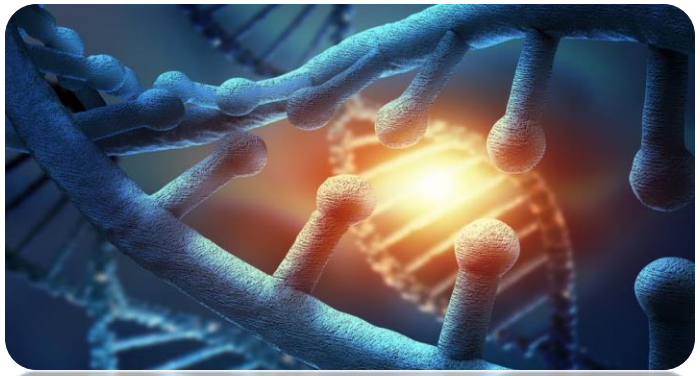
2021 SECTEI

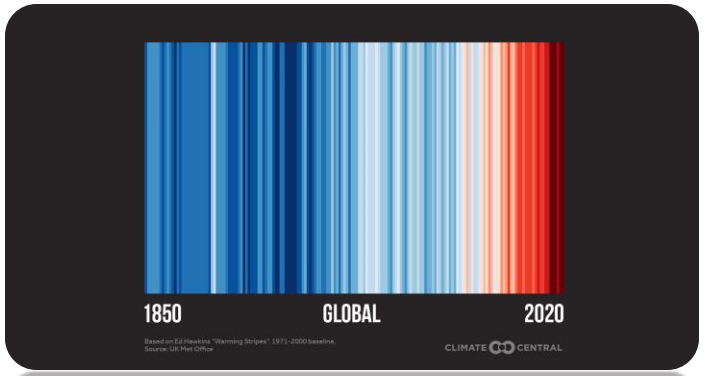
SEMANA DE LA CIENCIA, TECNOLOGÍA EMPRENDIMIENTO E INNOVACIÓN

VIII CONGRESO INTERNACIONAL

DE CIENCIA, TECNOLOGÍA, EMPRENDIMIENTO E INNOVACIÓN

# GENÓMICA BOVINA Y PLASTICIDAD FENOTÍPICA: TENEMOS ALTERNATIVA ANTE EL CAMBIO CLIMÁTICO?






EL FUTURO ES AHORA

Municipio de Riobamba

espoch

Unach
UNIVERSIDAD NACIONAL DE CHIMBORAZO
en movimiento

CORPORACIÓN DE CÁMARAS DE LA PRODUCCIÓN DE CHIMBORAZO

# ÍNDICE DE CONTENIDO

- El Cambio Climático y el Antropoceno
- Índice de Temperatura Humedad como medida de estrés calórico
- Plasticidad fenotípica definición, ejemplos en la naturaleza
- Una mirada al mini genoma del bovino criollo
- Reflexión final

# PARIS CLIMATE AGREEMENT

1.


Limit the avg. global temperature increase to < 2° centigrade + achieve net zero emissions by mid-century

2.

Enhance resilience and adaptation to climate impacts certain to occur

3.

Align financial flows in the world with these objectives

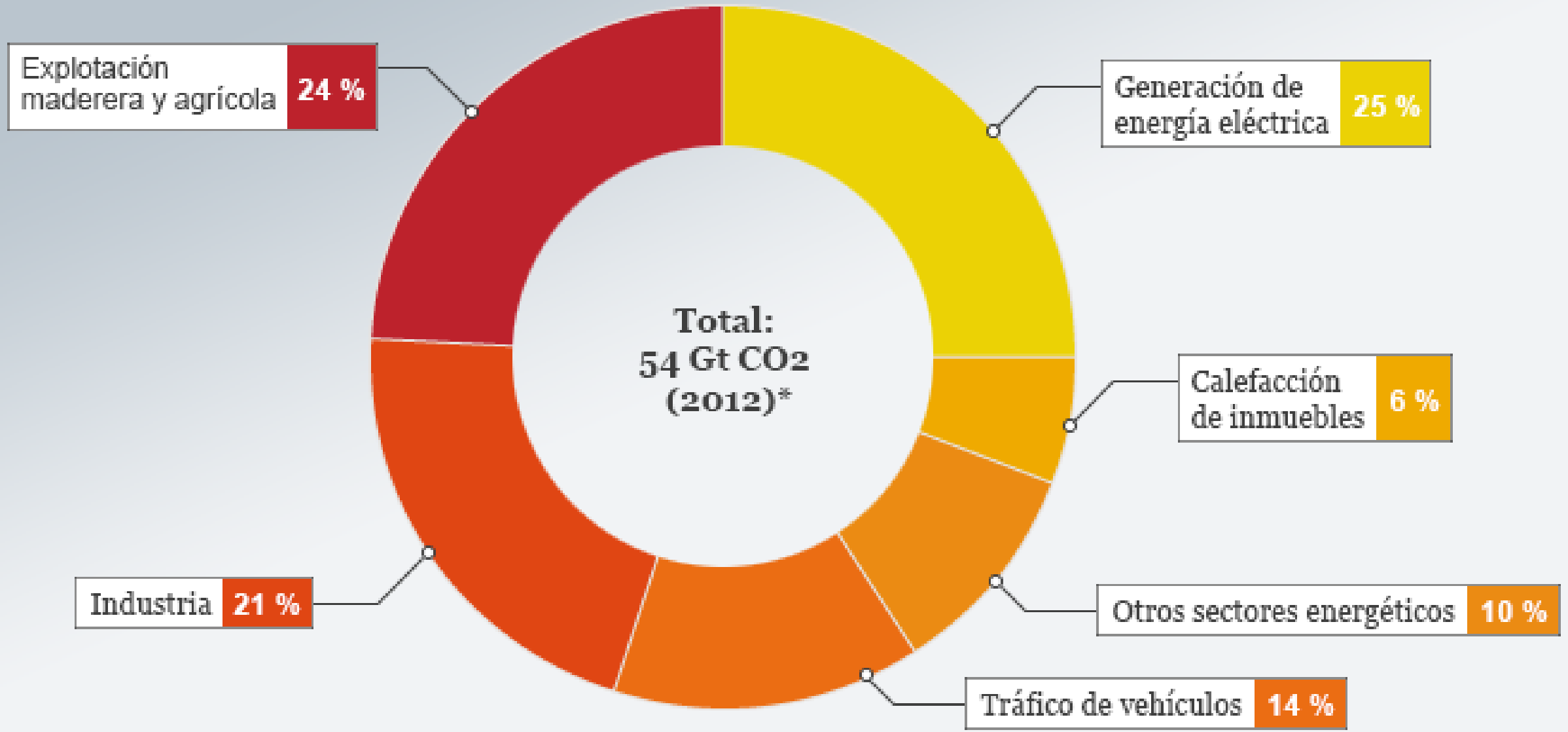
# CAMBIO CLIMÁTICO

El cambio climático se define como los cambios espaciales, tanto a nivel local y global y de carácter temporal de las variables climáticas ambientales en la Tierra (Rovelli et al 2020).

El informe IPCC, que los gases de efecto invernadero del tipo antropogénico, han sido responsables de la mayor parte del aumento de temperatura y ha estimado que su media global ha sufrido un incremento de 0,8 a 1,2°C

↑ 1,5°C para los años 2030 al 2052

# Emisiones globales de gases invernadero por sectores




Fuente: ipcc.ch | * datos en gigatoneladas (Gt) Equivalente en CO2

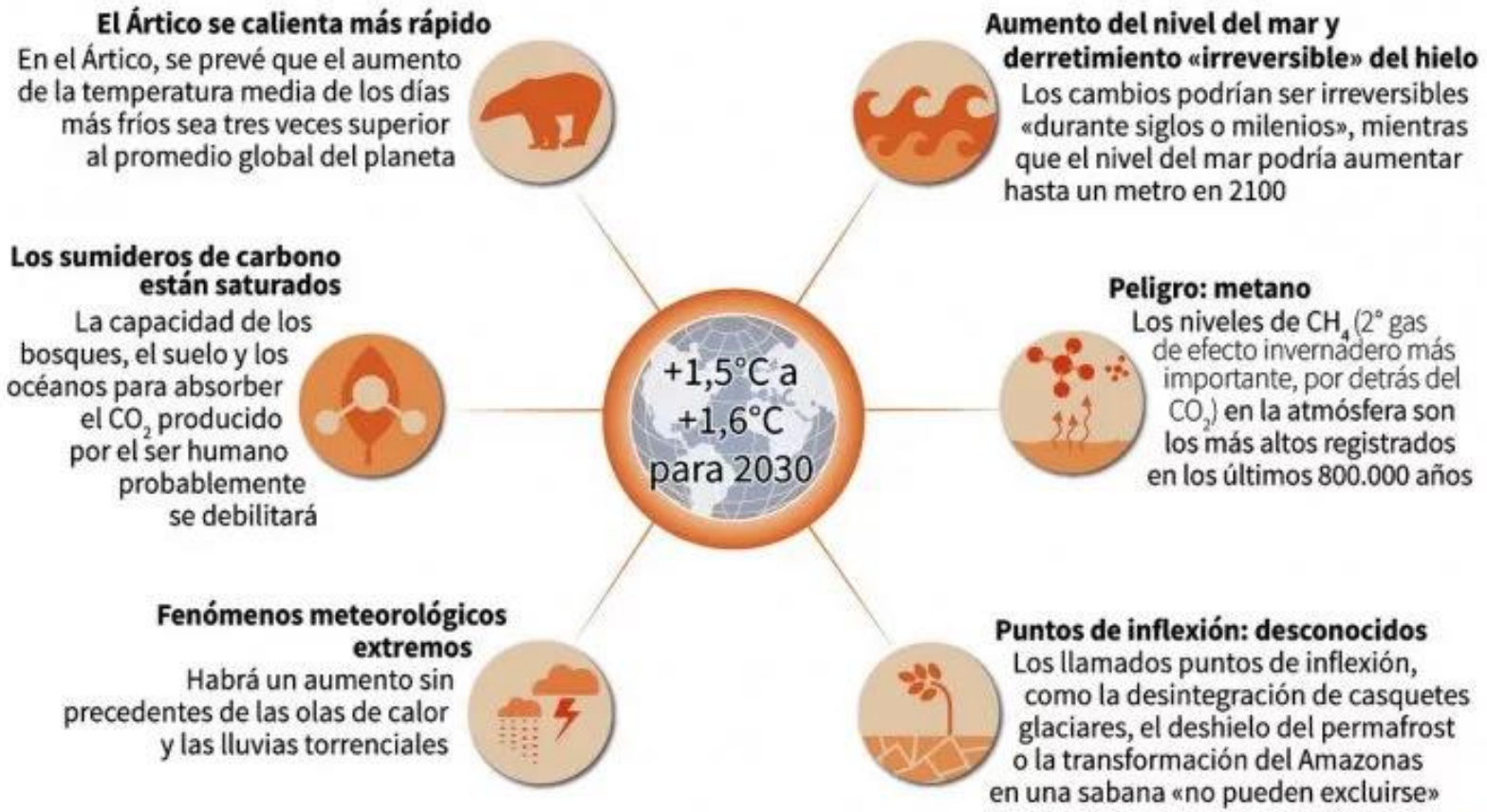
# Los países que más contaminan el aire

Países/regiones con mayor volumen de emisiones de dióxido de carbono en 2020 (mill. de toneladas)


Fuente: BP Statistical Review of World Energy 2021

# Cambio climático: puntos clave del informe del IPCC

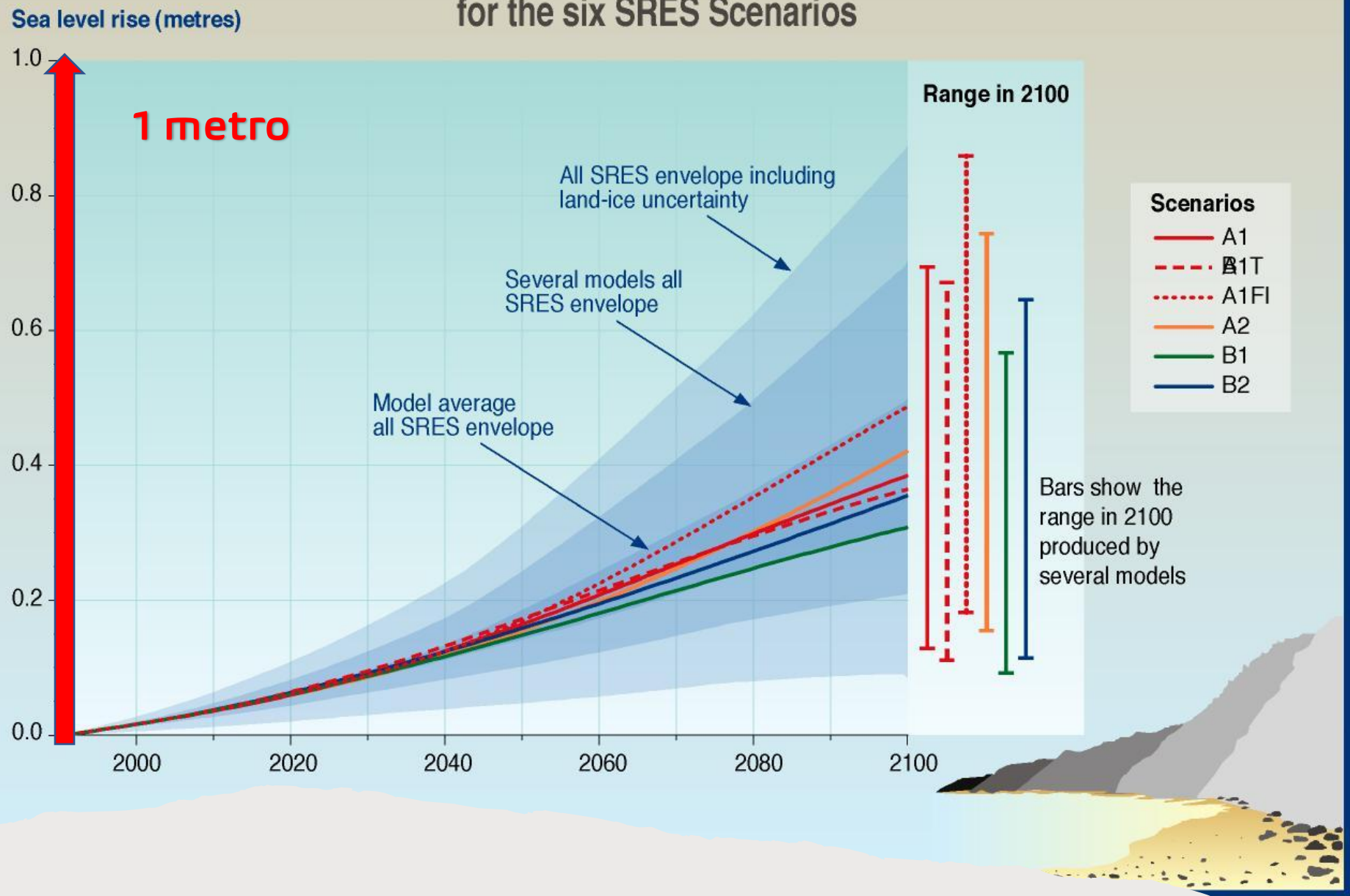
En todos los escenarios considerados se espera que, hacia 2030, la temperatura media del planeta sea **1,5 °C** o **1,6 °C** mayor a la de los niveles de la era preindustrial. Una década antes de lo previsto




*Fuente: Grupo Intergubernamental de Expertos sobre el Cambio Climático (IPCC)*

AFP

# Global average sea level rise (1990 - 2100)
## for the six SRES Scenarios




WG1 TS FIGURE 24

CLIMATE CENTRAL

# Coastal Risk Screening Tool

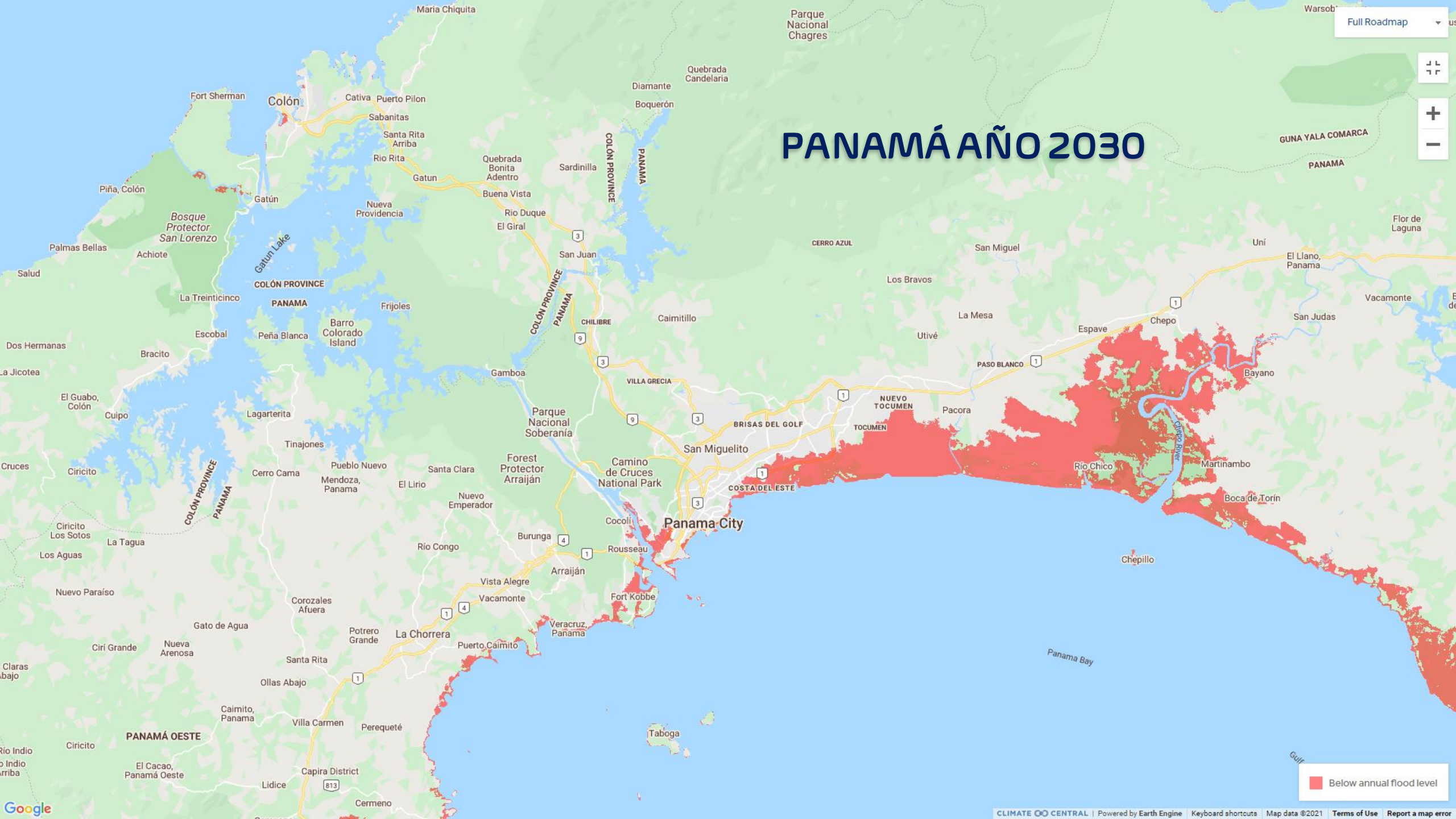
An interactive map showing areas threatened by sea level rise and coastal flooding. Combining the most advanced global model of coastal elevations with the latest projections for future flood levels.

