

The geosensor network experiment in the Atlantic forest

Humberto Rocha

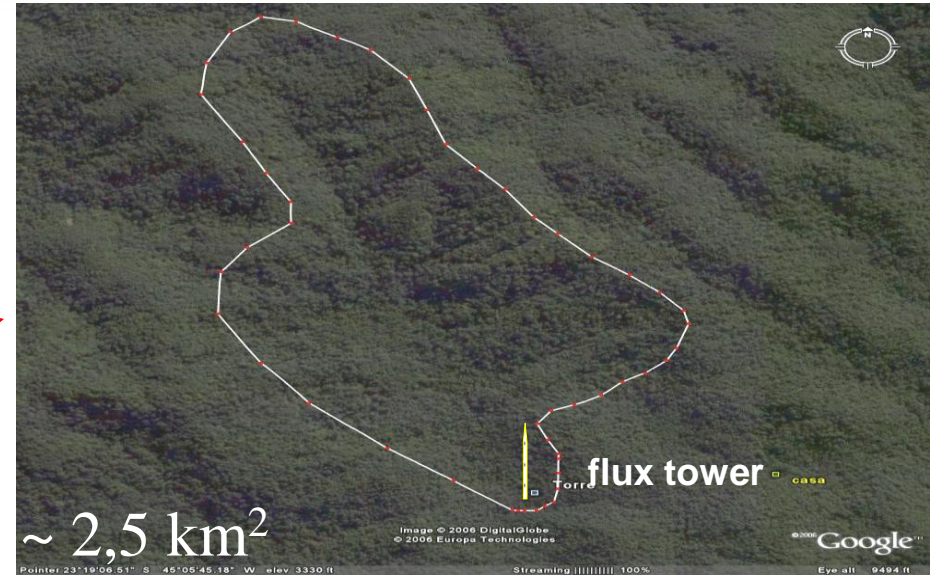
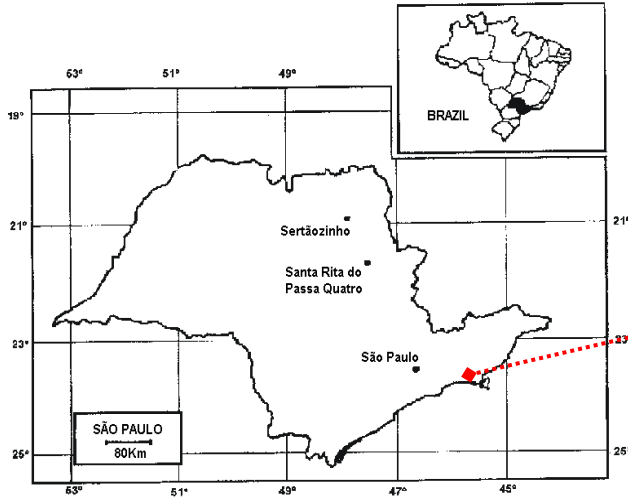
The Atlantic forest geosensor experiment

- What was it ?
- An experiment to survey canopy forest climate variables in an Atlantic Forest parcel in Brasil,
- which deployed motes (unities w/ thermometers, hygrometer, data logger and wifi transmission), installed in a physical network of towers built in the woods during ~one month in Dec 2009.

An historical of the Atlantic forest experiment

- Feb 09 exploration of possibilities
 - J. Salles/MSR, C. Nobre/Inpe, H. Rocha/Usp, A. Terzis/JHU, R. Fatland/MSR
- May 09 Visit to field site in Nucleo Santa Virginia
 - + H. Freitas/Usp, N. Neres/Usp; D. Carlson/JHU
 - support of Gradiente Funcional project C. Joly/Unicamp & L. Martinelli/Usp
- Jul 09 fund raising, towers' building & instrument assembling
- Sep 09 Field instalation aborted
- Nov 09 Field campaign (19 Nov – 18 Dec)
 - + von Randow and M. Santana/Inpe
- Feb 10 Instrument post-calibration
- Apr 10 preliminary data (Latam Faculty summit)
- Nov 10 Further analysis and planning for Amazonia

Sítio Experimental: Nucleo Santa Virginia, Parque Estadual da Serra do Mar



Ribeirão Casa de Pedra Watershed

60m flux tower with meteorological instrumentation (23° 19' 42.5" S; 45° 05' 35.2 " W)



The instrumental design

**Geosensor unit (mote) included
4 encapsulated sensors:**

3 thermometers (thermistor)

1 hygrometer (humicap)

**w/ shield, cables, box w/ circuit
board for data logger, battery
and node-to-node transmission**

(JHU & MSR manufacturing)

