The Energy and Resources Institute

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Ministry of New and Renewable Energy
Government of India

UNSW SYDNEY

Thematic track 10: Sustainable Cooling Alternatives

Pathways to High Performance Architecture:

Contextual design approach

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THE 10TH GRIHA SUMMIT 2018
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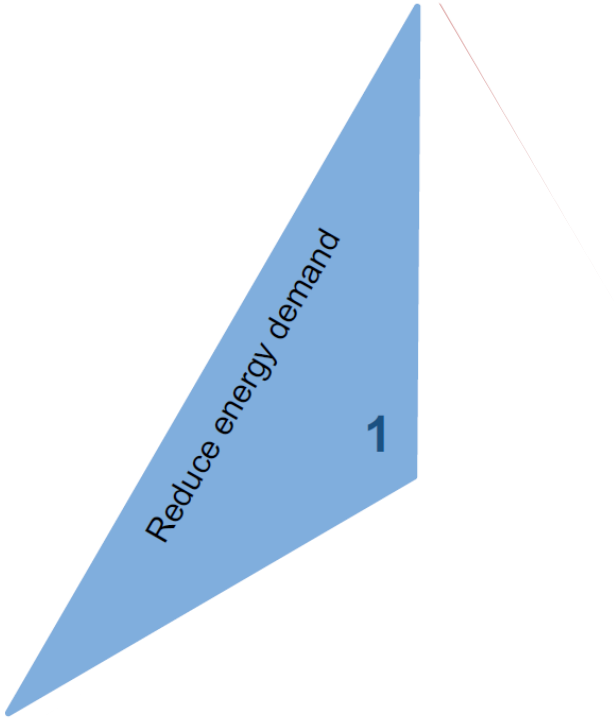
Fostering Partnerships for Sustainable Habitat

High performance building

The term '**high-performance building**' means a building that integrates and optimizes on a life cycle basis all major high performance attributes, including **energy conservation**, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.

(Energy Independence and Security Act, 2007 https://www.nibs.org/page/hpbc)

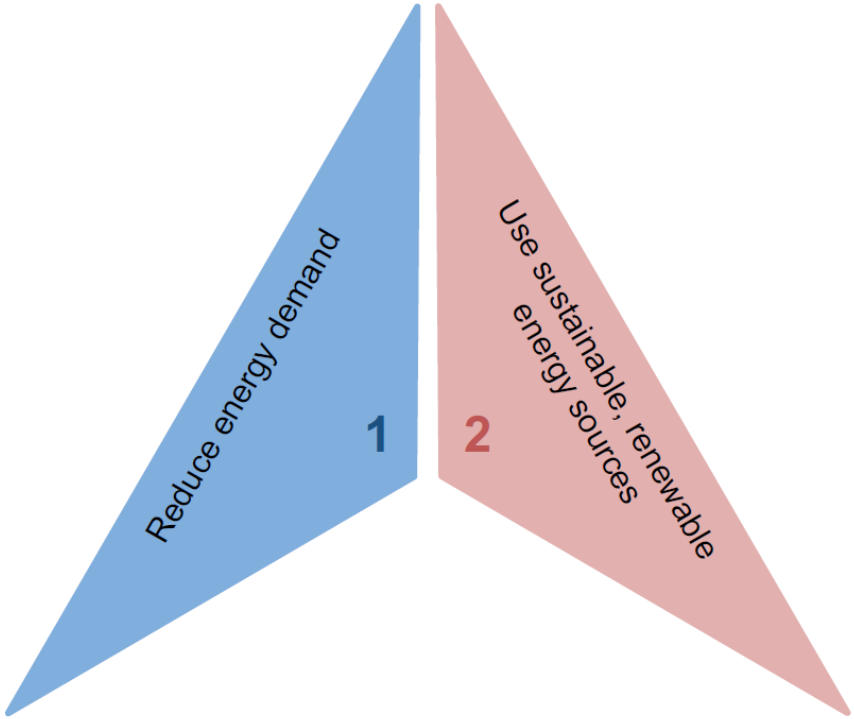
The “Trias Energetica” principle



First, prevent the use of energy (prevention)

(Konstantinou and Prieto, 2018)

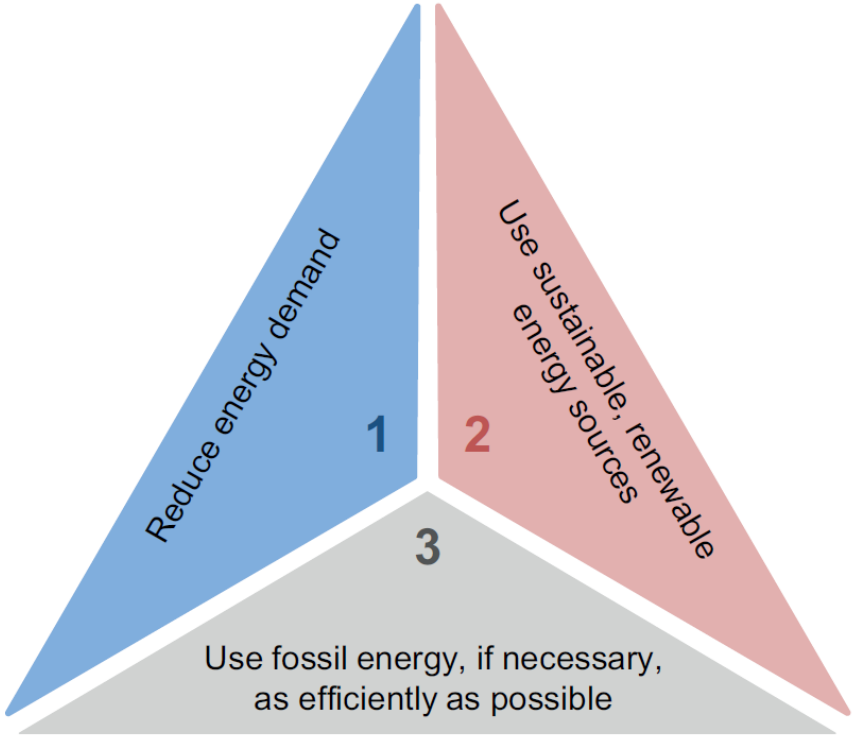
The “Trias Energetica” principle



use renewable energy sources as extensively as possible (renewable)

(Konstantinou and Prieto, 2018)

