# CORRECTION TO

Kaplan A., M.A. Cane, and Y. Kushnir, Reduced space approach to the optimal analysis interpolation of historical marine observations: Accomplishments, difficulties, and prospects, in *Advances in the Applications of Marine Climatology: The Dynamic Part of the WMO Guide to the Applications of Marine Climatology*, WMO/TD-1081 (JCOMM Technical Report No. 13), World Meteorological Organization, Geneva, Switzerland, pp. 199-216, 2003.

**Please note that on page 213 the formulas in the section "Problems with the covariance: representing small scales" got scrambled in the WMO typesetting process. The section with correct formulas is below.**

Problems with the covariance: representing small scales

A seemingly fruitful direction for producing high-resolution objective analyses is to literally combine analyses represented by the left-hand and right-hand parts of Figure 3. Note that the exact solution for the full grid OI can be separated into two parts:

$$\mathcal{T} = (H^T R^{-1} H + C^{-1})^{-1} H^T R^{-1} \mathcal{T}^o = CH^T (R + HCH^T)^{-1} \mathcal{T}^o =$$

$$= E\Lambda E^T H^T (HE\Lambda E^T H^T + HE'\Lambda' E'^T H^T + R)^{-1} \mathcal{T}^o$$
$$+ E'\Lambda' E'^T H^T (HE\Lambda E^T H^T + HE'\Lambda' E'^T H^T + R)^{-1} \mathcal{T}^o =$$
$$= E\alpha + C'H^T (HC'H^T + R)^{-1} \Delta\mathcal{T}^o = E\alpha + \Delta\mathcal{T}.$$

The first term $E\alpha$ here is our standard reduced space OI solution. The second part, $C'H^T(HC'H^T + R)^{-1}\Delta\mathcal{T}^o$, represents a correction to it towards the complete (exact) solution. This correction is defined by the covariance piece $C'$ and contributes predominantly to the small-scale variability. It is easy to check that $\Delta\mathcal{T}$ is a formal OI solution to the estimation problem

$$\Delta\mathcal{T}^o = H\Delta\mathcal{T} + \varepsilon^o, \qquad \langle \Delta\mathcal{T}\Delta\mathcal{T}^T \rangle = C', \qquad \langle \varepsilon^o \varepsilon^{o\,T} \rangle = R,$$

where $\Delta\mathcal{T}^o = \mathcal{T}^o - HE\alpha$ is an observational residual to the reduced space OI solution. We do not expect to be able to estimate $C'$ from the data without any special assumptions. However, this part of covariance can be modeled statistically under certain assumptions of spatial stationarity, e.g. as a function of spatial lag, in the style of the traditional kriging or successive correction approach. Thus, these traditional techniques can be successfully used for complementing the reduced space solution with small-scale corrections.