Reply to the comments made by the Referees and the editor

Firstly, we would like to express our appreciation for the referees' and the editor's thoughtful comments and constructive suggestions.

Our replies to the specific comments made by referee #2 are given below. Their comments are written in regular font style, and our reply is written in italic style.

Reply to Referee #2

General comments:

The Introduction refers to a variety of model approaches but that review would gain if including more recent, updated references, as well as references to modelling studies in China. Those are now abundant and adopt both mechanistic and water balance models; some are published in this journal. In fact, it is good that a study identifies advances relative to former research and to former studies applied to the country or region. In addition, the paper would gain if references would be better selected, e.g., the paper by Smith et al., 1997 does not refers to the subject of this study but to soil organic matter modelling. Other references have such type of limitation, i.e., do not directly concern the objectives of the study while several others do (case of various papers using soil water mechanistic models such as Hydrus and crop growth and yield models such as Wofost.

Reply: *Thanks for your suggestion. References to modeling studies in China are added in the new version of the manuscript. We also checked references carefully to refer to the subject of our study.*

Detailed comments:

1. I do not understand the opportunity of the discussion in lines 1-14 of page 3845.

Reply: *This paragraph is deleted in revised version.*

2. Study region and experimental field description Fig. 1 would gain if the represented river basin would be located relative to the NW of China.

Reply: *Thanks for your suggestion. The figure is revised.*

3. Climatic data acquisition is very insufficiently described, particularly referring to eddy covariance measurements. It is known they have a trend to underestimate actual ET and nothing is referred to the energy balance and the closure errors, or relative to required fetch. A couple of papers recently published (Agric. Water Manage. 2011),doi:10.1016/j.agwat.2010.12.015 describes the possible sources of errors in measuring ET by various methods and recommendations for presenting results in journal papers when accuracy is required, as for the case under appreciation.

Reply: *We measured latent heat during crop growth using eddy covariance systems (EC) (Li7500 & CSAT3, Cambell Scientific, USA). The correction of EC data was produced with revised EdiRE* *software from the University of Edinburgh (Xu et al., 2008).*

Xu Ziwei, Liu Shaoming, Gong Lijuan, et al.. A study on the data processing and quality assessment of the eddy covariance system. Advances in Earth Science, 2008, 23(4):357-370

4. Soil data in Table 1 are insufficient for using with a water flux model. The characteristics of the soil water retention curve and the soil hydraulic conductivity curve needed for solving the Richards equation are required

Reply: *The saturated conductivity had been measured at 10 cm, 40 cm and 100 cm, respectively with Guelph 2800K1 seepage apparatus. The saturated conductivity used as input to the model. The water retention properties of soil had been measured with Equi-pf apparatus in the laboratory. The measured relation between pressure head and water content and percentages of sand, silt, and clay of three soil layers were inputted into Rosetta softerware (Schaap and Bouten, 1996; Schaap et al., 1998) to calculate van Genuchten model's (1980) water retention parameters. The fitted curve and parameters are shown in Fig. 2 and Table 3.*

Schaap, M.G. and W. Bouten. 1996. Modeling water retention curves of sandy soils using neural networks. Water Resour. Res. 32:3033-3040.
Schaap, M.G., Leij F.J. and van Genuchten M.Th. 1998. Neural network analysis for hierarchical prediction of soil water retention and saturated hydraulic conductivity. Soil Sci. Soc. Am. J. 62:847-855.
van Genuchten, M.Th. 1980. A closed-form equation for predicting the hydraulic conductivity of unsaturated soils. Soil Sci. Am. J. 44:892-898.

5. In section 2.2 is referred that soil water content were measured with TDR with a hourly time step. However, it is not said where and at which depths observations were made and how soil water potential was obtained, which is required for solving the Richards equation (eq. 1). The advantage of hourly measurements is not evident. Observations of soil hydraulic conductivity, also required for the Richards equation, are not mentioned.

Reply: *Same to 4.*

6. The crop description should be performed including the variables observed, how observations were performed and data used for modeling

Reply: *The characteristics of the maize variety studied here are similar with those of grain maize 203 variety of Europe, such as drought-resistant, cold-resistant, plant height, leaf width, full grain, etc. So, the maize data set (MAG 203), which is provided by European Community (Boons-Prins et al., 1993), are chosen for the parameters of crop characteristics in the model.*

7. It is written: "The field was irrigated 9 times throughout the period of crop growth. The water amount of irrigation is approximately 100mm each time." This is a very exaggerated water application, approximately doubling the crop requirements. In a study aimed at improving

irrigation performance it is strange that such an irrigation management was applied. Anyway, it would have been necessary to explain how the management scenarios were set, the crop calendar in the various years of experimentation (not clear if only one year was adopted), and how irrigation decisions were taken. Also necessary to express how irrigation water was measured and how accurate this was.

Reply: *In the revised version of the manuscript, we listed the constituents of the soil water balance in Table 4. The results show that a large portion of realistic irrigation is contributed to deep percolation. To search for a potential, water-saving scheme, we assume the number of irrigations remain nine and gradually reduce each irrigation amount; meanwhile the ratio between actual root uptake and potential transpiration is restricted more than 0.8. The simulated results indicate the 60 mm water at each irrigating would be enough in this region. The simulated water balance under the guided irrigation scheme was compared with the actual irrigation shceme (Table 4). These results indicate that the guided irrigation scheme can save 350 mm of irrigation water. Water-saving is mainly due to decreases in deep percolation (284.2 mm) that accounts for 81.2 percent of total water-saving.*

Table 4 The simulated water balance under actual and guided irrigation schemes

	Irrigation+ precipitation	**Transpira-tion**	**Evapora-tion**	**Deep percolation**	**Change of soil moisture storage**
	mm				
Realistic irrigation scheme	983.6	364	203	344.6	72
Guided irrigation scheme	633.6	355	151	60.4	67.2
Difference	-350	-9	-52	-284.2	-4.8

8. In Section 3, the Wofost model is summarized. However, it was required that information be given about input data requirements, how these data were collected and checked as well as requirements for parameterization and model calibration and validation.

