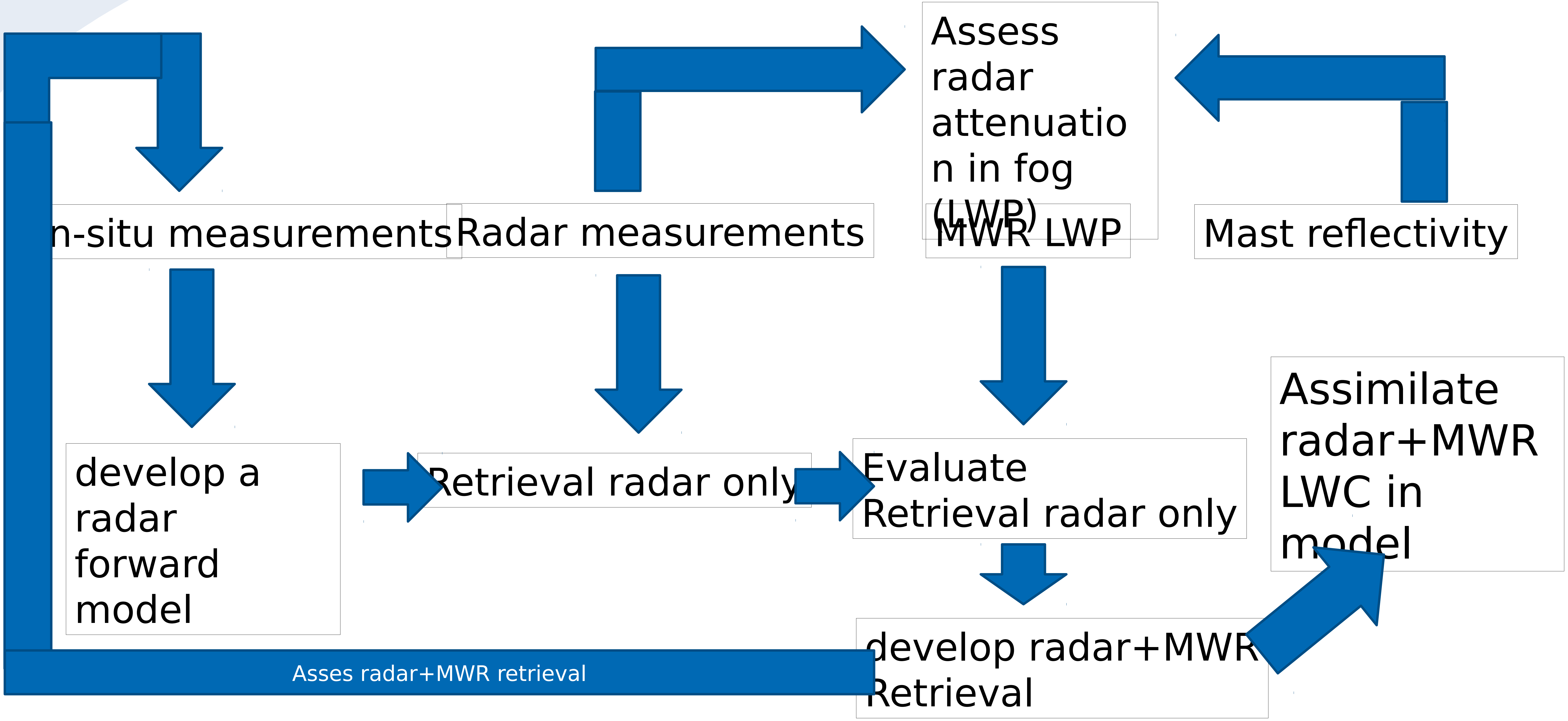
SOFOG3D

TASK 2: **FOG RETRIEVALS BASED ON REMOTE SENSING MEASUREMENTS**

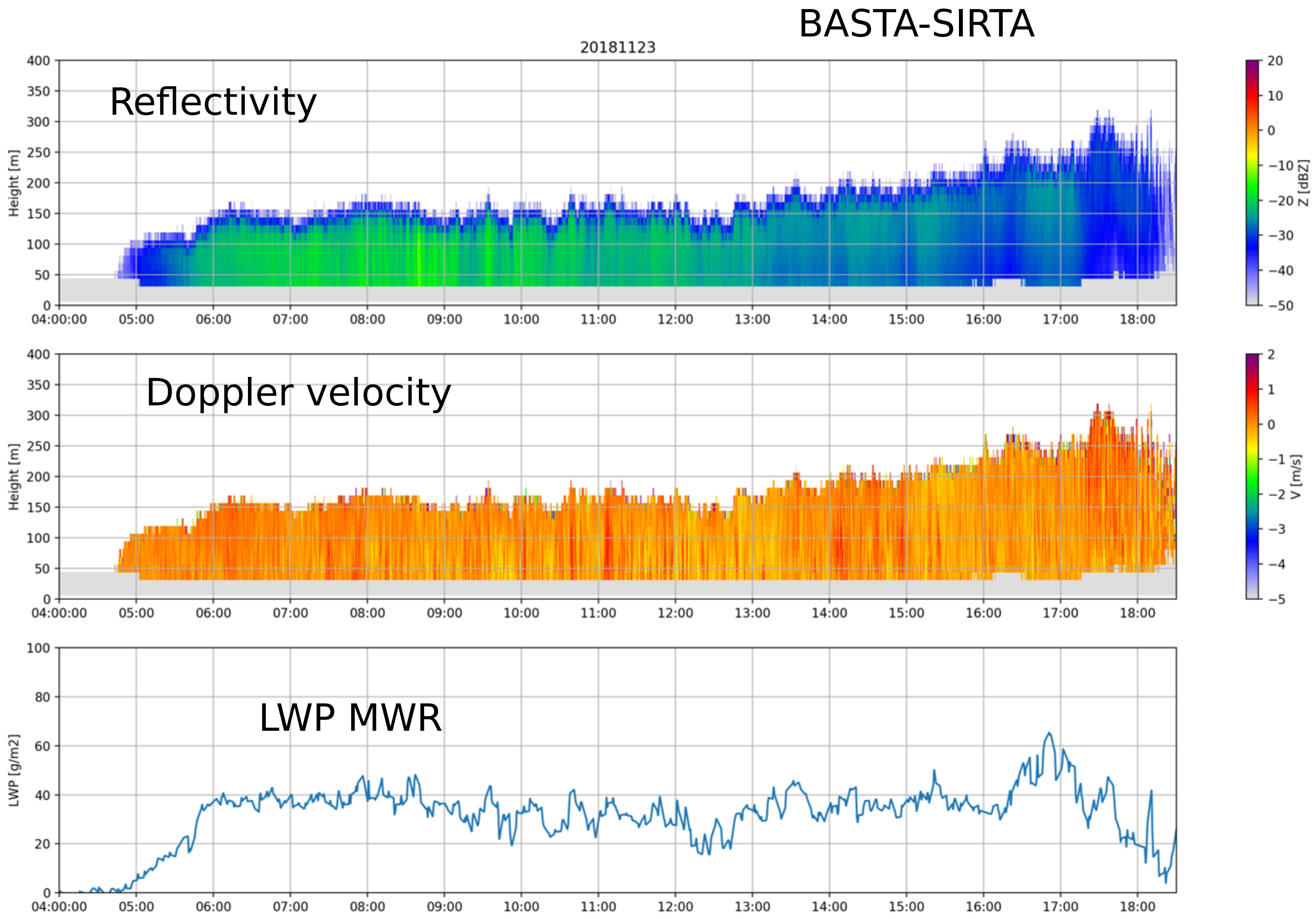
Objectives

- Improve retrievals of key fog parameters (temperature, humidity, fog water and microphysics, fog dynamics) based on the combination of the cloud radar (both reflectivity and Doppler spectrum) and the microwave radiometer (MWR) measurements.
- Geostationary satellite data will be extracted to characterize the spatio-temporal evolution and patterns of each fog case.
- Use the data collected during task 1 to derive the optimal products
- These products will feed task 4 for process studies, and task 5 to conduct the first data assimilation trials of both radar reflectivity and MWR brightness temperature measurements.


