SWOT Science Team Meeting June 14, 2016

II. Hydrology – Applications

51 Vinca Rosmorduc (FR) – Outreach/applications

53 Ed Beighley (US) – Improve SWOT discharge estimates and applications

52 Faisal Hossain (US) – Ground-truthing, discharge product and water management applications

51 Vinca Rosmorduc (FR) – Outreach/Applications

Surface
Water &
Ocean
Topography

Expanding altimetry outreach to a new dimension

www.aviso.altimetry.fr/swot

Objectives

- to foster development of SWOT outreach activities
- to federate outreach efforts
- to promote outreach efforts

Approach

- Open broad access to SWOT mission and applications
  - Take advantage of web and social media
  - Provide more background material
  - Create visuals, images and animations
- Adapt material to audience
  - General public, around the World (multiple languages)
  - Developing a Toolbox with outreach capabilities
  - Create educational material (University levels)
- Enhance visibility and sharing of outreach activities
  - Of Science Team members inside Science Team
  - Of Science Team outreach with respect to a hydrology community
  - Of Science Team outreach with respect to an ocean science community

SWOT Science Team Meeting June 13-16, 2016

II. Hydrology – Applications

53 Beighley (US) - Improve SWOT discharge estimates & applications

Integrating lateral contributions and longitudinal controls along river reaches to improve SWOT discharge estimates

Edward Beighley, Michael Durand, Cedric David, Hyongki Lee

Northeastern | The Ohio State University | Jet Propulsion Laboratory, California Institute of Technology | University of Houston

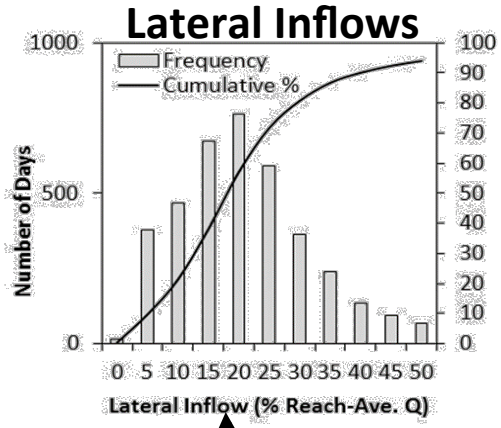
Application Partner: FM Global (Flood Insurance)

