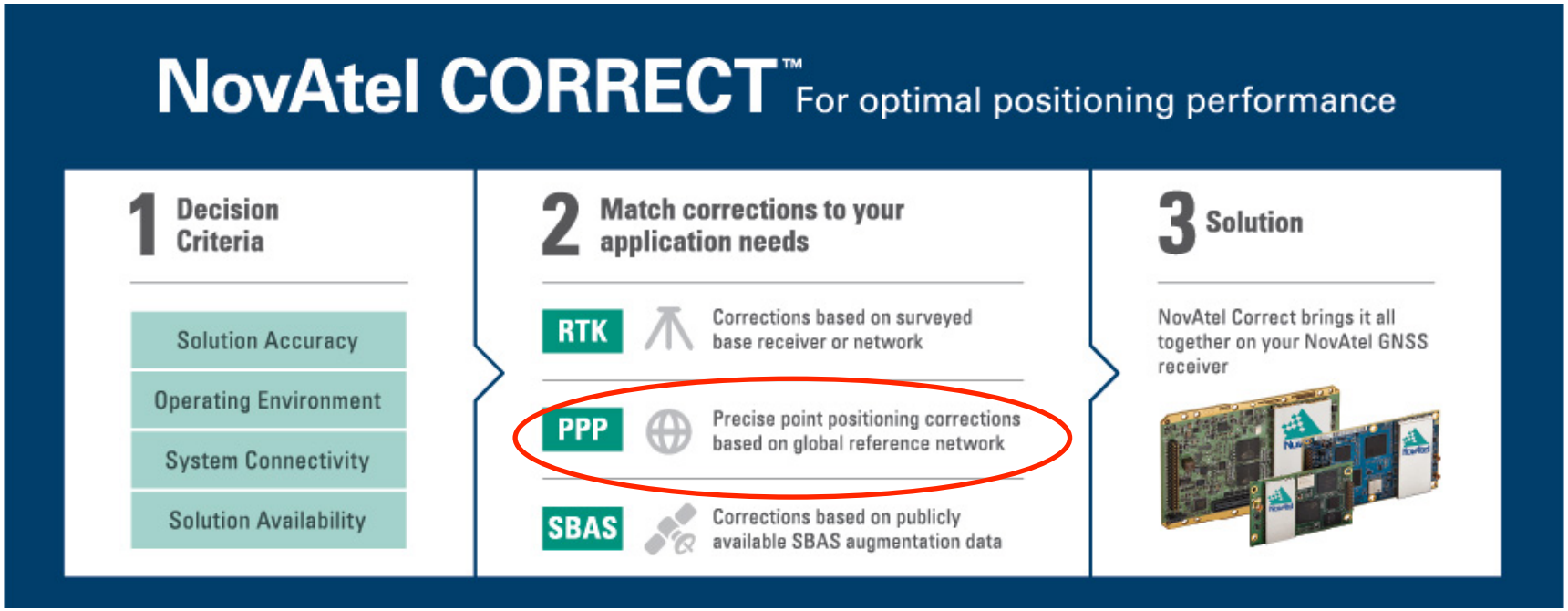
Evaluation of TerraStar in Agricultural Conditions

InfoAg 2015

Outline

- Introduction to NovAtel CORRECT, PPP and TerraStar
- Dynamic evaluation methodology
- Real-world results for TerraStar, using NovAtel CORRECT
  - Open sky conditions
  - Operation near trees
- Conclusions

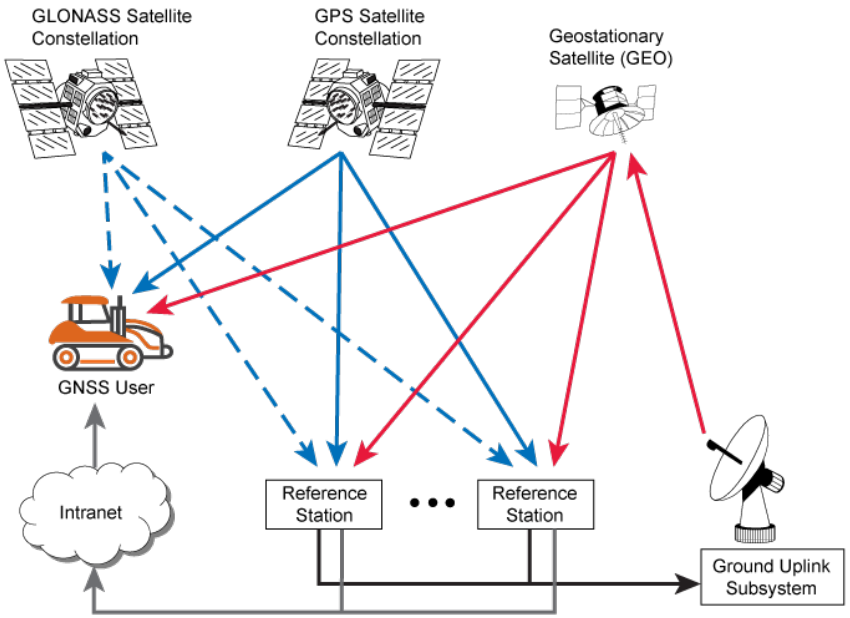
What is NovAtel CORRECT™?



