



VectorMap - A new resource for online mapping of mosquito, tick and sand fly species distribution data

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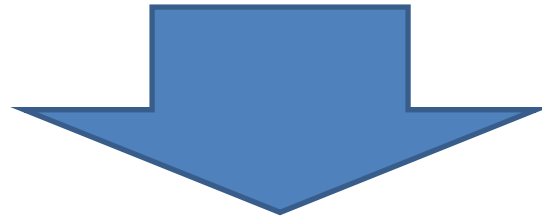
- **A database of geo-referenced vector surveillance data, to increase understanding of the biogeography and ecology of vectors, and the distribution of vector-borne diseases**

VectorMap.org

- **Attributes**

- Includes all species: a biodiversity and vector-borne disease assessment tool
- Museum based: emphasis on records backed by reliably identified voucher specimens
- Geocoordinates: standardized terminology and methodology
- Data use: freely available, full attribution of records

2009 MosquitoMap (ArcGIS 9.2 – 10)

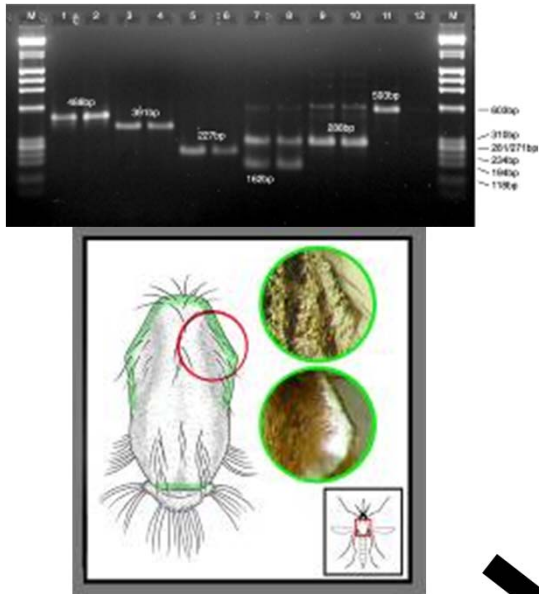


2011 VectorMap (ArcGIS 10)



- **Mosquito, tick and sand fly point data (~280k records)**
- **Vector distribution models**
- **Disease and host layers**
- **Host, parasite and ecology data**

