Efficiency of Magnetic Resonance Sounding to characterize hydrogeological properties of weathered hard rock aquifers

→ *the MRS method*
→ *interests and limits*
→ *field implementation strategy*

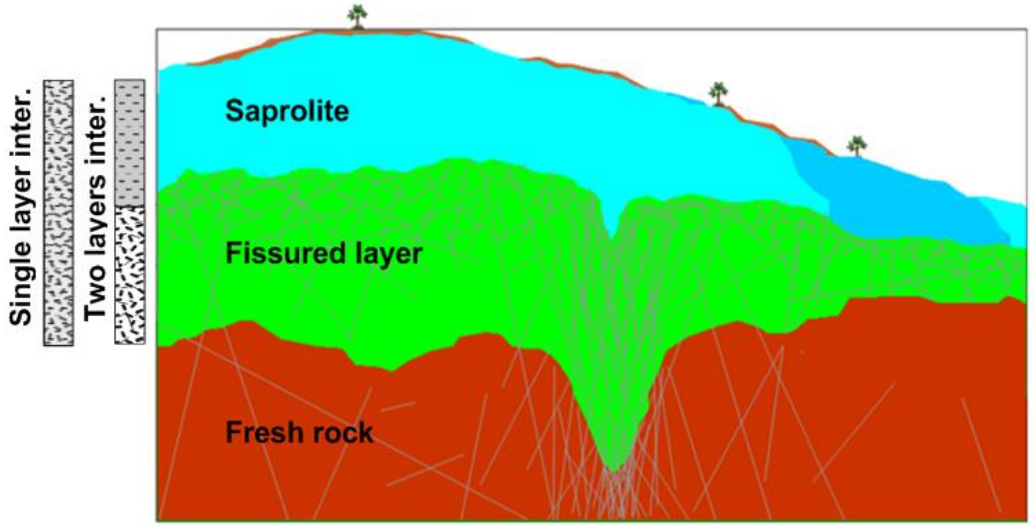
Results obtained thanks to GRIBA project

FMA. LAWSON, JM. VOUILLAMOZ, A. LEGCHENKO, and N. YALO

ABSTRACT n° 1858

25-29th September 2016
Montpellier, France
CORUM CONFERENCE CENTER
43rd IAH congress

The MRS method



(modified from Wins et al., 2004)

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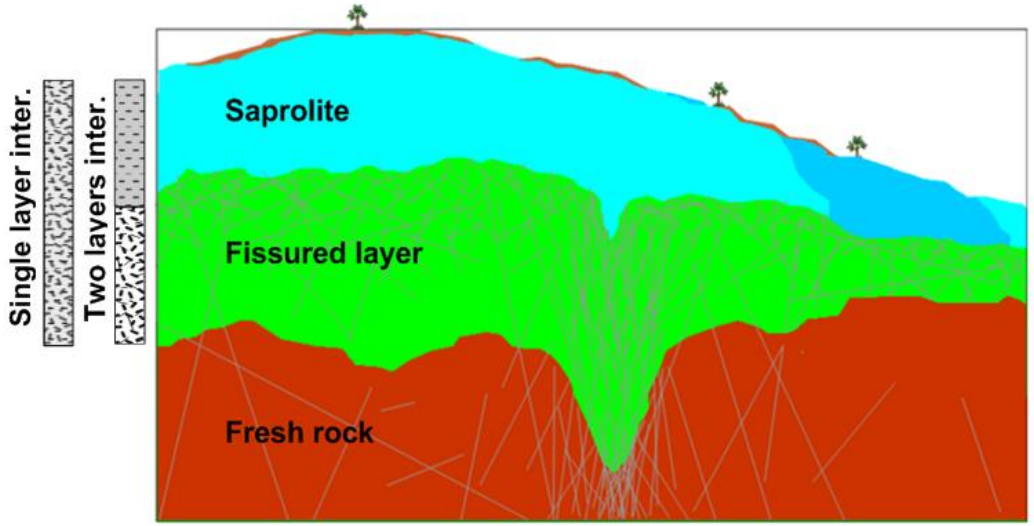
The MRS method



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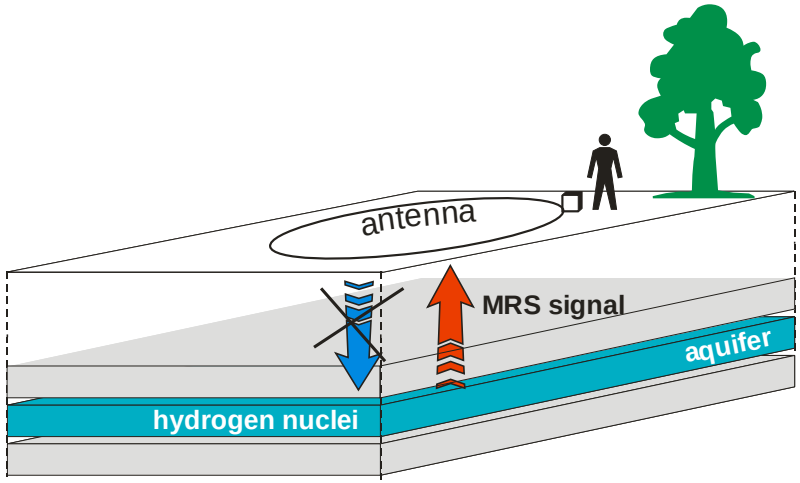
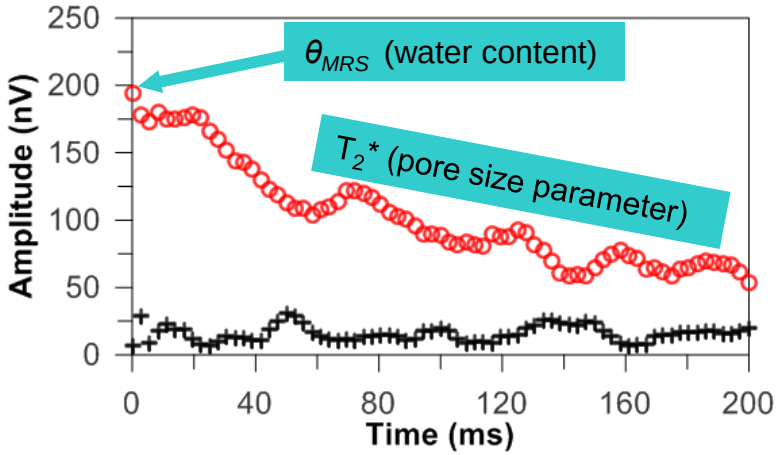
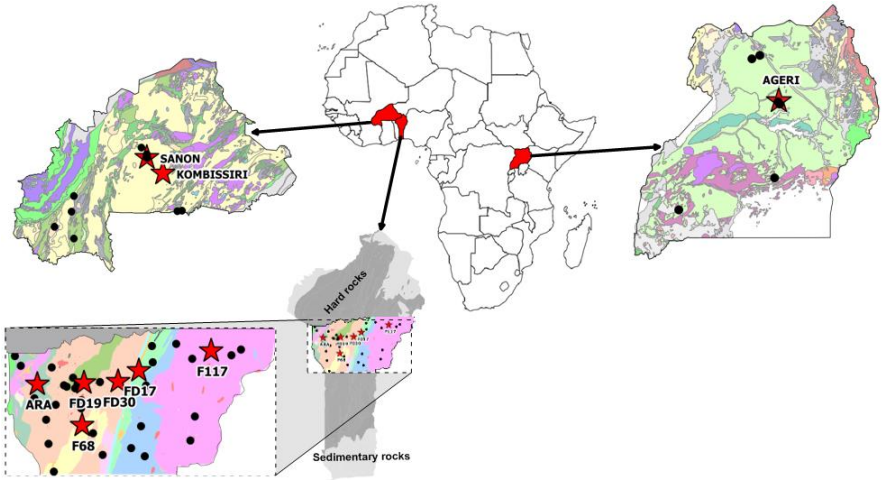




ABSTRACT n° 1858

Interests and limits

- How did we manage?

