New products for IGS AC in repro3: phase biases for PPP ambiguity resolution

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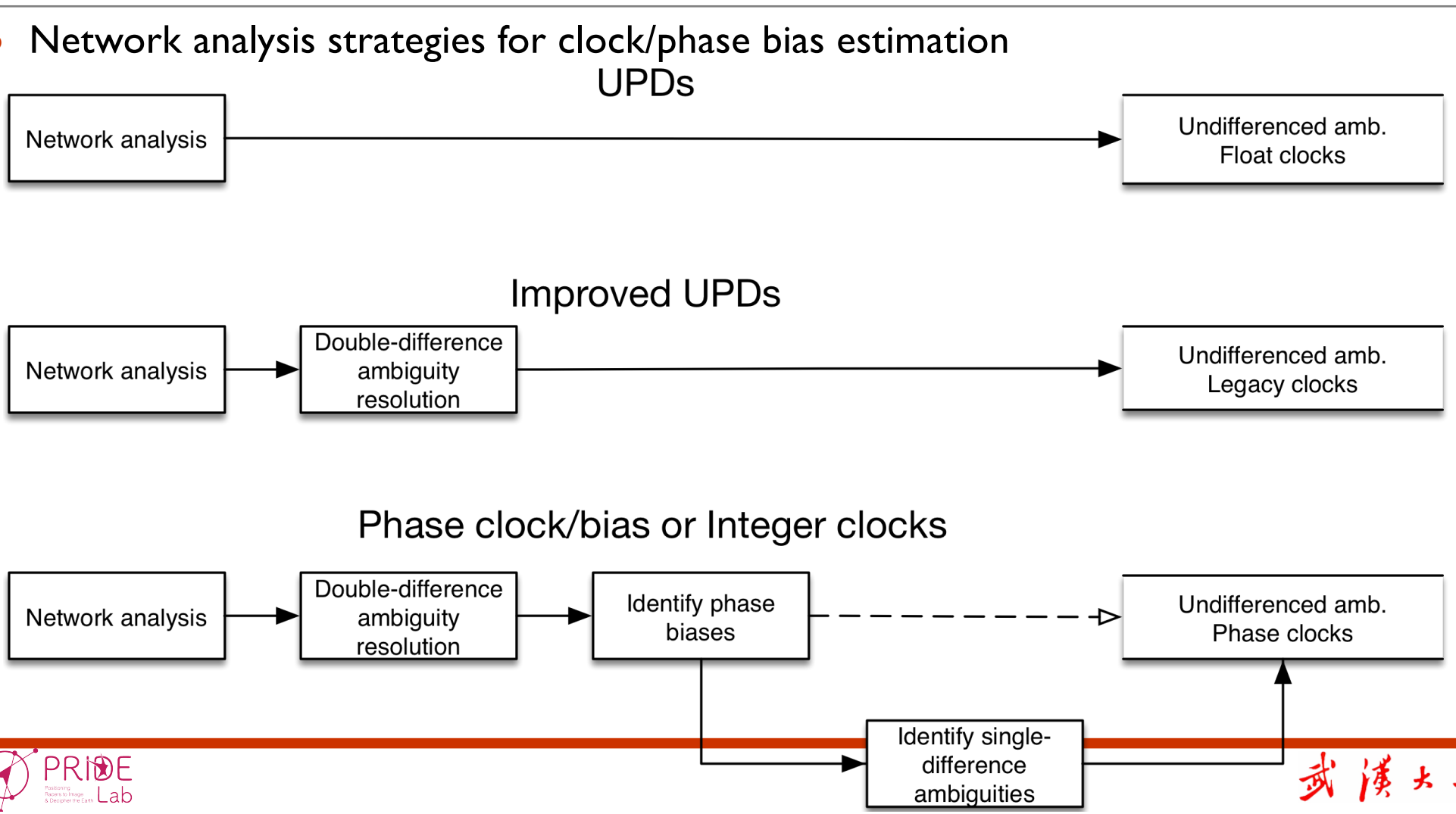
Motivation

