



Dealing with Flood Events at Hydroelectric Plant Areas in Western Greece

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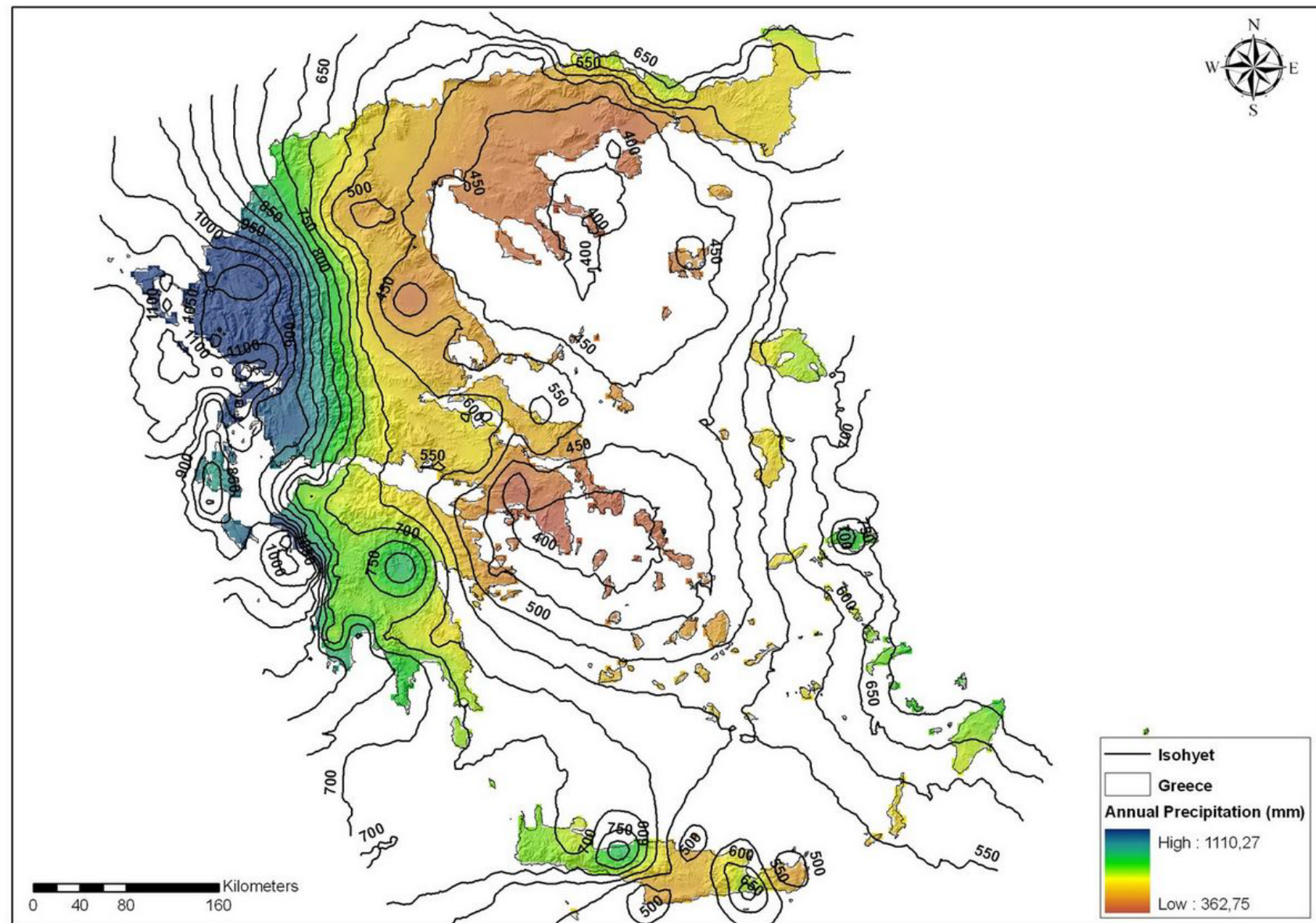
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Annual Precipitation in Greece (millimetres in height)



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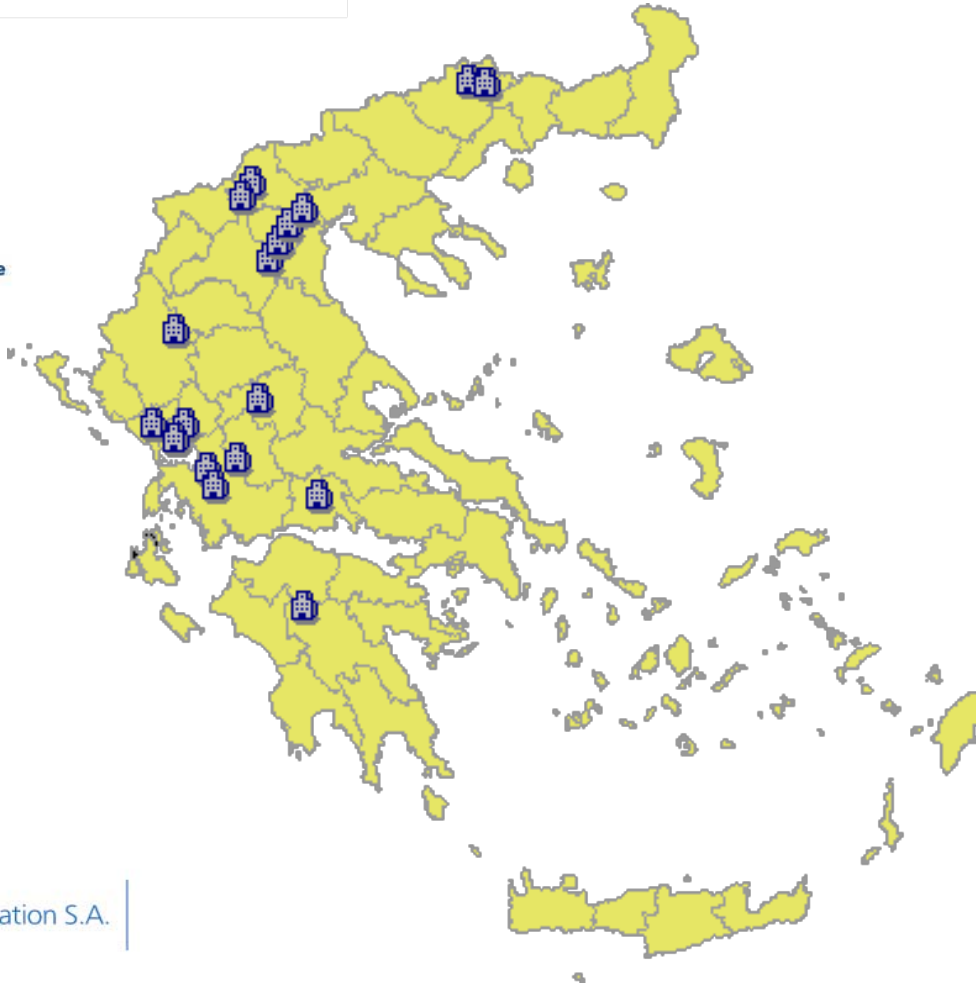
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The Hydroelectric development from 1950 up to date

