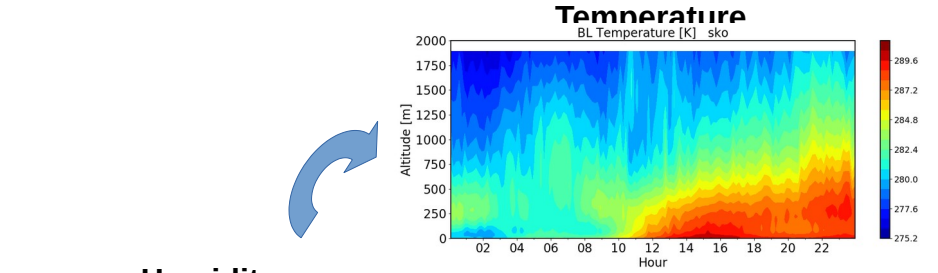
The SOFOG3D MWR network : on-going activities

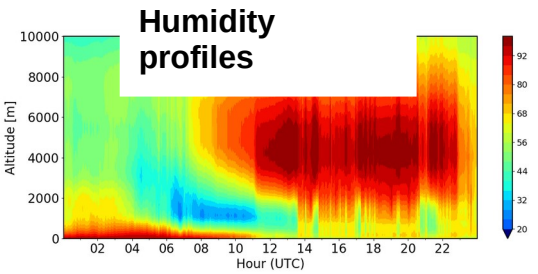
Task5 : Data assimilation and forecast

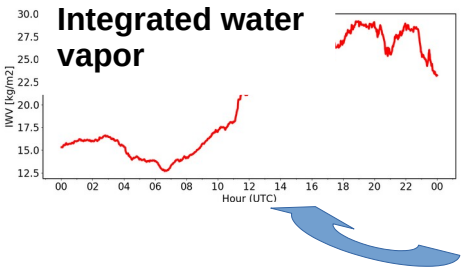
P. Martinet, A. Kremer, U. Löhnert, Donatello Gallucci, Domenico Cimini, E. Orlandi V. Unger, Constanze Seibert, Thomas August, G. Thomas and all WP5 partners

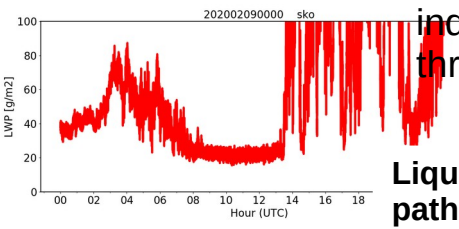
MWR : continuous temperature, humidity and LWP profiling

- Measurement of the downwelling radiative emission of the atmosphere in two spectral bands :
  22 - 31 GHz : water vapor, liquid water content
  51 - 60 GHz : temperature
- Elevation scans to increase resolution of temperature profiles
- **Continuous** measurements : **clear-sky / cloudy-ky**
- **Temperature profile** : well resolved in the BL (~50 to 150m resolution)
- Measurements of reference for the **IWV** (0.5 to 1kg/m²) and the **LWP** (10 to 20 g/m² error)





