Department of Astronomy and Planetary Science

A Faster Way to Account for Pixel Footprint Projection on Planetary Surfaces with Python: the SPiP Module

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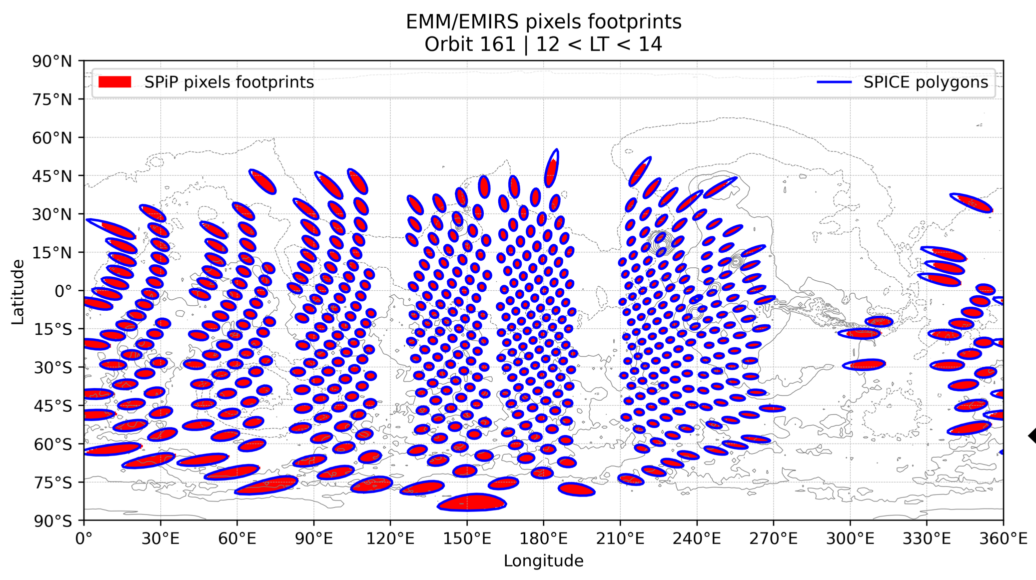
THE SPiP MODULE

SPiP: **S**pacecraft **Pi**xel footprint **P**rojection

- **Python 3** module
- Developped for the **EMIRS** instrument onboard the EMM "Hope" spacecraft
- Currently in **version 1.1**



Uses **3D trigonometry** to **approximate** the footprint of a pixel projected on a planetary surface.

Comparison between footprints computed by SPiP and the 20-points polygons derived by the SPICE kernel.