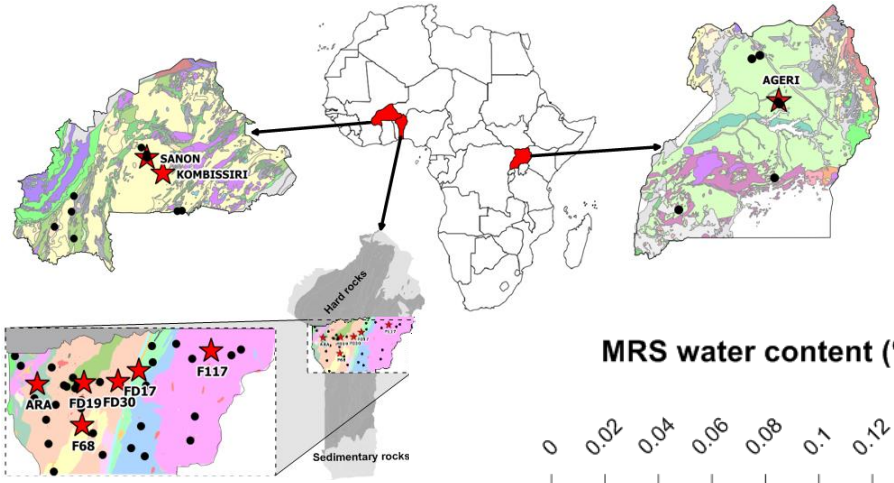


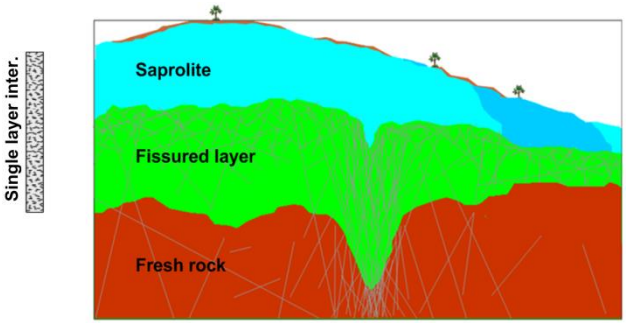
$f(Sy, T) = (\theta_{MRS}, T_2^*)$

ABSTRACT n° 1858

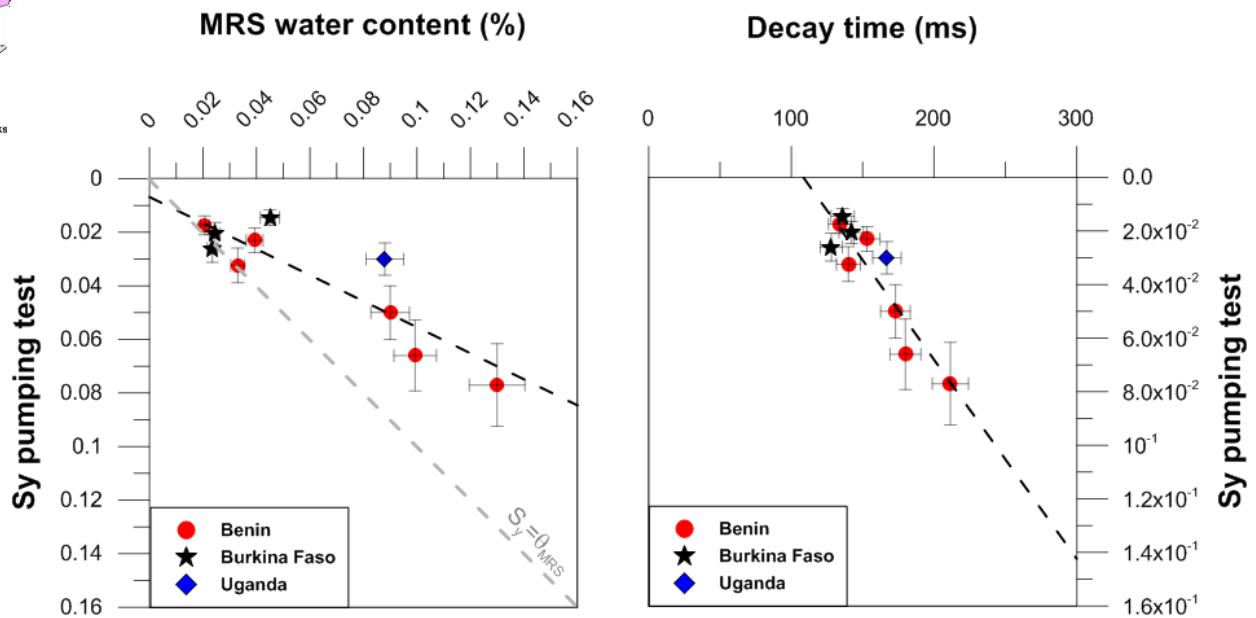
Interests and limits

- What did we find?





(modified from Wins et al., 2004)



(ε =27%)

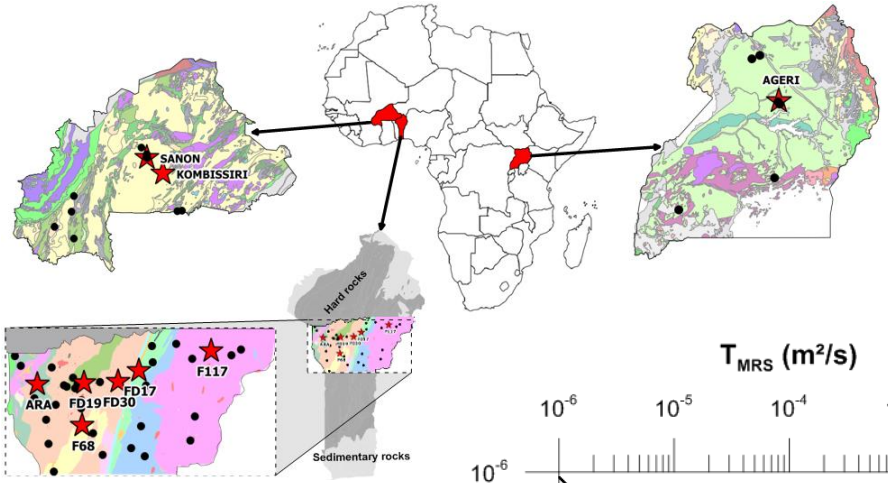
(modified from Vouillamoz et al., 2014)

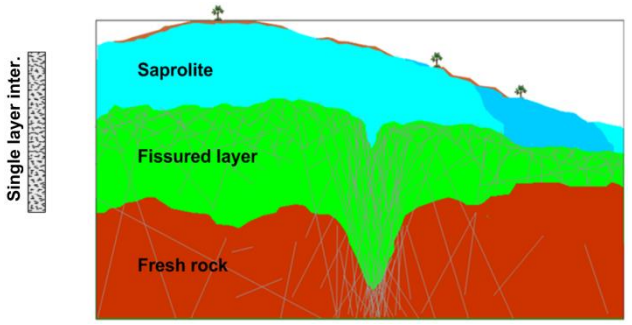
(ε =26%)

