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Multiscale window interaction and North Atlantic Oscillation

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The nonlinear multiscale dynamics of the North Atlantic Oscillation (NAO) is investigated in an attempt to understand the complex processes that control the climate anomalies over North America and Europe. Using a recently developed mathematical apparatus, multiscale window transform (MWT) by Liang and Anderson (SIAM J. MMS 6, 437-467, 2007), and the MWT-based localized barotropic and baroclinic instability analyses, we quantitatively investigate the nonlinear interactions between the chaotic synoptic transients and the low-frequency variability; we also investigate the internal interactions between the NAO and the slower manifold of the system, a subject mostly overlooked in the current NAO research, and the intrinsic mechanisms that may lead to the interannual/decadal NAO variability. On the 500-mb level, we find that the NAO has contributions of equal importance from both the energetic synoptic eddies and the mean circulation, through barotropic/baroclinic instability and/or inverse perfect transfers. The interactions are found highly localized, mostly pronounced over the North Atlantic and West Europe north of 30 degree (NH).