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Effects of changes in land cover on streamflow generation in the Rhine basin

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The hydrological regime of the river Rhine is believed to change as a result of climate change, i.e. due to increasing temperatures it will shift from more snow-melt dominated to more rainfall dominated. Together with a projected increase of extreme precipitation events, this will cause a higher probability of floods in winter and extensive droughts in summer. In a densely inhabited and heavily industrialized basin like the Rhine, this will have profound impacts on water management. One possible way to relieve damage from both extreme floods and droughts, is by land cover changes. For example, there is evidence that deforestation can amplify flood risk. The expected abandonment of agricultural land due to the extension of the European Community may invoke afforestation of a considerable area in the Rhine basin. Therefore, it is worthwhile investigating whether, and if yes to what extent, afforestation can reduce flood risk and/or relieve extensive summer droughts. We apply the Variable Infiltration Capacity (VIC) model to the Rhine basin, forced with downscaled re-analysis data, at a spatial resolution of 0.088 degrees and a temporal resolution of 3 hours. We investigate the effects of land cover change on hydrological extremes at three different scales, ranging from a single model pixel to get insight in modeled land use effects, via a small sub-basin to the entire Rhine basin. To represent current land cover, data from the European PELCOM database is used. To ensure realistic land use scenarios, data from the European EURURALIS project is used, providing a European land

cover map in 2030. In addition, to investigate the effect of afforestation, more extreme afforestation scenarios are applied in the sub-basin and the entire basin. At all scales, frequency, magnitude and timing of extreme peak flows and dry spells are compared for different land cover scenarios to get an idea of to what extent land use changes can help dealing with hydrological extremes.