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GPS occultation signals as a radio holographic meter to study climatology of internal waves in the atmosphere on a global scale

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We show that high-precision signals emitted by Global Positioning navigational System (GPS) satellites can be applied for remote sensing of the internal wave in the atmosphere with a global coverage. We use a new radio holographic technique to locate the layered structures in the atmosphere based on simultaneous observations of radio wave temporal intensity and phase variations in satellite-to-satellite links. The cornerstone of this method consists in combination of the amplitude and phase variations of GPS occultation signal. A new technique was applied to measurements provided during CHAllenging Minisatellite Payload (CHAMP) radio occultation (RO) mission. We establish the atmospheric origin of the amplitude and phase variations in RO signal at the altitudes 10 – 26 km. We observed in the first time in the RO practice examples of the internal wave breaking at the altitudes between 38 and 50 km. We obtained the geographical distributions and seasonal dependence of the atmospheric wave activity with global coverage for period 2001 – 2003 years and revealed an asymmetry in distribution of the wave activity at the 12 km level in the atmosphere. The maximal wave activity occurs in the summer polar region. At the 14 – 16 km levels the wave

activity is centered in the moderate latitudes both in the Northern and Southern Hemisphere. At 18 and 20 km levels, most of the internal wave's activity is concentrated in the equatorial areas. The local seasonal dependences are clear for some regions, e.g. Siberia at the height of 14 km in the winter, with a low wave activity and a high wave activity in the summer. A slow decrease of wave activity during the time interval 2001-2003 is seen. The possible cause of this decrease may be connected with gradual change in solar activity.