Impact of Climate Change on Crop Production and Nutrition in Central Asia

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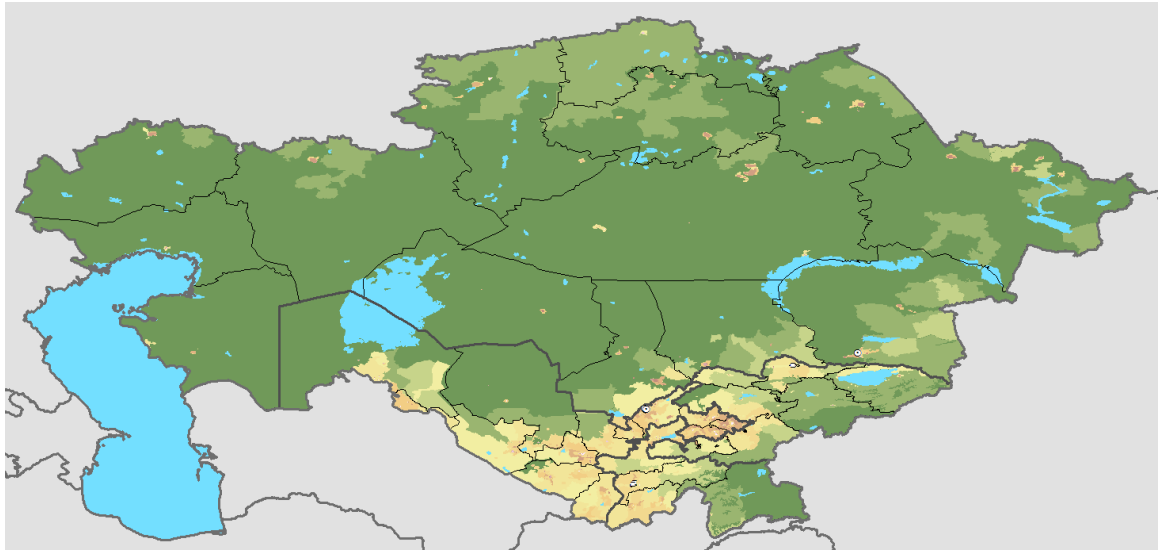
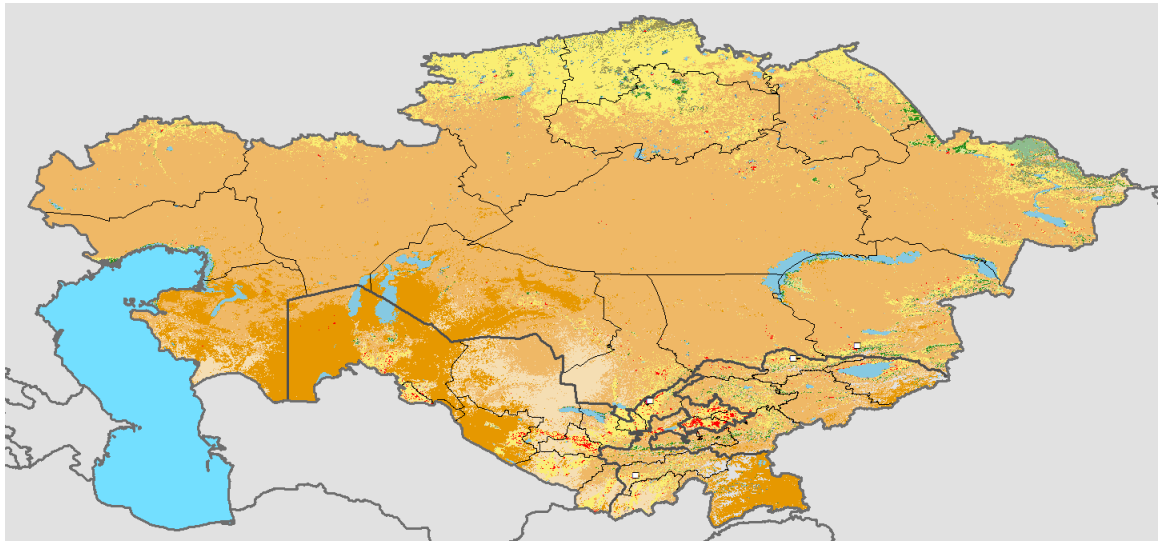
Population and land use

