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RESEARCH ARTICLE

ATMOSPHERIC ELECTRICAL CONDUCTIVITY AND RADON CONCENTRATIONS IN THE COASTAL BELT OF SOUTH ORISSA

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ABSTRACT

An attempt has been made on the study of the atmospheric Electrical Conductivity and radon Concentration on the Coastal Belt of South Orissa particular to Ganjam District. Meteorological parameters such as temperature, pressure, humidity, wind speed, mixing height & Sea breeze effect etc plays an important role for the relationship between radon concentrations, ion pairs production & Electrical conductivity. It was found that an increased trend in radon concentration and electrical conductivity were found during night time than day time. It happens due to increasing of the atmospheric ionization rate of radioactivity sources.

INTRODUCTION

Ionization takes place from nuclear radiation, radioactive mineral processing units & gases released from the earth's crust. However Ionization of cosmic rays, aerosol particles as well as radon ^{222} and its daughter products are important in the study of atmospheric electricity Conductivity. Radon is formed in the decay chain of radio nuclides ^{238}U, ^{232} Th and ^{235}U present in the earth's crust which depends on the concentration of the parent nuclide and enters into atmosphere which depends on the type of rock or soil matrix, water content, atmospheric temperature, pressure and other geological and climatic factors. Meteorological parameters play sensitive indicators of changes in climate and air pollution. The ground surface gets heated due to short wave IR radiations coming from sun during the day time and gets cooled during the night causing a temperature variation between the soil surface and below it for which it leads to significant variation of radon concentrations in atmosphere. The soil structure has pores which directly affects radon by capturing the radon from the soil matrix. The short-lived (half life period) daughters of radon are natural presence in the troposphere (1-11 km) at the boundary layer near the ground. They are electrically charged particles and are chemically reactive. Radon daughter elements are carried by aerosol particles of accumulation mode as well as by nanometer size particles. Small air ions are formed from decay of a radon atom & the daughter atom Polonium of nanometer size and its electric drift velocity in the fair weather atmospheric electric field is about 1 cm /sec. Hence the electrical conductivity of air at lower layers of the atmosphere depends on natural radioactivity, aerosol concentrations & other meteorological parameters.

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MATERIALS AND METHODS

Air flow meter was used for the monitoring of air ion concentration such as radon. Air is drawn through a glass fiber filter paper by means of a suction pump at a known flow rate. The radon concentration in air sample is retained on the filter paper. Total activity on the filter paper is measured at three different counting intervals of 10, 20, 30 min. Atmospheric electrical conductivity is measured at a height of 10 m with a Gerdien condenser. The concentration of radon in the atmospheric air is measured using low-level radon detection system (LRD) using the standard procedure. The minimum detectable accuracy for radon in LRD is as low as 1.2–6.8 Bqm~3, depending on the relative humidity conditions. Relative humidity is high in coastal belt. The exhalation rate of 222Rn was estimated by employing the accumulation chamber method (follow BIS radioactive measurement series). The measurements were carried out during the period from january 2009 to December 2009 at various locations namely Port area, Kanabana village, Haripur area, Sana-Arjipalli etc on the coastal belt of Ganjam District. The measurements of radon, its progeny concentrations, atmospheric electrical conductivity are carried out.

Table 1. Monthly variation of relative conductivity

Day	Relative conductivity (%)		
	2008	2009	2010
Jan	0.64	0.76	0.79
Feb	1.21	1.15	1.06
March	1.39	1.60	1.06
April	1.51	1.70	0.99
May	1.62	1.52	0.89
June	1.87	1.70	0.92
July	1.17	0.87	0.99
August	1.27	0.77	0.88
September	1.11	1.10	1.12
October	0.92	0.88	0.76
November	0.65	0.60	0.44
December	0.45	0.35	0.32