Additional Science Team and SWOT Applications Working Group Collaborators

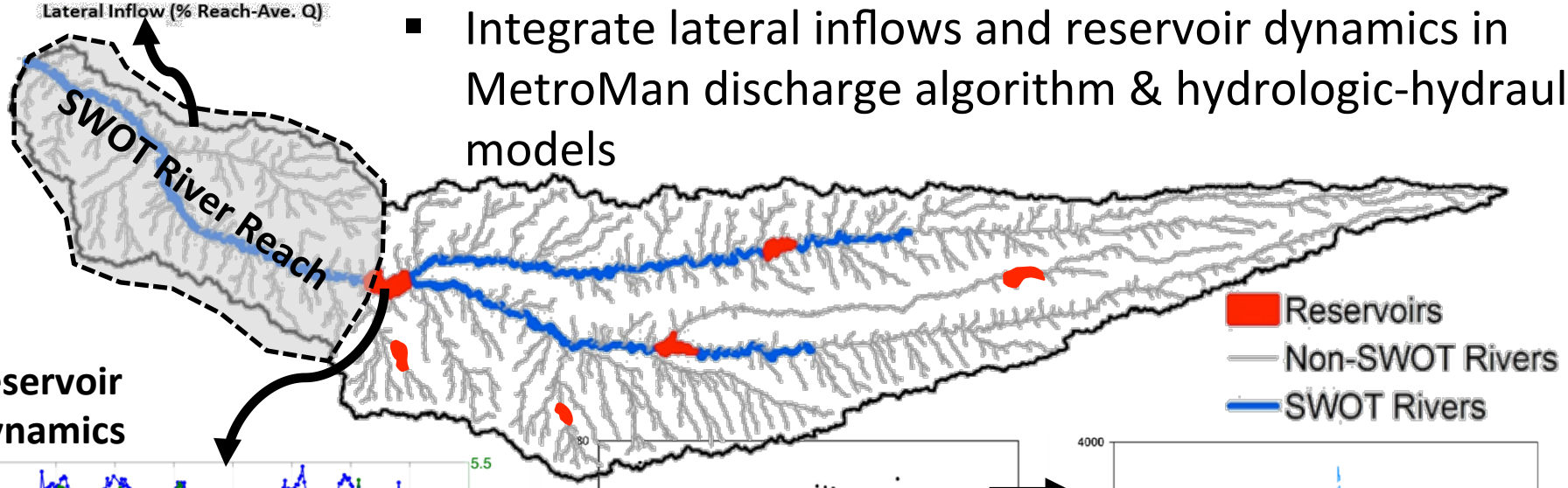
Project Objectives – Questions

- Integrate lateral inflows into a SWOT discharge algorithm
  - How do lateral inflows to SWOT river reaches vary w/ basin scale, climatology, season?
  - What is fraction of lateral inflow in reach-averaged flow?
- Integrate lake/reservoir dynamics into SWOT discharge algorithms and hydrologic-hydraulic models
  - How does distribution of SWOT observable lakes/reservoirs along observable and non-observable rivers impact lateral inflow to SWOT river reaches?
  - How are SWOT rivers impacted by reservoir regulation?
- Application in Flood Hazard/Risk & Insurance
  - How will SWOT derived data products developed over mission lifetime improve our ability to determine flood hazards, risks and effective mitigation measures?
  - What are cost impacts on private sector?
    - Higher/Lower: risk, insurance premiums, coverage limits or mitigation costs
    - Reduced potential losses resulting from mitigation and preparedness

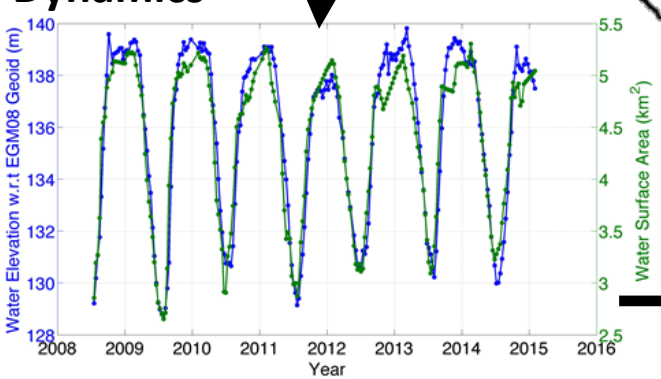
Methods: Lateral & Longitudinal Controls

