MERIT:

Climate information for the prevention and control of meningococcal meningitis in the Sahel: a multidisciplinary partnership

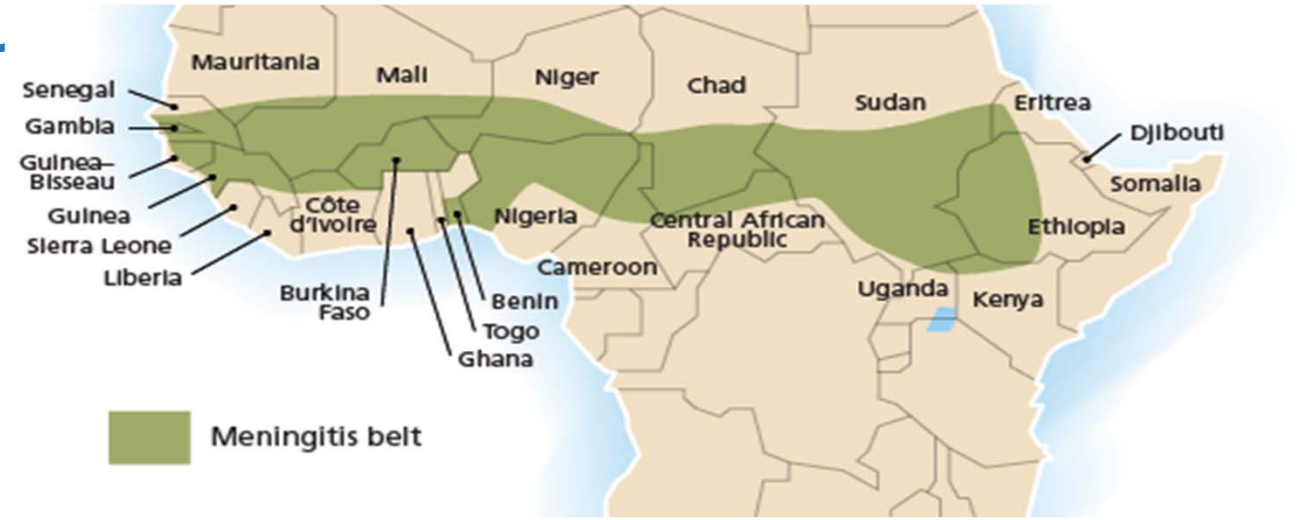
Madeleine C. Thomson[1], Masami Onoda[2], Emily Firth[3], Stéphane Hugonnet[3], Delia Gutiérrez[4], Slobodan Nickovic[5], Abere Mihretie[6], Michel Jancloes[7], David Rogers[7] and Eric G.Bertherat[3]

Presented by **Sylwia Trzaska, Columbia University, New York.**

Advances in Geospatial Technologies for Health
11-14 September 2011

Santa Fe, NM USA

Epidemic Meningitis in Africa: the problem



Source: Control of epidemic meningococcal disease, WHO practical guidelines, World Health Organization, 1998, 2nd edition, WHO/EMC/BAC/98.3 Extracted from http://www.meningvax.org/epidemics-africa.php

Meningococal Meningitis, bacterial form of meningitis

Direct transmission, person to person, respiratory droplets

12 serogroups. 4 in Africa: A, C, W135, X

Serious infection of the thin lining that surrounds the brain and spinal cord

Belt stretches from Senegal in the west to Ethiopia in the east (80 % of the global burden)

430 million people at risk, 1 million cases since 1998

10-50 % fatality rates, 10-20 % of survivors suffer permanent brain damage

Meningococcal Meningitis A Prevention and Control strategies

Old

Reactive - polysaccharide vaccine – used in response to epidemic (A, C, X etc.)

