Mean and turbulent measurements

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Summary

1. Data availability

2. IOP2
   - -global situation (time series and radiosonde)
   - -data from tethersonde
   - -turbulent fluxes and TKE

3. IOP6
   - -global situation (time series and radiosonde)
   - -turbulent fluxes and TKE

4.IOP14
   - -global situation (time series and radiosonde)
   - -data from tethersonde
   - -turbulent fluxes and TKE

5. Conclusion

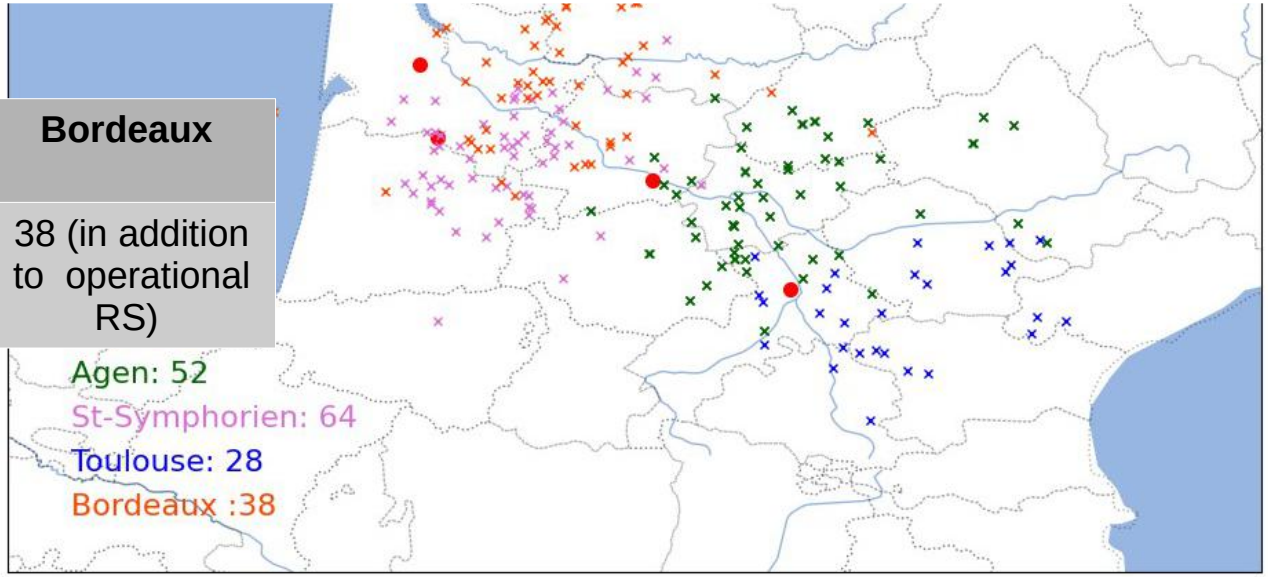
Data availability

POI	1 29/11	2 04/12	3 17/12	4 26/12	5 30/12	6 03/01	7 08/01	8 11/01	9 23/01	10 04/02	11 08/02	12 19/02	13 22/02	14 07/03	15 11/03
Stations **(P,T,RH, Wind, Radiation ,Soil meas.)**	10/11	10/11	10/11	10/11	10/11	10/11	10/11	10/11	11/11	11/11	11/11	11/11	11/11	11/11	11/11
RS	6	9	2	1	2	11	2	1	6	2	3	3	5	4	3
TS thermo + flux Nb of level	Y 26	Y 25	Y 5	Y/N 1	N	N	N	N	Y 21	Y 3	Y 6	Y 11	Y 7	Y 6	Y 9
T Profile	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan	Tuzan Nizan
Flux Meas.	Sore Jach	Sore Jach	Sore Jach	Sore Jach	Sore Jach	Sore Jach	Sore Jach	Sore Jach	Sore Jach	Sore Jach	Sore Jach	Sore Jach	Sore Jach	Sore Jach	Sore Jach
Lidar	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Data availability

- RS for thermodynamic

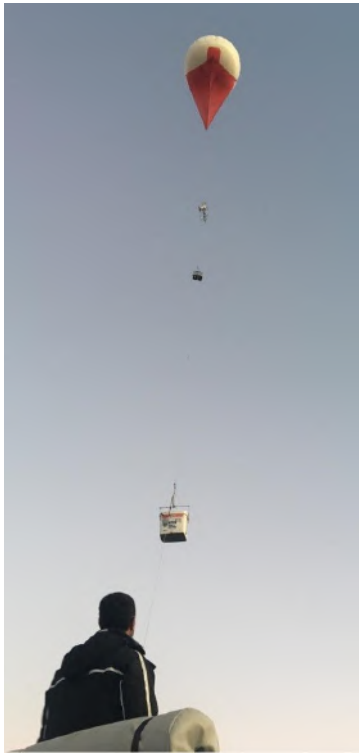
Location	Toulouse	Agen	St-Symhorien	Bordeaux
Tot. sounding	28	52	64	38 (in addition to operational RS)



- Some numbers on balloon-borne measurements :

120 hours of thermodynamic and wind measurement
120 levels to measure turbulent fluxes and variances
Additionnal payloads

- windcube lidar for wind/tke close to the ground



IOP2 : 5-7/12/2019

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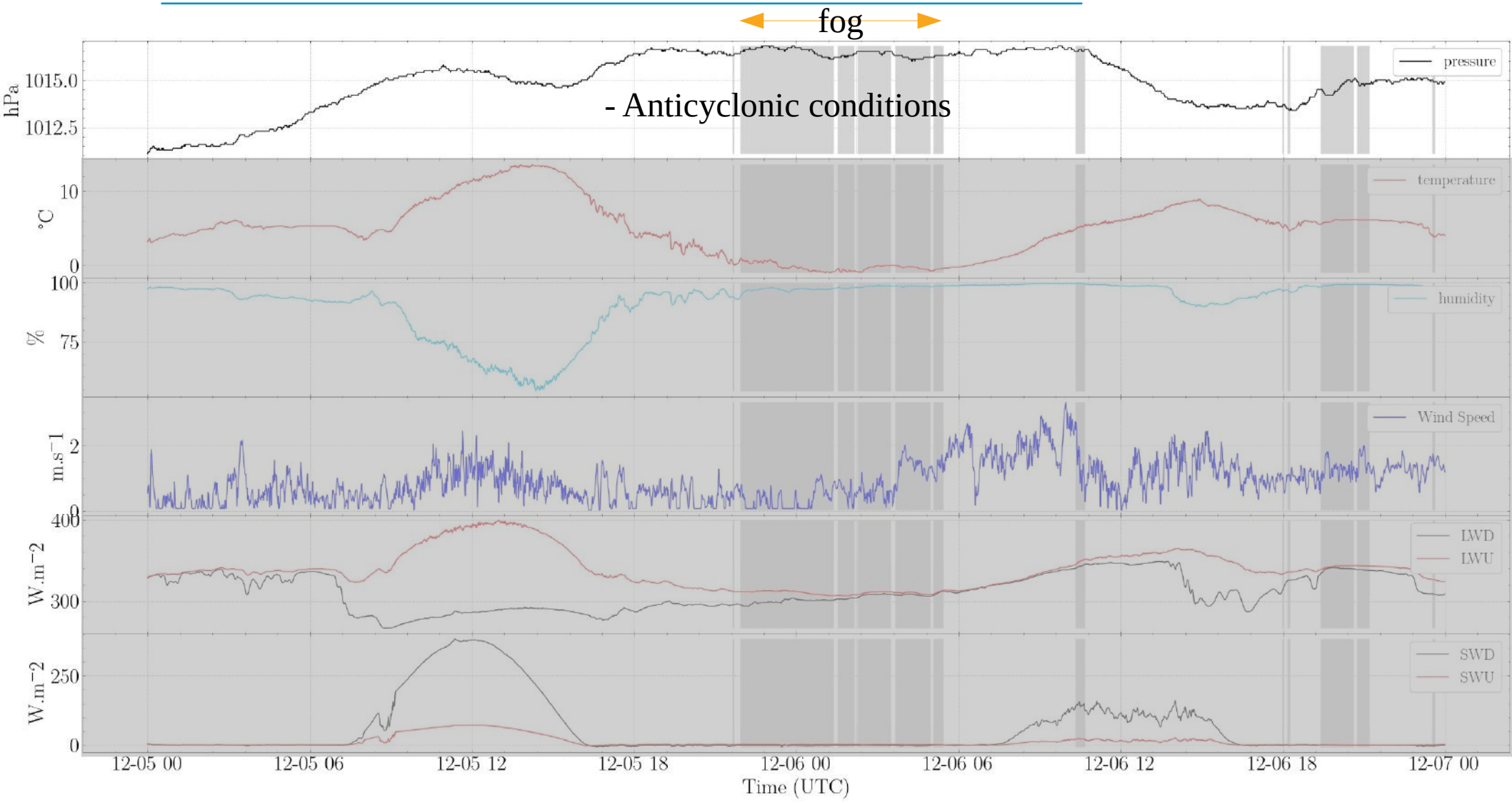

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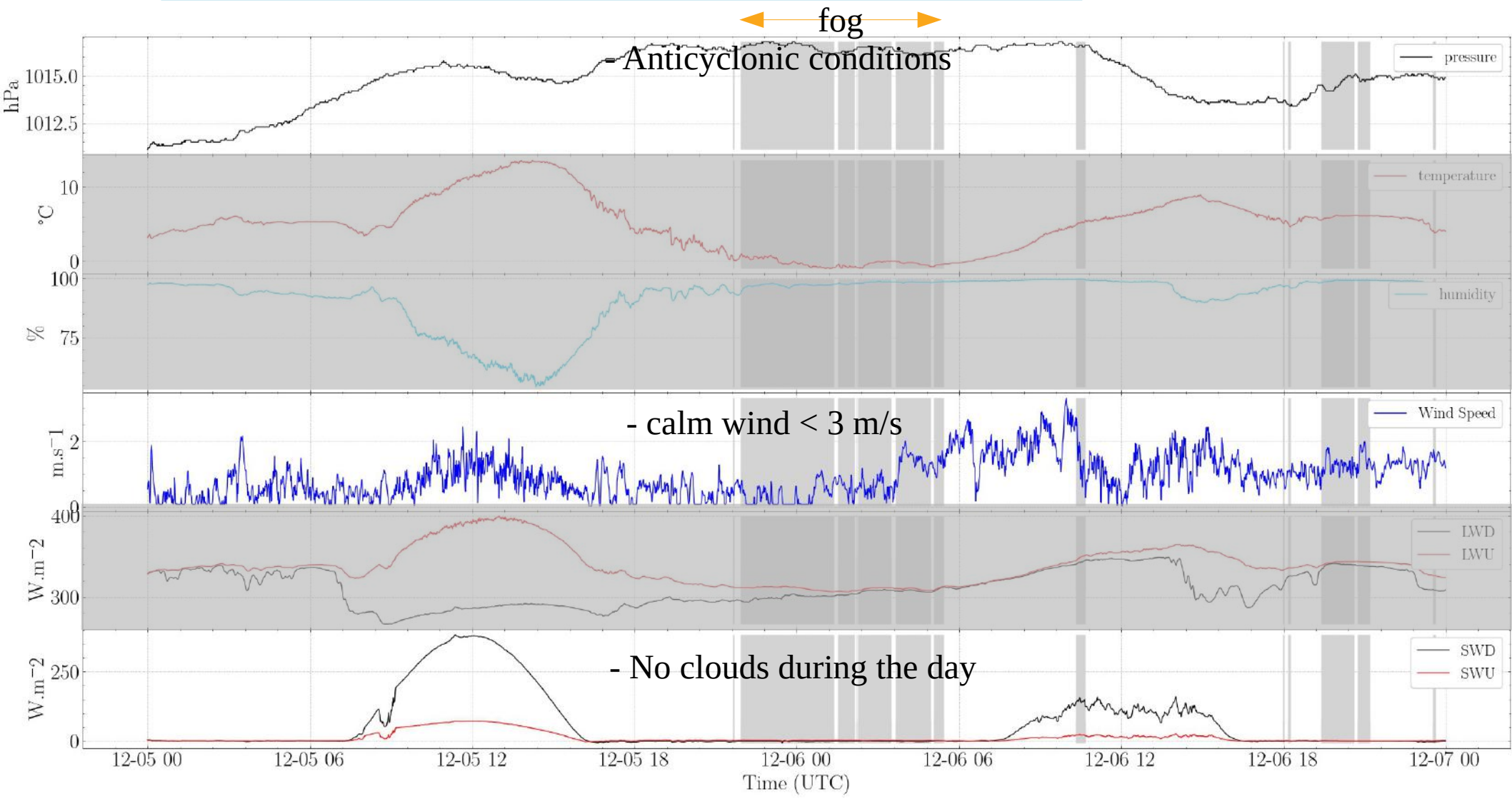

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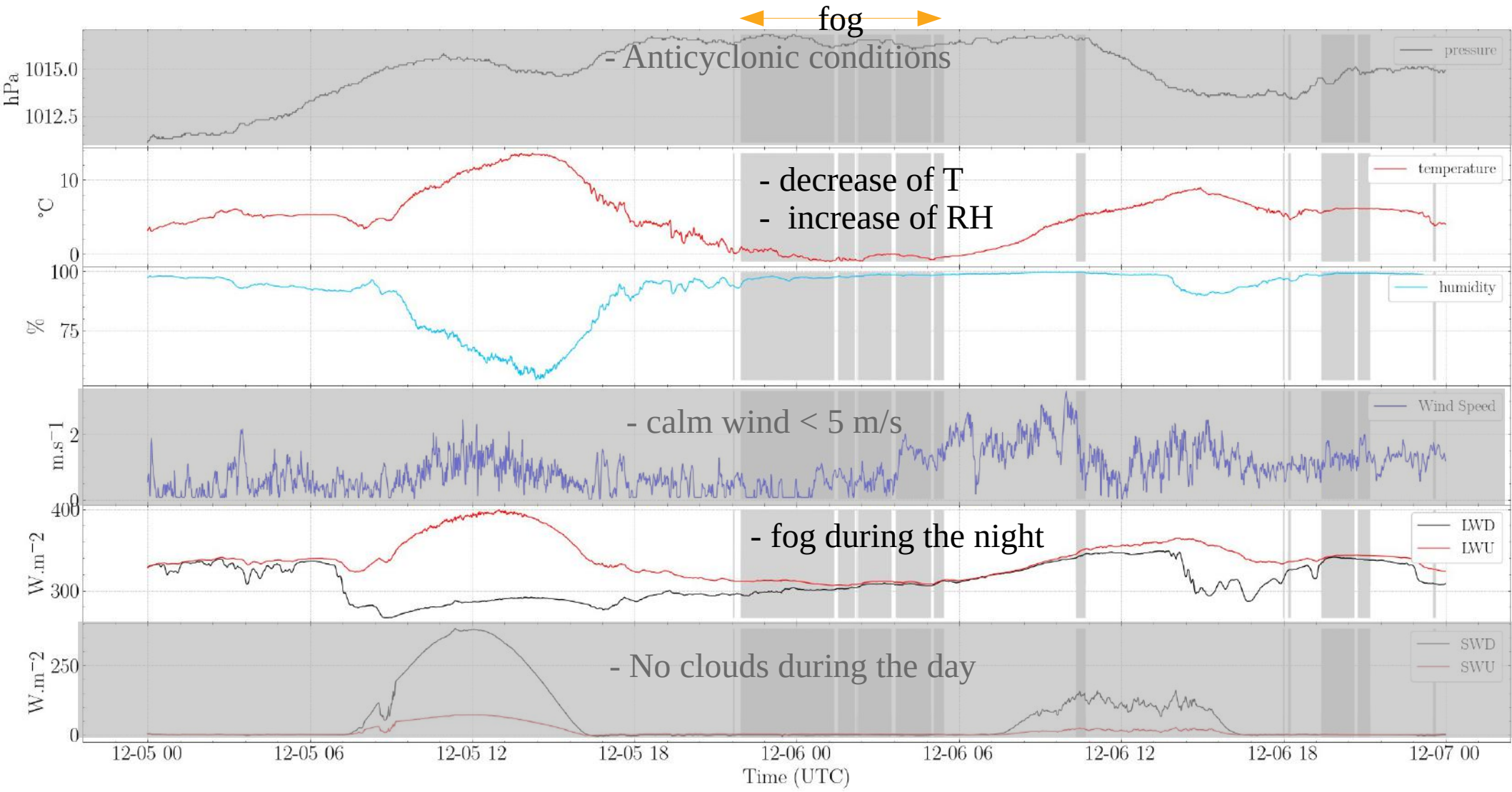

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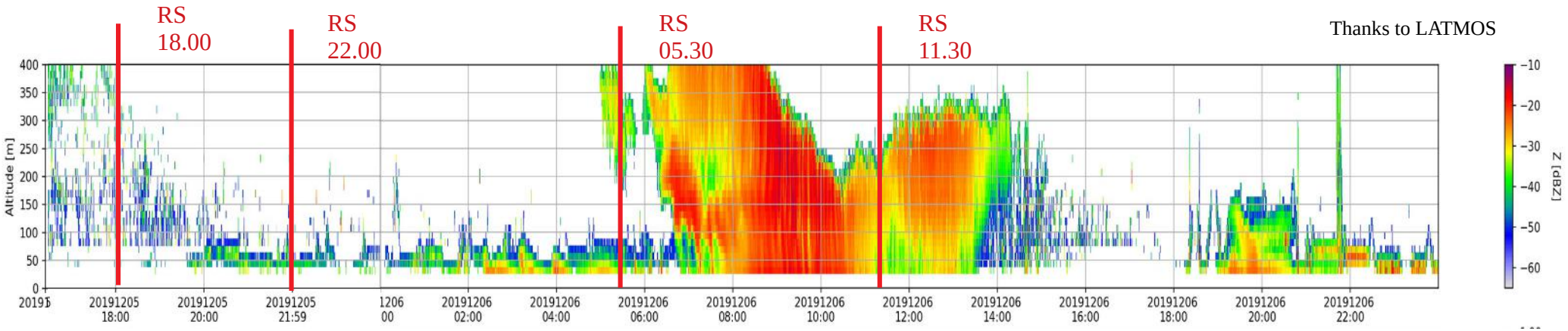
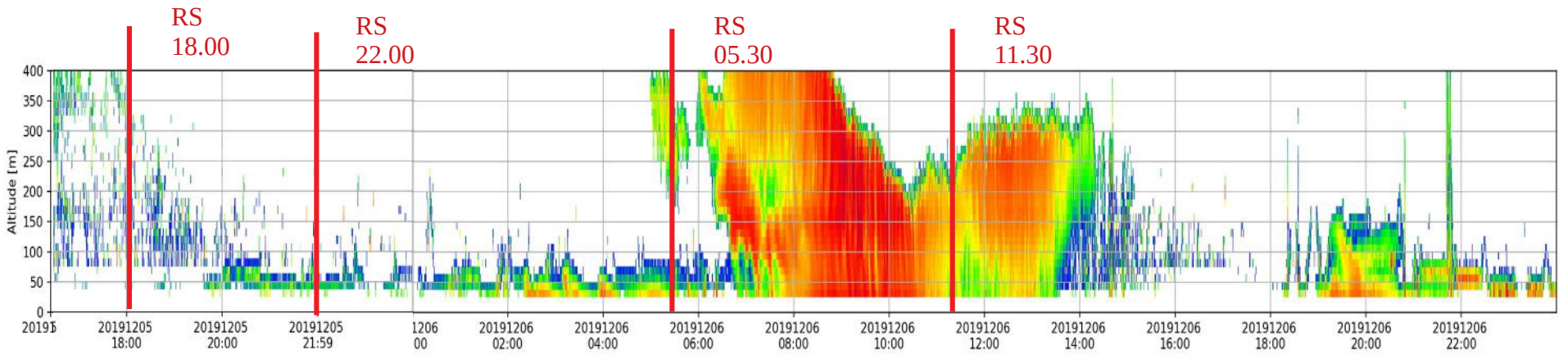
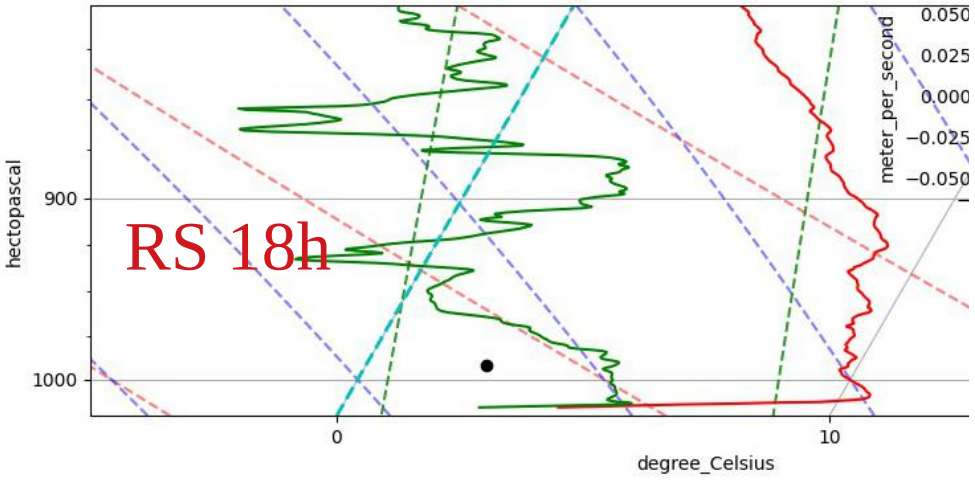


