

WPL meeting, Genève
March 2013

Setting the scene for the future of the Black Sea catchment

WP3

Demography – Climate - Land Use



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Andrea DeBono (UNEP),

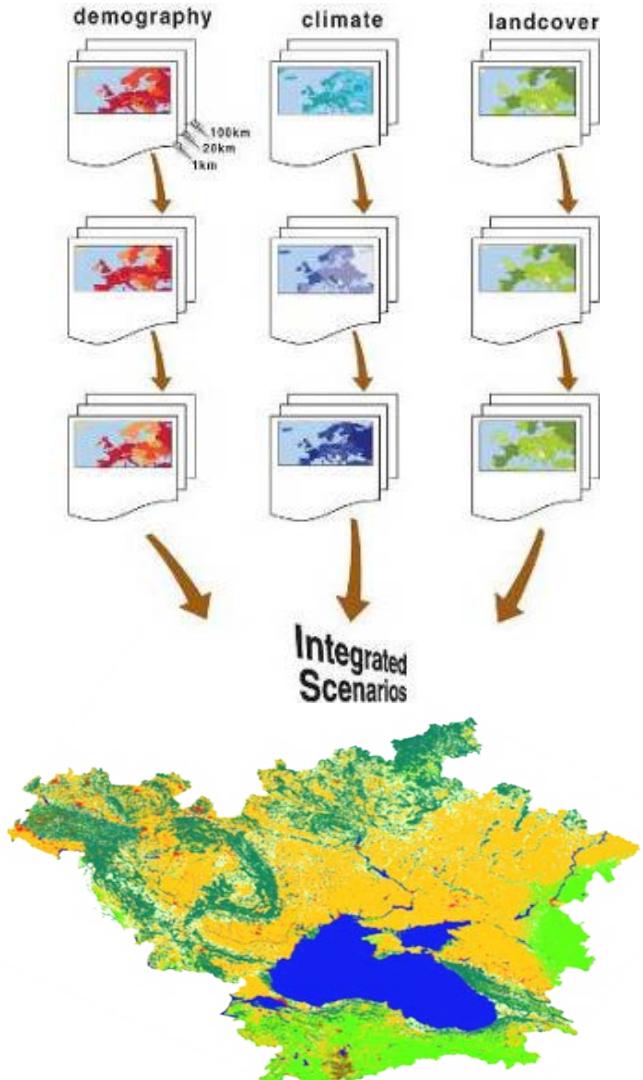
Ana Gago Da Silva (UNIGE)

Scope

2008

2025

2050



- To Create spatially explicit scenarios on:
 - Demographic Changes
 - Climate Changes
 - Land Cover Changes
- To integrate the three scenarios outputs

Reminder

Scenarios are neither prediction nor forecast,
**But a plausible description on how the future may develop, based on
a coherent and internally consistent set of assumption about key
relationship and driving forces.**

enviroGRIDS storylines

HOT

ECONOMIC

ALONE

GLOBAL

REGIONAL

COOP

ENVIRONMENTAL

COOL

Global competitive

A1

Regional Fragmented

A2

Strong Cooperation

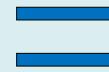
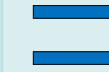
B1

Adaptive / Sustainable

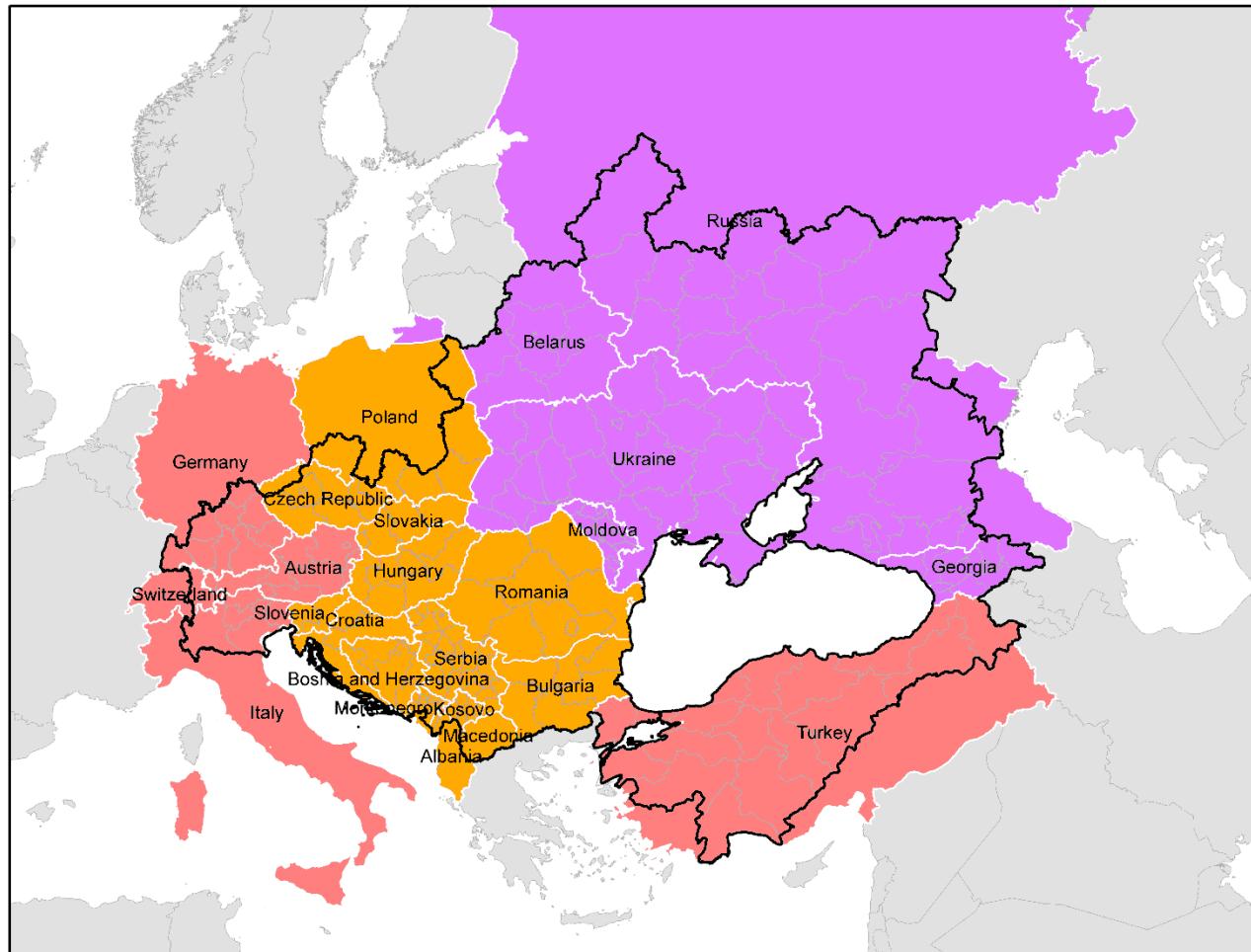
B2



From Global to Regional

	Demography	Urban	C02	Natural and Forest area	Agriculture	Climate change
						
HOT						
ALONE						
COOP						
COOL						

Regional guidelines (IMAGE 2.2 derived)



Regional model

- Black Sea basin
- NUTS2

Regions groups

- REF Eastern Europe
- OECD Western Europe
- Former USSR
- Out of studied area

Netherlands Environmental Assessment Agency (USS IMAGE 2.2)
<http://www.pbl.nl/en/themasites/image/projects/downloads/index.html>

Demography scenarios



Narrative (qualitative)

Projections (how many?)

Metronamica (Where?)

