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Global fate modeling of evaporated water across basin boundaries

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Due to the increasing relevance of analyzing water consumption along product life cycles, the method of Water Footprinting gained rising attention in the last years. In this context the water accounting and vulnerability evaluation model (WAVE+) was developed at the TU Berlin. Based on a consumption-to-availability ratio derived from the hydrological model WaterGap3, WAVE+ currently analyzes the vulnerability of basins to freshwater depletion in more than 8.000 basins. On the accounting level the atmospheric evaporation recycling within drainage basins is considered which can reduce the water consumption volumes within specific basins significantly. However, the model does not consider evaporation recycling patterns across basin boundaries until now.

This research focuses on the enhancement of the method by including the latter point. In addition to the consideration of the basin internal evaporation recycling (BIER) the basin external evaporation recycling (BEER) is included for the first time. The main outcome are monthly and basin-specific recycling patterns which are able to show in which drainage basins evaporated water will finally re-precipitate.

The results were gained from the atmospheric moisture tracking model WAM-2layers which was fed with climatic input data from the ERA-Interim reanalysis on a 1.5° latitude and 1.5° longitude grid for the period of 2001-2010. With regard to evaporation data, the Era-Interim data were replaced by data of the hydrological model WaterGap3 to ensure consistency with the WAVE+ model. The import and export of water flows were aggregated according to the basin delineation of the WAVE+ method.

First results for the region around Berlin show that most of the evaporated water re-precipitates over land, mainly in basins located in Eastern Germany, Poland, Czech Republic, Slovakia and the Ukraine. With regards to the region of Central Borneo most of the re-precipitation takes place on the island itself as well as over the surrounding sea and East Indonesia.

In addition to presenting basin-specific recycling patterns, the research discusses methodological aspects on how those results could potentially be used within the scope of Water Footprinting. In order to enable further application purposes, the un-aggregated raw data of the fate analysis of evaporated water will be provided on a 1.5° latitude and 1.5° longitude grid and be made publicly available.