**Total 52 motes(156
thermometers; 52 hygrometers**

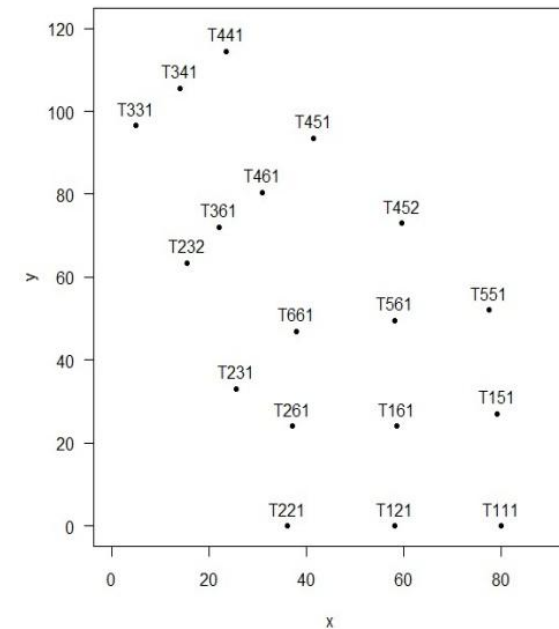
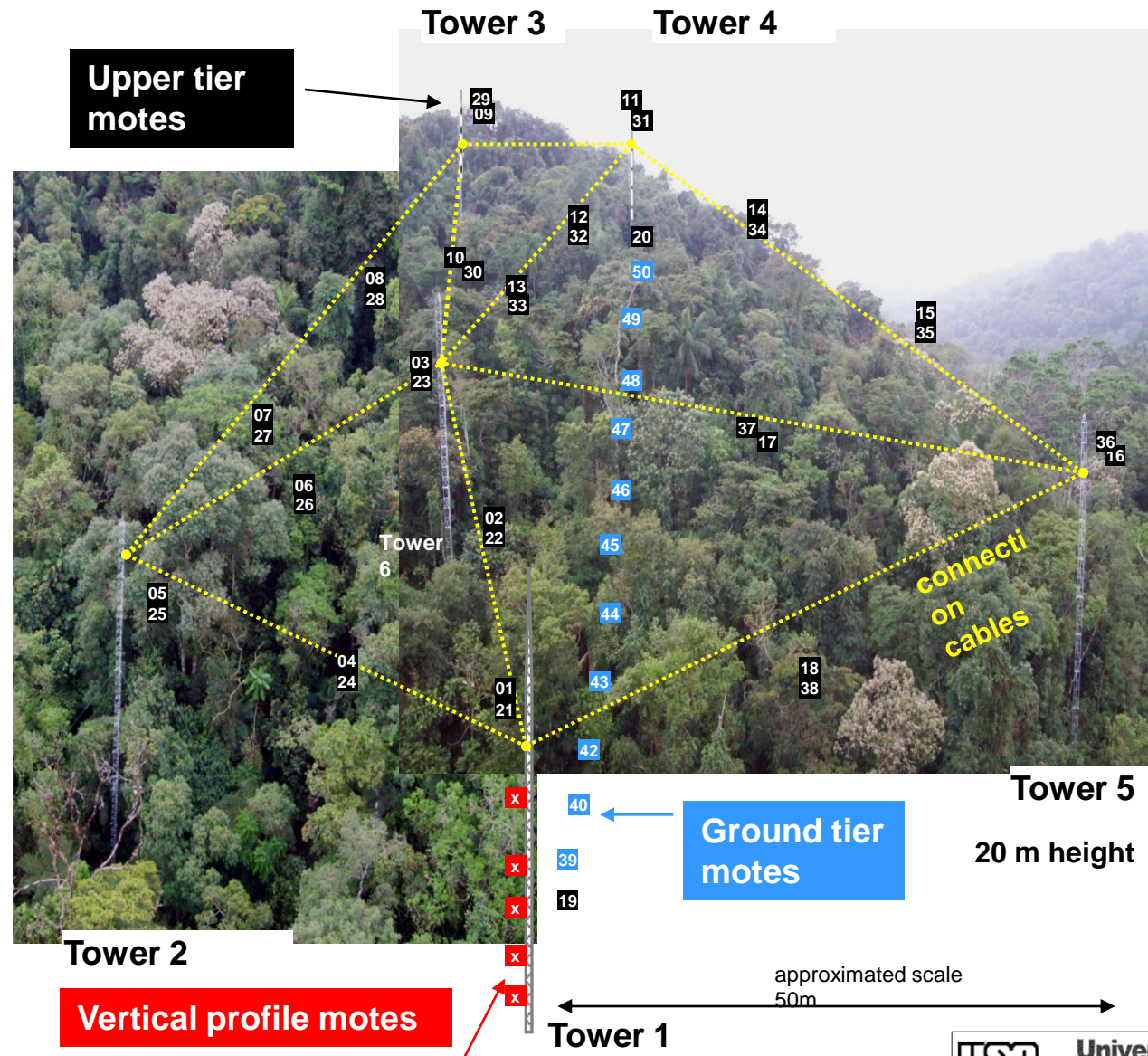


The network in the woods



Network in the Atlantic Forest, which includes five 25m towers linked by Kevlar cables. The network was placed east of the main tower, along an altitudinal transect of ~60m height.

