CMV4Clima

The experience with CLIMAAX project in Valchiavenna – phase 1

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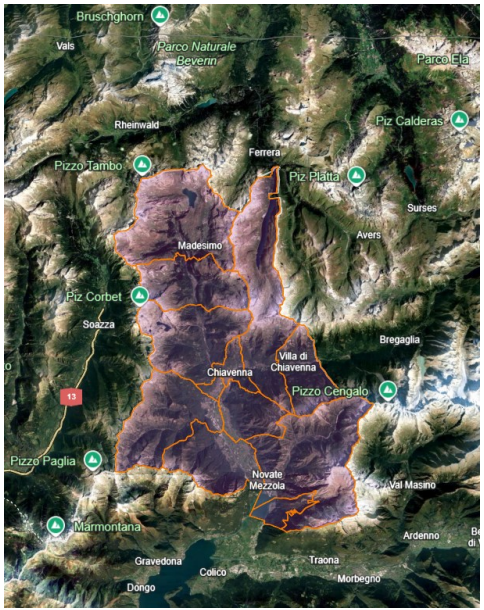
CLIMAAX
climate ready regions

Valchiavenna and the Mountain Community



- Milano –> 80 km south
- Zurich –> 110 km north-west
- Innsbruck –> 160 km north-east

Valchiavenna is a mountain area located in northern Italy, in the Lombardy region, bordering Switzerland on three sides, north, west and east.
It's characterized by complex geomorphology, scattered settlements, and a high exposure to hydro-meteorological hazards.

Comunità Montana della Valchiavenna

Public local authority formed by the union of the 12 municipalities of Valchiavenna whose goal is to **protect** and **enhance** the mountain territory while challenging the depopulation and marginalisation.

a. socio-economic and territorial-urban planning body;
b. coordinating body managing functions and services, directly or on behalf of the municipalities

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CMV4Clima: Focus of the risk analysis

Scoping phase → the valley faces a high level of **hydrogeological risk**, a complex threat influenced by multiple factors (*geomorphology, numerous water bodies, forest fires, land abandonment, and heavy rainfall following prolonged periods of drought, etc.*)

HEAVY RAINFALL

Extreme rainfall events are significant triggers for hydrogeological hazards including landslides and debris flows, as well as flooding in urbanized areas

RIVER FLOOD

River flooding: rising rainfall intensity and changes in snowmelt dynamics are expected to increase the frequency and severity of river flooding

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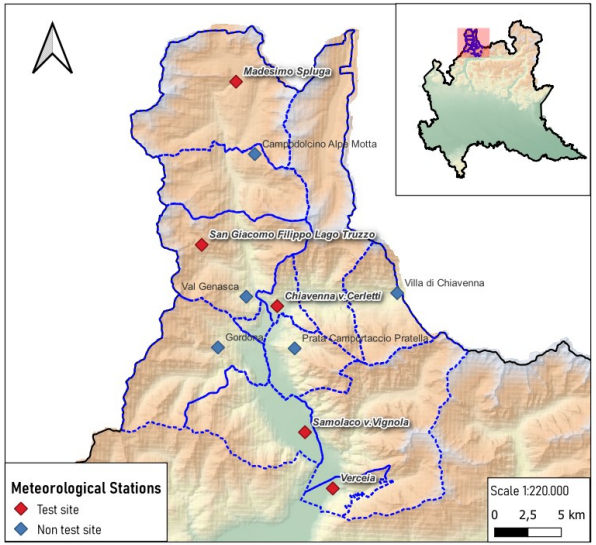
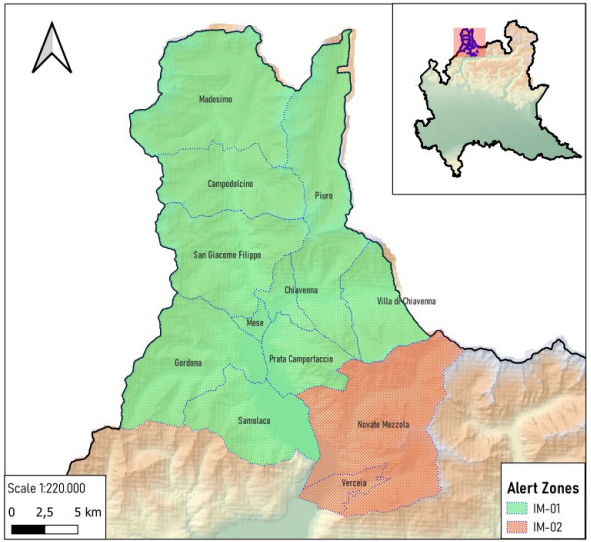
CMV4Clima: what we did

