BIOMASS - IS IT A PART OF ENERGY STRATEGY IN MITIGATION OF GLOBAL WARMING?

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Global Climate Change is one of the most serious problems of the 21st century!

Global warming reaching point-of-no-return: report

Agence France Presse | January 24, 2005

LONDON- Global warming is reaching the point-of-no-return, with widespread drought, crop failure and water shortages the likely result, according to a new to new international report highlighted in the British press Monday. The countdown to climate-change catastrophe is spelt out by a task force of senior politicians, business leaders and academics.

Climate change - „any change in climate over time, due to natural variability or as a result of human activity"

Reasons? GHG emission, example:

fossil fuel use → increased atmospheric concentration of CO_2

Solutions? ex. Agriculture, sequesting carbon and mitigation by using renewable energy

How climate is changing?

Warming of climate system is unequivocal, as is now evident from observations of

- increase in global average air and ocean temperatures,

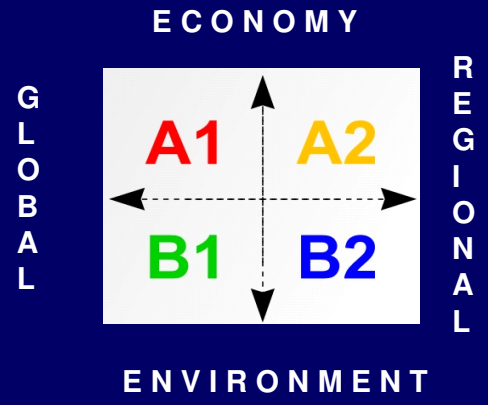
  (Eleven of the last twelve years rank among the 12 warmest years in the record of global surface temperature since 1850.)
- widespread melting of snow and ice, and
- rising global mean sea level.

Precipitation: highly variable spatially and temporally.

Numerous long-term changes in climate have been observed: warmer and more frequent hot days and nights, extreme weather conditions: droughts, heavy precipitation, warm spells / heat waves and the intensity of tropical cyclones.

CLIMATE MODELS

- scenarios with different economic, social and environmental aspects:

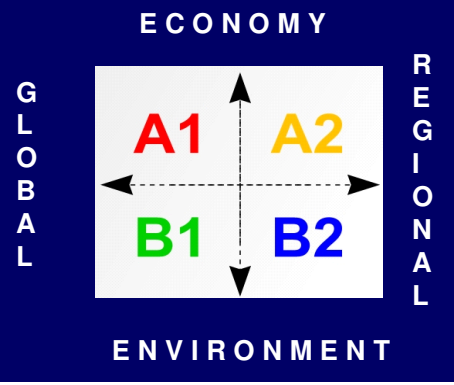


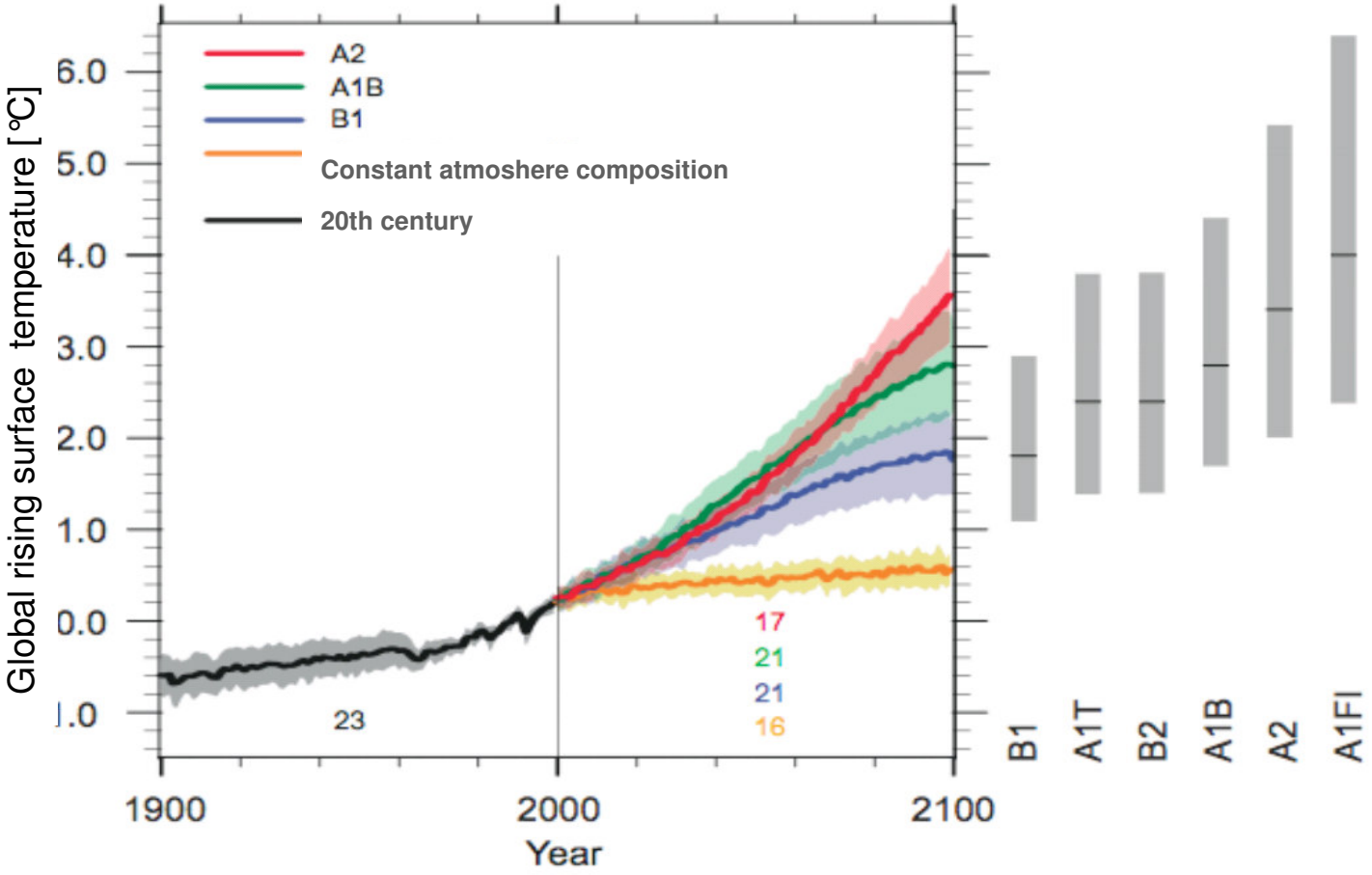
idealised emission and other different emission scenarios (low, high), GHG concentration assumptions, different economic development and global population growth, different technological emphasis: fossil intensive, non fossil energy sources or balance across all sources, global to local scale models (from several Institutes: UKMO, USA – GFDL).

They are showing patterns of natural climate variability and different anthropogenic forcing like the equilibrium of doubling of CO_2 concentration, etc.

Scenarios - pictures of how the climate may look like in the future.

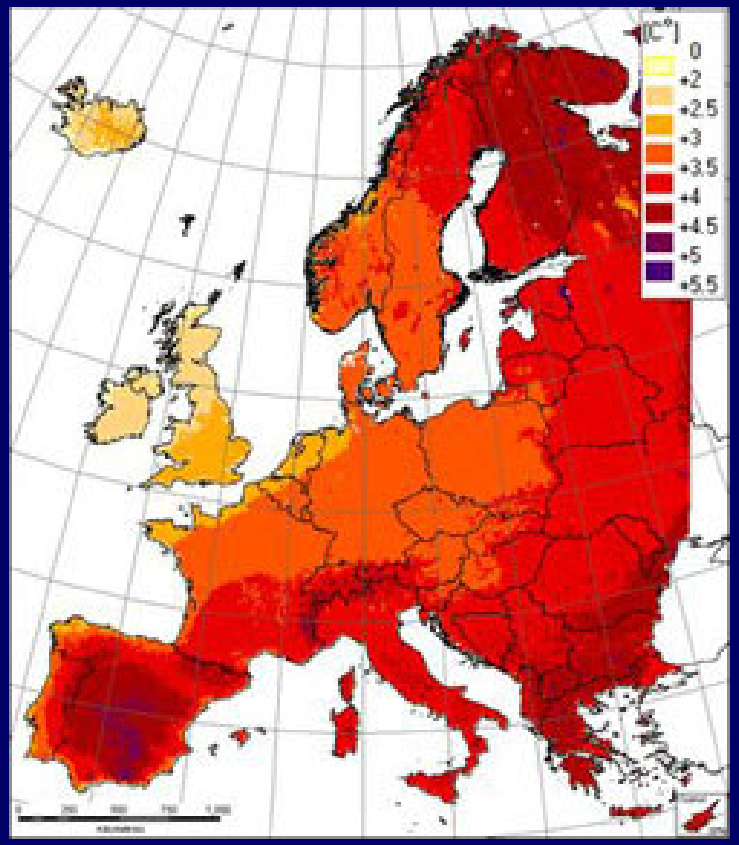
Intergovernmental Panel on Climate Change (Fourth Assessment Report, 2007)

