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National System and National Inventory Report of Germany for LULUCF

Capacity Development Workshop
“Understanding National Inventories for LULUCF Sector:
The experience of Annex-I Countries”
05-07 Nov., Berlin, Germany

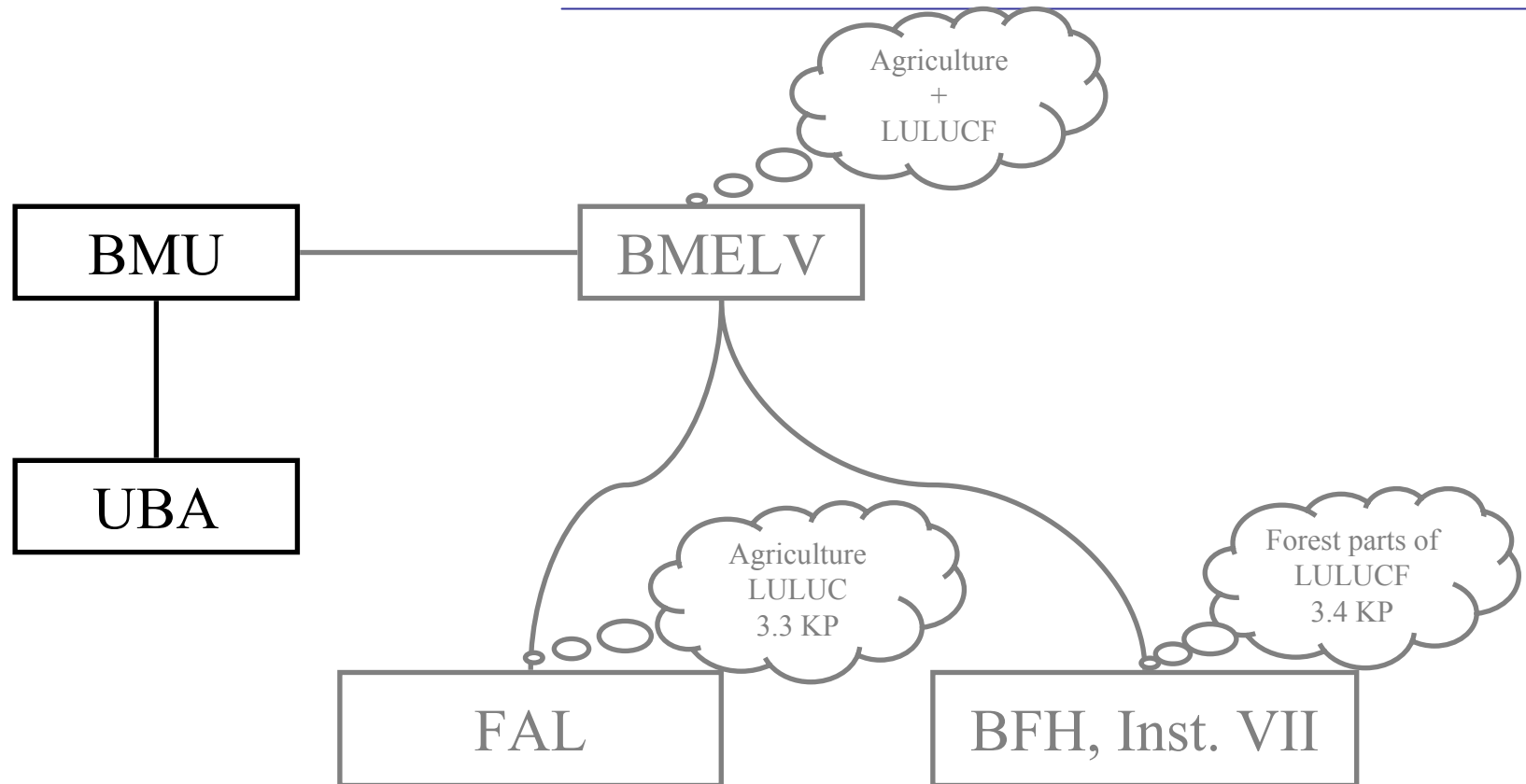
Outline

- german reporting commitments
- organisation of responsibilities
- actual methodology of reporting
 - areas and activities
 - emission factors, emissions and stock changes
- actual issues
- planned improvements

German reporting commitments

- **annual reporting under UNFCCC**
 - years from 1990 until actual year, annually
 - all Land use classes incl. transition classes
 - all relevant gases
 - all relevant pools
- **reporting and accounting under KP 3.3 and 3.4**
 - afforestation, (re)forestation, deforestation
 - forest management
 - 2008 - 2012

Organisation of responsibilities (historical)

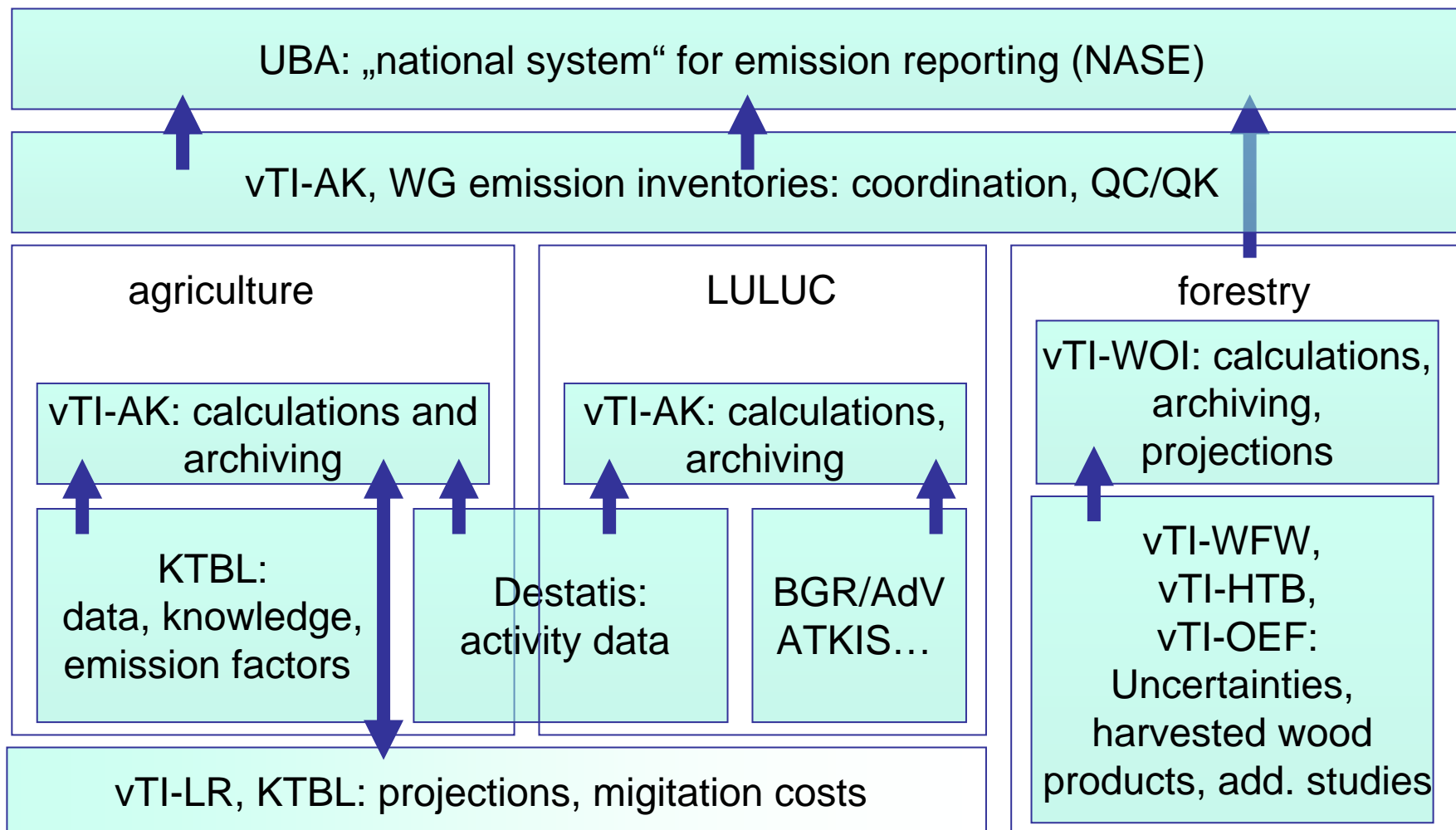


Reviews: institutional arrangements needed

Institutional Arrangements

- **starting point:**
 - **benefits by accounting for „forest sink“ expected**
 - **additional needs by Kyoto reporting identified**
- **Federal ministry of Food, Agriculture and Consumer Protection responsible for:**
 - **agriculture**
 - **LULUCF (incl. Kyoto ARD and FM)**
- **in place since 2007**
- **connected with financial resources for reporting (capacity building!)**

