RAINFALL INTERCEPTION BY DECIDUOUS AND CONIFEROUS TREES IN AN URBAN AREA

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RAINFALL INTERCEPTION

All of the precipitation that falls on the vegetation does not contribute to surface runoff. In general rainfall is divided into throughfall which reaches the ground and interception which retains in the canopy and slowly evaporates.

Hydrological properties of an area have been changed by the process of urbanization which results especially in increased runoff. Previous studies have suggested that rainfall interception by urban trees can reduce the runoff. Trees as part of the green infrastructure are becoming one of the best management practices to control runoff in urban areas.

A lot of studies about interception have been done in forests. The characteristics of trees and consequently the process of interception in forest are different from those in urban areas. Due to the growing importance of urban trees it is important to gain more knowledge about interception in urban areas.

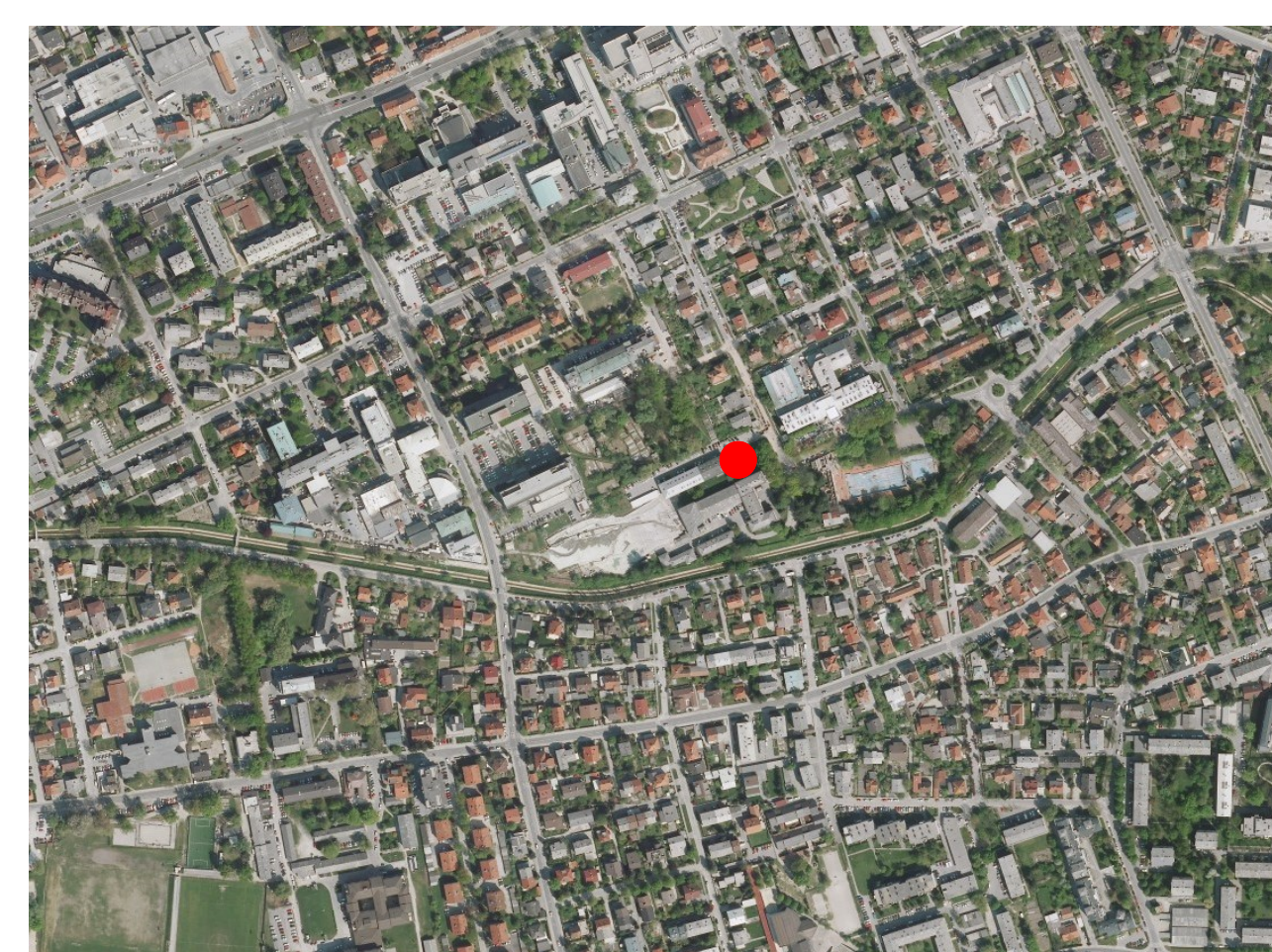## MEASUREMENTS

WHEN?

From 1 April to 31 July 2014.

WHERE?

- In centre of Ljubljana, capital of Slovenia
- Two deciduous trees: birch (*Betula pendula*)
- Two coniferous trees: pine (*Pinus sylvestris*)

HOW?

