National Technical University of Athens

School of Civil Engineering

Supplementary material

Modern vs traditional mapping methods for flood risk estimation: A case study for the river Pikrodafni, Athens, Greece

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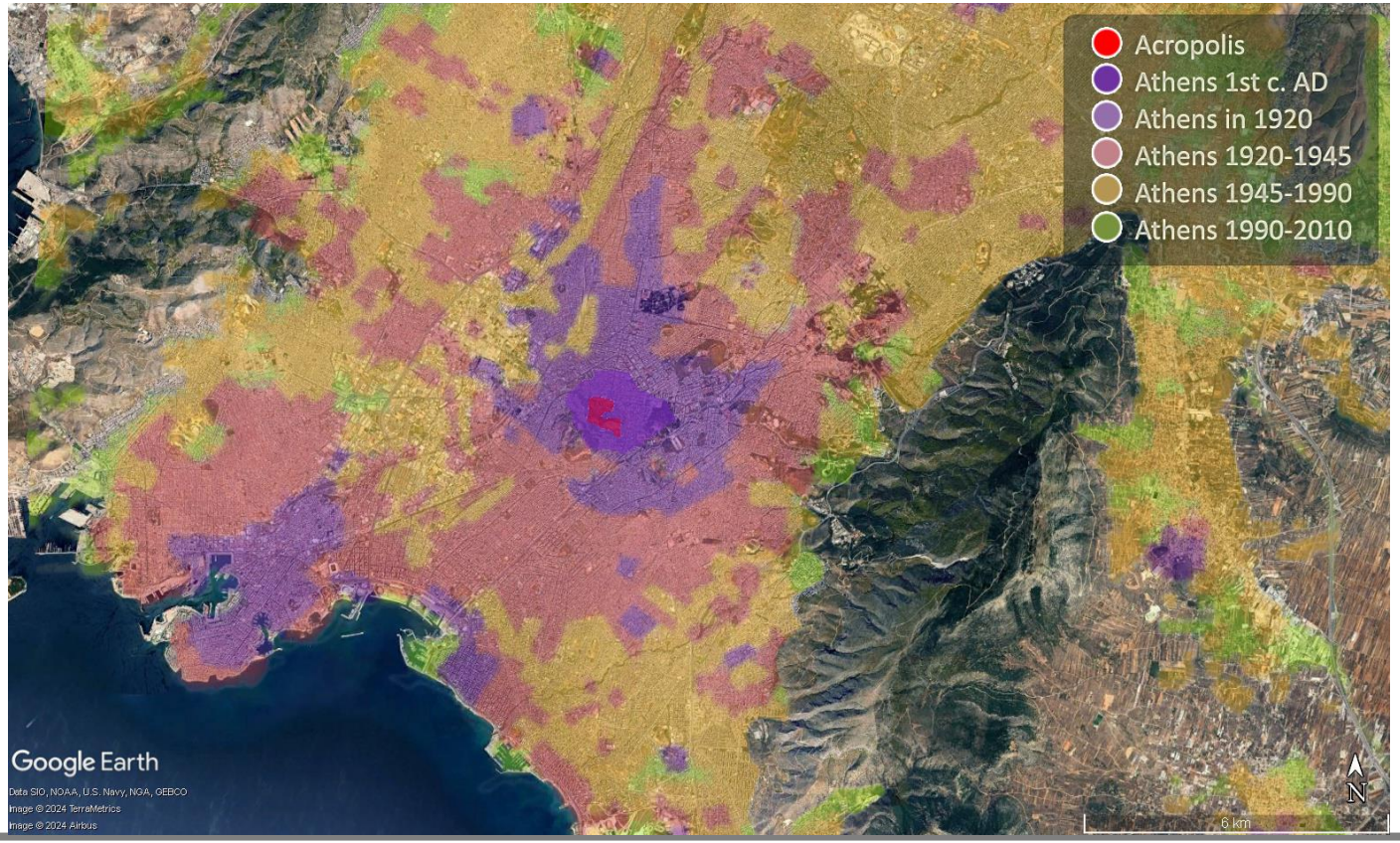
Introduction

