



HAL
open science

Soil's heat flux world

Bartosz Zawilski

► **To cite this version:**

Bartosz Zawilski. Soil's heat flux world. Journées ICOS France 2022, Nov 2022, Saint-Quentin en Yvelines, France. . hal-03846586

HAL Id: hal-03846586

<https://hal.science/hal-03846586>

Submitted on 10 Nov 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



SOIL'S HEAT FLUX WORLD

Zawilski B. M.

bartosz.zawilski@cnr.fr

Centre d'Etudes Spatiales de la BIOSphère

18 avenue Edouard Belin, 31400 Toulouse, FRANCE



Context & Objectives

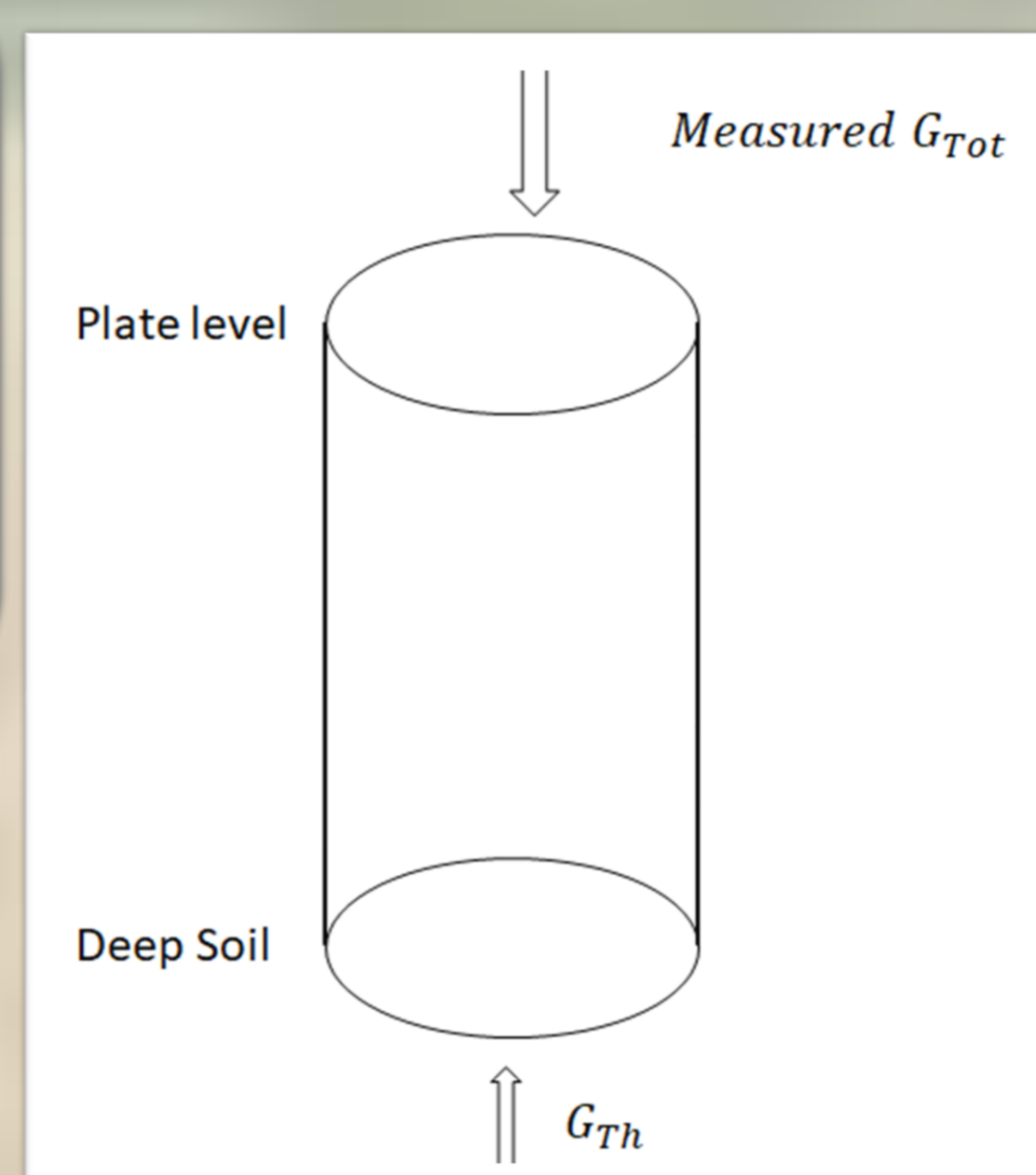
- In the context of global climate warming, soil heat flux is monitored. ICOS mandatory measurements are achieved using self-calibrated heat flux plates HFP01SC. Two questions arise:
 - How to check correct soil heat flux plates functioning?
 - Subsequently, why the annual soil heat flux budget is not closed?

