

Calculation of emission factors for living biomass in Swiss forests for the Swiss GHGI 2015

Internal documentation of data delivery and more recent data

Esther Thürig, Erik Rösler, Markus Didion

19.01.2015

Summary

For the last year's Swiss Greenhouse Gas Inventory (GHGI) 1990-2012 (FOEN 2014), forest emission factors for the years 2006 to 2012 were calculated based on data from National Forest Inventory (NFI) 3 (2004-2006) and NFI 4 data from 2009 to 2012 (NFI 4a+). For the most recent Swiss GHGI 1990-2013 (FOEN 2015), additional NFI 4 data from the year 2013 were available for calculating emission factors for the years 2006 to 2013 (NFI4b). Hence, the number of available sample plots for calculating emission factors increased by 658 plots from 2613 to 3271. Moreover, data of all inventory years 2009-2013 were checked for plausibility. Therefore, differences between data for FOEN 2014 and FOEN 2015 are caused by both the data plausibility check and by integrating additional data from the year 2013.

Plausibility checks of single tree measurements diameter at breast height (dbh), diameter at 7 m tree height (d7) and total tree height resulted in the correction of the raw data of approximately 70 trees. As a consequence of these corrections, the estimates of FOEN (2014) underwent a slight change. The estimation of growing stock based on NFI 4a+ (2009-2012) decreased by 0.15%, cut and mortality remained unchanged and gross growth decreased by 0.44%.

All other differences between NFI 4 data for FOEN (2014) and FOEN (2015) are caused by incorporating the new data year 2013. Overall, estimations of biomass in growing stock was 1.69 t ± 2.5 t per ha lower in the NFI 4b (2009-2013) than in the NFI 4a+ (2009-2012). This is a decrease of -0.7% ±1% . Cut and mortality increased by +3.7% ±5%. Gross growth decreased by -1.6% ±2%.

All changes of the estimates are within a single standard error and reflect the statistical variability of random samples.

1 Introduction

For the Swiss Greenhouse Gas Inventory (GHGI) 1990-2013 (FOEN 2015), forest emission factors for the years 2006 to 2013 were calculated based on data from the National Forest Inventory (NFI) 3 (2004-2006) and NFI 4b (2009-2013) (see Annex). As a consequence of the continuous inventory approach, implemented with the start of the NFI4, additional data from year 2013 were available for estimations. The number of available sample plots for calculating emission factors increased by 658 plots from 2613 to 3271. Emission factors for the Swiss GHGI are calculated annually from biomass in growing stock, cut and mortality and gross growth. This report describes and analyzes changes between the estimation of emission factors for the forestry sector reported in FOEN (2014) and FOEN (2015).

1.1 TCCCA criteria and verification: specific information for UNFCCC/KP reviewers

This report addresses the criteria for transparency, consistency, comparability, completeness and accuracy (TCCCA):

Transparency is achieved by detailing the various data sets that were used and by providing relevant metadata and references. The methodology is described and referenced in section 2, data sets are compared in section 3 and displayed in the Annex.

Consistency is obtained by relying on data sources that are measured and maintained in a consistent manner (Swiss NFI) and that will be available in the future (regulated by law). It was ensured that the methods were applied consistently and that results are reported correspondingly, including data per unit area, which are independent of temporal changes in the underlying forest area. See section 2.

Comparability is achieved by applying the default method of IPCC to report carbon stock changes by the difference of gains and losses.

Completeness is reached by calculating annual estimates since 1990 for standing stock, gains and losses for all 15 forest regions in Switzerland. Each of the NFIs (1, 2, 3 and 4b) are representative random samples for the 15 forest regions in Switzerland.

Accuracy is obtained by employing reliable and accurate data and a methodology reported in Brassel and Lischke (2001).

2 Data and methods

NFI 4b data are documented and published in Abegg et al. (2014). Metadata are available under <http://www.lfi.ch/dienstleist/daten-en.php>. The methods of data analysis are published in Brassel and Lischke (2001). Calculation of biomass is documented in Thürig and Herold (2013).

