Mapping groundwater availability and renewability in rural areas in Cambodia

a multi-disciplinary approach including geophysics, hydrogeology and geochemistry

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Content

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  - Cambodia map
  - Vulnerability to floods and drought
  - Lack of water for domestic and irrigation
- Main activities
  - I. Documenting the water cycle and assessing renewability of water resources through LETS sites
  - II. Mapping groundwater using geophysicsMain activities
- Main objective:

→ **Strengthening the capacities of the authorities and communities regarding water resources access and renewability**

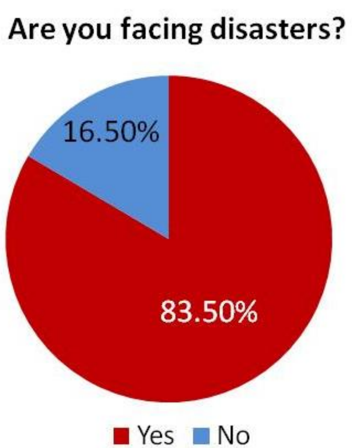
Introduction: country map

Introduction: lack of water

- Lack of water during the dry season for both domestic and irrigation needs

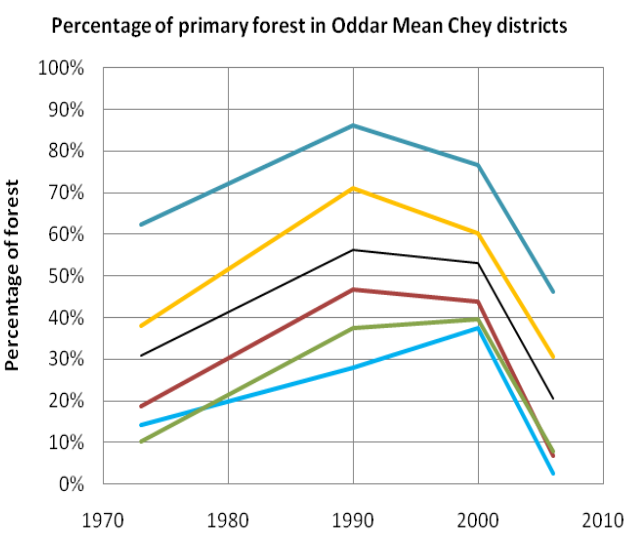
- *12% is unsafe drinking water from ponds or dams*
- *Almost no irrigation in dry season*

FRC surveys in Cambodia



FRC surveys in Cambodia

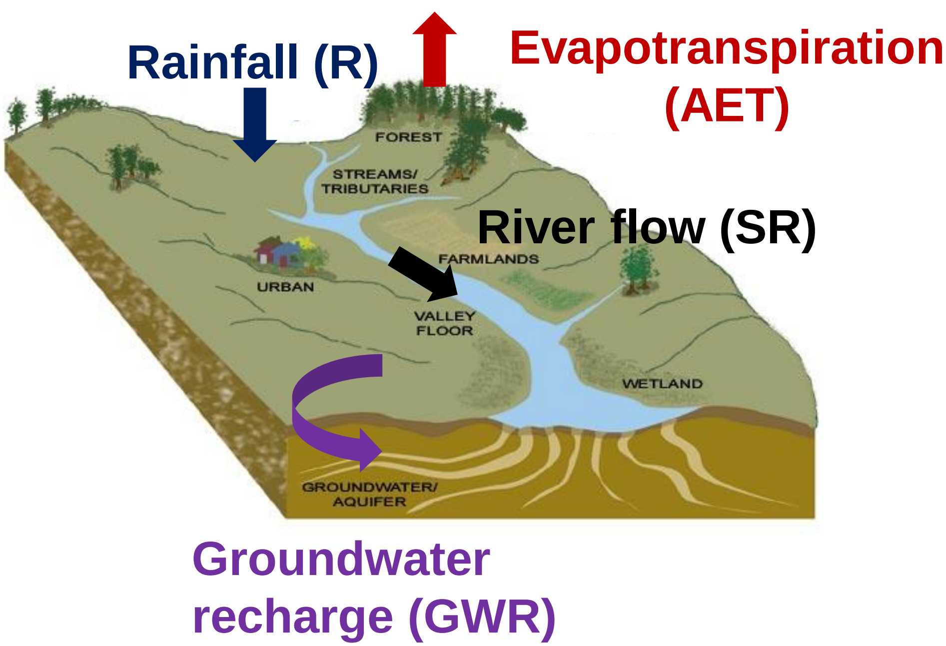
- Farmers are vulnerable regarding floods and drought hazards



- Population growth and pressure on natural resources like forest, lands and water