Organisation of responsibilities (current)



Separate reporting system on LULUC and F

- historical reasons for separation to forests reporting
- LULUC:
 - including all LUC except forests
 - based on Land use statistics and maps
 - most important pool: soils
- F:
 - including forests and transition classes from and to forests
 - based on statistical (plot-based) forest inventories
- continuous development of methodology
- *process of integration in development*

Prerequisites for reporting of activities

- activities in LUCUCF are mostly areas
- needed: definitions of land use classes
 - references:
 - IPCC GPG
 - Marakesh Accords (forests)
 - adaptations for national circumstances
 - analysis of differences between national definitions and references

Example: forest definition

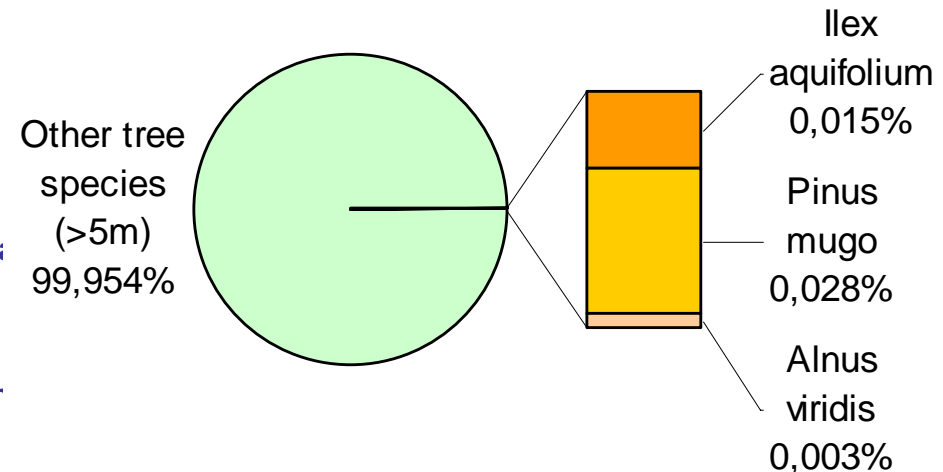
German NFI	Reference = Marrakesh Accords (FCCC/CP/2001/13/Add.1, p.58.)
<p>Forest is any ground area covered by forest vegetation with an area more than 0,1 ha and a width more than 10 m. Watercourses up to 5 m wide do not break the continuity of a forest area.</p> <p>Succession areas (swamp, moorland, pastures) are considered to be forests, if they have reached an average age of five years and if at least 50% of the area is covered by forest vegetation.</p> <p>Forests also include openings (areas of wooded ground temporarily without forest cover) and non-wooded ground (forest tracks, rides and firebreaks over 5 m, wide, landings, tree nurseries, seed and plant nurseries, wood-pastures and fields for game, the areas of yards and buildings used for forestry purposes, recreational facilities linked to the forest and rocks, boulders, gravel and water located in the forest).</p> <p>Cultivation of Christmas trees and parkland attached to urban areas are not forests.</p>	<p>minimum area of land of 0.05-1.0 hectares</p> <ul style="list-style-type: none"> - with tree crown cover (or equivalent stocking level) of more than 10-30 per cent - with trees with the potential to reach a minimum height of 2-5 metres at maturity <i>in situ</i>. <p>A forest may consist either of</p> <ul style="list-style-type: none"> - closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground - or open forest. <p>Young natural stands and all plantations which have yet to reach</p> <ul style="list-style-type: none"> - a crown density of 10-30 per cent or - tree height of 2-5 metres are included under forest, - as are areas normally forming part of the forest area which are <ul style="list-style-type: none"> o temporarily unstocked o as a result of human intervention such as <ul style="list-style-type: none"> ▪ harvesting or ▪ natural causes o but which are expected to revert to forest;

land use vs. land cover

Impact of forest definition parameters

- **Definition of Forest:**
 - tree crown cover: at least 10 % (\neq NFI)
 - minimum area: 0.1 ha (= NFI)
 - potential minimum height of trees: 5 meters (\neq NFI)
- **Differences to NFI definition (example for sensitivity analysis):**
 - min. height of 5 m
 - **Only 3 species in the German NFI species list, which (under some circumstances) not reach a potential height of 5m**
 - **Alnus viridis (green alder)**
 - **Pinus mugo (dwarf mountain pine)**
 - **Ilex aquifolium (Holly)**
 - area is lower than 0,05 % of the forest area (within forest area error estimation).

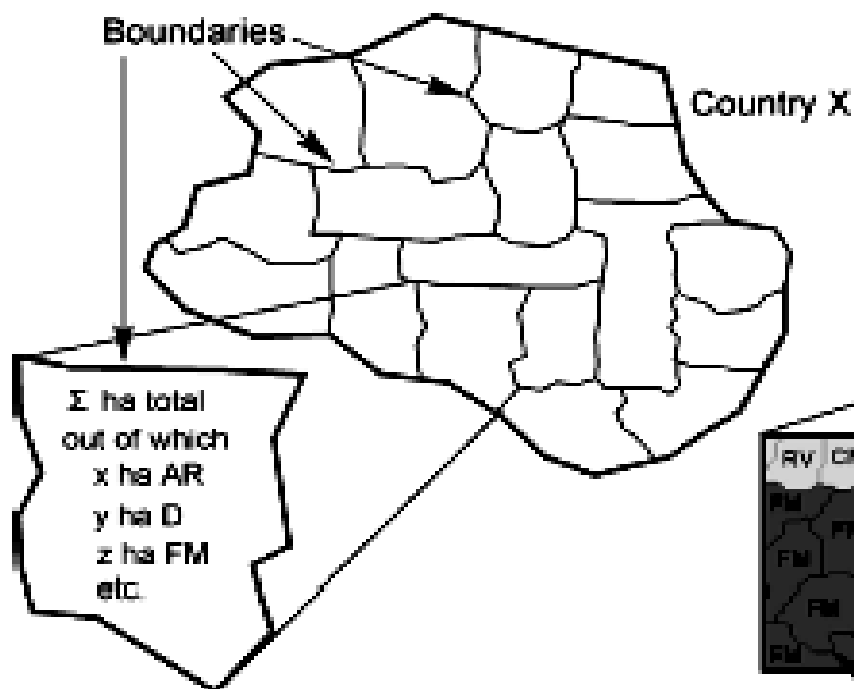
estimation of forest area impact of minimum height threshold (5m)



