Modelling tropical forest microclimate using remotely-sensed data

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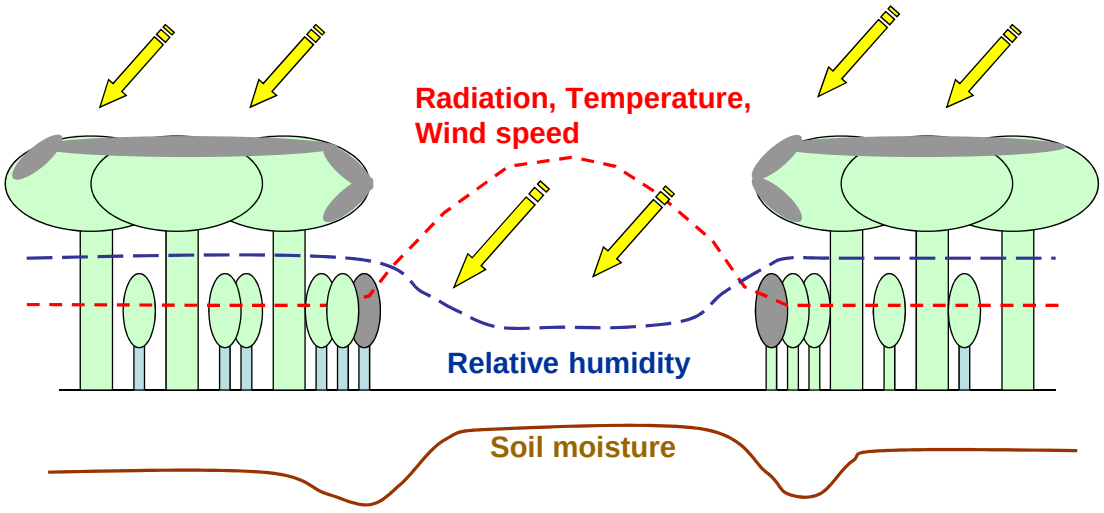
Introduction

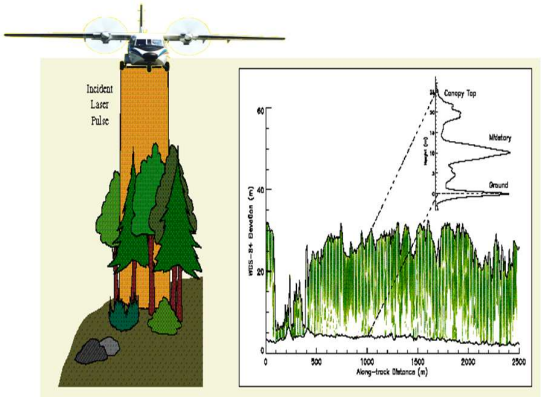
- Wind throw often creates canopy gaps which can dramatically change the microclimate and soil water balance (Abd Latif & Blackburn, 2010).
- Microclimate influence the regeneration dynamics and habitat properties.
- Understanding the microclimatic conditions in canopy gaps is a prerequisite in developing and improving techniques for forest management and conservation practices.

Hypothesis



Gradients of microclimate conditions and soil moisture in a treefall gap. The grey areas on the vegetation are parts of the crowns that receive direct solar radiation.

- Information is scarce on:
  - how precisely gap size and shape affects the microclimates within canopy gaps and beneath surrounding tree canopies
  - how the spatial distribution of gaps influences microclimate across entire forest stands.
- Remote sensing is increasingly seen as an important tool in forest studies where spatial properties of trees can be obtained over large areas



