Long term weather trends in western Maharashtra

A. Jacob[1] and A. K. Rajvanshi[2,1]
[1] French intern at NARI, student from Ecole Centrale de Lyon, Ecully 69130, France.
[2] Director NARI, Nimbkar Agricultural Research Institute (NARI), Phaltan 415523, India.

Abstract

This study aims at analysing the meteorological data collected by Nimbkar Agricultural Research Institute (NARI) since 1983. The main objectives were to provide average figures and curves of Phaltan weather, and to identify possible trends since 1983, especially warming. Results show that there is indeed a clear warming trend, but it seems to be influenced by changes in the surroundings of the station (microclimate). Wind velocity and evaporation have also slightly decreased. Increase in plant cover in Phaltan area might have played a role.

Keywords: climate change, rainfall trend, temperature trend, weather composites, rural area

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Knowledge of meteorological conditions is crucial to any agricultural work. Apart from the obvious rainfall and temperature factors, evaporation, wind and humidity are also affecting the way plants grow[0]. Usually climate is of less importance because of its very large timescale, but with the quick changes induced by the industrial era it may become a source of concern and a parameter to take into account. The aim of this study is thus to provide figures as well as composite (average) curves for the main meteorological parameters and identify possible trends. Only the most significant results have been presented here.

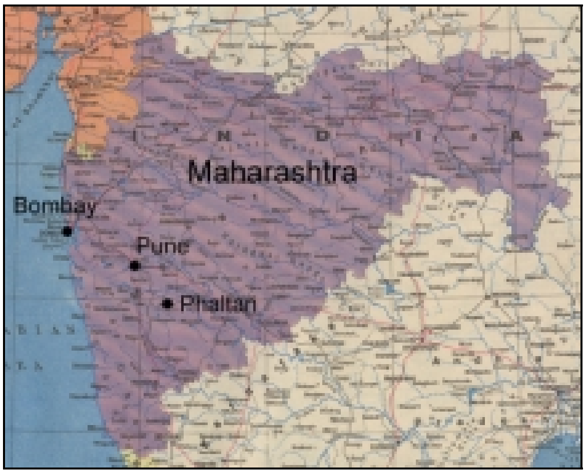

Figure 1 Location of Phaltan[4]

Nimbkar Agricultural Research Institute (NARI) has been collecting meteorological data since 1983. The weather station is located in Phaltan town (Satara district, Maharashtra) at 18° latitude and 750m above sea level. It is currently recording 11 parameters daily (minimum and maximum temperature, minimum and maximum relative humidity, rainfall, pan evaporation, wind speed at two different heights, wind orientation and nature of sky). The solar radiation has been recorded between from 1985 to 1991 and from 2000 to 2003.

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[1] For correspondence. (e-mail: nariphaltan@gmail.com)

The average weather data is given in table 1.

Table 1 Average weather of Phaltan weather

Parameter		Instrument used	Value
Temperature	Mean daily maximum	Min/max thermometer	33.5 °C
	Mean daily minimum		18.8 °C
	Mean daily average		25.1 °C
Rainfall	Yearly rainfall	Class A raingauge	521 mm/y
	Mean rainfall intensity		8.12 mm/d
	Number of rainy days		64 d/y
Wind	Mean velocity	Anemometer	5.06 km/h
Relative humidity	Mean daily maximum	Class A hygrothermograph	81.6 %
	Mean daily minimum		36.7 %
	Mean daily average		59.1 %
Evaporation	Mean daily evaporation	Pan	5.40 mm/d
Solar radiation	Yearly radiation	Total radiation pyranometer	1549 kWh/m^2-y
	Mean daily radiation		4.77 kWh/m^2-d

Composites for temperature, rainfall and solar radiation are given in figures 2, 3 and 4. The standard deviations of the values from all the years are shown in figures 2 and 4.