- Core positioning technology from NovAtel
- Enables sub-meter to centimeter accuracy
- Uses RTK, PPP, SBAS or DGPS correction data

What is PPP?

- **P**recise **P**oint **P**ositioning
- Another method to mitigate errors in the GNSS signals
- Precise near real-time corrections for satellite orbit and clock
  - Corrections generally over L-band downlink, but may also use NTRIP-based delivery



What is TerraStar-C?

PPP correction data:

» High quality correction data

» Similar to OmniStar, Trimble and StarFire

» But different

- NovAtel has ownership of position
- Marketed and sold through brands you know

Stara Constant Evolution

Ag Leader®

RAVEN

ME MUELLER ELECTRONICS

It's what we do with the data that counts:

» Better accuracy - 4cm

» Fast re-convergence

» Faster initial convergence

» Better performance near treelines

HEXAGON AGRICULTURE

NovAtel

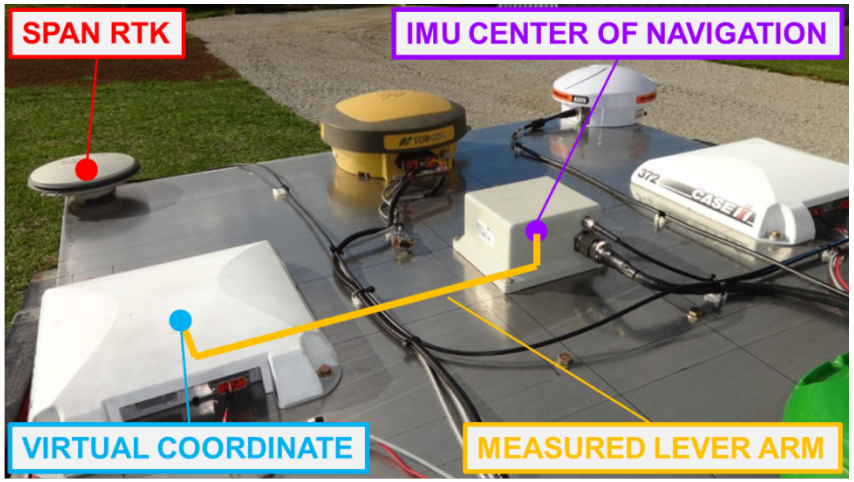
Who Is TerraStar?

TERRASTAR

- Provide clock and orbit corrections for land, airborne and near shore applications
- Parent company, Veripos, has serviced marine oil & gas market for 20+ years
- Corrections delivered over L-band
- Network of 80+ GNSS stations
- Redundant infrastructure
- Hexagon company

