ÖAW IWF

FWF Der Wissenschaftsfonds.

MAGNETOTAIL FLOWS NEAR LUNAR ORBIT AND THEIR RELATION TO SUBSTORMS

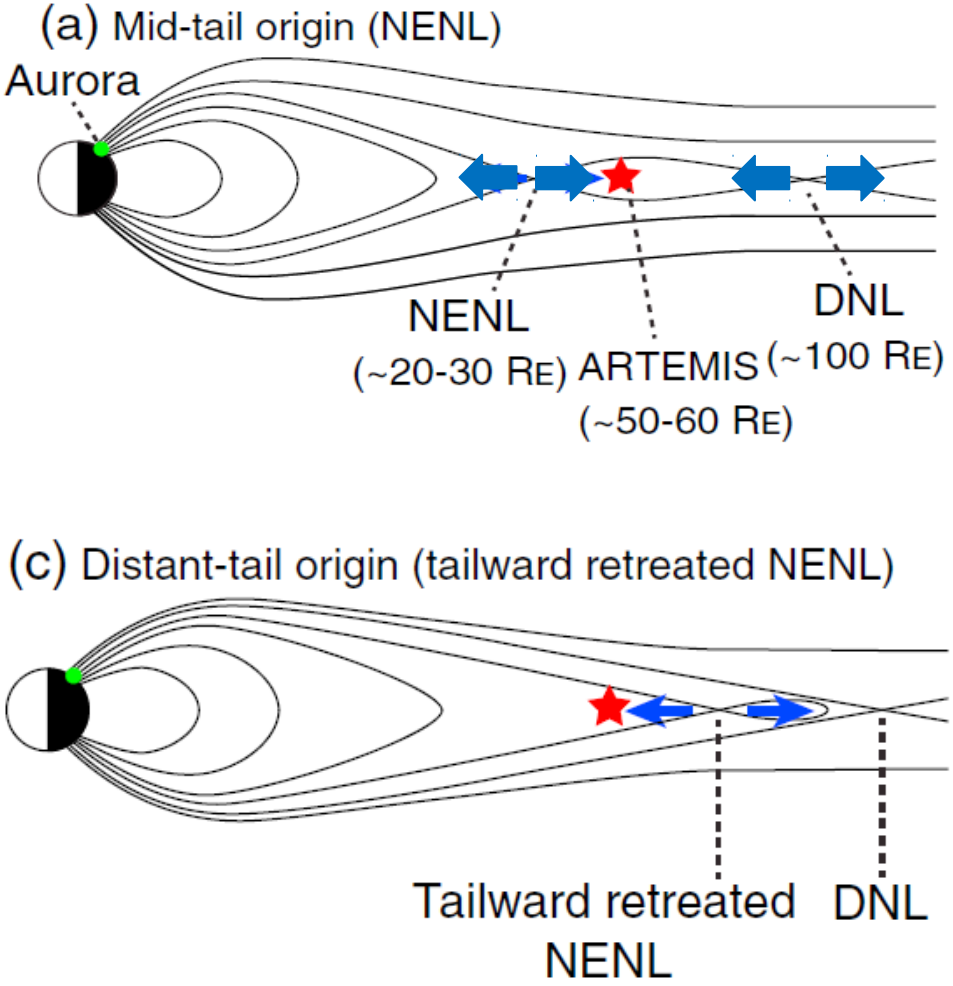
Stefan Kiehas (1), Andrei Runov (2), Vassilis Angelopoulos (2), Daniil Korovinskiy (1)

(1) IWF, Austrian Academy of Sciences, Graz, Austria

(2) IGPP, EPSS, UCLA, Los Angeles, USA

ÖAW IWF

MAGNETOTAIL FLOWS



after Nishimura et al., 2013

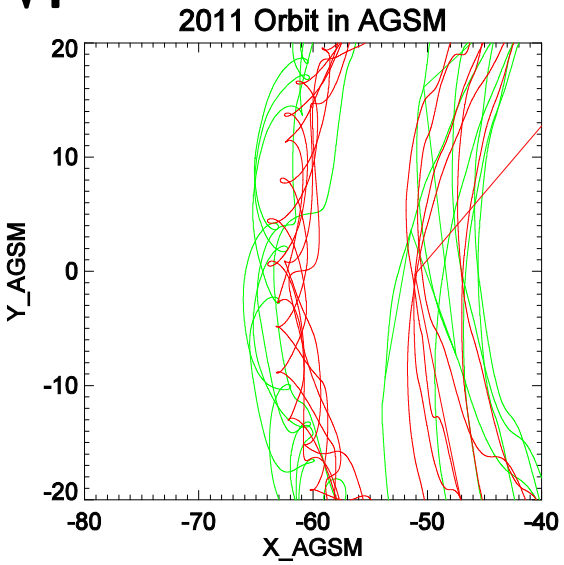
Tailward (TW) flows @ ARTEMIS:
Source X_GSM > - 60 RE

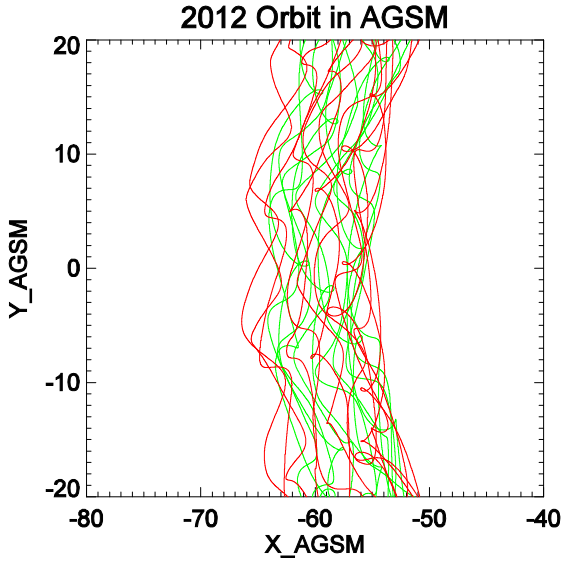
Earthward (EW) flows @ ARTEMIS:
Source X_GSM < - 60 RE

Source of EW flows:
- DNL?
- retreating NENL?
- patchy reconnection?

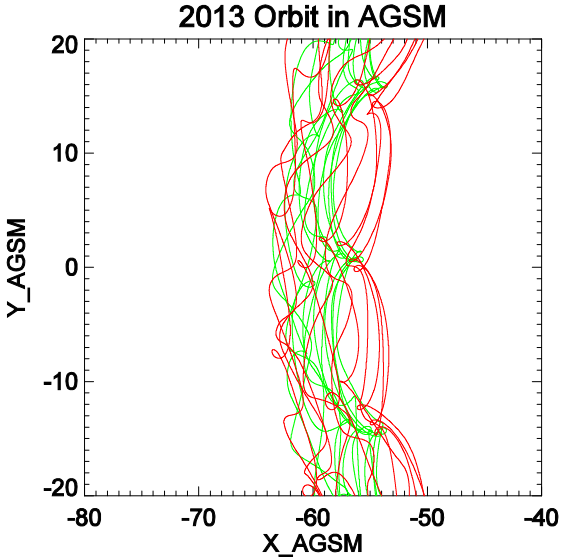
ÖAW IWF

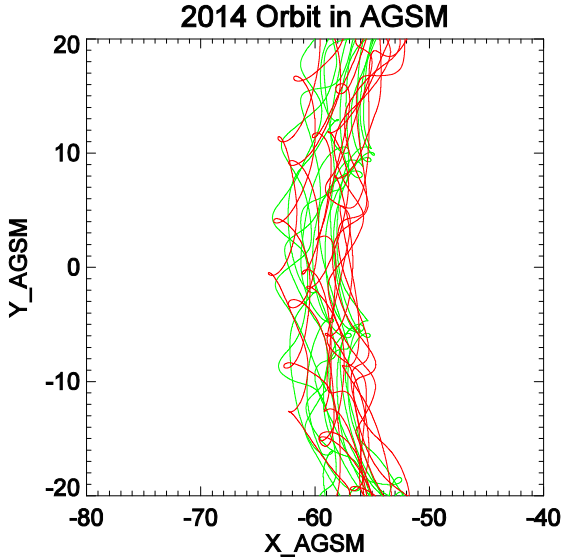
ARTEMIS ORBITS 2011-2015

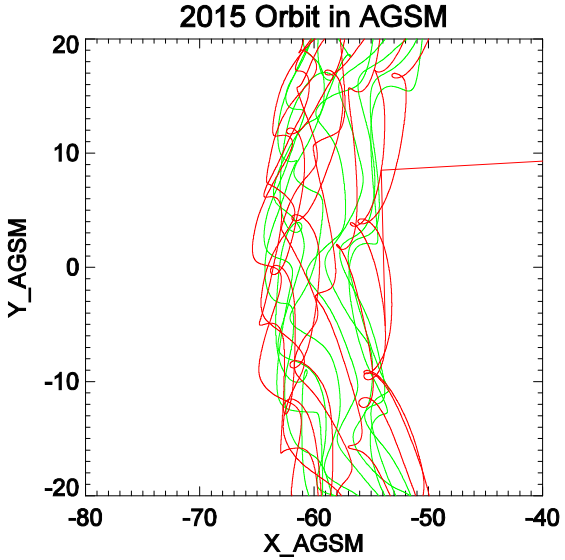




THB (P1)
THC (P2)





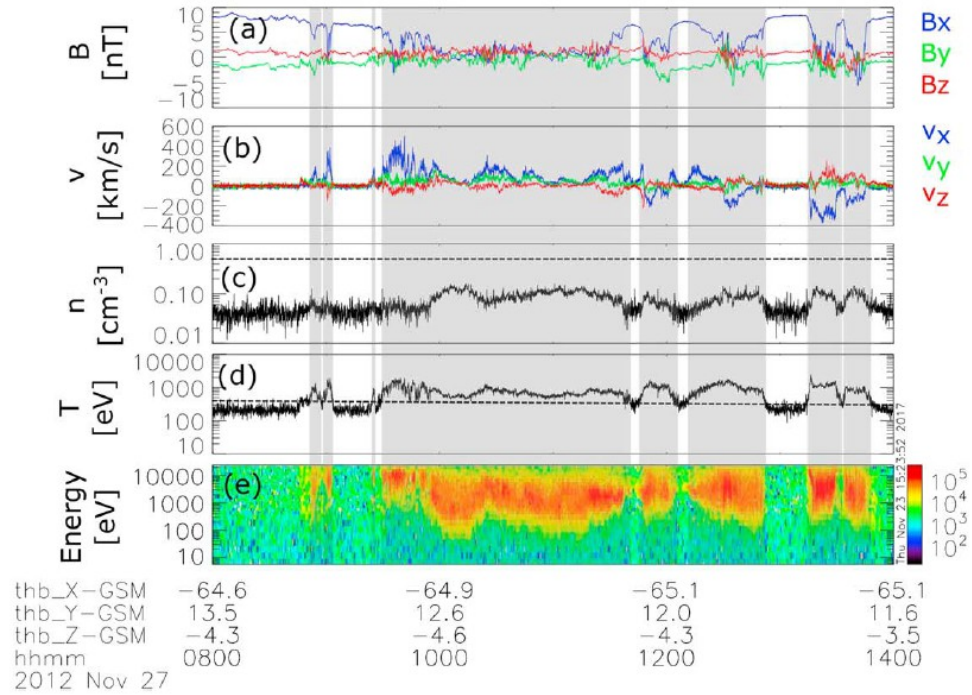


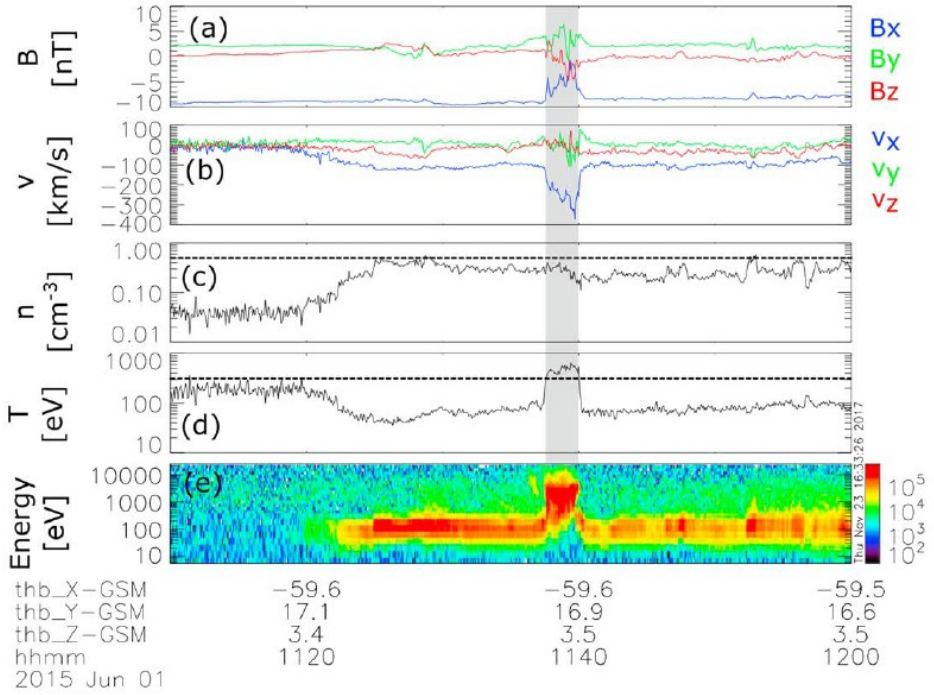
PLASMA SHEET SELECTION

Plasma sheet selection:

T > 500 eV

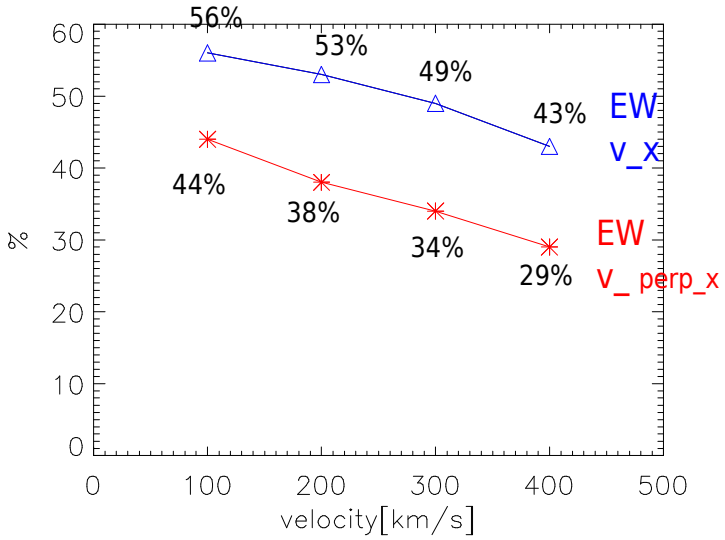
N < 0.5 cm-3



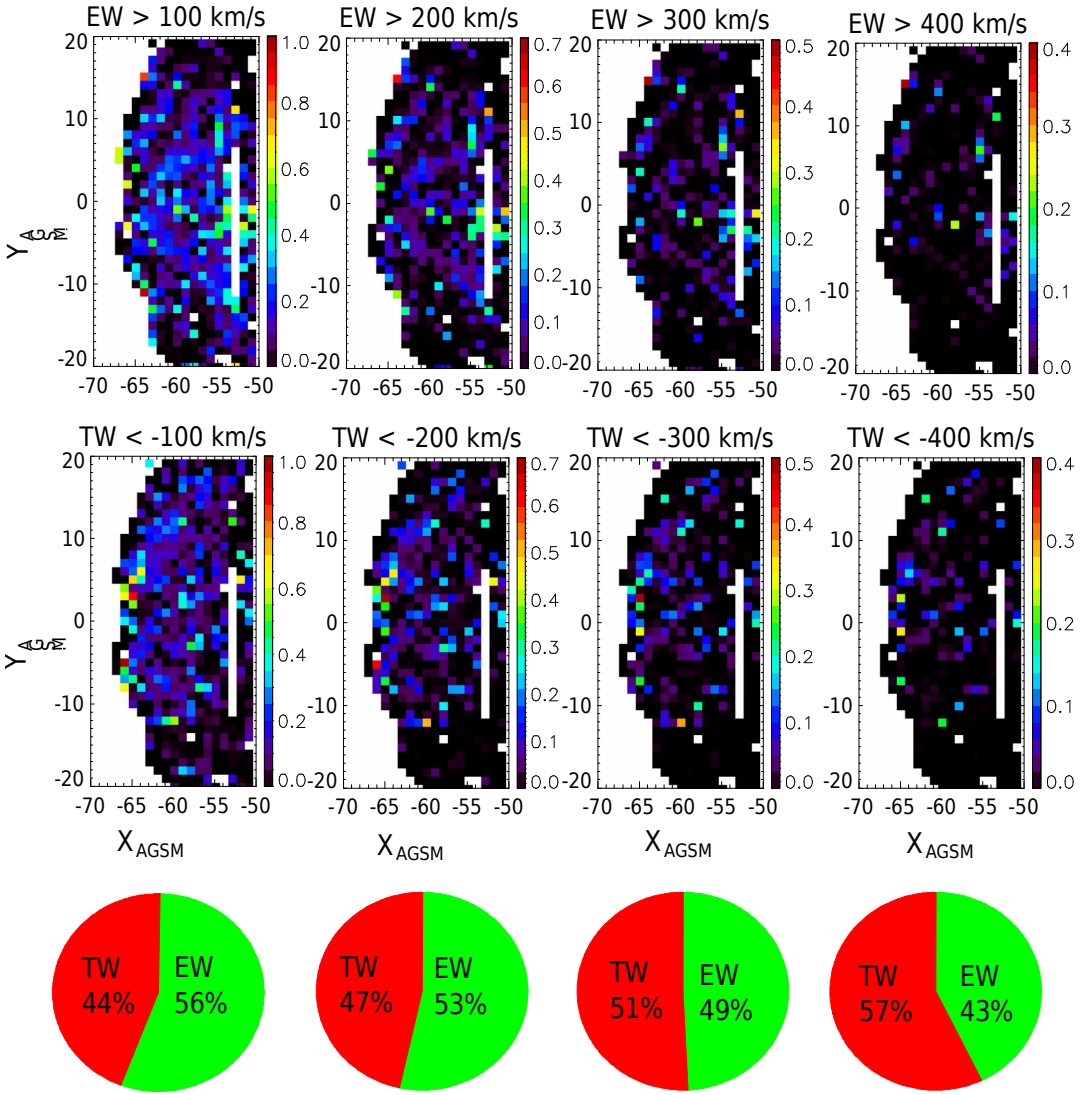


ÖAW IWF

OCCURRENCE RATE

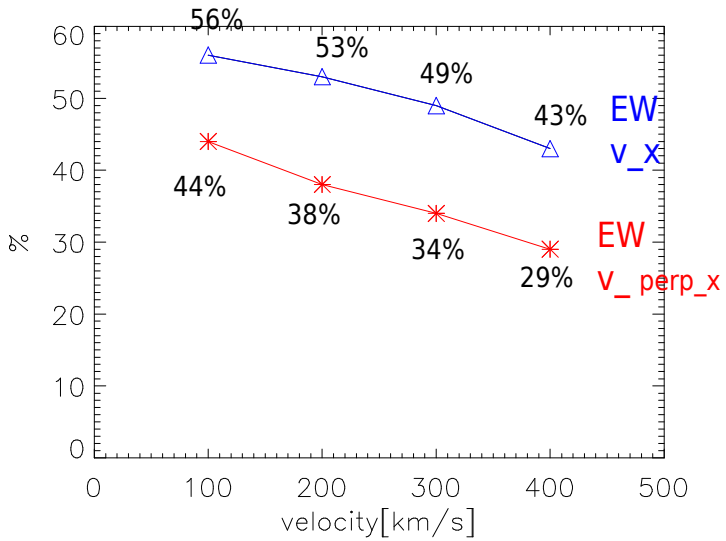


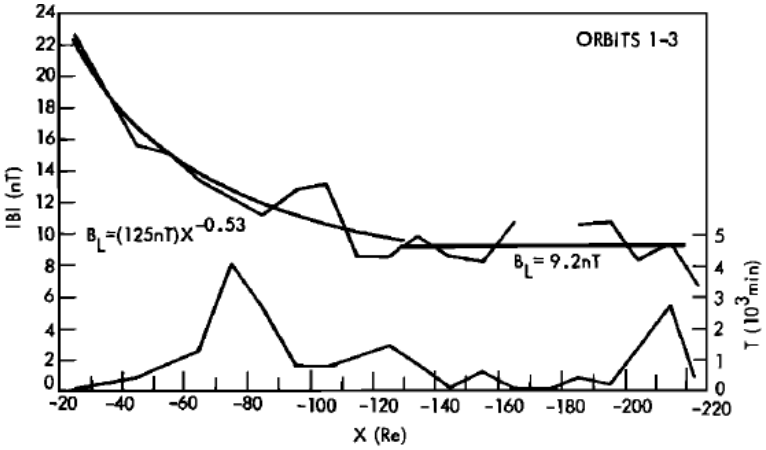
- 43% (v_x > 400 km/s) to 56% (v_x > 100 km/s) of the flows are directed EW
- 29% (v_perp_x > 400 km/s) to 44% (v_perp_x > 100 km/s) of the convectiveflows are directed EW
- The percentage of EW flows decreases with increasing flow speed



Kiehas et al., JGR, 2018

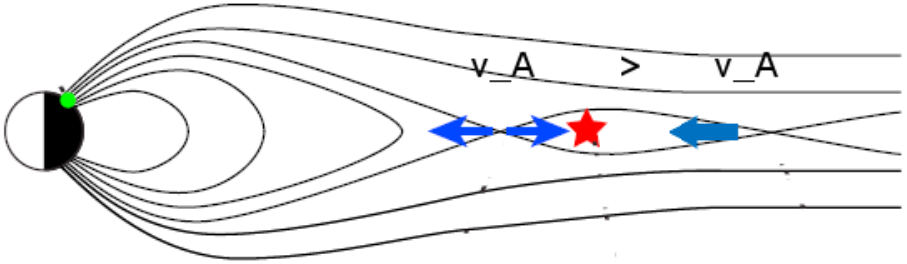
OCCURRENCE RATE



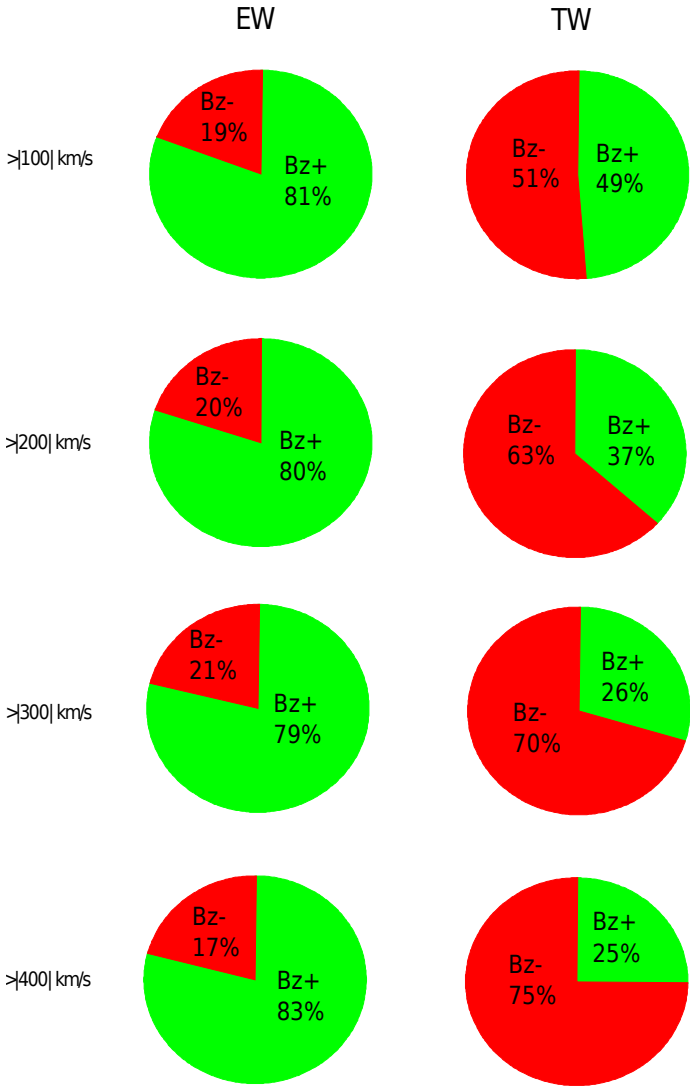


Slavin et al., 1985

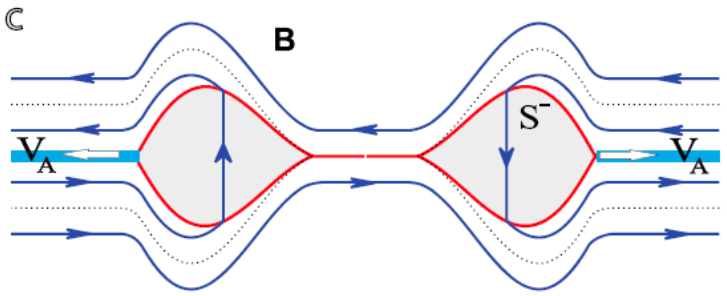
- Outflow speed ~ v_A in inflow region
- v_A decreases with downtail distance
- => high speed flows are more likely to origin from near Earth region (= TW flows @ ARTEMIS)
- => for high speed flows the percentage of EW flows is smaller

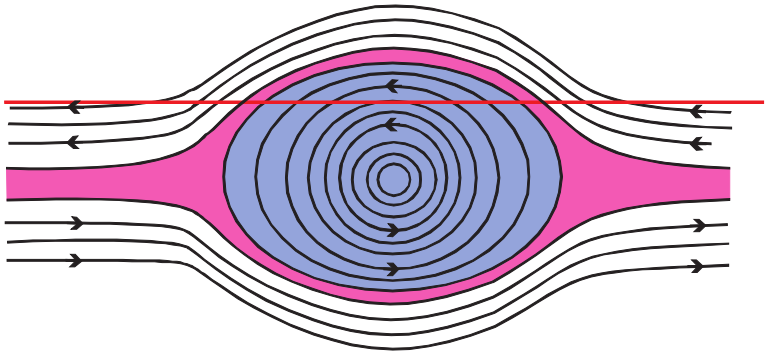


BZ ASSOCIATION WITH FLOWS



- EW flows: primarily associated with southward Bz
- TW flows: primarily associated with northward Bz, but less clear => plasmoids

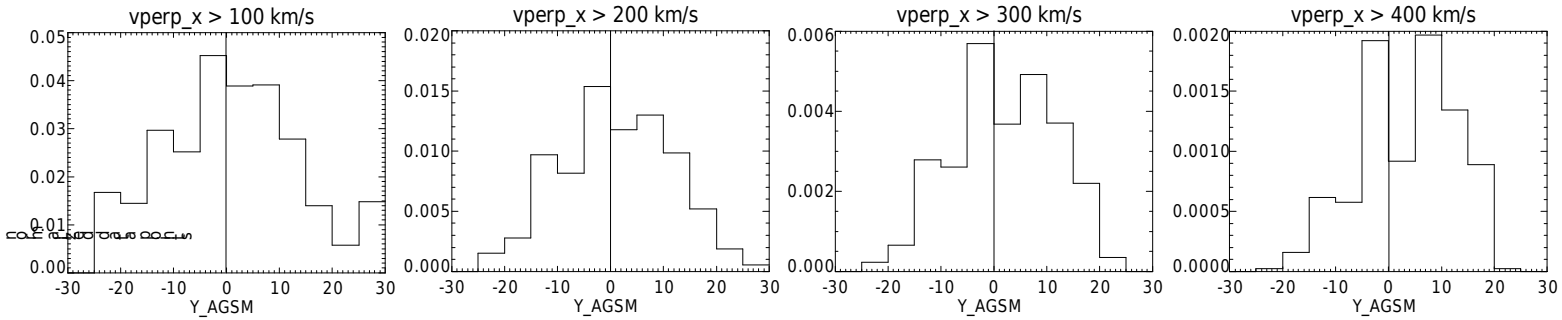


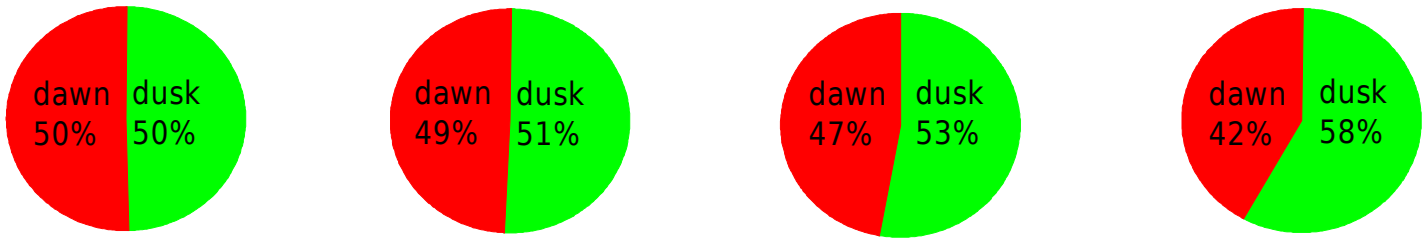


ÖAW IWF

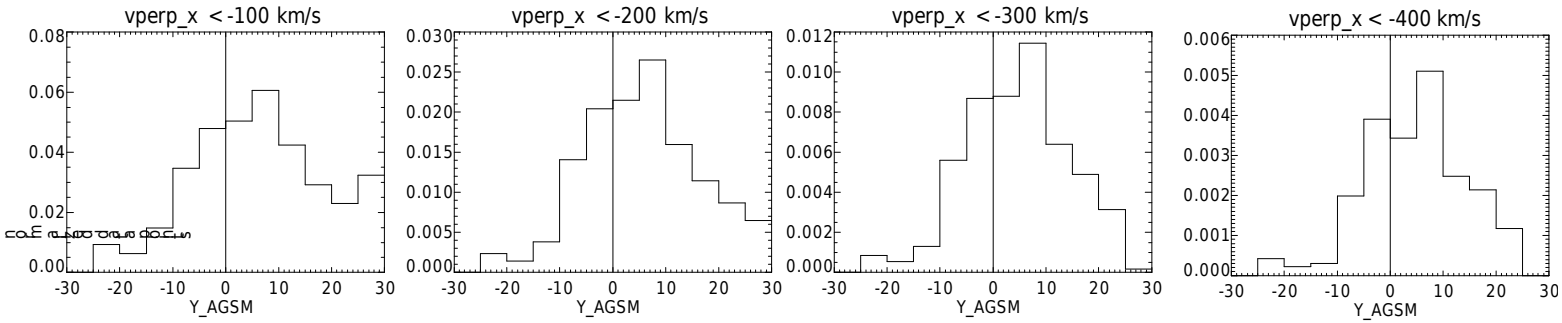
DAWN DUSK ASYMMETRY

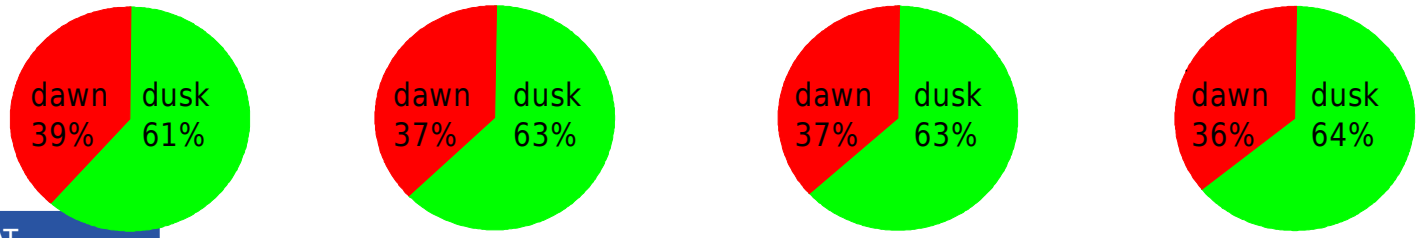
EW



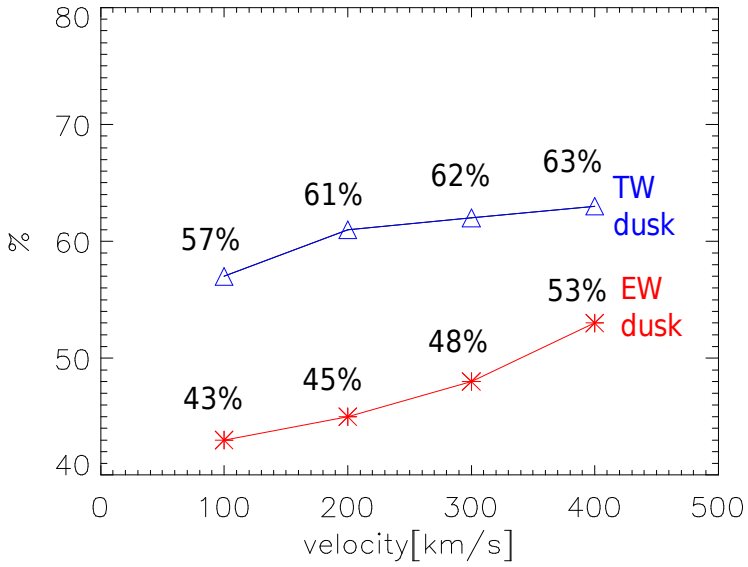


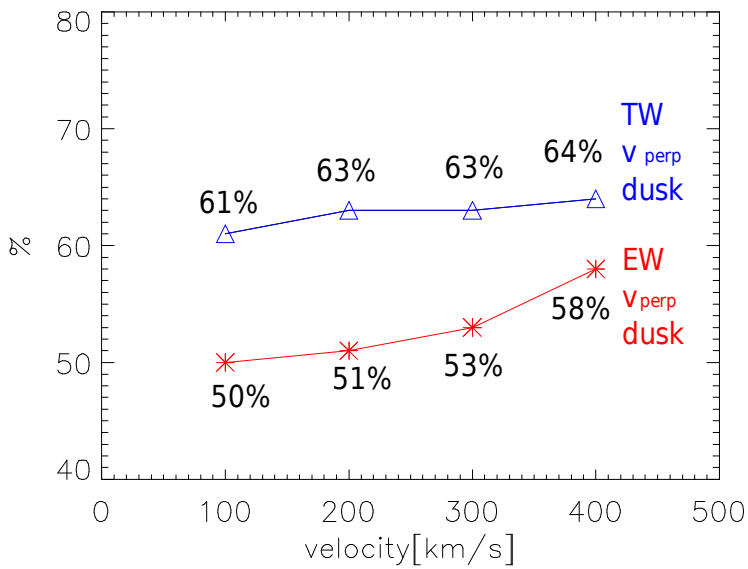
TW





DAWN DUSK ASYMMETRY

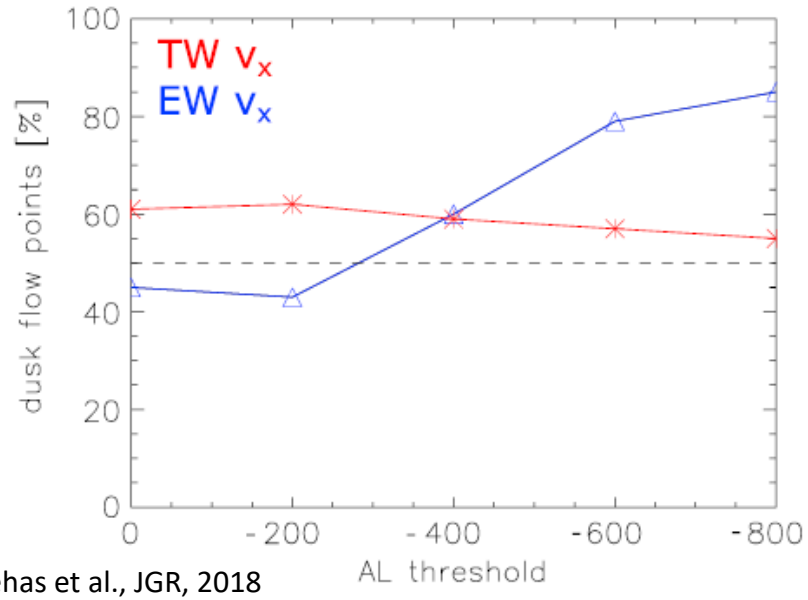


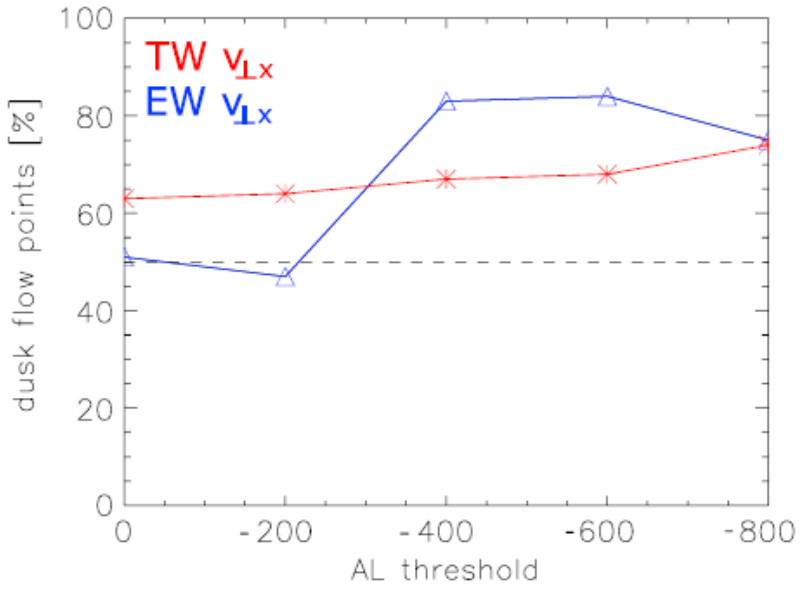


Kiehas et al., JGR, 2018

- No clear asymmetry for EW flows
- 60% of TW flows in dusk sector
- Since TW flows originate from near-Earth region => indication that asymmetry is more pronounced closer to Earth

DAWN DUSK ASYMMETRY – AL RELATION





Kiehas et al., JGR, 2018

- TW flows: dusk asymmetry similar for all AL thresholds
- EW flows:
  - low AL threshold: fairly symmetric
  - high AL threshold: EW flows become strongly asymmetric toward dusk

=> RX EW of ARTEMIS asymmetric. Distant tail RX (slower EW flows during low geomagnetic activity) symmetric. Higher geomagnetic activity (AL>|400| nT) near-Earth neutral line retreat downtail - passing by ARTEMIS.

ÖAW IWF

GEOEFFECTIVENESS – FLOW EVENTS

Find flow events when s/c was inside PS before detection of flow

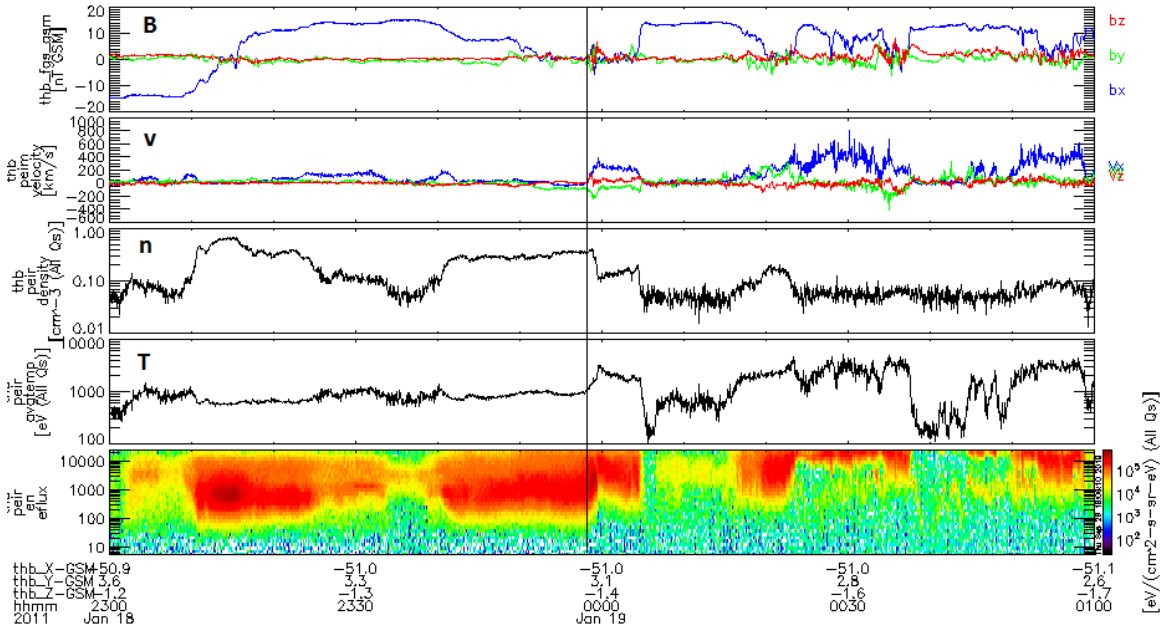
Criterion:

- s/c inside PS for at least 30 sec before flow detection
- Flows need to exceed 200 km/s

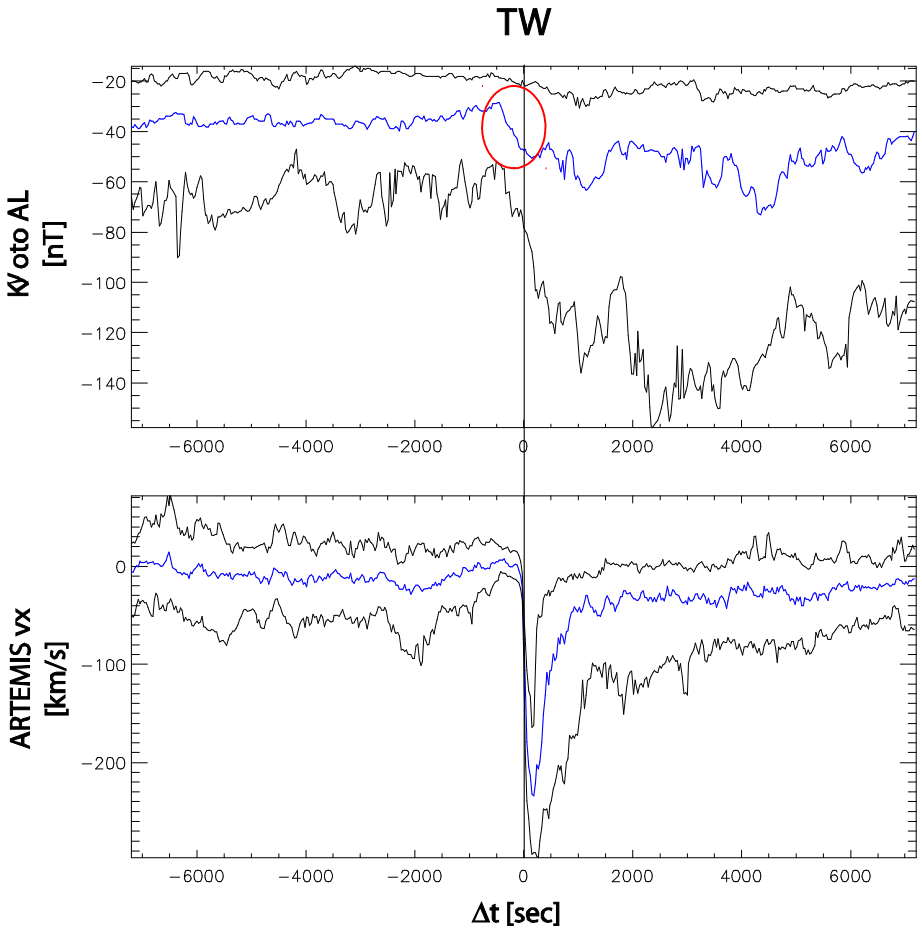
Result:

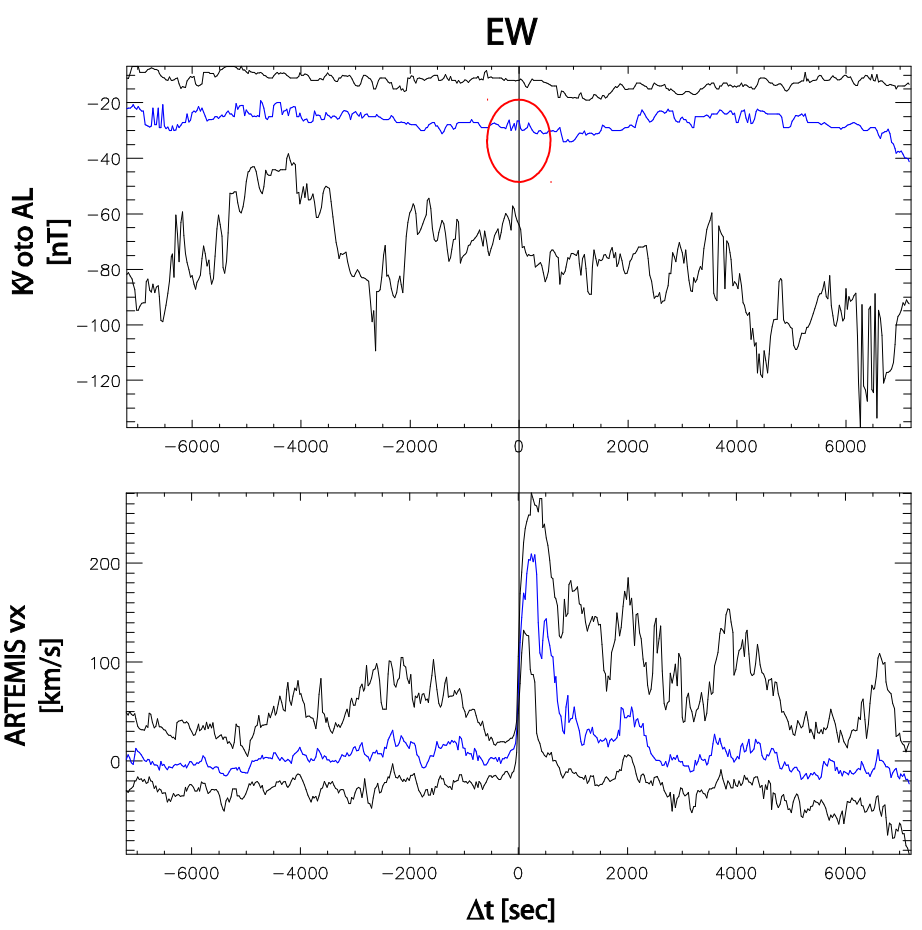
39 EW events

55 TW events



CORRELATION WITH AL – SUPERPOSED EPOCH





Clear correlation of TW flow onset with AL.

No correlation of EW flow onset with AL.

ÖAW IWF

SUMMARY

- 43% (v_x > 400 km/s) to 56% (v_x > 100 km/s) of the flows are directed EW
- 29% (v_perp_x > 400 km/s) to 44% (v_perp_x > 100 km/s) of the convective flows are directed EW
- The percentage of EW flows decreases with increasing flow speed

- EW flows: primarily associated with northward Bz
- TW flows: primarily associated with southward Bz, but less clear => plasmoids

- No clear asymmetry for EW flows
- 60% of TW flows in dusk sector
- => Dawn-dusk asymmetry stronger near Earth. In line with Hall E as asymmetry source (cf. San Lu et al.)

Asymmetry and AL: TW flows: dusk asymmetry similar for all AL thresholds. EW flows: for high AL threshold EW flows become strongly asymmetric toward dusk.

Clear correlation of TW flow onset (flows from within ~ -60 RE) with AL. No correlation of EW flows (flows originating from beyond ~ -60 RE) with AL.