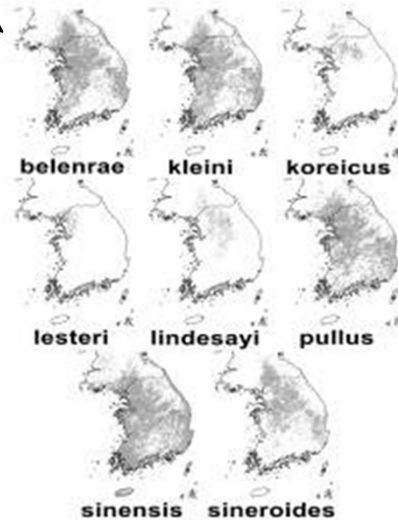
Taxonomic data



Point occurrence data



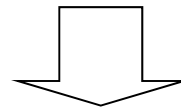
Environmental data



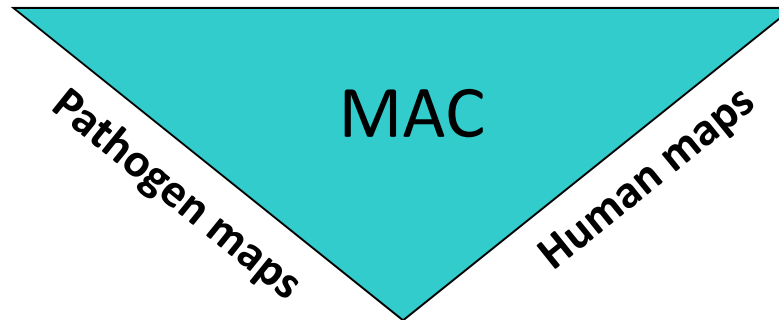
Mosquito Distribution Models

Workflow of VectorMap

Collection points  Distribution models



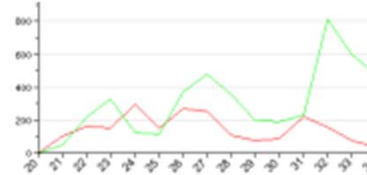
Vector maps



Disease risk assessment

VectorMap point data

Spatial
e.g. 'One-off'
data



Temporal
e.g. routine
weekly data

Vector

Host/Reservoir

MosquitoMap

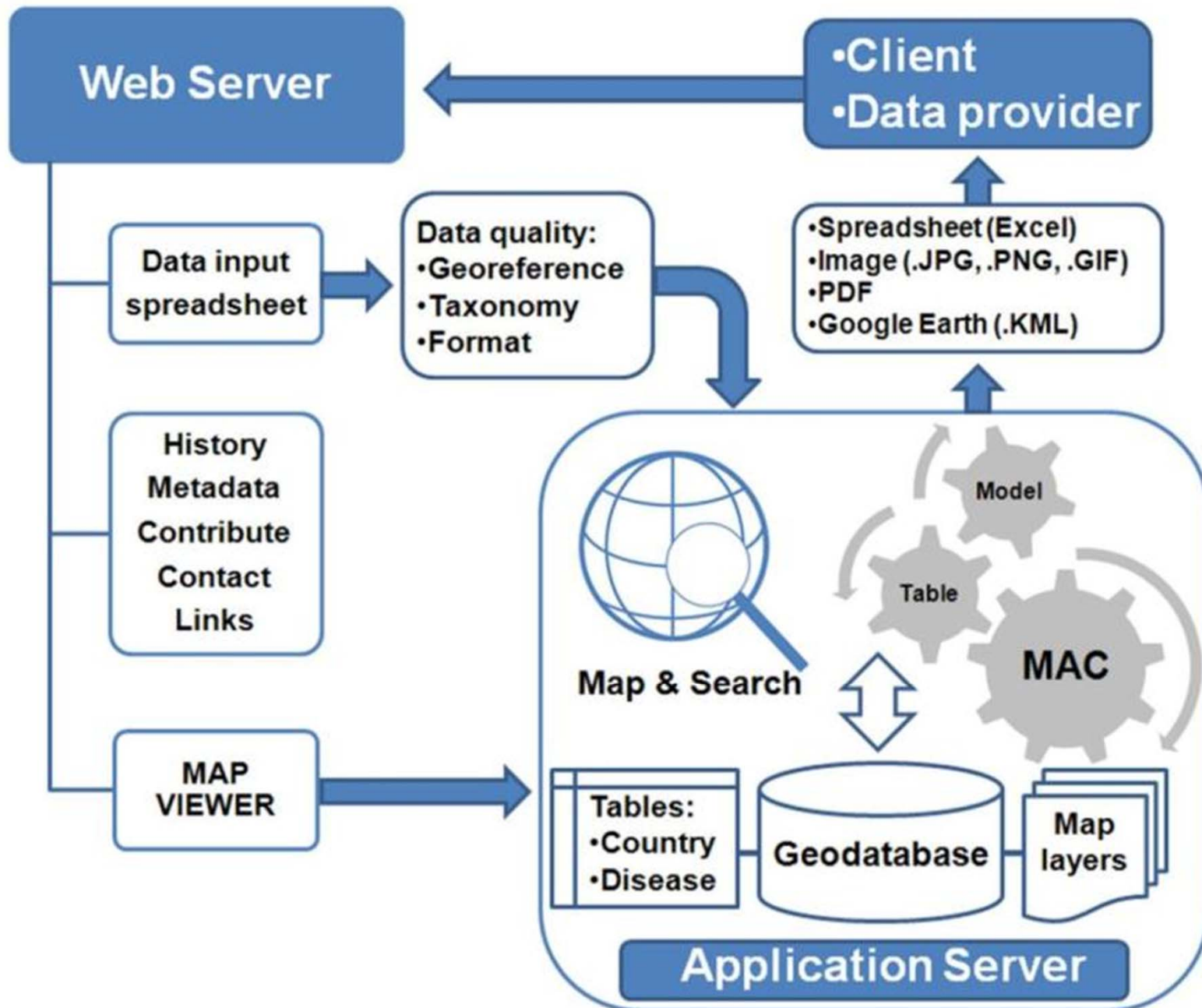
TickMap

SandflyMap

MiteMap

HostMap

VectorSurv



MaNIS - The Mammal Networked Information System - Classic Localities

"Alaska, off the coast of California"

"possibly central Chile"

"between Los Angeles and San Francisco"

"Mexico to Argentina"

"Location 201"

"Bob Jones' yard"

"Coast"

"Bridge E of Lodge"

"near Sand dunes"

"Ranch"

"National Park"

"Pacific Ocean somewhere toward Australia"

Mississippi river

FORUM

Importance of the “What,” “When,” and “Where” of Mosquito Collection Events

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J. Med. Entomol. 46(4): 717–722 (2009)

Mmap Data schema follows Darwin Core Standards with the addition of fields specific for mosquitoes, e.g. parasite data, larval habitats, behavior

(--The Darwin Core is a specification of data concepts and structure intended to support the retrieval and integration of primary data that documents the occurrence of organisms in space and time and the occurrence of organisms in biological collections)

Schema

SubmitterOrganization

SubmitterWebSite

SubmitterPerson

SubmitterEmail

SubmitterAddress

DateLastModified

Collector

InstitutionCode

CollectionCode

CatalogNumber

GlobalUniqueIdentifier

GenBankNumber

BasisOfRecord

Source

RelatedInformation

InformationWithheld

Kingdom

Phylum

Class

Order

Family

Genus

SubGenus

Species

ScientificName

AuthorYearOfScientificName

IdentifiedBy

DateIdentified

IdentificationMethod

EarliestDateCollected

LatestDateCollected

VerbatimDateOfCollection

TimeOfCapture

Country

StateProvince

County

Locality

DecimalLongitude

DecimalLatitude

GeodeticDatum

VerbatimLongitude

VerbatimLatitude

VerbatimCoordinates

VerbatimCoordinateSystem

CoordinateUncertaintyInMeters

GeoreferenceProtocol

GeoreferenceSources

GeoreferenceRemarks

IndividualCount

Sex

LifeStage

Remarks

CollectionMethod

CollectingEffortInHours

LarvalHabitatType

LarvalHabitatCondition

DistanceToHouseInMeters

DegreeOfShade

VerbatimElevation

AssociatedParasite

LifeStageOfParasite

IdentificationMethodForParasite

NumberOfMosquitoesTestedForParasite

RemarksAboutParasite

MosquitoMap Search Page and Base Map

Search Map Layers Results

Mal-area Calculator Tools Export Bookmarks Upload Data Home

Select one or more of the following options to filter the mosquito observation locations.

Submitter: << All >>

Collector: << All >>

Country: << All >> Algeria American Samoa Angola

Genus: << All >> Aedeomyia Aedes Anopheles

Species: << All >> abdita abebela ablechra

Parasite: << All >>

Basis Of Record: << All >>

Collection Dates: Between 1900-1-1 And

Search Clear

Basic Basemap Satellite

4000 km

Deg Min Sec 6° 30' 13.97\" S 115° 39' 49.09\" W

USER SCENARIOS

Point and distribution models:

- **What species have been collected in an AOI**
- **Where has a certain species been collected**
- **Where is a certain species expected**
- **Where is rich in species**
- **How to contribute collection records**
- **How to download data**

Mal-area Calculator:

- **Compare AOI for relative risk of VBD**
- **Compare AOI for distribution of hazard**
- **Compare sites for Human settlement**

What species have been collected in an AOI

The screenshot displays a GIS web application interface. At the top, there is a navigation bar with options: Search, Map Layers, Results, Mal-area Calculator, Tools, Export, Bookmarks, Upload Data, and Home. The main map area shows a geographical view of Kenya with a large, irregularly shaped Area of Interest (AOI) highlighted in purple. The AOI covers parts of the interior and coastal regions, including areas near Mombasa and the coast. Various geographical features are labeled, such as Kilimanjaro (National Park), Amboseli (National Reserve), Tsavo West (National Park), and Tsavo East (National Park). Major roads and cities like Mombasa, Malindi, and Nairobi are also visible. The map includes a scale bar (50 km) and coordinate information (Lat: 2° 44' 52.60"S, Lon: 40° 16' 22.74"E).

On the left side, a panel titled "Mosquitoes: 231 records" lists the species collected within the AOI. The records are sorted by ScientificName and include the following species:

- Aedes aegypti (multiple records)
- Aedes bromeliae
- Aedes calceatus (multiple records)
- Aedes fulgens (multiple records)

An "Identify" tool window is open over the map, showing a dropdown menu for "Layer" set to "<< All Visible Layers >>". The "Tool" section includes options for Buffer, Custom Shape, and Point. Below the tool options, there is a yellow text box with instructions: "This tool identifies features that intersect a user defined shape. Click on the map to add points to your shape. Press the 'DELETE' key to undo your last click."

Where has a certain species been collected

Search Map Layers Results Mal-area Calculator Tools Export Bookmarks Upload Data Home

Select one or more of the following options to filter the mosquito observation locations.

