Environment Center
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Ecosystem values in a changing climate: European forest recreation services

Global IQ: Impact Quantification of Global Changes

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Objective

I. To provide a review and indentify the **climate change impacts** on land use, ecosystem amenities and leisure activities

II. To review the **economic values** of the impacts

III. To carry out a **meta-analysis** of values of non-market goods related to forest ecosystems

   a) To determine a **central tendency** of recreation values estimated in previous research & to explain the **variability** across Europe & to test **stability** of the results

   b) To create a **benefit transfer tool** for prediction of welfare changes associated with forest land cover changes in Europe

IV. To evaluate **global change scenarios** of present and future development of forest land cover (← GLOBIOM model)

I. CC IMPACTS

CC and its effect on terrestrial ecosystem services

The ecological endpoints in the literature

- acid rain, ozone
- decreased soil fertility, decreased water availability
- **land use changes** from urbanization
- increased risk of flooding and forest fires
- seasonal changes (early alpine snowmelt)
- shifts in the range of a species ⇒ mass extinctions may occur

- → changes in quality or quantity of natural ecosystems and their specific services

IPCC, MEA, Schroter et al. (2005), Krupnick & McLaughlin (2011)

The evidence on economic assessment of ecosystem changes

- Standard environmental economics + welfare theory used
  - Non-market environmental goods and services
  - Instrumental value
  - ← preferences (subjective, anthropocentric values)
  - Changes in utility/welfare → monetary welfare measures

- Specifics of CC-related endpoints
  - The endpoints very complex
  - Far from the experience of the general public
  - Complicated assignment of economic values

Champ et al. (2003); Boyd and Krupnick (2009)

II. VALUES ASSOCIABLE TO THE CC IMPACTS

2 literature reviews

Focus:

1. Meta-analyses covering **CC relevant endpoints**
2. Meta-analyses investigating **forest recreation benefits at particular**

Meta-analyses covering CC endpoints

Meta-analysis (M-A)

- statistical method for synthesizing the results of a large collection of primary empirical studies
- explaining the heterogeneity within and across studies (*Glass, 1976, Smith & Pattanyak, 2002, Bergstrom & Taylor, 2006, Liu & Stern, 2008*)

- In total 48 M-A studies identified
- Meta-analytic literature so far covers following non-market goods related to CC endpoints:
  - Ecosystem services in general
  - Outdoor recreation
  - Existence of species
  - Aesthetics
  - Land cover changes
  - Water quality/flooding risks
- Previous M-A studies on forest recreation values in Europe
  - *Bateman et al., 1999, Bateman & Jones (2003), Zandersen & Tol, 2009, Giergiczny et al., 2008*

III. META-ANALYSIS ON FOREST RECREATION VALUES IN EUROPE

Focus of the study

- We concentrate on forests and recreational services / recreation values
  - forests closely related both to CC mitigation (*Morison et al., 2012*) and CC impacts (*Shugart et. al, 1992*)
  - benefits derived from leisure time activities / forest outdoor recreation form a significant portion of the human well-being from forest ecosystems
  - leisure activities easily and reliably assessed by general public
- Methodologically consistent (travel cost method)
- Sufficient geographical coverage within Europe
- Output: values attributable to land use

Meta-analysis: model

$$WTP_{ij} = SITE_{ij} + USER_{ij} + STUDY_{ij} + \varepsilon_{ij}$$

- WTP_{ij} WTP estimate *i* from study *j*
- $SITE_{ij}$ a vector of recreation site characteristics
- $USER_{ij}$ a vector of socio-economic variables describing particular user population
- $STUDY_{ij}$ vector of methodologic variables characterizing study design
- ε_{ij} residual unobserved variability of WTP

- Specification
  - simple ordinary least squares multi-reggression (Bergstrom and Taylor 2006, Shresta and Loomis 2001)
  - in most applications the functional form used is linear (Boyle et al. 1994, Shresta and Loomis 2001)
  - log-linear or semi-log model are also attractive (more realistic behaviour of the population)
  - panel data models: fixed effects, random effects (Zandersen 2009)

Forest recreation – synthesis of previous results within Europe

- Literature search
  - relevant papers and studies in the valuation databases (EVRI, DEFRA UK and EPA US…)
  - further using the online research databases like ScienceDirect, JSTOR or EBSCO
  - peer reviewed journals (Ecological Economics, Journal of Environmental Economics and Management of Environmental and Resource Economics)

- Selection
  - Year of data collection > 1980
  - Only TCM studies yielding estimate recalculable to per person/day of visit or per unit area

- Variable definition
  - Krupnick and McLaughlin (2011), Chiabai (2011), Rosenberger and Loomis (2000), Ojea (2010) etc.

- 357 TCM welfare estimates from 42 European studies
  - Covering 14 countries: Czech Republic, Denmark, Finland, France, Germany, Great Britain, Ireland, Italy, Netherlands, Poland, Romania, Slovakia, Spain, Switzerland
  - 6 different specifications of welfare measure

TCM studies used in the meta-analysis on forest recreation welfare measures

Study	Country	No. of estimates	Sample size	Mean CS per trip (EUR 2012)	Std. Deviation	Mean CS per population per year / *per person per year* (EUR 2012)	Std. Deviation
Aragón, J. M., P. Riera, M. Giergiczny, C. Colinas (2011)	Spain	1	300			688,273	-
Baranzini, A., D. Rochette (2008)	Switzerland	2	61	38.61	8.27		
Bartczak, A., Czajkowski, M., Giergiczny, M., Zylicz, T., Checko, E., Navrud, S., Englin, J., Pang, A. (2010)	Poland	18	740	4.51	1.18		
Bartczak, A., H. Lindhjem, S. Navrud, M. Zandersen, T. Zylicz (2008)	Poland	6	248-837	11.44	4.02	8,010,000,000	-
Bartczak, A., J. Englin, A. Pang (2012)	Poland	18	740	4.69	1.23		
Bartczak, A., Lindhjem, H., Navrud, S., Zandersen, M., Zylicz, T. (2008)	Poland	2	1002	26.15	9.19		
Bateman, I. J., G. D. Garrod, J. S. Brainard, A. A. Lovett (1999)	Great Britain	2	351	5.11	0.49		
…….	……	……	…….	…….	…….	……	……
Melichar, J. (2007)	Czech Republic	6	719	153.16	60.22		
Mitrica, E., B Mitrica, A. Stanculescu (2013)	Romania	1	29			*8.97*	-
Ovaskainen, V., J. Mikkola and E. Pouta (2001)	Finland	16	656	69.67	16.59		
Siderelis, C. and A. Attarian (1995)	USA	18	307-717	57.25	43.64		
Signorello, G., J. Englin, A. Longhorn, M. De Salvo (2009)	Italy	15	1280	29.33	6.35		
Starbuck, C.M., S.J. Alexander, R.P. Berrens and A.K. Bohara (2004)	USA	4	392	146.58	125.73		
Tempesta T., Visintin F., Marangon F. (2002)	Italy	18	"very small"	6.82	3	783,147	1,303,590
Termansen, M., Zandersen, M., C. J. McClean (2008)	Denmark	15	286	0.78	0.45	33,500,000	25,300,000
Van der Heide, C. M., J. C. J. M. van den Bergh, E. C. van Ierland, P. A. L. D. Nunes (2005)	Netherlands	2	216	*0.28*	*0.3*		
Whitehead, J.C., T.C. Haab and J. Huang (2000)	USA	2	2295	97.44	19.27		
Willis, K. G. (1991)	Great Britain	15	21	5.85	1.59	499,752	362,423
Willis, K. G., G. D. Garrod (1991)	Great Britain	30	21	3.25	3.36	5,143,023	15,600,000
Total mean by study		8.04	385.3	57	24	747,498,643	37,653,267

