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Strong KAM stability in the summer hemisphere subtropical stratosphere

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We have recently proposed a new explanation for the confinement of ozone-depleted air within the stratospheric polar vortex. The proposed mechanism differs from the traditional potential vorticity (PV) barrier mechanism in that it does not make use of dynamical constraints on the streamfunction. Rather, it is built on new results relating to the Kolmogorov–Arnold–Moser (KAM) theory for nonautonomous one-degree-of-freedom Hamiltonian systems with degeneracy. The new mechanism, which we have referred to as *strong KAM stability*, leads to the possibility that transport barriers in PV-conserving flows occur at locations that do not necessarily coincide with PV barriers. More specifically, it predicts that barriers should be present near westward jet core latitudes. We have argued that strong KAM stability provides an explanation for Jupiter's midlatitude weather layer belt–zone structure. Also, in addition to arguing that strong KAM stability provides an explanation for the trapping of ozone-depleted air within the stratospheric polar vortex, we have discussed its relevance for the Earth's summer hemisphere subtropical stratosphere. There westward jets develop with associated weak PV gradients. There exists observational evidence that links these westward jets, which constitute important elements of the so-called "tropical pipe," with barriers for the transport of long-lived chemical tracers. We search for evidence of this behavior in CMAM (Canadian Middle Atmosphere Model) winds on different isentropic levels. This is done by carrying out passive tracer evolution computations, computing finite-time Lyapunov exponent fields, and extracting from the latter Lagrangian coherent structures.