Ceres Coordinate System Description:
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C. Raymond, JPL and T. Roatsch, DLR

The Ceres coordinate system has been updated from the values published by Archinal et al. (2011) using data obtained by the Dawn mission. As a part of the Ceres gravity science investigation, the Ceres body-pole direction and rotation rate were determined together with its gravity field by processing the DSN radio data (8.4 GHz X-band) and optical imagery (IFOV of 93.3 μrad/pixel) acquired during the Approach and Survey phases of the mission (Park et al., 2015). The gravity field is modeled by Park et al. (2015) in a Ceres-fixed frame, and its inertial orientation in the International Celestial Reference Frame (ICRF; Archinal et al., 2011) is modeled with $\{\alpha, \delta, W_0 + \Omega\Delta t\}$, where α represents the spin pole right ascension, δ represents the spin pole declination, W_0 represents the prime meridian angle (fixed to $170.65°$), Ω represents the rotation rate, and Δt represents the time elapsed since J2000 = JD 2451545.0, i.e. 2000 January 1 12 hours TDB. Since the gravity field of Ceres perturbs Dawn's orbit, both gravity field and rotational parameters can be estimated by accurately tracking the spacecraft motion. The pole parameters are also estimated while solving for the topography within the stereophotogrammetry processing pipeline, with a map resolution of 0.41015 km/pixel or 20 pxl/deg (Preusker et al., 2015). These independent analyses produce rotation parameters that agree within measurement errors. The updated pole parameters and body axes are given in Table 1, along with the previous IAU system. The rotation rate was left unchanged as the current value is consistent with the short-arc of Dawn measurements. Table 1 reports the equivalent spherical body radius, **R,** the average equatorial radius of the oblate spheroidal shape, **A**, and the polar radius **B** at a level of precision commensurate with the preliminary nature of this determination and the needs of the users of the associated kernel. The Dawn project's configuration-controlled Planetary Constants and Models Document (JPL D-41251) archives the updates to the PCK.

Table 1. Comparison of pre-Dawn and post-Survey Dawn coordinate systems.

	α [deg]	δ [deg]	W_0 [deg]	Ω [deg/day]	R [km]	A [km]	B [km]
Previous system [1]	291 ± 5	59 ± 5	170.90	952.1532 ± 0.00003	476.2 ± 1.7	487.3 ± 1.8	454.7 ± 1.6
Dawn post-Survey Update (*dawn_ceres_v05.tpc*)	291.418 ± 0.03	66.764 ± 0.03	170.650	952.1532 ± 0.00003[2]	470	482	446

[1]Archinal et al. (2011), [2] Unchanged from previous system.

The previous coordinate system was anchored to a bright feature in the Hubble Space Telescope (HST) data (Thomas et al., 2005) that was dubbed "Feature #1" in Li et al. (2006). Feature #1 is centered at 1°E, 12°N in their map (Fig. 5 of Li et al., 2006) and is well-expressed in the F330W and F220W filters and much smaller and muted in the F555W filter. A bright crater of ~32 km diameter named Haulani is observed in the region of Feature #1, surrounded by a generally brighter ejecta deposit that together define a higher albedo region. The Dawn team was not able to confidently or exactly identify the location of Haulani with respect to Feature #1. Thus, the Dawn team has chosen a small crater (~0.8 km diameter) nearby Haulani to define the prime meridian. The location of this small crater is within the envelope of the broad feature identified in HST data to which the previous system was anchored. This small crater named 'Kait' defines the 0° longitude position. The location of Kait is illustrated in Fig. 1. As the rotation parameters become more precise, W_0will be adjusted to maintain Kait at 0° longitude.

The pole in the updated coordinate system moved away from the previous estimate reported in Thomas et al (2005) by more than the (one-sigma) error of "~5 degrees" and the shape of the body is also smaller by an amount that exceeded the previous estimate's error of ±1.7 km. The pole RA and dec have changed such that the previously-defined IAU pole moves on the surface of Ceres along the latitude of 82.231 degrees as Ceres rotates.