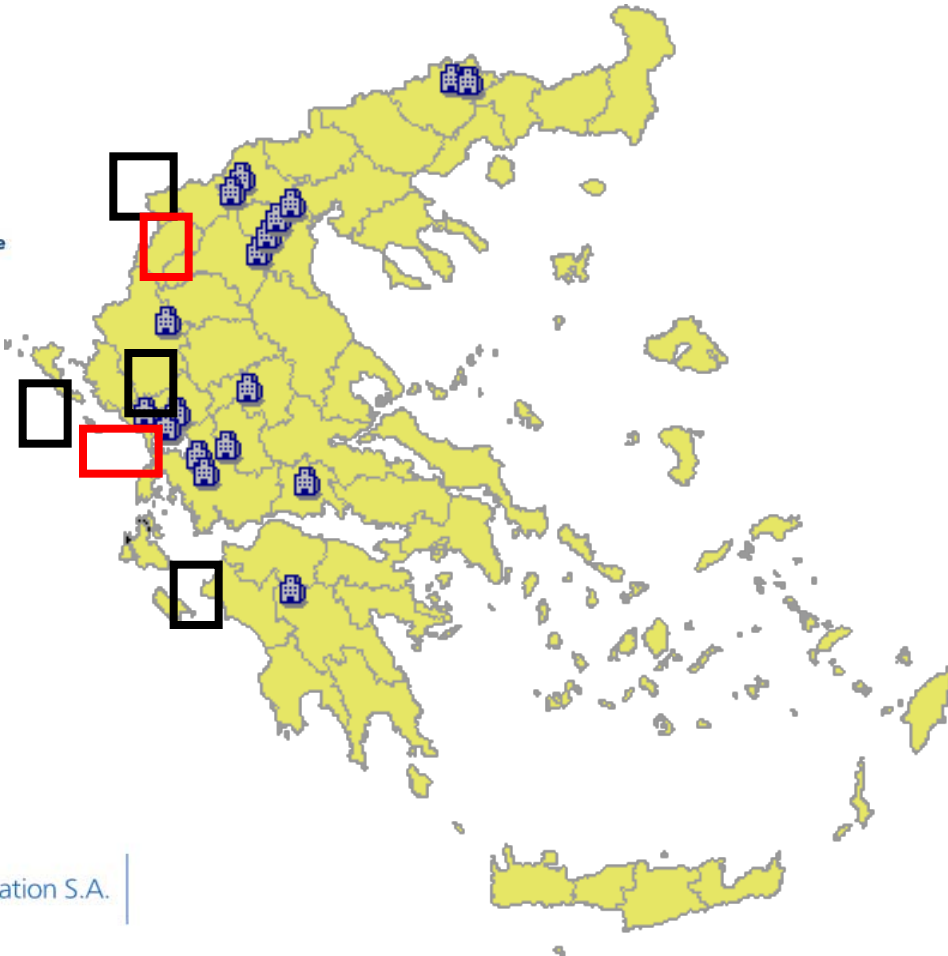
Greece is an over 80 % mountainous country with a complicated rugged relief and a variety of climates

Hydroelectric Power Plants are situated in the northwestern part, where most of the mountains are located

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1950-1975

8 large Hydroelectric Power Plants, totaling 1.410 MW, were built. Among them the 3 **biggest** ones : *Agras, Ladhon, Louros, Tavropos, Kremasta, Kastraki, Edessaïos, Polyphyto*

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9 **large** & 5 **small** Hydroelectric Power Plants, totalling 1.800,2 MW, were built. Among them the two pump storage plants: **Pournari I & II**, **Sfikia**, **Assomata**, **Stratos I**, **Stratos II**, **Pighai Aaos**, **Thissavros**, **Platanovryssi**, **Ghiona**, **Makrochori**, **Aghia Varvara**, **Ilarion HPP**, **Ilarion SHPP**



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The actual situation of PPC Hydroelectric Power Plants

- Acheloos r. Hydro Scheme (**Kremasta, Kastraki, Stratos-I**): 907,2 MW
 - Aliakmon r. Hydro Scheme (**Ilarion, Polyphyto, Sfikia, Assomata / Agras, Edessaïos**): 1020,0 MW
 - Arachthos r. Hydro Scheme (**Pournari-I, Pournari-II / Aoos**): 543,6 MW
 - Nestos r. Hydro Scheme (**Thissavros-Platanovryssi**): 500 MW
 - N. Plastiras HPP (**Tavropos r.**): 129,9 MW
 - Ladon HPP (**Ladon r.**): 70 MW
 - Small HPP: 46,7 MW
- TOTAL: 3.217,4 MW**

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The planning for dealing with the flood events

- a) anti-flood protection of the river side areas,
- b) hydroelectric installations safety, and
- c) maximizing power generation.

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The anti-flood protection rendered by a dam along with the relevant reservoir is proportionate to:

1. the effective capacity of the reservoir at the time of the flood occurrence,
2. the flood magnitude which is called to control (intensity, duration and water volume)
3. the safety constrains of every single Dam.

The existence of a Dam always has a beneficial contribution, as it limits the flood discharge against the natural discharge and the respective impact at the area

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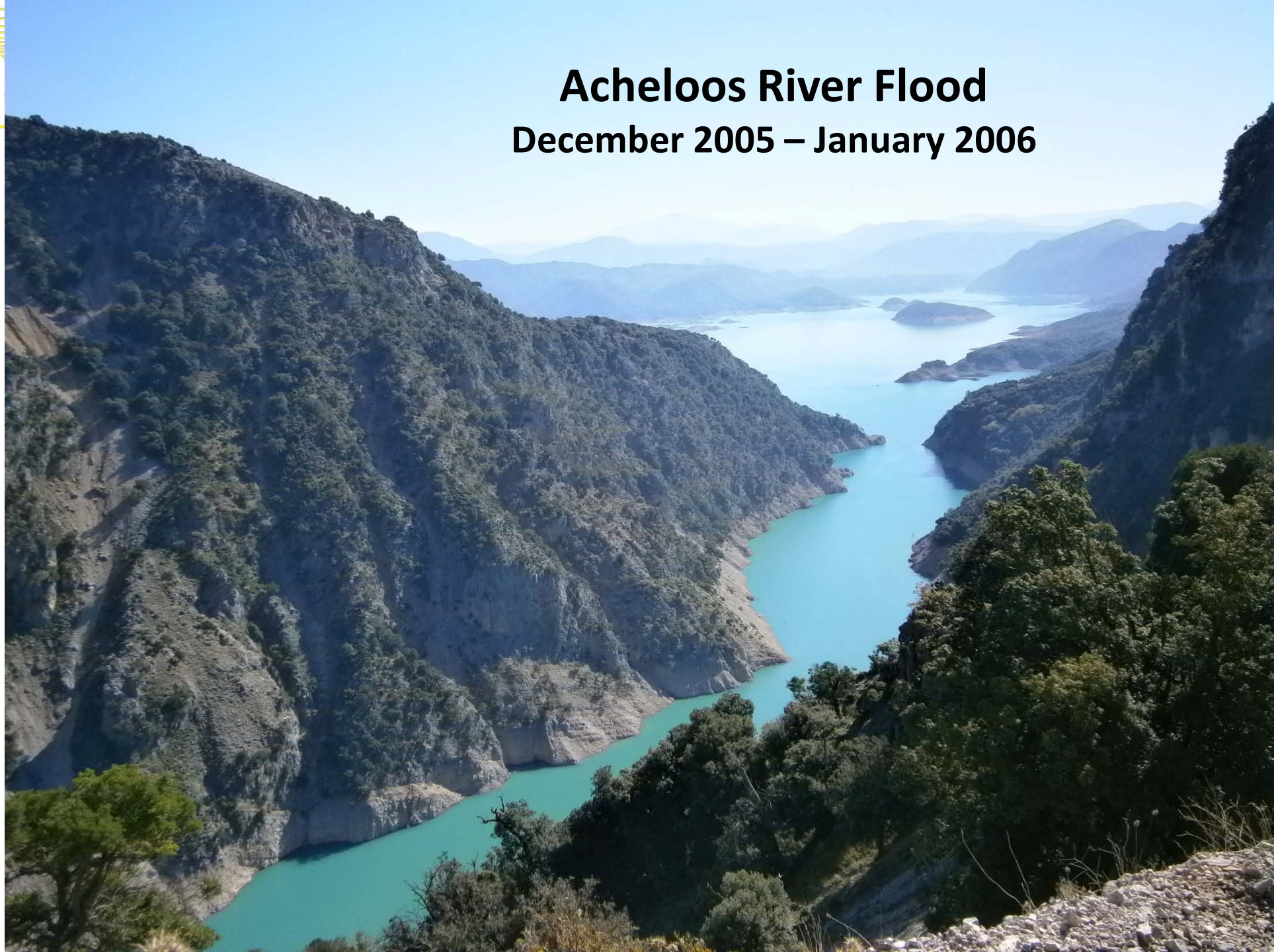
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Acheloos River Flood December 2005 – January 2006