- Throughfall: two trough gauges, one with tipping bucket and one with manual 60 l tank for control, ten manual roving gauges which were randomly moved under the tree canopy
- Stemflow: rubber collar fitted around the tree, connected to manually reading 20 l plastic tank
- Rainfall: tipping bucket rain gauge located on the clearing near the trees

Two deciduous trees (left) and two coniferous trees (right)

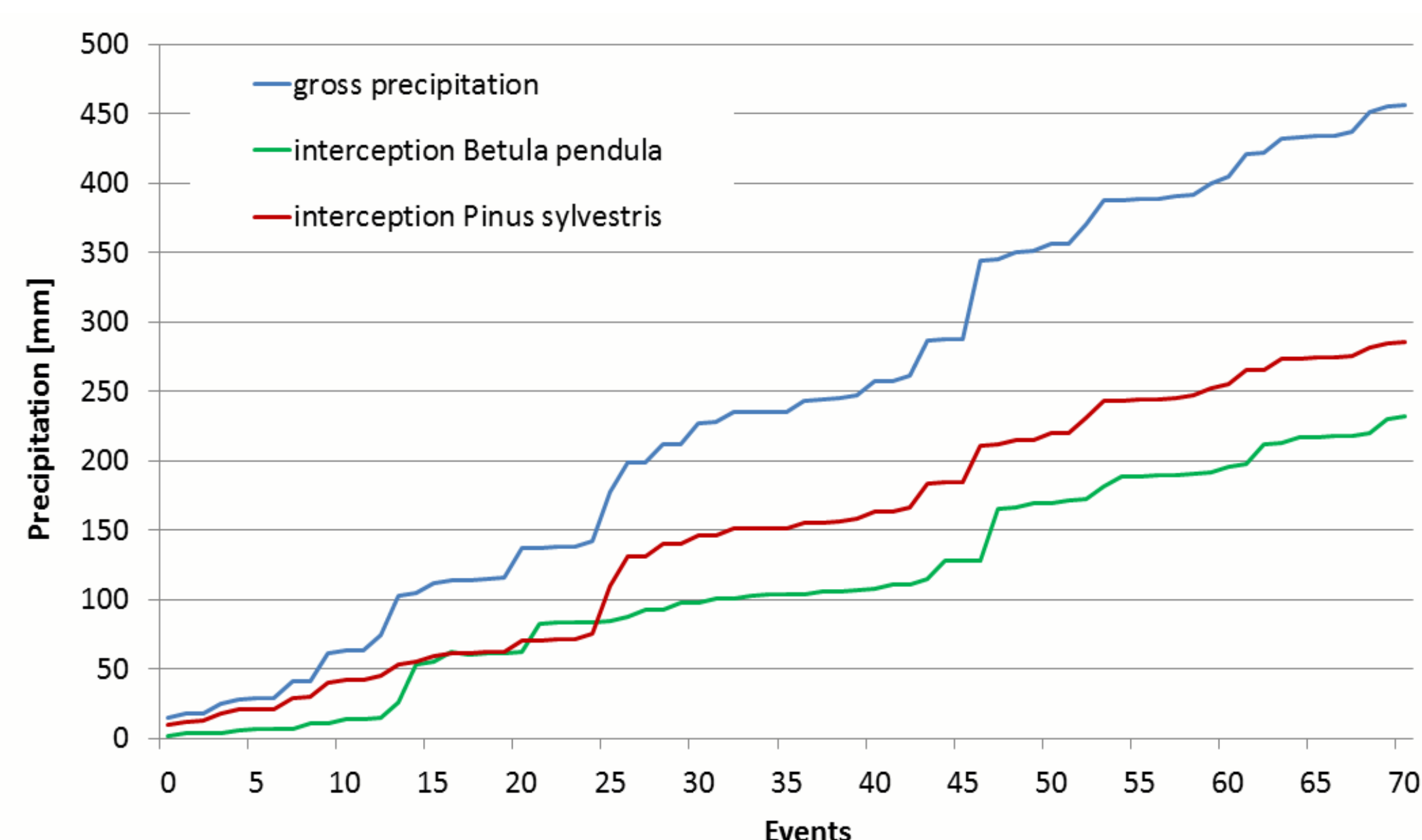Measurement of stemflow and manual roving gauges

