

Geo874 | FS25
University of Zürich

Databases in the Wild – The Swiss National Forest Inventory NFI

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Mission

Overview

- Recording objective information at the national level about forests
- **Political**, social, economic and **research** purposes
- Data collection is mainly based on a **systematic sample inventory**
- Aim: Provide results for Switzerland as a whole and for larger regions and individual cantons
- Collaboration project of Federal Office of Environment FOEN and WSL

Topics

- Forest area, number of stems, **growing stock**, increment, fellings, biodiversity, protective forest quality, and **socio-cultural services** of the forest
- International climate and forest reporting (e.g. **greenhouse gas** inventory)
- Forest research in general as well as bringing together remote sensing data with field data (ground truth, calibrating models)

Systematic Sample...

Flächen nach Speicherzeitpunkt

(Stand Feldaufnahmen LFI - Pensum 2025)

Ansichts-Auswahl

Suche  

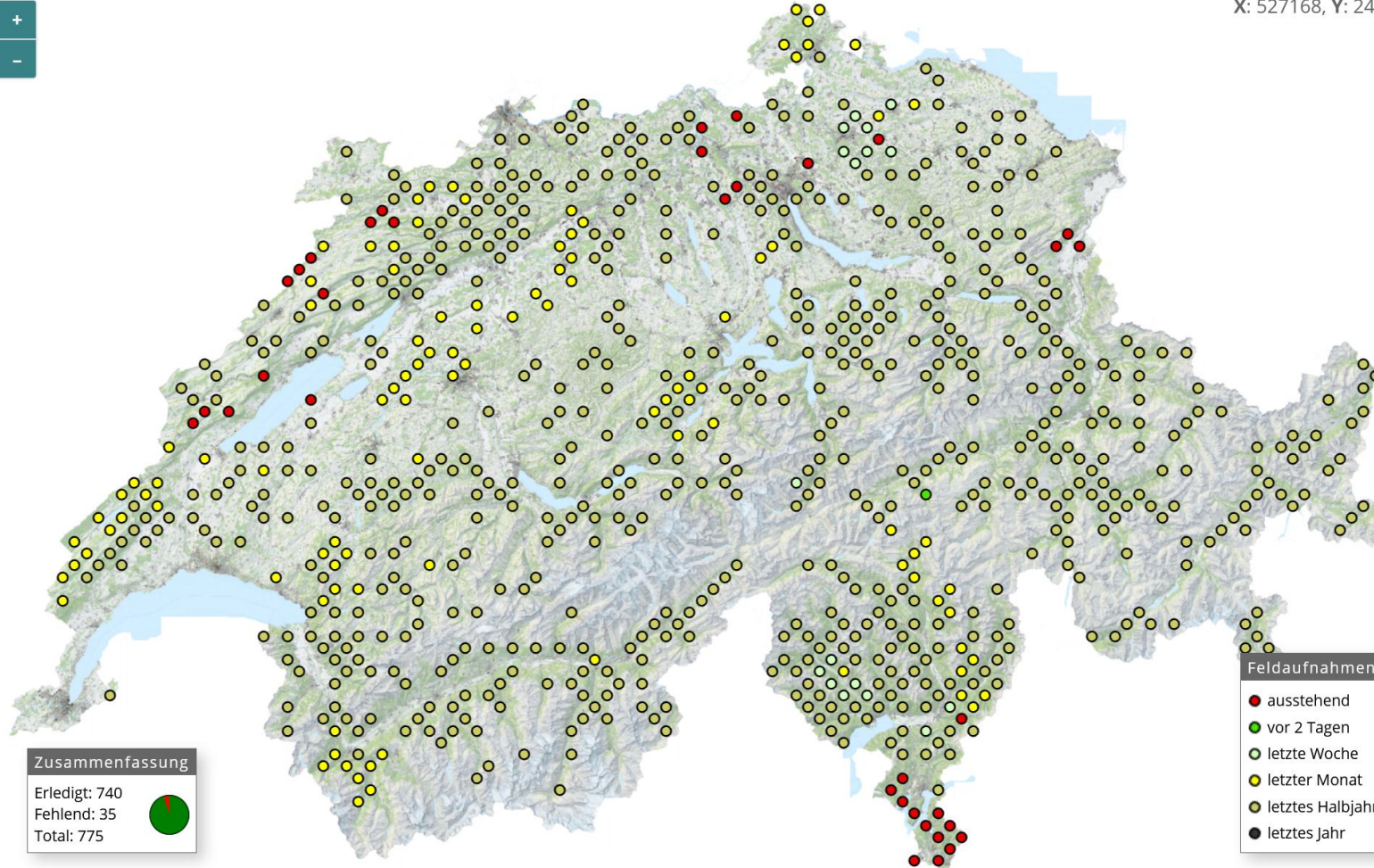
Full Extent

Landeskarte

Luftbild

Kantons Grenzen

X: 527168, Y: 245041



In the Wild...

Field work

- 6'500 sites and 80'000 trees measured along with 300 attributes over 9 years
- Why? Get the base data for further processing.
- Ruggedized Tablets with specialized Java Application (business logic)
- Each plot 2-4 hours of work (includes plot searching)
- Field manual with rules and definitions for the field teams

The essence

- Data transfered to **raw database** at WSL;
- Formalized files/pics being uploaded; then decomposed and spread to the correct tables;
- All databases spatially enabled



