Landesforstinventar
Inventaire forestier national
Inventario forestale nazionale
Inventari forestal naziunal

Processing and analysis of national forest inventory data -the current Swiss and Czech systems

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Content

- The Swiss NAtional Forest Inventory Data Analysis System (NAFIDAS)
  - Development and customers
  - Current system
  - Defining estimator calculation
- The Czech database and data analysis solution
  - The previous and current approach in brief

NAFIDAS principles

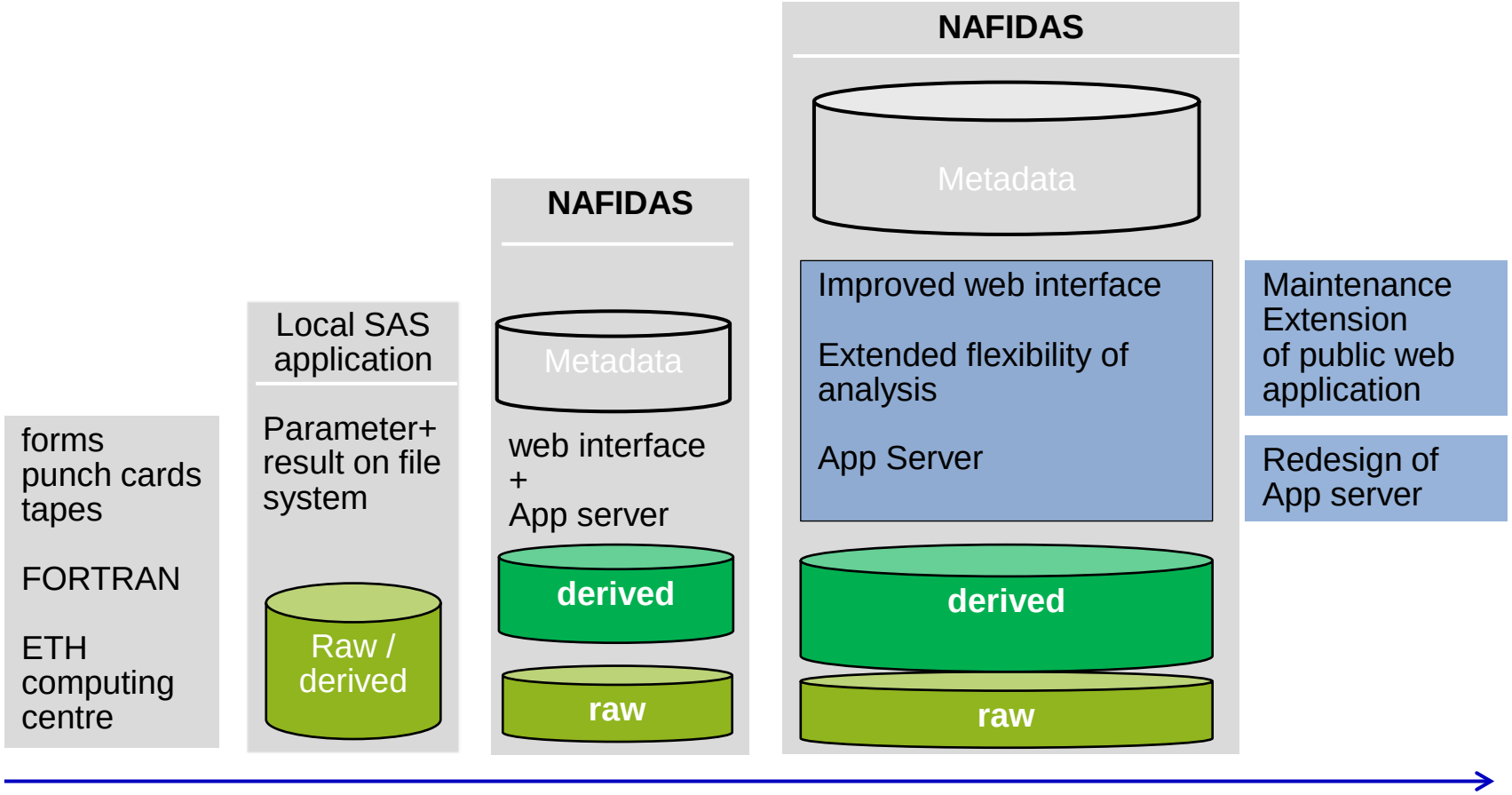
Main requirements

- Stakeholder: flexible, sustainable and well maintainable system
- User: fast access to NFI data, user friendly definition and search functions
- Technical: sustainable logic for input, storage and output of data

Questions

- How to maintain high data quality (reproducibility, transparency, security…)?
- How can NFI results be transparently offered to a broad user community?
- How to balance invested resources and benefits for the customer?