OBJECTIVES: Check the soil heat flux plates functioning and complete the soil heat fluxes balance.



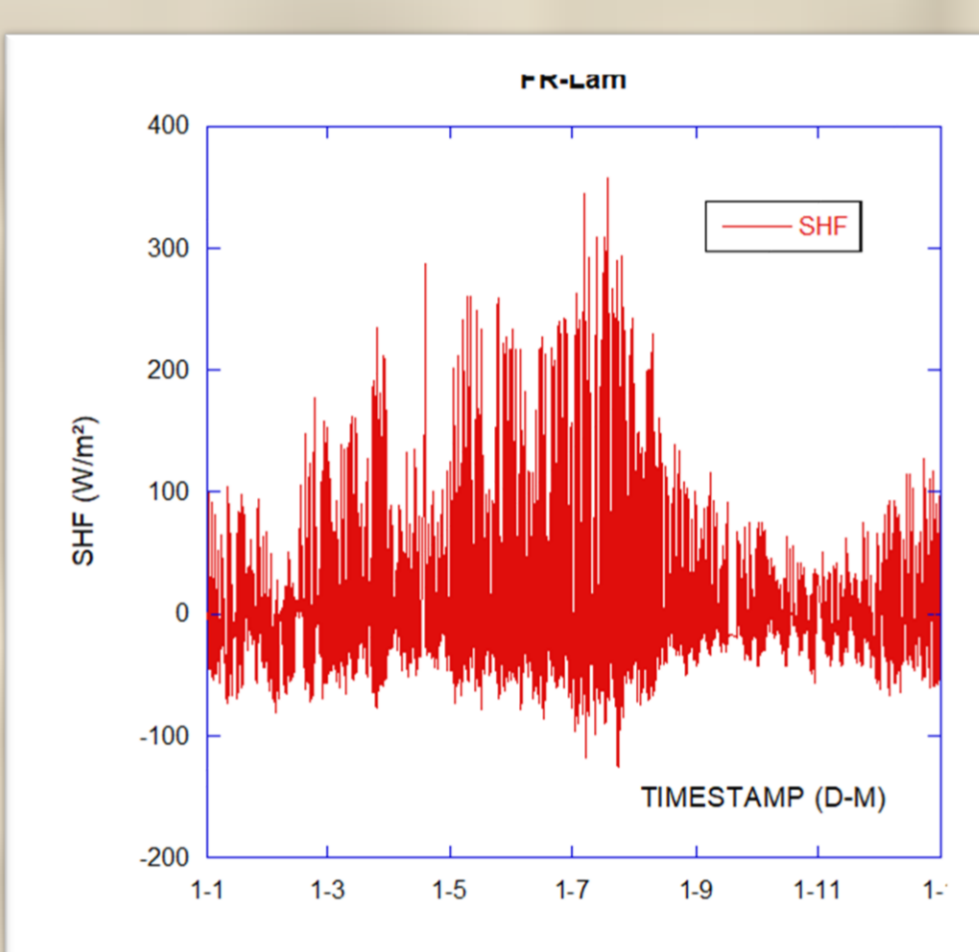
Soil Heat flux plates functioning

To check correct SHFP functioning is not so evident and an **annual integration** may be of great help. Annual integration should be **close to zero** as, by energy conservation, in the case of homogeneous soil with the same soil temperatures and moisture at the beginning and the end of the year, theoretically, the heat flux integration is equal to the geothermal energy flux integration. Heat propagate by radiation (concern only separation surfaces) by advection (concern only fluids) and by conduction. SHFP measure only conduction. Zawilski, B. M. <https://doi.org/10.5194/gi-11-223-2022>, 2022.

