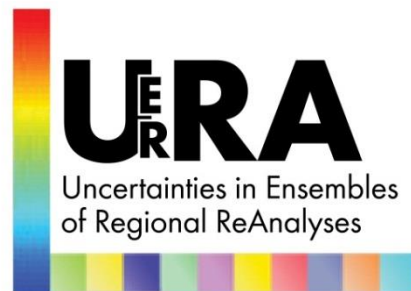




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Infilling in European temporal and spatial
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UERRA Work Package 1

Deliverable 1.4

Infilling in European temporal and spatial gaps for the pre-1950 period

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1. Introduction

This report presents an overview of the pre-1950 subdaily meteorological data recovered by Work Package 1 (WP1) on Data Rescue and Development (Gridded and Observational Datasets) from the EU-FP7-funded collaborative project entitled Uncertainties in Ensembles of Regional Reanalysis (UERRA: Grant agreement No. 607193, www.uerra.eu). The current work builds on the results presented in Deliverables D1.1, D1.2 and D1.3 from WP1, which:

1. Identified the Mediterranean Basin, eastern Europe and Scandinavia and Western Europe as regions with sub-optimal data coverage to support enhanced high-resolution regional reanalysis, especially for the two latter regions in the early Reanalysis period (e.g. 1960s and 1970s)
2. Located sources of undigitised subdaily data for the identified regions, and
3. Presented a summary of the 4.9 million observations that have so far been digitised in the post-1950 period across 13 countries.

Here we report on the temporal and spatial distribution of the subdaily data that have been digitised in the pre-1950 period by the WP1 partner University Rovira i Virgili (URV).

2. Pre-1950 recovered data details

In total, 1,553,265 observations have so far been recovered for the period from 1879 to 1949, digitised by a team of 11 geography students at the University Rovira i Virgili. This accounts for only 19.4% of the total number of observations digitised by the URV in the first 24 months of the UERRA project. The pre-1950 data are from 54 different stations in 10 countries over the European and wider Mediterranean region, as shown in Figure 1 and Table 1. Full station details are provided in Appendix A.



Country	Total	Percentage	No. of stations
Egypt	622,665	40.1	18
Algeria	340,033	21.9	17
Lebanon	261,562	16.8	1
Tunisia	160,464	10.3	6
Slovak Republic	49,997	3.2	2
Cyprus	45,069	2.9	2
Morocco	15,425	1.0	1
Czech Republic	10,965	2.7	4
Croatia	10,942	0.7	2
Rep. of Serbia	5,448	0.4	1
Total	1,522,570	100	54

Table 1. Total number of observations digitised by URV partner in UERRA WPI, 1879–1949.

