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Internal variability of the Canadian Regional Climate Model and Singular Vectors Decomposition

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Internal variability (IV) of a Regional Climate Model (RCM) fluctuates in time depending on synoptic events. This study analyses one episode of rapid IV growth using the singular vector (SV) technique. The hypothesis is that IV growth is arising through rapid-growing perturbations developed in dynamically unstable regions. SVs are generally able to capture atmospheric regions and periods characterized by large hydrodynamical instability. An ensemble of 21 simulations, differing only in the initial conditions, was run over North America using the Canadian RCM, and the IV was expressed in terms of total energy of CRCM perturbations. A set of ten SVs was computed to identify the orthogonal set of perturbations with maximum linear growth in terms of total-energy norm during the course of the CRCM evolution. CRCM perturbations were then projected onto the subspace of SVs. It is shown that a large part of the IV growth is explained by initially very small unstable perturbations represented by the ten SVs, the component inside the SV subspace accounting for an average of 70% of the CRCM IV growth after 36 hours. The projection on the first SV at final time is greater than the projection on other non-leading SVs and there is a high similarity of structure between the CRCM perturbations and the first SV after 24 to 36 hours of the tangent linear integration.