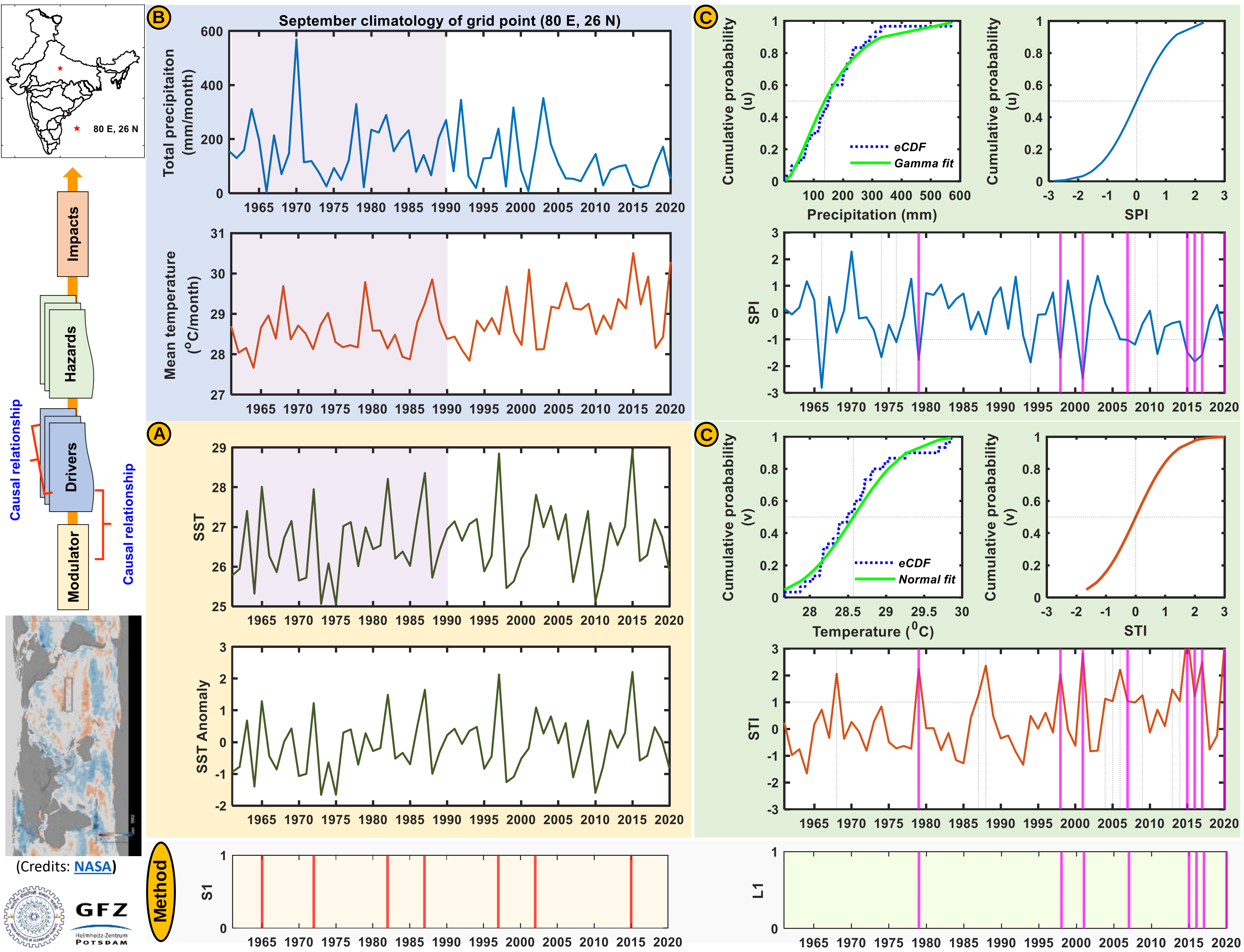


$$\mathbf{r} = \frac{r_{L1\rightarrow S1} + r_{S1\rightarrow L1}}{2}$$

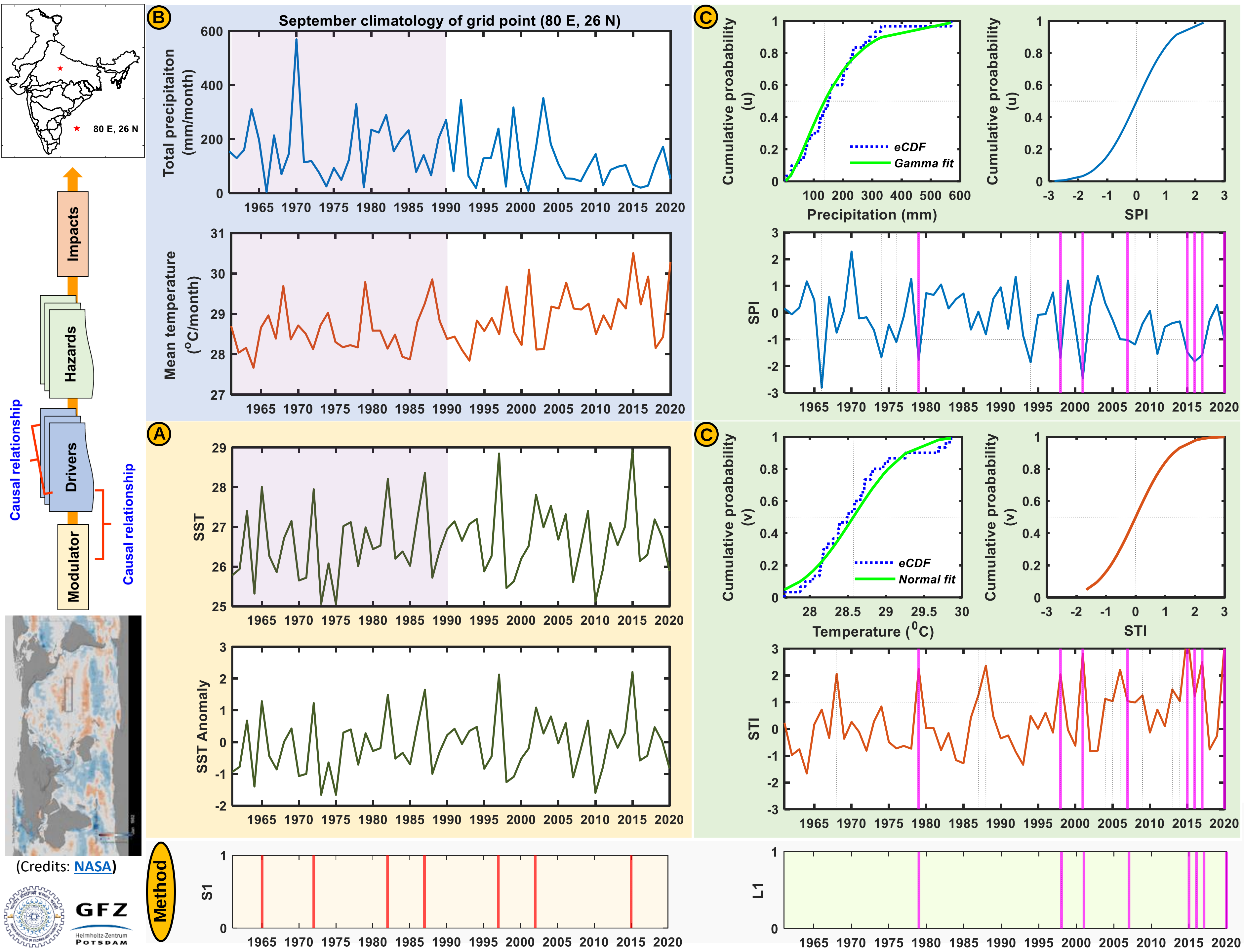
$$r_{L1\rightarrow S1} = \frac{1}{N_{L1}} \sum_{i=1}^{N_{L1}} H\left(\sum_{j=1}^{N_{S1}} I_{[0,\Delta T]}\left(\left(t_i^{L1} - \tau \right) - t_j^{S1} \right) \right)$$



r	S_1	S_2	…	S_{10649}
L_1	0.6			
L_2				
…				
L_{1004}				

$$\mathbf{r} = \frac{r_{L1\to S1} + r_{S1\to L1}}{2}$$

$$r_{L1\to S1} = \frac{1}{N_{L1}} \sum_{i=1}^{N_{L1}} H\left(\sum_{j=1}^{N_{S1}} I_{[0,\Delta T]}\left(\left(t_i^{L1} - \tau\right) - t_j^{S1} \right) \right)$$