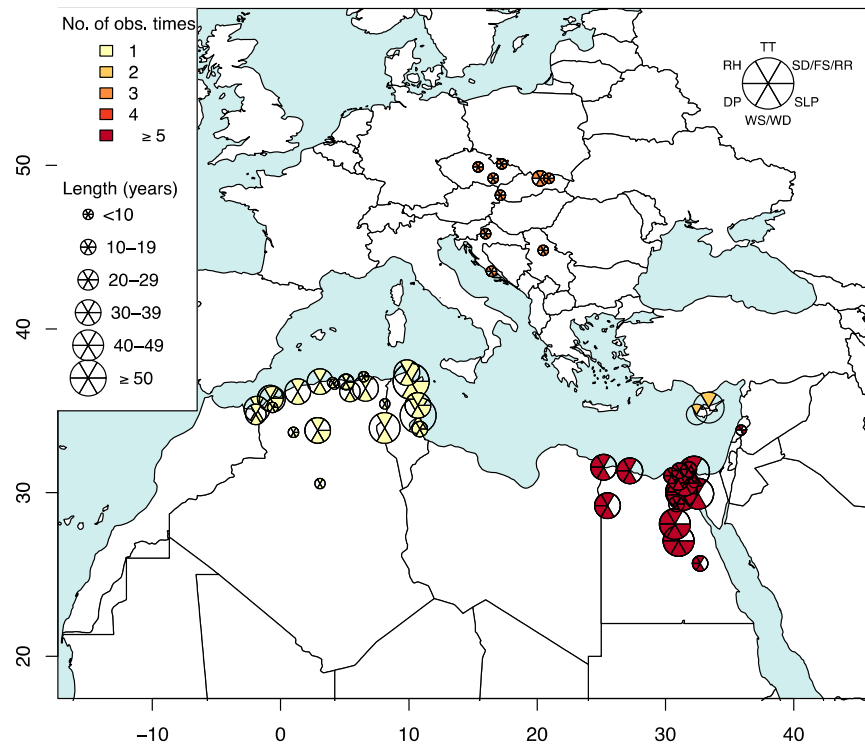


Figure 1. The geographical distribution of the pre-1950 stations digitised through UERRA WP1. Colours represent the number of observations available per day at each station; the shaded section indicates the variables digitised; and the size of the symbol represents the length of the digitised record. The variables are temperature (TT), relative humidity (RH), dew point temperature (DP), wind speed (WS), wind direction (WD), air pressure (SLP), total snow depth (SD), fresh snow (FS) and precipitation (RR).

The majority of the data (73.3%, or 1,138,587 observations) are for North Africa. In particular, around 62% of the digitised data are for Egypt and Algeria, and were obtained from French documents available through the US NOAA Climate Data Modernisation Program (CDMP, www.lib.noaa.gov/collections/imgdocmaps/data_rescue_home.html). The reason for this spatial bias is the availability of data sources: as outlined in D1.1, the majority of pre-1950 subdaily data rescue (DARE) sources identified contain data for the North African region, while DARE sources identified for the European sectors begin in the mid-20th century.

Additional hourly pre-1950 observations have been located and digitised for Lebanon, Cyprus and several central European countries, as listed in Table 1. The sources of these observations continue into the 1970s, and are also largely from the online resources of the CDMP Central Library of Foreign Climate Data.



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Data are currently (mid-December 2015) still being digitised for Algeria, covering the period 1879–1929. These include three new stations and a temporal extension for six stations with data already digitised. The variables being digitised are primarily temperature, wind strength and wind direction, with air pressure available for three stations. In total, these stations under digitisation should add an estimated 480,000 extra observations to the total count.



2.1. Distribution of recovered observations by variable and observation time

Figure 2 shows the percentage of observations per hour over the pre-1950 period. Many of the observations in this earlier period available from our gathered data sources were taken only once or twice a day, generally in the morning and afternoon with the observing times changing occasionally throughout the record. This is particularly true for Egyptian data, where the observation times changed in 1936 (increasing from once a day at 0800, to 0800 and 1400), 1946 (0800, 1400 and 2000) and 1948 (0600, 1200 and 1800). These changes lead to the high number of observing times within each source illustrated in Figure 1. Hourly data from Lebanon ensures that some observations are available for every hour of the day.

