TEC | Tecnológico de Costa Rica

Relationship between toxic environmental chemicals, epigenetic factors and Chronic Kidney Disease of unknown etiology in Costa Rica

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- International Medical Geology Association.

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- Society Environmental Toxicology and Chemistry, SETAC:

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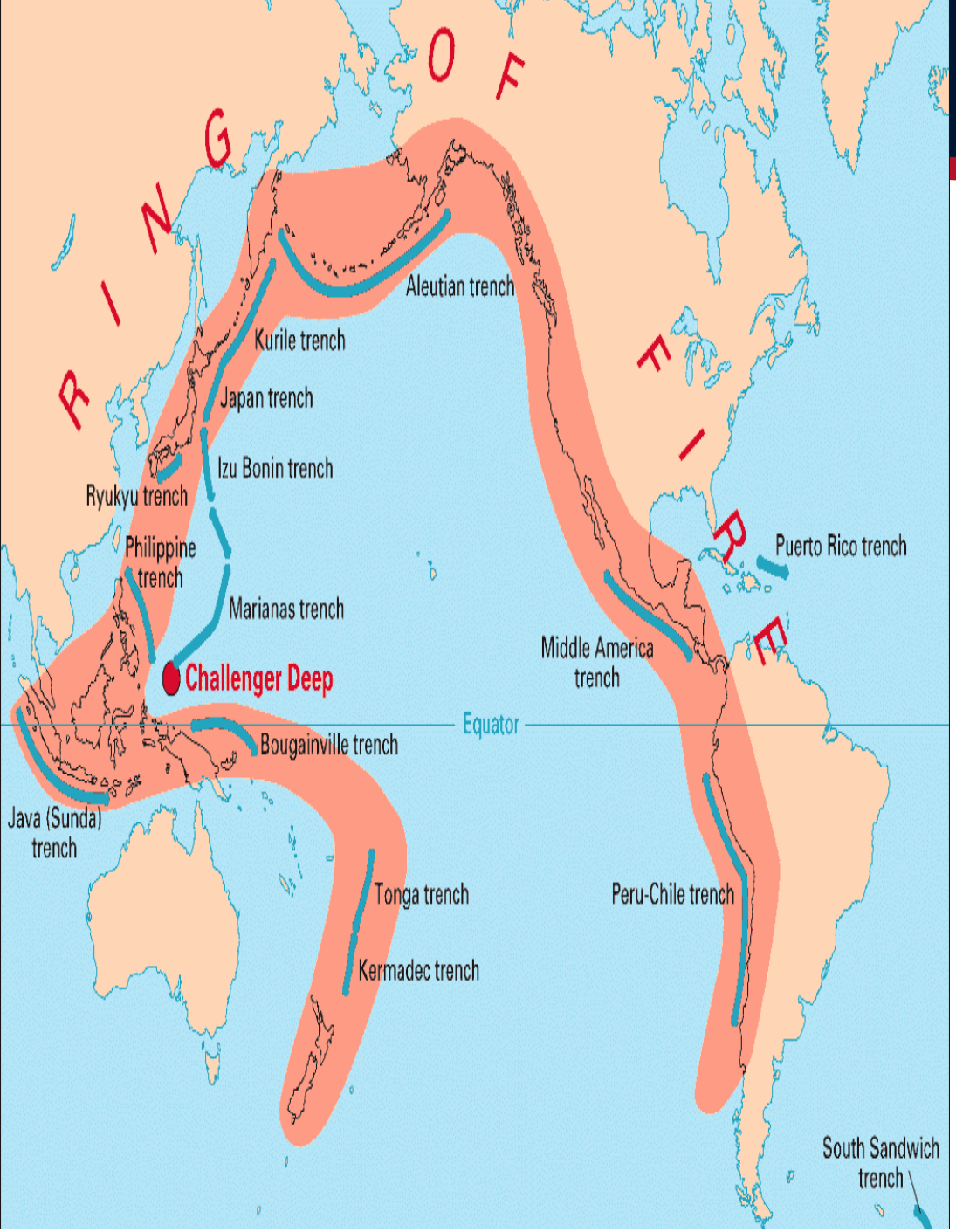
Situation

