

# TRANSMISSION OF FORESHOCK WAVES THROUGH THE EARTH'S MAGNETOSHEATH

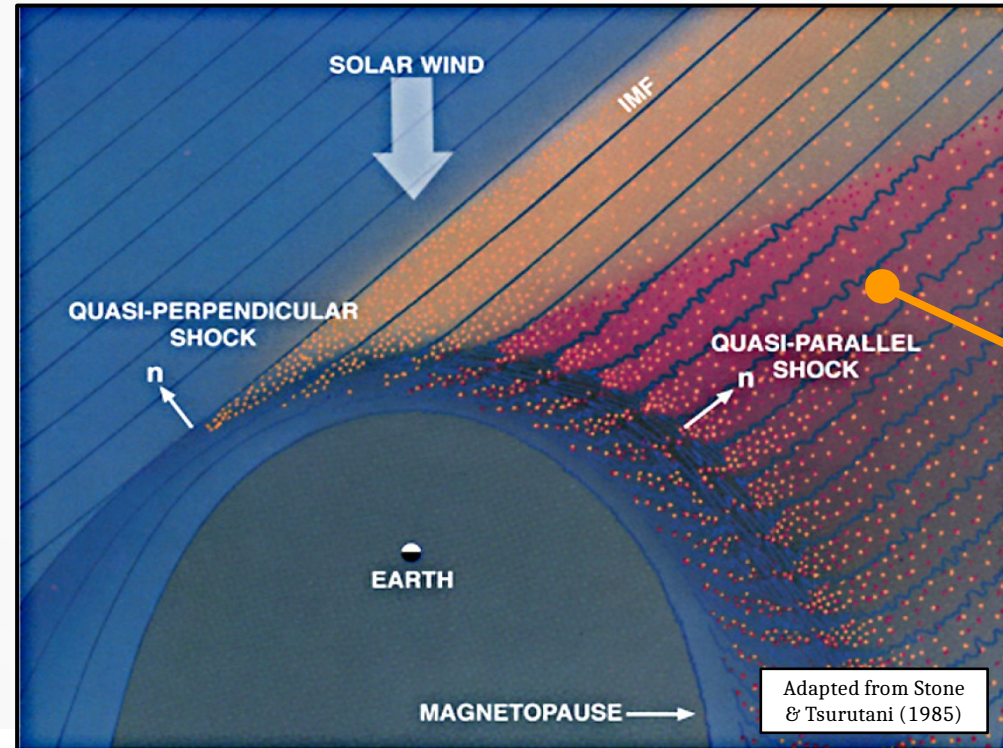
Lucile Turc<sup>1</sup>

O.W. Roberts, D. Verscharen, A.P. Dimmock, P. Kajdic, M. Palmroth,  
Y. Pfau-Kempf, A. Johlander, M. Dubart, E.K.J. Kilpua, J. Soucek,  
K. Takahashi, N. Takahashi, M. Battarbee, and U. Ganse

<sup>1</sup> Department of Physics, University of Helsinki, Helsinki, Finland



# THE EARTH'S FORESHOCK IS AN IMPORTANT SOURCE OF ULF WAVE ACTIVITY IN NEAR-EARTH SPACE



30-second  
waves  
generated in  
the foreshock  
by ion-ion  
beam  
instabilities

Adapted from Stone  
& Tsurutani (1985)



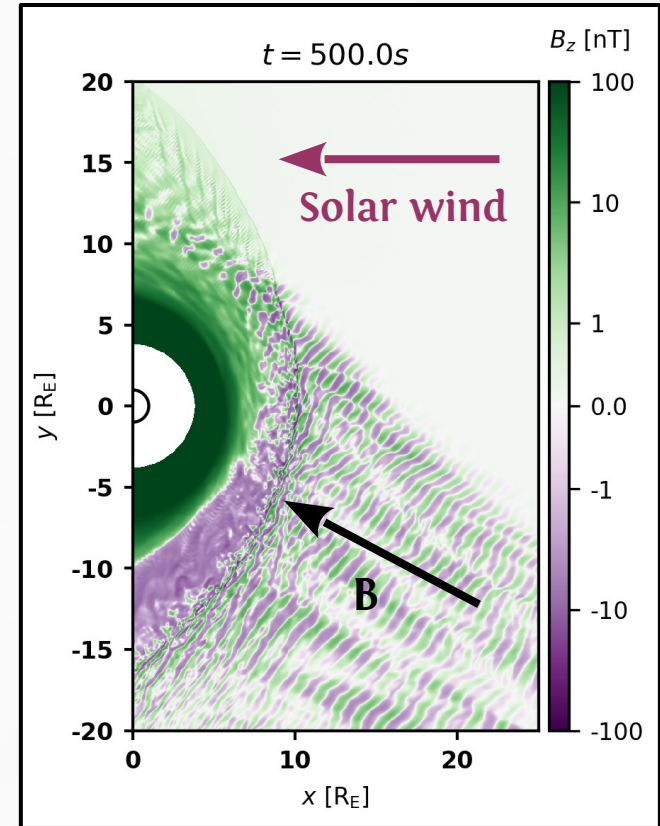




# NUMERICAL SIMULATIONS PROVIDE US WITH A GLOBAL VIEW OF FORESHOCK WAVE TRANSMISSION



- **Hybrid-Vlasov model** designed for **global magnetospheric simulations** [Palmroth et al., 2018]
- Ions treated as **velocity distribution functions**, electrons are a charge-neutralising fluid  
→ ion kinetic processes → self-consistent description of **foreshock waves**
- We use here a 2D global run, in the equatorial plane



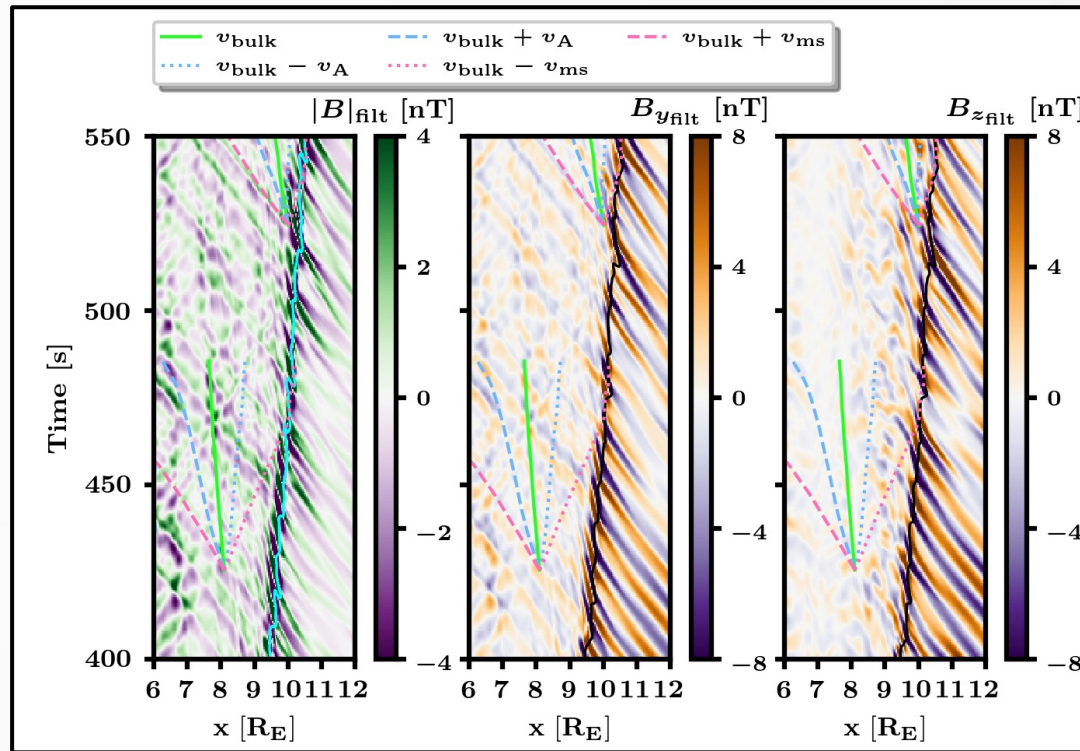
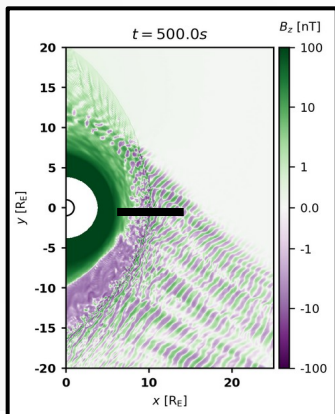


# WE IDENTIFY FAST-MODE WAVES IN THE MAGNETOSHEATH AT THE SAME FREQUENCY AS FORESHOCK WAVES

Earthward-propagating fast-mode waves in the magnetosheath in  
**direct continuation of the  
foreshock waves**

**Change of  
polarisation**

Circular, mostly  
transverse  
→ linear,  
compressional



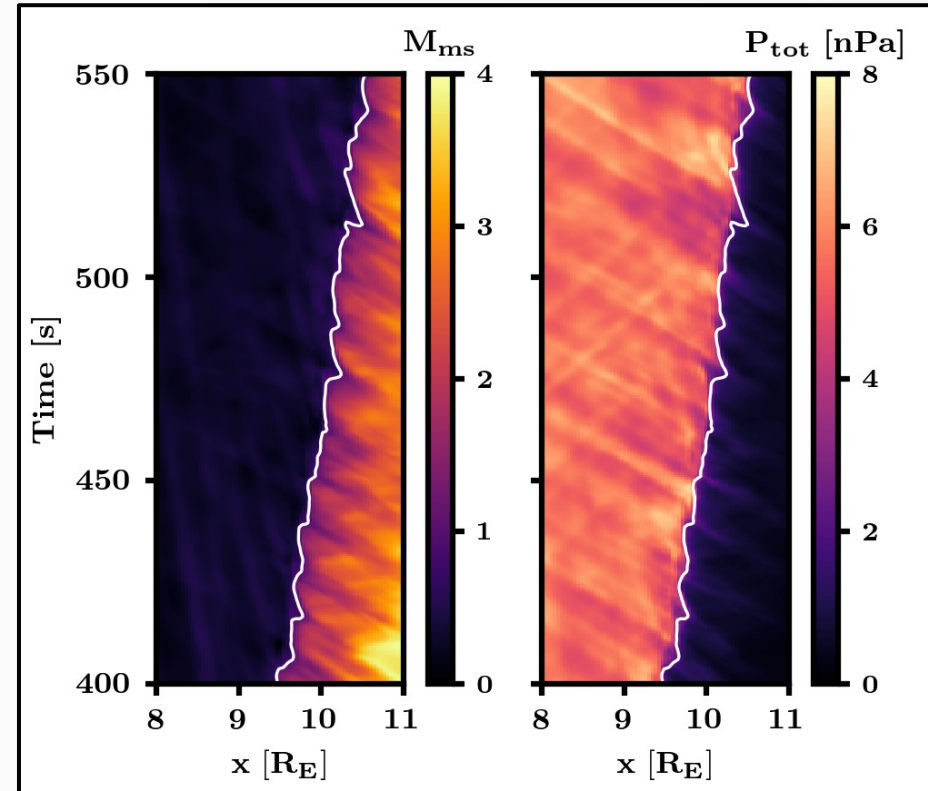
Turc et al., manuscript under review



# THE FAST-MODE WAVES TRAVERSING THE MAGNETOSHEATH ARE GENERATED AT THE SHOCK

Foreshock waves

- Modulation of the magnetosonic Mach number
- **Modulation of the shock compression ratio**
- Earthward-propagating fast-mode waves travelling across the magnetosheath



Turc et al., manuscript under review



# CONCLUSIONS

- Global numerical simulations performed with the Vlasiator model have allowed identifying how foreshock waves transmit through the magnetosheath
- **Indirect transmission**: the downstream waves are generated at the shock by a **process modulated by foreshock waves**
- Observational confirmation requires measurements in the subsolar magnetosheath → MMS data