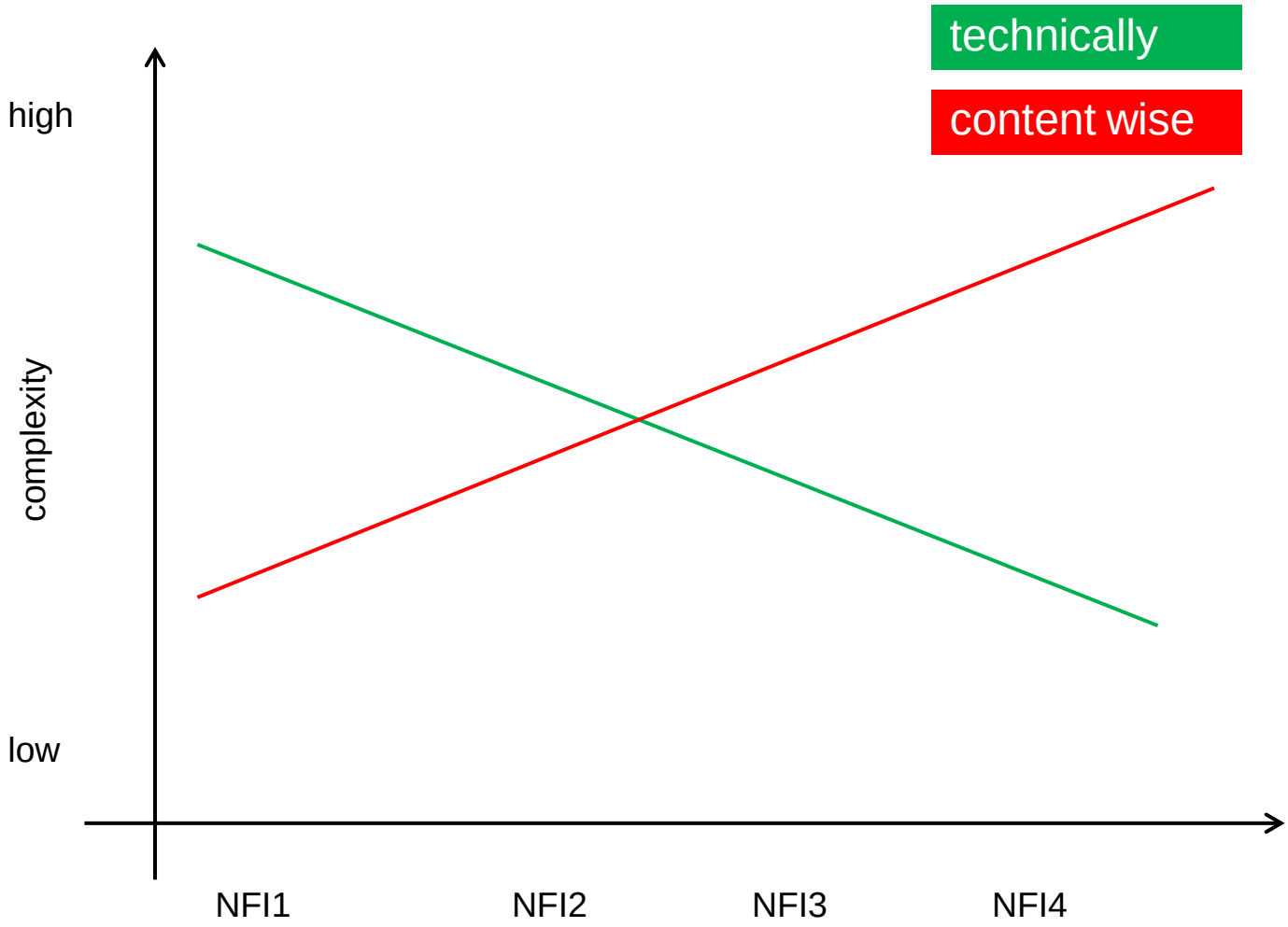
History of LFI data analysis systems



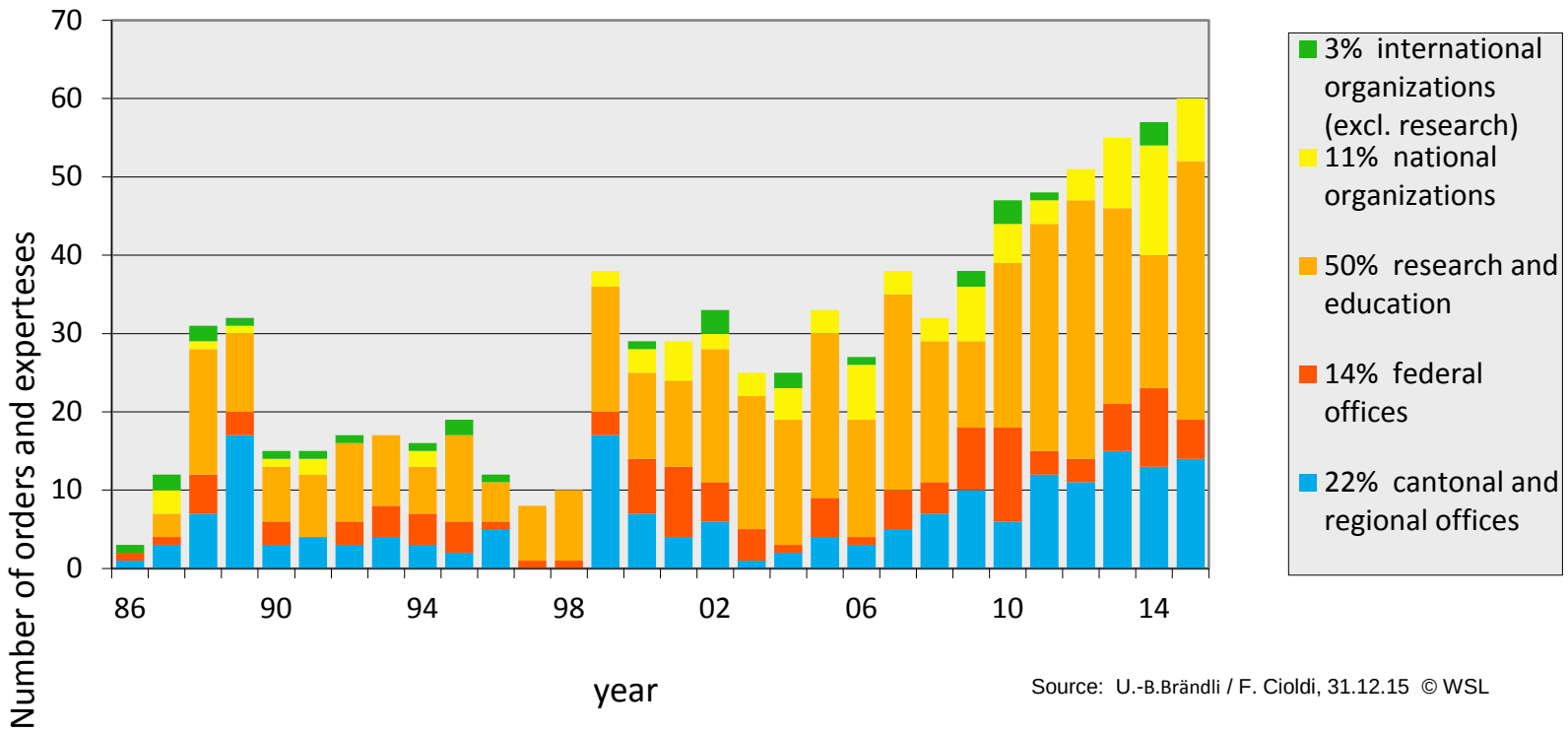
Source: Traub et al. 2016 (in prep.) © WSL