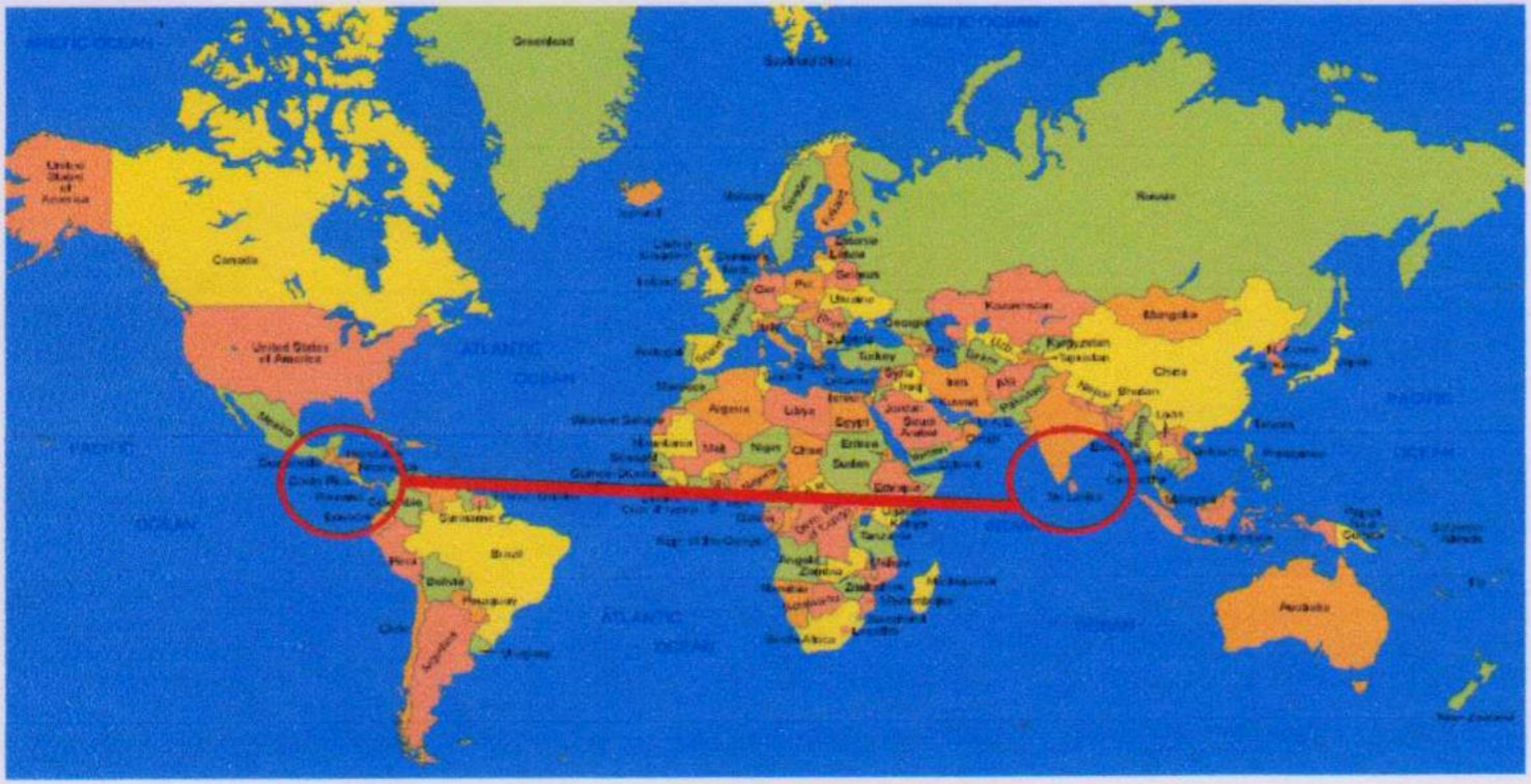
- The epidemic of Chronic Kidney Disease (CKD) affects some areas of Central America, has been considered one of the most important problems of public health in recent years, according to the Panamerican Health Organization.

- Disease affecting thousands of people in rural communities from Nicaragua, El Salvador , Costa Rica and other countries like Sri Lanka and India. More than 16,000 people have died in Central America between 2005 and 2009, according to the World Health Organization.

- The problem appears in certain areas of the countries, especially on the Pacific coast from Mexico to Panama. It seems to be related to the volcanic activity at the so-called Ring of Fire



The Ring of fire is an area where a large number of volcanic eru (o)ptions and earthquakes occur in the basin of the Pacific Ocean. We can see it in Central America and in a straight line above the line of meridian Ecuador, in this site we find Sri Lanka and India. These regions share certain conditions such as: Sugar cane farming and all its implications, like how it is harvested in spanish zafra. In this harvesting techique, the farmer burns the plants to facilitate the harvesting. By this practice, soot permeates the skin. Other shared environmental conditions are: similar high temperature and high humidity.



"Sri Lankan Agricultural Nephropathy"

- North Central Province.
- Alta prevalencia de ERC de causa desconocida.
- Predominante en hombres agricultores.
- Nefritis instersticial crónica.
- De etiología multifactorial: arsénico, cadmio, residuos de pesticidas, agua dura + características de los suelos.

Chronic Kidney Disease (CKD)

CKD is an irreversible kidney damage that stops the performance of normal vital functions such as removing toxics and regulating both water and blood chemicals such as sodium, potassium, phosphorus and calcium.

Chronic kidney disease: traditional causes

- Chronic kidney disease (CKD) is a serious global public health problem , the behavior of this illness is epidemic.

- The world-wide reported traditional causes of CKD are diabetes mellitus (DM) (30% to 40%) and hypertension (HTA) (25% to 30%), mainly associated with risk factors like a lifestyle and aging (> 60 years).

