

MTG IRS Inter-band Co-registration Assessment

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Outline

- Introduction
- SRD and S/S Report
- Geolocation Methods
- Simulation Results

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Introduction

MAG #	Comment
#04 10/2017	M4.A6: Co-registration issue between the two bands: To investigate and communicate on how to give the information (lat/lon per band) to the users
#05 05/2018	<p>(lat,lon) will be provided in the product files for one band + information (translation, rotation...) to retrieve the geolocation of the second band.</p> <p>This answers the action as it was minuted during MAG4. However, it appeared necessary to have more information on the accuracy of the geolocation. Closed. New action: EUMETSAT to provide more information on geolocation accuracy by next MAG (Autumn 2018)</p>

Introduction

MAG #	Comment
#06 11/2018	<p>The information that will allow the user to get the geo-location of the other IRS band will be stored in a static file giving, for each of the 160x160 pixel in the reference band, the corresponding pixel position (barycentre of PSF) in the other band. This will have to be formatted by EUM from the characterization data stored in the MTG-S SCCDB (TBC) and from the active sub-pixels list.</p> <p>Then, we have to define a procedure to derive the (lat,lon) from this static data. I see two possibilities:</p> <p>Reference Method: i) to convert the (lon, lat) in (az,el) by inverse GEOS projection, ii) to do a bilinear interpolation of the (az,el) and iii) to convert back to (lon,lat).</p> <p>Simple Method: to do a 2-D interpolation of the (lon,lat) of the 4 neighbouring pixels corresponding, in the reference band, to the sub-pixel position in the other band given by the alignment map.</p>

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SRD and S/S Report

- **According to the MTG SRD:**

PL-IRS-420-Level 1b: The absolute value of the IRS relative sample position error (RSPE) between any two spectral channels shall meet the following requirement when evaluated over a LAC:

Channel Group	Confidence Level	RSPE
Intra-band	68.26%	< 0.4 Km
Inter-band	68.26%	< 0.8 Km

- **Understanding:**

The confidence level means that for 68.26% of the spatial channels (= pixels) the co-registration needs to be within the specified values. For each spatial sample the worst case of co-registration error is used. It is sufficient to evaluate the performance for one dwell since all dwells of a LAC will have the same Inter- and Intra-Band Co-Registration performance. For performance estimation, the specification limits are converted into angular space.

SRD and S/S Report

- Instrument manufacturer report, see MTG-OHB-SY-TN-0175, issue 6:

Channel Group	Compliance Status
Intra-band	Compliant
Inter-band	NS: 991m Vs 800m EW: 1116m Vs 800m

- **Understanding:**

These measurements are to be considered at Sub-Satellite Point (SSP) where the nominal SSD is 4 Km

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Implemented Solutions

- **User dissemination:**

EUM will disseminate to the users the Lat/Lon coordinates of the sample of the reference band as part of L1B product and the pixels shift map in the detector frame as static data.

- **Possible approaches:**

To get the Lat/Lon coordinates of the sample of the second band, 3 different methods can be applied:

- Reference approach: Interpolate in Az/EI
- Simple approach: Interpolate the Lat/Lon
- Use of the same Lat/Lon for both bands: no de-registration accounted for