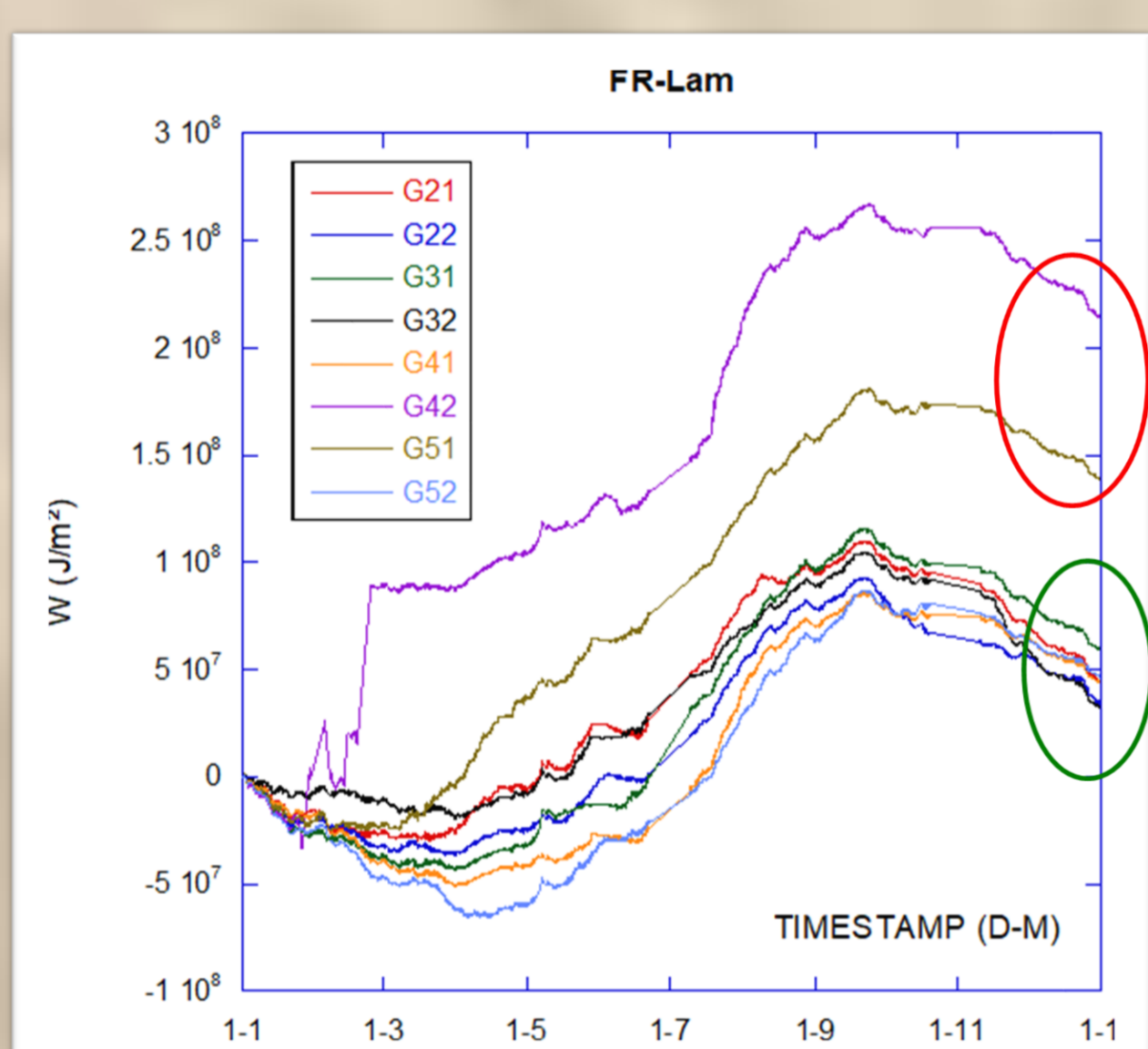