2.1 Spatial stratification

The NFI 4b data include approximately 55% of all NFI 4 plots of the accessible forest in Switzerland (3271 out of ca. 6000). Due to the large variability between sample plots, a minimum number of sample plots is needed to obtain reliable and representative estimates of means and sampling errors. Small strata did not include a sufficient number of plots (Table 1) and were merged with neighboring strata for the GHGI 2015 (FOEN 2015). The following strata were aggregated and treated as single strata:

- Plateau 601-1200 and >1200: new stratum Plateau > 600 m (283 plots)
- Pre-Alps \leq 600 and 601-1200 m: new stratum Pre-Alps \leq 1200 m (385)
- Alps West \leq 600 and 601-1200 m: new stratum Alps West \leq 1200 m (148)
- Alps Est \leq 600 and 601-1200 m: new stratum Alps Est \leq 1200 m (171)

Table 1 Number of sample plots by spatial strata in NFI 4b.

Alt	Jura	Plateau	Pre-Alps	Alps West	Alps Est	Southern Alps	Switzerland
\leq 600	143	369	17	18	10	54	611
601 - 1200	338	276	368	130	161	146	1419
>1200	69	7	214	342	397	212	1241
Total	550	652	599	490	568	412	3271

2.2 Time series consistency and accuracy

In November 2013, raw data of the inventory years 2012 and 2013 were checked for plausibility. The values of diameter at breast height (dbh), diameter at 7 m tree height (d7) and total tree height were analyzed. Measurements of approximately 70 trees were identified to be outside the range of plausible measurements and the respective values were corrected or the trees were removed from the database. Also, trees with an unrealistic proportion between d7 and tree height were removed. The estimates of growing stock and gains and losses were slightly affected by these corrections: growing stock decreased by 0.15% and gross growth decreased by 0.44%; cut and mortality remained unchanged

Compared to the data for the GHGI 2014, data from additional 658 NFI plots were available for the GHGI 2015 corresponding to an increase from 2613 to 3271 plots or 25%. Due to the additional data, the accuracy of the estimates increased and the sampling error decreased.

3 Result: Comparison between NFI data 2009-2012 and 2009-2013

To analyze the differences between the data delivery for the GHGI 2014 (NFI 2009-2012) and the GHGI 2015 (NFI 2009-2013), results with the original definition of 15 strata (see Table 1) were compared. The observed differences resulted from the database plausibility check and the incorporation of additional data from 2013.

Table 2 Biomass of living trees Difference of estimates between data delivery for GHGI 2014 and GHGI 2015. Positive numbers indicate an increase, negative number a decrease in the estimate for 2015 compared to 2014. The columns 'SE' contain the standard error which was estimated for the data prepared for the GHGI 2014. Except for the aggregated strata, the original biomass estimates are shown in Tables A1 and A4. Data are stratified by 5 NFI-regions, 3 altitudinal levels (altitude above sea level from DHM25) and conifers (Con) or deciduous (Dec) trees.

Alt		Jura		Plateau		Pre-Alps		Alp West		Alp Est		Southern Alps		CH	
		1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE
≤ 600	Con	1.39	10.2	7.38	7.1	10.59	38.7	5.53	10.8	-8.00	33.4	-2.24	5.4	4.87	5.0
	Dec	-6.62	12.3	-2.17	10.9	-11.46	53.2	1.70	46.4	-31.40	51.9	-3.33	16.2	-4.66	6.7
	All	-5.23	12.4	5.21	10.3	-0.87	54.1	7.23	49.4	-39.40	54.4	-5.57	16.7	0.21	7.6
601 - 1200	Con	-10.02	7.3	4.53	10.2	-6.10	9.7	6.35	10.3	4.55	13.9	1.29	7.6	-2.18	4.3
	Dec	-0.24	8.2	-5.26	12.6	0.83	8.0	-7.22	15.4	-5.35	11.5	3.80	13.7	-1.62	3.9
	All	-10.27	8.5	-0.73	15.2	-5.29	12.3	-0.87	16.3	-0.80	15.0	5.09	14.5	-3.81	5.5
>1200	Con	7.04	13.6	9.34	42.8	-4.73	15.1	7.36	9.4	-3.72	7.8	-1.00	12.1	-0.19	5.8
	Dec	-2.05	9.6	3.09	7.2	-5.57	7.1	-0.21	2.6	2.24	2.3	1.71	4.7	0.06	1.9
	All	4.98	11.1	12.43	39.8	-10.28	14.4	7.17	10.1	-1.48	8.1	0.71	10.8	-0.13	4.3
Total	Con	-5.00	6.3	6.65	6.1	-4.47	8.4	6.28	7.9	-1.44	7.2	1.18	7.8	0.18	3.0
	Dec	-2.89	6.8	-3.28	7.8	-2.79	6.4	-1.21	5.2	-0.64	4.3	0.22	6.6	-1.88	2.9
	All	-7.89	7.9	3.36	8.3	-7.26	9.1	5.08	8.0	-2.08	8.8	1.40	7.2	-1.69	2.5