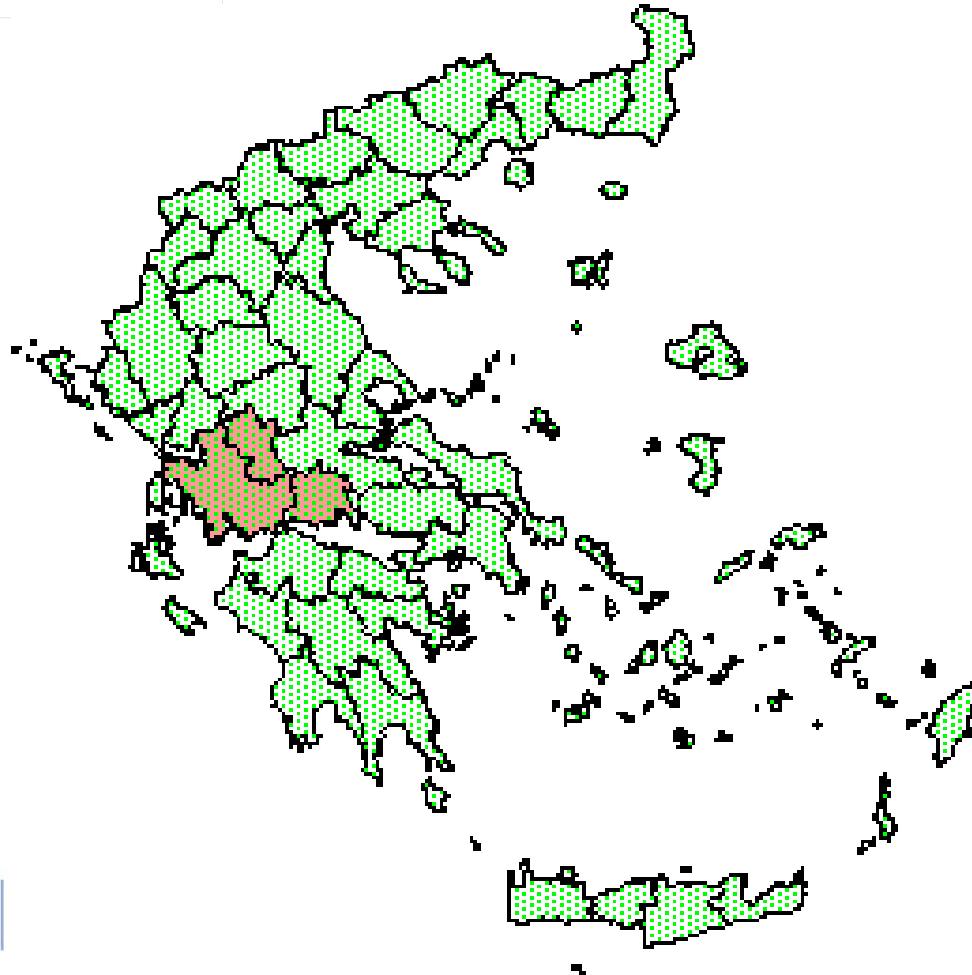


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Acheloos river Hydroelectric Scheme in Western Greece [Western Continental territory]

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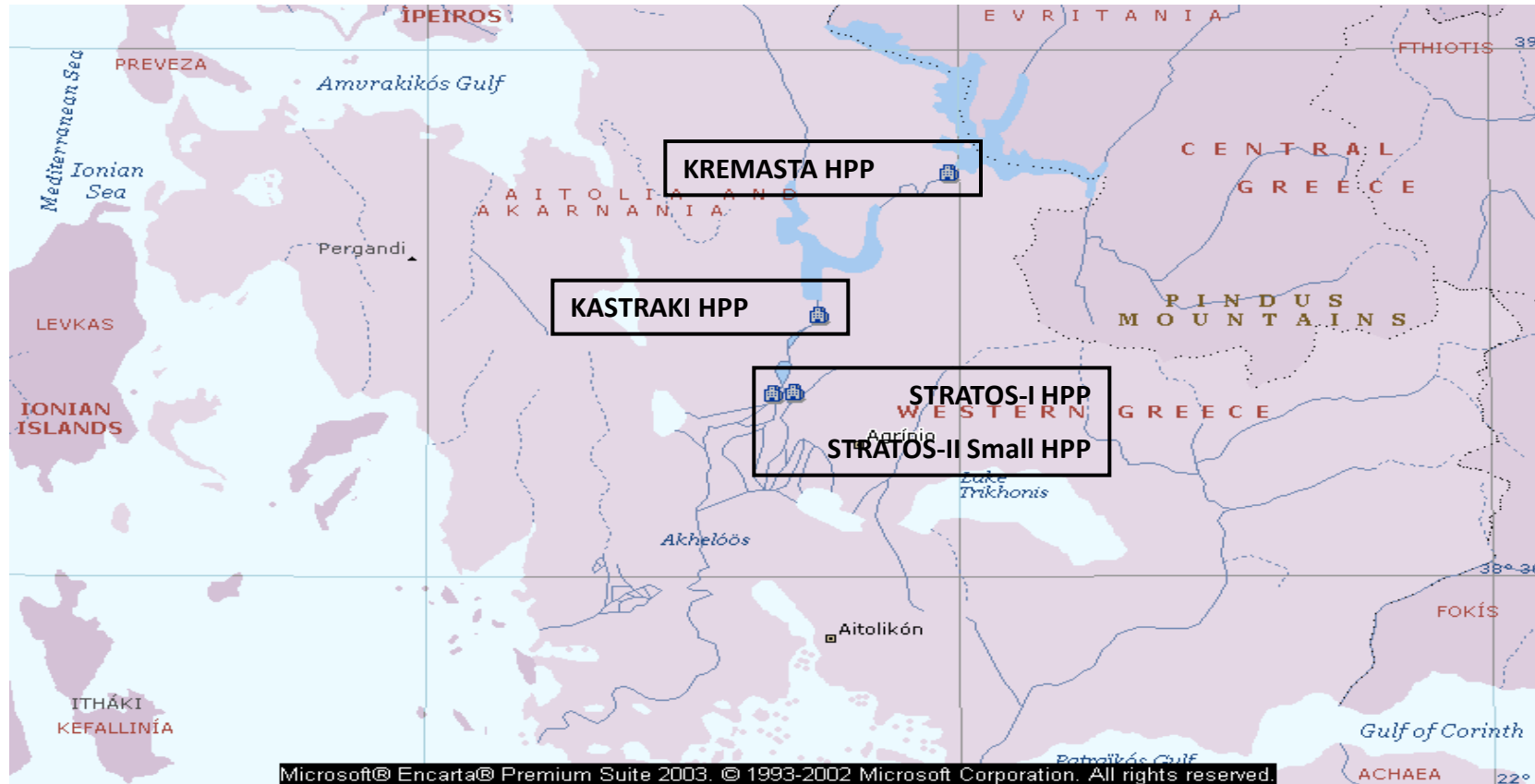
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Acheloos Hydroelectric Scheme

Total catchment basin: 5,470km²



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Acheloos Hydroelectric Scheme

