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Numerical and experimental study of flows in a rotating annulus with local convective forcing.

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We present a numerical and experimental study of flows in a rotating annulus convectively forced by local thermal forcing via a heated annular ring at the bottom near the external wall and a cooled circular disk near the centre at the top surface of the annulus. This new configuration is a variant of the classical thermally-driven annulus analogue of the atmosphere circulation, where thermal forcing was previously applied uniformly on the sidewalls. Two vertically and horizontally displaced heat sources/sinks are arranged so that, in the absence of background rotation, statically unstable Rayleigh-Bénard convection would be induced above the source and beneath the sink, thereby relaxing strong constraints placed on background temperature gradients in previous experimental configurations to better mimic *in fine* local vigorous convection events in tropics and polar regions whilst also facilitating baroclinic motion in midlatitude regions in the Earth's atmosphere. By using the Met Office/ Oxford Rotating Annulus Laboratory (MORALS) code, we have investigated a series of equilibrated, 2D axisymmetric flows for a large range of dimensionless parameters and characterized them in terms of velocity and temperature fields. Several distinct and different flow regimes were identified, depending upon the rotation rate and strength of differential heating. These regimes will be presented with reference to variations of horizontal Ekman layer thickness versus the thermal boundary layer thickness and corresponding scalings for various quantities such as the azimuthal velocity or the heat transport. Experimental investigation of the same setup is carried out with a 1m diameter cylindrical container on a rotating platform: local heating is produced with an electrically heated annular ring at the bottom of the tank and cooling is imposed through a circular disk near the centre of the tank at the upper surface, cooled with circulating water. Different unstable circulation regimes of the flow will be explored by varying control parameters.