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Climate change and irrigation water need sensitivity analysis

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Abstract

Irrigated agriculture vulnerability studies to climate change are evaluated by irrigation water needs impacts due to temperature and precipitation changes. These tasks are based on climate change models and aim to develop and propose adaptation and mitigation strategies measures to the water management sector. In this study, relative impact of irrigation water need due to climate change and field practices were evaluated. Even though it has been shown that climate change has impacted the irrigation water demand increase, sensitivity analysis has indicated that water demand is more sensible to final irrigation efficiency, revealing itself as an important adaptation measure to be considered.

Keywords: Irrigation; climate change, water resources..

1. Main text

In order to evaluate irrigation water needs (IWN) sensitivity to climate variables and field practices, mean monthly temperature, rainfall, and irrigation efficiency were considered. Climate variable ranges were analyzed based on a reference climatology climate dataset (1961-90) and IPCC A2 and B2 scenarios (Nakicenovic et al., 2000) climate change model projections to the year of 2040. Irrigation efficiency field surveys were performed in order to use a range close to farm reality in the region (Table 1). An algebraic sensitivity analysis was performed considering the water balance equation (Eq.1) simplicity (Norton, 2008), which avoided the need of Monte Carlo method. Sensitivity analysis was done using Statistical Analysis System SAS® software programming.

$$IWN = \frac{ET_{o_i} Kc}{Ef} - P \tag{1}$$

Where
IWN – irrigation water need (mm);
ET_o – Penman-Monteith reference evapotranspiration (mm);
Kc – crop coefficient (dimensionless);

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P – rainfall (mm).

Table 1. Range of each variable considered in the sensitivity analysis.

Variable	Range
Mean monthly maximum temperature (°C)	28.5 to 37.5
Mean monthly minimum temperature (°C)	22.2 to 25.8
Mean monthly reference evapotranspiration - ET_o (mm)	63 to 181
Mean monthly rainfall – P (mm)	0 to 200
Irrigation efficiency - Ef (%)	15 to 95

Sensitivity analysis results are presented in terms of linear model coefficients and exponential non linear for irrigation efficiency, which may be denominated irrigation water need sensitivity analysis coefficients, derived algebraically from each equation used (Table 2). Irrigation efficiency was the term that most influenced IWN, suggesting it to work as an important adaptation measure to climate change impacts.

Table 2. Irrigation water need sensitivity analysis coefficients, derived algebraically from the water balance equation used.

Month	Maximum temperature (mm $^{\circ}C^{-1}$)	Minimum temperature (mm $^{\circ}C^{-1}$)	ET_o (mm mm^{-1})	Rainfall (mm mm^{-1})	Irrigation efficiency (exponential model parameter)
1	14.25	-9.62	1.40	-1.00	148.52
2	14.40	-9.74	1.40	-1.00	123.14
3	14.95	-10.10	1.59	-1.00	135.42
4	15.24	-10.25	1.55	-1.00	111.10
5	12.81	-8.56	1.40	-1.00	100.58
6	12.32	-8.20	1.40	-1.00	100.58
7	13.93	-9.28	1.58	-1.00	135.24
8	14.52	-9.73	1.56	-1.00	156.80
9	14.16	-9.54	1.49	-1.00	159.80
10	13.93	-9.41	1.38	-1.00	159.21
11	14.59	-9,86	1.45	-1.00	155.70
12	13.78	-9.30	1.37	-1.00	155.48

2. References

NAKICENOVIC, N.; ALCAMO, J.; DAVIS,G.; DE VRIES, B.; FENHANN, J.; GAFFIN, S.; GREGORY, K.; GR, A.; JUNG, T.Y.; KRAM, T.; LA ROVERE, E.L.; MICHAELIS, L.; MORI, S.; MORITA, T.; PEPPER, W.; PITCHER, H.; PRICE, L.; RIAHI, K.; ROEHRL, A.; ROGNER, H-H.; SANKOVSKI, A.; SCHLESINGER, M.; SHUKLA, P.; SMITH, S.; SWART, R.; VAN ROOIJEN, S.; VICTOR, N.; DADI. Z. Special Report on Emission Scenarios. [NAKICENOVIC, N.; SWART, R. (eds.)]. Intergovernmental Panel on Climate Change, 2000. Available on: < http://www.ipcc.ch/ipccreports/sres/emission/index.htm>.

NORTON, J. P. Algebraic sensitivity analysis of environmental models. **Environmental Modelling & Software**, v. 23, p. 963-972, 2008.