Assessment of Diurnal Temperature Variability and its impact over India

Devi,Rani[a], Lenka, Smrutishree[a],Gouda, KC[a]

a. CSIR Fourth Paradigm Institute (C-MMACS), Bengaluru, India

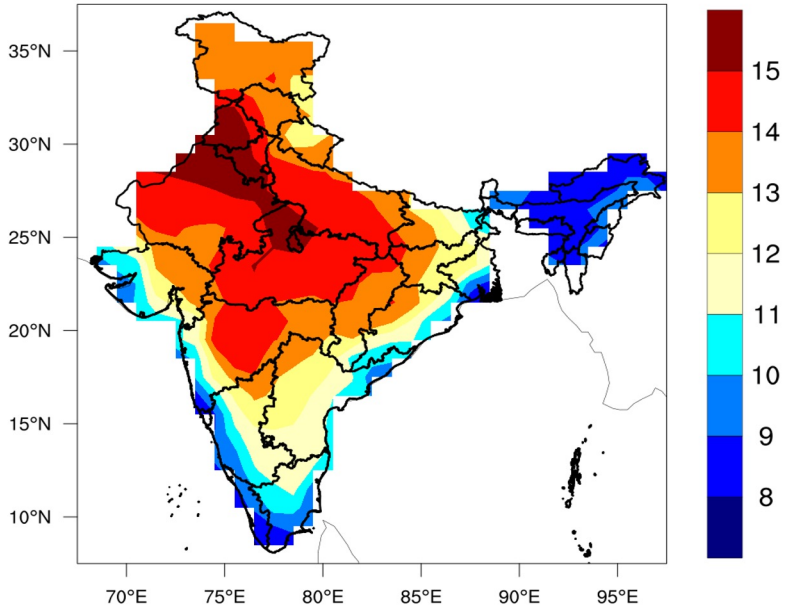
Abstract

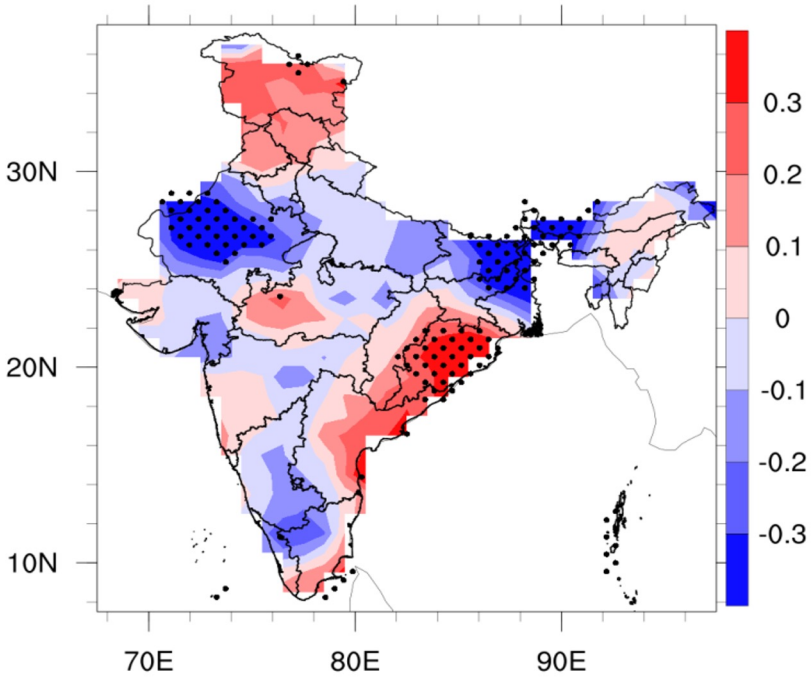
The sudden changes in daily maximum and minimum temperature is imposing the serious health risk to human health. The diurnal temperature range (DTR) is the metric of heat trap in atmosphere during a day as DTR includes the variability of daytime warming and night time cooling. This study analysed the spatio-temporal variability of DTR over Indian subcontinent using the daily maximum and minimum temperature record by India Meteorological Department (IMD) for the period 1951-2019. The spatial variability and distribution of DTR during summer (April-June) season follows the heat wave pattern in India and the analysis also indicates the direct effect of the regional climate change, urbanisation and weather instability on the atmospheric thermodynamics. This study also focussed on the impact of extreme DTR days on the heat wave propagation and associated mortality. The linkage of DTR with major parameters and processes like cloud cover, outgoing longwave radiation, incoming shortwave radiation and ENSO is also explored. The results indicates that north western and central part of India is highly vulnerable to the health impacts because of high DTR. The analysis also summarize that the DTR has been increasing all over India except the Indo-gangatic plains and coastal Gujrat. The number of extreme DTR days is high over the southern part and its frequency is increasing over the east coast of India. This study will be very much useful in the modelling studies and disaster management for the country.

