



APPLANIX PRODUCTS AND SOLUTIONS FOR MOBILE MAPPING AND POSITIONING  
*CAPTURE EVERYTHING*

# **Precise Georeferencing with POSPac MMS for Survey Applications**

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# Introduction

- **Applanix designs, builds, delivers and supports products and solutions for the offshore and hydrographic survey industries**
- **Our goal is to provide the most robust, accurate and reliable position and orientation solution, whatever the conditions**
- **Proven integration with all common hydrographic survey hardware and software**
- **The industry standard for georeferencing and motion compensation of hydrographic data**
- **Unique post processing capabilities ensuring the most robust solution whatever the environment**



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**POSPac MMS**



# POSPac Mobile Mapping Suite

- Unique post processing software to create the most robust and accurate georeferencing and motion compensation solution
- **IN-Fusion™**
  - Optimally Coupled processing of GNSS and Inertial Observables
- **SmartBase™**
  - Post Processed Virtual Reference Station, providing centimetric accuracy over long baselines
- **Precise Point Positioning**
  - Decimetric accuracy without the need for base stations or SBAS subscriptions



# POSPac MMS Context

GNSS Base  
Station(s)









Precise Clock  
and  
Ephemeris  
Data



Smoothed Best Estimate of  
Trajectory (SBET)