Submitter: << All >>

Collector: << All >>

Country: << All >>
Algeria
American Samoa
Angola

Genus: << All >>
Aedeomyia
Aedes
Anopheles

Species: << All >>
abdita
abebela
ablechra


Parasite: << All >>

Basis Of Record: << All >>

Collection Dates: Between 1900-1-1
And

Search Clear

Basic Basemap Satellite



Map data not yet available

Map data not yet available

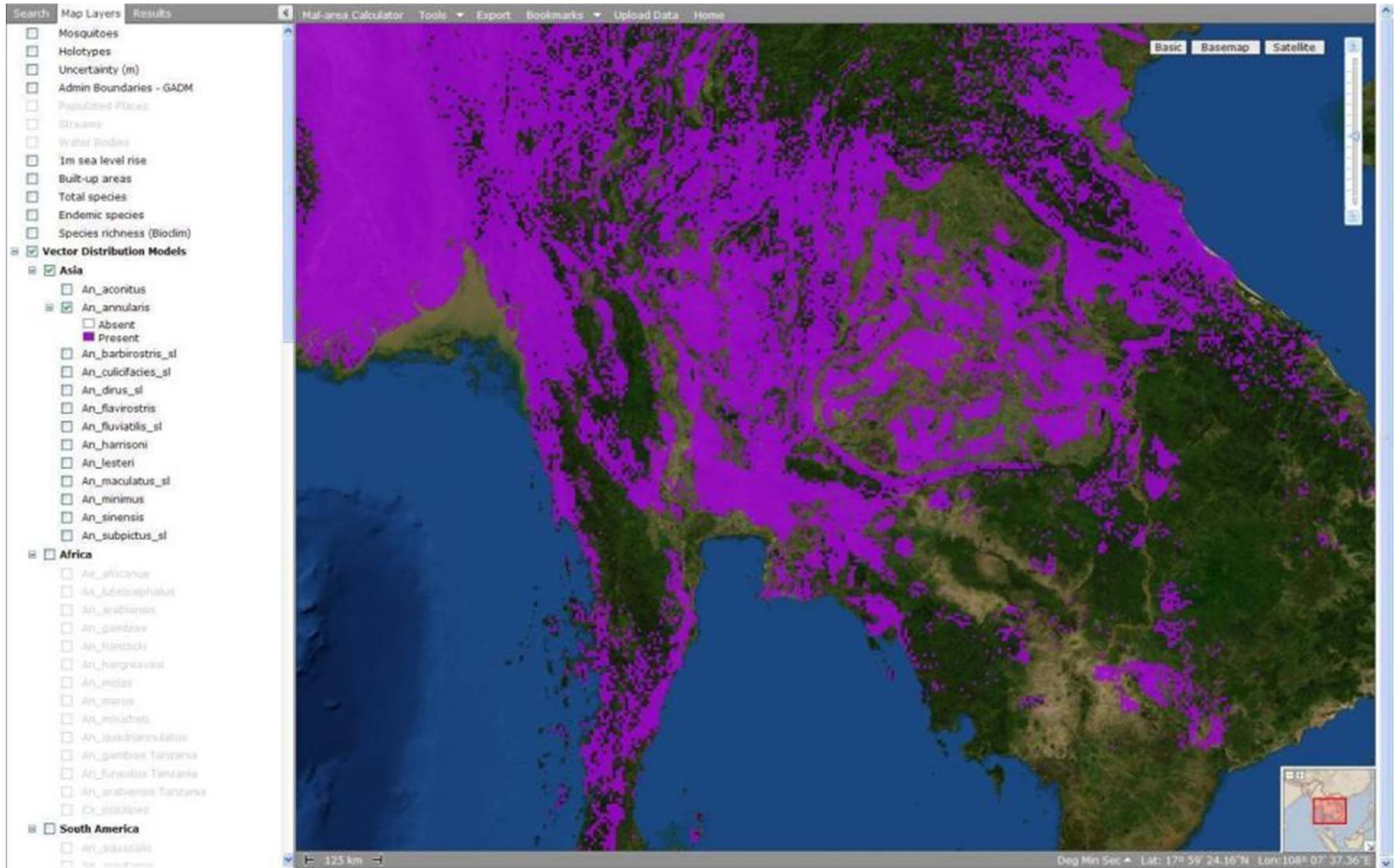
Map data not yet available

Species	Observations
aegypti	745

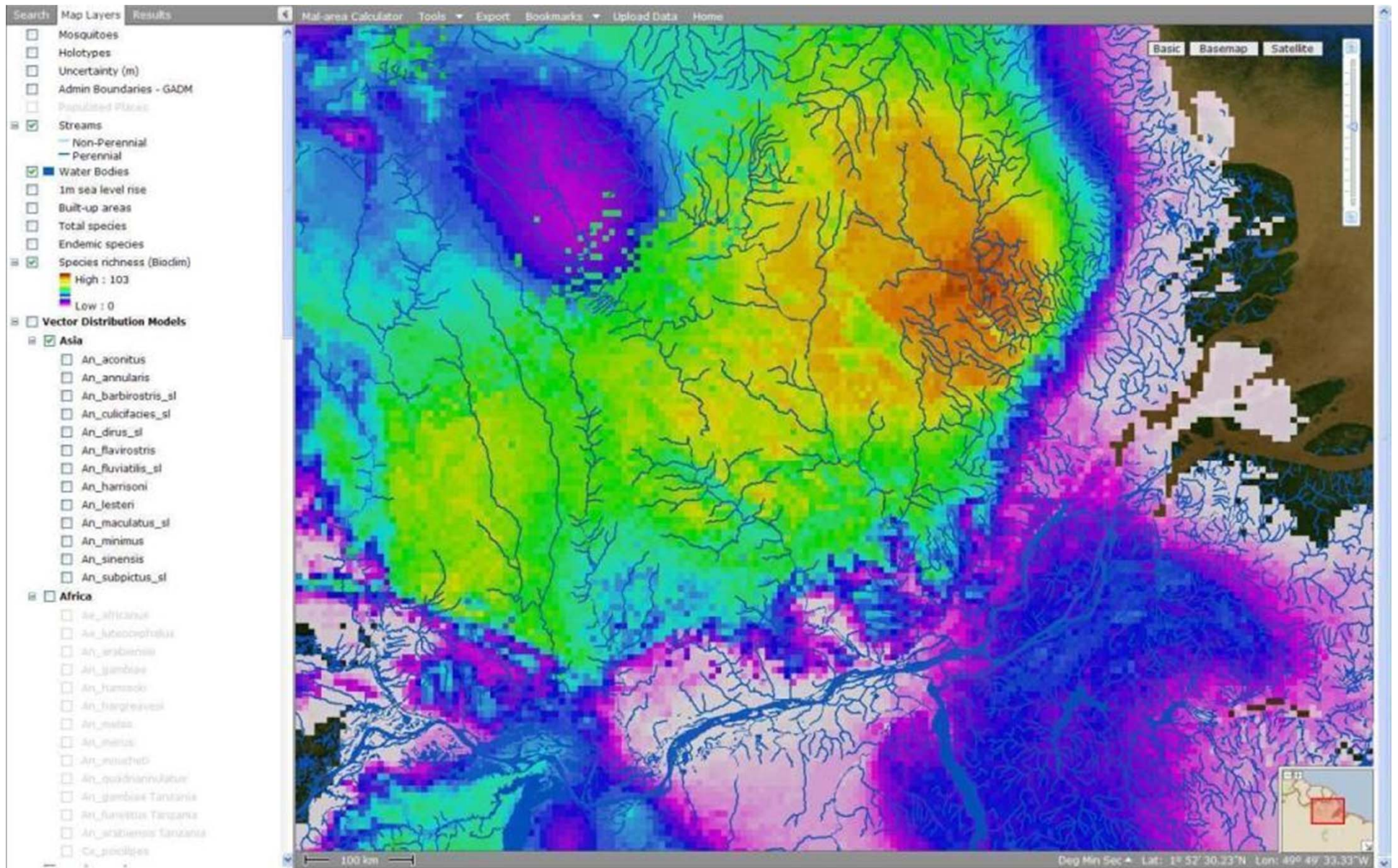
0 m

Deg Min Sec Lat: 99° 18' 58.92"S Lon: 218° 40' 15.86"E

Where is a certain species expected

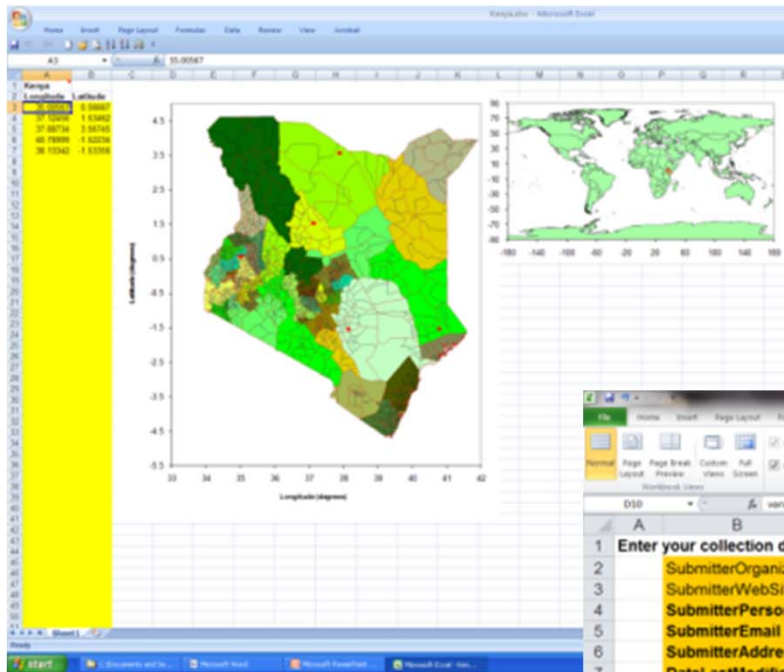


Where is rich in species



How to contribute collection records

Excel Mapper



Collection forms

The screenshot shows the 'Collection forms' spreadsheet. The form includes fields for SubmitterOrganization, SubmitterWebSite, SubmitterPerson, SubmitterEmail, SubmitterAddress, and DateLastModified. Below these is a table for collection records with columns for DecimalLongitude, DecimalLatitude, Species, Collector, DateOfCollection, BasisOfRecord, and CollectionCode. A dropdown menu is open for the Species field, showing a list of species names including varuna_Anopheles_Cella_jyengar 1924.

DecimalLongitude	DecimalLatitude	Species	Collector	DateOfCollection	BasisOfRecord	CollectionCode
1		varuna_Anopheles_Cella_jyengar 1924				
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						

How to download data

Excel

	A	B	C	D	E	F	G	H	I	J	K
	ScientificName	Id	SubmitterOrg	SubmitterWe	SubmitterPer	SubmitterEm	SubmitterAd	DateLastMod	Collector	InstitutionCo	CollectionCo
1	Anopheles al	12	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 424	
2	Anopheles al	20	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 434	
3	Anopheles al	22	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 435	
4	Anopheles al	25	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 436	
5	Anopheles al	39	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 391	
6	Anopheles al	45	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 393	
