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Using Sandia's Automatic Report Generator to Document EMPIRE-based Electrostatic Simulations

Philippe P. Pébaÿ, Jonathan Lifflander

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Using Sandia's Automatic Report Generator to Document EMPIRE-based Electrostatic Simulations

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Abstract

The goal of this report is to illustrate the use of Sandia's Automatic Report Generator (ARG), when applied to an Electrostatic simulation case run with Sandia's EMPIRE code. It documents the results of a hackathon session that was held at the March 19-22 DOE Workshop Workflow and Hackathon that was held in Livermore, where the co-authors demonstrated ARG's flexibilty by extending it to several aspect of such simulation in less than a day's worth of work.

The Explorator component of ARG automatically picks up the case's input deck, hereby determining the data components that the Generator and Assembler components are currently able to document: meta-data, input deck, mesh, and solution fields. The ARG is not yet capable of documenting the particles file created by the simulation, which will require further work.

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This document was generated on 2019-04-06 with the Automatic Report Generator (ARG) version "master" on the Darwin system `macbook`.

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Introduction

The structure of this report was built by the Explorator component of ARG, which explored the following directory:

`/Users/pppebay/Documents/Git/arg/tests/EMPIRE/SAND2019-xxxx/data`

and discovered the following relevant data:

- EMPIRE input deck with root `EMPIRE.yaml`
- ExodusII file in `blob.g`
- ExodusII partition in `mesh.exo.16`

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Chapter 1

EMPIRE Input Deck

This chapter describes the EMPIRE input deck `EMPIRE.yaml` found in the following directory:
`/Users/pppebay/Documents/Git/arg/tests/EMPIRE/SAND2019-xxxx/data`.

1.1 Meta-Data

This section provides the meta-information properties of this EMPIRE input deck.

item	value
input deck root file	`EMPIRE.yaml`
final time	`1.10974779e-08`
finite element model database name	`blob.g`
left boundary condition	`Dirichlet`
number of timesteps	`1000`
output file name	`mesh.exo`
particle dump file name	`pdump.h5part`
problem name	`One Examplar Case`
random key	`123456789`
solution methods	`block_1: Electrostatic`

Table 1.1: Meta-information of EMPIRE input deck.

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Chapter 2

ExodusII File Mesh

This chapter describes the ExodusII file mesh `blob.g` found in the following directory: `/Users/pppebay/Documents/Git/arg/tests/EMPIRE/SAND2019-xxxx/data`.

2.1 Overview

This section provides an overview (meta-data and global properties) of the mesh found in `blob.g`.

item	number
Exodus II files	1
nodes	60359
elements	337219
element blocks	1
side sets	1

Table 2.1: Topological properties of `blob.g`

block ID	block name	block type
1		TETRA

Table 2.2: Element blocks of `blob.g`

2.2 Mesh Blocks

This section provides a description of all blocks contained in the mesh `blob.g`.

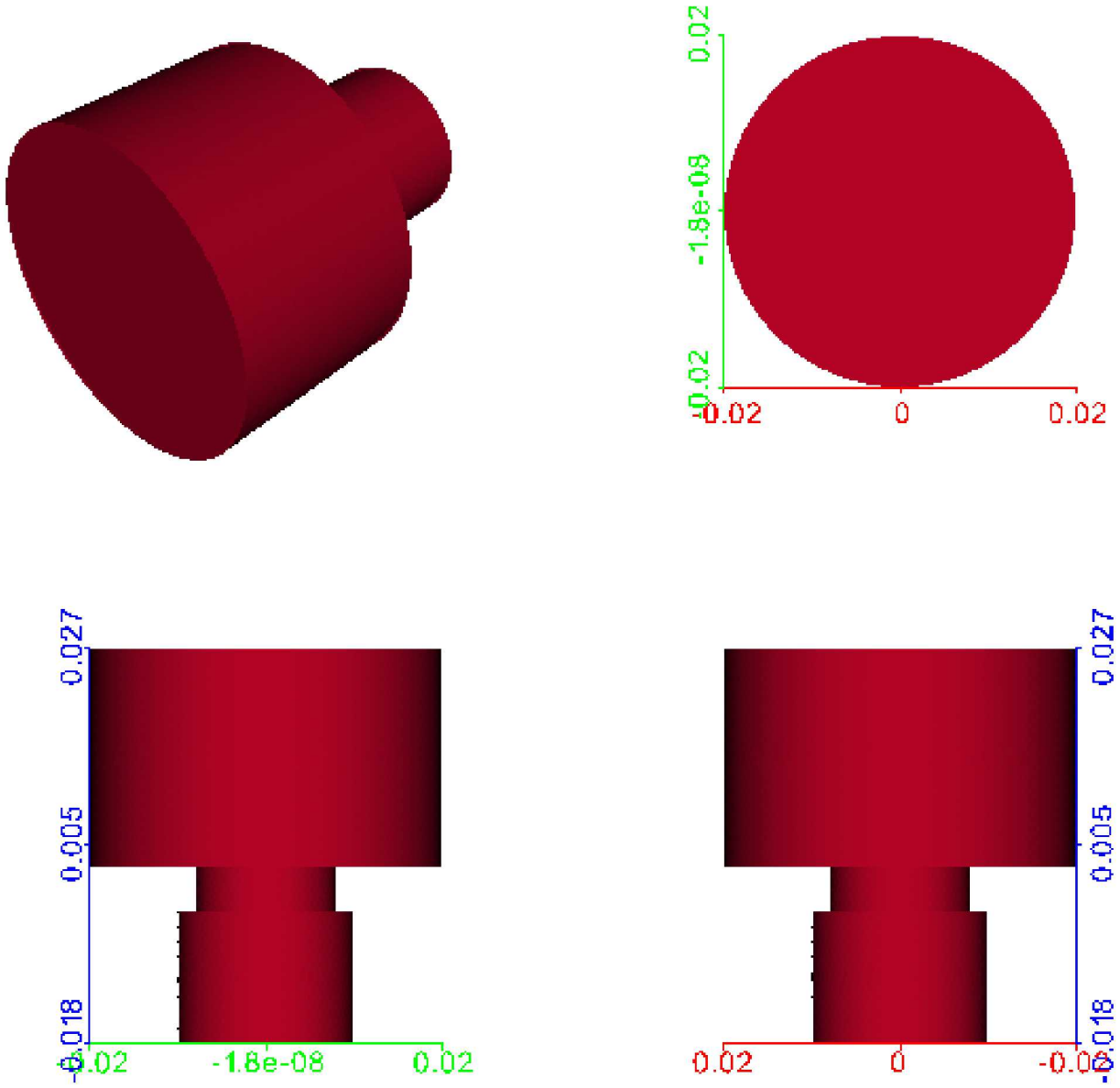

Figure 2.1: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `ObjectId`.

Block 1 (Unnamed block ID: 1 Type: TETRA)

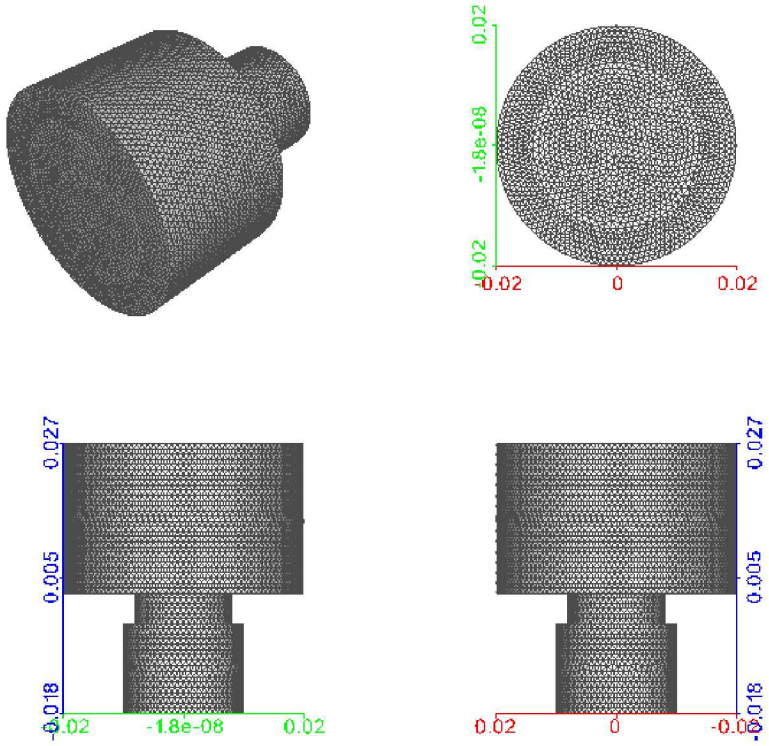

Figure 2.2: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of block Unnamed block ID: 1 Type: TETRA.

property	value
number of nodes	60359
number of elements	337219
type of first element in block	TET4

Table 2.3: Properties of block Unnamed block ID: 1 Type: TETRA.

Block 1 (`Unnamed block ID: 1 Type: TETRA`): Computed Mesh Quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\overline{\mathcal{Q}}$	$\max(\mathcal{Q})$	$\sigma_{\mathcal{Q}}$	$c_v(\mathcal{Q})$
scaled Jacobian	0.2699	0.6757	0.9868	0.1135	0.168
shape	0.5684	0.864	0.9995	0.07349	0.08505

Table 2.4: Quality properties of block `Unnamed block ID: 1 Type: TETRA`.

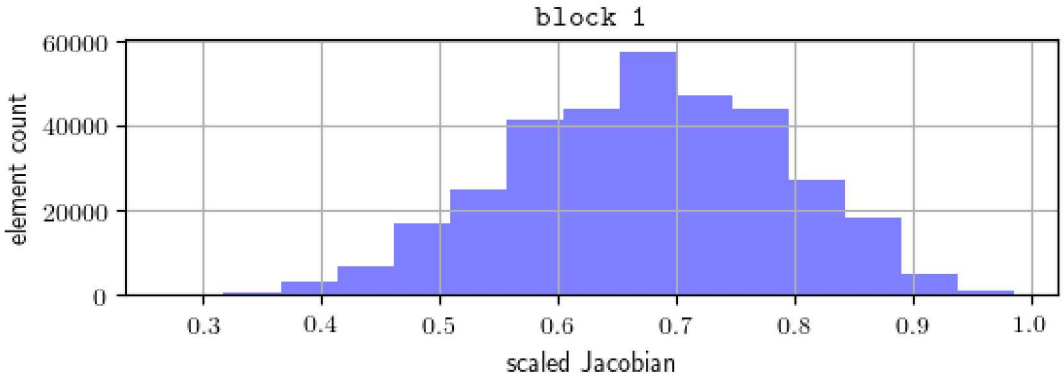

Figure 2.3: Histogram of scaled Jacobian element quality in block `Unnamed block ID: 1 Type: TETRA`.

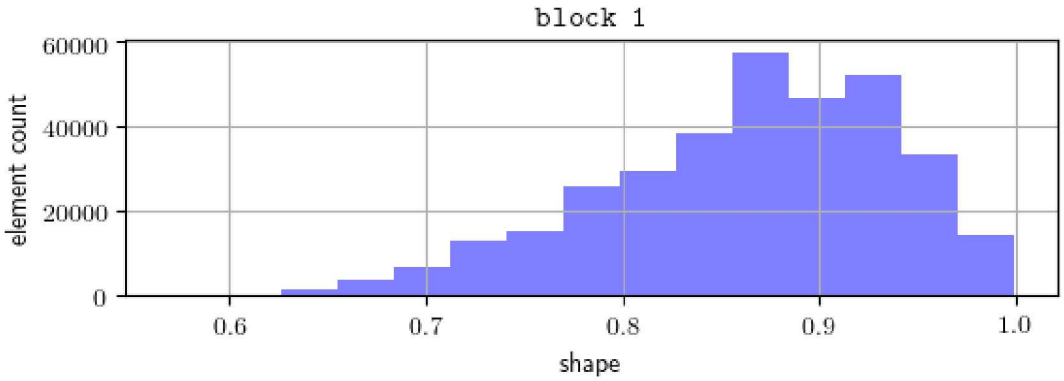

Figure 2.4: Histogram of shape element quality in block `Unnamed block ID: 1 Type: TETRA`.

Chapter 3

Electrostatic Solution

This chapter describes the `Electrostatic` solution found in the following directory: `/Users/pppebay/Documents/Git/arg/tests/EMPIRE/SAND2019-xxxx/data`.

3.1 Meta-Data

This section lists the meta-information properties found in `mesh.exo`.

item	number
Exodus II files	16
nodes	72486
elements	337219
element blocks	1
node sets	1
side sets	1
time-steps	21
node fields	4
element fields	4

Table 3.1: Topological properties of `mesh.exo.16`

variable	type
`E0`	node-based
`E1`	node-based
`E2`	node-based
`ES_POTENTIAL`	node-based
`E1`	element-based
`ES_POTENTIAL`	element-based
`LOAD_BAL`	element-based
`PROC_ID`	element-based

Table 3.2: Variables of `mesh.exo`

3.2 Field Data

This section reports on the variables of interest stored in the ExodusII partition `mesh.exo`.

Variable E0 (node-based scalar at time 0.0)

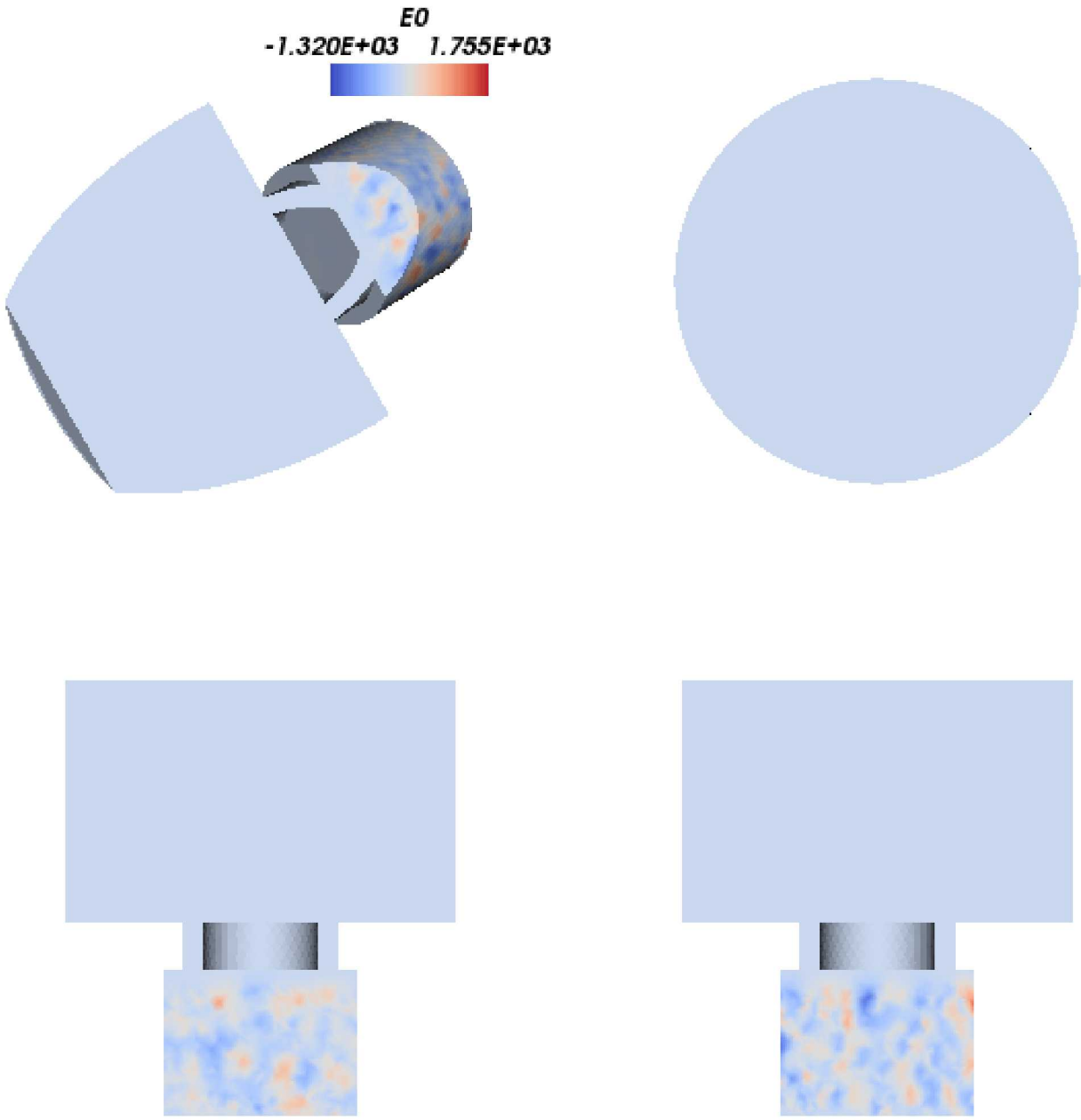

Figure 3.1: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E0.

Variable `E0` (node-based scalar at time 5.54873895e-10)

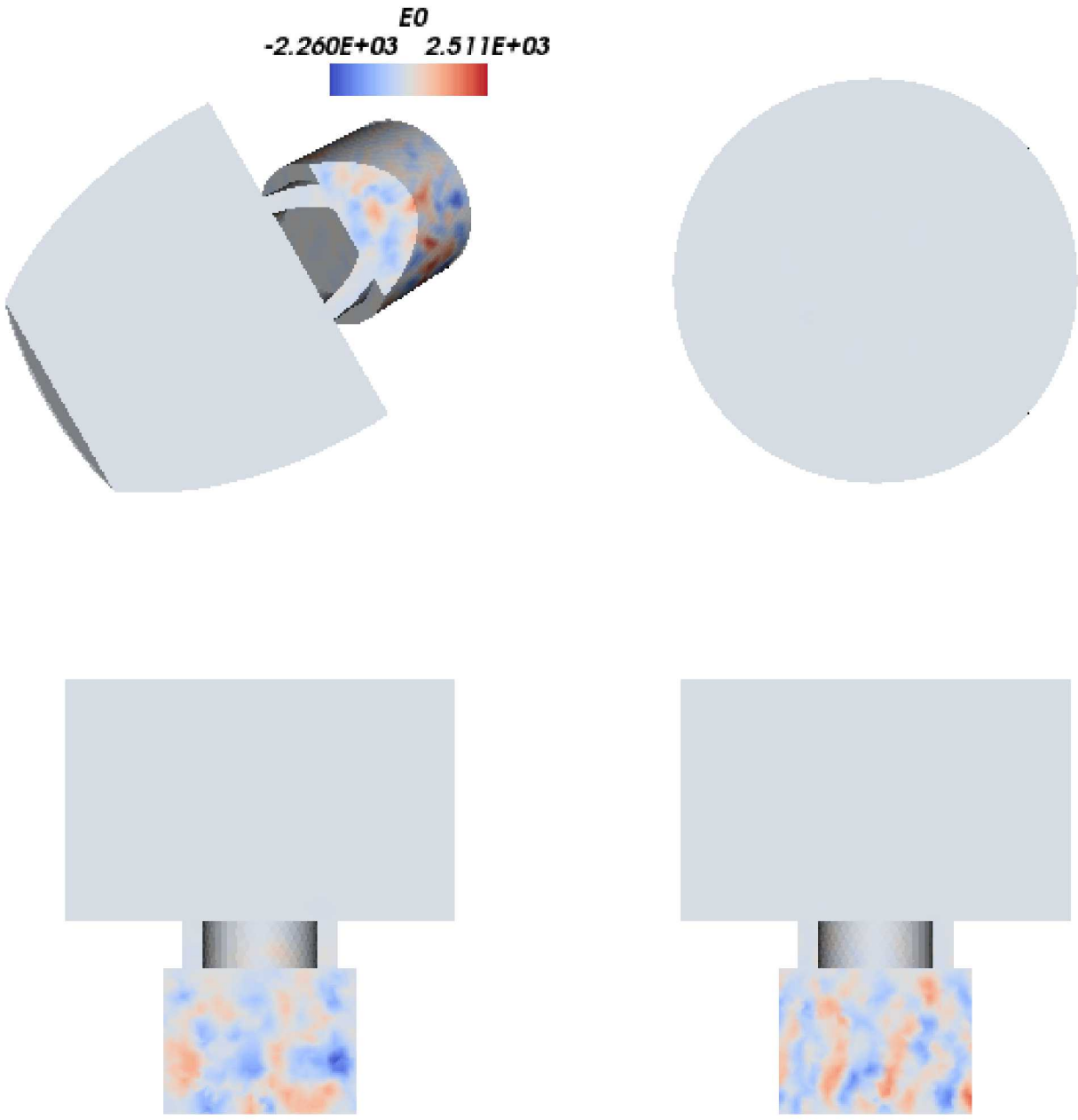

Figure 3.2: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E0`.

Variable `E0` (node-based scalar at time 1.10974779e-09)

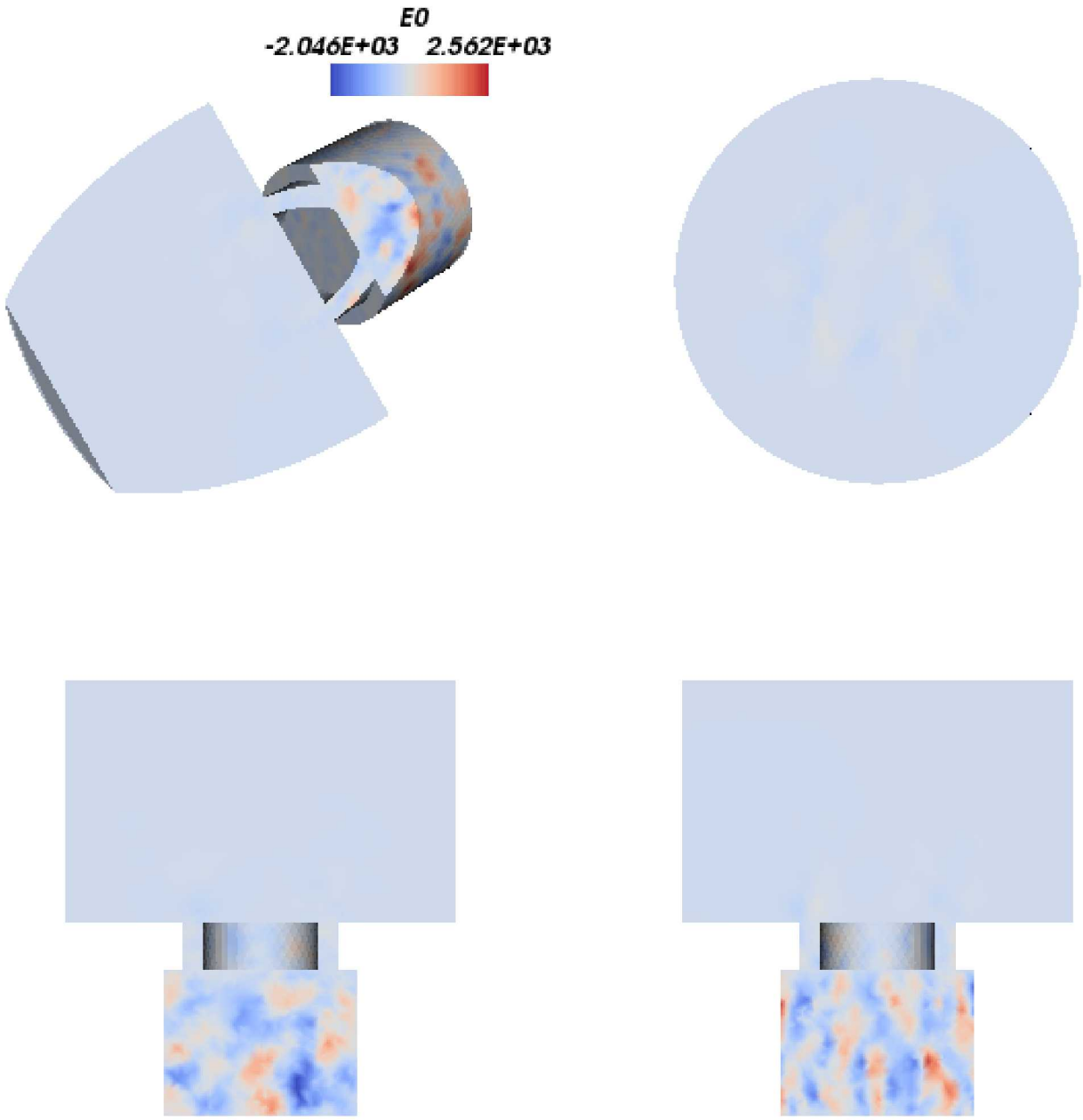

Figure 3.3: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E0`.

Variable `E0` (node-based scalar at time 1.664621685e-09)

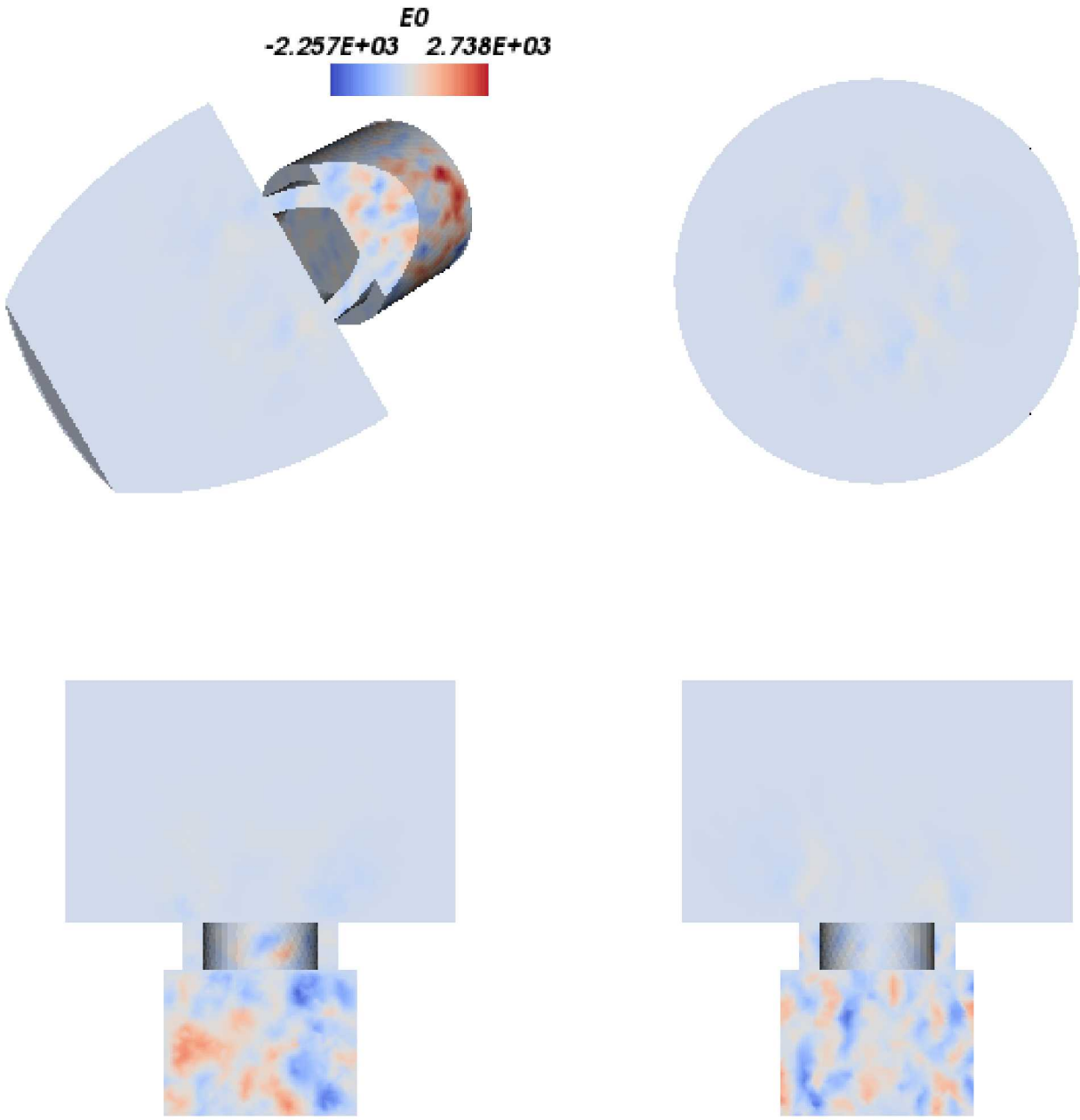

Figure 3.4: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E0`.

Variable `E0` (node-based scalar at time 2.21949558e-09)

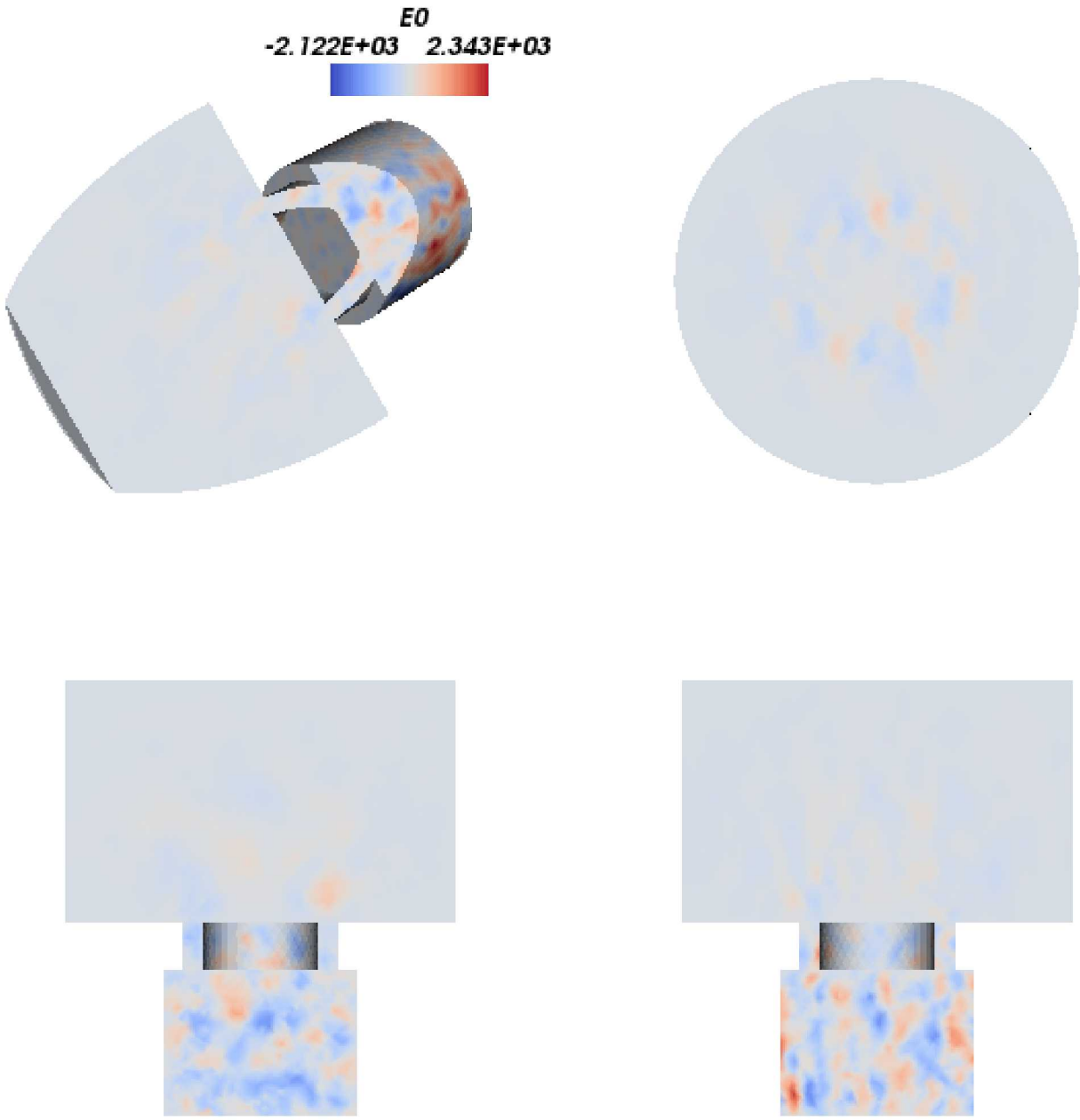

Figure 3.5: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E0`.

Variable `E0` (node-based scalar at time 2.774369475e-09)

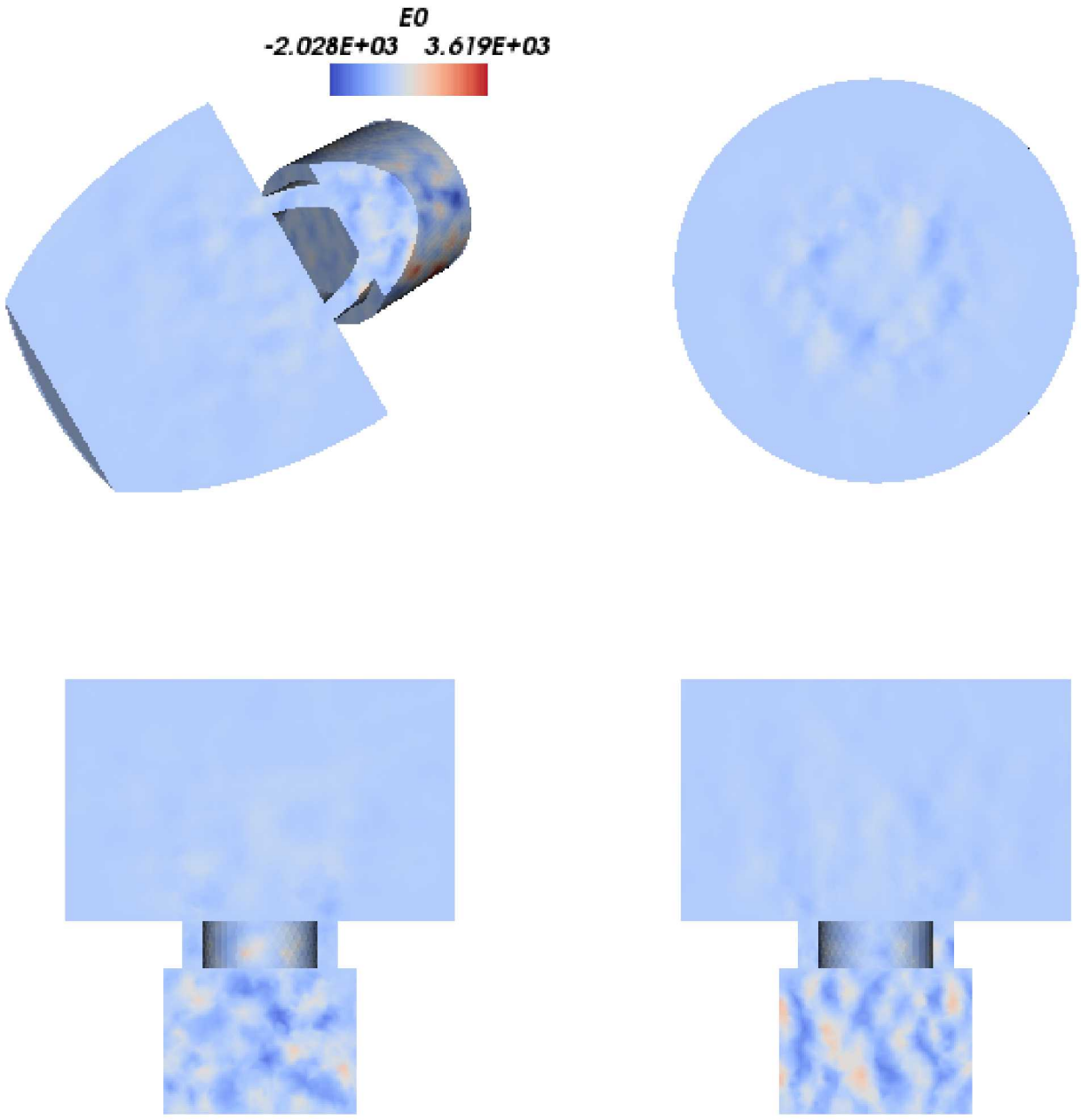

Figure 3.6: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E0`.

Variable `E0` (node-based scalar at time 3.32924337e-09)

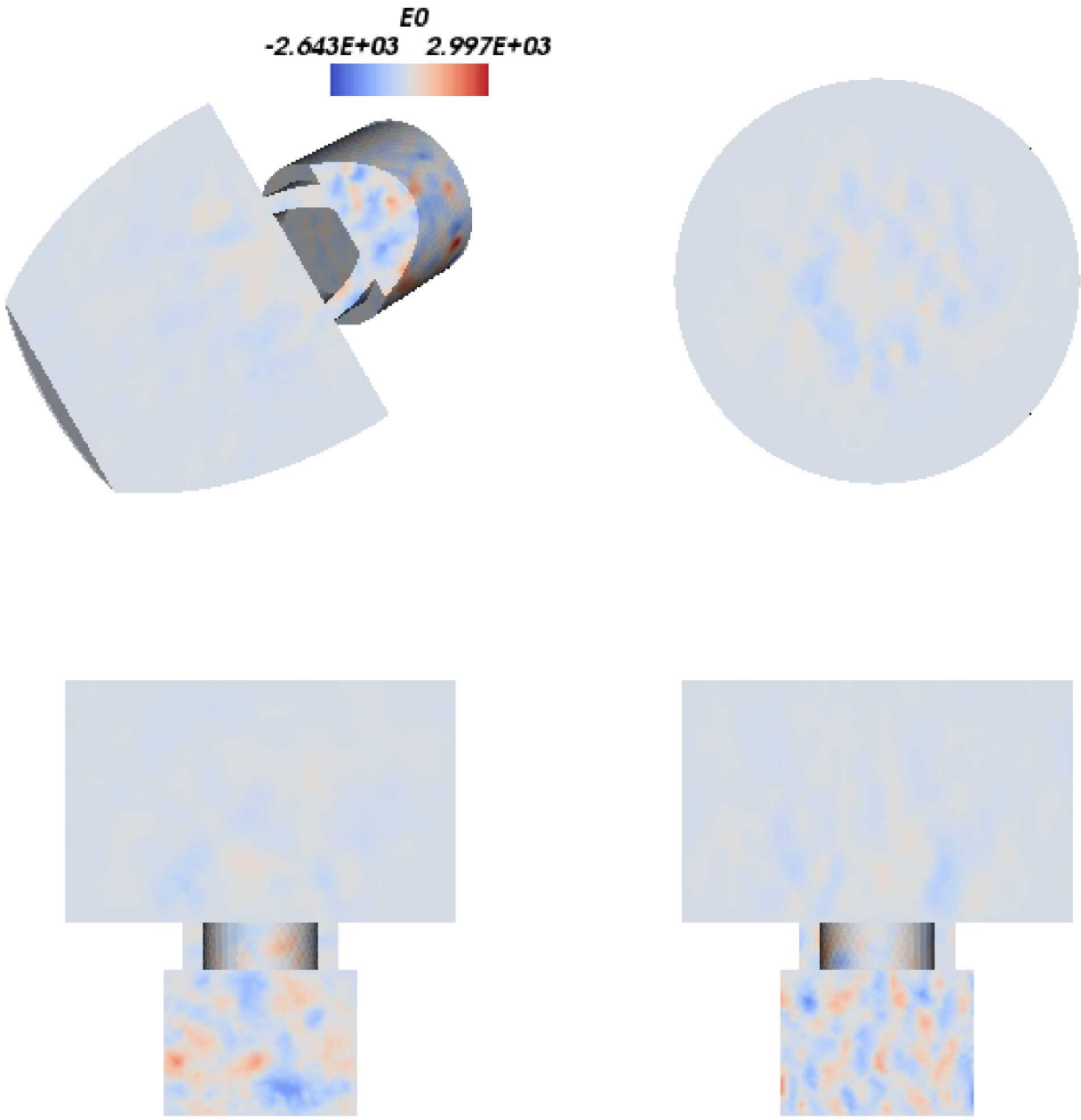

Figure 3.7: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E0`.

Variable E0 (node-based scalar at time 3.884117265e-09)

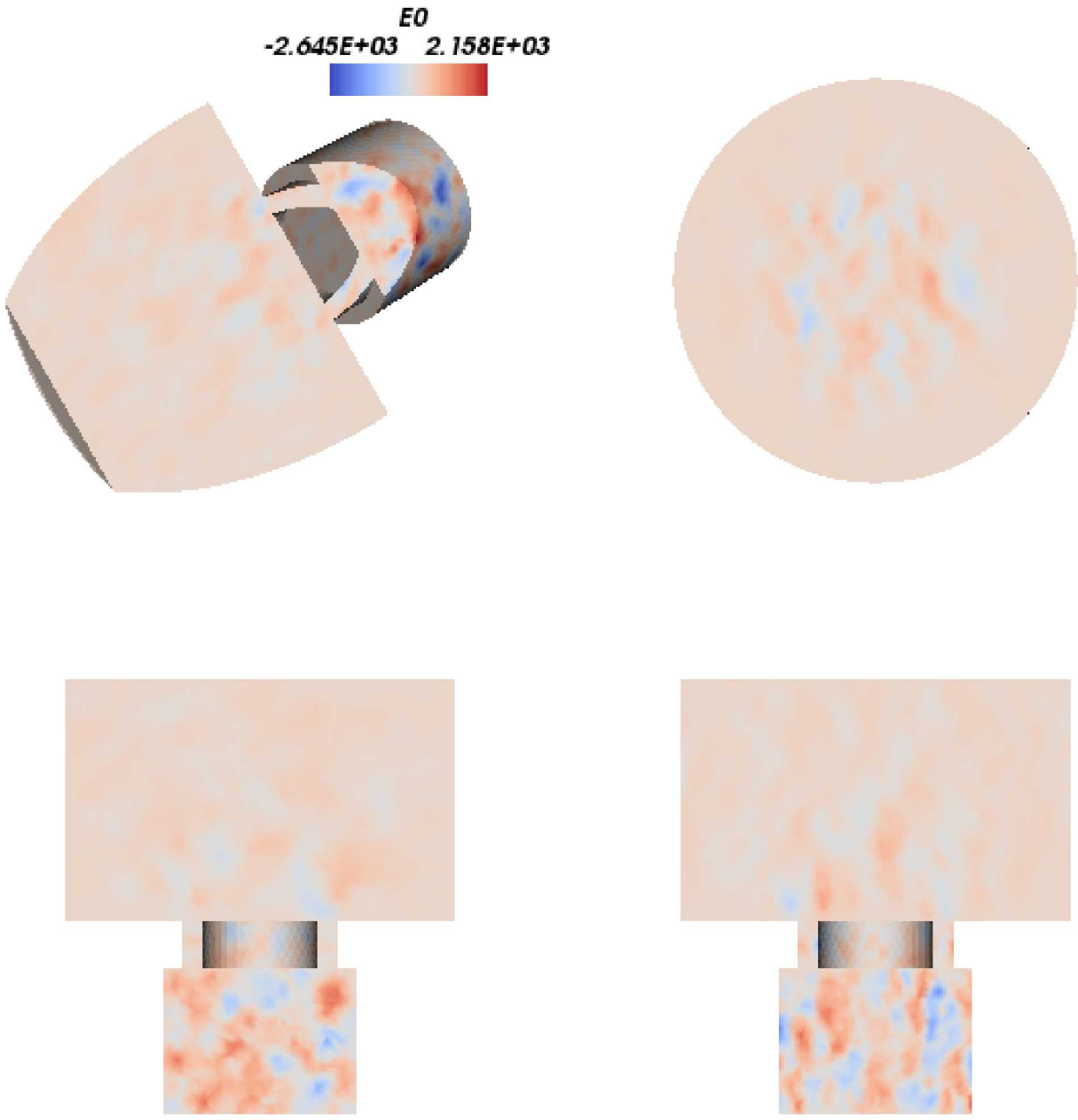

Figure 3.8: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E0.

Variable `E0` (node-based scalar at time 4.43899116e-09)

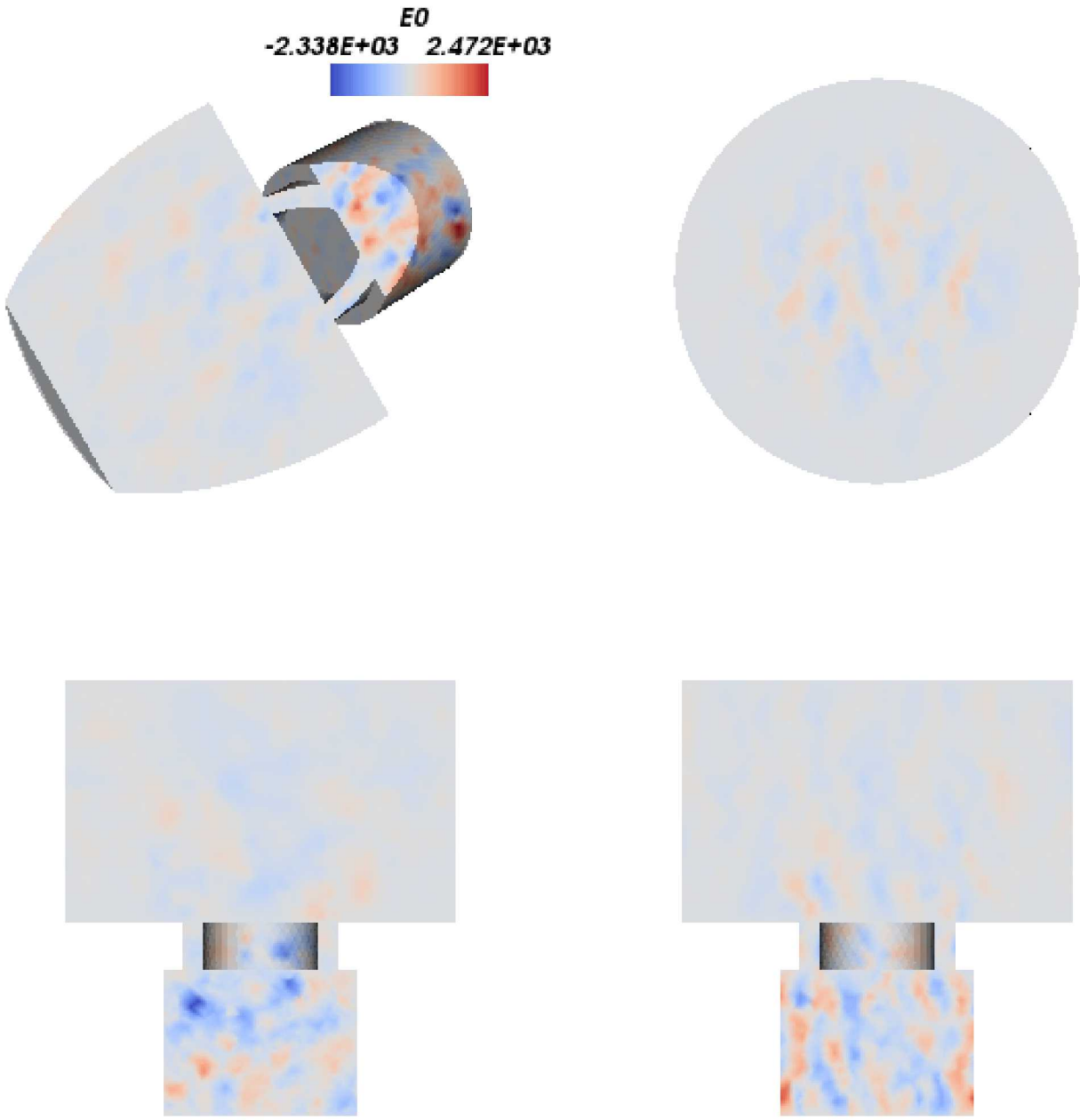

Figure 3.9: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E0`.

Variable E0 (node-based scalar at time 4.993865055e-09)

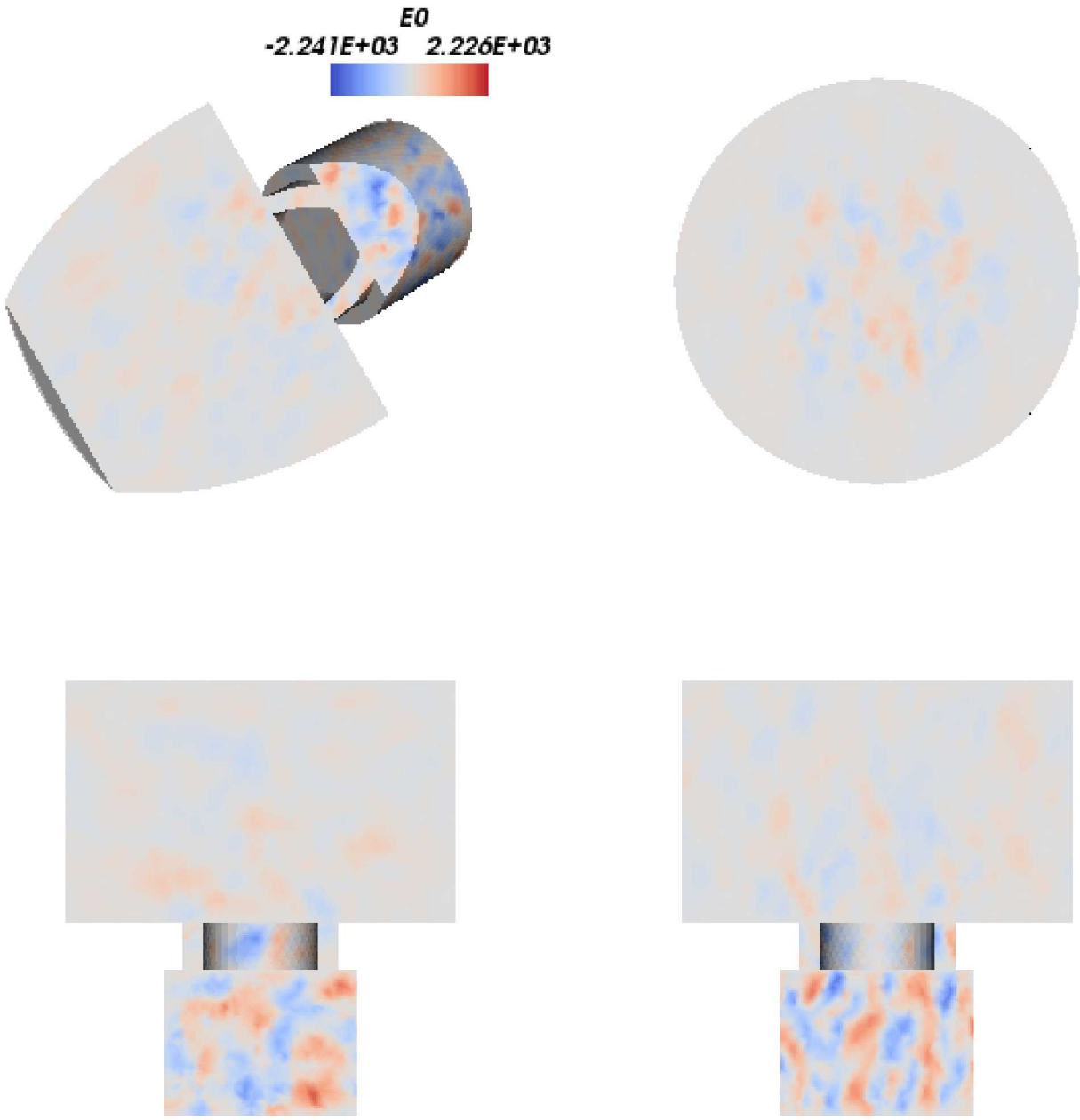

Figure 3.10: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E0.