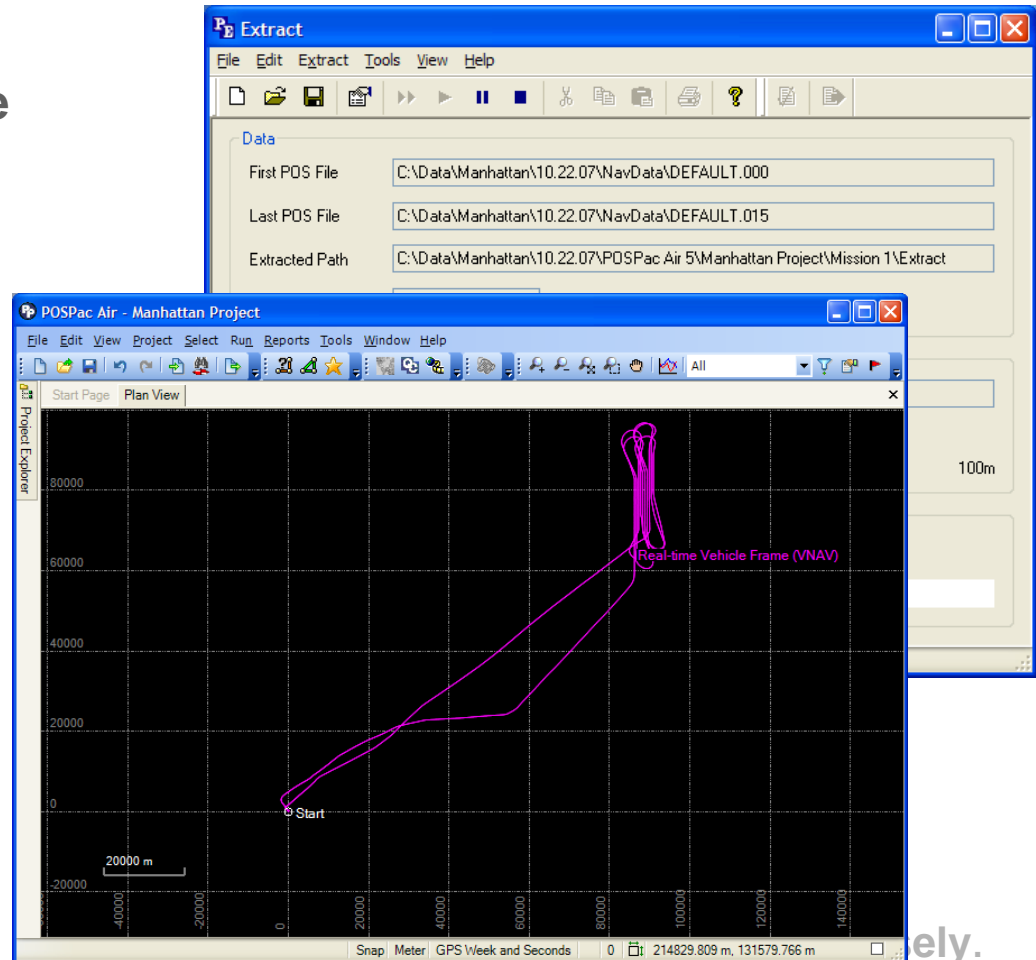
# POSPac MMS Workflow

-  – **Import** – Extracts POS MV and dedicated base station raw data, and imports it into the project
-  – **Find Base Stations** – Searches for, downloads, and imports publicly available base station data
-  – **SmartBase™ Quality Check** – Performs a network adjustment on base station network
-  – **Applanix SmartBase™** – Generates a post-processed virtual reference station (PPVRS)
-  – **POSGNSS** – Post-processes GNSS data (optional)
-  – **GNSS-Inertial Processor** – Blends IMU and GNSS data to create the Smoothed Best Estimate of Trajectory (SBET)



# Import

- Drag and drop raw POS MV files into the Plan View, or use the “Import” icon and select the first POS file to start importing
- Review the real time solution by viewing:
  - Message Logs
    - POS Data Import
    - IMU Data Continuity Checking
    - Primary GNSS Import
  - Real Time Display Plots





# Find Base Stations

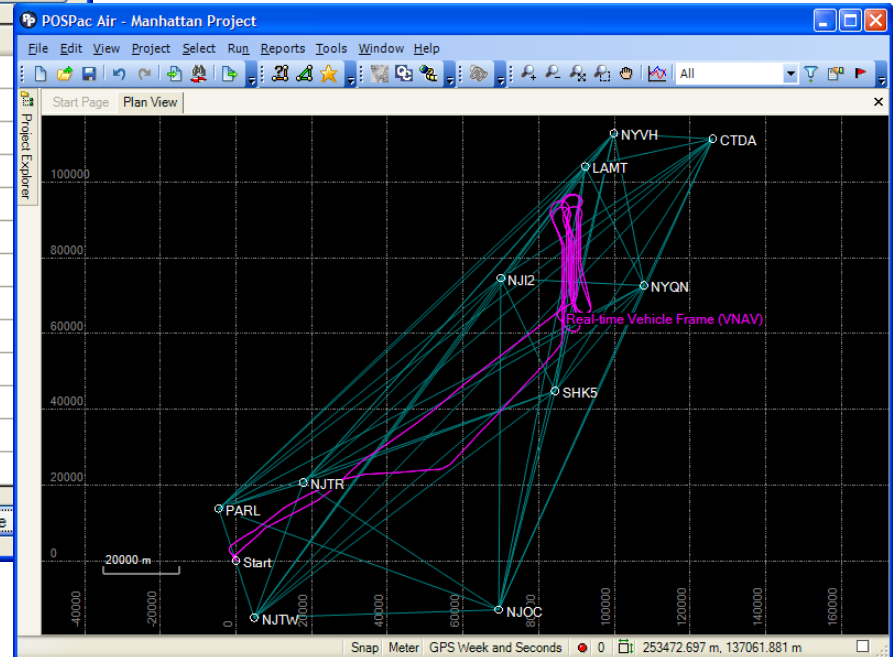
- Search for, download, and import base station data publicly available on the internet.
- Download precise and broadcast ephemeris files.

Find Base Stations

Search Radius: 90 km    Search Options    Number of Stations Found: 19    Preview Network