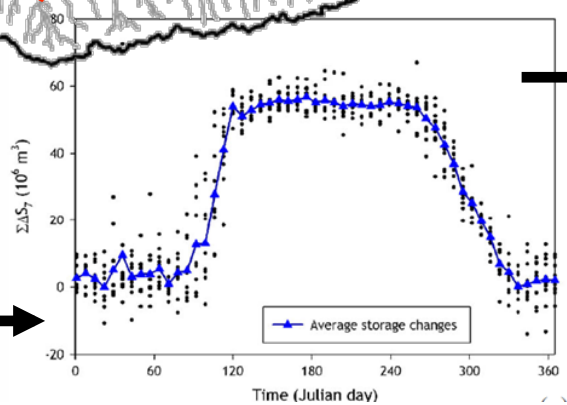


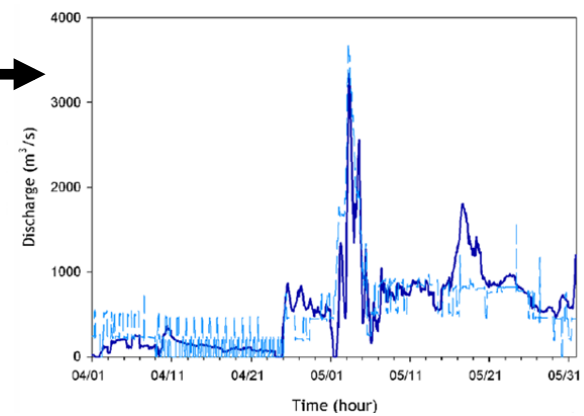
- Lateral inflows vary over time and can be appreciable → Use Land Surface Models & lateral routing to quantify contribution to reach-averaged discharge
- Reservoir dynamics often predictable → generalize behavior and model using synthetic SWOT data
- Integrate lateral inflows and reservoir dynamics in MetroMan discharge algorithm & hydrologic-hydraulic models