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Field Measurement

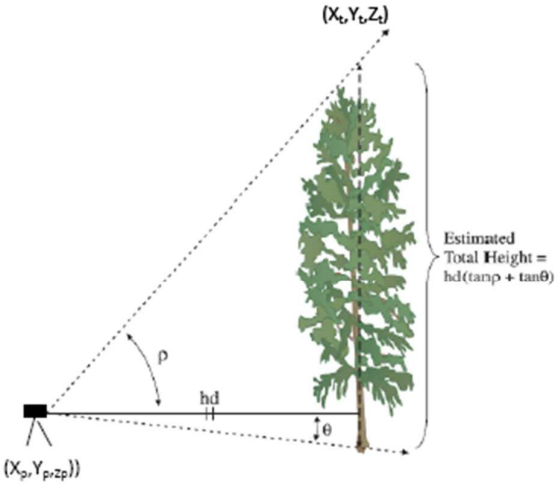
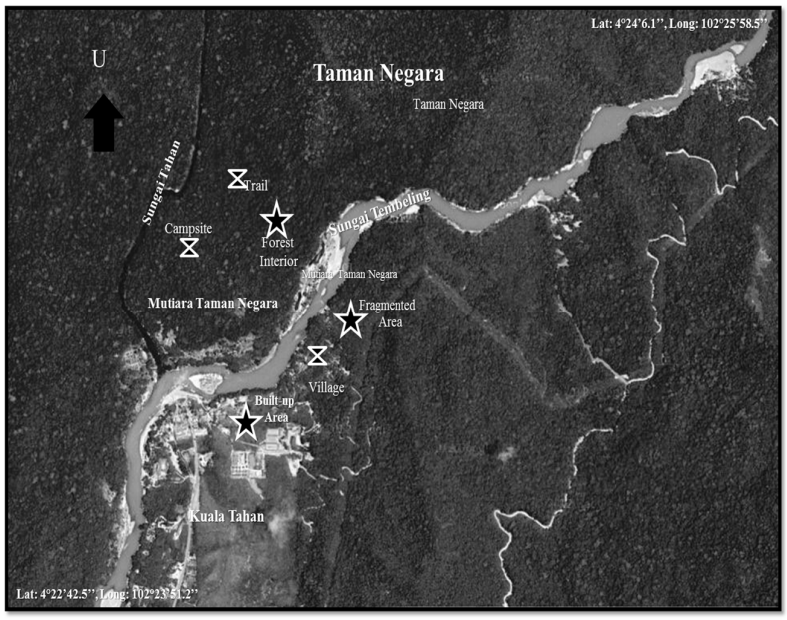


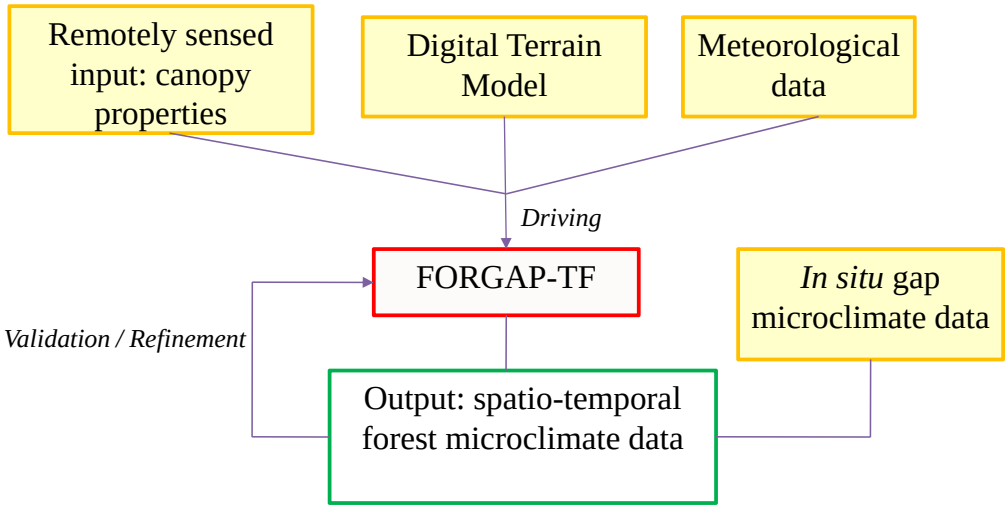
Figure 6.1 Conventional method of measuring total tree height in the field using trigonometric and surveying techniques.