Download	Date	Station	Distance	Status	Progress	Bytes	Service
<input type="checkbox"/>	10/14/2006	CTDA	88.46	Downloaded	100%	764590	CORS
<input type="checkbox"/>	10/14/2006	LAMT	61.24	Downloaded	100%	805798	CORS
<input checked="" type="checkbox"/>	10/14/2006	NJDY	22.85	File not found		Unknown	CORS
<input type="checkbox"/>	10/14/2006	NJI2	24.86	Downloaded	100%	640730	CORS
<input checked="" type="checkbox"/>	10/14/2006	NJIT	24.85	File not found		Unknown	CORS
<input checked="" type="checkbox"/>	10/14/2006	NJMT	33.48	File not found		Unknown	CORS
<input checked="" type="checkbox"/>	10/14/2006	NJOC	65.16	Connecting		Unknown	CORS
<input checked="" type="checkbox"/>	10/14/2006	NJTP	15.37	File not found		Unknown	CORS
<input checked="" type="checkbox"/>	10/14/2006	NJTR	53.07	Downloading	71%	647834	CORS
<input checked="" type="checkbox"/>	10/14/2006	NJTW	87.12	Connecting		Unknown	CORS
<input checked="" type="checkbox"/>	10/14/2006	NYQN	51.52	Connecting		Unknown	CORS
<input checked="" type="checkbox"/>	10/14/2006	NYVH	72.64	Connecting		Unknown	CORS
<input checked="" type="checkbox"/>	10/14/2006	PARL	75.61	Connecting		Unknown	CORS

Express Mode    Download    Cancel Downloads    Import    Close







# SmartBase™ Quality Check

- Scans imported base station files to ensure quality
- Quality Check requires:
  - 18 hrs of continuous data
  - Precise ephemeris files from three days (previous, present, and next)
- Performs a network adjustment on the station coordinates, with one station selected as the control station
- SmartBase QC will recommend action, but the user should still apply some “local knowledge”

SmartBase Quality Check Results Summary

Here are the results from SmartBase Quality Check. The flashing icon below the results table suggests the next action.

Station	Status	Horizontal	Vertical	Total	Time Span	Output Coords
SHK5	Control	0.000 m	0.000 m	0.000 m	23.88 h	Control
PARL	OK	0.008 m	0.019 m	0.020 m	23.88 h	Input
NYVH	OK	0.010 m	0.003 m	0.011 m	23.76 h	Input
NYQN	OK	0.010 m	0.014 m	0.017 m	23.88 h	Input
NJTR	OK	0.010 m	0.018 m	0.020 m	23.88 h	Input
NJOC	OK	0.009 m	0.007 m	0.011 m	23.88 h	Input
NJ12	OK	0.010 m	0.016 m	0.019 m	23.87 h	Input

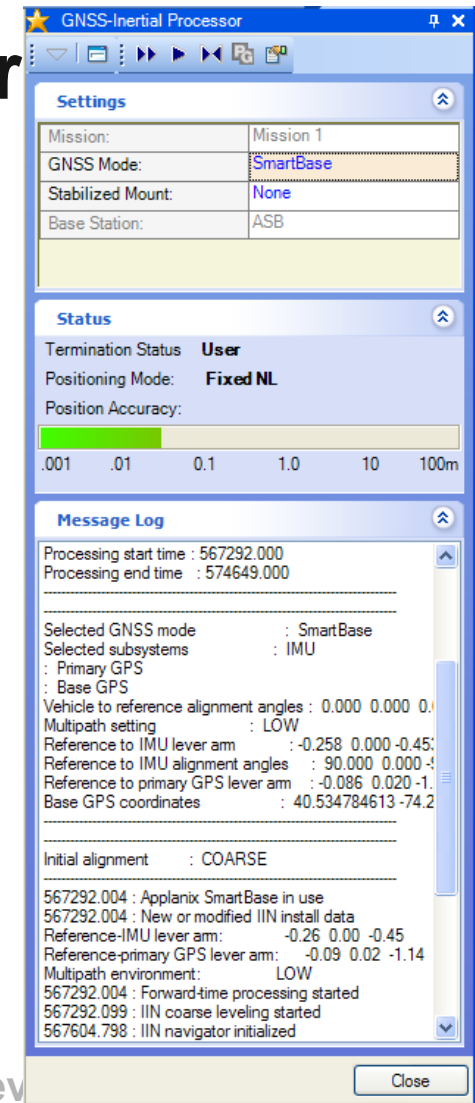
Choose any of the available actions or click 'Continue' to proceed with the suggested action. The 'Output Coords' column contains the recommended coordinate setting for the next action.

Select a new control station from the results table.

Re-run the SmartBase Quality Check processor.
 Run the Applanix SmartBase processor.