Demographic indicators

enviroGRIDS storylines

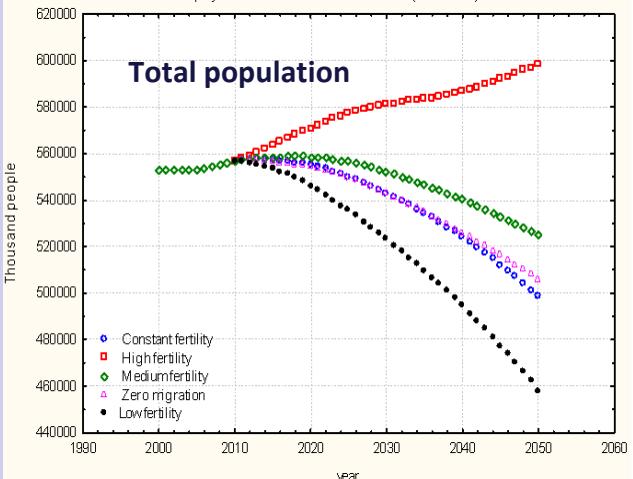
International (UN, Eurostat) and
National population projections

Integrated spatial distribution

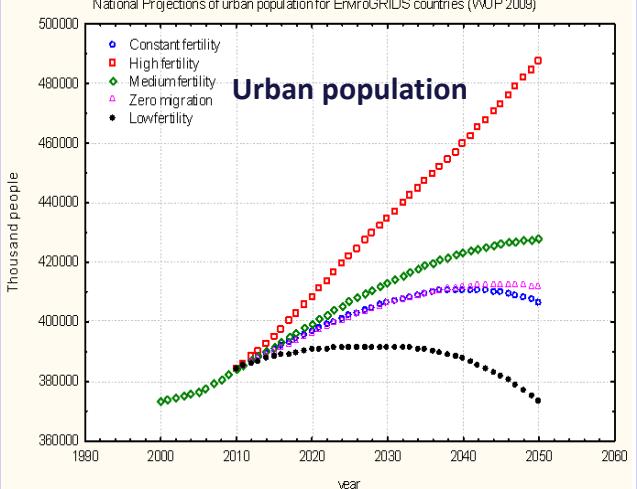
Outputs: urban population
in space and time

Projections

National projections for EnviroGRIDS countries (WPP 2010)



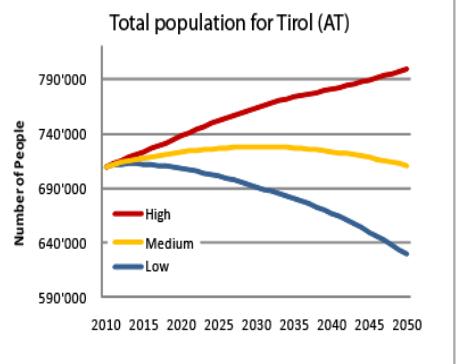
National Projections of urban population for EnviroGRIDS countries (WUP 2009)



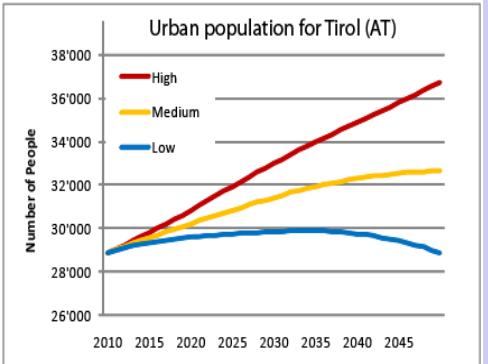
National level scenarios
From UN projections
(5 variants)

All enviroGRIDS countries
grouped 2000-2050

Total population for Tirol (AT)



Urban population for Tirol (AT)



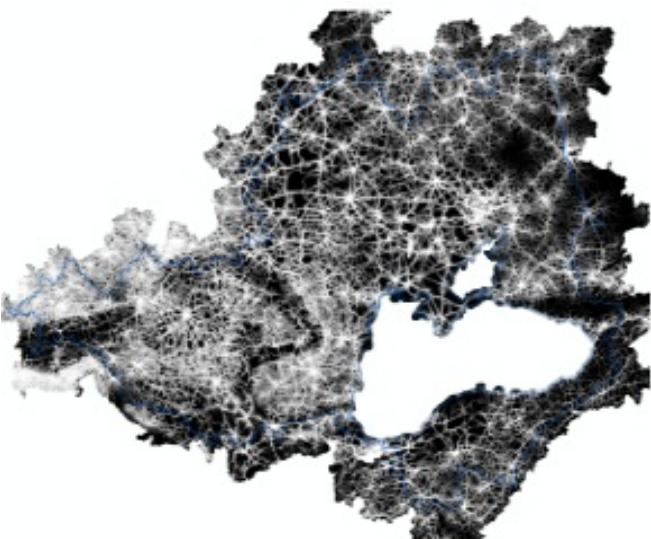
Regional level scenarios

According to the UN fertility variants
(low, medium, high),
we **downscaled** total and **urban**
population figures for all BSC 214 regions.

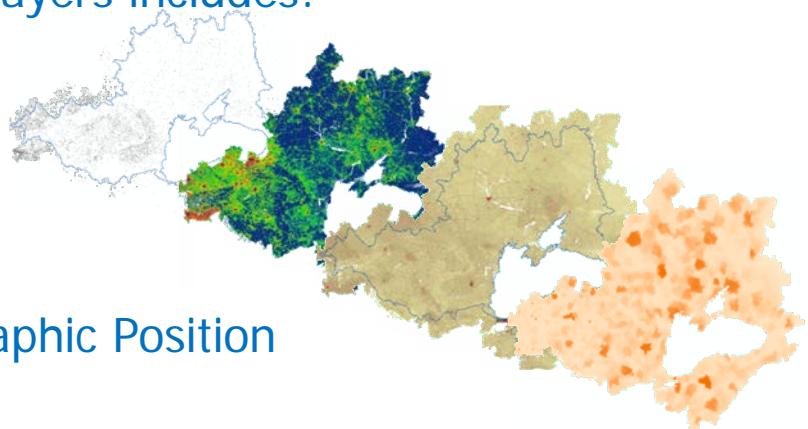
1. define and create suitability layers as proxies, where people are supposed to live.

More complex and important of them is an **Accessibility index** built on a cost-distance function where more accessible areas are supposed to be more suitable for peoples presence (Deichman 1996)

Other suitability layers includes:



- DEM,
- Nightlights,
- Slope,
- TPI: Topographic Position
- ...
- And biophysical parameters
(temp, solar expo..)

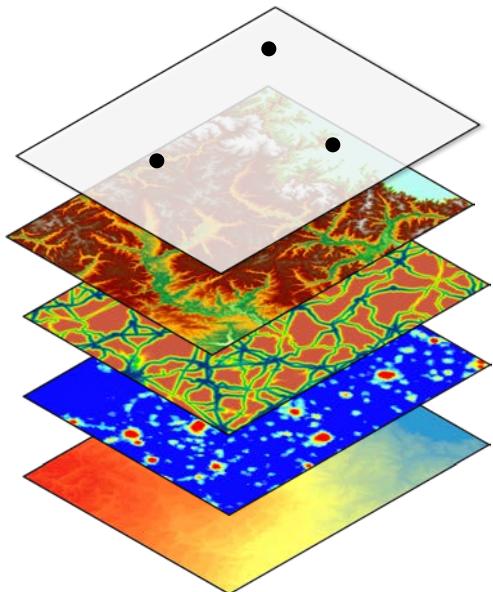


Accessibility index: white areas indicates more accessibility (scale 0-1). Index built using transportation network and distance to major cities.

$$\text{logit}[P(y = 1)] = \alpha + \beta_1 x_1 + \cdots + \beta_k x_k$$

Multiple Logistic Regression

$$P(y = 1) = \frac{e^{\alpha + \beta_1 x_1 + \cdots + \beta_k x_k}}{1 + e^{\alpha + \beta_1 x_1 + \cdots + \beta_k x_k}}$$



