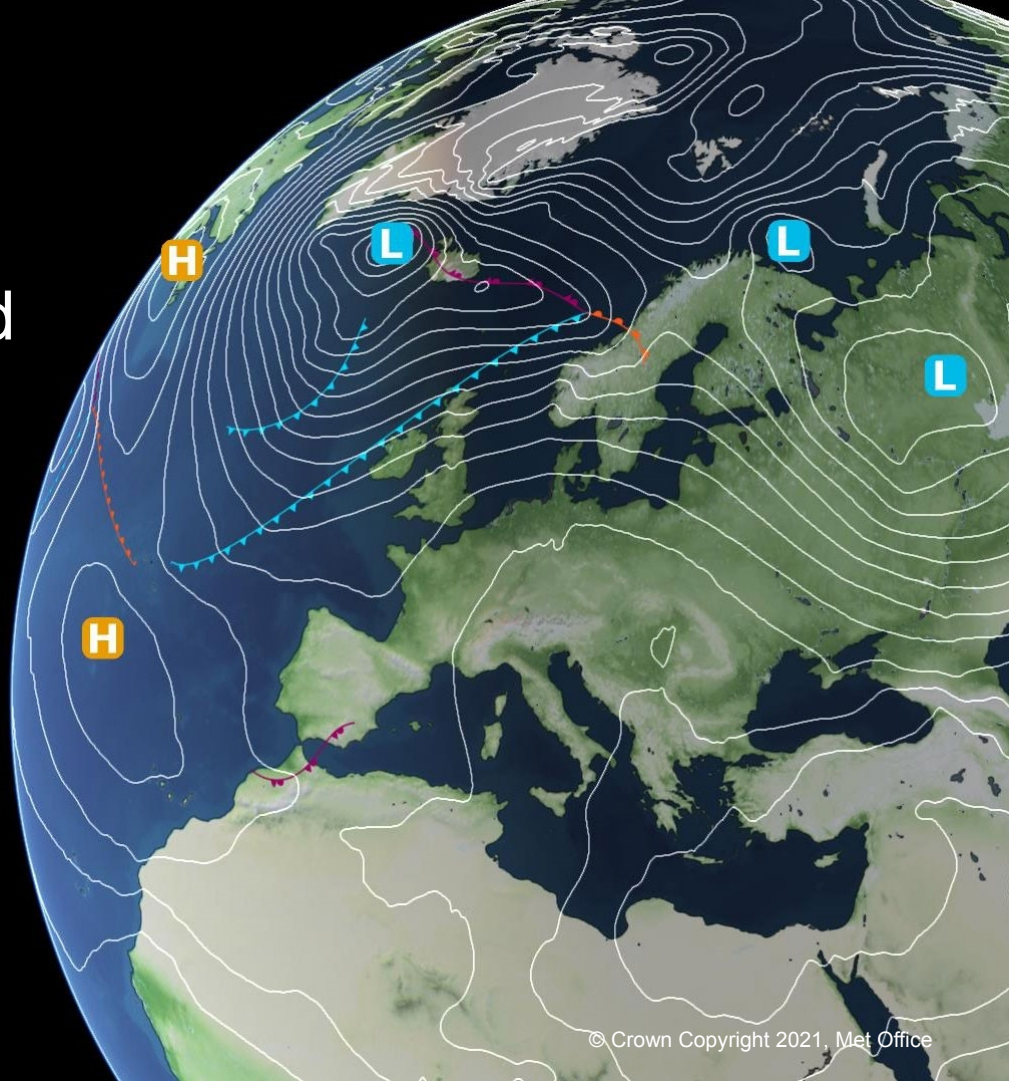


Update on Met Office SOFOG3D data analysis and future aims

*Jenna Thornton, Jeremy Price, Anne
McCabe, Paul Field, Steve Derbyshire, et
al.*

7th June 2021



Outline

1. Brief overview of observational cases assessed so far (over the UKMO site)
2. Selected case studies for current/future analysis
3. Noticeable outputs from Obs/Deterministic Model comparisons
4. Our next steps – shorter time-scales
5. Our next steps – on a longer time-scale
6. Summary

Observations – what we've analysed so far...