Estimation of European average values, I

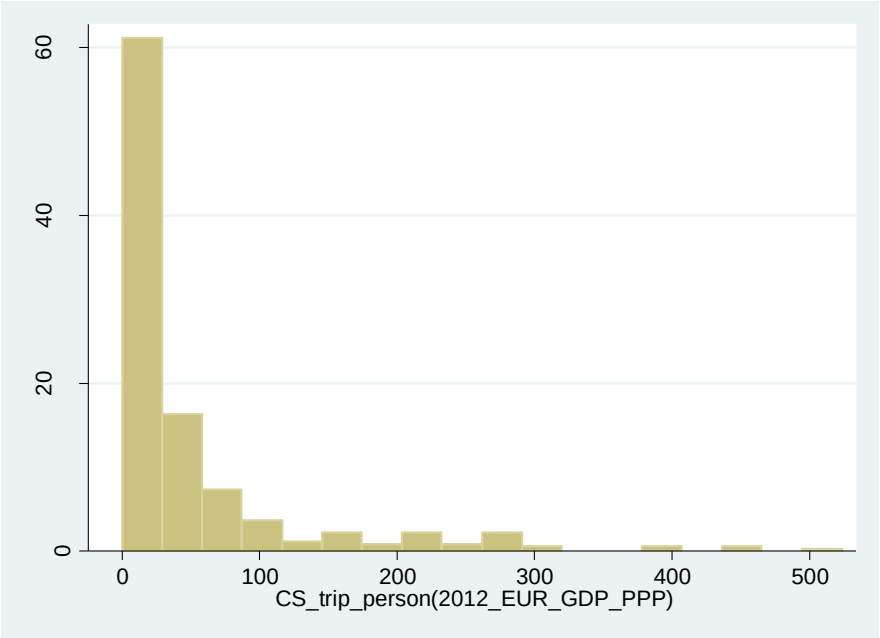
Average estimated welfare per site/sq. km of site:

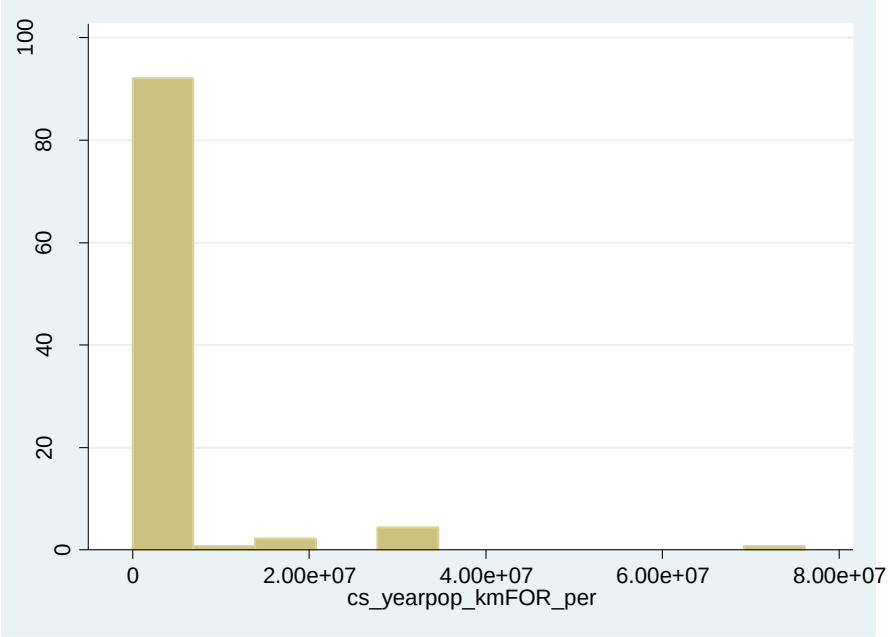
(values converted to EUR 2012 using OECD CPI and PPP exchange rate)

Variable	Observations	Mean	Median	Std. Dev.	Var. coef.
CS_day_person	162	35.8	19.3	56.9	1.59
CS_trip_person	288	42.79	14.1	74.9	1.75
CS_year_person	236	640.6	42.8	2,838.7	4.43
CS_year_population	157	2E+11	4E+06	9E+11	3.84
CS_year_person_km^2	212	3.5	0.3	10.1	2.89
CS_year_population_km^2	118	2,204,735	77,820	8,435,436	3.83

Estimation of European average values, II

- Very high variability of estimates throughout Europe





→ *transformation to logarithm, robust estimation*

Data trimmed at 90% quantile

Model specification

Most of M-A: pooled OLS regression and panel data models: fixed effects and random effects model

Pooled model

$$\boldsymbol{Y}_{ij} = \boldsymbol{X}_{ij}\boldsymbol{\beta} + \boldsymbol{u}_{ij}$$

i – observation (estimate), j - cluster (study) Y_i - welfare estimate, X_i - a vector of independent variables , β - a vector of coefficients, u_i - the error term (assumed to be independent and identically distributed)

- Seperate studies provide more than one estimates
  - correlation among study estimates likely to be present
  - data structure – an unbalanced panel (grouping: study)

Fixed effect model

$$\boldsymbol{Y}_{ij} = \boldsymbol{X}_{ij}\boldsymbol{\beta} + \boldsymbol{\alpha}_j + \boldsymbol{u}_{ij}$$

