Research Article

The Effect of Climate Change on Variations in Dew Amount in a Paddy Ecosystem of the Sanjiang Plain, China

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Due to global warming, a drying and warming trend has been observed over the last 50 years in the Sanjiang Plain of Heilongjiang Province, China, which could significantly affect the condensation of vapor in paddy ecosystems. Dew is a crucial factor in the water and nutrient cycling of farmland ecosystems, and it exerts an important influence on fertilization and other agricultural activities. In order to reveal the effects of global warming on dew variation in a paddy ecosystem, an *in situ* experiment was conducted in paddy fields in the Sanjiang Plain during the growing seasons of 2011 to 2013. Dew was collected and measured with a poplar stick. The results of correlation analysis between meteorological factors and dew intensity in the paddy ecosystem indicate that the dew point temperature and relative humidity significantly influenced the dew intensity. Based on synchronous meteorological data, a stepwise linear multivariation regression model was established to predict dew amount. The model successfully interpreted the relationship between simulated and measured dew intensity. The results suggest that a warmer and drier climate would lead to a reduction in dew amount because water cannot condense when relative humidity falls below 71%.

1. Introduction

Global climate change is significantly altering various environmental variables in many countries around the world. This situation could have important effects that seriously threaten populations as well as agriculture, environment, economy, and industry [1]. Atmospheric water vapor is one of the most important factors in determining the Earth's weather and climate because of its role as a greenhouse gas as well as the large amounts of energy involved in changing water from liquid and solid phases to the gaseous (vapor) phase [2]. As an indicator of water vapor levels in the air, relative humidity (RH) directly affects atmospheric visibility and strongly influences the formation of clouds, fog, and dew. Three sources of water are involved in dew formation in an ecosystem. The dominant one is water vapor in the lower atmosphere (dewfall). The second one originates from the flooded soil (dewrise). The last one is the guttation which is the loss of water and

dissolved materials from uninjured plant organs [3–5]. Direct condensation of atmospheric water vapor brings a net gain of water to the soil-plant-water system, compared to guttation from leaves and distillation of soil water [6]. Dew formation is a widespread meteorological and hydrologic phenomenon which can be an important water input in paddy fields [7], and dew also transports nutrients that benefit paddy growth as it condenses on leaves [3, 8]. Dew can also accelerate the dissolution of foliar fertilizer and pesticides which enhances their absorption via leaf tissue [9, 10]. Additionally, some of the nutrients in dew can be assimilated by certain fungal or insect pests [11]. Therefore, monitoring the dew formation may help farm workers determine the appropriate concentration and timing for foliar fertilizer applications.

Dew has attracted great interest and has been extensively studied. Experiments have been conducted that the variations in the amounts of dew falling daily or seasonally were observed [12, 13]. In some studies, dew was estimated by

a direct weighing method that compared the monitor at the beginning and end of the condensation process [5, 14]. Monitors such as microlysimeters [15], plywood, synthetic velvet [16], glass plates [17], and polyethylene plates [18, 19] have all been used to monitor dew. These direct methods are considered the most accurate. However, manual collection and evaluation of the monitors are required during the early morning. Therefore, models that are able to calculate dew have been considered [20–22].

Meteorological factors affect dew formation to a great extent. Nilsson stressed that, in humid Kungsbacka and arid Dodoma, dew volume data were correlated with dry bulb temperature, dew point temperature, wind speed, and cloud cover [23]. Atmospheric pressure, wind speed, and direction distinguished dew in different sites in Poland [24]. In the Philippines, dew formation was found to have a significant linear correlation with the nightly minimum vapor-pressure deficit [4]. Dew correlated positively with relative humidity [19]. A high relative humidity is needed to observe dew, but it does not mean that dew amounts exhibit the maximum, during the relative humidity in the air, reach to 100% [25]. Dew can form only when the temperature of condenser surface is below the dew point temperature. Indeed, the dew point temperature depends on the moisture conditions, and less heat is emitted from underlying surface for dew condensation at a higher relative humidity [26]. The wind speed is a key factor for dew formation. However, the function of wind for dew deposit is complicated. Although the strong wind enhances the heat exchange, this situation may homogenize the temperature quickly and decrease the temperature down below the dew point temperature. Meanwhile, it makes the vapor diffuse rapidly. It is known that wind speed (at 10 m elevation) greater than $3.0 \text{ m}\cdot\text{s}^{-1}$ significantly decreases collected dew volumes [27, 28]. Therefore, breeze is beneficial to enhancement of the transition of water vapor and heat loss in horizontal and vertical direction [19]. As a consequence, a mean wind speed as large as $3.5 \text{ m}\cdot\text{s}^{-1}$ is too fast to provide sufficient vapor for the frequent condensation [25]. Models based on meteorological factors such as the relative humidity, temperature, and wind speed can simulate observed dew to a satisfactory extent. This method requires less labor, but no internationally accepted standard model exists for dew observation since the conditions that allow the condensation of vapor are complex. Therefore, a suitable model needs to be constructed for each type of ecosystem.