In the Office I ...

Deriving

- Raw data is just the beginning; we freeze their state and transform them in a formalized way to a **derived database**;
- Processes to do so are all documented and reproducible; Each value in each formalized table column is defined by a formula; the values can be recalculated at any time;
- The derivations (formulas) itself are stored in the database with helping **metadata**; automatic calculations possible;
- We maintain 2000 derivations sitting as columns and filling values on ~30 tables; examples: wood volume of a tree (column on the derivation-tree table), number giant trees on a plot (column on the derivation-plot table);
- **Dependencies** for each derivation are stored; this leads to a directed acyclic graph (DAG) pattern; the more complex a derivation/formula is the deeper goes the tree;

In the Derivation Database...

Tabelle SQL UPDATE:



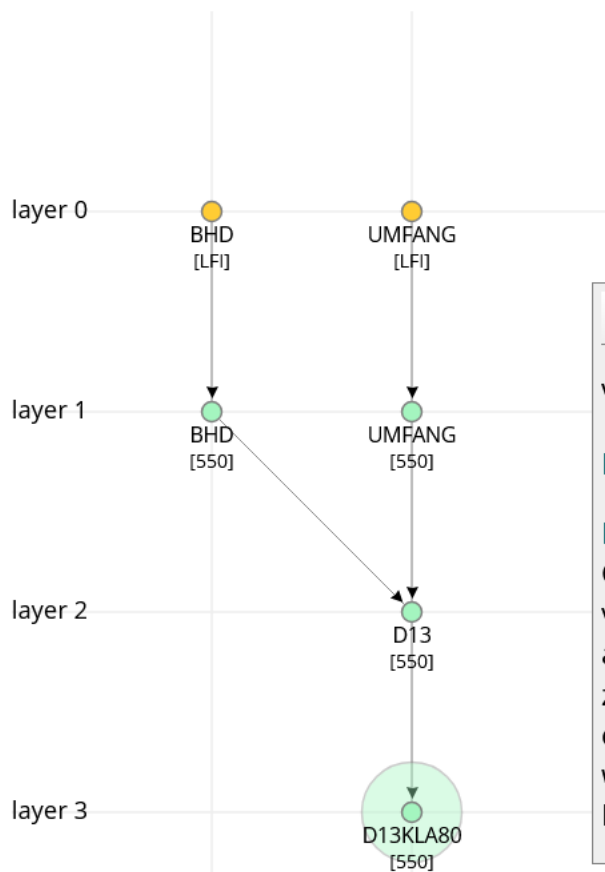
Ctrl+Z Rückgängig, Ctrl+Y Wiederholen, Ctrl+F: Suchen/Ersetzen, Ctrl+G: findNext, Ctrl+Shift+G: findPrevious, Alt+G: gotoLine, [mehr](#)

```
1 v v /*
2   Abhaengigkeit:
3   -----
4   Variable          Inventur
5   D13              550
6   */
7
8 v v UPDATE lfa.baa u
9   SET   u.D13KLA80 =
10      (
11        SELECT CASE WHEN a.D13 = -1 OR a.D13 IS NULL THEN -1
12                   WHEN a.D13 > 0 AND a.D13 <= 80 THEN 1
13                   WHEN a.D13 > 80 THEN 2
14                   ELSE -1
15        END
16        FROM lfa.baa a
17        WHERE a.invnr = 550
18        AND   u.clnr = a.clnr
19        AND   u.invnr = a.invnr
20        AND   u.banr = a.banr
21        AND   u.invnr = 550
22      )
23   WHERE u.invnr = 550;
```

