

## REPLY TO REVIEWERS COMMENT

### General comments

I would like to thank authors for trying to address my concerns, although they mostly remain. The manuscript needs further clarifications and improvements before I can recommend it for publishing. Please see below.

### REPLY:

First of all once again, we convey our sincere hearty thanks to the reviewer for the fruitful comments which has improved the present work manifold.

### Specific comments

#### COMMENT:

1. The equation showed at (VI) is wrong. The equation indicates autocovariance not about covariance. Please show the correct an equation used in the study.

#### REPLY:

Yes we do agree with the comment and now we have incorporated the correction in the revised manuscript as below (Line No. 205-219):

Covariance matrix is a matrix of covariances between the values  $X(t)$  and  $X(t+k)$ ., where  $k$  is a lag. When  $k$  is positive  $X(t)$  and  $X(t+k)$  tends to fluctuate together. The covariances among  $X(t)$  and  $X(t+k)$  can be estimated as

$$\text{COV} = \frac{\sum_{i=1}^n (X(t) - \overline{x(t)}) (X(t+k) - \overline{x(t+k)})}{n-1} \quad (\text{VI})$$

Where  $\overline{x(t)}$  and  $\overline{x(t+k)}$  represents the mean of  $x(t)$  and  $x(t+k)$  correspondingly. Now covariance matrix ( $\tilde{C}$ ) can be obtained by putting equal values  $\tilde{c}_{ij}$  at each matrix antidiagonal  $|i-j| = k$  as

$$\tilde{c}_{ij} = \frac{1}{N-|i-j|} \sum_{m=1}^{N-|i-j|} x_m x_{m+|i-j|} \quad (\text{VII})$$

Where  $1 \leq i, j \leq L$ ,  $N$  is the length of the time series and  $|i-j| = k$ .

From the eigenvectors of the covariance matrix measured at different lags the principal components of the time series is estimated. The principal components is also a time series having same length as the “embedded” time series. The computation of principal component is from simple matrix product as

$$\text{PC} = \tilde{C} * \text{matrix of eigenvectors} \quad (\text{VIII})$$

Where  $\tilde{C}$  is the covariance matrix, whose elements are  $\tilde{c}_{ij}$ .

**COMMENT:**

2. The equation (VII) is same to the equation (VI). Is S a matrix? The equation does not show the size of the matrix and the element, i-th row and j-th column. Please show the correct an equation used in the study.

**REPLY:**

Yes, the equation (VII) is similar to the equation (VI) and it is incorrectly placed thus we have incorporated the correction in the revised manuscript (Line No. 205-213). The following correction are made in the revised version as below:

Covariance matrix is a matrix of covariances between the values  $X(t)$  and  $X(t+k)$ ., where  $k$  is a lag. When  $k$  is positive  $X(t)$  and  $X(t+k)$  tends to fluctuate together. The covariances among  $X(t)$  and  $X(t+k)$  can be estimated as

$$\text{COV} = \frac{\sum_{i=1}^n (X(t) - \overline{x(t)}) (X(t+k) - \overline{x(t+k)})}{n-1} \quad (\text{VI})$$

Where  $\overline{x(t)}$  and  $\overline{x(t+k)}$  represents the mean of  $x(t)$  and  $x(t+k)$  correspondingly. Now covariance matrix ( $\tilde{C}$ ) can be obtained by putting equal values  $\tilde{c}_{ij}$  at each matrix antidiagonal  $|i-j| = k$  as

$$\tilde{c}_{ij} = \frac{1}{N-|i-j|} \sum_{m=1}^{N-|i-j|} x_m x_{m+|i-j|} \quad (\text{VII})$$

Where  $1 \leq i, j \leq L$ ,  $N$  is the length of the time series and  $|i-j| = k$ .

The following corrections were made in the revised manuscript regarding the size of the matrix and the element, i-th row and j-th column:

$$\text{PC} = \tilde{C} * \text{matrix of eigenvectors} \quad (\text{VIII})$$

Where  $\tilde{C}$  is the covariance matrix, whose elements are  $\tilde{c}_{ij}$ .

**COMMENT:**

3. Regarding lines 255-264. Kumar et al. 2015 does not claim “The periodic and aperiodic component mostly corresponds to diurnal and semidiurnal variation”. They claim that periodic components of radon data extracted by SSA consist of diurnal and semidiurnal components, since the components includes variation of 24-hour and 12- hour period. Therefore, lines 255-264 is not correct.

**REPLY:**

We have incorporated the correction in the revised version of the manuscript (Line No. 262-264) as “It has been earlier studied that the periodic components of radon data extracted by SSA consisted of diurnal and semidiurnal components since the components included variation of 24-hour and 12- hour period (Kumar et al., 2015)”.

**COMMENT:**

4. Regarding Fig. 4, 5, 8, 9, 12 and 13. The period in the eigenfunction components 3-9 (Fig. 4) is not clear, since no information about the unit of x-axis of the figure. The other figures 5, 8, 9, 12 and 13 have same problems.

**REPLY:**

The data of Radon emanation was recorded for every 15 minutes interval. The length of data is 7245 i.e.  $7245 \times 15 = 108675$  minutes data. To meet the theoretical requirements and to avoid the computational overflow we have selected the Window selection rule as one half of the length of the time series for the investigation (Golyandina, 2010; Khan, 2011; Hassani, 2007). Hence the data length is 3622.5 (rounded to 3622) i.e.  $3622 \times 15$  minutes. We do agree the Fig. 4, 5, 8, 9, 12 and 13 are not clear since no information about the unit of x-axis are in the figure. Now with necessary correction we have added the unit ( $L \times 15$  minutes) in the figure captions of the revised manuscript.

**COMMENT:**

Technical comments 1. Line 187. The equation is not correct.

**REPLY:**

The equation in Line 187 has been corrected in the revised manuscript (Line No. 191 in revised manuscript, Corrected equation:  $\sum_{i \in I} \lambda_i / \sum_{i=1}^d \lambda_i$  )

All the above corrections indicated are incorporated in the manuscript which has no doubt improved the manuscript to a better extent.

With Regards

Timangshu Chetia (Author)