α_j - a vector of fixed effects (study-specific effects)

Random effects model

$$\boldsymbol{Y}_{ij} = \boldsymbol{X}_{ij}\boldsymbol{\beta} + \alpha + \boldsymbol{e}_j + \boldsymbol{u}_{ij}$$

α – mean value of estimates, e_j - a study-specific error component

Explaining the variability of welfare measures I

Variables/Model	I	II	IV	V	VI	VII
	CS per day	CS per trip	CS per year per person	CS per year per population	CS/sq.km per year per person	CS/sq.km per year per population
constant	126.4***	123.3	110.0	19.83***	1,351***	-2,039***
samplesize	0.00423***	0.00141***	0.00256**	-0.00223	0.00203**	-0.00374
year	-0.0641***	-0.0587	-0.0551		-0.677***	1.029***
estimate_preferred	0.201***	0.216	0.192***	0.865*	0.226	0.569
primary_specific	-0.481***	1.351**	7.044***			
more_activities	0		0		-0.521	
substitute	-9.168***	1.080	-1.027		11.45	2.648
wage_rate	0.0260***	0.00997	0.0111	0.0400***	0.00586	0.0337***
onsite	4.368***	0.0714	0.951**			9.058***
endostrat_onsite	-0.122***	2.636***	4.986***		-0.0369	
rptrunc_onsite	-0.211***	0.0589	-0.192***		-0.195*	
onsite_trunc_endo		-3.096***	-5.051***		0	
journal	0.167***	-0.0379	0.143		1.367***	1.599
linear	-0.157***	0.308	-0.171	1.718***	-0.307	1.915**
rep_regional	-5.266***	1.609**	-6.656***		0.261	
pertriponly						

Explaining the variability of welfare measures II

Variables/Model	I	II	IV	V	VI	VII
	CS per day	CS per trip	CS per year per person	CS per year per population	CS/sq.km per year per person	CS/sq.km per year per population
gdp_cpt_market_2	0.0003***	-7.56e-05***	6.85e-05**	8.86e-06	-2.53e-05**	-9.27e-05
popdens_studysite	-0.0029***	-0.00375**	-0.0105***	0.00346*	0.00336***	-0.00569**
altitude	-0.0011***	-0.000140	0.00187***	-0.000405	-2.21e-05	0.000896
temperature_5-10	-0.000243	-0.0205	0.0341***	-0.0292	-0.0470	-0.0962*
precipitation_5-10	-0.120***	0.00534	-0.0394*	-0.0241*	-0.0959	-0.101***
area	-0.0001***	1.33e-05**	1.07e-05***	4.15e-07		
CLC311_broadleav _perc	-0.0259***	0.0187*	0.0127	0.0207	0.0957	0.0610
CLC312_conifer_perc	-0.0257***	-0.00133	-0.000675	0.00490	0.189	0.00892
CLC2_agri_perc	-0.0361***	-0.00292	-0.00515	-0.0102	-0.00768**	-0.0411***
CLC31_forest_perc	0.0328***	0.00975	0.0257***	0.0233**	0.0392**	-0.0221
defoliation_all	0.309***	-0.0409**	-0.111*		0.107	0.308***
Observations	118	157	126	65	120	48
Number of studies (clusters)	10	18	13	10	12	7
Model	RE	OLS	RE	FE	RE	OLS
R2 overall	0.96	0.82	0.91	0.34	0.91	0.90

Dependent variables enter the equation in logarithm form

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Meta-analysis: Interesting results

- Results for most variables **not stable** within models for different CS specifications – per person values vs. total per ha. values (Zandersen & Tol, 2009)
- Methodological variables explain the highest portion of variability (around 50%) – the result depends a lot on **how the study is designed!**
- The **preferred estimates** from which the authors derive conclusion of the study are not more conservative than the others within the study
- **Samples collected onsite** yield higher estimates of welfare and **accounting for onsite data problems** successfully correct the magnitude of the estimates
- **Income proxies** are poorly related to the welfare measure (Bartczak et al., 2008a, Zandersen and Tol, 2009)
- For some attributes such as **population, population density** it matters at which level the welfare variable is measured (per person vs. per ha) (Zandersen and Tol, 2009)
- Recreationists prefer forests which are denser in terms of **abundance of forest** cover within the site (Zandersen et al. 2007; Lindhjem and Navrud 2008)
- **Forest types** do not constitute important explanatory factors of welfare associated with forests (Ojea et al., 2009; Chiabai et al., 2011)

Benefit transfer – prediction over Europe

- Value function transfer $B_p = \propto_s + \beta_{1s}X_{1p} + \beta_{2s}X_{2p} + \ldots + \beta_{ks}X_{kp}$
  (Rosenberger and Phipps (2001))

- Sample: only estimates representative at national+ level
- Simpler model (→ fuller sample)

- State-specific values predicted from NUTS 0 level model (Bartczak et al., 2008c)

- 2 CS specifications tested for BT
  I. CS/year/population/square kilometer of forest within the study site
     - beneficial in evaluation of LC change - simple
     - very high variability (var. coef. 3.83) and relatively small sample (cca 60-70 obs.) → very unstable and volatile results
  II. CS/trip/person
     - lower variability, much bigger sample → more stable results
     - to yield values per population, it would be further necessary to identify the number of beneficiaries of recreation services attributable to the forest

Prediction model - I

- Most of the variables: same sig. and direction of influence as in the previous model
- Defoliation: also remains positive (no explanation → will enter the benefit transfer fixed at average sample value)
- Average absolute in-sample transfer error: 67% (median 45%),

$$TE = \frac{|(B_p^{est} - B_p^{obs})|}{B_p^{obs}}$$

- Navrud and Ready (2007): 20-40%
- Brander et al. (2006): 80% TE common
- → result robust enough for out-of-sample value transfer
- Overestimates low values (av. error in 1st quartile: +120%), the rest OK

Variables/Model	VII-2 CS/sq.km per population per year
constant	-698.3***
	(155.0)
year	0.352***
	(0.0781)
estimate_preferred	0.445
	(0.293)
wage_rate	0.0159
	(0.0135)
onsite	6.558***
	(1.355)
linear	1.635***
	(0.466)
b_pop	-0.00449***
	(0.00111)
temperature_5-10	0.0249
	(0.0245)
precipitation_5-10	-0.0491***
	(0.0128)
CLC2_agri_perc	-0.0349***
	(0.00765)
defoliation_all	0.128**
	(0.0535)
Observations	57
No. of studies	8
R-squared	0.88
Dependent variable enter the equation in logarithm form	

