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# **Estimation of absolute group delay variations (GDV) for GNSS satellite antennas**

*Zur Bestimmung absoluter Code-Verzögerungen (GDV)  
für GNSS-Satellitenantennen*

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Technische Universität Dresden

# Introduction

## Motivation

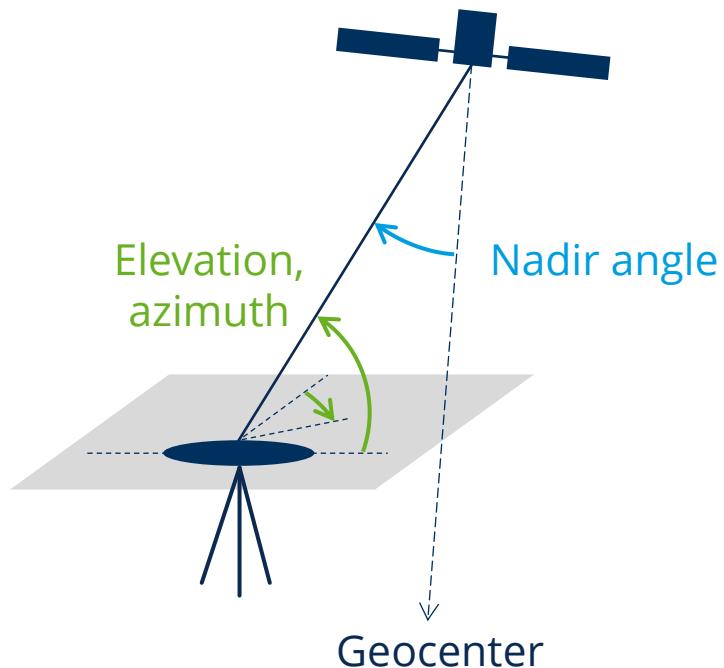
The GNSS phase observations are affected by antenna phase center variations (PCV).

**The GNSS code observations are affected by group delay variations (GDV).**

Receiver antennas



© <https://www.trimble.com>



Satellite antennas



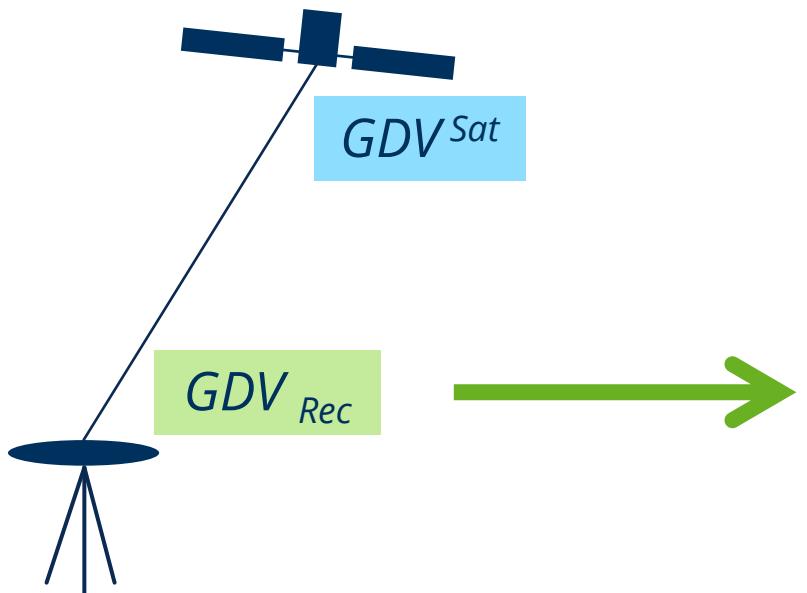
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# Introduction

## Absolute GDV for GNSS satellite antennas

Code observations contain the GDV of the satellite and the receiver antenna.