Territory and data

Two applications:

1. site-specific
2. regional





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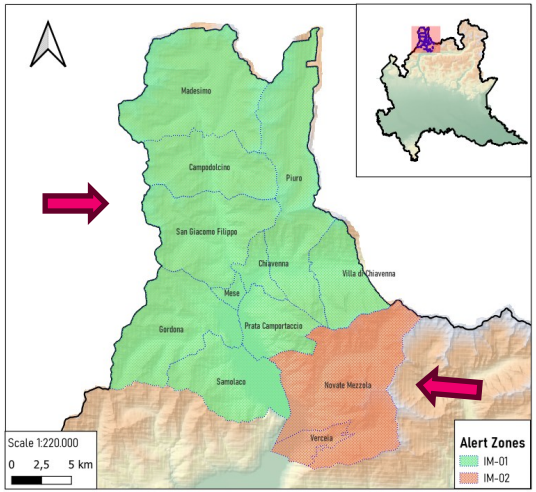
CMV4Clima: what we did

Exploring the thresholds

Heavy Rainfall Workflow

Critical thresholds based on Civil Protection early-warning system in place



making a connection to the Disaster Risk Management framework for the area

Hazard codes (heavy rainfall)	***Hazard level***	***Probability (%) of occurrence of heavy rainfall*** *(storms = extreme events)*
-	None	0
P1	Very low	1-10 (<2)
P2	Low	10-40 (2-10)
P3	Moderate	40-60 (10-20)
P4	High	>60 (>20)

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CMV4Clima: what we did

Exploring the thresholds

Reference values from the local alert system

Zone	Threshold	-	P1	P2	P3	P4
IM-01	6-hours [mm/6h]	0-15	15-35	35-45	45-70	>70
	12-hours [mm/12h]	0-20	20-45	45-55	55-85	>85
	24-hours [mm/24h]	0-25	25-60	60-85	85-110	>110
IM-02	6-hours [mm/6h]	0-15	15-30	30-40	40-65	>65
	12-hours [mm/12h]	0-20	20-40	40-50	50-80	>80
	24-hours [mm/24h]	0-25	25-50	50-80	80-100	>100

Selected values for testing

Zone	Alert level	D	I (mm)
IM-01	P3 -> P4	24	**110**
	> P4	24	**150**
IM-02	P3 -> P4	24	**100**
	> P4	24	**135**

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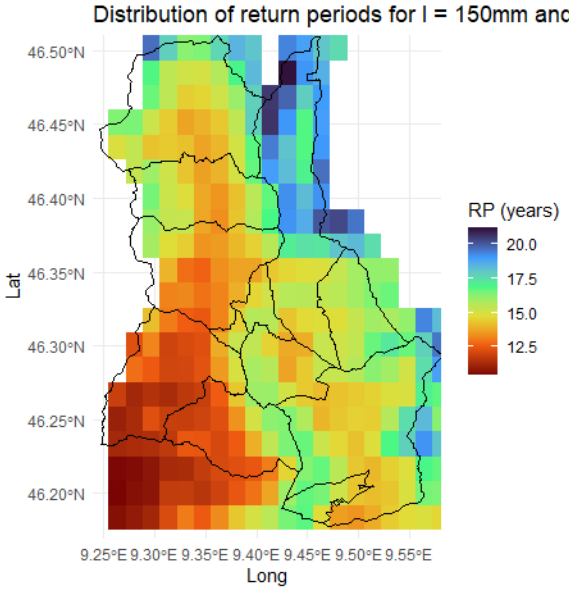
Heavy Rainfall Workflow

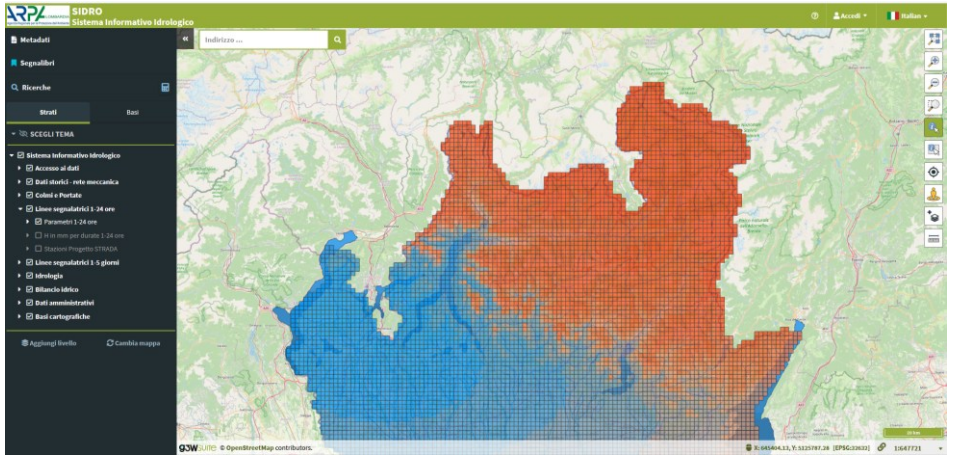
CMV4Clima: what we did

$$h_T(D) = a_1 w_T D^n$$

h = rainfall (mm)
T return period (y)
D = duration of the rainfall event (hours)



