# The need for regular monitoring and prediction of ephemeral water bodies in SERVIR regions

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# Outline

- Goals of this talk
- SERVIR Background
- How SERVIR connects science with development needs
- Proposed methods to map and predict small water bodies in West Africa
- Role of a Technical Assessment Group
- Expected outcomes of this project
- Acknowledgements

# Goals of this talk

1. Share our process of connecting science with development needs

2. Propose some methods to map and predict location and timing of small water bodies for pastoral management in West Africa

3. Open the door for feedback and input into this information service

# SERVIR Background

## Background: Linking Science to End User Needs

- SERVIR is a joint development initiative of NASA and USAID
- SERVIR is a link between research institutions and decision making.
- SERVIR efforts are led by the needs of the region.
- Presence of SERVIR Hubs, such as RCMRD, ICIMOD, ADPC, and AGRHYMET Regional Center, with regional governmental support, makes the linkage sustainable.
- NASA-ROSES selected SERVIR Applied Sciences Team
- Primary direct beneficiaries are national agencies (e.g., ministries, departments)

# A case on how SERVIR connects science with development needs

"Service planning framework" in a nutshell, for this environmental/development challenge

1. **Stakeholder Consultations and Needs Assessments** have been led by SERVIR West Africa Hub to identify needs of stakeholders that can be addressed with Earth observations and geospatial technologies

2. In the "**design**" phase, Hubs and users are united in a collaborative process to determine service design, development and implementation. NASA plays a role in facilitating access to datasets, methods, and in many cases, scientists.
   - Hub leads the development of a "Theory of Change" for this particular service

# A case on how SERVIR connects science with development needs

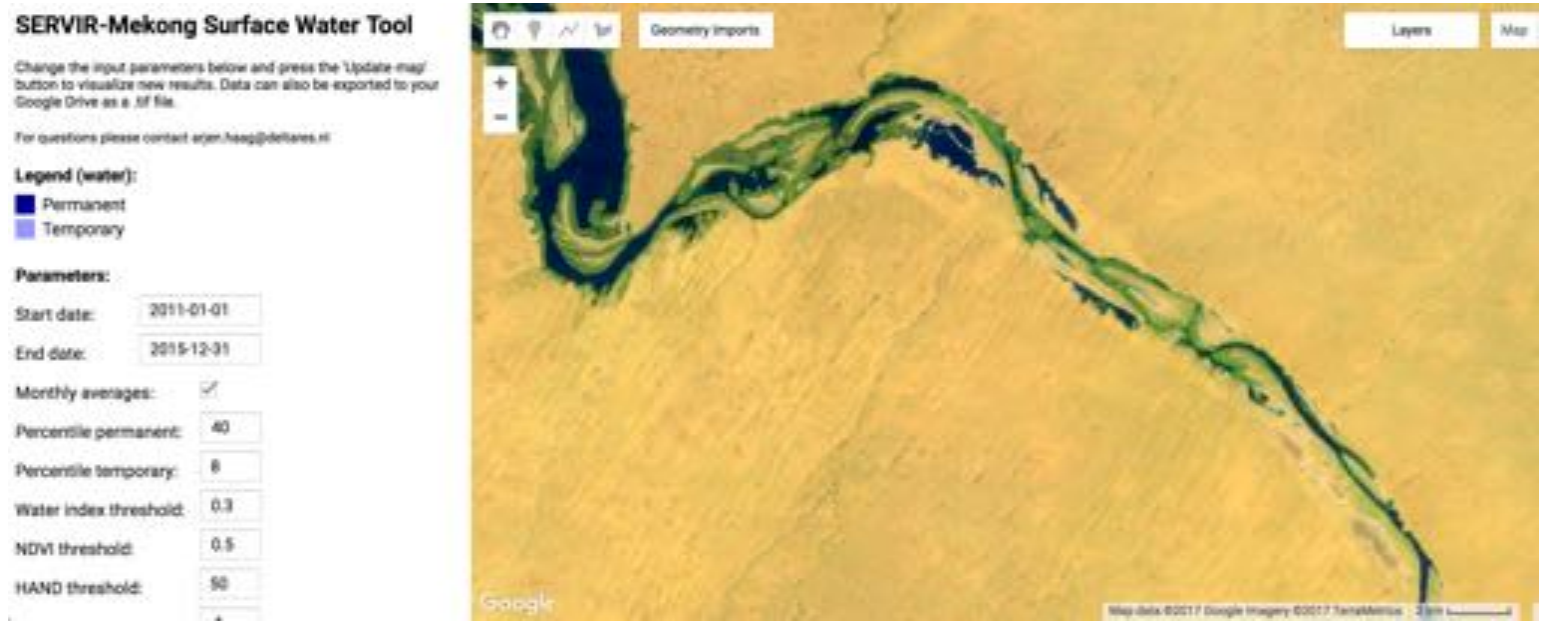
"Service planning framework" in a nutshell, for this environmental/development challenge

