

Understanding and enabling analysis of land use change, and estimation of accurate area of land conversions & Examples of remote sensing based GHG inventories

1st workshop style training, 8-10 January, Ankara

“Technical Assistance for Developed Analytical Basis for Land Use, Land Use Change and Forestry (LULUCF) Sector”

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Australia's monitoring system – description (NIR2018)

- ***Approach 1 for CL, GL, WL, SL, and OL*** (from supplementary spatial information/statistics) and ***Approach 3 for FLrFL, Conv to FL*** (satellite mapping);
- ***detailed protocol of remote sensing specifications as*** the exact way images are acquired, processed and classified ***for land cover change through extensive pilot testing to ensure time series consistency of methods***, and the provision of spatially accurate land cover change data through time;
- core is **remote sensing programme** used to identify forest lands and changes in forest cover: **series of automated analytical tools** and are **quality controlled through inspection** by trained operators to determine if these changes are due to human activity and are followed by land use change (e.g. forest clearing for agriculture, mining or urban development).
- time series on **annual basis using Landsat satellite data** (collected by MSS, TM, ETM+ and OLI sensors)

Australia's monitoring system - particularities

- maps are able to detect **fine scale changes in forest cover at a 25m by 25m resolution**;
- time series of national maps of forest cover extends across **25 time epochs from 1972 to 2016** and has been assembled on an annual basis since 2004.
- most of the areas without forest cover that have entered the monitoring system continue to be classified as “forest” provided that the **time since forest cover loss is shorter than the number of years within which tree establishment is expected**; and
- As an **interim estimate** for reporting purposes, a small proportion of the area being monitored is assumed to have undergone a land use change, proportion is based on historical observations (land use modelling exercise).
- see Australia **NIR 2018**, at: <https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/national-inventory-submissions-2018>

New Zealand's Geospatial System for GHG inventory

- **Approach 3** for land all land use categories;
- comprises servers for **spatial database storage, management, versioning and running web-mapping applications**;
- covered years **1990, 2008, 2012, 2016**;
- **interpolated linearly** between mapping dates, however, some of the land-use changes make use of surrogate data sets to better reflect land-use change trends within these periods;
- see **highlights** in the report on “Land Use and Carbon Analysis System SATELLITE IMAGERY INTERPRETATION GUIDE FOR LAND-USE CLASSES 2ND EDITION (LUCAS)” Ministry of Environment, New Zealand (<http://www.mfe.govt.nz/publications/climate-change/land-use-and-carbon-analysis-system-satellite-imagery-interpretation>)

Swiss's aerial photo based system

- aerial photos

For the reconstruction of the land use conditions in Switzerland during the inventory period four datasets were used:

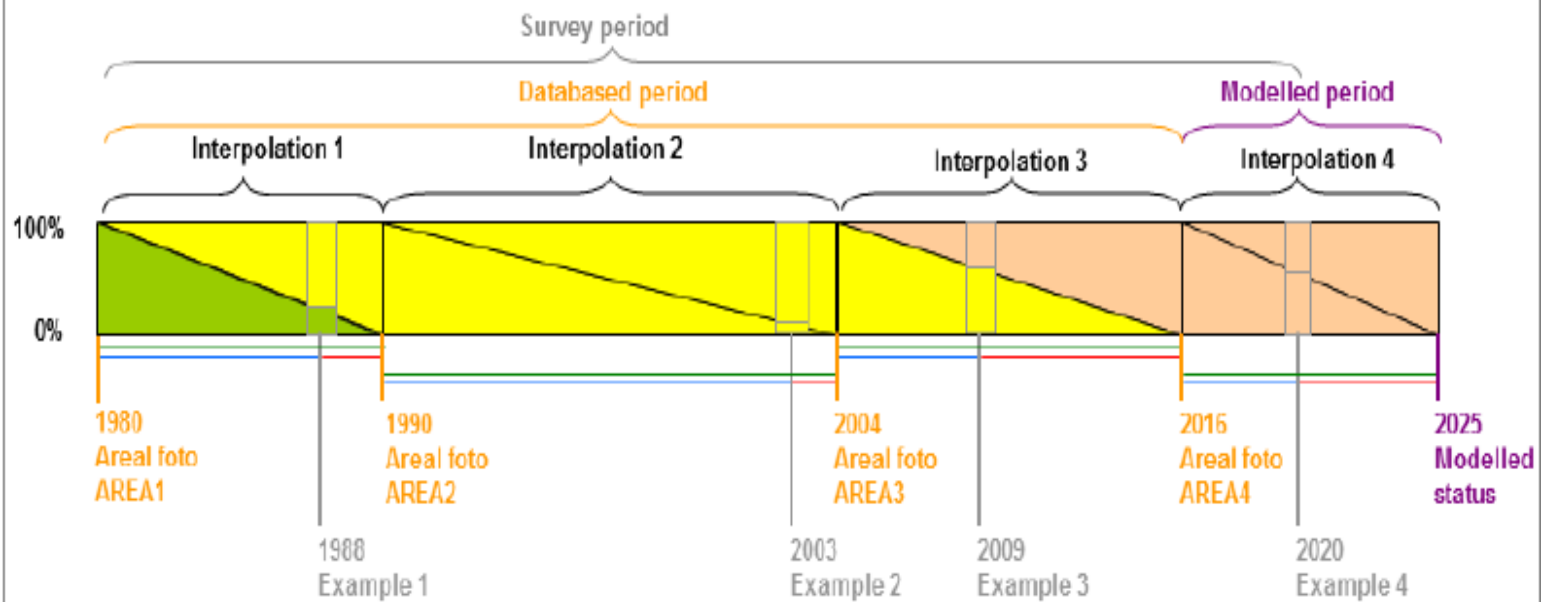
- Land Use Statistics "1979/85" (AREA1), status: completed
- Land Use Statistics "1992/97" (AREA2), status: completed
- Land Use Statistics "2004/09" (AREA3), status: completed
- Land Use Statistics "2013/18" (AREA4), status: 36% of territory processed.

