

Spatial scales relevant to the heat and scalar transports over Siberian Taiga forest revealed with the aircraft observation

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Motivation and Objectives

Land surface heterogeneity

- Scalar field (temperature, water vapor, CO₂ etc) are under the control of the corresponding flux in terms of its spatial distribution.
- Above the blending height, the surface features whose length scale is less than certain length cannot be sensed or recognized.

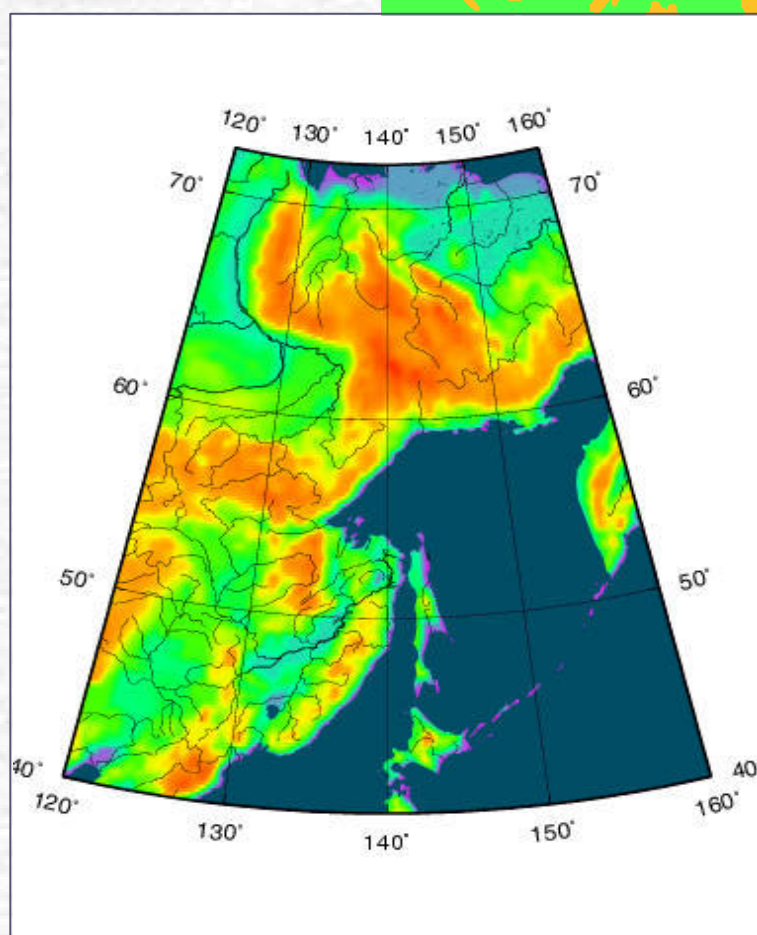
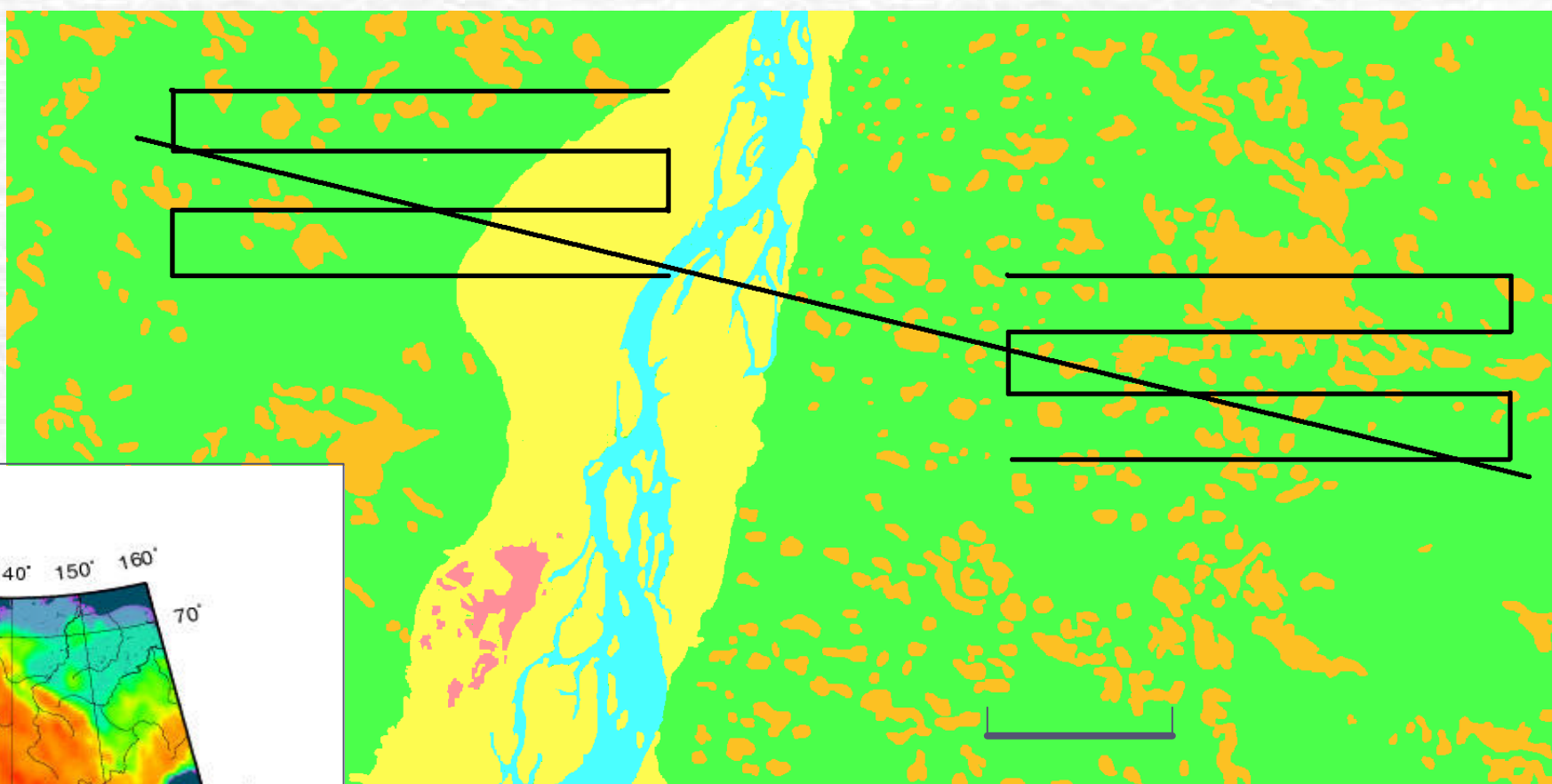
Objective