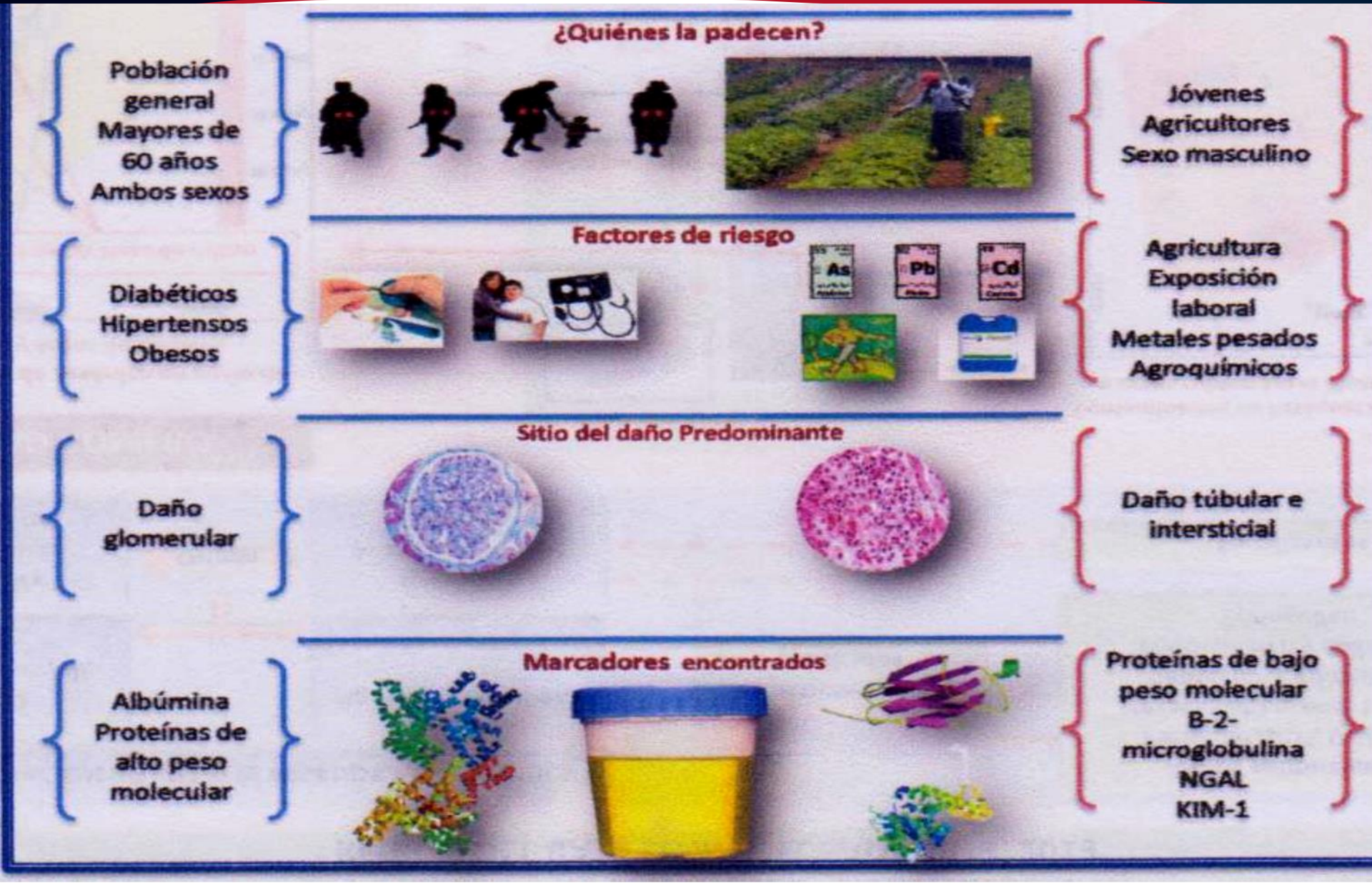
CKD of known vrs CKD of unknown causes

	CKD KNOWN ETIOLOGY	CKD UNKNOWN ETIOLOGY
WHO WILL BE AFFECTED	Elderly people	Predominant in young people (men), farmworkers.
CAUSES	Diabetes Mellitus Hypertension , Renal diseases (primary glomerulopathies)	It Is not due to traditional causes. Toxic causes associated with environmental and occupational safety Hypothesis: toxic, ischemic and dehydration causes.
RISK FACTORS	Diabetes Mellitus hypertension Obesity dislipidemias	Farm work, strenuous work, living in endemic areas, exposure to occupational and environmental toxics, social factors (poverty, low education, poor living conditions, poor access to health services).

CKD of known vrs CKD of unknown causes

	CKD KNOWN ETIOLOGY	CKD UNKNOWN ETIOLOGY
PROTEINS (ALBUMIN) IN URINE	high	low
STRUCTURE OF KIDNEY PREDOMINANTLY AFFECTED	Glomerulos	Tubules and interstitium
WORLDWIDE DISTRIBUTION	Global	Central America, Southern Mexico, Sri Lanka, India, Vietnam, Nepal, Egypt, countries of the Balkan region.

CKD ke NM


¿Quiénes la padecen?
Población general
Mayores de 60 años
Ambos sexos
Jóvenes
Agricultores
Sexo masculino
Factores de riesgo
As
Pb
Cd
Diabéticos
Hipertensos
Obesos
Agricultura
Exposición laboral
Metales pesados
Agroquímicos
Sitio del daño Predominante
Daño glomerular
Daño túbular e intersticial
Marcadores encontrados
Albúmina
Proteínas de alto peso molecular
Proteínas de bajo peso molecular
B-2-microglobulina
NGAL
KIM-1

One Century of the Discovery of Arsenicosis in Latin America

ISGSD
International Society of Groundwater for Sustainable Development

5th INTERNATIONAL CONGRESS ON ARSENIC IN THE ENVIRONMENT

Toxicological Risk Analysis for consumption of water containing arsenic in Canton Bagaces, Guanacaste, Costa Rica

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- The 50 % of the patients had values of arsenic in hair from about 0,445 mg/Kg up to 0,995 mg/kg , children being the most affected.

- These pacients had the following biomarker values and clinical testing of renal function.

Sample mean values

Age	Arsenic in hair (mg/kg)	Creatinin Up to 1 mg/dL	Cistatin C Up to 0,98 mg/L
Children 10-12 years	0,693	0,71	1,10
Adults 19-74 years	0,635	0,91	1,17

