El Niño, sus condiciones actuales y perspectivas trimestrales para las Américas y el Caribe. Visión general de los impactos de la temperatura y precipitaciones relacionados con el sector salud

José M. Gálvez

Axiom / NOAA WPC International Desks, College Park, Maryland

5 de octubre de 2023

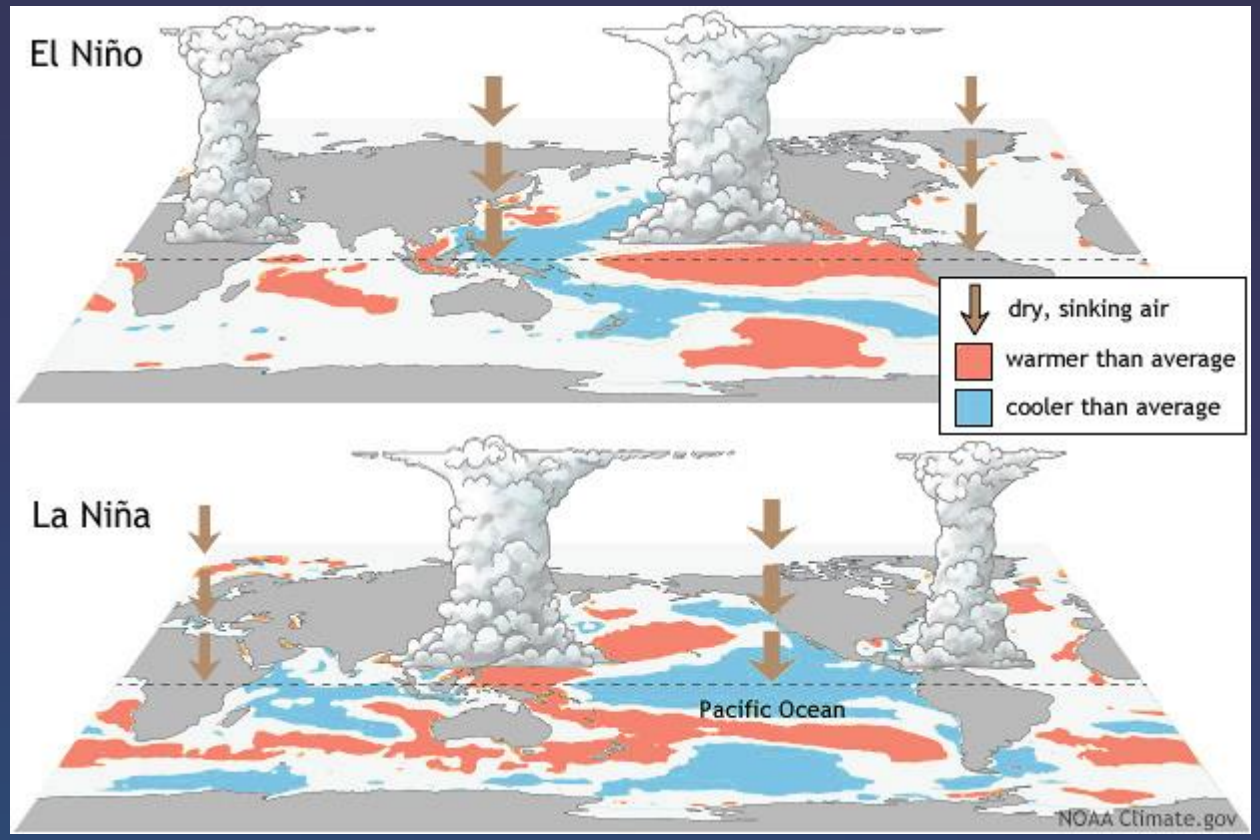
Webinario sobre El Niño y la reducción de sus impactos en el sector salud

El Niño-Southern Oscillation (ENSO)

ENOS (en español)

Definición

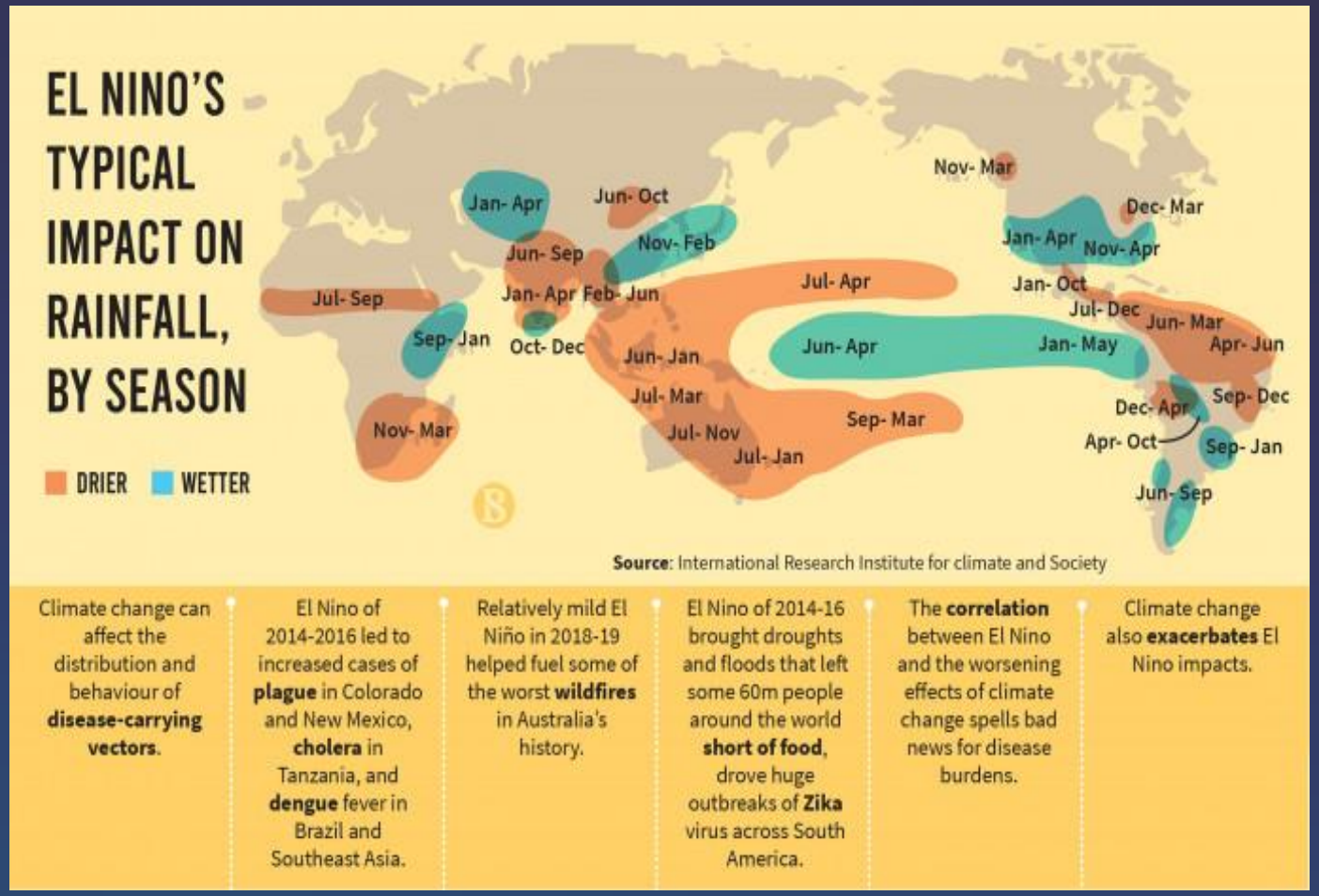
- Patrón climático recurrente en el Pacífico Tropical.
- Consiste en cambios en variables oceánicas y atmosféricas que persiste durante varios meses.
- Tiene 3 fases: El Niño (cálida), La Niña (fría) y neutral.



Fuente: Climate.gov

El Niño tiene impactos en la salud

- Modifica las circulaciones atmosféricas. Esto favorece olas de calor, sequías e inundaciones en diferentes regiones del mundo.
- Impactos en la salud
  - Epidemias como el Dengue, Cólera, Zika y la Chikunguya
  - Golpes de calor
  - Escasez de alimentos por proliferación de plagas y daños en culivos



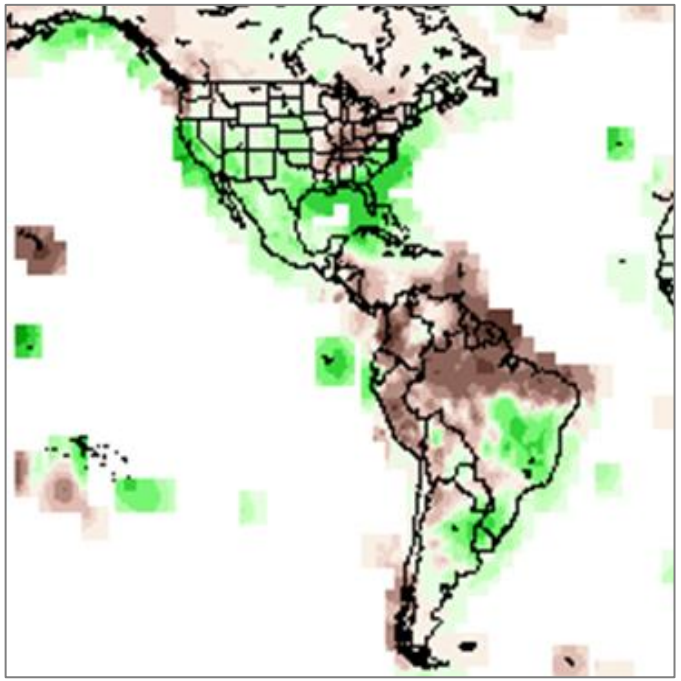
Fuente: tbsnews.net

Impactos de El Niño varían según la Estacionalidad e interacciones con otros sistemas climáticos

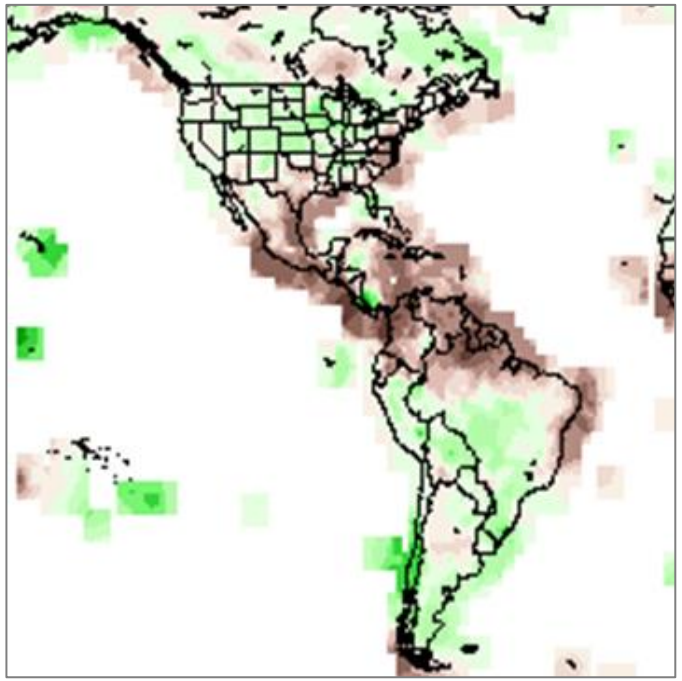
- Los impactos de El Niño varían mucho según la época del año.
- Ejemplo: Los impactos en enero-marzo en las lluvias son muy diferentes a julio-setiembre. →
- PERO: Los efectos también dependen de otras anomalías en el sistema tierra-atmósfera. En 2023, por Ejemplo, temenos un calentamiento global además de un Atlántico cálido, que están alterando la distribución de impactos.

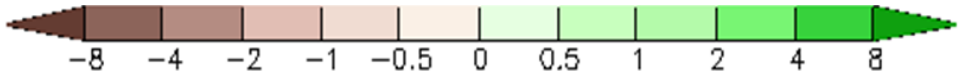
Regresión $SST_{3.4}$ - Lluvia (mm/día)

Enero a marzo



Julio a setiembre



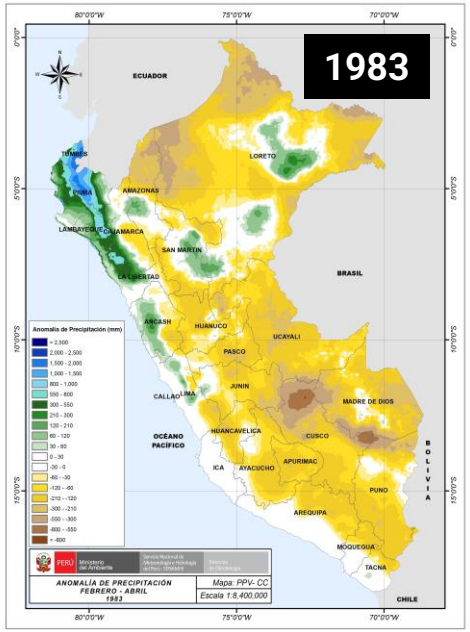


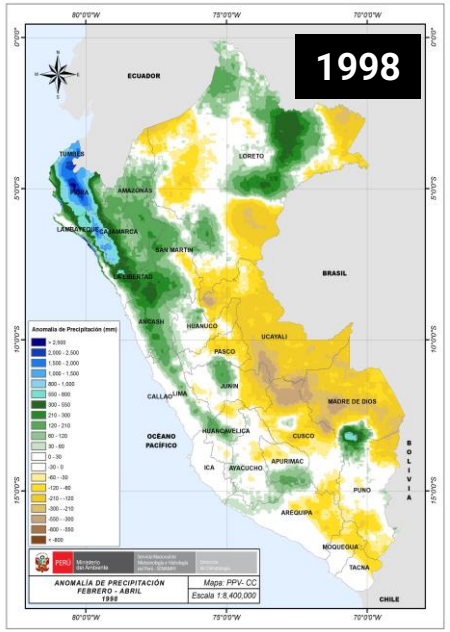
Green = More Rain during El Niño

Los impactos varían de evento a evento

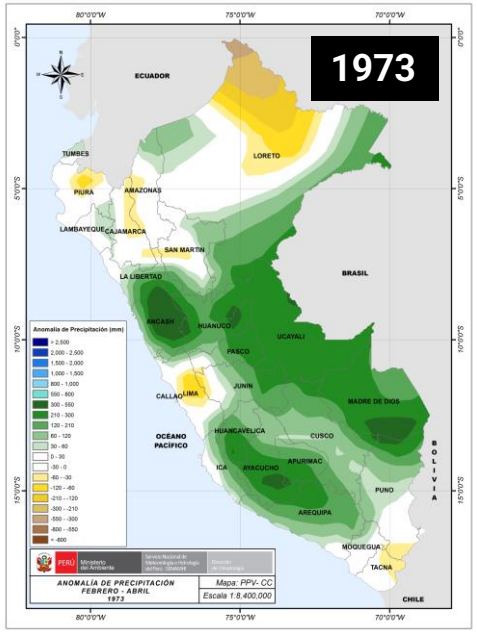
Anomalía de lluvias en Perú de Febrero-Abril

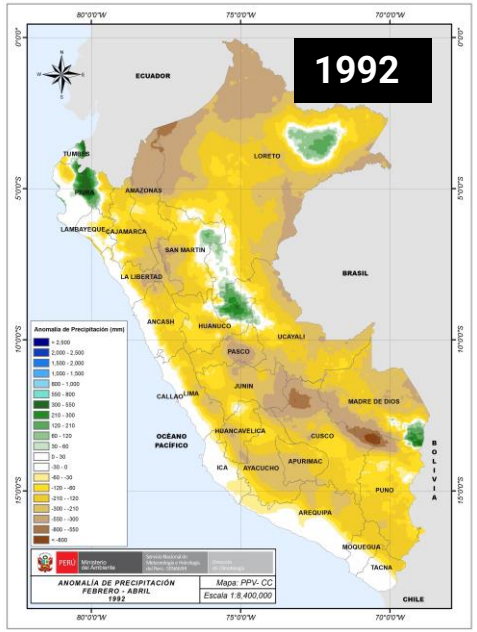
Niños Extraordinarios

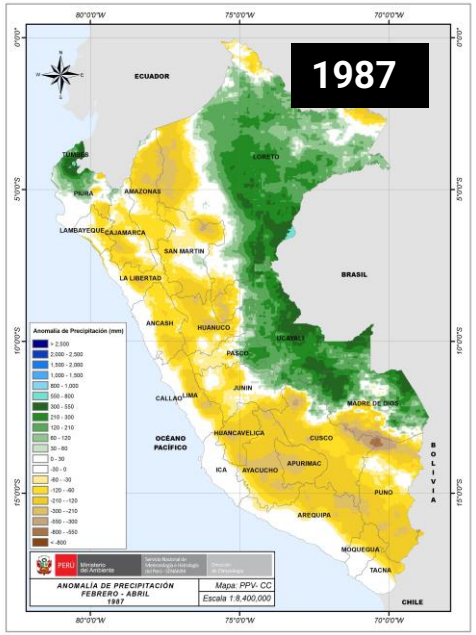




Niños moderados a fuertes

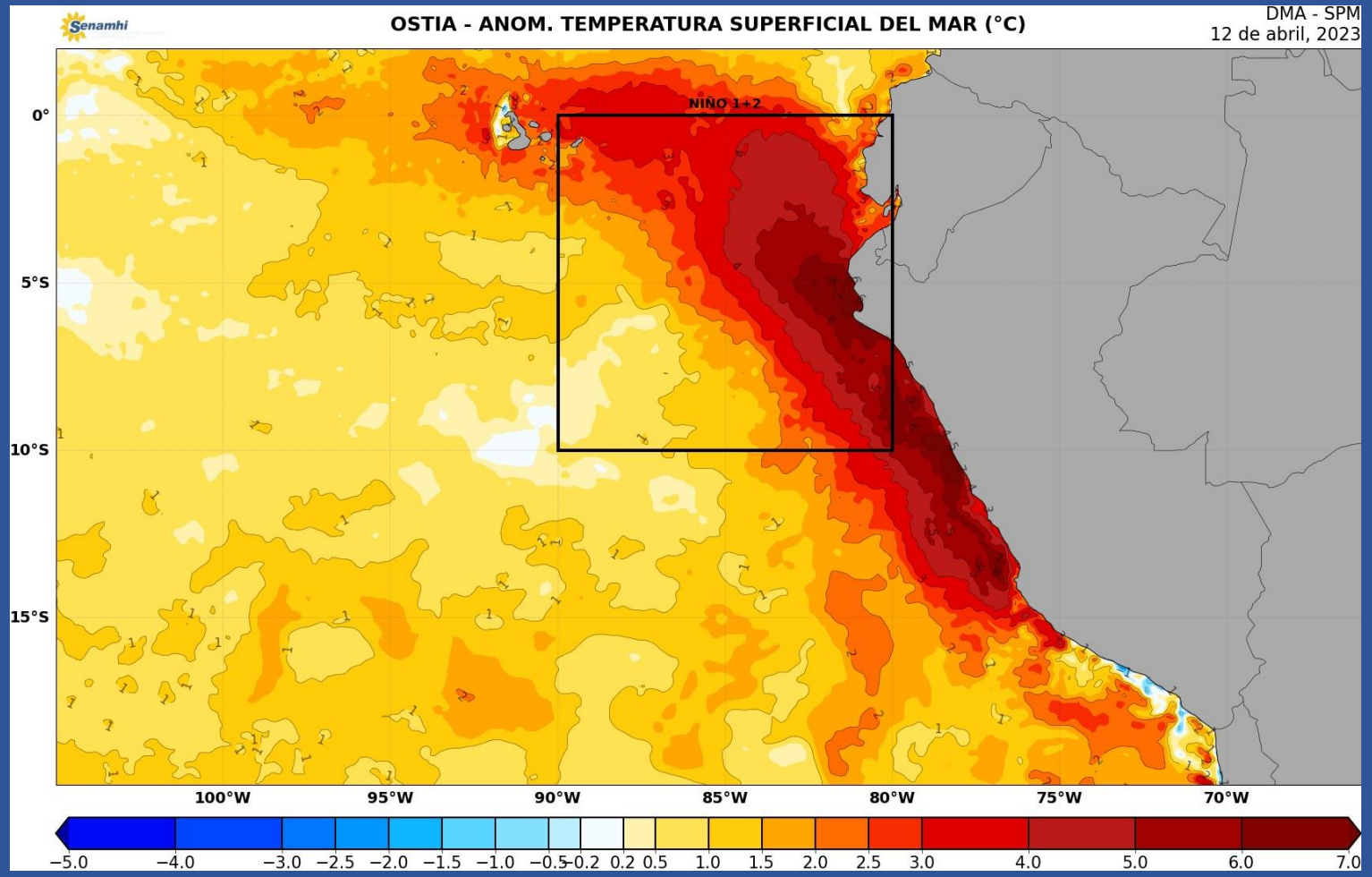






El Niño Costero

Calentamiento de la costa de Sudamérica



- Impactos extremos en el oeste de Sudamérica y Centroamérica.
- Lluvias extremas en Perú y Ecuador favorecen epidemias como el dengue.

