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# THE ROLE OF SYNOPTIC-SCALE CIRCULATION IN THE LINKAGE BETWEEN LARGE-SCALE OCEAN–ATMOSPHERE INDICES AND WINTER SURFACE CLIMATE IN BRITISH COLUMBIA, CANADA

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## ABSTRACT

In much of North America, variables such as temperature, precipitation, snowpack and streamflow are modulated by modes of large-scale ocean-atmosphere variability such as the Pacific Decadal Oscillation (PDO), El Niño-Southern Oscillation (ENSO) and the Pacific North American Pattern (PNA). In this study, we test the hypothesis that the influence of these modes on air temperature and precipitation in British Columbia (BC), Canada, can be explained in relation to changes in frequencies of synoptic-scale circulation types. A catalogue of 13 circulation types was derived by classifying daily mean sea-level pressure (MSLP) grids from 1948 to 2003. The grids cover BC and the North Pacific and were subjected to a standard pattern recognition algorithm employing principal component analysis followed by cluster analysis on the component scores. The circulation types are generally associated with distinctive patterns of precipitation and air temperature anomalies across BC. Multiple linear regressions for selected stations in BC using the type frequencies as predictors explain up to 75% of the variance of mean winter temperature and 65% of winter precipitation. The frequencies of most circulation types vary significantly between the different phases of ENSO, PDO and PNA in a manner consistent with the temperature anomalies associated with those modes and, to a lesser extent, with the more complex precipitation anomalies. In addition, however, average temperatures and precipitation amounts for some circulation types differ systematically between phases of ENSO and PDO. Subsequent analysis revealed distinct differences among ENSO and PDO phases in the upper-level circulation patterns associated with some surface types. A major part of the teleconnections can be explained through variations in the frequencies of synoptic-scale circulation types, but systematic within-type variability, particularly with PDO and PNA, can additionally influence the surface climate. Copyright © 2005 Royal Meteorological Society.

KEY WORDS: synoptic climatology; circulation patterns; temperature; precipitation; British Columbia; ENSO; PDO

## 1. INTRODUCTION

British Columbia (BC) is a region of complex terrain that is highly dependent on water resources delivered primarily by winter storms emanating from the North Pacific. Consequently, the region is sensitive to interannual and decadal climate variability arising from atmosphere–ocean interactions in the Pacific Basin, which are strongest during winter (Trenberth and Hurrell, 1994). Given the increasing ability to predict sea-surface temperatures (SSTs) with lead times of several months, an understanding of the teleconnections between ocean–atmosphere phenomena and the surface climate of BC may improve the ability to provide timely seasonal forecasts for a range of climate-sensitive sectors (including hydropower generation and fire and pest management in forestry). Furthermore, a detailed understanding of the impacts of the various modes

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