Multi-plateform monitoring of aerosols, clouds and atmospheric boundary layer dynamics in Vosges supersite in the framework of the COPS field campaign

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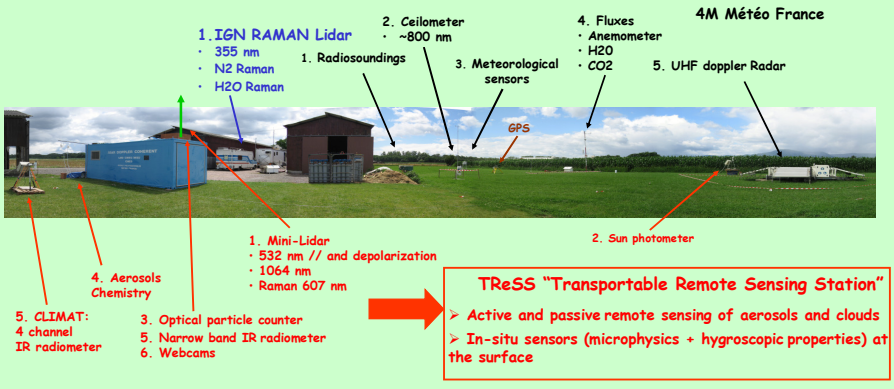
Summary and objectives

Atmospheric aerosols play an active role in cloud hydrological cycle, and thus precipitation processes, as they act as cloud condensation nuclei and ice nuclei. Their hygroscopic properties and number concentration have an impact in cloud microphysics, leading to suppress or enhance precipitations. The Transportable Remote Sensing Station "TReSS" was deployed in Vosges supersite in July 2007 in order to monitor the different contributions of atmospheric aerosols in the Rhin Valley region (i.e. rural and urban aerosols, desert dust in the upper atmospheric layers), clouds and atmospheric boundary layer dynamics. In the framework of COPS, TReSS deployment aimed at studying the role of aerosols on cloud properties. TReSS dataset has been conceived for :

1) Assessment of aerosol mixture impact on optical and hygroscopic properties,
2) Cloud cover description and optical properties retrieval,
3) CALIPSO satellite data validation and
4) Aerosol /cloud numerical modelling validation.

VOSGES SUPER SITE (SS): at Meistratzheim (48.4°N 7.5°E 161m)

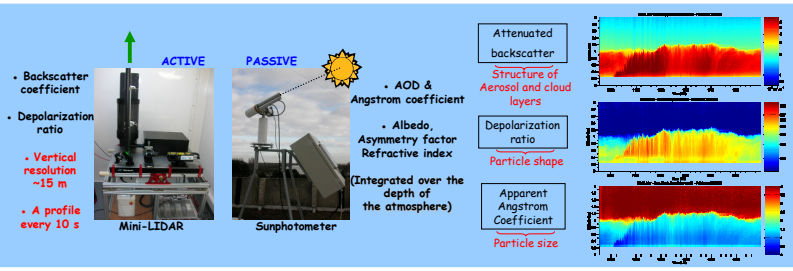


TReSS "Transportable Remote Sensing Station"

- Active and passive remote sensing of aerosols and clouds
- In-situ sensors (microphysics + hygroscopic properties) at the surface

Description of the TReSS platform

TReSS is an autonomous and high-performance system designed to observe radiative and structural properties of clouds and aerosol layers, as well as atmospheric boundary layer (ABL) dynamics. The standard payload is made of the following instruments: 1) a multi-wavelength elastic and Raman channels backscatter Mini-Lidar operating at 532, 1064 and 607 nm (with diverse polarization capability at 532 nm), 2) a sun-photometer, 3) an optical particle counter 4) filters for subsequent aerosol composition and hygroscopic properties analysis, (5) two multi-channel infrared radiometers including the CLIMAT radiometer from the Laboratoire d'Optique Atmosphèrique from Lille and (6) a full sky visible web-type camera.

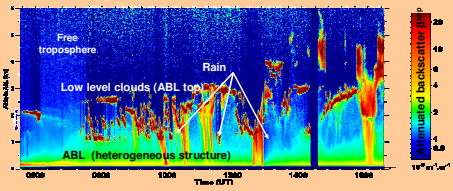


Variables measured by TReSS

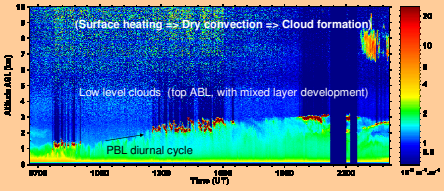
- **Atmospheric aerosols:** backscatter / extinction coefficient profiles (15 m vertical resolution, 10 s temporal resolution); Aerosol layers optical and geometrical depths; column-integrated size distributions and refractive indexes, surface measurements of size distribution between 0.15 and 10 μm (1 minutes) and chemical composition (Black carbon, Organic carbon, Hydrosoluble carbon, Ions, Mass, every 12 hours)
- **Clouds:** backscatter / extinction coefficient profiles; cover full-sky visible images (10 s); Thick cloud base altitude; Thin cloud optical and geometrical depths (15 m resolution);
- **ABL diurnal cycle** (using aerosols as tracer) and **Integrated water vapor content; IR irradiance** in the 8-13μm, 11.5-12.5 μm, 10.5-11.5 μm, 8.2-9.2 μm and 9.5-11.5 μm ranges;