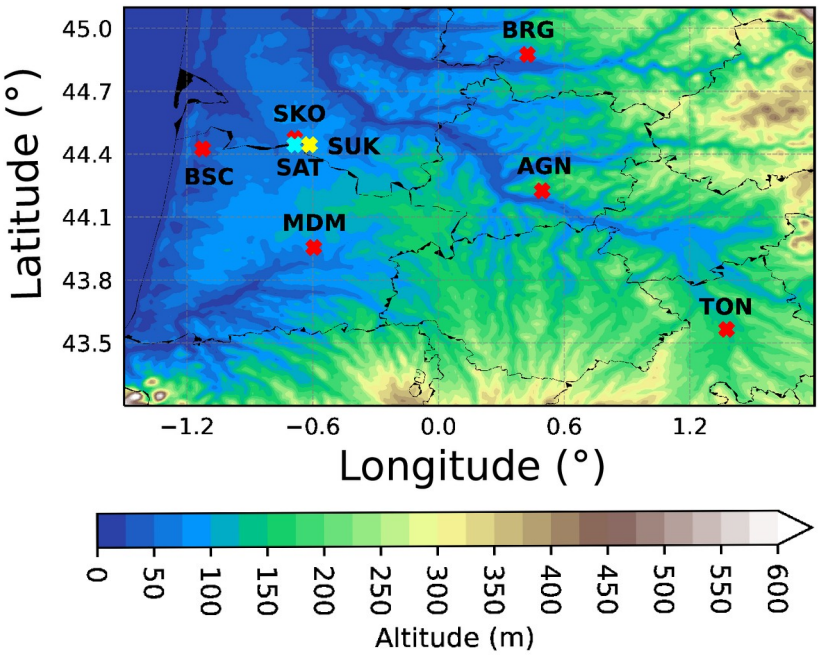




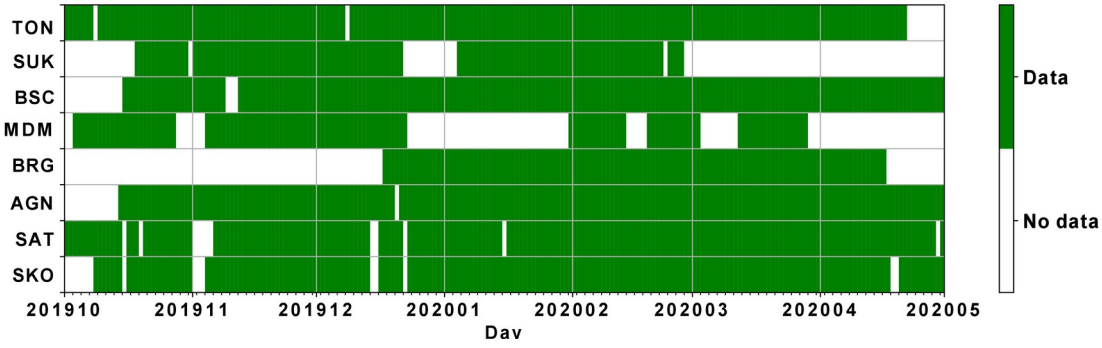
→ IR radiometer when available
+
→ LV3 products : boundary layer height / stability indices/ fog threat

Liquid water path

Reminder : The MWR network during SOFOG3D



Surface altitude (above see level) extracted from AROME. Locations of the MWR sites are shown with the crosses.



Data availability of each MWR unit through the whole experimental campaign period

Main deliverables expected from WP5

Deliverables	Progress
D 5.1 : Data assimilation trials with different settings and configurations (observations, background-errors, vertical and temporal resolutions).	- **Done**
D5.2 Data assimilation strategy for an optimal use of « fog sensitive » observations to improve NWP fog forecasts	- **Partially done** (4D-EnVar not possible, IWV observation operator not available for humidity assimilation, super-computer highly used for the AROME OPER limiting the number of assimilation experiments possible...)
D5.3 Quantitative evaluation of the benefit on the fog forecast using in-situ observations	- **Partially done** **(**RS used but not CDP or UAVs)

Other tasks related to WP5

Task involving WP5	Progress
- Data base on AERIS (NN and LWP offset correction implemented)	- **Done** (and Data Paper in review in BAST journal)
- Feasibility study of monitoring IASI level 2 products with MWR observations	- **Done** (internship C. Seibert Eumetsat) => - co-locations with IASI highlighted T oscillations in for G5 MWR (resolved with new NN version), - temperature std ~ 2 K, good agreement in IWV (std ~ 2.5 kg/m²) - better match with zenith MWR obs less resolved. => Will be continued by EUMETSAT

Other tasks related to WP5

Task involving WP5	Progress
- 1D-Var investigations	**- In progress :** - Bias correction from AROME O-B for all stations - Bias correction from RS has shown larger deviations (sampling too restricted?) - Degradation of the bias IWV for Toulouse when using the AROME BC => into investigations..
- MWR + IR synergy for LWP retrievals	**- In progress :** - several coefficients provided by D. Gallucci and applied to SOFOG3D Agent site by P. Martinet - Main issue : large overestimation of LWP when training the reg. with a database specific of low LWP - Biases in IR TB simulated compared to observed => need for a more advanced retrieval scheme (1D-Var?)

