# LULUCF and KP LULUCF

## in the Czech National GHG Inventory Reporting

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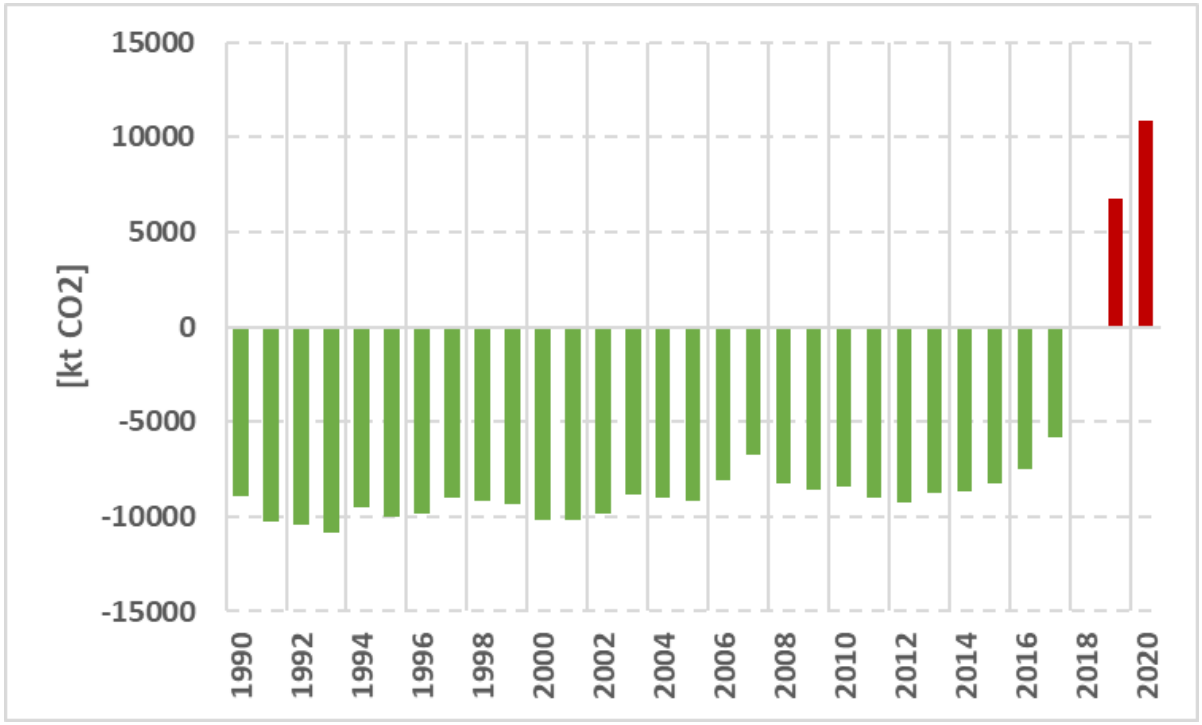
IFER – Institute of Forest Ecosystem Research, Ltd.

# Agenda

- Introduction to the LULUCF sector in the Czech Republic
- Land-use representation and land-use change identification system
- Emission estimation by land-use categories
- QA/QC sectoral specifications
- Questions, discussion

# The emission trends in LULUCF 1990-2020




Green values – net removals of GHG

Red values - net emissions of GHG due to development in forestry sector

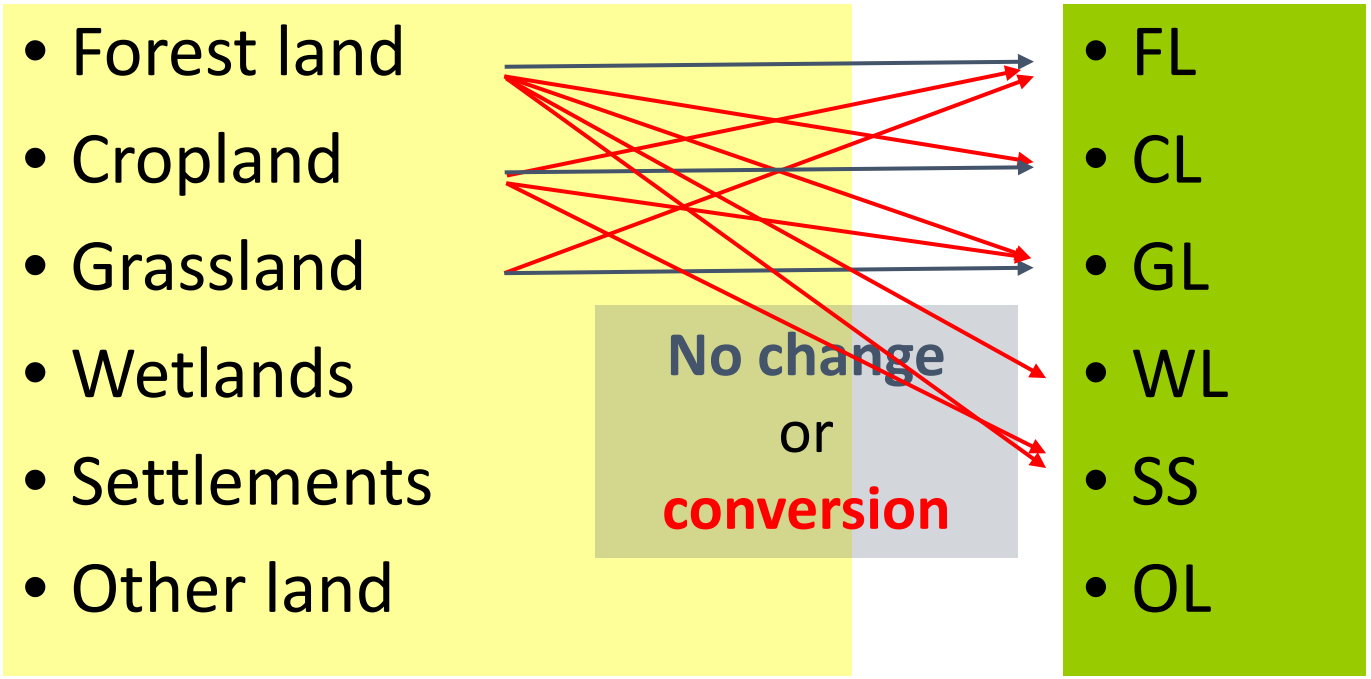
*IFER, preliminary data*

# Key categories of LULUCF in 2019 (NIR submission 2021)

- **4.A.1 Forest land remaining Forest land**
  - LA, TA
  - share of total GHG 11,40 %
- **4.G Harvested wood products**
  - LA
  - share of total GHG 1,10 %
- **4.A.2 Land converted to Forest land**
  - LA
  - share of total GHG 0,41 %

# Czech landscape

# Key issue of LULUCF inventory: representing land areas



# Land-Use and Land-Use change areas – data source

ČÚZK | State Administration of Land Surveying and Cadastre

## Czech Office for Surveying, Mapping and Cadastre (COSMC)

- land-use identification system – elaborated at the level of individual cadastral units (about 13 000)

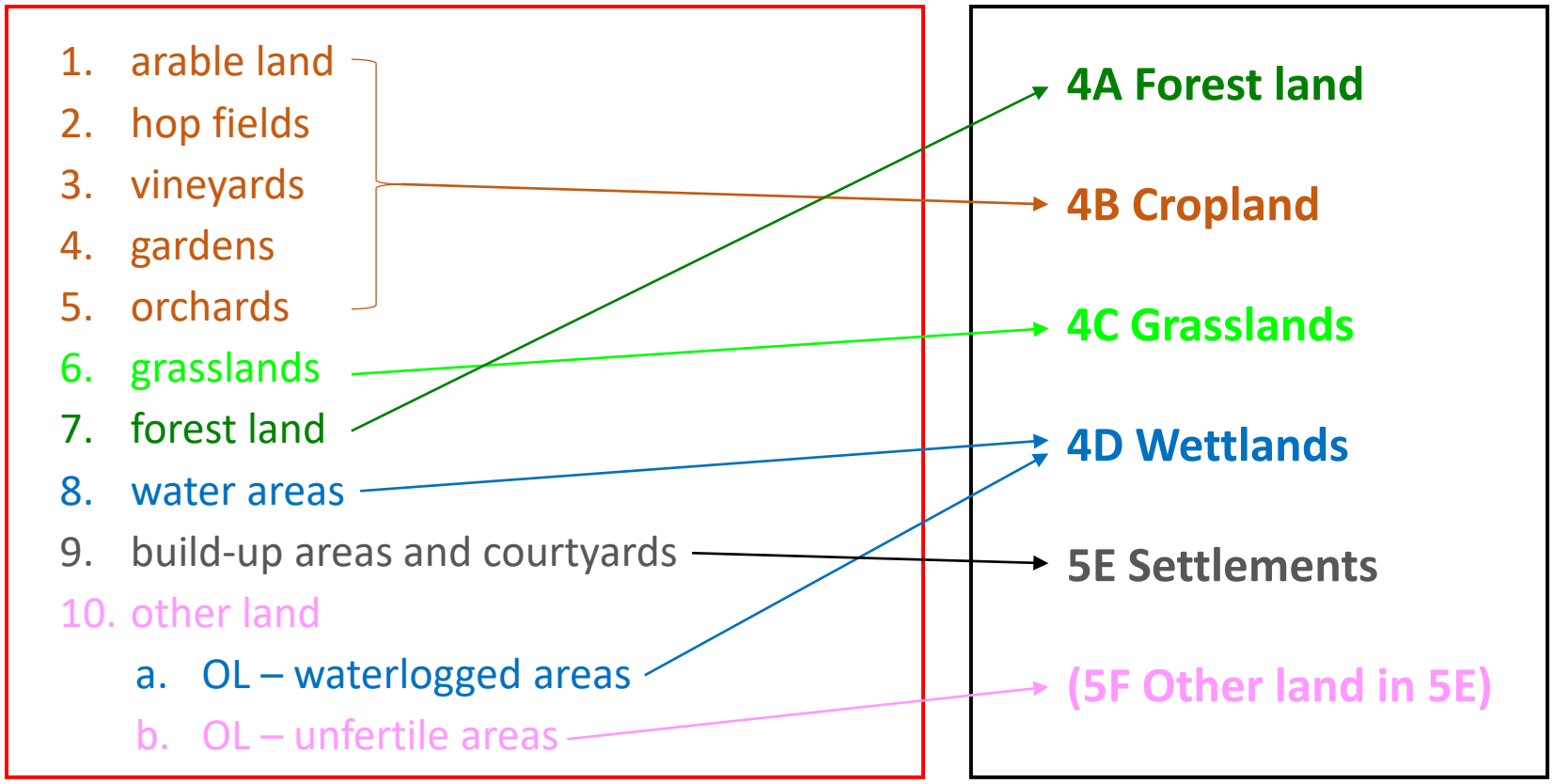
  **1) source data assembly** – database of "Aggregate areas of cadastral land categories" (AACLC)

  **2) linking land-use definitions** – 10 land categories of AACLC → 6 categories of LULUCF

  **3) identification of land-use change**

  **4) complementing time series** – due to the IPCC default time period of 20 years used for reporting the converted land, the source information contains data on land use since 1969

# Linking national land-use definitions to IPCC categories of land-use



# Identification of land-use change

- Year-to-year (until 2003) and explicit (since 2004) land-use conversions among IPCC land use categories

| Year (date) | ID CU (Name) | Forest land | Cropland | Grassland | Wetlands | Setttlements | Other land | Total |
|---|---|---|---|---|---|---|---|---|
| 31-12-2010 | 661635 (Kácov) | 1992637 | 2627349 | 1186759 | 376350 | 1415821 | NO | 7598916 |
| 31-12-2011 | 661635 (Kácov) | 1979724 | 2633115 | 1181825 | 376350 | 1427904 | NO | 7598918 |
| **Difference** | | **-12913** | **5766** | **-4934** | 0 | **12083** | - | 2 |

| Conversion type | Area ($m^2$) |
|---|---|
| Forest land - Cropland | 977 |
| Forest land - Settlements | 11936 |
| Cropland - Settlements | 247 |
| Grassland - Cropland | 4897 |
| Grassland - Settlements | 38 |
| Settlements - Cropland | 139 |

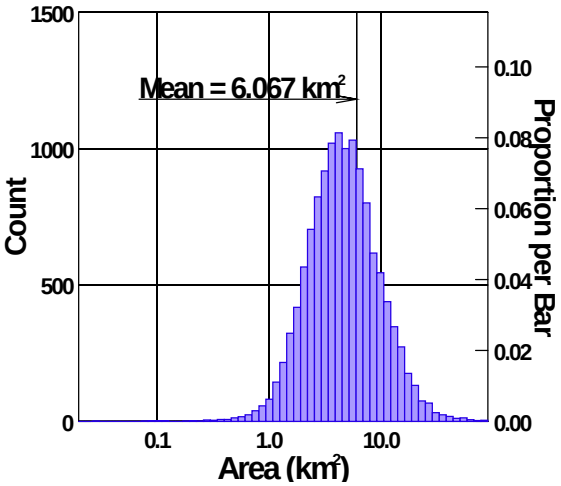
# Resulting LU matrices from "bottom-up" compilation

