An Phríomh-Oifig Staidrimh
Central Statistics Office

Expert Group on Environment Statistics and Indicators

17th November 2020

Using Meteorological Data for Water Statistics

- Flash presentation (3 minutes)

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Overview of Presentation

- Weather observing stations
- Examples of absolute precipitation indicators
- Flood risk and other hazards
- Climate data rescue
- Conclusions

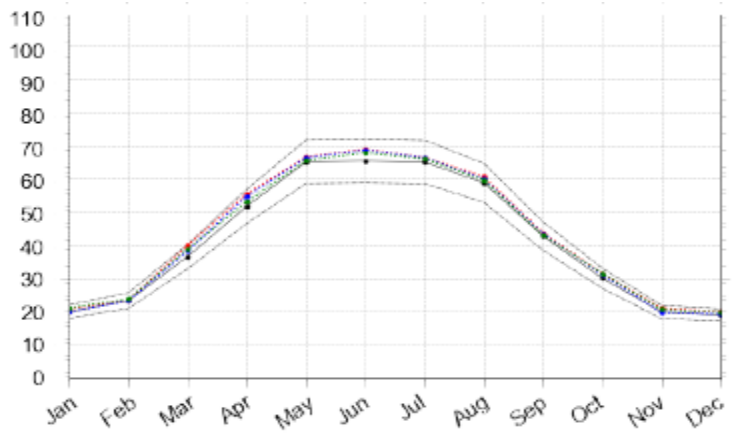
Weather Observing Stations

- National meteorological agencies collect a large amount of daily and sub-daily weather-related data that could be used for compiling water statistics and completing parts of Water Accounts
- Synoptic stations collect data at set times e.g. 00h00, 03h00, 06h00 etc. using instruments such as an anemometer, wind vane, pressure sensor, thermometer, hygrometer, and rain gauge
- Climatological stations are less automated and may collect less data and at a lower frequency than synoptic stations
- Countries may also have stations maintained on a voluntary basis e.g. to collect rainfall data only
- Total precipitation and evapotranspiration are best calculated by meteorologists as they require detailed data and complex calculations
- Precipitation and evapotranspiration are inputs into the calculation of groundwater recharge
- General rainfall indicators can be calculated in absolute terms such as number of wet days or in relative terms such as in reference to means over a 30-year period. A day in Ireland with temperatures exceeding 30 degrees Celsius is very unusual but may be a welcome relief in hot countries!
- Rainfall indicators can be used to detect long-term changes in rainfall patterns

Indicator	Definition
Rain days	Total daily rainfall of 0.2 mm or more
Wet days	Total daily rainfall of 1.0 mm or more
Very wet days	Days with total daily rainfall of 10 mm or more
Extremely wet days	Days with total daily rainfall of 20 mm or more
Wet spell	A period of 15 or more consecutive wet days
Absolute drought	A period of 15 or more consecutive days on none of which 0.2 mm or more of rain falls
Partial drought	A period of at least 29 days in which the mean daily rainfall does not exceed 0.2 mm
Dry spell	A period of 15 or more consecutive days on none of which 1.0 mm or more of rain falls
Daily or monthly	Monthly and annual means are easier to present in tables and graphs but a month with total rainfall of 20 mm could comprise an absolute drought and two days of 10 mm on each day

- Actual evapotranspiration was 38 billion m^3 or 44% of precipitation in Ireland in 2017

- Evapotranspiration can be actual or modelled (Penman/Monteith formulae)
- Evapotranspiration models take into account solar radiation, air temperature, relative humidity, and air speed
- There can be substantial seasonal variation with highest levels in Summer
- An example seasonal graph is shown for Valentia station in Ireland (mm)



Flood Risk and Other Hazards

- Rainfall data can be used in combination with other data such as river gauge hydrological measurements and sea tidal information to monitor the risk of serious flooding along rivers and in coastal towns
- Insurance companies use flood risk assessments when deciding whether to insure premises by using calculations on the frequency that an extreme weather event may occur e.g. once in a hundred years
- Statisticians have the expertise to assist in calculating these exceptional events
- The seasonality of rainfall can be critical especially for agricultural crops
- Environmental agencies are equally concerned about low levels of water flow as it can result in an increase in the concentration of pollutants from wastewater inflows into rivers
- Flood risk often arises from rainfall over a period e.g. if the ground is soaked then rainfall will run-off more quickly into rivers and storm drains resulting in more rapid increases in river water levels or in incoming loads that exceed the capacity of waste water treatment plants
- Disturbances to ecosystems such as urban expansion, and removing wetlands and tree areas can also increase the amount of, and shorten the time interval of, rainwater entering rivers

