

Climatic resiliency for Indian cities



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Resilient urban climate

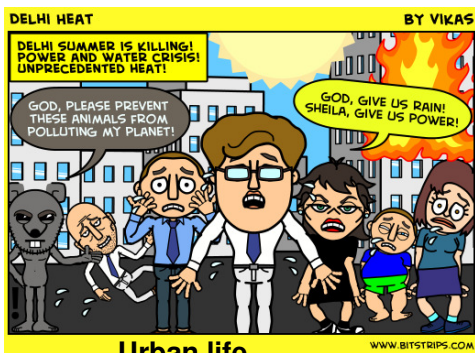
Resiliency means springing back into normalcy after being stretched

Reducing **resilience** increases vulnerability, exposing **urban** systems to greater **risk** of the vagaries of uncertainty and surprise

Climate risk reduction is one strong step forward to control **urban risk**

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Urban life

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Urban climate risk

Urbanization does more than just transforming ecosystems,

it also changes **fundamental variables** i.e. **CLIMATE CONTROLS** that influence **weather and climate**, such as land surface temperature, surface roughness, and evaporation.

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Climatic Controls

A number of factors influence the climates found around the globe. These factors are often referred to as controls.

- ➔ **MACRO CLIMATIC CONTROLS**
- ➔ **MICRO-CLIMATIC CONTROLS**
- ➔ **NEW URBANE CONTROLS**

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Urban climate risk

Modification of **CLIMATE CONTROLS** in **URBAN AREAS** are extreme; and it leads to **RISK** of **Unsustainable Urbanization**

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Macro-climatic controls

Latitude



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Distribution of water and land



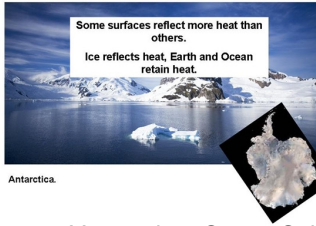
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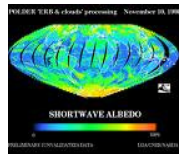


Earth surface

Albedo



Antarctica.



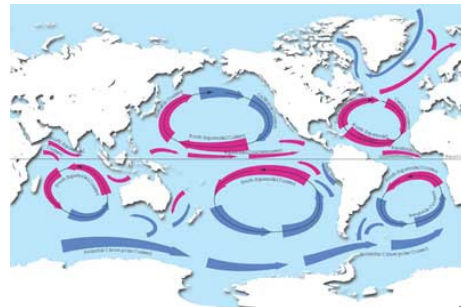
Vegetation, Snow, Soil, Water

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Circulation of water and air

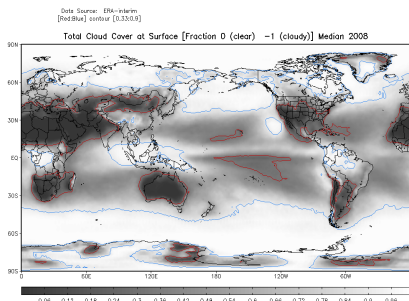


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Cloudiness



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Mountains



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Micro-climatic Controls

Issues:

- Distance from water-body
- Nature of soil
- Natural vegetation
- Neighbouring elements
- Climatic elements
 - Temperature
 - Humidity
 - Radiation
 - Wind

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New controls



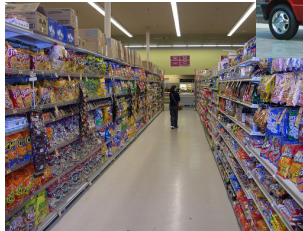
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New controls

HIGH CARBON FOOTPRINTS



CHANGED LIFESTYLE BASED ON HIGH DEMAND ON NATURAL RESOURCES

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Urban risk phenomena



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Urban heat island

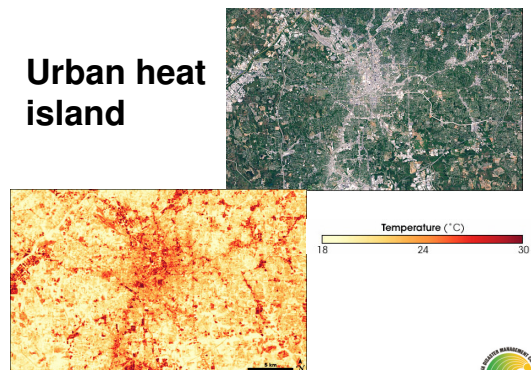
An **UHI** is an area of higher temperatures in an **urban setting** compared to the temperatures of the **suburban and rural surroundings**. It appears as an **island** in the pattern of clustered surface temperatures on a map.