**For a separation of the satellite antenna GDV from those of the receiver antennas absolute GDV of the receiver antennas are necessary.**



Wübbena et al. (2019)

### Geo++ Absolute Multi-Frequency GNSS Antenna Calibration

Gerhard Wübbena, Martin Schmitz, Andre Warneke

Geo++® GmbH  
30827 Garbsen, Germany  
[www.geopp.de](http://www.geopp.de)

# GDV Rec

# Obs.

# CMC-LC

# GDV Sat

## Absolute GDV of four types of receiver antennas (Wübbena et al. 2019)



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JAVRINGANT\_DM  
NONE



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TRM59800.00  
NONE



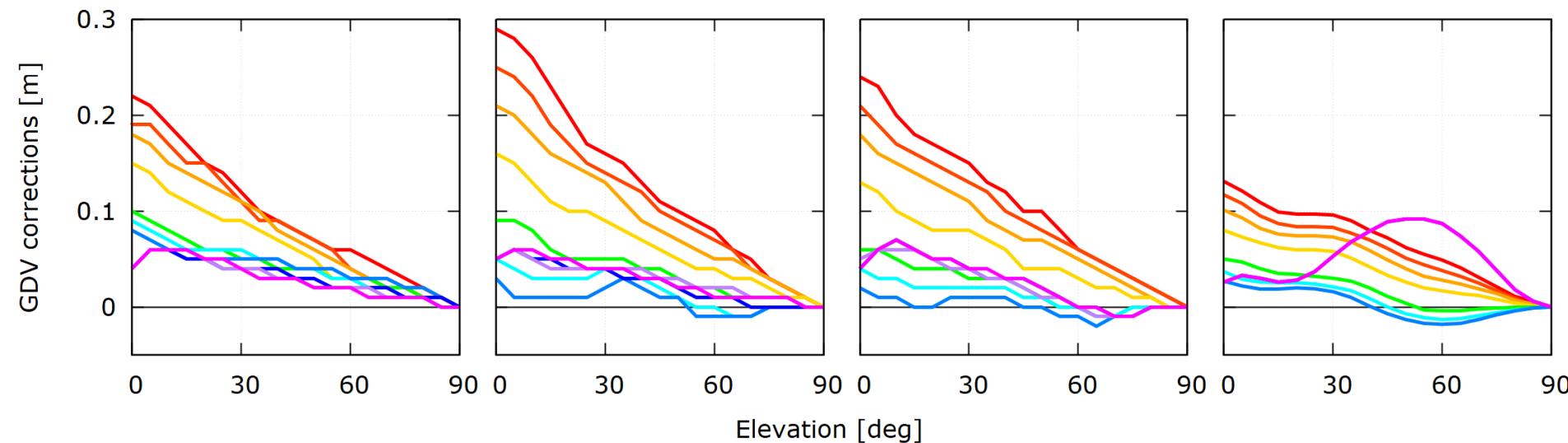
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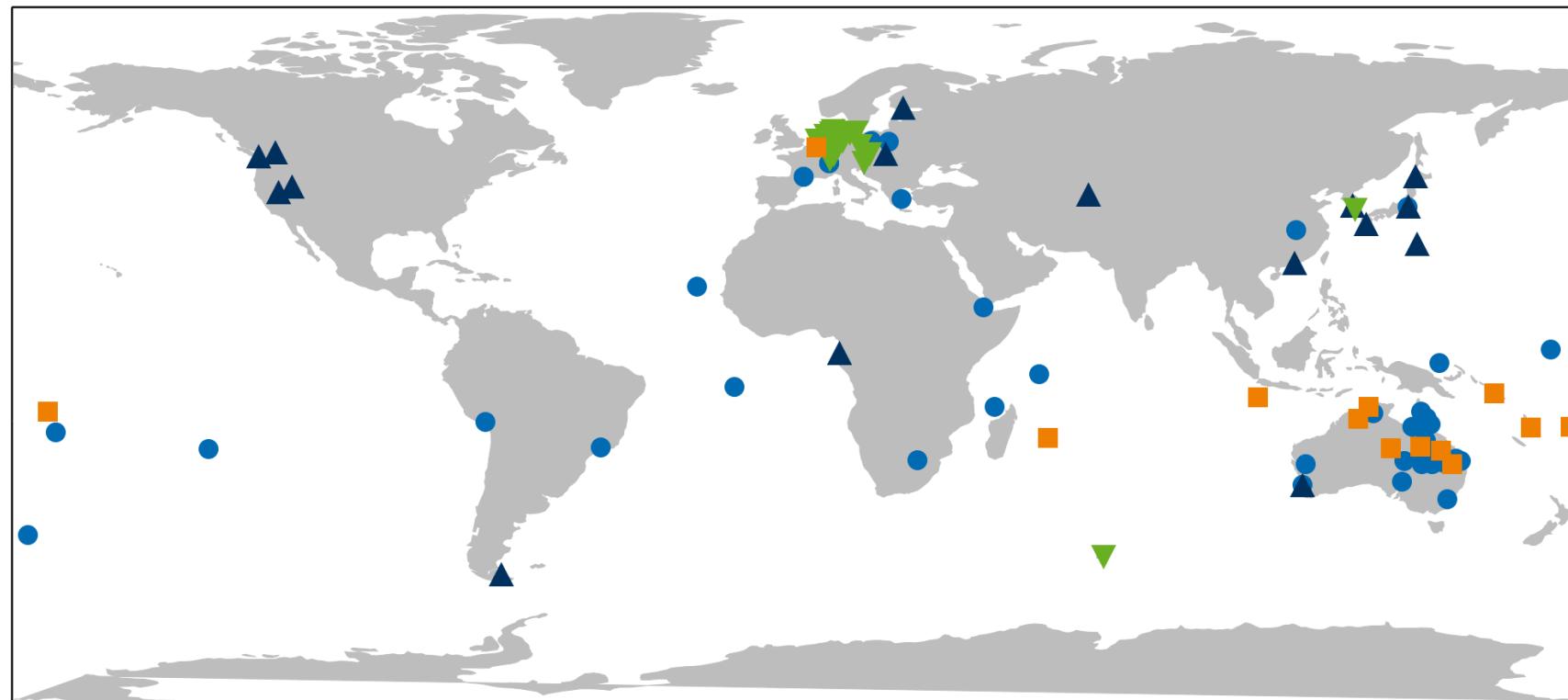