7	Anopheles al	53	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 446	
8	Anopheles al	69	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 297	
9	Anopheles al	73	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 395	
10	Anopheles al	75	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 396	
11	Anopheles al	77	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 399	
12	Anopheles al	78	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 400	
13	Anopheles al	82	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 81	
14	Anopheles al	84	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 352	
15	Anopheles al	123	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 450	
16	Anopheles al	129	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 463	
17	Anopheles al	186	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 459	
18	Anopheles al	219	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 302	
19	Anopheles al	223	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 303	
20	Anopheles al	225	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 37	
21	Anopheles al	237	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 367	
22	Anopheles al	240	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 372	
23	Anopheles al	241	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 374	
24	Anopheles al	242	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 375	
25	Anopheles al	244	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 376	
26	Anopheles al	246	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 377	
27	Anopheles al	247	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 384	
28	Anopheles al	249	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 408	
29	Anopheles al	252	Walter Reed	http://www.wr	Foley DH and foleydes@si	Walter Reed	5/1/08 0:00	WRBU collect	USNM	BHZ 411	
30	Anopheles al									USNM	BHZ 412

Google Earth



USER SCENARIOS

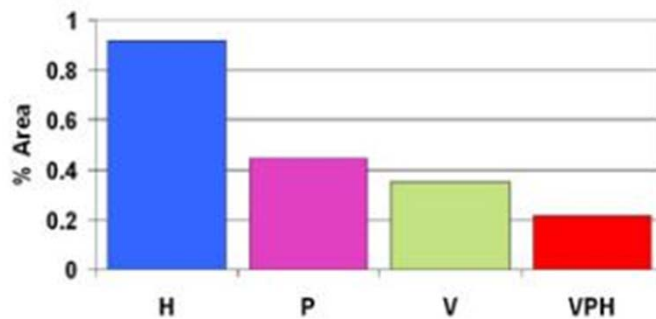
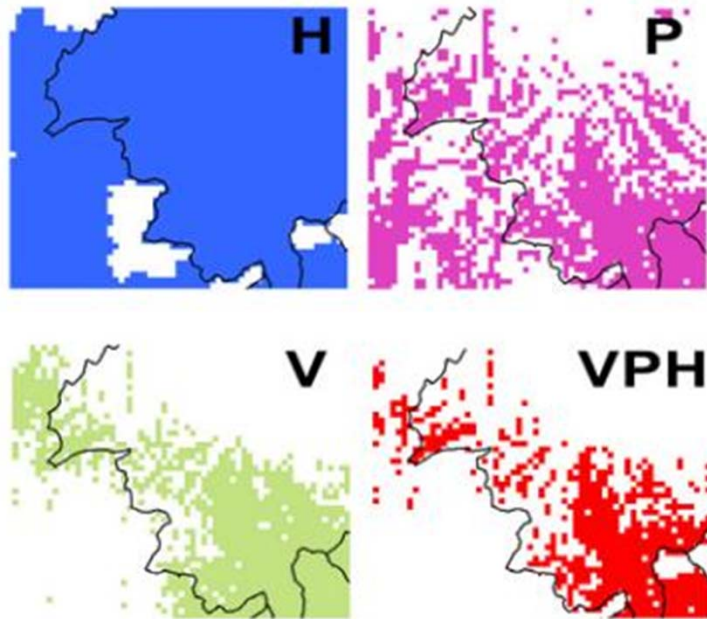
Point and distribution models:

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Mal-area Calculator:

- Compare AOI for relative risk of VBD**
- Compare AOI for distribution of hazard**
- Compare sites for Disease and Human settlement**

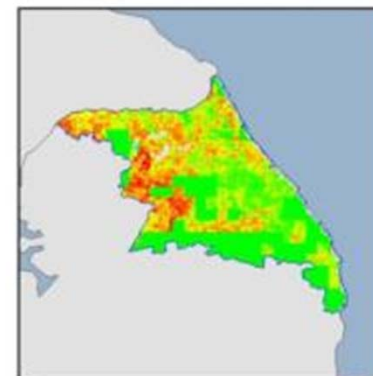
Mal-area Calculator – quantifying the Mal-area or area of co-occurrence (VPH) for Human (H), Parasite (P) and Vector (V)



- *Define the study area
- *Select the disease
- *Settings for the disease and vector models
- *Execute analysis
- *Generate report



Mal-area



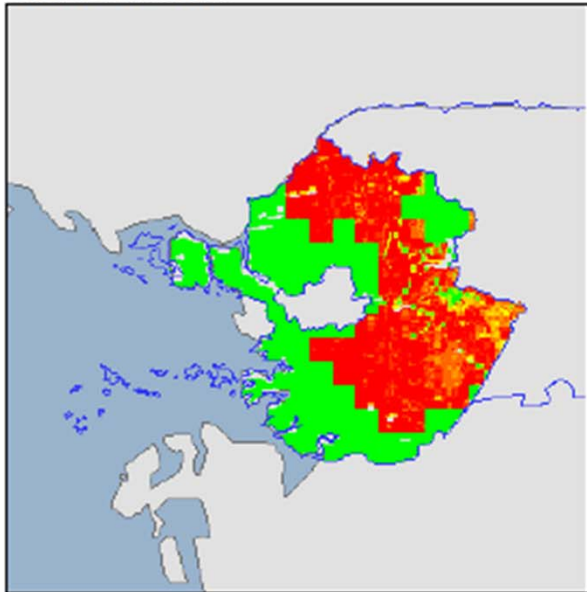
Statistics

Maximum positive pixel value	4
Minimum positive pixel value	0.1
Sum of pixel values	34,202.8
Average pixel value	1.28
Average positive pixel value	1.87
Area of interest (number of pixels)	27,728
Area of Mal-area (number of positive pixels)	18,335
Area of interest covered by Mal-area	66.12 %

Compare AOI for relative risk of VBD

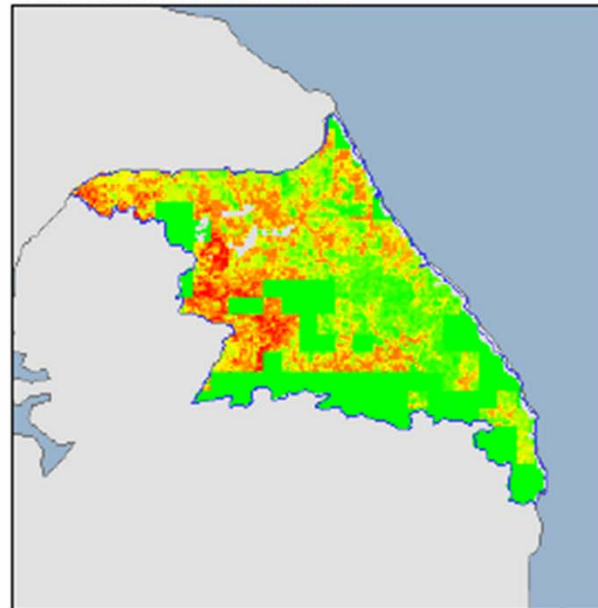
Compare AOI for distribution of hazard

for Area of interest



Maximum positive pixel value	1
Minimum positive pixel value	0.1
Sum of pixel values	6,946.4
Average pixel value	0.5
Average positive pixel value	0.91
Area of interest (number of pixels)	14,431
Area of Mal-area (number of positive pixels)	7,637
Area of interest covered by Mal-area	52.92 %

Mal-area for Area of interest



Maximum positive pixel value	4
Minimum positive pixel value	0.1
Sum of pixel values	34,202.8
Average pixel value	1.28
Average positive pixel value	1.87
Area of interest (number of pixels)	27,728
Area of Mal-area (number of positive pixels)	18,335
Area of interest covered by Mal-area	66.12 %

<http://www.vectormap.org/>



Home | About | Contact us | FORUM | WRBLL | MosquitoMap | SandflyMap | TickMap | Resources

Welcome to VectorMap

VectorMap is an entry point to data in the map services listed in the figure to the left. These services include spatial point data for vectors in MosquitoMap, SandflyMap and TickMap - geospatially referenced clearings/closures for arthropod disease - vector species collection records and distribution models. Users can pan and zoom to anywhere in the world to view the locations of past sand fly collections and the results of modeling that predicts the geographic extent of individual species. Collection records are searchable and downloadable, users can map and upload their own georeferenced collection data or distribution models, and all contributions will have full attribution. Currently, MosquitoMap has 241,429 records, TickMap has 38,292 records, and SandflyMap has 4,330 records.

VectorMap is designed to preserve and make available the results of past collecting and distribution modeling activity. The utility of VectorMap will increase as more records and models are added. Contributions are encouraged, especially from individuals and organizations with digitized, georeferenced records and those involved in ongoing mosquito surveillance. VectorMap is modeled on MosquitoMap - see *International Journal of Health Geographics*. For an introduction to georeferencing standards and procedures see *Journal of Medical Entomology*.

VectorMap is useful for:

- informing decisions about where vector collection efforts should be directed
- identifying areas relevant to the study of vector biogeography, evolution and biodiversity
- allow predictions about the potential spread of exotic vector introductions
- allow predictions about the potential effects of global warming on vector distributions
- allow insights into vector community structure, and environmental and climatic correlates to species occurrence (ecological niche)
- allow continent-wide rather than just local studies of vector-borne disease
- identifying cryptic evolutionary lineages that differ in geographic or ecological space.

The Mal-area calculator

A novel enhancement of VectorMap is the Mal-area calculator (MAC) that quantifies the overlap between vector and pathogen distribution models, and host (human) population. The co-occurrence of vectors, parasites and hosts are required for many vector-borne diseases, and the MAC quantifies this co-occurrence for a given area, thus potentially providing a map and simple index of disease risk for any area of interest. At the moment the MAC is at the 'proof of concept' stage, and only works in MosquitoMap for South Korea, but we plan to expand its coverage in the near future!

For best performance, set screen resolution for 1024 x 768 or greater, and use IE 8.0 or greater, Firefox 2.5 or greater, or Safari 3 or greater.

The quality and completeness of data cannot be guaranteed. Users employ these data at their own risk. By downloading and/or viewing data on the MosquitoMap, SandflyMap, and TickMap portals, you are agreeing to these conditions.