Trough gauge with tipping bucket
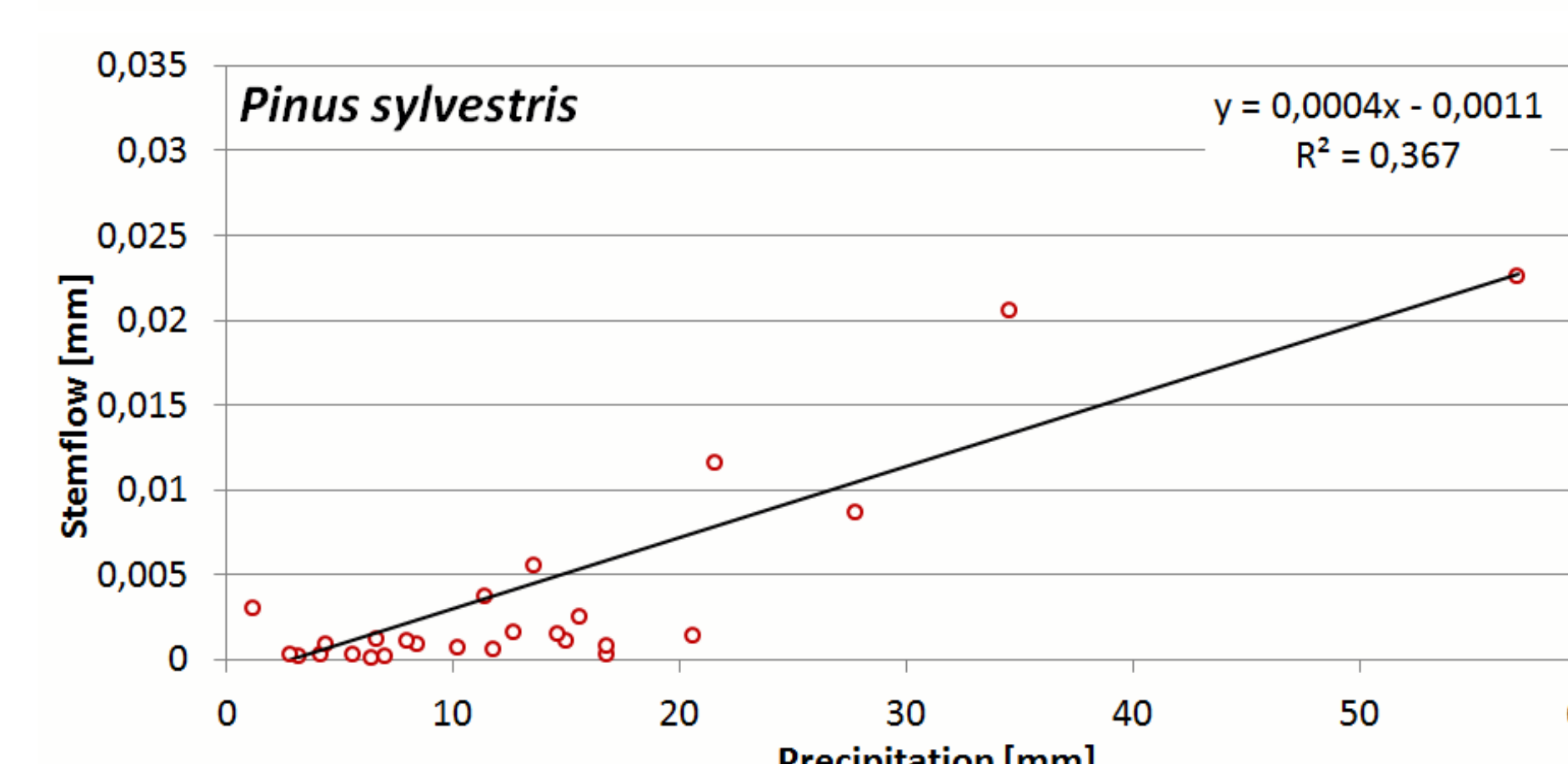