

COMPARISON OF EVAPOTRANSPIRATION OF TWO FOREST VEGETATIONS.  
ELABORATION OF LONGTERM LYSIMETER DATA AT CASTRICUM, NETHERLANDS,  
AND ST. ARNOLD, GERMANY.

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ABSTRACT

Studies on the impact of land cover on the water cycle and water resources are of all times. In particular the hydrological behavior of forests is receiving a lot of attention for almost a century. Moreover various species of forest, i.e. deciduous and pine forest show differences in evapotranspiration. Consequently the groundwater recharge can be highly dependent on the type of vegetation.

In the early 20th century the Provincial Water Supply Company North-Holland was confronted with the possible effects of forestation of dunes along the North Sea on the building up of exploitable groundwater resources for fresh water supply.

In order to gather knowledge about the influence of forest vegetation on evapotranspiration losses a large lysimeter experiment was set up in the period 1938-1940 some 2 km from the North Sea near the township of Castricum. Four lysimeters of 25x25 m, 2.5 m deep, were built of reinforced concrete, equipped with a drainage system on the bottom to collect the percolation water, and filled up with dune sand. One lysimeter was left bare as reference; the others were planted respectively with dune scrub, oak-seedlings and with seedlings of *Pinus Nigra Austriaca*.

A pit gauge free of wind effects was used for precipitation measuring. The investigations started in 1941 and continued almost unchanged for about sixty years. In the period 1941 till 1997 total evaporation was derived from the water balance of the lysimeters (Van der Hoeven, Warmerdam and Kole, 2005).

In the period 1962 to 1964 a similar lysimeter station was built by the formerly Water Authority Muenster in St.Arnold, North Rhine Westphalia, Germany. The main purpose was to quantify the groundwater recharge under forest of a sandy podzol soil in relation to that of grassland covers in this region.

This station was equipped with three lysimeters made of ferroconcrete, sized 20x20 m and 3.5 m deep (Schroeder, 1990). One lysimeter was planted with nine decimeter mixed deciduous forest (initially twelve different species, but cleared out to beech and oak trees in the 1970s), a second lysimeter planted with Eastern White pine forest and the third one with grass. The development of the mixed beech-oak forest suffered the drought of the 1970s requiring partly replant. Measurements of drainage outflow and precipitation using a recording pit gauge as well as meteorological variables to compute reference evapotranspiration are being carried out since 1966.

Analysis of the nearly sixty years of data collected at Castricum show a mean annual precipitation of 842 mm, while in St.Arnold an annual value of 794 mm was observed for the period 1966-2007. The average drainage volume of the oak forest lysimeter in

Castricum amounts to 35% of the average annual precipitation of 842 mm (1941-1971). The pine forest yields a mean annual percolation of 12%. Figure 1 shows mean monthly values of precipitation and drainage of the lysimeters with oak respectively pine forest at the Castricum station for the period 1941 to 1972. In summer time differences of the low percolation rates between the two types of forest are small.