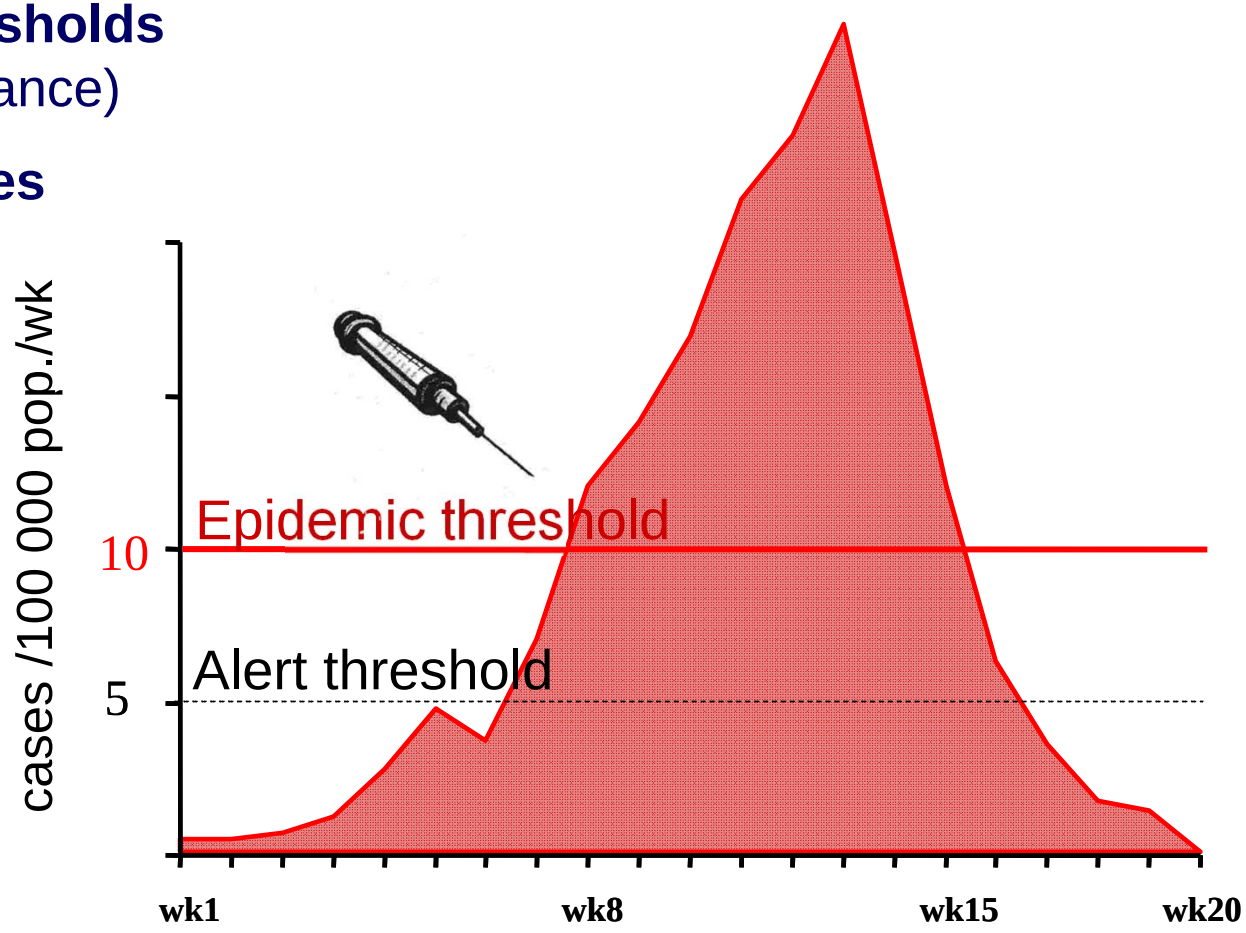
New

Proactive – Conjugate vaccine – used to prevent epidemics of Meningococcal Meningitis A.