**Land-use matrices** describing annual initial and final areas of particular land-use categories and the identified annual land-use conversions among these categories

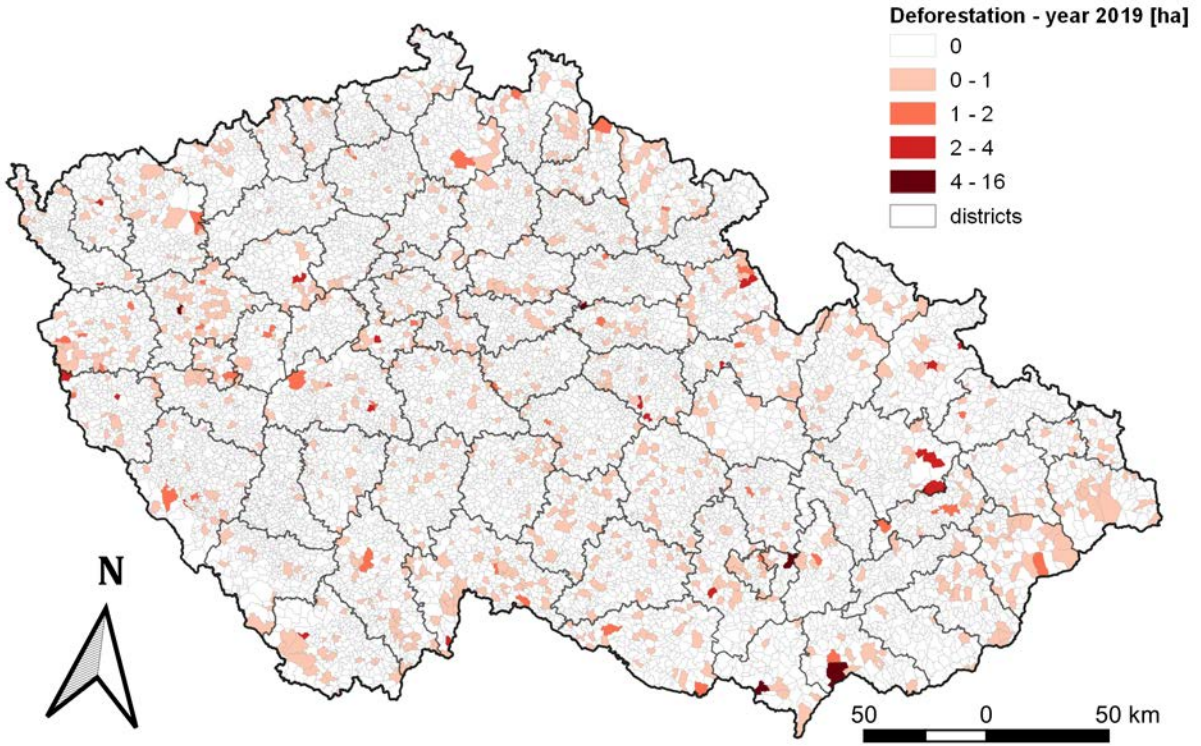
| | 1990 | Initial (1989) | | | | | | *Area [kha]* |
|---|---|---|---|---|---|---|---|---|
| | Category | Forest land | Cropland | Grassland | Wetlands | Settlements | Other land | |
| Final (1990)jj | Forest Land | 2 628.6 | 0.5 | 0.4 | 0.0 | 0.0 | 0.0 | **2 629.5** |
| | Cropland | 0.0 | 3 454.5 | 0.4 | 0.0 | 0.1 | 0.0 | **3 455.0** |
| | Grassland | 0.1 | 8.8 | 823.6 | 0.0 | 0.0 | 0.0 | **832.5** |
| | Wetlands | 0.0 | 0.4 | 0.4 | 155.9 | 0.8 | 0.0 | **157.5** |
| | Settlements | 0.3 | 3.7 | 3.7 | 0.1 | 804.1 | 0.0 | **811.9** |
| | Other Land | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| | *Area [kha]* | 2 629.0 | 3 467.9 | 828.5 | 156.1 | 805.0 | 0.0 | **7 886.4** |

| | 2019 | Initial (2018) | | | | | | *Area [kha]* |
|---|---|---|---|---|---|---|---|---|
| | Category | Forest land | Cropland | Grassland | Wetlands | Settlements | Other land | |
| Final (2019) | Forest Land | 2 672.9 | 0.6 | 0.4 | 0.0 | 1.7 | 0.0 | **2 675.7** |
| | Cropland | 0.0 | 3 182.3 | 1.3 | 0.0 | 0.9 | 0.0 | **3 184.6** |
| | Grassland | 0.1 | 6.8 | 1 008.8 | 0.1 | 1.9 | 0.0 | **1 017.6** |
| | Wetlands | 0.0 | 0.2 | 0.1 | 166.3 | 0.1 | 0.0 | **166.8** |
| | Settlements | 0.2 | 2.8 | 0.5 | 0.1 | 838.7 | 0.0 | **842.4** |
| | Other Land | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| | *Area [kha]* | 2 673.4 | 3 192.6 | 1 011.1 | 166.6 | 843.4 | 0.0 | **7 887.1** |


- about 13 000 individual cadastral units

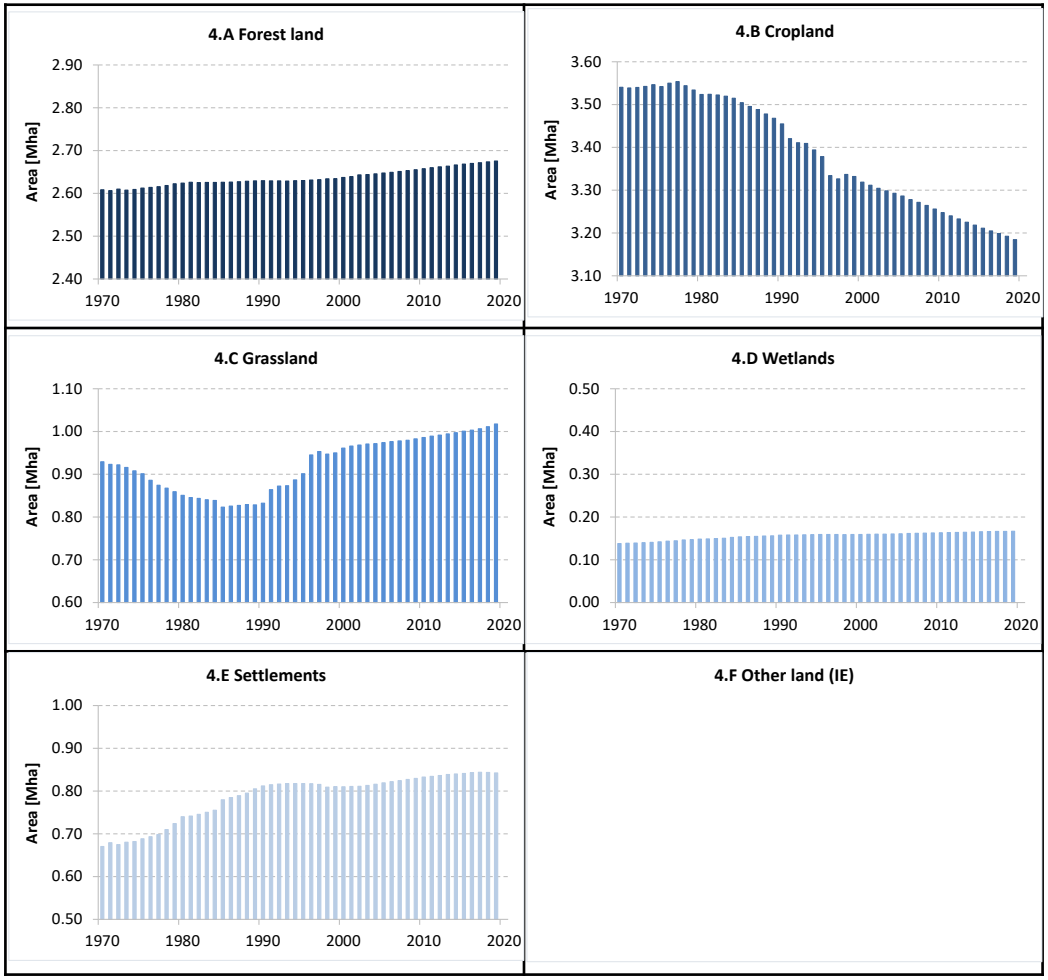



- identification of land-use and land-use changes at the level of cadastral units

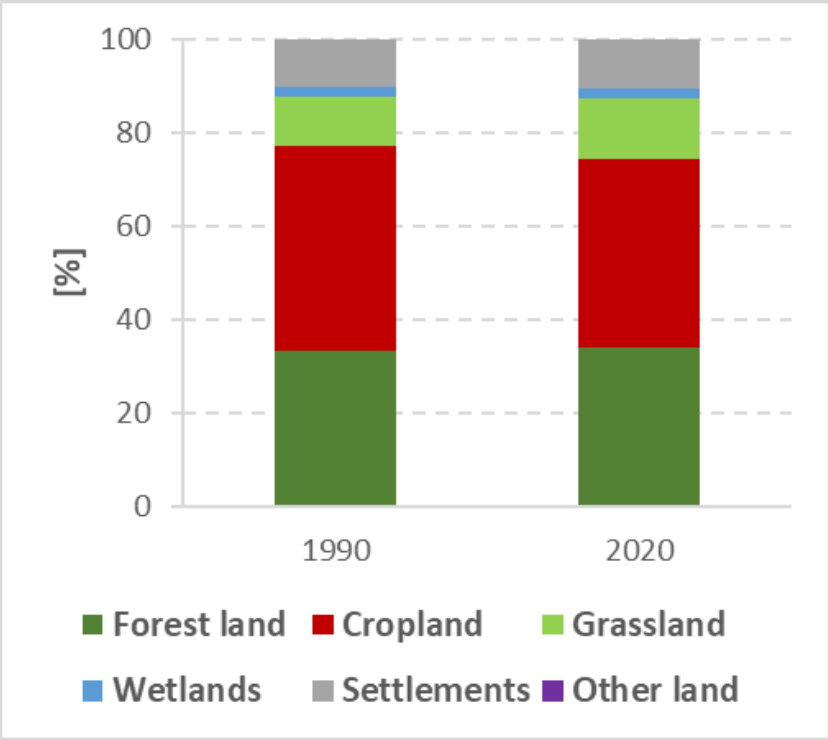


# Czech landscape by LU categories

**Total area per 6 land-use categories** (Forest land, Cropland, Grassland, Wetlands, Settlements, Other Land) divided into **“land remaining”** and **“land converted”**