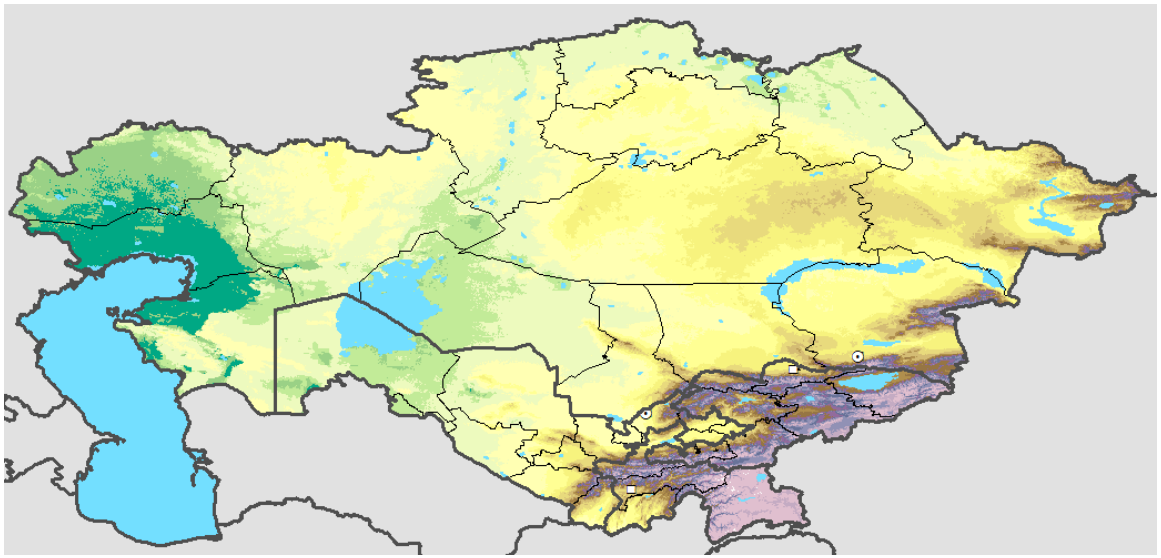


< 2
2 - 5
5 - 10
10 - 20
20 - 50
50 - 100
100 - 200
200 - 400
400 - 800
800 - 1,500
1,500 - 2,500
2,500 - 4,000
> 4,000

Water
Evergreen Needleleaf Forest
Evergreen Broadleaf Forest
Deciduous Needleleaf Forest
Deciduous Broadleaf Forest
Mixed Forests
Closed Shrublands
Open Shrublands
Woody Savannas
Savannas
Grasslands
Permanent Wetlands
Croplands
Urban and Built-Up
Cropland/Natural Vegetation Mosaic
Snow and Ice
Barren or Sparsely Vegetated

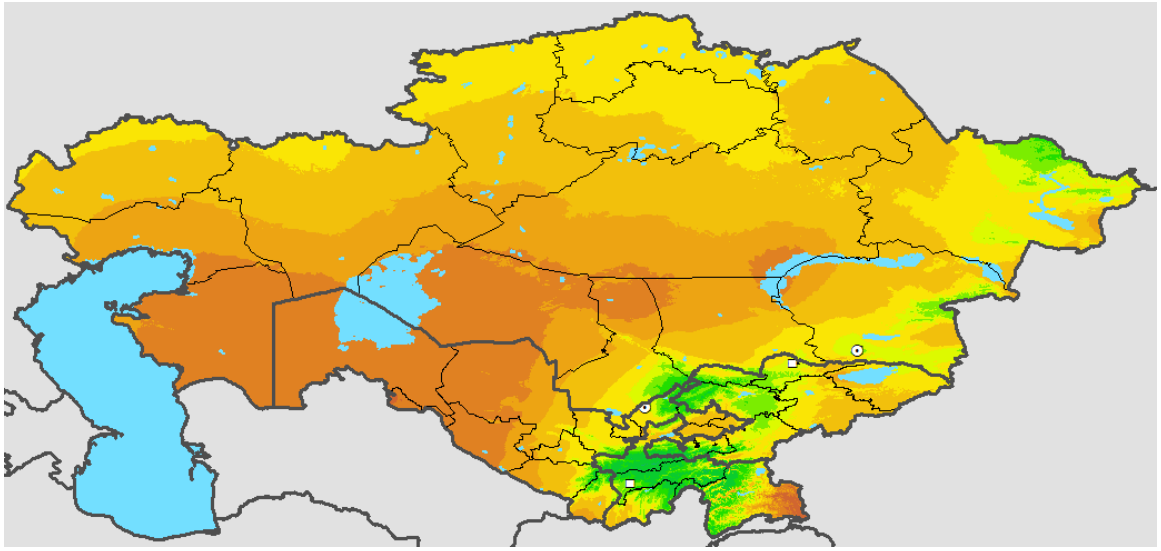


Elevation and annual precipitation (1950-2000)

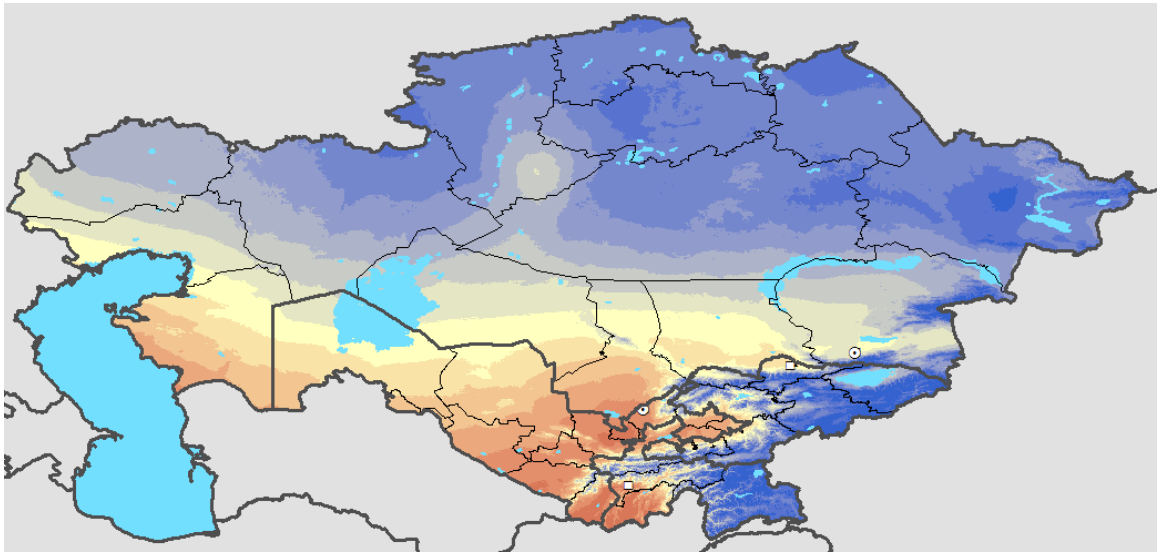


< 0
0 - 50
50 - 100
100 - 200
200 - 350
350 - 500
500 - 700
700 - 1,000
1,000 - 1,400
1,400 - 1,800
1,800 - 2,200
2,200 - 2,600
2,600 - 3,000
3,000 - 3,500
3,500 - 4,000
4,000 - 5,500
> 5,500

