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Sensitivity of VarBC to the misspecification of background error covariance.

Many observations, especially from satellites have biases: operationally, a variational bias correction (VarBC) is often used to correct these biases. VarBC assumes that all error covariances have been specified correctly, but this is often not the case. The impact of mis-specifying the background error covariance has previously been explored in a system without bias correction by Eyre and Hilton (2013); here we extend this to a VarBC system to explore the impact of mis-specifying both the state and the bias background error covariances on the analysis error covariances.

We derive expressions for the analysis error covariances of both the state and the bias correction coefficient when the background error covariances have been mis-specified. This reveals a dependence on the differences between the true and assumed background error covariance matrices, implying that the ability of the VarBC system to accurately remove observational bias may not behave as expected when the state background error covariance is mis-specified.

In an idealised system, we explore the sensitivity of the bias correction coefficient analysis to the accuracy of the assumed state background error variance. In order to see the effect of including the bias correction coefficient parameter in the variational system, we also explore how the state analysis error variance differs from the analysis error variance from a system without VarBC. These experiments highlight the conditions under which the bias correction may be impaired by mis-specifying the background error statistics.

Eyre, J.R. and Hilton, F.I., 2013. Sensitivity of analysis error covariance to the mis-specification of background error covariance. Quarterly Journal of the Royal Meteorological Society, 139(671), pp.524-533.

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