Ionospheric scintillation index study based on COSMIC occultation data

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1.Introduction

For the CDAAC scintillation data product *scnLv1*, the data are collected from both precise orbit determination (POD) and occultation (OCC) antennas over the high elevation angles (>2.5deg). Due to the satellite downlink bandwidth limitation, instead of using raw 50 Hz L1 amplitude data for S4 calculation, 1-second mean of L1 SNR and rms of intensity are downlinked and used to estimate the S4 index on the ground under the assumption of Gaussian distribution of scintillation. Low-elevation 50 Hz L1 amplitude data collected by the OCC antennas are also archived for neutral atmospheric study (*atmPhs*) in the CDAAC.

Aims:

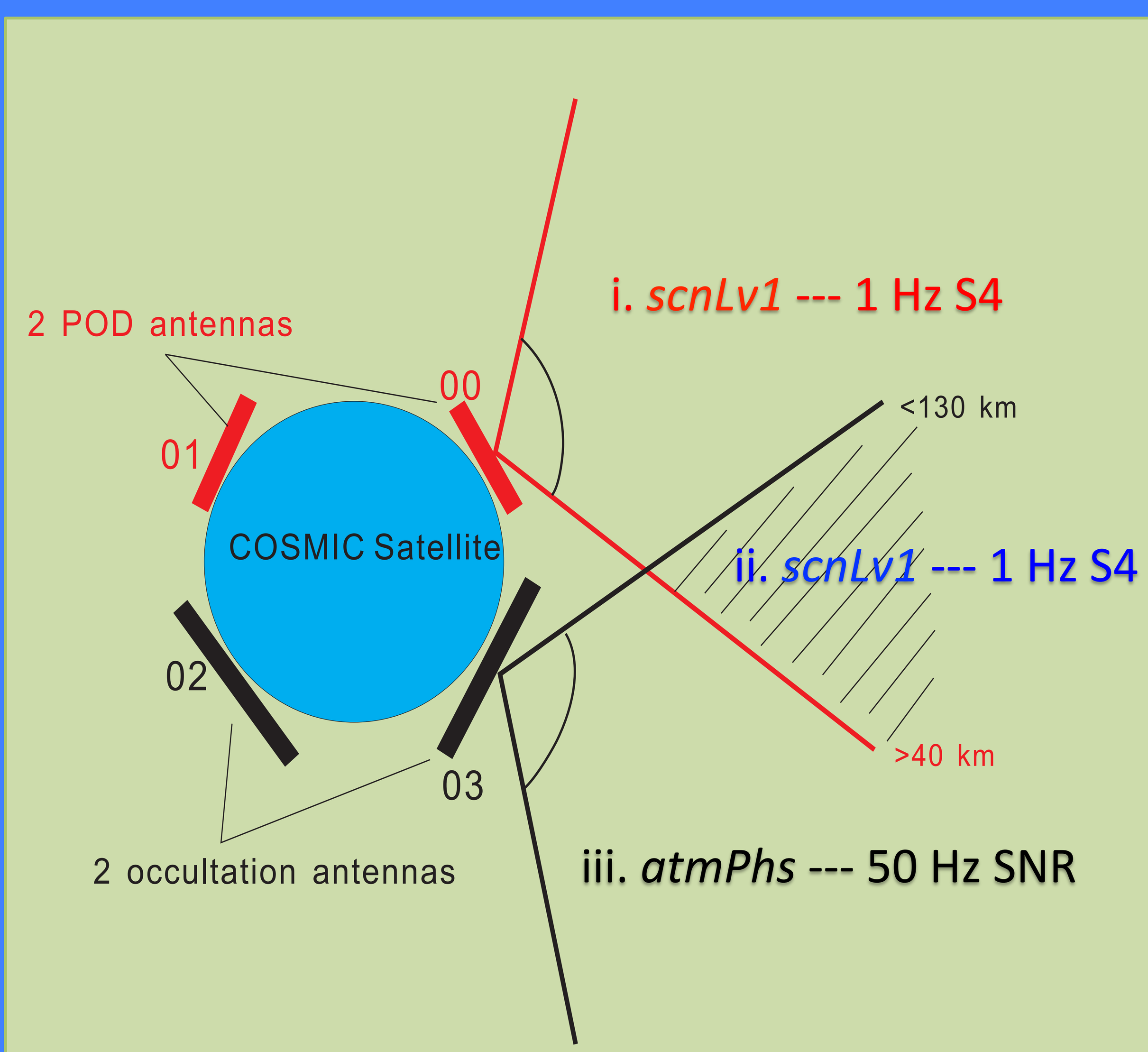
Based on the overlapped period among

(i) 1Hz POD data(from *scnLv1*)

(ii) 1Hz OCC data (from *scnLv1*)

