

# The Multiscale TROPICAL CatchmentS critical zone observatory in **Lao PDR** *Land use, hydrology, sediment and more...*



<https://mtropics.obs-mip.fr/>

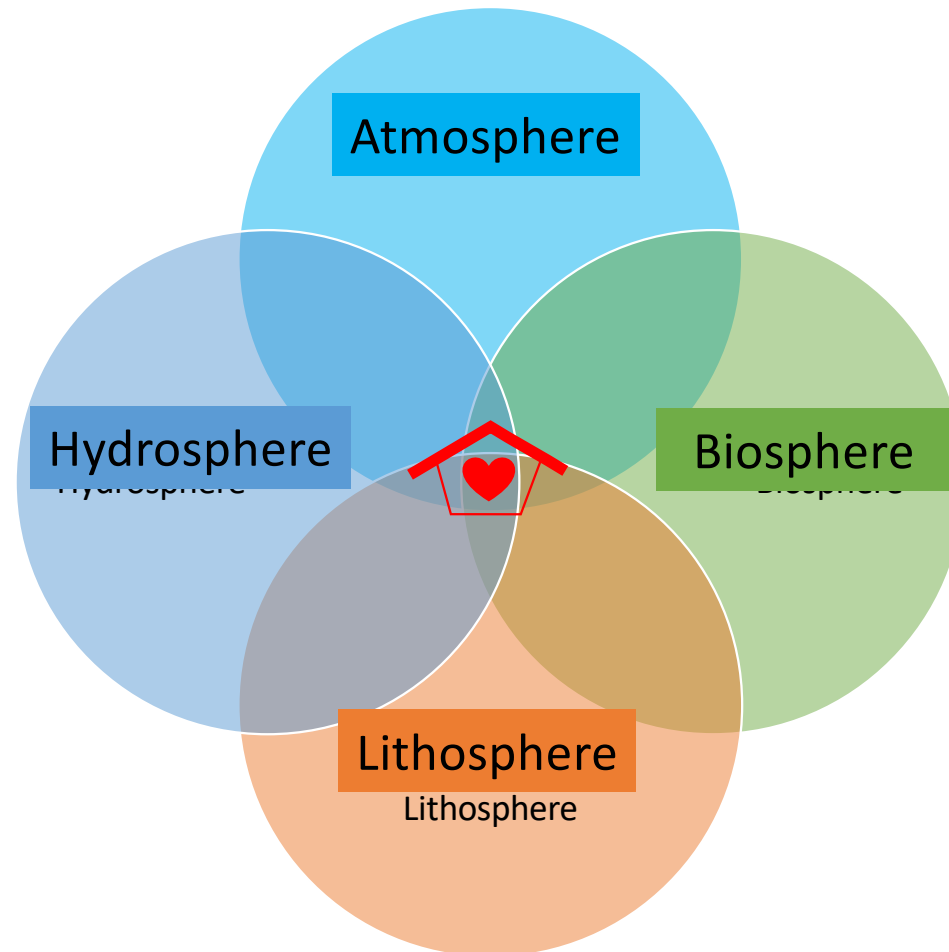
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Nyong  
(Cameroon)

Mule Hole,  
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(India)

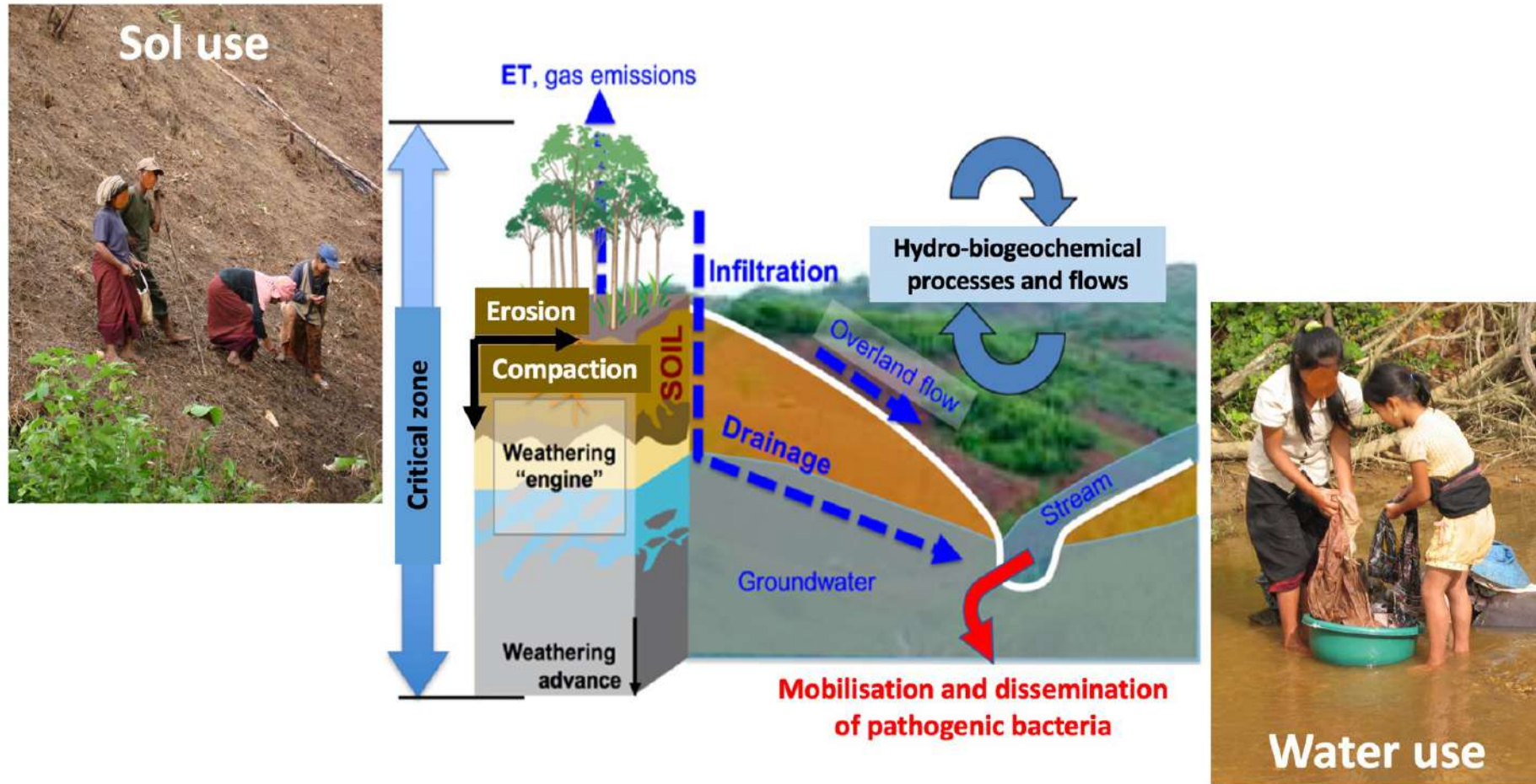
Houay Pano,  
Mekong  
(Laos)

