

Supplementary Material

Variation in leaf morphological traits of European beech and Norway spruce over two decades in Switzerland

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1.1 Supplementary Figures

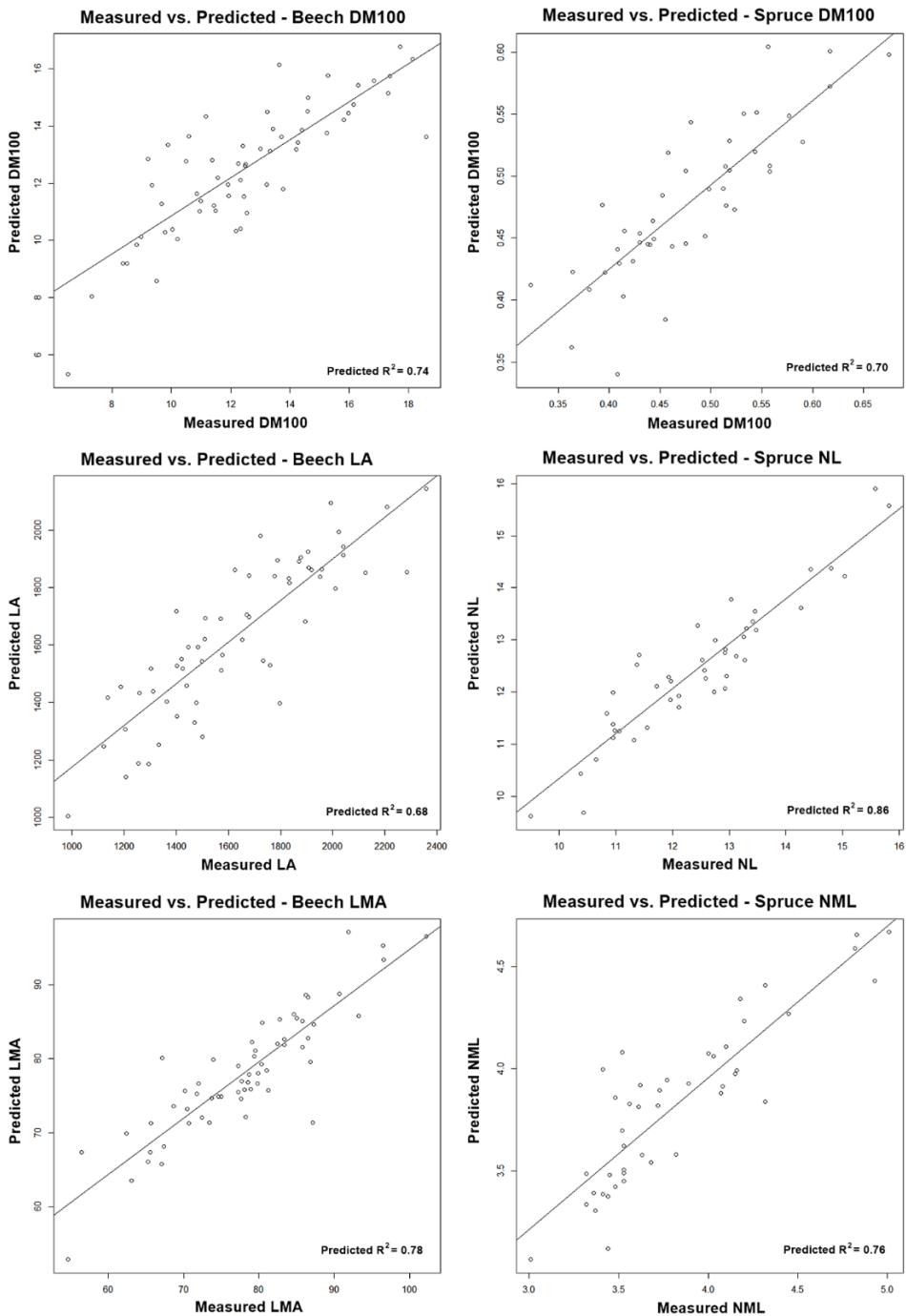


Figure S1: Predicted vs. measured values illustrating the model fit for leaf morphological traits. For beech, the models include the five variables that explain most of the variation. For spruce, the models are the ‘full averaged’ mean models from the ‘dredge’ selection with $\Delta AIC \leq 2$. DM100 = dry mass of 100 leaves or needles, LA = leaf area, NL = needle length, LMA = leaf mass per area, NML = needle mass per length.