[OPEN MosquitoMap](#)

[OPEN TickMap](#)

[OPEN SandflyMap](#)

What's new?

- 12 July 2010. Resources link to downloadable Excel map previewers for 3 countries
- 20 July 2010. Improved and expanded Excel country maps to 34 under 'Resource'
- 27 July 2010. Added 8 new Excel country maps under 'Resource'
- 15 Oct 2010. Added new Excel country maps under 'Resource' - now 47
- 17 Nov 2010. Added new Excel country maps under 'Resource' for Liberia and Nagal - now 49
- 30 Nov 2010. Added new Excel country maps under 'Resource' for Libya - now 50
- 19 Apr 2011. New Microsoft Silverlight version of the VectorMap viewer is now available.
- 3 June 2011. Added new Excel country maps under 'Resource' for Ukraine, Syria, Morocco, Ethiopia, Sudan, and Cayman Islands.
- 3 June 2011. Added new Excel country maps under 'Resource' for Azerbaijan, Cuba, El Salvador.

VectorMap meeting 1-12 Oct Washington DC!!!

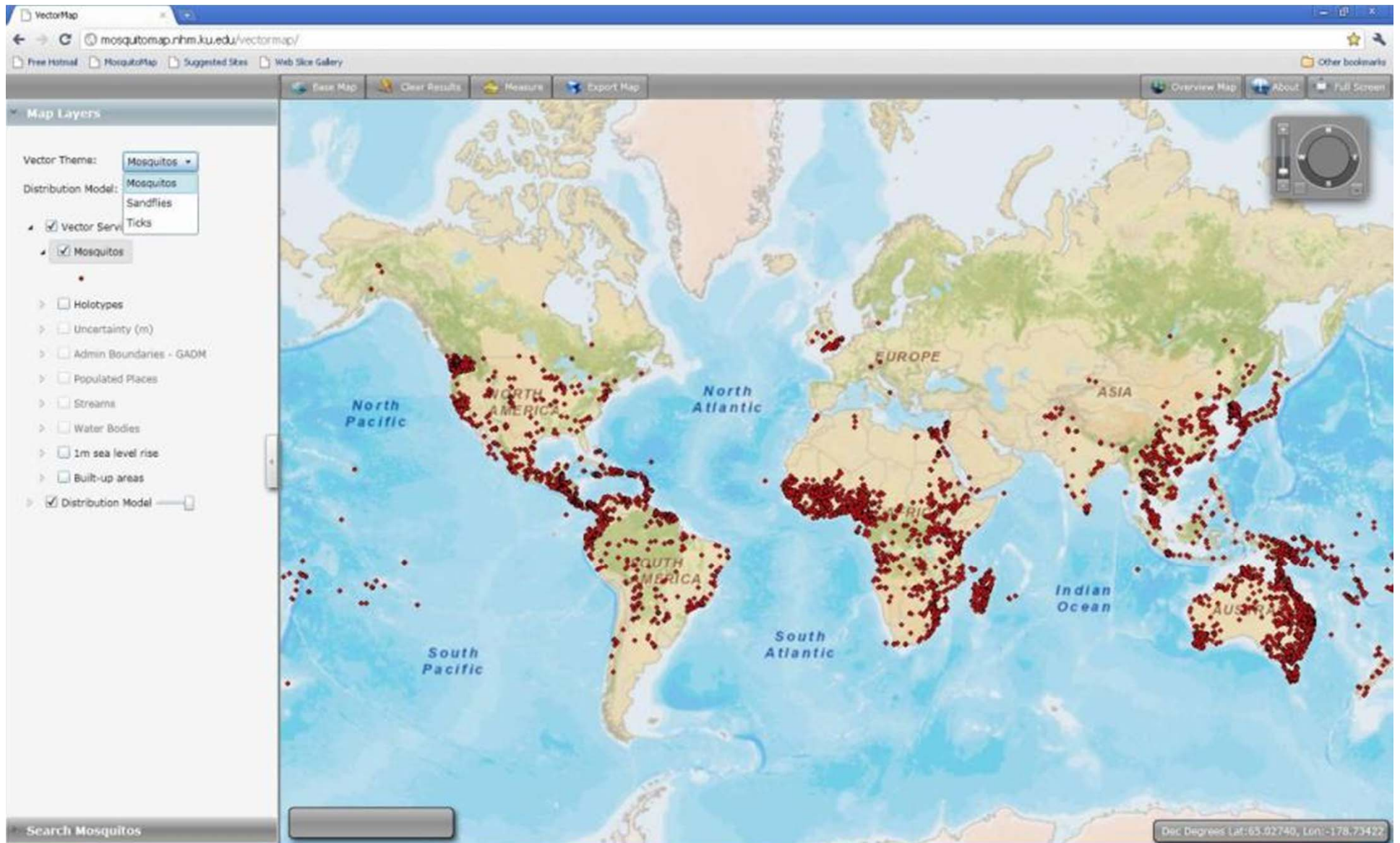
Funding for VectorMap was provided by the US Department of Defense Global Emerging Infections Surveillance and Response System (DoD-GEIS), a Division of the Armed Forces Health Surveillance Center, and from the Global Biovector Information System (GBVIS). Comments and questions should be directed to Diamond Foley, Polix Rueda and Richard Wilkinson, or by visiting the FORUM.

THANKS AGAIN TO 2010-2011 1428



New viewer site requires Silverlight

Opening screen



Zoom to AOI, different map choices

The screenshot displays the VectorMap web application interface. The browser address bar shows the URL mosquitomap.nihm.ku.edu/vectormap/. The application features a search bar at the bottom left labeled "Search Mosquitos".

