Spatial and Temporal Variability of the Equatorial Electrojet Observed by the CSES Satellite

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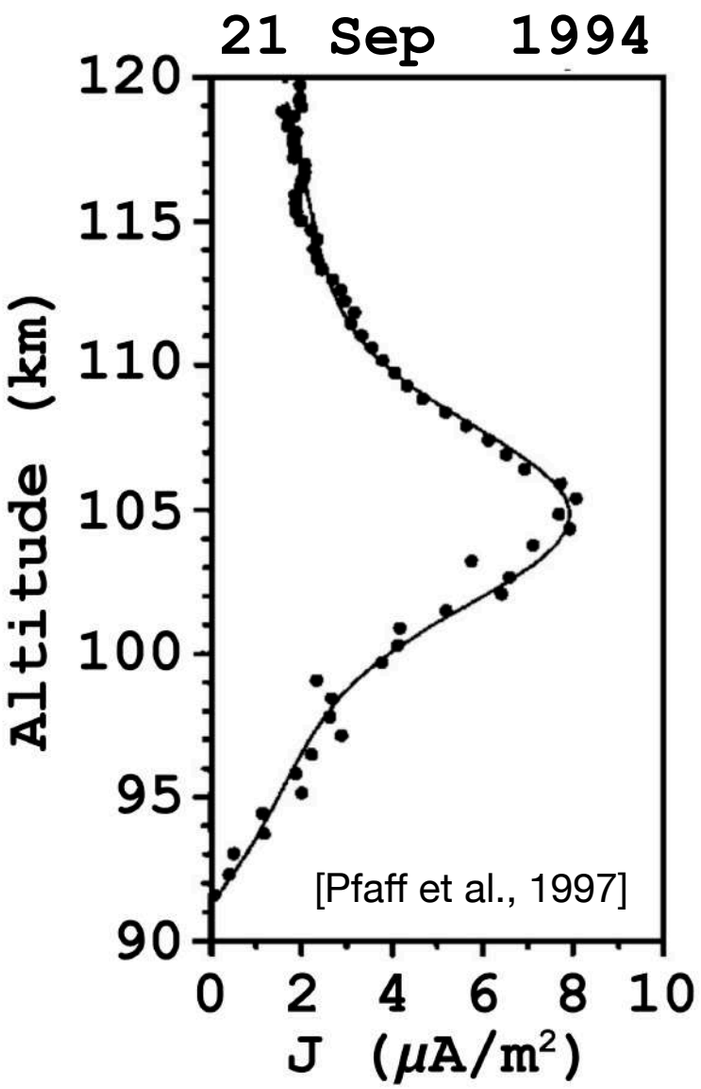
Swarm 10 Year Anniversary & Science Conference 2024, 08-12 April 2024,

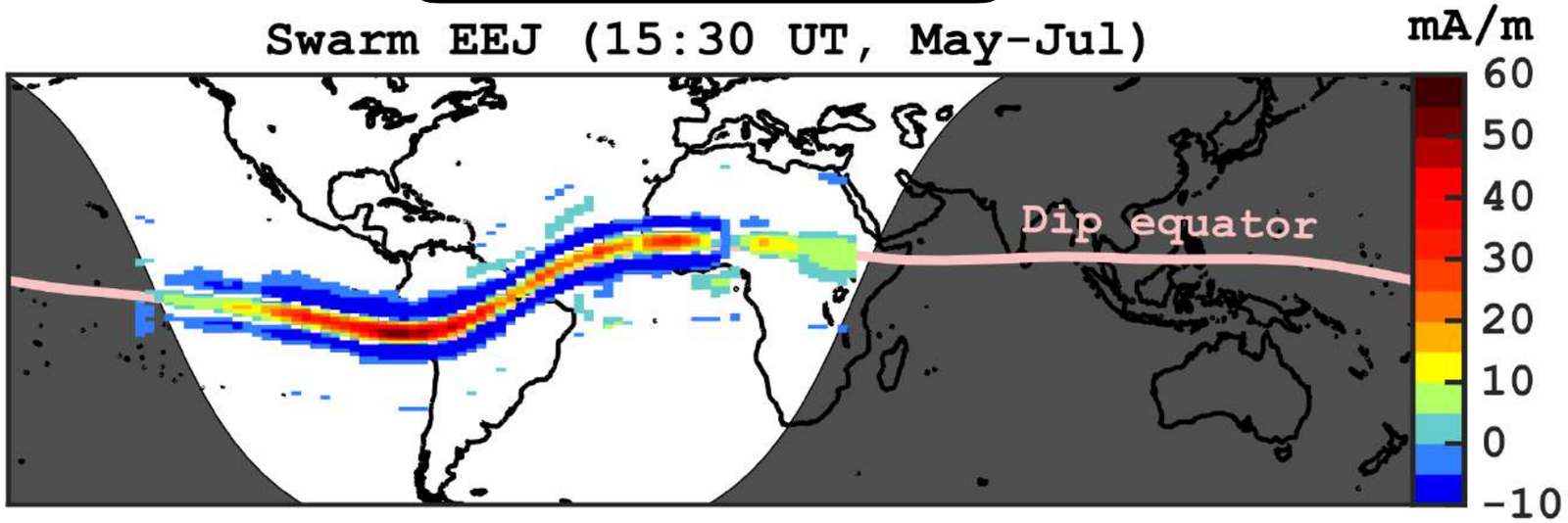
Equatorial Electrojet (EEJ)

Sounding rocket measurement



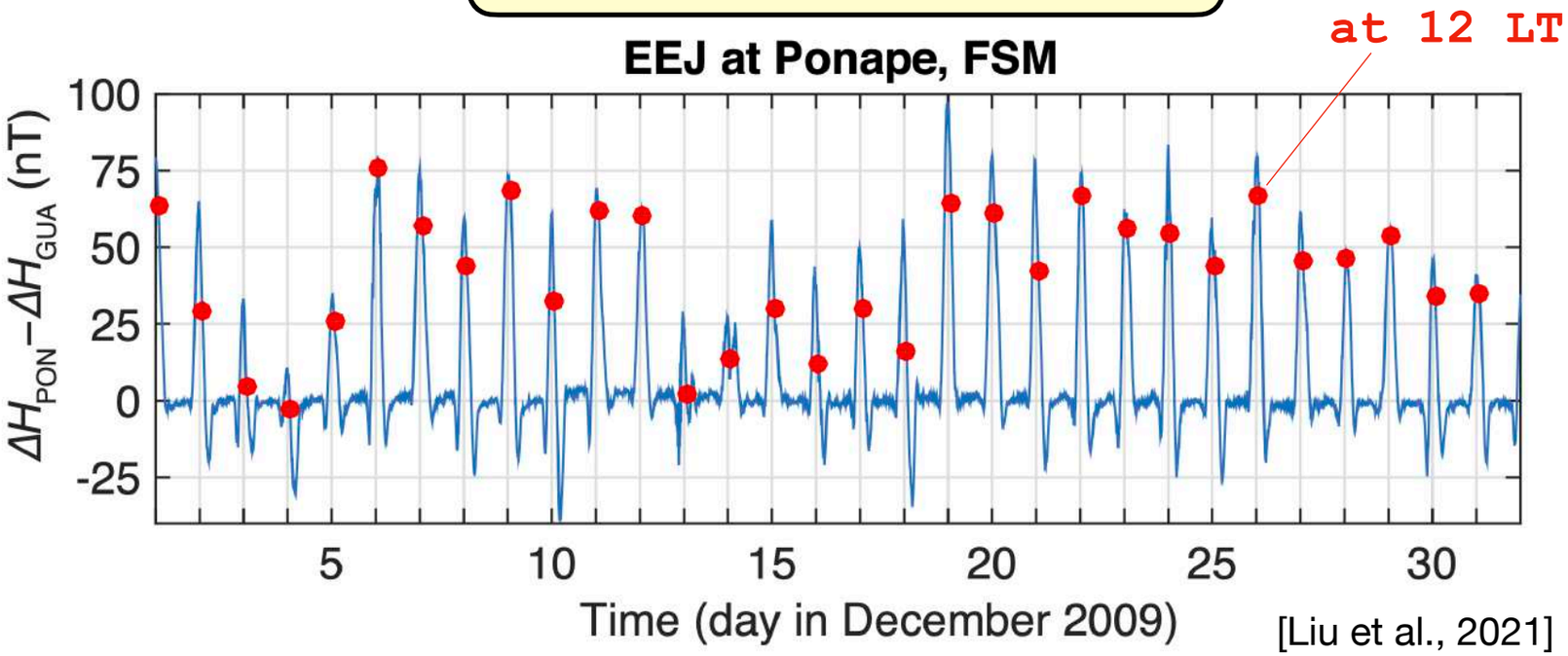
Confined in the E-region

Satellite measurement



Confined to the dayside near the dip equator

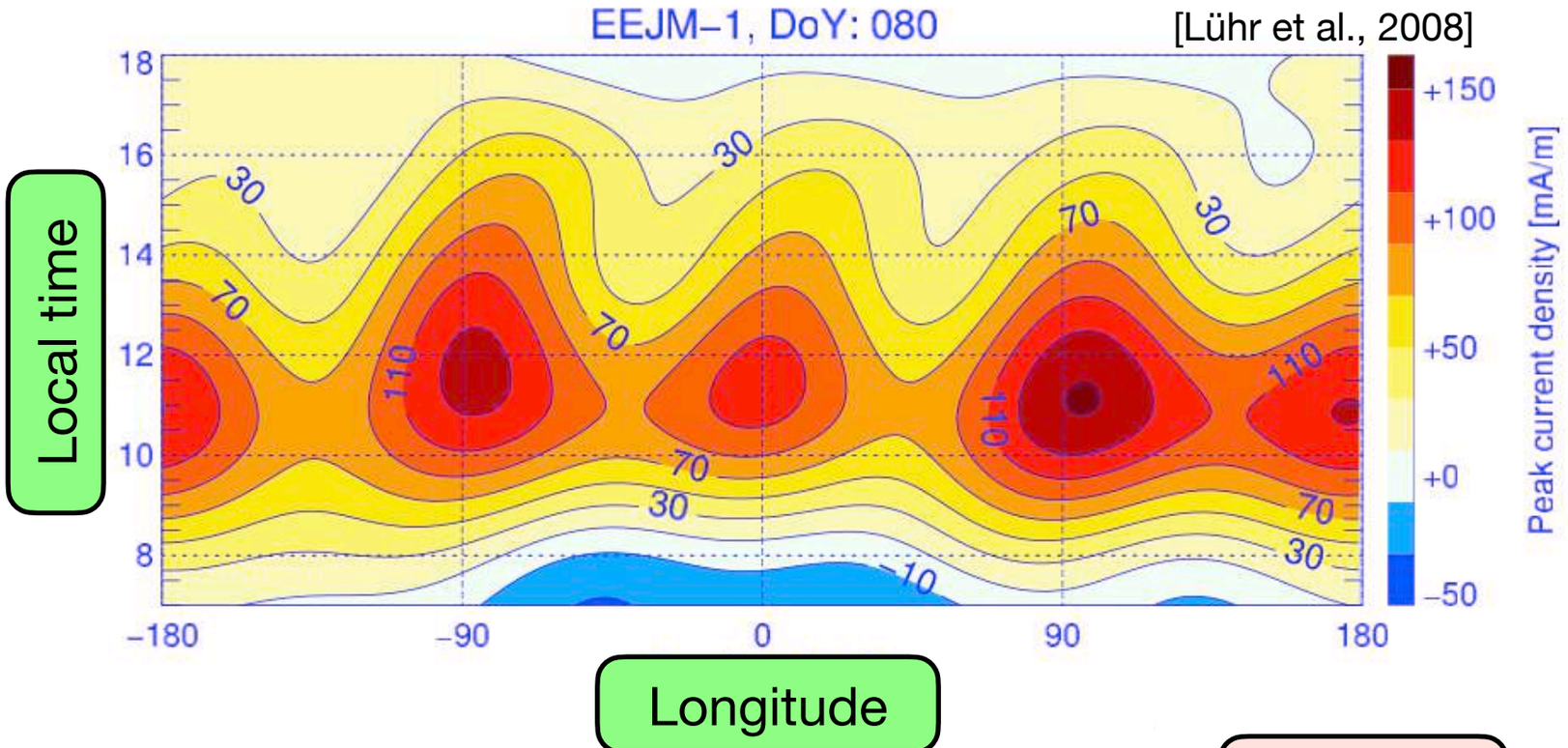
Ground-based measurement

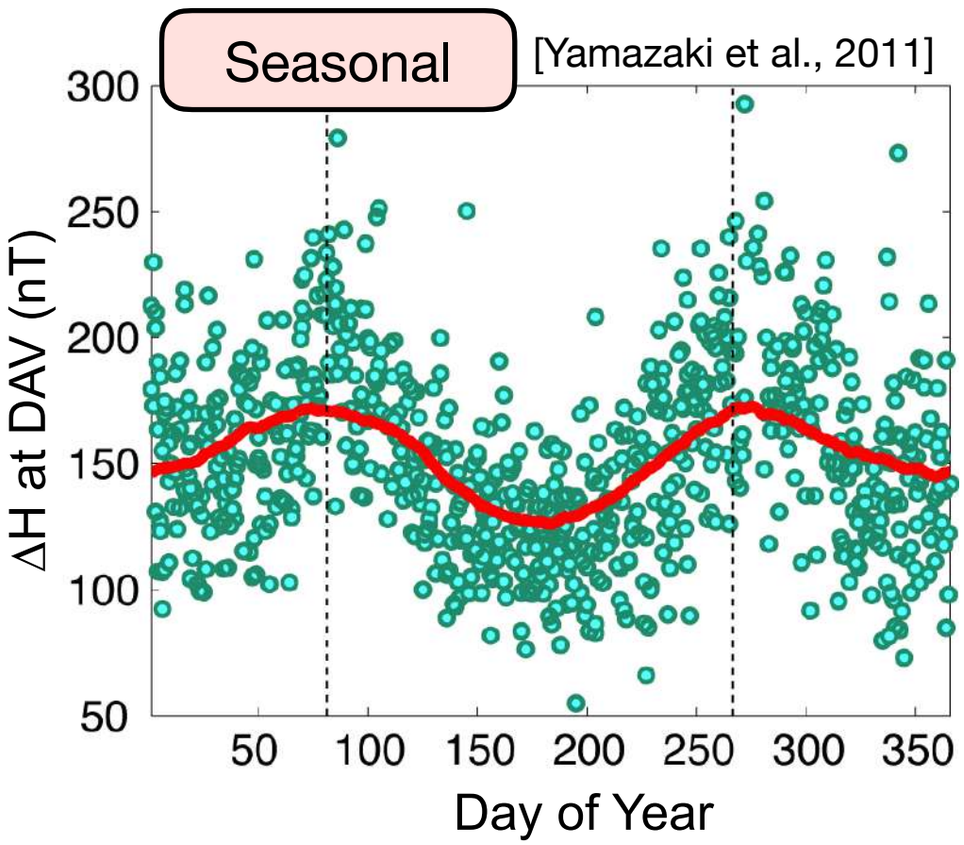


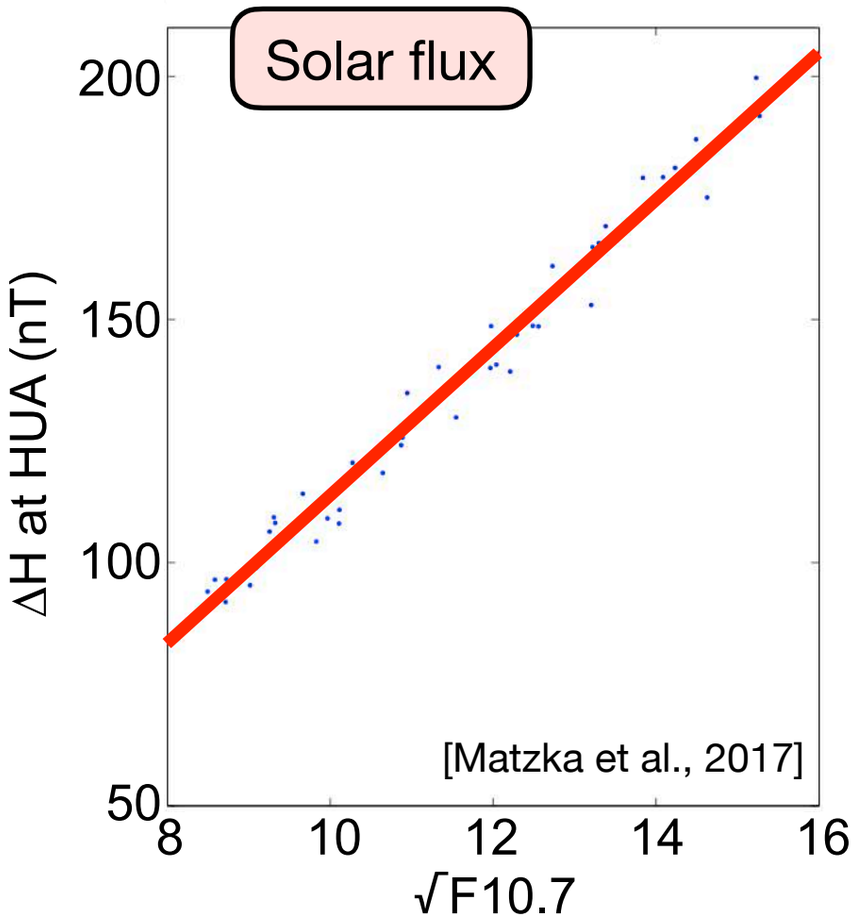
[Liu et al., 2021]

Considerable day-to-day variability

Equatorial Electrojet (EEJ) Variability







China Seismo-Electromagnetic Satellite (CSES)

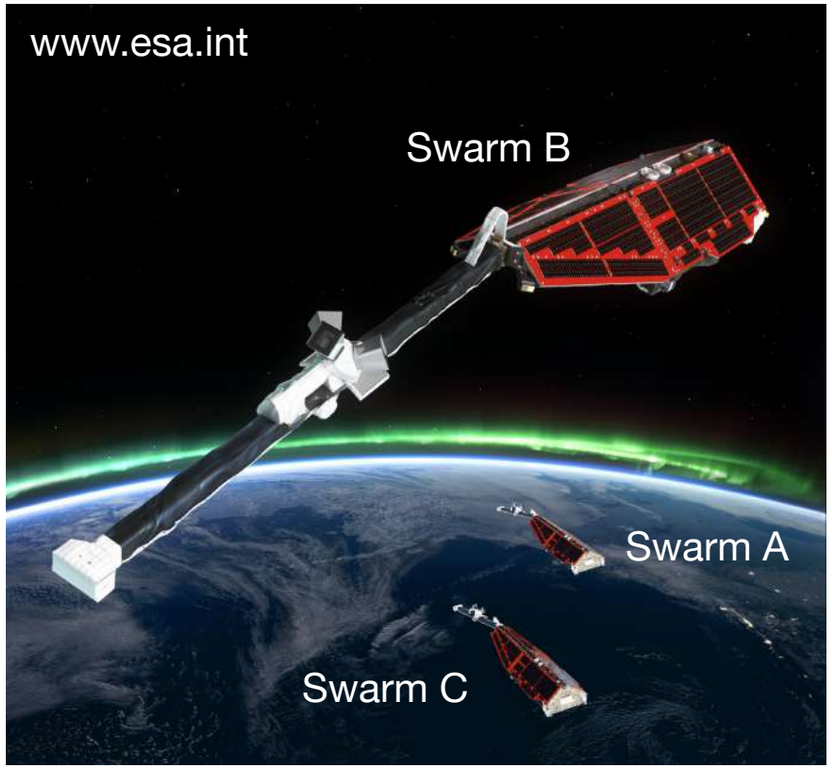
CSES (since 2018)
Sun-synchronous

Inclination: 98°

Altitude: ~500 km

Local time: Fixed (2 PM)

Swarm (since 2013)
non-Sun-synchronous



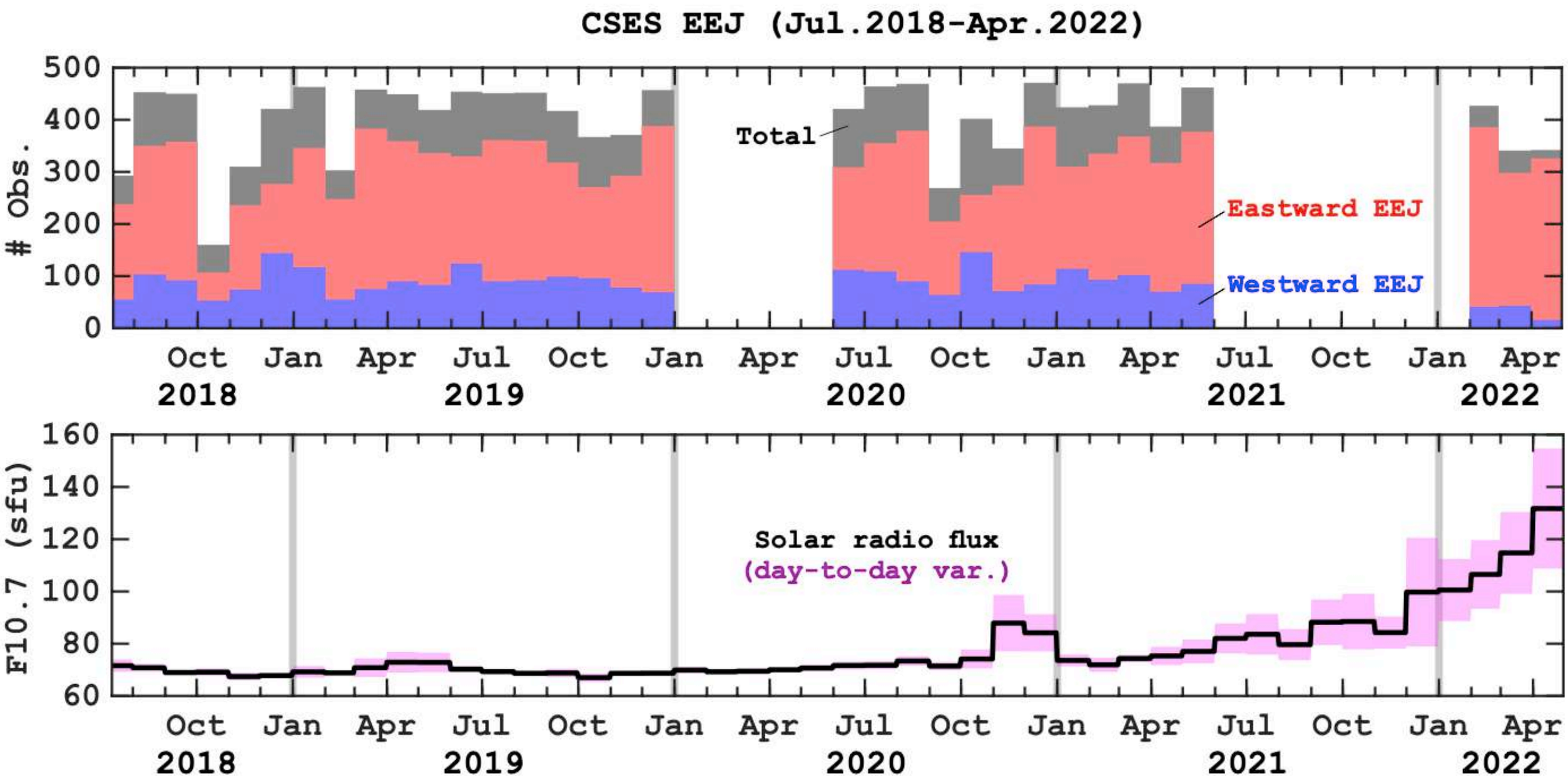
Inclination: 87°

Altitude: ~460 km (A & C)
~530 km (B)

Local time: Slow precession (1.5 h/month)

CSES EEJ Data Set

EEJ=equatorial electrojet

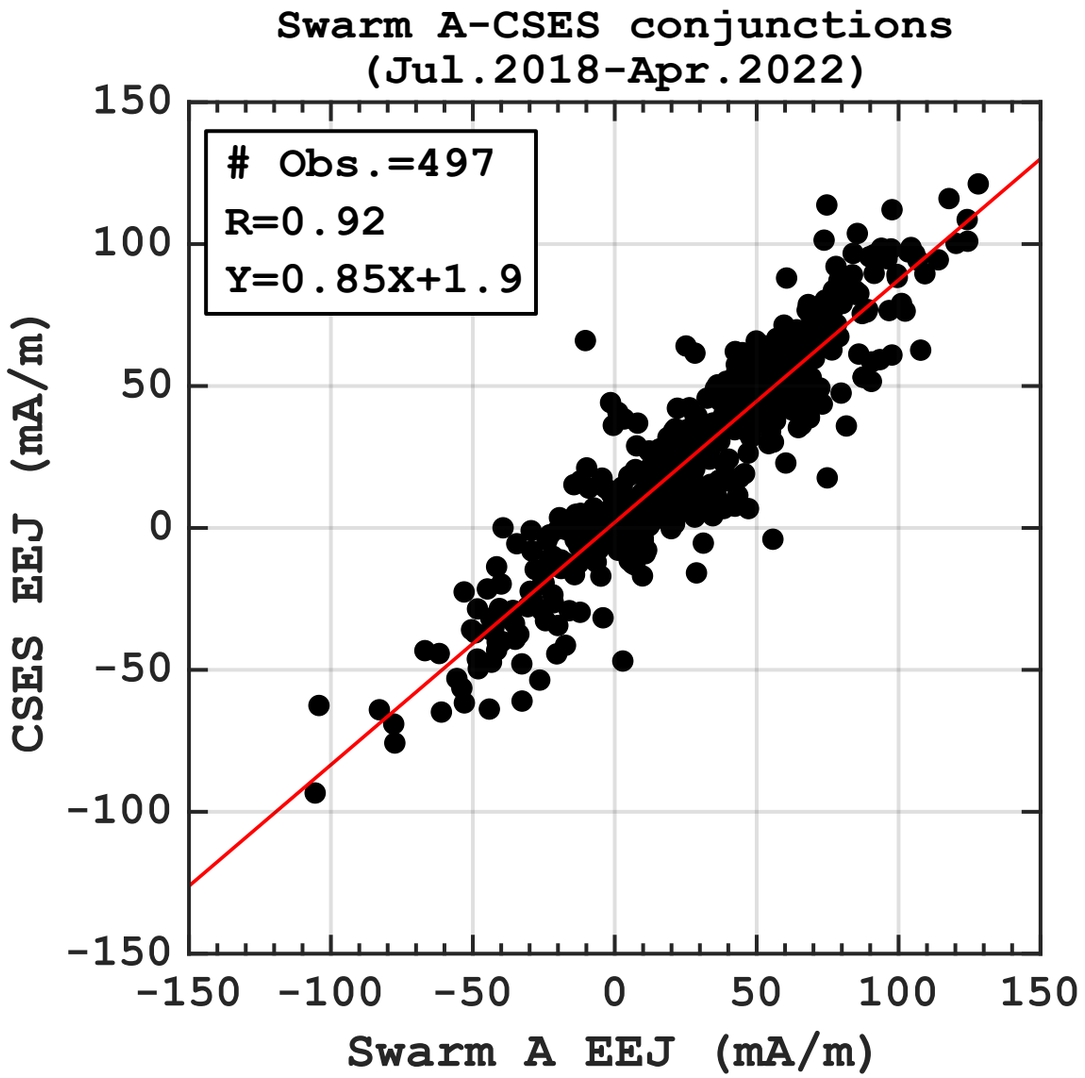


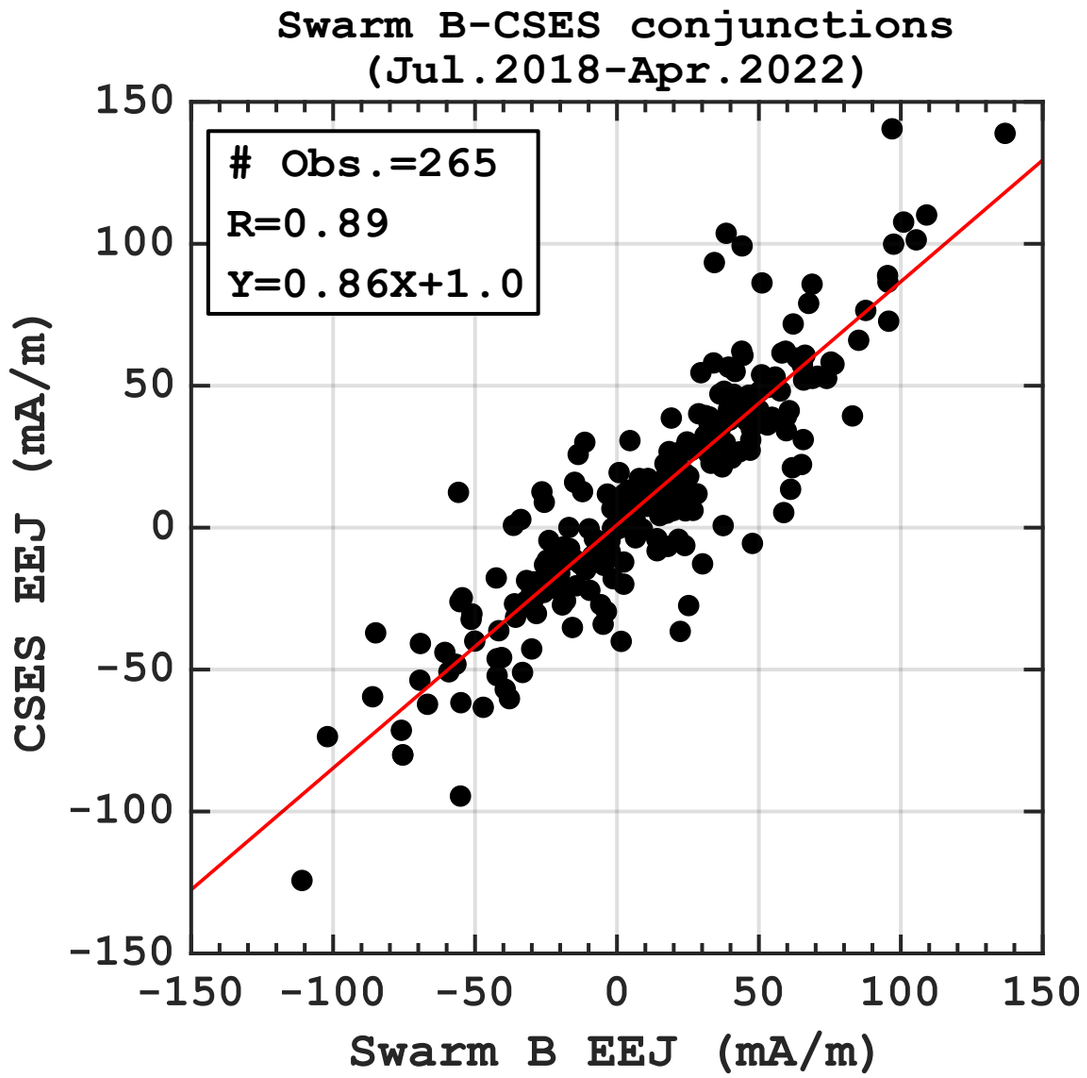
2.5 years under solar minimum conditions

Swarm EEJ vs. CSES EEJ

EEJ=equatorial electrojet

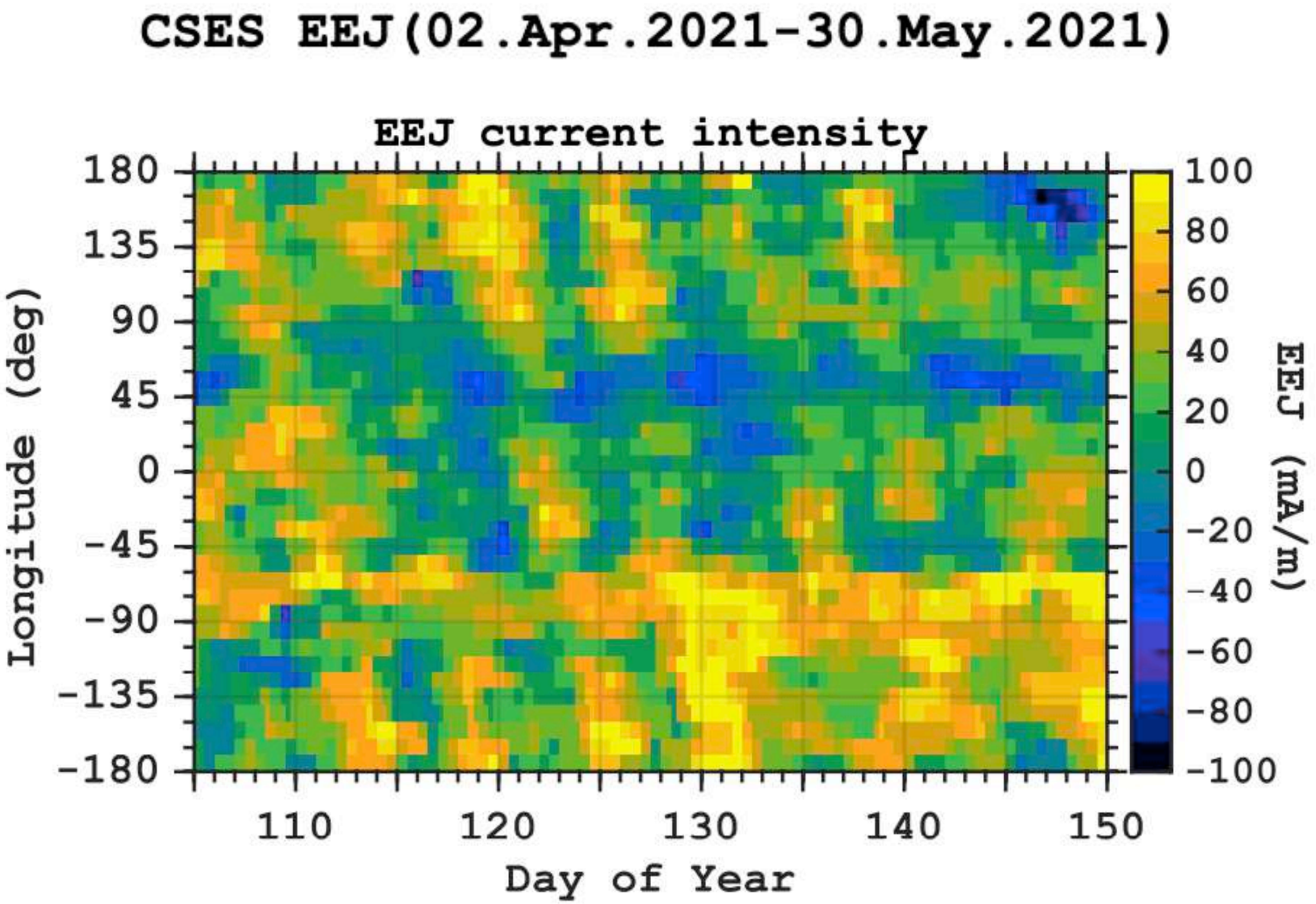
Conjunctions if: Δt<15 min, Δlon<10°





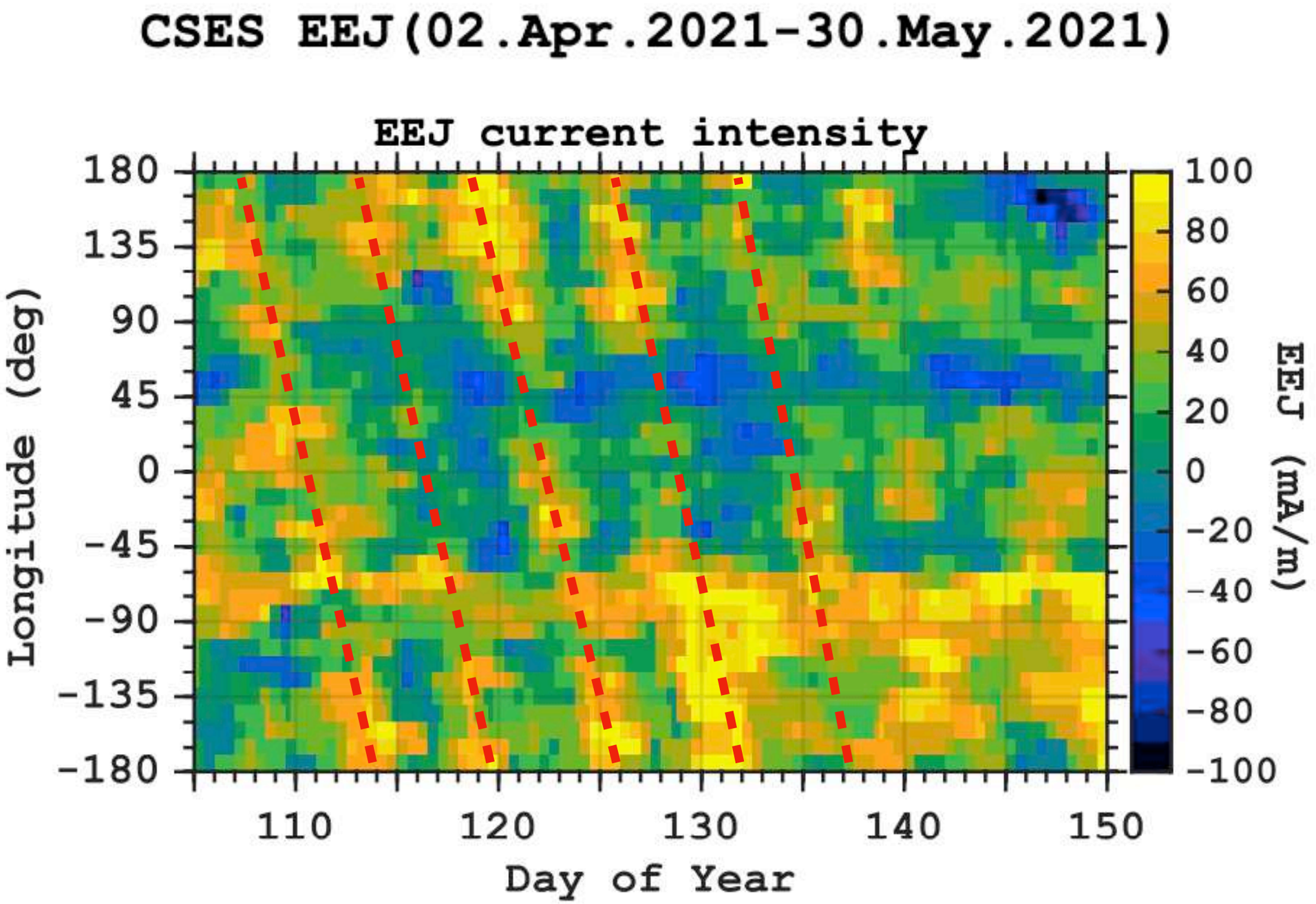
Strong correlation (R>~0.9) with EEJ from both Swarm A and Swarm B

Day-to-day and Longitudinal Variability (Ex. #1)



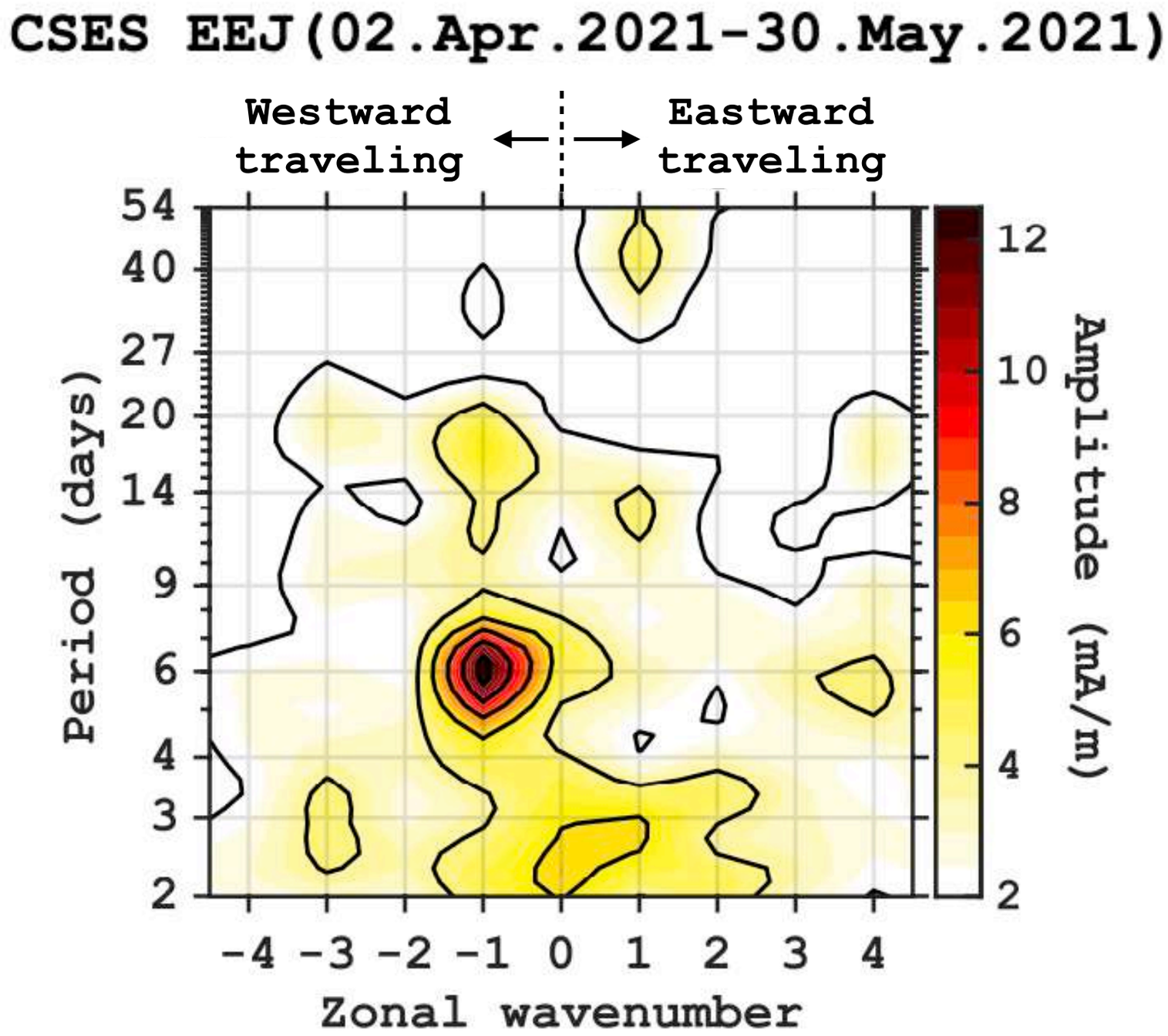
All measurements come from 2 PM local time.

Day-to-day and Longitudinal Variability (Ex. #1)



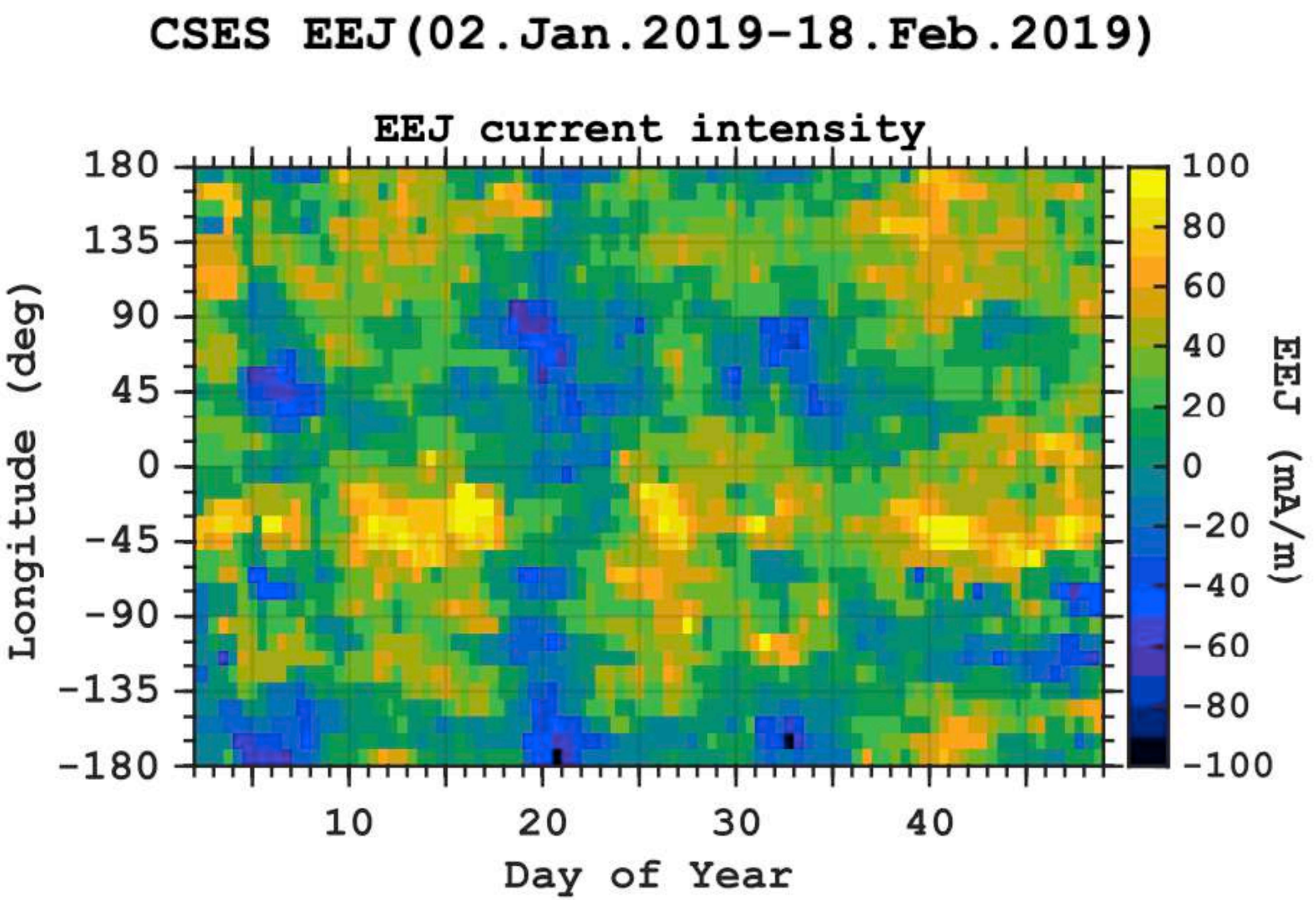
A westward-propagating wave?

Zonal Wavenumber–Period Spectrum (Ex. #1)

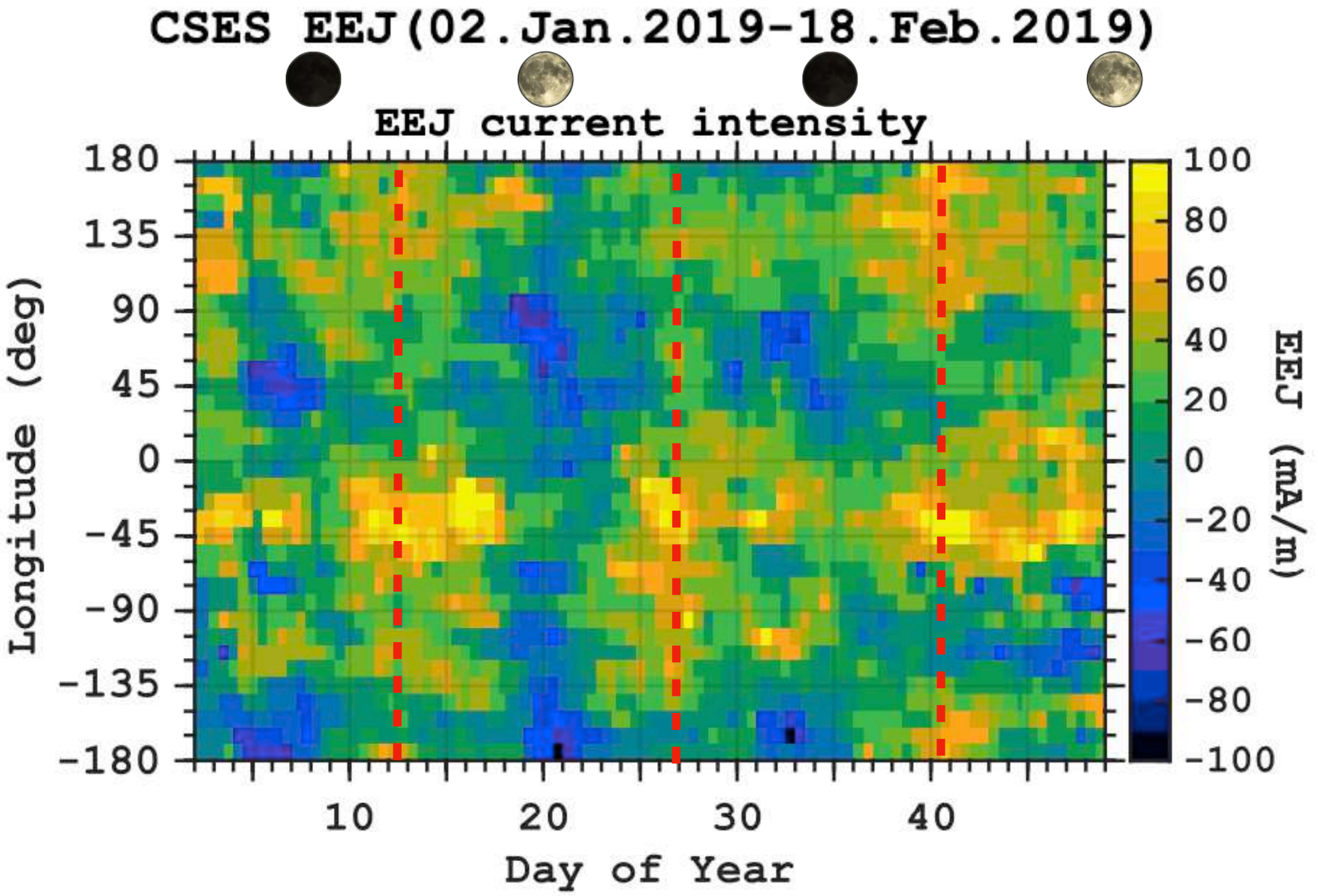


A westward-propagating 6-day wave with zonal wavenumber 1

Day-to-day and Longitudinal Variability (Ex. #2)

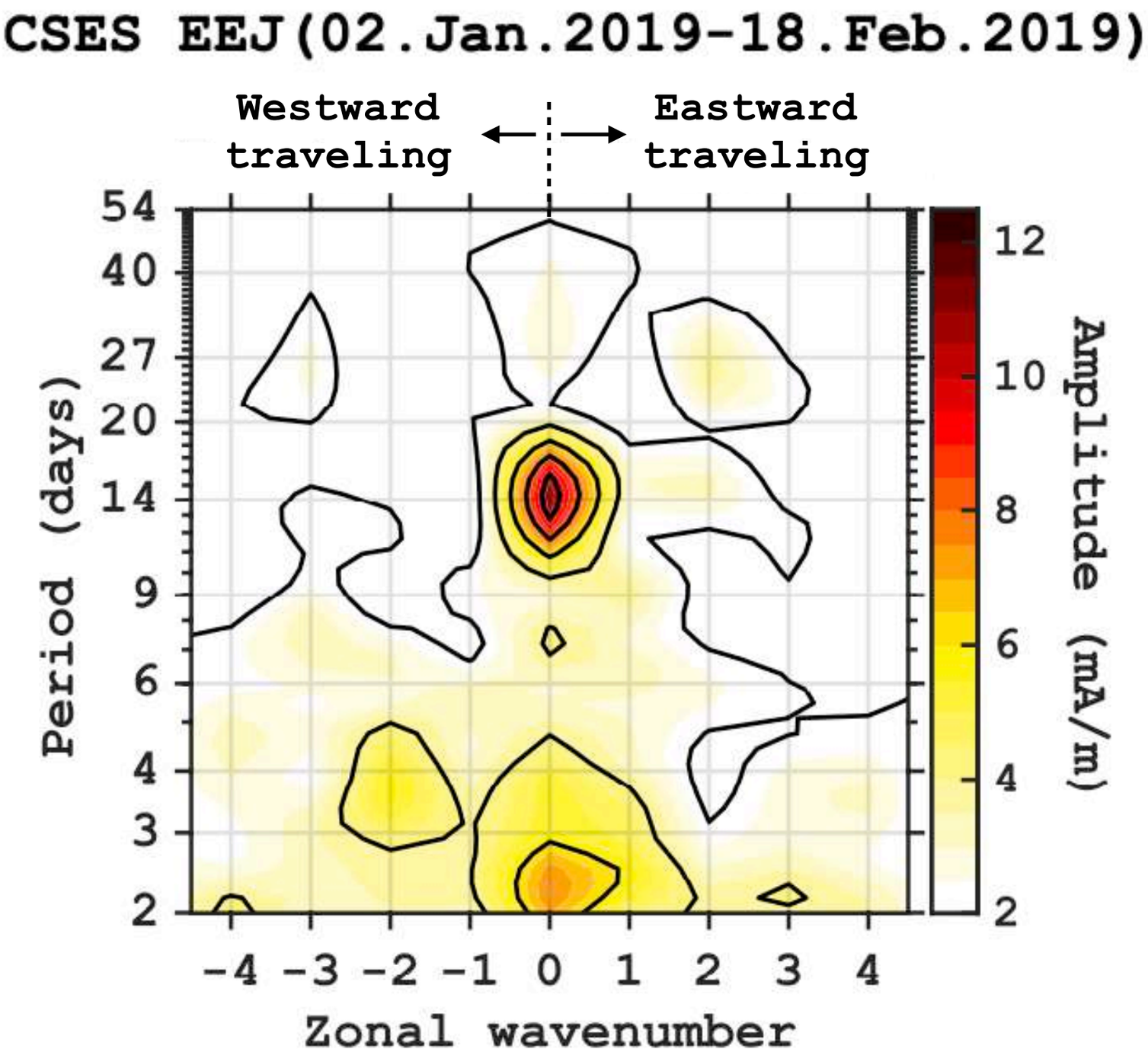


Day-to-day and Longitudinal Variability (Ex. #2)



A zonally-uniform oscillation?

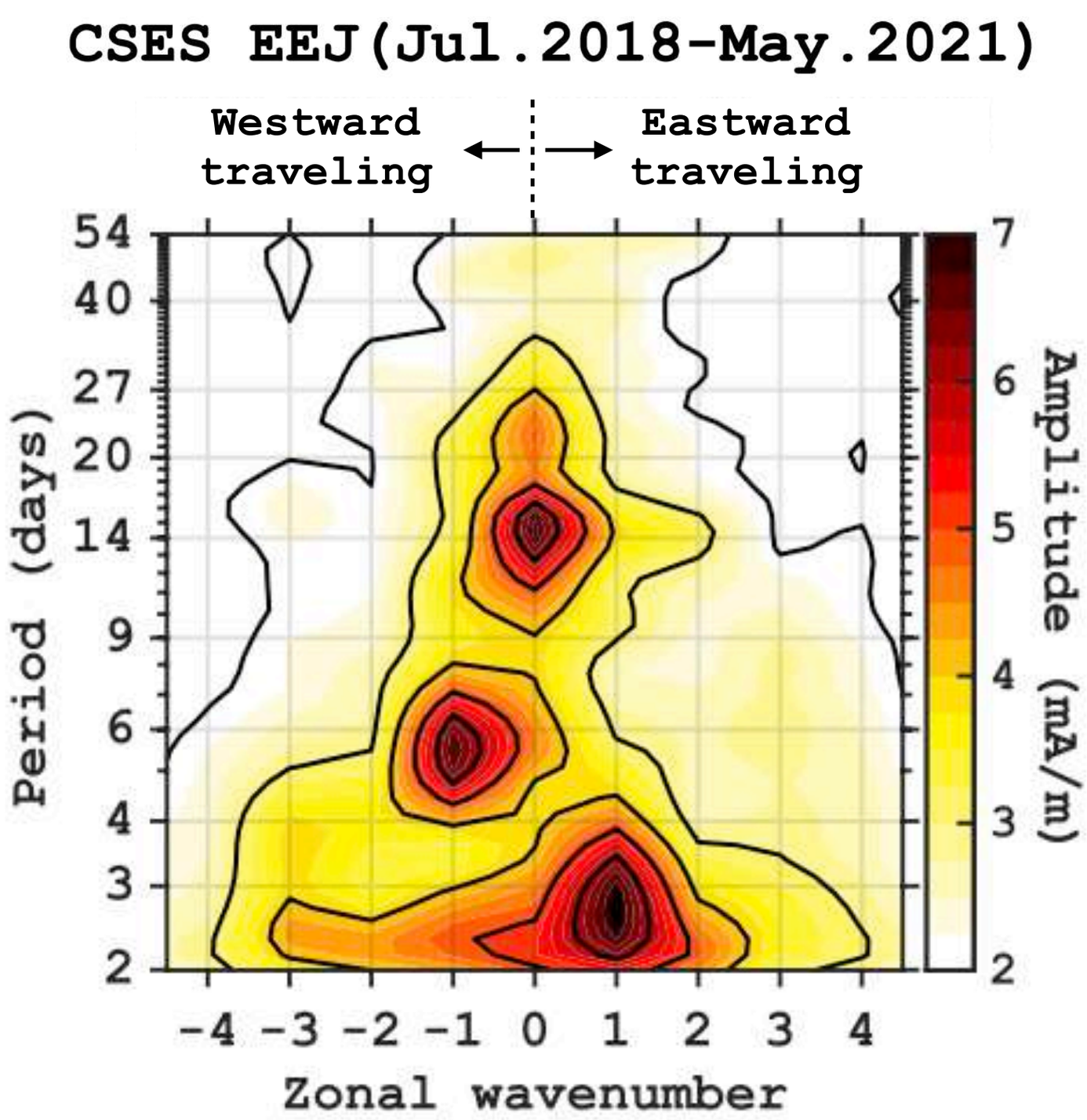
Zonal Wavenumber–Period Spectrum (Ex. #2)



Zonally uniform oscillation with a period of 14-15 days

Average Spectrum of the EEJ at 2 PM

EEJ=equatorial electrojet



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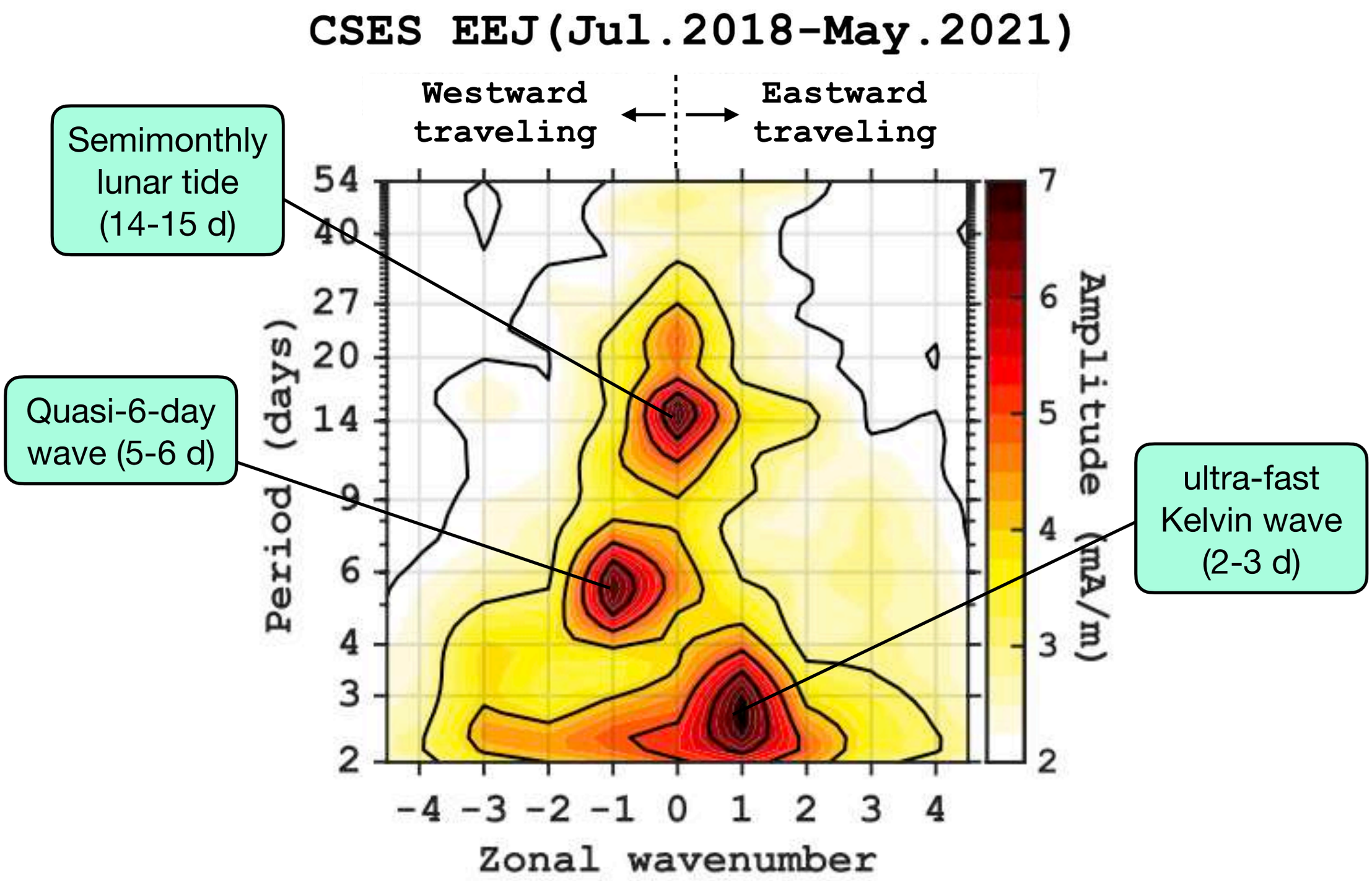


Atmospheric wave signatures dominate the average spectrum of the EEJ at 2 pm

Importance of Neutral Winds

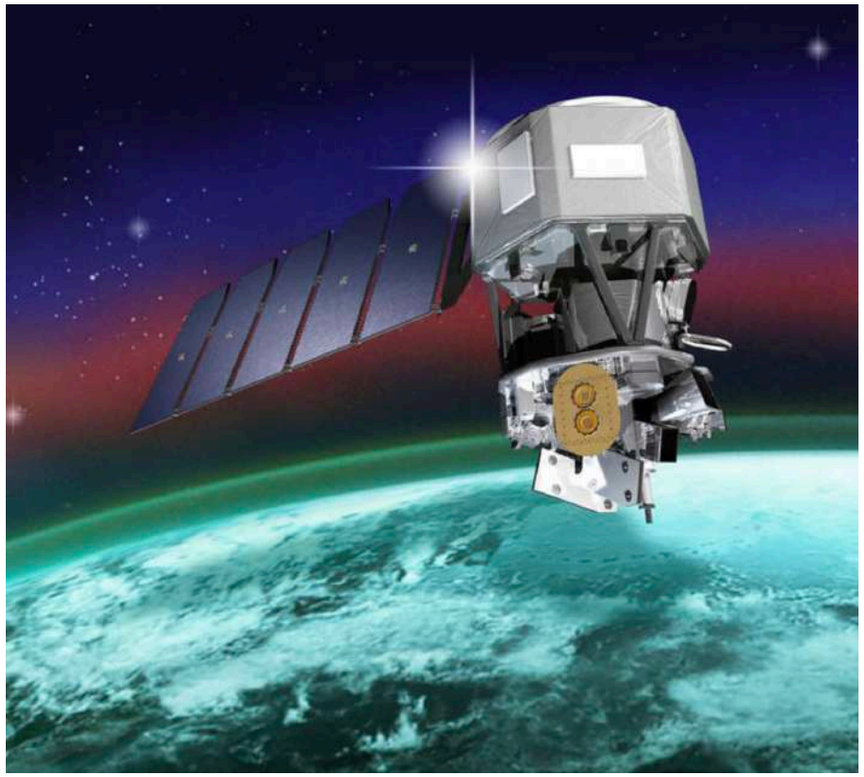
CSES (since 2018)

Inclination: 98°

Altitude: ~500 km

EEJ intensity (110 km)

ICON (2019-2022)



Inclination: 27°

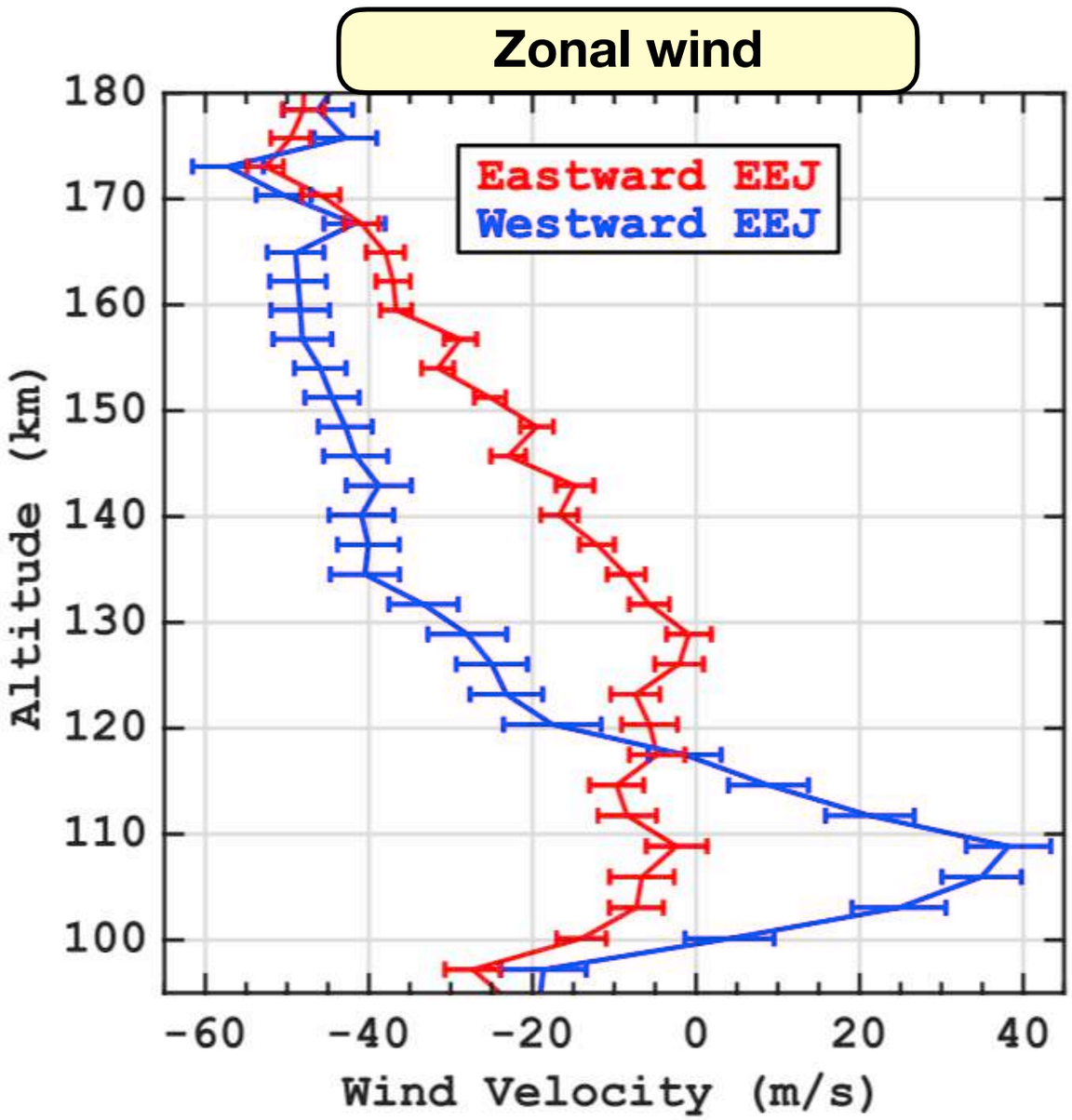
Altitude: ~600 km

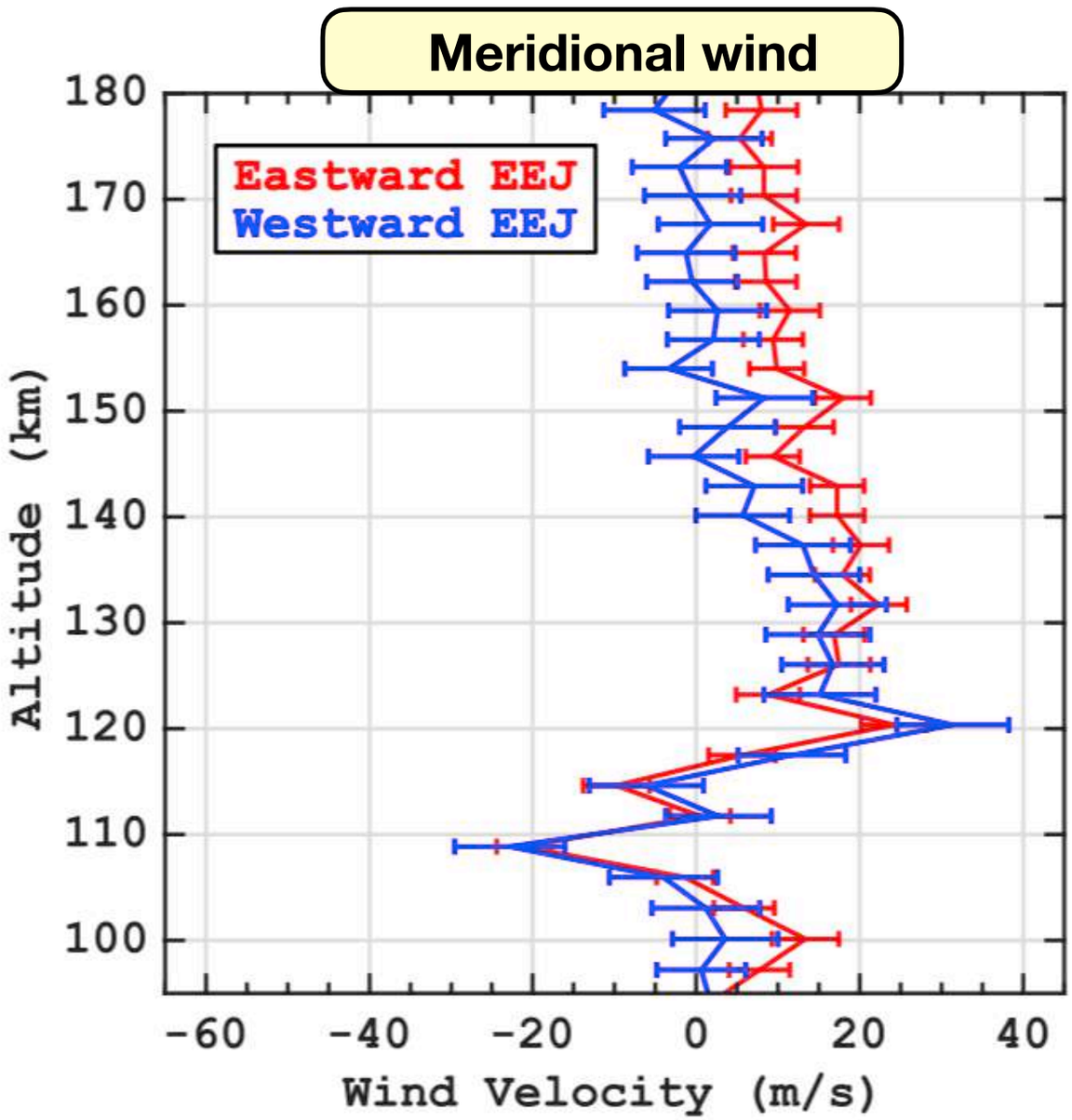
Wind profile (95-180 km)

Wind Profiles during Eastward & Westward EEJ

EEJ=equatorial electrojet

CSES-ICON conjunctions (# Obs.=240+76)





Conjunctions if: Δt<15 min, Δlon<10˚, Δlat<5˚

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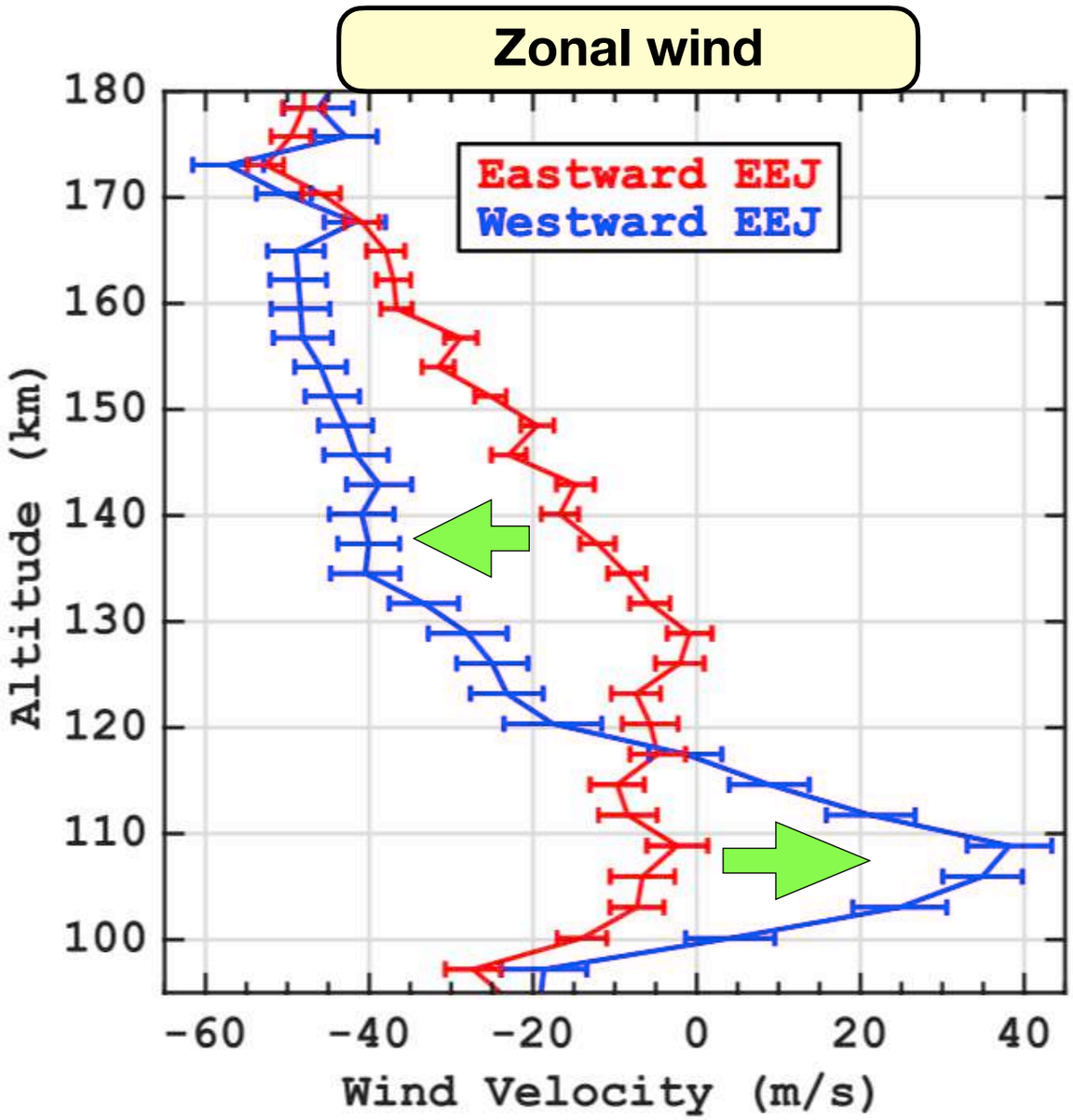
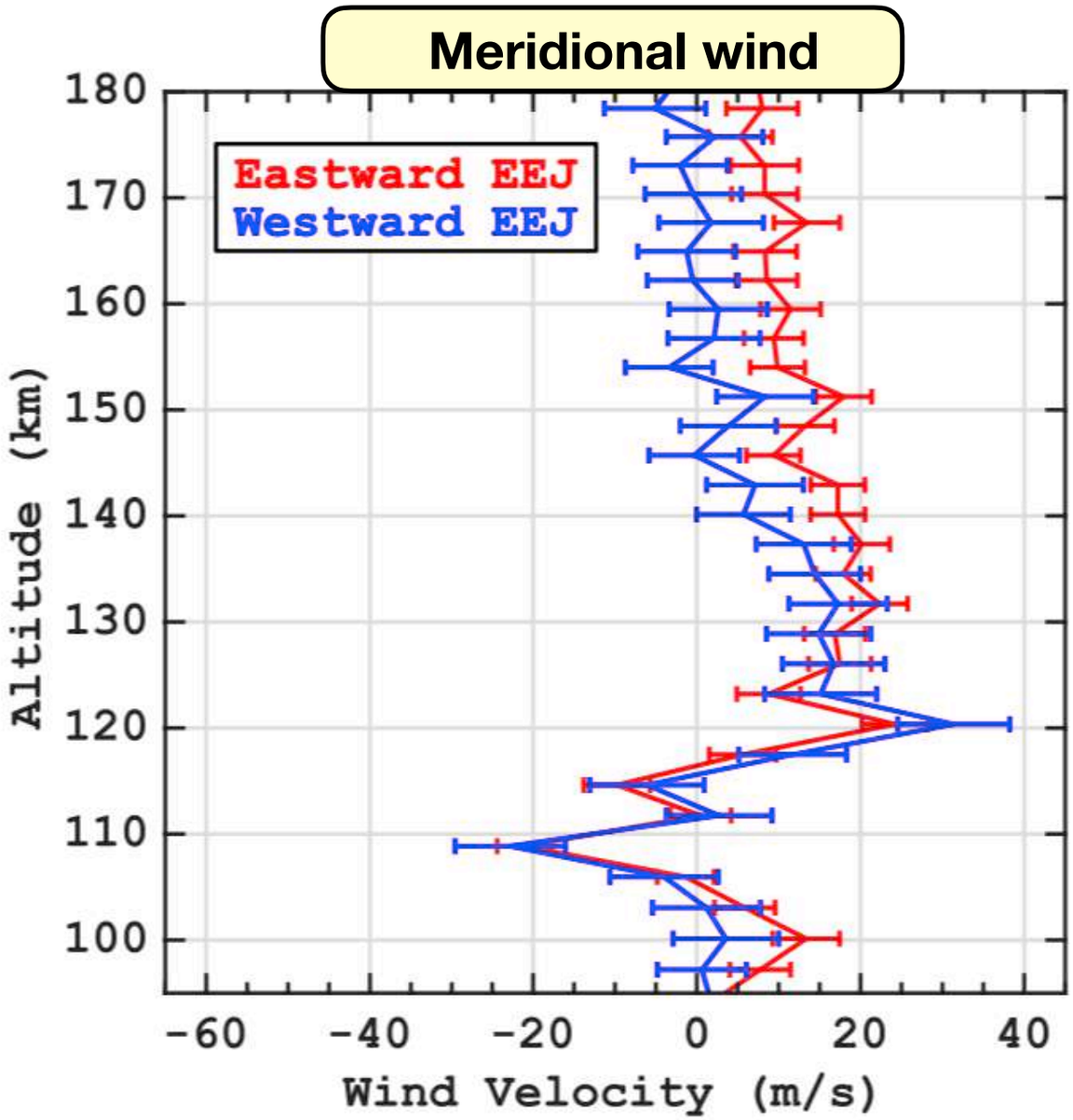


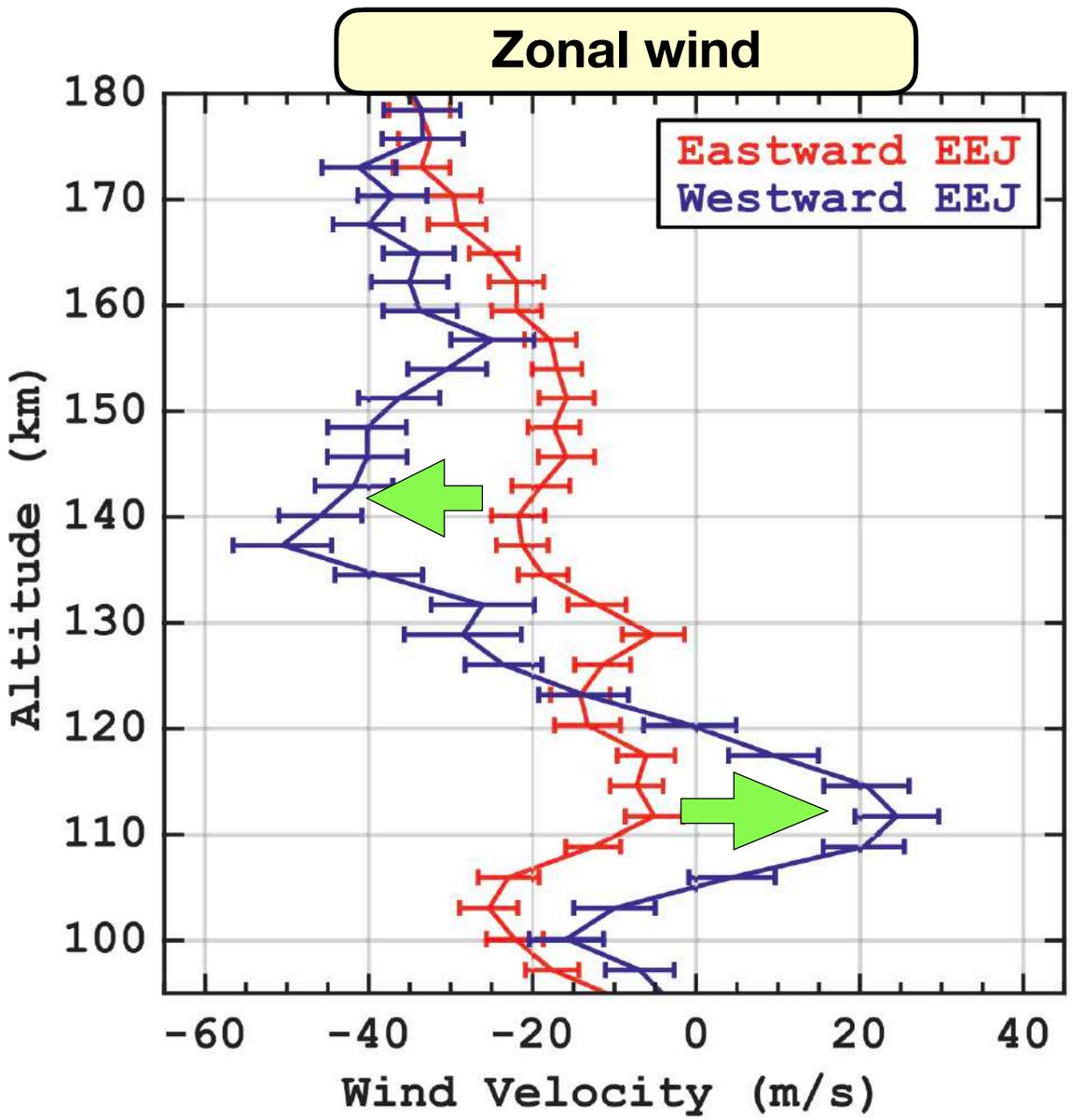


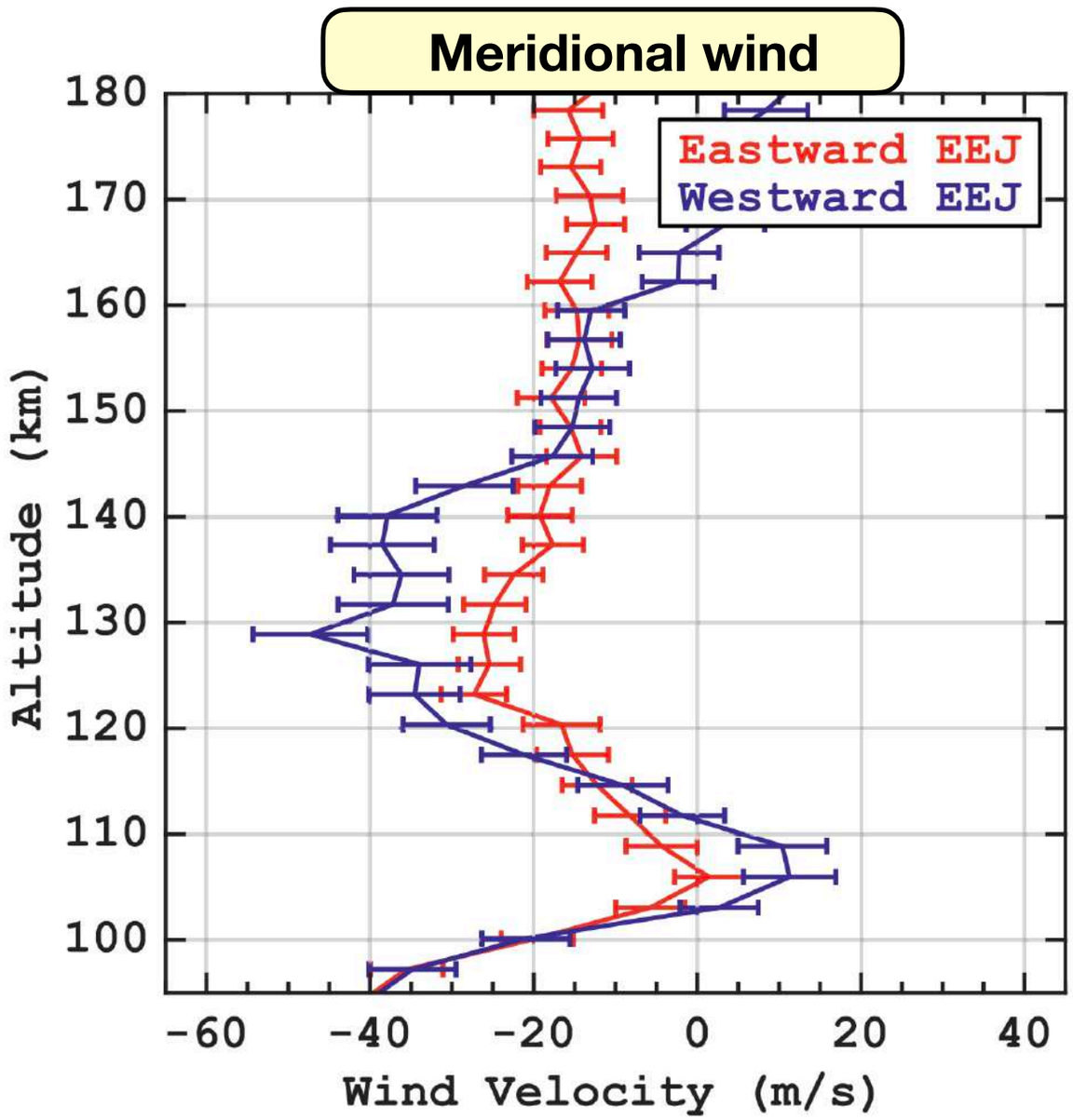
Zonal wind profiles are different between the times of eastward and westward EEJ

Wind Profiles during Eastward & Westward EEJ

EEJ=equatorial electrojet

Swarm A-ICON conjunctions (# Obs.=246)





[Yamazaki et al., 2021]

CSES results are consistent with earlier Swarm results (but w/o LT ambiguity)

Summary & Conclusions

1. Spatial and temporal variability of the **equatorial electrojet (EEJ)** was examined based on the magnetic measurements from the **Sun-synchronous CSES** satellite.

2. The EEJ intensities from **CSES and Swarm are in good agreement** during conjunction observations.

3. The following waves make a significant contribution to the longitudinal and day-to-day variations of the EEJ: **ultra-fast Kelvin wave**, **quasi-6-day wave**, **semimonthly lunar tide**.

4. Zonal wind profiles are different during the times of eastward and westward EEJ, underscoring the **zonal wind effect on the EEJ**.

Thank you for your attention!