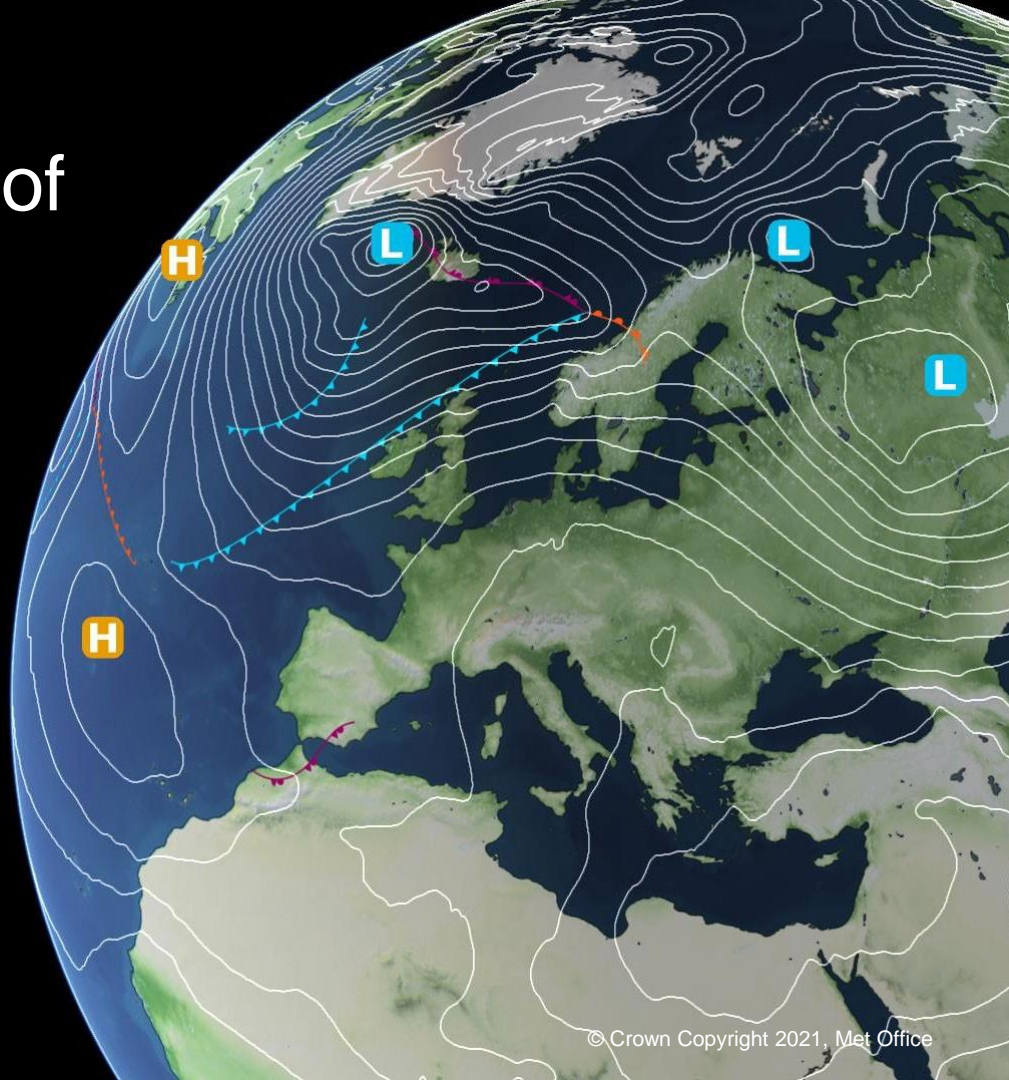


# Contrasting the evolution of radiation fog over a heterogeneous region in south-west France during the SOFOG3D campaign

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*12<sup>th</sup> June 2023*



# Outline

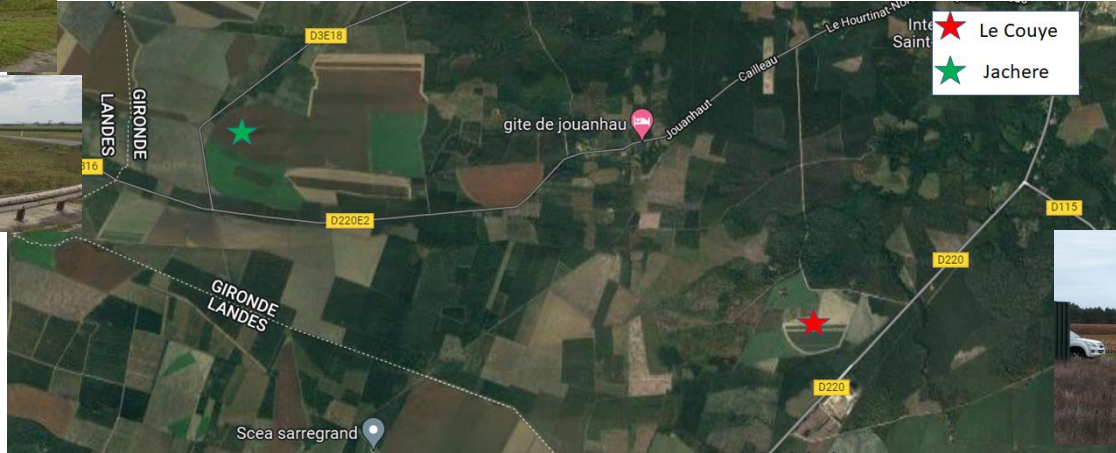
- (1) 50m mast sites – two radiation fog case studies
- (2) Near-surface only at the 50m mast sites – additional case studies
- (3) Near-surface at other sites – same case study dates
- (4) Conclusions