Variable E0 (node-based scalar at time 5.54873895e-09)

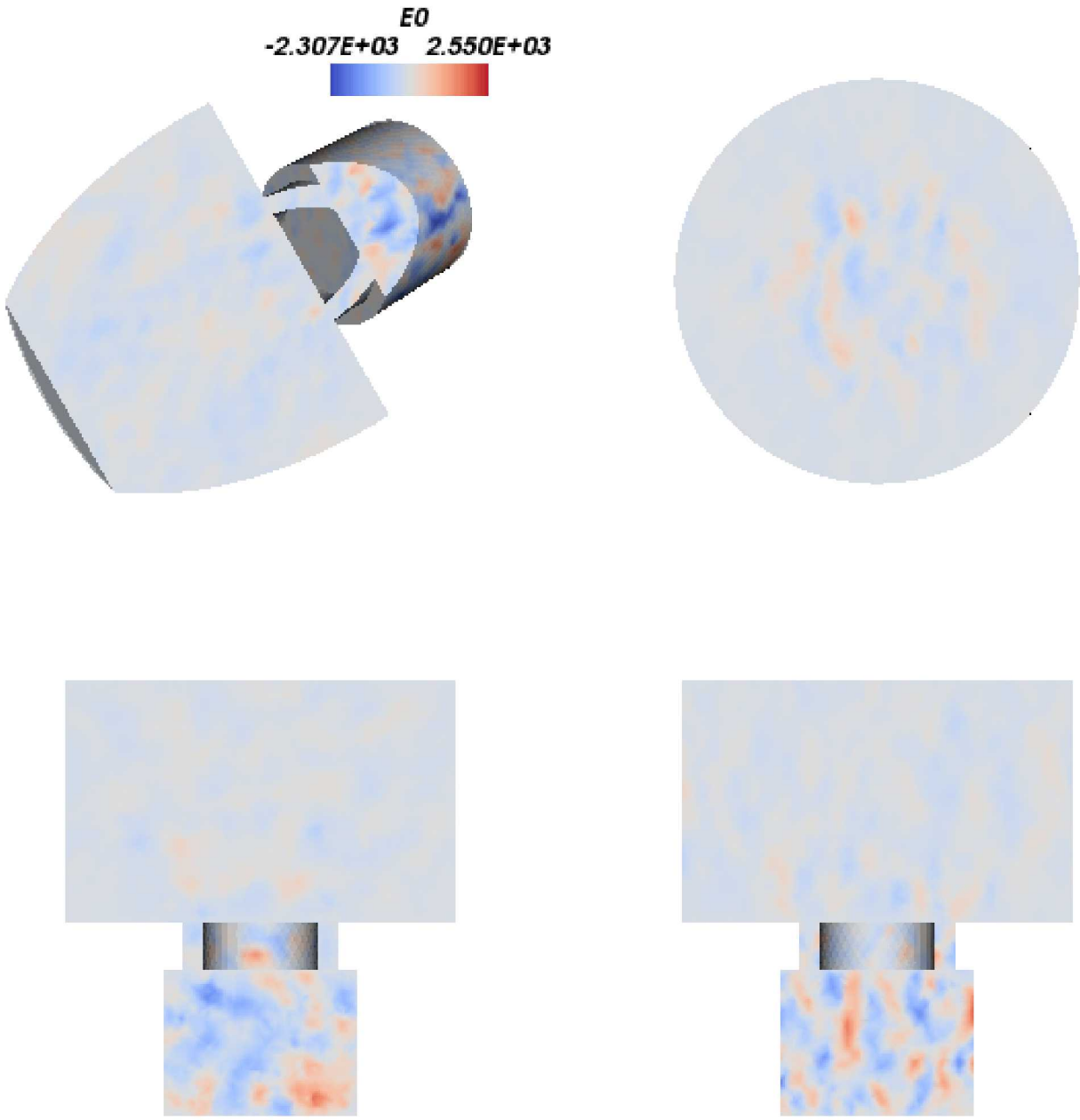

Figure 3.11: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E0.

Variable E0 (node-based scalar at time 6.103612845e-09)

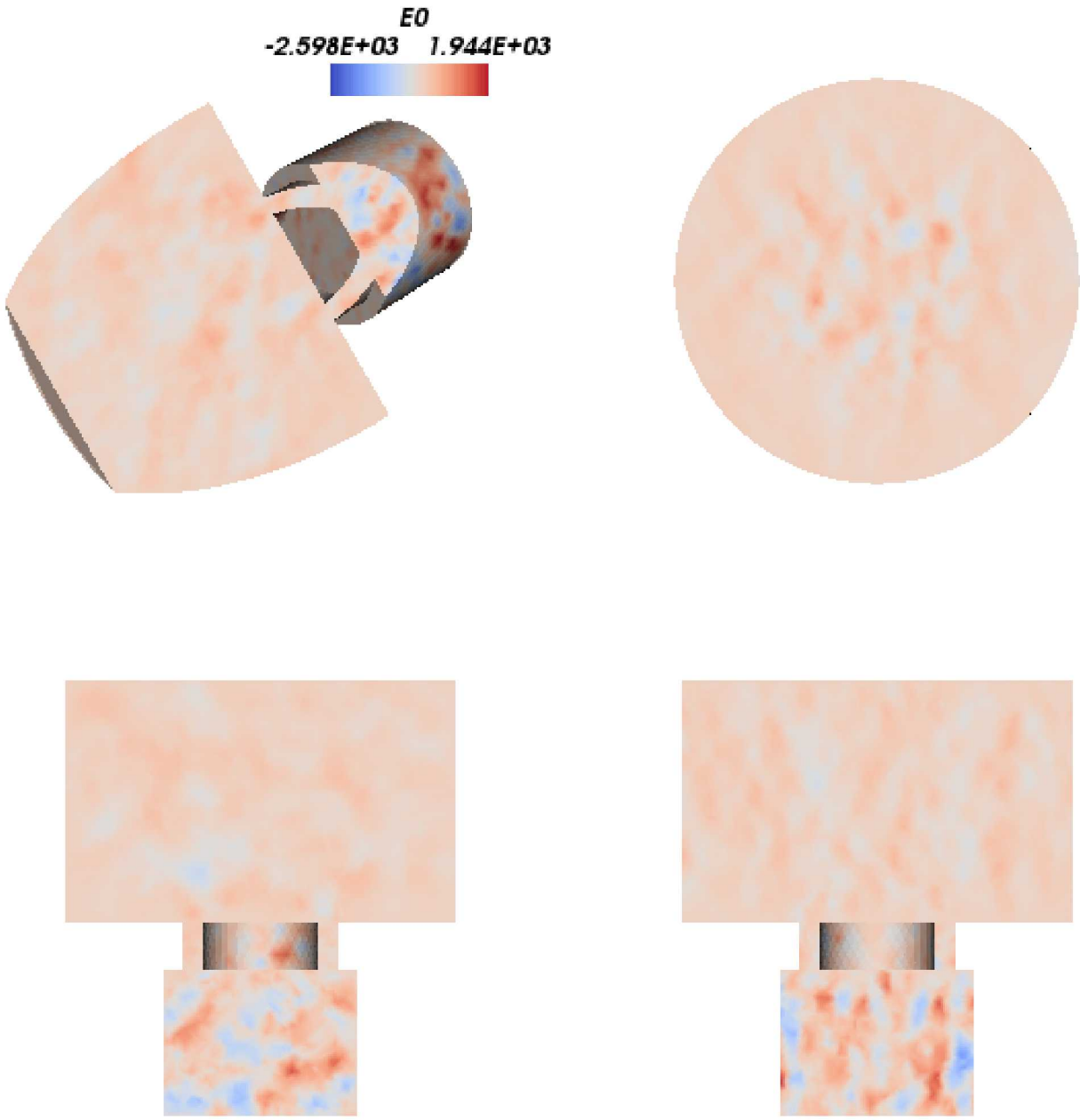

Figure 3.12: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E0.

Variable E0 (node-based scalar at time 6.65848674e-09)

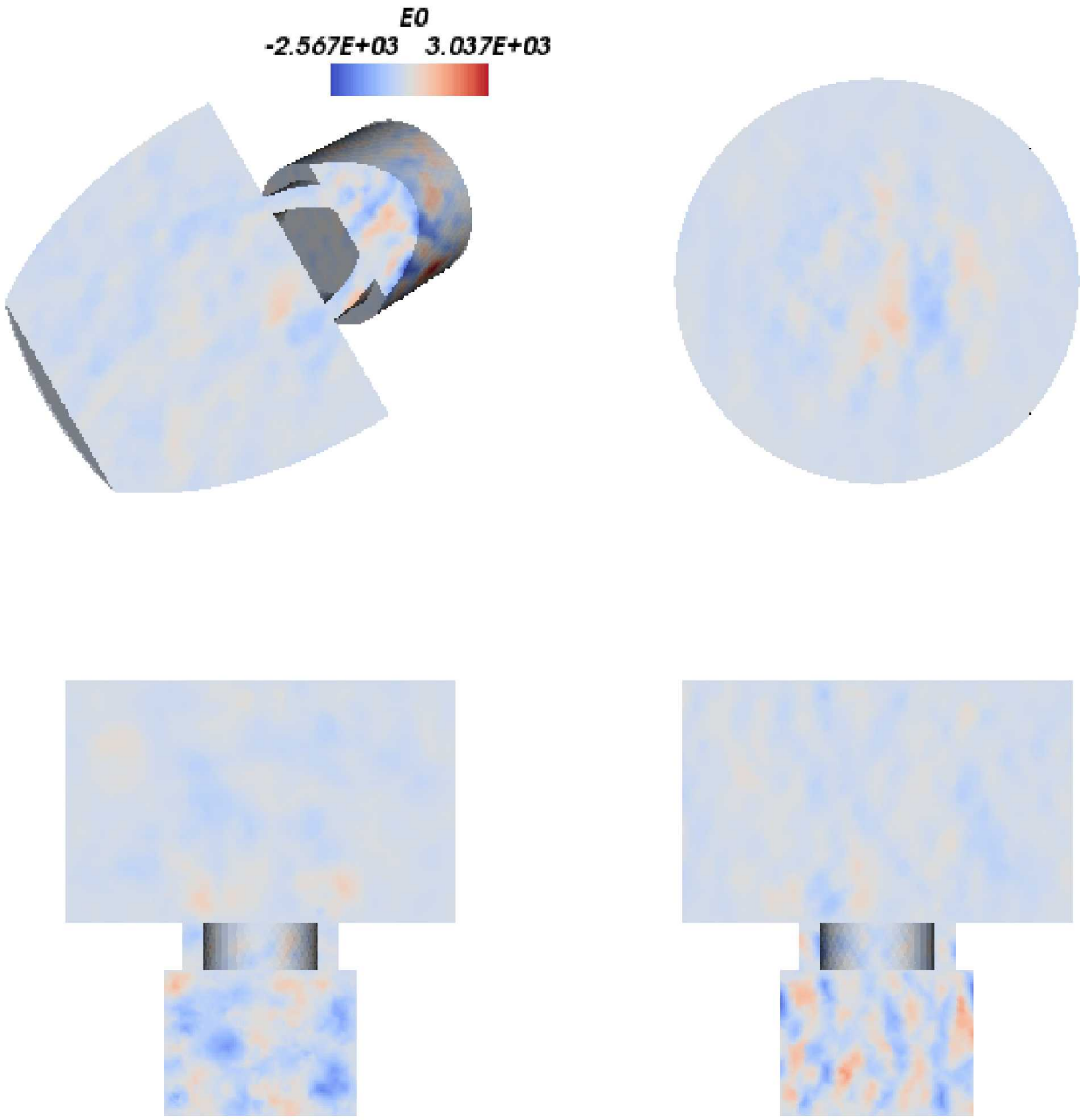

Figure 3.13: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E0.

Variable `E0` (node-based scalar at time 7.213360635e-09)

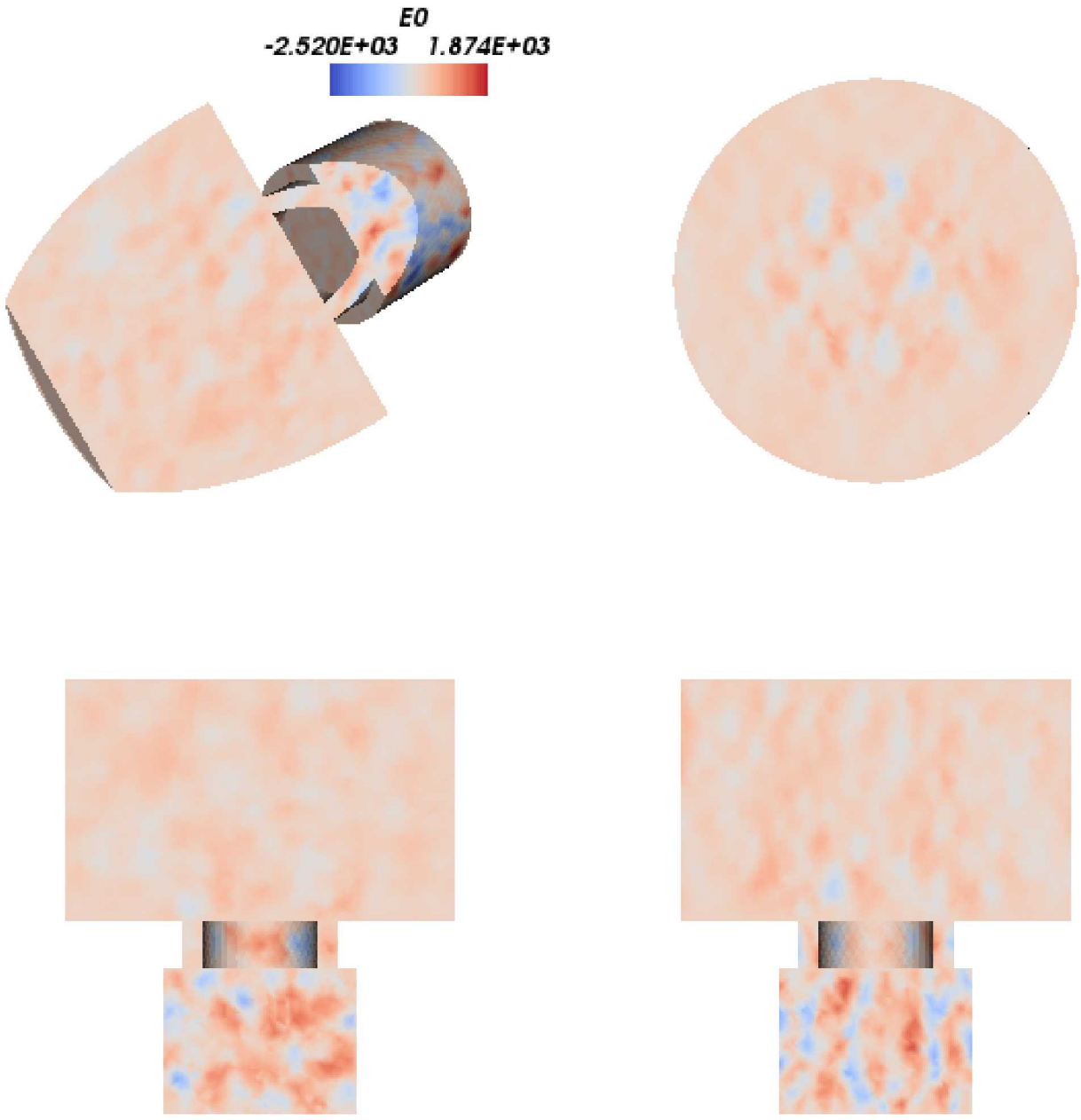

Figure 3.14: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E0`.

Variable E0 (node-based scalar at time 7.76823453e-09)

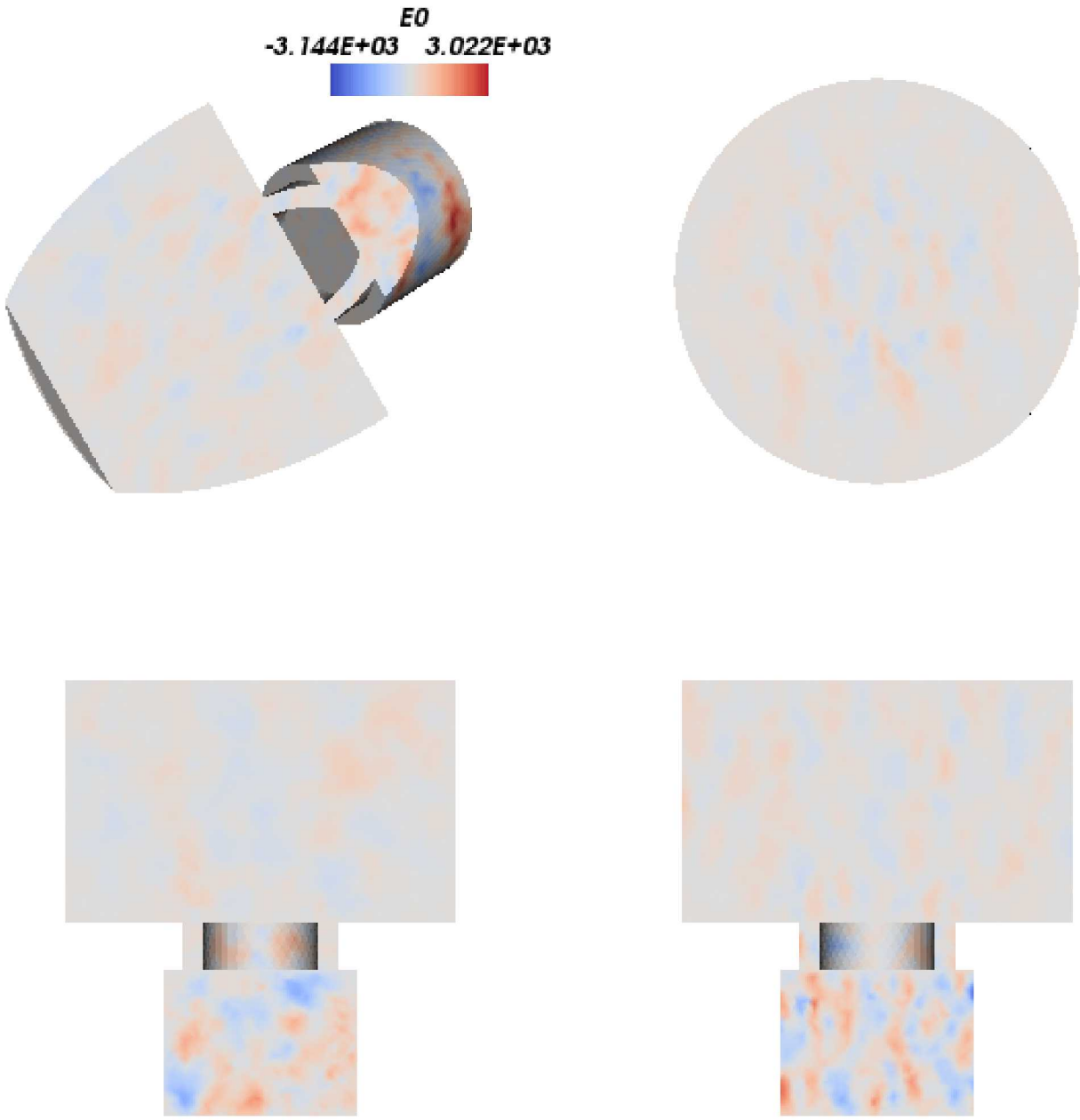

Figure 3.15: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E0.

Variable E0 (node-based scalar at time 8.323108425e-09)

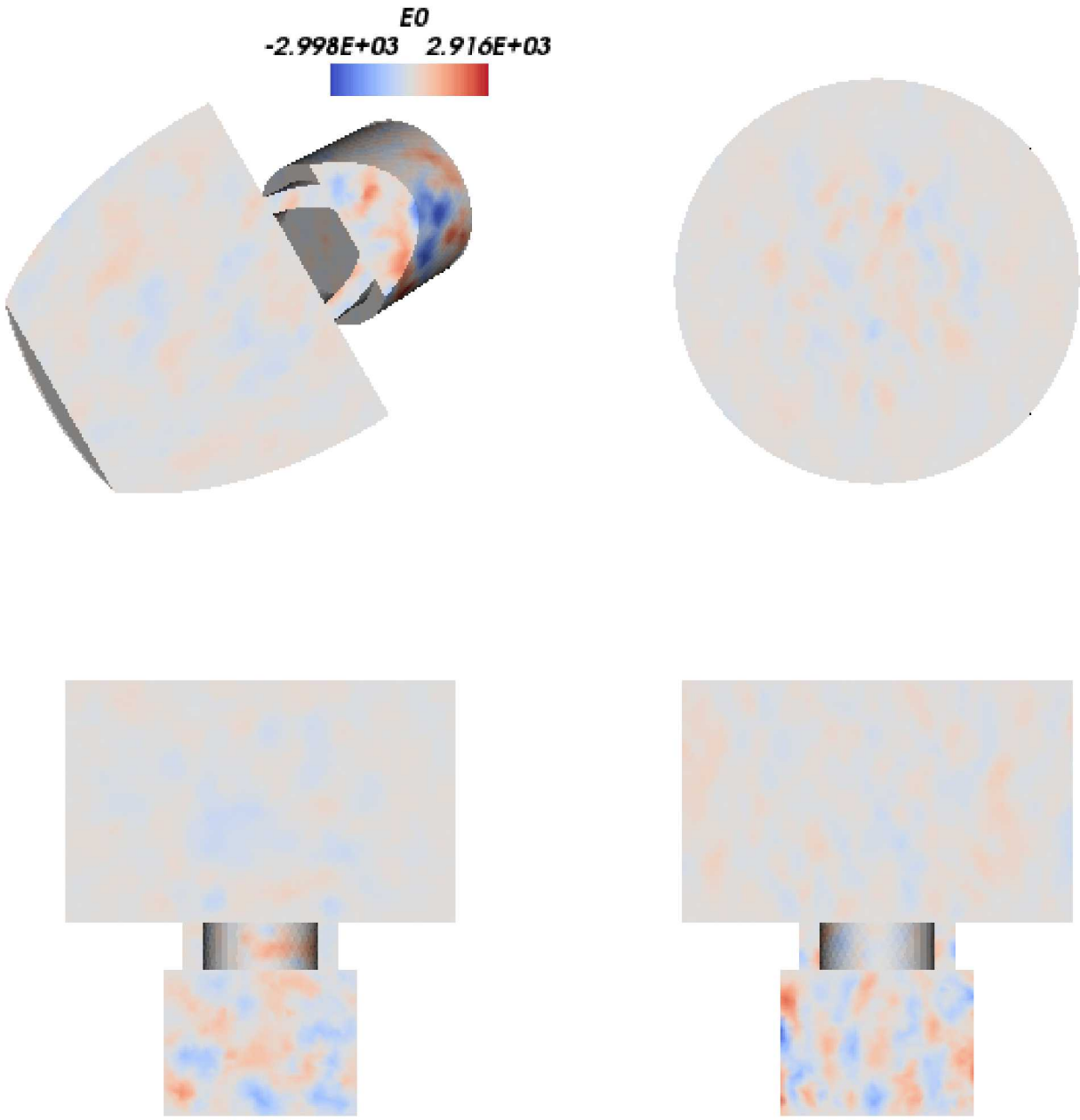

Figure 3.16: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E0.

Variable `E0` (node-based scalar at time 8.87798232e-09)

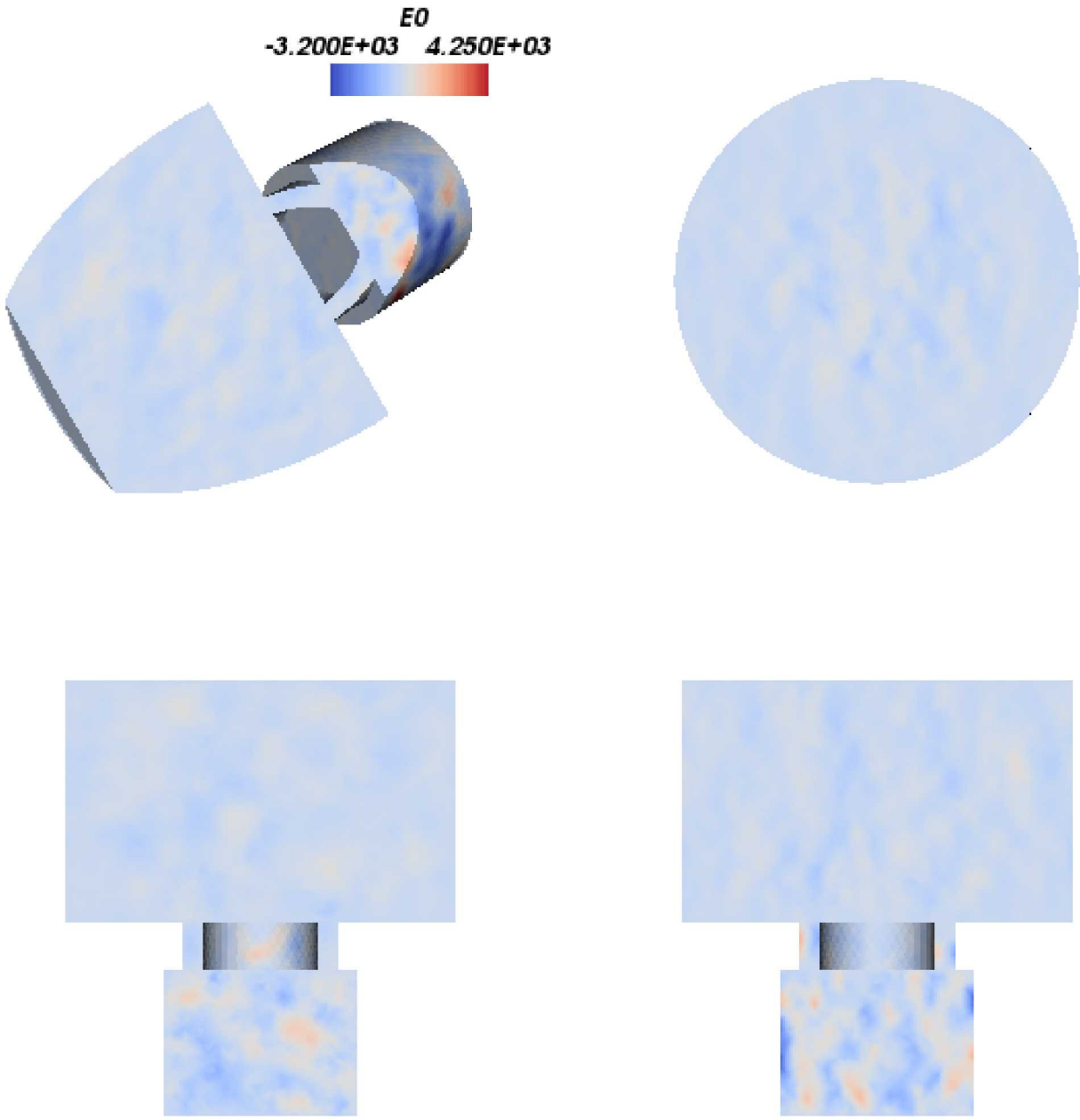

Figure 3.17: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E0`.

Variable E0 (node-based scalar at time 9.432856215e-09)

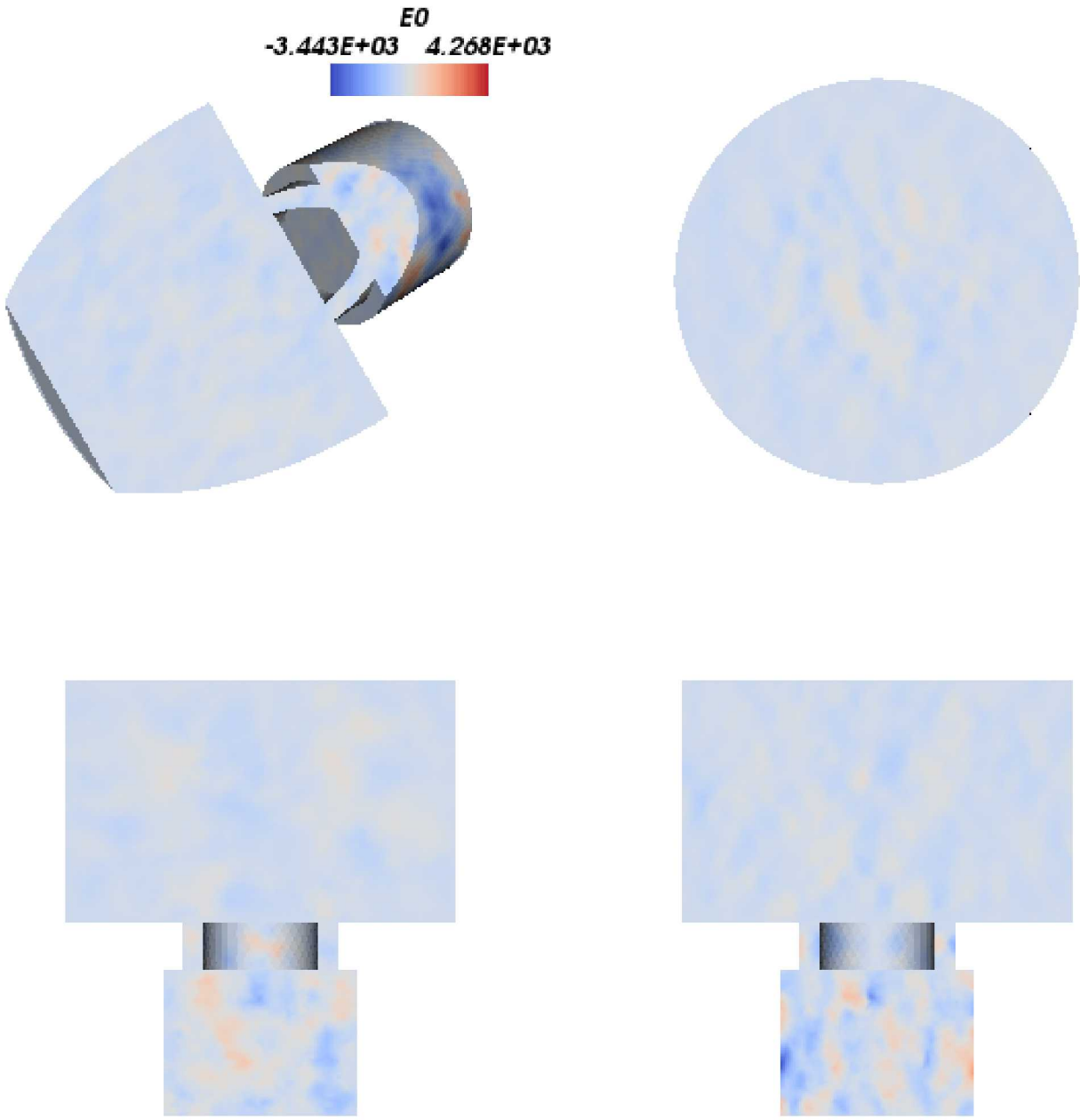

Figure 3.18: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E0.

Variable `E0` (node-based scalar at time 9.98773011e-09)

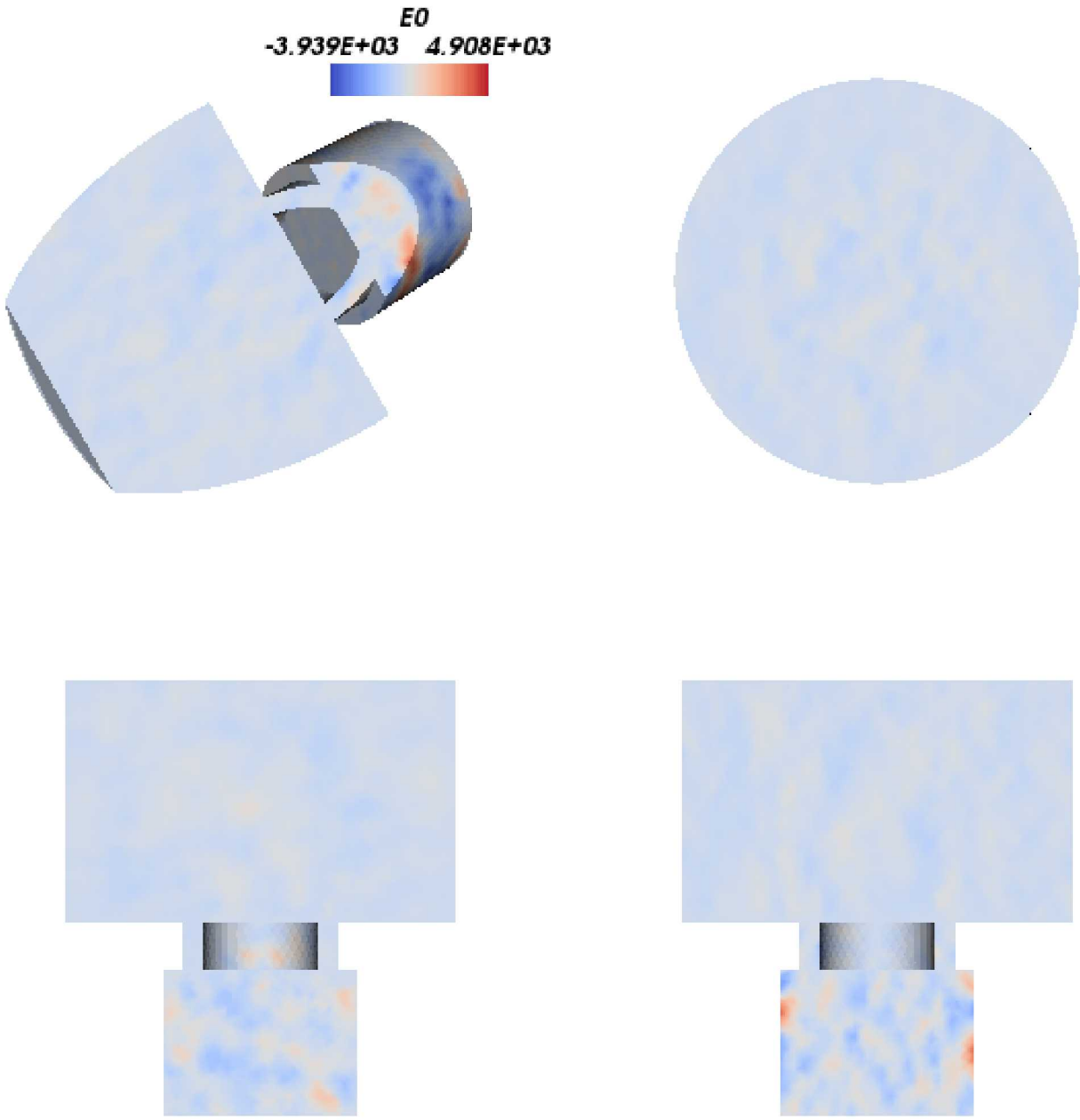

Figure 3.19: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E0`.

Variable E0 (node-based scalar at time 1.0542604005e-08)

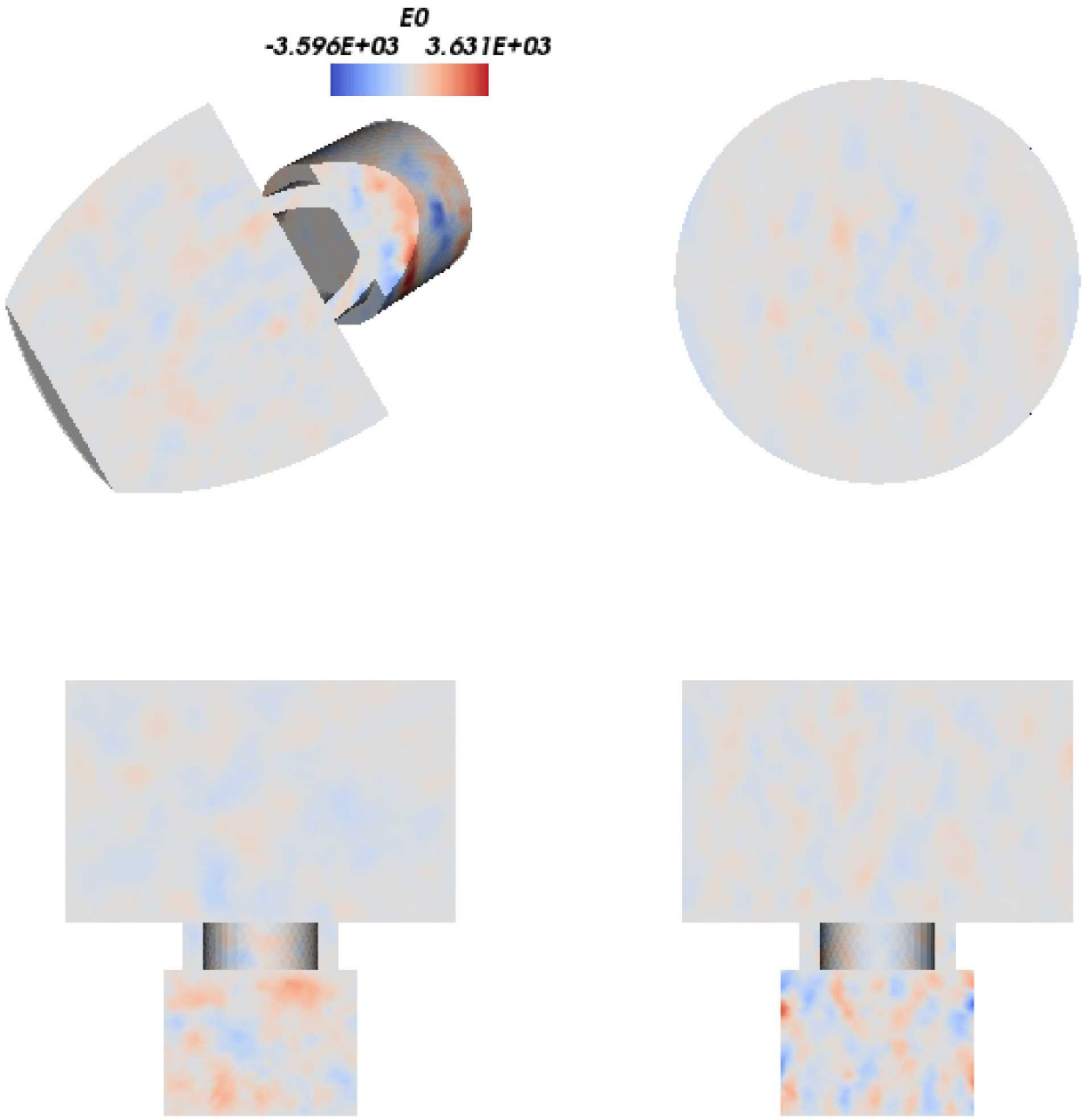

Figure 3.20: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E0.

Variable E0 (node-based scalar at time 1.10974779e-08)

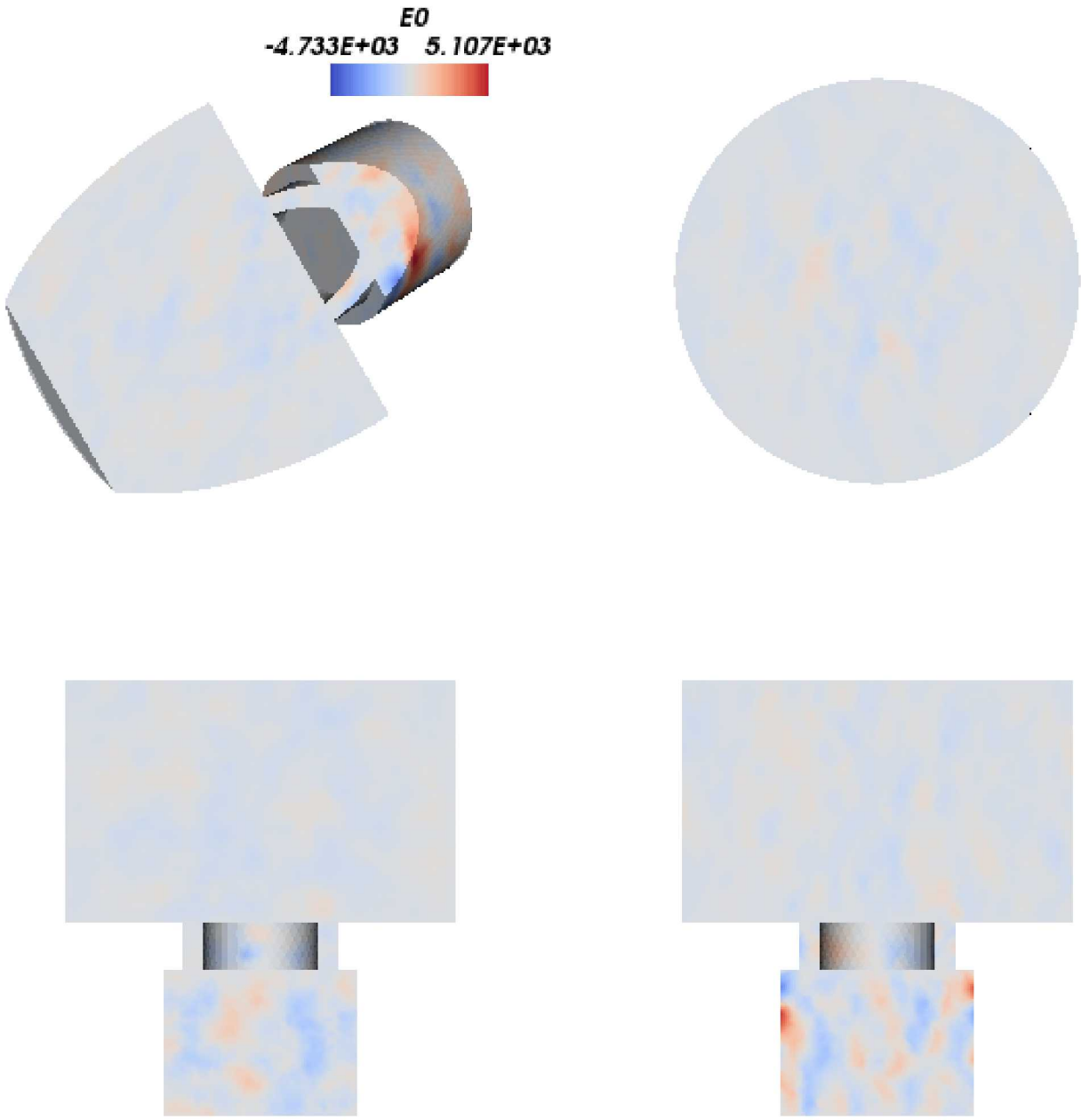

Figure 3.21: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E0.

Variable `E1` (node-based scalar at time 0.0)

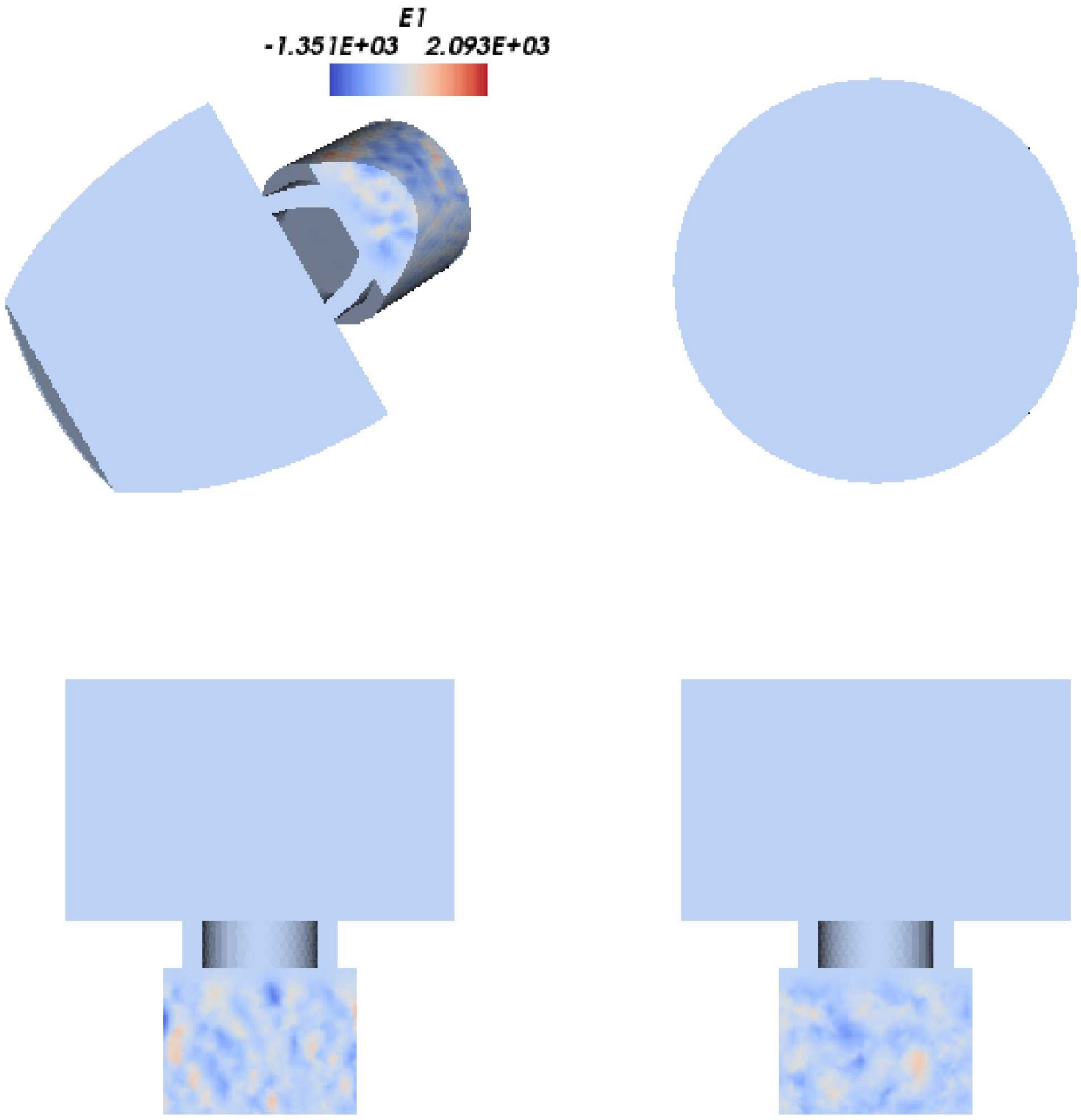

Figure 3.22: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E1`.

Variable `E1` (node-based scalar at time 5.54873895e-10)

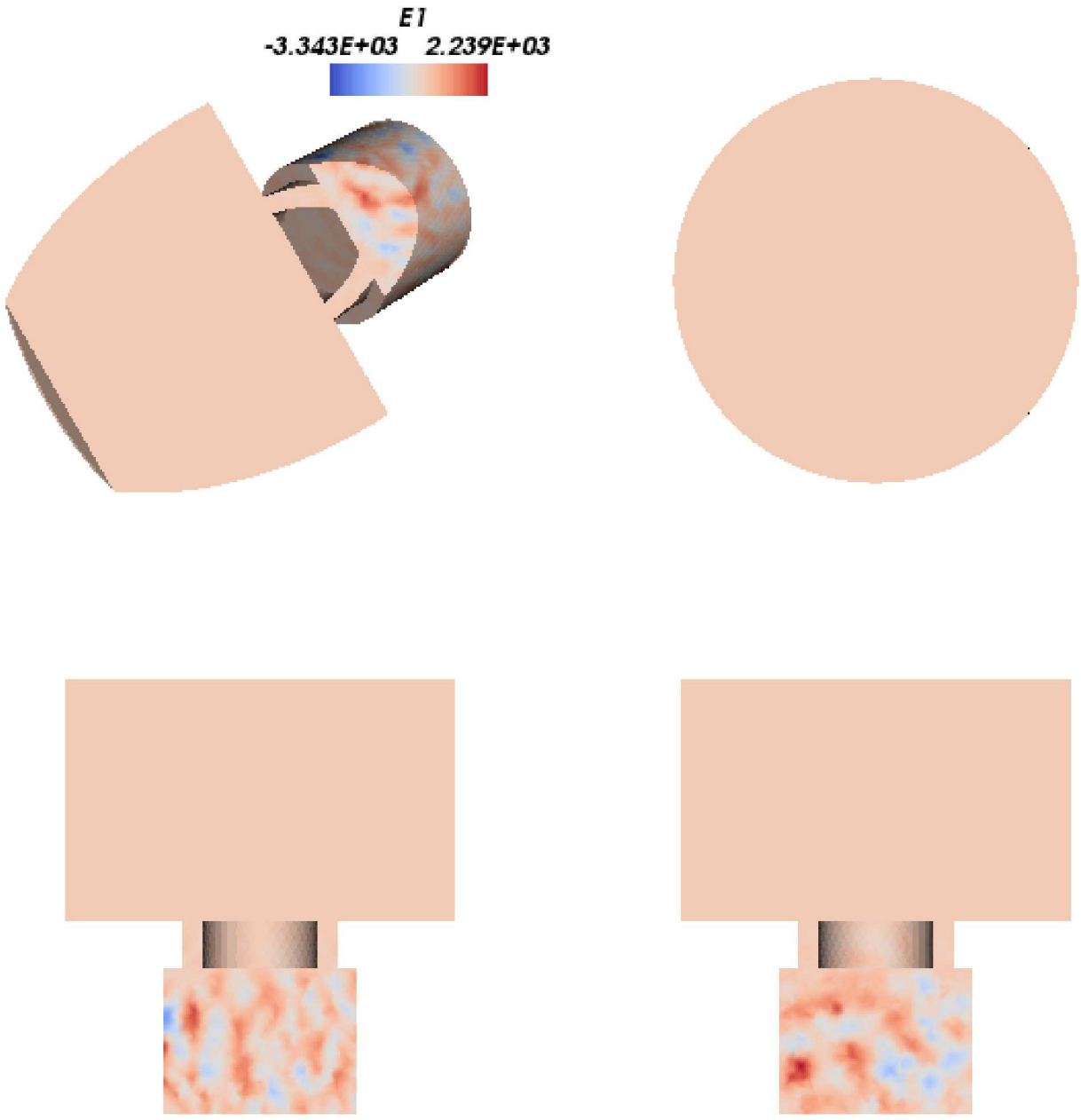

Figure 3.23: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E1`.