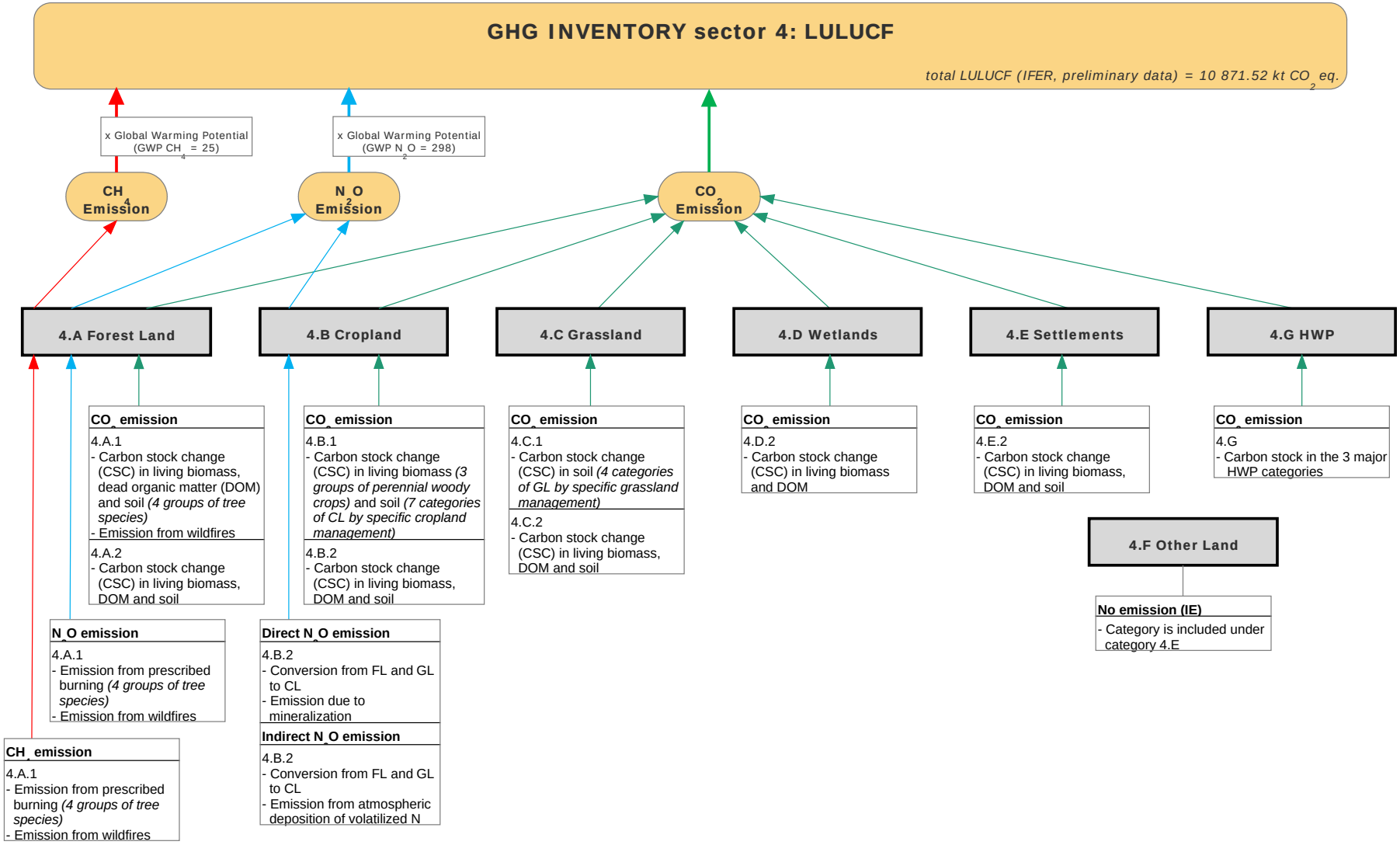
# Land–use categories in Czech Republic in 1990 and 2020



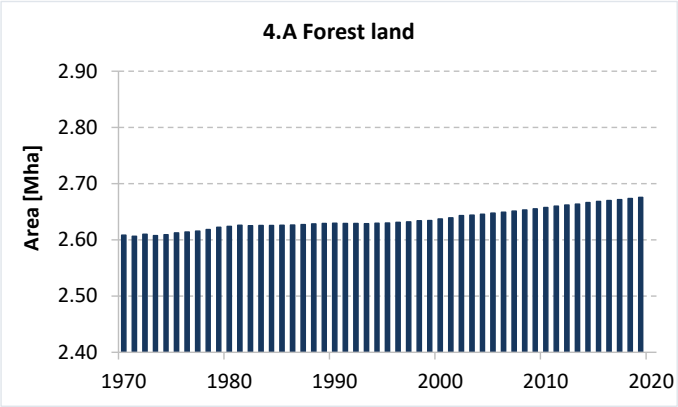

| | 1990 | 2020 |
|---|---|---|
| **Forest land** | 33,3 % | 33,9 % |
| **Cropland** | 43,8 % | 40,3 % |
| **Grassland** | 10,6 % | 13,0 % |
| **Wetlands** | | |
| **Settlements** | | |
| **Other land** | | |

# Generally on methodologies for emission estimates in the Czech NIR

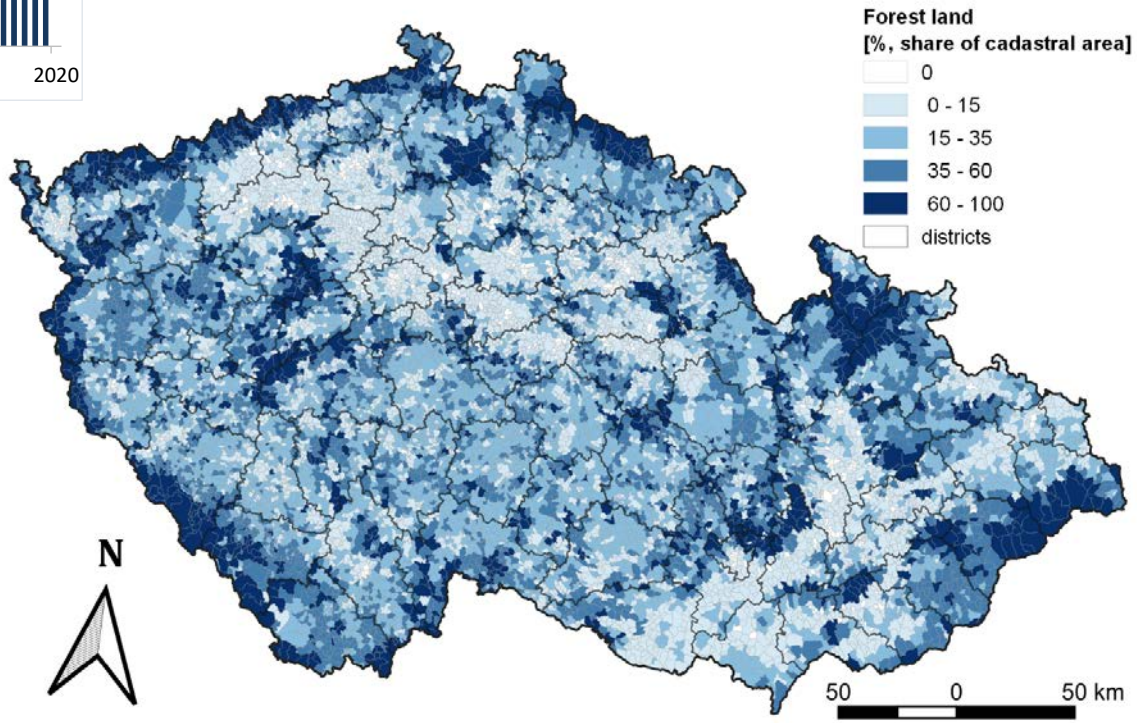
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 4
- 2013/14 KP Supplements
- Relevant national studies
- Tier 2/3 approaches applied for key categories
- Country-specific AD and factors deployed to maximum extent possible
- Methodological advices and recommendations from reviews

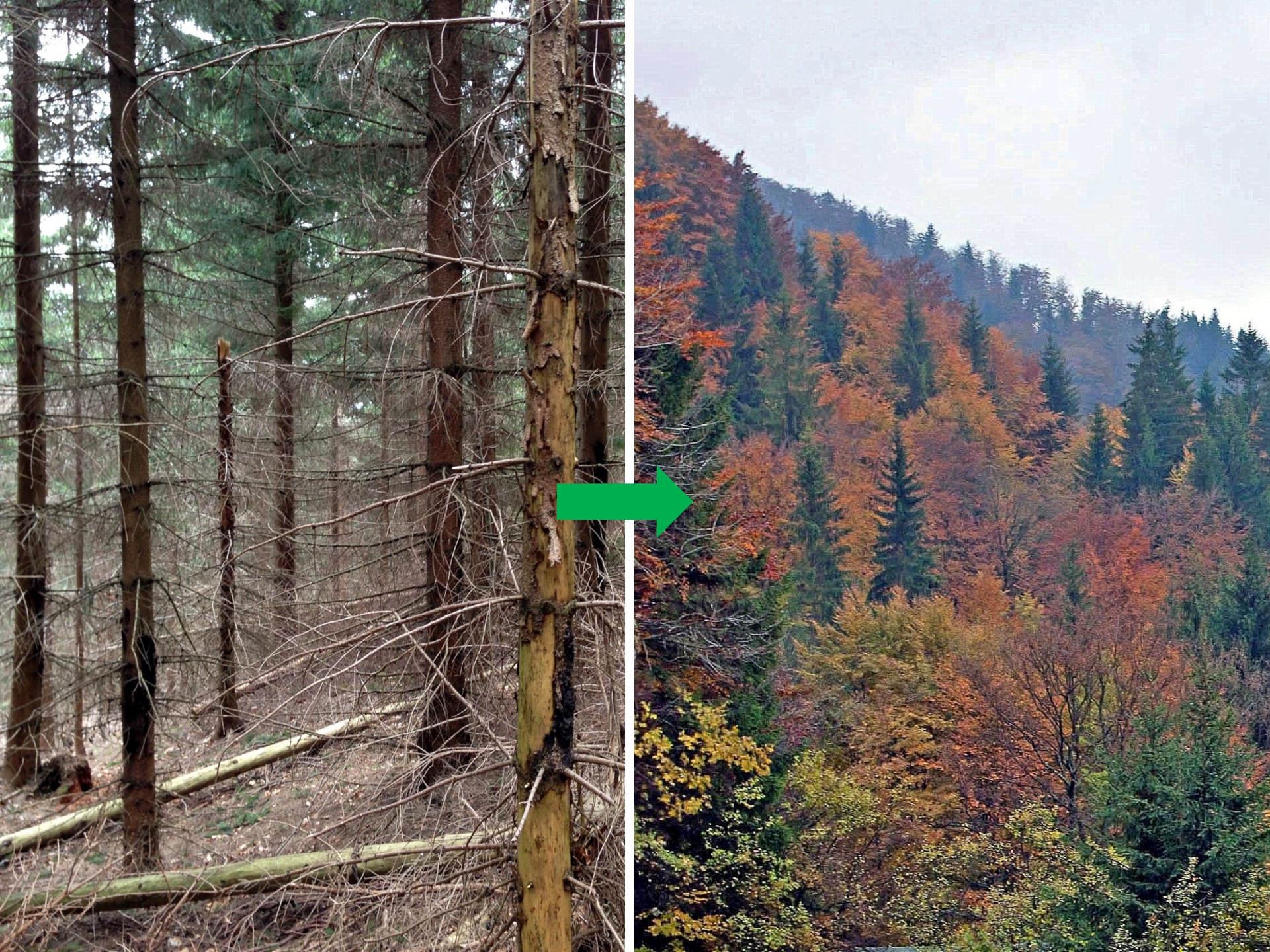

GHG INVENTORY sector 4: LULUCF
total LULUCF (IFER, preliminary data) = 10 871.52 kt CO2 eq.
x Global Warming Potential (GWP CH4 = 25)
x Global Warming Potential (GWP N2O = 298)
CH4 Emission
N2O Emission
CO2 Emission
4.A Forest Land
4.B Cropland
4.C Grassland
4.D Wetlands
4.E Settlements
4.G HWP
4.F Other Land
CO2 emission
4.A.1
- Carbon stock change (CSC) in living biomass, dead organic matter (DOM) and soil (4 groups of tree species)
- Emission from wildfires
4.A.2
- Carbon stock change (CSC) in living biomass, DOM and soil
CO2 emission
4.B.1
- Carbon stock change (CSC) in living biomass (3 groups of perennial woody crops) and soil (7 categories of CL by specific cropland management)
4.B.2
- Carbon stock change (CSC) in living biomass, DOM and soil
CO2 emission
4.C.1
- Carbon stock change (CSC) in soil (4 categories of GL by specific grassland management)
4.C.2
- Carbon stock change (CSC) in living biomass, DOM and soil
CO2 emission
4.D.2
- Carbon stock change (CSC) in living biomass and DOM
CO2 emission
4.E.2
- Carbon stock change (CSC) in living biomass, DOM and soil
CO2 emission
4.G
- Carbon stock in the 3 major HWP categories
No emission (IE)
- Category is included under category 4.E
N2O emission
4.A.1
- Emission from prescribed burning (4 groups of tree species)
- Emission from wildfires
Direct N2O emission
4.B.2
- Conversion from FL and GL to CL
- Emission due to mineralization
Indirect N2O emission
4.B.2
- Conversion from FL and GL to CL
- Emission from atmospheric deposition of volatilized N
CH4 emission
4.A.1
- Emission from prescribed burning (4 groups of tree species)
- Emission from wildfires

# 4.A Forest land




- 33,9 % of the area of the country as 2020





# 4.A.1 Forest Land remaining FL

- **Key category**
  - higher-tier methods required
- What method?