# GNSS-Inertial Processor

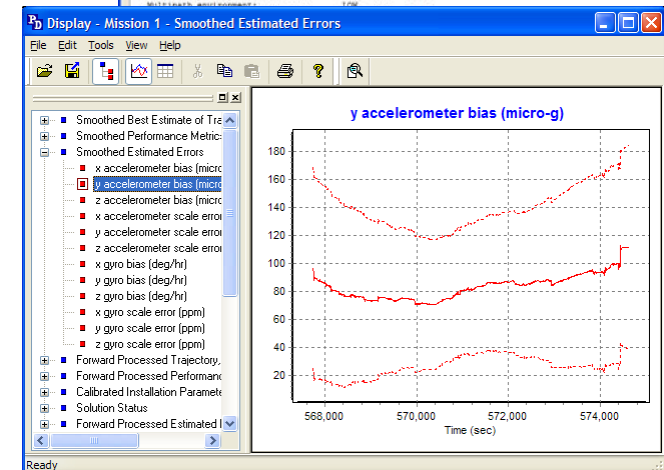
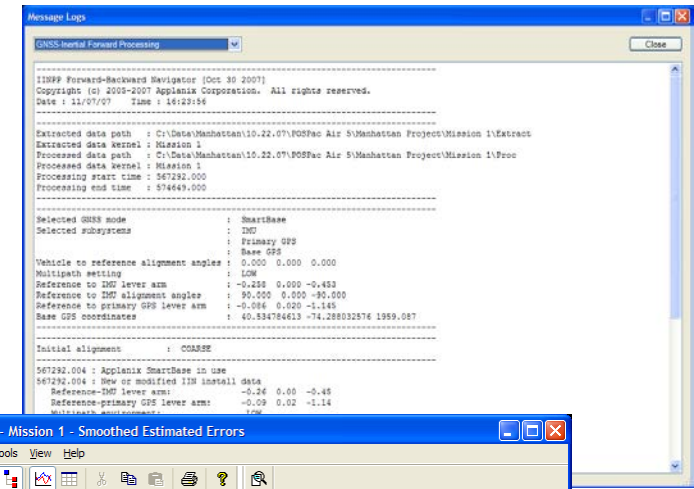
- GNSS and Inertial observables are simultaneously processed to create the Smoothed Best Estimate of Trajectory (SBET) solution
- Optimal GNSS aiding Mode is automatically selected. Processing modes are:
  - IN-Fusion SmartBase
  - IN-Fusion Single Base
  - IN-Fusion PPP (IAPPP)
  - IN-Fusion Autonomous
  - POSGNSS KAR
  - POSGNSS PPP
  - Primary GNSS Nav
  - Auxiliary GNSS Nav





