FLOOD-serv

FLOOD Emergency and Awareness SERVice

The FLOOD-serv Project Experience in Genoa

Hydrogeological Risk, Citizens, Institutions, Technology

Co-funded by the Horizon 2020 programme of the European Union

Grant Agreement N. 693599

FLOOD-serv

Public FLOOD Emergency and Awareness SERVice

The FLOOD-serv Project Experience in Genoa

Hydrogeological Risk, Citizens, Institutions, Technology

Municipality of Genoa Editor

Co-funded by the Horizon 2020 programme of the European Union

Grant Agreement N. 693599

Municipality of Genoa

Department of Architecture and Design (DAD)

Department of Political Science (DISPO)

This book is free of charge

Editing by Valentina Marin e Paola Salmona

Cover photo from flickr upon permission of the Municipality of Genoa

The images inside the text, if not otherwise specified have been kindly provided by the Municipality of Genoa or have been originally produced by the text authors

For the present book it has been used mainly Free and Open Source software:

Text editing: LibreOffice

Image processing: GIMP INKSCAPE

Paging: Scribus

CONTENTS

Foreword

Year 1970. Year 2011. Year 2014.

The city of Genoa cannot surely forget these dates, which, with their respective floods, have strongly marked the life of the city.

The morphology of our city is such that a high percentage of the city centre is affected by floods from the streams that traverse the Genoese valleys.

A city by now ready to cope with flood-related events but which, like many other cities, needs a constant exchange of information between Public Administration and citizens to better deal with dangerous situations.

The FLOOD-serv project, co-funded by the European Union within the scope of the Horizon 2020, Programme, aims to define a digital platform through which citizens and associations are actively called upon to gather territorial data and information serving to prevent the hydrogeological risk.

Through Genoa's pilot project, the choice was made to focus attention on the pre- and post-flood periods and share the results obtained in support of all those who intend embarking on a process of involvement of the population for the sake of territorial protection.

The project develops the idea of a proactive, personalised and citizen-centred public service; by using the modern technological networks of communication and information made up of persons, skills and sensors, the attempt is made to sensitise the public on the risk of floods, mitigate their extent and coordinate an effective action of response to the problem.

We have worked on building networks of local communities able to interact, not just virtually, while preserving their own identity and the personal relationships.

Through the involvement of people and the development of new supporting tools (new apps or existing social media, such as Facebook or Twitter), dialogue groups are formed that network people in a neighbourhood affected by a recurring event, in order to share basic concepts of city, urban planning and environment through the exchange of opinions and information and the dialogue with the administration.

The work focused on Val Bisagno through the involvement of Municipalities: 3 -

Bassa Valbisagno, 4 - Media Valbisagno and 8 - Medio Levante, and of schools of various levels and specialisations, whose students, with the support of teachers, have experimented with the technological tools after a brief training on the characteristics of our territory.

The development of the Genoese pilot project boasted the scientific support of the University of Genoa, especially the Department of Architecture and Design (DAD) and the Department of Political Sciences (DISPO).

A heartfelt thanks goes to all those who collaborated in the FLOOD-serv project and in the draft of this publication, as well as to the transnational partners with whom we had the chance of embarking on this process.

Arch. Simonetta Cenci

Councillor for Urban Planning and State property administration

at the Municipality of Genoa

Franca Balletti
Gerardo Brancucci

Urban Planning and Hydrogeological Risk in Genoa City: The Case of the Val Bisagno District

Hydrogeological Risk: Natural Considerations

"The vocation of mountains is to crumble"[1].

An apparently unremarkable statement which, however, masterfully summarises the problem of hydrogeological instability. The common perception is that the "inanimate" world of rocks or, more generally, the Earth's surface, is not a dynamic world. Far from it. "Steady as a rock" is a well-known saying, unless you happen to work with geological time scales, in which case this could be further from the truth. It is true that there are very hard rocks and other, more fragile ones. Similarly, there are very long geological time scales but also extremely short ones (one need only think of earthquakes). Therefore, to underestimate natural phenomena can be as dangerous as the phenomena themselves.

