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Use of the IMS infrasound network for global atmospheric studies

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The development of the Infrasound International Monitoring System (IMS), used for the verification of the Comprehensive Test Ban Treaty, represents a powerful tool to measure permanently, at a global scale and over large periods of time, the disturbances of the atmosphere. The network is mostly sensitive to infrasound in the range 0.02 to 5 Hz, but it also measures gravity waves at lower frequencies and tidal waves. Measurements with the IMS infrasound network provide both the state of the atmospheric wave guide and of the atmospheric waves which can be used to study the dynamics of the atmosphere. The first way is to study the variability of infrasound from quasi continuous sources such as ocean swells or volcanoes in relation with changes in large scale atmospheric structures. Since infrasound propagate in the stratosphere and mesosphere, atmospheric parameters which affect the infrasound propagation can be investigated from ground measurements of infrasound. Azimuth changes of infrasound from volcanis eruption were used to retrieve mesospheric zonal winds. The amplitude fluctuations of infrasound from ocean swells represent planetary waves which modulate the atmospheric wave guide. Fluctuations are much larger in Northern hemispheres than in Southern hemisphere, because the amplitude of planetary waves is larger in Northern hemisphere where continental areas are more important. Infrasound monitoring also revealed anomalies at a seasonal scale in Antarctica or at the scale of several days in Arctic regionsin relation with Sudden Stratospheric Warming. The second way is the direct observation of large scale gravity waves. These waves, mainly produced in the troposphere, propagate upwards and break in the stratosphere producing a chaotic forcing of the stratosphere. This is at the origin of a slow and large scale motion in which air masses are driven upward and poleward from the tropical lower stratosphere. In polar regions, they are pushed downward producing Sudden Stratospheric Warming with a possible effect in the troposphere and climate. In Antarctica, the IMS gravity wave observations in the IS27 station are submitted to a seasonal variation with larger amplitudes during the austral winter. A comparison with satellite observations shows that the wave activity could be related with wind blowing over mountains in Southern Andes and Antarctica peninsula. At middle and low latitudes, thunderstorms are important sources of infrasound and gravity waves. IMS observations in West Africa show that the origin of most of the gravity waves is produced by thunderstorm activity.
This paper then shows that monitoring of infrasound can be used to study the evolution of the acoustic gravity waves and the atmospheric circulation. This can be performed over large periods of time and in several regions submitted to different geophysical influences. Permanent global observations over large scales of time will show the evolution of this system with the climate change. The infrasound network can then contribute to the understanding of the dynamics of the atmosphere at regional and global scales in relation with climate.