NFI1	NFI2	NFI3	NFI4 (permanent field survey)	2016-
1983–85	1993–95	2004–2006	2009-2017	2020

Development of system complexity
- the internal user scope -



Specific data supplies and analyses for customers

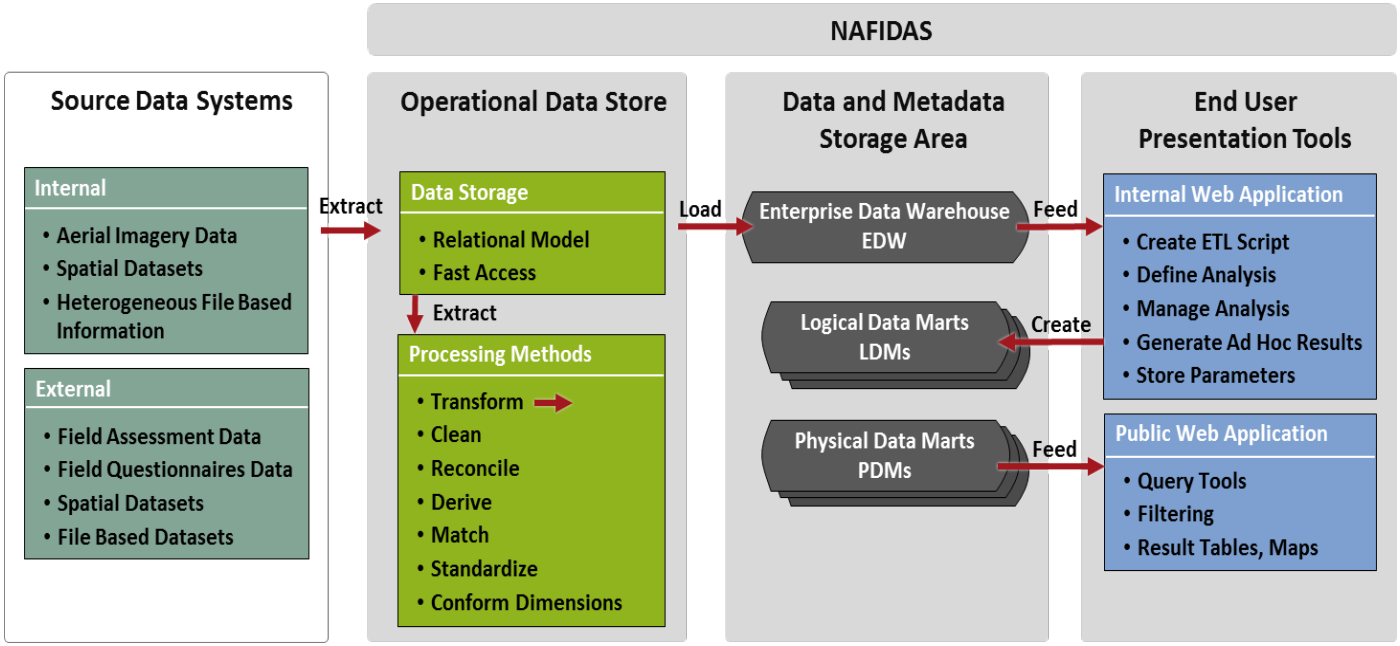


Source: U.-B.Brändli / F. Cioldi, 31.12.15 © WSL

Since 2000: increase of about 30 to 60 orders per year.

- Increase: Orders from cantonal offices and research organisations
- Stable: Orders from federal offices and international organisations
- Volatile: Requests from national organisations

The NAFIDAS data warehouse



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- EDW Enterprise data warehouse (hosts all ‘derived’ data of LFI-type inventories)
- LDM Logical data mart (created according to parameter set, basis for estimator calculation)
- PDM Physical data mart (set of result tables, permanently stored)

EDW tables – applying strict rules is key

Data Warehouse

Level 1

CLA				Plot Table
PlotID	InvID	Col A	Col B	...
1	0	—	—	...
2	0	—	—	...
3	0	—	—	...
...	...	...	...	...