The estimates of biomass in growing stock for the GHGI 2015 were generally within one standard error of the values for the GHGI 2014; all estimates were within two standard errors (Table 2). Overall, estimations of biomass in growing stock was 1.69 t ± 2.5 t per ha lower in the NFI 4b (2009-2013) than in the NFI 4a+ (2009-2012). This is a minus of -0.7% ±1% .

All but one estimate of cut and mortality for the GHGI 2015 were within one standard error of the value for the GHGI 2014 (Table 3). The estimate for cut and mortality in Switzerland increased by +0.18 ± 0.24 t Biomass per ha and year or plus 3.7%.

The values of gross growth which were estimated for the GHGI 2015 were all within two standard errors of the estimates for the GHGI 2014 (Table 4). Compared to the estimate for the GHGI 2014, the gross growth in Switzerland has decreased by 0.97% or 60 kg Biomass per ha and year with an uncertainty of ± 240 kg Biomass per ha and year (double standard error of the mean, simple error of the mean is ± 120 kg Biomass per ha and year, Table 4).

Table 3 Annual cut and mortality in biomass Difference of estimates between data delivery for GHGI 2014 and GHGI 2015. Positive numbers indicate an increase, negative number a decrease in the estimate for 2015 compared to 2014. The columns 'SE' contain the standard error which was estimated for the data prepared for the GHGI 2014. Bold figure indicates changes larger than twice the standard error. Except for the aggregated strata, the original biomass estimates are shown in Tables A2 and A5. Data are stratified by 5 NFI-regions, 3 altitudinal levels (altitude above sea level from DHM25) and conifers (Con) or deciduous (Dec) trees.

		Jura		Plateau		Pre-Alps		Alp West		Alp Est		Southern Alps		CH	
Alt		1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE
≤ 600	Con	0.28	1.0	-0.13	0.8	-0.11	1.2	0.09	1.1	1.87	1.1	0.00	NA	0.03	0.5
	Dec	0.73	0.8	-0.13	0.6	-0.30	3.1	-0.75	2.8	2.49	3.4	0.60	0.8	0.15	0.4
	All	1.01	1.2	-0.26	1.0	-0.41	3.1	-0.66	3.0	4.36	4.1	0.60	0.8	0.19	0.7
601 - 1200	Con	0.31	0.5	0.00	1.1	0.30	0.7	0.42	0.4	0.07	0.6	-0.17	0.8	0.19	0.3
	Dec	-0.17	0.5	0.56	0.5	0.35	0.4	0.44	0.4	-0.27	0.5	-0.18	0.6	0.15	0.2
	All	0.14	0.8	0.56	1.2	0.65	0.9	0.86	0.5	-0.19	0.8	-0.35	1.0	0.34	0.4
>1200	Con	0.01	0.5	0.25	0.8	-0.41	0.9	0.17	0.6	0.26	0.3	-0.12	0.4	0.03	0.2
	Dec	0.23	0.1	-	-	-0.05	0.1	-0.02	0.1	0.02	0.0	0.01	0.1	0.01	0.0
	All	0.24	0.6	0.25	0.8	-0.46	1.0	0.14	0.6	0.28	0.3	-0.12	0.4	0.04	0.3
Total	Con	0.25	0.4	-0.05	0.6	0.04	0.5	0.23	0.4	0.24	0.3	-0.12	0.4	0.10	0.2
	Dec	0.09	0.4	0.16	0.4	0.17	0.2	0.08	0.2	-0.02	0.2	-0.01	0.3	0.09	0.1
	All	0.34	0.6	0.10	0.8	0.21	0.6	0.31	0.4	0.22	0.3	-0.12	0.4	0.18	0.2