Experienced partner for Agriculture

Dynamic Evaluation Methodology

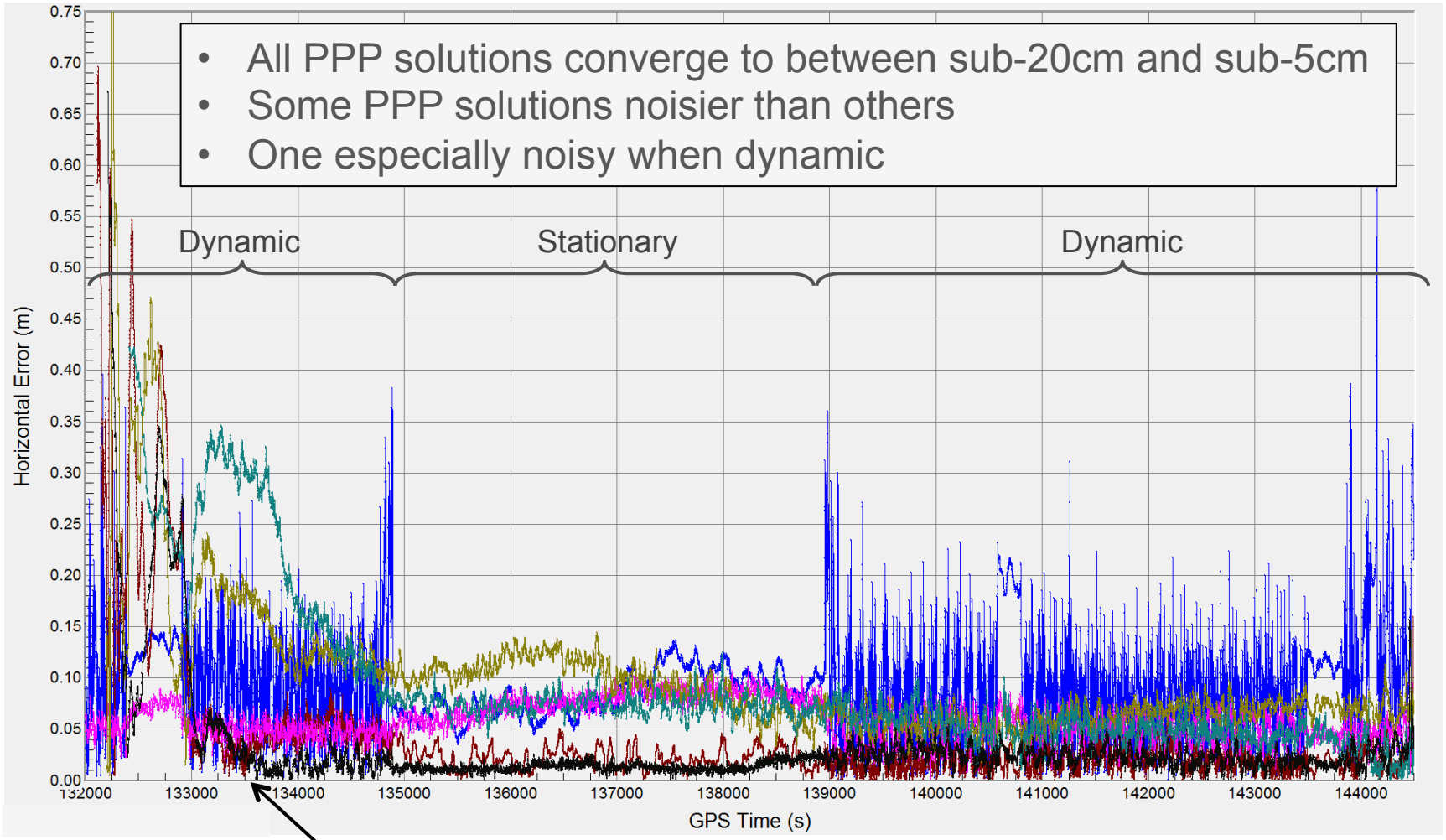


- Post-processed SPAN RTK solution
  - IMU attitude combined with measured lever arms to translate SPAN RTK solution to various antenna phase centers
    - Creates a virtual RTK trajectory for competitive products
- Compare real-time position data against SPAN RTK trajectories to determine horizontal and vertical position errors

Dynamic Evaluation – Machine Trajectory (Benign)