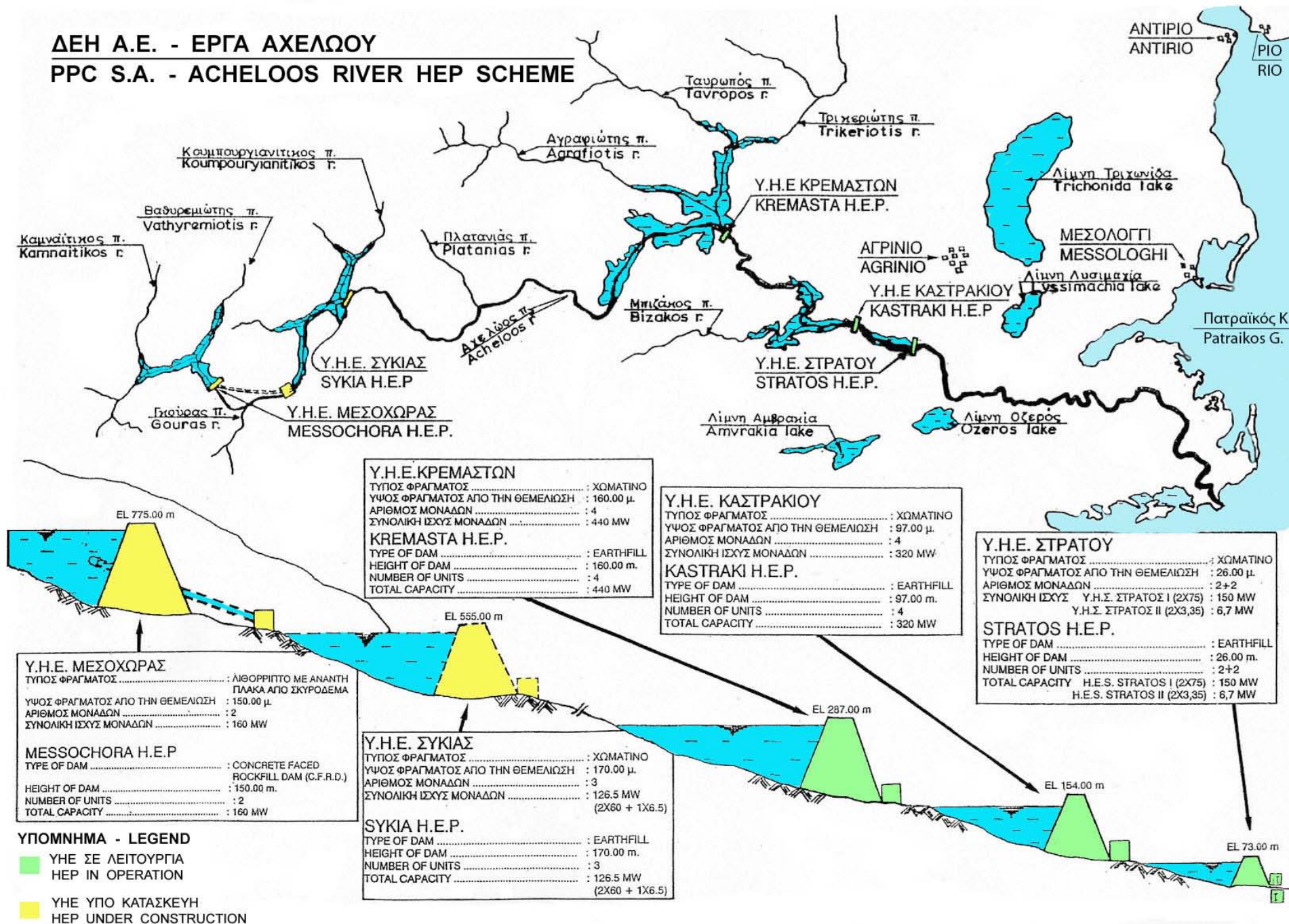
Acheloos river	Dam height (m)	Reservoir net capacity (10 ⁶ m ³)	Maximum Capacity of Spillway (m ³ /sec)
Kremasta HPP	165	3300	3000
Kastraki HPP	96	53	3700
Stratos-I HPP	26	11	4000
Stratos-II small HPP	-	-	

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Acheloos Hydroelectric Scheme

Kremasta HPP

Location: West. Cont. Greece,
Prefecture of Aetoloakarnania

Purpose: hydropower, flood control

Commercial operat.: 1966

Installed power: 437,2 MW(4x110)
Francis type turbines

Mean an. Product.: 848 GWH

Dam: earthfill, 165 m height

Reserv. net cap.: 3300 m. m³



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Acheloos Hydroelectric Scheme

Kastraki HPP

Location: West. Cont. Greece, Prefecture of Aetoloakarnania

Purpose: hydropower, irrigation, water supply

Commercial operat.: 1969

Installed power: 320 MW (4x80) Francis type turbines

Mean an. Product.: 598 GWH

Dam: earthfill, 96 m height

Reserv. net cap.: 53 m.c.m.



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Acheloos Hydroelectric Scheme

**Stratos-I HPP &
Stratos-II small HPP**

Location: West. Cont. Greece,
Prefecture of Aetoloakarnania

Purpose: hydropower, irrigation

Commercial operat.: 1989

Installed power: 150 MW Francis
type turb. 6,2 MW Tube-S type turb.

Mean an. Product.: 237 GWH

Dam: earthfill, 26 m height

Reserv. net cap.: 11 m.c.m.

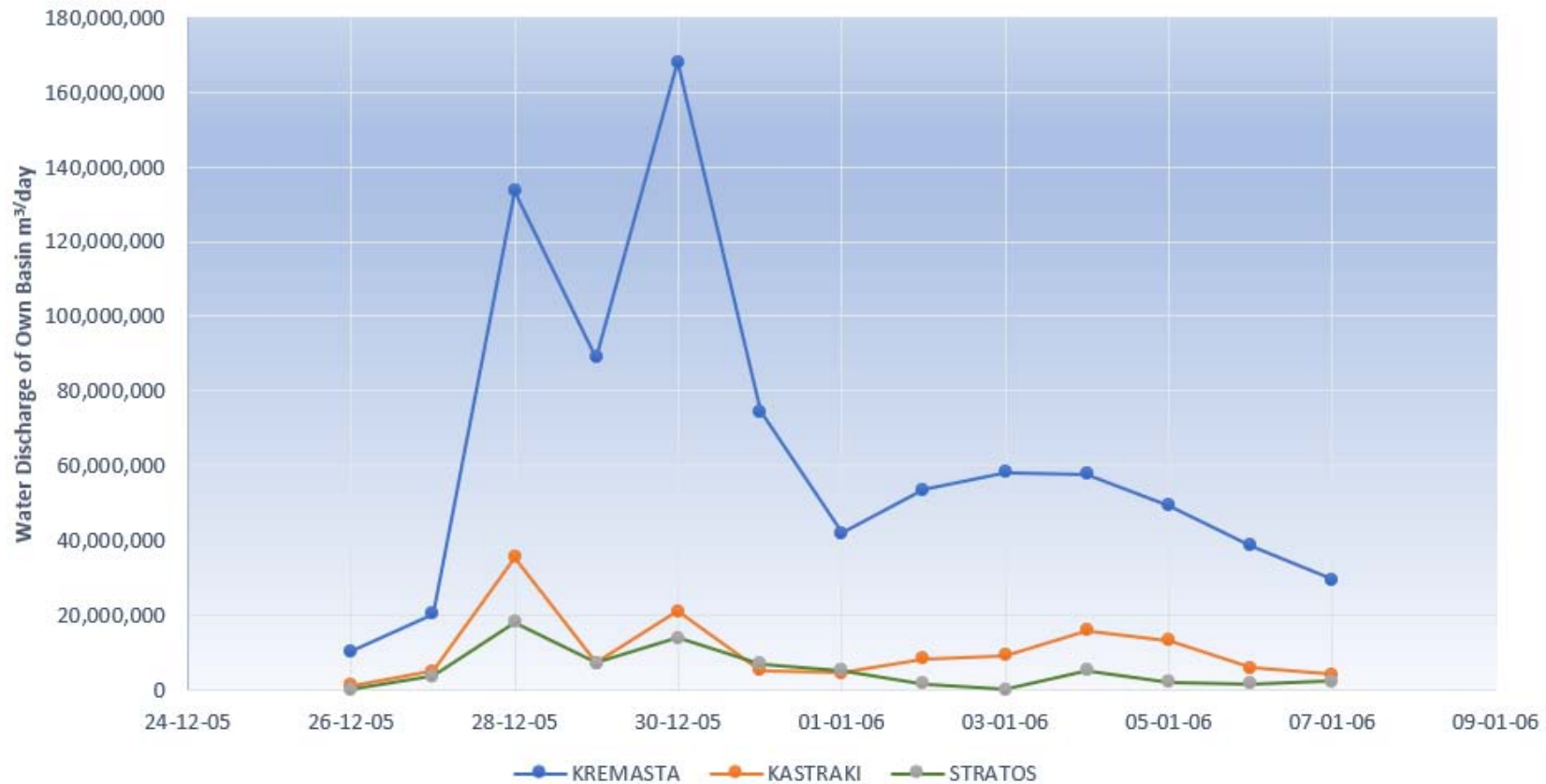


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Achelooos River System Floods 2005