# Reviewing GNSS-Inertial Solution

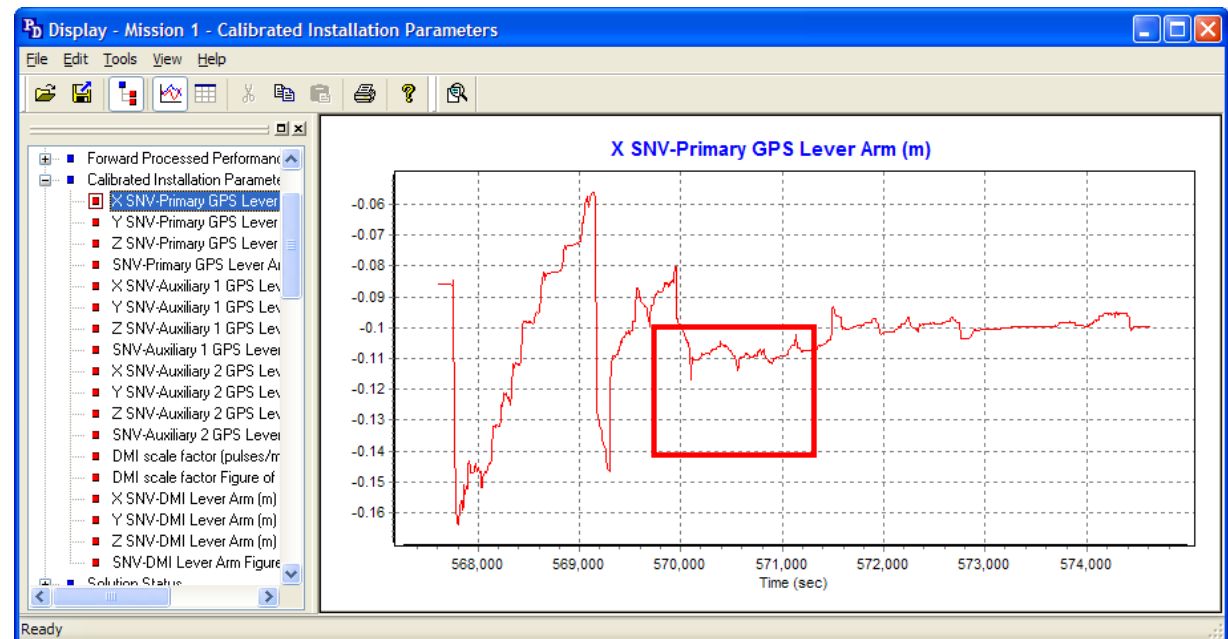
- POSPac MMS will flag any significant errors, but to ensure a quality solution, review:
  - Message Logs
    - GNSS-Inertial Forward Processing
    - GNSS-Inertial Backward Processing
    - GNSS-Inertial Combined Processing
  - Display Plots
    - Smoothed Performance Metrics
    - Calibrated Installation Parameters
    - Solution Status
    - Forward Processed Estimated Errors





# Reviewing GNSS-Inertial Solution

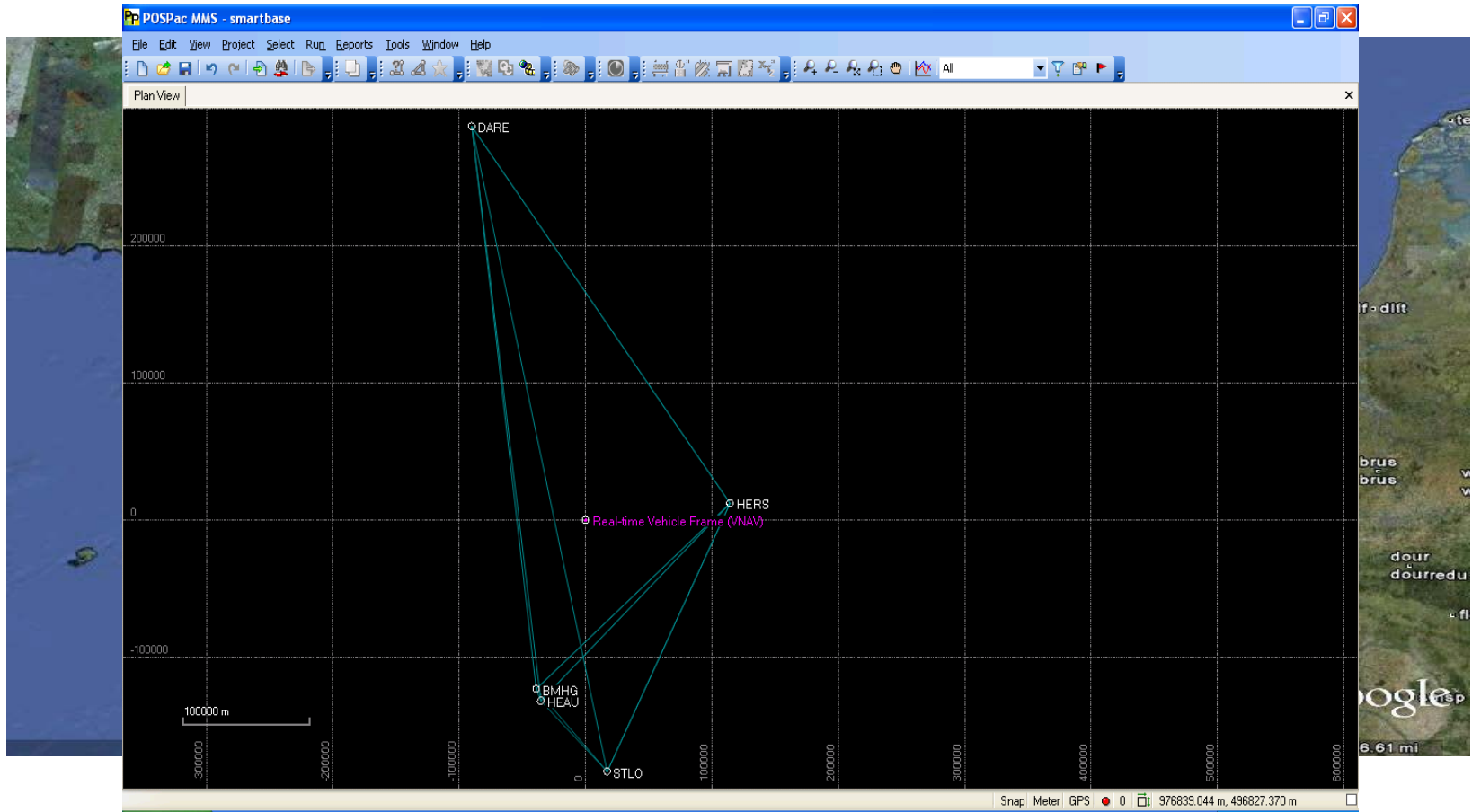
- POSPac MMS can estimate errors in lever arms applied in real time
  - This is often useful in validating both the surveyed values, and the interpretation of those values!





