The Biogeoclimatic Ecosystem Classification (BEC) system is used in British Columbia to classify ecosystems with applications in silviculture, ecological assessments, land-use planning, and climate change modelling[1 2]. Within a particular BEC variant, it is recognized that soil edaphology dictates the expression of ecosystems[3], as represented in the edatopic grid (edatope) concept, which organizes site series by their characteristic relative soil moisture regimes (RSMR) and soil nutrient regimes (SNR) (Figure 1). Since SNR is largely related to organic matter inputs, and productivity in most BC ecosystems is governed by growing-season soil water deficits, it is RSMR that is the fundamental edaphic factor driving site series expression[4 5]. While all RSMR-defining parameters (e.g. soil depth and texture, coarse fragment content, slope gradient and aspect, slope position) lend themselves to quantitative analysis using principles of soil physics[6], there is currently no quantitative system for classifying RSMR, which instead is done with classification keys and indicator plant species[7].

The lack of a quantitative approach to classifying RSMR is an obstacle to novel applications of the BEC system. For example, in mine reclamation, permitting is increasingly dependent upon ecological reclamation plans that take into account pre- and post-mine BEC classifications[8]. The use of field observations and vegetation indicators for RSMR classification are not applicable for such cases, given that reclamation plans are being developed for landscapes that are not analogous to natural soil systems and, in many cases, are years away from construction. One area of particular interest is to eliminate the reliance on slope position for RSMR classification. While it is a useful proxy for downslope transfer of plant-available water, this process does not substantively occur on certain types of sites (e.g. talus slopes, reclaimed waste-rock dumps) thus causing overestimation of RSMR.

Quantitative definition of RSMR in terms of volume of water supplied by a particular set of site and soil properties would also allow its integration with the absolute soil moisture regime (ASMR) concept, in which classes have explicit quantitative definitions in terms of the ratio of actual to potential evapotranspiration and length of growing-season water deficit[3]. This is a very important application for its link to projections of future climatic conditions. While work has been done to model spatial distributions of climax tree species and BEC zones under climate change[1 9], there has been limited work relating climate change to edaphic distribution of site series within particular BEC variants[10]. Studies of site series-level effects has focused on single archetypal sites representing selected RSMR classes rather than examining RSMR classes as a whole, due to the classes' lack of quantitative definition[10]. The proposed research can help this line of inquiry greatly. If the edatope's RSMR axis is quantitatively defined in terms of volume of plant-available water supplied, then ASMR can be determined for the entire edatope and the shift in relationships between RSMR and ASMR classes between past and future climate conditions can then be analyzed (Figure 1). This is essential to ensure that ecosystems and forests planned in a given area will be viable and productive for decades to come.

Quantitative RSMR classification rules will allow integration with GIS applications based on soil survey maps and digital elevation models in order to conduct predictive ecosystem mapping, whether on reclaimed or natural landforms. Recent attempts at this have had difficulty in predicting the occurrence of dry, upland RSMRs due to researchers' reliance on drainage-related topographical parameters that are more strongly related to wet, lowland ecosystems[11]. The proposed work will be suited for uplands in particular with its emphasis on soil moisture storage and transfer of water between slope positions.

The proposed research will be based upon a provincial database of over 8000 plots provided by the B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development and is expected to be done in 3 stages: (1) data cleaning, (2) integration of soil physics-based modelling of plant-available water supply, and (3) application of machine-learning approaches (e.g. random forest) for creation of RSMR classification procedures. The author already has experience in applying models of soil-moisture retention[12 13 14], topographical influence on soil-water balances[15 16], and climate change projections[17] to a smaller dataset, which has yielded promising results[18 19].

Figure 1 can be found at https://trevor-baker.github.io/CGS_M/Baker_CGS-M_Fig1.pdf

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