Bias Correction Methods for Aeolus Winds – Harmonic Bias Estimator and M1 Temperature Correlation

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Abstract

The original justification of setting up a Harmonic Bias Estimator (HBE) was the need to correct Aeolus winds for potential harmonic contributors to the wind bias, which could be for example induced by pointing and thermal effects that depend on the latitudinal position of the satellite. Since Aeolus is an Earth Explorer mission and the first of its kind, i.e. due to lack of heritage, the construction of the HBE was based on theoretical assumptions about the harmonic errors, on best knowledge from models and on end-to-end simulations. However, reality proved to be more complicated. The current performance of the HBE is assessed and limitations of the purely latitude-based HBE are presented in order to explain why a correction via harmonic bias estimation is not the preferred option for the current systematic Rayleigh wind speed errors.

On the basis of real Aeolus observations, it was found that the systematic Rayleigh wind speed error is strongly correlated with small variations in the temperature distribution across the primary mirror (M1) of Aeolus' telescope. These temperature variations are a function of Earth's outgoing short and longwave radiation at the top of the atmosphere and cause minimal distortions of the telescope structure. As a consequence, the wind bias shows complex patterns along the orbit that depend on latitude as well as on longitude. These patterns cannot be captured by the HBE approach. Methods are presented which correct for the distortion effect by applying a regression of the wind bias on the M1 temperature measurements contained in the housekeeping data. The improvement for the different approaches will be discussed, including the operational implementation.

Thereby, an effective bias correction via the M1 temperature might pave the way for new findings on Aeolus' wind bias dependencies and for a potential subsequent application of an HBE in the future aiming at any remaining biases.