Capacity Building for SWOT in the Developing World

NASA/SERVIR Science Coordination Office

Eric Anderson

SWOT Applications User Workshop – April 5-6, 2017

Engaging the User Community for Advancing Societal Application of Surface Water Ocean Topography (SWOT) mission

SERVIR

USAID FROM THE AMERICAN PEOPLE

NASA

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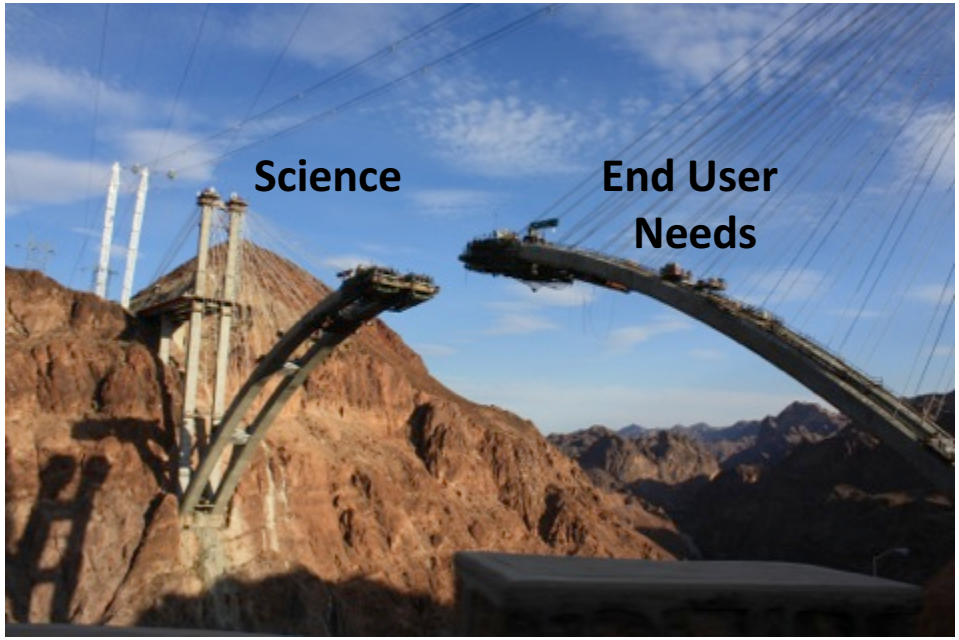
Overview of SERVIR

