



The climate in the Venetian and North Adriatic region: variability, trends and change

workshop

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TOPIC T3. Land motions and relative sea level

Regional land movement: focus on the Venice coastal area

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Short abstract:

The eastern Po plain, from the Ravenna area to the Venice region, is underlain by a subsiding sedimentary basin. Changes in ground elevation with respect to the Adriatic sea level have caused very deep modifications in its physiographical features over the last millennia.

The area was entirely emergent 18,000 years BP (Upper Adriatic Würmian paleoplain). It was then flooded during the Flandrian transgression, beginning about 12,000 years BP; the rising sea established its domain over the paleoplain and when the climate optimum was achieved, about 6,000 years BP, it outlined the coast in approximately in the present position giving origin to the Lagoon of Venice. Evidence of sea level variation and geoclimatic fluctuations in the Venice area during the Pleistocene and Holocene, lie in the interpretation of Quaternary sediment analyses and in the context of periods corresponding to greater sedimentation alternating with periods without deposition or erosion. Since that time sea level has experienced small oscillations. Since its formation, the geomorphologic transformation of the lagoon, both natural and man-induced, have been controlled by the relative subsidence, i.e. by interaction between land sinking and eustasy.

Land subsidence is, however, a phenomenon involving many Veneto regional areas and it is due to a number of factors acting individually or together. Natural causes of settlement are primarily the compaction of fine-grained deposits referable to river deltas located at the North and South lagoon edges that increase from the mainland toward the sea, and secondly the substratum deformation due to tectonics and geostatic load. Groundwater withdrawals for industrial, domestic, and agricultural uses, exploitation of mineral and thermal water, methane-bearing have produced ground settlements varying in time and space throughout the region, ranging from cm to m (in the Po Delta) and with a strong environmental impact.

Different survey techniques, with different characteristics, have been adopted to control land subsidence. To overcome the limits that characterize each single method and to enlarge the knowledge on regional land subsidence, an original integrated monitoring method and analysis have been designed. We combine five earth observation techniques, i.e. spirit leveling, Continuous Global Positioning System (CGPS), Differential GPS (DGPS), Interferometric Synthetic Aperture Radar (InSAR), and Interferometric Point Target Analysis (IPTA), together over about the last ten-years, and homogenized and integrated their results in both the time and space domains. The application of this

Subsidence Integrated Monitoring System (SIMS) provides a new complete and dependable picture of the vertical displacements in the Veneto Region never available before. The SIMS map, which refers to the 1992-2002 decade, shows that the central part of the area, which includes the cities of Venice, Padua and Treviso and surrounding territories, is generally stable, with scattered local bowls of subsidence up to 2-3 mm/year, while in the northern (rate up to 5 mm/year) and southern (rate up to 15 mm/year) coastland bounding the lagoon extremities land subsidence is a widespread phenomenon. Uplifts ranging from 0.5 to 1.5 mm/year have been measured in two different large areas located north of Treviso and south of Padua. More recently, for the period 2003-2007, local land lowering bowls from 5 to 15 mm/y have been measured also in the Cavallino littoral, probably due to the load increase on the ground surface because of newly urban developments. In particular another type of land subsidence (geochemical subsidence) is currently under way at an alarming rate of 1.5-2 cm/y in the southernmost part of the regional area, induced by oxidation of outcropping peat soils in reclaimed farmlands and by salinisation of clayey sediments. The geodynamic, geological, geomorphological characteristics of the region, ongoing human activities and knowledge of the cause-and-effect relationships clearly support the above displacement rates. .

The northern Adriatic coastal basin is sensitive to the relative land subsidence, as above mentioned, i.e. to very land surface lowering associated to sea elevation changes. An eustatic rising rate @ 1.2 mm/yr was computed for the XX century: the extent of the centennial period is sufficient to average alternating trends, corresponding to alternating climate variation. This figure resulted consistent with other values from gauges in the western Mediterranean. Actually, tide gauge measurements clearly show both annual and periodical oscillations of mean sea level, probably depending upon short-term climatic cycles and other phenomena influencing the behavior of tides.