Table 4 Annual gross growth of living trees in biomass Difference of estimates between the data delivery for GHGI 2014 and GHGI 2015. Positive numbers indicate an increase, negative number a decrease in the estimate for 2015 compared to 2014. The columns 'SE' contain the standard error which was estimated for the data prepared for the GHGI 2014. Except for the aggregated strata, the original biomass estimates are shown in Tables A3 and A6. Data are stratified by 5 NFI-regions, 3 altitudinal levels (altitude above sea level from DHM25) and conifers (Con) or deciduous (Dec) trees.

		Jura		Plateau		Pre-Alps		Alp West		Alp Est		Southern Alps		CH	
Alt		1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE	1000 kg/ha	± SE
≤ 600	Con	0.15	0.4	0.13	0.3	0.16	1.0	-0.22	0.6	-0.17	0.9	-0.62	0.8	0.06	0.2
	Dec	0.50	0.7	-0.13	0.4	-0.13	1.6	0.28	1.5	-0.89	3.3	0.06	1.0	0.02	0.3
	All	0.66	0.7	0.00	0.5	0.03	1.8	0.06	1.3	-1.06	3.5	-0.56	1.2	0.08	0.3
601 - 1200	Con	-0.25	0.3	-0.04	0.4	-0.18	0.4	-0.03	0.5	-0.03	0.4	0.06	0.2	-0.11	0.2
	Dec	-0.09	0.3	0.04	0.4	0.13	0.3	-0.01	0.7	-0.19	0.3	-0.10	0.8	-0.01	0.2
	All	-0.34	0.3	0.01	0.5	-0.06	0.5	-0.04	0.9	-0.22	0.5	-0.05	0.8	-0.13	0.2
>1200	Con	-0.37	0.6	0.24	0.3	-0.18	0.4	0.01	0.3	0.06	0.3	-0.01	0.4	-0.03	0.2
	Dec	0.06	0.4	0.02	-0.1	-0.03	0.2	-0.14	0.2	0.05	0.1	0.04	0.2	-0.01	0.1
	All	-0.32	0.8	0.26	0.3	-0.21	0.5	-0.13	0.4	0.11	0.3	0.03	0.5	-0.04	0.2
Total	Con	-0.16	0.2	0.07	0.2	-0.15	0.3	-0.02	0.3	0.03	0.2	-0.03	0.3	-0.05	0.1
	Dec	0.06	0.3	-0.06	0.3	0.04	0.2	-0.08	0.3	-0.04	0.2	-0.06	0.4	-0.02	0.1
	All	-0.10	0.3	0.01	0.3	-0.11	0.4	-0.10	0.4	-0.01	0.3	-0.09	0.4	-0.06	0.1

3.1 Uncertainty

Total uncertainty of net carbon stock change in living biomass in terms of carbon per unit area ($U_{liv.biom.}$) arises from different sources: 1) sampling error of measured NFI data (Köhl 1994) to estimate gains and losses in stem wood over bark from the NFI, 2) whole-tree biomass estimation, incl. biomass expansion, 3) variability in carbon content, and 4) variation in wood density. Up to now, there is no data and no methodology available in Switzerland to simultaneously estimate $U_{liv.biom.}$ as combined uncertainty of all four components. Therefore, $U_{liv.biom.}$ is calculated as the sum of the single uncertainty components. In this report, we calculate the uncertainty of the random sample gains and losses in stem wood over bark. The other components are calculated in the most recent NIR (FOEN 2015). Total $U_{liv.biom.}$ is calculated by adding all *relative uncertainties* following equation 6.4 in chapter 'Quantifying Uncertainties in Practice' (IPCC 2000).