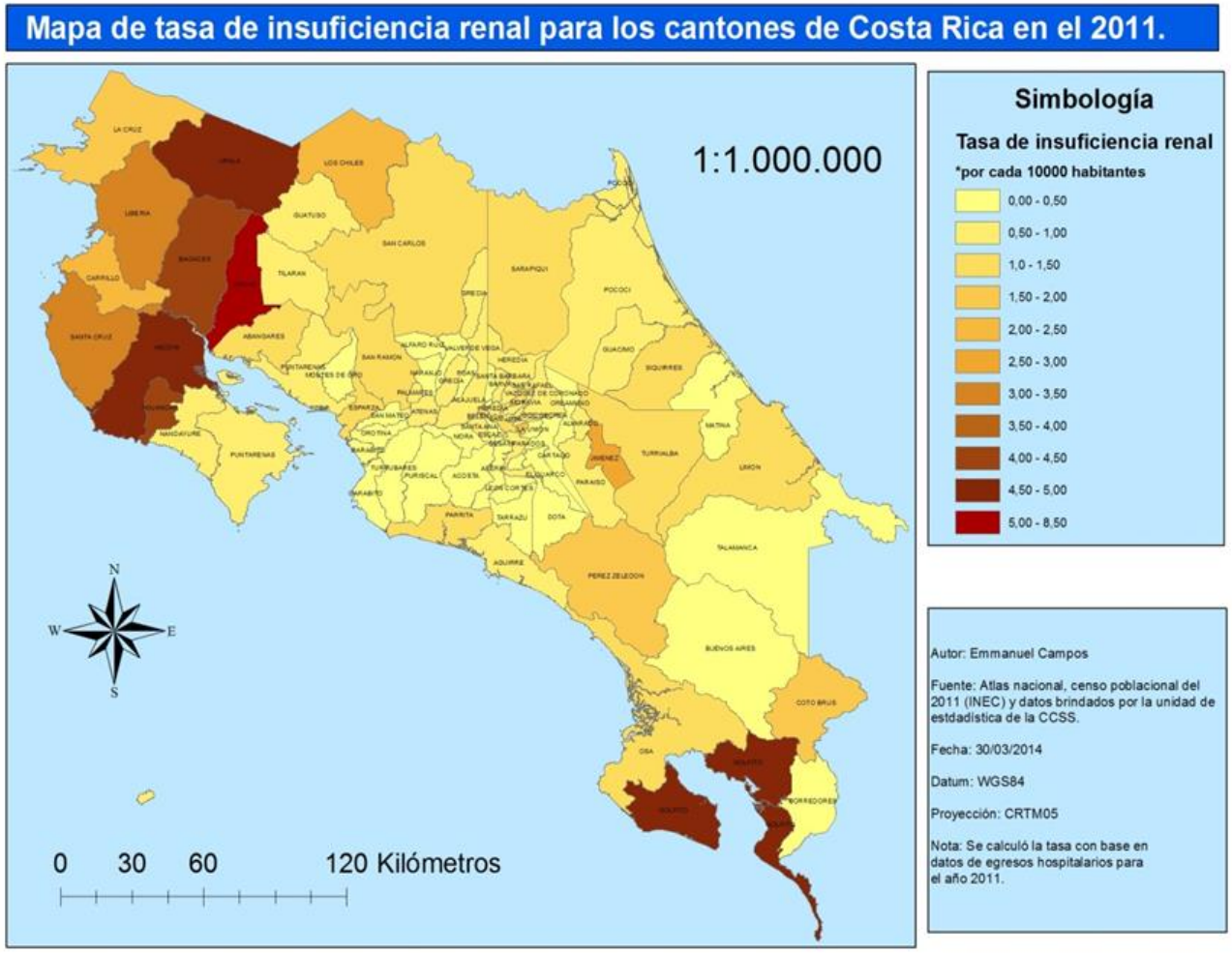
Agroquímicos y plaguicidas	Glifosato (herbicida, quelante de metales)
	2,4-D (herbicida, ácido 2,4-diclorofenoxiacético y dioxina)
	Clorpirifós (insecticida, inhibidor de la colinesterasa)
	Cipermetrina (insecticida, modulador de los canales de sodio)
	Paraquat (herbicida, especie reactiva de oxígeno = produce radicales libres que reaccionan con el oxígeno formando radicales superóxido = necrosis tubular aguda)
Exposición a metales y toxinas	Cadmio
	Arsénico
	Plomo
	Sílice (de la quema de caña de azúcar)
	Ácido aristolóquico
	Antiinflamatorios no esteroideos (iatrogénicos)
Causas metabólicas	Hipocalemia
	Hiperuricemia
Causas infecciosas	Lesptospirosis
	Hanta virus
Deshidratación recurrente y estrés térmico	Rabdomiólisis subclínica
	Deshidratación con estimulación de vasopresina
	Deshidratación con activación de aldosa reductasa y fructocinasa en el túbulo renal
	Uricosuria
	Golpe de calor

- Causes proposed for the NM that were reviewed during the Second Workshop of CENCAM in 2015.

What is the toxicokinetic of glyphosate?

- The toxicokinetic studies also indicate that human glyphosate exposures estimated from urine biomonitoring fall thousands-of-fold short of external doses capable of producing blood concentrations sufficient to result in the breast milk concentrations described in the MAA report.
- Finally, in contrast to highly lipophilic compounds with bioaccumulation potential in breast milk, the physico-chemical properties of glyphosate indicate that it is highly hydrophilic (ionized) at physiological pH and unlikely to preferentially distribute into breast milk.

CKD Rate in Costa Rica by cantons in 2011



Statistical relationship between drinking water with arsenic, and the incidence of CKD as determined with a Pearson Correlation Coefficient of **0.791** with **p: 0.002.**