Study area

- The study area is located at Kuala Tahan, Pahang (known as Pahang National Park).
- Six points were selected in an accessible area at the entrance of Pahang National Park and its surrounding area. The points indicated as star and hourglass are locations where automatic weather stations and temperature data loggers (Tinytag) were placed respectively.



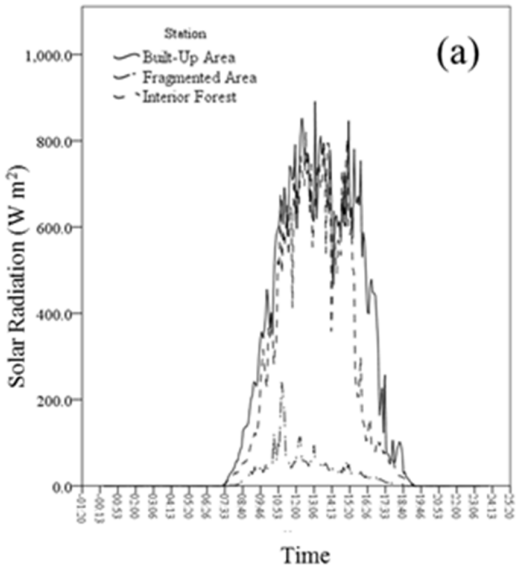
Methodology

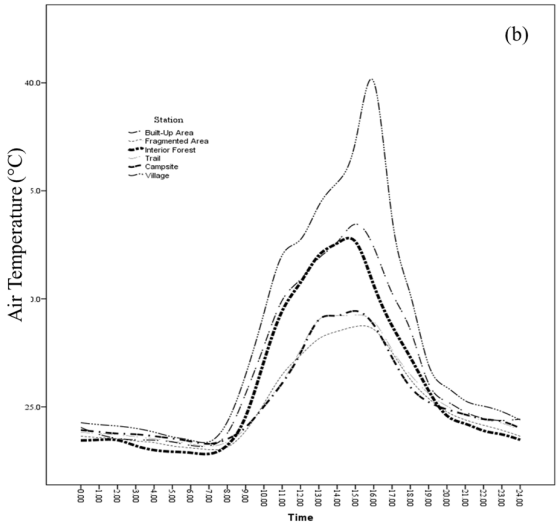


Methodology

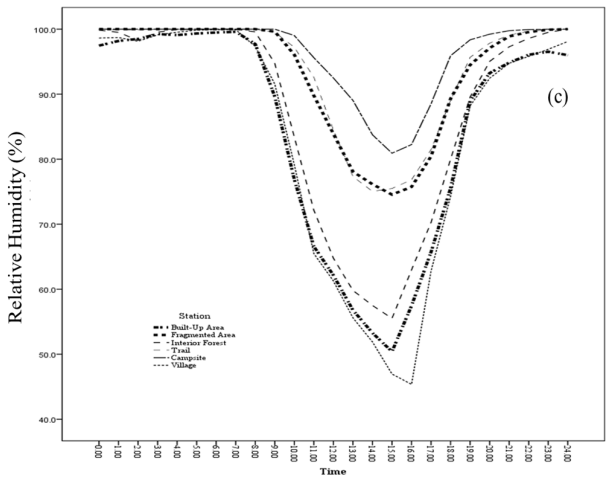
- The points indicated as star and hourglass are locations where mobile weather stations and temperature data loggers (Tinytag) were placed respectively.
- The microclimate measurements of seven days were observed (Julian days: 52nd-58th, 2012), results from only five days (53rd-57th,2012).
- The measured microclimate parameters are solar radiation (I), air temperature (Ta), relative humidity (h), wind speed (v) and rainfall (r) .

