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Corrigendum to "The Sailor diagram – A new diagram for the verification of two-dimensional vector data from multiple models" published in Geosci. Model Dev., 13, 3221–3240, 2020

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A minor correction is needed in some of the equations of our original paper because of a typo identified in them and a missing N factor. The error in the paper affects exclusively the numerical RMSE values. The rest of the findings in the paper (ellipses, orientation of axes and structure of the diagram) are not affected. The practical implementation of the software has also been corrected in the CRAN and Zenodo servers.

We made publicly available the R package SailoR together with our recently published paper. We have been informed by one of its users that he was getting some suspicious RMSE values. We have made a thorough revision of all the equations involved both in the paper and the package, and we have identified a typo in the paper and a missing N factor that propagated to the computation of the RMSE values.

There is a missing N factor in Eqs. (10) and (11), which should be written as follows:

$$\mathbf{P}_u^T \mathbf{P}_u = N \boldsymbol{\Sigma}_u^2, \tag{10}$$

$$\mathbf{P}_u^{*T} \mathbf{P}_u^* = N \mathbb{1}. \tag{11}$$

This missing N factor does not affect the majority of the results of the paper, and its main finding (the structure of the diagram) is not affected at all. However, it propagated through Eqs. (26) to (30) into the computations of the numerical RMSE values in the paper and the SailoR package. Equation (26) must be rewritten:

$$\mathbf{D}_{uv} = N\mathbf{E}_u \boldsymbol{\Sigma}_u^2 \mathbf{E}_u^T + N\mathbf{E}_v \boldsymbol{\Sigma}_v^2 \mathbf{E}_v^T - \left(\mathbf{E}_u \boldsymbol{\Sigma}_u \mathbf{P}_u^{*T} \mathbf{P}_v^* \boldsymbol{\Sigma}_v \mathbf{E}_v^T + \mathbf{E}_v \boldsymbol{\Sigma}_v \mathbf{P}_v^{*T} \mathbf{P}_u^* \boldsymbol{\Sigma}_u \mathbf{E}_u^T\right). \tag{26}$$

Equation (27) must be rewritten as

$$\mathbf{D}_{uv} = N\mathbf{E}_u\boldsymbol{\Sigma}_u^2\mathbf{E}_u^T + N\mathbf{E}_v\boldsymbol{\Sigma}_v^2\mathbf{E}_v^T - \left(\mathbf{E}_u\mathbf{P}_u^T\mathbf{P}_v\mathbf{E}_v^T + \mathbf{E}_v\mathbf{P}_v^T\mathbf{P}_u\mathbf{E}_u^T\right). \quad (27)$$

The same change must be applied to Eqs. (29) and (30):

$$\mathbf{D}_{uv} = N\mathbf{E}_u\boldsymbol{\Sigma}_u^2\mathbf{E}_u^T + N\mathbf{R}_{vu}\mathbf{E}_u\boldsymbol{\Sigma}_v^2\mathbf{E}_u^T\mathbf{R}_{vu}^T - \left(\mathbf{E}_u\mathbf{P}_u^T\mathbf{P}_v\mathbf{E}_u^T\mathbf{R}_{vu}^T + \mathbf{R}_{vu}\mathbf{E}_u\mathbf{P}_v^T\mathbf{P}_u\mathbf{E}_u^T\right), \quad (29)$$

$$\mathbf{D}_{uv} = N\mathbf{E}_u\boldsymbol{\Sigma}_u^2\mathbf{E}_u^T + N\mathbf{R}_{vu}\mathbf{E}_u\boldsymbol{\Sigma}_v^2\mathbf{E}_u^T\mathbf{R}_{vu}^T - \left(\mathbf{E}_u\boldsymbol{\Gamma}_{vu}\mathbf{E}_u^T\mathbf{R}_{vu}^T + \mathbf{R}_{vu}\mathbf{E}_u\boldsymbol{\Gamma}_{vu}^T\mathbf{E}_u^T\right). \quad (30)$$

As we stated before, this error only affects the RMSE values, and the rest of the diagnostics shown in Tables 1 and 2 are correct. As an example, we reproduce correct Tables 1 and 2 below with the values which change from the ones in the paper marked in bold font.