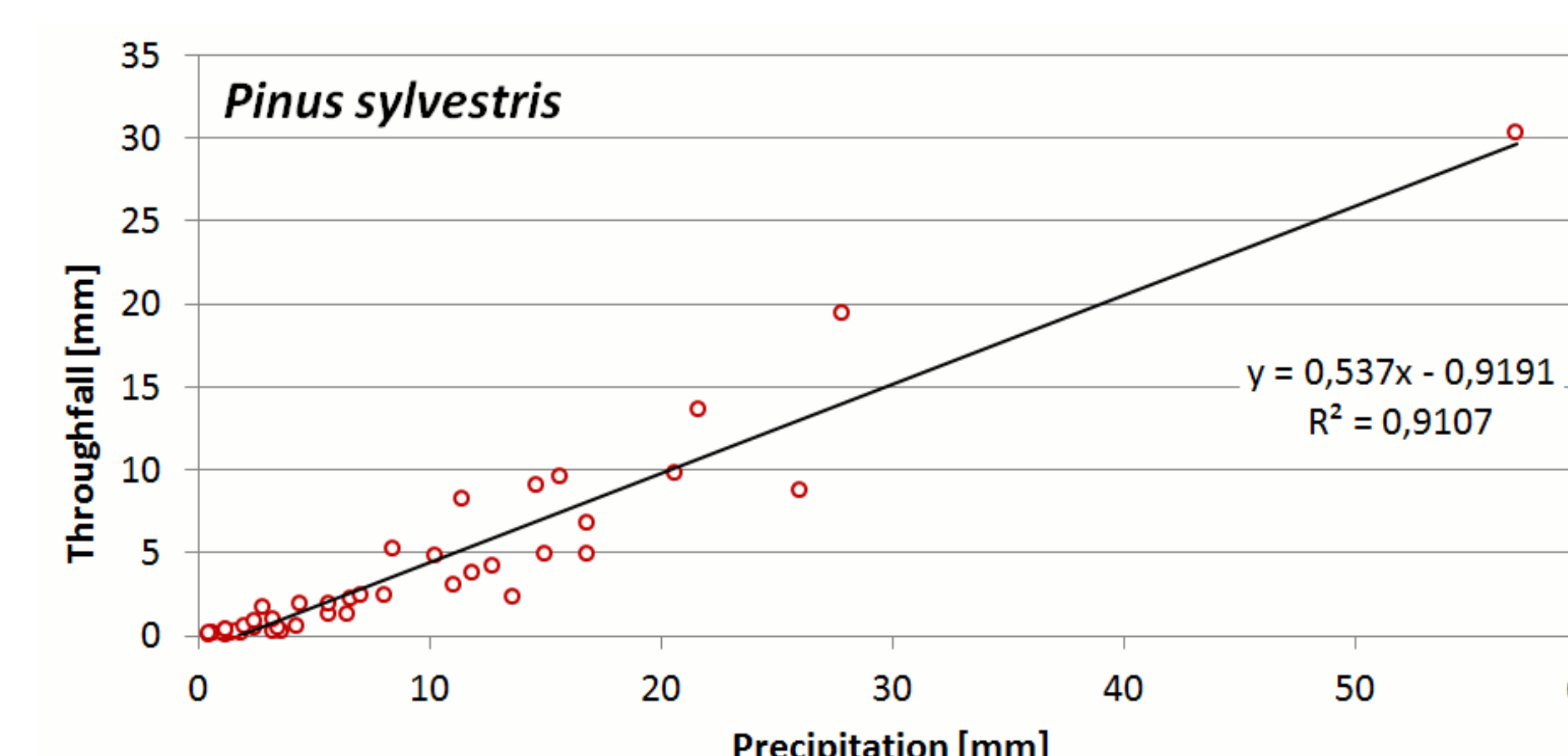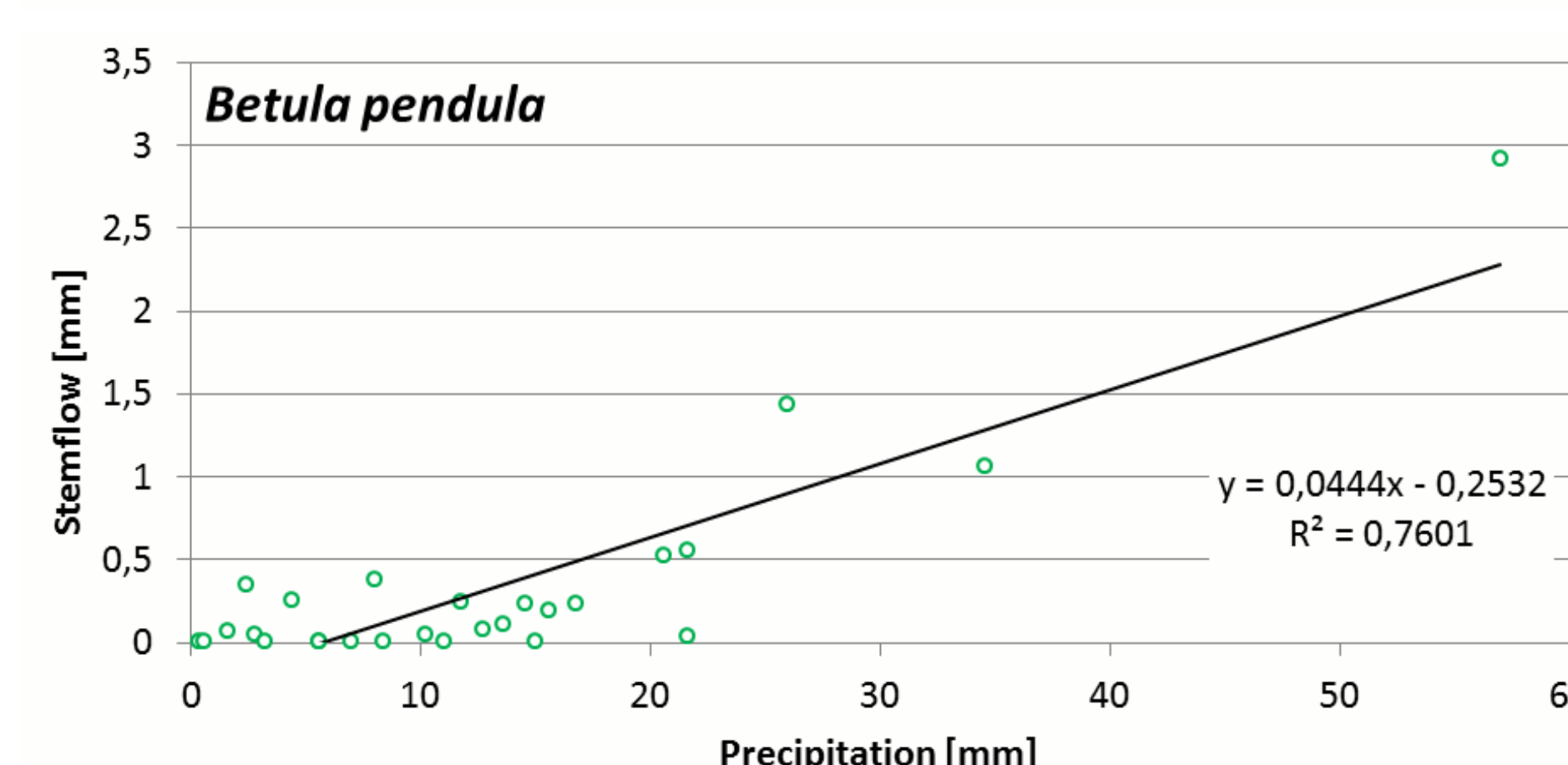