

User Guide for Saturn's Gravity Field Data Using Slepian Functions

Seho Kim and Marzia Parisi

Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA

November 12, 2024

1. Introduction

This dataset contains gravity field models of Saturn, derived from data collected during the Cassini Gravity Science Experiment from May to July 2017 (Rev 273, 274, 278, 280, 284). The solutions for Saturn's gravity field are based on two approaches: a Slepian-combined method and a spherical-harmonic-only method. Detailed derivations and methods for this dataset are available in the following article, submitted to *Geophysical Research Letters*:

S. Kim, M. Parisi, C. R. Mankovich, D. R. Buccino, O. Yang, "Saturn's small-scale winds revealed by its high-degree gravity field", *Geophysical Research Letters*, 2024 (submitted Oct 2024)

2. File Format

This dataset includes ASCII delimited files with the "*.csv" extension, formatted as Comma-Separated Values (CSV) in plain text. Each file contains a header row describing each column, with values separated by commas (",").

3. Archive Information

This archive contains two data products in ASCII delimited plain-text format. Each file is described in detail below:

1) Saturn Gravity Field Solution with Slepian and Spherical Harmonics

File Name: grav-coeff-slepian.csv

This file provides Saturn's gravity field solution from Cassini data (Rev 273, 274, 278, 280, 284), expressed in spherical harmonic coefficients (J2-J12) and Slepian coefficients (s13-s15). The Slepian basis functions are defined over the latitudinal range 32°S to 32°N. For detailed derivations, refer to S. Kim et al., 2024.

Column Descriptions:

- Column 1: Name of each gravity field coefficient
- Column 2: Estimated central values of the normalized spherical harmonics (J2-J12) and Slepian coefficients (s13-s15) from Cassini observations (unitless)
- Column 3: Estimated formal uncertainty for each gravity coefficient (unitless)
- Column 4: Estimated formal uncertainty, multiplied by 3, for each gravity coefficient (unitless)

2) Saturn Gravity Field Solution with Spherical Harmonics Only

File Name: grav-coeff-sph-har.csv

This file provides Saturn's gravity field solution from Cassini data (Rev 273, 274, 278, 280, 284), expressed in spherical harmonic coefficients (J2-J20). For further details, see S. Kim et al., 2024.

Column Descriptions:

- Column 1: Name of each gravity field coefficient
- Column 2: Estimated central values of the normalized spherical harmonics (J2-J20) from Cassini observations (unitless)
- Column 3: Estimated formal uncertainty for each gravity coefficient (unitless)
- Column 4: Estimated formal uncertainty, multiplied by 3, for each gravity coefficient (unitless)

4. Acknowledgements

The research was conducted at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration (80NM0018D0004). Funding for this work was provided by NASA's Cassini Data Analysis Program (80NM0018F0612).

© 2024. California Institute of Technology. Government sponsorship acknowledged.

5. Primary Point of Contact

Seho Kim
Planetary Radar and Radio Sciences
Jet Propulsion Laboratory
(818) 354-9254
seho.kim@jpl.nasa.gov