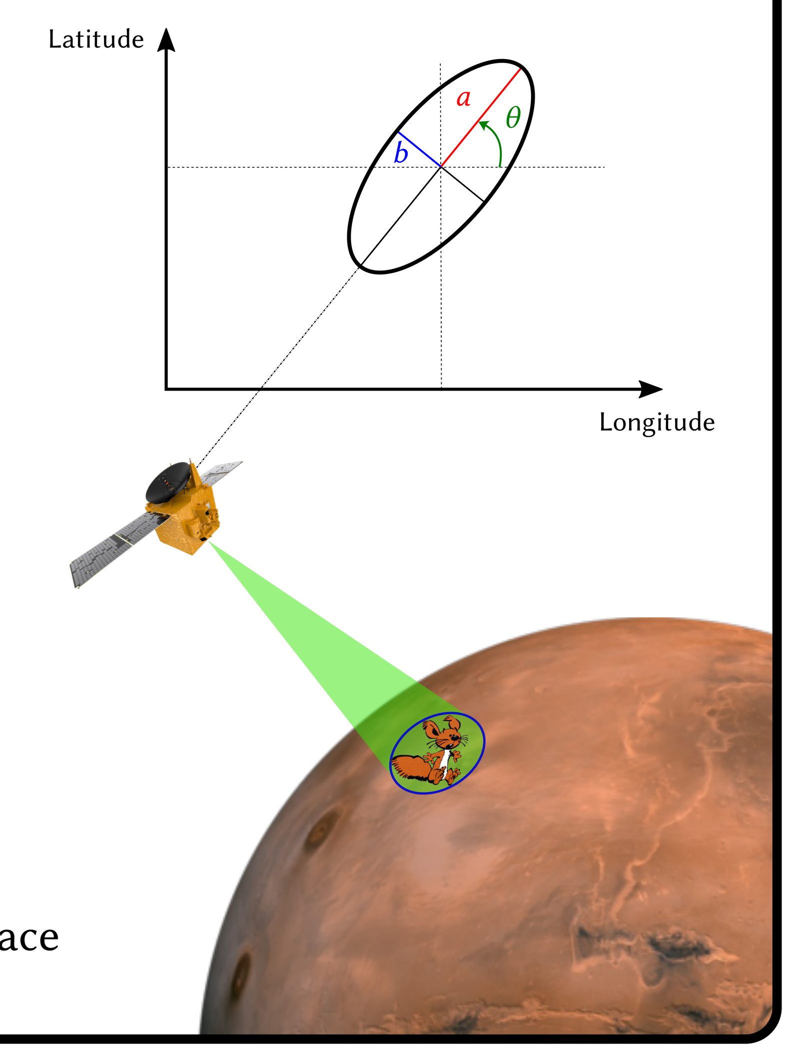
PROJECTING THE PIXEL FOOTPRINT WITH 3D TRIGONOMETRY

Ellipse parameters retrieved

- a : semi-major axis
- b : semi-minor axis
- θ : orientation

Parameters we need

- Center longitude of the pixel
- Center latitude of the pixel
- Sub-spacecraft longitude
- Sub-spacecraft latitude
- Emergence angle
- Instrument pixel FOV
- Distance between spaceraft and planet surface