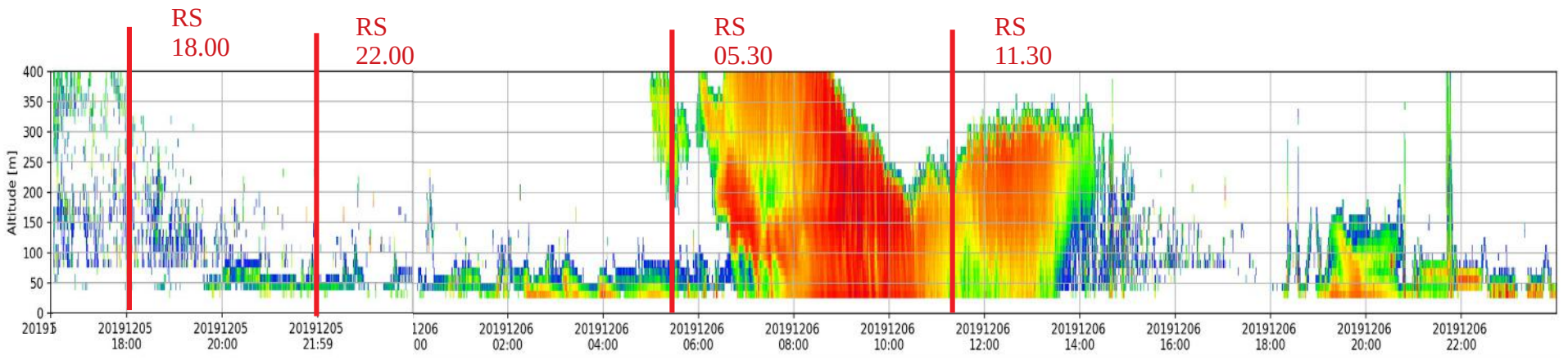


Patchy fog with Sc above

Stratus becoming fog

Inversion of temperature
→ Decreasing of temperature at the ground

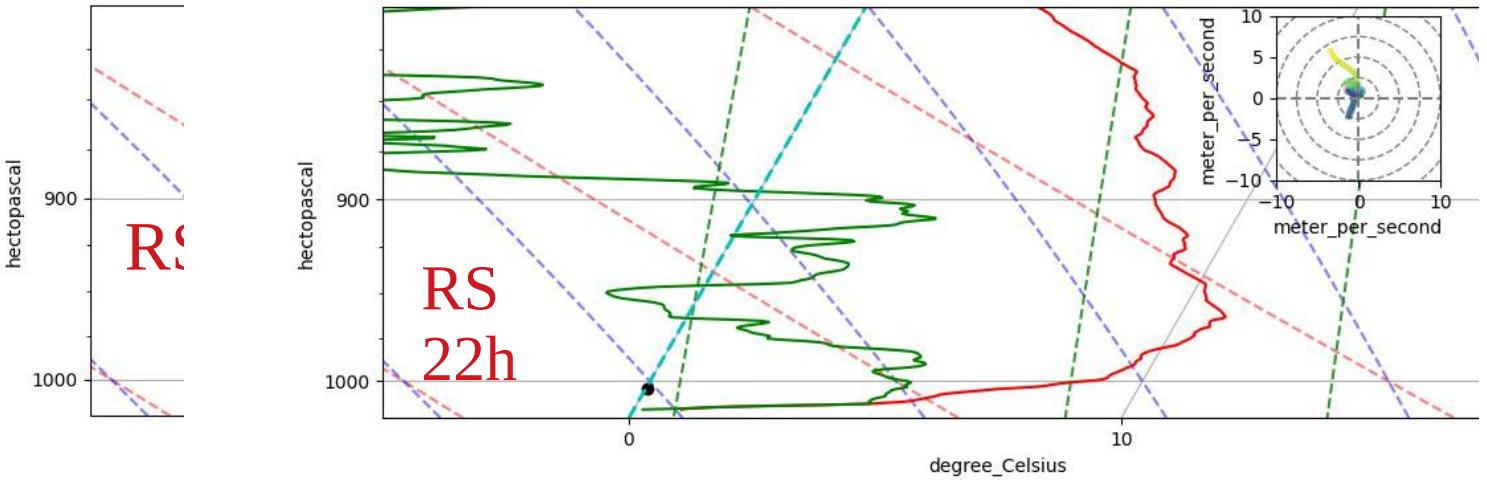


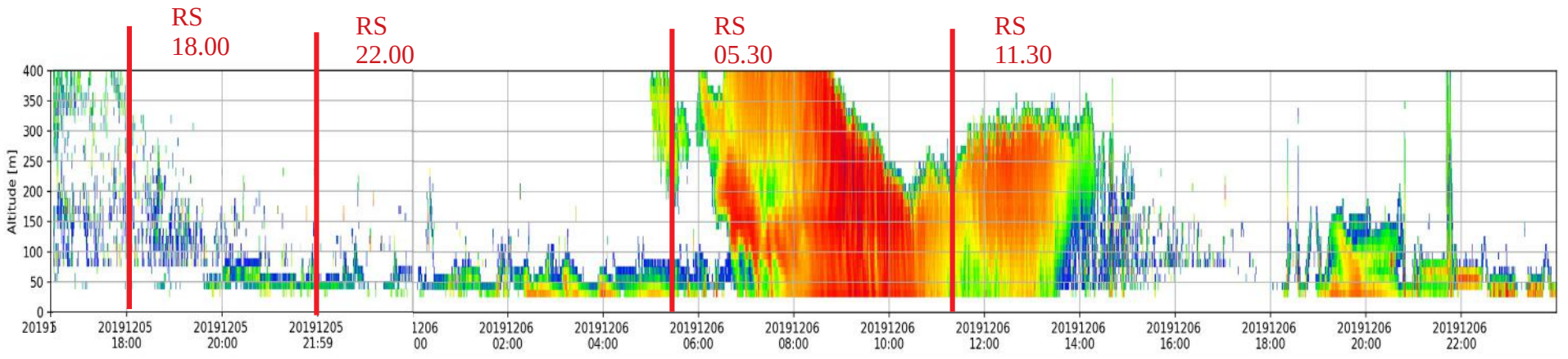


Patchy fog with Sc above

Stratus becoming fog

- Temperature continues to decrease → not yet equal to Td
- The warm area close to the ground disappears

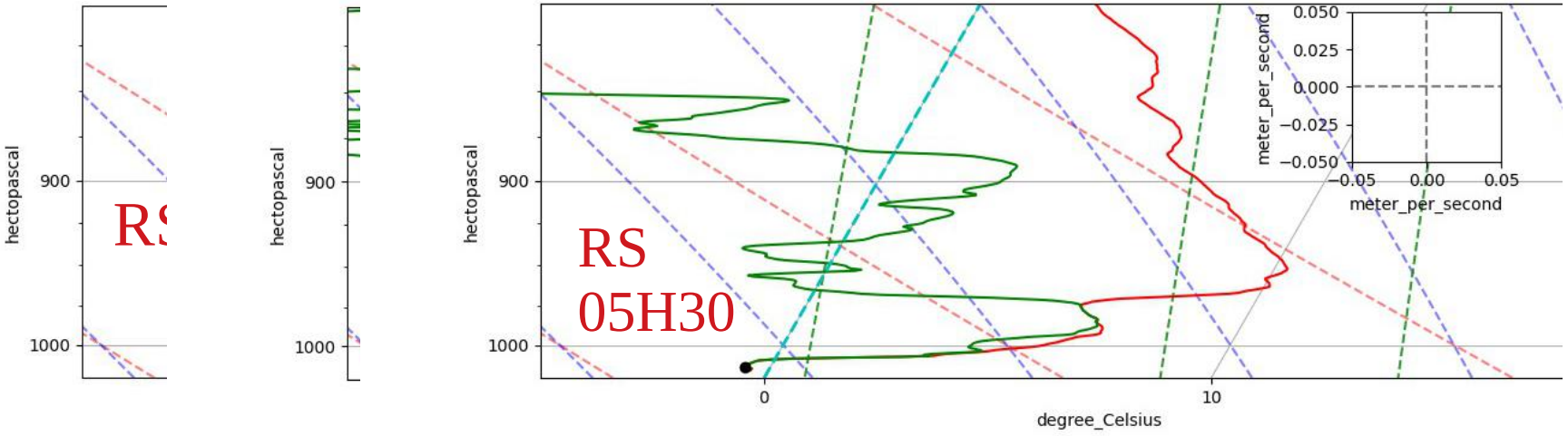


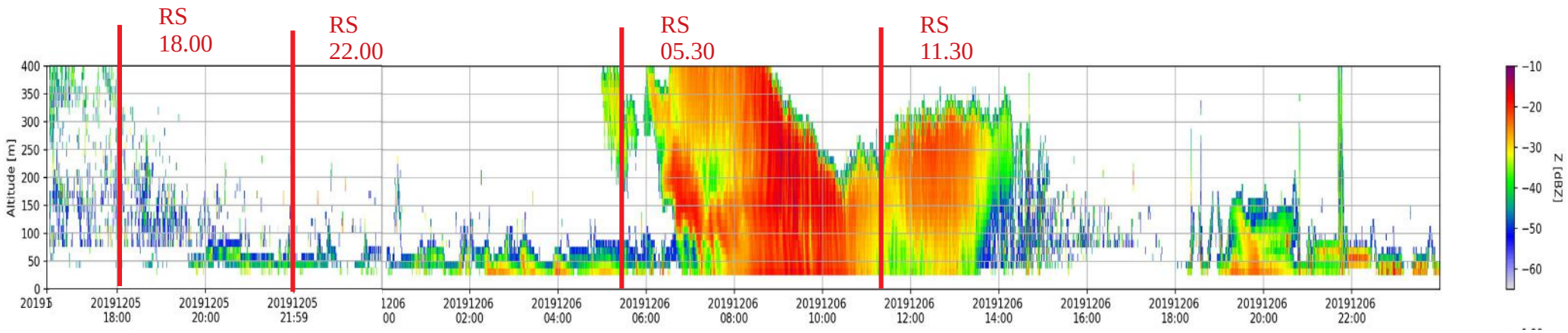


Patchy fog with Sc above

Stratus becoming fog

- fog but very thin
- Cloud around 300 m height → stop the fog formation

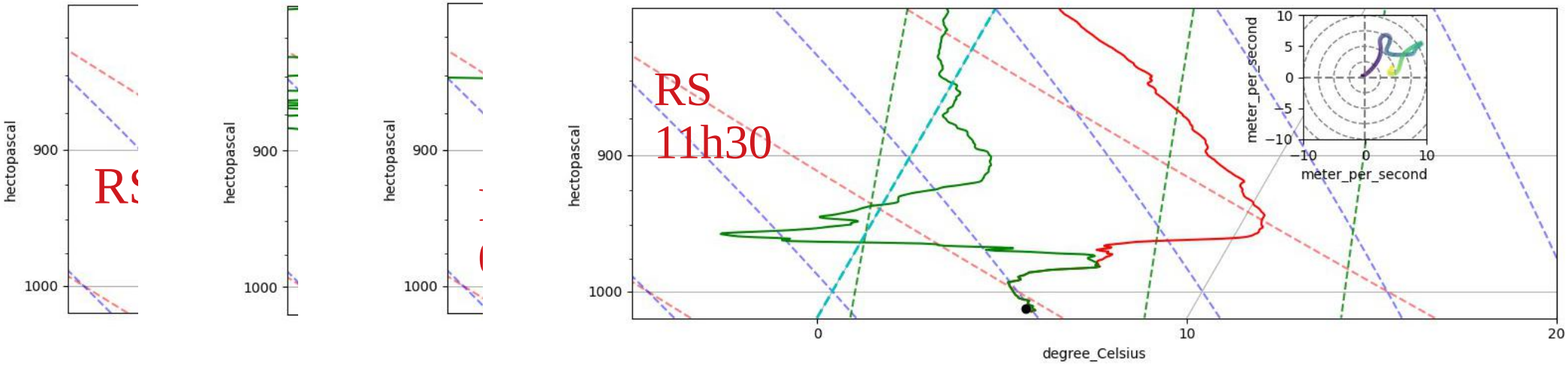




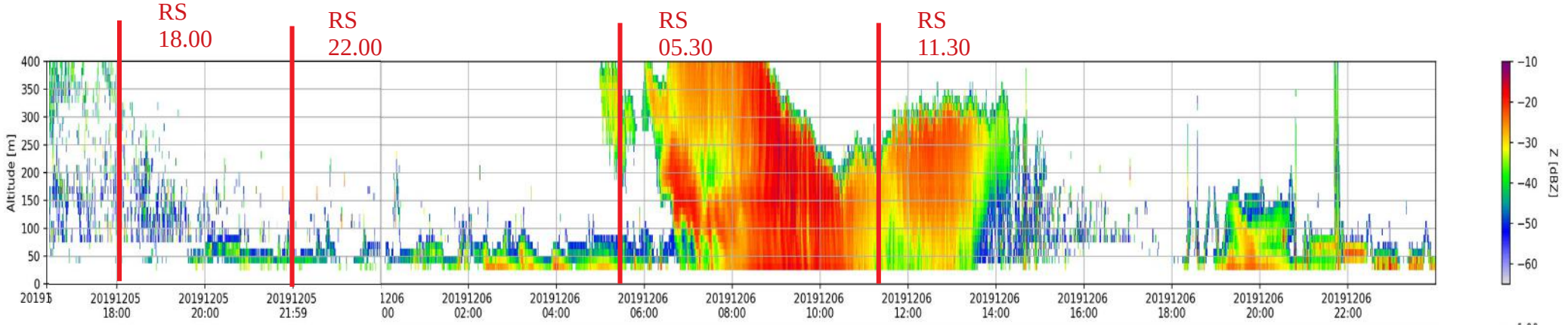
Patchy fog with Sc above

Stratus becoming fog

- Temperature increase at the ground after the sun rise
- Potential temperature constant up to 350 m

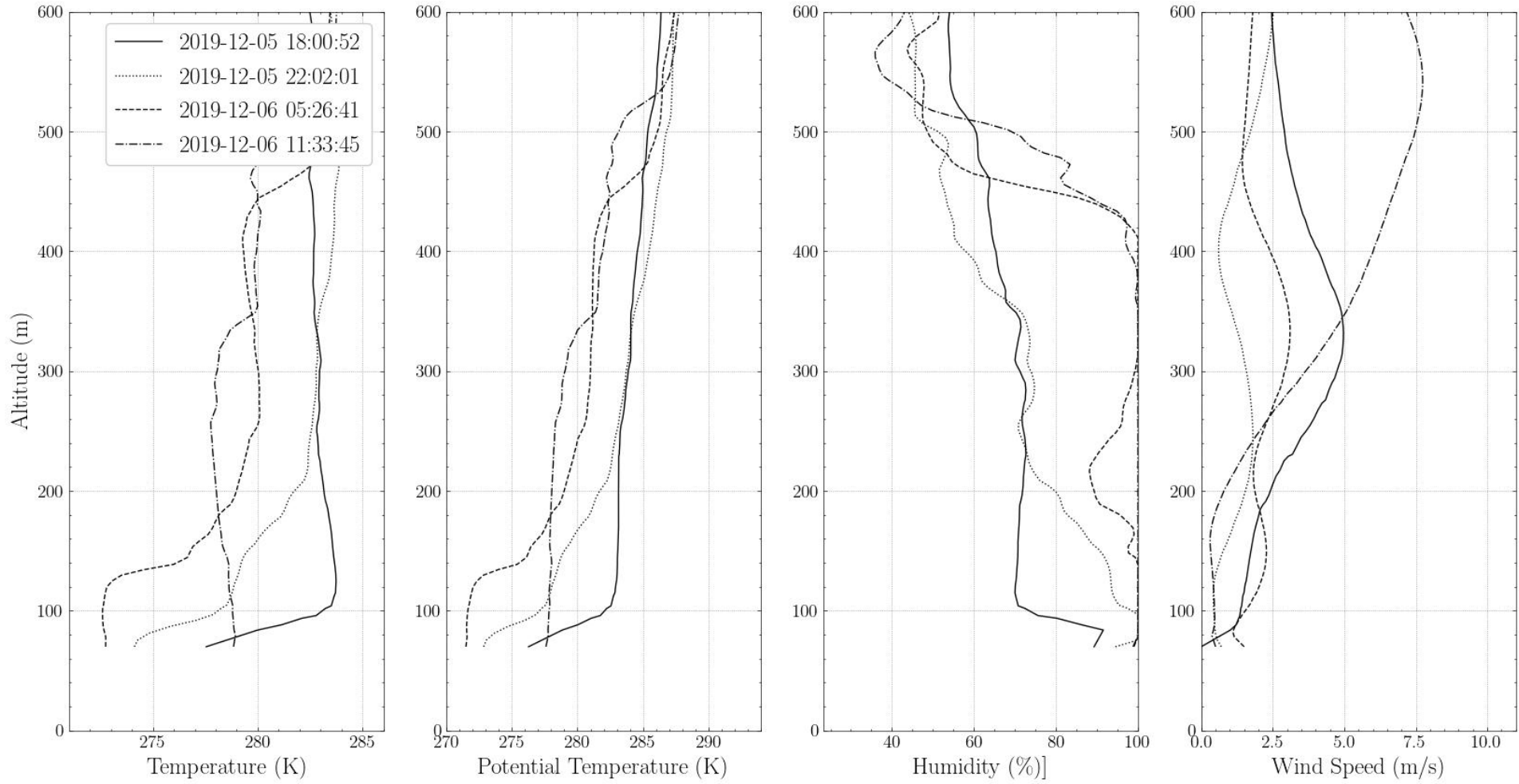


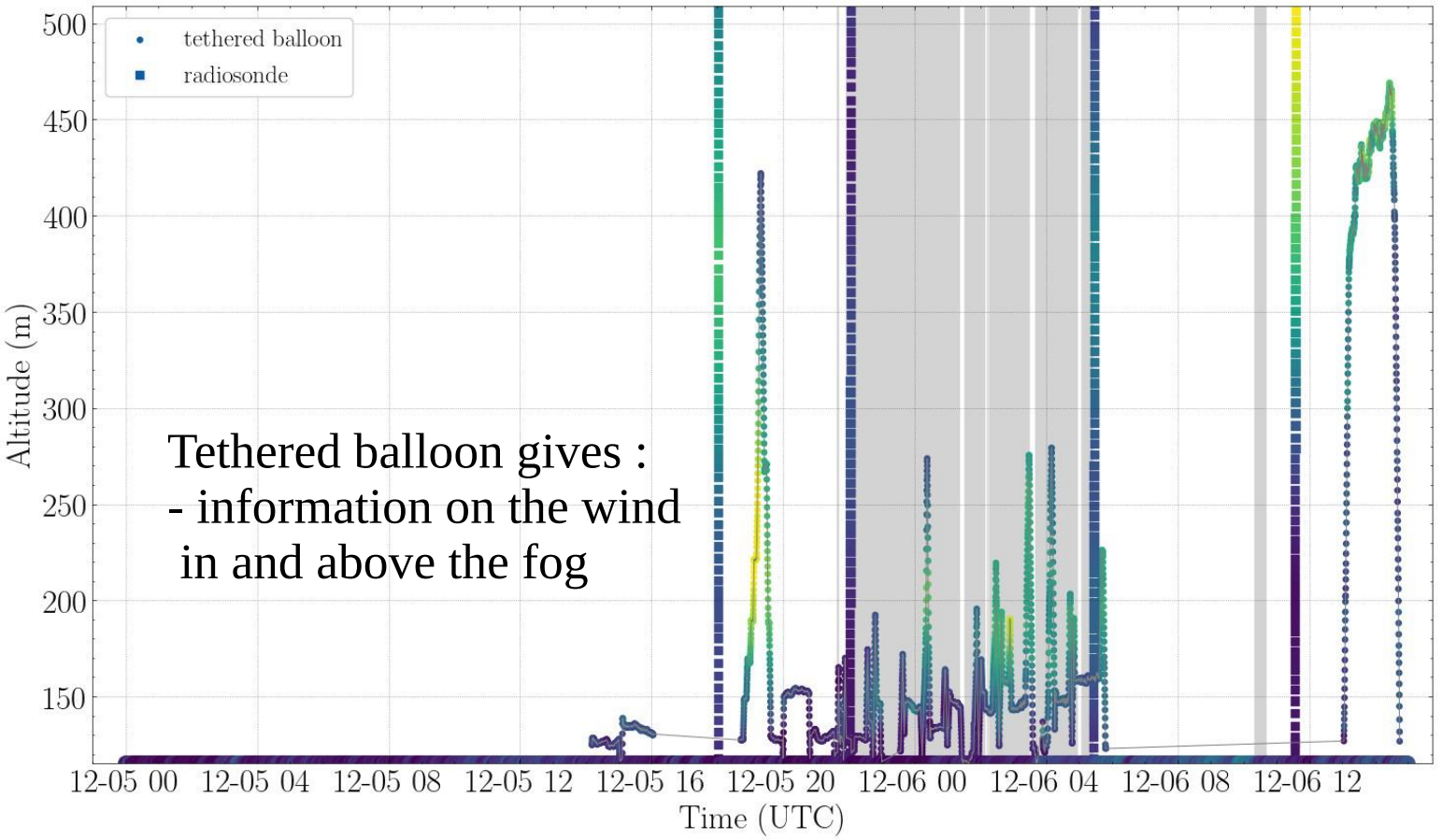
- Question : dry layer disappearance with the stratus becoming fog ?