Methodologies for areas identification

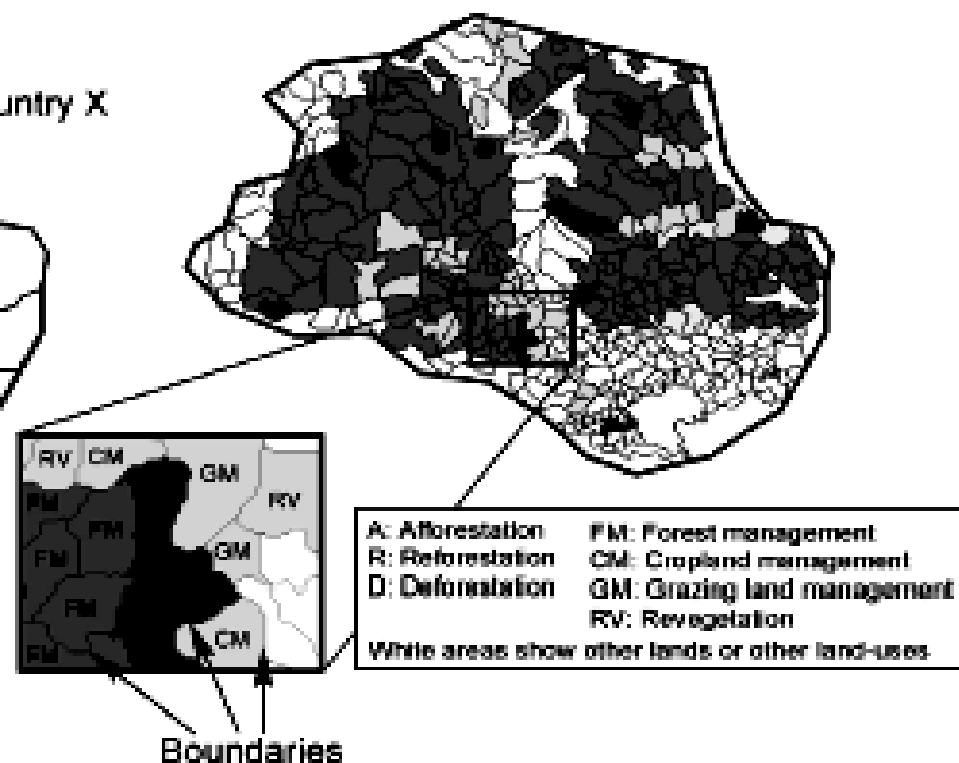
Reporting Method 1

A geographic boundary encompasses units of land or land subject to multiple activities.



Reporting Method 2

A geographic boundary encompasses units of land or land only subject to a single activity.



Area identification in LULUC (historical)

- **official German statistics**
 - **„Flächenerhebung“ (Survey of Area by Actual Use)**
 - **„Agrarstrukturerhebung“**
 - **„Bodennutzungshaupterhebung“ (Main Statistics of Land Use)**
 - **„Ernteerhebung“ (Main Statistics of Harvests)**
 - **„Wein- und Obstbauerhebung“ (Main Statistics of Viniculture and Fruitproduction)**

Area identification in LULUC (historical)

Excerpt from combined Database derived from
official German statistics

Survey of Area by Actual Use & Main Statistics of Land Use

Schlüssel	Kreis	Landwirtschaftsfläche in ha		Differenz 2001 - 2000 in ha					
		LF 2001	LF 2000	Acker	Dauerkultur	Rebland	Grünland	Brache	Pool
01001	Flensburg	1389	1396	-53	1	0	51	-6	7
01002	Kiel	4004	4032	5	1	0	-18	-18	30
01003	Lübeck	7983	8149	-55	0	0	-59	-52	165
01004	Neumünster	3057	3094	44	-1	0	-71	-9	37
01051	Dithmarschen	111180	111269	1406	-26	0	-1167	-302	89
01053	Herzogtum Lauenburg	76081	76212	389	-2	0	-120	-397	130
01054	Nordfriesland	158411	158778	2404	-6	0	-2324	-443	368
01055	Ostholstein	102736	103074	459	-9	0	-292	-496	338
01056	Pinneberg	42894	43195	170	-153	0	-235	-83	301
01057	Plön	74729	75086	332	-21	0	-296	-373	358
01058	Rendsburg-Eckernförde	159790	159934	1778	-17	0	-1410	-496	144
01059	Schleswig-Flensburg	160270	160275	1841	-5	0	-1309	-532	5
01060	Segeberg	93429	93765	722	-2	0	-646	-410	336
01061	Steinburg	78692	78964	517	1	0	-601	-190	273
	Deutschland	18976246	19026907	-16209	383	-543	-35069	778	50661

Data for german LULUC-inventory (new)

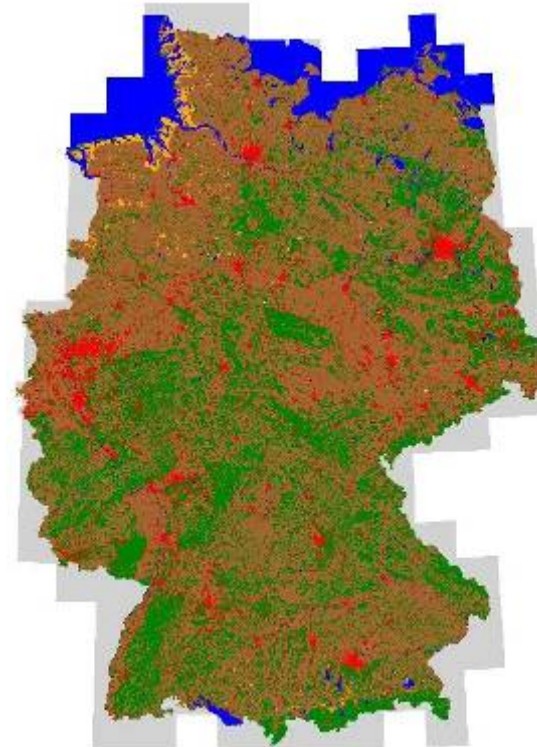
District borders



Soil map



Land use



Example: Land use changes 2005-2007 by map intersection

Legend

Cropland
crop
forl
gras
othl
sett
wetl

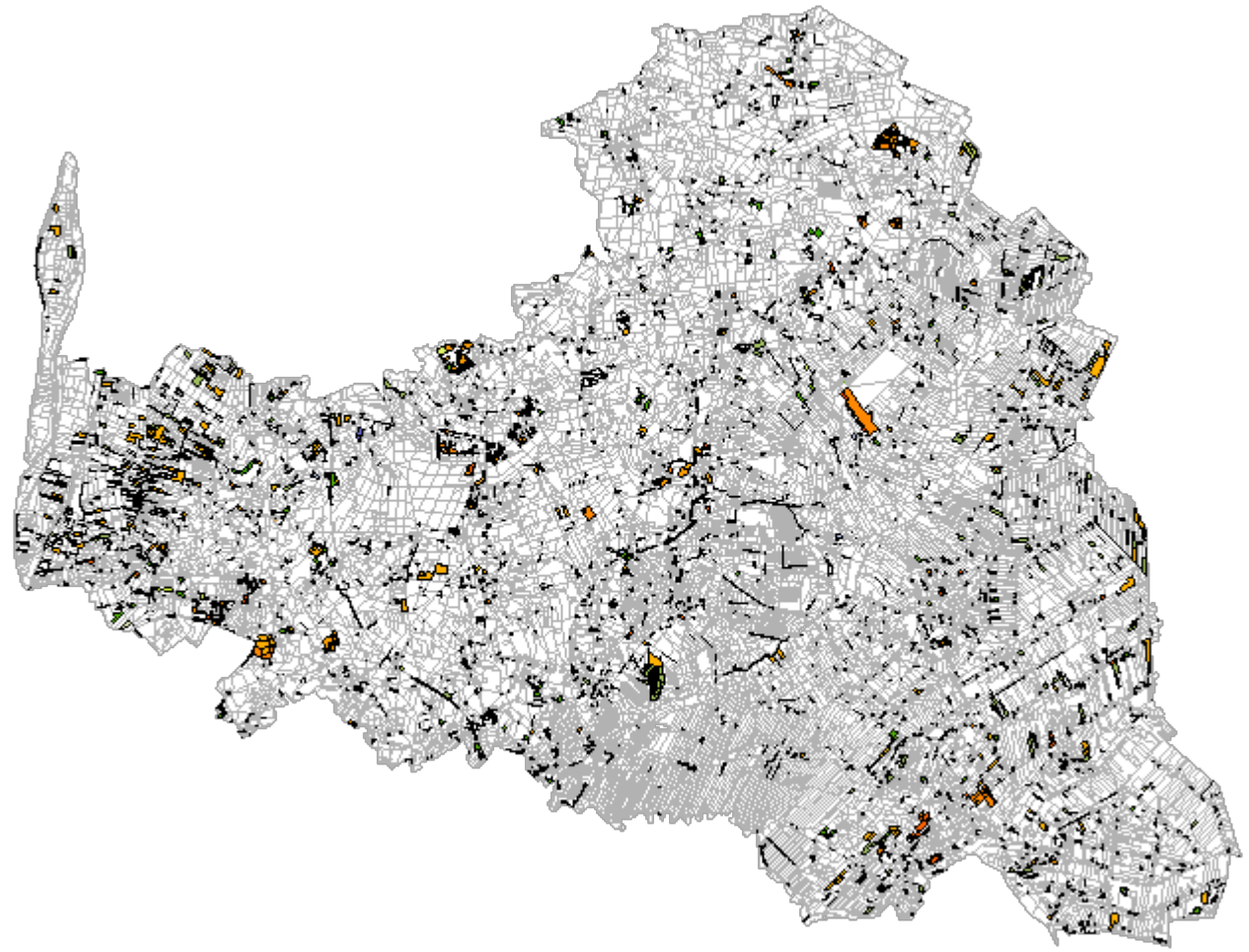
Grassland
crop
forl
gras
othl
sett
wetl

Forestland
crop
forl
gras
othl
sett
wetl

Settlements
crop
forl
gras
othl
sett
wetl

Other land
crop
forl
gras
sett
wetl

Wetlands
crop
forl
gras
sett



0 2.500 5.000 10.000 Meters

Application of Emission factors (LULUC)