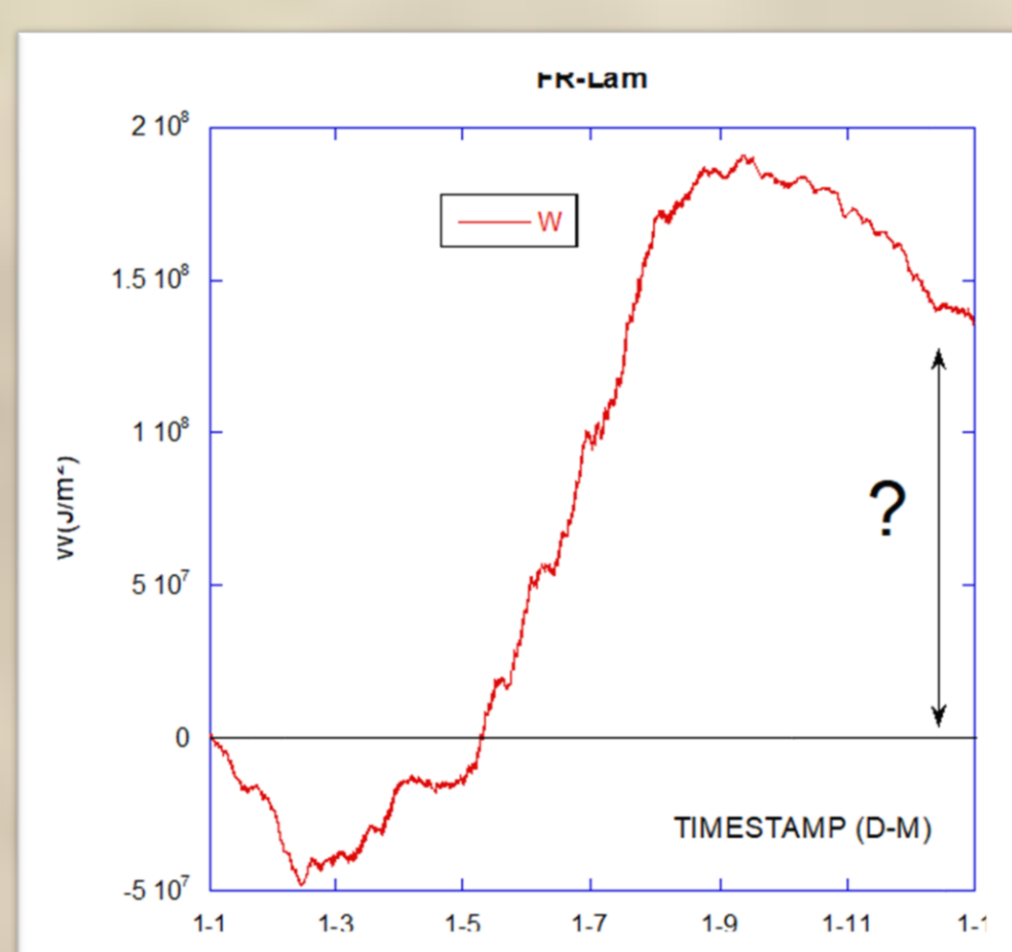