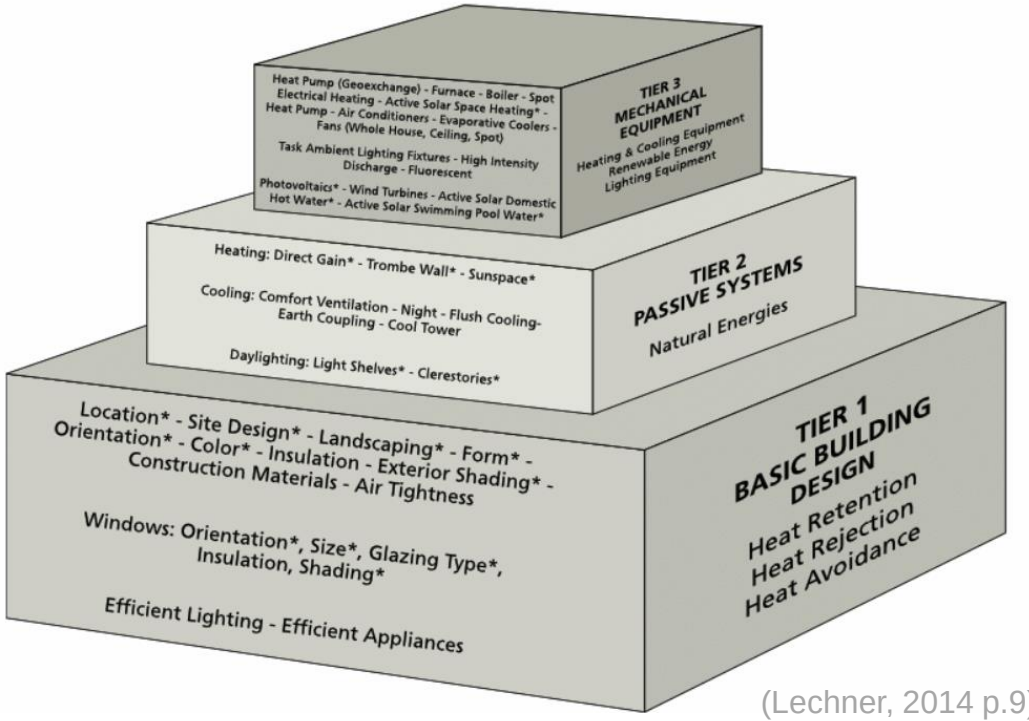
The “Trias Energetica” principle



Finally, if still needed, use fossil fuels as efficiently as possible (efficiency)

(Konstantinou and Prieto, 2018)

An approach to sustainable design



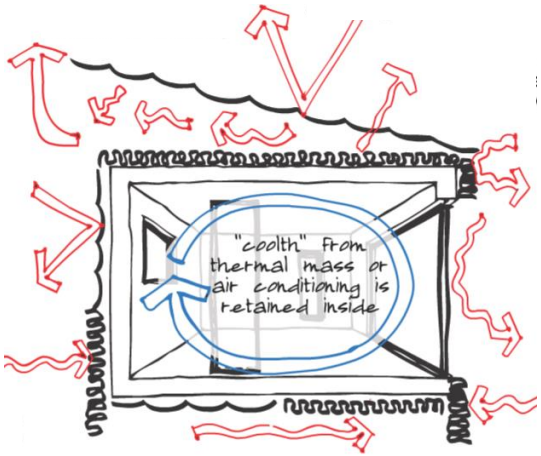
(Lechner, 2014 p.9)

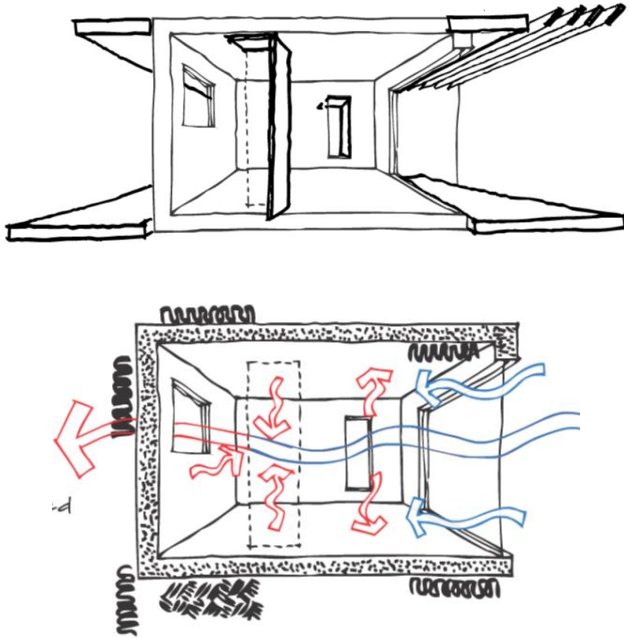
Table 1.4A The Three-Tier Design Approach

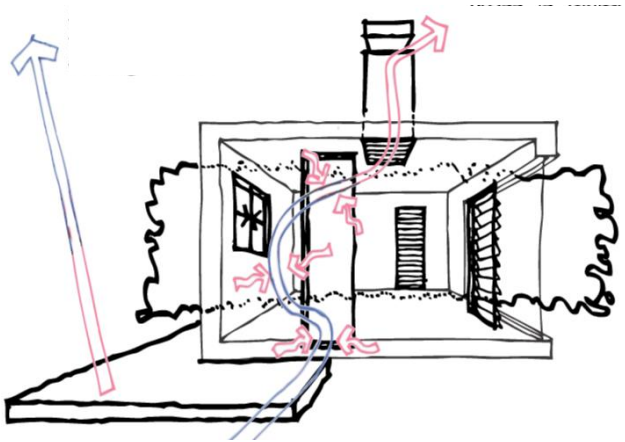
	Heating	Cooling
Tier 1	*Conservation*	*Heat avoidance*
Basic Building Design	1. Surface-to-volume ratio 2. Insulation 3. Infiltration	1. Shading 2. Exterior colors 3. Insulation 4. Mass
Tier 2	*Passive solar*	*Passive cooling*
Natural Energies and Passive Techniques	1. Direct gain 2. Trombe wall 3. Sunspace	1. Evaporative cooling 2. Night-flush cooling 3. Comfort ventilation 4. Cool towers
Tier 3	*Heating equipment*	*Cooling equipment*
Mechanical and Electrical Equipment	1. Furnace 2. Boiler 3. Ducts/Pipes 4. Fuels	1. Refrigeration machine 2. Ducts 3. Geo-exchange