Calculation of I-D-F triplets



Station	Zone	I (mm)	D (hours)	F (years)	Coord Y	Coord X
Samolaco v.Vignola	IM-01	**150**	24	**16,5**	46,23611	9,426654
Madesimo Spluga	IM-01	**150**	24	**14,7**	46,47167	9,348123
Chiavenna v.Cerletti	IM-01	**150**	24	**15,4**	46,32081	9,395591
San Giacomo Filippo Lago Truzzo	IM-01	**150**	24	**14,8**	46,36054	9,319988
Verceia	IM-02	**135**	24	**10,8**	46,19868	9,455462

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CC scenarios and datasets

Pre-calculated (CLIMAAX - Path A) precipitation flow datasets

GCM	RCM	RCP	BIAS CORR	Hist	Time_Hor
ichec-ec-earth	knmi-racmo22e	rcp85	F	1976-2005	2011-2040
ichec-ec-earth	knmi-racmo22e	rcp85	F	1976-2005	2041-2070
mohc-hadgem2-es	knmi-racmo22e	rcp85	F	1976-2005	2011-2040
mohc-hadgem2-es	knmi-racmo22e	rcp85	F	1976-2005	2041-2070
mpi-m-mpi-esm-lr	smhi-rca4	rcp85	F	1976-2005	2011-2040
mpi-m-mpi-esm-lr	smhi-rca4	rcp85	F	1976-2005	2041-2070

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Outputs: 1976-2005 vs 2011-2040 (short-term)

Heavy Rainfall Workflow

		INPUT			PARAMETERS		OUTPUT		
Stazione	ZOA	INTENSITY_TH	DURATION_TH	FREQUENCY_TH	GCM	RCM	Magn_var (%)	TR_new (years)	TR_change (years)
SAM	IM-01	150	24	16,5	ichec-ec-earth	knmi-racmo22e	-26	93	76,5
MAD	IM-01	150	24	14,7	ichec-ec-earth	knmi-racmo22e	-9	27	12,3
CHI	IM-01	150	24	15,4	ichec-ec-earth	knmi-racmo22e	-25	82	66,6
SGF	IM-01	150	24	14,8	ichec-ec-earth	knmi-racmo22e	-14	33	18,2
VER	IM-02	135	24	10,8	ichec-ec-earth	knmi-racmo22e	-12	24	13,2
SAM	IM-01	150	24	16,5	mohc-hadgem2-es	knmi-racmo22e	-1	18	1,5
MAD	IM-01	150	24	14,7	mohc-hadgem2-es	knmi-racmo22e	-2	16	1,3
CHI	IM-01	150	24	15,4	mohc-hadgem2-es	knmi-racmo22e	-1	16	0,6
SGF	IM-01	150	24	14,8	mohc-hadgem2-es	knmi-racmo22e	-1	16	1,2
VER	IM-02	135	24	10,8	mohc-hadgem2-es	knmi-racmo22e	5	9	-1,8
SAM	IM-01	150	24	16,5	mpi-m-mpi-esm-lr	smhi-rca4	10	12	-4,5
MAD	IM-01	150	24	14,7	mpi-m-mpi-esm-lr	smhi-rca4	-4	19	4,3
CHI	IM-01	150	24	15,4	mpi-m-mpi-esm-lr	smhi-rca4	10	11	-4,4
SGF	IM-01	150	24	14,8	mpi-m-mpi-esm-lr	smhi-rca4	6	11	-3,8
VER	IM-02	135	24	10,8	mpi-m-mpi-esm-lr	smhi-rca4	15	7	-3,8

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Outputs: 1976-2005 vs 2041-2070 (medium-term)