Mineral soils:

$$\Delta C_{ms} = C_f - C_i = a * ef * C_w - a * C_w$$

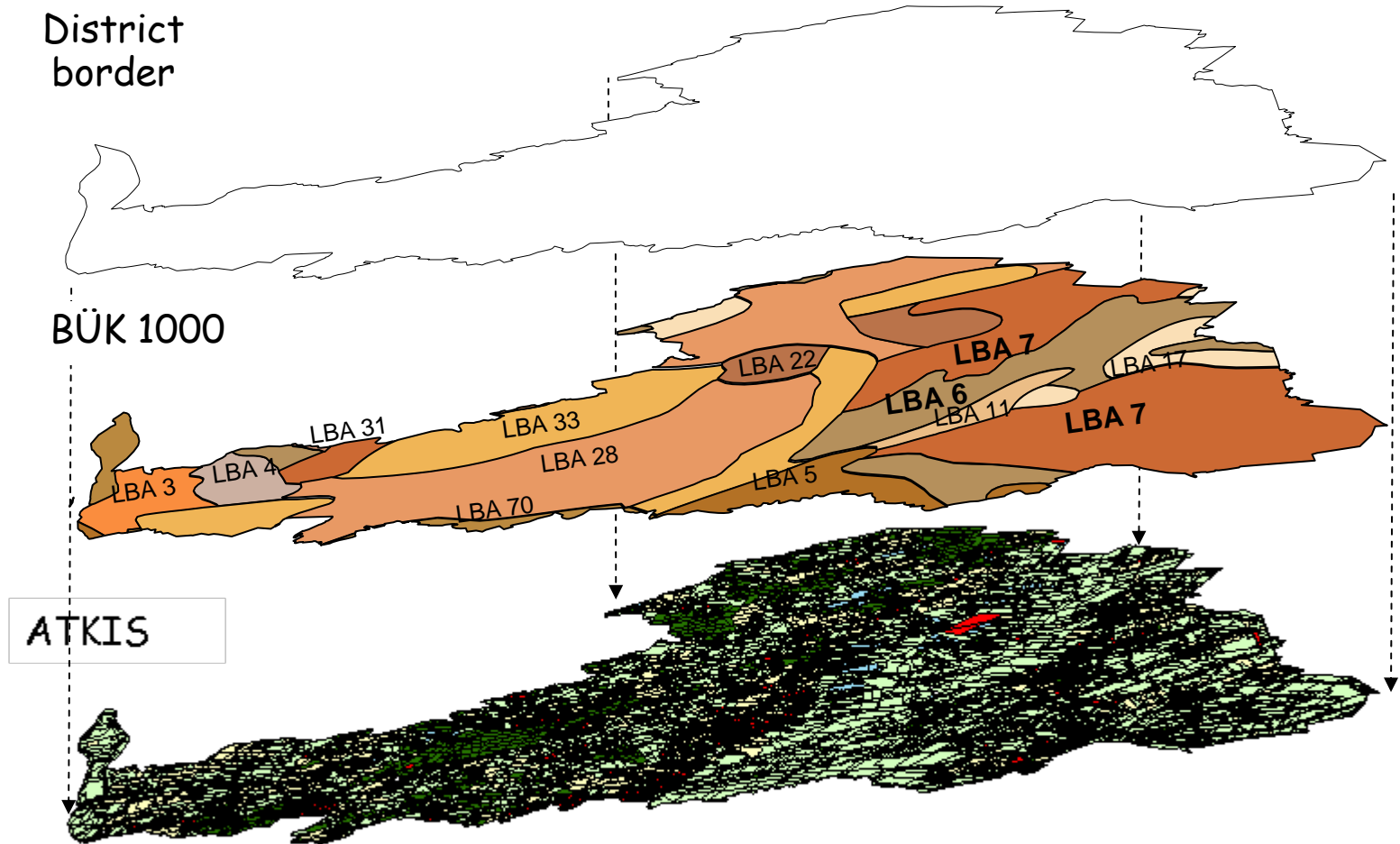
- ΔC_{ms} : Change in soil carbon stocks due to land use change in metric tons / district * report period
- C_f : Final soil carbon stocks in metric tons
- C_i : Initial soil carbon stocks in metric tons
- a : area of land use change in ha
- ef : Emission factor (free of dimension)
- C_w : Weighted (by district and land use) carbon stocks in metric tons/ha

Organic soils:

$$\Delta C_{os} = a * ef_{org.}$$

- ΔC_{os} : Change in soil carbon stocks due to land use change on organic soils in metric tons / district * report period
- a : Area of land use change in ha
- $ef_{org.}$: Emission factor for organic soils under specific use in metric tons/ha*a

Intersection of soil maps with LUC from CORINE/ATKIS



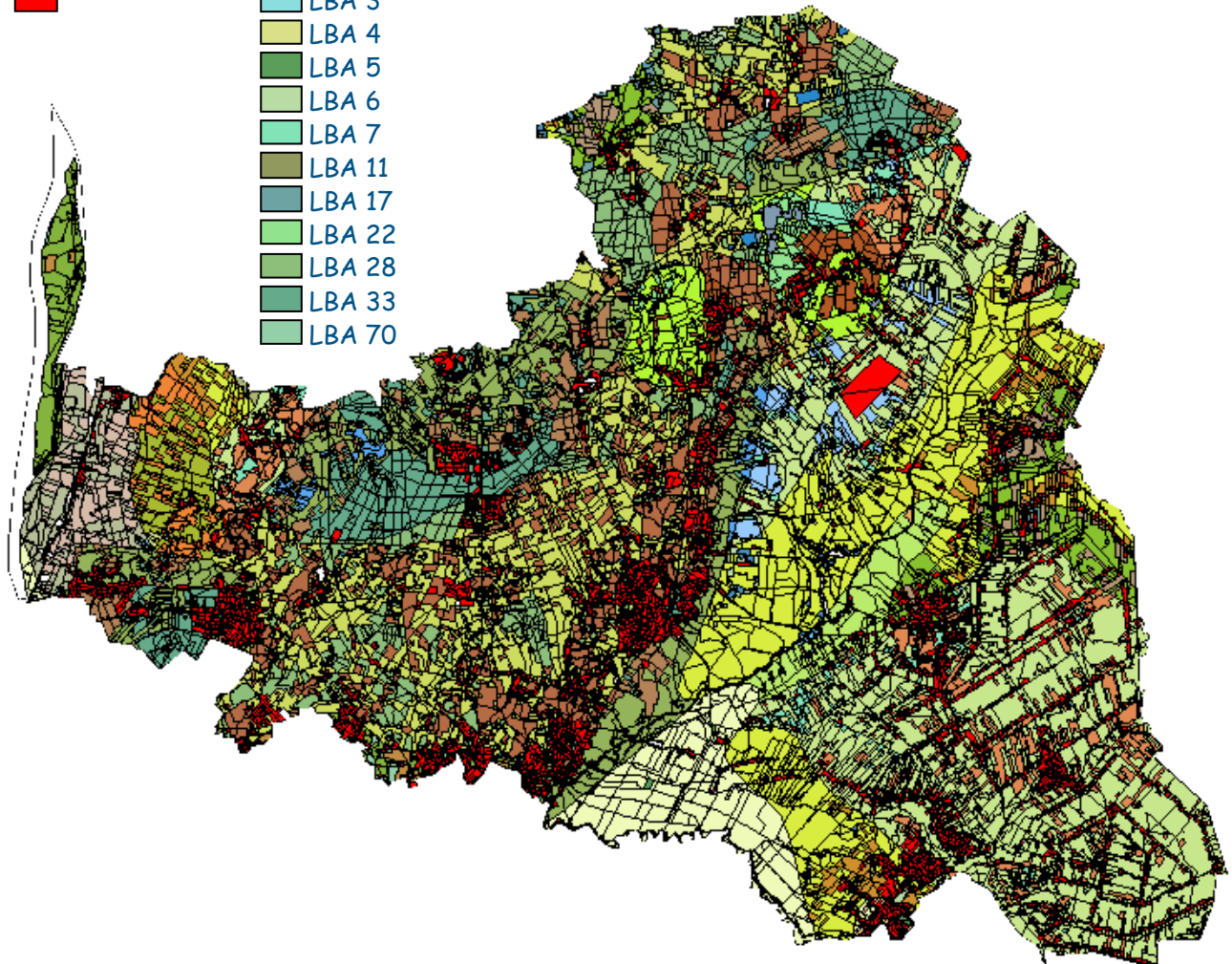
Application of Emission factors (LULUC)

