# The Possibility of Using GNSS Quality Control Parameters to Assess Ionospheric Scintillation Errors

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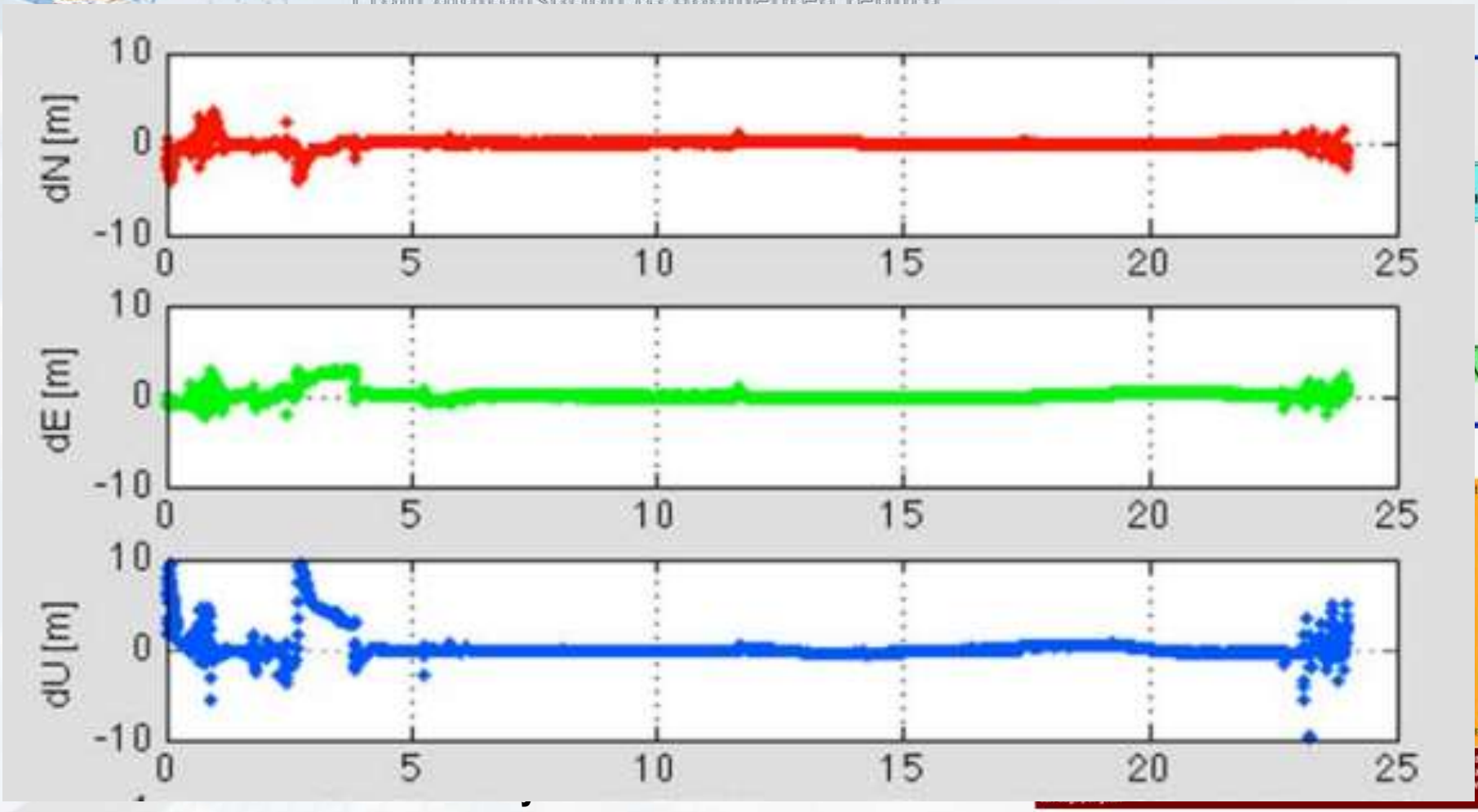

dN [m]
dE [m]
dU [m]
10
0
-10
0
5
10
15
20
25

- **What are the current techniques for assessing scintillation error?**
- **Use of specialized GNSS receivers (Scintillation Monitoring)**



- **Calculation of Total Electron Content (TEC) and Rate of TEC (RTEC)**
- **Calculation of Rate Of TEC Index (ROTI)**

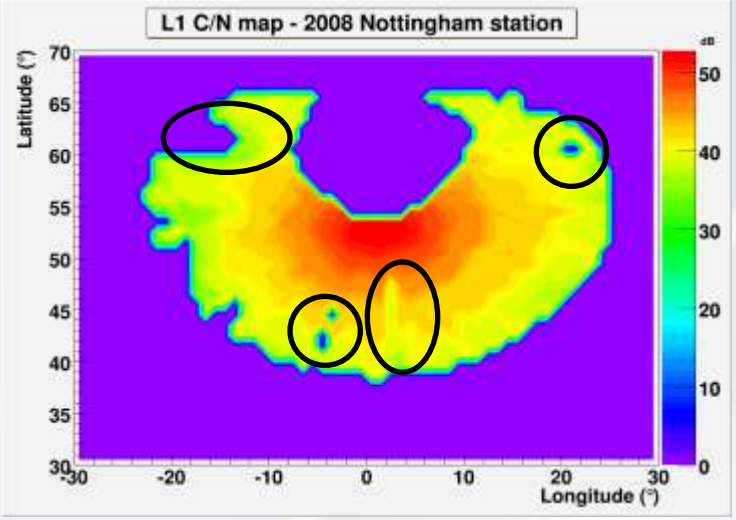
- **Can Quality Control Parameters from TEQC be of any benefit?**