Climate Data Rescue

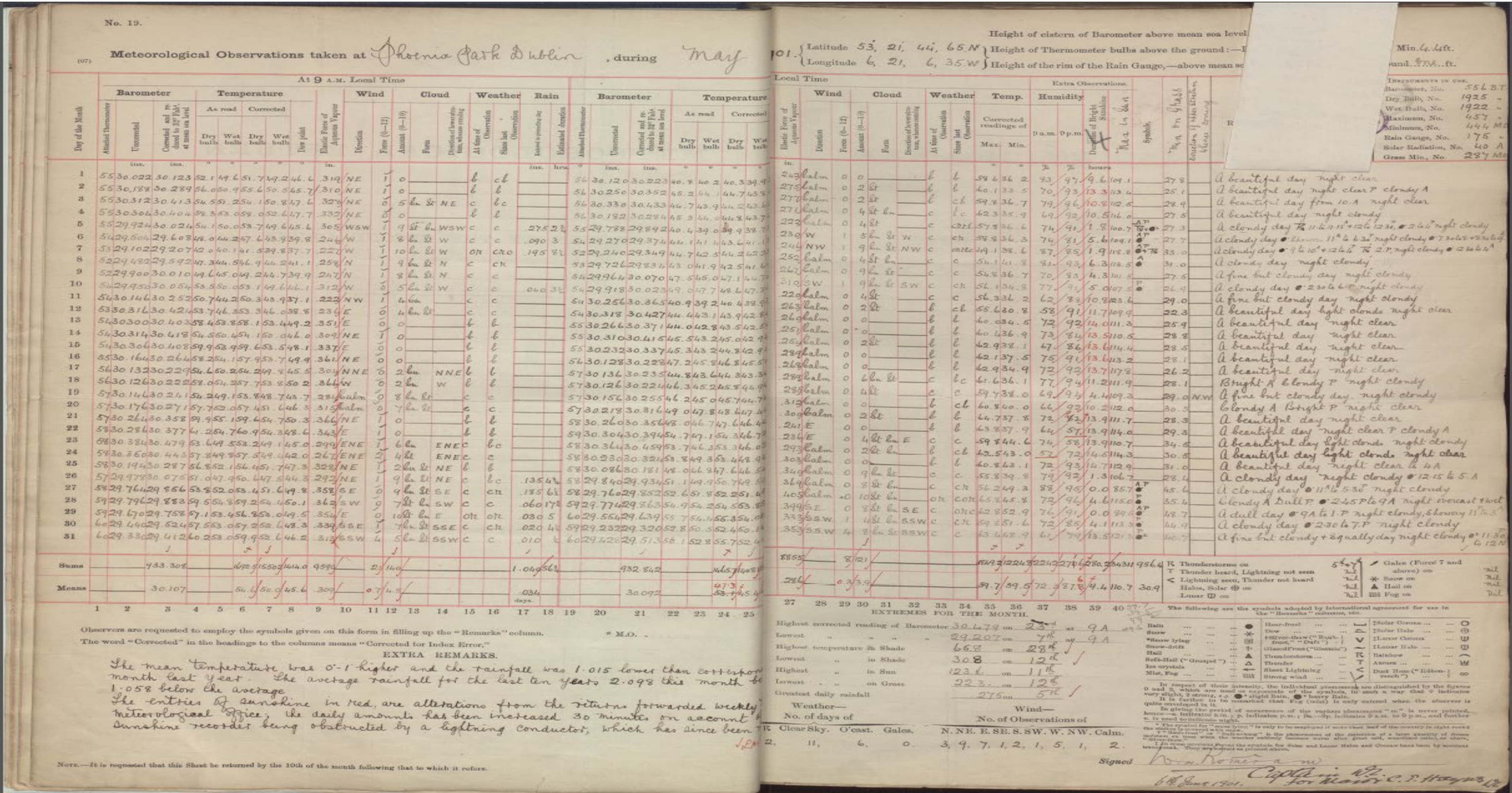
- Met Eireann have computerised daily rainfall from 1941 and temperature and other data from 1960
- The CSO started a data rescue project with Met Eireann in March 2018 to rescue historical daily data back to around 1870 and to 1829 for one station
- Met Eireann scanned the images from original library manuscripts and CSO created excel templates, keyed the data, and are quality checking it
- It takes at least six hours for CSO to fully process one station month and we have keyed around 7,000 station months and fully checked around one-quarter of these
- Beware! Meteorologists are scientists and each individual figure needs to be correct. While small errors in the daily figures may balance out in a monthly mean, they do not balance out when the daily figures are published.