Reservoir Dynamics

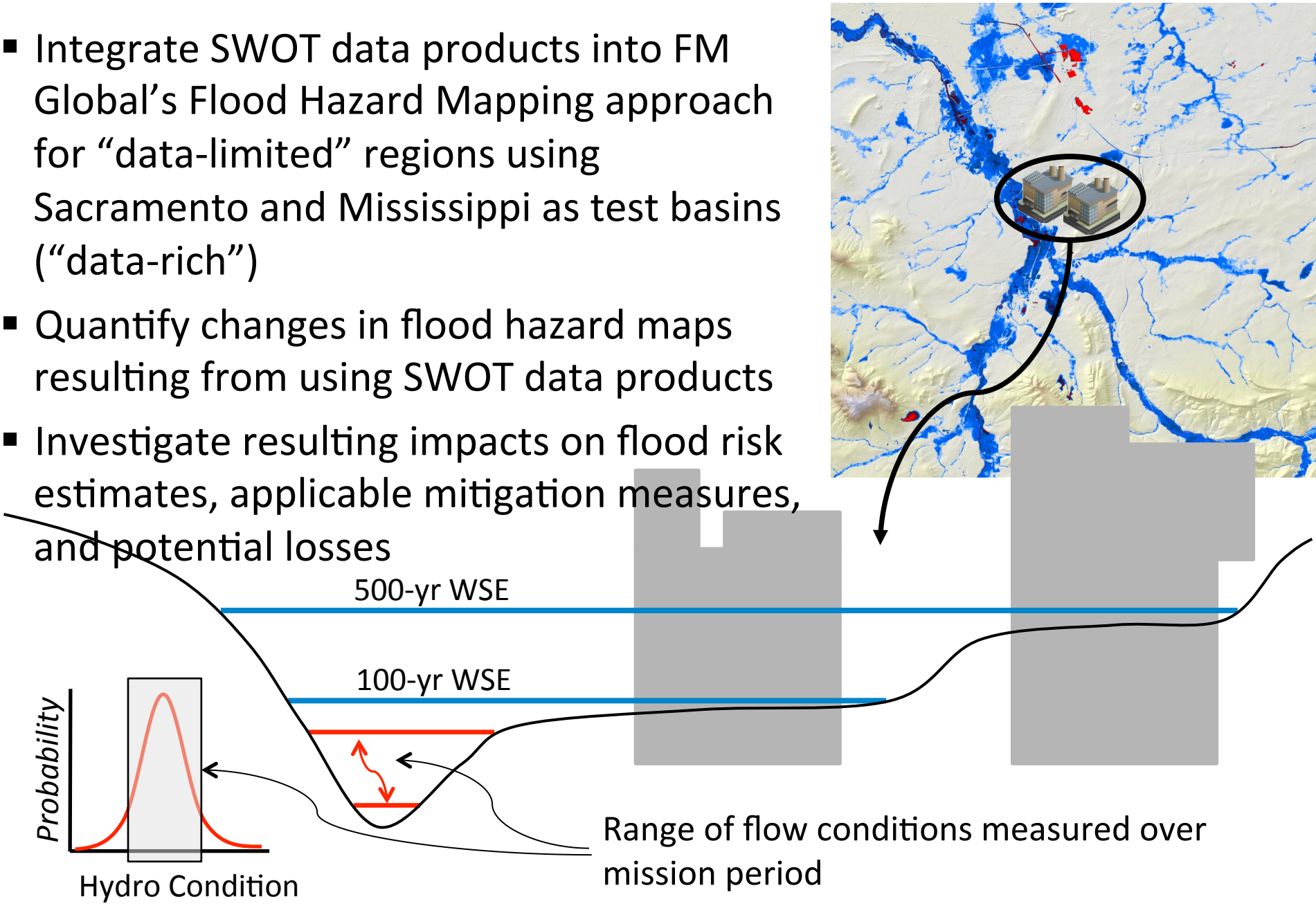






Methods: Application - Flood Insurance

- Integrate SWOT data products into FM Global's Flood Hazard Mapping approach for "data-limited" regions using Sacramento and Mississippi as test basins ("data-rich")
- Quantify changes in flood hazard maps resulting from using SWOT data products
- Investigate resulting impacts on flood risk estimates, applicable mitigation measures, and potential losses



SWOT Preparations for Ground-Truthing, Discharge Product Development and Water Management Applications in Asian River Systems

Faisal Hossain

University of Washington

Collaborators: Mike Durand, Colin Gleason, Dave Bjerklie, Ed Beighley, Hyongki Lee

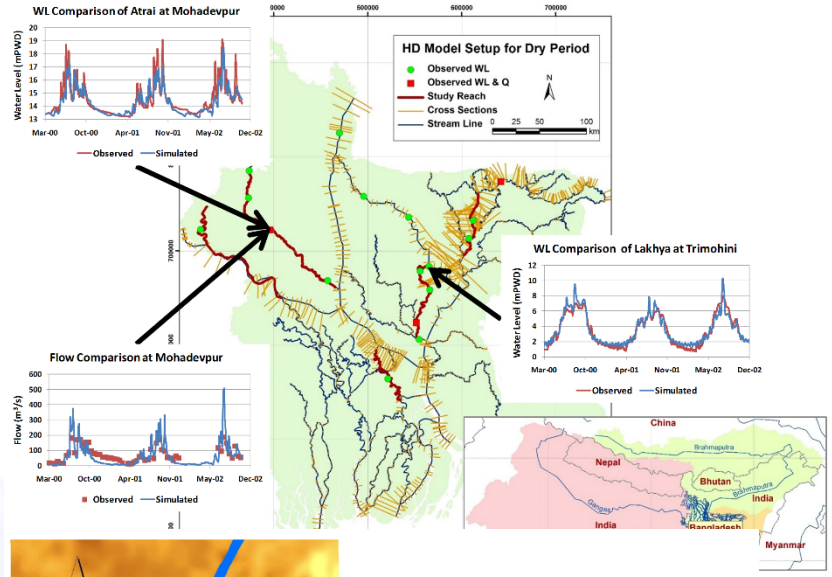
Project Objectives

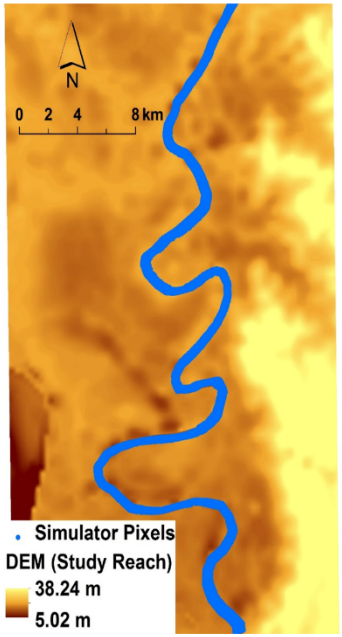
Objective 1: To understand and advance SWOT-observation based surface water flux estimation (river/reservoir discharge) through simulator-based experiments in Monsoon-driven Asian (large) river systems. (*Ganges, Brahmaputra, Indus and potentially Mekong and Red (Han) Rivers*)