Cropland	Grasland
LBA 3	LBA 3
LBA 4	LBA 4
LBA 5	LBA 5
LBA 6	LBA 6
LBA 7	LBA 7
LBA 11	LBA 11
LBA 17	LBA 17
LBA 22	LBA 22
LBA 28	LBA 28
LBA 31	LBA 31
LBA 33	LBA 33
LBA 70	LBA 70

Settlements
[Red Box]

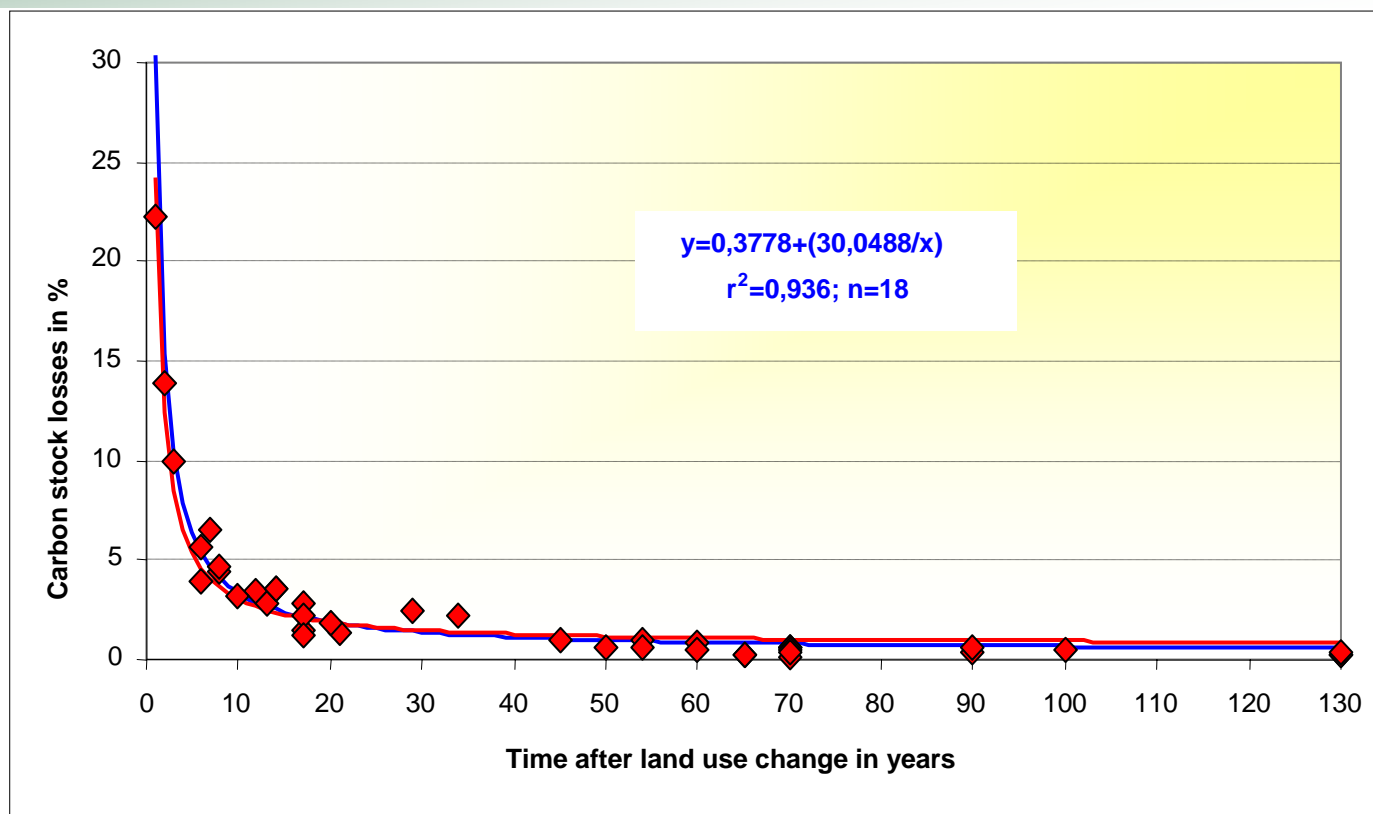
Forestland
LBA 3
LBA 4
LBA 5
LBA 6
LBA 7
LBA 11
LBA 17
LBA 22
LBA 28
LBA 33
LBA 70

Wetlands	Other Land
LBA 3	LBA 3
LBA 4	LBA 4
LBA 5	LBA 5
LBA 6	LBA 6
LBA 7	LBA 7
LBA 11	LBA 11
LBA 17	LBA 17
LBA 22	LBA 22
LBA 28	LBA 28
LBA 31	LBA 31
LBA 33	LBA 33
LBA 70	LBA 70



Specific emission trends for transitions

Relationship between loss from initial soil carbon content and duration of land use change (grassland, perennial crops, fallow or forest to cropland)

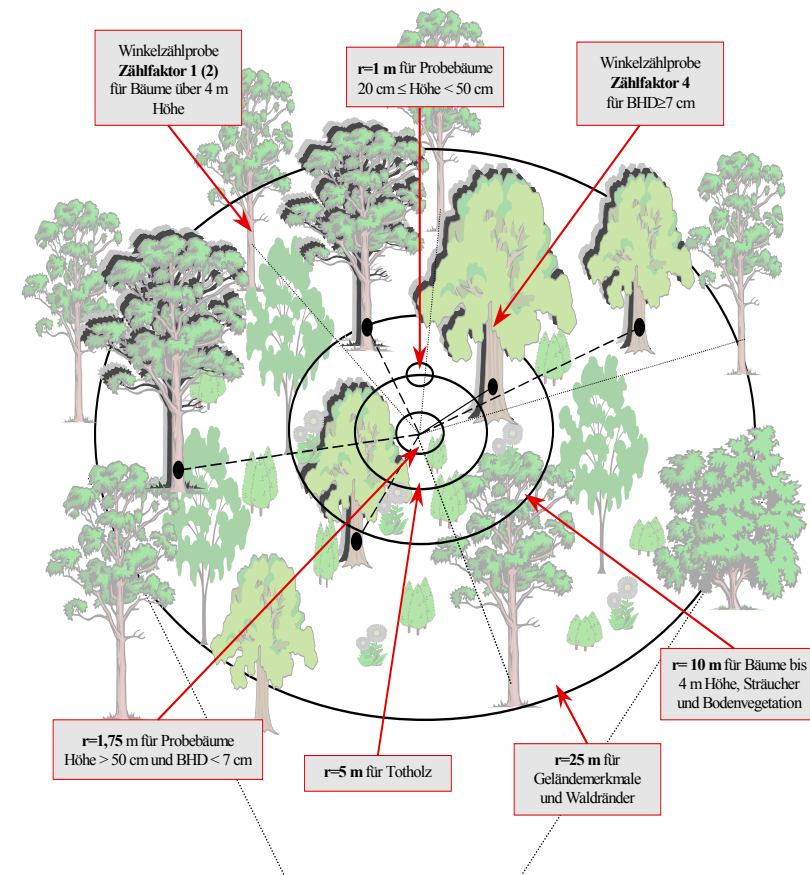


Data sources for forests (incl. area):