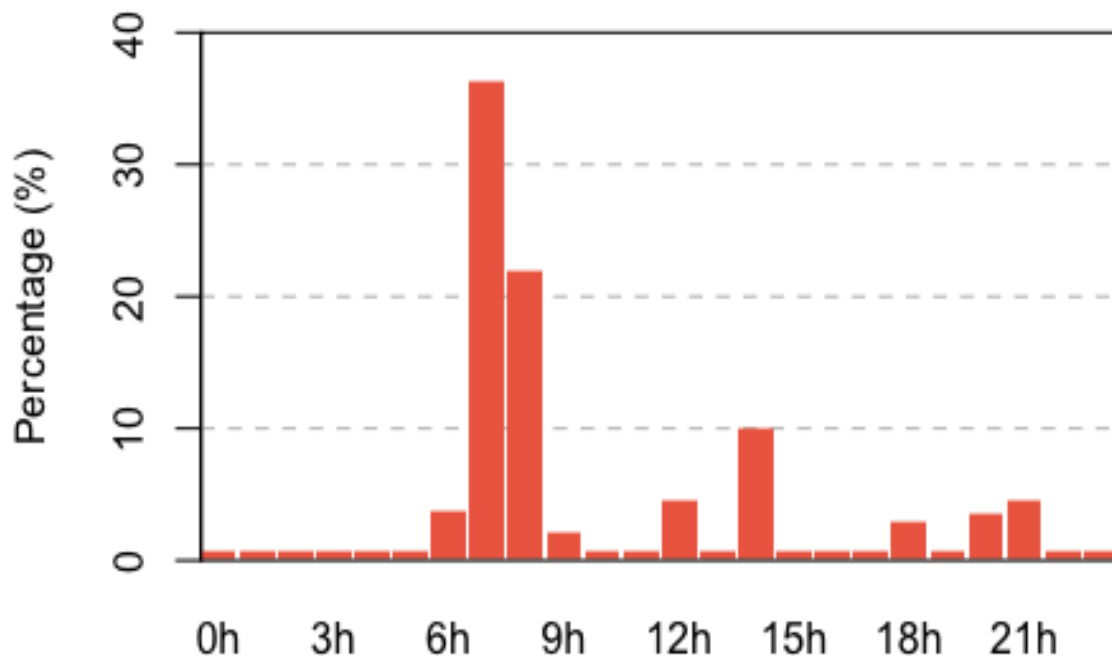


Figure 2. Percentage of total digitised observations by hour, 1879–1949.

Temperature is the most commonly digitised variable in the pre-1950 period, accounting for 34.1% (529,707) of the total data digitised. This is shown in Figure 3. Wind observations (direction and speed) were the second most common, representing 18.4% (286,649) and 16.8% (260,487) of the digitised data respectively. The discrepancy between the two wind variables is due to the fact that wind speed observations were provided in qualitative descriptions (e.g. Moderate, light) until 1924 for Egypt, and so were not digitised.

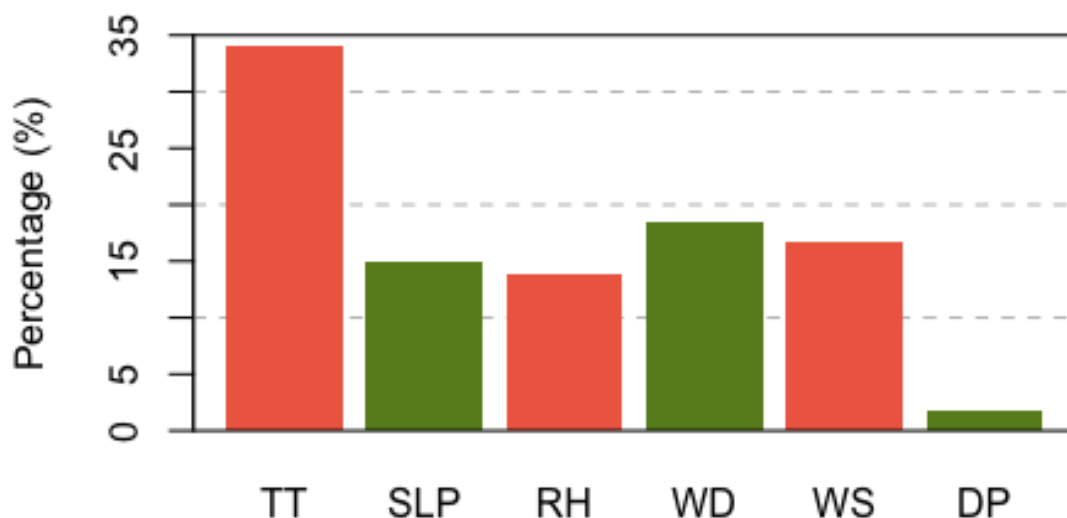


Figure 3. Percentage of total observations by variable, 1879–1949. Variable abbreviations as Figure 1.