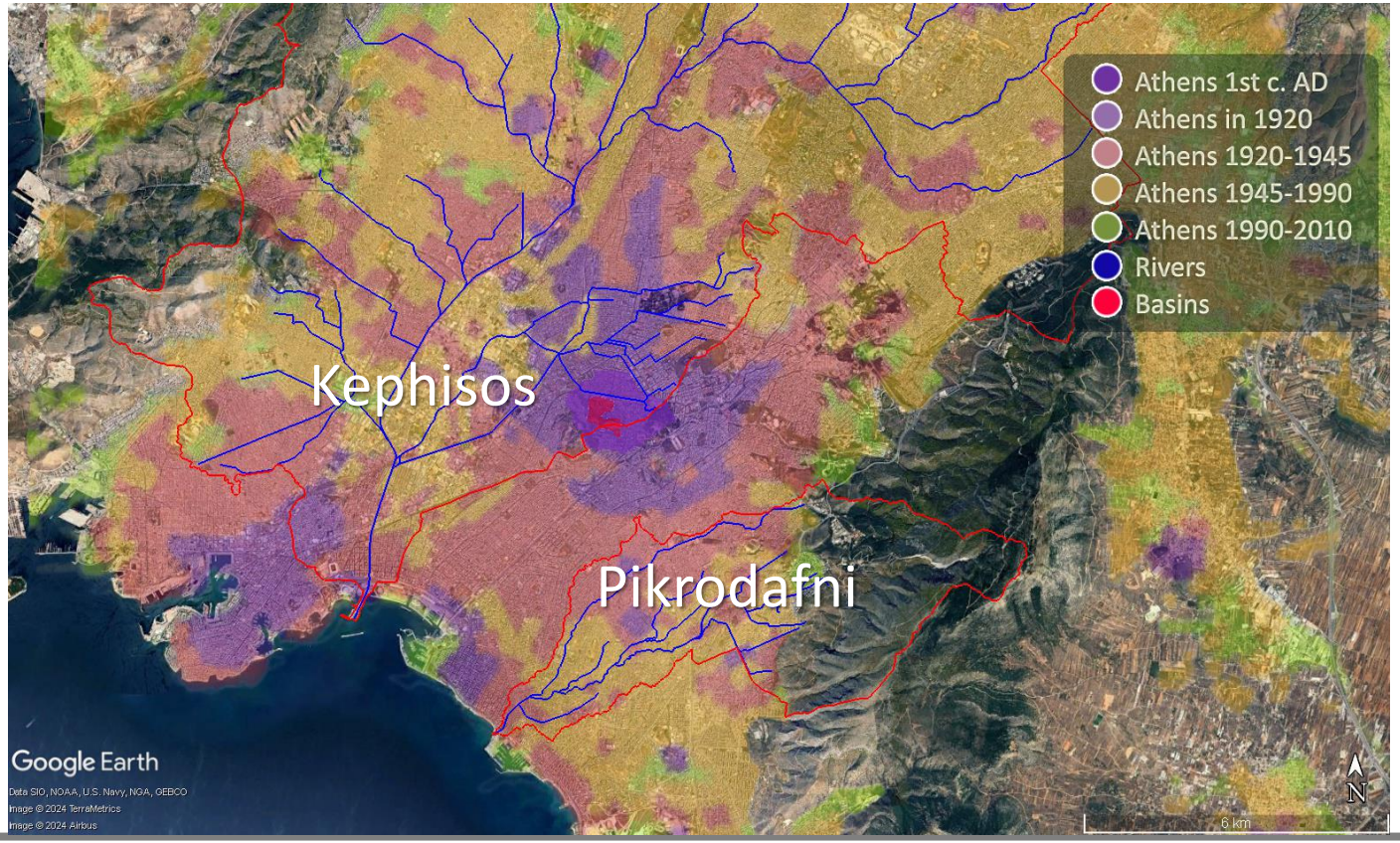
- The transformation of civilization in the 20th century led to the evolution urbanization. However, the speed at which this occurred did not incorporate historical memory, testimonies, and the wisdom contained within tradition.
- Therefore the question emerge: Floods attack cities or cities have invaded to flood plains?
- Thus, cities developed recklessly [1, 2, 3], often within flood-plain areas and for this reason, the need for the advancement of flood risk studies became imperative to safeguard them [4, 5].
- In this presentation we demonstrate the evolution of Athens and evaluate the progress of engineering studies analyzing and managing flood risk between the 1970s and present times.
- Greece has 13 272 settlements and about 500 of them have a flood risk potential. Koutsoyiannis and Mamassis have estimated that on average, 10 flood events per year will exceed the design flood in some of the 500 settlements and a flood of a 500-year return period will occur once every year in one of these settlements [6].

The evolution of Athens



Map form Google Earth after adaptation [7, 8]