Heavy Rainfall Workflow

		INPUT			PARAMETERS		OUTPUT		
Stazione	ZOA	INTENSITY_TH	DURATION_TH	FREQUENCY_TH	GCM	RCM	Magn_var (%)	TR_new (years)	TR_change (years)
SAM	IM-01	150	24	16,5	ichec-ec-earth	knmi-racmo22e	-17	35	18,5
MAD	IM-01	150	24	14,7	ichec-ec-earth	knmi-racmo22e	-12	29	14,3
CHI	IM-01	150	24	15,4	ichec-ec-earth	knmi-racmo22e	-17	33	17,6
SGF	IM-01	150	24	14,8	ichec-ec-earth	knmi-racmo22e	-11	26	11,2
VER	IM-02	135	24	10,8	ichec-ec-earth	knmi-racmo22e	1	11	0,2
SAM	IM-01	150	24	16,5	mohc-hadgem2-es	knmi-racmo22e	27	9	-7,5
MAD	IM-01	150	24	14,7	mohc-hadgem2-es	knmi-racmo22e	21	8	-6,7
CHI	IM-01	150	24	15,4	mohc-hadgem2-es	knmi-racmo22e	26	8	-7,4
SGF	IM-01	150	24	14,8	mohc-hadgem2-es	knmi-racmo22e	30	7	-7,8
VER	IM-02	135	24	10,8	mohc-hadgem2-es	knmi-racmo22e	27	6	-4,8
SAM	IM-01	150	24	16,5	mpi-m-mpi-esm-lr	smhi-rca4	10	12	-4,5
MAD	IM-01	150	24	14,7	mpi-m-mpi-esm-lr	smhi-rca4	5	12	-2,7
CHI	IM-01	150	24	15,4	mpi-m-mpi-esm-lr	smhi-rca4	10	11	-4,4
SGF	IM-01	150	24	14,8	mpi-m-mpi-esm-lr	smhi-rca4	1	15	0,2
VER	IM-02	135	24	10,8	mpi-m-mpi-esm-lr	smhi-rca4	10	8	-2,8

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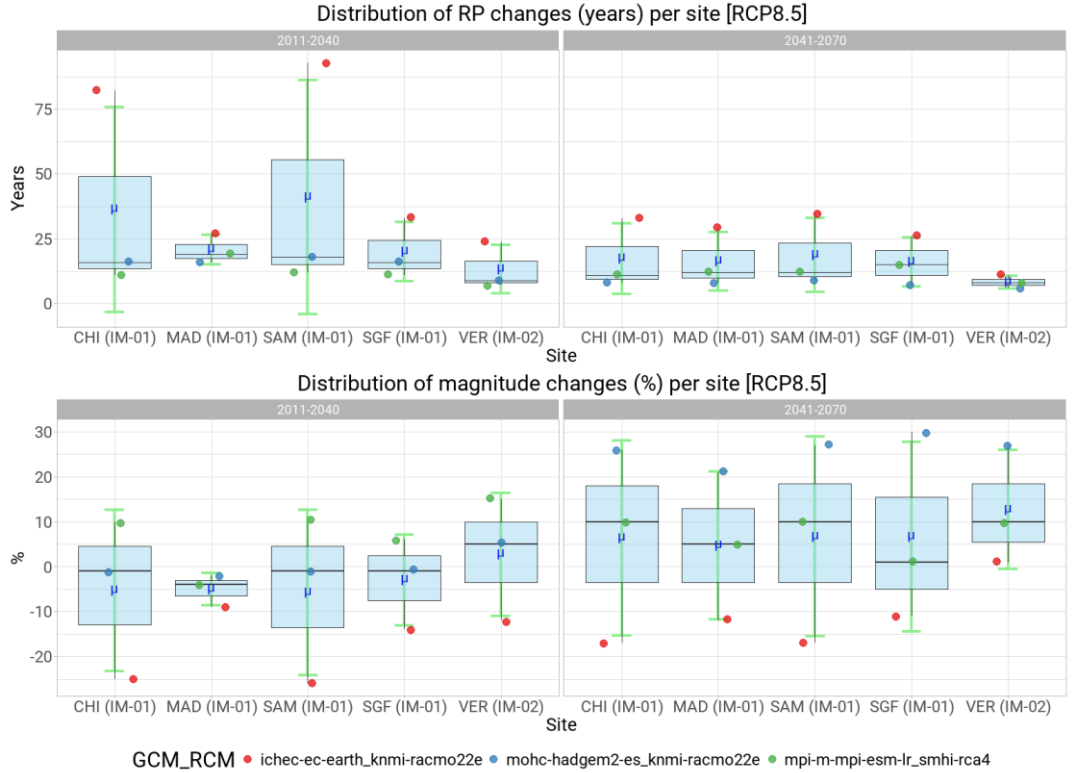
Outputs: 1976-2005 vs 2041-2070 (medium-term)