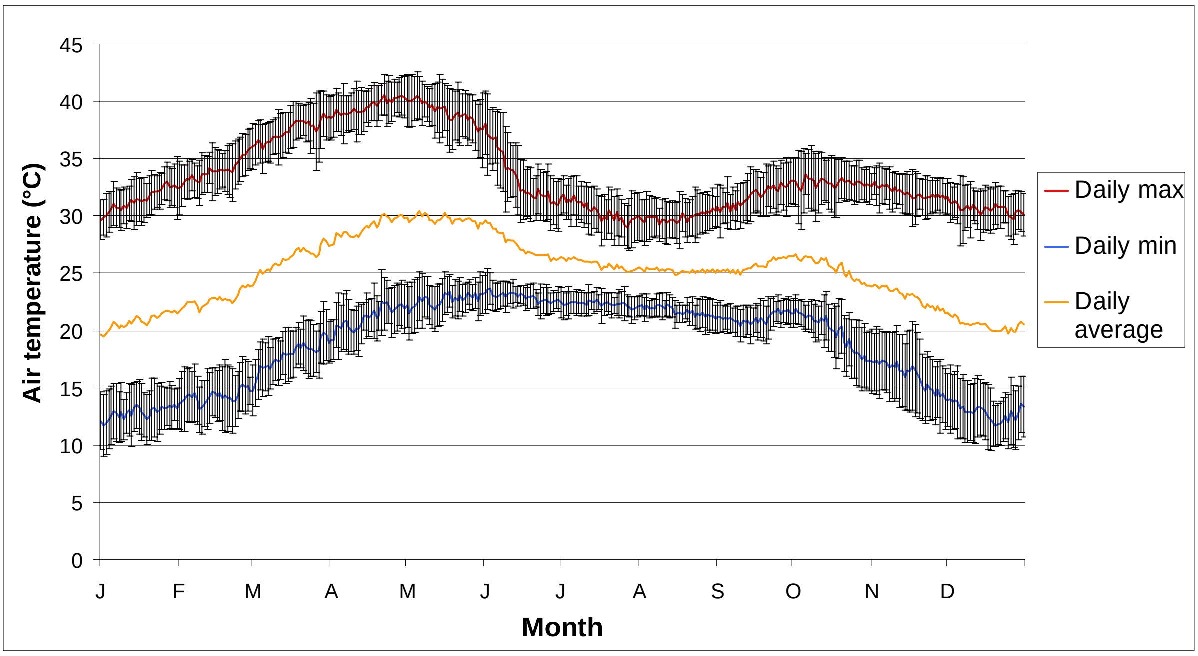

Figure 2 Temperature composite

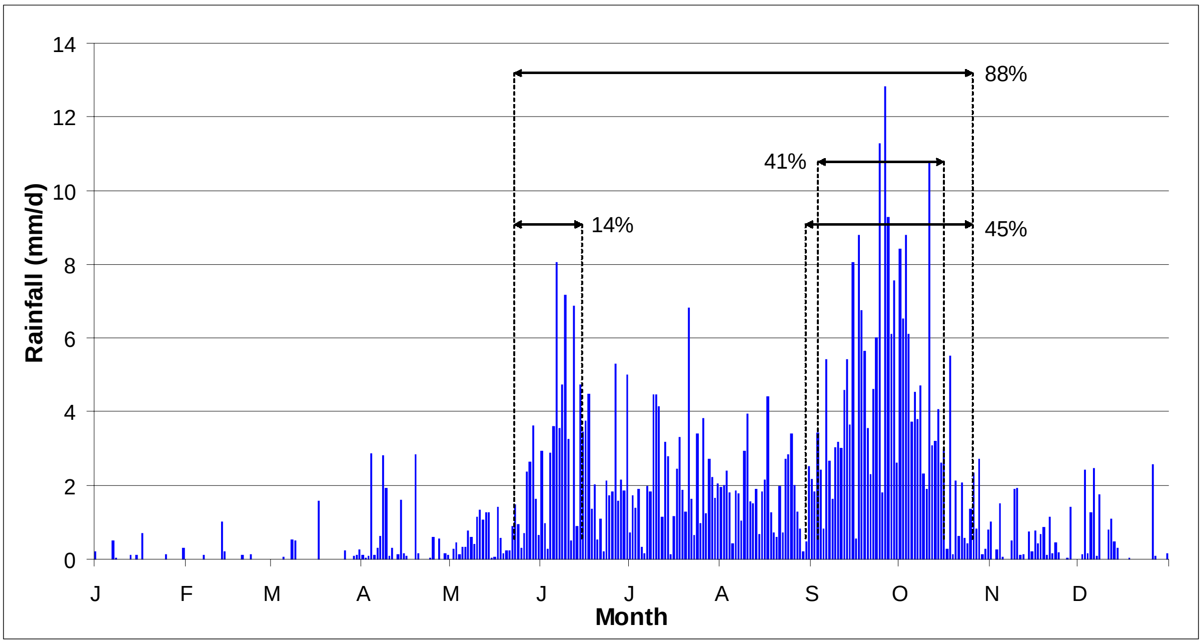

Figure 3 Rainfall composite

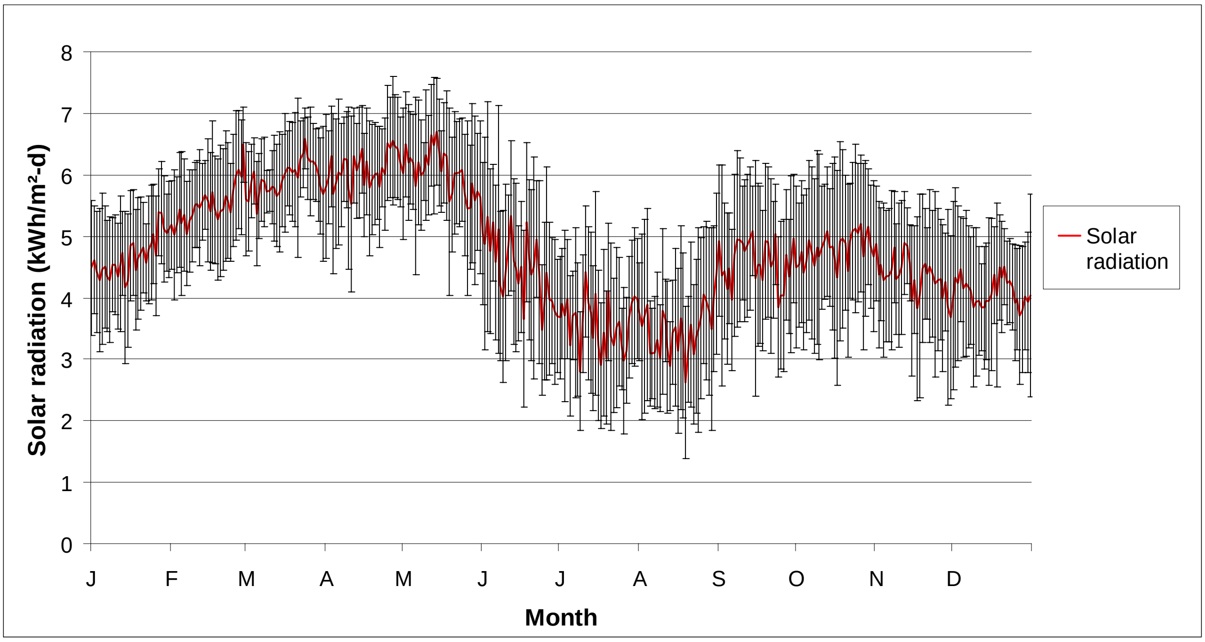

Figure 4 Solar radiation composite

Figure 3 indicates that most of the rainfall falls during 5 month (June, July, August, September and October). Two peaks correspond to onsetting and receding monsoons. Phaltan gets most of its rainfall during receding monsoon. Thus second peak is much more significant, accounting for 41% of yearly rainfall in 43 days only. As most regions in India, rainfall is highly concentrated with an average of only 64 rainy days in the year and 72% of yearly rainfall falling in one fifth of the rainy days. These heavy downpours are difficult to harvest because of the surface runoff. Besides, yearly rainfall at Phaltan is 521mm which is quite low compared to the national average of 1280mm[2]. Moreover, the region is drought-prone as shown by the coefficient of variability of yearly rainfall of 35% which is quite high. Efficient water harvesting technologies are thus critical to fulfil irrigation and drinking water needs throughout the year.