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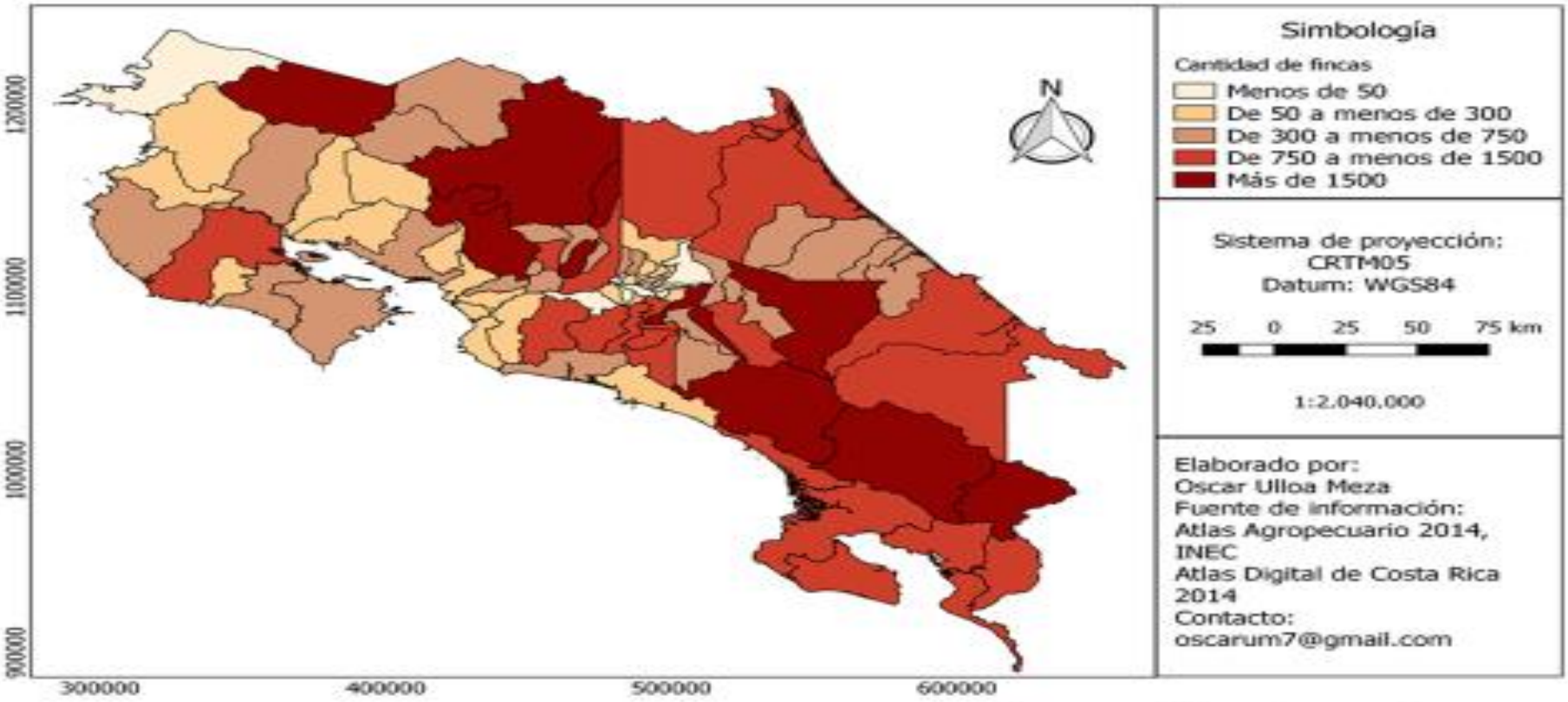
- Farms with main agricultural activity in CR



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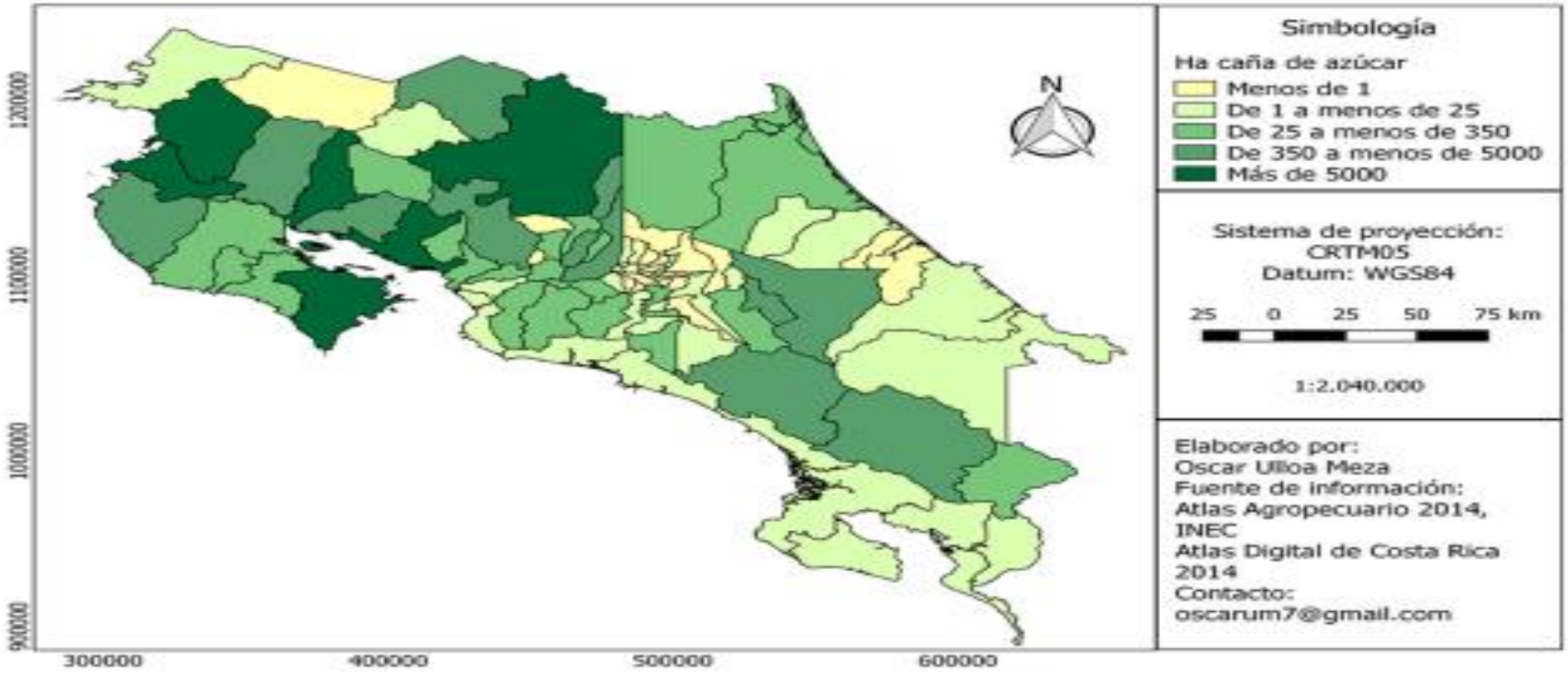
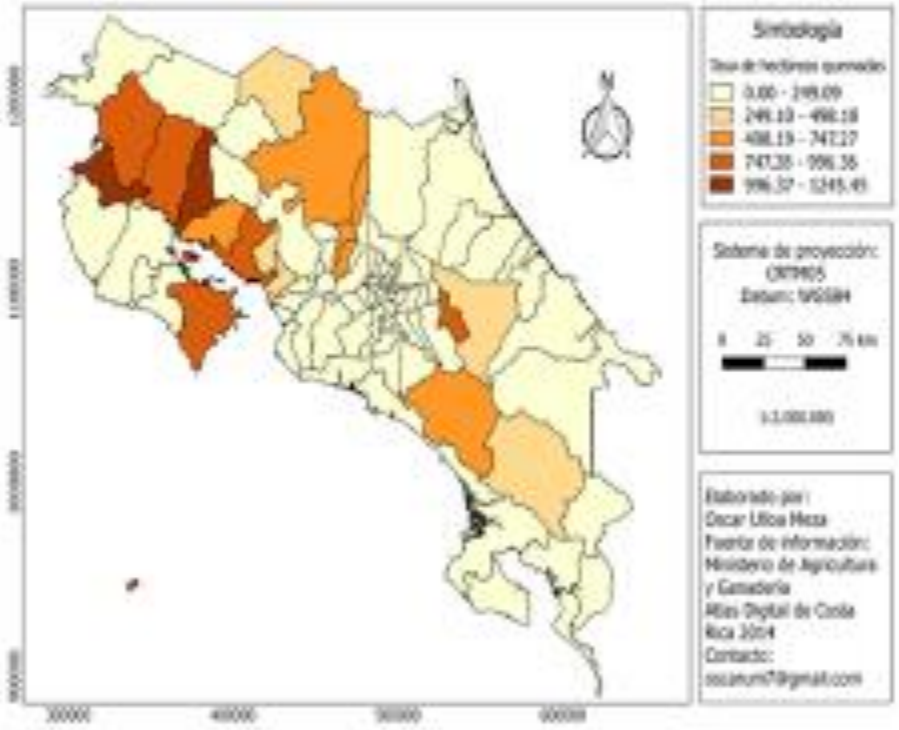
- Sugar cane planted in CR