< 50
50 - 100
100 - 150
150 - 200
200 - 300
300 - 400
400 - 500
500 - 650
650 - 800
800 - 1,100
1,100 - 1,400

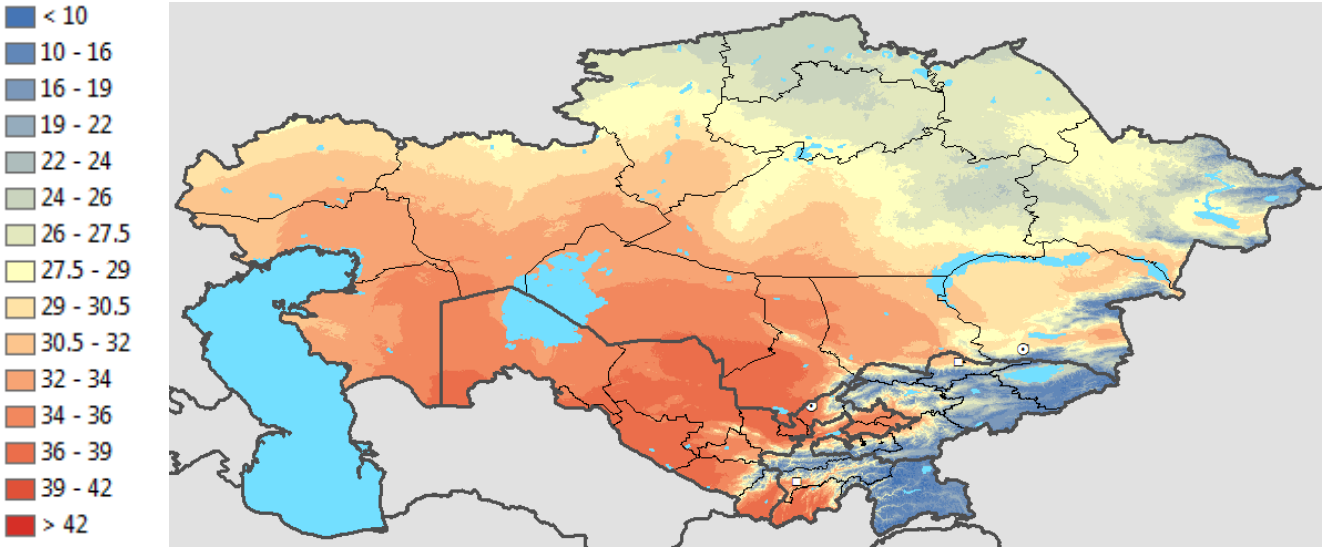


Temperature (1950-2000)