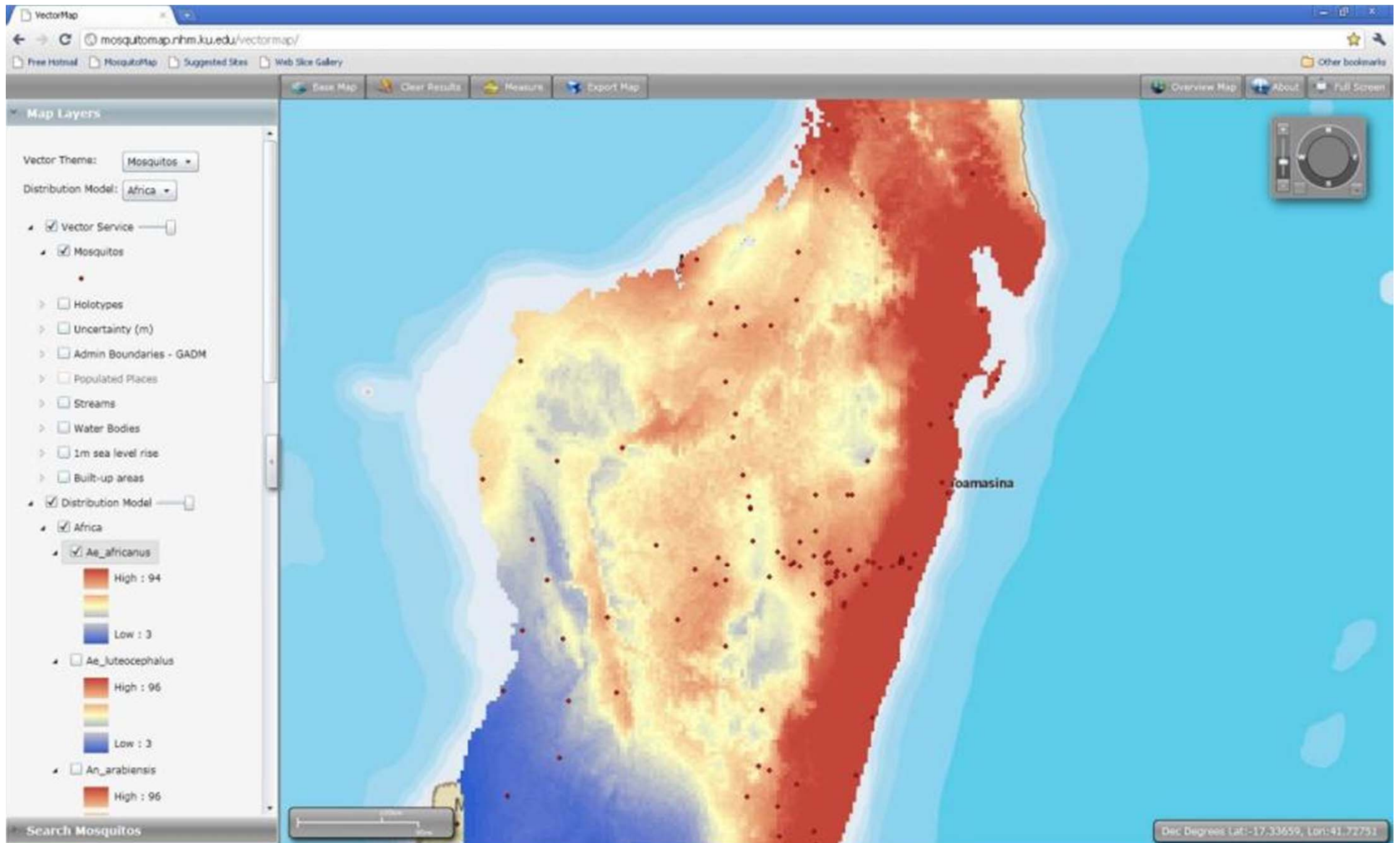
The "Map Layers" panel on the left includes the following settings:

- Vector Theme: Mosquitos
- Distribution Model: Africa
- Vector Service
- Mosquitos
- Holotypes
- Uncertainty (m)
- Admin Boundaries - GADM
- Populated Places
- Streams
- Water Bodies
- 1m sea level rise
- Built-up areas
- Distribution Model

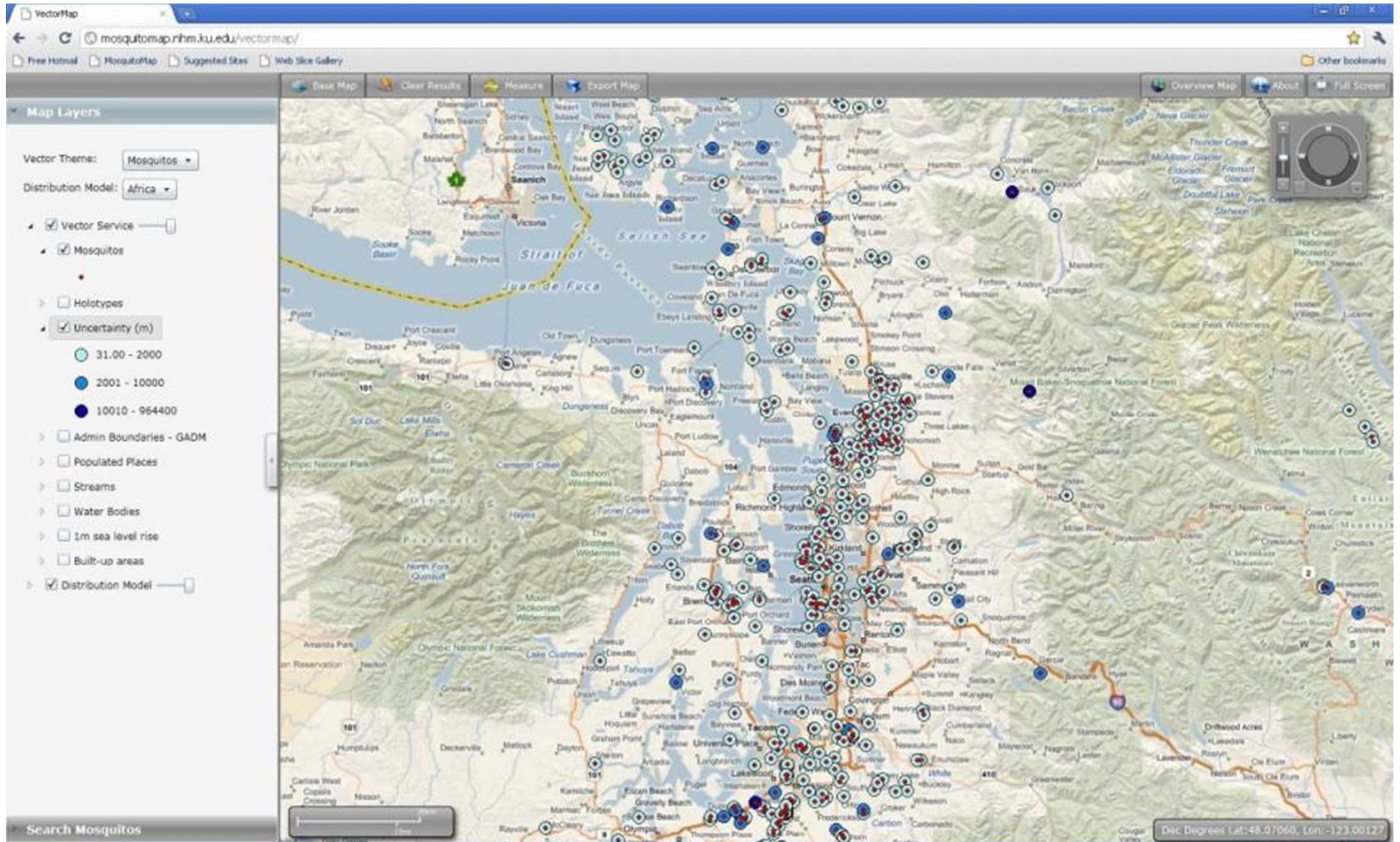
The map displays the island of Madagascar and the Comoros islands. The map is overlaid with a distribution model for mosquitoes, indicated by red dots. The map is titled "COMOROS" at the top. The map includes a scale bar at the bottom left and a coordinate display at the bottom right showing "Dec Degrees Lat: -11.95500, Lon: 41.91603".