Patchy fog with Sc above

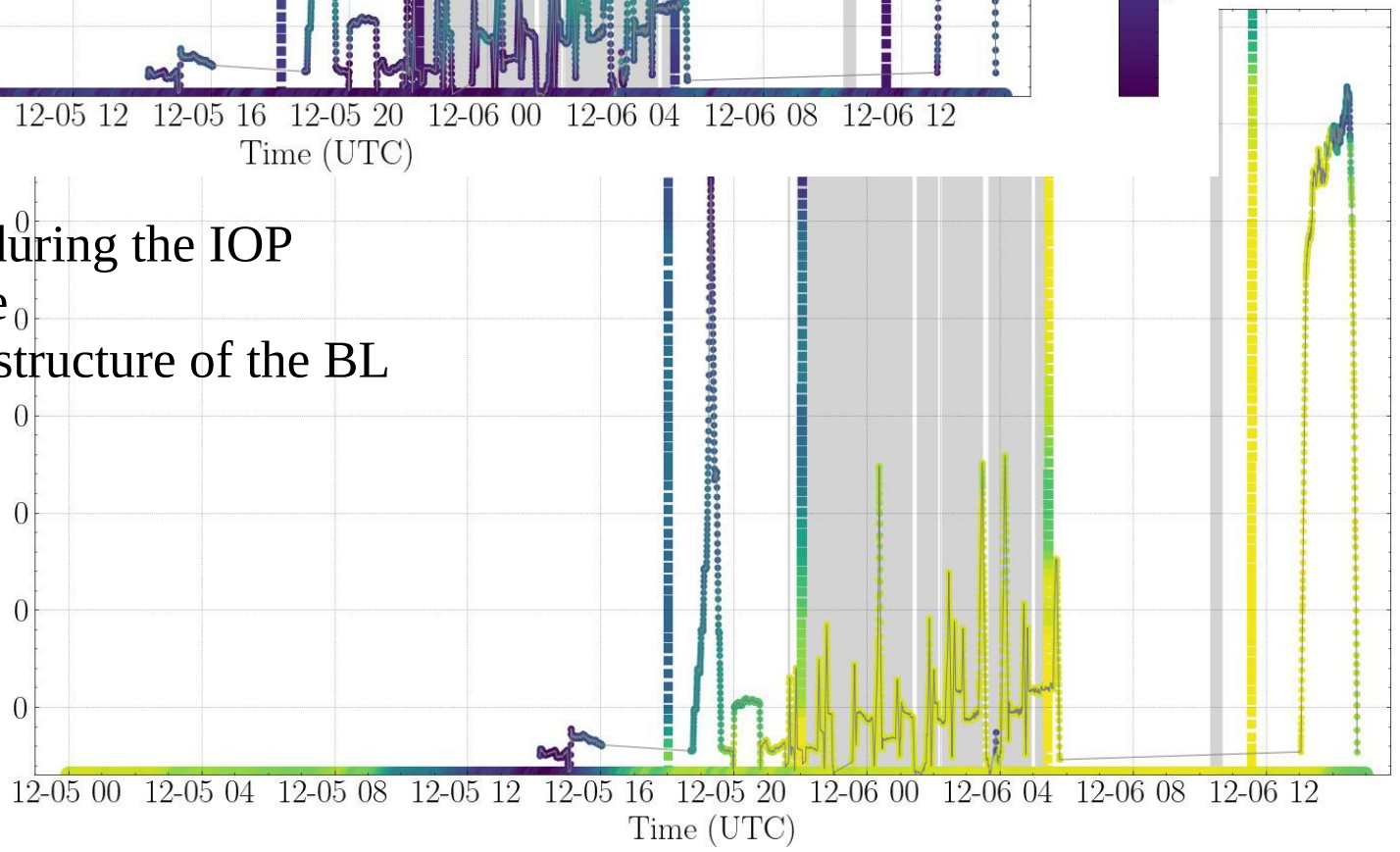
Stratus becoming fog





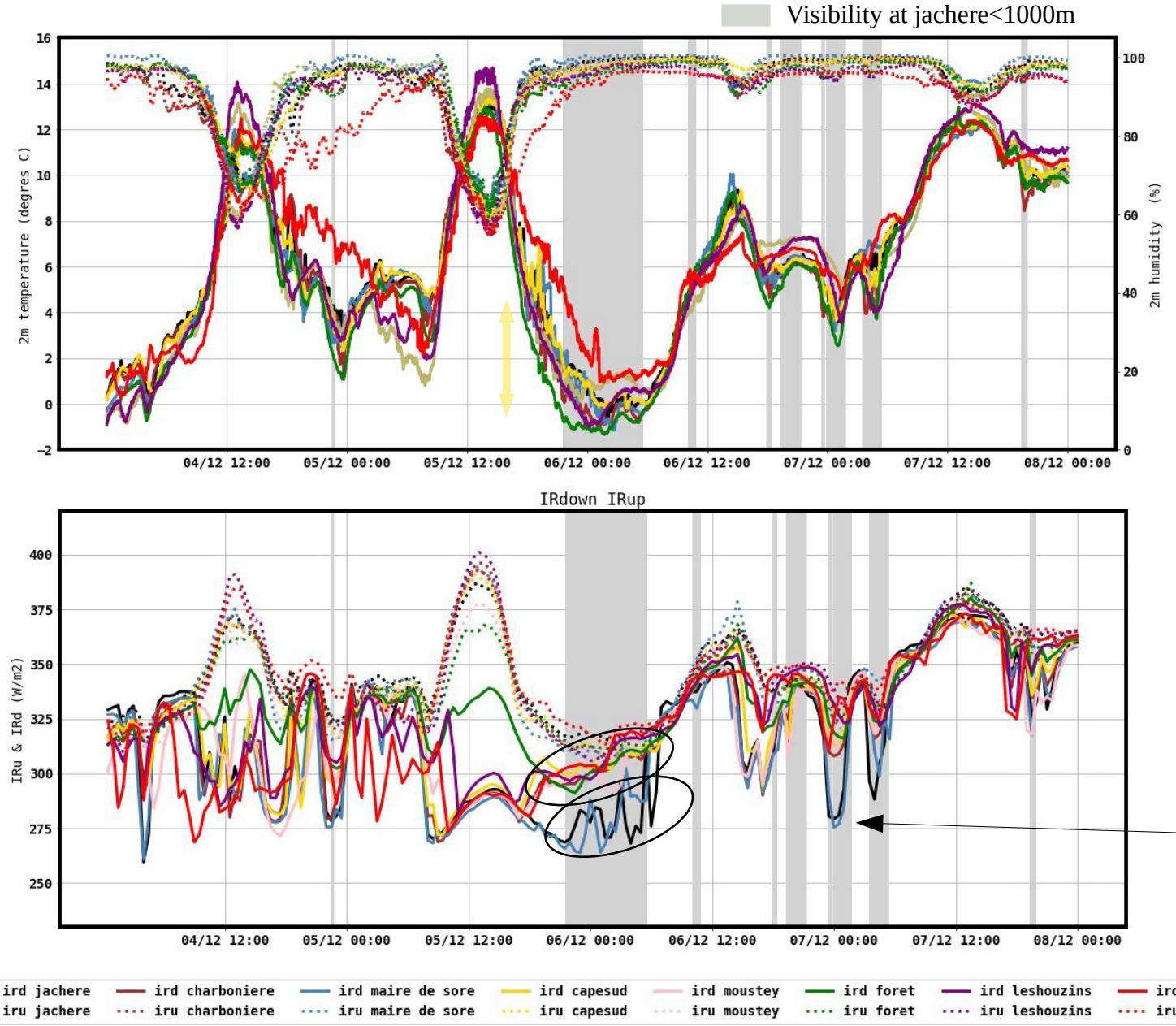
Tethered balloon gives :
- information on the wind
in and above the fog

- More profiles during the IOP
to investigate the
thermodynamic structure of the BL



IOP2 : 5-7/12/2019

Surface Data: Heterogeneities between differents sites



Exemple of temperature and humidity :

- Up to 4 degrees of difference between the site of Bommes and the coldest site in the forest

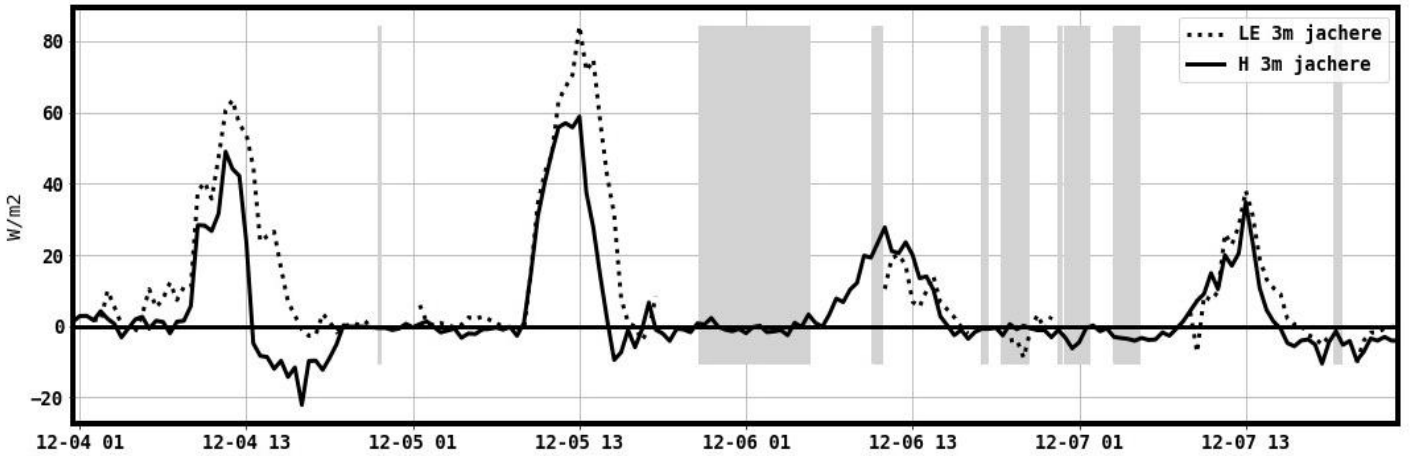
Others parameters : 10m wind, soil temperature and humidity

Exemple of longwave up and down radiation :

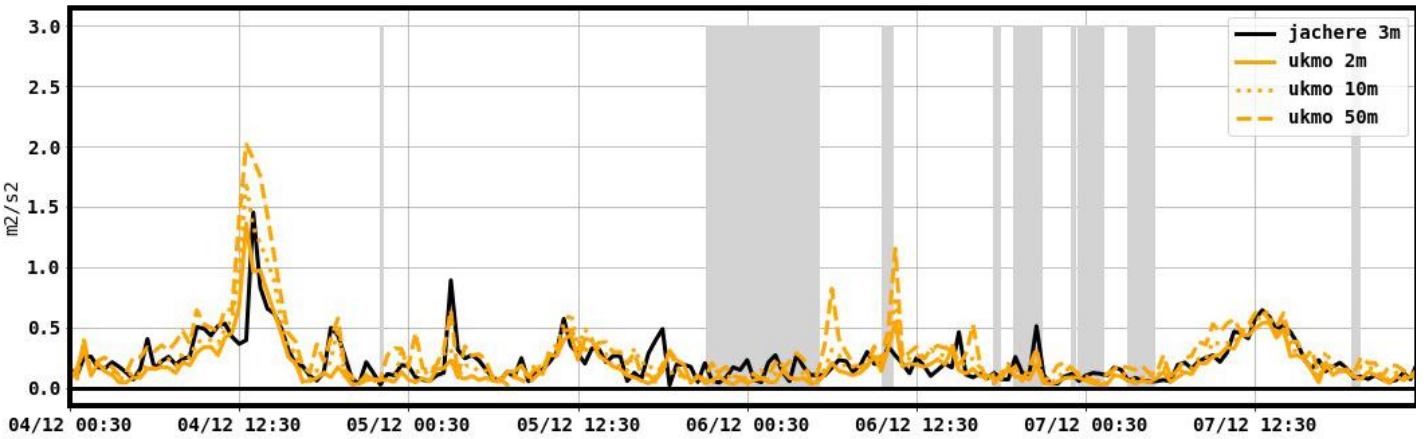
- Jachere and maire de sore present similarity
- probably differences in the start of the fog on the sites but I did not look at
- night of 7/12 : non-persistent fog, probably high cloud

IOP2 : 5-7/12/2019

- Heat fluxes/TKE : Data from mast at jachere and Ukmo site



- not data from Maire de sore for the IOP
- after good quality check for the latent heat flux, unfortunately no data with the Jachere site at 2m during the fog episode

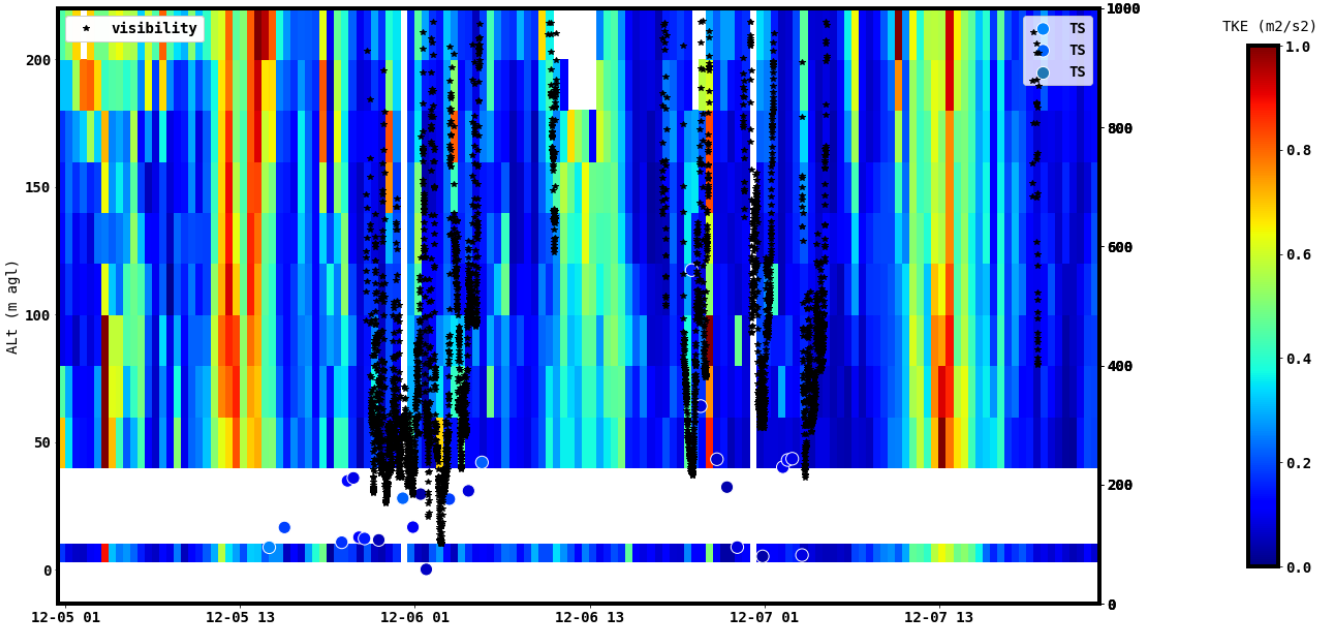


- Concernning the TKE from the differents mast :
- we can see similarities between the site
- low values during the fog
- maximum at 0,25 m/s-2 during the first night and 0,5 during the second night

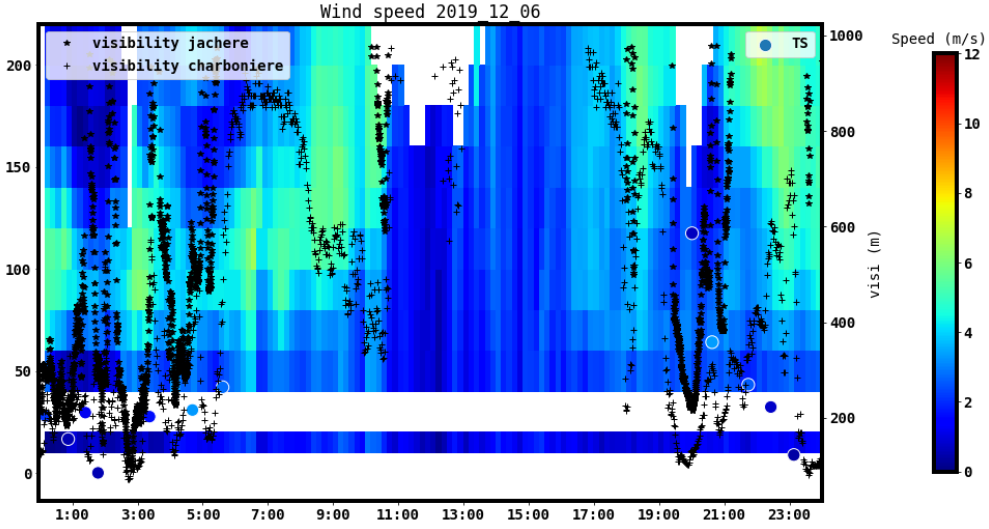
IOP2 : 5-7/12/2019

- TKE from Lidar and tethersond

On the super site during this IOP good complemtarity between TS and wind lidar during the fog

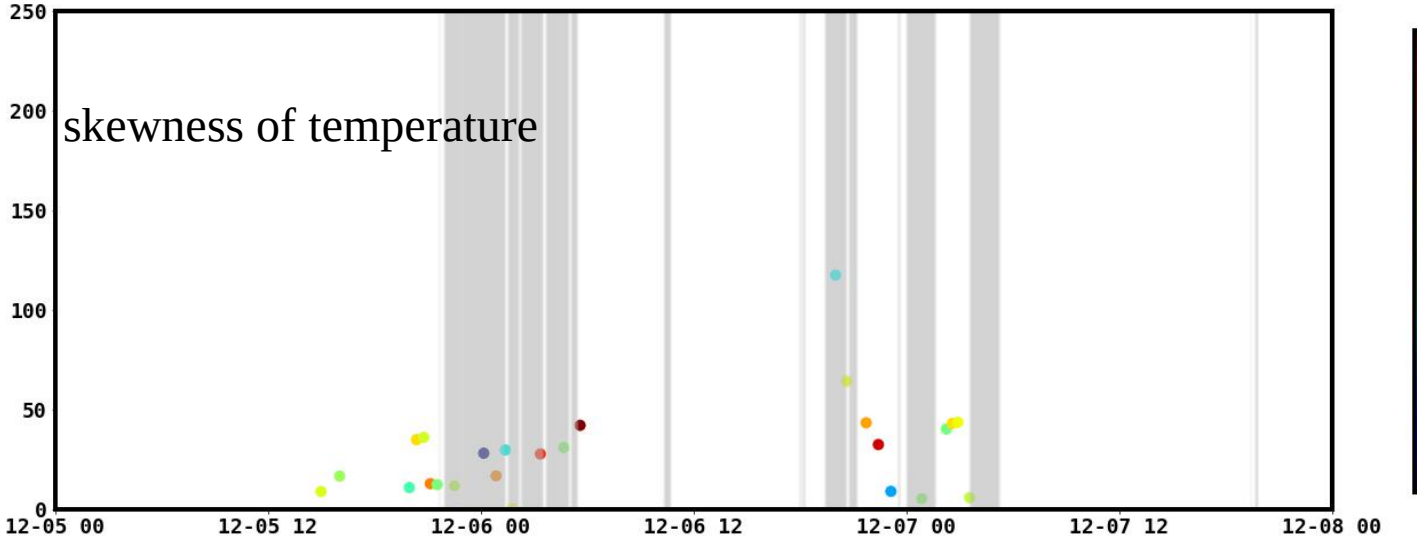


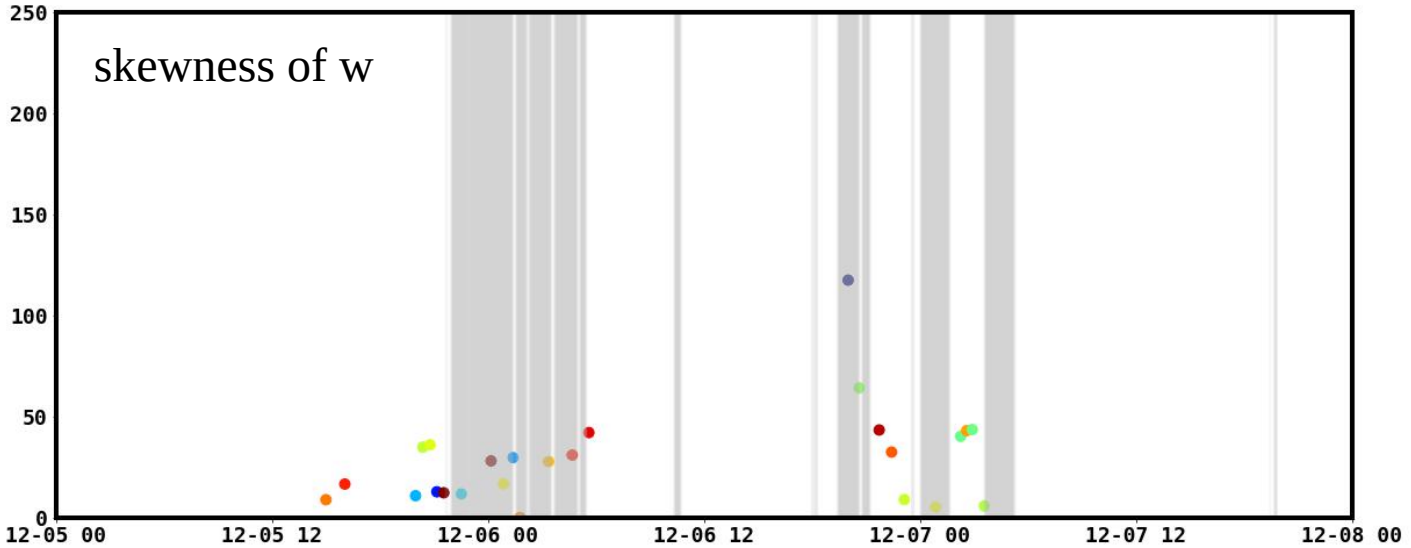
The wind has values between 5-6 m/s throughout the night with the fog and the wind decreases over the entire layer when the fog dissipates



IOP2 : 5-7/12/2019

- Turbulent parameters from thethersond





Turbulents parameters with the tethersound. Many levels during the 2 nights.
Focus on the skewness of T and W :

- skew of T slightly positive just before the fog and skew of w negative
- before the end of the fog skew w becomes positive

