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A risk-based approach to assessing climate impacts

Presentation by

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Outline

- Define *risk*
- *Risk* in the context of climate change
- *Risk* in specific climate domains in Africa
- Methods of quantifying *risk*
- Demonstration of *risk* quantification methods

Acknowledgement

- Members of the *Global Change Risk Analysis* project team

What is *risk*?

- Merriam Webster definitions:
  - possibility of loss or injury
  - the chance of loss or the perils to the subject matter of an insurance contract ; *also* **:** the degree of probability of such loss
- Uncertainty regarding the occurrence of some undesirable event
- Risk measured in terms of chance/probability of occurrence

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Why investigate *risk*?

- We want to be better informed
- We all want to be better prepared
- We want to better understand future trends
- Mitigation strategies more *practical* and *affordable* than rebuilding
- Gives us the window of oppurtunity

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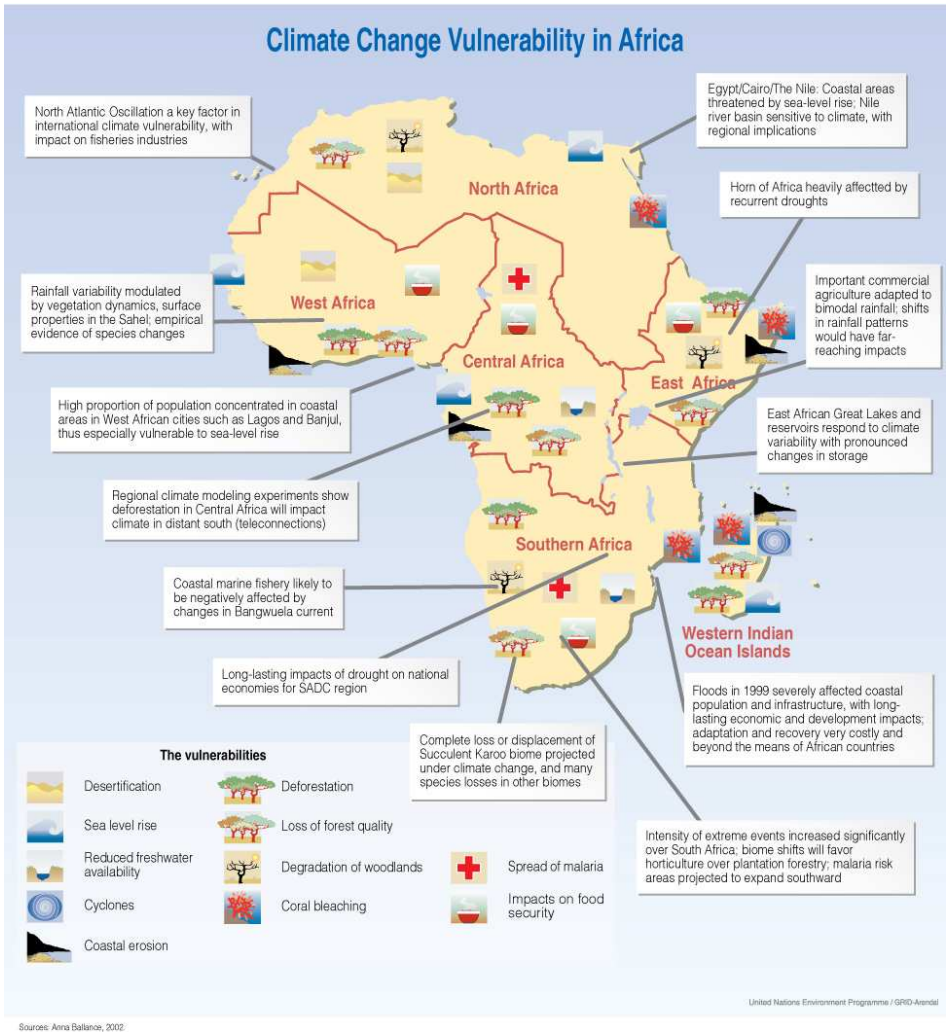
Risk and climate change