Christian HARTMANN (IRD, iEES-Paris) for the M-TROPICS team

# What is the critical zone?



# What is the critical zone?



# M-TROPICS Lao PDR: study sites, long term data (since 1998)



**Partnership with**  
 Departement of  
 Agricultural Land  
 Management  
 Lao PDR



Dr. Nivong  
 SIPASEUTH

Mean annual temperature = **23.4 °C**  
 Mean annual rainfall = **1366 mm**  
 Slope gradient = **1%–135%**  
 Geology: argillites, siltstones etc.  
 Soils: Entisol, Ultisol and Alfisol



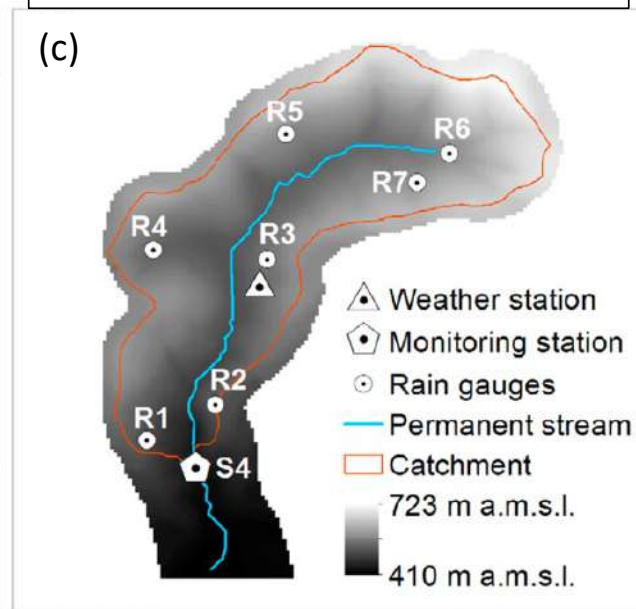
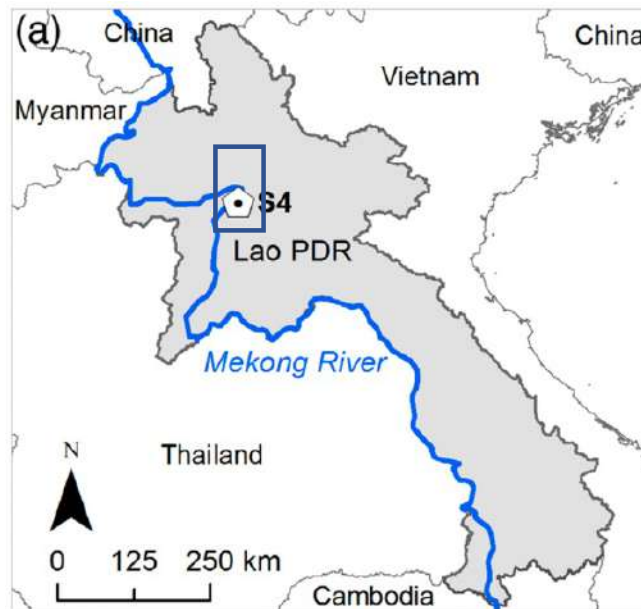
Alain PIERRET