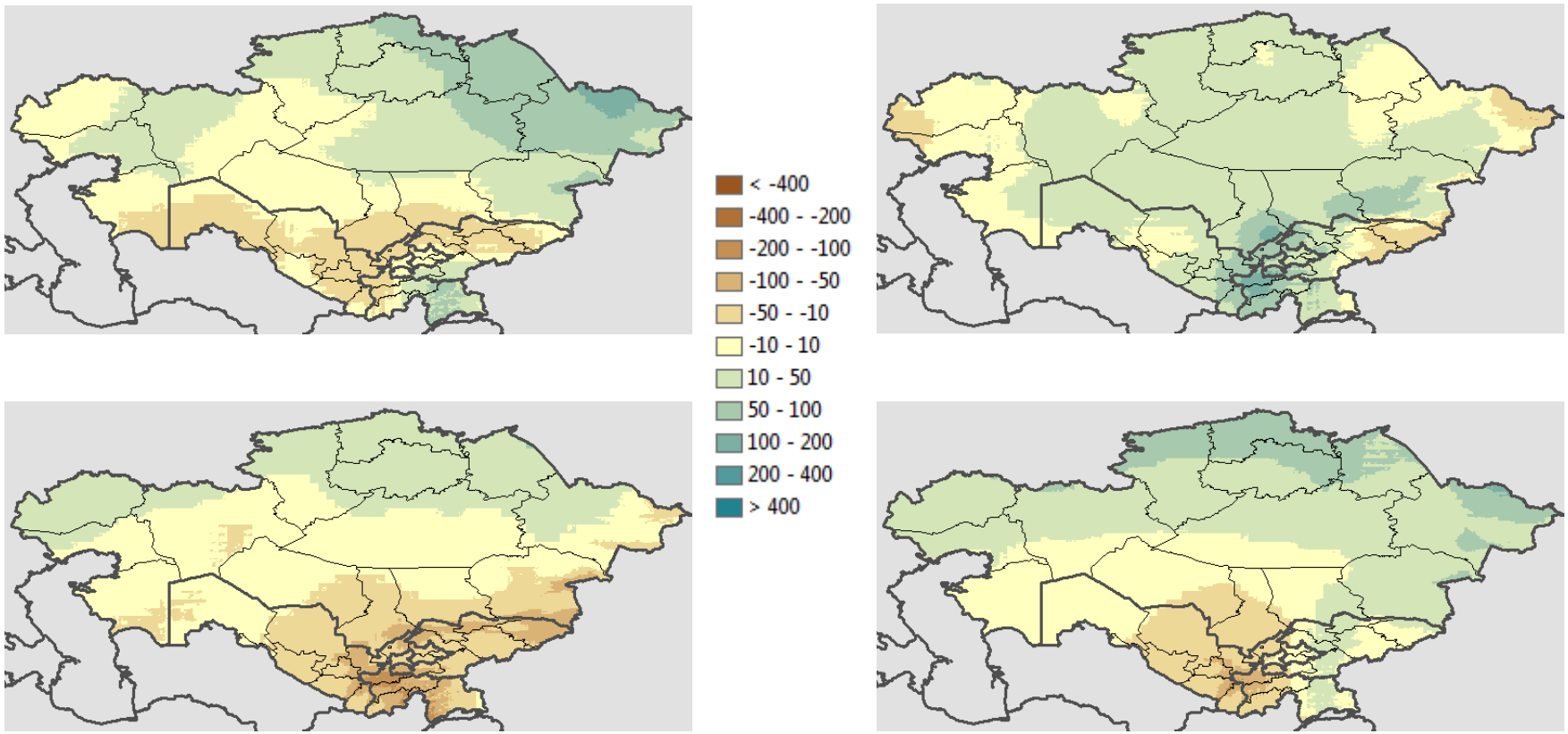


Mean daily minimum for coldest month

Mean daily maximum for warmest month

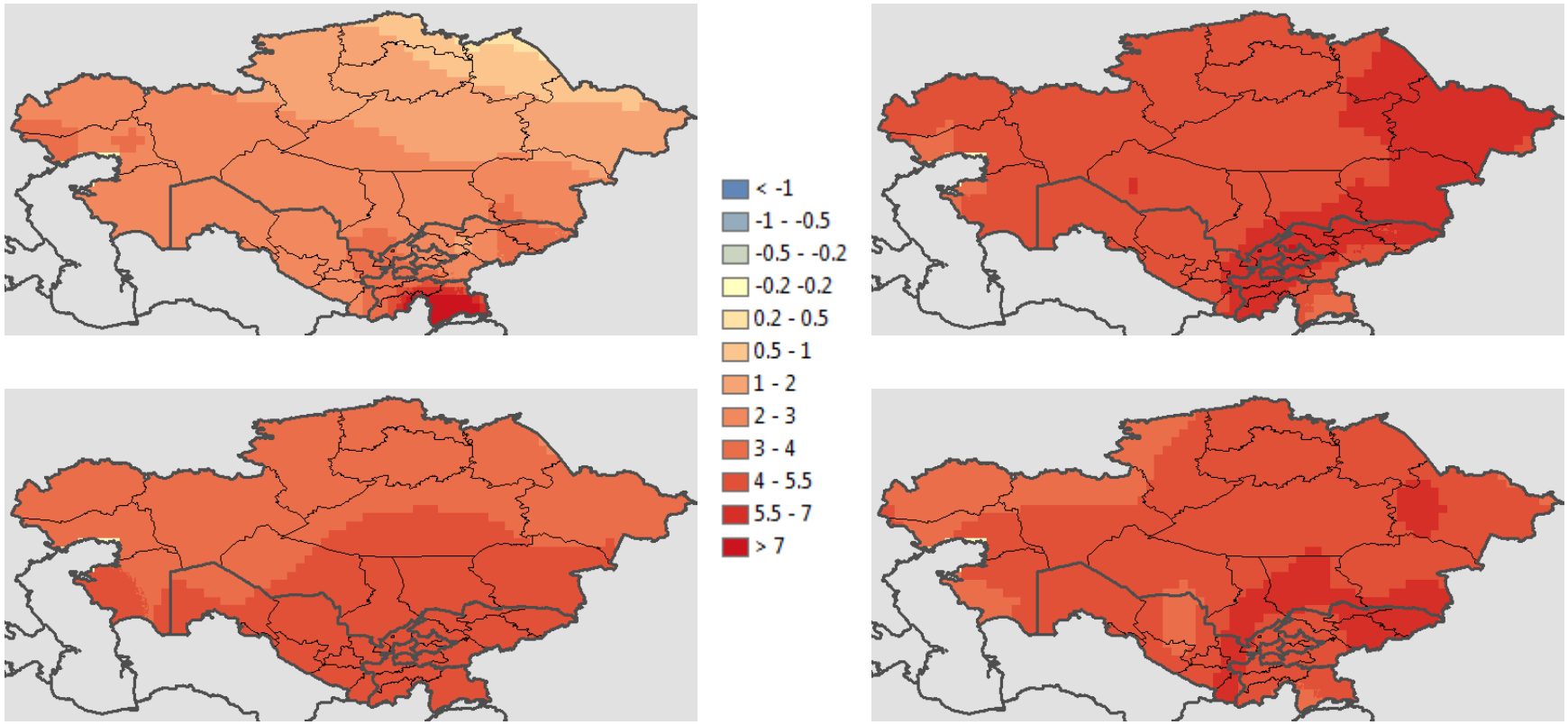


Precipitation Change, mm (2000-2050)



All GCMs (climate models) are from the AR5, RCP8.5. Top left, GFDL; top right, HadGEM; bottom left, IPSL; bottom right, MIROC. Values are for annual changes.

Temperature Change, ^{O}C (2000-2050)