Northeastern China is one of the areas mostly influenced by global change and has particular climate characteristics. According to the data from 1949, the climate in the area trended to become warming-drying. It was more obvious in summer and autumn and in sensitive areas such as Sanjiang Plain [29, 30]. The Sanjiang Plain is the largest concentrated area of freshwater wetlands in China. Over the last 50 years, most of the marsh areas have been reclaimed into paddy fields. Large-scale land reclamation severely affects the climate in this region. It has been shown that the annual mean temperature in the Sanjiang Plain has increased by $+1.2^\circ\text{C}$ to $+2.3^\circ\text{C}$ from 1955 to 1999 [31]. Decreases in annual precipitation have also been observed, falling by $-8.9 \text{ mm}\cdot 10 \text{ a}^{-1}$ from

1951 to 2002 [32]; meanwhile, the relative humidity decreased obviously by 5–16% from 1950 to 1985. This trend is expected to continue [33]. Based on previous research, the actual dew reached 26 mm to 31 mm each year in the paddies of the conservation unit area on the Sanjiang Plain. This accounted for 6.0% to 9.0% of the rainfall during the same period [34]. Therefore, dew plays an important role in the water balance of paddy ecosystems, but few studies have focused on the change in dew resulting from climate change. It is hard to distinguish the vapor from the atmosphere or from the flooded soil in a paddy field, and, in the present study, dew is defined as the mixture of dewfall and dewrise. The objectives of this study are to (a) formulate a model based on relative meteorological factors that will predict dew intensity and (b) explore the effect of climate change on dew amount in paddy ecosystems.

2. Materials and Methods

2.1. Study Site. The experiment was organized in the Sanjiang Farmland Experimental Station ($47^\circ 35' \text{N}$, $133^\circ 31' \text{E}$) of the Chinese Academy of Sciences in Tongjiang, Heilongjiang Province, Northeast China (Figure 1). The station has an area of 7.13 ha. The elevation is approximately 56 m above sea level. The Sanjiang Plain is characterized by a typical temperate semihumid continental monsoon climate with four distinctive seasons and a long freezing period. The frost-free period is 115–130 d, the frozen period is approximately 210 d, and the snow period is roughly 120 d. The average annual temperature is 1.9°C . The average temperature during the experimental period was 15.8°C . The average total annual sunshine is 2304.3 h, and the annual evaporation is 1257.1 mm. Seasonal variation of wind direction is significant, and the annual average wind speed is $3.6 \text{ m}\cdot\text{s}^{-1}$. The precipitation from June to September is typically 550 to 600 mm and normally accounts for over 65% of the annual precipitation [35].

2.2. Methodology. Measurements in the paddy began in mid-May and ended in mid-October for two reasons. First, our study focuses on dew which condenses on leaves, and summer to early autumn is the growing season. Second, the dew point temperature (T_d) is below zero after October. Dew was monitored from 2011 to 2013. Polished poplar wood sticks with dimensions of $18 \times 3.5 \times 3.5 \text{ cm}$ (length $\times$ width $\times$ height) were used as monitors. There were five sites used for dew monitoring. Based on isotopic mass conservation to partition quantitatively the contribution of different vapour sources of dew, dew water consisted of a downward flux of water vapor from above the canopy (98%) and upward fluxes originated from soil evaporation and transpiration of the leaves in the lower canopy (2%) in a cropland [3]. As to paddy dew, the evaporation of surface water was supposed to take more partition. Dewfall and dewrise will be the focus of this study. For each experiment plot, an observation shelf was set up with two layers, a bottom layer (5 cm above surface water level) and a canopy layer. The canopy layer was continually adjusted to the height of the rice canopy. The canopy monitor mainly estimated the dew formed by condensation of atmospheric

