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Solar local dynamo in global scale

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We have achieved high resolution calculation of the solar global magneto-convection in spherical geometry with a top boundary at 0.99Rsun. The reduced speed of sound technique (RSST) is adopted in this study. Compared with the anelastic approximation, the RSST has two major advantages: One is the good scaling in parallel computing. Second is the accessibility to the real solar surface. These enable us to use a large grid of 720x1280x3072 and to set the location of the top boundary at 0.99Rsun. Due to large contrasts between the bottom and top regions in the density ($>$600 times) and the pressure scale height, our calculation includes multi-scale thermal convection, i.e., 100 Mm scale at the base and 10 Mm scale near the top boundary. This type of the small convection pattern is achieved for the first time in the global convection. In our current calculation, the rotation is not included in order to investigate the local dynamo effect in the global scale.

We find that the small scale convection generated near the surface layer unites in relatively deeper layer and becomes strong downflow. Thus at the downflow region, the convection is significantly turbulent and the vorticity has large value. At these regions, the local dynamo is very effective and super-equipartition magnetic field is frequently generated. It is also found that this local dynamo action depends on the location of the surface layer.