ABSTRACT n° 1858

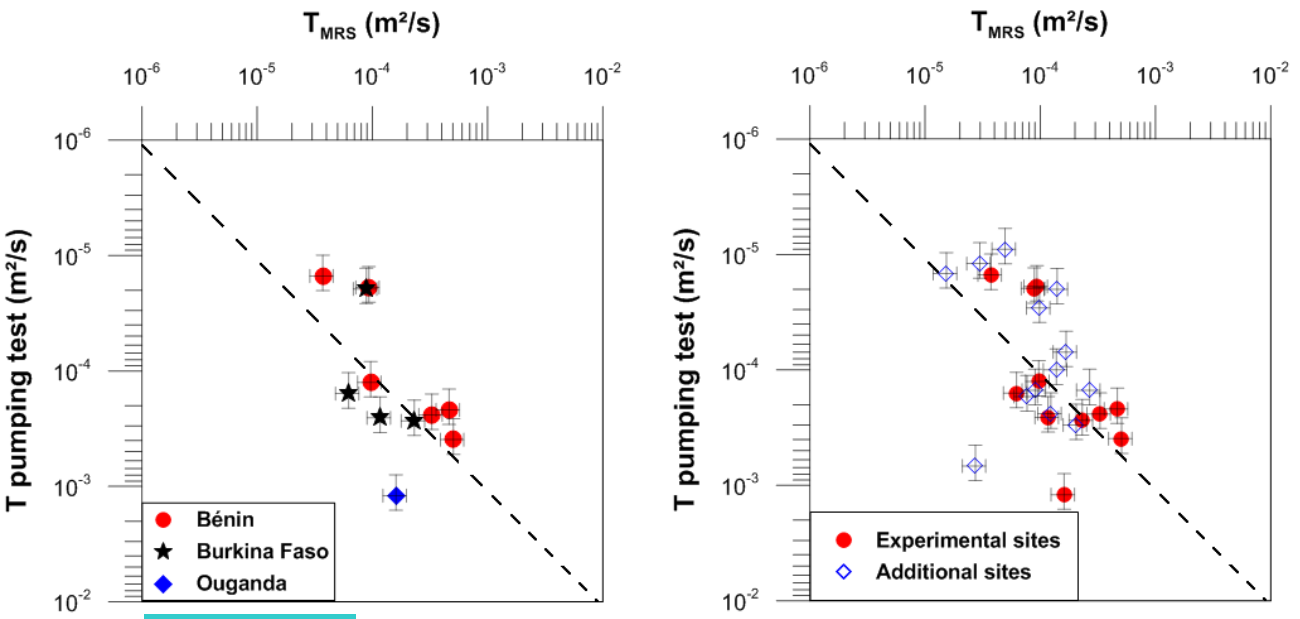
Interests and limits

- What did we find?





(modified from Wins et al., 2004)



(ε =90%)

(modified from Vouillamoz et al., 2014)

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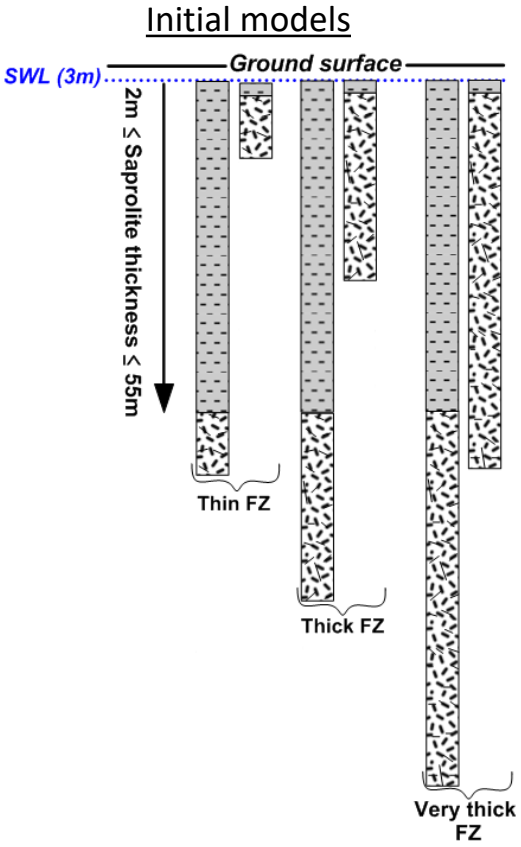
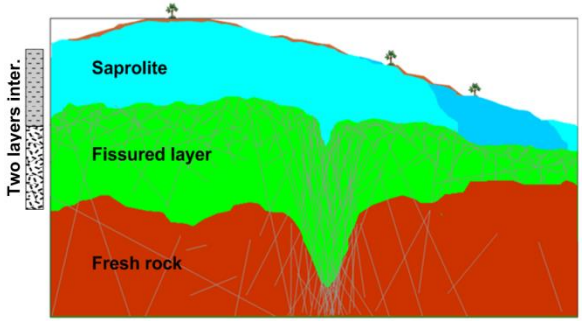
Interests and limits

- MRS Numerical modeling





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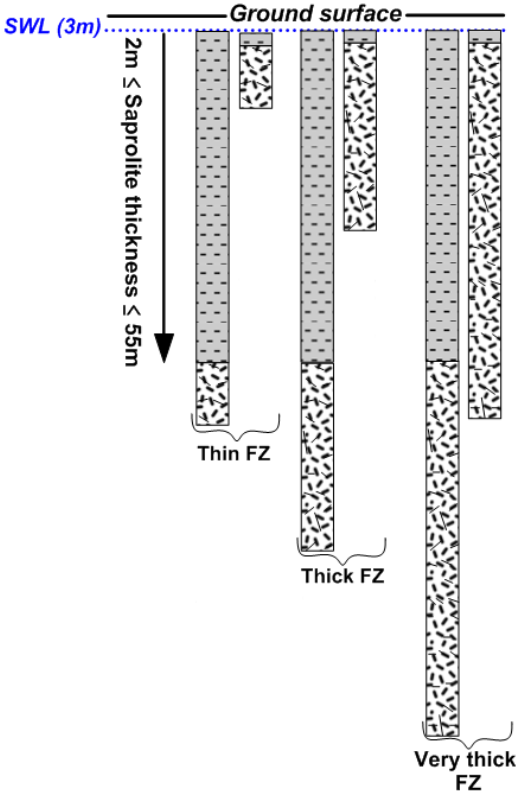
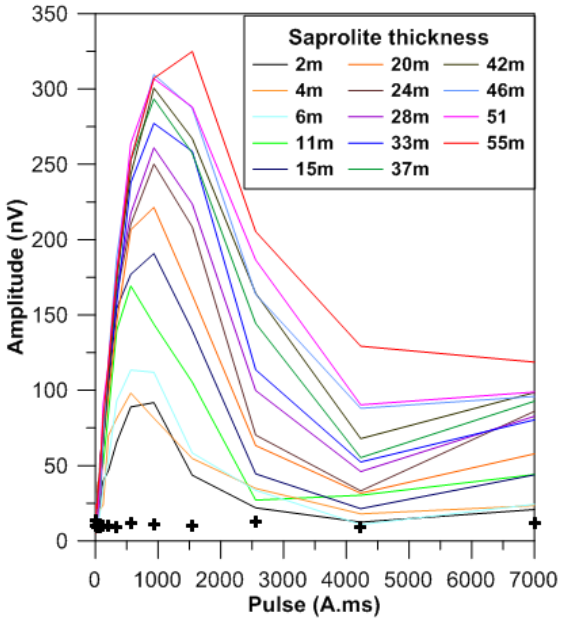
Interests and limits

