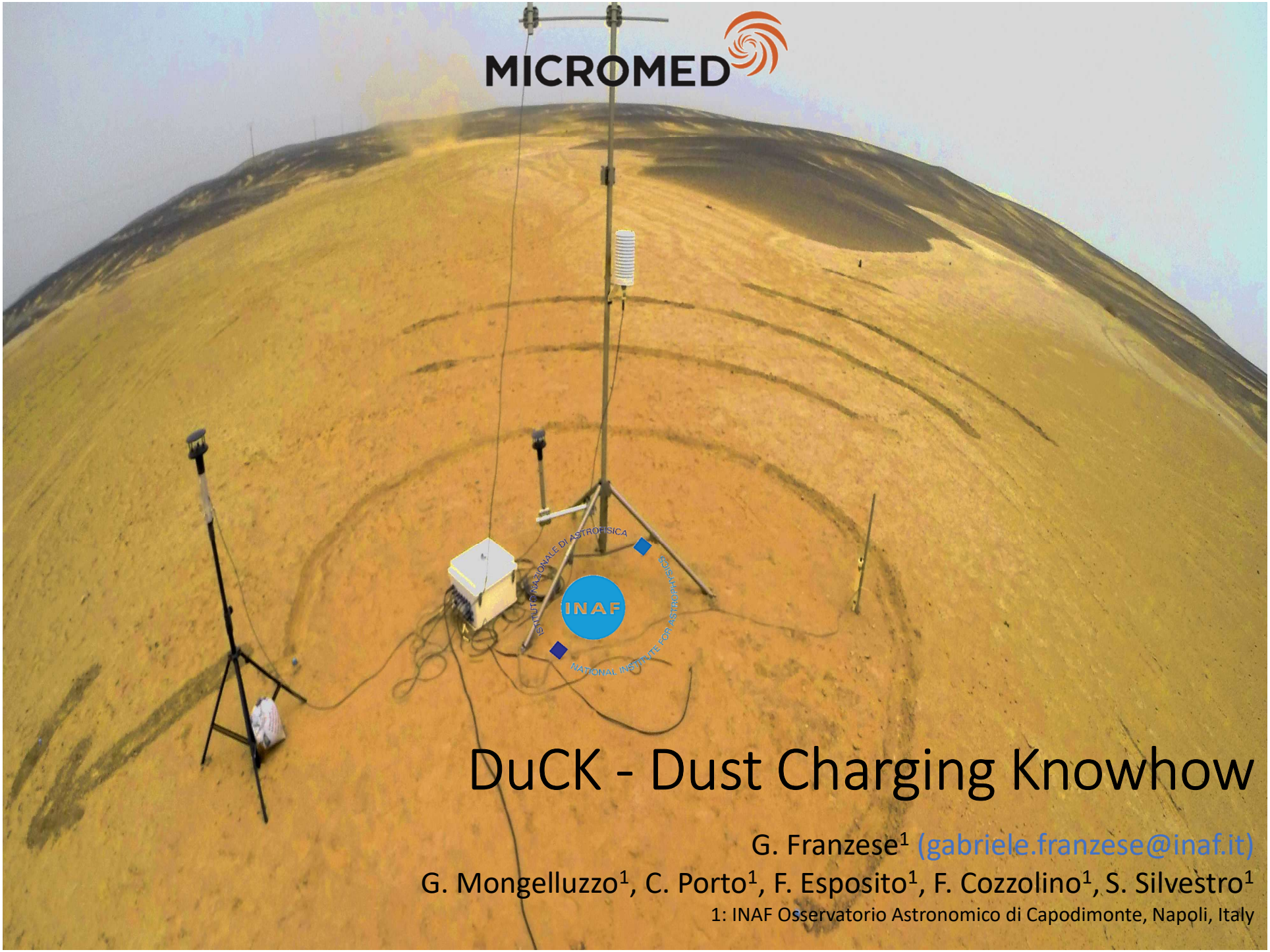

DuCK - Dust Charging Knowhow

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Mineral Dust

from suspension of minerals constituting the soil
grain size ~ [10^{-2} µm : 65 µm]

effects on the atmosphere:

it scatters and absorbs visible and infrared radiation

it cools down the surface and the low atmosphere, it heats the upper layers favouring a stable atmosphere

it inhibits the turbulence
it reduces the vertical exchange of momentum, decreasing the near surface wind

it influences the composition and vertical structure of the clouds

depending on the relative position of the dust layer and the cloud coverages

it can:

enhance the cloud evaporation

enhance the cloud lifetime

it alters the optical proprieties of clouds the formation of droplet and the precipitation formation

contribution to atmospheric dust:

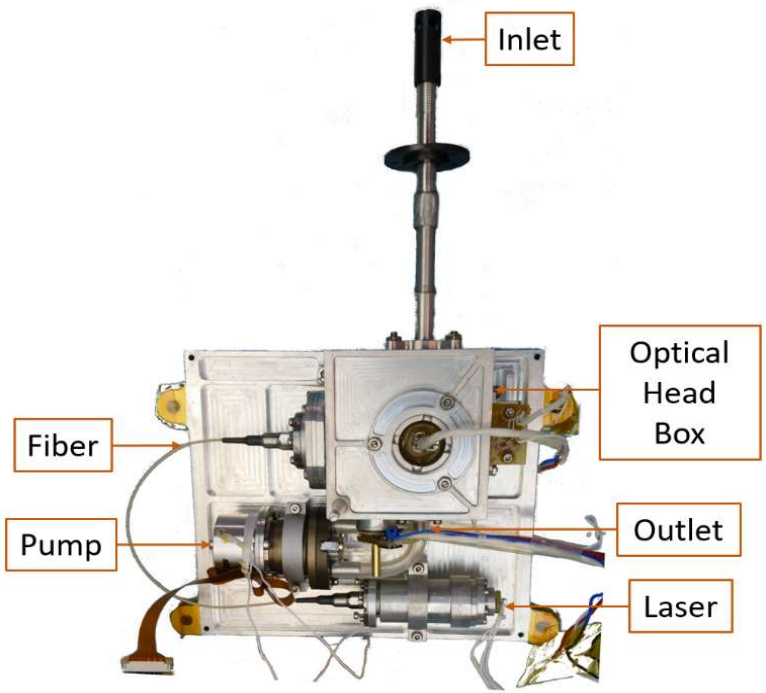
~ 50 %

Dust Storms

~ 50 %

Dust Devils

Dust Complex



Dust Complex:
suite of 4 instruments specifically aim to characterize martian dust lifting phenomena and electrification.

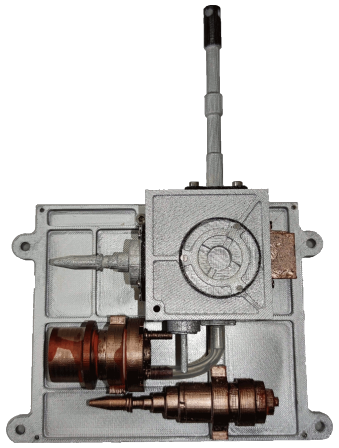
- impact sensor: detection of the saltating sand and charge measurement;
- electric probe for atmospheric E-field;
- electromagnetic activity sensor (EMA) for possible electromagnetic discharges;
- optical particle counter (MicroMED) dust concentration and size distribution.

MicroMED
Primarily scientific purposes:
First in situ analysis of the primary lifted dust.
In particular it will measure the lifted dust:

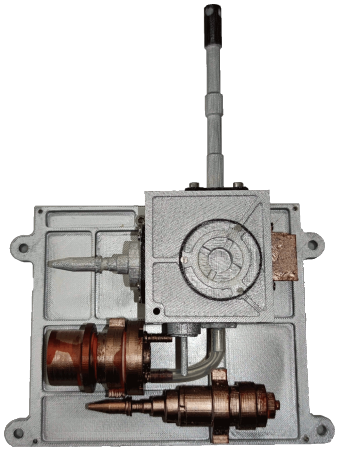
- concentration
- size distribution

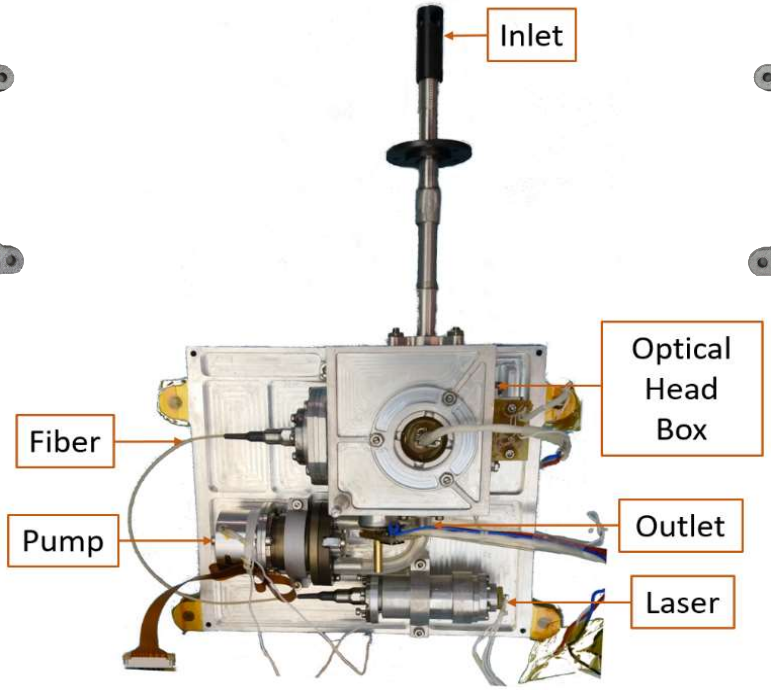
MicroMED

Optical System

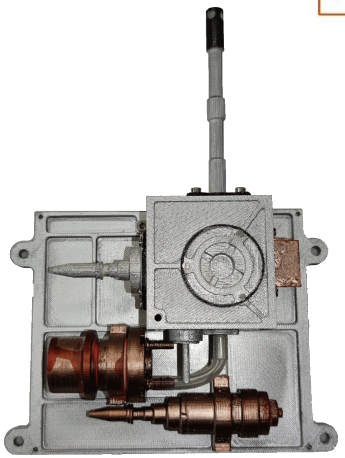


Optical Head

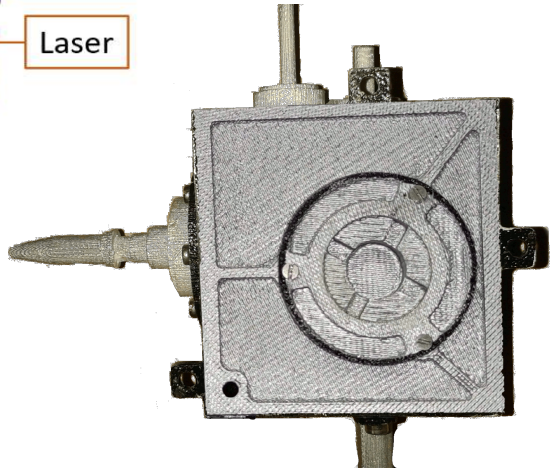




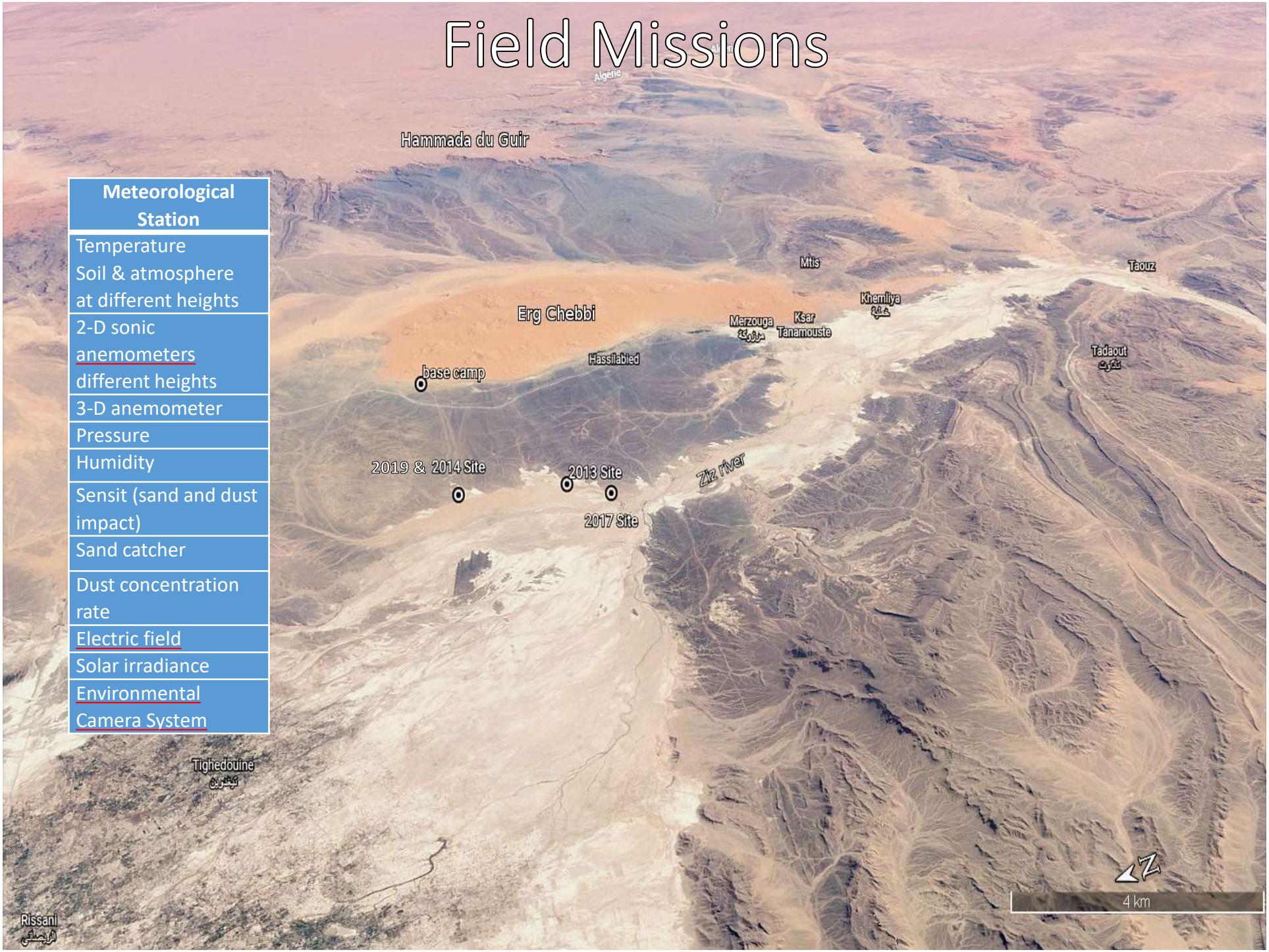
Pump System



Inside Optical Head

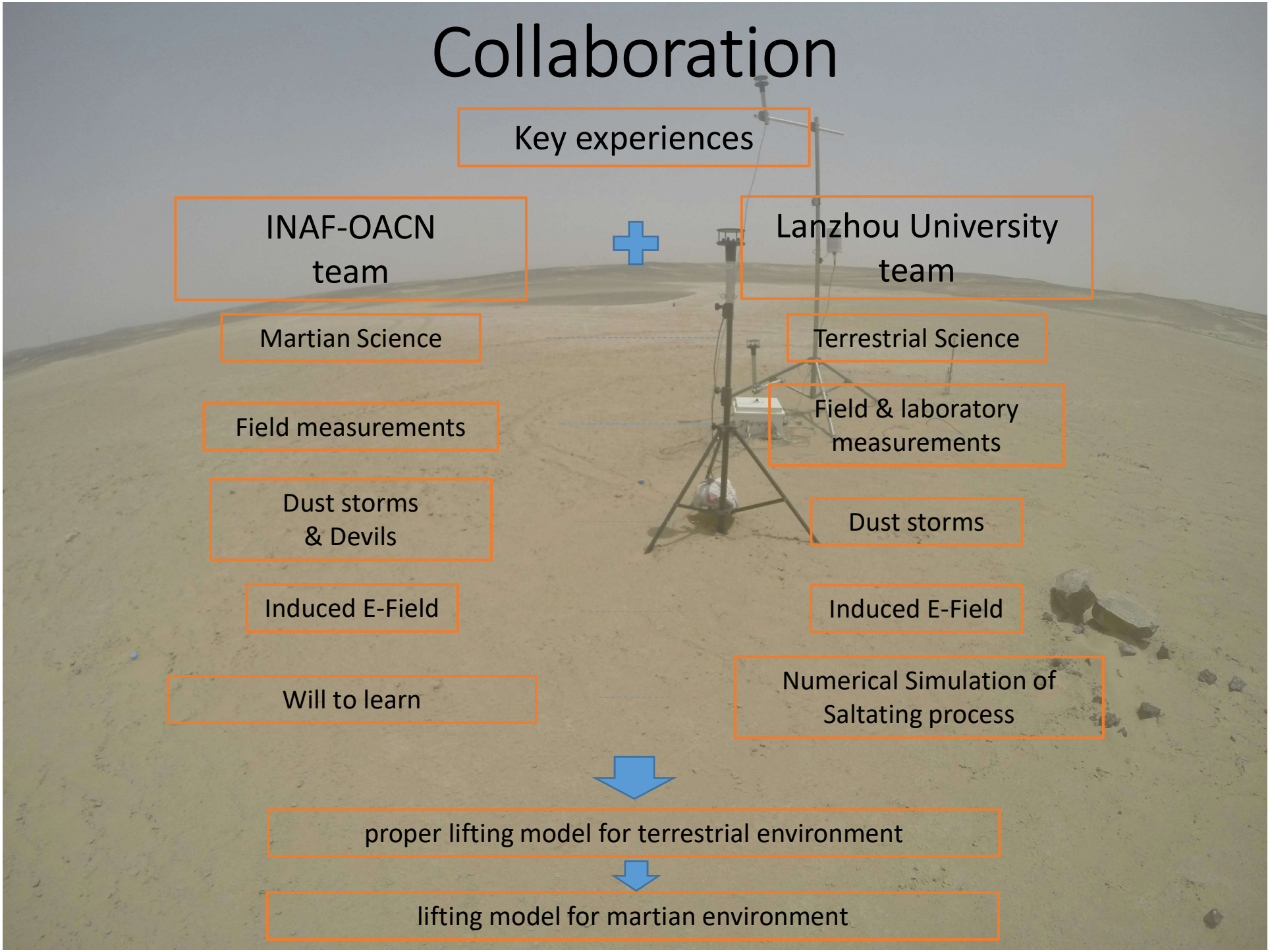


Field Missions



Meteorological Station
Temperature Soil & atmosphere at different heights
2-D sonic anemometers different heights
3-D anemometer
Pressure
Humidity
Sensit (sand and dust impact)
Sand catcher
Dust concentration rate
Electric field
Solar irradiance
Environmental Camera System

Collaboration



Key experiences

INAF-OACN team	Lanzhou University team
Martian Science	Terrestrial Science
Field measurements	Field & laboratory measurements
Dust storms & Devils	Dust storms
Induced E-Field	Induced E-Field
Will to learn	Numerical Simulation of Saltating process

proper lifting model for terrestrial environment

lifting model for martian environment

Objectives

Current Knowledge

Presence of an atmospheric electric circuit is not confirmed on Mars
(lack of dedicated instruments)

Laboratories and simplified study cases suggest how
E-field could lower the lifting threshold
however
current saltation models don't consider the E-field contribution

Fail to apply a single electrification model due to the complexity of the process
main dependencies on size and composition

Most common configuration is:
dipole like
dust cloud negatively charged over a positive saltating sand bed

Our contribution

Modeling in steps of increasing difficulty

I

unidirectional wind (dust storm)	single mode grain population (only sand)	a priori charge-to-mass ratio (empirically derived)

II

vortex wind (dust devils)	bi mode grain population (sand + dust)	parametric description charge-to-mass ratio (tuned on field data)

III

adaptation
from terrestrial ➡ to martian environment

(different ionic species
possible electron avalanches and discharges.)

Thanks to all