Earth's surface has always been in evolution. Indeed, the Earth's surface has always been subject to phenomena defined by mankind as "natural catastrophes" due to a variety of conditions linked to lithological and climatic characteristics and geomorphological factors such as the gradient and exposure of slopes, the presence or absence of vegetal cover and the quality of this. Landslides, earthquakes, volcanic eruptions and coastal storms are all part of the morphogenetic system that has been shaping our planet for 4.5 million years.

What is the problem, then? The problem emerges due to the presence of mankind which, in proportion to its technical abilities, interacts increasingly with the environment around it. Not, it would initially seem, changing the morphogenetic processes but rather accelerating their time scales, by performing actions on the land through agriculture, road building, urban development and increasing narrowing of rivers and their beds. Essentially, by interfering severely with the dynamics of the Earth's surface and ignoring its laws, at one time unknowingly but, as time goes on, more and more knowingly.

The Situation in the Genoa Area

The Liguria Region, in general, and the area around Genoa, in particular, especially with regard to the Tyrrhenian coast of Liguria, features a rugged morphology; indeed, the hillsides drop towards the sea with significant gradients, and flat areas are scarce and, where present, of limited size. This morphology favours erosion linked to the flow of surface water arranged in a small- to medium-sized hydrographic network. These morphological conditions intensify the water's erosive power, particularly when combined with abundant/heavy rainfall. In addition, there has been a notable change to the rainfall characteristics, in terms of both intensity and frequency, mainly due to the altered thermodynamic conditions of the atmosphere. Genoa is notorious, from a meteorological perspective, as a cyclogenetic area and is therefore "genetically" predisposed to substantial precipitation.

Of the various hydrographic river basins in the metropolitan area of Genoa, the Bisagno river holds the unedifying record number of floods suffered. The following table lists the main events documented, together with a brief description.

Of the various hydrographic river basins in the metropolitan area of Genoa, the Bisagno river holds the unedifying record number of floods suffered. The following table lists the main events documented, together with a brief description.

An initial point to note is the frequency of these events; indeed, over the course of 192 years, except between 1822 and 1892 when 70 years passed between one flood and the next, the recurrence times (normally calculated at 50, 200 or 500 years to define the various degrees of overflow) have gradually decreased (with two events in the same year in 1951), reaching an impressive frequency from 1992 to date.

Data	Evento
26 October 1822	first documented overflow of the Bisagno river at 11.30 am.
8 October 1892	second documented flood of the Bisagno river. Its flow rate at that time is estimated at between 300 and 1200 cubic metres per second. Following this event, the idea of culverting the river took form.
7 July 1908	after six hours of non-stop rain, the Bisagno reached its maximum depth at 6 am, without overflowing.
29 October 1945	overflow of the Bisagno river and the Fereggiano tributary. Submersion of the S.Agata bridge. Collapse of several bridges of the SS45 road.
25 January 1951	flooding of the streets Via Martiri della Libertà, Corso Buenos Aires, Corso Torino and Via Casaregis and the square Piazza Tommaseo.
8 November 1951	overflow of the Fereggiano and Geirato tributaries. Collapse of a newly rebuilt bridge on the SS45 road.
19 September 1953	Overflow of the Bisagno and Trebbia rivers. 10 killed.
21 March 1968	landslide on Via Digione after heavy rainfall. 19 killed.
7 - 8 October 1970	overflow of the Polcevera, Leira and Bisagno rivers. Flow rate of the Bisagno no less than 950 cubic metres per second at its mouth. 35 killed (25 according to other sources) and eight missing.
6 October 1977	overflow of the Bisagno river with no damage.
27 September 1992	overflow of the Bisagno and Sturla rivers.
23 September 1993	overflow of the Varenna and Leira rivers and other watercourses in Western Genoa. 2 killed and 3 missing.
30 September 1998	overflow in the province of Imperia.
6 e 23 November 2000	flooding of Verbone and Armea rivers and others. 3 killed. flooding at Ceriana (2 killed) and Imperia (2 killed).
25 December 2009	flooding in province of La Spezia
4 October 2010	flooding in province of Genova and La Spezia
25 October 2011	overflow of the Vara, Magra and Taro rivers and other minor watercourses, due to heavy rainfall - 10 killed
4 November 2011	floodings following very heavy rainfall with peaks exceeding 500 mm recorded in just a few hours in several areas of Genoa and its province. This resulted in overflow of the Bisagno river and the Fereggiano tributary and of the Sturla, Scrivia and Entella. 6 killed
9 e 10 October 2014	Genoa following heavy rainfall resulting in approximately 395 mm in 24 hours. Flooding of the Bisagno, Sturla, Fereggiano, Noce and Torbella, in the Municipality of Genoa, and the Scrivia, Stura, Entella and Carpi, in the Province of Genoa. 1 killed