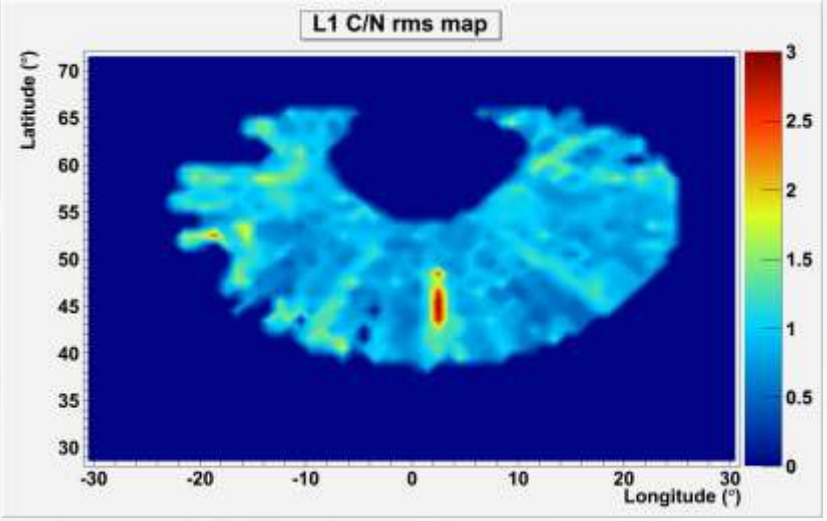
- **This study is a feasibility study to investigate whether it may be possible that TEQC parameters can contribute to information about scintillation**
- **TEQC is a Quality Control Software for GNSS data from UNAVCO (www.unavco.org)**
- **In this study we concentrate on the Multipath Parameters (MP1, MP2 etc)**

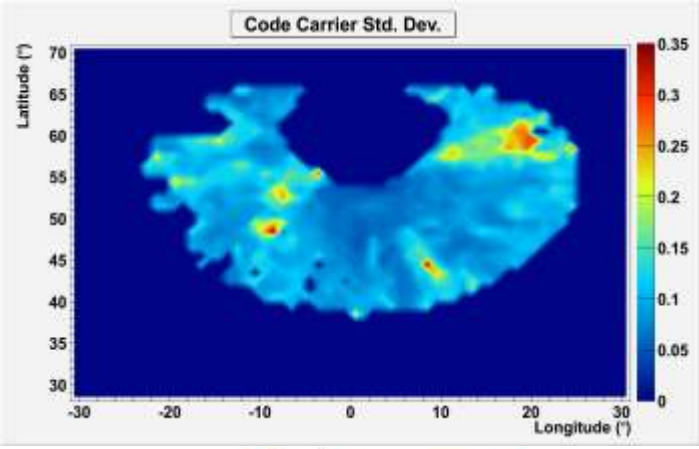
- **What are the possible benefits?**

- The use of non specialized GNSS receivers for error mitigation (Lower Cost, Denser Networks)
- The possibility of analyzing archived GNSS data
- Creation of ionospheric scintillation error maps and models from denser GNSS CORS networks
- Assessment of effects of scintillation on new signals (BeiDou)
- Possibility of Tracking Scintillation for forecasting and prediction

