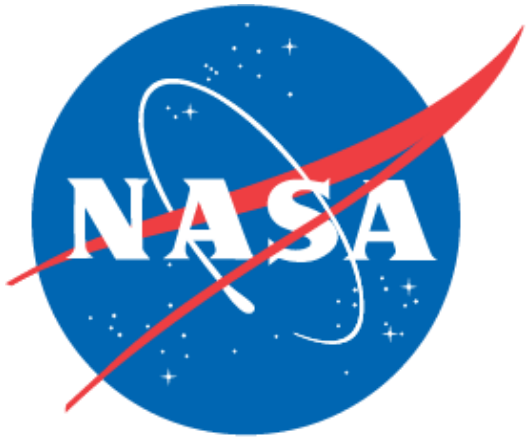

HEALTH & AIR QUALITY

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Getting to Zero: Satellite Informed System to Eliminate Malaria in the Americas (SISTEMA)

William Pan (Mark Janko and Justin Lana presenting)

March 29-30, 2023

mark.janko@duke.edu

Project Summary

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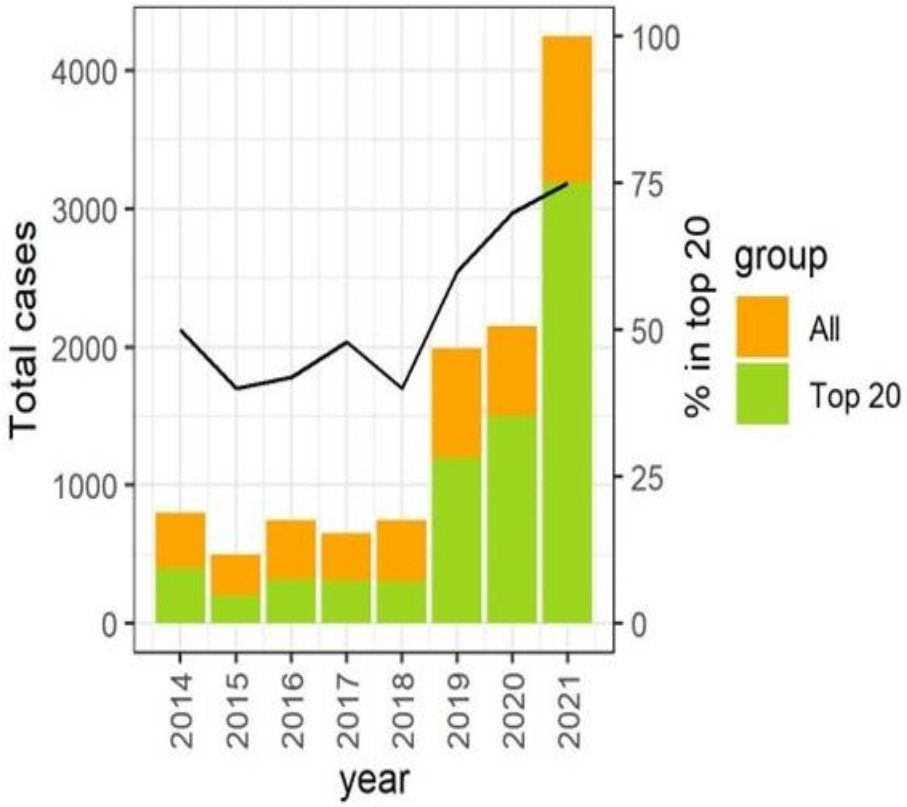
- **Getting to Zero: Satellite Informed System to Eliminate Malaria in the Americas**
- SISTEMA
- William Pan
- Solicitation under which the project funding was awarded
- Goal: Develop tools that can predict malaria outbreaks in communities in elimination settings
- Panama, Honduras



Earth Observations, Models, and/or Technologies

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Satellite Sensor/Model/Tech.	Product Used	Temporal Coverage and Latency required	Comments
Optical	AVHRR	1000m	1992-93
Optical	MODIS	500m	2001-2019
Optical & Microwave	LandSAT, ALOS, SPOT	100m	2012
Optical	LandSAT	30m	1999-2020
Optical	Sentinel-2	30m	2017
Optical	MODIS & LandSAT	30m	2000-2020
Microwave (L)	JERS, ALOS/PALSARI1-2	12.5m	1996, 2007-10, 2015-20
Microwave (C)	Sentinel-1	12.5m	2014-present
Microwave (L)	NISAR	10	2023-2025