Methods

1. HW Definition used: The HW day is declared
   a) When normal temperature >40 Deg C (<40 Deg C) over (base period) with the daily maximum temperature anomaly greater than 4 Deg C (5 Deg C) and persists for 2 or more days.
   b) When the daily maximum temperature>45 Deg C.
1. Base period : 1951-1980
2. Diurnal Temperature Range (DTR) : Maximum Temperature - Minimum Temperature
3. Pearson's correlation of DTR with HW days and hot days in summer season.

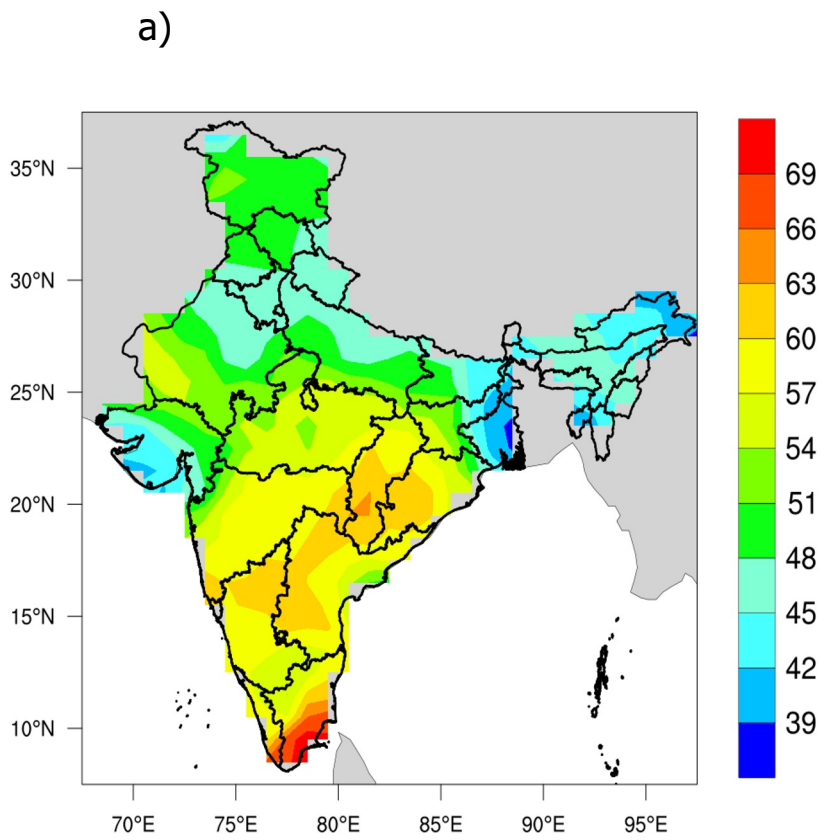
Figure 1.