Heavy Rainfall Workflow



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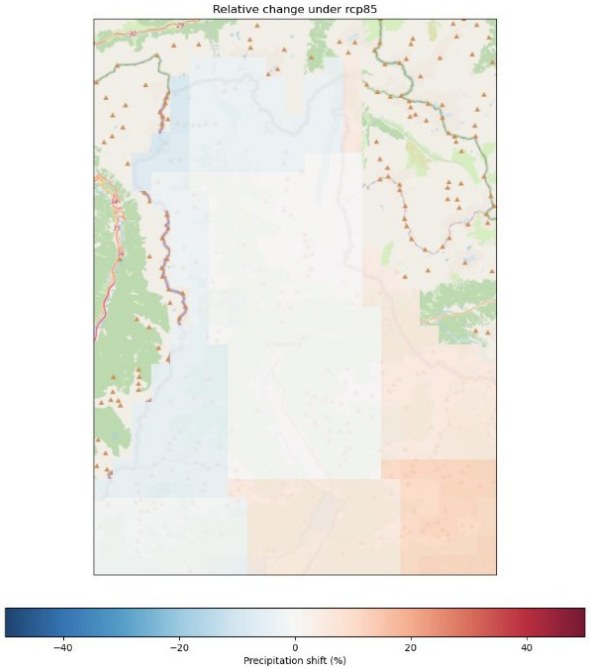
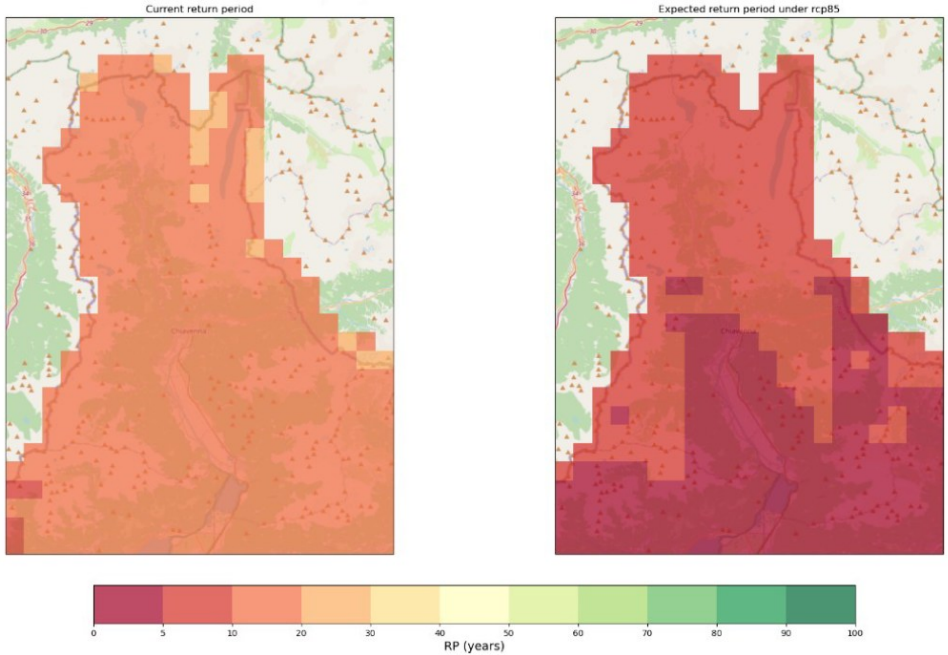
Outputs: 1976-2005 vs 2041-2070 (medium-term)

Heavy Rainfall Workflow

Shift of magnitude - fixed TR=15 - 2011-2040



Shift of frequency - 150mm/24h - 2011-2040



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CMV4Clima: Initial assumptions and considerations

In approaching the assessment of the aforementioned risks for the study area, it is important to note that the context is characterized by:

- a **mature framework of policy instruments for hazard and risk management**
- a **well-established knowledge system supporting hazard and risk analysis** (including ARPA meteorological stations and I-D-F curves)
- a **risk and emergency management system** that is integrated into the **Civil Protection** and land protection framework (such as hydraulic monitoring services and flood monitoring services, early warning systems, and local civil protection systems)

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CMV4Clima: Next steps

Heavy Rainfall Workflow

- Test **more GCM/RCM combinations** for a more robust indication and evaluation of uncertainty –> *which ones?*
- Investigate further the thresholds: *where exactly do they come into play in* ***triggering the alert phases*** *in Civil Protection procedures?*
- Investigate further the role of *heavy* rainfalls as **precursors of other related hazards** (landslides, river floods, urban floods) –> *what are really these thresholds?*

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