M20a INJECTION OF MAGNETIC ENERGY AND MAGNETIC HELICITY INTO THE SOLAR ATMOSPHERE BY AN EMERGING MAGNETIC FLUX TUBE

○ Magara T.、Longcope, D. W. (Montana State University)

We present a detailed investigation of the dynamical behavior of emerging magnetic flux using 3- dimensional MHD numerical simulation. A magnetic flux tube with a left-handed twist, initially placed below the photosphere, emerges into the solar atmosphere. This leads to a dynamical expansion of emerging field lines as well as an injection of magnetic energy and magnetic helicity into the atmosphere. The field-aligned distributions of forces and plasma flows show that emerging field lines can be classified as either expanding field lines or undulating field lines. A key parameter determining the type of emerging field line is an aspect ratio of its shape (the ratio of height to footpoint distance). The emergence generates not only vertical flows but also horizontal flows in the photosphere, both of which contribute to injecting magnetic energy and magnetic helicity. The contributions of vertical flows are dominant at the early phase of flux emergence, while horizontal flows become a dominant contributor later. The emergence starts with a simple dipole structure formed in the photosphere, which is subsequently deformed and fragmented, leading to a quadrapolar magnetic structure.