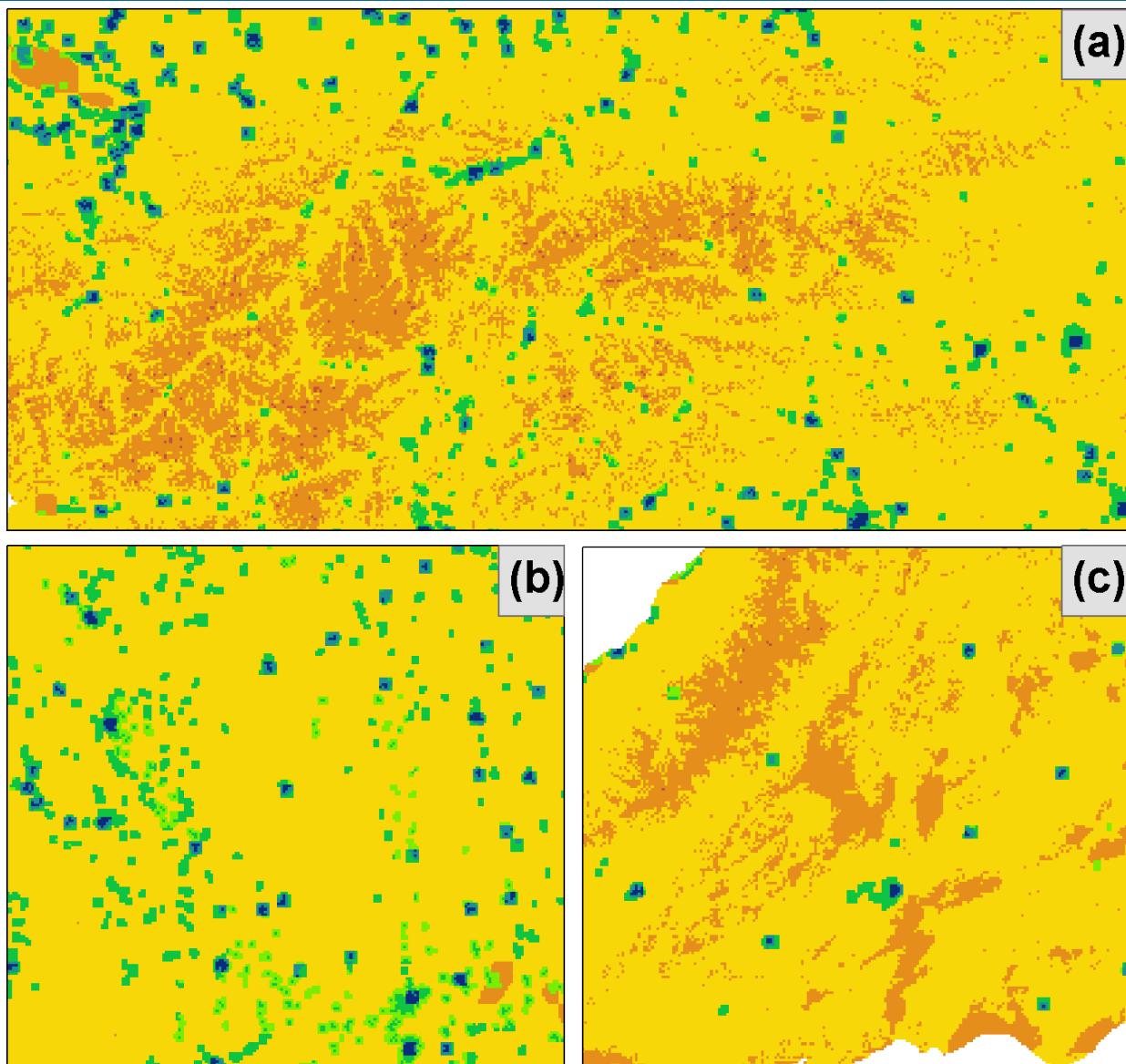
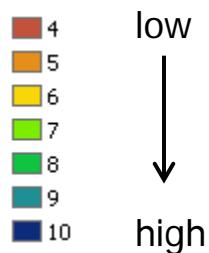
X	Y	SRTM	SLOPE	TPI	TRI	NTL	DistJ	MOS	ALPHA20	BIO1	BIO2	BIO9	BIO13	BIO16	BIO19	City
6458166	3862379	273	1.2	0.1	4.9	0	7723	720	0.8	43	87	-36	114	185	74	1
6587190	3888132	142	0.1	-0.1	4.3	2	9338	720	0.4	47	89	-34	110	176	64	1
6521377	3724251	126	1.6	0.0	3.1	0	7200	720	0.1	57	90	-22	112	162	59	1
6506550	3695377	146	0.4	0.0	1.9	0	6935	720	0.0	58	90	-21	116	161	58	1
6502388	3669364	105	1.6	-0.1	4.5	0	3413	862	0.1	61	90	-18	115	156	56	1
6509411	3666503	110	1.1	0.1	3.5	0	5300	720	0.3	61	90	-18	115	155	56	1
6449842	3702661	115	1.6	-0.2	6.3	0	6220	180	0.7	59	90	-18	117	161	63	1
6488341	3885271	230	1.0	0.0	2.2	0	8914	720	0.3	44	87	-37	110	185	72	1
6302870	3864981	175	1.3	-0.1	3.2	0	8660	720	0.1	48	86	-28	118	197	86	1
6293245	3861339	161	2.3	0.5	10.6	0	10532	720	0.0	49	86	-26	118	197	86	1
6298708	3850413	161	0.5	0.1	3.1	6	7723	720	0.0	49	86	-27	118	195	85	1
6280239	3901398	154	1.1	-0.2	5.2	0	16918	720	0.9	47	85	-29	120	202	87	1
6216768	3933394	127	1.7	0.1	4.0	0	13605	720	0.0	48	84	-26	115	207	88	1
6217808	3945360	130	0.4	0.0	1.6	0	13417	720	0.0	47	83	-26	115	207	88	0
6226913	3933914	122	1.5	0.0	3.6	0	9394	720	0.0	48	84	-26	115	206	88	0
6240960	3990882	142	1.9	0.2	5.2	0	6767	720	0.0	46	82	-28	121	210	88	0
6300789	3982298	147	0.4	0.0	2.3	0	3342	720	0.0	45	83	-30	124	204	85	0
6298188	3956806	82	0.6	-0.2	3.6	0	8769	180	0.2	49	83	-27	123	200	85	0
6286742	3920128	171	0.4	0.0	1.6	0	8335	720	0.0	46	85	-30	123	204	88	0
6182691	3934695	123	0.6	0.1	2.3	0	4178	720	0.1	48	84	-25	111	209	88	0

α	β SRTM	β SLOPE	β TPI	β TRI	β NTL	β DistJ	β ALPHA20	β MOS	β BIO1	β BIO2	β BIO9	β BIO13	β BIO16	β BIO19
-2.693	-4.55E-04	-0.02781	-0.09533	-0.00323	0.1616	-1.78E-06	2.015	-7.67E-05	-0.00883	0.01952	0.005044	-0.00371	0.006572	-0.01151