GDV Rec

Obs.

CMC-LC

GDV Sat



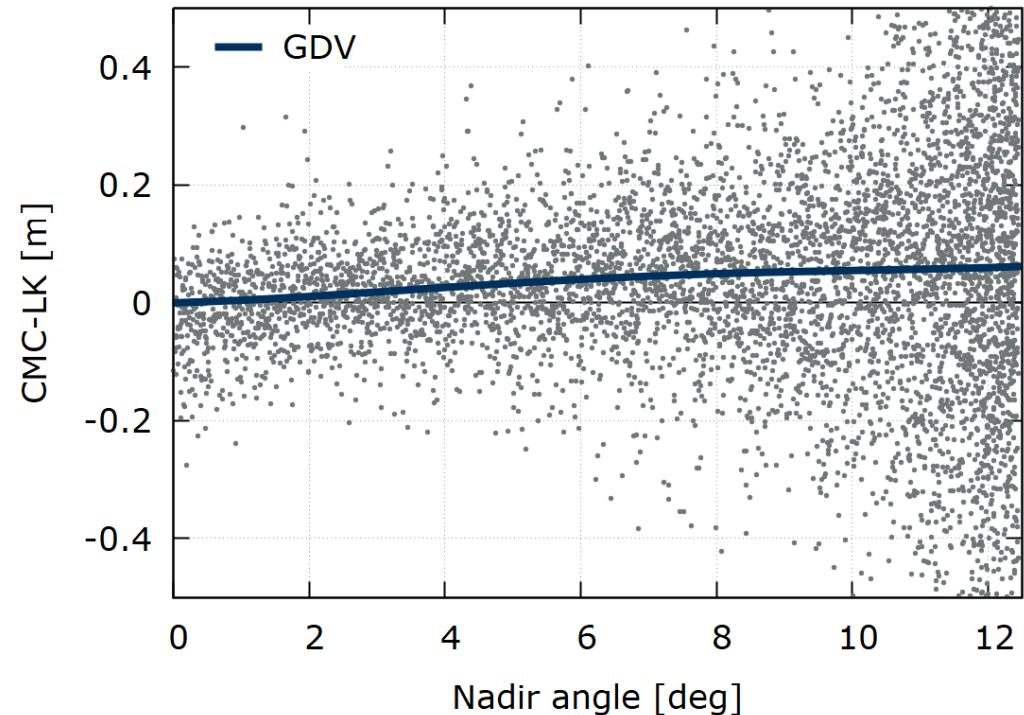
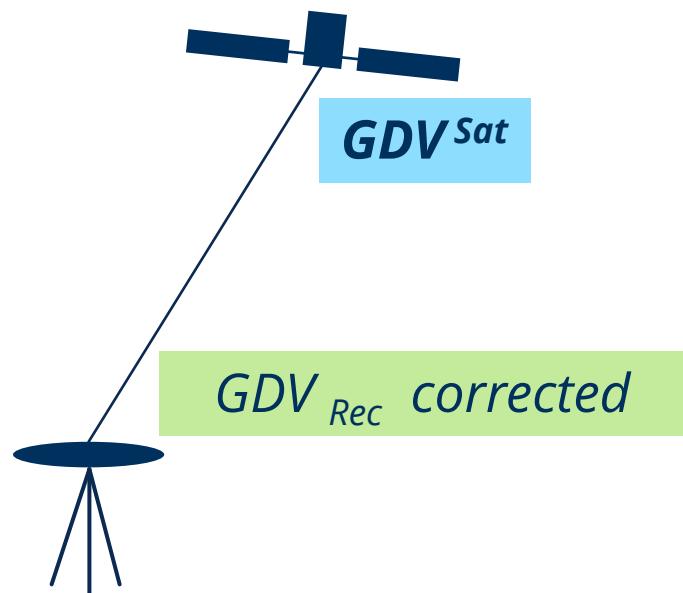


**Corrected observations**



**Code-minus-carrier linear combination (CMC-LC)**

Example: Galileo PRN E01, frequency E5a (L5) , 10 days



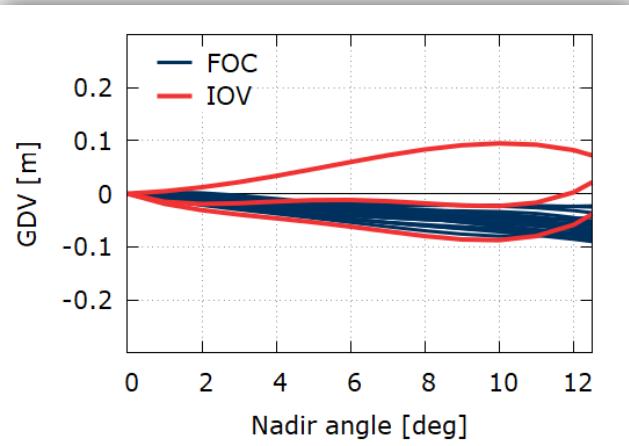
GDV Rec

Obs.