- Preliminary assessments of:

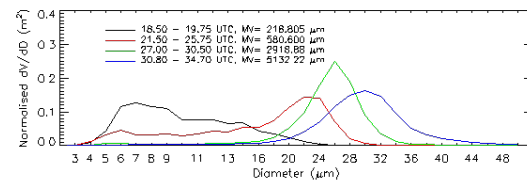
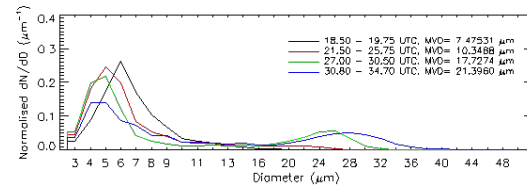
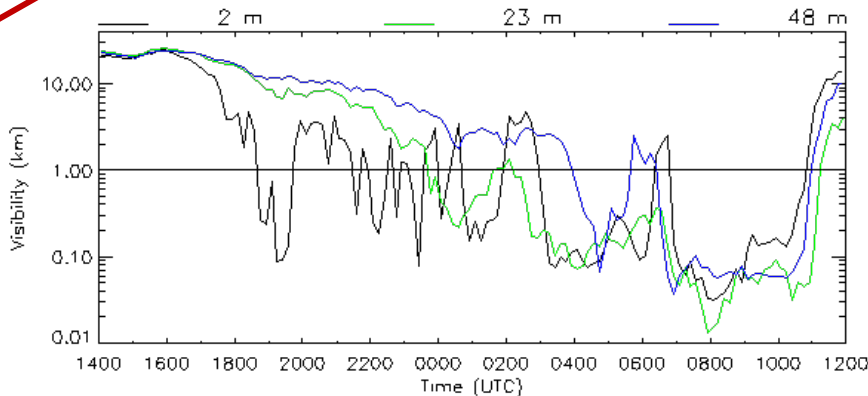
- (1) 2019-10-28
- (2) 2019-10-29
- (3) 2019-12-05
- (4) 2020-01-08
- (5) 2020-01-11
- (6) 2020-02-04
- (7) 2020-02-08
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- (9) 2020-02-23
- (10) 2020-03-07
- (11) 2020-03-11

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- (10) 2020-03-07
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Fog Event – inhomogenous initially due to low RH and cloud – replaced eventually by stratus fog

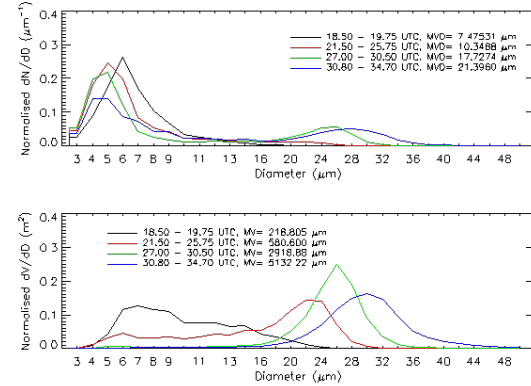
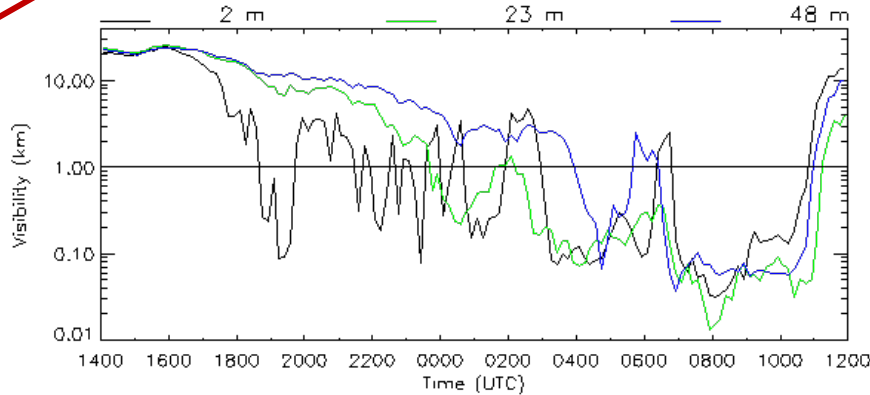


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Fog Event – inhomogenous initially due to low RH and cloud – replaced eventually by stratus fog



Interestingly..... stratus fog appeared to over-run the existing fog by advecting from the S-SW and fog subsequently became deep-adiabatic.

It is interesting to learn therefore, that such advective-fog events can occur in flat regions.

