

# Evaluation water balance components for forested headwater catchment undergoing environmental changes

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# Experimental catchment Uhlířská



- ✓ Jizera Mountains, North Bohemia
- ✓ Drainage area: 1.78 km<sup>2</sup>
- ✓ Average altitude: 822 m a.s.l
- ✓ Annual precipitation: 1370 mm
- ✓ Annual temperature: 6 °C
- ✓ Vegetation: spruce forest and grass from Poaceae family
- ✓ 4 monitoring stations
- ✓ 19 years of hydrometeorological data (2000 – 2018)
- ✓ Hydrological year from 1 Nov to 31 Oct; summer season from 1 May to 31 Oct.

# Water balance

Underrepresented processes affecting the water balance taken into account

- ✓ Interception
- ✓ Snow sublimation
- ✓ Reduction of transpiration due to dew formation
- ✓ Biomass water consumption
- ✓ Changing vegetation cover (proportion of forest and grasses) in time (also LAI changes over the years)
- ✓ Diversified calculation of transpiration of grass and for spruce forest

# Water balance equation

Measured precipitation

## Interception loss and transpiration

an algorithm describing the evaporation of intercepted water and reduced plant transpiration due to the wet canopy effect. Transpiration is calculated by Penman-Monteith equation ([Monteith, 1965](#)).

$$P = Q + I + T + Sub + C + \Delta S$$

Measured runoff

Change of water storage

**Amount of snow sublimation** estimated according to [Yao et al., 2018](#).

**Water use for forest growth (new wood mass)** is approximated as a 1% of water transpired by trees

[Monteith J.L. \(1965\)](#) Evaporation and environment. Symp. Soc. Exp. Biol. 19: 205–234.

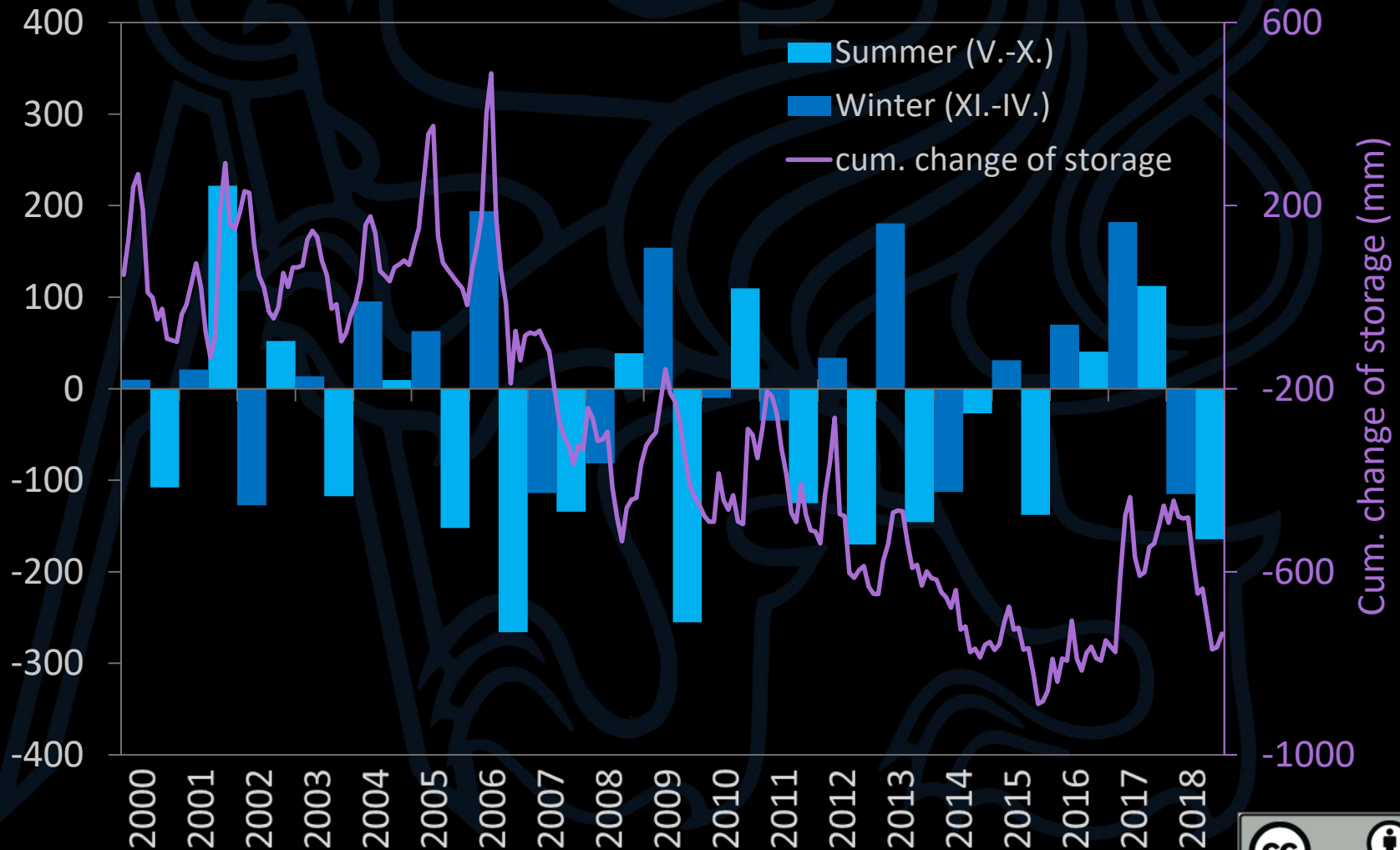
[Yao, H., Field, T., McConnell, Ch., Beaton, A., James, A. L. \(2018\)](#) Comparison of five snow water equivalent estimation methods across categories. Hydrol. Process. 32, 1897-1908.

# Results

Hydrological variable	Annual		Summer		Winter	
	19- year averages					
<i>Units</i>	<i>mm/year</i>	<i>%</i>	<i>mm/year</i>	<i>%</i>	<i>mm/year</i>	<i>%</i>
Precipitation	1370.2	-	728.8	-	641.4	-
Runoff	956.5	69.5	400.3	52.5	555.1	87.8
Transpiration	326.9	25.4	283.4	43.9	43.5	7.3
Evaporation= interception loss	105.7	8.0	105.1	15.3	0.6	0.1
Sublimation snow amount	17.0	1.3	0.0	0.0	17.0	2.8
Water consumption to growth	3.6	0.3	3.1	0.5	0.4	0.1
	°C		°C		°C	
Temperature	5.7		11.5		0.0	

✓ The effect of dew deposited on the vegetation was considered as significant. The annual decrease of transpired amount is 29 mm in average.

# Results



# Conclusions

19 years of hydrometeorological data (2000-2018) from the small headwater catchment Uhlířská located in the Jizera Mountains (Czech Republic) were analyzed.

- ✓ Results showed that the effect of interception is not negligible.
- ✓ Sublimation, interception, and influence of dew formation - normally underestimated components were taken into account.
- ✓ Components of the water balance were either directly measured (precipitation, runoff) or estimated (transpiration, evaporation = interception, sublimation and water consumption to growth of new wood mass).
- ✓ Negative water balance in years 2007, 2008 and 2014 is caused by the warm winter, when a snow melts gradually and the water catchment storage is not sufficiently replenished.
- ✓ Further significant declines in water storage can be observed in the extremely dry years 2015 and 2018.



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