$$\Delta E = \int_{t_0}^{t_1} (G_{Tot} - G_{Th}) dt$$

$$\int_0^{365 \text{ Days}} (G_{Tot} - G_{Th}) dt = 0$$



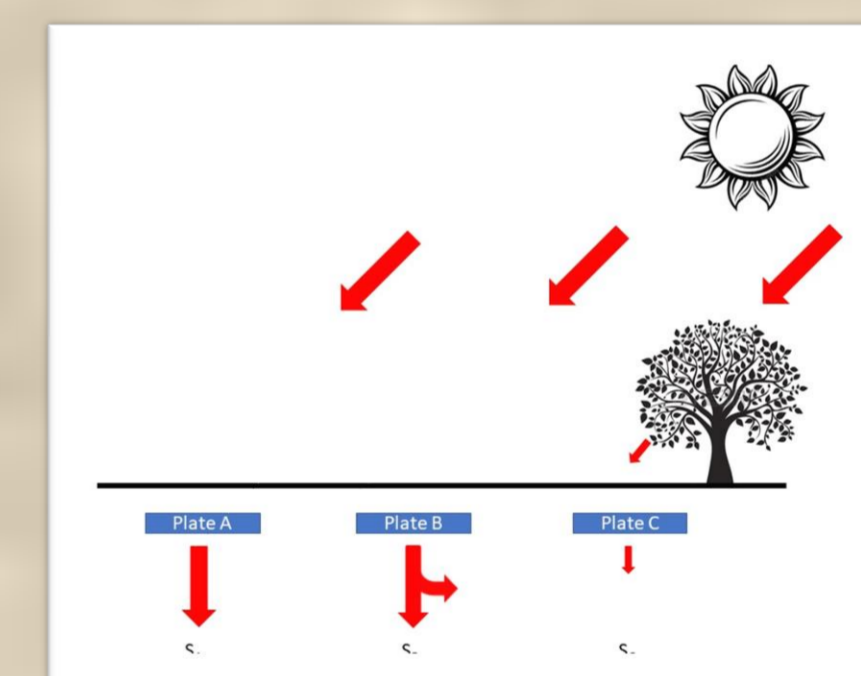
Annual
Integration



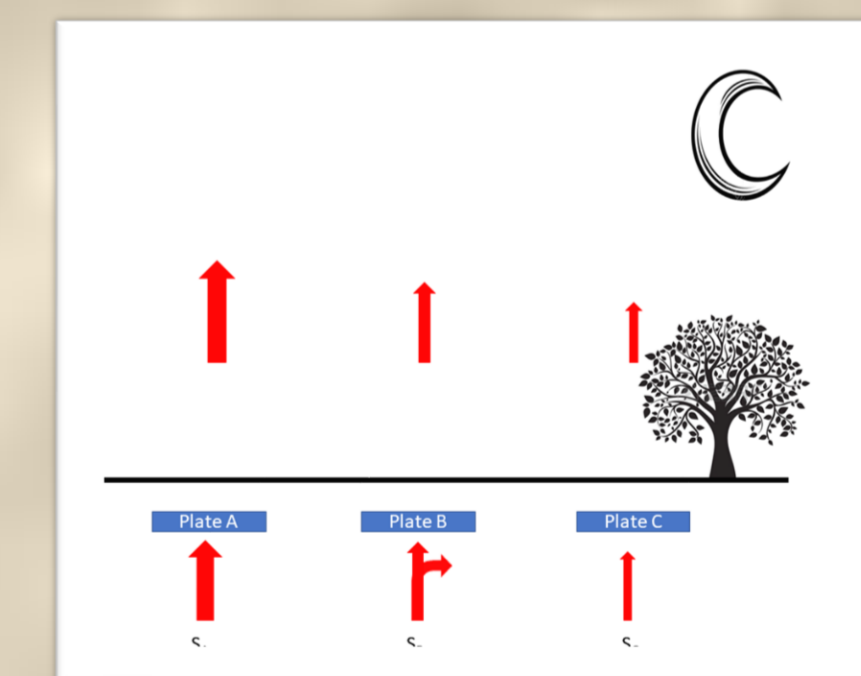
Localized unbalances

- Annual soil heat flux integration is not nil and geothermal energy does not explain this unbalance.
- Particularly important unbalance may be attributed to the soil or the sunshine inhomogeneities boundaries proximity.