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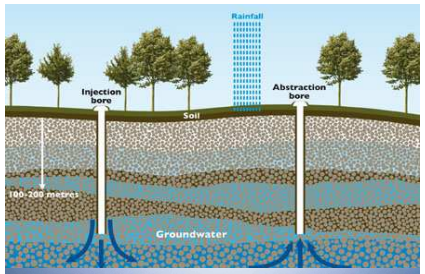

Risk in certain domains

- Ground water
  - Access to potable water is a key indicator of the quality of life
  - Agriculture fed by rainfall could drop by 50% in some African countries by 2020
  - Groundwater is sustained when the abstraction rate is < than the recharge rate in aquifers
  - Anticipated that both the *amount* and *frequency* of rainfall will affect the recharge of aquifers

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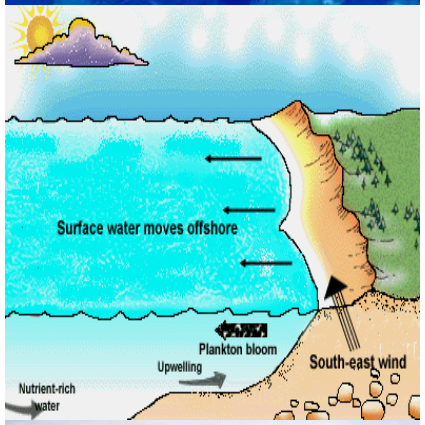
Risk in certain domains

- Wildfires
  - Africa accounts for about half of the area burned by wildfires throughout the world
  - Combination of fuel, weather and source of ignition
  - Threat to crops, livestock, infrastructure and human life
  - Models to predict the return period of certain *large* fire danger index days
  - Models to predict future area burnt



Risk in certain domains

- Benguela Upwelling
  - Upwellings appear as cold water anomalies from equatorial to subtropical ocean systems
  - Are highly productive
  - Account for a large fraction of global fisheries production
  - Becoming increasingly susceptible to effects of harmful algae blooms (HABs)
  - Can climate indicators be predictive of HAB events in upwelling systems?’

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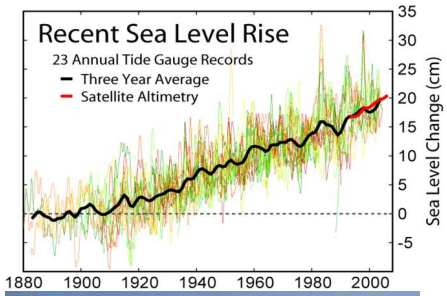


Risk in certain domains

- Sea level Rise
  - Fourth Assessment Report of the IPCC projects sea-level rise of 0.2-0.6m by 2100
  - South Africa's Coast: Perimeter ratio is 37%
  - Rise in sea level is an important risk to the country's coastline and port infrastructure
  - Interaction of changing storm intensities and wind fields can produce changes in sea conditions
  - Can we analyse relevant data to predict the return times of certain *extreme* high waves?

How to quantify risk?