- **Station Characterisation at Nottingham UK**

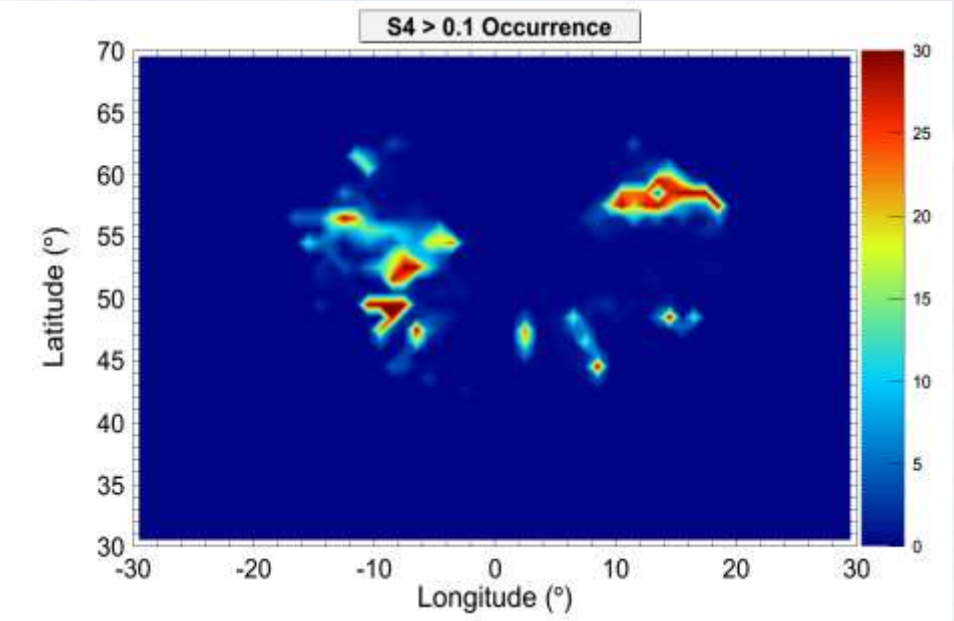


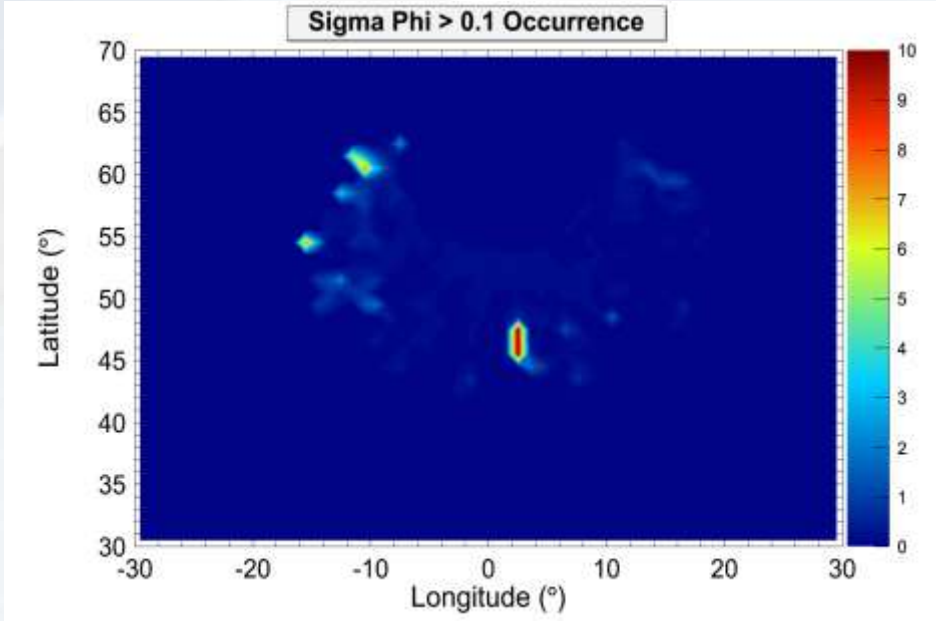