Implemented Solutions: Az/EI Interpolation

Reference Band

Lat/Lon

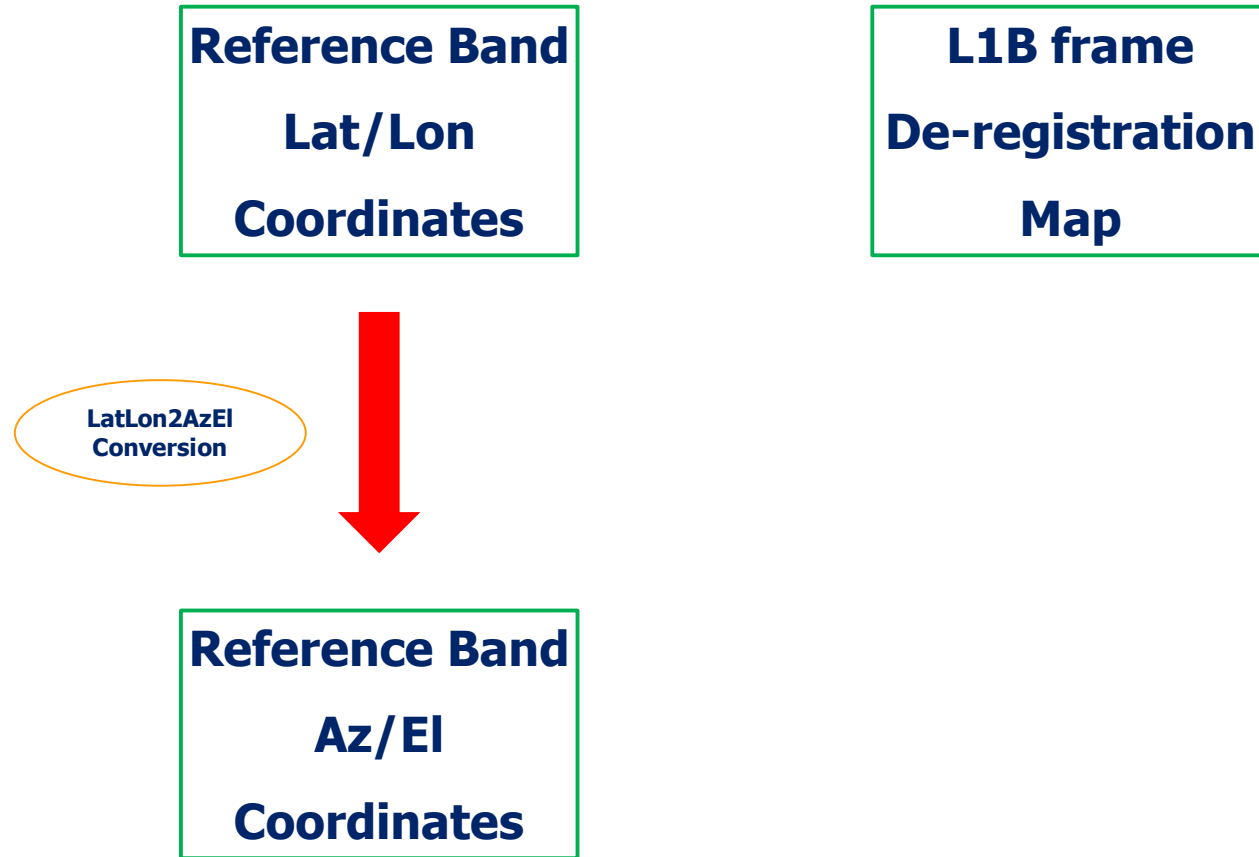
Coordinates

L1B frame

