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Venus and Mars are the closest neighbours of our planet Earth. Venus has been explored by means of spacecrafts since the 60's with the Venera-4 mission achieving the first in situ measurements. Since then, a variety of mission has attempted to unveil the major characteristics of this planet, which harbours a rather drastic environment where life emergence and maintenance is extremely challenged. After a fruitful exploration campaign in the 80's and early 90's, Venus exploration has been put on hold until the recent European ESA Venus Express mission (inserted in orbit in April 2006 and still orbiting).
The dense, cloud covered CO2 atmosphere puts significant restriction to Venus exploration. Remote sensing techniques have had difficulties to probe through the thick sulphuric acid cloud cover, and the drastic thermal environment at the surface (~465°C) reduces the lifetime of landed modules to a few hours at most. Despite these strong shortcomings, Venus remains fascinating for it provides the most extreme example of a terrestrial planet turned into a "hellish" environment. At times when the Earth is threatened by the human activity, responding in turn by a significant climate warming subsequent to the massive injection of greenhouse gases (CO2 in particular) in the atmosphere, Venus reminds us all of the fragile climatic equilibrium that has permitted life to appear and to subsist here on Earth.
The main characteristics of Venus can be summarized as follows:
• A young (100's of million years old) surface,
• CO2 and N2 are the main components of the atmosphere (97 and 3 %respectively),
• The sharp anomaly in water abundance: the total inventory being about 100,000 times smaller than on the Earth,
• The large mass of the atmosphere, 90 times denser than on the Earth,
• The very hot surface,
• The thick cloud cover with possesses a very high reflectivity (making Venus one of the brightest objects one can contemplate in our skies),
• Super-rotation: the motion of the atmosphere with speed lof OO m/s relative to the solid body rotation of the planet,
• The very cold (-100 K) night upper atmosphere (so-called cryosphere, replacing the thermosphere terminology prevailing for Mars and the Earth).
Despite the wealth of data collected by current and past missions, several key problems remain incompletely addressed (Moroz, Advances in Space Research, 2002), namely:
• The minor constituents of the atmosphere as well as the noble gases
• The atmosphere/surface exchange,
• The heat transfer and the greenhouse effect,
• The dynamics of the atmosphere, especially super-rotation,
• The aerosols, clouds and hazes, and their chemical composition at different altitudes.

In this presentation, I will introduce some of these outstanding questions that have set the frame of previous and current studies aimed at decyphering the current state and past evolution of Venus.