Carrying on from previous work:

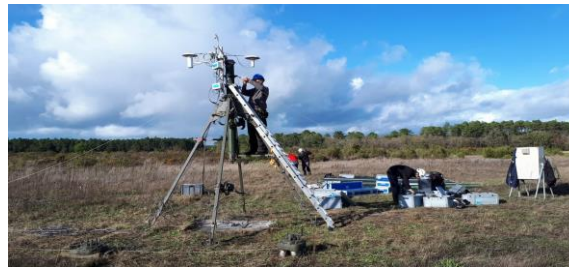
[http://www.umr-cnrm.fr/IMG/pdf/ukmo\\_observations\\_20220607\\_jt.pdf](http://www.umr-cnrm.fr/IMG/pdf/ukmo_observations_20220607_jt.pdf)



**Jachere** - MeteoFrance site – field within an open area



**Le Couye** – UKMO site – field surrounded by forested area (we refer to the site as being **sheltered**)

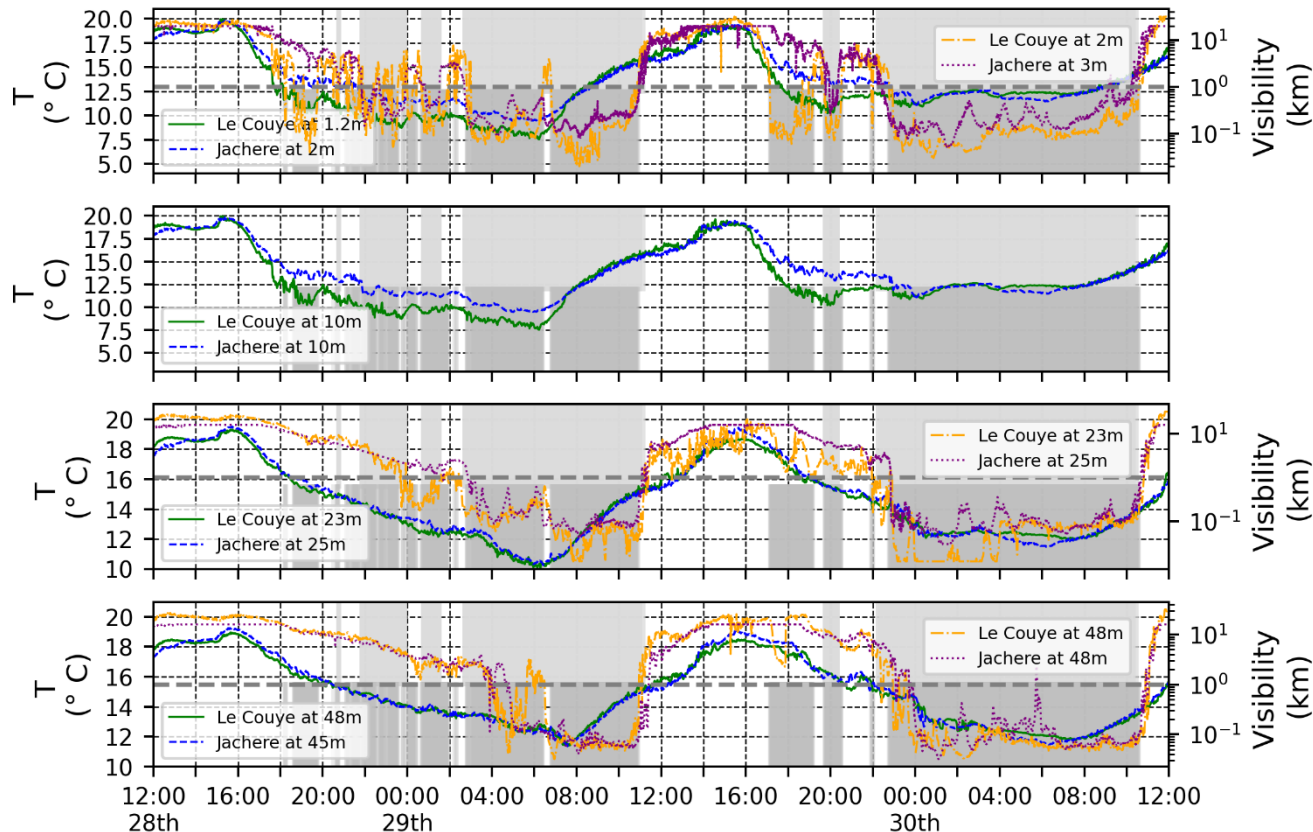


## Two cases of **radiation fog** whilst both 50m masts were erect: 28<sup>th</sup> to 29<sup>th</sup> and 29<sup>th</sup> to 30<sup>th</sup> October 2019