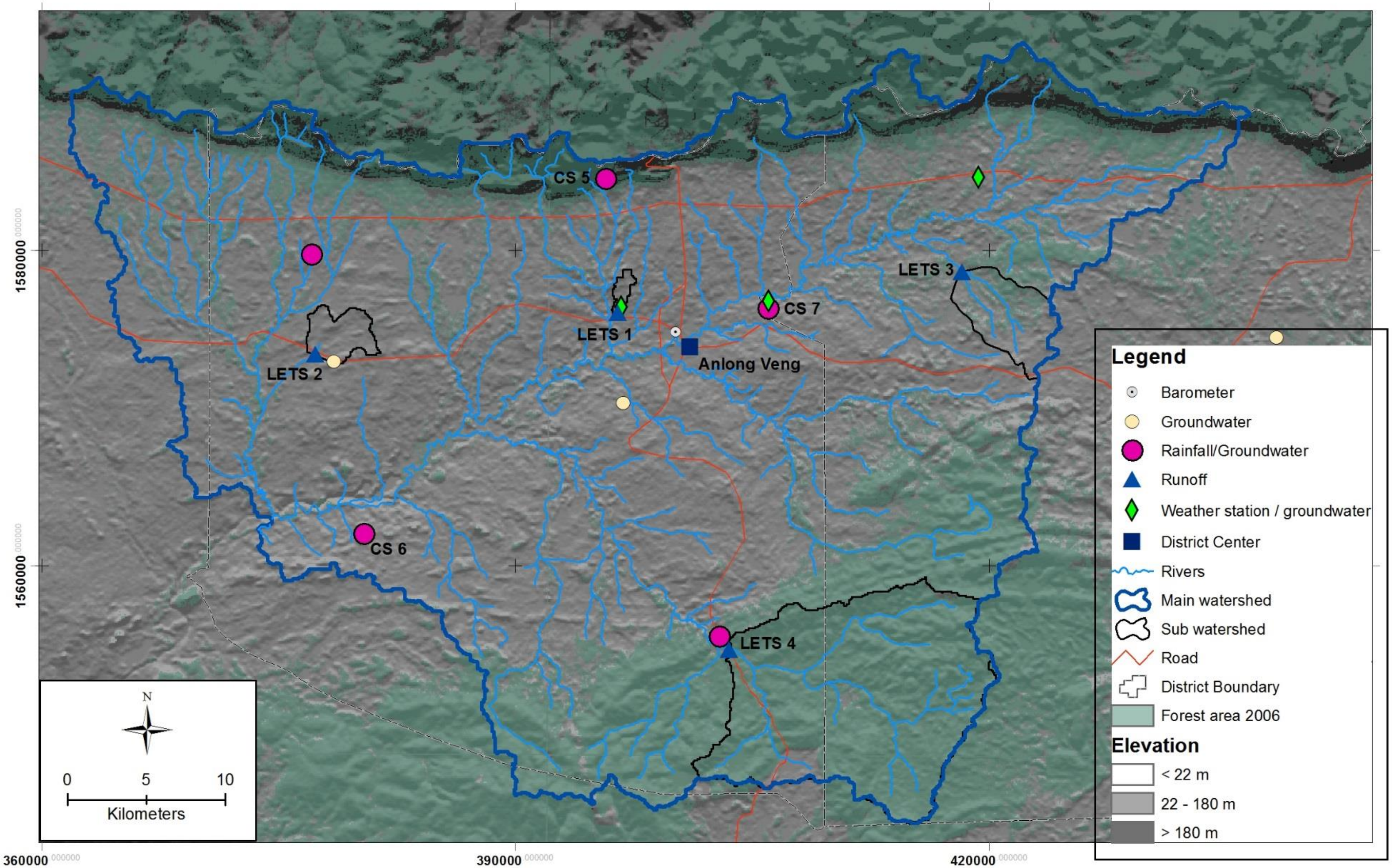
Activity I

Learning, Experimenting and Teaching Sites (LETS) implementation and assessment of water resources renewability