-need to analyse with all the variances and fluxes

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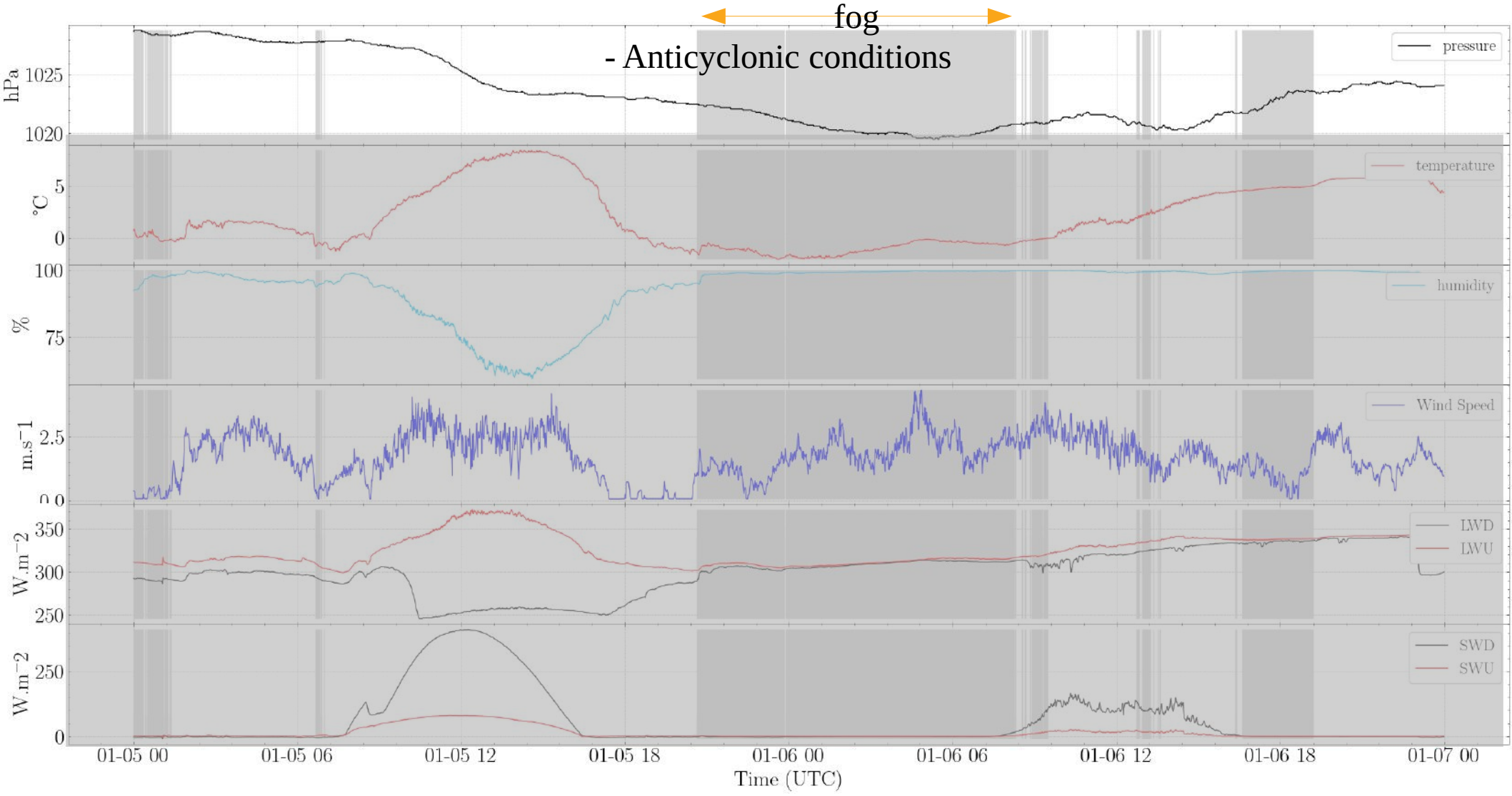
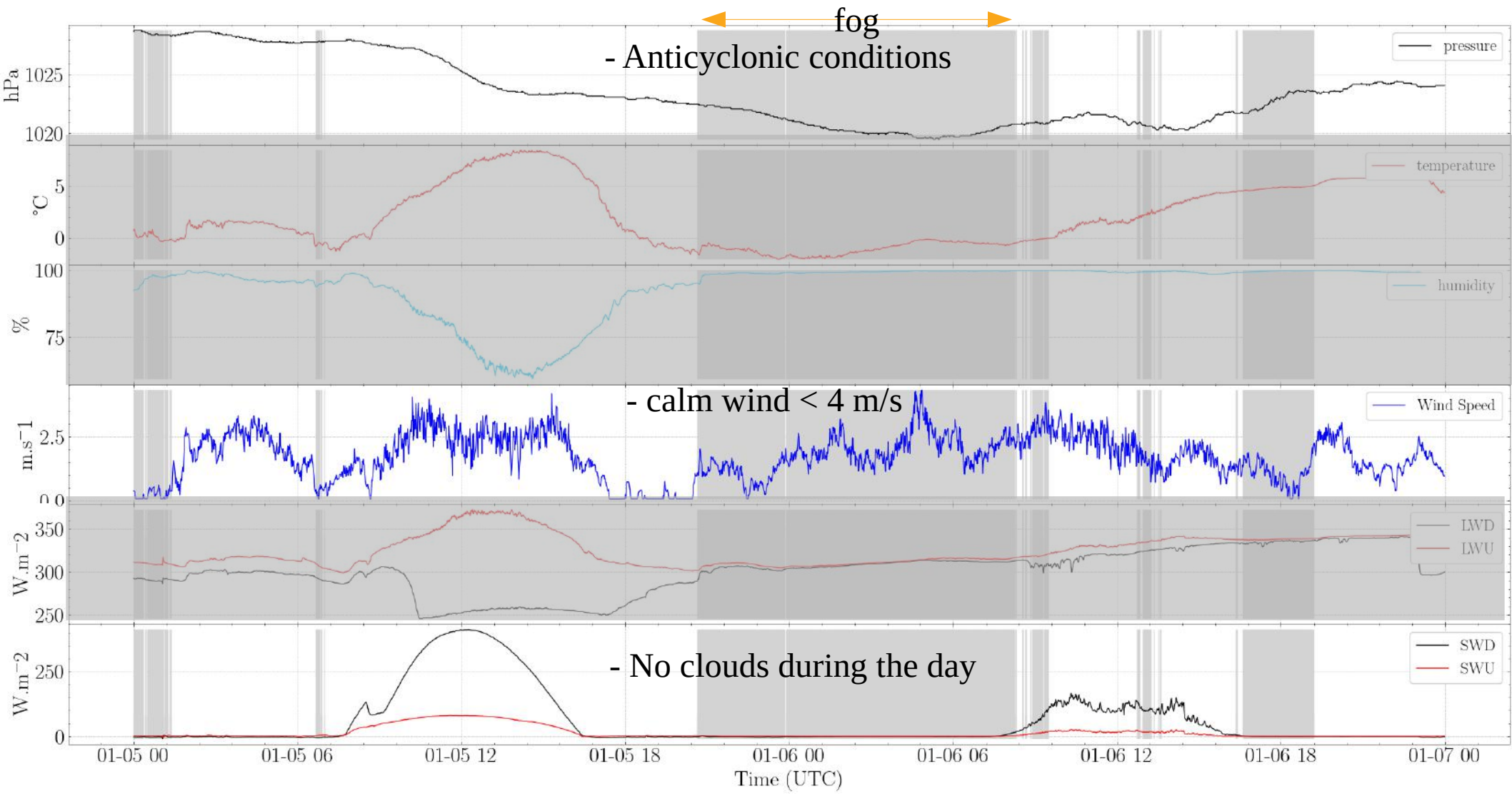
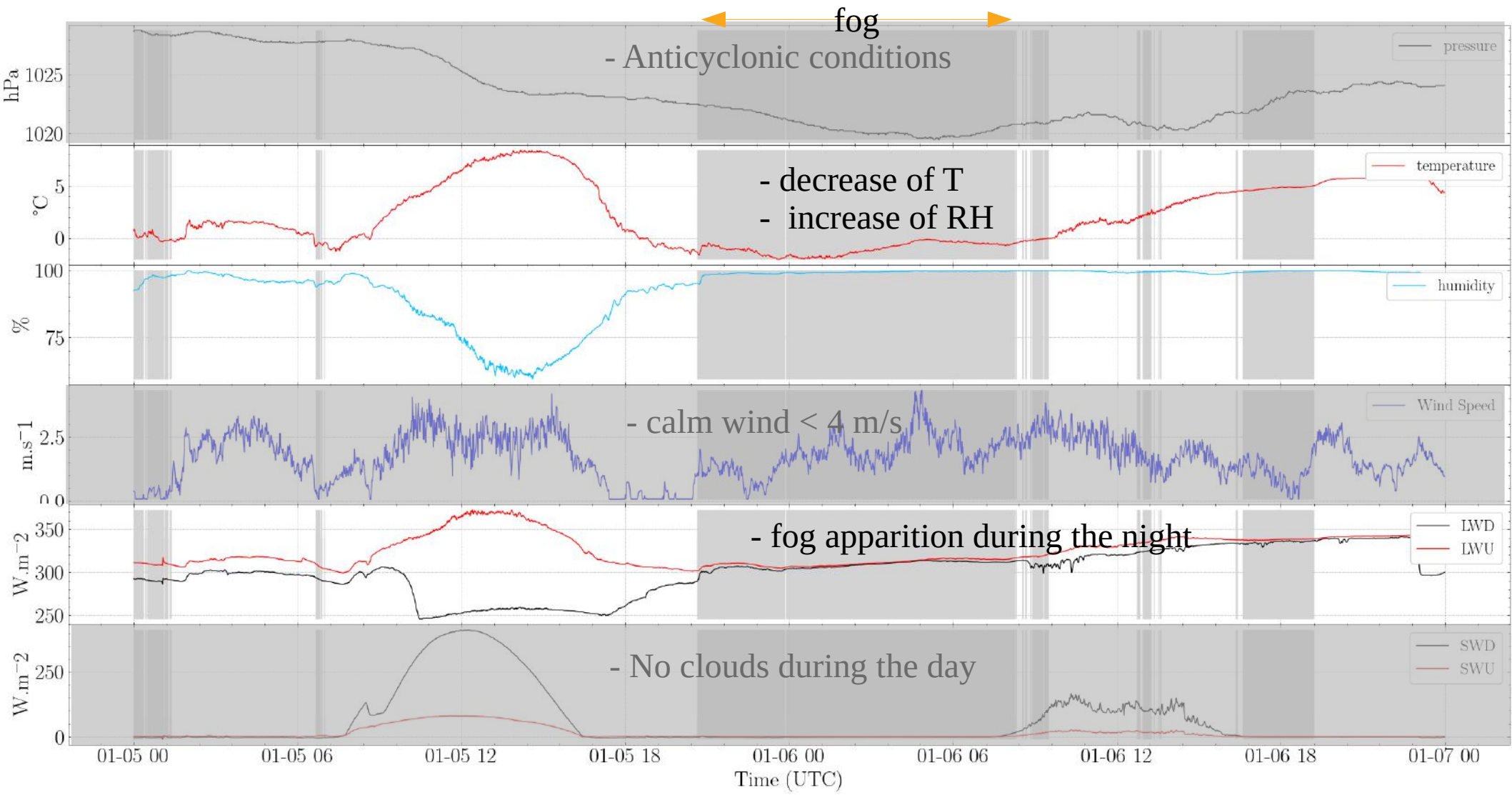


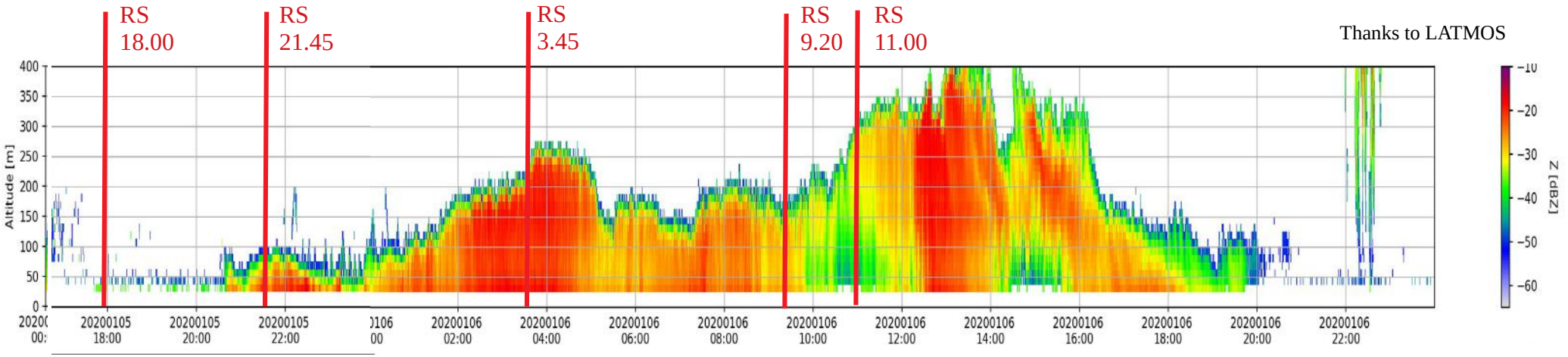
IOP6 05-07/01/2020



IOP6 05-07/01/2020

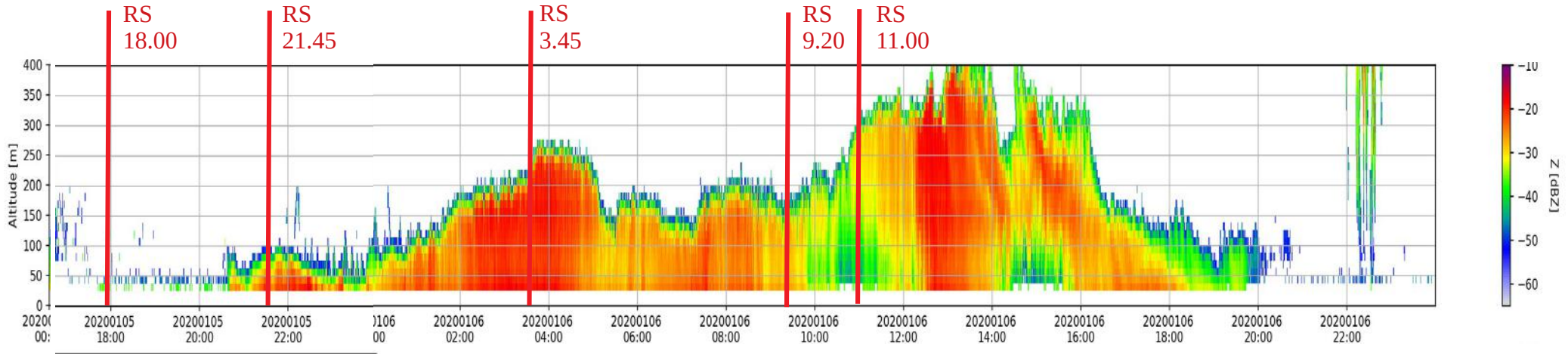


IOP6 05-07/01/2020

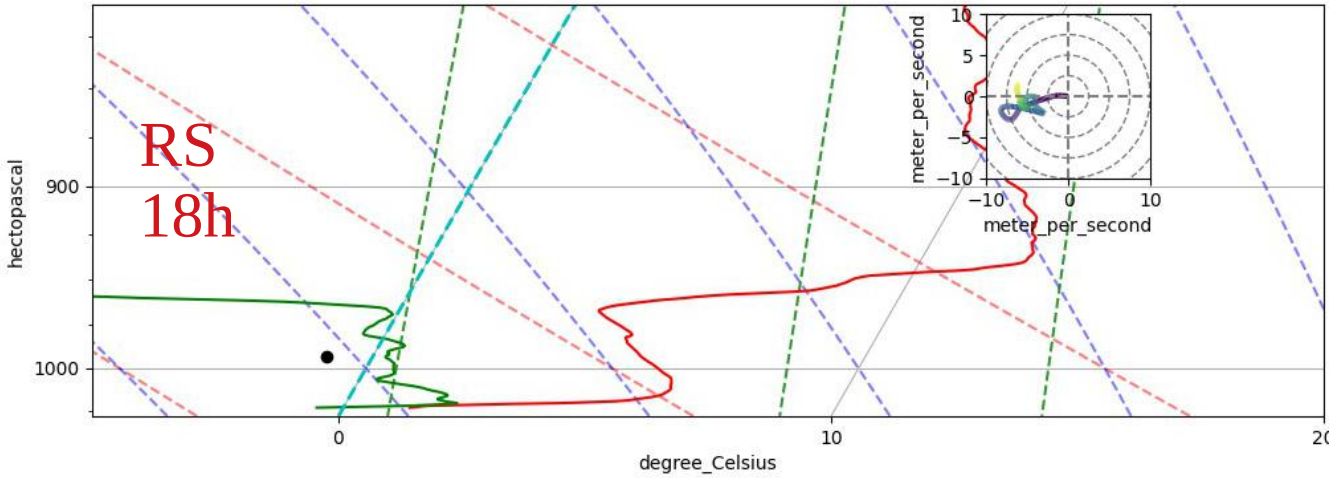


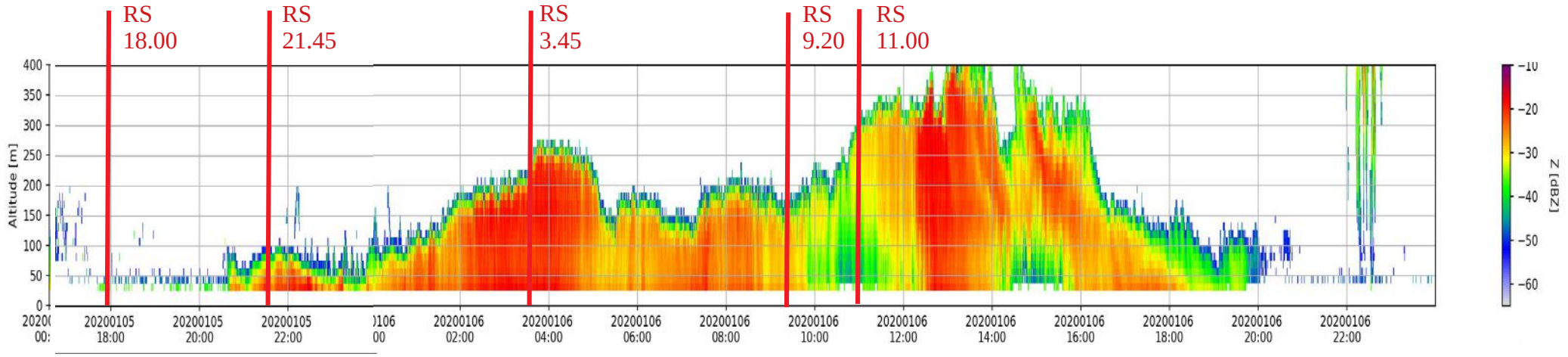
Thanks to LATMOS

Ice fog around 21h30 Stratus around 9h30

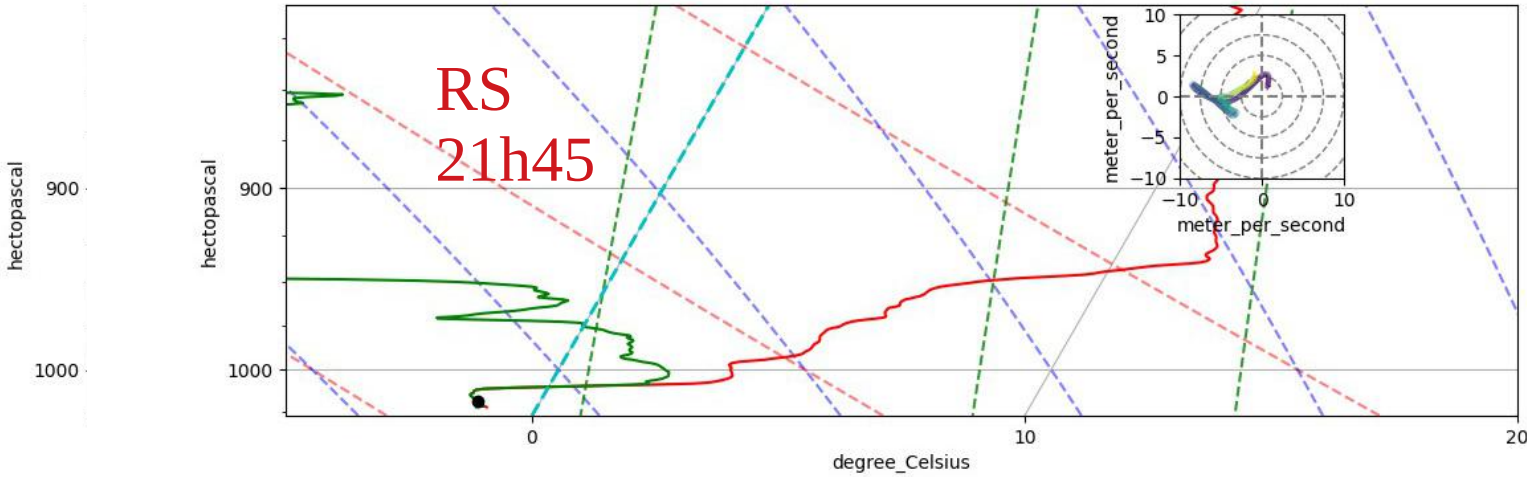


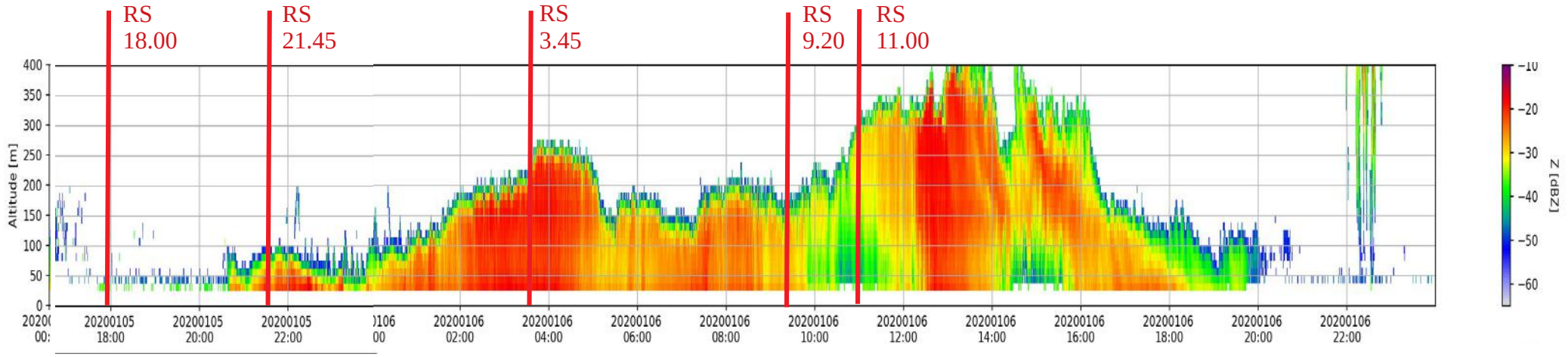
A little bit early → decreasing of temperature has just started



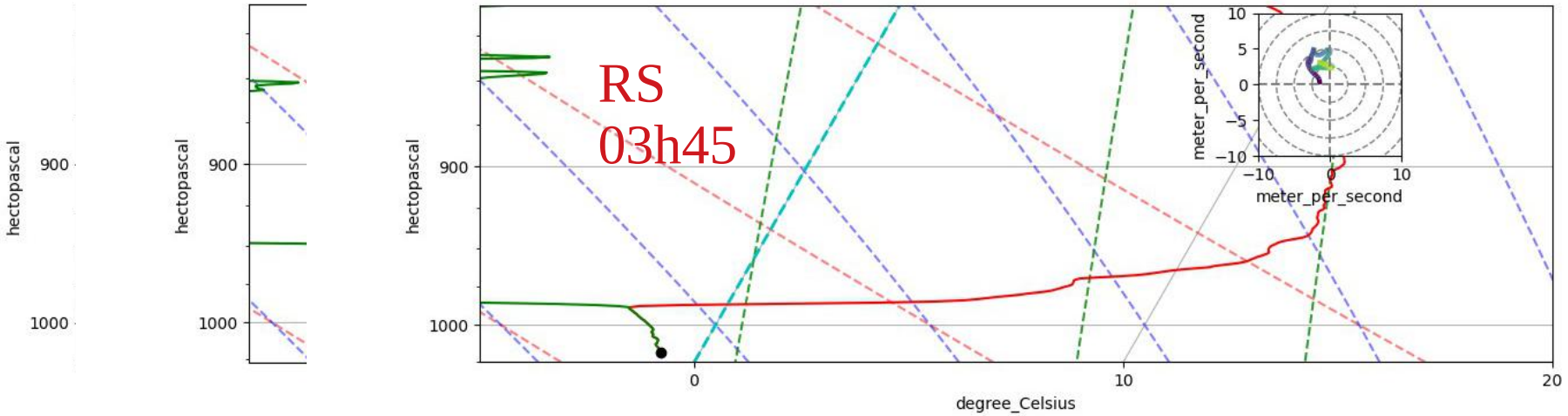


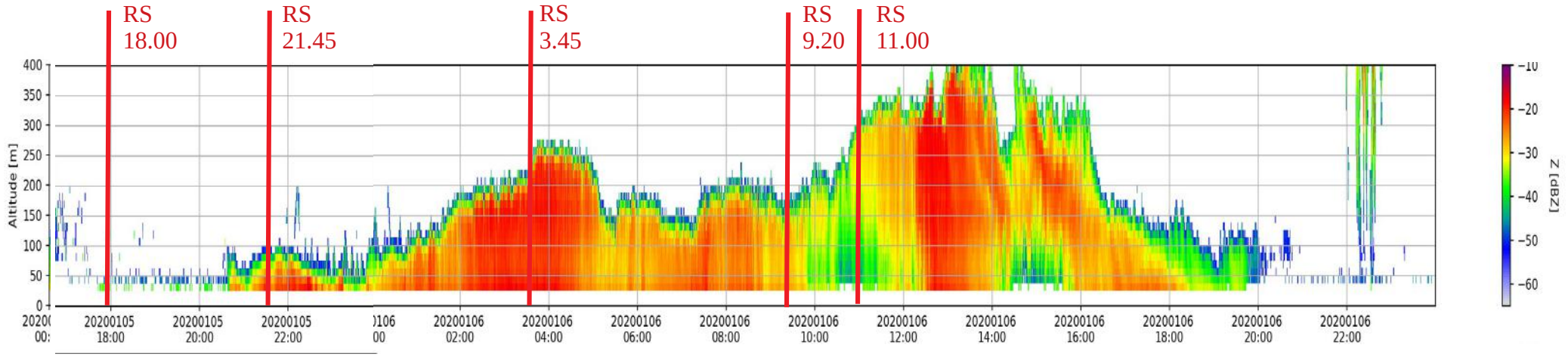
- Decrease of T
- Fog → thickness about 100m