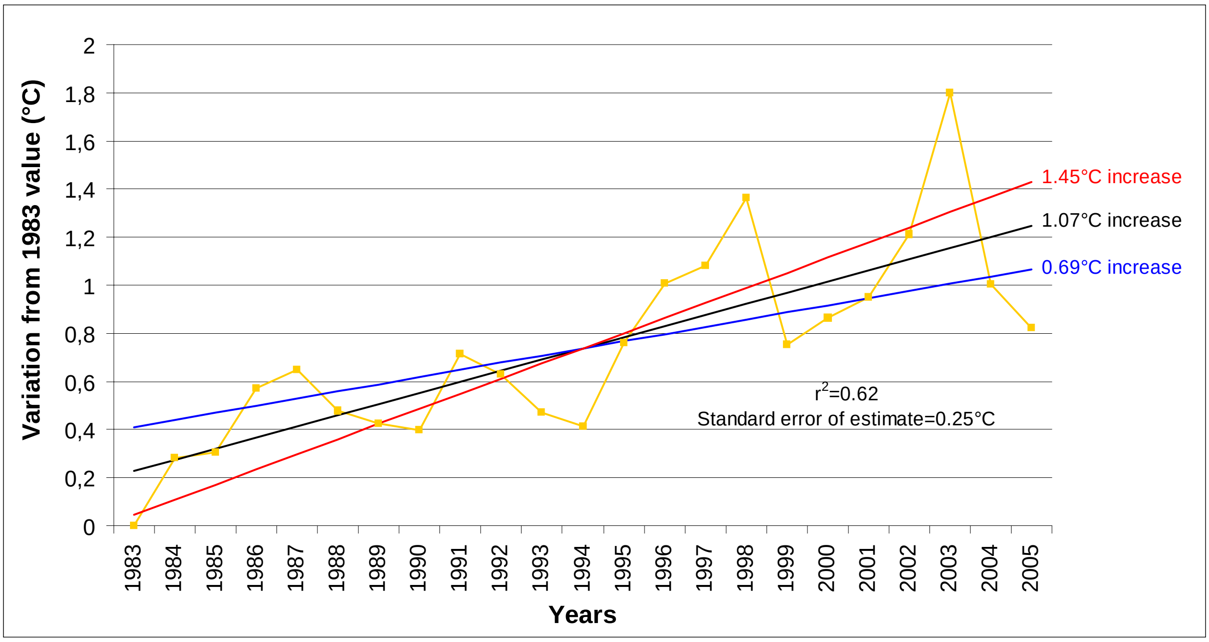

Figure 5 Temperature trend (average)

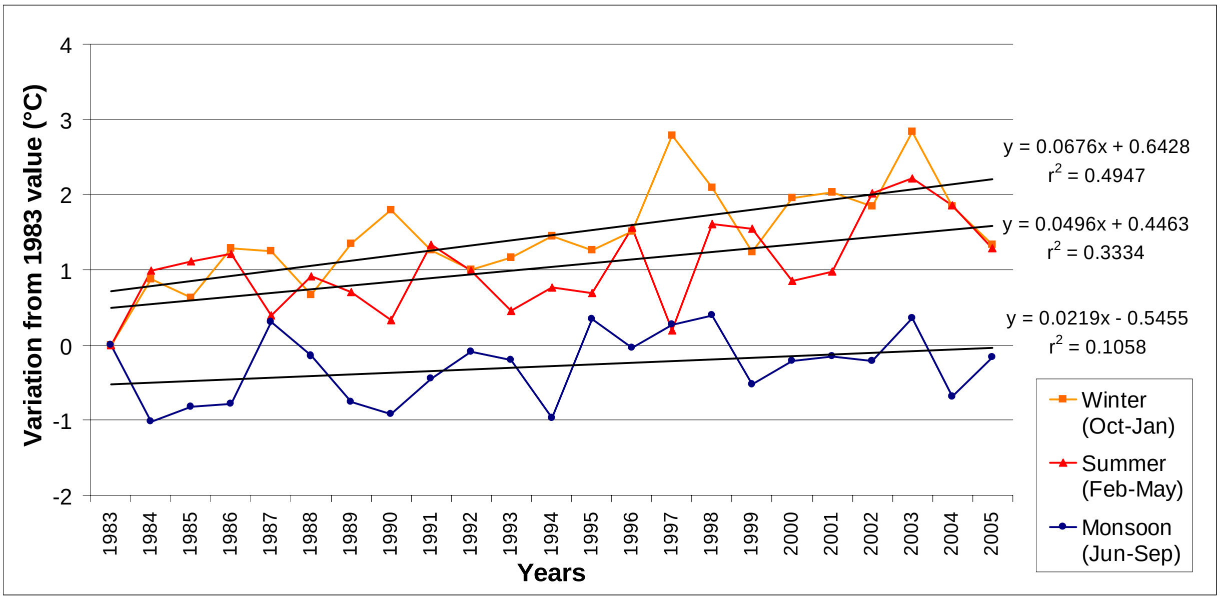

Figure 6 Seasonal temperature trends (average)