Table 2. Weekly variation of relative conductivity

Day/Month MAY	Relative conductivity (%) 2008	2009	2010
Sun	0.64	0.76	0.79
Mon	1.01	1.11	1.06
Tues	1.19	1.20	1.26
wed	1.51	1.70	1.44
Thurs	1.42	1.52	0.99
fri	1.66	1.60	1.62
Sat	1.57	1.77	1.77

Table 3. Weekly variation of relative conductivity

Day/Month JULY	Relative conductivity (%) 2008	2009	
Sun	0.44	0.56	0.69
Mon	1.01	1.11	1.16
Tues	0.69	0.65	0.62
wed	0.51	0.60	0.44
Thurs	1.18	1.12	1.15
fri	1.26	1.20	1.22
Sat	1.37	1.37	1.47

Table 4. Weekly variation of relative conductivity

Day/Month DECEMBER	Relative conductivity (%) 2008	2009	2010
Sun	0.54	0.56	0.69
Mon	1.21	1.31	1.16
Tues	1.39	1.25	1.26
wed	1.41	1.40	1.64
Thurs	1.68	1.52	1.55
fri	1.56	1.60	1.67
Sat	1.77	1.87	1.87

RESULTS AND DISCUSSION

Measurements were made on radon exhalation rate from the ground surface, radon and its progeny concentrations in the air at a height of 10 m from the ground surface for the month of January to December 2009. Temperature difference between lower and upper layer is positive and this results in an upward convective radon flux which may leads to higher radon exhalation rate during nighttime and in the early morning hours. During summer (Month of May-2009), the ground temperature is high and atmospheric pressure is slightly low, moisture content of the soil was less and there was no rainfall during these periods and hence the diffusion of radon increases. During winter (Month of December) season exhalation rates were low, temperature inversion conditions often prevail and the atmospheric pressure is usually higher than in summer. Because of this exhalation rate is lower in winter. Due to Wash out effect one should go through deep study for rainy Season (Month of July -2009). The results we are getting abnormal. Concentrations of radon in the outdoor environment are affected by the magnitude of the exhalation rates and atmospheric mixing phenomena. Solar heating during the daytime tends to induce some turbulence, so that radon is more readily transported upwards and away from the ground. Night atmosphere is relatively calm with low winds and little convective motion. Radon exhaled from the soil accumulates near the ground leading to gradual increase in the concentrations. After sunrise, as temperature increases, the humidity decreases due to increased vertical mixing which results in lower concentration of radon and its progeny at the ground level. As a consequence, the aerosol to which radon and its daughters are attached will be present at higher concentrations during night and in the early morning hours at ground level, which in turn increases the ionization rate in the atmosphere. The maximum values in the concentration of radon and its progeny are the highest in winter followed by rainy and summer seasons.

It is observed that the conductivity and ion pair production rate shows maximum in the early morning hours and attain minimum in the afternoon. The increase in conductivity during the early morning hours is mainly due to the ionization produced by radioactive substances present in the atmosphere. As the day advances the temperature increases as well as turbulence increases and thereby reducing ionization leading to the decrease of conductivity in the afternoon. During day time the UV radiation stimulates gas to particle conversion and generates ultra fine aerosol particles which are the main sink of small air ions. This process results in the depression of conductivity during daytime. The diurnal variation of conductivity on the above site during May the conductivity is low compared to those in the months of December and July. This is possibly due to the upward movement of air during summer carrying radon with it. During winter due to intense temperature inversion conditions radon will be accumulated near the surface thus increasing the ionization rate. The conductivity shows positive correlation with humidity, where as with temperature it is negatively correlated. Relative conductivities on different months of 2008,2009 & 2010 has been represented in Table-1and different days of a week during May, July & December-2008 , 2009 , 2010 are shown in Table-2,3,4 respectively.

Conclusion

The concentration of radon, exhalation rate & Electrical Conductivity shows maximum in the early morning hours and minimum in the afternoon. The stable atmosphere and higher radon exhalation rate during night helps more accumulation of radon and hence the increase of conductivity during night than the day . In an Unstable atmosphere Concentrations are lower in the

afternoon. Conductivity is lower during Sundays compared to other weekdays due to lower local anthropogenic activities. Higher concentrations are observed during summer compared to other seasons due to local meteorological activities. But in Summer 2010, concentrations are lower than the previous years due to solar radiation are effectively lower as compared to 2008 and 2009.