- **National Forest Inventory:**
 - **areas**
 - **biomass (aboveground and belowground)**
 - **deadwood**
- **National Forest Soil Inventory:**
 - **(areas)**
 - **litter**
 - **soil organic matter**
- **NFI sub-sample 2008 (Biomass, Deadwood, esp. for GHG)**
- **Dataset on Forest Resources (DFR, new states, until 1993)**
- **Additional data (forest fire statistics, remote sensing data)**

Data sources details (NFI):

- **National Forest Inventory:**
 - nationwide terrestrial multipurpose inventory
 - regular cluster grid with permanent sample plots
 - sample (cluster) distribution nationwide 4 km x 4 km (intensified in some areas)
 - each cluster a quadrangle with sides of 150 m (4 plots)
 - on plots angle-count sampling and sample circles
 - ca. 50,000 forest plots
- inventory cycles:
 - 1987 (Old federal states)
 - 2002,2012 (whole country)
 - additional sub-sample 2008 (ca. 2,500 forest plots, whole country)

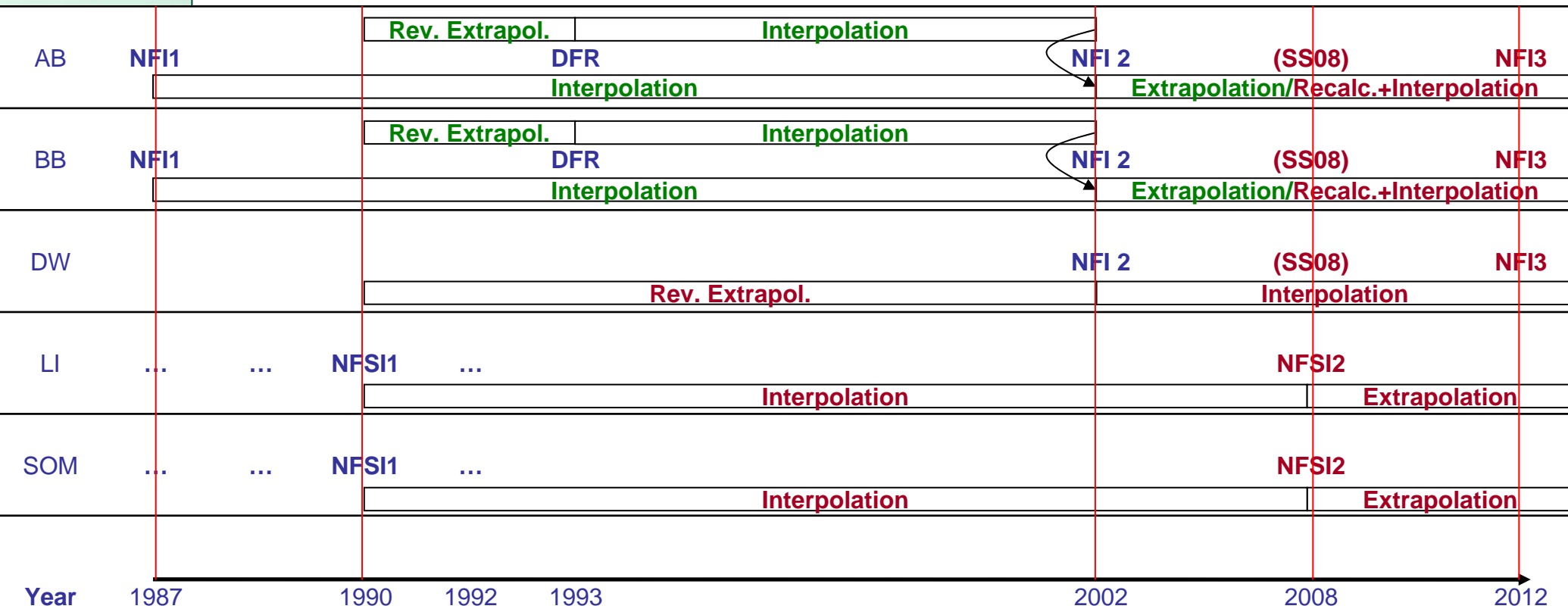


Data sources details (NFSI):

- **National Forest Soil Inventory:**
 - nationwide terrestrial inventory
 - regular grid with permanent sample plots
 - sample distribution nationwide 8 km x 8 km
 - on plots various measurements for evaluation of litter-, soil-, and (stand) parameters
 - ca. 2,000 forest plots
- **inventory cycles:**
 - 1987 -1992
 - 2007-2009

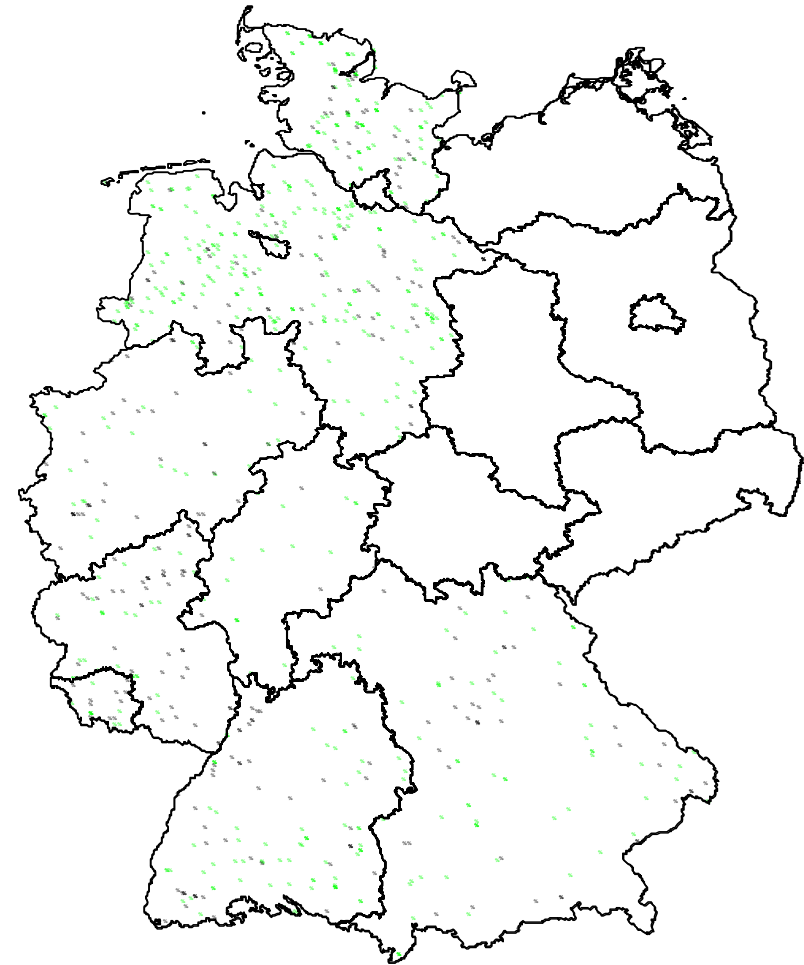
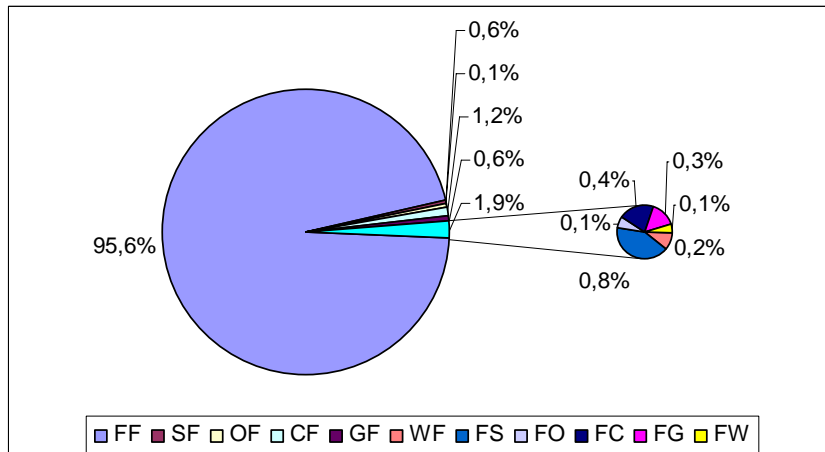


Reporting on Emissions from forests: concept, data sources and time schedule



Area estimation from NFI

- „forest / non forest“ as plot parameter
- repeated inventories allow change detection
- parameter „land use bevor/after forest use“ allows division by transition classes