Condiciones Actuales

Estado actual del sistema ENSO

El Niño CPC Advisory

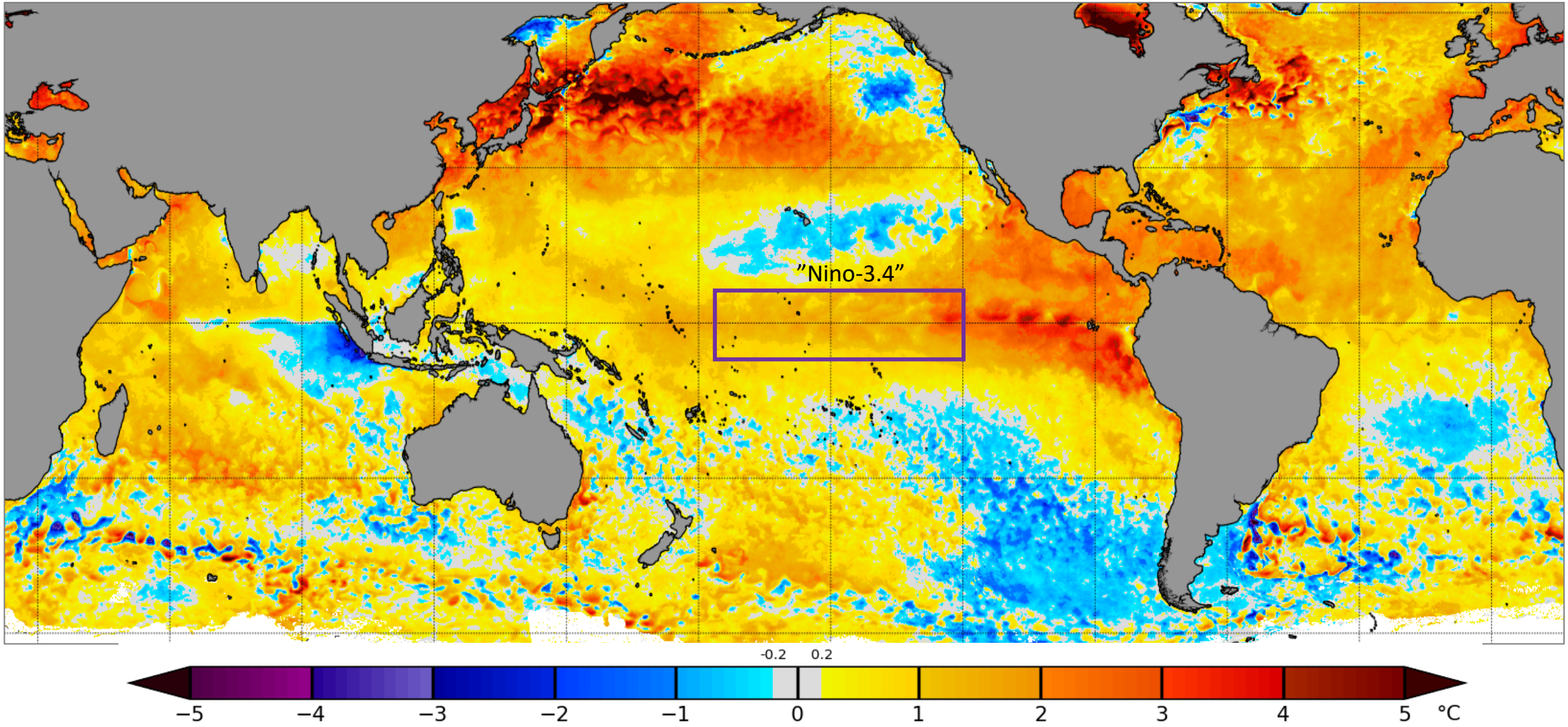
Actualización del 14 de setiembre de 2023

Se anticipa que El Niño continue durante el invierno del hemisferio norte con chances mayores al 95% para el periodo enero-marzo de 2024

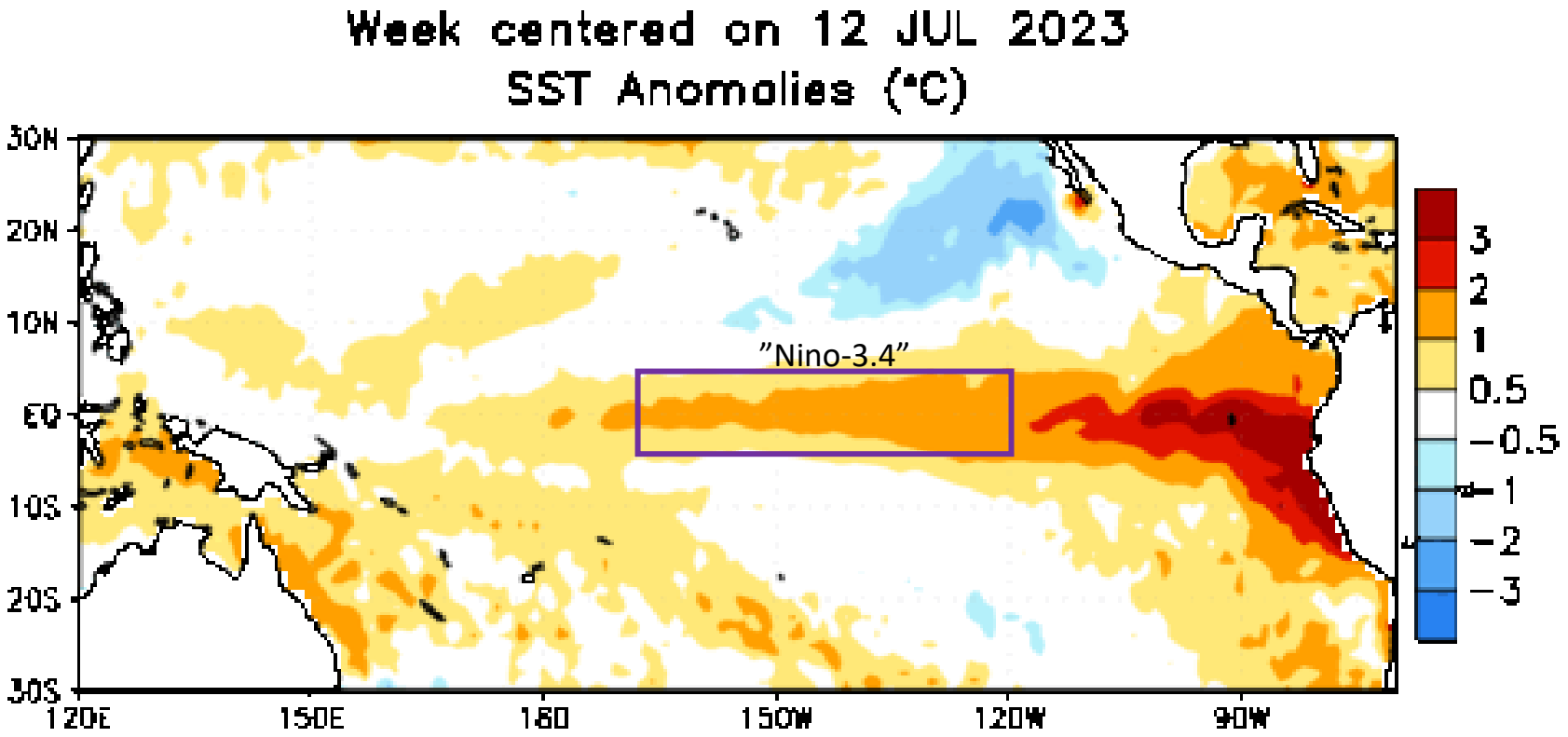
Referencias: NOAA Climate Prediction Center (CPC)
https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.shtml

Anomalías de la Temperatura del Mar

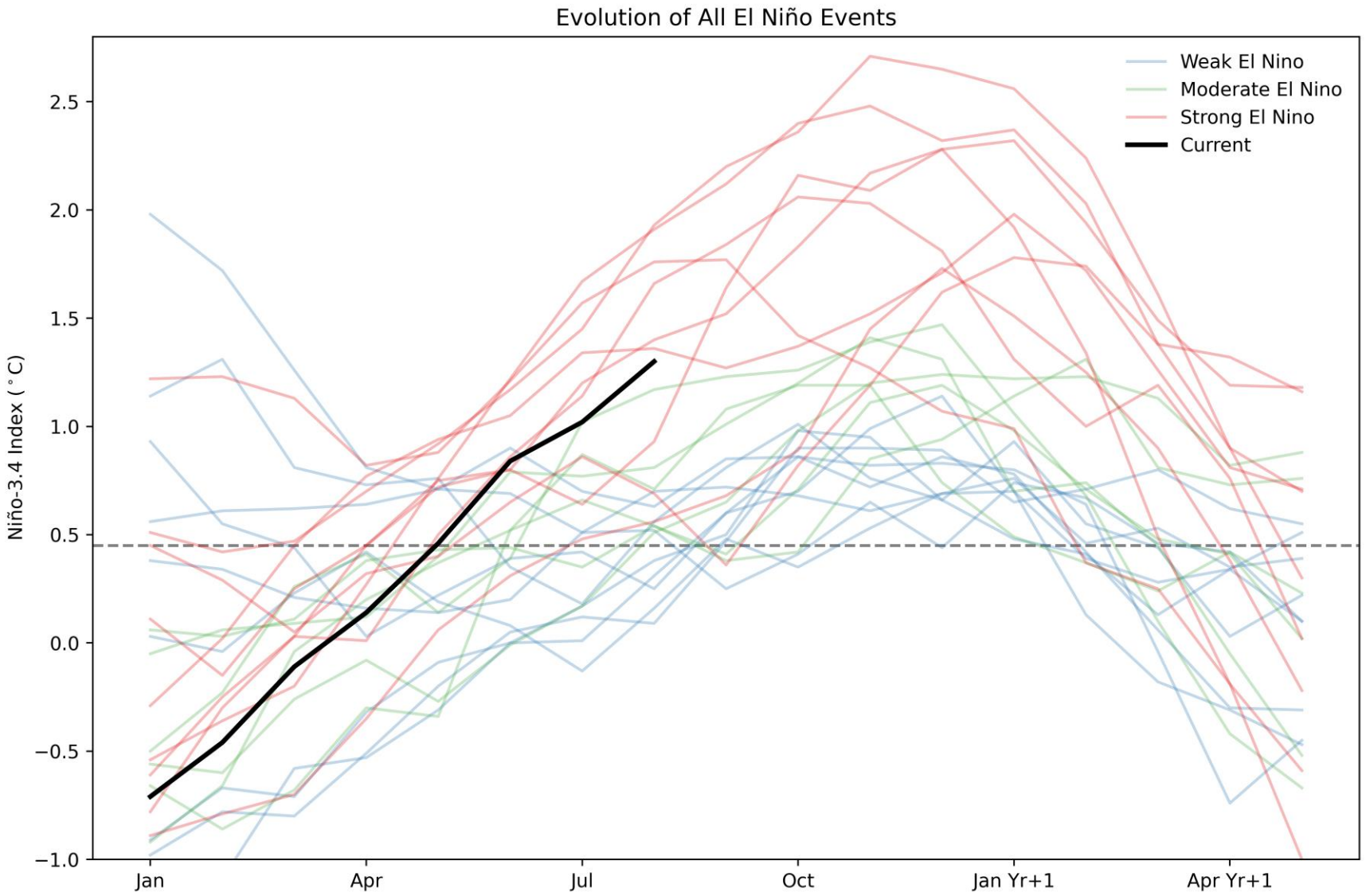
3 de octubre de 2023



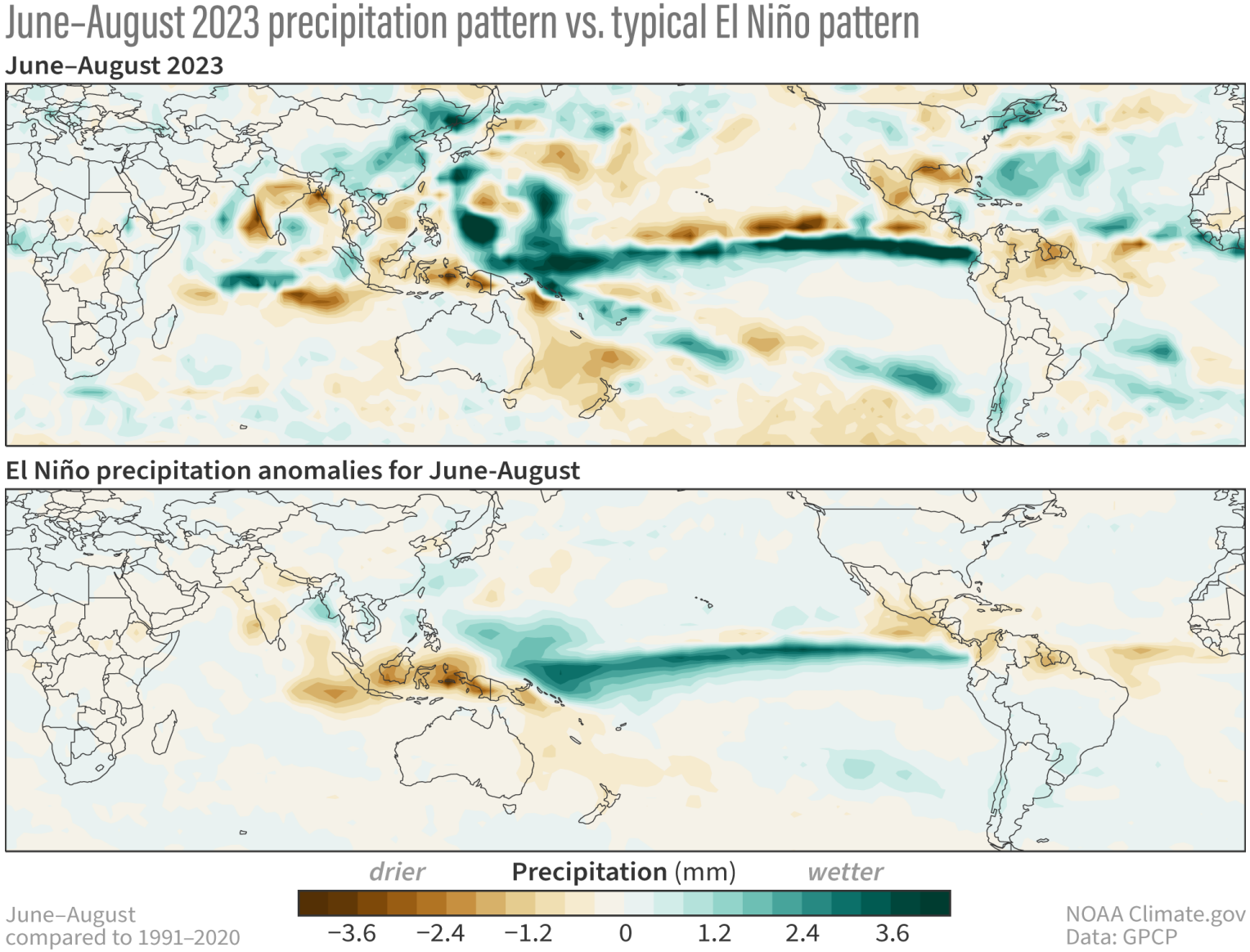
Anomalías de la Temperatura del Mar
3 de octubre de 2023



Evolución del Indice Niño-3.4 para todos los episodios Niño desde 1950



Data: NOAA ERSSTv5 (with 30-year moving climatologies)

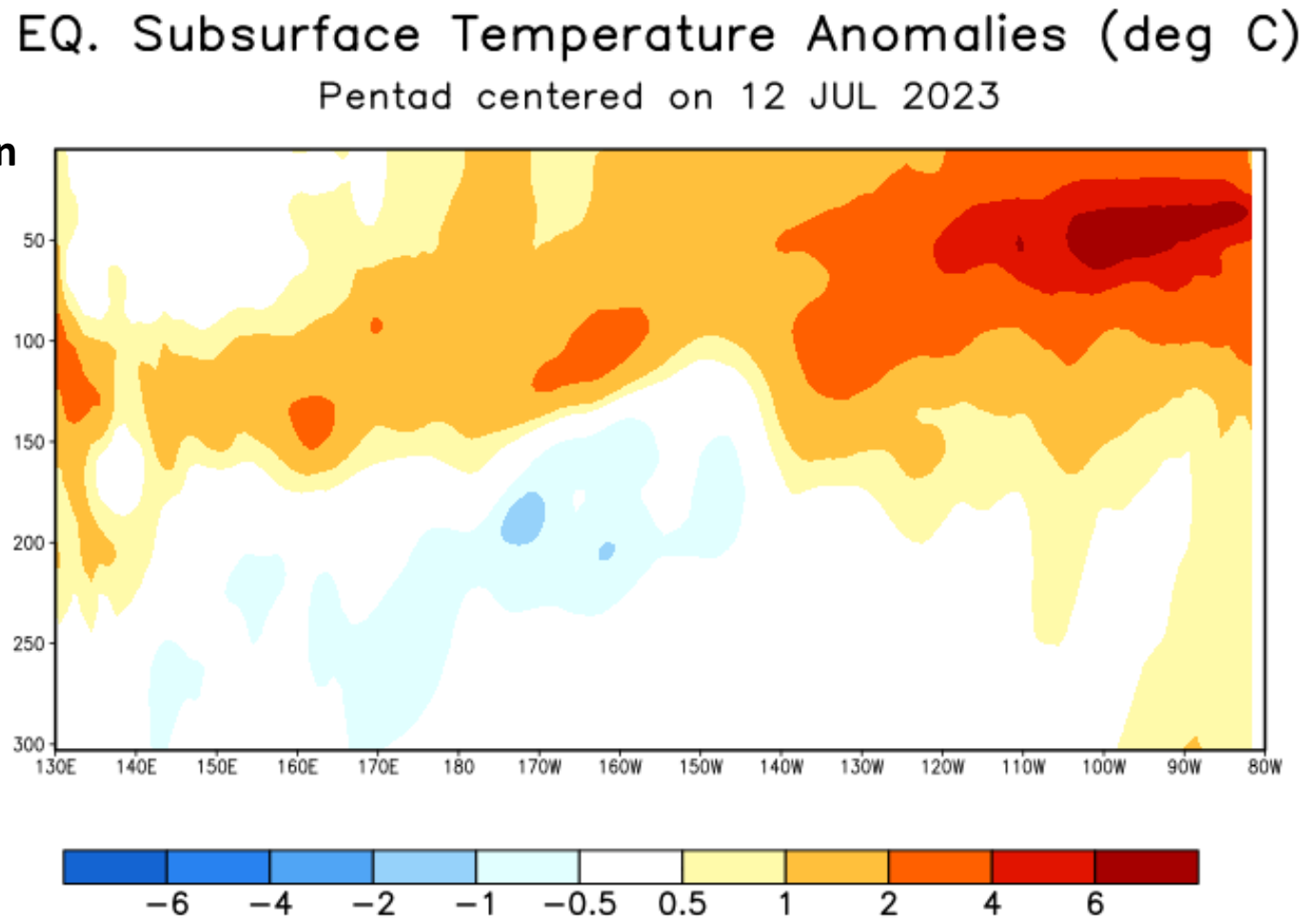


https://www.climate.gov/news-features/blogs/september-2023-enso-outlook-el-nino-convo

Perspectivas para los siguientes 3 meses

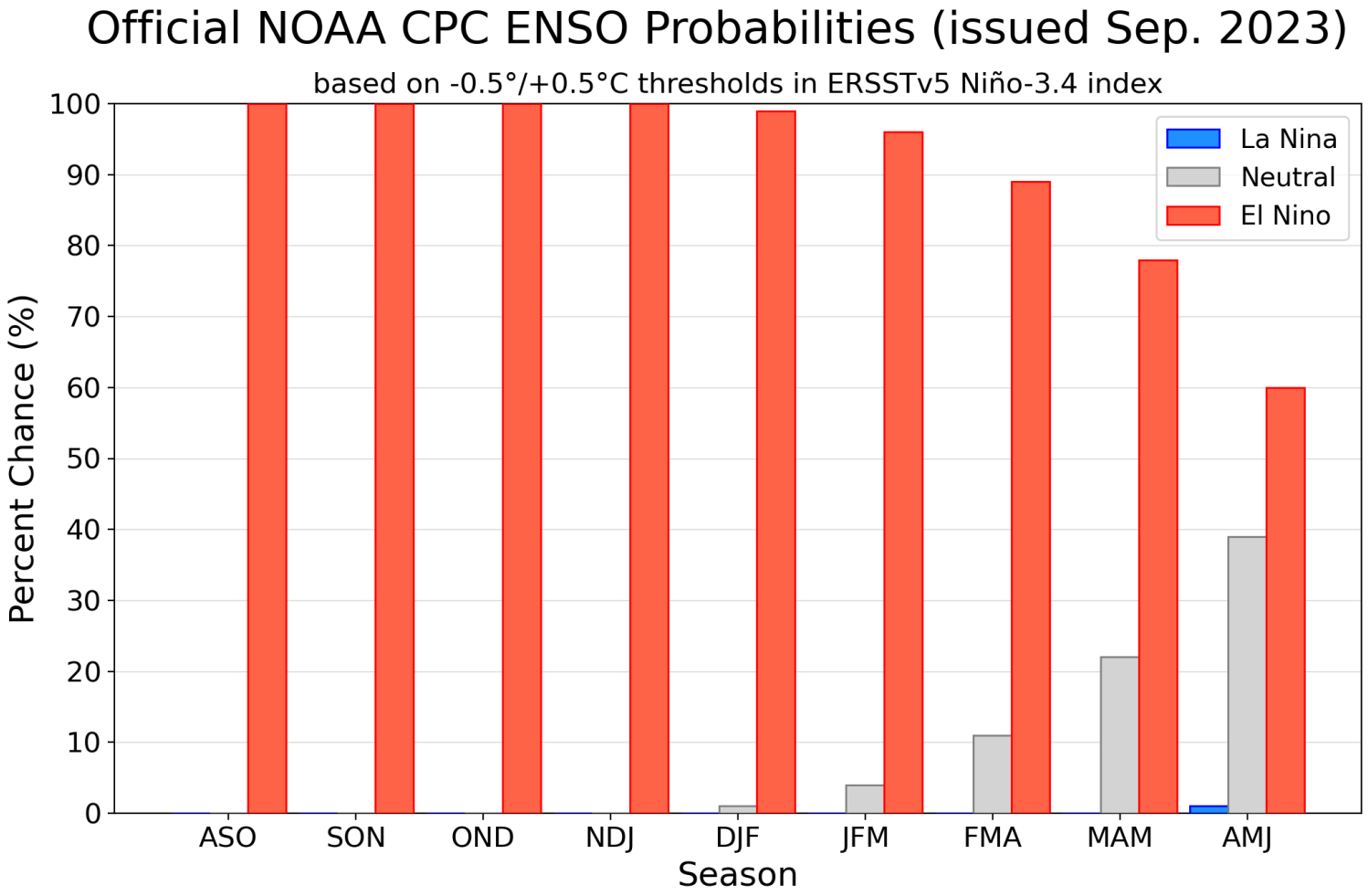
Pronóstico de El Niño: Se basa en muchos factores

Surface of Ocean



300 meters below surface

Pronóstico Probabilístico de El Niño más reciente



https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.shtml

Pronósticos de Intensidad del Niño 3.4

This table shows the forecast probability (%) of Niño-3.4 index exceeding a certain threshold (in degrees Celsius).
For negative thresholds, the table shows the probability (%) of a Niño-3.4 index value that is less than (more negative) that value.
For positive thresholds, the table shows the probability (%) of a Niño-3.4 index value that is greater than (more positive) that value.
This tool supports the official ENSO Diagnostic discussion updated on the 2nd Thursday of each month.

Target	< -1.5°C	< -1.0°C	< -0.5°C	> 0.5°C	> 1.0°C	> 1.5°C
ASO	~0	~0	~0	~100	98	49
SON	~0	~0	~0	~100	97	65
OND	~0	~0	~0	~100	97	73
NDJ	~0	~0	~0	~100	95	71
DJF	~0	~0	~0	99	89	60
JFM	~0	~0	~0	96	78	42
FMA	~0	~0	~0	89	57	19
MAM	~0	~0	~0	78	36	7
AMJ	~0	~0	1	60	20	3
	< -1.5°C	< -1.0°C	< -0.5°C	> 0.5°C	> 1.0°C	> 1.5°C

Para Oct-Dic y Nov-Ene, CPC espera un 71% to 73% chance de que el Indice de Niño Oceánico mayor a +1.5°C (“fuerte”).

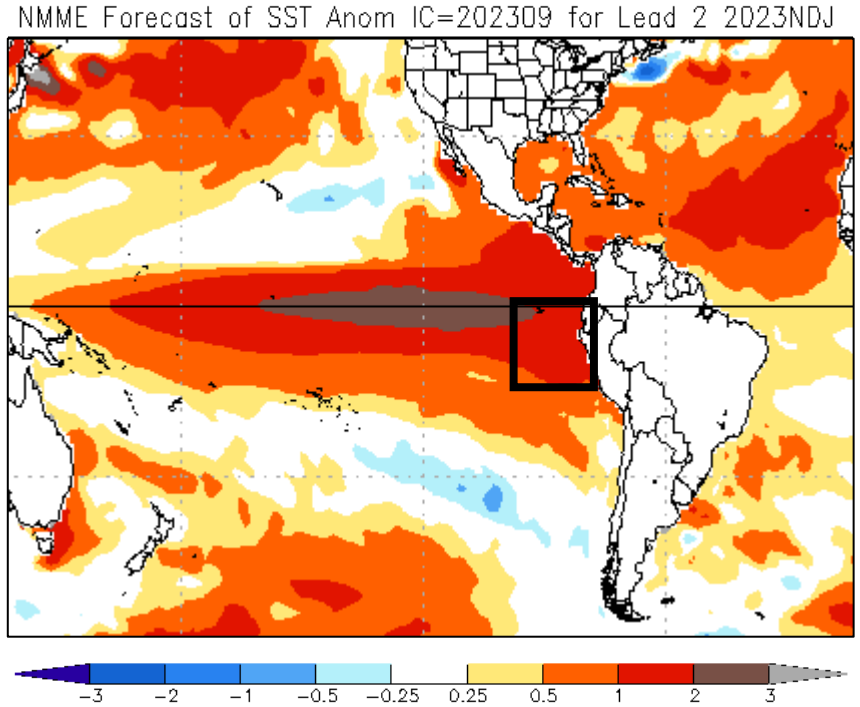
https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/strengths/index.php

Pronóstico Para la Costa de Sudamérica

Para la región Niño 1+2, se estima una mayor probabilidad de condiciones cálidas fuertes hasta noviembre de 2023 **(**Tabla 9 **y** Figura 46**).** Finalmente, para el verano 2023-2024 la mayor probabilidad corresponde a El Niño costero de magnitud moderada (51%), seguida de la probabilidad de magnitud fuerte (35%) **(**Tabla 11**).**

Tabla 9. Probabilidades mensuales estimadas de las condiciones cálidas y frías anómalas en el Pacífico oriental (región Niño 1+2) entre setiembre y febrero 2024.

Pacífico oriental	Octubre (%)	Noviembre (%)	Diciembre (%)	Enero (%)	Febrero (%)
Fría fuerte	0	0	0	0	0
Fría moderada	0	0	0	0	0
Fría débil	0	0	0	0	0
Neutro	0	0	1	2	4
Cálida débil	0	2	5	8	10
Cálida moderado	37	47	47	46	44
Cálida fuerte	62	50	46	43	41
Cálida extraordinario	1	1	1	1	1



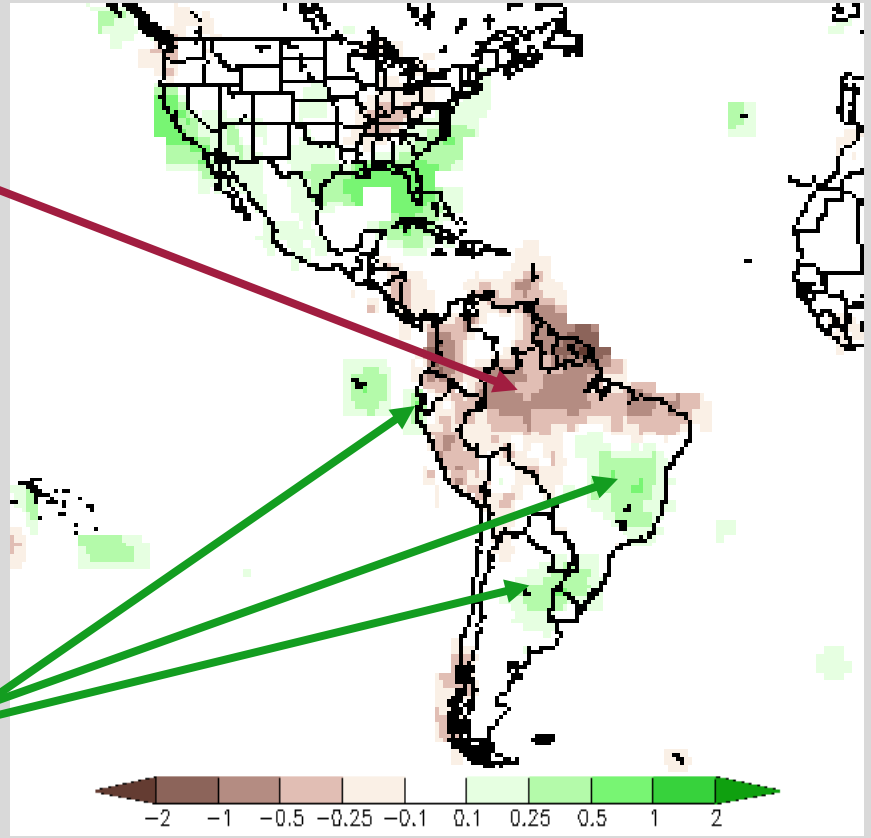
Fuente: ENFEN (Peru)

El Niño y Precipitaciones Noviembre-Enero

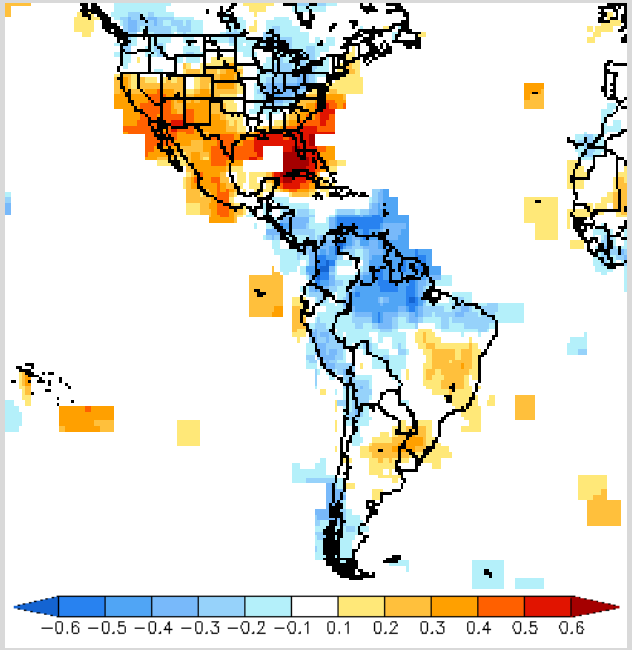
Sequías en la Amazonía, norte de Brasil, oeste de Sudamérica. Impacto en agricultura y disponibilidad de alimentos

Lluvias/inundaciones en Ecuador y norte de Perú; y en el NE de Argentina, Uruguay, S de Brasil y S de Paraguay: Impacto en desarrollo de plagas y epidemias en regiones inundadas

Regresión: mm/día



Correlación



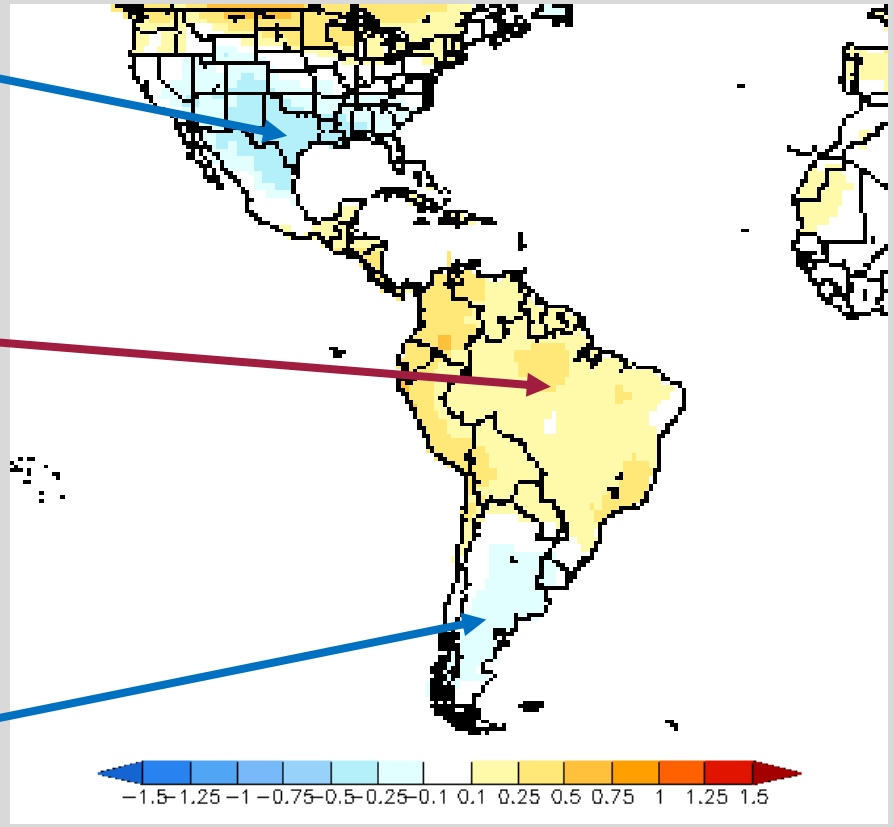
El Niño y Temperaturas Noviembre-Enero

Temperaturas menos extremas en Argentina y sur de Chile (o por debajo)

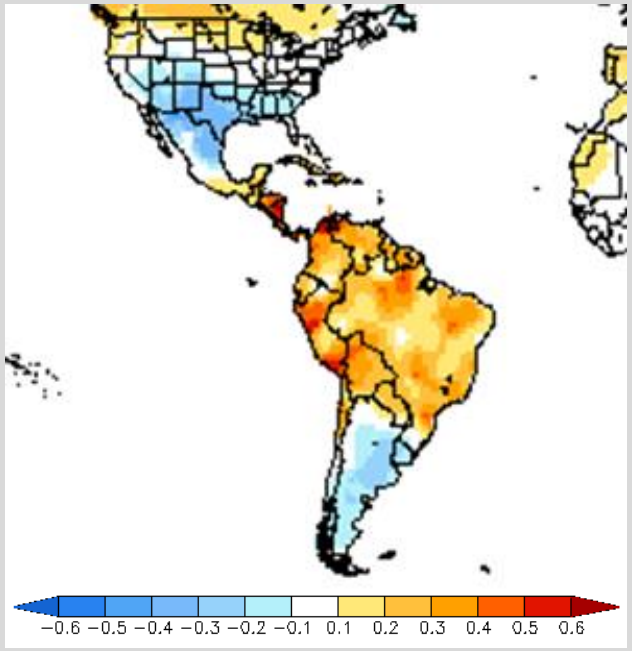
Temperaturas por encima de lo normal en la mayor parte de las Americas

Temperaturas menos extremas en Argentina y sur de Chile (o por debajo)

Regresión: °C



Correlación



Muchas Gracias!

Referencias

- NOAA Climate Prediction Center ENSO Team (2023), personal communication.
- Presentaciones de los WPC International Desks.
- Dos Santos Ferreira et al. (2022): Impacts of El Niño Southern Oscillation on the dengue transmission dynamics in the Metropolitan Region of Recife, Brazil

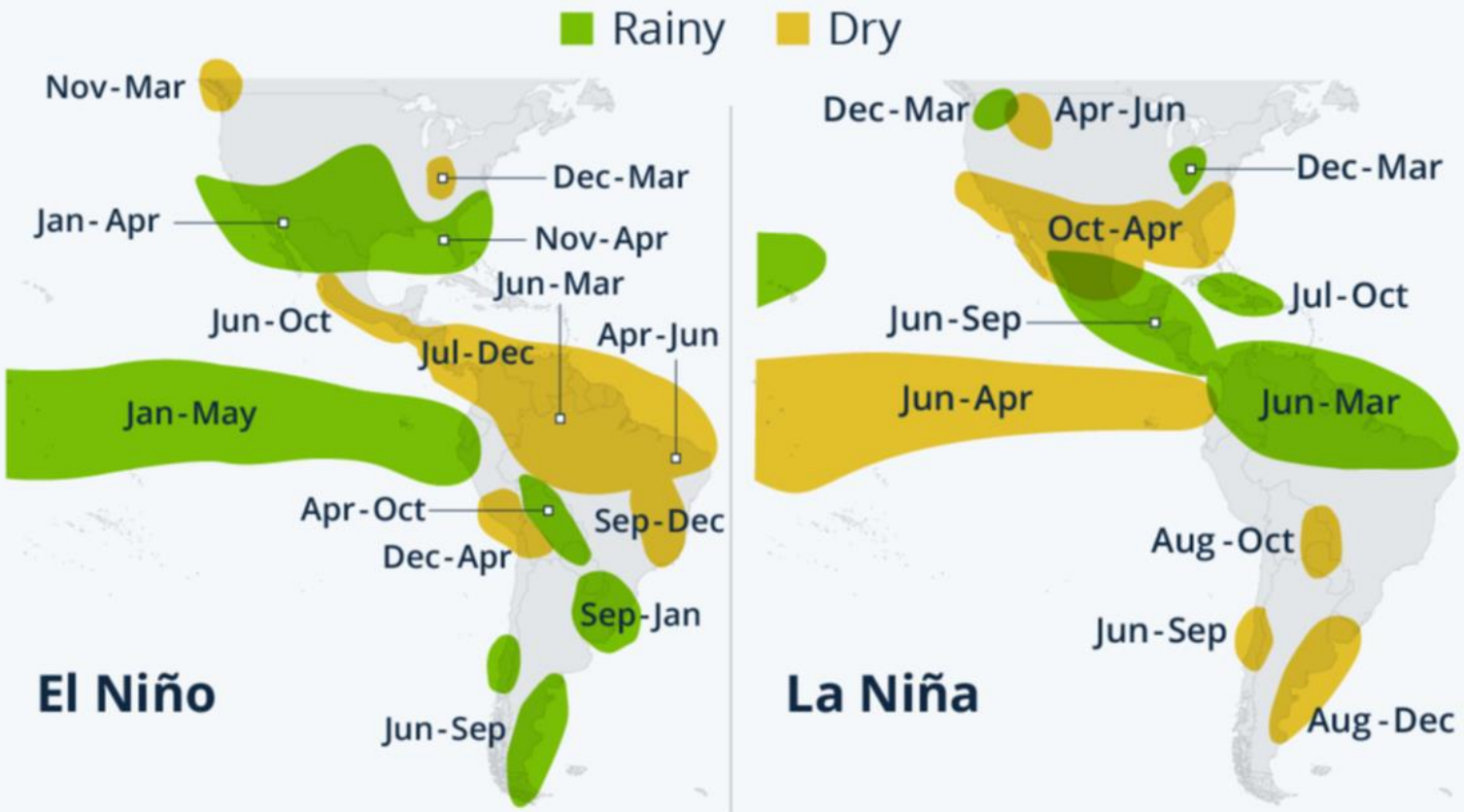
Health sector's preparedness and response to the El Niño Southern Oscillation

Daniel Buss
Unit Chief, Climate Change and Environmental Determinants of Health, PAHO

PAHO Pan American Health Organization
World Health Organization Regional Office for the Americas

When To Expect El Niño and La Niña

Projected rainfall patterns in the Americas during El Niño (left) and La Niña (right) phenomena



Source: International Research Institute for Climate and Society, Columbia University (U.S.)


Brasil, September 2023


New York City, June 2023


Brasil, September 2023


Chile, June 2023


Uruguay, March 2023

EL NIÑO EFFECTS AND HEALTH CONSEQUENCES

Source: WHO, El Niño and Health, 2016

Pan American Health Organization
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Table 2: Key health risks in the context of El Niño, July-Sep 2023.

Public health risk	Likelihood	Public health consequences	Level of risk*	Rationale
Malnutrition	Almost Certain	Severe	Very High Risk	Increased food insecurity and diarrhea results in malnutrition, especially in drought-affected regions. This may further contribute to population displacement.
Cholera and other diarrheal diseases	Highly likely	Severe	Very High Risk	Water contamination due to flooding or water scarcity in the event of droughts, highest risk in affected countries in east Africa.
Other waterborne and foodborne diseases	Likely	Moderate	High Risk	Water contamination, flooding, deteriorations in hygiene and sanitation
Malaria	Likely	Major	High Risk	Increased vector breeding. The majority of effects on malaria spread expected from El Niño can be expected in late 2023 and early 2024. Despite this, vector control programmes implemented in the short term may be effective against future transmission.
Arboviral diseases like dengue, Zika, chikungunya	Likely	Major	High Risk	Increased vector breeding and global distribution, changes in water storage practices. Risks are highest after periods of heavy rainfall. As with malaria, greater effects of El Niño on arboviral disease transmission will likely be seen later than September 2023, although early prevention measures today may be effective.
Other vector-borne diseases	Likely	Moderate	High Risk	Increased vector breeding, exposure to vectors and movement of animals
Rodent-borne diseases	Likely	Minor	Moderate Risk	Increased breeding and movement of rodents. As with malaria and arboviral diseases, the effects of El Niño on rodent-borne disease transmission may occur significantly later than September 2023
Vaccine-preventable diseases	Likely	Moderate	High Risk	Increased crowding due to flooding or displacement. An increase of meningitis cases in the Sahel region is possible in 2023 but more likely to occur in 2024.

WHO, Public Health Situation Analysis – El Niño Global Climate Event
July 2023

phsa-el-nino-2023_final_na.pdf (who.int)

*Level of risk:
Red: **Very high risk**. Could result in high levels of excess mortality/morbidity.
Orange: **High risk**. Could result in considerable levels of excess mortality/morbidity.
Yellow: **Moderate risk.** Could make a minor contribution to excess mortality/morbidity.
Green: Low risk. Unlikely to make a significant contribution to excess mortality/morbidity

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Table 2: Key health risks in the context of El Niño, July-Sep 2023.

Public health risk	Likelihood	Public health consequences	Level of risk*	Rationale
Biotoxins: fish and shellfish poisoning	Likely	Minor	Moderate Risk	Increased sea surface temperatures resulting in algal proliferation. Associations between biotoxins and El Nino warrant further study, but some association has been observed in Caribbean and Pacific islands.
Heat stress and air pollution	Almost certain	Moderate	High Risk	Heat stress is the leading cause of weather-related death and can exacerbate underlying NCDs. Air pollution results from multiple mechanisms, including smoke from wildfires. Risk of wildfires is highest in SE Asia, esp. Indonesia. There are additionally increased risks in the United States of America and Canadian Pacific Northwest. Elsewhere (Australia, South America) risks will be higher after September 2023.
Worsening maternal and child health	Likely	Moderate	High Risk	Decreased access to health services, displacement, others
Direct injuries	Likely	Minimal	Low Risk	Flooding, storms, wildfires
Gender-based violence	Highly Likely	Moderate	High Risk	Reduced livelihoods, food insecurity, displacement, others
Conditions requiring mental health and psychosocial support	Highly Likely	Moderate	High Risk	Reduced livelihoods, food insecurity, displacement, others

WHO, Public Health Situation Analysis – El Niño Global Climate Event July 2023

phsa-el-nino-2023_final_na.pdf (who.int)

*Level of risk:
Red: **Very high risk**. Could result in high levels of excess mortality/morbidity.
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Impacts and Inequity

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World Health Organization
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The challenge: Health impacts attributable to preventable environmental risks in the Americas

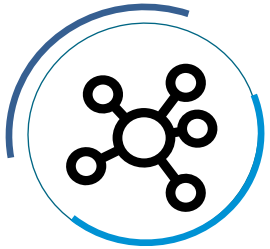
Water, Sanitation and Hygiene: 431 million of people in LAC lack safely managed sanitation systems. 9,9 million people practice open defecation. 161 million people do not have access to safely managed water sources – resulting in over 30,000 preventable deaths per year.

1,016,000

Premature deaths per year

Air pollution: linked with 320,000 premature deaths in LAC due to cardiovascular and respiratory diseases and cancer. Over 74 million people depend on polluting fuels (wood, coal, kerosene) for cooking and heating.

19% In low- and middle-income countries



Exposure to chemical hazards: Globally, at least 2 million deaths related with the exposure to chemical products with lead, mercury, arsenic and pesticides. Most affected people are children, elderly, and occupational exposures.

13% In high-income countries

Climate-related impacts: Extreme weather and slow onset events exacerbate food and water insecurity, air contamination, zoonotic pathogen transmission patterns and water-borne diseases, and mental health issues. Health impacts are higher in areas low-income areas, with insufficient health services and inadequate infrastructure.

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Health sector's preparedness and response to the El Niño Southern Oscillation

Strengthen Healthcare service Delivery

Early Warning Systems and Surveillance

Research, Capacity building and Communication

Intersectoral coordination for action, at all levels

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Health sector's preparedness and response to the El Niño Southern Oscillation (ENSO)

1. Strengthen Healthcare service Delivery

- *Train healthcare professionals and first responders to manage ENSO-related health crises.*
- *Maintain a stockpile of medical supplies and emergency resources in readiness for increased demand.*
- *Have contingency plans in healthcare facilities to accommodate a surge in patients during ENSO-related health crises.*
- *Deploy mobile medical units to reach remote or disaster-affected areas.*
- *Anticipate and monitor potential population displacements (e.g. due to the loss of crops, economic stress, extreme events) and strengthen healthcare provision and humanitarian support to these areas.*
- *Offer psychological support services due to the stress of extreme weather events.*

On the long-term:
Improve health infrastructure: assess and transform health infrastructure to make them safer and operational during and after climate-related events, and using greener technologies

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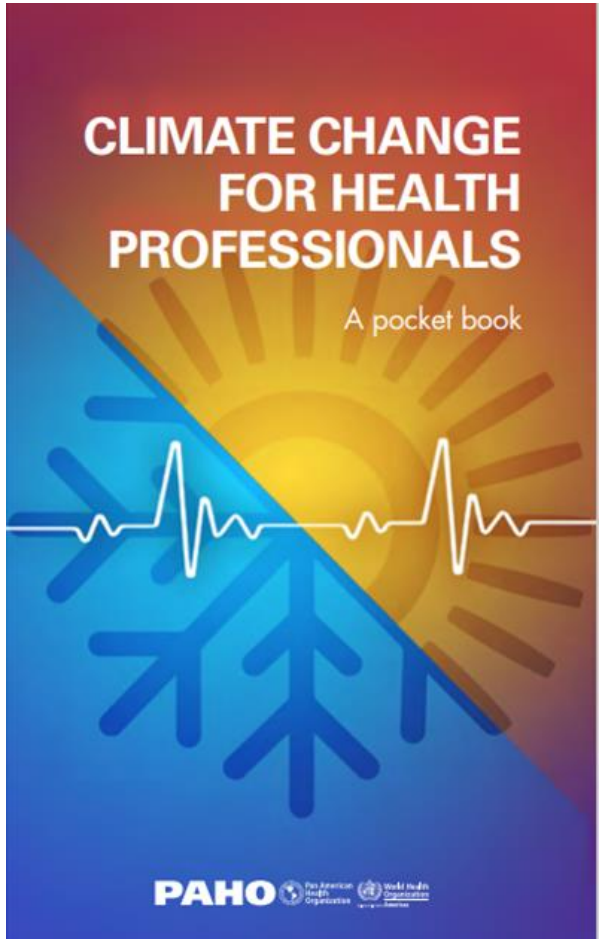

EMPIRICAL DATA

HEAT

- The risk of hospitalization for myocardial infarction increases by 1.6% with each 1°C (1.8°F) increase in temperature (Sun et al., 2018).
- There is a clear association between heat and mortality from cardiovascular disease (Liu et al., 2015).
- Heat exhaustion is the most common heat-related condition and is not associated with signs of organic damage (Health Canada, 2011).
- In some 85% of people who experience heatstroke, their electrocardiogram shows alterations such as sinus tachycardia (40%-80%) and prolongation of the QT interval (60%) (Mimish, 2012).

Diuretics

- More than 30% of people whose health was affected during a heat wave in Australia and in France had been under treatment with diuretics and most were 70 years old or more (Faunt et al., 1995; Argaud et al., 2007).
- Hyponatremia in people with heart failure increases the risk of death by 40%-70% (Rusinaru et al.; 2012).

Antiarrhythmics

- Some 10%-26% of people treated with antiarrhythmics (amiodarone, quinidine, and procainamide) experience nausea and vomiting (Sinha et al., 1992; Nygaard et al., 1986).
- More than one third of children under 15 given intravenous amiodarone develop hypotension (Saul et al., 2005).

Digoxin

- Nearly 11% of elderly people (average age: 81) experience nausea and vomiting associated with clinical digitalis toxicity (Boman, 1983).

Climate Change for Health Professionals: A Pocket Book (paho.org)

Cambio climático para profesionales de la salud: un libro de bolsillo (paho.org)

Mudança do clima para profissionais da saúde: Guia de bolso (paho.org)

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World Health Organization Americas
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Climate Resilient Health Infrastructure

- The Health Sector contributes ~4-10% of national GHG emissions (4.4% of global emissions).

- 71% of GHG emissions are due to the production chain (production, transportation and waste treatment/disposal; HCWH 2019).

- 77% of health facilities in LA&C are located in areas at risk of climate disasters.