**Default: Increment - loss**

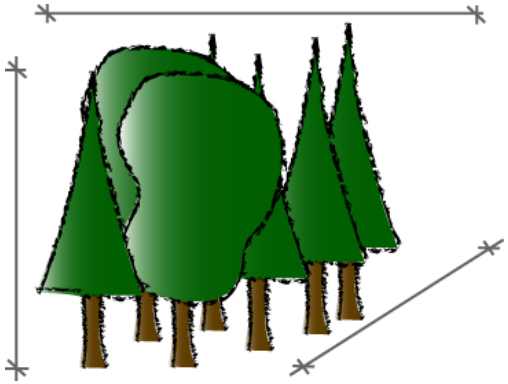
$$\Delta C = \sum_{ijk} [A_{ijk} \bullet (C_I - C_L)_{ijk}]$$

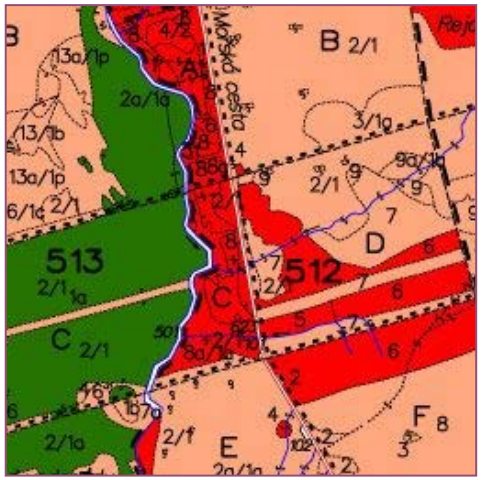
**Stock change: Stock in time 2 – Stock in time 1**

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

# Available source data

## National stand-wise inventory (forest management planning)

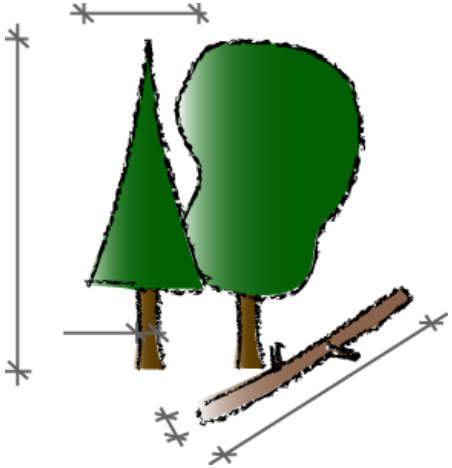


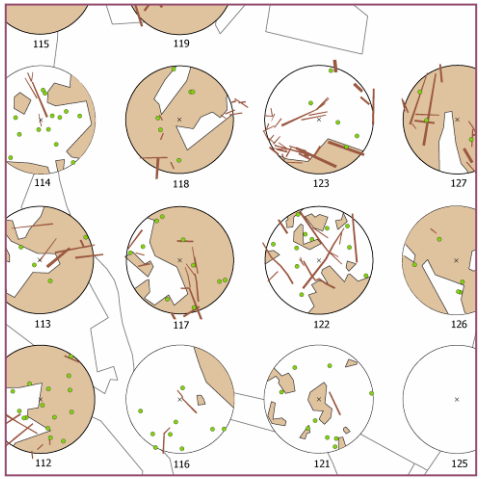



**Database updated annually**

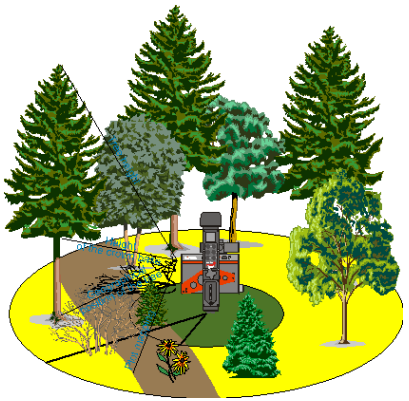
**Official source on forest data in the Czech Republic**

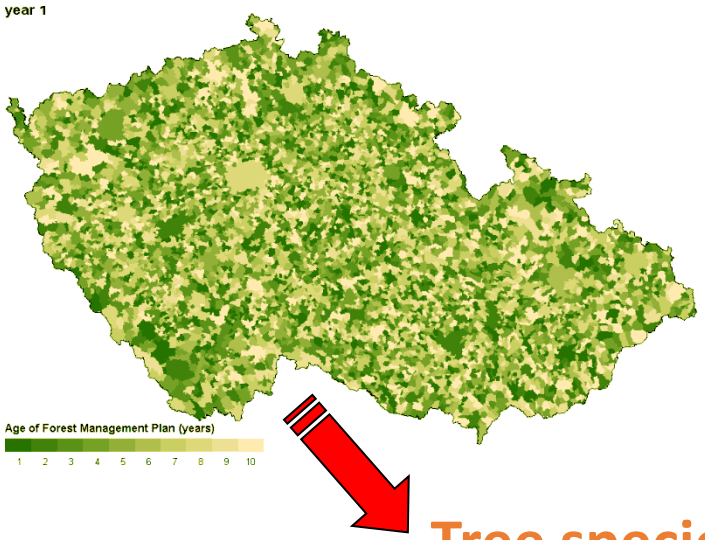
## National Forest Inventory (statistical forest inventory)






**Currently in preparation for annual sampling and reporting**






# FMP data aggregation

## Tree species groups

1. Beech (all broadleaves except oaks)
2. Oak (all oak species)
3. Pine (pine species and larch)
4. Spruce (conifers except pines and larch)

## Aggregated data

| | SPECIES$ | YEAR | AGE_CLASS | AREA_HA | MER_VOL_HA | MER_VOL |
|---|---|---|---|---|---|---|
| 1 | Beech | 1987 | 5 | 28559 | 0.2 | 6289 |
| 2 | Beech | 1987 | 15 | 37615 | 6.2 | 235077 |
| 3 | Beech | 1987 | 25 | 46387 | 36.0 | 1668192 |
| 4 | Beech | 1987 | 35 | 43673 | 81.3 | 3550800 |
| 5 | Beech | 1987 | 45 | 47124 | 122.2 | 5758139 |
| 6 | Beech | 1987 | 55 | 38668 | 148.6 | 5747609 |
| 7 | Beech | 1987 | 65 | 25790 | 183.4 | 4731098 |
| 8 | Beech | 1987 | 75 | 21629 | 220.7 | 4773013 |

# 4.A Forest Land – Data sources

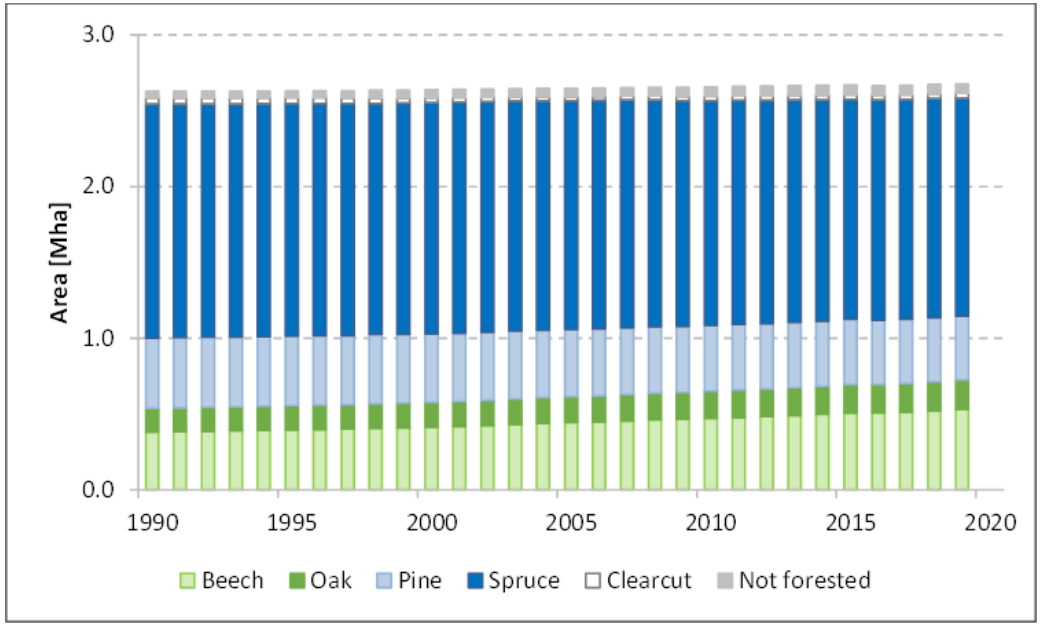

Ústav pro hospodářskou úpravu lesů
Brandýs nad Labem
www.uhul.cz | Informace o lesích

- Forest management institute (FMI)
  - official source of information on forest resources in CZ
  - main continuous data source
  - forest taxation data in Forest Management Plans (FMP)
- **National Forest Inventory (NFI)**
  - auxiliary source of information (NFI1 2001-2004, NFI2 2011-2015), statistical data
- **Czech Landscape Inventory (CzechTerra)**
- Czech Statistical Office (CzSO)
  - official source of information about harvest

CZECH STATISTICAL OFFICE

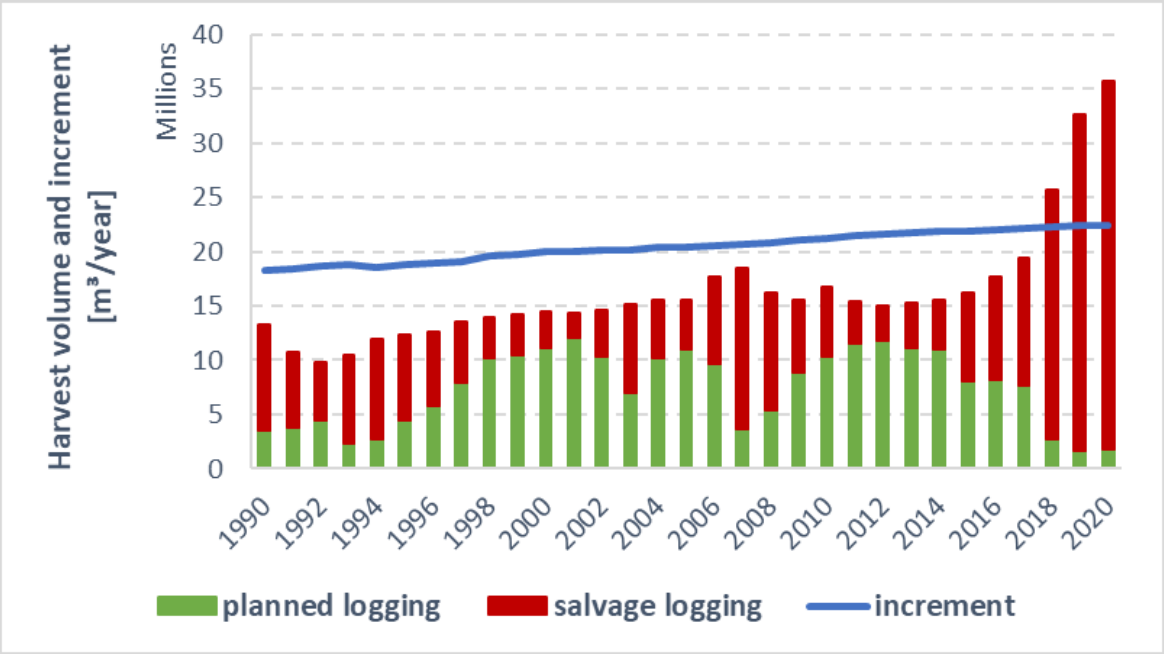
# 4.A Forest Land – Activity data

- Area of major groups of species (beech, oak, pine, spruce) and clear-cut area (FMI)
- Current annual increment for major groups of species (FMI)
- Mean growing stock volume by stand age for major groups of species (FMI)



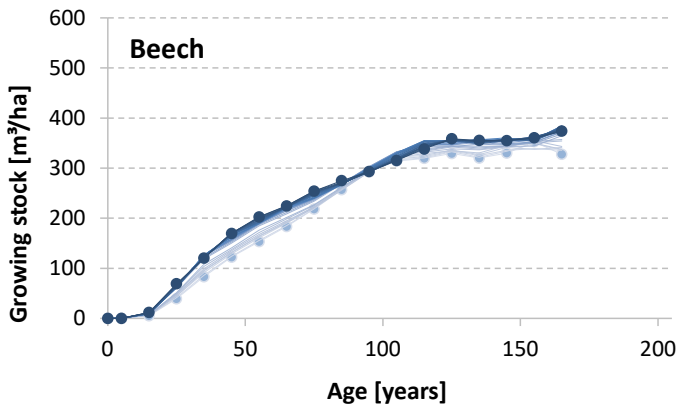
# 4.A Forest Land – Activity data

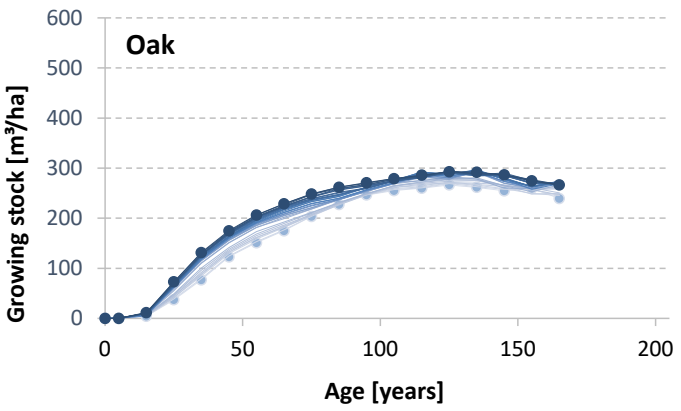
- Annual harvest volume (CzSO)
- Additional harvest loss (CzSO)
- Share of salvage logging (CzSO)
- Forest area affected by fires (CzSO)
- Mean C stock in deadwood and litter (NFI)