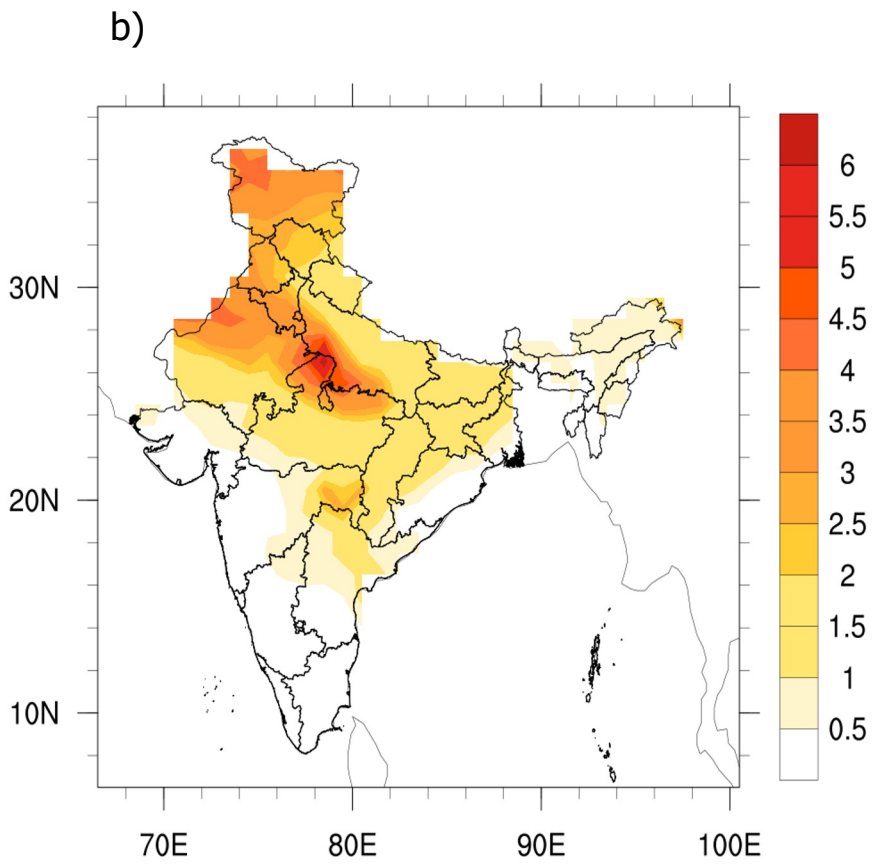




The DTR ranges between 6 to 15 Deg C over the Indian region and follows the same pattern of heat wave. The extreme high and low DTR value causes the various health diseases among elders and children. The DTR is the negative proxy of cloud cover also. The significant increasing trend of DTR in summer season is due to the rapid increase in maximum temperature.