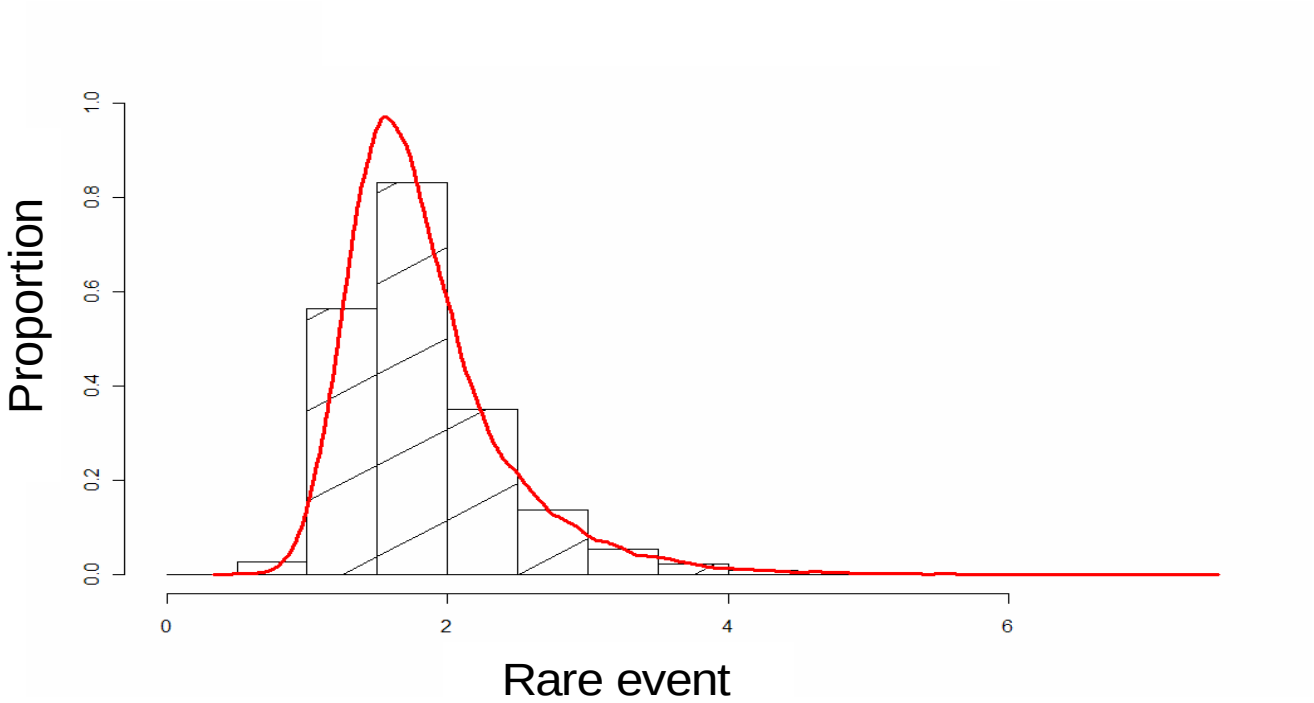
- Block Maxima Approach
  - For climate data, look for '*extreme*' values every year or season or month
  - If *Block=Year*, identifies *annual maxima*
  - Investigate behaviour of block maximas
  - Not all block maxima are serious
  - May be investigating too many *non-extreme* events
  - Is this a good approach?

How to quantify risk?

- Alternative - Threshold Approach
  - Look for data points over a *threshold* value
  - Choice of appropriate threshold value crucial
  - Too low ⇨ too many non-extreme events
  - Too high ⇨ too few data to investigate

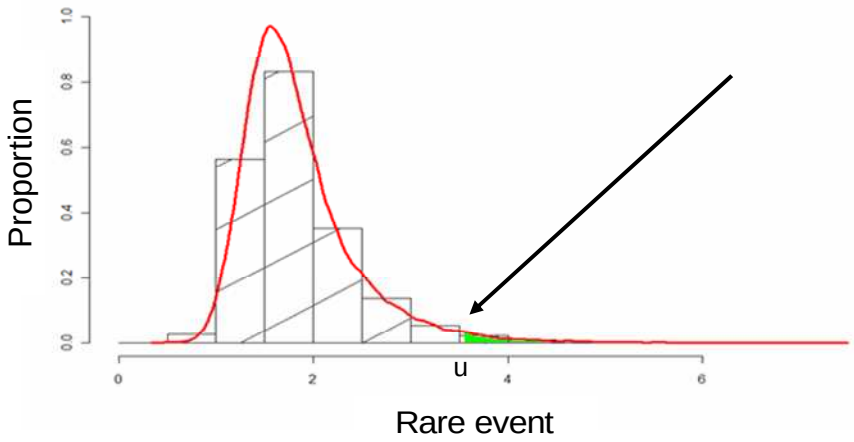
How to quantify risk?

- Behaviour of the ‘extreme’ events



How to interpret result?