In Switzerland, gains and losses are estimated as random variables from the NFI. The uncertainty of gains and losses in stem wood over bark is approximated by sampling theory as the sample variance of the NFI plots (Brassel and Lischke 2001). Net change of stem wood over bark is calculated as the difference between gains and losses. The uncertainty of the two combined random variables is calculated by the law of error propagation (Eq. 1).

$$SE_{gains - losses} = (SE_{gains}^2 + SE_{losses}^2)^{0.5} \quad \text{Eq. 1}$$

where SE_{gains} and SE_{losses} are in absolute values. Absolute estimates for standing stock and its Standard Errors (SE) can be calculated from Abegg et al. 2014:

$$\text{Absolute values of } gains = 8.95 \pm 2\% = 8.95 \pm 0.179 \text{ m}^3 \text{ ha}^{-1} \text{ year}^{-1}$$

$$\text{Absolute values of } losses = 7.64 \pm 4\% = 7.64 \pm 0.306 \text{ m}^3 \text{ ha}^{-1} \text{ year}^{-1}$$

The net carbon stock change in stem wood over bark is calculated as the difference between gains and losses and results in 1.31 m^3 stem wood over bark per ha and year. The uncertainty of this estimate can be calculated with Eq. 1.

$$SE_{gains - losses} = (0.179^2 + 0.306^2)^{0.5} = \pm 0.35 \text{ m}^3 \text{ ha}^{-1} \text{ year}^{-1}$$

Equation 1 assumes the random variables gains and losses to be independent. This may result in an overestimation of the error estimation. However, this is partly compensated by disregarding model errors in the estimation of stem wood volumes from the measured dbh, d7 and tree height.

In NIR (FOEN 2015), uncertainties of all four components are combined by adding *relative uncertainties* following equation 6.4 in chapter 'Quantifying Uncertainties in Practice' (IPCC 2000). Relative uncertainty is calculated as the ratio of $SE_{gains - losses}$ ($\pm 0.35 \text{ m}^3 \text{ ha}^{-1} \text{ Jahr}^{-1}$) and the absolute sink value ($1.31 \text{ m}^3 \text{ ha}^{-1} \text{ Jahr}^{-1}$). This results in a relative uncertainty of the estimation of net carbon stock change in stem wood over bark of $\pm 27\%$.

4 Literature

Abegg M, Brändli U.-B, Cioldi F, Fischer C, Herold-Bonardi A, Huber M, Keller M, Meile R, Rösler E, Speich S, Traub B, Vidondo B. 2014. Fourth national forest inventory - result tables and maps on the Internet for the NFI 2009-2013 (NFI4b). [Published online 06.11.2014] Available from World Wide Web <<http://www.lfi.ch/resultate/>>. Birmensdorf, Eidg. Forschungsanstalt WSL.

Brassel P, Lischke H (eds) 2001. Swiss National Forest Inventory: Methods and Models of the Second Assessment. Birmensdorf, Swiss Federal Research Institute WSL. 336 pp.

FOEN 2014. Switzerland's Greenhouse Gas Inventory 1990–2012. National Inventory Report 2014 including reporting elements under the Kyoto Protocol. Submission of 15 April 2014 under the United Nations Framework Convention on Climate Change and under the Kyoto Protocol: 279-360.

FOEN 2015. Switzerland's Greenhouse Gas Inventory 1990–2013. National Inventory Report 2015 including reporting elements under the Kyoto Protocol. Submission of April 2015 under the United Nations Framework Convention on Climate Change and under the Kyoto Protocol.

IPCC 2000. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC GPGU). Intergovernmental Panel on Climate Change. <http://www.ipcc-nggip.iges.or.jp/public/gp/english/> [19.01.2015]

Köhl M. 1994. Statistisches Design für das zweite Schweizerische Landesforstinventar: Ein Folgeinventurkonzept unter Verwendung von Luftbildern und terrestrischen Aufnahmen. Mitt. Eidgenöss. Forsch.anst. Wald Schnee Landsch. 69, 1: 1-141.
http://www.wsl.ch/dienstleistungen/publikationen/suche_DE?fulltext_search=k%C3%B6hl&publikationsjahr=&search=Go [19.01.15]

Thürig E, Herold A. 2013. Recalculation of emission factors in Swiss forests for the Swiss GHGI. Internal documentation of technical adjustments of data delivery and more recent data. 10 pp.



