## Additional file 1: Details of the model

Notations used :

| | |
|---|---|
| $a_t (t = 1,2,...,n)$ | White noise series normally distributed with mean zero and variance $\sigma^2$ |
| $p$ | Order of the non - seasonal autoregressive part of the model |
| $q$ | Order of the non - seasonal moving average part of the model |
| $d$ | Order of the non - seasonal differencing |
| $P$ | Order of the seasonal autoregressive part of the model |
| $Q$ | Order of the seasonal moving average part of the model |
| $D$ | Order of the seasonal differencing |
| $s$ | Seanality or period of the model |
| $\phi_p(B)$ | AR polynomial of B of order $p, \phi_p(B) = 1 - \varphi_1 B - \varphi_2 B^2 - ... - \varphi_p B^p$ |
| $\theta_q(B)$ | MA polynomial of B of order $q, \theta_q(B) = 1 - \vartheta_1 B - \vartheta_2 B^2 - ... - \vartheta_q B^q$ |
| $\Phi_P(B^s)$ | Seasonal AR polynomial of BS of order $P, \Phi_P(B^s) = 1 - \Phi_1 B^s - \Phi_2 B^{s2} - ... - \Phi_P B^{sP}$ |
| $\Theta_Q(B^s)$ | Seasonal MA polynomial of BS of order $Q, \Theta_Q(B^s) = 1 - \Theta_1 B^s - \Theta_2 B^{s2} - ... - \Theta_Q B^{sQ}$ |
| $\Delta$ | Differencing operator $\Delta = (1-B)^d (1-B^s)^D$ |
| $B$ | Backward shift operator with $BY_t = Y_{t-1}$ and $Ba_t = a_{t-1}$ |
| $Z\sigma_t^2$ | Prediction variance of $Z_t$ |
| $N\sigma_t^2$ | Prediction variance of noise forcasts |

A Transfer Function model describing the relationship between the dependent and predictor series has the following form:

$$Z_t = f(Y_t)$$
$$\Delta Z_t = \mu + \sum_{i=1}^{k} \frac{Num_i}{Den_i} \Delta_i f_i(X_{it}) + \frac{MA}{AR} a_t \qquad \textbf{(1)}$$

Droping the predictor series yields univariate ARIMA:

$$\Delta Z_t = \mu + \frac{MA}{AR} a_t \qquad \textbf{(2)}$$

Main features of the model :

- Initial data transformations of the dependent and predictor series
- A constant term $\mu$
- The unobserved i.i.d., zero mean, Gaussian error process $a_t$ with variance $\sigma^2$
- The moving average lag polynomial $MA = \theta_q(B)\Theta_Q(B^s)$ and the auto - regressive lag polynomial $AR = \phi_p(B)\Phi_P(B^s)$
- The difference/lag operators $\Delta$ and $\Delta_t$
- Predictors are assumed given. Their numerator and denominator lag polynomials are of the form :

$$Num_i = (\omega_{i0} - \omega_{i1} B - ... - \omega_{iu} B^u)(1 - \Omega_{i1} B^s - ... - \Omega_{iv} B^{vs})B^b \text{ and}$$
$$Den_i = (1 - \delta_{i1} B - ... - \delta_{ir} B^r)(1 - \Delta_{i1} B^s - ...)$$

- The "noise" series

$$N_t = \Delta Z_t - \mu - \sum_{i=1}^{k} \frac{Num_i}{Den_i} \Delta_i X_{it}$$ is assumed to be a mean zero, stationary ARMA process.