El-Niño temperature component, wind speed, red tide algae and seismodegasation

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Abstract

Since the discovery of America, the Spaniards have known about the episodic appearance of the warm current of El-Niño near the Peruvian shores, which means "baby" in Spanish. Usually it manifests itself strongly after 6-7 years, extremely many times less often. The importance of his study is related to the hypothesis that he is the most important signal in the inter-annual climatic variability of the Earth. At the stage of identifying the genesis of El-Niño, oceanographers determine its appearance with a change in the direction of the prevailing winds, meteorologists consider the change of winds to be the result of water warming and compare the development of temperature anomalies with the difference in atmospheric pressure between Tahiti and Darwin (Australia). As a result, is it not clear whether changes in the wind field or water heating are primary, how are processes connected in the regions of Tahiti and Peru separated by thousands of miles? The result of the inexplicable confinement of the Peruvian El Niño to the Catholic nativity, the characteristic displacement of its main morose jet into the southern hemisphere, sometimes the isolation of the warming of various zones and its stagnation is the lack of a stable forecast of El Niño.

This study focuses on the accompanying El-Niño haze of water, up to red tides. Such flowering of waters is characteristic of places of high concentration of biogens in situations of occasional weakening of mixing or arrival of significantly warmer waters (absolute temperature values are not so critical, temperature growth above the background is important, since the solubility of many gases will decrease). Weakening mixing leads to an increase in stratification, a decrease in the flow of nutrients. With the onset of phosphorus deficiency, some algae begin to mass-produce ichthyotoxins to protect against other phosphorus users and divide on a huge scale. As their number grows, the water becomes cloudy, acquires various colors, including brown-red (red tides). Thanks to the duckweed, the photic layer is reduced, the surface water is additionally warmed. Overheating stops when the flowering rate decreases, which is characteristic when the temperature decreases below the regionally critical one (the solubility of many gases increases), for example, with upwelling, storm stirring, intensification of currents whose waters are enriched with biogens or cool, and when seismodegasation is activated, which cool brings biogenes to the photographic layer.

In the morose north of the Peruvian region rich in biogens, quasi-stiff conditions, haze and warmup of the waters are characteristic from November to February - confined to the Catholic nativity of the "boy." For the remaining tropical Latin American regions, the wind speed as a whole is many times higher, wind weakening is characteristic in spring. The crushing of the El-Niño language in the Latin American region, the isolated development of overheated waters and the stagnation of warming (except dynamic) are due to the entry of biogens to the surface during seismodegasation.

The characteristic displacement of the El-Niño jet in the morose part of the Pacific Ocean into the southern hemisphere is associated with degassing north of the equator and Rossby waves at the equator. In the western and central Pacific Ocean, El-Niño certainly stagnates or disappears when earthquakes are activated near the Golden Country *of* Solomon*, in the subduction zone (the only place in the tropics of contact, the subsidence of the Pacific Plate under the Indo-Australian), in the convergence zone of the Coralline and Fijian geoblocks, in the strait between lithospheric microplanes This strait is located at the border of the El-Niño emergence zone. What is this simple coincidence on a 30-year row or Pythagorean lever, the "string" at the equator on which "plays the bond" of earthquakes at the junction of geoblocks, what is the mechanism of this regional seismic effect on Earth?*

Keywords: *overheating of surface waters, algae of red tides, aggressive reproduction, - division of algae of red tides, duckweed, mixing, biogenes, seismodegasation, stagnation of El-Niño.*

1. Introduction. Status of the question

Since the discovery of America by the Spaniards (more than 500 years ago), it has been known about the episodic appearance of a warm current off the Peruvian shores. Peruvian fishermen call it "El-Niño," which means "baby" in Spanish, since its appearance and the associated mass fishes are dedicated to Catholic Christmas. It usually manifests itself strongly after 6-7 years, extremely many times less often [1, 33].

With the development of satellite observations, extensive temperature anomalies throughout the tropical Pacific Ocean began to be recorded. In itself, an increase in water temperature, including off the coast of Peru by 0.5 C, is considered only a condition for the emergence of El-Niño. And only a five-month anomaly, classified as El-Niño, in extreme situations it can damage the economy by falling fish catches of tens of billions of dollars [43, 50].

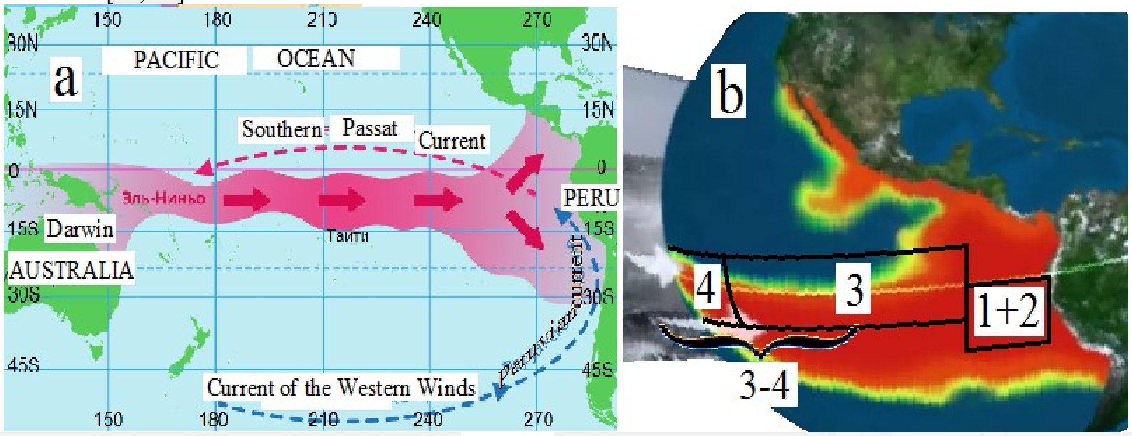

Fig. 1. *a* - Pacific surface currents [29]; *b* – El-Niño zoning [28, 47, 53].

The importance of studying the El-Niño phenomenon is also related to the hypothesis that it is the largest and most important signal in the inter-annual climatic variability of the Earth. At the stage of identifying the genesis of El-Niño, oceanographers determine its appearance with a change in the direction of prevailing winds, meteorologists consider the change of winds to be the result of warming up water and compare the development of temperature anomalies with the difference in atmospheric pressure between Tahiti and Darwin (Australia). There is an explanation for the development of the El-Niño - La-Niña phenomena (El-Niño antipode) by a modulating mechanism for the rearrangement of Rossby waves and associated large-scale currents [3]. Thus, there is a kind of vicious circle, removed from time and geography (Peru has a "boy," but Mexico and Tahiti do not, from Australia to Tahiti no closer than from Tahiti to Peru).

El-Niño forecasts are unsustainable and contradictory (Fig. 2). Statistical estimates of characteristic periods of phenomenon development remain without estimation of current phases (when calculating tides, both periods and phases of phenomena are obtained). The division of El-Niño into zones (Fig. 1,b) did not drastically improve the situation. These zones began to move randomly with the same result [4, 5, 10, 12, 17, 18, 25, 27, 36, 37].

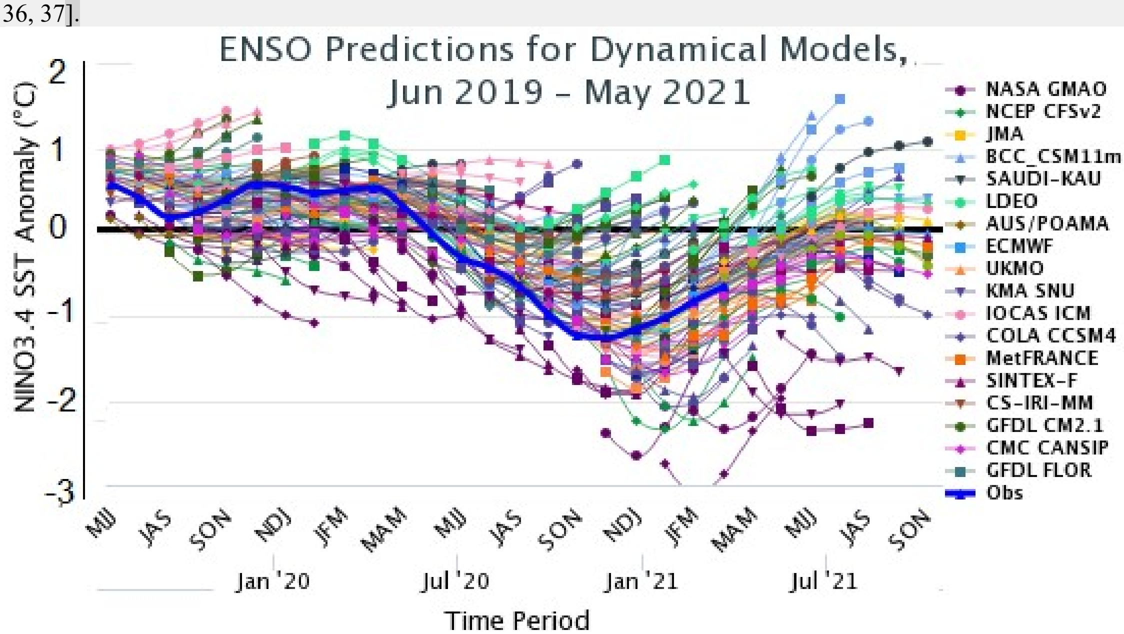

Fig. 2. Model forecast of water surface temperature in the area of 3.4 (refer to Fig. 1.*b*) [33].

There is an "ozone" version of the development of El-Niño [13, 20]. According to it, since there is increased insolation in ozone holes, earth temperatures, including of sea surface temperature (SST), should also be higher. However, comparing the integral concentration of ozone in the equatorial stratosphere with the development of TPE anomalies does not show stable trends (Fig. 3). For example, if their in-phase course was observed in 1988, 2003, 2002, 2005 and 2006, then in 1992, 1993-1995 and 2003. was asinfasic, in 2003 and with an extremely strong El-Niño in 1997-1998. there were no unambiguous long-term in-phase changes. However, the above analysis is not enough for conclusions, since the comparable areas of phenomena may differ several times (northern and western tropics are also taken into account for counting ozone anomalies, but El-Niño is unlikely there).

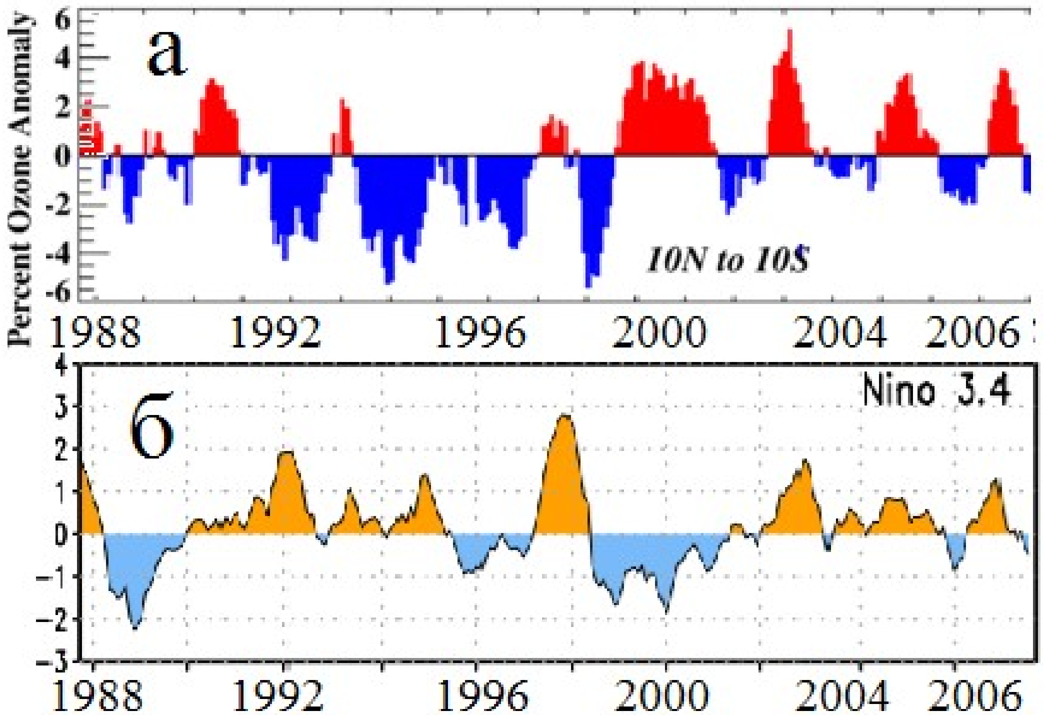

Fig. 3. Comparison of ozone holes with El-Niño. *a* - monthly ozone anomalies (as a percentage) of the long-term monthly averages for the Equatorial Zone 10 N - 10 S [52], *b* – El-Nino area indices calculated as averaged by the area of the sea surface temperature anomaly (°C) between 5N-5S, 170W-120W.

In addition to the listed hydrometeorological approaches to assessing the genesis and forecast of El-Niño, there are also geological ones. Some are based on hypothetical connection of geological and meteorological phenomena [2, 15]. Others rely on the fact that El-Niño arises in the Pacific ring of fire (volcanic) with rift zones, the most powerful centers of hydrogen-methane degassing. In particular, off the coast of Peru and Chile there is a massive release of hydrogen sulfide. Water is burrowing, there is a terrible smell [14].

2. Seismogenic degassing

Analyze the development of El-Niño from the point of view of degassing. Massive degassing of methane and carbon monoxide is manifested in the atmosphere in the area of earthquakes in California and Mexico, over faults and volcanic beds offshore and mainland slope near Mexico, Costa Rica, Ecuador and Peru, near the Galapagos Islands and above the ocean bed along the equator (Fig. 4-6). The corresponding zones of increased concentrations of gases are blurred, they exceed the dimensions of earthquake centers by several times (due to mixing). Typical gas yields from earthquakes or volcanic eruptions are 10^5-10^6 m^3, in a year in large seismoactive areas the account goes to 10^9 m^3 [9, 11].

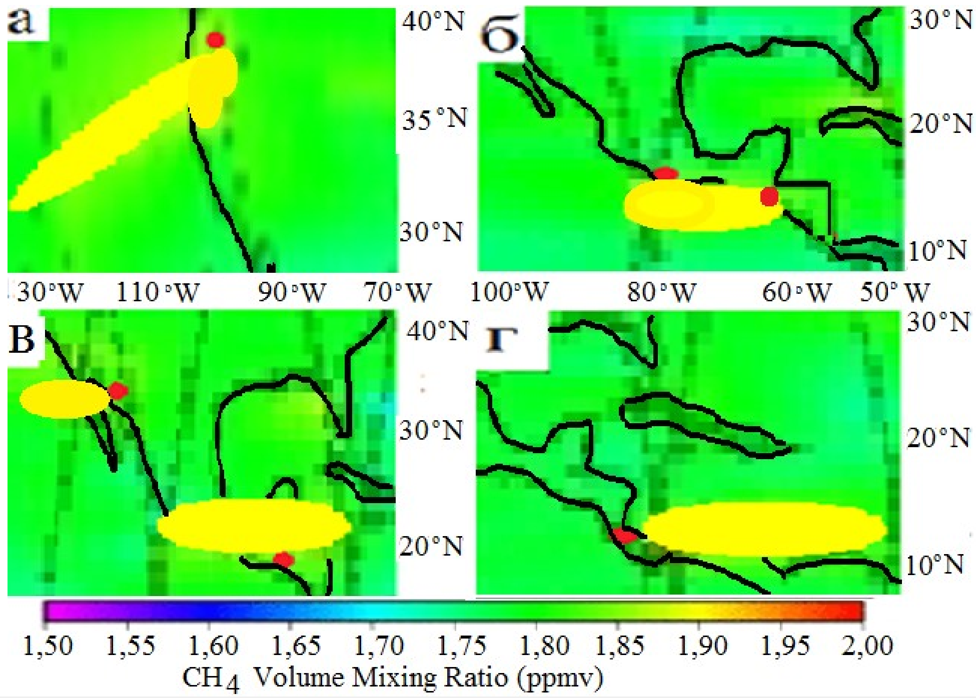

Fig. 4. Methane plumes come from the epicenters of earthquakes (red circles) according to the AQUA radiometer AIRs [26].

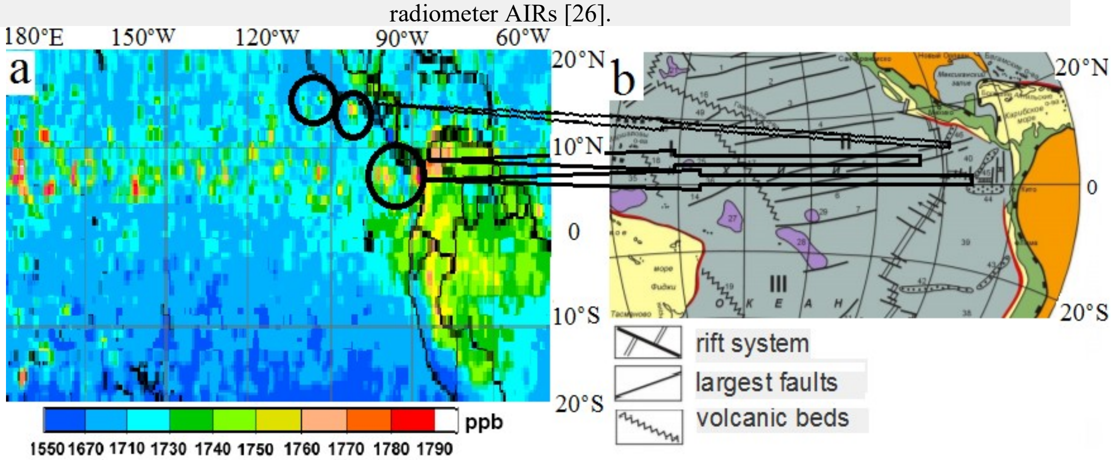

Fig. 5. *a* - average methane content in the atmosphere 2003-2005 [16]; *b* - is a fragment of the Pacific tectonic map [31].

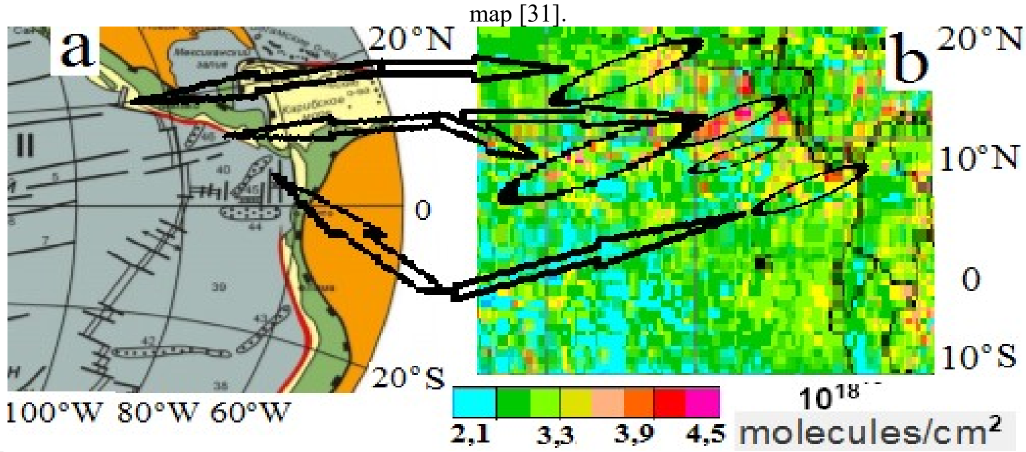

Fig. 6. *a*- average carbon monoxide content in the atmosphere 2003-2005. [16]; *b* - is a fragment of the Pacific tectonic map [31],

Seismic activity of the "fire ring" from 1979 to 2012 increased several times, there are no systematic monthly "preferences" (Fig. 7). The eastern and western equatorial parts of the seismic ring are activated in antiphase (Fig. 8). Between seismo activation in the east and west of the ring takes an average of 6 months, which coincides with the change of monsoons, current directions and corresponding water surges off the coast.

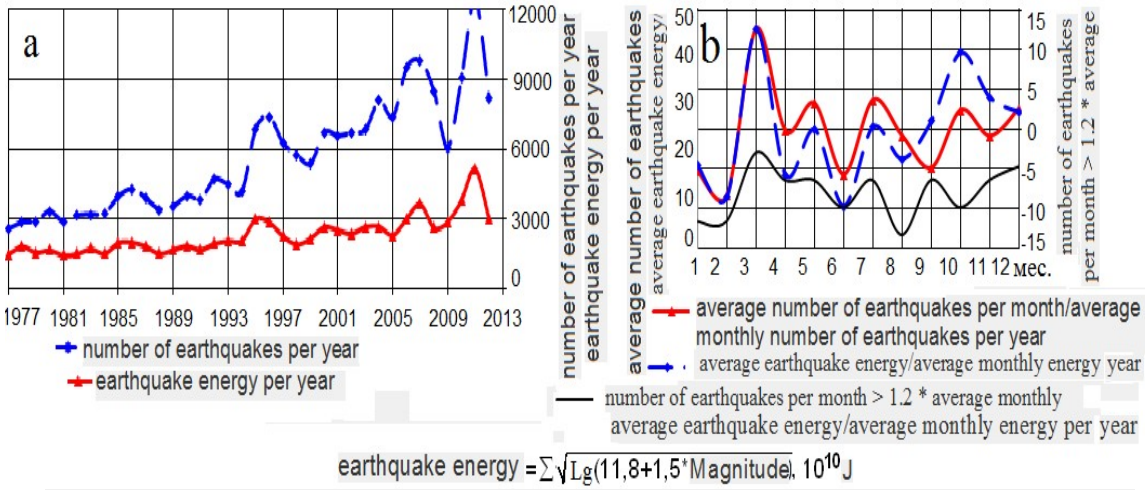

Fig. 7. *a* - the number and energy of earthquakes of the ring of fire for 1977-2013; *b* - is the monthly distribution of the number and energy of earthquakes.

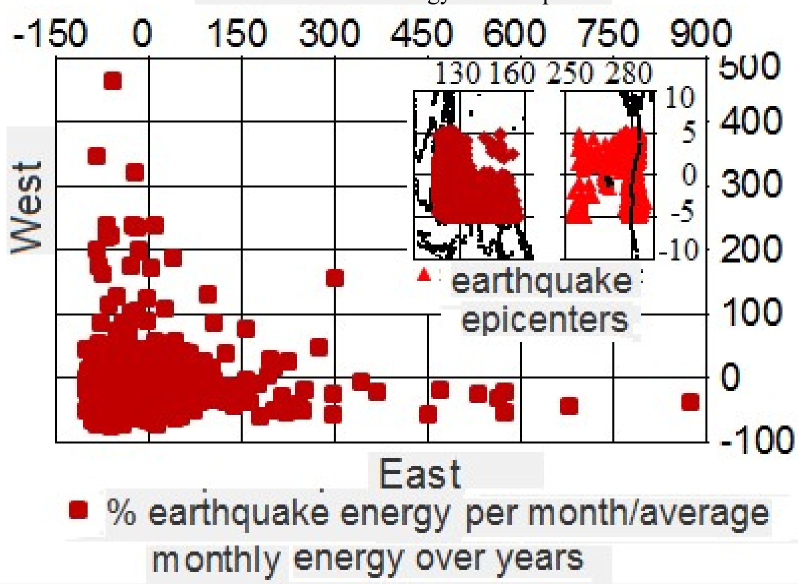

Fig. 8. The ratio between the monthly earthquake energy normalized to the average monthly energy for 1977-2012 in the east and west of the equatorial part of the Pacific Ring of Fire (epicenters on the tie-in).

3. Unclear situations in the development of El-Niño

In our opinion, in order to improve the forecasts of El-Niño development, it is necessary, at a minimum, not to cut off the analysis of short (monthly) temperature anomalies and determine the following aspects:

3.1. why El-Niño is often not a single warm language, but crushed, exists in several regions separately, for example, along the morose equator, near the Galapagos Islands, fragmented off the coast from California to Peru, which causes stagnation of warming;

3.2. what is the reason for the heating of the water, what contributes to it?

3.3. why is the Peruvian phenomenon timed to coincide with Catholic Christmas?

3.4. Features of the development of El-Niño in the central and western equatorial parts of the Pacific Ocean

3.5. Why is the purple stream of El-Niño mainly shifted by 100 sound300km south of the Equator (Fig. 1).

3.6. What causes the stagnation of the El-Niño phenomenon in the morose equatorial part of the Pacific Ocean.

3.7. What causes the stagnation of the El-Niño phenomenon in various zones.

The answers to some of the listed questions are also derived from the analysis of the above listed works and directions.

3.1. Why is El-Niño often not a single warm language, but crushed, exists in several regions separately, for example, along the morose equator, near the Galapagos Islands, fragmented off the coast from California to Peru, which causes stagnation of warming?

Let us begin with geographical and hydrographic comparisons of such natural phenomena as dynamics of temperature anomalies against the background of seismic events [7].

In May - early July 1979, against the background of several earthquakes at Galapagos (M = 4.3-5.5), there were no significant accumulations of warm waters in the region (Fig. 9). The formation of two vast clusters of warm waters west of Galapagos and around them from the second decade of July to the second decade of October by October was not hindered by seismodegasation. Warm waters separated the centers of earthquakes (M = 4.4-5.5). By November, the eastern stagnated against the background of a series of Galapagos earthquakes (M = 4.4-5.5).

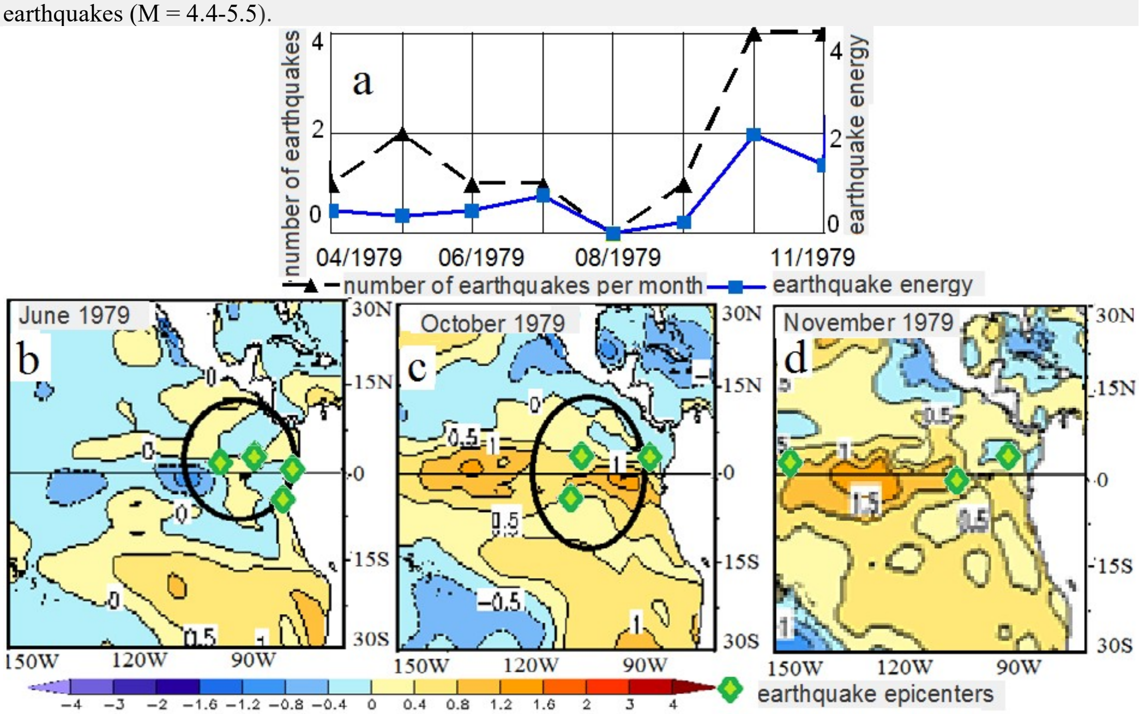

Fig. 9. *a* - the average monthly course of the number and energy of earthquakes from April to November 1979; *b-g* on the maps of temperature anomalies on 5m are the epicenters of earthquakes [51, 58, 60]. In ellipses - discussed phenomena.

From February to May 1982, earthquakes were east of 240E in the latitudinal strip from -5S to 5N against the background of the absence of significant positive temperature anomalies, both north and south of the equator (Fig. 10). By August, earthquakes south of the equator stopped and the formation of El-Niño began here. In November, the intensification of earthquakes was only north of the equator, south of the equator - strong El-Niño.

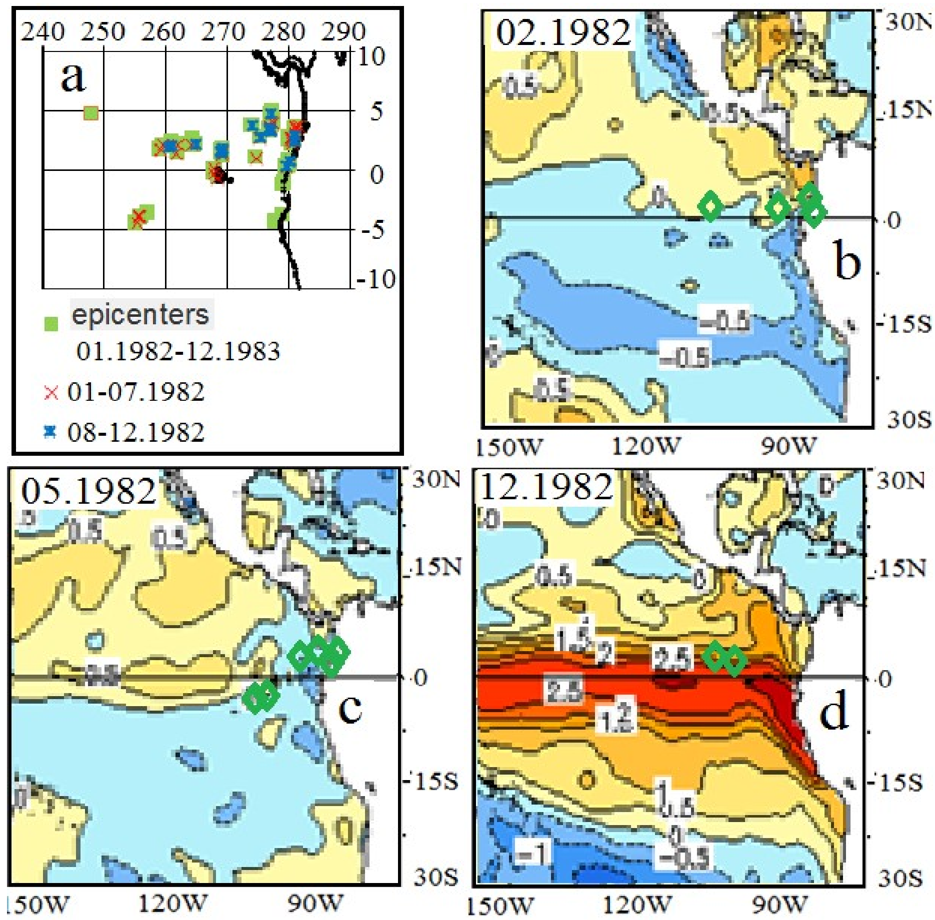

Fig. 10. *a* - position of earthquake epicenters in 1982; *b-d* - on the maps of temperature anomalies epicenters of earthquakes are shown.

In January 1983, the El-Niño language occupied the east of the tropics. Small warm anomalies were observed off the seismic coasts of Mexico and Costa Rica, the latter was separated from the main El-Niño jet by the November 1982 earthquakes near Ecuador (Fig. 11). By April 1983 amid the cessation of earthquakes, Ecuador also disappeared the latitudinal splitting of warm waters! Longitude fragmentation occurred at the epicenter of the March earthquake west of the Galapagos Islands. (2,3N,261W, M≈4,4)!

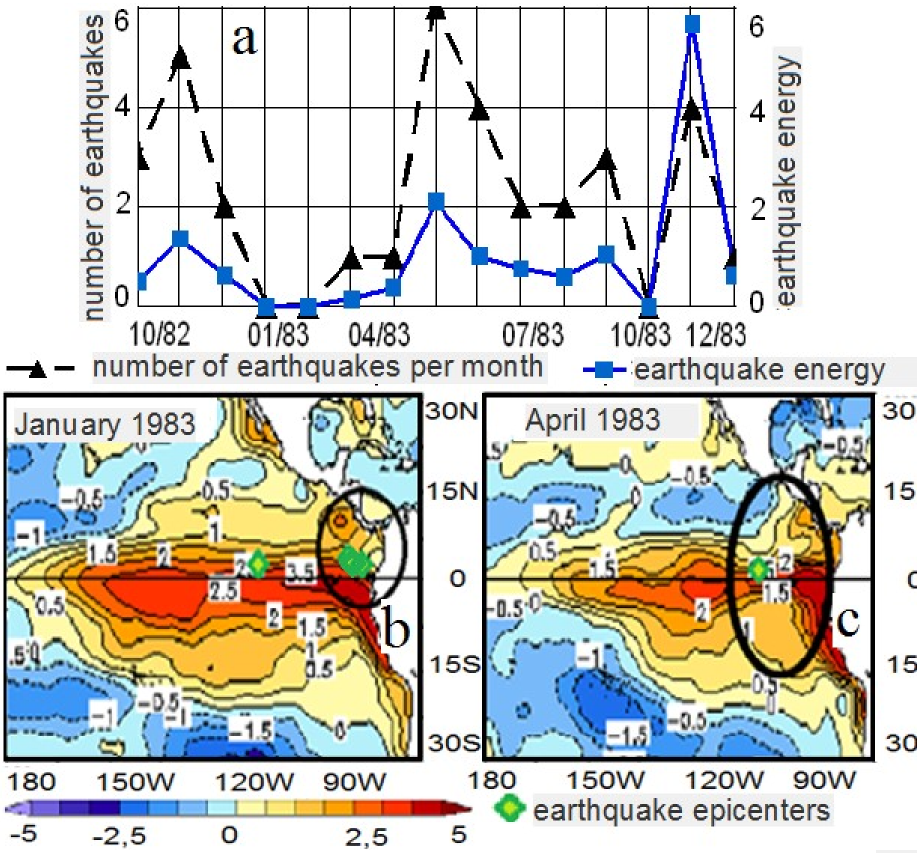

Fig. 11. *a* - the time course of the number of earthquakes from 10.1982 to 12.1983; *b, c* - on the maps of temperature anomalies epicenters of earthquakes are indicated, on the January map - November and December 1982, on the April 1983-March 1983, (the only one since the beginning of the year).

By August 1983, El-Niño was "pushed" by cool waters from the west (Fig. 12). There are two earthquakes on their "tip." By November, only barely warm spots remained from El-Niño in Panama and Peru. In Colombia, they were separated by cool waters, in which there were three earthquakes (M≈4,7-5,4).

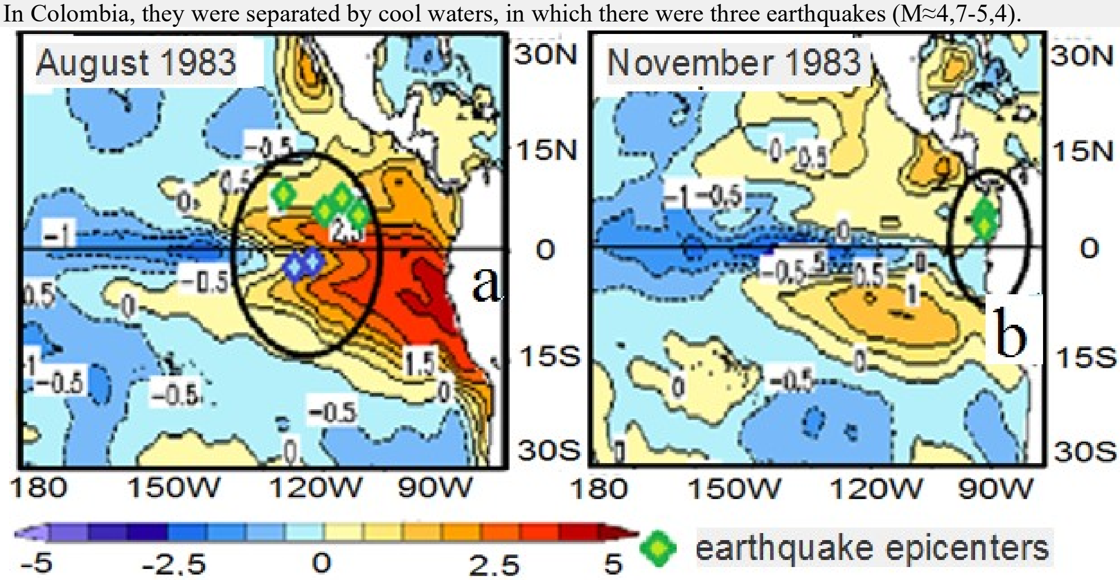

Fig. 12. The maps of temperature anomalies show the epicenters of earthquakes; *a* - August 1983, *b* - November 1983.

El-Niño in February-July 1987 developed separately along the equator west of Galapagos and off the coast of Latin America (Fig. 13). Their cool seismoactive region was separated (M = 4.2-5.6). By September, both heat fragments did not close at the equator, but 100-500 km south in seismic waters. By the end of 1987, earthquakes began in Ecuador and the coastal part of El-Niño stagnated.

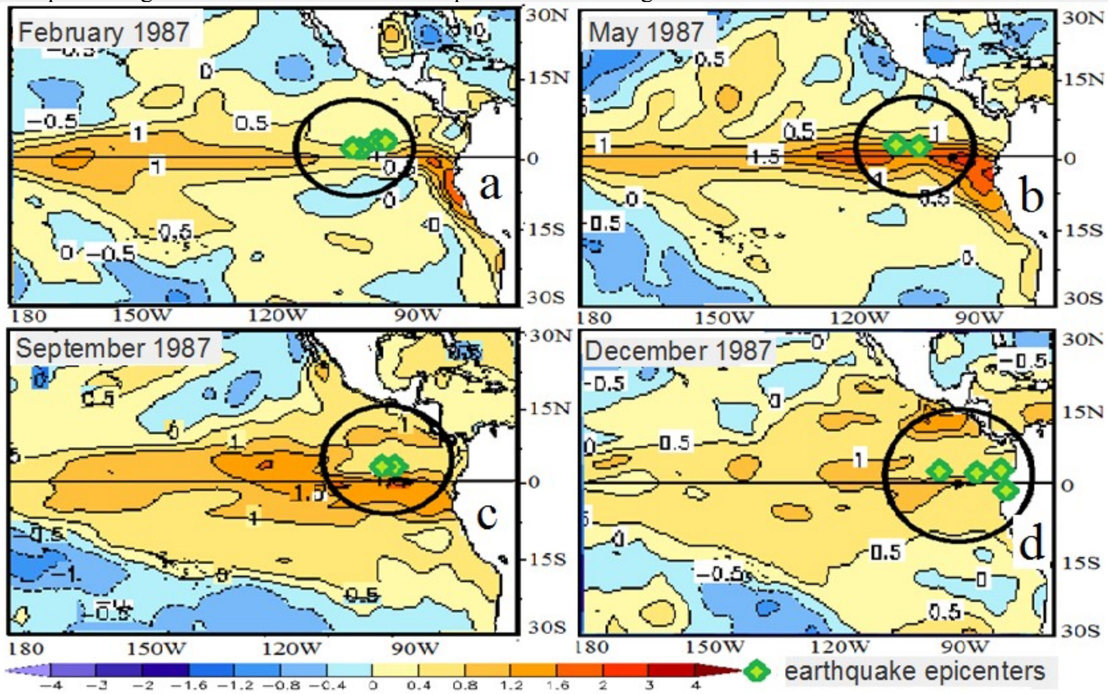

Fig. 13. The maps of temperature anomalies in 1987 show the epicenters of earthquakes.

In April-May 1992, temperatures in the Ecuador-Peruvian zone of El-Niño were above the norm per 2-3℃ (Fig. 14). In June, against the background of only two earthquakes with M = 5.1 and M = 4.7 water warmups.

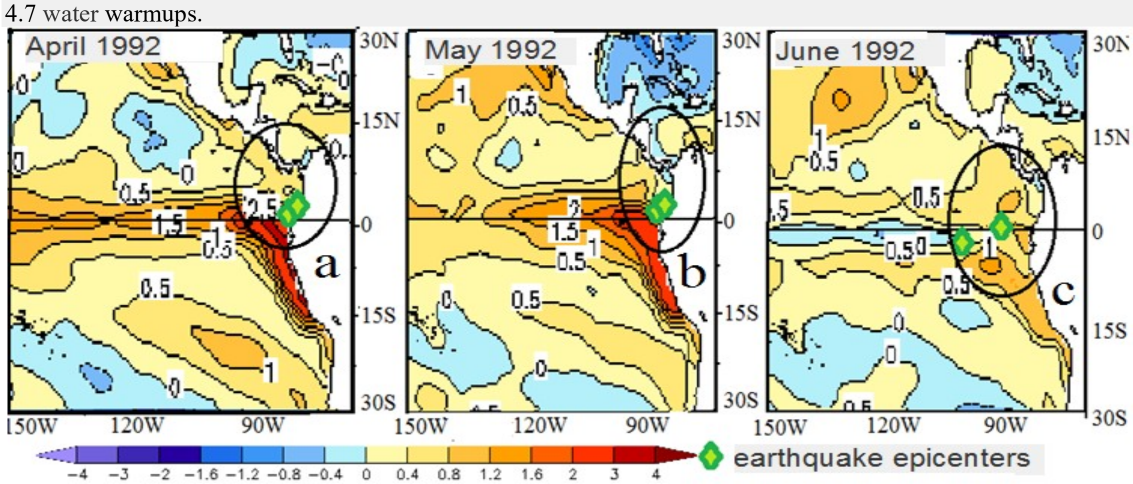

Fig. 14. The maps of temperature anomalies in 1992 show the epicenters of earthquakes.

In the earthquake of 1997 and early 1998, there was a powerful El-Niño and suddenly La-Niña - earthquakes (Fig. 15). The June-July 1998 quakes "dispersed" the morose El-Niño, lowered the pace of contoured warm waters on the 1-3℃! Zones of cooled waters are spread by currents from earthquake centers.

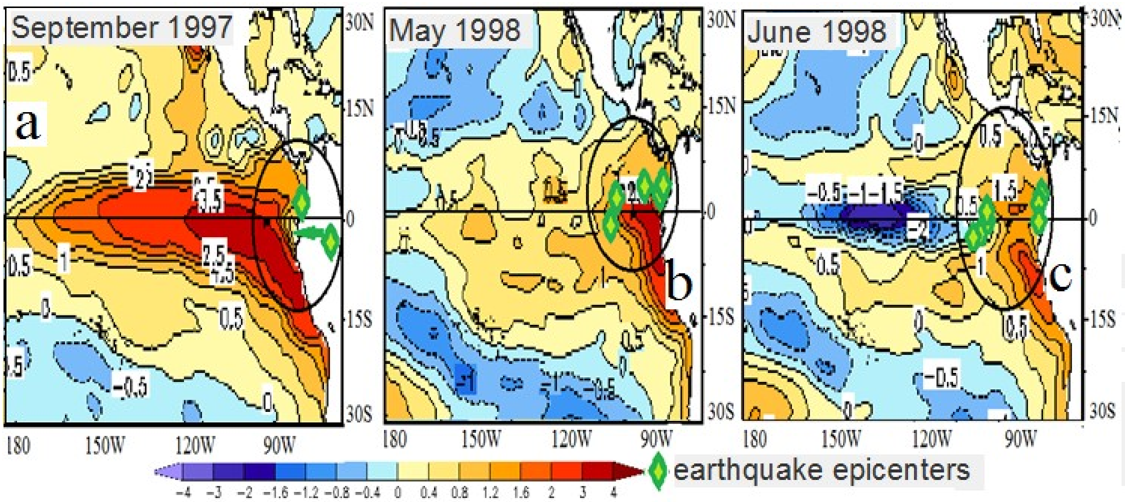

Fig. 15. The maps of temperature anomalies in 1998 show the epicenters of earthquakes.

As a minimum, it follows that in the areas of the tropical Latin American zone (shelf, mainland slope), the El-Niño temperature component and the intensification of seimic activities are incompatible. At the centers of earthquakes, SST cools to the background for tens to hundreds of km. It is not the deep mixing of the waters to the thermocline, which is ≈30÷50m (Fig. 16), but the elimination of the surface cause of heating. Based on this, we conclude that seismogenic degassing in the Latin American region is sufficient for the biological stagnation of El-Niño. This conclusion does not deny other paths to stagnation, including the arrival of biogens during storms, upwelling, with currents or cooling (increasing the solubility of some biogenic gases).

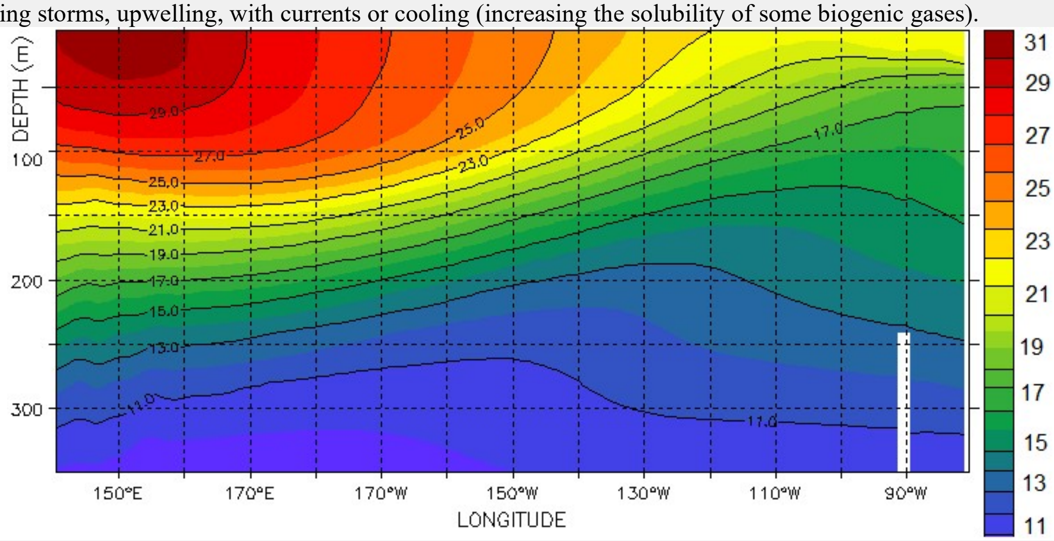

Fig. 16. Distribution of water temperature (°C) along the vertical section of the Pacific Ocean along the equator. The average per 01.01.1993 is 01.04.2010 [23].

3.2. What is the reason for the heating of water, what contributes to it? What is the "merit" of biogens?

Unicellular algae from the dinoflagellate group are present in water, in phosphorus-rich waters they are slightly toxic. With the onset of deficiency of phosphorus and other nutrients (nutrients), algae mass-produce ichthyotoxins, use "chemical weapons" to protect against zooplankton, and for the sake of destroying other algae that "eat" phosphorus, begin to divide on a huge scale. Poisonous algae not only kill fish, but also infect mollusks. With an increase in the number of algae, the flowering process begins, a film noticeable to the naked eye forms at the surface of the water. Its color depends on the pigment that is contained in dinoflagellate cells. It usually ranges from green to brown-red, while the water can seem discolored or cloudy [6, 29, 35, 41, 47, 48, 56, 59].

These phenomena arise after the cessation of dynamic mixing, for example, the upwelling of nutrients, severe storms or the weakening of currents with cool water or rich in biogens. Biogens with heavy silicon and phosphorus compounds are the first to gravitationally settle out of the photic layer [8], a "fight" begins for them, the beginning of flowering.

The corresponding mechanism is due to the fact that with the cessation of mixing, the growth of stratification, "locking" layers are formed, the thickness of which can be from several centimeters to several meters, and the length - several kilometers. Such "traps" for phytoplankton can exist for several months. Plankton accumulates in them in large quantities, which leads, in particular, to "red tides," reduction of the photic layer and increase SST [35] (Fig. 17).

Fig. 17. Red tide. *a* - [40], *b* - [32], *c* - [57].

For the emergence of Red Tides in the El-Niño region, there is a rich nutrient environment (Peruvian current) and periodic weakening of the mixing of the photic layer (weakening of passates in the South Pacific Ocean until their cessation. To stagnate the "emergency" reproduction of aggressive algae, the entry of biogens is required, including with the processes of seismodegasation [8].

3.3. **Why is the Peruvian phenomenon dedicated to Catholic Christmas**?

An analysis of materials on the speed of the drive wind shows that quasi-stiff conditions are characteristic on the northern shore of Peru from November to February (calm (0.5 m/s) and quiet wind (0.5 sound1.7m/s)) (Fig. 18). Hence the name "boy," the arrival of warm waters, El-Niño is characteristic of a Catholic nativity.

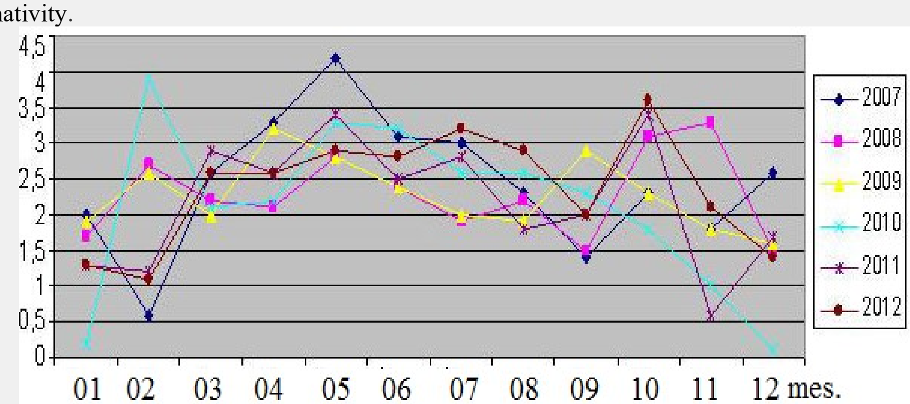

Fig. 18. In the north-west of Peru (Chiclayo), the minimum average wind speed for 2007-2012 [61].

Other regions, in particular, Colombia, Ecuador [42, 53], the Galapagos Islands and Tahiti are characterized by characteristic wind speeds many times higher, in general there are no climatically determined Christmas stills, wind weakening is characteristic in spring (Fig. 19)

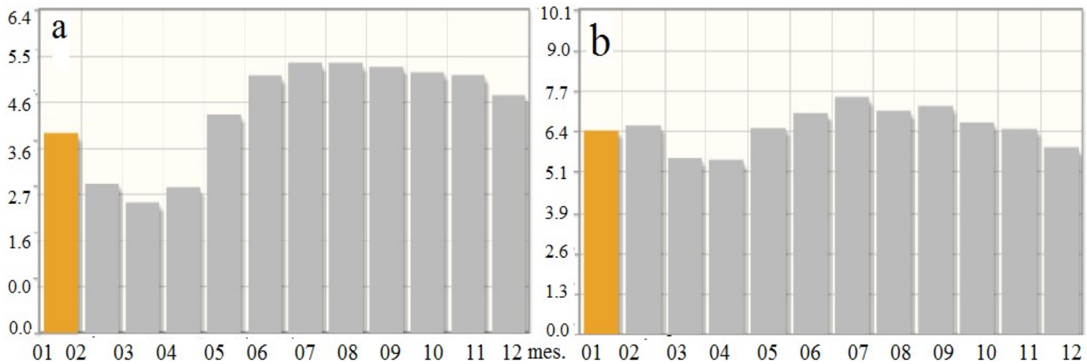

Fig. 19. Average wind speed by month. *a* - Bahia (Galapagos) [38]; *b* - Tahiti [39].

3.4. Features of the development of El-Niño in the central and western equatorial parts of the Pacific Ocean.

3.5. Why is the purple stream of El-Niño mainly shifted by 100 sound300km south of the Equator (Fig. 1).

The characteristic displacement of the El-Niño jet into the southern hemisphere in the morose equatorial zone occurs against the background of increased methane degassing in the strip north of the equator by 300-700 km (Fig. 5a). In a strip along the equator with a width of ≈300÷500км, mixing is carried out by Rossby waves. Moreover, the more westerly, the weaker the temperature contrasts from these waves as the thickness of the upper quasi-uniform temperature layer grows to the west, especially this is manifested in El-Niño (Fig. 16, 20). Under El-Niño, Rossby waves only stir superheated waters for a while, large-scale not eliminating the cause of overheating, not introducing enough biogens to stop the protective behavior of algae, including their reproduction.

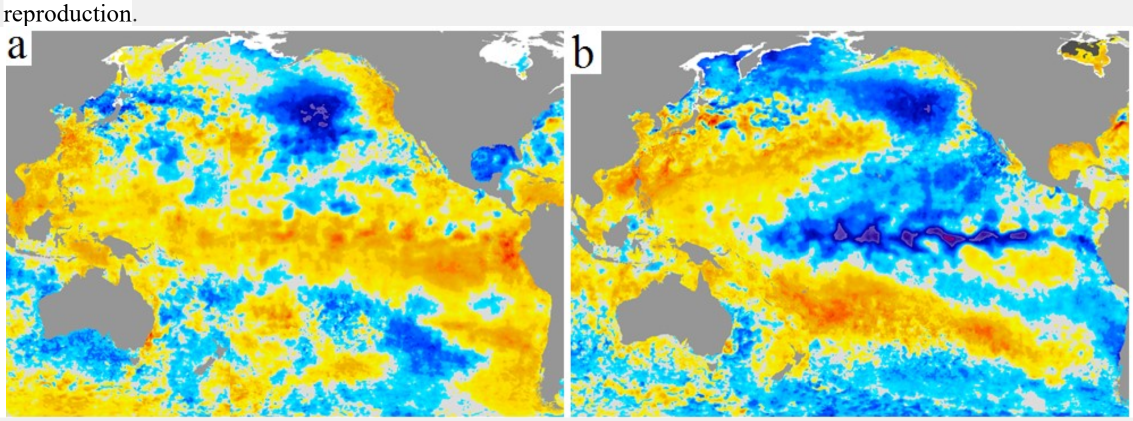

Fig. 20. *a* - satellite maps SST 1.12.1987 [21], *b* - 1.12.1998 [22].

With a strong El-Niño, it expands into the northern hemisphere, however, warm languages turn to the shores of Mexico and California only in biogen-enriched (from currents) waters east of 150 ° W, where the fault zone ends (see Fig. 1.b, 5, a, 15.a).

3.6. What causes the stagnation of the phenomenon in the morose equatorial part of the Pacific Ocean.

El-Niño is born at the subduction zone, (subsidence of the lithospheric Pacific Plate under the Australian) [44]. Plate contact occurs in the seismically active region between lithospheric microplates, in the strait between the Solomon Islands "Golden Country of Solomon" and the islands of Santa Cruz (Fig. 21, 22) [45].

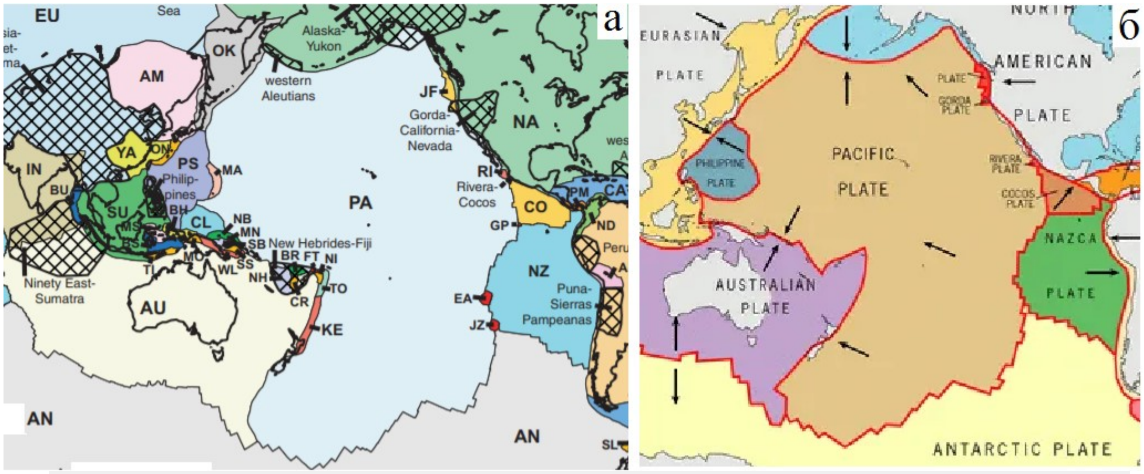

Fig. 21. *a* - The 52 plates of model PB2002 are shown with contrasting colors [19]. *b* - lithospheric plates in the Pacific Ocean [32].

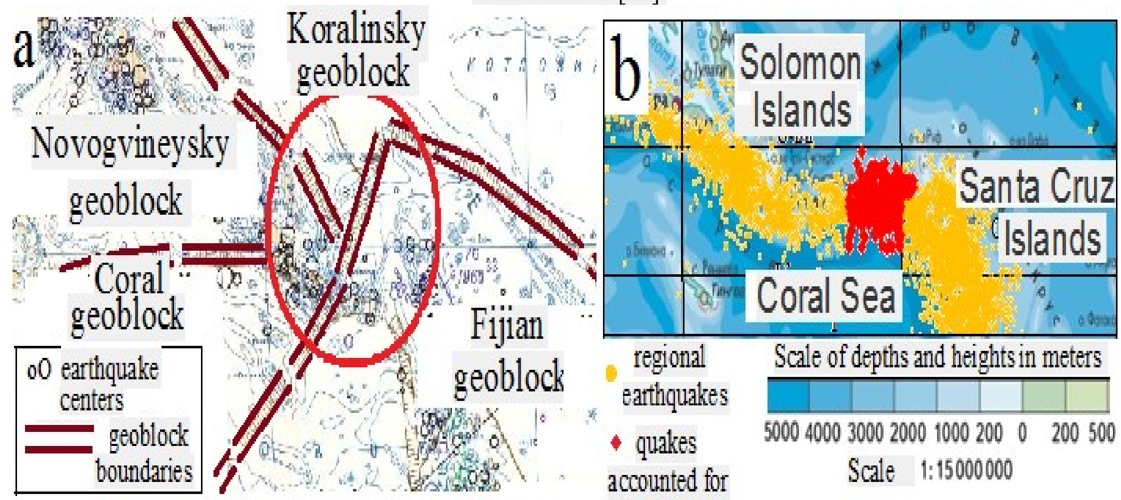

Fig. 22. *a* - is a fragment of the geological map of the Pacific Ocean, in an ellipse the discussed place of spreading [24]; *b* - on the map of Solomon region epicenters of earthquakes from 1977 to 2012 and recorded earthquakes are applied [46].

From the analysis of the temporal course of the anomalous warm-up of SST in the western region of El-Niño (area №4 with Fig. 2.b), it follows that its development largely limits seismic activity in the subduction zone east of the Solomon Islands, on the border of the Korala and Fijian geoblocks. This particularly affects the initial stage of development. For example, the transition from La Niña to El-Niño in the spring of 1984 prevented 5 earthquakes with a magnitude of up to 5.8, in general similar to December 1988 8 earthquakes in October 1999, a series of earthquakes 2011, with a magnitude of February 5.9 (Fig. 23). Mass earthquakes with magnitudes over 5.8 in the initial stages of El-Niño development were followed by warming (reached 1°C) - in March 1993 and November 2004 the magnitude exceeded 5.8 (the number of earthquakes > 10). In July-August 1997, with extreme El-Niño, the magnitude of four earthquakes did not exceed 5.5. In seismically active March 1993 (27 earthquakes), the magnitude reached 6. Extreme development of El-Niño (1÷4°C) was received during the earthquake months of 1983, 1986-87, 1991-1992, 1994, 1997-1998, 2002, 2009-2010 (the number of earthquakes per month with magnitudes over 4 did not exceed 5, and magnitude 5.5). The above concerned not only "recognized" El-Niño (lasting at least 5 months), but also shorter ones.

Such a different intensity of seismic activity on the development of El-Niño is due to the fact that at the initial stages of seismodegasation, the "throwing" of cool biogens into the photic layer compensates for their natural decline and suspends the aggressive behavior of red tide algae.

During the development of temperature anomalies in the west (№4, Fig. 1.b) and the Peruvian zones (№1 + 2, Fig. 1.b), it should be that they are generally in-phase. However, Solomon's seismodegasation "controlling" warm-up in the west does not affect the east so unequivocally (Fig. 24). Five spring earthquakes of 1983 led to the stagnation of El-Niño in the west, then in the east the warming up only intensified. Since the second half of

1983, against the background of almost continuous seismodegasation with magnitudes up to 5.8, there was no significant heating of the waters, rather, a weak La Niña was observed.

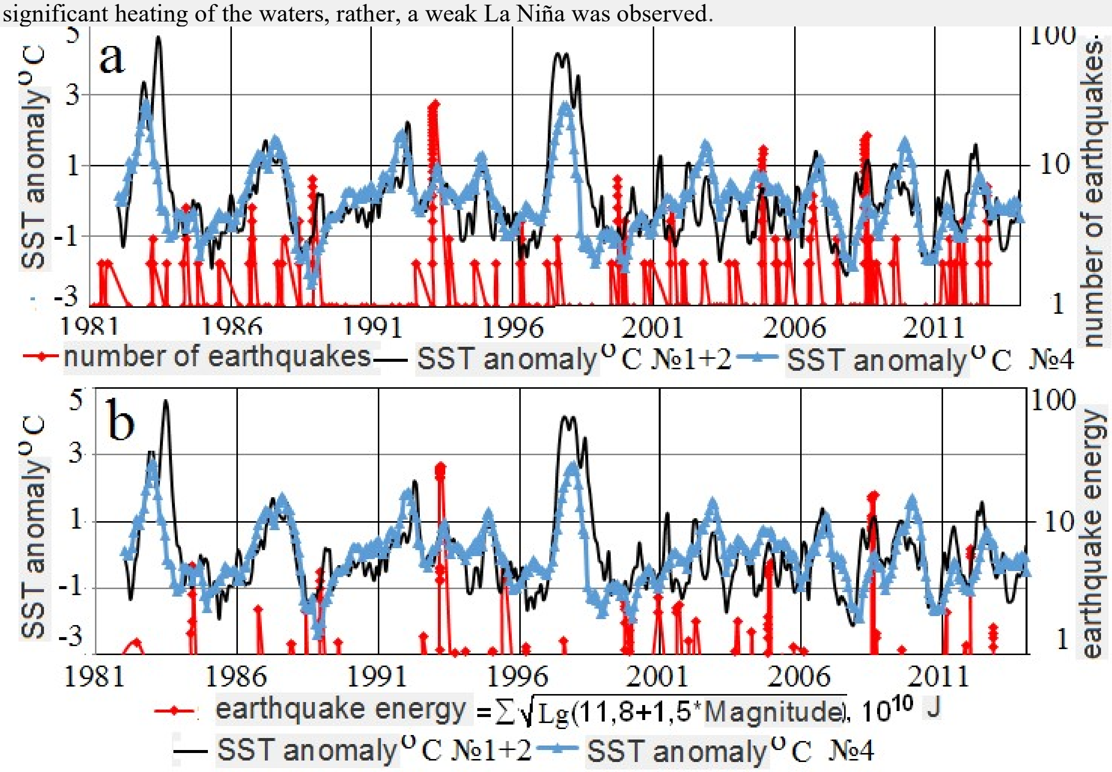

Fig. 23. Comparison of time course of SST anomalies [54] with number (*a*) and earthquake energy (*b*).

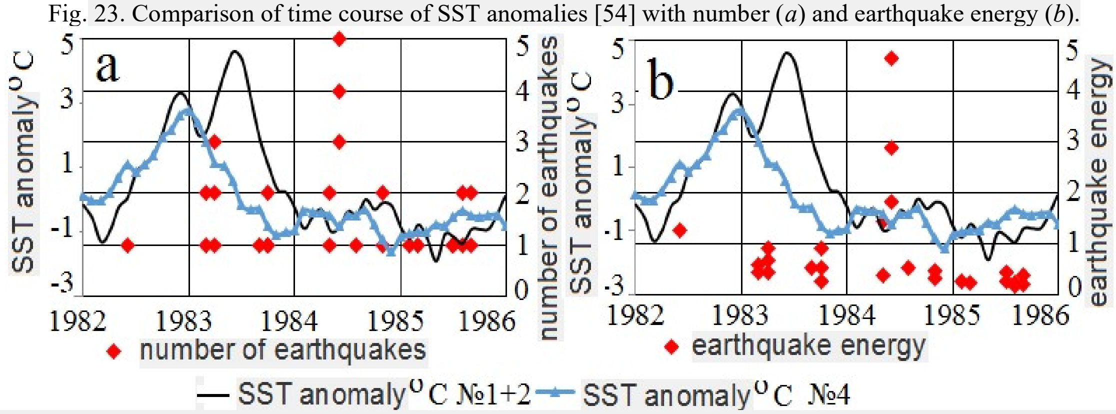

Fig. 24. A fragment of Fig. 23 comparing the time course of SST anomalies with the number (*a*) and energy of earthquakes (*b*) for 1982-1986.

3.7. **What causes the stagnation of the El-Niño phenomenon in various zones.**

The stagnation of the El-Niño phenomenon occurs when the flowering rate decreases, which is characteristic of a decrease in temperature below the regionally critical one (the solubility of many gases increases), which is also characteristic of upwelling, storm stirring to a layer of water rich in biogens, seismodegasation agitation of silts rich in biogens (and the rise of biogens from the depth of the thermocline).

In the eastern tropical edge of the Pacific Ocean, as described above, there is enough seismogenic degassing to stagnate, it is of course welcome to return waters with biogens or with cool water, including upwelling, storm mixing, or seismogenic degassing. In the center and west of the ocean, stagnation of El-Niño occurs when earthquakes in the subduction zone of the Pacific and Indo-Australian platforms, the border of the Corala and Fiji geoblocks, as well as massive fragmented degassing of methane and carbon monoxide in the western tropics (Fig. 25).

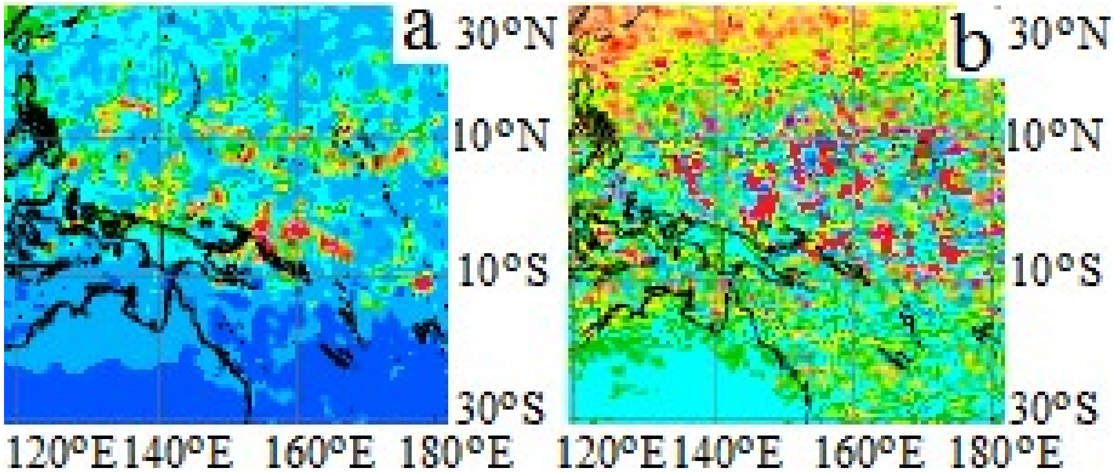

Fig. 25. Average content of methane (*a*), carbon monoxide (*b*) in atmosphere 2003-2005 [16].

4. Conclusions

The phenomenon of Peruvian El-Niño is overheating and flowering of part of the water mass in places of high concentration of biogens. It begins, as a rule, on the days of Catholic Christmas. This is also due to quasi-stillic situations characteristic from November to February, weakened mixing, increased stratification, and reduced nutrient influx. With the onset of phosphorus deficiency, some algae begin to mass-produce ichthyotoxins to protect against other phosphorus users and divide on a huge scale. As the number of algae grows, the water becomes cloudy, acquires various colors, including brown-red (red tides). Thanks to the duckweed, the photic layer is reduced, the surface water is additionally warmed. Water overheating stops when the flowering rate stagnates, which occurs when the temperature decreases below the regionally critical one (the solubility of many gases increases), for example, when upwelling, stormy stirring to a layer of water rich in biogens, intensifying currents whose waters are enriched in biogens or cool, and when activating seismodegasation, which brings biogens coolly.

For the remaining tropical Latin American regions, the wind speed as a whole is many times higher, and wind weakening is characteristic in spring. The crushing of the El-Niño language in the Latin American region, the isolated development of overheated waters and the stagnation of warming (except dynamic) are due to the entry of biogens to the surface during seismodegasation.

The characteristic displacement of the El-Niño jet in the morose part of the Pacific Ocean into the southern hemisphere is associated with degassing north of the equator and Rossby waves at the equator. In the western and central Pacific Ocean, El-Niño certainly stagnates when earthquakes are activated near the Golden Country of Solomon, in the subduction zone (the only place in the tropics of contact, the formation of the Pacific Plate under the Indo-Australian), in the zone of convergence of the Corala and Fiji geoblocks, in the strait between lithic microplates under the This strait is located at the border of the El-Niño emergence zone. What is this simple coincidence on a 30-year row or Pythagorean lever, the "string" at the equator on which "plays the bond" of earthquakes at the junction of geoblocks, what is the mechanism of this regional seismic effect on Earth?

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