Prevent the use of energy - cooling

Heat protection/ rejection



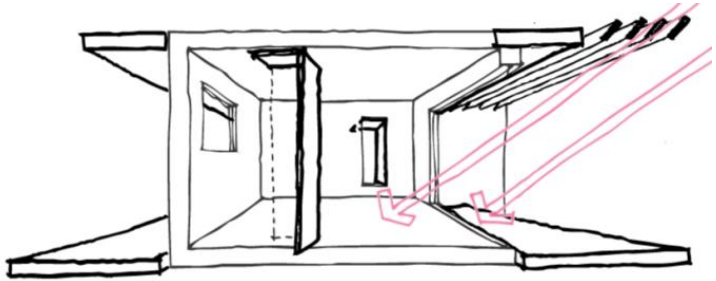


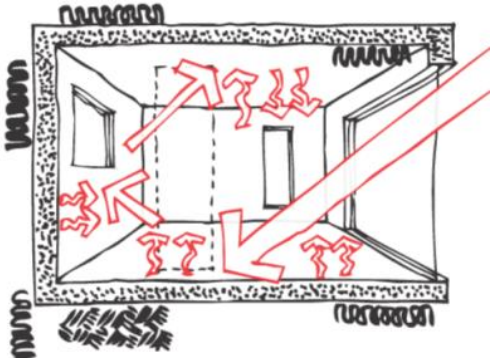


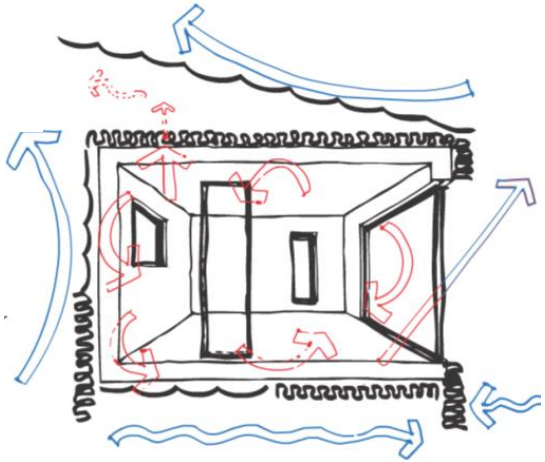
(www.designingforclimate.com.au, 2018)

Prevent the use of energy - heating

Heat gain/ retention







(www.designingforclimate.com.au, 2018)

Cooling strategies

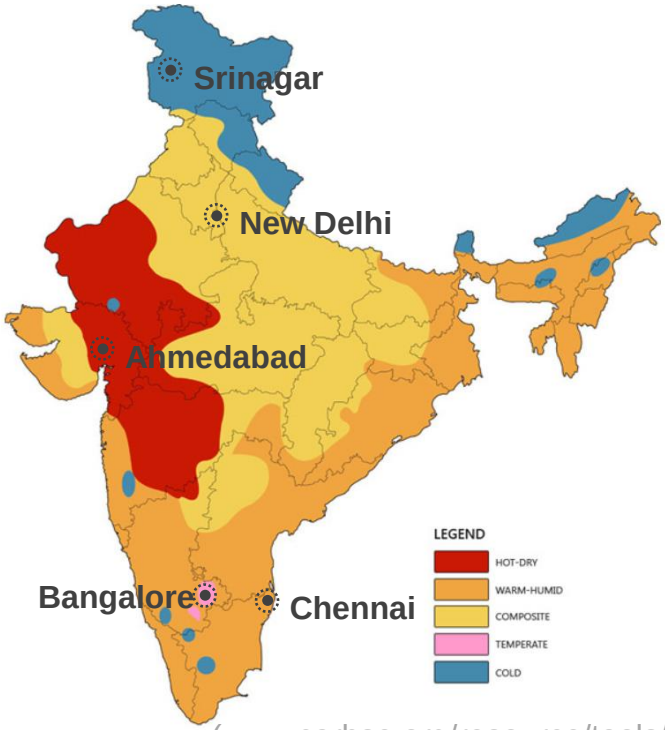
Hot and Dry climate

Gaza, Israel, Middle East
(http://eartharchitecture.org/?tag=domes)

Hot and Humid climate

Malay house, Malaysia
(http://nalenda14.blogspot.com.au/2010/11/malay-vernacular-architecture.html)

Indian climate zones



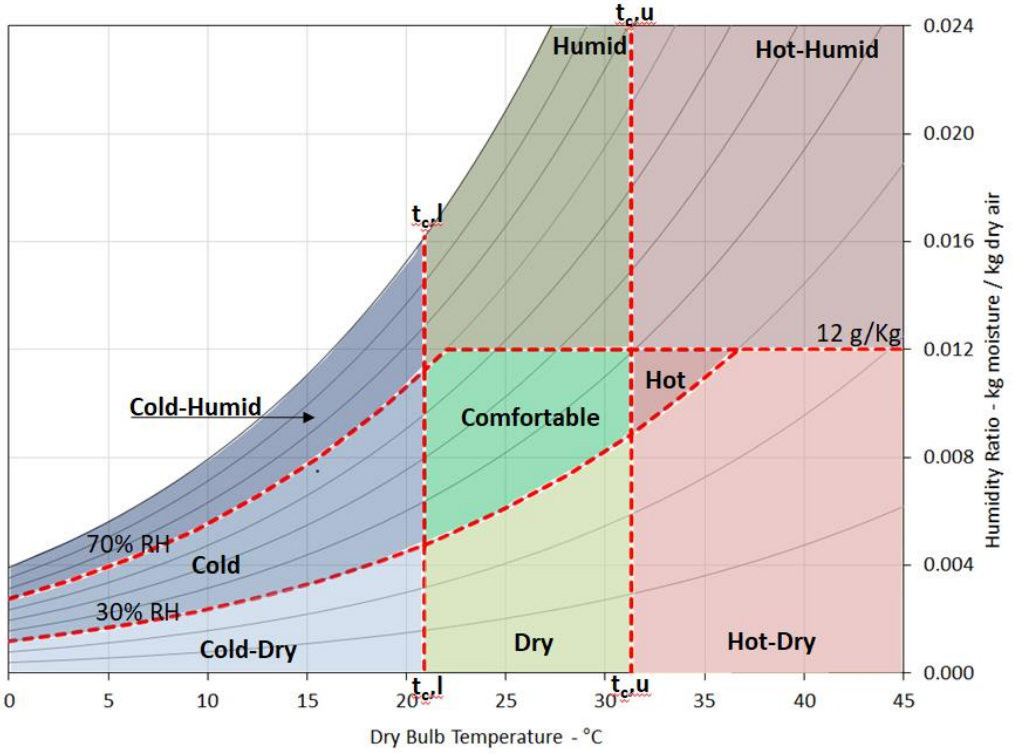
(www.carbse.org/resource/tools/)

Sl No.	Climatic Zone	Mean Monthly Maximum Temperature °C	Mean Monthly Relative Humidity Percent
(1)	(2)	(3)	(4)
i)	Hot-dry	Above 30	Below 55
ii)	Warm-humid	Above 30	Above 55
		Above 25	Above 75
iii)	Temperate	25-30	Below 75
iv)	Cold	Below 25	All values
v)	Composite	*see* **3.2.2**	

3.2.2 Each climatic zone does not have same climate for the whole year; it has a particular season for more than six months and may experience other seasons for the remaining period. A climatic zone that **does not have any season for more than six months** may be called as **composite zone**.