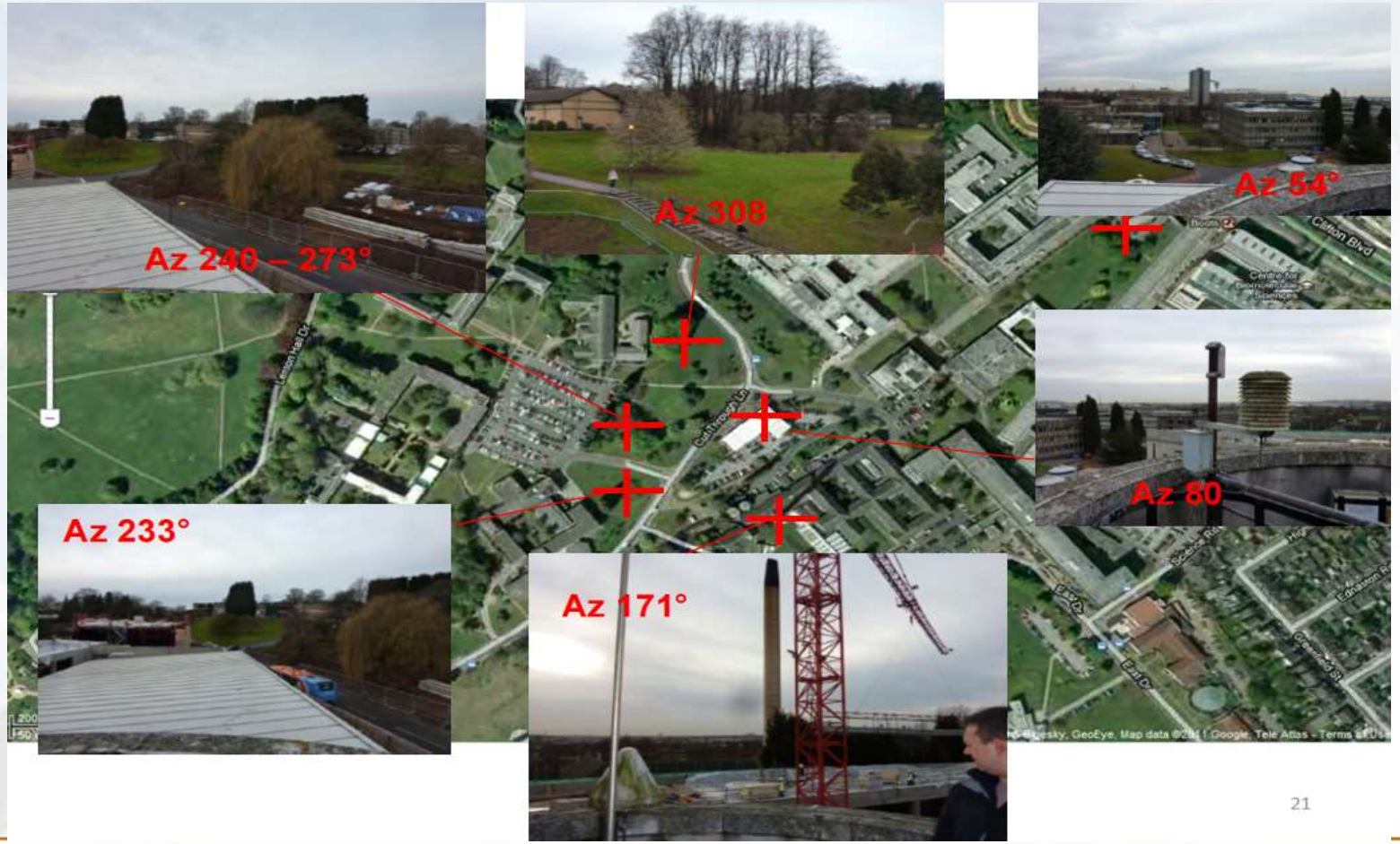

- **See Romano et al 2013**

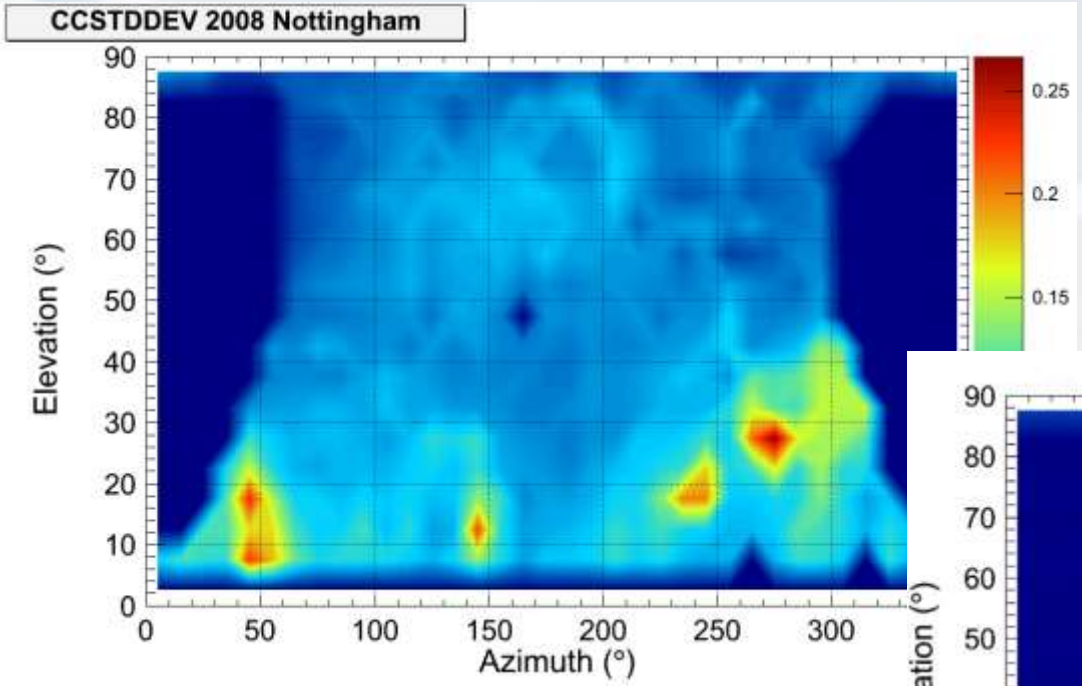
- **Characterisation with Scintillation Parameters**