Table 1 - Main Floods Affecting the Bisagno River and its Tributaries https://it.wikipedia.org/wiki/ http://www.biologiamarina.eu/Alluvione%20Genova.html

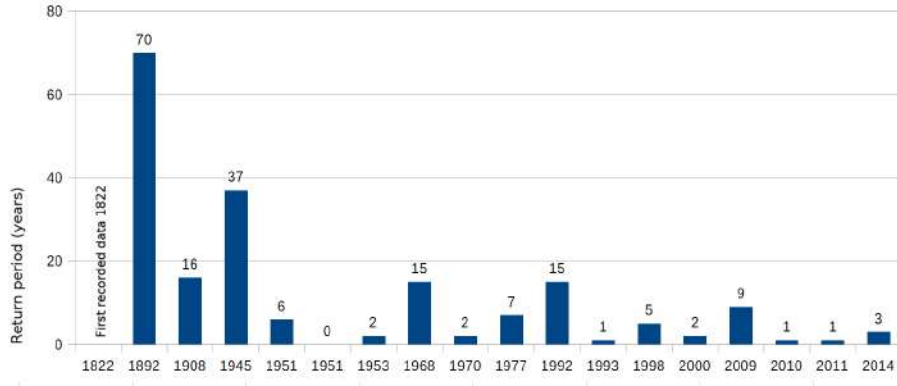

Figure 1 - Flooding return period in the Liguria Region

One might wonder as to the reasons for the intensification of these events. This subject merits a lengthy discussion which we cannot go into here. We can, however, attempt to summarise the possible causes. As mentioned at the beginning, the dynamic morphogenetics of the Earth's surface are a natural occurrence which follows its own laws and practices. When human actions enter this equation, interference between nature and anthropisation occurs. Anthropisation can also create new kinds of phenomena and certainly causes acceleration of the natural time scales. Added to this, as we have already mentioned, a deteriorating climate, with increasingly extreme events, has resulted in greater hazards and, consequently, increased hydrogeological risk.

Hydrogeological Risk: Urban Planning Considerations

Genoa is a complex city, not least from an environmental perspective, the area's morphological structure being profoundly conditioned by the arrangement of the settlement system, contributing to the creation of fragile situations that appear very difficult to rectify.

The city stretches along the coast for some thirty kilometres, joining the limited available flat areas in a building continuum, and only extends inland in correspondence to the two main watercourses - the Polcevera and Bisagno rivers - the final parts of which flow through the urban fabric.

The mountainsides, near the coastline, reach altitudes of over 600 m above sea level,

with average gradients exceeding 25%. During Italy's pre-Republican era, the hillside areas and inland valleys underwent anthropisation resulting in the characteristic "terracing" for agricultural use, particularly for cultivation of olive trees and grapevines.