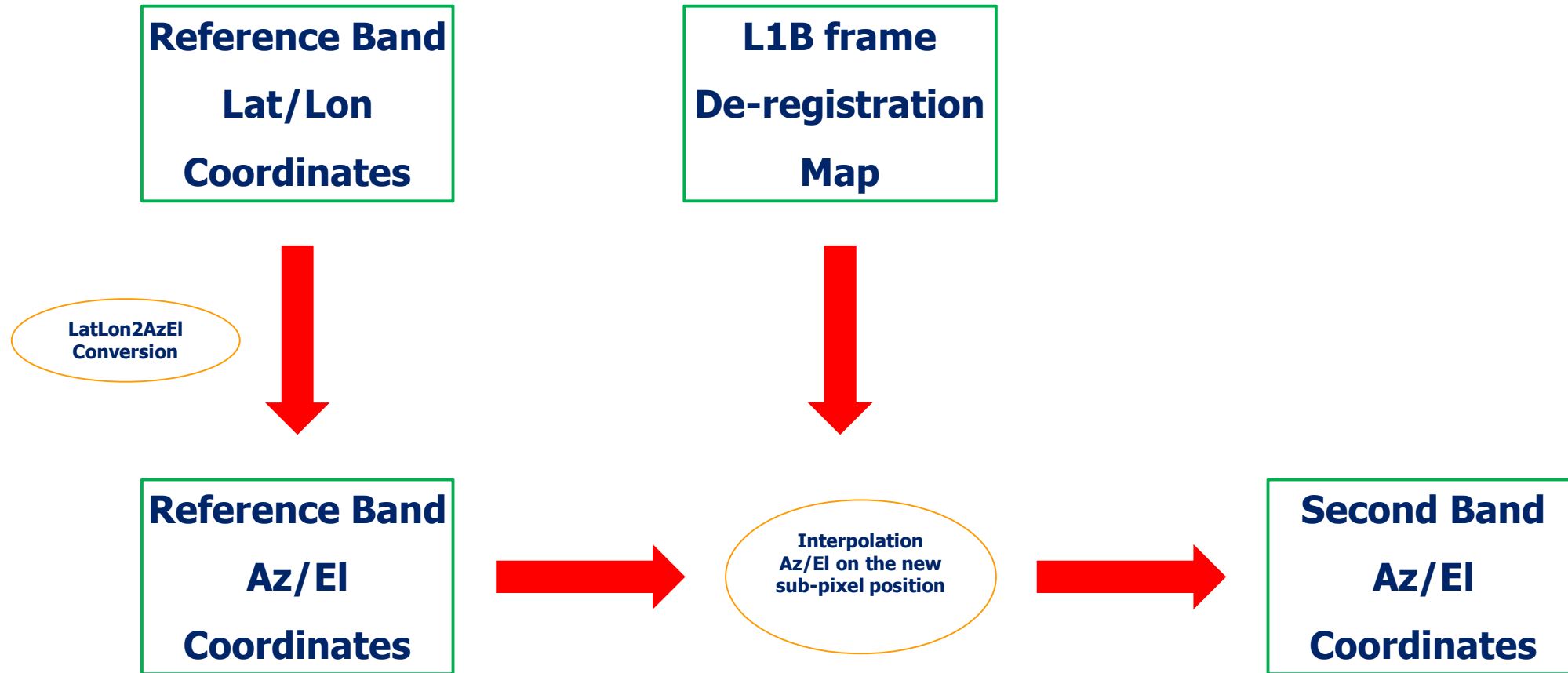
De-registration

Map

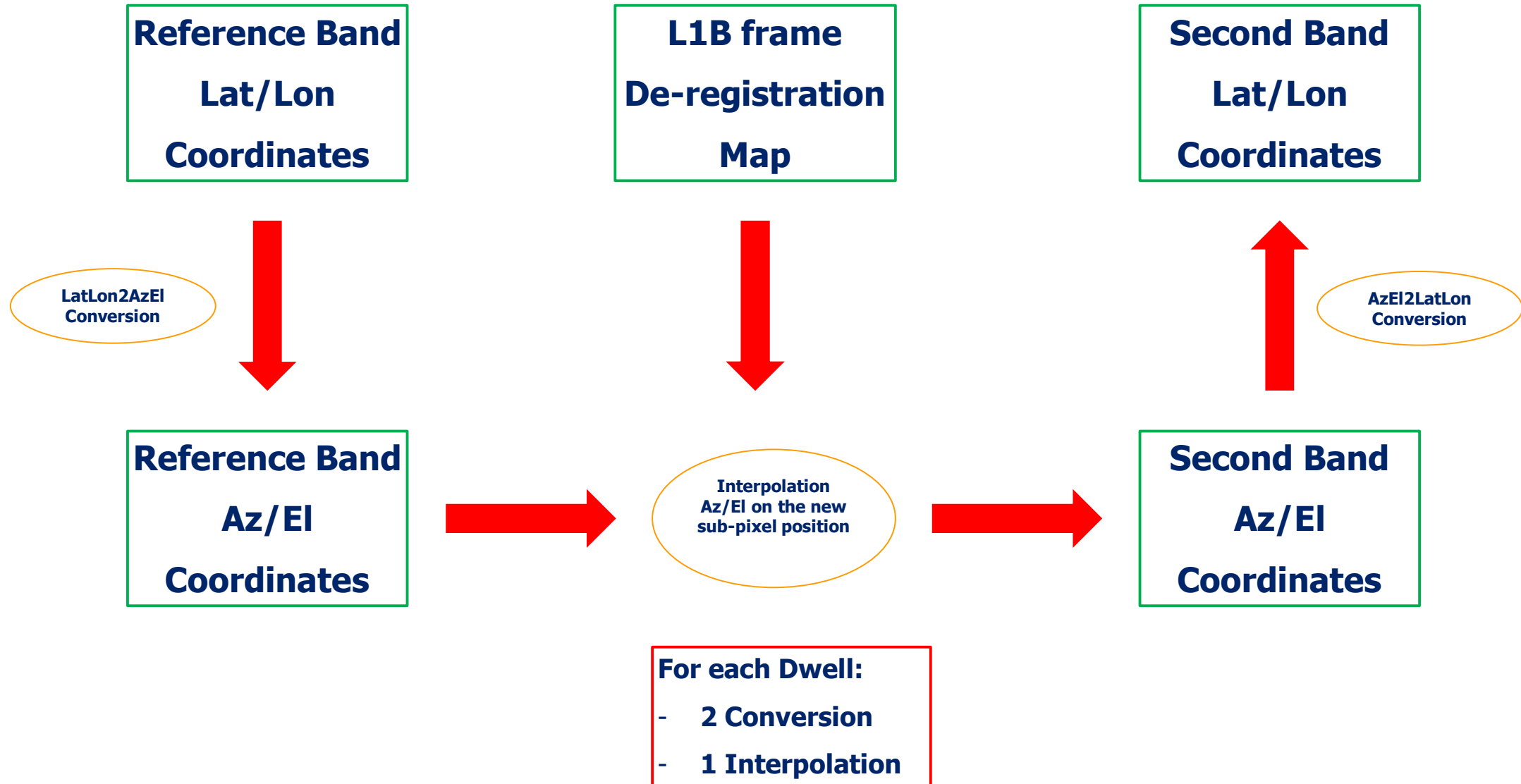
Implemented Solutions: Az/EI Interpolation



