

The ESA GMES TERRAFIRMA Project and its First Applications in Russia

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Synthetic aperture radar interferometry (InSAR) has been available to us for over a decade, providing ground deformation data at cm resolution. In the past 2 years, new ways of processing satellite radar images have been invented that allow ground movements to be mapped and monitored to better than 1 mm per year. The technique depends on the existence of radar scatterers which consistently reflect signals from successive satellite passes (PSI). This means it works best in urban and arid conditions where vegetation cannot interfere with the coherence. Four scatterers per km² are sufficient to obtain a result, and in some cities, more than 500 scatterers per km² have been obtained. As part of the European Space Agency's GMES programme, the project "TerraFirma" has been established to promote the new and existing InSAR technologies and to exploit the 12-year archive of radar data which is already held. Participants include the EMSC, national geoscience centres, universities, engineering consultants and Earth observation companies. Sixteen TerraFirma cities have been processed from Dublin to Athens and Haifa, providing key examples of applications in tectonic movements, flood risk assessment, subsidence from mining, tunnelling and ground heave in response to groundwater recharge. In 2004, the project was extended to include the first Russian city - St. Petersburg. In the processing, 45 InSAR scenes were extracted from the ESA archive of radar data. The date range covered by scenes is from November 1992 to February 2004. The results show that most parts of the territory of the city are stable but some local zones of subsidence and uplifting are identified. Parts of the subsidence zones are connected with lines of the underground metro. The average velocity of subsidence or uplifting may reach 20 mm/year. Revealed zones will become targets for more careful investigations, the results of which will be reported.