There is a typo which affected the transposes in Eqs. (10) and (11) in the paper, but it has no consequences since we used the transposes correctly in each of Eqs. (27), (28), (29) and (30). The transposes affect Eq. (13) in the paper, which should read as follows (considering the N factor as well):

$$|\mathbf{P}_u^{*T}\mathbf{P}_u^*| = |\boldsymbol{\Sigma}_u^{-1}\mathbf{E}_u^T\left(\mathbf{U}-\overline{\mathbf{U}}\right)^T\left(\mathbf{U}-\overline{\mathbf{U}}\right)\mathbf{E}_u\boldsymbol{\Sigma}_u^{-1}| = N. \quad (13)$$

However, this equation was not used to plot the ellipses. Thus, the ellipses in the figures of the paper are correct in shape, orientation and size and need no change at all. In order to show that the structure of the plots does not change with the corrections described above, we have selected Figs. 6b and 8a of the original paper. Figures 1 and 2 in this corrigendum show the original version of the figures included in the published paper (left) but also their corrected counterparts (right). The only difference between them are the values of RMSE, which are marked in blue in the original version and in red in the new, corrected one. The same happens for all the figures in the paper. Thus, the main objective of the paper (the design of the diagram) is not affected by the numerical error in the RMSE values of the legends.

We have already uploaded a corrected version (1.2) of the SailoR package to the CRAN server; future users of the software should use this version 1.2 or later. We are sorry for the inconveniences.

Table 1. Individual components of the error for the synthetic datasets used for the illustration of the methodology. σ^2 represents the total variance ($m^2\,s^{-2}$) of every dataset as computed from the original zonal and meridional components. $\sum_i \sigma_i^2$ represents the variance ($m^2\,s^{-2}$) of wind for every dataset (reference or model) as computed from the EOF decomposition (axes of the ellipses in the diagrams). θ_u and θ_v represent the angles (radians) of the semi-major axes of the ellipses calculated for reference and models. θ_{vu} (radians) represents the relative rotation of the semi-major axis of the model data with respect to the observations. R^2 represents the two-dimensional squared correlation coefficient (sum of the squared canonical correlations). |bias| represents the magnitude of the bias ($m\,s^{-1}$). RMSE lists the root mean squared errors ($m\,s^{-1}$). The eccentricity of the ellipses (ε) is the same for all the synthetic datasets because of the way they have been built. Finally, g_{11} represents the congruence coefficient (Eq. 20) for EOF1 of all models with respect to EOF1 as derived from observations.

Model	σ^2	$\sum_i \sigma_i^2$	θ_u	θ_v	θ_{vu}	R^2	|bias|	RMSE	ε	g_{11}
Ref	47.56	47.56	1.93						0.92	
MOD1	47.56	47.56		1.93	0.00	2.00	8.34	**8.34**	0.92	1.00
MOD2	47.56	47.56		2.46	0.52	2.00	2.88	**4.37**	0.92	0.87
MOD3	47.56	47.56		−1.21	0.72	0.00	0.00	**9.01**	0.92	1.00
MOD4	190.24	190.24		1.93	0.00	2.00	5.56	**8.45**	0.92	1.00

Table 2. Agreement of simulations by different models with observed vertically integrated water vapour transport from soundings. σ_x and σ_y represent the semi-major and semi-minor axes of the ellipses (kg m^{-1} s^{-1}). The R^2 column represents the value of the two-dimensional correlation coefficient following Crosby et al. (1993) ($R^2 = 2$ for a perfect model). The differences between the datasets described by the bias $|\overline{\mathbf{U}} - \overline{\mathbf{V}}|$ (kg m^{-1} s^{-1}) and total root mean squared error (kg m^{-1} s^{-1}) are also shown. Finally, the eccentricity of the ellipses (ε) and the congruence coefficient g_{11} of the EOF1 of every model with the one derived from observations are also shown. The congruence coefficient g_{11} represents the absolute value of the cosine of the relative rotation of model ellipses with respect to the observational one (Sect. 3.2).

