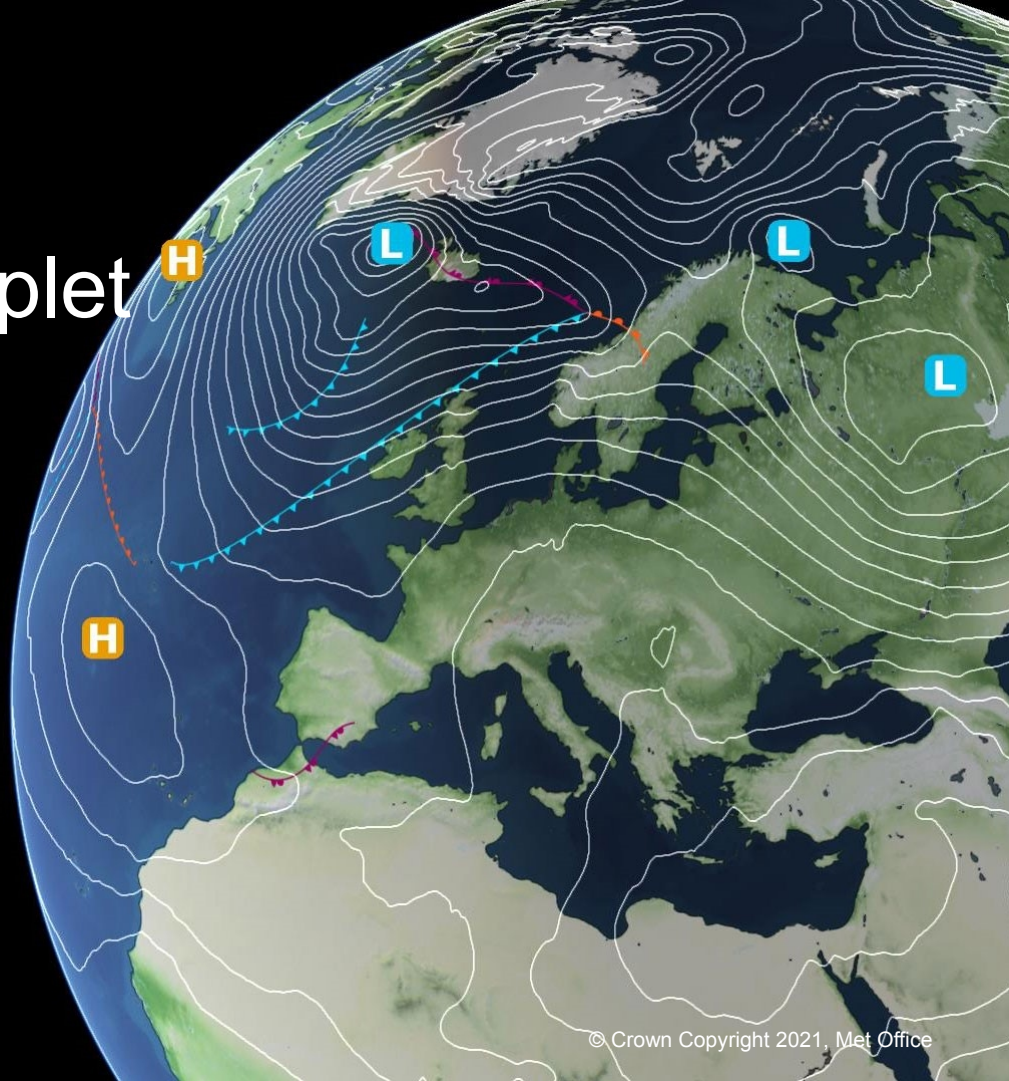
Observations of fog droplet deposition at Le Couye during SOFOG3D

Jeremy Price, et al.

7th June 2022



Met Office

Outline

(1) Fog droplet deposition has been studied at Le Couye using dewmeter data, DMT FM120 fog spectrometer data and sonic data, during SOFOG3D

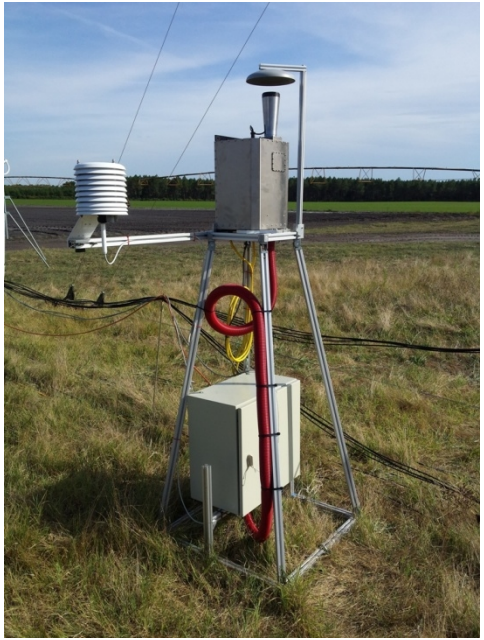
(2) Gravitational deposition rate has been estimated and compared to the total water deposition rate