Assess radar attenuation in fog (LWP)
In-situ measurements
Radar measurements
MWR LWP
Mast reflectivity
develop a radar forward model
Retrieval radar only
Evaluate Retrieval radar only
Assimilate radar+MWR LWC in model
develop radar+MWR Retrieval
Asses radar+MWR retrieval

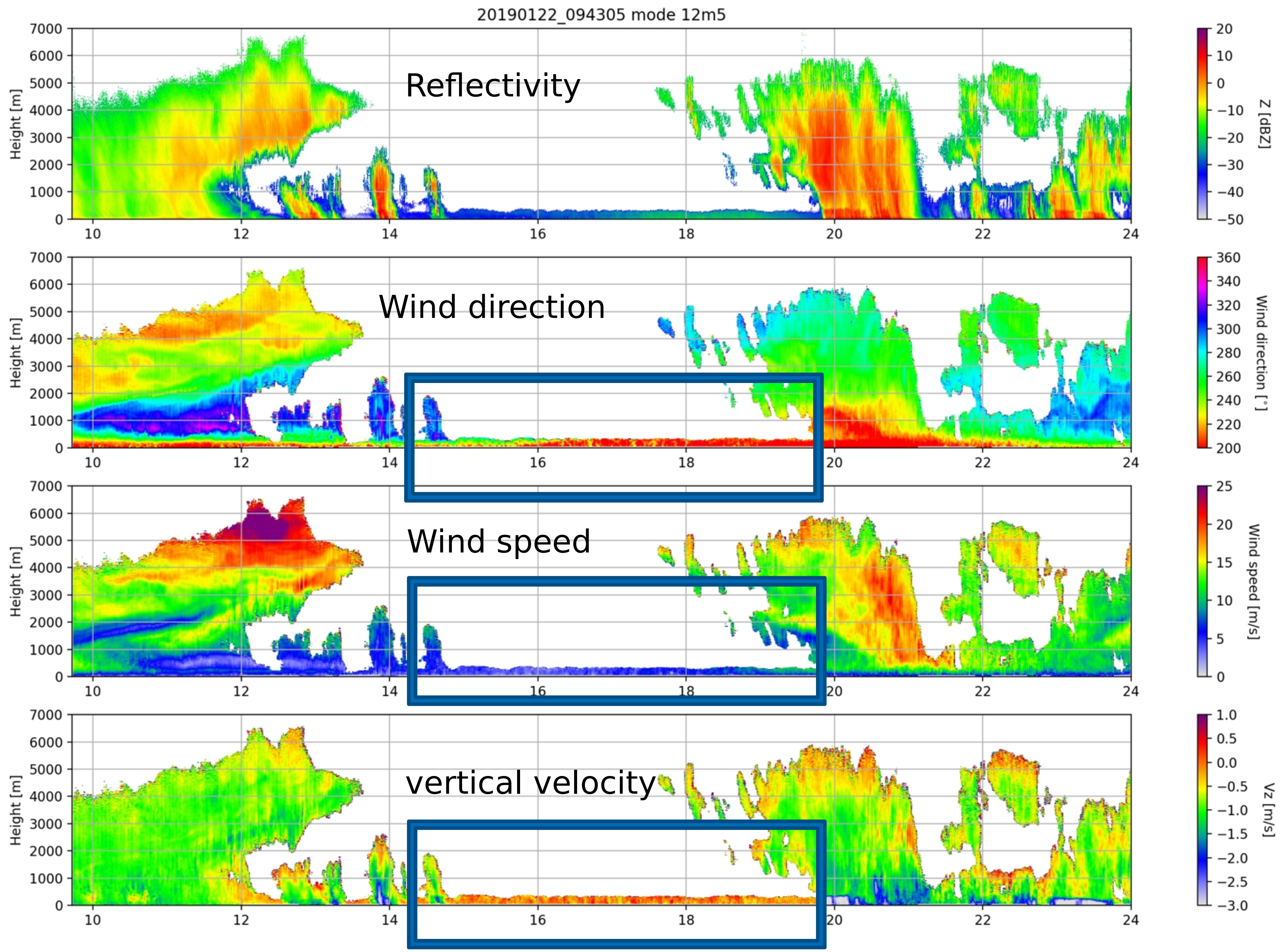
Sub-task 2.1: LWC and fog dynamics retrievals from radar and MWR (T0+9- T0+21)

- Combining cloud radar and MWR observations => fog dynamic and microphysics.
  - The development of a forward model which will convert the state vector (containing what we want to retrieve, LWC, effective radius, total number concentration– to be defined during the study) into radar reflectivity and possibly the Doppler spectrum.
  - The MWR LWP will be used as an external constraint in the retrieval.
  - Study the possibility to add the Doppler velocity as a constraint on the droplets size and/or the vertical air motion.
  - The radar forward model development will be based on in-situ measurements collected during previous campaigns at SIRTA site and will be refined thanks to the measurements provided by T1 and the closure analysis (T2.2).



