**Tidal data “Read Me” file** for “Tidally Induced Fault Motion within Europa’s Ice Shell and Implications for Subsurface Communication Development”

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**Initial Setup:**

Tidal displacement data were imported into Ansys Mechanical and applied to the basal face of the ice block geometry to serve as a boundary condition that represented the continuation and tidal deformation of the ice shell below the modeled block dimensions. Tidal stress data were imported into Ansys Mechanical and applied to the whole block geometry as an initial stress body load. The tidal stress and displacement calculations are described in Section 2.2 and Supplemental Material S3.

**Data Overview:**

Displacement vectors that result from tidal forcing on Europa’s ice shell from Jupiter were computed at the base of the ice block geometry, corresponding to XZ coordinates at Y = ‑2500 m (spatial resolution 100 m). Stress tensors resulting from tidal forcing were computed throughout the specified model domain at 100-m resolution. The tidal displacement vectors and stress tensors are dependent on geographic location on Europa, depth within the ice shell, and orbital longitude (i.e. Europa’s true anomaly position).

**File Naming Convention:**

* Static data: *DataType*\_Perijove*\_GeographicLocation\_CoordSys0X*.xlsx
  + *DataType*: displacement or stress
  + Perijove: these data are all computed for Europa at the perijove orbital location
  + *GeographicLocation*: Subjovian (0°, 0°) or Thera Macula (50°S, 180°E)
  + *CoordSys0X*: CoordSys01 or CoordSys02 (see descriptions below)

*Note: Only CoordSys01 was used for the Subjovian location because lateral stress components (XX, ZZ) are symmetric and shear components are* ≤ *10‑2 at this location; we infer, therefore, that our results would be the same for CoordSys02 at the Subjovian*

* Time-dependent data: *tX*\_ *DataType*\_TheraMacula.xlsx
  + *tX*: t0 – t12, corresponding to 30° true anomaly increments (**Table 1**)
  + *DataType*: tidal displacement or stress
  + TheraMacula: all time-dependent data was computed for Thera Macula geographic coordinates and CoordSys02 model domain (see description below)

**Table 1.** Time point labels with respect to corresponding true anomaly increment and time.

|  |  |
| --- | --- |
| File Label | True Anomaly, *f* (degrees from apojove) |
| t0 | 0 |
| t1 | 30 |
| t2 | 60 |
| t3 | 90 |
| t4 | 120 |
| t5 | 150 |
| t6 | 180 |
| t7 | 210 |
| t8 | 240 |
| t9 | 270 |
| t10 | 300 |
| t11 | 330 |
| t12 | 360 |

**Coordinate Systems:**

The coordinate systems are oriented so that east is in the positive X-direction, south is in the positive Z-direction, and the positive Y direction is vertically upwards.

* For all datasets (CoordSys01 and CoordSys02):
  + +X: east
  + +Y: vertically upwards
  + +Z: south

The model domain (block directional dimensions) differs for files labeled “CoordSys01” and “CoordSys02” to represent rotation of the fault orientation.

* CoordSys01 files model domain (used for static Subjovian and static Thera Macula (east-dipping fault) models):
  + X (m): [-1500, 1500]
  + Y (m): [-2500, 0]
  + Z (m): [-1000, 1000]
* CoordSys02 files model domain (used for static Thera Macula (north-dipping fault) and both time-dependent (Thera Macula, north-dipping, 45- or 85-degree fault) models):
  + X (m): [-1000, 1000]
  + Y (m): [-2500, 0]
  + Z (m): [-1500, 1500]

**Variables:**

* Displacement data files (static and time-dependent):
  + dX (m): resulting displacement in meters at the specified coordinates in the X direction
  + dY (m): resulting displacement in meters at the specified coordinates in the Y direction
  + dZ (m): resulting displacement in meters at the specified coordinates in the Z direction
* Stress data files (static and time-dependent):
  + sXX (Pa): resulting normal stress in Pascals at the specified coordinates for the XX stress tensor component
  + sYY (Pa): resulting normal stress in Pascals at the specified coordinates for the YY stress tensor component
  + sZZ (Pa): resulting normal stress in Pascals at the specified coordinates for the ZZ stress tensor component
  + sXY (Pa): resulting shear stress in Pascals at the specified coordinates for the XY stress tensor component
  + sXZ (Pa): resulting shear stress in Pascals at the specified coordinates for the XZ stress tensor component
  + sYZ (Pa): resulting shear stress in Pascals at the specified coordinates for the YZ stress tensor component