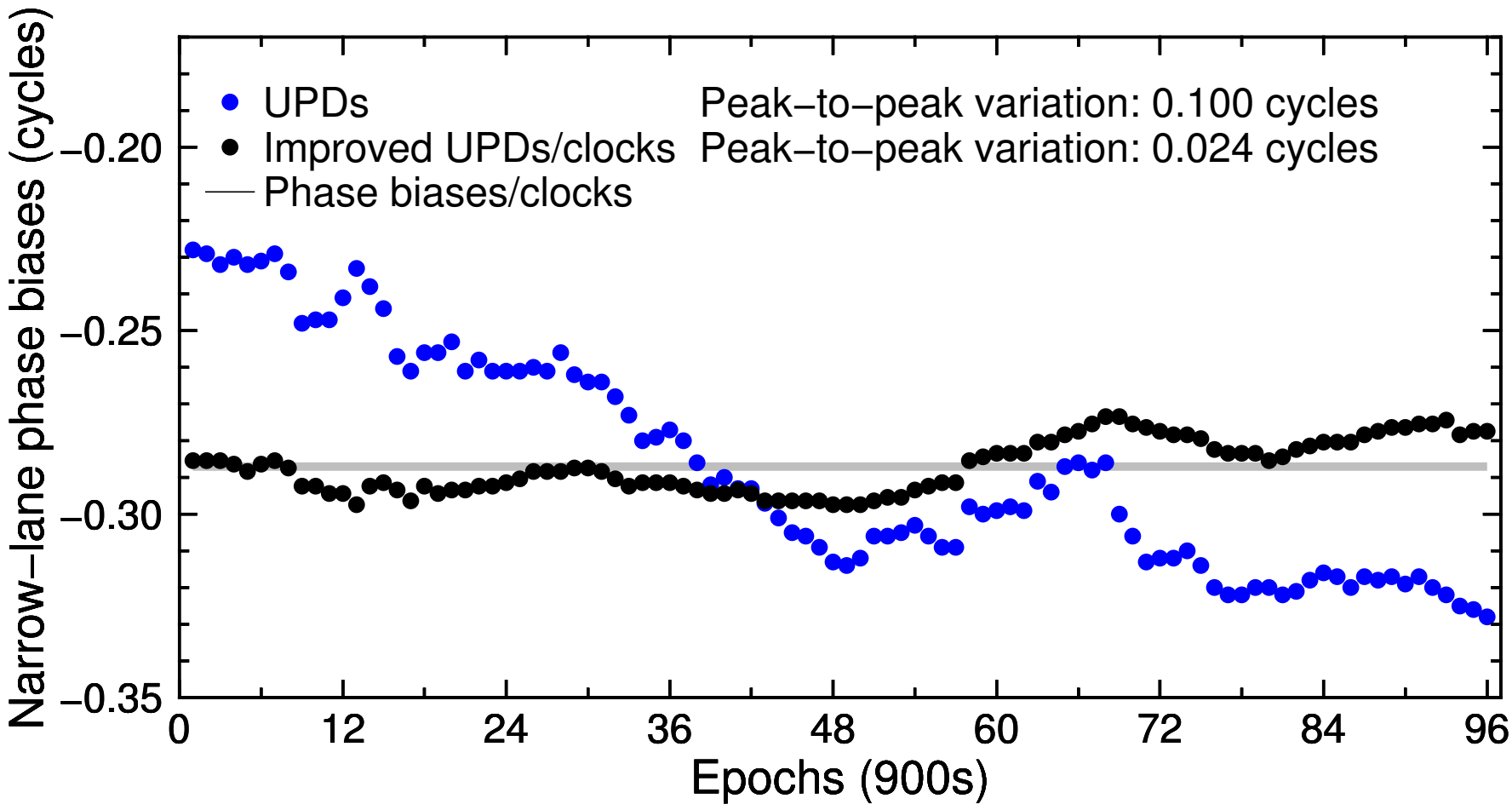
- Phase biases are important to enabling highly efficient ambiguity fixing at a single station
  - They can be simply taken as the fractional parts of ambiguities
- Several ACs have been able to provide such phase bias products (COD, ESA, WHU, etc.)
  - WHU has released 13 years of such products from 2006 to 2018
- Are there anything that we should pay attention to for phase bias estimation?
  - Transition from double-difference (DD) to undifferenced (UD) ambiguity-fixed network analysis
  - Alignment with legacy/code clocks

