Mercury Thermal Model & Polar Mapping Tool

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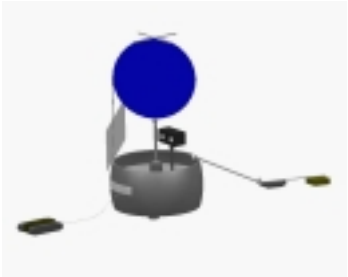
14th European Workshop on Thermal and ECLS Software
ESTEC - 7-8 November 2000

Mercury Surface Element Study

The work has been performed within the frame of the ESTEC internal study for a Mercury Surface Element (MeSE)



MeSE is a soft lander part of the ESA BepiColombo mission to Mercury

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The Landing problem

The temperature on the Mercury surface is:
700 K at subsolar point (perihelion)

600 K at subsolar point (aphelion)

100 K on the dark side

100 K at the poles

Is there any "thermally benign" area on the planet surface such that the Thermal Control for a landing probe is simplified ?

The Landing problem (2)

To find a sufficiently large zone on the surface of Mercury with the following characteristics:

•Temperature within the range ~(-50 ºC/+50 ºC) during all the permanence time

•Permanence time = 7 days

•Solar illumination for photovoltaic use

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Mercury Thermal Model - Assumption

No heat generated inside the planet

No atmosphere effect

Smooth surface (crater effects disregarded)

Heat transferred only via conduction along the crust thickness (1-D model)

Inclination of the Mercury equator to the planet orbit = 0

Mercury physical properties

Albedo = 0.07

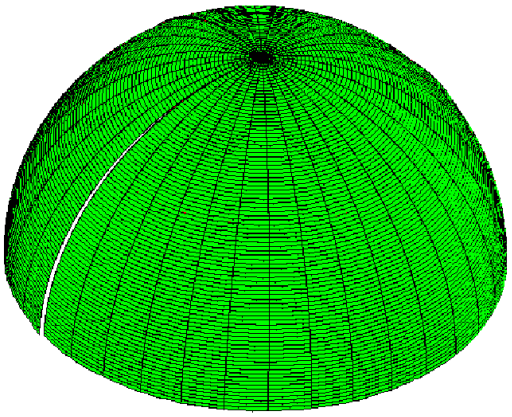
Emissivity = 0.9

Density (regolith type) = 1300 Kg/m^3

Specific heat = 800 J/KgK

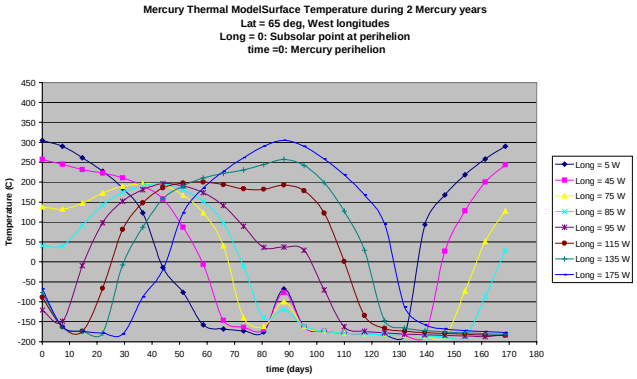
Thermal Conductivity variable with temperature and depth

Mercury ESARAD model



Nodes:
90 lat
36 long
50 depth

Mercury Surface Temperature ESATAN computation



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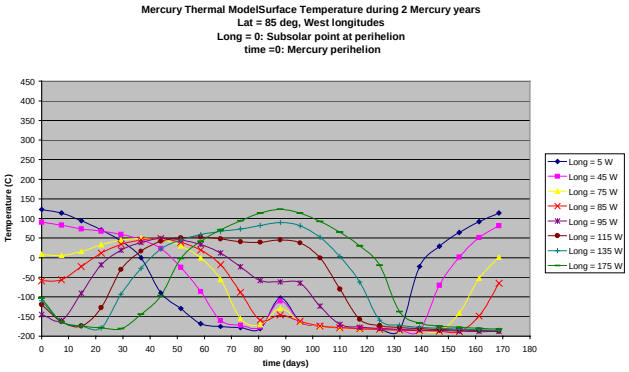
Mercury Surface Temperature ESATAN computation (2)