Reply: *Running the coupled model (including WOFOST) requires atmospheric (minimum temperature, maximum temperature, irradiation, vapor pressure ,wind speed and precipitation) and irrigation conditions at a daily scale, the parameters of crop characteristics (including parameters referring to, among other things, phenology, assimilation and respiration characteristics, and partitioning of assimilates to plant organs) and the soil hydraulic parameters(* θ_r *,* θ_s *, α, n,* K_S *).*

The meteorological data are acquired by the meteorological station. The parameters of crop characteristics choose the maize data (MAG 203) provided by the European Community (Boons-Prins et al., 1993). An atmospheric boundary condition is needed at the soil surface. The atmospheric boundary conditions required daily irrigation, precipitation rates, potential *evaporation and transpiration rates as inputs. The daily irrigation and precipitation rates were observed. The potential evaporation and transpiration rates are calculated by the meteorological data and the parameters of the crop growth (LAI and height of the crop), which are shown in Fig. 4. Meanwhile, a deep drainage condition was used at the bottom. The initial reference groundwater depth is given. The soil hydraulic properties are modeled using the van Genuchten – Mualem constitutive relationships at HYDRUS model . The soil profile is divided into three layers in vertical direction according to the soil physical properties. The fist layer is from the ground to a depth of 30 cm. The second layer and the third layer are from a depth of 30 cm to a depth of 60 cm and from a depth of 60 cm to a depth of 100 cm, respectively. The measured relation between pressure head and water content and percentages of sand, silt, and clay of three soil layers were inputted into Rosetta softerware (Schaap and Bouten, 1996; Schaap et al., 1998) to calculate van Genuchten model's (1980) water retention parameters. The fitted curve and parameters are shown in Fig. 2 and Table 3.*

The coupled model is mostly validated by soil moisture, TAGP (total above-ground dry production), WSO (dry weight of storage organs) and the LAI (Leaf area index). The comparison between simulated soil moisture and observed soil moisture is shown in Fig. 5. The NSE values of the soil moisture for the three soil layers are 0.750, 0.699 and 0.842, respectively. The observed TAGP, WSO and the LAI are compared with the simulation results, which are shown in Fig.6 and Fig.7. The NSE value of TAGP, WSO and LAI are 0.965, 0.978 and 0.924, respectively. The results show the simulated dry matter accumulation and partition between the various crop organs match the observations well. The related parameter values are reasonable for local maize characteristics in the study field.

9. In the same section, model Hydrus is summarized. Input data requirements, parameterization, calibration and validation should have been described.

Reply: *Running the coupled model (including HYDRUS) requires atmospheric (minimum temperature, maximum temperature, irradiation, vapor pressure ,wind speed and precipitation) and irrigation conditions at a daily scale, the parameters of crop characteristics (including LAI, height of crop and root depth) and the soil hydraulic parameters(θ_r , θ_s , α, n, K_s).*

An atmospheric boundary condition need at the soil surface. The atmospheric boundary conditions required daily irrigation, precipitation rates, potential evaporation and transpiration rates as inputs. The daily irrigation and precipitation rates were observed. The potential evaporation and transpiration rates are calculated by the meteorological data and the parameters of the crop growth (LAI and height of the crop), which are shown in Fig. 4. Meanwhile, a deep drainage condition was used at the bottom. The initial reference groundwater depth was given. The soil hydraulic properties are modeled using the van Genuchten – Mualem constitutive relationships at HYDRUS model . The soil profile is divided into three layers in vertical direction according to the soil physical properties. The fist layer is from the ground to a depth of 30 cm. The second layer and the third layer are from a depth of 30 cm to a depth of 60 cm and from a depth of 60 cm to a depth of 100 cm, respectively. The measured relation between pressure head and water content and percentages of sand, silt, and clay of three soil layers were inputted into Rosetta *softerware (Schaap and Bouten, 1996; Schaap et al., 1998) to calculate van Genuchten model's (1980) water retention parameters. The fitted curve and parameters are shown in Fig. 2 and Table 3.*

The HYDRUS model was mostly validated by soil moisture. The comparison between simulated soil moisture and observed soil moisture is shown in Fig. 5. The NSE values of the soil moisture for the three soil layers are 0.750, 0.699 and 0.842, respectively.

10. Apparently, an only one year observation was used. There is no evidence of an experimental design aimed at distinct/independent calibration and validation of the parameters of both models.

Reply: *Thanks for your suggestion. The main objective of this paper is to study the effect of model parameters and structure on the seasonal maize output estimation by the UA/SA method. So, a growth season is convenient for this study.*

11. There is no description of the ensemble estimation adopted and of its validation.

Reply: *UA/SA analysis, based on statistics and stochastic views, is different from optimization algorithm adopted estimation with objective function. All parameter samples are used for model running for UA/SA methods and then calculate the variance and statistic variable of outputs. The UA/SA analysis is commonly used to identify the effect of model parameters and structure on the output estimation, not rather to find optimal solution.*