Prevailing meteorological conditions in July 2007 observed in Vosges SS

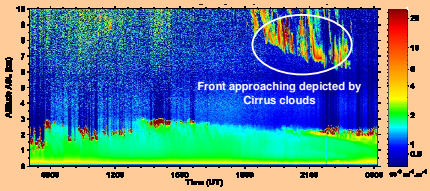
Low and mid level clouds: 20 cases. 11/07 example



Expected conditions: only 4 cases of typical diurnal PBL cycles (30/07)

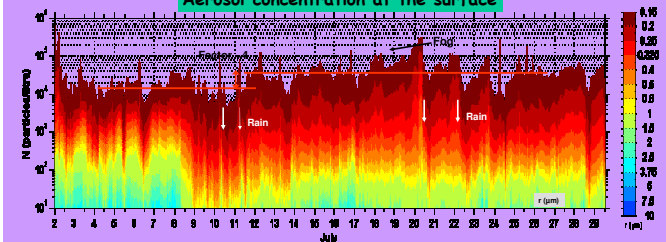


High level clouds (cirrus): 10 cases. 22/07 example

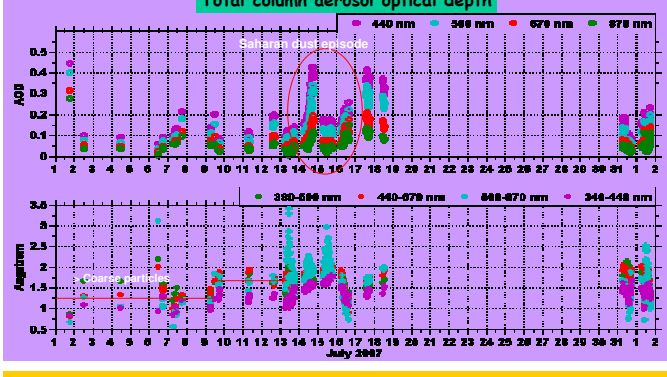


Aerosol variability

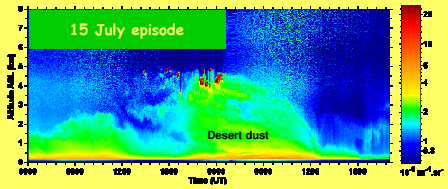
Aerosol concentration at the surface



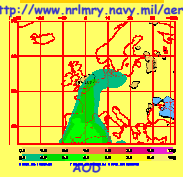
Total column aerosol optical depth

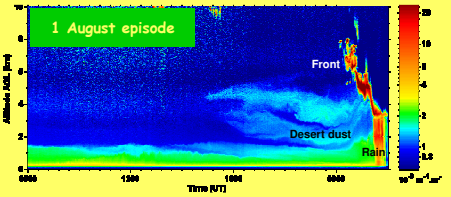


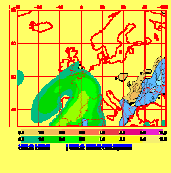
Dust transport episodes

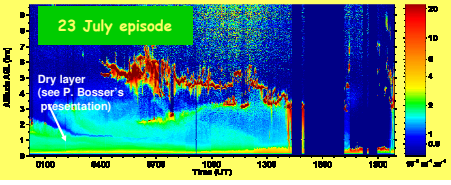


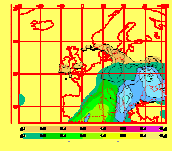
NAAPS simulation (http://www.nrlmry.navy.mil/aerosol/)











Perspectives and future collaborations

* Golden days: 15/07 and 01/08 (major dust episodes) and 17/07 and 23/07 (interactions)
*Database to study:
  * Evolution of aerosol transports: their origin (desert, urban, rural), concentration and size variability
  * Variability of aerosol content: e.g. rain scavenging (link with numerical modelling in collaboration S. Berthet, J-P. Pinty from LA)
  * ABL evolution influenced by its diurnal cycle, orography?, wind shear? (Collaboration with S. Batin SA/IPSL)
* Hygroscopic properties of aerosols using chemical analysis (collaboration with Jean Sciare LSCE /IPSL)
* Synergy with other measurements: IGN (P. Bosser and O. Bock), 4M-Meteo France (G. Pigeon), LEANDRE 2 (C. Flamant SA/IPSL)