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Urban heat island



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Urban heat island

The **urban heat island** affects the amount of energy a city needs to keep its residents cool and comfortable AND healthy

The influencing factors

- **Insolation**
- **Albedo**
- **Greenhouse gases, Dust dome, smog**

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Urban heat island

- **Vegetation-** soil, plant type, canopy size, evapo-transpiration rate
- **surface-** texture, colour, material
 - **horizontal** - pavement & roof: permeability
 - **vertical surface** –albedo, thermal performance
- **urban geometry-** height, setbacks,
- **water body**

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Earth surface character

Primarily change in **earth surface**

character singularly most important

contributor to the UHI and to the **climate**

risk problem as a whole

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Urban hydrological distress

- Urban **hydrological cycle** in Indian cities has become significantly erratic to face both the problems of **drought and flood**.
- Water level is going down, reason being
 - faster rate for tapping the ground water than refilling the aquifer,
 - reduced scope to recharge has also been minimized

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Water woes



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URBAN FLOOD

Urban setup is also facing flood situation due to natural and human intervention

– Natural causes

- high intensity rainfall
- erratic spatial distribution of rainfall
- inflows from rivers in the urban drainage system during high stages and
- topography

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URBAN FLOOD

– **Anthropogenic causes**

- Increase in imperviousness due to urban growth, resulting in large quantities of storm water
- Obstruction of natural waterways during urban development process
- Inadequately and improperly designed drainage system causing surcharge and results in street flooding
- Inadequate Street cleaning practice creating clogging of drains and street inlets. Choking of drains due to garbage, plastic bags

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URBAN FLOOD

– **Anthropogenic causes** contd.

- Filling up of local ponds
- Encroachments of drains,
- Extreme reduction of Garbage dumping places in towns
- Uncontrolled development in cities and towns
- Unplanned embankments which restrict the river width and play havoc, if breached
- Lack of public awareness etc.


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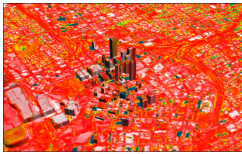
Mitigation policies

- **Monitoring climate risk**
- **Short-term problem solvers**
- **Corrective CONTROL modification**
- **Geo-engineering**

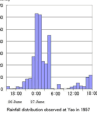
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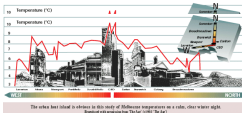
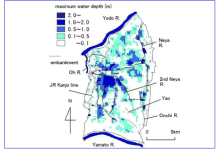


Monitoring climate risk




Microclimate area
Heat analysis for the
entire urban area




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Geo-Engineering

- Geo-engineering could slow or halt climate change by either restricting the amount of sunlight heating Earth's surface or reducing levels of carbon dioxide in the atmosphere.
- But they could also have disastrous side effects, such as stifling the Asian monsoons or altering the oceans' oxygenation or pH.

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Short-term problem solver



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Corrective CONTROL modification

- **Partially intervened CONTROLS**
 - soil
 - prevailing wind
- **Severely intervened CONTROLS**
 - Earth Surface
 - Natural vegetation
 - Water body
 - Air quality
 - Density, materials and height of structures
 - Population density
 - Changed livelihood pattern

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Corrective CONTROL modification

Earth Surface

- Soil cover
- Pavement
- Parking
- Roof surface
- Surface water body

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Corrective CONTROL modification

Urban heat island

- Plantations
- Pervious Pavement, Parking,
- Green Roof surface
- Surface water body retention
- Vertical surface- high albedo
- Urban geometry

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Corrective CONTROL modification

Urban hydrology

- Water body retention & introduction
- Rain water harvesting
- Reduction of runoff targets
- Permeable pavement & parking surface
- Maintenance of city drainage system

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Corrective CONTROL modification

Process to follow

- Regulations and byelaws
- Awareness through consultation
- R&D and implementation
- Demonstrations
- Technical & construction guidelines
- Incentives

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