Conclusions

- Meteorological stations have huge amounts of very high-quality data that can be used at their actual frequency or can be summarised to monthly and annual levels
- The data collection stations must be nationally representative if you want to calculate monthly and annual national figures rather than monthly and annual station means
- The data can be used for compiling water statistics and in the completion of water accounts
- Statistical offices may be able to use their expertise in data processing to extend the national time series back beyond the 1970s when car ownership and foreign holidays took off! In Ireland's case the series is being extended from 60 to 130 years.
- The indicators can be absolute or relative to a base 30-year reference period

- The next three slides give more information on our climate data rescue project which involves keying numeric measurements, weather symbols, and text data

Climate Data Rescue – Keying from manuscript….



....to Excel File

Latitude 53° 21' 48" 25N — Height of cistern of Barom
Meterological Observations taken at Ordnance Survey Office, Phoenix Park, Dublin during May 1901 — Height of Thermometer bu
Longitude 6° 20' 59" 15W — Height of the rim of the Ra

At 9 A.M. Local Time

Day of the Month	Barometer: Attached Thermometer	Barometer: Uncorrected	Barometer: Corrected and reduced to 32° Faht. at mean sea level	Temperature: As read Dry Bulb	Temperature: As read Wet Bulb	Temperature: Corrected Dry Bulb	Temperature: Corrected Wet Bulb	Dew Point	Elastic Force of Aqueous Vapour	Wind: Direction	Wind: Force (0 – 12)	Cloud: Amount (0 – 10	Cloud: Form	Cloud: Direction of lower stratum, whence coming	Weather: At time of Observation	Weather: Since last Observation	Rain: Entered to preceding day	Rain: Estimated Duration (hrs.)
Numbers of Columns	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	55	30.022	30.123	52.1	49.6	51.7	49.2	46.6	0.319	NE	1	0	–	CALM	b	c b	0	0
2	55	30.188	30.289	56	50.9	55.6	50.5	45.7	0.31	NE	1	0	–	CALM	b	b	0	0
3	55	30.312	30.413	54.5	51.2	54.1	50.8	47.6	0.328	NE	0	5	Cu St	NE	c	b c	0	0
4	55	30.304	30.404	58.3	53	58	52.6	47.7	0.332	NE	0	0	–	CALM	b	b	0	0
5	55	29.924	30.024	54.1	50	53.7	49.6	45.6	0.305	WSW	1	9	St Cu	WSW	c	c	0.275	2.75
6	54	29.504	29.608	48	44.2	47.6	43.9	39.8	0.246	W	1	8	Cu St	W	c	c	0.09	3
7	53	29.102	29.207	42	40.1	41.5	39.8	37.7	0.227	W	1	10	Cu St	W	or	c r o	0.195	8.5
8	52	29.482	29.592	47.3	44.5	46.9	44.2	41.1	0.258	N	1	9	Cu St	N	c	c r	0	0
9	52	29.9	30.01	49.6	45	49.2	44.7	39.9	0.247	N	1	8	Cu St	N	c	c	0	0
10	54	29.95	30.054	53.5	50	53.1	49.6	46.1	0.312	W	0	5	Cu St	W	c	c	0.04	3.5
11	54	30.146	30.252	50.7	44.2	50.3	43.9	37.1	0.222	NW	1	4	Cu	CALM	c	c	0	0
12	53	30.316	30.424	53.7	46.3	53.3	46	38.8	0.236	E	0	4	Cu St	CALM	c	c	0	0
13	54	30.3	30.403	58.4	53.8	58.1	53.4	49.2	0.351	E	0	0	–	CALM	b	b	0	0
14	54	30.314	30.418	54.5	50.4	54.1	50	46	0.309	NE	1	0	–	CALM	b	b	0	0
15	54	30.306	30.408	59.9	53.9	59.6	53.5	48.1	0.337	E	0	0	–	CALM	b	b	0	0
16	55	30.164	30.264	58.2	54.1	57.9	53.7	49.9	0.361	NE	0	0	–	CALM	b	b	0	0
17	56	30.132	30.229	54.6	50.2	54.2	49.8	45.5	0.304	NNE	0	2	Cu	NNE	b	b	0	0
18	56	30.126	30.222	58	54.2	57.7	53.8	50.2	0.366	W	0	2	Cu	W	b	b	0	0
19	57	30.146	30.241	54.2	49.1	53.8	48.7	43.7	0.284	CALM	0	8	Cu St	CALM	c	c	0	0
20	57	30.176	30.271	57.7	52	57.4	51.6	46.3	0.315	CALM	0	7	Cu St	CALM	c	c	0	0
21	57	30.264	30.358	59.9	55.1	59.6	54.7	50.3	0.366	NE	1	0	–	CALM	b	b	0	0
22	58	30.286	30.377	61.2	54.7	60.9	54.3	48.6	0.343	E	1	0	–	CALM	b	b	0	0
23	58	30.384	30.479	53.6	49.5	53.2	49.1	45	0.299	ENE	1	6	Cu	ENE	c	b c	0	0
24	58	30.35	30.443	57.8	49.8	57.5	49.4	42	0.267	ENE	2	4	St	ENE	c	c	0	0
25	58	30.194	30.287	56.8	52.1	56.4	51.7	47.3	0.328	NE	1	2	Cir St	NE	b	b	0	0
26	57	29.978	30.075	51	47.9	50.6	47.5	44.3	0.292	NE	1	9	Cu St	NE	c	b c	0.135	4.75
27	58	29.764	29.856	53.8	52	53.4	51.6	49.8	0.358	SE	0	9	Cu St	SE	c	c r	0.185	6.5
28	59	29.796	29.883	59.5	54.8	59.2	54.4	50.1	0.362	SW	0	7	St Cu	SW	c	c	0.06	17.75
29	59	29.67	29.758	57.1	53.4	56.8	53	49.5	0.354	E	0	10	St Cu	E	or	or	0.03	5
30	60	29.44	29.524	57.5	53	57.2	52.6	48.3	0.339	SSE	1	7	Cu St	SSE	c	c r	0.02	4.5
31	60	29.33	29.412	60.2	53	59.9	52.6	46.2	0.313	SSW	4	5	Cu St	SSW	c	c	0.01	0.5
Sums			933.308			1692.5	1550.2	1414	9.590		21	140					1.04	56.75
Means			30.107			54.6	50.0	45.6	0.309		0.7	4.5					0.034	
Sums			933.308			1692.5	1550.2	1414	9.590		21	140					1.04	56.75
Means			30.107			54.6	50.0	45.6	0.309		0.7	4.5					0.034	