GPS network analysis

- Network analysis strategies for clock/phase bias estimation

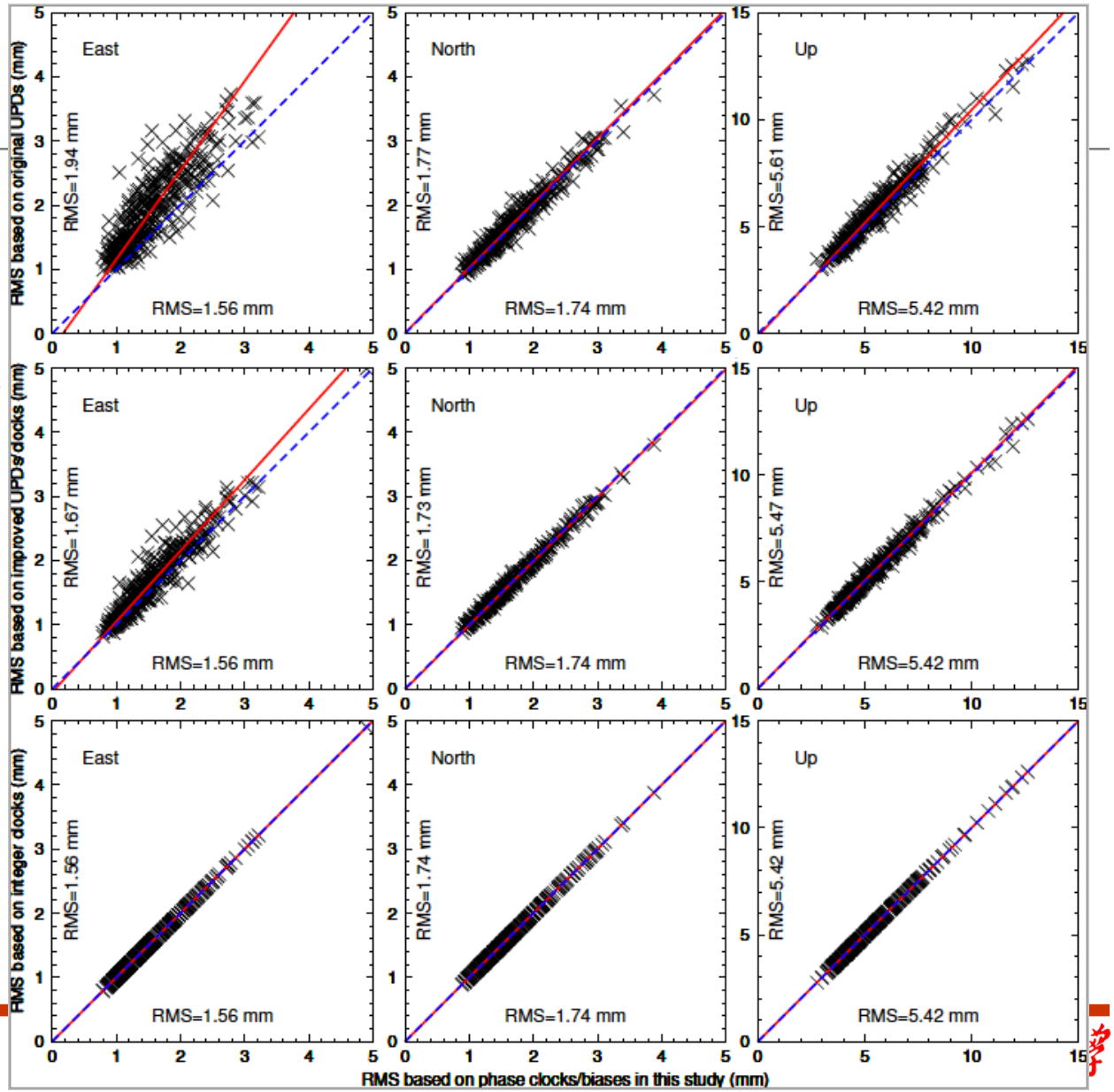


Comparison of phase bias estimates



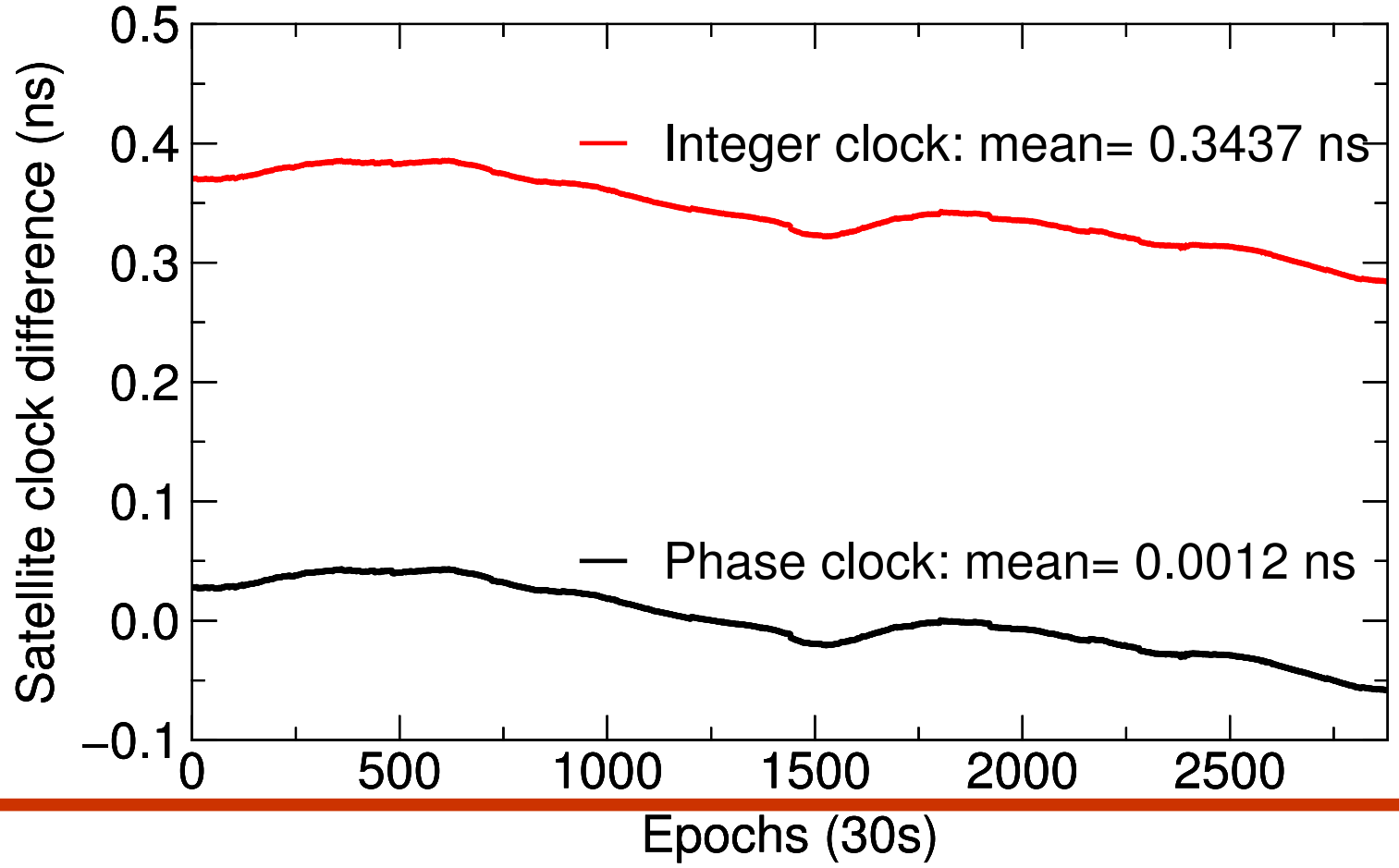
Position accuracy

- Compared to IGS weekly solutions
  - UPDs
  - Improved UPDs after DD-AR
  - Integer clocks
  - Phase clock/bias
- Ambiguity-fixed phase clocks/bias or integer clocks seem to have the best performance among all phase bias solutions