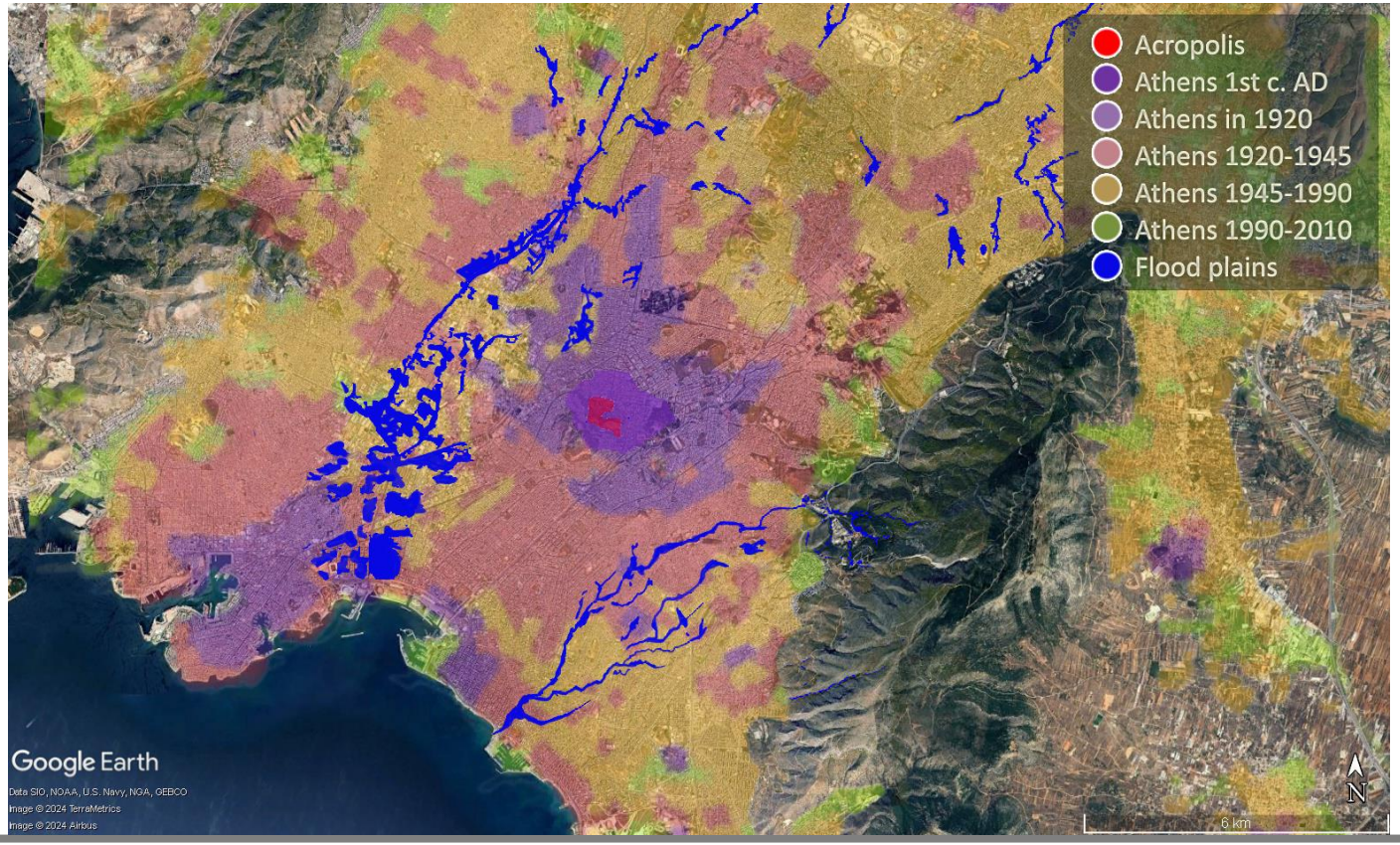
The evolution of Athens



Rivers and basins after adaptation [9,10]

Map form Google Earth after adaptation [7, 8]

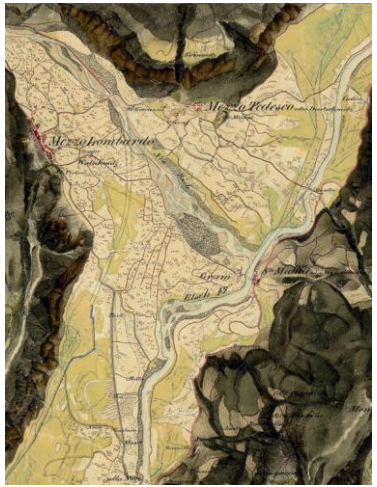
The evolution of Athens



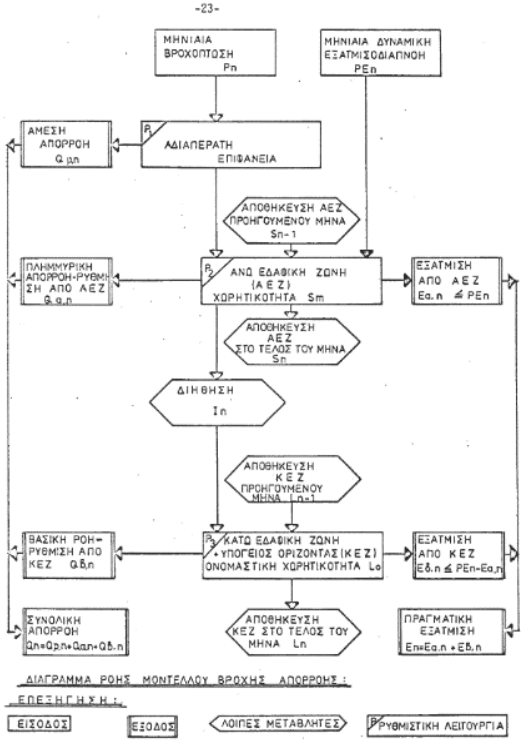
Graphical abstract of flood plains after adaptation [9,10]

Map form Google Earth after adaptation [7, 8]