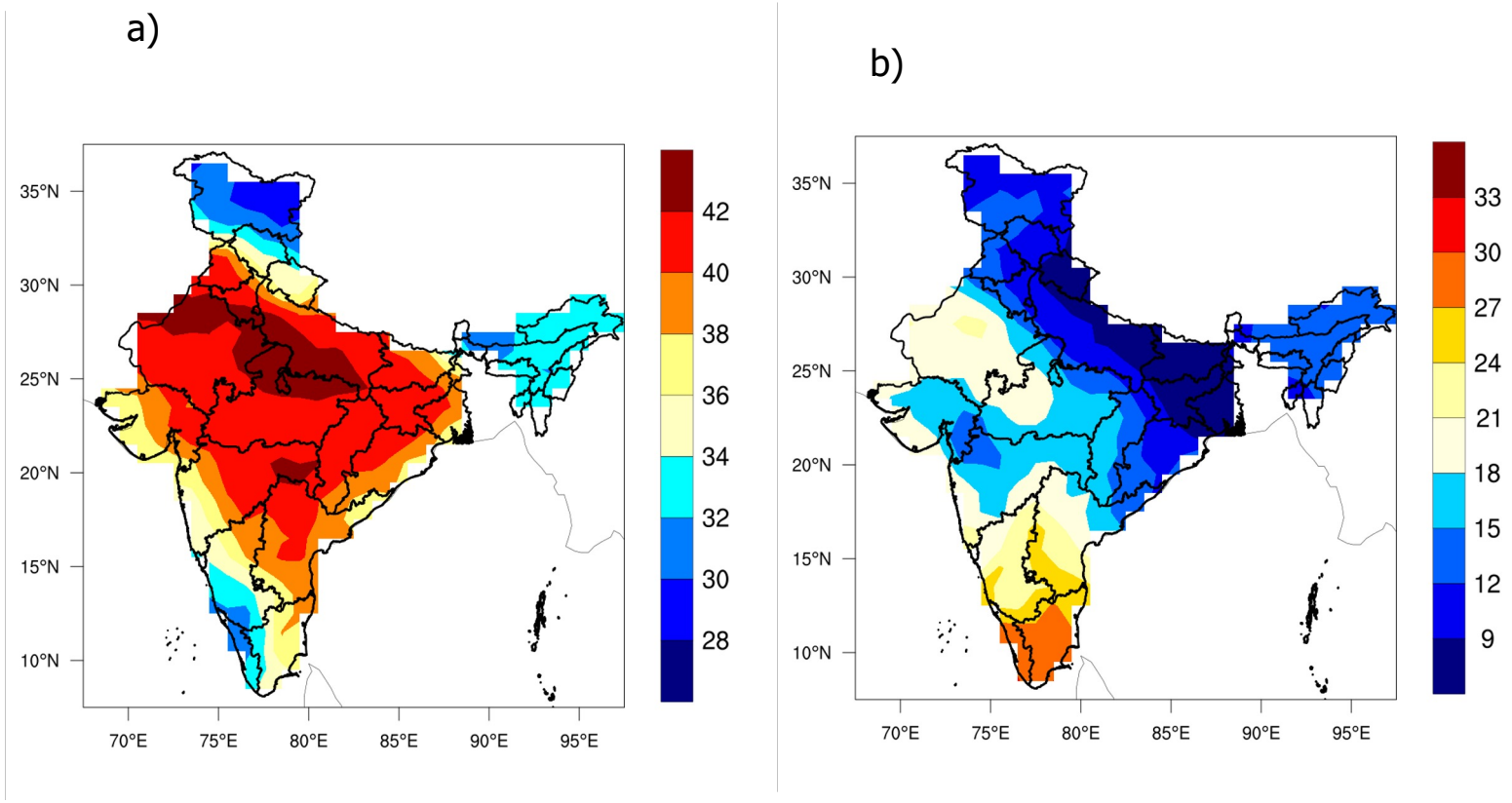
Figure 2.