Variable E1 (node-based scalar at time 1.10974779e-09)

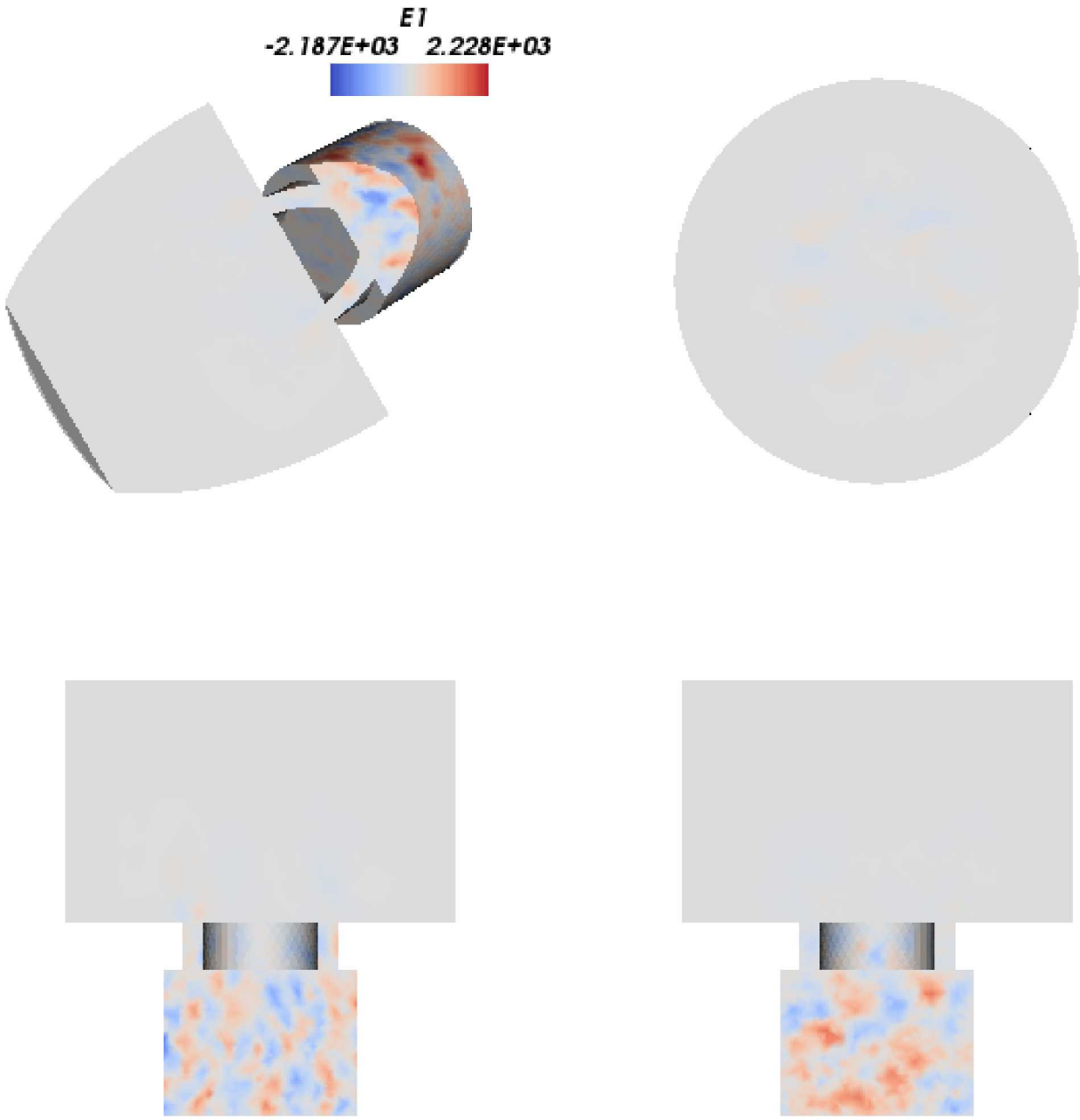

Figure 3.24: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable E1 (node-based scalar at time 1.664621685e-09)

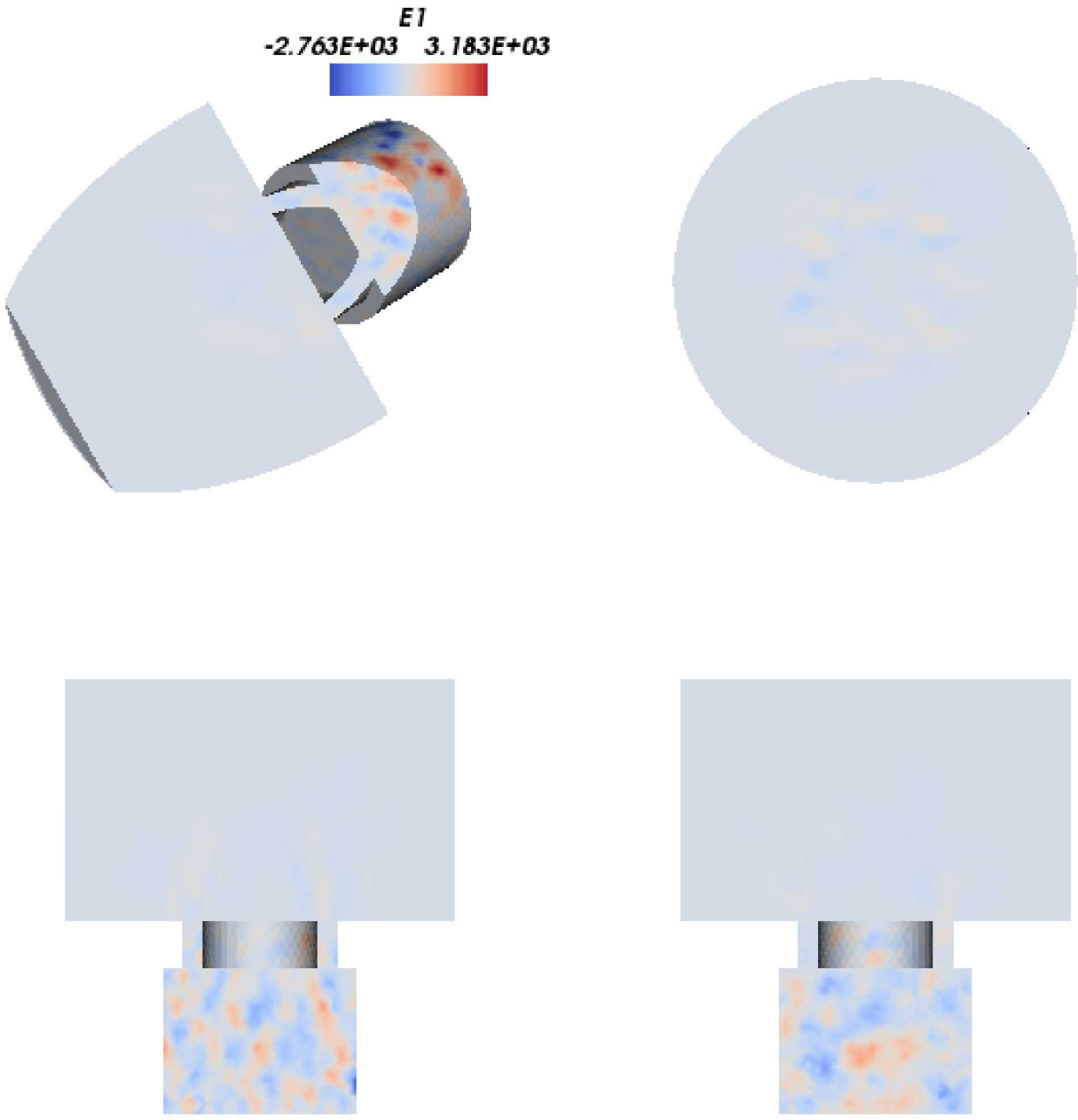

Figure 3.25: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable E1 (node-based scalar at time 2.21949558e-09)

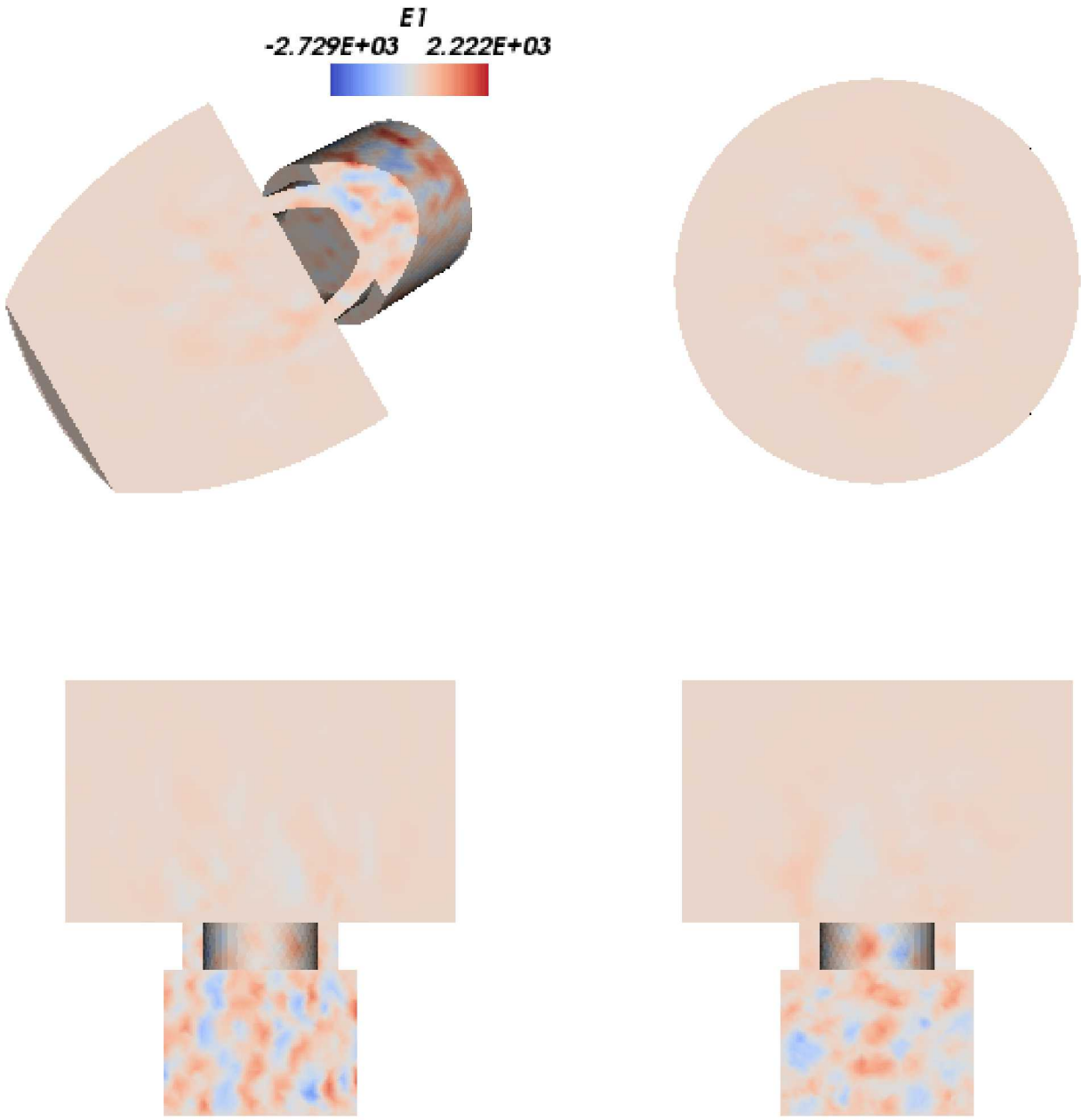

Figure 3.26: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable `E1` (node-based scalar at time 2.774369475e-09)

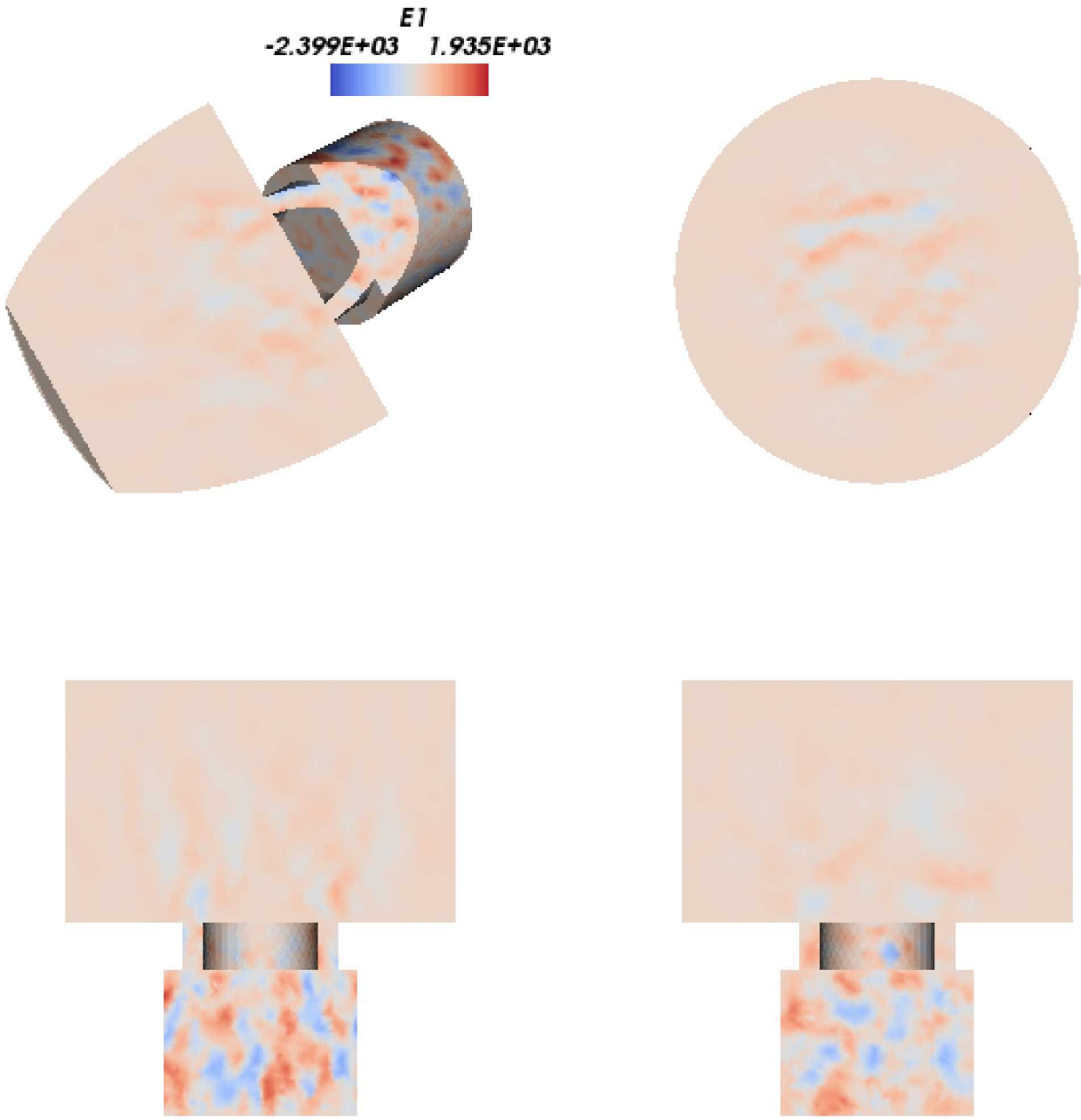

Figure 3.27: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E1`.

Variable E1 (node-based scalar at time 3.32924337e-09)

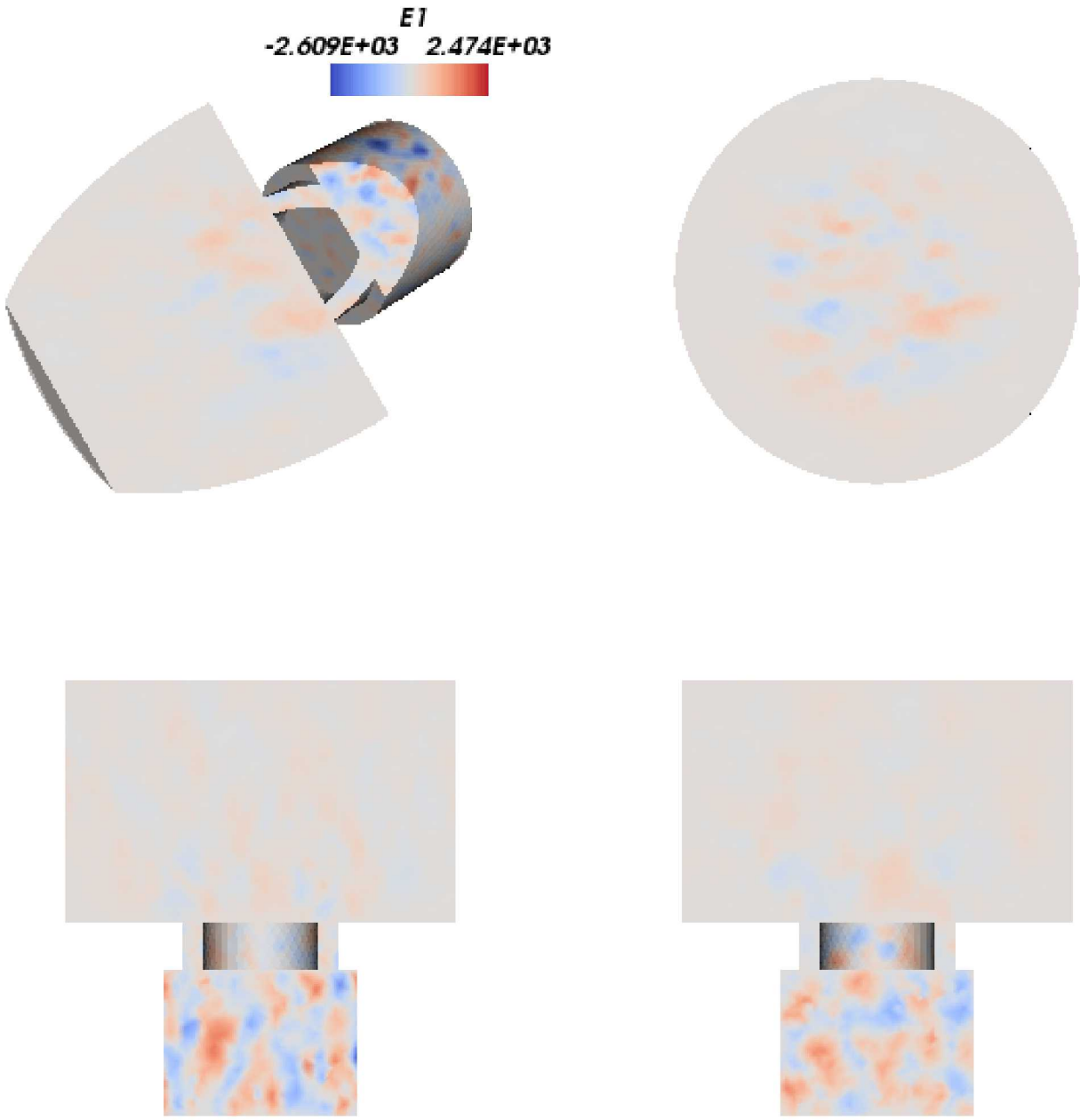

Figure 3.28: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable E1 (node-based scalar at time 3.884117265e-09)

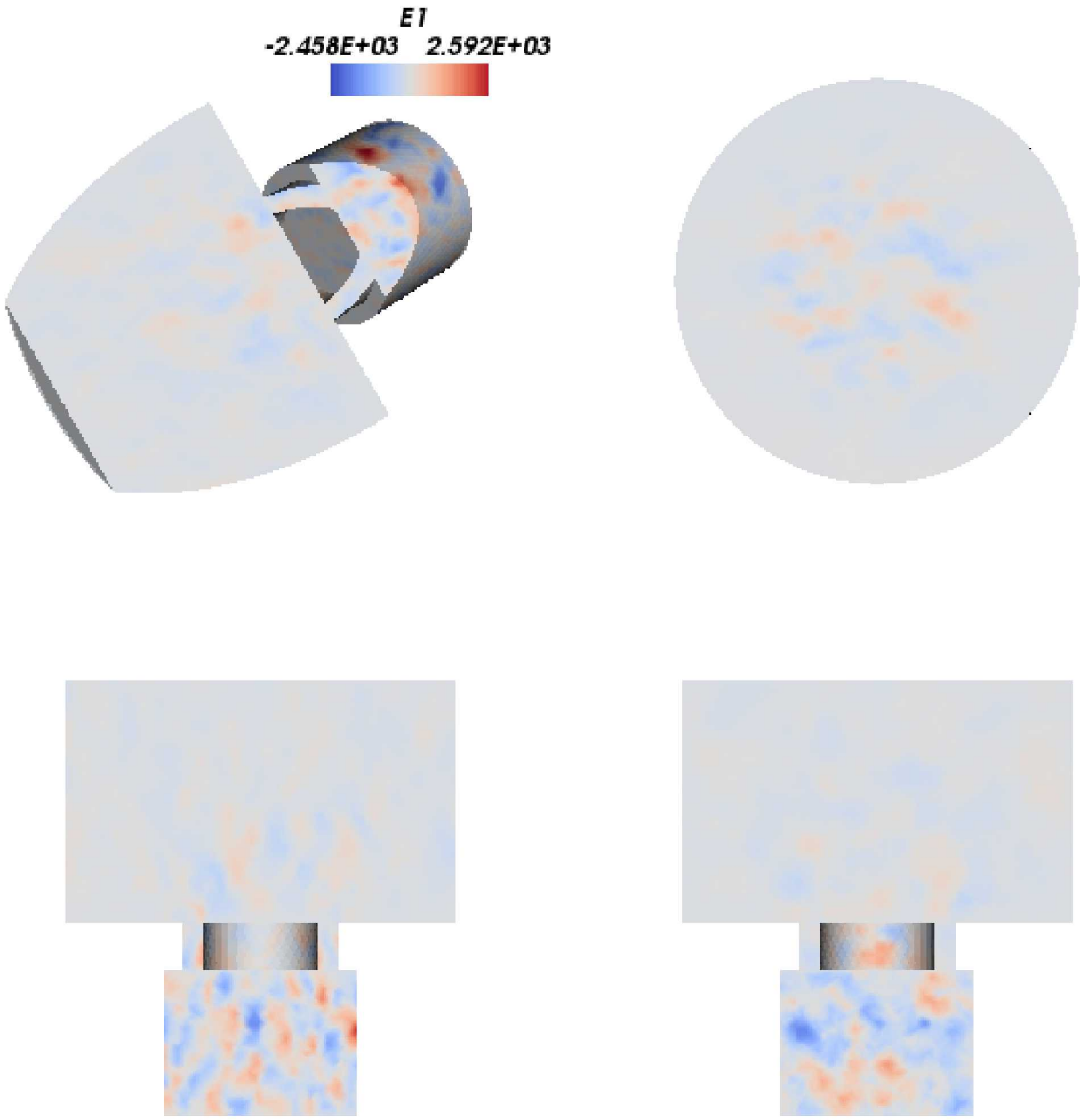

Figure 3.29: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable E1 (node-based scalar at time 4.43899116e-09)

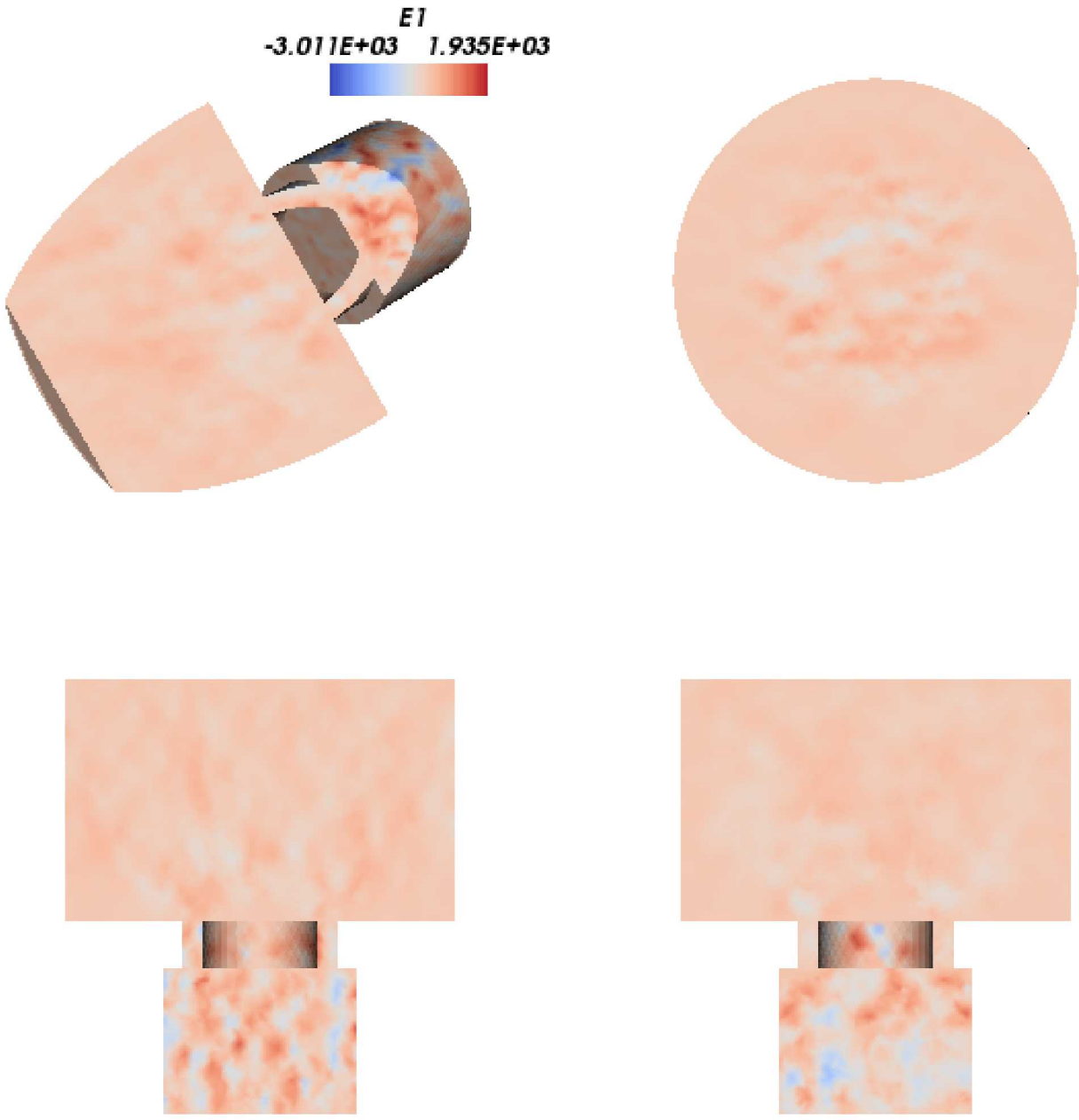

Figure 3.30: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable `E1` (node-based scalar at time 4.993865055e-09)

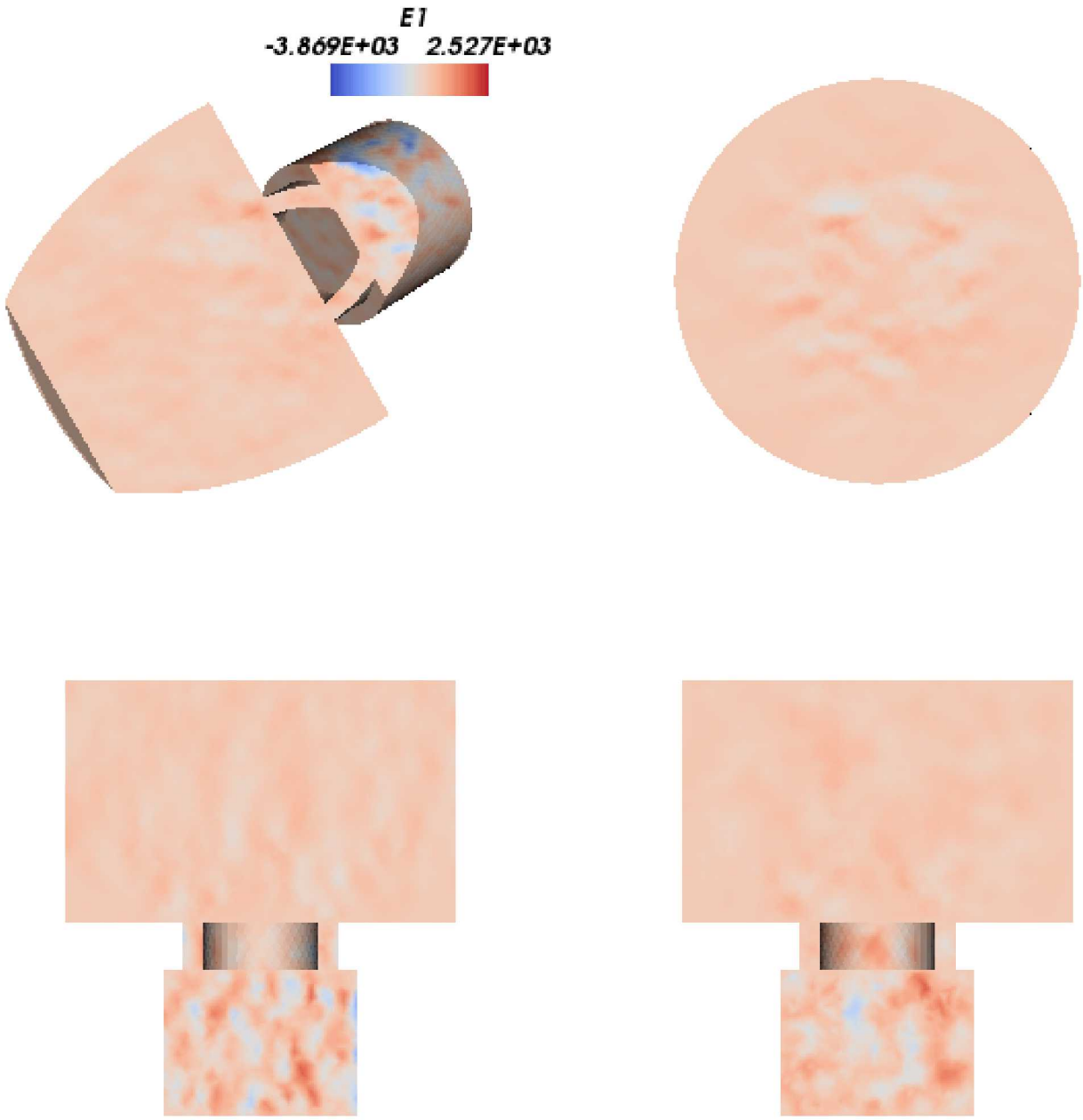

Figure 3.31: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E1`.

Variable E1 (node-based scalar at time 5.54873895e-09)

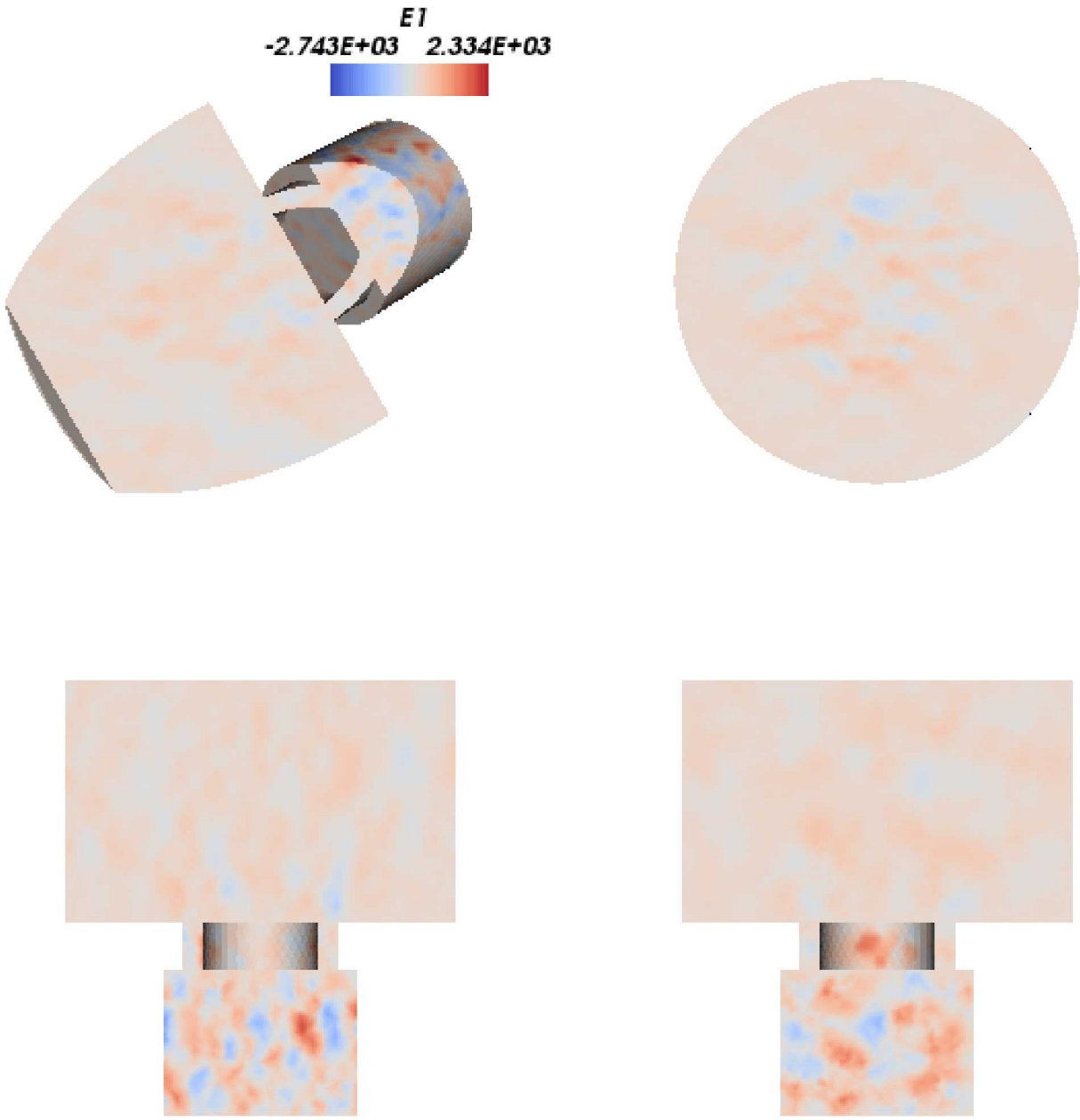

Figure 3.32: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable E1 (node-based scalar at time 6.103612845e-09)

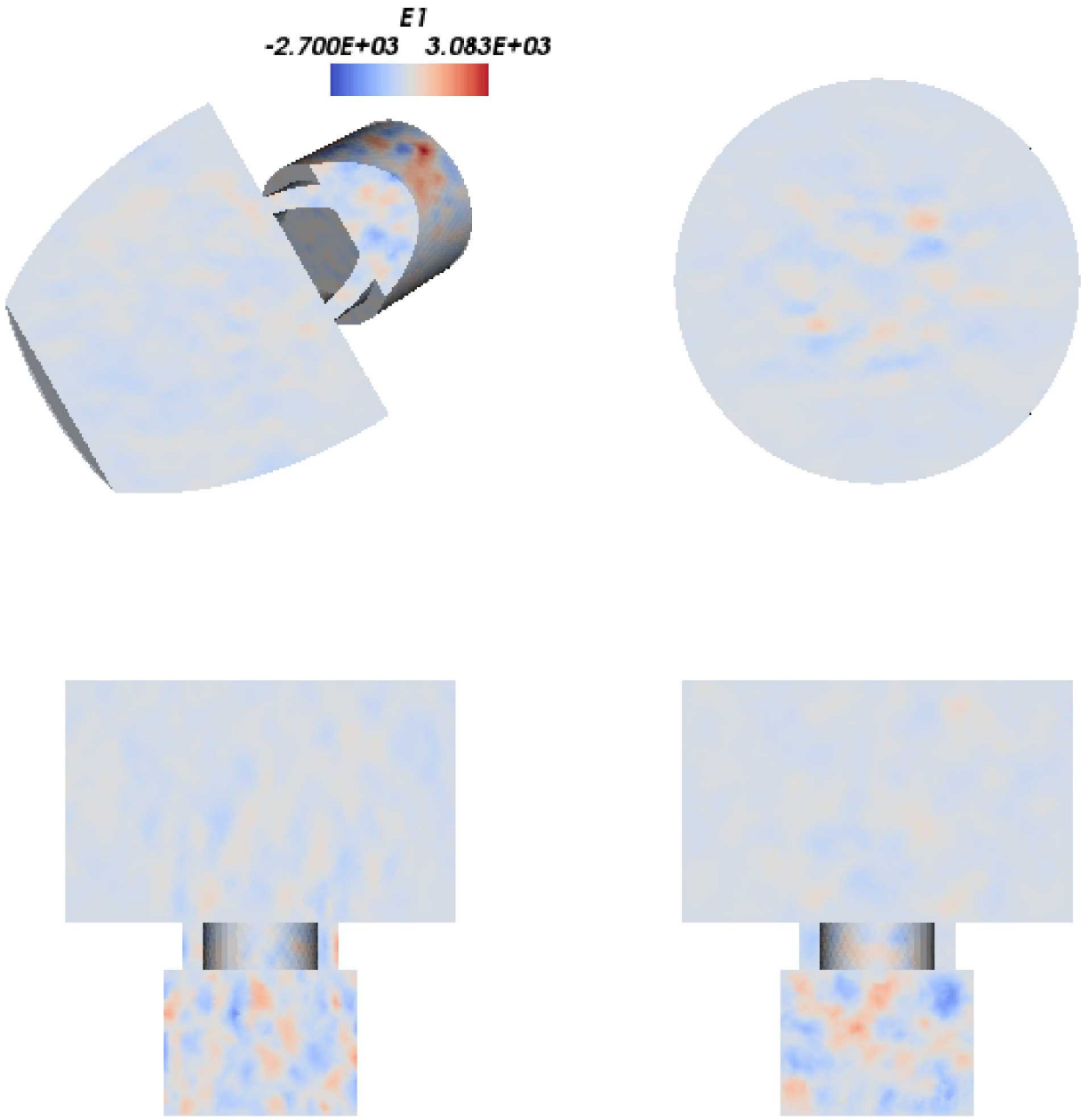

Figure 3.33: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable E1 (node-based scalar at time 6.65848674e-09)

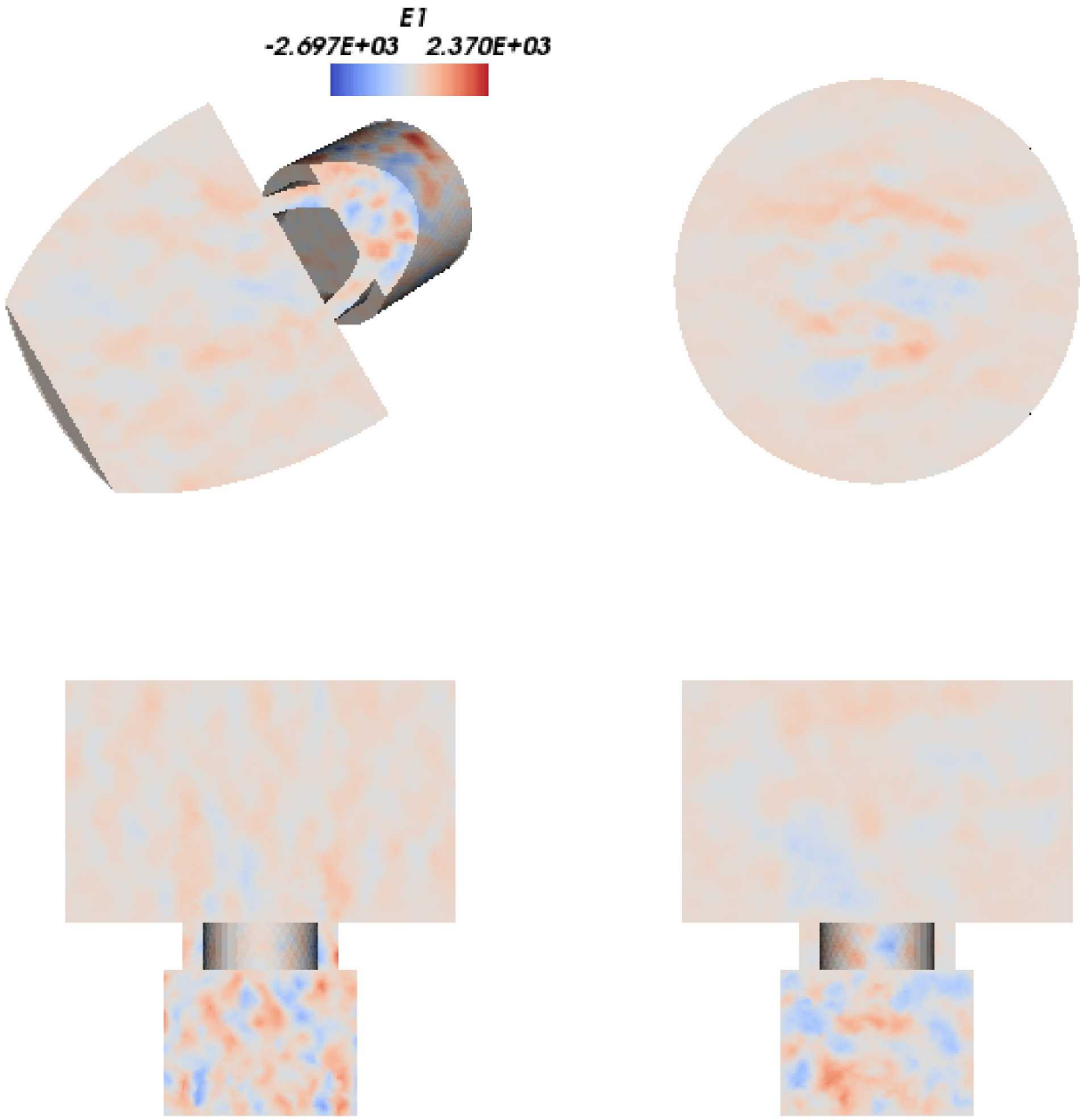

Figure 3.34: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable E1 (node-based scalar at time 7.213360635e-09)

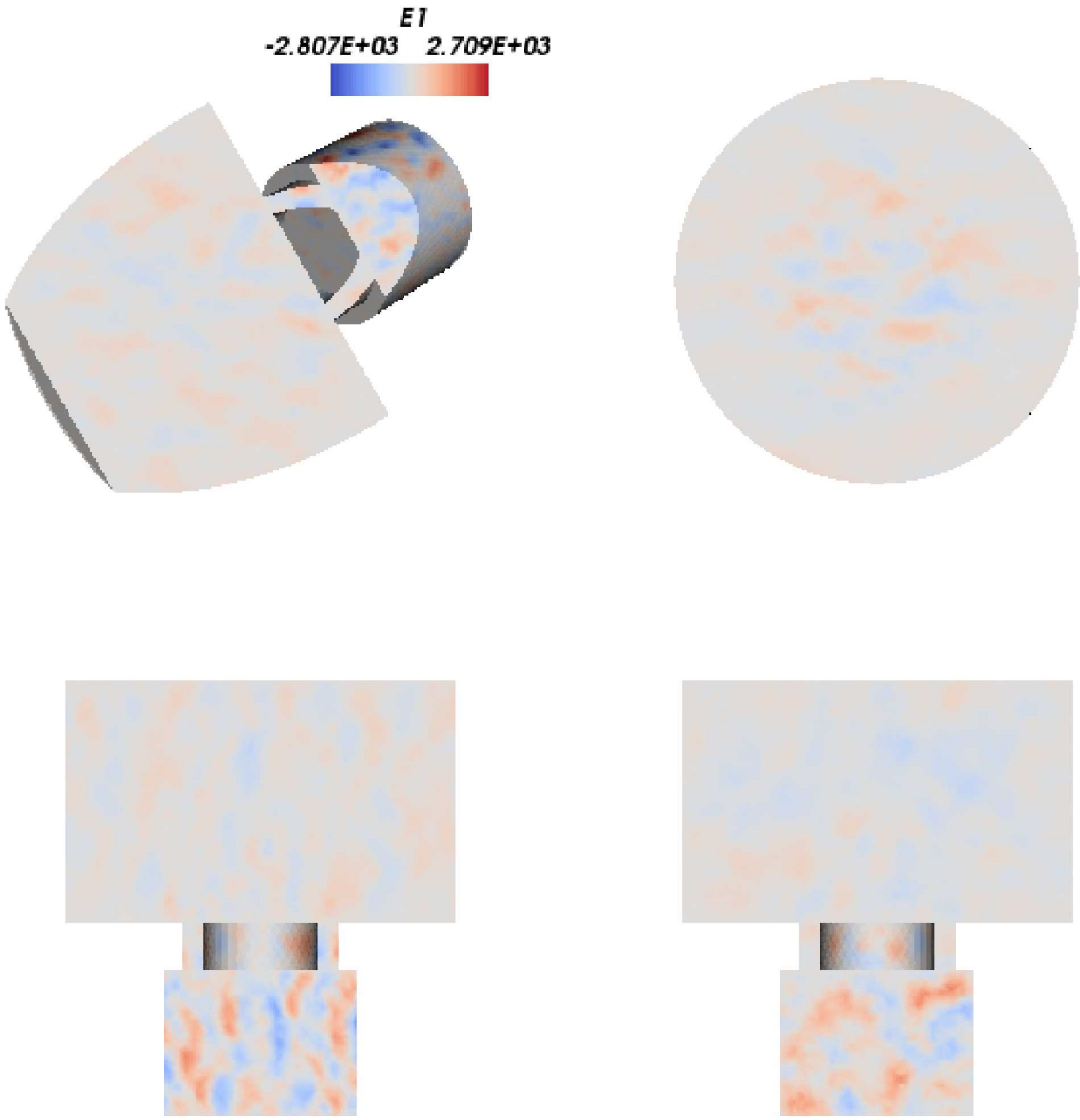

Figure 3.35: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable `E1` (node-based scalar at time 7.76823453e-09)

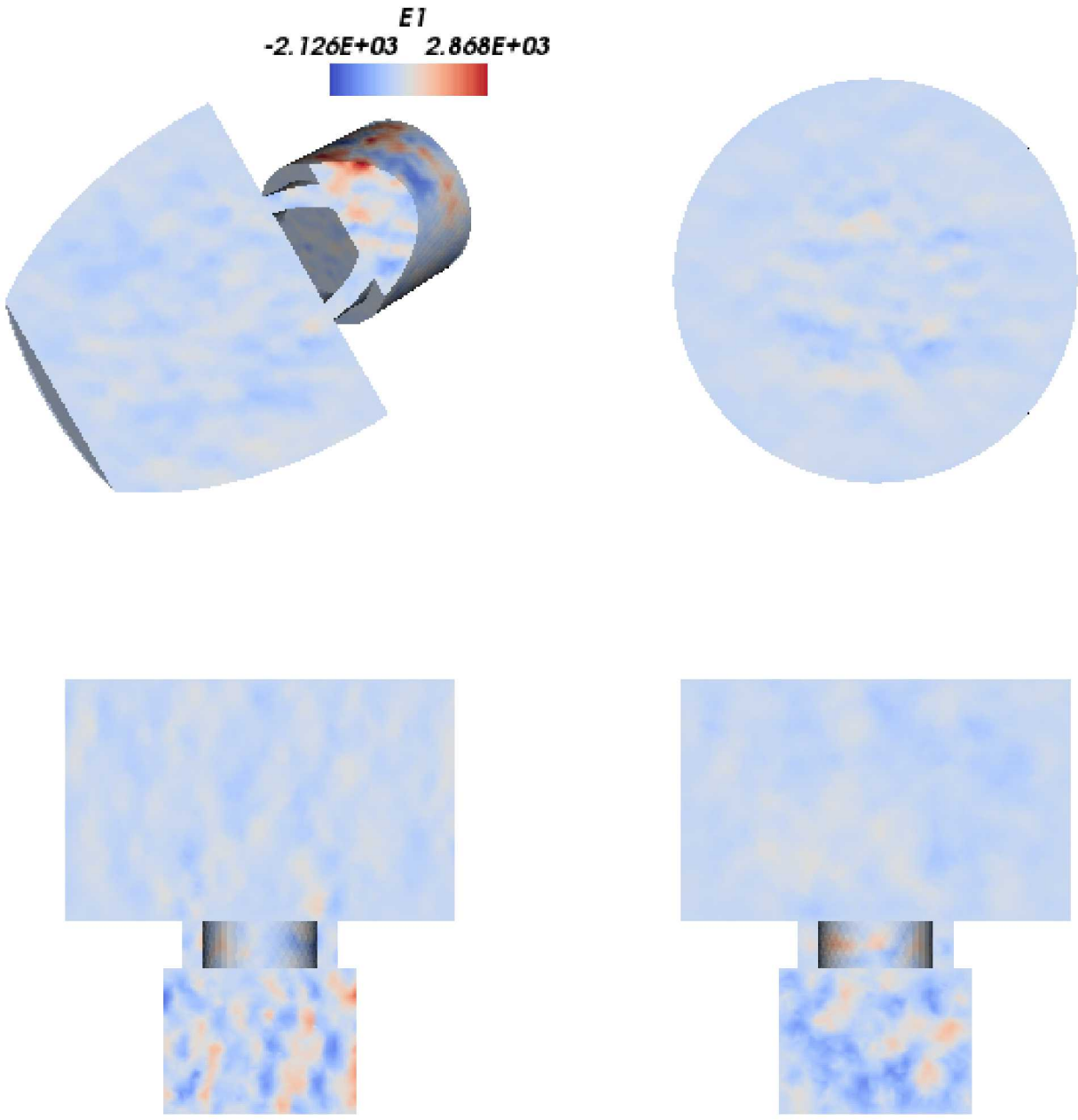

Figure 3.36: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E1`.