Annex

Data delivery 2009-2012 (NIR 2014)

A1 Data delivery NIR 2014: Biomass of living trees, common and accessible forest area NFI 3/2009-2012. Data are stratified for 5 NFI-regions, 3 altitudinal levels (altitude above see from DHM25) and for conifers (Con) or deciduous (Dec) trees.

		Jura		Plateau		Pre-Alps		Alp West		Alp Est		Southern Alps		CH	
Alt		1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %
≤ 600	Con	73.11	14	102.13	7	188.84	5	84.5	11	149.75	9	5.56	98	83.74	6
	Dec	175.03	7	155.91	7	121.84	7	114.53	13	109.15	11	180.37	9	168.56	4
	All	248.14	5	258.04	4	310.68	3	199.03	8	258.9	6	185.93	9	252.3	3
601 - 1200	Con	146.06	5	148.41	7	188.84	5	84.5	11	149.75	9	28.18	27	143.09	3
	Dec	136.63	6	153.88	8	121.84	7	114.53	13	109.15	11	152.61	9	129.45	3
	All	282.7	3	302.3	5	310.68	3	199.03	8	258.9	6	180.79	8	272.55	2
>1200	Con	136.28	10	148.41	7	251.8	6	188.39	5	193.99	4	151.03	8	192.62	3
	Dec	47.98	20	153.88	8	37.15	19	13.16	20	9.49	24	29.12	16	20.77	9
	All	184.26	6	302.3	5	288.94	5	201.54	5	203.48	4	180.15	6	213.39	2
Total	Con	125.95	5	121.68	5	211.12	4	157.88	5	180.83	4	86.84	9	150.33	2
	Dec	136.27	5	155.05	5	91.87	7	42.92	12	39.14	11	94.33	7	96.18	3
	All	262.22	3	276.74	3	302.99	3	200.8	4	219.97	4	181.17	4	246.51	1

A2 Data delivery NIR 2014: Annual cut and mortality of living trees, common and accessible forest area NFI 3/2009-2012. Data are stratified for 5 NFI-regions, 3 altitudinal levels (altitude above see from DHM25) and for conifers (Con) or deciduous (Dec) trees.

		Jura		Plateau		Pre-Alps		Alp West		Alp Est		Southern Alps		CH	
Alt		1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %
≤ 600	Con	2.9525	33	5.681	14	4.4698	15	1.2738	28	2.6455	22	0	.	4.2245	12
	Dec	3.5218	23	4.1699	14	1.5462	24	1.2461	40	1.9596	27	2.5805	30	3.8974	11
	All	6.4743	19	9.8509	10	6.0161	14	2.52	24	4.605	18	2.5805	30	8.1219	9
601 - 1200	Con	3.0554	15	6.539	16	4.4698	15	1.2738	28	2.6455	22	0.8401	98	3.7241	9
	Dec	2.9548	17	3.2085	16	1.5462	24	1.2461	40	1.9596	27	1.9977	31	2.1895	10
	All	6.0102	13	9.7475	12	6.0161	14	2.52	24	4.605	18	2.8378	36	5.9136	7
>1200	Con	1.1923	45	6.539	16	3.6117	26	1.8288	31	1.6048	19	1.1488	35	1.9182	13
	Dec	0.2131	59	3.2085	16	0.2269	40	0.1302	39	0.0504	46	0.2834	44	0.1509	21
	All	1.4054	43	9.7475	12	3.8386	25	1.959	30	1.6551	18	1.4321	29	2.0691	13
Total	Con	2.8111	14	6.0435	10	4.1662	13	1.6659	25	1.9144	14	0.8803	41	3.1426	6
	Dec	2.7821	14	3.7637	11	1.0794	23	0.4578	33	0.6184	27	1.2156	22	1.7513	7
	All	5.5933	11	9.8072	8	5.2455	12	2.1237	21	2.5327	13	2.0959	21	4.8939	5

A3 Data delivery NIR 2014: Annual gross growth of living trees, common and accessible forest area NFI 3/2009-2012. Data are stratified for 5 NFI-regions, 3 altitudinal levels (altitude above see from DHM25) and for conifers (Con) or deciduous (Dec) trees.