Implemented Solutions: Az/EI Interpolation



Implemented Solutions: Az/EI Interpolation



Implemented Solutions: Lat/Lon Interpolation

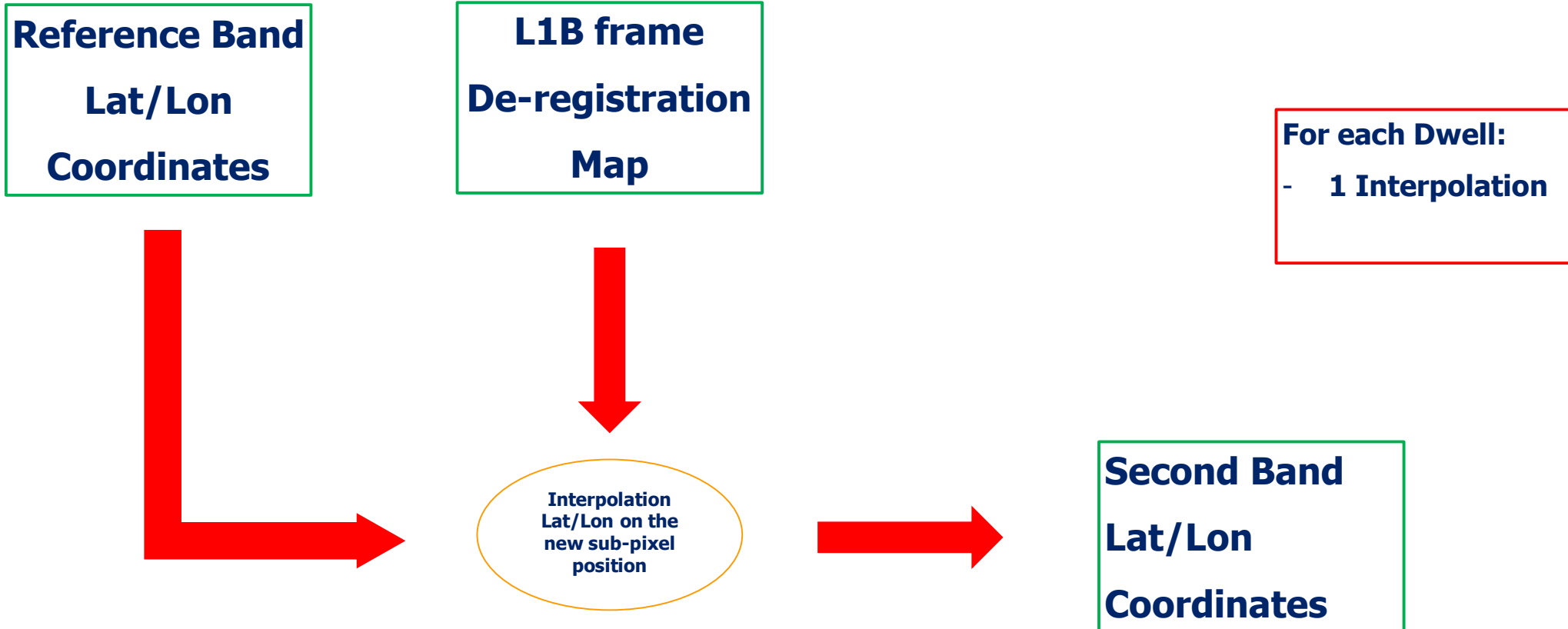
Reference Band

**Lat/Lon
Coordinates**

L1B frame

**De-registration
Map**

Implemented Solutions: Lat/Lon Interpolation



Outline

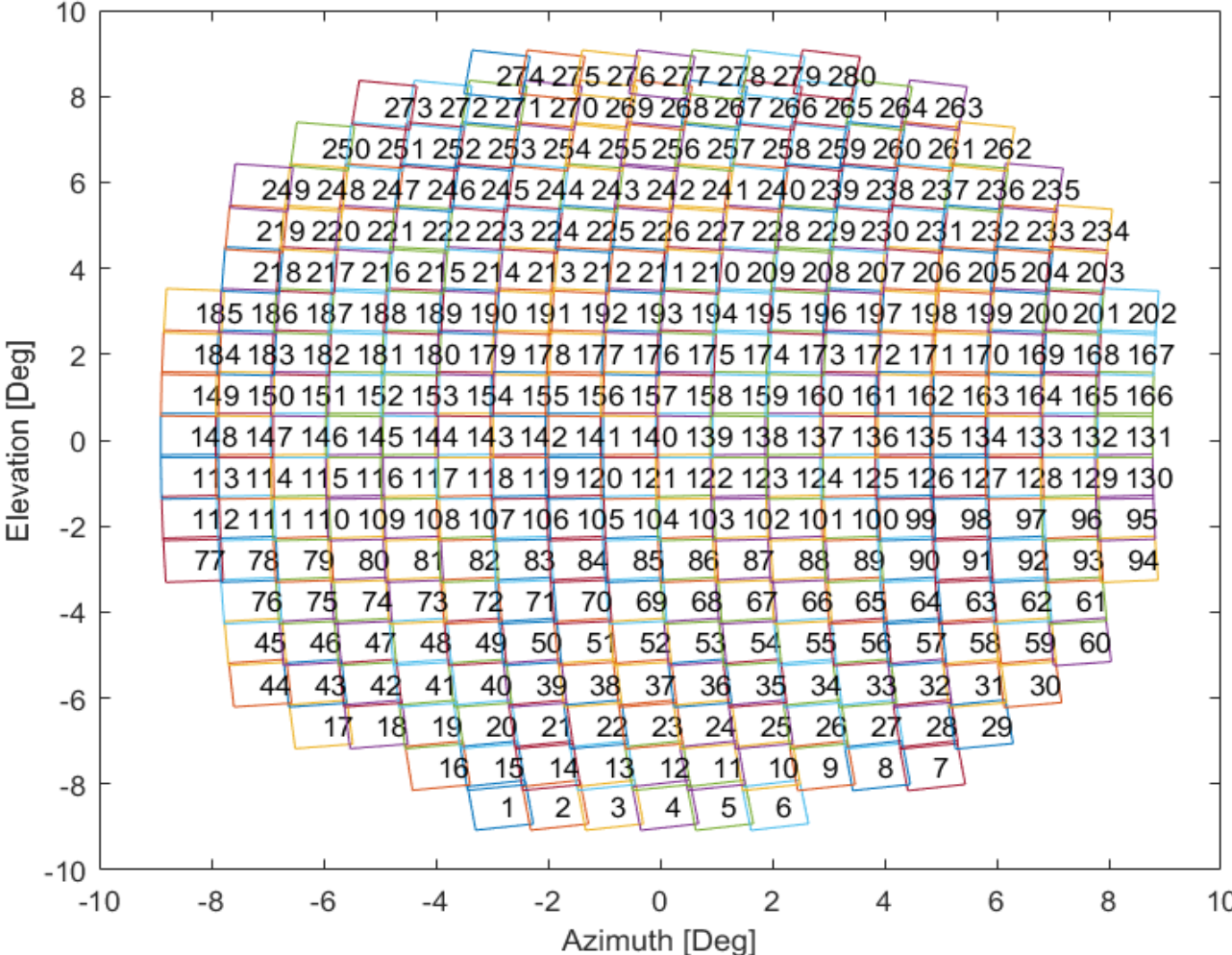
- Introduction
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- **Simulation Results**

Simulation Results

- **Assumption:**
 - Satellite in the ideal orbit
 - No Perturbation
 - The error NS and EW has been translated as portion of pixel, e.g. 1 Km SSP equal to 0.25 pixel
 - 68% of points below 0.279 pixel error in EW, i.e. 1116 m at SSP
 - 68% of points below 0.247 pixel error in NS, i.e. 991 m at SSP
 - The simulation de-registration is implemented applying a rotation and a shift along both Col and Row
 - De-registration apportionment: mainly rotation accounting for 0.2286 pixel error EW and 0.2282 pixel error NS
 - Reference method compared to Lat/Lon Method and No Interpolation Method

