

The Influence of Digital Elevation Model Resolution, Source, and Quality on Streamflow and Potential Inundation Modeling

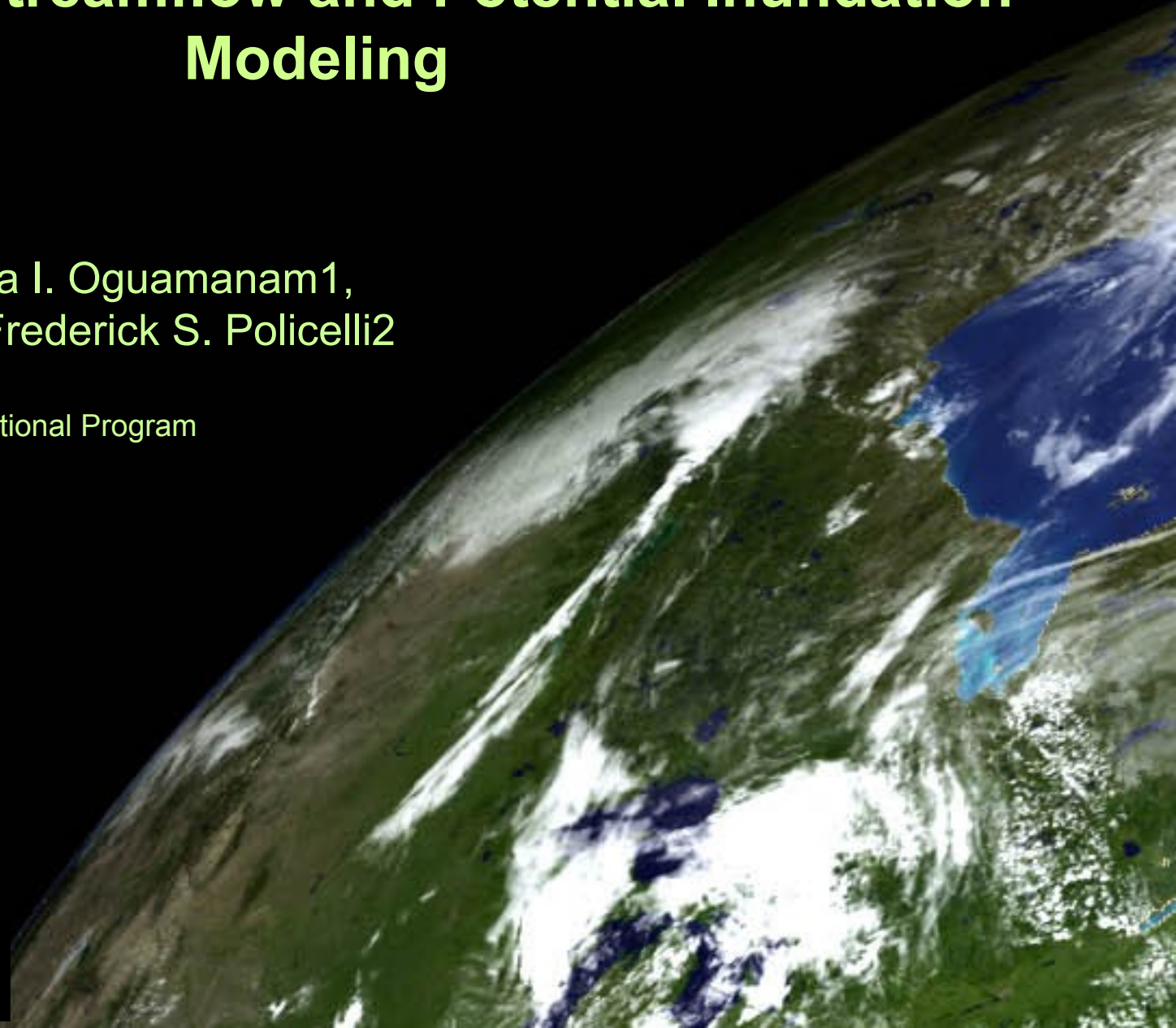
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1) NASA GSFC DEVELOP National Program