		Jura		Plateau		Pre-Alps		Alp West		Alp Est		Southern Alps		CH	
Alt		1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %
≤ 600	Con	2.0725	18	3.9271	8	4.9238	7	2.2217	20	3.2212	12	0.7791	97	3.0386	7
	Dec	4.3743	15	5.3339	7	2.913	11	2.2615	30	2.9321	14	4.982	19	5.1214	6
	Tot	6.4469	11	9.261	5	7.8368	5	4.4832	17	6.1532	9	5.7611	20	8.16	4
601 - 1200	Con	3.6042	8	5.1363	8	4.9238	7	2.2217	20	3.2212	12	0.3363	56	3.8079	4
	Dec	3.0186	9	4.1961	9	2.913	11	2.2615	30	2.9321	14	4.7042	17	3.2249	5
	Tot	6.6229	5	9.3324	5	7.8368	5	4.4832	17	6.1532	9	5.0405	16	7.0328	3
>1200	Con	3.3385	18	5.1363	8	5.2282	8	3.6063	9	3.3554	8	3.2758	13	3.7477	4
	Dec	0.7276	49	4.1961	9	0.5362	32	0.7607	30	0.2936	26	0.4851	48	0.515	17
	Tot	4.0661	19	9.3324	5	5.7644	8	4.3671	10	3.649	7	3.761	12	4.2628	4
Total	Con	3.175	7	4.438	5	5.0315	5	3.1998	9	3.3155	7	1.8747	14	3.6385	3
	Dec	3.1036	8	4.8532	6	2.0719	11	1.2014	21	1.0785	14	2.6211	14	2.5711	4
	Tot	6.2786	5	9.2912	3	7.1034	5	4.4012	8	4.394	6	4.4958	9	6.2096	2

Data delivery 2009-2013 (NIR 2015)

A4 Data delivery NIR 2015: Biomass of living trees, common and accessible forest area NFI 3/2009-2013. Data are stratified for 5 NFI-regions, 3 altitudinal levels (altitude above see from DHM25) and for conifers (Con) or deciduous (Dec) trees.

		Jura		Plateau		Pre-Alps		Alp West		Alp Est		Southern Alps		CH	
Alt		1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %
≤ 600	Con	74.5	12	109.51	6	104.92	36	25.15	49	75.41	41	3.32	74	88.61	6
	Dec	168.41	7	153.74	6	254.59	20	146.82	28	274.07	20	177.04	8	163.9	4
	All	242.91	5	263.25	4	359.51	14	171.97	24	349.48	18	180.36	8	252.51	3
601 - 1200	Con	136.04	5	150.8	6	187.85	5	100.23	10	158.92	8	29.47	23	140.91	3
	Dec	136.39	5	152.67	7	114.87	6	102.89	12	90.12	11	156.41	8	127.83	3
	All	272.43	3	303.47	4	302.71	3	203.12	7	249.04	6	185.88	6	268.74	2
>1200	Con	143.32	9	234.35	16	247.07	5	195.75	5	190.27	4	150.03	7	192.43	2
	Dec	45.93	17	12.38	54	31.58	18	12.95	18	11.73	19	30.83	14	20.83	8
	All	189.24	7	246.73	15	278.66	5	208.71	4	202	4	180.86	5	213.26	2
Total	Con	120.95	4	128.33	4	206.65	4	164.16	4	179.39	4	88.02	7	150.51	2
	Dec	133.38	4	151.77	5	89.08	6	41.71	11	38.5	10	94.55	6	94.3	2
	All	254.33	2	280.1	3	295.73	3	205.88	4	217.89	3	182.57	4	244.82	1

A5 Data delivery NIR 2015: Annual cut and mortality of living trees, common and accessible forest area NFI 3/2009-2013. Data are stratified for 5 NFI-regions, 3 altitudinal levels (altitude above see from DHM25) and for conifers (Con) or deciduous (Dec) trees.