Derivation D13KLA80 – categorizes trees to be a giant tree or not

In the Derivation Database...




 varNr: **1282**, invNr: **550**, selected: **true** 6 Knoten/5 Kanten: ● 2 Rohvariablen ● 4 Ableitungen


Informationen:



Variable D13KLA80 [550]

Beschrieb kurz: Gigant BHD-Klasse ≤ 80 / > 80 cm

Beschrieb lang: Durchmesser eines Probebaumes auf 1.3m Höhe in 2 Klassen mit der Grenze 80cm. Als Eingangsgrösse wird der auf ganze cm abgerundete D13 verwendet, d.h. ein Baum mit einem gemessenem BHD von z.B. 80.9 cm erhält einen abgerundeten D13-Wert von 80 cm und wird folglich der Klasse 'BHD bis 80cm' zugeteilt. Ein nicht auf ganze cm abgerundeter und gemessener Wert von z.B. 80.1 cm würde jedoch bereits der Klasse 'BHD grösser 80cm' zugeteilt. Ab Methode LFI5 werden daher aus Kompatibilitäts-/Vergleichbarkeitsgründen der Ableitung D13KLA80 ebenfalls auf ganze cm abgerundete D13-Werte verwendet.

Derivation D13KLA80 is dependent of D13 and BHD and UMFANG (= calculation chain)

In the Derivation Database...

Derivation Table for Tree Species Occurrence on a Plot

Column	Type	Nullable	Default	Comments
CLNR	NUMBER(6)			[] Clusternummer
INVNR	NUMBER(6)			[] Inventurnummer
VORKEHARTPK	NUMBER(3)			[] Gehölzartencode Primärschlüssel
VORKEHART	NUMBER(3)	-1		[Code] Vorkommende Gehölzart
INVNEOVK	NUMBER(2)	-1		[Code] Invasive und potentiell invasive Neophyten
NEOPHYTVK	NUMBER(3)	-1		[Code] Neophyten
IVKGEHARTPB	NUMBER(1)	-1		[Code] Vorkommende Gehölzart bei den Probestäumen
IVKGEHARTZA	NUMBER(1)	-1		[Code] Vorkommende Gehölzart 40 - 130 cm
IVKGEHARTZAKL	NUMBER(1)	-1		[Code] Vorkommende Gehölzart 0.1 - 11.9 cm BHD
IVKGEHARTZAGR	NUMBER(1)	-1		[Code] Vorkommende Gehölzart 0.1 - 11.9 cm BHD
BART19KLVK	NUMBER(2)	-1		[Code] Baumart (19 Klassen)
Key				
ARTVORKA_PK	Column(s)	Type		
ARTVORKA_PK	CLNR, INVNR, VORKEHARTPK	P		
ARTVORKA_BART19KLVKINV	INVNR, BART19KLVK	R		
ARTVORKA_INVNEOVKINV	INVNR, INVNEOVK	R		
ARTVORKA_IVKGEHARTPBINV	INVNR, IVKGEHARTPB	R		
ARTVORKA_IVKGEHARTZAGRINV	INVNR, IVKGEHARTZAGR	R		
ARTVORKA_IVKGEHARTZAINV	INVNR, IVKGEHARTZA	R		
ARTVORKA_IVKGEHARTZAKLINV	INVNR, IVKGEHARTZAKL	R		
ARTVORKA_NEOPHYTVKINV	INVNR, NEOPHYTVK	R		
ARTVORKA_VORKEHARTINV	INVNR, VORKEHART	R		
Index				
ARTVORKA_PK	Column(s)	Type		
ARTVORKA_PK	CLNR, INVNR, VORKEHARTPK	unique		