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(8) 2020-02-22

(9) 2020-02-23

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Fog Event - Shallow stable fog developing into deep adiabatic

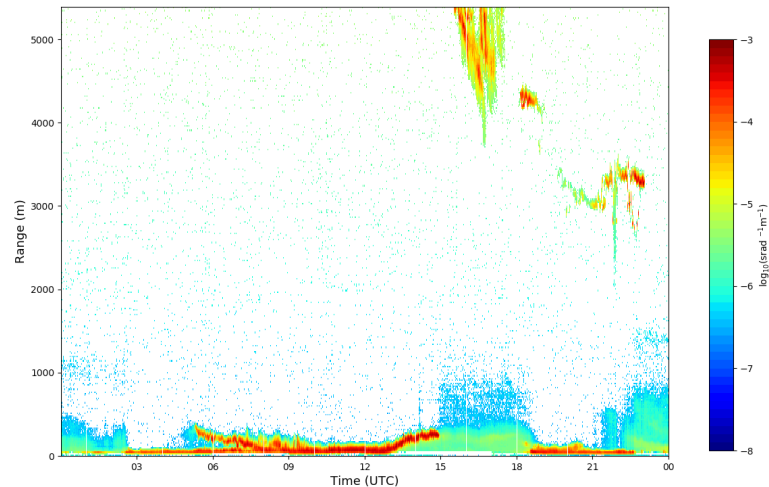
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Fog event -
Shallow stable
fog developing
into deep
adiabatic

SOFOG 20191206

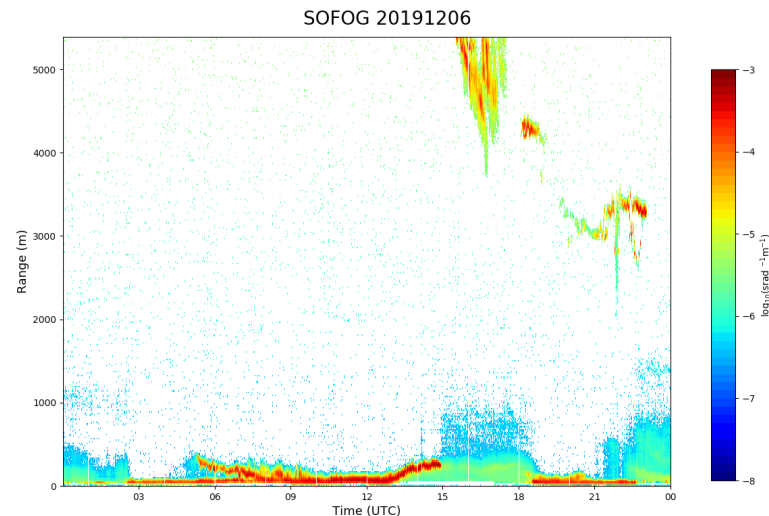


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Fog event -
Shallow stable
fog developing
into deep
adiabatic



Interestingly..... Layer of stratus (base at 300m) picked up by Lidar at 0515UTC. Over the next few hours the base of this layer reduced, eventually merging with the fog layer.

The reason for the descent is unknown at present. Cloud radar data from other SOFOG sites may help clarify the event.

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Fog Event - Shallow fog that did not develop deeper

No fog – Low turbulence, low temperature, but RH values were too low (good 'null' case)

Fog Event – But short-lived fog that formed late (due to low RH)

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Fog event - Stratus fog that lasted for several hours