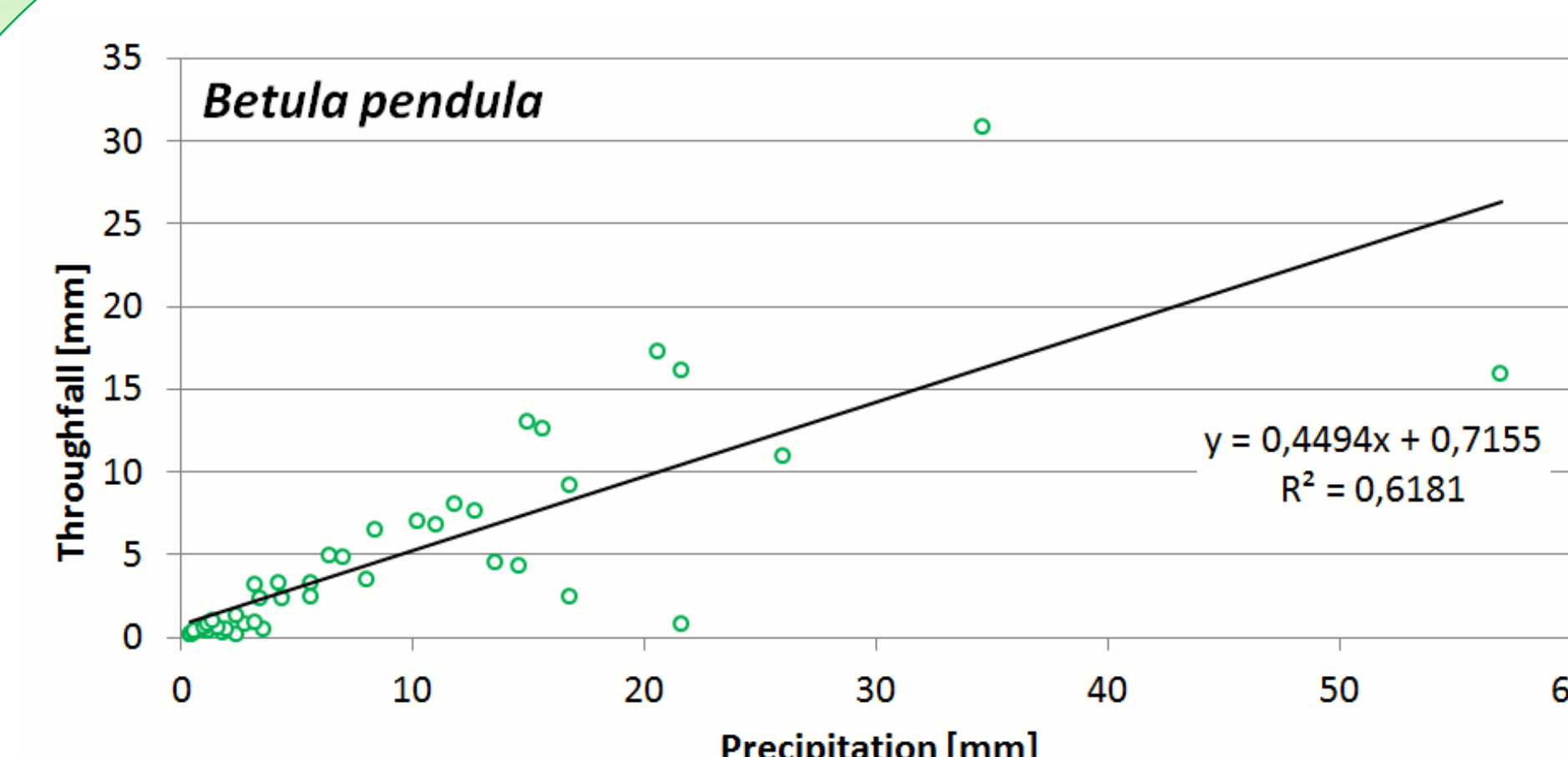
Tipping bucket rain gauge