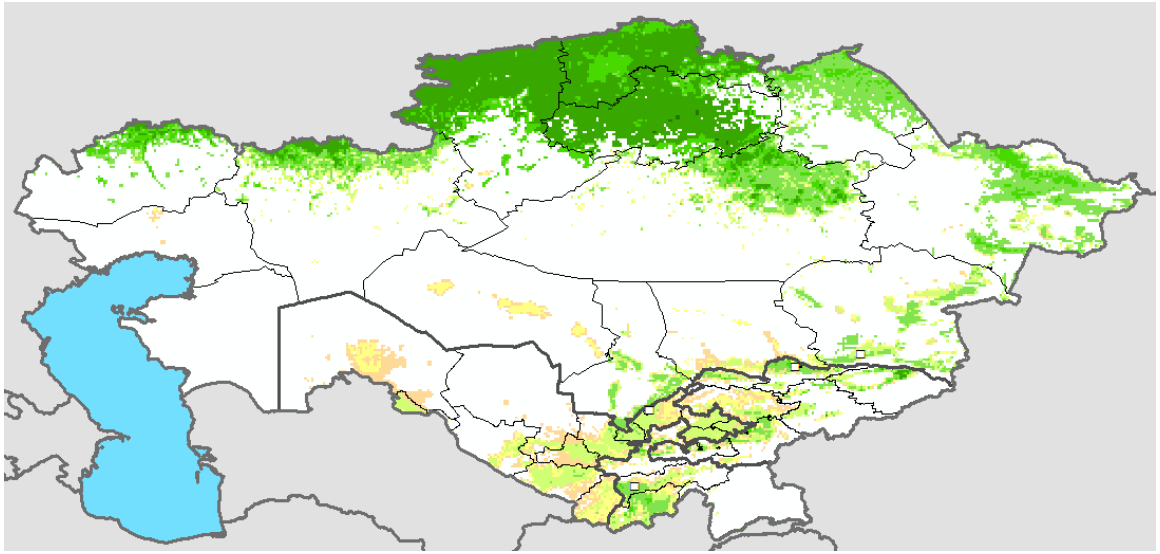


All GCMs (climate models) are from the AR5, RCP8.5. Top left, GFDL; top right, HadGEM; bottom left, IPSL; bottom right, MIROC. Temperature changes are based on the month with the highest mean daily maximum temperature.

How Crop Models Work

- We use DSSAT, which has proven to be one of the best models available
- For each 9 km pixel, input soil, climate, crop variety, and farm management practices
- DSSAT simulates daily weather based on the monthly climate data
- We “grow” the crop using the model 80 separate times for different simulated weather
- We do that for the climate of 2000, and for each climate model in 2050
- We use the average yields to compute yield changes
- We use SPAM and country data to estimate how much of the crop is grown in each pixel, and use that for a weighted average of yield changes for each country

Climate Impact on Spring Wheat Yield, 2000-2050

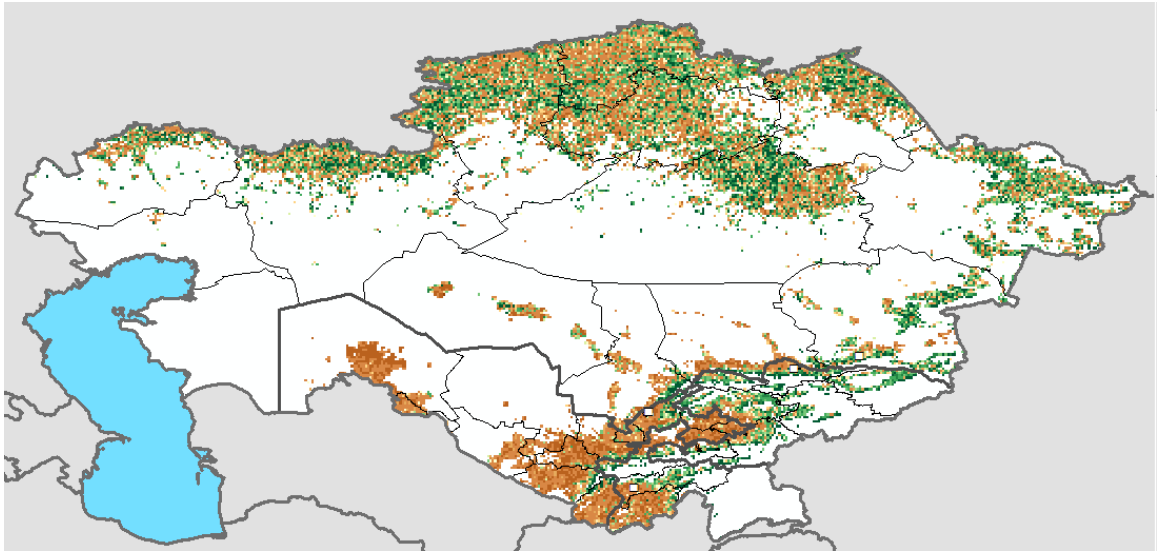


Hectares harvested per pixel of 8,000 hectares

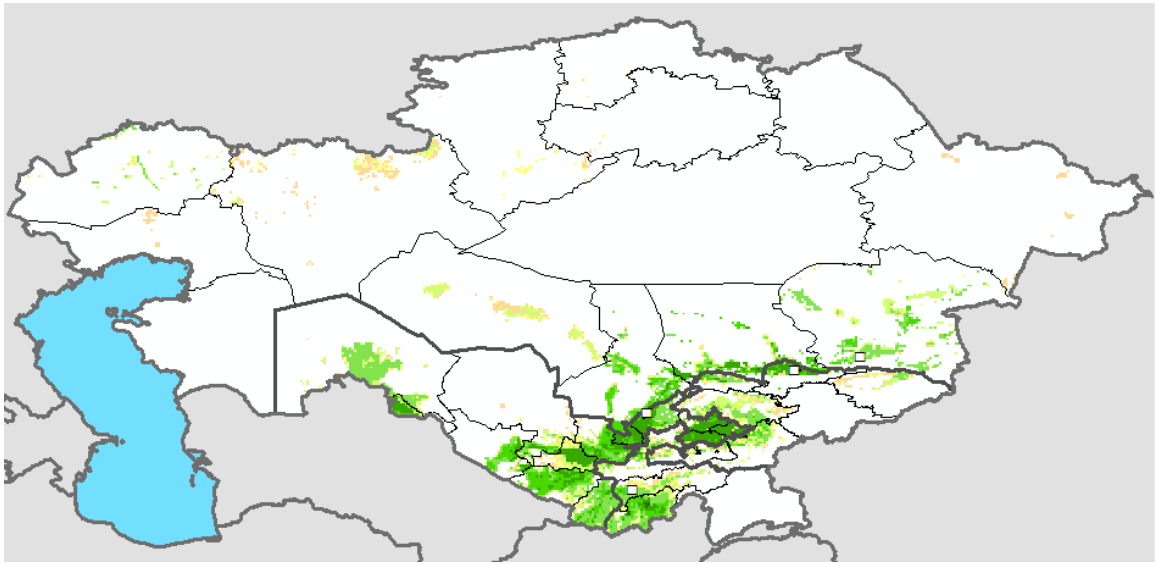
- 0
- < 10
- 10 - 30
- 30 - 100
- 100 - 500
- 500 - 1,000
- 1,000 - 2,500
- > 2,500