In modern and contemporary times, building development for residential and production purposes and for construction of the communication infrastructure system not only saturated the flat parts of the area but also took over the hillsides up to the altitude at which building costs outweighed the expected profits. The secondary watercourses were culverted, the riverbeds modified through works that reduced their flow rate, and some parts of the beds covered in order to build roads and car parks.

Figure 2 - Urbanisation in the valley floor and partial coverage of the Bisagno stream

A fragile hydrogeological balance increased the frequency of overflow, both of rivers and of minor tributaries, resulting in material damage, casualties and unsafe conditions for a significant part of Genoa's population.

The flood that, from 7 to 8 October 1970 (Figure 3), struck the city of Genoa with dramatic effects is a tragic confirmation of the chaotic nature of the city's urban development and the folly of land management which, in the name of "affluent society" brought about the anxieties and discomforts of a precarious state that was imagined to be a thing of the past.

IL SECOLO XIX

SPECIALE

Apriamo l'indagine sulle cause della tragica alluvione di giovedì 8 ottobre

PROCESSO AL BISAGNO

Il problema dell'allarme

GENOVA

Gli ostacoli sul greto del torrente alzano il livello dell'acqua

GLI OSTACOLI

IL TORRENTE FANTASMA

LA COPERTURA

Figure 3 - Page of the "Secolo XIX" newspaper of 17 October 1970

It is only for the last decade that the challenges of making the city safe in terms of hydrogeological risk and prevention have been part of the administrative practices of public bodies responsible for governing the area's transformation.

The river basin plans, prepared and approved for each watercourse in accordance with Law no. 183 of 1989, are the reference tool for land conservation, protection and improvement and correct water use. The cognitive, legislative and technical/operational content of these tools, which override all levels of planning, are, today, an integral part of the city's municipal development plan, approved in December 2015.

The associated urban transformation operations are programmed excluding - with few exceptions - the use of undeveloped land, instead using regeneration of the existing heritage and reuse of abandoned areas and buildings.

A more complex issue is planning, in established urban areas, of works designed to increase the soil permeability and the provision of green areas and to restore culverted watercourses to safe conditions. Indeed, such works have to reckon with the difficulty of dealing with private property and the scarcity of available financial resources.

In the hillside areas, characterised by small, traditional rural centres and scattered buildings, the local protection necessary (and indispensable) in order to ensure maintenance of the terracing and control of the waterways is provided, primarily, by residents who engage in forms of part-time agriculture. The wooded areas, meanwhile, are rapidly growing, occupying meadows and agricultural areas, almost exclusively outside of any control or maintenance and creating further conditions of hydrogeological risk.

Val Bisagno: a Study District

Val Bisagno is a study district of great complexity and interest since it synthesises within it many of the contradictions and critical issues characteristic of contemporary cities. Historically, it was a small, agricultural valley, administratively independent of the city of Genoa but linked to it not only in economic terms (providing foodstuffs and labour for urban activities) but also as home to the "villa" residences of the Genoese nobility.