MRS Numerical modeling

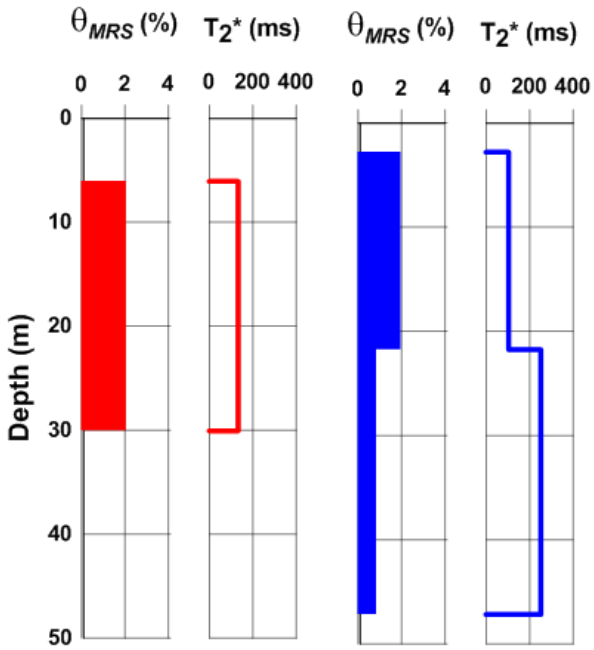
Initial models



Synthetic data for a thick FZ (30m)



Inversion results



Comparison

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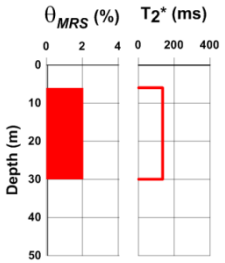
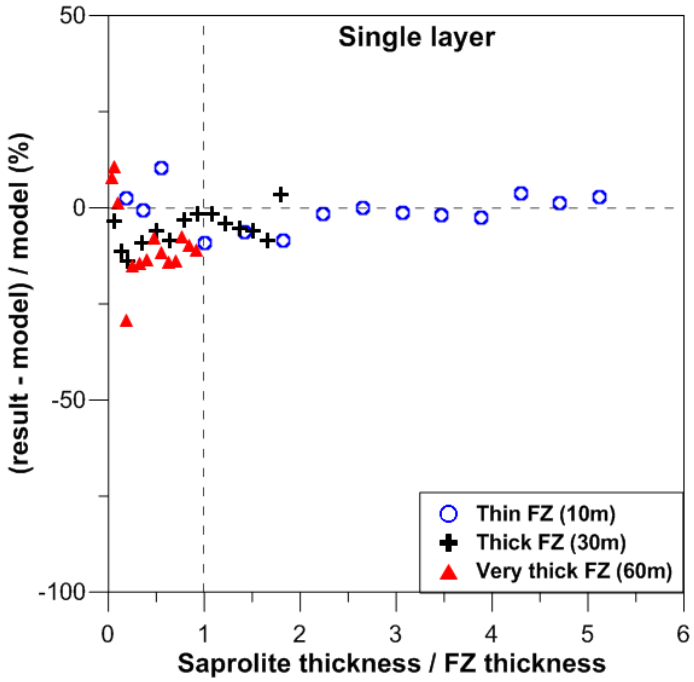
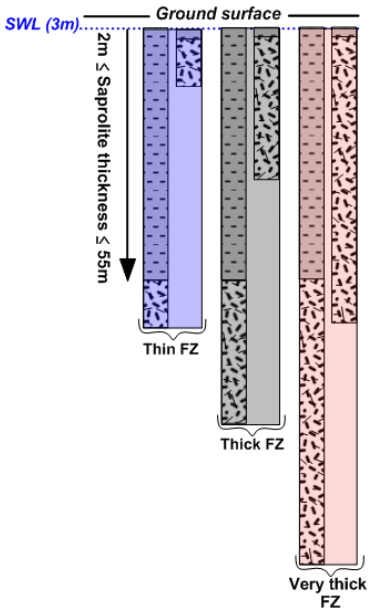
Interests and limits

