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25 years of infrasound monitoring: achievements and challenges

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The infrasound International Monitoring System (IMS,) is a unique tool for atmospheric observations due to its high capacity for long-range detection and localisation. Its development, starting in the nineties, motivated technological innovations in sensors, array stations, network configuration and automatic detection algorithms. The rapidly increasing number of certified stations detected a large diversity of anthropic and natural infrasound events, well identified thanks to their accurate description. Numerical simulations, based on propagation laws and atmospheric models, determined the IMS specifications for infrasound monitoring. They were revisited at the end of the 2000s, integrating an improved representation of the variable atmospheric environment, showing the high performances of the network. Data analyses clearly demonstrated that most uncertainties originate from the middle atmosphere disturbances, which control the infrasound waveguides and are under-represented in models. Unexpectedly, relevant atmospheric parameters were identified in infrasound signals from well-known sources such as volcanoes, opening new infrasound remote sensing possibilities. The association of the infrasound IMS to complementary multi-instrument platforms provided new middle atmosphere data, needed for the determination of uncertainties in atmospheric models and infrasound simulations for more precise event analyses. New methods are developed for middle atmospheric remote sensing from IMS infrasound ocean swell noise observations. Such global observations could be relevant for future data assimilation systems used in numerical weather prediction models. A remote volcano information system is developed to provide in the future notification to civil aviation in case of large eruptions of non-instrumented volcanoes. Large-scale climatology systems, such as the inter-tropical convergence zone (ITCZ) of the winds and the semi-annual oscillation (SAO) of stratospheric winds were recently identified. They can provide relevant information about the evolution of climate related parameters. This shows the high IMS potential for weather, climate and civil safety applications.