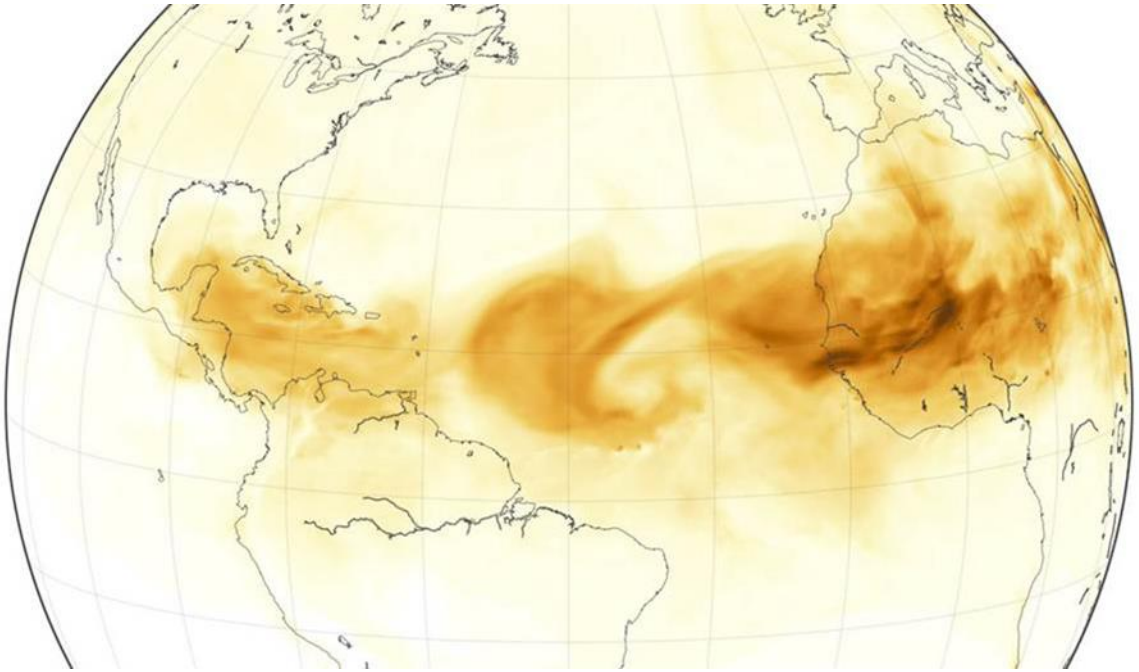


Tasa de hectáreas de caña de azúcar quemadas por cada 10 000 hectáreas de terreno en Costa Rica



Puntos de muestreo de agua determinados como positivos por arsénico en Costa Rica

Nube de polvo del Sahara



Distribución del polvo del Sahara en Mesoamérica por acción del viento. Tomado de Martins (2018).