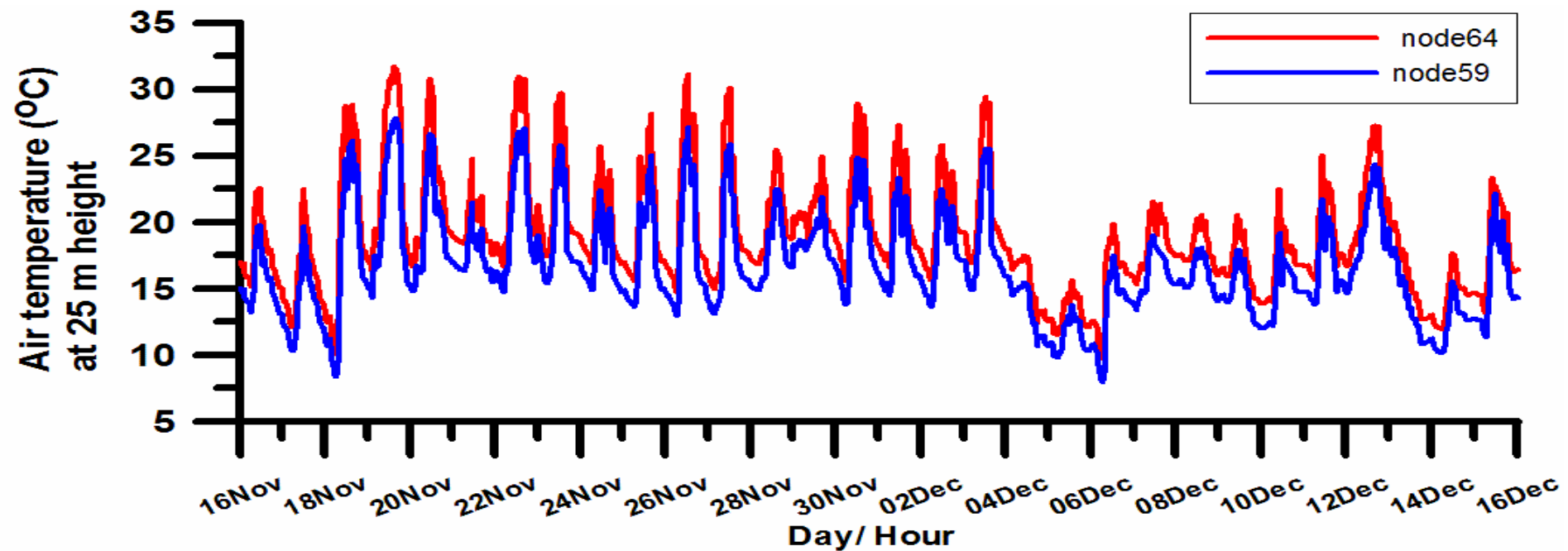
Geosensor network in the Atlantic forest : experimental design