Sub-task 2.1: LWC and fog dynamics retrievals from radar and MWR (T0+9- T0+21)

BASTA-LATMOS-VAD



- The fog dynamics using the Doppler capability of the radar.
  - The combination of both terminal fall velocity and vertical air motion will be directly measured by the vertically pointing radar. W (vertical air motion) will be used to characterize the vertical stability of the fog layer.
  - VAD to estimate the horizontal wind speed of the fog layer.

Sub-task 2.2: Closure analysis and retrievals assessment (T0+15- T0+24)

Compare in-situ measurements and remote-sensing retrievals on fog microphysical properties.

1. Evaluate the retrieved LWP derived from BASTA radar only with LWP derived from HATPRO microwave radiometer, taking into account for instrumental uncertainty and sensitivity.
2. In-situ data collected in T1 (as LWC, effective radius and number concentration measured with optical granulometer) => a closure analysis in order to asses and improve the retrievals derived with cloud radar in vertically pointing mode.
3. Radar attenuation will be quantified by measuring the backscattered radar signal on well-known calibrated reflectivity metallic targets installed at the top of several ten meter high masts.

Sub-task 2.3 MWR profiles retrieval constrained by radar LWC (T0+18- T0+24)

- Cloud radar LWC profile will be used in the MWR 1D variational retrieval algorithm (1D-Var, Martinet et al 2015) as a sink variable (no adjustment during the minimization) to obtain more realistic temperature and humidity profiles by accurately taking into account the cloud emission in the radiative transfer.
- After validation by in-situ data collected in T1, the retrieved profiles will then be used in T5 to be directly assimilated in the AROME model.
- The possibility of directly adjusting the LWC profile during the minimization will be investigated.

Sub-task 2.4 SEVIRI/MSG retrievals (T0+21-T0+27)

- Track fog and low stratus spatio-temporal evolution to help visualize and understand the spatio-temporal patterns of each fog case, based on the SEVIRI imager on board the Meteosat Second Generation geostationary satellite.

- A set of geo-satellite indicators have been defined to track (temporally and spatially) physical processes that drive fog and stratus dissipation:

1. Surface warming feedback (from below) based on variations of IR brightness temperature
2. transparency of clouds is tracked based on a normalized cloud reflectance;
3. high-altitude cloud warming feedback (from above) is tracked through variations of classified pixel fractions;
4. advection (from aside) is tracked through the shift of fog edge.

These processes are tracked by analysing temporal behaviours of indicators.

Fog dissipation is characterized by significant trends in one or more indicators, while fog persistence translates into flat signals due to lack of trend.

Man power

The post-Doc researcher (T2.1-2.2-2.3) will contribute to the development of the fog retrieval technique based on the combination of the radar and the MWR, its validation and the closure analysis. She/he will be involved in the field campaign and will process the radar-MWR data in order to provide optimal profiles of LWC, humidity and temperature.

Deliverables

D2.1.1 LWC profiles depending on different constraints from dedicated variational method

D2.1.2 Dynamics of the fog layer from velocity azimuth display technique
D2.2.1 Evaluation of radar LWC retrievial vs in-situ measurements
D2.2.2 Improve radar forward model thanks to calibrated metallic targets
D2.3.1 Improved MWR temperature and humidity profiles retrieved with cloud radar LWC

D2.3.2 Feasibility study of cloud radar LWC assimilation within the MWR 1D-Var framework

D2.4.1 Time series of 2-D maps of cloud classes using a classification adapted for fog and low stratus evolution tracking (e.g. separating core fog, dissipation fog, formation fog pixels)

D2.4.2 Time series of fog evolution indicators, such as distance to fog boundaries, cloud albedo and evolution of brightness temperature of the different cloud classes.