The map interface includes a "Map Layers" panel on the left, a "Search Mosquitos" bar at the bottom left, and a "Scale" bar at the bottom center. The map shows the island of Madagascar and the Comoros islands, with various geographical features and labels. The map is titled "COMOROS" at the top. The map includes a scale bar at the bottom left and a coordinate display at the bottom right showing "Dec Degrees Lat: -11.95500, Lon: 41.91603".

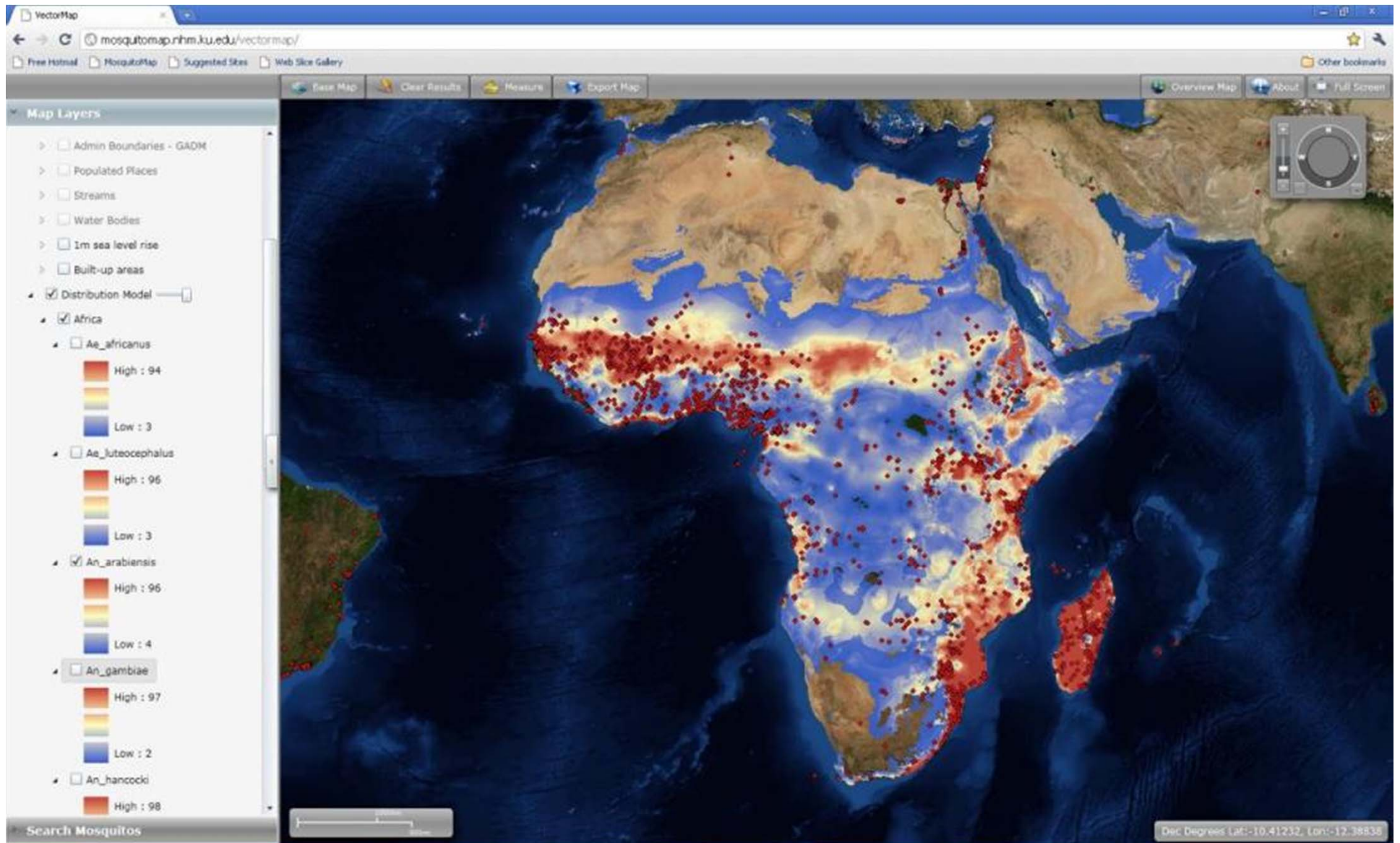
Distribution models for vector species



Uncertainty



Relate vector distribution to collection records



Text-based searching of point data

The screenshot displays the VectorMap web application interface. The browser address bar shows the URL `mosquitomap.nihm.ku.edu/vectormap/`. The main map area shows a geographical view of East Africa with a heatmap overlay in shades of red and yellow, indicating mosquito observation density. Numerous red dots are scattered across the map, representing individual observation points. On the left side, there is a 'Map Layers' panel with a 'Search Mosquitos' section. This section contains several search filters:

- Submitter: << All >>
- Collector: << All >>
- Country: Japan, Kenya, Kiribati
- Genus: << All >>, Aedeomyia, Aedes
- Species: << All >>, abdita, abebela
- Parasite: << All >>
- Basis of Record: << All >>
- Collection Date: Equals, <M/d/yyyy>

Buttons for 'Search' and 'Clear' are located below the filters. At the bottom left, a status bar indicates 'Results - 230 records'. At the bottom right, a coordinate box shows 'Dec Degrees Lat: -3.20959, Lon: 30.31176'. An 'Overview Map' inset is visible in the bottom right corner of the map area.

Details of search results for collection records

The screenshot displays the VectorMap web application interface. The browser address bar shows the URL mosquitomap.nihm.ku.edu/vectormap/. The page features a search bar with the text "Search Mosquitos" and a results list showing 230 records. A "Vector Details" popup window is open, displaying the following information:

Attribute	Value
AuthorYearOfScientificName	(Linnaeus 1762)
ID	17764
Sequence	100017764
SubmitterOrganization	Walter Reed Biosystemati
SubmitterWebSite	http://www.wrbiu.org/
SubmitterPerson	Foley, D.H. & Wikerson, J
SubmitterEmail	foleydes@si.edu/wikerson
SubmitterAddress	Walter Reed Biosystemati
DateLastModified	10/30/2008 12:00:00 AM
Collector	Beley C, Keiro and Adria
InstitutionCode	USNM
CollectionCode	KEVP-41
CatalogNumber	9073976

The background map shows the Americas with a color-coded overlay representing mosquito distribution. A scale bar at the bottom left indicates 100 miles. The bottom right corner displays the coordinates: Dec Degrees Lat: -2.28732, Lon: 30.17666.

In progress...

SUMMARY

- VectorMap is an online database for georeferenced collection records, distribution models and disease models
- Vmap = MMap + SFMap + TMap
- Vector data is fundamental for predictive surveillance models
- Future - Host and Longitudinal surveillance data
- Online collection form and Excel Mapper



***Know the vector,
know the threat***



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