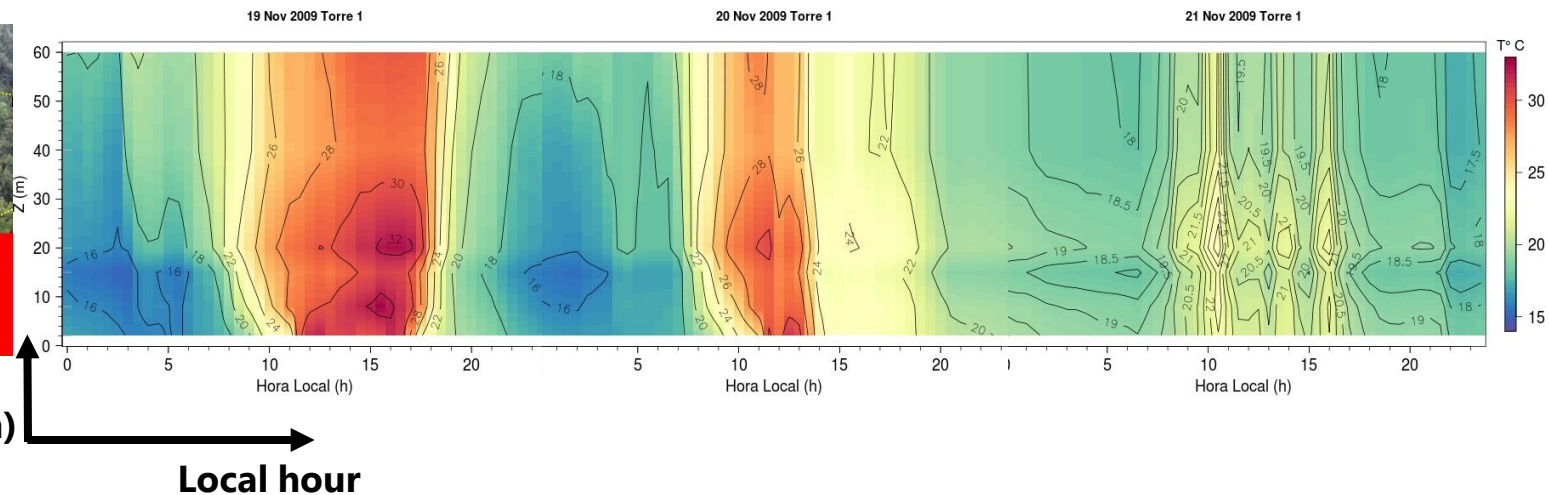
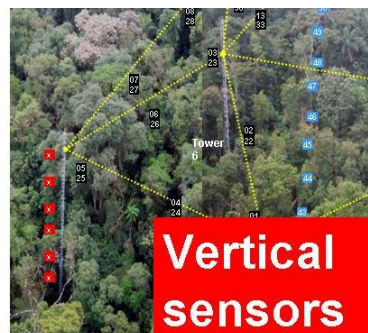
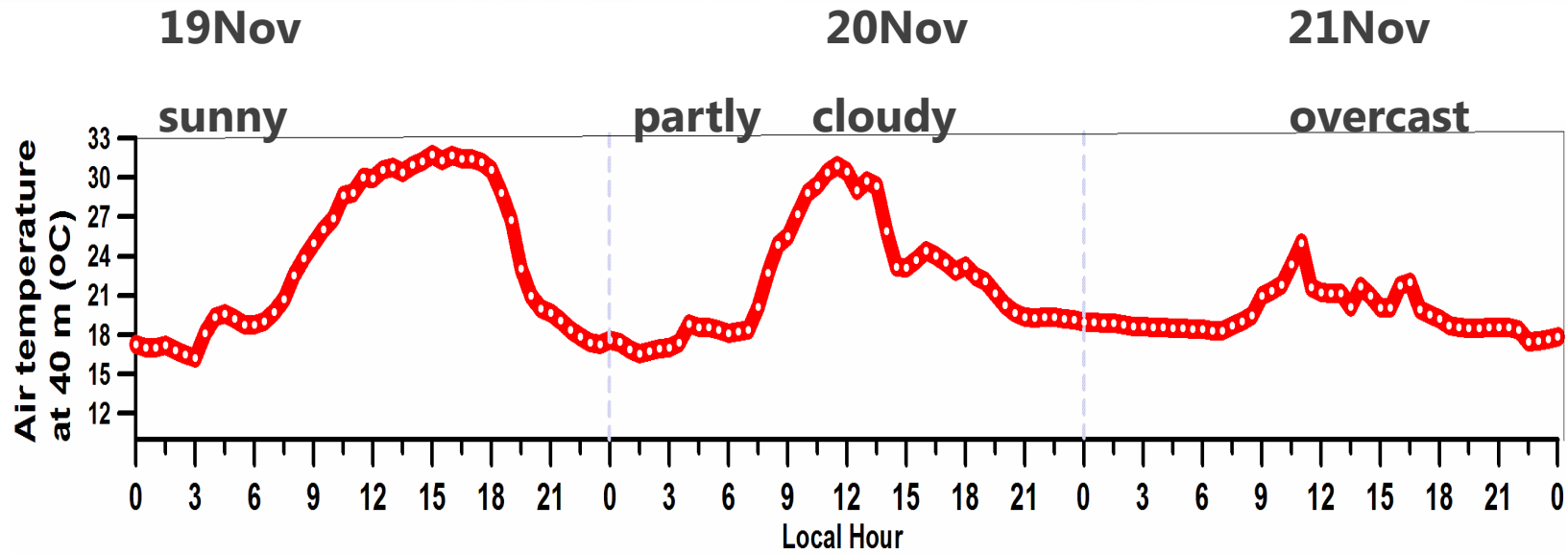
Upper tier with 18 nodes

Temporal variability at 25 m height

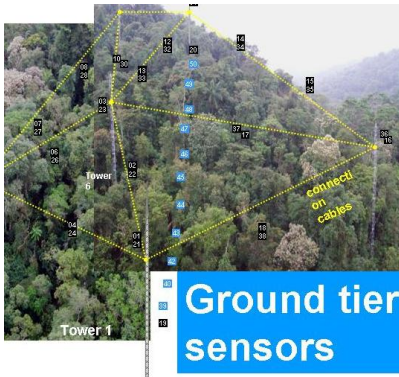
Period of measurements: 16Nov-18Dec 2009



