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Two-fluid simulations of chromospheric heating by Alfven and slow magnetosonic wave pulses

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Abstract. We study a chromospheric heating process, via spontaneous excitation of Alfvén wave pulses and slow magnetosonic wave pulses.We use a two fluid (ion-neutral) numerical code to model the three-dimensional dynamics of protons and neutral-hydrogen particles, which couple through proton/neutral-hydrogen collisions. We model the convective neutral-hydrogen flows at the photospheric boundary, in an initially uniform vertical and oblique magnetic field. It was found that the down-flow regions, associated with convective motions, accumulate vertical magnetic fields, from where vertically propagating Alfvén and sound wave pulses are spontaneously generated. While in the oblique magnetic field, slow magnetosonic wave pulses are excited. Alfvén waves propagating in an initially vertical magnetic field with $B_0 = 10^{-2}$ T strongly heat protons in the upper chromosphere, to temperatures of $\approx 3 \times 10^5$ K, while neutral-hydrogen is only weakly heated to $\approx 1.5 \times 10^4$ K. It was found that neutral-hydrogen is heated by dissipation of sound wave pulses, while the protons are collisionally heated by Alfvén wave pulses. We conclude that the energy flux transfered by the Alfvén wave pulses is sufficient to heat coronal regions to their observed temperatures. This numerical study suggests that Alfvén wave pulses, with a pulse width $\lambda \approx 600$ km propagate along strong magnetic flux tubes embedded in photospheric inter-granular lanes.