Pan American Health Organization | World Health Organization | UKaid

Organización Panamericana de la Salud | Organización Mundial de la Salud | Américas | OPS

Health sector's preparedness and response to the El Niño Southern Oscillation (ENSO)

2. Early Warning Systems and Surveillance

- *Strengthen early detection capacity of the health sector to climate-related events.*
- *Use meteorological data to predict extreme weather events (floods, droughts, wildfires, poor air quality).*
- *Implement disease surveillance to detect early outbreaks and patterns linked to ENSO.*
- *Establish clear communication channels to disseminate alerts to healthcare providers and communities.*

Health and climate surveillance systems

Observatories on Climate and Health

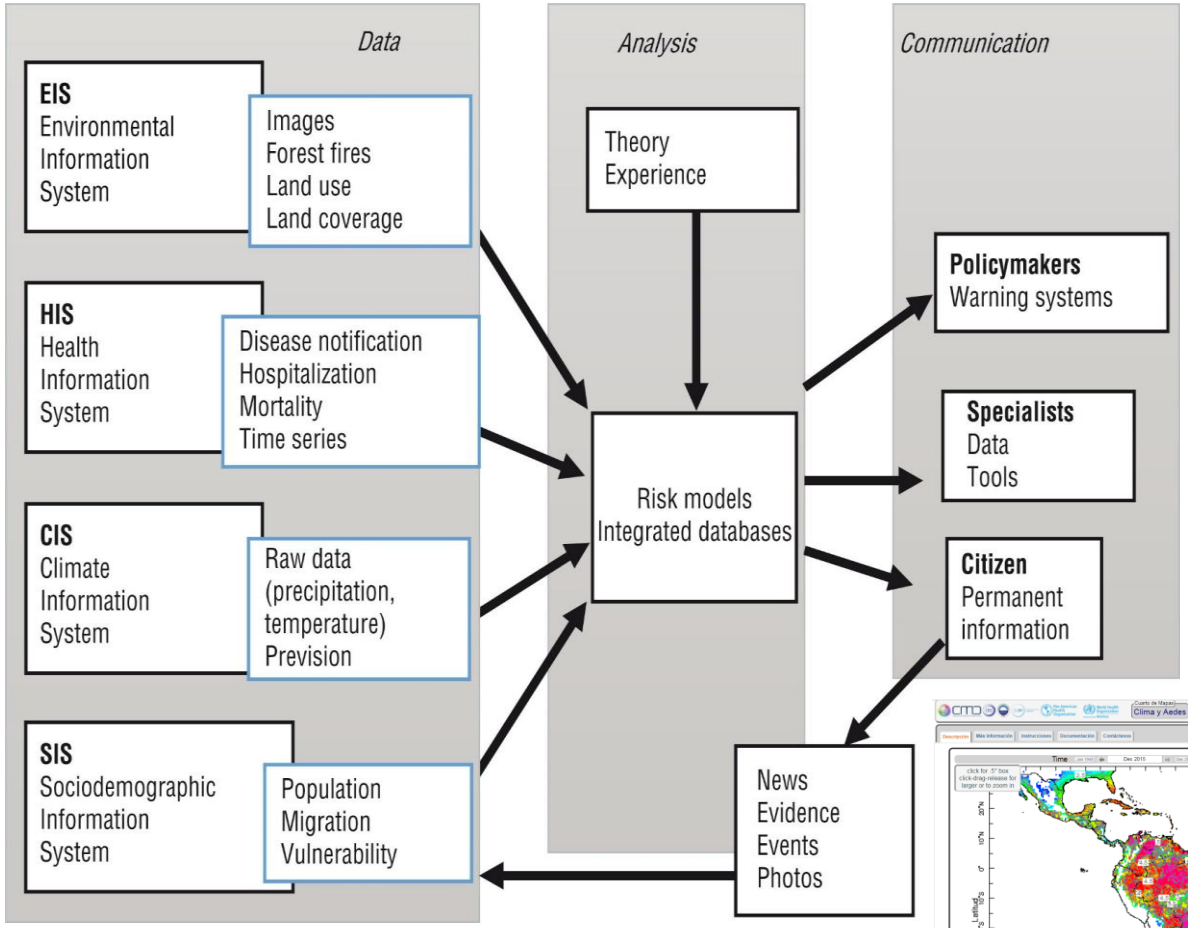


Fig. 2: Ejemplo del mapa de alertas publicado el 18 de febrero de 2018.

Servicio Meteorológico Nacional

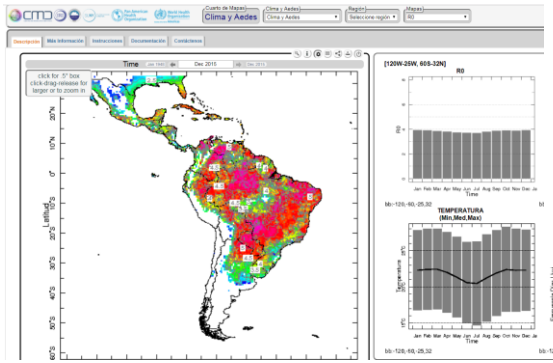
VERDE: Sin efecto sobre la salud
Sin peligro sobre la salud de la población.

AMARILLO: Efecto leve-moderado
Pueden ser peligrosas, sobre todo para los grupos de riesgo: bebés y niños pequeños, mayores de 65 años y enfermos crónicos.

NARANJA: Efecto moderado-alto
Pueden ser muy peligrosas, especialmente para los grupos de riesgo.

ROJO: Efecto alto-extremo
Muy peligrosas. Pueden afectar a todas las personas saludables.

Fig. 1: Niveles de alerta del SAT-OCS y sus efectos sobre la salud. Fuente: Secretaría de Gobierno de Salud.



Organización Panamericana de la Salud
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Colombia

Boletín

CLIMA Y SALUD

Edición No. 7 de 2021

La salud es de todos | Minsalud

02 Región Amazónica

CLIMATOLOGÍA DEL MES DE JULIO

PREDICCIÓN DE LA PRECIPITACIÓN JULIO

07 Posibles efectos y sus recomendaciones en salud

Conforme con las predicciones climáticas del IDEAM para el mes de julio, a continuación se resumen los posibles efectos y recomendaciones en salud para los eventos de interés en salud pública.

ENFERMEDADES TRANSMITIDAS POR VECTORES

Dengue, Chicunguña y Zika

Para las Regiones Caribe, Pacífica y Amazonía se espera un favorecimiento de las condiciones ambientales propicias para la ocurrencia de casos de Dengue, Chikunguña y Zika, en los departamentos de Cesar, Magdalena y el distrito especial de Cartagena; en los departamentos

En consecuencia, se presentan las características para el desarrollo del vector debido a la acumulación de agua lluvia en tanques de almacenamiento sin tapas adecuadas, recipientes inservibles, albercas y demás criaderos artificiales en mal estado dentro de las viviendas.

En la región Andina y Orinoquía, se espera un comportamiento epidemiológico habitual de casos con un aumento en el departamento de Norte de Santander de Dengue, Zika y Chikunguña.

RECUERDE LA IMPORTANCIA DE:

- ✓ Intensificar la vigilancia epidemiológica
- ✓ Fortalecer la búsqueda de casos,
- ✓ El adecuado control vectorial
- ✓ Fortalecer los procesos de información a las comunidades a través de las

Boletines mensuales

En este documento Colombia realiza predicciones de precipitación en las diferentes regiones del país, basados en el mes previo. Adicional a ello realiza recomendaciones en salud para los efectos del clima, según regiones

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Health sector's preparedness and response to the El Niño Southern Oscillation (ENSO)

3. Research, Capacity building and Communication

- *Foster research to increase the understanding of the direct and indirect effects of ENSO in health, and its interplay with other social and environmental drivers.*
- *Create effective communication and information exchange channels between academia, decision-makers at all levels, civil society, and private sector.*
- *Provide capacity-building for action, at all levels.*
- *Educate the public on the health risks and preventive measures during ENSO periods.*
- *Involve local communities in planning and response efforts to enhance community resilience.*

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CLIMATE CHANGE IN THE AMERICAS

IMPACTS

EXCESS HEAT KILLS OVER 56,000 PEOPLE EACH YEAR IN THE AMERICAS(1)

THE AMERICAS REPORTED OVER 3 MILLION CASES OF DENGUE IN 2019, THE HIGHEST NUMBER ON RECORD(2)

THE HEALTH SECTOR IS RESPONSIBLE FOR 3-10% OF NATIONAL GREENHOUSE GAS EMISSIONS IN THE AMERICAS(3)

CHILDREN BORN IN THE AMERICAS IN 2020 WILL EXPERIENCE:

- 1.3x MORE WILDFIRES
- 1.8x MORE RIVER FLOODS
- 2x MORE DROUGHTS
- 2.5x MORE CROP FAILURE
- 4.5x MORE HEAT WAVES

COMPARED TO SOMEONE BORN IN 1960(4)

GLOBAL PROPORTION OF CATEGORY 4 & 5 HURRICANES WILL INCREASE BY 13% WITH A 2°C GLOBAL TEMPERATURE SHIFT(5)

ADVANCES

OF THE 35 COUNTRIES IN THE AMERICAS...

28 COUNTRIES HAVE CLIMATE CHANGE INTERMINISTERIAL COMMITTEES THAT INCLUDE HEALTH(a)

31 COUNTRIES RECOGNIZE THE IMPORTANCE OF **HEALTH** IN NATIONAL CLIMATE CHANGE COMMITMENTS(b)

... BUT MOST (30) **STILL LACK** HEALTH NATIONAL ADAPTATION PLANS (HNAPs)

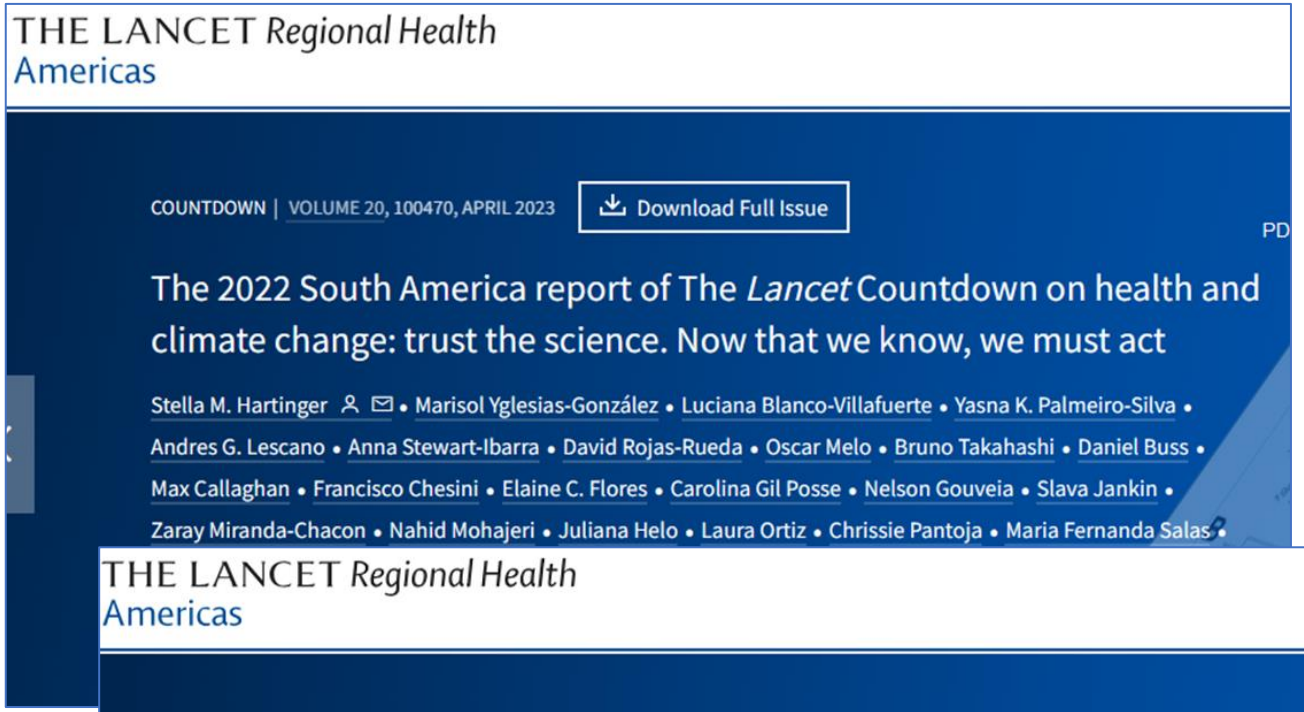
17 COUNTRIES HAVE IMPLEMENTED **HEALTH** AND CLIMATE SURVEILLANCE ACTIVITIES(c)

12 COUNTRIES RECEIVED INTERNATIONAL **FUNDS** FOR CLIMATE CHANGE AND **HEALTH**(d)

7 COUNTRIES HAVE A **NATIONAL TARGET** FOR HEALTH SECTOR GREENHOUSE GAS EMISSION REDUCTIONS(e)

PAHO

Health sector and ENSO: Research, Capacity building and Communication



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Health sector's preparedness and response to the El Niño Southern Oscillation (ENSO)

4. Intersectoral coordination for action, at all levels

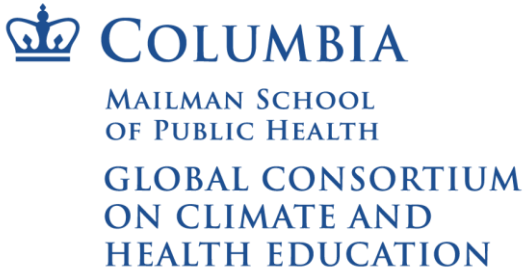
- *Coordinate with multiple sectors to develop comprehensive response plans to address specific health risks during ENSO events.*

Examples:

- *Strengthen social safety nets, food assistance programs, to support households during periods of food scarcity and economic stress.*
- *Engagement with national meteorological and hydrological services for detailed updates on rainfall observed as well as more localized predictions to assist preparedness and response.*
- *Energy Sector: Collaborate to maintain power supply for medical facilities and equipment in times of increased demand.*
- *Water Resources Management: Work together to ensure access to safe drinking water, critical in preventing waterborne diseases.*
- *Transportation Sector: Ensure efficient movement of relief supplies and healthcare teams to affected areas during El Niño events.*

Intersectoral coordination for action, at all levels

United Nations
Framework Convention on
Climate Change



CLIMATE &
CLEAN AIR
COALITION
TO REDUCE SHORT-LIVED
CLIMATE POLLUTANTS

RED ARGENTINA DE
MUNICIPIOS FRENTE AL
CAMBIO CLIMÁTICO

Financiamiento de programas de salud y clima

- ***Preparación de portafolios y de capacidades locales para la generación de proyectos sobre salud y cambio climático para el GCF y otras agencias de cooperación***

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PAHO

Pan American Health Organization

World Health Organization

Americas

OPS

Organización Panamericana de la Salud

Organización Mundial de la Salud

Américas

OPS

Organisation panaméricaine de la Santé

Organisation mondiale de la Santé

Amériques

OPAS

Organização Pan-Americana da Saúde

Organização Mundial da Saúde

Américas

Daniel Buss
Climate Change and Environmental Determinants of Health

PAHO, Washington DC

Webinar on El Niño and the reduction of its impacts on the health sector
05 October 2023

Products and service delivery

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Focal Point for integrated Health Services WMO Region IV-Cuba and leader Climate-Health Group.

Climate Center. Institute of Meteorology. Havana. Cuba

Climate - Health Group
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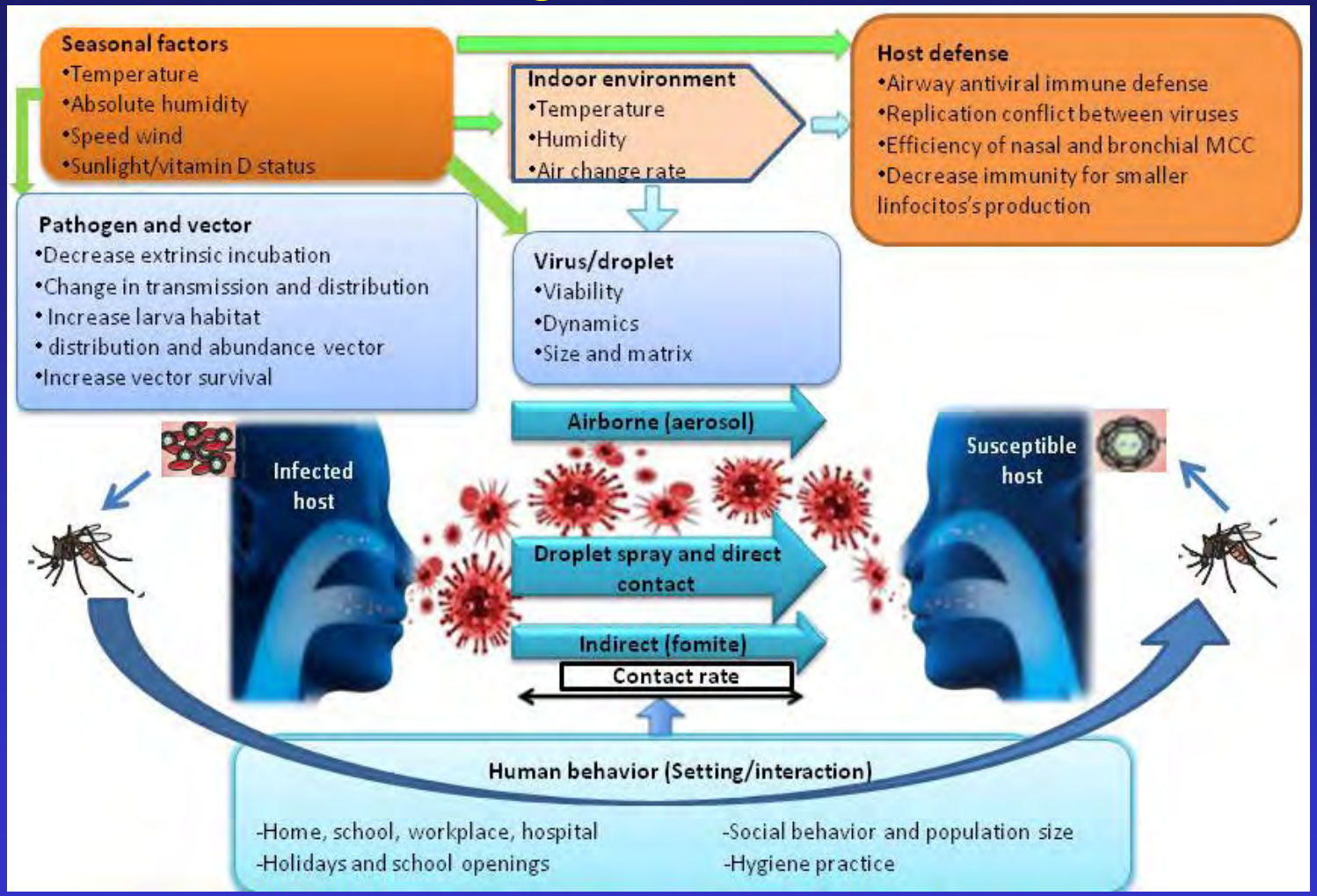
Some Concepts are Needed

Effects of the environment and climate on Co-Circulation SARS-CoV-2 and dengue transmission.



Linares-Vega Y and Ortiz Bultó PL. Dengue and SARS Cov2 Co-Circulation Early Warning according to Climate Variations in Cuba. Mycol Mycological Sci, 2021, 4(3): 000149. DOI: 10.23880/OAJMMS-SC-21-149

Two approaches: According to (Lowry, 1988)

1. Independent variables

2. Compound variables (those that give rise to the formulation of indexes).

Approach 1: example: temperature or humidity (only explains a partial part of climate and its impact on organisms and biological systems).

Approach 2: permits to explain more consistently the effects of climate variability, allowing to maximize its relevance to human health. Since humans and other organisms react to the configuration of coexisting climate variables and interact with each other from their immediate environment, researchers are encouraged to use climate index that combine individual climate variables.

Cuba has its own methodology to deal with the effects of weather and climate on the virus, which does not exclude the use of the method of separate variables indistinctly.

CLIMATE PREDICTION IN HUMAN HEALTH. EARLY WARNING SYSTEM OF CUBA

How are the relationships between climate variability and change and epidemiological pattern changes?

Variability and Climate Change

≠

Changes in the biological transmission
. Dynamics of the vector
.Dynamics of the pathogens

Ecological Change
. Biodiversity Loss
. Community location
. Nutrient cycle changes

Socio-Economic Change
•Migration
•Famine
•Sanitation
•Population

Epidemiological Change
Vector-Borne diseases or not

Malaria
Dengue
Filariasis
ARIs
ADDs
Hepatitis
Others
Yellow fever
Meningococcal meningitis

•Ortíz, P L, Pérez A.R , Rivero A.V León N.V. Díaz M and Pérez A (2006). Mini- Monograph "Resulted to assessing the human health vulnerability to climate variability and change in Cuba. "*Environmental Health Perspectives* (*EHP*). E.U.

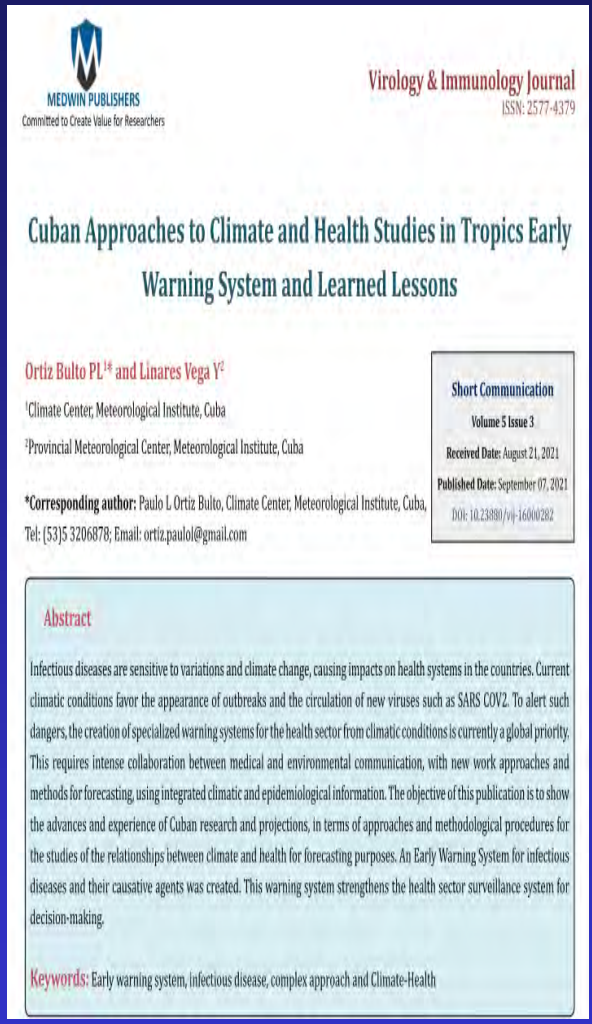
•Ortíz, P L et al. (2008). Assessment of Human Health Vulnerability in Cuba due to Climate or Weather Variability and Change In book "Global Warming and Climate Change: Kyoto - Ten Years and Still Counting Vol 1-2 Editor Velma I Grover. Publisher Science Pubs Inc- UK

Expression of anomalies in different scales of variability calculation.

$$IB_{t,r,p} = \sum_{1}^{n} \alpha_{\varepsilon} \left[\frac{\omega_{\varepsilon,t} - \varpi_{\varepsilon}}{\sigma_{\varepsilon}} \right]$$

$IB_{t,r,p}$: the Bultó Index expresses the climate variability (CV) at time **t**, in region **r**, in the country **p** where:

- ε: describes the CV that characterizes the study region
- α_{ε}: weight for each variable
- $\omega_{\varepsilon,t}$: series of weather and CV at time t
- ϖ_{ε}: mean value of CV
- σ_{ε}: standard deviation of variable



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Virology & Immunology Journal
ISSN: 2577-4379

Cuban Approaches to Climate and Health Studies in Tropics Early Warning System and Learned Lessons

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Short Communication
Volume 5 Issue 3
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Abstract

Infectious diseases are sensitive to variations and climate change, causing impacts on health systems in the countries. Current climatic conditions favor the appearance of outbreaks and the circulation of new viruses such as SARS COV2. To alert such dangers, the creation of specialized warning systems for the health sector from climatic conditions is currently a global priority. This requires intense collaboration between medical and environmental communication, with new work approaches and methods for forecasting, using integrated climatic and epidemiological information. The objective of this publication is to show the advances and experience of Cuban research and projections, in terms of approaches and methodological procedures for the studies of the relationships between climate and health for forecasting purposes. An Early Warning System for infectious diseases and their causative agents was created. This warning system strengthens the health sector surveillance system for decision-making.

Keywords: Early warning system, infectious disease, complex approach and Climate-Health

Ortíz, P L, Pérez A.R , Rivero A.V León N.V. Díaz M and Pérez A (2006). Mini- Monograph "Resulted to assessing the human health vulnerability to climate variability and change in Cuba. "*Environmental Health Perspectives* (*EHP*). E.U.

Ortíz, P L et al. (2008). Assessment of Human Health Vulnerability in Cuba due to Climate or Weather Variability and Change In book "Global Warming and Climate Change: Kyoto - Ten Years and Still Counting Vol 1-2 Editor Velma I Grover. Publisher Science Pubs Inc- UK

Interpretation of indexes.

- **$IB_{t,1,c}$** describes inter-monthly and inter-seasonal variation; Includes maximum and minimum mean temperature, precipitation, atmospheric pressure, vapor pressure, and relative humidity.

- **$IB_{t,2,c}$** describes seasonal and inter-annual variation; Includes solar radiation and sunshine duration as factors that affect temperature and humidity. Positive values are associated with a high solar energy level.

- **$IB_{t,3,c}$** describes inter-annual and decadal scale variation and includes the same climate variables as IBt,1,c

- **$IB_{t,4,c}$** describes the relationships among socioeconomic variables and can be interpreted as life quality, or the degree of poverty as they influence disease risk.

- Ortíz, P L, Pérez A.R , Rivero A.V León N.V. Díaz M and Pérez A (2006). Mini- Monograph "Results of assessing the human health vulnerability to climate variability and change in Cuba. "*Environmental Health Perspectives* (*EHP*). E.U.

Months	min	10	25	50	75	90	max
$IB_{1,JAN,C}$	-2.80	-3.00	-3.10	-3.20	-3.30	-3.40	-3.66
$IB_{1,FEB,C}$	-2.55	-2.75	-2.85	-2.90	-3.00	-3.10	-3.20
$IB_{1,MAR,C}$	-1.48	-1.82	-1.92	-2.00	-2.10	-2.20	-2.30
$IB_{1,APR,c}$	0.07	-0.45	-0.55	-0.66	-0.84	-0.96	-1.28
$IB_{1,MAY,c}$	0.50	0.72	0.94	1.25	1.35	1.41	1.91
$IB_{1,JUN,c}$	1.40	1.72	1.91	2.21	2.37	2.50	2.71
$IB_{1,JUL,c}$	1.00	1.66	1.74	1.84	1.93	2.03	2.32
$IB_{1,AUG,c}$	1.82	2.17	2.29	2.37	2.45	2.50	2.64
IB_{1-SEP}	1.89	2.25	2.35	2.64	2.80	2.89	2.06
IB_{1-OCT}	1.02	1.29	1.37	1.51	1.72	1.81	2.12
IB_{1-NOV}	0.45	0.011	-0.10	-0.23	-0.45	-0.63	-0.78
IB_{1-DEC}	-1.72	-2.11	-2.20	-2.30	-2.42	-2.50	-2.71

Less Rainy Season

Rainy Season

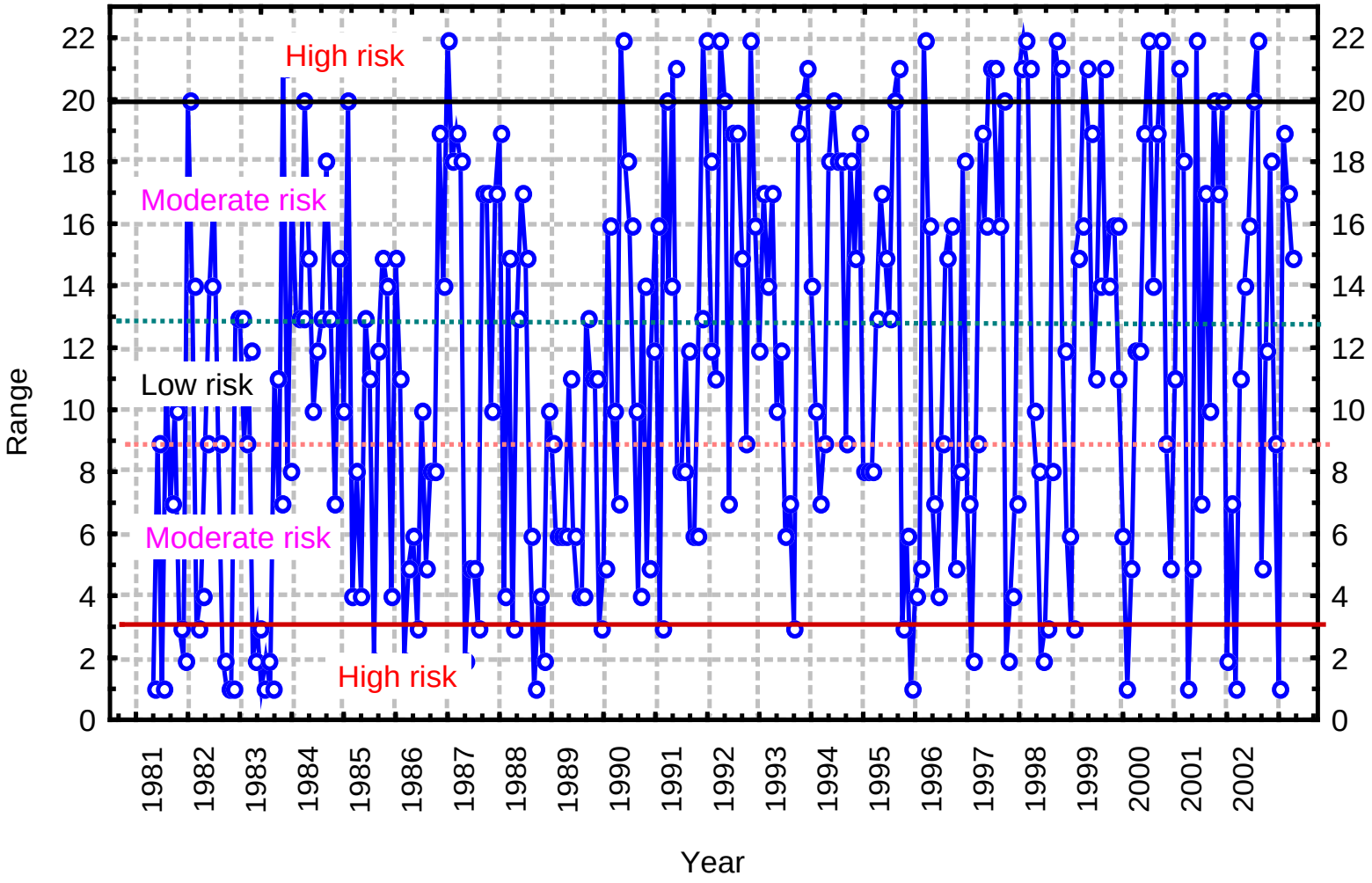
Less Rainy Season

Legend:

$IB_{1,t,C} < 10$	Very Low Variability
$10 \leq IB_{1,t,C} < 25$	Low variability
$25 \leq IB_{1,t,C} \leq 75$	Normal variability
$75 < IB_{1,t,C} \leq 90$	High variability
$IB_{1,t,C} > 90$	Very High Variability

t = 1,2…12

Behavior of the ranges by months to determine the climate risk level of the variation according to $IB_{t,1C.}$

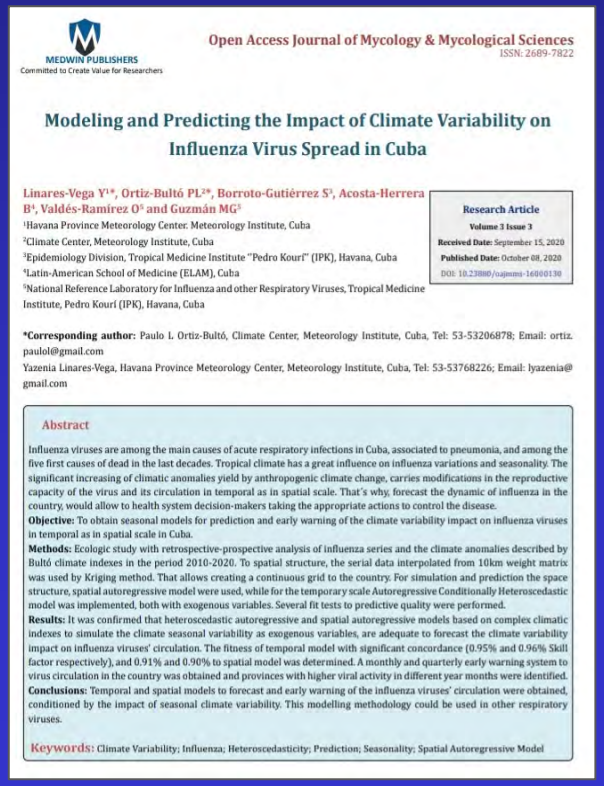


Desarrollo de modelos espacio-temporal para la predicción de enfermedades infecciosas como Dengue , SARS-CoV-2 etc.

$$y = \rho W y_{t-1} + \beta X_{t-1} + u_t$$

$$u_t = \lambda W_2 u_{t-1} + \varepsilon$$

$$\varepsilon \sim N(0, \Omega)$$



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Open Access Journal of Mycology & Mycological Sciences
ISSN: 2689-7822

Modeling and Predicting the Impact of Climate Variability on Influenza Virus Spread in Cuba

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Research Article
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Abstract

Influenza viruses are among the main causes of acute respiratory infections in Cuba, associated to pneumonia, and among the five first causes of dead in the last decades. Tropical climate has a great influence on influenza variations and seasonality. The significant increasing of climatic anomalies yield by anthropogenic climate change, carries modifications in the reproductive capacity of the virus and its circulation in temporal as in spatial scale. That´s why, forecast the dynamic of influenza in the country, would allow to health system decision-makers taking the appropriate actions to control the disease.

Objective: To obtain seasonal models for prediction and early warning of the climate variability impact on influenza viruses in temporal as in spatial scale in Cuba.

Methods: Ecologic study with retrospective-prospective analysis of influenza series and the climate anomalies described by Bultó climate indexes in the period 2010-2020. To spatial structure, the serial data interpolated from 10km weight matrix was used by Kriging method. That allows creating a continuous grid to the country. For simulation and prediction the space structure, spatial autoregressive model were used, while for the temporary scale Autoregressive Conditionally Heteroscedastic model was implemented, both with exogenous variables. Several fit tests to predictive quality were performed.

Results: It was confirmed that heteroscedastic autoregressive and spatial autoregressive models based on complex climatic indexes to simulate the climate seasonal variability as exogenous variables, are adequate to forecast the climate variability impact on influenza viruses' circulation. The fitness of temporal model with significant concordance (0.95% and 0.96% Skill factor respectively), and 0.91% and 0.90% to spatial model was determined. A monthly and quarterly early warning system to virus circulation in the country was obtained and provinces with higher viral activity in different year months were identified.

Conclusions: Temporal and spatial models to forecast and early warning of the influenza viruses' circulation were obtained, conditioned by the impact of seasonal climate variability. This modelling methodology could be used in other respiratory viruses.

Keywords: Climate Variability; Influenza; Heteroscedasticity; Prediction; Seasonality; Spatial Autoregressive Model

MEDICC Review

Original Research

Spatial Models for Prediction and Early Warning of *Aedes aegypti* Proliferation from Data on Climate Change and Variability in Cuba

Paulo L. Ortiz MS PhD, Alina Rivero MS, Yazenia Linares, Alina Pérez MS, Juan R. Vázquez MS

ABSTRACT

INTRODUCTION Climate variability, the primary expression of climate change, is one of the most important environmental problems affecting human health, particularly vector-borne diseases. Despite research efforts worldwide, there are few studies addressing the use of information on climate variability for prevention and early warning of vector-borne infectious diseases.

OBJECTIVE Show the utility of climate information for vector surveillance by developing spatial models using an entomological indicator and information on predicted climate variability in Cuba to provide early warning of danger of increased risk of dengue transmission.

METHOD An ecological study was carried out using retrospective and prospective analyses of time series combined with spatial statistics. Several entomological and climatic indicators were considered using summer Bultó indexes (1 and 2 Minoria) spatial autocorrelation coefficient specified for a matrix of neighbors with a radius of 20 km, was used to identify the spatial structure. Space structure simulation was based on simultaneous autoregressive and conditional autoregressive models, agreement between predicted and observed values for number of *Aedes aegypti* foci was determined by the receiver-operator index (I) and skill factor (I).

RESULTS Spatial and temporal distributions of populations of *Aedes aegypti* were mapped. Models for describing, simulating and predicting spatial patterns of *Aedes aegypti* populations associated with climate variability patterns were put forward. The ranges of climate variability affecting *Aedes aegypti* populations were identified. Favorable maps were generated for the municipal level.

CONCLUSIONS Using the Bultó indices of climate variability, it is possible to construct spatial models for predicting increased *Aedes aegypti* populations in Cuba. At 20 x 20 km resolution, the models are able to provide warning of potential changes in vector populations in rainy and dry seasons and by month. This demonstrates the usefulness of climate information for epidemiological surveillance.

KEYWORDS Climate variability, spatial analysis, prediction, autoregressive models, *Aedes aegypti*, vector-borne disease, surveillance, Cuba

INTRODUCTION

Climate change and variability have substantial impact on the ecological niches in which many infectious diseases develop.

Vector-borne disease burden Climate change and variability are shortening the reproductive cycle of vectors of medical importance, such as mosquitoes transmitting dengue, malaria, equine

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2016

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Improving public health decision-making in a new climate

CASE STUDIES

RISK FORECASTS

BIO-CLIMATIC BULLETINS TO FORECAST DENGUE VECTORS IN PANAMA

Authors: A. McDonald, P. [Departamento de Investigación en Sistemas de Salud, Ambiente y Sociedad, Instituto Conmemorativo Gorgas de Estudios de la Salud]; A. Cumbrera [Departamento de Investigación en Sistemas de Salud, Ambiente y Sociedad, Instituto Conmemorativo Gorgas de Estudios de la Salud]; C. Cruz [Universidad de Panamá, Escuela de Estadística]; A. Pereira [Departamento de Hidrometeorología, Empresa de Transmisión Eléctrica, S.A.]; A. Moreno de Rivera [Departamento de Investigación en Sistemas de Salud, Ambiente y Sociedad, Instituto Conmemorativo Gorgas de Estudios de la Salud].

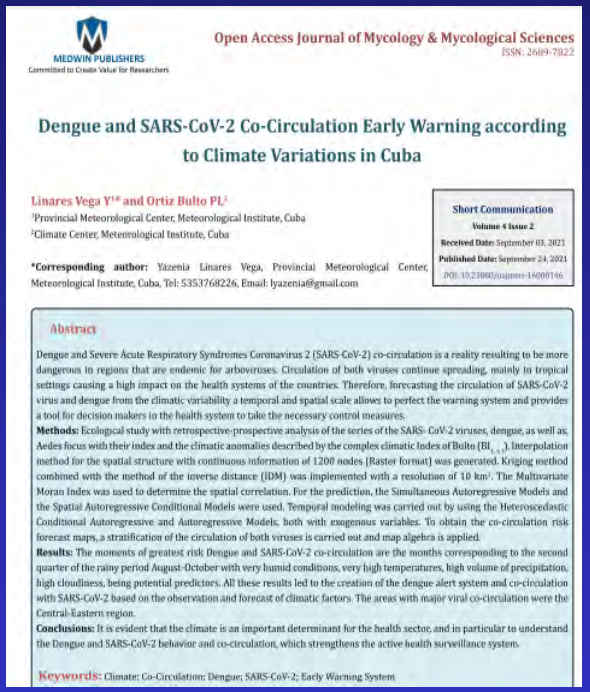
CONTEXT

Climate is an important health determinant. Human health can be directly affected by climatic conditions, particularly by extreme weather and climate events. Determining how climate variability impacts human health is a complex process, because of the different susceptibilities and vulnerabilities of different populations.

Climatic conditions can influence the transmission dynamics of communicable vector-borne diseases (VBD), and water-borne diseases (ll) and even of some noncommunicable diseases (k2

NEW APPROACHES

Prior to 2008 in Panama, no projects investigating the relationship between climate and health existed. Therefore, the Gorgas Memorial Institute of Health Studies (GMIHS) and its Department of Health Systems, Environment and Society Studies (DSEAS) addressed this gap and defined this new area of national research by



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Open Access Journal of Mycology & Mycological Sciences
ISSN: 2689-7822

Dengue and SARS-CoV-2 Co-Circulation Early Warning according to Climate Variations in Cuba

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[1]Provincial Meteorological Center, Meteorological Institute, Cuba
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Abstract

Dengue and Severe Acute Respiratory Syndromes Coronavirus 2 (SARS-CoV-2) co-circulation is a reality resulting to be more dangerous in regions that are endemic for arboviruses. Circulation of both viruses continue spreading, mainly in tropical settings causing a high impact on the health systems of the countries. Therefore, forecasting the circulation of SARS-CoV-2 virus and dengue from the climatic variability a temporal and spatial scale allows to perfect the warning system and provides a tool for decision makers to the health system to take the necessary control measures.

Methods: Ecological study with retrospective-prospective analysis of the series of the SARS- CoV-2 viruses, dengue, as well as, Aedes focus with their index and the climatic anomalies described by the complex climatic Index of Bulto ($BI_{1,2,3}$). Interpolation method for the spatial structure with continuous information of 1200 nodes (Raster format) was generated. Kriging method combined with the method of the inverse distance (IDM) was implemented with a resolution of 10 km^2. The Multivariate Moran Index was used to determine the spatial correlation. For the prediction, the Simultaneous Autoregressive Models and the Spatial Autoregressive Conditional Models were used. Temporal modeling was carried out by using the Heteroscedastic Conditional Autoregressive and Autoregressive Models, both with exogenous variables. To obtain the co-circulation risk forecast maps, a stratification of the circulation of both viruses is carried out and map algebra is applied.

Results: The moments of greatest risk Dengue and SARS-CoV-2 co-circulation are the months corresponding to the second quarter of the rainy period August-October with very humid conditions, very high temperatures, high volume of precipitation, high cloudiness, being potential predictors. All these results led to the creation of the dengue alert system and co-circulation with SARS-CoV-2 based on the observation and forecast of climatic factors. The areas with major viral co-circulation were the Central-Eastern region.

Conclusions: It is evident that the climate is an important determinant for the health sector, and in particular to understand the Dengue and SARS-CoV-2 behavior and co-circulation, which strengthens the active health surveillance system.

Keywords: Climate; Co-Circulation; Dengue; SARS-CoV-2; Early Warning System

PLOS | NEGLECTED TROPICAL DISEASES

RESEARCH ARTICLE

Spatial-Temporal Distribution of Hantavirus Rodent-Borne Infection by *Oligoryzomys fulvescens* in the Agua Buena Region - Panama

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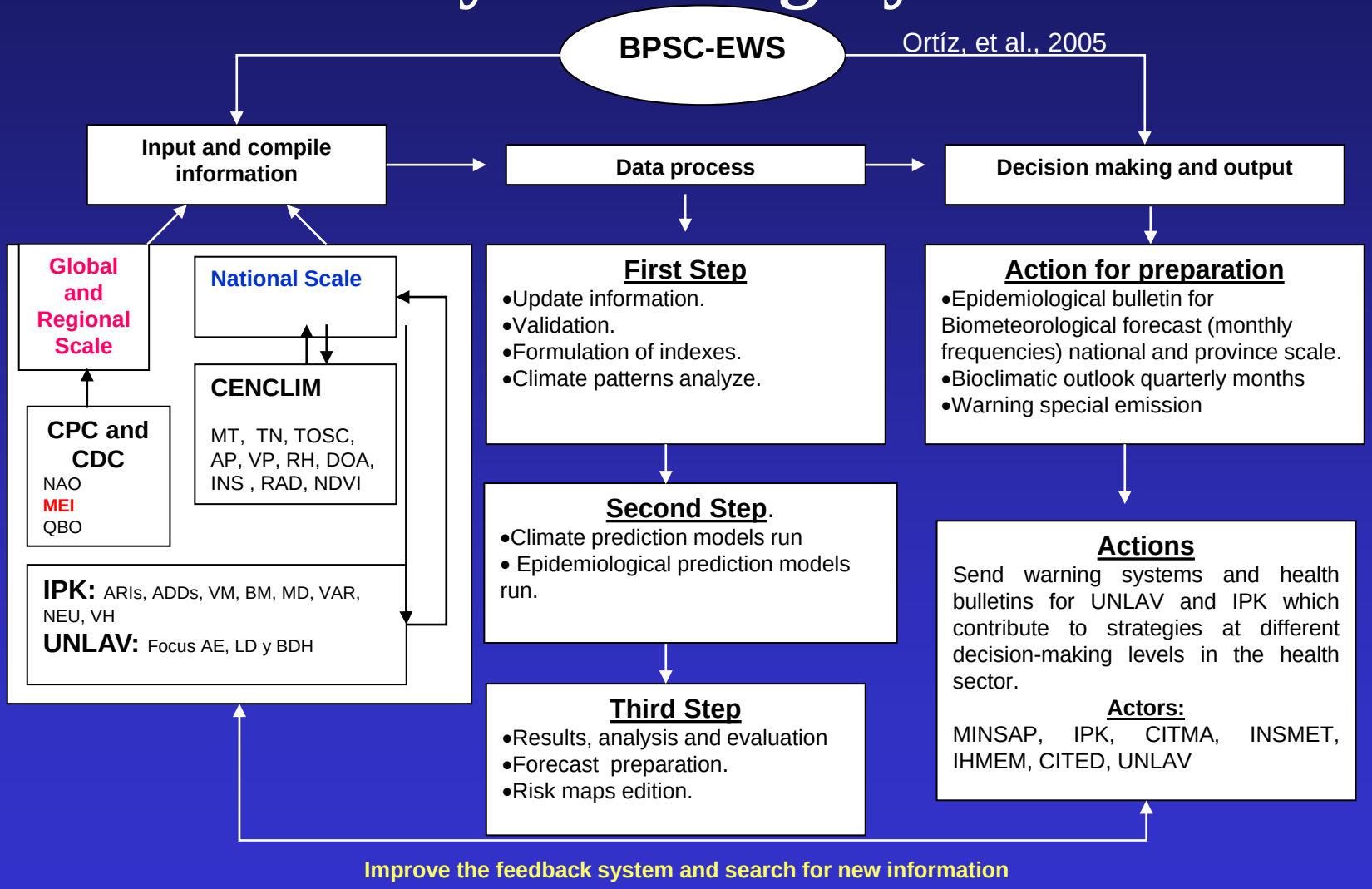
Cuban Bioclimatic Prediction System - Early Warning System



Ortíz, et al., 2008 . Global Warming and Climate Change. Ten Years after Kyoto and Still Counting. Volume 2.

Climate - Health Group.
Project-Cuba

Example. Information policy and decision makers

SIGNOS Y SÍNTOMAS

Es característico del paciente infectado con parásitos del paludismo la presencia de:

- fiebre intermitente
- escalofríos (aka nundú ro'y)
- decaimiento, dolor corporal y desgano

Acuda o remita al probable infectado al colaborador voluntario del SENEPA o a las Zonas o Sectores de la Institución más cercanos para recibir atención.

ESTRATIFICACIÓN DEL PALUDISMO

En la figura 3 se presenta el riesgo de contraer paludismo en los diferentes departamentos del país. Seis departamentos de la región oriental presentan índices de mediano y alto riesgo.

Figura 3. Estratificación de riesgo de paludismo en el Paraguay según departamentos

INSTITUTO DE INVESTIGACIONES EN CIENCIAS DE LA SALUD (IICS-UNA)

SERVICIO NACIONAL DE ERRADICACIÓN DEL PALUDISMO (SENEPA)

ENTIDAD BINACIONAL ITAIPU

Cualquier información que sea requerida comuníquese a:

SENEPA

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ITAIPU BINACIONAL

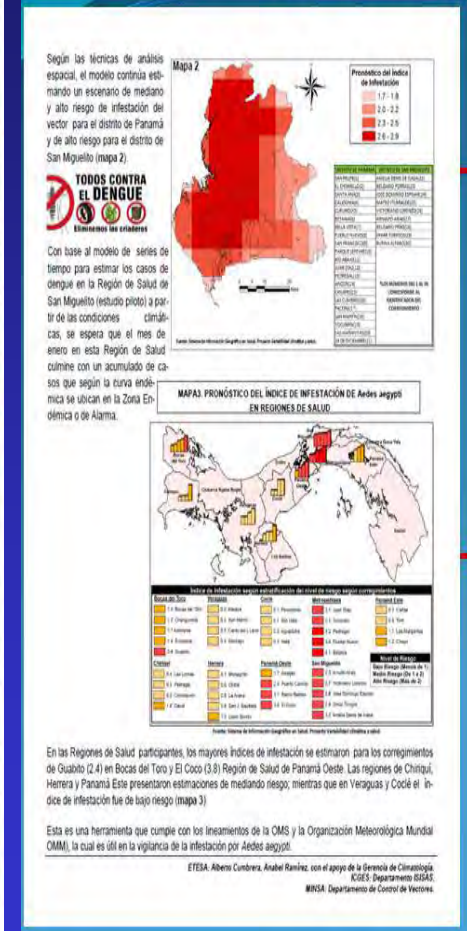
BOLETÍN BIOCLIMÁTICO

PRONOSTICO DE PALUDISMO EN EL AREA DE INFLUENCIA DE LA REPRESA ITAIPU

ALTO PARANÁ Y CANINDEYÚ

ENERO Y FEBRERO DE 2003

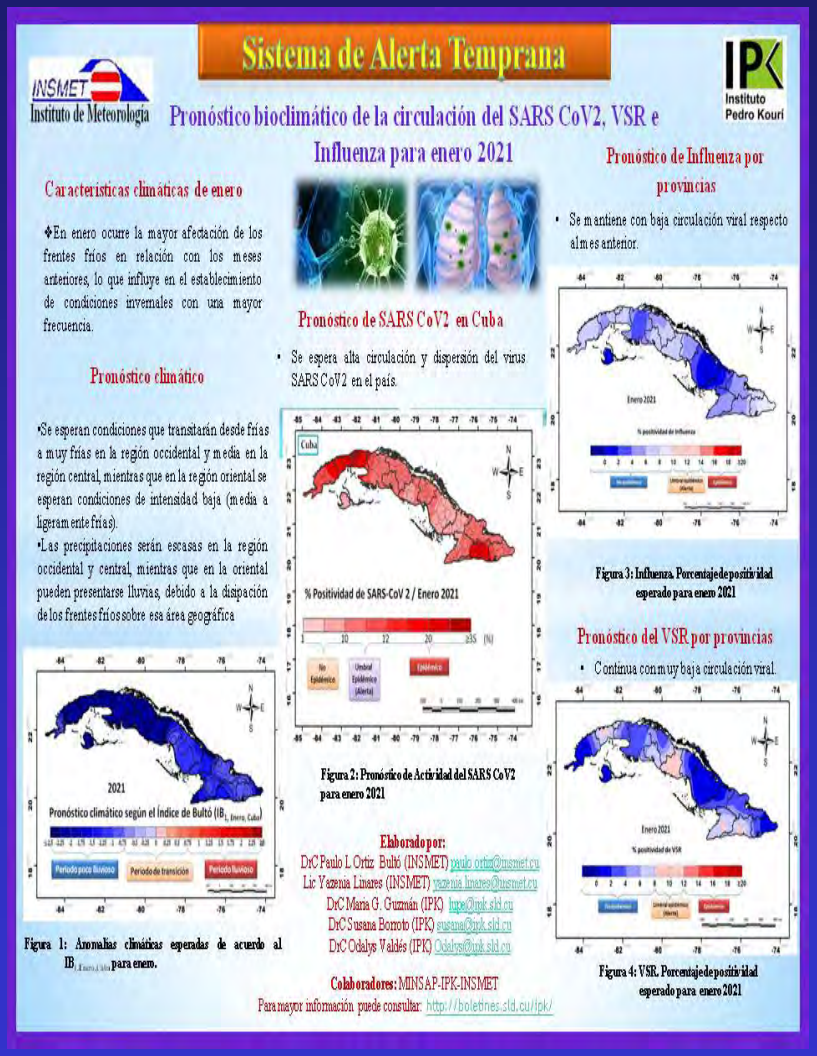
INFORME BIOCLIMÁTICO



PRONÓSTICO DEL INDICE DE INFESTACIÓN SEGÚN EL ANÁLISIS ESPACIAL

PRONÓSTICO DEL INDICE DE INFESTACIÓN A NIVEL PROVINCIAL BASADO EN EL NIVEL DE RIESGO (BAJO, MEDIO O ALTO)

Example. Information policy and decision makers



Sistema de Alerta Temprana

INSMET Instituto de Meteorología

IPK Instituto Pedro Kourí

Pronóstico bioclimático de la circulación del SARS CoV2, VSR e Influenza para enero 2021

Características climáticas de enero

♦En enero ocurre la mayor afectación de los frentes fríos en relación con los meses anteriores, lo que influye en el establecimiento de condiciones invernales con una mayor frecuencia.

Pronóstico climático

•Se esperan condiciones que transitarán desde frías a muy frías en la región occidental y media en la región central, mientras que en la región oriental se esperan condiciones de intensidad baja (media a ligeramente frías).

•Las precipitaciones serán escasas en la región occidental y central, mientras que en la oriental pueden presentarse lluvias, debido a la disipación de los frentes fríos sobre esa área geográfica

Figura 1: Anomalías climáticas esperadas de acuerdo al $IB_{Enero,Cuba}$ para enero.

Pronóstico de SARS CoV2 en Cuba

- Se espera alta circulación y dispersión del virus SARS CoV2 en el país.

Figura 2: Pronóstico de Actividad del SARS CoV2 para enero 2021

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Para mayor información puede consultar: http://boletines.sld.cu/ipk/

Pronóstico de Influenza por provincias

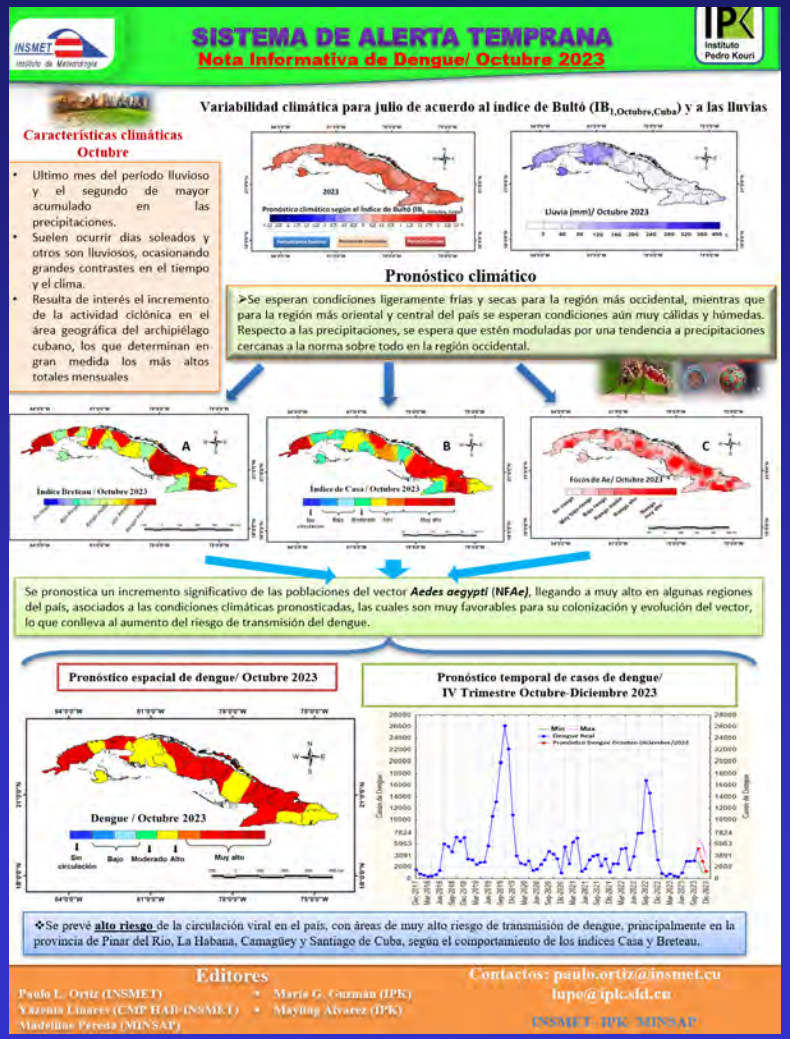
- Se mantiene con baja circulación viral respecto al mes anterior.

Figura 3: Influenza. Porcentaje de positividad esperado para enero 2021

Pronóstico del VSR por provincias

- Continua con muy baja circulación viral.

Figura 4: VSR. Porcentaje de positividad esperado para enero 2021



INSMET Instituto de Meteorología

SISTEMA DE ALERTA TEMPRANA

Nota Informativa de Dengue/ Octubre 2023

IPK Instituto Pedro Kourí

Variabilidad climática para julio de acuerdo al índice de Bultó ($IB_{1,Octubre,Cuba}$) y a las lluvias

Características climáticas Octubre

- Ultimo mes del período lluvioso y el segundo de mayor acumulado en las precipitaciones.
- Suelen ocurrir días soleados y otros son lluviosos, ocasionando grandes contrastes en el tiempo y el clima.
- Resulta de interés el incremento de la actividad ciclónica en el área geográfica del archipiélago cubano, los que determinan en gran medida los más altos totales mensuales

Pronóstico climático

➢Se esperan condiciones ligeramente frías y secas para la región más occidental, mientras que para la región más oriental y central del país se esperan condiciones aún muy cálidas y húmedas. Respecto a las precipitaciones, se espera que estén moduladas por una tendencia a precipitaciones cercanas a la norma sobre todo en la región occidental.

Se pronostica un incremento significativo de las poblaciones del vector *Aedes aegypti* (NFAe), llegando a muy alto en algunas regiones del país, asociados a las condiciones climáticas pronosticadas, las cuales son muy favorables para su colonización y evolución del vector, lo que conlleva al aumento del riesgo de transmisión del dengue.

Pronóstico espacial de dengue/ Octubre 2023

Pronóstico temporal de casos de dengue/ IV Trimestre Octubre-Diciembre 2023

❖Se prevé alto riesgo de la circulación viral en el país, con áreas de muy alto riesgo de transmisión de dengue, principalmente en la provincia de Pinar del Río, La Habana, Camagüey y Santiago de Cuba, según el comportamiento de los índices Casa y Breteau.

Editores
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INSMET IPK MINSAP

Climate - Health Group.
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Current Diseases Included in Early Warning Systems In Cuba

Diseases	
Included in the system	Acute diarrhoeal diseases **(Bacterial Enteropathogens)**
	Viral hepatitis
	Acute respiratory infections **(Syncytial Virus, Influenza and SARS-CoV2)**
	Varicella **(chicken pox)**
	Meningococcal diseases
	Bacterial meningitis
	Meningitis by *Streptococcus pneumoniae*
	Viral meningitis
	Malaria
	Dengue
	Lectospira
Not included	Yellow fever
	Leishmaniasis

Application.

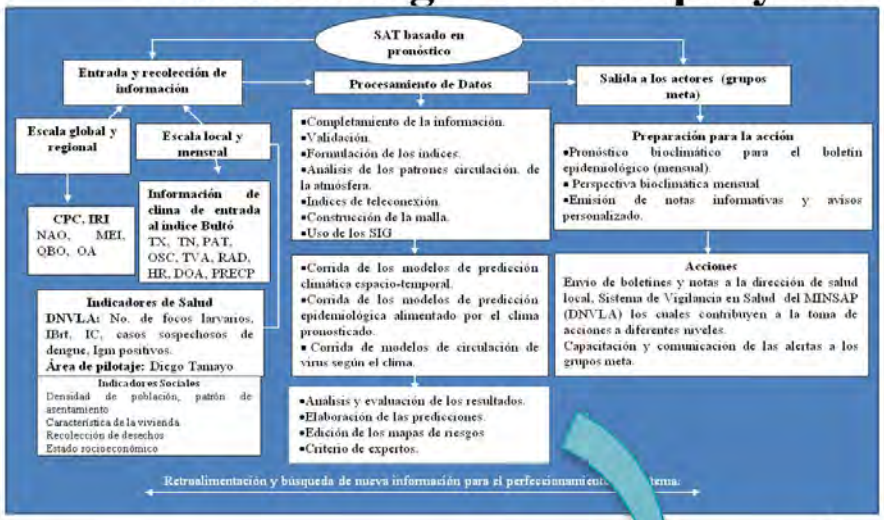
Brazil, Colombia, Bolivia, Paraguay, Panama Guatemala, Dominican Republic, and Cuba. [Epidemiological control of disease outbreaks. Examples: ARIs; BA, Varicella (Chicken pox), Hepatitis, ADDs, Viral and Bacterial (pneumococcal and meningococcal) meningitis, Dengue and Malaria]

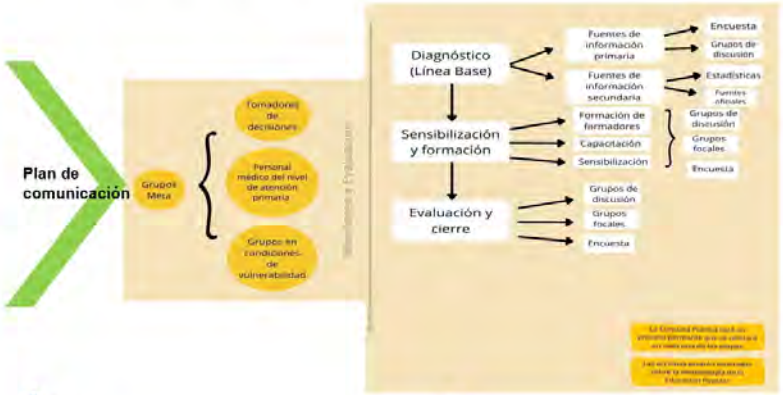
Implementation system

- Paraguay, Panama, Costa Rica, Honduras, Nicaragua and Cuba.

EWS Outlook

Estructura general del proyecto: SAT de Dengue sensible al clima





SAT

- Escalable a otras enfermedades y agentes.
- Replicable a otras áreas de diferentes climas

Favorece el trazado de políticas públicas que permita mayor protección de la salud, lo que conlleva a reducir el riesgo de contraer el dengue

Future actions

- Continue training decision-makers.

- Refine the EWS tailored to the user, which allows strengthening the national epidemiological surveillance network of MINSAP.

- Continue improving the input information to the models, both climatic, epidemiological and virological.

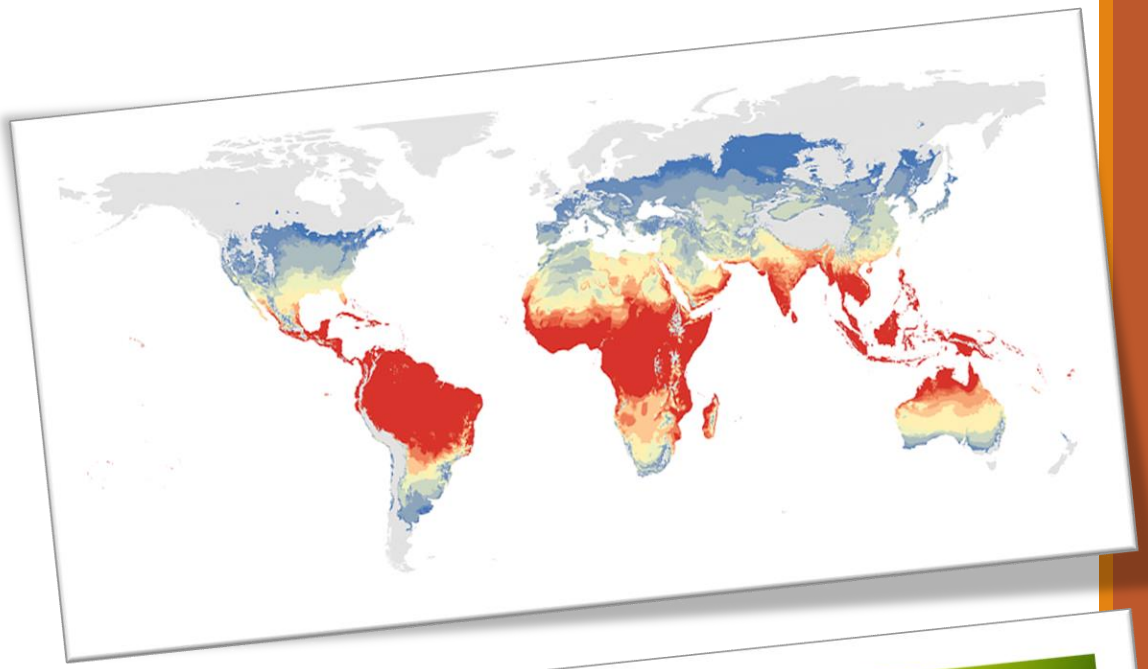
- Strengthen INSMET capacity and cloud platform capacity to integrate the Early Warning System and all required data.

Thanks

Caribbean
Public Health
Agency

CARPHA

Preventing disease
Promoting and protecting health



Climate Integrated Early Warning Systems for Health

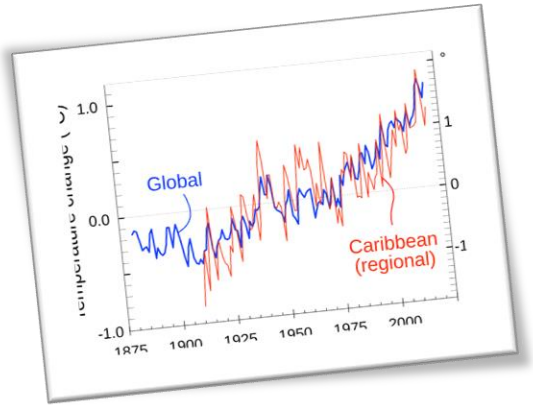
Focus on Vector Borne Diseases: Examples of Best practices for adaptation/response

Presented By:
Dr. Laura-Lee Boodram
CARPHA

October 5, 2023

Caribbean Public Health Agency
CARPHA

Climate Trends in the Caribbean



Caribbean Public Health Agency
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Thus far….

- Average annual air temp. increases, new highs - 0.5 ºC higher than previous
- Sea level rise 10 cm per 100 yrs
- Variations in dry/wet spells
- Increasing hurricane strength

Scenarios for the Future

- Ocean acidification
- More intense tropical storms (10-20% wind speed increase)
- Sea level rise: 35-50 cm over the next 50 years
- Drier mid-year, wetter end of year
- 0.5 - 4.2 ºC from 2010 to 2099

Caribbean Climate and Health Context

Caribbean populations/health systems remain highly vulnerable to impacts from climate change

- Can affect health through the following pathways:

Effects mediated via natural systems e.g. extreme weather and climate events

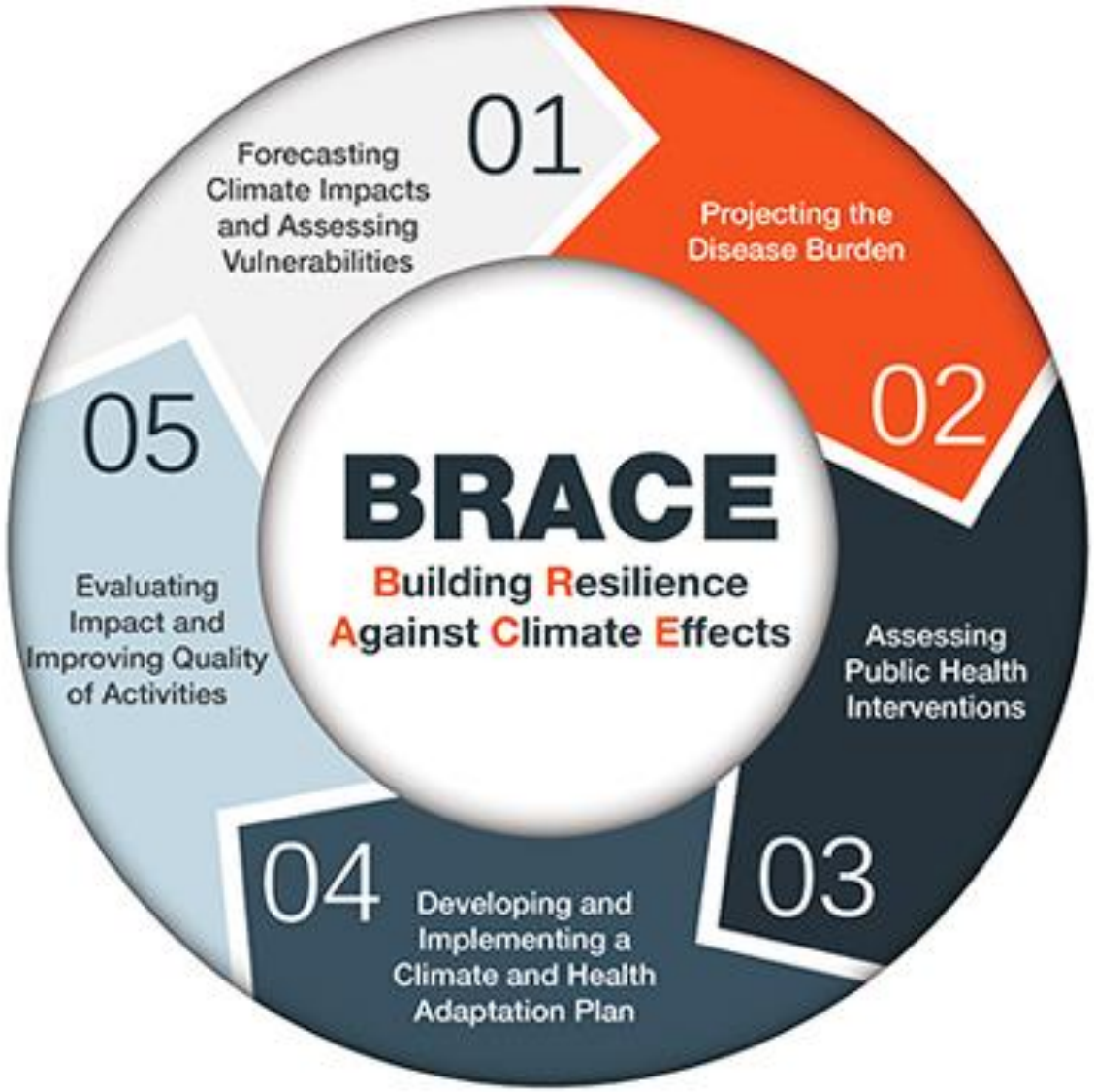
- Hurricanes, floods, droughts, heat waves, Saharan dust incursions
- Effects on human health and social development in the Caribbean region
  - Water availability and safety, poor air quality, food safety and security
  - Adverse health outcomes: respiratory complications, heat-induced morbidity, outbreaks of vector-, food- and water-borne diseases, injuries, fatalities, mental health
  - Current low emphasis on gender considerations

Effects mediated via human systems

- Migration/displacement of populations
- Loss of livelihood, poverty
- Lost/reduced work capacity and productivity
- Inability to attain the Sustainable Development Goals (SDGs)

Caribbean Climate and Health Context cont'd

- Strong links demonstrated between climate variables and infectious disease transmission and spread
- Incipient work in the region over the past few years – country collaborations with CIMH, CARPHA,CCCCC, Red Cross, PAHO, UWI/PPCR
- Seeking to strengthen interactions between multisectoral professionals for creation and implementation of early warning systems for health.
- Output: Climate integrated, health tools and services that generate information to support public health decision making and resource allocation.



