

# DOES A PRIORI INFORMATION IMPROVE OCCULTATION MEASUREMENTS?

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The stellar occultation inversion problem can be divided rather naturally into two quite different inversion problems: spectral and vertical inversion. The spectral inversion problem is for modern measurements (using CCD-detectors) overdetermined whereas the vertical inversion problem is and will be underdetermined because a continuous function is sought from a finite number of measurements.

The spectral inversion does not necessarily require additional information but in some cases improved results can be obtained including a priori information. The motivation to consider a priori data in the spectral inversion comes from two features of the stellar occultation measurement in the UV-visible domain. First, cross sections of different constituents are correlated with each other and there are no really clean spectral windows for any constituent. Second, stars are weak sources of radiation and therefore signal to noise ratio is often low. This means that we have to retrieve constituent signatures from the middle of noise. In this paper we show that by including prior information of neutral density we can improve ozone and aerosol retrievals at low altitudes.

The vertical inversion is underdetermined and data do not uniquely determine a solution. One commonly used method to solve underdetermined problems is to search for so called regularized solution assuming, for example, some smoothness of the unknown parameters. We show how smoothness requirement included in the vertical inversion can be used to improve especially the results of NO<sub>2</sub> and NO<sub>3</sub> retrievals.

The inclusion of prior information is always a tradeoff between accuracy, resolution and possible bias. We have found that Markov chain Monte Carlo (MCMC) methods offer a practical tool for studying effects of prior information. The MCMC methods allow us to compute the posterior distributions of the unknown parameters also in the case of non-linear problems.

We will in this paper discuss how to include prior information in stellar occultation inversion in such a way that the main mission objective, long term monitoring of atmospheric constituents with a good vertical resolution, is not disturbed. Moreover, the importance of widely used definition for resolution and general discussion on prior atmospheres (like ECMWF analysis and its accuracy) is emphasized.