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A technique for modeling the three-dimensional structure of solar corona and solar wind

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We present a fully three-dimensional steady-state MHD model of the solar corona and solar wind. Our simulation approach includes (i) decomposition of our computational domain into three regions (I: 1–20 $R_\odot$, II: 20 $R_\odot$–1 AU, and III: 1–100 AU), (ii) incorporation of Alfvén waves as an additional source of energy and momentum for solar wind flow, and (iii) account for the effects of pickup protons in the distant heliosphere. The time relaxation technique is applied to obtain a steady-state solution in region I and the marching-along-radius method is employed in regions II and III. The relaxation code is written to run on massively parallel computers under the Message Passing Interface. The governing equations are solved in spherical coordinates; in order to circumvent the geometrical singularity on pole, we employ a composite grid consisting of three overlapping fragments of spherical grids. We produce realistic simulations of the solar corona and solar wind as determined by boundary conditions at the base of solar corona and compare model output with spacecraft data.