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Weather regimes and the evolution of circulation in the North Atlantic/European region

D. Fereday
Met Office, Hadley Centre, Exeter, United Kingdom (david.fereday@metoffice.gov.uk)

Weather regimes for the North Atlantic/European region in winter are investigated using daily sea level pressure fields. Each pressure field can be thought of as a point in phase space whose coordinates are given by the field's projection onto the leading modes of variability. As the atmospheric circulation changes in time, the system traces a trajectory through phase space. The system's evolution can then be examined by analysing this trajectory; this is done by investigating how quickly a trajectory moves depending on its starting location.

Previous work has suggested that weather regimes found through cluster analysis correspond to regimes found in dynamical systems. The analysis method is therefore first applied to the well-known Lorenz attractor, a system with two regimes. These regimes can readily be identified as regions of slow motion through phase space surrounded by regions of faster motion. Applying the same technique to the sea level pressure data, evidence for regimes is much weaker; the motion through phase space is more uniform, and the slower moving regions are not aligned with weather regimes found by cluster analysis. Nevertheless, there is structure to the evolution of the atmospheric circulation - analysis of the trajectories shows preferred directions of motion through phase space, corresponding to sequences of weather patterns.