From the late afternoon:

(1) Visibility drops hours earlier at **Le Couye** than **Jachere** at the lowest measured level

(2) Screen-level and 10m temperatures drop lower and more rapidly at Le Couye

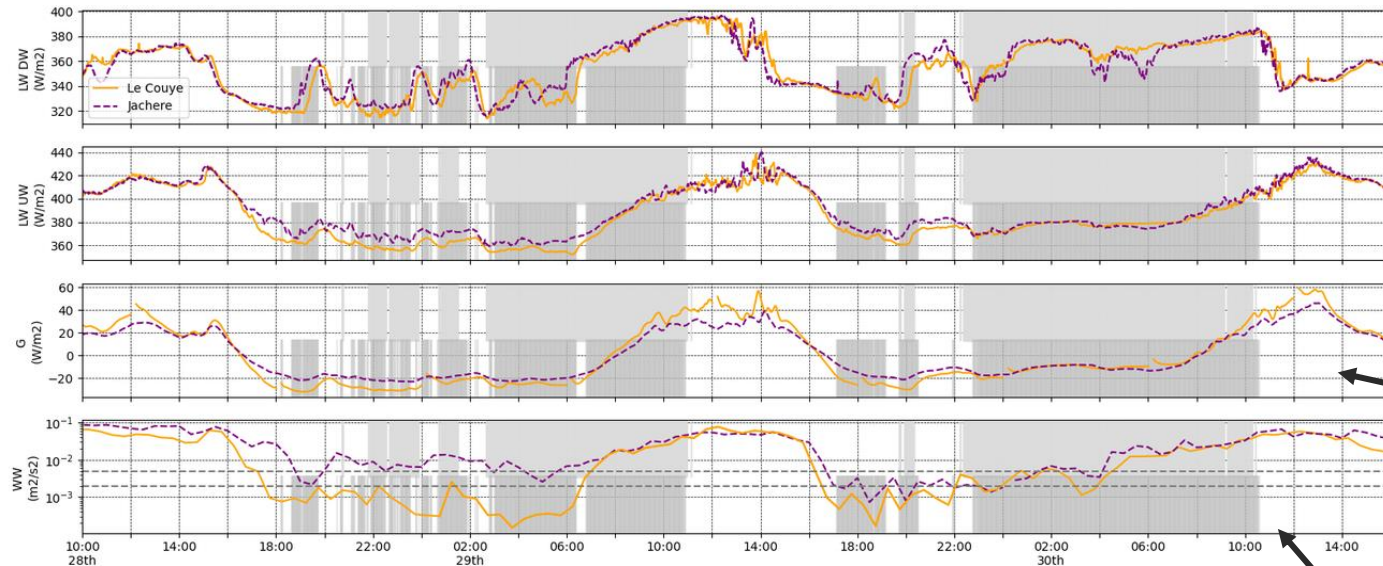


25m and 50m (approx.) are similar across the sites – tree level is around 20m

(1) 50m mast sites – two radiation fog case studies

# More cooling at **Le Couye** – why?

Near Surface Radiation Measurements



Similar **LWDW (2m, 1m)** (any differences expected to either be within measurement uncertainties or reflect the presence of cloud over the site)