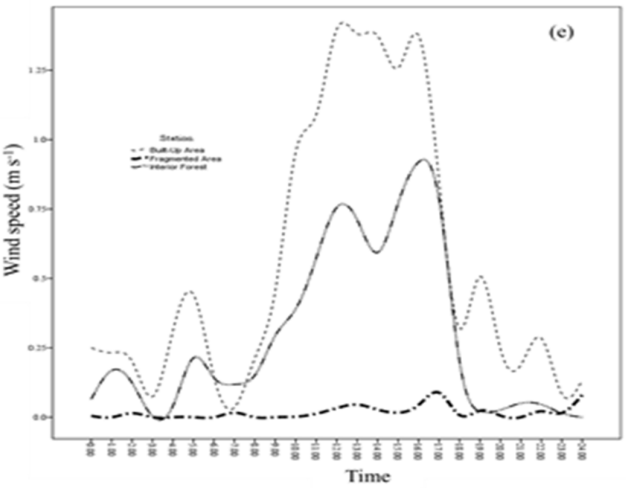
In-situ microclimate data





In-situ microclimate data





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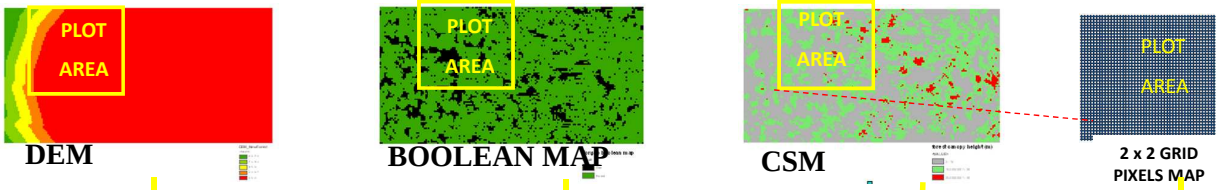
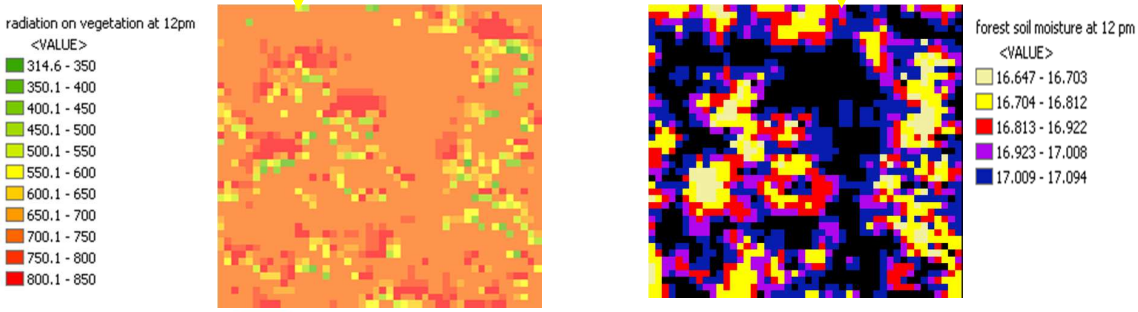
Forest microclimate modelling

- FORCLiM-TF model was developed based on previous reviewed literature and *in-situ* field measurements.
- Written using a dynamic script modelling language, PcRaster.
- Comprises 2 sub-modules, radiation and soil water balance.
- Driven by spatial inputs from remote sensing (canopy height, gap map, LAI, DEM, canopy extinction coefficient map) and meteorological data from a nearby weather station.
- FORCLiM-TF model generated outputs both spatial and temporal estimates of forest microclimates.





