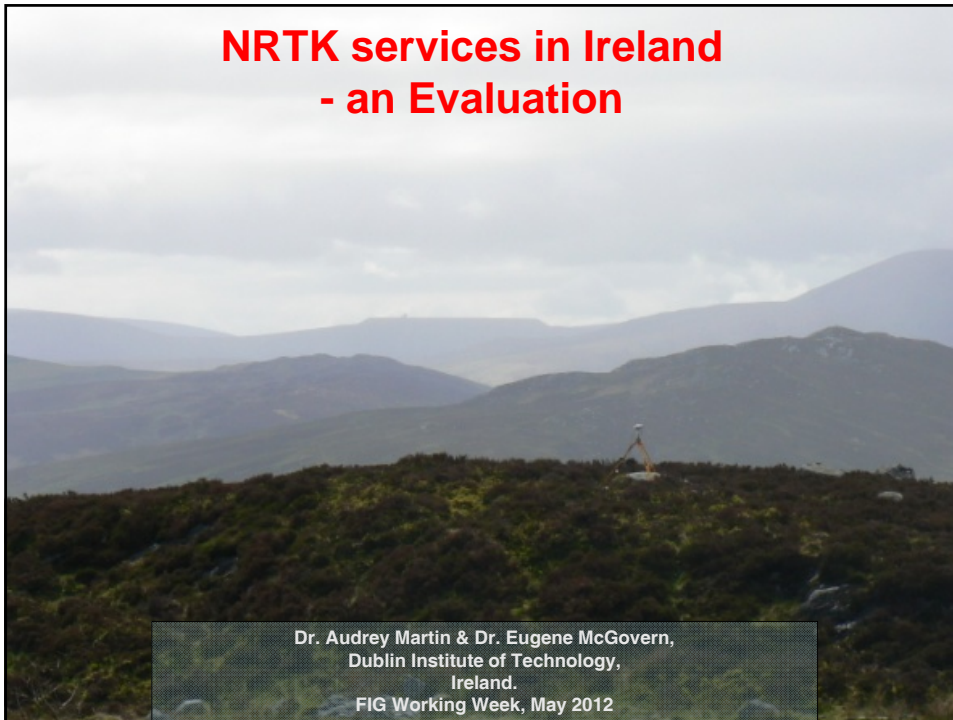


NRTK services in Ireland - an Evaluation



Ireland's Survey Infrastructure

1995

- IRENET
- ING
- 185 Ground Points
- ± 20 mm

2002

- IRENET02
- ITM
- CORS
- RINEX Output
- ± 10 mm

2004

- Active CORS Network
- NRTK
- 12 Stations
- GPS only
- GSM

Ireland's Survey Infrastructure

2006

- Active CORS Network
- GPRS

2009

- Active CORS Network
- 16 Stations
- GPS + GLONASS

2012+

- 23 Stations
- *Planned:*
- OS IE/UK09
- OSGM09
- ~8 Infill stations



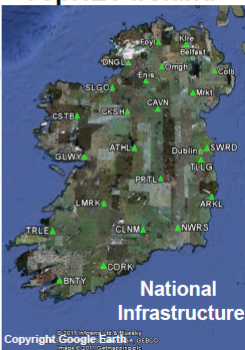
NRTK Users



Advantages of NTRK

- No base station(s) required
- Users only require one receiver
- Increases productivity
- Reduces outlay
- High quality Infrastructure
- Geodetic quality GNSS receivers
- Calibrated choke ring antennas reduce multipath
- Direct access to National Coordinate Reference Frame
- Integrity monitoring

NRTK Service Providers in Ireland

Leica SmartNet Ireland	Trimble VRS NOW Ireland	TOPCON TopNET Ireland
 <p>National Infrastructure</p> <p>Copyright Google Earth</p>	 <p>Trimble Infrastructure</p>	 <p>National Infrastructure</p> <p>Copyright Google Earth</p>
<p>SIS (for OSi) 23 stations MAC solution</p>	<p>Korec Irl. 22 stations VRS solution</p>	<p>Topcon Irl. Smartnet stns MRS solution</p>

MAC Solution (Master Auxiliary Concept)

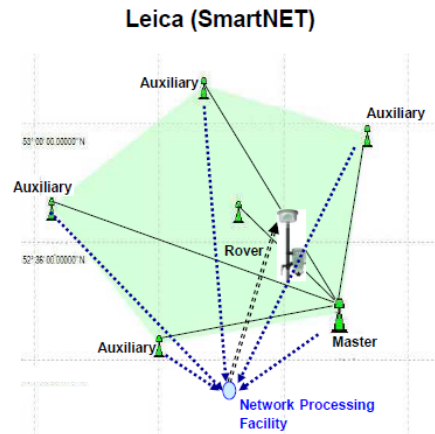
Data hub receives streaming data from CORS network

- Fixes ambiguities between master station and auxiliary network stations
- Estimates ionospheric, tropospheric and orbit error effect at each station
- Sends to rover full observation and coordinate information for a master reference station plus data for all auxiliary stations