Vorkommen von Arten auf der Probefläche

Lookup Tables Constraining the Value Domain

Column	Type	Nullable	Default	Comments
INVNR	NUMBER(10)			[] Inventurnummer
VORKEHART	NUMBER(3)			[Code] Vorkommende Gehölzart
Key				
VORKEHARTINV_PK	Column(s)	Type		
VORKEHARTINV_PK	INVNR, VORKEHART	P		
Index				
VORKEHARTINV_PK	Column(s)	Type		
VORKEHARTINV_PK	INVNR, VORKEHART	unique		

Codebedeutung für Vorkommende Gehölzart

One derivation table with eight derivation columns; all columns constrained with a lookup table;

In the Office II ...

Statistics

- Only derived data and their specific metadata serves as a primary source for the statistical calculations;
- Analysis of the thematic and spatial characteristics of the forest as well as geostatistic;
- Aerea based results (cantons, production regions, ...) based on plot based information coming from systematic sampling in the field
- In addition: more dense grid with aerial photo interpretation for [two phase sampling](#);
- Technology stack: database (oracle, postgresql), python server (flask, gunicorn), webserver (nginx), webapplication (apache, php)

Results of Statistics ...

[i definitions](#)
[? interpretation help](#)
[↓ download](#)
[🌐 display map](#)

NFI5

total number of stems

giant (yes/no) · conifers and broadleaves

regional demarcation: production region

unit: 1000 n

evaluation area: accessible forest without shrub forest

grid: 1.4 km grid, subgrids 1-5

state 2018/26

		production region											
		Jura		Plateau		Pre-Alps		Alps		Southern Alps		Switzerland	
giant (yes/no)	conifers and broadleaves	1000 n	±%	1000 n	±%	1000 n	±%	1000 n	±%	1000 n	±%	1000 n	±%
no	conifers	39081	5	41206	5	71021	4	143278	3	27163	8	321749	2
	broadleaves	45808	4	44826	4	37553	6	48198	5	56633	5	233018	2
	indeterminable	54	74	17	100	17	100	49	58	0	.	137	40
	total	84943	3	86049	3	108591	3	191525	2	83796	4	554904	1
yes	conifers	195	23	318	16	407	14	860	10	286	22	2066	7
	broadleaves	15	71	191	24	48	41	54	38	185	29	493	16
	total	210	22	508	13	455	14	913	10	472	17	2558	6
total	conifers	39277	5	41524	5	71428	4	144138	3	27449	8	323815	2
	broadleaves	45823	4	45017	4	37600	6	48252	5	56818	5	233510	2
	indeterminable	54	74	17	100	17	100	49	58	0	.	137	40
	total	85153	3	86557	3	109045	3	192439	2	84268	4	557462	1

Webapplication for Mapping ...

[back](#)

 table  center  print  export

- ▼ content
- giant (yes/no)
 - conifers and broadleaves
 - n/a
 - n/a
 - conifers
 - broadleaves
 - indeterminable
 - total
 - no
 - n/a
 - conifers
 - broadleaves
 - indeterminable
 - total
 - yes
 - n/a
 - conifers
 - broadleaves
 - indeterminable
 - total**
 - total
 - n/a
 - conifers
 - broadleaves
 - indeterminable
 - total