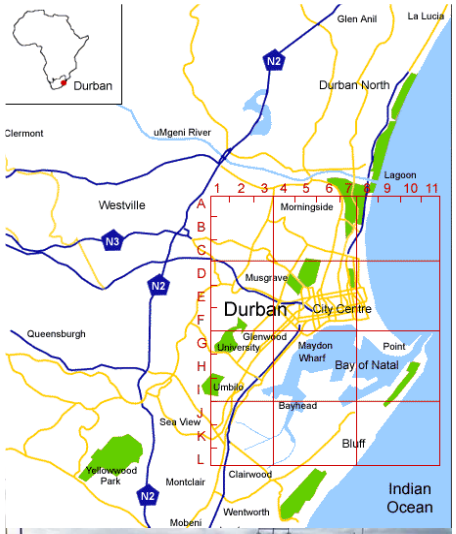
- Probability of event above a certain cut-off

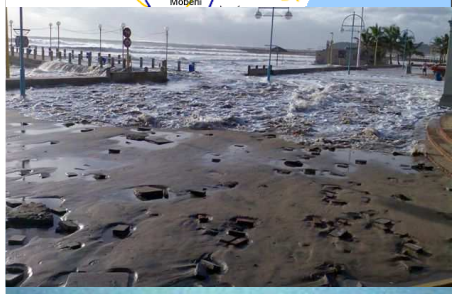


- Translate to return period terms where,

$$Return\ Period = \frac{1}{Prob.of\ \ event}$$

$$If\ \ Prob.of\ \ event = 0.01, then\ Return\ Period = {}^{1}\!/_{0.01} = 100$$





Example motivated by the Durban storm of 2007

- 19th March, 2007 along the eastern coast of S.A.
- Caused serious damage to coastal infrastructure