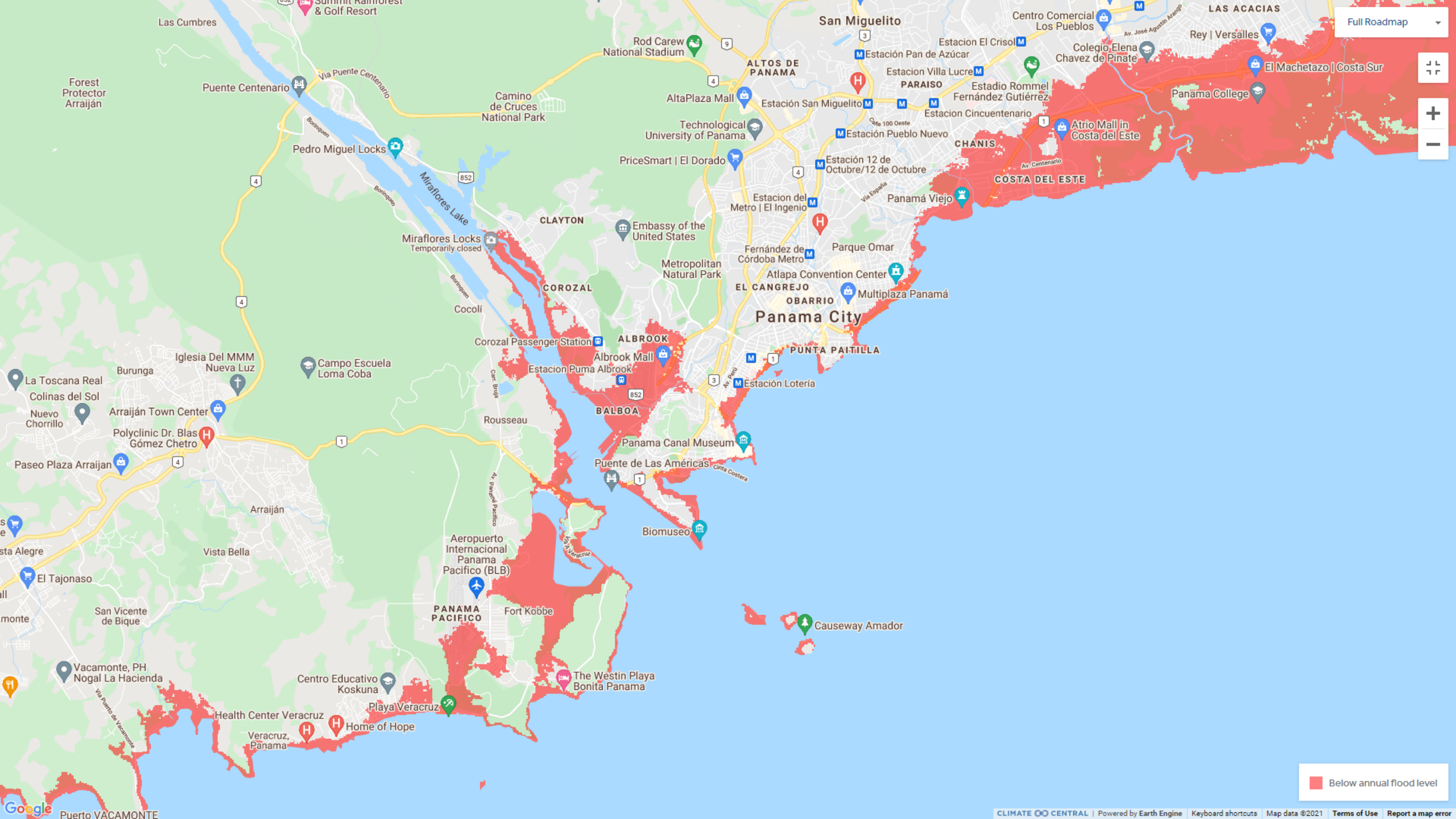
CHOOSE MAP | WATCH TUTORIAL

## Cutting-Edge Science

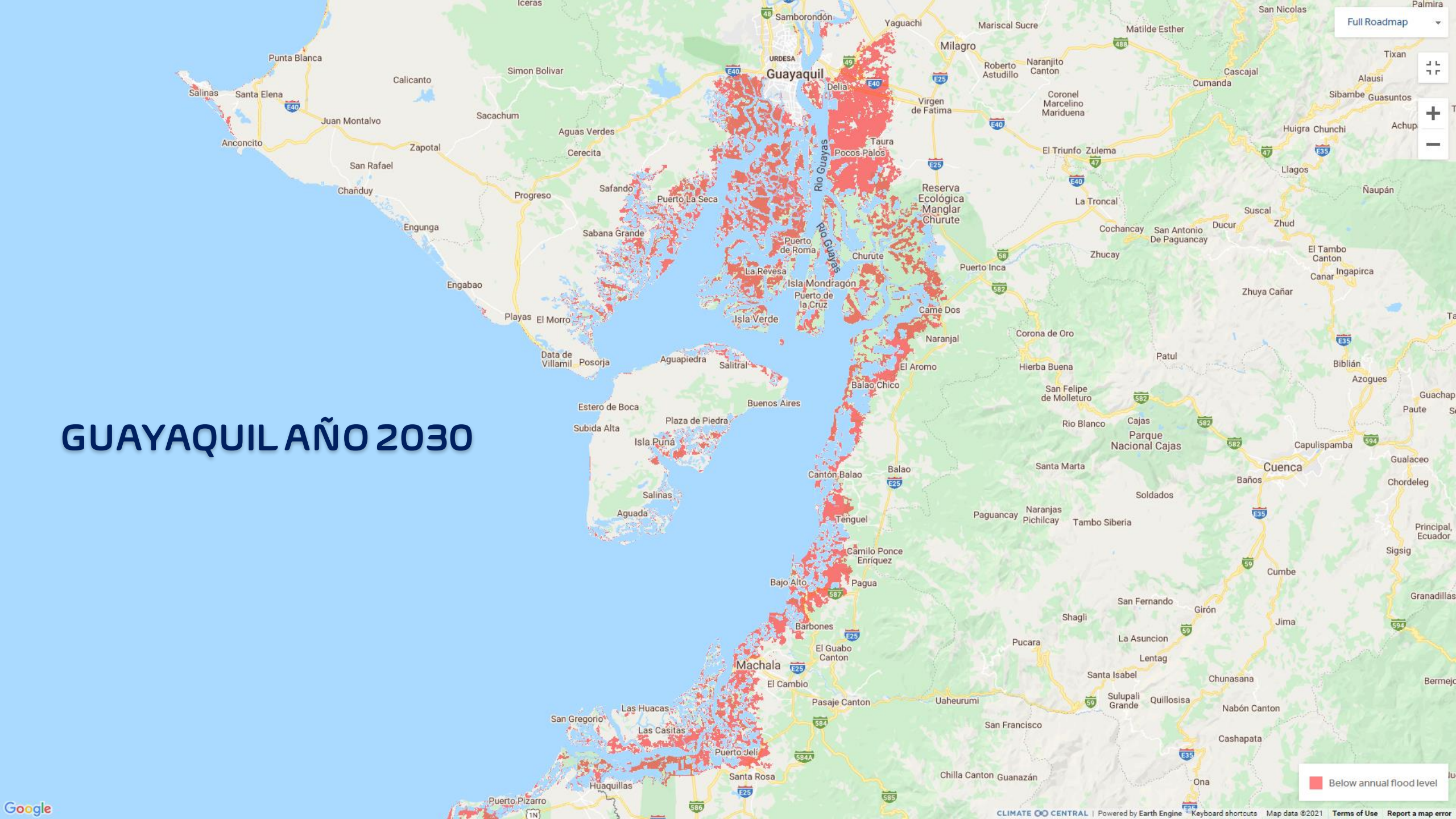
Flood maps are only as good as the elevation data they're founded on. We used machine learning to develop CoastalDEM®, a high-accuracy digital elevation model (DEM) for

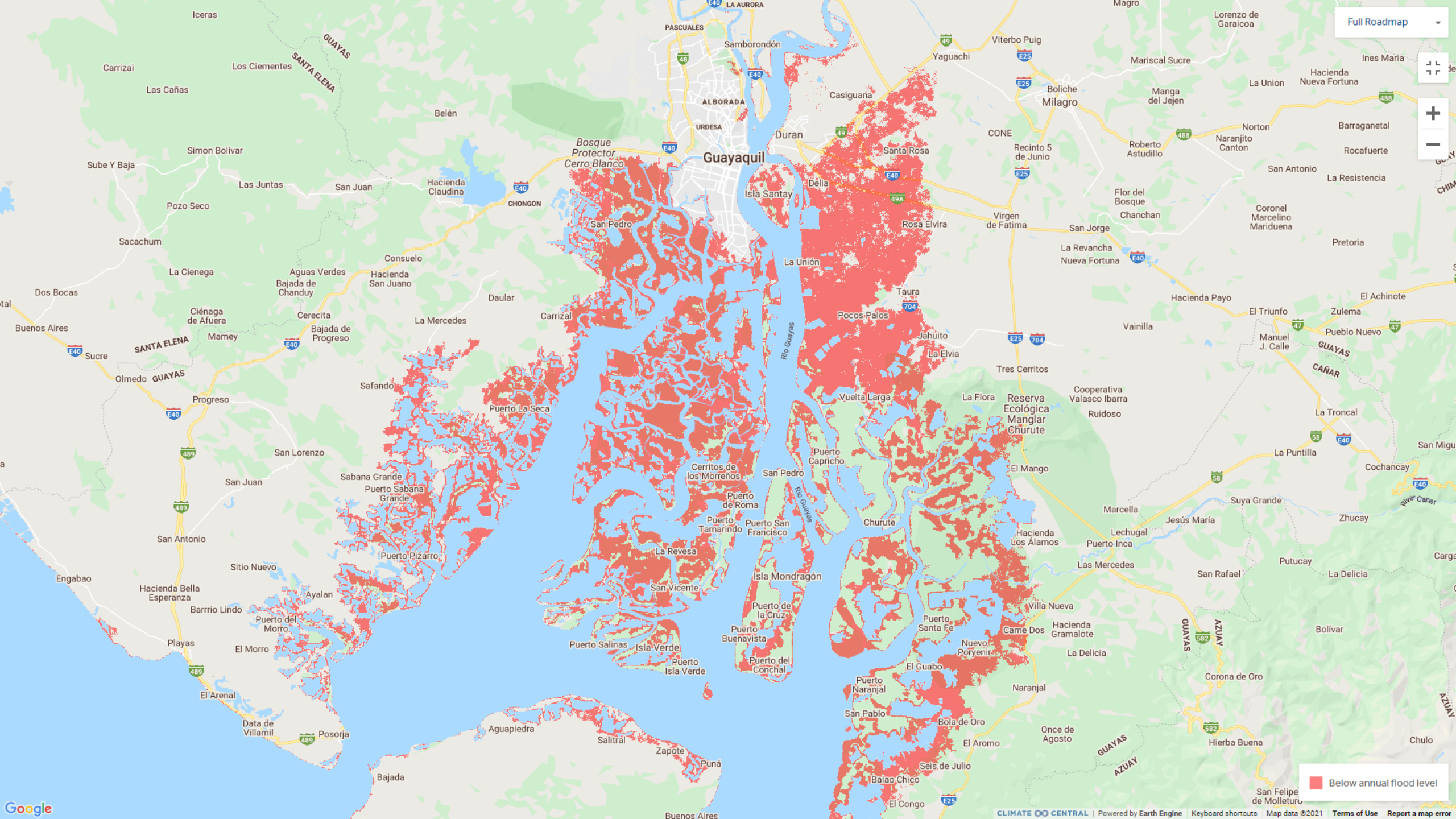
Climate change science is constantly improving. Our maps are based on the latest sea-level projections, including the recently released Sixth Assessment Report (AR6)


PANAMÁ AÑO 2030
Full Roadmap
Below annual flood level
Panama City
Colón
San Miguelito
Panamá Oeste
Parque Nacional Soberanía
Camino de Cruces National Park
Forest Protector Arraiján
Bosque Protector San Lorenzo
Barro Colorado Island
Gatun Lake
Panama Bay
Taboga
La Chorrera
Arraiján
Tocumen
Río Chico
Martinambo
Bayano
Chepo
Chepillo
Boca de Torín
Fort Kobbe
Fort Sherman
Veracruz, Panamá
Puerto Caimito
Vacamonte
Rousseau
Burunga
Cocolí
Pacora
Nuevo Tocumen
Brisas del Golf
Costa del Este
Villa Grecia
Chilibre
Caimitillo
Gamboa
Gatún
Colón Province
Panamá
Guna Yala Comarca
Cerro Azul
Los Bravos
La Mesa
Utivé
Espave
San Miguel
El Llano, Panamá
San Judas
Vacamonte
Flor de Laguna
Uní
Paso Blanco
Sardinilla
Quebrada Bonita Adentro
Buena Vista
Rio Duque
El Giral
San Juan
Nueva Providencia
Rio Rita
Santa Rita Arriba
Sabanitas
Cativa
Puerto Pilon
Diamante
Boquerón
Quebrada Candelaria
Parque Nacional Chagres
Maria Chiquita
Piña, Colón
Palmas Bellas
Achiote
Salud
La Treinticinco
Escobal
Peña Blanca
Frijoles
Dos Hermanas
Bracito
La Jicotea
El Guabo, Colón
Cuipo
Lagarterita
Tinajones
Cruces
Ciricito
Cerro Cama
Pueblo Nuevo
Mendoza, Panamá
Santa Clara
El Lirio
Nuevo Emperador
Río Congo
Ciricito Los Sotos
La Tagua
Los Aguas
Nuevo Paraíso
Corozales Afuera
Gato de Agua
Cirí Grande
Nueva Arenosa
Potrero Grande
Santa Rita
Ollas Abajo
Caimito, Panamá
Villa Carmen
Perequeté
Ciricito
El Cacao, Panamá Oeste
Capira District
Lidice
Cermeno
Río Indio
Claras Abajo
Google
CLIMATE CENTRAL | Powered by Earth Engine | Keyboard shortcuts | Map data ©2021 | Terms of Use | Report a map error


Full Roadmap
Below annual flood level
Las Cumbres
Summit Rainforest & Golf Resort
Forest Protector Arraiján
Puente Centenario
Via Puente Centenario
Rod Carew National Stadium
San Miguelito
ALTOS DE PANAMA
Camino de Cruces National Park
AltaPlaza Mall
Estación San Miguelito
Estacion El Crisol
Estación Pan de Azúcar
Estacion Villa Lucre
PARAISO
Estadio Rommel Fernández Gutiérrez
Estacion Cincuentenario
Centro Comercial Los Pueblos
LAS ACACIAS
Rey | Versalles
Colegio Elena Chavez de Pinate
El Machetazo | Costa Sur
Panama College
Technological University of Panama
Estación Pueblo Nuevo
Atrio Mall in Costa del Este
CHANIS
COSTA DEL ESTE
Pedro Miguel Locks
PriceSmart | El Dorado
Estación 12 de Octubre/12 de Octubre
Miraflores Lake
Estacion del Metro | El Ingenio
Panamá Viejo
CLAYTON
Embassy of the United States
Miraflores Locks
Temporarily closed
Fernández de Córdoba Metro
Parque Omar
Metropolitan Natural Park
Atlapa Convention Center
COROZAL
EL CANGREJO
OBARRIO
Multiplaza Panamá
Cocolí
Panama City
Corozal Passenger Station
ALBROOK
Albrook Mall
Estacion Puma Albrook
PUNTA PAITILLA
Estación Lotería
Iglesia Del MMM Nueva Luz
Campo Escuela Loma Coba
Burunga
La Toscana Real
Colinas del Sol
Nuevo Chorrillo
Arraiján Town Center
BALBOA
Rousseau
Polyclinic Dr. Blas Gómez Chetro
Panama Canal Museum
Paseo Plaza Arraijan
Puente de Las Américas
Cinta Costera
Arraiján
Biomuseo
Aeropuerto Internacional Panama Pacifico (BLB)
Vista Bella
El Tajonaso
PANAMA PACIFICO
Fort Kobbe
San Vicente de Bique
Causeway Amador
Vacamonte, PH Nogal La Hacienda
Centro Educativo Koskuna
The Westin Playa Bonita Panama
Playa Veracruz
Health Center Veracruz
Home of Hope
Veracruz, Panama
Puerto VACAMONTE
Google
CLIMATE CENTRAL | Powered by Earth Engine | Keyboard shortcuts | Map data ©2021 | Terms of Use | Report a map error