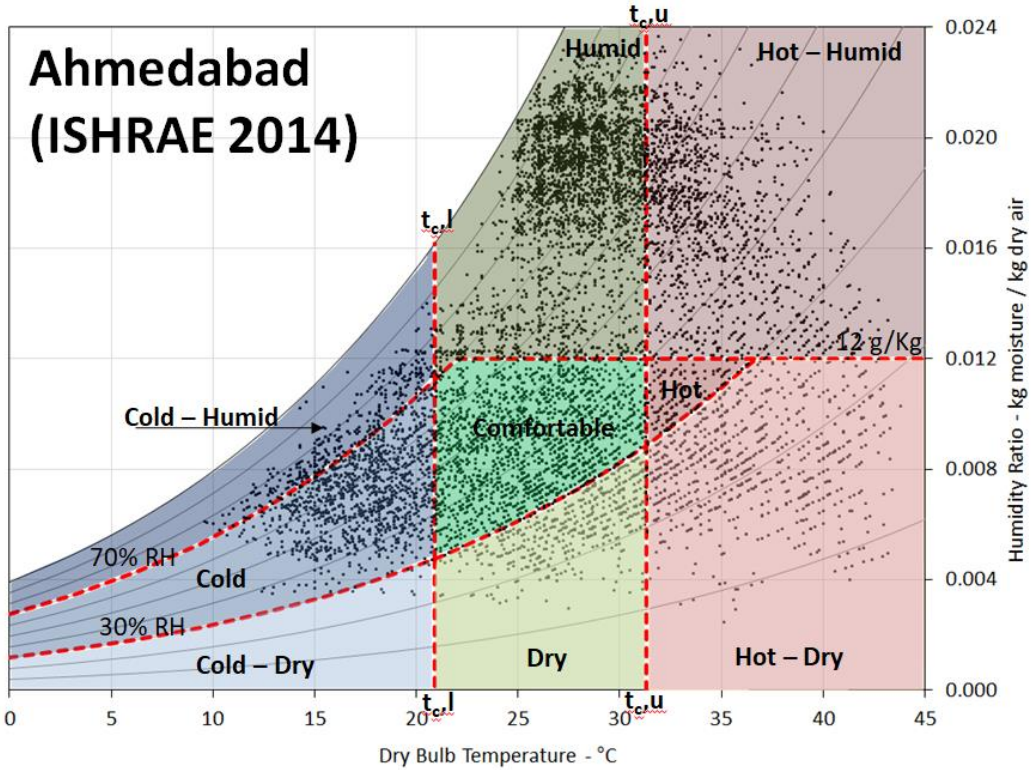
(National Building Code of India, 2016, Vol 2 p.8)

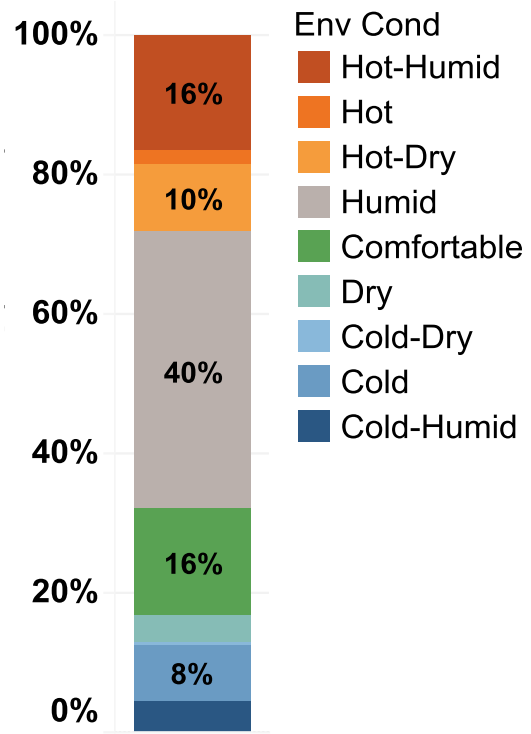
Thermal environmental conditions



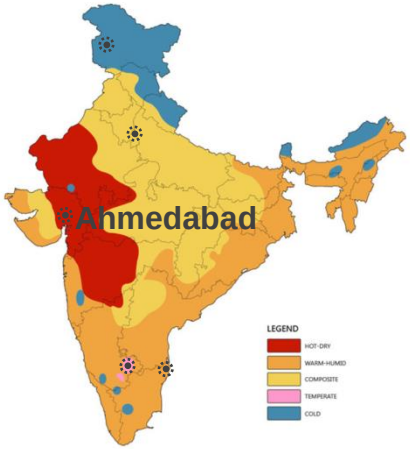
(Upadhyay, 2018)