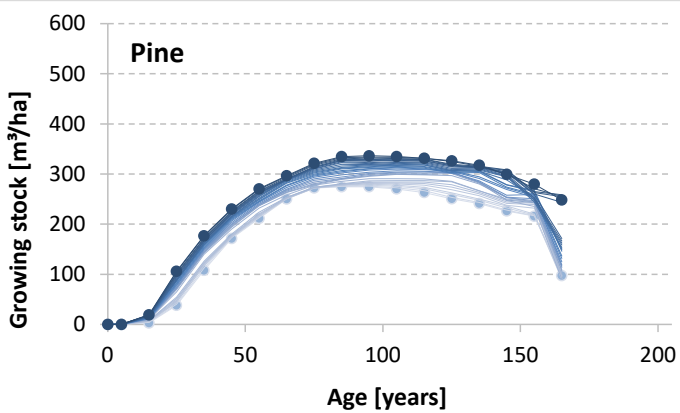


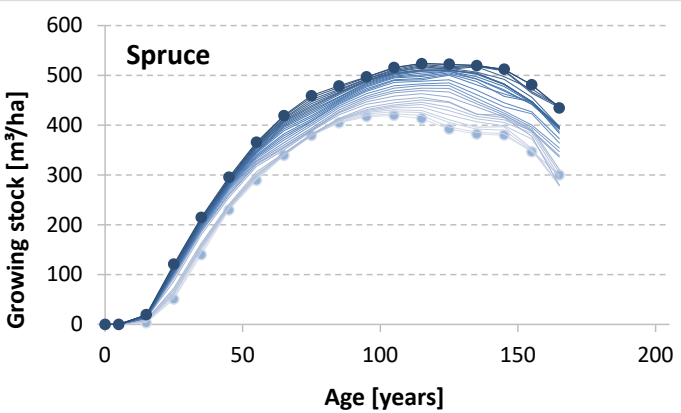
# 4.A Forest Land – annually updated data

- Growing stock, harvest, increment, biomass conversion and expansion factors, root-shoot-ratio, timberland area share, extent of fires



# 4.A Forest Land - calculation

**4.A.1**

**1) Carbon stock change (CSC) in pools:**

- CSC in living biomass
- CSC in dead organic matter (DOM) – dead wood and litter
- CSC in soil
- **Calculation using model CBM-CFS3**

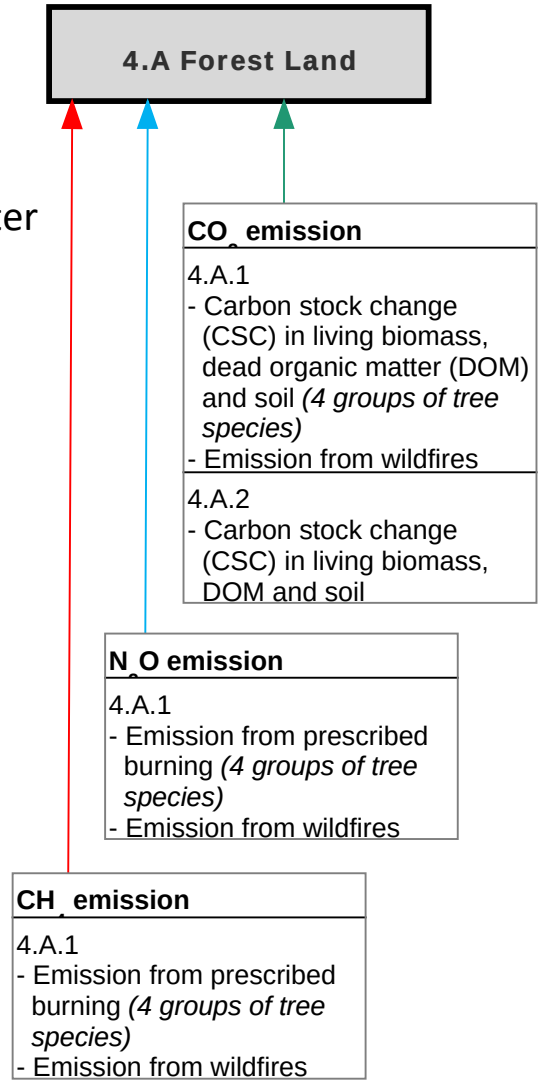
**2) Other sources of GHG**

- Prescribed burning
- Wildfires

**4.A.2**

**Carbon stock change (CSC) in pools:**

- CSC in living biomass
- CSC in dead organic matter (DOM)
- CSC in soil
- **Calculation using model CBM-CFS3**



# 4.A Forest land - model CBM-CFS3*

Forest Carbon Budget Modeling Toolbox (CBM-CFS3) - C:\Program Files (x86)\Operational-Scale CBM-CFS3\Projects\ForNIR1\ForNIR1.mdb

File View Project Tools Help

Results Explorer

Views Same Grid

- Views
  - My Views
    - Deadwood, Litter, Soil
    - BGandAG Deadwood,
  - Default Views
    - Stocks
    - Stock Changes
      - Total Delta Ecosyst
      - Total Delta DOM
      - Total Delta Biomas
      - SP Total Delta Bion
      - PI Total Delta Biom
      - OA Total Delta Bior
      - BE Total Delta Bion
      - Annual Carbon Stoc
    - Age classes
    - Advanced Views
      - NPP and NEP
      - NBP
      - GHG Emissions
      - Disturbance Emissi
      - Disturbance Emissi

Results Same Grid

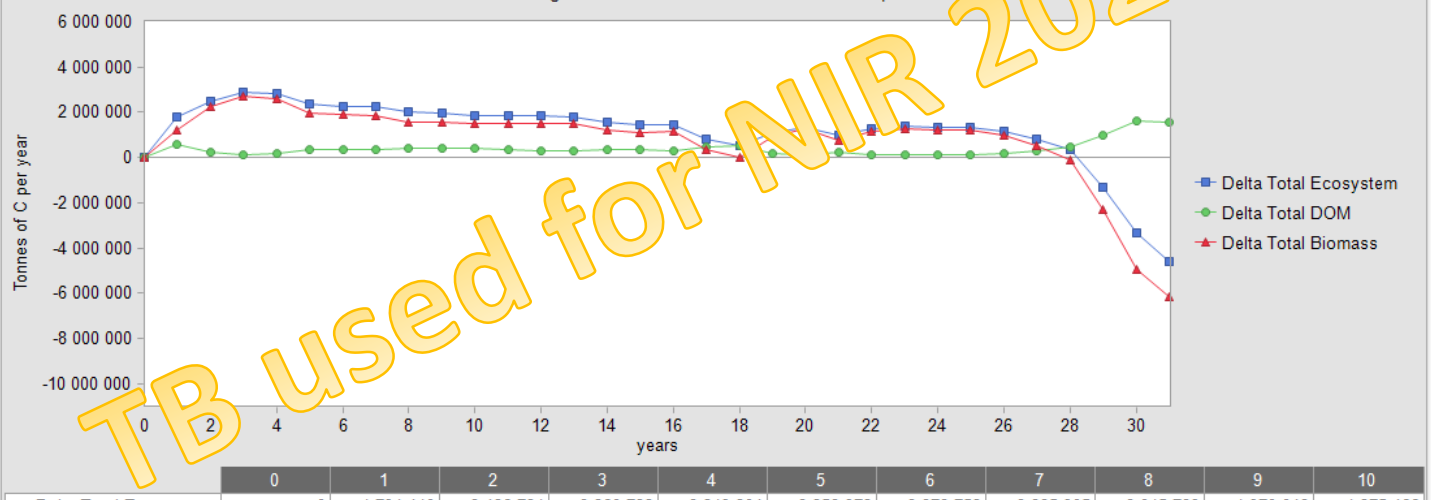
- ForNIR1 Default Simulation Ass

Results

(Deadwood, Litter, Soil C) {1} | (GHG Emissions) {1} | (NPP and NEP) {1} | (Total Delta Ecosystem) {1} | **(Annual Carbon Stock Changes) {1}**

File Copy To Clipboard View Tools Help

Annual Carbon Stock Changes for ForNIR1 Default Simulation Assumption Run#1



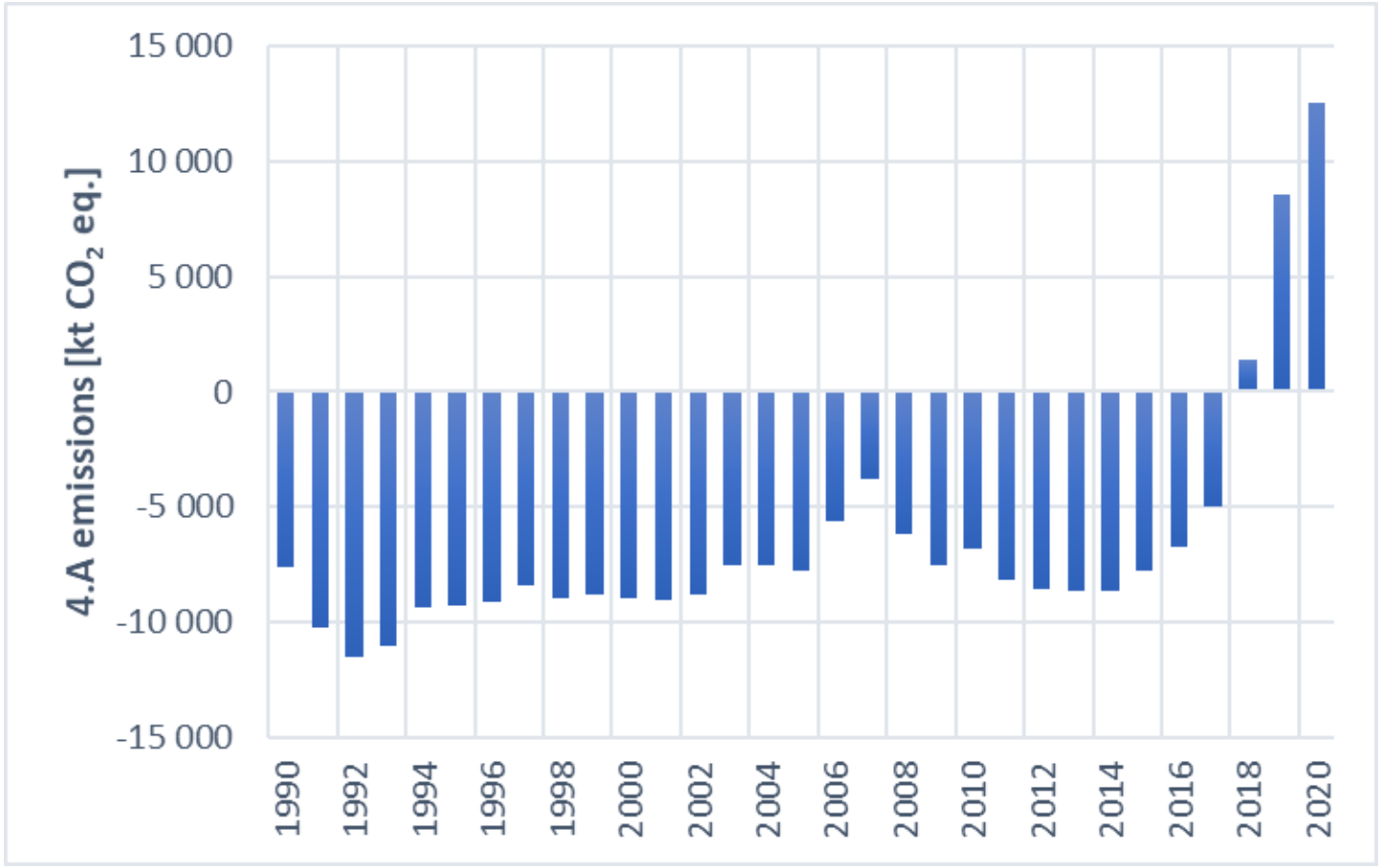

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Delta Total Ecosystem | 0 | 1 791 410 | 2 486 731 | 2 860 733 | 2 819 304 | 2 352 973 | 2 272 758 | 2 225 905 | 2 015 729 | 1 970 042 | 1 875 466 |
| Delta Total DOM | 0 | 588 419 | 249 071 | 144 181 | 203 291 | 369 394 | 381 270 | 369 860 | 434 860 | 428 082 | 396 301 |
| Delta Total Biomass | 0 | 1 202 991 | 2 237 660 | 2 716 552 | 2 616 013 | 1 983 579 | 1 891 487 | 1 856 045 | 1 580 869 | 1 541 960 | 1 479 166 |