FIGURE 1: Location of the experimental station and the monitors installed in the field.

water vapor, and the lower monitor mainly estimated dew formed from water vapor rising from the surface of the water. The monitors were weighed daily at sunset and sunrise with an electronic balance (accuracy within 0.001 g). For each height, three monitors were set up 30 min after sunset. These monitors were gathered 30 min before sunrise and weighed again. The actual dew per unit area for each plot was computed as the average of the two heights and the actual dew measurement was computed as the average of five sites. The monitors were left in the paddy during the day to prevent excessive air drying and eliminate the effects of moisture absorption on measuring accuracy [34, 36]. A total of 70, 86, and 75 samples were collected in 2011, 2012, and 2013, respectively.

The leaf area index (LAI) of the paddy was measured using a LAI-2000 Plant Canopy Analyzer (LI-COR, Inc., USA) over a 10-day interval. Distinguishing dew from rain was difficult, so dew was recorded as zero if there was rainfall during the measuring period. Meanwhile, the daily meteorological factors, including air temperature ($^{\circ}\text{C}$) (T_a), dew-point temperature ($^{\circ}\text{C}$) (T_d), relative humidity (%) (RH), wind speed ($\text{m}\cdot\text{s}^{-1}$) (V_{night}) at 10 m elevation, total nocturnal net radiative heat loss ($\text{MJ}\cdot\text{m}^{-2}$) (R_n), rainfall (mm), and water vapor pressure (hPa) (V_p), were measured at hourly intervals during the condensation period via the MILOS 520 automatic weather station (VAISALA, Finland) at the Sanjiang Paddy Station. RH, T_d , V_p , V_{night} , and T_a were the factors used in the models and all were the mean values for the period of condensation. The dew intensity and the meteorological factors were analyzed using a one-way analysis of variance (ANOVA), and the significance level was set to $P < 0.05$.

2.3. Data Analysis and Model Establishment. Dew intensity (I) is defined as the amount of dew that condenses on all the terrestrial objects including plants and soil in unit land area in one night. It represents the ability of condensation. The unit is counted by millimeter.

Dew intensity was calculated with the following formula:

$$I = \frac{10 \times (W_r - W_s)}{S}, \quad (1)$$

where I is the dew intensity (mm); W_r is the weight of the condenser before sunrise (g); W_s is the weight of the condenser after sunset (g); S is the surface area of the condenser (cm^2); and 10 is a conversion factor.

Dew amount (DF) is defined as the amount of dew that condenses on all the terrestrial objects including plants and soil in unit land area in a particular period. It represents the quantity of dew, including the amount of dewfall and dewrise. The unit is counted by millimeter. The total dew amount was calculated via the following formulas:

$$DF = \sum_{i=1}^n DF_i, \quad (2)$$

$$DF_i = 2 \times LAI_i \times \bar{I}_i \times D_i,$$

where DF is the total dew amount (mm); DF_i is the dew amount in a particular period (mm); and LAI is the leaf area index. LAI_i is the LAI in a particular period ($\text{cm}^2\cdot\text{cm}^{-2}$); $\bar{I}_i$ is the average I in a particular period (mm); and D is the number of dew days. D_i is the D in a particular period (days); 2 is a coefficient to account for both sides of the leaf; and

FIGURE 2: Variation of dew-related meteorological factors in the dew days during the experimental period.

n is the time period of measuring LAI [34, 36]. Statistical analyses were carried out using the SPSS (Statistical Product and Service Solutions) software version 16.0 (USA). To test for a normal distribution of dew intensity, Q-Q probability plots were employed.

In this study, data were subjected to correlation tests. Based on the results of the statistical analysis, a stepwise linear multivariable regression model was chosen as the method to estimate the dew intensity. A t -test was used to validate the model. Data from 2011 and 2012 were used to build the model, and data from 2013 were used to verify the model.