Thermal environmental conditions



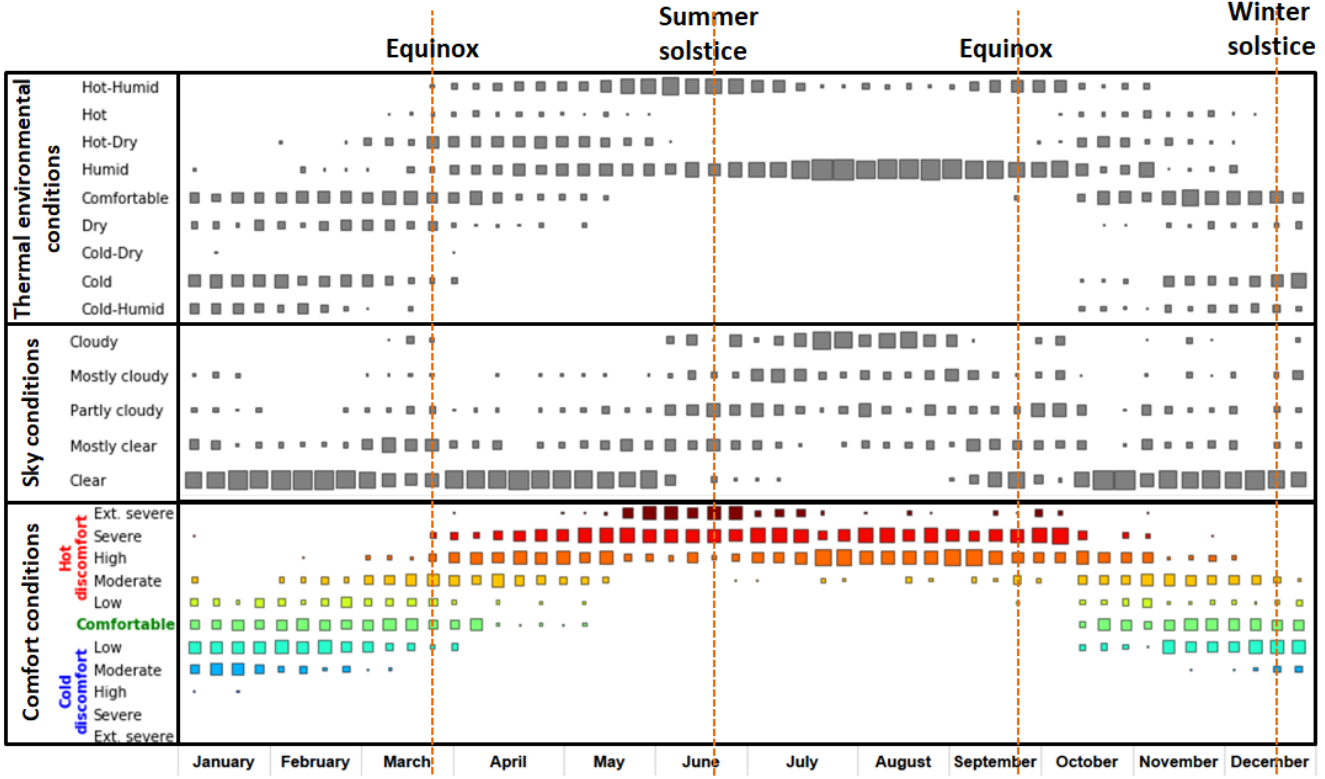


Ahmedabad climate outlook

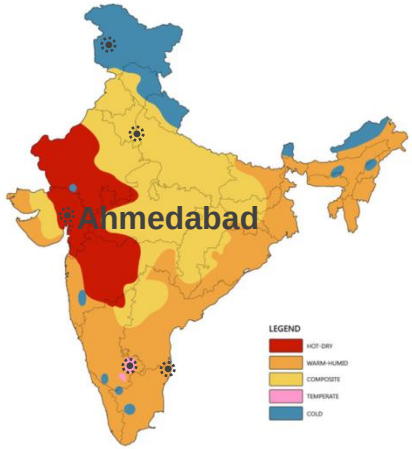


Classified as

hot-dry

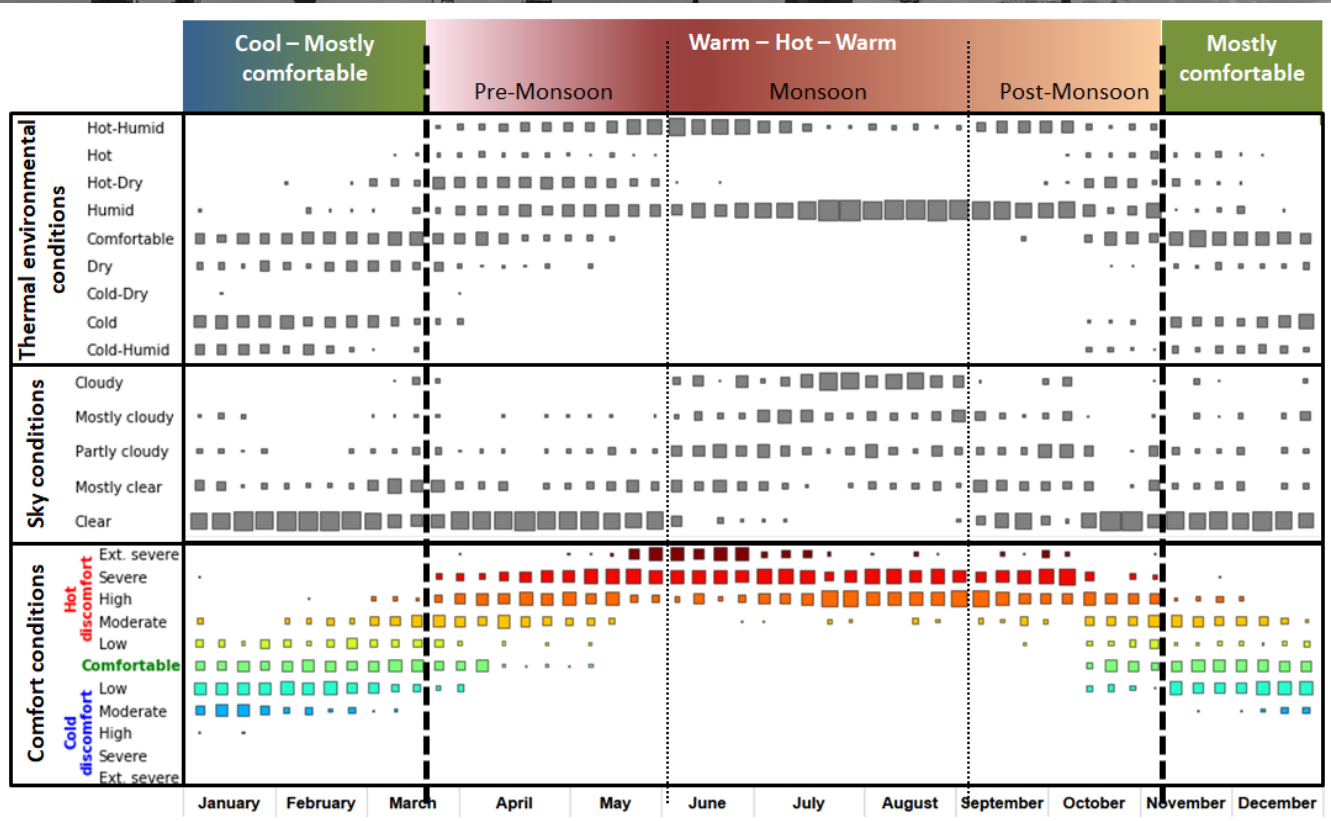


Ahmedabad climate outlook



Classified as

hot-dry



Torrent Research centre, Ahmedabad

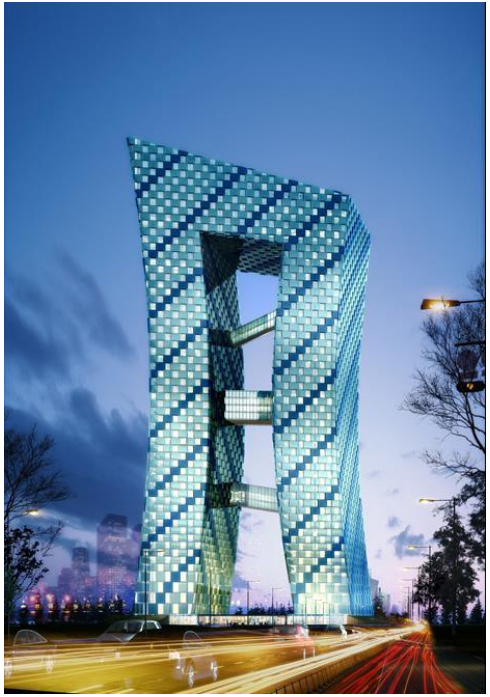
https://archnet.org/sites/4454/media_contents/17672