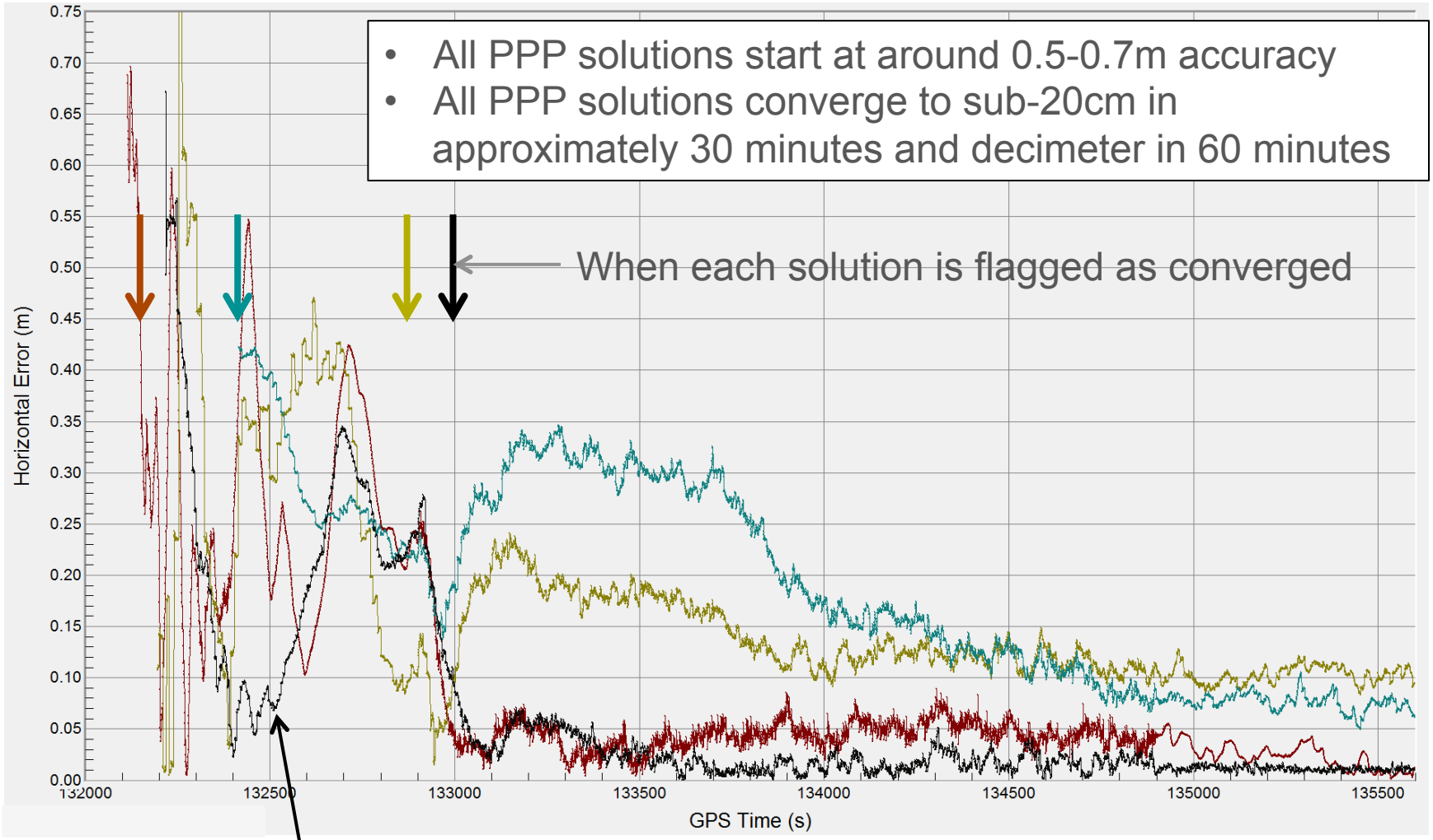
South American campaign – December 2014

Dynamic Evaluation – Horizontal Errors (Benign)