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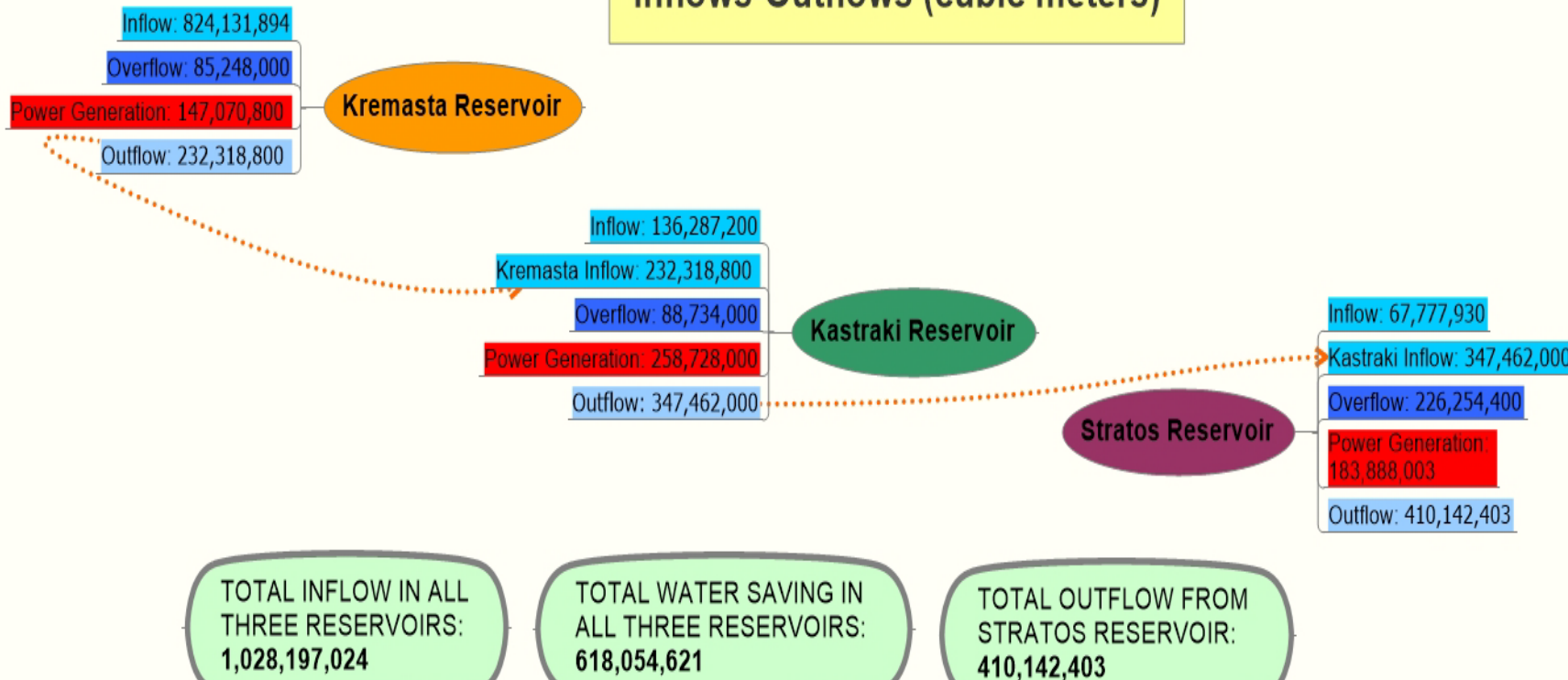


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Kremasta, Kastraki, Stratos Reservoirs Cumulative Inflows-Outflows (cubic meters)



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Kremasta Dam Spillway in operation Dec 2005



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Kastraki Dam Spillway in operation Dec 2005



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Stratos Dam Spillway in operation Dec 2005



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Arachthos River Floods December 2005 – January 2006 and January – February 2015



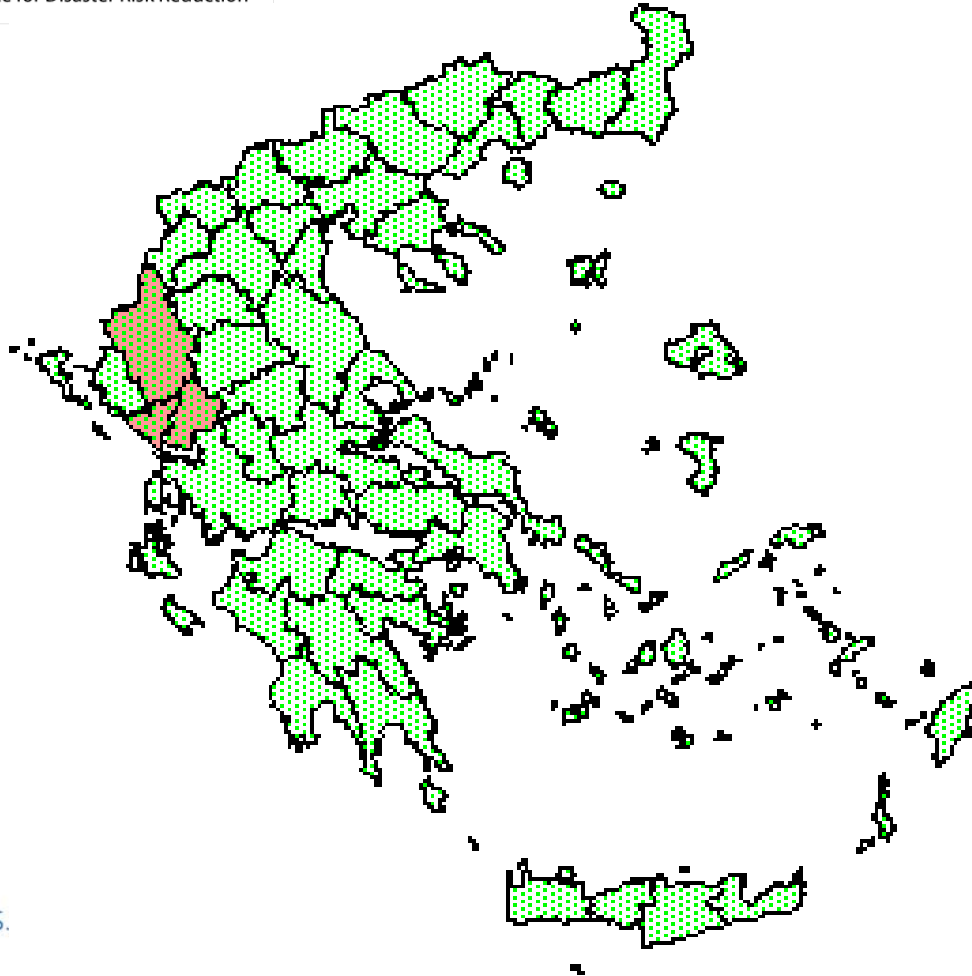
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Arachthos river Hydroelectric Scheme in Northwestern Greece [Epirus territory]