Historical approaches of flood risk studies



A detail, close to the Noce-Adige rivers junction, north to Trento, of the map of the “Second Military Survey”, alsonamed Franziszeische Landesaufnahme, sketched between 1816 and 1823 for the Adige river area in 1:28.800 scale.[11]



Flow chart of the rainfall-runoff model [12]

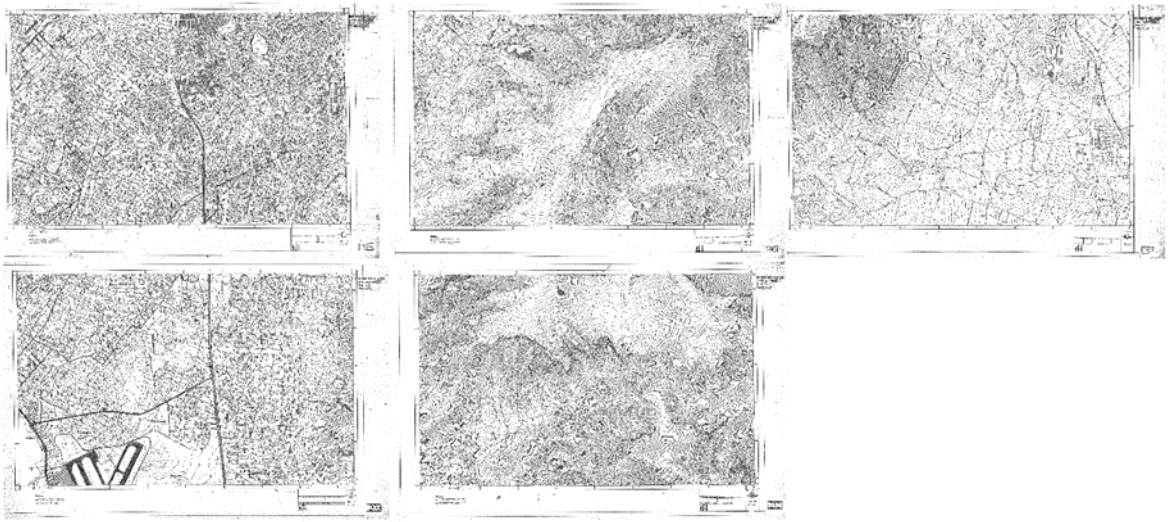
ΠΙΝΑΚΑΣ 1.2.1. ΜΕΣΕΣ ΜΗΝΙΑΙΕΣ ΘΕΡΜΟΚΡΑΣΙΕΣ ΣΤΑΘΜΟΥ ΘΕΣΣΑΛΟΝΙΚΗΣ

ΥΔΡΟΛ.ΕΤΟΣ	Ο	Ν	Δ	Ι	Φ	Μ	Α	Μ	Ι	Ι	Α	Σ
1959-60	15,79;	13,23;	12,13;	7,02	7,82	9,31	13,93	19,04	23,39	25,40	26,37	20,43
1960-61	19,46	14,51	11,50	5,68	6,97	12,09	16,57	19,54	23,98	25,71	26,27	22,46
1961-62	17,94	13,91	7,13	7,09	5,57	9,98	14,91	21,63	23,08	25,92	27,60	22,75
1962-63	17,46	14,39	5,49	3,63	7,17	9,54	13,99	18,79	23,83	27,26	26,89	23,31
1963-64	17,01	13,72	7,99	3,45	6,28	9,98	14,35	18,03	23,99	25,18	24,89	20,38
1964-65	17,56	12,78	8,75	6,74	3,07	9,82	13,27	18,04	24,09	25,87	24,26	22,42
1965-66	16,69	12,00	8,49	4,51	11,23	10,16	15,67	18,87	22,68	26,43	26,64	22,21
1966-67	20,39	13,15	7,77	4,58	5,74	10,28	13,66	19,39	22,46	25,57	26,81	22,25
1967-68	18,20	12,82	7,68	4,04	8,65	9,50	15,64	21,82	23,31	26,45	24,33	22,16
1968-69	16,30	13,09	7,05	4,17	8,40	8,81	13,22	21,33	23,58	24,45	25,26	23,01
1969-70	16,66	13,19	8,65	7,62	8,43	10,21	15,98	17,36	23,43	25,18	25,68	21,82
1970-71	15,95	11,84	7,63	8,95	6,90	8,77	13,54	20,33	23,24	24,46	25,82	20,42
1971-72	14,90	11,26	8,28	6,67	7,52	10,36	15,42	19,51	24,42	25,59	25,32	20,23
1972-73	13,20	11,53	6,48	4,86	8,11	8,03	13,85	20,06	22,63	26,13	24,78	22,20
1973-74	16,83	9,16	6,17	6,18	8,76	10,18	12,41	18,22	22,27	25,30	25,81	21,74
1974-75	18,12	11,29	7,18									
1975-76				6,50	6,55	8,80	14,52	18,91	22,48	24,70	22,41	20,34
1976-77	17,45	12,20	7,37	6,70	10,90	11,20	14,20	19,90	23,60	26,10	25,60	20,80
1977-78	15,20	13,40	5,50	5,09	8,50	11,70	13,50	18,34	24,28	25,82	24,57	19,46
1978-79	15,06	9,21	9,17	5,04	8,13	12,00	12,96	19,68	24,86	25,12	24,45	21,11
1979-80	15,33	12,41	8,66									
Μ.Τ.	16,73	12,45	7,96	5,73	7,62	10,30	14,29	19,41	23,45	25,61	25,46	21,55