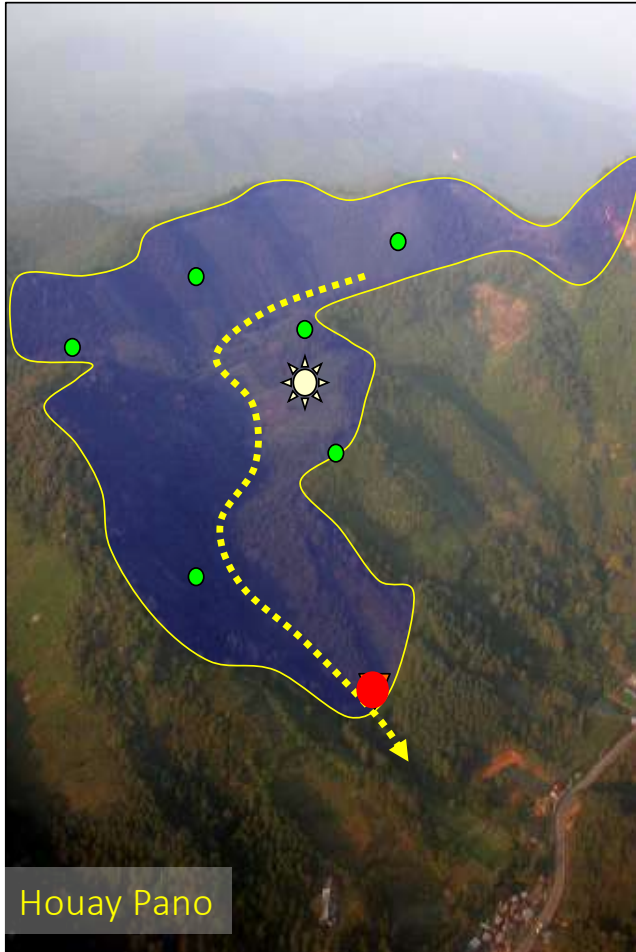
Xaysatith  
 SOULIYAVONGSA



Norbert SILVERA



# Long-term multiscale monitoring of hydro-sedimentary variables



Photo, G. Lestrelin, IRD

1-m<sup>2</sup> microplots

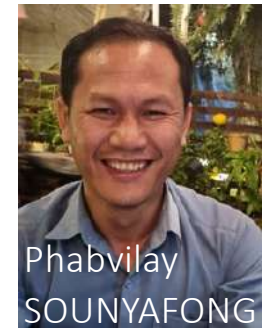
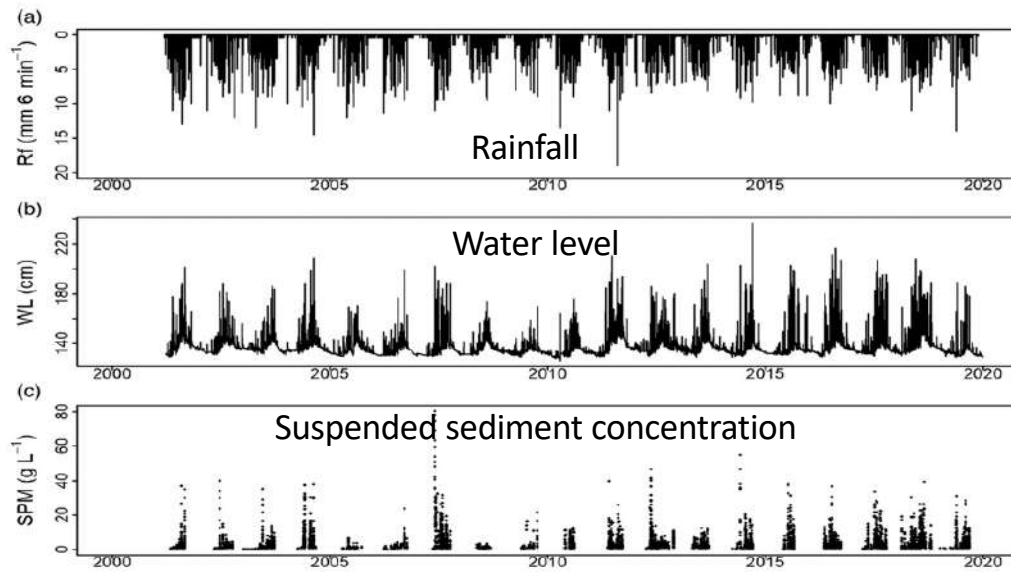


Photo: L. Boithias

0.6 km<sup>2</sup> catchment



Photo: O. Ribolzi



# Long-term land use monitoring (since 1998)

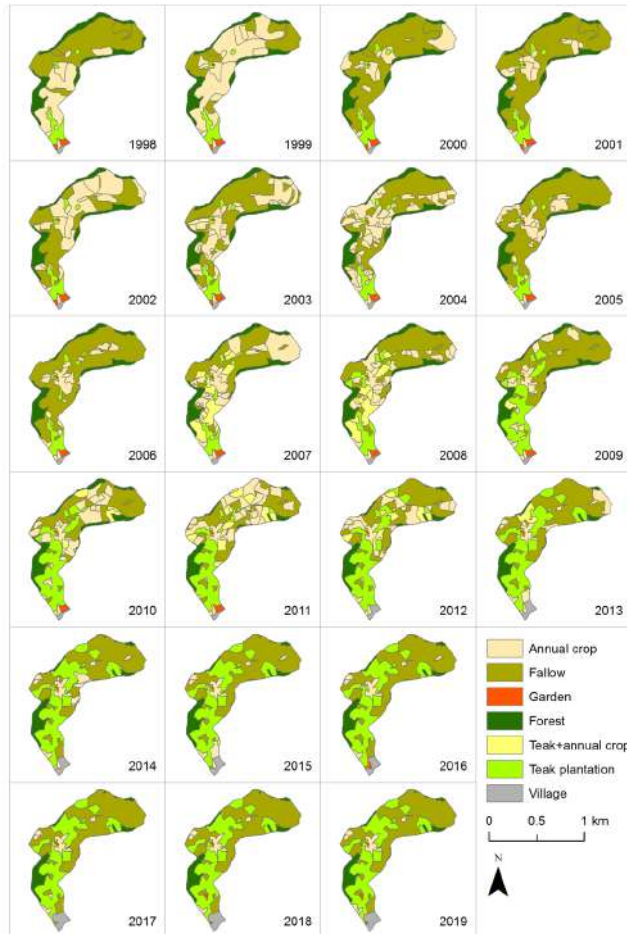
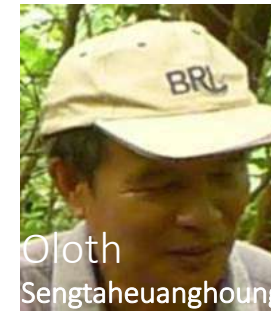
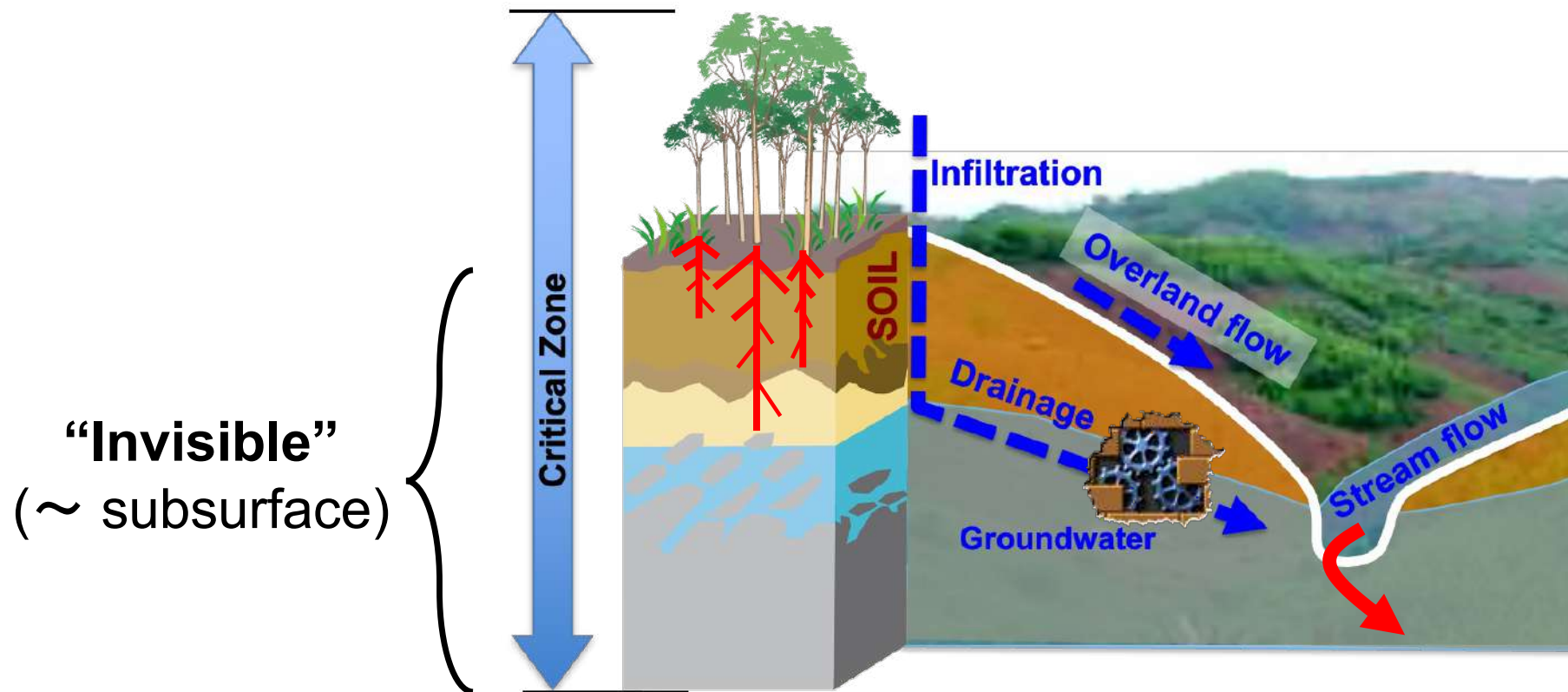