- To identify the spatial scale relevant to the heat and scalar flux over Siberian Taiga forest
- To check if an aircraft turbulence observation can capture the characteristic scale of the spatial heterogeneity of the scalar field.

Analyzed data

Aircraft Flux Observations

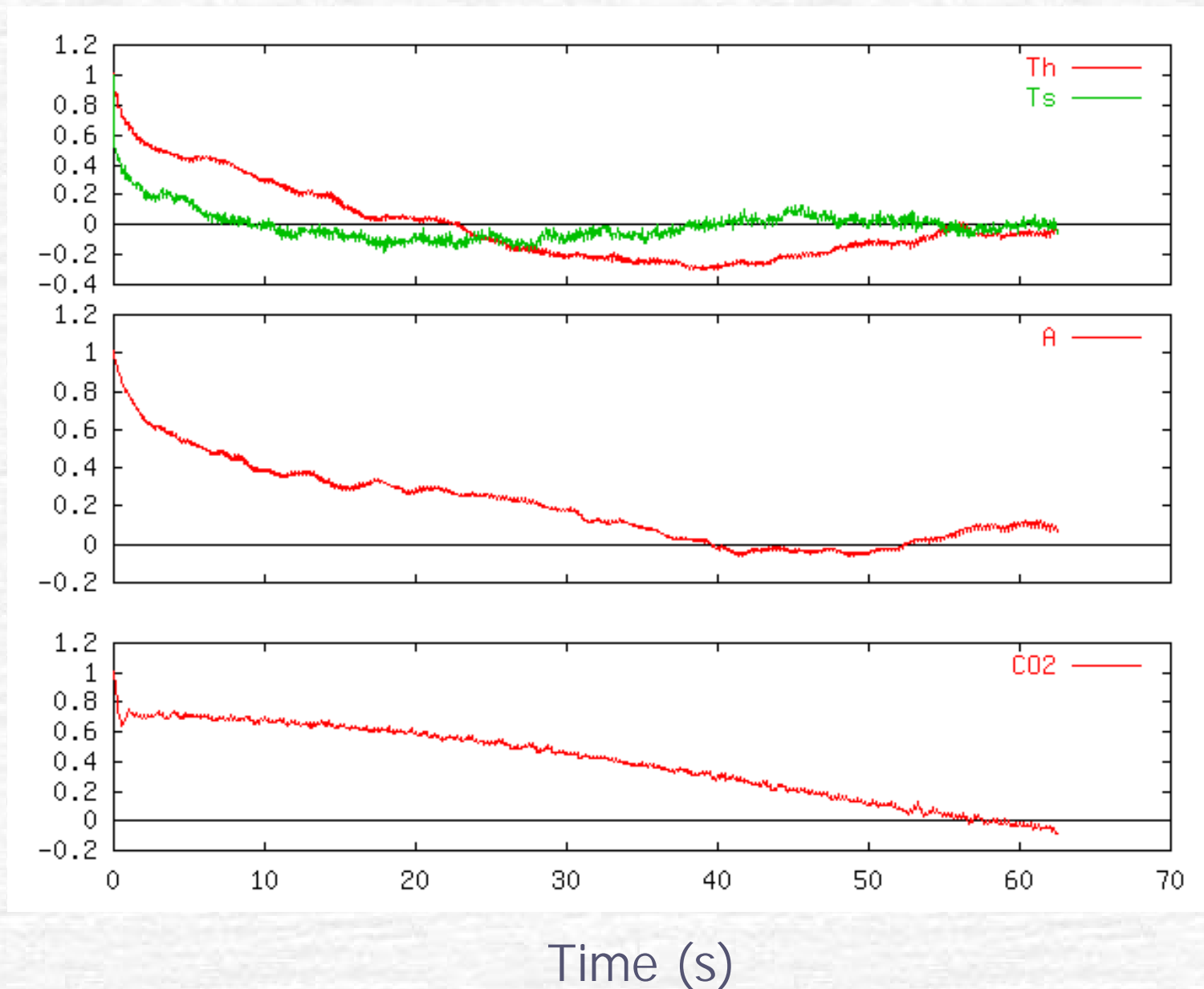
- During GAME-Siberia Yakutsuk IOP 2000
- Ilusin-18 @ 100m/s
- 9 Flights (days) from April to June
- Grid flight pattern @ 100m and 150m (AGL) over the left and right bank to capture the flux distribution
- Analyzed parameters
 - Potential temperature
 - Surface radiative temperature
 - Absolute humidity
 - CO2 concentration



