ASSESSMENT OF THE EFFECTS OF CLIMATE CHANGE A CASE STUDY IN NORTHERN ITALY

G. Bellocchi, C. Maestrini, G. Fila, F. Fontana
Research Institute for Industrial Crops - Bologna, Italy
web: http://www.isci.it, email: agronomy@isci.it

Introduction

The regional assessment of the impact of climate change and atmospheric CO_2 enrichment on agricultural productivity and the environment is an important application of cropping system models. Global circulation models (GCMs) are currently used to provide climate change scenarios. Such scenarios vary according to different GCMs, and different climate estimates are produced as advancements are made in GCM development. Hence, an update in the study of the effects of climate change is needed.

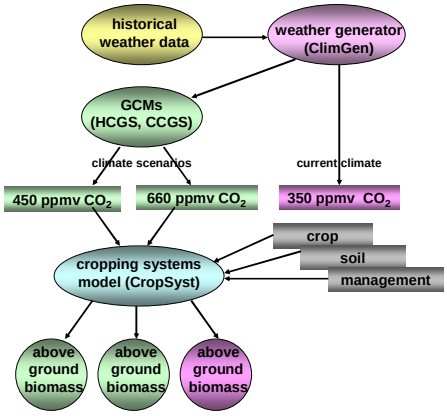
Objective

To investigate the potential effects of climate change on crop biomass production of a typical cropping system implemented in Northern Italy, due to an increase of atmospheric CO_2 concentration.

Methods

Long term weather records at Budrio (province of Bologna, Italy, Figure 1) were used to generate current and future climate datasets (50 years), by using the ***ClimGen*** stochastic generator.

The transient climate simulations of two GCMs (with sulfate aerosols effects), and the cropping system model ***CropSyst***, were used to estimate the impact of climate change on the above ground biomass of different crops, according to the scheme below.



Climate scenarios

Climate scenarios were generated referring to the years 2030 (projected CO_2 concentration: 450 ppmv) and to the year 2090 (estimated CO_2: 660 ppmv).

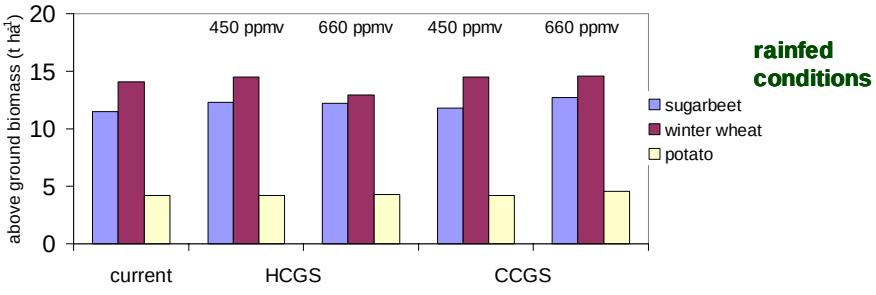
meteo variable	current	HCGS		CCGS	
		450 ppmv	660 ppmv	450 ppmv	660 ppmv
Rainfall (mm)	661	725	670	703	624
Tmax (°C)	20.1	20.8	23.3	21.1	22.6
Tmin (°C)	8.1	9.2	11.7	9.5	11.1
Radiation (MJ m^{-2} d^{-1})	12.1	12.0	12.2	12.2	12.3

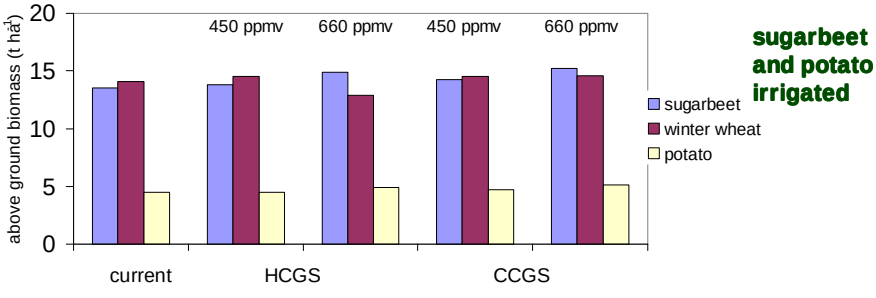
Simulations

A typical crop rotation was simulated: **sugarbeet-winter wheat-potato-winter wheat**. Irrigation was simulated for sugarbeet and potato, using ***CropSyst*** automatic irrigation mode to mimic irrigation schedule commonly adopted in the area. Nitrogen simulation was switched off. An experiment was started in 1999 with the cropping system of interest on a shallow loamy-silty soil at Budrio. Crop and soil data collected in the period 1999-2001 were used to calibrate ***CropSyst***.

Results

The simulated values of above ground biomass for current and future climate conditions are reported in the graphs below for both rainfed and irrigated conditions. Little increase in biomass production was observed, mostly due to the increase of temperature and the increased photosynthetic efficiency at higher than current atmospheric CO_2. Therefore, the general shortening of the growing season was compensated by a better avoidance of the summer water stress. The evaporative demand did not increase under global warming, thus a larger supply of water was not required for irrigated crops as a consequence of the climate change.





Conclusions

❑ Spring sowing crops (sugarbeet and potato) responded better than autumn sowing crop (wheat) to climate change from two GCMs. However, the preliminary results from this study indicated that crop biomass production in Northern Italy may not be greatly affected by future climate change, characterized by increased temperature. In particular, no additional irrigation was needed to maintain current levels of biomass production.

❑ The effect on crop biomass production was positive with both GCMs at 450 ppmv, whereas the response was different according to the GCM used. The sensitivity of simulation outputs to GCM estimates confirmed that cropping systems simulation is, at this stage, still related to GCMs evolution.

2002 – VII ESA Congress, Cordoba, Spain