Project Partners/Collaborators

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List project Co-Investigators, collaborators, and other partners

Role	Name	Affiliation	Organization Type
Co-I, LDAS development Post-doc, LDAS development	Ben Zaitchik Prakrut Kansara	Johns Hopkins University	University
Co-I, Implementation Partner	Justin Lana	Clinton Health Access Initiative	NGO
Entomologist, Vector ecology model Master student	Jose Loaiza Alejandro Almanza	INDICISAT	Research Institute
Co-I, Land use/land cover (LULC) analyst	Naiara Pinto	NASA-JPL	Government
Co-I, Malariaologist & modeler Clinical expert, Vector modeler Co-I, Macro-climate cycling & malaria Post-doc, climate-malaria modeling Co-I, LULC analyst (LandSAT)	Mark Janko Paul Lantos Shineng Hu Mengxin Pan Peter Harrell	Duke University	University
Co-I, Implementation Partner	Anna Stewart	InterAmerican Institute for Global Change Research	Inter-Government Consoritum
Implementation Advisor	Christian Lara	United Nations	Government

Project End-users & Stakeholders

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List organization names and organization types

Organization Name	Organization Type	Decision Making Activity
Clinton Health Access Initiative (CHAI)	NGO	Technical support for malaria surveillance & decision-making by National Malaria Control Programs (NMCPs)
InterAmerican Institute of Global Change Research	Inter-Government Organization	Provides technical assistance to government agencies to support decision-making
Ministry of Health-Panama	Government	(1) Decisions on when/where interventions are deployed; (2) integration of environmental data into decision-making (i.e., activity 1); and (3) Improvement in deployment of intervention based on retrospective analysis
Ministry of Health-Honduras	Government	

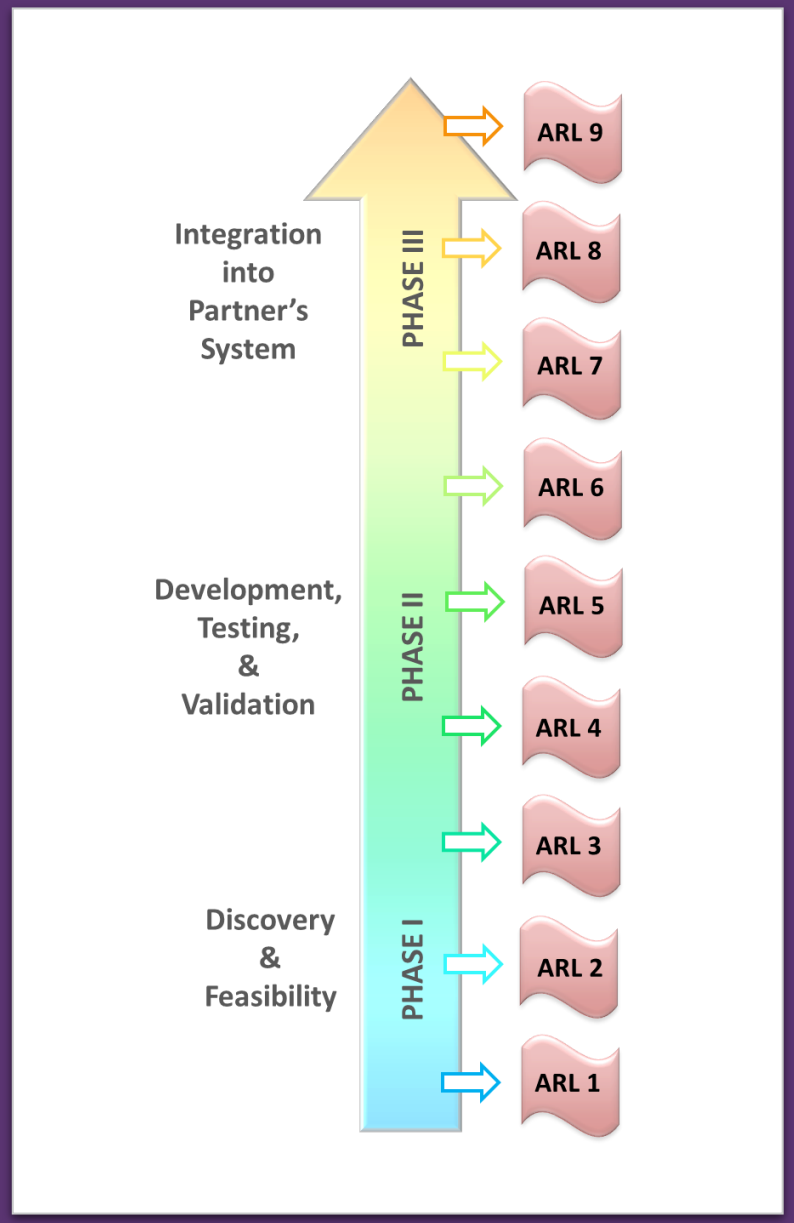
Engagement plan and recent updates

We have finalized MOUs between Duke and CHAI to share malaria data in Honduras. We obtained approvals from MOH in Panama, but leadership changed and we have renewed the request.

Our implementing partners (CHAI) participate in our monthly project meetings

Schedule & Milestones (start date 6/1/2022)

Expected ARL	Time	Expected Milestone	Observed/Comments
4	Y1, Q1	**Data acquisition** (Surveillance, GIS, Vector, Intervention, EO Images & regular updates)	EO Images obtained, MOU to share data started
4	Y1, Q2	**Data acquisition; LDAS** (5km hydrometeorological data)**; Pan Tropical** (assessment of teleconnections between pan-tropical ocean basins on malaria incidence and vector densities); **LULC** (high and low resolution land cover analysis)	MOU signed but data sharing stalled due to change in MOH leadership, LDAS runs begin, Pan tropical analysis begins, Vector data obtained
4	Y1, Q3	**Malaria Elimination Support Models (MESM) – MESM1** (Vector Ecology Models), **MESM2** (Malaria Early Warning)(development, validation, outputs); **LDAS, Pan-Tropical, LULC**	LDAS output provided; MESM1 models begun
4	Y1, Q4	**MESM1, MESM2, Capacity Building** (Training, Dashboard)	MESM1 models continue; MESM2 models begun; Pan-tropical teleconnections begun
5	Y2, Q1	**Environmental Characterization System (ECS) –** (combines & updates Data, LDAS, LULC, Pan-tropical) **Pan-Tropical models, MESM1, MESM2**	Developing code base for linking malaria surveillance and LDAS data
5	Y2, Q2	**Pan-Tropical, MESM1, MESM2, Capacity Building**	
6	Y2, Q3	**Pan-Tropical, MESM1, MESM2, ECS Development**	
6	Y2, Q4	**Pan-Tropical, MESM1, MESM2, Capacity Building**	
7	Y3, Q1	**Pan-Tropical, MESM1, MESM2, Data Updates**	
7	Y3, Q2	**Pan-Tropical, MESM1, MESM2, ECS Development, Capacity Building**	
8	Y3, Q3	**Pan-Tropical, MESM1, MESM2, Data Updates, Capacity Building**	
8	Y3, Q4	**Pan-Tropical, MESM1, MESM2, ECS Development, Capacity Building**	



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ARL Performance

- Start-of-Project ARL = 4 *(6/1/2022)*
  - Leveraging prior completed work in the Amazon to demonstrate potential
- Goal ARL = 8
- Current ARL = 4 *(3/29/2023)*
  - No changes from start of project (aiming to advance to ARL 5 in next 3-6 months)

Current ARL-Supporting Evidence

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- We are on schedule with no change from our starting ARL
- Justification for starting ARL:
  - We have 3 main products for this project: The Environmental Characterization System (LDAS, LULC) and Malaria Elimination Support Models (vector ecology models and early warning models)
  - ECS—preexisting project from the Amazon developed an LDAS to support malaria early warning system. LDAS has demonstrated utility in the region to support malaria incidence prediction
  - MESM – preexisting project from the Amazon developed malaria forecasts 12 weeks in advance. Similar data and methods are being applied to this project