Mean predicted CS/ha per population per year to European forests by countries

Country	Predicted CS/ha per population per year (EUR 2012)	95% confidence intervals	
		Lower bound	Upper bound
Austria	1,488.2	907.1	2,441.4
Belgium	331.2	154.1	711.9
Bulgaria	1,034.8	721.2	1,484.8
Cyprus	1,484.2	919.0	2,397.0
Czech Republic	715.7	484.3	1,057.5
Denmark	440.5	293.9	660.3
Estonia	2,567.1	1,426.3	4,620.4
Finland	3,404.6	1,726.4	6,714.1
France	937.0	639.8	1,372.1
Germany	492.2	293.5	825.5
Greece	1,311.7	848.8	2,027.2
Hungary	514.9	354.6	747.8
Ireland	2,761.2	1,427.7	5,340.1
Italy	573.7	356.2	923.9
Latvia	2,301.2	1,326.5	3,992.3
Lithuania	1,369.6	913.8	2,052.7
Luxembourg	945.4	544.4	1,641.8
Netherlands	218.3	78.3	608.7
Poland	756.8	518.2	1,105.4
Portugal	1,414.7	858.9	2,330.4
Romania	807.9	568.2	1,148.7
Slovakia	1,010.5	673.9	1,515.1
Slovenia	1,858.1	1,053.4	3,277.4
Spain	1,078.8	727.0	1,600.9
Sweden	3,397.9	1,714.5	6,734.4
United Kingdom	653.5	358.6	1,190.8
Average	**925.5**	**582.6**	**1,470.2**

Benefit transfer – prediction over Europe

- Comparison of transfer exercise with previous results
  - **Giergiczny et al. (2008)** - BT
    - CS per population in Europe per ha based on very conservative UK study & further scaled by a factor of 1/3
    - Country results range between 2 and 50 EUR 2012
  - **Primary studies** yielding national estimates of CS per ha
    - Bartczak (2008a): CS per ha in Poland: 622 EUR 2012
    - Dubgaard (1998): CS per ha in Denmark: 167-200 EUR 2012
    - Willis and Benson (1989), Willis (1991), Willis et al. (2003): CS per ha in Great Britain: 70-463 EUR 2012
    - Our estimates slightly higher

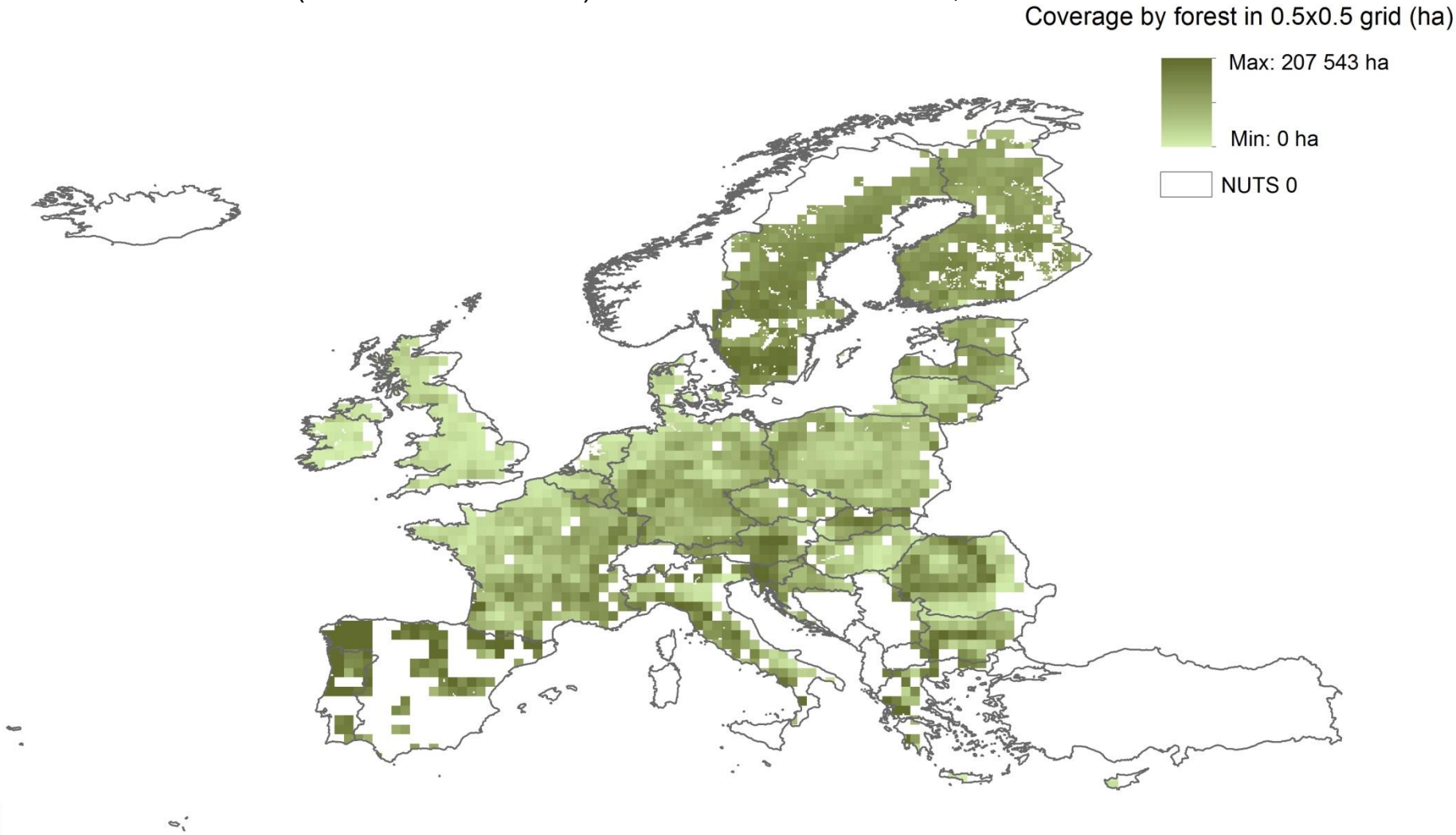
CC SCENARIO EVALUATION

Evaluation of land use changes up to 2030

- **Recreation value** related to forest ecosystems
  - Managed
  - Unmanaged
- **GLOBIOM data** on land cover in 2000, 2010, 2020, 2030 (IIASA)
  - Old forests (already existing in 2000)
  - New forests (planted after 2000)