	Model	σ_x	σ_y	R^2	$\lvert\overline{\mathbf{U}} - \overline{\mathbf{V}}\rvert$	RMSE	ε	g_{11}
1	OBS	183.45	107.83				0.81	
2	WRF N	195.53	118.21	1.57	15.41	**88.21**	0.80	0.99
3	WRF D	173.47	100.19	1.94	5.65	**31.30**	0.82	1.00
4	ERAI	196.99	111.18	1.92	4.69	**42.14**	0.83	1.00

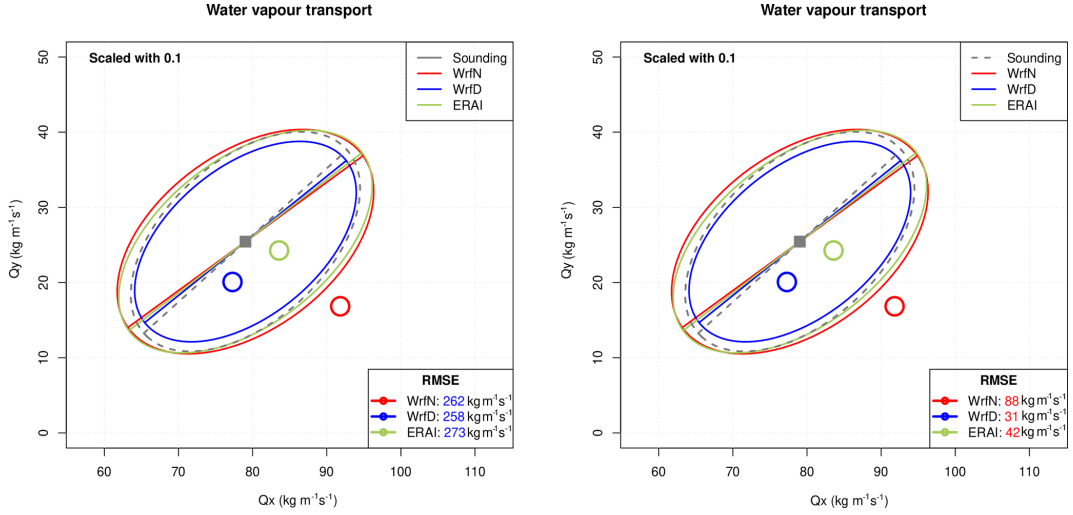

Figure 1. In this figure we show Fig. 6b of the published paper with the original RMSE values in blue font (left) and the new version of the figure with the corrected RMSE values in red font (right).

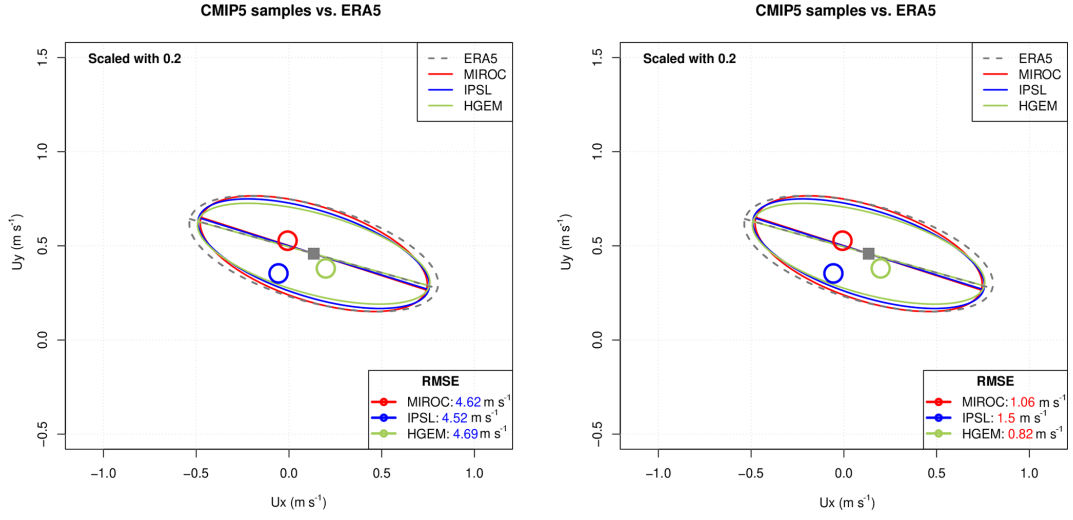

Figure 2. In this figure we show Fig. 8a of the published paper with the original RMSE values in blue font (left) and the new version of the figure with the corrected RMSE values in red font (right).