Challenges and Risks

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Rank	Type *	Risk	Mitigation Action	Date first noted/Date resolved (if applicable)
1	PM	Data sharing delay (malaria surveillance & infrastructure rom CHAI/MOH)	Held/scheduled in-person meetings with stakeholders	November 2022
2	T	Cloud free LandSAT	Evaluation of other projects (e.g. Google Earth engine using Sentinel 2)	August 2022/resolved

* Please designate risk type as: Technical (T), Budget (B), End-User/Stakeholder (ES), or Project Management (PM)

Accomplishments since Last Update

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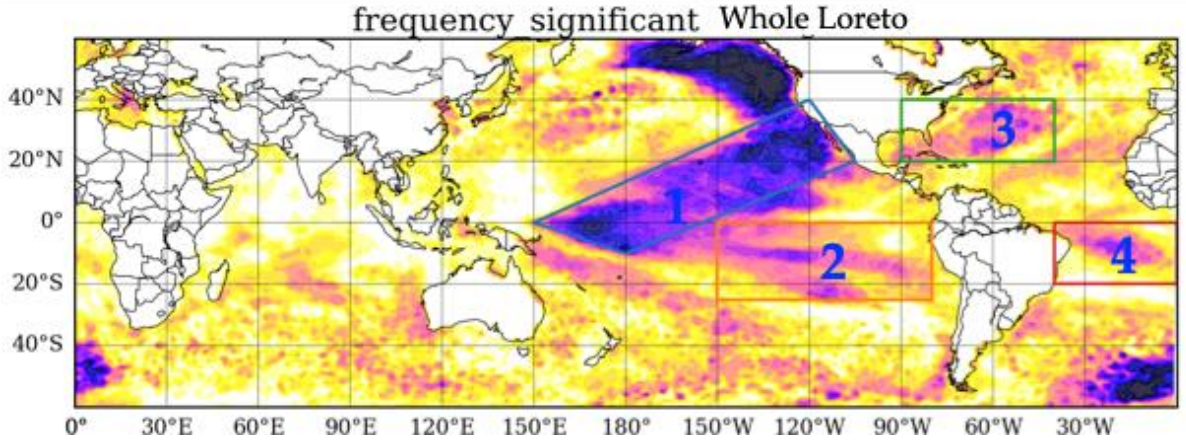
- Vector dataset for all of Panama finalized from 1980-2021
- LDAS methodology errors have been resolved
- First round of LDAS results have been produced
- Preliminary sea surface temperature model shows ability to predict malaria up to 9+ months in advance



