Resolution dependence of magnetosheath waves in global hybrid-Vlasov simulations

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Simulations set-up
- Global hybrid-Vlasov model: VLASIATOR [1]
- Cartesian 2D spatial grid
- Cartesian 3D velocity grid
- Protons described as velocity distribution functions (VDFs)
- Electrons as a cold massless charge neutralizing fluid
- Closure of the system: generalised Ohm’s law with Hall term
- Noon-midnight meridional plane (X-Z)
- Inner boundary at 4.7 RE from the centre of the Earth
- Solar wind: flowing in -X direction, 750 km/s
- IMF: 5 nT, 45 degrees angle with respect to X, southward
- Temperature: 0.5 MK
- Density: 1 cm⁻³

Three different spatial resolutions

\[ \Delta r = 300 \text{ km} = 0.76 \text{ di} \]
\[ \Delta r = 600 \text{ km} = 0.38 \text{ di} \]
\[ \Delta r = 900 \text{ km} = 0.25 \text{ di} \]

Ion-scale waves
- Fast Fourier Transform
- Mirror Modes [2]

Velocity Distribution Functions

• Proton cyclotron and Mirror instabilities well resolved at \( \Delta r = 300 \text{ km} \). Sufficient maximum resolution
• Proton cyclotron instability not resolved at \( \Delta r = 900 \text{ km} \)
• Temperature anisotropy increases at low resolution due to not resolving AIC waves

Temperature anisotropy

\[ \Delta r = 440 \text{ km} = 0.6 \text{ di} \] presents an acceptable minimum resolution for study of magnetosheath waves in global hybrid-Vlasov

Alfvén Ion Cyclotron waves
circularly polarised

Left-handed → [Alfvén Ion Cyclotron waves]

Mirror Modes [2]