It should also be mentioned that the majority of the wind speed observations were recorded in units of wind force, reducing the accuracy of the data. The observations from Egypt for example, are provided in Beaufort scale units until 1949, when most stations changed to knots. Similarly, wind data from Morocco were recorded in a 9-point "wind power" scale until 1940. No rainfall or snowfall observations were found for digitisation for the pre-1950 period.



Appendix A. Complete list of stations with pre-1950 subdaily digitised data digitised under UERRA WP1.

Country	Station name	WMO code	Latitude	Longitude	Altitude (m)	Variables	Observing times	Period
Algeria	Alger (Ville)	60369	36.78	3.07	59	TT,WD,WS	7h	1900-1938
	Bejaia-Bougie (Port)	60401	36.75	5.1	9	SLP,TT,WD,WS	7h	1909-1926
	Constantine	60419	36.37	6.62	660	TT,WD,WS	7h	1900-1938
	El-Golea	60590	30.55	3.07	394	TT,WD,WS	7h	1926-1929
	Laghouat	60545	33.8	2.89	767	SLP,TT,WD,WS	7h	1900-1938
	Nemours (Gazaouet)	60517	35.1	-1.85	83	TT,WD,WS	7h	1900-1938
	Oran	60461	35.7	-0.65	53	TT,WD,WS	7h	1900-1938
	Oran-Cap Falcon	60485	35.77	-0.8	78	SLP,TT,WD,WS	7h	1896-1929
	Orleansville	60425	36.17	1.34	112	TT,WD,WS	7h	1900-1938



Country	Station name	WMO code	Latitude	Longitude	Altitude (m)	Variables	Observing times	Period
	Setif	60445	36.18	5.4	1081	TT,WD,WS	7h	1910-1938
	Skikda-CapBougarouni	60355	37.08	6.47	195	SLP,TT,WD,WS	7h	1931-1938
	Fort National	60395	36.63	4.2	942	TT,WD,WS	7h	1930-1938
	Bejaia-Cap Carbon	60400	36.78	5.1	225	TT,WD,WS	7h	1926-1938
	Geryville (El Bahadh)	60550	33.68	1	1320	SLP,TT,WD,WS	7h	1930-1938
	Sidi-Bel-Abbes	60520	35.2	-0.63	476	SLP,TT,WD,WS	7h	1930-1938
	Tizi Ouzou	60395	36.72	4.05	222	TT,WD,WS	7h	1930-1938
	Tebessa	60475	35.42	8.12	863	TT,WD,WS	7h	1930-1938
Croatia	Split-Marjan	14445	43.52	16.43	122	SLP,TT,RH,WD,WS	7h/14h/21h	1949-1984
	Zagreb-Gric	14236	45.82	15.98	157	SLP,TT,RH,WD,WS	7h/14h/21h	1949-1984



Country	Station name	WMO code	Latitude	Longitude	Altitude (m)	Variables	Observing times	Period
Cyprus	Nicosia	17606	35.19	33.37	152	TT	9h/21h	1881-1922
	Paphos	17600	34.77	32.43	30	TT	9h/21h	1901-1922
Czech	Rep. Brno-Kvetna	11721	49.2	16.57	233	SLP,TT,RH,WD,WS	7h/14h/21h	1948-1960
	Caslav-filipor	11622	49.9	15.4	252	SLP,TT,RH,WD,WS	9h/14h/21h	1948-1960
	Praded	11735	50.08	17.23	1490	SLP,TT,RH,WD,WS	11h/14h/21h	1948-1957
	SkalnatePleso	—	49.2	20.92	1778	SLP,TT,RH,WD,WS	10h/14h/21h	1948-1960
Egypt	Asyut-Heat airport	62393	27.05	31.02	226	TT,SLP,RH,DP,WD,WS	6h/8h/12h/14h/20h	1907-1957
	Cairo Ezbekiya	62374	30.05	31.25	20	TT,RH,DP,WD,WS	6h/8h/12h/14h/20h	1909-1957
	Cairo Giza	62375	30.03	31.21	28	TT,RH,DP,WD,WS	6h/8h/12h/14h/20h	1907-1957
	Cairo Helwan	62378	29.86	31.34	116	TT,RH,DP,WD,WS	6h/8h/12h/14h/20h	1907-1957