- MRS Numerical modeling
  - MRS storage = θ_{MRS} . Δz



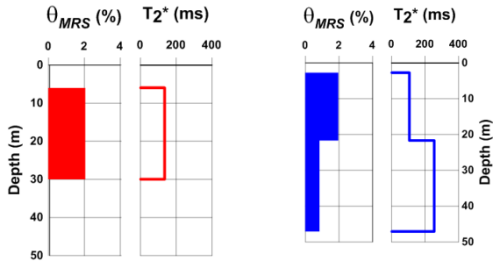


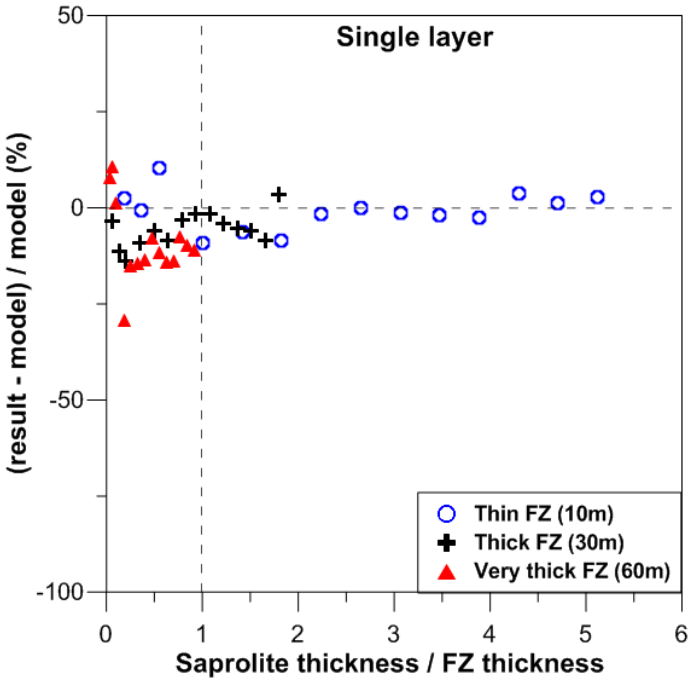


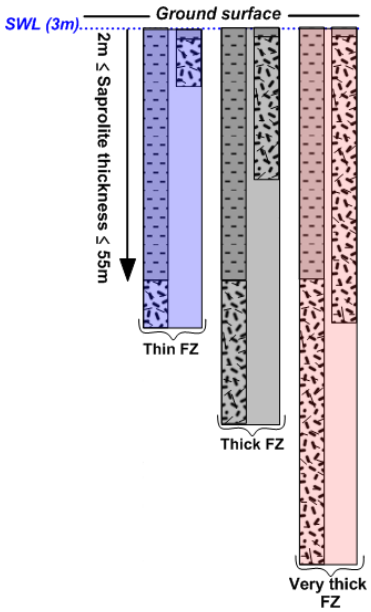
ABSTRACT n° 1858

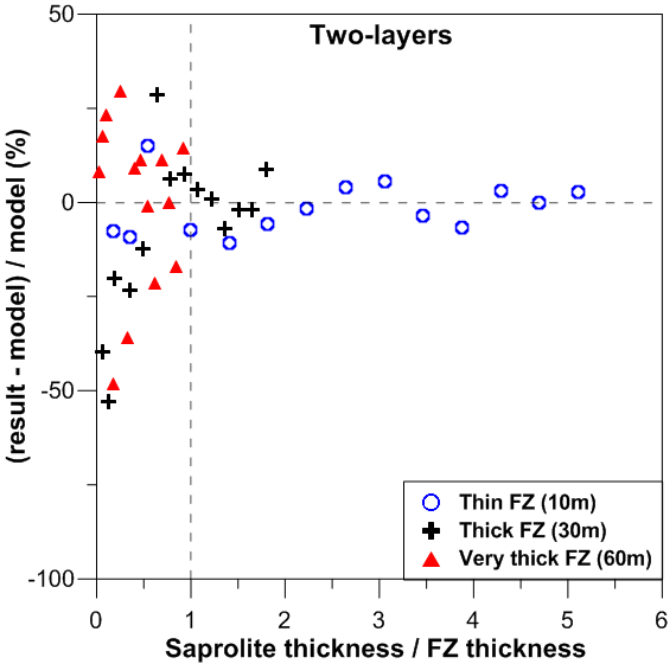
Interests and limits

- MRS Numerical modeling
  - MRS storage = θ_{MRS} . Δz









MRS storage is well estimated when controlled by the saprolite

The FZ is not well resolved with MRS

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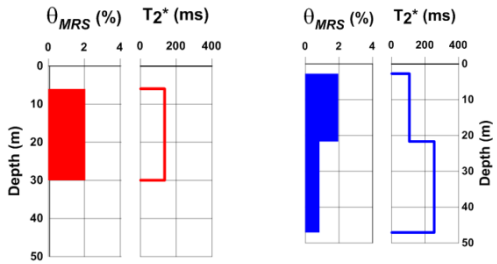
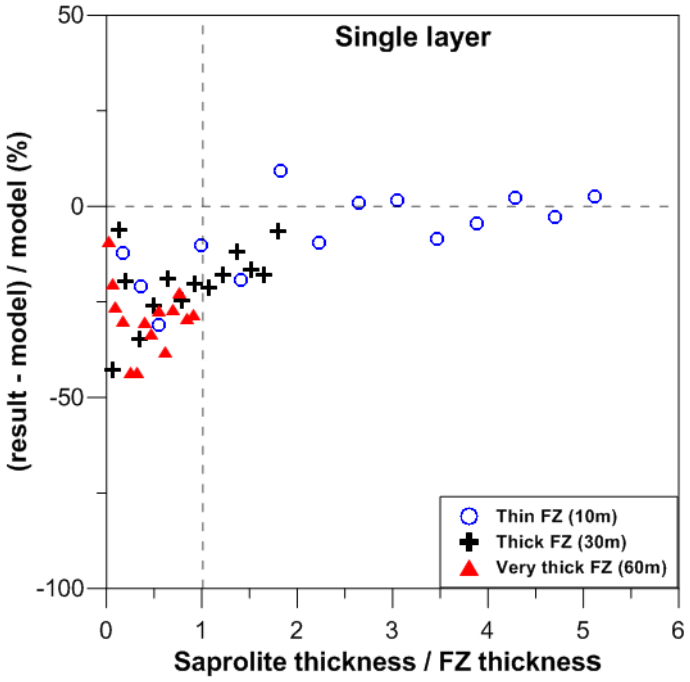
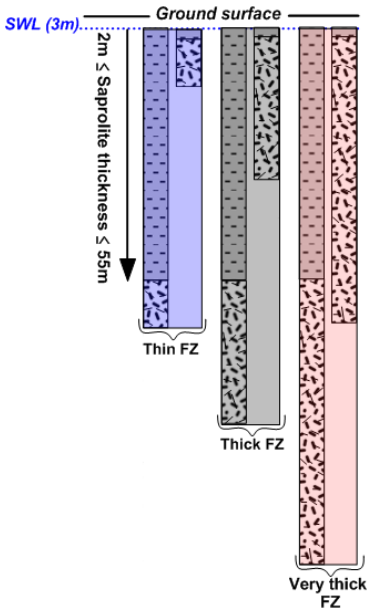
Interests and limits

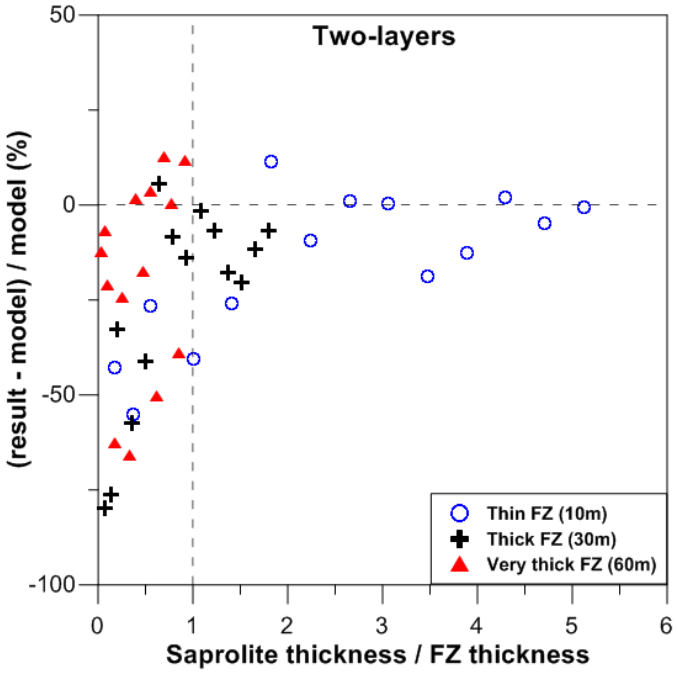
MRS Numerical modeling

- MRS storage = θ_{MRS} . Δz
- Transmissivity:
  $T = (T_2^*)^2 . \theta_{MRS} . \Delta z$









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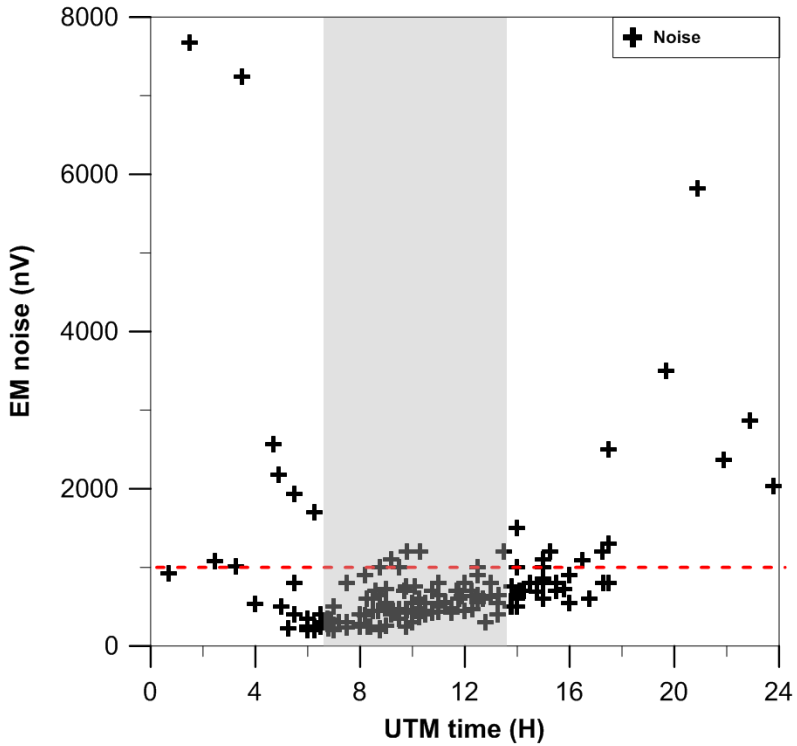
Field implementation strategy