Variable E1 (node-based scalar at time 8.323108425e-09)

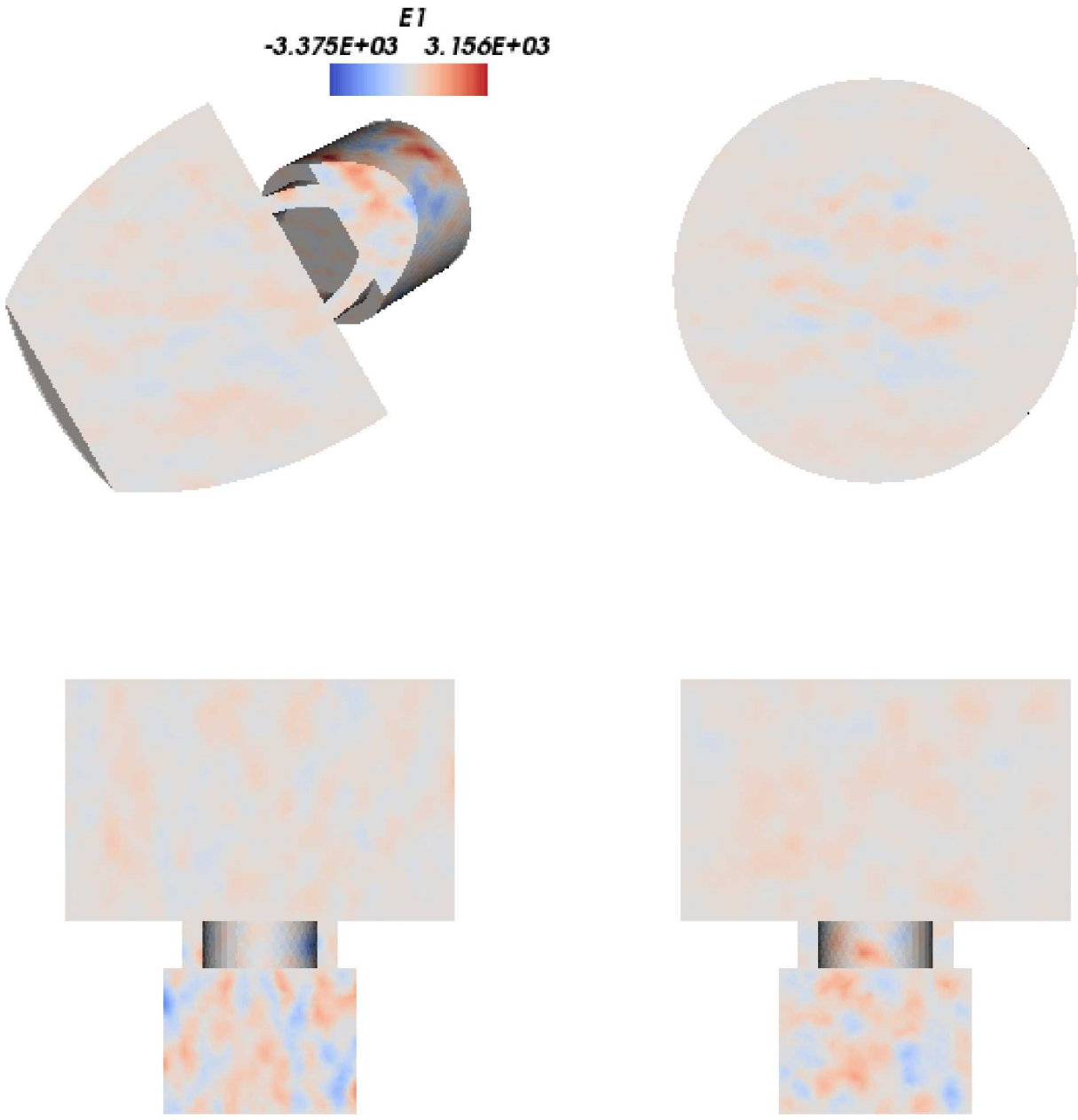

Figure 3.37: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable E1 (node-based scalar at time 8.87798232e-09)

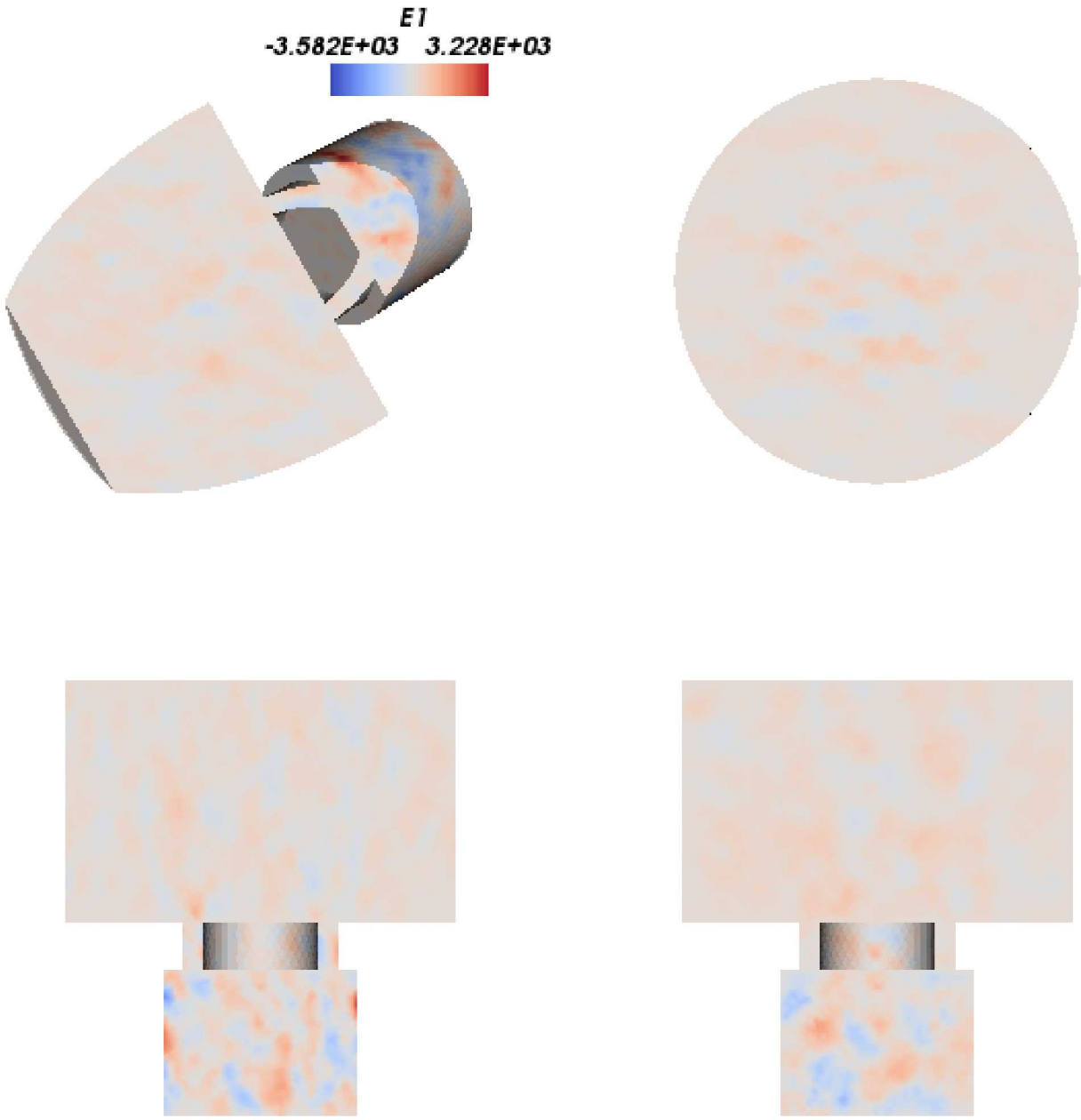

Figure 3.38: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable E1 (node-based scalar at time 9.432856215e-09)

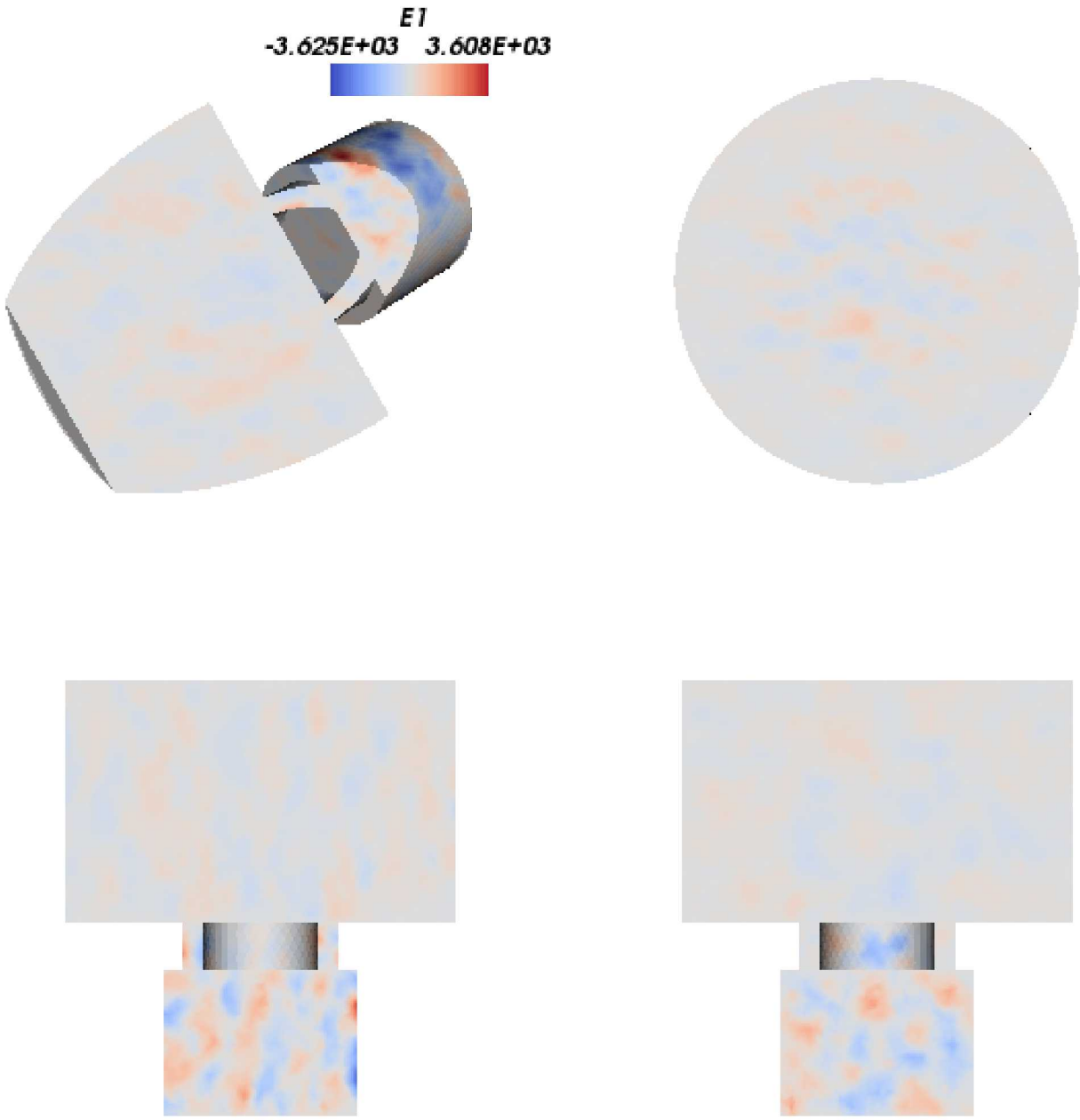

Figure 3.39: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable E1 (node-based scalar at time 9.98773011e-09)

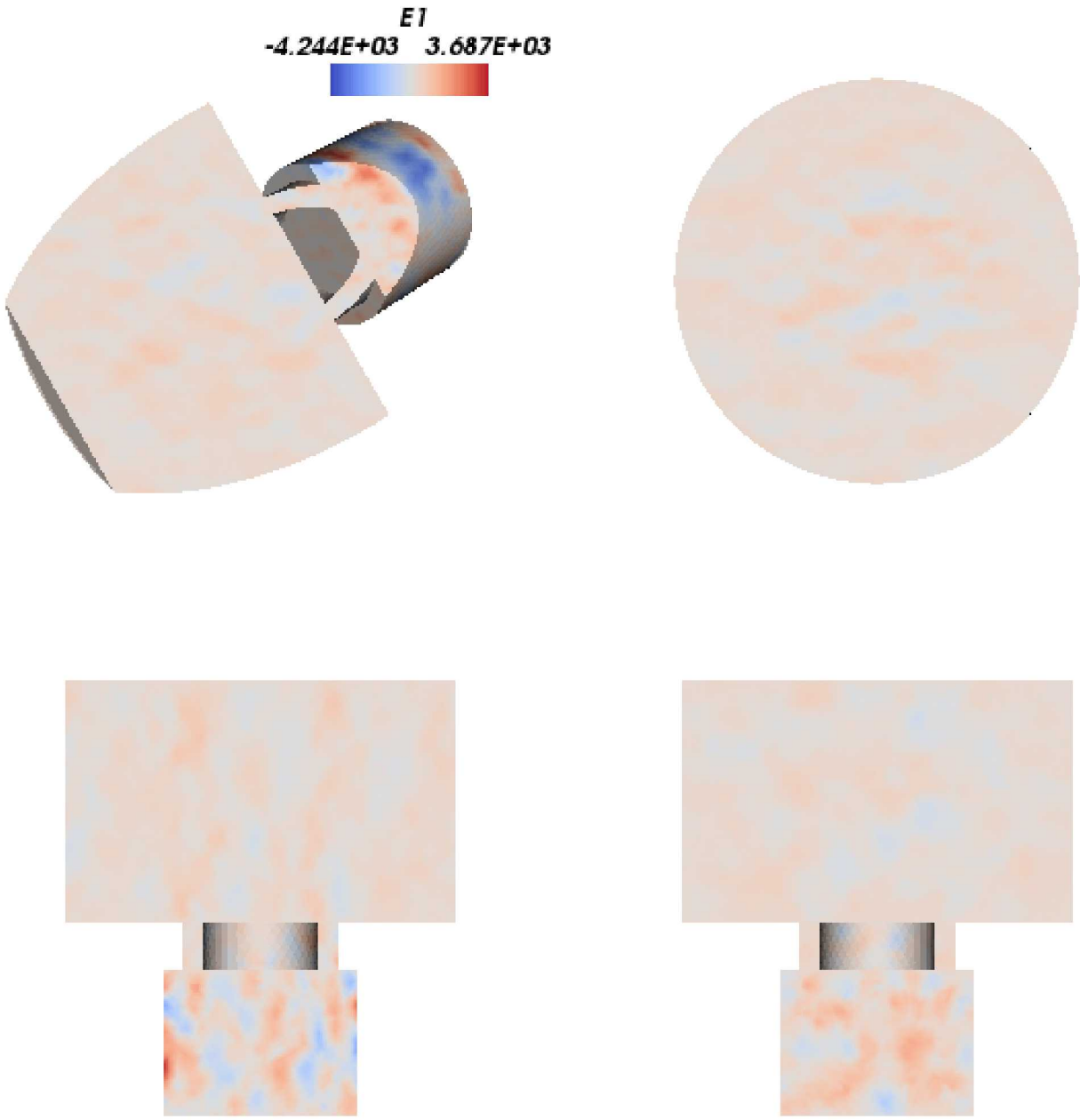

Figure 3.40: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E1.

Variable `E1` (node-based scalar at time 1.0542604005e-08)

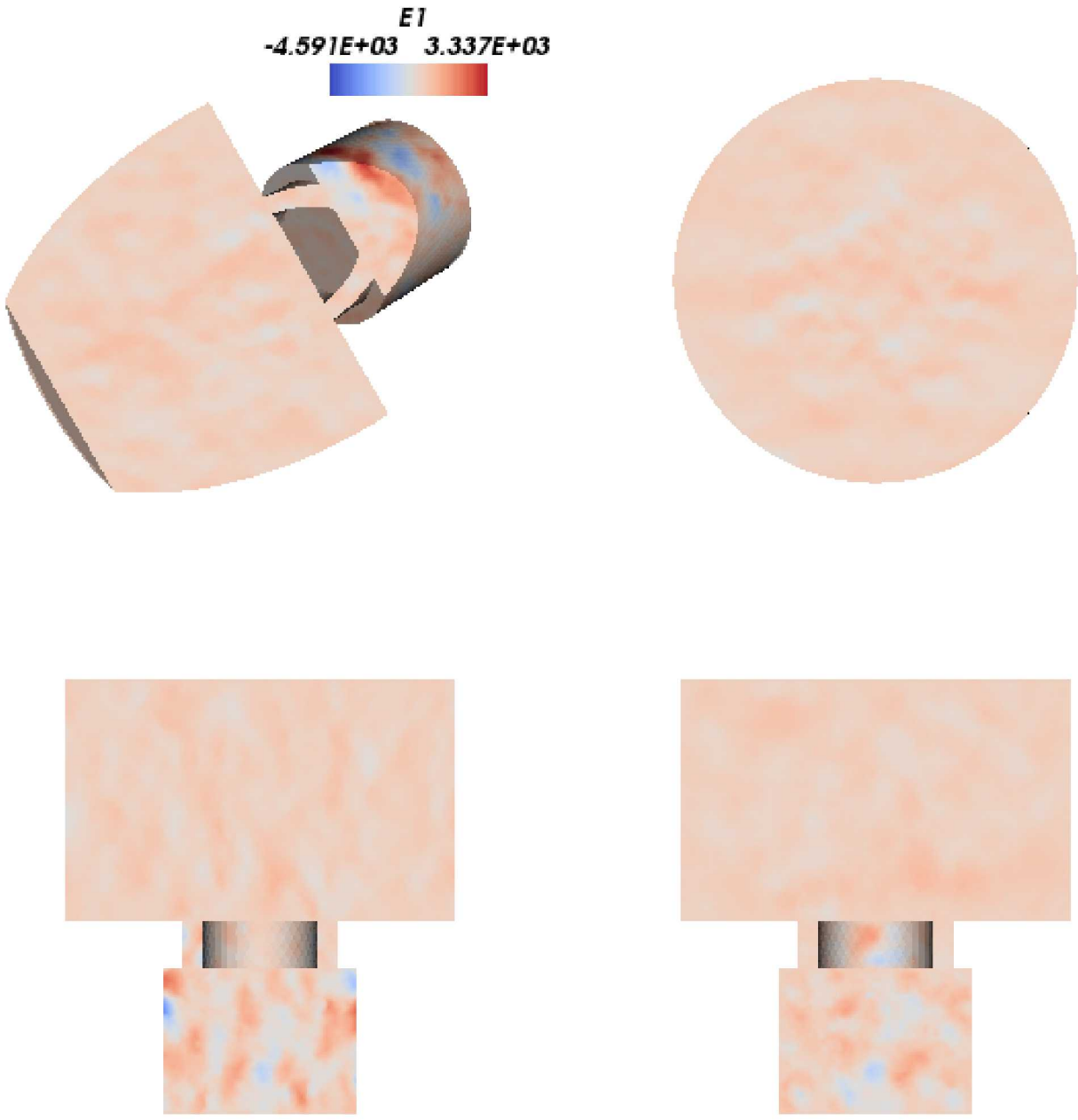

Figure 3.41: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E1`.

Variable `E1` (node-based scalar at time 1.10974779e-08)

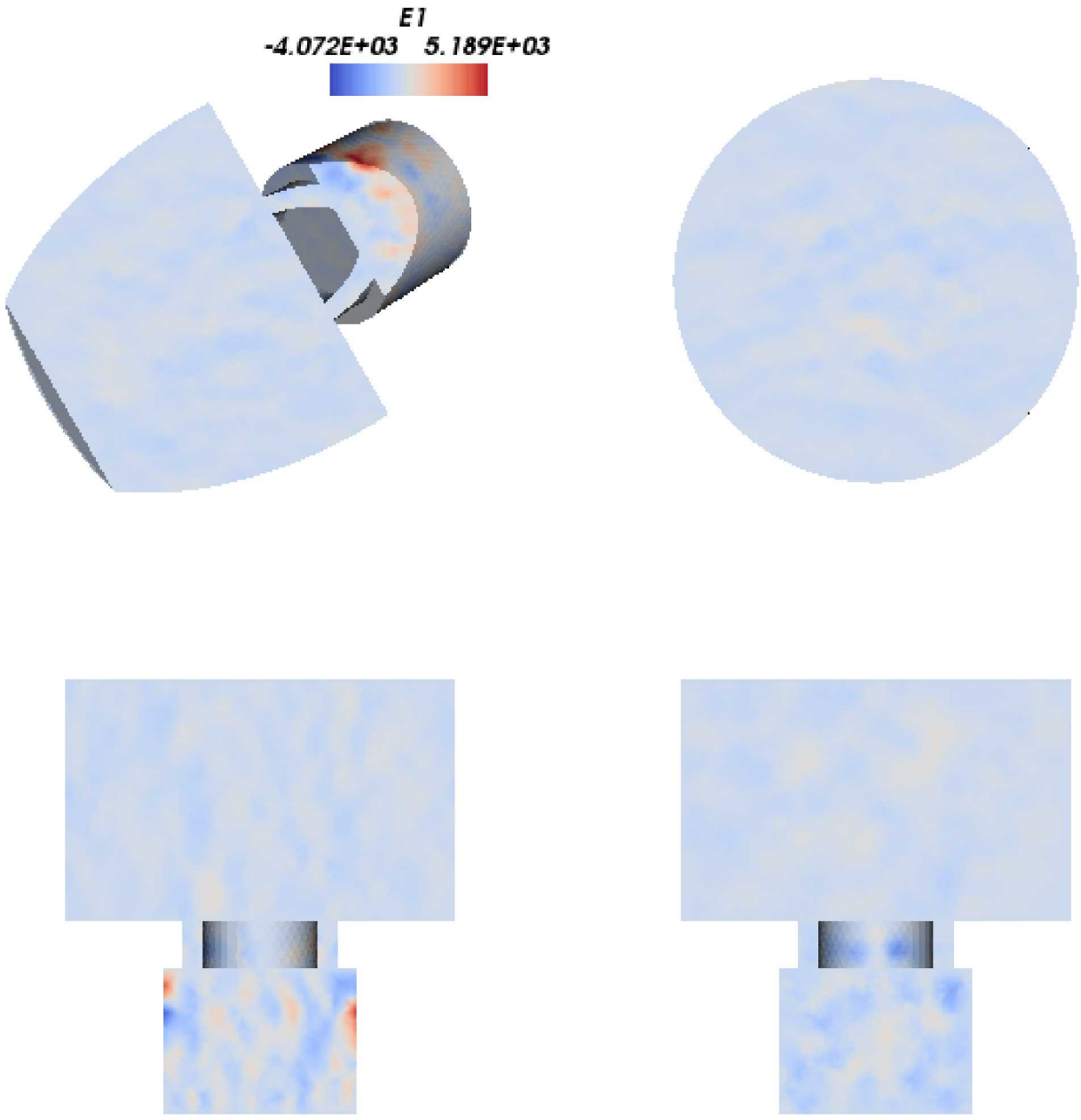

Figure 3.42: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by `E1`.

Variable E2 (node-based scalar at time 0.0)

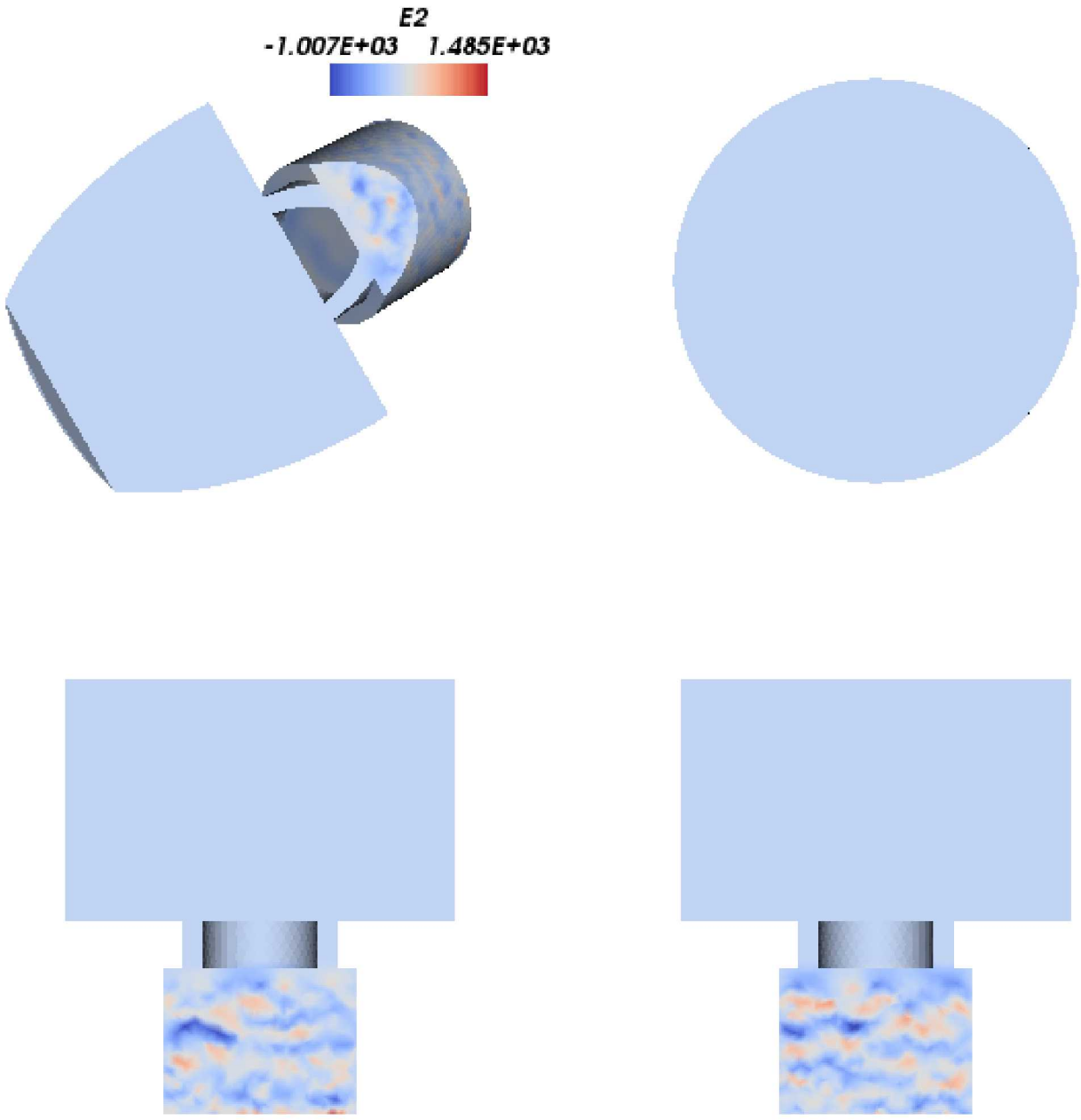

Figure 3.43: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 5.54873895e-10)

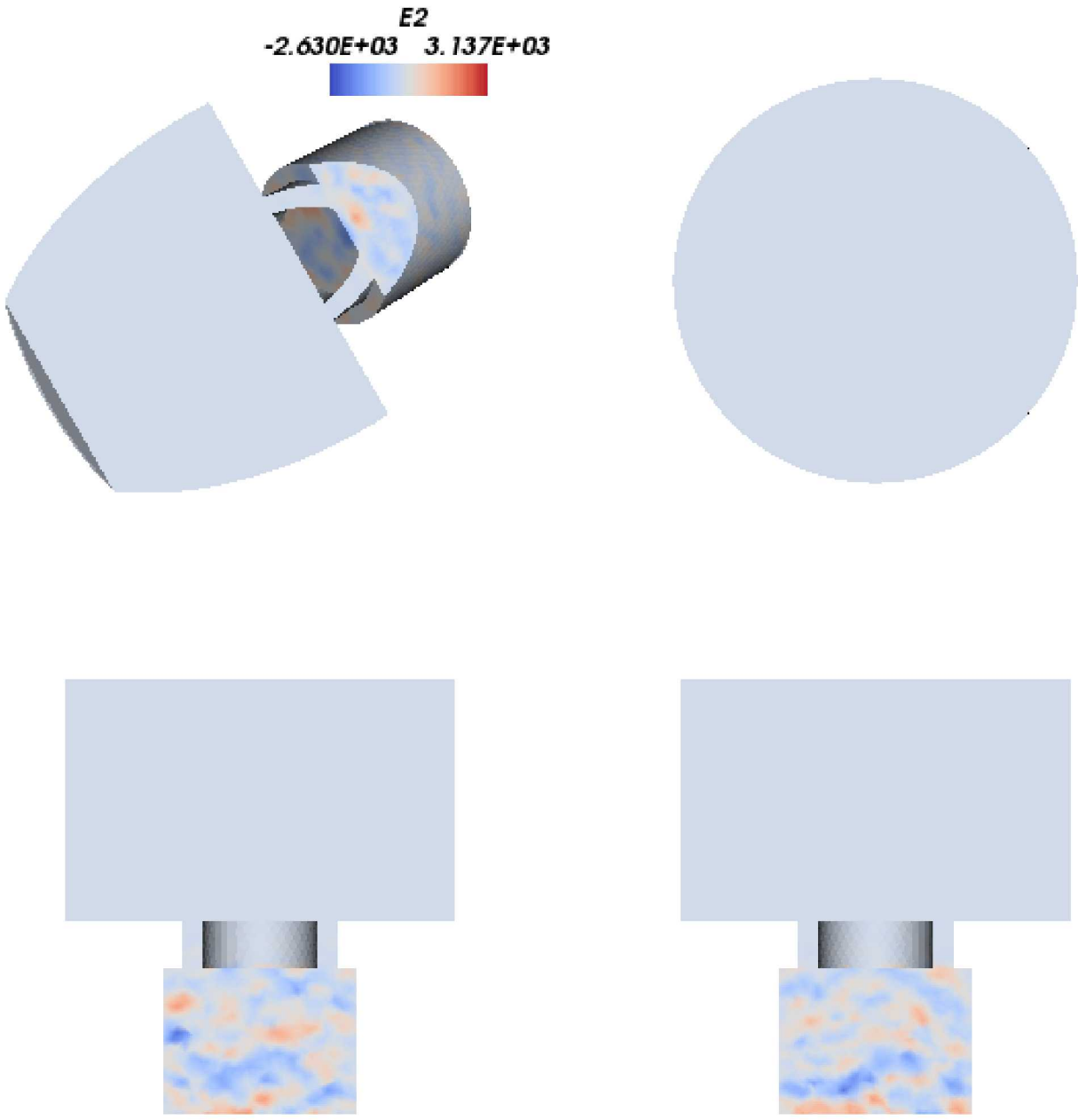

Figure 3.44: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 1.10974779e-09)

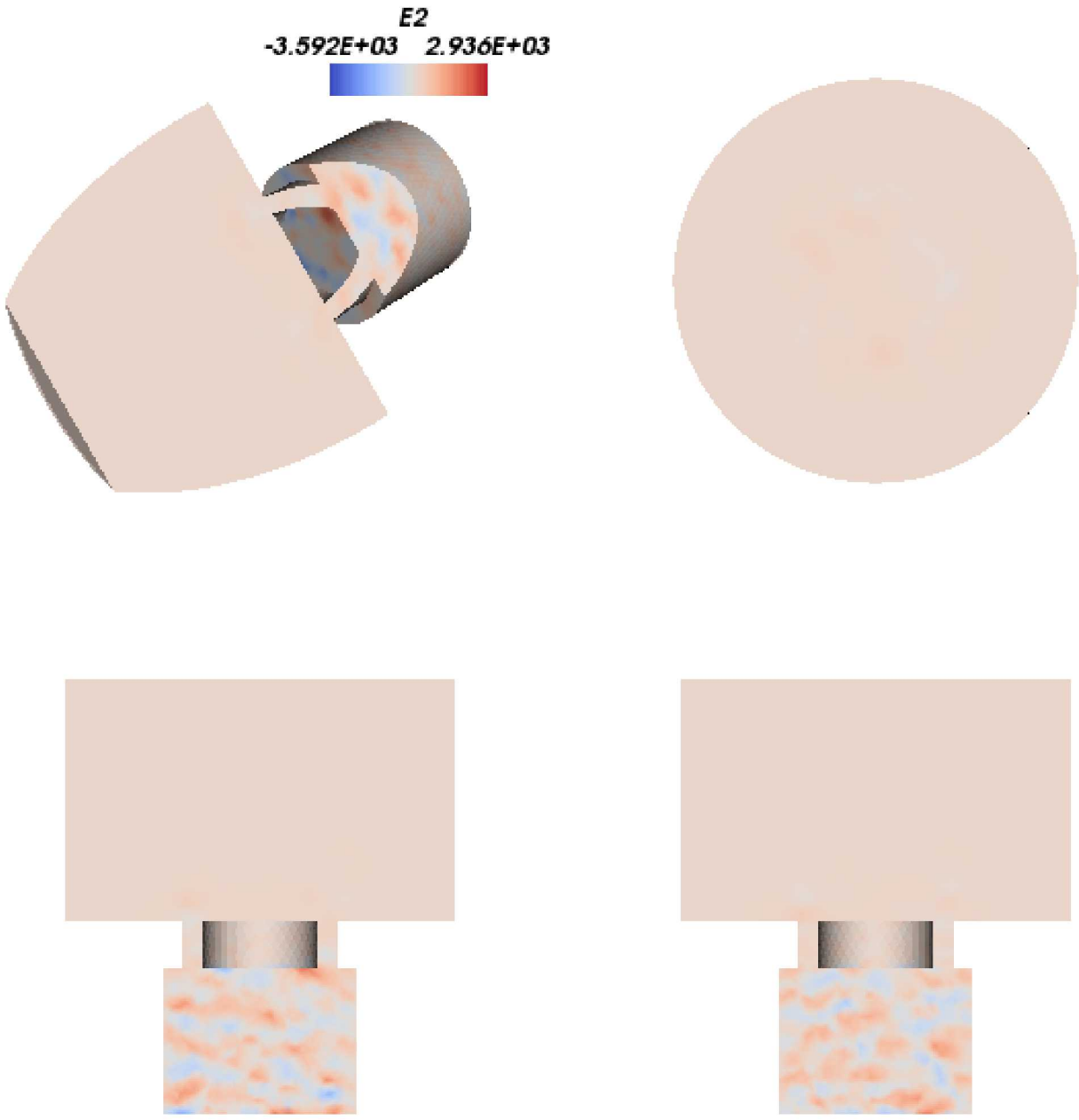

Figure 3.45: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 1.664621685e-09)

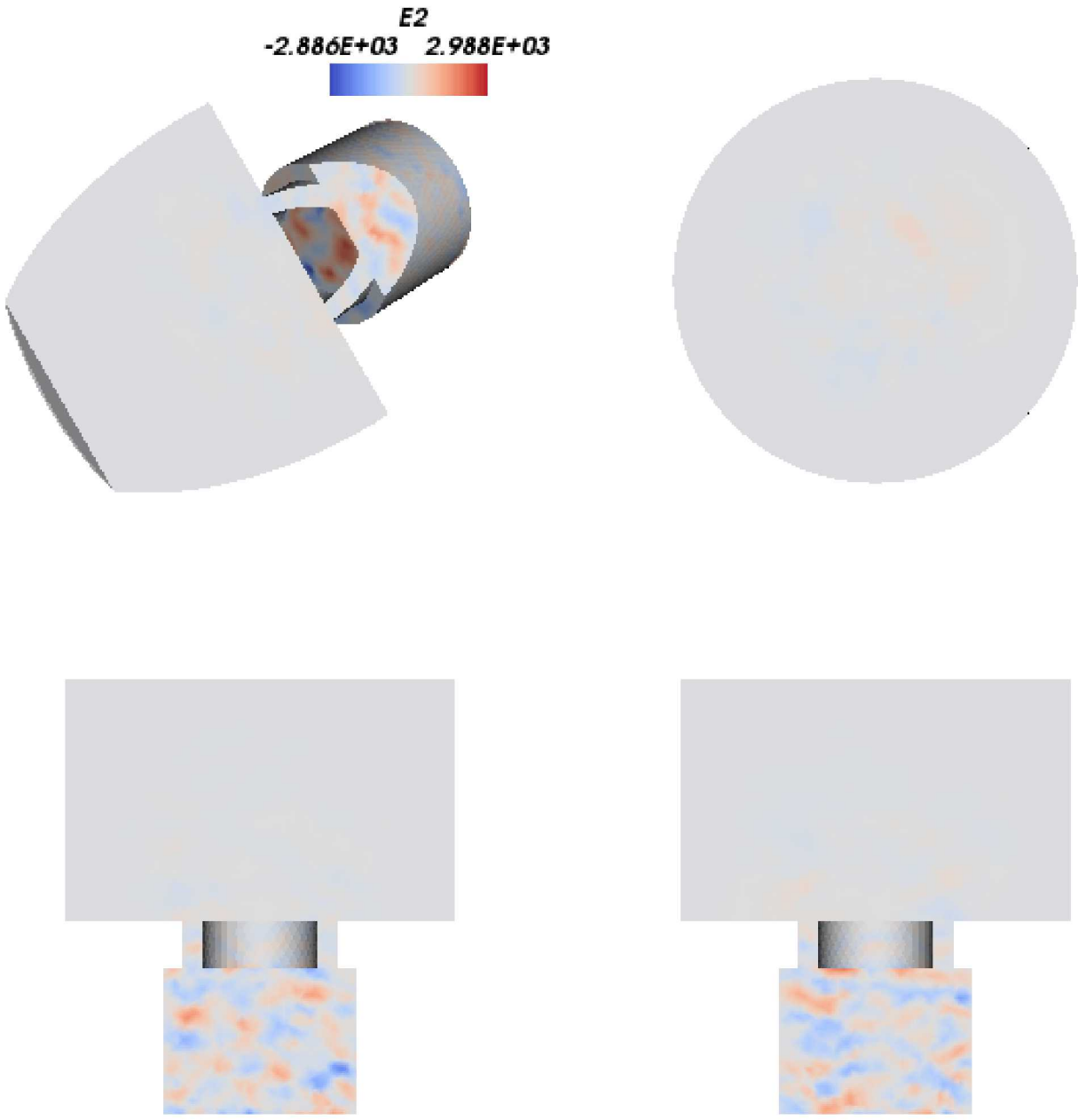

Figure 3.46: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 2.21949558e-09)

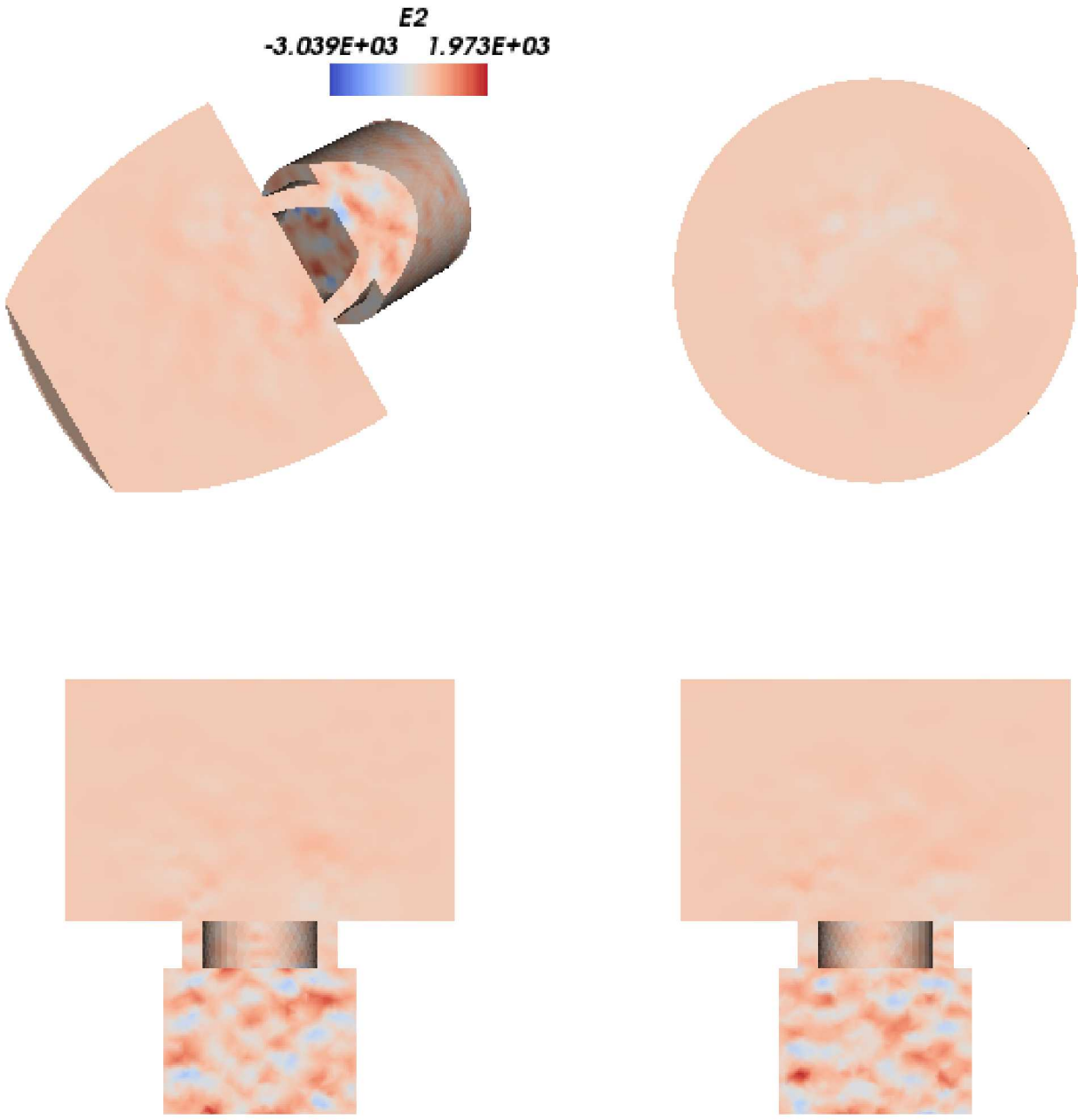

Figure 3.47: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 2.774369475e-09)

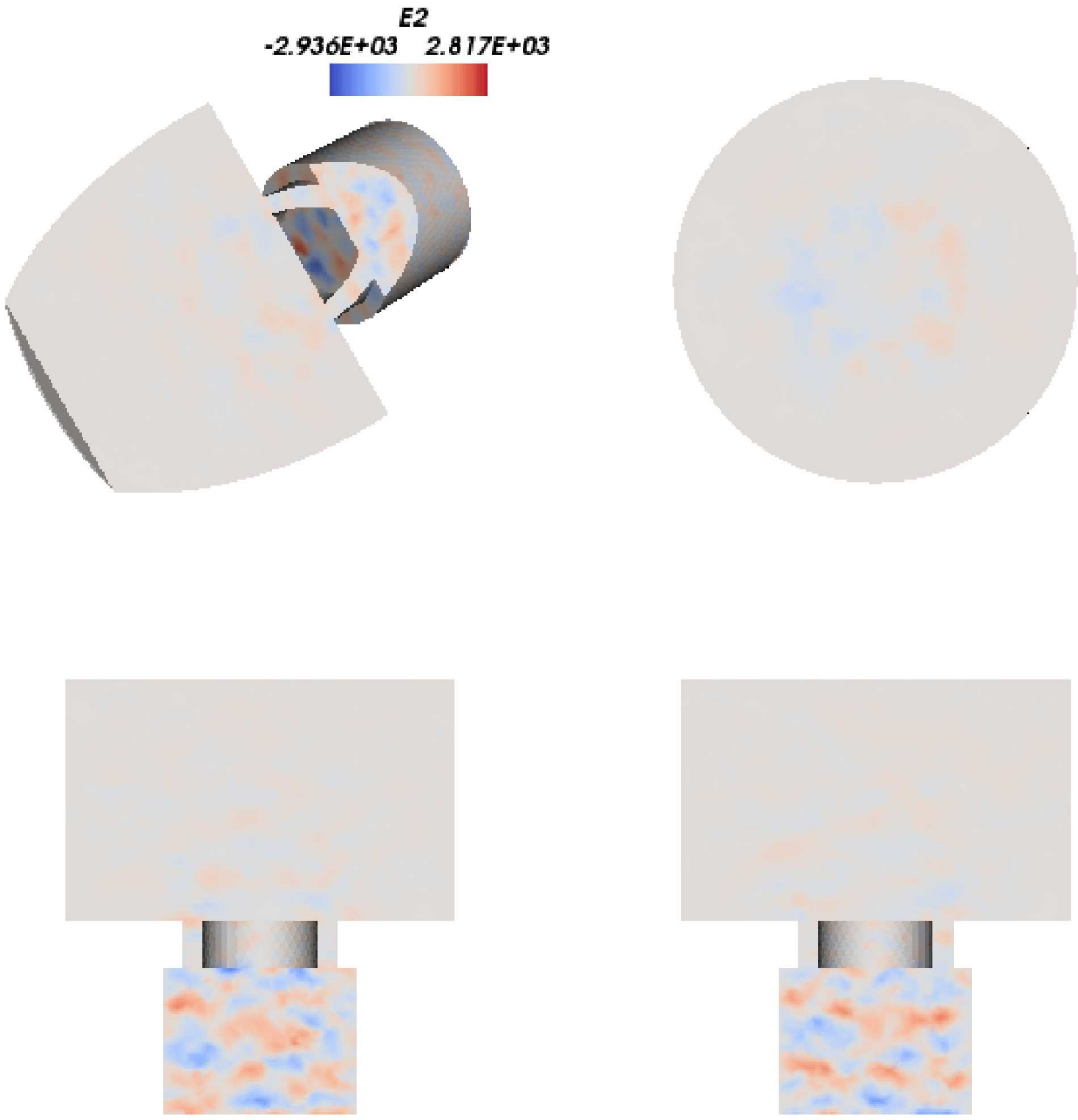

Figure 3.48: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 3.32924337e-09)

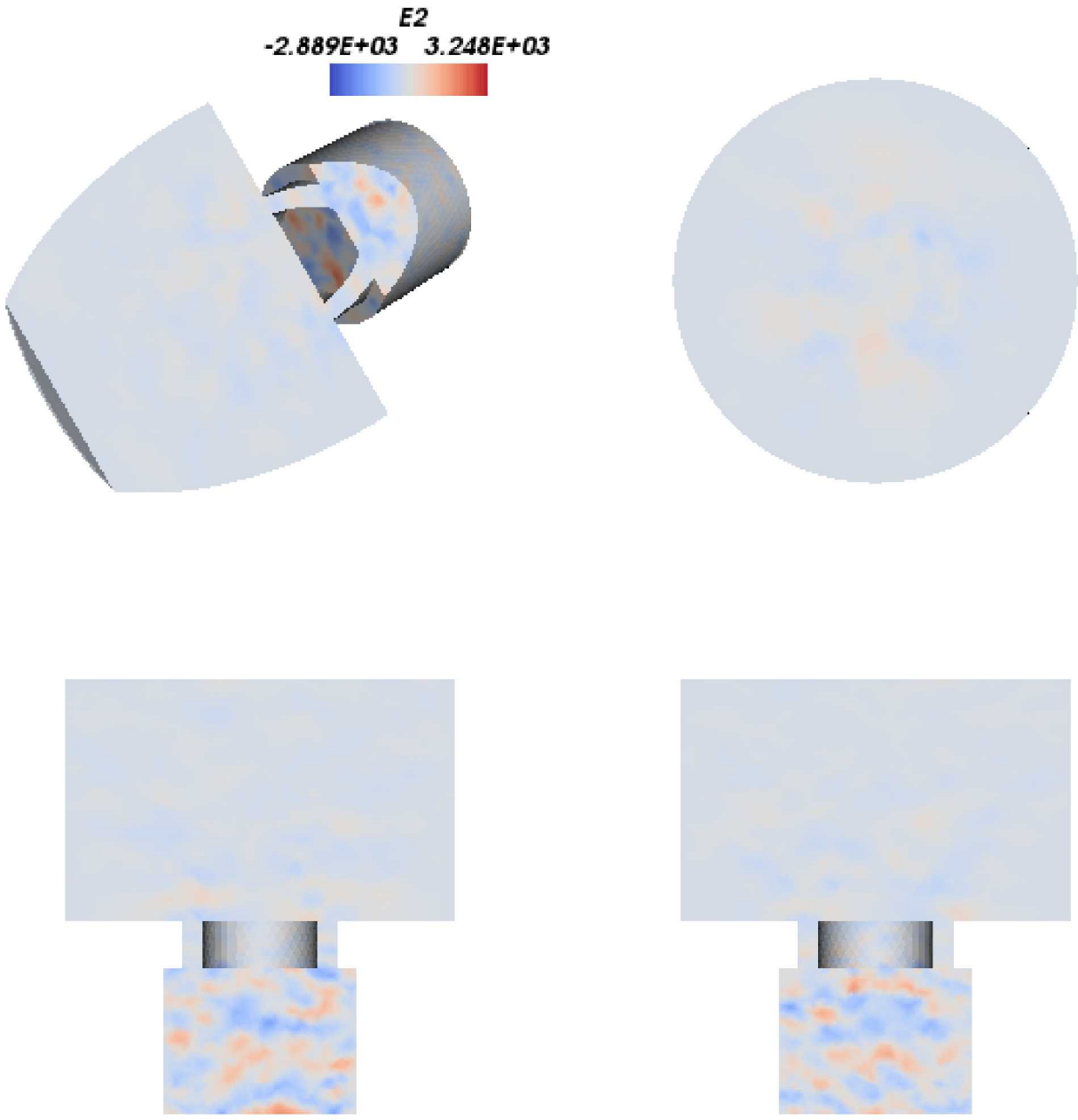

Figure 3.49: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 3.884117265e-09)

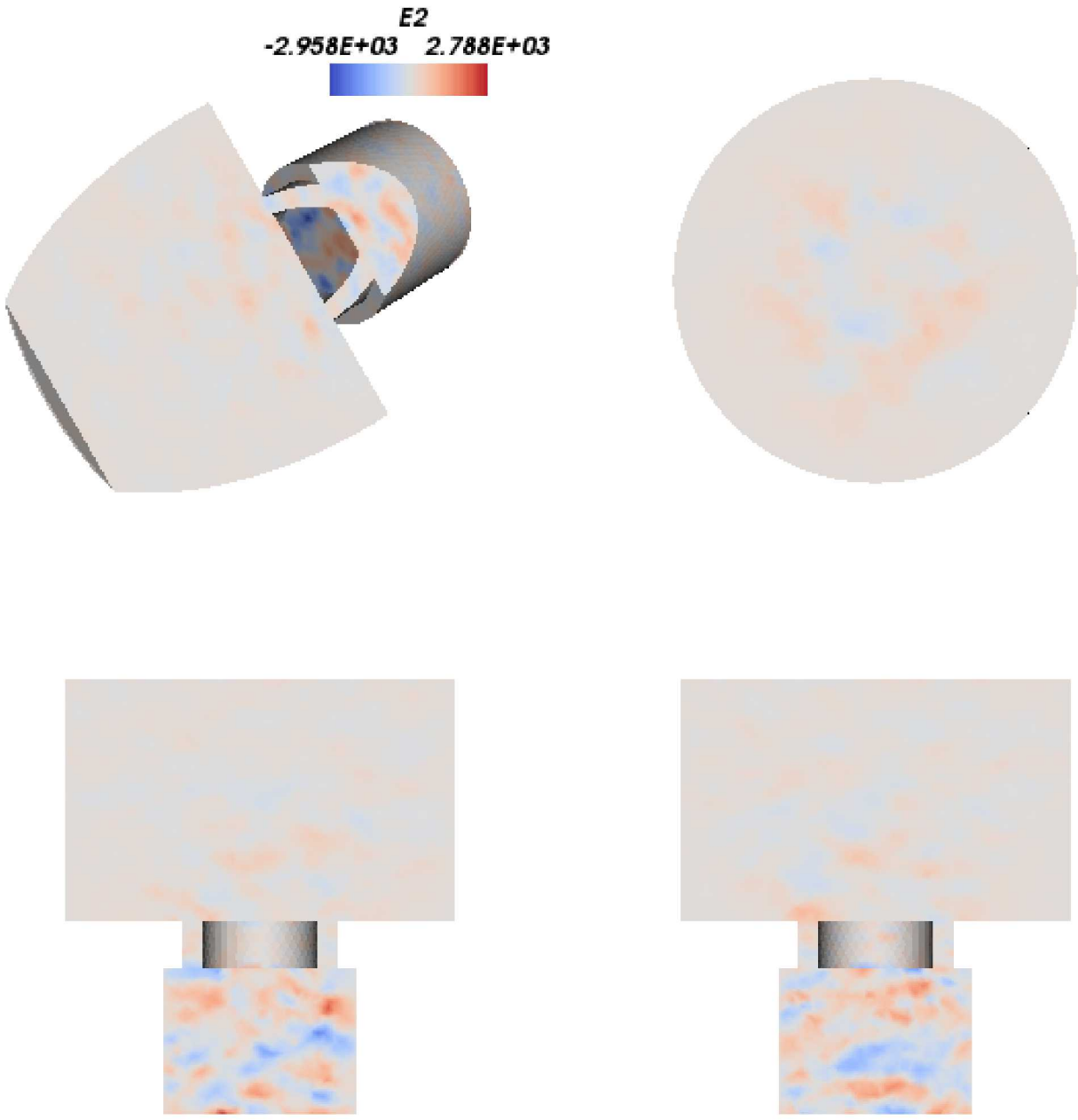

Figure 3.50: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 4.43899116e-09)

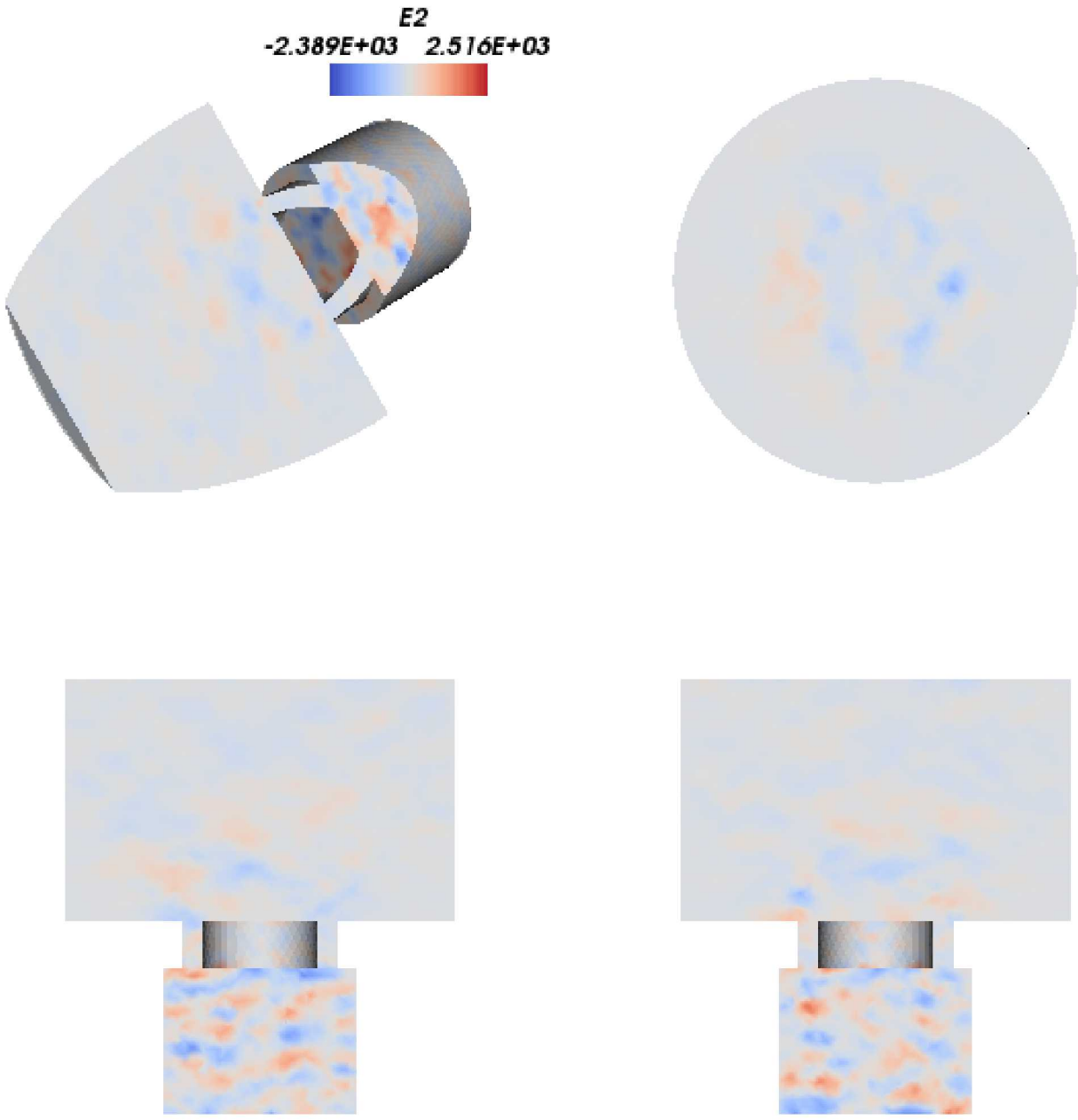

Figure 3.51: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 4.993865055e-09)