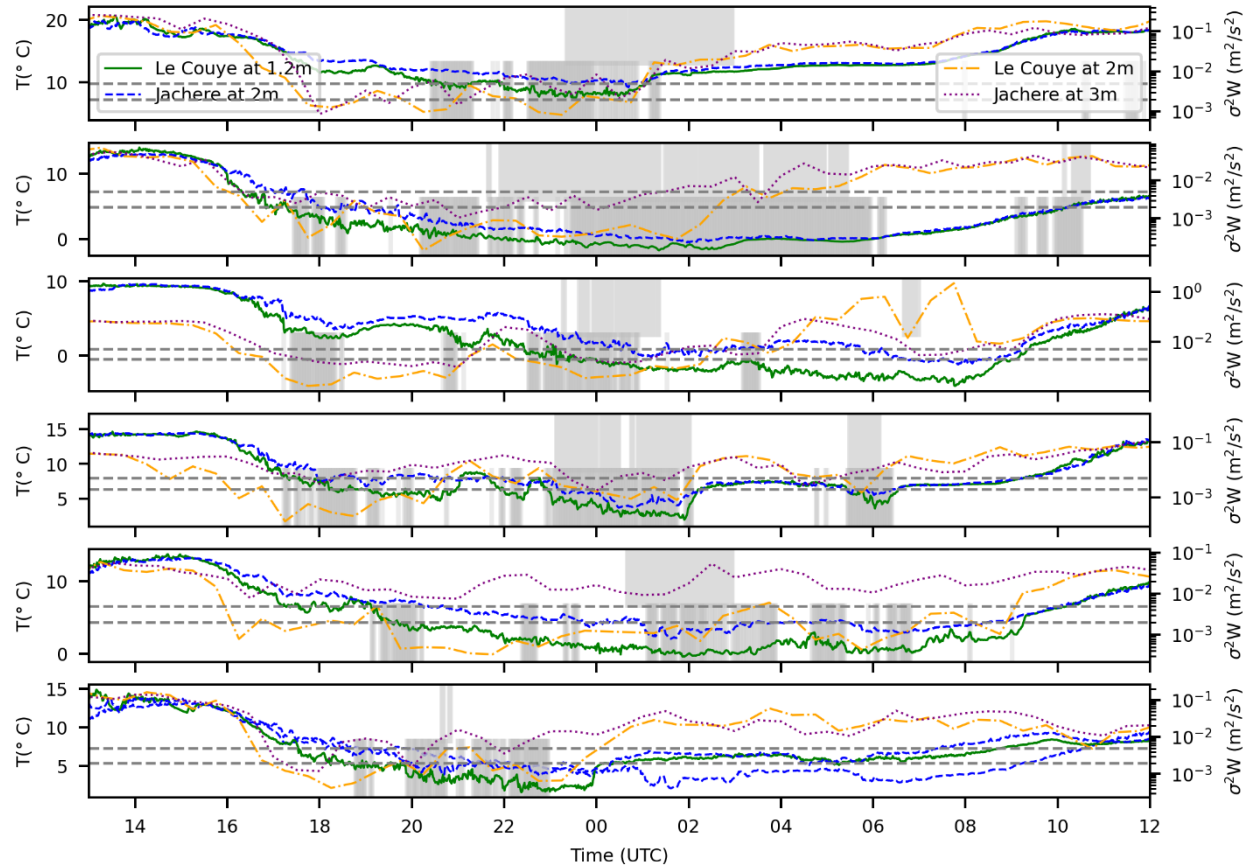
**LWUW (2m, 1m)** – lower at Le Couye due to cooler temperatures

**Soil heat flux (G) (~-2cm)**  
 - driven by soil temperature gradient so more negative at Le Couye due to cooler skin temperatures

**Vertical velocity variance (WW) (turbulence) (2m, 3m)** - drops more rapidly at Le Couye in late afternoon/early evening – limiting the transfer of warmer air downwards & allowing more cooling.

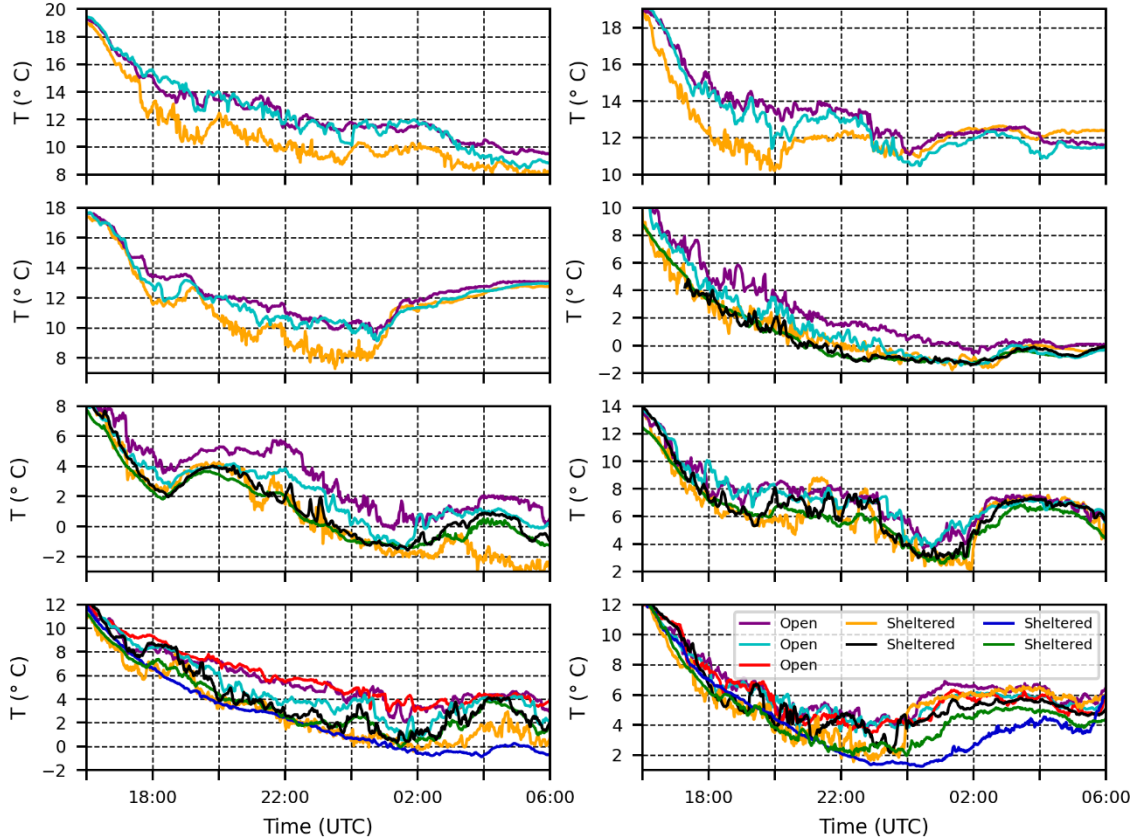
We suggest that the lower vertical turbulence caused by sheltering allows the near-surface to cool more rapidly and for fog to form.