3. Results and Discussion

3.1. Dew Intensity and Factors. Figure 2 shows the patterns of dew intensity and meteorological factors from 2011 to 2013 in the Sanjiang Plain. All the highest dew intensities were observed in August. The impact of meteorological factors on dew formation can be seen in Figure 2. According to the statistical analyses, the monthly meteorological factors follow a normal distribution pattern. The dew levels in 2011 correspond to higher RH, T_d , and V_p . The rainfall was abundant in July and August, resulting in sufficient atmospheric vapor and increased RH and V_p values. Correspondingly, the low dew intensity in May and October was due to the significant RH deficit which resulted in a decreased T_d during these months compared with other months ($P < 0.05$). The RH values in July and August were significantly higher than in other

TABLE 1: Correlation coefficients between dew intensity and meteorological factors.

	R_n	RH	T_d	V_{night}	V_p	$T_d - T_a$
Dew intensity	0.162	0.872**	0.342**	-0.510**	0.366**	0.850**

** Correlation is significant at the 0.01 level (2-tailed).

months ($P < 0.05$), resulting in increased vapor condensation at night during the rainy season.

The wind speed is another key factor for vapor condensation. Strong wind can enhance heat exchange and homogenize the temperature quickly, which lowers the temperature to below the dew point temperature. Meanwhile, it makes the vapor diffuse rapidly. Breezes enhance the transition of water vapor and heat loss in the horizontal and vertical directions [19]. Figure 2 shows that most of the dew events occurred with wind speeds below $3.1 \text{ m}\cdot\text{s}^{-1}$ and that the largest dew amount occurred with wind speeds around $1.8 \text{ m}\cdot\text{s}^{-1}$.

3.2. Model Establishment. A model to predict dew intensity was built based on the correlation analyses between dew intensity and meteorological factors (Table 1). Dew intensity shows the highest positive Pearson correlation coefficient with RH (0.872) while $T_d - T_a$, V_{night} , V_p , and T_d have coefficients of 0.850, -0.510, 0.366, and 0.342, respectively. This combined with the tests of normativity suggests that RH, T_d ,

TABLE 2: Model summary showing R^2 , adjusted R^2 , and standard error of the estimate.

Model	R	R squared	Adjusted R squared	Std. error of the estimate
1	0.875 ^a	0.766	0.763	0.01081
2	0.889 ^b	0.790	0.785	0.01029
3	0.900 ^c	0.810	0.803	0.00986

^aPredictors: (constant), RH.^bPredictors: (constant), RH, $T_d - T_a$.^cPredictors: (constant), RH, $T_d - T_a$, T_d .

Dependent variable: dew intensity.

V_p , $T_d - T_a$, and V_{night} exhibit linear relationships with dew intensity. Therefore, they were selected as the variables to establish the stepwise linear multivariable regression model.

As shown in Table 2, the correlation coefficients (R) between dew intensity and meteorological factors increased from Models 1 to 3 with more factors included in model. RH accounted for 76.6% of the variability in dew intensity. Including $T_d - T_a$ and T_d in the model increased the explanatory power to 79.0% and 81.0%. R increased to 0.900 in Model 3. Thus, Model 3 showed a better prediction ability for dew intensity. In this case, RH, T_d , and $T_d - T_a$ were selected to predict dew intensity.

In conclusion, Model 3 was chosen for this study. The equation that best predicted the outcome (Table 3) can be described by

$$I = -0.717 + 0.8RH - 0.031(T_d - T_a) + 0.001T_d \quad (3)$$

$$(R^2 = 0.810).$$

3.3. Model Validation. The equation was validated as follows. Each coefficient was found to be statistically significant ($P < 0.05$) (Table 3). The tolerance of RH, T_d , and $T_d - T_a$ was 0.792, 0.508, and 0.602, respectively. These values were not close to 0. Variance inflation factor (VIF) values of RH, T_d , and $T_d - T_a$ were 1.263, 1.968, and 1.660, respectively. These values are not considered high. No collinearity was observed between the predictors.

R^2 , the coefficient of determination, is the squared value of the multiple correlation coefficients. It shows that 76.6%, 79.0%, and 81.0% of the variation in dew intensity is explained by Models 1 to 3, respectively. As a further measure of the strength of the model fit, the standard errors of the estimate in the model summary table (0.01081, 0.01029, and 0.00986 for Models 1 to 3) are significantly small. A residual is the difference between the observed and model-predicted values of the dependent variable. The residual for a given product is the observed value of the error term for that product. A P - P plot of the residuals in Figure 3 is a visual check on the assumption of normality in the error terms. The P - P plotted residuals could be plotted on a 45° line. The P - P plot indicated that the assumption of normality could not be verified. The plot of residuals showed that the variances of the errors were well scattered based on the predicted values.