Background: Linking Science to End User Needs

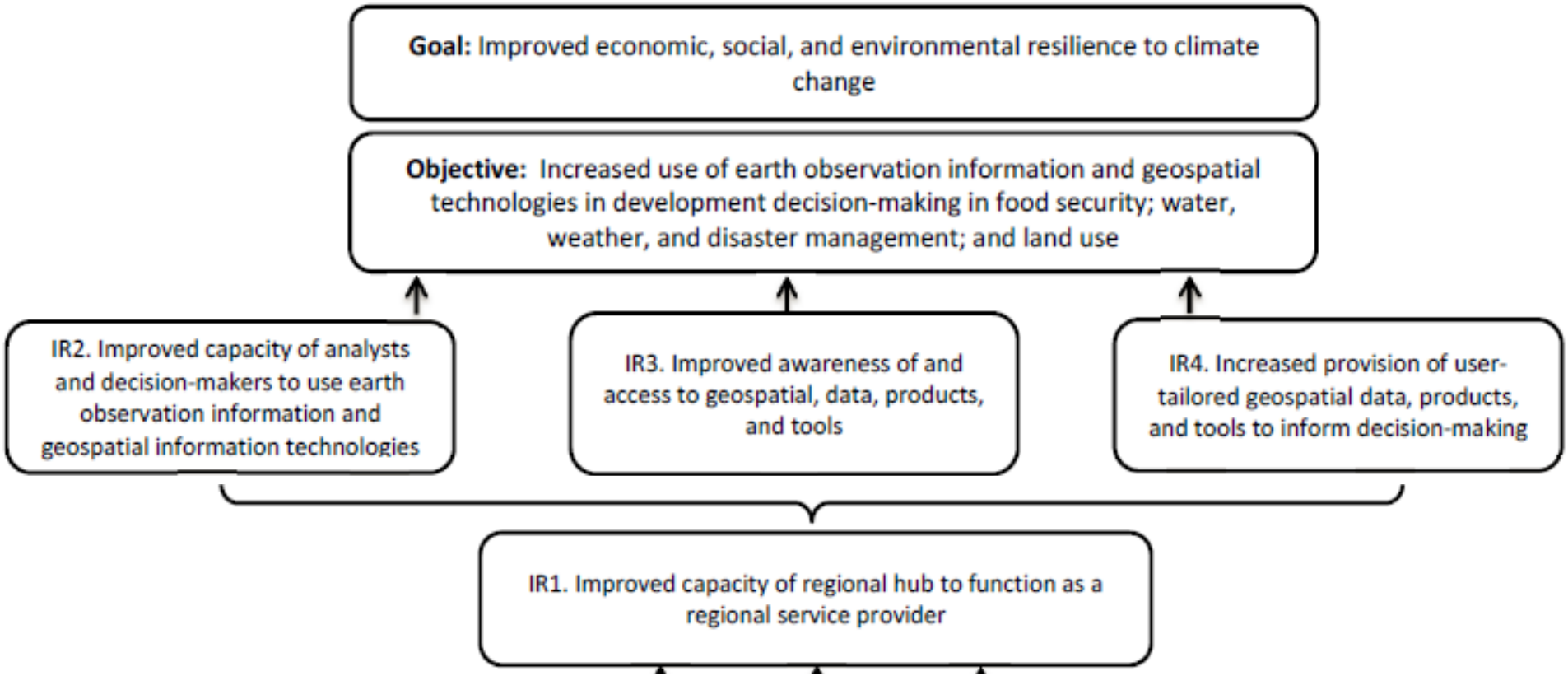
- SERVIR is a link between research institutions and end user decision making.
- SERVIR efforts are led by the needs of the region.
- Presence of SERVIR Hubs, such as RCMRD, ICIMOD, ADPC, and AGRHYMET Regional Center, with regional governmental support, makes the linkage sustainable.
- NASA-ROSES selected SERVIR Applied Sciences Team



- Primary direct beneficiaries are national agencies (e.g., ministries, departments)

Overview of SERVIR

Key Objectives: SERVIR Results Framework



Food security & agriculture

Water resources & disasters

Land cover, land use & ecosystems

Weather & climate

Specific application: Increasing access to river monitoring in the Lower Mekong, overcoming issues of transboundary data sharing: "Virtual rain and stream gauge data service"

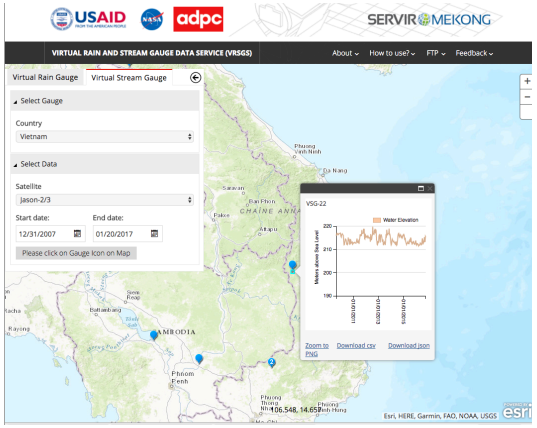
- Builds on success from Jason-2 integration in IWM & FFWC in Bangladesh (Hossain et al, SERVIR AST; NASA WR)
- Multiplier effect of "Altimetry Toolkit" developed by Lee and Okeowo with add'l co-development at NASA/SERVIR and SERVIR-Mekong (Okeowo 2016)
- Answers a *need* identified in SERVIR-Mekong Needs Assessment (https://servir.adpc.net/publications/needs-assessment-geospatial-data-and-technologies-lower-mekong-region)
- Complete service will include:
  - Data: Jason-1/2/3, Sentinel-3, AltiKa, GRACE
  - Models: VIC
  - Resources: Training materials, open-source software,
    - http://depts.washington.edu/saswe/Manual_VIC_V_1.1.pdf
    - https://github.com/doluoke/Jason2_Altika_TimeseriesGeneration
    - https://github.com/andersoner/altimetry_toolkit_arcgis_plugin
    - https://github.com/KMarkert/servir-vic-training
  - Improve reservoir outflow and river flood simulations

Building geospatial IT and software development capacity as well as scientific understanding of satellite altimetry and how it can be incorporated into hydrology.