MWR network next steps

1) Finalization of retrievals

- Optimization of 1D-Var retrievals (bias correction and B matrix)
- More in depth evaluation of in-cloud / in-fog temperature profiles retrievals

2) Process study

- Documentation of fog properties between the different sites : temporal evolution of temperature and humidity, evolution of temperature and humidity vertical gradients, inversion strengh and LWP
- Link with other variables : fog top and Doppler velocity from BASTA cloud radar + dynamics from Doppler lidar+aerosol activation from CL31 backscattering profiles

Publication planned by end 2023 on 1) + 2)

3) DA

- Finalized analysis of assimilation experiments
- Publication

METEO FRANCE

Communications

ACL: Marquet, **P., Martinet**, P., Mahfouf, J.-F., Barbu, A. L., and Ménétrier, B.: Towards the use of conservative thermodynamic variables in data assimilation: a case study using ground-based microwave radiometer measurements, Atmos. Meas. Tech., 15, 2021–2035, https://doi.org/10.5194/amt-15-2021-2022, 2022

ACL: **Martinet, P**., Unger, V., Burnet, F., Georgis, J-F., Hervo, M., Huet, T., Löhnert, U., Miller, E., Orlandi, E., Price, J., Schröder, M., Thomas, G.: Database of temperature, humidity and liquid water path retrievals from a fog dedicated network of ground-based microwave radiometers, BAST, in review, 2022.

C-COM: **P. Martinet**, A. Bell, A. Kremer, M. Letillois et al: Benefit of microwave radiometer and cloud radar observations for data assimilation and fog process studies during the SOFOG3D experiment, EMS, 2021

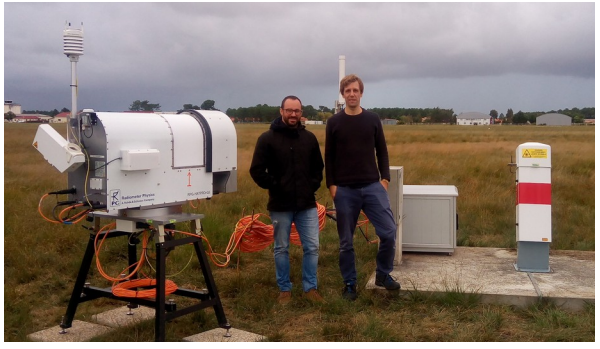
C-COM: Cimini, D., Gandoin, R., Fiedler, S., Wilson, H., Pospichal, B., **Martinet, P.**, Balotti, A., Gentile, S., and Romano, F.: Assessment of atmospheric stability measurements from microwave radiometer observations for offshore wind energy applications, EGU General Assembly 2022, Vienna, Austria, 23–27 May 2022, EGU22-12954, https://doi.org/10.5194/egusphere-egu22-12954, 2022.

C-COM: **Martinet, P.**, Bell, A., Caumont, O., Vié, B., Burnet, F., and Delanoë, J.: Optimal estimation of thermodynamic and microphysical profiles within fog events from ground-based microwave radiometer and cloud radar synergy., EGU General Assembly 2022, Vienna, Austria, 23–27 May 2022, EGU22-12410, https://doi.org/10.5194/egusphere-egu22-12410, 2022

C-COM : Thomas, G., **Martinet, P**., Brousseau, P., Chambon, P., and Burnet, F.: Data assimilation experiments of a ground-based microwave radiometer network for fog forecast improvement., EGU General Assembly 2022, Vienna, Austria, 23–27 May 2022, EGU22-7025, https://doi.org/10.5194/egusphere-egu22-7025, 2022.

METEO FRANCE

Thanks for your attention and thanks to all the MWR network partners !



METEO FRANCE