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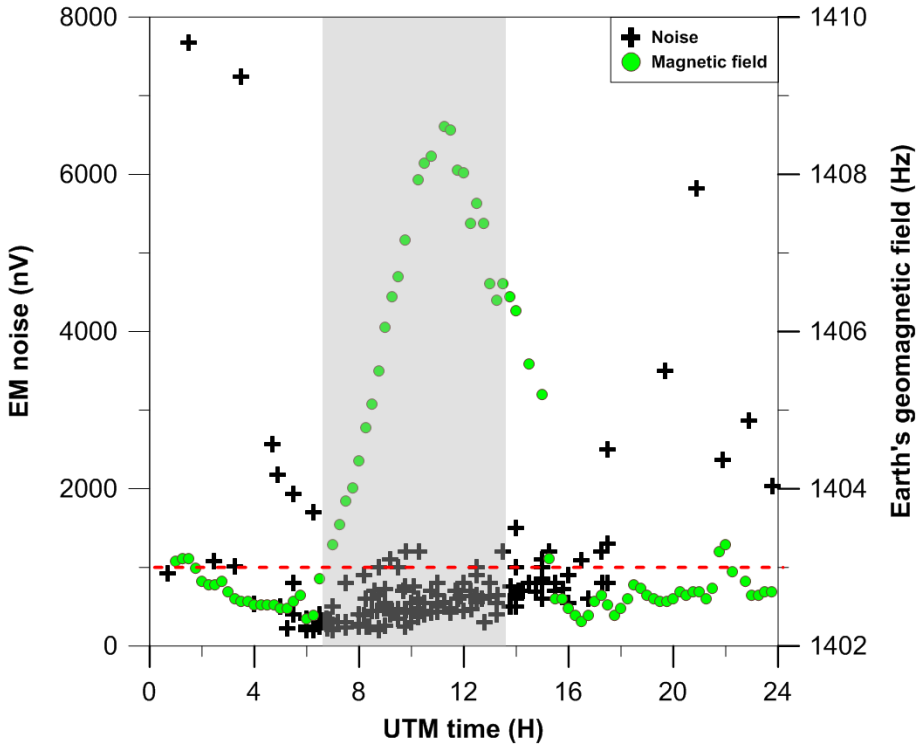
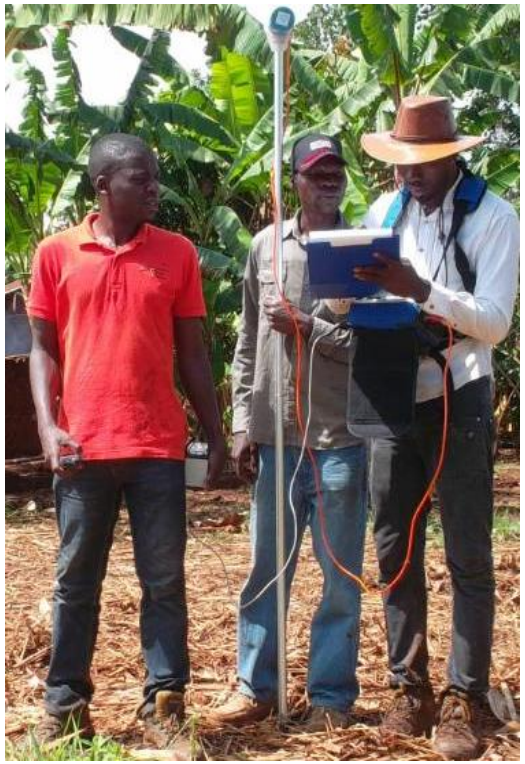
Field implementation strategy





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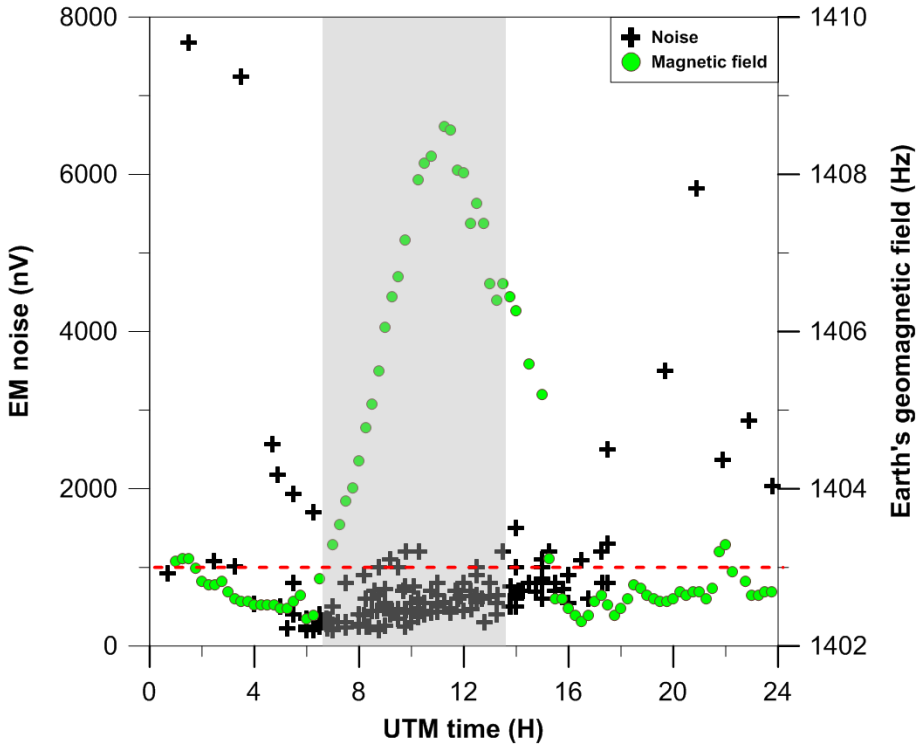

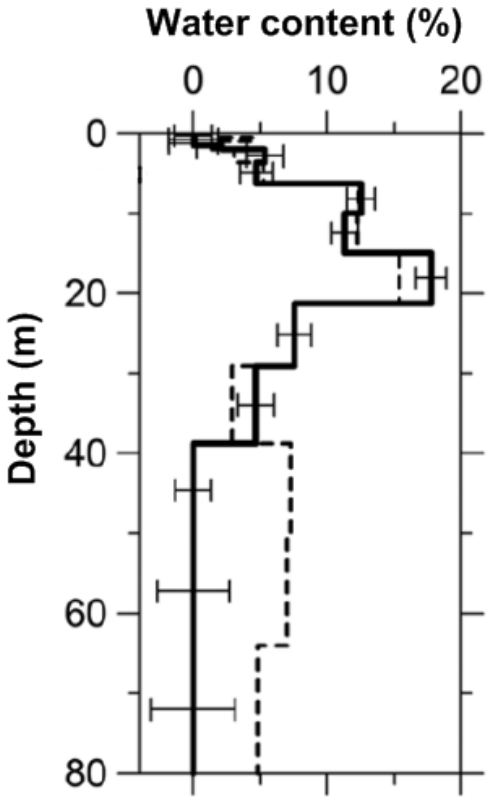

(modified from Legchenko et al., 2016)

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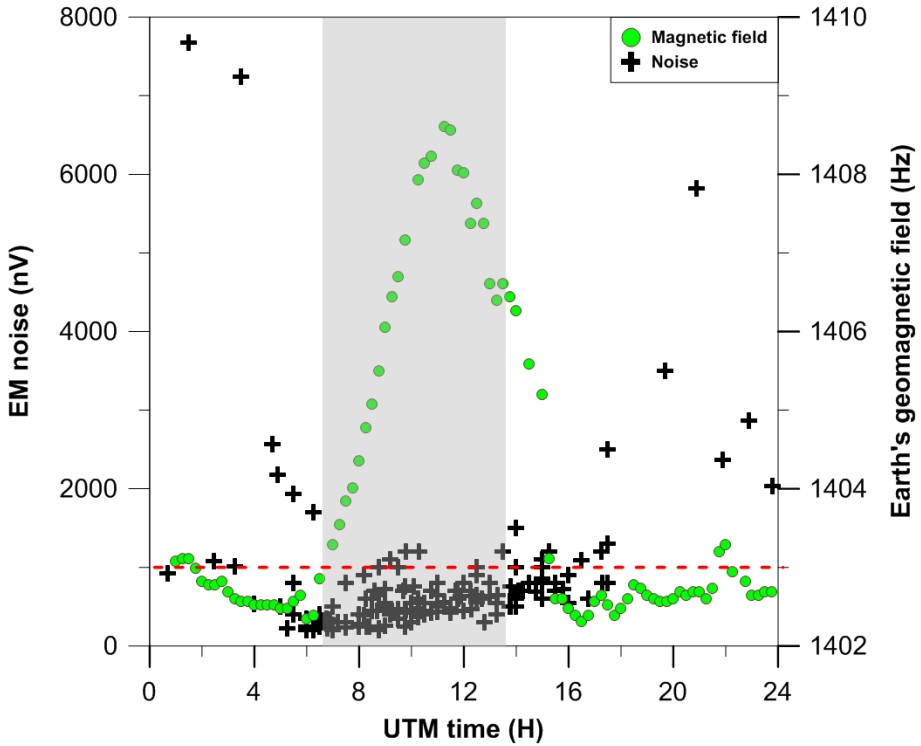