Day



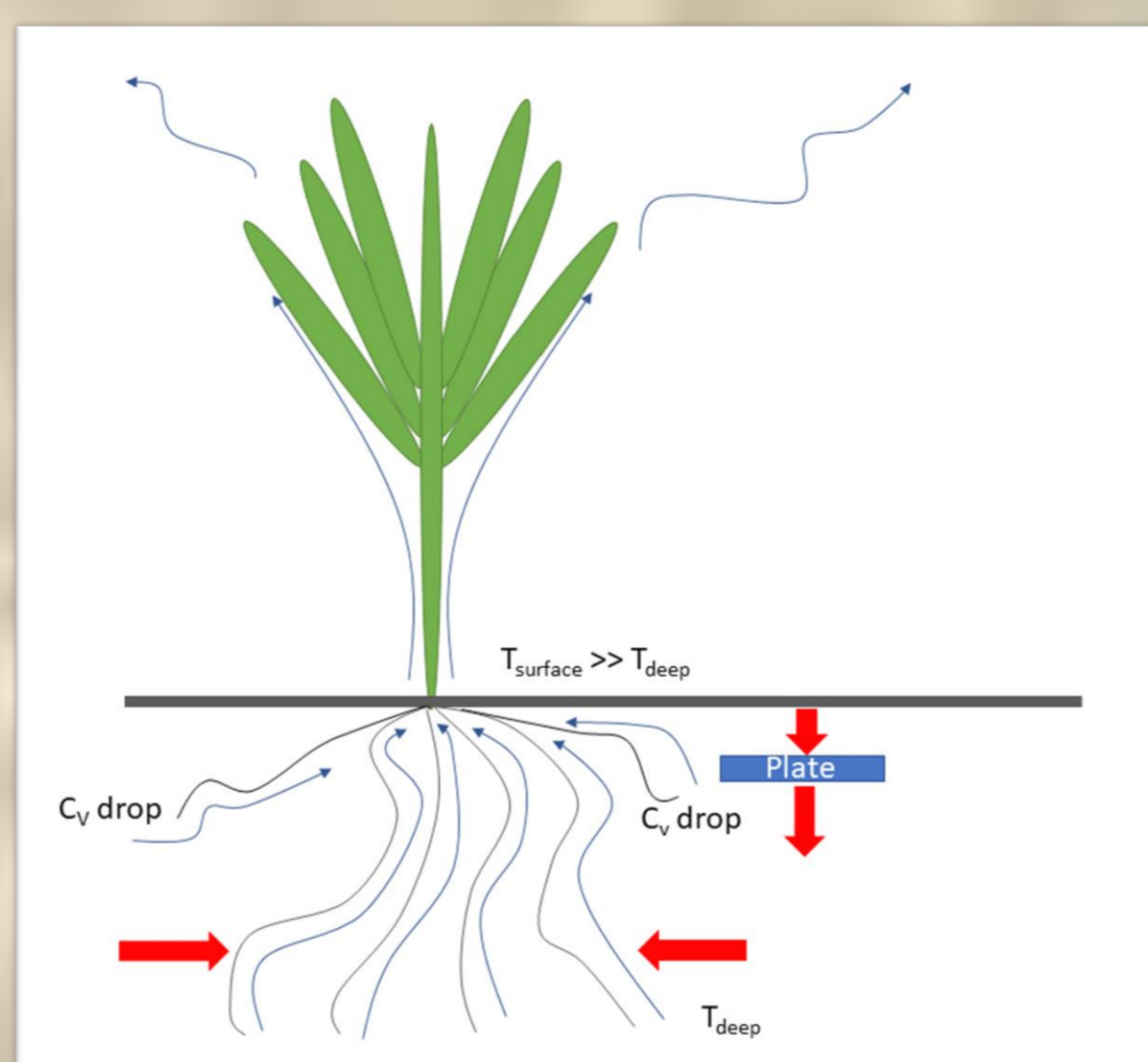
Night



Systematic unbalances

- Systematic unbalance may be, in part, attributed to the advective fluxes.
 - Evapotranspiration causes advective fluxes.
 - Rainfall water infiltration causes surface cooling but also advective fluxes.

