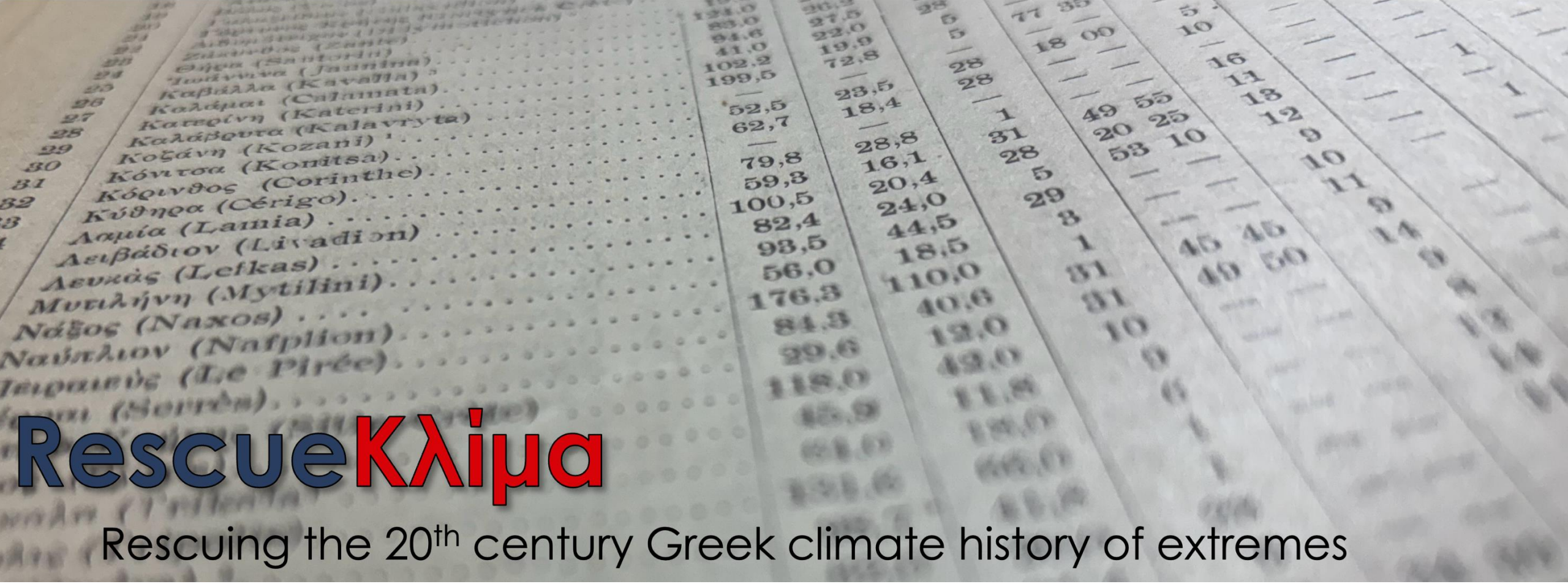


RescueΚλίμα

Rescuing the 20th century Greek climate history of extremes

S. Misios, D, Konsta, I. Fountoulakis, J. Kapsomenakis, S. Kosta, E. Tsouri, P. Nastos, M. Hatzaki, V. Amiridis, D. Founda, I. Mavropoulou, *N. Leoutsarakos, E. Kougemitrou, E. Avgerinos, M. Michelaraki, A. Marinaki,* C. Zerefos

Rome, 17 September 2026

Climate Change Service
climate.copernicus.eu

ACADEMY OF ATHENS

HELLENIC REPUBLIC
National and Kapodistrian University of Athens

HELLENIC NATIONAL METEOROLOGICAL SERVICE
ΕΘΝΙΚΗ ΜΕΤΕΩΡΟΛΟΓΙΚΗ ΥΠΗΡΕΣΙΑ

HELLENIC REPUBLIC
Ministry of Rural Development and Food

This summer in the Island of Tinos…





“ ΜΕΣΟΝ ΝΥΚΤΟΣ ΠΑΡΑΣΚΕΥΗΣ ΕΠΙΦΩΣΚΟΥΣΗΣ ΚΑΙ 30 ΝΒΡ του 1873 ΕΝΕΚΑ ΒΡΟΧΗΣ/ ΜΕΓΑΛΗΣ ΔΥΟ Η ΤΡΙΩΝ ΩΡΩΝ ΚΡΟΥΝΗΔΟΝ/ ΚΑΤΑΠΕΣΟΥΣΗΣ ΚΑΙ ΠΟΛΛΟΥΣ ΤΩΝ ΑΓΡΩΝ/ ΜΕΤΑ ΔΥΟ ΟΙΚΙΩΝ ΠΑΡΑΣΥΡΑΣΗΣ/ ΑΝΗΛΘΕΝ ΕΩΣ ΩΔΕ ΤΟΥ ΠΟΤΑΜΟΥ ΤΟ ΡΕΥΜΑ”

In the middle of the night, Friday is dawning, of 30 November 1873 because of torrential rain for 2 or 3 hours, two houses collapsed, the stream raised up to this point



The history of meteorological observations in Greece

Island of Corfu
1805-1811, …, 1869-1875

Island of Zante
1826-1861

Chios, Patras, Chania etc.

NOA historical stations
See Dimitra's talk

Traveler journeys
sporadic, in books

Shiplogs
Unexplored

NOA historical stations
about 20-80 stations, stops in 1931

Hellenic National Meteorological Service
Starts in 1932, still operates many historical stations

Athens water company
Local to Marathonas region, one monthly record from 1900, daily???, daily obs from 1926 in 15 sites, many still measuring

Ministry of of Rural development
Started in the end of 1920's, mainly high altitude, 392 stations

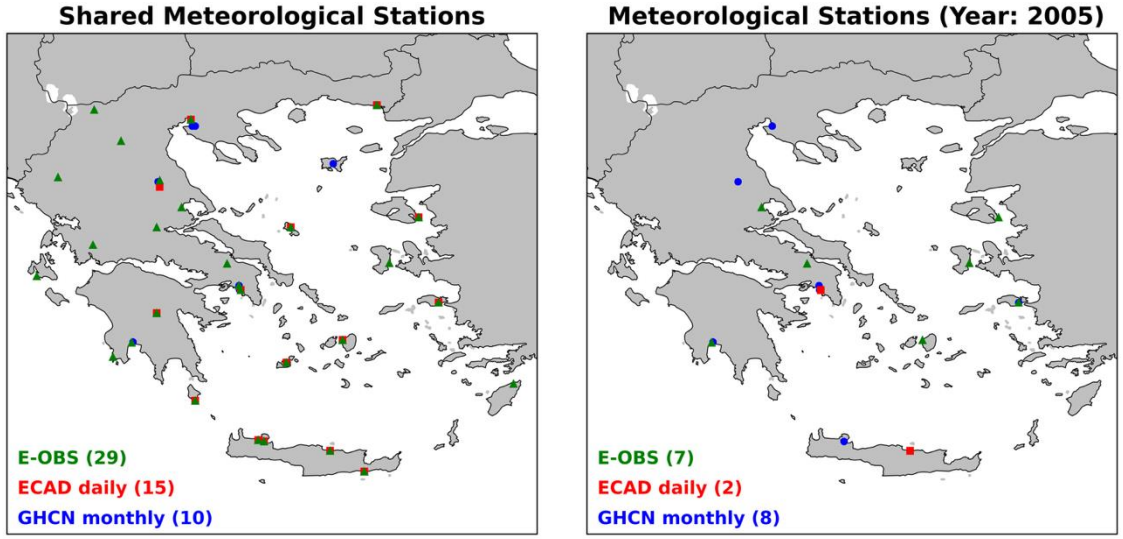
Public Electric Company
Starting in the 1950s