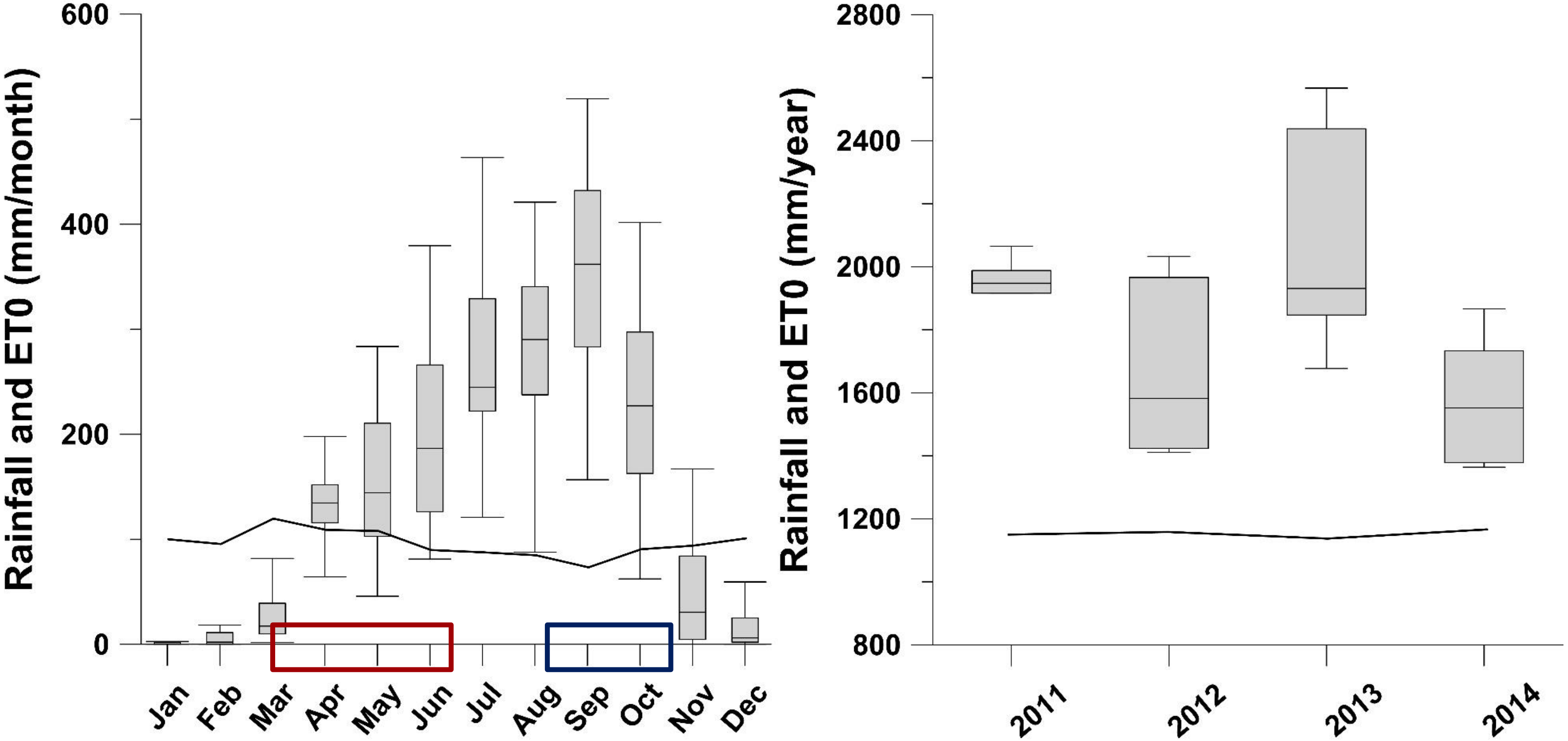


R = AET + SR + GWR

Hydrological Researching Sites (LETS)