NFI5

total number of stems

giant (yes/no) · conifers and broadleaves

regional demarcation: canton

unit: 1000 n

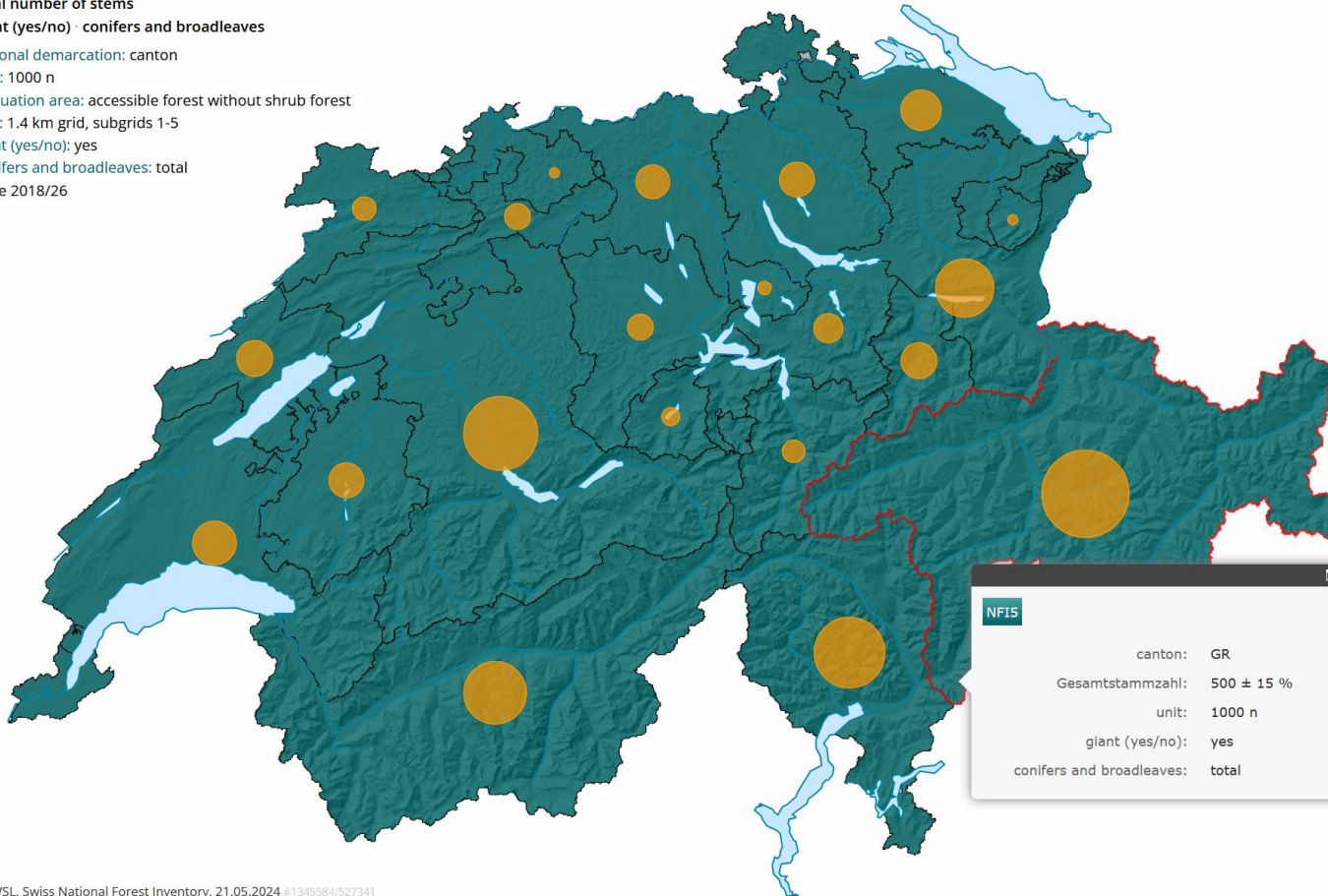
evaluation area: accessible forest without shrub forest

grid: 1.4 km grid, subgrids 1-5

giant (yes/no): yes

conifers and broadleaves: total

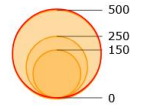
state 2018/26






legend




Gesamtstammzahl

unit: 1000 n



GR: 500 ± 15 %

-  value available
-  not applicable
-  value excluded

-  relief
-  water bodies
-  regional borders

▼ layout

- relief
- lakes
- rivers

NFI5

canton: GR

Gesamtstammzahl: 500 ± 15 %

unit: 1000 n

giant (yes/no): yes

conifers and broadleaves: total

Out of the Office ...