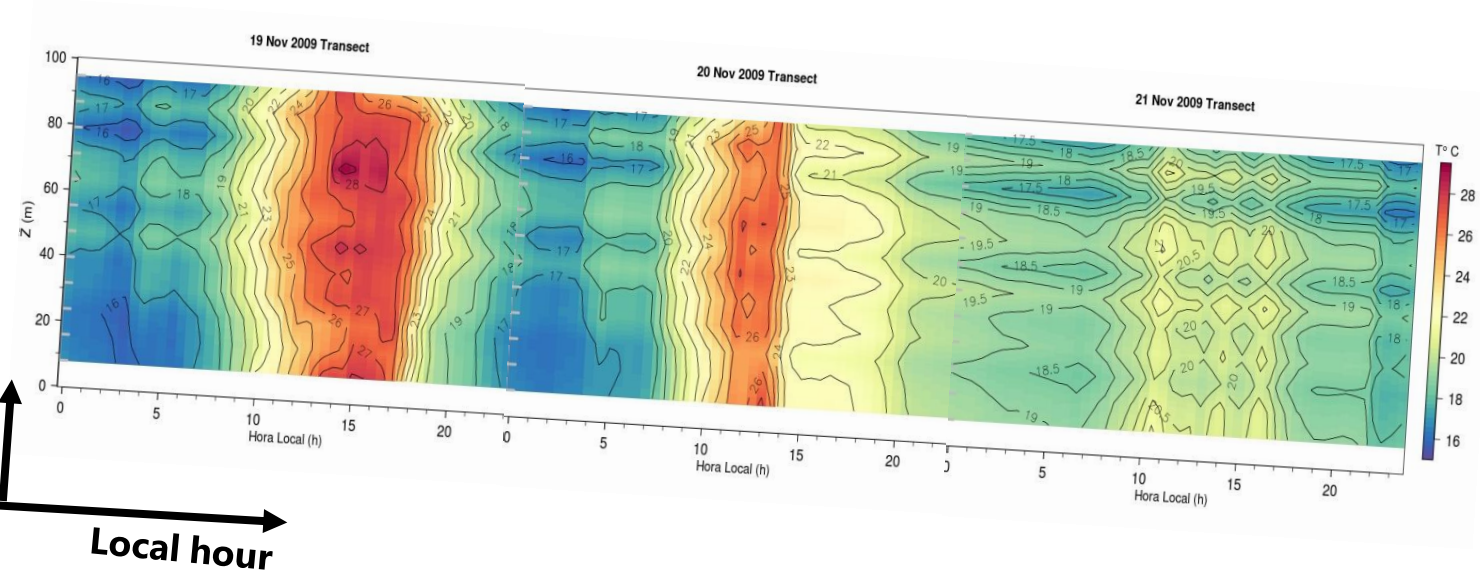
Variability within the canopy



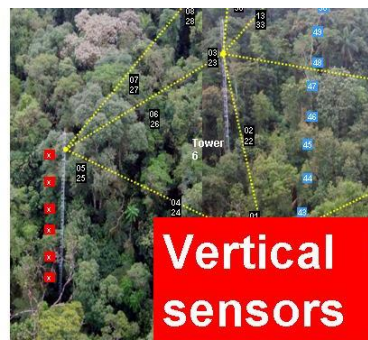
Variability within the canopy



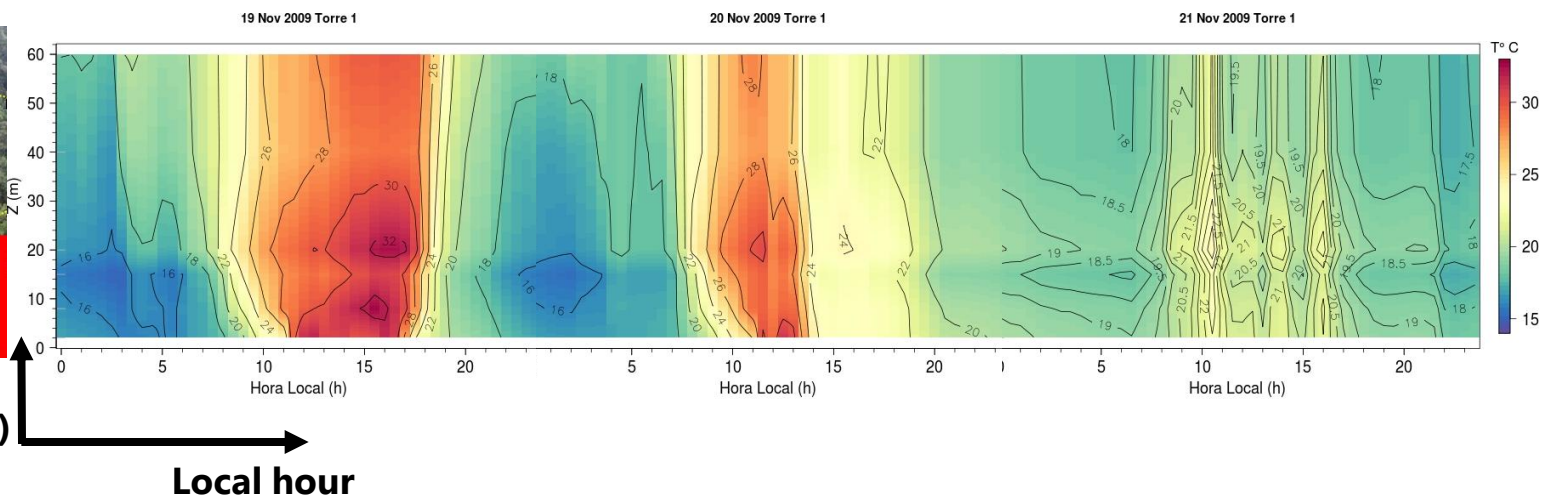
Horizontal distance on the ground (m)