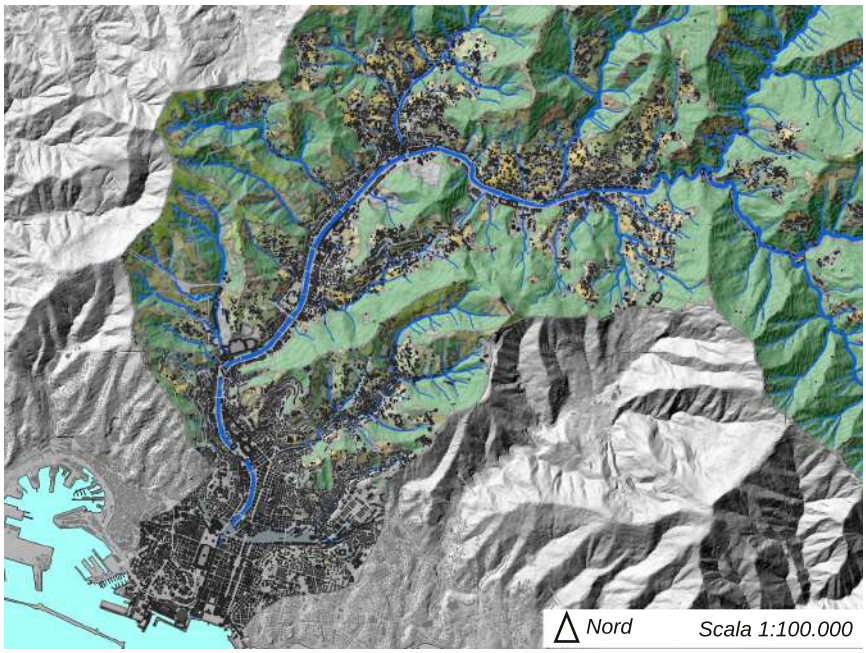

Figure 4 - Map of the lower and middle Val Bisagno

In the nineteenth century, when the Monumental Cemetery of Staglieno was established, the valley became an area hosting the less qualified urban services.

This process was accelerated following the annexation to Genoa, in 1873, of the municipalities situated in the lower and mid valley, to the extent that, upon formation of “La Grande Genova”, in 1926, when Genoa’s administrative limits reached their current extent, the valley floor was already home to the prison, the stadium, the fruit and vegetable market, the gasworks, the rubbish dump, the almshouse and many social housing quarters, among other things.

Between the mid-nineteenth century and the early decades of the twentieth century, building development was carried out under the urban planning scheme approved in 1877 which, in line with the traditional principles of nineteenth-century urban planning, proposed a succession of orthogonal grids of varying density depending on the social classes for which the works were intended. Urban development extended to the entire flat area located in the mid-to-lower stretch of the Bisagno river, even invading areas already considered flood-prone. In 1929, to promote the creation of large-scale road networks bordered by imposing buildings, coverage of the Bisagno river between the railway and the sea was commenced.

In the period following World War II, the assault on the hills (Figure 4 and 5) permitted by the urban planning scheme of 1959 - one of the worst in Italy - further compromised the valley's environmental and settlement quality. Its few flat areas were completely built up, and "1960s" buildings reached and took over many historic hillside centres, particularly those nearest to the city centre. The social housing quarters, deliberately positioned on the hillsides and almost on the ridges of the hills, provided prime streets and urban developments for private building speculation so that, over the years, they came to join the urban fabric of the valley floor.

While green pockets have been safeguarded in the flat areas (in some squares designed by the nineteenth-century scheme which went as far as to plan rows of plane trees), in the hillside areas, the building density is such that even the width of the streets and necessary car parking have been sacrificed.

Figure 5 - Urban spread on the hills in Val Bisagno

However, just above this, particularly in the most inland part of the valley, there is a framing area subdivided into two large bands. The first comprises a belt of rural centres and terraced agricultural areas (largely conserved albeit in the form of "urban countryside") and the second features large green areas, partly falling within the Urban Park of the City Walls and Fotrs, which constitutes a kind of "green lung", in environmental terms, of healthiness for the inhabitants and of perceptual quality.

Figure 6 - The green area beyond the boundary of the building

Tackling the issues associated with risk situations arising from these senseless modes of land use requires a plurality of integrated approaches and operating tools that involve local authorities and citizens in various capacities.

Courses of Action

A we know, Risk is the product of Hazard and Vulnerability (R = H x V): risk cannot be eliminated, merely mitigated, whereas it is possible to influence vulnerability with a better chance of success, minimazing damages (resilience).

Figure 7 - 8 - Cars dragged by the water of the Rio Ferreggiano (2011)

Figure 9 - Volunteers at work to remove the mud

In this perspective, there are two possible courses of action.