Monthly meteorological data [12]

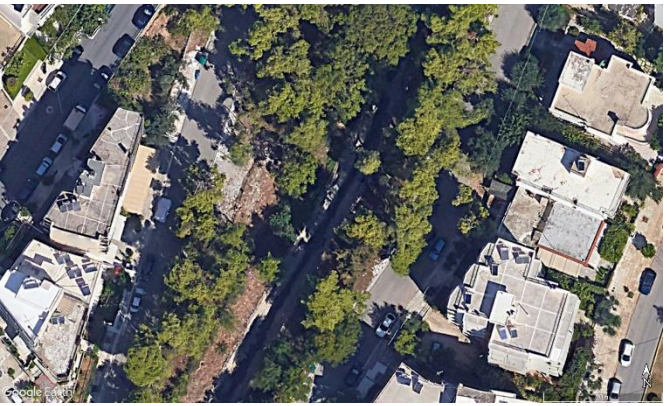
Historical approaches of flood risk studies

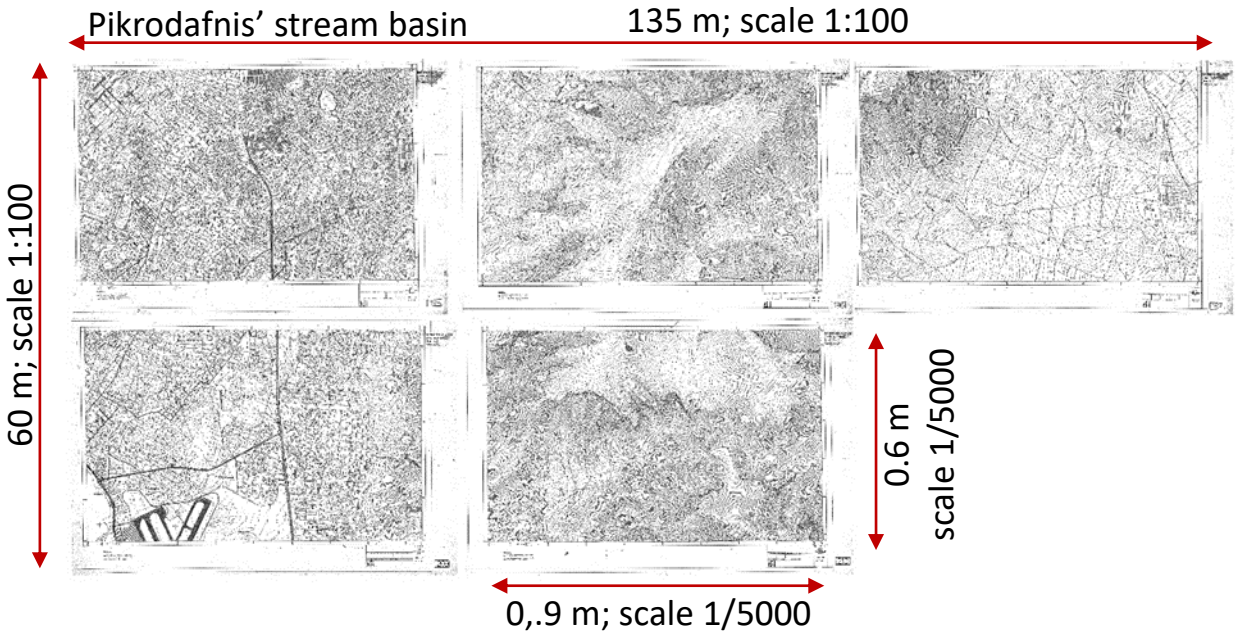
Pikrodafnis' stream basin



- Each map in scale 1:5000, represents an area about 4.5 km horizontally and 3 km vertically.
- The physical dimension of each map (without borders) is 0.9m×0.6m