Level 2

WAA				Inventory Plot Table
PlotID	InvID	Col M	Col N	...
1	85	—	—	...
2	85	—	—	...
3	85	—	—	...
1	92	—	—	...
3	92	—	—	...
...	...	...	...	...

Level 3

BAA					Inventory Tree Table
PlotID	InvID	TreeID	Col S	Col T	...
1	85	101	—	—	...
1	85	102	—	—	...
1	85	103	—	—	...
2	85	104	—	—	...
3	85	105	—	—	...
1	92	101	—	—	...
1	92	102	—	—	...
3	92	105	—	—	...
3	92	127	—	—	...
...	...	...	...	...	...

Metadata Storage

Generate

Structure Generating Scripts – Variables

- Defines exactly one column
- Limit the semantic scope of all values in this column

Example

Col S — Creation of column S

Insert

Record Inserting Scripts

- One script per table and inventory
- Insert records for assigned inventory with according identifier fields

Example

All tree records of inventory no. 92 inserted with their IDs

Update

ETL Scripts

- One script per variable and inventory
- Calculate and update all values for a defined column restricted to the records of the assigned inventory

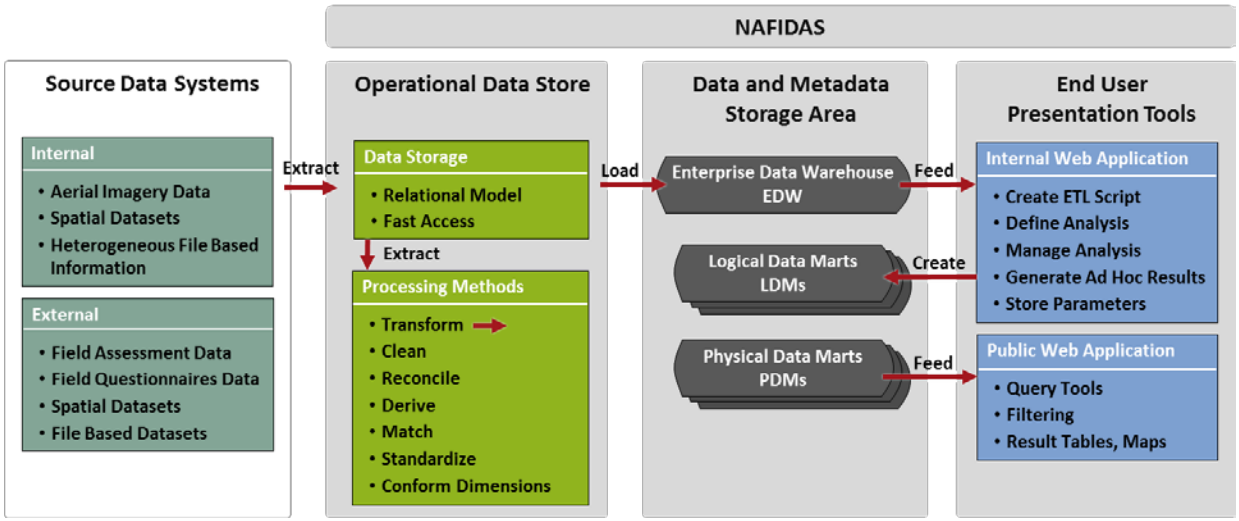
Example

Column S values being updated on all tree records of inventory no. 92

Source: Traub et al. 2016 (n prep.) © WSL

Key properties in terms of efficiency and reproducibility

1. **Loading the EDW is separated from ad hoc queries**
2. **ETL as well as analysis Definition is controlled by metadata**
3. **(Public) access to PDMs does not require data analysis**



