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PS-001

A COMPARISON OF METHODS FOR TESTING HOMOGENEITY OF AVERAGE TEMPERATURE AND PRECIPITATION SERIES

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ABSTRACT

Testing homogeneity of data is one important part in validation process of climate data to maintain originality. Homogeneous climate data is defined as a condition in which there is variation in the data caused only by variations in climate. Homogeneity test on average temperature and monthly precipitation using approching method of standard normal homogeneity test (SNHT) and Buishand Range Test (BRT). Checking the homogenization of data can be performed based on the identification of homogeneity data. In test methods of homogenization, there is also the ability to specify a breakpoint of inhomogeneous data. Average temperature and precipitation series shows the homogeneity of data.

Keywords: *validation, average temperature,precipitation series, SNHT,BRT*

INTRODUCTION

Availability of climate data sourced from the existing network of monitoring stations in the Meteorology, Climatology and Geophysics Agency (BMKG) requires verification and validation of data observasi[1] .Identification of climate data used as an indication of climate changes[2].The Simple validation techniques that have been made at this time, would be a step good start in the homogeneity test.

An understanding of the needed for homogeneity analysis is a first step to fix the data and applying quality control of climate data assets that exist in BMKG. The importance of scientific obligation to provide information whether a data series has been tested homogeneity or not.

Condition data is not reliable and have not been able to produce accurate climate studies, need to test the homogeneity of daily data and determine the breakpoint. Climate data elements that will be examined is the average temperature and daily rainfall stations of Sibolga Pinang Sori. In a previous research [3], validation of climate data on Station Sibolga Pinang Sori has been done, the results found discrepancies of data with the results of observation and documents are still missing value.

The research is a further analysis of previous research [3], which performs data validation average temperature and precipitation. This study aims to identify any inhomogenity in climate data at observation stations Pinang Sori Sibolga.

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METHODOLOGY

The time and Place. The research conducted in August 2013, at the Center for Meteorology Climatology and Geophysics Region I Field. The test method used is the Standard Normal Test homogeneity (SNHT) and Buishand Range Test (BRT), the source of a data from the Meteorological Station Pinangsori of Sibolga that average temperature from January 1980 through December 2012.

Data analysis. The data on average temperature, which is collected performed simple validation includes several stages a data validate climate, among that checking of bias / error is roughly (gross error check), the test of tolerance (tolerance test), the test interval of a data (test range) [4], the test internal consistency (The internal constency test), and advanced data validation to the test the homogeneity of a data (homogeneity test).

Error checks a data is roughly done manually or automatically with specific attention to a logical limit filters to a data element. Tolerance test is done by indicating the value of the data beyond the limits (upper and lower) which was determined. Tolerance limits for categories a data value may not be determined based on the amount a data that goes beyond the tolerance limit of ± 4 times the standard deviation (standard deviation). Addition the existence of identical values for four consecutive days or more can also be an indication of the possibility of data recording errors. For the Last reviewed section was not included in the software program for validate of climate. Therefore, the user must do it manually or use another program.

Checking the maximum and minimum limits (Range Test) conducted by comparing the value of an element to the maximum and minimum limits. The determination of the maximum and minimum limit value, be determined using specific statistical analysis, one of which uses the distribution analysis frekuensi [5]

The internal consistency test illustrates the relationship between some elements of the observed climate. Therefore, the consistency of this test should take into account the condition of a data elements of weather / climate others.

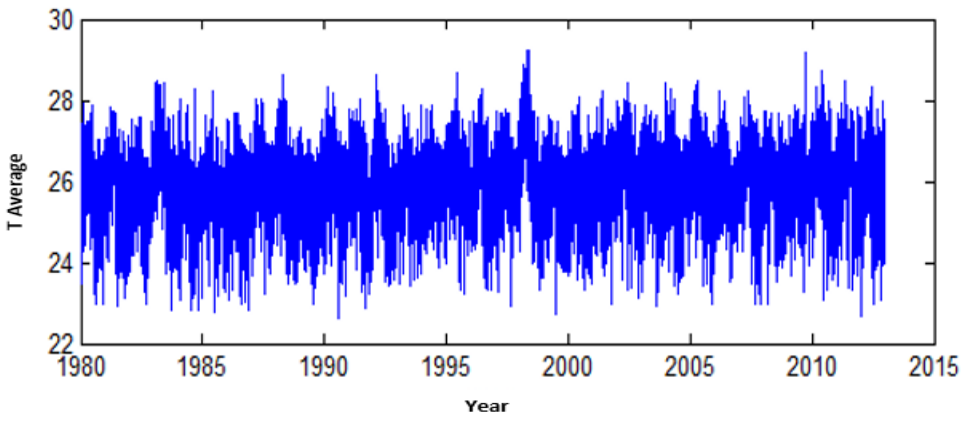

Figure 1. Graphs, the normal average temperature station of Sibolga period 1980 to 2012

The results of The internal consistency the test average daily temperature of Sibolga period 1980 to 2012 can be seen in Figure 1 and Figure 2.

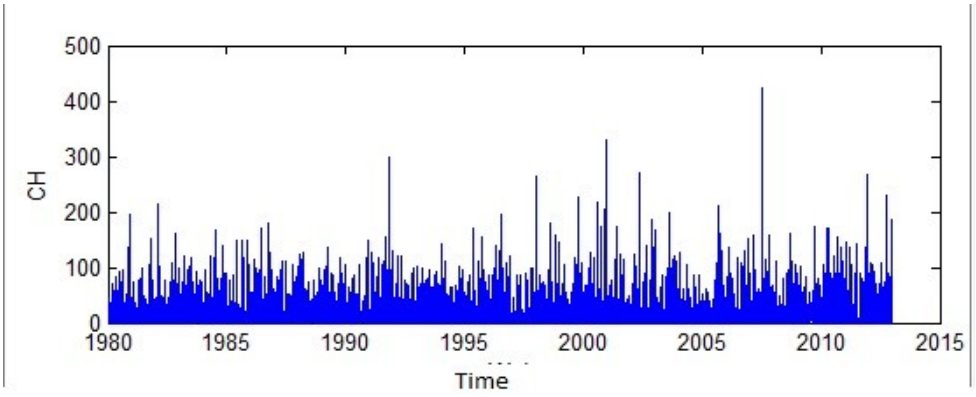

Figure 2. Graphs, the normal rainfall, station of Sibolga period 1980 to 2012

The homogenization process on this research begins with a daily temporal resolution, which must be converted into a data monthly or yearly. Standard methods of calculation procedures homogeneity Normal Test (SNHT) was performed using the formula through the calculation of the value of the similarities 1 and 2: [5]

$$\bar{z} = \frac{1}{k}\frac{\sum_{i=1}^{k}(Yi-\bar{Y})}{s} \quad (1)$$

and

$$\bar{z} = \frac{1}{n-k}\sum_{i=k+1}^{k}(Yi-\bar{Y})/s \quad (2)$$

Where is two values z1 and z2 calculate the value of T (k) with the following equation 3:

$$T(k) = kz_1^2 + (n-k)z_1^2 \; k = 1,\ldots, \quad (3)$$

Normal Standard Test Method homogeneity (SNHT) can be used to find the breakpoint, one way is to display the value of T (k) in a time series graph.The breakpoint usually occurs due to the influence of factors other than climate that cause climate data becomes homogeneous. Factors in addition climate as an example that because of the damage and / or replacement equipment, changes in environmental conditions around the station such as the growth of trees, establishment of new buildings around the station, and so forth. Based on the calculation of the Standard Normal Test homogeneity (SNHT), in general, a breakpoint on a data point can be identified by looking for the maximum value of T (k), where the test statistic T0 can be represented in equation (4):

$$T0 = \max T(k) \quad 1 \le k < n \quad (4)$$

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When value of T0 is above the limit of a critical value, then the data are not homogeneous concluded. The relationship between the value of T0 with T (n) which is a function of the sample data can be analyzed based approach where:[6]

$$T0 = \frac{n(T(n))^2}{n-2+(T(n)^2} \qquad (5)$$

Based on the comparison between the value of T0 by critical threshold values on 1% and 5%, if the value of T0 exceeds the threshold value, it means that a data is not homogen.[6]

Buishand Range Test (BRT) is a form of homogenization test other approaches that consider the presence or absence of systematic deviations in the data against the average value of the data. Identify deviations based on the value 'adjusted partial sum' which is defined Wijngaard et al. (2003) as:

From these values, the data will be fairly homogeneous if the value of S * k fluctuate around zero (0). Point breakpoint causes homogeneous data can be identified through the identification value S * k the maximum or minimum occurs in k. Values shown in the chart is the statistical value calculated from the equation: (S * k / s) / √n. The value of this equation is then compared with the value of R (rescaled adjusted range) which is calculated from the difference between the value of S * k maximum and minimum and standard deviation divided by the value of the data, follow the following equation:

Determination of the homogeneity of the data is done by comparing the value of R / √n with critical values compiled by Buishand (1982). Critical value used consisted of the 1% and 5%, as shown in Table 1.

Table 1. The critical value of 1% and 5% for R / √n of BRT as a function of n (Buishand 1982)

N	20	30	40	50	70	100
1%	1.60	1.70	1.74	1.78	1.81	1.86
5%	1.43	1.50	1.53	1.55	1.59	1.62

RESULTS AND DISCUSSION

Test homogentitas average temperature can be done visually from the graphs generated by the test results. Testing by homogeneity Normal Standard Test method (SNHT) has a positive critical limit value6, homogeneous data will have a statistical value that is smaller than the critical limit values (interval 1% or 5%).[7]

The average temperature. Figure 3 is a normal average temperature of Sibolga area, from 1980 to 2012 were obtained from the monthly average. The average temperature this month showed upward trend.

In Figure 4, produces statistical value on the annual average temperature in 1989 and 1995 beyond the point of critical (dotted line breaking green (5%)) and the peak value close to

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1% breakpoint was in 1993, but did not exceed the critical limit point (red dotted line broke (1%). the condition shows a data homogeneous, because the results of the test statistic does not exceed the limit point SNHT critical (red dotted line broke (1%) and green (5%)). this is reinforced by the condition its average temperature in Figure 5.

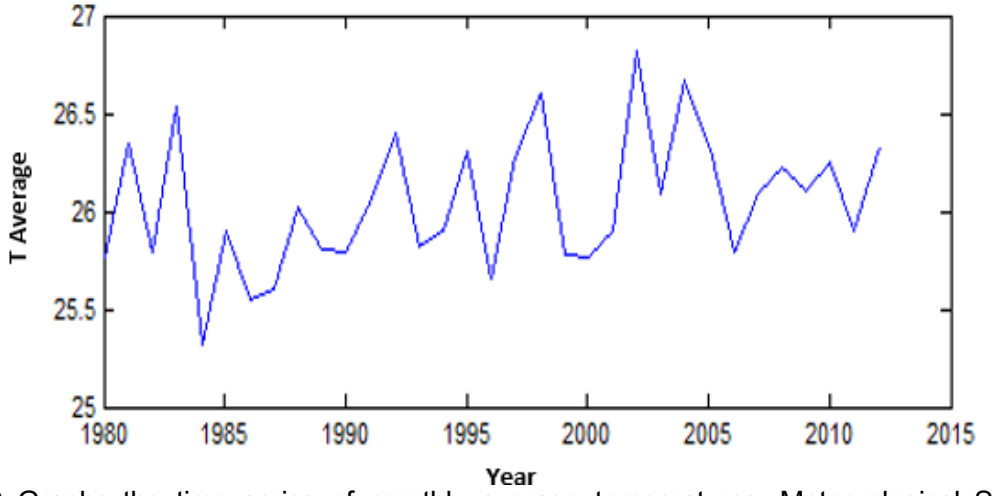

Figure 3 Graphs the time series of monthly average temperatures, Meteorological Station Pinang Sori of Sibolga year period 1980 to 2012.

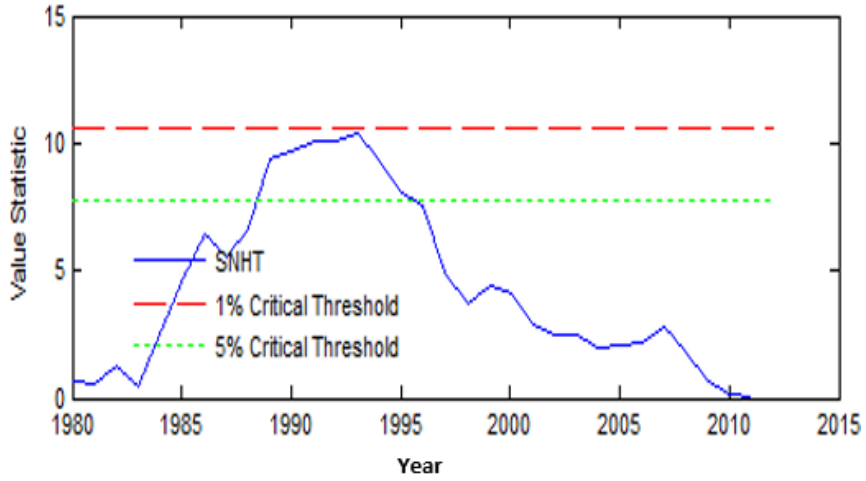

Figure 4 Graph Value Test SNHT the average temperature - average period of 1980 to 2012

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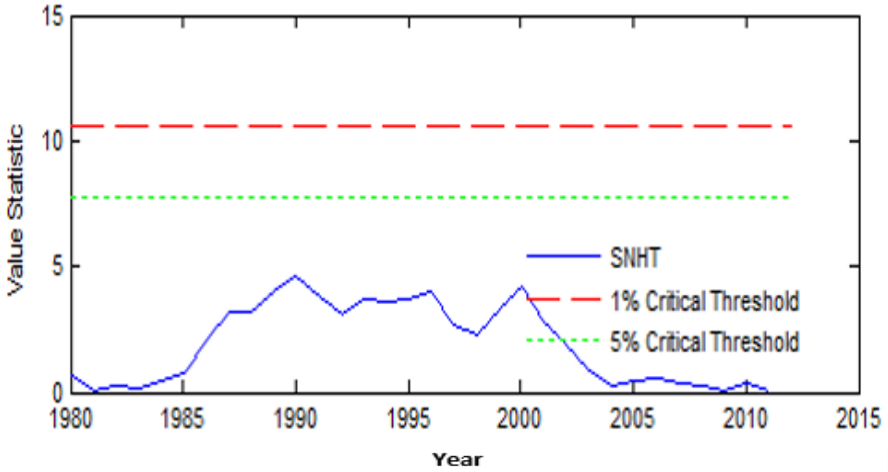

Figure 5 . Graph Value Test SNHT the average temperature in the period 1980 to 2012

Rainfall. Monthly rainfall chart above is the result of temporal changes daily. Figure 6 shows the average rainfall is highest in 1993.

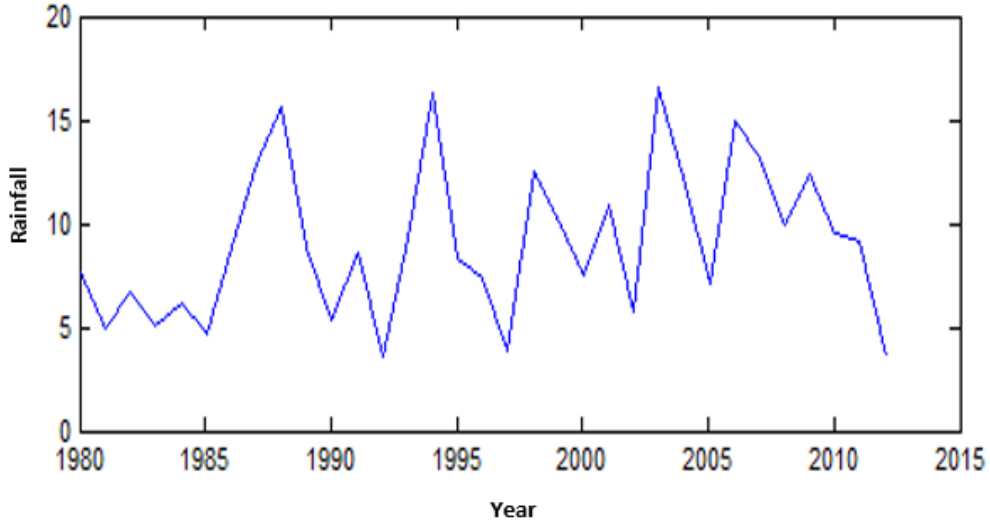

Figure 6 Graph of monthly rainfall on the of Sibolga period 1980 to 2012

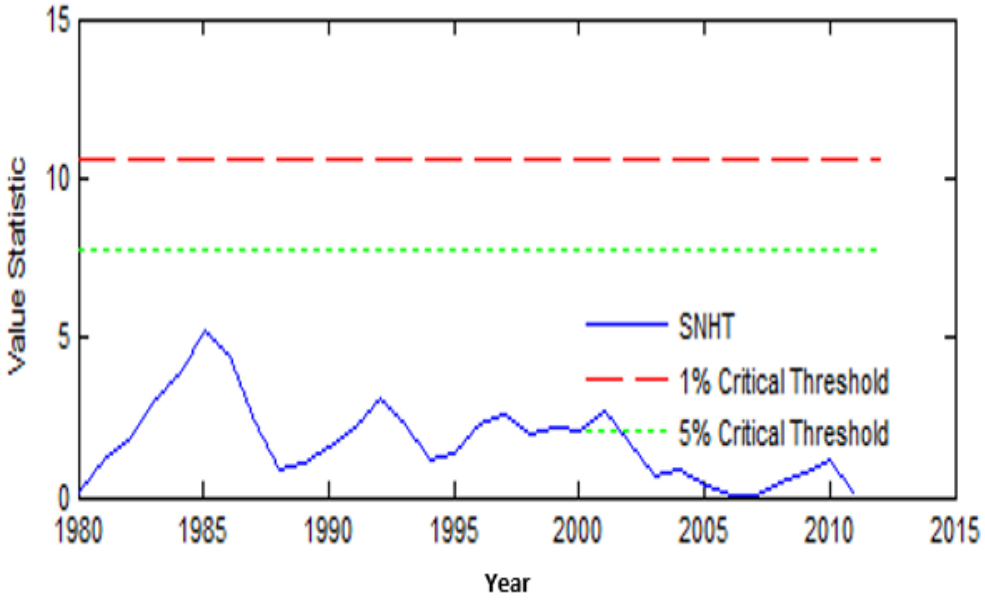

Figure 7 Graphs the value of the the test SNHT rainfall period 1980 to 2012

In Figure 7, shows the curve (blue) monthly rainfall on the Sibolga homogeneous. This is illustrated on the graph results homogeneity Standard Normal Test (SNHT) whose value does not exceed the critical threshold point (red dotted line broke (1%) and green (5%).

The results of the calculation of statistical values can be seen in Table 1 Value average monthly temperature for T0 is 4.5623 which is the value dilai (T (k)) maximum. And his T0n 0.0005248. Monthly rainfall values 5.2666 0.0047 mm and its T0n. The result of this calculation illustrates the value of T0 does not exceed the critical threshold value which is a function of the size of a data sample size (n). [7][8]

Table 1. Value Calculation Result Statistics from Standard Normal Test homogeneity (SNHT)

	T0	**T0n**
T07	12,7581	0,0001464
T13	7,3818	0,0002129
T18	5,1534	0,0006359
T_Average	4,5623	0,0005248

CONCLUSION

The results of homogeneity test average temperature on the Pinang Sori of Sibolga Station gives the following results: The number of time series over 20 years of good use to the homogeneity of a data. By daily data element average temperature were tested by Standard Normal Homogeneity Test and Buishand Range Test method indicates a data are homogeneous. There preformance difference homogenty test is, in SNHT test has a positive

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value of the critical limit, while Buishand test has two limits (upper and lower) to the critical value. Homogeneous data will have statistical values that are within the range of critical limits (interval 1% or 5%). If the data is found to be outside the critical limit, then the data is not homogeneous.

PROSPECT

Testing homogeneity of climate data single the station would certainly be a good step in the validate and further in Touch ups efforts to maintain the quality of climate data BMKG, with the many various options for method validate, particularly with respect to the existing methods of statistical analysis, the expected homogeneity test in this study need to be continue to be developed and adapted to the needs and supporting the advancement of science.

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