HNMS
Public Electric Comp.
NOA modern network

19th Century **20th Century** **21th Century**

Lack of obs. increases uncertainties over Greece

Greek stations in EOBS, GHCN, ECA&D



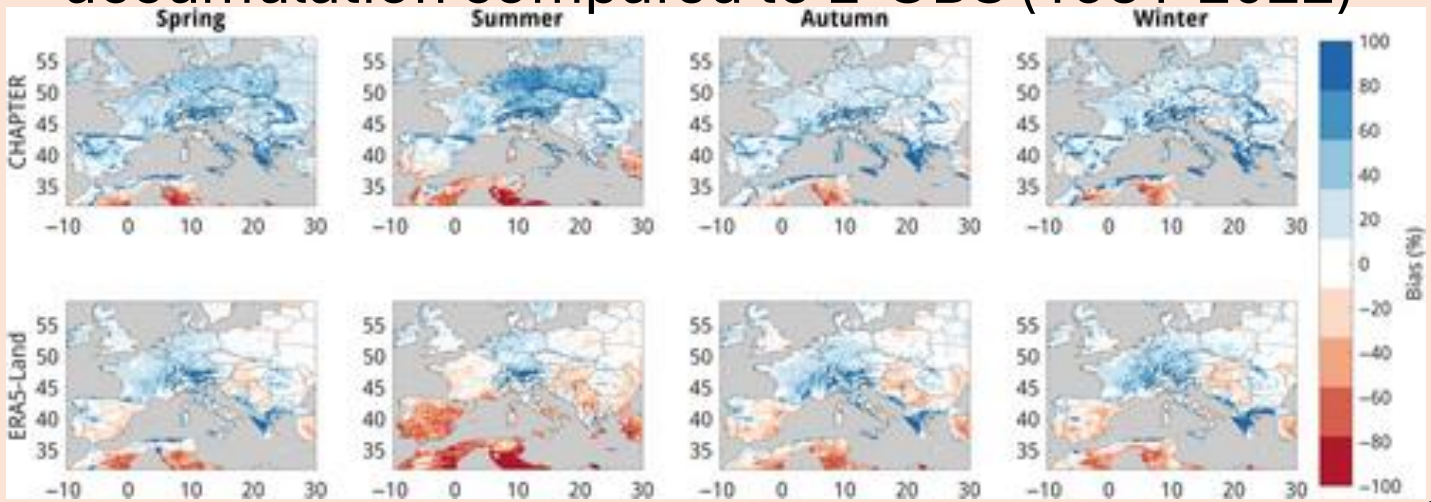
29 stations are included
Data spans from 1892 (Thessaloniki) to 2024 (e.g. Mitilini).
After 2004, 7 stations only (Samos Airport, Anchialos, Chios, Mitilini, Naxos, Kalamata, Tanagra) for temperature. Quality checks.

High errors over Greece in precipitating months.

This might be explained by the lack of dense stations and termination of data after 2004

Bernini et al., 2025

Percentage bias of the daily precipitation accumulation compared to E-OBS (1981-2022)



RescueΚλίμα The project

Climate Change Service
climate.copernicus.eu

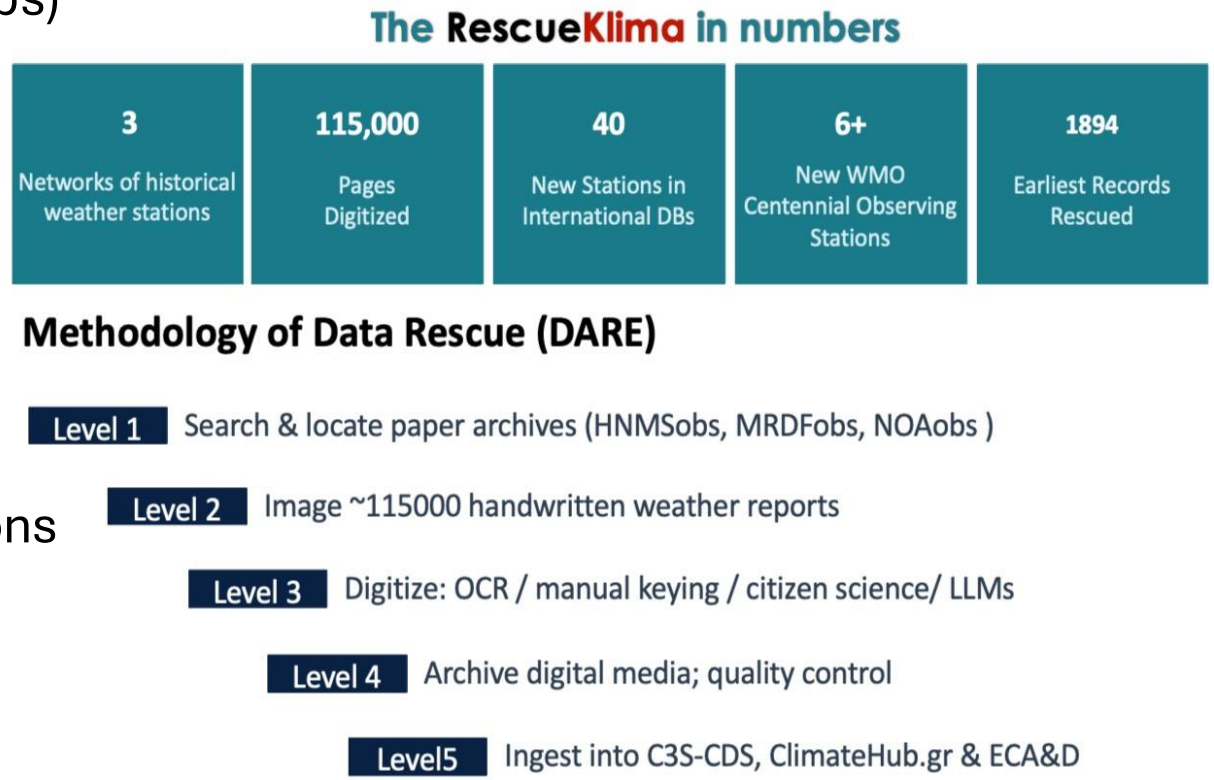
RescueΚλίμα is responding to the national request for actionable climate information by digitizing late-19th and early-20th century weather stations and verifying post-1950 weather observations, thus significantly enhancing the number, quality, availability and access of national historical climate data.

RescueΚλίμα will handle, digitize, homogenize, and archive weather reports from:

- Hellenic National Meteorological Service (HNMSobs)
- Ministry of Rural development and Food (MRDFobs)
- National Observatory of Athens (NOAobs)

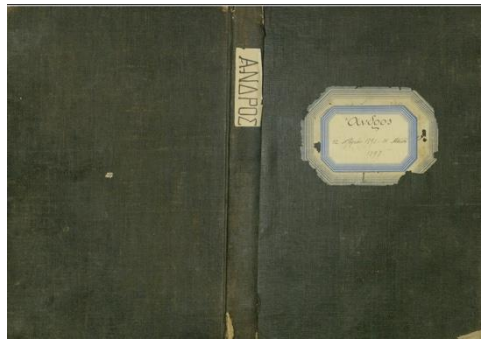
The overall objective of **RescueΚλίμα** is

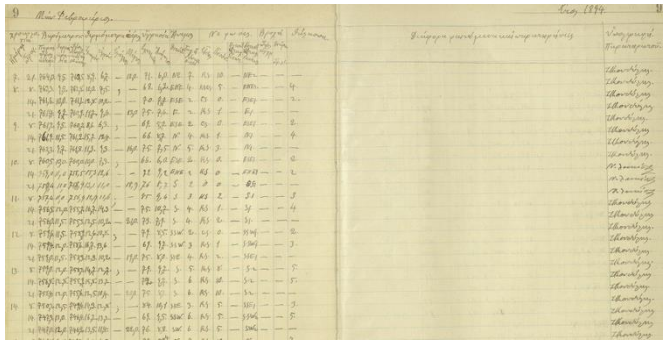
- to advance national efforts to rescue weather observations dating back to 1894
- to produce quality-verified centennial in-situ observations
- to increase the number of WMO-registered stations in international databases
- to support societal adaptation to climate change



The weather observations: DARE level 1

National Observatory of Athens (NOAobs)



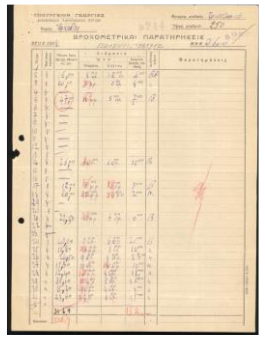


See Dimitra's talk.
Mostly digitized. DARE level 3 and 4
We are using ~6 stations.