# Is this also the case across other radiation fog events?



Six other **radiation fog** events – show consistent results – lower vertical turbulence, more cooling, and earlier fog formation at the sheltered site of **Le Couye**

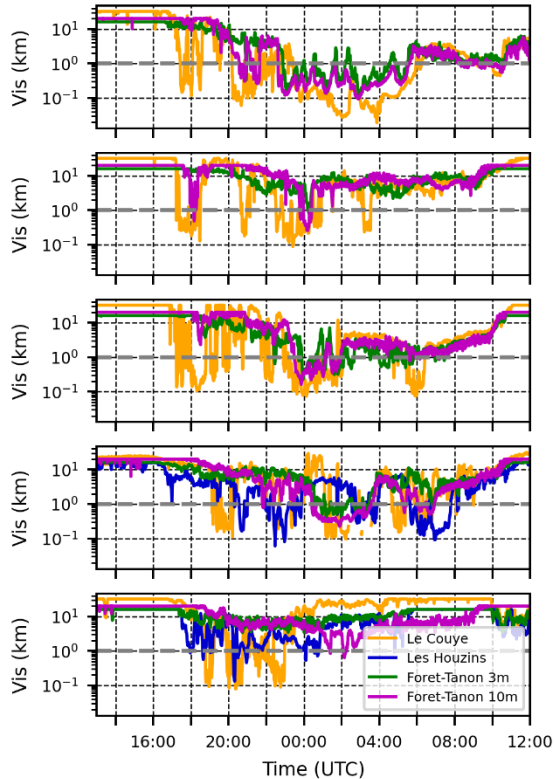
The grey shading at the top half and the bottom half of each plot correspond to when fog had formed at the lowest level at **Le Couye** and **Jachere**, respectively.



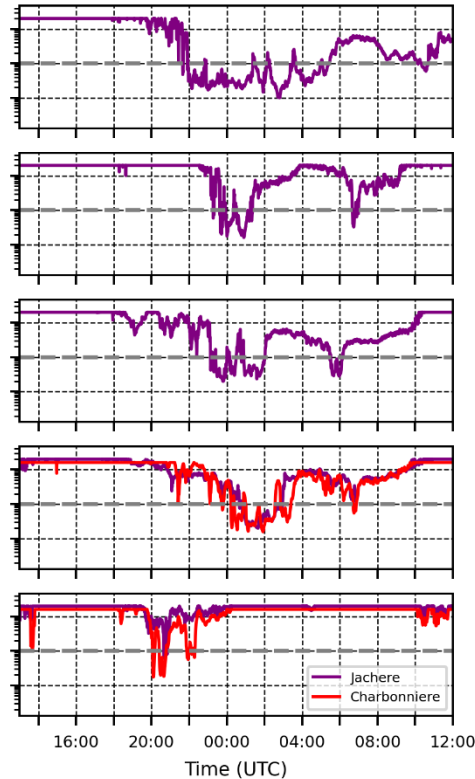
Near-surface temperatures cooler at 'sheltered' sites.

Similarity between each of the 'open' sites, and each of the 'sheltered' sites.

## Sheltered sites



## Open sites



Near-surface visibility at **Les Houzins** and **Le Couye** (sheltered) do drop earlier than at the two open sites  
 But fog occurs at **Foret-Tanon** (very sheltered) around the time it does at the open sites.

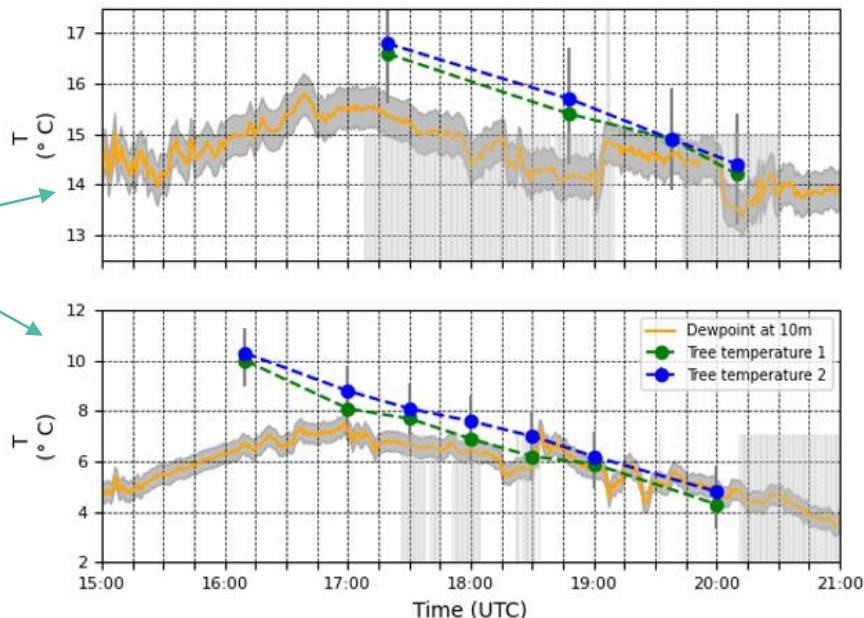
However the **10m** vis at Foret-Tanon tends to drop earlier than at **3m**.