Simulation Results

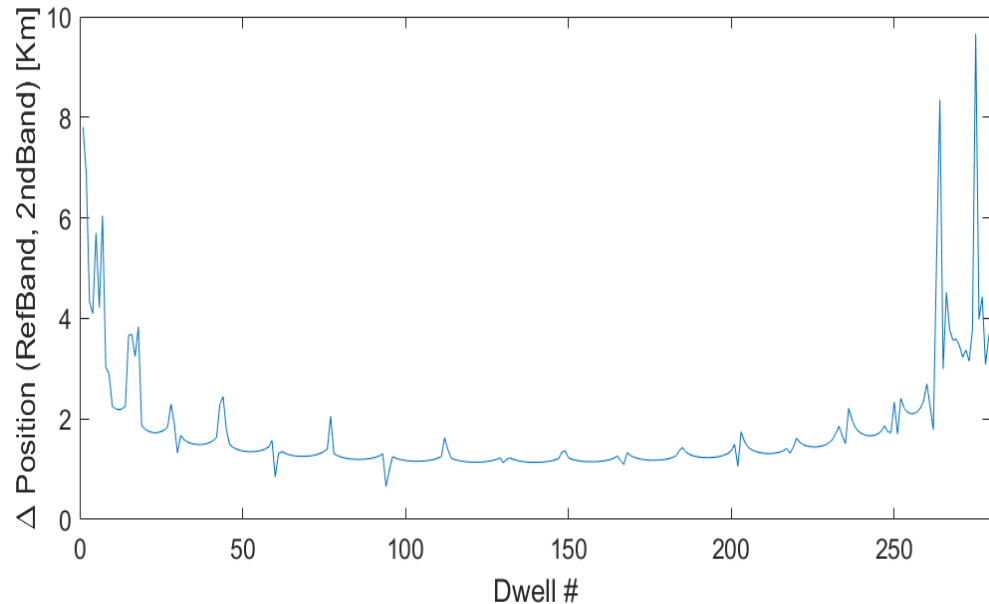
- FD dwells



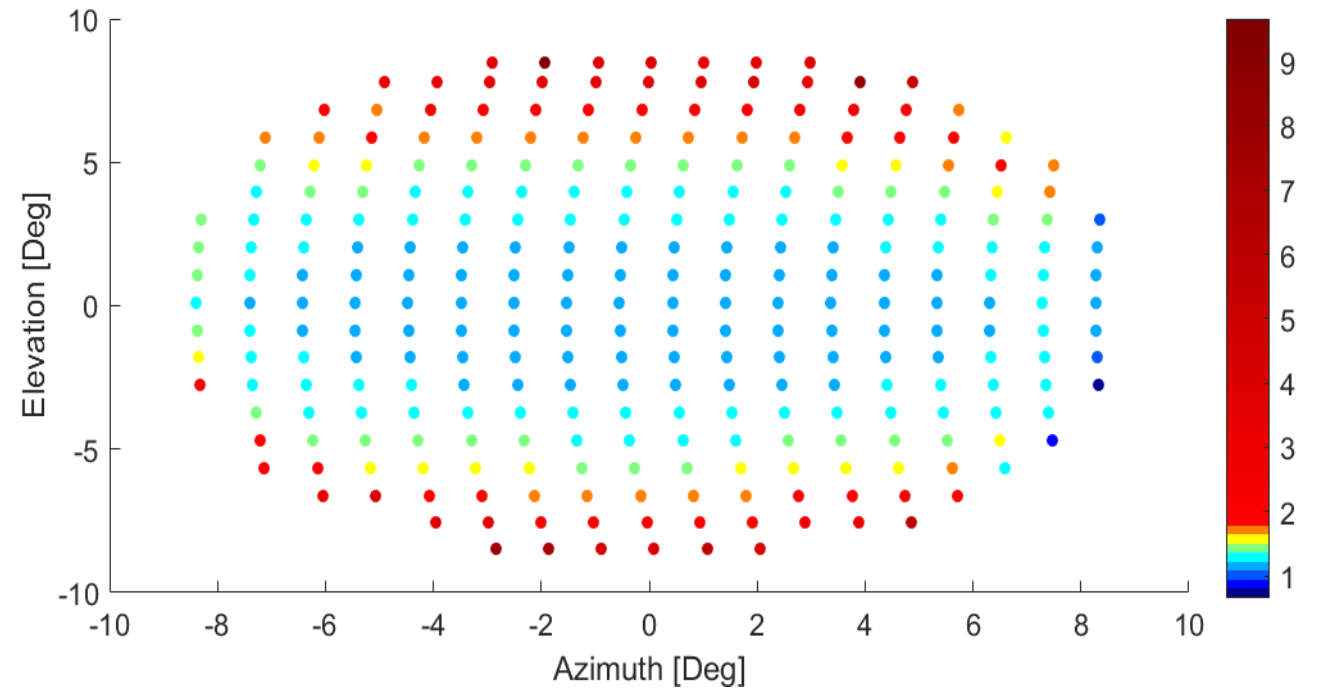
Simulation Results: Latitude

- **No interpolation vs Az/EI Interpolation (reference method)**

Mean: 1.752 Km
Std : 1.137 Km



**Error along
Latitude [Km]**

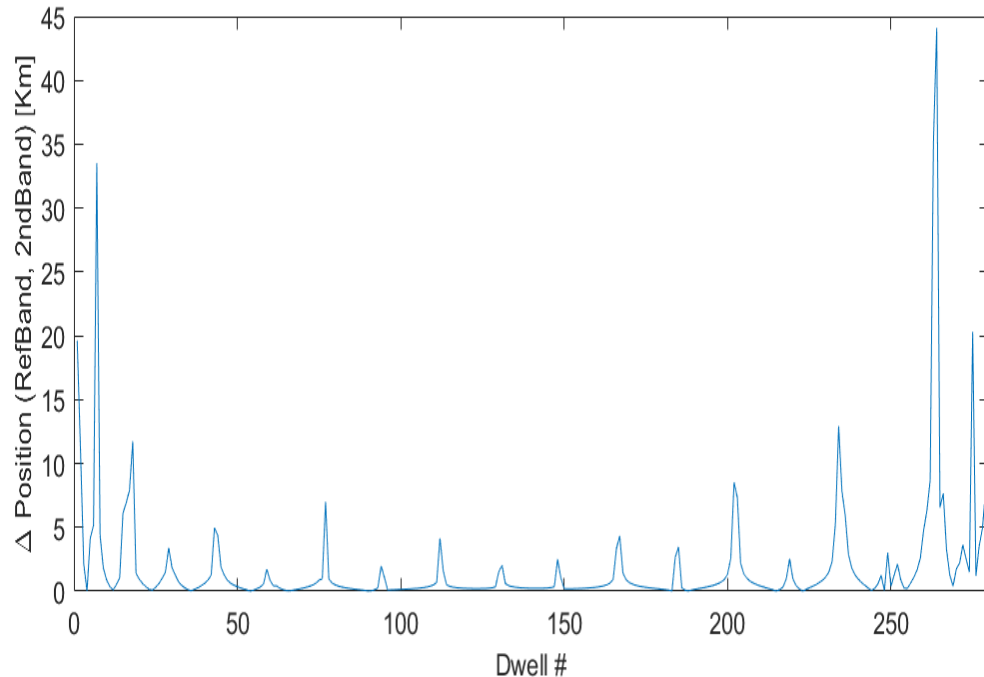