Ministry of Rural development and Food (MRDFobs)

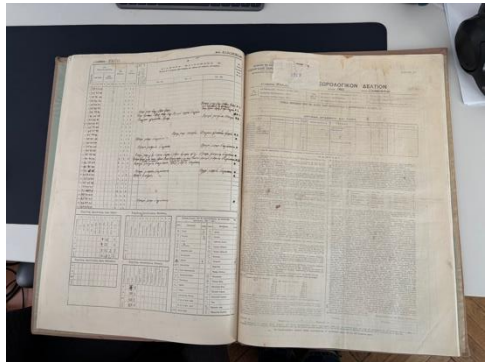






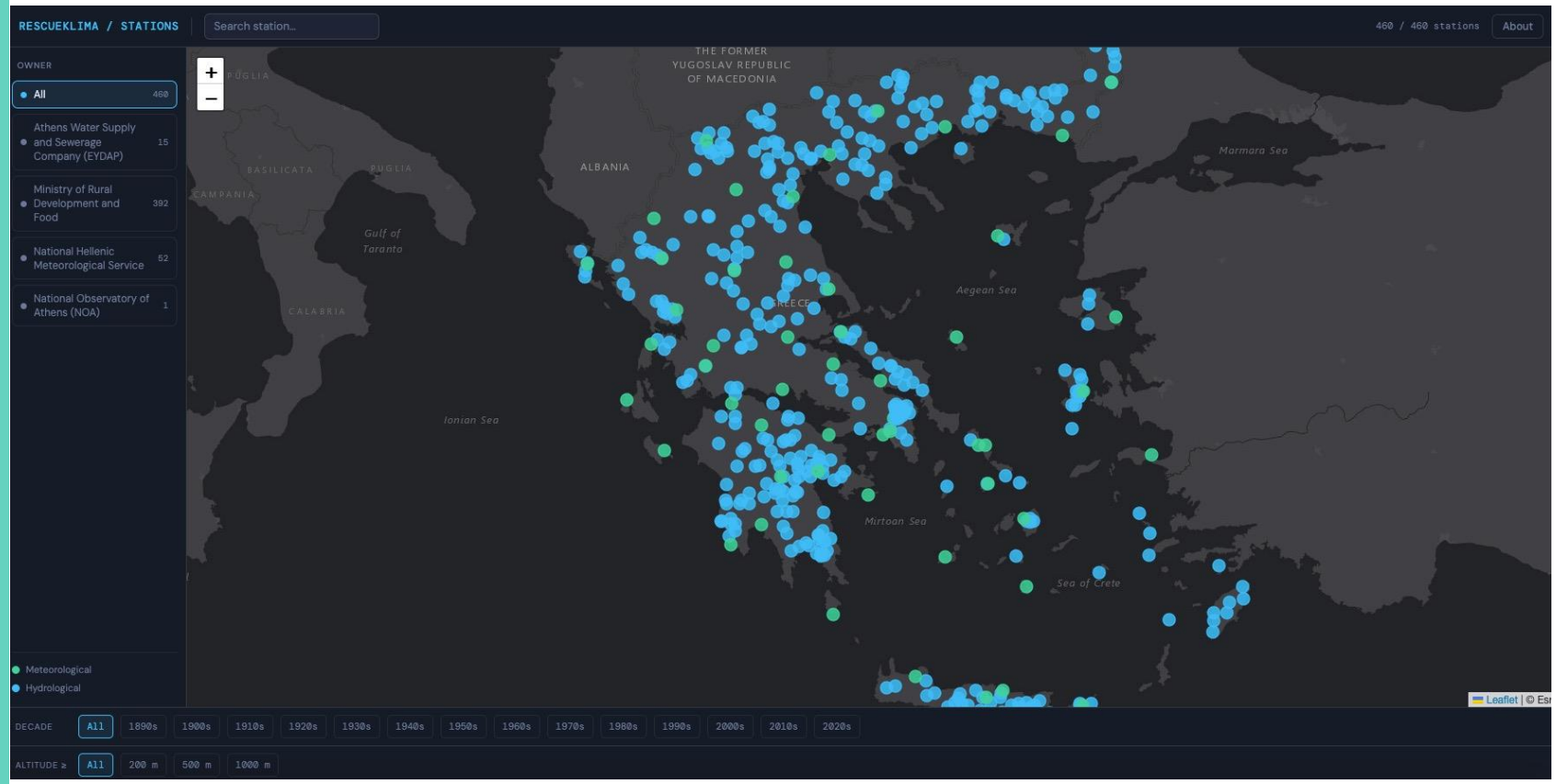
Monthly sums are digitized.
Daily reports at DARE level 1.

Hellenic National Meteorological Service (HNMSobs)



Monthly and dailies are digitized back to 1955.
Monthly summaries are digitized over 1932-1955.
Daily and sub-daily reports at DARE level 1.
We will merge NOAobs and HNMSobs for centennial time series

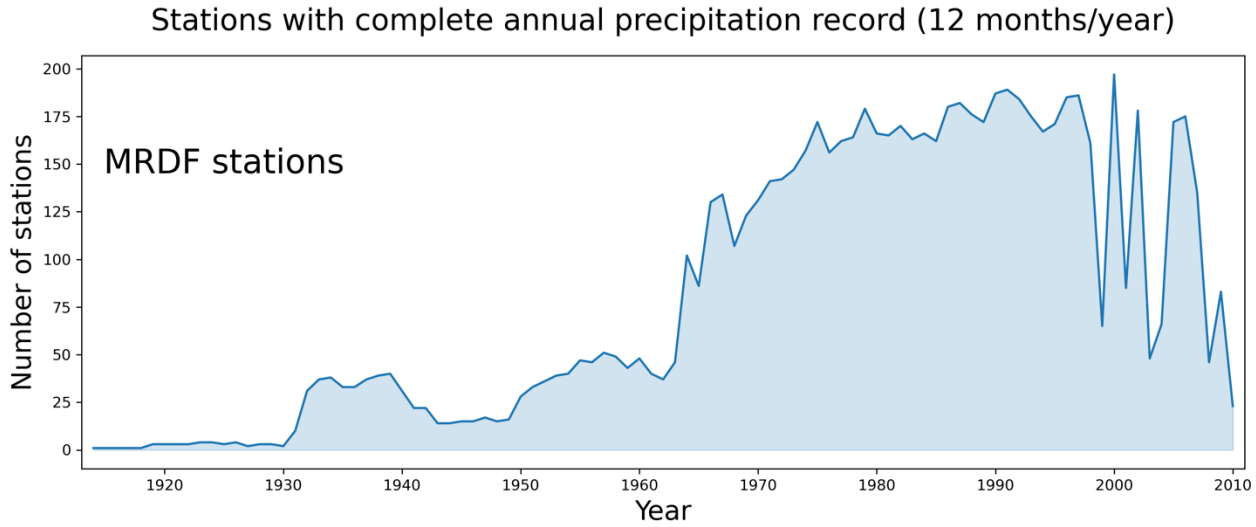
A database to ease digitization

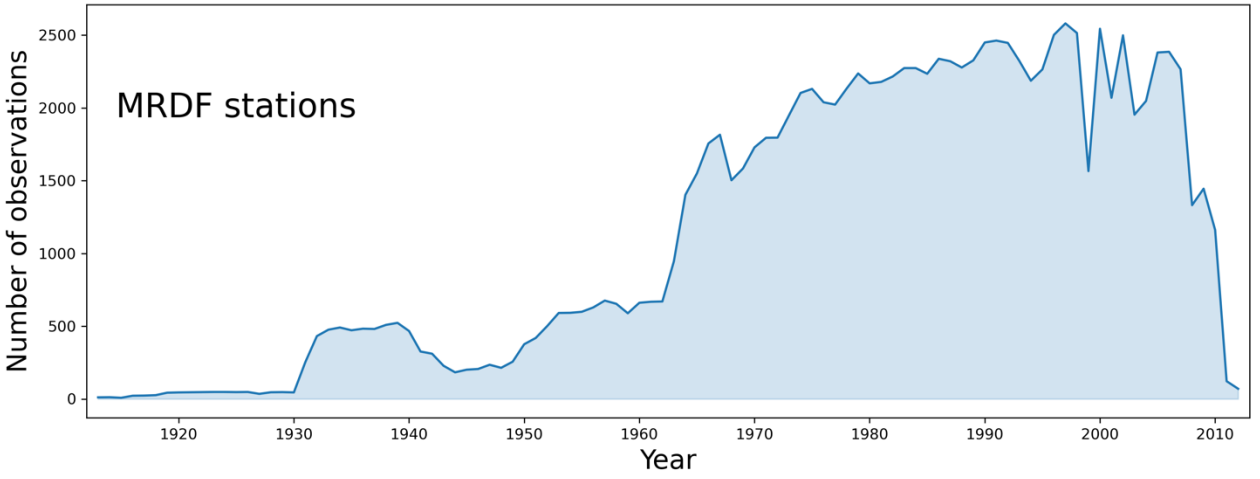


Metadata:
Station_id
Latitude
Longitude
Elevation
Period_of_operation
WMO_id
Owner
Variables
Scanned reports

Includes information from 460 stations.
Selection according to decade, altitude, provider, type.
Will provide accounts on the imaging processes.
Helps to prioritize our work by identifying important stations.