Percent yield change, 2000-2050

- < -80
- -80 - -50
- -50 - -20
- -20 - -10
- -10 - -5
- -5 - -2
- -2 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 80
- > 80



Climate Impact on Winter Wheat Yield, 2000-2050



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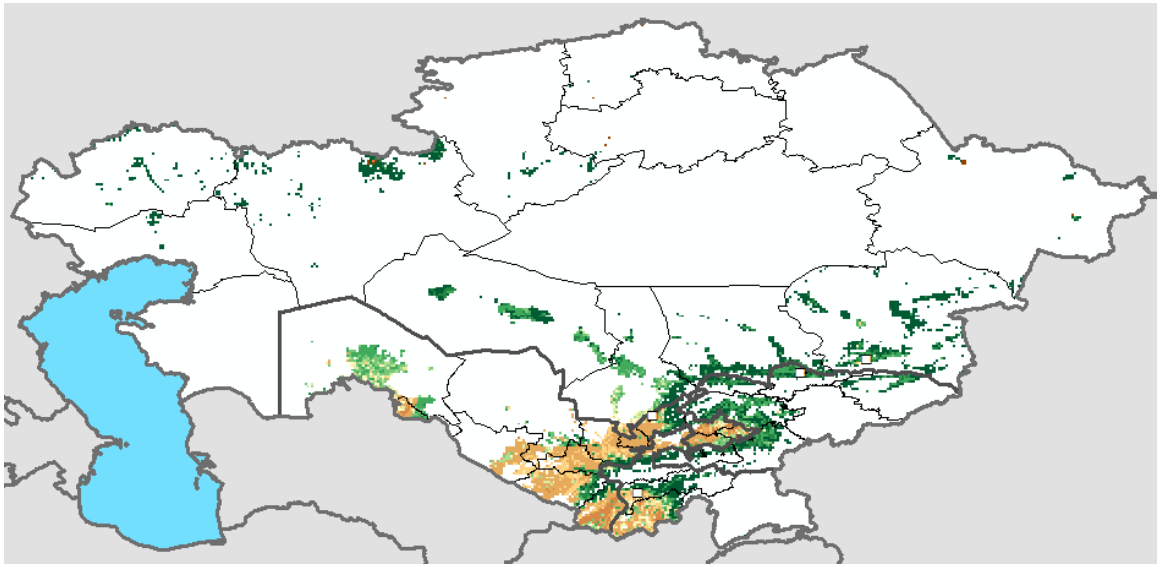
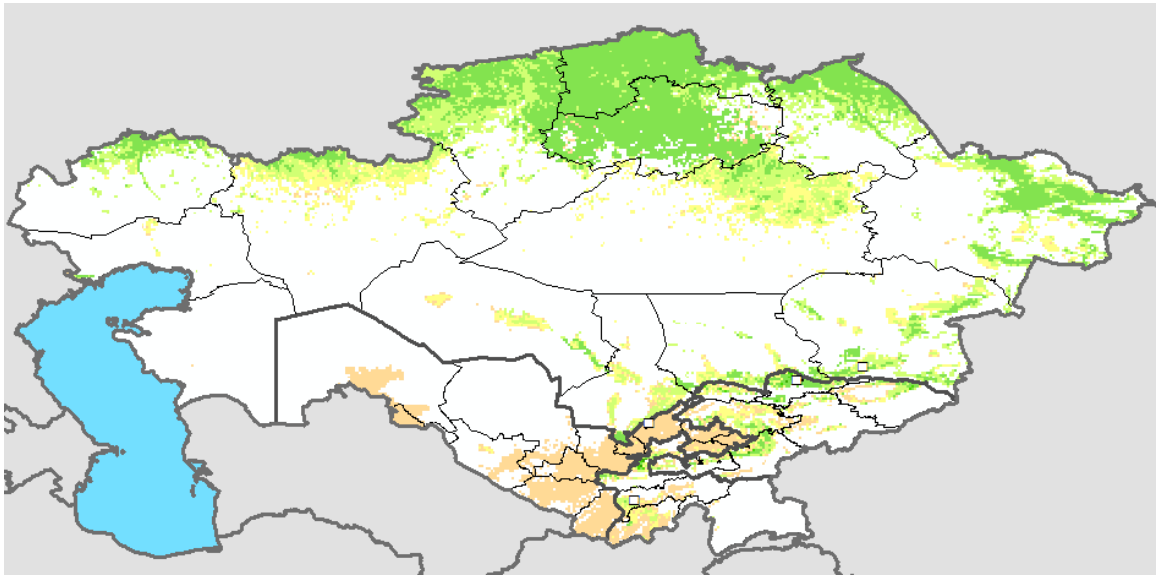
- -5 - -2
- -2 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 80
- > 80