Divide By Exp Refresh Gra Tabl Rep



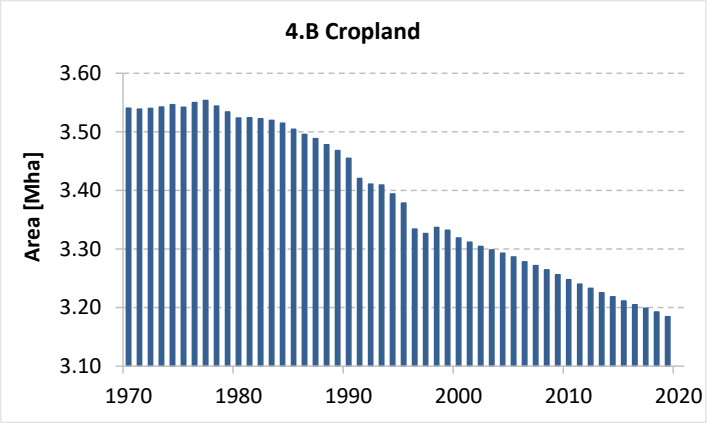
* KULL, S. J., G. J. RAMPLEY, S. MORKEN, J. M. METSARANTA, E. T. NEILSON a W. A. KURZ, 2016. *Operational-scale Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3) version 1.2: user's guide. 2016.* [online] [vid. 2019-12-16]. ISBN 978-0-660 048987. https://cfs.nrcan.gc.ca/publications?id=36556

# 4.A Forest land

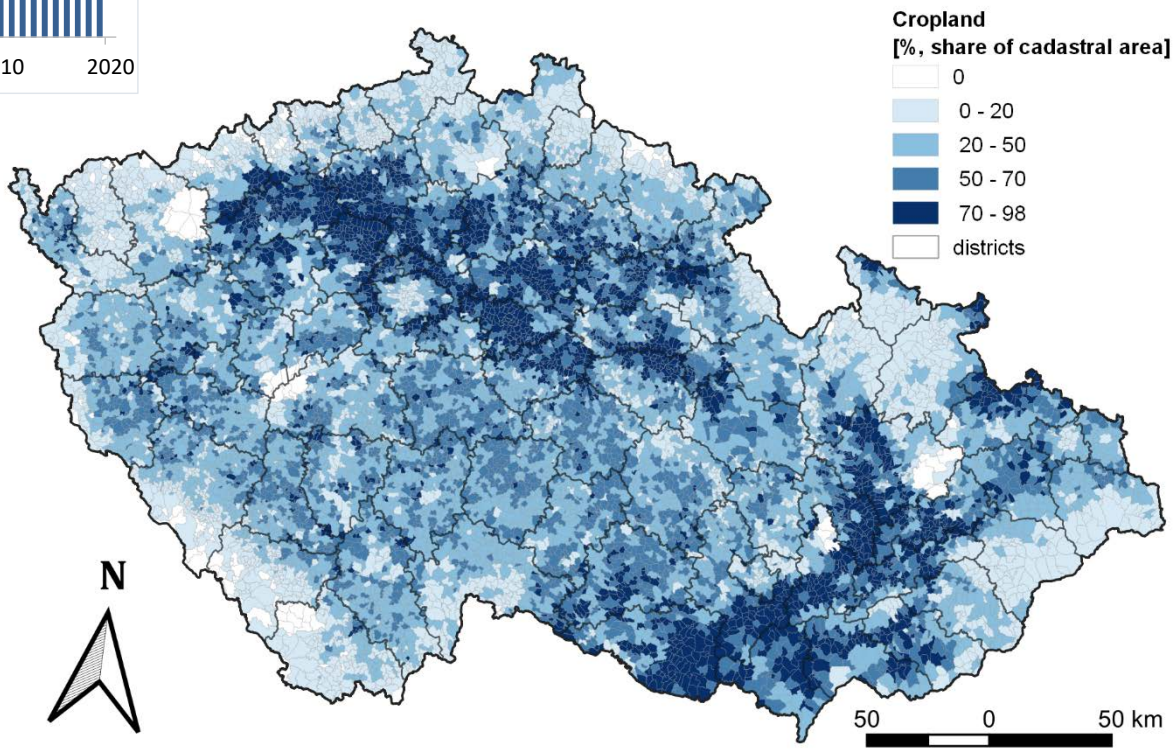



*IFER, preliminary data*

# 4.B Cropland




- The largest land-use category, but its share has decreased from 44 % in 1990 to 40 % in 2020



# 4.B Cropland – Data sources

ČÚZK | State Administration of Land Surveying and Cadastre

- **Czech Office for Surveying, Mapping and Cadastre (COSMC)**
  - official source of information about areas of categories of 4.B.1 according to cropland management (arable land, gardens, hop fields, orchards, vineyards)
  - official source of identifications of land-use changes

- **Czech Statistical Office (CzSO)**
  - information about area of arable land fallow (category of 4.B.1)

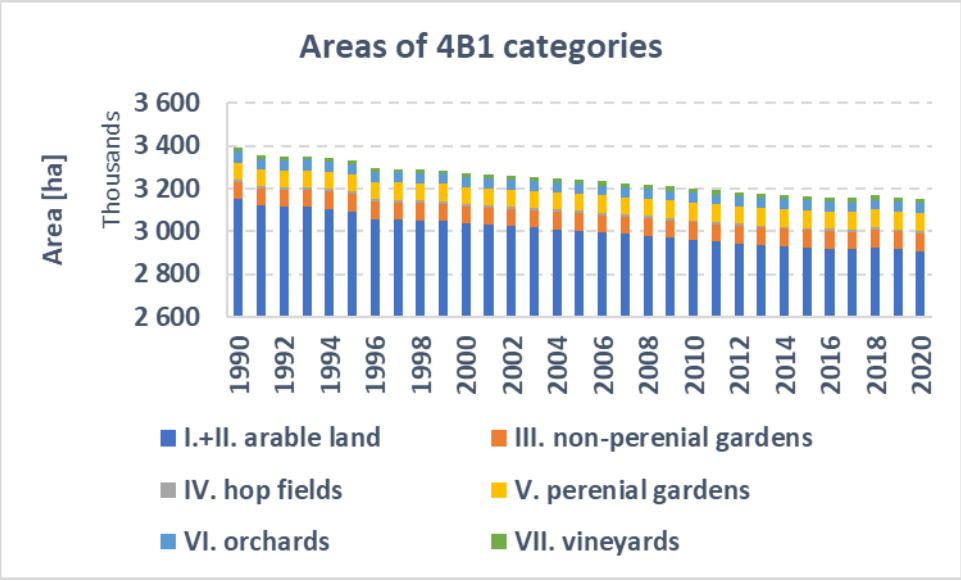
CZECH STATISTICAL OFFICE

- **Research Institute for Soil and Water Conservation (RISWC)**
  - vector map of topsoil organic carbon content

Výzkumný ústav meliorací a ochrany půdy, v.v.i.

# 4.B Cropland – Activity data

- Area of 7 categories of 4.B.1 (COSMC, CzSO)
  - arable land no fallow, arable land fallow, non-perennial gardens, hop fields, perennial gardens, orchards, vineyards
- Area of land-use changes, land converted to Cropland (COSMC)
- Average carbon stock on cropland soil (RISWC)
- Relative stock change factors for different cropland management (CS, D)

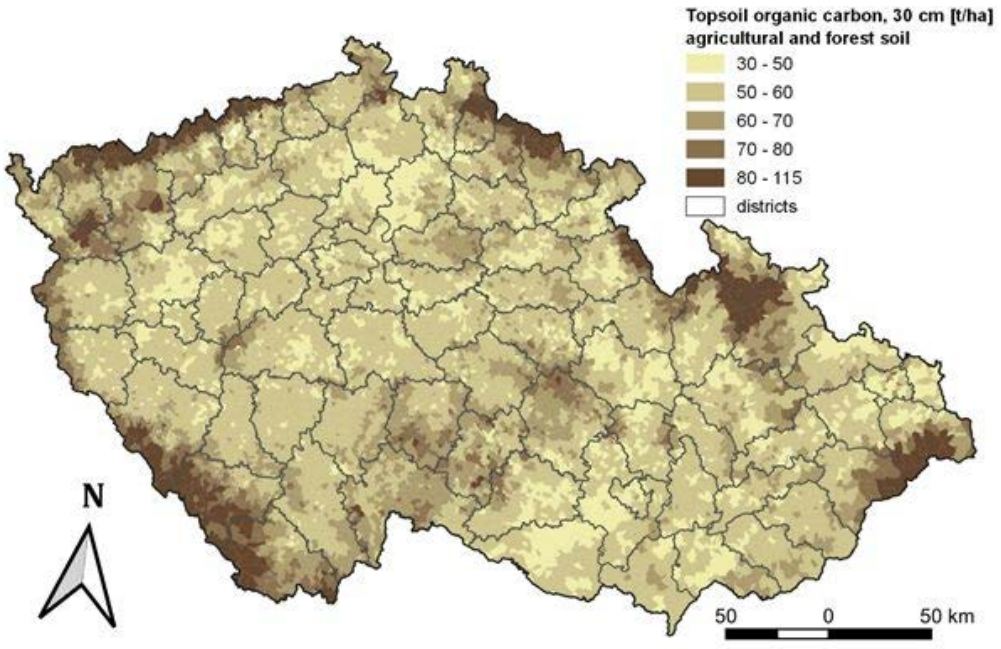


# 4.B.2 – Activity data for category Land converted to Cropland

- **Land-use changes areas:**
  - annual changes, accumulated changes (20 years), cumulative areas (COSMC)
- **Carbon stock on soil in individual cadastral units:**
  - explicitly on forest land soil (FMI)

    and cropland soil (RISWC)
  - implicitly on grassland soil

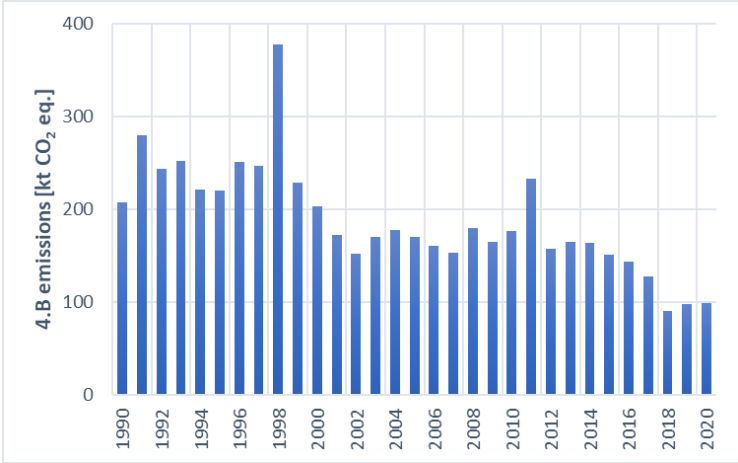
    and settlements soil



# 4.B Cropland - Calculations

## 4.B.1 – Carbon stock change (CSC) in pools:

- CSC in living biomass - perennial cropland
- CSC in soil




## 4.B.2

### 1) Carbon stock change (CSC) in pools:

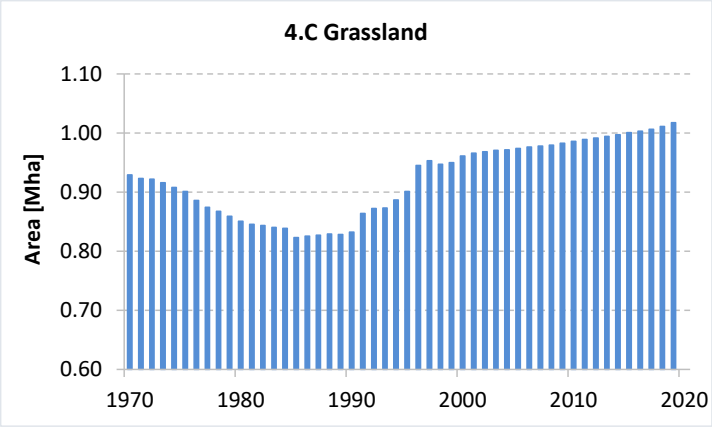
- CSC in living biomass
- CSC in dead organic matter (DOM)
  - dead wood and litter
- CSC in soil