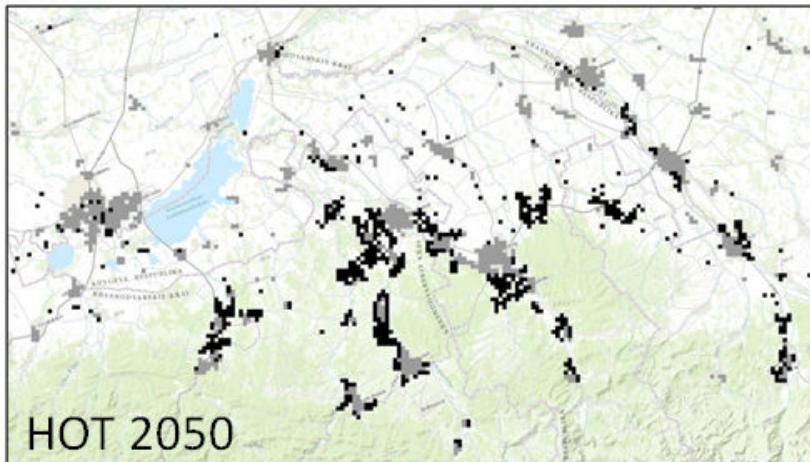
R, WinBUGS and SAGA

Demography

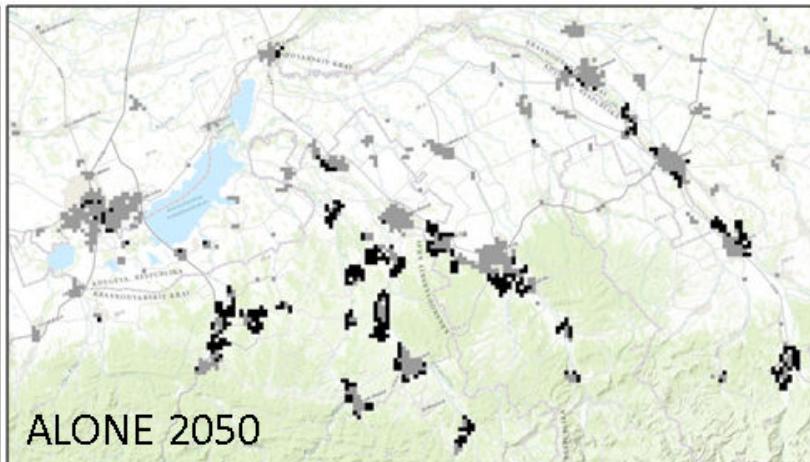
Physical Suitability



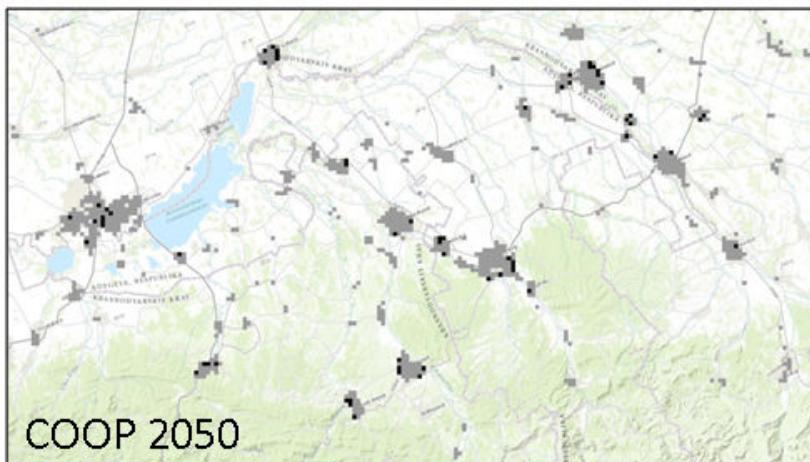
Urban Sprawl



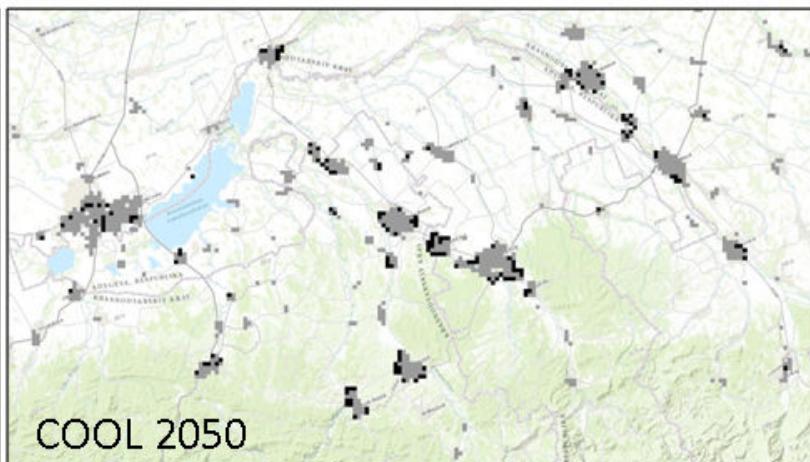
HOT 2050



ALONE 2050



COOP 2050



COOL 2050



Delta Method

- ✓ The delta method requires current and future climate projections from a **Regional Climate Model**, in order to estimate the deltas
RCMs → DT and DP
- ✓ assumes that future model biases for both mean and variability will be the same as those for present-day simulations
- ✓ existing local observations of air temperatures (T_{obs}) and precipitations (P_{obs})

$$\begin{aligned}T(t) &= T_{\text{obs}} + \Delta_t T \\P(t) &= P_{\text{obs}} \times \Delta_t P\end{aligned}$$

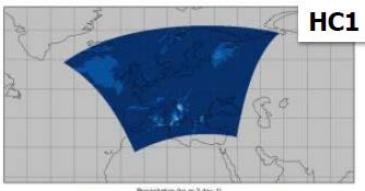
Climate Scenarios



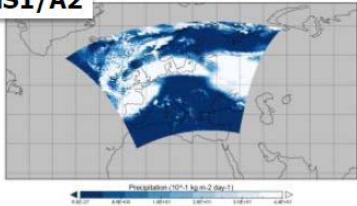
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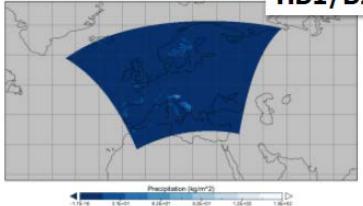
PRUDENCE DMI (HIRHAM)



HS1/A2

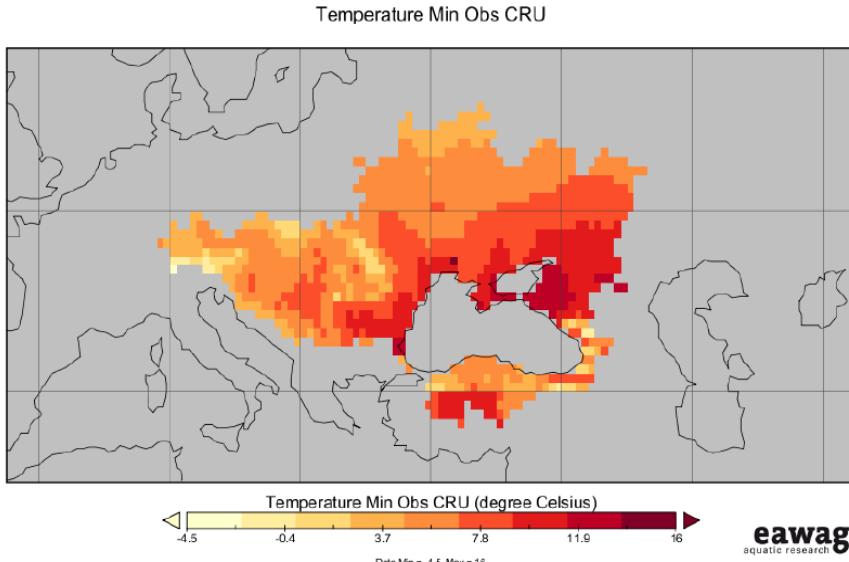


HB1/B2



Precipitation 13 January 1961 and 2071

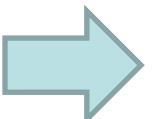
- ✓ Delta Method applied to daily CRU Obs dataset



- ✓ In a second phase the delta method is being applied to other observed data (**WMO** and **ECA**)

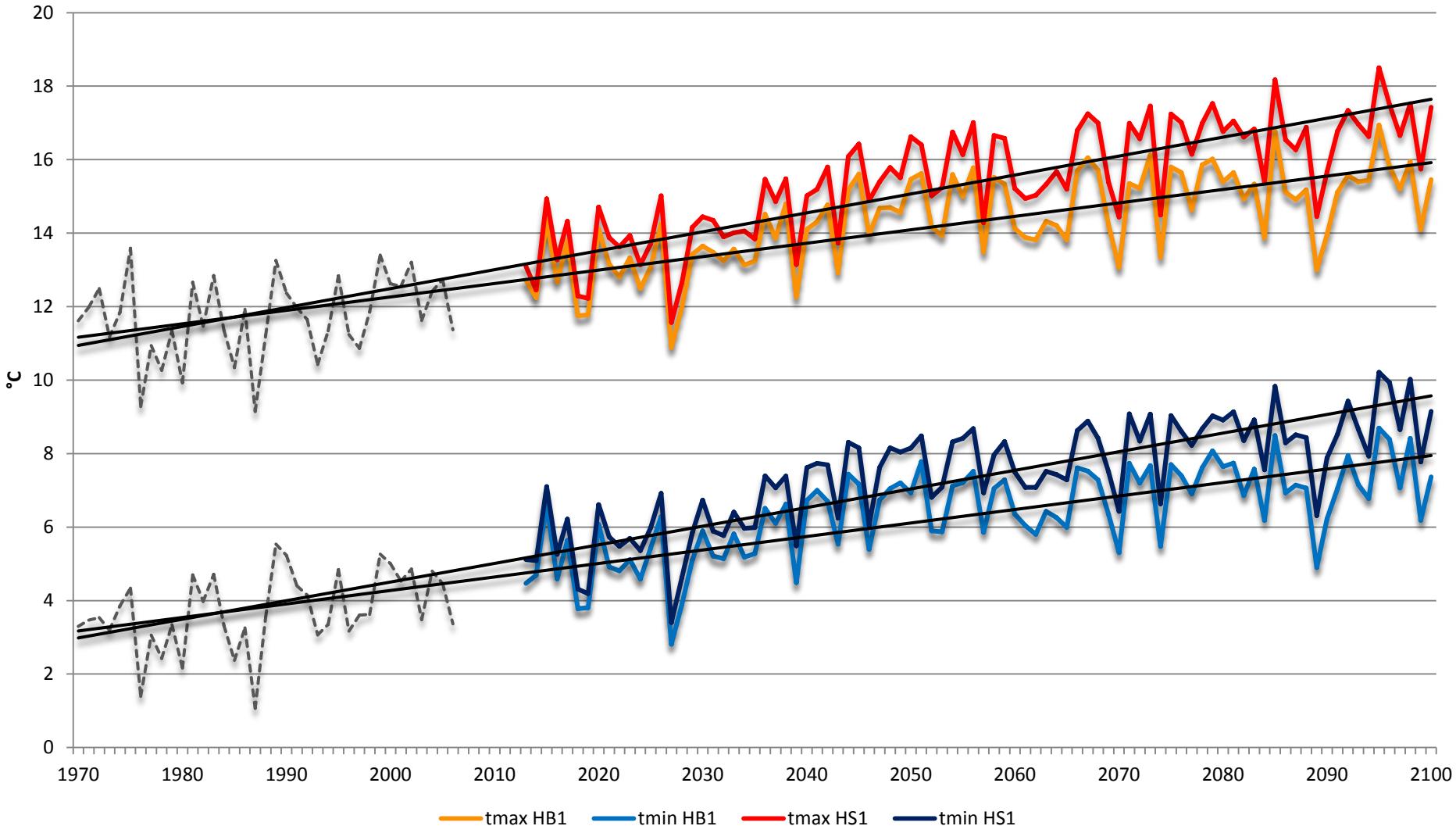
Which required an interpolation of missing observations for Weather Stations