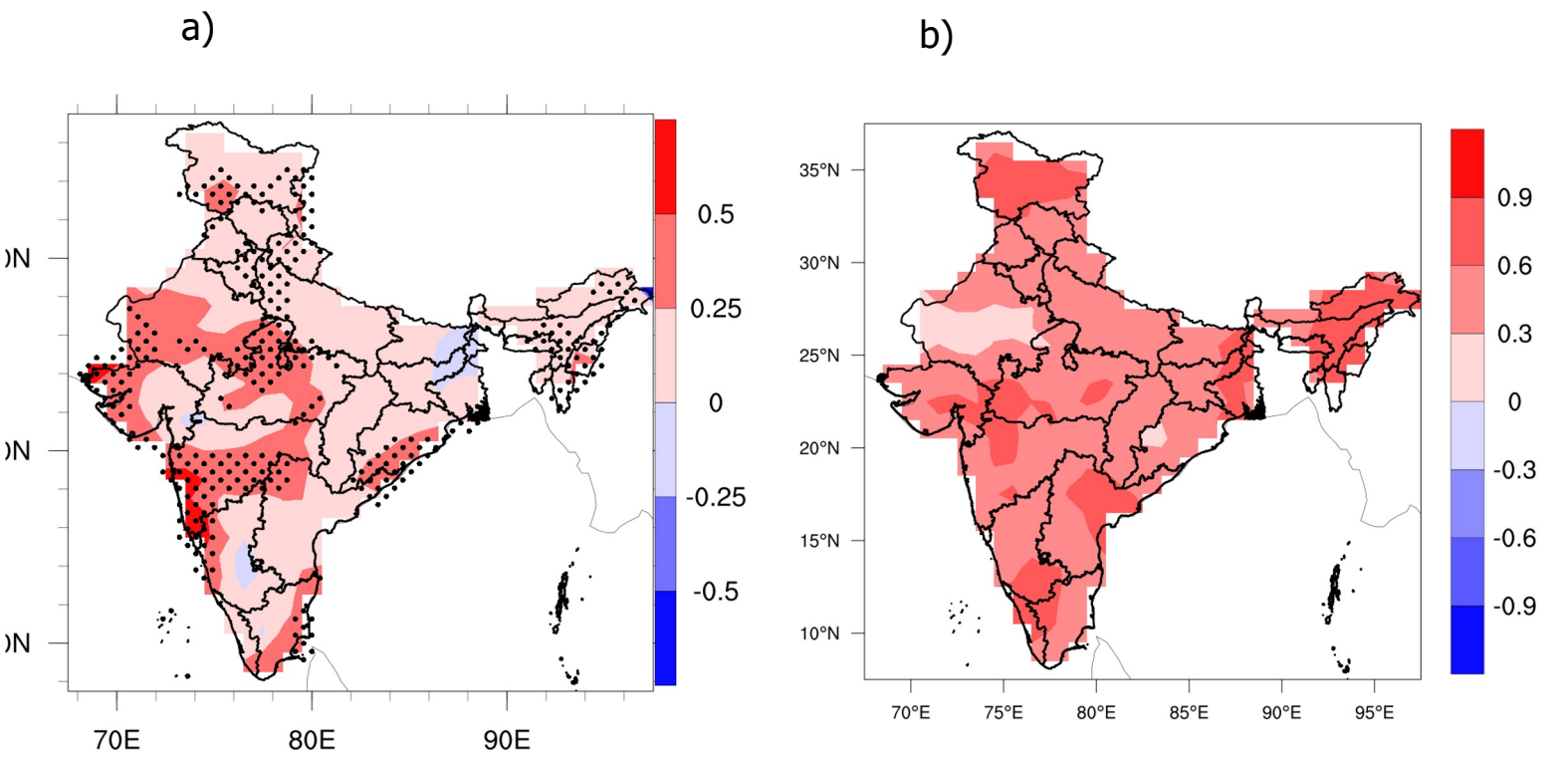
The Figure (a) is showing the extreme DTR days on which the DTR value is greater than normal and (b) shows the average number of heat wave events.

Figure 3.



The figure (a) shows the threshold maximum temperature at 90th percentile and (b) shows the number of climatological hot days occurrence over Indian region. The southern part of country has faced the drastic changes in temperature under climate change scenario and so the maximum number of hot days occurs. The core heat wave zone north western part also faces the extreme hot days.

Figure 4.



The figure (a) and (b) shows the increasing trend of hot days and its correlation with the DTR in summer season. The normal temperature has shifted towards the positive side due to the climate change and so every 2 years one hot day is increasing significantly.

Conclusion

- The DTR value extremities needs to be addressed as it has been linked with several infection due to sudden changes in temperature throughout the day.
- The DTR has direct positive correlation with the hot days in summer season, also linked with the cloud cover and outgoing long-wave radiation.
- This study points out the clear need of mitigation plan in view of hospitality due to the extreme DTR changes.

Acknowledgement / Funding

- UGC For Fellowship
- CSIR – 4PI for support
- Head, CSIR-4PI for encouragement

Author contact

ranijangra1992@gmail.com

Keywords (select up to 3):

Energy, Climate, Modeling