RECORDED EVENTS

From 1 April to 31 July 2014 there were **71** detected rainfall events. To define the rainfall event we considered that in average 4 hours have passed between the end of precipitation and its next start. For two rainfall events throughfall data were missing due to clogging of the instruments, in case of 22 events throughfall was not recorded (interception is 100%) and in case of 29 events automatically recorded data were incomplete and therefore combined with manual measurements.

The total precipitation was **456.3** mm. Four larger storms (rainfall > 20 mm) account for 32% of the total precipitation and 46 smaller events (rainfall < 5 mm) accounted for only 11% of the total precipitation.

For the *Betula pendula* the total intercepted precipitation was **50.6%** (231 mm). For the *Pinus sylvestris* the total intercepted precipitation was **62.5%** (285.4 mm). For both trees the throughfall has started when the amount of precipitation exceeded 0.4 mm.
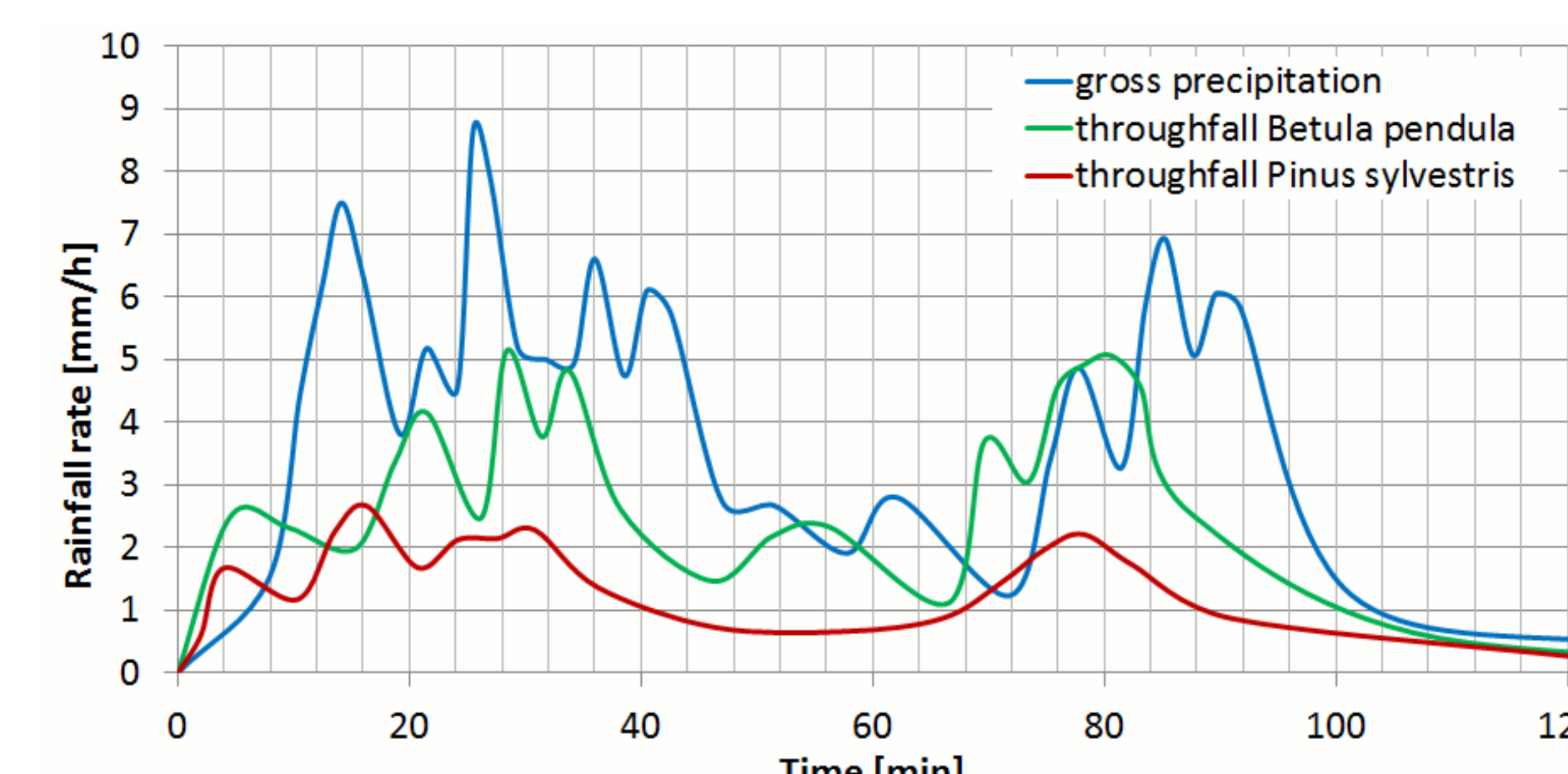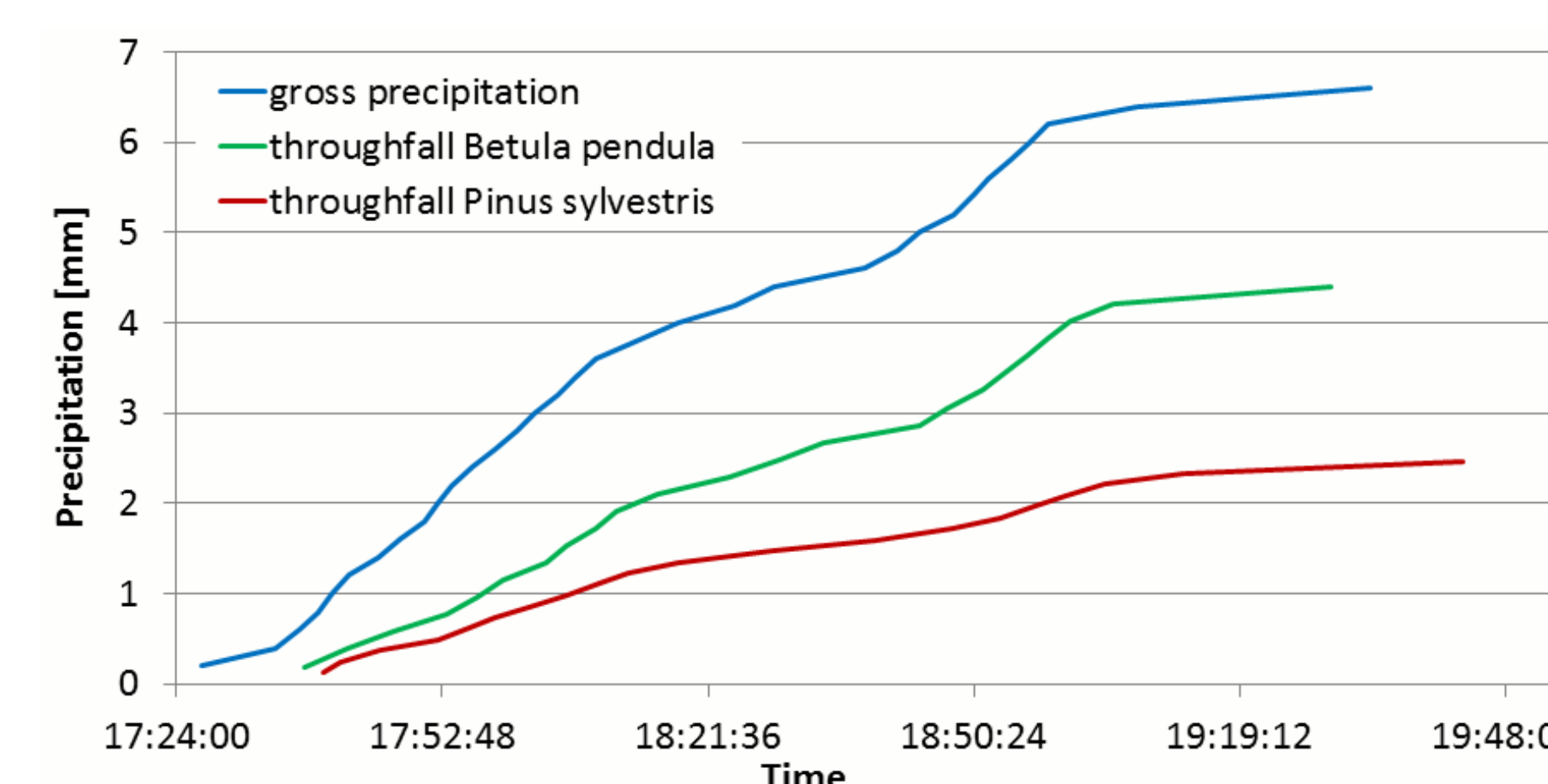
RESULTS