		Jura		Plateau		Pre-Alps		Alp West		Alp Est		Southern Alps		CH	
Alt		1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %
≤ 600	Con	3.2353	26	5.552	12	1.7857	62	1.1857	74	4.5804	44	0	.	4.2568	11
	Dec	4.2525	18	4.0412	13	4.7861	61	2.6378	85	7.4936	51	3.1791	21	4.0517	10
	All	7.4879	15	9.5932	9	6.5718	45	3.8235	62	12.074	46	3.1791	21	8.3085	7
601 - 1200	Con	3.3638	13	6.7015	13	4.9082	13	1.7208	31	2.7121	19	0.6674	99	3.916	7
	Dec	2.7819	15	3.8568	14	1.7016	21	1.3732	38	1.4819	28	1.8162	28	2.3373	8
	All	6.1457	11	10.5583	10	6.6098	12	3.094	24	4.194	16	2.4836	33	6.2533	6
>1200	Con	1.198	38	1.1033	64	3.2023	24	1.9975	24	1.868	17	1.0275	30	1.9517	11
	Dec	0.4468	44	0	.	0.1812	40	0.1054	37	0.0701	34	0.2897	38	0.1584	18
	All	1.6448	32	1.1033	64	3.3835	23	2.1029	23	1.9381	16	1.3171	25	2.1101	11
Total	Con	3.0589	11	5.991	9	4.2102	11	1.8943	19	2.1542	12	0.7649	37	3.2404	5
	Dec	2.8717	12	3.9197	9	1.2461	19	0.5345	31	0.5995	24	1.2103	18	1.838	6
	All	5.9306	9	9.9107	7	5.4563	10	2.4288	17	2.7536	11	1.9752	18	5.0784	4

A6 Data delivery NIR 2015: Annual gross growth of living trees, common and accessible forest area NFI 3/2009-2013. Data are stratified for 5 NFI-regions, 3 altitudinal levels (altitude above see from DHM25) and for conifers (Con) or deciduous (Dec) trees.

		Jura		Plateau		Pre-Alps		Alp West		Alp Est		Southern Alps		CH	
Alt		1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %	1000 kg/ha	± %
≤ 600	Con	2.225	16	4.0548	7	1.932	52	0.9498	50	2.5102	34	0.1598	101	3.0966	6
	Dec	4.8783	9	5.2061	6	5.2653	29	3.5768	36	10.049	29	5.0386	16	5.1444	5
	All	7.1033	7	9.2609	4	7.1973	23	4.5266	25	12.5593	26	5.1983	15	8.241	3
601 - 1200	Con	3.359	6	5.118	7	4.9112	6	2.3456	17	3.2278	11	0.3939	41	3.6962	3
	Dec	2.9243	8	4.3603	8	2.9052	9	2.0991	28	2.1825	13	4.5993	14	3.211	5
	All	6.2832	5	9.4783	4	7.8164	4	4.4447	15	5.4103	8	4.9933	13	6.9071	3
>1200	Con	2.9649	14	4.629	7	5.0524	8	3.6194	8	3.4157	7	3.27	10	3.7163	4
	Dec	0.7847	36	-0.0657	114	0.5024	27	0.6223	29	0.3451	21	0.5252	35	0.5023	14
	All	3.7496	15	4.5633	7	5.5548	8	4.2418	8	3.7608	6	3.7952	10	4.2186	4
Total	Con	3.0147	6	4.5111	5	4.8771	5	3.1837	7	3.3467	6	1.8419	11	3.5915	2
	Dec	3.1643	6	4.7914	5	2.114	9	1.1224	19	1.0347	12	2.5624	11	2.5533	3
	All	6.179	4	9.3025	3	6.991	4	4.306	7	4.3814	5	4.4042	7	6.1448	2