Outputs:



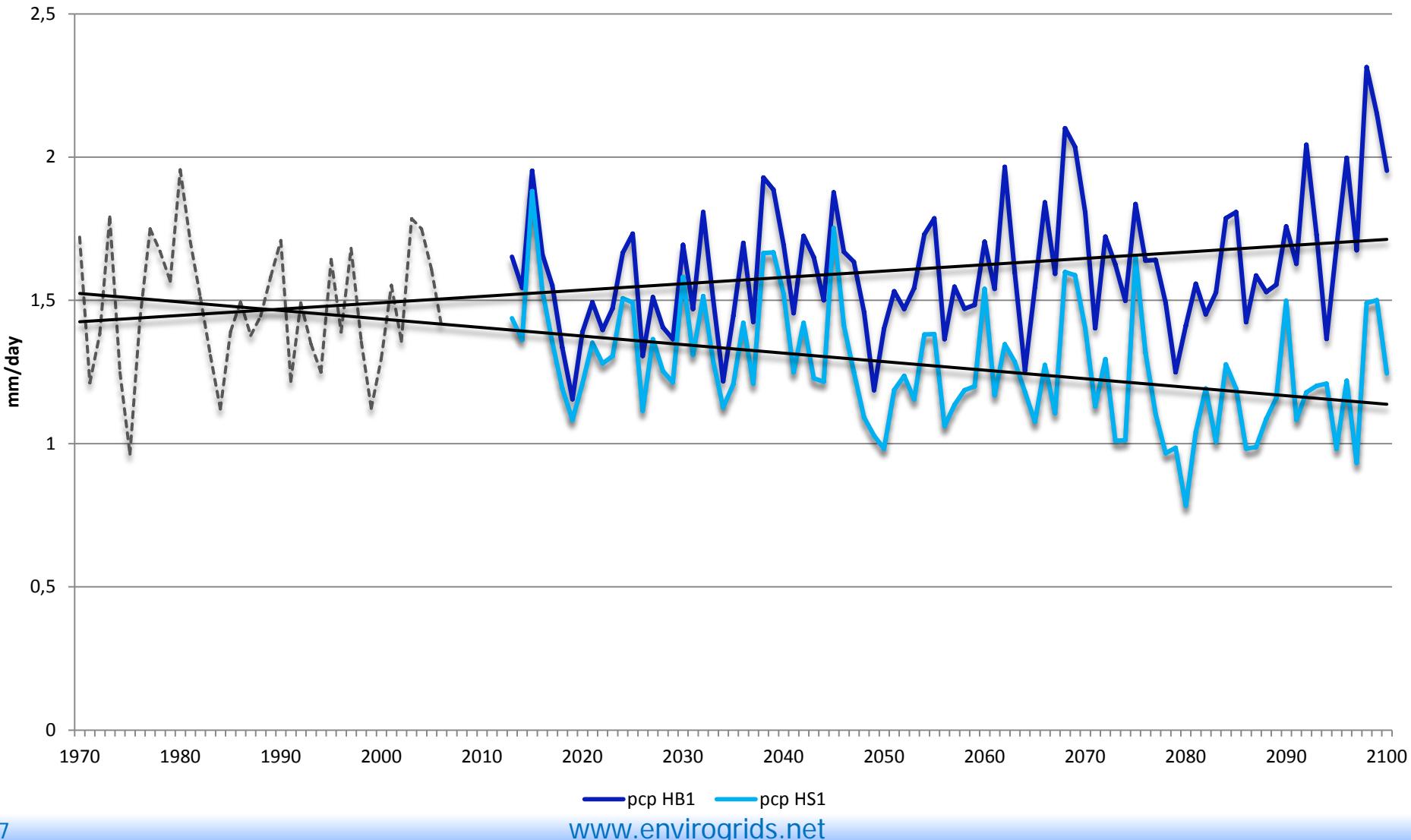
- ✓ Climate surface (~0,125 degrees)
- ✓ SWAT input format
- ✓ CSV format
- ✓ NETCDF format (Obs and Scenarios)

Delta Method HB1(B2) & HS1 (A2)



tmax HB1 tmin HB1 tmax HS1 tmin HS1

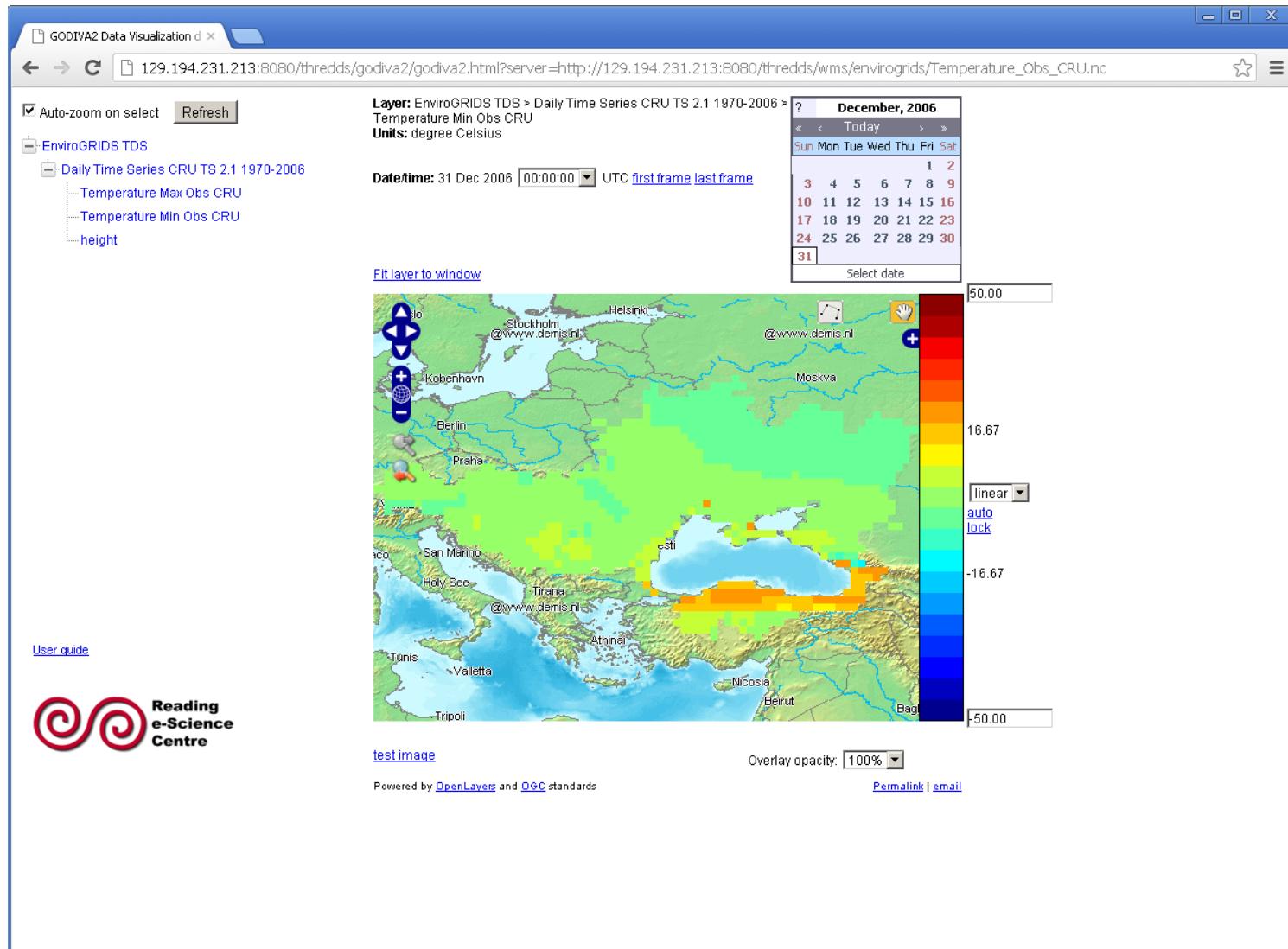
Delta Method HB1(B2) & HS1 (A2)



