Mars Geodesy & Cartography Working Group

A Report to the
Mars Exploration Program Analysis Group (MEPAG)

by

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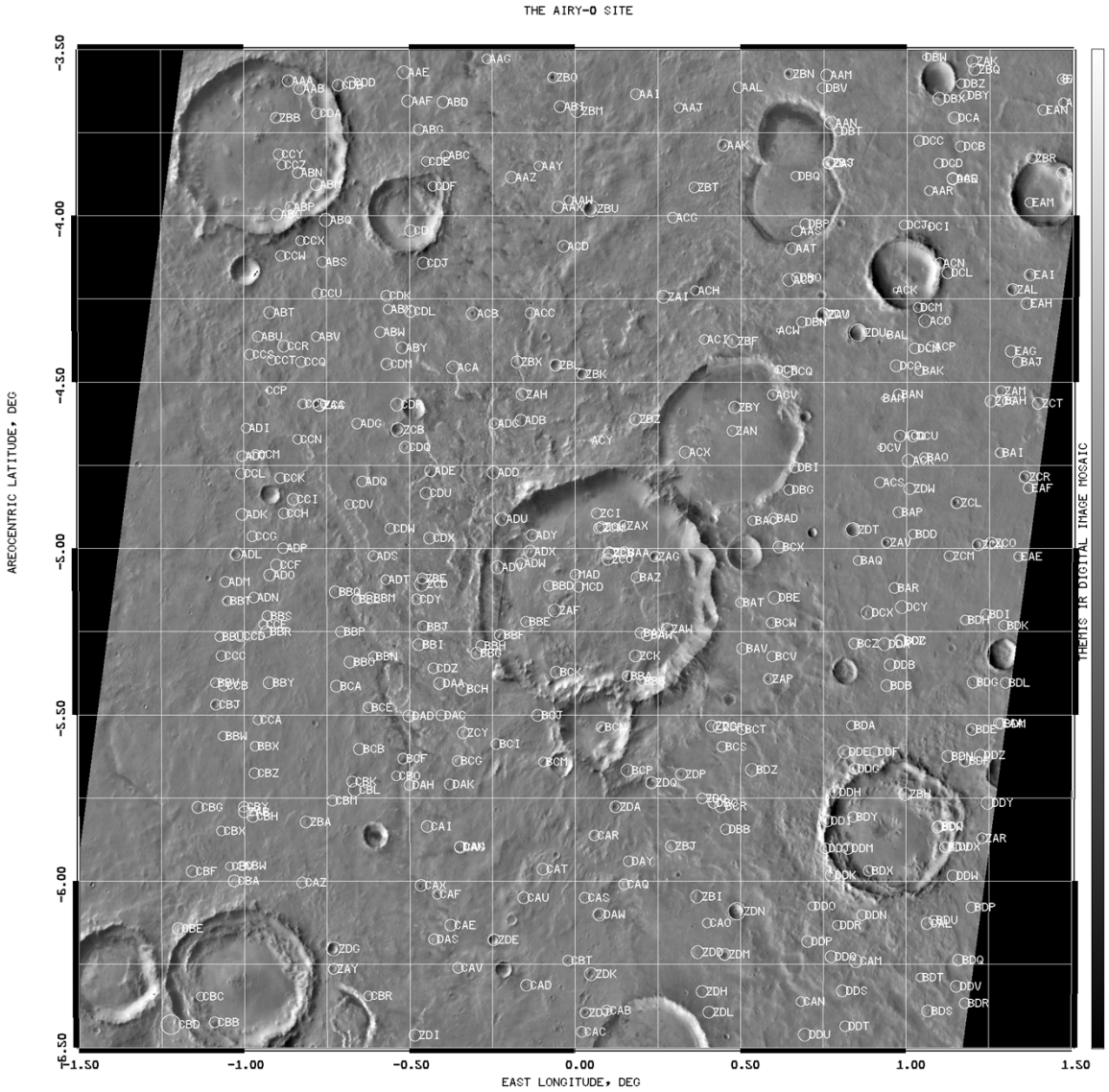
Mars Geodesy & Cartography Working Group