Method of the Analysis

Autocorrelation

$$A_a(t) = \overline{a(t)a(t+t)}$$



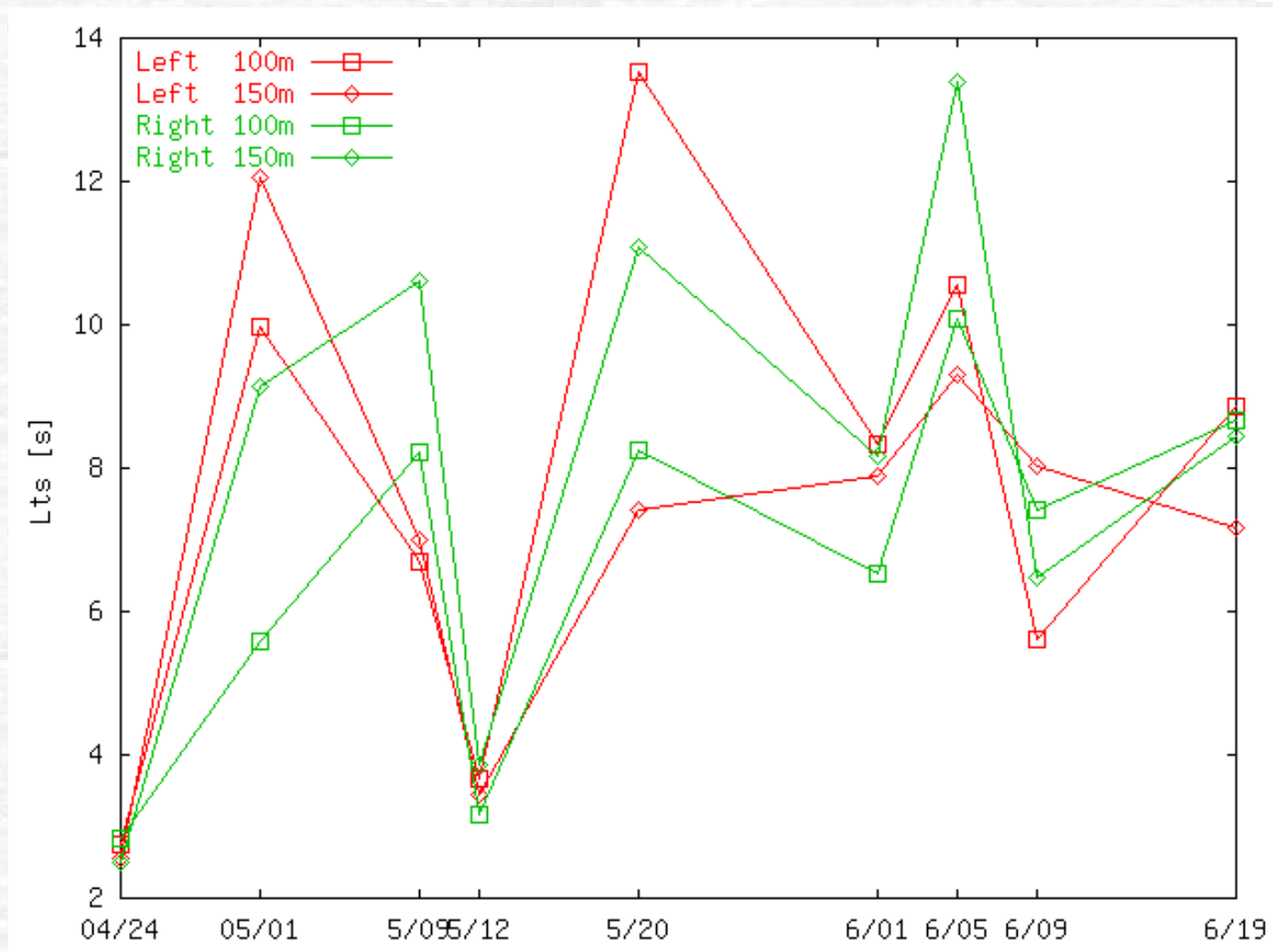
Integral Scale

$$T_a = \int_0^{\infty} A_a(t) dt$$

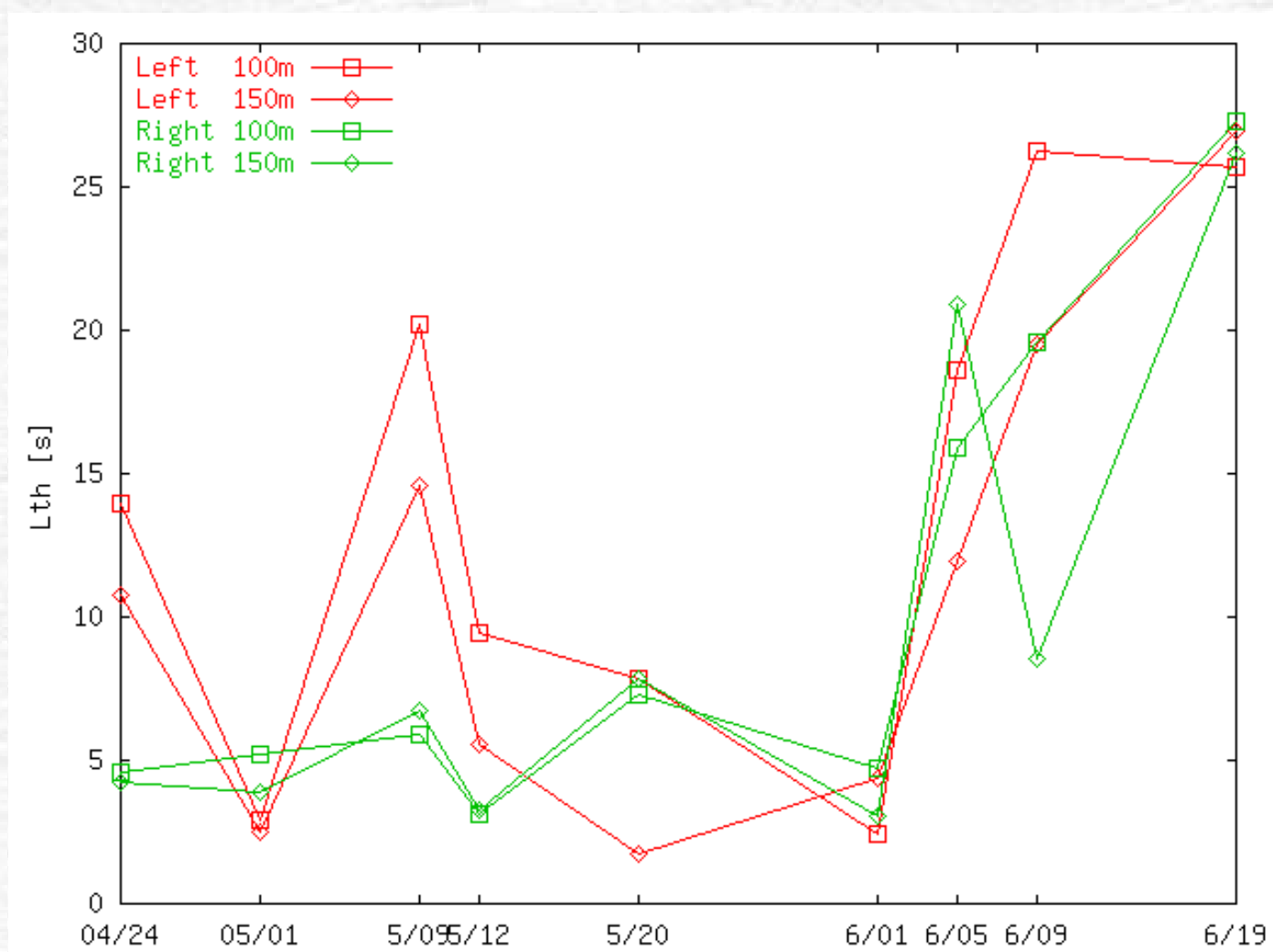
- Time/length scale of the memory of the turbulence (the time/length distance where the correlation at the two points vanishes).
- Scale of the largest eddies of the turbulence