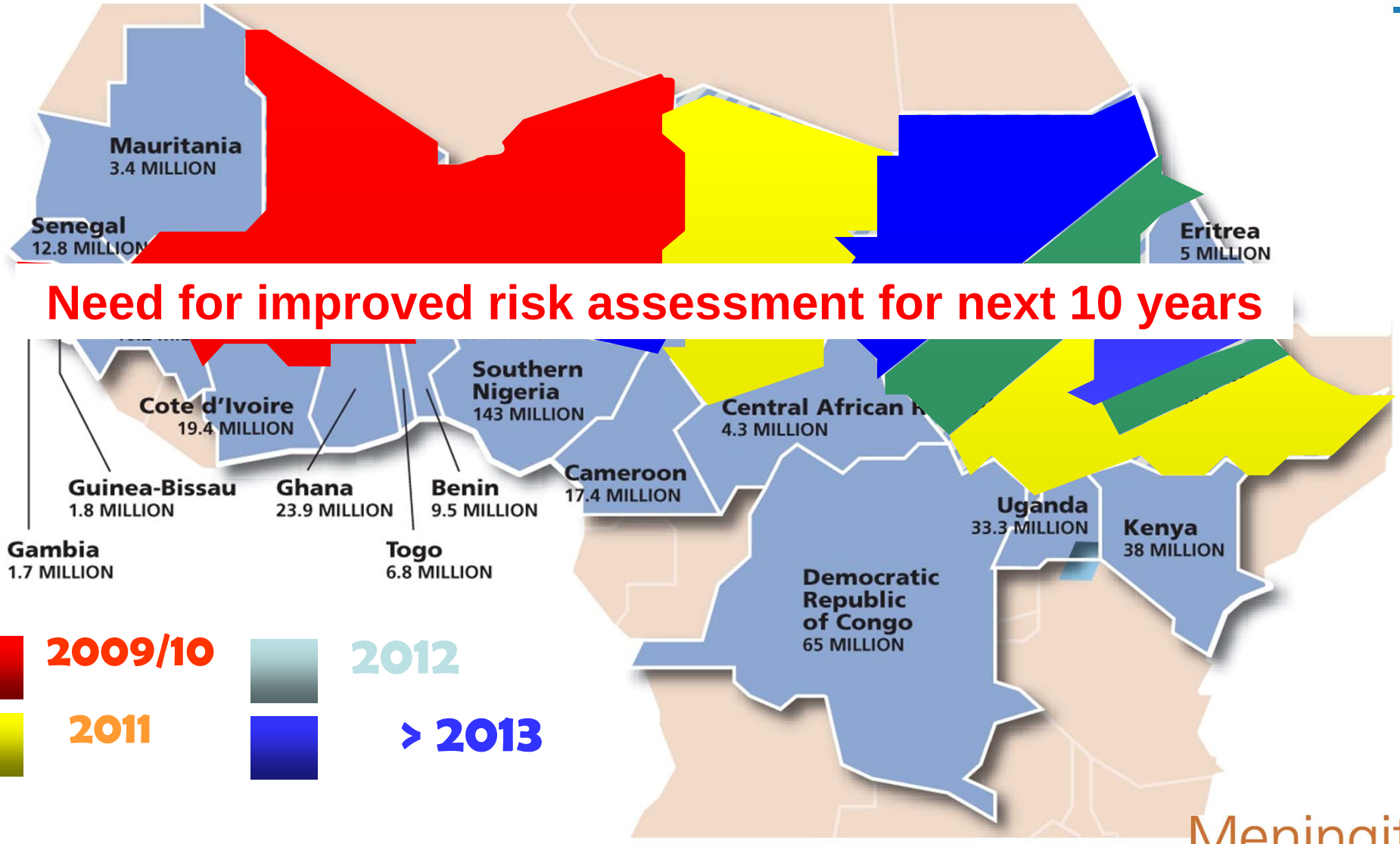
Control: reactive vaccination

- **District level**
- **Based on incidence thresholds** (enhanced weekly surveillance)
- **Does not prevent all cases**

***CHALLENGE*: timely vaccination to optimize the control of the epidemics**



Proposed MenA conjugate vaccine introduction



Decision makers concerns

Response to outbreaks

- Reducing time between outbreaks onset and reactive vaccination
- Setting criteria for ending response to outbreaks
- Forecasting: vaccine production and procurement

Introduction of a new conjugate vaccine

- Coverage scaling up: where first?
- Is the belt changing?
- Protection effectiveness over time?
- Coverage level required to prevent outbreaks ?
- Risk assessment of non A meningitis outbreaks ?(Alert and Attack rates)

How can climate/environmental information inform epidemic meningitis prevention and control?

- improve understanding of the mechansisms of climate impact on transmission and disease
- estimate populations at risk (risk mapping)
- estimate seasonality of disease and timing of interventions
- monitor and predict year-to-year variations in incidence (including early warning systems)
- monitor and predict longer term trends (climate change assessments)
- improve assessment of the impact of interventions (by removing climate as a confounder)

Creation of the MERIT Initiative

Meningitis Environmental Risk Information Technologies

- ✓ Established in 2007 at a GEO hosted meeting in Geneva
- ✓ Collaborative initiative of WHO and members of the environmental, public health and epidemiological communities to help reduce the burden of epidemic meningitis in Africa
- ✓ Research projects, modeling developments and collaborative partnerships progressing within the MERIT framework
- ✓ To inform and support the reactive and preventative vaccination strategies by combining knowledge, research and expertise of about 30 international and regional partners

Meningogoccal Meningitis: an environmental disease

At the time MERIT was formed climatic and environmental factors were understood t affect:

- Geographic occurrence of severe epidemics (the meningitis belt – confined to the semi-a Sahel)
- Seasonality of disease (confined to the hot, dry and dusty dry season)

Also - Widespread acceptance of the importance of immunity, bacterial strains and population characteristics (including density)

- Tantalizing hints that climate variability might be important in the timing and intensity of disease occurrence – but research lacked quality climate, environmental and epidemiologic data and robust analysis.
- Speculations on the mechanism(s) by which climate/environmental factors impact on meningococcal meningitis transmission and conversion from carriage to invasive disease – but little concrete evidence.