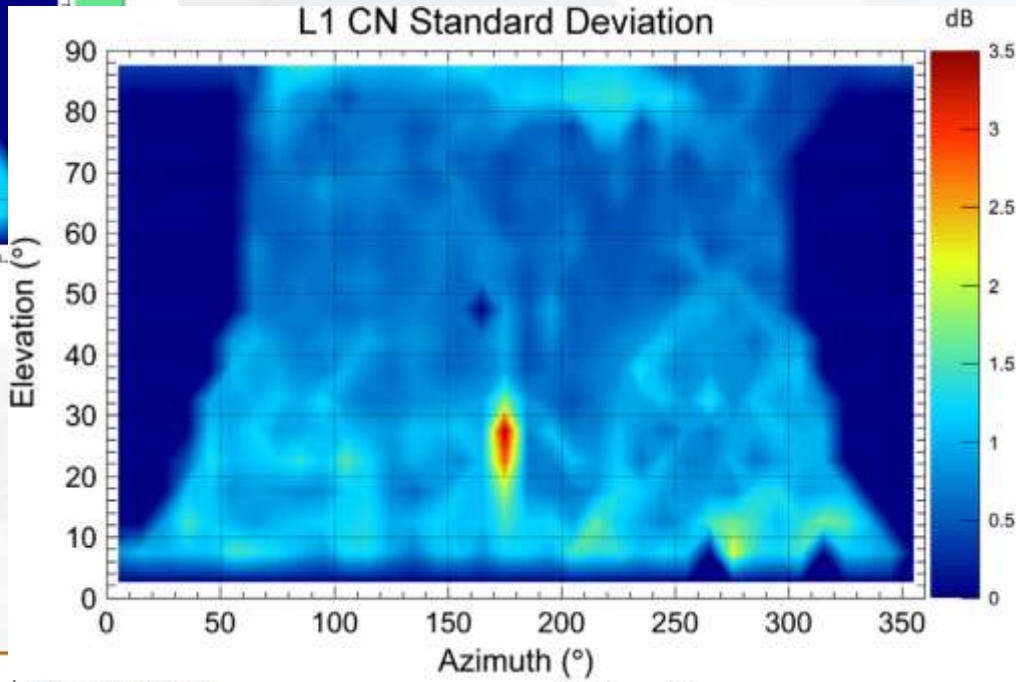


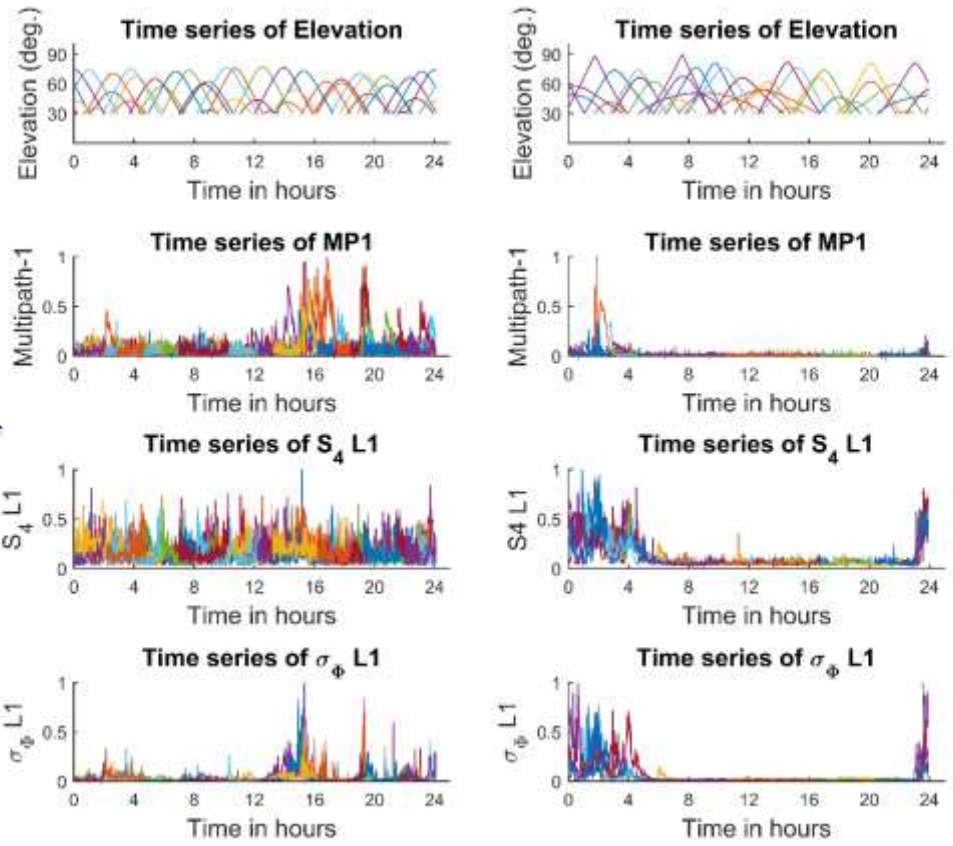
- **Area Surrounding Nottingham Station**




CCSTDDEV 2008 Nottingham
Elevation (°)
Azimuth (°)
0
10
20
30
40
50
60
70
80
90
0
50
100
150
200
250
300
0.25
0.2
0.15