r	S_1	S_2	...	S_{10649}
L_1	0.6	0.8		0.3
L_2	0.3	0.7		0.4
...				
L_{1004}	0.6	0.3		0.2

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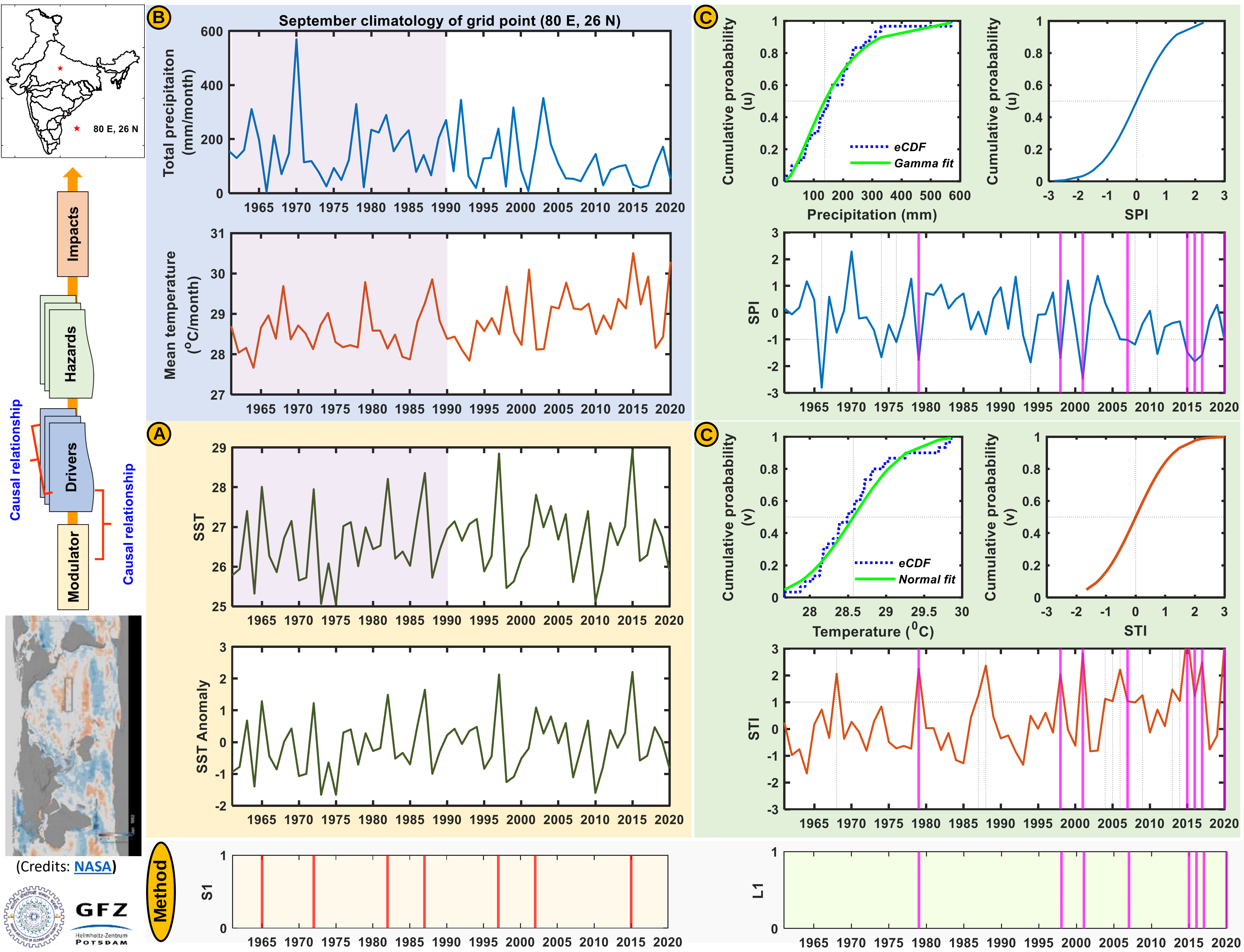