2) NASA GDFC



Society of Wetlands
Scientists
Lafayette, LA October 20-22,
2011

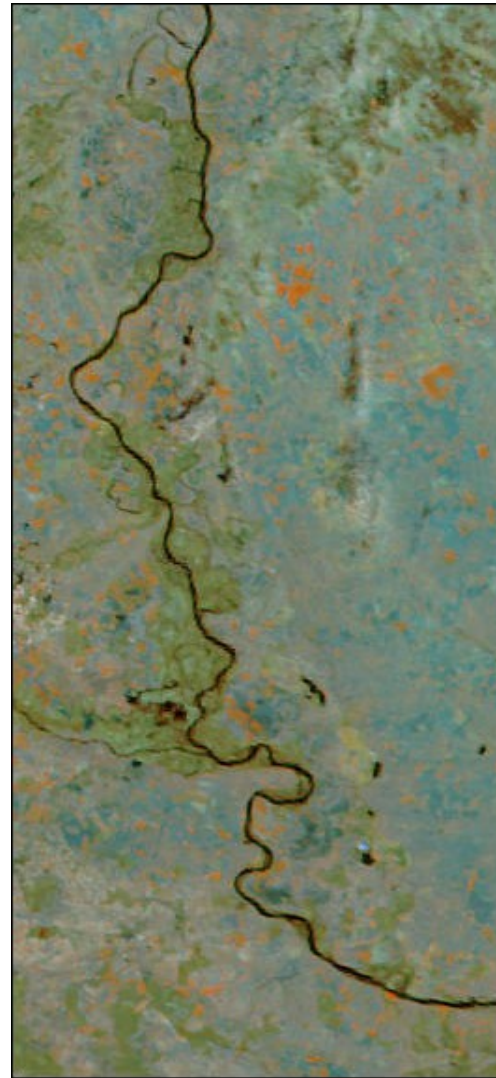


Overview

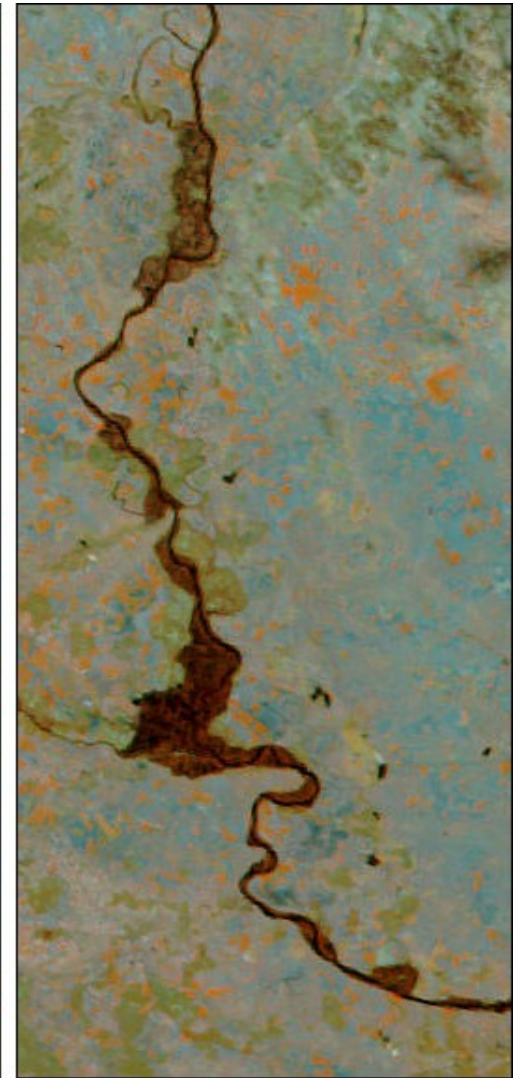
- | **Basic Needs**
- ▢ **Primary Questions**
- ▢ **The Big Picture**
- ▢ **DEVELOP's Wetlands Project**
- ▢ **Study Area**
- ▢ **Data Acquisition**
- ▢ **DEMs and Derived Inputs**
- ▢ **Preliminary Results and Findings**