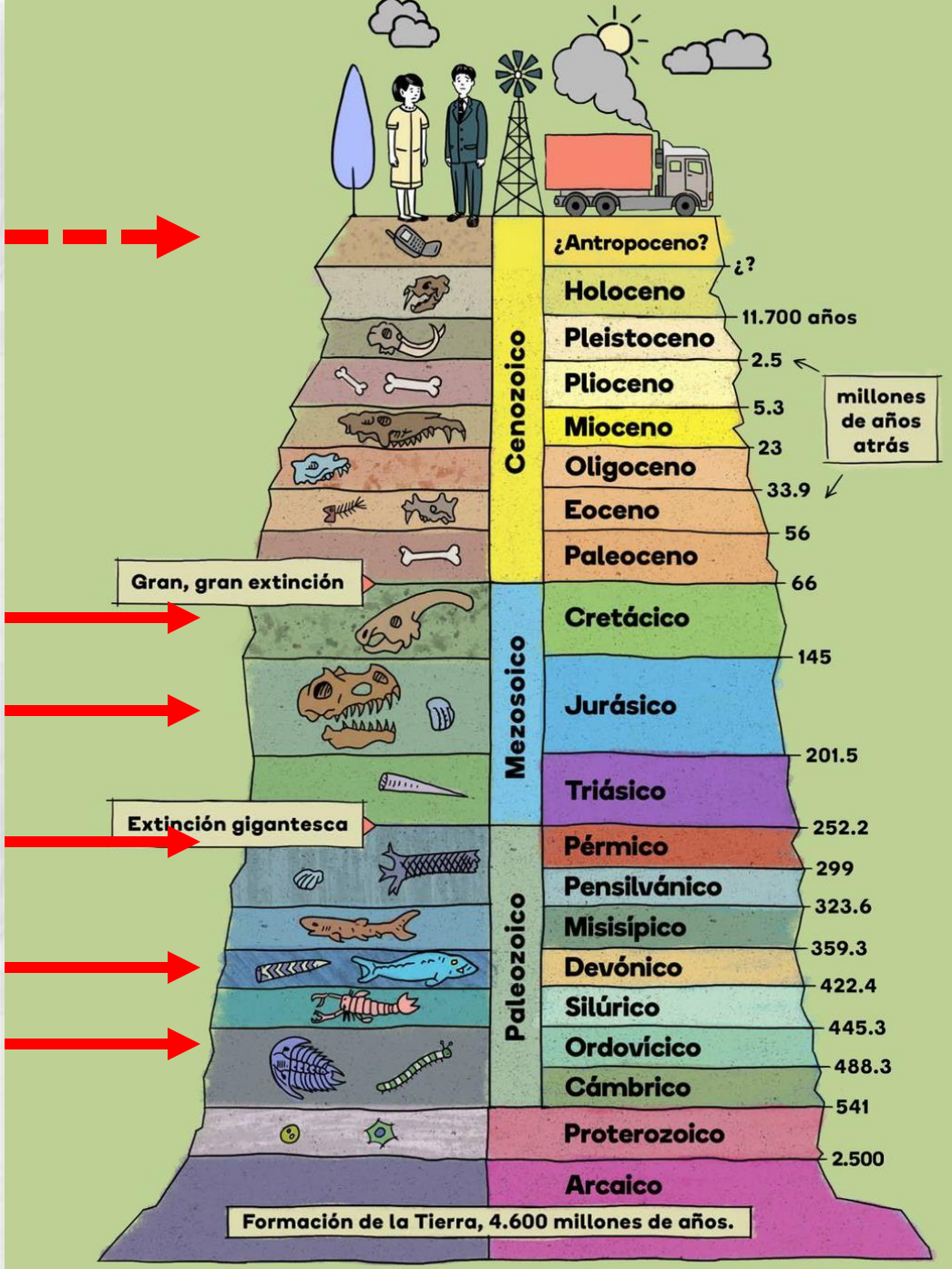
# GUAYAQUIL AÑO 2030



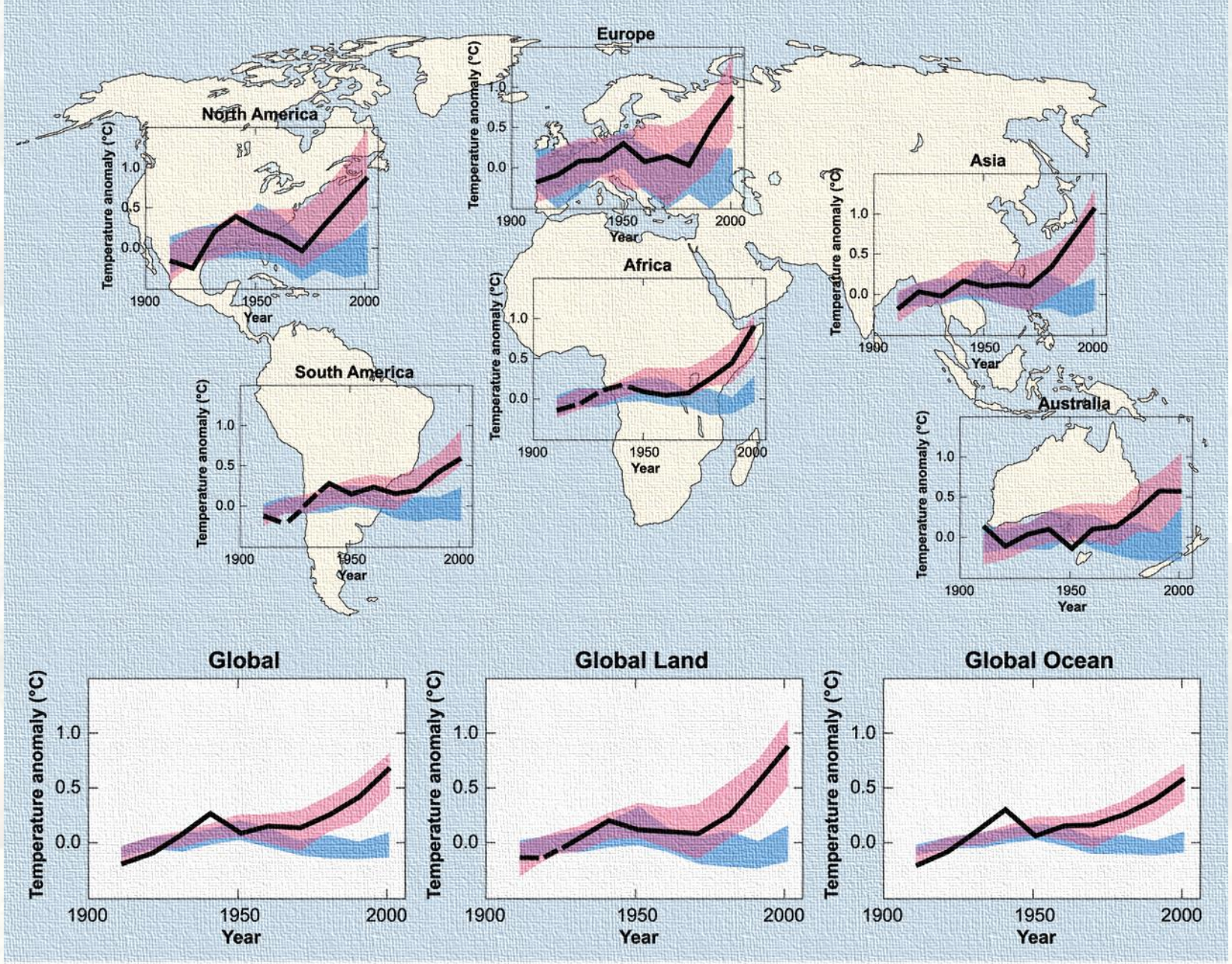

Full Roadmap
Guayaquil
Duran
Samborondón
Bosque Protector Cerro Blanco
Isla Santay
Río Guayas
Below annual flood level
CLIMATE CENTRAL | Powered by Earth Engine | Keyboard shortcuts | Map data ©2021 | Terms of Use | Report a map error
Google

# *¡BIENVENIDOS AL ANTROPOCENO!*

Esta nueva "época de los seres humanos", el ***Antropoceno***, comenzó con la Revolución industrial a finales del siglo XVIII. La humanidad seguirá siendo una fuerza ambiental predominante durante miles de años **(Crutzen, 2002)**




Fuente: Tabla Cronoestratigráfica Internacional 2015. Comisión Internacional de Estratigrafía.

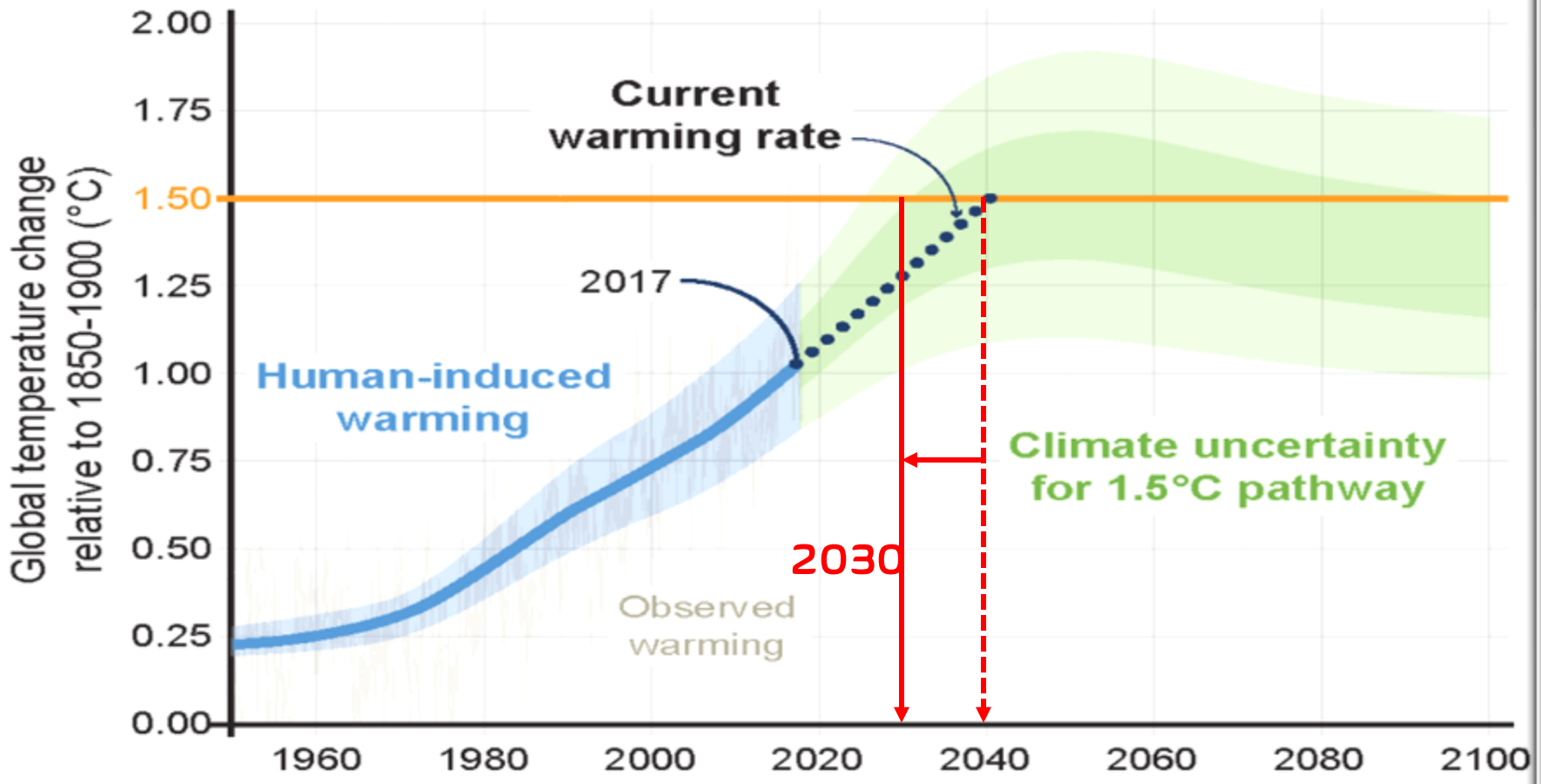



LA TIERRA SIN HUMANOS →

Forster, P., Hegerl, G., Knutti, R. et al.. Nature Clim Change 1, 63 (2007).

# FAQ1.2: How close are we to 1.5°C?

Human-induced warming reached approximately 1°C above pre-industrial levels in 2017



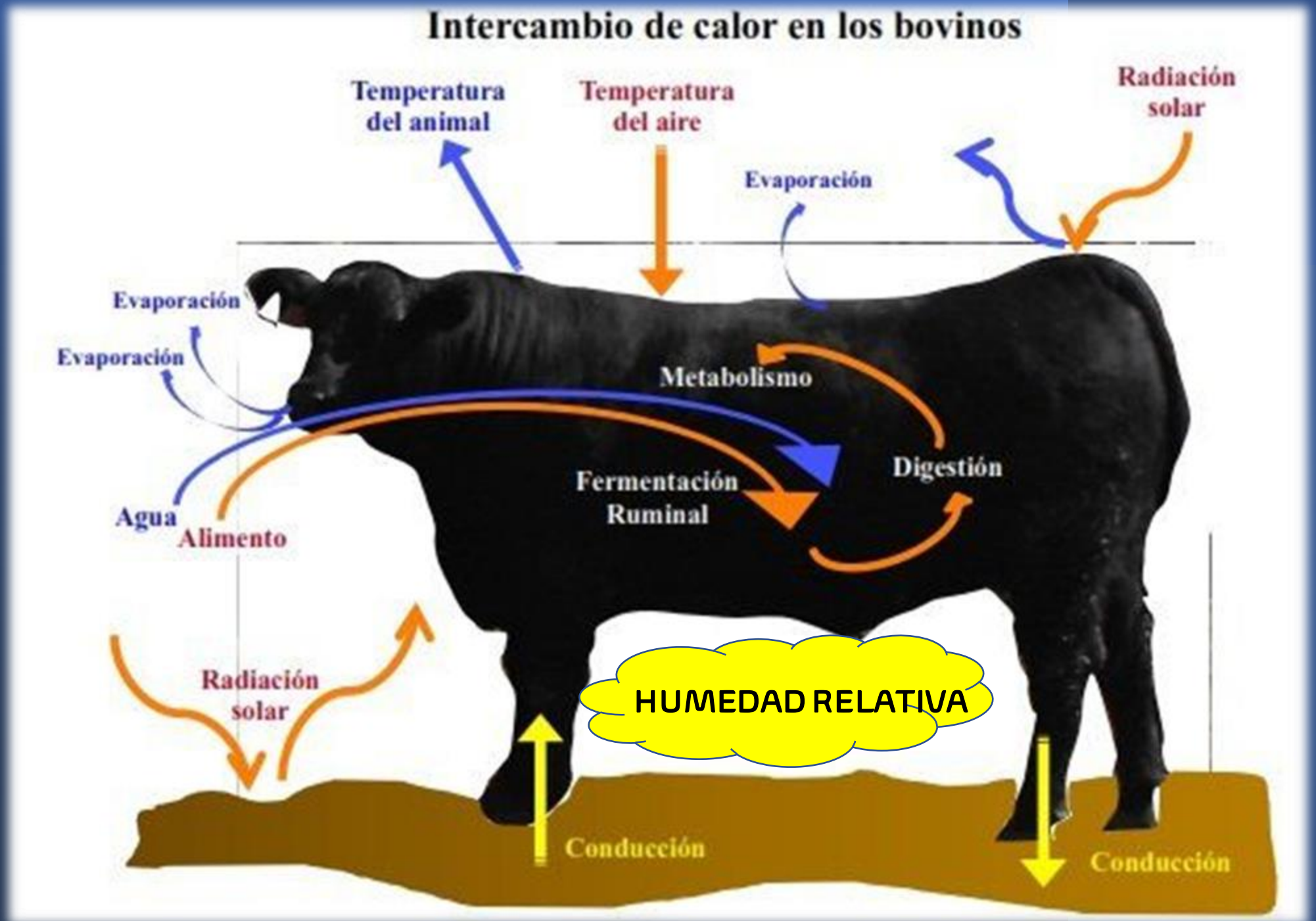
# ÍNDICE DE TEMPERATURA-HUMEDAD (ITH)

El estrés calórico es una medida ampliamente utilizada que hace referencia a los efectos negativos de condiciones de alta temperatura del aire, asociada con alta humedad relativa y radiación solar directa, sobre la respuesta productiva y fisiológica del ganado

El ITH indica el grado de estrés calórico de los animales, producto de la combinación de los efectos de la temperatura y la humedad relativa

| Nivel de Alerta | ITH | Signos esperados de Jadeo (Mader. 2006) |
|---|---|---|
| Normal | <74 | Respiración normal |
| Alerta | ≤ 75–≤ 78 | Respiración agitada |
| Peligro | ≤ 79–≤ 83 | Jadeo pesado con la boca abierta; saliva usualmente presente |
| Emergencia | >84 | Jadeo severo con la boca abierta acompañado de protuberancia lengua y salivación excesiva; generalmente con cuello extendido hacia adelante |

Livestock Weather Safety Index (LWSI)


Intercambio de calor en los bovinos
Temperatura del animal
Temperatura del aire
Radiación solar
Evaporación
Evaporación
Evaporación
Metabolismo
Digestión
Fermentación Ruminal
Agua
Alimento
Radiación solar
HUMEDAD RELATIVA
Conducción
Conducción

