Shifts in global CCI soil moisture trends

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Soil moisture is one of the main drivers of the exchange of water, energy, and carbon between the land surface and atmosphere. The ESA Climate Change Initiative (CCI) soil moisture data records exceed a 40-year time span (1972-2010). The existence of monotonic changes present in the merged satellite-based surface soil moisture product (SM-MW, 1988-2010) have been previously demonstrated (Dorigo et al. 2012). However, information on timing and type of such trend shifts lack at global scale. Timing and type contain essential complementary information for the interpretation of trend shifts, in particular when deriving the impact of changes from such data (Verbesselt et al. 2010, 2012, De Jong et al. in review). In this work, we detect major shifts in CCI soil moisture trends (1988-2010) and their associated type and timing. We specifically focus on the differentiation between changes caused by a change in the input sensor constellation versus climate and anthropological driven changes.

The capacity to characterize major change types spatially and temporally currently forms a gap in our knowledge, but is critical for understanding their impact within a global change context. Changes in soil moisture trends may, for instance, point to (recovery from) major disturbances and sustained structural changes may indicate transitions between different vegetation-activity regimes, i.e. greening or browning and affect carbon exchange (De Jong et al. 2011). We refer to sustained changes, when they are beyond the scale of short-term disturbances (e.g., floods). Especially with today's increasing populations density, higher frequency of weather extremes, and the rise of global atmospheric CO2 concentrations and air temperature, it is critical to assess (1) when and where a trend shift in soil moisture dynamics occurred and (2) what implication the trend shift had on the ecosystem. In this study, we therefore characterize interruptions and trend reversals in soil moisture dynamics (Verbesselt et al. 2010, 2012, De Jong et al. in review) and we demonstrate its application using the latest global soil moisture CCI dataset. We focused on the question “when and where have major trend shifts occurred and what were their ecological implications”? Detecting changes is the first step towards understanding the process. We, therefore, revisit techniques for the detection of breakpoints in Normalised Difference Vegetation Index time series and our adjustments for major shifts (Verbesselt et al. 2010, 2012). Subsequently, we apply a classification scheme to describe ecologically meaningful change types (De Jong et al. in review). With this combined analysis using global CCI soil moisture records we contribute to the understanding of large-scale structural changes in the biosphere.
Key words:

Soil moisture, trend shifts

Key references: