ANALYSES OF PSMSL SERIES

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National Oceanographic Center-(Proudman Oceanograhic Laboratory) – Liverpool University - May 2012

ABSTRACT

This presentation

1)-gives a historic overview on the cooperation between POL, LU and USP;

2)- shows all PSMSL(RLRANN96) Series , analyzed in terms of their collinearity, proximity coefficients and as a F function ;

3)- gives an Analysis/Discussion of these coefficients and the F function;

4)- and ends with an overall balance of PSML trends.

1-HISTORIC

- Collaboration between USP (University of Sao Paulo) and POL (Proudman Oceanographic Laboratory) started in (1972) with Adm A S Franco of IO-USP and Prof H Charnock , who signed a “Memorandum of Understanding”,via the NOI (National Oceanographic Institute).(Next Slide-1).
- Later (1987) the agreement was re-signed by Prof Jose Goldemberg the Rector of USP and by Dr B S McCartney Director of POL. (Next Slide-2).
- Presently (2009) the agreement was extended to the Liverpool University (LU), via its Department of Earth and Ocean Science. (Next Slide-3).

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MEMORANDUM OF UNDERSTANDING BETWEEN THE INSTITUTE OF OCEANOGRAPHY USP AND THE INSTITUTE OF OCEANOGRAPHIC SCIENCE FROM GREAT BRITAIN

The Institute of Oceanography of the University of São Paulo Brazil and the Institute of Oceanographic Science of Great Britain, wishing to cooperate in the field of Oceanography, firm the intention of collaborating in a programme of work with the following objectives

1- To develope techniques and systems for the aquisition, interpretation and analysis of oceanographic data.

2- To contribute for a greater brazilian and british participation on the highly developing Oceanographic technology, with the aim of magnifying and deepening their scientific knowledge.

3- To familizarize the brazilian technical staff with the already existing data aquisition and processing systems of scientific oceanographic data.

The way of achieving the foregoing objectives as well as the fields of cooperation concerned will be commonly agreed between staffs of both Institutes and presented as a Plan of Work.

For the accomplishement of the programme the IOUSP and the IOSGB with the authority of coordinators for the Brazilian and British personel, agree to endeavour to secure that all the obligations commonly consented will be observed.

Each part will provide funds to cover its own expenses necessary to carry on its own obligations regarding the transport and maintenance of personel and equipment.

The IOSGB and the IOUSP will designate each one, one Programme Administrator, that will take the responsability of coordination of the commonly agreed responsabilities. The Programme Administrators are the Presidents of groups of work, which will be the principal instruments to secure the execution of the programme and to maintain both parts continuously informed about the course of the work.

The group may stablish technical sub-commissions necessary for the programme execution.

The scientific results will be published in the way commonly agreed.

AlMTE. FRANCO
INSTITUTO OCEANOGRÁFICO
DA USP.

Prof. H. CHARNOCK
INSTITUTE OF OCEANOGRAPHIC SCIENCE
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COOPERATIVE AGREEMENT BETWEEN THE PROUDMAN OCEANOGRAPHIC LABORATORY AND THE UNIVERSITY OF SAO PAULO (BRASIL) FOR THE DEVELOPMENT OF PROGRAMS IN OCEANOGRAPHY

The Proudman Oceanographic Laboratory, formerly the Institute of Oceanographic Sciences (Bidston), and the University of Sao Paulo enter into the present cooperative agreement for the development and furtherance of a broad program of teaching and research in the various fields of Oceanography.

1. Each of the two Institutions will appoint a coordinator and will establish an appropriate coordinating mechanism to provide for overseeing and facilitating the detailed implementation of this agreement as interests, resources, and other circumstances may indicate to be both desirable and feasible. The Director of the P.O.L. and the Rector of the University of Sao Paulo shall designate their respective coordinator(s) and fix their terms of office. The coordinator(s) are to be generally responsible:

a) for identifying specific projects in which the Institutions concerned might collaborate,

b) for disseminating on their respective campuses information concerning the resources and interests of the two Institutions,

c) for helping scholars and departments from each Institution to get in touch with their nearest counterparts at the other, and

d) for making recommendations to the Director of the P.O.L. and the Rector of the University of Sao Paulo as well as to other appropriate officials of the Institutions, concerning opportunities for specific joint efforts and suggestions regarding the ways and means of carrying out those joint efforts.

When appropriate and useful, the coordinators will establish committees to handle the details of specific programs as may be developed. Secretarial assistance will be made available, as required, to each coordinator by the respective Institution.

Periodically the coordinator(s) will review the progress of the programs and ascertain their usefulness to the Institutions participating and will report to the Proudman Oceanographic Laboratory and to the University of Sao Paulo authorities -- i.e., to the Director and the Rector on their findings.

The coordinator(s) will also provide assistance and advisory services, on a long-range basis, for the discussion and possible solution of problems concerned with the purposes of this agreement.

As occasions may warrant, there will be a joint meeting of the coordinators at a mutually convenient time and place.

2. The timing and the extent of agreed activities shall be determined by funds available at both Institutions and by the financial contributions which may be obtained from other resources.

3. The interpretation and application of clauses contained in this agreement shall be flexible enough to allow for amendments or extensions as circumstances demand, in line with the general objectives of this agreement.

This agreement shall commence on 3rd January 1988 and shall remain in effect for a five year period thereafter. Extension of the agreement for additional periods will be considered upon recommendation from the Proudman Oceanographic Laboratory and the University of Sao Paulo coordinators. Such recommendations should be submitted to the principals sixty (60) days prior to the date of expirations.

IN WITNESS WHEREOF each of the parties hereto has caused this agreement to be signed by its proper officer.

PROUDMAN OCEANOGRAPHIC LABORATORY	UNIVERSITY OF SAO PAULO
By [signature]	By [signature]
Date 8th December 1987	Date

INTERNATIONAL CO-OPERATION AGREEMENT

Co-operation Agreement by and between Proudman Oceanographic Laboratory (POL), University of Liverpool (LU) The Instituto Ocenaográfico and the Universidade de São Paulo (USP).

By this Co-operation Agreement, the parties hereto, to wit: 'Proudman Oceanographic Laboratory' (POL) of Liverpool, UK , herein represented by its Director Professor Andrew Willmott; 'University of Liverpool' (LU) and its 'Department of Earth and Ocean Sciences' (DEOS), herein represented by the Chair of DEOS, Professor David Prior ; and the 'Universidade de São Paulo' (USP), herein represented by its Rector, Professora Suely Vilela, and the "Instituto Oceanografico", herein represented by its Directora, Profa Ana Maria Setúbal Pires Vanin, have mutually agreed and covenanted as follows:

1. OBJECT

This Agreement covers academic co-operation in Oceanography and related fields in continuation of an already existing program of co-operation, being conducted according to the work plan ("Work Plan") appended hereto, and which is hereby made an integral part hereof.

2. TARGETS AND FORMS OF CO-OPERATION

2.1-Each of the three Institutions will appoint a coordinator and will establish an appropriate coordinating mechanism to provide for overseeing and facilitating the

9. JURISDICTION

For the purpose of settling any doubts or disputes that may arise concerning the performance or construction of this Agreement, the parties elect the jurisdiction of the Public Treasury Courts of the Capital of the State of São Paulo, to the exclusion of any other, however privileged.

And having thus agreed and covenanted, the parties hereto execute this Co-operation Agreement in identical counterparts, to one and same effect.

São Paulo, 23 NOV. 2009

UNIVERSIDADE DE SÃO PAULO

Profa. Dra. Suely Vilela
Rector

Por Delegação da M. Reitora
Art. 42 do Estatuto da USP
FRANCO MARIA LAJOLO
Vice-Reitor

INSTITUTO OCENOGRAFICO

Profa. Dra. Ana Maria Setúbal Pires Vanin
Director

Liverpool, 23 NOV. 2009

DEPARTMENT OF EARTH AND OCEAN SCIENCE, LIVERPOOL UNIVERSITY

Prof. David Prior, Head of Department

PROUDMAN OCEANOGRAPHIC LABORATORY

Prof. Andrew Willmott
Director

Witnesses:

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TOPICS OF INTEREST

- FGGE (FIRST GLOBAL GARP (Global Atmospheric Research Programme) EXPERIMENT.(1979).
- SEA LEVEL IN THE SOUTH ATLANTIC.
- ACCLAIM (ANTARTIC CIRCUMPOLAR CURRENT LEVELS BY ALTIMETRY AND ISLAND MEASUREMENTS).
- SEA LEVEL OF BRAZILIAN COAST.
- GLOSS (Global Sea Level Observing System).
- GLOBAL (PSMSL) SEA LEVEL DATA.

Science and UK People

- Tidal Analysis and Tide Potential (Dr David Cartwright & Dr Ian Vassie) .
- Permanent Service for the Mean Sea Level (Ms Elaine Spencer and Prof Philip Woodworth).
- Global Observing Sea Level System (Dr David Pugh, Prof Philip Woodworth, Dr I Vassie, and Dr Trevor Backer).
- Bottom Pressure Recorders (Eng Robert Spencer and Eng Peter Foden).
- Oceanic Modeling (Norman Heaps, Roger Flather and Allan Davies).

Science and BRA People

- Tidal Analysis and Tide Potential (Adm Dr Alberto dos Santos Franco, Prof Afranio Rubens de Mesquita & Dr Joseph Harari).
- Permanent Service for the Mean Sea Level (Dr A R de Mesquita & Dr Carlos Augusto de Sampaio Franca).
- Global Observing Sea Level System (Prof A. R. de Mesquita, Dr Ricardo Camargo and Dr Jose Edson).
- Bottom Pressure Recorders (Eng Luiz Vianna Nonato & Eng Francisco Vicenttini).
- Oceanic Modeling (Dr J Harari, Dr R Camargo & C A S Franca).

THE ACTIVITIES

- 1)-The British Council and the CNPq (Conselho Nacional de Pesquisas Científicas e Tecnológicas), funded the activities.
- 2)-POL provided the modern technological and science expertise and USP provided the adequate scientific personnel to absorb them.
- 3)-The GLOSS (Global Sea Level Observing System) with aims of improving coverage of PSMSL (Permanent Service for the Mean Sea Level), was created at IOC (Intergovernmental Oceanographic Committee) of UNESCO.
- 4)-Cruises of Noc Prof W Besnard of USP and Training Courses (1993 and 1999) of IOC,gave rise to the AAGN (Afro America GLOSS News), as a "Forum" for the Spanish and Portuguese speaking (Sea Level) countries. Communities of the Americas, Africa and others.
- **5)-Articles of the Newsletter can be seen in** www.mares.io.usp.br , Icon AAGN.

2-ANALYSES OF PSMSL96 SERIES

ANALYSES

- At the time the analyses of the PSMS96 series, there was a clear indication (Etkins & Epstein, (1982), Barnett (1983), Gornitz et al (1982)), that the Global Sea Level was rising.
- To not repeat the above previous studies, it was decided to look at the statistical properties of the entire set of PSMSL96 series;
- as the correlation, the corresponding regression and the Proximity values;
- and the newly defined F values and Global Sea Level Balance.

THE REGRESSION X CORRELATION PLOT - (r X ρ) PLOT -

The regression value (r) of each time series, that were used in a ($r\ x\rho$) plot, was calculated by using expressions taken from Standard Mathematical Tables.

$$r = \frac{N\sum x_i y_i - (\sum x_i)(\sum y_i)}{N\sum x_i^2 - (\sum x_i)^2} \quad , \qquad i = 1,2,\ldots\ldots\ldots,N \qquad (1)$$

Where x_i are the sea level heights of the sea level series and y_i are their corresponding values of instants t_i of a series with N pairs (x_i ,y_i).
The correlation (ρ) of the N pairs (x_i ,t_i), was calculated , once the (r) values were known from (1) by using the expression below , where C = r:

$$\rho = \frac{\frac{1}{N}\sum C.(x_i - \bar{x})(t_i - \bar{t})}{\sqrt{\sum \frac{C^2.(x_i - \bar{x})^2}{N} . \sum \frac{(t_i - \bar{t})^2}{N}}} \quad , \text{ where } \bar{t} = \frac{\sum t_i}{N} \text{ and } \bar{x} = \frac{\sum x_i}{N} , \text{ for } i = 1,2,\ldots\ldots.N \qquad (2)$$

It follows, by putting in evidence (C/N), $N \neq 0$ and canceling them in

denominator, $$\rho = \frac{\sum (x_i - \bar{x})(t_i - \bar{t})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (t_i - \bar{t})^2}} \quad , i = 1,2,3\ldots\ldots\ldots\ldots.N \qquad (3)$$

From which one can see that for each sea level series, the regression value (r) does not appear in expression (3) which was used to determine the correlation (ρ). Therefore the (ρ) value does not depend of its corresponding (r) value. Similarly the (r) value does not depend on the (ρ) value, as the (ρ) value does not appear in expression (1) used to calculate (r). The regression values (r_i) and the correlation coefficients (ρ_i) are then independent variables.

- COEFFICIENT OF PROXIMITY

In Fig 1 one can see that the co-ordinates of a point $y_i;x_i$, which belongs to the cloud of points that surrounds the straight line.

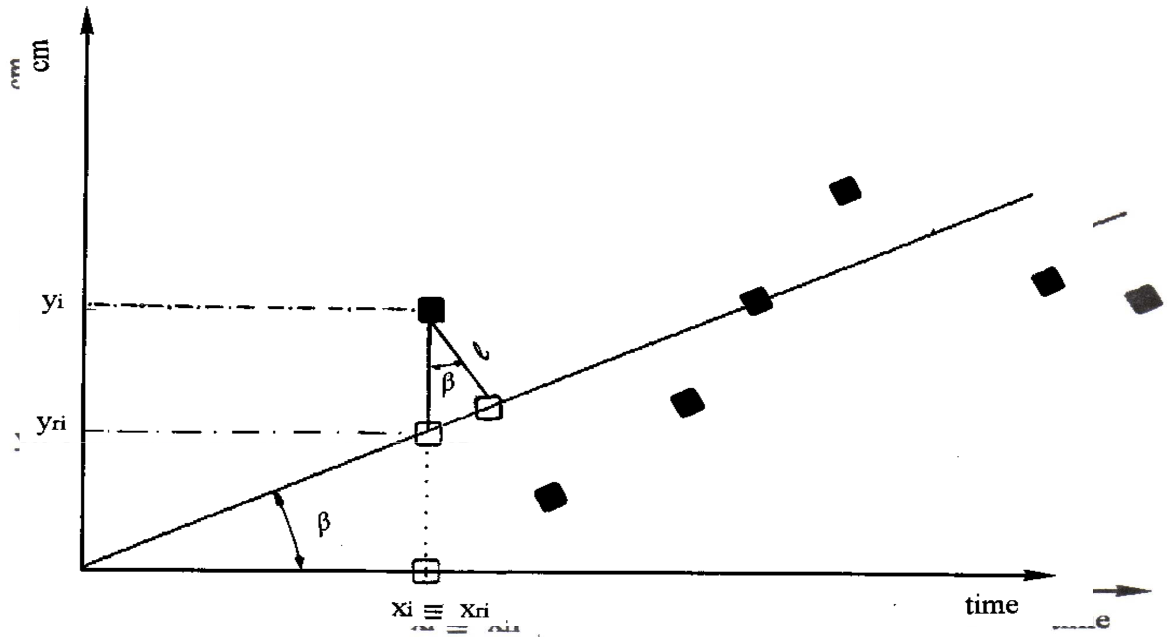


Fig. 1 - The regression line and its generating points (black squares). ℓ_i (cm or mm) are the distances of the points (x_i, y_i), $i=1,...,n$, to the regression line. Their projections on the straight line (x_{ri}, y_{ri}) are represented by white squares. β is the inclination of the regression straight line relative to the x (time) axis. $\beta_o = \tan(\beta)$ is the regression coefficient

From its inclination β, it is possible to see the co-ordinates $xr_i;yr_i$ of its projection on the abscissa line, and the distance of length ℓ_i to the straight line, so that one can write for all (*i*) distances:

$$\ell_i = (y_i - yr_i)\cos\beta, \qquad (1)$$

and making the substitution $yr_i = x_i \tan\beta$, one gets:

$$\ell_i = y_i \cos\beta - x_i \sin\beta\ , \qquad i=1,2,\dots\dots,n \qquad (2)$$

One can see from expressions (1) and (2), as they are Euclidean distances, the ℓ_i values are necessarily invariant with the inclination β. Their corresponding co-ordinates of points $x_i;y_i$, as the Cartesian system of reference translates, or rotates in the plane of the Figure, are indifferent. For any variation of β, all co-ordinates x_i and y_i should acquire correspondingly adequate values, so that the above (1) and (2) expressions satisfy the physical distances ℓ_i as constants. By taking the mean over all distances ℓ_i the coefficient ℓ of proximity is obtained for each PSMSL series.

– COEFFICIENT OF COLLINEARITY

The known concept of correlation coefficient is of a measure of linear dependence between two random variables (X and Y)(Jenkins and Watts, 1978, pages 74-75) and, when the correlation ρ is equal to one, there is an exact linear relationship of the form

$$y_i = \tan(\beta)\, x_i + \alpha \,, \qquad (3)$$

where $\beta_o = \tan(\beta)$ is the regression coefficient and α is the intercept, i=1,2,3.....n.

In the special case of time series, in which $x_i = t_i$,i = 1,2, ...n, however , the series is not a random variable, and the name **collinearity** seems to be more appropriate to nominate this sort of correlation

When the collinearity coefficient ρ is equal to zero there is no linear dependence between the two (X and Y) random variables. In the case of collinearity zero, $\beta_o = \tan(\beta)$ may assume any value from $-\infty$ to $+\infty$ and the inclination β of the line will take any value within $\pm\pi/2$ radians.

-CORRELATION, COLLINEARITY AND PROXIMITY COEFFICIENTS

To examine that, let X and Y be two random variables with values x_i and y_i and that one wishes to approximate the values of Y by a linear combination of the form: $y_{ri} = \alpha + \beta_o x_i$. Following the method of minimum squares, the differences of the random variable Y and the above adjusted line is used to form the sum of squared error as:

$$\varepsilon^2 = \sum_{i=1}^{n} (y_i - y_{ri})^2 , \quad \text{or} \qquad (4)$$

$$\varepsilon^2 = \sum_{i=1}^{n} (y_i - \hat{\beta}_o . x_i - \hat{\alpha})^2 \;, \; i = 1,2,3.....n \qquad (5)$$

Symbols with a ^ are sample estimates and from here to the end $\hat{\beta}_o = \tan(\hat{\beta})$ also represents the regression coefficient; the ^ will be omitted from now on.

By taking the derivative of ε^2 relative to β_o and separately a derivative relative to α , making the resulting expressions equal to zero and equating the expressions for α, one obtains:

$$\alpha = 1 / n \left(\sum_i y_i - \sum_i \beta_o . x_i\right) \qquad (6)$$

which, when replaced in the first derivative produce

$$\beta_o = \left(n \sum_i y_i x_i - \sum_i y_i \sum_i x_i\right) / \left(n \sum_i x_i^2 - \left(\sum x_i\right)^2\right) . \qquad (7)$$

By expanding the above expression and by adding and subtracting in the denominator

$$(\sum_i x_i)^2,$$

β_o **and** ρ_c **can be expressed in terms of :**

VAR[X]= $[1/n\sum (x_i - \bar{x})^2] = \sigma^2(x_i)$, **where** $\bar{x} = 1/n\sum_i x_i$. (8)

VAR[Y]= $[1/n\sum (y_i - \bar{y})^2] = \sigma^2(y_i)$ **and** (9)

COV[YX]= $n\sum_i x_i y_i - \sum_i x_i \sum_i y_i$ **so that to obtain:**
(10)

$$\beta_o = \frac{COV[YX]}{\sqrt{VAR[X]VAR[X]}} \quad \text{and} \quad \rho_c = \frac{COV[YX]}{\sqrt{VAR[X]VAR[Y]}}, \qquad (11)$$

where β_o **is the regression coefficient and** ρ_c **indicates correspondingly the collinearity coefficient, when time** t_i **is taken linearly to represent the variable** $x_i = t_i$**, or , in general,** x_i **= alfa.**t_i**, where alfa is a constant . Note that expression (11) is the equation (3) of Section (The Regression x Correlation – (r x** $\rho_c =$**) Plot.**

In order to relate the β_o **and** ρ_c **values, one can divide their expressions above, to obtain:**

$$\beta_o / \rho_c = \frac{COV[X,Y]/[Var[X].Var[Y]]^{1/2}}{COV[X,Y]/[VAR[X].VAR[X]]^{1/2}}, \qquad (13)$$

giving:

$$\rho_c = \beta_o \frac{std[X]}{std[Y]} = \frac{\beta_o \sigma(t_i)}{\sigma(y(t_i))}, \qquad (14)$$

but the standard deviation $\sigma(y(t_i))$ has a real value that can, in all cases, be divided by $\sigma(t_i) \neq 0$, producing a real number $\beta^{''}$, not always equal to β_o, and the above value (14) is reduced to:

$$\rho_c = \beta_o / \beta^{''} = m_o, \qquad (15)$$

where m_o is a dimensionless constant less or equal to one . In this circumstance the collinearity coefficient ρ_c is, for each regression line, independent of the inclination, or rather, of the regression coefficient given by β_o = tan(β) , as one would have sought for . For a given β_o there will be always a $\beta^{''}$ to make the above quotient equal to m_o.

THE F VALUES

As the proximity ℓ and the collinearity ρ_c coefficients, are independent of the inclination angle β, it is convenient to define a variable F that is also independent of the inclination such as:

$$F = \ell \times \rho_c \,. \qquad (13)$$

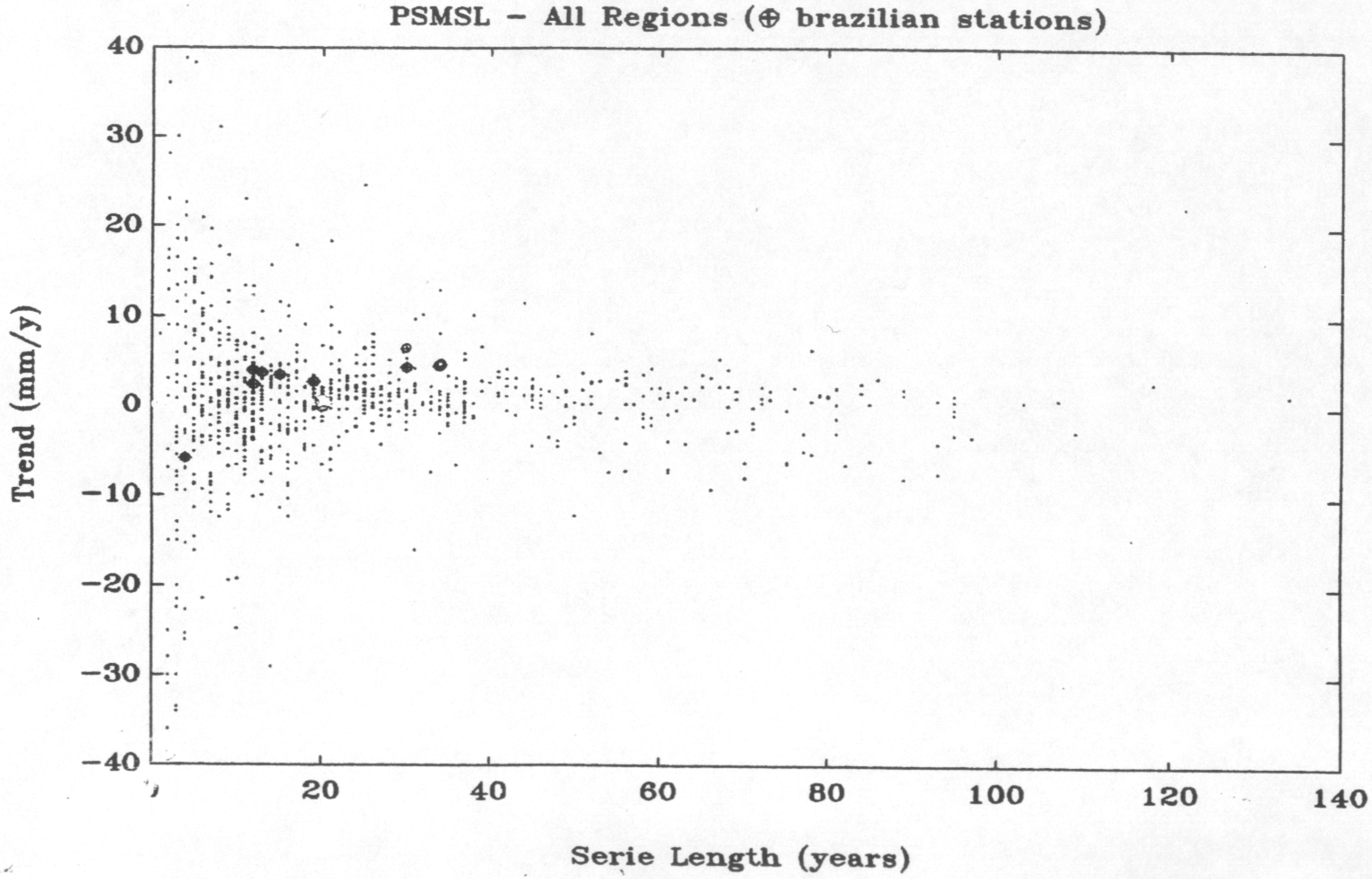
From (13) *F* depends on the coefficients of proximity ℓ and collinearity ρ_c and has a constant value for each planetary series, that are the sea level series of PSMSL.

For values of collinearity ρ_c equal to zero, will correspond large proximity ℓ values and for values of collinearity equal to one, they will correspond to proximity values equal to zero.

In this way, the values of the *F* function, being the product of both coefficients, have a sort of push and pull action. Values of *F* will be equal zero if either collinearity or proximity values are zero.

3-FIGURES OF PSMSL96 SERIES

PSMSL96 Trends x Length of Series-
-Brazilian Trends are in black dots-
- Long series seem to point to 18 cm/cty-



Trends x Collinearity Plot for Africa,PacificSAm,Atlantic and Brazil Ports

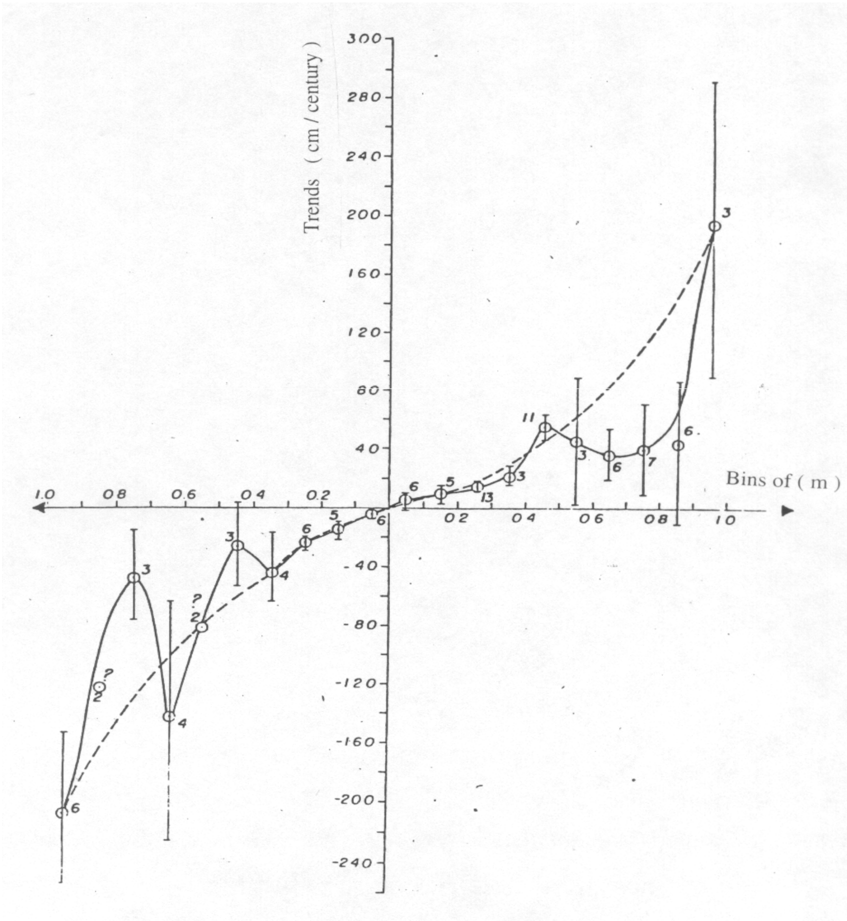


Fig 5 - Values of trends (C) x correlation coefficients (m)

Means and the numbers of elements in each bin are indicated with the error bars.

- 1-Africa,Atlantic,PacificSA and Brazil trends.
- 2-Bars are standard deviations
- Numbers indicate total of series trends, from all places, in each bin
- 3-Full line joins the trends mean values of each bin.
- 4-Dotted line supposes a symmetric balance of negatively and positively trended series.
- 5-Trend mean values seem to be following an exponential function, within collinearity bins -0.4 to +0.4 , showing very low standard deviations.
- 6-There appear negatively trended bins to be, in absolute values, greater than the positive ones.
- 7- Each bin contains Trend values from any (Africa,PaciSm,Atlantic and Brazil ports) coast..

Latitudes x Trends
-PSMSL96-

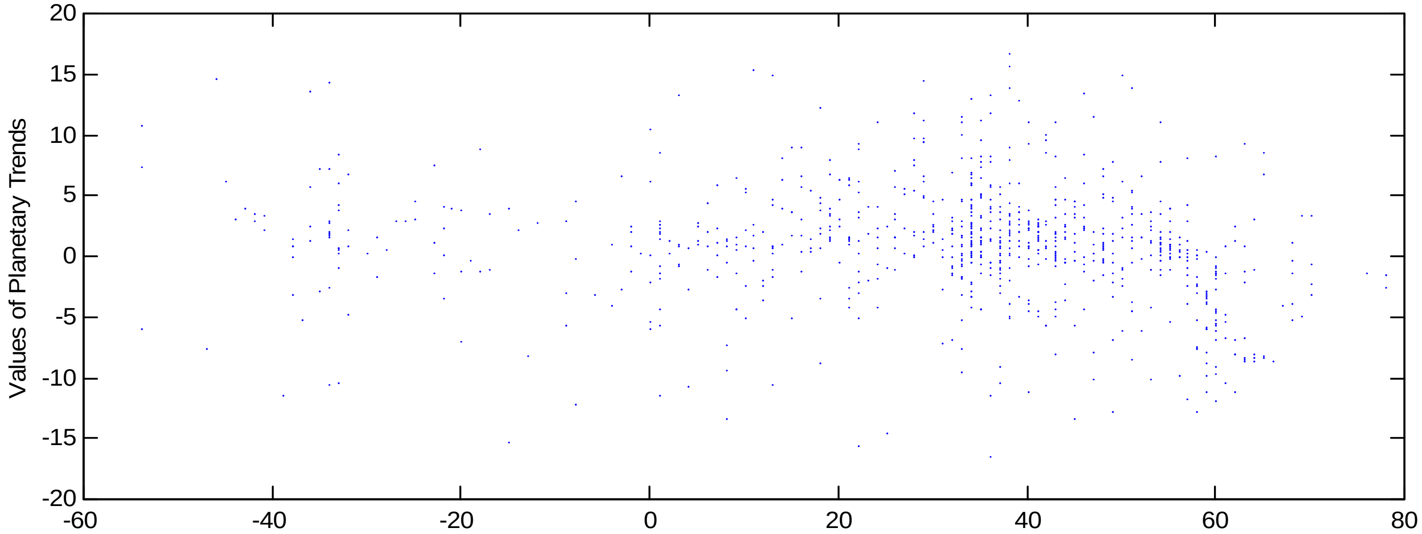


Fig 14 - Distribution along the Latitudes of Planetary Trends

Trend Values seem well distributed along the Latitudes

Longitudes x Trends
-PSMSL 96-

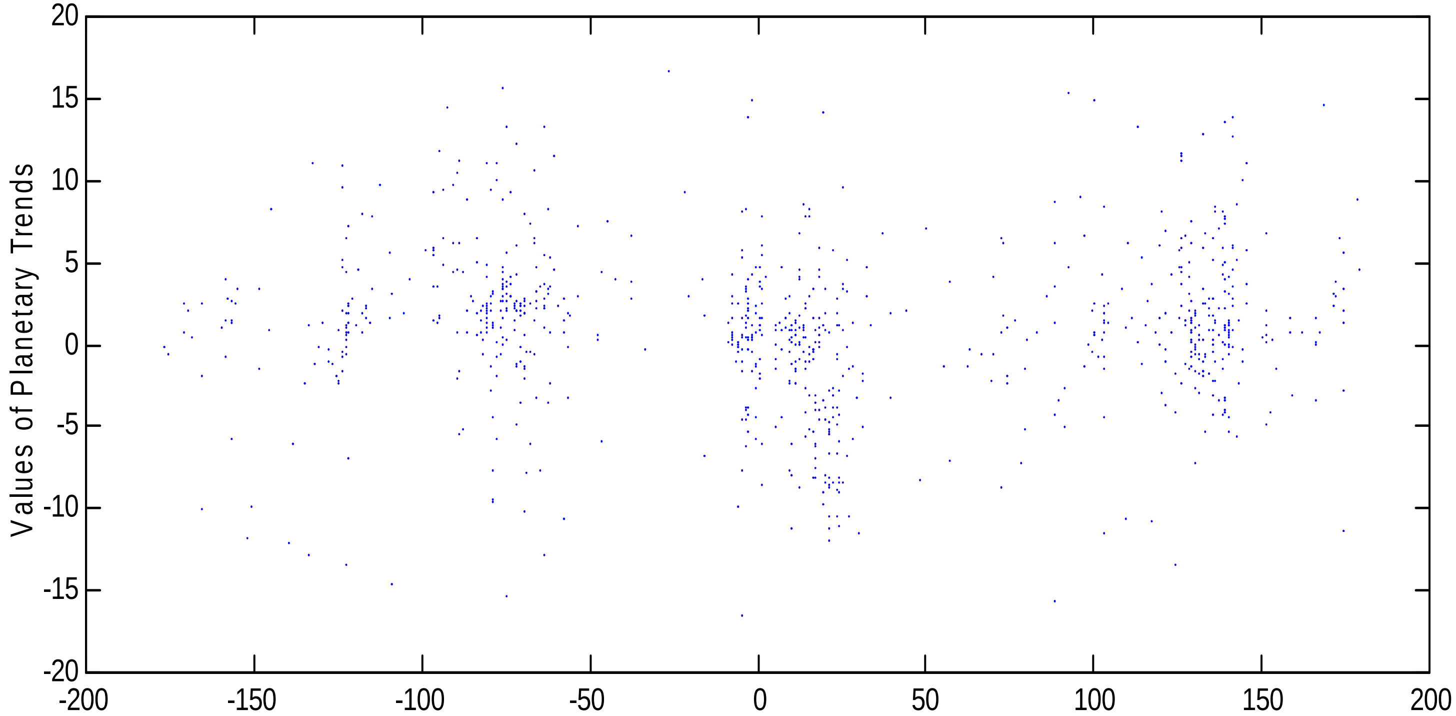


Fig 15 - Distribution along the Longitudes of Planetary Trends

Trend values seem well distributed along the longitudes

PSMSL96- Collinearity x Trends

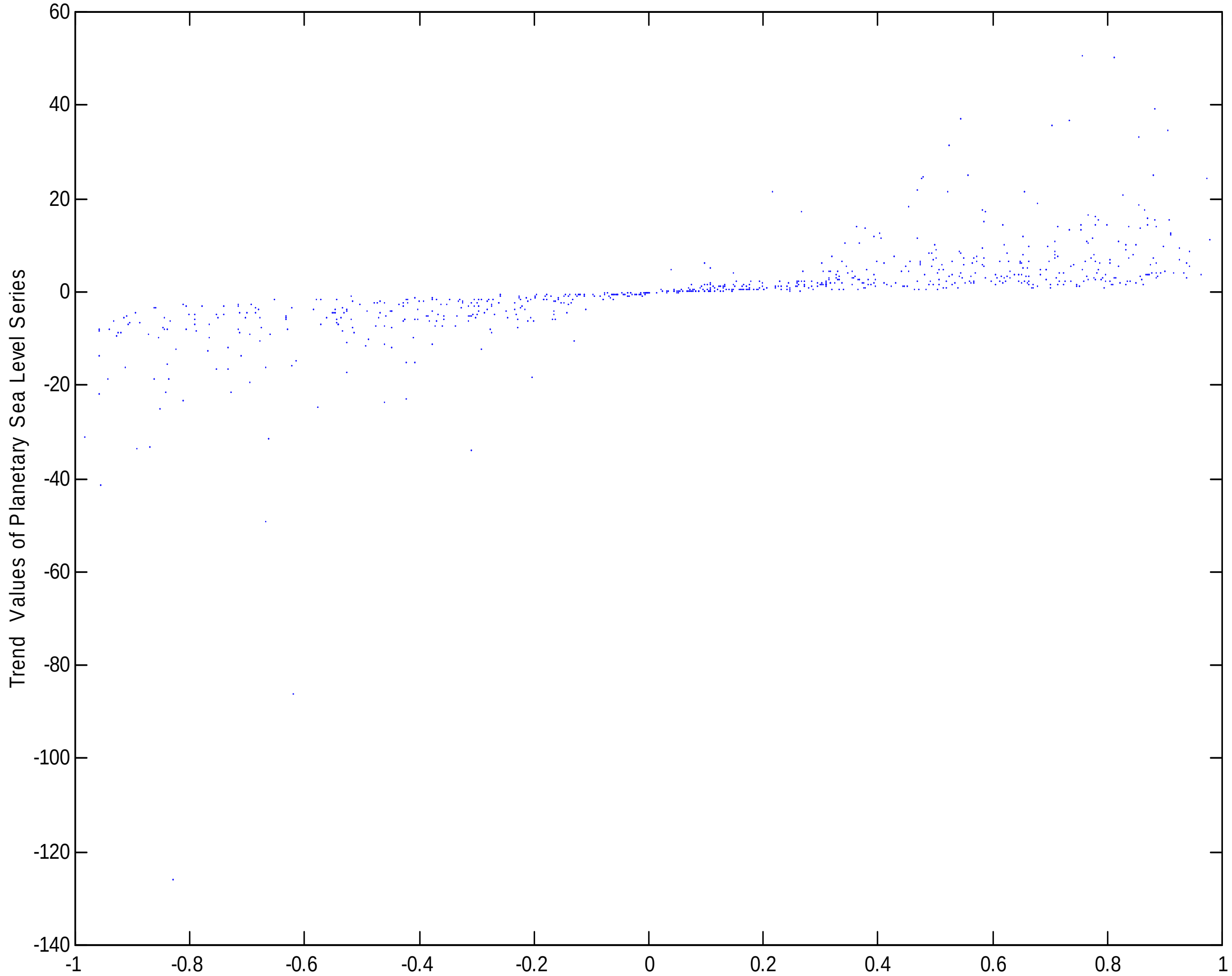
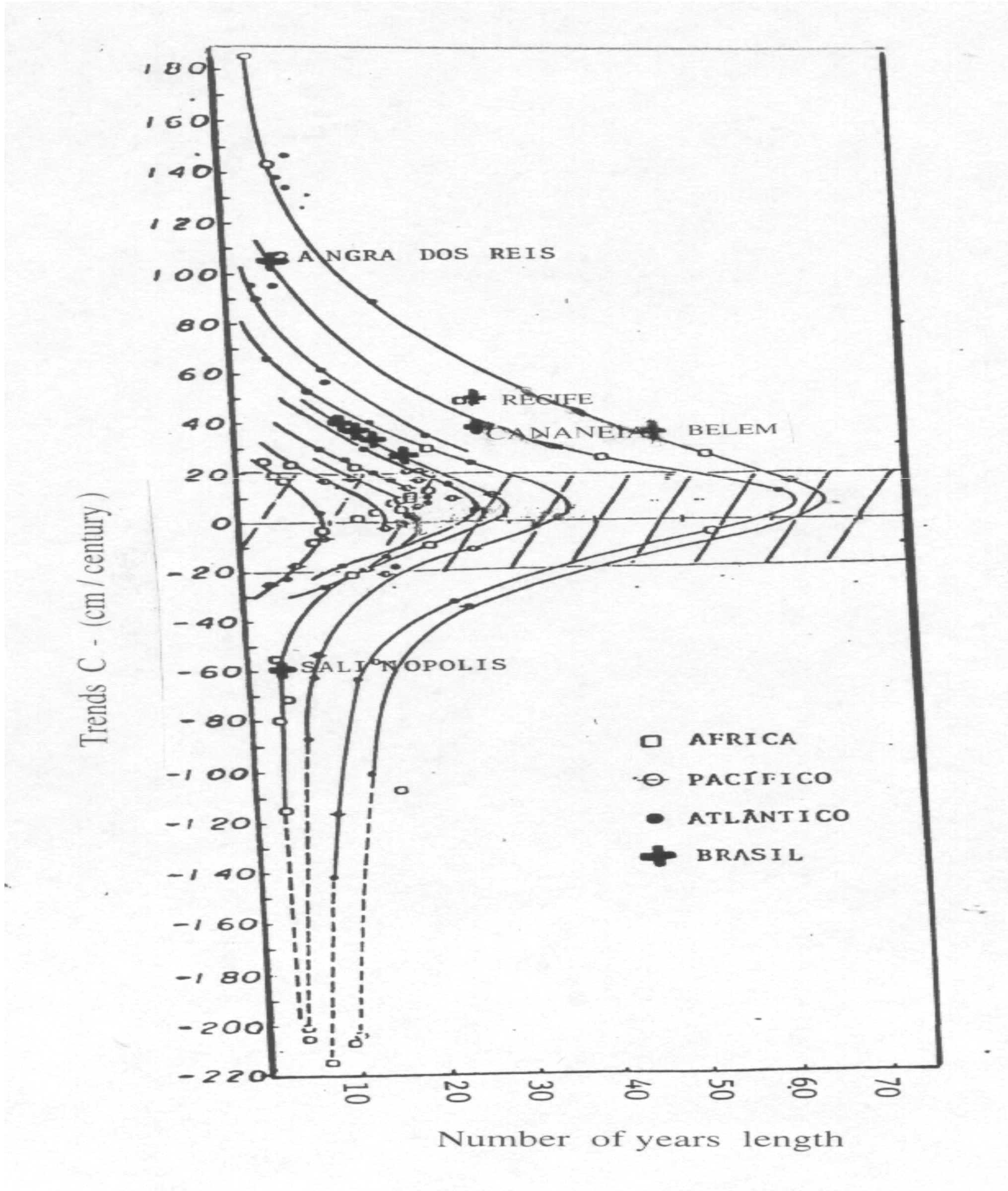


Fig 3 Collinearity Values of Planetary Sea Level Series

Africa,Atlantic,PacificSAm and Brazil Trends x Series Lengths



- LINES ARE HYPOTHETICAL. MADE TO INDICATE ALSO 18 CM/CTY.

  SHADED AREAS CORRESPOND TO COLLINEARITY VALUES LESS THAN 0.3.

Histogramme of Collinearity Values - Nearly Retangular–PSMSL96 Series -

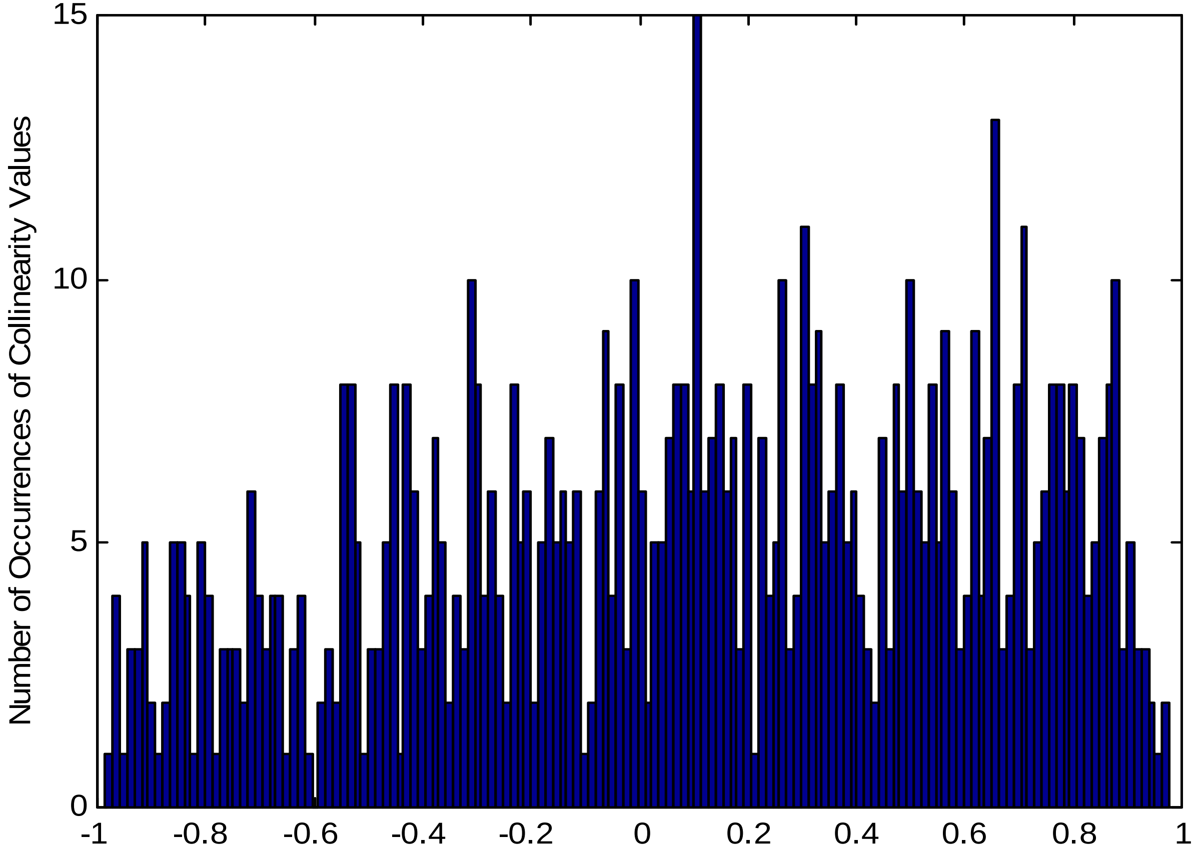
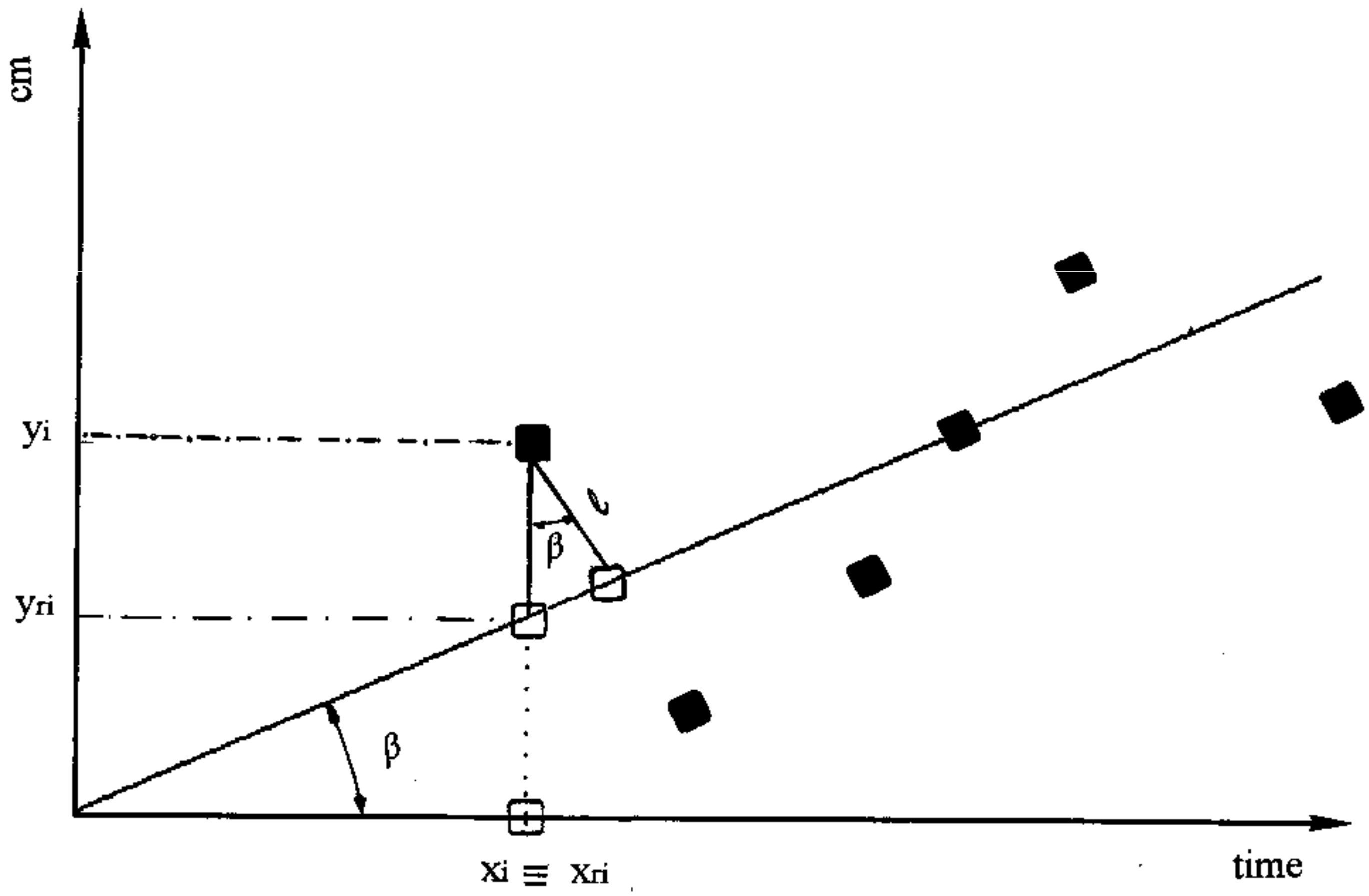


Fig 4 Histogram of Collinearity Values of Planaetary Sea Level Series

See that distances (y-yr), relative to the Regression Line, can be Positive, equal to Zero and also Negative.



HISTOGRAMME OF PSMSL96 PROXIMITY COEFFICIENTS . NOTE THE TAIL IS LARGER IN THE NEGATIVE SIDE.

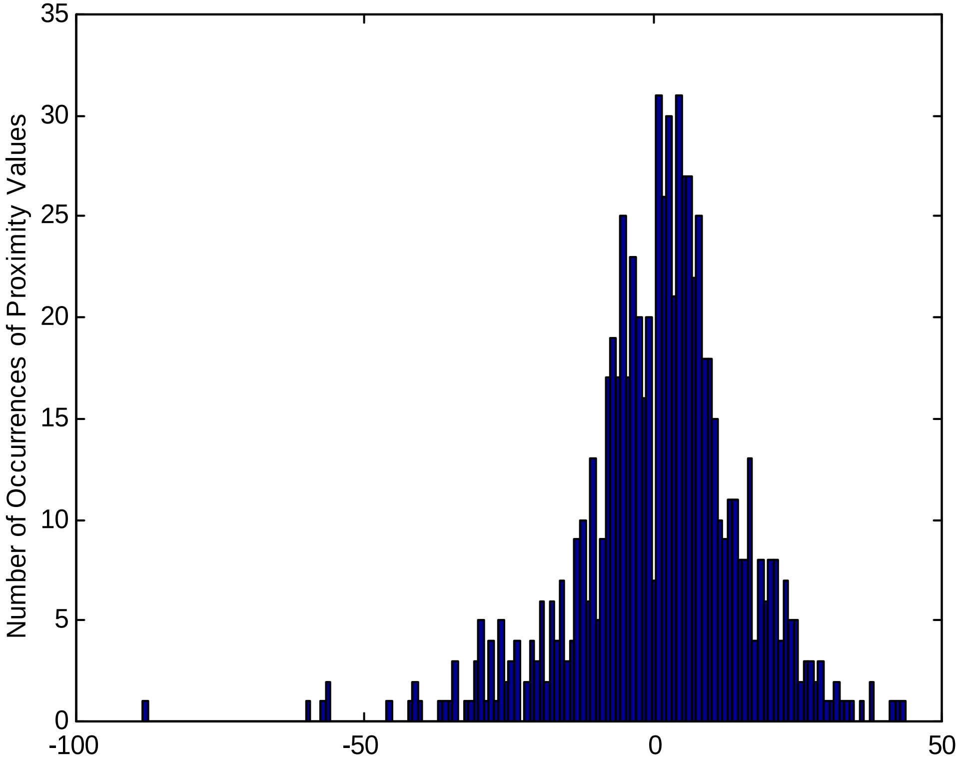


Fig 4a Histogram of Proximity Values of Planetary Sea Level Series

ABS(Proximity) x Trends
-PSMSL96 Series-

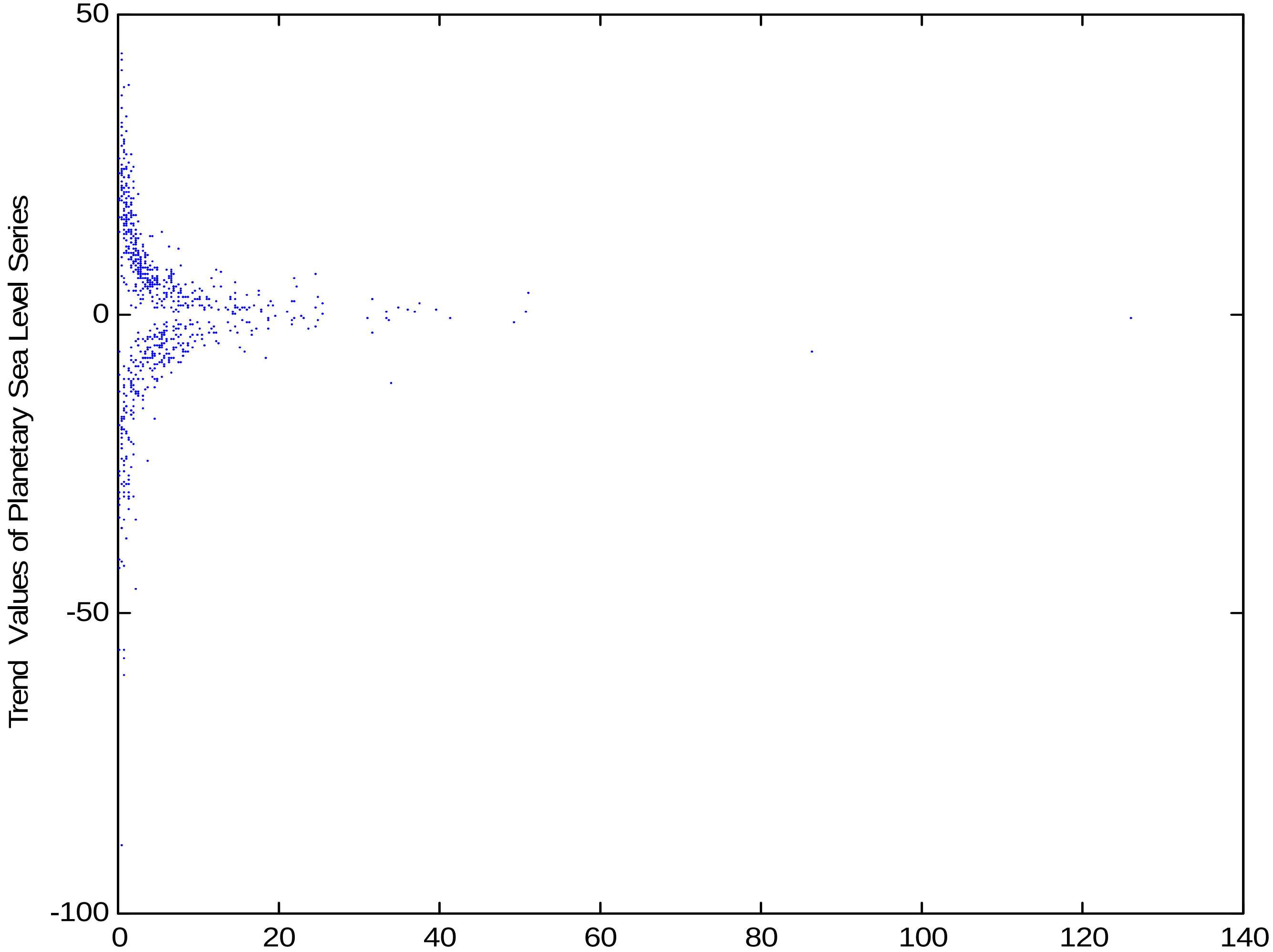


Fig 9 Proximity Values of Planetary Sea Level Series

The ABS(Prox) x Coll Push and Pull Characteristic –PSMSL96-

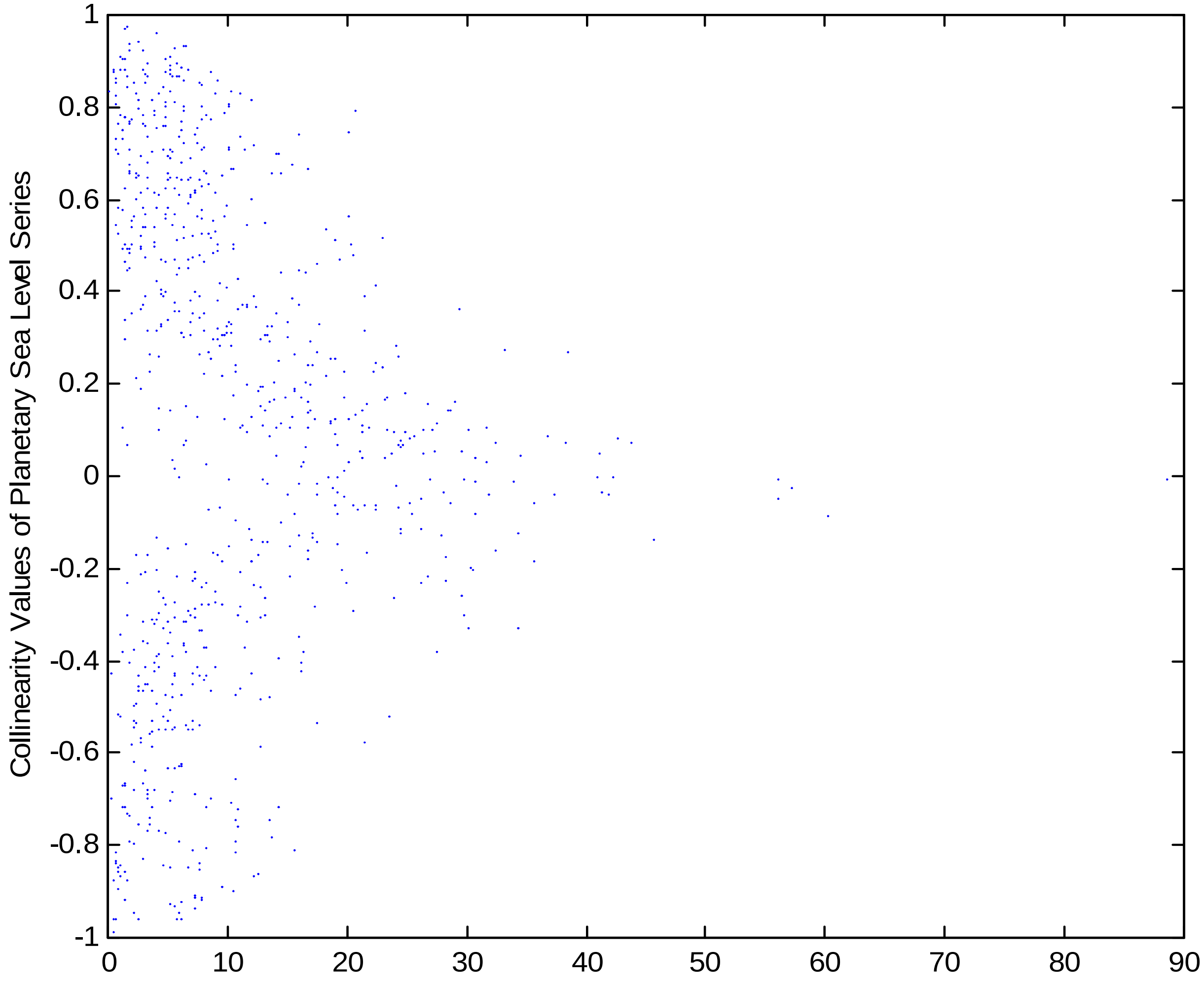


Fig 11 Proximity Values of Planetary Sea Level Series

- For low values of Proximity correspond high values of Collinearity and vice versa.
- For Collinearity low values correspond high values of Proximity.
- The F values, being their product, seem to measure a sort of **“state of variability”** of the Sea Level Series..

Histogramme of F Values
- PSMSL96 Series -

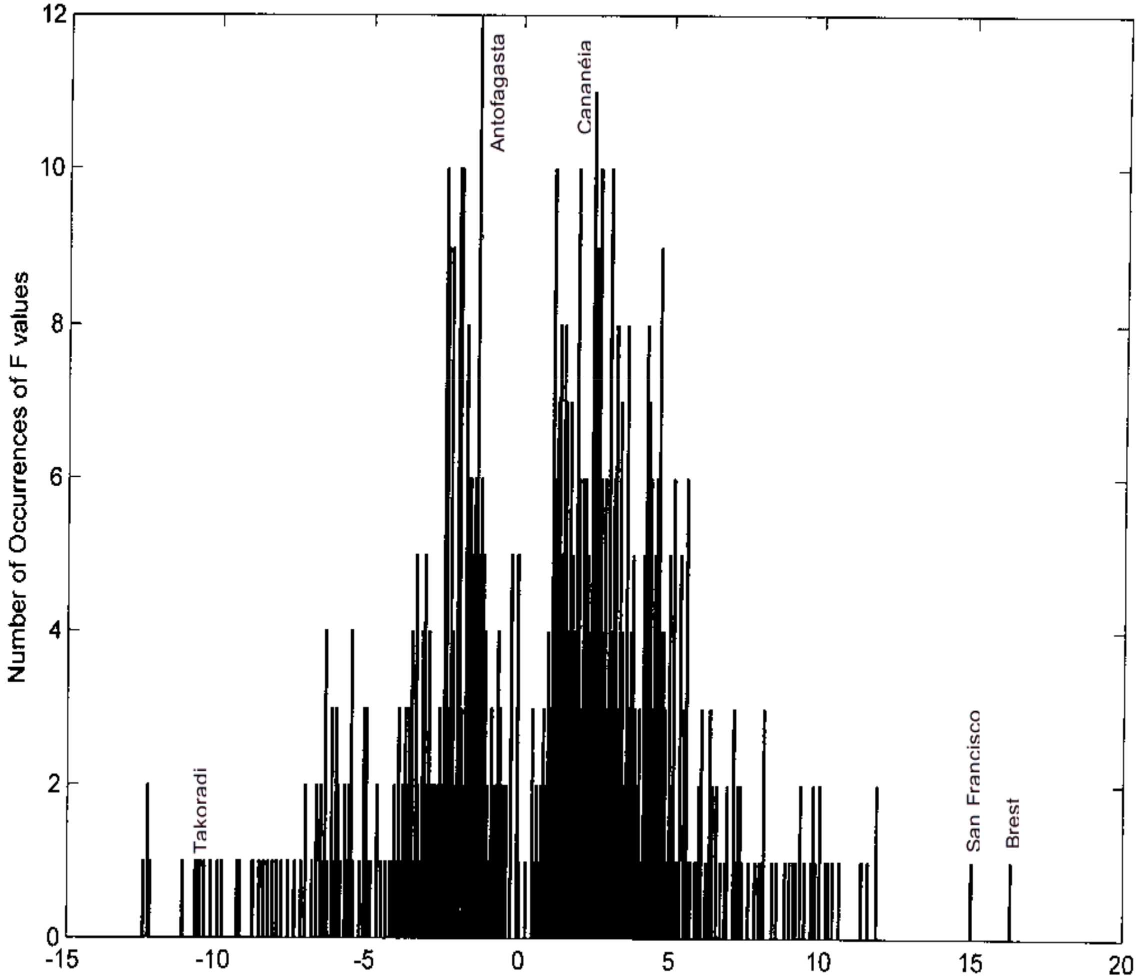


Fig.13 - Bins of F values for PSMSL Series

F values equal to zero, as expected, are not frequent, while places as San Francisco and Brest have the highest scores.

The histogramme shape is nearly constant with the time.

F Values for PSMSL96 Series Greater than 10 Years.

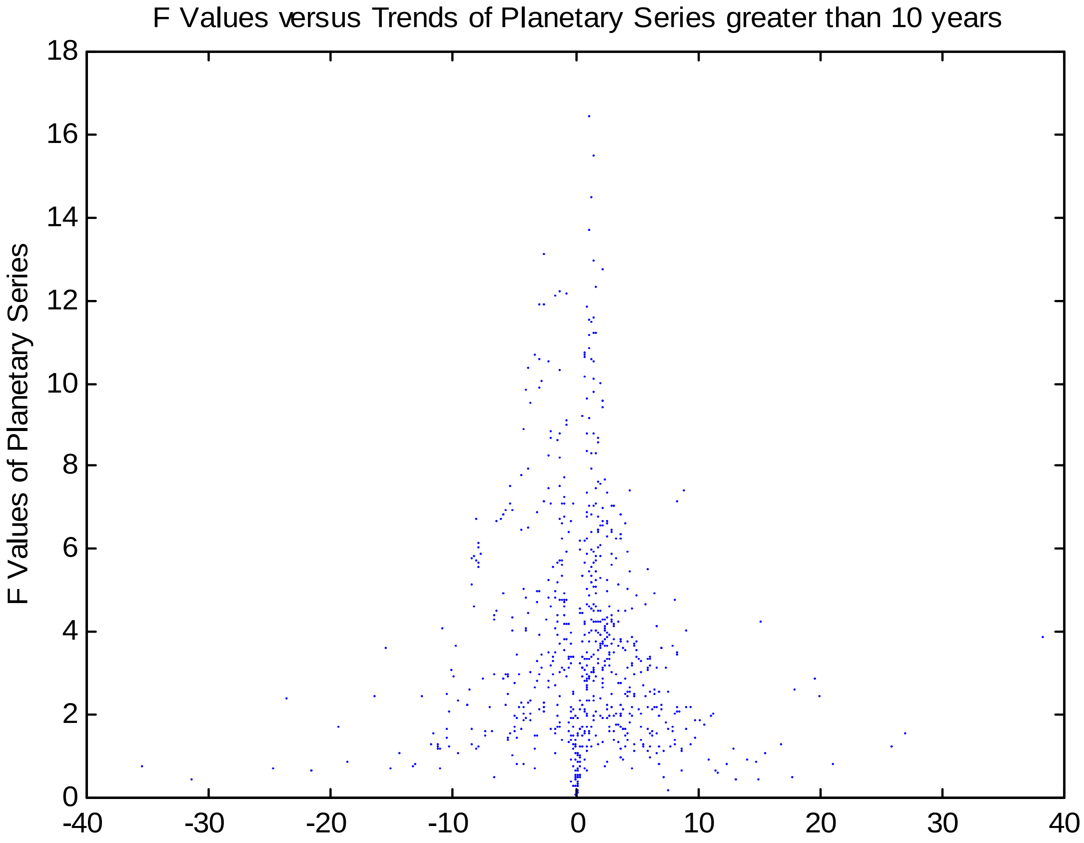
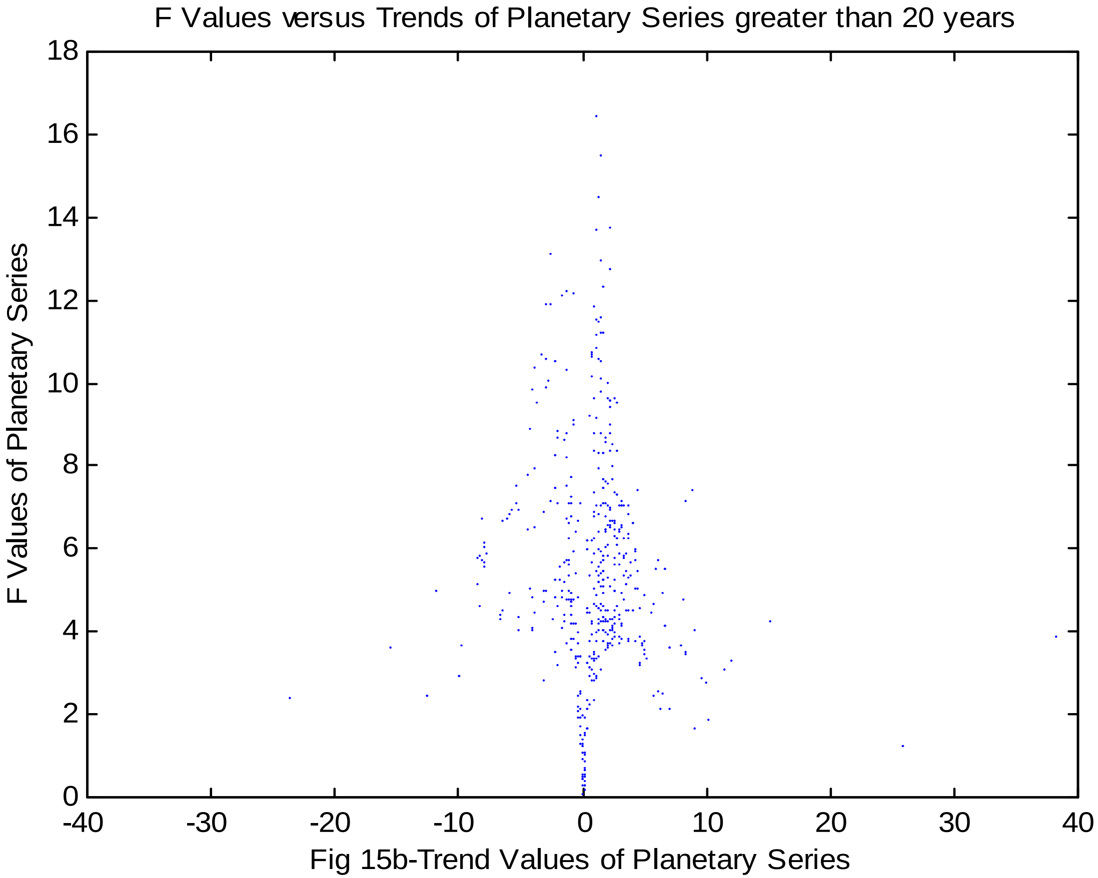


Fig 15a-Trend Values of Planetary Series

-Trend and F values, like a Christmas tree, have a stem just about on trend and F values equal to zero.

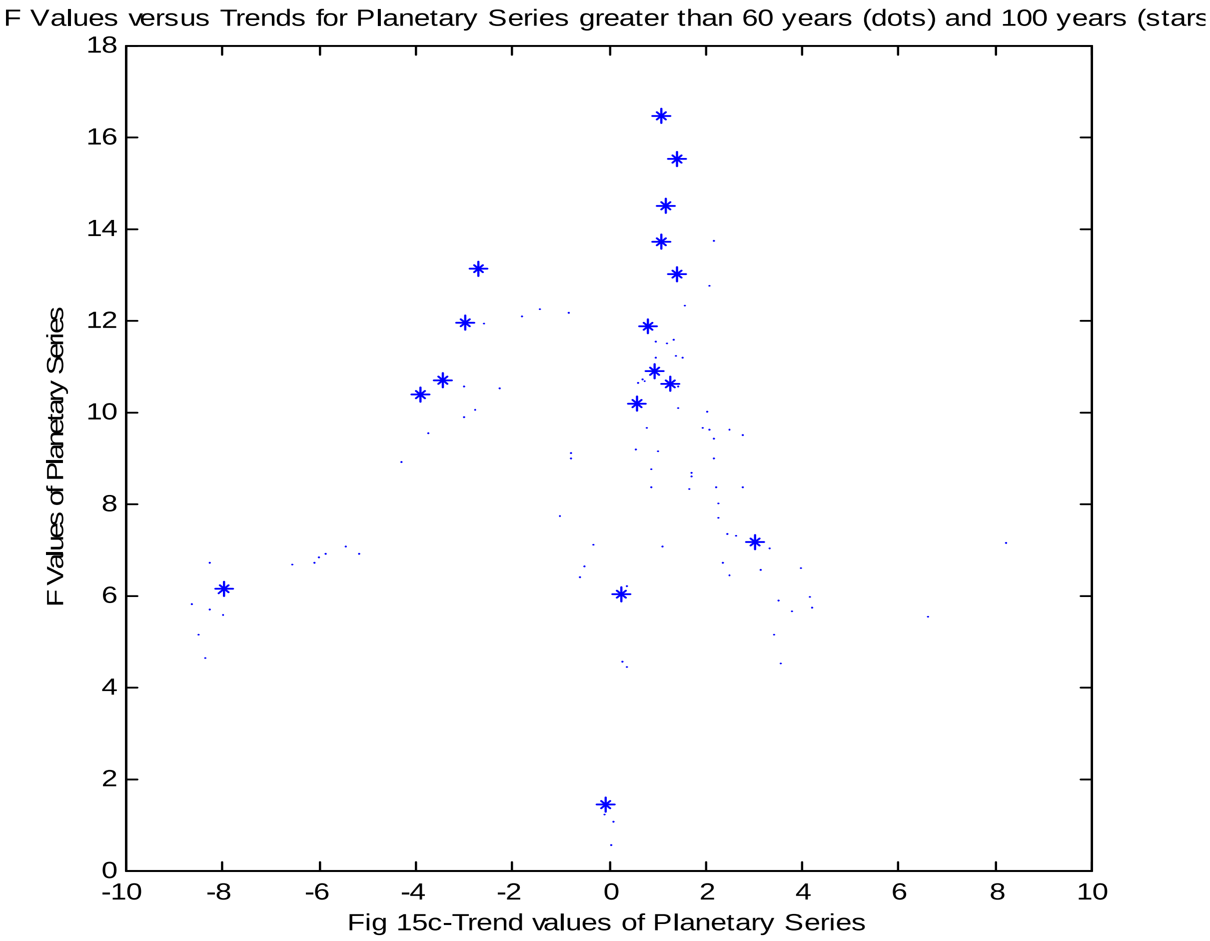
-From this point the stem seems to brake to the left side (negative) and to the right side (positive), reaching greater F values.

F Values for PSMSL96 Series Greater than 20 Years.



F values,for series with more than20 years in length, clearly shows the separation of negative and positive trends.

F Values for PSMSL96 Series Greater than 60 and Hundred Years.



1-The right side of the Figure shows F values with a line of "stars" indicating a mean trend value of 18 cm/cty .

2-But the left branch shows high and low F values with trends very much towards the negative side of the Figure.

3-The left side with negative trends, seems to have a distinct characteristic shape, relative to trends of the right side of the Figure.

Collinearity Bins x Mean Trends -PSML96 Series-

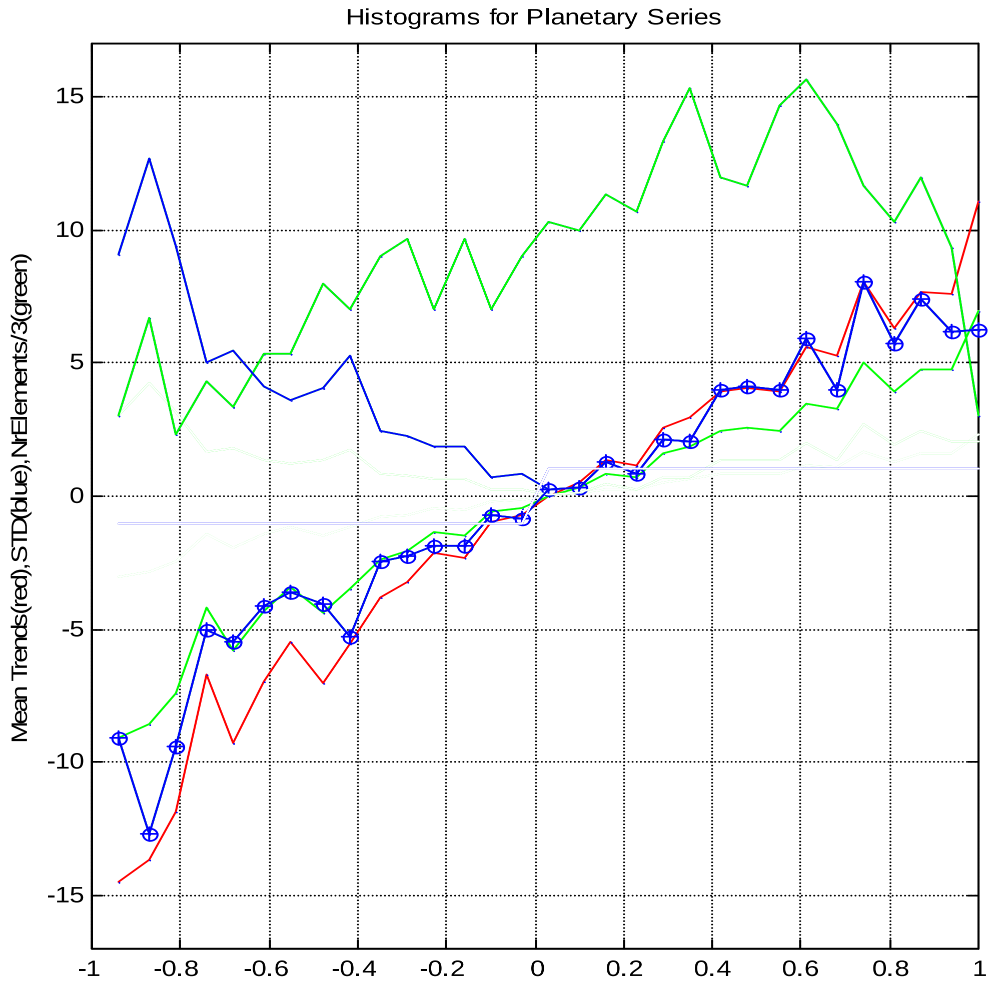


Fig 13a - Collinearity Bins of Planetary Series

The overall Charac-_
-teristics of Slide 25,
which has smaller amount
of data, are preserved
in this slide, considering
all PSMSL96 data.

1-Has equally low std values (blue), near zero trend values.

2-Has also, as Fig 25, an exponential (red) line inclination, towards higher trend values in the negative side of the Fig..

3-This, however, is not repeated in the positive side of the slide.

4 – Next slide repeats slide 25 for comparison.

Trends x Collinearity Plot for Africa,PacificSAm,Atlantic and Brazil Ports.

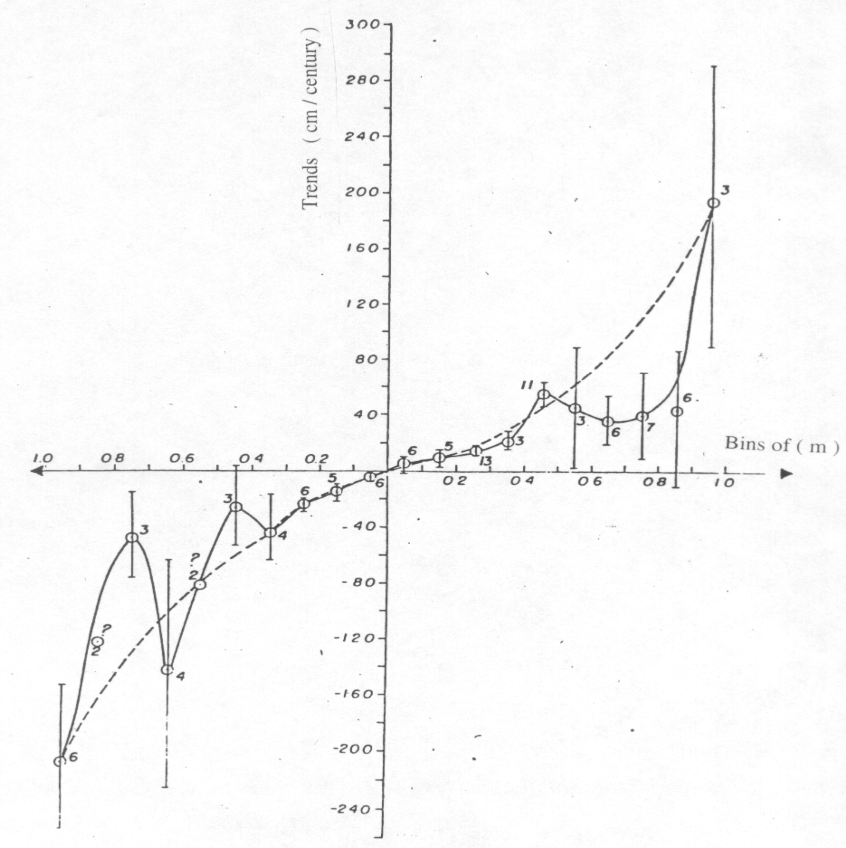


Fig 5 - Values of trends (C) x correlation coefficients (m)

Means and the numbers of elements in each bin are indicated with the error bars.

- 1-Africa,Atlantic,PacificSA and Brazil trends are shown in the Fig .
- 2-Bars are standard deviations.
- Numbers indicate total of series trends, from all places, in each bin
- 3-Full line joins the trends mean values of each bin.
- 4-Dotted line supposes a symmetric balance of negatively and positively trended series.
- 5-Trend mean values seem to be following an exponential function, within collinearity bins -0.4 to +0.4 , showing very small standard deviations.
- 6-There appear negatively trended bins to be, in absolute values, greater than the positive ones.

Distribution along the Latitudes x Longitudes of High and Low values of Trends – 60 to 100 years- PSMSL96 Series.

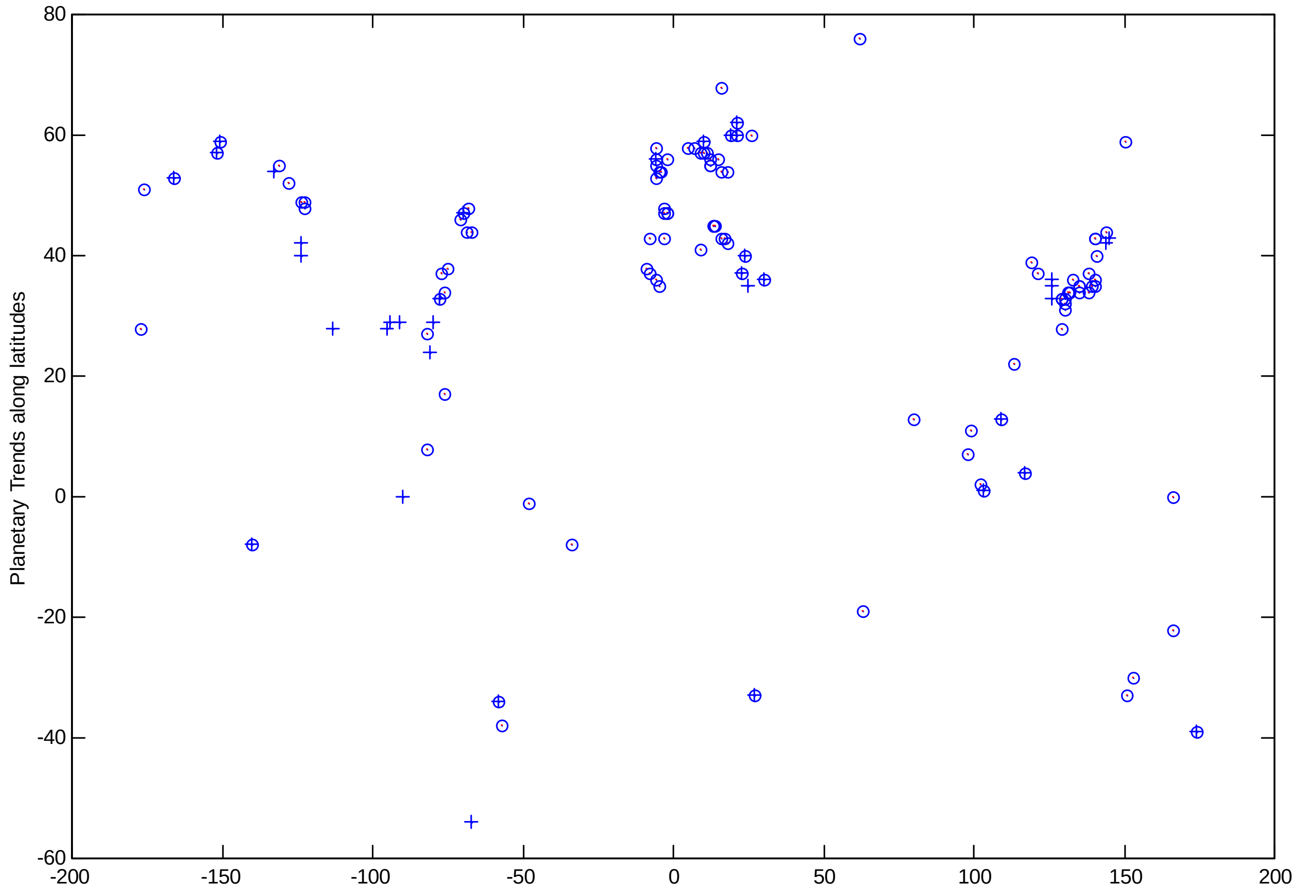


Fig 16 - Trends, nearly stable, maximum negative, maximum positive along longitudes

Places of High and Low values of Trends are often close to each other.

+ High positive.

• High negative.

o Nearly zero.

TABLE I---Values of *n, ny*, , , *rv*, , *n*, *m*, *F , Fn, Lat and Long* for Planetary Series with Lengths Greater than 60 years,

column 1 are the Stations numbers of the rlrann96.tel PSMSL global series ***(n)***; column 2, the number of years of the series of sea level (***ny)***; column 3, the trend values of the series; column 4, the collinearity values **;** column 5, the ratio of standard deviations (***rv)*** of sea levels and the time; columns 6, values of the coefficient of proximity **() ;** column 7, the values of proximity normalised *n=/max, (*not used); column 8, values collinearity calculated from expression (***m***) ; column 9, values of (***F)*****= x** ; column 10 , values of *F* with the proximity normalised, (not used) ; other columns are, respectively, the (**Latitudes)** of the Stations, positive to the North, and (**Longitudes),** positive to the West.ns of Stations

- ***n*** ***ny*** **rv** ***n*** ***m*** ***F*** ***Fn*** ***Lat*** ***Long***
- 32 71 -.800 -.428 -.184 -21.355 -.301 -.430 -9.150 -.129 60 24 +1 05 18 -1
- 37 70 -5.908 -.897 -.805 -7.752 -.111 -.897 -6.954 -.099 59 54 +1 10 45 –1
- 41 86 -2.267 -.803 -.645 -13.135 -.153 -.805 -10.550 -.123 58 22 +1 11 13 -1
- 43 81 -1.436 -.577 -.332 -21.285 -.263 -.578 -12.271 -.151 57 43 +1 11 57 -1
- 45 95 -.859 -.519 -.269 -23.498 -.247 -.520 -12.194 -.128 57 06 +1 12 13 –1
- 46 66 .044 .016 .000 36.726 .556 .016 .602 .009 55 31 +1 12 54 -1
- 48 95 .588 .365 .133 29.281 .308 .365 10.675 .112 55 25 +1 13 49 -1
- 49 109 -.059 -.038 -.001 -37.434 -.343 -.039 -1.441 -.013 56 06 +1 15 35 -1

51 110 -2.987 -.865 -.748 -13.820 -.126 -.865 -11.950 -.109 58 45 +1 17 52 -1

52 102 -3.439 -.876 -.767 -12.209 -.120 -.879 -10.695 -.105 59 12 +1 17 37 -1

53 108 -3.916 -.901 -.812 -11.551 -.107 -.904 -10.406 -.096 59 19 +1 18 05 -1

55 85 -6.123 -.937 -.878 -7.218 -.085 -.938 -6.762 -.080 60 38 +1 17 58 -1

56 91 -6.043 -.938 -.880 -7.316 -.080 -.942 -6.861 -.075 60 40 +1 17 10 -1

57	70	-8.024	-.929	-.864	-6.027	-.086	-.936	-5.601	-.080	62	20	+1	17	28	-1
59	104	-7.950	-.964	-.929	-6.399	-.062	-.964	-6.169	-.059	64	00	+1	20	55	-1
60	80	-8.658	-.936	-.875	-6.228	-.078	-.944	-5.827	-.073	64	55	+1	21	14	-1
61	61	-8.103	-.886	-.784	-6.862	-.112	-.898	-6.077	-.100	65	40	+1	24	31	-1
62	82	-8.288	-.930	-.865	-7.252	-.088	-.933	-6.744	-.082	65	02	+1	25	25	-1
65	70	-8.299	-.931	-.868	-6.156	-.088	-.933	-5.734	-.082	63	42	+1	22	42	-1
66	93	-8.540	-.968	-.936	-5.333	-.057	-.971	-5.160	-.055	63	06	+1	21	34	-1
67	61	-8.393	-.924	-.855	-5.039	-.083	-.941	-4.658	-.076	63	04	+1	20	48	-1
71	75	-6.602	-.921	-.848	-7.280	-.097	-.921	-6.702	-.089	61	36	+1	21	28	-1
74	78	-5.451	-.915	-.837	-7.771	-.100	-.918	-7.107	-.091	60	51	+1	21	11	-1
75	77	-5.179	-.913	-.834	-7.610	-.099	-.920	-6.951	-.090	60	36	+1	21	14	-1
76	63	-4.324	-.774	-.599	-11.547	-.183	-.783	-8.935	-.142	60	26	+1	22	06	-1
81	69	-2.797	-.716	-.513	-14.095	-.204	-.724	-10.092	-.146	59	47	+1	21	22	-1
84	77	-3.037	-.780	-.609	-13.593	-.177	-.783	-10.607	-.138	59	57	+1	22	22	-1
85	68	-3.047	-.743	-.552	-13.369	-.197	-.749	-9.932	-.146	59	46	+1	22	57	-1
86	81	-3.747	-.841	-.707	-11.366	-.140	-.844	-9.556	-.118	59	49	+1	22	59	-1
88	109	-2.710	-.815	-.665	-16.110	-.148	-.816	-13.134	-.120	60	09	+1	24	58	-1
89	71	-1.811	-.518	-.268	-23.403	-.330	-.526	-12.122	-.171	60	07	+1	25	25	-1
98	63	.984	.278	.077	33.128	.526	.282	9.196	.146	56	32	+1	20	59	-1
111	136	1.168	.798	.637	18.170	.134	.799	14.499	.107	54	11	+1	12	05	-1
112	143	1.404	.868	.753	14.988	.105	.870	13.003	.091	53	54	+1	11	28	-1
113	94	.967	.627	.393	18.444	.196	.633	11.564	.123	54	34	+1	11	56	-1

112	143	1.404	.868	.753	14.988	.105	.870	13.003	.091	53	54	+1	11	28	-1
113	94	.967	.627	.393	18.444	.196	.633	11.564	.123	54	34	+1	11	56	-1
115	103	.265	.218	.047	27.663	.269	.219	6.025	.058	55	41	+1	12	36	-1
116	90	.054	.035	.001	31.724	.352	.035	1.108	.012	56	06	+1	12	28	-1
117	91	.737	.540	.291	19.820	.218	.541	10.696	.118	55	20	+1	11	08	-1
118	89	.929	.631	.398	17.788	.200	.633	11.216	.126	55	17	+1	10	50	-1
121	101	.966	.748	.560	14.546	.144	.753	10.885	.108	55	34	+1	09	46	-1
122	95	.537	.493	.243	18.696	.197	.497	9.224	.097	56	09	+1	10	13	-1
123	85	.248	.191	.036	24.161	.284	.191	4.604	.054	57	26	+1	10	34	-1
124	90	-.364	-.226	-.051	-31.615	-.351	-.226	-7.148	-.079	57	36	+1	09	58	-1
126	101	1.073	.573	.328	23.927	.237	.573	13.709	.136	55	28	+1	08	26	-1
132	103	.586	.503	.253	20.306	.197	.499	10.212	.099	57	09	+1	02	05	+1
137	91	2.006	.851	.725	11.810	.130	.851	10.055	.110	55	00	+1	01	27	+1
147	70	3.964	.901	.811	7.357	.105	.902	6.625	.095	51	27	+1	00	45	-1
153	81	1.676	.832	.692	10.362	.128	.842	8.620	.106	50	06	+1	05	33	+1
191	167	1.103	.830	.689	19.829	.119	.829	16.458	.099	48	23	+1	04	30	+1
208	99	1.336	.770	.594	15.075	.152	.771	11.614	.117	38	41	+1	09	25	+1
212	71	1.696	.770	.592	11.319	.159	.770	8.710	.123	37	06	+1	08	40	+1
222	106	1.278	.810	.657	13.092	.124	.809	10.610	.100	43	18	+1	05	21	-1
229	84	1.656	.861	.741	9.716	.116	.860	8.364	.100	44	24	+1	08	54	-1

246	86	1.161	.636	.405	18.098	.210	.639	11.515	.134	45	39	+1	13	45	-1
279	79	2.034	.608	.370	20.999	.266	.608	12.767	.162	44	06	+1	39	04	-1
292	61	-2.619	-.409	-.167	-29.223	-.479	-.409	-11.953	-.196	04	53	+1	01	45	+1
331	111	.811	.661	.437	17.986	.162	.663	11.886	.107	18	55	+1	72	50	-1
469	63	3.383	.923	.851	5.619	.089	.929	5.185	.082	35	09	+1	139	37	-1
517	65	-.813	-.355	-.126	-25.339	-.390	-.357	-9.006	-.139	32	26	+1	131	40	-1
546	85	.348	.261	.068	23.852	.281	.261	6.226	.073	34	54	+1	132	04	-1
557	65	-1.018	-.627	-.393	-12.371	-.190	-.629	-7.759	-.119	37	24	+1	136	54	-1
570	70	8.183	.903	.815	7.968	.114	.903	7.192	.103	14	35	+1	120	58	-1
590	63	2.170	.670	.448	14.117	.224	.672	9.453	.150	32	55	-1	151	48	-1
591	97	.679	.541	.293	19.864	.205	.545	10.747	.111	33	51	-1	151	14	-1
606	83	1.377	.696	.485	16.143	.194	.700	11.240	.135	36	51	-1	174	46	-1
647	91	1.515	.745	.556	15.063	.166	.748	11.229	.123	21	19	+1	157	52	+1
677	75	-.093	-.046	-.002	-27.355	-.365	-.055	-1.248	-.017	55	20	+1	131	38	+1
678	64	1.417	.549	.301	18.431	.288	.552	10.113	.158	54	19	+1	130	20	+1
689	66	.333	.181	.033	24.844	.376	.182	4.484	.068	49	17	+1	123	07	+1
695	84	.741	.453	.205	21.373	.254	.455	9.674	.115	48	25	+1	123	22	+1
705	97	2.033	.869	.755	11.077	.114	.870	9.628	.099	47	36	+1	122	20	+1
707	69	-.525	-.229	-.052	-29.221	-.423	-.231	-6.684	-.097	46	13	+1	123	46	+1
713	61	-.639	-.291	-.084	-22.173	-.363	-.294	-6.442	-.106	41	45	+1	124	12	+1
716	141	1.387	.793	.628	19.580	.139	.794	15.518	.110	37	48	+1	122	28	+1

Continued

723	71	.861	.514	.264	17.118	.241	.520	8.793	.124	33	43	+1	118	16	+1
727	66	2.405	.844	.713	8.747	.133	.848	7.386	.112	32	52	+1	117	15	+1
728	88	2.238	.894	.800	8.628	.098	.898	7.717	.088	32	43	+1	117	10	+1
753	88	1.424	.711	.505	14.879	.169	.713	10.575	.120	08	58	+1	79	34	+1
785	64	.860	.480	.231	17.508	.274	.480	8.407	.131	38	35	-1	58	42	+1
790	83	1.566	.627	.393	19.690	.237	.628	12.341	.149	34	36	-1	58	22	+1
814	61	1.097	.685	.469	10.357	.170	.687	7.091	.116	09	21	+1	79	55	+1
844	86	6.595	.960	.922	5.790	.067	.962	5.560	.065	29	19	+1	94	48	+1

Circles Indicate Nearly Trend Zero

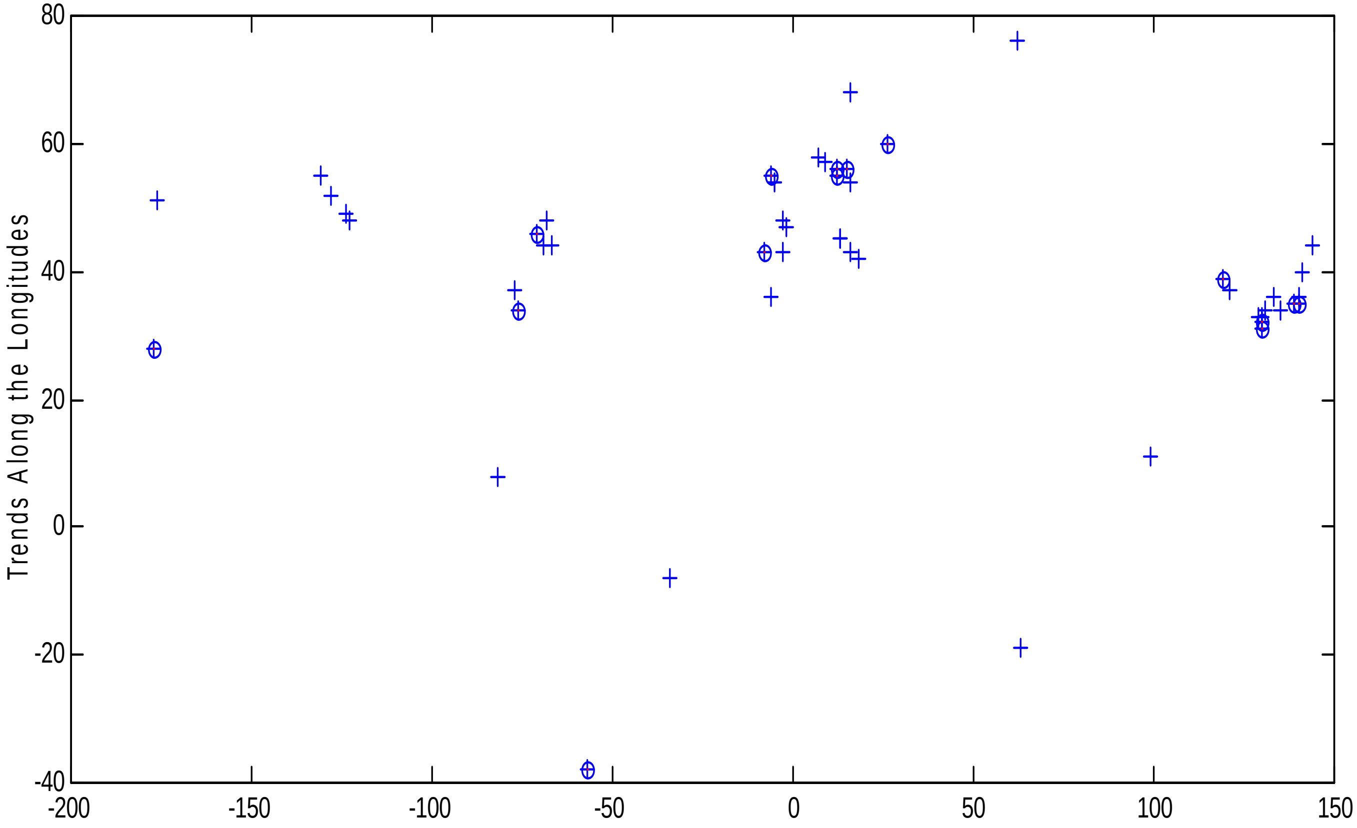


Fig 18 - Nearly Zero Planetary Trends Along the Longitudes (Circles)

Trends with low values are spread along all longitudes.

4-OVERALL BALANCE OF THE POSITIVE AND NEGATIVE TRENDS

PSMSL96 Series Starting in 1920

Mean values of bins are displaced in negative and positive sides along "new" straight lines with different inclinations. As collinearity and trends are independent variables, they are distributed this way, for some global strain.

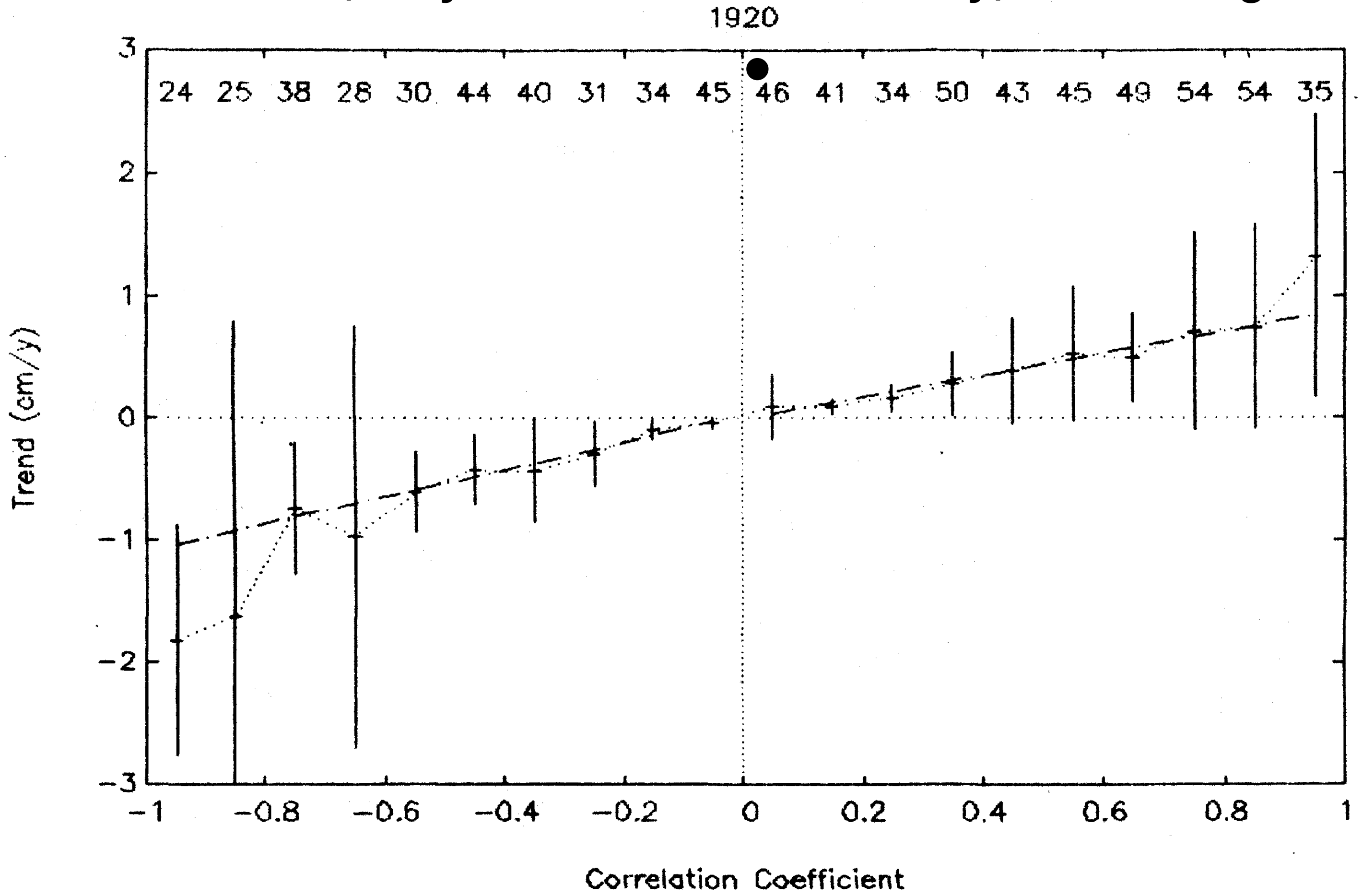


Fig 4

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Positive and Negative Trends

	negativo		positivo	
	A1	B1	A2	B2
1920	0.02	1.11	-0.02	0.92
1930	-0.03	0.96	-0.04	0.88
1940	-0.02	0.94	0	0.83
1950	-0.03	0.89	0	0.85
1960	-0.03	1.03	0.01	0.92
1970	-0.07	1.04	0.03	0.92
1980	0.05	3.08	0.04	1.45

Values of A (Intercepts) and B (Regressions) of positive and negative sides of Figures, similar to the previous slide, for sea level series starting, in steps of 10years, first one beginning in 1920.Most of them ending in 1996. Sum is negative.

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Thanks for your attention