Pobre expresión de estro
Pobre calidad de ovocitos

Bajo estrógenos

Pérdidas embrionarias → Infertilidad

Bajo GnRH-LH

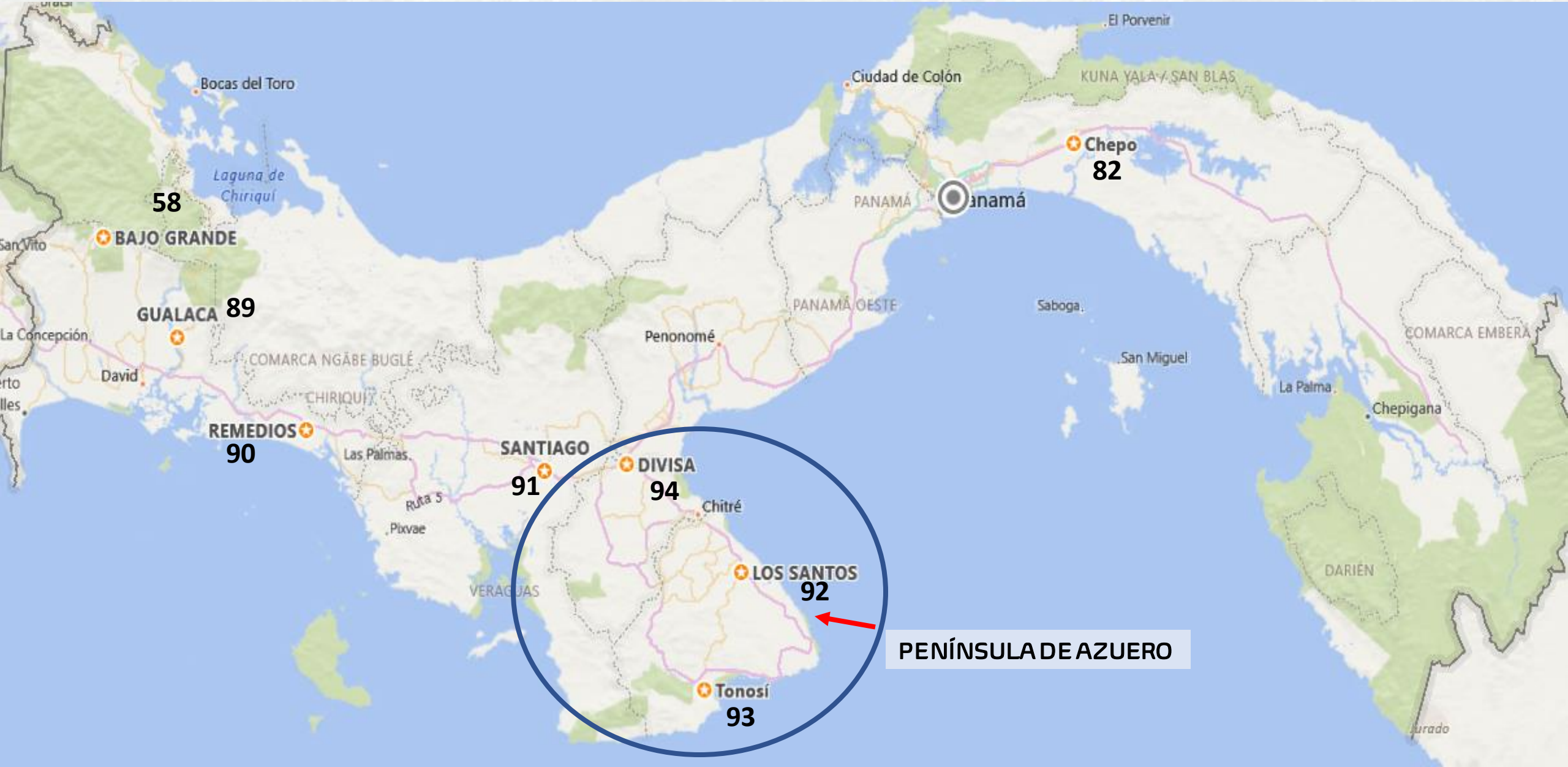
Ambiente uterino comprometido

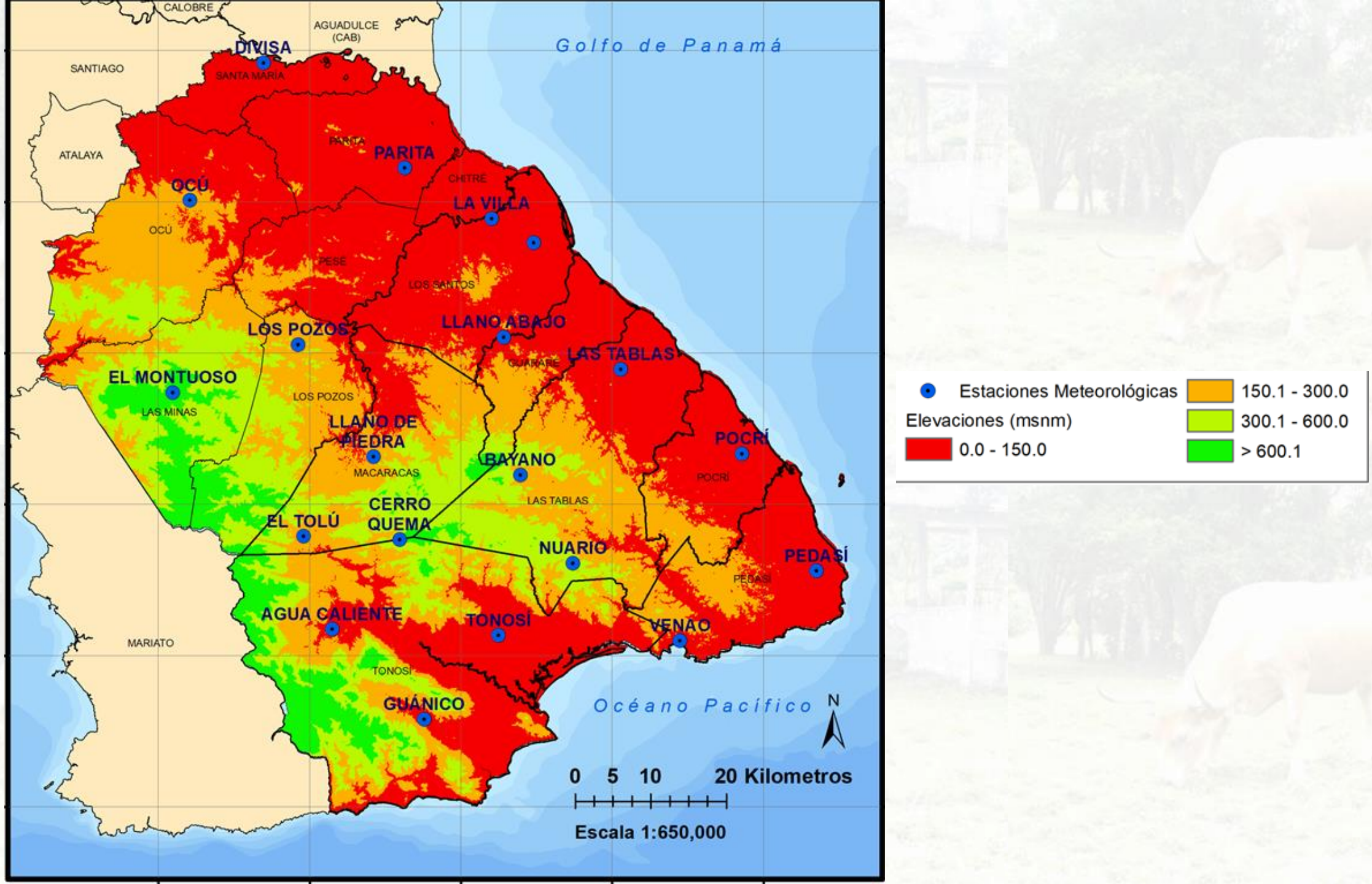
Balance energético negativo

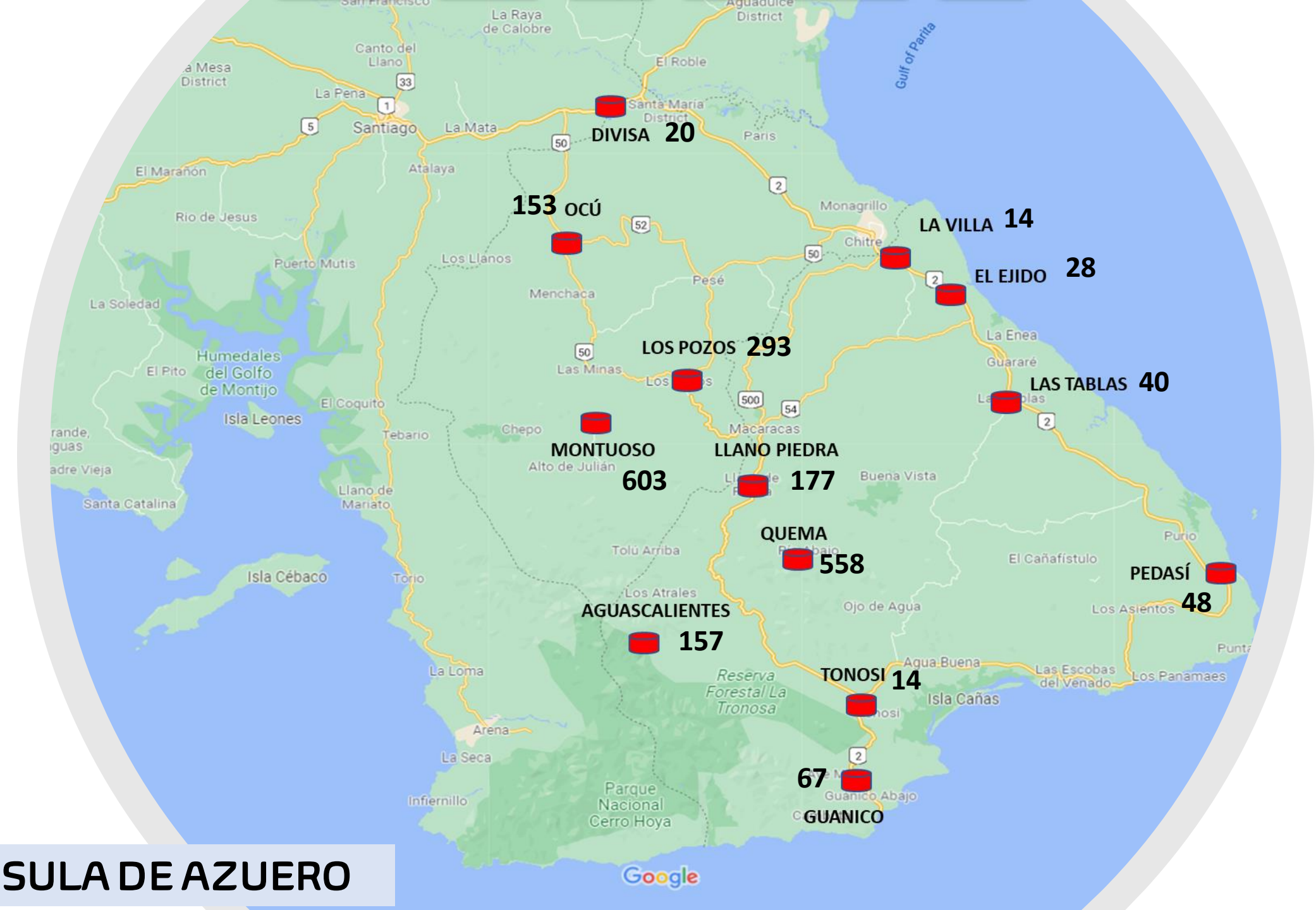
Baja ingesta
Materia seca

Estrés ambiental (calórico)

# Valores promedios de ITH en varias regiones de Panamá




Golfo de Panamá
Océano Pacífico
CALOBRE
AGUADULCE (CAB)
DIVISA
SANTA MARIA
SANTIAGO
ATALAYA
PARITA
PARITA
CHITRE
OCÚ
OCÚ
LA VILLA
PESE
LOS SANTOS
LLANO ABAJO
LOS POZOS
LOS POZOS
LAS TABLAS
GUARARE
EL MONTUOSO
LAS MINAS
LLANO DE PIEDRA
MACARACAS
POCRÍ
POCRÍ
BAYANO
LAS TABLAS
CERRO QUEMA
EL TOLÚ
NUARIO
PEDASÍ
PEDASÍ
AGUA CALIENTE
TONOSÍ
VENAO
MARIATO
TONOSÍ
GUÁNICO
N
0 5 10 20 Kilometros
Escala 1:650,000
Estaciones Meteorológicas
Elevaciones (msnm)
0.0 - 150.0
150.1 - 300.0
300.1 - 600.0
> 600.1




# PENÍNSULA DE AZUERO

# MODELOS DE ANÁLISIS DE ITH

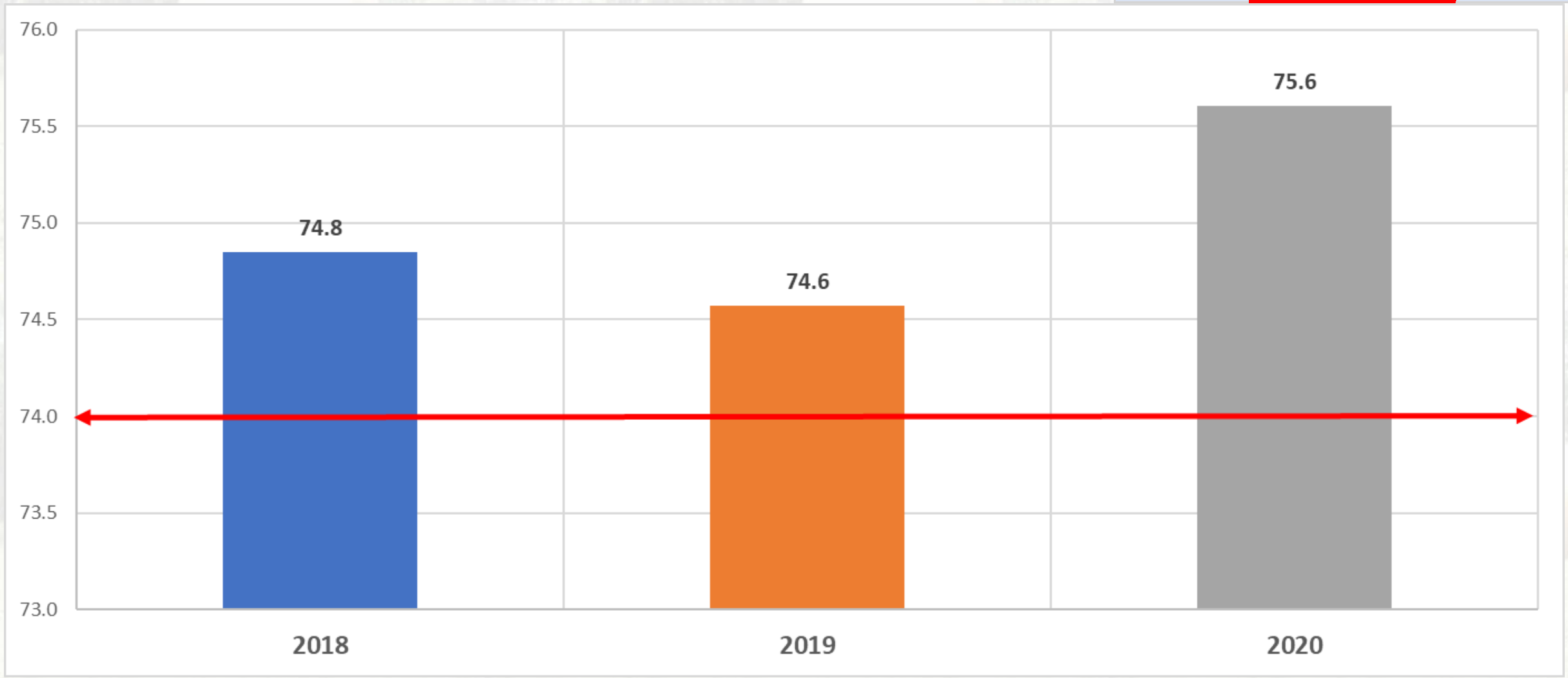
**ITH = 0.8*Ta + ((HR/100) *(Ta – 14.3)) + 46.4.** Mader, 2003

**ITH = (0.8 * Ta + 32) - (0.55 - 0.55 HR/100) (1.8 Ta -26)** Thom, 1959

| | | |
|---|---|---|
| NORMAL | | <74 |
| ALERTA | | ≤ 75-≤ 78 |
| PELIGRO | | <79-≤ 83 |
| EMERGENCIA | | >84 |

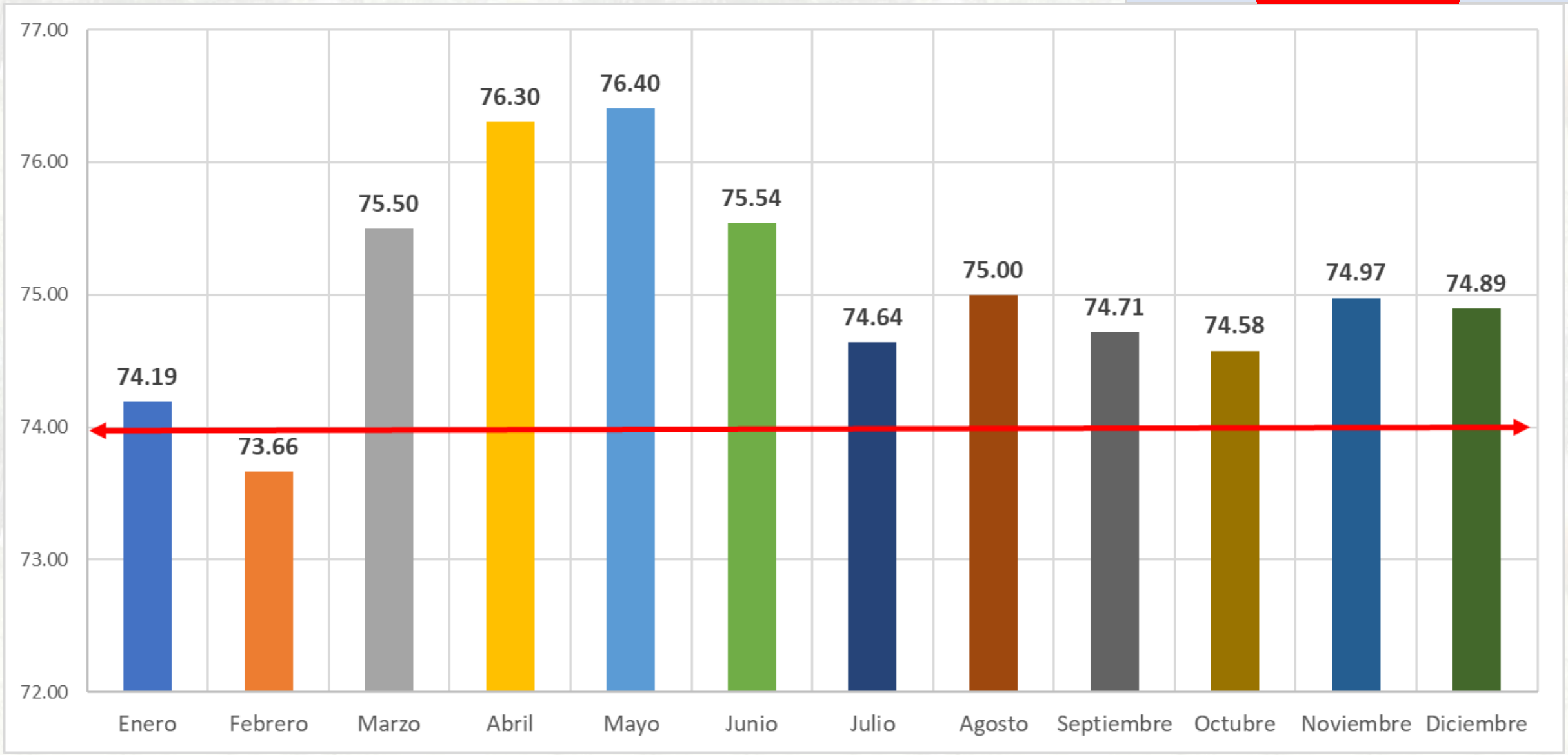
# MEDIA INTERANUAL REGIÓN AZUERO

| | | |
|---|---|---|
| NORMAL | | <74 |
| ALERTA | | ≤ 75-≤ 78 |
| PELIGRO | | <79-≤ 83 |
| EMERGENCIA | | >84 |



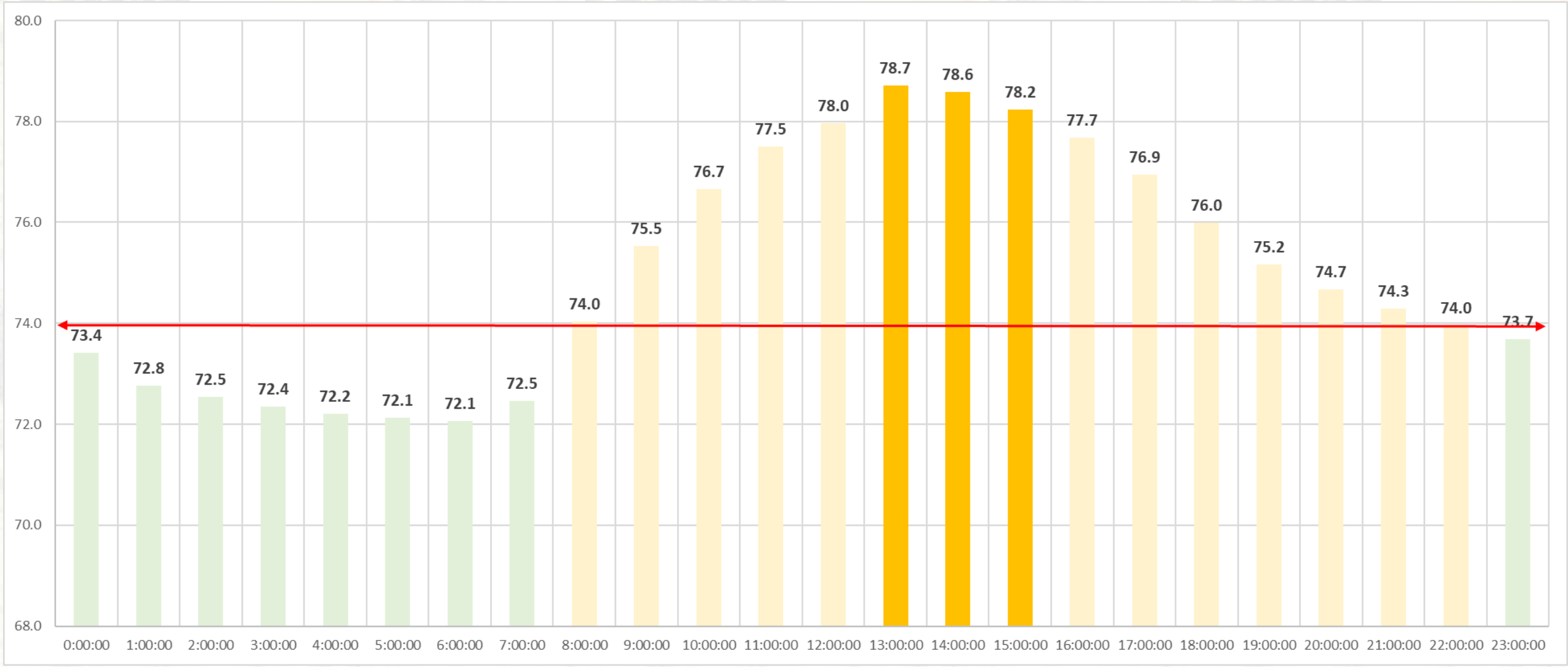
# MEDIA MESES DEL AÑO

| | | |
|---|---|---|
| NORMAL | | <74 |
| ALERTA | | ≤ 75-≤ 78 |
| PELIGRO | | <79-≤ 83 |
| EMERGENCIA | | >84 |



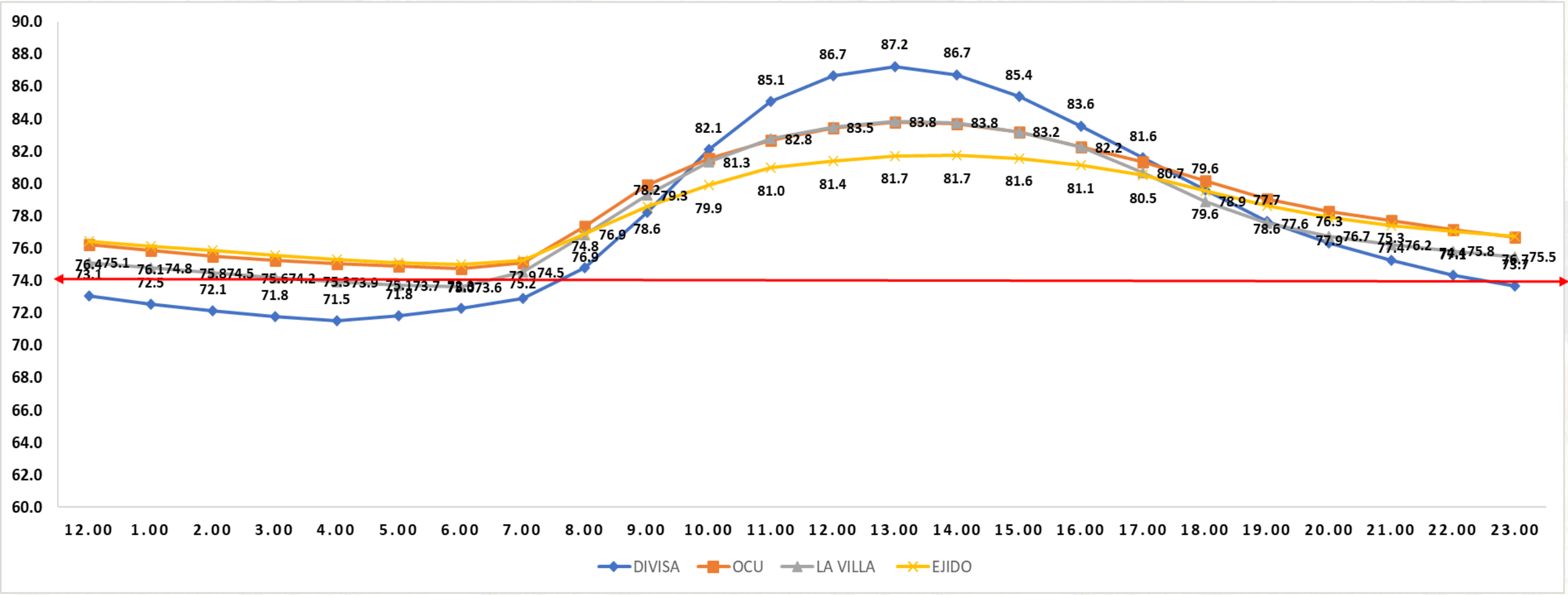
# ITH POR HORA DEL DÍA

| | | |
|---|---|---|
| NORMAL | | <74 |
| ALERTA | | ≤ 75-≤ 78 |
| PELIGRO | | <79-≤ 83 |
| EMERGENCIA | | >84 |

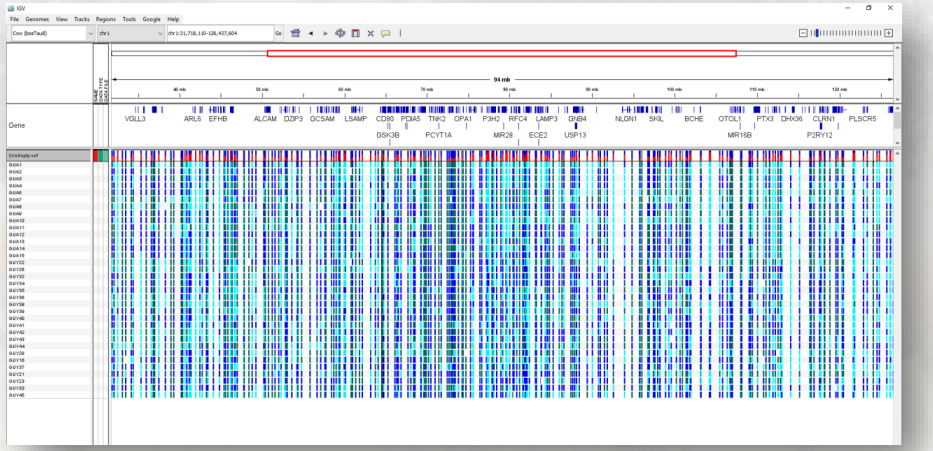


# FLUCTUACIÓN DE ITH EN 4 LOCALIDADES AGROPECUARIAS

| | | |
|---|---|---|
| NORMAL | | <74 |
| ALERTA | | ≤ 75-≤ 78 |
| PELIGRO | | <79-≤ 83 |
| EMERGENCIA | | >84 |

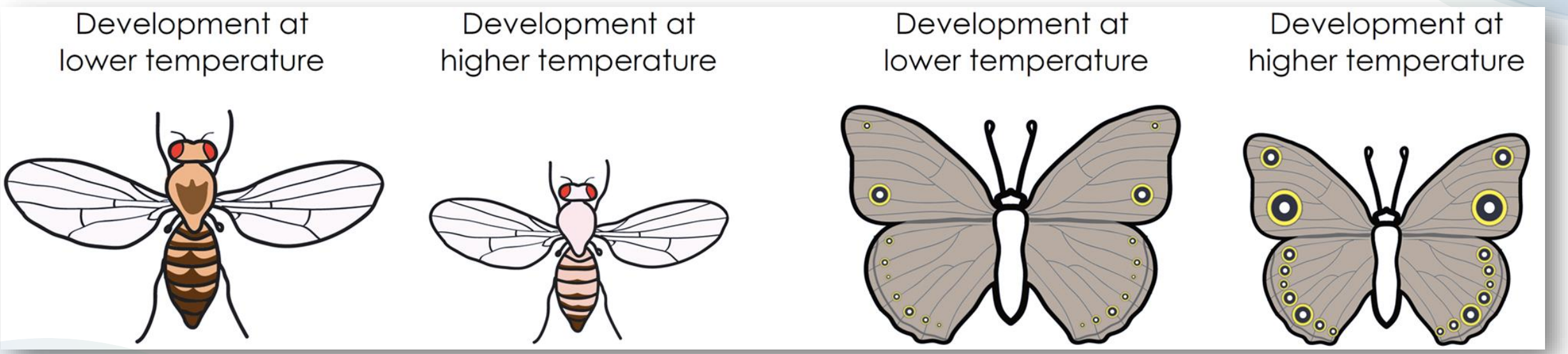


# PLASTICIDAD FENOTÍPICA



Plasticidad fenotípica: propiedad de un genotipo para originar diferentes fenotipos, según las condiciones del medio circundante ya sean bióticos o abióticos (*Schmalhausen 1949*).

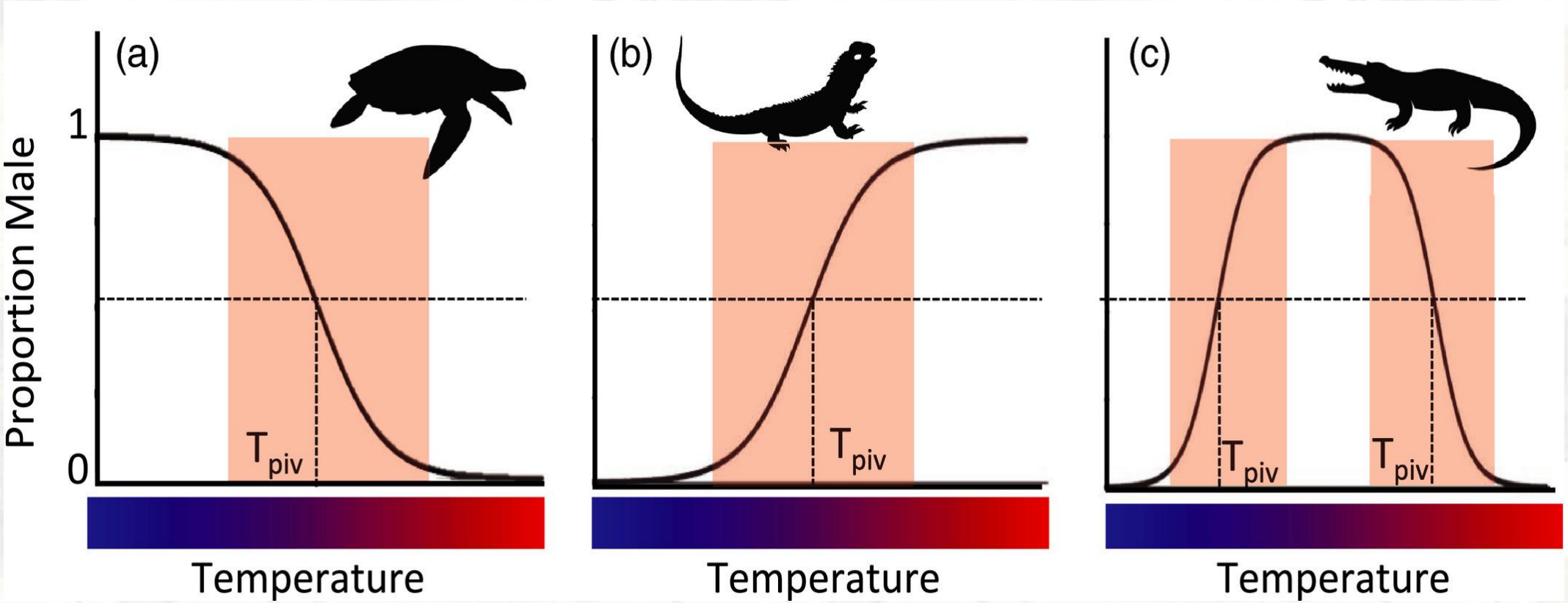
# Efectos ambientales sobre la expresión del fenotipo




***Drosophila melanogaster*** ***Bicyclus anynana***

Lafuente and Beldade 2019, FRONTIERS IN GENETIC

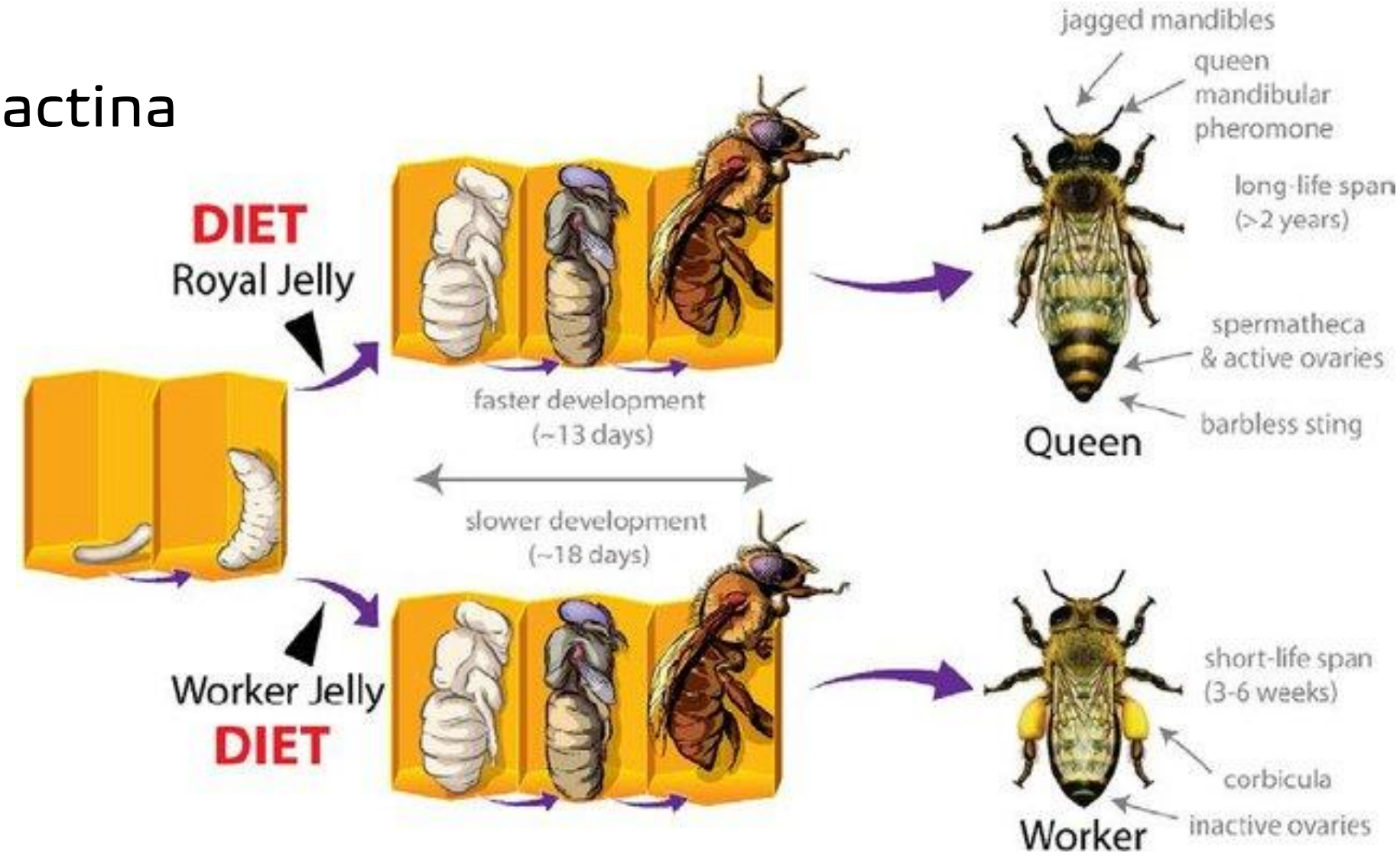
# Efectos ambientales sobre la expresión del fenotipo



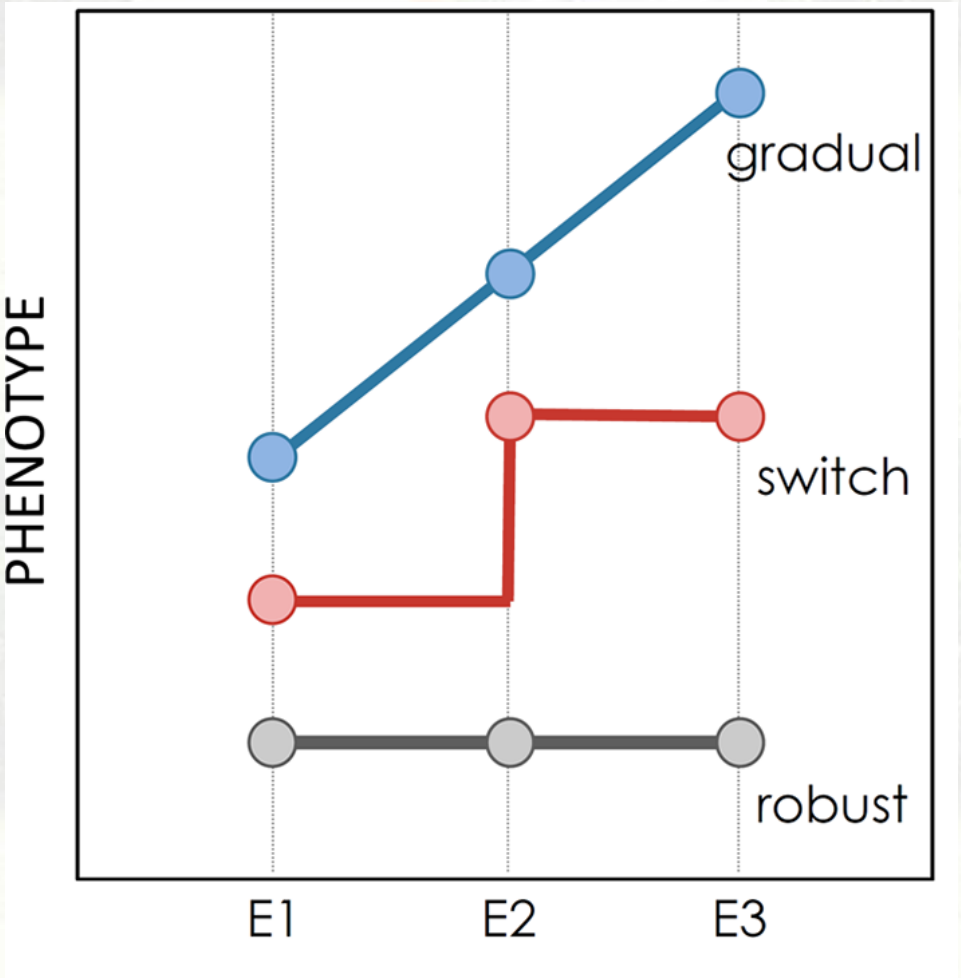

Lockley and Eizaguirre 2021, Evolutionary Applications,

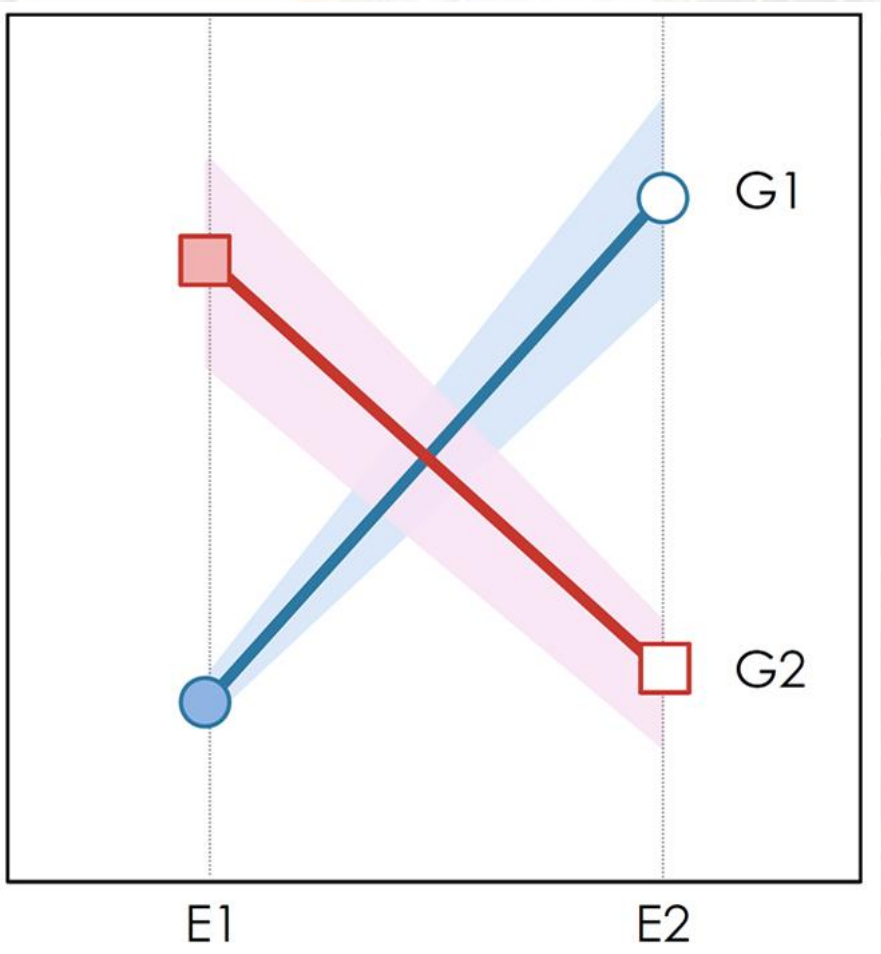
# Efectos ambientales sobre la expresión del fenotipo

## Royalactina



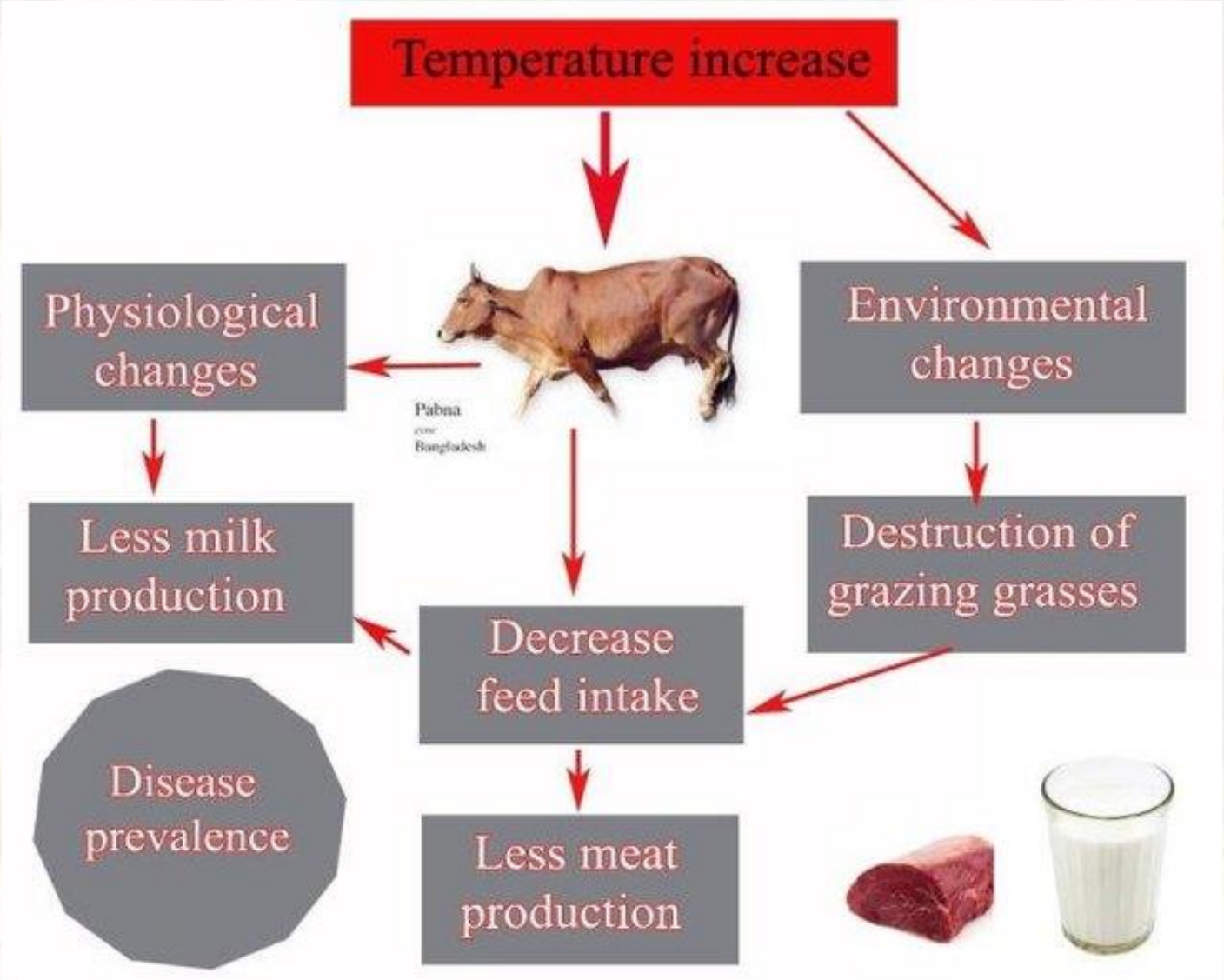
# Efectos ambientales sobre la expresión del fenotipo



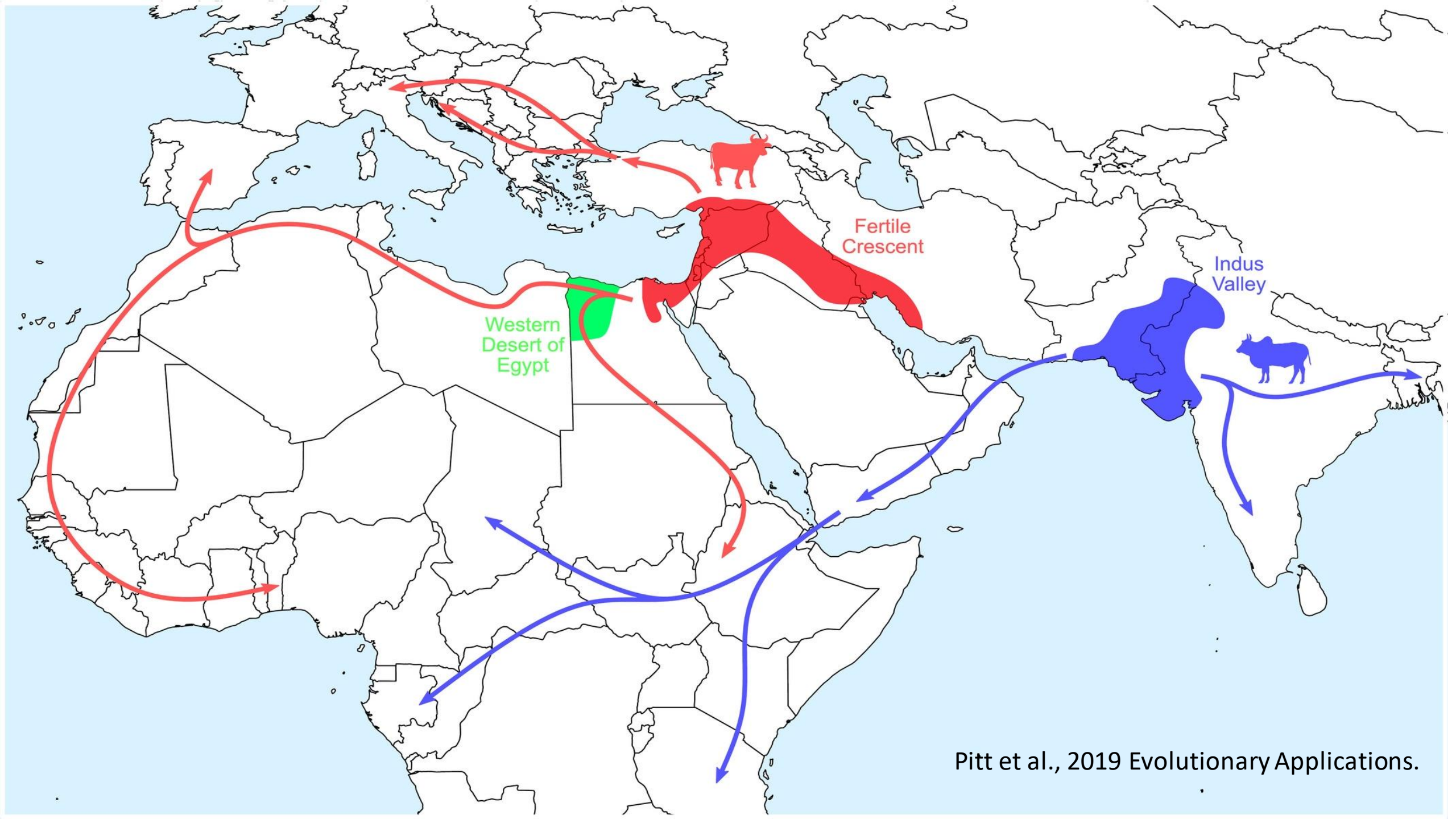




Lafuente and Beldade 2019, FRONTIERS IN GENETIC

# ¿¿PLASTICIDAD FENOTÍPICA EN GANADO??




Kader Chowdhury et al 2016 American Journal of Agricultural Science, Engineering and Technology




Pitt et al., 2019 Evolutionary Applications.

# ALGUNOS MODELOS GENÉTICOS EXPLICATIVOS

- Sobre dominancia (ventaja heterocigota): La plasticidad es función inversa del número de loci heterocigotos. ↓
- Pleiotropía: Por expresión diferencial de un gen en diferentes ambientes debido a algún efecto pleiotrópico ↑
- Epistasis: interacción entre genes, determina el grado de respuesta al ambiente ↑

# PLEIOTROPÍA

MUTACIÓN DEL GEN KRT75 (plumaje encrespado)

alteraciones en el tamaño de los órganos, falta de depósitos de grasa hipodérmica y retraso en la madurez.


Ng et al., 2012 PLoS Genetic

# EPISTASIS

Síndrome de "**cola de rata**" en el ganado, proporcionando el primer ejemplo de interacción epistática entre varios loci de los genes, **MC1R** y **PMEL**.

Knaust et al., 2016 Genet Sel Evol

# GENES ASOCIADOS CON VARIABLES CLIMÁTICAS

## VARIABLES

- Temperatura anual
- Rango de temperatura
- Cantidad e intensidad de lluvia
- Irradiación
- Humedad
- ITH

## CATEGORÍAS

- Desarrollo y función del sistema fisiológico
- Función molecular y celular
- Enfermedades y desórdenes

# Genes Candidatos Asociados a Adaptación a Variables Climáticas

| CATEGORÍA | GEN | FUNCIÓN |
|---|---|---|
| Desarrollo y función del sistema fisiológico | TOX4 | Desarrollo y función del sistema nervioso |
| | SLC46A1 | Desarrollo y morfología de tejidos |
| | LAP3 | Morfología de órganos |
| | MLST8 | Desarrollo organizacional |
| Función molecular y celular | NCAPG | Morfología celular |
| | KCNH1 | Organización y ensamblaje celular |
| | TCF7 | Desarrollo celular |
| | DISP1 | Función celular y mantenimiento |
| Enfermedades y desórdenes | ANTXR2 | Prevención de cáncer |
| | ADGRL2 | Enfermedades gastrointestinales |
| | CRLF3 | Lesiones y anomalías organizativas |
| | LCORL | Morfología tumoral |

Flori et al., 2019, Mol Ecol.

# EJEMPLO DEL GEN TCF7 (FACTOR DE TRANSCRIPCIÓN 7)

Está asociado, no solo con la temperatura media anual de un área geográfica determinada, sino también con las precipitaciones, la radiación, la humedad y el índice de relación entre temperatura y humedad.

# UNA MIRADA AL MINI GENOMA DEL BOVINO CRIOLLO

IMAGE
Innovative Management of Animal Genetic Resources

European Commission | Horizon 2020 European Union funding for Research & Innovation

# IMAGE

## Innovative Management of Animal Genetic Resources

Grant Agreement Number: 677353

Horizon 2020 FRAMEWORK PROGRAMME

**TOPIC: MANAGEMENT AND SUSTAINABLE USE OF GENETIC RESOURCES**

Topic identifier: SFS-07b-2015

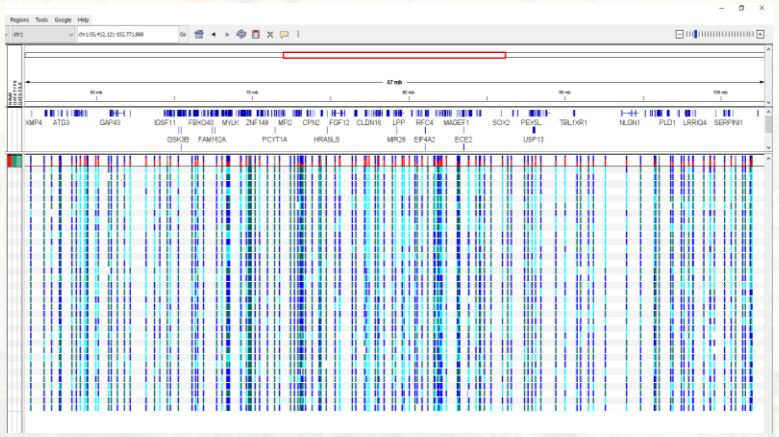
**Type of Action: Research and Innovation Action (RIA)**

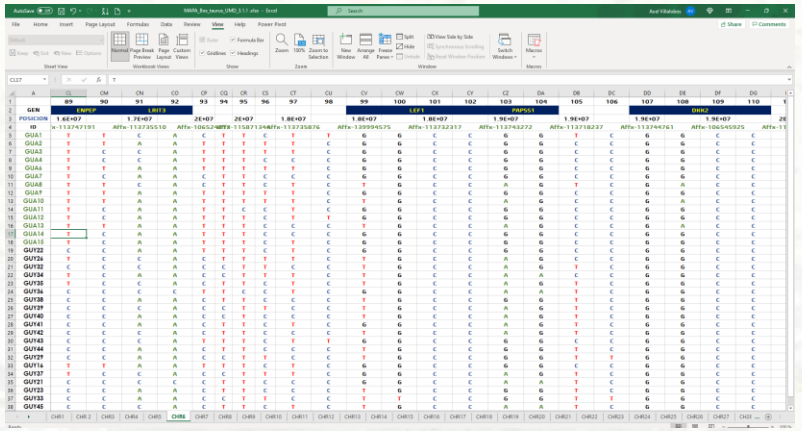
DELIVERABLE D4.5
Deliverable title: A standard multi-species chip for genomic assessment of collections.

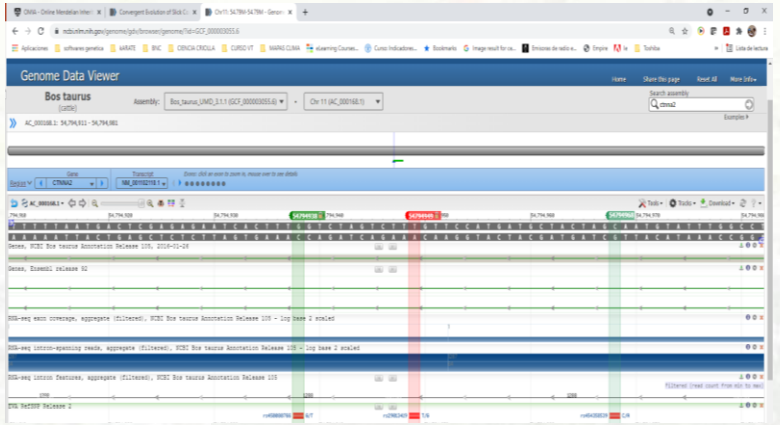
Affymetryx
8416 SNP´s

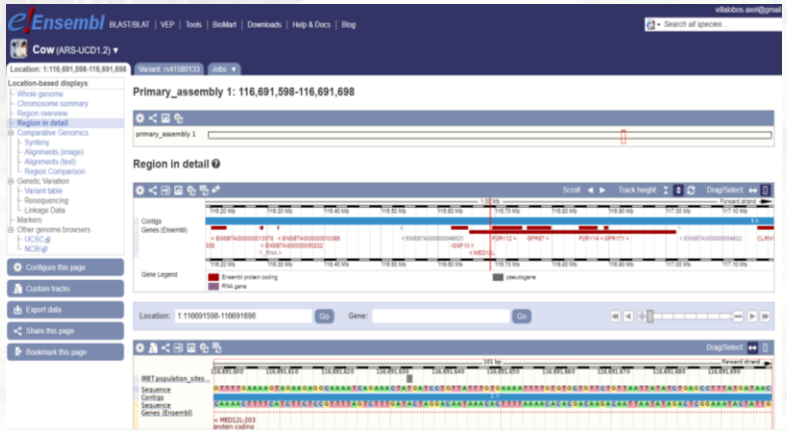
VCF

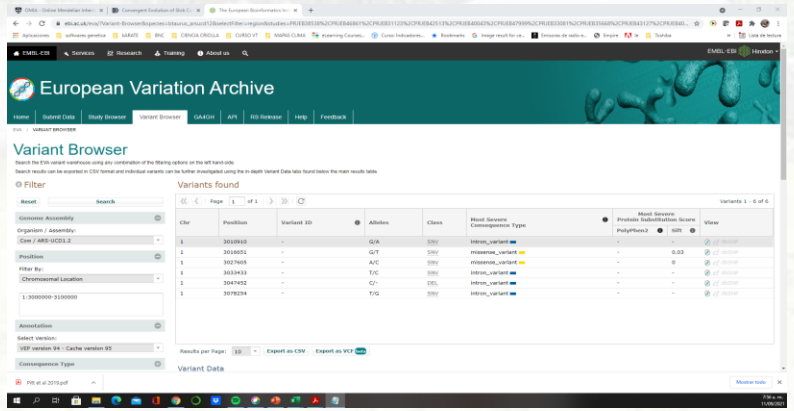
VCF validator

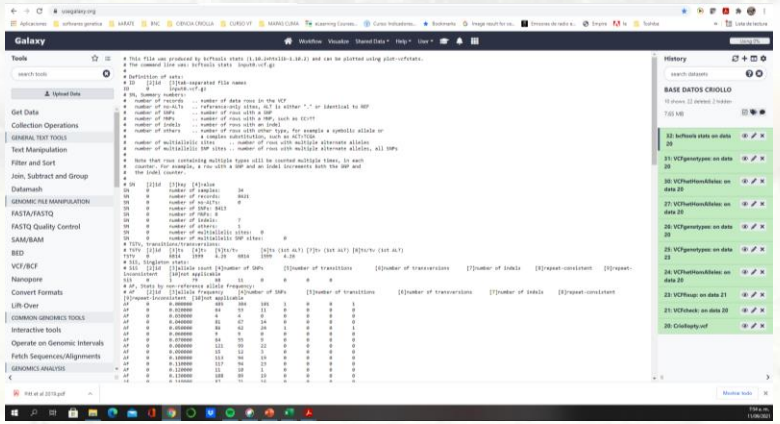






# CLUSTERS DE MARCADORES SNP´s

## COLOR DE LA CAPA

| # | ID/Affymetrix | UMD 3.1.1/bosTau8 | ARS-UCD1.2/bosTau9 | RS GDV | GEN | CHR | ALELOS |
|---|---|---|---|---|---|---|---|
| 1 | Affx-113736872 | 111,155,237 | 110,396,989 | rs29019900 | PAX3 | 2 | T>C |
| 2 | Affx-986699251 | 9,479,761 | 9,361,962 | N/A | COPA | 3 | T>C |
| 3 | Affx-113735246 | 118,671,665 | 118,091,938 | rs42246196 | TWIST2 | 3 | G>A |
| 4 | Affx-113726876 | 38,486,244 | 38,301,044 | rs41649821 | CACNA2D1 | 4 | T>G |
| 5 | Affx-257089488 | 57,669,926 | 57,345,315 | rs718553050 | PMEL | 5 | G>A |
| 6 | Affx-115874352 | 71,873,004 | 70,209,643 | rs110113047 | KIT | 6 | G>A |
| 7 | Affx-106530222 | 74,084,829 | 72,419,275 | rs109535691 | IGFBP7 | 6 | C>T |
| | Affx-106500128 | 74,112,802 | 72,447,764 | rs41654347 | IGFBP7 | 6 | G>C |
| 8 | Affx-113720708 | 109,076,621 | 106,527,328 | rs109118798 | EFNA5 | 7 | C>A |
| 9 | Affx-113726920 | 31,721,931 | 31,643,340 | rs43544399 | TYRP1 | 8 | G>A |
| 10 | Affx-106547009 | 25,107,556 | 23,430,999 | rs41627954 | SDR16C5 | 14 | G>A |
| 11 | Affx-106539294 | 25,175,950 | 23,498,304 | rs43157020 | SDR16C6 | 14 | G>A |
| 12 | Affx-106505043 | 26,450,034 | 24,767,026 | rs41627964 | NSMAF | 14 | G>A |
| 13 | Affx-106528471 | 26,685,204 | 25,002,052 | rs109375770 | TOX | 14 | A>C |
| | Affx-113733181 | 26,836,013 | 25,152,867 | rs42406063 | TOX | 14 | T>C |
| | Affx-139996262 | 26,926,569 | 25,243,415 | rs42404957 | TOX | 14 | C>A |
| 14 | Affx-113738066 | 59,183,752 | 58,404,974 | rs41775649 | BDNF | 15 | T>C |
| 15 | Affx-113719562 | 74,032,690 | 72,049,948 | rs110312389 | MAPK1 | 17 | G>A |
| 16 | Affx-986699241 | 31,746,503 | 31,628,135 | N/A | MITF | 22 | A>G |
| | Affx-986699253 | 31,769,189 | 31,650,821 | rs210634530 | MITF | 22 | T>A |
| 17 | Affx-113728840 | 23,461,479 | 23,191,365 | rs41617831 | SUFU | 26 | G>T |
| 18 | Affx-106524426 | 8,426,911 | 8,382,369 | rs109326209 | LYST | 28 | T>C |
| | Affx-115879492 | 8,508,619 | 8,464,077 | rs481318527 | LYST | 28 | T>A |