The first is risk mitigation through the reduction of environmental vulnerability, for instance through structural works and landscaping of slopes to reduce the hazards relating to meteorological events. It is a question of launching a complex programme of environmental rehabilitation interventions covering built-up areas and agricultural and wooded areas on hillsides, involving public and private property. It is necessary to reinforce the historic terracing, revive traditional agricultural activities, reactivate the waterway control system, check the flow rate of culverted watercourses, implement drainage areas, where possible replacing impermeable ground coverings, and prevent further land consumption.

During this phase, due to the gravity of situations that have accumulated over time, structural works are also necessary in order to enhance the safety of the main watercourse system. The works in question concern reinforcements to the banks, demolition of buildings constructed on riverbeds or within a necessary buffer zone, reconstruction of coverings deemed non-removable, and redesign of bridges and footbridges.

In the last decade, the city has undergone many such works, the most significant regarding the Bisagno river itself, considered one of the nation's most critical situations. The first construction site concerned the covering, between the railway embankment near Brignole Station and the outlet to the sea, which should permit a

significant improvement to the watercourse's flow rate. The safety enhancement project also includes the construction of two floodways, for the Fereggiano, a tributary on the left bank of the Bisagno, and for the Bisagno itself. The smaller channel, into which the Noce and Rovare watercourses also flow, is complete, while excavation of the tunnel, intended to channel waters from the Bisagno to the sea, from an intake located halfway up the valley, is due to commence in 2020.

The second course of action, already mentioned in the previous chapters and specifically tackled during the FLOOD-serv project, is to reduce social vulnerability, for instance by implementing awareness rising campaign concerning the problem of flooding, with the aim of increase the capacity of adopting self-protection measures. During the FLOOD-serv project, through the activities developped with local stakeholders, we had the opportunity to experience first-hand the amount of misinformation that still exists with regard to natural phenomena. Misinformation increases the risk of becoming a casualty during extreme events. It is therefore necessary to provide citizens with at least basic training during "peacetime" in order to empower them to be resilient during such events.

1 Maifredi P., 1974

Genoa University - Polytechnic School - Department of Architecture and Design (DAD)

Gerardo Brancucci

Geologist, Professor of Applied Geomorphology at the DAD Department of Genoa University and co-founder of the Spin Off GeoSpectra s.r.l. He focuses primarily on the evolution of the Earth's surface in relation to anthropic activity and is the author of more than 120 scientific articles in Italian and overseas journals, along with a number of monographs.

Franca Balletti

Architect, Town Planning teacher at the DAD Department. The research issues tackled are connected to the relationship between town planning and landscapes from a historical standpoint and participation and value-adding processes with regards to the territory.

Paola Salmona

PhD in Architecture, currently a technician at the Geomorfolab – An applied geomorphology lab where the main focus is on the configuration and application of GIS (Geographical Information Systems) to support tools and procedures in town planning and management.

Valentina Marin

PhD in Environmental Sciences, with a specific focus on environmental sustainability and coast management. Currently a technician at the DAD Department's Geomorfolab, working on data processing and computerised cartography for territorial analysis and management.

Daniela Rimondi

Adjunct Professor at the DAD Department. Co-founder of the research group INSITO which focuses specifically on inclusive processes and citizens' participation in planning and territory management.

Roberta Prampolini

PhD in Governance and Complex System Sciences, with a current focus on socio-territorial studies, specifically on: visual, urban sociology and INSITO Society and Territory, she collaborates with the DAD Department and with public and private bodies.

This book presents the results of the Genoa participation to the FLOOD – Serv FLOOD emergency and Awareness SERVice project.
The project aim has been to promote citizen involvement for a greater awareness of flood risks and related impacts and to support the Public Authorities in implementing mitigation strategies.
The project through the potentialities of ICT tools aims to make citizens aware about flood risks, to find out shared mitigation actions, and to cooperate with local stakeholders for the best exploitation of their specific knowledges about hydrogeological hazard before and after a flood.
The project has been implemented in the Genoa districts of Media Val Bisagno, Bassa Val Bisagno e Medio Levante.