GLOBIOM coverage in Europe

Forest area (old + new forests) in Reference scenario, 2010



Evaluation of land use changes up to 2030

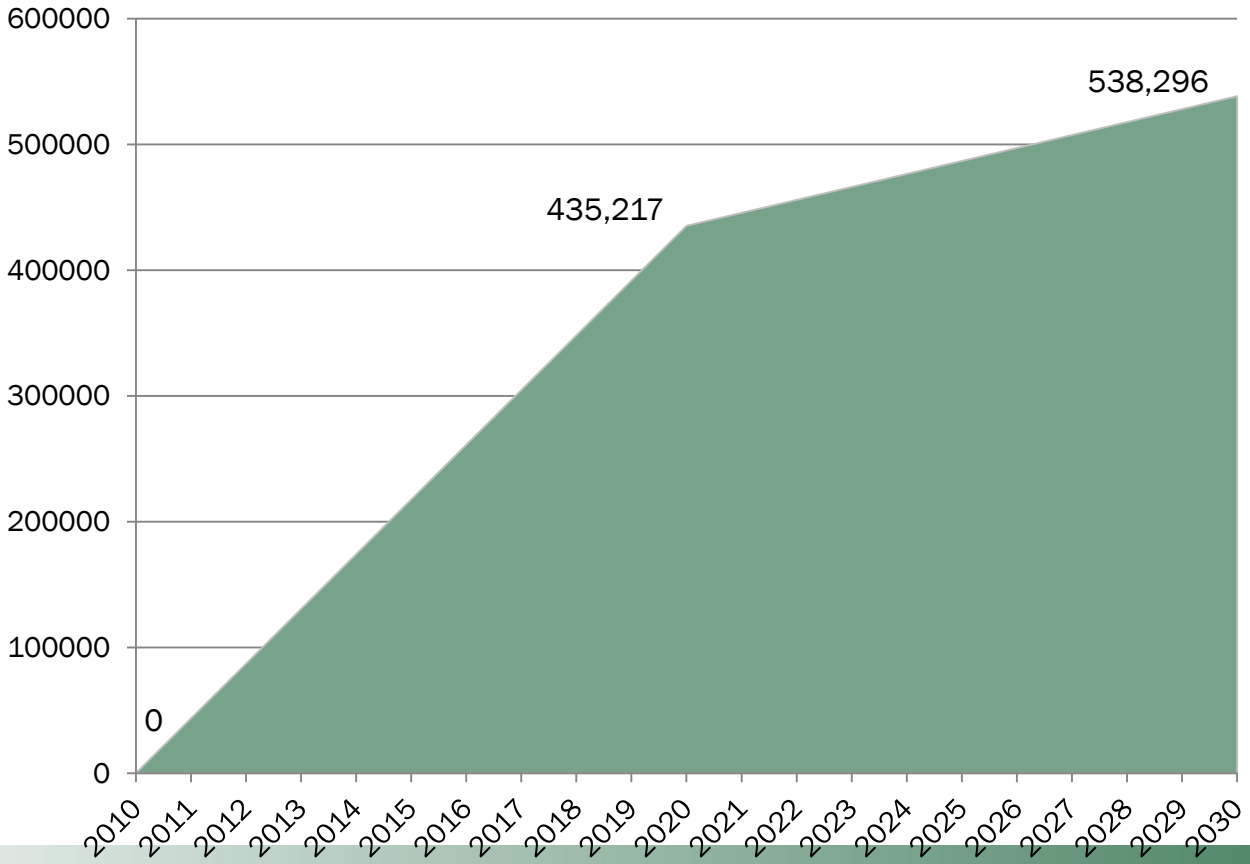
- → **Scope of evaluation:**
  - National recreation use values (accruing to residents of the respective country)
  - Only values attributable to **changes in forest LC** in **GLOBIOM covered areas**
    - not other LC GLOBIOM category: cropland, grassland, fast growing tree plantations, other natural vegetation, manmade environment
    - Δ in forest LC $\leftrightarrow \Delta$ in different LC category, which is not accounted for!
    - **Overestimation** of effects on recreation value associated with ↑ forest LC (grassland…)
    - For some LC GLOBIOM categories not such a problem (recreation CS → 0)

Evaluation of land use changes up to 2030

- Scenarios
  - Reference scenario
    - Implementation of already adopted EU policies by 2020:
      - GHG emissions reduction (20%)
      - Share of renewable energy (20%)
      - Improvements in energy efficiency (20%)
    - LU change and forestry excluded from EU domestic reduction target, but are accounted for under international commitments
  - GHG40/EE/RES30
    - Full implementation of 20/20/20 targets and the following by 2030 (EC, 2014; EREC, 2014):
      - GHG emissions reduction (40%) (reference in 2030: 23,4%)
      - Share of renewable energy (30%) (reference in 2030: 24,4%)
      - Improvements in energy efficiency (30.1 %) (reference in 2030: 21,0%)
    - Forest land use contribute to climate mitigation and adaptation
    - LU change and forestry should be included in the GHG reduction target

Evaluation of land use changes up to 2030

- Difference in evolution of forest LC in ha from 2010 to 2030
  - = (GHG40/EE/RES30 – Reference)
  - Assuming linear trend of development between the predictions