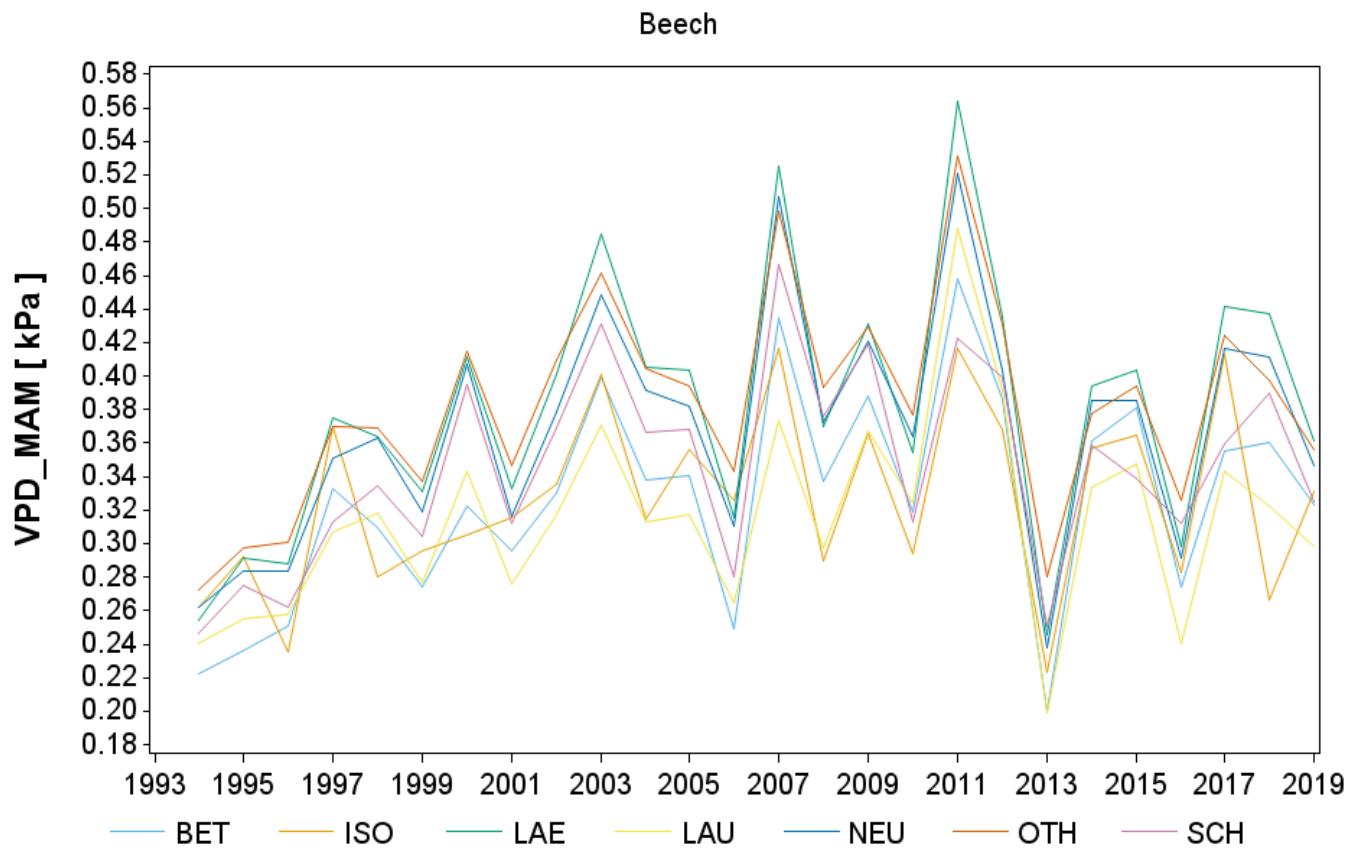


Figure S2: Spring (March, April, May) vapor pressure deficit (VPD) in beech plots for the observation period 1994–2019. For plot codes see **Table 1**.