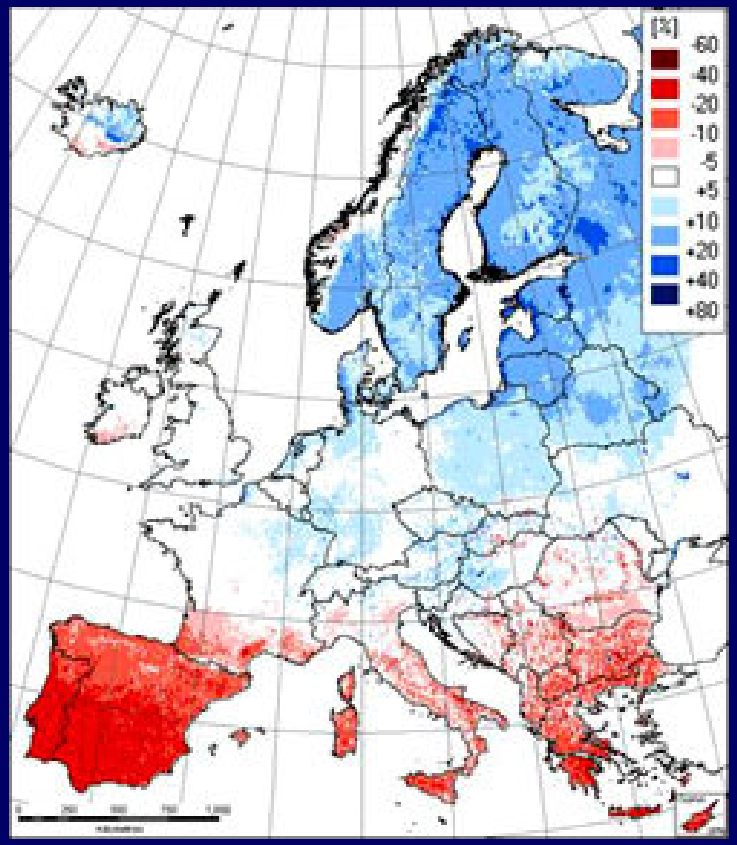




From 1961-1990 to the end of the century

(In Hungary: + 3-3,5 oC and -5 - +5 % of precipitation variability)





Climate change has already considerable impacts on our life, so optimal preparing and response strategies are needed.

→ Green Paper, July 2007. …

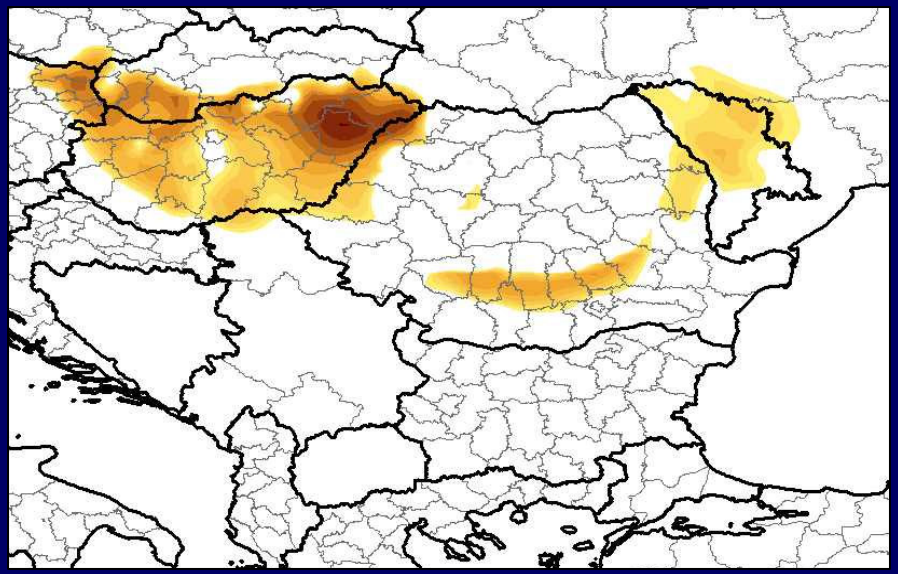
→ National Climate Change Adaptation Programme.

Our work is based on GCMs downscaled to Debrecen, one of the centers of hungarian agricultural production.