A	s_1	s_1	...	s_{10649}	k
L_1	1	1		0	Σ
L_2	0	1		0	Σ
...					...
L_{1004}	1	0		0	Σ

r	s_1	s_2	...	s_{10649}
L_1	0.6	0.8		0.3
L_2	0.3	0.7		0.4
...				
L_{1004}	0.6	0.3		0.2

$$A_{ij} = \begin{cases} 1, & r_{ij} \geq 0.5 \\ 0, & else \end{cases}$$

$$\mathbf{r} = \frac{r_{L1\to S1} + r_{S1\to L1}}{2}$$

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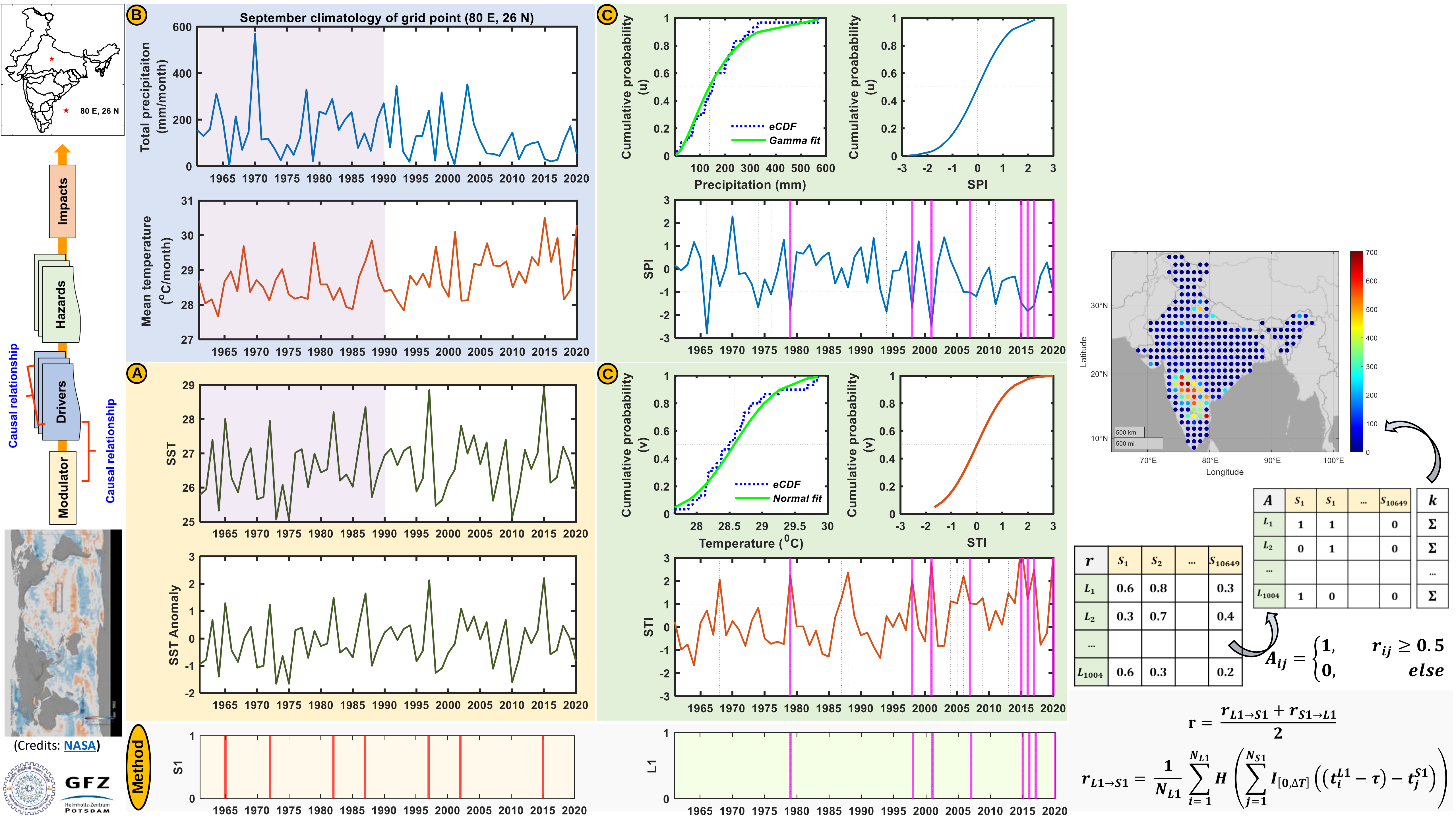