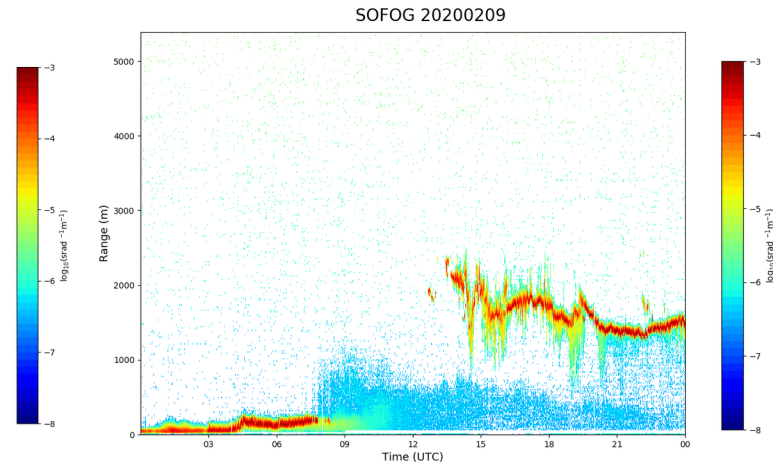
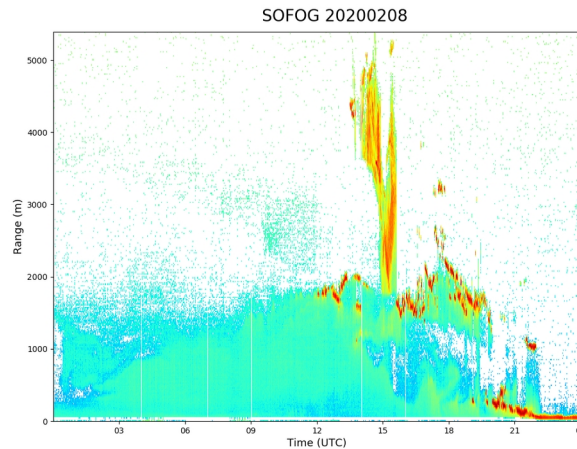
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Fog event - Stratus fog that lasted for several hours

Interestingly... Lidar showed stratus fog descending which initially appeared broken, but thickened as it lowered. Is there an accepted explanation for this type of evolution?



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Fog event – Short-lived radiation fog

Fog event – Short-lived radiation fog – affected by stratus cloud over-running

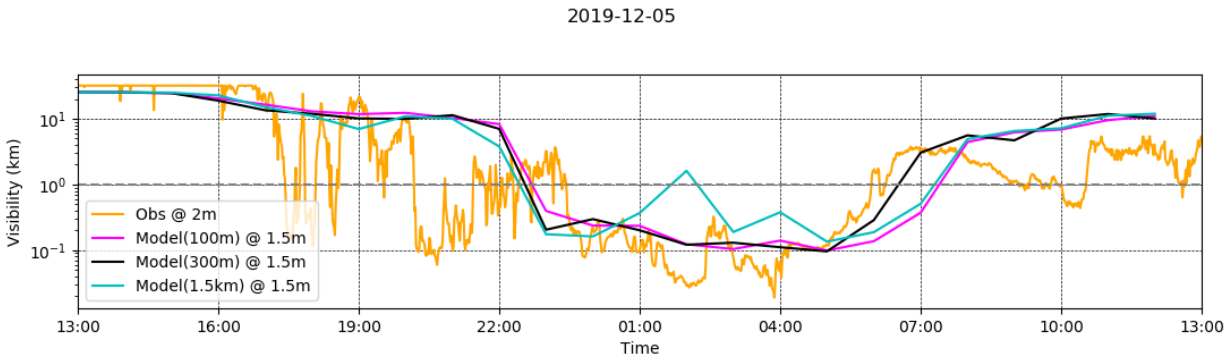
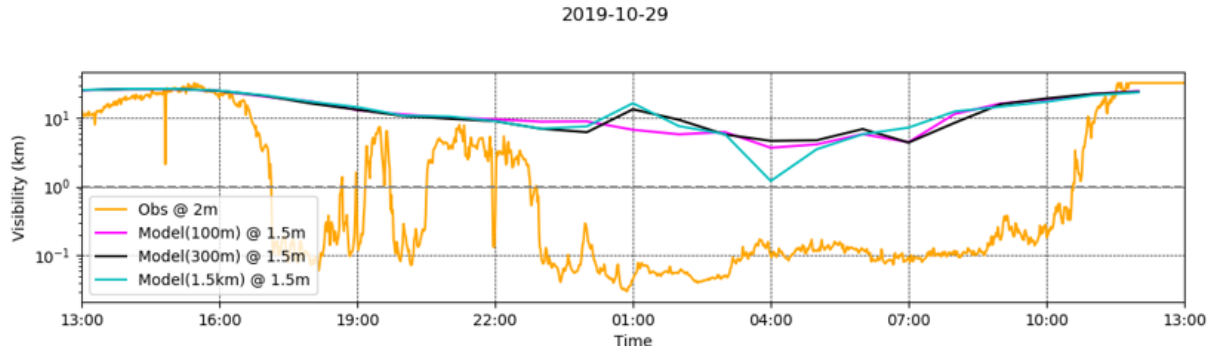
Fog event – Advective stratus fog

Fog event – Radiation fog that developed to ~70m, and was affected by cloud at times