Emissions from forests (and related LUC)

- data actually only for living biomass available
- data on soils, litter and deadwood expected in near future
- (carbon) stock data collected together with Land use information in statistical (plot-based) forest inventories
 - repeated Inventories cause need for interpolation and extrapolation (**no annual data**)
- CO₂-Emissions from biomass burning integrated in stock change (study on other gases actually under preparation)

Emission calculation method (forest biomass)

- “stock-change-method”

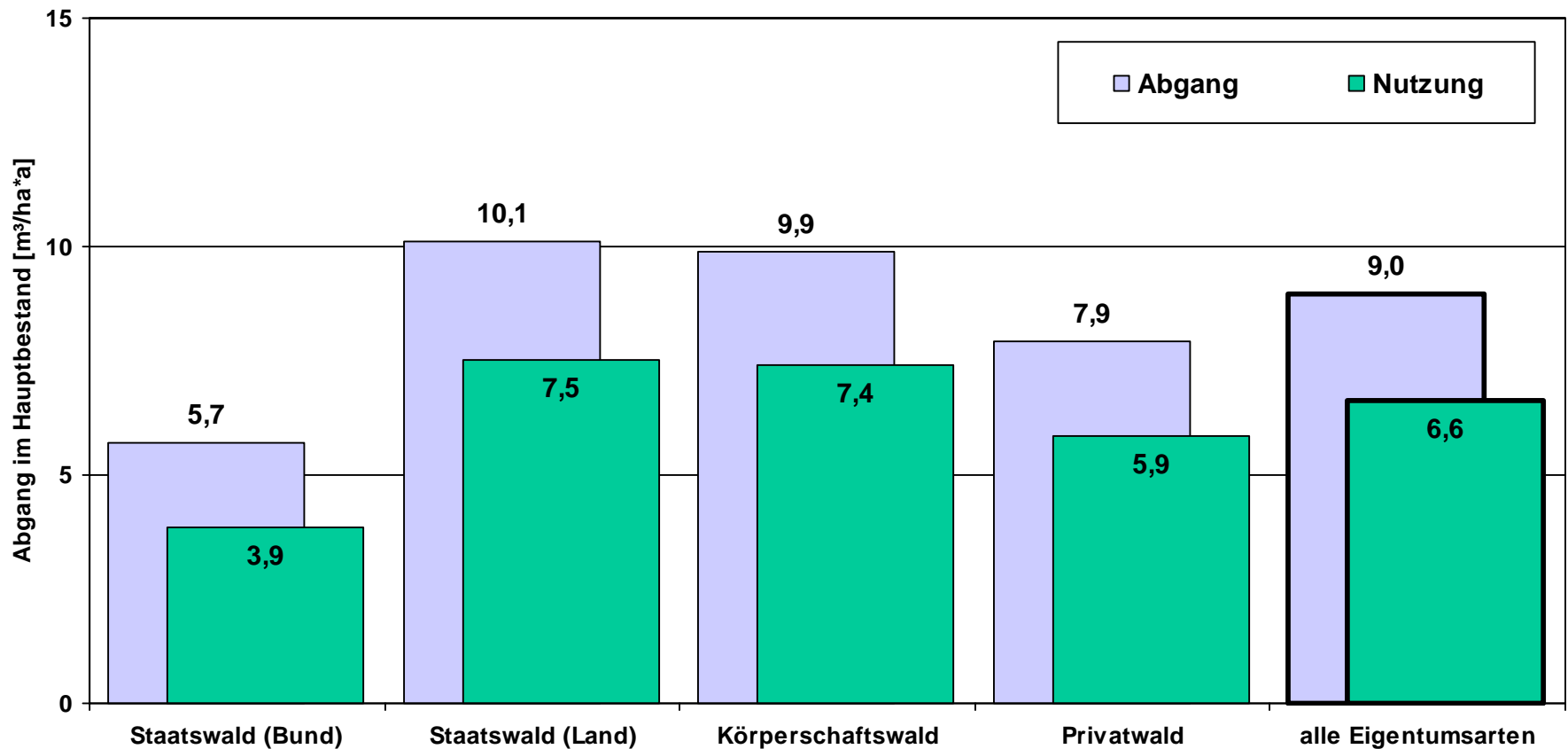
$$\Delta C = (C_{t_2} - C_{t_1}) / (t_2 - t_1)$$

- Expansion-/Conversions factors on tree level

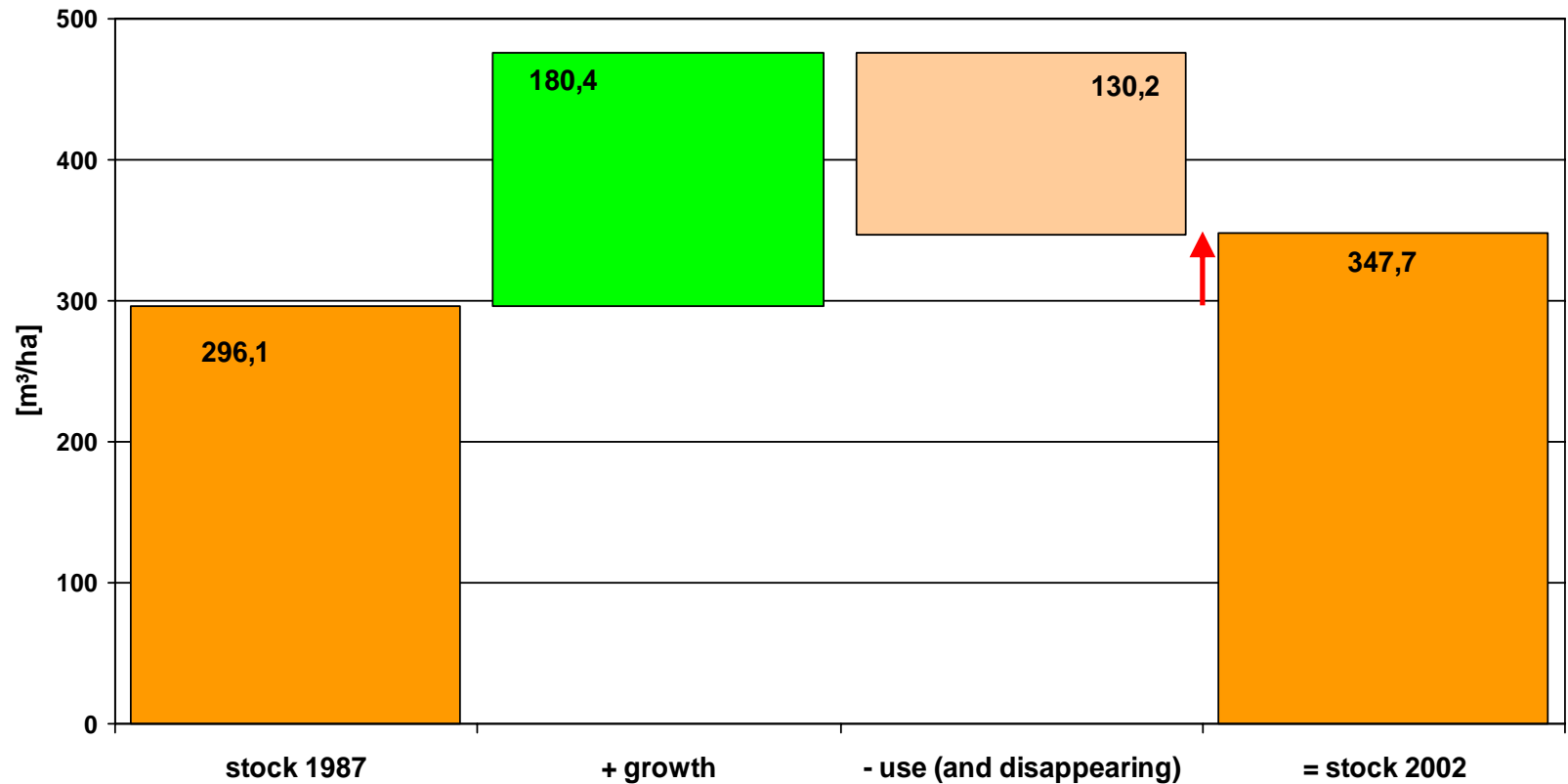
$$C = [V \cdot D_D + V \cdot D_A \cdot (VEF - 1)] \cdot (1 + R) \cdot CF$$