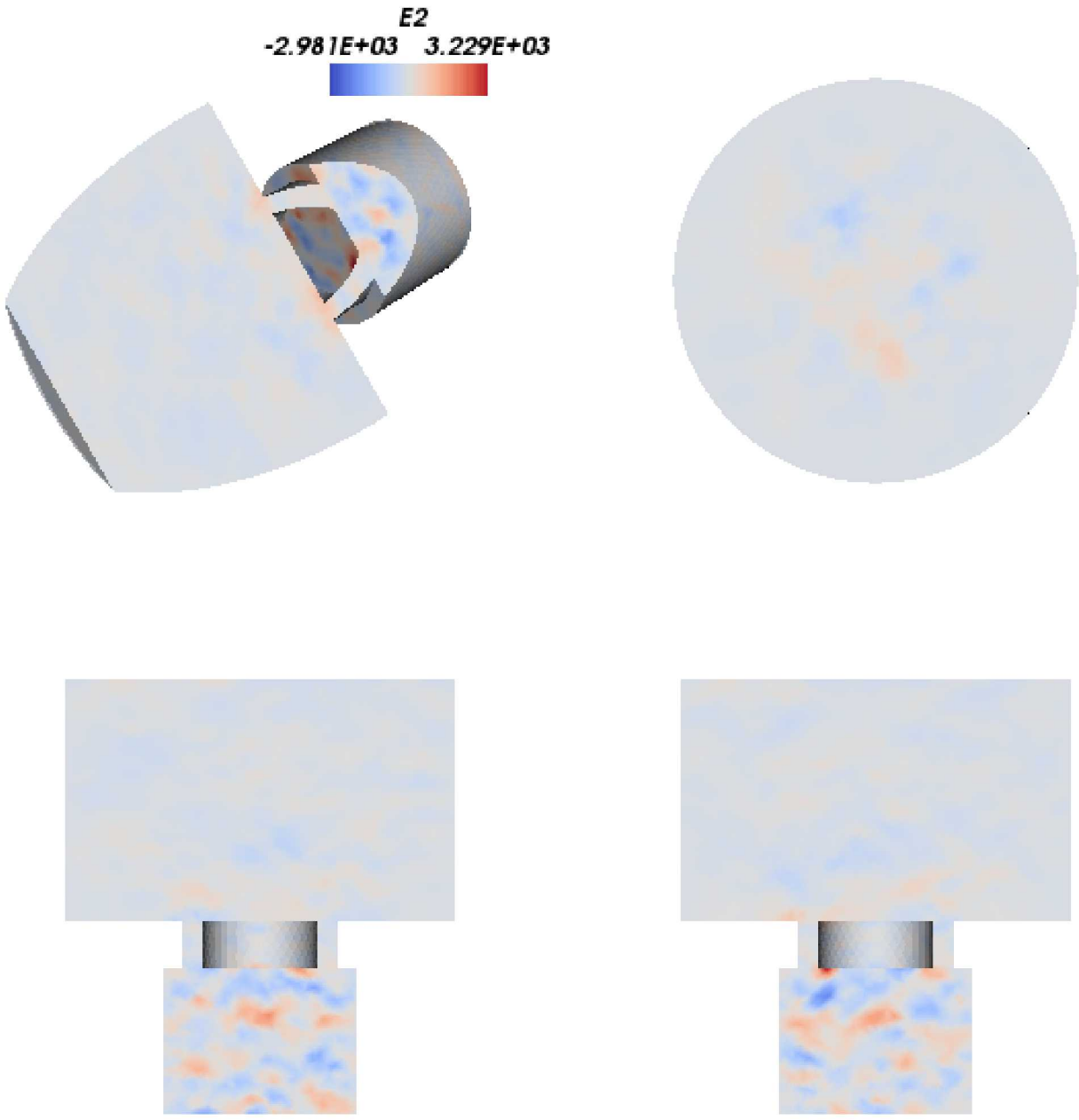

Figure 3.52: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 5.54873895e-09)

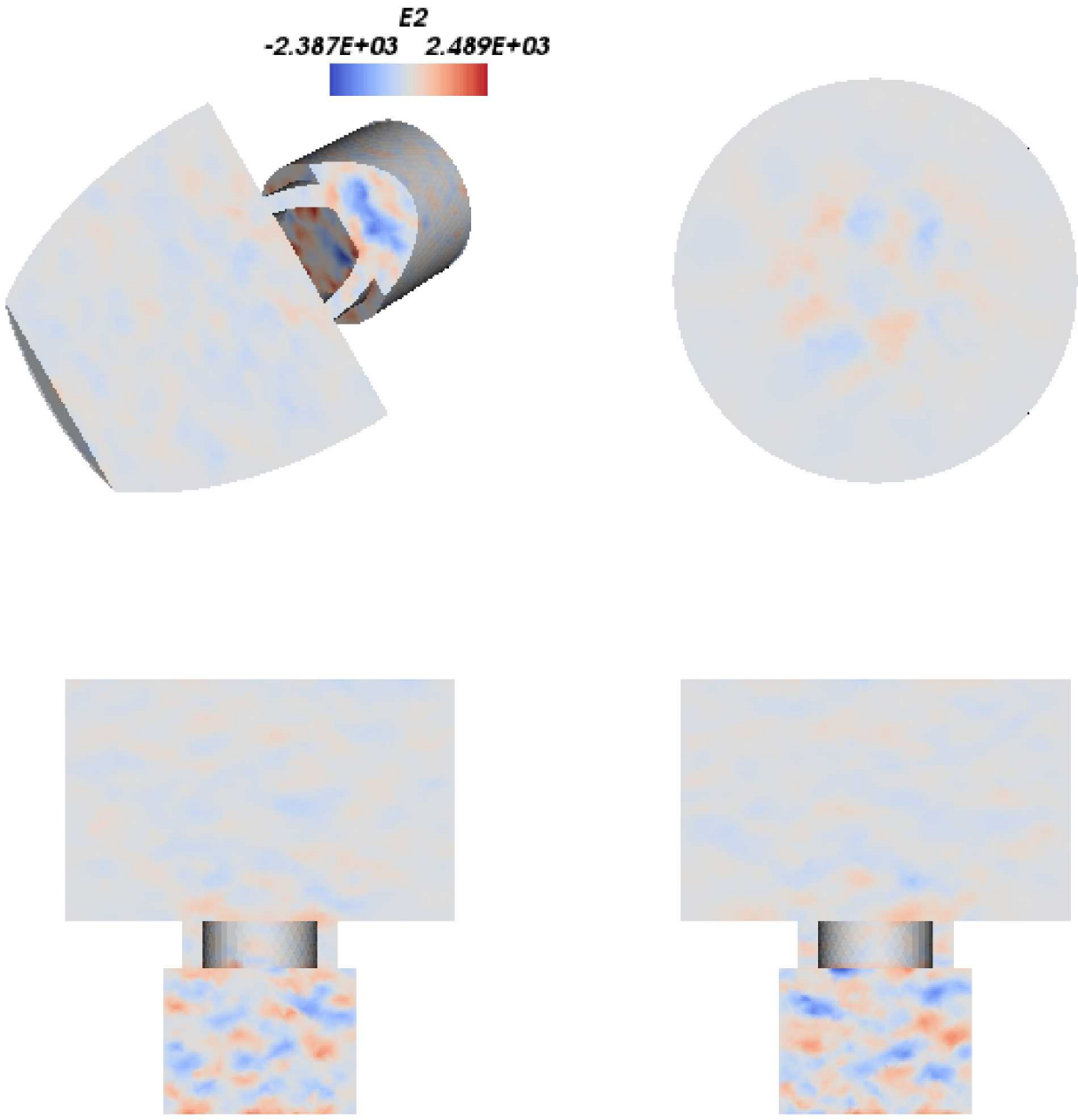

Figure 3.53: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 6.103612845e-09)

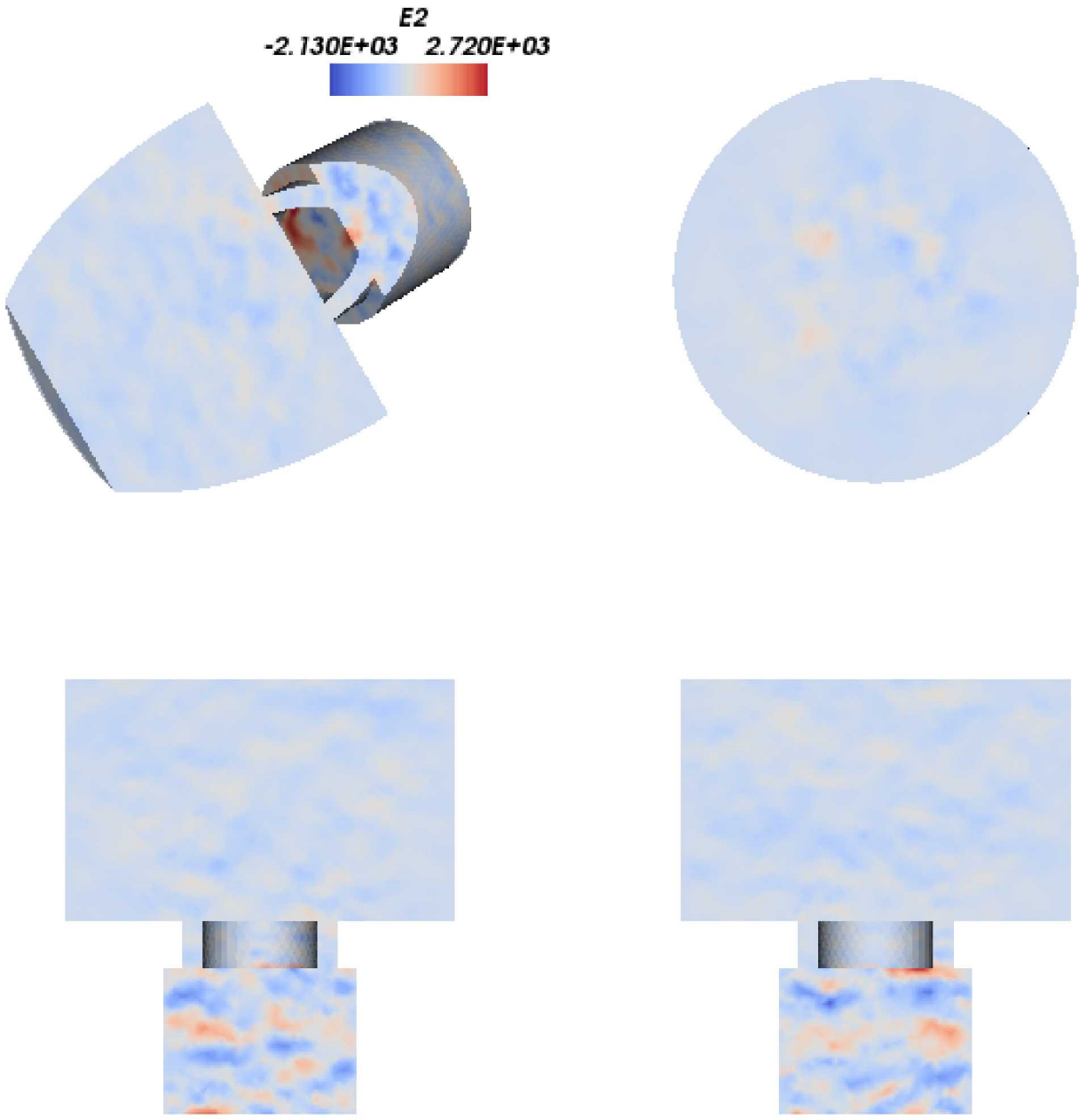

Figure 3.54: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 6.65848674e-09)

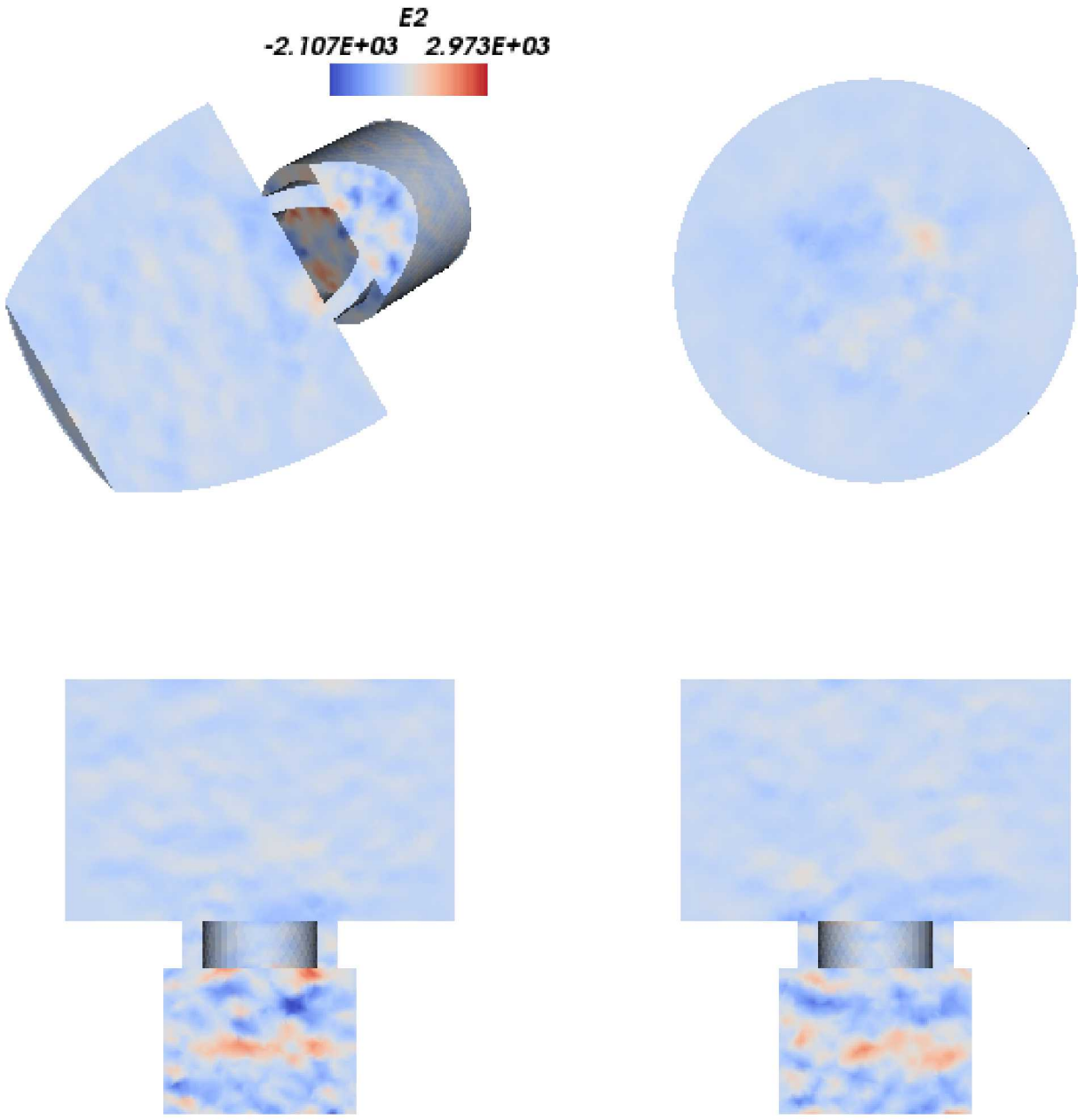

Figure 3.55: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 7.213360635e-09)

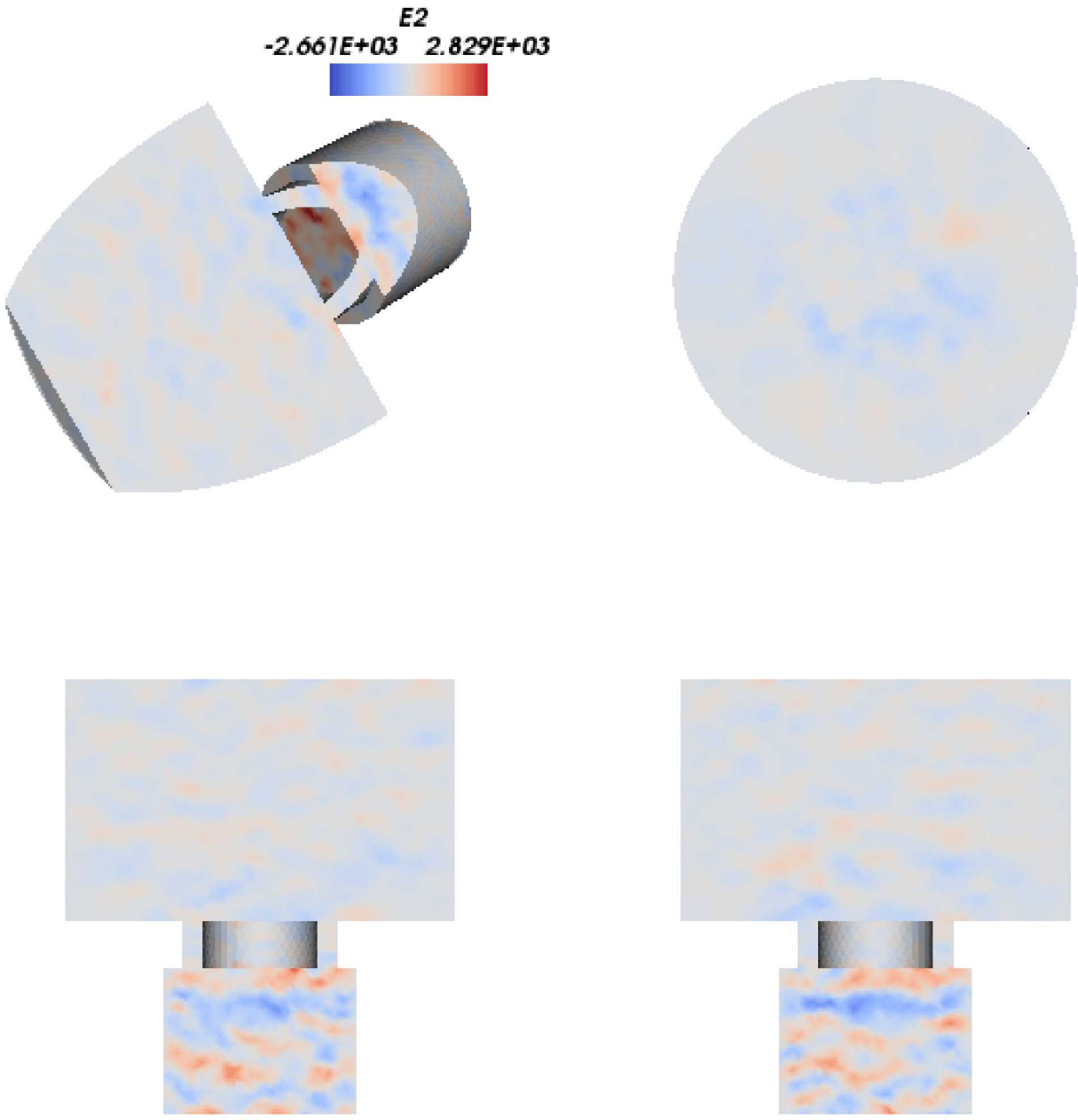

Figure 3.56: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 7.76823453e-09)

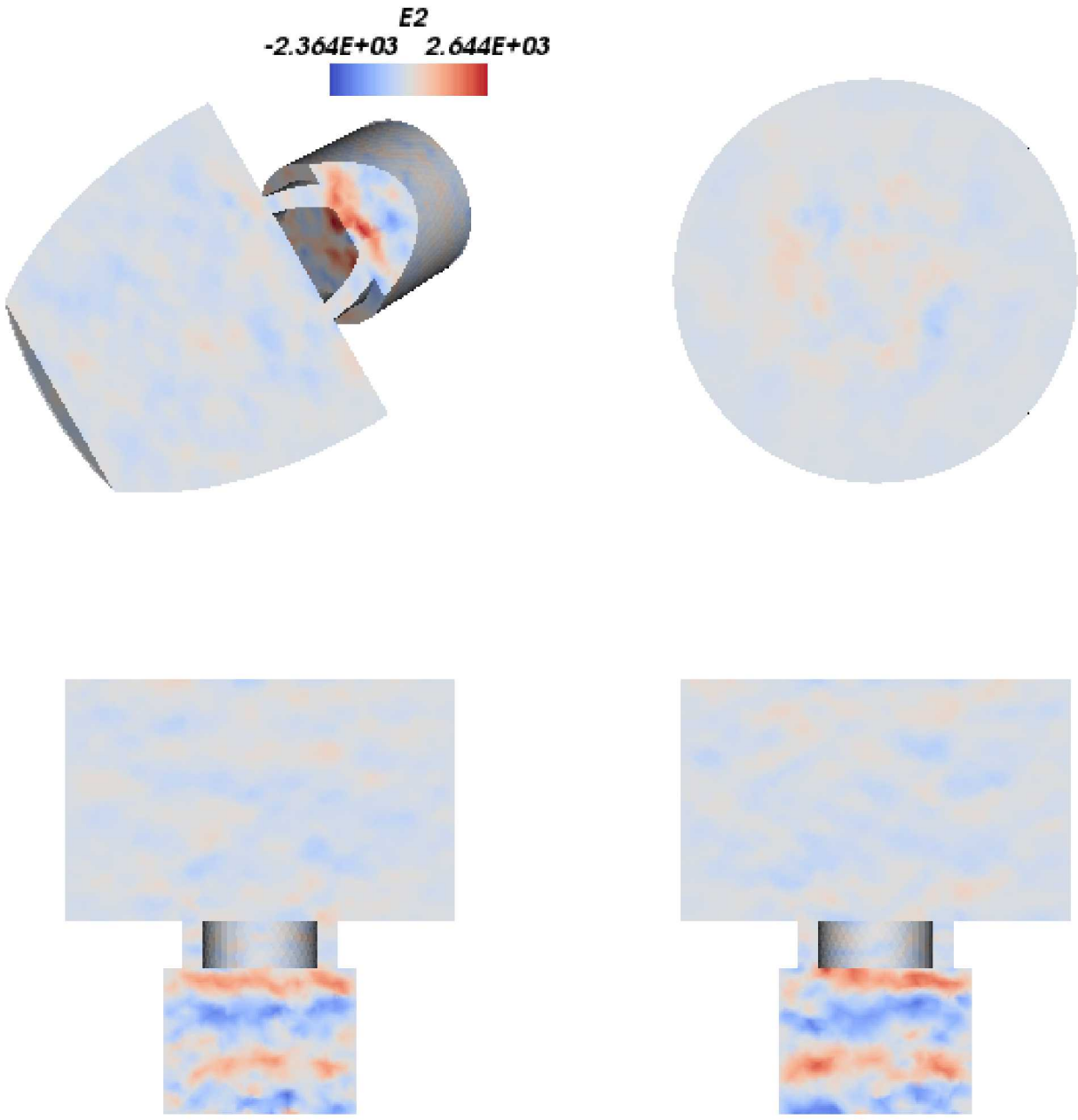

Figure 3.57: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 8.323108425e-09)

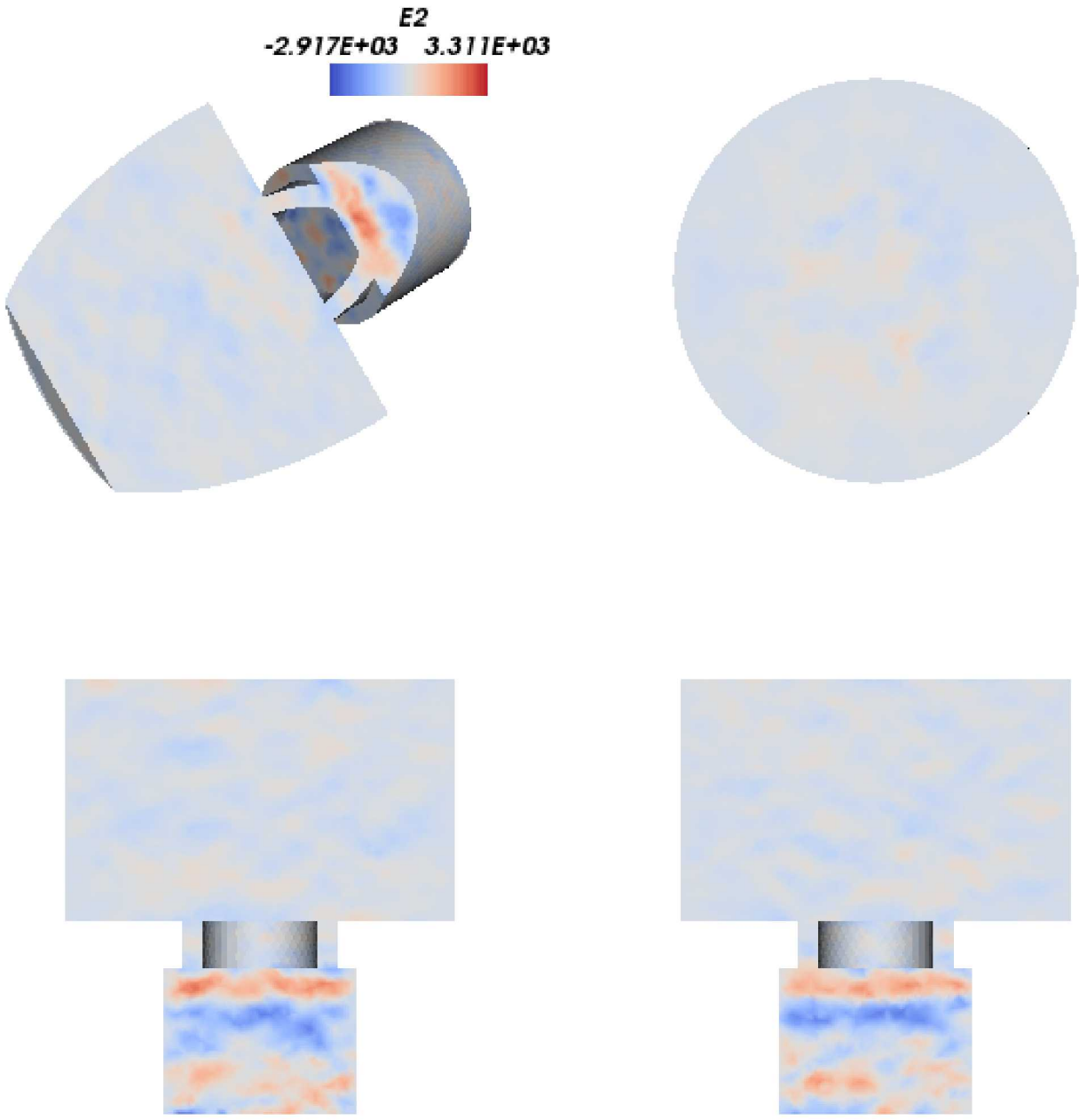

Figure 3.58: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 8.87798232e-09)

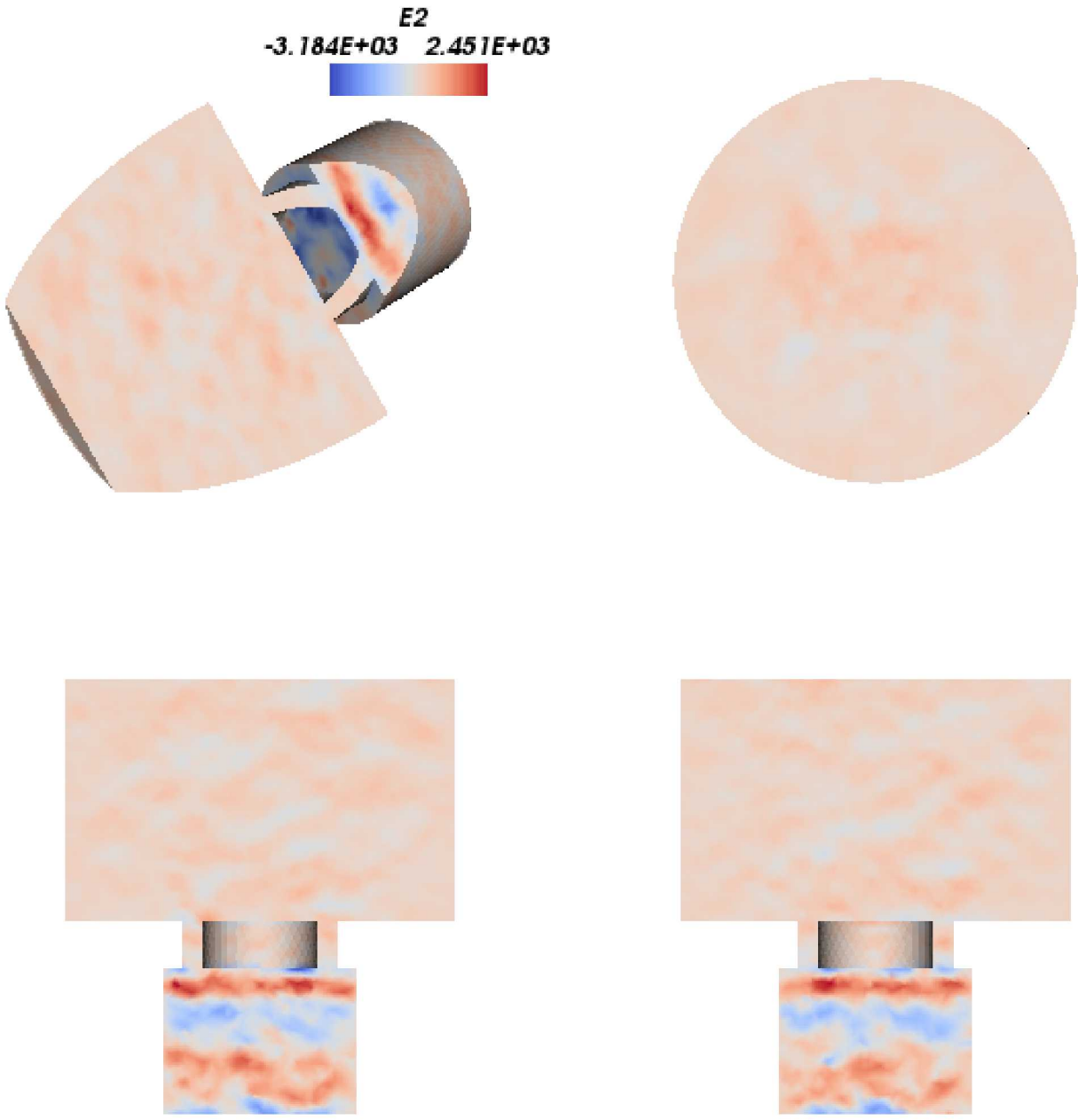

Figure 3.59: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 9.432856215e-09)

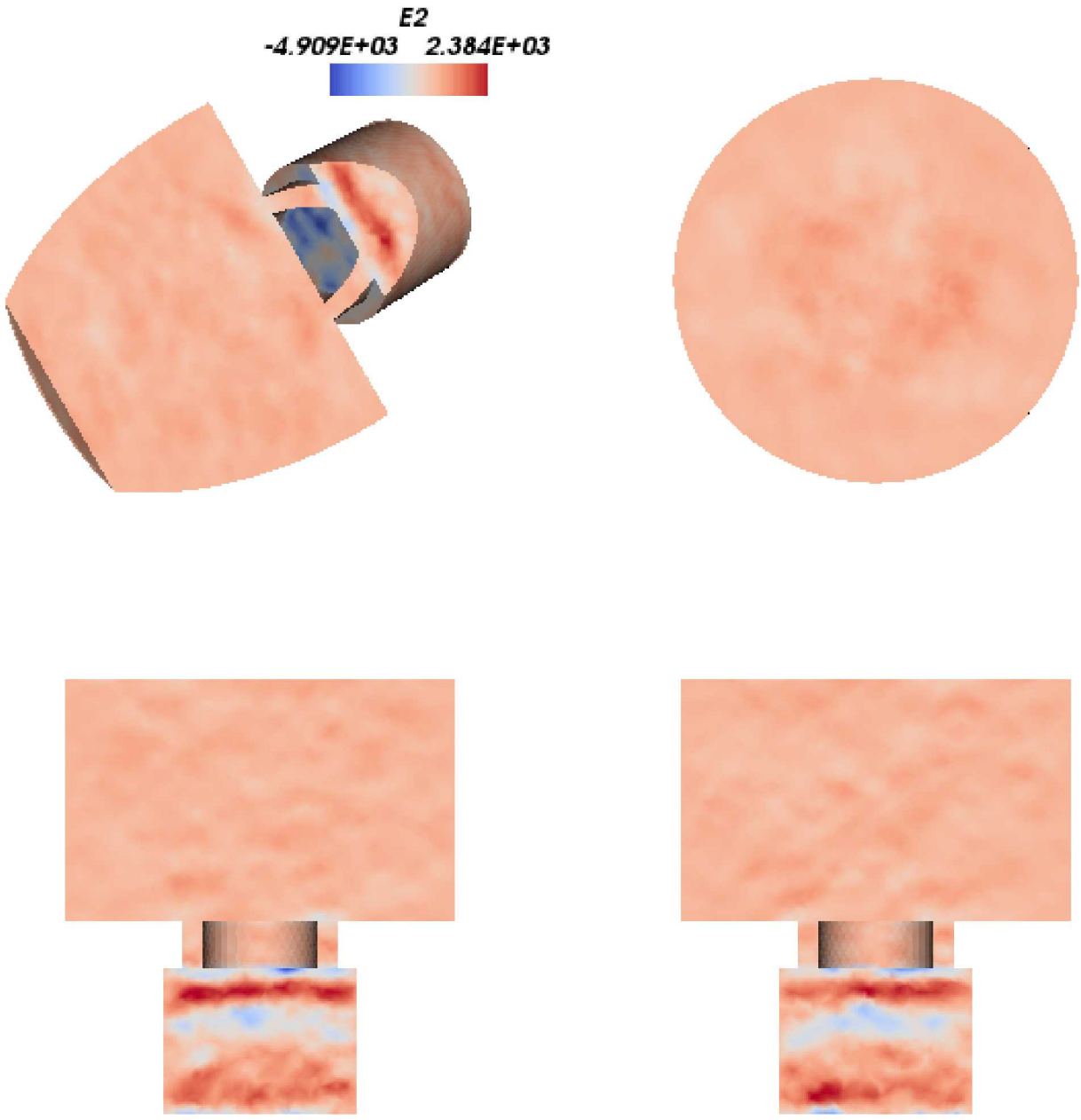

Figure 3.60: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 9.98773011e-09)

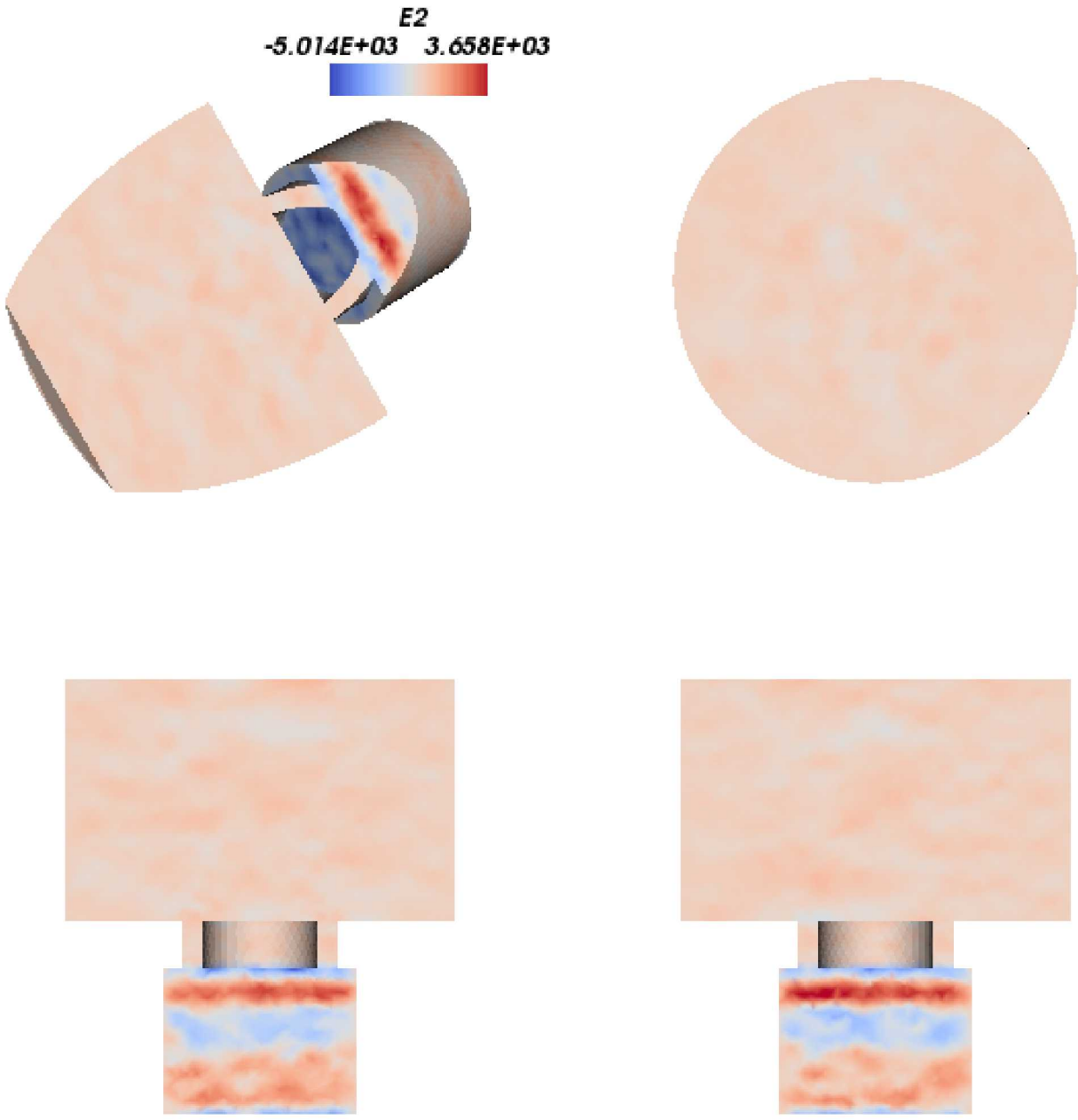

Figure 3.61: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 1.0542604005e-08)

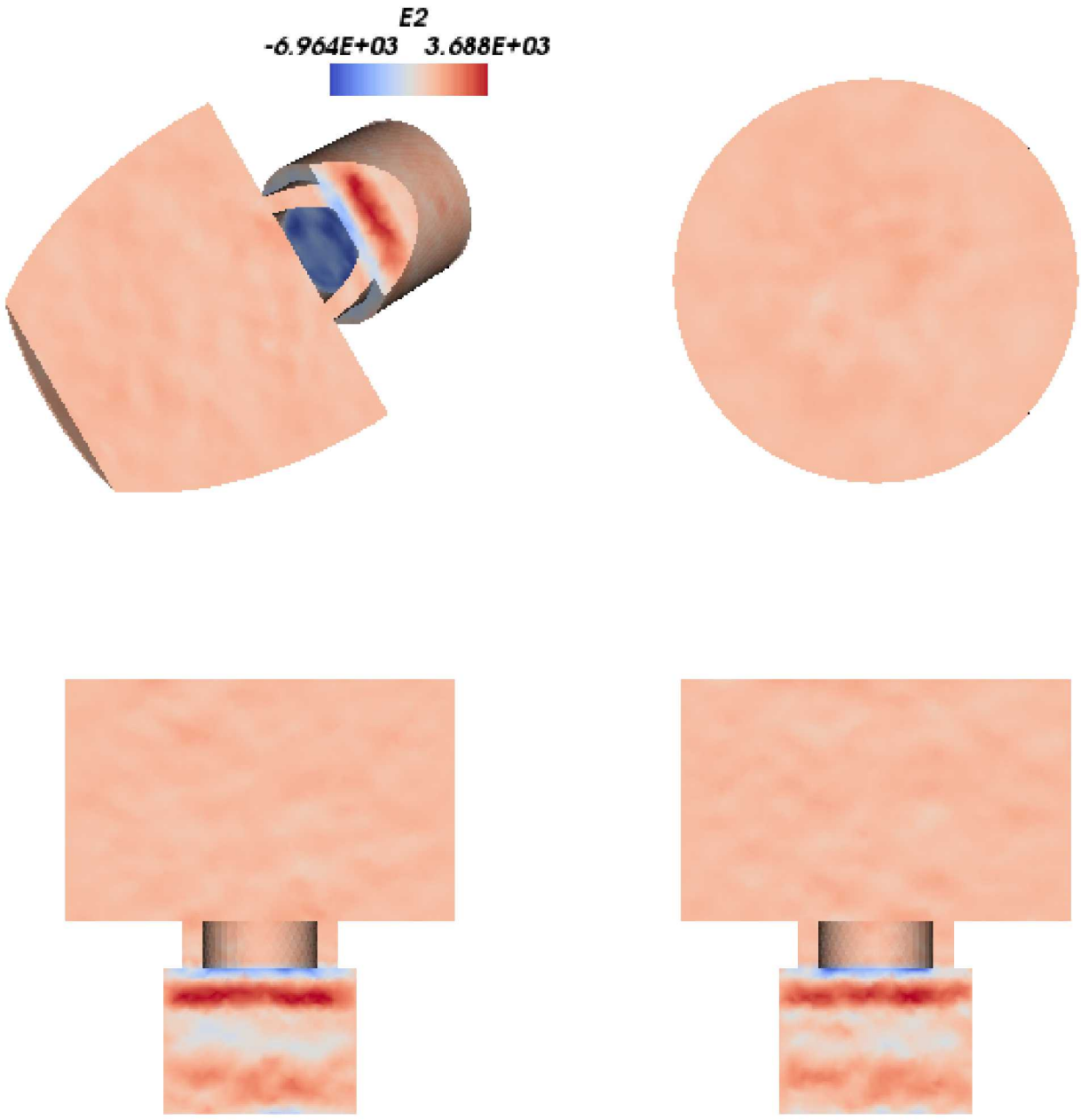

Figure 3.62: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable E2 (node-based scalar at time 1.10974779e-08)

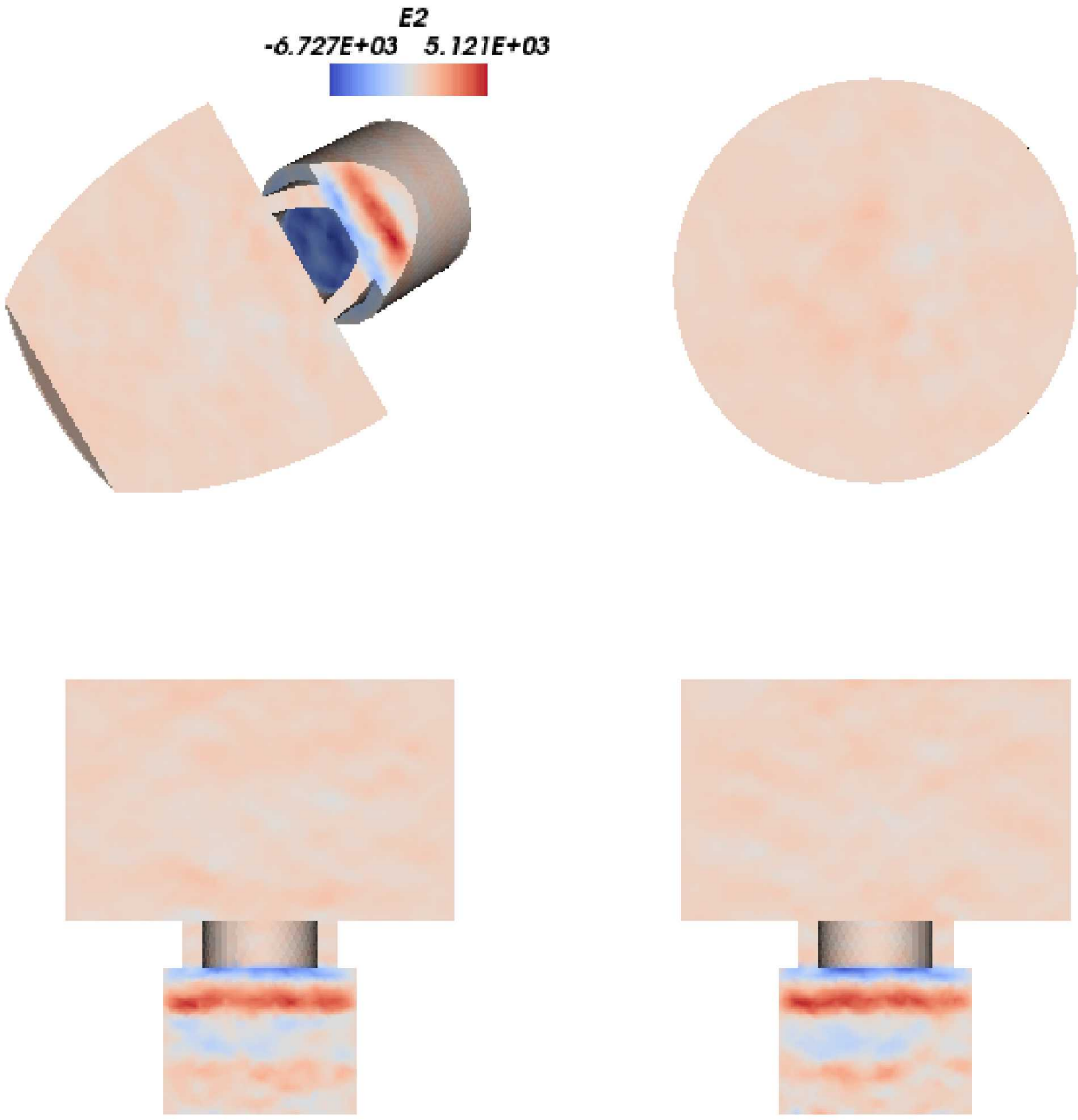

Figure 3.63: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by E2.