3. A service for monitoring temporary ponds will be "**delivered**" to address the development challenge identified. Main design and delivery approaches:
   - Modeling platform / system co-developed by SERVIR-West Africa and NASA/SERVIR Science Coordination Office (using best available data and science)
   - Internal training at SERVIR-West Africa consortium member CSE on methods and models
   - Creation of a dissemination platform (still TBD with users and stakeholders)
   - External training to users of this platform, focused on interpretation of products
   - Throughout – monitoring, evaluation, and learning, of indicators for success

# Some previous work

- Soti et al. (2010) Modeling temporary ponds dynamics. HESS
  - Simple hydrologic model / TRMM / ASTER DEM / Quickbird for cal/val
  - Driven by need to map ponds for Rift Valley Fever modeling
- Verdin (1996) Remote Sensing of ephemeral water bodies. Int. J. R.S.
  - AVHRR / focused on sharp differences in temperature. ~1km scale
- Donchyts et al. (2016) A 30 m Resolution Surface Water Mask Using Landsat 8, Remote Sens.

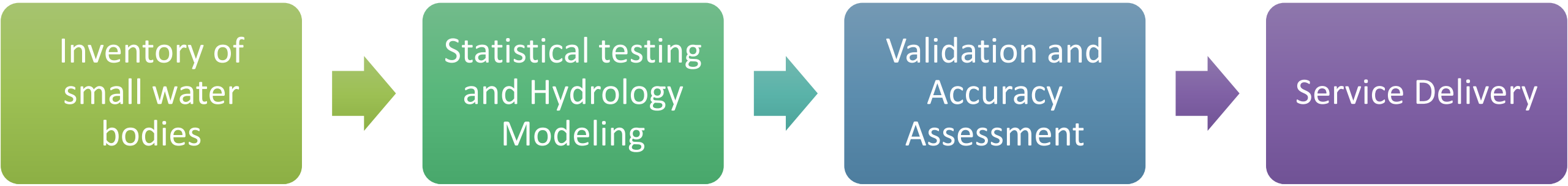
http://surface-water-servir.adpc.net/



# Proposed methods to map and predict small water bodies in West Africa (1)

- General technical methods

- On a monthly basis, determine which ponds are dry, and which have water (aiming for roughly ~100m x 100m sized water bodies)
  - Any indication of content (e.g., amount, quality) would be a plus