Rover generates approximate coordinates

- Interpolates ionospheric, tropospheric and orbit errors for location
- Ambiguities fixed between rover and all network sites and position determined

– Significant computational burden at rover

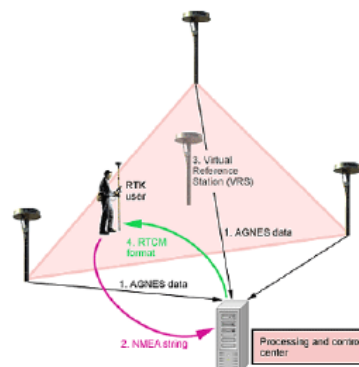


VRS & MRS Solutions (Virtual/Modelled Reference Station)

Data hub receives streaming data from particular CORS network

- Rover computes approximate position and transmits it to the data hub
- Data hub then
 - models the ionosphere, troposphere & orbit effects for the rover location
 - generates a data stream for the specific rover location
- These “data” then becomes the virtual reference station data
 - VRS data transmitted to the rover
 - VRS “site” becomes the fixed base station
 - very short baseline to rover, therefore ambiguity resolution is easy

– Reduced requirement for sophisticated software in rover
– Traceability may present a QA issue



Research Objective

Get a “snapshot” of the performance of the three NRTK systems under typical “hire-out” conditions.

i.e.

- Standard hire-fleet equipment
- Used “as-is”
- No mission planning
- No further processing



Leica
NetRover



Trimble R8



Topcon GRS-1

Methodology

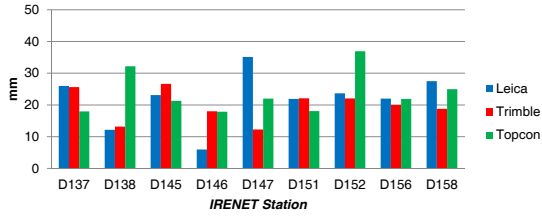


- 9 IRENET points
- Simultaneous recording
- Epoch rate = 5 secs
- Cut-off angle = 10°
- Measurement time = ~45 mins
- GLONASS On then Off
- No further processing
- Results compared to IRENET coords

