Enhancements for FFGS improved operations

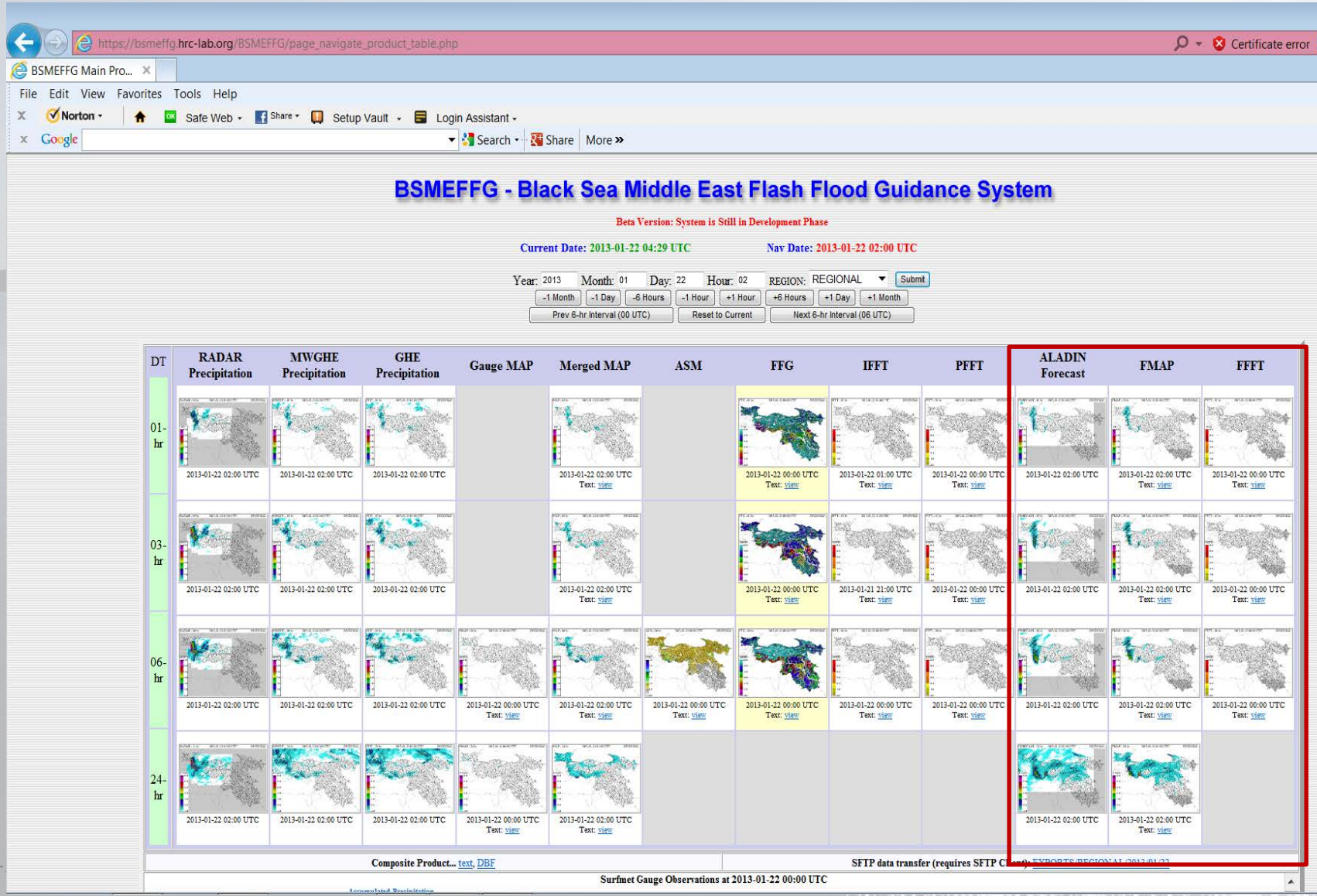
Hydrologic Research Center

3-5 May 2017

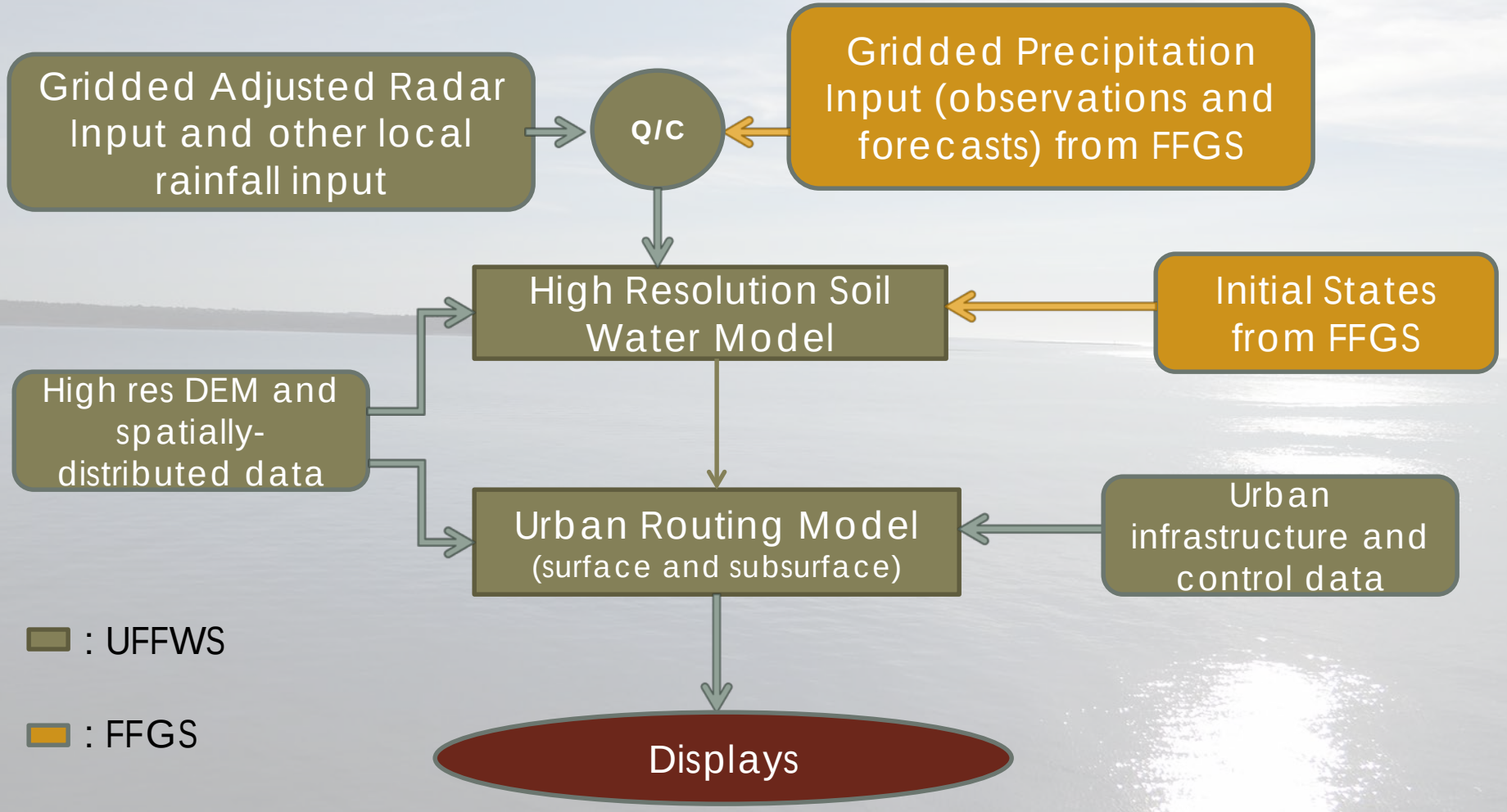
Enhancements to be discussed

- A. Multiple Mesoscale Model Input
- B. Urban Flash Flood Warning
- C. Use of satellite inundation mapping to correct soil moisture
- D. Landslide occurrence prediction
- E. Riverine routing capability