Standing timber Branch wood Root wood

Example: forest increment and removals



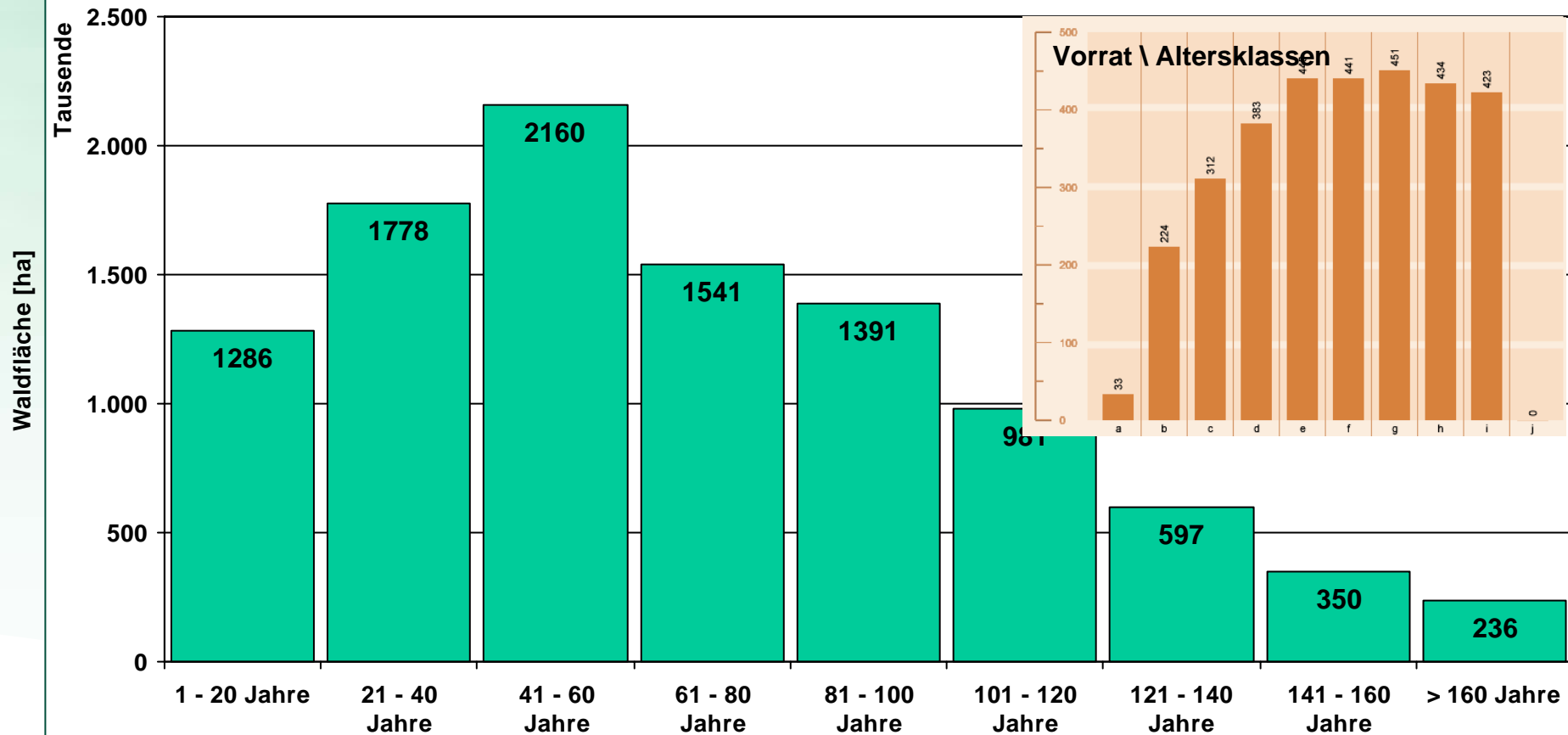
Example: Biomass stock change in forests



Actual tasks

- Forestry:
 - Inventory subsample 2008 (regarding KP commitments)
 - Studies:
 - Emissions from forest fires
 - Biomass functions / uncertainties
 - Improvement of Documentation, QA/QC
- Other LULUC
 - Project on emissions from organic soils
 - 2/3 of emissions in LULUC
 - mostly on grassland and cropland
 - High uncertainties

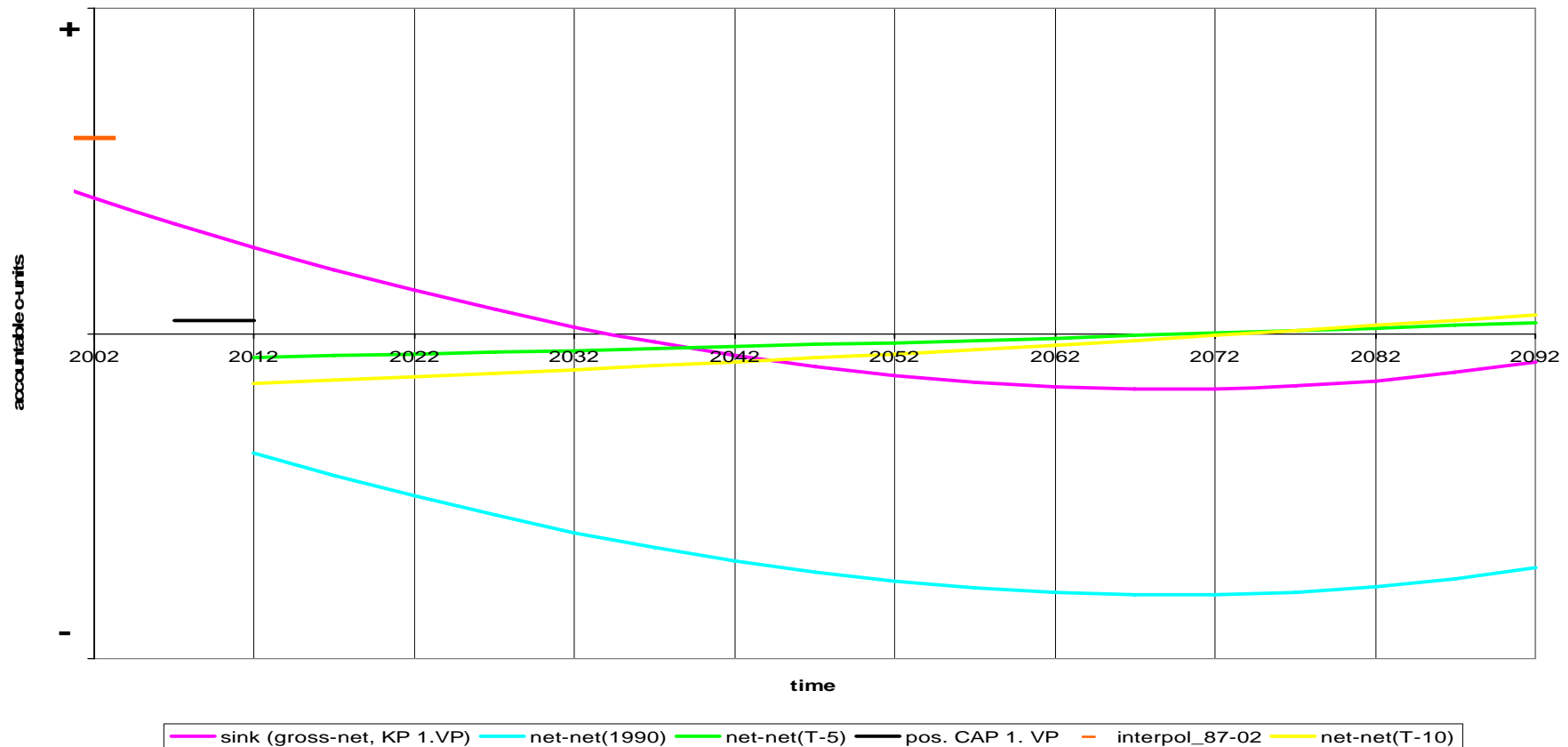
Excuse: Projection models



Projections for political decision support

- Example: FM „sink“ under different accounting scenarios

accounting trends at different approaches for german forest "sink" (based on projection model)



Thank you for attention.