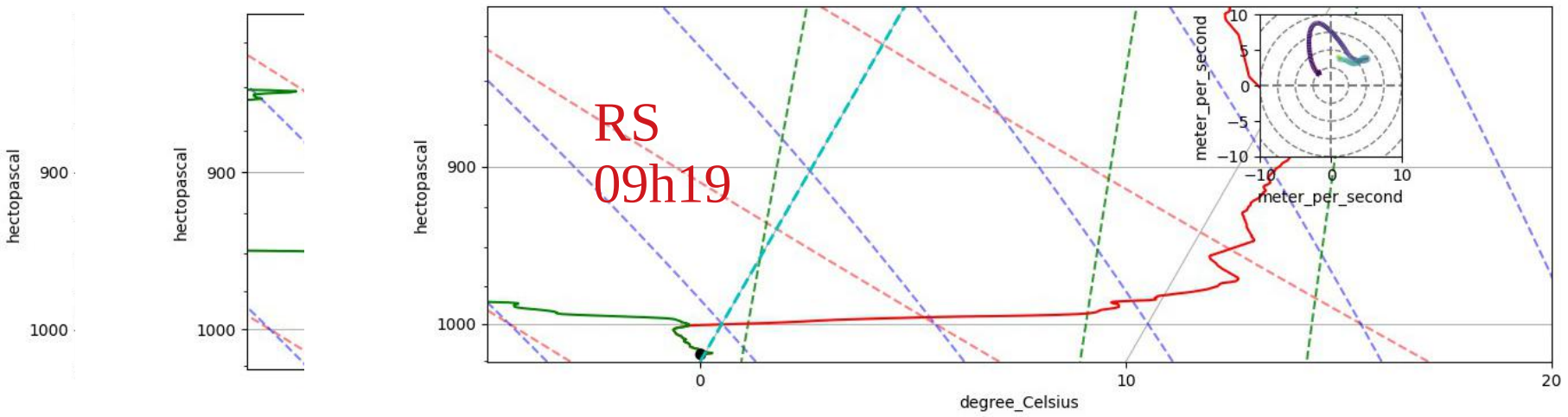


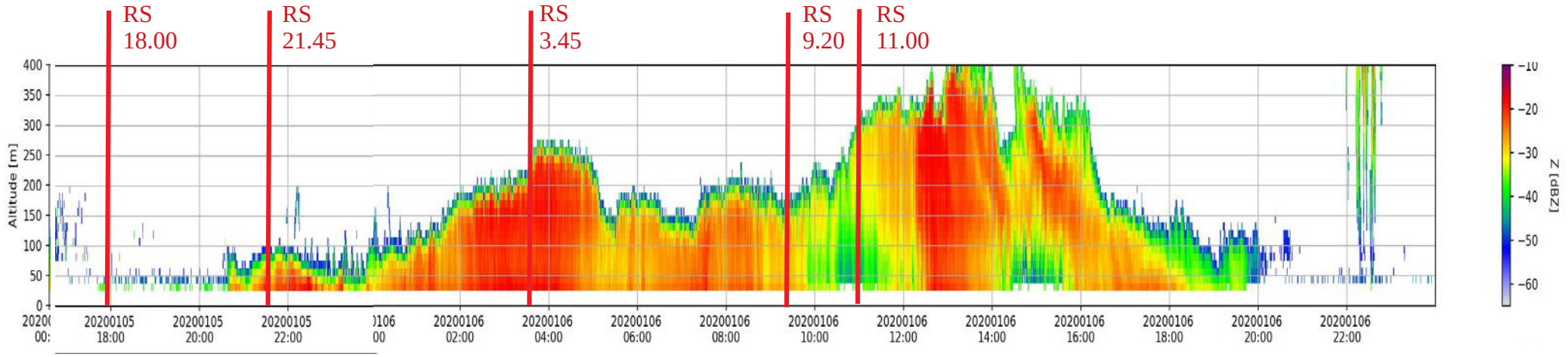
- Dense fog → 250m thickness
- very dry above



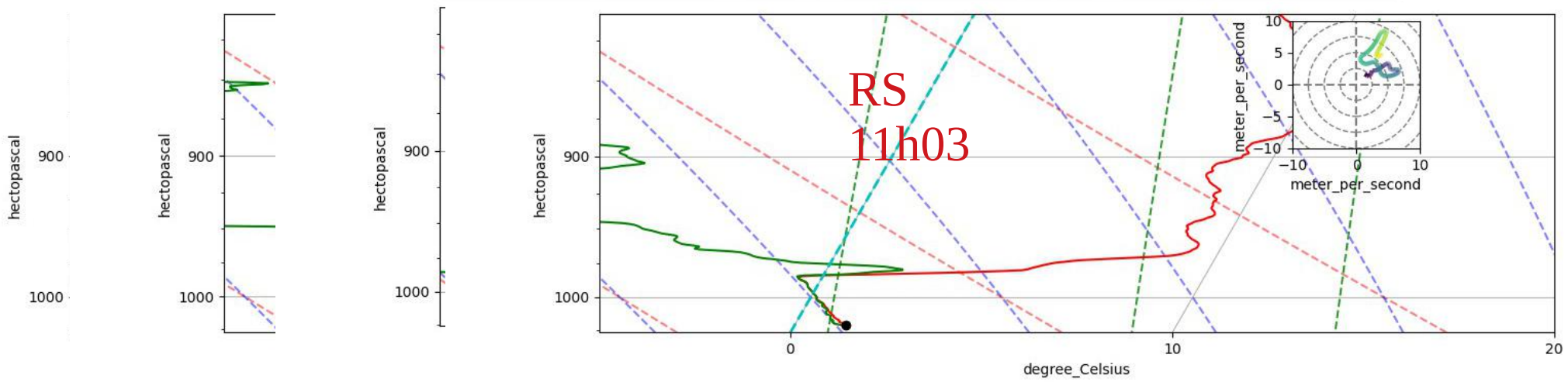


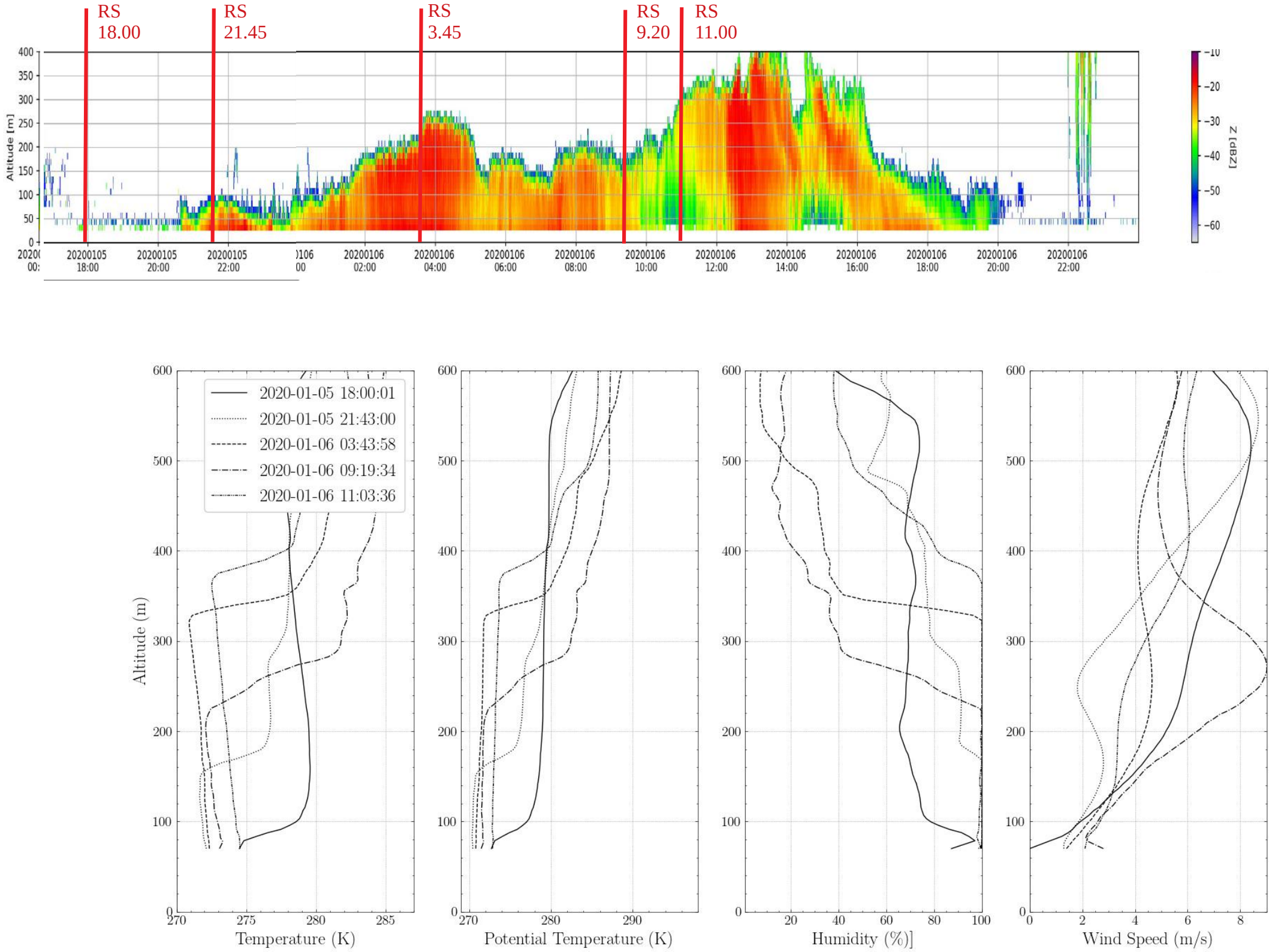
- fog → 160m thickness
- very dry above associated with strong wind





- Potential Temperature constant up to 380m
- dissipation just after the sun rise
- cloud around 100 m at 11h




RS
18.00
RS
21.45
RS
3.45
RS
9.20
RS
11.00
Altitude [m]
Z [dBZ]
2020-01-05 18:00:01
2020-01-05 21:43:00
2020-01-06 03:43:58
2020-01-06 09:19:34
2020-01-06 11:03:36
Altitude (m)
Temperature (K)
Potential Temperature (K)
Humidity (%)]
Wind Speed (m/s)

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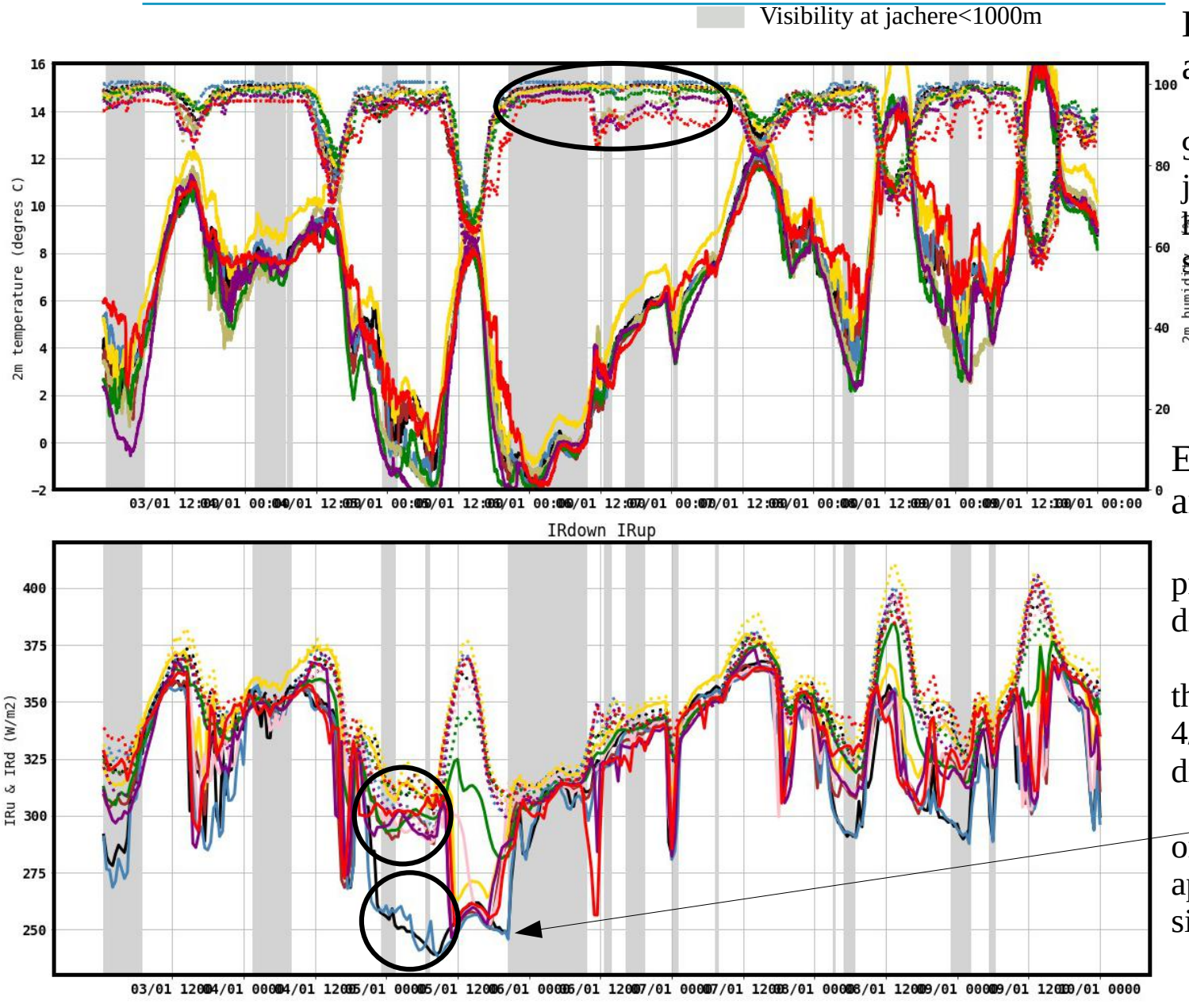

Exemple of 2m temperature and humidity :

- humidity was more than 95 % during all the day of 6 january in many sites. Only les houzins and bommes present a significant decreasing

Exemple of longwave up and down radiation :

- Jachere and maire de sore present similarity and large difference with the others sites
- probably differences in the presence of the fog (night 4/5 january) on the sites but I did not look at
-night 5/6, I guess the fog on the jachere and maire de sore appeared 2hours after the others sites.

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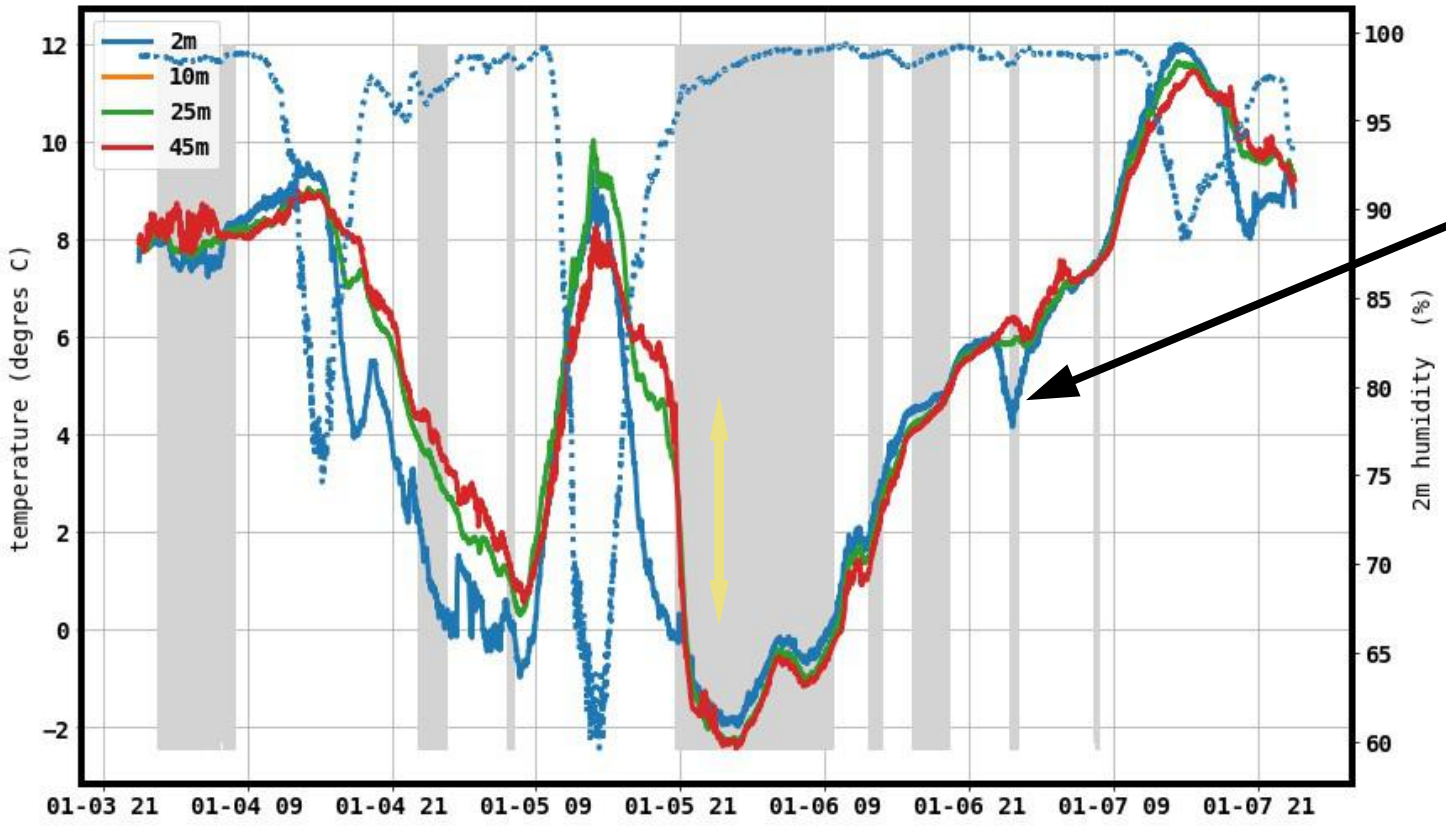
Temperature from the 40m tower (Tuzan 2km to super site)



A significant gradient until the fog appears, up to 5 degres.

It will be interesting to look in details this moment where only the temperature at 2 m decreases and the fog is very short.

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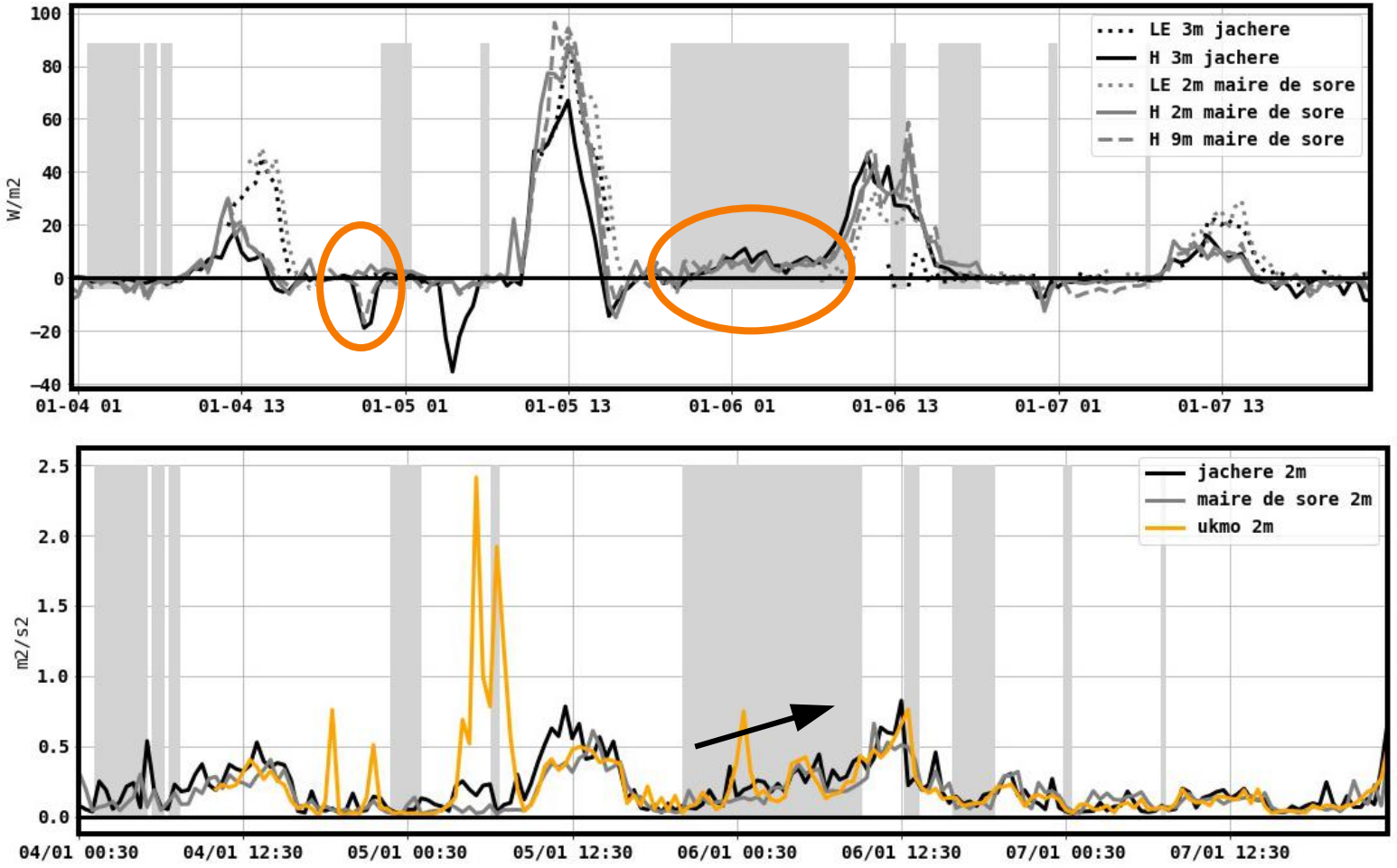
- Heat fluxes/TKE : Data from mast at jachere and Ukmo site



During the night between 5 and 6 january sensible heat fluxes at jachere and maire de sore are the same order around 10 W/m². These values present large difference that with the IOP2 where the heat flux was zero. The night before we observe a large negative heat flux fore the fog.