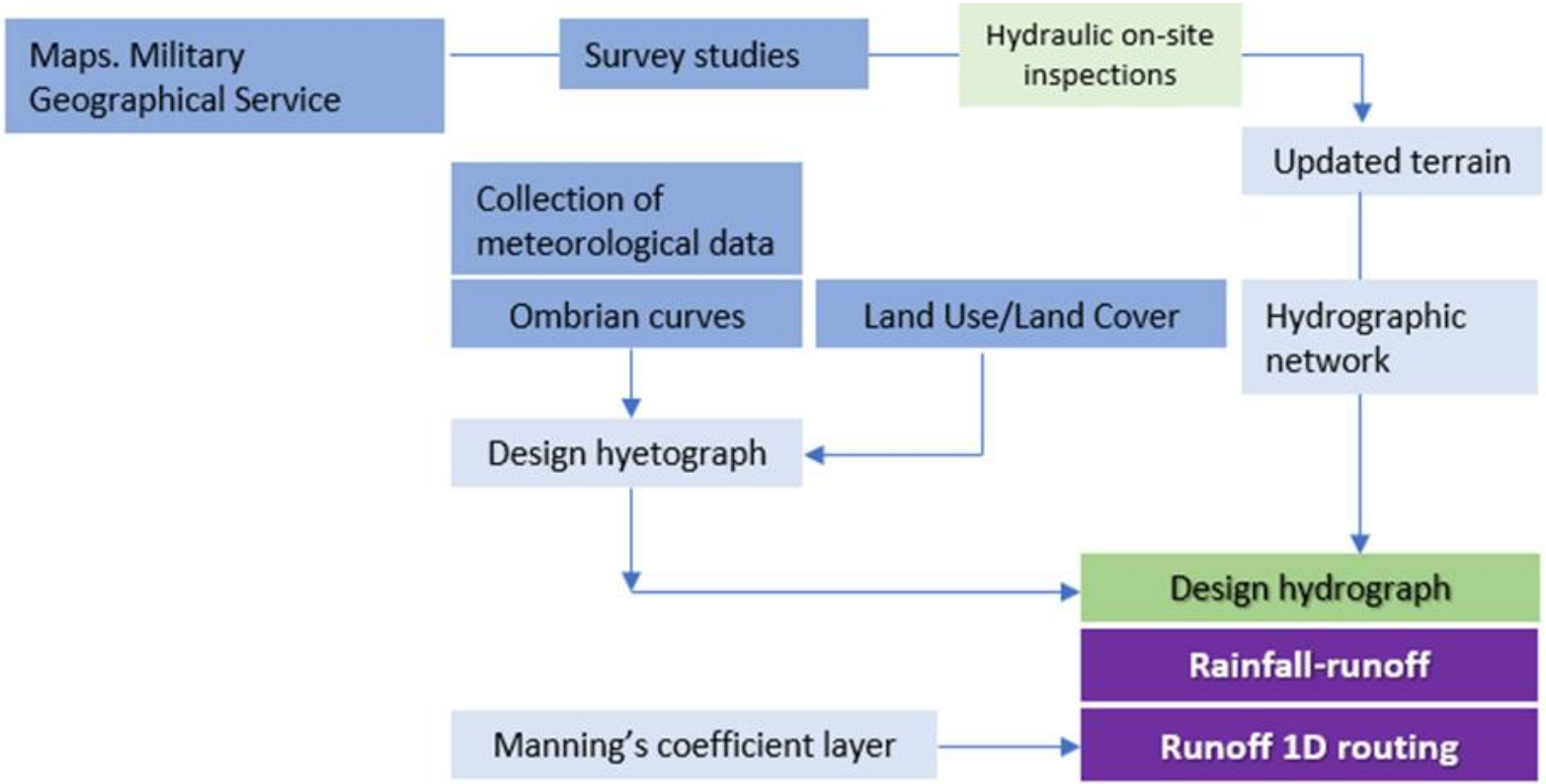
Evaluation of historical and modern mapping tools





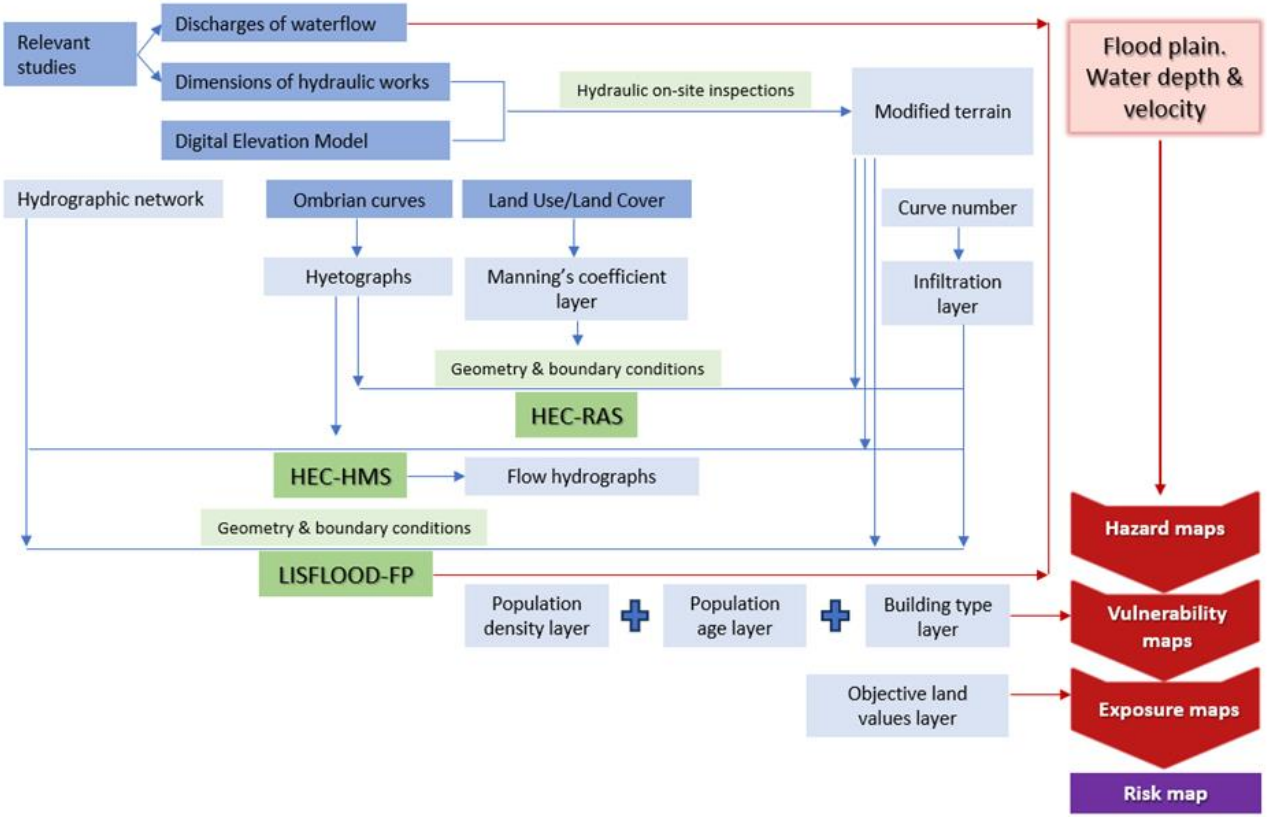
- The informations given by Google Earth are corresponding with a map in scale 1:100
- The dimensions of the map of Pikrodafnis' basin in scale 1:100 will be about 135×60 m