The MRDFobs record









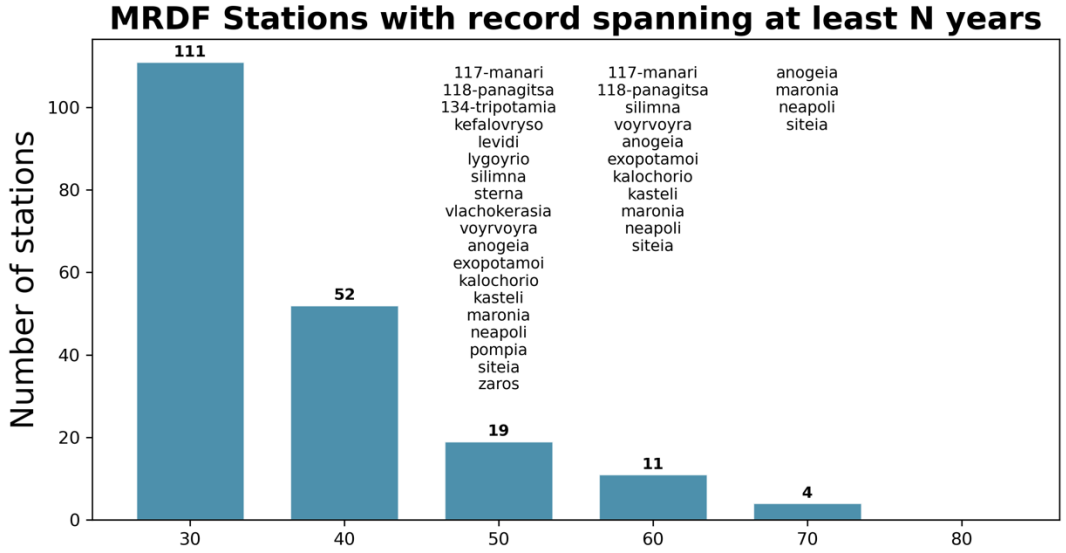
392 stations

4 stations with 70 years

29040 daily reports if digitize all stations with 40 years

50280 reports with 30 years

In 2010 it was terminated. Not all stations. Many continue to operate.



The MRDFobs stations

Μουζάκι-Καρδίτσα

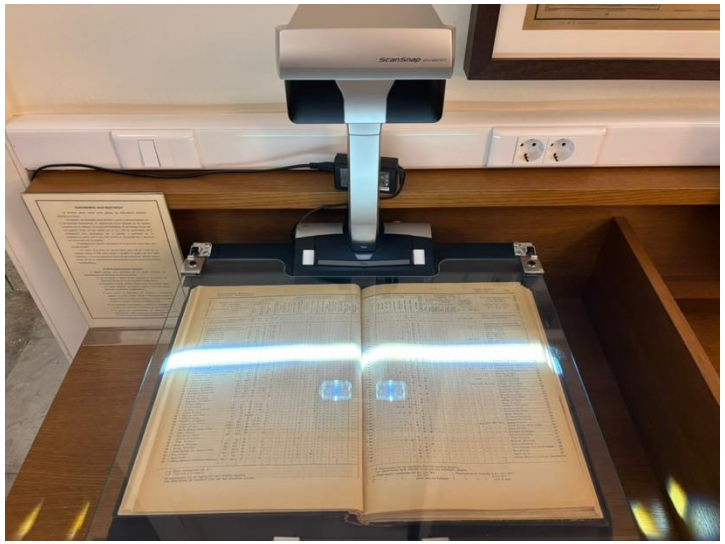


Λιόπρασο-Τρίκαλα



Imaging weather reports: DARE level 2

Fujitsu ScanSnap SV600





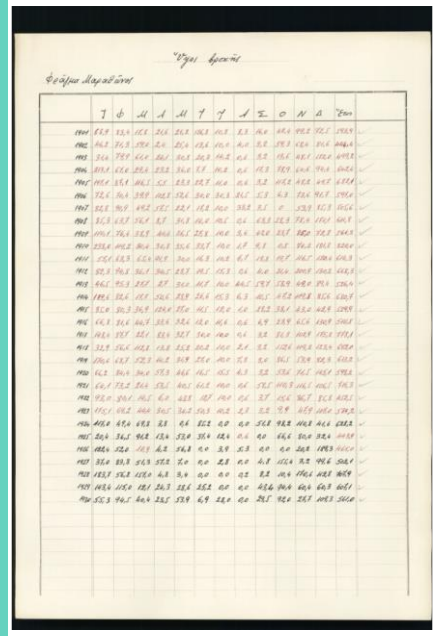
In our plans!



We are using book scanners and table scanners
Students are imaging the reports. Now 3 students are involved in scanning MRDFobs
The MRDFobs might be completed in 4 months full time work.

Next month we are starting digitization of HNMSobs. Different methodology using DSLR.

Transcribing weather reports: DARE level 3



The Vision Layer

olmOCR 2

Gemma 4

Chandra OCR 2

Claude

Gemini 2.5 Flash

HUGGING FACE

MeteoSaver v1.0

Transcription 1

Transcription 2

Transcription 3

Time series

Mac or desktop with GPU



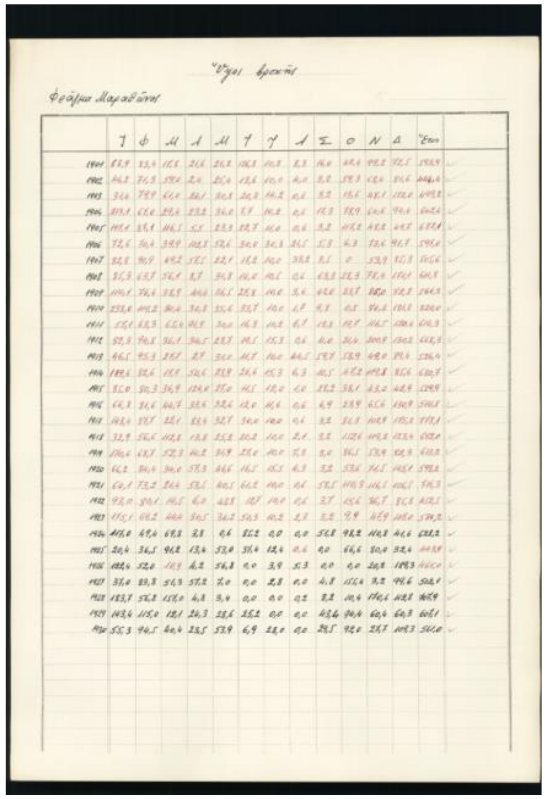
HPC



Google academic research awards

- We transcribe using three models
- Transcriptions are compared for matching
- If 2 out of three agree we keep the record. Else flagged for human check.
- Time series will quality controlled (DARE level 4).