Trends for different weather parameters are given in figures 5 to 11. Figure 5 shows a warming trend with a variation comprised between 0.69°C and 1.45°C with a 95% confidence level and an average estimation of 1.07°C. These figures are comparable to those in Indian cities[3]. But since plant cover has increased in the region, the temperature should have been reduced. A possible explanation is that our 23 years' span is not sufficient to rule out "natural" cyclical variations, for which at least 50 years would be needed[3]. Seasonal trends in figure 6 reveal a strange phenomenon:

while average temperature is increasing for both winter and summer, it remains more or less constant for monsoon. This fact does not have any simple explanation since yearly rainfall, which occurs mostly during monsoon season, has not increased significantly (figure 7). Moreover seasonal average wind speeds have decreased at the same rate. But these differences in temperature increase tend to prove that the high increase in average temperature is not due to instrument errors.

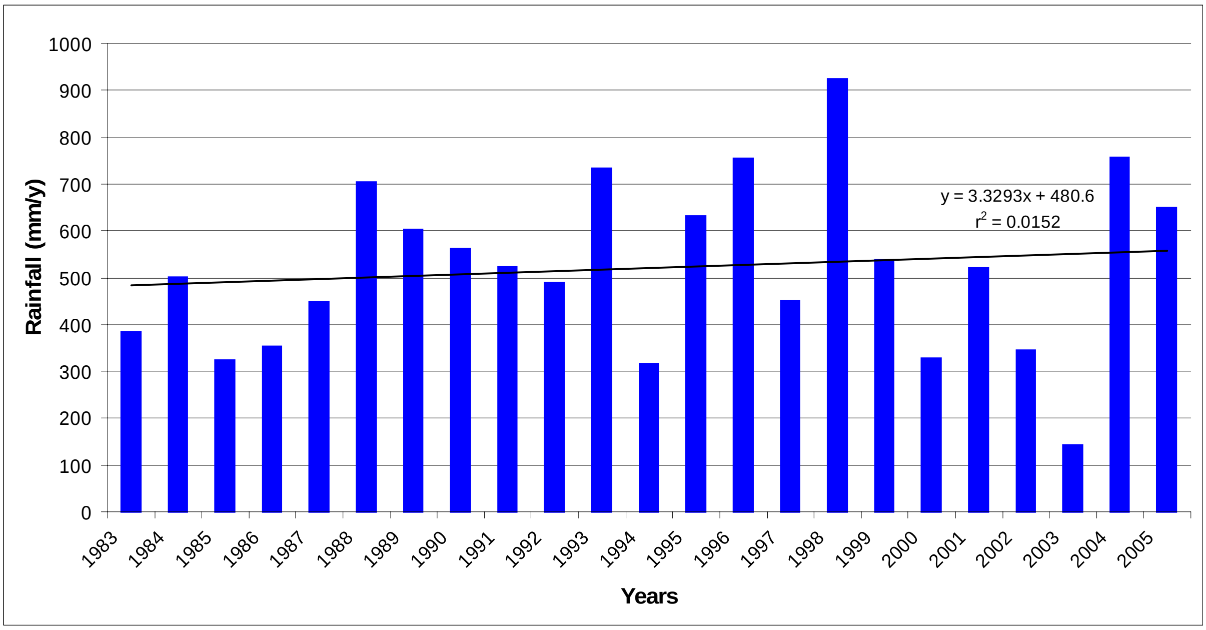

Figure 7 Rainfall trend (yearly)