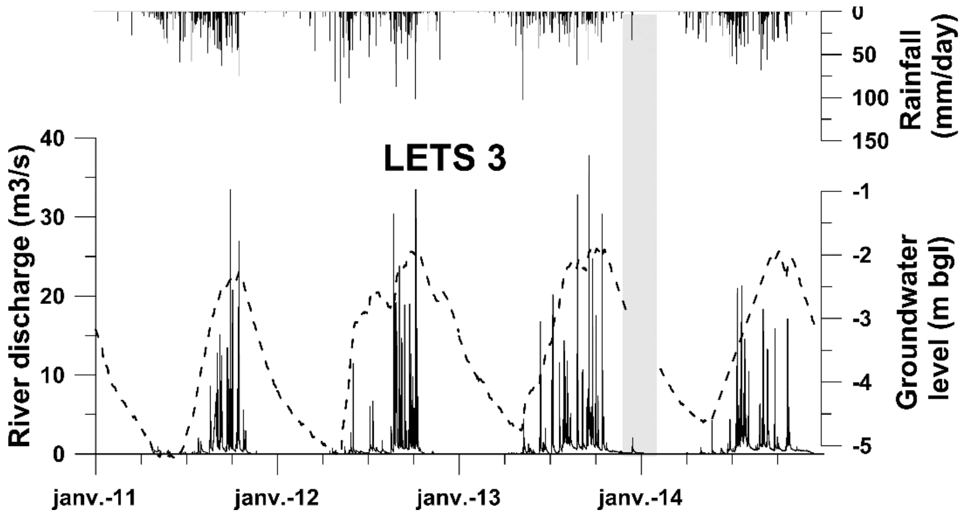
LEARNING on rainfall behaviour

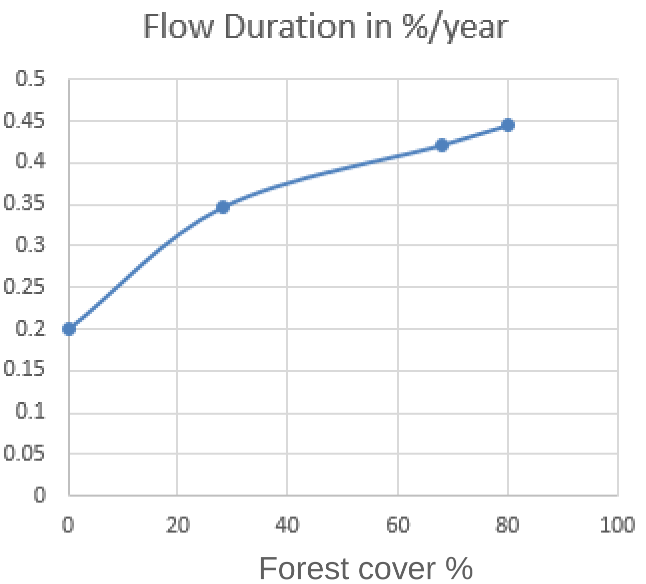


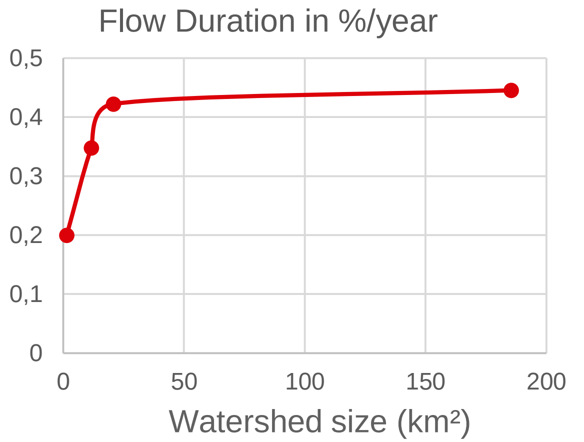
Valois et al, submitted

Rainfall highly variable in Oddar Meanchey, Cambodia
→ **Floods** & **drought**

LEARNING on surface runoff





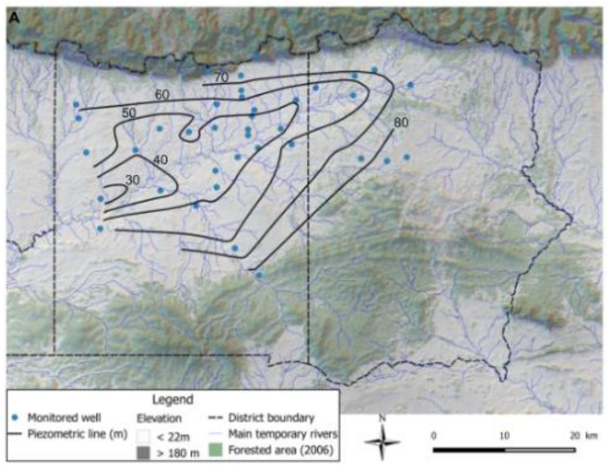


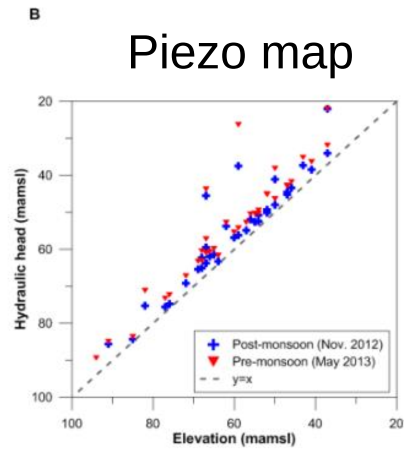
Link forest cover – flow duration ?
Bias with watershed size…