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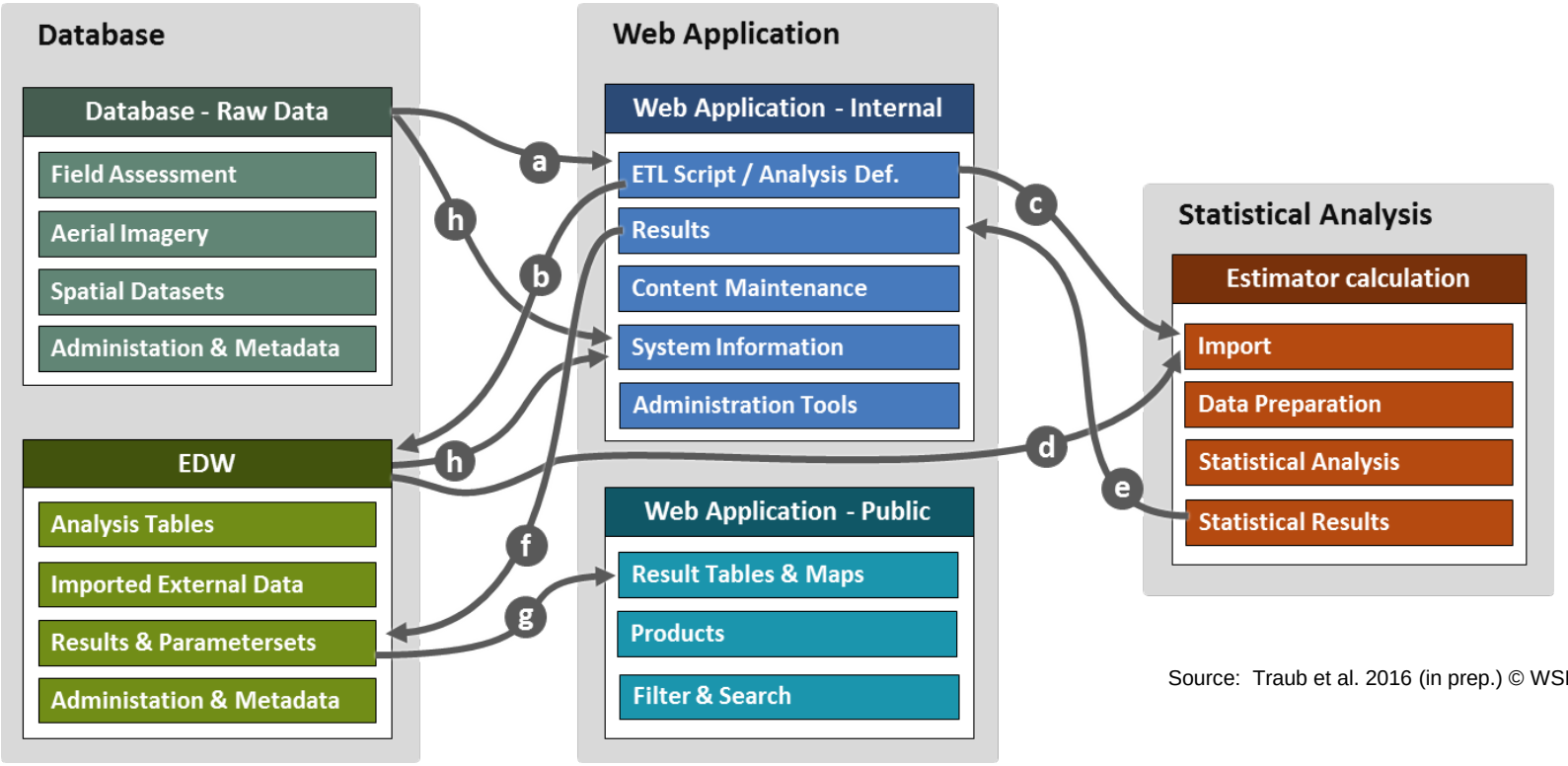
Definition of analysis / estimator calculation



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(c) define analysis and send parameter set to Application server (CGI)

(d) import data (basis for LDM)

(e) send results back to web application (html)

NAFIDAS definition of an analysis

Auswerte-Parameter festlegen

Auswertungsart

- Differenzauswertung
- Veränderungsauswertung
- Zustandsauswertung

Inventur / Periode

- LFI4b [452]
- LFI4a [451]
- LFI3 [350]
- LFI2 [250]

Zielgrösse

Zielgrösse filtern

- Waldfläche ha [44]
- Vorrat m3 [21]
- Gesamtvorrat m3 [4]
- Stammzahl Anz [73]
- Basalfläche m2 [92]
- Biomasse der lebenden Bäume kg [18]
- Biomasse der lebenden Bäume ohne vpps kg [173]

☐ nur im Web öffentlich Publizierte anzeigen

Stichprobennetz

- Netz LFI4 Pensum 2009 - 2010 [1427, N4P12]
- Netz LFI4 Pensum 2009 - 2011 [1428, N4P123]
- Netz LFI4 Pensum 2011 [1521, N4P3]

Auswertungseinheit

- zugänglicher Wald ohne Gebüschwald LFI4 [434, ZWALD]
- zugänglicher Wald ohne Gebüschwald LFI3/LFI4 [1429, ZGWALD34]

LFA.ADAPPZIGR

CODE	TEXT_L01	ZIGRUNIT	TABNR	ADTYPGESHA
21	Vorrat	4	5	1

LFA.ADAPPZIGRSQL

	INVNR	ADAPPZIGR	ZIGRSQL
1	451	21	(vmrd+vpps)*rpstz*ipopleb*ipopbaum
2	15210	21	CASE WHEN duerr IN (1,10) THEN NULL ELSE vmrd*rpstz END

LFA.ADAPPAUSWART, ADINV

LFA.ADAPPZIGR ADAPPZIGRSQL

LFA.ADVAR

Quality: Controlling Parameterisation I

Auswertungsart LFA.ADAPPAUSWART

CODE	TEXT
1	Zustandsauswertung
2	Veränderungsauswertung
3	Differenzauswertung

Inventur / Periode LFA.ADINV

INVNR	INVNAME_L01	INVSTARTDT	INVENDDT
451	LFI4a	10.08.2009	27.11.2011

LFA.ADAPPPARA

ADAPPAUSWART	INVNR	ADAPPZIGR	ADAPPNETVARNR	ADAPPAUSWVARNR
1	451	21	1427	434
1	451	21	1427	1429
1	451	21	1428	434
1	451	21	1428	1429
1	451	21	1521	434
1	451	21	1521	1429

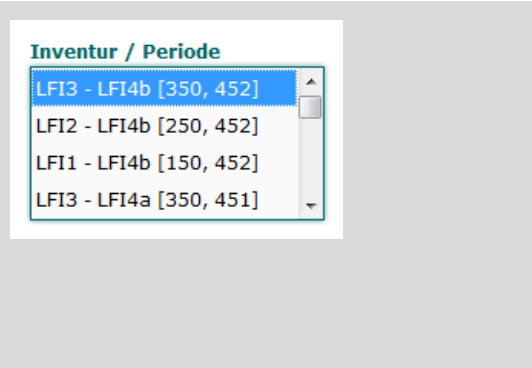
Explanation:
In case state analysis (1) of target variable volume (21) for inventory cycle LFI4a (451) is selected:

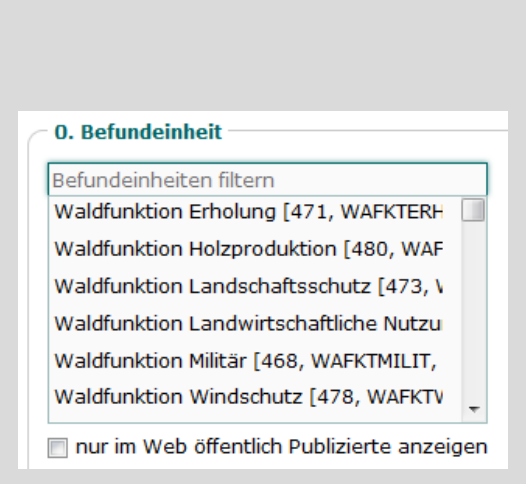
available sampling grids are: 1427, 1428, 1521
available forest domains are: 434, 1429

VARNR	COLCOMMENT
434	[Code] zugänglicher Wald ohne Gebüschwald
1427	[Code] Netz LFI4 Pensum 2009 - 2010
1428	[Code] Netz LFI4 Pensum 2009 - 2011
1429	[Code] gem. zugänglicher Wald ohne Gebüschwald I-34
1521	[Code] Netz LFI4 Pensum 2011

Quality: Controlling Parameterisation II

Internal web application





EDW

350, 452 →

WAFUNKT (forest functions)

CODE	TEXT_L01
1	wood production
2	agricultural use
3	windbreak
4	drinking water protection
5	protection forest
6	protection forest (BSF)
7	protection forest (non-BSF)
8	nature reserve
9	landscape protection

350 ↙ 452 ↘

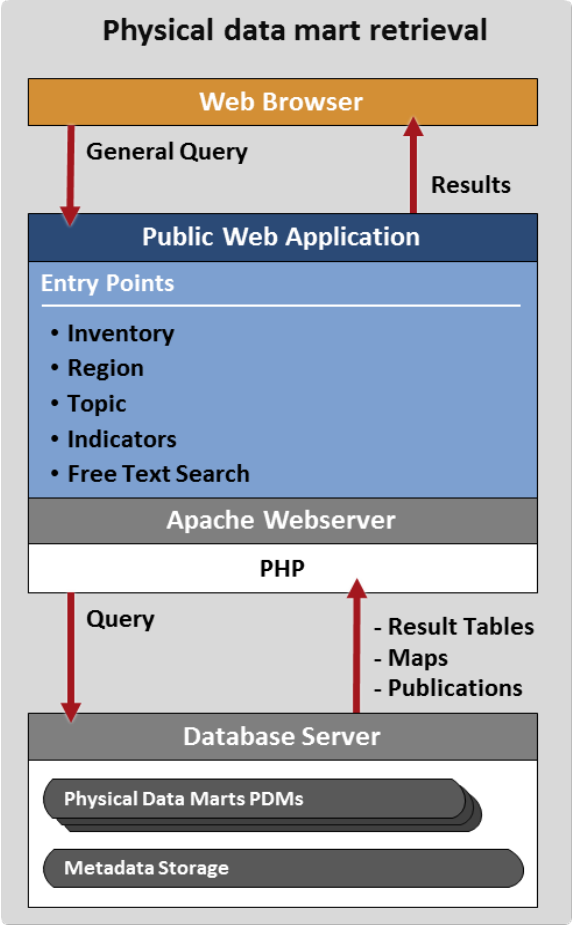
INVNR	WAFUNKT
350	3
350	4
350	6
350	7

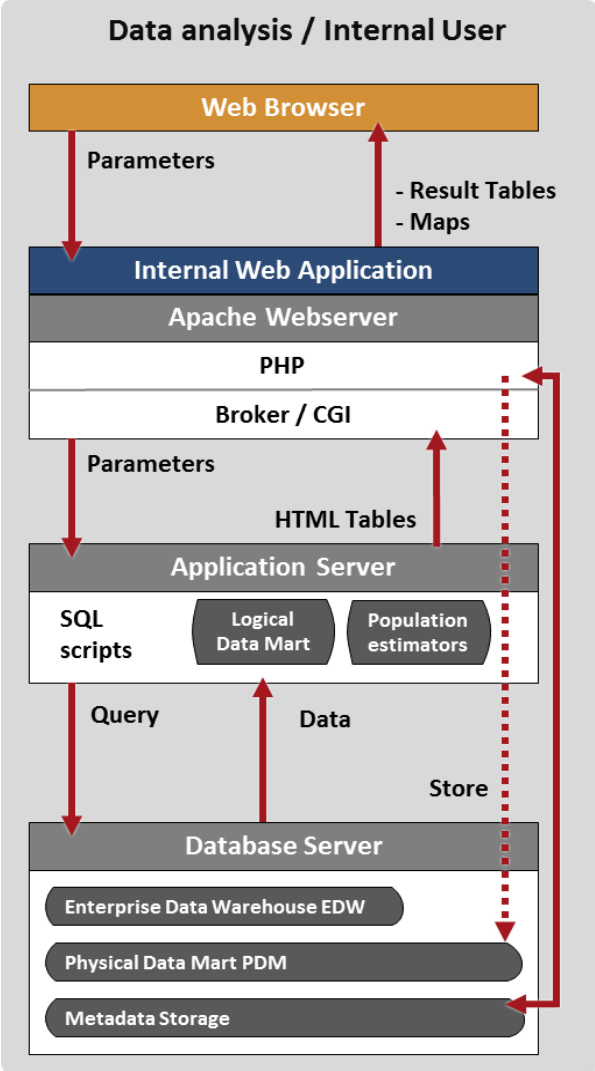
INVNR	WAFUNKT
452	3
452	4
452	5
452	8
452	9