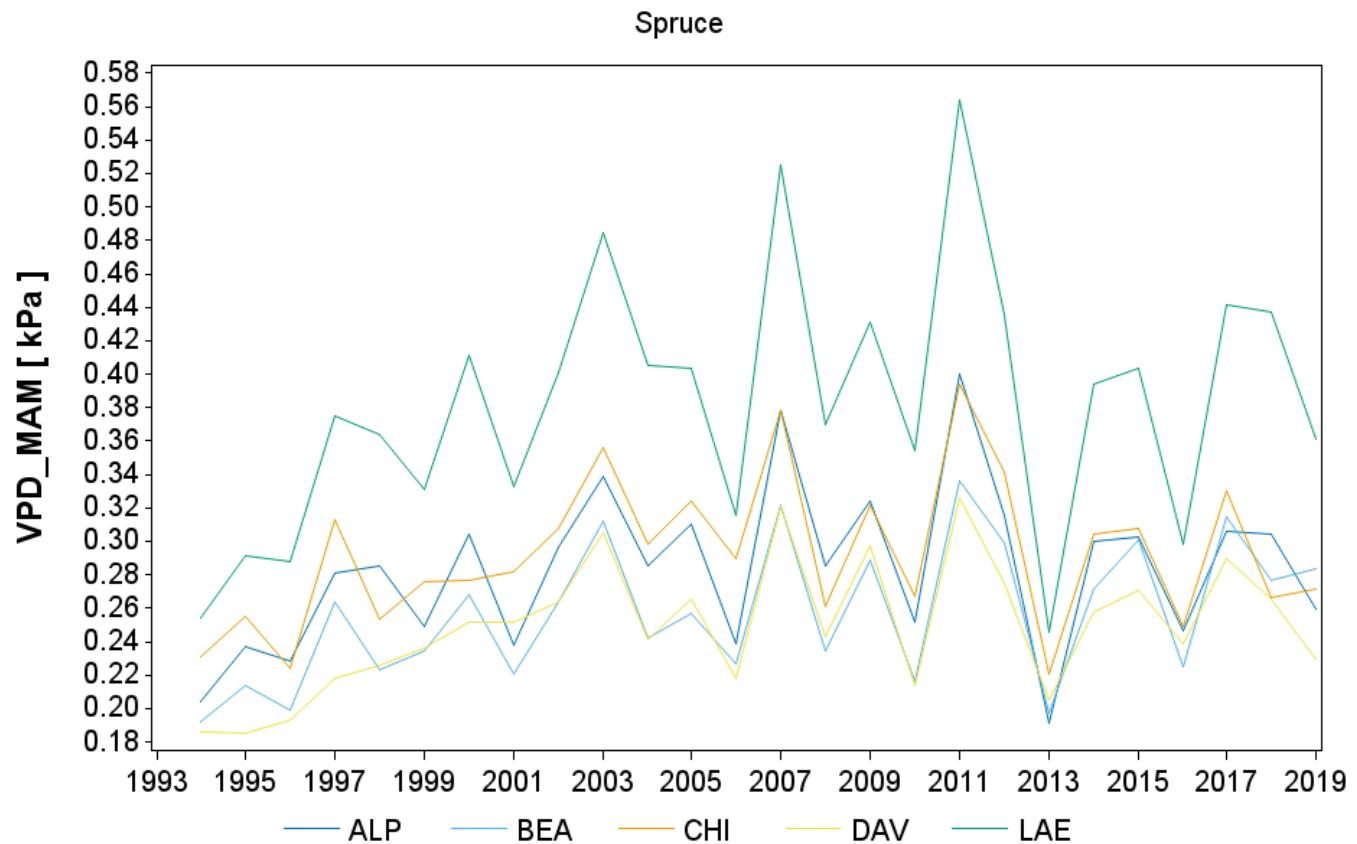


Figure S3: Spring (March, April, May) vapor pressure deficit (VPD) in spruce plots for the observation period 1994–2019. For plot codes see **Table 1**.

1.2 Supplementary Tables

Table S1: Characteristics of the sample trees per plot. Top height of the forest stand, as well as mean values of tree height, sampling height and stem diameter at breast height (DBH, 1.3 m above ground) of the sample trees are given (minimum and maximum value in brackets). Top height is the mean tree height of the 100 thickest trees per ha calculated based on the trees surveyed in the regular tree inventory following the ICP Forests Manual Part X ‘Tree Growth’ (Dobbertin and Neumann 2010) and carried out as described in detail by Hug et al. (2011). Tree height and diameter of sample trees were measured during the tree inventory carried out in the dormancy period 2014/2015.

Plot	Stand	Sample trees			
		Top height (m)	Species	Tree height (m)	Sampling height (m)
ALP	21.5	<i>Picea abies</i>	28.6 (25-31)	26.3 (20-32)	56.3 (43-75)
BEA	28.2	<i>Picea abies</i>	27.8 (25-32)	26.2 (13-32)	56.7 (43-67)
CHI	34.2	<i>Picea abies</i>	36.6 (34-39)	32.8 (28-38)	60.9 (49-75)
DAV	29.9	<i>Picea abies</i>	30.1 (27-33)	27.8 (22-31)	43.7 (30-59)
LAE	34.9	<i>Picea abies</i>	40.1 (32-46)	36.5 (25-44)	72.2 (46-94)
BET	25.2	<i>Fagus sylvatica</i>	25.2 (23-27)	22.6 (19-28)	50.7 (45-58)
ISO	18.8	<i>Fagus sylvatica</i>	21.3 (19-23)	16.7 (13-21)	46.1 (40-56)
LAE	34.9	<i>Fagus sylvatica</i>	36.2 (33-40)	31.5 (28-35)	69.8 (44-93)
LAU	39.8	<i>Fagus sylvatica</i>	42.4 (38-44)	35.7 (34-39)	62.4 (57-67)
NEU	32.9	<i>Fagus sylvatica</i>	29.8 (27-34)	26.4 (21-37)	53.9 (39-74)
OTH	40.9	<i>Fagus sylvatica</i>	35.6 (32-38)	34.7 (27-39)	78.2 (64-92)
SCH	39.0	<i>Fagus sylvatica</i>	37.2 (35-40)	35.2 (31-37)	48.1 (44-53)

Table S2: Long-term average climatic data for beech plots (1994–2019). For plot codes see **Table 1**, for variable abbreviations see **Table 2**.

	BET	ISO	LAE	LAU	NEU	OTH	SCH	Unit
ltP_yr	1504.0	1799.2	1184.4	1241.6	944.1	1058.6	1839.1	mm
ltT_yr	7.4	6.7	9.1	8.4	9	9.8	8.1	°C
ltVPD_yr	0.319	0.324	0.342	0.307	0.324	0.339	0.311	kPa
ltSWB_yr	-25.9	16.3	-54.5	-62.3	-119	-93.2	-6.6	mm
ltETAP_yr	0.947	0.959	0.880	0.939	0.894	0.928	0.988	-
ltP_MAM	368.5	457.4	295.9	297.9	229	265.3	439.4	mm
ltT_MAM	6.7	5.8	8.8	7.8	8.8	9.7	7.7	°C
ltVPD_MAM	0.326	0.326	0.381	0.315	0.368	0.382	0.346	kPa
ltP_JJA	390.7	555.7	394.0	339.7	277.9	316.8	622.4	mm
ltT_JJA	15	14.9	17.4	16.7	17.6	18.5	16.3	°C
ltVPD_JJA	0.499	0.498	0.613	0.573	0.616	0.633	0.522	kPa
ltP SON	338.2	563.2	261.7	316.2	210.3	237.2	409.6	mm
ltT SON	7.9	7.0	9.3	8.7	9.0	9.8	8.4	°C
ltVPD SON	0.275	0.26	0.241	0.224	0.212	0.222	0.236	kPa
ltP DJF	418.8	216.8	234.6	289.5	231.9	241.8	369.9	mm
ltT DJF	0.2	-1.0	1.1	0.4	0.6	1.4	0.0	°C
ltVPD DJF	0.175	0.210	0.132	0.115	0.102	0.119	0.139	kPa

Table S3: Long-term average climatic data for spruce plots (1994–2019). For plot codes see **Table 1**, for variable abbreviations see **Table 2**.

	ALP	BEA	CHI	DAV	LAE	Unit
ltP_yr	2153.7	1450.0	1596.9	1139.0	1184.4	mm
ltT_yr	6.4	5.2	5.4	3.2	9.1	°C
ltVPD_yr	0.273	0.273	0.295	0.249	0.342	kPa
ltSWB_yr	-1.5	0.5	-5.9	-2.7	-54.5	mm
ltETAP_yr	0.995	0.996	0.968	0.983	0.88	-
ltP_MAM	520.7	350.2	405.7	224.5	295.9	mm
ltT_MAM	5.7	4.1	4.5	2.4	8.8	°C
ltVPD_MAM	0.283	0.257	0.292	0.249	0.381	kPa
ltP_JJA	713.4	487.0	454.4	440.5	394.0	mm
ltT_JJA	14.4	12.9	13.7	11.5	17.4	°C
ltVPD_JJA	0.447	0.411	0.474	0.409	0.613	kPa
ltP SON	466.3	301.5	484.5	266.4	261.7	mm
ltT SON	6.9	5.9	5.9	4.0	9.3	°C
ltVPD SON	0.222	0.249	0.245	0.223	0.241	kPa
ltP DJF	457	313.3	249.1	208.4	234.6	mm
ltT DJF	-1.5	-2	-2.5	-5.0	1.1	°C
ltVPD DJF	0.137	0.174	0.170	0.116	0.132	kPa

References

- Dobbertin, M., and Neumann, M. (2010). Tree Growth. Part V. *Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests* [<http://www.icp-forests.org/Manual.htm>]. UNECE ICP Forests Programme Co-ordinating Centre, Hamburg.
- Hug, C., Dobbertin, M., Nussbaumer, C., and Stettler, Y. (2011). *Brusthöhenumfang- und Höheninventur*. Langfristige Waldökosystem-Forschung (LWF). Eidg. Forschungsanstalt für Wald, Schnee und Landschaft (WSL), Birmensdorf.