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# Activities at a European Planetary Simulation Facility

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## Abstract

IFA Aarhus University operates a unique environmental simulation facility capable of re-creating extreme terrestrial and other planetary environments. It is supported by ESA and EU activities. Specifically it is capable of recreating the key physical parameters such as temperature, pressure (composition), wind flow and importantly the suspension/transport of dust or sand particulates. This facility is also available to the scientific community for collaborative research. Recent research and testing/calibration activities will be presented.

## 1. Activities Overview

This environmental simulator facility is utilized for a broad range of research programs including; the study of other planets (such as Mars), for recreating extreme terrestrial environments, or in specific investigations involving aerosols and other forms of particulate transport.
Under the EU supported EUROPLANET trans-national access program several research groups have had access to this facility, mostly involving specific Martian environment studies.
This facility is also part of a European network (VERTIGO) recently established to investigate the dynamics within ash clouds and pyroclastic flows.
Other activities include the development, testing and calibration of sensor and planetary lander systems, both for ESA and NASA. Instrument cross calibration and testing has also been carried out under a European network of metrology agencies with the aim of improving climatic and meteorological sensor data.

## 2. Design and Operation

The simulator has been loosely based on a previous smaller facility operating since 2000 and consists of an environmental (thermal-vacuum) chamber within which a re-circulating wind tunnel is housed [1,2]. The wind is generated by a set of two fans which draw flow down the 2m×1m tunnel section and return it above and below. The test section can be fully removed for access. Wind speeds in the range 1-25 m/s have been demonstrated.

Figure 1 The new Mars Simulation Facilities at AU

Cooling is achieved by a novel liquid nitrogen flow system which has achieved temperatures below -150ºC, an electric heater system is also employed. The inner chamber is thermally isolated from the vacuum chamber.
A server based control system provides both control over wind flow, temperature, pressure, lighting, etc., but also acts as a data logger.

## 3. Planetary Simulation

In recent work at the facility the formation of $CO_2$ ice has been studied in order to resolve speculation as to the optical properties of the (seasonal) Martian polar $CO_2$ ice. The existence of highly transparent $CO_2$ ice layer in Martian polar areas has been debated for some time. Our aim has been to constrain the conditions suitable for the formation and preservation of the transparent $CO_2$ layer.

Figure 2 Planetary Simulator design.

In another study the scattering of light by suspended dust particulates was simulated to better understand the observed scattering of sun light by dust in the Martian atmosphere.

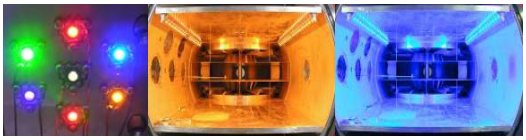

Figure 3 section of the multi wavelength LED light source (left) and wind tunnel tests section using different lighting settings (center/right).

## 4. Terrestrial Meteorology

The ability to reproduce a specific terrestrial environment and control wind flow, humidity, pressure, temperature, etc., is of use in meteorology / climatology for the calibration of sensors and traceability of their data. This work is part of the EU supported European MeteoMet collaboration and the EURAMET network. For this wind tunnel facility it involves detailed calibration and testing of the wind tunnel operational parameters and modifications where necessary.

## 5. Dust Aerosols and Sand transport;

A unique capability of this wind tunnel facility is the production and controlled study of suspended particulates (dust, ash, sand, etc.).
This type of experiment is a continuation of a large body of research performed over the past decade studying dust aerosols, specifically granular electrification, erosion and deposition rates [1,2,3,4].

This research has direct relevance to aerosol studies on Earth which impact air quality, the environment and climate.
An advanced type of Laser aerosol and (2D) wind flow sensor with particle sizing capability has recently been installed and is allowing detailed study and control these environmental parameters.

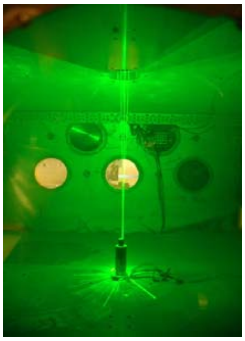

Figure 4 Optical testing in the windtunnel (left) Laser based wind/dust sensor (right).

## 6. Conclusion

This planetary simulation facility has many unique features which make it well suited for both research applications and the development/testing of instrumentation. Details of this laboratory facility will be presented and some of the recent (past few years) activities will be summarized. For information on access to this facility please contact the author.

## References


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