Near-surface temperatures at Foret-Tanon are similar to those at Le Couye yet fog did not form as early at the lower level... we speculate as to why:

(1) Water is captured by the trees at Foret-Tanon  
 - Comparing the dewpoint T and tree temperatures at Le Couye – at Le Couye it is plausible (radiation fog cases – 29/10/2019 & 05/12/2019)

(2) Alternatively, fog may typically have advected at higher levels, or formed at tree-top level, and in this case the fog did not always reach the lower canopy due to unfavourable conditions there

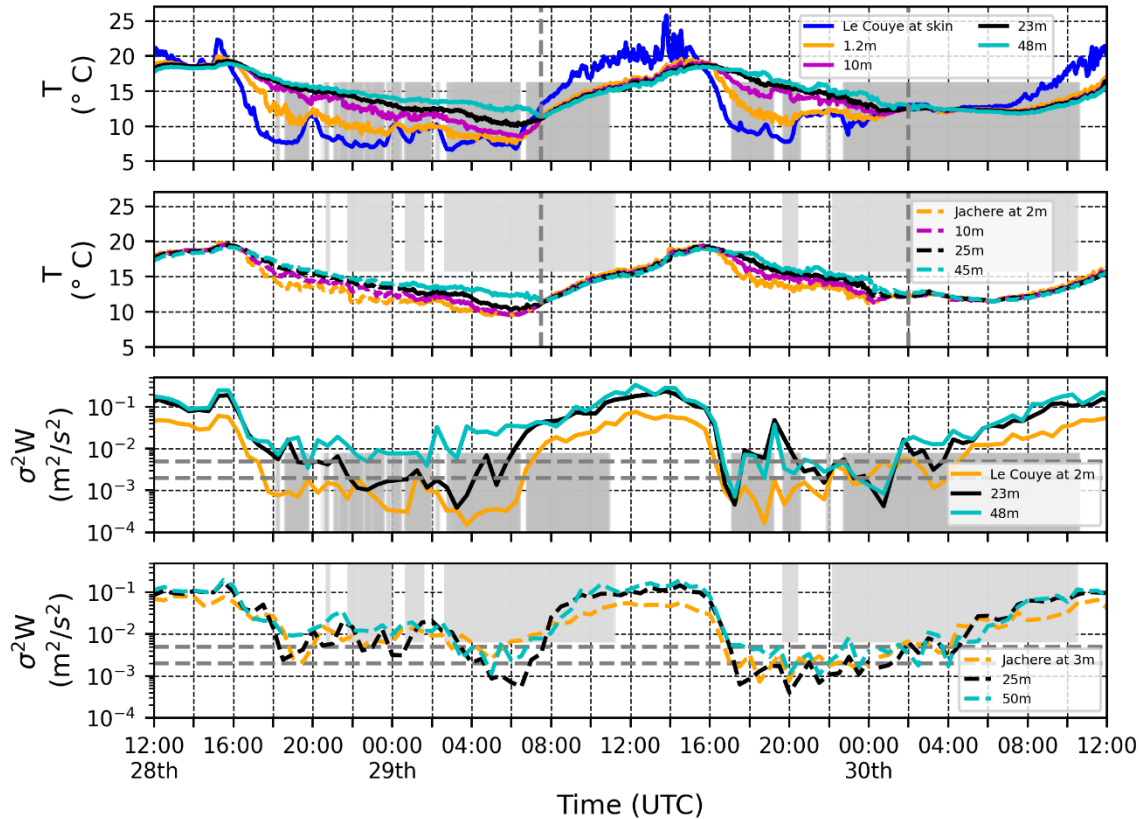


(3) Near surface at other sites – for the same case dates

- Fog forms at the lowest visiometer level at the sheltered site of Le Couye hours before it does at the open site of Jachere.
- This coincides with more rapid cooling from the late afternoon at Le Couye (below tree-height only)
- And greater reductions in vertical turbulence near the surface
- Therefore we suggest that the surrounding forest creates a sheltering effect that causes a reduction in vertical mixing, and allows for more cooling and fog formation.
- We see this across all 8 of the radiation fog cases we looked at.
- At additional sites we find that there is a scale of openness somewhere between very open sites (Jachere, Charbonniere) and very narrow forest clearings (Foret-Tanon) where fog formation is enhanced by sheltering from the surrounding forested area (Le Couye, Les Houzins).
  