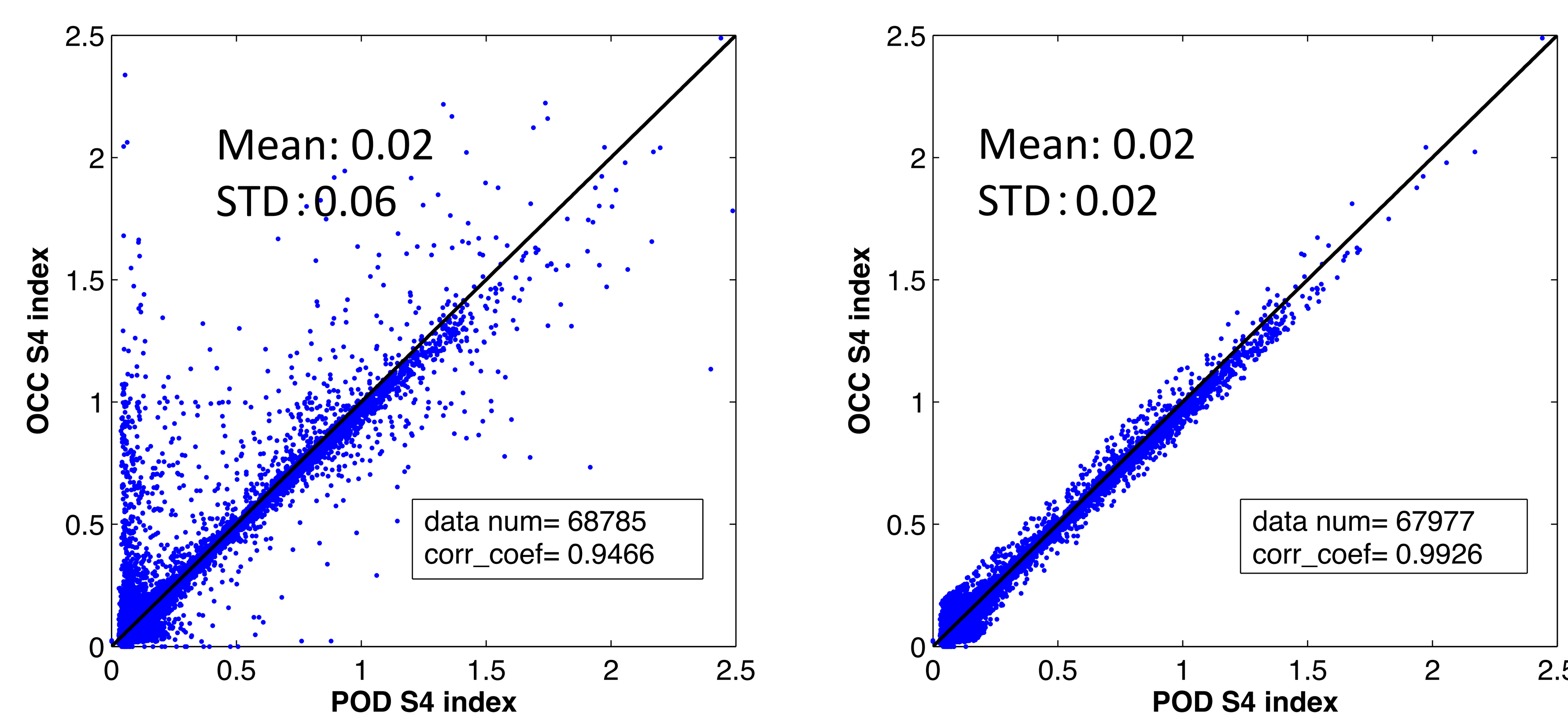
(iii) 50Hz OCC data (from *atmPhs*) ,

we can compare the CDAAC S4 calculated from (i) and (ii) to investigate the difference between antennas. And we can validate the current CDAAC S4 products (ii) using high rate data set (iii). It shows the S4 difference when using SNR observations of different sampling rate.