Variable ES_POTENTIAL (node-based scalar at time 0.0)

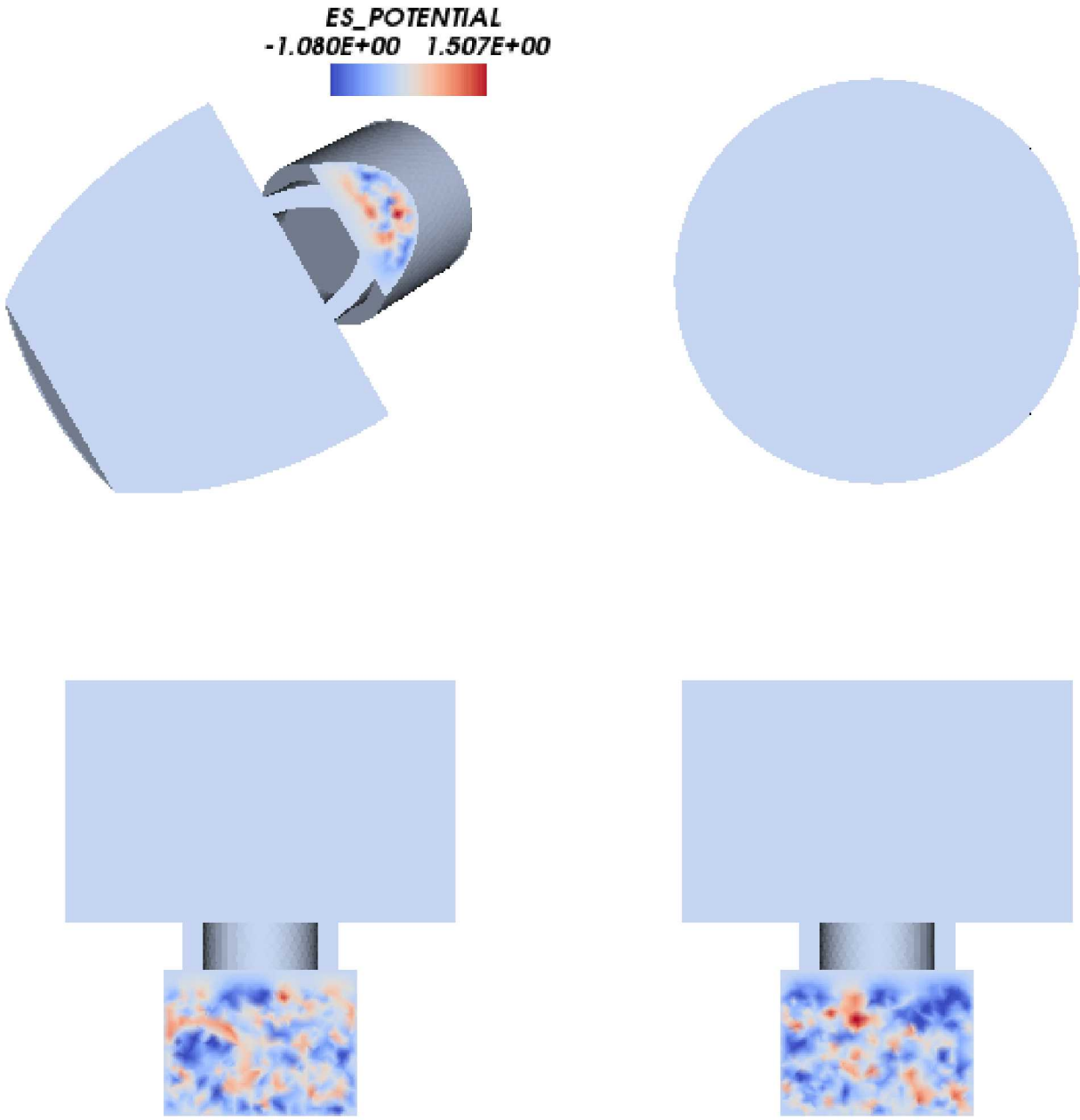

Figure 3.64: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 5.54873895e-10)

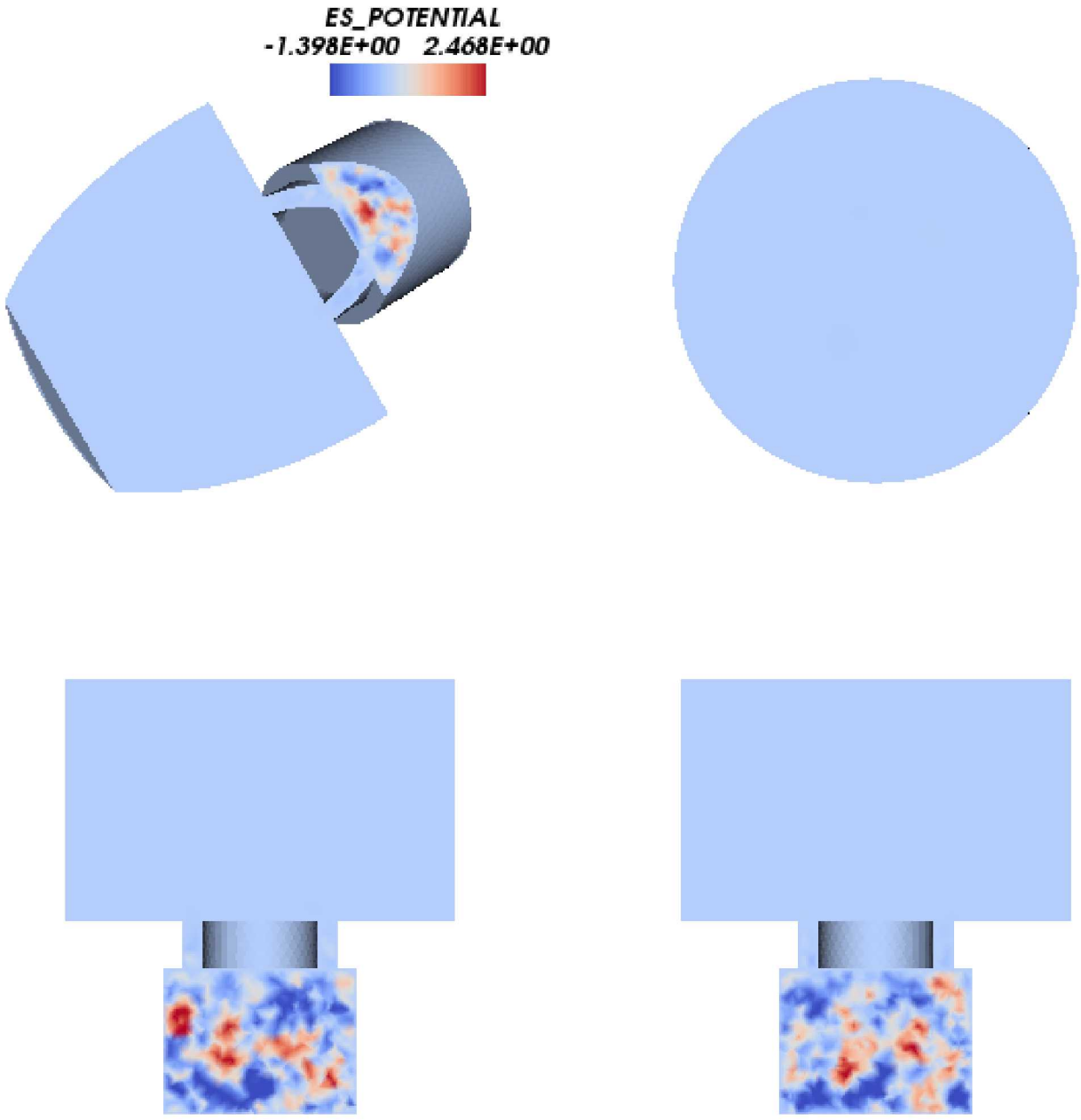

Figure 3.65: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 1.10974779e-09)

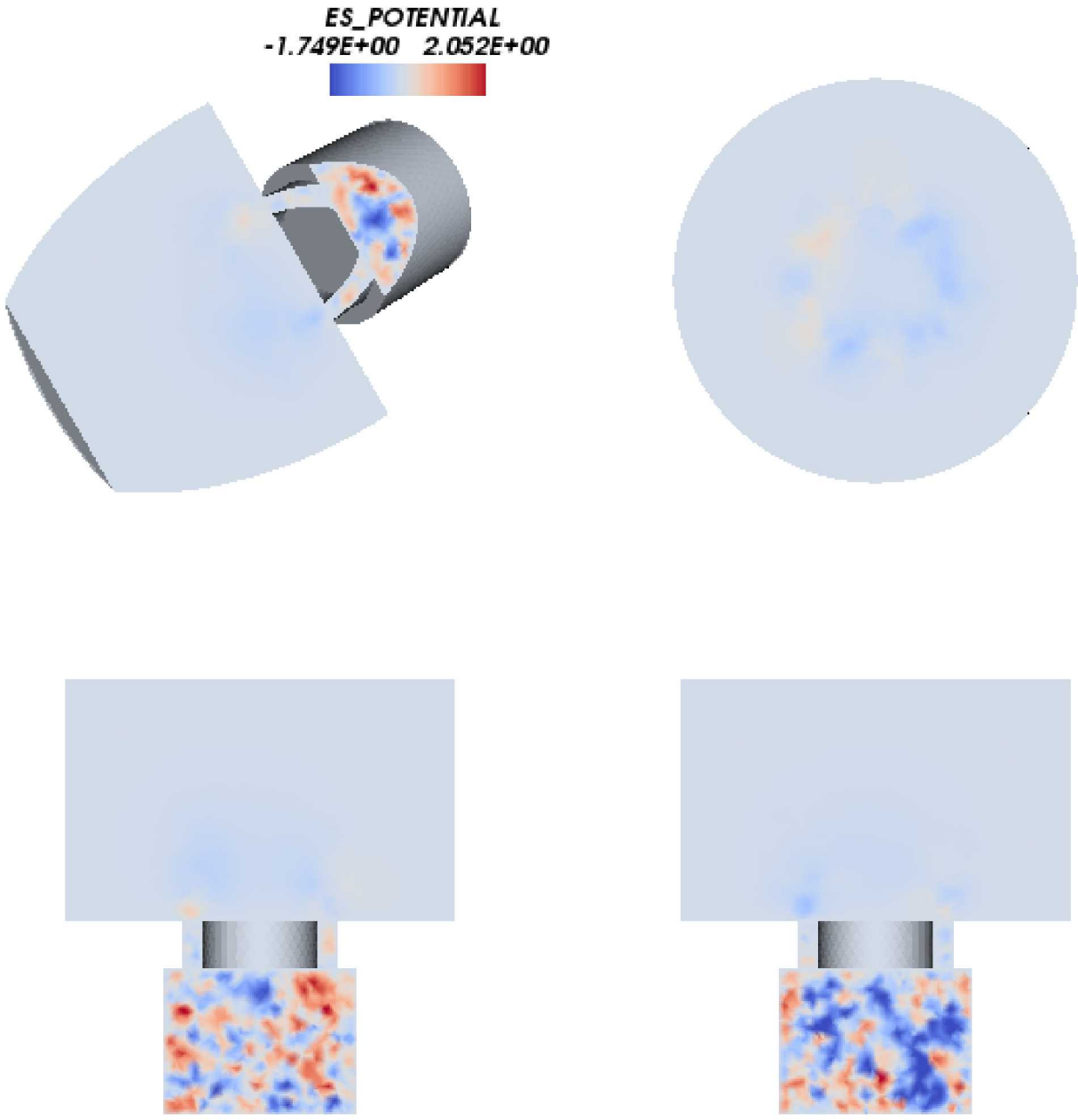

Figure 3.66: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 1.664621685e-09)

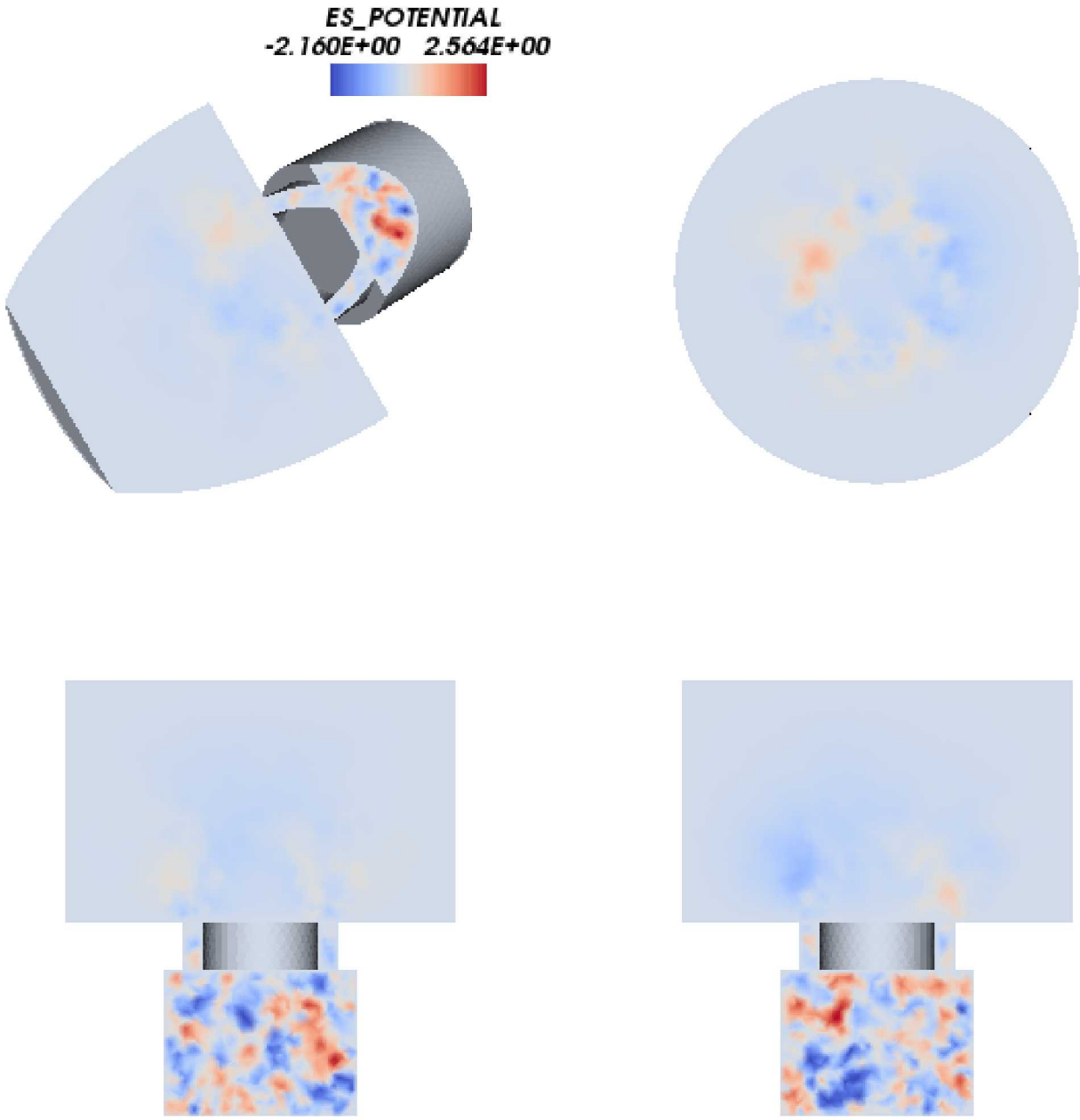

Figure 3.67: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 2.21949558e-09)

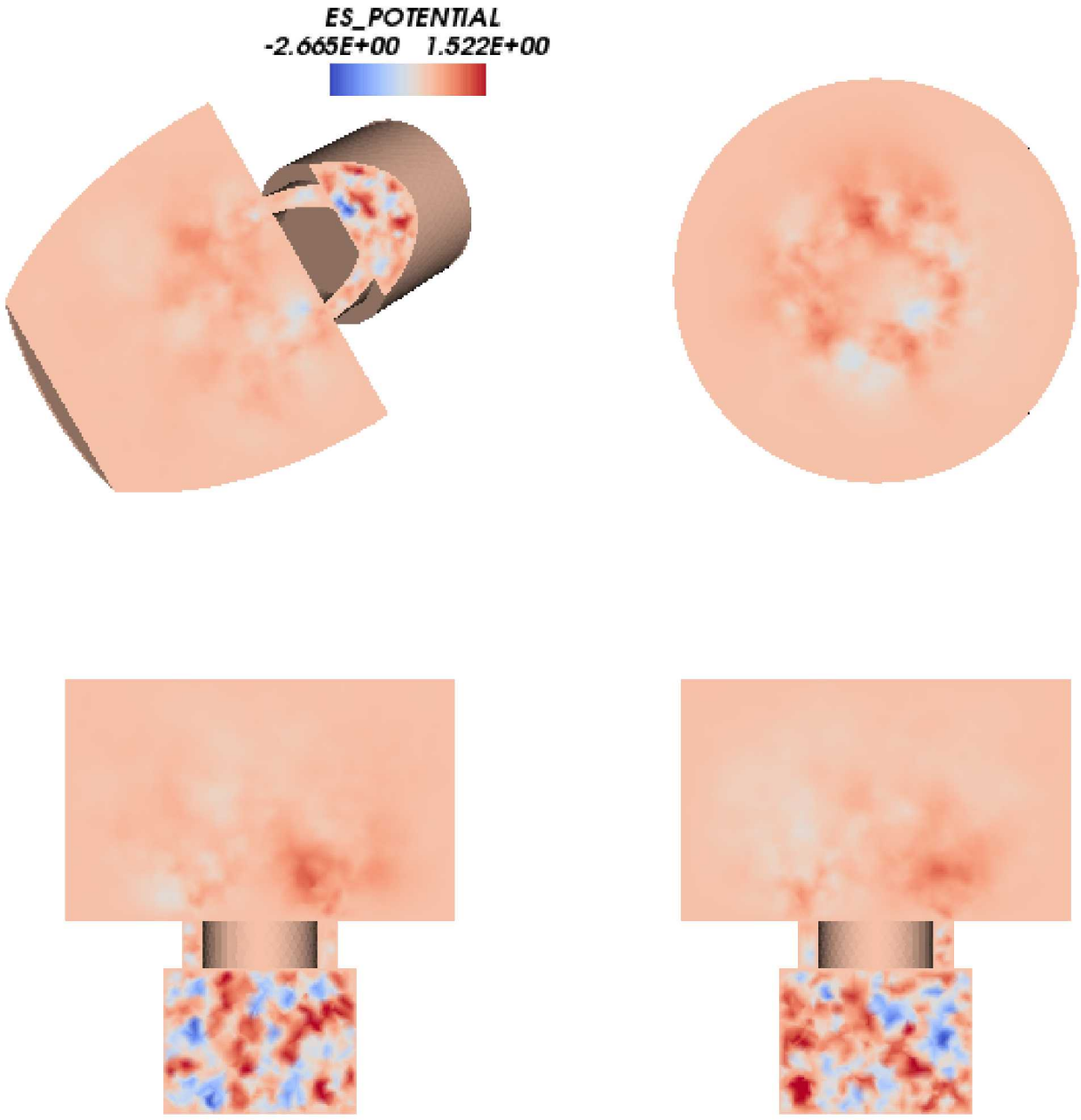

Figure 3.68: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 2.774369475e-09)

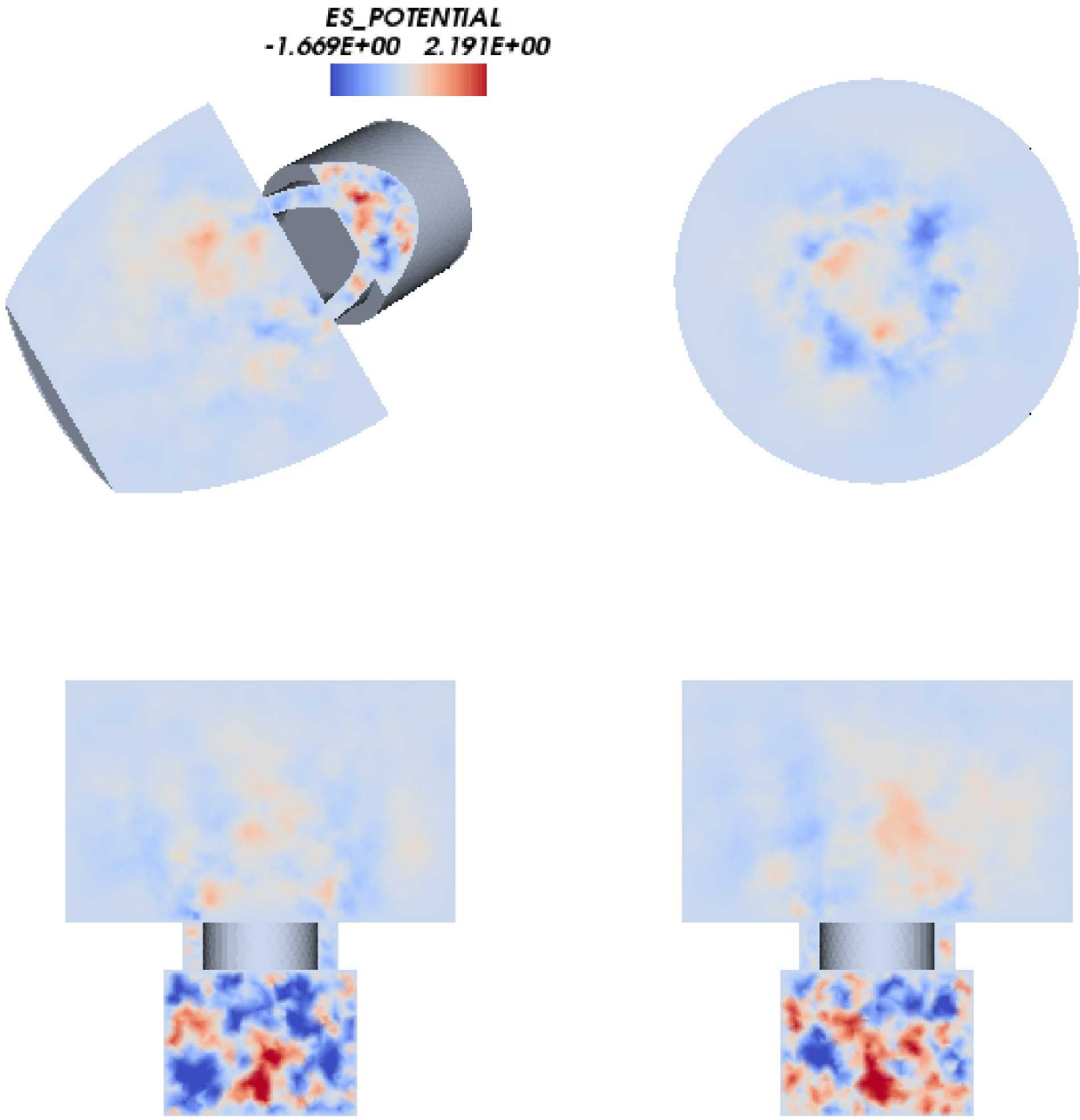

Figure 3.69: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 3.32924337e-09)

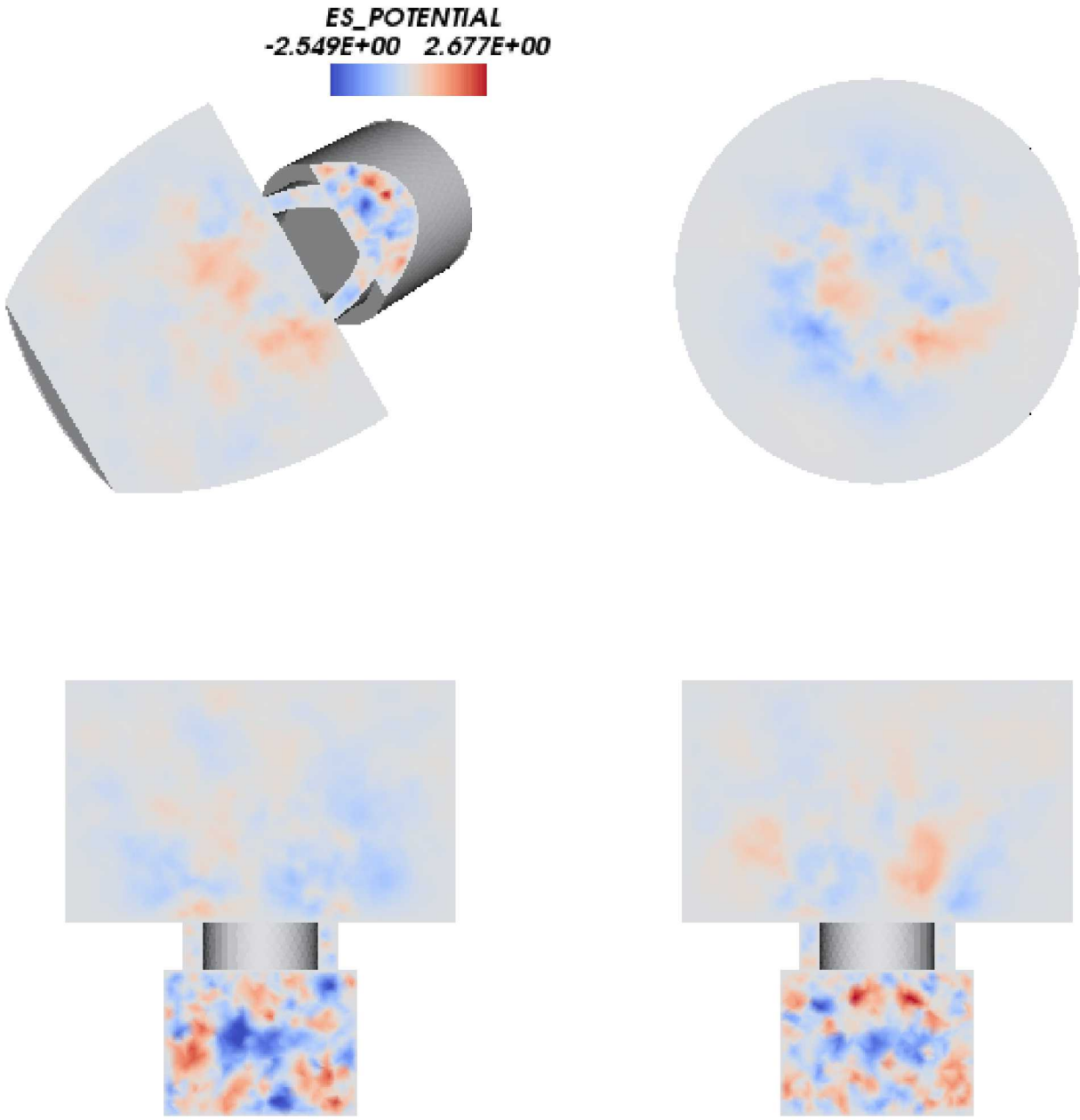

Figure 3.70: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 3.884117265e-09)

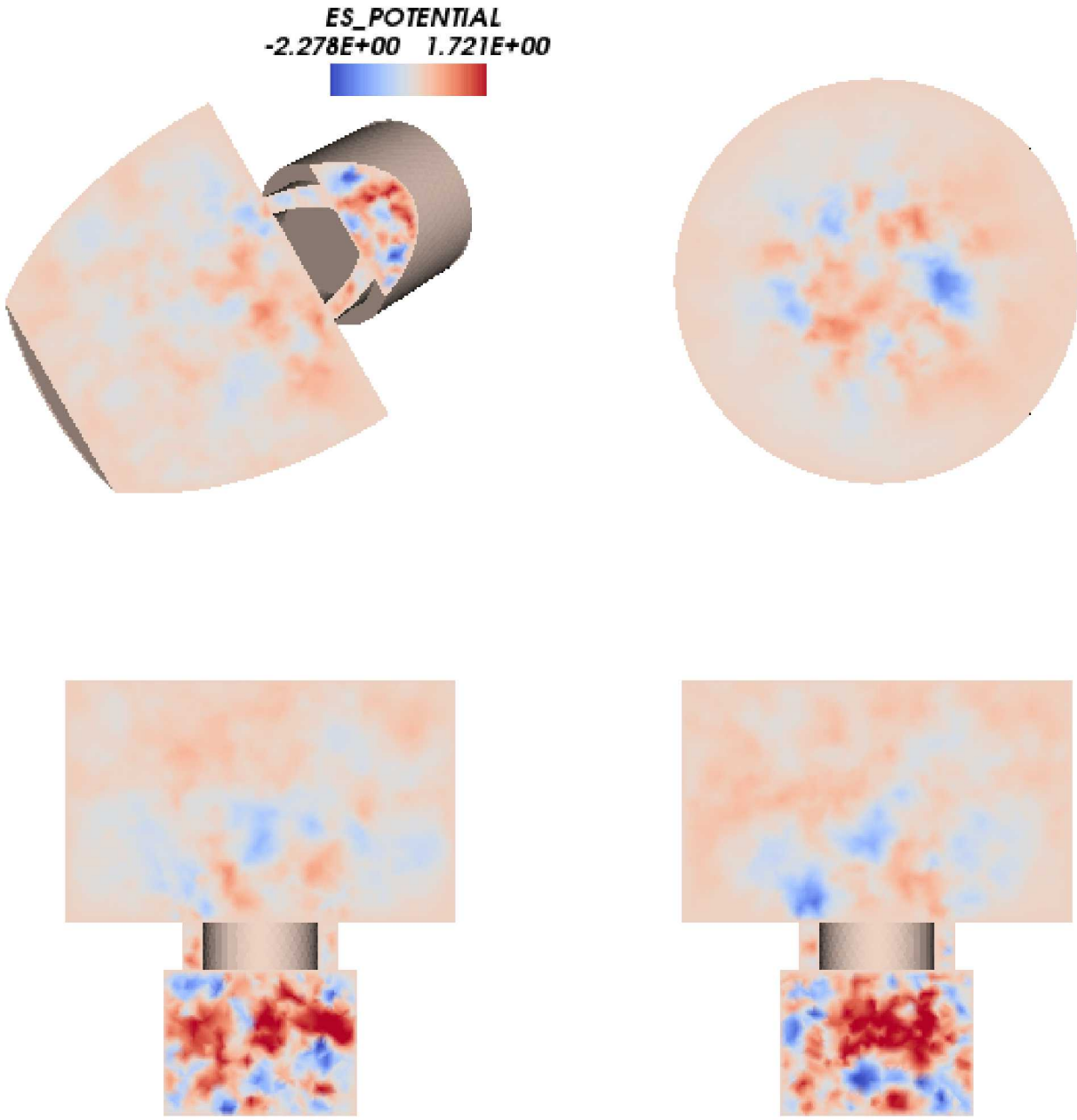

Figure 3.71: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 4.43899116e-09)

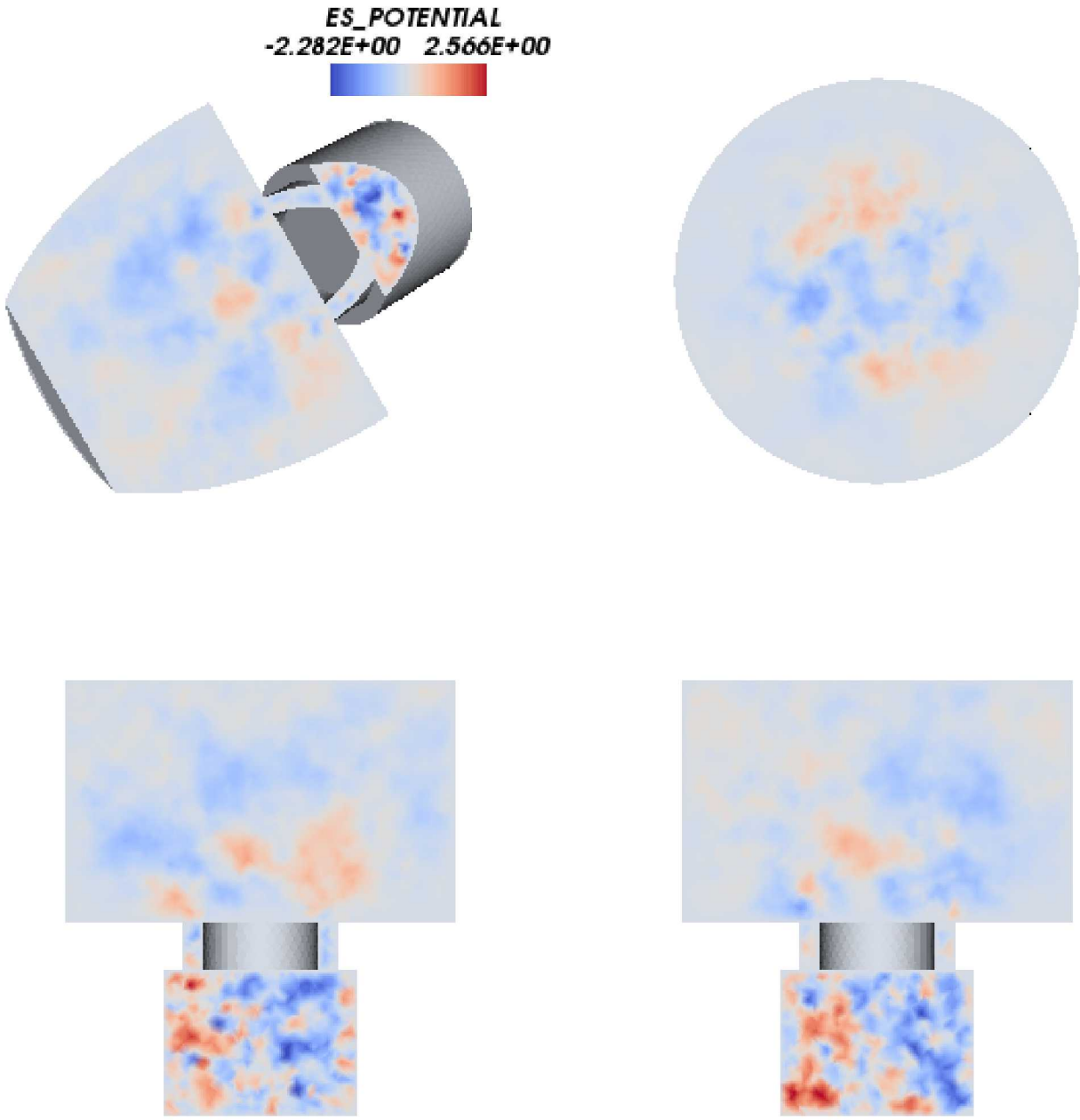

Figure 3.72: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 4.993865055e-09)

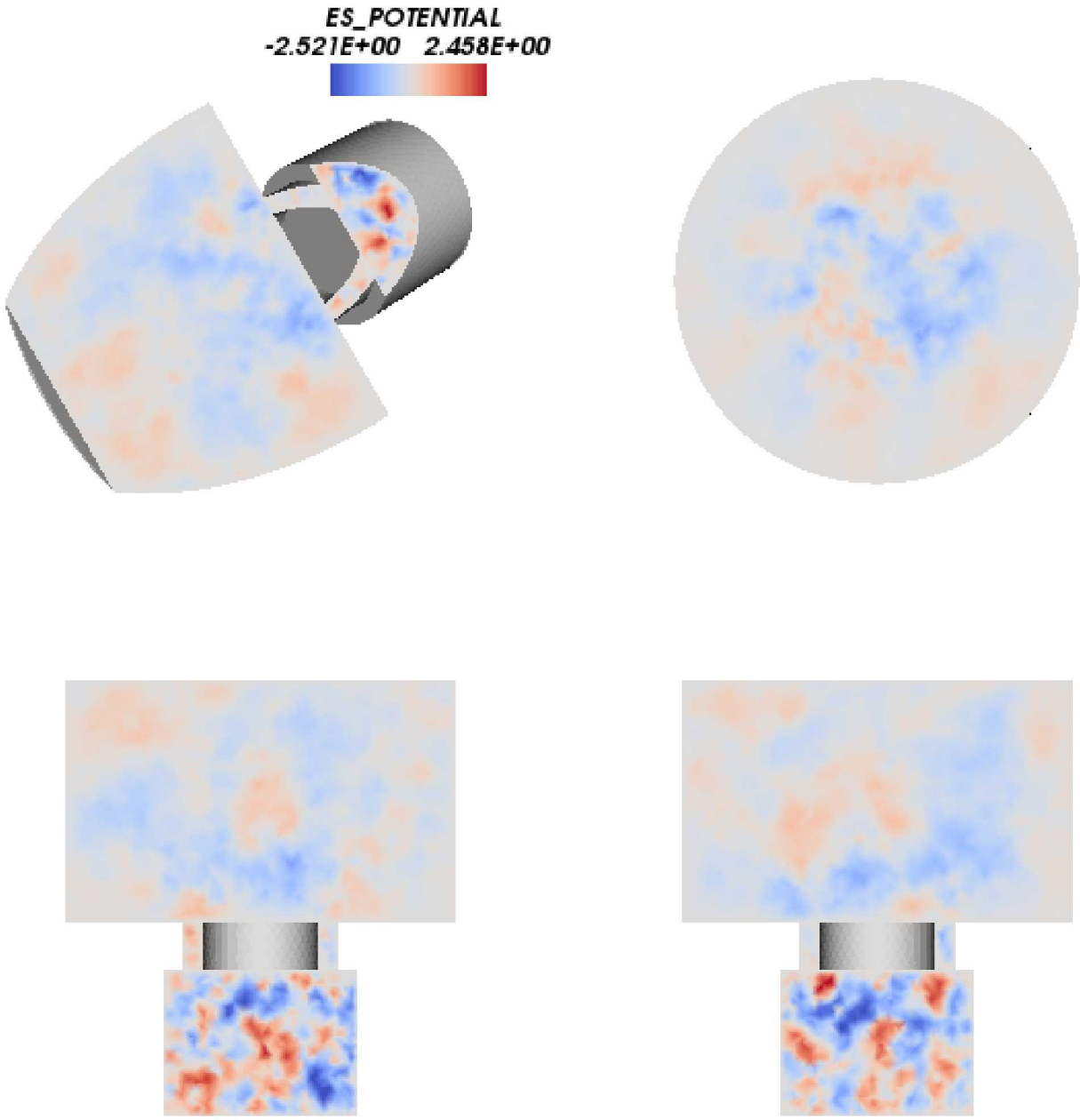

Figure 3.73: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 5.54873895e-09)

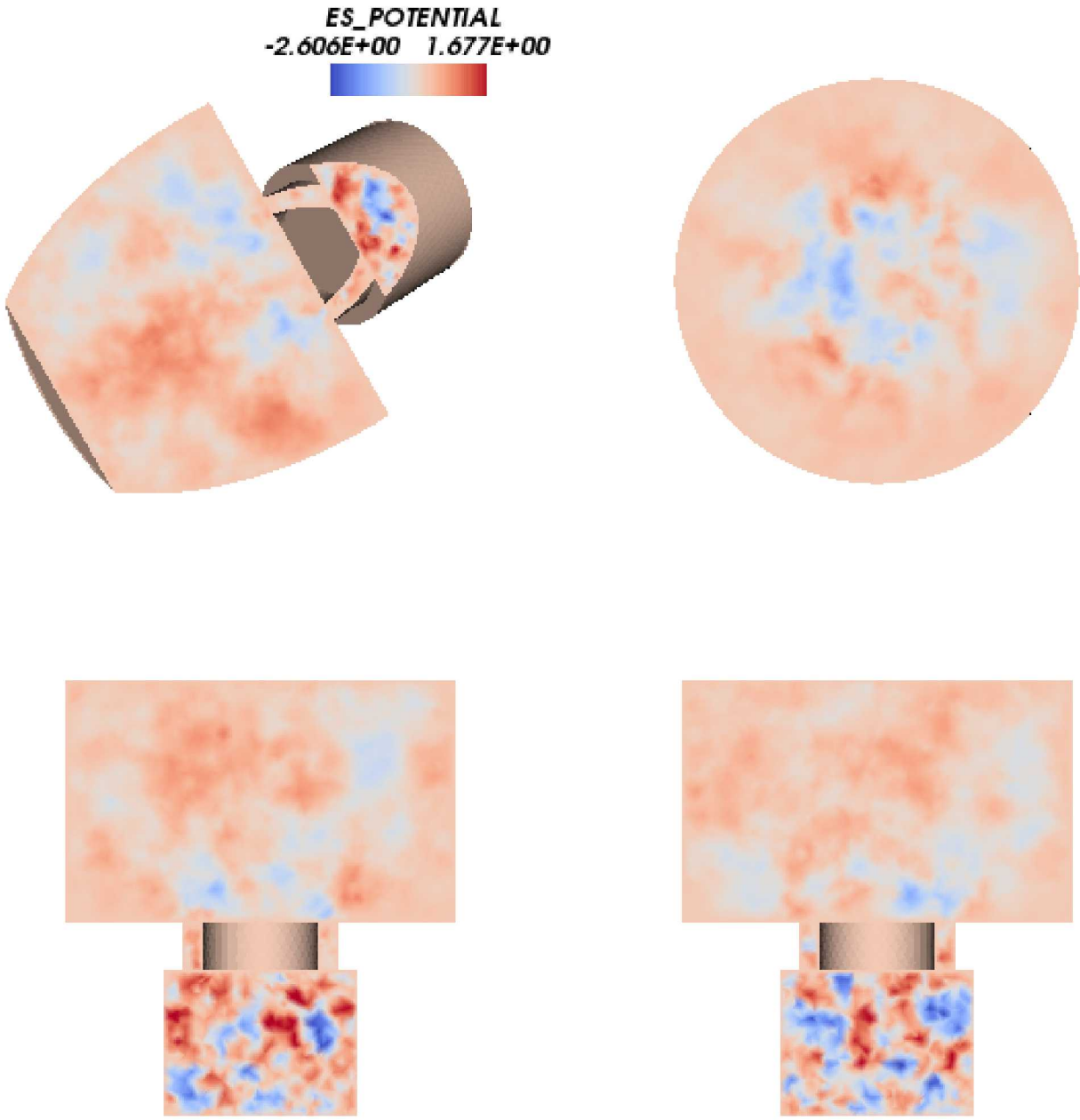

Figure 3.74: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 6.103612845e-09)

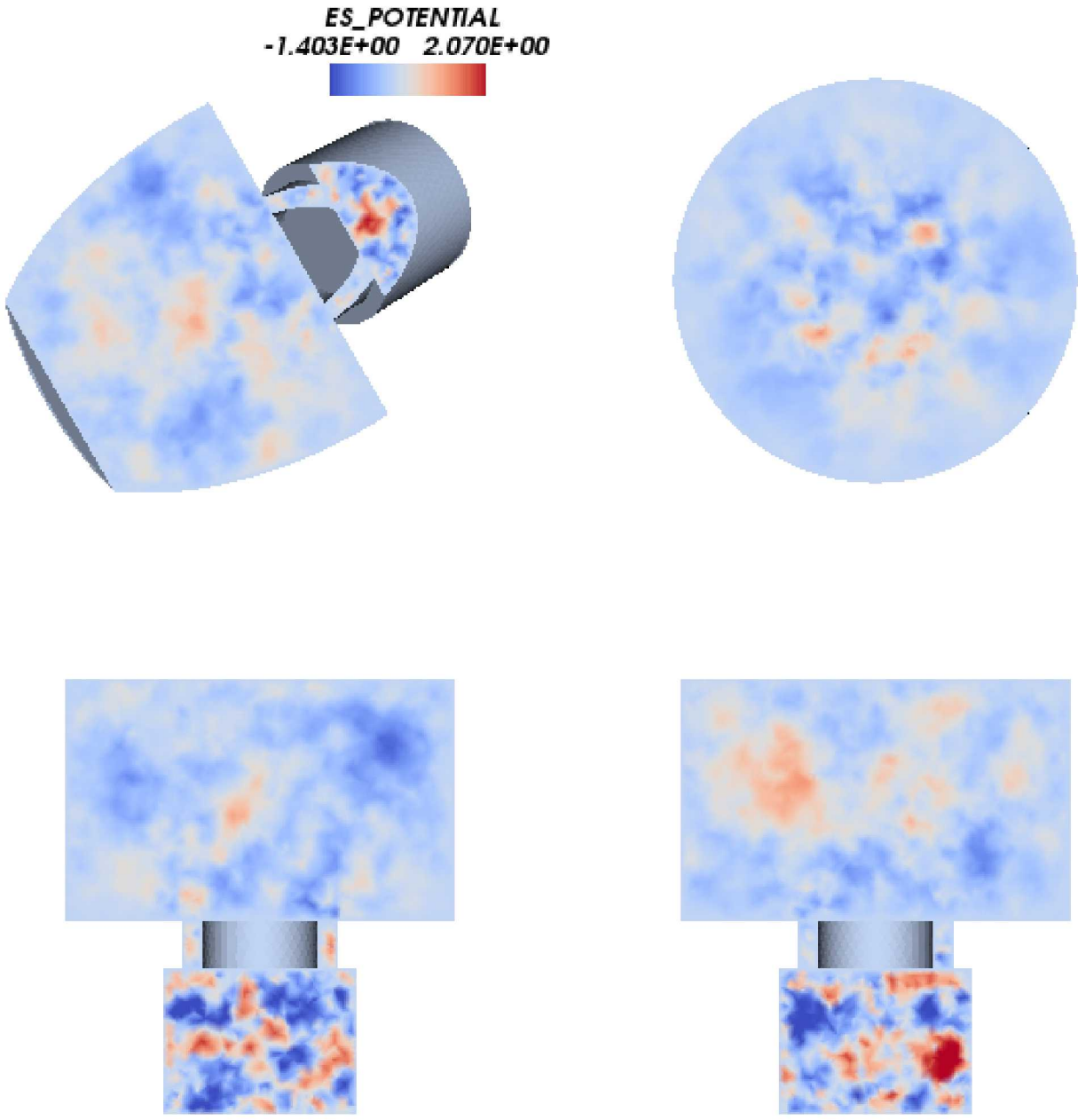

Figure 3.75: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 6.65848674e-09)

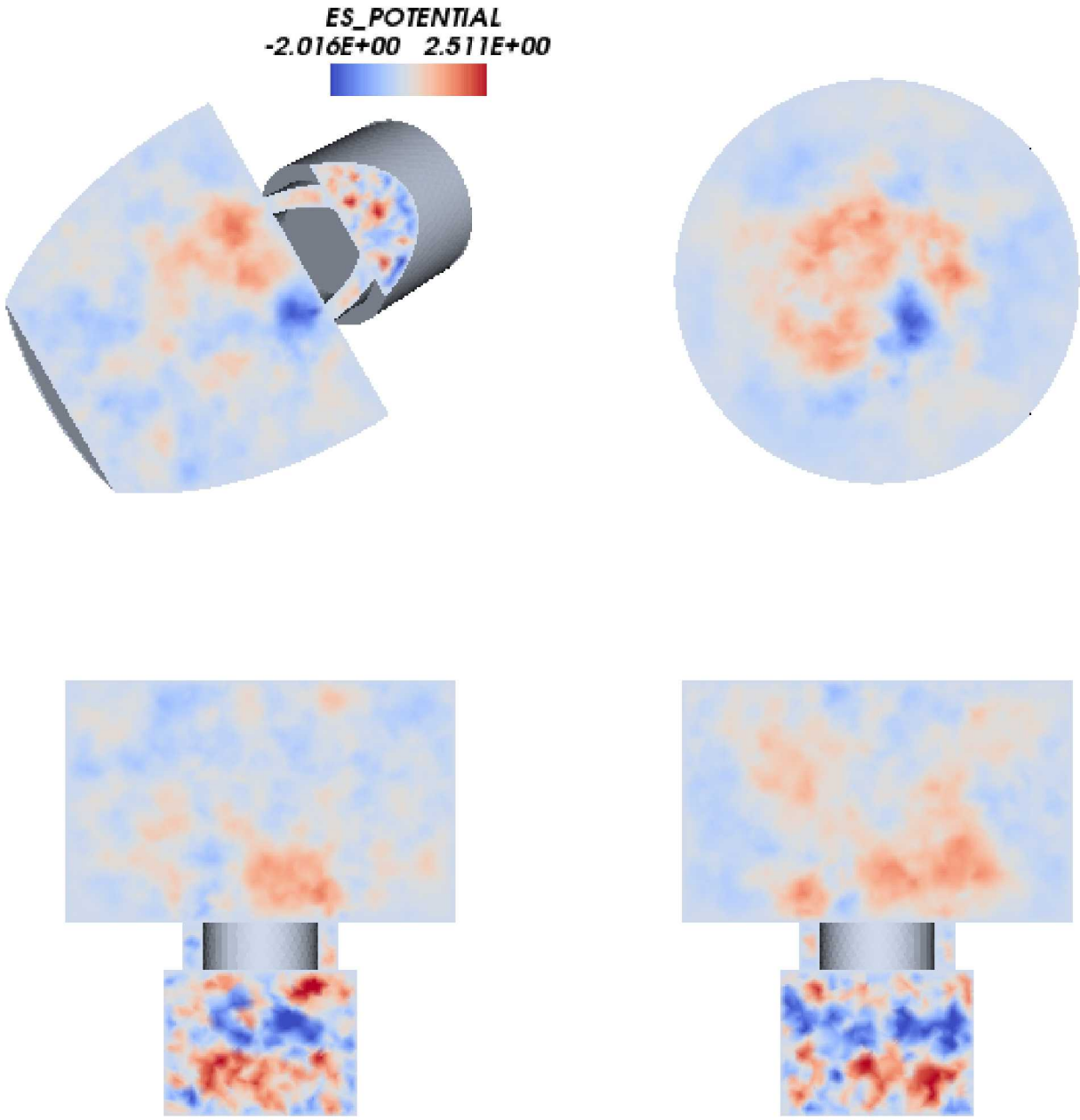

Figure 3.76: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 7.213360635e-09)

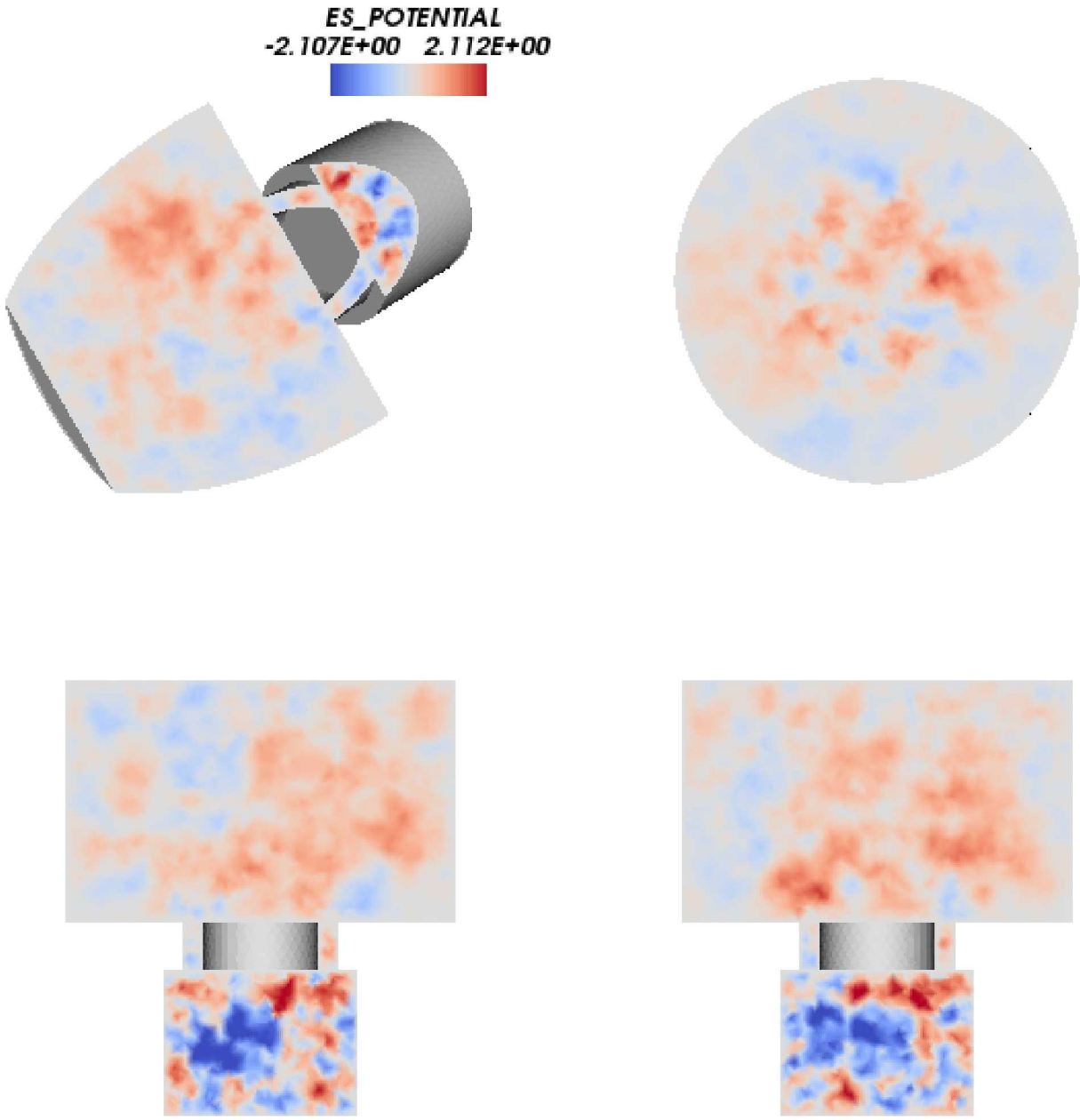

Figure 3.77: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 7.76823453e-09)

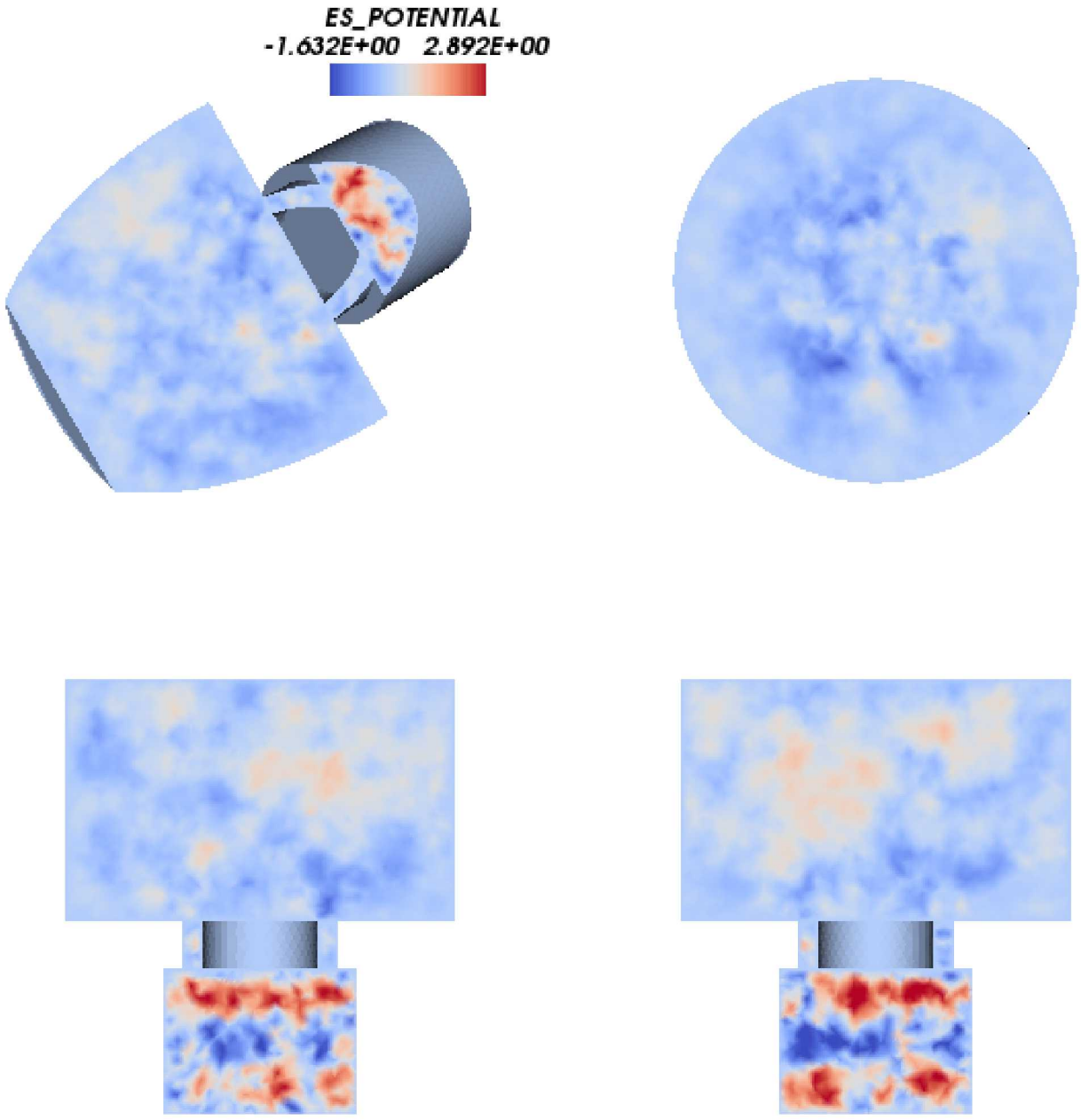

Figure 3.78: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 8.323108425e-09)