Local hour

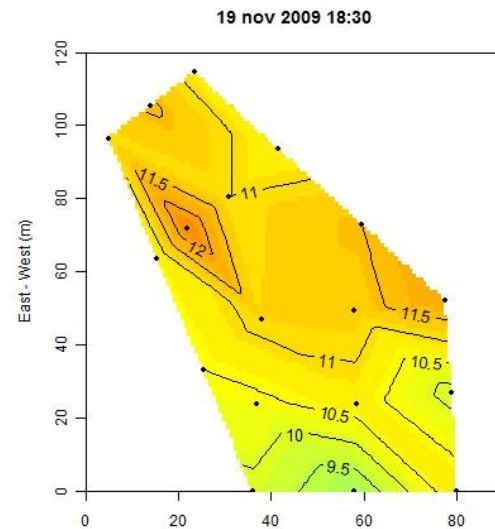
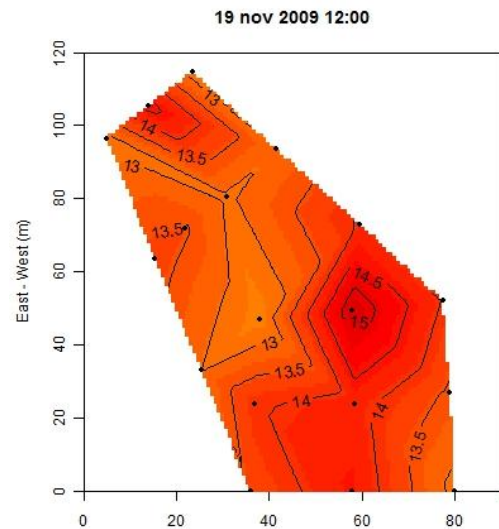
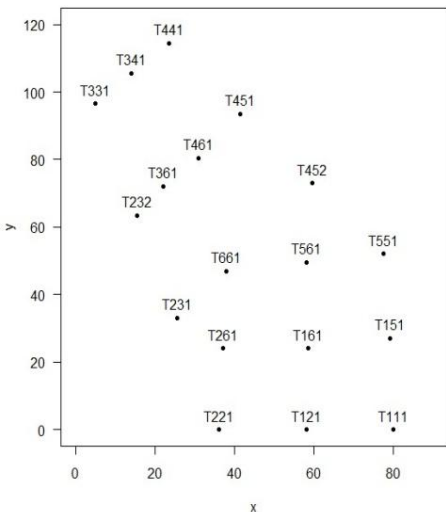
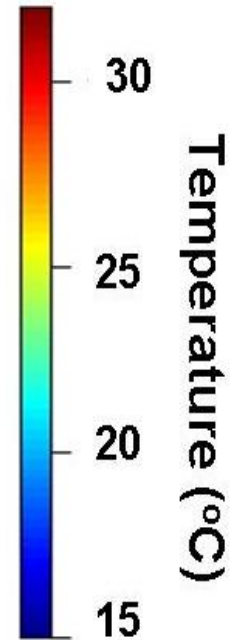
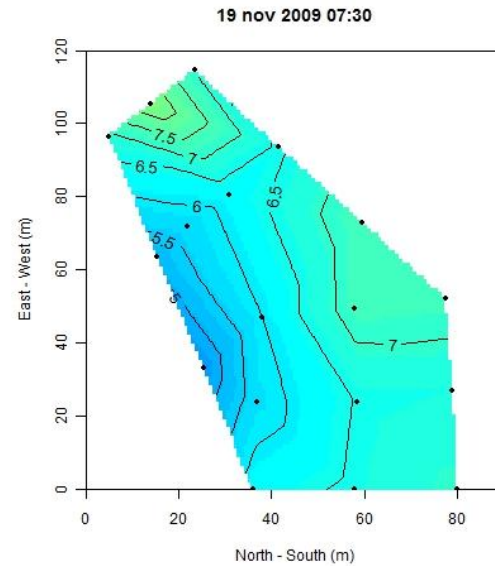
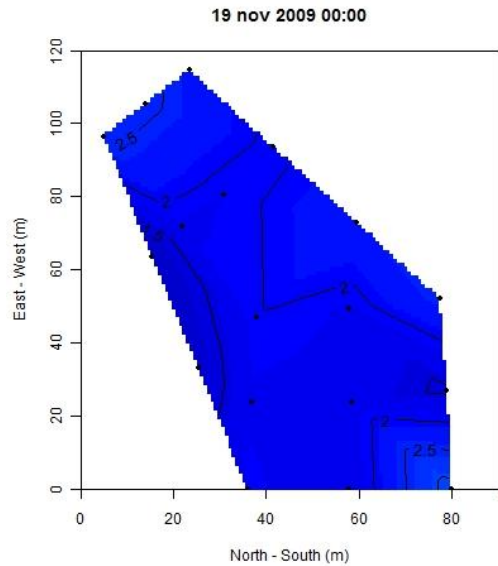
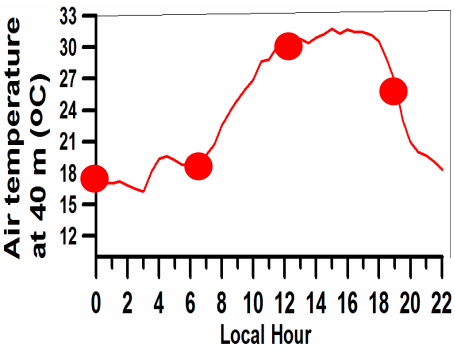


