

## HELI-DEM PROJECT



HELI-DEM PROJECT (Helvetia-Italy digital elevation model) was funded by the European Regional Development Fund within the Italy-Switzerland cooperation program.

The project involves the following partners: Regione Lombardia (Project Leader) – Regione Piemonte – Fondazione Politecnico di Milano – Politecnico di Milano (sede Como) – Politecnico di Torino (sede Vercelli) – Scuola Universitaria Professionale della Svizzera Italiana (SUPSI)

The aim of the project is the creation of a unique DTM for the alpine and subalpine area between Italy (Piedmont, Lombardy) and Switzerland (Ticino and Grisons Cantons). The final DTM, correctly georeferenced, is produced validating and integrating all the available data (DTM20, DSM1, DHM25), validated and integrated, together with geoid data. Project is divided in 9 work-packages managed by the partners as defined by the Convention.

Elevation data are one of the basic ingredients/components of Geographical Information Systems (GIS), and also one of the 34 spatial themes needed for environmental applications addressed by the European INSPIRE Directive (2007), which establishes an infrastructure for spatial information in Europe. Within the INSPIRE Infrastructure, data should be made compatible and usable in a transboundary context. Heli-Dem focuses on DTM data, and provides a common DTM, integrated and shared between Lombardy, Piedmont and Switzerland, that is available to local administrations and enterprises that deal with Environmental Engineering, Civil Engineering, Soil and Land Planning, etc. (e.g. tunnels, highways, dams, flood preventions, environmental evaluation impacts).

FESR - Fondo Europeo di Sviluppo Regionale



Le opportunità non hanno confini

Partner di progetto:



Regione Lombardia  
Territorio e Urbanistica



Scuola universitaria professionale  
della Svizzera italiana

**SUPSI**



## Contatti

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Helvetia Italy Digital Elevation Model



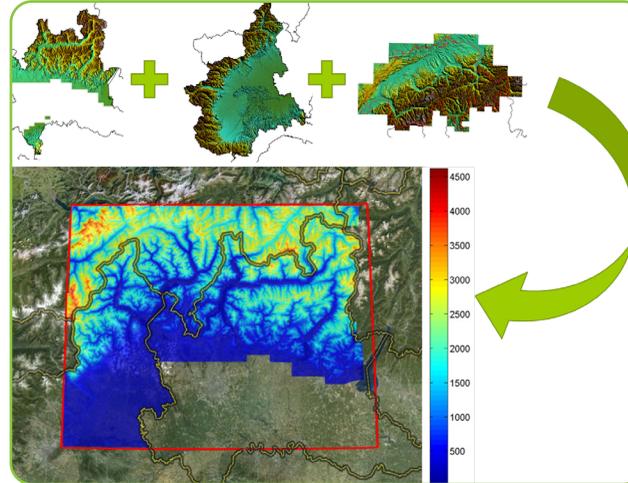
[helidem.eu](http://helidem.eu)

## The cross-border GNSS network



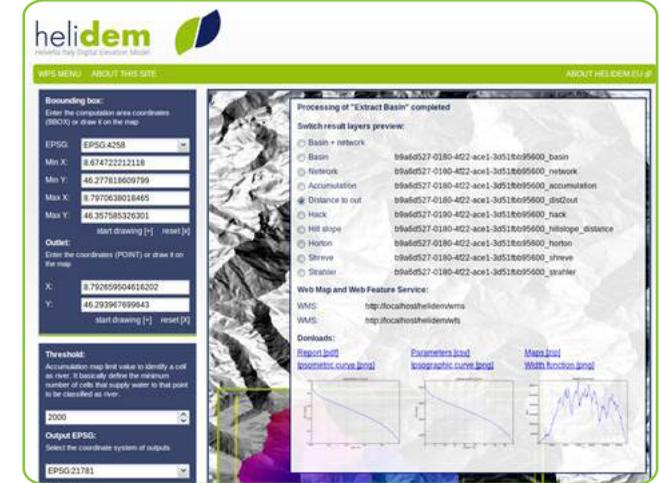
In order to test a real-time service of GNSS positioning and to try out a geoid model for the HELIDEM area, it was decided to establish a cross-border network of GNSS permanent stations selecting almost all existing CORSS stations in the Project area. This network, adjusted in the european ETRF2000 reference frame (the reference frame of the Project), shows a significant variability of orthometric heights and it can be considered “interesting”, from a scientific point of view, because presents an unusual spatial dislocation of the CORSS stations and also for the analysis of the atmospheric effects on GNSS signals. The cross-border network has been validated through NRTK (Network Real Time Kinematic) measurements at different altitudes that have allowed us to affirm the goodness of its operation even at high altitudes (eg. Punta Indren 3260 m). This network was also used to validate the DTM available for the area involved in the project as well as support for GNSS static surveys on points that are later leveled in order to determine the geoid undulation.

## HeliDEM final DTM creation



The input DTMs can be classified into three groups. Low Resolution DTMs (20-25 m of resolution), that cover the whole project area and partly overlap at the borders, are characterized by accuracies of some meters. Medium Resolution DTMs (5 m), present in a significant part of the project, have accuracies of the order of the meter. High Resolution DTMs (1-2 m), that cover particular areas, have accuracies of some decimeters. By a proper fusion of all the available elevation data in the area of interest of the project, a multiresolution and multiaccuracy DTM has been produced and correctly georeferenced in the european ETRF2000 reference frame. At first, all the original DTMs have been georeferenced in the same reference frame. To achieve the aim of the project, two different levels of information have been created: one LR DTM for the whole area and one HR DTM where input HR data exist. The LR DTM has been obtained by the fusion and interpolation of the regional partly overlapping LR and MR DTMs. The consistency of the input DTMs has been cross-checked in the overlapping areas, before their interpolation. Note that, once transformed to ETRF2000, original data are no more on a regular grid. To interpolate them on the final grid, a robust algorithm has been studied, tested and applied: the algorithm is based on bicubic interpolation. Moreover, the LR unified DTM has been locally corrected by using the local HR data where it exist. This has been accomplished by applying a proper filtering to the differences between HR and LR DTMs. It is worth to note that, to numerically optimize the filtering, Fast Fourier Transform technique has been applied.

## The Project geoport



The HeliDEM geo-portal is based on a Service Oriented Architecture (SOA) composed by a server side and a client side component. The system is extensively based on open standards from OGC (Open Geospatial Consortium) and uses Open Source Software to implement a series of processing functionalities capable to dynamically elaborate elevation data models. Enabled processing are: conversion of a feature from and to different coordinate systems; extraction of portion of DTM based on specified bounding box; calculation of terrain profiles along a drawn polyline; determination of contour lines based on user specific settings; hydro-morphological characterization of watershed, including accumulation, basin, network maps, river orders maps and time of concentration according different methodologies, ipsometric and ipso-graphic curves, width function and a summary report.