**Error along
Latitude per Dwell
Position [Km]**

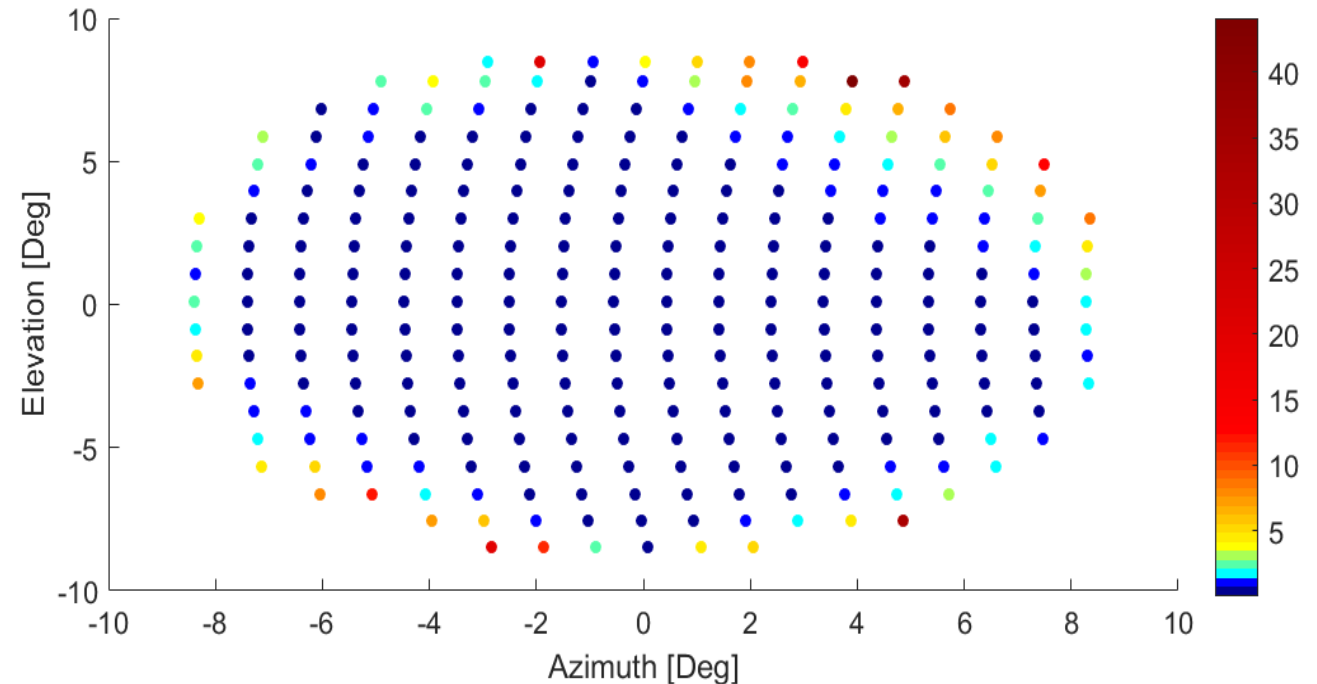
Simulation Results: Longitude

- **No interpolation vs Az/EI Interpolation (reference method)**

Mean: 1.823 Km
Std : 4.630 Km



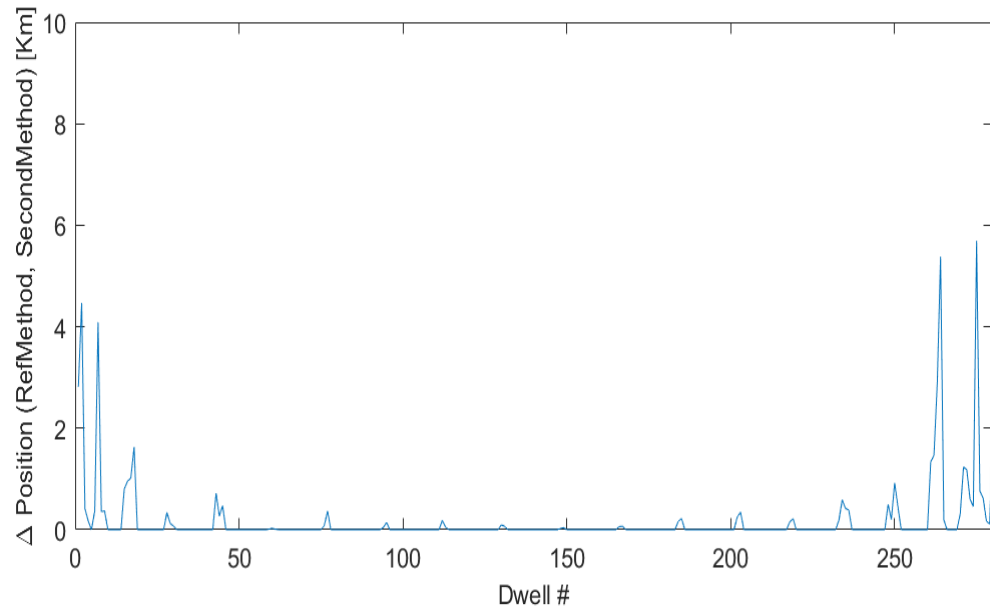
**Error along
Longitude [Km]**