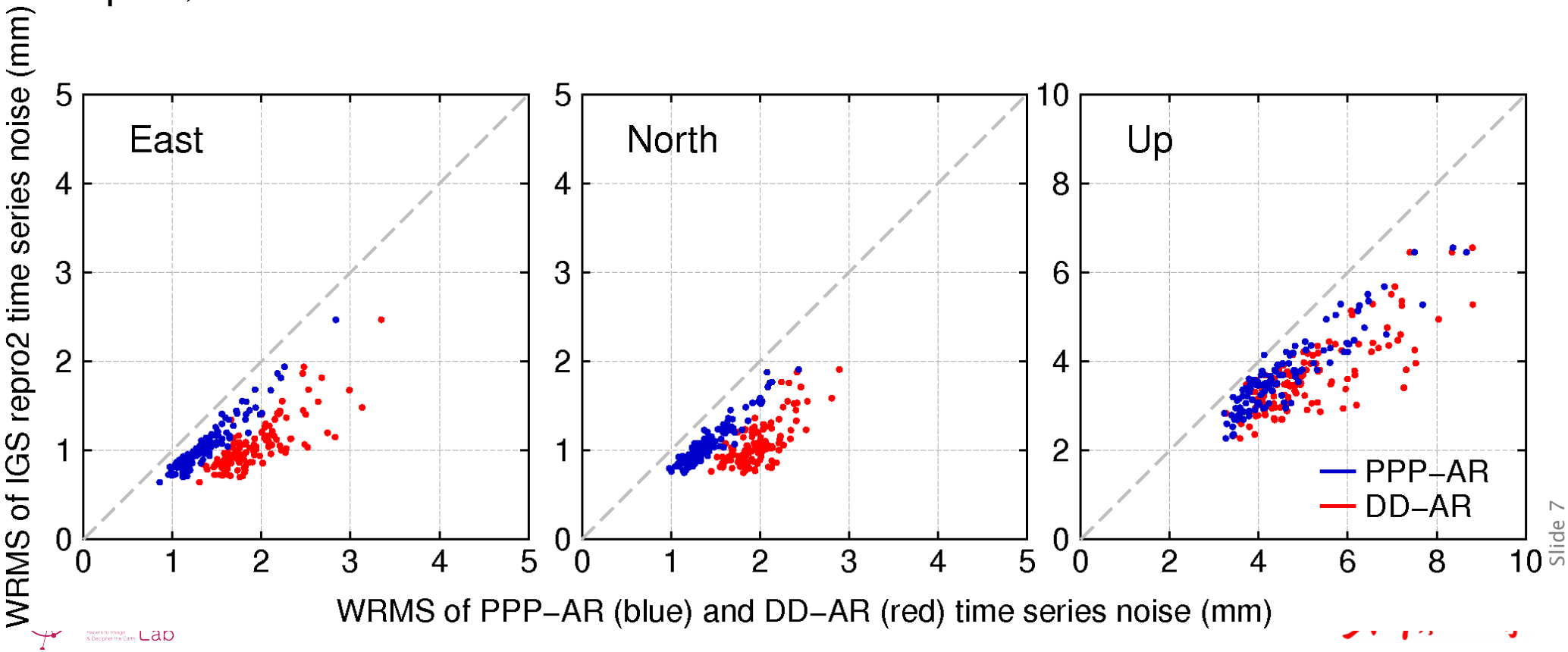
Phase clock alignment with legacy clocks