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S1
L1
Latitude
Longitude
500 km
500 mi
r | s_1 | s_2 | ... | s_{10649}
L_1 | 0.6 | 0.8 | | 0.3
L_2 | 0.3 | 0.7 | | 0.4
...
L_{1004} | 0.6 | 0.3 | | 0.2
A | s_1 | s_1 | ... | s_{10649} | k
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L_2 | 0 | 1 | | 0 | Σ
... | | | | | ...
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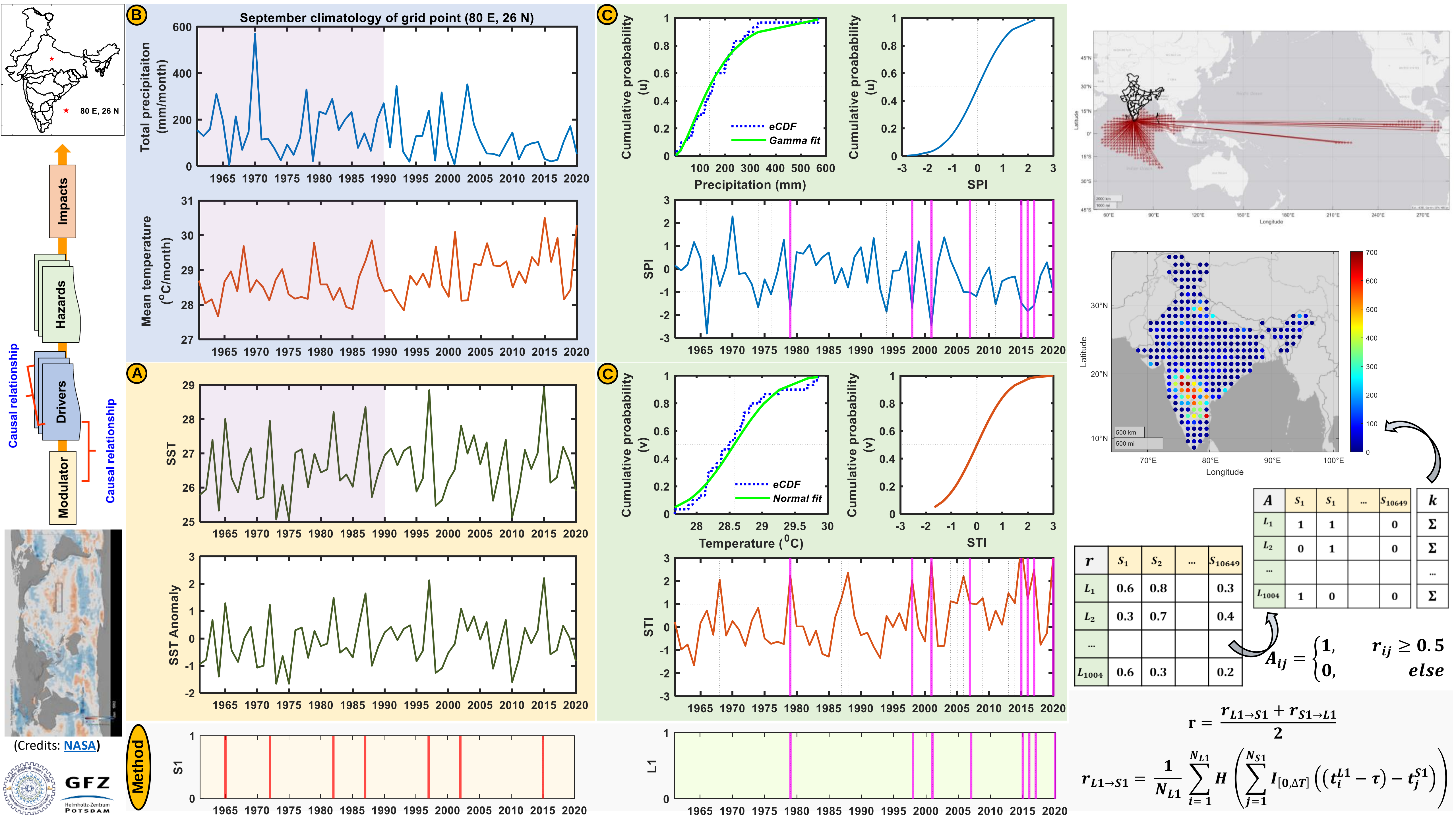