## DESÓRDENES GENÉTICOS

| # | UMD 3.1.1 | ARS-UCD1.2 | RS GDV | GEN | CRH | ALELOS | COD. AMBIG |
|---|---|---|---|---|---|---|---|
| 1 | 1,390,292.00 | 2,112,483.00 | rs381397077 | IFNGR2 | 1 | G>A | R |
| 2 | 69,756,880.00 | 69151931 | N/A | UMPS | 1 | C>T | Y |
| 3 | 145,114,963.00 | ################ | rs445709131 | ITGB2 | 1 | T>C | Y |
| 4 | 43,412,427.00 | 43,261,945.00 | rs438228855 | SLC35A3 | 3 | C>A | M |
| 5 | 95,601,697.00 | 95,015,373.00 | N/A | RNF11 | 3 | T>C | Y |
| 6 | 63,150,400.00 | 62,810,245.00 | rs448942533 | APAF1 | 5 | C>T | Y |
| 7 | 13,956,640.00 | 12,840,983.00 | N/A | MAN2B1 | 7 | G>A | R |
| | 13,957,949.00 | 12,842,292.00 | N/A | MAN2B1 | 7 | T>C | Y |
| 8 | 65,106,237.00 | 63,101,792.00 | rs43002144 | GLRA1 | 7 | G>T | K |
| 9 | 31,721,931.00 | 31,643,340.00 | rs43544399 | TYRP1 | 8 | G>A | R |
| 10 | 85,304,450.00 | 83,872,913.00 | rs41658989 | IARS1 | 8 | C>T | Y |
| | 85,329,708.00 | 83,898,171.00 | rs110616196 | IARS1 | 8 | C>A | M |
| | 85,341,291.00 | 83,909,754.00 | N/A | IARS1 | 8 | C>G | |
| 11 | 62,054,844.00 | 61,831,200.00 | N/A | FBN1 | 10 | G>A | R |
| | 62,141,462.00 | 61,917,867.00 | N/A | FBN1 | 10 | G>A | R |
| 12 | 14,760,164.00 | 14,742,184.00 | rs445770480 | SPAST | 11 | G>A | R |
| 13 | 100,802,781.00 | ################ | N/A | ASS1 | 11 | C>T | Y |
| | 100,810,072.00 | ################ | rs109614872 | ASS1 | 11 | G>T | K |
| 14 | 15,707,169.00 | 15,449,481.00 | rs1115118696 | CWC15 | 15 | C>T | Y |
| 15 | 77,667,135.00 | 76,792,588.00 | N/A | LRP4 | 15 | C>T | Y |
| | 77,675,516.00 | 76,800,972.00 | rs438564602 | LRP4 | 15 | C>A | M |
| | 77,675,517.00 | 76,800,973.00 | N/A | LRP4 | 15 | G>T | K |

## GENES DE CARNE

| # | ID/Affymetrix | UMD 3.1.1/bosTau8 | ARS-UCD1.2/bosTau9 | RS GDV | GEN | CHR | ALELOS | COD. AMBIG | STATUS |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Affx-113719101 | 122,749,207 | 122,190,776 | rs109499728 | FABP3 | 2 | G>A | R | OK |
| 2 | Affx-986699240 | 6,213,889 | 6,279,187 | rs449270218 | MSTN | 2 | T>C | Y | OK |
| | Affx-986699196 | 6,213,980 | 6,279,278 | rs110065568 | | 2 | C>A | M | OK |
| | Affx-289861645 | 6,214,012 | 6,279,310 | N/A | | 2 | C>G | S | |
| | Affx-986699207 | 6,216,138 | 6,281,436 | rs110384917 | | 2 | C>T | Y | OK |
| | Affx-986699267 | 6,216,204 | 6,281,500 | N/A | | 2 | T>G | K | |
| | Affx-986699268 | 6,216,482 | 6,288,727 | N/A | | 2 | T>G | K | |
| | Affx-986699239 | 6,216,499 | 6,288,794 | N/A | | 2 | A>G | R | |
| 3 | Affx-113720710 | 14,288,570 | 14,252,644 | rs41592766 | PDE1A | 2 | T>C | Y | OK |
| | Affx-106532658 | 14,350,005 | 14,313,229 | rs110323715 | | 2 | G>A | R | OK |
| | Affx-115869809 | 14,451,635 | 14,420,711 | rs29012658 | | 2 | T>C | Y | OK |
| 4 | Affx-113722862 | 189,616,808 | 189,229,727 | rs110264726 | CAPZB | 2 | C>T | Y | OK |
| | Affx-106550867 | 189,861,562 | 189,275,476 | rs110348656 | | 2 | C>T | Y | OK |
| | Affx-113743302 | 189,914,351 | 189,328,464 | rs110367089 | | 2 | A>G | R | OK |
| 5 | Affx-113731688 | 98,287,549 | 92,444,591 | rs110559656 | LEP | 4 | T>C | Y | OK |
| 6 | Affx-113899767 | 71,421,017 | 71,421,017 | rs110544310 | PDGFRA | 6 | T>C | Y | OK |
| 7 | Affx-106587992 | 68,089,888 | 61,890,096 | rs110671282 | ATP8A1 | 6 | T>G | K | OK |
| 8 | Affx-113739880 | 98,845,992 | 97,412,082 | rs110961068 | LCORL | 6 | A>C | M | OK |
| 9 | Affx-106529529 | 96,498,047 | 96,087,310 | rs109804679 | CAST | 7 | G>T | K | OK |
| | Affx-113718528 | 98,584,197 | 96,119,746 | rs109677898 | | 7 | T>C | Y | OK |
| | Affx-106520805 | 98,566,891 | 96,152,289 | rs109354718 | | 7 | T>C | Y | OK |
| 10 | Affx-113718886 | 98,488,346 | 97,028,774 | rs23009886 | PARK2/PRKN | 9 | A>C | M | OK |
| | Affx-113718133 | 98,526,916 | 97,073,540 | rs110819142 | | 9 | C>T | Y | OK |
| | Affx-113720808 | 98,676,460 | 97,213,682 | rs110888478 | | 9 | C>T/C>A | Y | OK |
| | Affx-113730738 | 98,923,817 | 97,467,290 | rs109091400 | | 9 | T>C | Y | OK |
| | Affx-106512841 | 99,206,183 | 97,749,602 | rs41657151 | | 9 | T>C | Y | OK |
| | Affx-113716940 | 99,685,101 | 98,228,903 | rs41657169 | | 9 | C>T | Y | OK |
| 11 | Affx-106506495 | 60,267,486 | 60,063,649 | rs41614846 | SLC27A2 | 10 | C>T | Y | OK |
| 12 | Affx-106527609 | 97,880,642 | 97,713,144 | rs109425580 | CAPN3 | 10 | T>C | Y | OK |
| 13 | Affx-106510765 | 69,103,108 | 69,126,370 | rs109860548 | CAPN13 | 11 | G>A | R | OK |
| 14 | Affx-113719964 | 31,752,520 | 30,056,908 | rs41655485 | MTFR1 | 14 | C>T | Y | OK |
| 15 | Affx-115860587 | 27,896,859 | 26,212,648 | rs48084548 | RAB2A | 14 | C>T | Y | OK |
| 16 | Affx-115880748 | 9,385,588 | 9,310,093 | rs41638691 | TG | 14 | T>C | Y | OK |
| | Affx-257141995 | 9,487,459 | 9,432,157 | N/A | | 14 | G>A | R | |
| | Affx-986699191 | 9,487,846 | 9,432,544 | rs449252958 | | 14 | T>G | K | OK |
| | Affx-106506285 | 9,496,612 | 9,441,111 | rs110456580 | | 14 | T>C | Y | OK |
| 17 | Affx-106547009 | 25,107,556 | 23,430,999 | rs41627954 | SDR16C5 | 14 | G>A | R | OK |
| 18 | Affx-106539294 | 25,175,950 | 23,498,304 | rs43157020 | SDR16C6 | 14 | G>A | R | OK |
| 19 | Affx-106486471 | 78,874,686 | 76,498,799 | rs41624092 | WWP1 | 14 | G>C | S | OK |
| 20 | Affx-106532675 | 57,280,972 | 56,477,787 | rs41727701 | CAPN5 | 15 | G>A | R | OK |
| 21 | Affx-139995249 | 85,333,265 | 84,795,986 | rs110708339 | MYOD1 | 15 | C>T | Y | OK |

## GENES DE LECHE

| # | ID/Affymetrix | UMD 3.1.1/bosTau8 | ARS-UCD1.2/bosTau9 | RS GDV | GEN | CHR | ALELOS | COD. AMBIG | STATUS |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Affx-113728320 | 79,008,429 | 72,588,087 | rs109018046 | GLI2 | 2 | G>A | R | ok |
| 2 | Affx-113731688 | 93,257,549 | 92,444,591 | rs110559656 | LEP | 4 | T>C | Y | ok |
| 3 | Affx-115860975 | 44,926,243 | 43,452,999 | rs110191167 | PPARGC1A | 6 | C>T | Y | ok |
| 4 | Affx-257097165 | 87,149,464 | 85,418,630 | rs43885179 | CSN1S1 | 6 | G>A | R | ok |
| | Affx-257101617 | 87,157,909 | 85,428,068 | rs138474041 | | 6 | G>A | R | ok |
| 5 | Affx-93064370 | 87,181,364 | 85,451,043 | rs433954503 | CSN2 | 6 | G>A | R | ok |
| | Affx-93064370 | 87,181,376 | 85,451,055 | rs454089280 | | 6 | T>G | K | ok |
| | Affx-46504028 | 87,181,458 | 85,451,132 | rs43708018 | | 6 | C>G | S | ok |
| | Affx-115868861 | 87,181,501 | 85,451,180 | rs43708012 | | 6 | G>T | K | ok |
| | Affx-115868377 | 87,181,542 | 85,451,221 | rs109299401 | | 6 | T>G | K | ok |
| | Affx-986699269 | 87,181,619 | 85,451,298 | rs43703011 | | 6 | T>G (C>A) | K | RV? |
| | Affx-115858086 | 87,188,081 | 85,452,710 | rs721259074 | | 6 | C>T | Y | ok |
| | Affx-115879284 | 87,188,084 | 85,452,713 | NA | | 6 | C>G | S | ok |
| 6 | Affx-294714908 | 87,266,177 | 85,533,780 | rs441966828 | CSN1S2 | 6 | C>T | Y | ok |
| | Affx-257089800 | 87,268,880 | 85,536,484 | rs468985801 | | 6 | G>T | K | ok |
| 7 | Affx-115873506 | 87,390,198 | 85,656,358 | NA | CSN3 | 6 | G>C | S | ok |
| | Affx-115879666 | 87,390,448 | 85,656,608 | NA | | 6 | T>A | w | ok |
| | Affx-115864651 | 87,390,458 | 85,656,618 | rs110870385 | | 6 | C>A | M | ok |
| | Affx-115862472 | 87,390,459 | 85,656,619 | rs716557965 | | 6 | G>A | R | ok |
| | Affx-115876548 | 87,390,479 | 85,656,639 | rs43706475 | | 6 | T>G | K | ok |
| | Affx-115869210 | 87,390,573 | 85,656,733 | rs450402006 | | 6 | C>T | Y | ok |
| | Affx-115876005 | 87,390,576 | 85,656,736 | rs43708015 | | 6 | T>C | Y | ok |
| | Affx-115878329 | 87,390,604 | 85,656,764 | NA | | 6 | T>G | K | ok |
| | Affx-115875489 | 87,390,612 | 85,656,772 | rs43703016 | | 6 | C>A | M | ok |
| | Affx-115860147 | 87,390,619 | 85,656,779 | rs439304887 | | 6 | A>G | R | ok |
| | Affx-115859485 | 87,390,682 | 85,656,792 | rs43703017 | | 6 | A>G | R | ok |
| | Affx-115877665 | 87,390,673 | 85,656,833 | rs110014544 | | 6 | G>A | R | ok |
| 8 | Affx-106540014 | 75,960,737 | 73,897,250 | rs43530556 | GABRG2 | 7 | A>G | R | ok |
| 9 | Affx-113722071 | 90,087,629 | 88,877,587 | rs43606608 | ESR1 | 9 | C>T | Y | ok |
| | Affx-106504855 | 90,155,533 | 88,995,486 | rs41595010 | | 9 | T>C | Y | ok |
| | Affx-113728784 | 90,199,490 | 89,039,438 | rs43609859 | | 9 | G>A | R | ok |
| 10 | Affx-106515846 | 26,767,851 | 26,732,147 | rs43618177 | TEP1 | 10 | T>C | Y | ok |
| 11 | Affx-115880763 | 9,365,588 | 8,310,093 | rs41638691 | TG | 14 | C>T | Y | ok |

## REPRODUCCIÓN/FERTILIDAD

| # | ID/Affymetrix | UMD 3.1.1/bosTau8 | ARS-UCD1.2/bosTau9 | RS GDV | GEN | CHR | ALELOS |
|---|---|---|---|---|---|---|---|
| 1 | Affx-113743871 | 69,244,252 | 68,682,461 | rs110391667 | KALRN | 1 | A>C |
| | Affx-113717635 | 69,283,880 | 68,623,214 | rs110230072 | | | G>A |
| | Affx-113724264 | 69,620,870 | 69,016,673 | rs41633052 | | | G>A |
| 2 | Affx-113742197 | 39,350,058 | 38,586,453 | rs29015740 | ACVR1 | 2 | G>A |
| 3 | Affx-113715998 | 116,477,222 | 115,665,427 | rs110100182 | AGFG1 | 2 | T>C |
| 4 | Affx-113717488 | 23,479,543 | 23,369,869 | rs109715445 | NOTCH2 | 3 | G>T |
| 5 | Affx-139994998 | 26,589,623 | 26,473,706 | rs29011537 | CD2 | 3 | T>C |
| 6 | Affx-106535673 | 97,832,127 | 96,980,813 | rs109583935 | EXOC4 | 4 | A>C |
| | Affx-106517244 | 98,016,975 | 97,164,428 | rs110275975 | | | T>C |
| | Affx-113742639 | 98,486,908 | 97,634,866 | rs109311371 | | | A>G |
| 7 | Affx-106511343 | 49,842,685 | 49,613,116 | rs109855975 | SRGAP1 | 5 | T>C |
| | Affx-113725625 | 49,977,047 | 49,747,347 | rs110704596 | | | G>A |
| 8 | Affx-113733301 | 20,325,702 | 19,113,510 | rs109168860 | KDM4B | 7 | A>C |
| 9 | Affx-106529529 | 98,498,047 | 96,087,310 | rs109804679 | CAST | 7 | G>T |
| 10 | Affx-106500677 | 66,587,451 | 66,468,697 | rs110298128 | PAPD7 | 20 | G>A |
| 11 | Affx-113716882 | 35,339,647 | 35,677,683 | rs110175723 | ZMAT4 | 27 | G>A |
| | Affx-106538455 | 35,486,995 | 35,824,524 | rs41570143 | | | C>T |
| | Affx-113719221 | 35,513,325 | 35,850,855 | rs110698703 | | | T>G |

## PLASTICIDAD FENOTÍPICA

| # GENES | ID/Affymetrix | UMD 3.1.1/bosTau8 | ARS-UCD1.2/bosTau9 | RS GDV | GEN | CHR | ALELOS | COD. AMBIG | STATUS |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Affx-106520129 | 117,585,231 | 116,691,648 | rs41580133 | MED12L/P2RY12 | 1 | T>C | Y | OK |
| | Affx-106534614 | 117,751,796 | 116,814,936 | rs42432959 | | 1 | G>A | R | OK |
| 2 | Affx-106551578 | 62,738,616 | 62,531,741 | rs42482471 | ADGRL2 | 3 | A>G | R | OK |
| 3 | Affx-113727125 | 25,338,659 | 25,228,045 | rs41624677 | SPAG17 | 3 | A>G | R | OK |
| 4 | Affx-139994575 | 18,399,973 | 17,148,783 | rs41621541 | LEF1 | 6 | T>G | K | OK |
| | Affx-113732317 | 18,450,433 | 17,199,828 | rs43708820 | | 6 | T>C | Y | OK |
| 5 | Affx-986699266 | 62,054,844 | 61,831,200 | N/A | FBN1 | 10 | G>A | R | OK |
| | Affx-577354311 | 62,141,462 | 61,917,867 | N/A | | 10 | G>A | R | OK |
| 6 | Affx-106505793 | 54,730,416 | 54,807,232 | rs41565994 | CTNNA2 | 11 | T>G | K | OK |
| | Affx-139996442 | 54,765,154 | 54,841,971 | rs211690801 | | 11 | A>G | R | OK |
| | Affx-113726067 | 54,794,949 | 54,871,764 | rs29013419 | | 11 | T>G | K | OK |
| | Affx-113743600 | 54,946,590 | 55,025,522 | rs110528191 | | 11 | T>C | Y | OK |
| | Affx-106536085 | 54,970,636 | 55,049,570 | rs41668252 | | 11 | C>T | Y | OK |
| | Affx-113717011 | 55,290,247 | 55,369,267 | rs41663399 | | 11 | G>A | R | OK |
| | Affx-113742636 | 55,496,607 | 55,575,538 | rs41663416 | | 11 | T>C | Y | OK |
| | Affx-113716457 | 56,039,089 | 56,117,126 | rs41584429 | | 11 | G>T | K | OK |
| 7 | Affx-113728158 | 29,508,182 | 29,222,649 | rs29017684 | FAM107B | 13 | T>C | Y | OK |
| 8 | Affx-106532347 | 34,148,235 | 32,085,909 | rs109169231 | PREX2 | 14 | G>A | R | OK |
| 9 | Affx-113719223 | 3,078,843 | 1,926,589 | rs109875744 | TSNARE1 | 14 | T>C | Y | OK |
| 10 | Affx-113734183 | 80,082,923 | 77,723,052 | rs29010281 | RALYL | 14 | T>C | Y | OK |
| | Affx-207038569 | 80,525,887 | 78,164,370 | rs110857876 | | 14 | A>G | R | OK |
| | Affx-106515133 | 80,558,266 | 78,189,730 | rs110400380 | | 14 | G>A | R | OK |
| | Affx-106505201 | 80,753,881 | 78,385,087 | rs110942324 | | 14 | A>C | M | OK |
| 11 | Affx-113738246 | 74,512,606 | 72,611,810 | rs41829951 | KCNH1 | 16 | T>G | K | OK |
| 12 | Affx-106523756 | 65,635,111 | 64,152,734 | rs29013977 | LAMC1 | 16 | A>G | R | OK |
| 13 | Affx-106541378 | 31,630,574 | 30,880,560 | rs41799745 | SMYD3 | 16 | A>G | R | OK |
| | Affx-113745503 | 31,654,996 | 30,904,995 | rs41799830 | | 16 | A>G | R | OK |
| | Affx-113735895 | 31,787,385 | 31,034,463 | rs41799658 | | 16 | T>C | Y | OK |
| | Affx-106550187 | 32,063,762 | 31,310,200 | rs41797772 | | 16 | A>G | R | OK |
| | Affx-113743365 | 32,169,733 | 31,415,926 | rs42383968 | | 16 | G>A | R | OK |
| 14 | Affx-113737365 | 18,539,339 | 18,190,397 | rs29019767 | SUZ12 | 19 | A>G | R | OK |