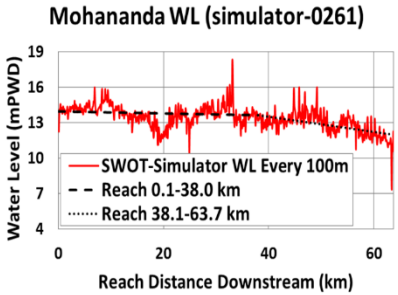
Objective 2: To advance the application potential of SWOT observational capability for water and disaster management through close proactive engagement with stakeholder water management agencies. (*Focus on US federal and Asian water management stakeholders*)

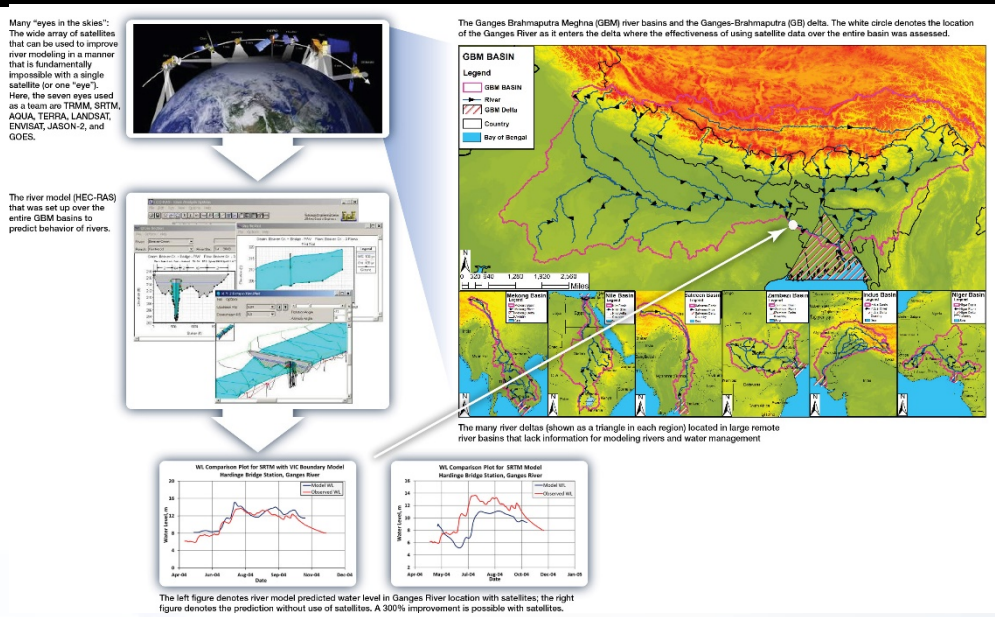
To provide leadership and synergy between SWOT Applications Working Group (SAWG) and SWOT Science Team on miscellaneous activities (early adopter program; engagement with ST (DAWG) and cal/val team.

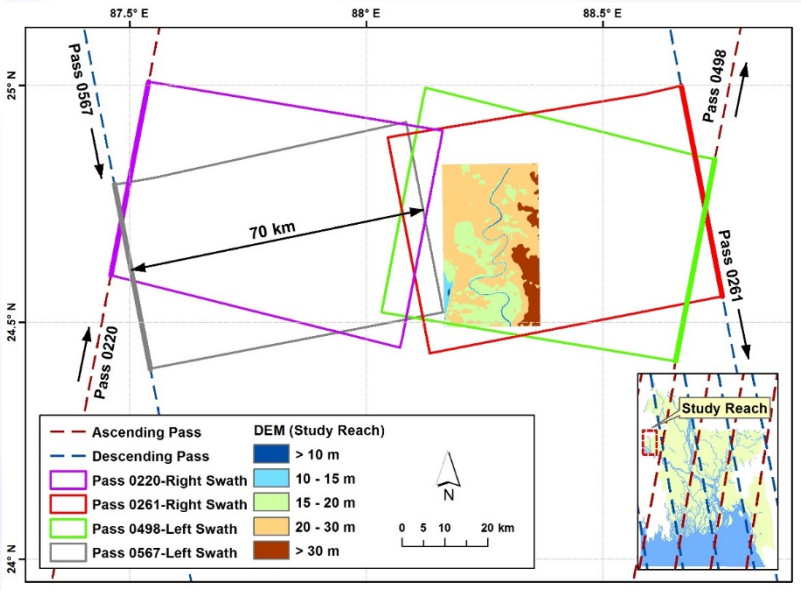
Background (Models, Data, Study Region, Users)











