An investigation of the fate of petroleum contaminants (LNAPL) under fluctuating groundwater table levels induced by climate change

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1. LIGHT-NON-AQUEOUS-PHASE-LIQUIDS (LNAPLs)?
- Derived from petroleum hydrocarbons (gasoline, diesel fuel...)
- Viscous liquids with a density < 1 g/cm³ and a lifetime > 10 yrs
- Composition: mainly aliphatic hydrocarbons and BTEX
- 40% of soil and groundwater contaminations

2. CLIMATE CHANGE, GROUNDWATER AND LNAPLs
- The presence of groundwater table fluctuations:
  - favors the vertical spreading of the LNAPL across the soil (Fig.1)
  - favors the release of the LNAPL compounds in the air and groundwater
  - favors the natural attenuation of the LNAPL source/reduces the LNAPL longevity

WHAT WE NEED TO KNOW:
The effect of increased groundwater level fluctuations on the LNAPLs’ mobilization, release and natural attenuation rates, and the consequences for short/long-term groundwater and air quality at contaminated sites.

3. OUR WORK
- Improve the monitoring techniques of LNAPLs contaminated sites in combining different in-situ and ex-situ monitoring techniques
- Improve the understanding of LNAPLs behavior under various climatic conditions (current or future)

WHAT WE MONITOR?
- Gaseous surface emissions (flux, composition, µGC)
- The LNAPL saturation distribution in soil (electrical resistivity and permittivity)
- Other soil physical-chemical properties (pH, RedOx, water tension, temperature)
- The concentration and composition of the dissolved LNAPL phase (suction cups, SPE, GC/MS, TPH, DOC, FTIR)

THE GOALS:
- Improve the monitoring techniques of LNAPLs contaminated sites in combining different in-situ and ex-situ monitoring techniques
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IN THE LABORATORY:
- Calibrations of in-situ signals (tensiometers, permittivity, resistivity) under controlled saturations of LNAPL/water/air (2 tanks/1D columns)
- Numerical modeling of the LNAPL transport and mobilization.
- Optimization of analytical protocols for contaminated water samples.

IN THE COMING MONTHS:
- Application in field for the real-time monitoring of a contaminated site.
- Upscaling of modelisation at the field scale for prediction of climate change effects on the fate of LNAPL contaminated sites.