All historical datasets were simultaneously (re-) interpreted, each hectare basis

The website <https://map.geo.admin.ch> allows a visualization of the completed AREA surveys

Swiss' aerial photos based system

Land-use status for the years between two data collection dates can be calculated by linear interpolation – **random application to one year over the concerned period**



Example 1:

$y_{diff} = 1990 - 1980 = 10$
 $y_{before} = 1988 - 1980 = 8$
 $y_{after} = 1990 - 1988 = 2$

Calculations:

Percentage „Cropland ₁₉₈₈ “ = (y_{after} / y_{diff}) * 100	„State 1988“
Percentage „Surrounding of Buildings ₁₉₈₈ “ = (y_{before} / y_{diff}) * 100	

Example 2:

$y_{diff} = 2004 - 1990 = 14$
 $y_{before} = 2003 - 1990 = 13$
 $y_{after} = 2004 - 2003 = 1$

Calculations:

Percentage „Surrounding of Buildings ₂₀₀₃ “ = (y_{after} / y_{diff}) * 100	„State 2003“
Percentage „Surrounding of Buildings ₂₀₀₃ “ = (y_{before} / y_{diff}) * 100	

Example 3:

$y_{diff} = 2016 - 2004 = 12$
 $y_{before} = 2009 - 2004 = 5$
 $y_{after} = 2016 - 2009 = 7$

Calculations:

Percentage „Surrounding of Buildings ₂₀₀₉ “ = (y_{after} / y_{diff}) * 100	„State 2009“
Percentage „Buildings ₂₀₀₉ “ = (y_{before} / y_{diff}) * 100	

Example 4:

$y_{diff} = 2025 - 2016$
 $y_{before} = 2020 - 2016$
 $y_{after} = 2025 - 2020$

Calculations:

Percentage „Buildings ₂₀₂₀ “ = (y_{after} / y_{diff}) * 100	„State 2020“
Percentage „Buildings ₂₀₂₀ “ = (y_{before} / y_{diff}) * 100	

USA's national system

- **National Resources Inventory**

- is a **statistically-based survey** conducted by the USDA Natural Resources Conservation Service and is designed to assess soil, water, and related environmental resources on non-federal lands;
- The NRI has a **stratified multi-stage sampling design**, where primary sample units are stratified on the basis of county and township boundaries. Within a primary sample unit (typically a 160 acre [64.75 ha] square quarter-section), three sample points are selected according to a restricted randomization procedure. Each point in the survey is assigned an area weight (expansion factor) based on other known areas and land-use information;
- NRI survey utilizes data derived from **remote sensing imagery and site visits** in order to provide detailed information on land use and management, particularly for Croplands and Grasslands;

- (combined with) **Forest Inventory and Analysis**

- achieved every five to 14 years
- has three phases;
- Phase 1 refers to **collection of remotely-sensed data (either aerial photographs or satellite imagery)** primarily to classify land into forest or non-forest and to identify landscape patterns like fragmentation and urbanization;

- **National Land Cover Dataset** - a supplementary database to account for land not accounted for the others two - Land Cover Change Products for 2001, 2006, and 2011 (Landsat Thematic Mapper imagery at a 30-meter resolution)