Climate Impact on Spring Barley Yield, 2000-2050



Hectares harvested per pixel of 8,000 hectares

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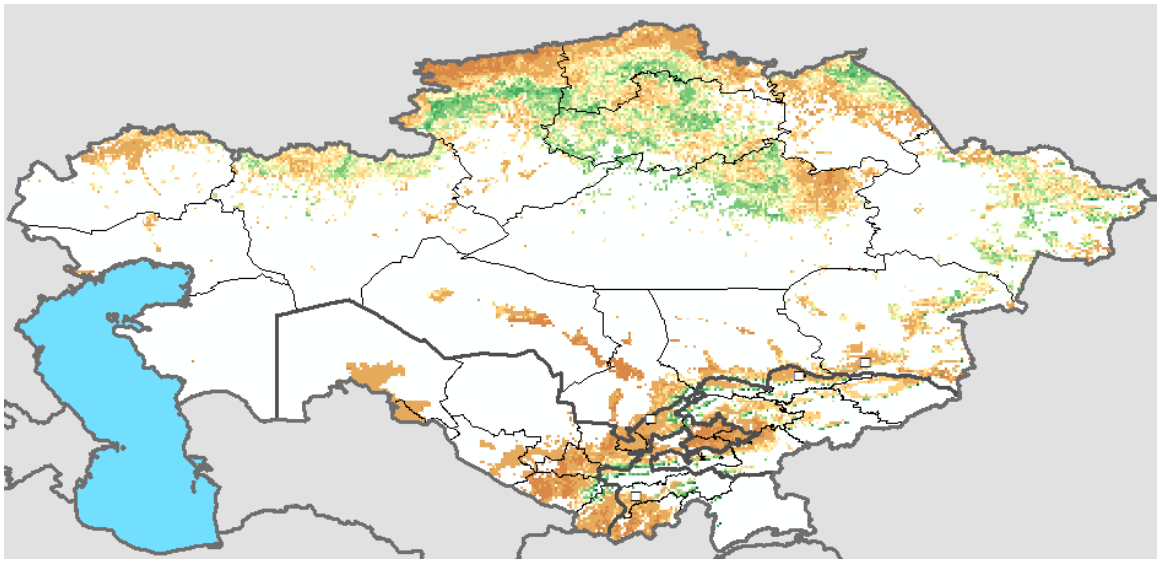
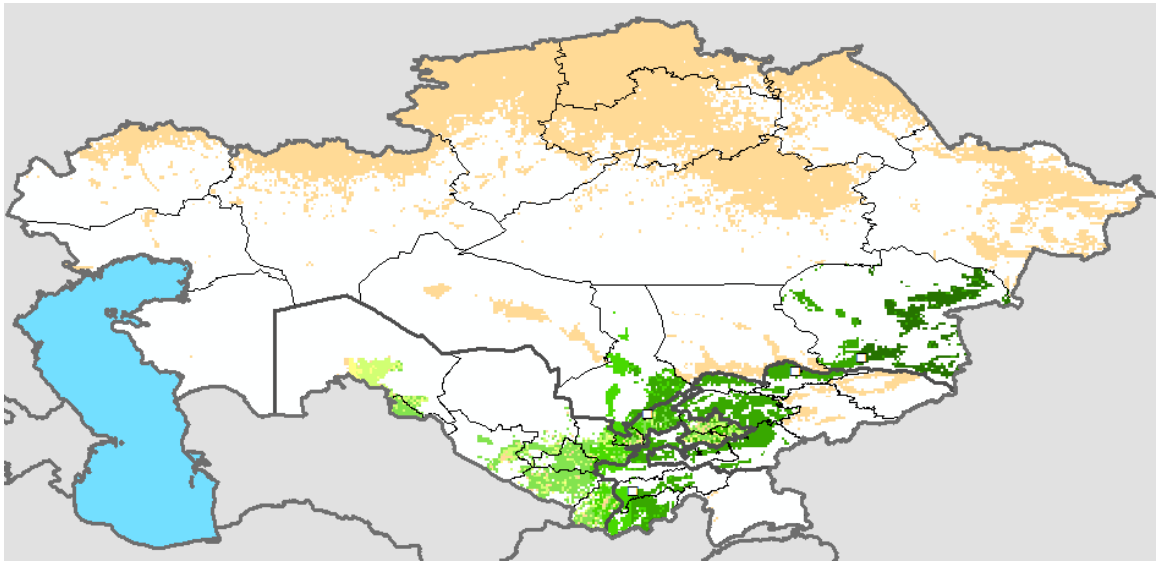
- -5 - -2
- -2 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 80
- > 80



Climate Impact on Winter Barley Yield, 2000-2050



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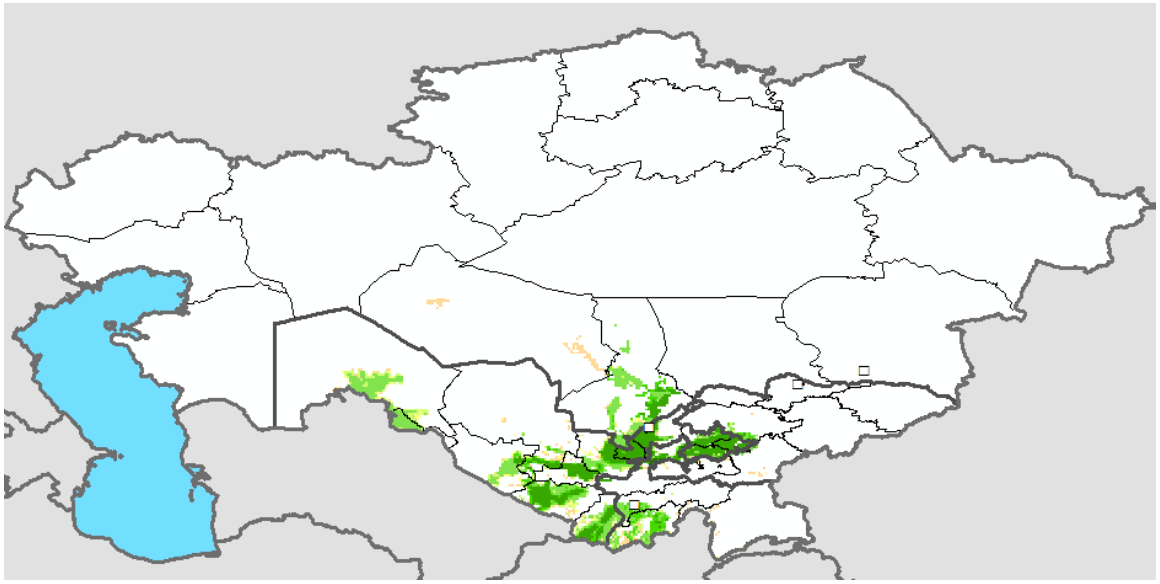
- -10 - -5
- -5 - -2
- -2 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 80
- > 80