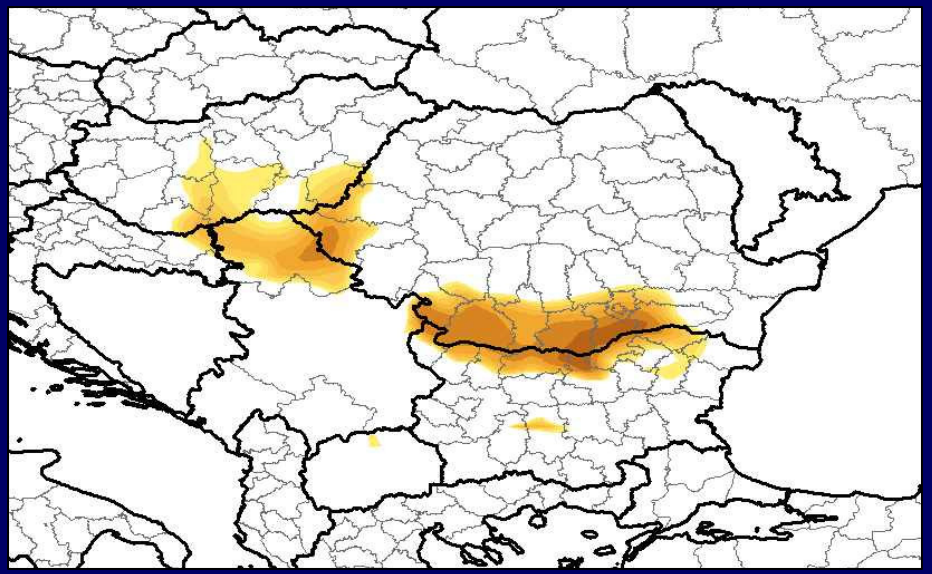
Example:

Geographical analogous for Debrecen using temperature data

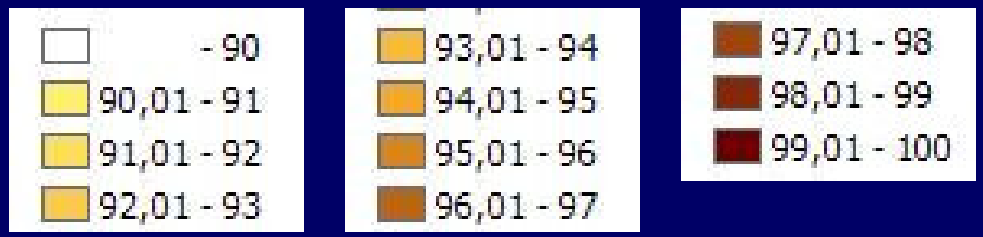
1961-1990, observed



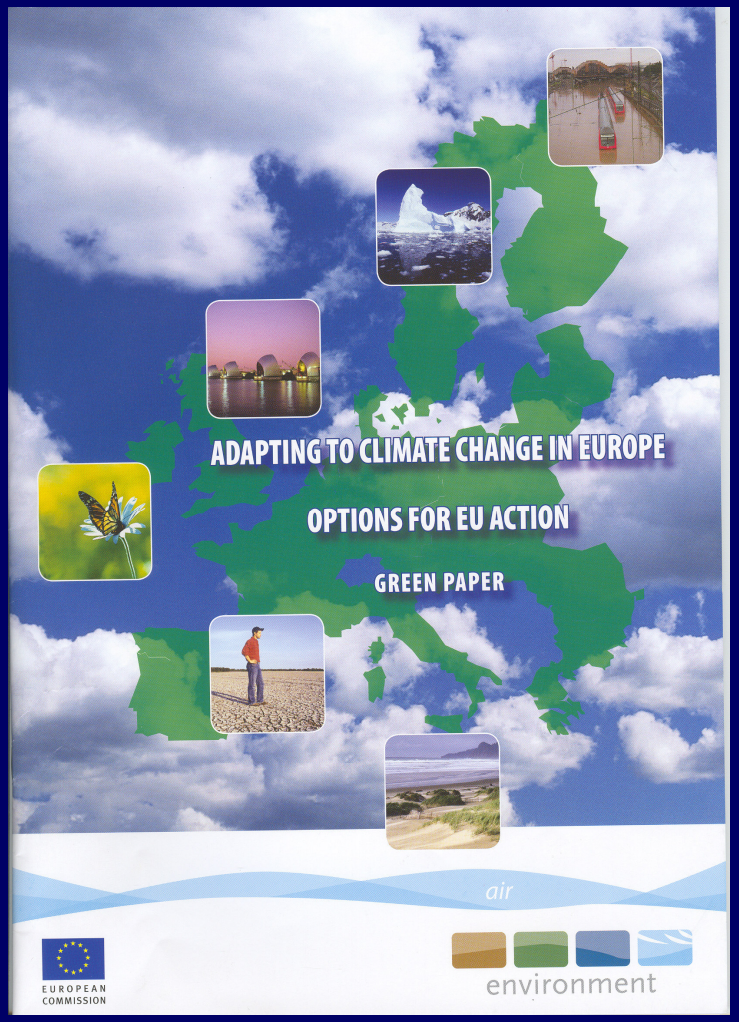
2011-2040, A1FI scenario



Temperature analogous (%):



