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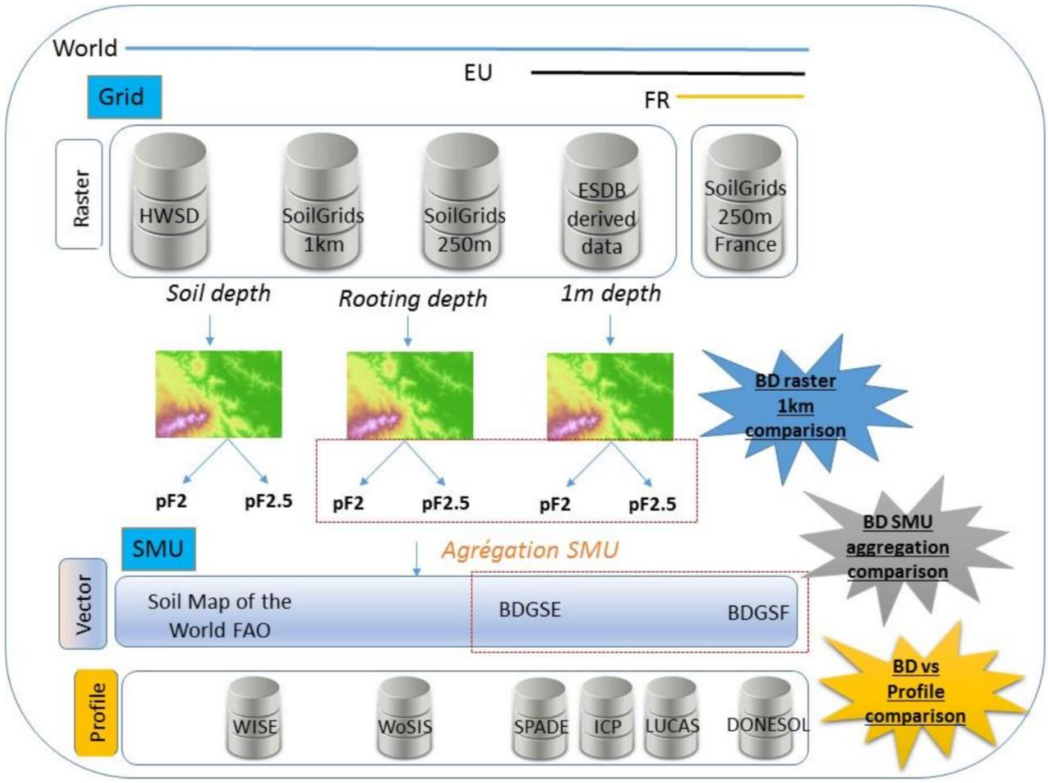

Soil Properties from Geographic Databases: a prerequisite for soil water balance mapping in European Forests

Principle investigator: Joseph Levillain

Partners: ONF R&D, US Infosol

Collaboration: Alain Benard, Nathalie Bréda, Vincent Badeau, Noémie Pousse, Christine Lebas

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Context — In the context of climate change inducing more frequent and more severe drought events in many parts of the world, an increased plant water shortage is expected (Nemani et al. 2003; Schär et al. 2004). In France, past recurrent or extreme drought events have been clearly identified as the hazard-inducing cycles of forest dieback and mortality of vulnerable trees (Levy and Becker 1987; Bréda et al. 2000; Bréda and Badeau 2008; Badeau et al. 2010). Indeed, drought events generate soil water deficits that induce (1) regulation of gas exchanges through stomatal regulation, i.e. reduction of carbon fixation and climate change mitigation and (2) cessation of their growth, i.e. reduction of carbon storage (Bréda et al. 1993; Bréda et al. 1995; Bréda and Granier 1996; Granier et al. 2000). In case of long or intense water deficits, trees adaptation is insufficient and irreversible damages occur compromising tree health and sometimes survival (Bréda et al. 2006). Thus, it is important to understand the vulnerability and regional adaptability of European forests, the scientific community investigates only recently that field (Lindner et al. 2014). The spatial and temporal quantification of soil water deficit is a key factor to understand and anticipate the impacts on forest health and productivity.

Objectives — This research focuses on the modeling of forest soil water balance to understand the distribution of soil water deficit that forests have to cope with depending on soil types, climate and forest types all over Europe

Approach — BILEUROPE proposal aims at establishing sampling strategies of geographic databases in order to define soil properties required by BILJOU© the forest soil water balance model we developed. From informatic point of view, all necessary adjustments on model will be studied to optimize calculation time of water balance on large data sets. To assess quantitatively and geographically severity of water deficit in

European forest stands, we will analyze the distribution of drought indices computed by the forest water balance model BILJOU©.

Key results — Inventory of European soil databases highlight the diversity (figure 1), strengths and limits of databases at global, European and French scales. R scripts have been developed to extract SOIL parameters from the most promising databases (SoilGrid and ESDB 1km).

The optimization of Biljou© water balance model calculation time was treated as a priority because its success conditioned the further organization of the project. It has made it possible to highlight productivity gains thanks in particular to the implementation:

- Multiprocessing (use of several central processing units (CPUs) within a computer system) see figure 2,
- Parallelization (use of several digital electronics architectures to process information simultaneously)
- Improvement of writing time (use of SSD hard disks).

Main conclusions including key points of discussion — European databases are constantly evolving, currently the latest updates aim to rectify one of the major flaws pointed out in this project which is the estimation of the soil depth. However, these databases should enable us to define the SOIL and ROOT parameters required by the BILJOU © water balance model and to automate their writing via R scripts. These Biljou© optimizations make it possible to envisage the computation of water balance at the scale of Europe on the some 13000 000 pixels of the European databases at a resolution of 1*1km.