Torrent Research centre, Ahmedabad

https://archnet.org/sites/4454/media_contents/17675

Gift City, near Ahmedabad

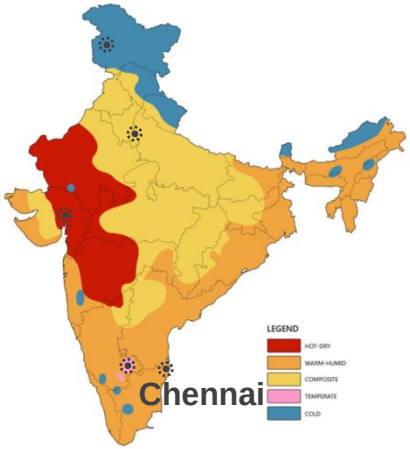
http://www.giftgujarat.in/photo-category#lg=1&slide=7



http://www.giftgujarat.in/photo-category#lg=1&slide=4

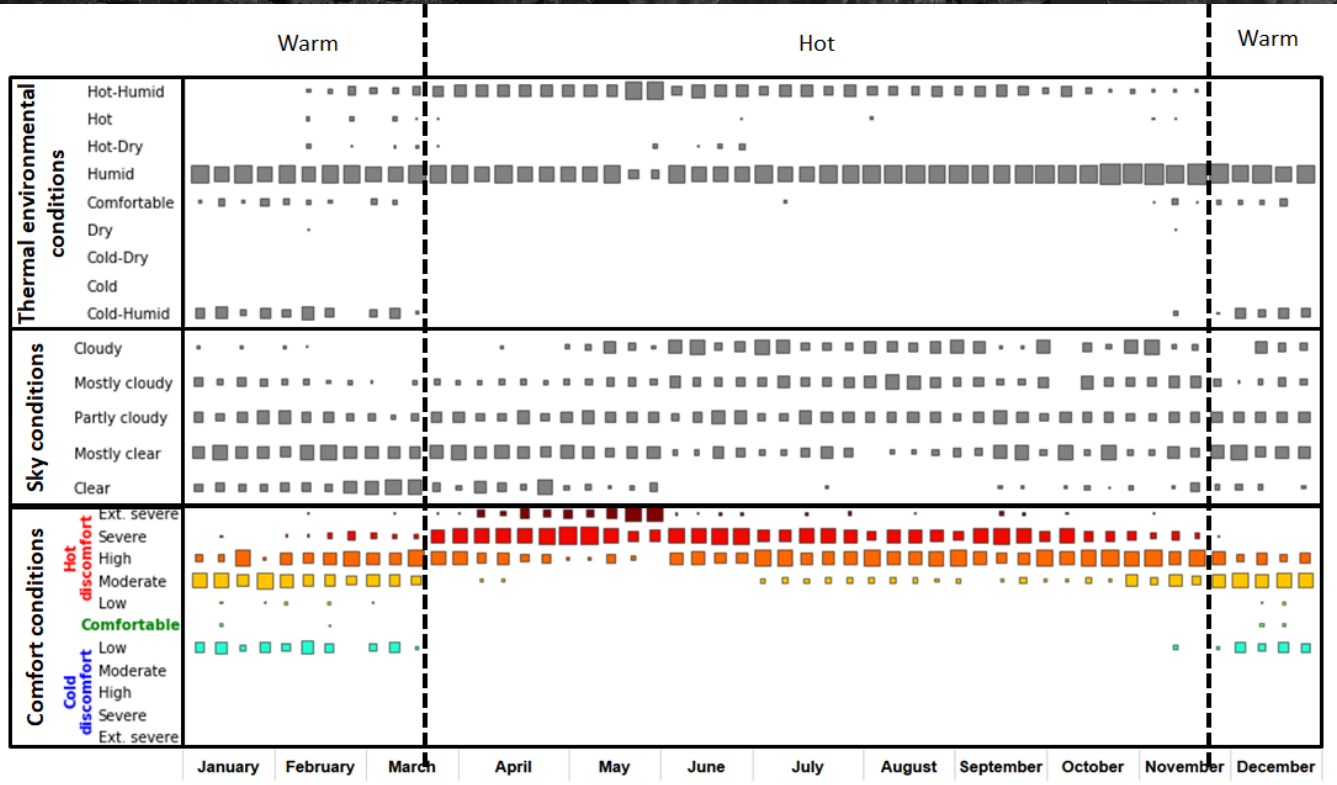
http://www.giftgujarat.in/photo-category#lg=1&slide=3