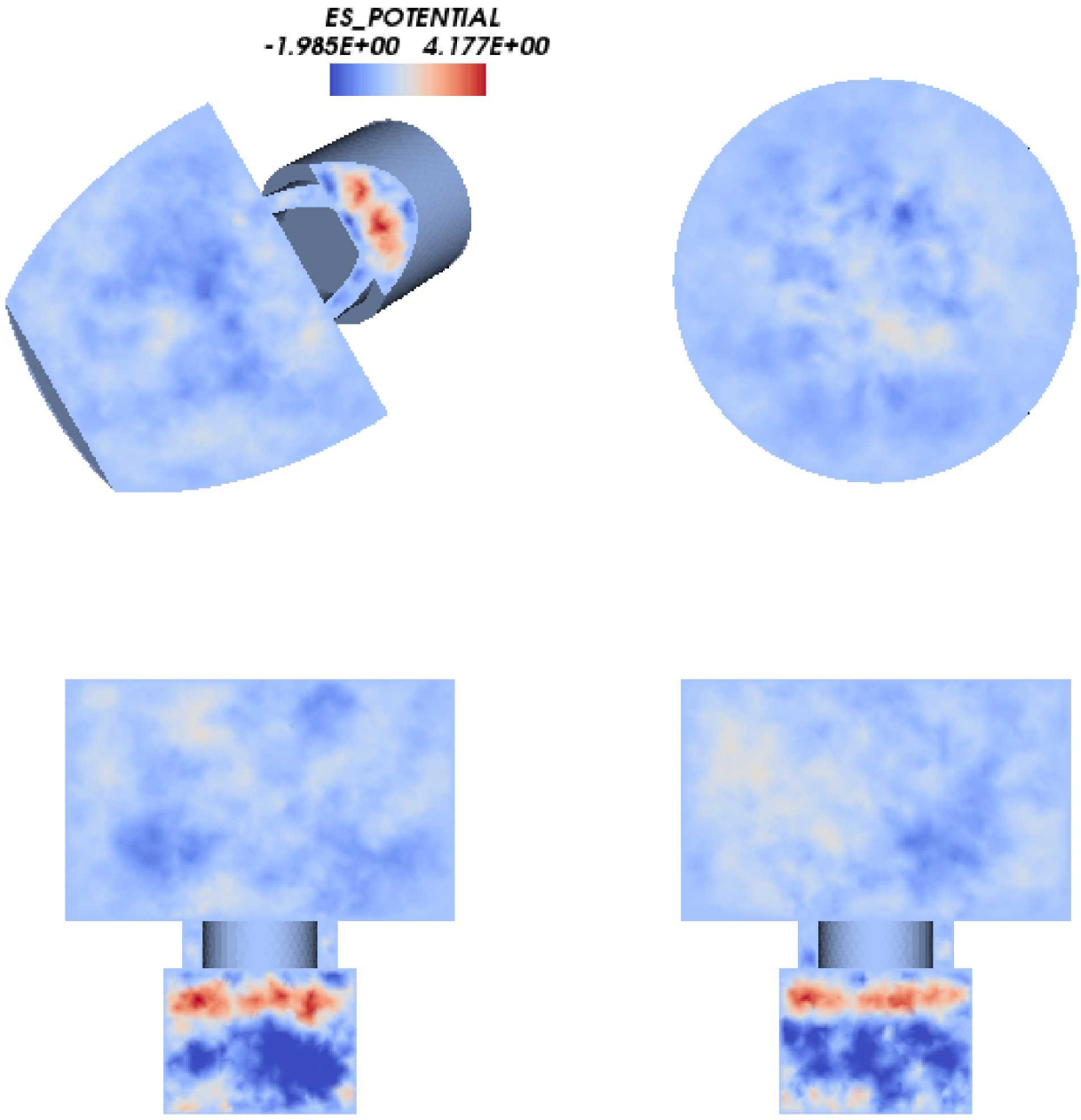

Figure 3.79: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 8.87798232e-09)

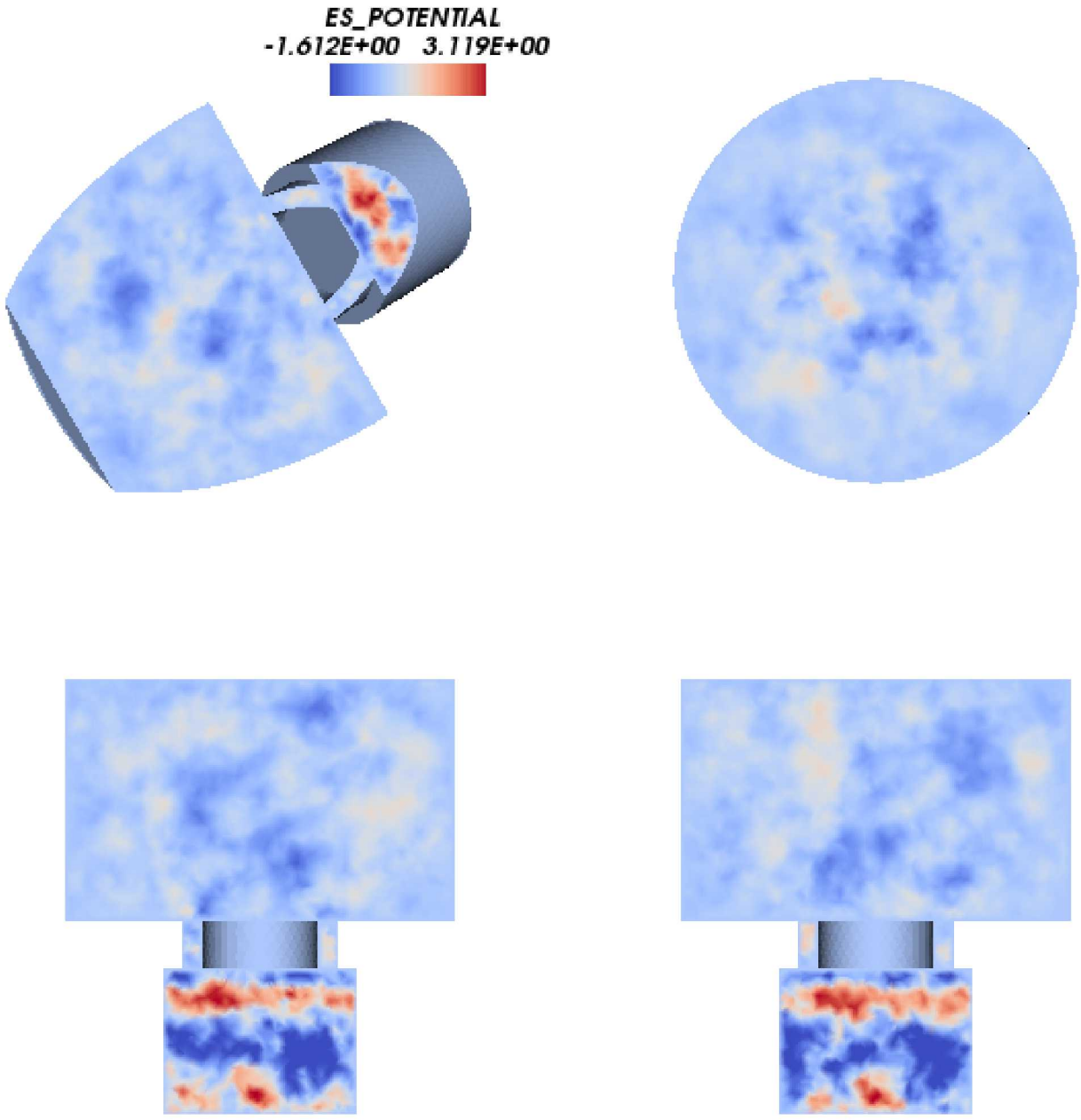

Figure 3.80: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 9.432856215e-09)

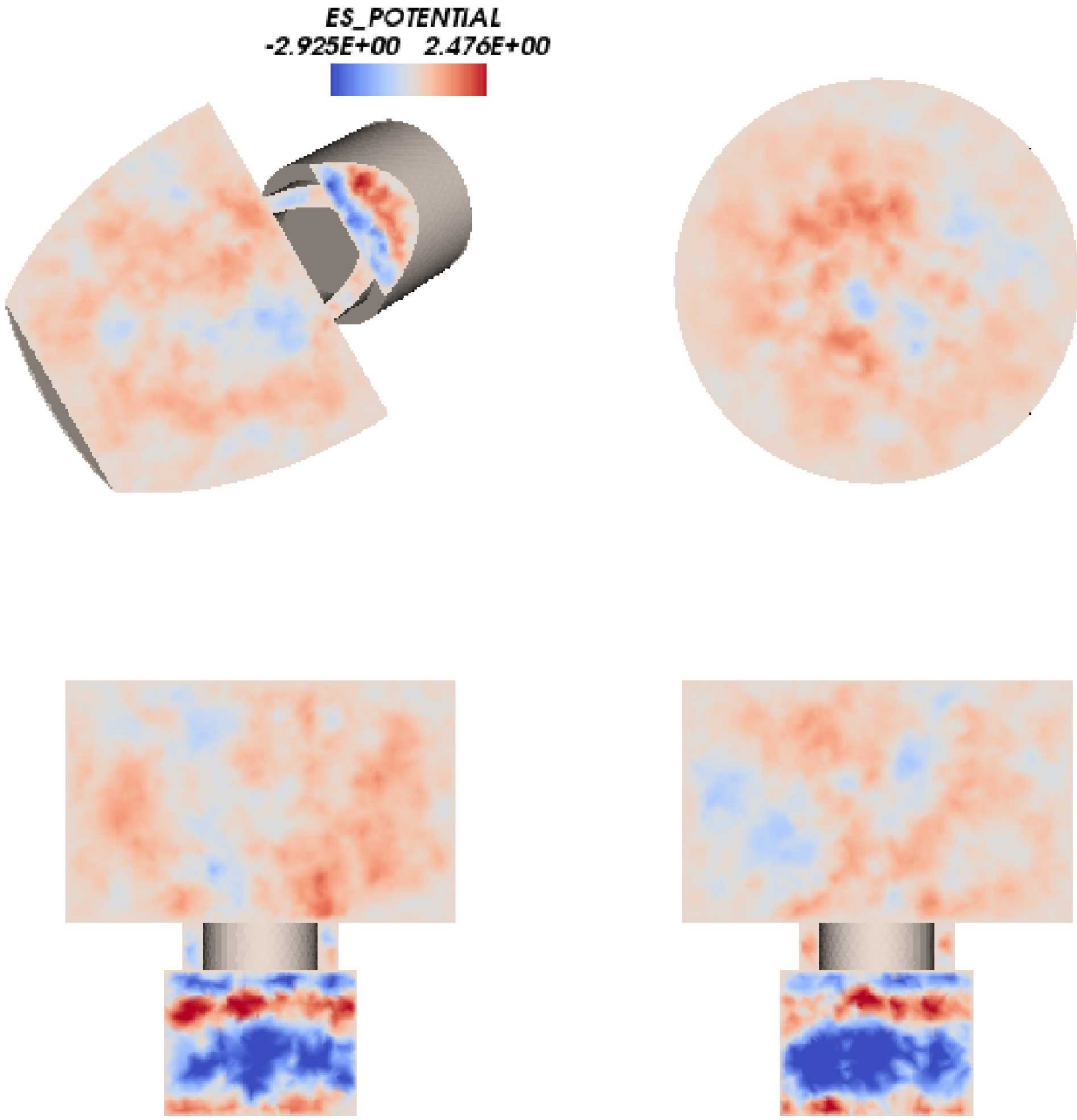

Figure 3.81: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 9.98773011e-09)

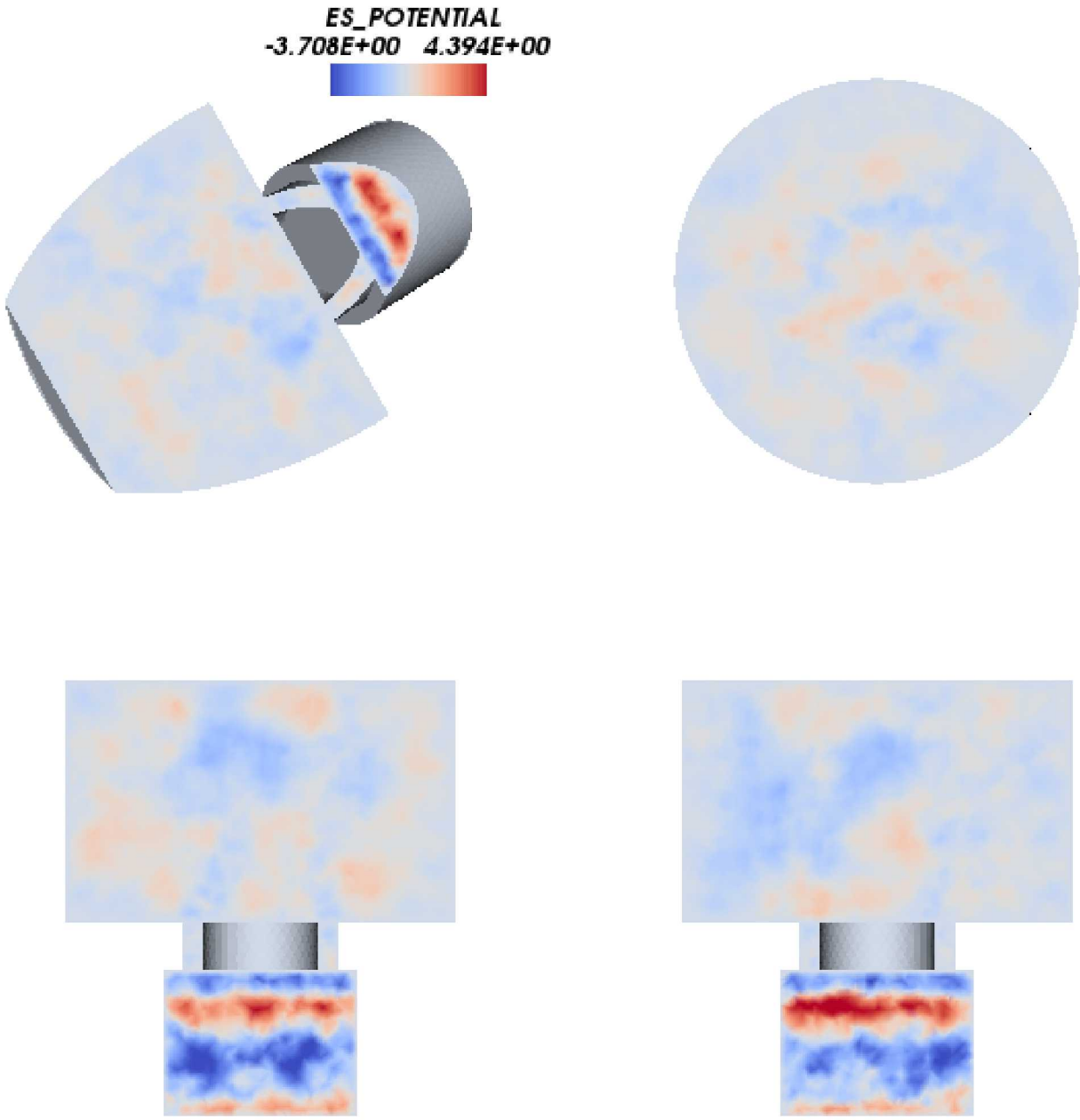

Figure 3.82: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 1.0542604005e-08)

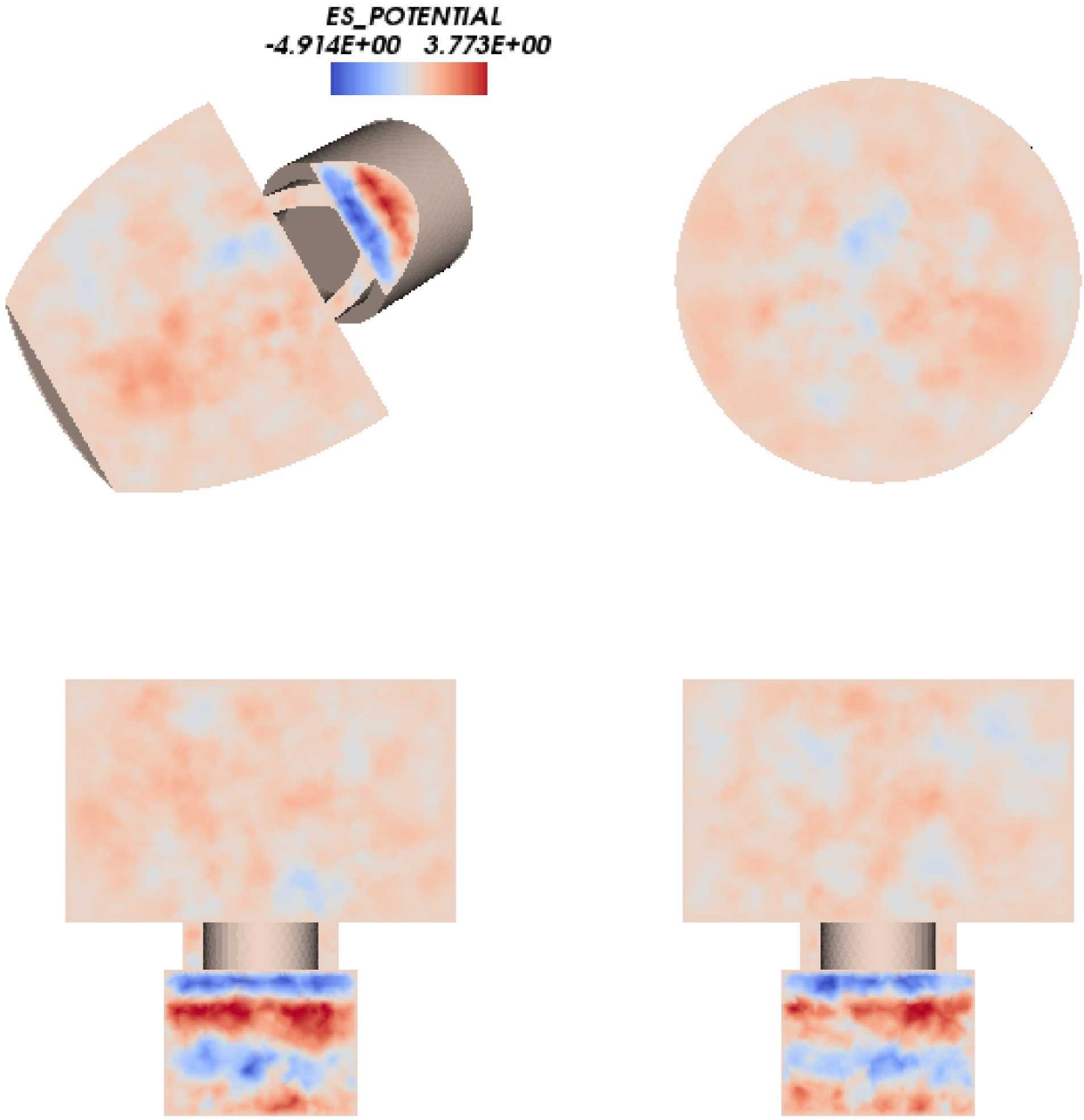

Figure 3.83: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable ES_POTENTIAL (node-based scalar at time 1.10974779e-08)

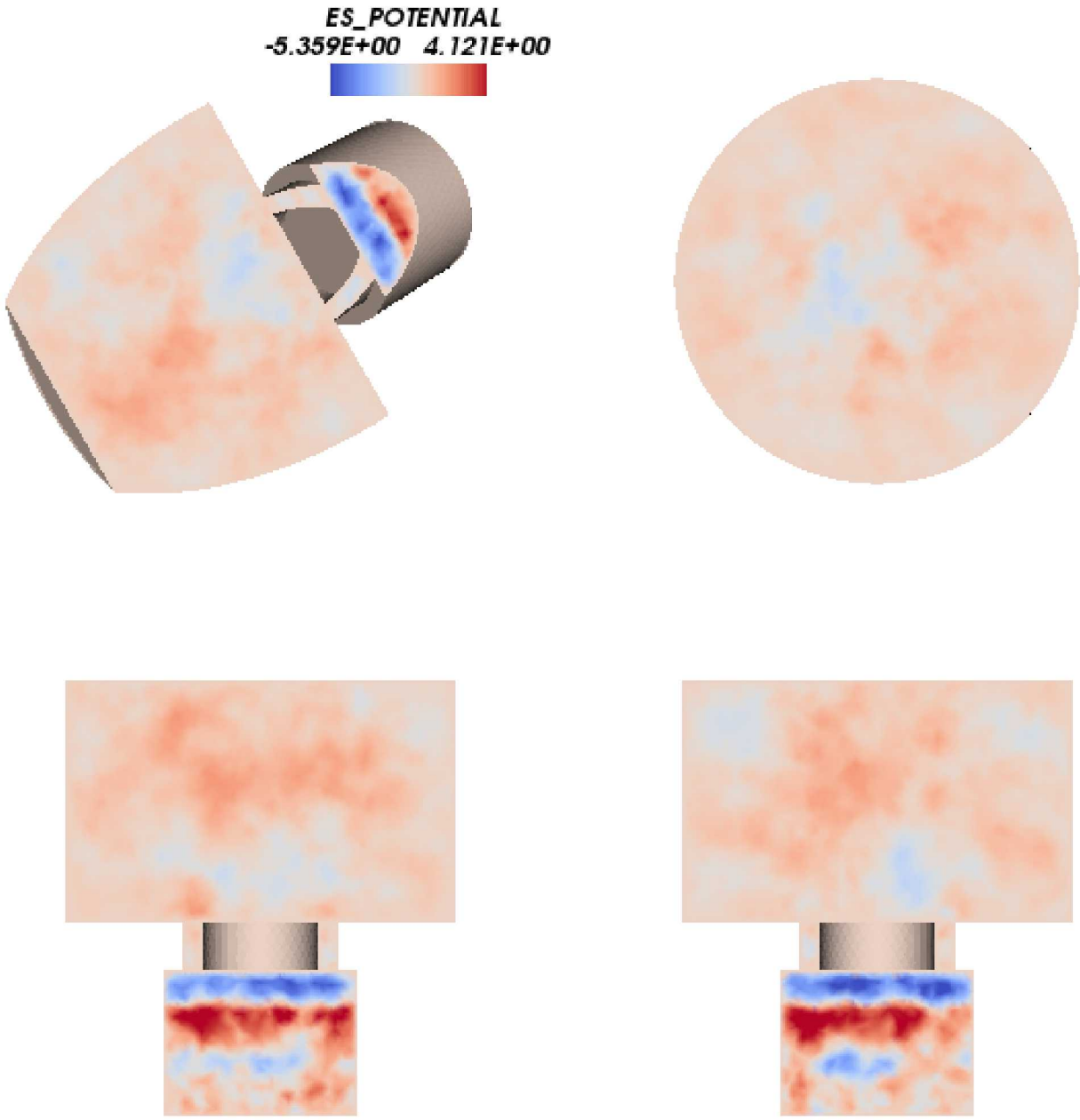

Figure 3.84: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by ES_POTENTIAL.

Variable PROC_ID (element-based scalar at time 0.0)

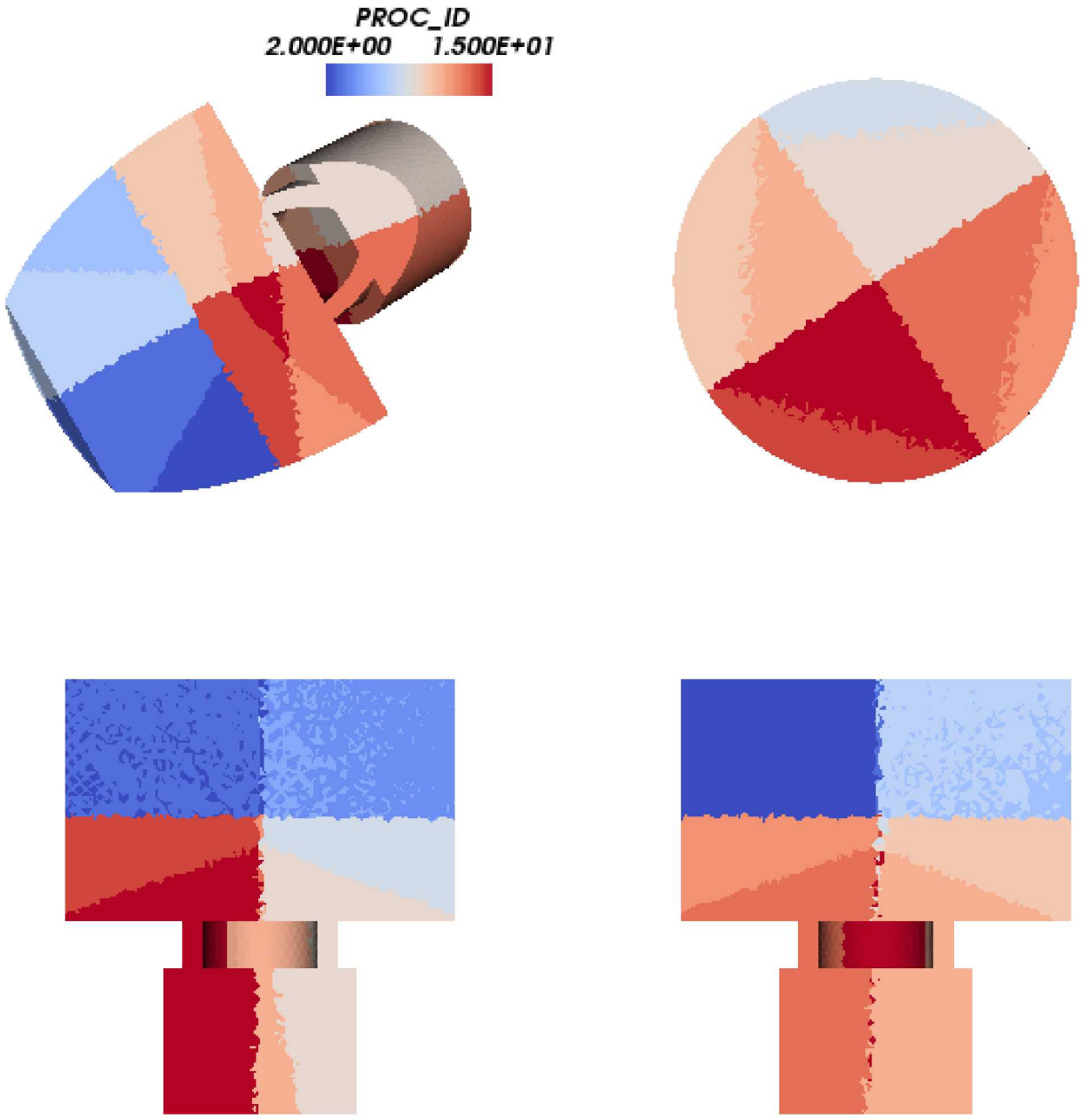

Figure 3.85: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 5.54873895e-10)

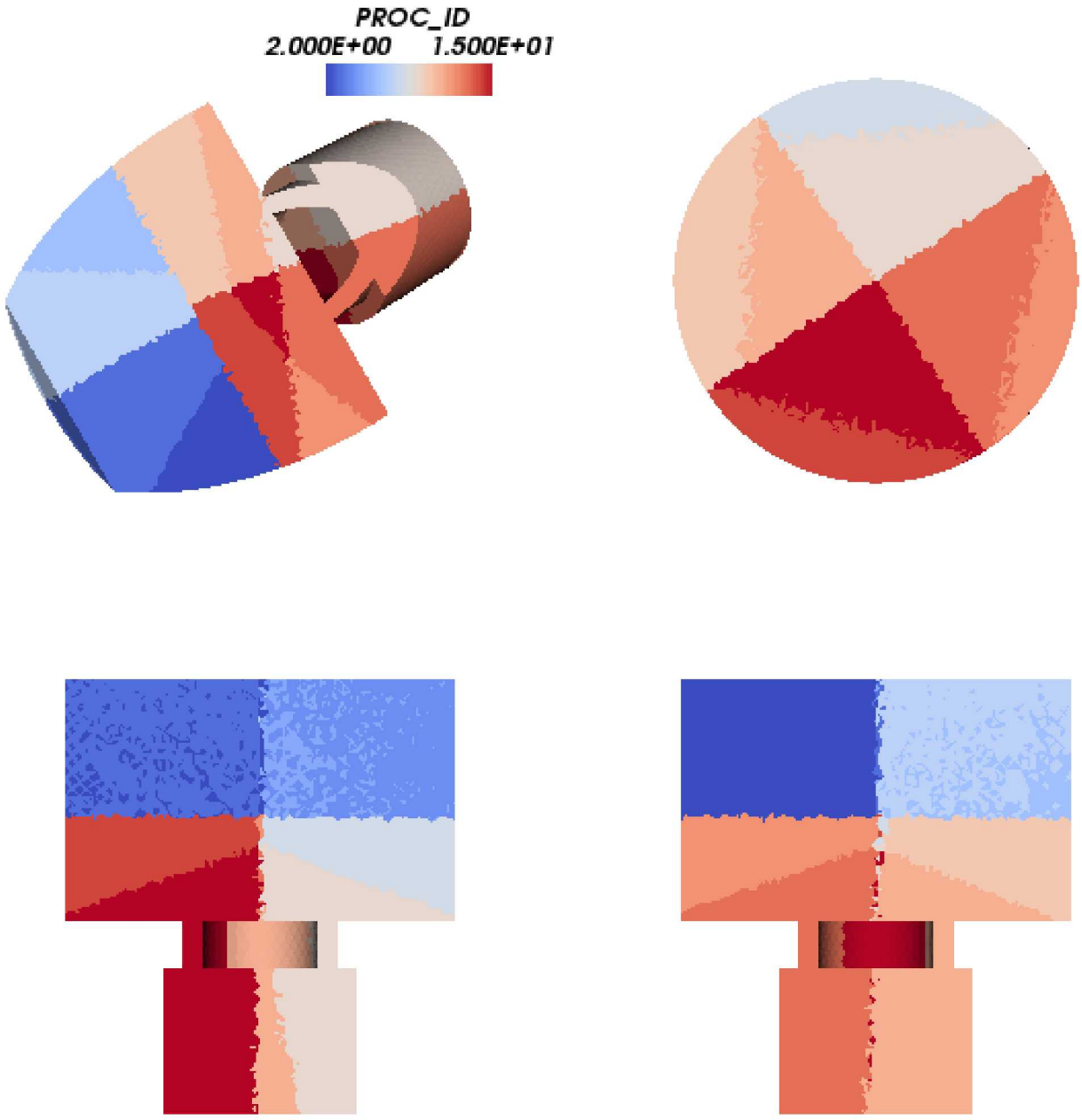

Figure 3.86: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 1.10974779e-09)

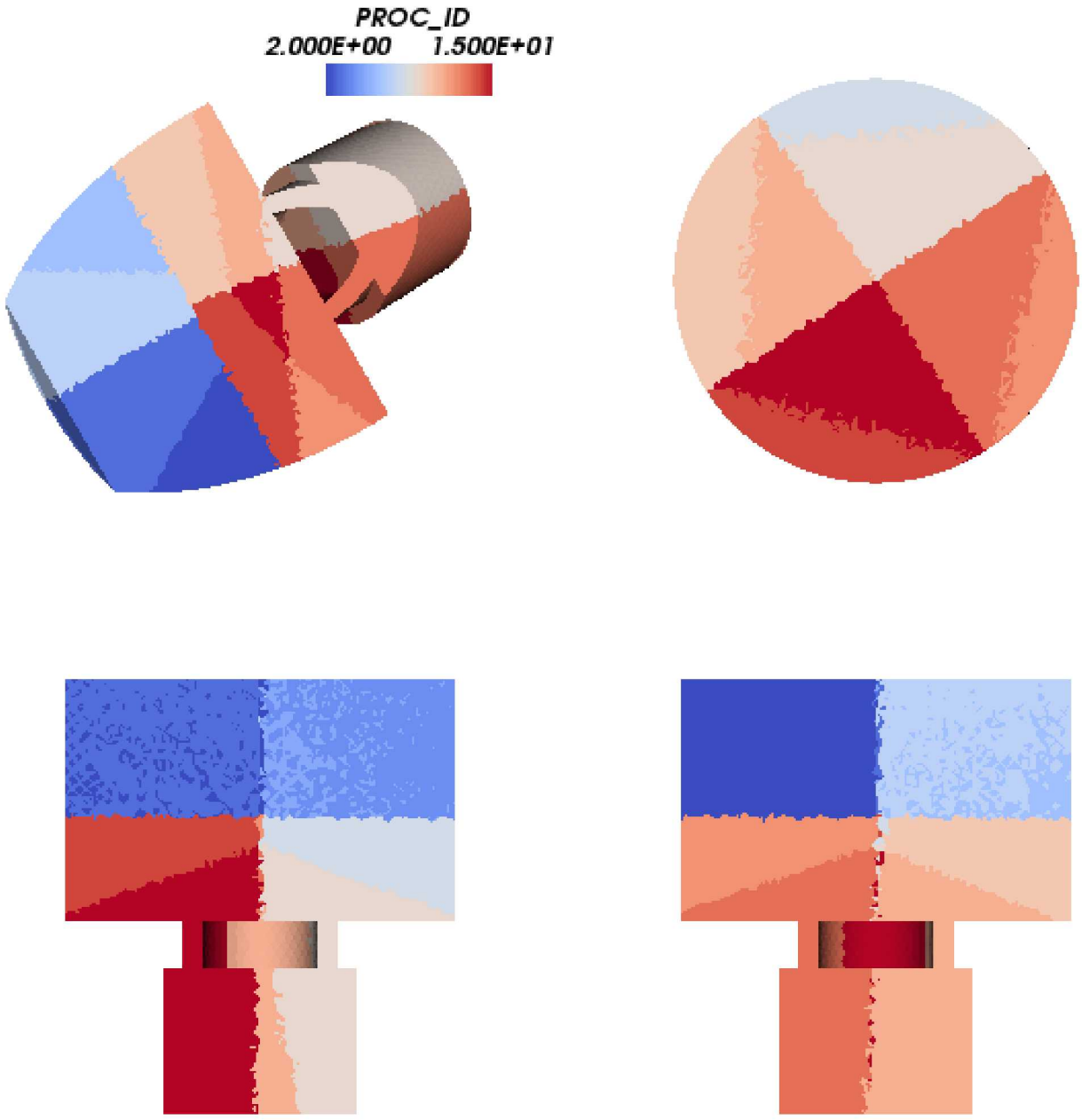

Figure 3.87: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 1.664621685e-09)

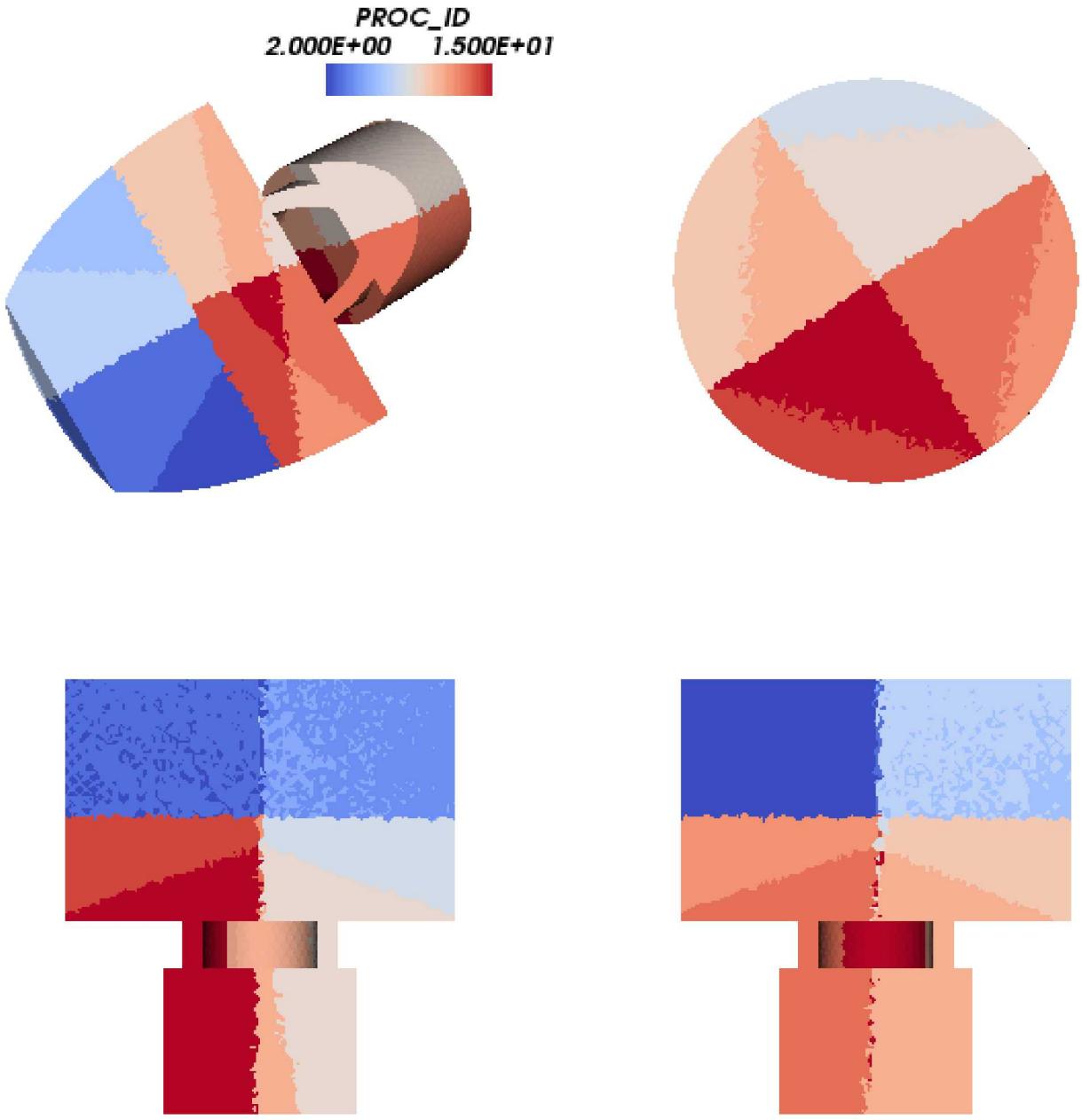

Figure 3.88: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 2.21949558e-09)

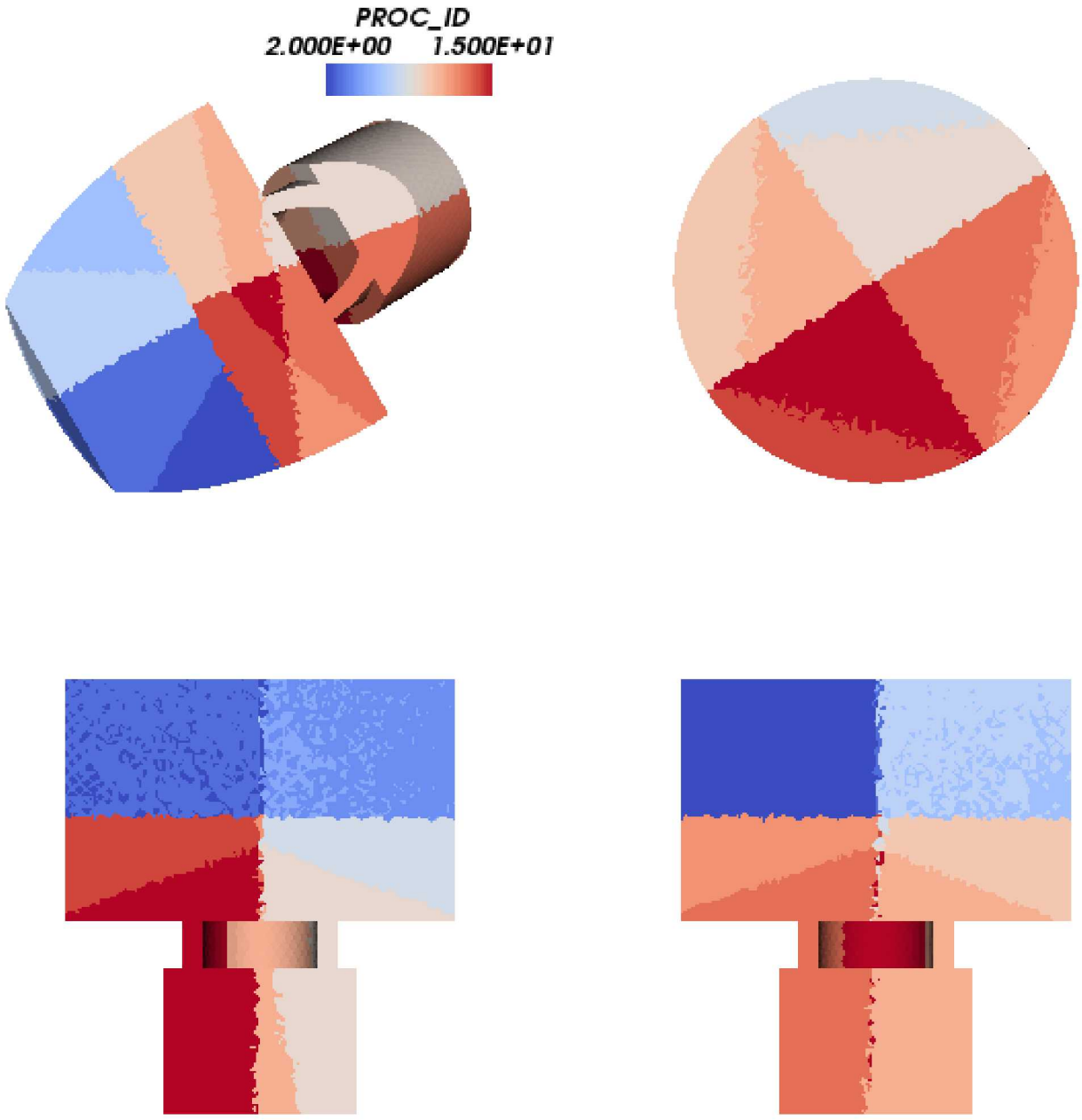

Figure 3.89: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 2.774369475e-09)

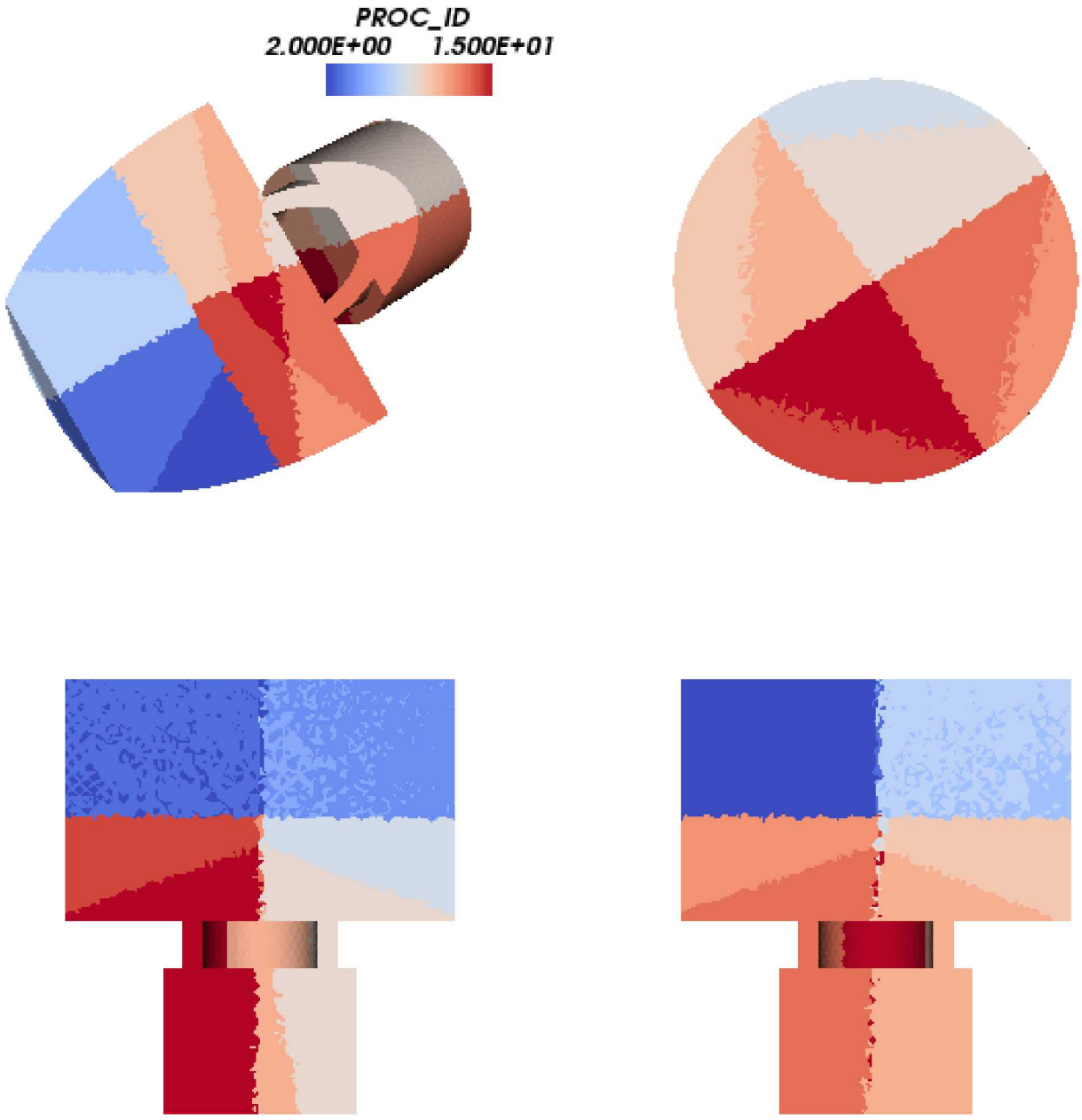

Figure 3.90: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 3.32924337e-09)

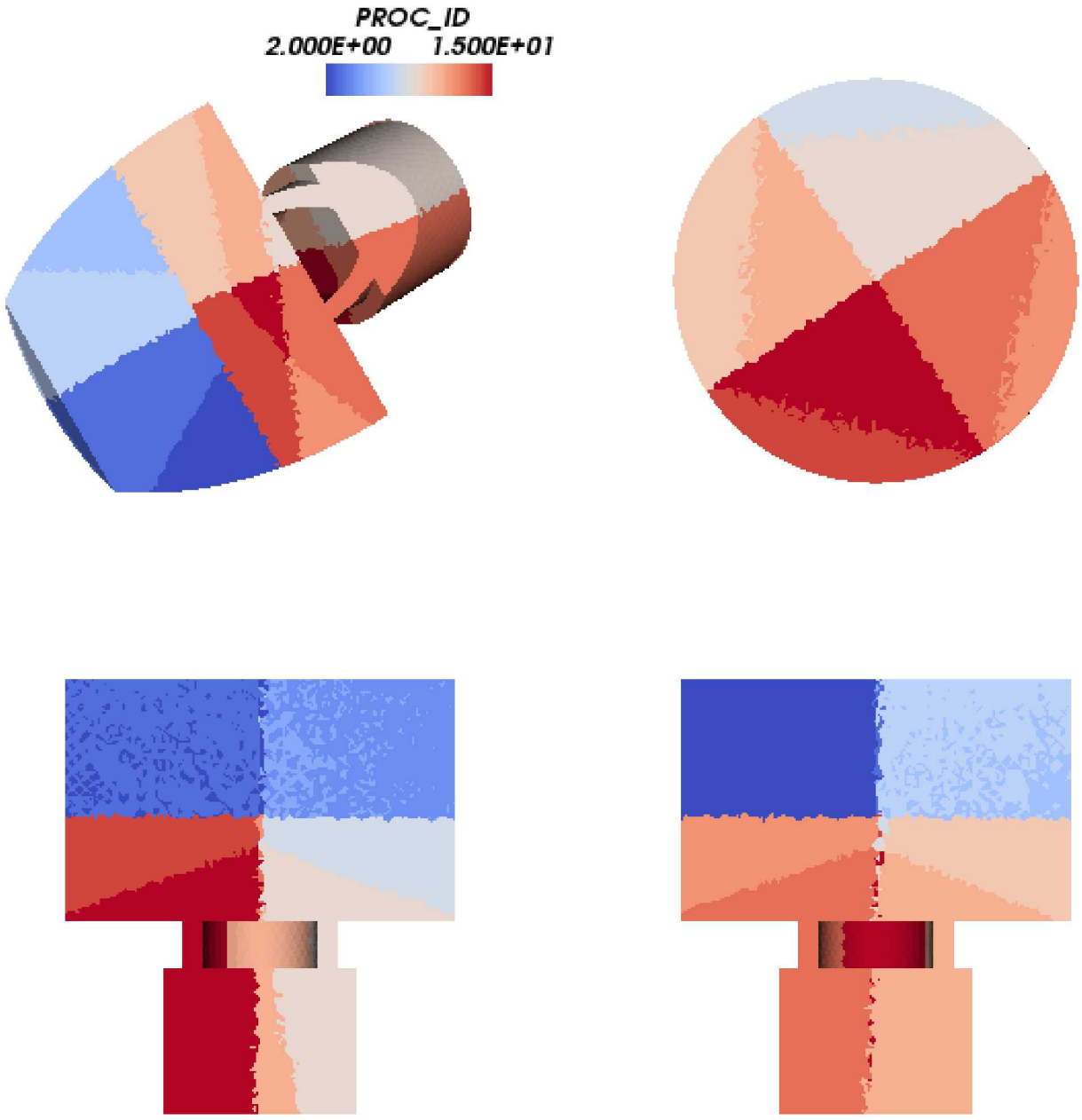

Figure 3.91: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 3.884117265e-09)

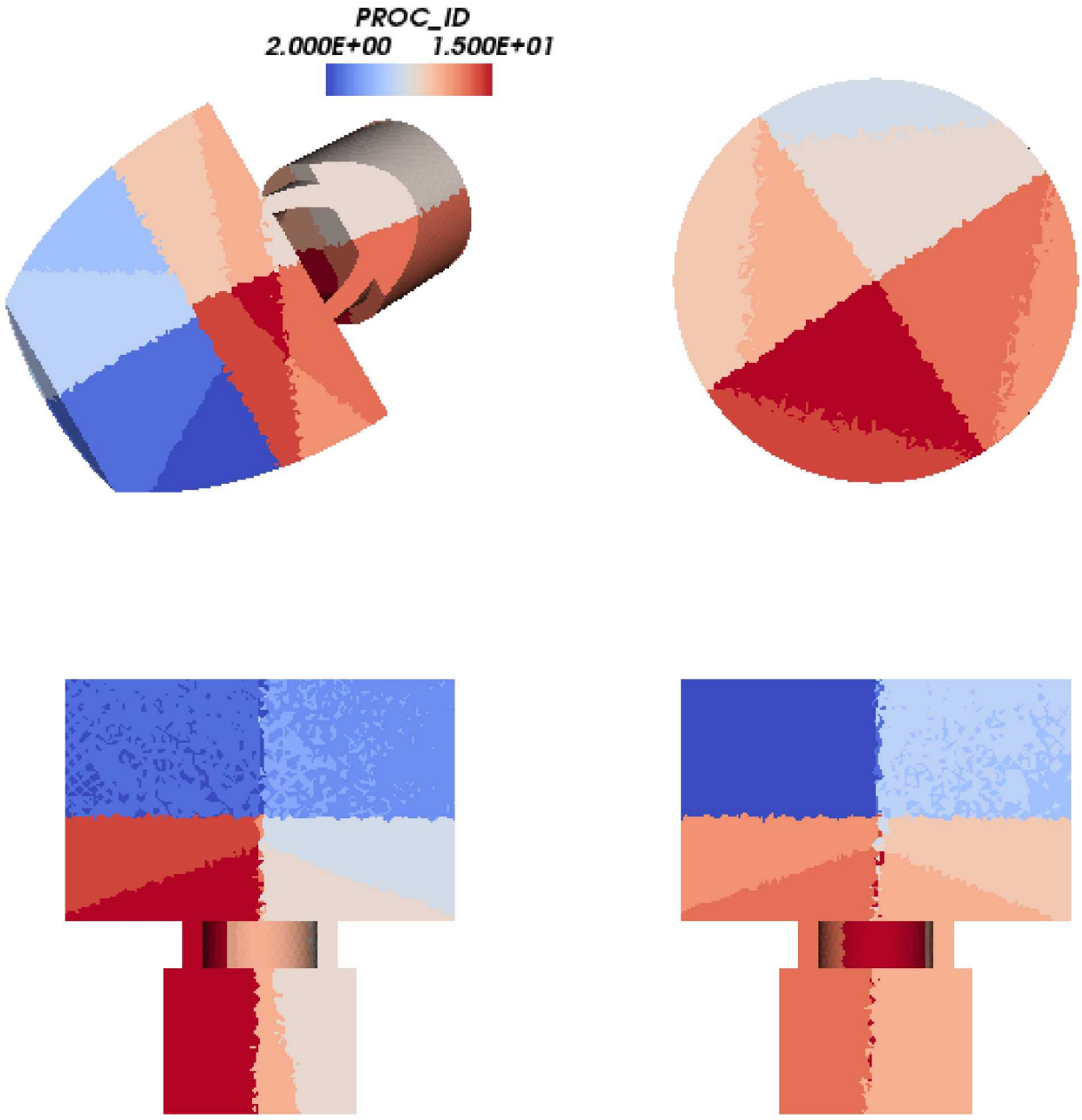

Figure 3.92: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 4.43899116e-09)

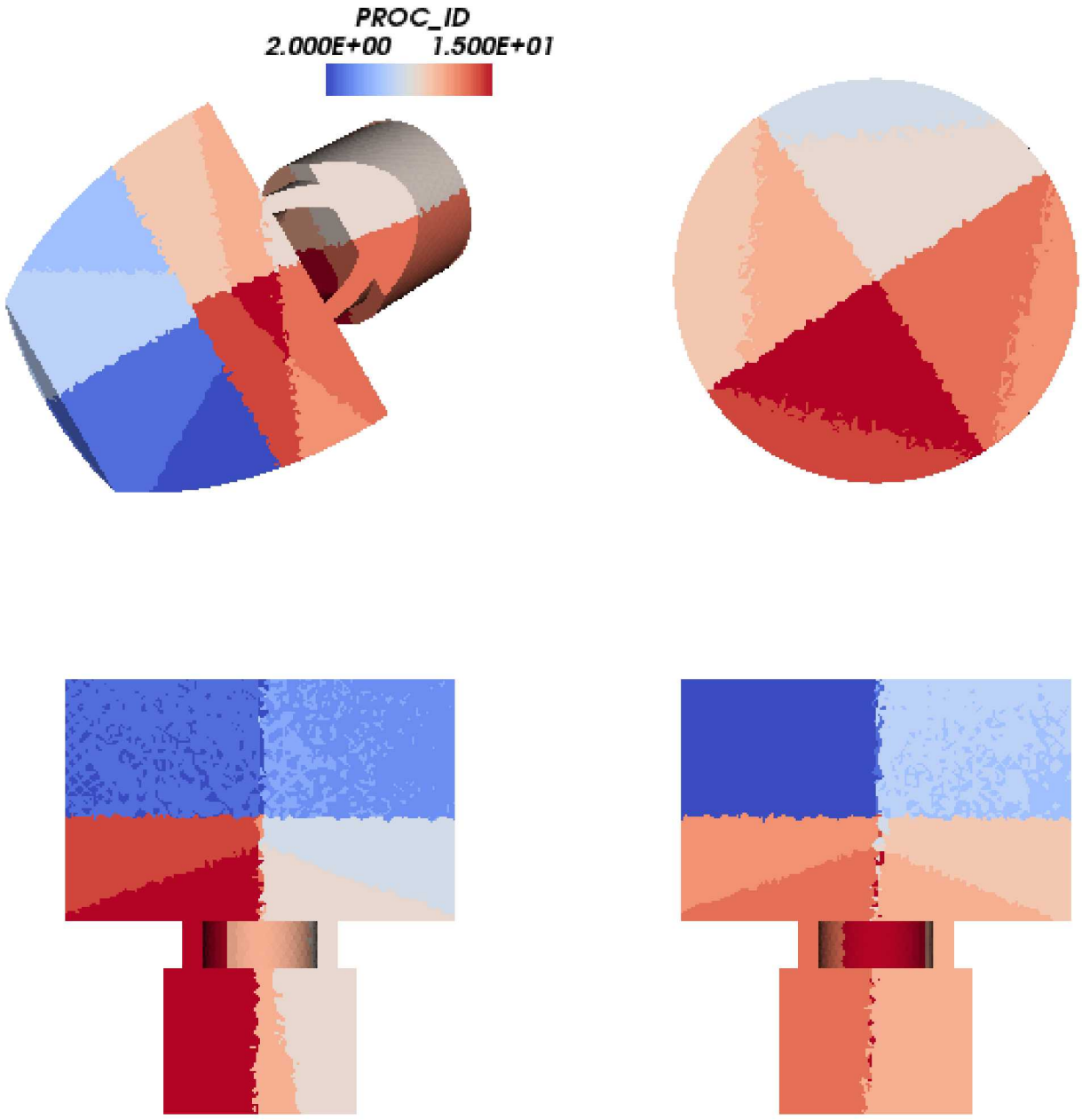

Figure 3.93: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 4.993865055e-09)

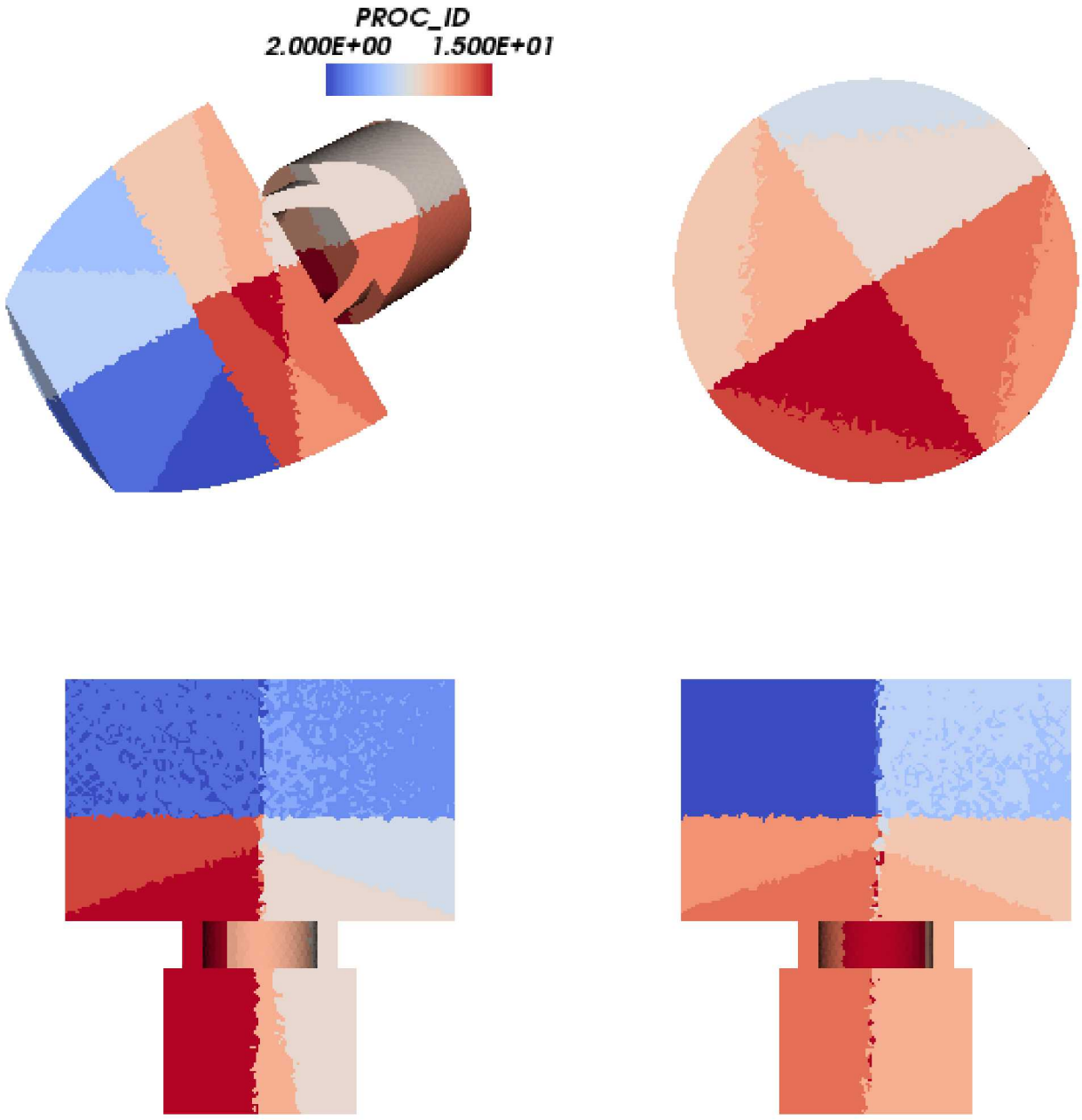

Figure 3.94: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 5.54873895e-09)

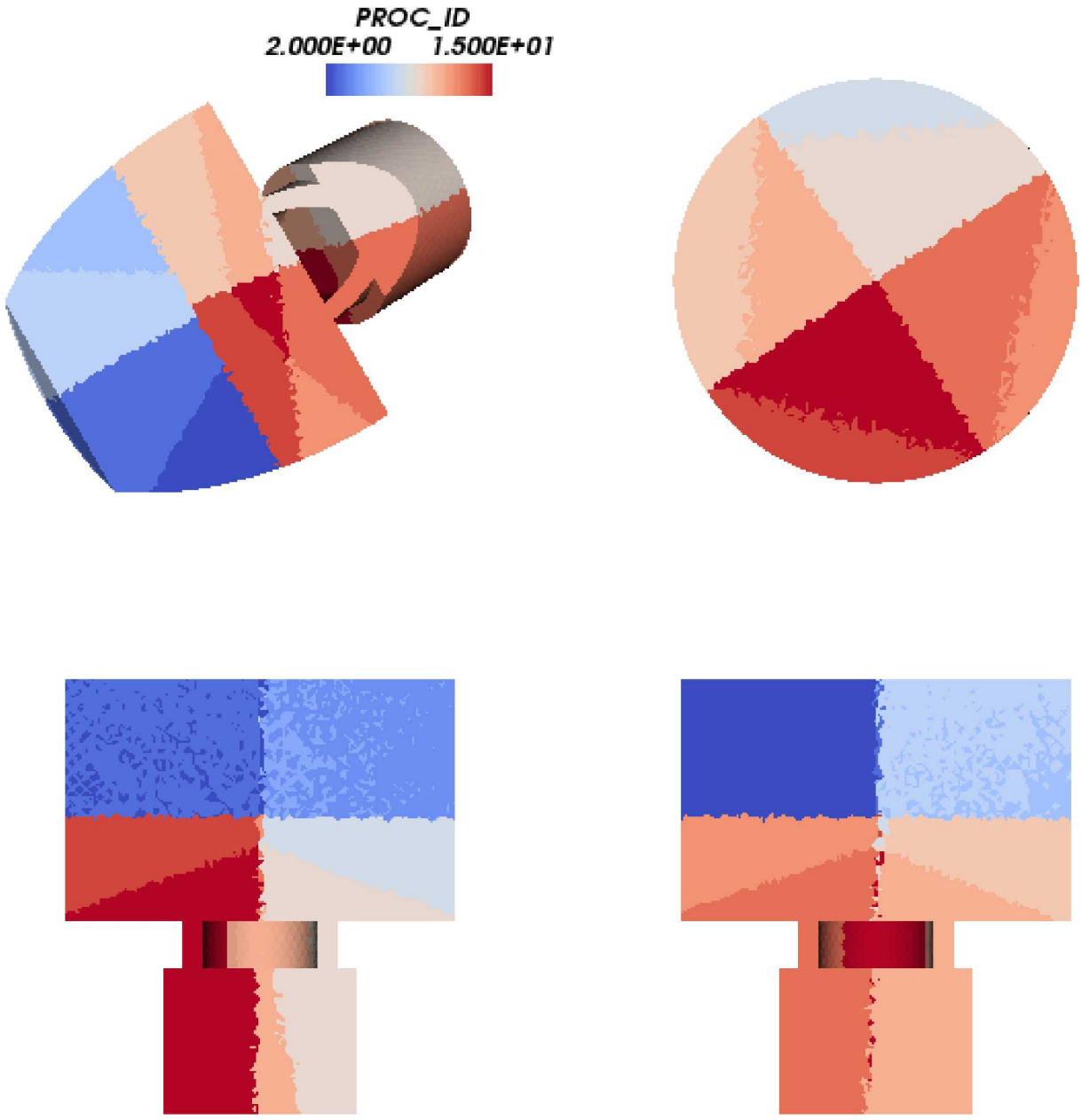

Figure 3.95: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 6.103612845e-09)

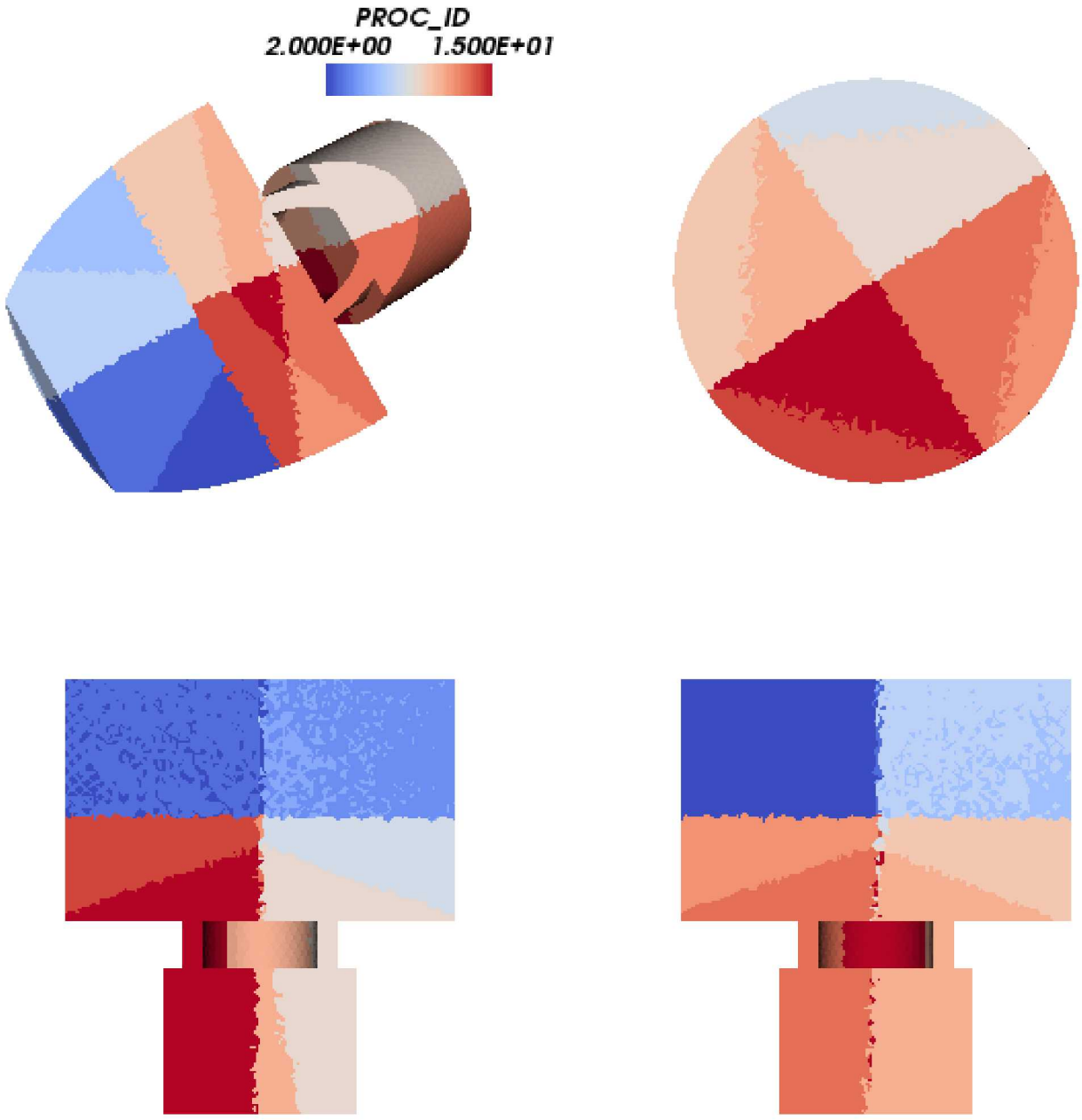

Figure 3.96: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 6.65848674e-09)

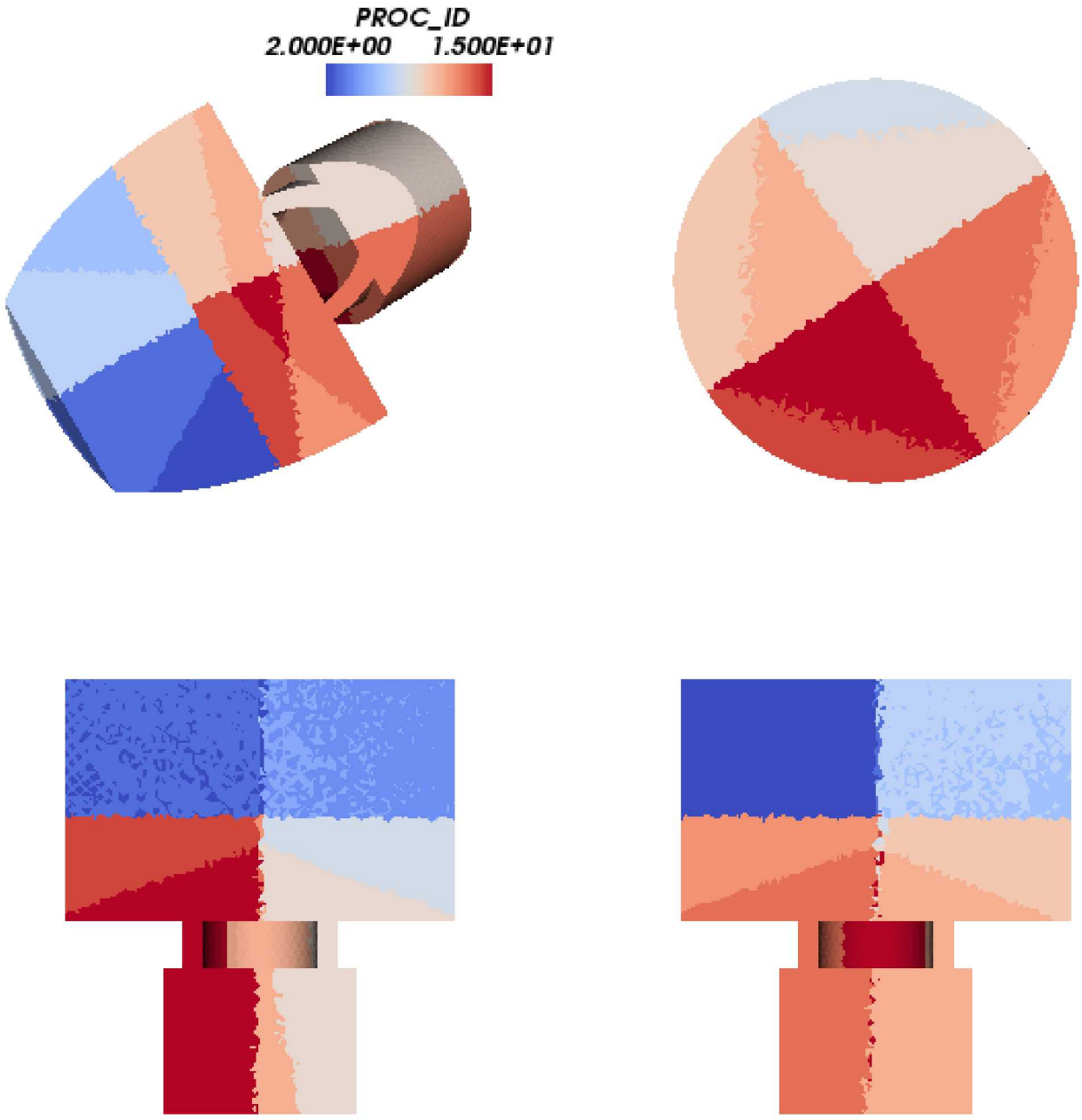

Figure 3.97: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 7.213360635e-09)

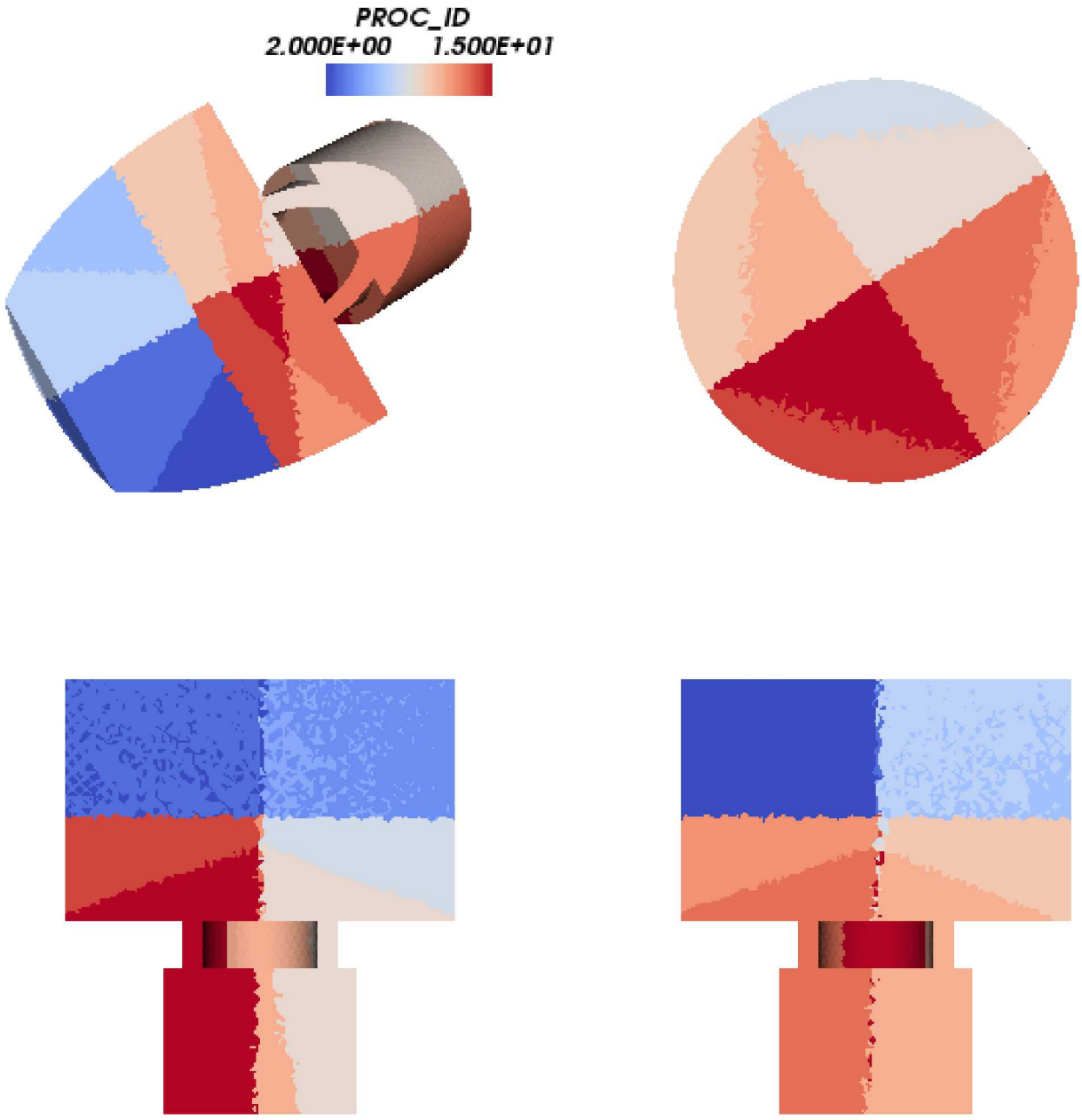

Figure 3.98: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 7.76823453e-09)

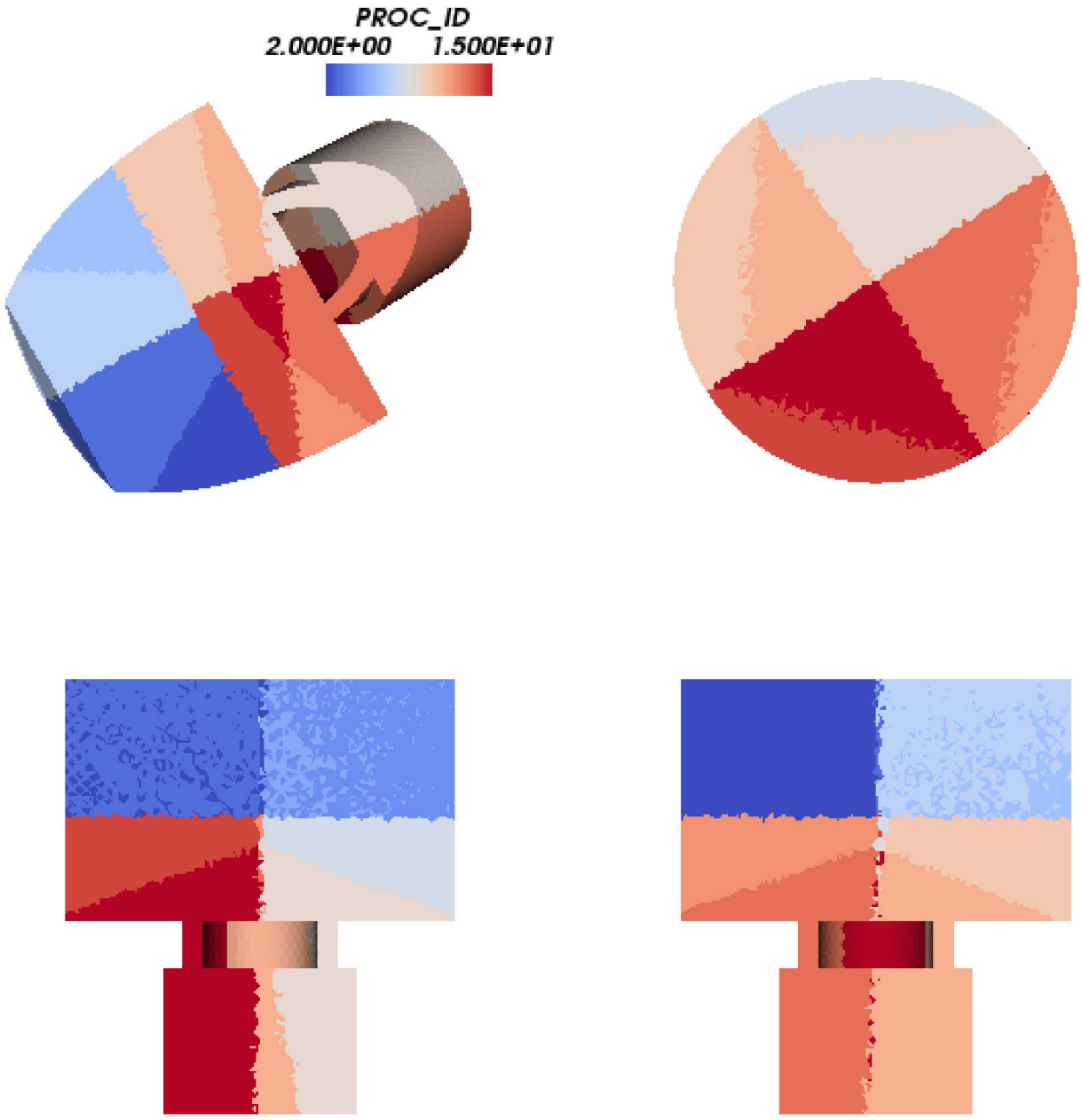

Figure 3.99: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 8.323108425e-09)

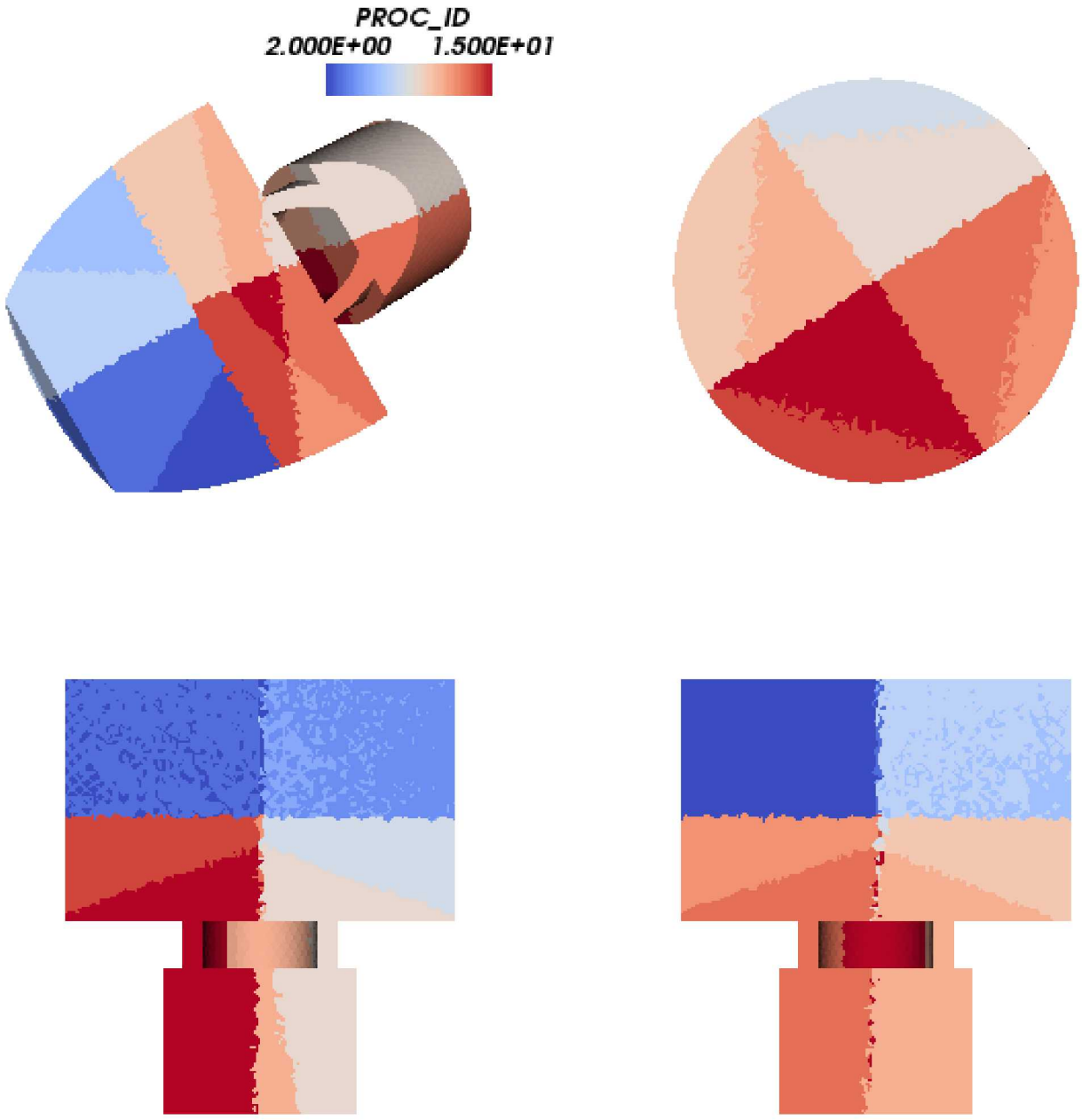

Figure 3.100: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 8.87798232e-09)

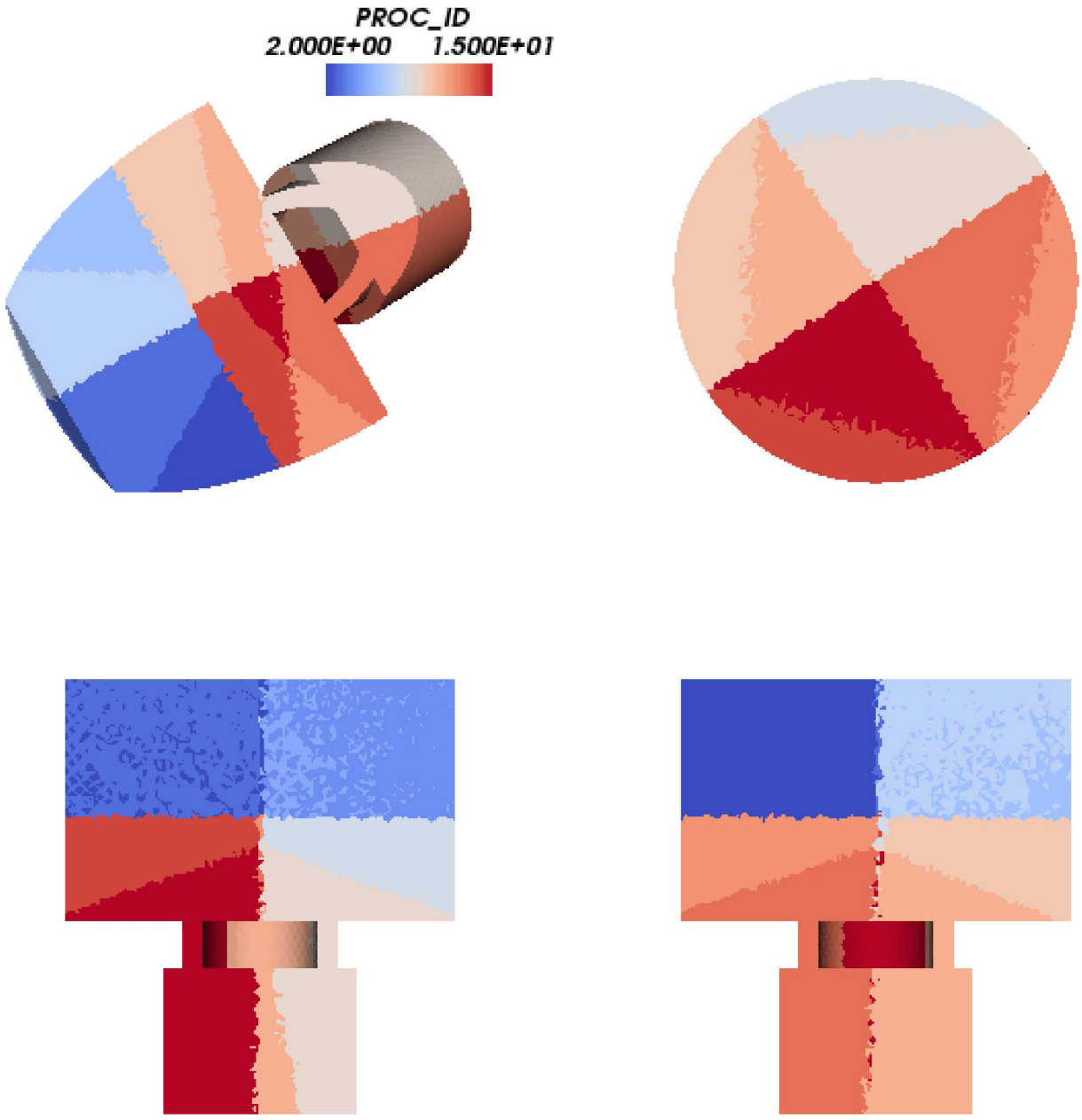

Figure 3.101: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 9.432856215e-09)

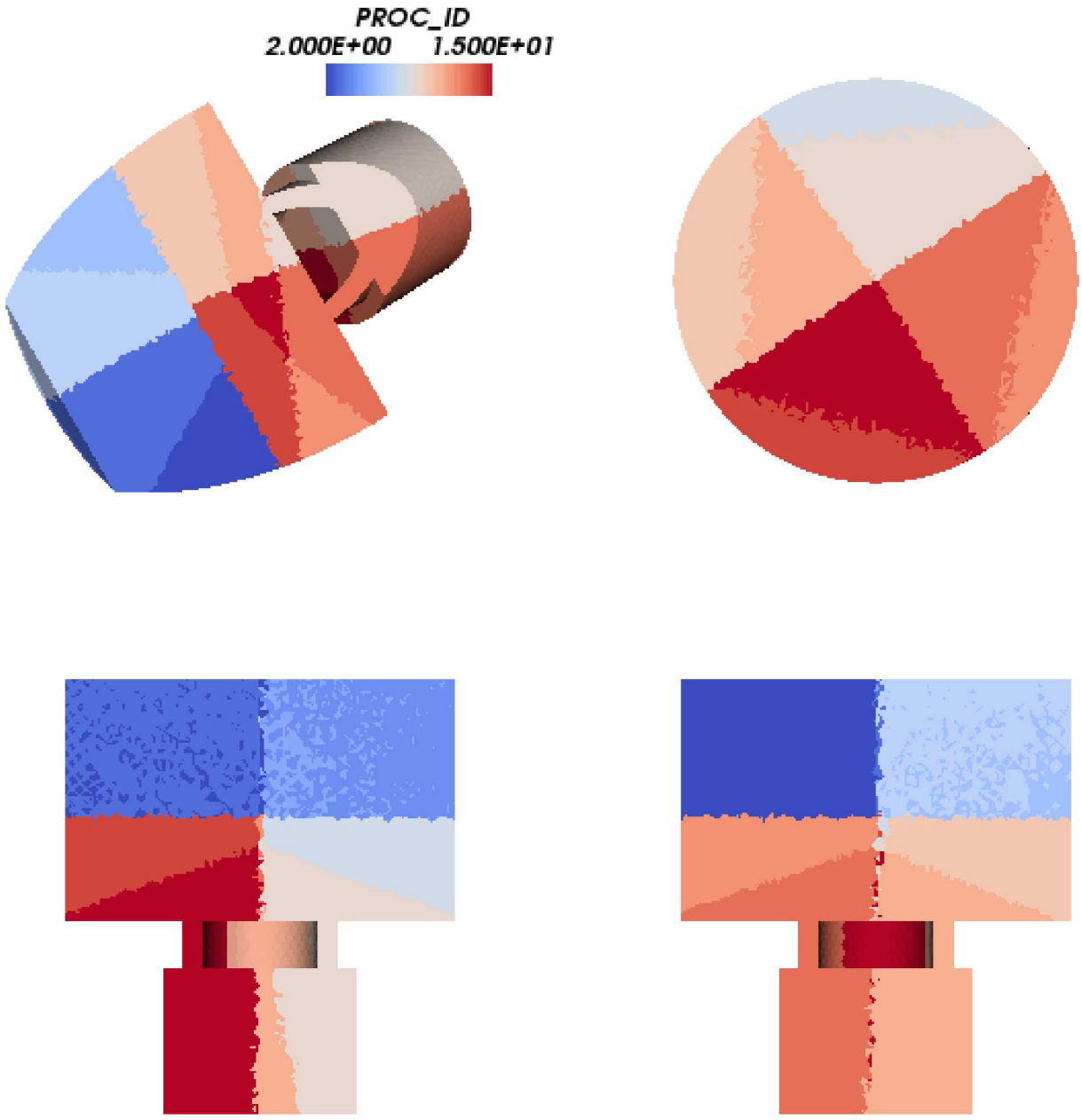

Figure 3.102: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 9.98773011e-09)

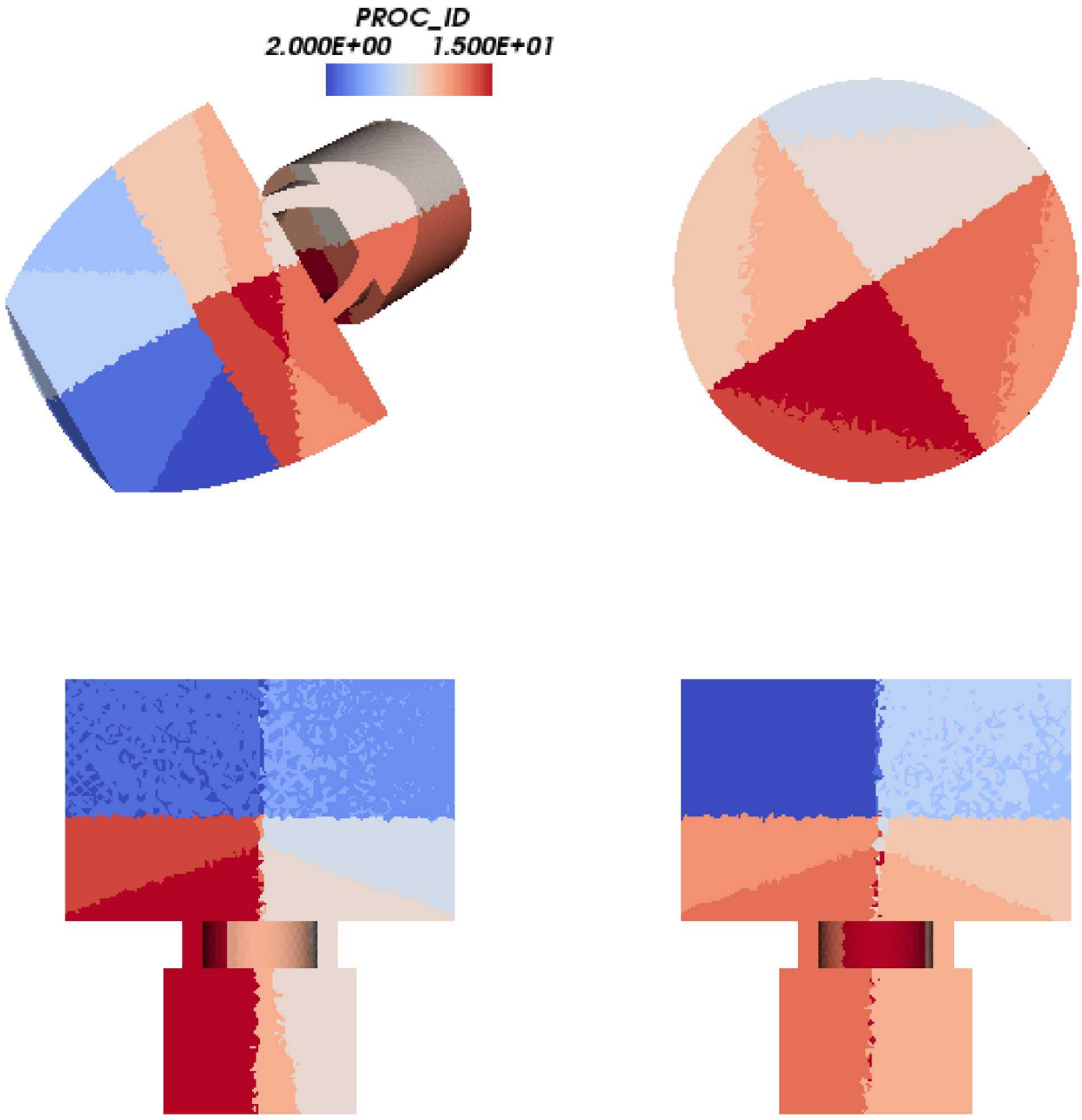

Figure 3.103: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 1.0542604005e-08)

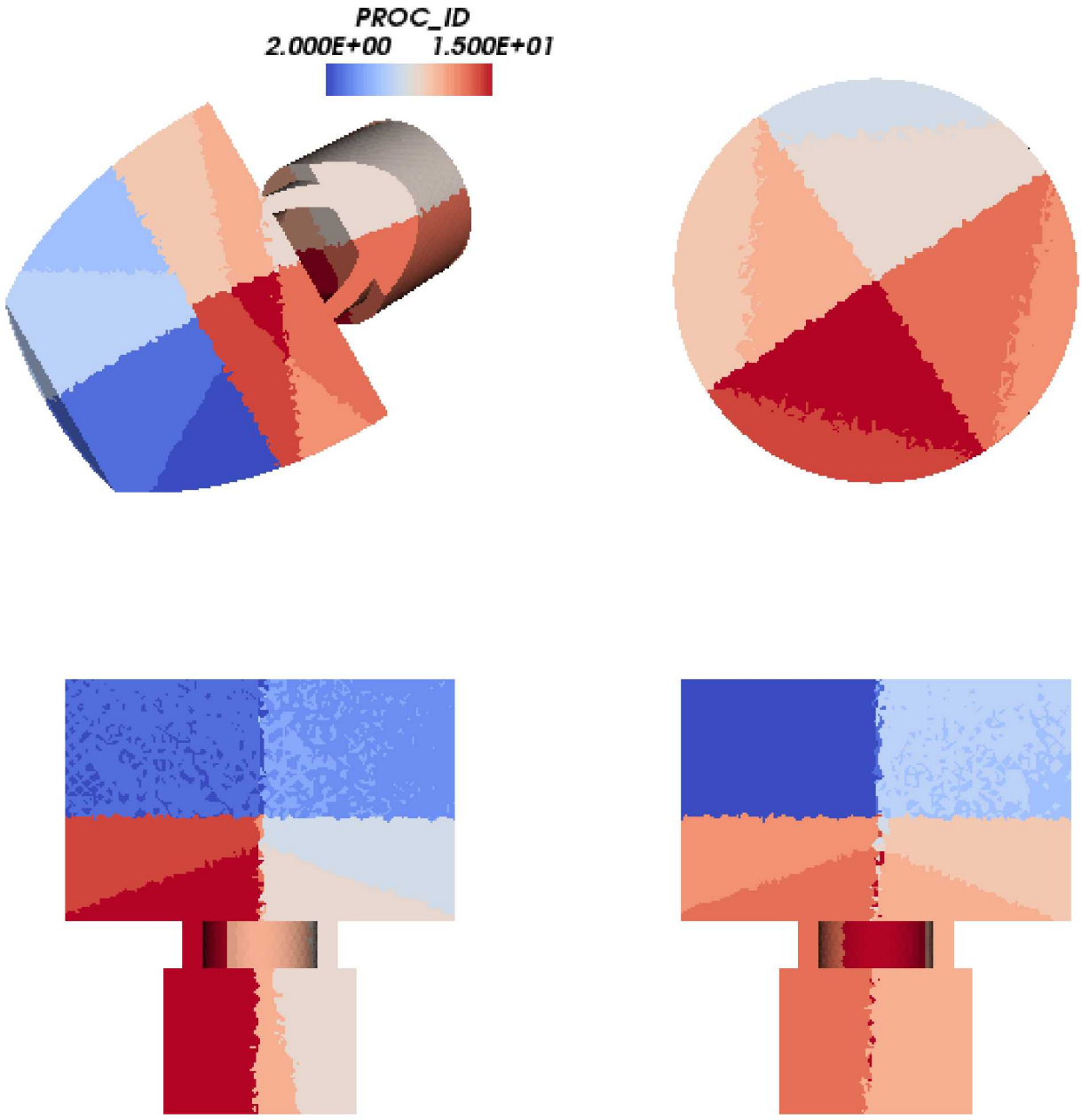

Figure 3.104: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

Variable PROC_ID (element-based scalar at time 1.10974779e-08)

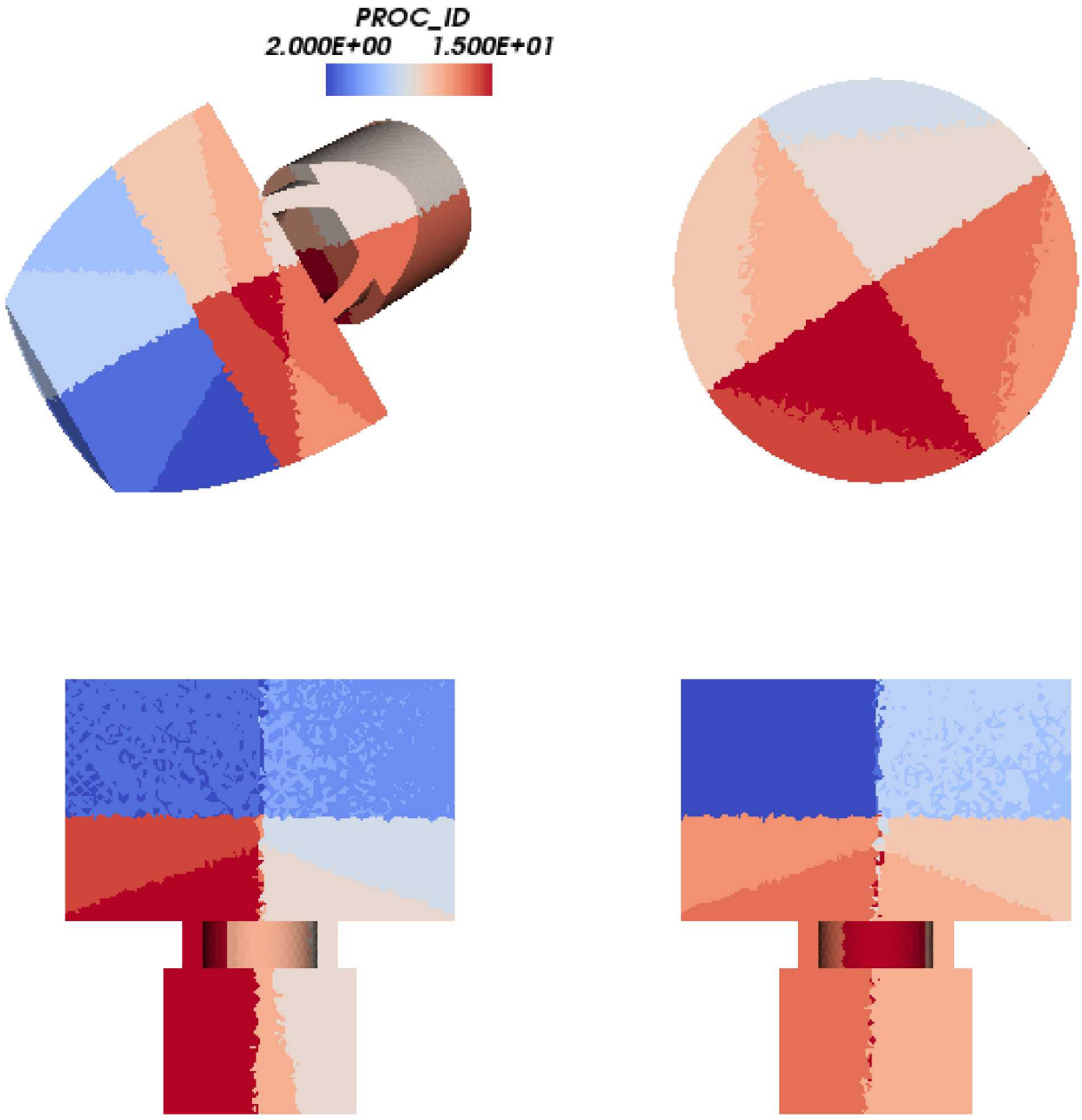

Figure 3.105: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) views of the mesh surface, colored by PROC_ID.

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