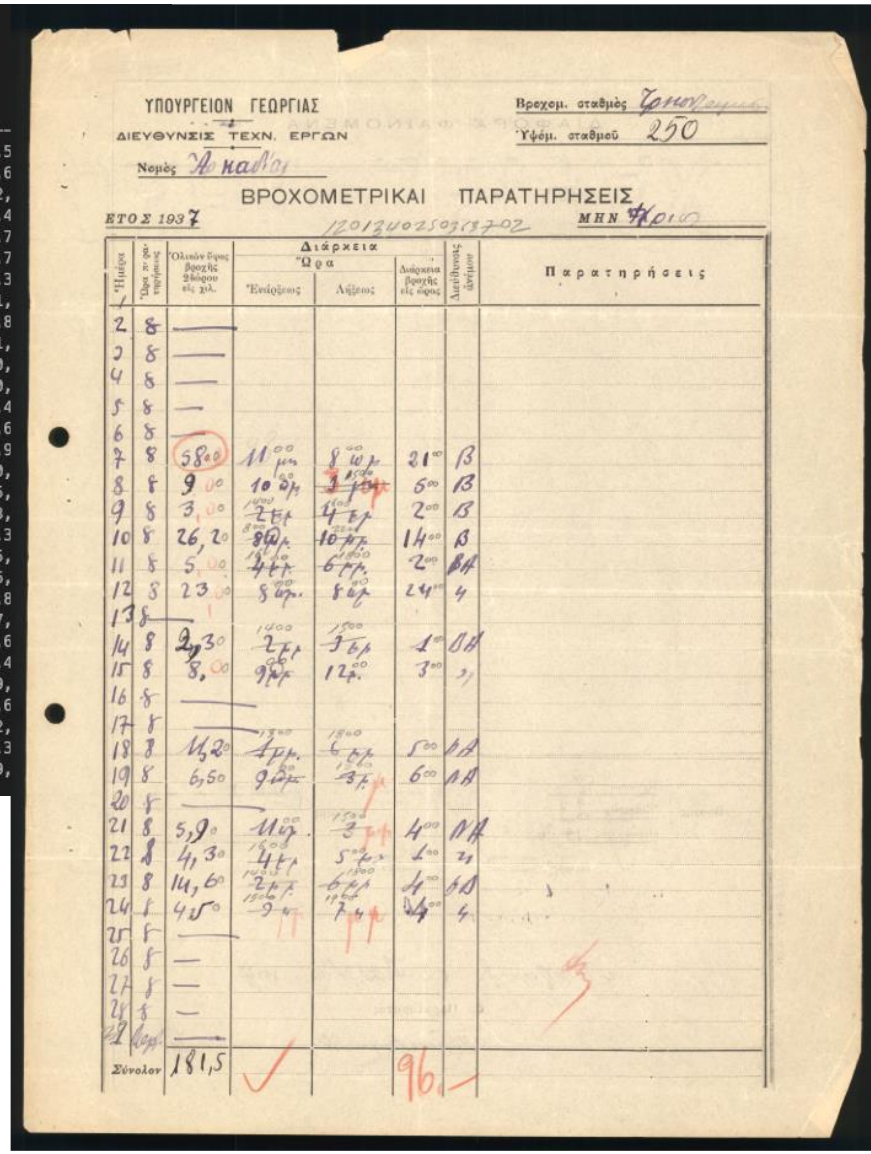
Transcribing weather reports



Ύψος βροχής

Φαινόμενα Μαραθώνος

	T	φ	M	A	M	T	Y	A	Σ	O	N	Δ
1901	68,9	83,4	17,8	21,6	26,2	126,8	10,8	8,3	16,0	42,4	99,2	72,5
1902	46,2	71,3	59,0	2,4	25,4	13,6	10,0	4,0	3,2	59,3	68,4	81,6
1903	31,4	79,9	61,0	24,1	30,8	20,3	14,2	0,6	3,2	13,6	48,1	172,
1904	213,1	67,0	29,4	23,2	36,0	7,7	10,2	0,6	17,3	78,9	64,6	94,4
1905	197,1	87,1	116,5	5,5	23,3	22,7	11,0	0,6	3,2	117,2	48,2	49,7
1906	72,6	70,4	39,9	102,8	52,6	30,0	30,3	21,5	5,3	6,3	73,6	91,7
1907	82,8	90,9	49,2	57,5	22,1	17,2	10,0	33,2	3,5	0	53,9	85,3
1908	85,3	63,7	56,1	8,7	31,8	14,0	10,5	0,6	63,3	28,3	78,4	171,
1909	110,1	76,4	38,9	44,4	26,5	27,8	10,0	3,6	42,0	23,7	85,0	72,8
1910	238,0	119,2	84,4	30,8	35,6	33,7	10,0	1,7	9,8	0,8	74,2	181,
1911	55,1	63,3	65,4	91,9	30,0	16,3	10,2	6,7	18,8	19,7	116,5	120,
1912	82,3	94,8	36,1	34,5	28,7	19,5	15,3	0,6	4,0	21,4	200,9	130,
1913	46,5	95,3	27,7	2,7	31,0	11,7	10,0	44,5	59,7	58,9	49,0	89,4
1914	189,6	82,6	17,7	50,6	28,9	26,6	15,3	6,3	10,5	47,2	119,8	85,6
1915	85,0	80,3	36,9	124,0	27,0	11,5	12,0	1,0	28,2	38,1	43,0	42,9
1916	66,8	81,6	44,7	33,6	32,6	12,0	11,6	0,6	6,9	23,9	65,6	130,
1917	148,4	87,7	22,1	83,4	32,7	30,0	10,0	0,6	3,2	81,3	102,9	175,
1918	32,9	56,6	112,8	13,8	25,2	20,2	10,0	2,1	3,2	152,6	119,2	123,
1919	170,6	68,7	52,3	14,2	31,9	27,0	10,0	7,8	8,0	86,5	53,9	82,3
1920	66,2	84,4	34,0	57,3	46,6	16,5	15,5	4,3	3,2	53,6	71,5	145,
1921	64,1	73,2	21,4	53,5	40,5	61,2	10,0	0,6	58,5	110,3	116,5	106,
1922	93,0	80,1	14,5	6,0	43,8	12,7	10,0	0,6	3,7	15,6	86,7	85,8
1923	175,1	69,2	44,4	30,5	34,2	50,3	10,2	2,3	3,2	9,9	47,9	107,
1924	117,0	49,4	69,8	3,8	0,6	85,2	0,0	0,0	51,8	98,2	110,8	41,6
1925	20,4	36,5	91,2	13,4	53,0	37,4	12,4	0,6	0,0	66,6	80,0	32,4
1926	122,4	52,0	10,9	4,2	56,8	0,0	3,9	5,3	0,0	0,0	20,2	189,
1927	37,0	83,8	51,3	57,2	7,0	0,0	2,8	0,0	4,8	155,4	3,2	99,6
1928	183,7	56,8	157,0	4,8	3,4	0,0	0,0	0,2	8,2	10,4	170,6	112,
1929	143,4	115,0	12,1	24,3	28,6	25,2	0,0	0,0	43,4	94,4	60,4	60,3
1930	55,3	94,5	40,4	23,5	53,9	6,9	28,0	0,0	29,5	92,0	27,7	109,