- Data simulated by NCEP* of 11 years of 8-hourly HMO data from 1997 to 2008
  - Not related to the 2007 storm
- Perform both models to estimate return period
  - Block maxima method: *Block=calendar month*
  - Threshold method: *at 3.8 m*

*: National Centers for Environmental Prediction

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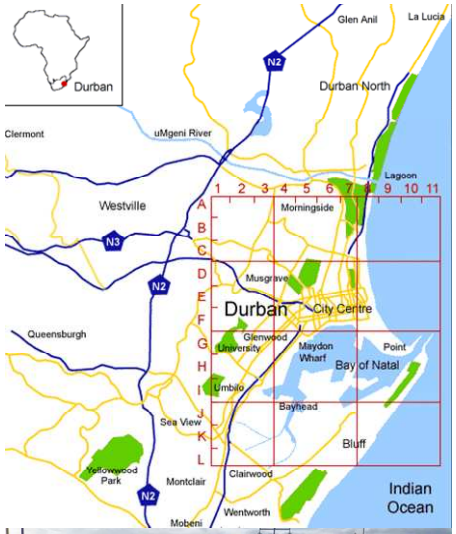
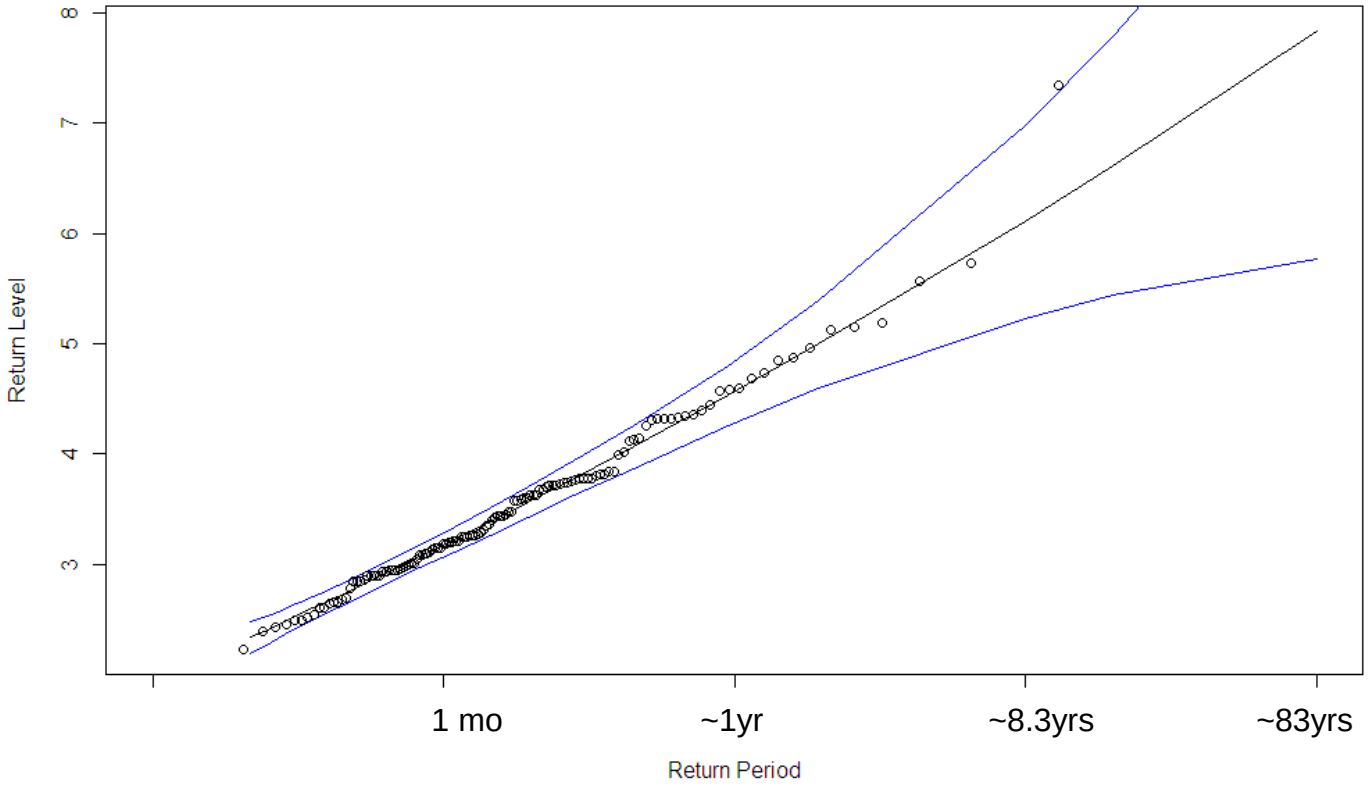