Chennai climate outlook

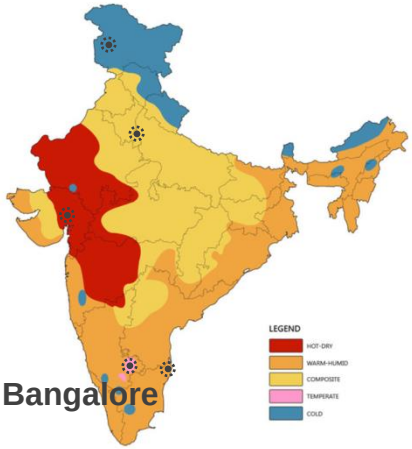


Classified as

warm-humid

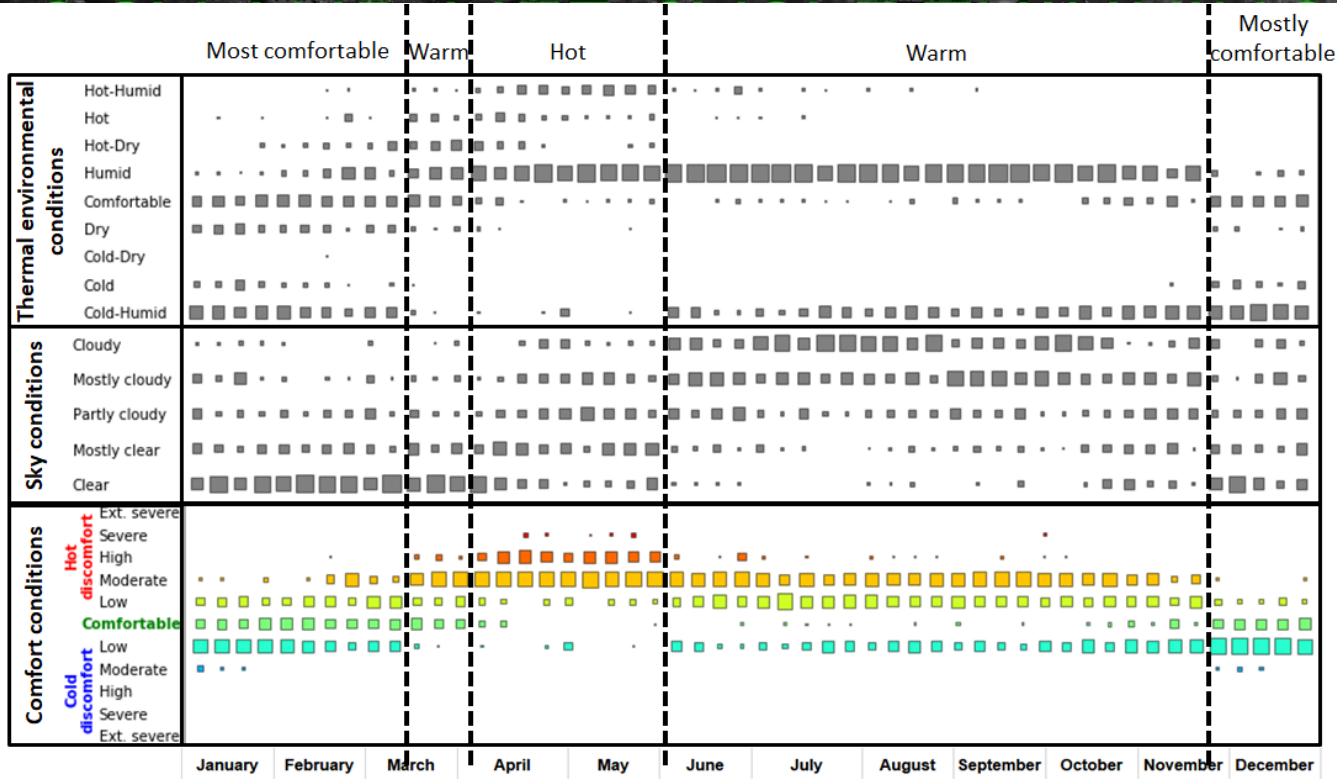


Bangalore climate outlook

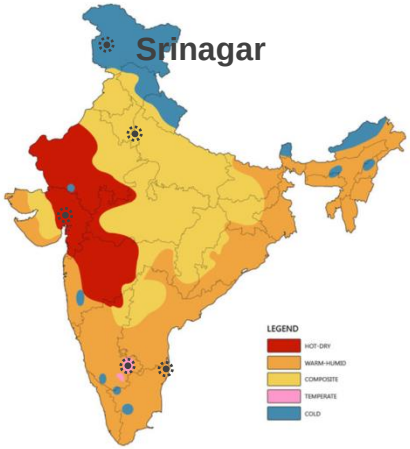


Classified as

warm-humid

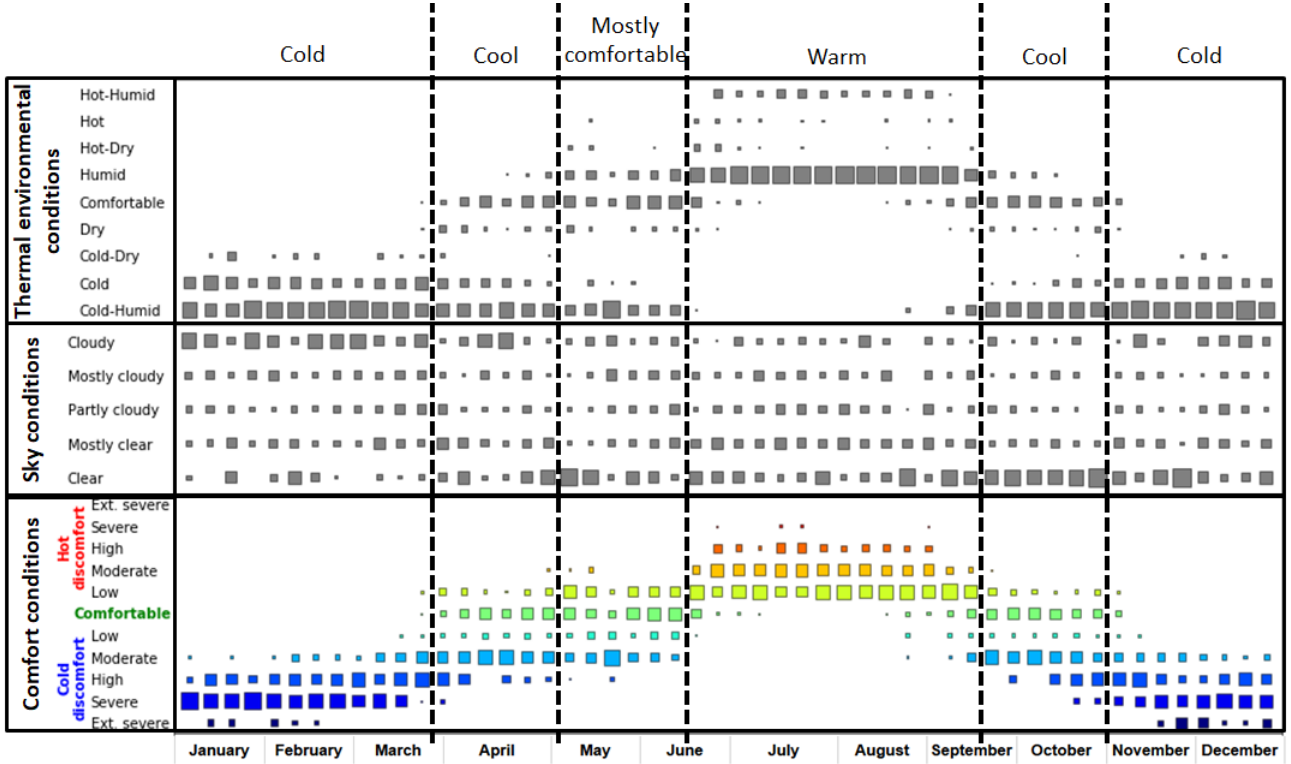


Srinagar climate outlook

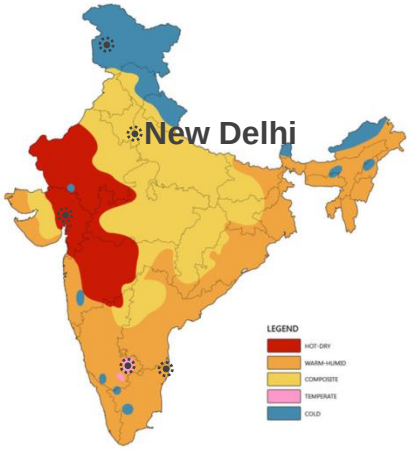


Classified as

cold

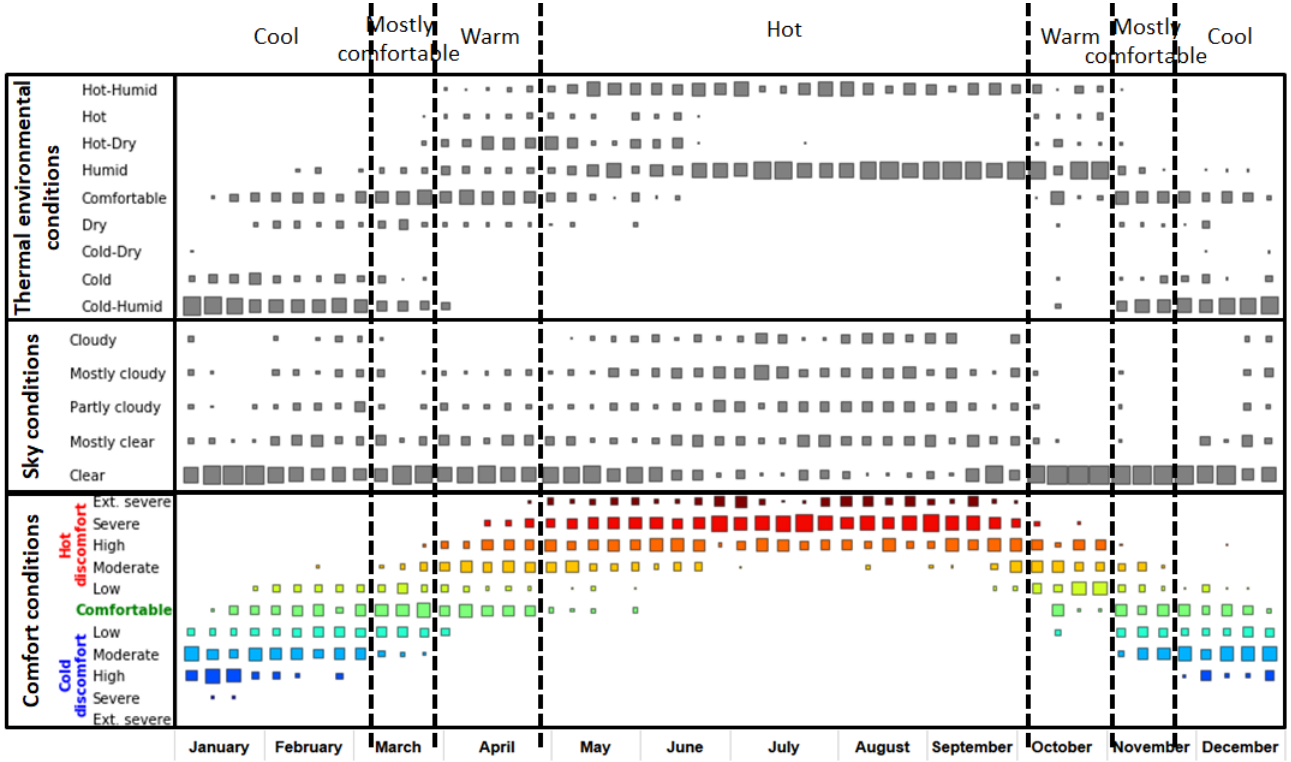


New Delhi climate outlook

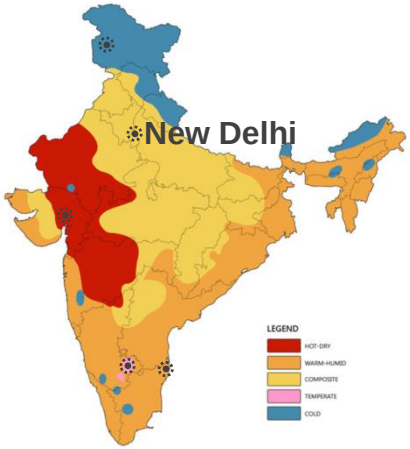


Classified as

composite



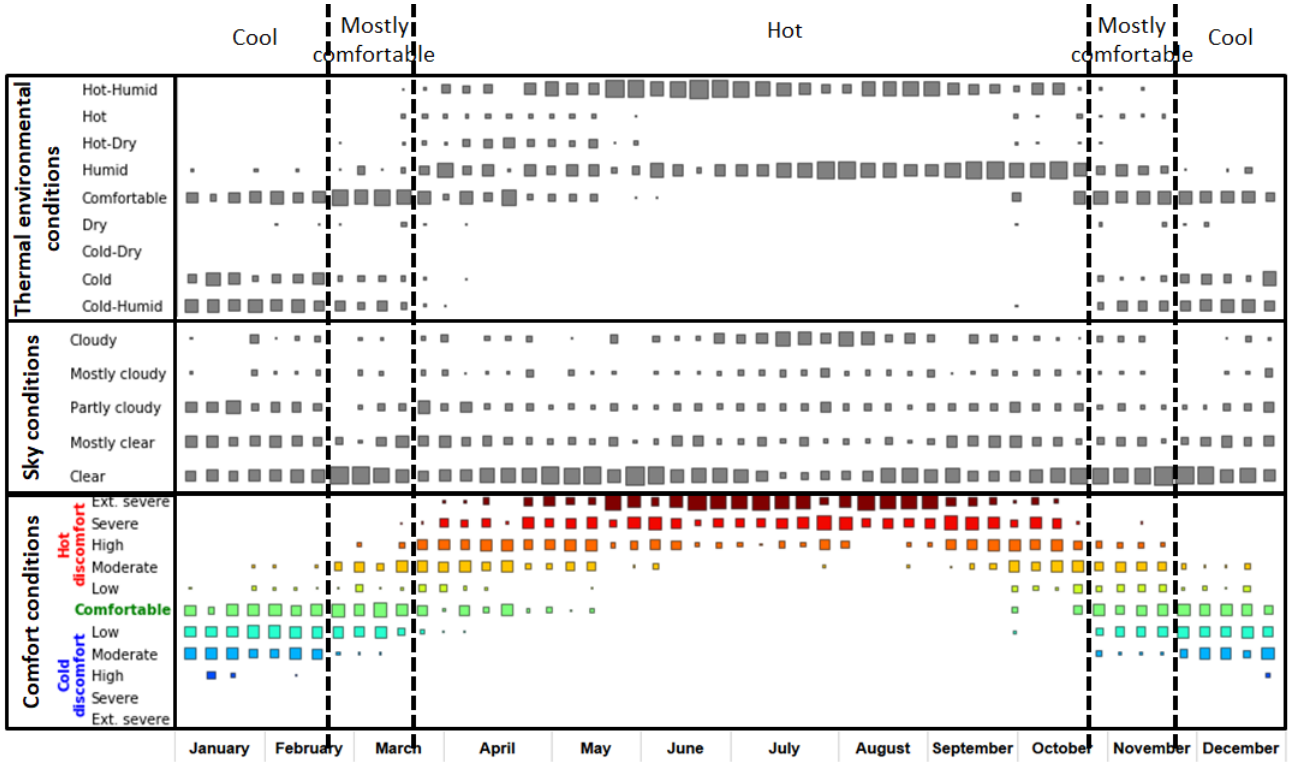
New Delhi climate outlook (2050)



should be Classified as

~~**composite**~~

predominantly hot with a brief cool period



Conclusions

- Architectural design can help moderating climate variables to achieve indoor comfort without significant energy input
- Architectural response for hot and humid conditions are not the same
- Current climate classification of India needs to be revisited for high performance buildings, particularly for cooling and heating
- Understanding of the local climate will help developing specific strategies to suite to the local context and also to changing climatic context

Thanks!

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