**Error along
Latitude per Dwell
Position [Km]**

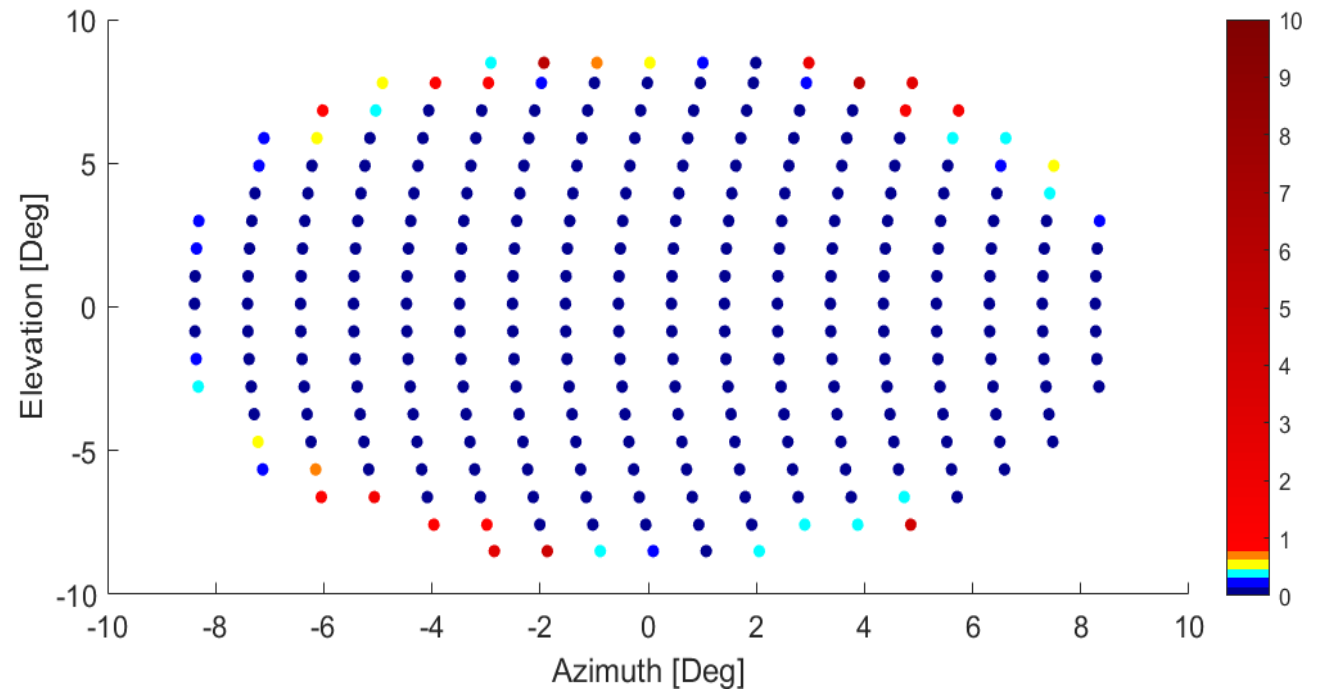
Simulation Results: Latitude

- **Lat/Lon interpolation vs Az/EI Interpolation (reference method)**



Error along Latitude [Km]

Mean: 0.180 Km
Std : 0.678 Km



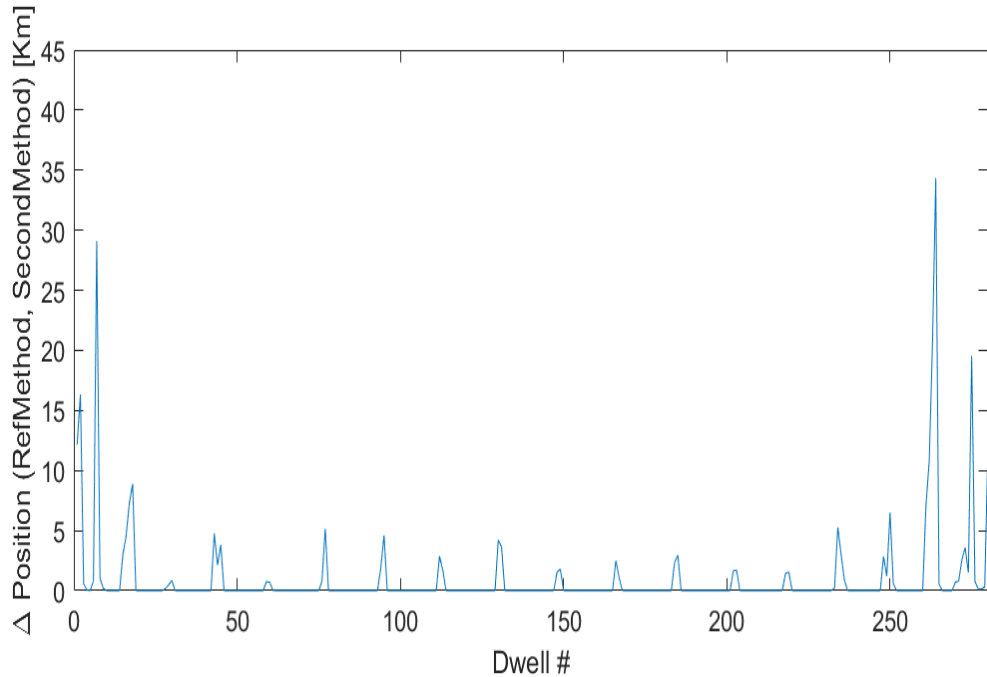
Error along Latitude [Km]