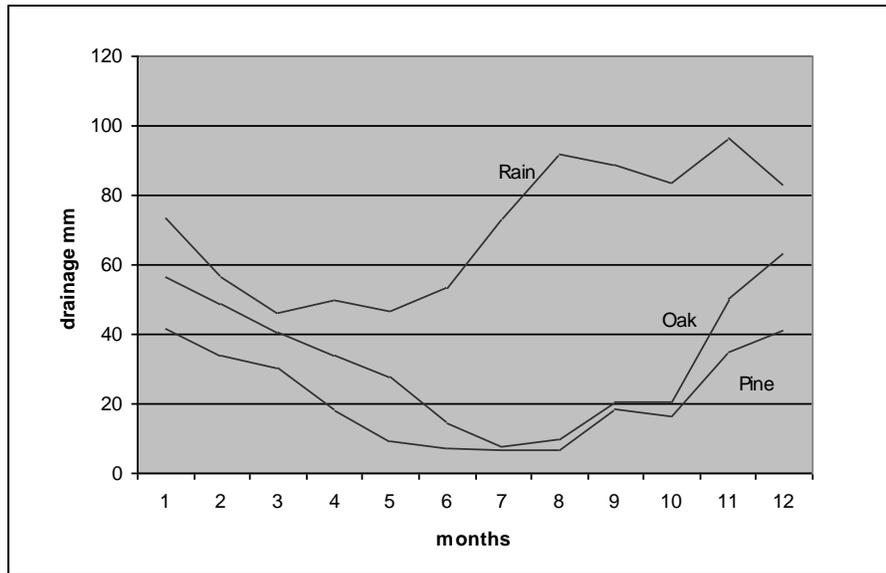


Figure 1. Mean monthly values of precipitation and drainage of oak and pine forest lysimeters at Castricum (1941-1971). Month 1 is January.

A similar result of the forested lysimeters is found at St. Arnold, however the mean recharge values of the months November and December appears also almost equal (Fig. 2).

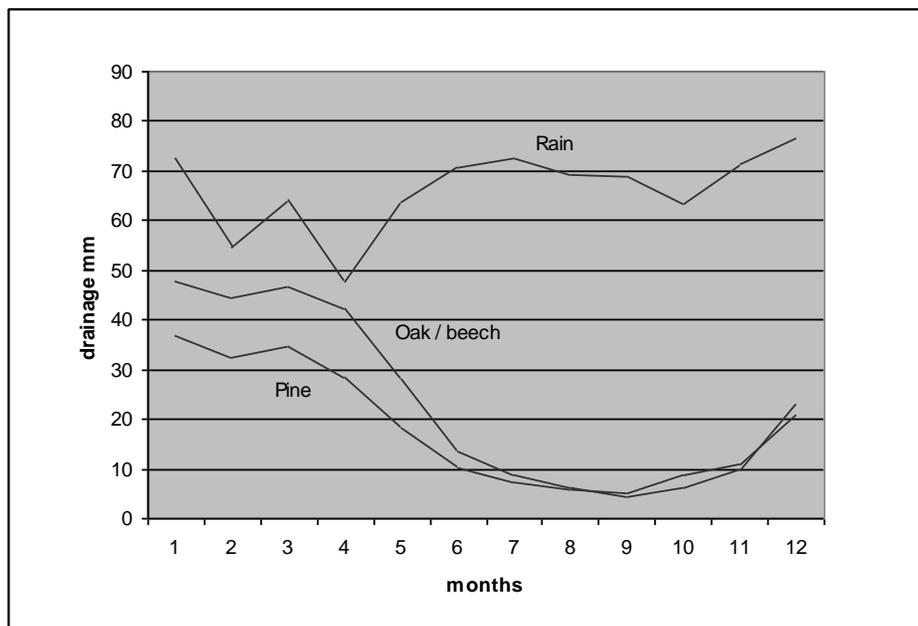


Figure 2. Mean monthly values of precipitation and drainage of oak- beech and pine

forest lysimeters at St.Arnold (1966-2006). Month 1 is January.

The average percolated volume of the beech-oak forest lysimeter in St.Arnold measured from 1966 to 2007 amounts to 36% of the average annual precipitation of 794 mm. This is almost equal to the Castricum results. The pine forest shows a mean annual percolation of 26%, being twice of the Castricum observation. In the paper a detailed comparison of the time series of the lysimeters at Castricum and St. Arnold will be presented.

These long-term studies show explicitly the large effect of forest on the recharge of groundwater resources in a humid climate.

#### REFERENCES

- Hoeven, van der, P.C.T., Warmerdam, P.M.M. and Kole, J.W., 2005. Description of the Castricum lysimeters 1941-2000, The Netherlands. Comparison of rain gauges and through fall. Proceedings Conference on forest impact on hydrological processes and soil erosion. Yundola 2005, Bulgaria.
- Schroeder, M., 1990. Verdunstung von Land und Wasserflaechen in St.Arnold bei Rheine in den Jahren 1980 bis 1987. Deutsche Gewaesserkuendliche Mitteilungen, 34(4), 1990.