MERIT seeks to inform…

three operational areas:

- the reactive vaccination strategy (improve the impact of the reactive mass vaccination campaigns, prepare for the following epidemic season, refine the response strategy for outbreaks due to serogroups other than A, assess the risk of Nm A outbreak in areas previously vaccinated with the conjugate A vaccine);

- the preventive vaccination campaigns with the conjugate A vaccine (guide the introduction of the conjugate A vaccine and estimate the impact of the conjugate A vaccine); and

- 5 to 10 years time-horizon forecasting to gather information on the possible vaccine needs in the medium and long term.

Key to the MERIT concept was that research needs would be demand led, ie. Identified by those that were responsible for solving the health problem.

Partnerships – 3rd Technical MERIT meeting Niamey 2009.

Meningitis Vaccine Project

The changing landscape of MERIT

2007

- Creation of MERIT at a GEO-hosted meeting in Geneva
- Collaboration between health, environmental and research communities

2008

- 2nd technical MERIT meeting and Ethiopia national workshop, Addis Ababa
- How to make operational use of research for reactive strategy?
- MERIT-Ethiopia case study development

2009

- 3rd technical MERIT meeting and Niger national workshop, Niamey
- Niger case study - development of a decision-tree for testing in the next epidemic season
- Collaboration between partners and various modelling approaches, New York

.. 2010, 2011 and beyond

2010

- Near real-time monitoring of the 2010 epidemic season from January - April
- MERIT modeling workshop, May 2010 New York
- Prequalification of the new conjugate Men A vaccine, June 2010
- 4th Technical MERIT meeting an national workshop, Ethiopia
- MenAfriCar Carriage studies precedeConjugate A vaccine
- Introducution of Conjugate A vaccine in 3 countries

2011

- Integrate and align modelling and research activities to meet specific public health needs
- Finalise MERIT modelling work in case study countries
- 5th Technical MERIT meeting – Geneva – External Review
- Re-orientate MERIT to serve new policy environment

2012

- Build activities according to New MERIT strategy

MERIT Challenges

- Quality and homogeneity of epidemiological data
- Availability, quality and analysis of in-situ meteorological and dust data
- Quality of low resolution atmospheric reanalysis data (2.5x2.5 deg)
- Limitations of satellite sensors and general lack of data and understanding.
- Climate not analyzed in conjunction with other factors (e.g. susceptibility/ Immunity)
- Lack of knowledge on mechanisms or other factors
- Factors changing over time: e.g. circulating serogroups, climate, vaccination type
- Expansion of the Belt and introduction of conjugate vaccine