GREEN PAPER http://ec.europa.eu/environment/climate



July, 2007

Environment Commissioner Stavros Dimas said, "People all over Europe will increasingly feel the threatening effects of climate change on their health, jobs and housing, and the most vulnerable members of society will be the hardest hit."
European Advisory Group for Adaptation to Climate Change (EAG first report – middle of 2008.)

Regional Consultation Workshops:

Adopting to climate change in Europe, Options for EU action (Bp, Oct.15)

Future climate change policy in the new members states and candidate countries (Bp, Oct. 16)

"We must sharply reduce global GHG emissions to prevent future climate change from reaching dangerous levels, but at the same time Europe must also adapt to the climate change that is already happening.
… we could be forced into taking sudden, unplanned, far more costly adaptation measures to react to increasingly frequent crises and disasters."

Renewable energy - solution or business
- pros and cons

Publications about developing and using RE

BUT:
- Is it possible to replace traditional energy form?
- When? and How?
- difficulties (technical, human)
- What is the amount we need?

energy – ecology – economy – efficiency – possibility - …

Uncertainty?

Socio-economic discussions

Nowadays less competitive, governmental support?

Agricultures primary aim is food and feed supply.

Energy crops implementation needs changes in land use.

Possible solution?

Converting secondary biomass, plant residues to valuable energy products.

Bioenergy production from secundary biomass.

Biofuels - fuels made from biomass:

Starches from cereals, grains, sugar crops, waste products, residues from agriculture and forestry like corn stems and cobs.

Biomass potential of Hungary

half – half of products and byproducts

maize has significant by-product

We analysed the effects of changing climate on the proportion of grain, leaf, corn-stalk and root in corn biomass by modeling.

simulation method – great opportunity

Modelling, 4M model

developed by the Hungarian Agricultural Model Designer Group from the various institutes in the country. It contains several

- models to describe the physiological interactions of soil - plant systems and
- offers a possibility of building up different system models in it for the specific purposes of the users need.

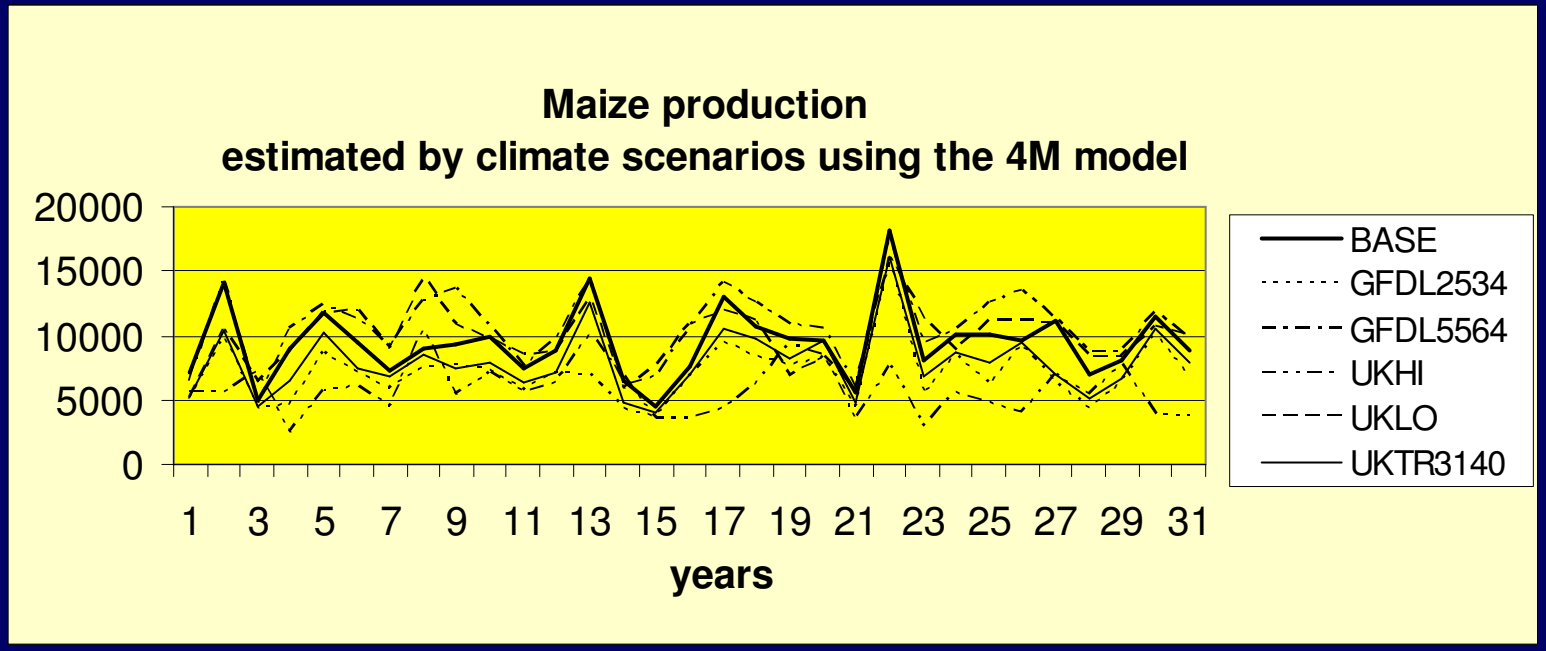
The CERES model was chosen to be a starting point, as for several other crop models in the world.

