Whole Atmosphere Coupling in Terrestrial and Martian Atmospheres

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Abstract: Atmospheric gravity waves, also known as buoyancy waves, play a crucial role in energy, momentum, and mass transport in all stably stratified planetary atmospheres. Their primary sources are in the lower atmosphere (troposphere) and they propagate upward, growing in amplitude due to the exponentially decreasing background atmospheric density. They reach the upper atmosphere (i.e., thermosphere) with significant amplitudes and produce effects due to wave dissipation. Hence, gravity waves cause long-range vertical coupling between the lower and upper layers of the atmosphere and ionosphere. They reverse the mesospheric circulation on Mars and Earth by transferring to the mean flow the momentum they carry from the lower atmosphere and they cool upper atmospheres. On Mars, thermospheric gravity wave effects are about two times stronger during global dust storms than during quiet times. Gravity waves modify the large-scale circulation on Mars and contribute substantially to the upward transport of water vapor. At higher altitudes, hydrogen, produced by the dissociation of water vapor, can escape to space and gravity waves not only enhance the upward transport of water but they also intensify Jean's escape. This talk will provide a concise overview of the role of gravity waves in vertical coupling in Earth's and Mars's atmospheres and ionospheres.

Bio: Erdal Yiğit received his Ph.D. from the University College London, UK, in 2009 in physics. In March 2009, he moved to the USA to work at the University of Michigan's Atmospheric Oceanic and Space Sciences Laboratory as a Postdoctoral Researcher. In 2012, he joined UC Berkeley's Space Sciences Laboratory as a Postdoctoral researcher, where he was later promoted to an Assistant Research Physicist position. In September 2013, he joined George Mason University's Department of Physics and Astronomy as a tenure-track faculty member. He is current a Professor of Physics. His research interests cover topics from atmospheric, space and planetary sciences, in particular, global modeling of and internal wave effects in planetary atmospheres and ionospheres, such as, Earth and Mars. He is the developer of the first whole atmosphere gravity wave parameterization suitable for general circulation models of planetary atmospheres. He is the recipient of the 2016 Zeldovich Medal jointly presented by COSPAR and the Russian Academy of Sciences for his significant contributions to the study of coupling between the lower and upper atmospheres on Earth and Mars by gravity waves. He is the sole author of the Springer's two-volume monograph series on "Atmospheric and Space Sciences", one on Neutral Atmospheres and the second on Ionospheres and Plasma Environments.