- Could a few clearings in a more generally open landscape cool the air sufficiently to reduce temperatures over a wider region and hence allow fog to form, that otherwise would not?
- Requirement for further measurement campaigns to explore the fog life-cycle on a very fine scale within forests and their surroundings to better describe the transition from forest to clearing.

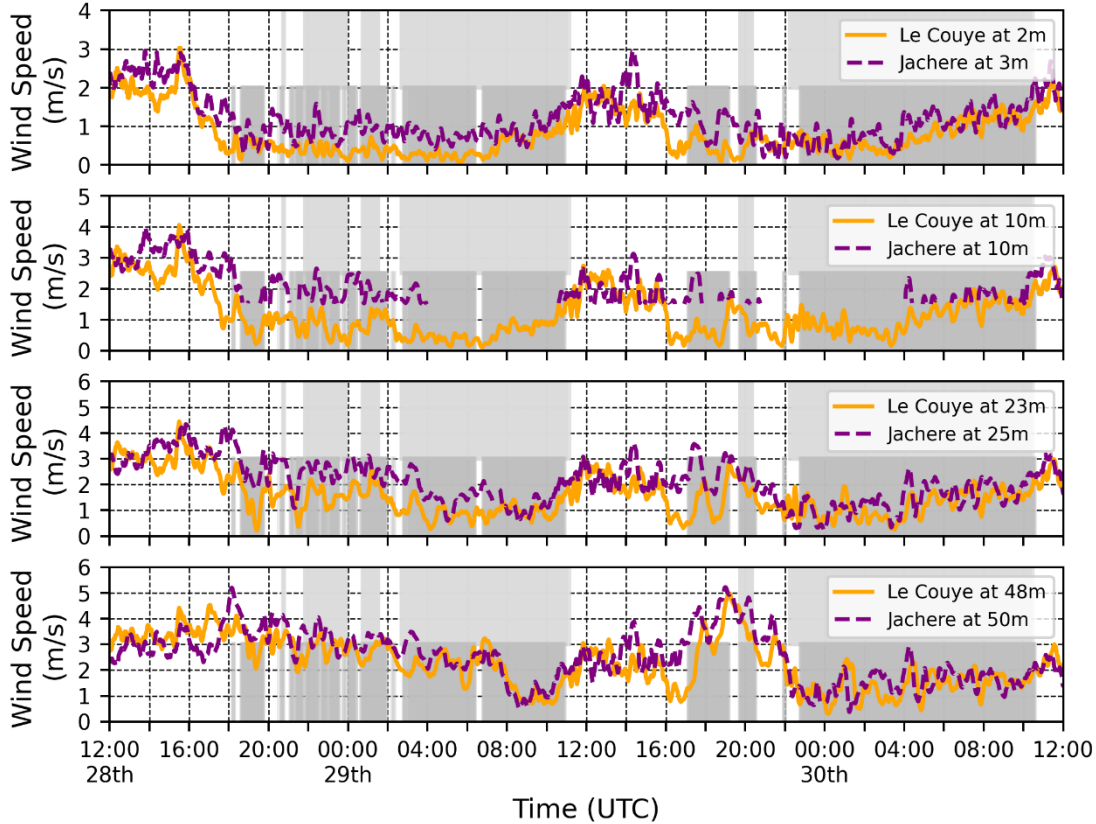
Acknowledgement: Merci beaucoup to all who have been involved in the collection and provision of data at the Jachere, Charbonniere, Les Houzins, Foret-Tanon sites.