ΥΠΟΥΡΓΕΙΟΝ ΓΕΩΡΓΙΑΣ

ΔΙΕΥΘΥΝΣΙΣ ΤΕΧΝ. ΕΡΓΩΝ

Νομός Αττικής

Βρεχομ. σταθμός Ζαππείον

Υψόμ. σταθμού 250

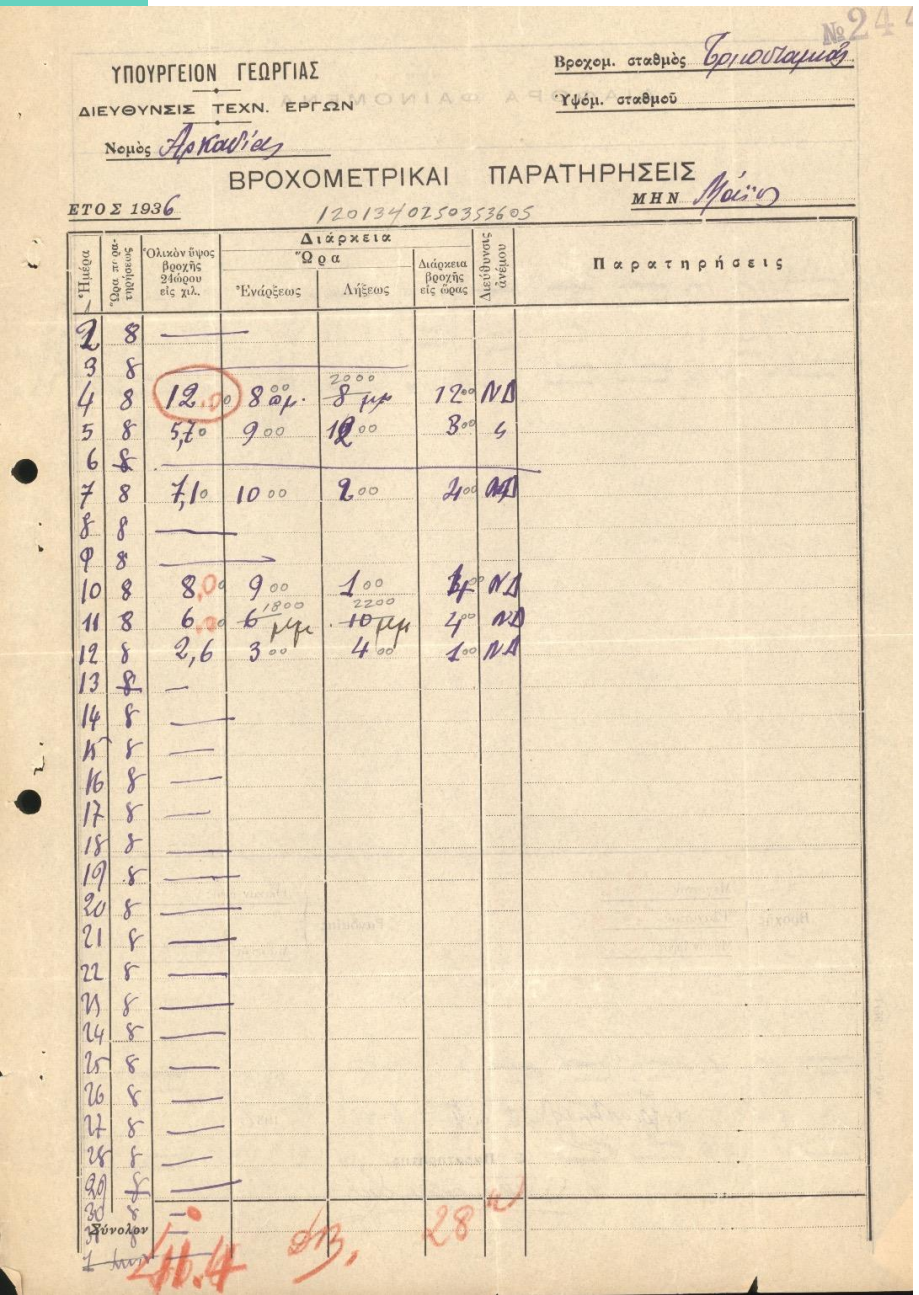
ΒΡΟΧΟΜΕΤΡΙΚΑΙ ΠΑΡΑΤΗΡΗΣΕΙΣ

ΕΤΟΣ 1937 ΜΗΝ Νοέμ

Ημέρα του μηνός	Ύψος ατμοσφαιρικών κατακρημνισμάτων εις χιλ.	Διάρκεια Ώρα Ενάρξεως	Διάρκεια Ώρα Λήξεως	Διάρκεια βροχής εις ώρας	Διεύθυνσις άνεμου	Παρατηρήσεις
1						
2	8					
3	8					
4	8					
5	8					
6	8					
7	8	5	11	21	Β	
8	8	9	10	5	Β	
9	8	3	4	2	Β	
10	8	26,2	8	14	Β	
11	8	5	6	2	ΒΑ	
12	8	23	8	24	Α	
13	8					
14	8	2,3	2	1	ΒΑ	
15	8	8,	9	3	Α	
16	8					
17	8					
18	8	14,2	4	5	ΒΑ	
19	8	6,50	9	6	ΒΑ	
20	8					
21	8	5,9	11	4	ΝΑ	
22	8	4,3	4	1	Α	
23	8	14,6	2	4	ΑΒ	
24	8	4,5	9	4	Α	
25	8					
26	8					
27	8					
28	8					
29	Καμ					
Σύνολον	181,5			96		

We get excellent transcription with well-written text. Needs to be qualified....
We will compare Chandra2 and Gemini-flash and Meteosaver.
Not so good with bad hand-writing or corrections or text with multiple marks.
Models do not understand symbols.

Transcribing weather reports



ΥΠΟΥΡΓΕΙΟΝ ΓΕΩΡΓΙΑΣ

ΔΙΕΥΘΥΝΣΙΣ ΤΕΧΝ. ΕΡΓΩΝ

Νομὸς Ἀρκαδίας

Βροχομ. σταθμὸς Τριποταμιά

Ὑψόμ. σταθμοῦ

№ 244

ΒΡΟΧΟΜΕΤΡΙΚΑΙ ΠΑΡΑΤΗΡΗΣΕΙΣ

ΕΤΟΣ 1936

ΜΗΝ Μάϊος

1201340250353605

Ἡμέρα	Ὥρα παρατηρήσεως	Ὁλικὸν ὕψος βροχῆς 24ώρου εἰς χιλ.	Διάρκεια Ὥρα Ἐνάρξεως	Διάρκεια Ὥρα Λήξεως	Διάρκεια βροχῆς εἰς ὥρας	Διεύθυνσις ἀνέμου	Παρατηρήσεις
2	8	—					
3	8						
4	8	12.0	8.00 π.μ.	8.00 μ.μ.	12.00	ΝΔ	
5	8	5.7	9.00	12.00	3.00	S	
6	8						
7	8	7.1	10.00	2.00	4.00	ΝΔ	
8	8	—					
9	8						
10	8	8.0	9.00	1.00	4.00	ΝΔ	
11	8	6.0	6.00 μ.μ.	10 μ.μ.	4.00	ΝΔ	
12	8	2.6	3.00	4.00	1.00	ΝΑ	
13	8	—					
14	8	—					
15	8	—					
16	8	—					
17	8	—					
18	8	—					
19	8	—					
20	8	—					
21	8	—					
22	8	—					
23	8	—					
24	8	—					
25	8	—					
26	8	—					
27	8	—					
28	8	—					
29	8	—					
30	8	—					
Σύνολον		40.4			28		

Notes:
- Day 4 precipitation 12.0 is circled in red
- Red ink checkmark on sum 28