Photo: O. Ribolzi

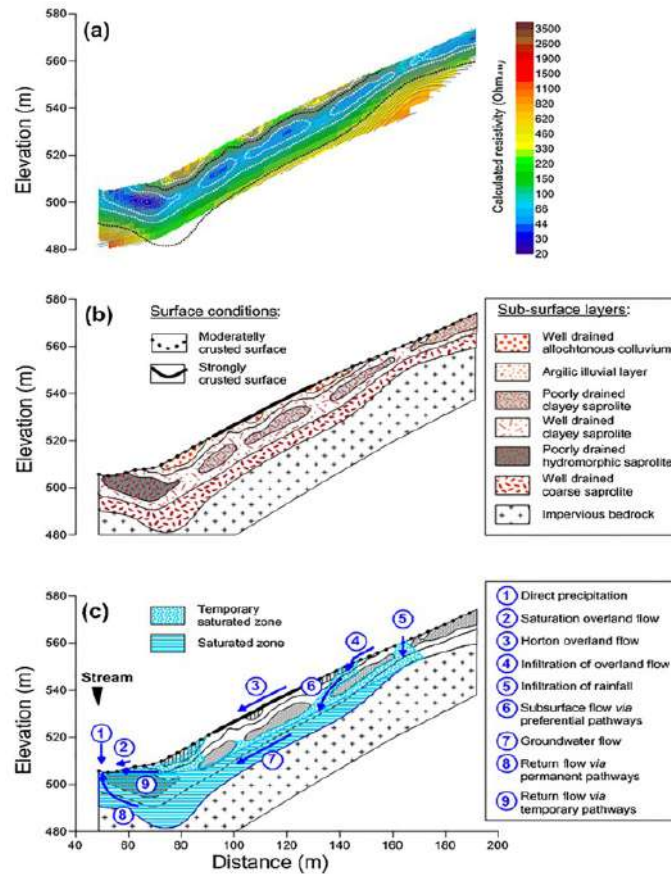


Boithias, L., Auda, Y., Audry, S., Bricquet, J., Chanhphengxay, A., Chaplot, V., Rouw, A., Tureaux, T.H., Huon, S., Janeau, J., Latsachack, K., Le Troquer, Y., Lestrelin, G., Maeght, J., Marchand, P., Moreau, P., Noble, A., Pando-Bahuon, A., Phachomphon, K., Phanthavong, K., Pierret, A., Ribolzi, O., Riotte, J., Robain, H., Rochelle-Newall, E., Sayavong, S., Sengtaheuanghoung, O., Silvera, N., Sipaseuth, N., Soulileuth, B., Souliyavongsa, X., Sounyaphong, P., Tasaketh, S., Thammahacksa, C., Thiebaut, J., Valentin, C., Vigiaki, O., Viguier, M., Xayyathip, K., 2021. The Multiscale TROPICAL Catchments critical zone observatory M-TROPICS dataset II: land use, hydrology and sediment production monitoring in Houay Pano, northern Lao PDR. *Hydrol. Process.* 1–9. <https://doi.org/10.1002/hyp.14126>

# Monitoring the « invisible » part of the critical zone



# Characterisation of subsurface soil structures and water paths



Ribolzi, O., Lacombe, G., Pierret, A., **Robain, H.**, Sounyafong, P., de Rouw, A., Soullieuth, B., Mouche, E., Huon, S., Silvera, N., Latxachak, K.O., Sengtaheuanghoung, O., Valentin, C., 2018. Interacting land use and soil surface dynamics control groundwater outflow in a montane catchment of the lower Mekong basin. *Agric. Ecosyst. Environ.* <https://doi.org/10.1016/j.agee.2018.09.005>



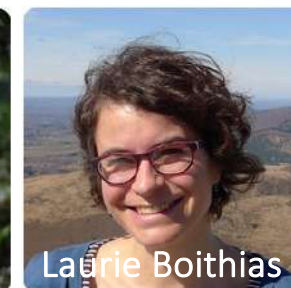
# The M-Tropics website – data repository