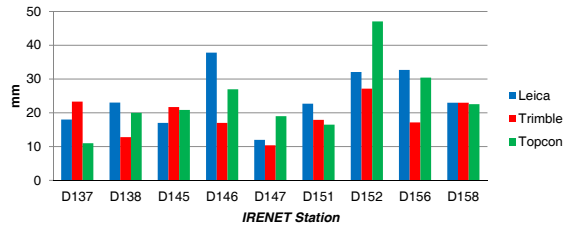


Results - 2D

2D RMSE - Glonass included

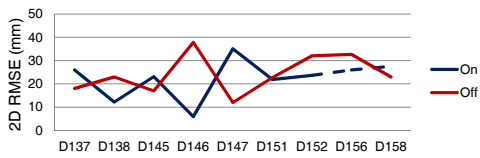


2D RMSE - Glonass not included

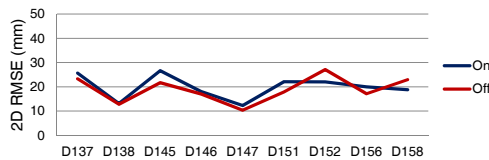


Results - 2D GLONASS On/Off

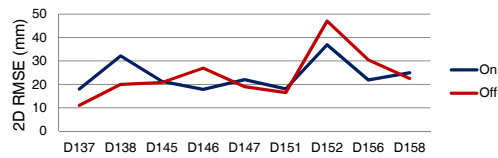
Leica - Glonass on/off



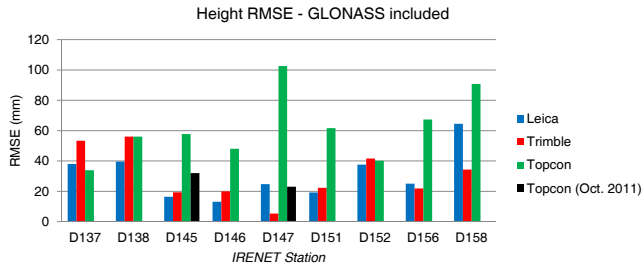
Trimble - Glonass On/Off



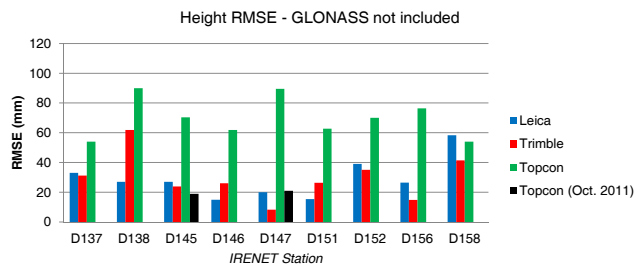
Topcon - Glonass On/Off



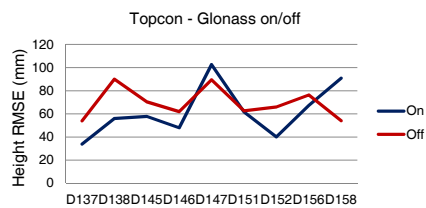
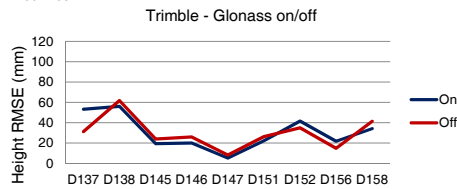
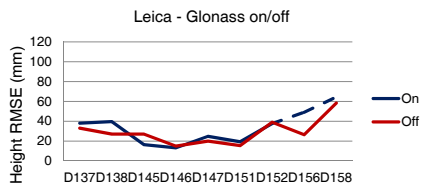
Results - Height



Note: Topcon heighting was subject to an incorrect setting

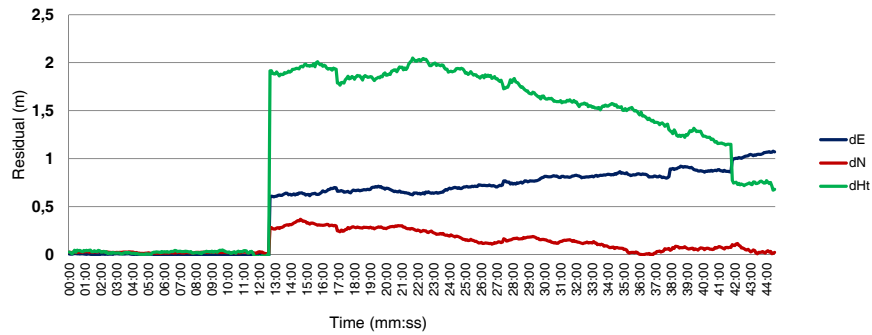


Results - Height GLONASS On/Off



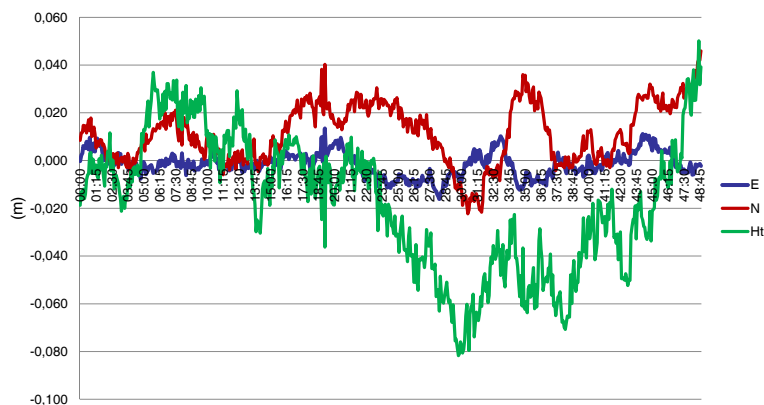
Note: Topcon heighting was subject to an incorrect setting

Results - Initialization Issues



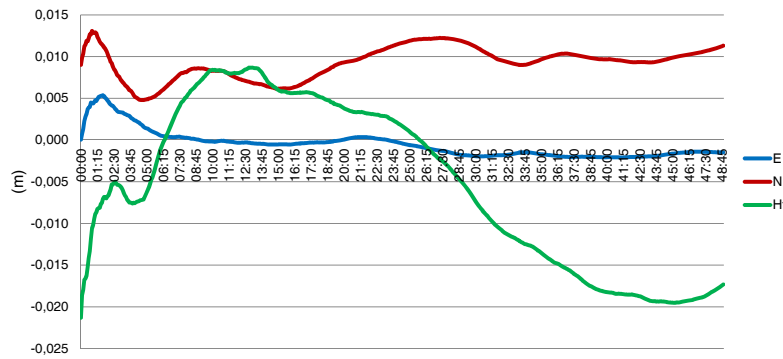
Example of a loss of initialization and failure to correctly reinitialize at D138.

Results - Windowing



Example of variability of residuals with time for one observing session

Results - Averaging



Example of accumulated mean residuals for one observing session.

Results - Elevation Difference



IRENET Pt. D156 in Wicklow Mountains (El. 488 m)

- Results for D156 were comparable to other locations.
- A significant initialization issue did, however, occur.

Conclusions

With respect to measurements taken at the nine IRENET stations.....

- Three NRTK systems deliver comparable accuracies
- The addition of GLONASS did not make a difference
- Initialisation issues can occur
- Averaging and Windowing may not improve results
- Sig. elevation difference was not an issue

- XY accuracy = 22 mm \pm 8 mm
- Z accuracy = 29 mm \pm 14 mm

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- Topcon Ireland (Topcon)

Thank you for your attention