Results - temperature

Surface Temperature

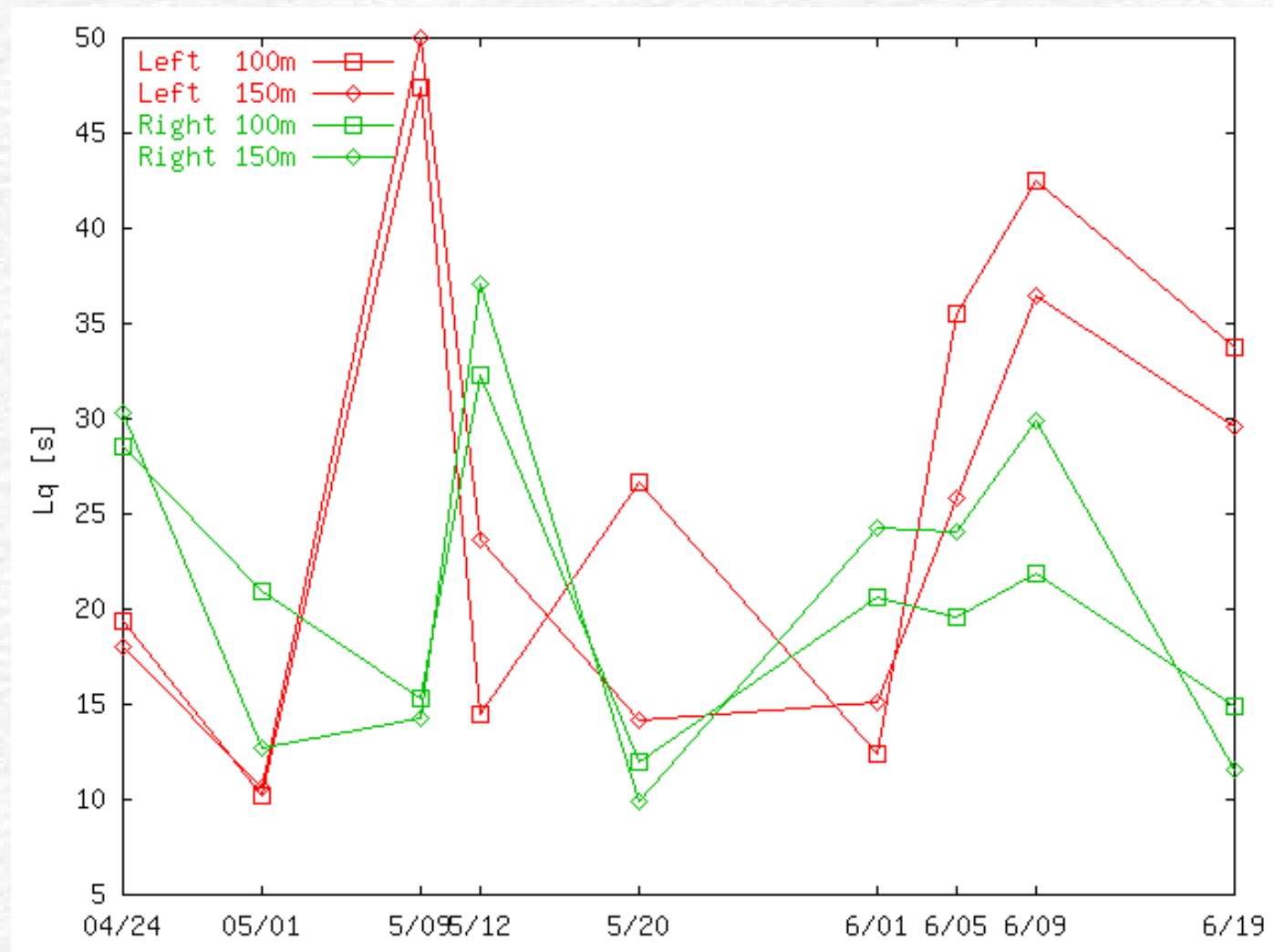


Air temperature

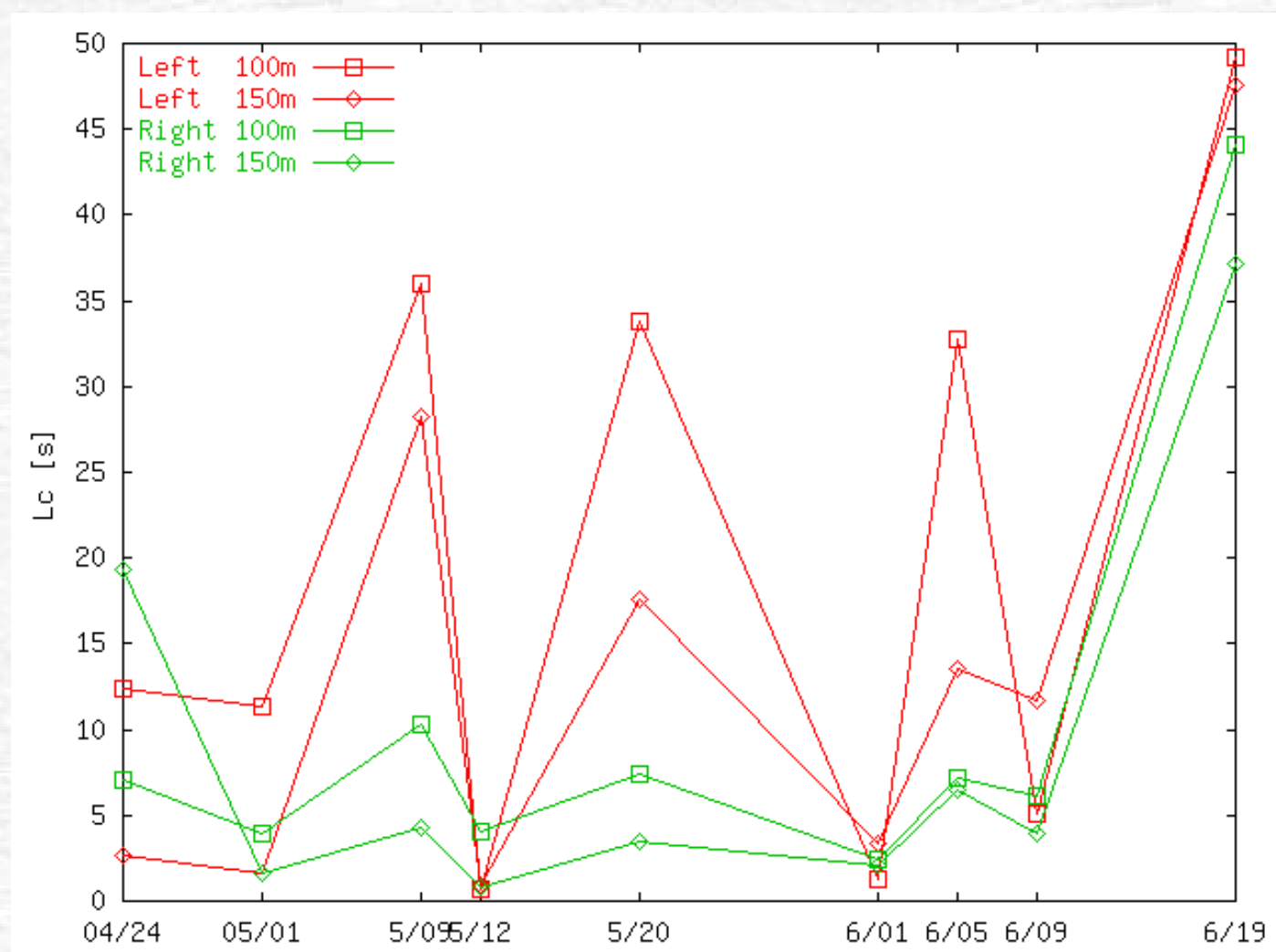


Results -scalars

Humidity



CO2 concentration



Summary

- Calculated integral scale of the temperature shows a inter-seasonal variation, getting larger, while that of the humidity and CO₂ are more dominant with day-to-day variation.
- Difference between the integral scale of the surface temperature measured at 100m and 150m may be due to the temporal variation or due to the uncertainty of the measurements or the calculation.
- The left bank of the Lena river tends to give the larger integral scales than the right bank, which may be due to the difference in the land cover and the land use.
- The integral scale of the air temperature and the surface temperature does not show clear mutual correlation.