Simulation Results: Longitude

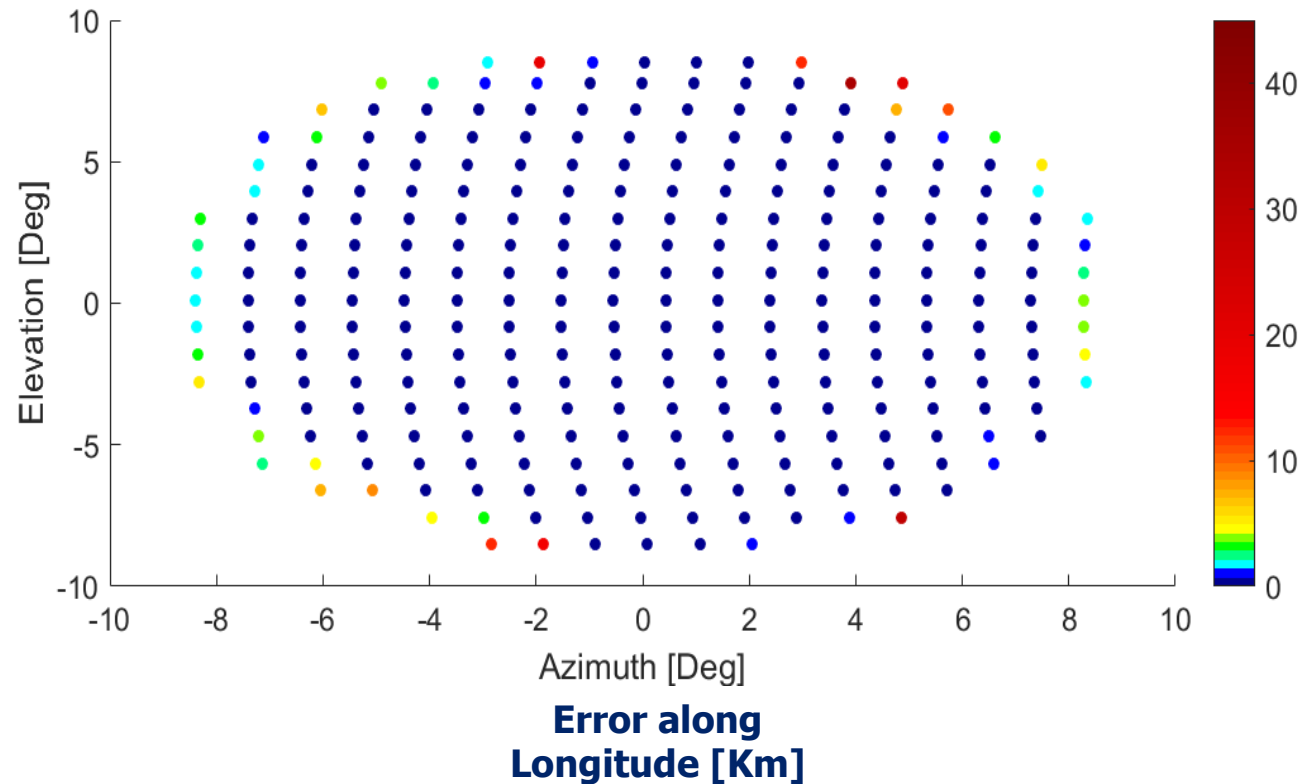
- **Lat/Lon interpolation vs Az/EI Interpolation (reference method)**

Mean: 0.9905 Km

Std : 3.6624 Km



Error along Longitude [Km]



Error along Longitude [Km]

Conclusions

- In this presentation a simulation of focal plan de-registration has been implemented
- The assessment of three approaches to derive the Lat/Lon coordinates of each samples of both bands has been implemented
- The reference method (AzEL Interp) needs 2 frame conversions and 1 interpolation operations for each dwell to be performed
- the gain in accuracy vs ignoring the co-registration map is limited
- The LatLon Interpolation method is simpler but introduces a large error

Conclusions

- The reference method accuracy needs to be better assessed with the IRS LOS precise model including optical distortion and focal plane geometry comparing the models with the actual on-ground measurements
- The MTG IRS User Guide will describe the computation of the Lat/Lon for the 2 bands using the reference methods, i.e. Az/EI interpolation



Kiitos Asante Matondo
 Grazie Mochchakkeram
 Spasibo Mator Nuwun
 Multumesc Nirringrazzjak
 Asante Ua Tsaug Rau Koj
 Dankon Mochchakkeram
 Dank Je You Merci
 Mochchakkeram Bbrigado
 Spasibo Grazie Dankon Welalin
 Mochchakkeram Merci
 Grazie Arigato
 Mochchakkeram Nirringrazzjak
 Cam on ban Ua Tsaug Rau Koj
 Matondo Kia
 Terma Kasih Welalin Raibh Maith Agat