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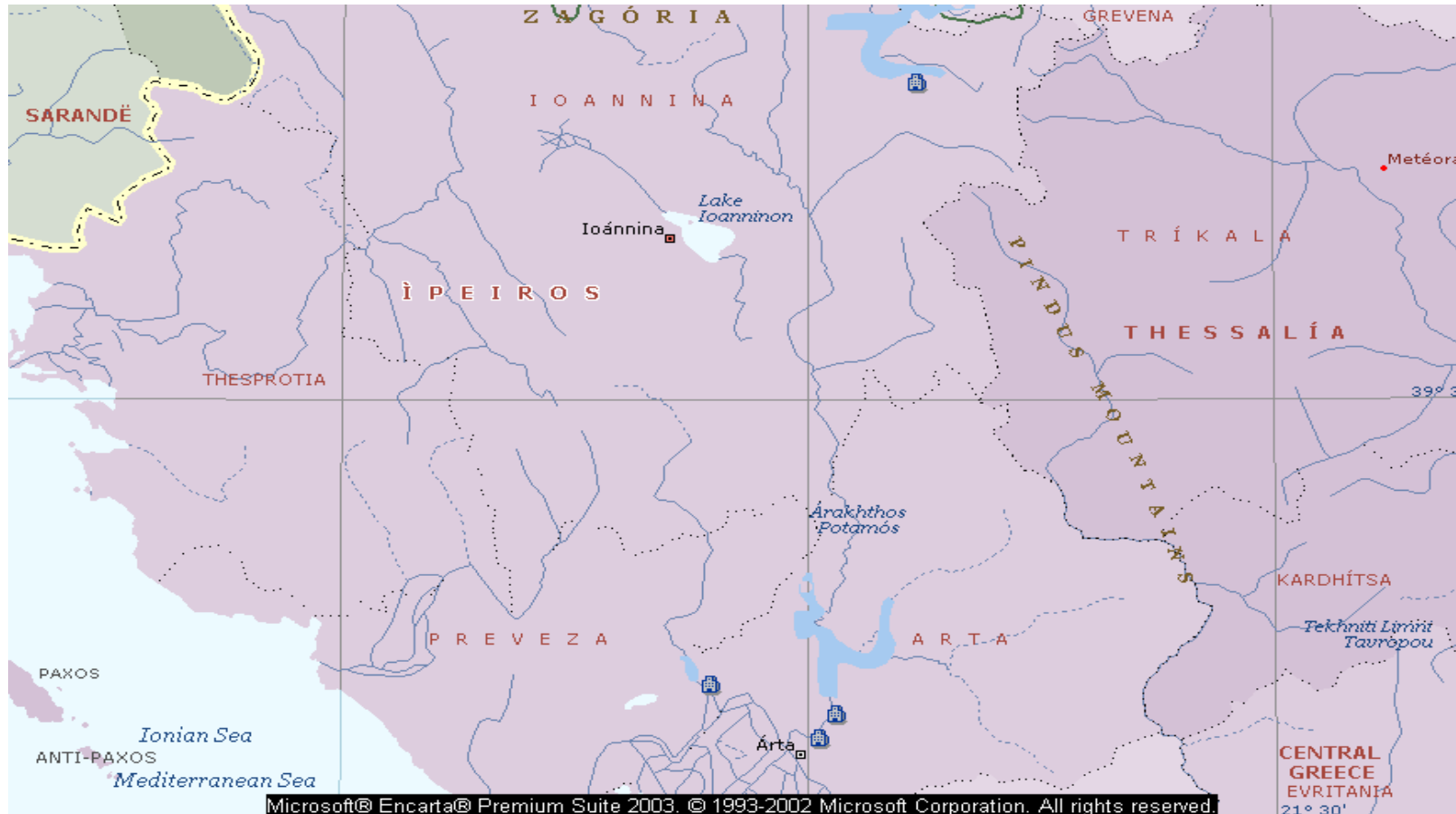
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Arachthos Hydroelectric Scheme

Total catchment basin: 1.890km²



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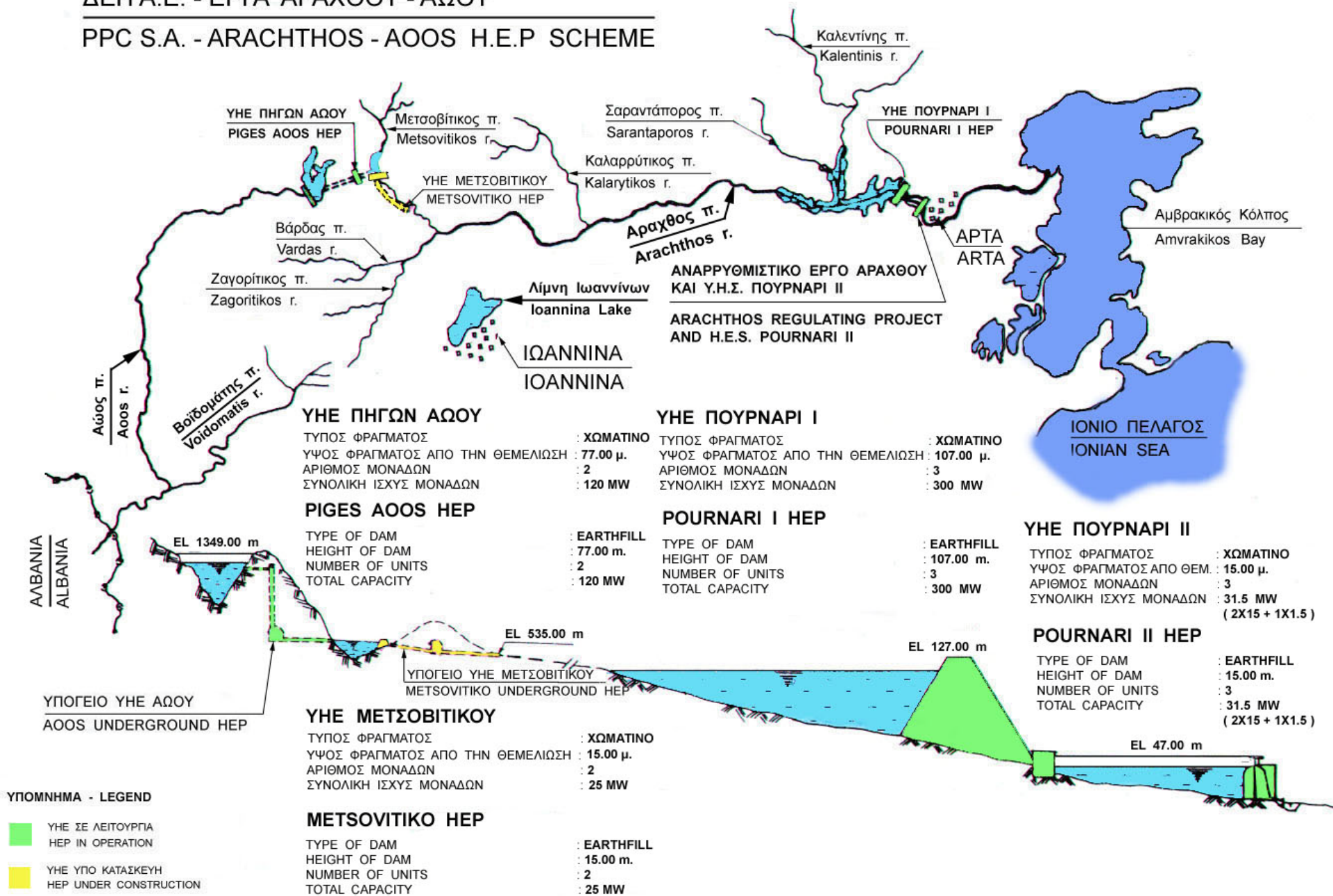
Arachthos Hydroelectric Scheme

	Dam height (m)	Res. net capacity (mi M3)	Installed Power (MW)
Springs of Aoos river			
Pighai Aoos HPP	78	144,3	210
Arachthos river			
Pournari_I HPP	87	303	300
Pournari_II HPP	15	4	33,6
Louros river			
Louros small HPP	22	0,37	10,3
TOTAL			553,9

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PPC S.A. - ARACHTHOS - AOOS H.E.P SCHEME





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Arachthos Hydroelectric Scheme

Pournari-I HPP

Location: Epirus, Prefecture of Arta

Purpose: hydropower, irrigation, flood control

Commercial operat.: 1981

Installed power: 300 MW (3x100)
Francis type turbines

Mean an. Product.: 235 GWH

Dam: earthfill, 87 m height

Reserv. net cap.: 303 m.c.m.