SPiP VS POLYGONS

Testing if a point is within a 20-points polygon

↓

20 tests to performs: 1 per side

↓

Time-consuming, not efficient

VS

Testing if a point is within an ellipse

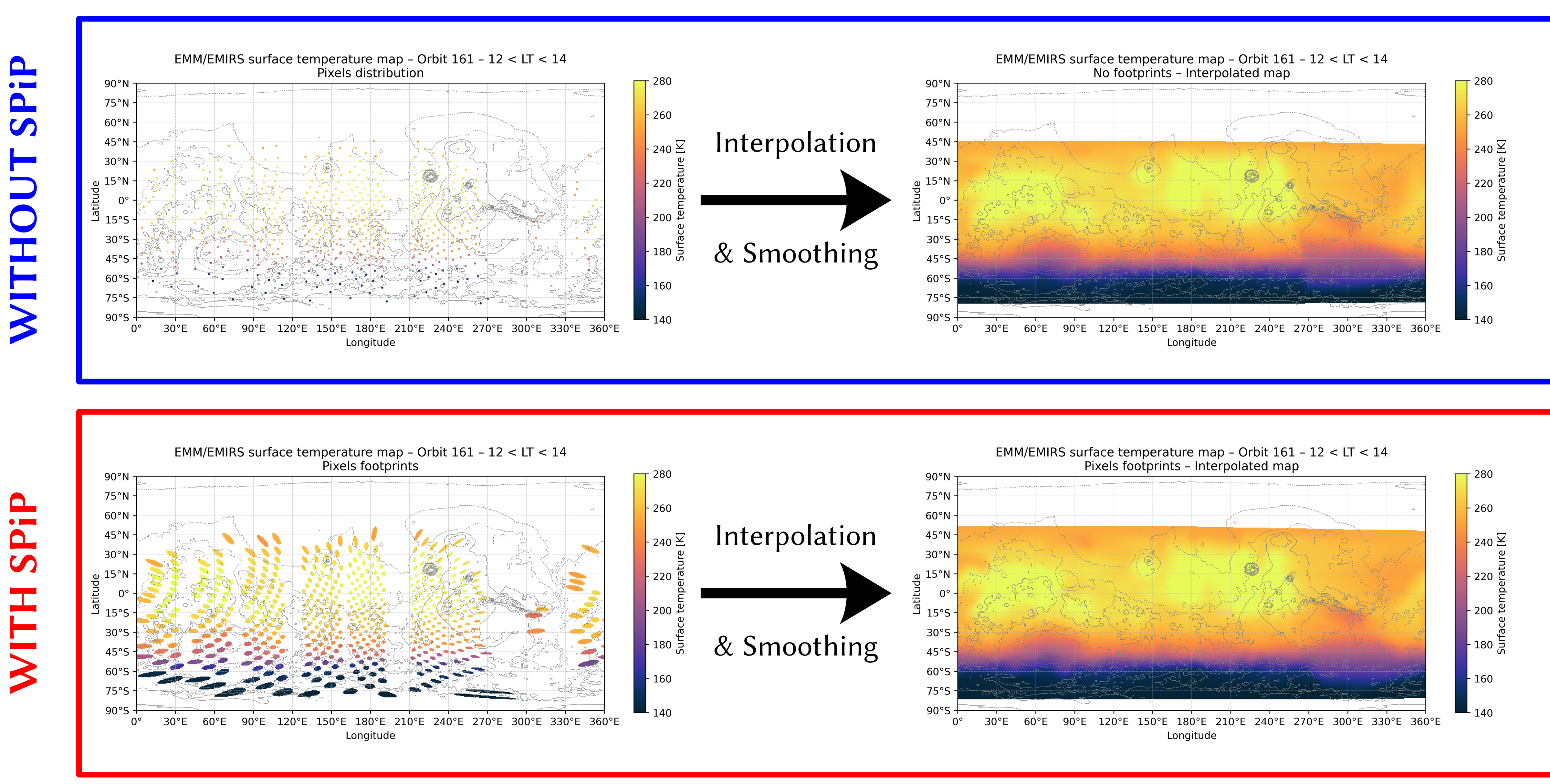
↓

Testing if (x, y) verify 1 single equation

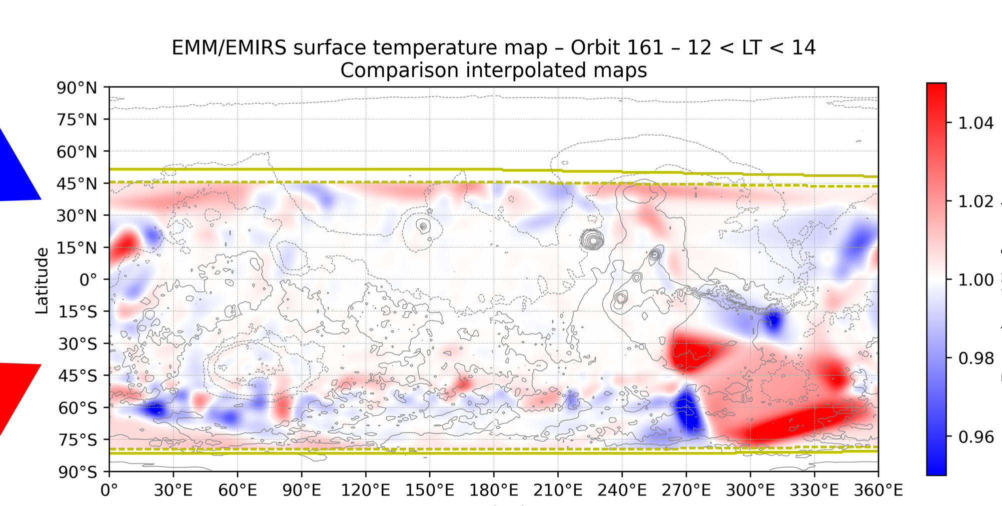
$$\frac{[(x-x_0)\cos(\theta)+(y-y_0)\sin(\theta)]^2}{a^2}+\frac{[(x-x_0)\sin(\theta)-(y-y_0)\cos(\theta)]^2}{b^2}\leq 1$$

+ Can be computed in one time for the whole grid using numpy arrays *(#PythonPower)*

WHY IS IT IMPORTANT TO ACCOUNT FOR THE SPATIAL EXTENT OF THE PIXELS?



Ratio $\frac{\text{map with the pixels footprints}}{\text{map without considering the pixels footprints}}$



- Interpolated data values may vary up to +/- 5%
- Latitude coverave increases by 6°

CONCLUSION & PERSPECTIVES

- **SPiP** provides an **easy** and **quick** way to handle the **spatial extent of pixels** from orbital instruments on the surface.
- Already used to generate **all L3 gridded products from the EMIRS instrument** available on the EMM SDC.
- Future work:
  - Replace perfect sphere by ellipsoid.
  - More instruments/celestial bodies?

ACCESSING SPiP

On GitHub: https://github.com/NAU-PIXEL/spip

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GitHub