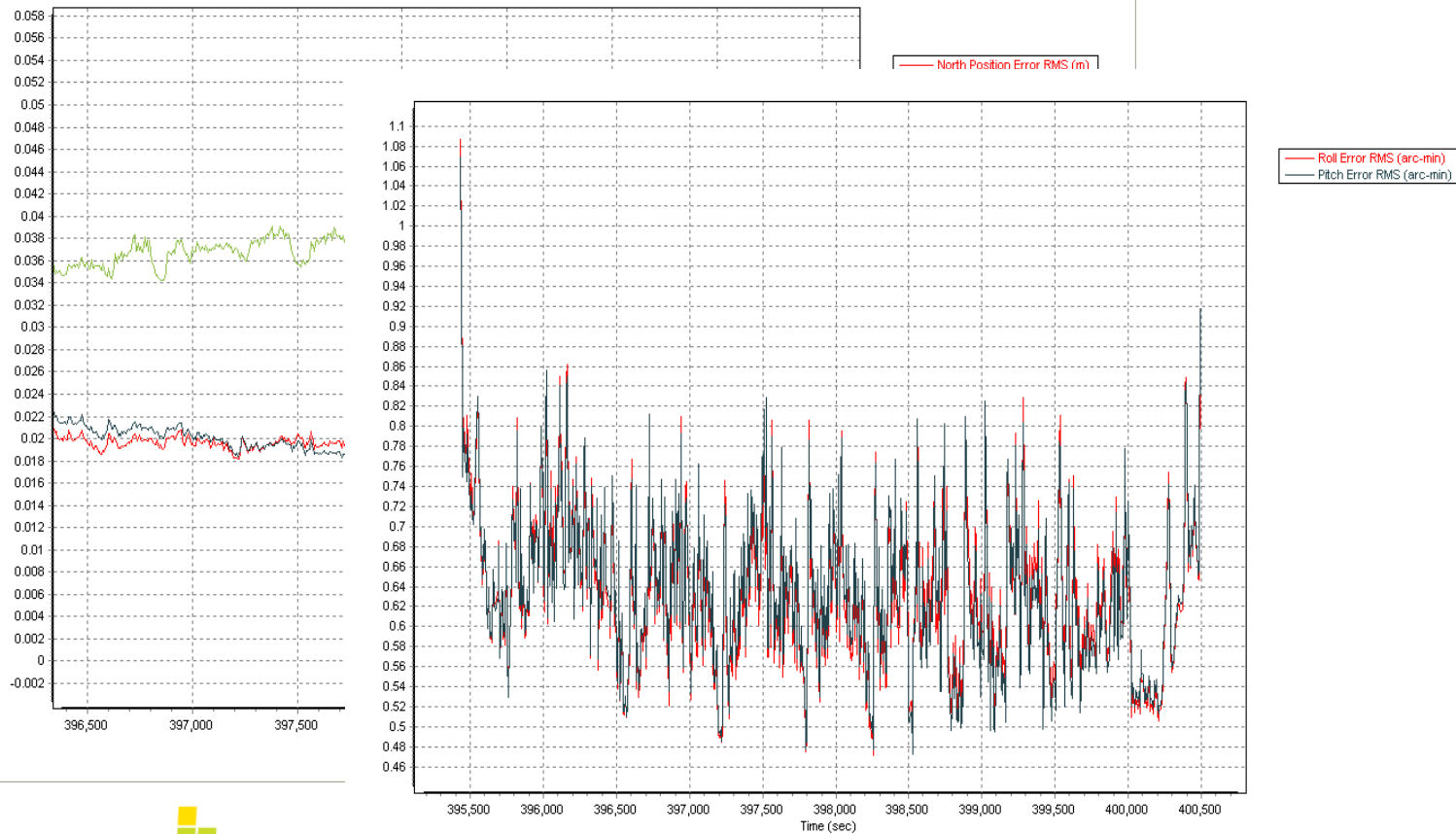
# SmartBase™

- **What is Applanix SmartBase™?**
  - Post-Processed Virtual Reference Station (PPVRS)
  - Joint development by Applanix and the Trimble GNSS Centre of Excellence
  - Based on Trimble VRS technology
- **How does it work?**
  - Uses a network of reference stations which may be 70 km or more distant
  - Spatially models ionospheric and geometric errors at base and rover locations
  - Generates an optimal observation set for a VRS at the rover location
  - Performs ambiguity fixed solution with respect to the VRS





# SmartBase Results





# PPP in POSPac MMS

- **Precise Point Positioning**
  - A robust, and easy to use solution providing decimetric levels of accuracy no matter how far you are from shore or GNSS base station infrastructure.
  - Uses freely available precise ephemeris and clock data from various online sources
- **IN-Fusion PPP**
  - Provides the capability to maintain PPP convergence should the number of satellites tracked drop temporarily
  - Optimal smoothing allows the converged solution to be carried backwards in time, ensuring PPP level accuracies throughout the survey trajectory
- **POSGNSS PPP**
  - provides a better solution in an open skies environment, at the expense of a slightly more complex workflow





# IN-Fusion PPP

### Data Preview: Precise GPS Ephemeris

Product	Service
Precise GPS Ephemeris	CODE Final