### 2) N2O emission from land-use changes FL and GL to CL

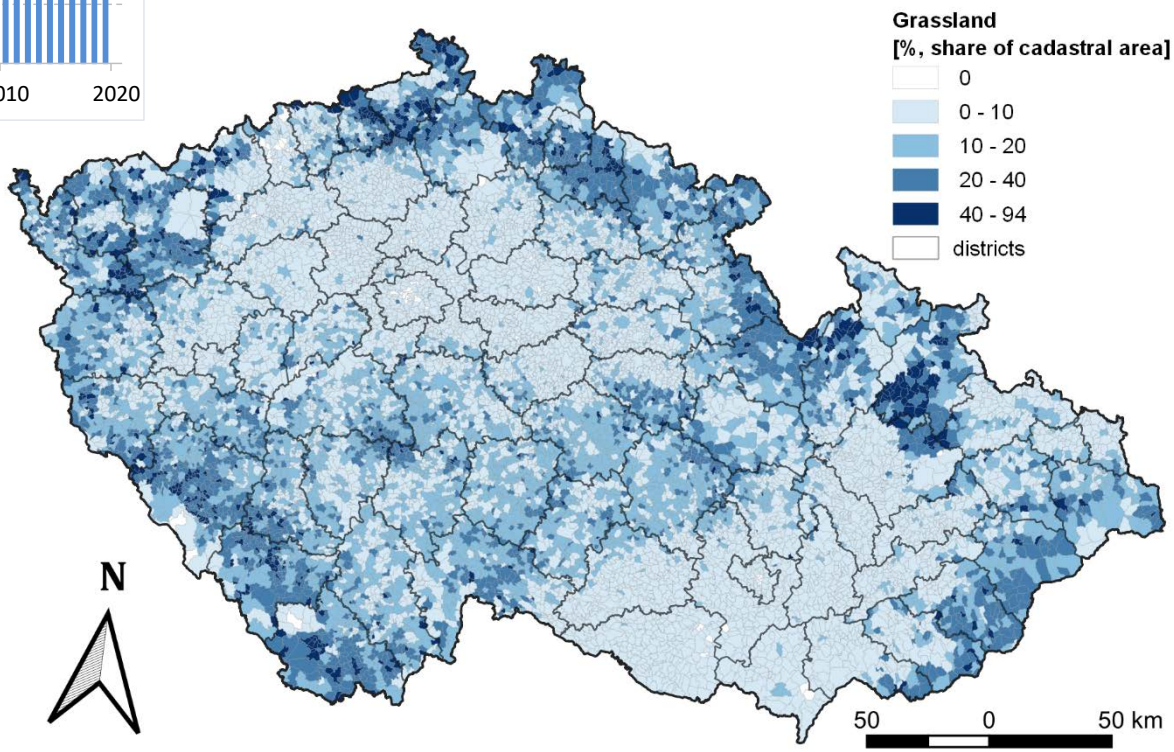
- Direct N2O emission due to mineralization
- Indirect N2O emission from atmospheric deposition of volatilized N

*IFER, preliminary data*

# 4.C Grassland




- Covered 13 % of the country in 2020, up from 10,6 % in 1990



# 4.C Grassland – Data sources

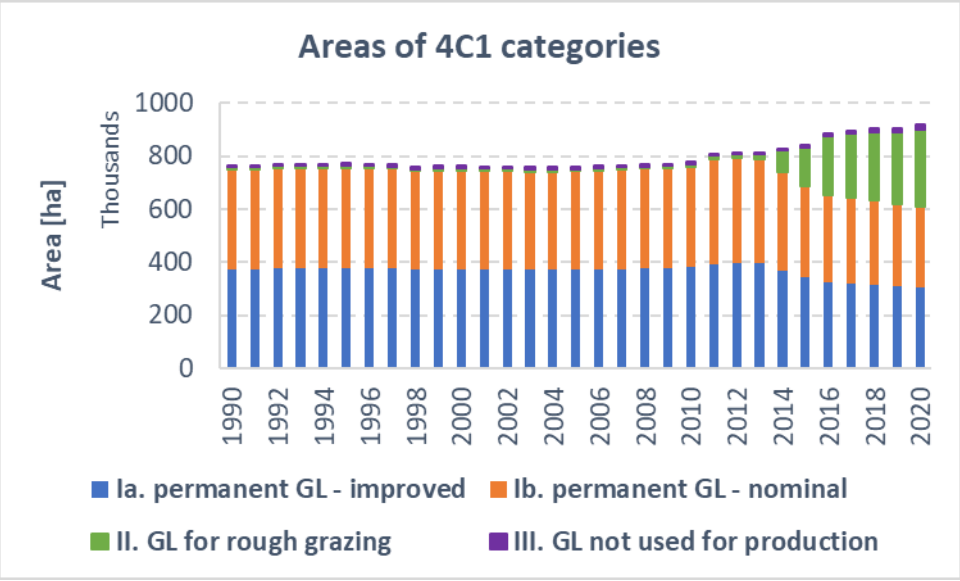
- **Czech Office for Surveying, Mapping and Cadastre (COSMC)**
  - official source of identifications of land-use changes

- **Czech Statistical Office (CzSO)**
  - Integrated Farm Survey (categories of 4.C.1 according to grassland management)

- **Research Institute for Soil and Water Conservation (RISWC)**
  - vector map of topsoil organic carbon content

# 4.C Grassland – Activity data

- Area of 4 categories of 4.C.1 (CzSO)
  - improved permanent grassland, nominal permanent grassland, grassland for rough grazing, grassland not used for production
- Area of land-use changes, Land converted to Grassland (COSMC)
- Average carbon soil on grassland soil (RISWC)
- Relative stock change factors for different grassland management (D)



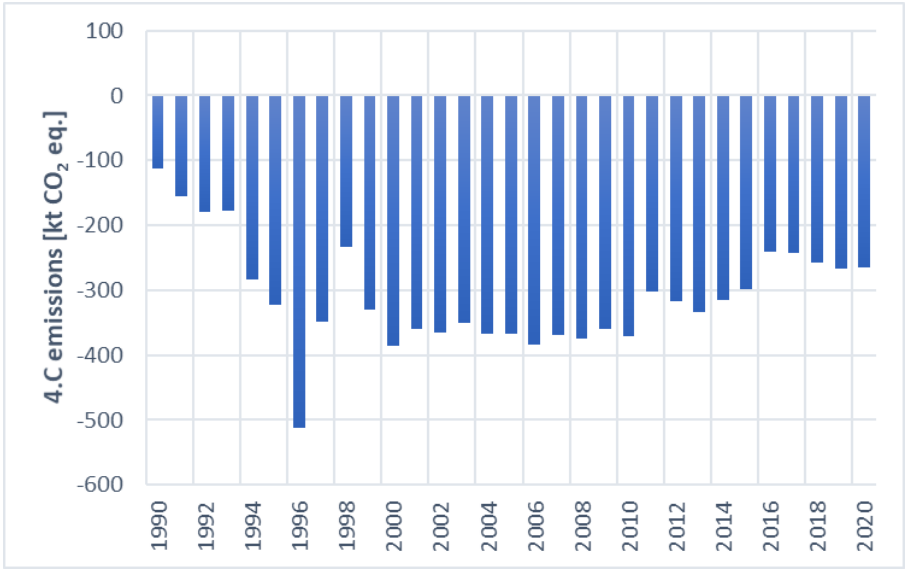
# 4.C Grassland - Calculations

**4.C.1 – Carbon stock change in pools:**

- CSC in soil

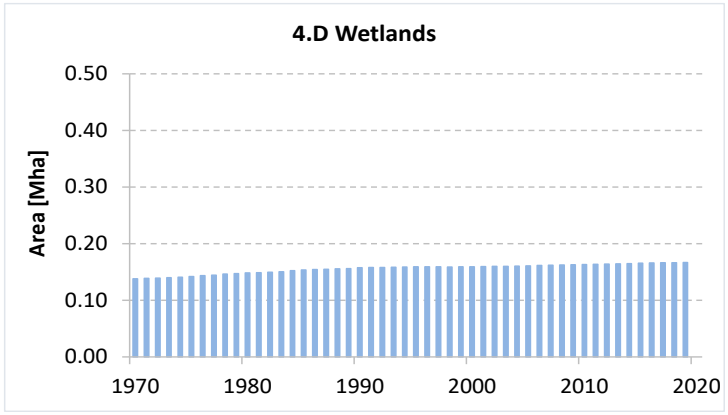
**4.C.2 - Carbon stock change (CSC) in pools:**

- CSC in living biomass
- CSC in dead organic matter (DOM)
  - dead wood and litter
- CSC in soil

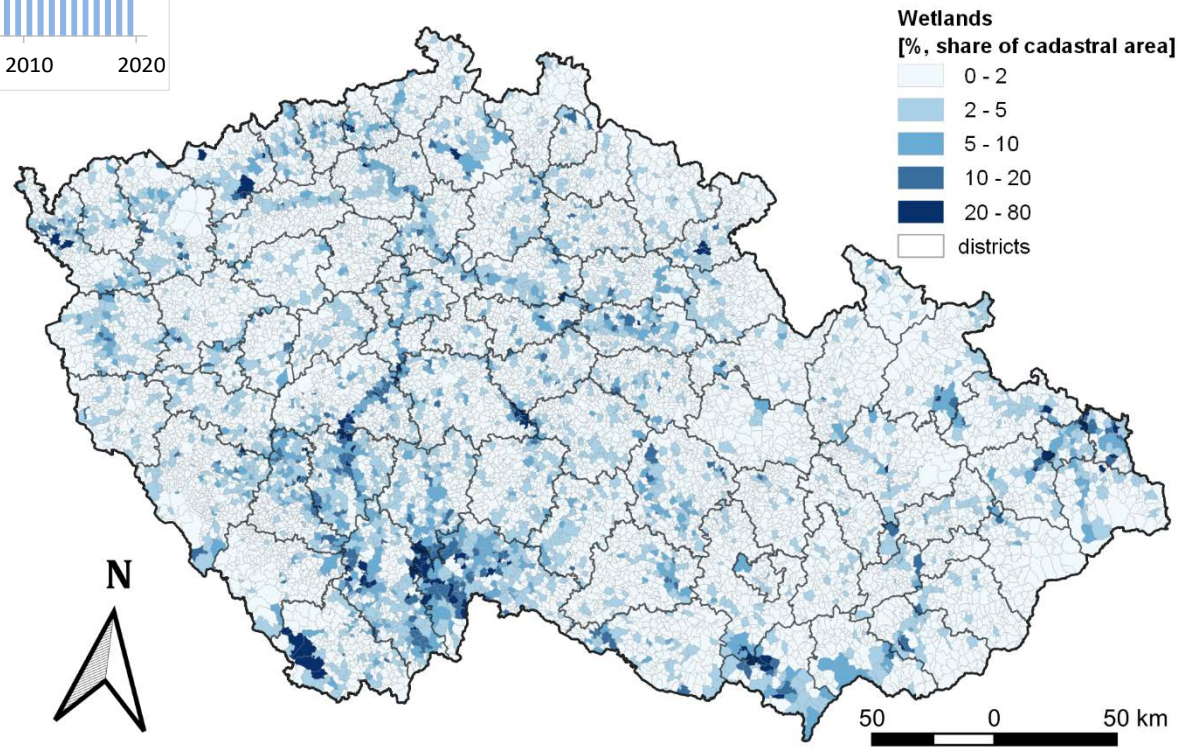



*IFER, preliminary data*

# 4.D Wetlands

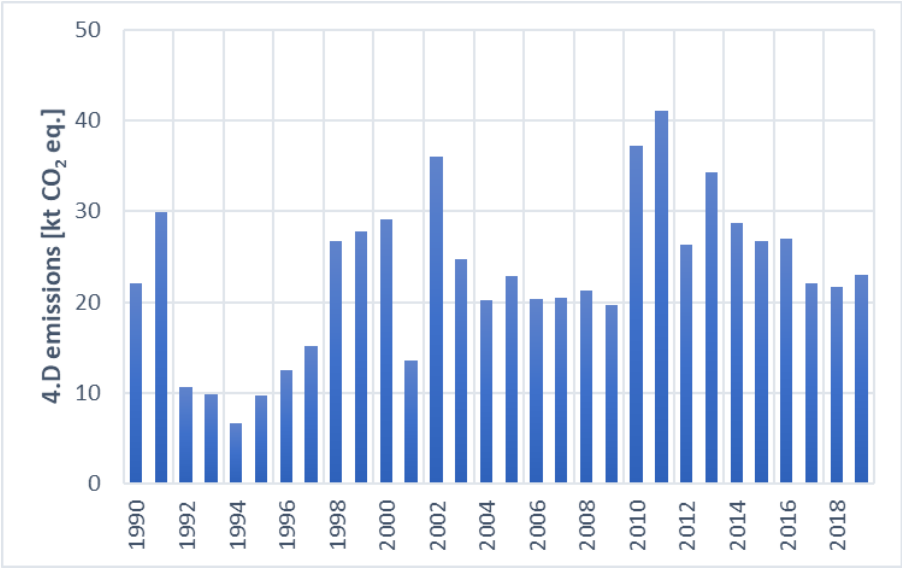



- As defined, they cover 2,1 % of the country



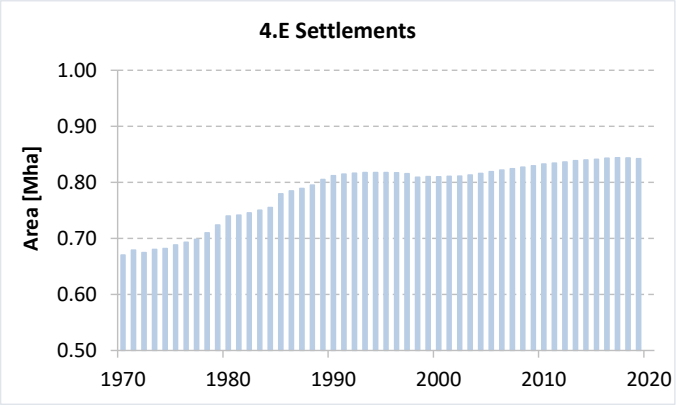
# 4.D Wetlands – AD, Calculations

- **Emission estimation only for 4.D.2 Land converted to Wetlands**
- **Activity data:** Land-use changes areas:
  - annual changes, accumulated changes (20 years), cumulative areas (COSMC)
- **Calculations:** Carbon stock change (CSC) in pools:
  - CSC in living biomass
  - CSC in dead organic matter (DOM)