| GEN | nombre | CHR | UMD 3.1.1/bosTau8 | ARS-UCD1.2/bosTau9 | RS GDV | ALELOS | REF |
|---|---|---|---|---|---|---|---|
| MED12L | Mediator Complex Subunit 12 Like | 1 | 117,585,231 | 116,691,648 | rs41580133 | T>C | Flori et al 2018 |
| | | 1 | 117,751,796 | 116,814,936 | rs42432959 | G>A | Luo et al 2020 |
| ADGRL2 | Adhesion G Protein-Coupled Receptor L2 | 3 | 62,738,616 | 62,531,741 | rs42482471 | A>G | Flori et al 2018 |
| SPAG17 | Sperm-Associated Antigen 17 | 3 | 25,338,659 | 25,228,045 | rs41624677 | A>G | Luo et al 2020 |
| LEF1 | Lymphoid Enhancer Binding Factor 1 | 6 | 18,399,373 | 17,148,783 | rs41621541 | T>G | Flori et al 2018 |
| | | 6 | 18,450,433 | 17,199,828 | rs43708820 | T>C | Luo et al 2020 |
| FBN1 | Fibrillin 1 | 10 | 62,054,844 | 61,831,200 | N/A | G>A | Flori et al 2018 |
| | | 10 | 62,141,462 | 61,917,867 | N/A | G>A | Luo et al 2020 |
| CTNNA2 | Catenin Alpha 2 | 11 | 54,730,416 | 54,807,232 | rs41565994 | T>G | Flori et al 2018 |
| | | 11 | 54,765,154 | 54,841,971 | rs211690801 | A>G | Luo et al 2020 |
| | | 11 | 54,794,949 | 54,871,764 | rs29013419 | T>G | Luo et al 2020 |
| | | 11 | 54,946,590 | 55,025,522 | rs110528191 | T>C | Luo et al 2020 |
| | | 11 | 54,970,636 | 55,049,570 | rs41668252 | C>T | Luo et al 2020 |
| | | 11 | 55,290,247 | 55,369,267 | rs41663399 | G>A | Luo et al 2020 |
| | | 11 | 55,496,607 | 55,575,538 | rs41663416 | T>C | Luo et al 2020 |
| | | 11 | 56,039,089 | 56,117,126 | rs41584429 | G>T | Luo et al 2020 |
| FAM107B | Family With Sequence Similarity 107 Member B | 13 | 29,508,182 | 29,222,649 | rs29017684 | T>C | Luo et al 2020 |
| PREX2 | Phosphatidylinositol-Trisphosphate Dependent Rac Exchange Factor 2 | 14 | 34,148,235 | 32,085,309 | rs109169231 | G>A | Flori et al 2018 |
| TSNARE1 | T-SNARE Domain Containing 1 | 14 | 3,078,843 | 1,926,589 | rs109875744 | T>C | Luo et al 2020 |
| RALYL | RALY RNA Binding Protein Like | 14 | 80,082,923 | 77,723,052 | rs29010281 | T>C | Luo et al 2020 |
| | | 14 | 80,525,887 | 78,164,370 | rs110857876 | A>G | Luo et al 2020 |
| | | 14 | 80,558,266 | 78,189,730 | rs110400380 | G>A | Luo et al 2020 |
| | | 14 | 80,753,881 | 78,385,087 | rs110942324 | A>C | Luo et al 2020 |
| KCNH1 | Potassium Voltage-Gated Channel Subfamily H Member 1 | 16 | 74,512,606 | 72,611,810 | rs41829951 | T>G | Flori et al 2018 |
| LAMC1 | Laminin Subunit Gamma 1 | 16 | 65,635,111 | 64,152,734 | rs29013977 | A>G | Flori et al 2018 |
| SMYD3 | SET And MYND Domain Containing 3 | 16 | 31,630,574 | 30,880,560 | rs41799745 | A>G | Flori et al 2018 |
| | | 16 | 31,654,996 | 30,904,995 | rs41799830 | A>G | Luo et al 2020 |
| | | 16 | 31,787,385 | 31,034,463 | rs41799658 | T>C | Luo et al 2020 |
| | | 16 | 32,063,762 | 31,310,200 | rs41797772 | A>G | Luo et al 2020 |
| | | 16 | 32,169,733 | 31,415,926 | rs42383968 | G>A | Luo et al 2020 |
| SUZ12 | SUZ12 Polycomb Repressive Complex 2 Subunit | 19 | 18,539,339 | 18,190,397 | rs29019767 | A>G | Flori et al 2018 |
| PRLR (slick) | Prolactin Receptor | 20 | 39,136,666 | 39,099,321 | NA | C>T | Porto Neto et al 2018 |
| ZKSCAN7 | Zinc Finger With KRAB And SCAN Domains 7 | 22 | 16,437,316 | 16,394,774 | rs42001169 | G>A | Flori et al 2018 |
| NRG1 | Neuregulin 1 | 27 | 27,726,880 | 28,524,504 | rs42127055 | G>A | Flori et al 2018 |

| CHR | 14 | | | | | | 16 | | | | | | | | | | 16 | | 16 | | 19 | | | | 22 | | 27 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GEN | RALYL | | | | | | SMYD3 | | | | | | | | | | LAMC1 | | KCNH1 | | SUZ12 | | PRLR66 | | ZKSCAN7 | | NRG1 | |
| POSICION | ####### | | ####### | | ####### | | ####### | | ####### | | ####### | | ####### | | ####### | | ####### | | ####### | | ####### | | ####### | | ####### | | ####### | |
| ID | x-207038569 | | Affx-106515133 | | Affx-106505201 | | Affx-106541378 | | Affx-113745503 | | Affx-113735895 | | Affx-106550187 | | Affx-113743365 | | Affx-106523756 | | Affx-113738246 | | Affx-113737365 | | Affx-986699217 | | Affx-106507925 | | Affx-106505841 | |
| GUA1 | A | A | G | G | C | C | G | A | A | G | T | C | A | G | G | A | A | G | G | G | G | G | C | C | G | A | A | A |
| GUA2 | A | A | G | A | A | C | G | A | A | G | T | C | A | G | G | A | G | G | G | G | G | A | C | C | G | A | A | A |
| GUA3 | A | A | G | G | C | C | A | A | A | A | T | T | A | A | A | A | A | G | G | G | G | A | C | C | G | A | A | A |
| GUA4 | A | A | G | A | C | C | G | A | A | A | T | C | A | G | G | A | A | G | G | G | A | A | C | C | A | A | A | A |
| GUA6 | A | A | G | G | A | A | G | G | A | G | C | C | G | G | G | A | G | G | G | G | G | G | C | C | G | A | A | A |
| GUA7 | A | A | G | G | C | C | A | A | A | A | T | T | A | A | A | A | A | G | G | G | A | A | C | C | G | A | A | A |
| GUA8 | A | G | G | G | A | C | A | A | A | A | T | T | A | A | A | A | A | A | G | G | G | A | C | C | G | G | A | A |
| GUA9 | A | A | G | G | A | A | G | G | A | G | C | C | G | G | G | A | G | G | G | G | G | A | C | C | G | A | A | A |
| GUA10 | A | A | G | G | A | A | A | A | A | A | T | T | A | A | A | A | A | G | G | G | G | A | C | C | G | G | A | A |
| GUA11 | A | G | G | A | A | C | G | G | A | G | C | C | A | G | G | G | A | G | G | G | G | A | C | C | G | A | A | A |
| GUA12 | A | G | G | G | A | C | G | A | A | G | T | C | A | A | G | A | A | G | G | G | G | A | C | C | G | A | A | A |
| GUA13 | A | G | G | A | C | C | G | A | A | G | T | C | A | A | G | A | A | A | G | G | G | A | C | C | G | A | A | A |
| GUA14 | A | G | G | G | A | A | G | G | G | G | C | C | A | G | G | G | A | G | G | G | A | A | C | C | A | A | A | A |
| GUA15 | A | G | G | G | A | A | G | G | A | G | C | C | G | G | G | G | G | G | G | G | G | G | C | C | A | A | A | A |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GUY22 | A | G | G | A | C | C | G | G | A | A | C | C | G | G | G | A | G | G | G | G | G | G | C | C | G | G | G | A |
| GUY26 | A | G | G | G | C | C | G | G | A | A | C | C | G | G | G | G | A | A | G | G | G | G | C | C | A | A | G | A |
| GUY32 | G | G | G | G | C | C | G | G | A | G | C | C | G | G | G | A | G | G | T | G | G | G | C | C | G | A | G | A |
| GUY34 | A | G | G | G | C | C | G | G | A | G | C | C | G | G | G | A | G | G | G | G | G | A | C | C | G | A | G | G |
| GUY35 | A | G | G | G | C | C | G | G | A | G | C | C | G | G | G | A | G | G | G | G | G | G | C | C | G | A | G | A |
| GUY36 | G | G | G | G | C | C | G | G | A | A | C | C | G | G | A | A | G | G | G | G | G | A | C | C | A | A | G | A |
| GUY38 | A | A | G | A | C | C | G | G | A | A | C | C | G | G | G | A | A | G | G | G | G | G | C | C | G | G | G | A |
| GUY39 | A | G | G | G | C | C | G | G | A | A | C | C | G | G | G | A | G | G | G | G | G | A | C | C | A | A | G | A |
| GUY40 | A | G | G | G | C | C | G | G | A | G | C | C | A | G | A | A | A | G | T | G | G | A | C | C | G | A | G | A |
| GUY41 | A | A | A | A | C | C | G | G | A | A | C | C | G | G | G | A | A | G | G | G | G | A | C | C | G | A | A | A |
| GUY42 | A | A | G | A | C | C | G | G | A | G | C | C | G | G | G | G | A | G | G | G | G | A | C | C | G | A | G | A |
| GUY43 | A | G | G | A | C | C | G | G | A | G | C | C | A | G | A | A | A | G | G | G | G | A | C | C | A | A | A | A |
| GUY44 | A | G | G | A | C | C | G | G | A | G | C | C | G | G | G | G | A | G | G | G | G | A | C | C | A | A | A | A |
| GUY29 | G | G | G | G | C | C | G | G | A | G | C | C | G | G | G | G | A | G | G | G | A | A | C | C | G | G | G | A |
| GUY16 | A | A | A | A | C | C | G | A | A | G | T | C | A | A | G | A | G | G | G | G | G | G | C | C | A | A | A | A |
| GUY37 | G | G | G | G | C | C | G | G | A | G | C | C | G | G | G | G | G | G | G | G | G | A | C | C | G | A | G | A |
| GUY21 | A | G | G | G | C | C | G | G | A | G | C | C | G | G | G | A | G | G | G | G | G | A | C | C | G | A | G | G |
| GUY23 | A | G | G | A | C | C | G | G | A | G | C | C | G | G | G | A | A | G | G | G | G | G | C | C | G | G | A | A |
| GUY33 | A | A | G | A | C | C | G | G | G | G | C | C | G | G | G | G | A | G | G | G | G | A | C | C | A | A | G | A |
| GUY45 | A | G | G | A | A | C | G | G | A | G | C | C | G | G | G | A | G | G | G | G | G | A | C | C | A | A | G | A |

# Receptor de la Prolactina (PRLR)

**PRLR (slick)** Prolactin Receptor

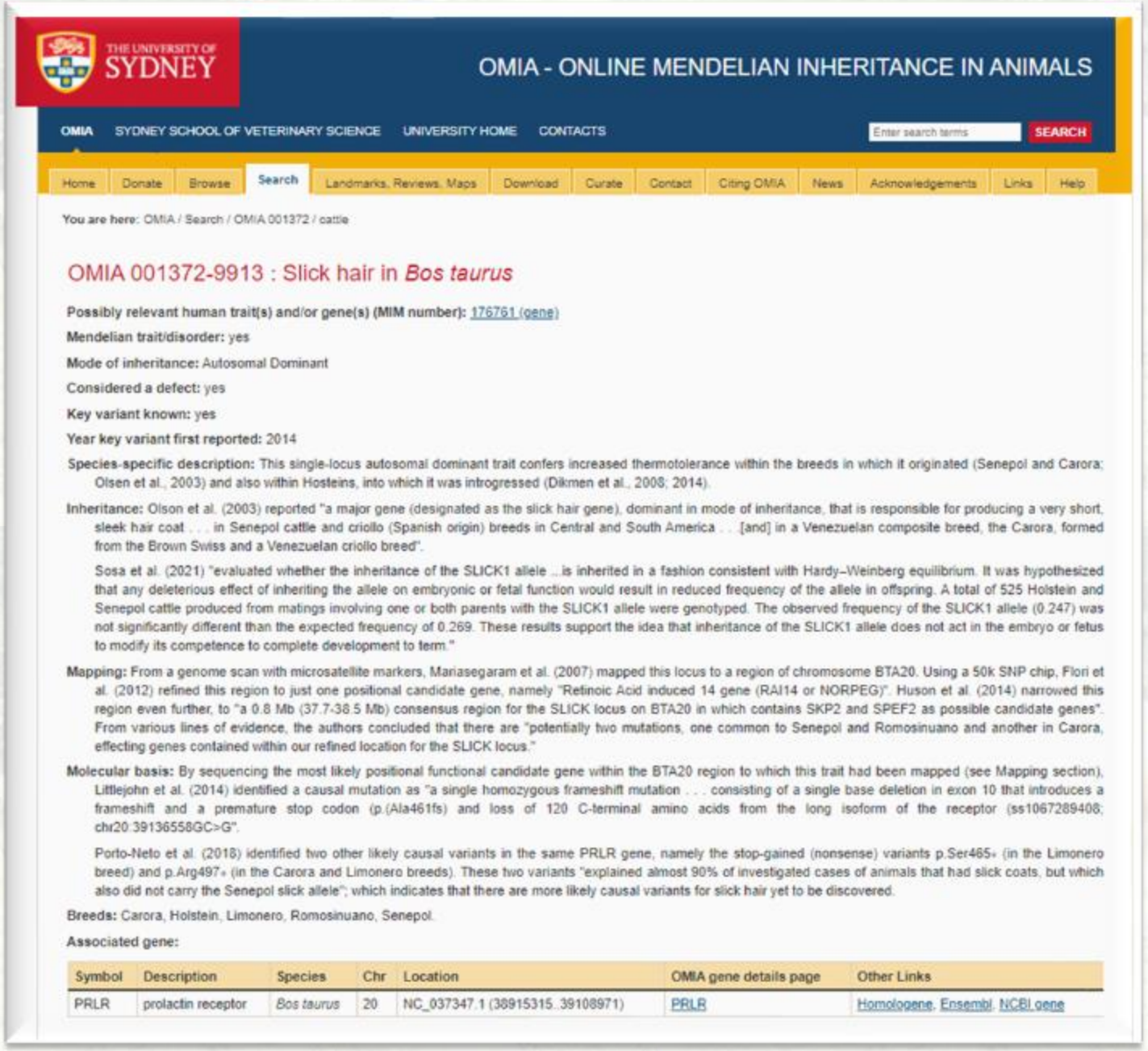
**Cromosoma 20**

| | |
|---|---|
| UMD 3.1.1/bosTau8 | 39,136,666 |
| ARS-UCD1.2/bosTau9 | 39,099,321 |

**g.39099321C>T**

**Porto Neto et al 2018**

**Reportado en Ganado Carora y Limonero**



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## OMIA 001372-9913 : Slick hair in *Bos taurus*

**Possibly relevant human trait(s) and/or gene(s) (MIM number):** 176761 (gene)

**Mendelian trait/disorder:** yes

**Mode of inheritance:** Autosomal Dominant

**Considered a defect:** yes

**Key variant known:** yes

**Year key variant first reported:** 2014

**Species-specific description:** This single-locus autosomal dominant trait confers increased thermotolerance within the breeds in which it originated (Senepol and Carora; Olsen et al., 2003) and also within Hosteins, into which it was introgressed (Dikmen et al., 2008; 2014).

**Inheritance:** Olson et al. (2003) reported "a major gene (designated as the slick hair gene), dominant in mode of inheritance, that is responsible for producing a very short, sleek hair coat . . . in Senepol cattle and criollo (Spanish origin) breeds in Central and South America . . . [and] in a Venezuelan composite breed, the Carora, formed from the Brown Swiss and a Venezuelan criollo breed".

Sosa et al. (2021) "evaluated whether the inheritance of the SLICK1 allele ...is inherited in a fashion consistent with Hardy–Weinberg equilibrium. It was hypothesized that any deleterious effect of inheriting the allele on embryonic or fetal function would result in reduced frequency of the allele in offspring. A total of 525 Holstein and Senepol cattle produced from matings involving one or both parents with the SLICK1 allele were genotyped. The observed frequency of the SLICK1 allele (0.247) was not significantly different than the expected frequency of 0.269. These results support the idea that inheritance of the SLICK1 allele does not act in the embryo or fetus to modify its competence to complete development to term."

**Mapping:** From a genome scan with microsatellite markers, Mariasegaram et al. (2007) mapped this locus to a region of chromosome BTA20. Using a 50k SNP chip, Flori et al. (2012) refined this region to just one positional candidate gene, namely "Retinoic Acid induced 14 gene (RAI14 or NORPEG)". Huson et al. (2014) narrowed this region even further, to "a 0.8 Mb (37.7-38.5 Mb) consensus region for the SLICK locus on BTA20 in which contains SKP2 and SPEF2 as possible candidate genes". From various lines of evidence, the authors concluded that there are "potentially two mutations, one common to Senepol and Romosinuano and another in Carora, effecting genes contained within our refined location for the SLICK locus."

**Molecular basis:** By sequencing the most likely positional functional candidate gene within the BTA20 region to which this trait had been mapped (see Mapping section), Littlejohn et al. (2014) identified a causal mutation as "a single homozygous frameshift mutation . . . consisting of a single base deletion in exon 10 that introduces a frameshift and a premature stop codon (p.(Ala461fs) and loss of 120 C-terminal amino acids from the long isoform of the receptor (ss1067289408; chr20:39136558GC>G".

Porto-Neto et al. (2018) identified two other likely causal variants in the same PRLR gene, namely the stop-gained (nonsense) variants p.Ser465* (in the Limonero breed) and p.Arg497* (in the Carora and Limonero breeds). These two variants "explained almost 90% of investigated cases of animals that had slick coats, but which also did not carry the Senepol slick allele"; which indicates that there are more likely causal variants for slick hair yet to be discovered.

**Breeds:** Carora, Holstein, Limonero, Romosinuano, Senepol.

**Associated gene:**

| Symbol | Description | Species | Chr | Location | OMIA gene details page | Other Links |
|---|---|---|---|---|---|---|
| PRLR | prolactin receptor | *Bos taurus* | 20 | NC_037347.1 (38915315..39108971) | PRLR | Homologene, Ensembl, NCBI gene |

# Histona Metil transferasa (SMYD3)

SMYD 3

Cromosoma 16

| | |
|---|---|
| UMD 3.1.1/bosTau8 | 31,589,293 - 32,333,420 |
| ARS-UCD1.2/bosTau9 | 30,839,274 - 31,580,547 |

rs29013977
rs41799745
rs41799830
rs41799658
rs41797772
rs42383968

Flori et al., 2018

**Variables climáticas y resistencia a enfermedades**


Lewis Carroll (1871) "A través del espejo y lo que Alicia encontró allí"



Juan María Montalvo Fiallos
(1832-1889)

"La verdad es fuerte por sí misma; encendida con el fuego del patriotismo, arde sobre los culpables y consume a los enemigos de la libertad y las virtudes"

EL FUTURO ES AHORA

Municipio de Riobamba

espoch

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en movimiento

CORPORACIÓN DE CÁMARAS DE LA PRODUCCIÓN DE CHIMBORAZO