LEARNING on groundwater recharge

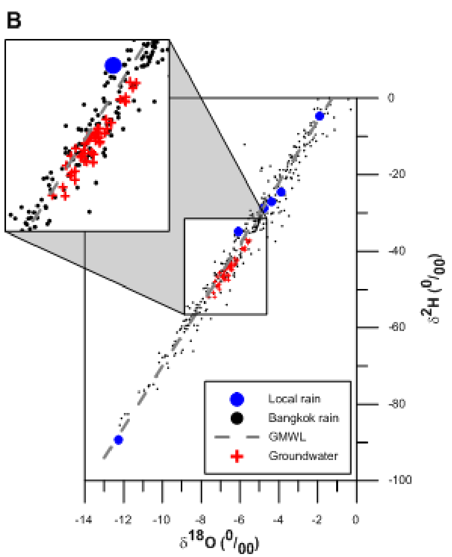
Vouillamoz et al, 2015

Piezo map

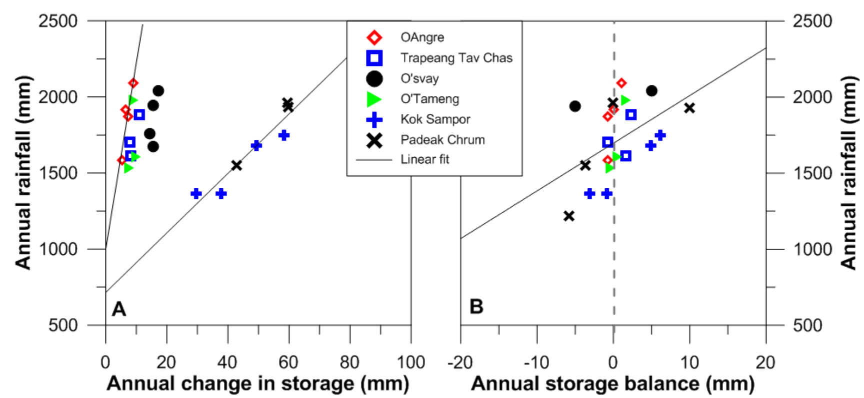




geochemistry

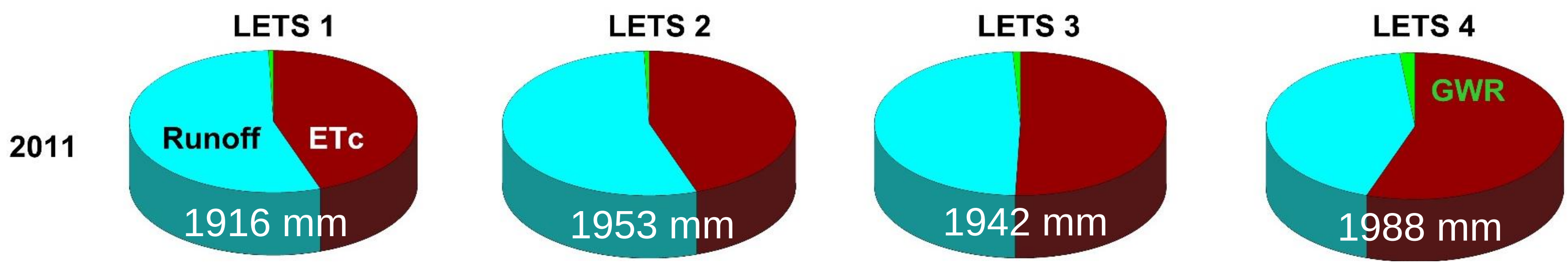


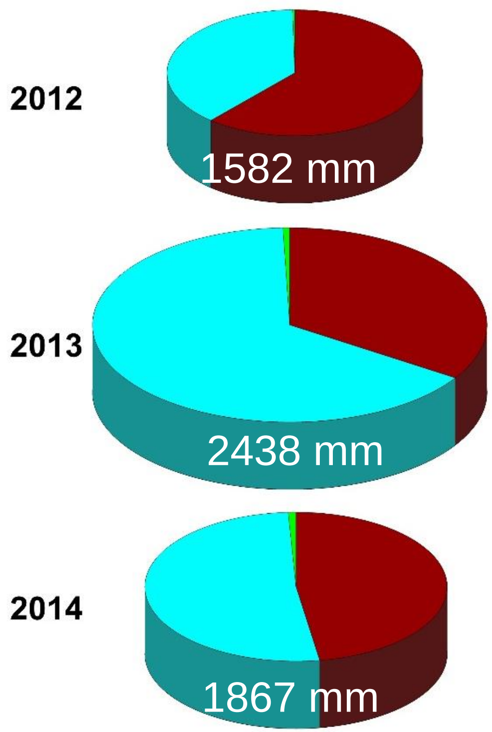
From WTFM & MRS porosities



→ Recharge is low (46 mm in average), fast and direct (no prior evaporation)

LEARNING on water balance





Spatial variability

In 4 years, the water balance is very different in LETS 1 due to the amount of precipation

→ Rainwater is mainly split into an ET and SR components
→ Because of quite stable annual ET, annual rainfall variations are absorbed by SR variations
→ GWR is low but increase with annual rainfall

Temporal variability

Valois et al, submitted

Surface hydraulic infrastructures

About 200 Household ponds were dug

3 village scale dams were built

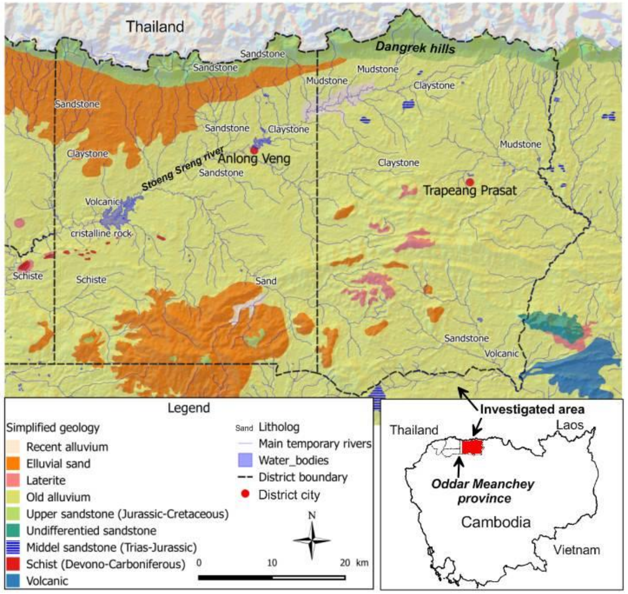
Activity II

Mapping groundwater using Magnetic Resonance Sounding (MRS) and Time-Domain Electro-Magnetics (TDEM)

MRS

TDEM

Applications of MRS and TDEM



- MRS and TDEM are useful tools:

- To identify good sites for underground water: reduce negative boreholes from 40% to 5%

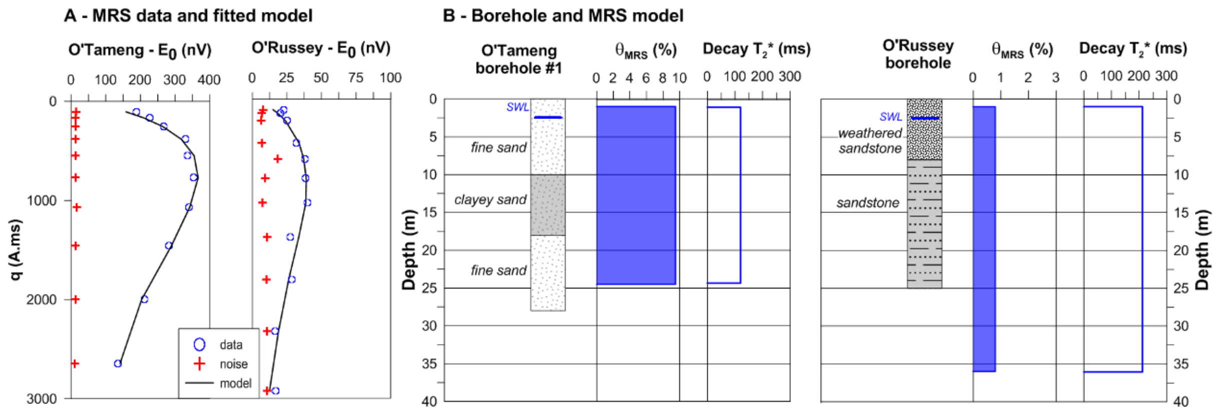
- To access to the effective porosity for ground water recharge assessment and sustainable usage of underground resources

