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Title:	IMPACT Project Integrated Modeling of Perturbations in Atmospheres for Conjunction Tracking A New Orbital Prediction Model to Avoid Collisions in Space
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IMPACT Project

Integrated Modeling of Perturbations in Atmospheres for Conjunction Tracking

A New Orbital Prediction Model to Avoid Collisions in Space

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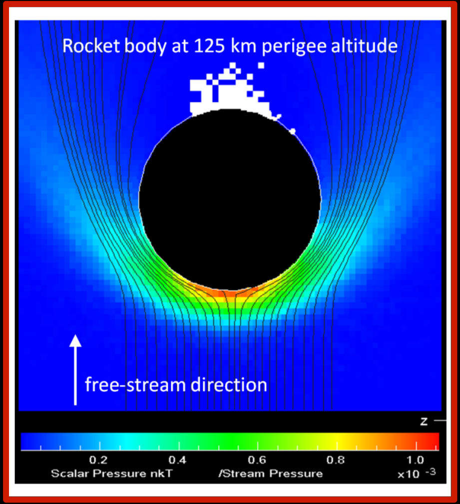
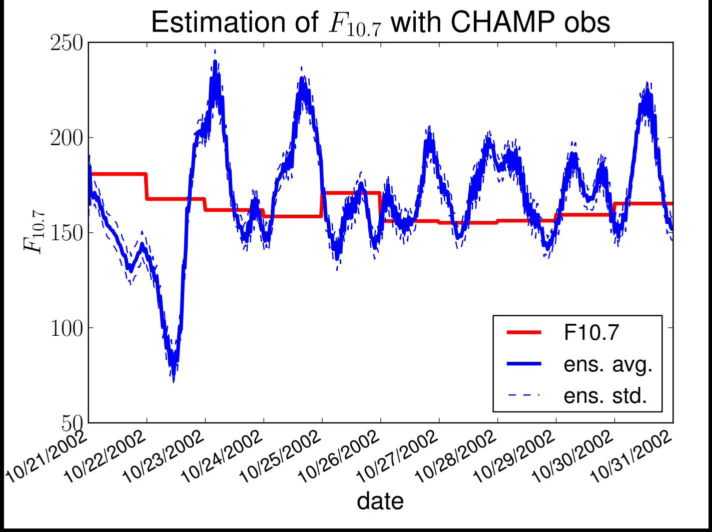
Integrated Modeling of Perturbations in Atmospheres for Conjunction Tracking

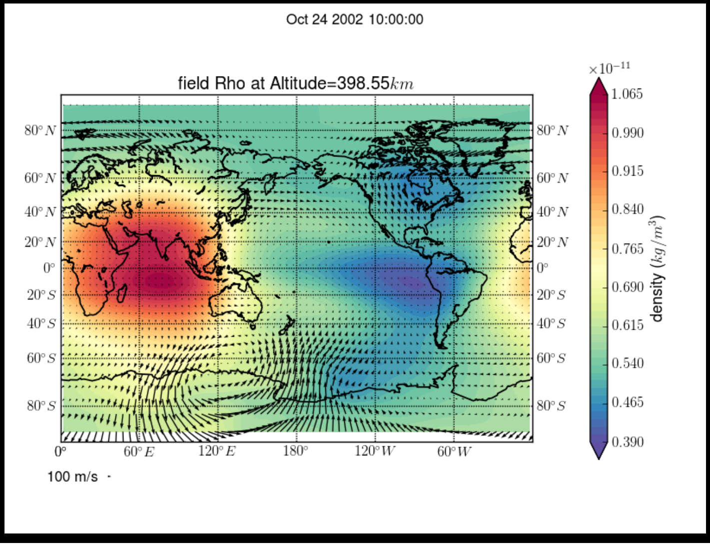
- We are developing a new physics-based satellite drag model to accurately predict satellite paths and to prevent collisions in space.
- Institutional Computing resources have been used to
  - develop a data assimilative thermospheric density model
  - employ Direct Simulation Monte Carlo calculations of the satellite drag coefficient
- First results include
  - Ensemble Kalman Filter method used to estimate the coupling between solar drivers and thermospheric density changes
  - First self-consistent drag coefficients calculations using the physics-based and assimilative thermosphere model