Basic Needs

▮ NRT and Foretasted Flood Extent



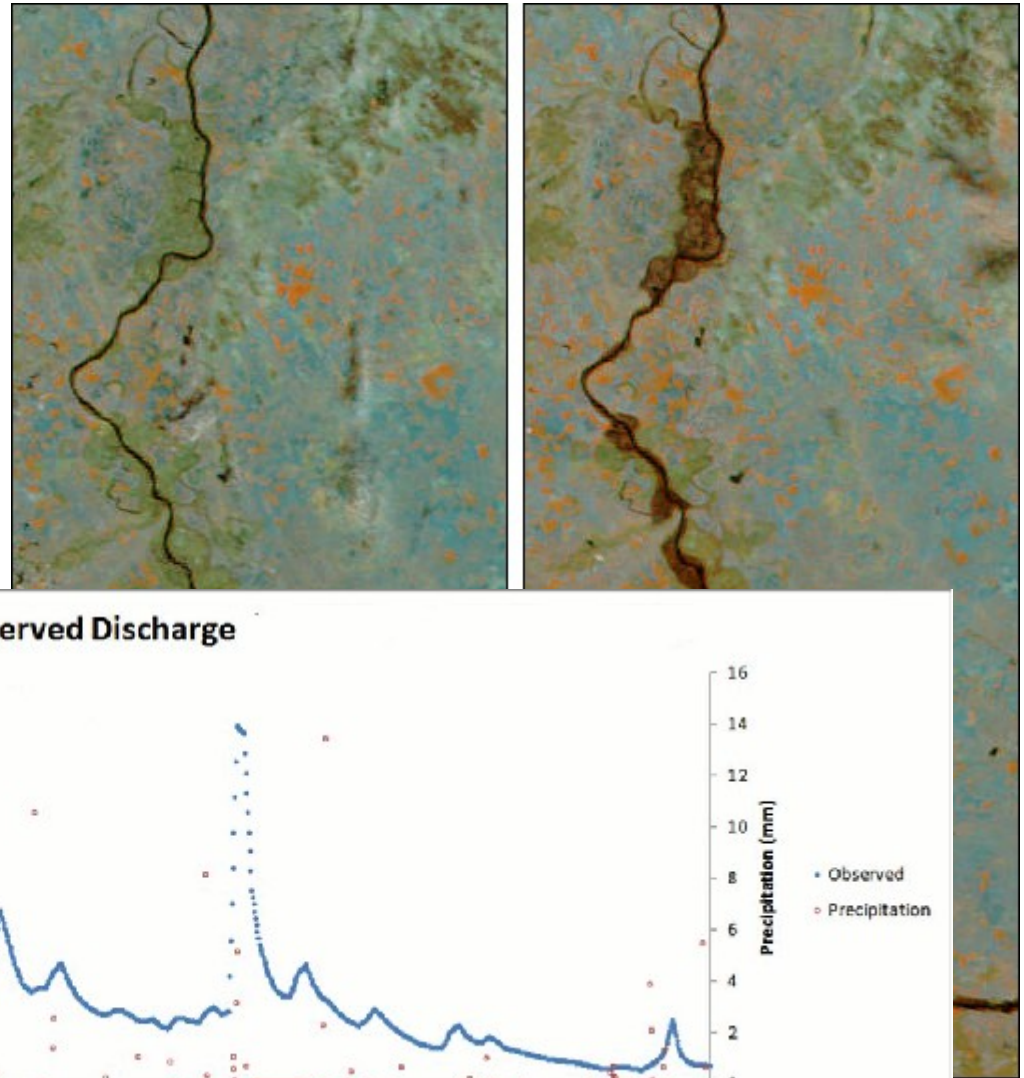
March 17, 2002



April 2, 2002

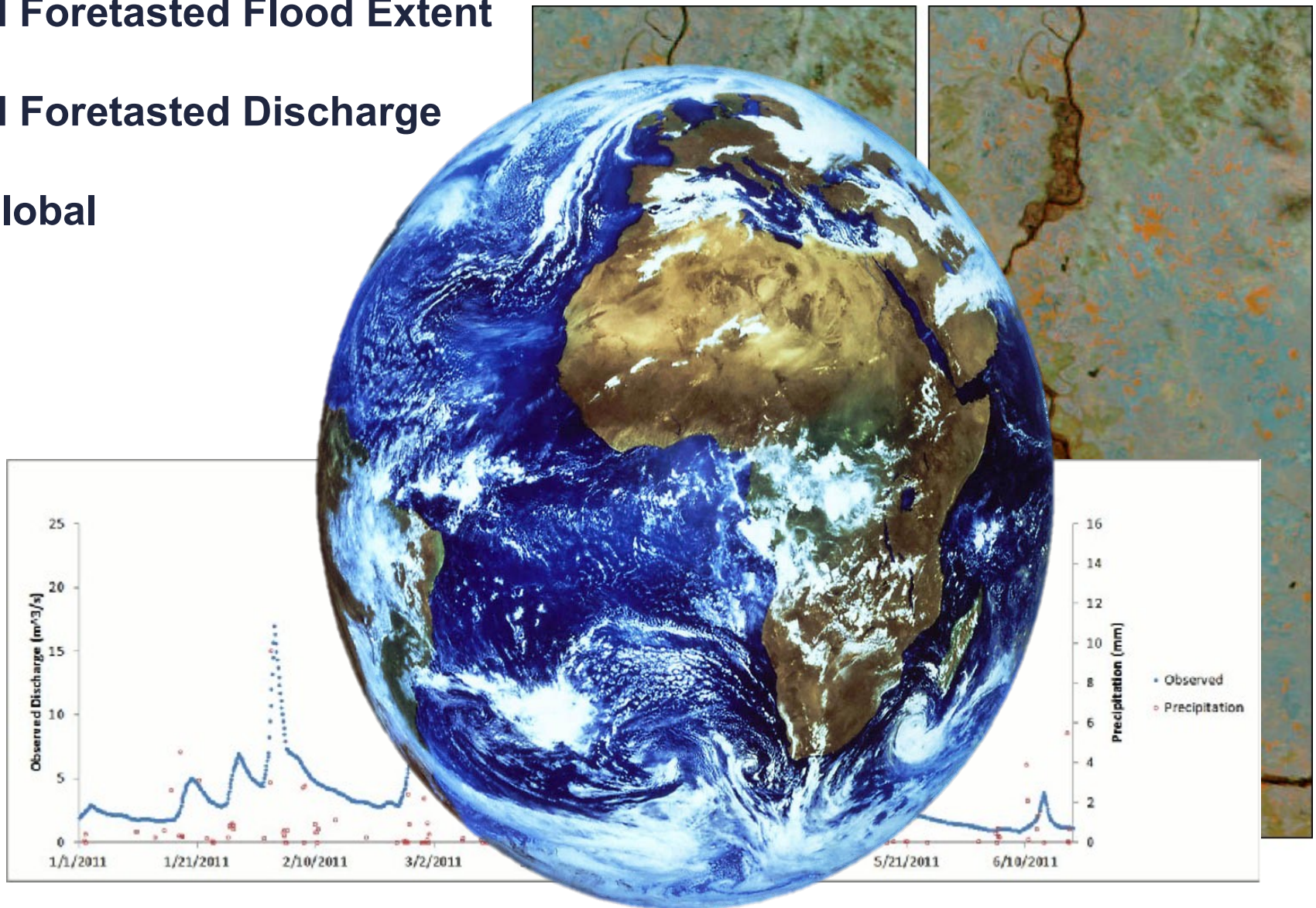
Basic Needs

- ▯ **NRT and Foretasted Flood Extent**
- ▯ **NRT and Foretasted Discharge**



Basic Needs

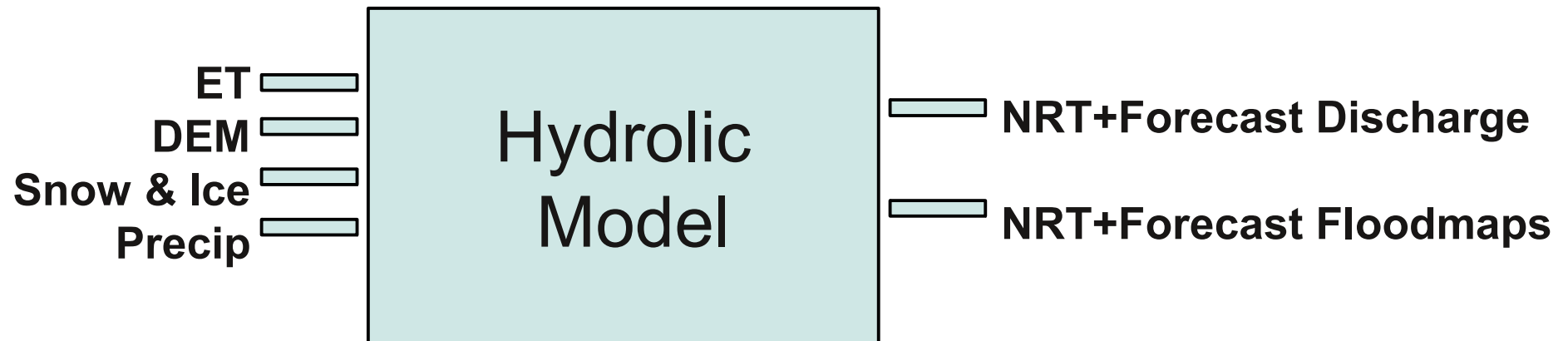
- ▯ **NRT and Foretasted Flood Extent**
- ▯ **NRT and Foretasted Discharge**
- ▯ **Going Global**



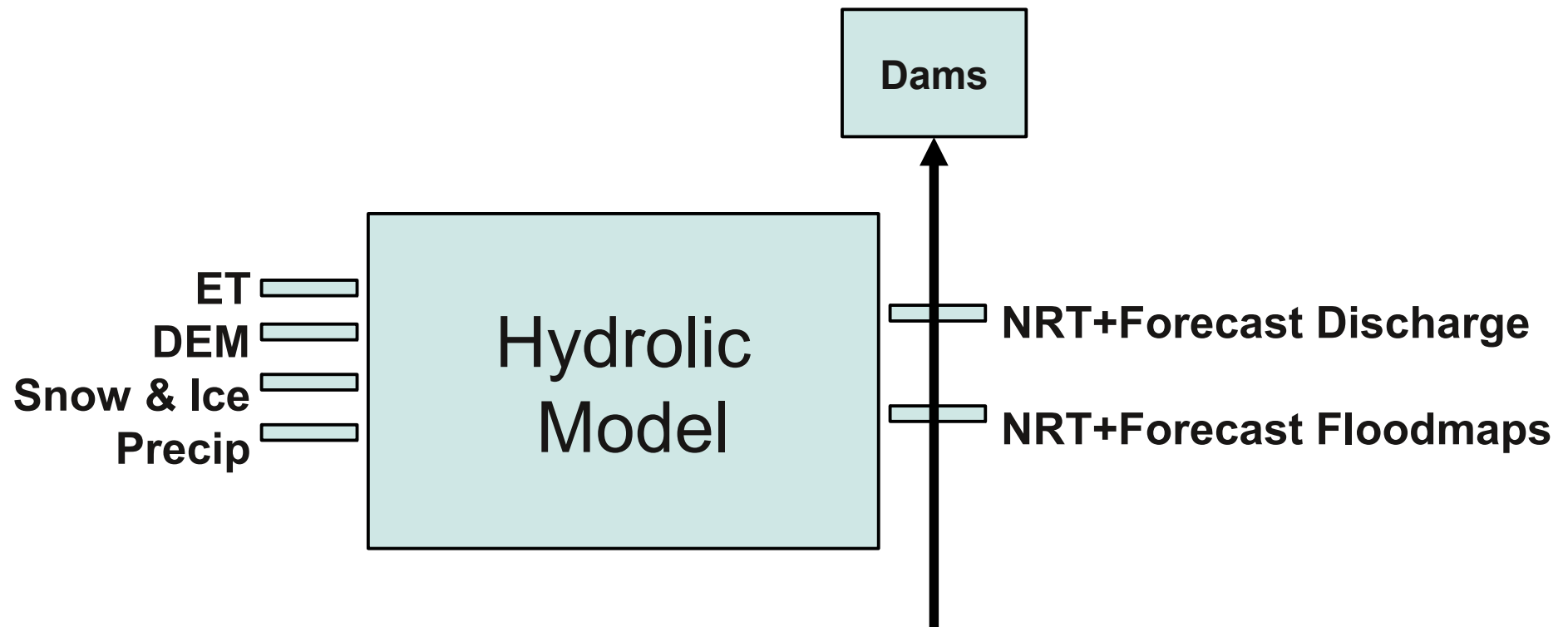
Primary Questions:

- ▯ The effect of DEM quality and resolution on modeled streamflow and inundation
- ▯ The effect of spatial and temporal resolution of precipitation data modeled outputs
- ▯ How can we both calibrate and validate the results over a wide range of scales
- ▯ What are the best hydrologic models for this application, what are their limits, and where do they break down

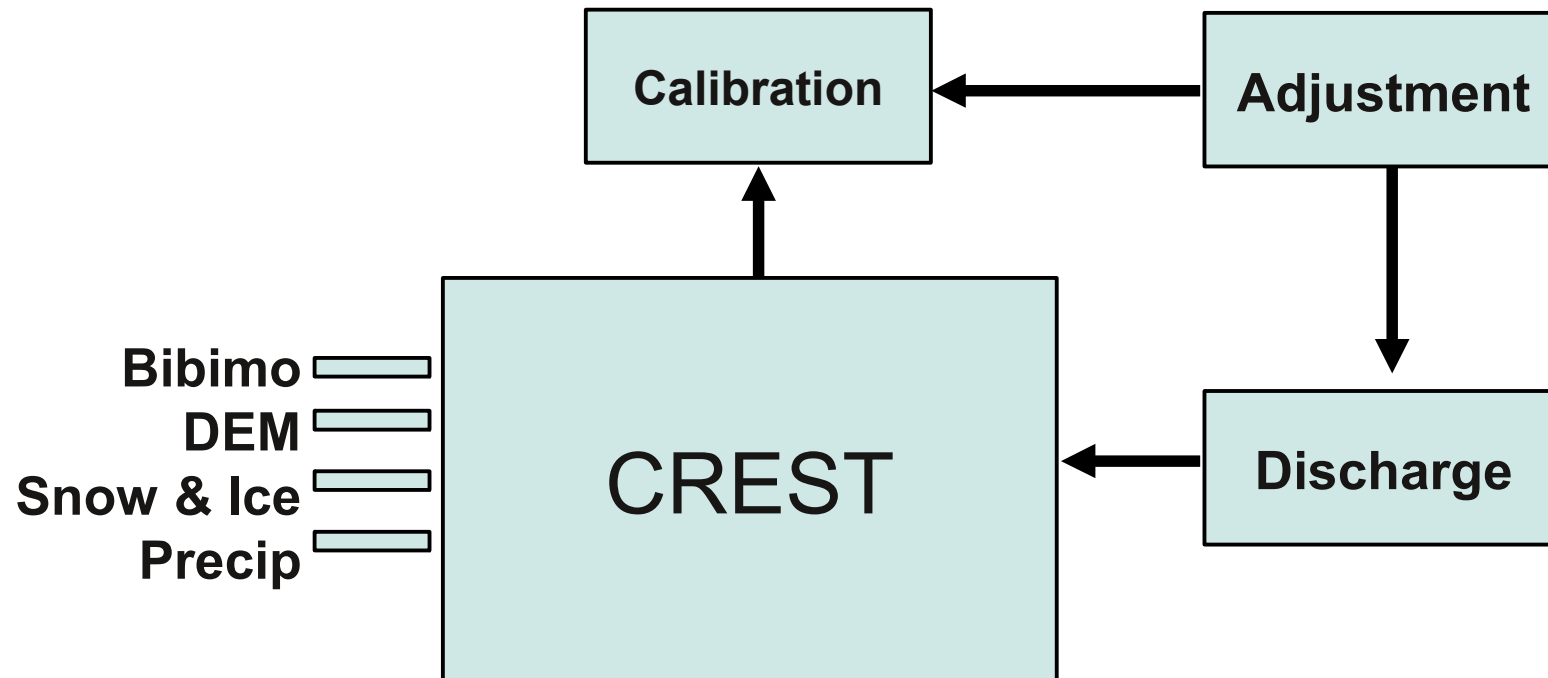
Big Picture



Big Picture



The DEVELOP Wetlands Project



Study Area and Objectives

Project Objectives

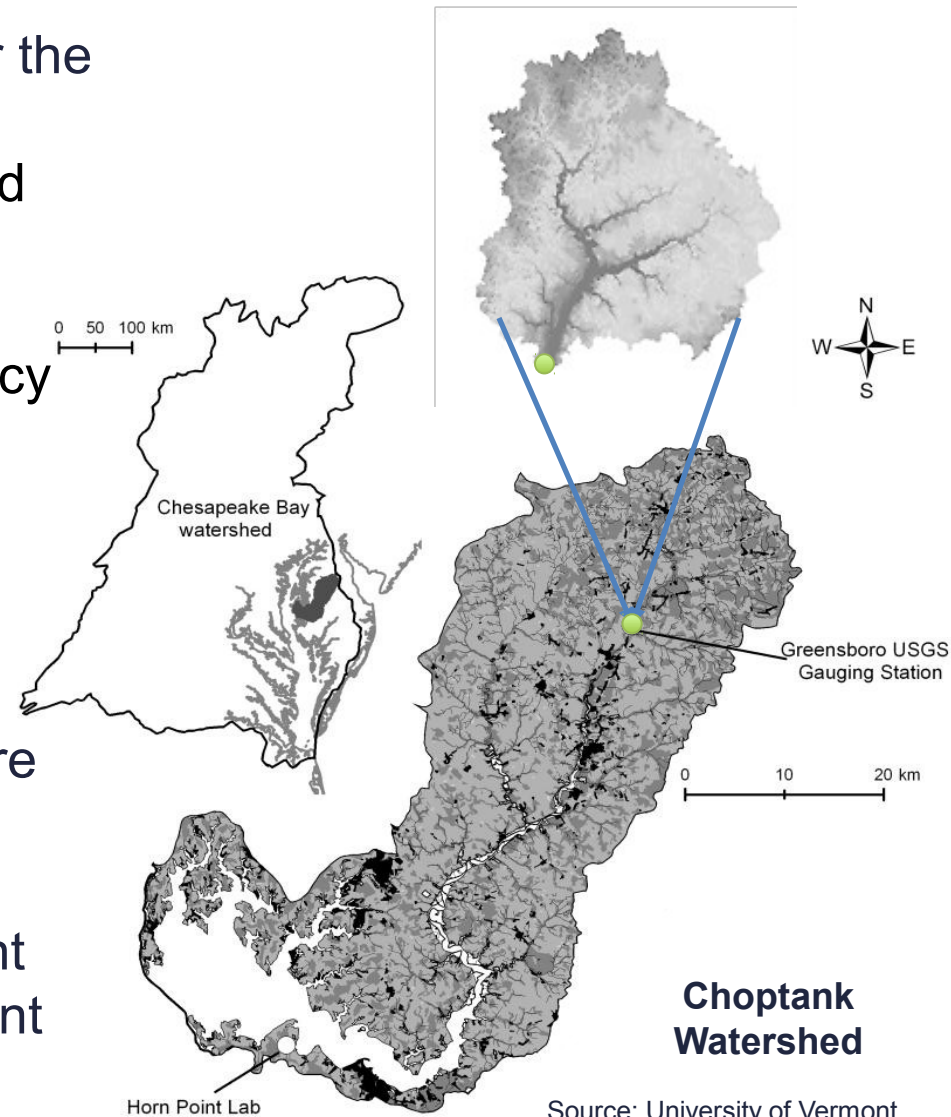
- Calibrate the CREST hydrological model for the Greensboro watershed
- Determine forecasting benefits of LiDAR and Radar based DEMs at the same spatial resolution
- Determine impact of model flow rate accuracy when increasing spatial resolution of DEMs

Study Area

- Greensboro Watershed
- ~ 293 sq. km of relatively low relief (1.86 to 44.38m)
- More hydric soils, forests and less agriculture than the Choptank (Fisher et al, 1998)

Data Sources

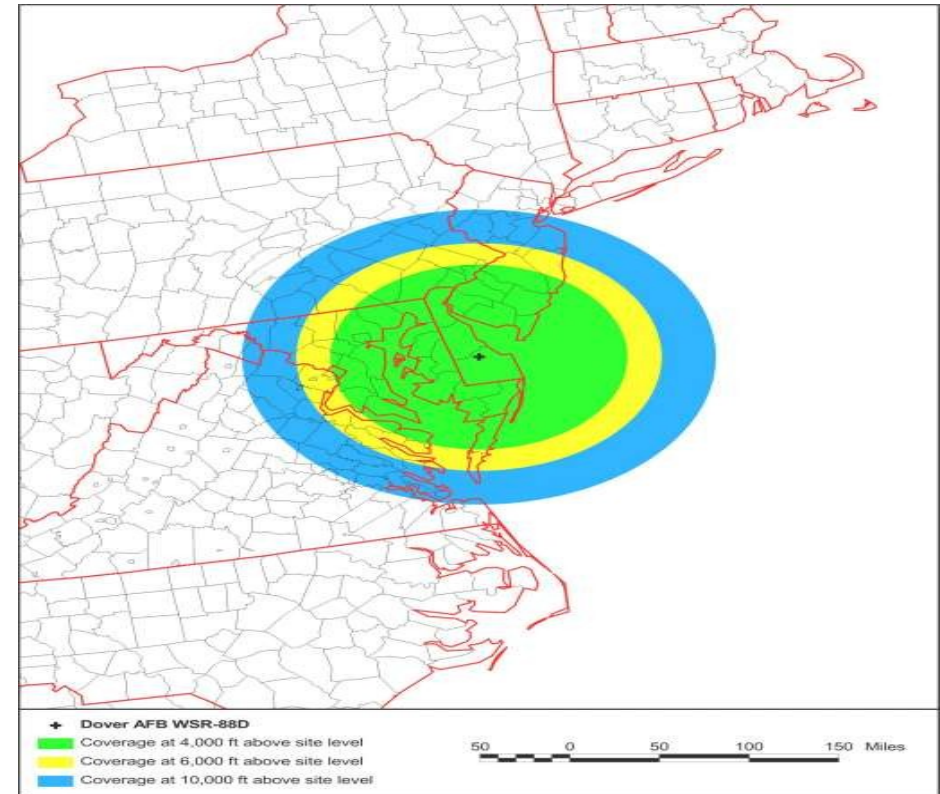
- Gauge data is available from 2002 – Present
- Rainfall data is available from 2002 – Present
- LiDAR flown in 2003



Data Acquisition

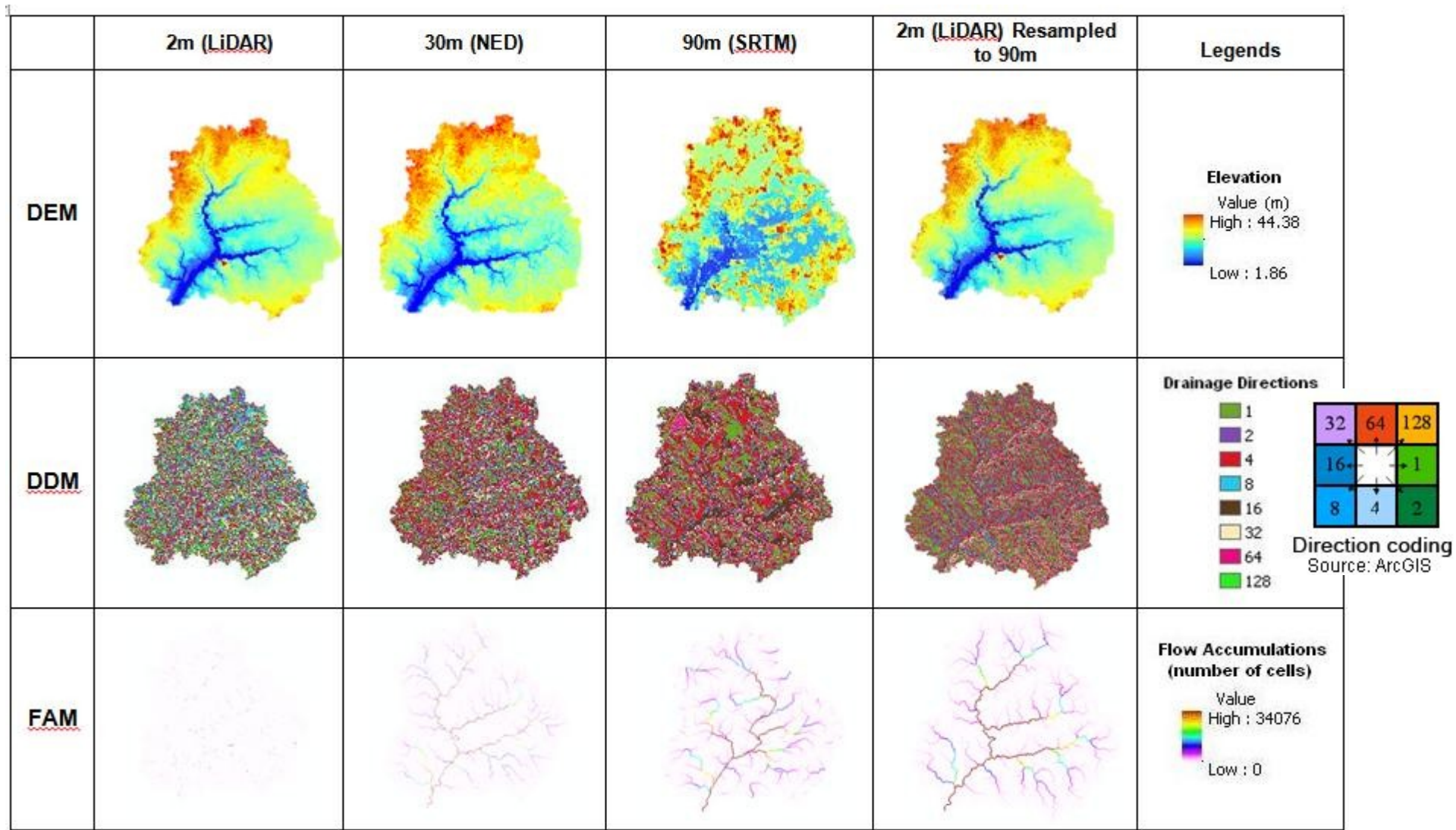
- ▯ LiDAR ~2m (1/9th arc-second) Digital Elevation Model (DEM)
- ▯ National Elevation Dataset (NED) 30m DEM
- ▯ Shuttle Radar Topography Mission (SRTM) 90m DEM
- ▯ Potential EvapoTranspiration (PET) preinstalled in CREST (Bibimo) a global monthly mean
- ▯ Next-Generation Radar (NEXRAD) precipitation data 90m
- ▯ Tropical Rainfall Measuring Mission (TRMM) precipitation data 12km
- ▯ USGS stream gauge data (# 01491000)

NEXRAD Coverage

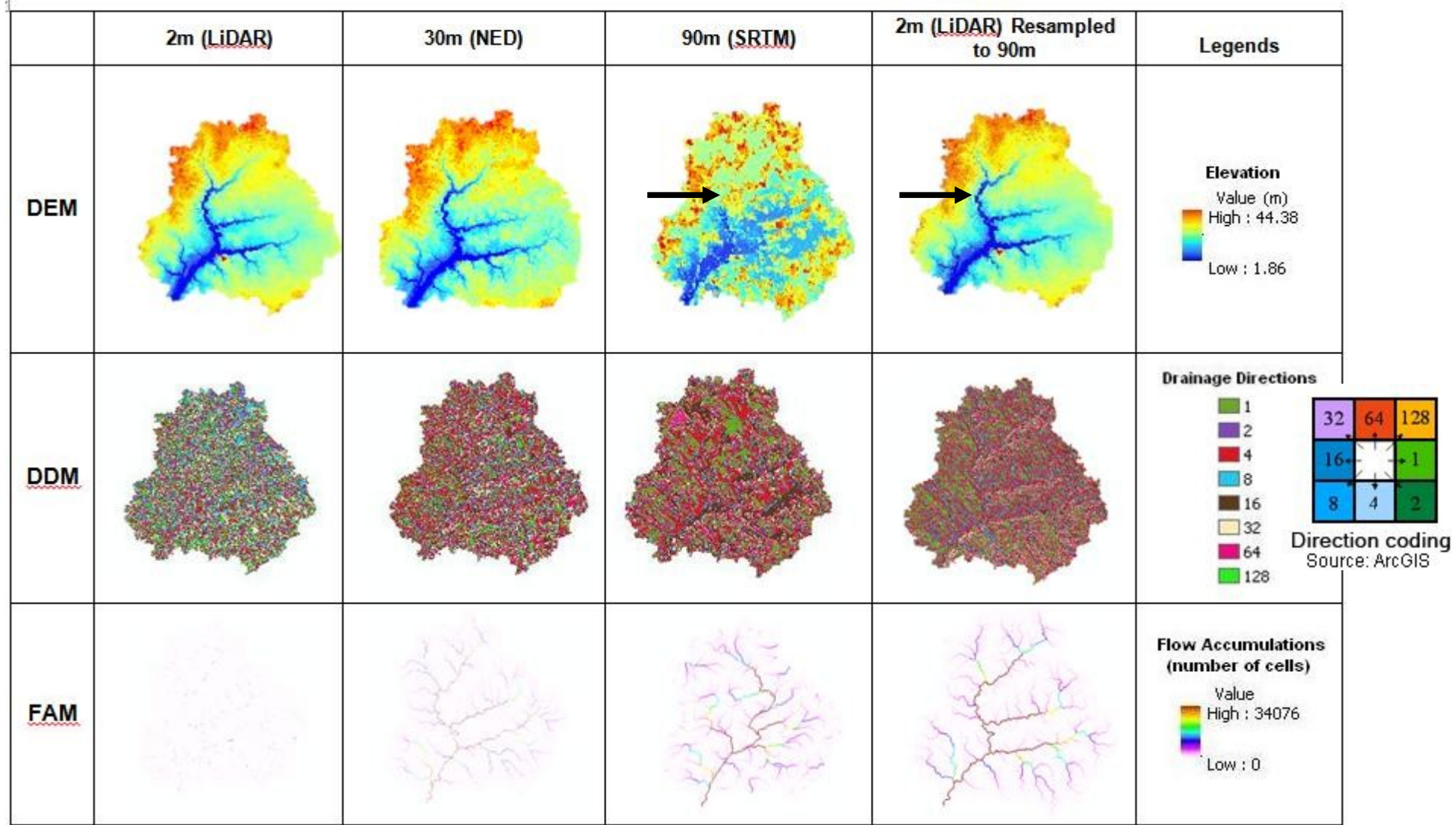


Source: Noaa.gov

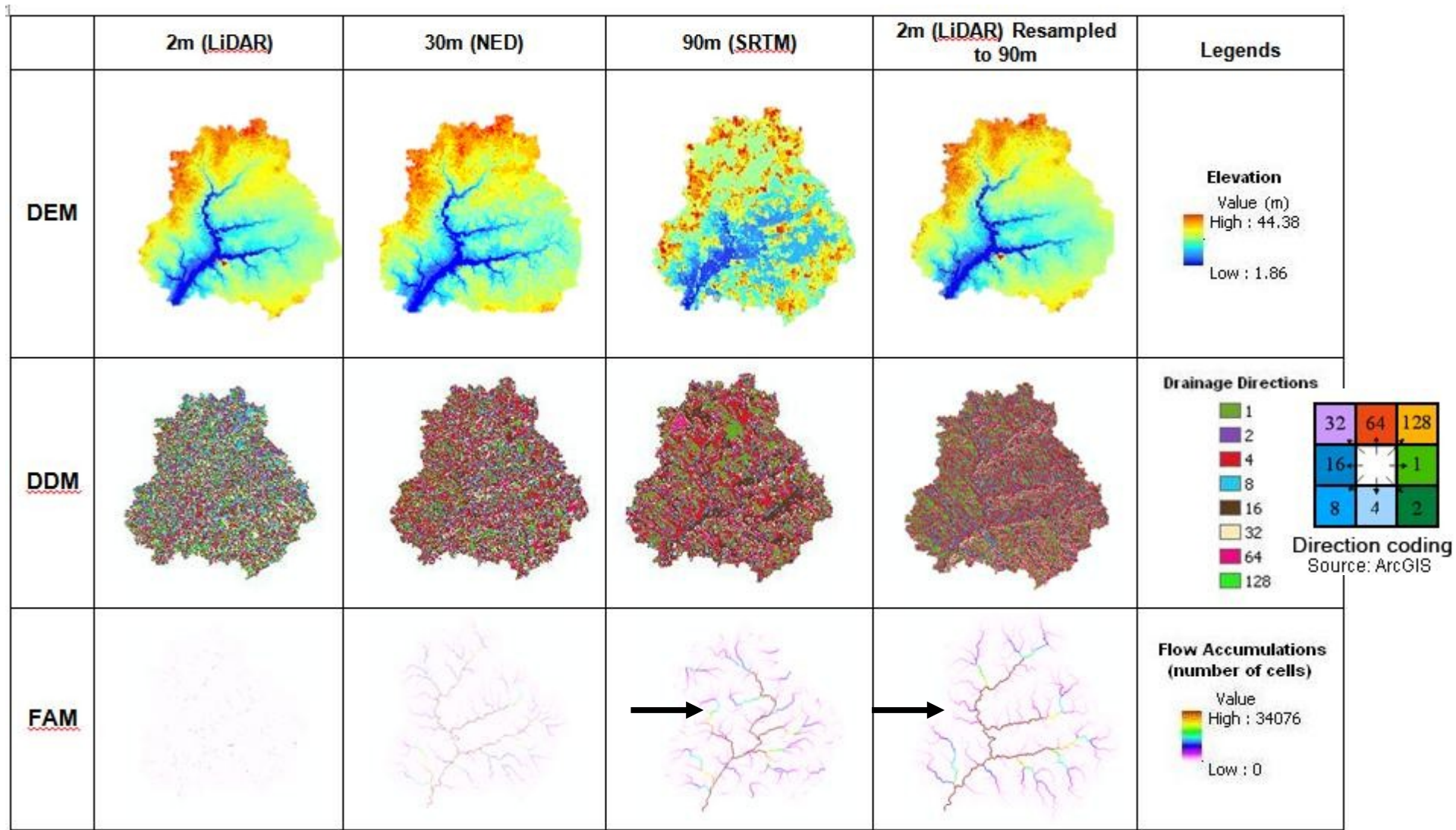
DEMs and Derived Inputs



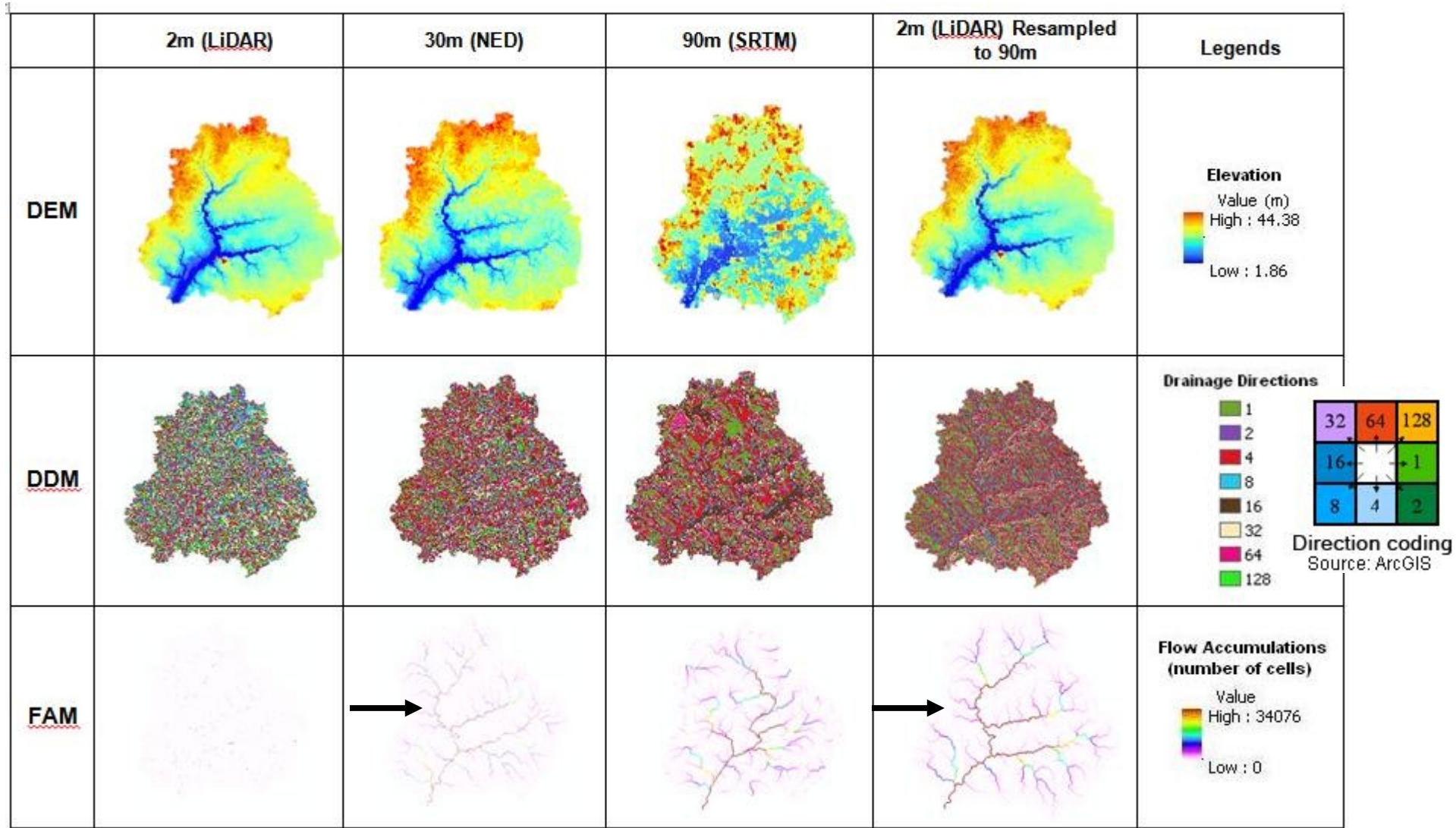
DEMs and Derived Inputs



DEMs and Derived Inputs



DEMs and Derived Inputs

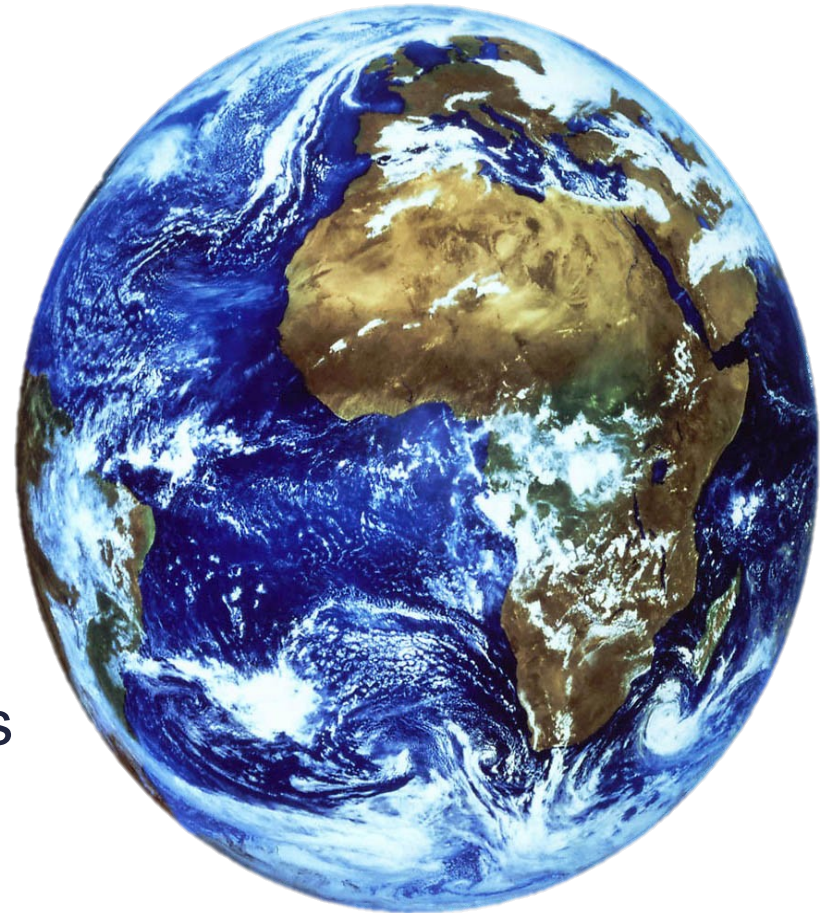


DEMs and Derived Inputs

NSCE	Bias	coeM	expM	River	Under	LeakO	LeakI	Th	GM	pWm	pB	pIM	pKE	pFc	iWU	iSO	iSU	Run Num	
-0.26072	-98.2648	149.6364	0.596777	2.901155	0.750448	0.430652	0.245512	30	1.332395	31.38873	0.057765	3.470812	1.092507	2.961565	41.33973	5.994159	18.49954	1	
-0.26409	-99.4108	20.84089	0.830367	1.221621	0.451027	0.695739	0.017893	30	1.332395	198.7479	0.987293	3.229873	2.581508	4.611582	41.33973	5.994159	18.49954	2	
-0.26164	-98.6054	31.82427	0.877978	1.835359	0.676251	0.511194	0.171707	30	1.332395	39.11105	1.145407	6.056932	2.185239	9.076012	41.33973	5.994159	18.49954	3	
-0.26188	-98.8035	99.07614	0.305502	1.875713	0.978874	0.999228	0.135831	30	1.332395	169.7509	1.005619	5.540051	2.935504	9.11731	41.33973	5.994159	18.49954	4	
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
-0.26281	-99.1615	53.17767	0.686033	1.965346	0.250679	0.76237	0.267859	30	1.332395	78.25552	0.16387	3.418428	2.714748	3.820025	41.33973	5.994159	18.49954	37	
-0.26063	-98.3439	69.53299	0.706522	0.241272	0.514801	0.802395	0.370732	30	1.332395	265.3788	0.466686	5.294013	1.01347	4.285421	41.33973	5.994159	18.49954	38	
-0.26052	-98.3547	34.89988	0.465782	0.593014	0.718117	0.910771	0.277815	30	1.332395	220.669	0.701491	8.632578	2.270191	5.684187	41.33973	5.994159	18.49954	39	