- For a mapping of underground water resource in target districts for actual and future development

More than 60 MRS soundings and 500 TDEM soundings have been carried out in order to map ground water in Cambodia (2 districts ~ 4500 km2)

Linking MRS and pumping tests

Vouillamoz et al, 2015



MRS :
→ Water content %
→ T2* (sensitive to pore size)

Vouillamoz et al, 2012

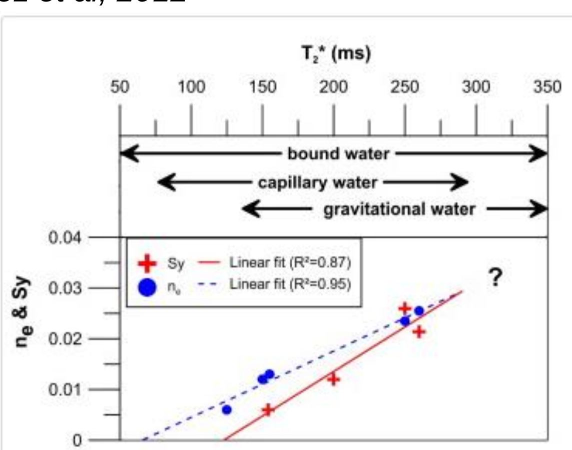
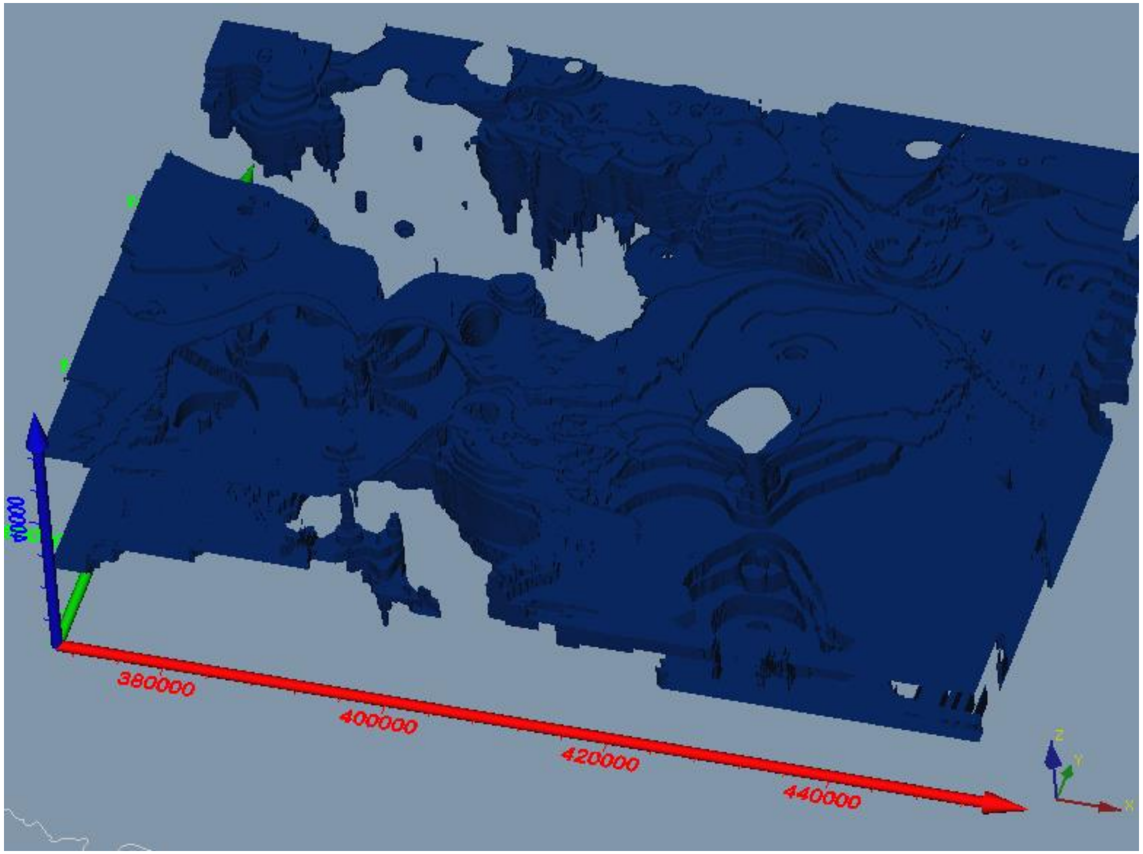


Fig. 6.
Comparison of MRS decay time with storage-related properties.