- ✓ **Take into account varying GMF**

  (Legchenko,A., 2016)

- ✓ **Measurements last in 2 days in average**

  (Vouillamoz et al., 2014)

- ✓ **Use big size of MRS loop increase S/N**

  (Vouillamoz et al., 2014)

- ✓ **Use of classicals noise filtering technics**

  (Legchenko,A., 2007)

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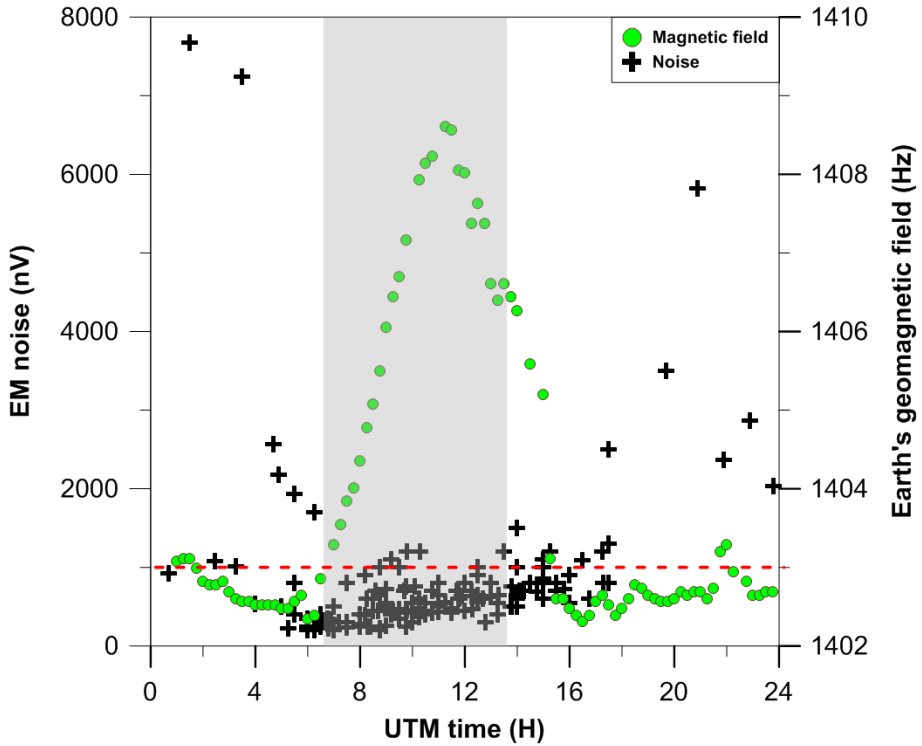
Field implementation strategy



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  (Vouillamoz et al., 2014)

- ✓ **Use of classicals noise filtering technics**

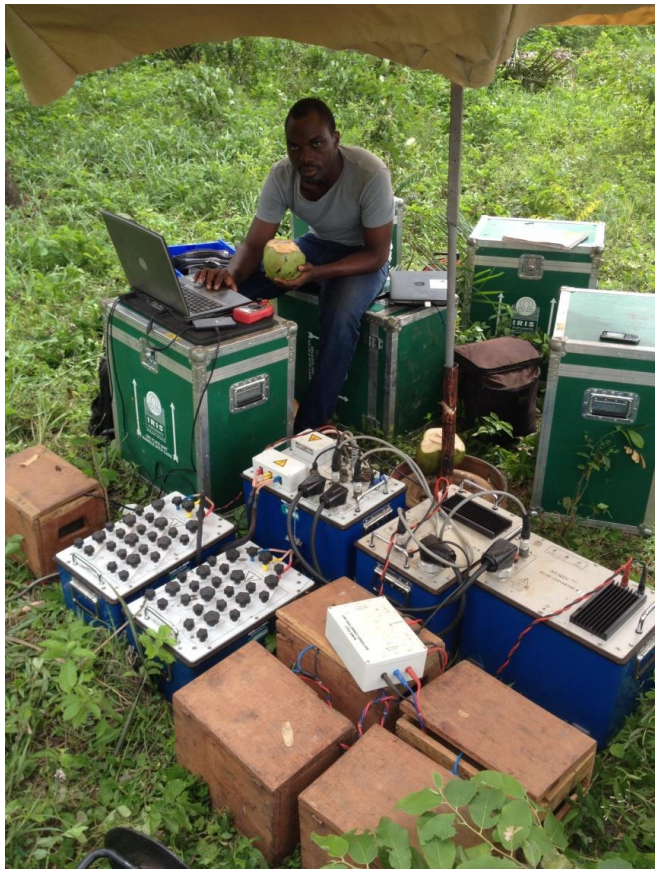
  (Legchenko,A., 2007)

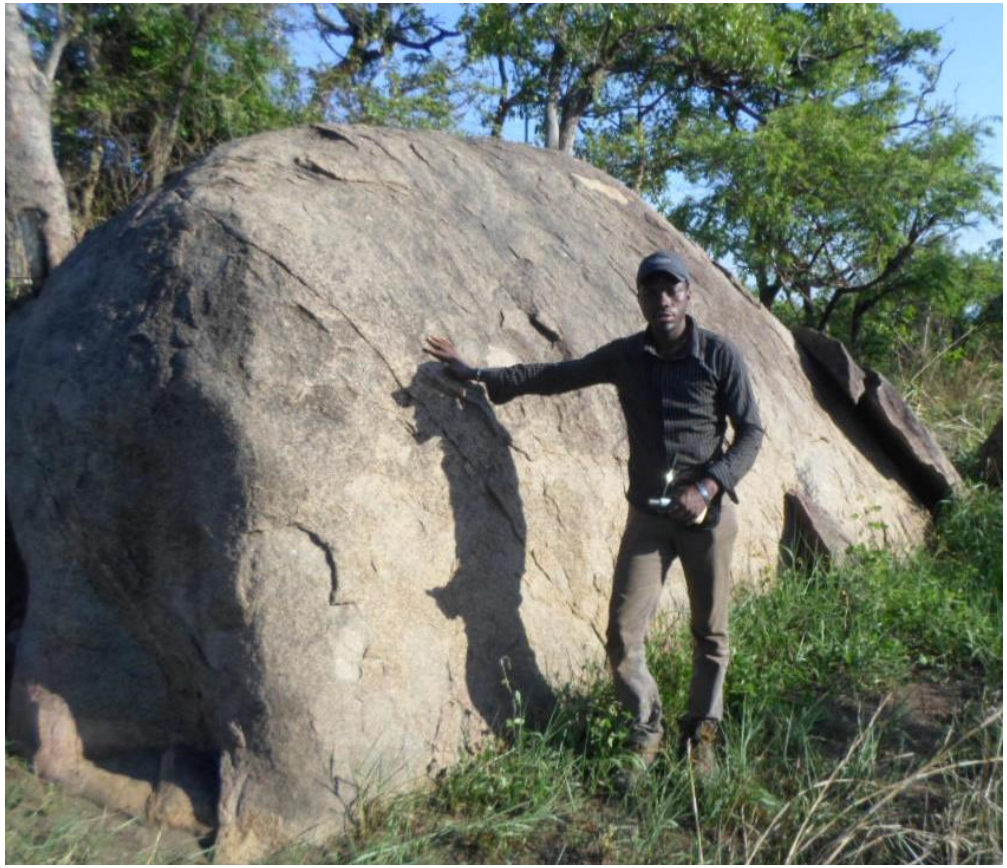
- ✓ **Integrated parameters well estimated**

- ✓ **Parameters according to depth not yet well estimated**

ABSTRACT n° 1858

Thanks for your attention!





