**Soil moisture retrieved from space and assimilation in a hydrological model**

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**Water cycle**

- Water is a central component in the Earth’s system and is essential for life development.
- Available water: 97% oceans, 1.5% ice, 1.5% land
- On land: ground water, permafrost, lake, soil moisture, wetland, water vapor, river, biological water.
- Human water demand: drinking water, sanitation and industrial-agricultural water (ratio ~3:4:92)
- Agricultural water is expected to double by 2050
- Water cycle needs to be well understood from local to global scales to face the future challenges in water management

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**What is seen from space**

- Soil moisture (SM) is involved in all the steps of the water cycle: evapotranspiration, surface runoff, soil infiltration
- Best frequency to monitor SM: L-band (1.4 GHz)
- 2 technologies of instruments: passive (natural emission of the Earth), active (observation of a backscattered emission)
- 3 main layers are involved and need to be quantified in the signal: atmosphere, vegetation, soil
- Global scale by satellite observations assimilated in hydrological models for local scales

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**SMOS**

- Soil Moisture Ocean Salinity: launched in November 2009, 6am/6pm, 3 arms of 4 m, covers the globe every 3 days (1000 km swath)
- Radiometer: interferometer, L-band, multi-angular from 0 to 60°, resolution of ~40km
- Retrieve SM using L-MEB (L-band microwave emission of the biosphere) model, by taking into account both polarizations and all the available angles (also retrieves vegetation parameter)

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**SMAP**

- SMAPVEX12 field campaign
- SMAP: L-band, 40°, resolution of ~40km, active-passive
- SMOS soil moisture
- SMOS observation errors at the global scale
- Assimilation: implement 3D-C1, bias correction, variational approach (to avoid gaps), take into account SMOS observation errors (biased value now)
- Investigate stream flow output and the complete water/energy balance
- Improve the model calibration (upper saturation for example)
- Assess the impact of finer satellite observations in the assimilation process (SMOS vs. SMAP)

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**Data assimilation**

- 2 options are tested:
  - SMOS soil moisture Level 3 product
  - SMOS soil moisture
- Time series of simulated soil moisture for 2010 with in situ measurements
- 3D-C1: state variables are updated using a single SMOS observation
- 3D-Cm: state variables are updated using multiple SMOS observations

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**Bibliography**

- Leroux et al., Comparison between SMOS, VUA, ASCAT and ECMWF soil moisture products over four watersheds in the U.S., IEEE TGRS, 2013a.
- Leroux et al., Spatial distribution and possible sources of SMOS errors at the global scale, RSE, 2013b.