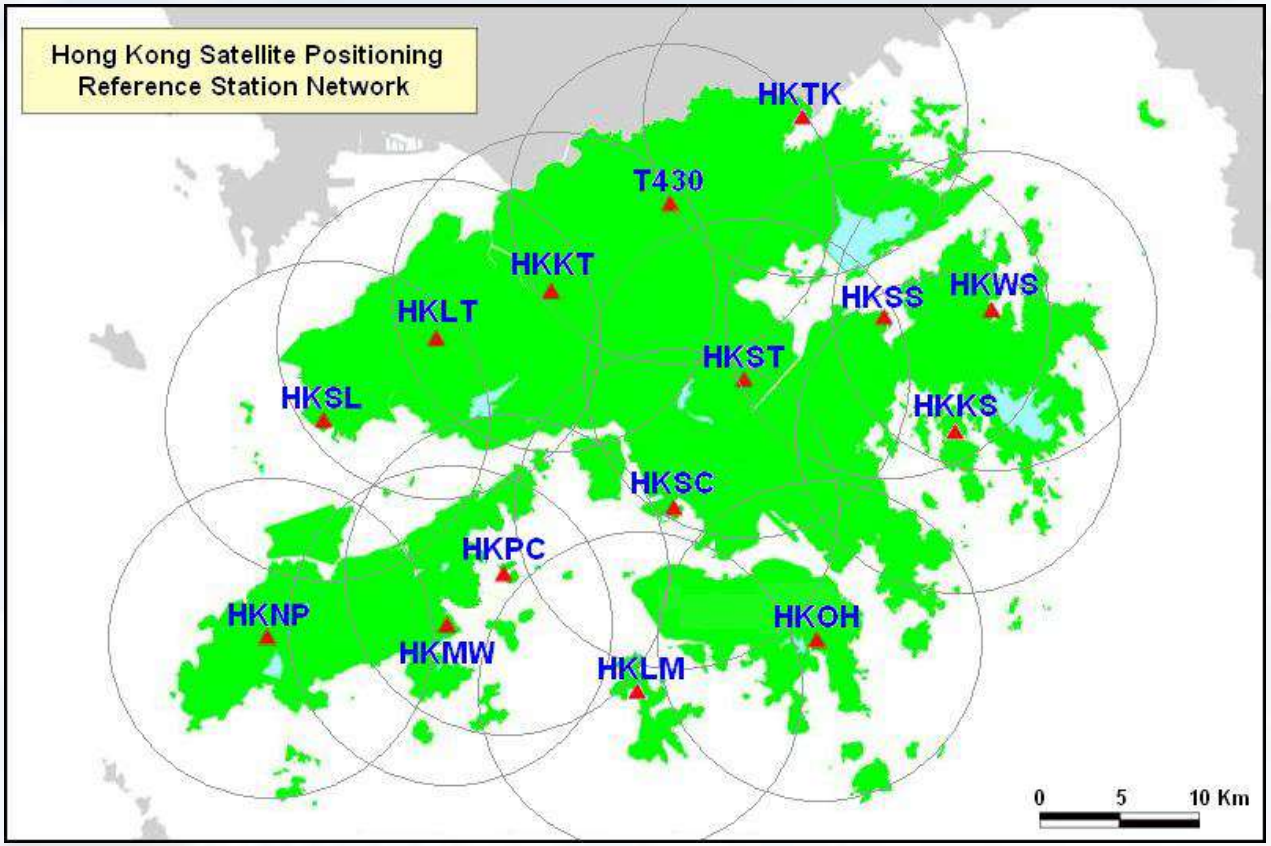

L1 CN Standard Deviation
dB
Elevation (°)
Azimuth (°)
0
10
20
30
40
50
60
70
80
90
0
50
100
150
200
250
300
350
3.5
3
2.5
2
1.5
1
0.5
0