FIGURE 3: Normal P - P plots of regression standardized residual.

Also, the simulated and measured I were not significantly different ($n = 75$, $P > 0.05$) (Table 4). These results illustrate that this model successfully expressed the relationship between meteorological factors and dew intensity.

3.4. Dew Amount Prediction. As the average global temperature increases, observations show that the regional averaged pan evaporation over some districts has a steady descent trend in the late 50 years, including the United States, the former Soviet Union [38], India [39], Nigeria [40], and east of China [29]. Soil moisture is also reduced in summer over extensive midcontinental regions of both North America and Eurasia in middle and high latitudes [41]. The declining trend in evaporation is consistent with what one would expect from the observed large and widespread decreases in sunlight resulting from increasing cloud coverage and aerosol concentration [42, 43]. The air relative humidity shows a fluctuant decreasing trend over much of the world [29, 40, 44], while wind speed is positively correlated with relative humidity, and wind speed holds downtrend recently [29, 44].

For the formation of dew largely depends on the surroundings, temperature, light, relative humidity, and so forth, the models which include meteorological data to calculate dew amount were established around the world. The correlated parameters in the models were shown in Table 5.

From the models mentioned above, in general, there existed positive correlation between dew amounts and relative humidity (RH), water vapor pressure (V_p), net radiative loss (R_n), soil moisture, and dew-point temperature (T_d), while wind speed (V_{night}), cloud cover, and air temperature (T_a) were negatively correlated to dew amounts, respectively. Therefore, the meteorological conditions under the climate

TABLE 3: Coefficients of dependent variable (dew intensity).

Model	Unstandardized coefficients		Standardized coefficients	<i>t</i>	Sig.	Collinearity statistics	
	<i>B</i>	Std. error	Beta			Tolerance	VIF
1							
(Constant)	−0.142	0.003		21.054	0.000		
RH	0.200	0.001	0.471	7.399	0.000	1.000	1.000
2							
(Constant)	0.052	0.007		8.015	0.000		
RH	−0.513	0.001	0.520	8.111	0.000	0.943	1.061
$T_d - T_a$	0.600	0.004	−0.203	−3.170	0.002	0.943	1.061
3							
(Constant)	−0.717	0.012		2.387	0.018		
RH	0.080	0.001	0.461	6.654	0.000	0.792	1.263
$T_d - T_a$	−0.031	0.005	−0.304	−3.830	0.000	0.602	1.660
T_d	0.001	0.000	0.183	2.119	0.035	0.508	1.968

^aDependent variable: dew intensity.

TABLE 4: Results of the independent samples test.

	<i>F</i>	Sig.	<i>t</i>	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference	
								Lower	Upper
Equal variances assumed	1.785	0.187	6.179	52.00	0.000	0.03194	0.00517	0.02153	0.04231
Equal variances not assumed			6.179	44.678	0.000	0.03194	0.00517	0.02153	0.04235

TABLE 5: Parameters in models at Sanjiang Plain and at reported sites.

Site	China, Sanjiang Plain	Philippines, Los Banos	Netherlands, Wageningen	Israel, Negev	Morocco, Mirleft	USA, Iowa State	Saudi Arabia, Dhahran	France, Ajaccio and Bordeaux
References	This study	[4]	[10]	[15]	[18]	[20]	[22]	[37]
RH (%)	✓			✓	✓	✓	✓	✓
T_a (°C)	✓		✓	✓	✓	✓	✓	✓
V_{night} (m/s)		✓		✓	✓	✓		✓
V_p (hpa)		✓						
Cloud cover (N, in octas)					✓	✓	✓	✓
T_d (°C)	✓				✓	✓		
R_n (MJ/m ²)			✓	✓				
Soil moisture (%)				✓				

* ✓ stands for the parameter in the model.

change (except wind speed) are not suitable for dew formation. Heavy dew may threaten the dispersal of pollen, leading to the high ghost rate during the flowering period [4]. It has been found that removing dew in the early morning during the flowering stage can improve the grain yield [45]. It is good for grain with the decreasing dew. However, dew is collected for household use [18] and serves as source of water for small animals, plants, and biological crusts in arid region [15].