Height (m)



Local hour

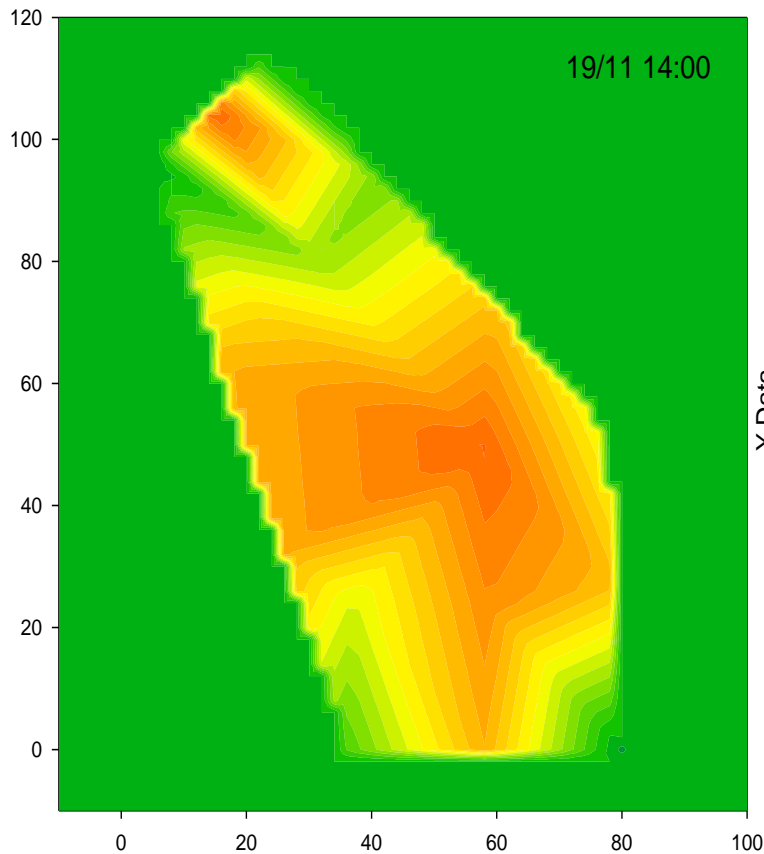
Viewing spatial variability at upper tier



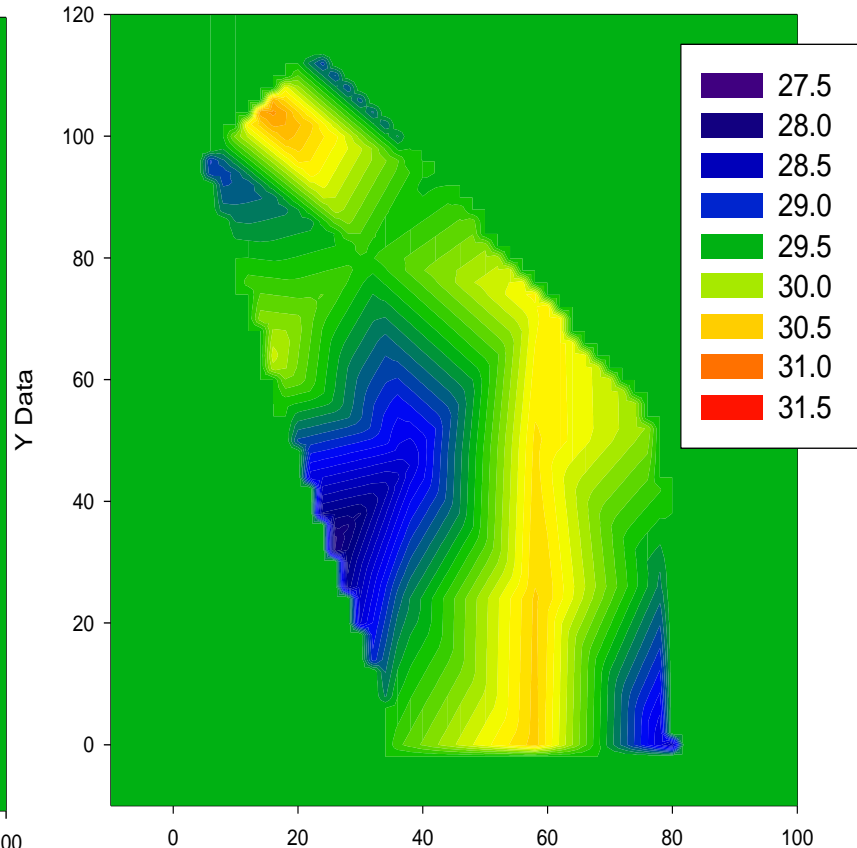
Effects of instrumental calibration

Mean 30 min air temperature at 25 m height (°C)