Case Study Selection

- **29th to 30th October 2019** (persistent fog in obs, no fog in model)
- **5th to 6th December 2019** (persistent fog in obs, fog in model)
- **5th to 6th January 2020** (IOP 6 – persistent fog in obs, short-lived fog in model)
- **11th to 12th January 2020** ('null' case - no fog in obs)
- **8th to 9th February 2020** (IOP 11; stratus fog in obs, fog in model)
- **7th to 8th March 2020** (IOP 14; stratus fog in obs, some fog in model)
- **A date where fog was indicated by model but was not observed** – so far unable to identify a case like this

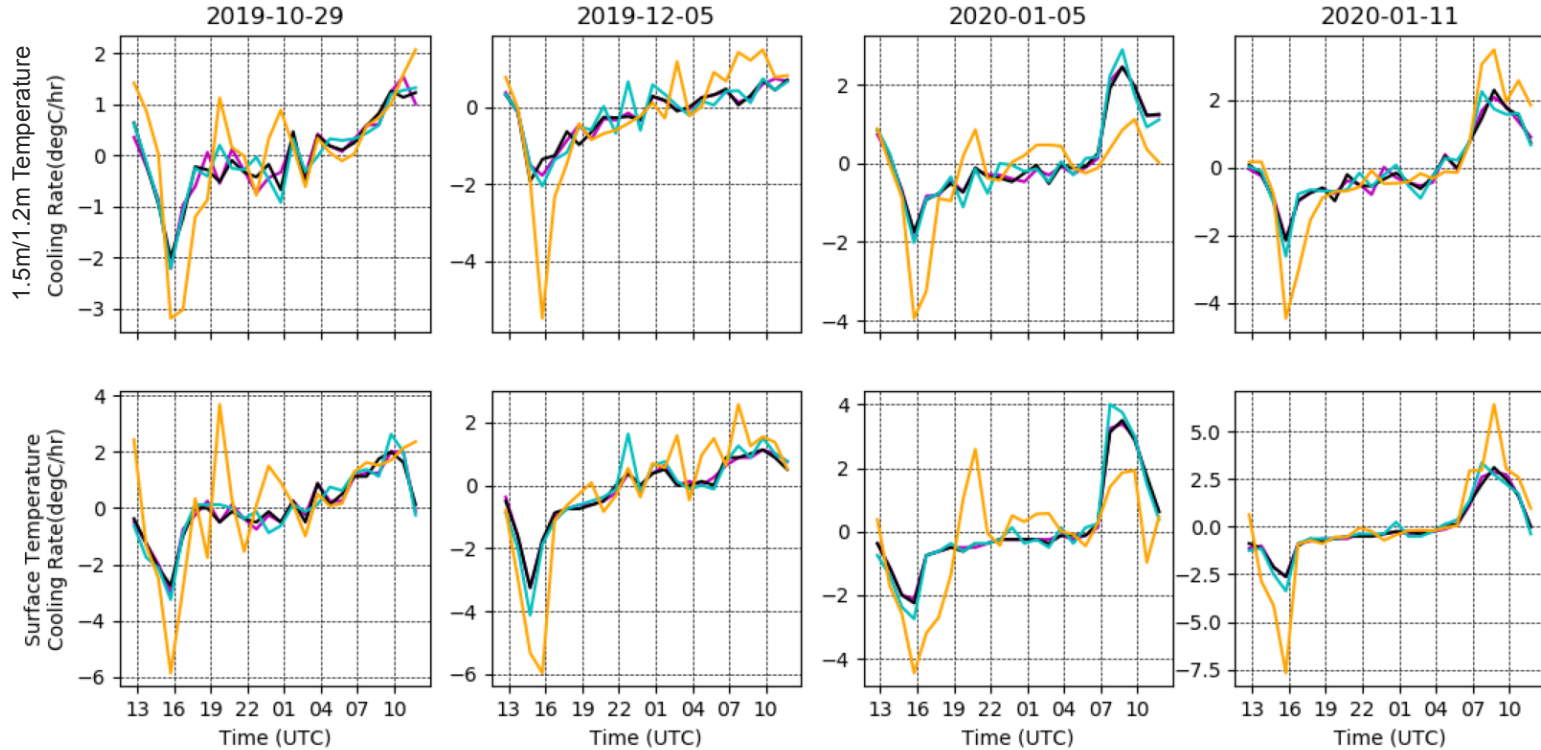
Model vs Obs - Case studies 2019-10-29 & 2019-12-05



- In both cases shallow fog was initially observed over the site – this had transformed into deep adiabatic fog by the early hours.
- However deterministic model only forecast fog during the 2019-12-05 case (and not until hours after fog was initially observed)

Model vs Obs - Cooling Discrepancies

- Recurring issue – not as much cooling in the late afternoon/early evening in the model – at both the surface and screen temperature.