- To be compatible with IGS code biases, this alignment is necessary



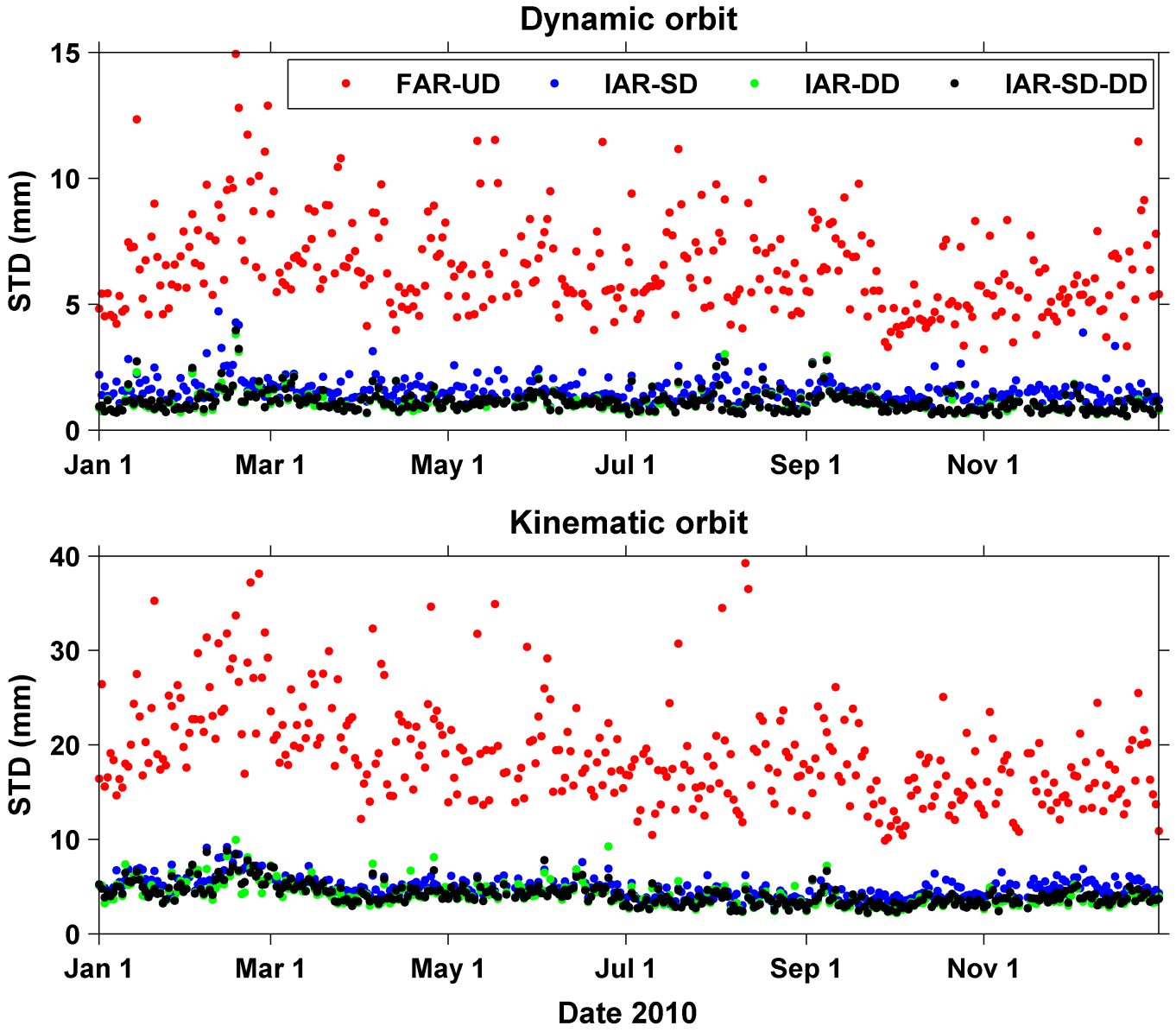
Benefits of providing phase biases

- Obtain station positions accurately connected with ITRF without network analysis
- With 10 years of GPS data (2007-2016) using PRIDE PPP-AR, comparison among IGS repro2, PPP-AR and DD-AR solutions



GRACE KBR validation

- With one year of GARCE data (2010), a KBR validation of phase bias/clock products
- Dynamic orbits:
  - Float: 6.7 mm
  - PPP-AR: 1.7 mm
  - DD-AR: 1.1 mm
- Kinematic orbits:
  - Float: 19.7 mm
  - PPP-AR: 5.0 mm
  - DD-AR: 4.2 mm



PRIDE Lab

Summary

- IGS ACs are encouraged to estimate phase bias products in their repro3 network analysis for orbit and clock generation
  - SD ambiguities have to be fixed for an easy-to-use phase bias products
  - After DD-AR, identify the SD-ambiguities and phase biases in order to re-estimate satellite clocks
- Phase clock products should be aligned with code/legacy clocks in order to be compatible with IGS code biases