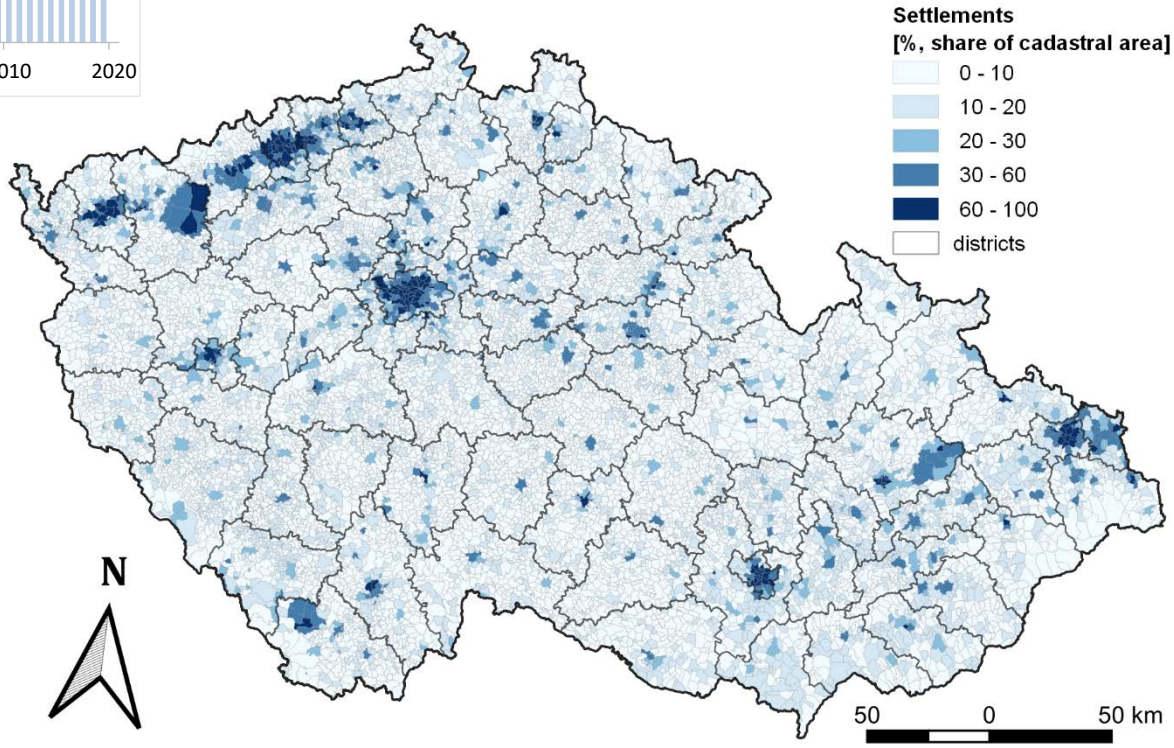



*IFER, preliminary data*

# 4.E Settlements

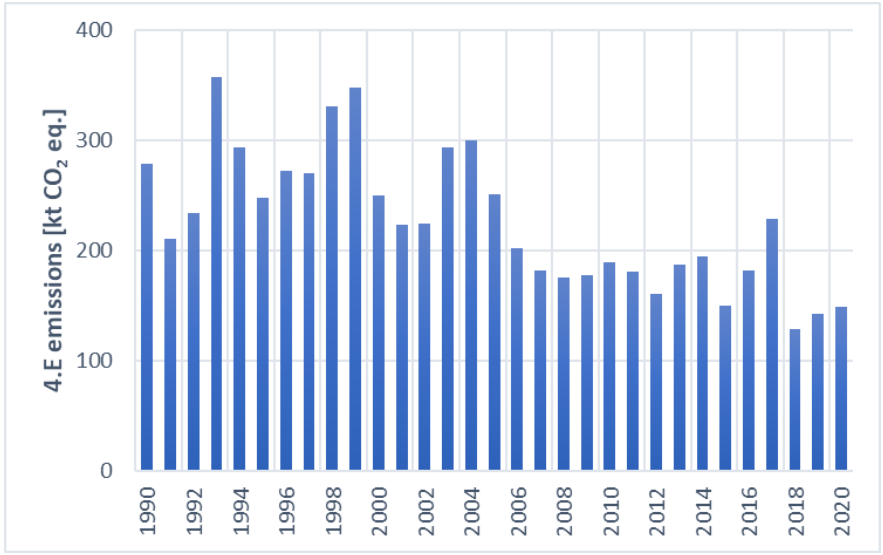



- Covering 10,7 % of the country in 2020 and increasing



# 4.E Settlements– AD, Calculations

- **Emission estimation only for 4.E.2 Land converted to Settlements**
- **Activity data:** Land-use changes areas:
  - annual changes, accumulated changes (20 years), cumulative areas (COSMC)
  - Carbon stock on soil in individual cadastral units
- **Calculations:** Carbon stock change (CSC) in pools:
  - CSC in living biomass
  - CSC in dead organic matter (DOM)
  - CSC in soil




*IFER, preliminary data*

# 4.G Harvested Wood Products

The contribution of HWP is mandatorily included by Decision 2/CMP7 in emission inventories under UNFCCC and KP since the 2015 inventory submission

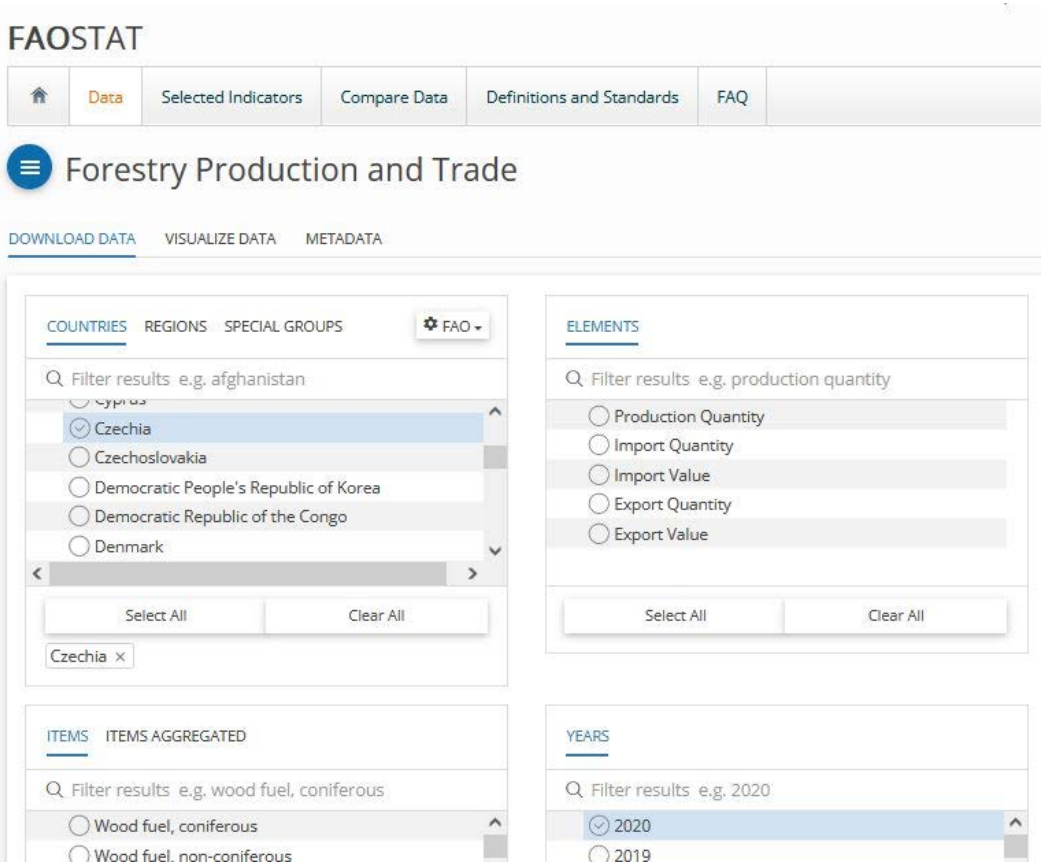
- **specific non land-use category**

## Data sources:


- Food and Agriculture Organization of the United Nations (FAO)
  - official source of information about Forestry production and trade
  - the database contains data on the production and trade in roundwood and in primary wood and paper products for all countries in the world

# 4.G Harvested Wood Products – activity data

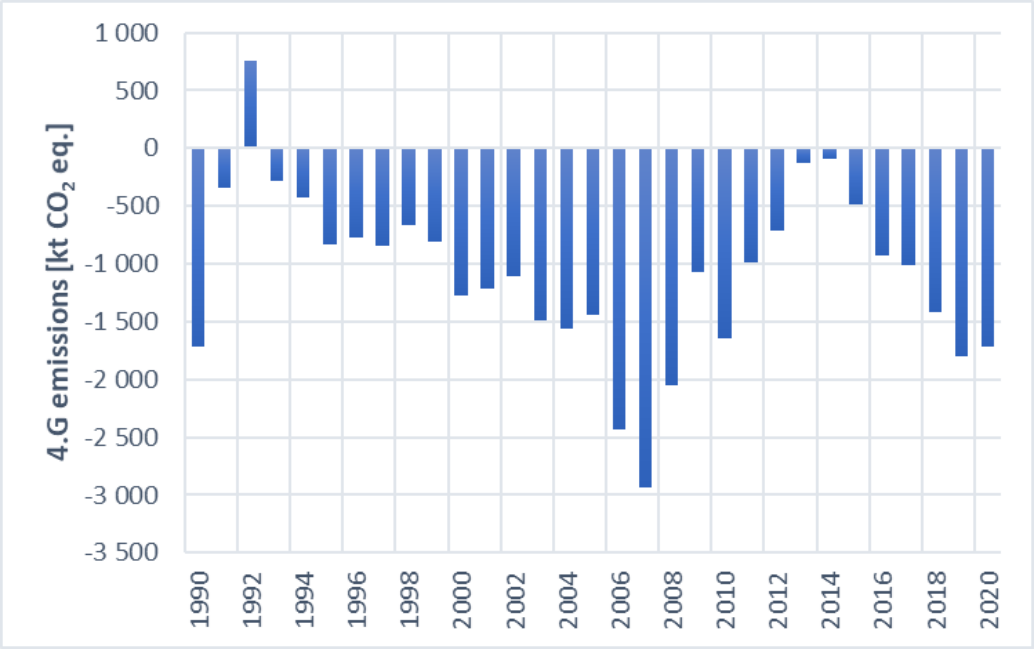
- Production, import and export of:
  - **sawnwood**
  - **wood-based panels**
  - **paper and paperboard**



# 4.G Harvested Wood Products

## Calculation:

- **only domestically produced and consumed HWP**
- method of first order decay (default half-life constants)




*IFER, preliminary data*

# Quality assumption/Quality control

- IFER experts provide internal routine technical support (data, spreadsheets, reports)
- The consistency of AD is crosschecked with information from other sources (Czech Statistical yearbook versus documents and data from Ministry of Agriculture, Ministry of the Environment)
- Update of calculation spreadsheets in cooperation with data specialist (technical point of view)
- Close cooperation with experts from MoA and MoE regarding specific issues (projections), assumptions on emission reduction, missing data

# Thank you for your attention!

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