The simulations were run for the daily average temperature and precipitation amount forecasted by climate scenarios.

Examples for Debrecen region:

maize yield and maize secondary biomass for future, proportion of the parts of the corn plant, grain mass of winter wheat

estimated by using different climate scenarios.

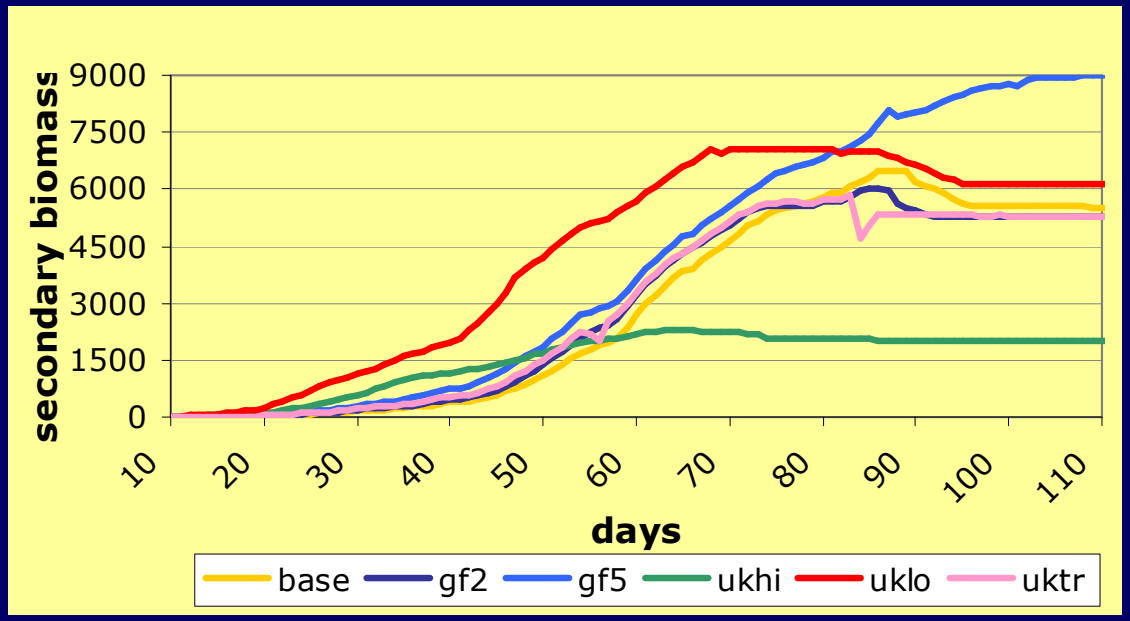


SCENARIO	BASE	UKHI	UKLO	UKTR3140	GFDL2534	GFDL5564
average	**9429.65**	**5831.87**	**9806.97**	**7101.35**	**7941.55**	**10600.19**
st.deviation	2877.95	2048.57	2497.38	2372.81	2557.62	2887.04
CV	0.31	0.35	0.25	0.33	0.32	0.27

The variability doesn't change much for the used climate scenarios, but the estimated mean yield does.

Same region in the last decade: 6518 kg/ha.