For the TKE the values are around 0,5 and same order in the 3 sites. We can see an increase during the night of fog

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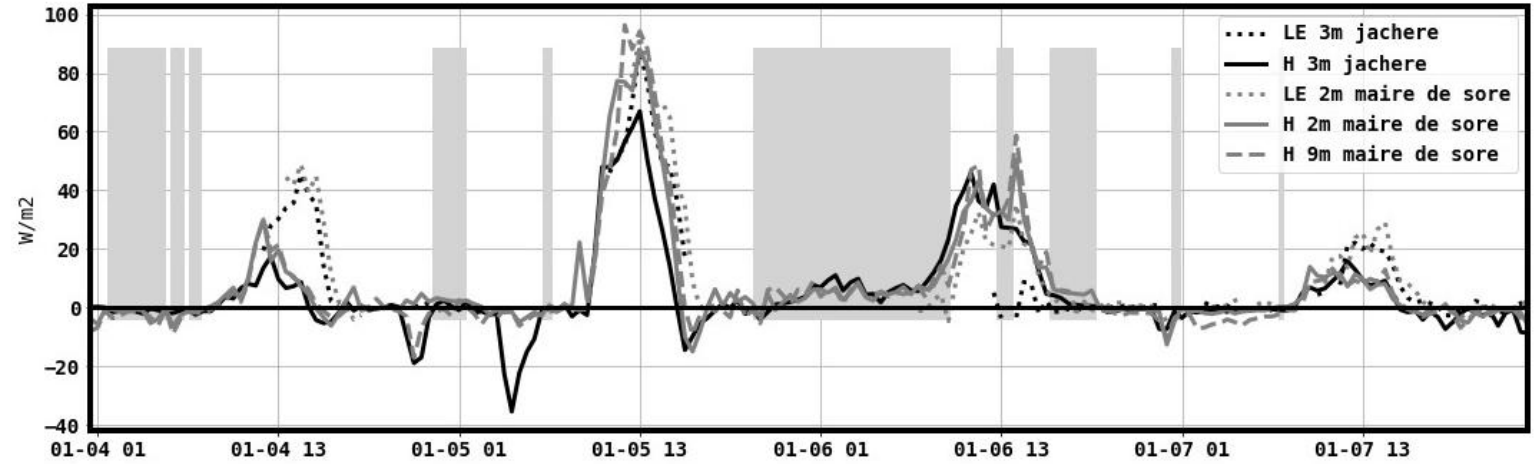
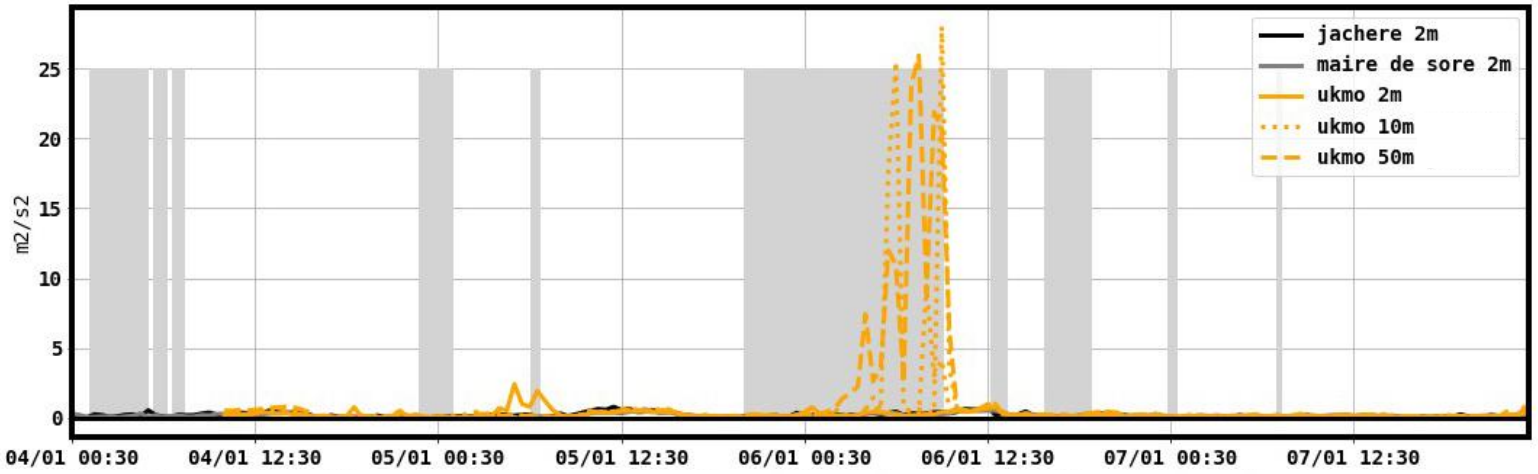
- Heat fluxes/TKE : Data from mast at jachere and Ukmo site

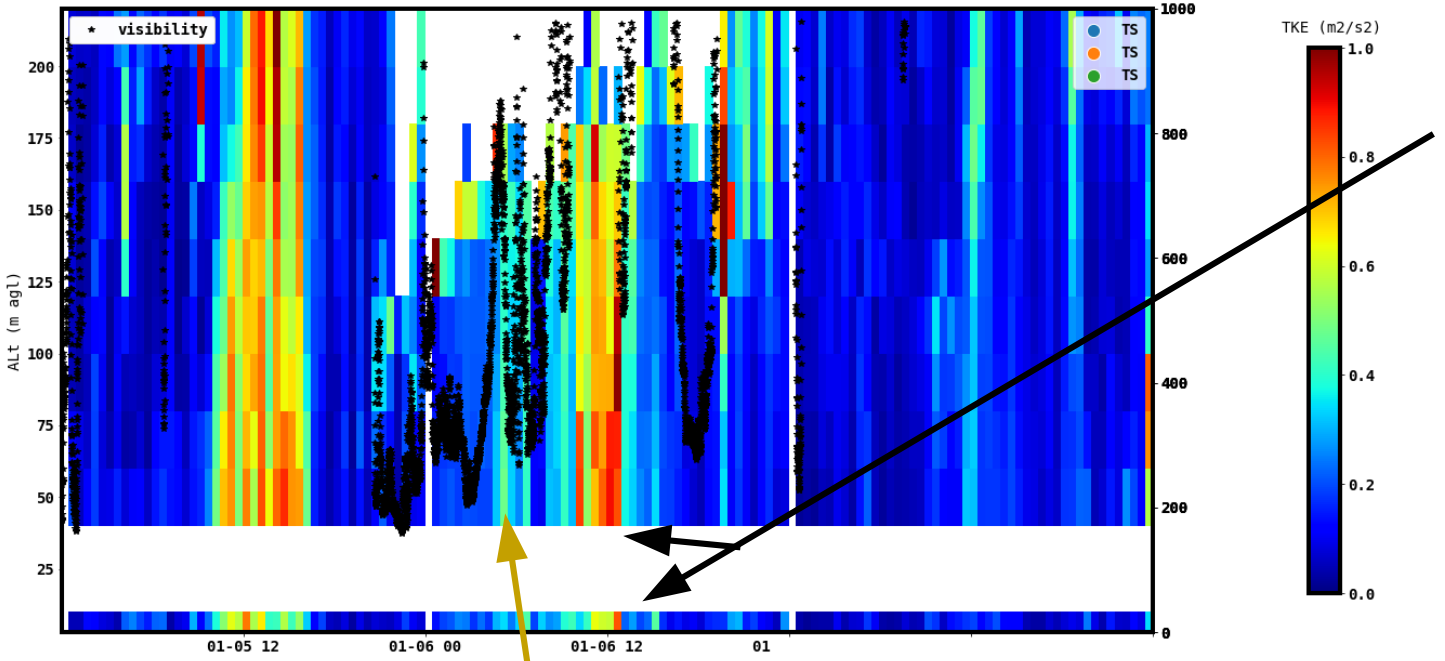




During the night between 5 and 6 january sensible heat fluxes at jachere and maire de sore are the same order around 10 W/m². If we look more in details it seems that the end of the episode is early at Jachere site.

When we look at the altitude values on the ukMO site we observe some rather strong values. It will be necessary to see why.

IOP6 05-07/01/2020

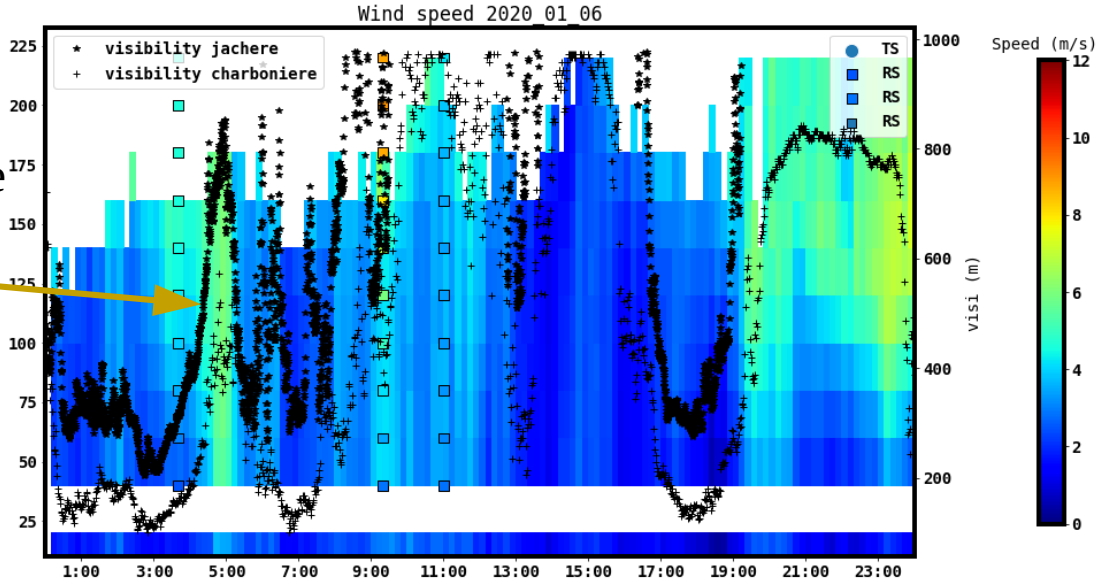


Large agreement between the two sets of data (lidar and 2m mast)

Also, a good agreement in the windspeed between RS, mast and wind lidar

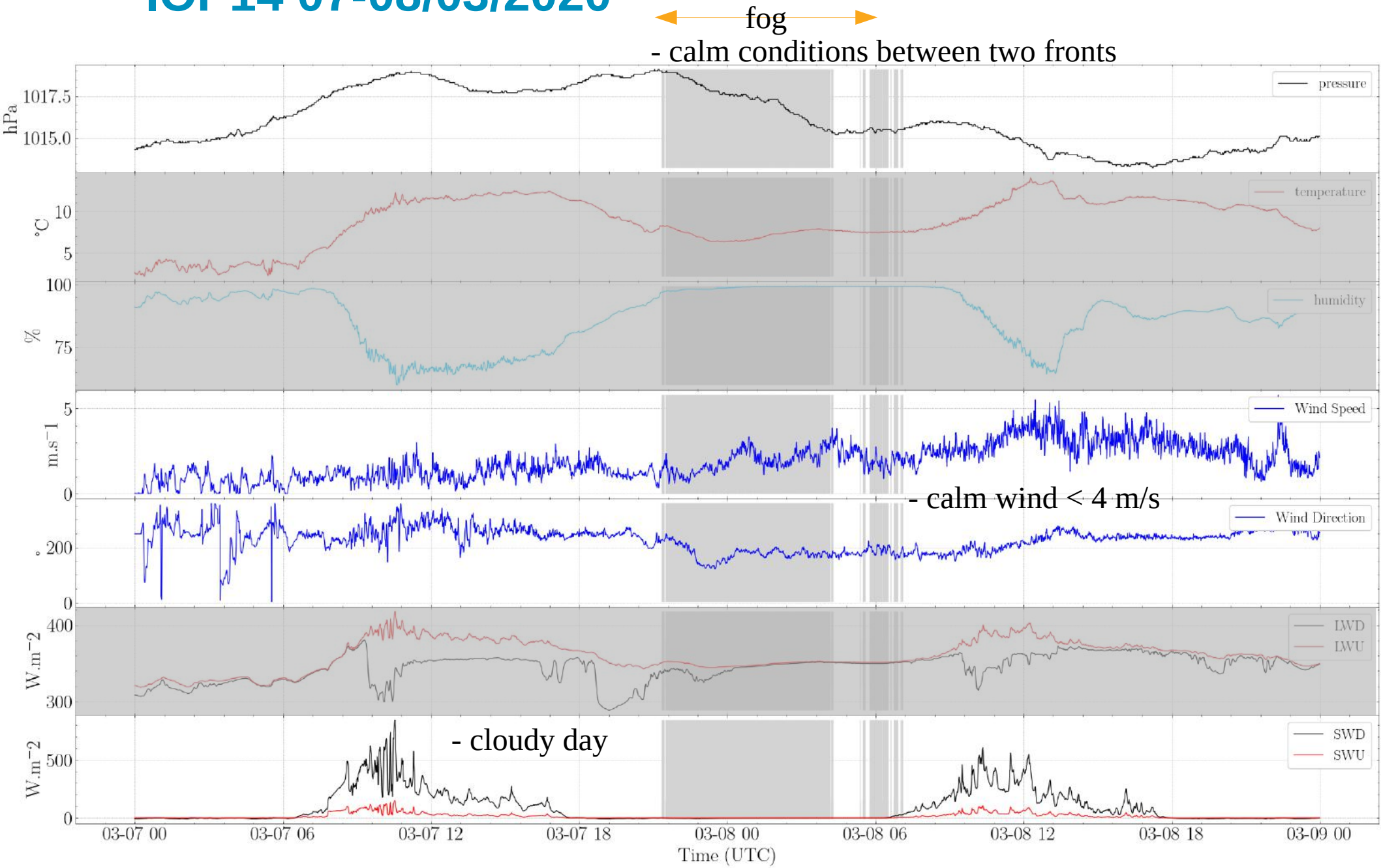
In accordance with the surface data, TKE increases at the end of the night up the max of altitude of the Lidar. We wsee in the same time an increase of the windspeed up to the surface

At the end of the afternoon a decrease in visibility is followed by a strengthening of the wind.

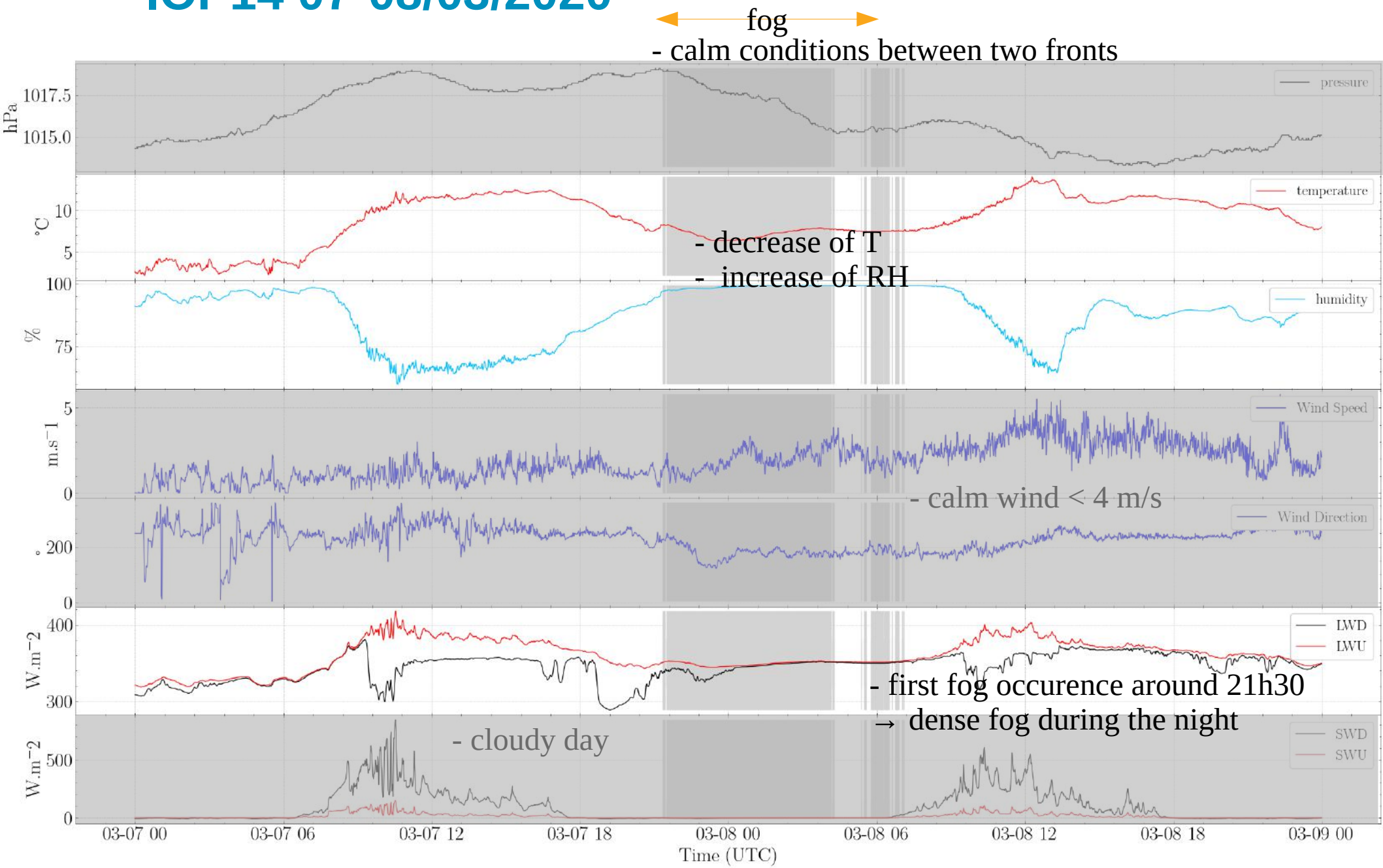


IOP14 07-09/03/2020

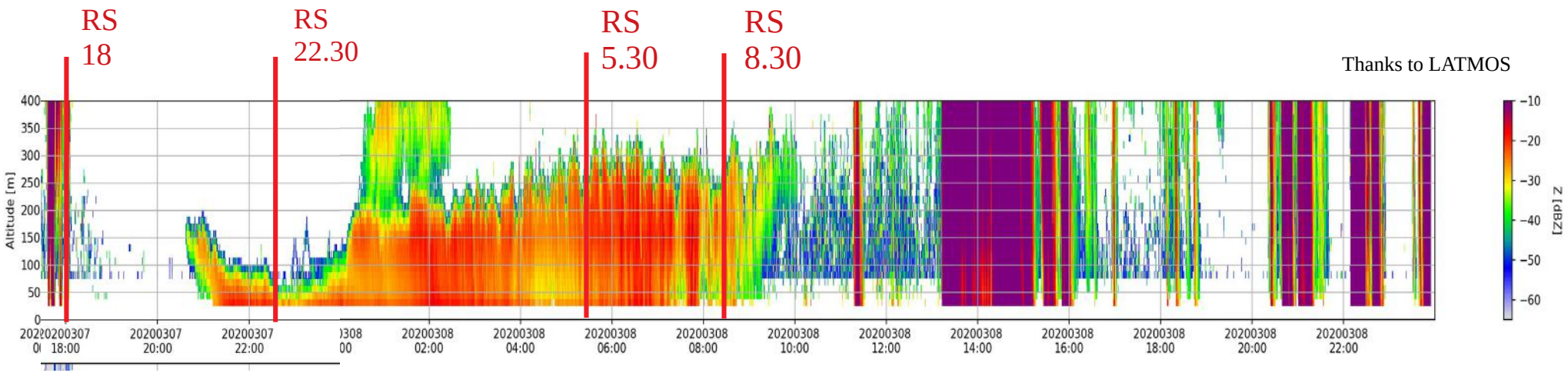
IOP14 07-08/03/2020



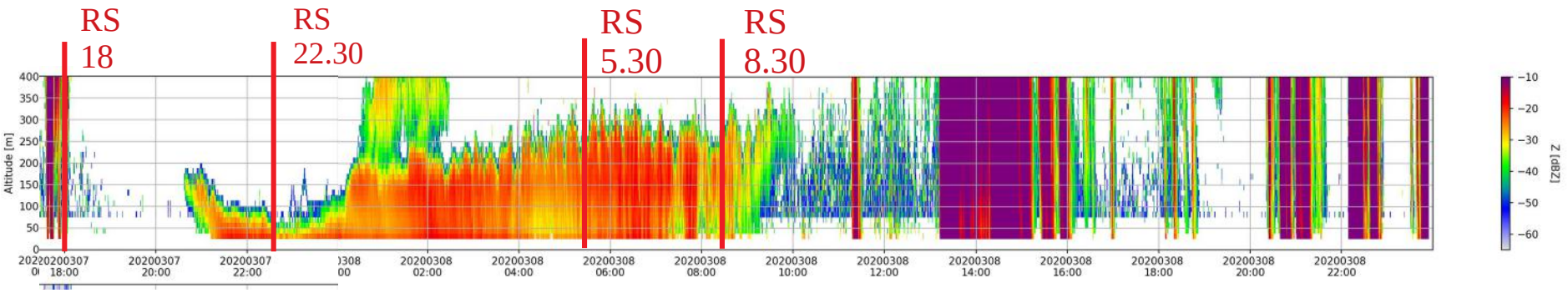
IOP14 07-08/03/2020



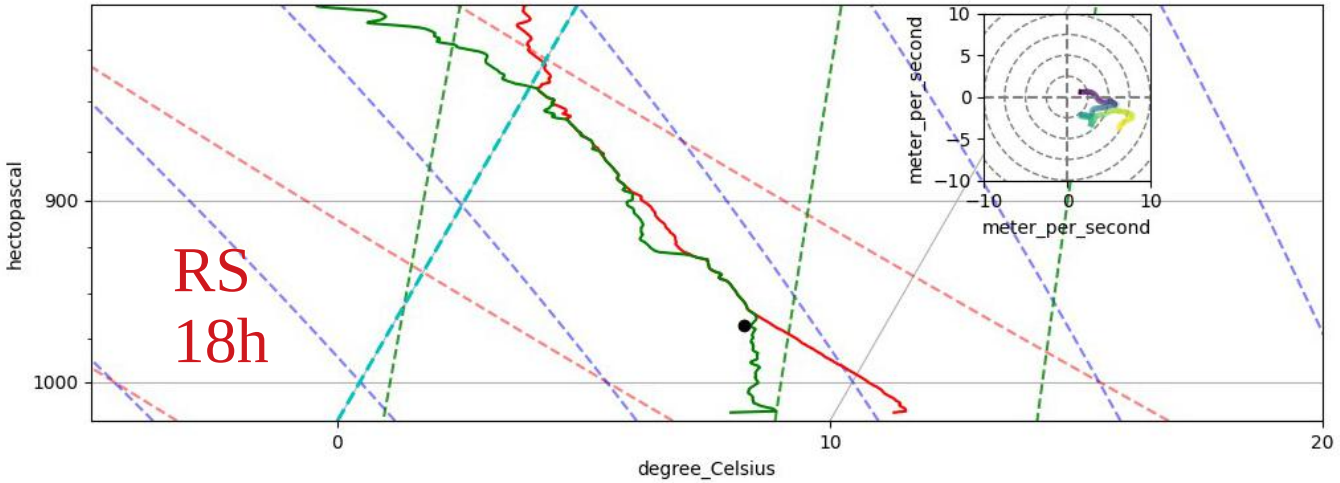
IOP14 07-08/03/2020

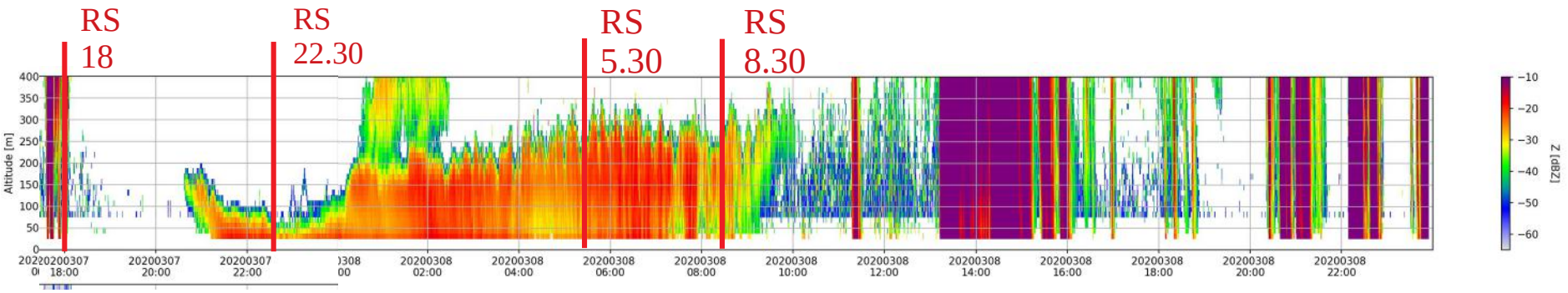


Dense fog during the night

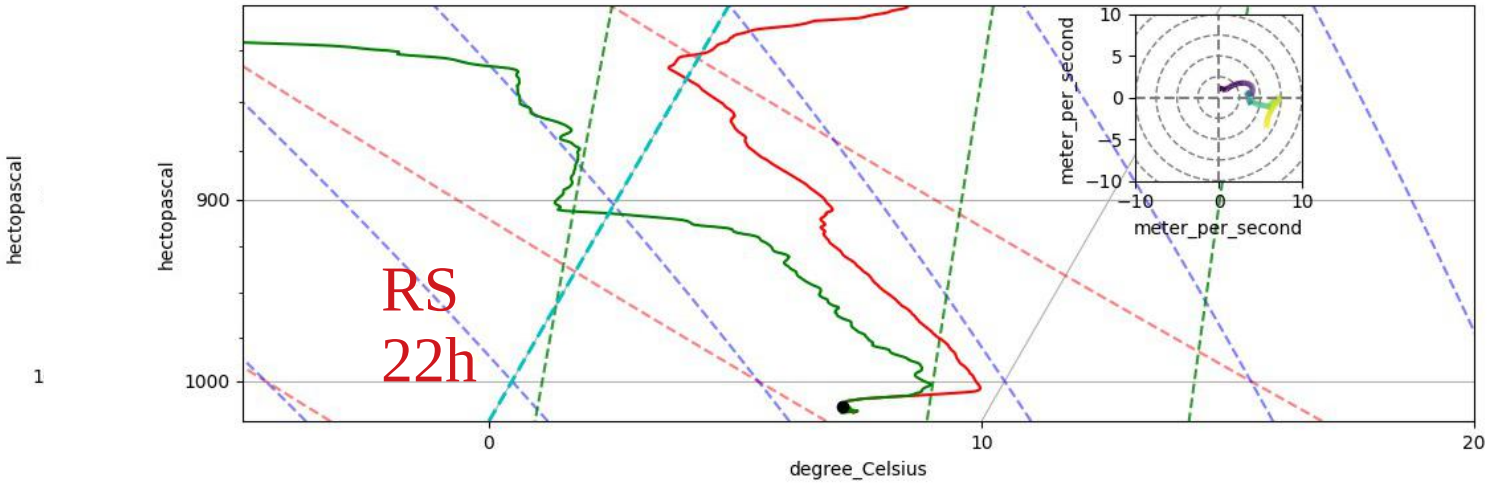


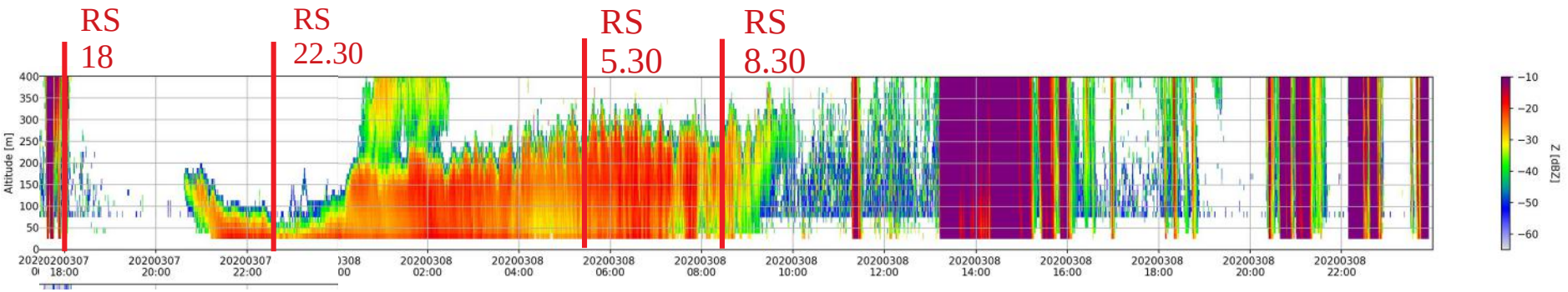
Too early → decreasing of temperature has not started