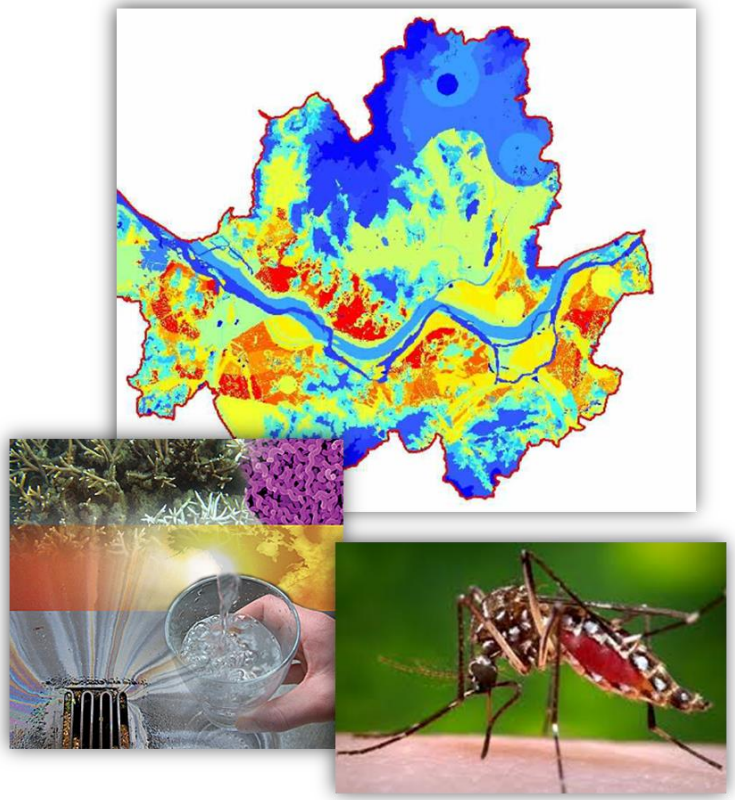
https://www.cdc.gov/climateandhealth/BRACE.htm

- Caribbean SIDS have limited capacity to respond presently

  Current and future focus - building climate resilience in the health sector; appropriate adaption and mitigation strategies.

Development of Early Warning Systems (EWS) for Health

- Use of integrated surveillance data, e.g. disease, entomological + weather variables.
- Development of statistical risk prediction models based on surveillance and other data. Models can be developed for both communicable and non-communicable diseases
- Allows predicting of potential outbreaks (infectious disease models) at least 3 months before an event can occur
- Allows health sector to allocate/programme resources to mitigate the impact of outbreaks



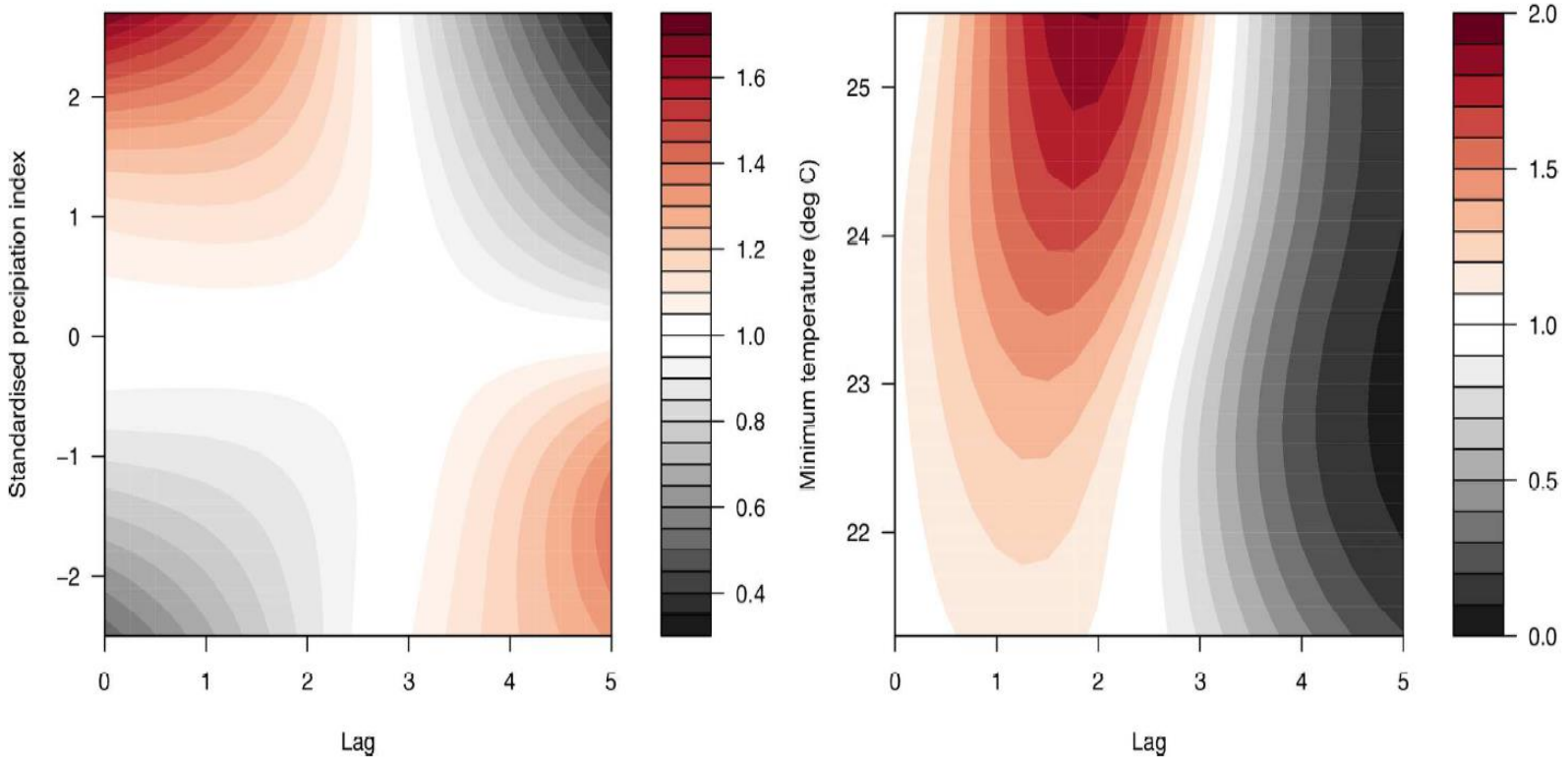


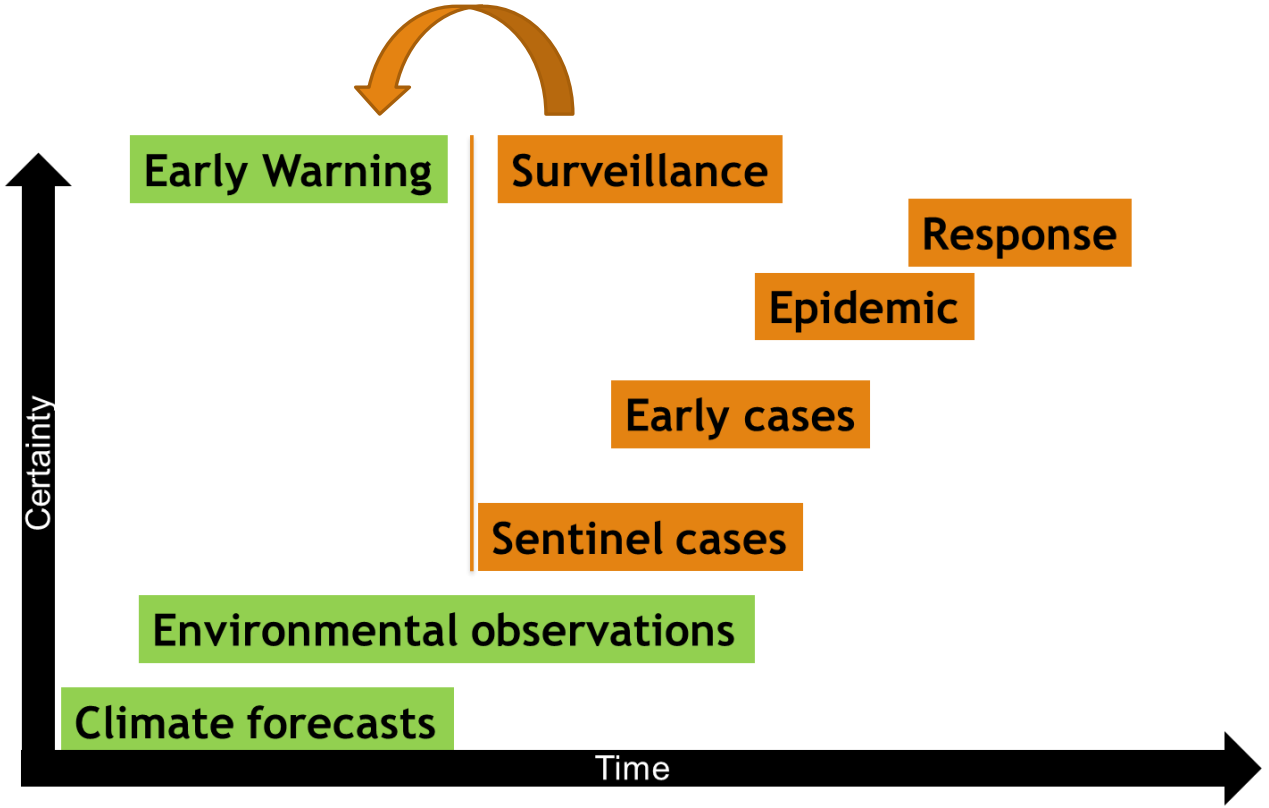
Fig 2. Relative risk of dengue given climatic exposures and time lags. Three-dimensional (upper panel) and contour (lower panel) plots of the exposure–lag–response association between (left) SPI-6 relative to normal conditions (SPI-6 = 0) and (right) mean temperature anomalies relative to Tmin of 20˚C, at lags between 0 and 5 months. SPI-6, 6-month Standardised Precipitation Index; Tmin, minimum temperature.

https://doi.org/10.1371/journal.pmed.1002613.g002

Early warning Systems for Health

- Brings together climactic variables and disease data for future health/disease prediction.
- Improved weather forecasting gives opportunity to develop early warning systems for weather-based events
- Models well applied to vector borne diseases, respiratory illness, some application to food and water borne illness.

Surveillance vs. Early Warning



- Disease surveillance systems collect and summarize data; detect disease outbreaks as they occur.
- Early warning systems alert the population, governing bodies and response groups **in advance** about potential adverse conditions that could lead to a disease outbreak
- Surveillance data feeds into early warning system frameworks, combined with environmental and climate data – robust risk predictions.
- Caters for for implementation of effective measures to reduce adverse health outcomes

EWS – What's involved

Data	Spatial and temporal coverage of critical weather variables
Methods	Simple correlation; trend analysis; etc.
Acceptability / credibility	Timely; relevant; compatible with existing decision-making protocols; accessible
Context	Note: Early warning systems are not contingent on climate information alone

01

Evaluate potential for epidemic transmission

02

Identify epidemic-prone areas and populations at risk to allow rapid:

- Prediction and detection
- Targeting of response
- Planning of logistics for response

03

Quantify climatic and non-climatic disease risk factors

04

Quantify the link between climate variability and disease outbreaks

- Construct predictive models

Prediction of Possible Health Outcomes

Features Of Early Warning Systems

Provide warning in sufficient time for action

Are affordable

- Require minimal skill and training to operate and maintain

Give minimal false positive or negative responses

Are robust, reproducible, and verifiable

Can be easily modified to address a changing climate

An effective and timely response plan

Ongoing evaluation of the system and its components

Early Action Response Plans and Mechanisms

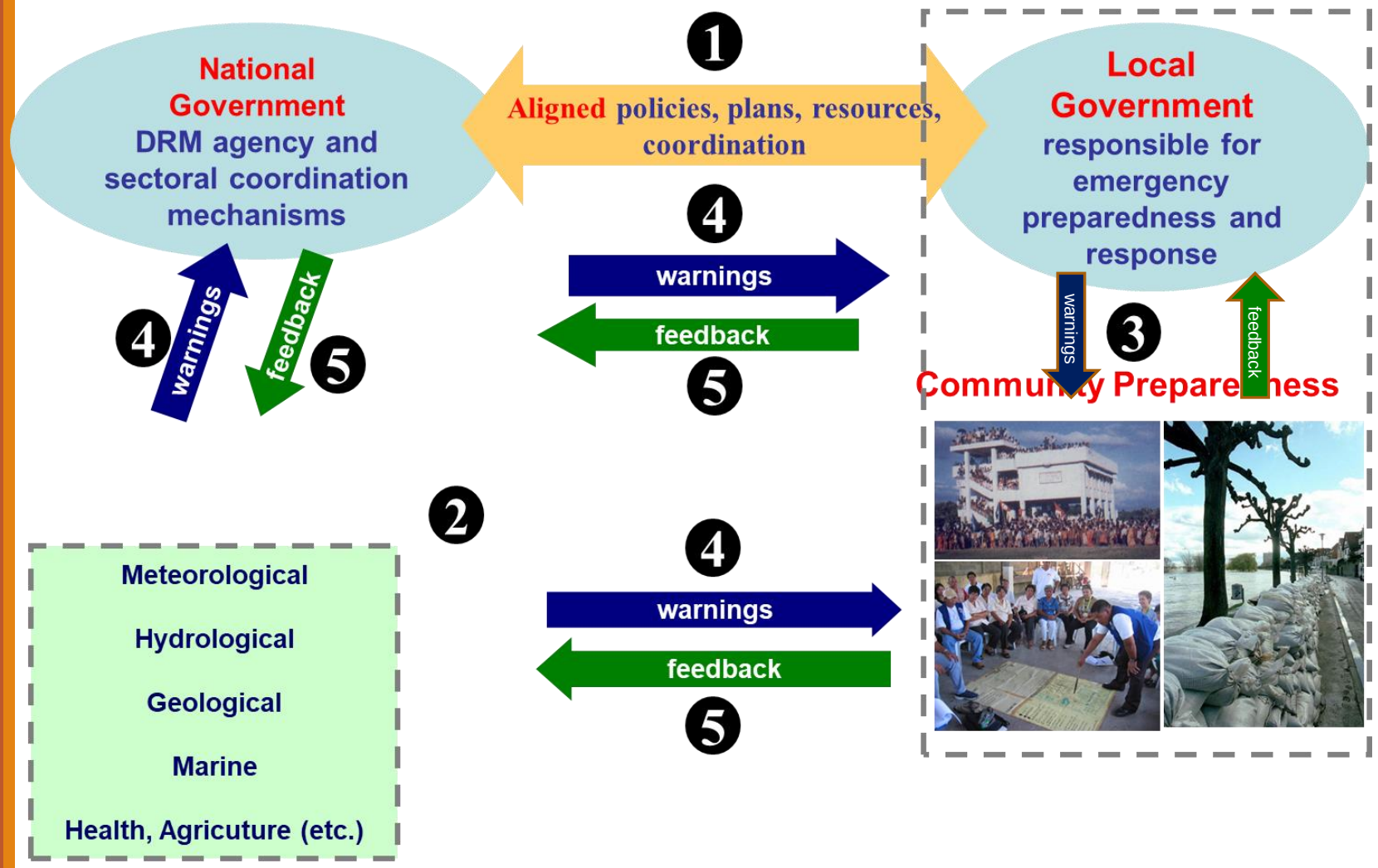
Where the response plan will be implemented?

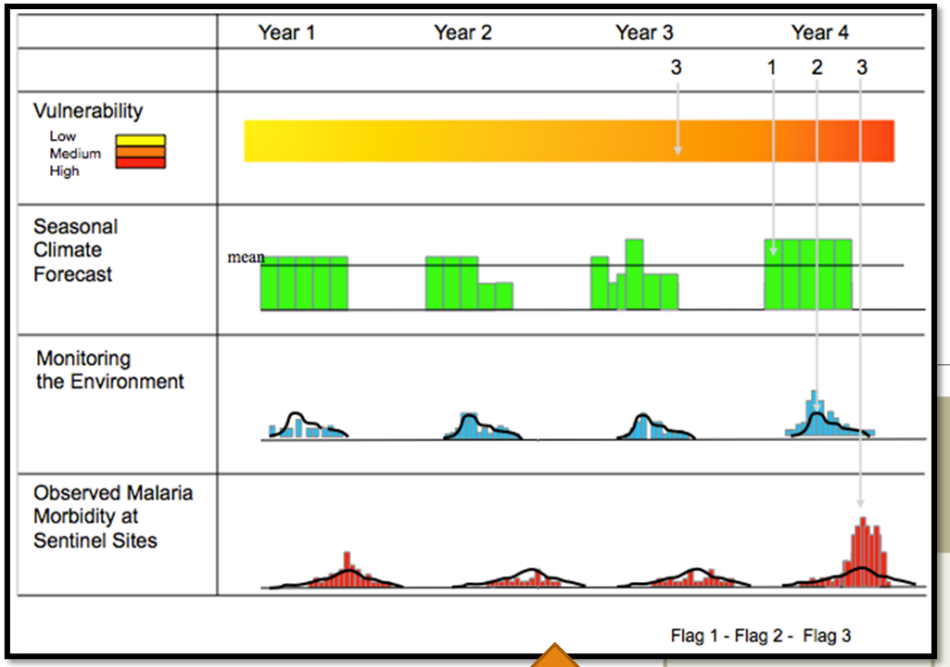
When interventions will be implemented, including thresholds for action?

What interventions will be implemented?

How will the response plan be implemented

Risk communication to whom? Warnings ***and*** feedback critical.





Malaria EWS / EA

	Example of early warning	Example of early action
Years	Rising risk of malaria in areas that were malaria free in the past, due to rising temperatures	Prevention/mitigation: Continually update risk maps, build community health infrastructure, advocate for/build surveillance mechanism Preparedness: Identify changing vulnerable groups, train health workers/volunteers, and develop sustained health campaigns
Months (seasonal)	Forecast of enhanced risk of malaria outbreaks in particular areas, based a.o. on rainfall and temperature (as observed and forecast for the coming months)	Preparedness: Coordinate with government and WHO to update contingency plans, prepare local health and care facilities, sensitize communities about enhanced risk, distribute bednets
Weeks	Reports of malaria outbreaks in a particular region	Response: Facilitate access to treatment and continue to sensitize communities to use bednets

Monitoring and Evaluation

- What are the chances that the system will fail to predict an epidemic, and how many disease cases or fatalities could occur?
- What are the chances of sounding a false alarm, thereby wasting resources and undermining public trust?
- Is the system as responsive as needed? How could disease incidence be reduced or lives saved if the system response was faster?
- Is the system cost-effective?

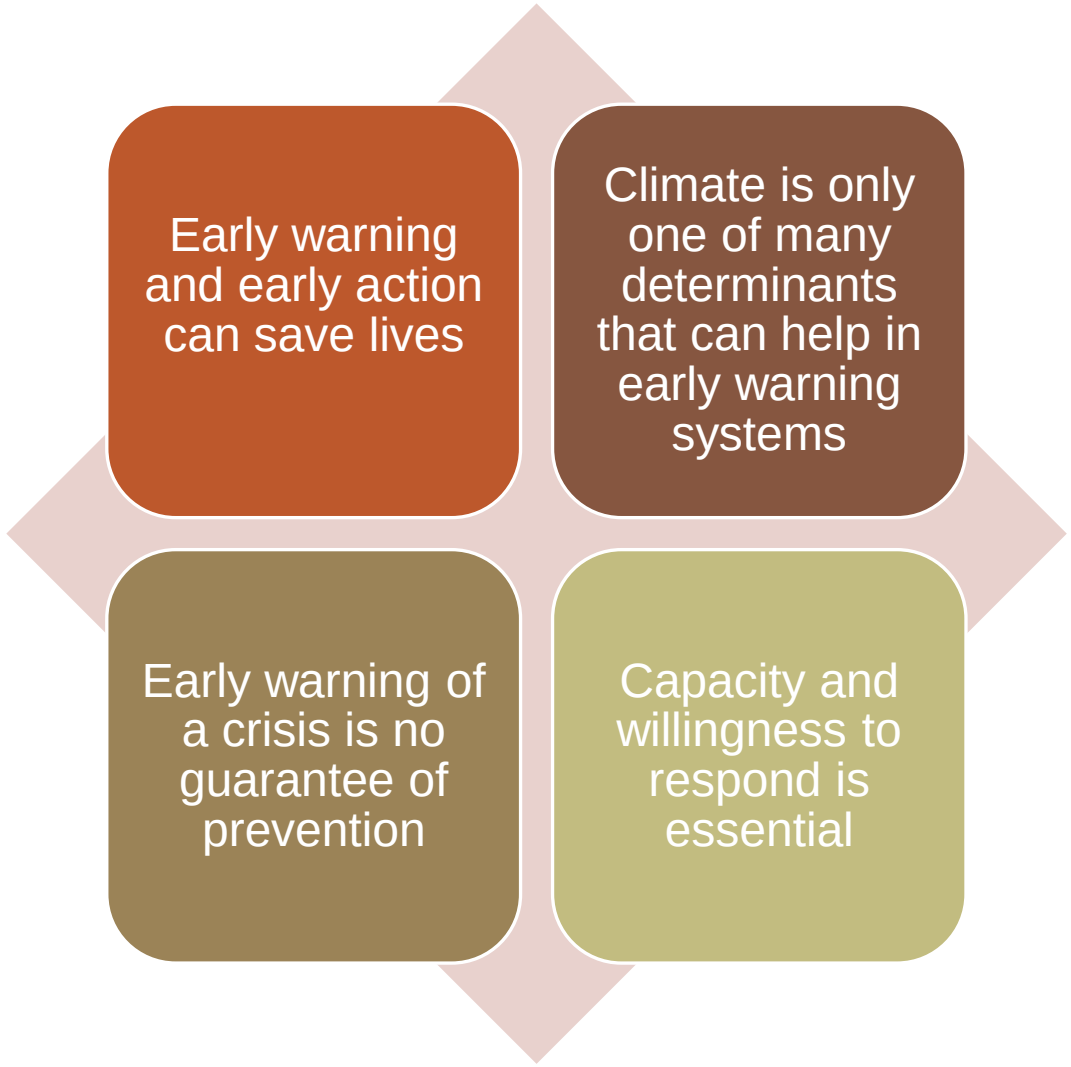
Development of EWS in the Caribbean

CARPHA/CIMH/PAHO implementing agencies; Consulting team: Inter American Institute for Global Research (IAI)

- Beneficiary countries: St. Lucia, Grenada, Barbados
- Four aspects under consultancy:
  1. Feasibility study/Baseline assessment
  2. Data harvesting – Epidemiological, Entomological, Meteorological data
  3. Model Development, training and implementation
  4. Monitoring and Evaluation and Sustainability

VBD EWS

- Creation of spatio-temporal tools (model outputs) to describe arboviral risk and forecast arboviral patterns
- Work to be carried out between September 2022 – June 2024; primary focus of 3 countries is on MBDs
- Focus on collaborative co-creation process with country to ensure usability and sustainability
- Recommendations from these pilots will feed into feed into developing EWS for other CMS



Lessons Learned

Sustainability in the future

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How to integrate the work carried out such that countries sustainably utilize and build on outputs?

Role of implementing agencies and countries/beneficiaries?

Incipient work – continued need for resource mobilization to expand pilot initiatives to other countries.