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Arachthos Hydroelectric Scheme

Pournari-II HPP

Location: Epirus, Prefecture of Arta

Purpose: hydropower, irrigation

Commercial operat.: 1998/9

Installed power: 33,6 MW (2x16) bulb & (1x1,6) S units

Mean an. Product.: 45 GWH

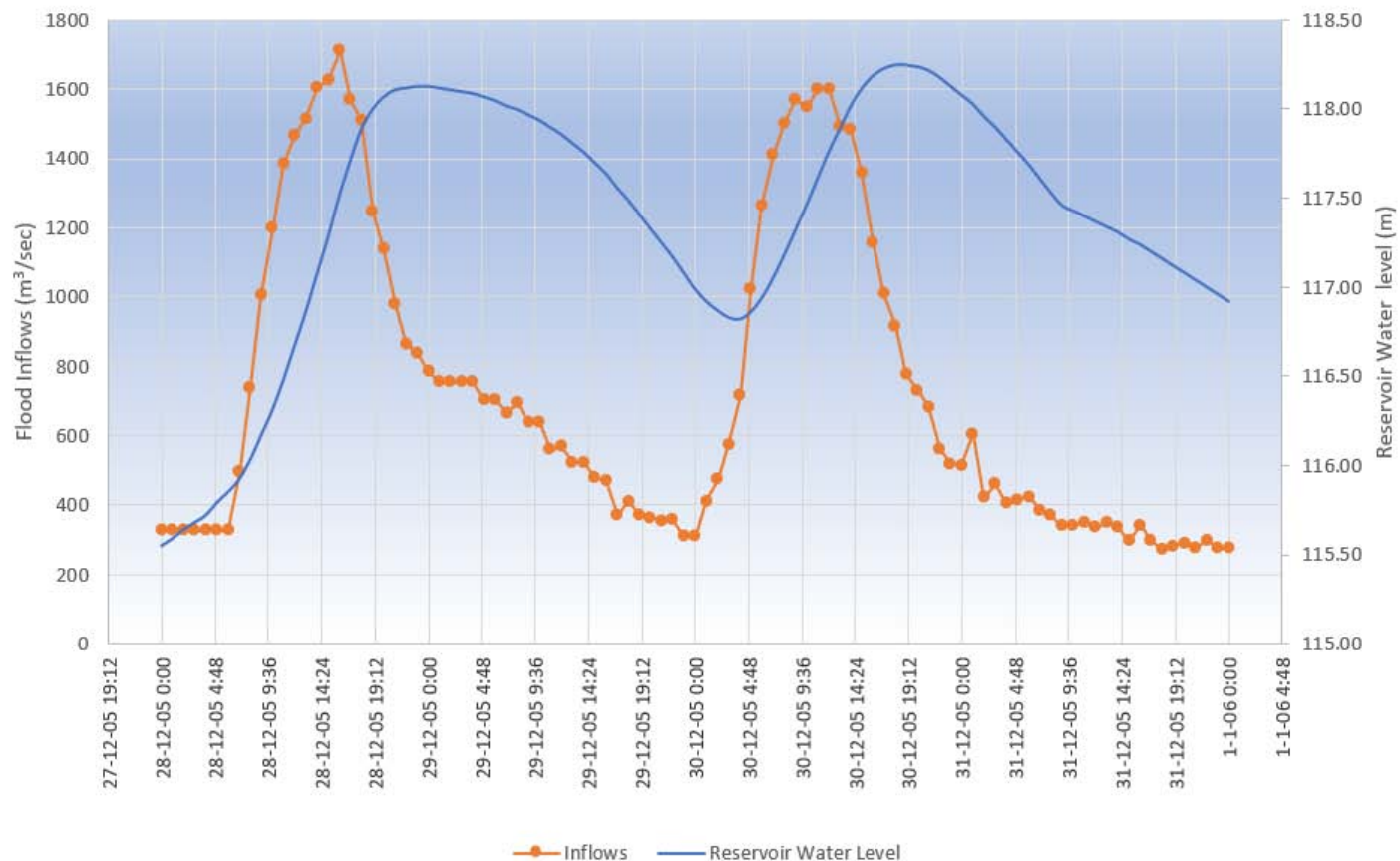
Dam: earthfill, 15 m height

Reserv. net cap.: 4 m.c.m.



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Pournari Dam Reservoir - Flood 2005 Hourly Flood Inflows



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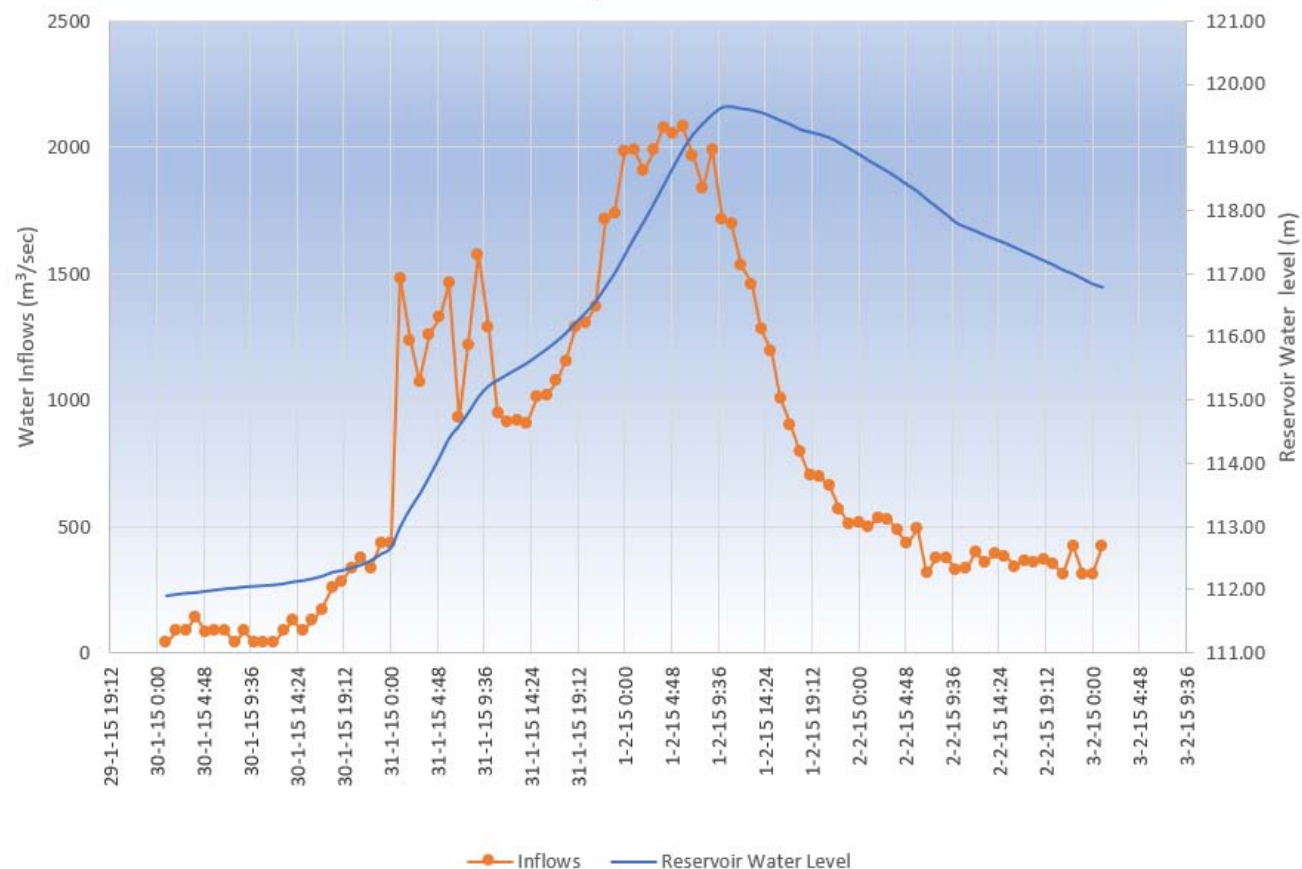




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Pournari Dam Reservoir - Flood 2015

Hourly Flood Inflows



Pournari I Dam Spillway in operation Feb 2015



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Pournari I Dam Spillway in operation Feb 2015



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Pournari II Dam Spillway in operation Feb 2015



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Arta, 02/02/2015



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Plaka Bridge, a 19th-century stone one-arch bridge located at the borders of Arta and Ioannina prefectures, over Arachthos River was the **largest single-arch bridge in the Balkans for 148 years.**