Observers are requested to employ the symbols given on this form in filling up the "Remarks" co — *M.O.

The word "Corrected" in the headings to the columns means "Corrected for Index Error."

EXTRA REMARKS

EXTREMES FOR THE MONTH.

Highest corrected Reading of Barometer	30.479	on	23rd	at	9am
Lowest corrected Reading of Barometer	29.207	on	7th	at	9am
Highest Temperature in Shade	65.8	on	28th		
Lowest Temperature in Shade	30.8	on	12th		
Highest Temperature in Sun	123.6	on	11th		

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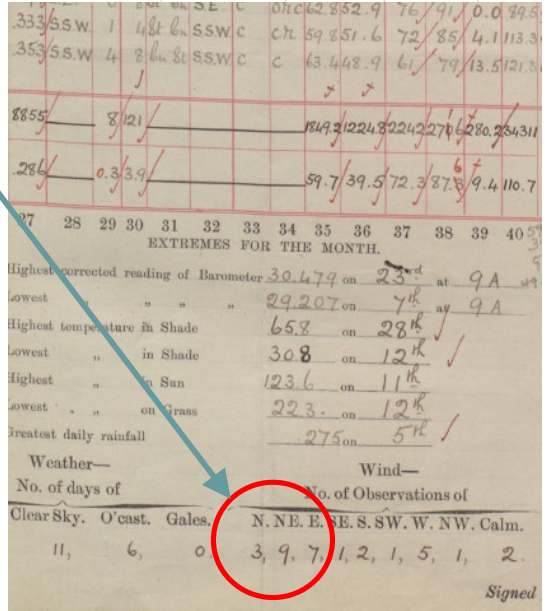
Climate Data Rescue – Quality Checking

1. Look at SAS Output – does check = 0?

size_class	Derived	CSO	check
CALM	2	2	0
E	7	7	0
N	3	4	-1
NE	9	8	1
NW	1	1	0
S	2	2	0
SE	1	1	0
SW	1	1	0
W	5	5	0

2. Look at keyed Excel file

Wind - No. of Observations of								
N	NE	E	SE	S	SW	W	NW	Calm
3	9	7	1	2	1	5	1	2



3. Compare Excel with original manuscript

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