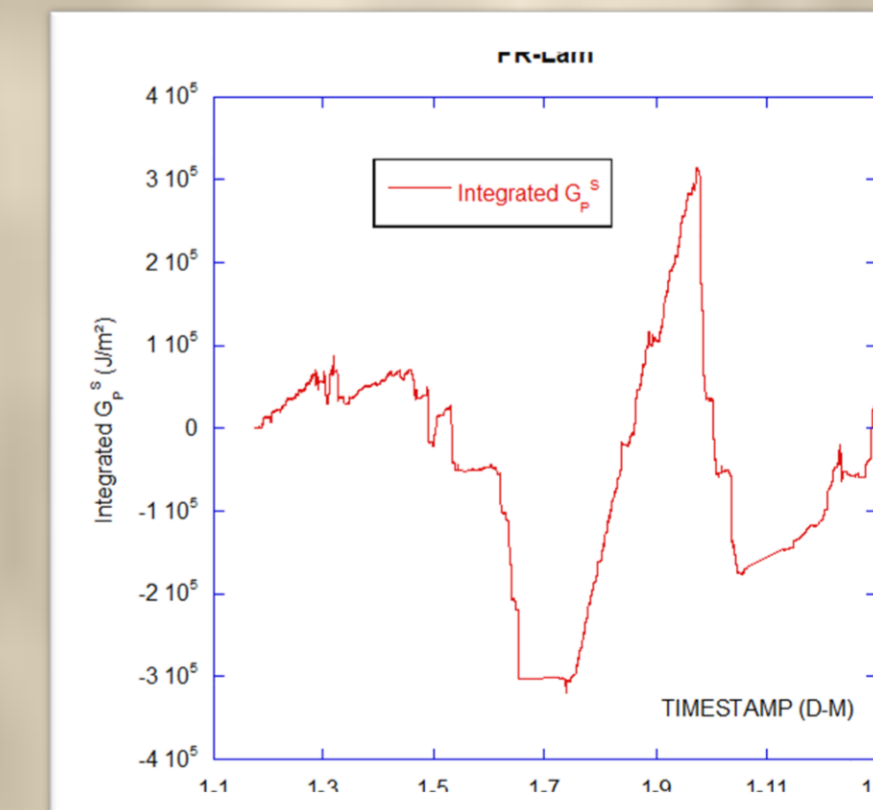
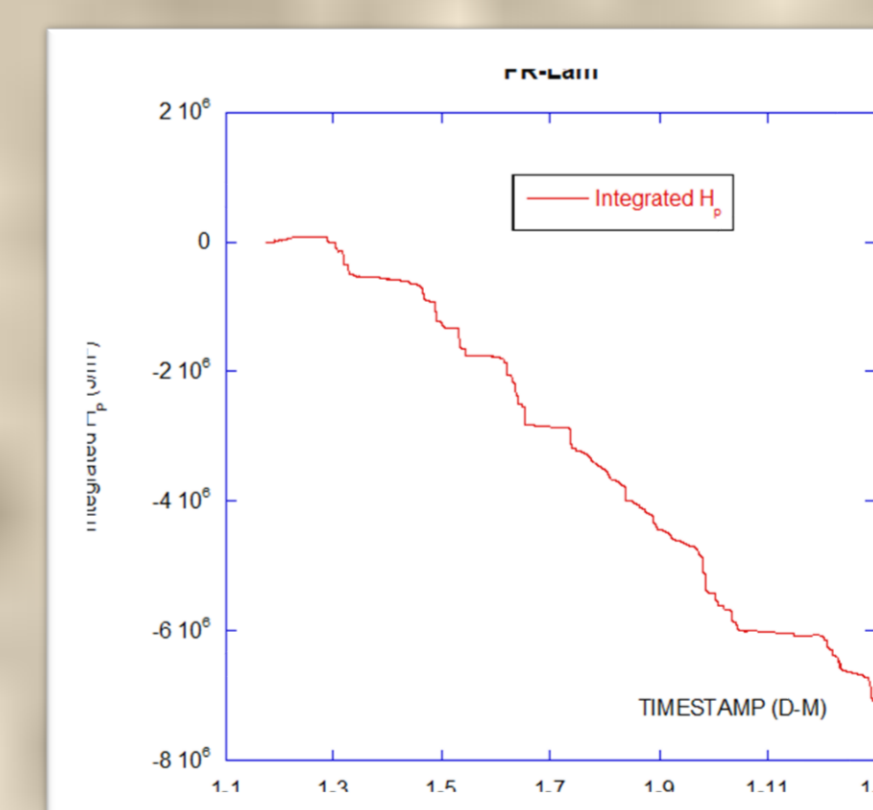
Evapotranspiration



Rainfall ?

Surface cooling
Not yet an
unbalance

Water infiltration
Not causing notable
unbalance



Conclusion

- Soil Heat Flux Plates functioning can be checked by an annual integration.
- Important unbalance may be observed due to boundaries proximity of inhomogeneities and also due to the unmeasured advective fluxes.

Acknowledgments

FR-Lam installation were mainly funded by the Institut National des Sciences de l'Univers of the Centre National de la Recherche Scientifique (CNRS-INSU) through the ICOS and OSR observatories. I would also to acknowledge Aurore Brut (FR-Lam PI) and Franck Granouillac (FR-Lam Tech).