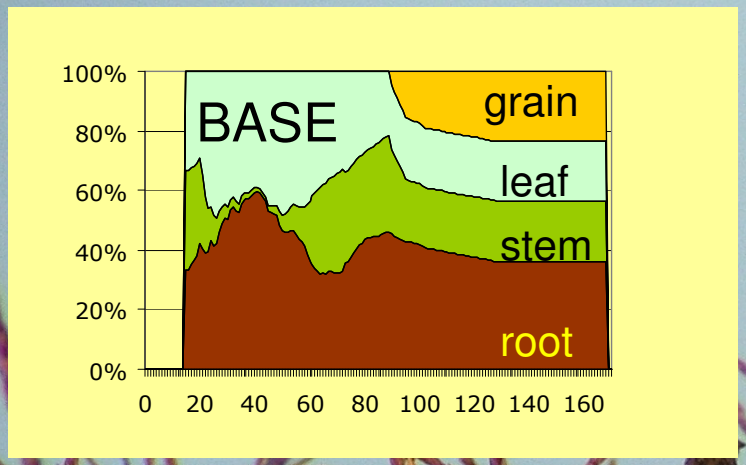
Predicted quantities of the secondary biomass available for biofuel production (kg/ha):

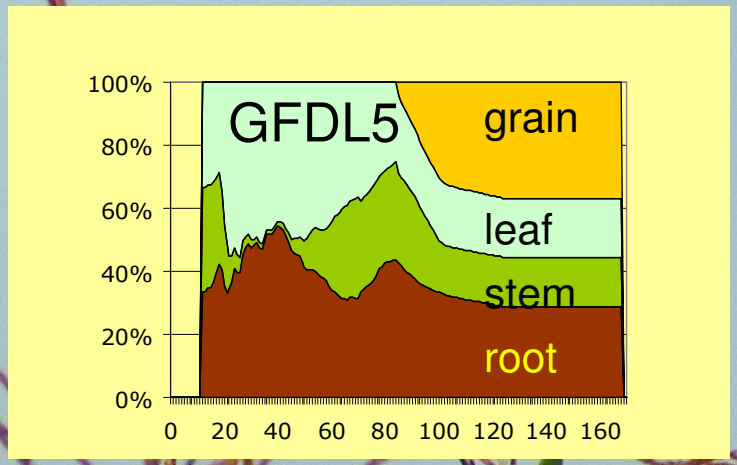


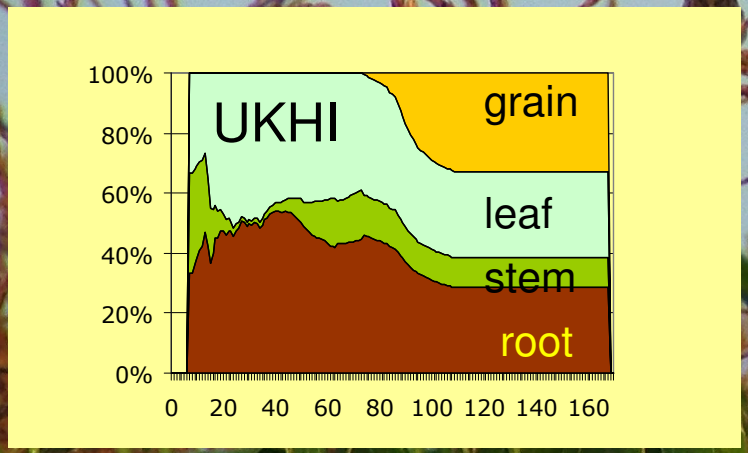
Scenarios	BASE	GFDL2	GFDL5	UKHI	UKLO	UKTR
Biomass (kg/ha)	4977	4254	5538	3842	5727	4665