Ubicación de las montañas cercanas a Cañas, Guanacaste

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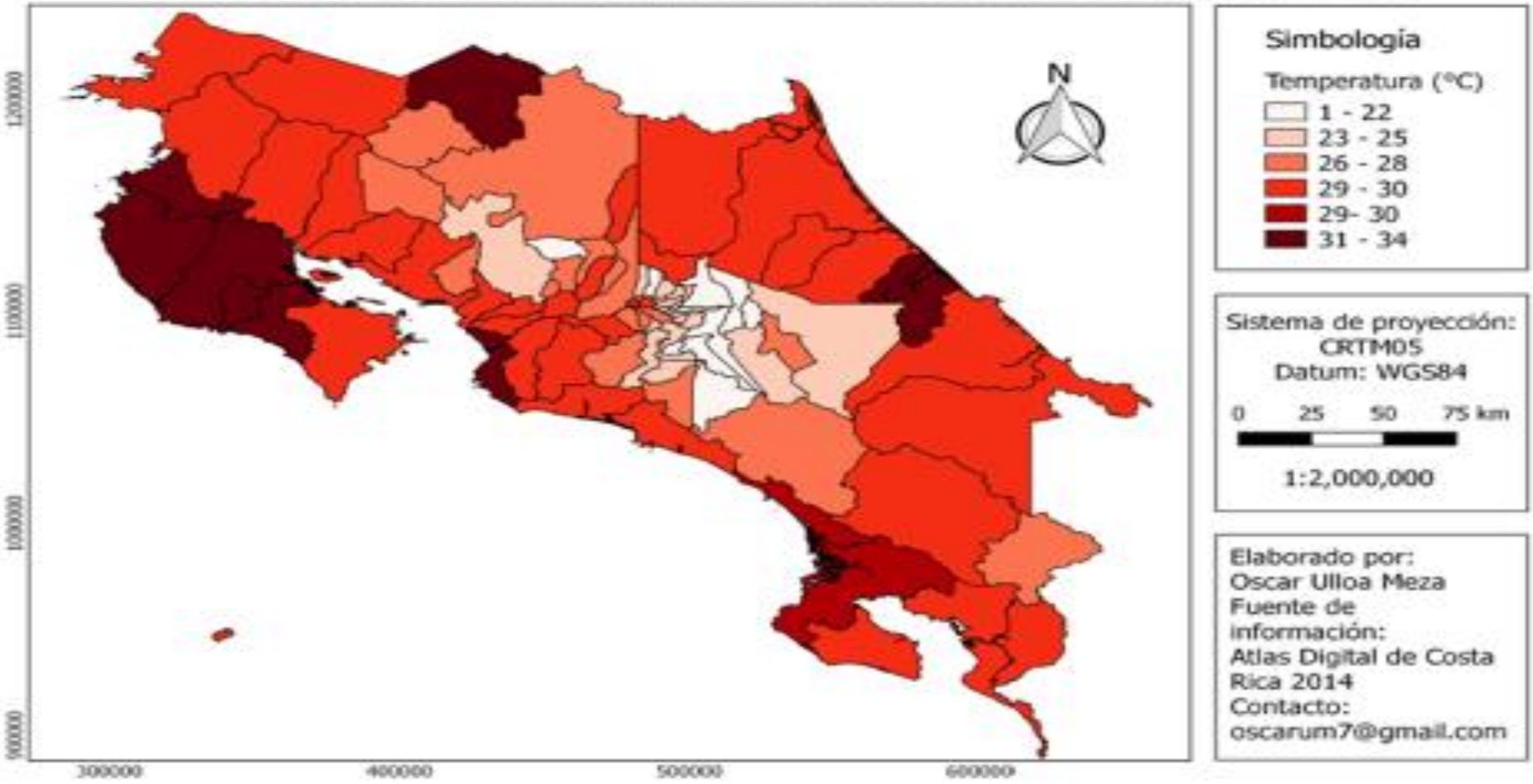
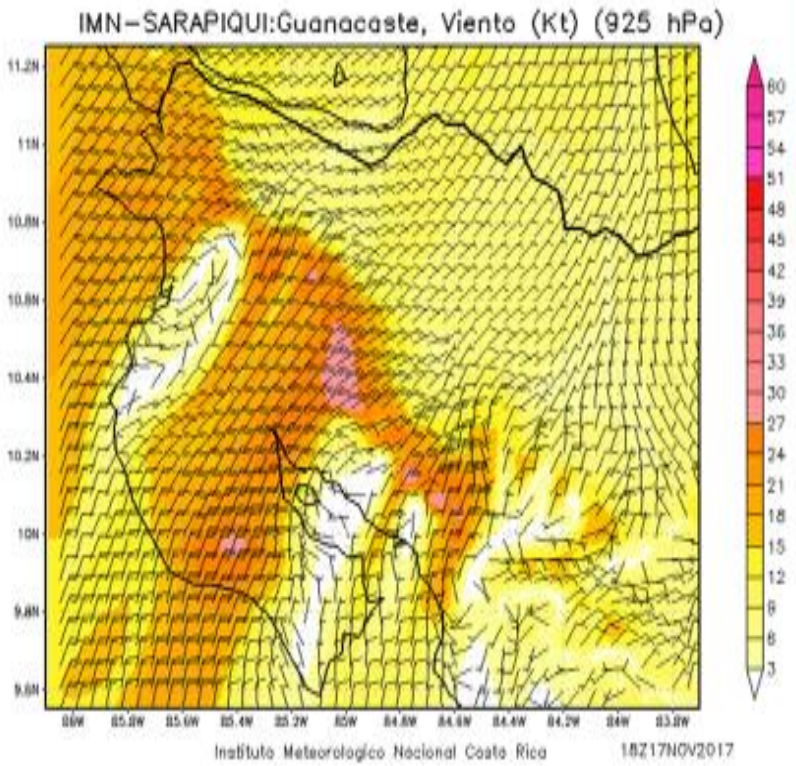
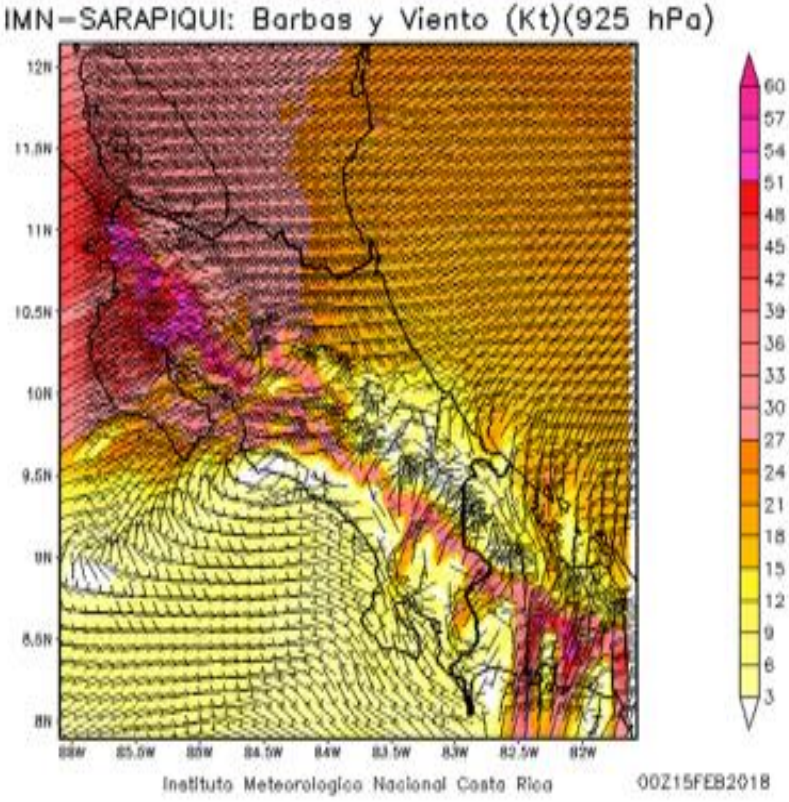
Temperatura máxima promedio anual en Costa Rica