Historical approaches of flood risk studies



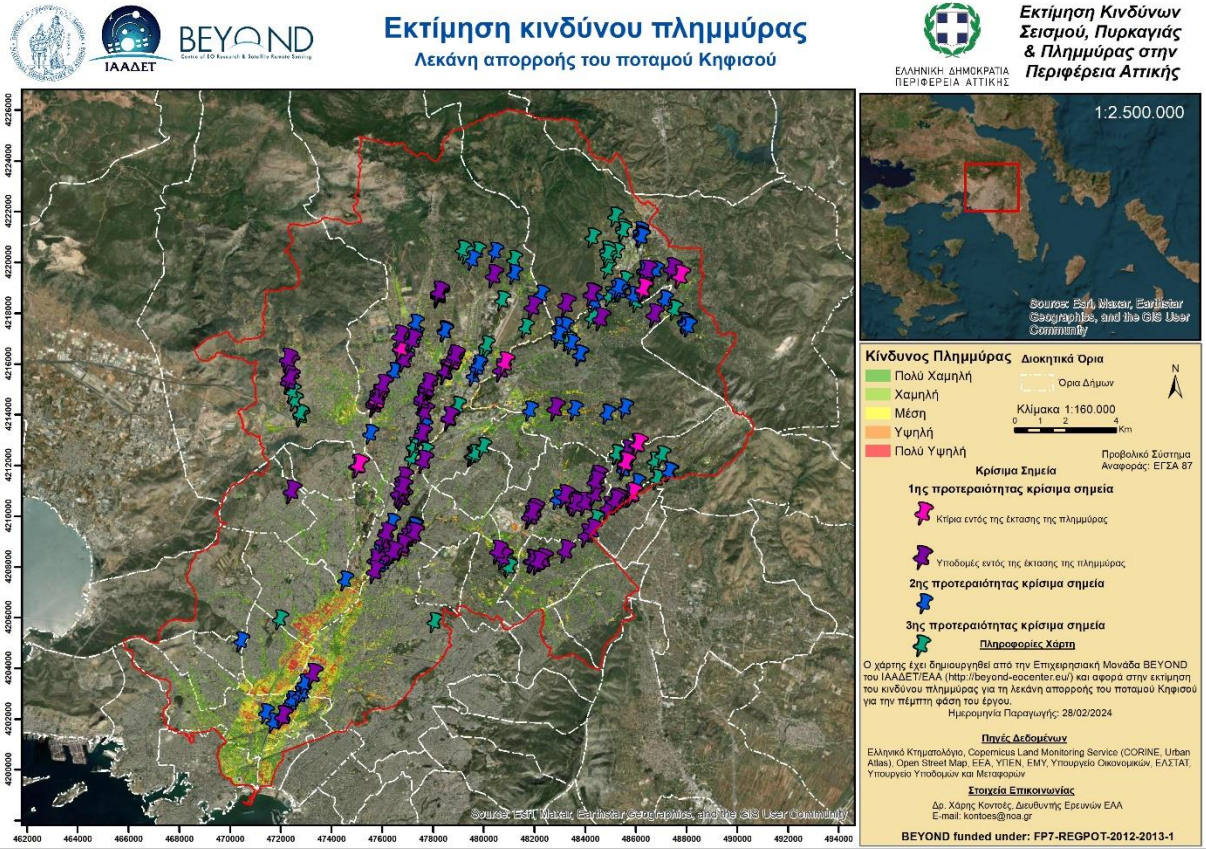
Kougia et al., Modern vs traditional mapping methods