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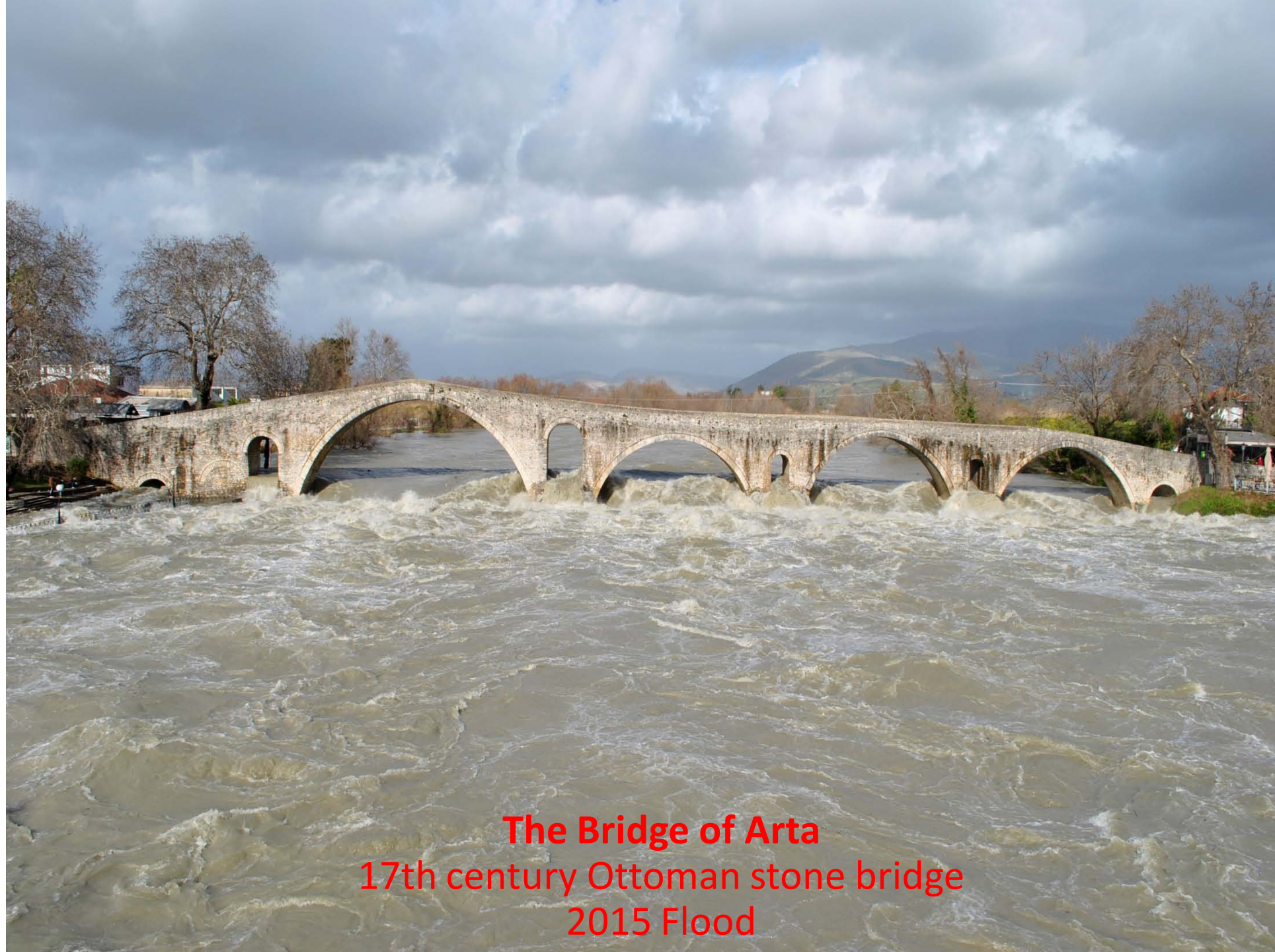


The historic bridge, which was one of the most impressive examples of Greek popular architecture, collapsed on **1 February 2015** due to Arachthos river flood.



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The Bridge of Arta
17th century Ottoman stone bridge
2015 Flood





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Comparison of 2005 και 2015 Floods in Arachthos river

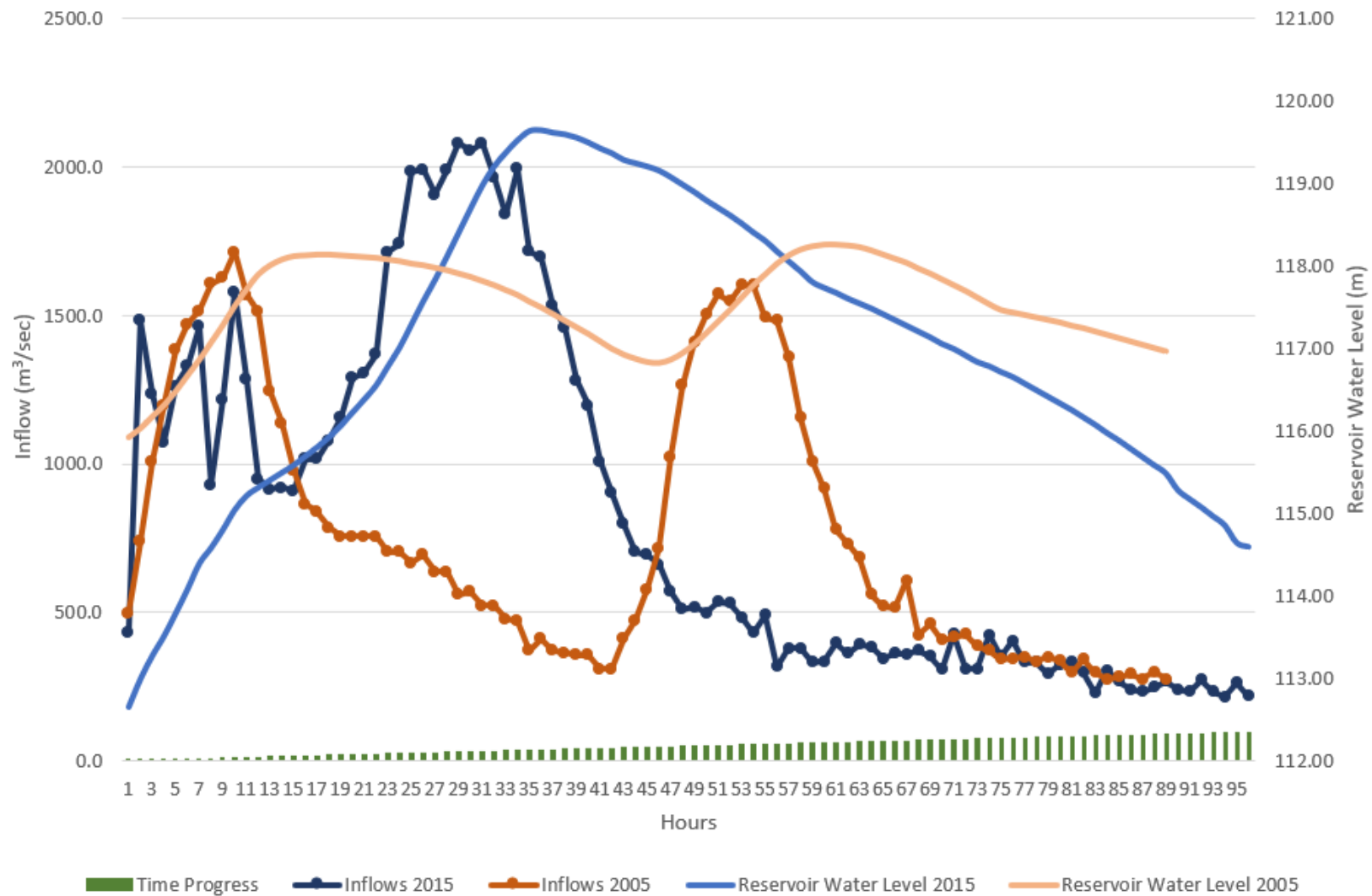
FLOOD DAY	DATE		MEAN DAILY DISCHARGE (m ³ /sec)		CUMULATIVE INFLOWS SINCE THE BEGINNING OF THE FLOOD (m ³)	
	2005	2015	2005	2015	2005	2015
1st Day	28/01/2005	31/01/2015	985,8	1260,55	85.173.500	108.911.250
2nd Day	29/01/2005	01/02/2015	543,88	1386,00	132.164.300	228.661.950
3d Day	30/01/2005	02/02/2015	1038,84	389,36	221.919.700	262.302.700

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Pournari Dam Reservoir Comparison of 2005 and 2015 Floods



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