Country	Station name	WMO code	Latitude	Longitude	Altitude (m)	Variables	Observing times	Period
	Damanhour	62339	31.03	30.47	2	TT,RH,DP,WD,WS	6h/8h/12h/14h/20h	1934-1957
	Damietta	62330	31.42	31.82	5	TT,RH,DP,WD,WS	6h/8h/12h/14h/20h	1934-1957
	El Mansura	62342	31.34	31.08	10	TT,RH,DP,WD,WS	6h/8h/12h/14h/20h	1932-1957
	El Suez	62450	29.93	32.55	10	TT,RH,DP,WD,WS	6h/8h/12h/14h/20h	1907-1957
	Fayoum	62381	29.3	30.85	23	TT,SLP	6h/8h/12h/14h/20h	1932-1957
	Ismailia	62441	30.6	32.23	10	TT	6h/8h/12h/14h/20h	1948-1957
	Luxor Airport	62405	25.67	32.7	93	TT,RH,DP,WD,WS	6h/8h/12h/14h/20h	1936-1957
	Mersa Matruh	62306	31.33	27.22	25	TT,RH,DP,WD,WS	6h/8h/12h/14h/20h	1920-1957
	Minya	62387	28.08	30.73	40	TT,SLP,RH,DP,WD,WS	6h/8h/12h/14h/20h	1907-1957
	Port Said	62333	31.28	32.23	6	TT,RH,DP,WD,WS	6h/8h/12h/14h/20h	1907-1957



Country	Station name	WMO code	Latitude	Longitude	Altitude (m)	Variables	Observing times	Period
	Salloum	62300	31.55	25.18	4	TT,RH,DP,WD, W	6h/8h/12h/14 h/20h	1919-1957
	Siwa	62417	29.2	25.48	-15	TT,RH,DP,WD, WS	6h/8h/12h/14 h/20h	1912-1957
	Tanta	62348	30.78	31	15	TT,RH,DP,WD, WS	6h/8h/12h/14 h/20h	1927-1957
	Zagazig	62354	30.58	31.5	13	TT,SLP,RH,DP, WD,WS	6h/8h/12h/14 h/20h	1913-1957
Lebanon	Ksara	40106	33.82	35.89	918	SLP,TT,RH	Hourly	1930-1939
Morocco	Oujda	60115	34.78	-1.93	478	TT,WD,WS	7h	1910-1938
Rep. Of Serbia	Beograd-Surcin	13272	44.8	20.47	132	SLP,TT,RH,WD, WS	7h/14h/21h	1949-1970
Slovak Rep.	Bratislava-Trnavaka	11814	48.17	17.13	139	SLP,TT,RH,WD, WS	7h/14h/21h	1948-1968
	Lomnický Stit.	11930	49.2	20.22	2638	SLP,TT,RH,WD, WS	7h/14h/21h	1940-1966
Tunisia	Bizerta-Cap Blanc	60714	37.33	9.84	264	TT,WD,WS	7h	1899-1938



Country	Station name	WMO code	Latitude	Longitude	Altitude (m)	Variables	Observing times	Period
	Djerba	60769	33.88	10.85	4	SLP,TT,WD,WS	7h	1898-1912
	El Djem	60743A	35.33	10.7	112	SLP,TT,WD,WS	7h	1900-1932
	Sfax	60750	34.72	10.72	23	TT,WD,WS	7h	1886-1938
	Tozeur	60760	33.95	8.11	50	TT,WD,WS	7h	1897-1938
	Tunis	60715	36.8	10.17	36	SLP,TT,WD,WS	7h	1886-1938