Methods: Using the dynamic global vegetation and water balance model LPJmL, we quantified the VWC of temperate cereals and maize, at high spatial resolution (0.5°). We analyzed present conditions and scenarios of future climate and increasing atmospheric CO₂ concentrations (HadCM3, ECHAM5 and CCSM3 climate models, A2 emissions scenario).

Current VWC: Lowest values were found e.g. for Central Europe, and highest values are common in large parts of Africa, indicating that water-use efficiency of crops is much lower in the latter region. The regional patterns of VWC result from complex and interactive processes; the dominant factor is the crop yield level (high VWC values occur most frequently in regions with low yields).

Future VWC under climate change only: Worldwide VWC patterns will change significantly, with a pronounced regional pattern. Although globally the water use efficiency is projected to increase, many regions—including parts of the U.S., East and Mediterranean Europe, South Africa, Argentina, Australia and South East Asia—are projected to become less water efficient (higher VWC) for at least one of the crop types.

Drivers of VWC change: The changes in regional VWC patterns reflects primarily the changes in yields as driven mainly by regionally decreasing precipitation, increasing temperature and increasing atmospheric CO₂ concentration. CO₂ fertilisation was simulated to generally reduce VWC, though realisation of this effect in the field will strongly depend on management.