<https://mtropics.obs-mip.fr/>



Stéphane AUDRY

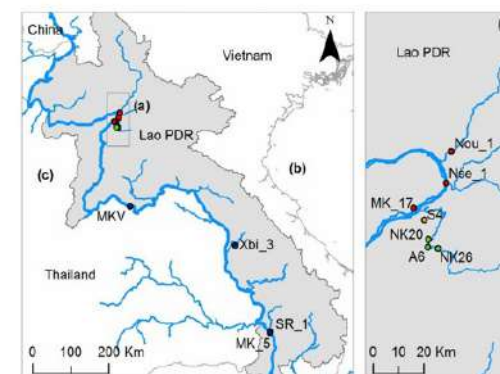


Laurie Boithias

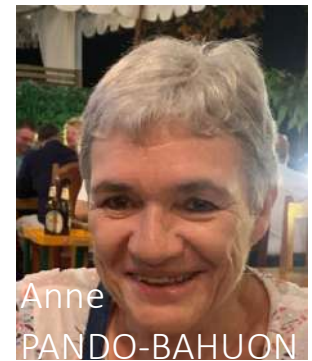
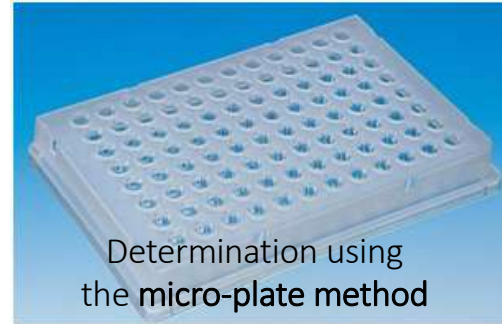
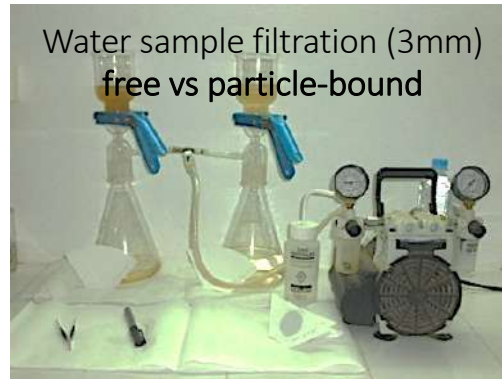
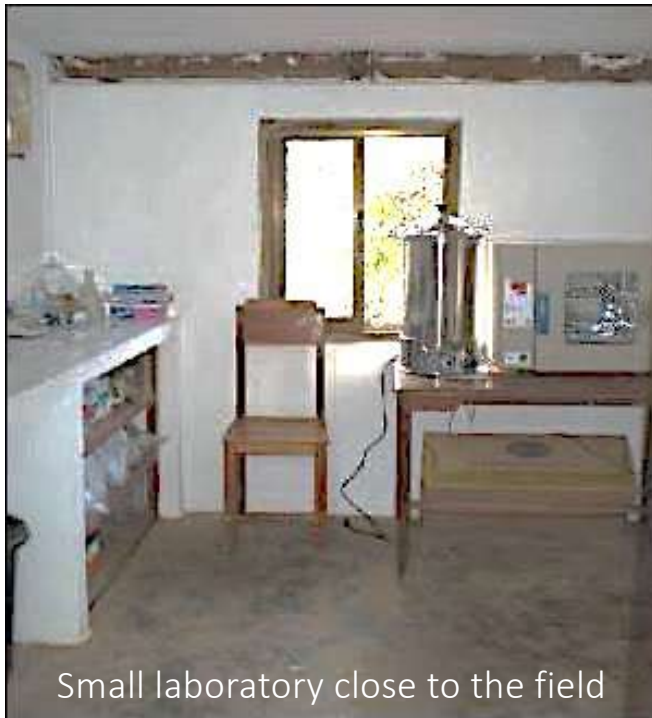
Associate Professors  
*physicien-adjoint CNAP*

## LAOS

The basic hydro-meteorological monitoring in Laos was initiated in 1998 within the Houay Pano catchment (Boithias et al., 2021). Aside from land use, water, and sediment fluxes, the observation in Laos was extended to water quality in 2011, including the fecal indicator bacterium *E. coli* and following a multiple-scale monitoring approach (to date: 0.6-272,155 km<sup>2</sup>) within the Mekong river basin (Boithias et al., 2022).



# *Escherichia coli* concentration, multiscale monitoring since 2011



# DATA PAPER: *Escherichia coli* concentration, multiscale monitoring over the decade 2011-2021 in the Mekong basin, Lao PDR



<https://doi.org/10.5194/essd-2021-440>  
Preprint. Discussion started: 6 January 2022  
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Open Access  
Earth System  
Science  
Data  
Discussions



Laurie BOITHIAS

Olivier RIBOLZI

The database includes a total of 1,602 records and is publicly available online as a collection of three files hosted within the DataSuds platform (<https://dataverse.ird.fr/>).

The three repositories are:

- 1) *Escherichia coli* concentrations and physico-chemical measurements at the outlet of 29 catchments of the Mekong river basin, Lao PDR, during dry and rainy seasons (2016) (Ribolzi et al., 2021c): <https://doi.org/10.23708/ZRSBM4>
- 2) *Escherichia coli* concentrations and physico-chemical measurements (2011-2021) at the outlet of six catchments of the Mekong river basin, northern Lao PDR (Ribolzi et al., 2021a): <https://doi.org/10.23708/1YZQHH>
- 3) *Escherichia coli* concentrations and physico-chemical measurements (2011-2021) at the outlet of the Houay Pano catchment, northern Lao PDR (Ribolzi et al., 2021b): <https://doi.org/10.23708/EWOYN>

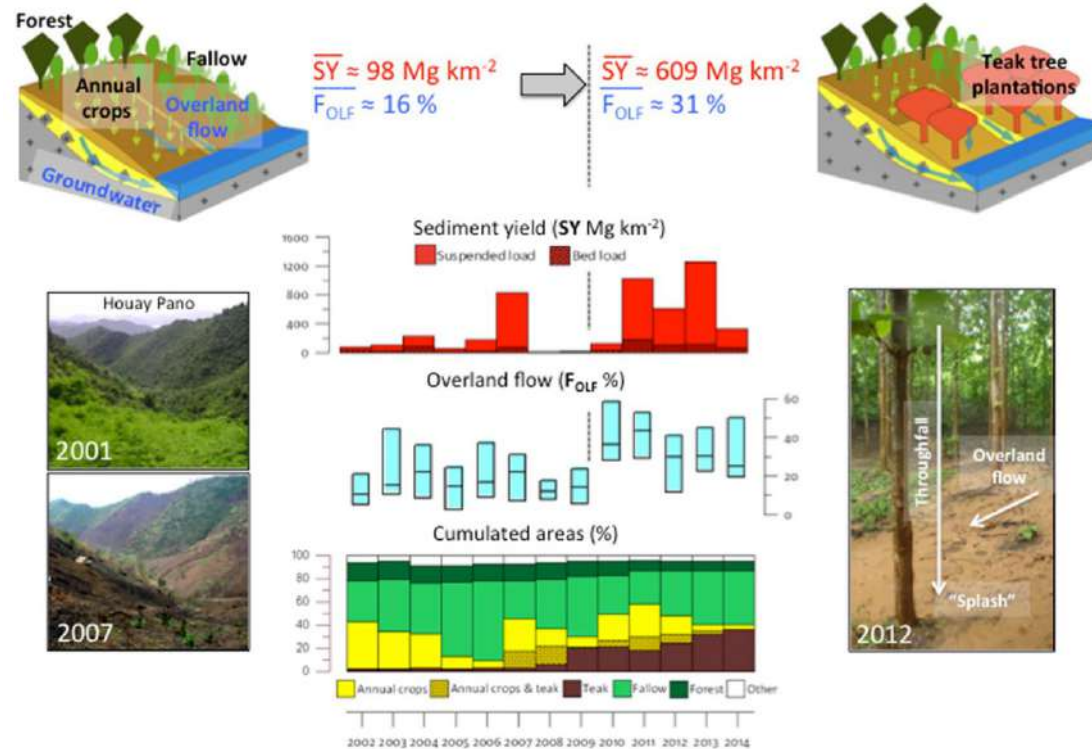
Boithias, L., Ribolzi, O., Rochelle-newall, E., Nakhle, P., Soullieuth, B., Pando-bahuon, A., Latsachack, K., Silvera, N., Sounyafong, P., Zimmermann, R., Rattanavong, S., Oliva, P., Evrard, O., Huon, S., Causse, J., Henry-des-tureaux, T., Sengtaheuanghoung, O., Sipaseuth, N., Pierret, A., 2022. *Escherichia coli* concentration, multiscale monitoring over the decade 2011-2021 in the Mekong basin, Lao PDR. *EARTH Syst. Sci. Data* 1–20. <https://doi.org/https://doi.org/10.5194/essd-2021-440>

Ribolzi, O., Boithias, L., Thammahacksa, C., Silvera, N., Pando-Bahuon, A., Sengtaheuanghoung, O., Sipaseuth, N., Latsachack, K., Soullieuth, B., Sounyafong, P., Khampaseuth, X., and Pierret, A.: *Escherichia coli* concentrations and physico-chemical measurements (2011-2021) at the outlet of six catchments of the Mekong river basin, northern Lao PDR [Data set], <https://doi.org/10.23708/1YZQHH>, 2021a.

Ribolzi, O., Boithias, L., Thammahacksa, C., Rochelle-Newall, E., Pando-Bahuon, A., Silvera, N., Sengtaheuanghoung, O., Sipaseuth, N., and Pierret, A.: *Escherichia coli* concentrations and physico-chemical measurements (2011-2021) at the outlet of the Houay Pano catchment, northern Lao PDR [Data set], <https://doi.org/10.23708/EWOYN>, 2021b.

Ribolzi, O., Zimmermann, R., Thammahacksa, C., Rattanavong, S., Oliva, P., Sengtaheuanghoung, O., and Pierret, A.: *Escherichia coli* concentrations and physico-chemical measurements at the outlet of 29 catchments of the Mekong river basin, Lao PDR, during dry and rainy seasons (2016) [Data set], <https://doi.org/10.23708/ZRSBM4>, 2021c.

# Upstream consequences of inappropriate LU on soil and fertility loss



Conversion from traditional crops to teak tree plantations induced **rapid overland flow** and **massive soil erosion**

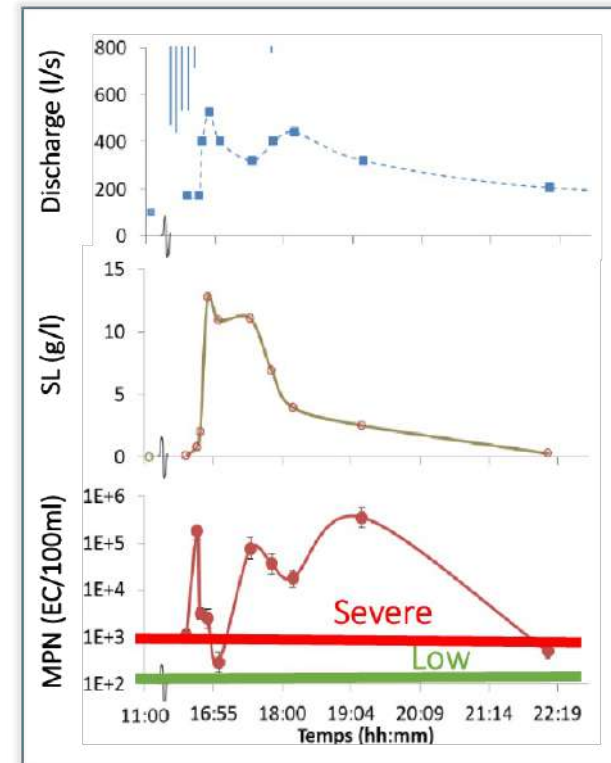
Ribolzi, O., Evrard, O., Huon, S., Rouw, A. De, Silvera, N., Latsachack, O., Soullieuth, B., Lefèvre, I., Pierret, A., 2017. From shifting cultivation to teak plantation : effect on overland flow and sediment yield in a montane tropical catchment. Sci. Rep. 1–12. <https://doi.org/10.1038/s41598-017-04385-2>

