# The relative importance of topography and land use on the Veluwe rainfall maximum in The Netherlands

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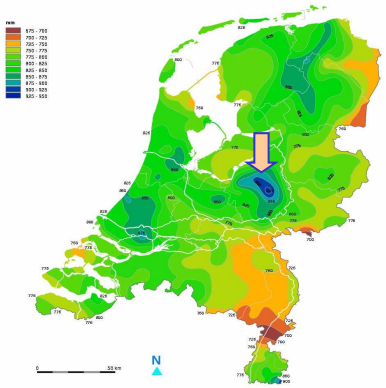
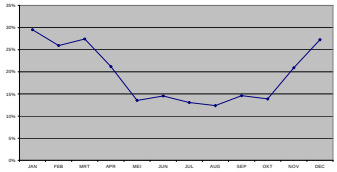
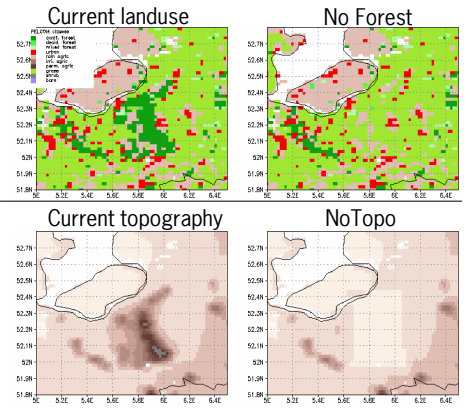
## Introduction

The Veluwe exhibits an average yearly precipitation sum which is 75-100 mm higher than the rest of the country, a difference of around 20 % per year. These differences change seasonally with larger values in the winter months. At present this precipitation hotspot is thought to be orographic, however other experiments have shown that forest also contributes to this phenomenon (e.g. HAPEX-Mobilhy, Noilhan et al., 1991, MWR)



Relative difference in precipitation over a year between stations on the Veluwe (orange dots) and stations around the Veluwe (blue dots)






## Methodology

The cause of this maximum is investigated by comparing a control simulation to two scenarios in a regional atmospheric model (RAMS): NoForest- and NoTopo-scenario.

The NoForest-scenario uses a land cover with the Veluwe area converted from forest to grassland.

NoTopo-scenario it is assumed that the Veluwe is converted to flat land with an altitude of 0 m.

### Model configuration

In this study RAMS version 4.3 was used in a nested grid configuration together with SWAPS-C

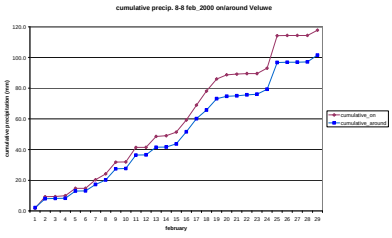
Model options used:

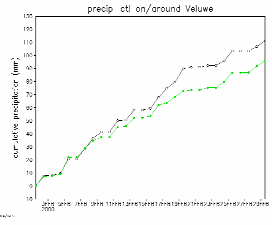
| grids | 1 | 2 | 3 |
|---|---|---|---|
| δx, δy | 18 km (50x54) | 6 km (60x62) | 2 km (149x149) |
| δt | 20 sec | 20 sec | 6.667 sec |
| δz | 25 - 1000 m (35) | | |
| radiation | Harrington (1996) | | |
| land surface | SWAPS-C (Ashby, 1998) | | |
| diffusion | Mellor/Yamada | | |
| forcing | ECMWF | | |
| forcing time scale | lateral 1800 s | | |
| convection | Full microphysics package (Flatau, 1989) | | |
| period | 7 May 2005 – 7 June 2005/1 Feb 2000-29 Feb 2000 | | |

## Validation

Cumulative precipitation for February 2000 is simulated well. Also the difference between precipitation on and around the Veluwe is simulated well. The dynamics of the precipitation, mostly frontal precipitation, are also captured reasonably well by the model.

The simulated precipitation for May 2005 (not shown) is in general simulated well. However at the end of the simulation precipitation is overestimated due to a wrong placement of a frontal system which is simulated above The Netherlands.



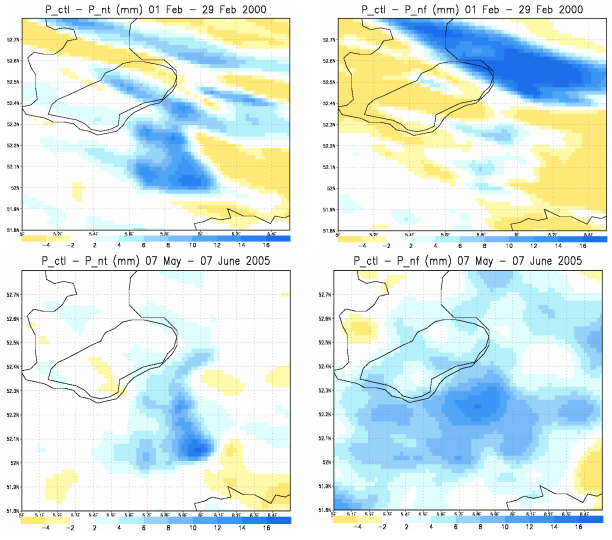




## Results

Looking at the differences between the control simulation and the NoTopo-scenario (left panel, figure below) it can be concluded that the differences are limited to the area affected by the removal of topography

The differences between the control simulation and the NoForest-scenario (right panel, figure below) suggests that the effect of the forested area of the Veluwe on precipitation is more widespread and not limited to only the Veluwe.

Comparing summer and winter simulations shows that a change in landuse on the Veluwe leads to a change in stream patterns when frontal weather sytems dominate local weather as is more common in winter situations.




This study is supported by the ACER project of The Netherlands research programme "Climate *changes* Spatial Planning", and the programs on "Climate Change" and on "Sustainable development and adaptation of ecosystems and landscapes in a metropolitan context" of the Wageningen University And Research Centre

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