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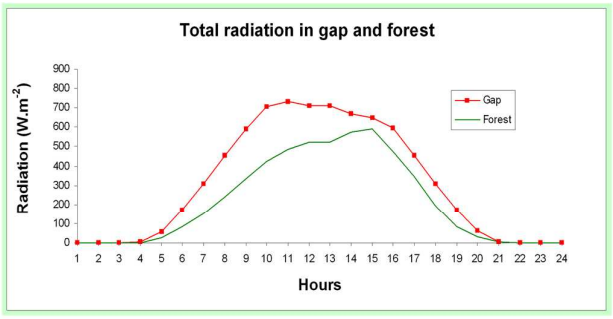
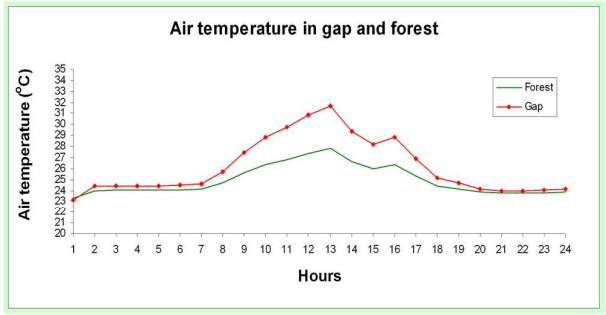
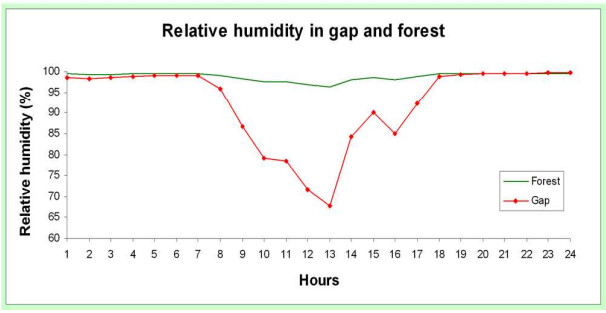
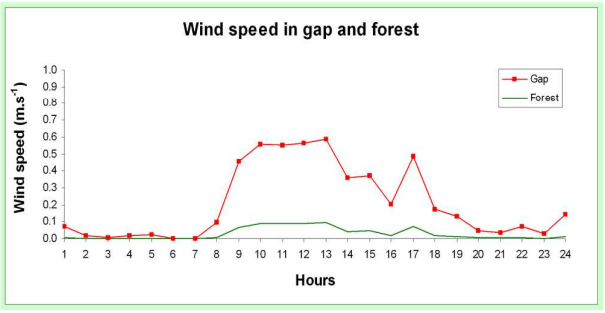
Results

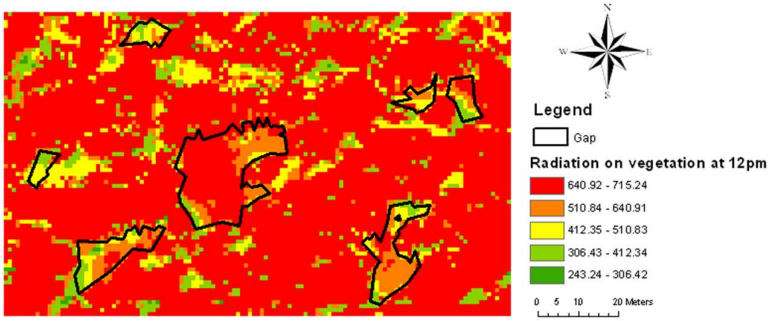


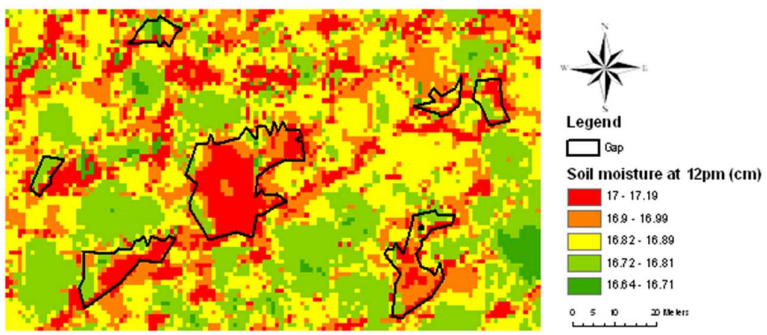






- Spatial outputs of microclimate condition (total radiation) and soil moisture for a specific time point (solar noon) which illustrate the detailed spatial information that the model is able to generate.





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Conclusion

- This study has demonstrated that it is possible to drive a simulation model using gap and canopy data derived from remote sensing in order to generate spatial and temporal estimates of microclimate and soil water content.
- Preliminary results have supported hypotheses established for the study.

Acknowledgement

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Thank you for your attention!

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