Final Result - 2hr:12min																			
-0.25585	-96.2941	110.3695	0.726233	2.84586	0.709115	0.832429	0.283711	30	1.332395	27.8946	0.746552	5.976897	0.498842	6.286557	41.33973	5.994159	18.49954	1	
-0.25797	-97.3597	140.6069	0.294831	1.176718	0.328296	0.743468	0.367557	30	1.332395	119.7919	1.251955	9.536644	0.994416	6.217665	41.33973	5.994159	18.49954	2	
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
-0.26071	-98.1637	93.18839	0.877302	2.971694	0.344626	0.92869	0.176146	30	1.332395	279.9736	0.842466	4.655126	0.613051	4.401947	41.33973	5.994159	18.49954	9	
-0.26072	-98.2648	149.6364	0.596777	2.901155	0.750448	0.430652	0.245512	30	1.332395	31.38873	0.057765	3.470812	1.092507	2.961565	41.33973	5.994159	18.49954	10	
-0.25881	-97.5206	123.4503	0.623786	2.473857	0.533121	0.73381	0.268232	30	1.332395	114.7622	0.724685	5.90987	0.799704	4.966934	41.33973	5.994159	18.49954	Average	
0.002361	0.912441	26.24849	0.247458	0.866291	0.227807	0.215795	0.079794	0	0	118.0639	0.495697	2.625603	0.288099	1.596501	0	0	0	STD DEV	

Data Acquisition: Findings

- Formal quantitative analysis pending, but qualitatively...
- 90m DEMs resampled from 2m LiDAR data results in structurally similar Flow Accumulation Maps (FAM).
- SRTM derived DEMs are too noisy to use in shallow relief areas.
- TRMM (12km) is too coarse and removes all spatial variability
- Using global monthly PET means does not characterize what fine scale dynamics



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