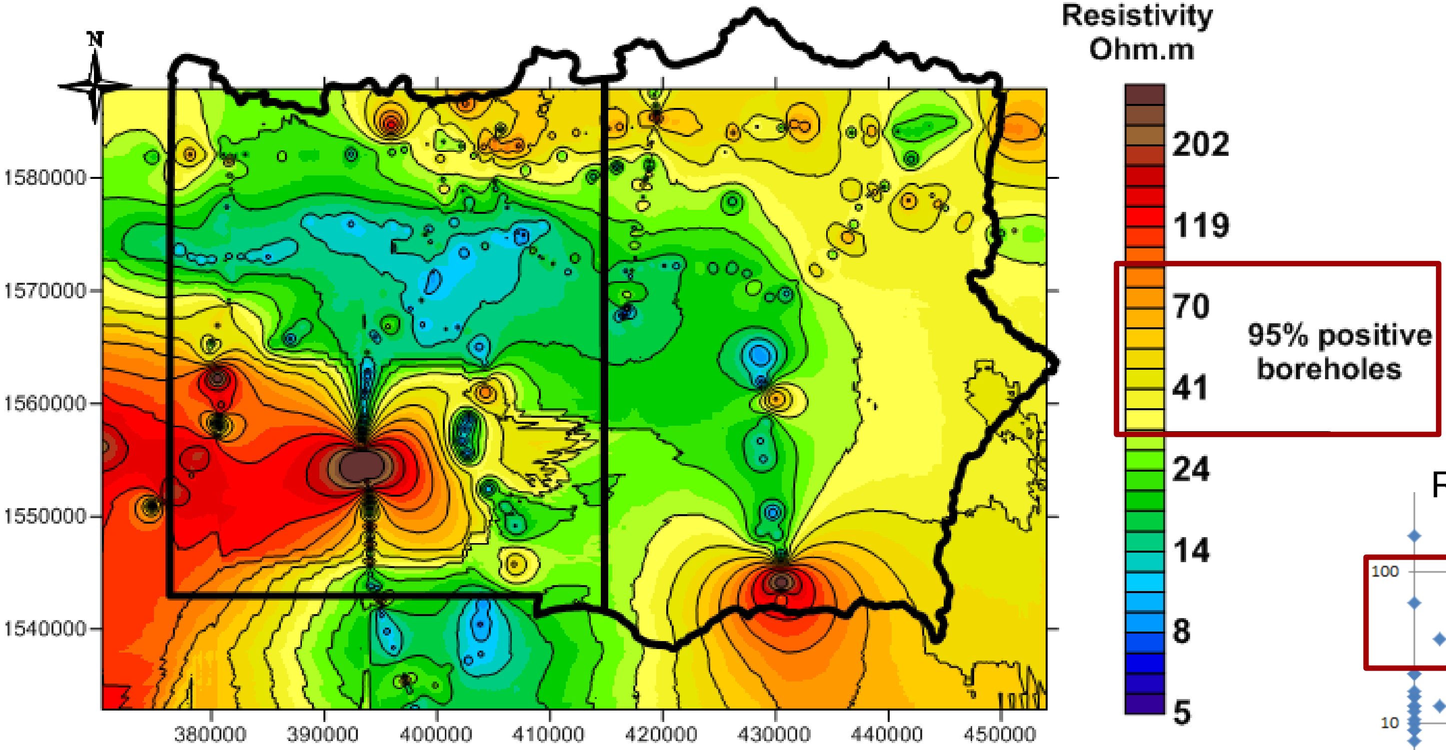
→ Link between Sy and T2*

3D model of resistivity thanks to more than 500 TDEM soundings

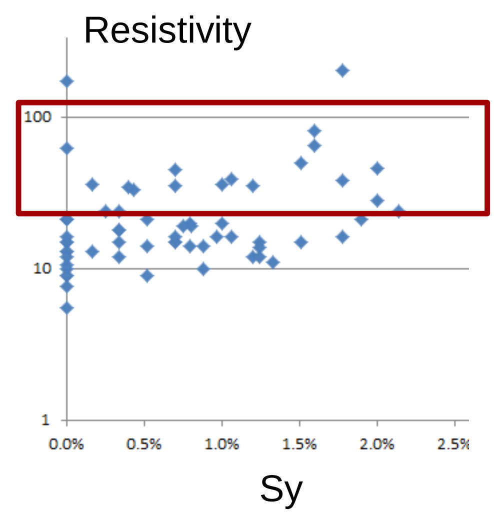


Iso surface of 30 ohm.m
(On going work)

2D map export at 45 meters deep



Linking TDEM and pumping tests through MRS



→ **On going study to spatialize underground reserve and Sy**

Conclusions

- By setting-up the LETS network and using geophysics:

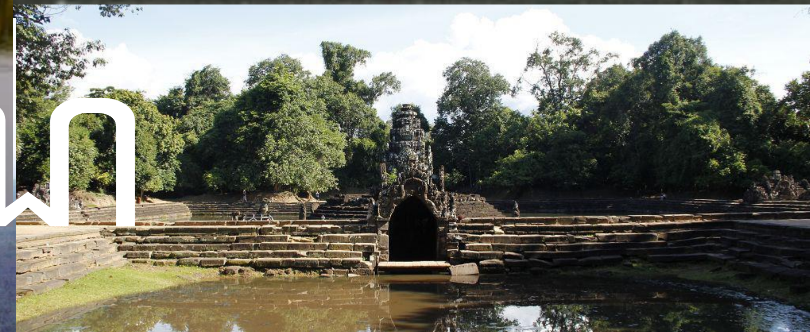
- Better understand water balance, droughts/floods conditions, studying natural and human impacts on water balance

