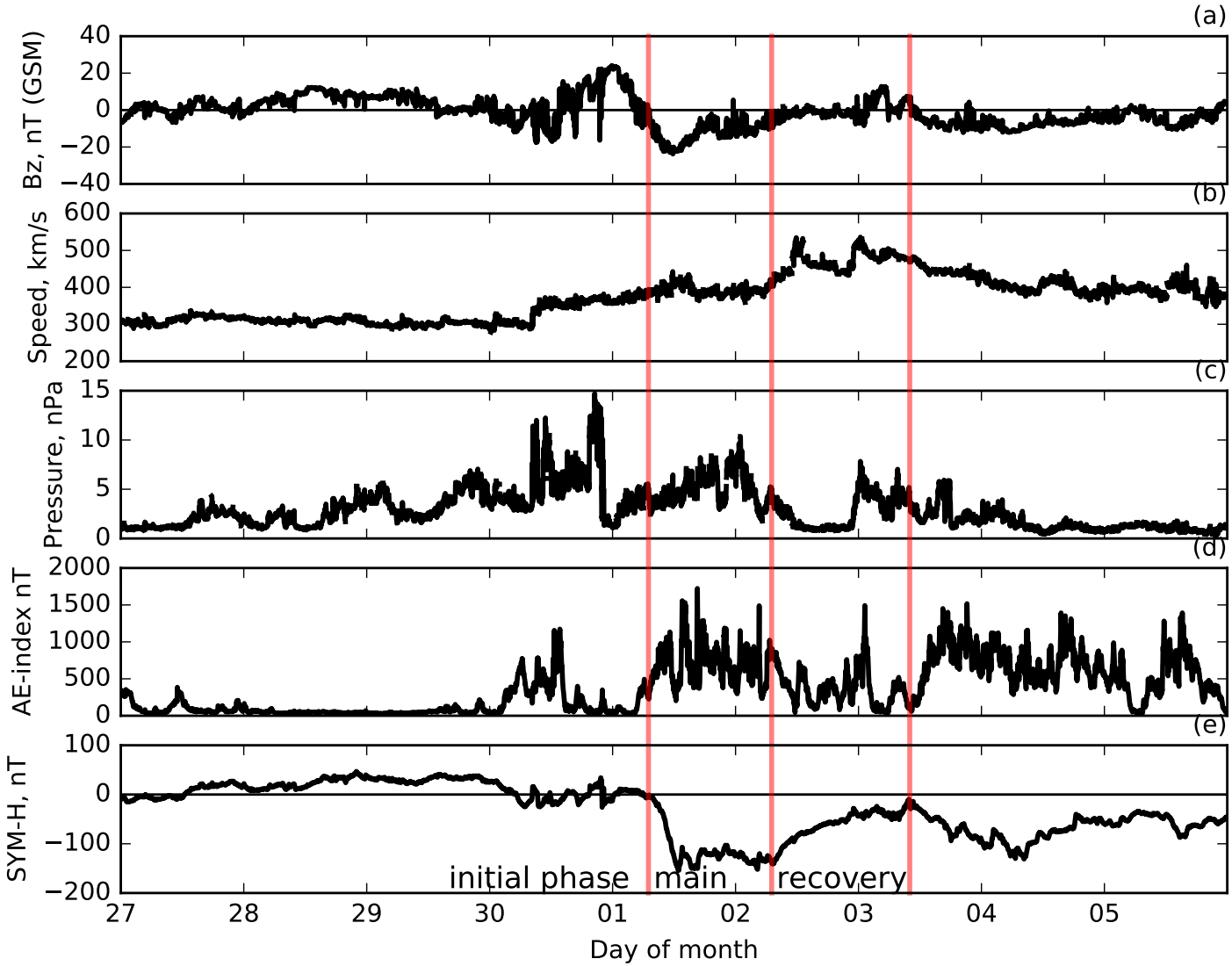
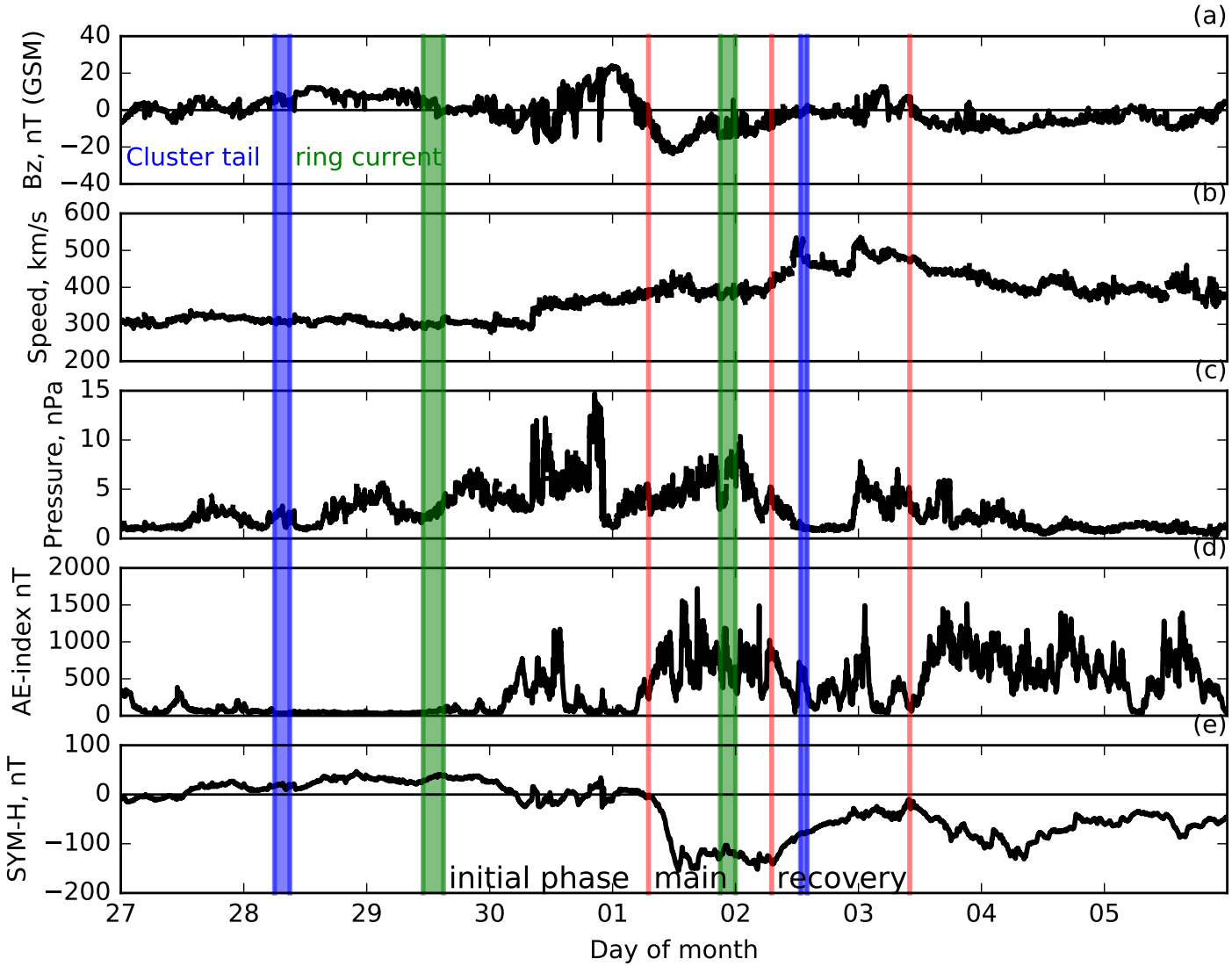
Tutorial: magnetic storm on Sep 27 – Oct 4, 2002



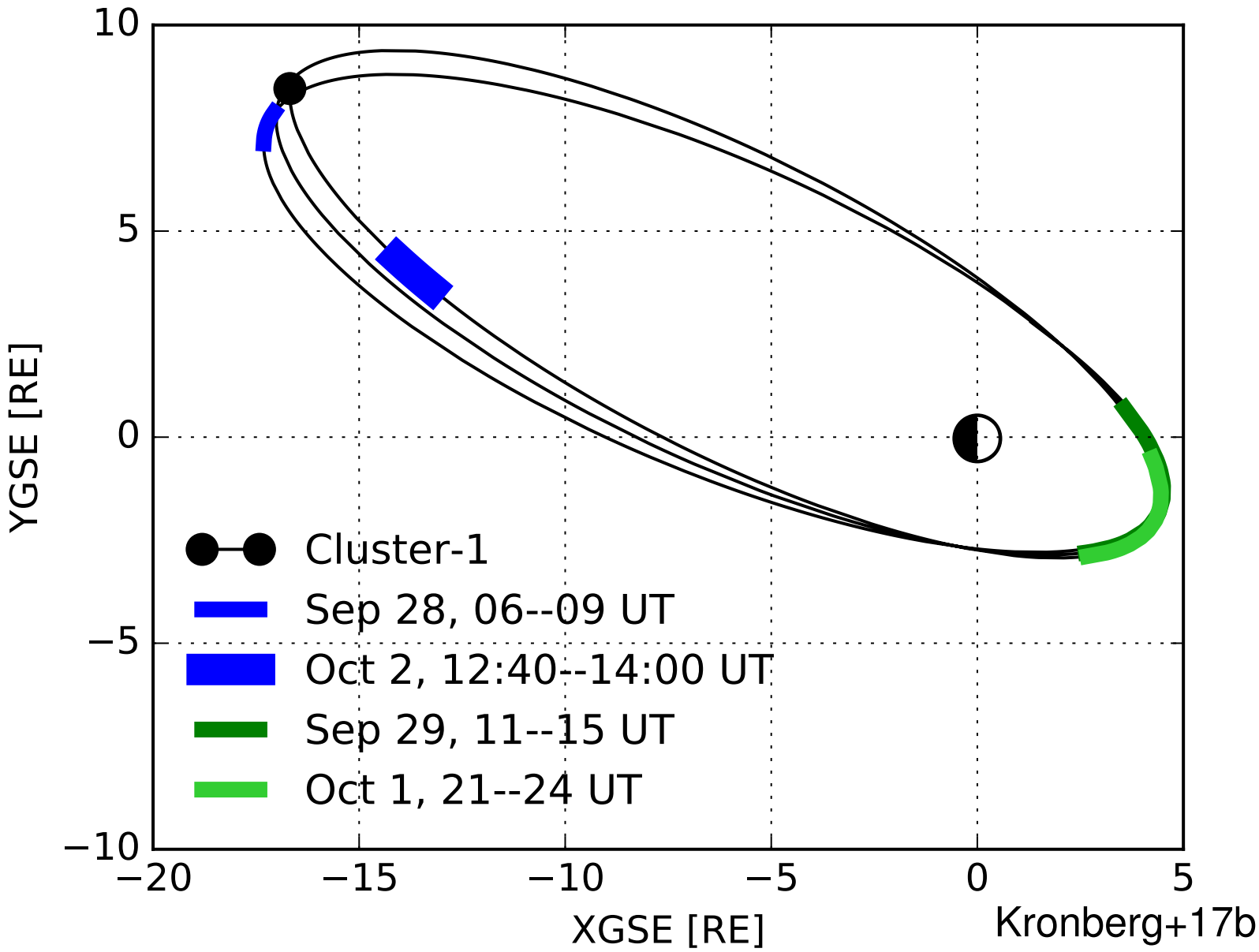
Kronberg+17b

Magnetic storm: Sep 27 – Oct 4, 2002

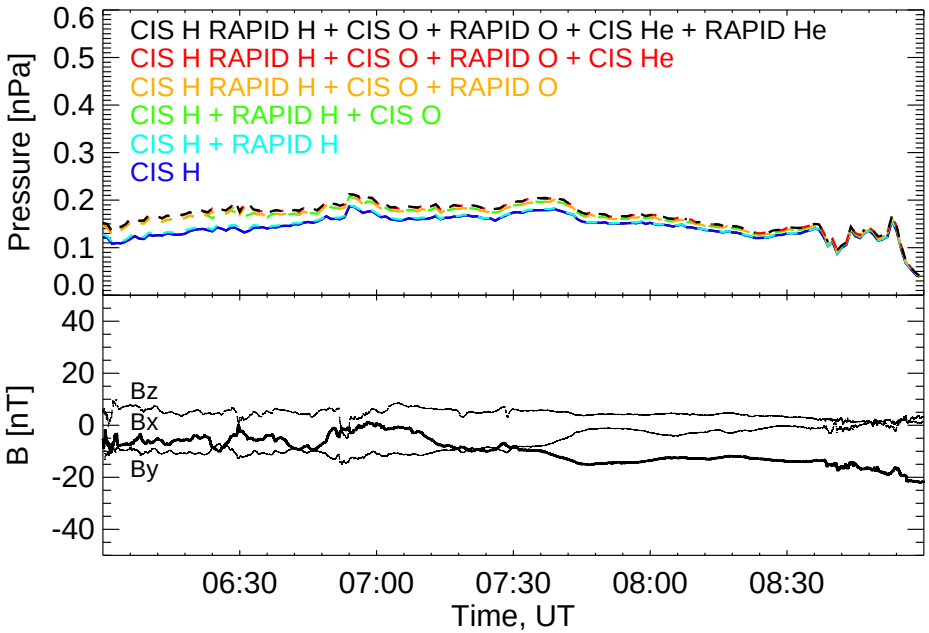


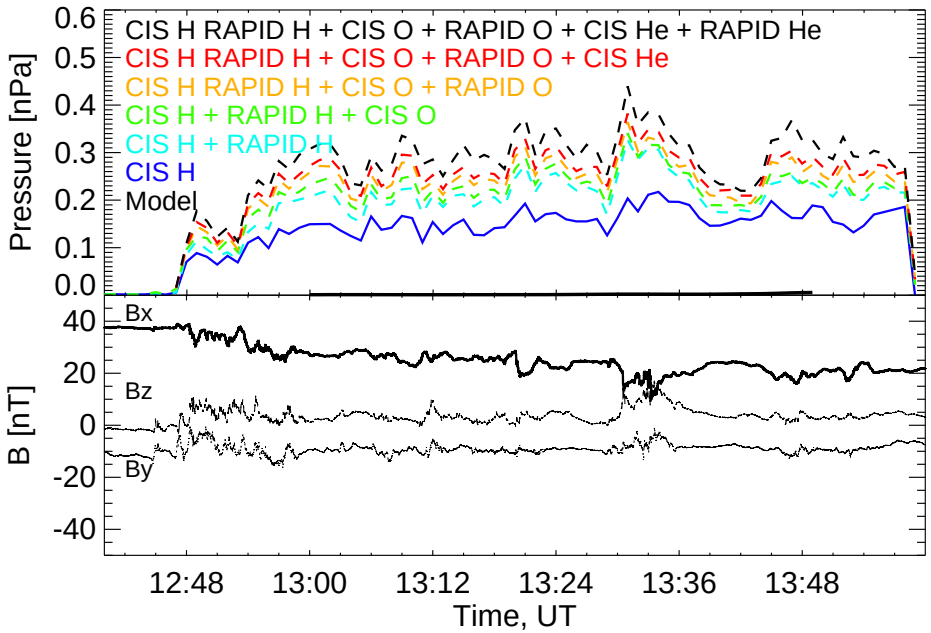
Kronberg+17b

Location of the satellites in the inner magnetosphere



Plasma pressure in the tail before and after the magnetic storm



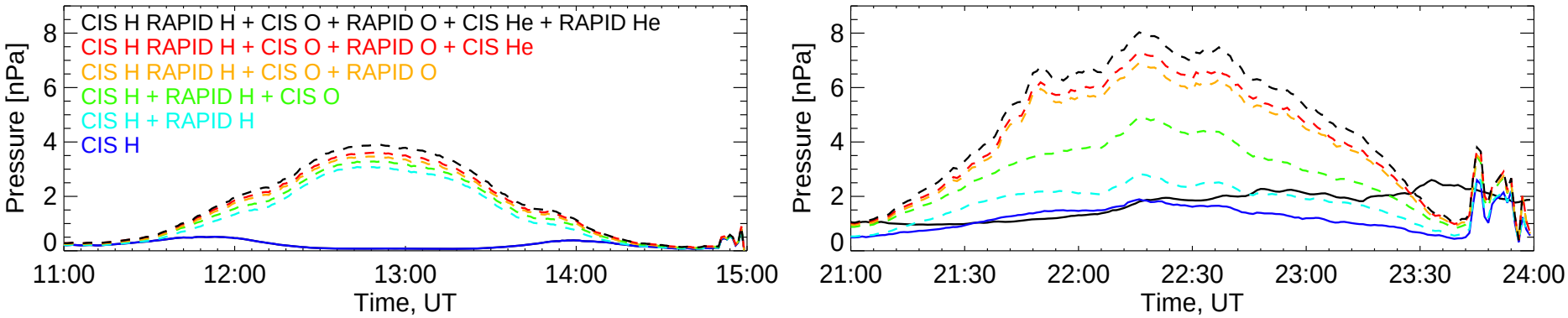


CIS$<$40 keV

RAPID$>$40 keV

Kronberg+17b

Plasma pressure in the ring current before and after the magnetic storm



CIS$<$40 keV

RAPID$>$40 keV

Kronberg+17b

Exercise

- Estimate the magnetic field depression for this event during the main phase
  1. considering only protons
  2. and considering protons, helium and oxygen.

Solution to exercise: Estimate the magnetic field depression for this event

- We use formula for ΔB_R from Slide 31 of Lecture 4. We take as a change of the total energy of the ring current $U_R = 3/2nkT = (PV = nkT) = 3/2\Delta P \cdot V$
- We use $B_E = 3.1 \cdot 10^{-5}$T for magnetic field on Earth at equator.
- We calculate the volume of the ring current as $V = \pi \cdot h(R_1^2 - R_2^2)$, where h is the thickness of the ring current, R_1 and R_2 are the radii of the outer and inner ring current boundaries, respectively.
- We assume that the ring current has a thickness of 7 R_E and the outer and inner boundaries are at 7 and 1 R_E, respectively.
- If we use only thermal pressure from protons $P_{CIS\ H}$, $\Delta P \simeq$1.5 nT, (dark blue lines) we get a magnetic field depression $\sim$15 nT.
- Using the total plasma pressure P_{tot}, $\Delta P \simeq$4 nT, (black dashed lines) we get $\simeq$41 nT, approximately half of the value as indicated by the SYM/H index (depression is also triggered by other sources e.g. changes in the magnetopause topology).