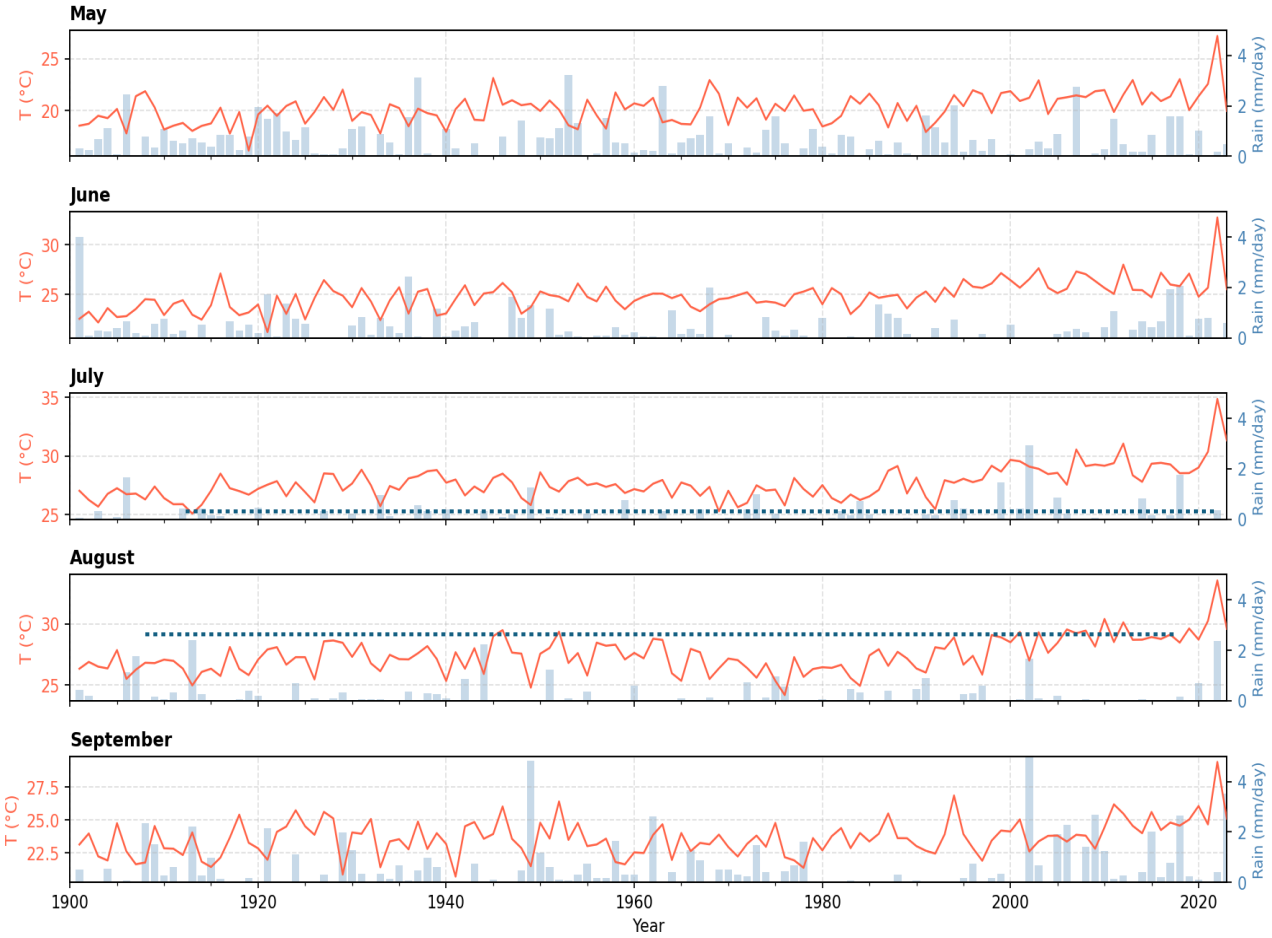
Google academic research awards

Application: the summer of 1913

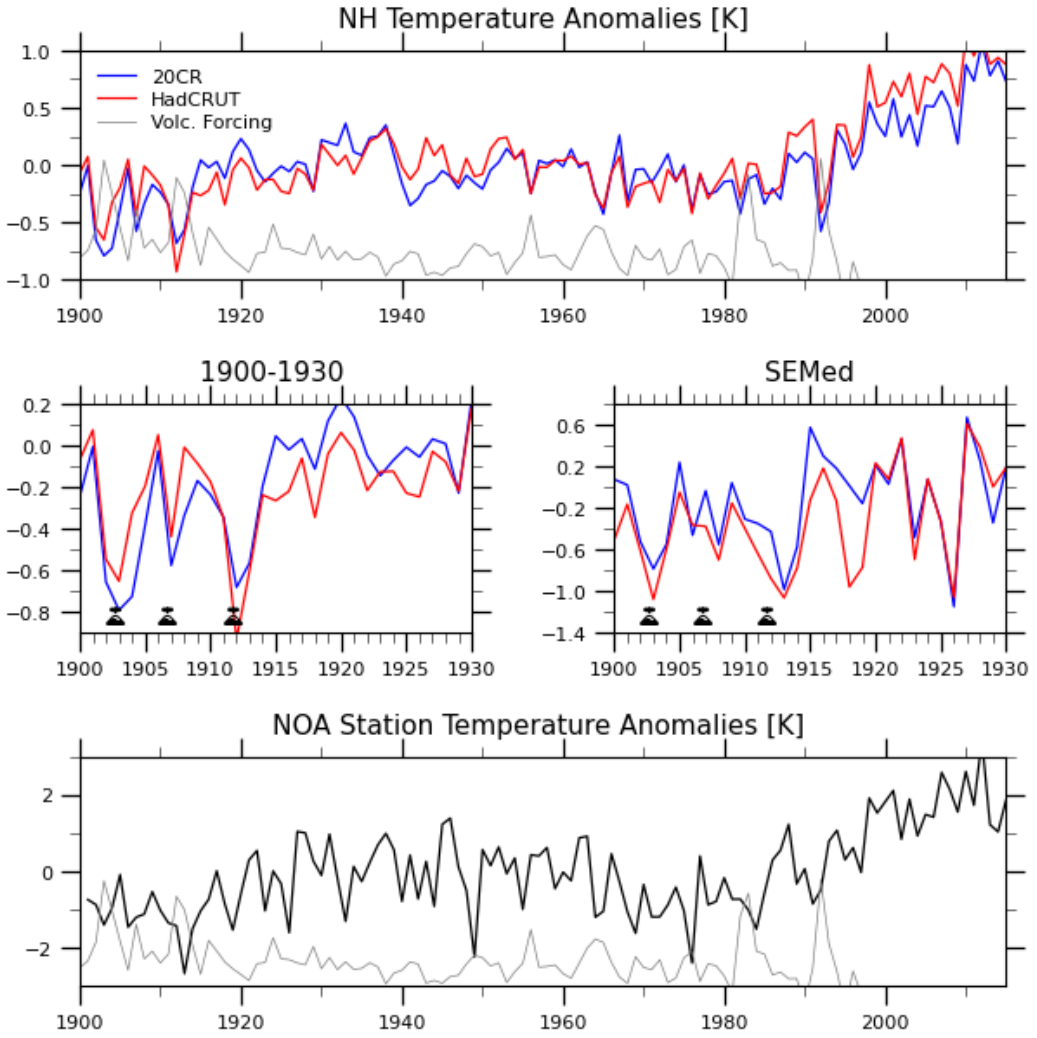
Summer of 1913 recorded in Thisio station (NOA):

- the coldest mean July-August in the record
- the coldest July in the record
- the wettest August in the record

Monthly Temperature and precipitation anomalies

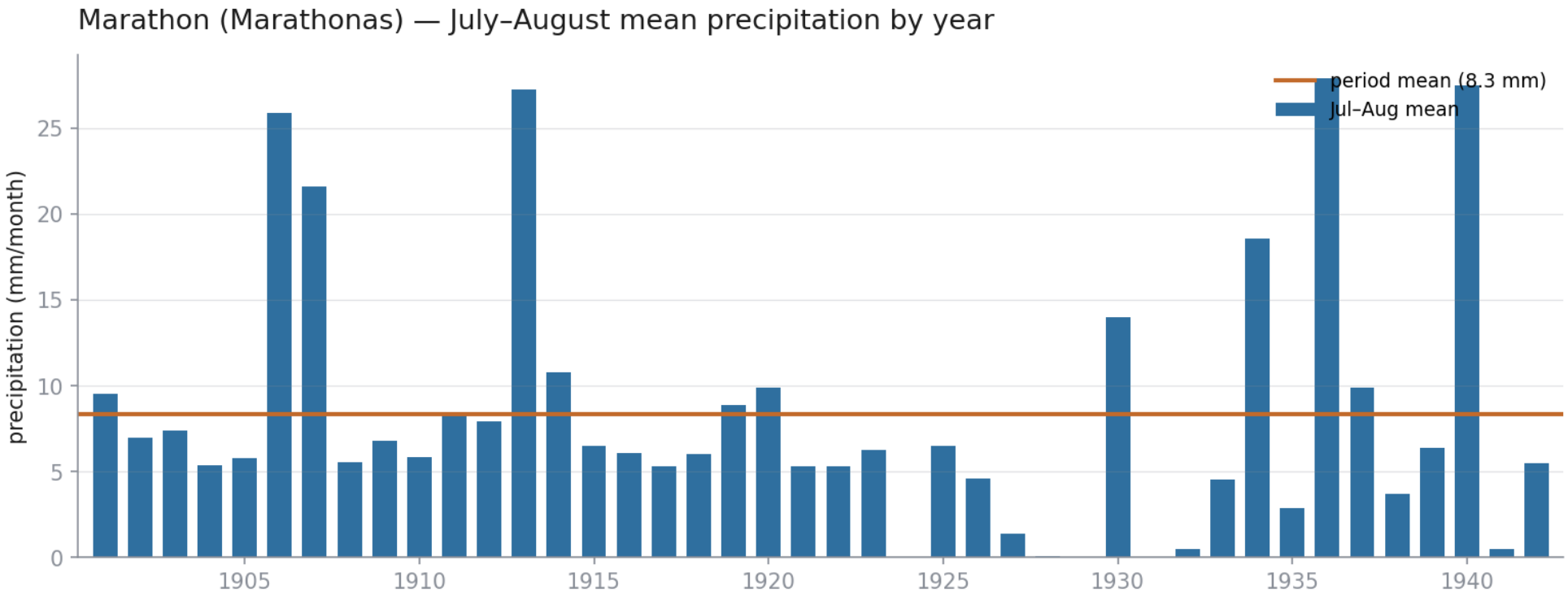


JA anomalies



Application: the summer of 1913

The newly digitized Marathonas station



1913: a very rainy summer. The JA is ranked third.
The wettest August in the record with 44 mm precipitation.
Marathonas is close to Thisio. We are extending to other remote stations.

Back to the Tinos flood

Newspaper “Ermoupolis”, Siros, 4-DEC-1873

— Κατὰ τὴν ἑβδομάδα ταύτην παρετηρήθη ἐν Σύρῳ φαινόμενον σπάνιον. Εἴχομεν βροχὴν ραγδαίαν καὶ διαρκῆ ἐπὶ δύο ὅλας ἡμέρας καὶ νύκτας σχεδόν. Σπανίως βρέχει ἐν Σύρῳ. Μῆνες ὁλόκληροι παρέρχονται ἄνευ βροχῆς, ὡς συνέβη ἐφέτος, καὶ οἱ ἄνθρωποι λαμβάνουσιν ἀνάγκην ὕδατος, ἐξαντλουμένων τῶν οἰκιακῶν δεξαμενῶν. Σπανιώτατα δὲ συμβαίνει νὰ διαρκέσῃ ἡ βροχὴ ἡμέραν ὁλόκληρον.

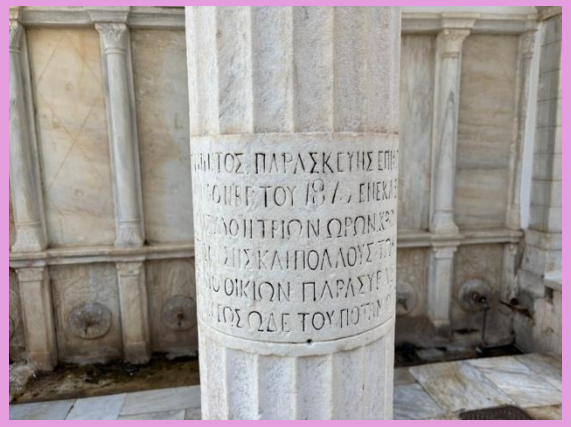
This week something extraordinary happened. There was heavy rain for 2 days and nights….