Mercury Surface Element Study (2)

Results obtained using simulation

Visualisation of orbit and descend phases

Visualisation of the operations timeline

Mercury terrain generation and properties analysis, effects of craters

Support the selection of the location of the landing site

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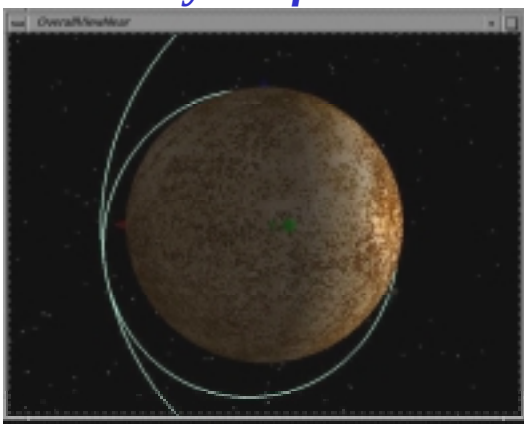
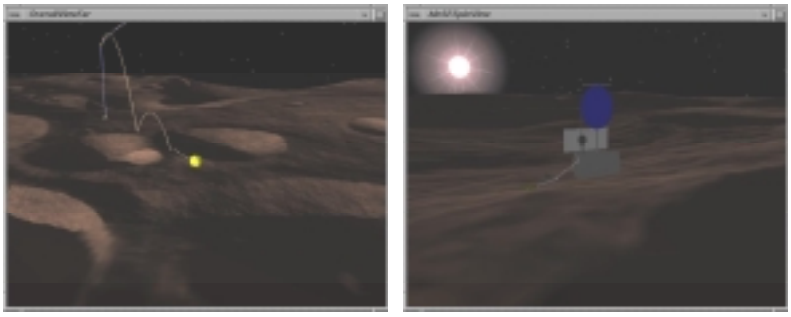
Mercury Surface Element Study (3)



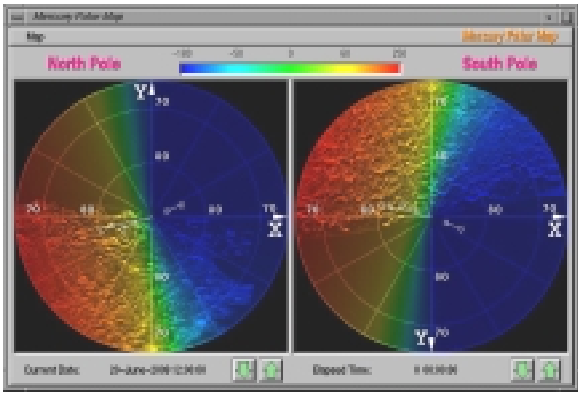
Visualisation of orbit and descend phases

Mercury Surface Element Study (4)



Visualisation of the operations timeline

Mercury Polar Mapping Tool



Mercury Polar Mapping Tool (2)

Mercury thermal data (ASCII file)

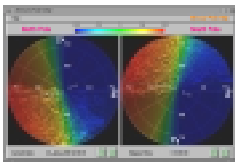
- 1 degree latitude/longitude
- covering Mercury thermal cycle (2 Mercury years)

C data structure (using text editor macros)

Simulator data

- date/time
- landing sites
- Sun position

Mariner-10 image data



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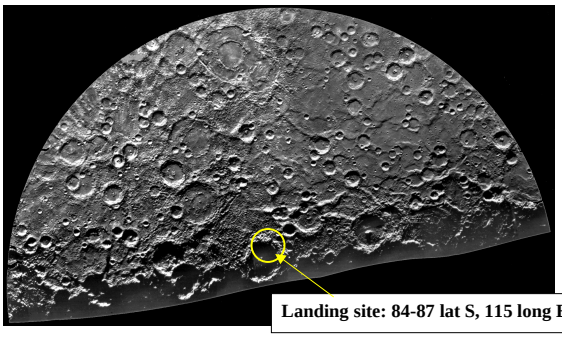
Mercury Thermal model - Preliminary selection



Mercury Terrain simulation

What is the chance of landing into a shadowed area ?

Mercury terrain generation
and property analysis