Could these be affecting the initial onset of fog?

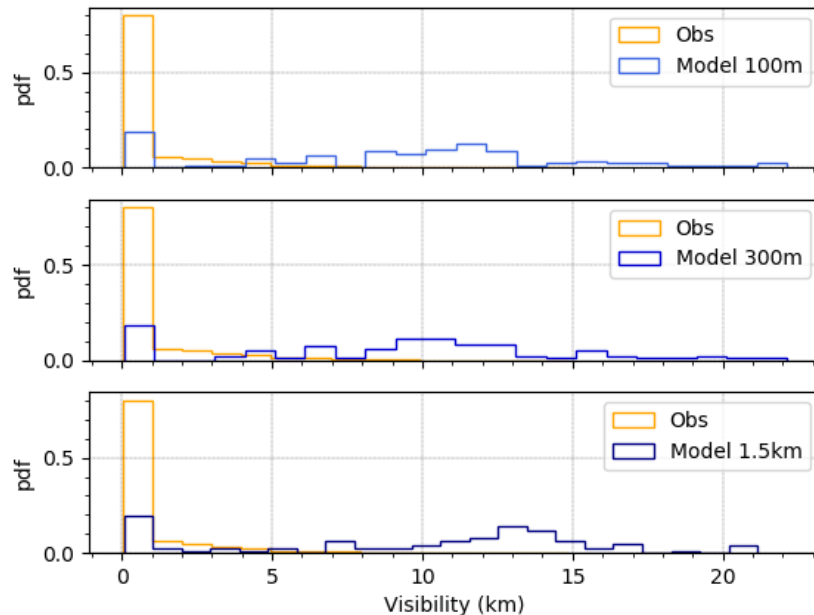
Model vs Obs - Model Resolution

From 20 chosen dates, periods of observed fog were identified on 11 dates, i.e. visibility dropped below 1km in the observations.

Visibility during these fog events was plotted as a PDF for the observations (orange), 100m, 300m, and 1.5km model resolution, respectively (blue).

No significant difference in fog prediction between the model resolutions.

Visibility during Observed Fog Events



Future/Current Work – shorter time-scale

- Analyse observational data over the 5th to 6th January 2020 case
- Start comparison work between observations at UK and French 50m mast sites during two fog events from 28th to 30th October 2019.
- Work currently being carried out to finalise corrections to our 1.2m RH measurements
- Further investigation into temperature bias seen in model output – currently undergoing analysis of the model surface energy budget & soil moisture
- Use data from other field sites for initial comparisons against model output – are there events where the model correctly predicts fog at some sites, but not at others?
- Analyse model data where the number of model levels have been doubled from 70 to 140
- Analyse model data where a bi-modal cloud scheme has been implemented

Future/Current Work – longer time-scale

- Examine droplet deposition/coalescence in the observations - relate dew-meter data to observed fog spectra – and use to constrain deterministic model microphysics
- Explore the effect of local sheltering in forested areas – is there evidence to suggest that shallow radiation fog forms preferentially in sheltered areas? Is the model able to simulate this?
- Repeat visibility pdf at different model resolutions using LANFEX data and compare to SOFOG plots – does the flatter SOFOG3D terrain present different results to the more hilly terrain of LANFEX?
- Explore the effect of modifying various constraints on the deterministic model, e.g. modifications based on the comparisons between model and obs, i.e. relating to the coupling between surface and soil.

Summary

- We have carried out a preliminary assessment of observational data over 11 cases – and highlighted some interesting features for further analysis
- These cases, and others, have been narrowed down to a list of case studies to take forward for more detailed analysis
- We have carried out comparisons between the observations and our diagnostic model
- There appears to be no significant difference between model resolutions for these cases – this is possibly a consequence of the area here being fairly uniform in altitude, and not a characteristic of the model in general.
- The deterministic model doesn't cool enough in the late afternoon/early evening - and temperatures don't drop low enough, which could be affecting the onset of fog in some cases.