Climate Scenarios



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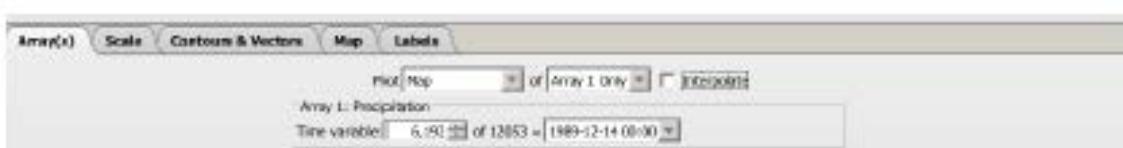
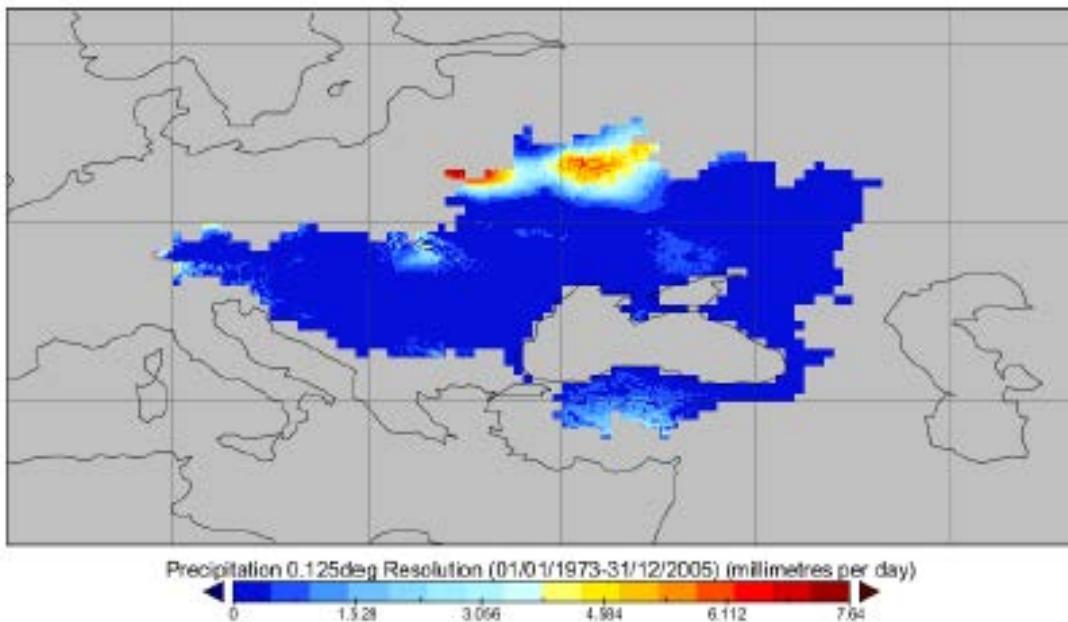
Climate Scenarios



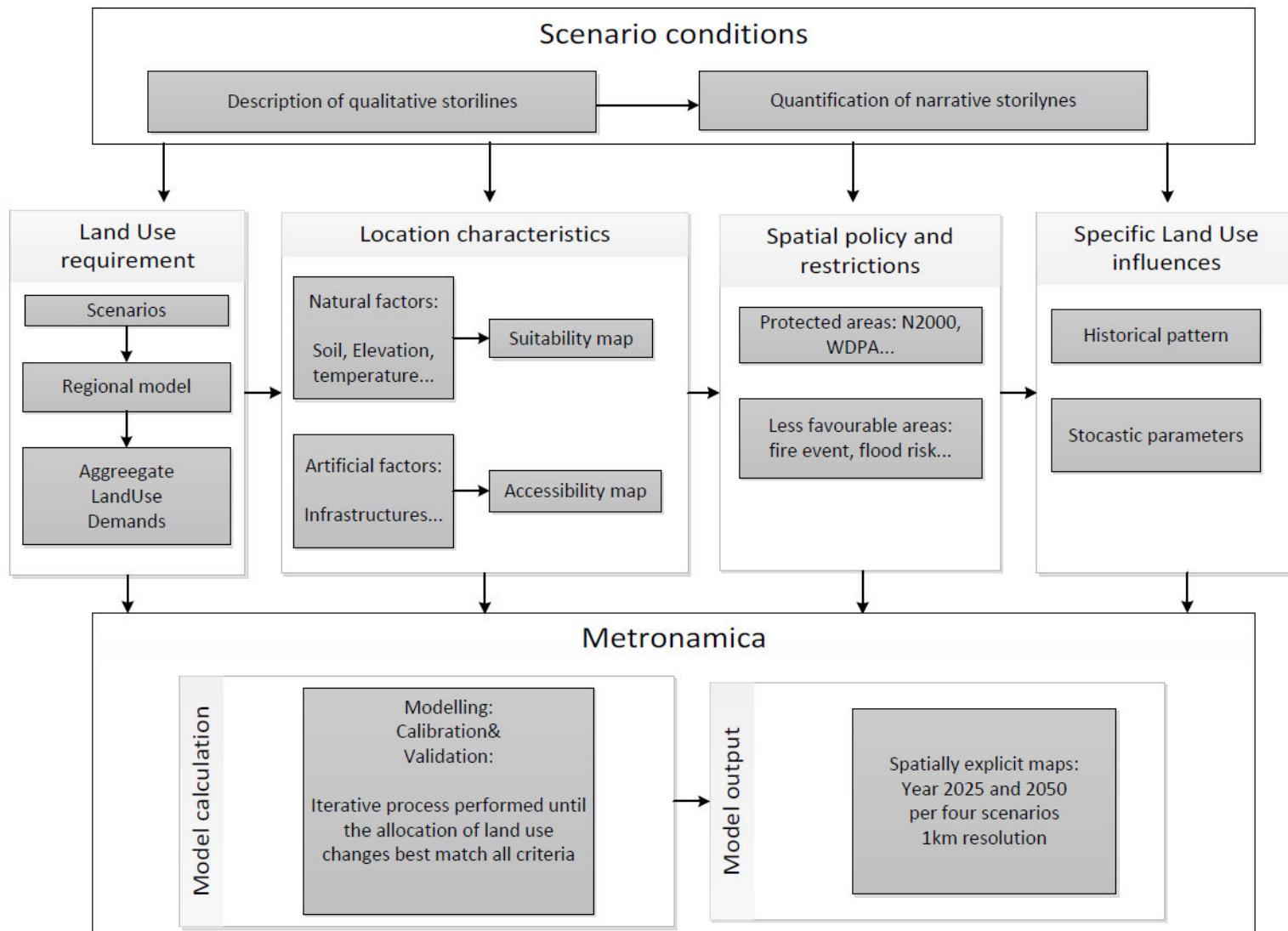
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Precipitation 0.125deg Resolution (01/01/1973-31/12/2005)