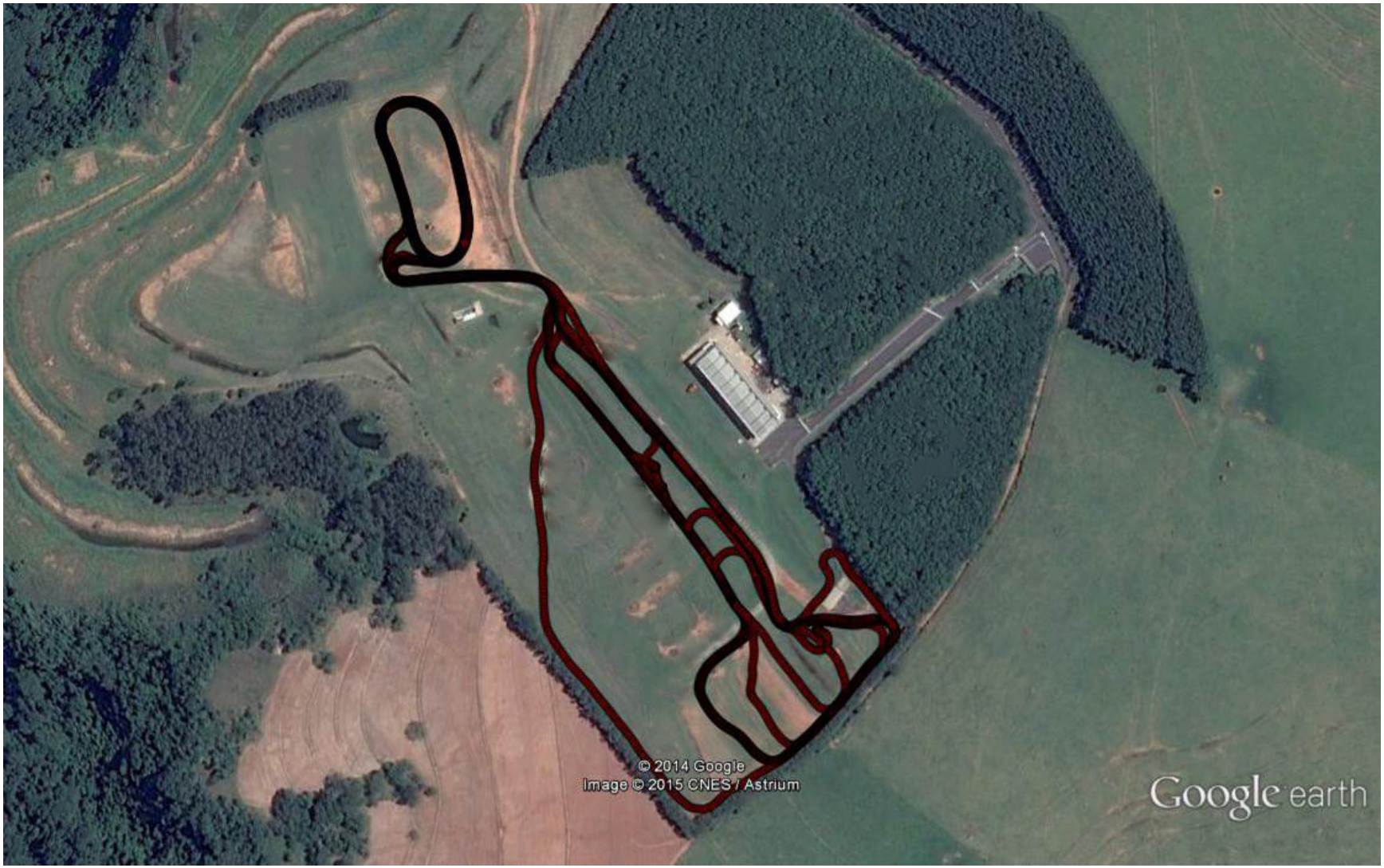
NovAtel CORRECT with TerraStar

Dynamic Evaluation – First Hour Showing Convergence



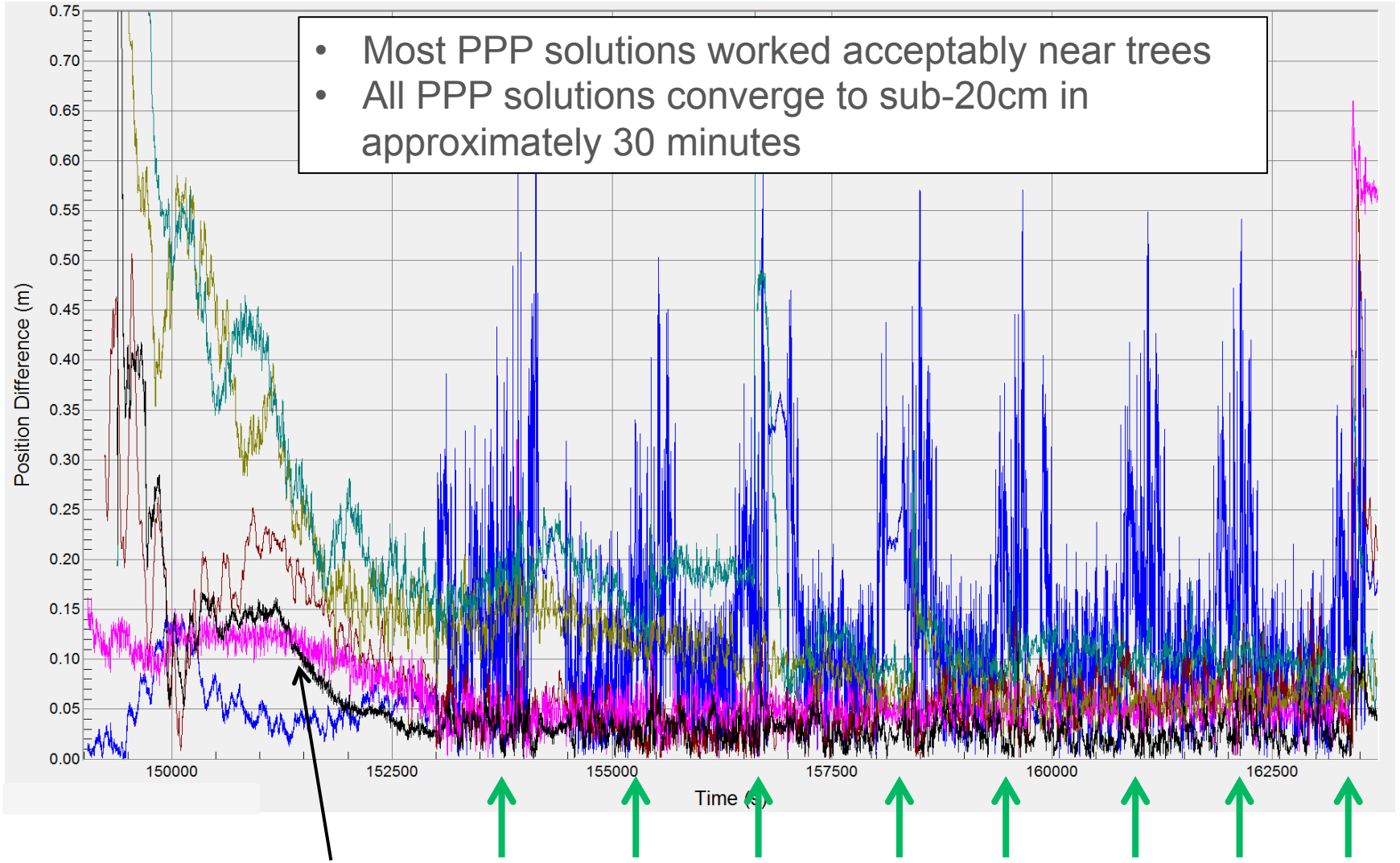
NovAtel CORRECT with PPP

Dynamic Evaluation – Machine Trajectory (Not So Benign)