- Get a first 3D geological model to target groundwater for communities

- Choose and design adapted water infrastructures according to water availability and renewability

→ 3 villages were equipped with groundwater access and water towers

- Improve knowledge of government staffs and communities on water resources



Thank you

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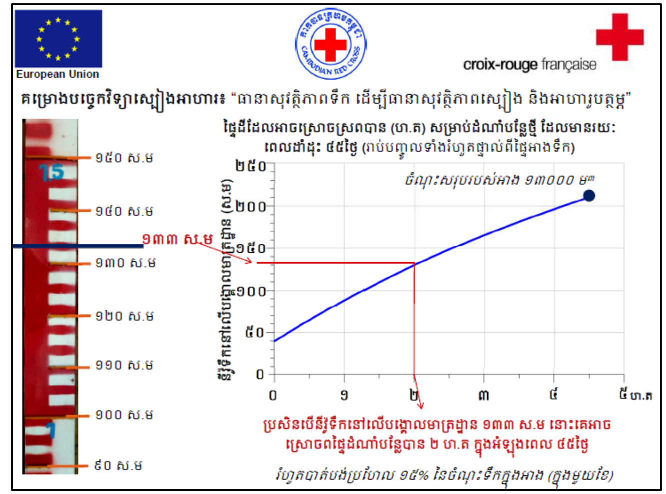
Partnerships with technical departments

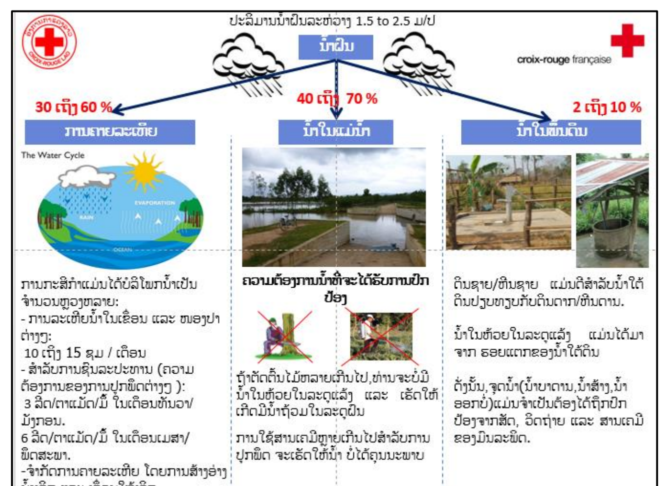
PDWRM

- Installation of weather stations with PDWRM staff
- Hydro-weather data collection and maintenance of equipments with PDWRM staff
- On the job and formal trainings of technicians on water resources and GIS
- Data of weather stations in Cambodia sent by modem for MWRM and available on: http://weather.irrigateway.net/Cambodia/

Capacity building of communities

- Communities
  - Training of committees in order to manage and maintain water infrastructures properly
  - Training of committees on sustainable use of water resources according to water crops needs and water avaibility
  - Advocacy on water cycle and natural resources preservation in schools and with farmers





Partnerships with ITC, CRC

ITC

- Partnership between FRC and the Rural Engineering Department of ITC since 2009
- Internship of around 10 ITC students on the different projects in Oddar Meanchey, on water research and engineering activities
- Inputs of ITC professors on water research and engineering activities

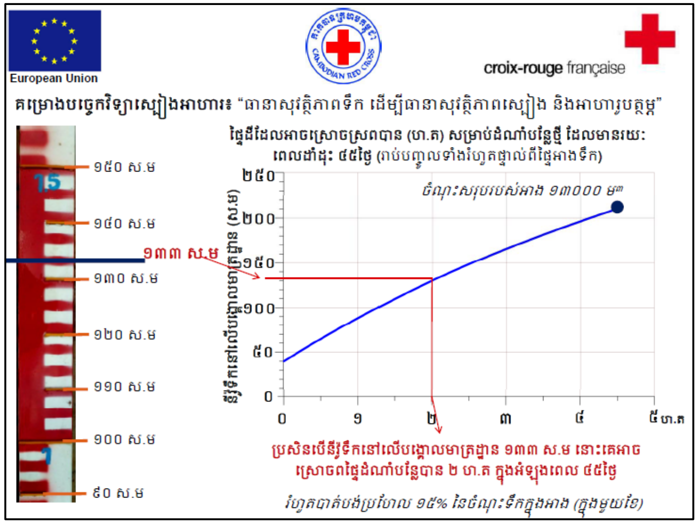
Cambodian Red Cross

- Implementation partners
- Skilled CRC staff for hydrogeology trained by FRC and IRD
- Volunteers network in target villages: participate in training activities at village level

Outputs for communities: 3 dams (for around 100 households)

→ Designed in accordance to peak flow thanks to LETS data

→ With scale linked to farming surface



Outputs for communities: 186 family ponds (186 households)

→ Designed in order to allow 860 mm of direct ET and enough volumes for several homegardens cycles

Outputs for communities: 20 ringwells with rope pumps (20 households)

→ In areas where MRS shallow results are good enough

9 borehole & water tanks systems (for around 70 households)

→ In areas where MRS results are good enough