**Any Questions?**



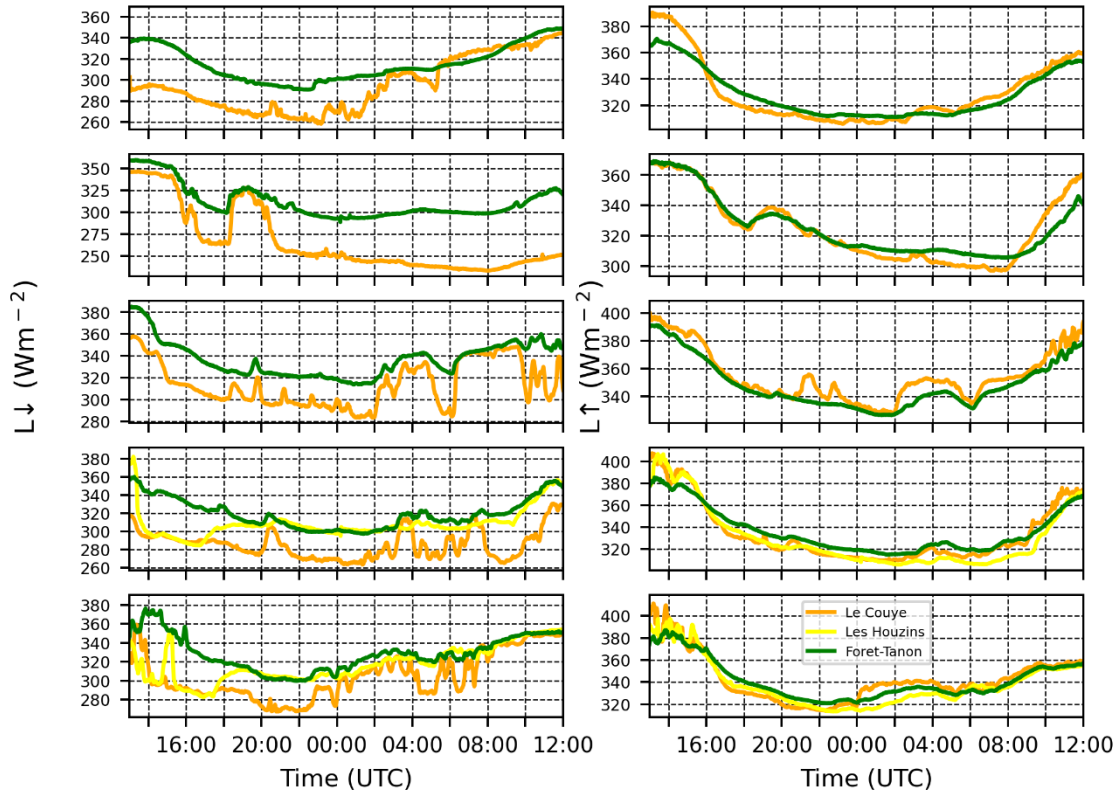
Temperature and  
WW at multiple  
heights – Le  
Couye and  
Jachere on  
separate plots.

October cases



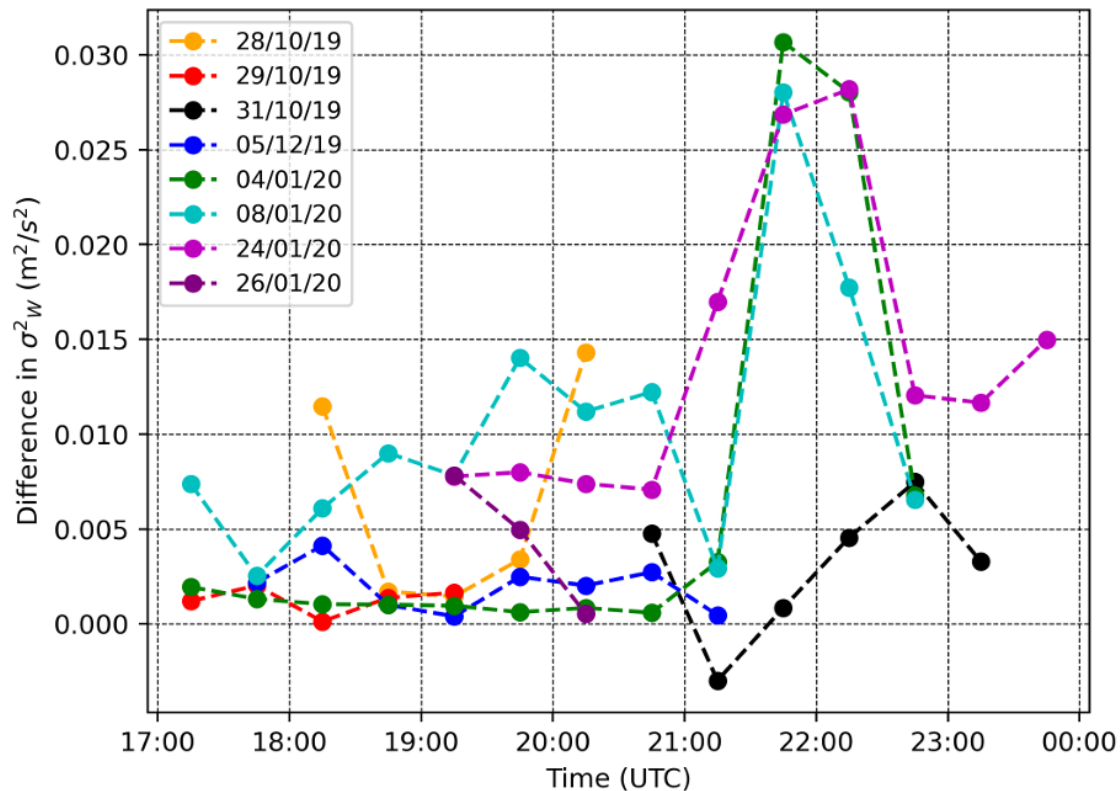
Wind speed at multiple heights – Le Couye and Jachere on same plots.

October cases



LW downwelling and upwelling at the 'sheltered' sites

additional cases (from 5<sup>th</sup> December 2019)



Difference between WW at Le Couye and Jachere for each of the 8 cases.

# Sensible Heat Flux – near to surface