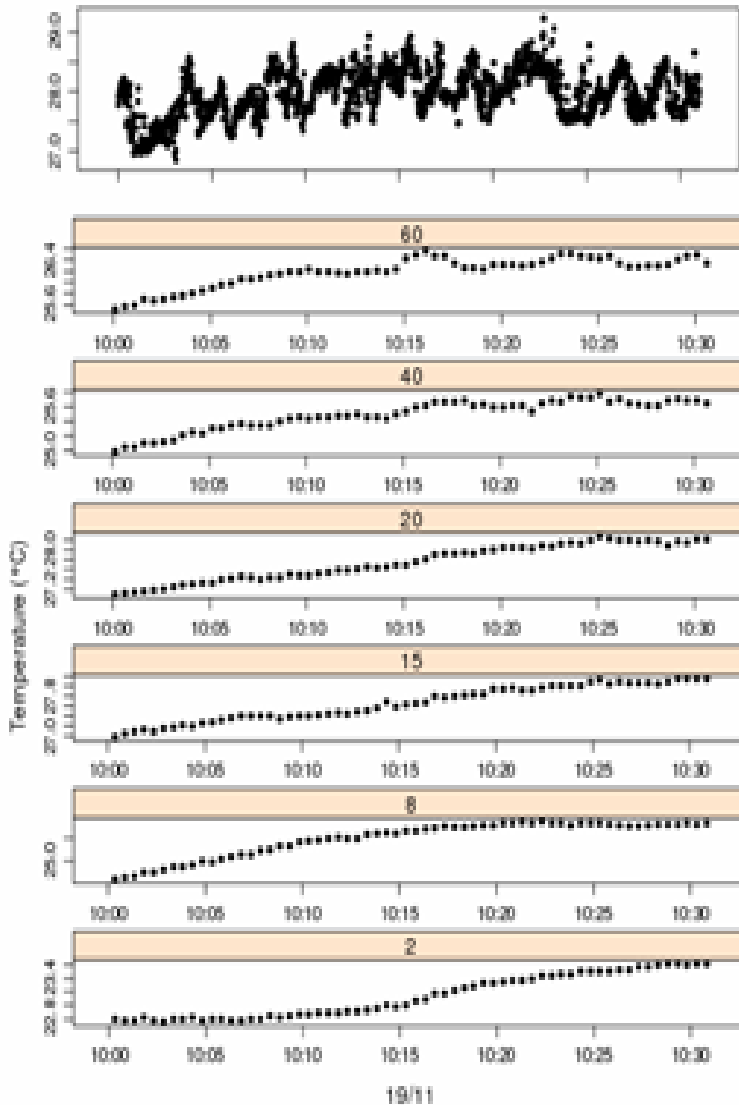
Factory calibration (*courtesy C. von Randow)



Post-calibration



Sensitivity to turbulent fluid dynamics



1 second data acquisition of air temperature (doppler sonic CSAT3) at 60m

30 seconds data acquisition of air temperature with the mote at various heights in Tower1

60, 40, 20, 15, 8, 2 m

Conception of a broad experiment in Amazonia

- **A survey with technological, social and biophysical components**

-

Goals: to survey the environment in specific areas and conditions in Amazonia,

- over regions especially selected to demonstrate the variability of the landscape,
- with the association of technology, science and social dimensions,

- **to prioritize**

- the media of

Soil and vegetation
biodiversity

- their overlying atmosphere, in riverine and inland habitats;

-

- With the deployment of specific tools (e.g. geosensors in several kilometer length scale), the purpose of which is to report

- 1) the functionality of the water and carbon cycles of the ecosystems,
- 2) the different habitats and species, and the different physiological tolerances and competition abilities
- 3) data for biophysical and ecological models, which would be used to create scenarios of the impacts of deforestation and climate change in the carbon and water cycles and the species richness.

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Conception of a broad experiment in Amazonia



The results would especially help the valuation of ecosystem services, with emphasis in the climate regulation, water resources, plant and animal diversity, and cultural services.

An example is to implement a mesh with thousand geosensors, across a 10-500 km scale, to measure temperature, moisture, groundwater, radiation and rainfall, collards in animals, carbon stocks and fluxes, with the integration of local communities, which would include riparian and indian habitants, to help data collection based on citizen-science approach.



Large Scale Biosphere-
Atmosphere Experiment
in Amazonia



Programa FAPESP de
Pesquisa sobre
Mudanças Climáticas
Globais (PFPMCG)

Take advantage of existing

measurements in the Amazon
basin with aircraft, satellite,
flux tower and computer
simulations of the
atmospheric structure and
Carbon transports