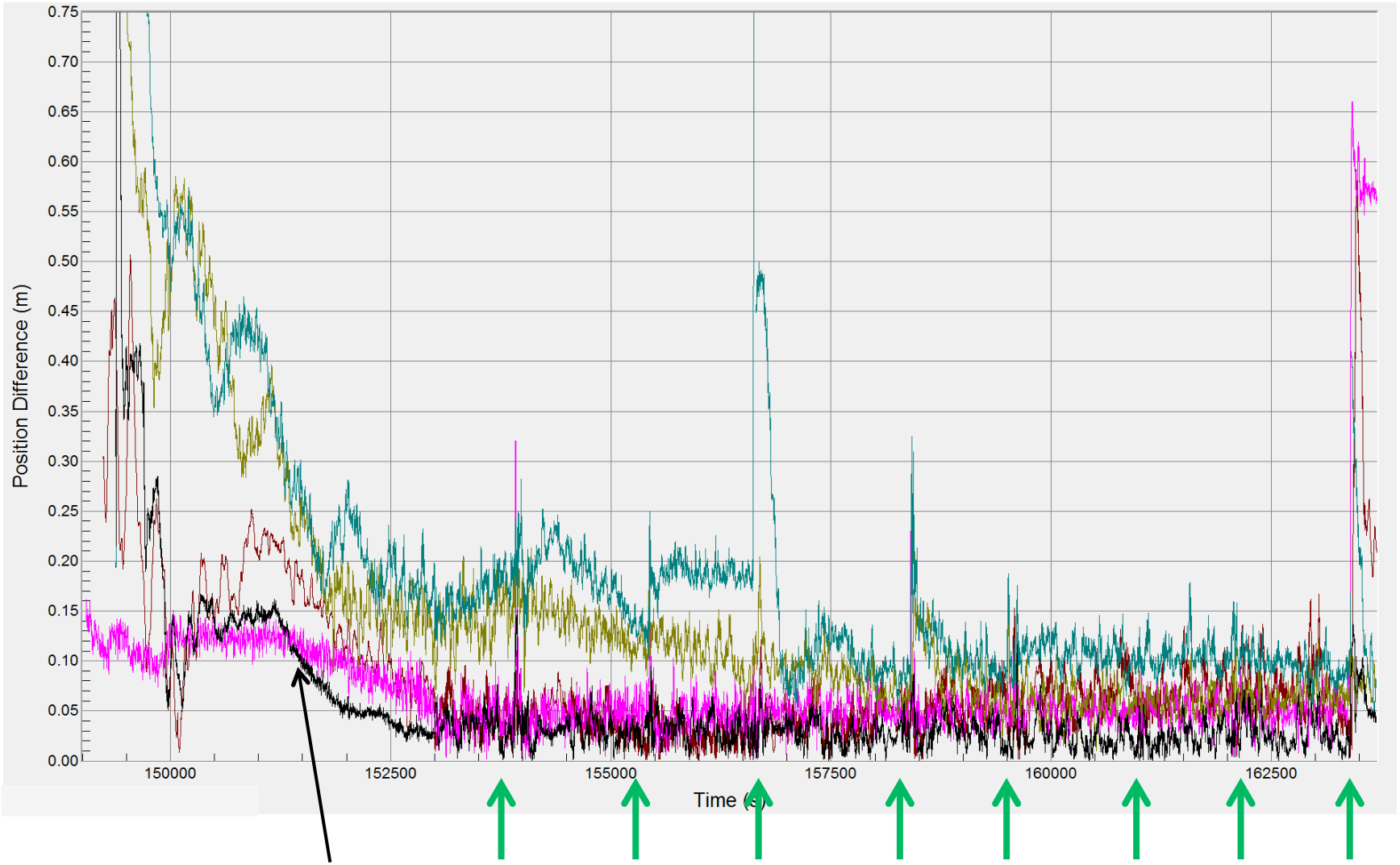
South American campaign – December 2014

Dynamic Evaluation – Robustness



Dynamic Evaluation – Robustness

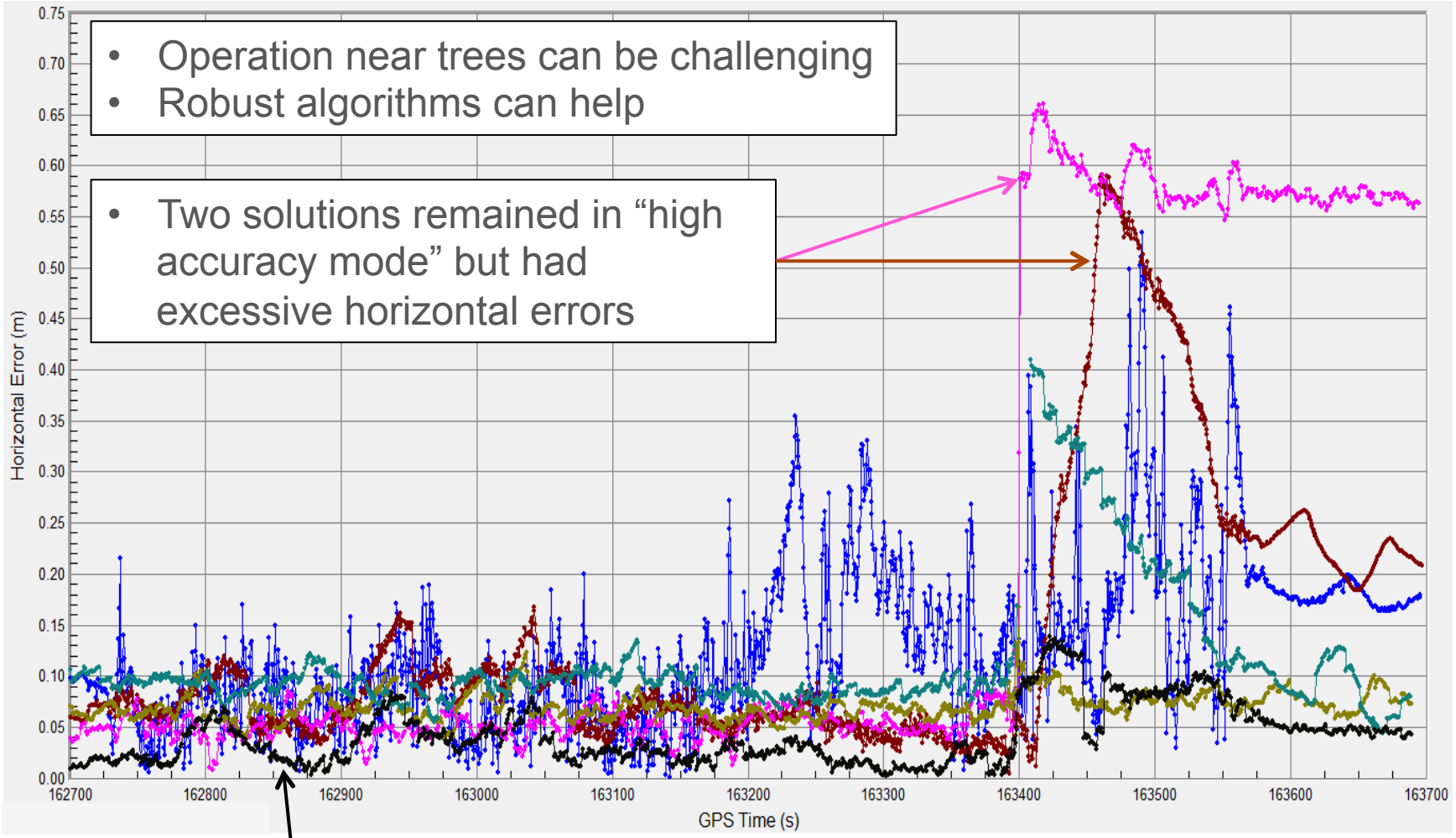
Blue solution omitted for clarity



NovAtel CORRECT with TerraStar

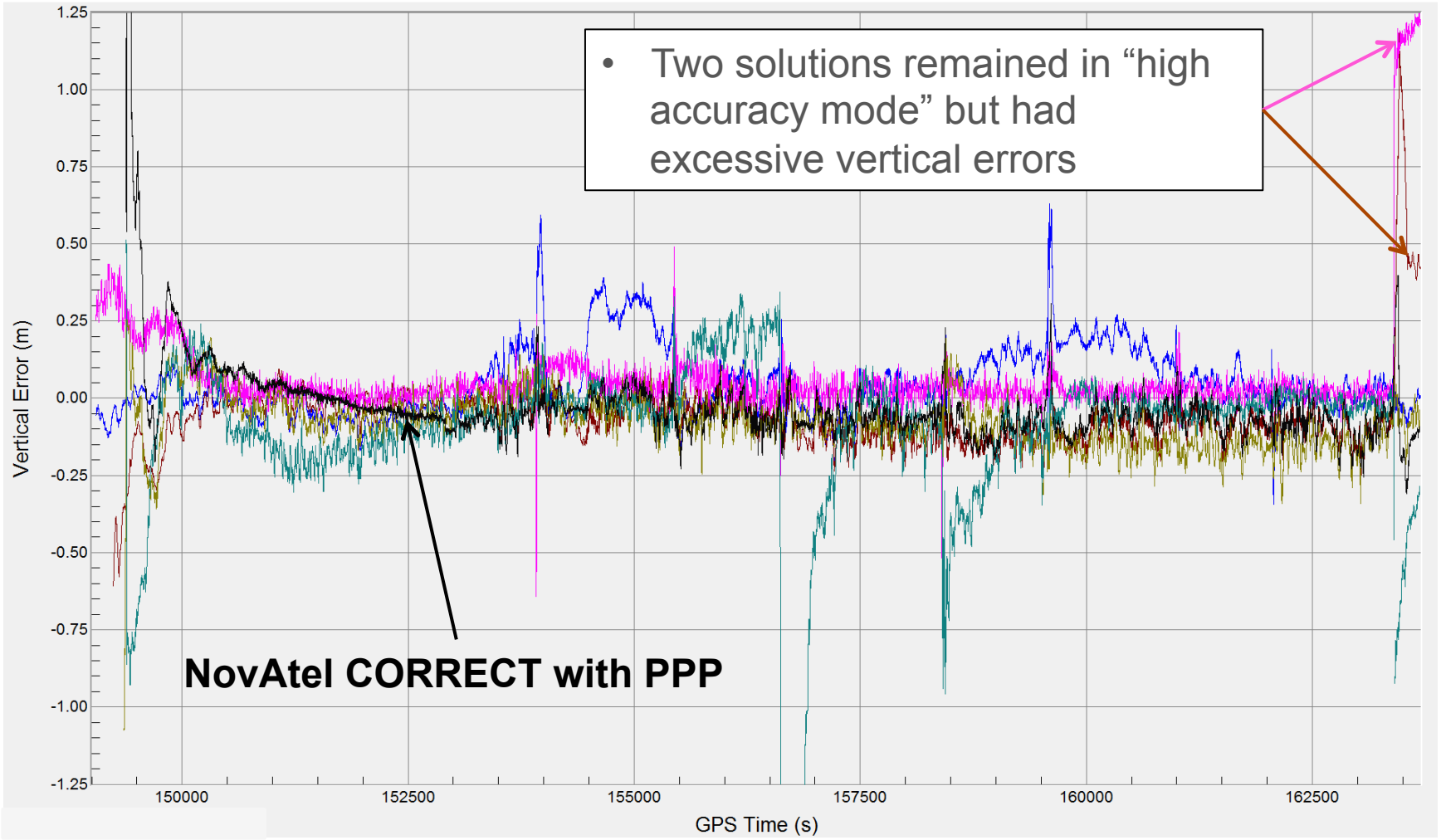
Operation near trees

Dynamic Evaluation – Robustness

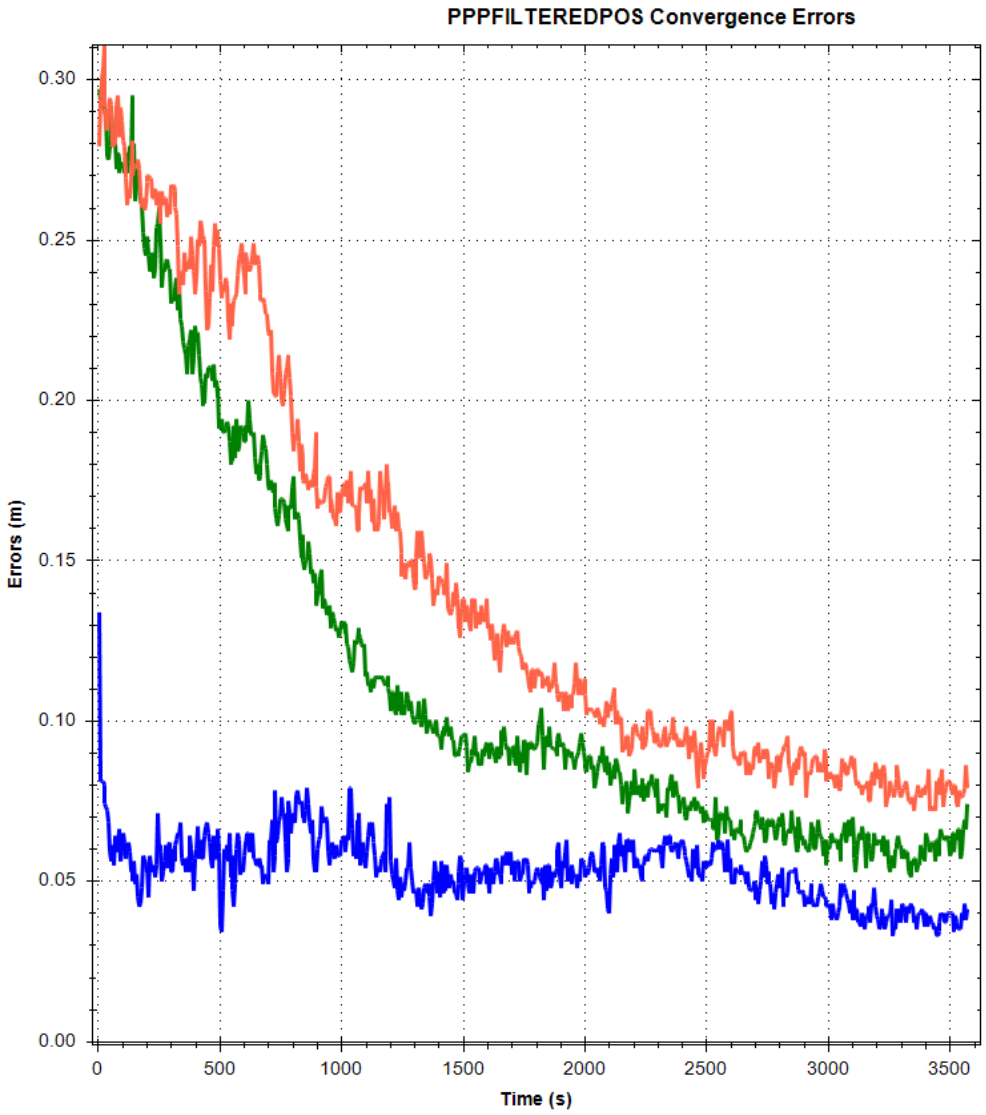


NovAtel CORRECT with PPP

Dynamic Evaluation – Robustness



Calgary Rooftop, 30s outages



TerraStar-D on 6.510

TerraStar-D on 6.600

TerraStar-C on 6.600

- Full GNSS & correction signal outages
- Static data
- TerraStar-C re-converges almost instantly after 30s outage

Testing Conclusions

- Initial convergence to dm accuracy can take tens of minutes for any PPP solution
- Dynamic performance of NovAtel CORRECT with TerraStar is excellent
  - Many days of dynamic testing in real-world conditions
    - North and South America
    - Just finished test campaign in Australia
  - 6-8 different PPP solutions evaluated concurrently
  - Some solutions noisier than others, especially when dynamic
  - Most competitive solutions can provide a reliable decimeter-level solution
  - Operation near trees can be challenging

NovAtel Advantage

- Our TerraStar implementation works extremely well
  - TerraStar-C is robust, accurate, enables fast re-convergence
  - New services being added to compliment GLIDE (sub-meter)
- We know OEM, including:
  - We let our customers manage the end user
  - Process, support, quality, delivery
  - M2M tools for OEM sales & support
- TerraStar service infrastructure built for reliability


Questions?