# Downstream consequences of inappropriate land use combined with an extreme rainfall event



Bountang\_18/09/2014

➔ Surface runoff increase enhances *E. coli* dissemination

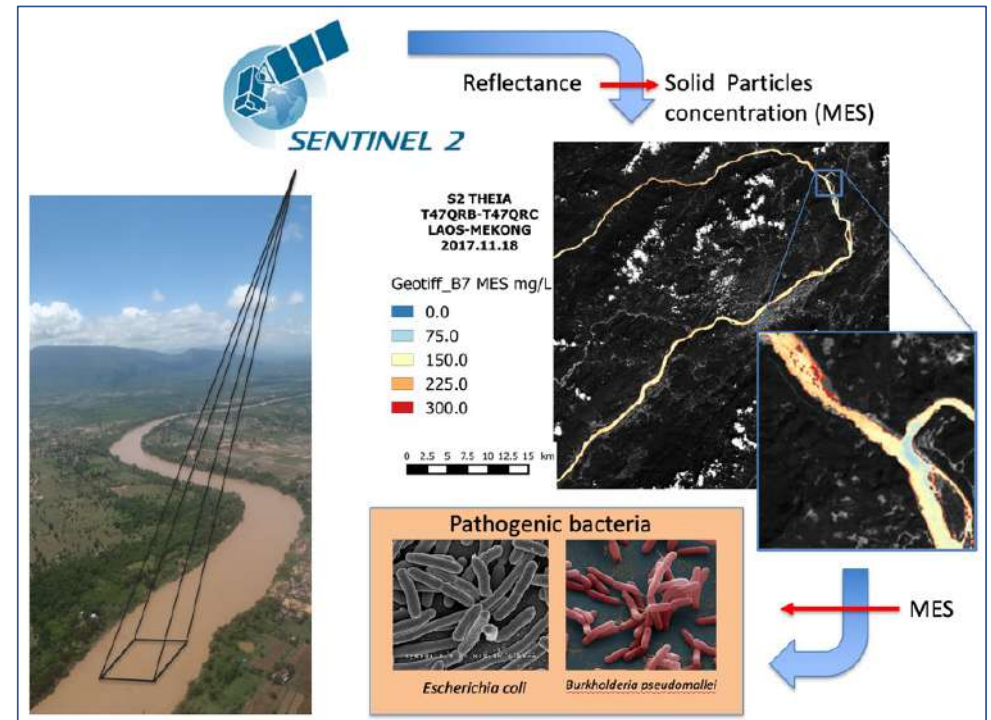


Causse, J., Billen, G., Garnier, J., Henri-des-Tureaux, T., Olaya, X., Thammahacksa, C., Latsachak, K.O., Soullieuth, B., Sengtaheuanghoung, O., Rochelle-Newall, E., Ribolzi, O., 2015. Field and modelling studies of *Escherichia coli* loads in tropical streams of montane agro-ecosystems. *J. Hydro-environment Res.* 9, 496–507. <https://doi.org/10.1016/j.jher.2015.03.003>