- Reports to the Mars Exploration Program Scientist
  - Dr. Richard Zurek, JPL
  - Participating Members (Volunteers) Funded Independently
    - NASA, ESA, Roscosmos, . . .
- Provides IAU with Improved Mars Geodetic / Cartographic Constants, Conventions
  - Spin Pole Direction, Spin Rate, Prime Meridian
- Recommend to NASA and International Mars Projects and Geodesy / Cartography Research Groups "Best" Data Sets to Use
  - Planetary Ephemerides, Phobos / Deimos Ephemerides, Digital Terrain Models,
  - Reconstructed Orbits, Spin Pole / Rate and Prime Meridian, NAIF SPICE Kernels,
- Provides an Independent Review / Validation of Precision Cartographic Landing Site Map Products used for Mission Operations
  - MPF, MPL, Beagle 2, MER, Phoenix, MSL, PhSRM (GRUNT)
- Makes Observation Recommendations to Individual Projects that Support MGCWG Objectives
  - Observe Geodetic / Cartographic Targets
    - VL-1, VL-2, MPF, MER-A/B, Phoenix, Airy 0, . . . MSL
  - Track Landers for Spin Property Improvements
- Provides Mechanism to Discuss Instruments / Datasets Across Projects

MARS PRIME MERIDIAN – AIRY 0



Mars Exploration Program Analysis Group (MEPAG)
chartered by NASA HQ to assist in planning the scientific exploration of Mars

TGD: LOLA / CROC

MARS POLE / SPIN RATE

- Current Model of the Form:

$$\alpha = 317^{\circ}.25268883 - 0^{\circ}.108965725\,T$$
$$\delta = 54^{\circ}.4097083 - 0^{\circ}.057933172\,T$$
$$W = 176^{\circ}.07653755 + 350^{\circ}.8919824964918\,d$$

- Does not Reflect Seasonal Mass Movements Between the Poles or Improved Spin Rate (Konopliv, et. al., Folkner, et. al.)
  - Periodic Variations Having Amplitudes of up to 15 meters (~100 HiRISE pixels)

NEW FORM OF MARS SPIN DIRECTION / RATE

- An Update to the Mars Spin Pole Direction and Spin Rate is Being Prepared to be Provided this summer to the IAU as the New Recommended Standard – Awaiting New Results from Konopliv, et. al.
- Example of new form derived from Konopliv, A., et. al., Folkner, W., et. al.

$$
\begin{aligned}
\alpha &= 317^\circ.25268883 - 0^\circ.108965725\,T \\
&\quad +0^\circ.00006767 \sin(198^\circ.944201 + 19139^\circ.4819985\,T) \\
&\quad +0^\circ.00023839 \sin(226^\circ.282688 + 38280^\circ.8511281\,T) \\
&\quad +0^\circ.00005222 \sin(249^\circ.644835 + 57420^\circ.7251593\,T) \\
&\quad +0^\circ.00000876 \sin(266^\circ.184339 + 76560^\circ.6367950\,T) \\
&\quad +0^\circ.44896527 \sin(73^\circ.035239 + 0^\circ.5042615\,T) \\
\delta &= 54^\circ.4097083 - 0^\circ.057933172\,T \\
&\quad +0^\circ.00005167 \cos(122^\circ.492467 + 19139^\circ.9407476\,T) \\
&\quad +0^\circ.00014139 \cos(43^\circ.055283 + 38280^\circ.8753272\,T) \\
&\quad +0^\circ.00003110 \cos(57^\circ.650369 + 57420^\circ.7517205\,T) \\
&\quad +0^\circ.00000532 \cos(79^\circ.487357 + 76560^\circ.6495004\,T) \\
&\quad +1^\circ.57456751 \cos(165^\circ.350003 + 0^\circ.5042615\,T) \\
W &= 176^\circ.07653755 + 350^\circ.8919824964918\,d \\
&\quad +0^\circ.00015111 \sin(36^\circ.608523 + 38281^\circ.0473591\,T) \\
&\quad +0^\circ.00012404 \sin(136^\circ.527087 + 19140^\circ.0328244\,T) \\
&\quad +0^\circ.00003378 \sin(75^\circ.822238 + 57420^\circ.9295360\,T) \\
&\quad +0^\circ.00000935 \sin(54^\circ.276892 + 76560^\circ.2552215\,T) \\
&\quad +0^\circ.00000110 \sin(104^\circ.723812 + 95700^\circ.4387578\,T) \\
&\quad +0^\circ.61643271 \sin(116^\circ.072965 + 0^\circ.5042615\,T)
\end{aligned}
$$

Will be provided to the US / International Community as NAIF SPICE Kernel. Each Project / Research Group will Evaluate for Adoption.