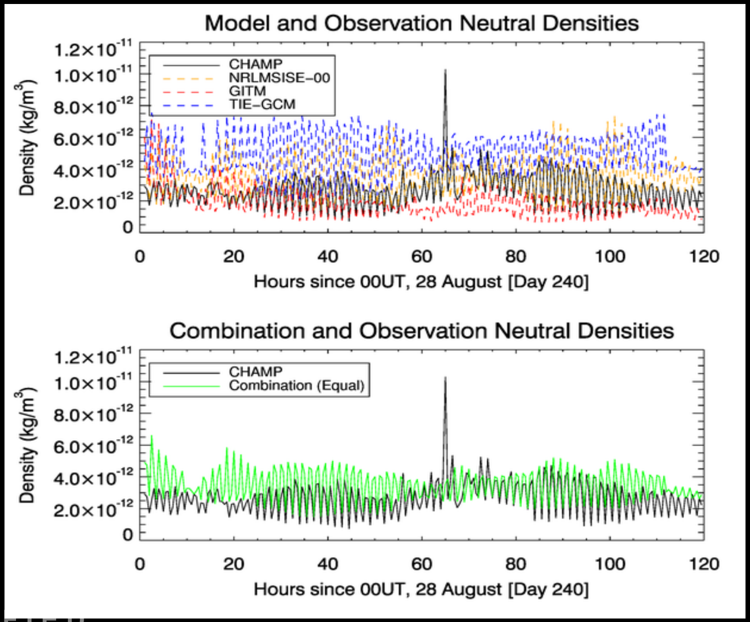


Rocket body simulation in low Earth orbit

Assimilative thermosphere model is filling gaps in sparse data set







Data Assimilation: Enhancing the GITM model using a localized ensemble transform Kalman Filter. Top left: Estimated F10.7 using assimilation to drive GITM. Top right: GITM result after assimilating CHAMP data. Bottom right: Multi-model simulation (GITM, TIE-GCM, MSIS) compared to CHAMP data and multi-model average.

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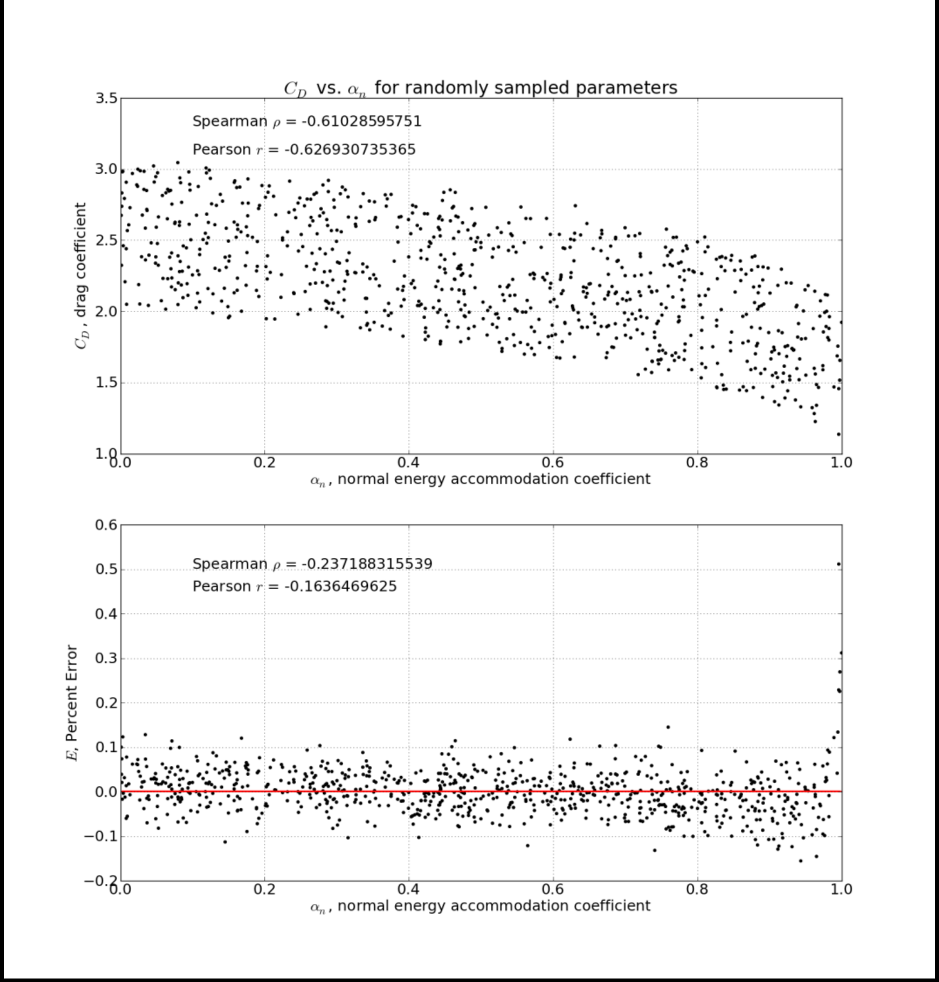
Drag coefficient calculation with Direct Simulation Monte Carlo Method (DSMC)



Drag Coefficient Modeling: The Drag coefficient is a function of chemical composition, thermospheric temperature, thermospheric densities, etc. All of these are affected by space weather. We are the first to perform self-consistent calculations of satellite drag coefficients using our physics-based model of neutral densities and chemical composition of the upper atmosphere.

Top plot: 1000 simulated drag coefficients as a function of energy accommodation coefficient.

Bottom plot: the associated error compared to a modified closed-form solution. Each data point represents a full serial Direct Simulation Monte Carlo (DSMC) simulation for the drag coefficient of a sphere. The input parameters for each simulation are sampled from the global parameter space using Latin Hypercube Sampling.