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GeoLinkage: a GRASS-GIS plugin to integrate surface waters and groundwater in WEAP-MODFLOW models

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Water resources management requires specialized computer tools that allow explicit integration of surface and groundwater fluxes, which generally have domains with different spatial discretization. On one hand, a surface hydrological domain, D1, is typically segmented in sub-basins, elevation contour bands or hydrological response units. These elements usually are represented by grids, triangles, or simple irregular polygons. In D1, the elements are connected to each other and incorporated into a drainage network that defines a surface topology, t1. On the other hand, an aquifer domain, D2, is organized in hydrogeological units, which can be represented by geometrical elements such as grids, triangulations, Voronoi or Quadratree diagrams. In D2, a regular connection is typically associated to structured meshes that defines a groundwater topology, t2. We present a new tool called GeoLinkage (v.geolinkage) that creates an ESRI-format linkage shapefile of the new surface-groundwater topology, $t_{1\text{-}2}$. This python-based open-source tool has a graphical user interface (GUI) as an add-on for GRASS-GIS, which was constructed using Pygrass and Flopy libraries. It was developed to be used in WEAP-MODFLOV models, but it can also be used with other water resources management models. GeoLinkage allows processing models with reasonable computation times, which facilitates scenario analysis. It calculates the locations of the surface element geometries (nodes and arcs) using the GRASS platform and connects them to each element of a structured mesh in MODFLOW models. GeoLinkage was applied to obtain groundwater levels and coverage of water demand in Azapa Valley, a hyper-arid zone in the desert of Chile, where a grid of 70.305 cells and six fields with detailed geometry were processed in only 12 min.