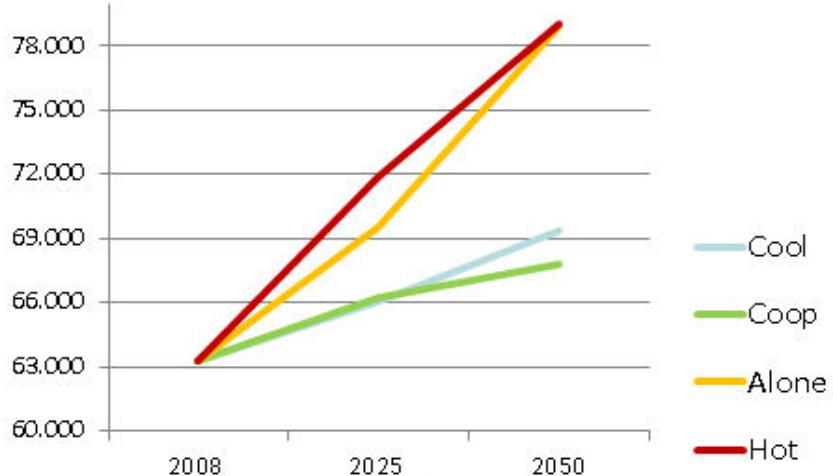


Land use

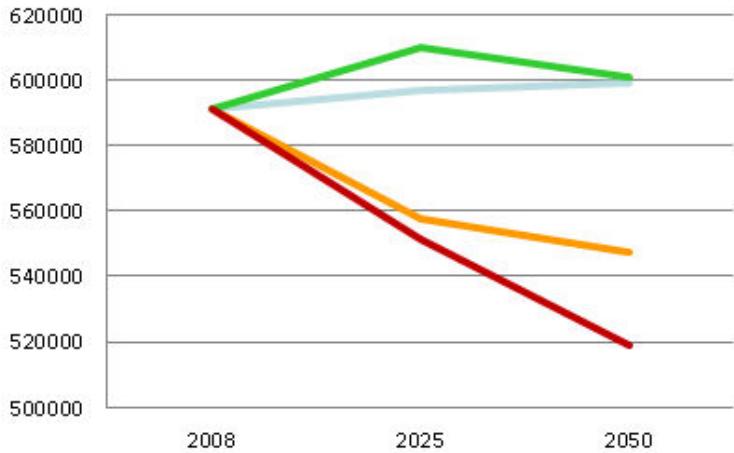


Land use Results

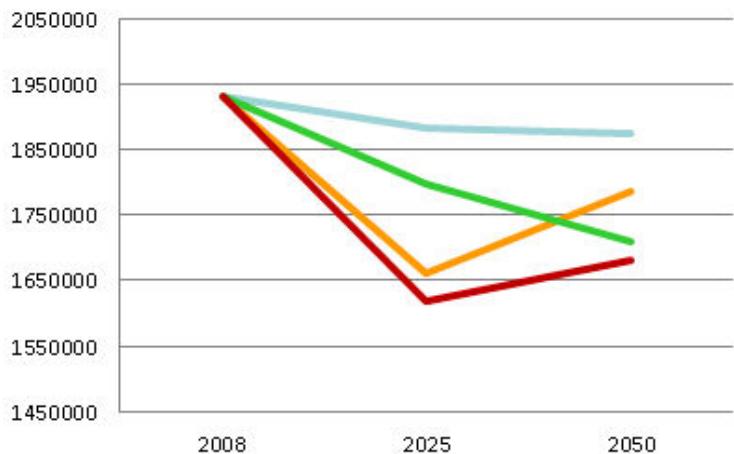
Urban



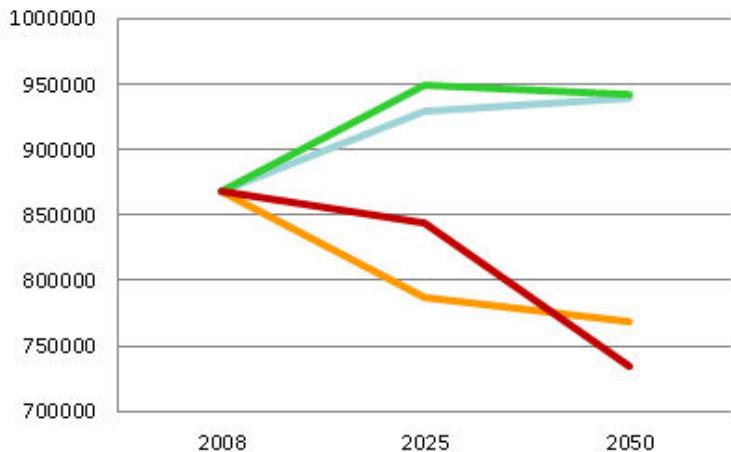
Grassland



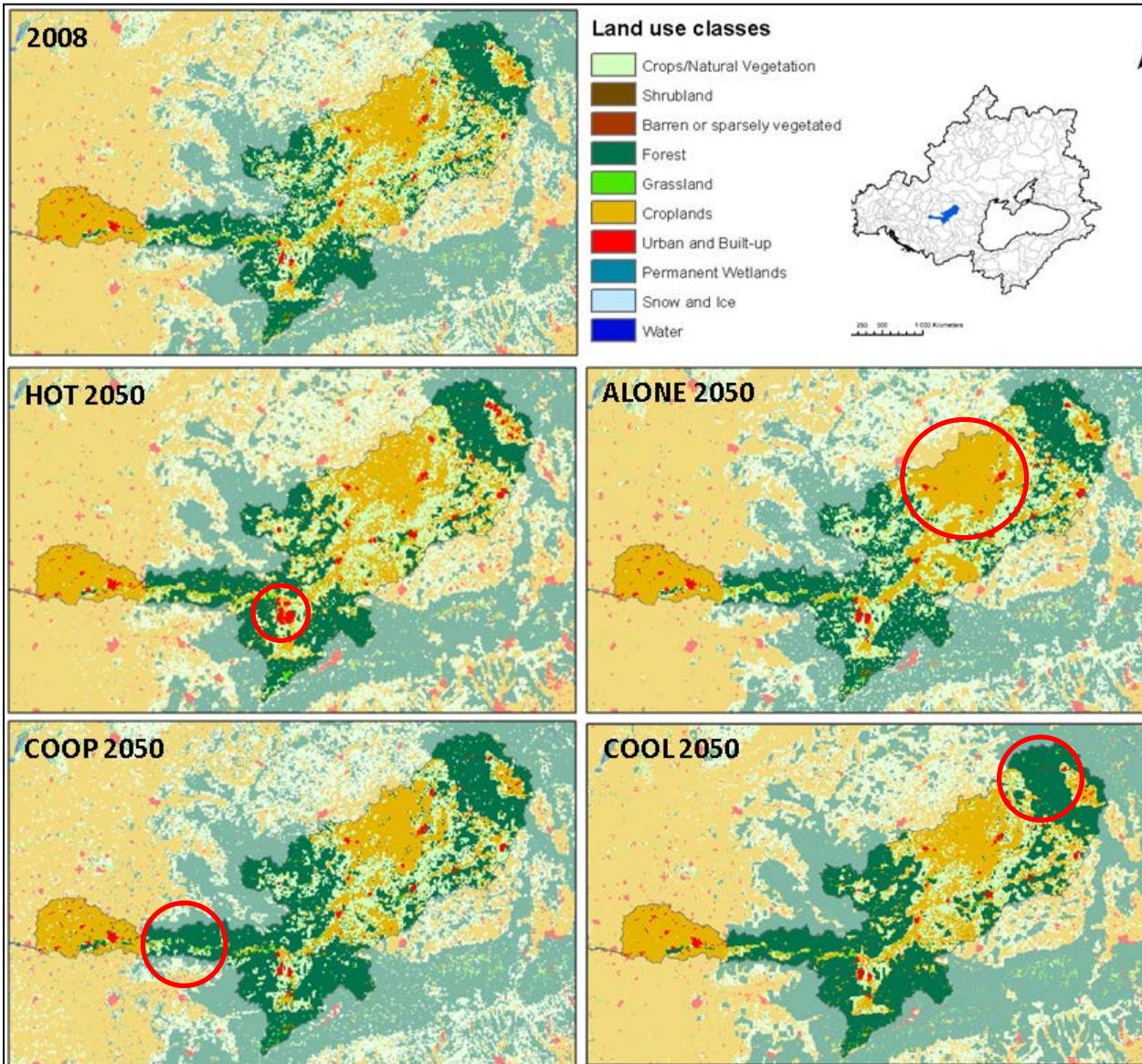
Croplands



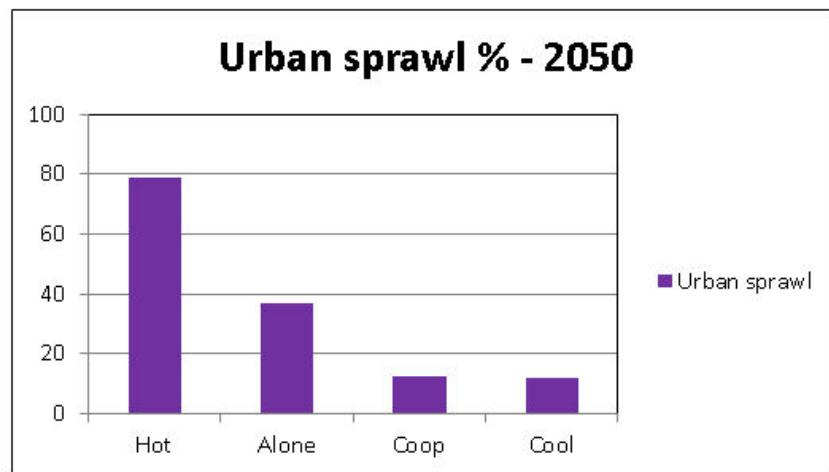
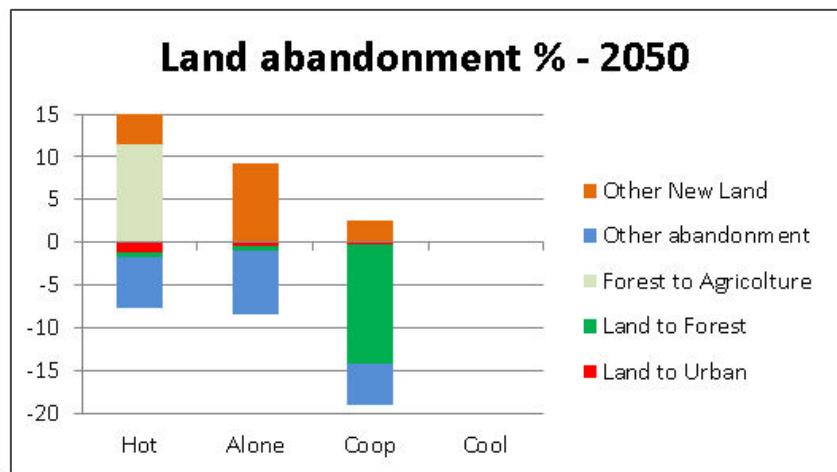
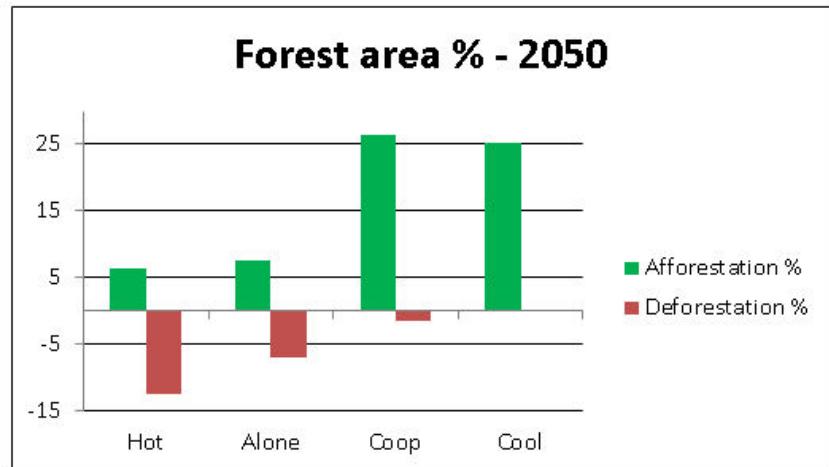
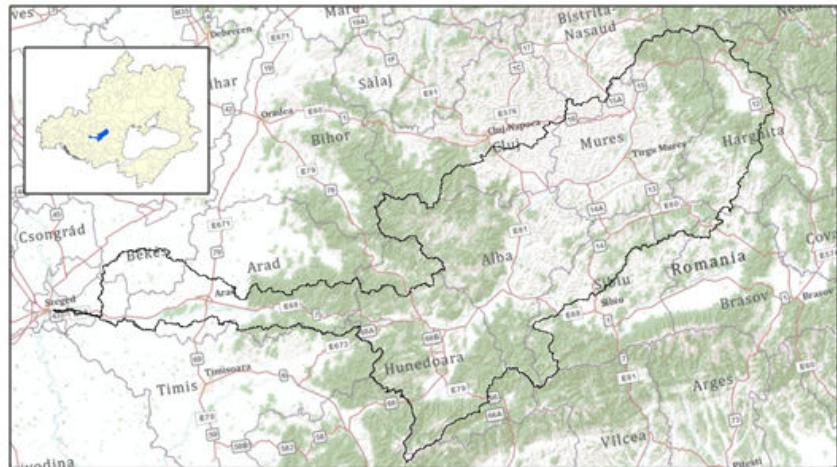
Forest



Scenarios of Change

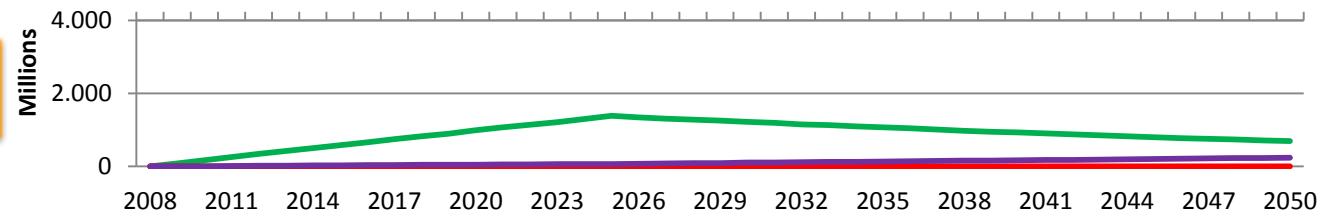


Countries undergoing economic reform

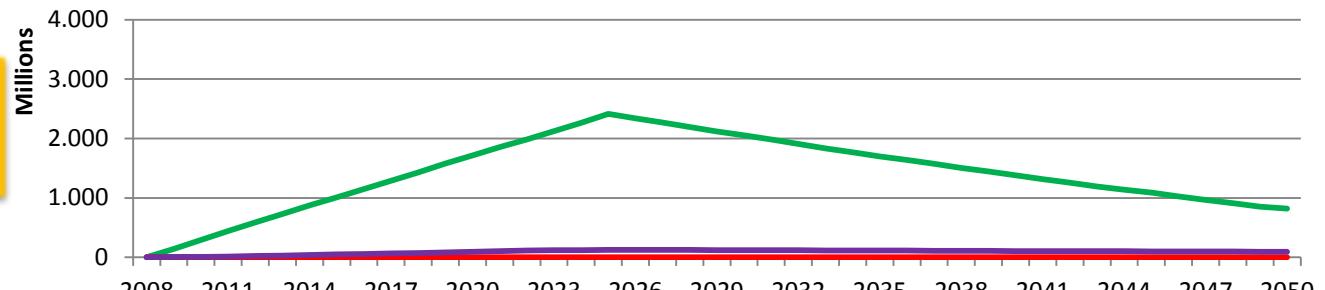


Afforestation trends

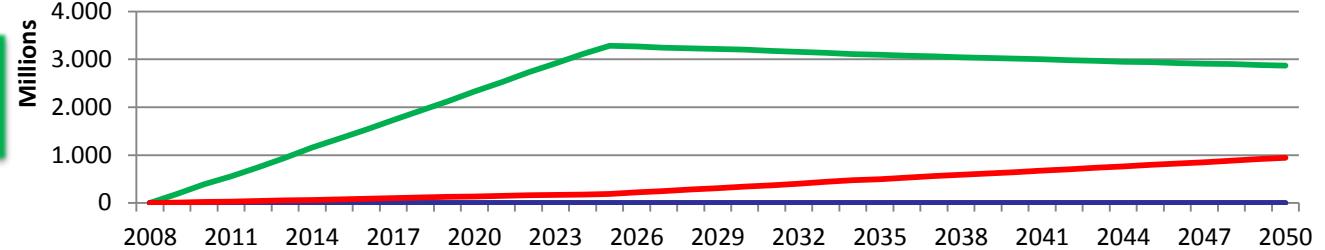
HOT



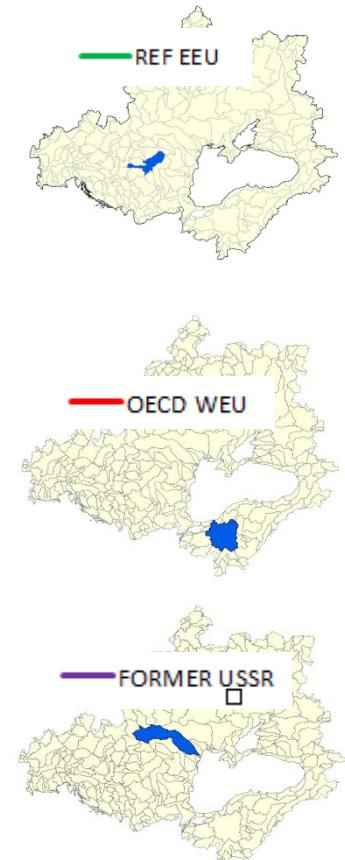
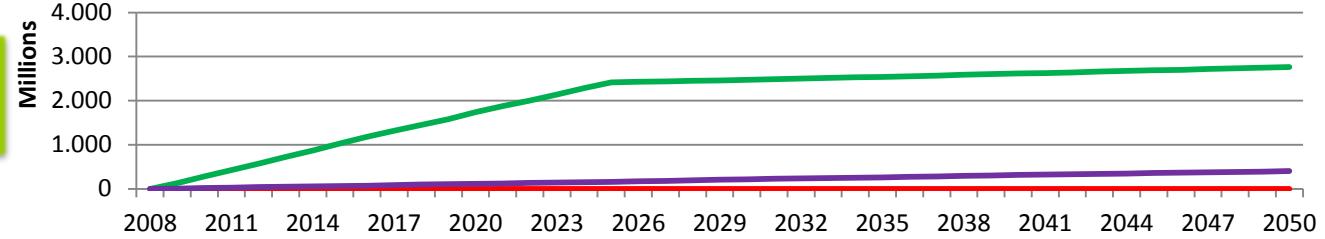
ALONE



COOP



COOL



Conclusion

- ✓ Five-yearly (2010-2050) LU integrates scenarios (Hot, Alone, Coop and Cool)
- ✓ Annual population 2001-2050, historical and projections, 4 scenarios per subnat. level ('NUTS2')
- ✓ Observed and future daily climate data till 2100

Compliant with international policy initiative INSPIRE, GEOSS .

- ✓ The methodologies applied to reach the results were described in eight public deliverables and will take part of a scientific article per thematic.

Filling the data gap and increment the capacity to build up a sustainable development in the Black Sea catchment providing basis to assess the analysis on environment and especially on water resources.

Thank you!!!

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