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REFERENCES

[1] M.S. Chandrashekara J. Sannappa, L. Paramesh, 2006; Studies on atmospheric electrical conductivity related to radon & its progency concentrations in the lower atmosphere at Mysore in Atmospheric Environment pp87-95 .

[2] Wilkening, M.H., 1977. Influence of the electric fields of thunderstorms on radon-222 daughter ion concentrations. In: Electrical Processes in Atmospheres. Steinkopff, Darmstadt, pp. 5459.

[3] Wilkening, M., 1990. Radon in the environment. Elsevier, Amsterdam, pp. 1137

[4] Israelson, S., Tammet, H., 2001. Variation of fair weather atmospheric electricity at Marsta Observatory, Sweden, 19931998. Journal of Atmospheric and Solar-Terrestrial Physics 63, 16931703.

[5] Ruhnke, L.H., Michnowski, S. (Eds.), 1989. Proceedings of the International Workshop on Global Atmospheric Electricity Measurements, Madralin, Poland, September 1016, 1989. Publications of the Institute of Geophysics, Polish Academy of Sciences, vol. D-35, p. 238.

[6] Harrison, R.G., 1997. Climate change and the global atmospheric electrical system. Atmospheric Environment 31, 34833484.

[7] Otton, J.K., 1992. Radon in soil gas and soil radioactivity in Prince George's County, Maryland. US Geological Survey Open-File, Report, 1192.

[8] Stranden, E., Kolstad, A.K., Lind, B., 1985. The influence of moisture and temperature on radon exhalation. Radiation Protection Dosimetry 7 (14), 5558.

[9] Nazaroff, W.W., 1992. Radon transport from soil to air. Reviews of Geophysics 30 (2), 137160.

[10] UNSCEAR, 1993. Sources and Effects of Ionizing Radiation. Report to the U.N. General Assembly with Scientific Annexes.

[11] Sannappa, J., Paramesh, L., Venkataramaiah, P., 1997. Seasonal variation in the rate of radon exhalation from soil in Mysore. Indian Journal of Physics 71B (5), 613618.

[12] Schery, S.D., Wasiolek, M.A., 1998. Modeling Radon Flux from the Earth's Surface. In: Radon and Thoron in the Human Environment. World Scientific Publishing, Singapore, pp. 207–217.

[13] Sannappa, J., Paramesh, L., Venkataramaiah, P., 1999. Study of radon exhalation rate in soil and air concentrations. Indian Journal of Physics 73B (4), 629–639.

[14] Schubert, M., Schulz, H., 2002. Diurnal radon variations in the upper soil layers and at the soil-air interface related to meteorological parameters. Health Physics 83 (1), 9196.

[15] Mayya, Y.S., 2004. Theory of radon exhalation into accumulators placed at the soil-atmosphere interface. Radiation Protection Dosimetry 111 (3), 305318.

[16] Sheng, T.K., Jer, H.S., 2003. Indoor radon radioactivity at the University of Brunei Darussalam. Pure and Applied Geophysics 160, 7580.

[17] Qiuju, G., Sun, K., Cheng, C., 2004. Methodology study on evaluation of radon flux from soil in China. Radiation Protection Dosimetry 112 (2), 291296.

[18] Porstendorfer, J., Butterweck, G., Reineking, A., 1991. Diurnal variation of the concentrations of radon and its short-lived daughters in the atmosphere near the ground. Atmospheric Environment 25, 709713.

[19] Wasiolek, P.T., James, A.C., 2000. Unattached fraction measuring technique and radon lung dose. Journal of Environmental Radioactivity 51(137), 151.

[20] Srivastava, G.K., Raghavayya, M., Khan, A.H., 1984. A low- level radon detection system. Health Physics 46 (1), 225228.

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