Precise GPS Ephemeris	IGS Final
Precise GPS Ephemeris	MIT Final
Precise GPS Ephemeris	ESOC Final
Precise GPS Ephemeris	IGS Rapid
Precise GPS Ephemeris	CODE Final
Precise GPS Ephemeris	IGS Final
Precise GPS Ephemeris	MIT Final
Precise GPS Ephemeris	ESOC Final
Precise GPS Ephemeris	IGS Rapid
Precise GPS Clock	CODE Final (5 s)
Precise GPS Clock	CODE Final

Cancel Checking Select Best

### PPP Data Download

Data Validation
Other Options

Tolerance in Clock Difference:  nanosec

Maximum Clock Extrapolation:  samples

Maximum Differential Code Bias:  nanosec

Download	Product	File Name	Status	Progress	Bytes	Service
<input type="checkbox"/>	Precise GPS Eph...	COD16121.EPH	Downloaded	100%	126621	CODE Final
<input type="checkbox"/>	Precise GPS Eph...	COD16122.EPH	Downloaded	100%	126697	CODE Final
<input checked="" type="checkbox"/>	Precise GPS Clock	COD16121.CLK_...	Downloading	20%	6402497	CODE Final (...)
<input checked="" type="checkbox"/>	Precise GPS Clock	COD16122.CLK_...	Downloading	1%	6841979	CODE Final (...)
<input checked="" type="checkbox"/>	Earth Rotation P...	COD16127.ERP	Connecting		Unknown	CODE Final
<input checked="" type="checkbox"/>	Ionosphere model	CGIM3330.10N	Connecting		Unknown	CODE Final
<input checked="" type="checkbox"/>	Ionosphere model	CGIM3340.10N	Connecting		Unknown	CODE Final
<input checked="" type="checkbox"/>	P1-C1 DCB	P1C11011.DCB	Connecting		Unknown	CODE DCB ...