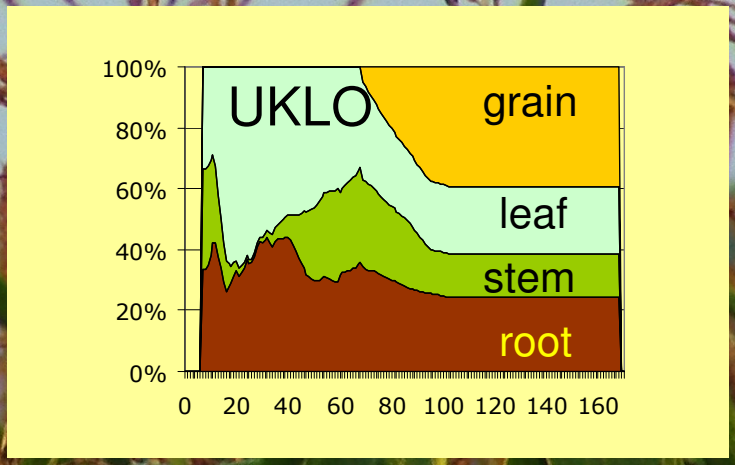
1960-90 reference period : 2331,6 kg/ha

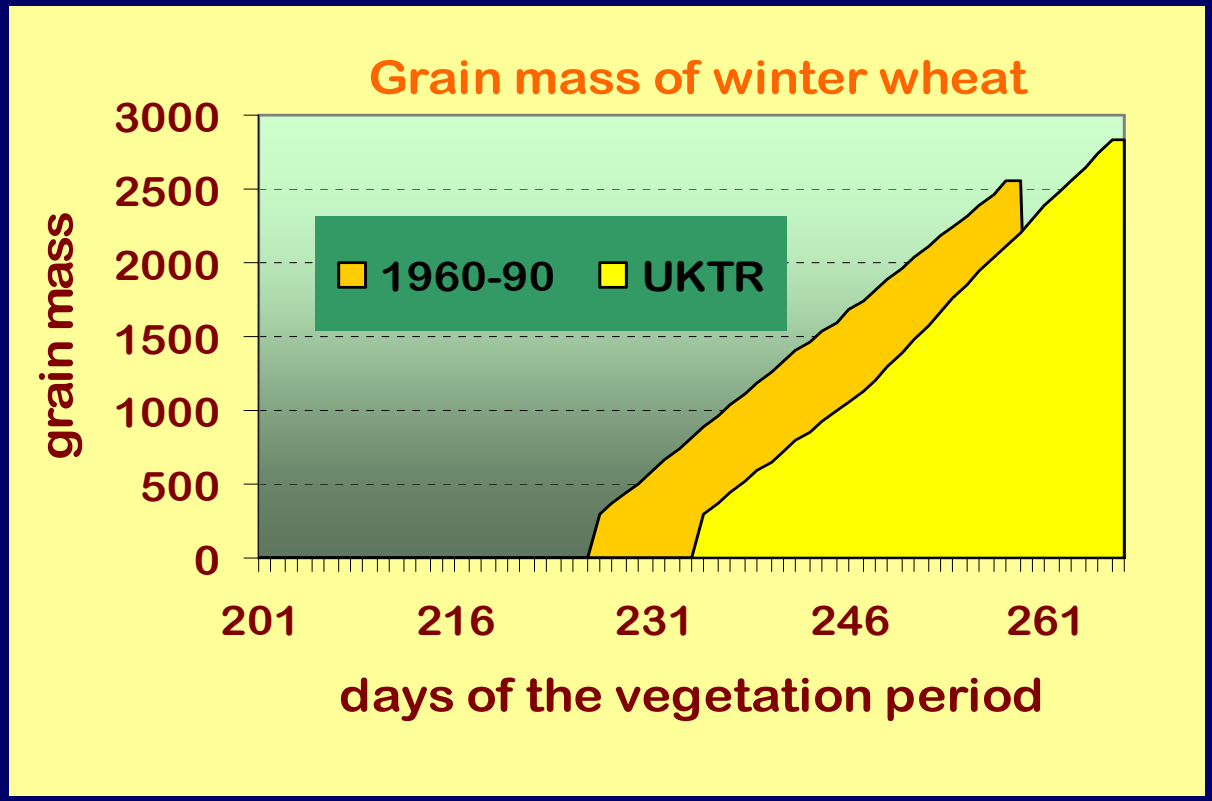
Proportion of the parts of the plant for the days of its vegetation period predicted by climate scenarios











	1960-90			UKTR		
	average	st.dev.	CV	average	st.dev.	CV
grain mass	2695,21	510,62	0,19	3512,86	688,62	0,20
biomass	7420,07	1656,15	0,22	10038,71	1281,49	0,13

Conclusion, discussion:

Rising temperatures may allow earlier sowing dates, enhance crop growth and increase potential crop yield.

Bioenergy - best opportunity to reduce GHG emission, but with no additional pressure on the environment

Diversity in energy supply would bring greater economic security and stability for the environment and the society.

Energy crop has a high potential to create new jobs and introduces high-tech applications into rural areas.

Our task is to create well-designed descriptive and forecasting systems, to define optimal preparing and response strategies to the condition in change,

SO - to call the attention to this topic,

- to continue collaboration and research.

Thank you for your attention!

Journal, You are welcome:

Applied Ecology and Environmental Research

www.ecology.kee.hu