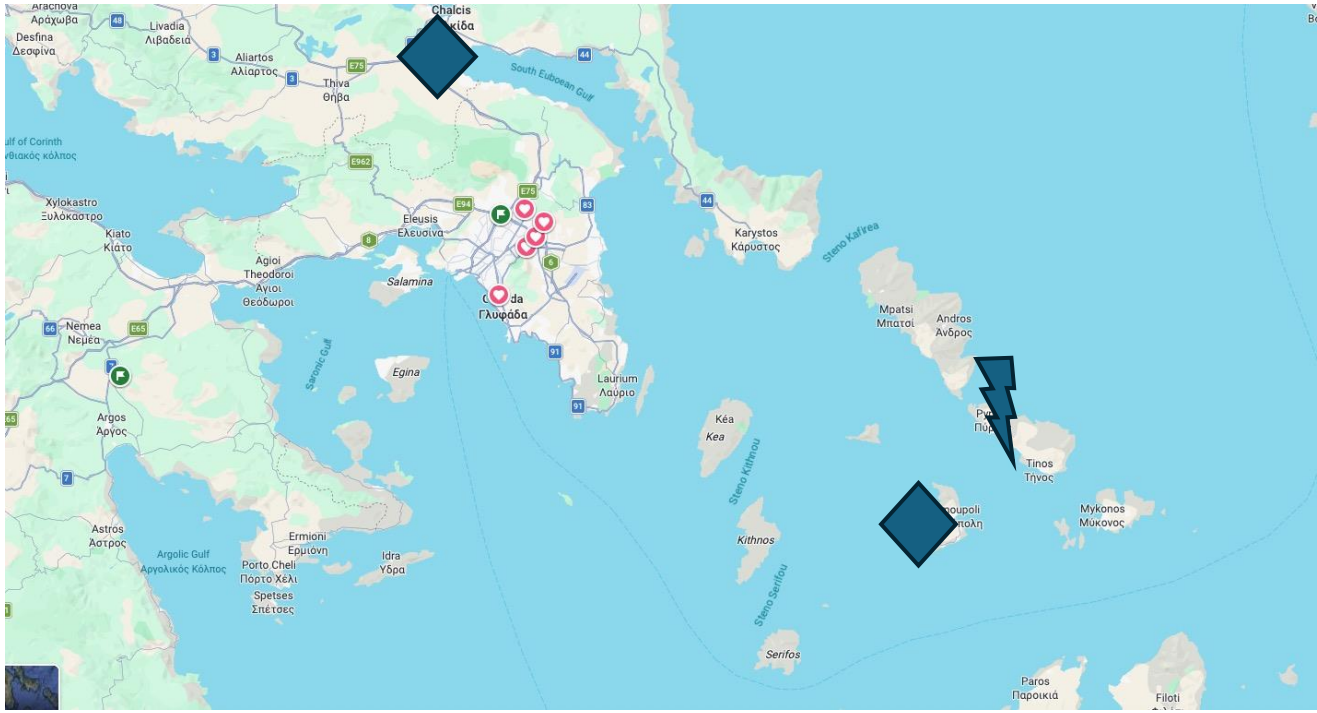
— Ἕνεκεν τῆς κακοκαιρίας καὶ τῶν ραγδαίων βροχῶν ἐβλάβησαν διάφοροι τηλεγραφικαὶ γραμμαὶ τῆς ξηρᾶς ἔν τε τῇ Ἑλλάδι καὶ τῇ Τουρκίᾳ καὶ ἐπῆλθε διακοπὴ τῆς τηλεγραφικῆς συγκοινωνίας μετὰ τοῦ ἐξωτερικοῦ καὶ τοῦ ἐσωτερικοῦ.

Because of bad weather and heavy rains many telegraphic lines in Greece and Turkey were destroyed…

— Ἐκ Λαμίας 24 νοεμβρ. Πρὸ ὀκτὼ ἡμερῶν ἔχομεν συνεχεῖς βροχάς, τὰ ὕδατα τῶν ὁποίων συρρεύσαντα εἰς τὸν ποταμὸν Σπερχειὸν ἐξώγκωσαν αὐτὸν εἰς τοιοῦτον μοναδικὸν τρόπον, ὥστε ἐπλημμύρησε καὶ κατέπνιξεν ἅπασαν τὴν πεδιάδα τῆς Φθιώτιδος, διέκοψε πᾶσαν συγκοινωνίαν, καὶ κατέστρεψεν εἴκοσι χιλιάδων κοιλῶν σπέρον δημητριακῶν καρπῶν. Διακεκομμένης οὔσης τῆς συγκοινωνίας τῆς Λαμίας μετὰ τῶν ἐν τῇ πεδιάδι χωρίων, δὲν δυνάμεθα, ἐπὶ τοῦ παρόντος νὰ πληροφορηθῶμεν τὰς μεγάλας ζημίας, αἵτινες ἀφευκτα ἔλαβον χώραν, διότι καὶ ἄνθρωποι καὶ ζῶα πειθανῶς ἐπνίγησαν, καὶ χωρία κατεστράφησαν· ἡ δὲ μετὰ τῆς πρωτευούσης συγκοινωνία ἡμῶν, καὶ ταύτης μετὰ τῶν μερῶν τούτων διεκόπη, καὶ κύριος οἶδε ἐπὶ πόσον θέλει παραταθῇ, διότι καὶ ὁ τηλέγραφος πρὸ 15—20 ἡμερῶν διατελεῖ ἐν ἀ-

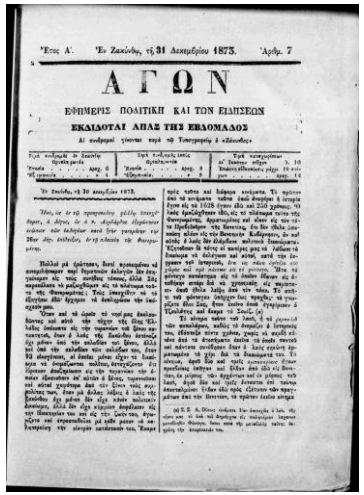
In the middle of the night, Friday is dawning, of 30 November 1873 because of torrential rain for 2 or 3 hours, two houses collapsed, the stream raised up to this point





Beyond quantitative information

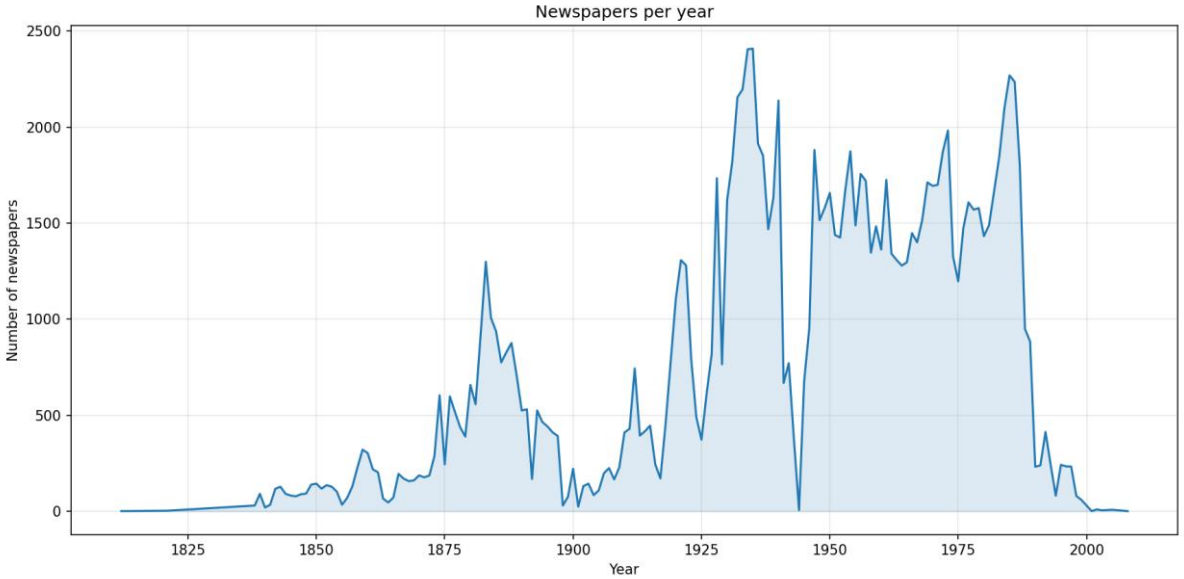
1873, Zante



1912, Tinos



We have download **130,080** daily newspapers from the national archive. Much more available.
22 locations
Transcribing using Chandra (cheap).



Newspapers

vLLM
Chandra, HPC

Md text.

RAG

impresso
Media
Monitoring of the Past

Summary

RescueΚλίμα runs for 2 years funded by C3S.
We are digitizing late-19th and early-20th century weather stations.
We are using a system of 3 vLLMs.
6 new centennial stations are expected.
New stations will update national and international datasets.

Besides weather reports,
we are digitizing newspapers to provide the history of weather-related impacts in Greece from the mid-19th century.

Need observations during II WW.



Climate Change Service
climate.copernicus.eu

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HELLENIC NATIONAL METEOROLOGICAL SERVICE
ΕΘΝΙΚΗ ΜΕΤΕΩΡΟΛΟΓΙΚΗ ΥΠΗΡΕΣΙΑ

HELLENIC REPUBLIC
Ministry of Rural Development and Food