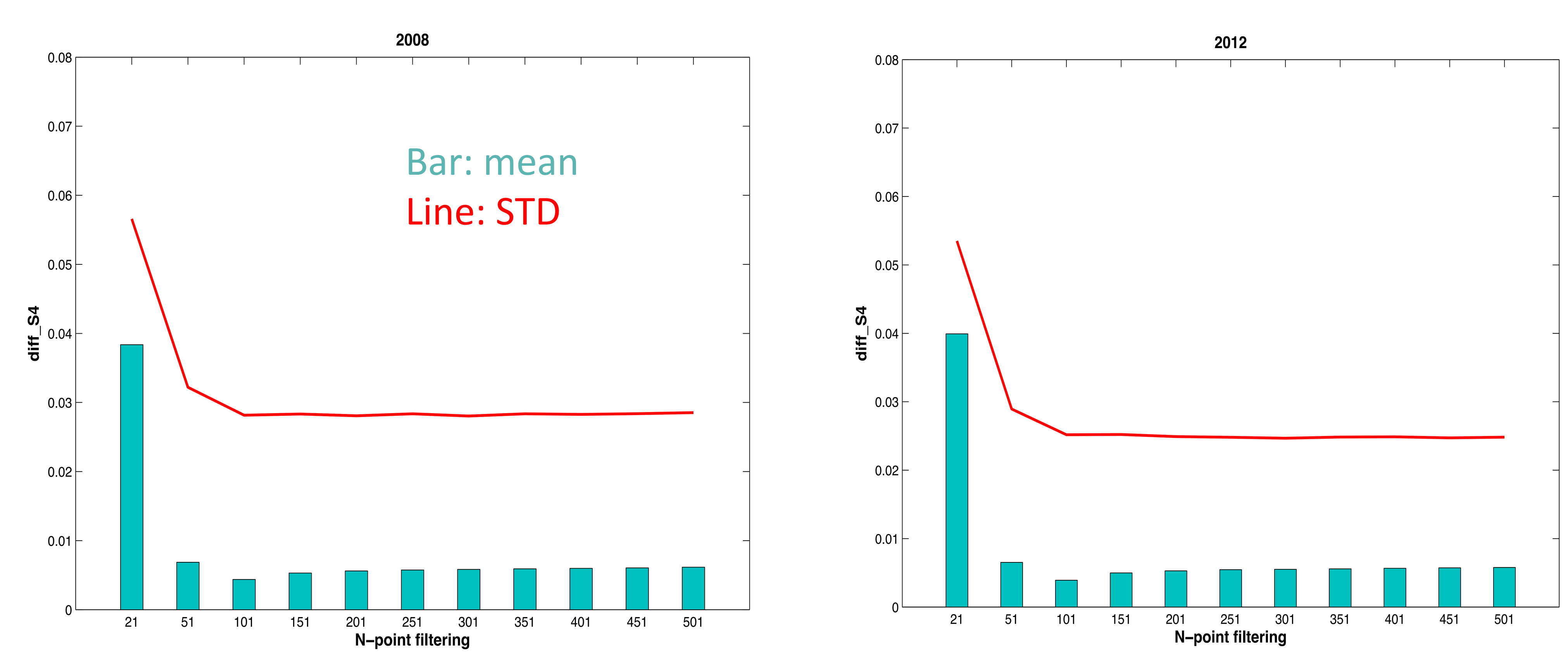
2.Comparison between antennas

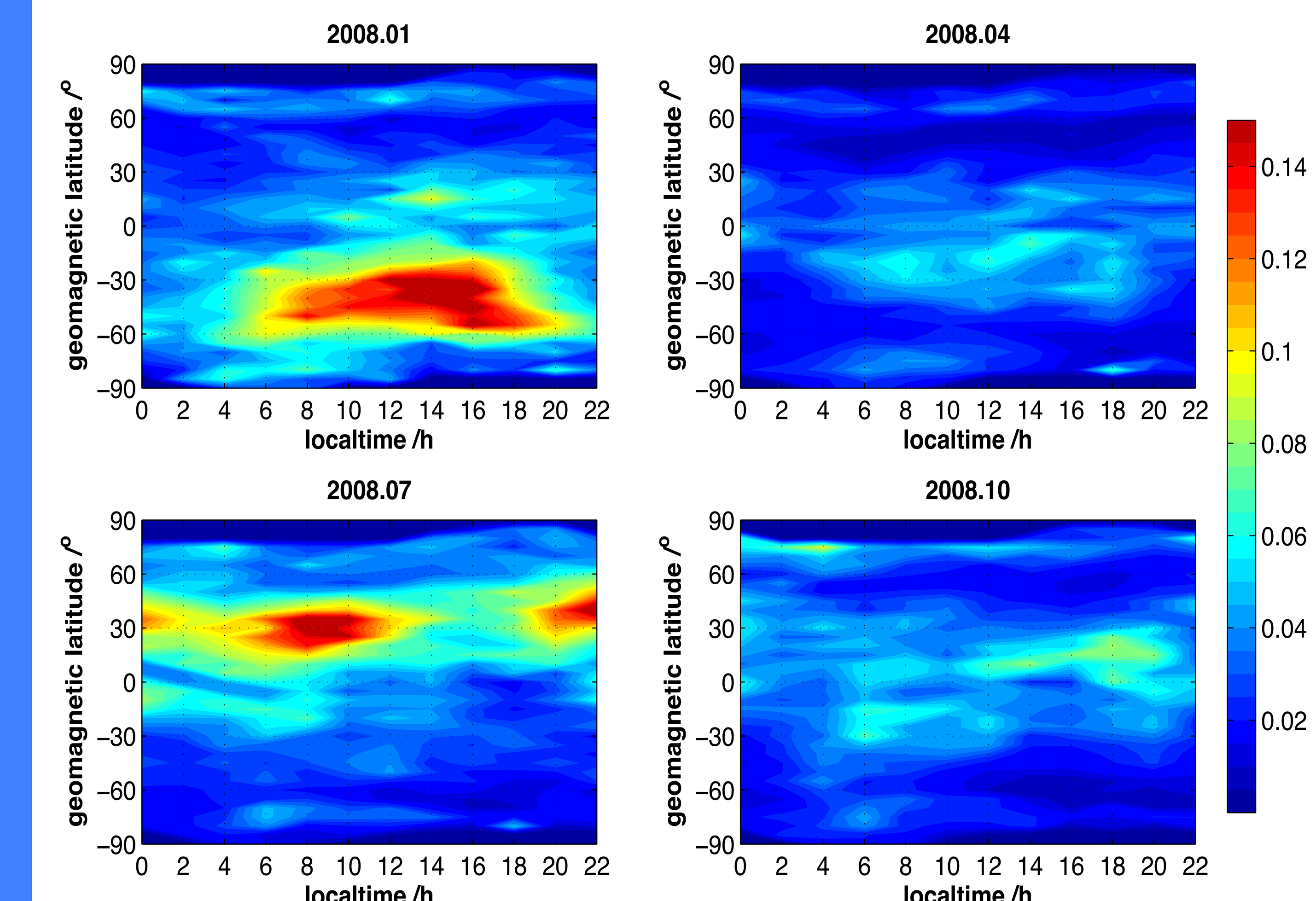
In 5 days of 2008, the S4 indexes during overlapped periods of all RO events are matched and plotted in the left scatter diagram. For the majority S4 profiles, the POD antenna data have very good agreement with the occultation antenna data, except for some gross errors of the occultation antenna and when very strong scintillation occurs. However, those outliers just take up less than 3% of all the RO events. When we apply a criterion of 3σ elimination, almost all the gross errors are taken out, shown in the right panel.