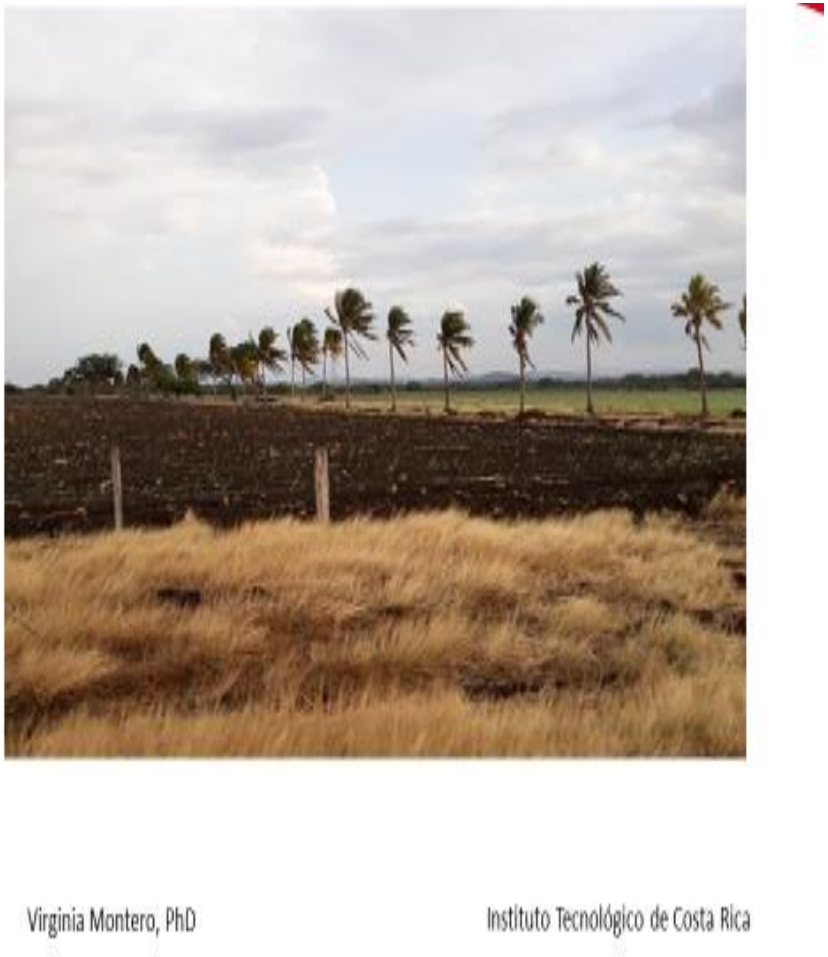




Modelo computacional del viento en Guanacaste para el 17 de noviembre de 2017. Fuente: (IMN, 2017).



Modelo computacional del viento en Guanacaste para el 15 de febrero de 2018. Fuente: (IMN, 2018).



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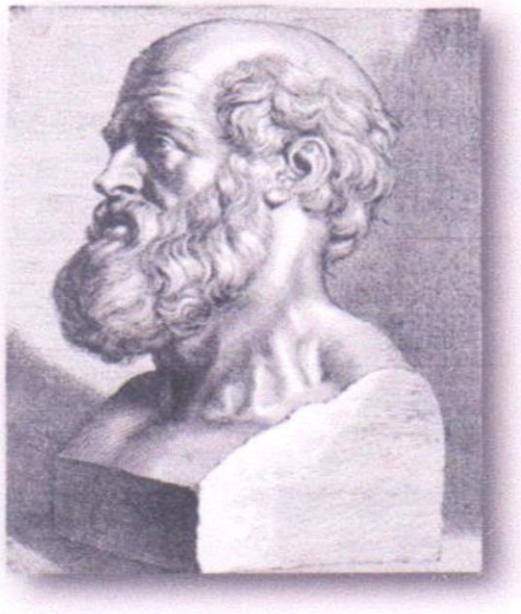

“The occurrence of disease in human populations is influenced by the quality of air, water and food; the topography of the land and the life habits “

Hipocrates 450 BC