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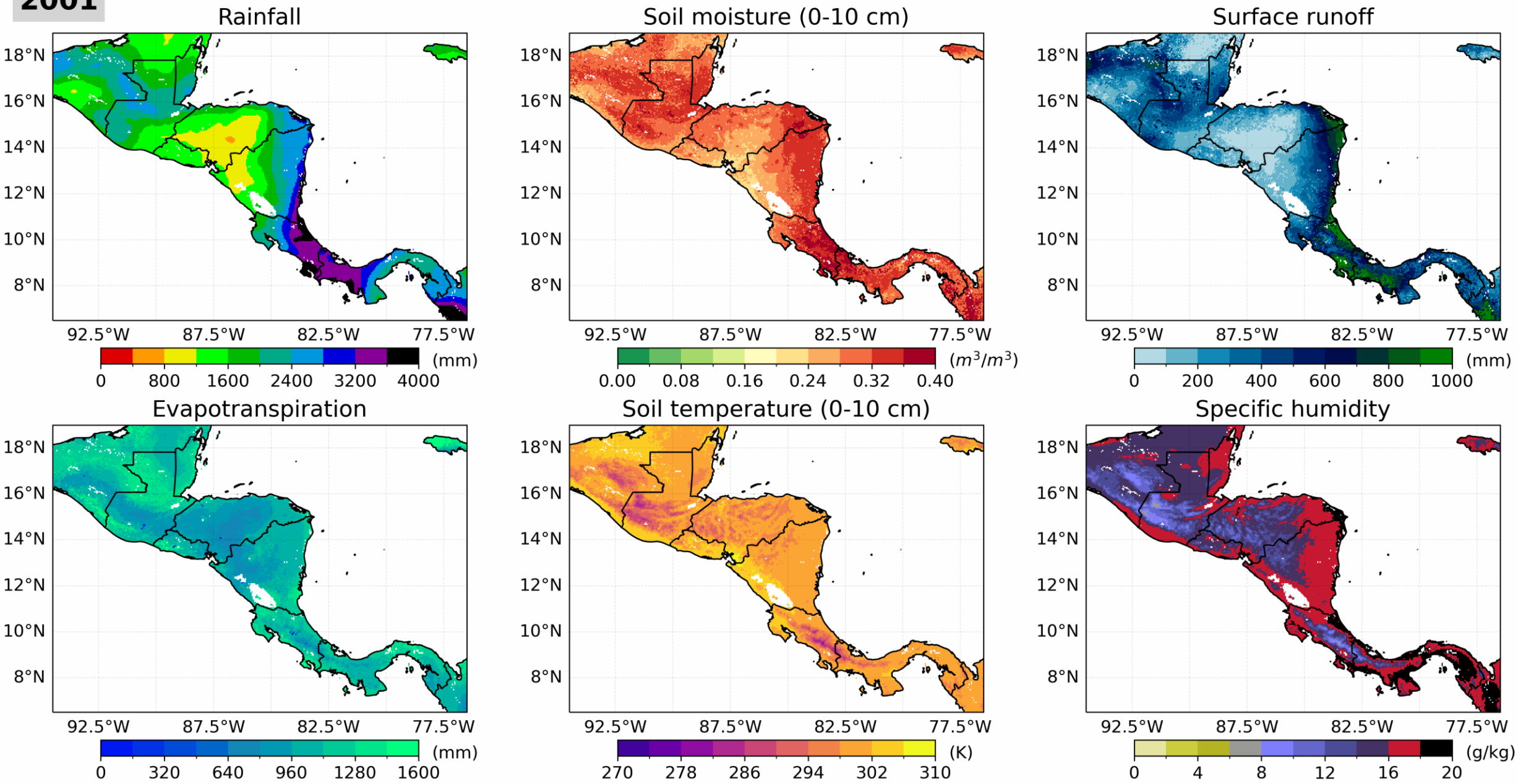
Rainfall
18°N
16°N
14°N
12°N
10°N
8°N
92.5°W
87.5°W
82.5°W
77.5°W
0
800
1600
2400
3200
4000
(mm)
Soil moisture (0-10 cm)
0.00
0.08
0.16
0.24
0.32
0.40
(m^3/m^3)
Surface runoff
0
200
400
600
800
1000
(mm)
Evapotranspiration
0
320
640
960
1280
1600
(mm)
Soil temperature (0-10 cm)
270
278
286
294
302
310
(K)
Specific humidity
0
4
8
12
16
20
(g/kg)

Highlight Image

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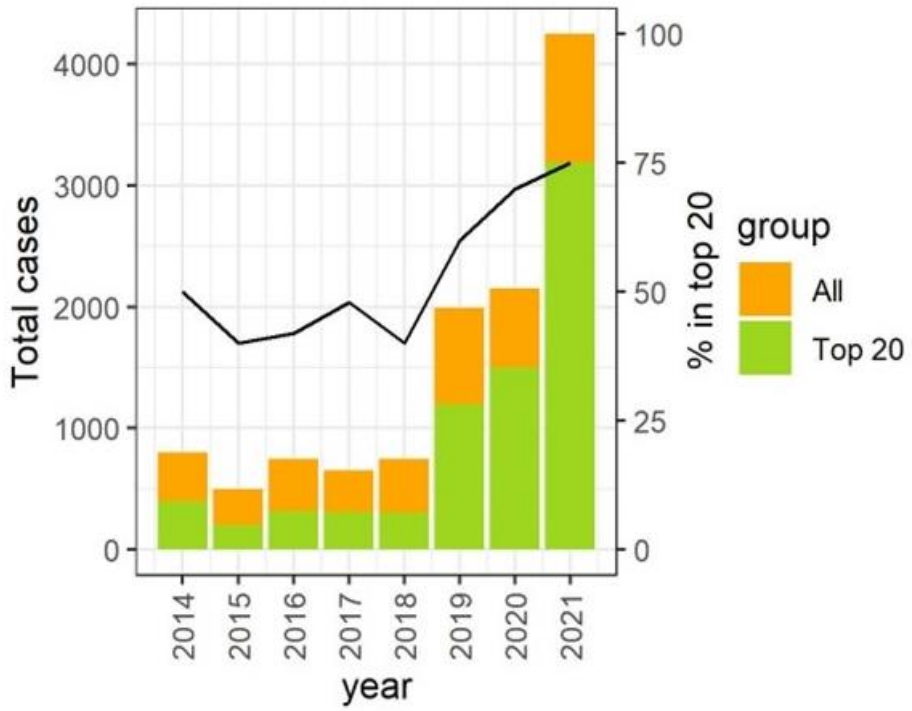