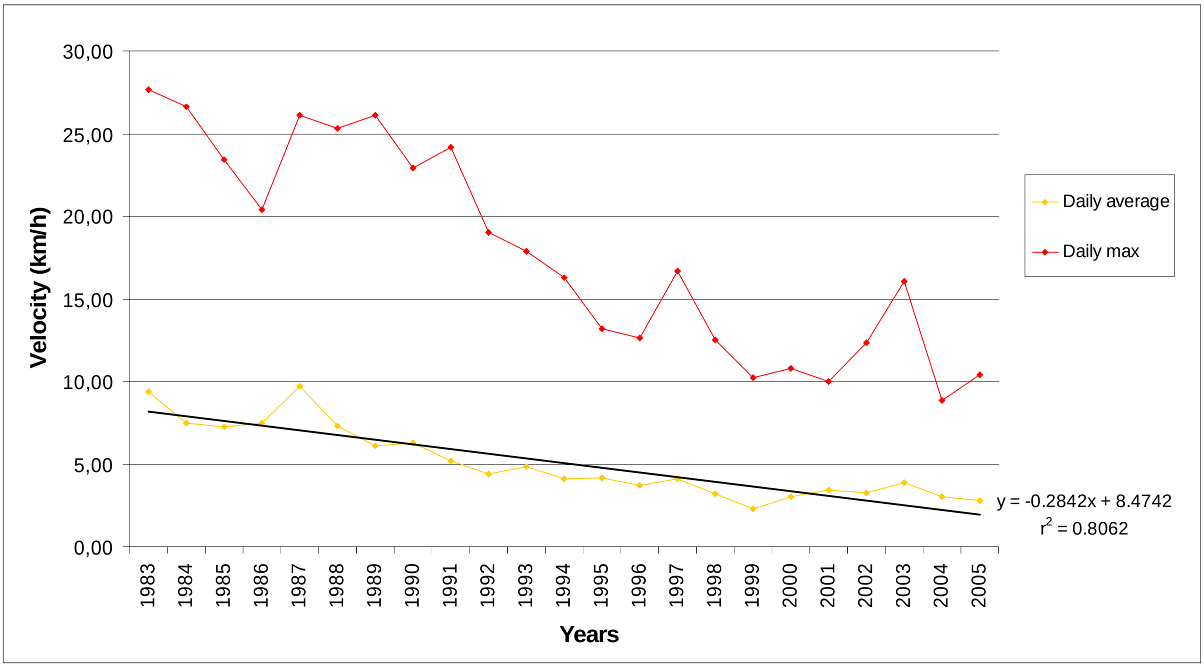

Figure 8 Wind velocity trends

The wind trend in figure 8 shows a steady decline since 1983. It might be a consequence of increase in plant cover in the region. Without green cover solar radiation heats the ground which creates more wind. Planting of trees in the close surroundings (approx. 20m) of the weather station might have reinforced this trend.

