



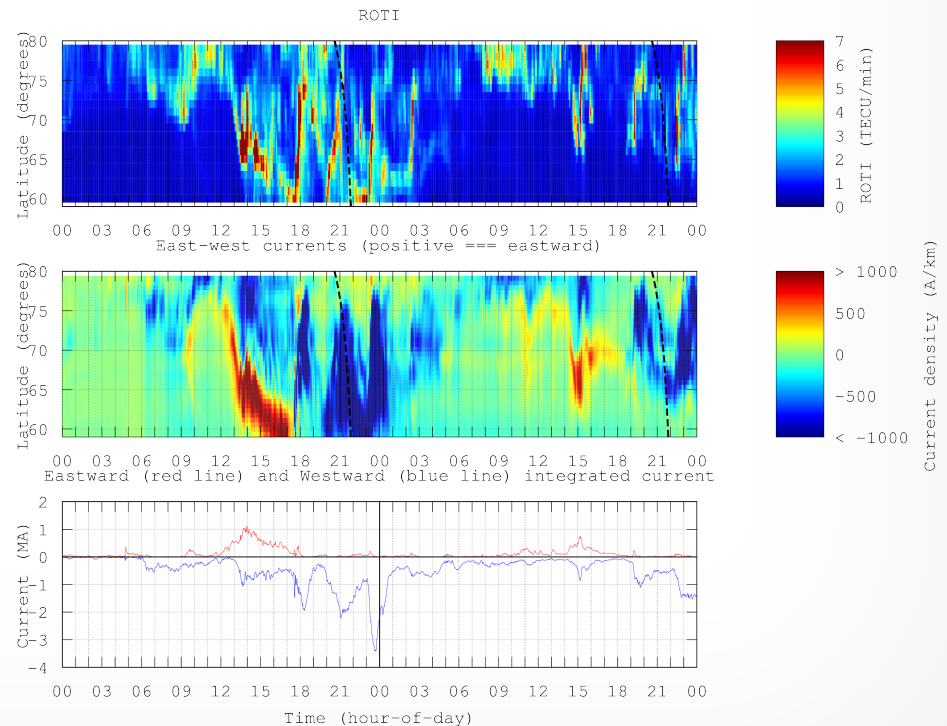
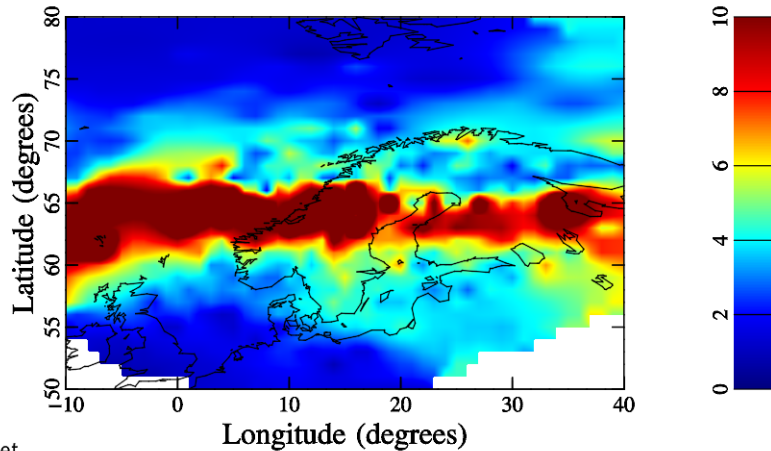
# Kartverket

## Overview of the 2015 St. Patrick's day storm and its consequences for RTK and PPP positioning in Norway

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Norwegian Mapping Authority

Published in Journal of Space Weather and Space Climate, Vol. 6  
<http://dx.doi.org/10.1051/swsc/2016004>

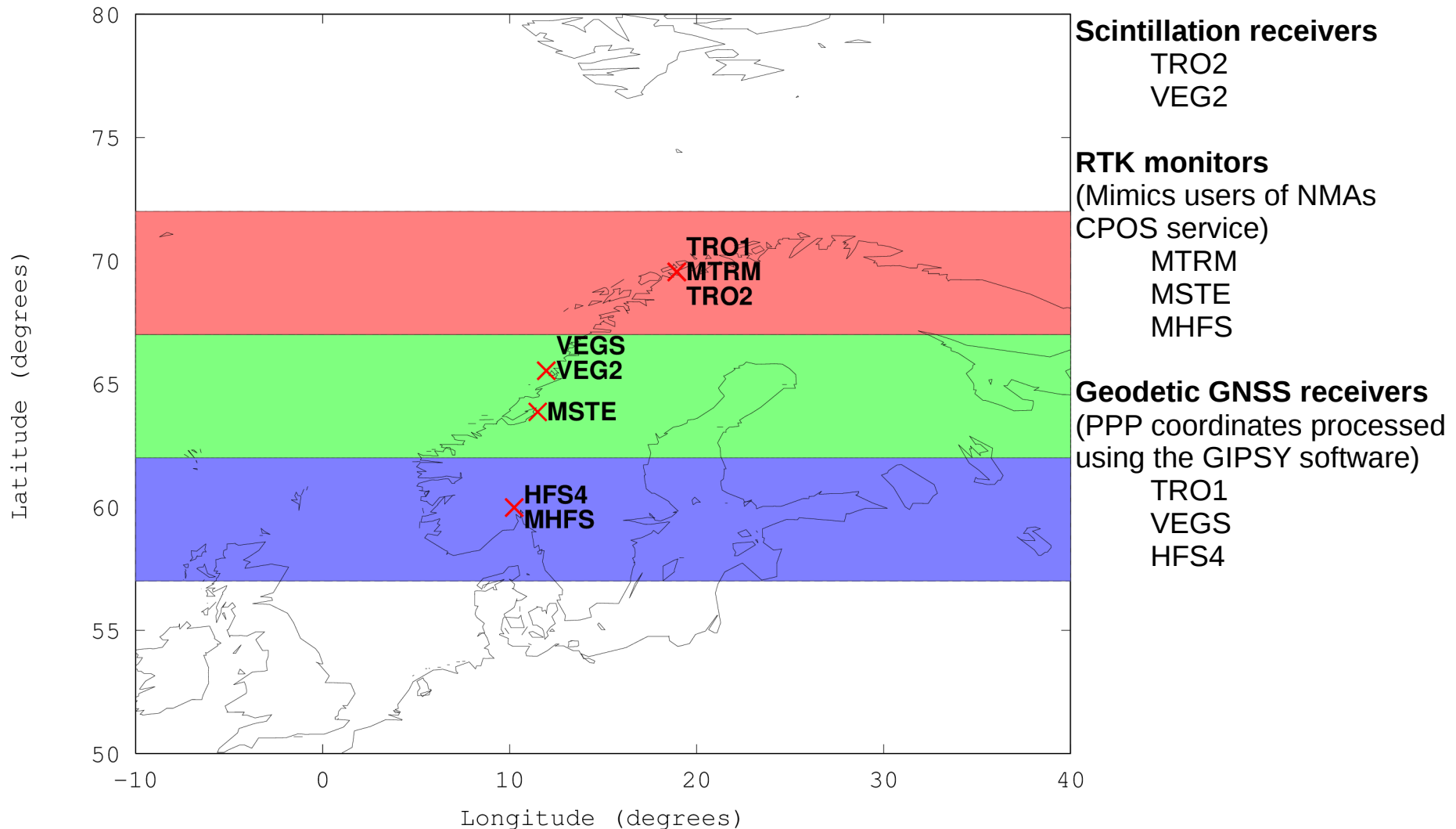
ROTI [TECU/min]  
2015-03-17 17:45 UTC





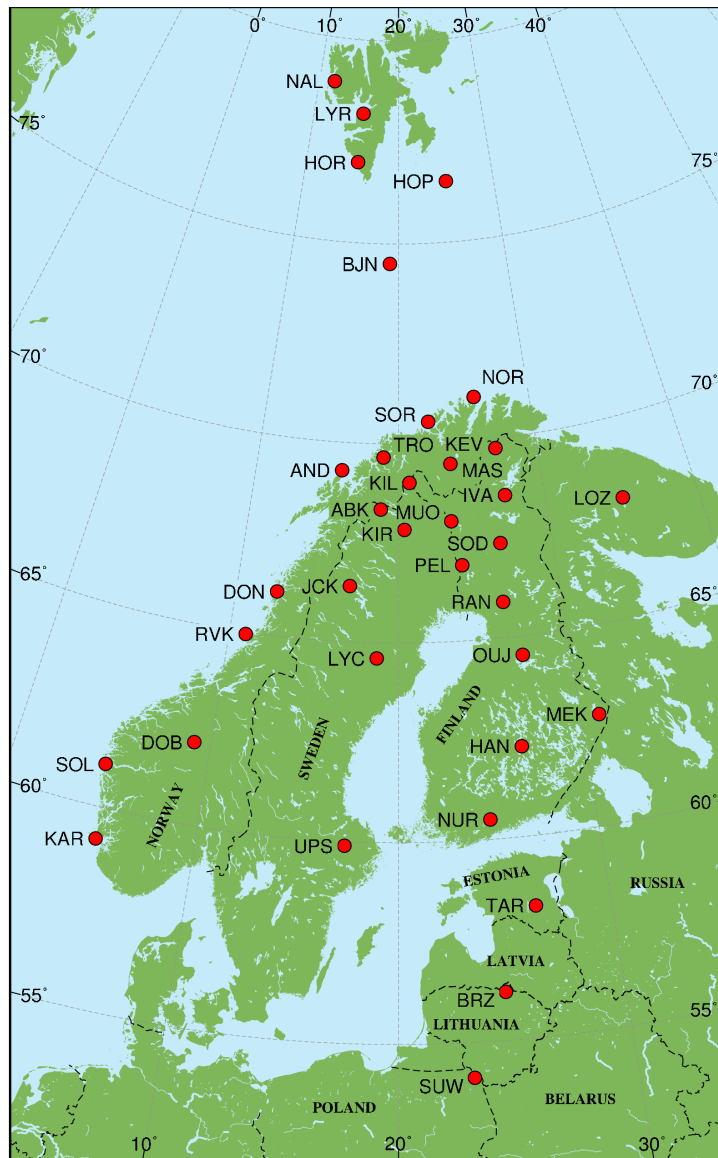
# Data sources – GNSS 2

## Specific receivers used in analysis

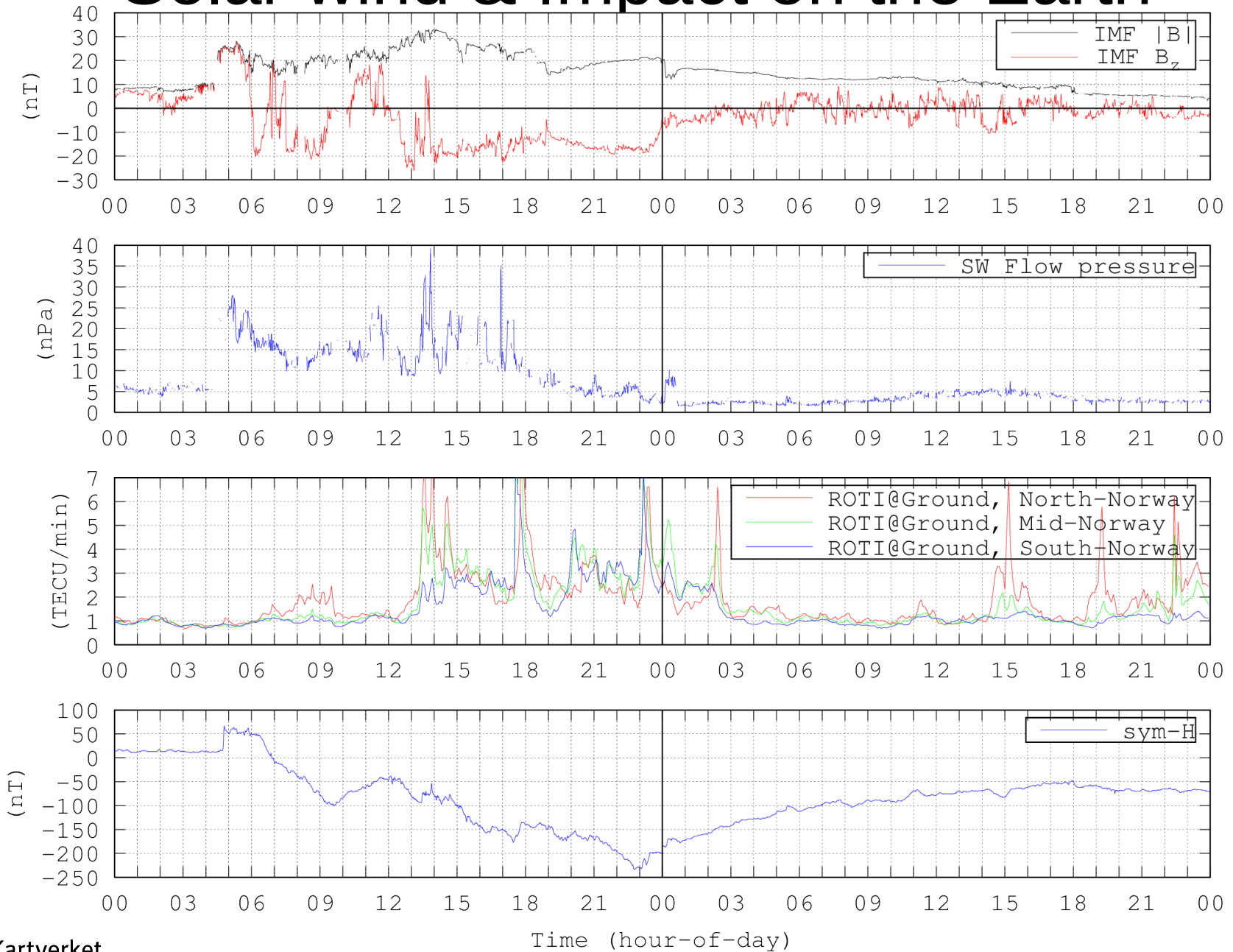


# Data sources – Magnetometers

## The IMAGE network



# Solar wind & Impact on the Earth

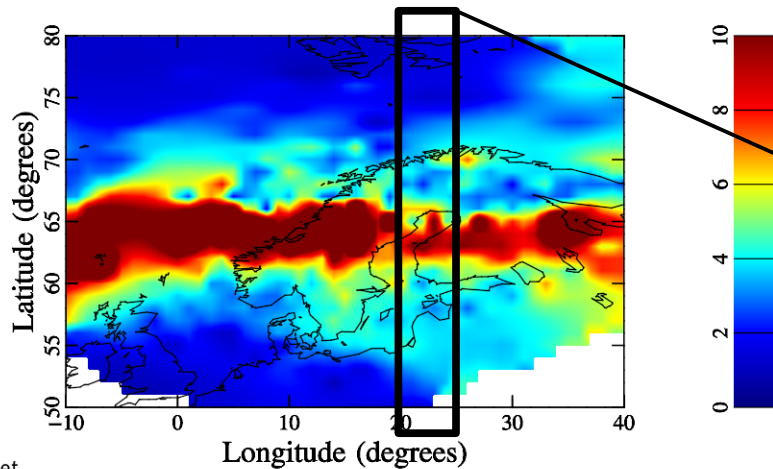


# ROTI VS Auroral electrojet current

Rate-Of-TEC Index (ROTI) is the standard deviation of the geometry-free phase combination.

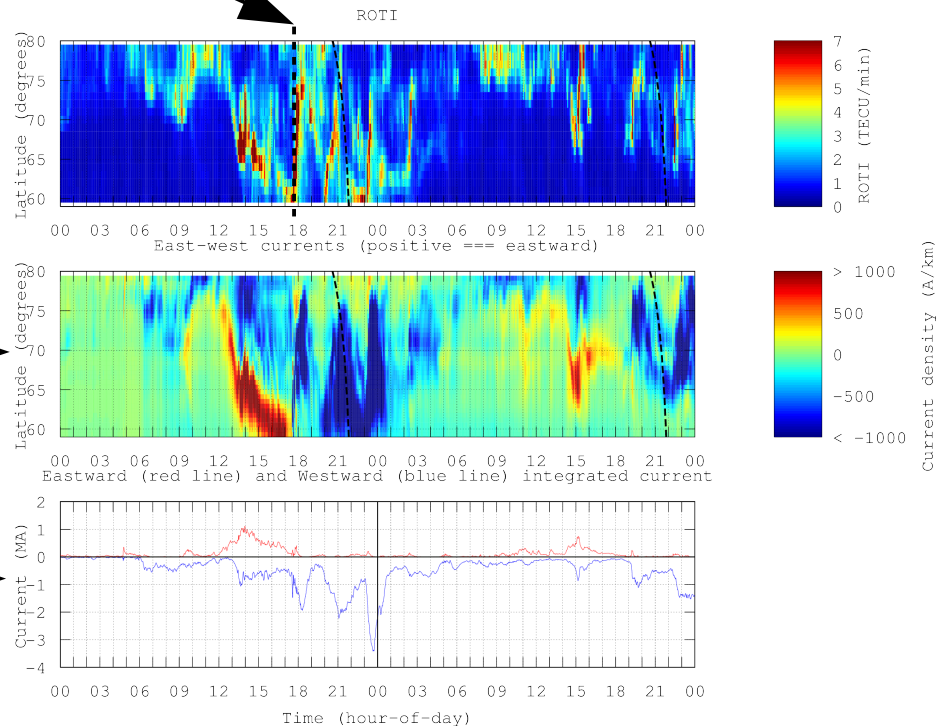
To compare ROTI to auroral currents, a latitudinal slice is taken every 5 minutes to form the upper panel of the plot below.

ROTI [TECU/min]  
2015-03-17 17:45 UTC

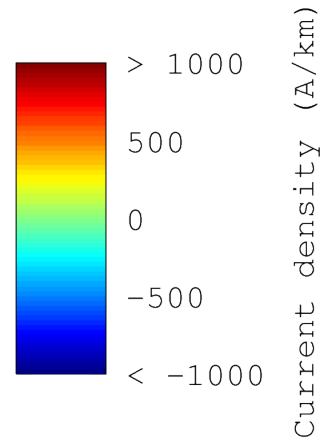
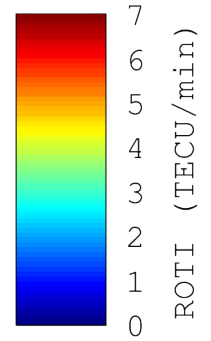
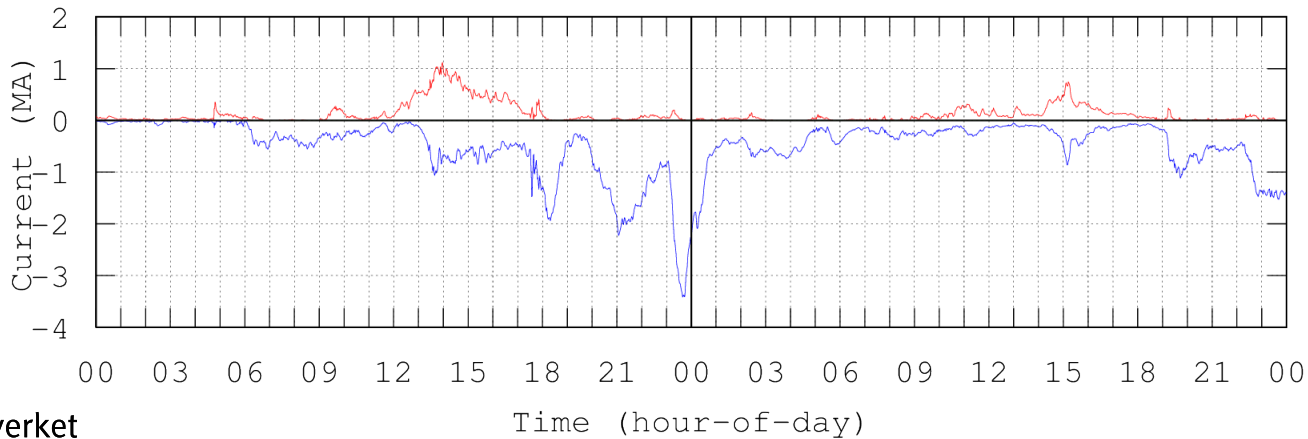
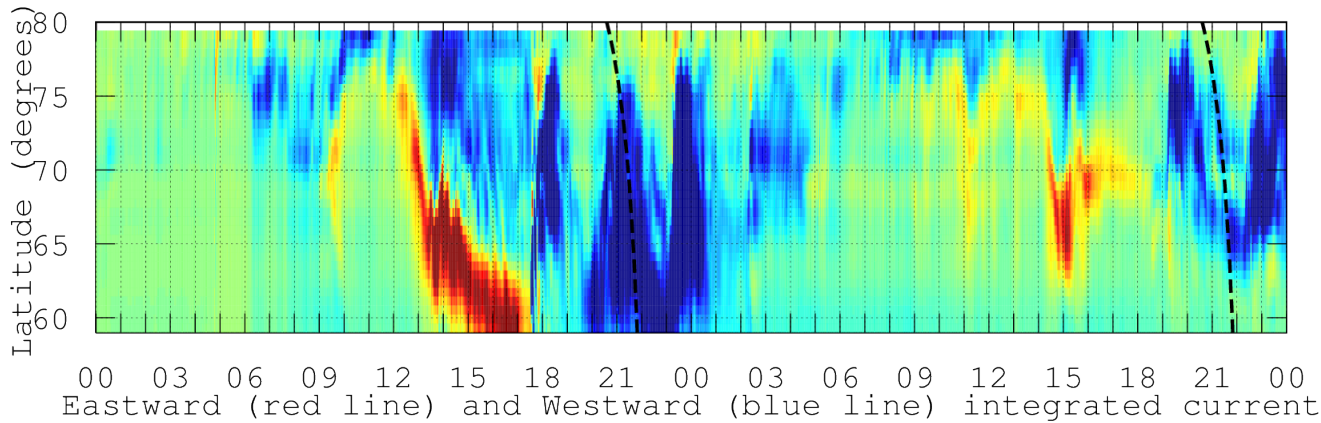
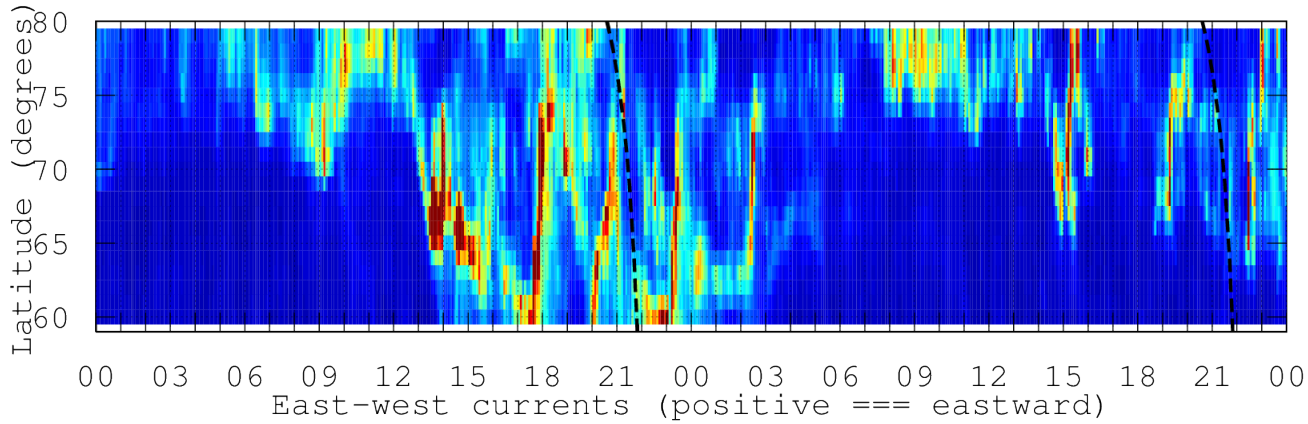


East-west current density →

Total east/west current →



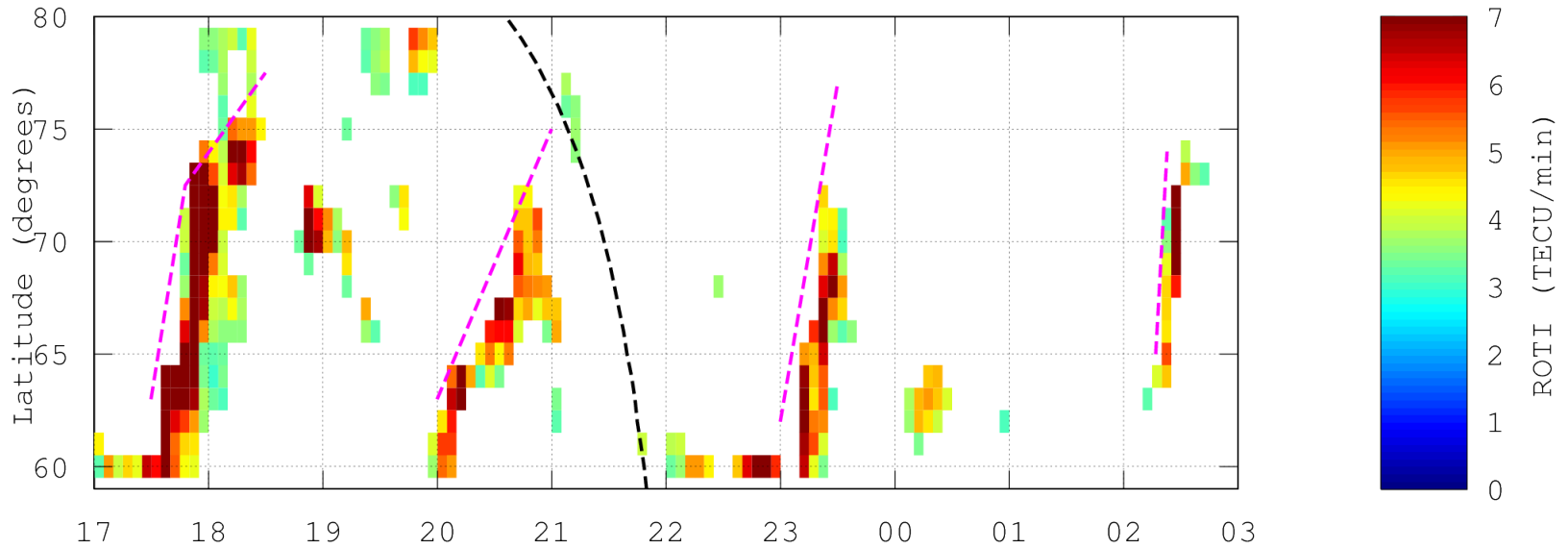
# ROTI



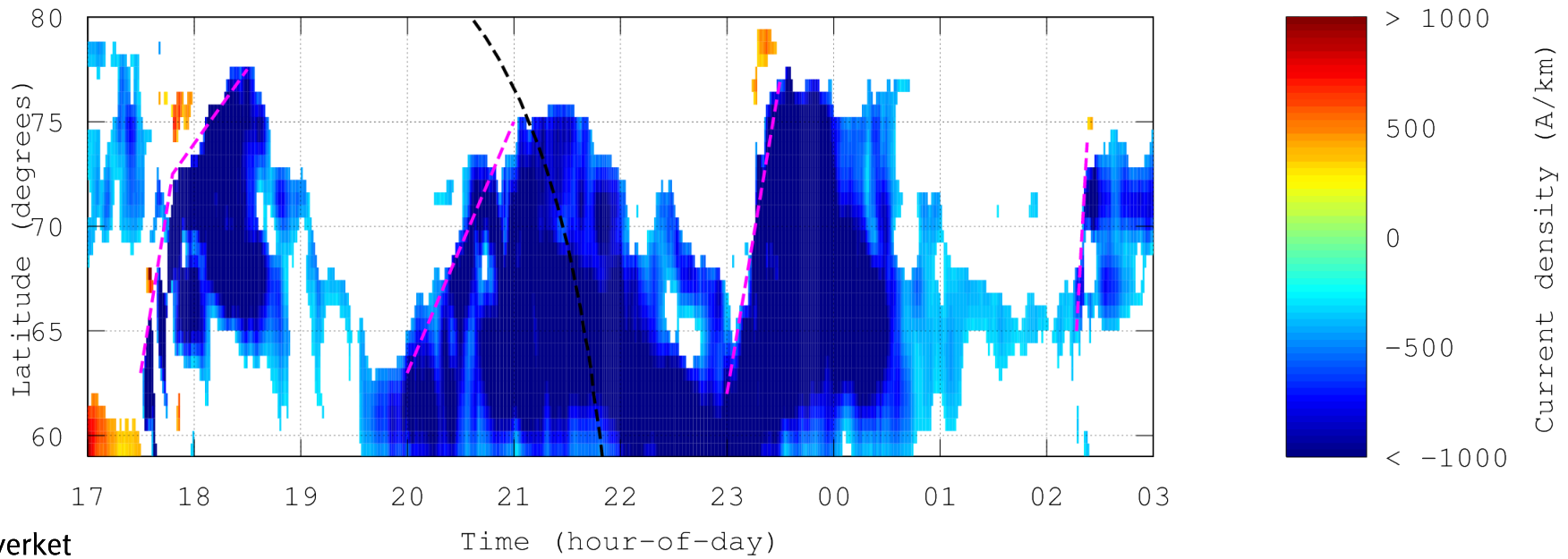
Current density (A/km)



Only ROTI  $\geq 3$  TECU/min



Only the currents  $\geq 300$  A/km

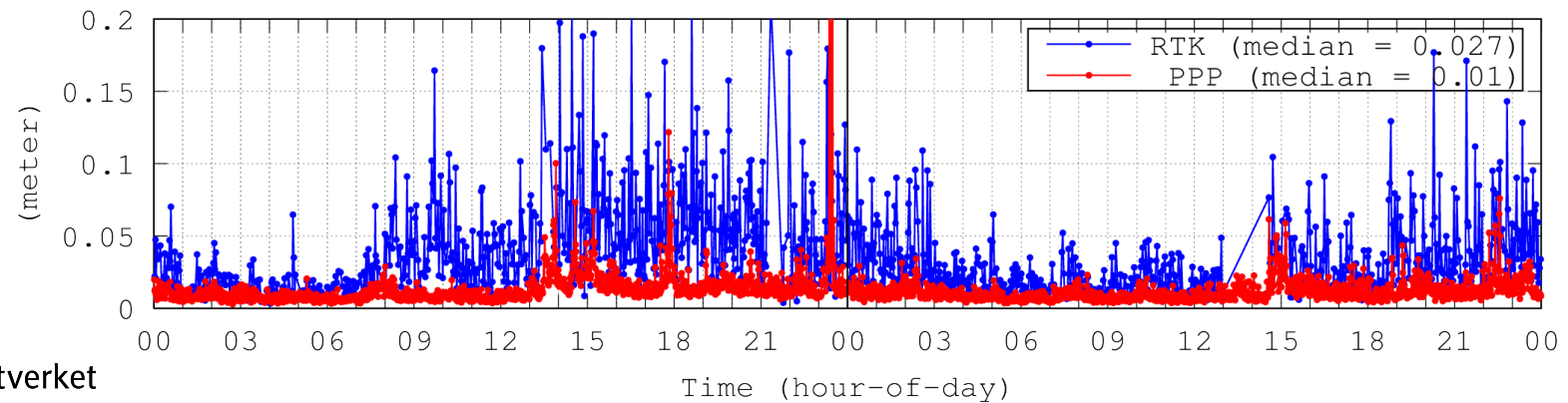
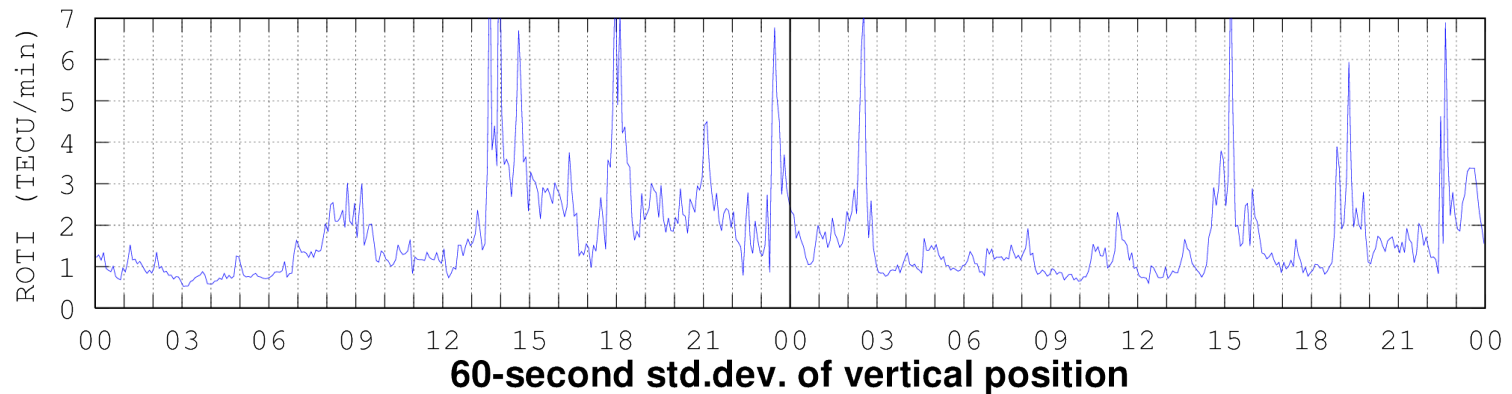
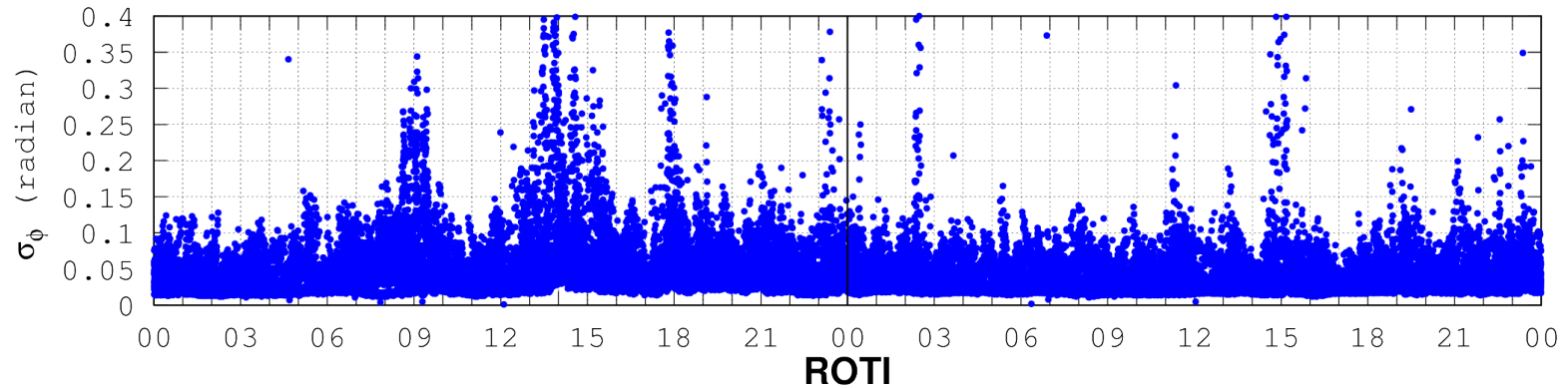




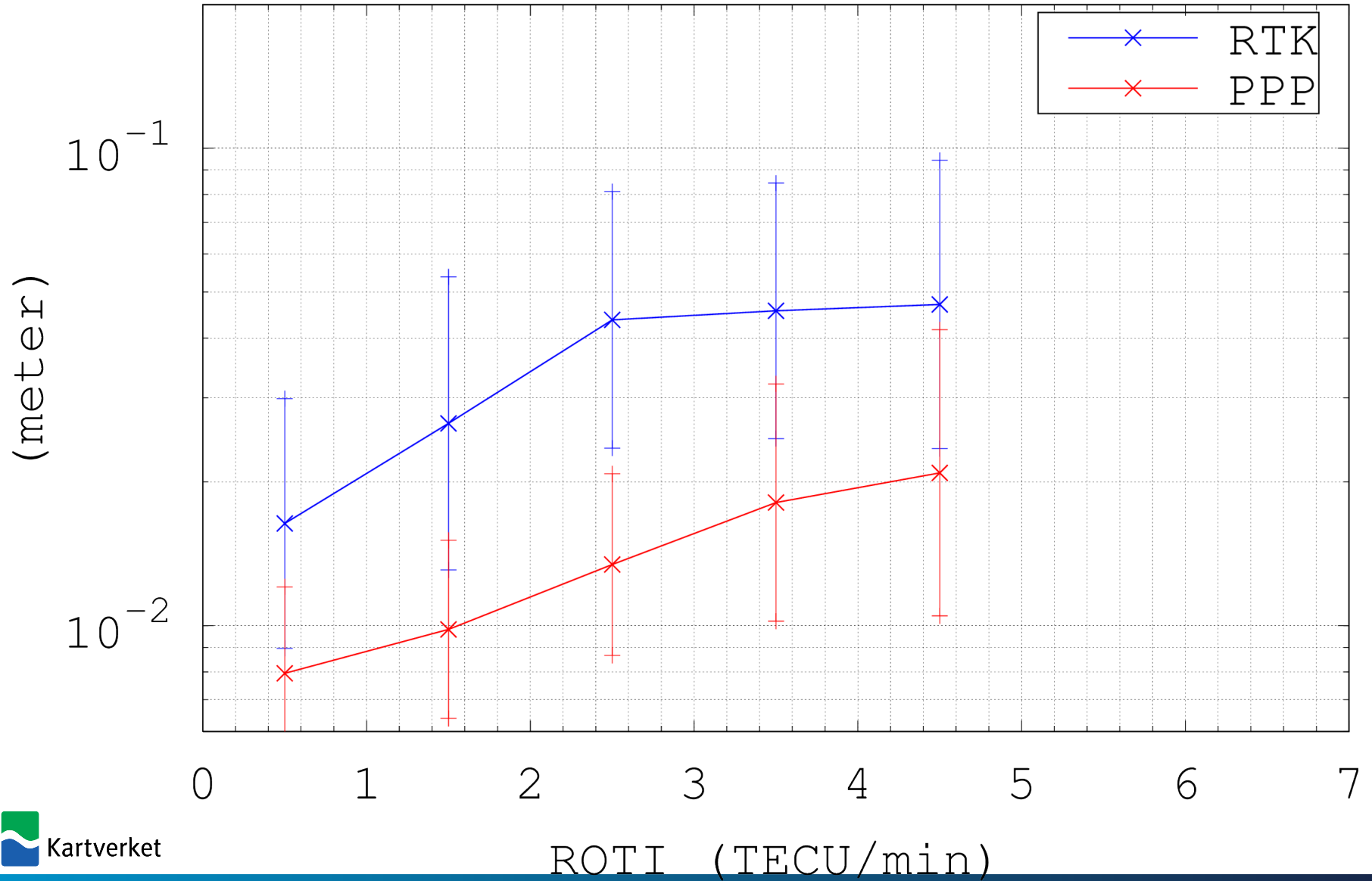
# ROTI VS Position errors

Location:  
Tromsø

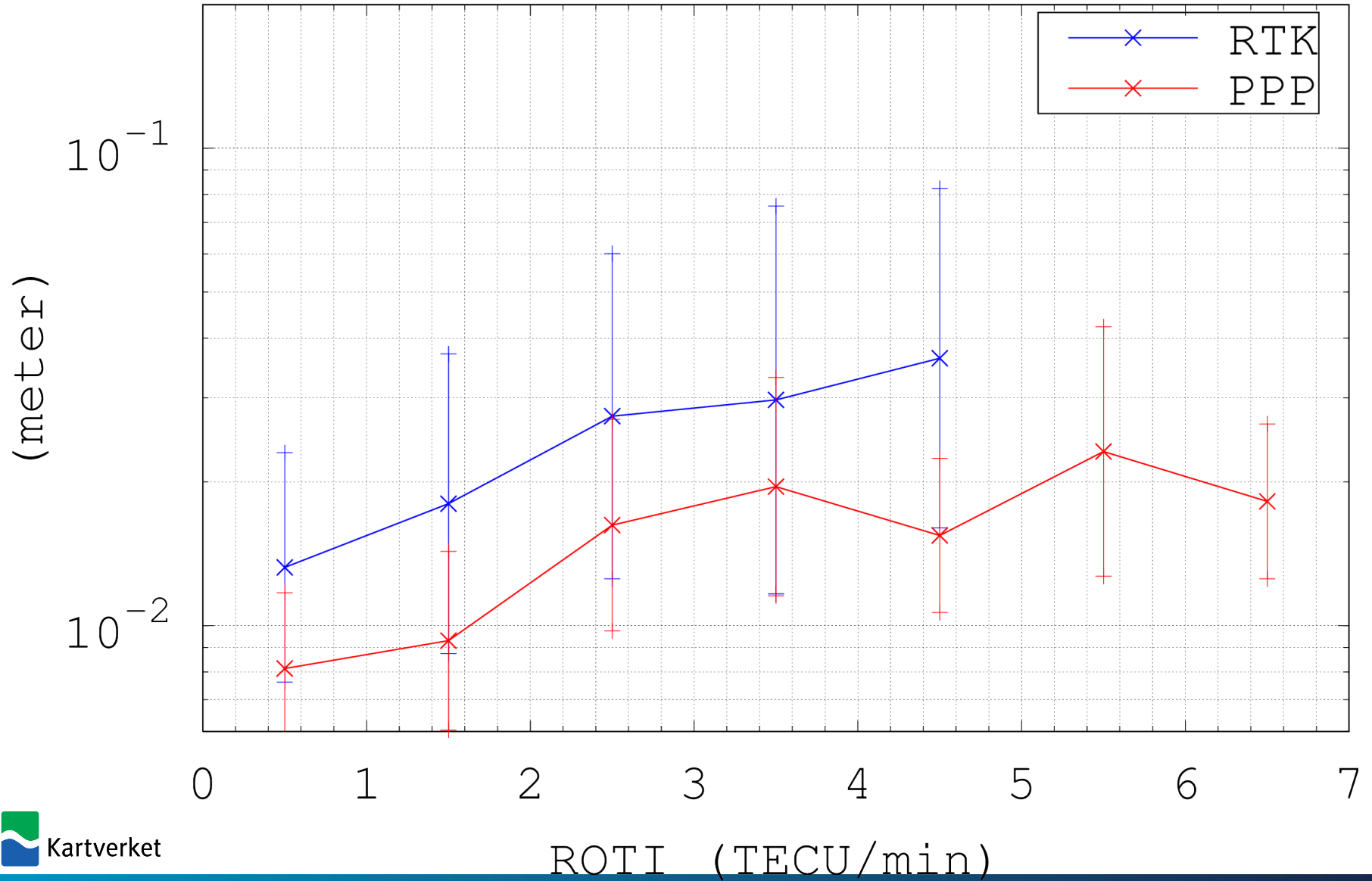
Phase scintillation



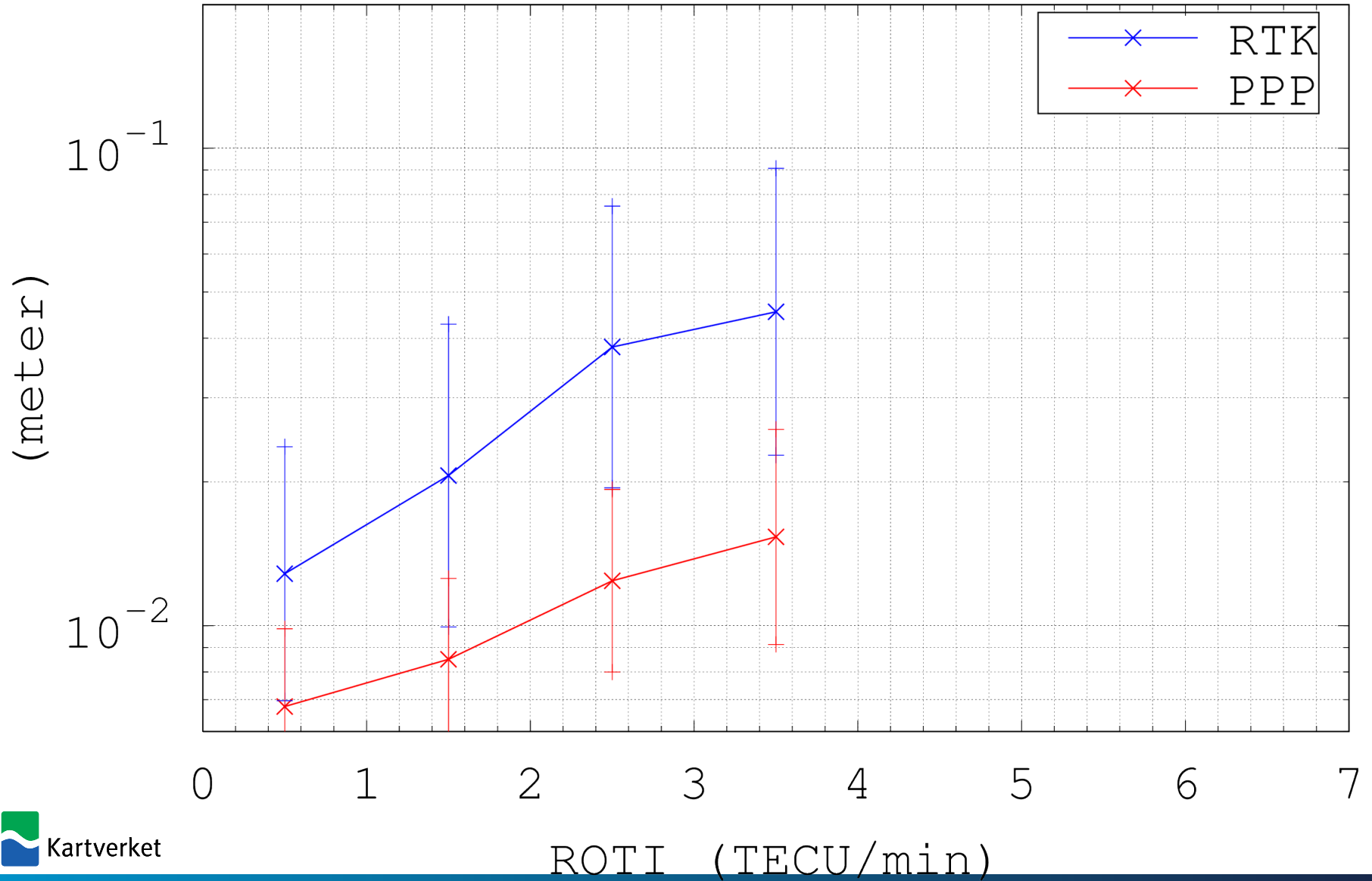
# Position error binned by ROTI Tromso



# Position error binned by ROTI Vega



# Position error binned by ROTI Honefoss



# Conclusions

- Strong GNSS disturbances were observed at all latitudes in Norway on March 17th and early on the 18th. Late on the 18th, strong disturbances were only observed in the northern parts of Norway.
- GNSS disturbances, measured by ROTI, were most intense on the poleward edge of poleward-moving electrojet currents. This is possibly related to patches and/or particle precipitation activity caused by active tail reconnection. The relative importance of these phenomena, or the importance of having both simultaneously, cannot be determined from our data.
- Regions with less intense currents and/or equatorward motion of the current region were associated with less severe GNSS disturbances.
- Positioning errors increased rapidly with ROTI for both the RTK and PPP techniques. PPP was most precise regardless of disturbance level.