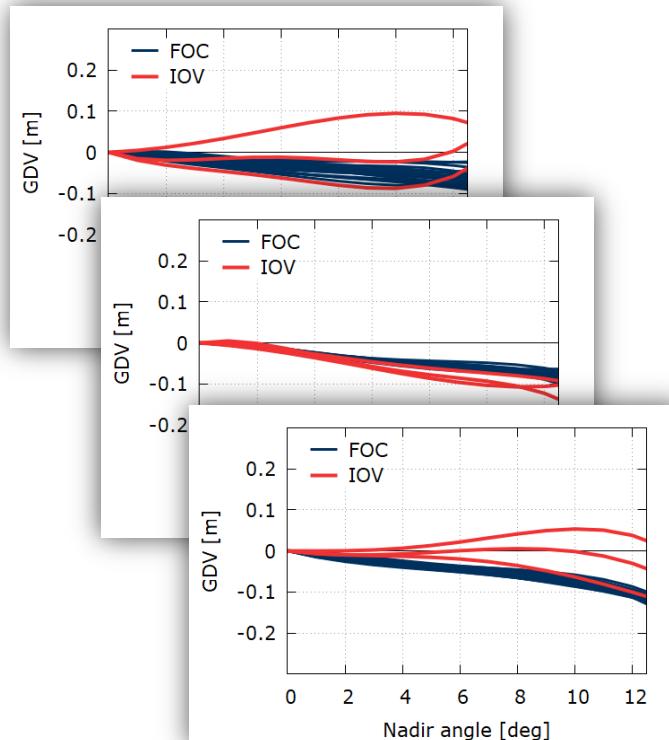
CMC-LC

GDV Sat

all satellites



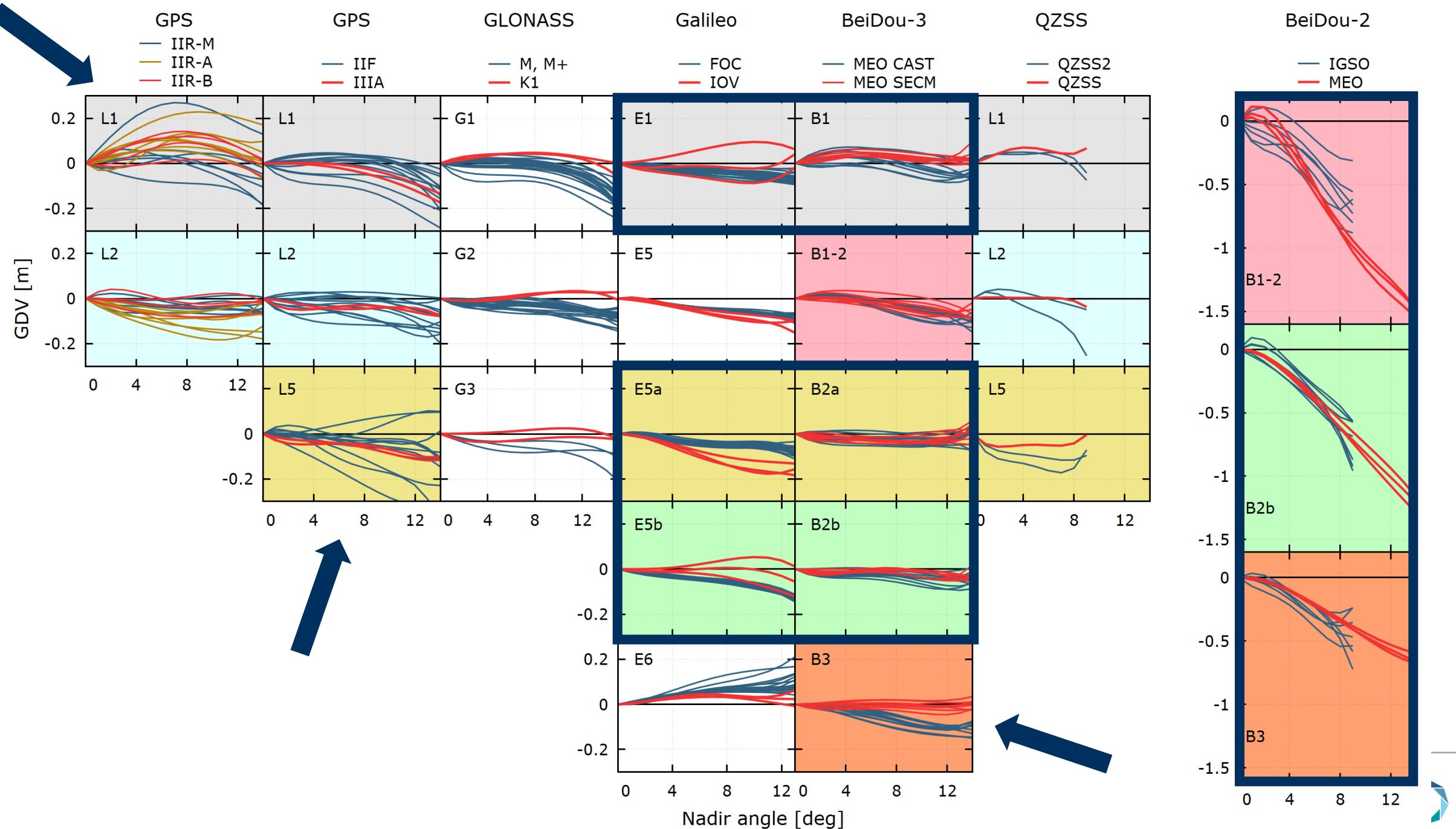
all frequencies



all GNSS



• • •

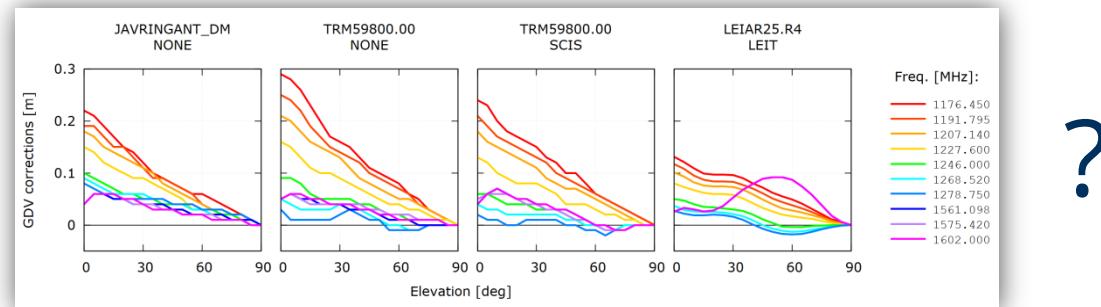


# Conclusions

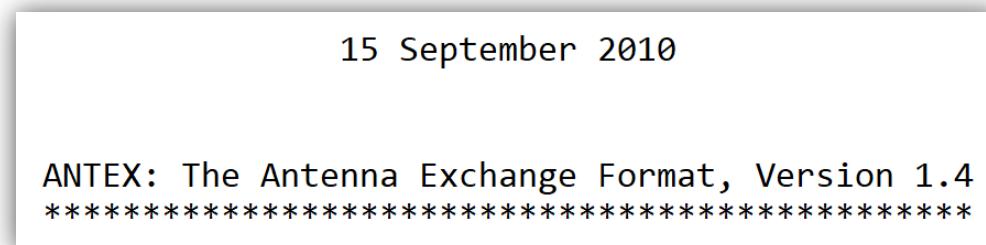
## Summary and challenges

- ✓ We estimated absolute satellite antenna GDV based on absolute receiver antenna GDV.
- ✓ Absolute satellite antenna GDV can reach one to a few decimeters, except for the BeiDou-2 satellites whose GDV are much larger.
- ✓ Satellites of the same block or generation of a GNSS mostly show similar patterns.

### ➤ Validation of the receiver antenna GDV



### ➤ Format for the exchange of GDV → ANTEX



# Thank you very much for your attention!

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ORIGINAL ARTICLE



## Estimation of absolute GNSS satellite antenna group delay variations based on those of absolute receiver antenna group delays

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