Example motivated by the Durban storm of 2007

Figure 1: Return period using block maxima method



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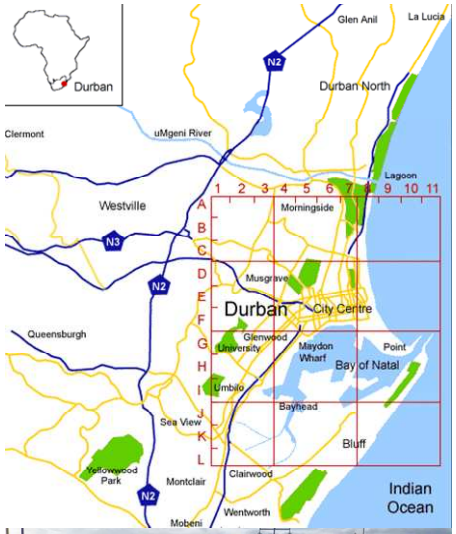
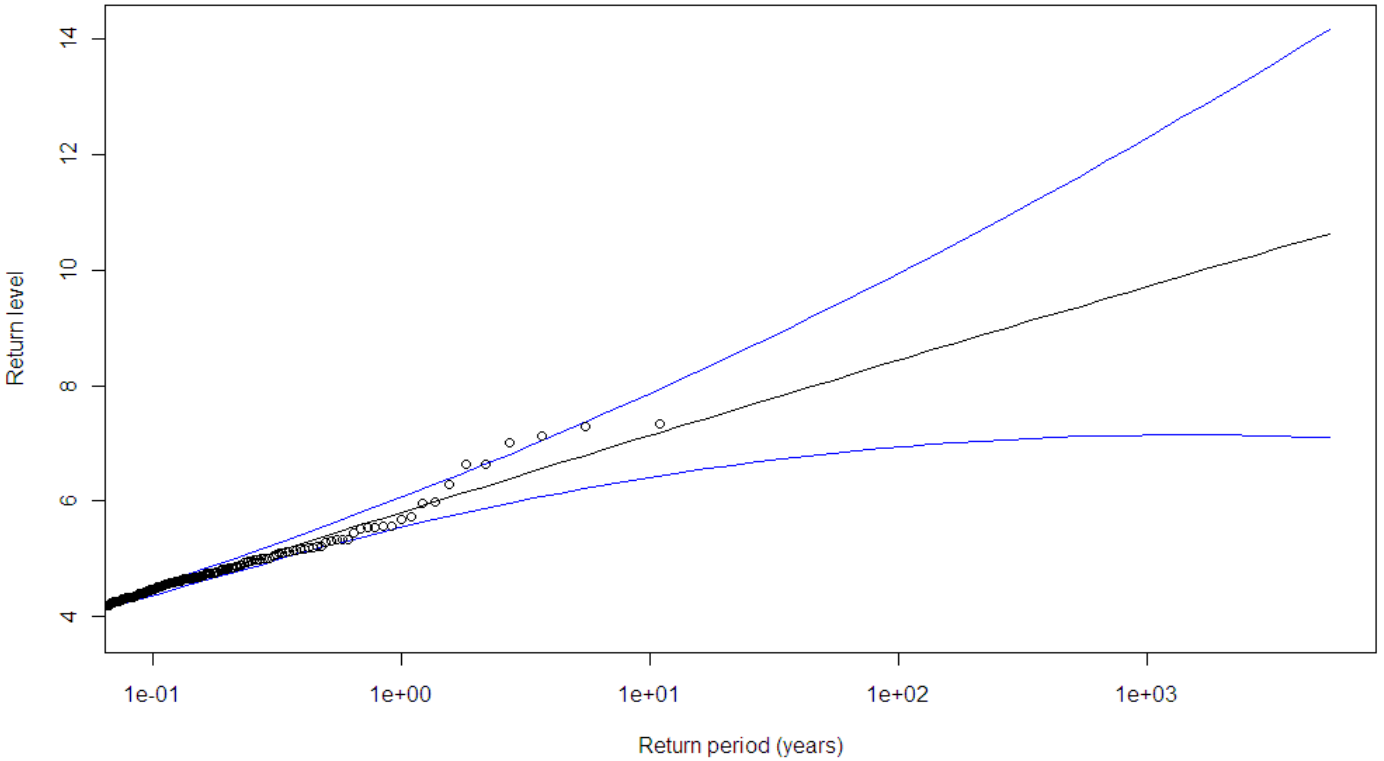


Example motivated by the Durban storm of 2007

Figure 2: Return period using threshold method



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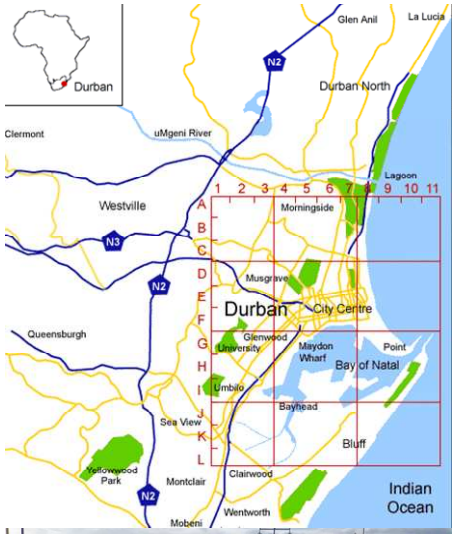

Example motivated by the Durban storm of 2007

- Results not to be literally interpreted
- Demonstrates how risk can change when using different models with different specifications
- Dependent on the realism of the artificially generated data

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Risk Analysis and the Role of Stakeholders

- Governments, industry and individuals
- Undertake *evidence-based* policy and decision making
- Need to understand the *scope* and *limitations* of risk modelling
- Need to understand the interpretation of results
- Communicate risk measures to all stakeholders
- Enhancing participation in strategies to adapt to changing climate

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Risk Analysis and the Role of Stakeholders

- Probabilistic results can be inputs to economic models
- Translate risk probabilities into Rand terms
- *Practical* and *affordable* to react sooner than later
- Need local measuring stations for regional data
- Need funds to bolster climate risk assessment at the regionally relevant levels.

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Thank you

Images source: CSIR and Google

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