# Ideal framework for **technical and methodological innovations** in the field of environmental observation

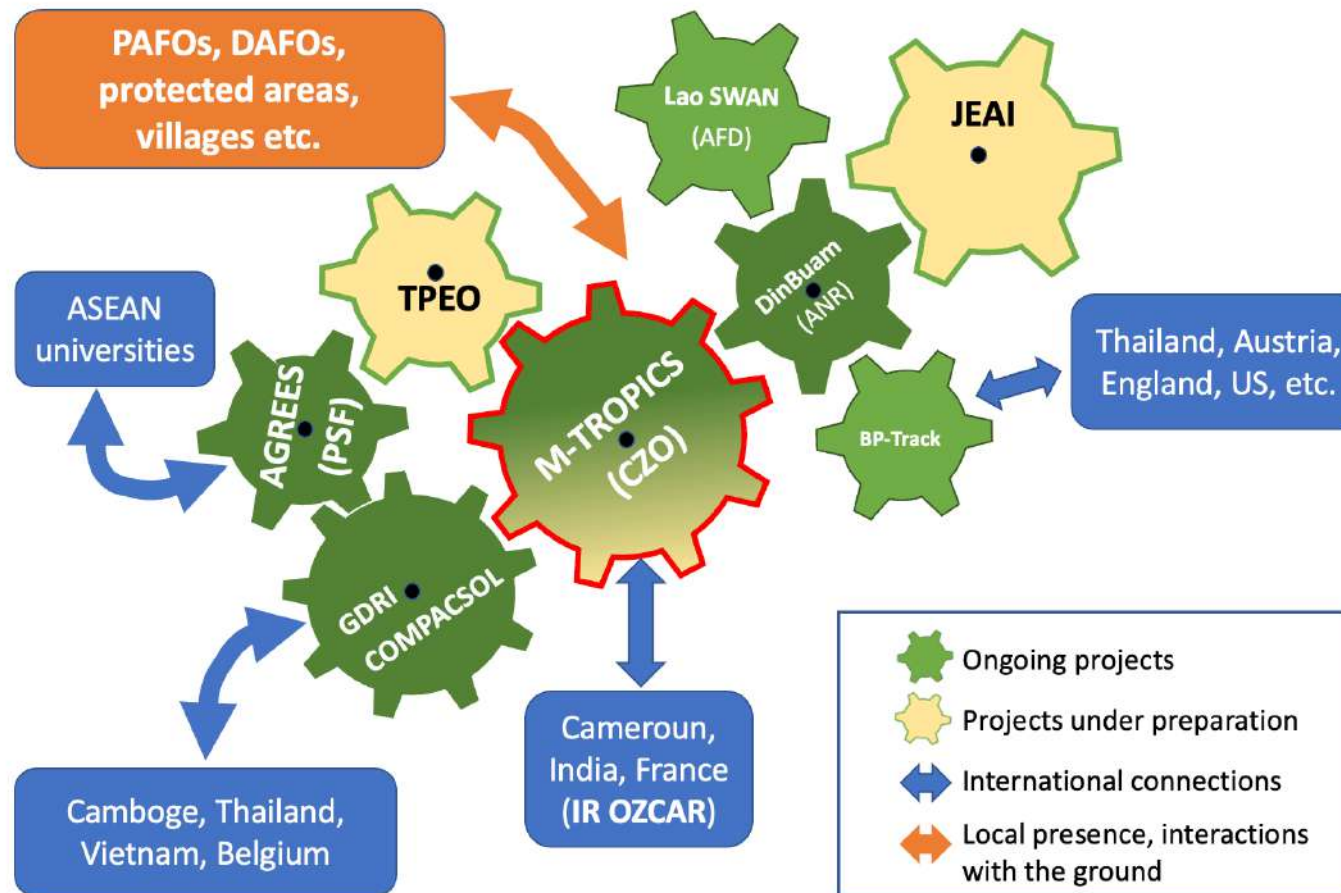


Development and deployment of low cost hydro-meteorological sensors



Monitoring water quality through satellite water colour measurement

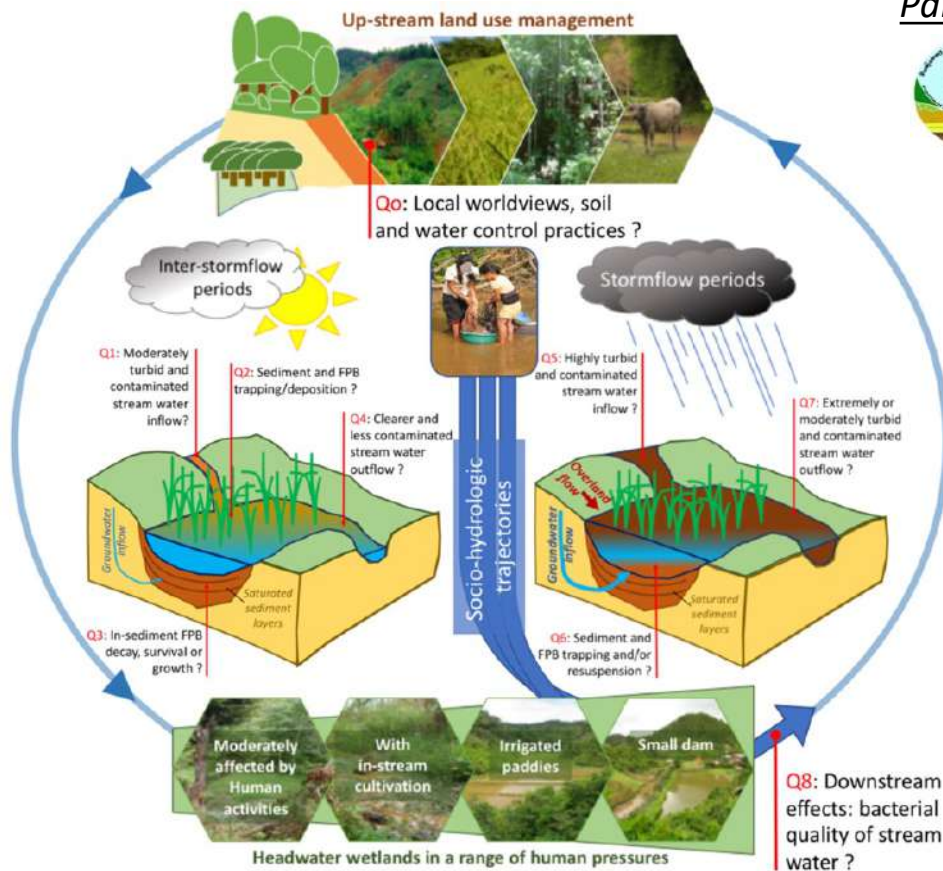
# Hub and foundation for a coherent set of projects



Partnership with:



Interdisciplinary consortium of 5 french units:

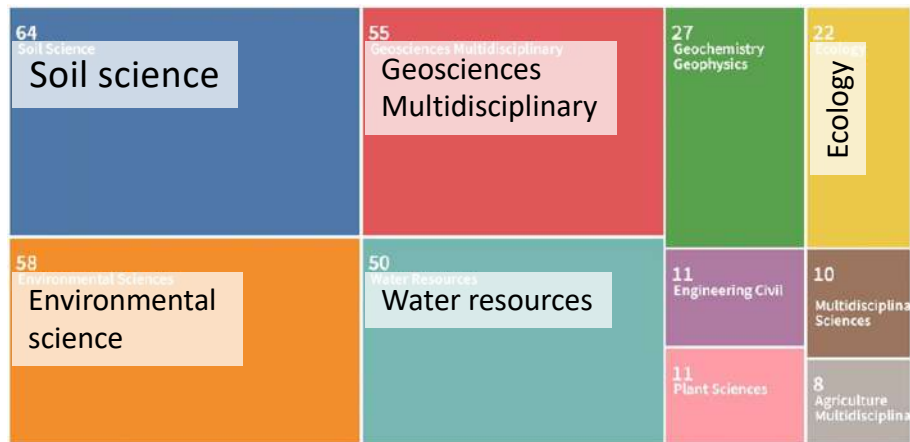


[Olivier.ribolzi@ird.fr](mailto:Olivier.ribolzi@ird.fr)

PI (IRD, GET)



# Scientific production & Capacity building



**Over 140 publications**, including ~90 articles in peer-reviewed international journals; ~30 articles in National journals; more than 10 book chapters; 2 information booklets; ~15 flyers and policy briefs, in the English and Lao languages.

Since 2000, about **130 students** at L1-M2 level and 9 PhDs



Data and info: <https://mtropics.obs-mip.fr/>

 @mtropics\_czo



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Partnership with:



Coordinating laboratories:



Funding:

