



Snow observations in forested mountain areas

Workshop on snow data assimilation

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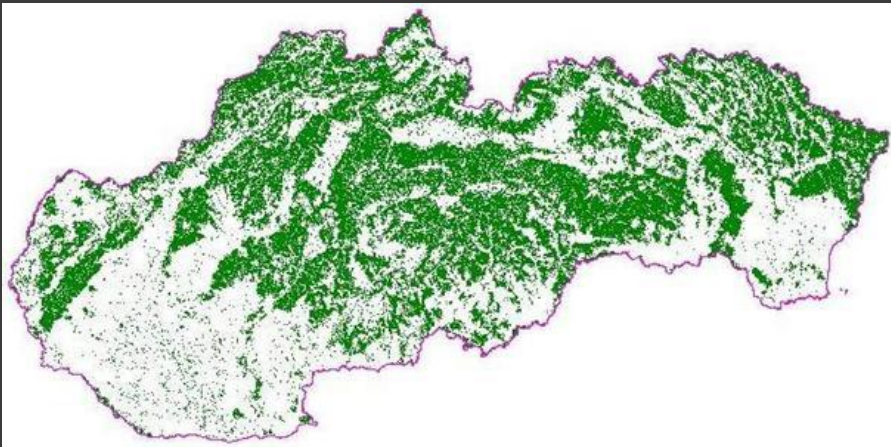


DWD, Offenbach

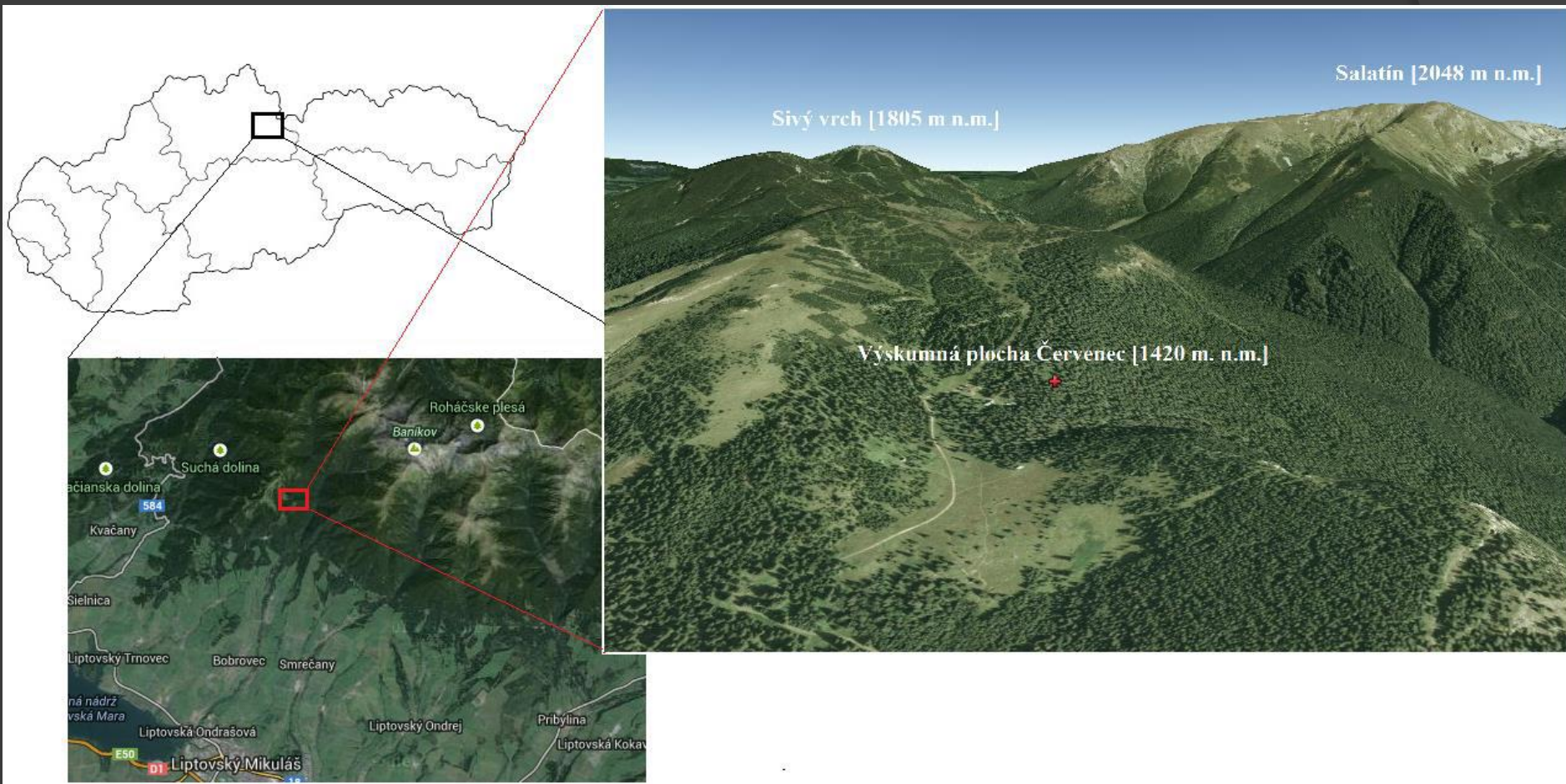
8.-9.March 2017

Forest and snow

- Forest area 2 012 tsd ha (41% of SR)
- Forest decline

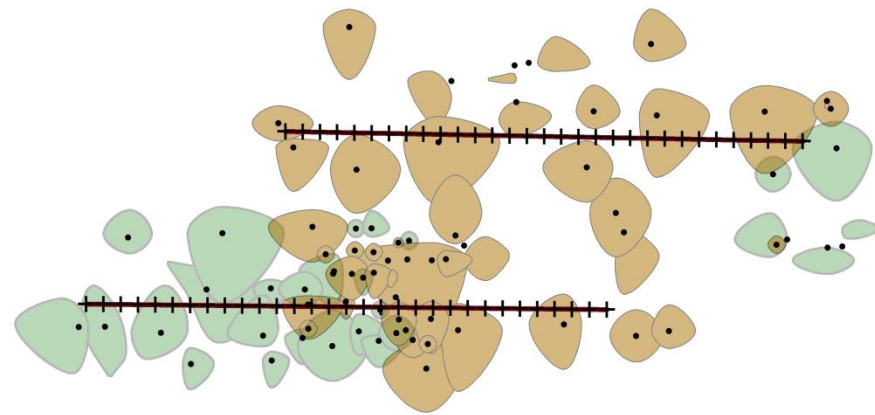
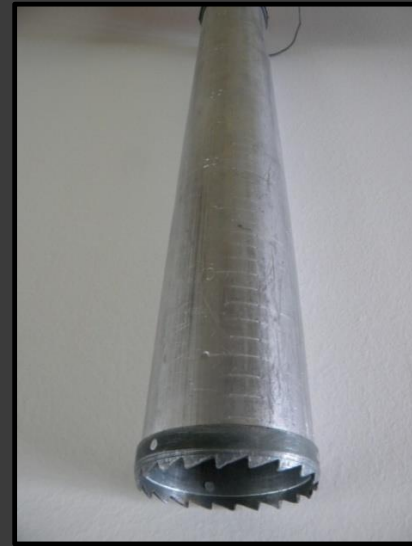


Research area Červenec

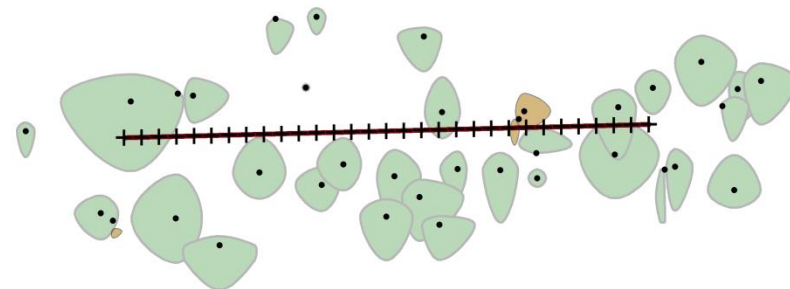


Snow cover monitoring

- February 2009
- winter 2012/13
- SWE
- SD

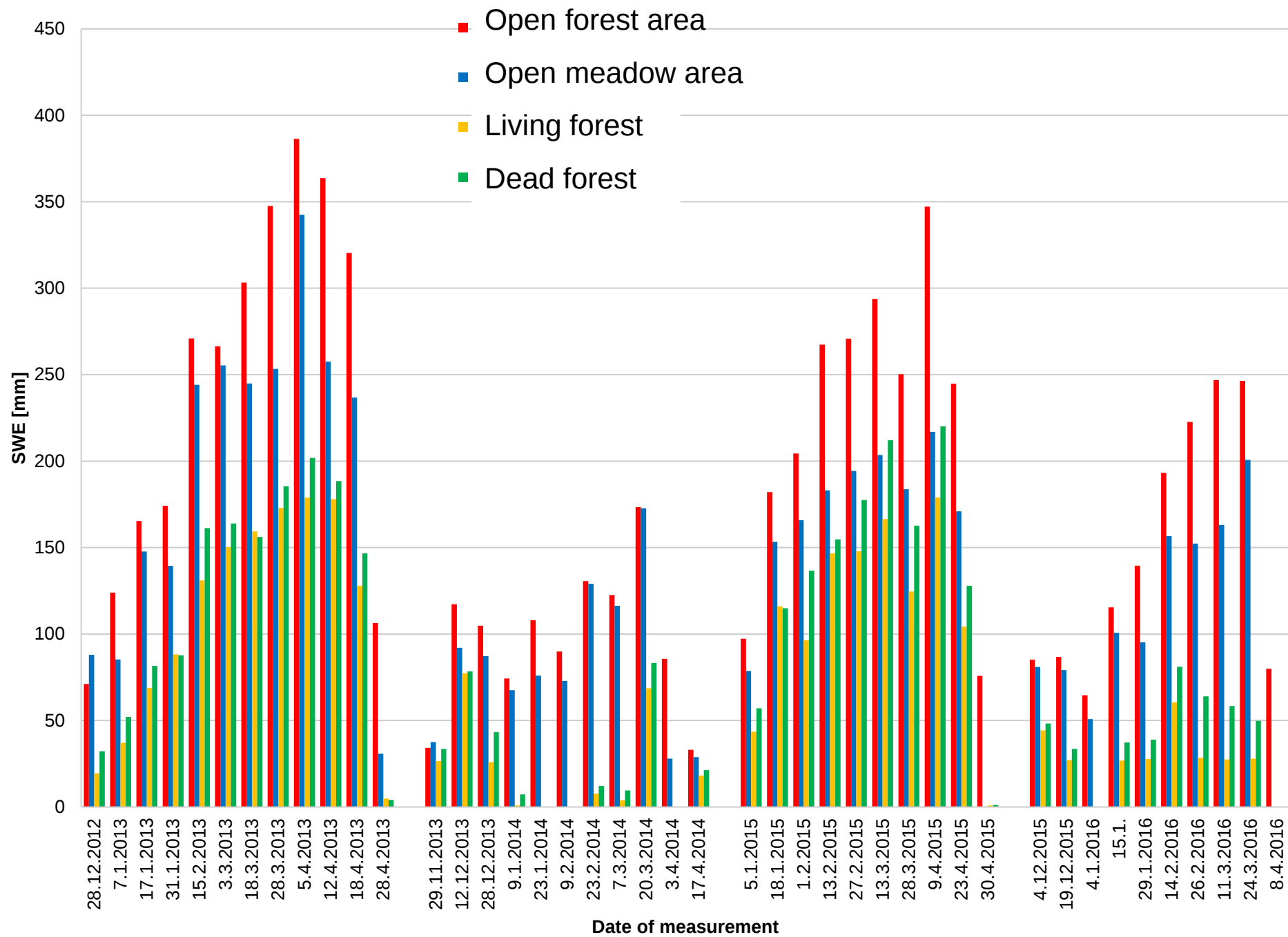


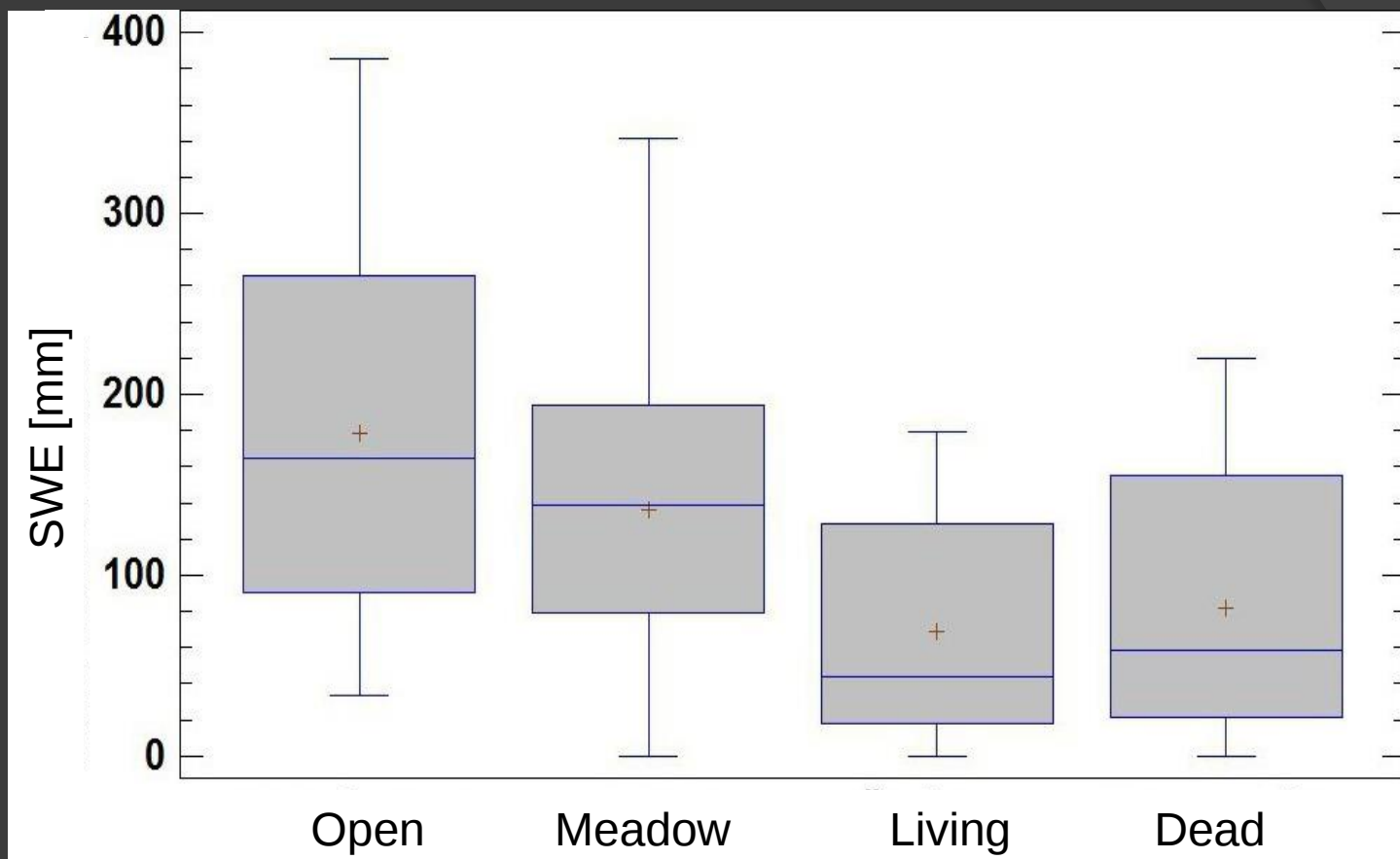
0 5 10 20 Meters



Results

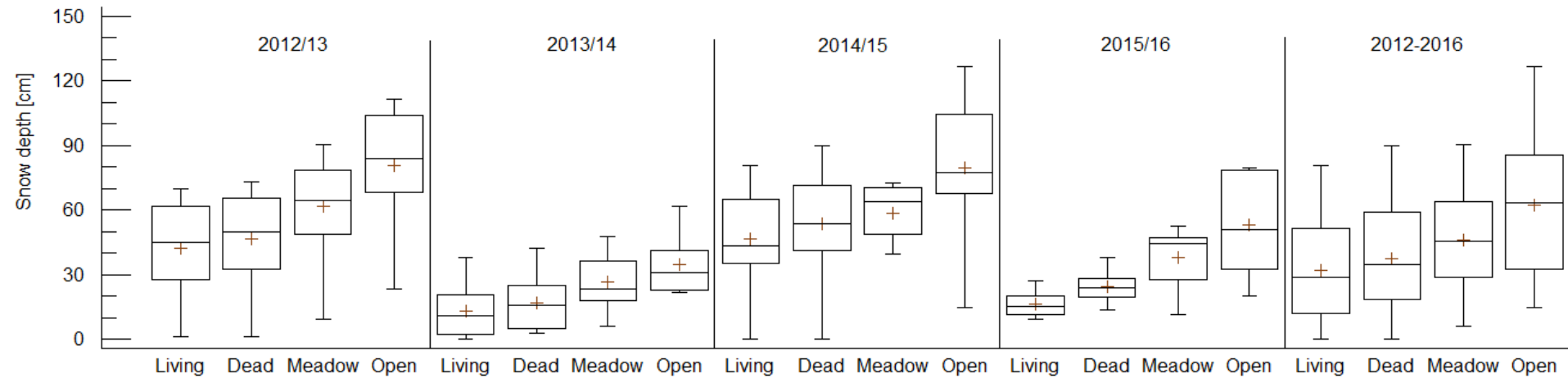






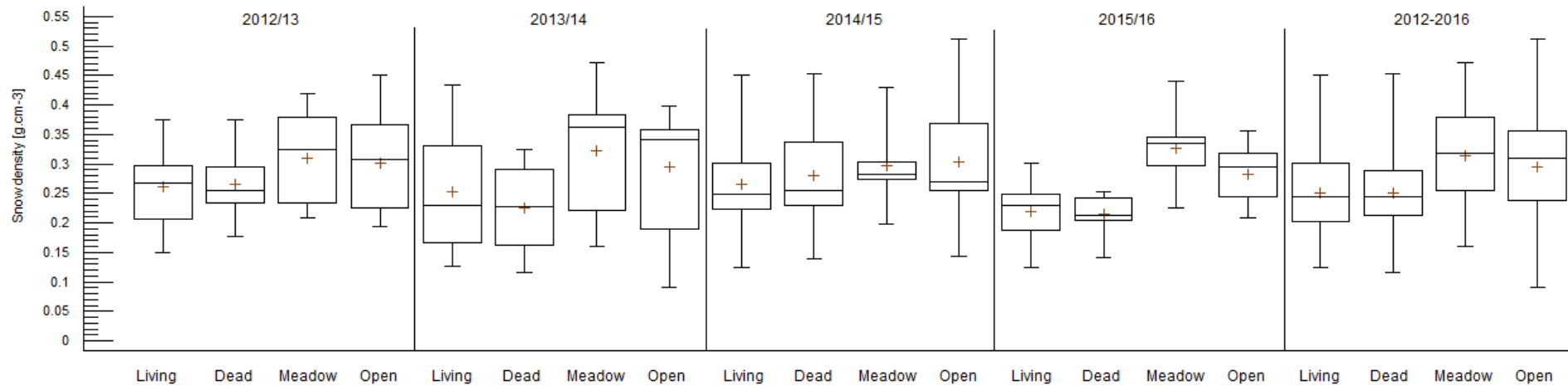
Locality	Count	Mean	Standard deviation	Coeff. of variation	Minimum	Maximum	Range
Open forest area	43	178,744	98,6714	55,20%	33	386	353
Meadow	43	136,349	80,1376	58,77%	0	342	342
Living forest	43	68,3721	62,6608	91,65%	0	179	179
Dead forest	43	81,9535	69,856	85,24%	0	220	220

Snow depth



	2012/13				2013/14				2014/15				2015/16				2012-2016			
	Count	Average	Standard deviation	Coeff. of variation	Count	Average	Standard deviation	Coeff. of variation	Count	Average	Standard deviation	Coeff. of variation	Count	Average	Standard deviation	Coeff. of variation	Count	Average	Standard deviation	Coeff. of variation
Living	12	42.5	22.5	53.0%	8	13.2	12.9	97.1%	10	46.6	23.3	50.0%	8	16.1	6.1	38.1%	38	31.9	23.3	73.3%
Dead	12	46.5	23.2	49.9%	8	17.0	13.5	79.2%	10	53.4	26.0	48.7%	8	24.4	7.6	31.1%	38	37.5	24.3	65.0%
Meadow	12	61.7	23.6	38.2%	11	26.3	12.1	45.9%	9	58.7	13.2	22.6%	9	37.6	13.9	37.0%	41	46.3	22.3	48.1%
Open	12	80.5	28.7	35.6%	11	34.5	12.7	36.9%	10	79.7	31.3	39.3%	10	53.0	24.0	45.3%	43	62.2	31.3	50.3%
Total	48	57.8	28.2	48.8%	38	24.0	14.8	61.7%	39	59.6	26.8	45.0%	35	34.1	20.6	60.4%	160	45.0	28.0	62.1%

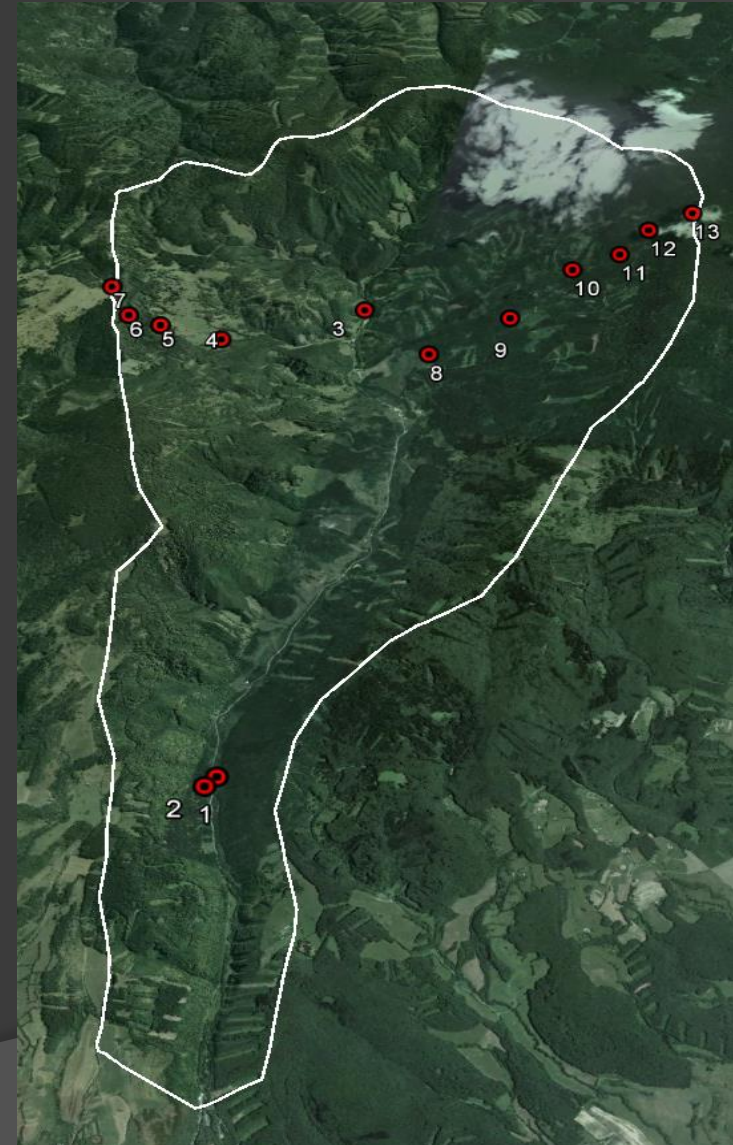
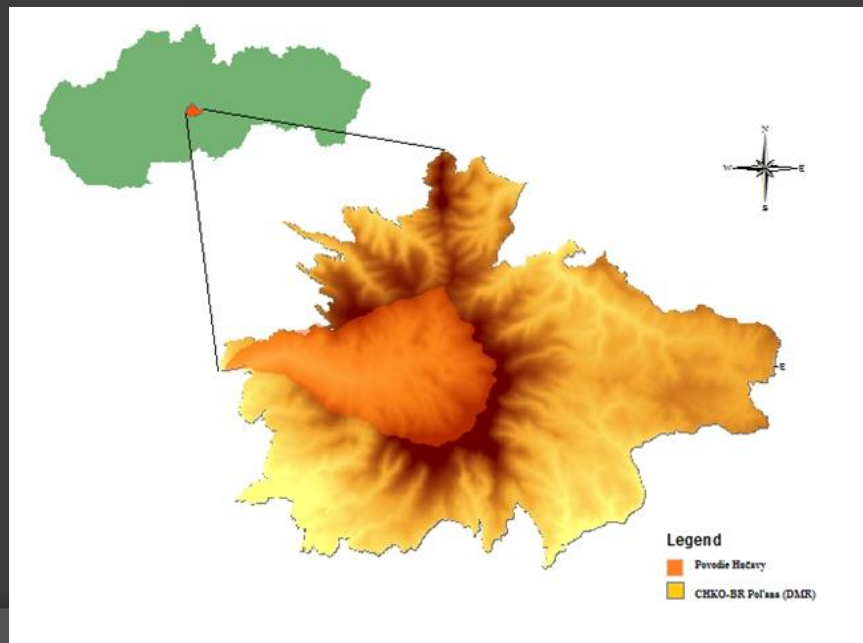
Snow density



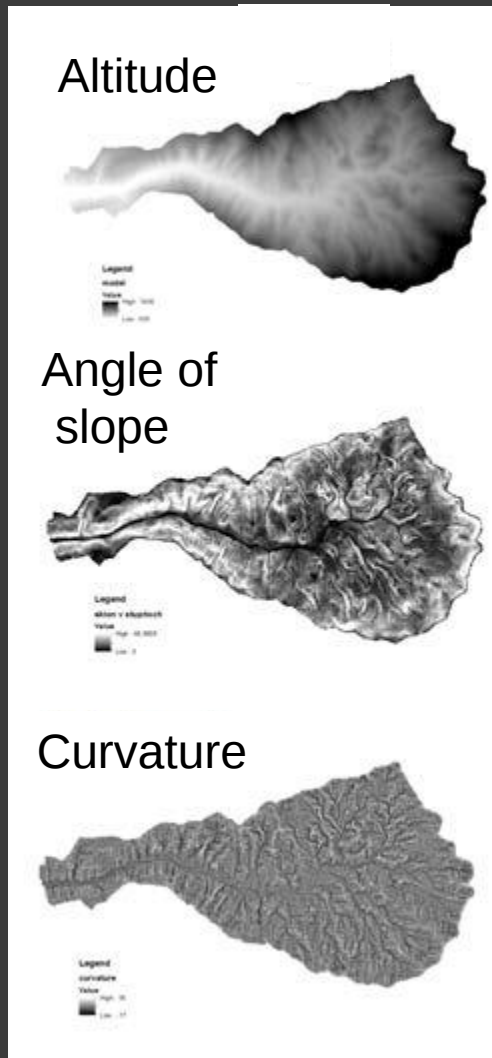
	2012/13				2013/14				2014/15				2015/16				2012-2016			
	Count	Average	Standard deviation	Coeff. of variation	Count	Average	Standard deviation	Coeff. of variation	Count	Average	Standard deviation	Coeff. of variation	Count	Average	Standard deviation	Coeff. of variation	Count	Average	Standard deviation	Coeff. of variation
Living	12	0.260	0.066	25.3%	8	0.252	0.107	42.4%	10	0.266	0.087	32.8%	8	0.220	0.054	24.7%	38	0.252	0.079	31.2%
Dead	12	0.266	0.058	22.0%	8	0.225	0.078	34.5%	10	0.280	0.090	32.0%	8	0.214	0.036	16.6%	38	0.250	0.071	28.5%
Meadow	12	0.310	0.077	24.8%	11	0.322	0.100	31.0%	9	0.298	0.070	23.5%	9	0.326	0.066	20.1%	41	0.314	0.078	24.8%
Open	12	0.301	0.084	27.8%	11	0.295	0.108	36.5%	10	0.303	0.102	33.7%	10	0.283	0.050	17.6%	43	0.296	0.086	29.1%
Total	48	0.284	0.073	25.6%	38	0.279	0.103	36.8%	39	0.286	0.086	30.1%	35	0.264	0.069	26.0%	160	0.279	0.083	29.7%

Water supply estimation of snow cover in small forested catchment using GIS

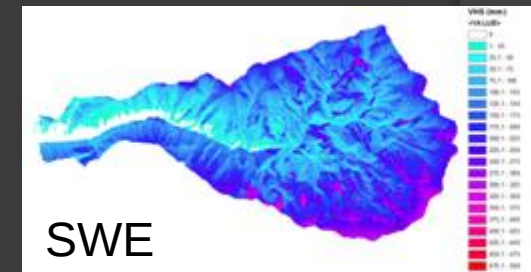
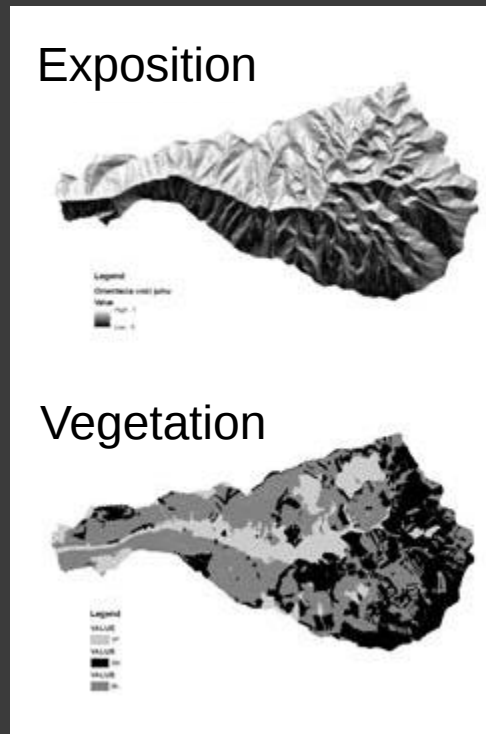
- Biosphere reservation Poľana, Hučava catchment
- 41,16 km², 522 -1458 m a.s.l.
- Forest covers 81%, Norway spruce (45%), European beech (36%),



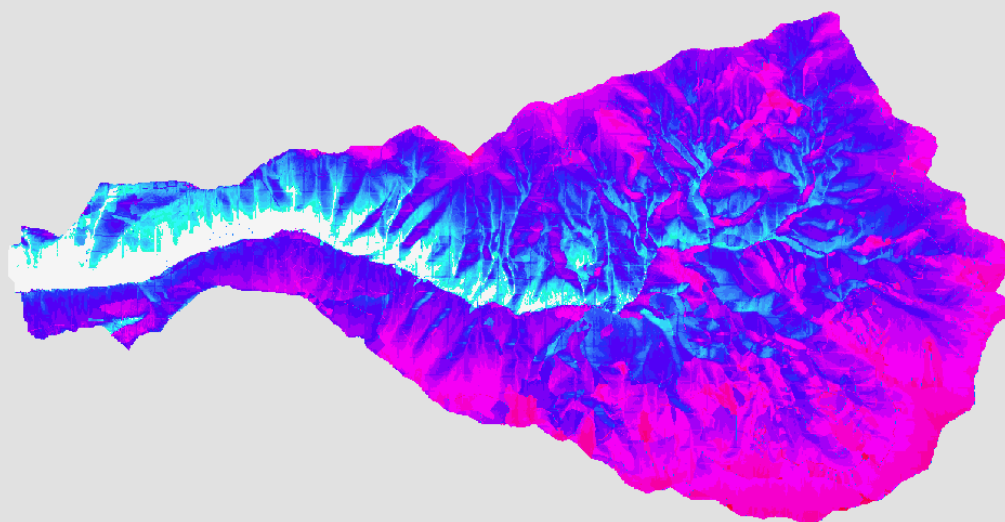
Multiple regression analyse



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Vodná hodnota snehu v povodí Hučavy

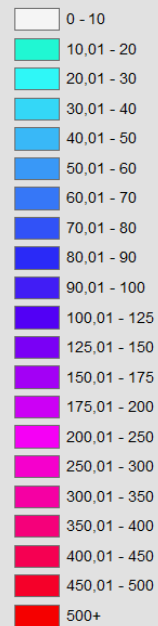


2.4.2013

Legend

VHS (mm)

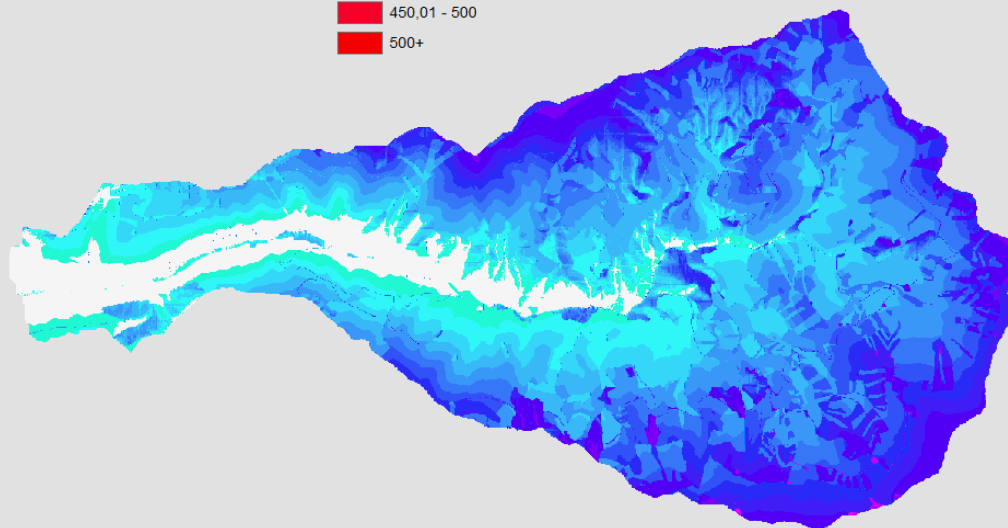
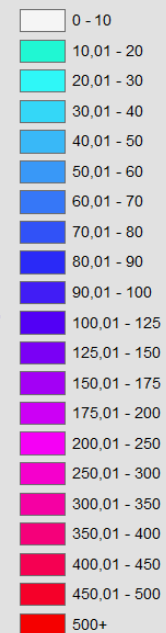
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Legend

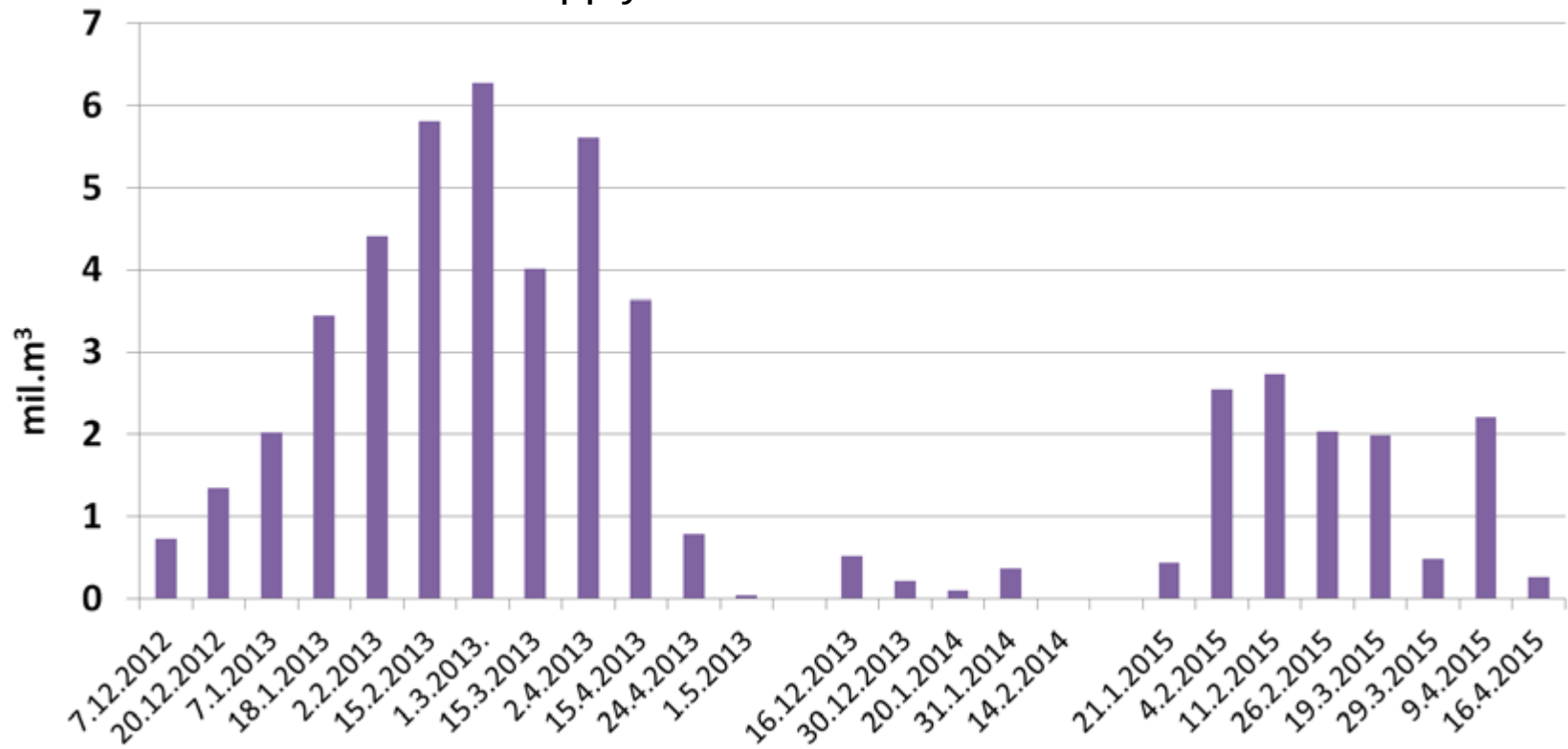
VHS (mm)

<VALUE>



9.4.2015

Water supply in snow cover in Hucava catchment



CONCLUSIONS

From Cervenec research area (1 420 m. a s.l. declined spruce forest)

- The average SWE in the living forest, dead forest, and meadow was 38 %, 46% and 76% of the SWE at the open area, respectively.
- The comparison of snow accumulation and melting in the living and dead forest revealed that the snow cover was more stable in the living forest
- Differences between living and dead forest in snow depth was significant but not in density

From Hucava catchment

- Better calculation of snow water supply in catchment
- Dominant factors were vegetation, altitude, exposition (during melting period in beech and open)
- SWE in spruce forest 57 % of SWE in open area and in beech forest 94 % of SWE in open area



Thanks for your attention