Norway




Brazil

- Hong Kong CORS Network

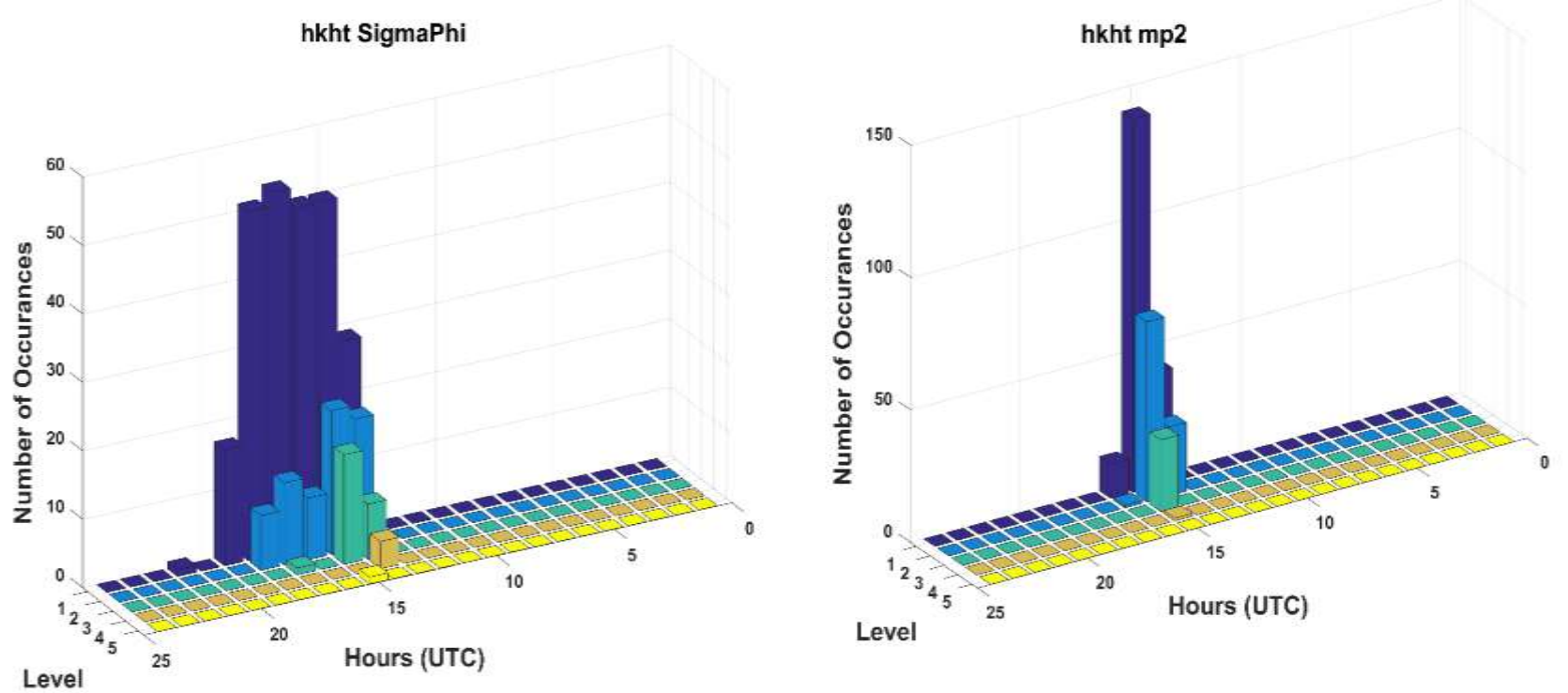



| Level | S4 and $\sigma_\phi$ |
|---|---|
| 1 | >0.2 – 0.4 |
| 2 | 0.4 – 0.6 |
| 3 | 0.6 – 0.8 |
| 4 | 0.8 – 1.0 |
| 5 | >1 |

