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A generic identification method for hydrological drought in different climates across the globe

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Thorough knowledge about the space-time development of droughts is necessary for an adequate assessment of impacts and associated drought management. Droughts can cover multiple river basins, several countries or large parts of continents. Since major droughts usually occur at extensive scales, it is important to investigate them at the correct spatial scale. The identification of hydrological drought at global scale has received considerable attention during the last decade. However, large-scale studies require a drought identification method that can be applied to areas with different climatic conditions in the same way. All developed hydrological drought identification tools so far do not operate well in the drier regions of the world (both cold and warm), where discharge can be zero for a considerable period of time. An adequate hydrological drought analysis of these drier regions, mostly transition zones, is extremely important, as their area is expected to increase in the future.
Our research focuses on the development of a generic method for drought identification at global scale and across different climates. The method combines the characteristics of the classical variable threshold level method and the consecutive dry days (period) method. The newly developed combined method was demonstrated by identifying droughts from observed discharge observations of four rivers situated within different climate regimes, as well as from simulated runoff data at global scale obtained from an ensemble of five different Land Surface Models. The identified drought events obtained by the combined method were compared to applying both known methods separately. Results show that, in general, for drier regions, the threshold level method overestimates drought duration, because zero runoff periods cause difficulties as a result of the definition used for the method. The consecutive dry period method underestimates drought occurrence, since it is not able to identify droughts for periods with runoff. The developed method especially shows its relevance for the transitional areas, because beyond these regions, results are identical to the classical threshold level method. By combining both methods mentioned, the new method is more robust and able to identify droughts during both positive and zero runoff periods. It also includes droughts that continue from periods with runoff into periods without runoff and the other way around. This leads to a more realistic characterization of large-scale droughts especially within drier environments.