← WAFUNKT

Source: S. Speich 2016 © WSL

NAFIDAS client server system





Source: Traub et al. 2016 (in prep.) © WSL

Result table

NFI4a

volume
lower/higher altitudinal zones · conifers and broadleaves

unit of reference: production region
unit: m³/ha
unit of evaluation: accessible forest without shrub forest
grid: terrestrial grid NFI4 pensum 2009–2011
state 2009/11

regions (known area)

(forest) domain (unknown area)

domains (unknown area)	sub-population	production region											
		Jura		Plateau		Pre-Alps		Alps		Southern Alps		Switzerland	
lower/higher altitudinal zones	conifers and broadleaves	m³/ha	± %	m³/ha	± %	m³/ha	± %	m³/ha	± %	m³/ha	± %	m³/ha	± %
lowlands	conifers	174	8	187	7	273	10	193	11	28	36	177	4
	broadleaves	219	6	187	6	198	10	149	11	195	7	192	3
	total	392	4	373	4	472	6	343	7	223	7	368	2
high altitude areas	conifers	268	8	322	25	351	5	271	4	212	9	282	3
	broadleaves	96	12	71	40	78	11	23	14	33	16	46	7
	total	364	6	393	22	429	5	294	4	245	7	329	3
total	conifers	204	6	191	6	326	5	256	4	130	10	231	2
	broadleaves	179	5	183	6	118	8	48	10	105	8	116	3
	total	383	3	374	4	443	4	304	3	235	5	348	2

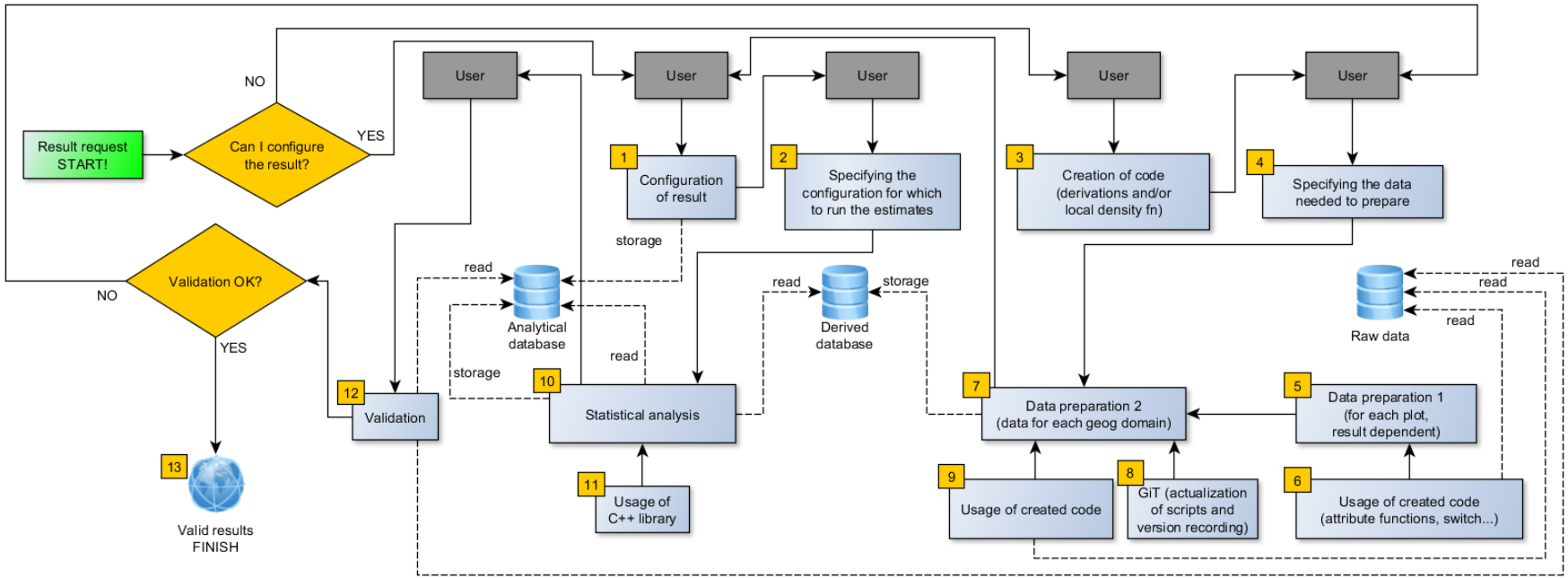
<u>Calculation steps separate per region:</u>

1. volume separate by domains x sub-population (cell)
2. forest area separate by domains (only by sub-population total)
3. ratio of 1 and 2 by domains x sub-population (cell)

CH total values = sum (regions)