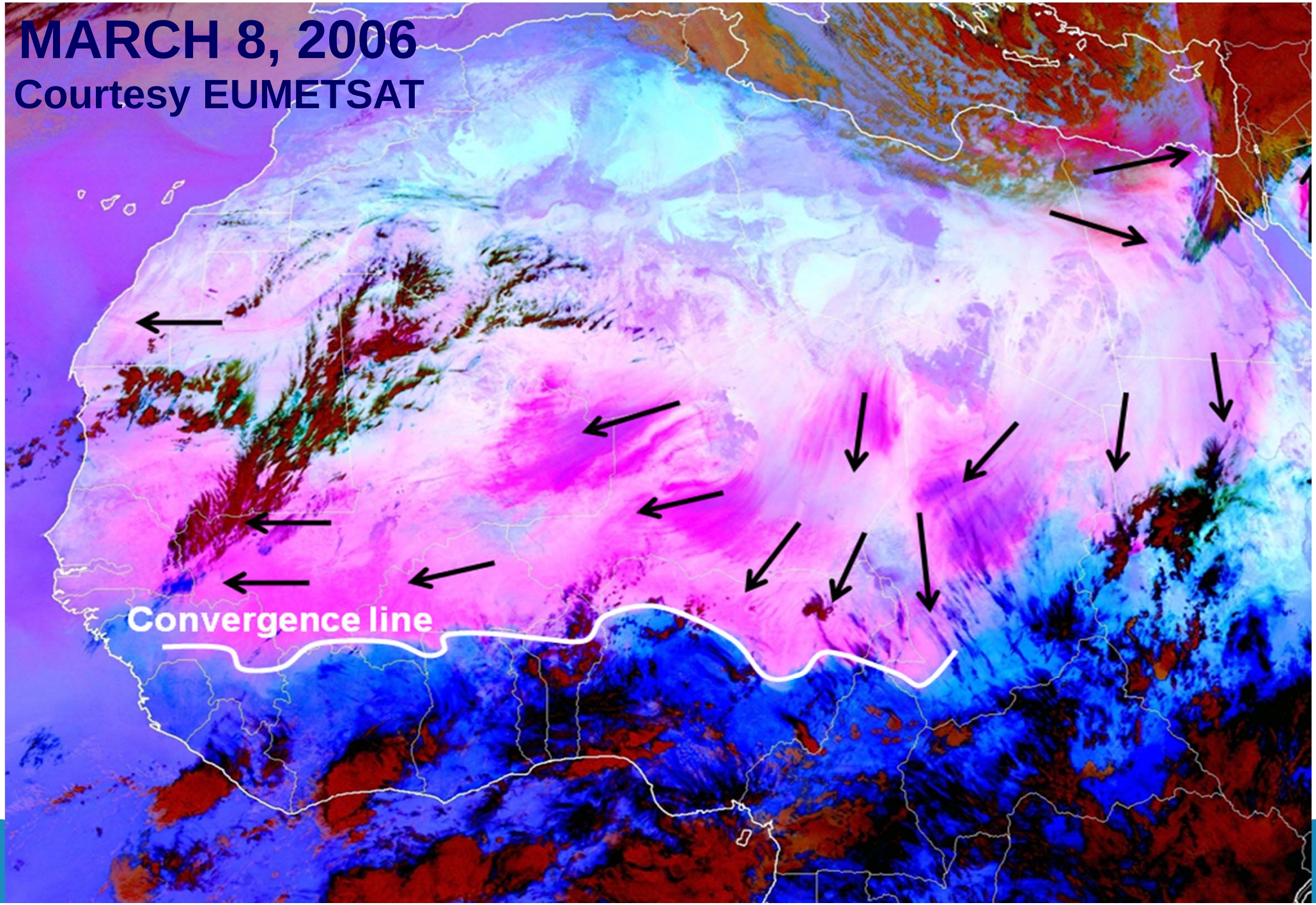
Focus on 5 variables

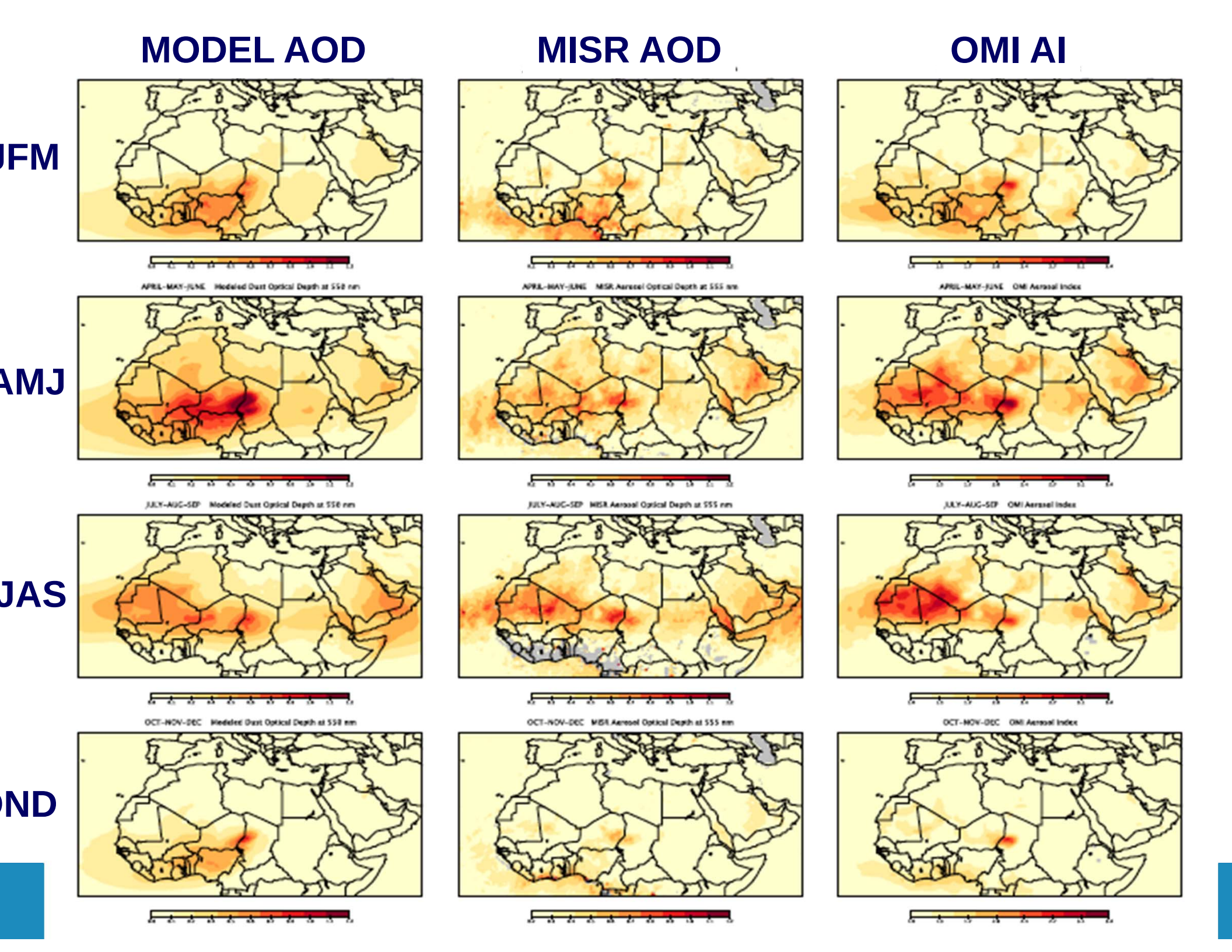
- Inter-Tropical Discontinuity (ITD)
- Absolute Humidity
- Dust
- Rainfall (and drought)
- Temperature