(3) Liquid water content has been compared to total water deposition rate (in progress)

(4) Eight cases analysed so far, including radiation and stratus fogs

(5) Conclusions and Further work

Primary Instrumentation used



DMT FM120 spectrometer

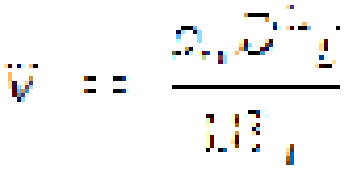
Cardington dewmeters (natural canopy used when possible)

Gill HS50 sonic anemometers at 2m agl

Overview of Instrumentation

Gravitational settling and dewmeter

Gravitational settling estimated from Stoke's law:



Corrections for air temperature and pressure applied

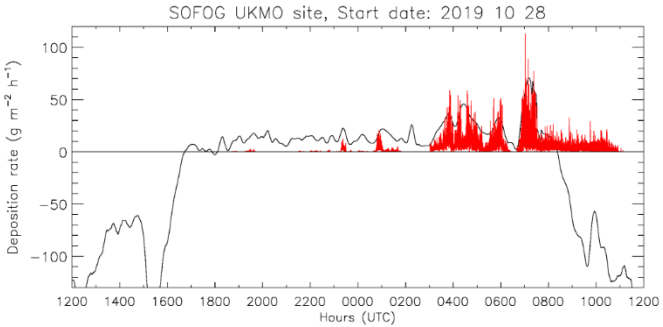
Dewmeters measure the following processes

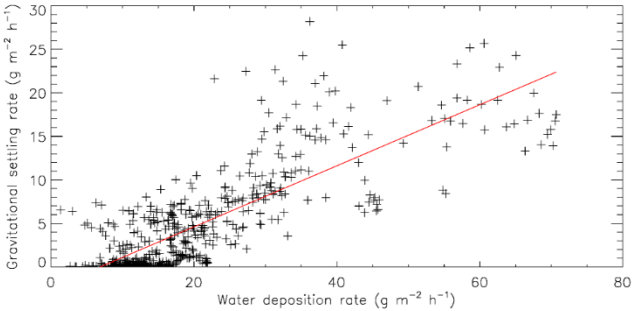
1) Hygroscopic adsorption
2) Dewfall
3) Gravitational Droplet settling
4) Turbulent droplet deposition
5) Droplet capture by ventilation

4) and 5) taken together as the as 'dynamic' deposition

Results - examples

Shallow radiation fog, m= d_g/d_t =0.35

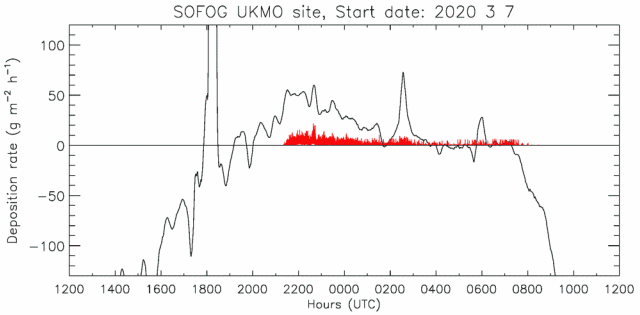


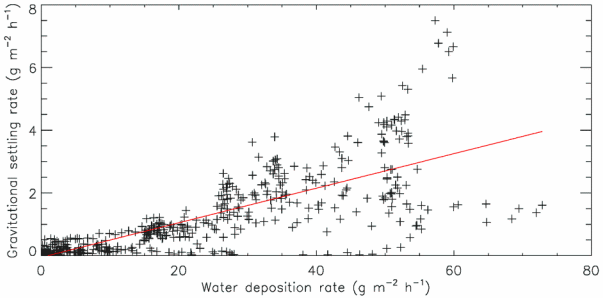


Red: dg, gravitational

Black: dt total

Advective stratus fog, m= d_g/d_t =0.06





Red line denotes fitted gradient, d_g/d_t

Does the ratio of d_g/d_t vary with the level of turbulence?

