FLAGSHIP PROJECT

DYVALOCCA project

Monitoring cloud evolution in the context of climate change

DYVALOCCA: pushing atmospheric science projects via a suite of instruments including an infrared sky imager

The DYVALOCCA project is a collaboration between French, German and Gabonese partners. Reuniwatt's **Sky InSight**™ (infrared all-sky imager) was used during a field campaign to monitor the evolution of clouds and evaluate their effects on water and light availability in a forest along the Atlantic coast of Central Africa.

Photo credits: DYVALOCCA

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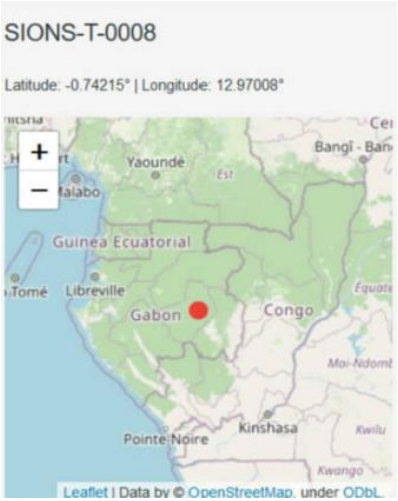
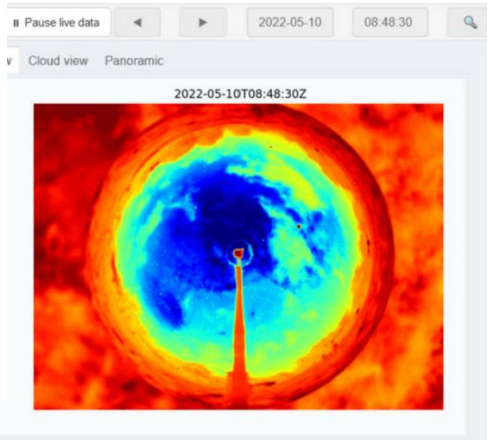
Understanding low clouds' impact on climate

Low clouds are key components of climate. However, they are rarely well represented in weather and climate models. Along the Atlantic coast of Central Africa, from the coastal plains of Gabon and Congo-Brazzaville to the interior plateaus, a unique cloudy dry season develops from May to September. The region's dense evergreen forests might be particularly vulnerable to climate change as any reduction of these low clouds may represent a major tipping-point for forest cover and functioning.



The **DYVALOCCA project** was funded by the French and German research agencies (ANR and DFG) to collect existing in-situ data and satellite estimates to establish diagnostic and modelling analyses of the dynamics and variability of these low clouds. With a range of measurement material (Ceilometer, Disdrometer, Sodar, Microwave sounder, Tethersondes and radiosondes, infrared sky imager), the research consortium, co-led by Dr. Nathalie Philippon (CNRS researcher at IGE), has been developing the first conceptual model for low-cloud formation and dissolution in western equatorial Africa, in order to provide a basis for development of intraseasonal to seasonal forecasts of low cloud variations, and quantify the water and light constraints underneath the low clouds. The project's results will also give directions for an evaluation of climate change simulations with a focus to inform the assessment of tipping-points for the evergreen forests in past and future climates.



Reuniwatt provided the DYVALOCCA project a **Sky InSight**™, permitting to collect ultra-local information about the clouds passing above it. An infrared camera enables to observe the cloud ceiling with a 180° angle corresponding to a 2-kilometer radius. Various cloud cover parameters are then obtained by processing the sky temperature map.

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All-sky imagers' impact on cloud cover monitoring

A decade after the first version of its **Sky InSight**™, Reuniwatt has shown that using infrared enables an unprecedented accuracy for day and night cloud detection. Unlike visible light sensors, which cannot operate in the dark, infrared sensors detect the thermal radiation emitted by clouds and the Earth's surface. This capability is crucial for the continuous monitoring of cloud dynamics performed at observatories, ensuring that data is collected around the clock. 24/7 observations are essential for understanding the full lifecycle of clouds, from formation to dissipation, and for capturing rapid changes that may occur overnight. Different users worldwide, from atmospheric sciences to defence and space applications rely on our instruments' measurements.

Another significant advantage of infrared imaging is its ability to penetrate cloud cover and reveal information about the structure and properties of clouds. Infrared radiation can pass through thin clouds and haze, providing clearer images of the underlying and embedded cloud layers. This is particularly useful in studying complex cloud systems, such as those involving multiple layers of clouds at different altitudes. By analysing infrared images, researchers can gain insights into the vertical distribution of cloud layers, their thickness, and their temperature profiles. The **Sky InSight**™ calculates the Cloud Optical Depth (COD) by retrieving it from measured cloud infrared radiation and ground temperature, estimating liquid water content and effective water droplet sizes within clouds. The clear-sky water vapour contribution to cloud infrared radiation is then removed, and a model is optimised empirically using an instrument during the calibration period to deliver the COD.

Moreover, infrared imaging is instrumental in identifying and analysing cloud microphysical properties, such as particle size and phase (liquid or ice). Different types of cloud particles emit infrared radiation differently, allowing researchers to infer their characteristics based on the emitted wavelengths. Understanding these microphysical properties is essential for studying cloud formation processes, precipitation mechanisms, and the interactions between clouds and aerosols. As infrared technology continues to advance, its applications in cloud studies will likely expand, offering even deeper insights into the complexities of cloud formation and behaviour.

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Customer feedback

Dr Nathalie Philippon, CNRS searcher and co-leader of DYVALOCCA:

"We installed the Sky InSight Infra-Red camera for 6 months in Gabon with the aim of understanding the diurnal evolution of the cloud cover during the dry season. The instrument was easy to handle, and took only a few days to self-calibrate. Reuniwatt provided us with high-quality data of total cloud fraction, and cloud optical depth calculated from the images acquired by the camera.

The Sky InSight data confirmed that during the dry season, the cloud cover is maintained throughout the day, and more rarely, breaks up more or less early in the afternoon.

Reuniwatt's technicians and engineers were attentive to our needs and helpful (quality control during the campaign and post-campaign data analysis). The Sky InSight is well suited to research in climate."

About Reuniwatt

Reuniwatt is a major player of the solar radiation and cloud cover assessment producing solar and wind power forecasts. Based on solid Research and Development works, the company offers reliable products and services intended for professionals of various fields, making the best out of two key facets of the meteorology: atmospheric physics and data sciences. A particular focus has been placed on solar energy forecasting, while developing cutting edge solutions to improve the short-term prediction of the solar resource.

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