Access tool:
https://servir.adpc.net/tools/satellite-radar-derived-virtual-rain-and-stream-gauge-data-service

Users:

- National hydro-meteorological services
- National disaster management agencies
- Water resources departments
- Hydropower companies
- Mekong River Commission
- Irrigation departments
- Agriculture departments
- Research institutes



Exploring additional applications

- Reservoir level monitoring top improving water resource modeling and management in East Africa by IGAD Climate Prediction and Applications Center (ICPAC) and RCMRD

- Coastal subsidence in Lower Mekong delta and threats to coastal cities and agro-ecosystems

- Monitoring lake height in Guatemala, Lake Authorities and Watershed Management Authorities, and Ministry of Environment and Natural Resources (MARN)

Potential impact of pressing gaps in these key applications: how we get there

- **Capacity** is built at SERVIR hubs to make appropriate use of SWOT data to address needs as expressed by their stakeholders
- More people are **aware** of satellite-based data and potential uses
- Greater **access** to new data, products, and tools
- More **custom-tailored tools** or **custom-integrations** of EO data, products, tools in decision-making environments

- When Earth observations data and/or tools are **used regularly or semi-regularly in a decision-making environment**, especially without constant support from scientist

Potential impact of pressing gaps in these key applications: what we hope it looks like

- SERVIR Hubs are providing higher quality services, and by extension, practitioners in developing countries are making better use of Earth observation data, tools, products

- Transboundary and inter-agency data sharing increase because people have new means to estimate what is happening on the ground

- Entrepreneurship and innovation increase through collaboration between government agencies and subsequently with NGOs and academia, benefiting from more data and accelerated open-source application development

Examples of expected impacts

- Flood warnings are more accurate, come earlier, and are more effective
- Pre-emptive action can be taken sooner to mitigate potential impacts of drought, minimizing risk of food insecurity
- Reservoir management and dam operation decision are improved, leading to better allocation of water resources, fewer catastrophic flood events, and more and more efficient renewable energy production

Data needs/gaps

- Data format, structure, access
  - Currently our chron jobs access satellite altimetry data in netCDF format. Provide answers to online queries as tables and downloadable csv and json
- Models
  - Typically integrate into hydrology model (VIC)
  - Agencies may later connect this to hydrodynamic models (e.g., MIKE, HEC series)
- Simply having observations where ground observations do not exist or are not shared can be revolutionary. Still need to understand and be able to communicate assumptions and uncertainties.
- Latency and sampling: next slide

SWOT's Relevance

- Latency and sampling: we need help from the satellite altimetry science community in our understanding of best use of data in real-life applications:
  - E.g., "to what extent can we expect to improve current flood DSSs with SWOT (and any satellite altimetry) data, given satellite overpass day and flood crest and stage?"
- Uses (current and potential future):
  - Flood forecasting
  - Reservoir inflow/outflow
  - Drought monitoring
  - Water balance and water resources management

Support SERVIR may need from SWOT (or roadblocks to update)

- Awareness and understanding of geodesy and satellite altimetry basics
- Determining which bodies of water meet criteria in terms of SWOT's ability to resolve height (making sure we don't try to make sense of noise)
- Understanding the times SWOT data will and will not improve decision support for various applications, especially flood forecasts (Latency and sampling scheme mentioned earlier)

Summary

Our “lecture” to the SWOT Mission, since you asked…

- Do listen. Understand unique decision making environments *inside* of an agency and how the agency interacts with other agencies / communities *outside* (information flow mapping)
- Do help us build appropriate applications with Jason-1/2/3, AltiKa, and Sentinel-3, **today**.
- Do train applications users though **co-development** of science applications and not only through training workshops.
- Do pay attention to ARSET’s Remote Sensing Training: Methods and Best Practices (https://arset.gsfc.nasa.gov/all/webinars/best-practices-2016)
- Don’t expect to reach a lot of decision making users with expensive software. What can we do with completely free-and-open solutions?
- Do find the multipliers/connectors among users.
- Do find a few champions. This requires trust and relationship building over a long period of time.
- Do remember for what your applications partners are held accountable.
- Do find people to tell your story (Don’t just tell it yourself).