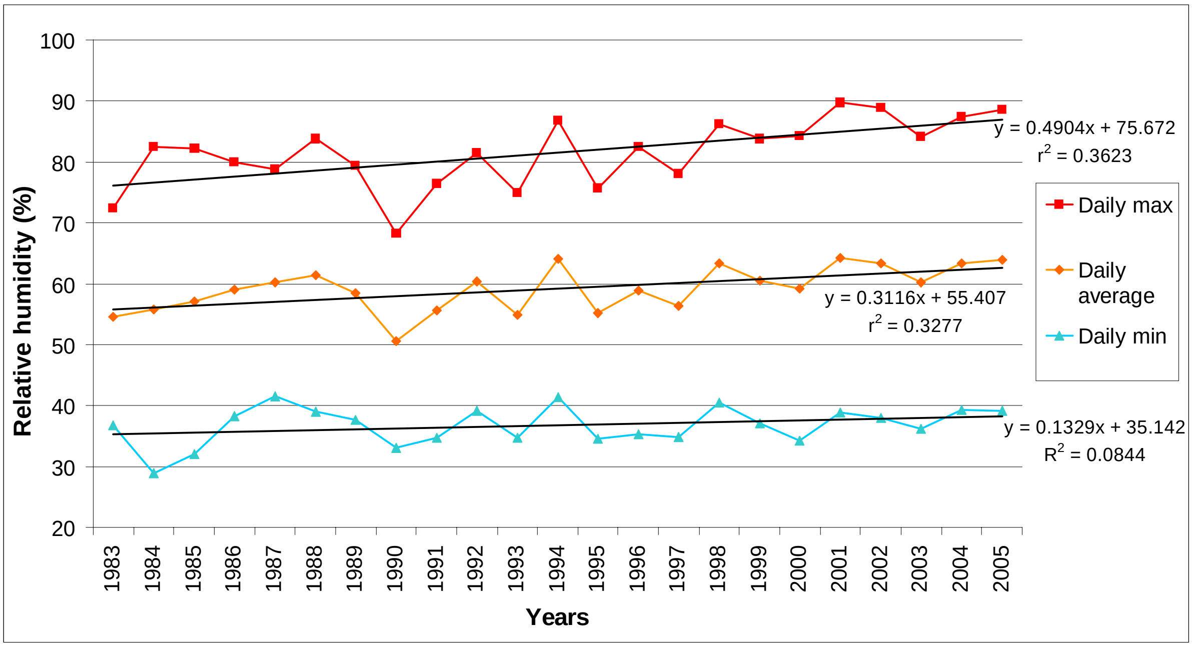

Figure 9 Humidity trends

Average humidity has increased of 7.2% but the coefficient of determination is only 0.33. Thus, more data is needed to validate or refute this trend. An increase in humidity could again be explained by the increase in biomass in the region.

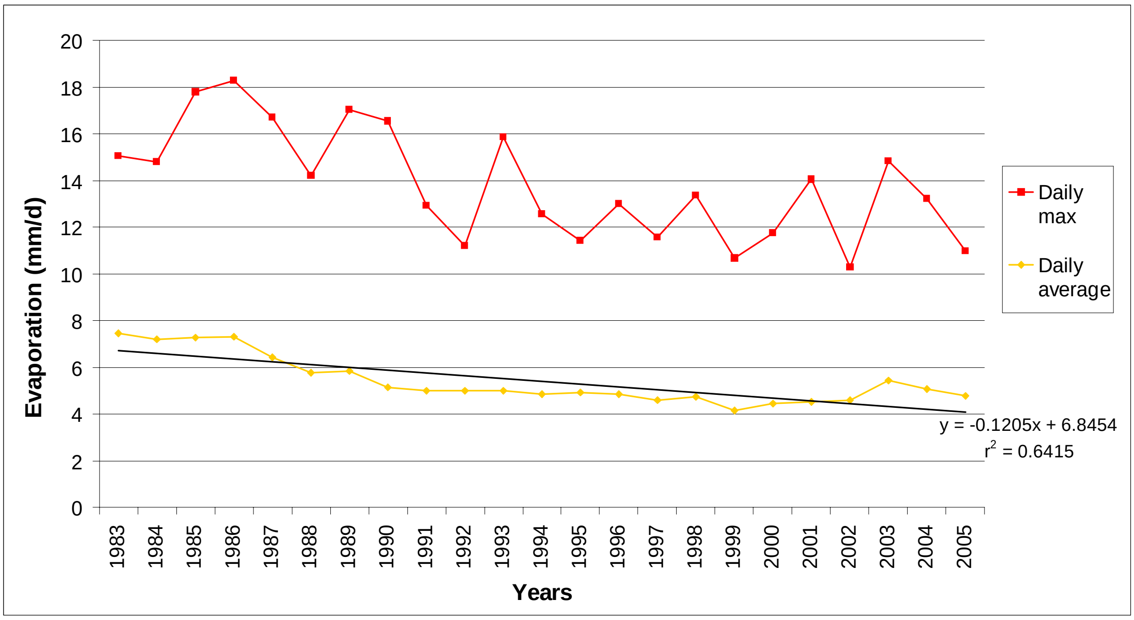

Figure 10 Evaporation trends

Figure 11 shows a clear decreasing trend for average evaporation. Evaporation is a function of temperature, wind speed and humidity. A good correlation can be found between wind and evaporation trends indeed since their coefficient of correlation is 0.87. Possible increase in humidity might have also played a minor role in this trend but the coefficient of correlation between the two parameters is only -0.34. Finally, the increase in temperature should have tempered the decreasing trend in evaporation but it didn't seem to have much influence.

Even though our data may be inadequate to ascertain trends, we have still recorded clear tendencies towards warming and reduced wind speed and evaporation. Increase in vegetation in the surroundings of Phaltan might have played a role in wind and evaporation trends, but some facts such as the high increase in temperature and the constant monsoon temperature remain unexplained. Composites and average figures can still be used fruitfully by farmers to plan their crops and anticipate rainfall and temperature variations.

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