Geophysical Research Abstracts, Vol. 8, 00597, 2006
SRef-ID: 1607-7962/gra/EGU06-A-00597
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Alfvén waves and alfvénic turbulence in the solar photosphere and chromosphere.

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Alfvénic turbulence in the solar photosphere and chromosphere is believed to play an important role in the plasma heating of the solar corona and acceleration of the solar wind. The emerging wave flux in the corona can in fact accelerate the wind directly (wave pressure) and indirectly (plasma heating), but both the amount of the flux transmitted in the corona and the wave energy spectrum are necessary to give precise quantitative estimate. The source of the alfvénic fluctuations is to be found in the footpoint motions of the magnetic field lines anchored in the photosphere. The stochastic velocity field, resulting from the plasma dynamics in the convection zone, shakes the magnetic field lines and launches Alfvén waves propagating upward at the Alfvén speed along the mean magnetic field (organized in flux tubes). The stratification of the atmosphere and the flux tube expansion cause the wave reflection so that a strong nonlinear cascade in the perpendicular wave number can develop. The high reynolds numbers and the wide range of length-scales involved in the process allow numerical simulations which only partially reproduce the phenomenology despite high computational costs. Given that some simplifications are needed, and that the wave reflection is fundamental for the development of the turbulent cascade (it triggers the nonlinear interactions), we choose to treat as rigorous as possible the wave propagation in a highly stratified atmosphere while we adopt a 2D shell-model to reproduce the turbulent cascade (hence loosing some spatial dependence in the perpendicular plane). The evolution with distance of the frequency spectrum is studied in variety of initial conditions (different time series and different energy distribution in the perpendicular plane, different flux tube geometry) in order to quantify the plasma heating and the amount of flux transmitted to the coronal layer. Particular attention is posed on the several time-scales present in the simulation, whose ordering may lead or not to the development of the turbulent cascade.