Select Preview Express Mode Download Cancel Downloads Import Close



# Precise Point Positioning





## Features and Benefits - POSPac

- **SmartBase**
  - ✓ Lower or no infrastructure cost (longer baselines, no dedicated base stations, no telemetry)
- **IAPPP - Decimetric accuracy everywhere, regardless of distance from shore**
  - ✓ No expensive SBAS subscriptions
- **IAPPK**
  - ✓ Centimetric accuracy maintained in the most difficult GPS environments



## Summary

- **POSPac MMS provides the most accurate and robust position and orientation solution from a given data set**
- **Observables from POS MV, public and dedicated GNSS base stations, as well as precise clock and ephemeris data are all used to produce the optimal result**
- **SmartBase QC checks the quality of base station data and coordinate information**



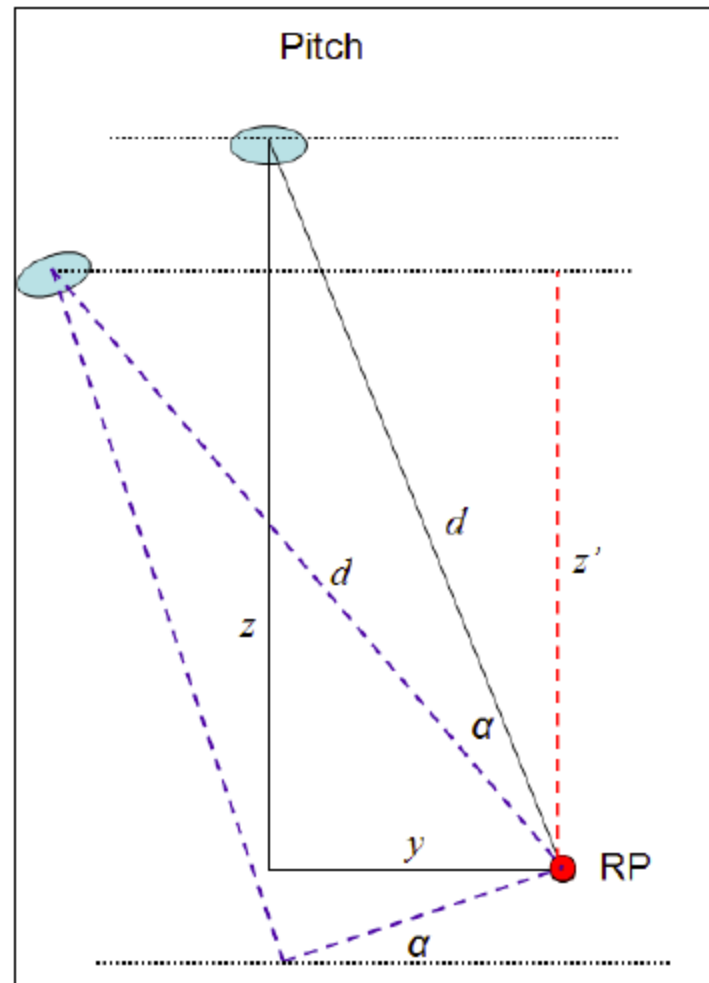
## Summary

- SmartBase extends the baseline over which centimetric accuracy is possible – a fixed integer solution is possible even when the nearest base station is 70km or more away
- Precise Point Positioning (PPP) provides decimetric accuracy in X, Y and Z no matter how far from shore



# Deriving Tides from GNSS Observations

- Deriving tidal data sufficiently accurate
  - Precise GNSS accuracy
  - SmartBase and environment
  - The integrated vessel motion



requires

adequate vertical

so in the offshore

MMS captures all



# Deriving Tides from GNSS Observations

- When using ellipsoid to survey datum models, care must be taken to understand the reference frame in which the GNSS observations have been made (ITRF vs. ETRS, for example)
- The surveyor must ensure that any reference stations utilized have been deployed correctly
  - SmartBase QC can assist with this process