How abrupt change in surface temperature impacts water balance over France? A case-study of bread wheat cultivated areas.

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Abstract (500 words maximum)**:**

Agricultural risk management is a major challenge for decision makers, public authorities and agricultural insurance companies, as crop losses linked to climate hazard are expected to increase in the context of climate change (Boucher et al., 2019). The present work is part of a PhD in partnership between Groupama insurance company (Domaine Assurance Récolte) and Biogeosciences laboratory (University of Burgundy). This collaborative research aims at depicting how, with the abrupt surface temperature warming, climate hazard evolution has affected water balance over France, and related agro-climatic risks.

Since 1980s over western Europe, the warming trend intensifies strongly, consistent with climate simulations including anthropogenic forcing (Terray & Boé, 2013). As a result of this warming tendency, a shift is detected in maximum and minimum air temperature, delimiting two main climate periods: 1959-1987 and 1988-2009 (Brulebois et al., 2015). Along with this abrupt warming, a trend towards stagnation of crop yields is observed since the 1990s. Bread

wheat yields are particularly affected. Yet this crop represents an important part of insured areas. In addition to maize and grapevine, the impact of climate hazard and agro-climatic risk on the evolution of bread wheat yields is a major issue for agricultural insurance companies. What are the patterns of water cycle responses to abrupt changes in temperature? Beyond that, how did surface warming shift impact water balance over main french bread wheat production basins?

Clearly, quality and reliability of surface climate data sets remain an issue for the assessment of water cycle component changes. The SIM (Safran-Isba-Modcou) dataset of reanalysed surface meteorological observations offers the opportunity to address the complexity of processes leading to changes in local water cycle (Soubeyroux et al., 2018). With an 8km spatial resolution at daily time step, SIM interpolated precipitation and computed PET (Potential EvapoTranspiration) and AET (Actual EvapoTranspiration) from 1959 to 2019 data are relevant to this aim. Water balance is computed using a two-reservoirs model (Jacquart & Choisnel, 1995), and SIM climate data and bread wheat agronomic parameters as inputs. To focus on bread wheat production basins, only SIM grid point containing at least 10% of surface covered with bread wheat fields are retained. Regions of interest are selected and characterized through a teamwork with the insurance company collaborators.

Our results suggest that the abrupt shift in air temperature in 1987/88 had a strong influence on the water cycle variables evolution. Water balance decreased on the post-shift period, along with the increase of water demand and soil drying. Consequently, water constraints increased fastly at the end of the 1980s, both annual and seasonal scale. Along with various seasonal evolution, changes in the hydrological cycle hide geographical disparities over France.

Evolving climate hazard linked to water balance impacts agro-climatic risk, identified as one of the main factor affecting the evolution of bread wheat yields. Such conclusions suggest that, with both mean and variability changes in water balance state, probability to overcome risk threshold changes. This is of major concern for our partners, and may lead to adaptation process from managers.

Number of words: 500

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