Betula pendula — $y = 0,4494x + 0,7155$; $R^2 = 0,6181$

Pinus sylvestris — $y = 0,537x - 0,9191$; $R^2 = 0,9107$

Betula pendula — $y = 0,0444x - 0,2532$; $R^2 = 0,7601$

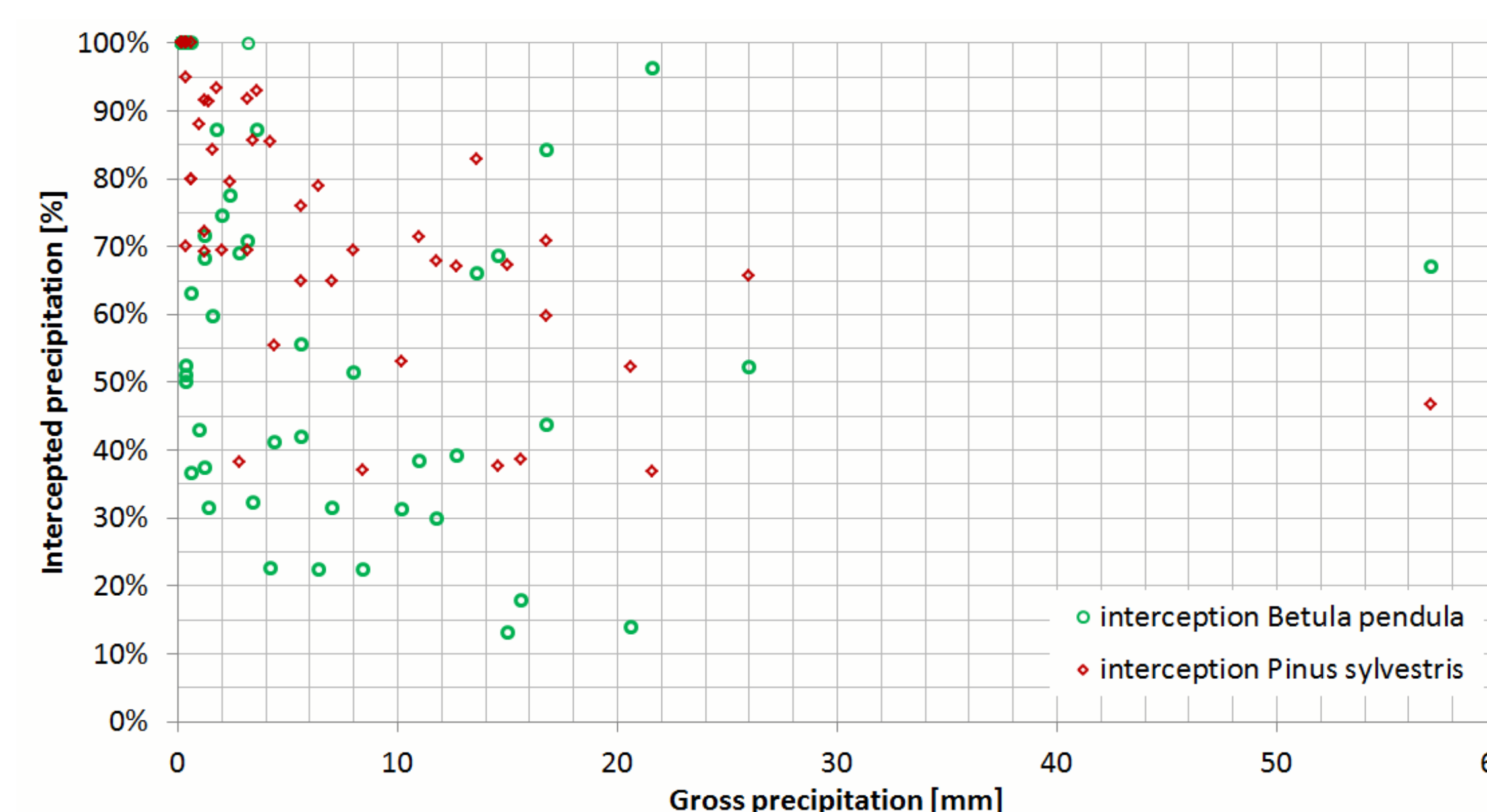*Pinus sylvestris* — $y = 0,0004x - 0,0011$; $R^2 = 0,367$

Throughfall was about 47% of gross precipitation on the *Betula pendula* and 37% on the *Pinus sylvestris*. The linear relationship for *Betula pendula* is weak due to data scattering of larger events (rainfall > 15 mm). The linear relationship for *Pinus sylvestris* is good also for the largest recorded rainfall event. Stemflow was about 3% of gross precipitation on the *Betula pendula* and only 0.05% on the *Pinus sylvestris*. The linear relationship is weak for small events. In order to establish better relationship more data is needed.

ONE OF THE RAINFALL EVENTS: 29 MAY 2014

The event occurred on 29 May 2014 and lasted for almost 281 minutes. The total precipitation of the event was 7 mm of which *Betula pendula* intercepted 1.83 mm (26%) and *Pinus sylvestris* 4.5 mm (65%). Throughfall was first recorded under the *Betula pendula* 11 minutes after the beginning of precipitation. Under *Pinus sylvestris* throughfall was recorded two minutes later, after 13 minutes from the beginning of the event. The average rainfall rate of the event was 4.38 mm/h. It was quite high at the beginning of the event, but half way through, however, has significantly reduced. The average throughfall rainfall rates were lower: 2.89 mm/h (*Betula pendula*) and 1.51 mm/h (*Pinus sylvestris*).

COMPARISON OF INTERCEPTION BY DECIDUOUS AND CONIFEROUS TREE

In general percent of intercepted precipitation is lower when the total precipitation is higher. In case of smaller storms interception by *Pinus sylvestris* is higher than interception by *Betula pendula* which is not so evident for larger storms. For two out of four largest events (rainfall > 20 mm) the interception by *Betula pendula* is higher than interception by *Pinus sylvestris*. This indicates that there are other important parameters influencing the process of interception that should be considered in the analysis.