Maswood, M., F. Hossain (2016). Advancing River Modeling in Ungauged River Basins using Remote Sensing: The Case of Ganges-Brahmaputra-Meghna Basins. *Journal of River Basin Management*,vol. 14(1), pp. 103-117, (doi: 10.1080/15715124.2015.1089250).

Sample 'Early Adopter' User Community

- ✓ **Indus River System Authority** – IRSA.
- ✓ **Pakistan Council for Research on Water Resources** – PCRWR.
- ✓ Bangladesh **Institute of Water Modeling** (IWM) and **Flood Forecasting and Warning Center** (FFWC)
- ✓ Vietnam **National Center for Hydrometeorological Forecasting** (NCHMF)
- ✓ **Mekong River Commission** (MRC)
- ✓ **National University of Civil Engineering** (NUCE), Vietnam.

Near-future Engagement:

- US Army Corps of Engineers, US Bureau of Reclamation (via American Society of Civil Engineers).
- Potential workshop for engagement (Developed and Developing World) in 2017.

Sample Quad Chart For Swot Early Adopter Plan – Calibrating Hydraulic Models used in Operational Forecasting

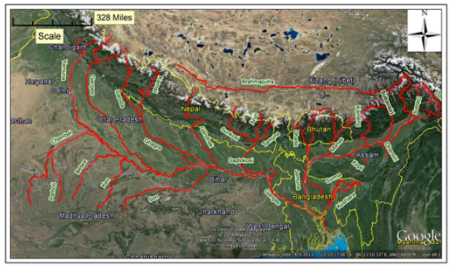
Research Objectives

- Assess the value of SWOT data (distributed water elevation and inundated area) for improving hydraulic model calibration and set up.
- Assess the skill of the continental-scale hydraulic model in operational nowcast of transboundary streamflow, flood forecast and river heights

Team Membership

- Faisal Hossain (UW), Safat Sikder (UW) and
- Nishan Biswas (UW)
- Stakeholder – Institute of Water Modeling and FFWC
- Bangladesh

Methodology



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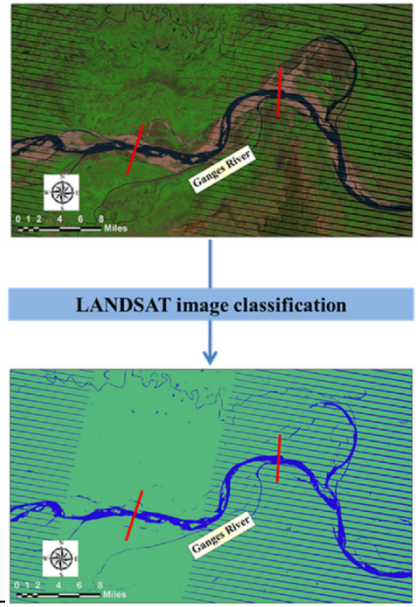


Status

- **Current state:** HEC RAS is set up over Ganges-Brahmaputra river basin. But stage-width relationship available at few places using altimeter and non—sync Landsat/MODIS
- **Region**: South Asia
- **Data available for sharing?** – Model and Ensuing data will be available
- **Qualifiers:** SWOT Simulator with Rivwidth is needed
- We will test how the simultaneous availability of height and width (to set up stage-width and Q relationship improves our HEC RAS model).
- Eventually – we want to apply ALL platforms, SWOT and others (Landsat, MODIS, altimeters)

Methodology, Schedule and Issues

- We'll corrupt a 'reference' HEC RAS water level with SWOT simulator and then derive stage-width and Q relationships. Next, we will insert into reference HEC RAS the 'SWOT' based river bathymetry data. We will repeat the same for reference HEC RAS using altimeter-Landsat based bathymetry (non-sync). Simulation of water level downstream in delta region (stakeholder agencies are interested in this) will be compared for the 3 options (reference, SWOT and altimeter-Landsat non-sync)
- Fall 2016 – start applying simulator on HEC RAS water DEM
- Fall 2017 – assessment of performance after replacing river bathymetry
- Fall 2018 – Report results and share with IWM/FFWC

Sample Quad Chart For SWOT Early Adopter Plan – Operational Reservoir Management (Seasonal Timescales)

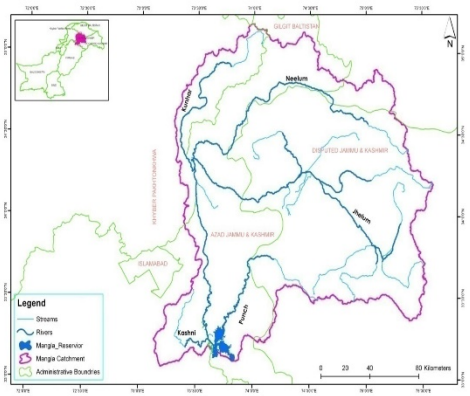
Research Objectives

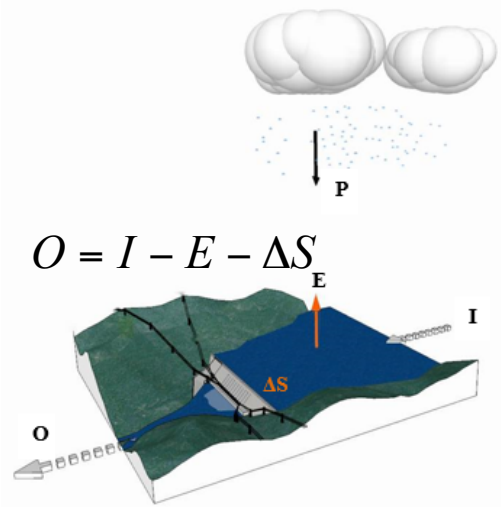
- Assess the value of SWOT data (distributed water elevation and inundated area) for improving reservoir operations (outflow estimation, storage change and inferring rule curves

Team Membership

- Faisal Hossain (UW), Matthew Bonnema (UW)
- Stakeholder – Institute of Water Modeling (Bangladesh),
- PCRWR (Pakistan) and NUCE (Vietnam)

Status





Data product/Methodology

- We will apply the following mass-balance approach using SWOT simulator data outlined in Bonnema et al. (2016) –
- Bonnema*, M., S. Sikder, Y. Mao, X. Chen and F. Hossain, I.A. Pervin, S.M. M. Rahman and H. Lee. (2016). Understanding Satellite-based Monthly-to-Seasonal Reservoir Outflow Estimation as a function of Hydrologic controls *Water Resources Res.*, (doi: 10.1002/2015WR017830).
- SWOT simulator will be applied on reservoir surface area and height data (derived from altimeter, SRTM, MODIS/Landsat). Three reservoirs are selected – Mangla or Tarbela (Pakistan), Kaptai (Bangladesh) and a reservoir on Red river (Vietnam)

Schedule and Issues

- Fall 2016 –Spring 2017– start applying simulator on selected resevoirs after reservoir bathymetry is derived from in-situ or non-SWOT data
- Summer 2017-Spiring 2018– assessment of performance of SWOT data in reservoir outflow and storage changes.
- Summer 2018-Spring 2019 – rule curve inference.
- Data and results will all be made available freely

Altimetry+GPM+SRTM+AQUA/TERRA/ LANDSAT+SWOT are a multi-mission constellation for outflow estimation for reservoir operations management