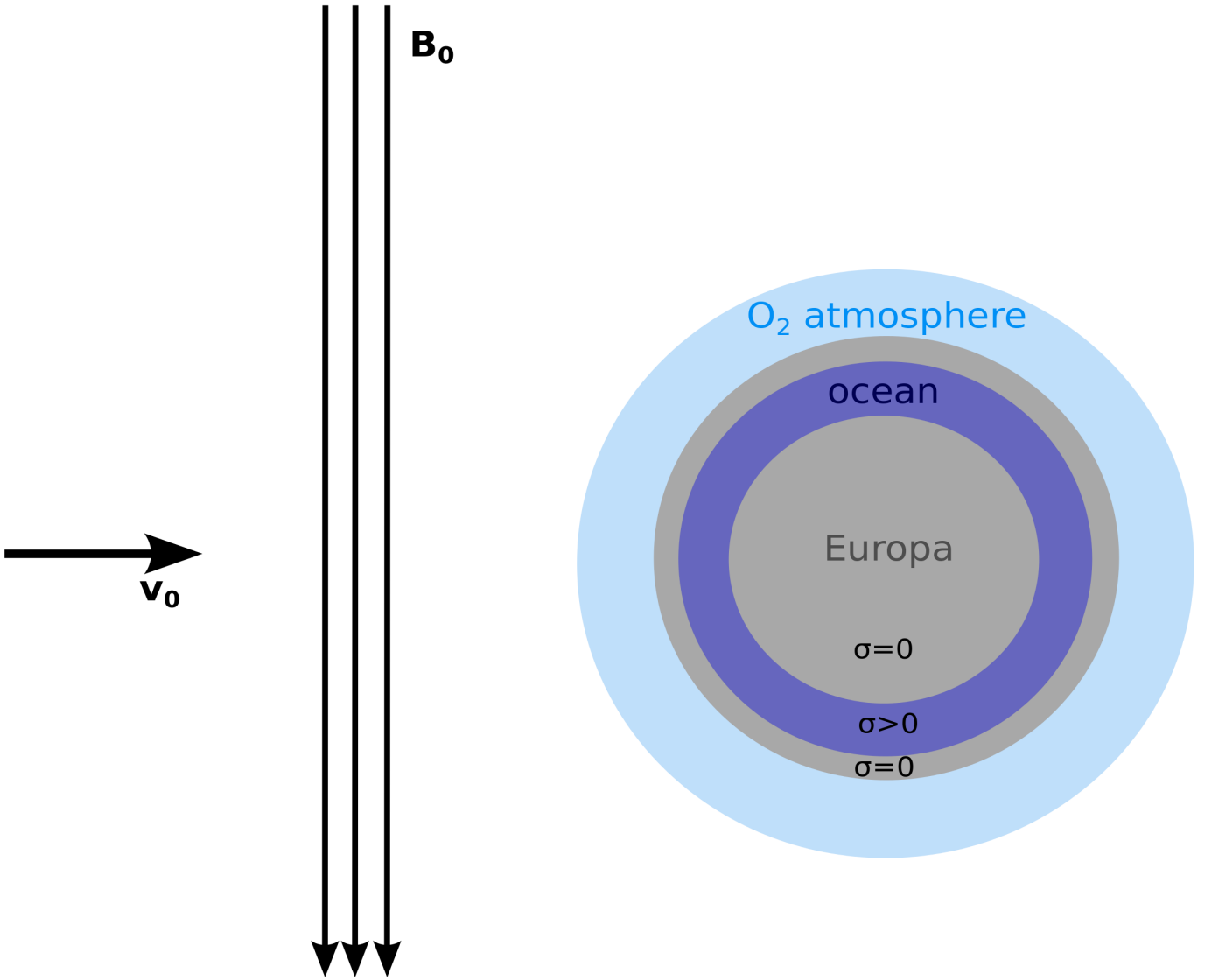
Modeling Europa's interaction with Jupiter's magnetosphere

MHD model



MHD model

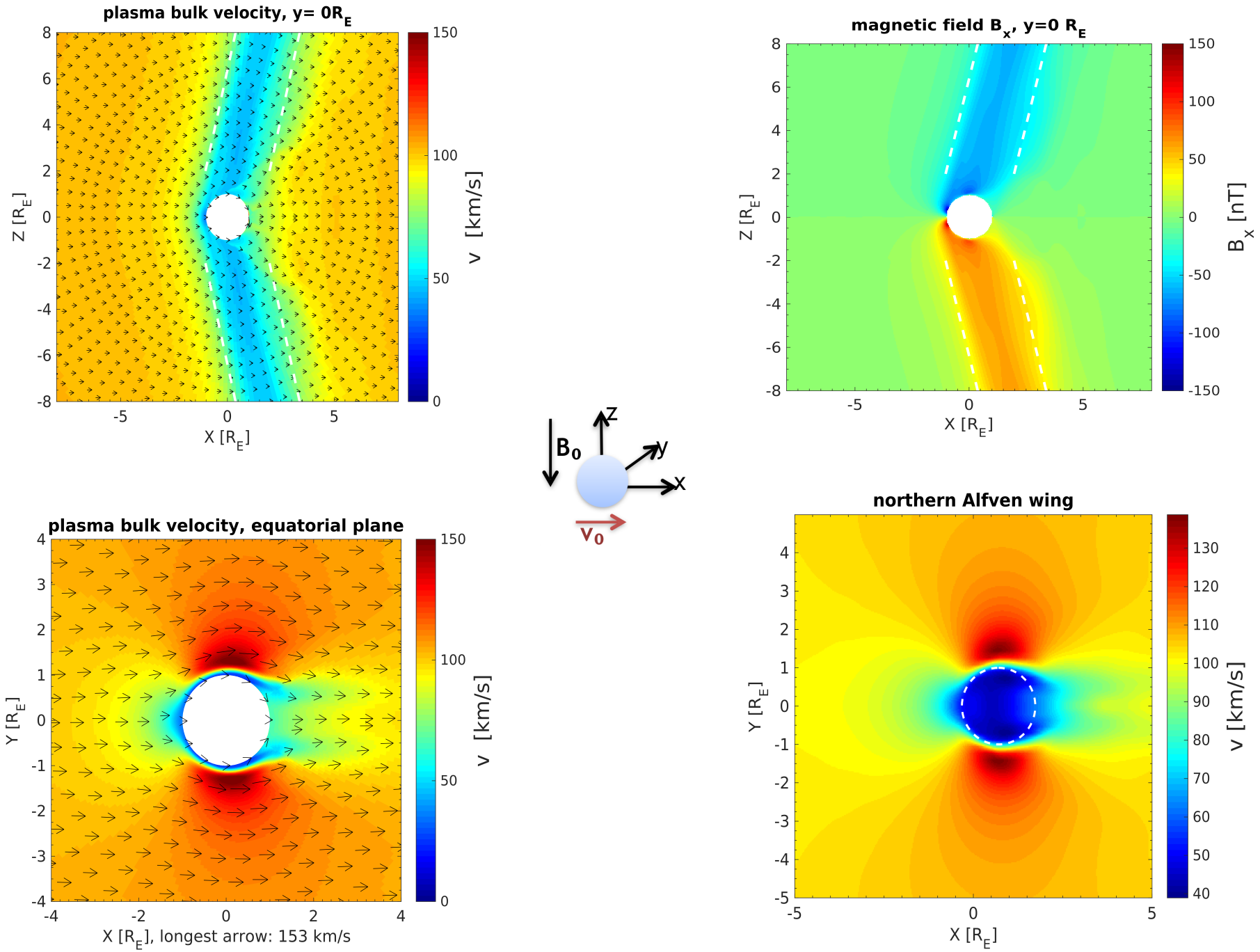
Continuity equation $$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \underline{v}) = (P - L) m_i$$

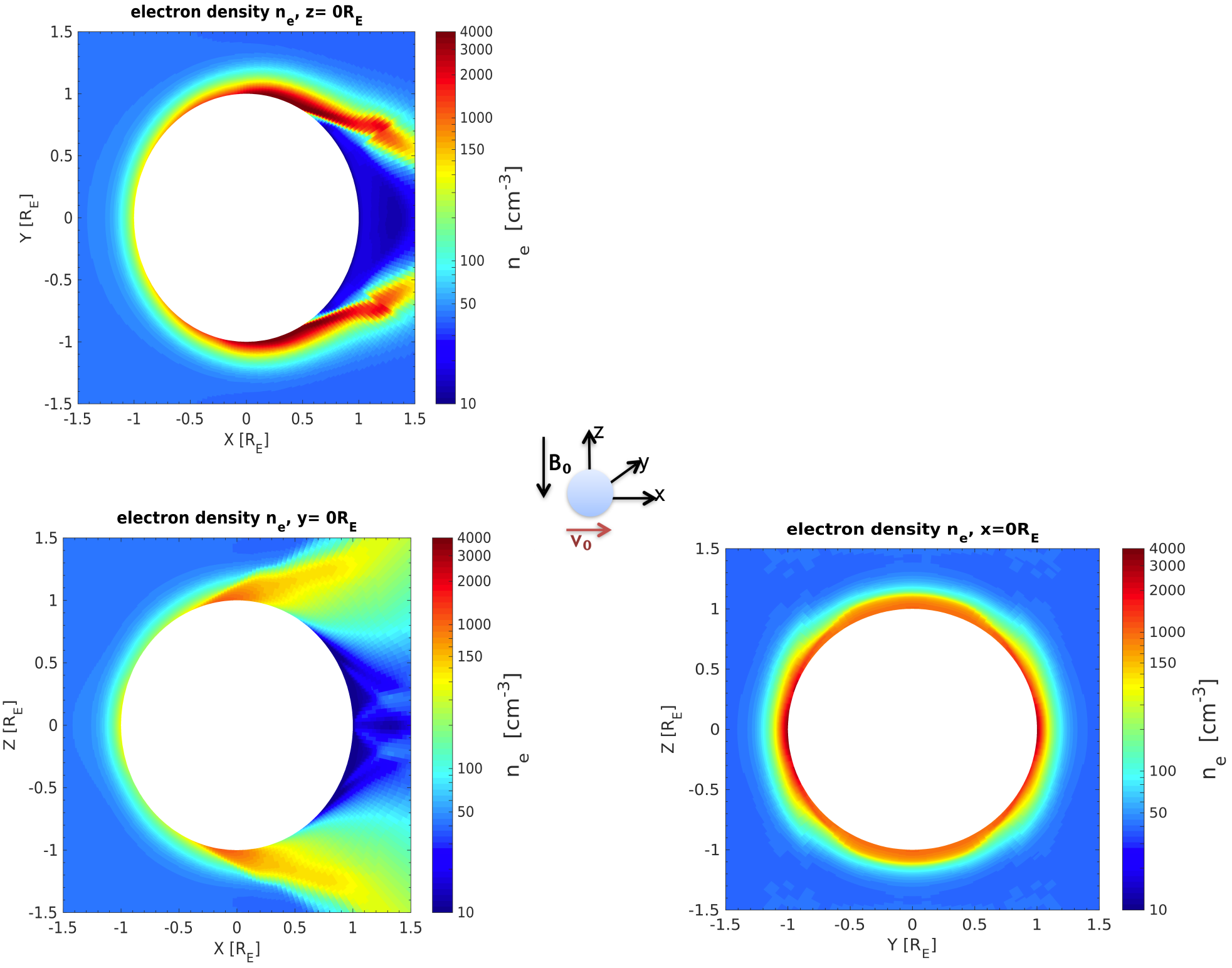
Momentum equation $$\rho \frac{d\underline{v}}{dt} = -\nabla p + \underline{j} \times \underline{B} - \rho \nu_{in} \underline{v} - P m_i \underline{v}$$

Induction equation $$\frac{\partial \underline{B}}{\partial t} = \nabla \times (\underline{v} \times \underline{B})$$

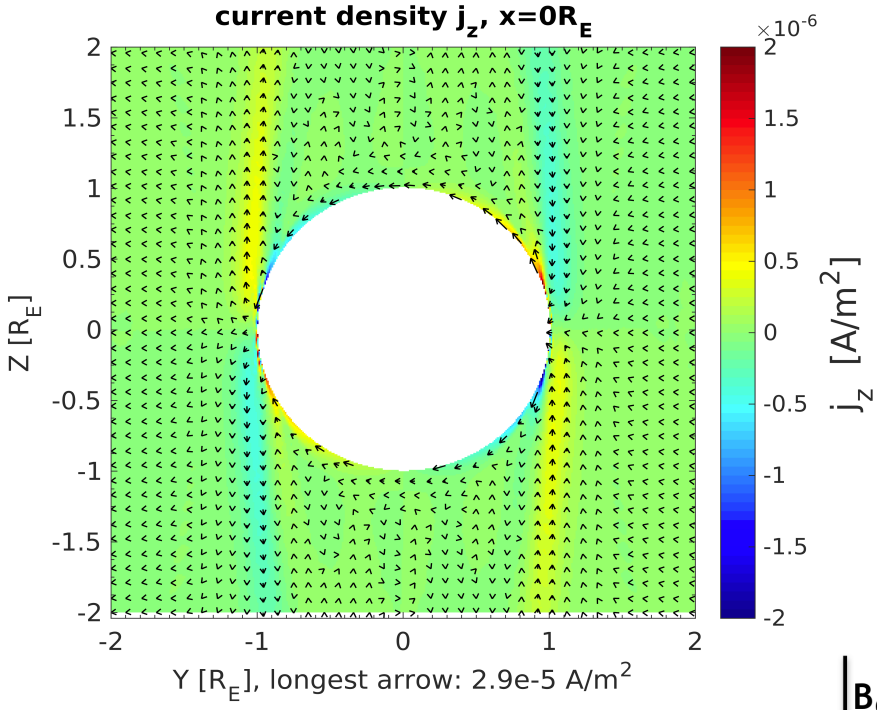
Energy equation $$\frac{\partial}{\partial t} \epsilon + \nabla \cdot (\epsilon \underline{v}) = -p \nabla \cdot \underline{v} - \frac{1}{2} v^2 (m_i P + \nu_{in} \rho) - \frac{3}{2} k_B T L$$

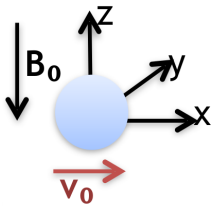
- Electron impact ionization, dissociative recombination, elastic ion-neutral collisions and charge exchange
- Induced fields can be included

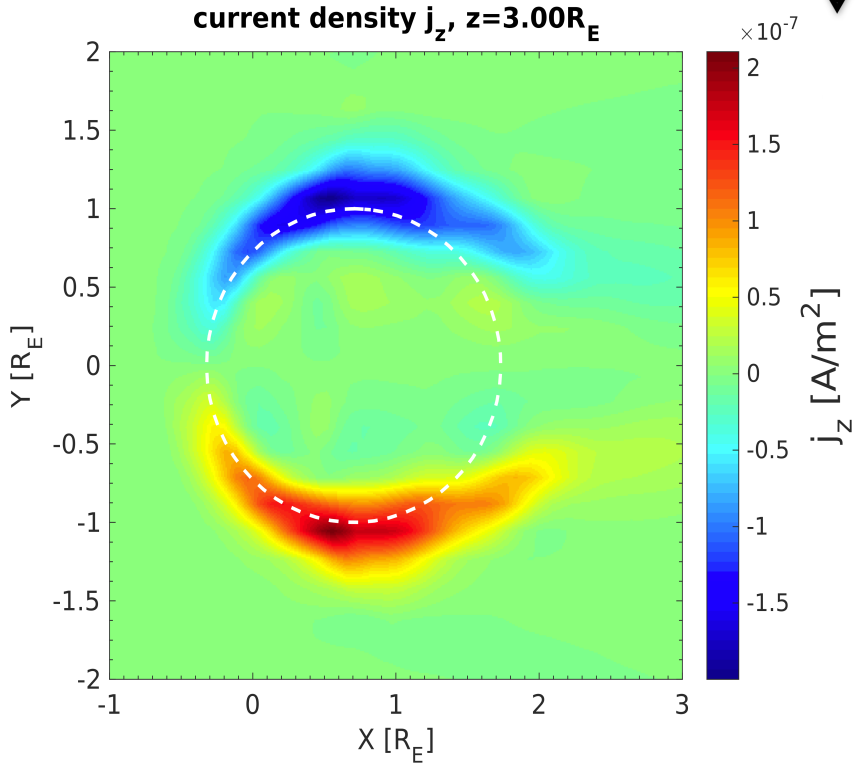

plasma bulk velocity, y= 0R_E
Z [R_E]
X [R_E]
v [km/s]
magnetic field B_x, y=0 R_E
B_x [nT]
B_0
z
y
x
v_0
plasma bulk velocity, equatorial plane
Y [R_E]
X [R_E], longest arrow: 153 km/s
northern Alfven wing

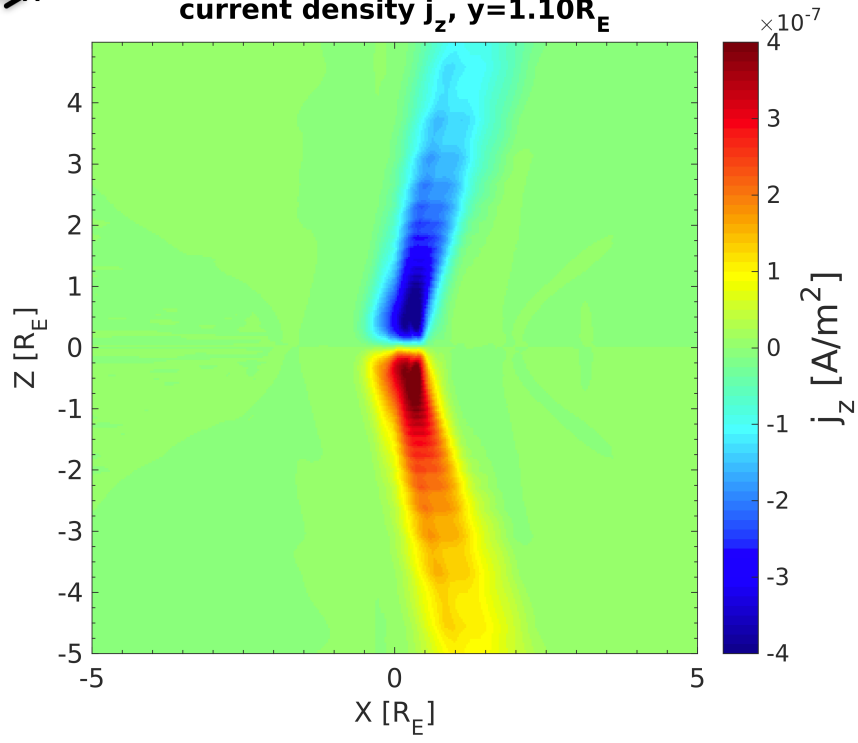

electron density n_e, z= 0R_E
Y [R_E]
X [R_E]
n_e [cm^{-3}]
4000
3000
2000
1000
150
100
50
10
B_0
z
y
x
v_0
electron density n_e, y= 0R_E
Z [R_E]
X [R_E]
electron density n_e, x=0R_E
Z [R_E]
Y [R_E]

field-aligned currents









Ionospheric current