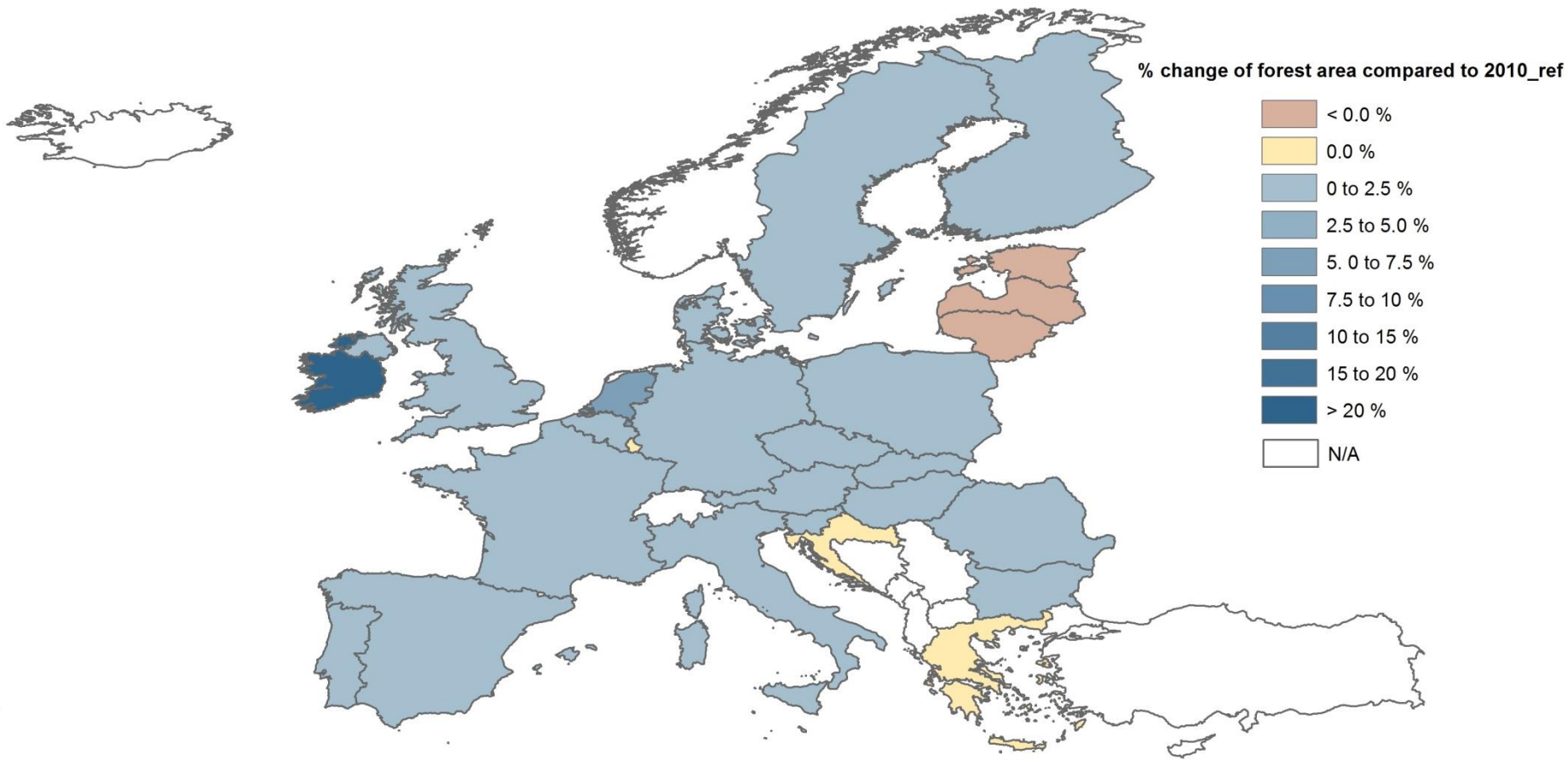
Evolution in respective countries (2020, 2030)

- Difference between scenarios in respective years related to the original area of forest in 2010
- In %

Country	2020	2030
AT	0.43	1.14
BE	0.62	0.75
BG	0.02	0.05
CZ	0.05	0.08
DE	0.02	0.03
DK	0.35	0.84
EE	-0.02	-0.02
EL	0.00	0.00
ES	0.01	0.01
FI	0.10	0.22
FR	2.15	2.35
HR	0.00	0.00
HU	0.05	0.10
IE	6.28	21.50
IT	0.00	0.00
LT	-0.03	-0.03
LU	0.00	0.00
LV	-0.02	-0.02
NL	13.99	6.42
PL	0.02	0.03
PT	0.09	0.15
RO	0.05	0.15
SE	0.05	0.05
SI	0.01	0.02
SK	0.04	0.06
UK	0.09	0.18

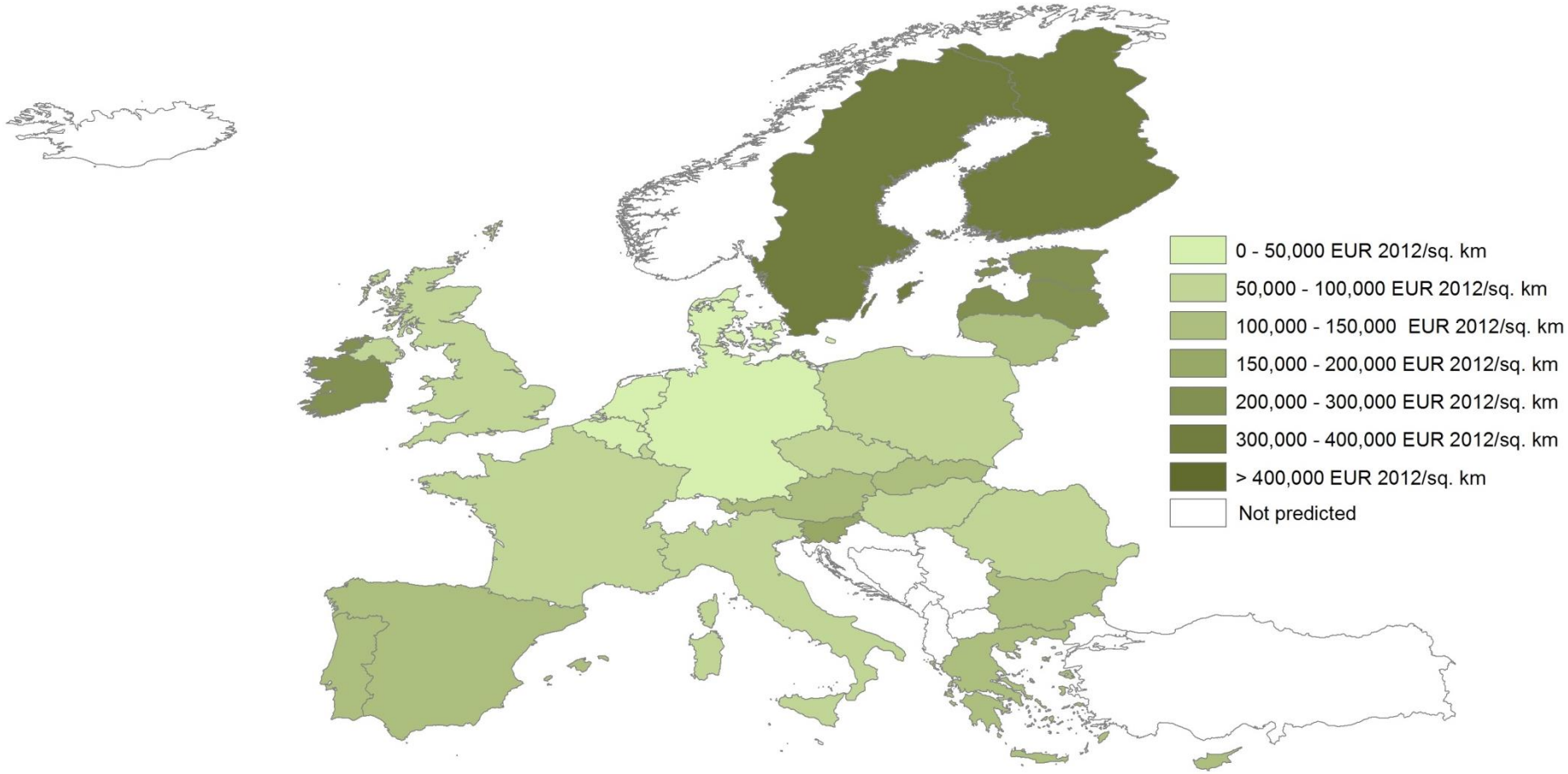
Evaluation of land use changes up to 2030