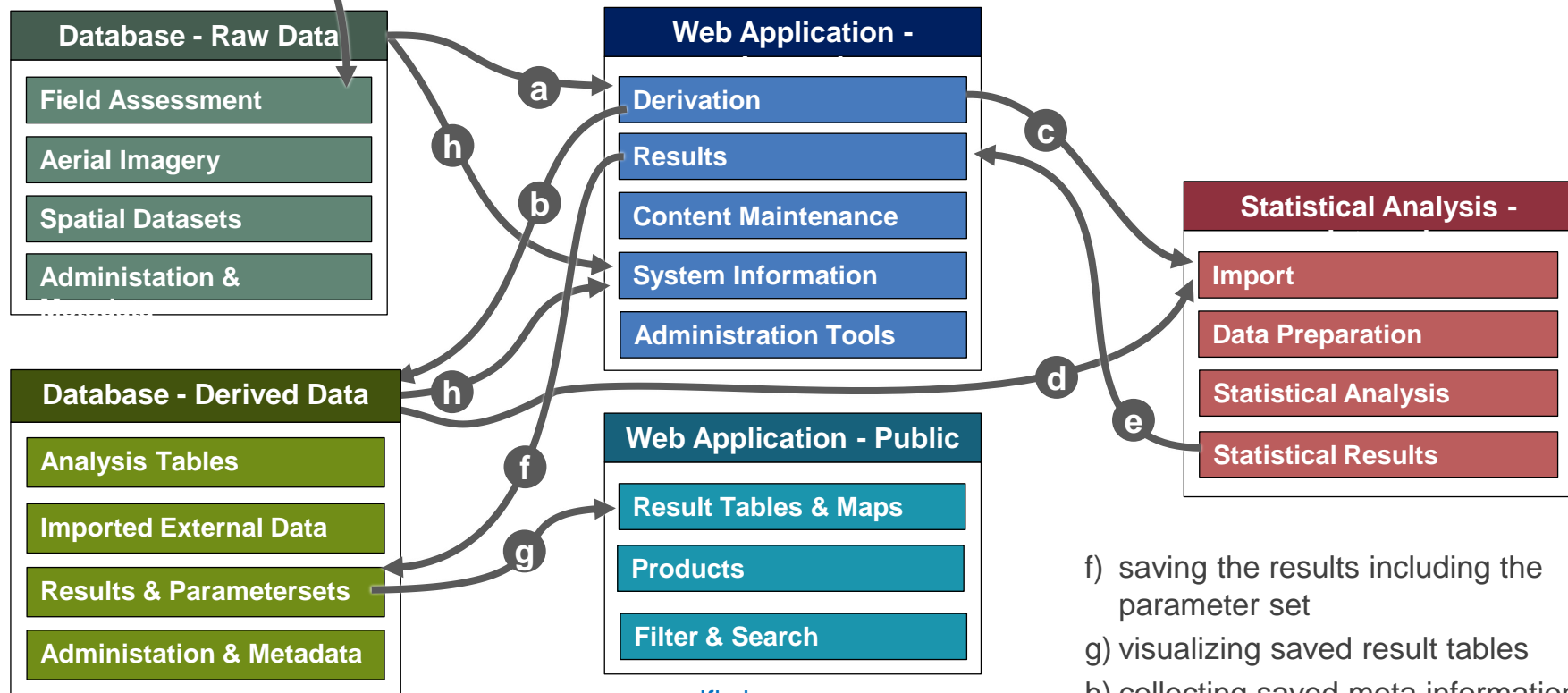
Products

- Internal calculations and web applications to support processes;
- External webapplication with 100'000+ official result tables; four languages; <https://www.lfi.ch/en/>
- Map producing directly from database with vector-tile technology
- Providing **linked data** for Swiss Open Government Data
<https://visualize.admin.ch/en>
- Base data for scientific papers and applied publications for stakeholders (cantons, FOEN, communities, foresters, public)
- Providing high precise **ground truth** data for calibrating all kinds of models, training machines (KI-models) and remote sensing products;

The Full Overview of NFI Dataflow ...



- collecting data according to the formula used in the derivation
- saving the results of each derivation in the respective analysis table and saving all metadata about the derivation
- importing collected parameter set which defines a specific analysis
- importing data for a desired statistical analysis
- generating web result based on statistical results delivered



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