	MERIT 1	MERIT 2	MERIT 3	MERIT 4
	2007	2008	2009	2010
Overview of MERIT MVP and MenAfricar	[1, 2]		[3-5]	[6-8]
Recent and Current situation in the belt			[9]	[10, 11]
Overview of topic	[12-18]	[19, 20]	[21-24]	[25-29]
Overview related projects	[30-35]	[36-38]	[39-45]	[46-52]
Overview ongoing projects	[53, 54] [55-57]	[58-61]	[62-68]	[69-75]
Project results	[76, 77] [78]	[79-81]	[67, 82-87]	[88, 89]
Overview of related tools	[90]			
Overview of proposed tools		[91]	[92-94]	
New tools available				[95]
Overview related data sources				
Overview proposed data sources	[16]	[60, 96]		
New Data sources available				[97]

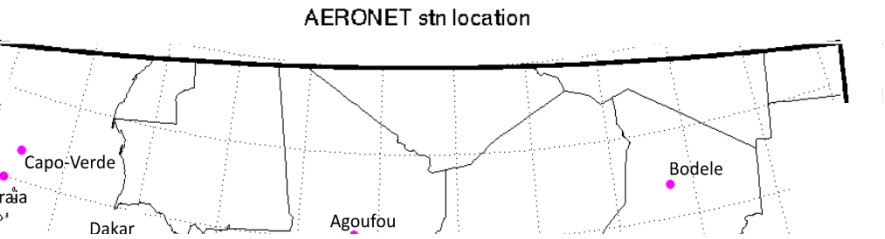
Approximately 100 research papers presented at MERIT Int. Technical Meetings