The Czech solution

Current state of analytical database in Czech NFI

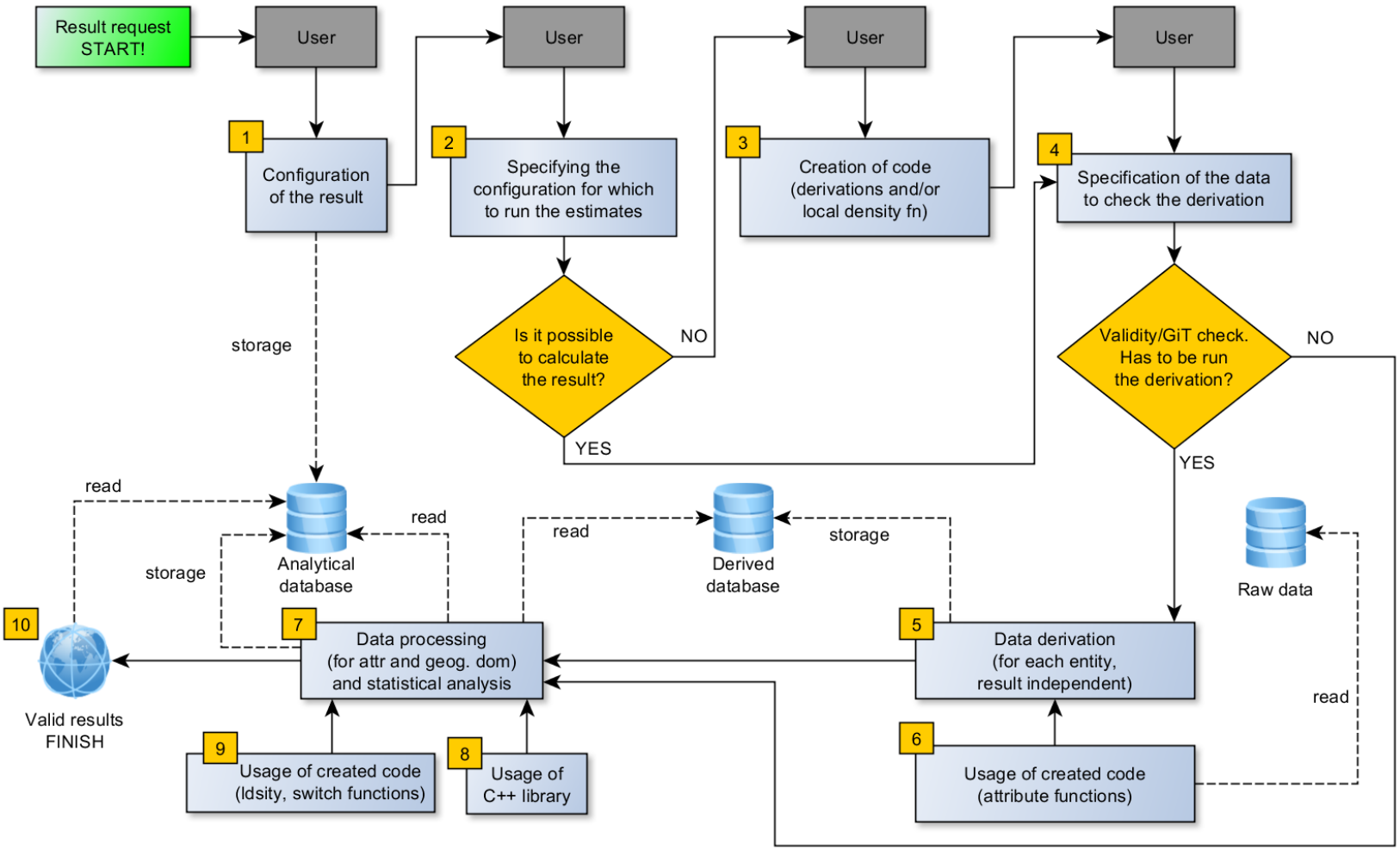


Pros and Cons of the Czech system

- Pros
  - Problematic cases and missing data solved by attribute functions (‘derivations’)
  - “Local density” stored for each plot, geographical and attribute domain
  - GiT versioning system for keeping track of changes in procedures
  - Configuration table where each result is specified
  - Fast calculation of result by C++ library

- Cons
  - If raw data change, difficult to find the cause (within plot)
  - All functions are called “on the fly” – machine time demanding
  - Functions has hard coded attribute sorting (new attribute domain = new function)
  - Repeatedly calling calculations
  - Storing data for attribute and geographic domain (change in 1 plot = recalculation of all data)
  - Fast calculation of result X very slow preparation of data

Proposed improvements inspired by NAFIDAS



Thank you for listening

ANY QUESTIONS?

lfi.ch

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National forest inventory

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- About the NFI
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  - Regions
  - Inventories
  - Criteria and indicators
  - Legacy data
- Services
- Publications
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- Contact

Search for results

go back

help | basket (0)

Searching for: **volume**

Filter results

inventory		theme	
NFI4b	(2378)	annual increment	(1548)
NFI3–NFI4b	(4249)	annual increment*	(573)
NFI3	(2203)	annual mortality	(240)
NFI2–NFI3	(3675)	annual mortality*	(72)
NFI2	(1450)	annual salvage logging	(912)
NFI1–NFI4b	(285)	annual salvage logging*	(228)
show more...		show more...	

classification		region	
altitude (400 m classes)	(432)	biogeographical region	(3169)
altitudinal vegetation zone	(2448)	canton	(2540)
altitudinal vegetation zone (3 classes)	(20)	economic region	(3123)
avalanches SilvaProtect	(660)	forest district (as of 2013)	(1128)
cause of salvage logging	(585)	production region	(3387)
conifers/broadleaves	(3267)	protection forest region	(3123)
show more...			

unit of evaluation	
accessible forest without shrub forest	(2873)
accessible forest without shrub forest NFI1/NFI2	(474)