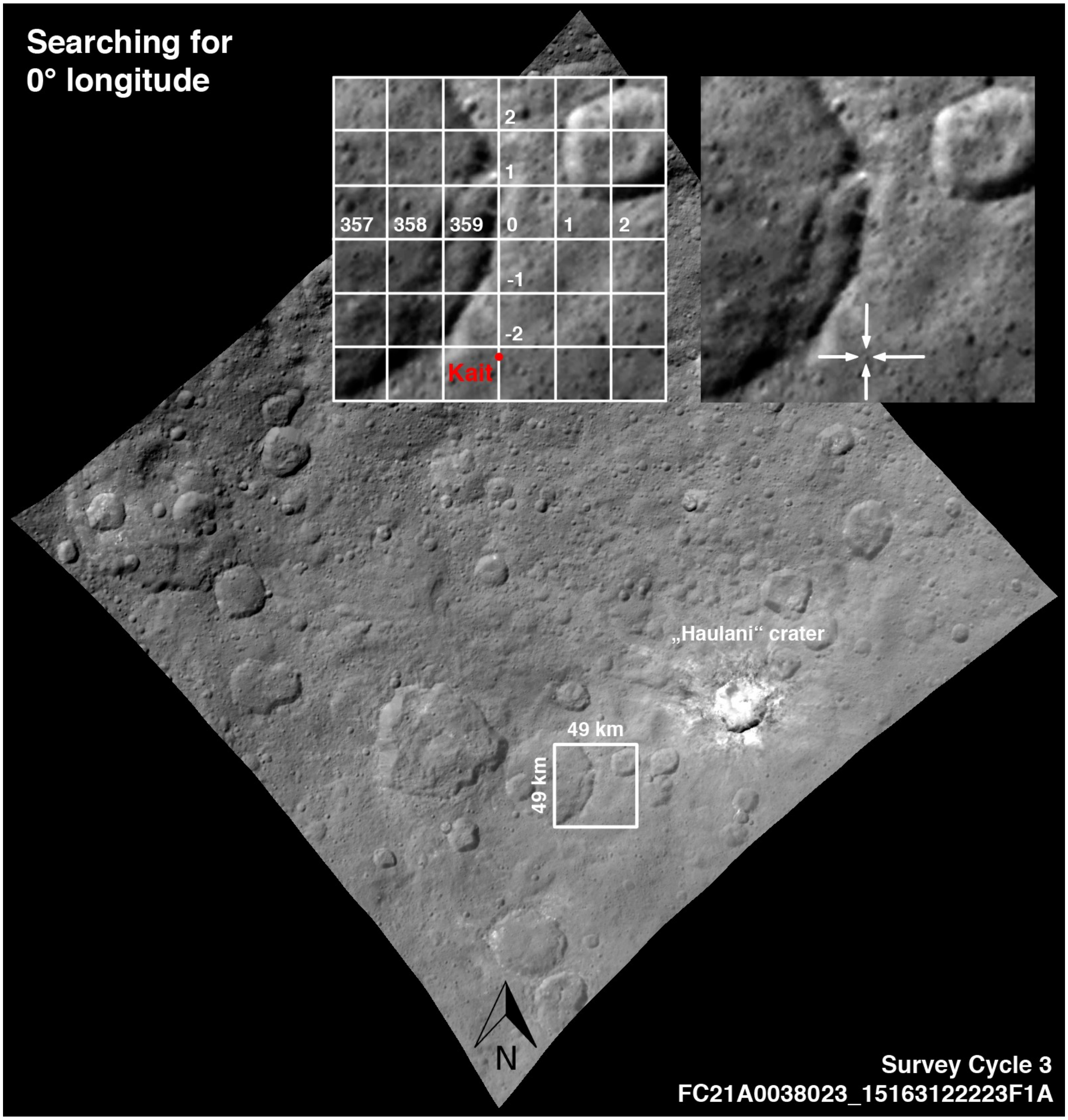

Figure 1. The tiny Kait crater defines the 0° longitude position in the updated coordinate system. Kait can be located within the inset region (shown by white box) of this camera image. The inset region image at top right points out the tiny crater Kait. The inset at the top middle position shows Kait's location exact location of 0° lon, -2.1° lat on a plot gridded in one-degree increments. Kait will anchor the prime meridian and W_0 will be adjusted as needed to maintain the system as higher precision data become available.

References:

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