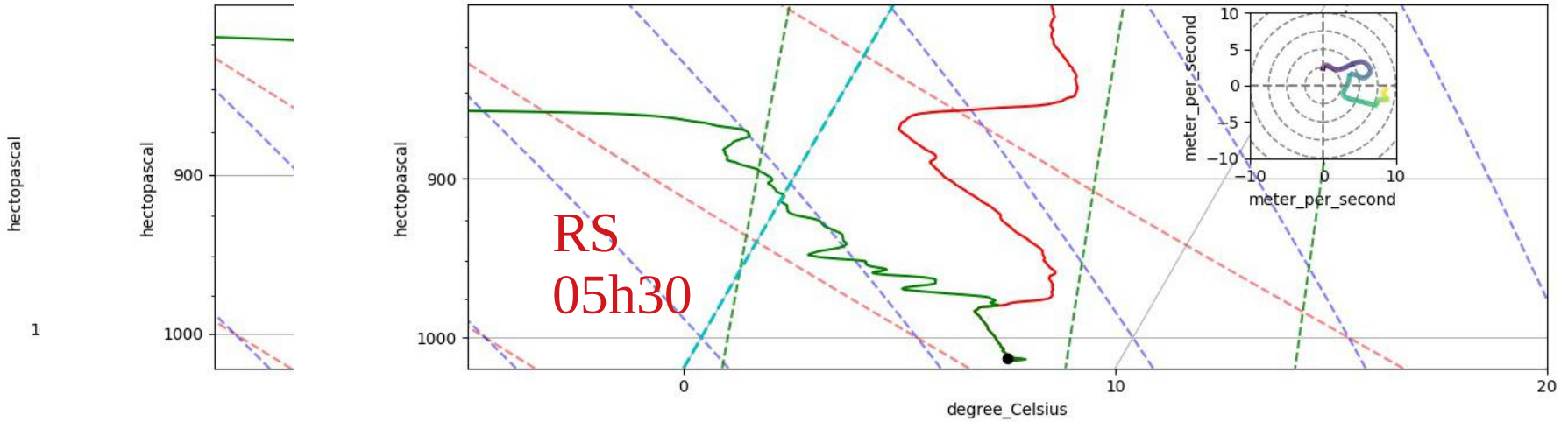


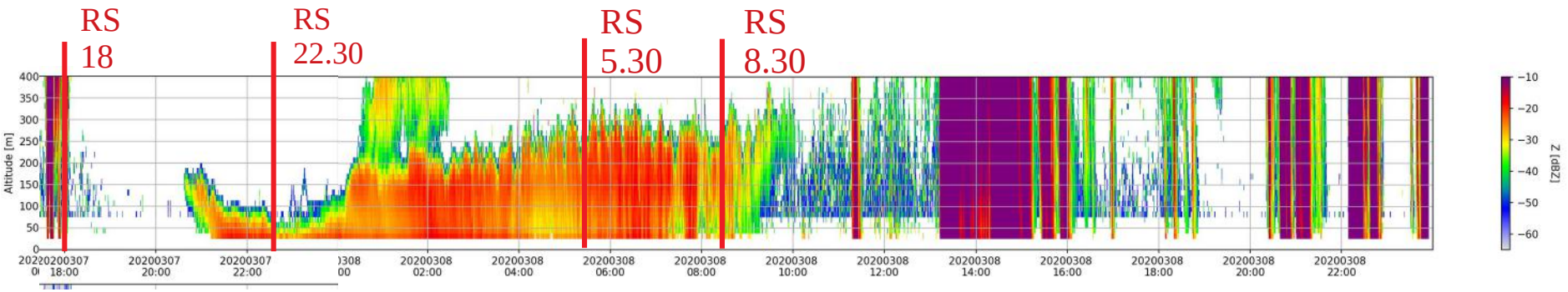
- Decrease of T
- Fog → 60m thickness



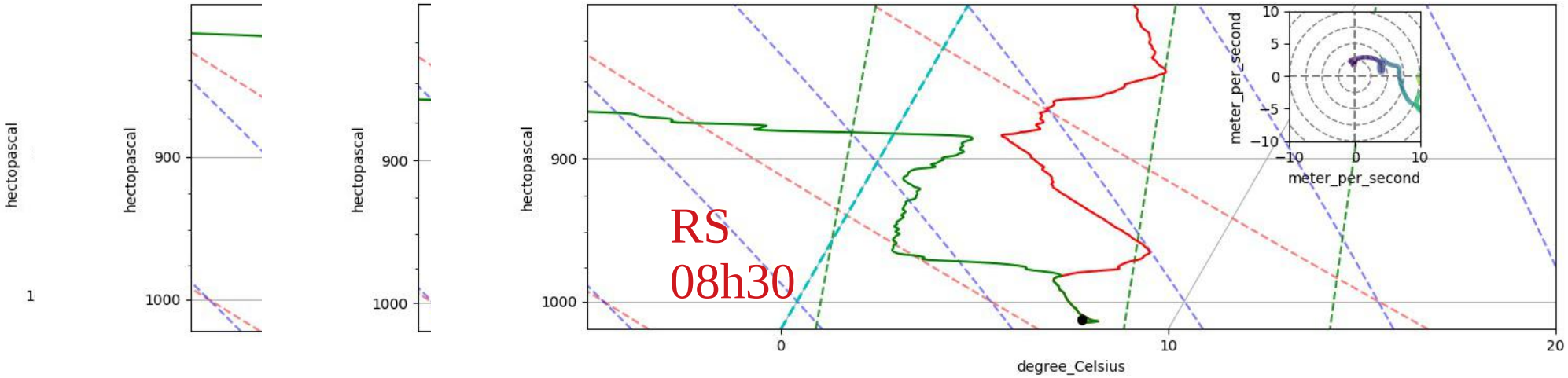


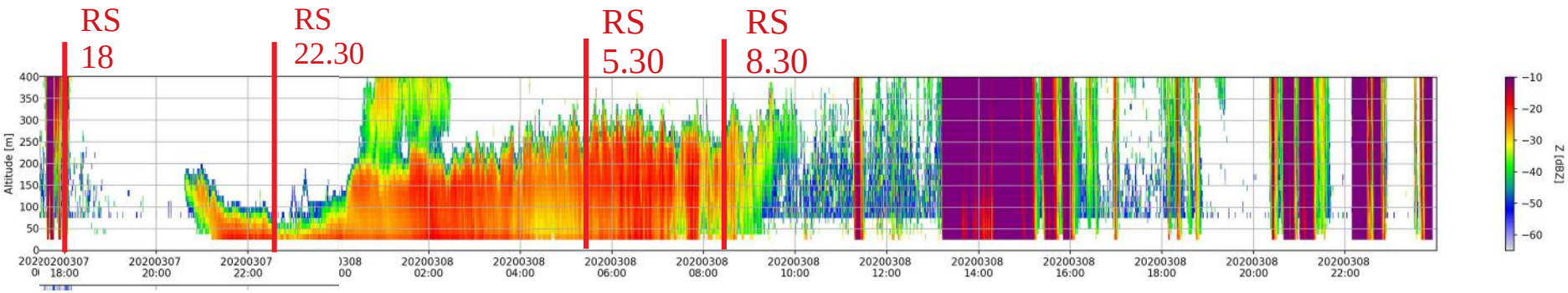
- Fog → 300m thickness
- dry above

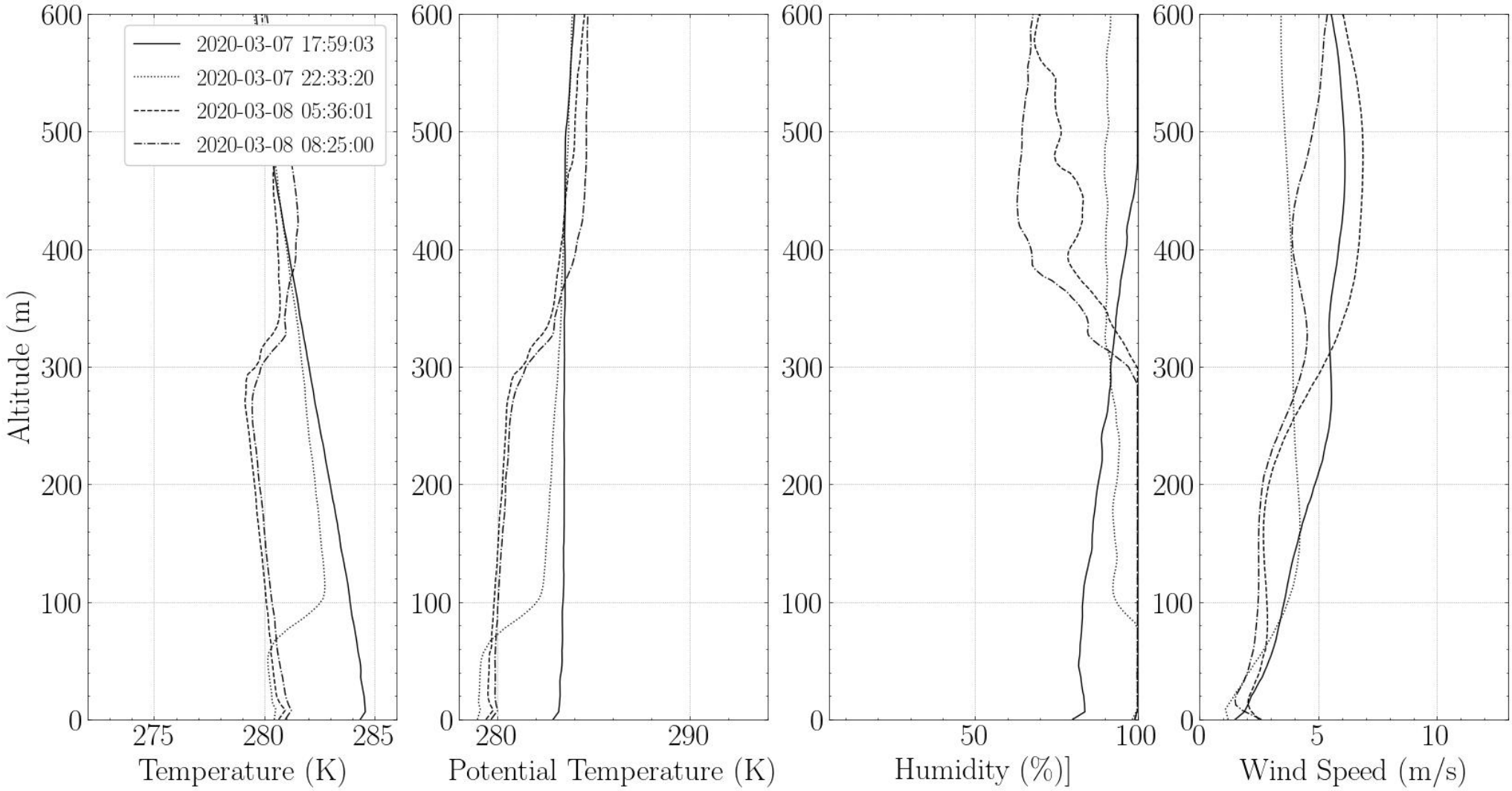




- very similar to the 5.30 sounding

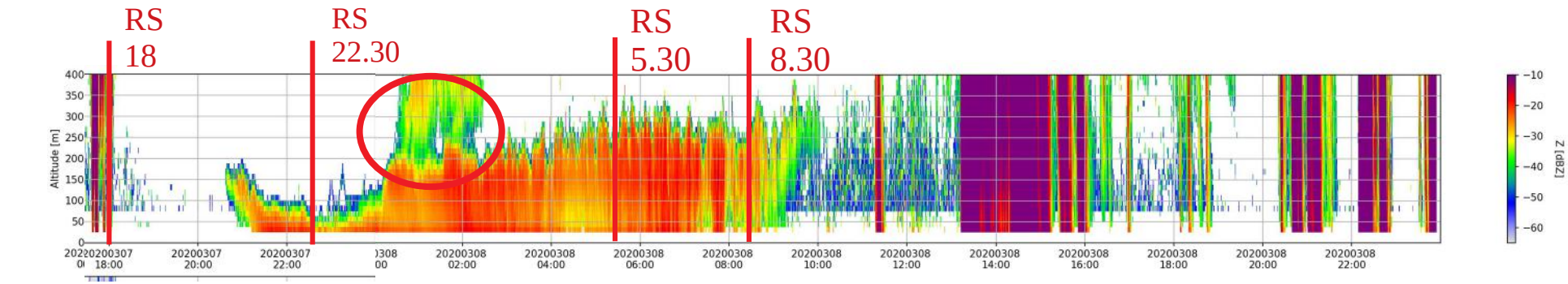


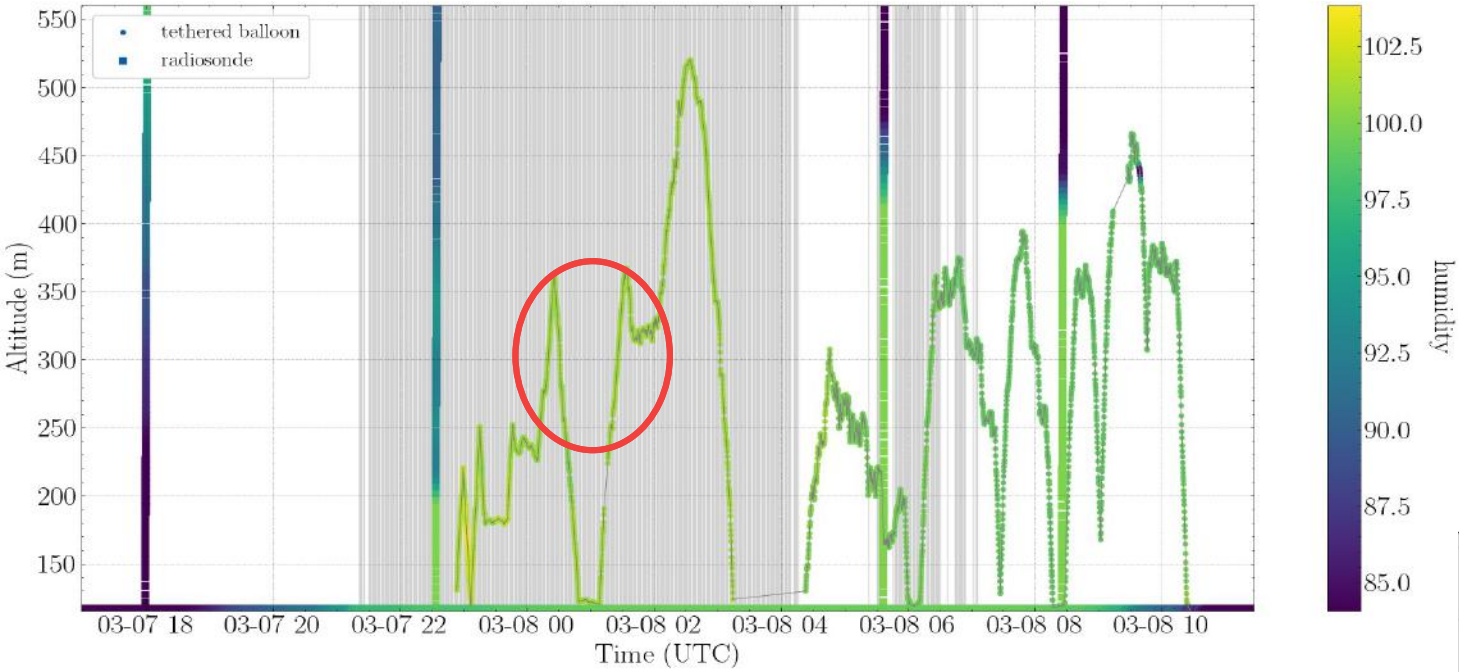

RS
18
RS
22.30
RS
5.30
RS
8.30
Altitude [m]
[dBZ] Z


2020-03-07 17:59:03
2020-03-07 22:33:20
2020-03-08 05:36:01
2020-03-08 08:25:00
Altitude (m)
Temperature (K)
Potential Temperature (K)
Humidity (%)]
Wind Speed (m/s)

IOP14 07-09/03/2020

Tethered balloon gives :
- information on the wind in and above the fog
- link between humidity, advection of
vertical structure of RH, T and wind





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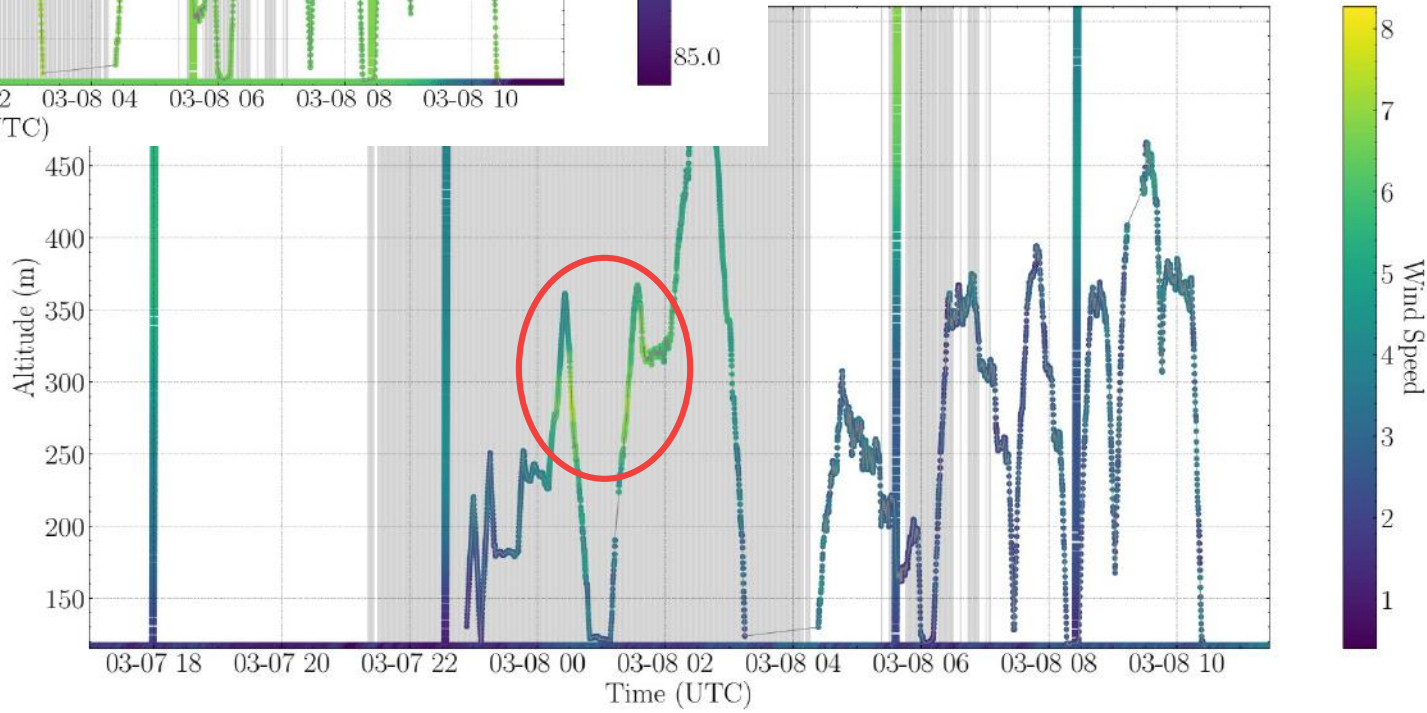

