Development of the Prairie Hydrology Design and Analysis Product (PHyDAP)

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Currently, there are no tools which account for the complexities of prairie hydrology and hydrography available to hydrological practitioners for calculating return-period flows and flooding at small scales on the Canadian Prairies. The need for such tools is especially great due to non-stationarity from the effects of climate change and surface drainage. The Prairie Hydrology Design and Analysis Product (PHyDAP) uses the research results of the Global Water Futures - Prairie Water Project to produce a spatial dataset which will allow practitioners to determine return-period flows and flooded areas in a scientifically defensible manner, while incorporating changes in the local climate and land use.

PHyDAP uses the classification of Canadian prairie basin types undertaken by Prairie Water for 4175 basins, each having an area of approximately 100 km². For each class, a Cold Regions Hydrological Modelling (CRHM) platform "virtual" basin model was created and parameterized. These virtual basin models have been used by Prairie Water to investigate the effects of changes in climate and drainage throughout the region. For PHyDAP, each basin's model is forced with local gridded meteorological data derived from either historical values or downscaled and bias-corrected simulations of future climates. PHyDAP datasets are subdaily (hourly or three-hourly depending on the meteorological forcing data) values of rainfall, snowmelt, evaporation from ponded water, runoff from uplands, and basin discharges. The PHyDAP values are computed using several forcing data sets including 1) hourly historical meteorological forcings (1980-–2018; Regional Deterministic Reforecast System), 2) fifteen realizations of 3-hourly combined historical and downscaled future climate forcings (1951–2100; CanRCM4-WFDEI-GEM-CaPA), and 3) hourly reanalysis values (1950–2020; ERA5). The intent is that the PHyDAP datasets can be used as forcings for hydraulic models of detailed local conditions to determine changes in return-period flows and flooding due to changes in climate and/or local depressional storage. However, it is probable that the PHyDAP values may have other uses, such as forcing basin-scale hydraulic models for analyses and design of local infrastructure under extreme runoff events. In these cases, when the modelled depressional storage for a basin class differs greatly from the actual depressional storage of a given basin., it may be necessary to directly simulate the effects of local depressional storage on the discharges using a model such as the Hysteretic and Gatekeeping Depressions Model (HGDM).

The PHyDAP data sets are available online at the Federated Research Data Repository: https://doi.org/10.20383/102.0694