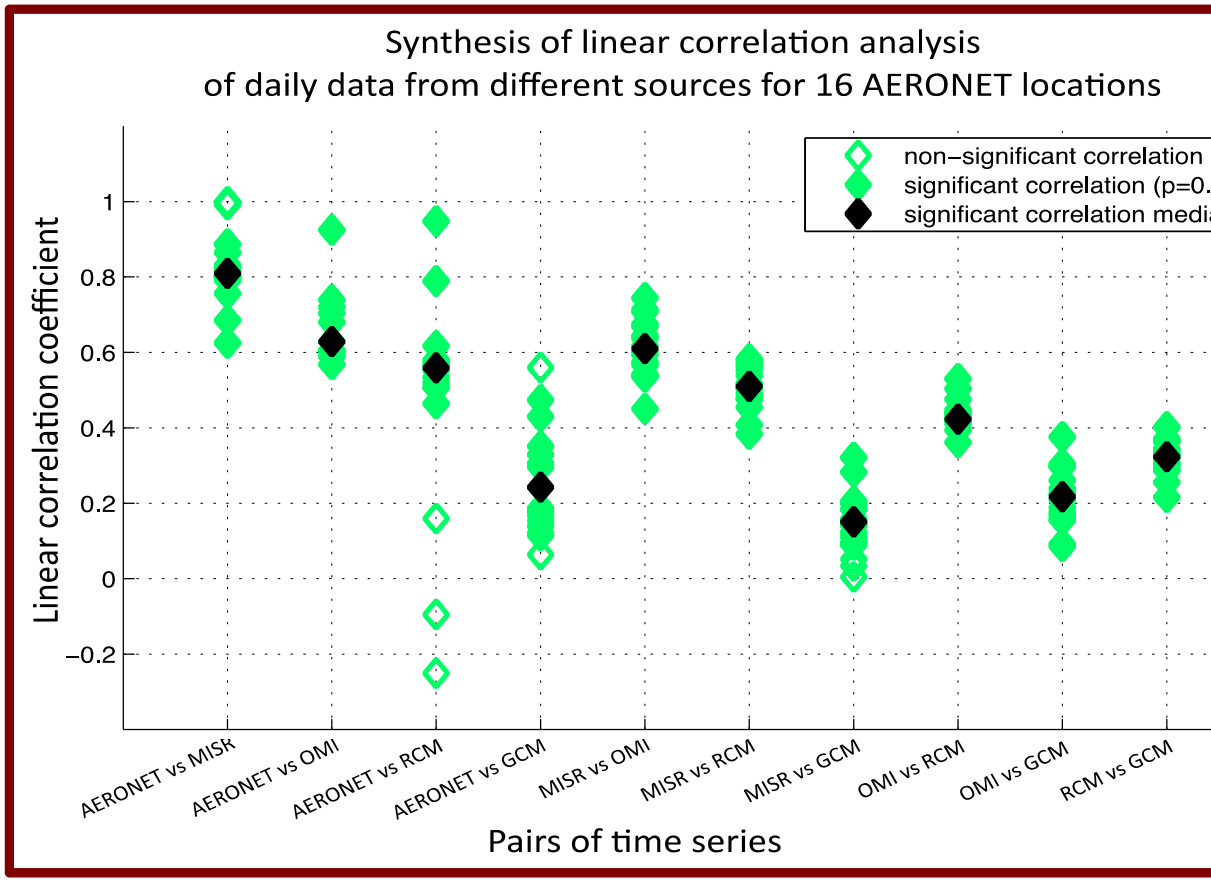
Examples - Dust




MODEL AOD
MISR AOD
OMI AI
JFM
AMJ
JAS
OND

Example - Dust





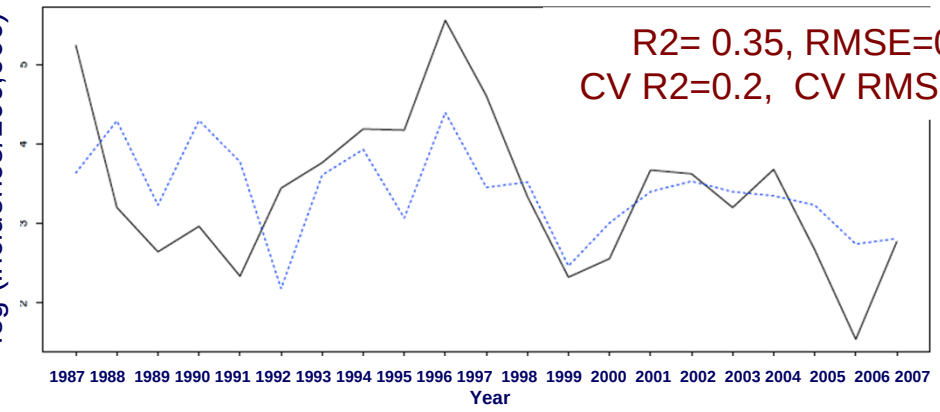
GCM
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2