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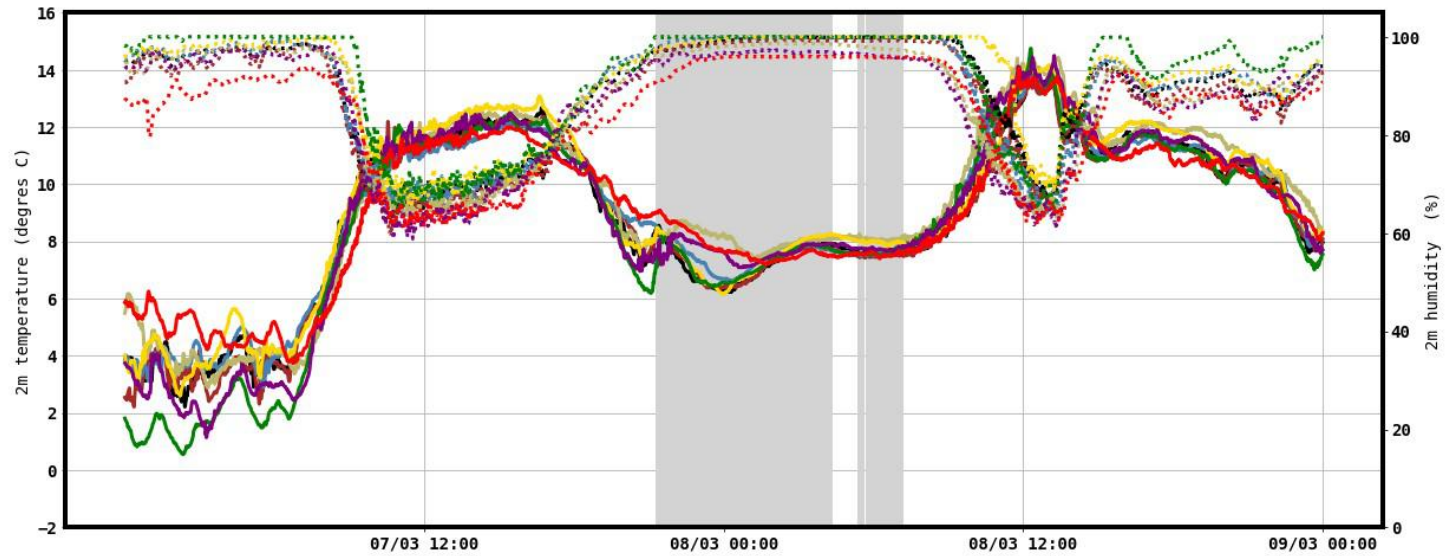
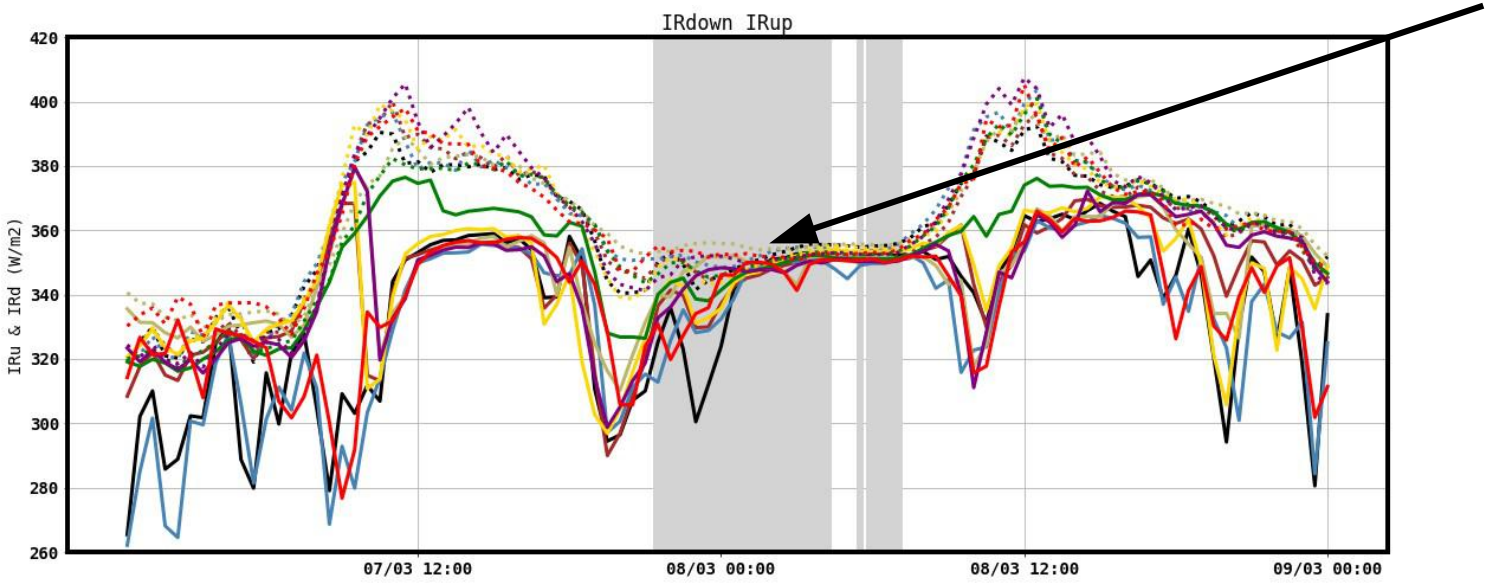




ird jachere · iru jachere · ird charboniere · iru charboniere · ird maire de sore · iru maire de sore · ird noilhan · irm noilhan · ird capesud · iru capesud · ird foret · iru foret · ird leshouzins · iru leshouzins · ird bommes · iru bommes

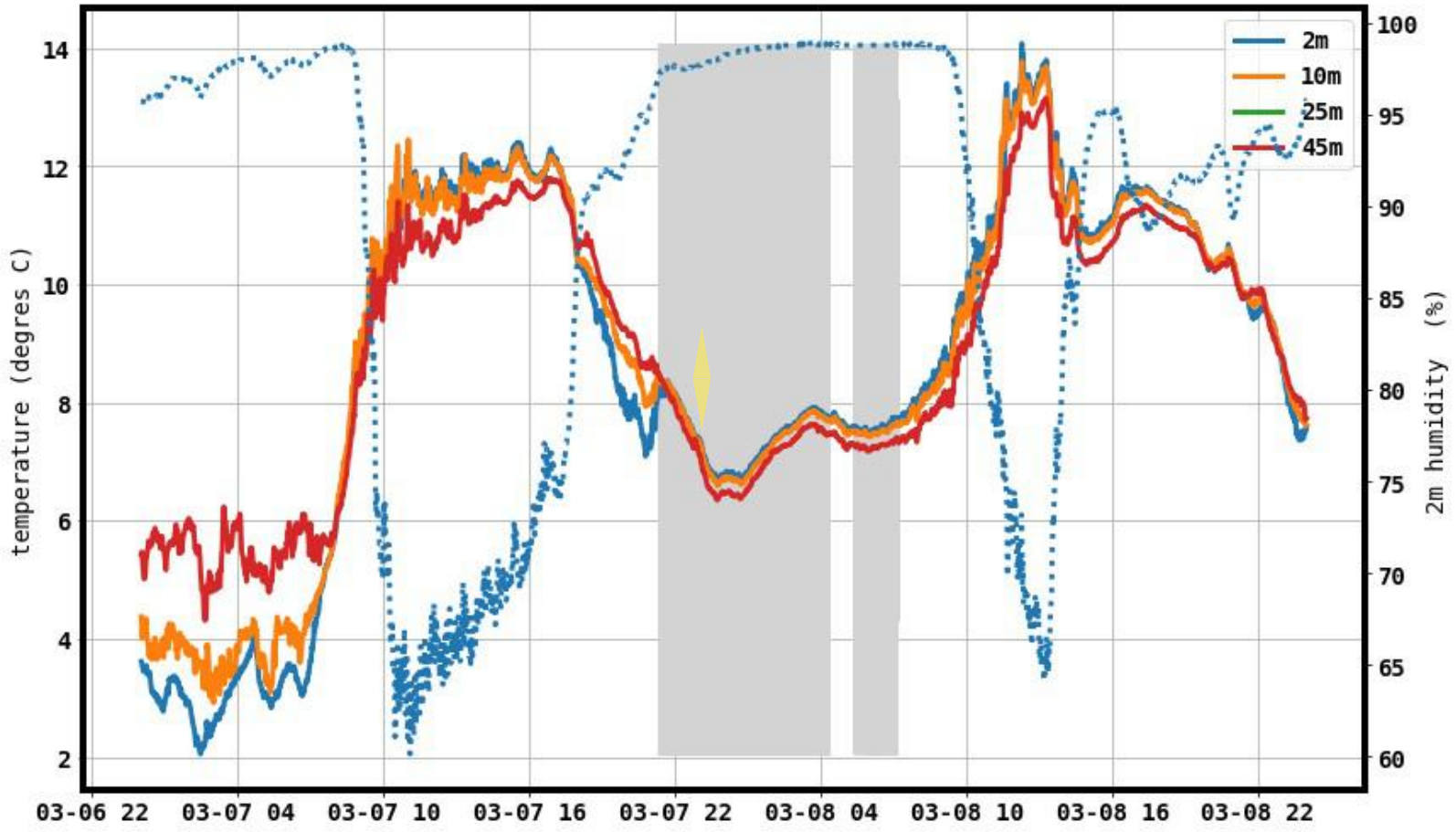
2m humidity and infrared radiation show fog present on all the site

Only after several hours of fog the up and down infrared radaition are equal

METEO FRANCE

IOP14 07-08/03/2020

Temperature from the 40m tower (Tuzan 2km to super site)

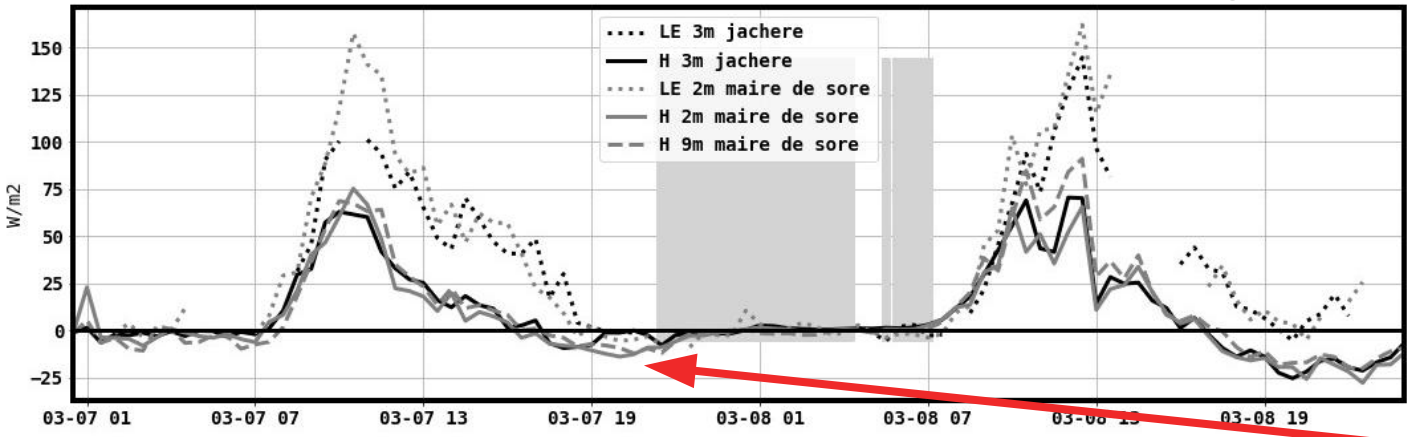


A temperature gradient until the fog appears lower than the IPO6, only 1 degres.

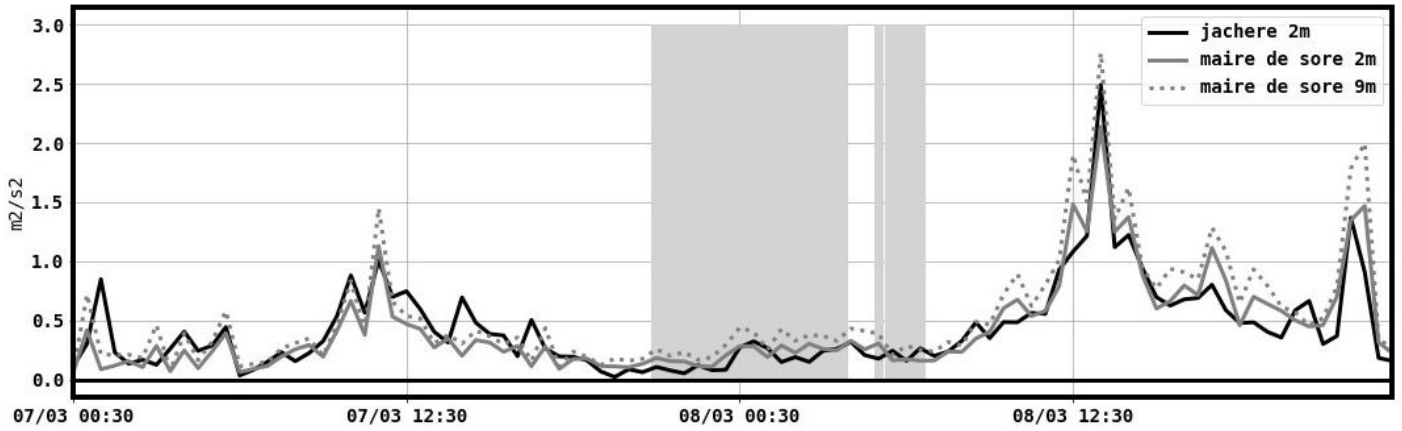
During the fog the layer 2 and 10 m stay well mixed and the 45 m temperature show a temperature colder.

IOP14 07-08/03/2020

- Heat fluxes/TKE : Data from mast at jachere and Ukmo site

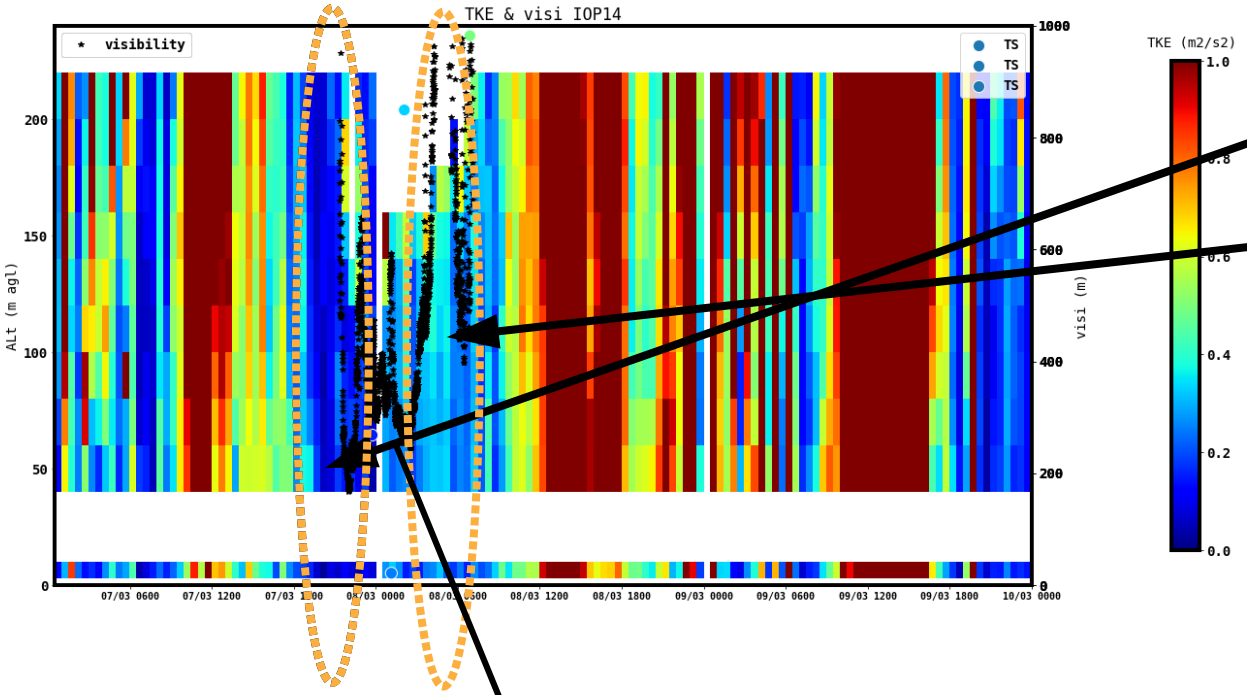


-heat fluxes =0 during the fog
-large difference with the IOP 6.
H is slightly negatif before the beginning of the fog. This radiative loss is significantly higher to maire de sore



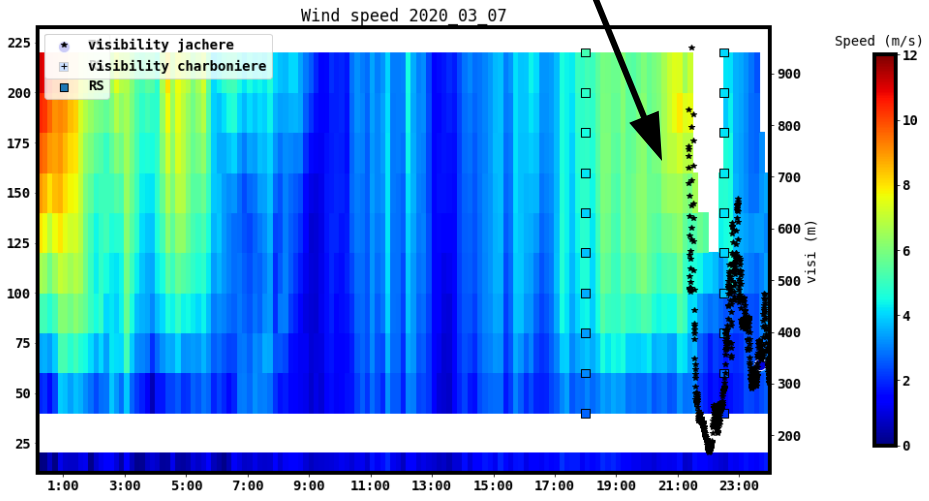
TKE stay around 0,25-0,5. Relatively high values in fog.
We can see the increase of TKE between 2m and 9m at sore.

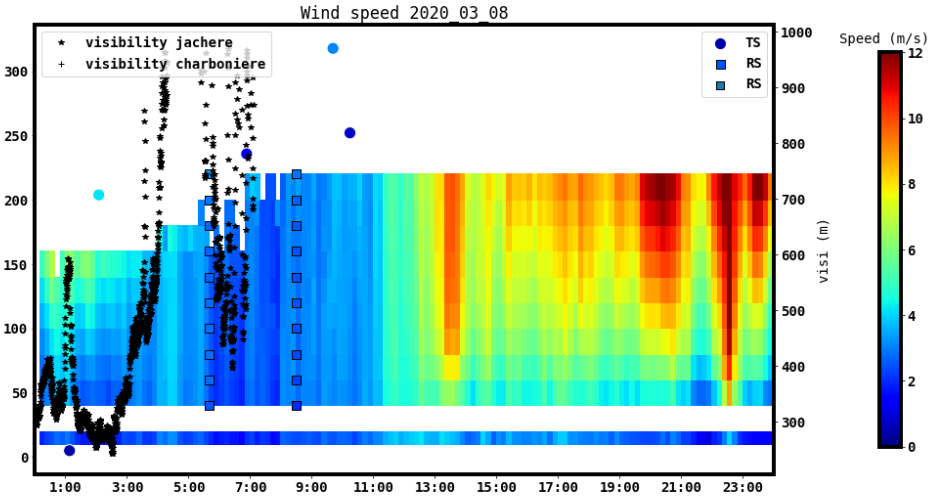
IOP14 07-08/03/2020



-Very low TKE before the fog despite wind

- correlation when the visibility increase and the TKE also increase during the fog





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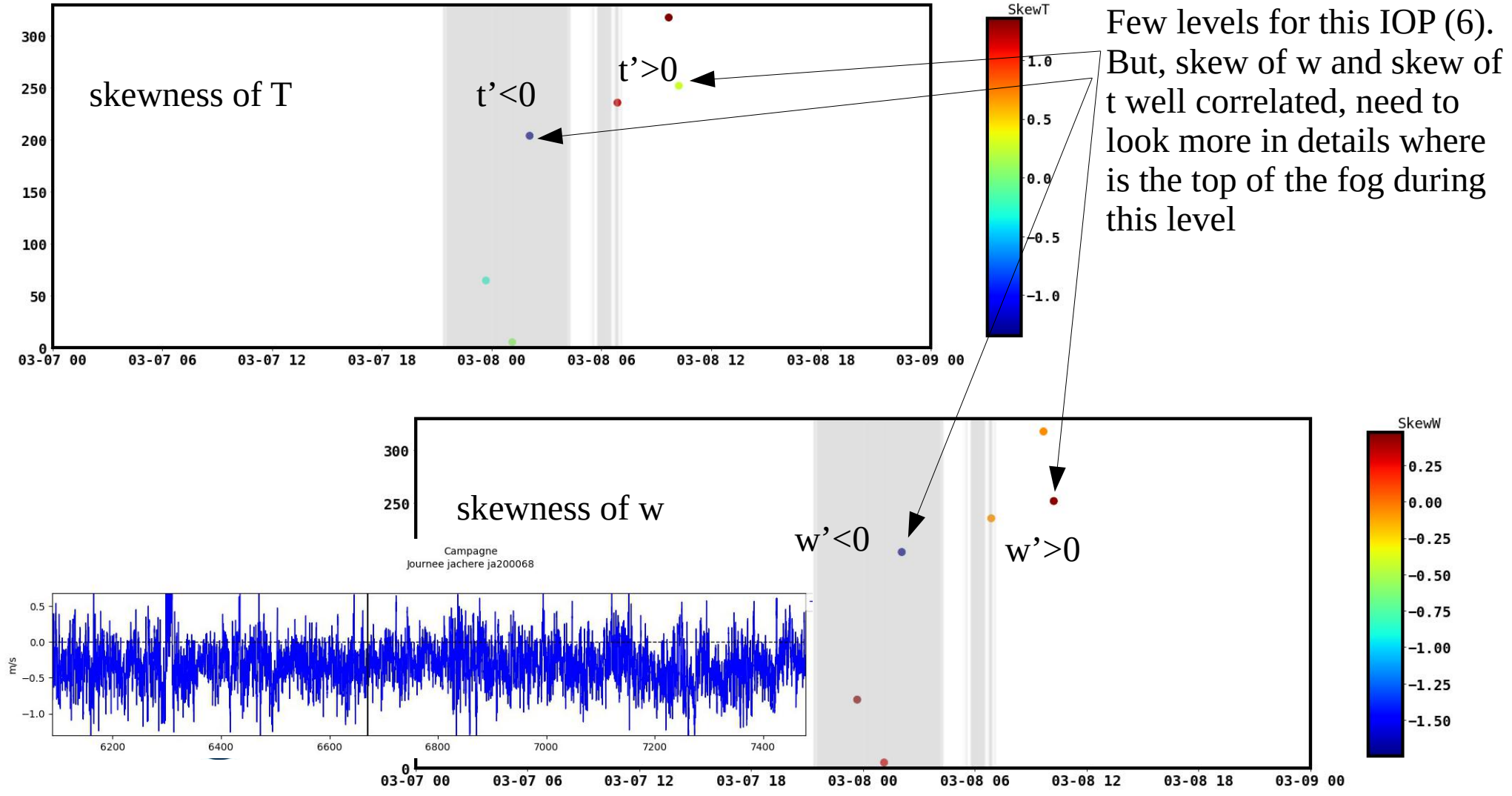
- Turbulent parameters from thethersond



Few levels for this IOP (6). But, skew of w and skew of t well correlated, need to look more in details where is the top of the fog during this level

Conclusion

- Only an overview of the set of data during the field campaign and 3 IOPS concerning the surface Data with means and turbulents parameters from surface stations, 10m mast, 45m tower, RS, tethered balloon and wind lidar

- Don't forget the soil data, humidity and temperature

- A big set of Data to analyze now, the work starts with a good temporal and vertical complementarity.

- Other interesting case during IOP 9 : the night of January 24th to January 25th → no fog but very windy !

Conclusion

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