Modern approaches of flood risk studies



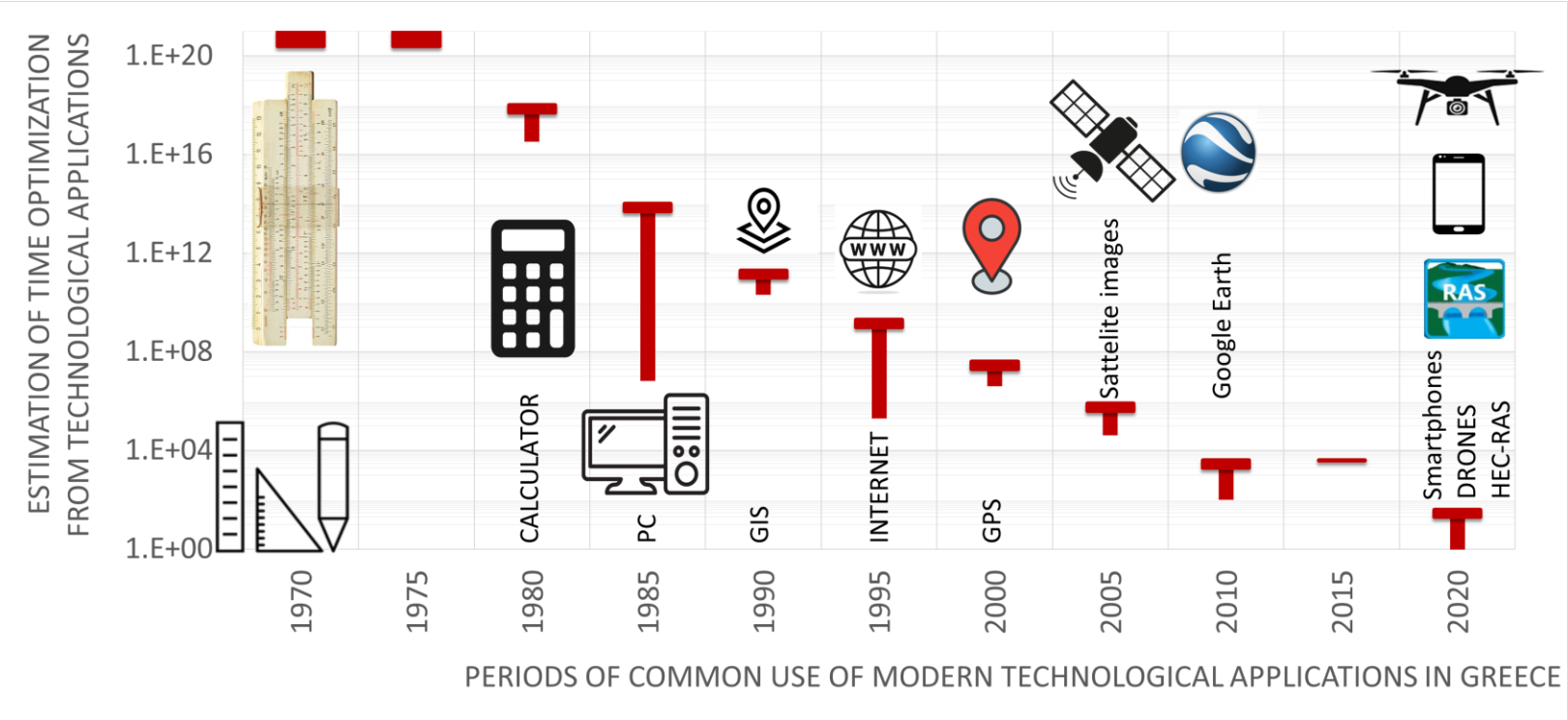
[9, 10]

Modern approaches of flood risk studies



[9, 10]

Timeline of the appearance of modern tools



Timeline of the appearance of modern tools used for flood risk studies in Greece and time optimization from the technological applications

Conclusions

A study of flood risk in 1970s would have the following limitations:

- Calculations to 2nd digit. Even if we assume that the calculations were correct, this limitation leads to computational errors.
- Time lag of the hydrological data was monthly. In present the time lag is 10 minutes.
- No simulation process for the creation of synthetic timeseries.
- The analysis in 1970s was in 1D. 2D analysis were not referred in Greece.
- The provided blue print maps in 1970s (scale 1:5000) refers approximately to a cell's grid in DEM 250X250. The DEM background with cell 2X2 refers approximately to a map in scale 1:100.
- The hydraulic analysis in one dimension does not provide information for the two-dimensional flow. Therefore, it loses the information about the hydraulic losses from upstream in correlation with hydraulic supply with downstream. Modern methods diminish this issue.
- The cumulative progress which is depicted in the estimation of time optimization shows that studies with similar accuracy and visualization would be impossible in 1970s.

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