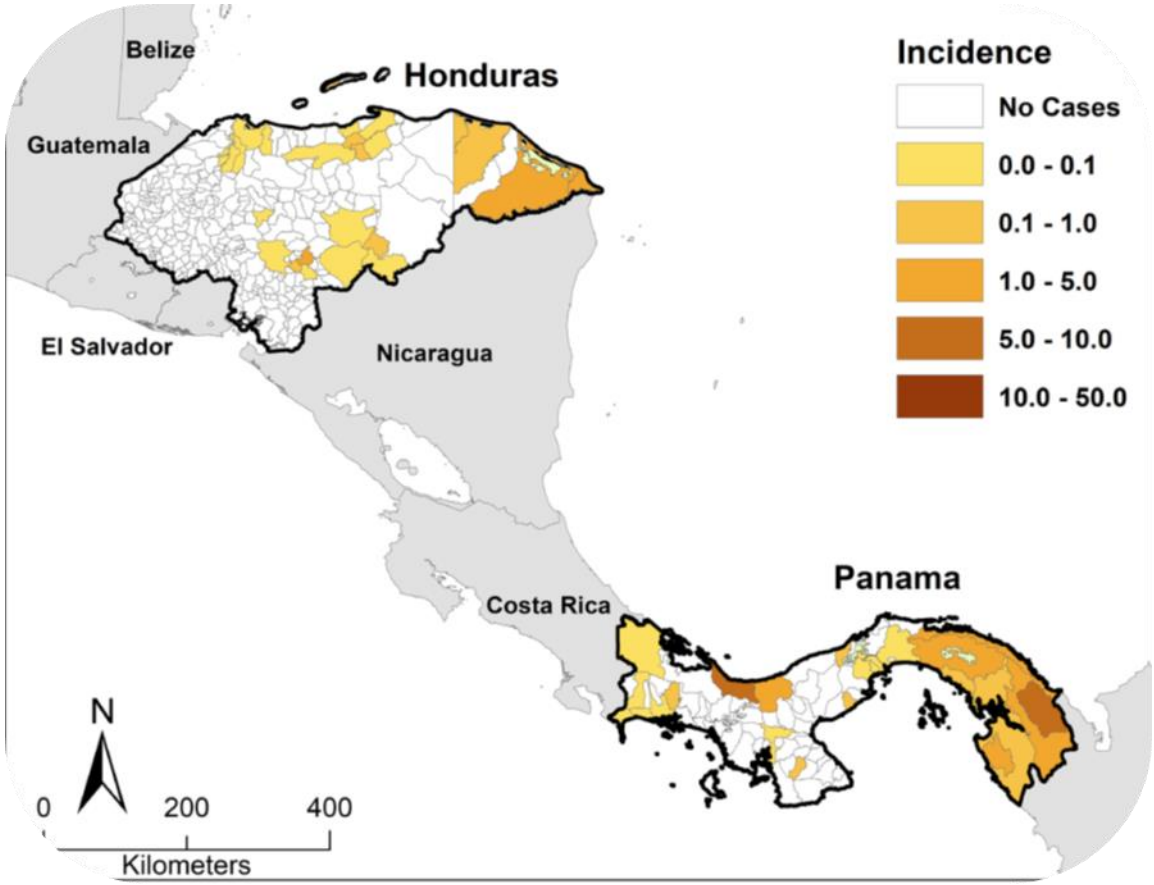

SISTEMA