- Difference in forest LC 2030 in particular countries
  - In % of original forest coverage (2010)
  - = ((GHG40/EE/RES30_2020 – Reference_2020)/Reference_2010)*100



Evaluation of land use changes up to 2030

Mean predicted CS/sq. km per population per year to European forests by countries



Evaluation of land use changes up to 2030

- Stream of forest abundance in all years 2010-2030
- National forest recreation values for respective countries

- → **Present value** of the stream of forest recreation benefits of GHG40/EE/RES30 compared to Reference scenario

- Discount rate
  - Optimal growth rate: $p_x = d + ge$

    d = pure rate of time preference (0.01)

    g = growth in per capita consumption (data: 0.031)

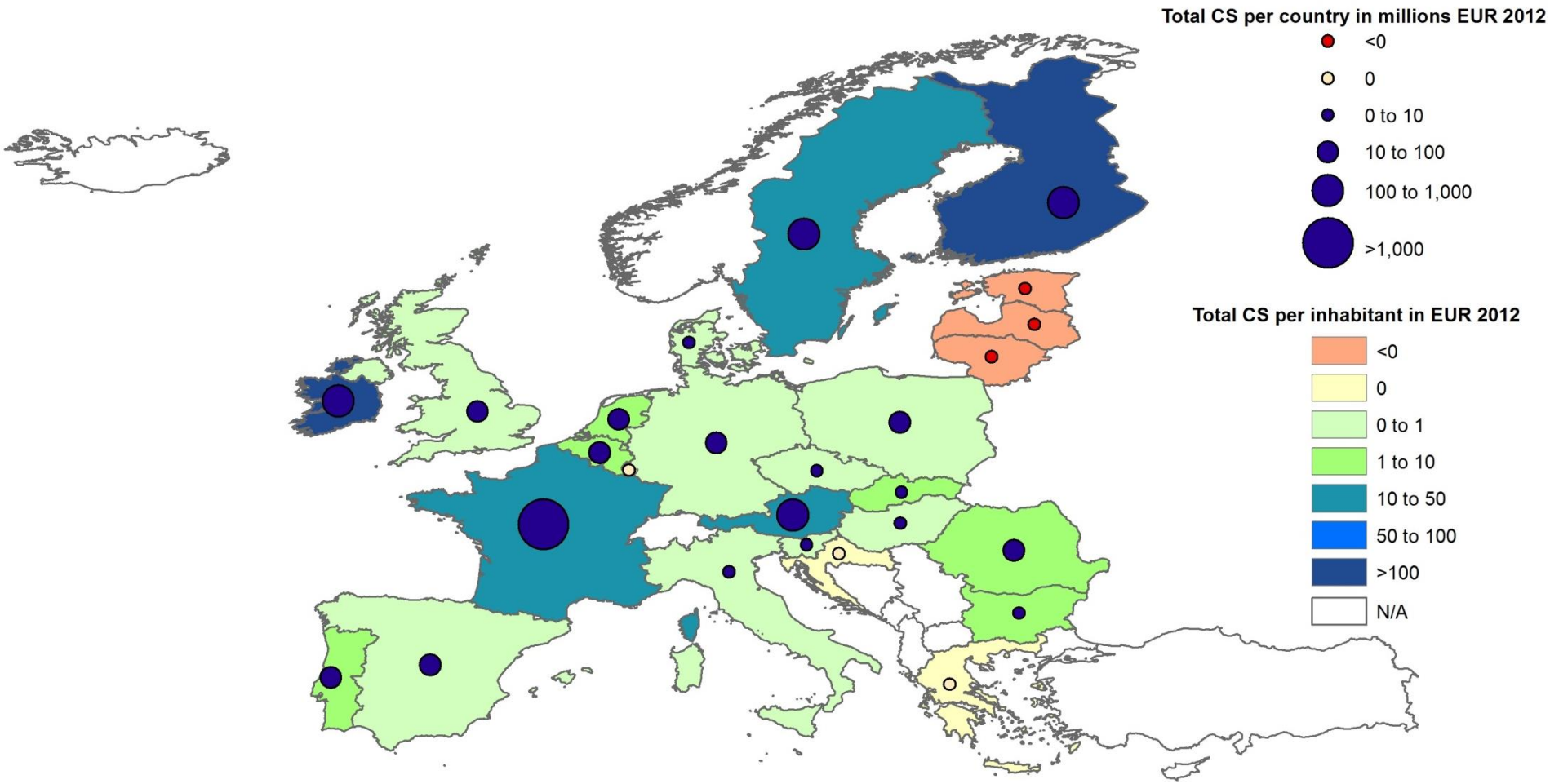
    e = absolute value of the rate at which the marginal value of consumption declines as per capita consumption increases (1)
  - 0.041 (with sensitivity analysis from 0.02 to 0.05)

Evaluation of land use changes up to 2030 *(millions EUR 2012)*

Country	px = 0.02	px = 0.03	px = 0.041	px = 0.05
FR	3,605.0	3,206.0	2,837.7	2,561.9
FI	946.0	831.3	726.5	648.8
IE	915.5	798.4	692.0	613.5
SE	426.3	378.6	334.7	301.8
AT	422.5	370.1	322.4	287.1
NL	107.7	96.9	86.8	79.1
PT	60.4	53.3	46.9	42.1
RO	51.0	44.6	38.7	34.4
BE	20.6	18.3	16.2	14.6
PL	19.6	17.3	15.3	13.7
UK	16.6	14.6	12.8	11.5
DE	13.7	12.1	10.6	9.6
ES	13.0	11.5	10.2	9.2
CZ	11.9	10.5	9.2	8.3
BG	11.9	10.4	9.1	8.1
SK	11.1	9.8	8.6	7.8
DK	7.0	6.1	5.3	4.8
HU	6.2	5.5	4.8	4.3
SI	2.5	2.2	1.9	1.7
IT	0.4	0.3	0.3	0.3
EL	0.0	0.0	0.0	0.0
HR	0.0	0.0	0.0	0.0
LU	0.0	0.0	0.0	0.0
LT	-7.6	-6.8	-6.0	-5.4
EE	-8.4	-7.5	-6.7	-6.1
LV	-13.2	-11.8	-10.4	-9.4
Total	6,640.5	5,872.7	5,167.6	4,642.0