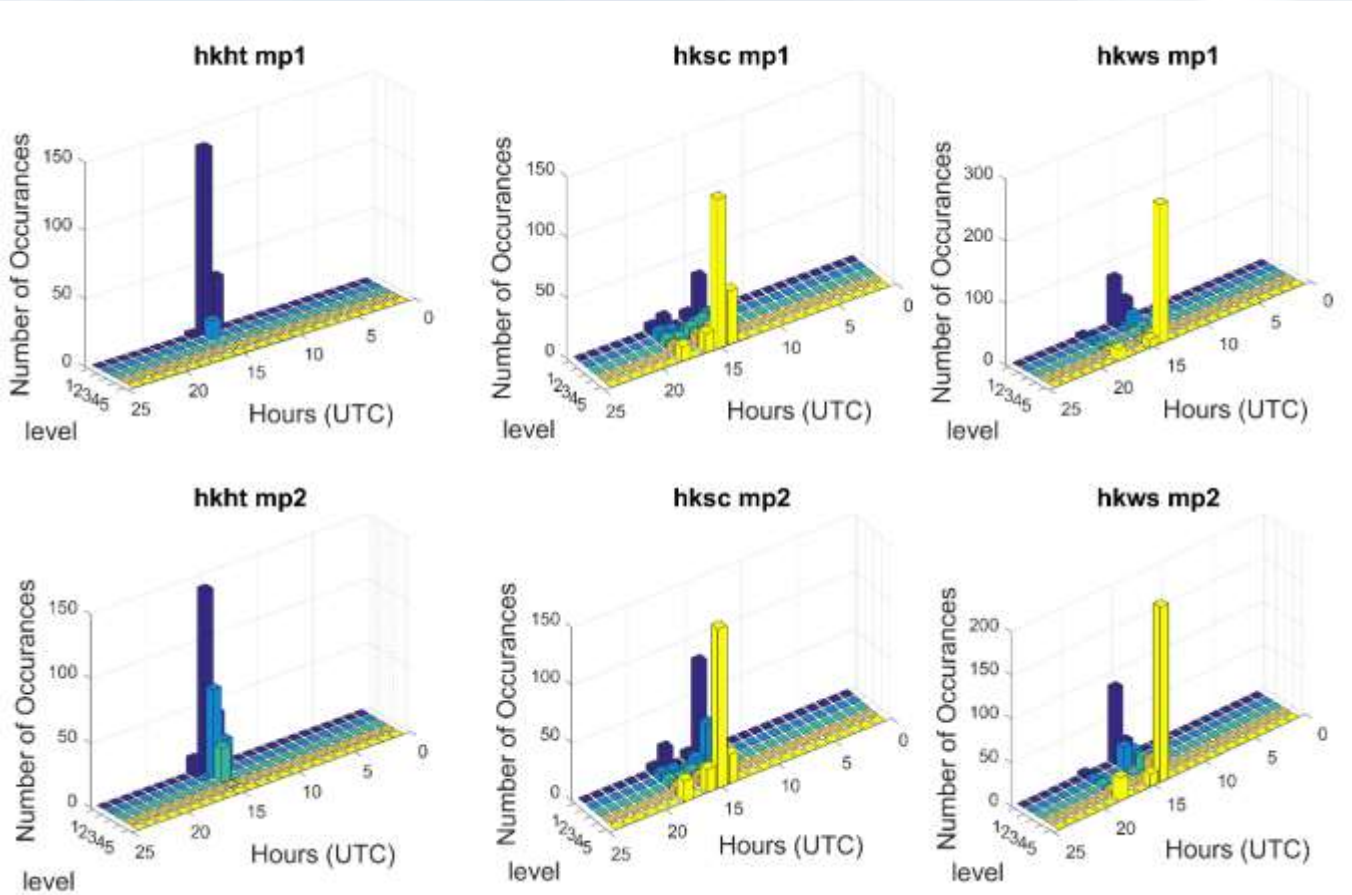
- **See Xu et al 2012**

| Level | MP1 or MP2 |
|---|---|
| 1 | >0.4 – 0.8 |
| 2 | 0.8 – 1.2 |
| 3 | 1.2 – 1.6 |
| 4 | 1.6 – 2.0 |
| 5 | 2.0 – 2.4 |

- Comparison of σϕ and MP2 at 2 Stations in HK (30 degree cutoff)



- Comparison of MP1 and MP2 at 3 Stations in HK (30 degree cutoff)



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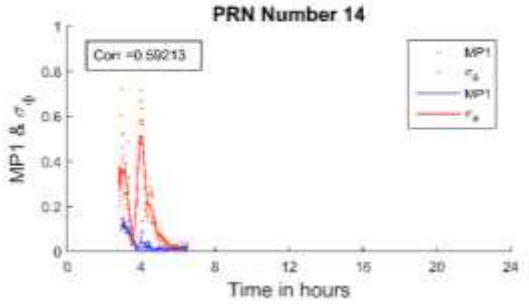
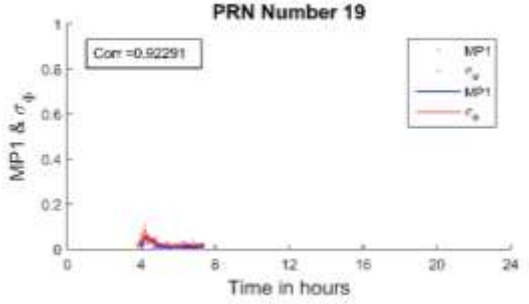
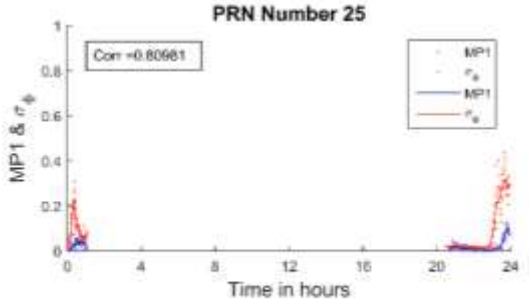
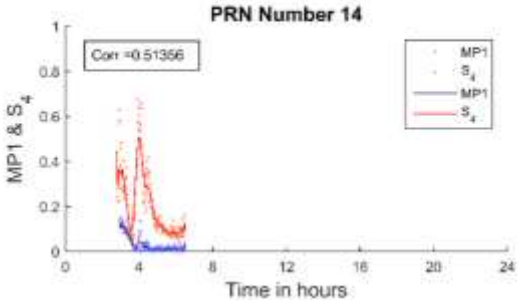
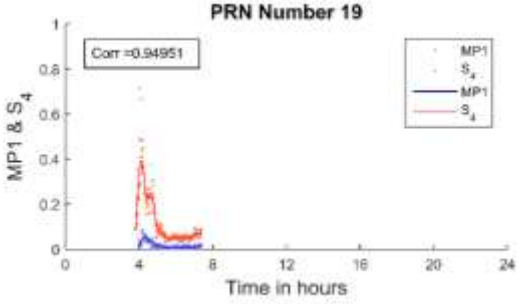
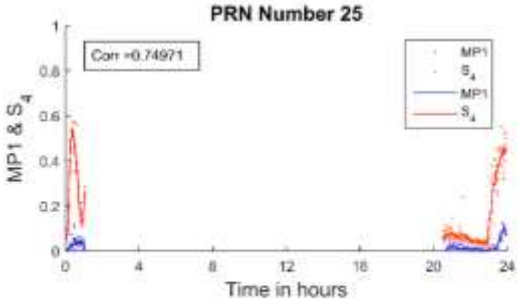

PRN Number 14
Corr =0.59213
MP1
MP1 & $\sigma_\phi$
Time in hours


PRN Number 19
Corr =0.92291
MP1
MP1 & $\sigma_\phi$
Time in hours


PRN Number 25
Corr =0.80981
MP1
MP1 & $\sigma_\phi$
Time in hours


PRN Number 14
Corr =0.51356
MP1
MP1 & $S_4$
Time in hours


PRN Number 19
Corr =0.94951
MP1
MP1 & $S_4$
Time in hours


PRN Number 25
Corr =0.74971
MP1
MP1 & $S_4$
Time in hours

- Conclusions

- Correlation exists between MP values from TEQC and Scintillation Parameters
- More investigation is necessary to investigate the extent of the correlation and the influence of other errors on the results (freq analysis)
- Future work includes using Machine Learning Algorithms to detect scintillation using MP values and/or a combination of MP values with TEC, RTEC, ROTI etc

THANK YOU!