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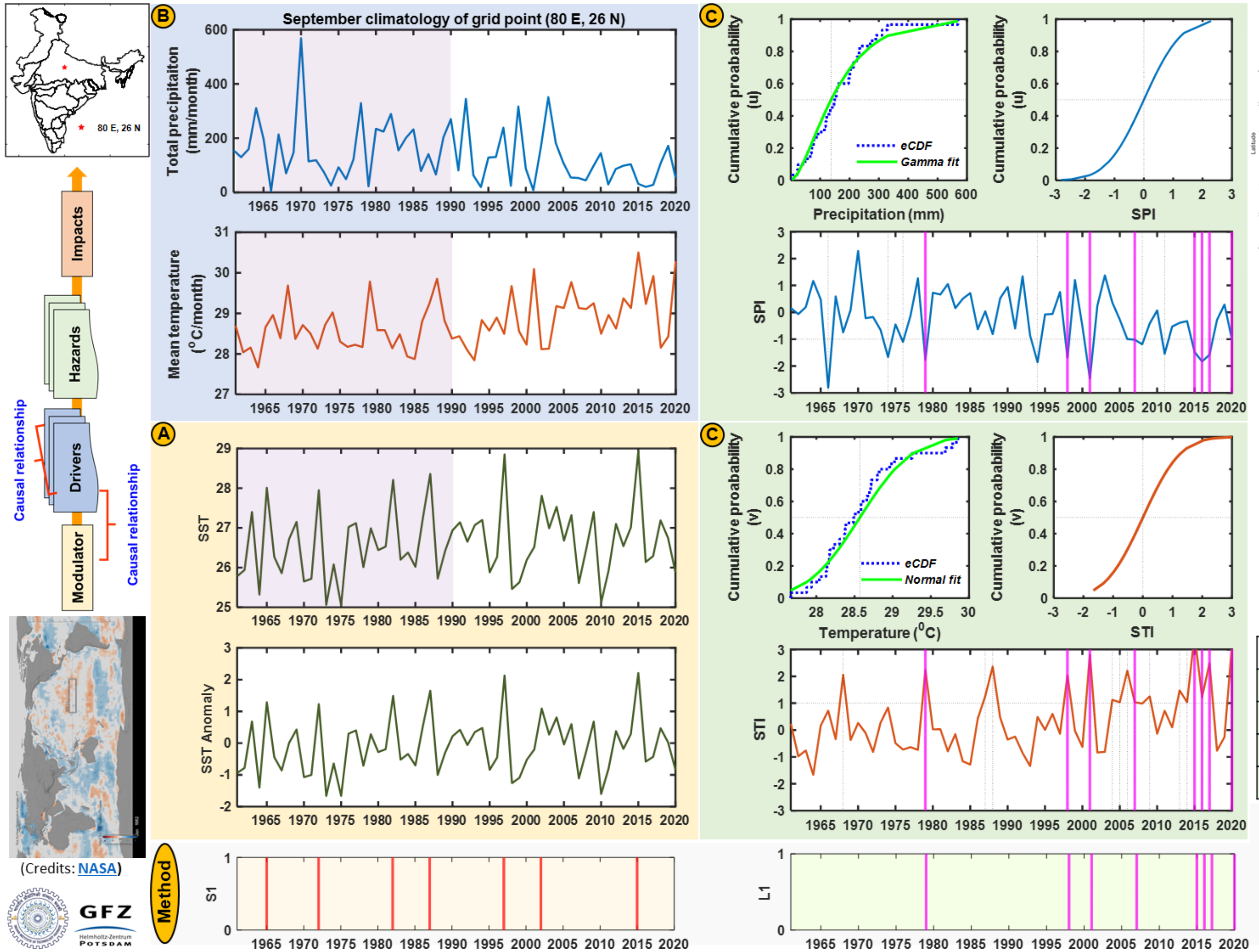
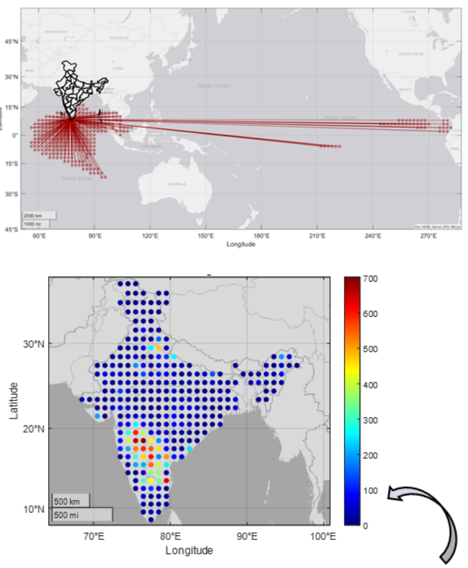
Co-PREPARE

Thanks !





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