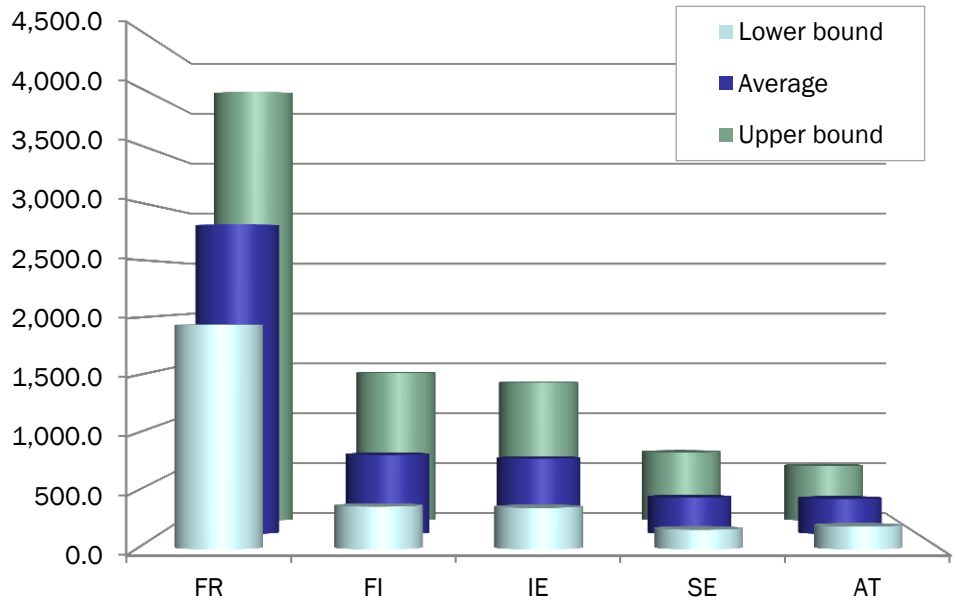
Evaluation of land use changes up to 2030

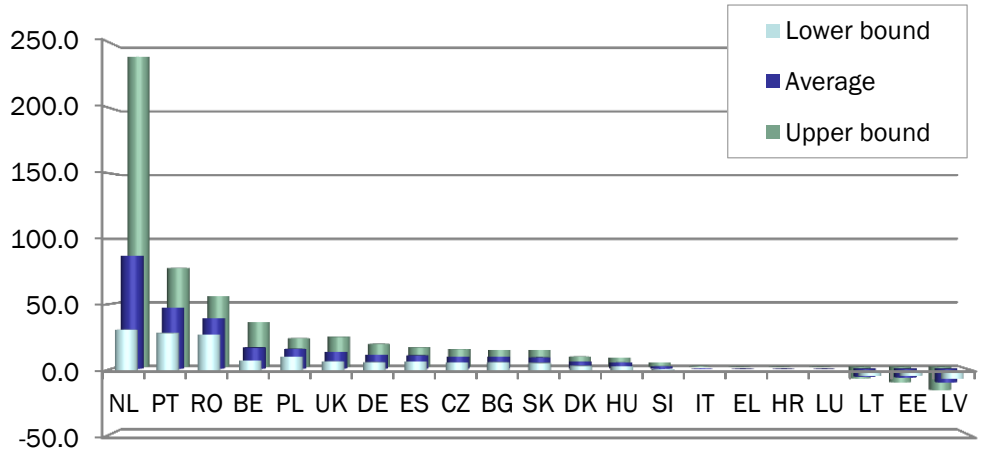
(p_x = 0.041, average country values)



Evaluation of land use changes up to 2030 *(millions EUR 2012)*

Country	Lower bound	*Average*	Upper bound
FR	1,937.7	*2,837.7*	4,155.7
FI	368.4	*726.5*	1,432.7
IE	357.8	*692.0*	1,338.2
SE	168.9	*334.7*	663.3
AT	196.5	*322.4*	528.9
NL	31.1	*86.8*	241.9
PT	28.5	*46.9*	77.2
RO	27.2	*38.7*	55.1
BE	7.5	*16.2*	34.8
PL	10.5	*15.3*	22.3
UK	7.0	*12.8*	23.3
DE	6.3	*10.6*	17.8
ES	6.9	*10.2*	15.1
CZ	6.3	*9.2*	13.7
BG	6.4	*9.1*	13.1
SK	5.8	*8.6*	12.9
DK	3.6	*5.3*	8.0
HU	3.3	*4.8*	7.0
SI	1.1	*1.9*	3.3
IT	0.2	*0.3*	0.5
EL	0.0	*0.0*	0.0
HR	0.0	*0.0*	0.0
LU	0.0	*0.0*	0.0
LT	-4.0	*-6.0*	-9.0
EE	-3.7	*-6.7*	-12.0
LV	-6.0	*-10.4*	-18.1
Total	**3,167.5**	***5,167.6***	**8,626.9**





Policy relevant conclusions from the transfer exercise

- The average predicted recreation benefit per population per year associated with 1 square kilometer of forest is **925,5 EUR 2012 per 1 hectare of forest**
  - With 95% probability, the average value lies between 582,59 and 1470,21 EUR 2012 per ha of forest
  - **What is needed**
    - More studies of high methodological prudence, mainly in Central and Eastern Europe
    - Estimates of total yearly visitation – scarce & reliability not discussed

- With **GHG40/EE/RES30**, we can expect an overall increase in the **total** forest recreation use value in EU up to year 2030 of **5,2 millions EUR 2012**
  - **Imprecisions**
    - parallel Δ in recr. value of the other GLOBIOM LCs not accounted for
    - Coverage of the analysis < the whole area of EU
  - **What is needed**
    - Recreation value attributable to the rest of GLOBIOM LC categories
    - Predict the avg. recreation use value especially for „grassland“ and „other natural area“ LCs

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Thank you for your attention!

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GLOBAL IQ
IMPACT QUANTIFICATION OF GLOBAL CHANGES

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