Decline of dew and rainfall is supposed to lead to a weaker hydrological cycle, which connects directly to availability and quantity of fresh water.

As to our research site, Zhao and Zeng [46] found that the meteorological conditions in the Sanjiang Plain have changed dramatically during the past 50 years. The air temperature has increased and the relative humidity has declined [29]. The rate of change in the Sanjiang Plain exceeded the global

TABLE 6: The average decrement of dew amount due to climate changes.

RH (%)	Dew amount (mm)				
	T_a (°C)				
	20	21	22	23	24
80	0.0	1.6	1.6	1.6	1.7
79	-2.9	-1.3	-1.3	-1.3	-1.2
78	-5.9	-4.3	-4.3	-4.3	-4.2
77	-8.8	-7.2	-7.2	-7.2	-7.1
77	-8.8	-7.2	-7.2	-7.2	-7.1
76	-11.7	-10.2	-10.2	-10.2	-10.1
75	-14.6	-13.1	-13.1	-13.2	-13.0
74	-17.5	-16.2	-16.2	-16.2	-16.1
73	-20.5	-19.1	-19.1	-19.1	-19.0
72	-23.4	-22.1	-22.1	-22.1	-21.9
71	-26.4	-25.0	-25.0	-25.0	-24.9
70	-29.3	-27.9	-27.9	-27.9	-27.8

TABLE 7: Monthly total dew intensity of bottom and canopy in paddy.

Year	Dew intensity (mm)									
	Month									
	June		July		August		September		October	
	Bottom	Canopy	Bottom	Canopy	Bottom	Canopy	Bottom	Canopy	Bottom	Canopy
2011	0.379	0.361	0.784	1.024	0.856	1.142	0.723	1.147		
2012	0.669	0.727	0.823	1.115	0.986	1.112	0.513	0.709	0.321	0.607
2013			0.608	1.02	0.854	1.45	0.921	1.371	0.112	0.202

rate of climate change. According to Liu [47], the relative humidity decreased by 5–16% from 1950 to 1985, and this trend is expected to continue. As a result, the average annual relative humidity is expected to decrease from 80% to 70% in the Sanjiang Plain, and the average annual air temperature is expected to increase from 20 to 24°C. Table 6 shows the average decrement of dew amount in the paddies. For example, when the average air temperature increases to 22°C, the average relative humidity is expected to decrease to 75%. According to the model equation (1), the average daily dew intensity would decline by 0.036 mm under these conditions. From 2008 to 2013, dew fell on an average of 70 days. The average LAI during growth periods were 0.02, 2.12, 4.37, 4.83, 3.32, and 1.10 $\text{cm}^2 \cdot \text{cm}^{-2}$ from May to October, respectively. If the number of days with dew and the LAI did not change, dew amount would be reduced by 13.1 mm under these conditions. Dew amount was 26–31 $\text{mm} \cdot \text{yr}^{-1}$ in the period of 2005–2012 [34]. If the average relative humidity decreased from 80% to 71%, there would be almost no dew in the paddies of the Sanjiang Plain at any time. The results can be used to guide land managers in decisions related to the concentration and timing of sprayed foliar fertilizer and pesticide applications.

3.5. Contribution of Dewfall versus Dewrise. The canopy and bottom monitors mainly estimated the dew formed by condensation of dewfall and dewrise, respectively. As shown

in Table 7, dew intensity varied with the height and was found in canopy to be higher than that in the bottom. The ratio of intensity in canopy and bottom was varied with time. The contribution of dewfall versus dewrise was almost same in June, and the intensity of canopy was more than twice as much as the bottom in October. In order to discriminate the different vapor sources of dew, stable isotope ($\delta^{18}\text{O}$ and δD) of dewfall and dewrise should be monitored in the further study.

4. Conclusion

The regression equation between meteorological factors and dew intensity was established as $I = -0.717 - 0.031(T_d - T_a) + 0.8\text{RH} + 0.001T_d$. The accuracy degree of the simulation of this model was good. If the climate in the Sanjiang Plain becomes warmer and drier, condensation of water vapor is made significantly less likely. If the climate continues to warm, a significant decrease in dew amount is anticipated. Dew could not form when the relative humidity decreased from 80% to 71%.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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