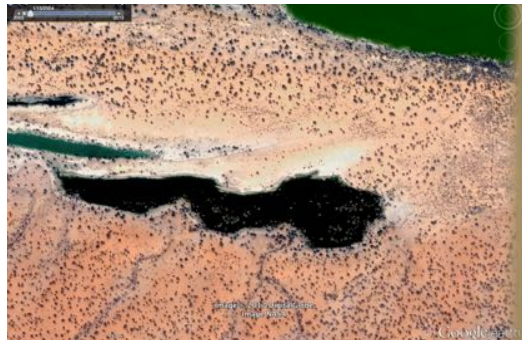


# Proposed methods to map and predict small water bodies in West Africa (2)

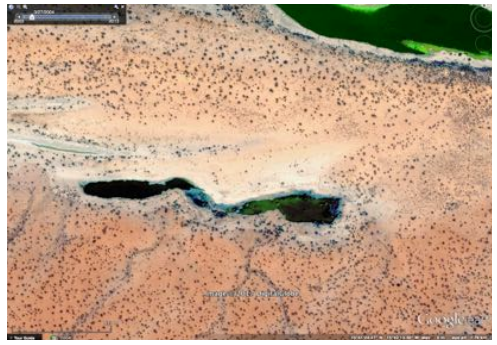
1. **Create / add to existing inventory of water bodies in the Ferlo region of Senegal**

- Catalog the location, extent, and dates of ponds
  - using available high resolution and very high resolution data (e.g., Landsat series, Sentinel-1/2, and ALOS PALSAR, Radarsat-2 if available)
- Locations of many ponds are already known

May 2003



Jan 2004



Mar 2004

Feb 2013

# Proposed methods to map and predict small water bodies in West Africa (3)

## 2. Prepare potential explanatory variables

- *Given our objective to map and characterize ponds on a monthly basis, all potential explanatory variables will need to be available readily and regularly*

- **Earth observation** datasets such as
  - Rainfall (TRMM, GPM, CHIRPS)
  - Vegetation (e.g., composite products from MODIS)
- Daily **modeled** variables such as soil moisture and runoff (VIC)
- **Static** topographic, soil, geologic variables
  - DEM-derived topographic variables (e.g., curvature/concavity) and hydrologic indices such as topographic wetness, sediment transport, stream power
  - Available global or national data on soils and geology

# Proposed methods to map and predict small water bodies in West Africa (4)

**3. Test and validate models to predict small water bodies, using statistical (and potentially machine learning) methods**

- Presence/absence of ponds: logistic regression
  - Will test a range of dynamic and static variables. Expect many dynamic variables to have different cumulative of lagged effects on ponds.
- Potentially, machine learning techniques such as neural networks

- Spatio-temporal dynamics of ponds: simple hydrologic model
  - Would seek cal/val data on pond height (in situ), surface area (VHR imagery)

- May need to distinguish pond types, e.g., those close to main rivers (runoff-fed) and those further away (direct rainfall-fed) (Soti 2010)

# Role of a Technical Assessment Group

- Group of external experts who look closely at scientific and technical methods to comment on validity and make suggestions for improvement

- Recommendations from previous TAG on Surface Water & Floods
  - Overall, SERVIR products and tools followed **sound technical methods**
  - **User guides** would greatly enhance the usability of most tools
  - Recognized that validation is very difficult in data sparse conditions. Recommended specific **case address** these limitations.

- Ultimately, through TAGs, we hope to elevate the scientific rigor of SERVIR services and bring in world class experts to assess how we're doing

# Expected outcomes of this project

- Reliable and timely information on ponds is available and used
- Populations' capacity to use geospatial information is increased

- SERVIR-West Africa internal capacity is built

- New capabilities are scalable and replicable in other SERVIR regions and beyond

**Current ARL = 2 or 3 (based on literature and our very experience). Goal = 9**

# Request for feedback

- First reaction to the feasibility and proposed methods
- Are our concerns well-founded? Suggestions for addressing them…
- What haven't we thought of yet? What are we missing?

# Acknowledgements


- NASA Applied Sciences Program / Capacity Building Program

- USAID Washington and USAID West Africa Regional Mission

- SERVIR-West Africa consortium, particularly Bako Mamame and Paul Bartel
- Amadou Moctar Dieye, Mamadou Adama Sarr, Khady Yarna Sarr of CSE

- Emil Cherrington, Rebekke Meunch, Kelsey Herndon, Kel Markert, Ashutosh Limaye, and Dan Irwin of NASA/SERVIR Science Coordination Office