Averaged results over 8 fog episodes

	All data	'High' turbulence	'Low' turbulence
Mean, m	0.15	0.11	0.22
n	8	7	6
Std. Dev.	0.11	0.08	0.13
Std. Err.	0.04	0.03	0.05

Data were filtered according to turbulence level (ww, vertical velocity variance) : - high or low. Threshold=0.003 m^2s^2

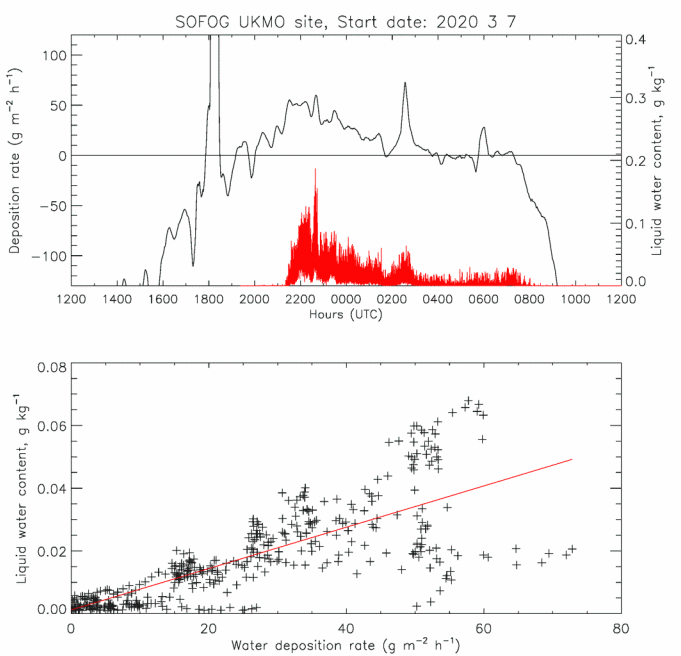
Results show low turbulence regimes have a significantly higher value of, m, i.e. there is relatively more gravitational settling in the lower turbulent regimes – these tend to be the shallow stable fogs

Other threshold values tested – gradients differed but significance in difference between high and low regimes unchanged

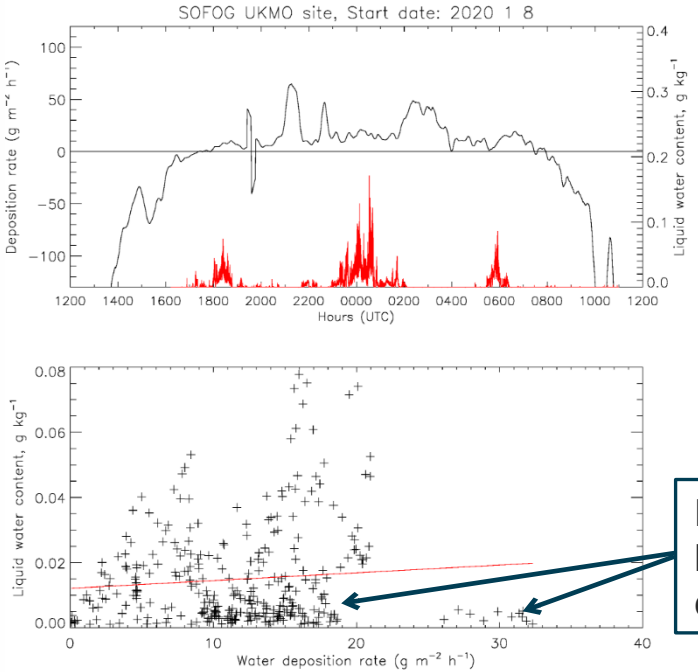
Liquid Water Content and water deposition – examples

Can we relate LWC to the measured water deposition?

Good example (stratus fog)



Not-so-good example (thin radiation fog)



Data ‘contaminated’ by continued dewfall in fog?

Averaged LWC results over 8 fog episodes

Mean, m (lwc/d_d)	0.0017
n	8
Std. dev.	0.0012
Std. err.	0.0004

- The high standard deviation indicates no universal relationship for all cases

- However, results are preliminary and better filtering and more data will be employed.

Conclusions and Further Work

- Analysis shows that the gravitational deposition of fog droplets is a small fraction (0.15) of the total water deposition during these fog cases
- The fraction of gravitational deposition is greater for cases where the turbulence intensity is lower – these typically are shallow stable radiation fogs (0.22, compared to 0.11 when ww>0.003 m^2s^2)
- The liquid water content shows some proportionality with the total water deposition in fog, though for these data there does not appear to be a universal relationship over all cases.
- However, some results may be affected by continued dewfall when the fog is shallow.

- Analysis of further cases, where possible, will provide a stronger statistical analysis
- An attempt will be made to filter out unwanted signal from dewfall in shallower fogs, or these cases could be eliminated from the analysis
- Conduct further investigation into the relation between LWC and d_t.

Any Questions?