Picture unavailable

Climate Impact on Spring Cotton Yield, 2000-2050



Hectares harvested per pixel of 8,000 hectares

- 0
- < 10
- 10 - 30
- 30 - 100
- 100 - 500
- 500 - 1,000
- 1,000 - 2,500
- > 2,500

Percent yield change, 2000-2050

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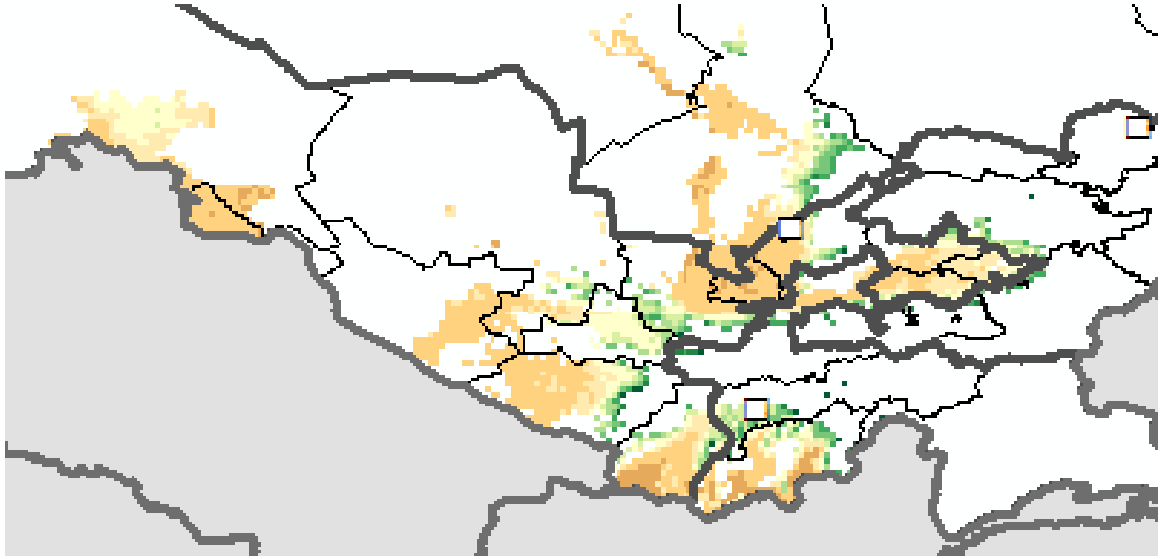
- -50 - -20
- -20 - -10
- -10 - -5
- -5 - -2
- -2 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 80
- > 80



Summary of Results

	Cotton		Barley		Wheat	
Country	Harvested area, 2000	Climate effect (%), 2000-2050	Harvested area, 2000	Climate effect (%), 2000-2050	Harvested area, 2000	Climate effect (%), 2000-2050
Kazakhstan	216,735	2.1	1,589,339	-4.3	11,417,717	2.2
Kyrgyzstan	45,690	6.3	101,261	-7.6	380,636	25.3
Tajikistan	281,988	0.7	41,494	-4.4	316,597	-7.9
Uzbekistan	1,445,796	-4.8	68,768	5.4	1,437,458	-9.4

	Maize		Potatoes	
Country	Harvested area, 2000	Climate effect (%), 2000-2050	Harvested area, 2000	Climate effect (%), 2000-2050
Kazakhstan	137,104	-3.1	209,041	-19.6
Kyrgyzstan	17,159	-0.1	32,684	29.1
Tajikistan	21,303	-17.6	27,046	-12.1
Uzbekistan	49,178	-21.1	52,831	-14.4

Issues not addressed

- Variability of weather to increase with climate change (more droughts, more intense rainfall, more heat waves). These were not included in the crop model work.
- Potential for increased harm by pests due to warmer winters.
- The potential of farmers to reduce greenhouse gas emissions.

Policy Implications

- Central Asia is projected to experience greater climate shocks than most regions through temperature changes
- This presents opportunities for gains (mostly in the winter) and points to challenges that need to be addressed (e.g., impact on spring crops)
- Rapid changes will challenge farmers' ability to learn new climate-appropriate methods, suggesting need for communicating between researchers and farmers

Policy Implications (page 2)

Options for supporting farmers in dealing with climate change include

- developing heat and drought tolerant varieties (requires investment in research or giving private sector incentives to do research)
- switching to different crops
- encouraging relocation and development of new areas for farming (potentially related to land tenure laws)
- increasing fertilizer use and using improved seeds (facilitate improving input availability)
- increasing soil organic matter through integration with livestock; cover crops; crop residues
- using water and nutrient conserving technologies

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Thank You!