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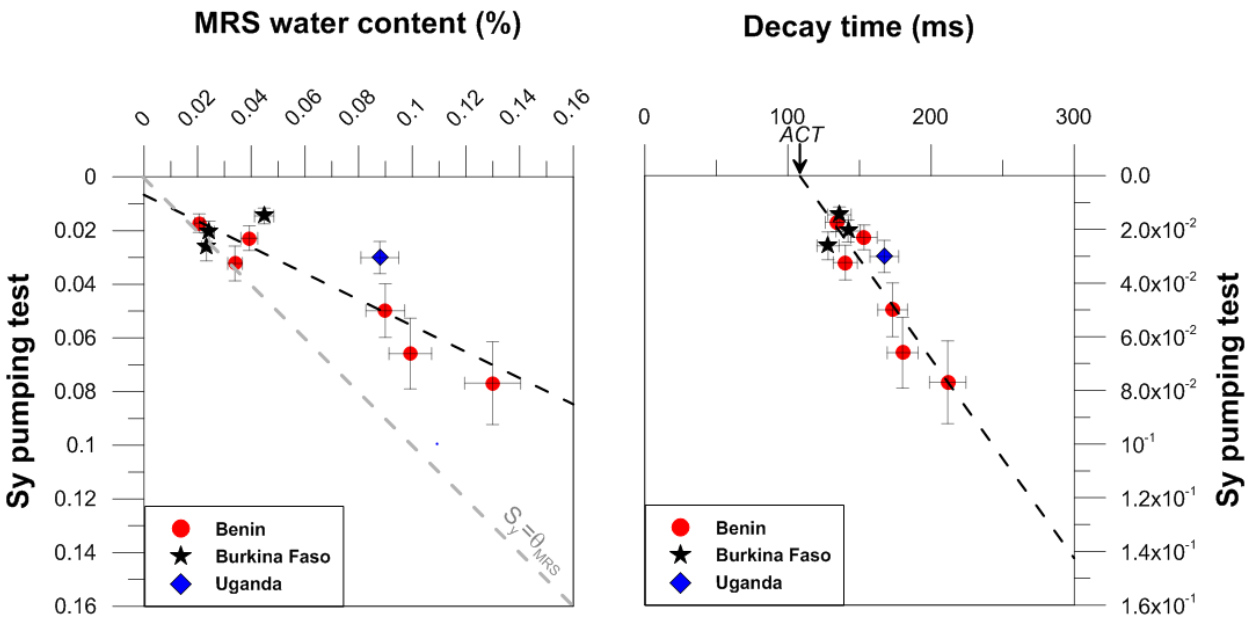
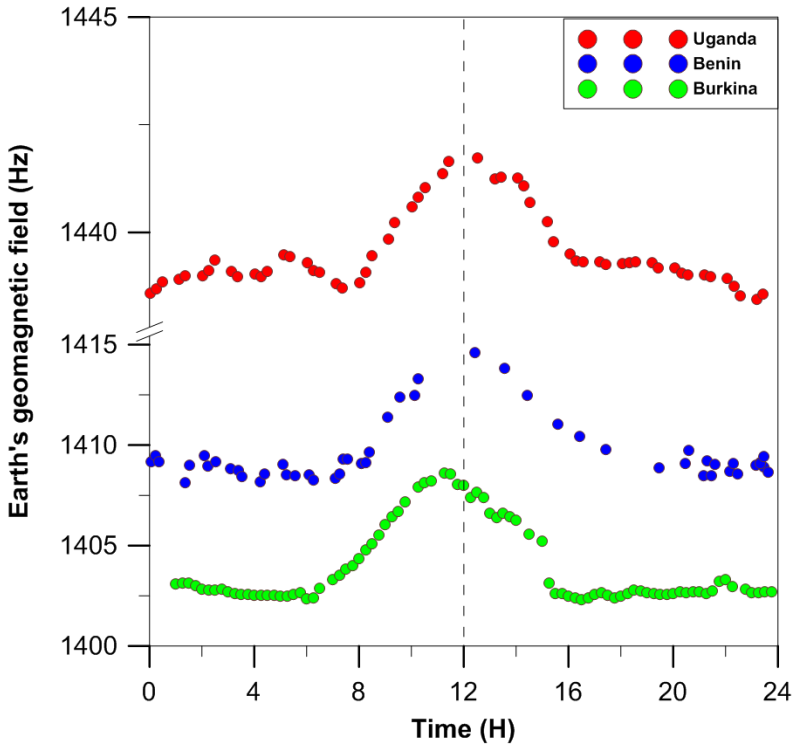
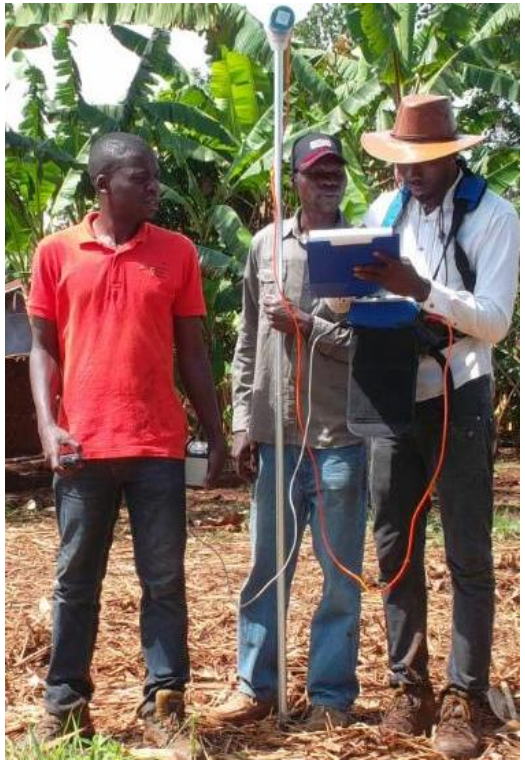

MRS water content (%)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Sy pumping test
Benin
Burkina Faso
Uganda
Sy =θMRS
Decay time (ms)
0
100
200
300
ACT
0.0
2.0x10-2
4.0x10-2
6.0x10-2
8.0x10-2
10-1
1.2x10-1
1.4x10-1
1.6x10-1
Sy pumping test
Benin
Burkina Faso
Uganda

field implementation strategy

- Best acquisition moment





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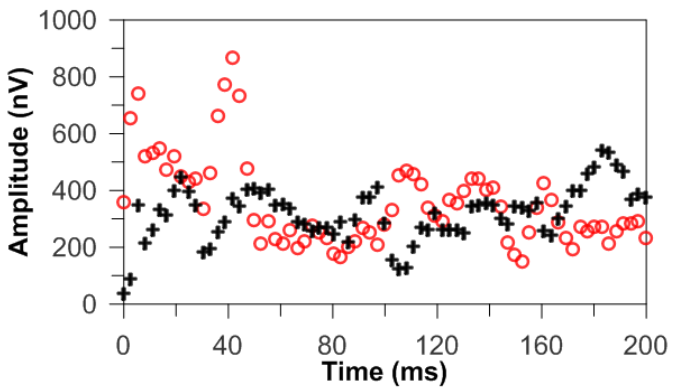
field implementation strategy

- Deal with EM noise



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