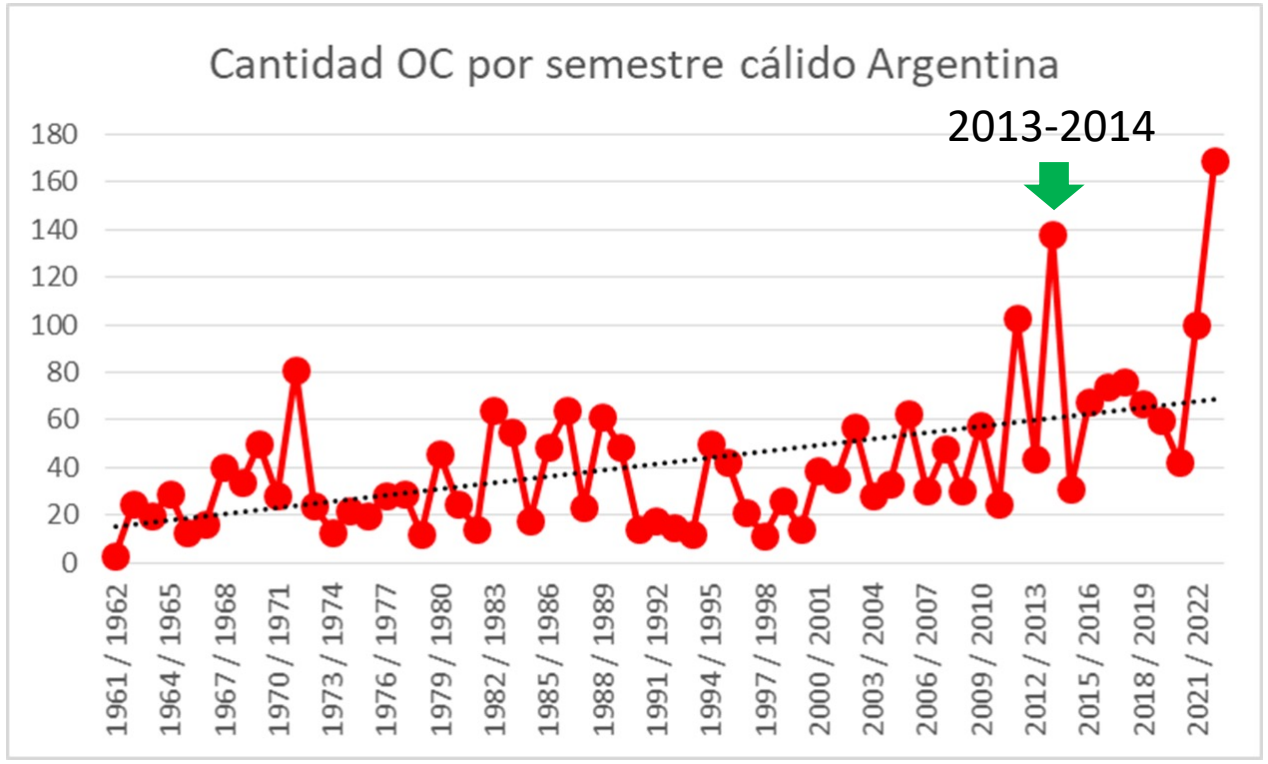

Thank
you

Temperaturas extremas en Argentina: evidencia, alerta temprana y vigilancia sanitaria

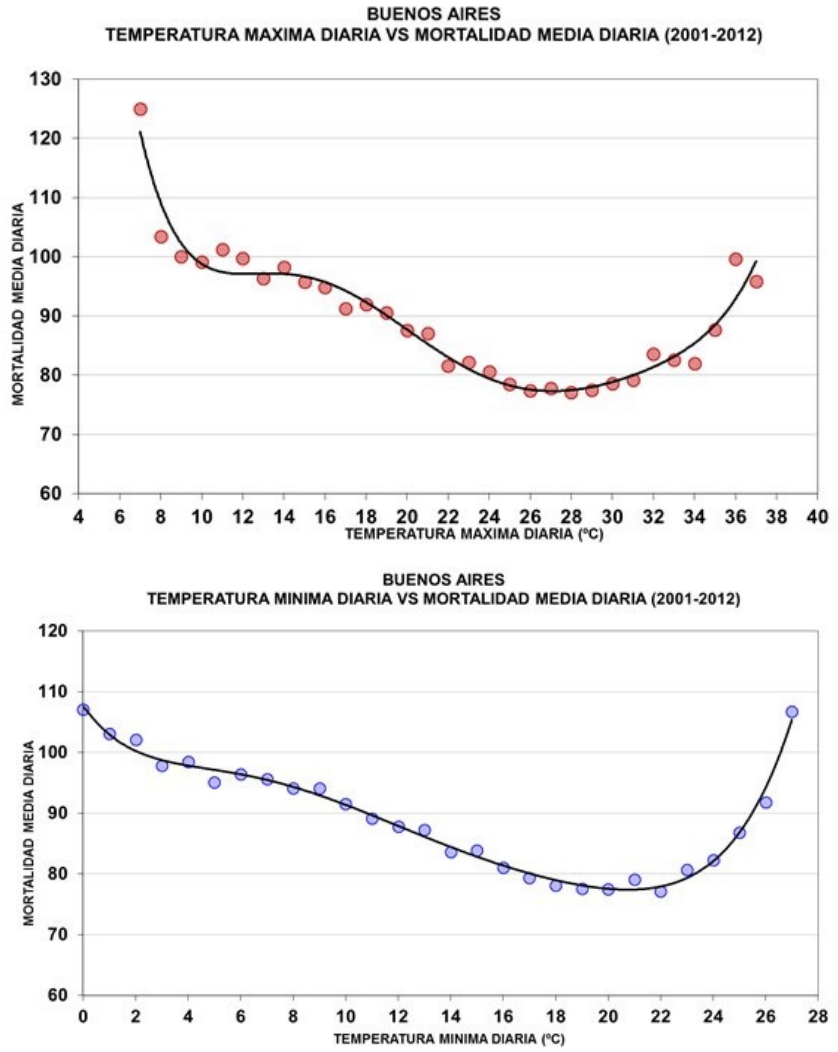
Webinar: El Niño y la reducción de sus impactos en el sector salud

Francisco Chesini
Ministerio de Salud de Argentina

Olas de calor en Argentina: evidencia

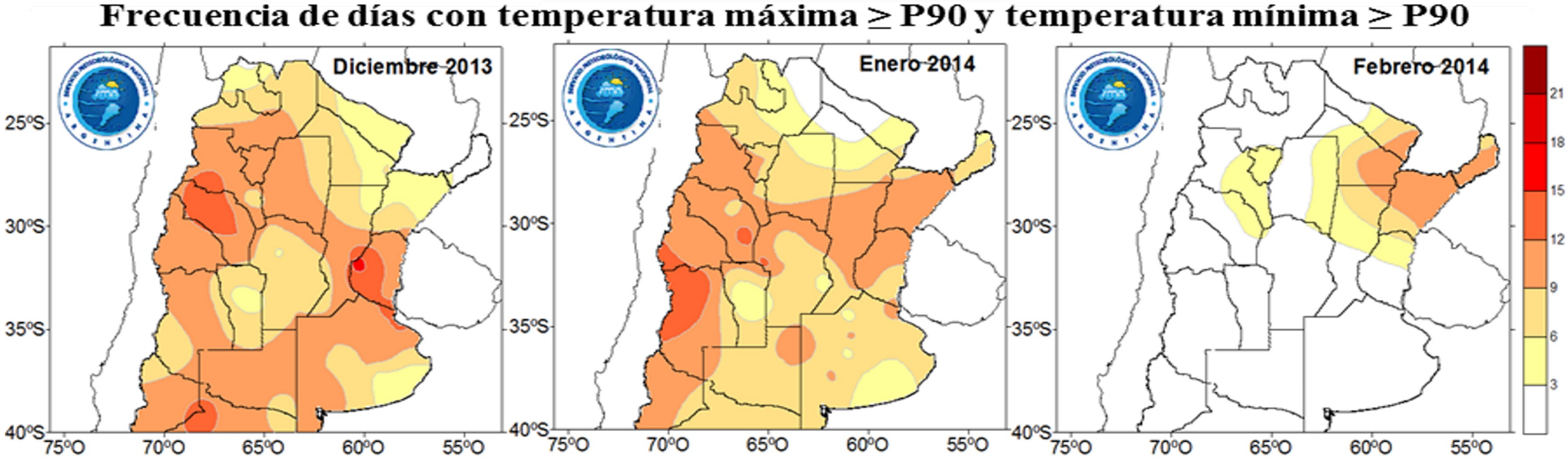


Fuente: Servicio Meteorológico Nacional (2023)



Fuente: Almeira G, Rusticucci M y Suaya M (2016)

Olas de calor verano 2013-2014 en Argentina



Fuente: Servicio Meteorológico Nacional

Mortalidad por olas de calor en el verano 2013-2014 en Argentina

Ola de Calor	Cantidad de Provincias alcanzadas	Duración promedio	Nº de Prov. con incrementos en la mortalidad*	Nº de muertes en exceso
Diciembre	17	6,9	7	1046
Enero	16	5,2	6	635
Febrero	4	13	3	196
Total	**19**	**6,3**	**13**	**1877**

* Con incremento en el Riesgo Relativo (RR) con un intervalo de confianza del 95%

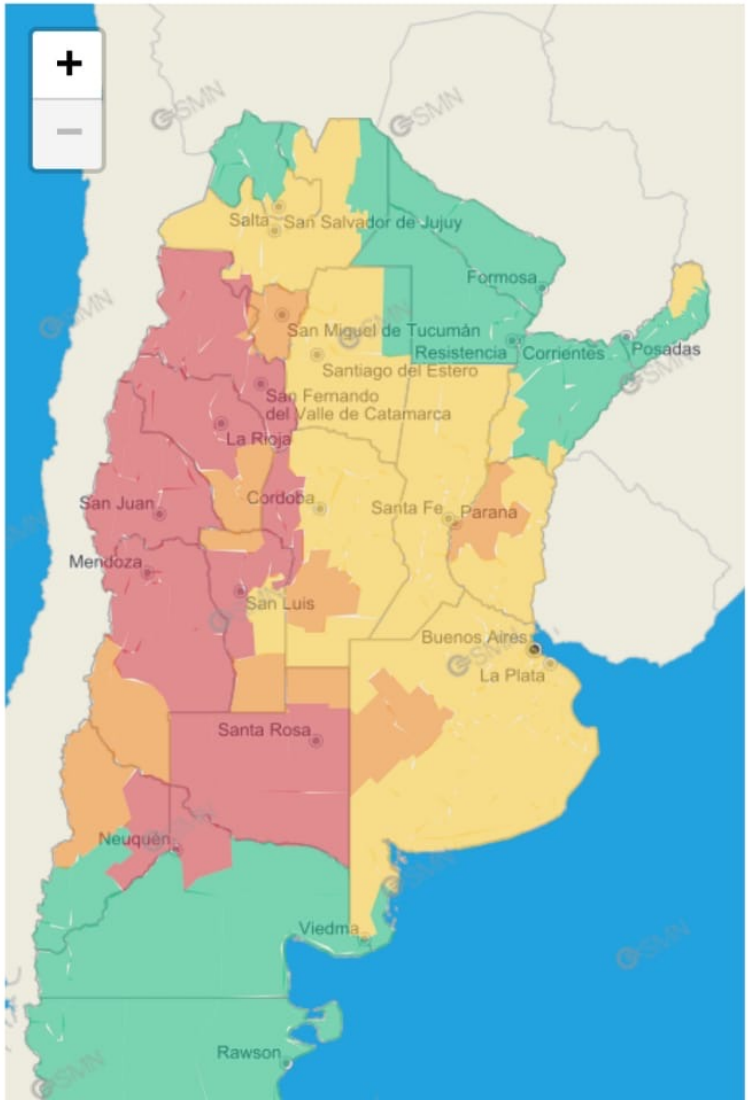
- **Mortalidad por edad:** El riesgo de morir se incrementó con la edad, fue significativo en cuatro provincias para el grupo de 60-79 años y en seis jurisdicciones en 80 años y más.
- **Causas de defunción:** respiratorias, cardiovasculares, cerebrovasculares, insuficiencia renal y diabetes (con riesgo significativamente incrementado).

Fuente: Chesini F, et al. (2022) https://doi.org/10.1590/1413-812320222275.07502021

Servicio Meteorológico Nacional

Sistema de alerta temprana por temperaturas extremas

Fecha de emisión: 11/01/2022 18:21h



Temperaturas extremas: calor

Nivel rojo: efecto alto a extremo en la salud

Muy peligrosas. Pueden afectar a todas las personas, incluso a las saludables.

Nivel naranja: efecto moderado a alto en la salud

Pueden ser muy peligrosas, especialmente para los grupos de riesgo.

Nivel amarillo: efecto leve a moderado en la salud

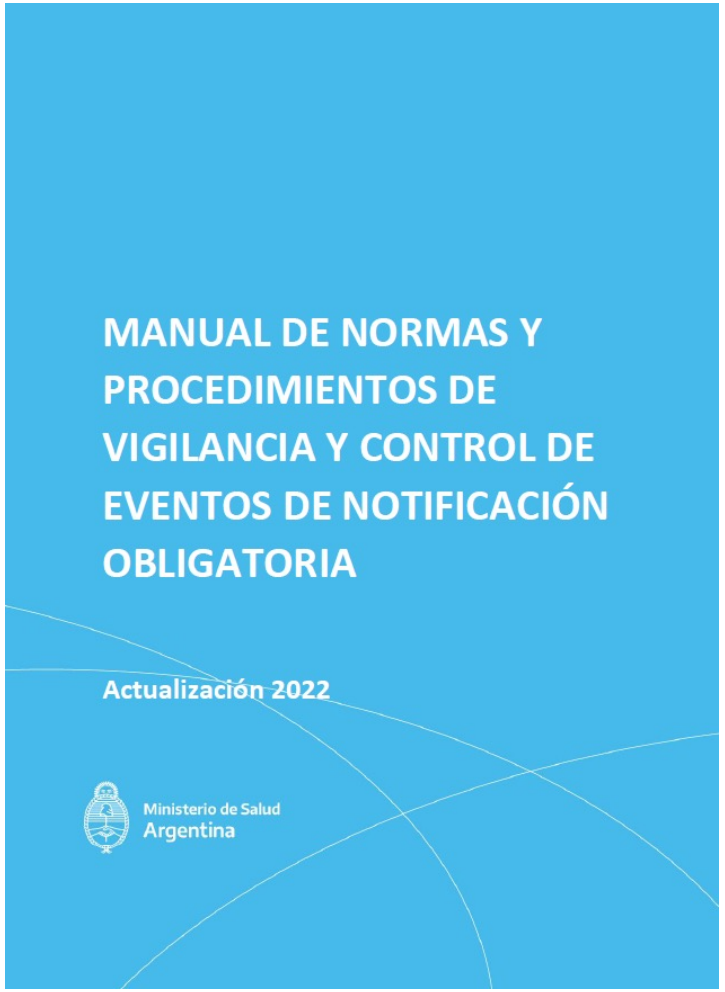
Pueden ser peligrosas, sobre todo para los grupos de riesgo, como bebés y niños pequeños, mayores de 65 años y personas con enfermedades crónicas.

Nivel verde: sin efecto sobre la salud

Sin peligro sobre la salud de la población.

Nota Técnica SMN 2021-111.
http://repositorio.smn.gob.ar/handle/20.500.12160/1726

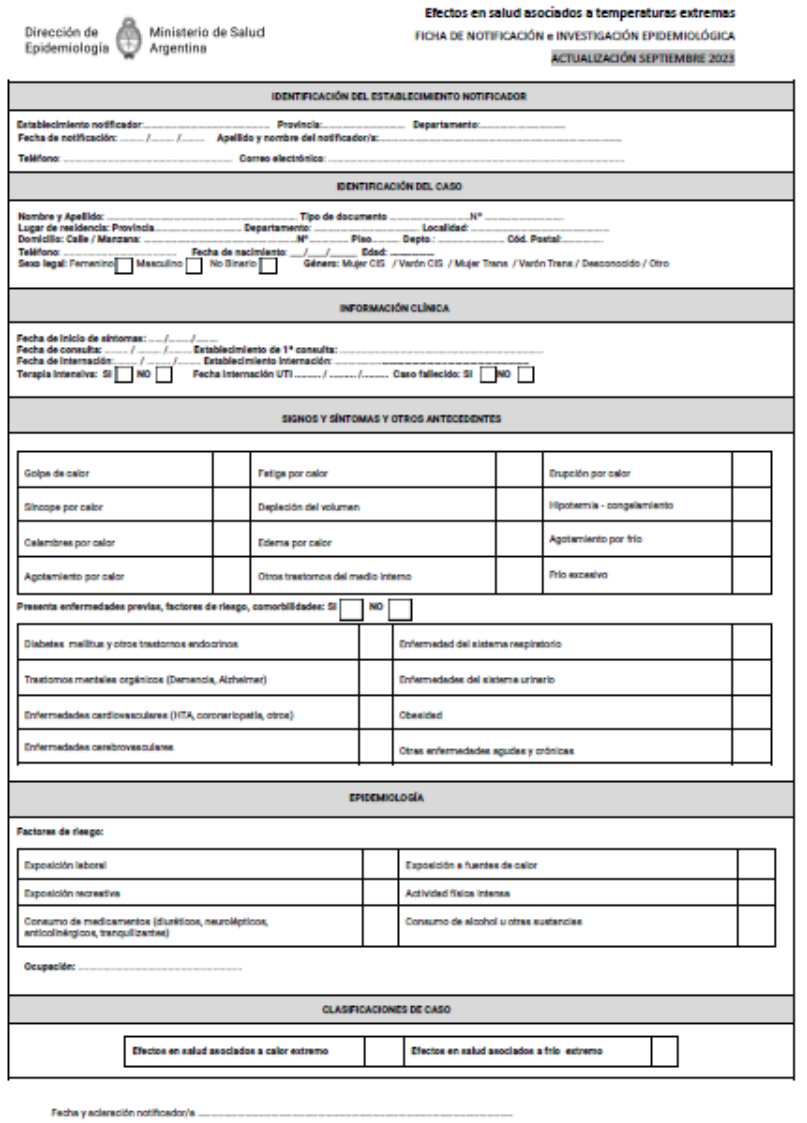
Olas de calor: vigilancia sanitaria



Evento de notificación: "Efectos en la salud asociados a temperaturas extremas"

Vigilancia universal / agrupada

Vigilancia centinela:
Un hospital por provincia
Individual
Prueba piloto: octubre 2023-Marzo 2024.



Dirección de Epidemiología — Ministerio de Salud Argentina

Efectos en salud asociados a temperaturas extremas

FICHA DE NOTIFICACIÓN e INVESTIGACIÓN EPIDEMIOLÓGICA

ACTUALIZACIÓN SEPTIEMBRE 2023

IDENTIFICACIÓN DEL ESTABLECIMIENTO NOTIFICADOR

Establecimiento notificador: ..... Provincia: ..... Departamento: .....
Fecha de notificación: ... / ... / ... Apellido y nombre del notificador/a: .....
Teléfono: ..... Correo electrónico: .....

IDENTIFICACIÓN DEL CASO

Nombre y Apellido: ..... Tipo de documento ..... N° .....
Lugar de residencia: Provincia ..... Departamento: ..... Localidad: .....
Domicilio: Calle / Manzana: ..... N° ..... Piso ..... Depto.: ..... Cód. Postal: .....
Teléfono: ..... Fecha de nacimiento: ... / ... / ... Edad: .....
Sexo legal: Femenino ☐ Masculino ☐ No Binario ☐ Género: Mujer CIS / Varón CIS / Mujer Trans / Varón Trans / Desconocido / Otro

INFORMACIÓN CLÍNICA

Fecha de inicio de síntomas: ... / ... / ...
Fecha de consulta: ... / ... / ... Establecimiento de 1ª consulta: .....
Fecha de internación: ... / ... / ... Establecimiento internación: .....
Terapia Intensiva: SI ☐ NO ☐ Fecha internación UTI ... / ... / ... Caso fallecido: SI ☐ NO ☐

SIGNOS Y SÍNTOMAS Y OTROS ANTECEDENTES

Golpe de calor		Fatiga por calor		Erupción por calor	
Síncope por calor		Depleción del volumen		Hipotermia - congelamiento	
Calambres por calor		Edema por calor		Agotamiento por frío	
Agotamiento por calor		Otros trastornos del medio interno		Frío excesivo	

Presenta enfermedades previas, factores de riesgo, comorbilidades: SI ☐ NO ☐

Diabetes mellitus y otros trastornos endocrinos		Enfermedad del sistema respiratorio	
Trastornos mentales orgánicos (Demencia, Alzheimer)		Enfermedades del sistema urinario	
Enfermedades cardiovasculares (HTA, coronariopatía, otros)		Obesidad	
Enfermedades cerebrovasculares		Otras enfermedades agudas y crónicas	

EPIDEMIOLOGÍA

Factores de riesgo:

Exposición laboral		Exposición a fuentes de calor	
Exposición recreativa		Actividad física intensa	
Consumo de medicamentos (diuréticos, neurolépticos, anticolinérgicos, tranquilizantes)		Consumo de alcohol u otras sustancias	

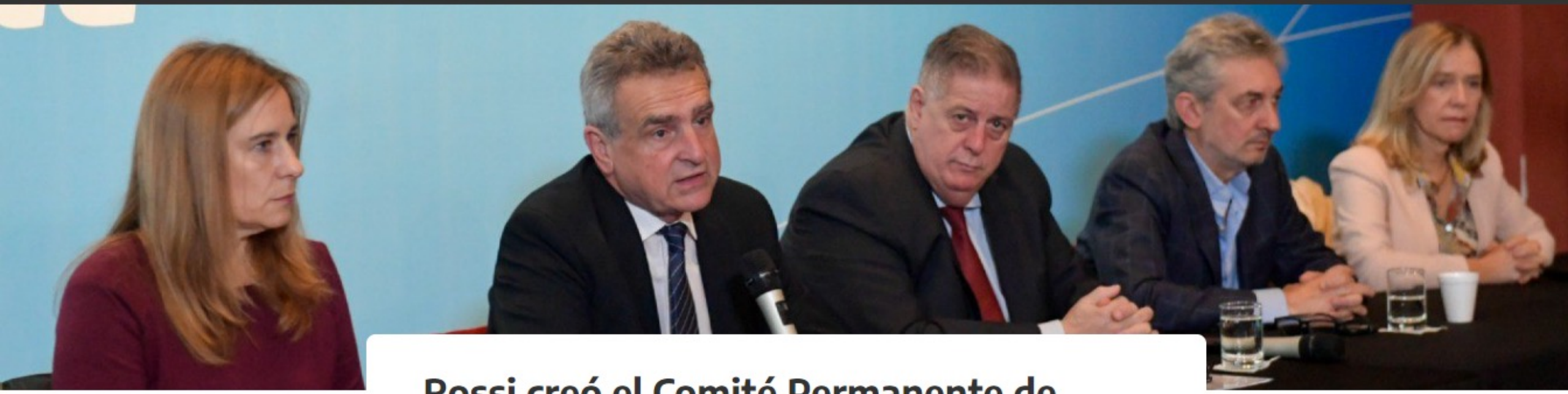
Ocupación: .....

CLASIFICACIONES DE CASO

Efectos en salud asociados a calor extremo		Efectos en salud asociados a frío extremo	

Fecha y aclaración notificador/a .....

Jefatura de Gabinete de Ministros /



Rossi creó el Comité Permanente de Seguimiento y Respuesta al fenómeno meteorológico El Niño

Asimismo, en el encuentro, se presentaron los programas, medios y capacidades disponibles para articular a nivel interministerial.

Compartir en redes sociales

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Fuente: https://www.argentina.gob.ar/noticias/rossi-creo-el-comite-permanente-de-seguimiento-y-respuesta-al-fenomeno-meteorologico-el

Muchas gracias por su atención

Francisco Chesini
Coordinación de Salud Ambiental
Ministerio de Salud de Argentina