3.Comparison between different sampling rate

When the 50 Hz SNR is available from *atmPhs*, the 1 Hz S4 can be easily calculated according to its definition. Then we compare this S4 index with the CDAAC OCC S4 over the same period. All the RO data in 2008 and 2012 are included, and the mean deviation and STD between those two S4 are made statistics below. The bar represents for the difference between CDAAC S4 and recalculated S4 based on 50 Hz SNR. The red line shows their STD error. 11 different detrending windows (from 21-point filtering to 501-point filtering) are applied respectively to compute the final S4. We find when the filter window is larger than 101-point, the S4 difference will be very stable. The absolute S4 difference is quite small though, mostly under 0.01.

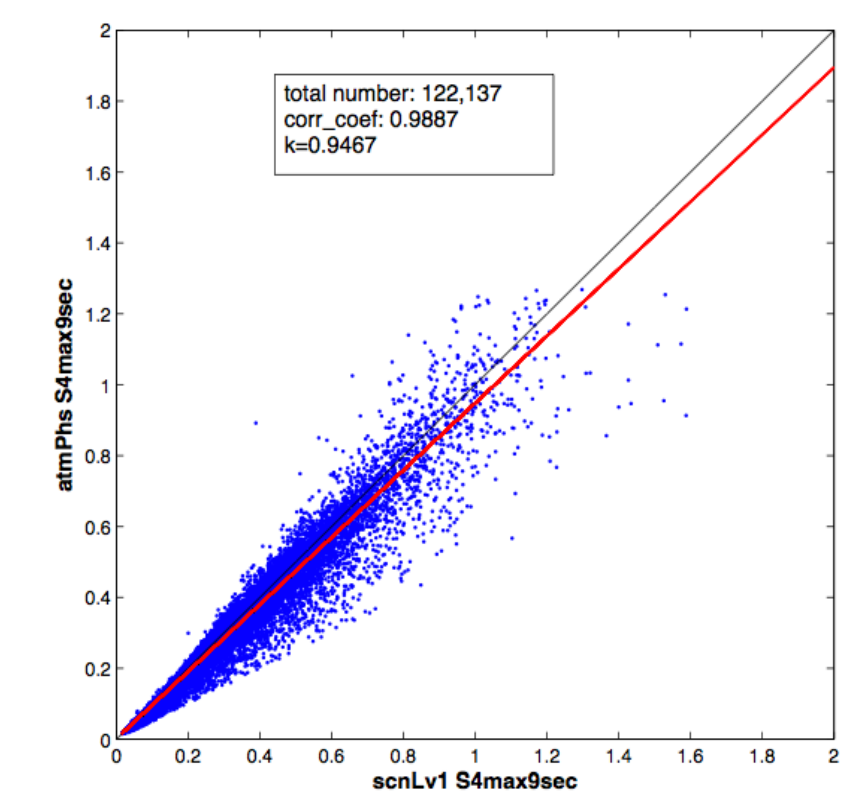




Studying the distribution of S4 difference in four months in 2008, we can find its dependence on local time (X-axis) and geomagnetic latitude (Y-axis) when using 21-point filter window.

4.Conclusions

a. The POD S4 index agrees well with S4 from occultation antennas except ~3% outliers;
b. For S4 index, 1 Hz data have almost the same behavior with the 50 Hz SNR data, and the CDAAC S4 is just slightly greater (relatively ~0.5% bigger).



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