1995 ----------2

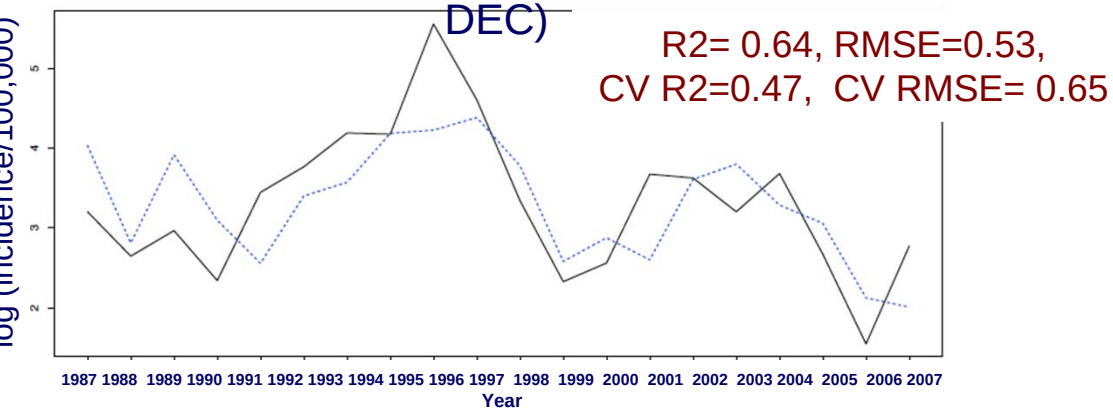
Example - predicting annual attack rates in Nige

NATIONAL SCALE

Log (incidence JAN-MARCH)
~ Log (early season Climate)

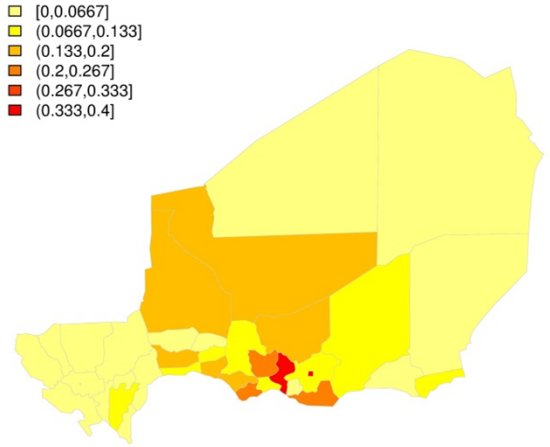


Log (incidence JAN-MARCH)
~ Log (early season Climate)& Log (incidence DEC)

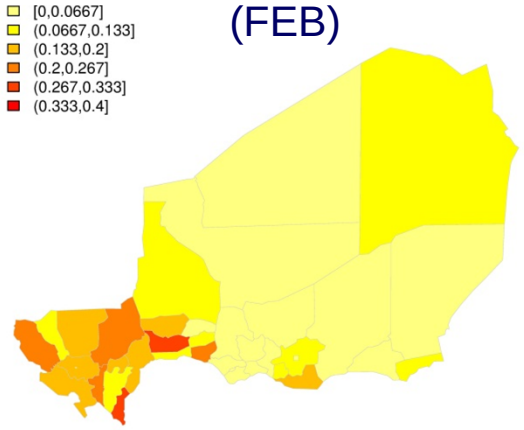


DISTRICT SCALE

Log (incidence JAN-MARCH)
~ Humidity (DEC)



Log (incidence JAN-MARCH) ~
Min Surface Temperature
(FEB)



In summary – achievements to date

- **Health- Climate alliance:** WHO initiative, established at a GEO hosted meeting in 2007 in Geneva:
- **Scientific platform**
  - 4 Internaional technical meetings.
  - Operational research: monitoring in near real time environmental conditions and epidemics, modelling and forecast testing
  - Research subgroups.
  - Country and regional settings
  - Global partnerships
- **Information and knowledge** dissemination; database development
- **Training**

MERIT community of partners

World Health Organization (Chair)

World Meteorological Organization

Group on Earth Observations

AEMET, Agencia Estatal de Meteorologia, Spain

Climate and Health Working Group, Ethiopia

Health and Climate Foundation

International Federation of the Red Cross and Red Crescent Societies

International Research Institute for Climate Society, Columbia University

Meningitis Vaccine Project

ACMAD

Agence Medecine Preventive

Anti Malaria Association, Ethiopia

CERMES

CIESIN

Google.org

Institut Pasteur

London School of Hygiene and Tropical Medicine

Liverpool School of Tropical Medicine

Mailman School of Public Health, Columbia University

National Meteorological Service

NHRC, Ghana

NIH

Penn State University

Sanofi

UCAR

UNICEF

University of Lancaster

University of Niamey

University of Paris

and others…

4-7 April 2011

Global Alert and Response Department

World Health Organization