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Homoclinic bifurcations that give rise to heterodimensional cycles near a saddle-focus equilibrium

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We show that heterodimensional cycles can be born at the bifurcations of a pair of homoclinic loops to a saddle-focus equilibrium for flows in dimension 4 and higher. In addition to the classical heterodimensional connection between two periodic orbits, we found, in intermediate steps, two new types of heterodimensional connections: one is a heteroclinic between a homoclinic loop and a periodic orbit with a 2-dimensional unstable manifold, and the other connects a saddle-focus equilibrium to a periodic orbit with a 3-dimensional unstable manifold.