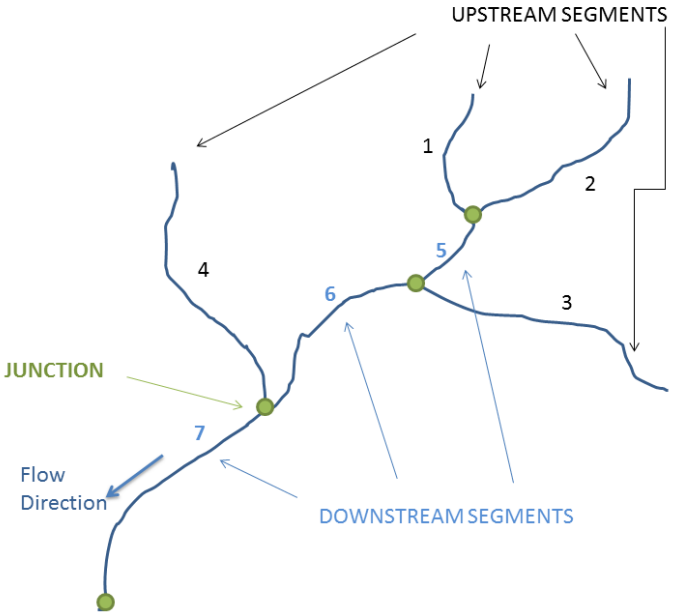
A. Multiple Mesoscale Model Input

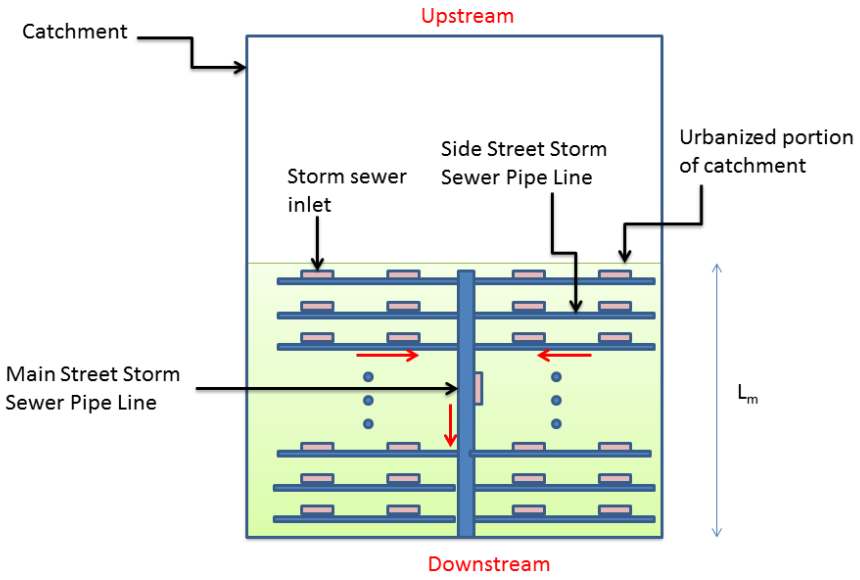


B. Urban Flash Flood Warning



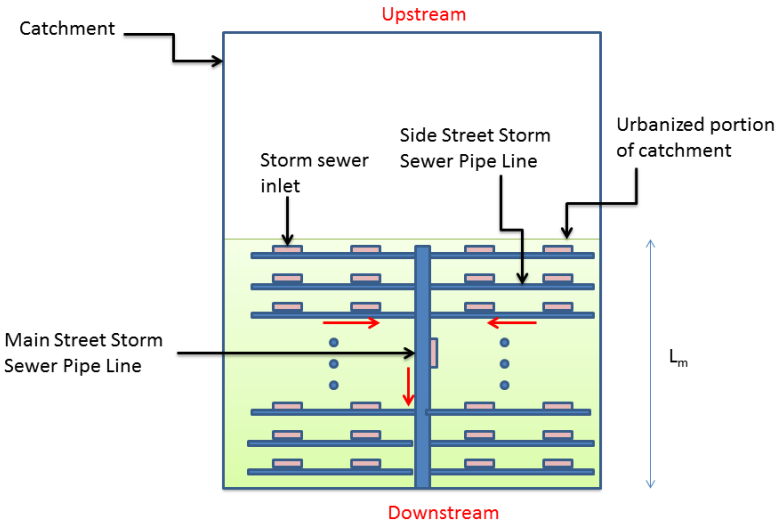
Basic technical elements UFFWS

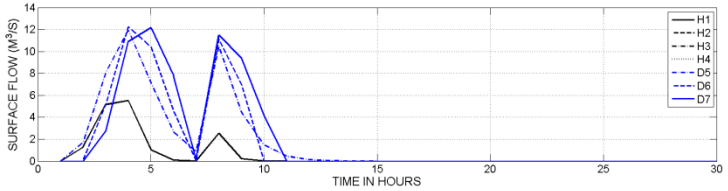


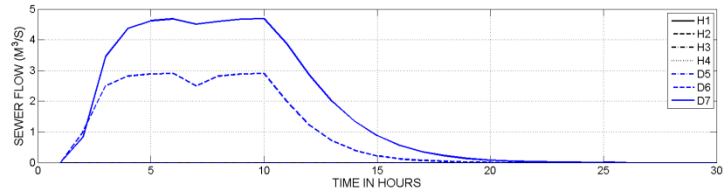


$$\partial y/\partial t + \partial(vy)/\partial x = 2q_L/B - f \qquad S_f = S_0 - \partial y/\partial x$$

Basic technical elements UFFWS







Total Rainfall Generating Inlet Capacity:

$(N_s+N_m)\ Q_T = (1/3.6)\ U_0\ f_A\ A$

Total Storm Sewer Volume Capacity:

$$X_s^0 = \sum_{k=0}^{M} (\pi\ D_k^2 / 4)\ L_k$$

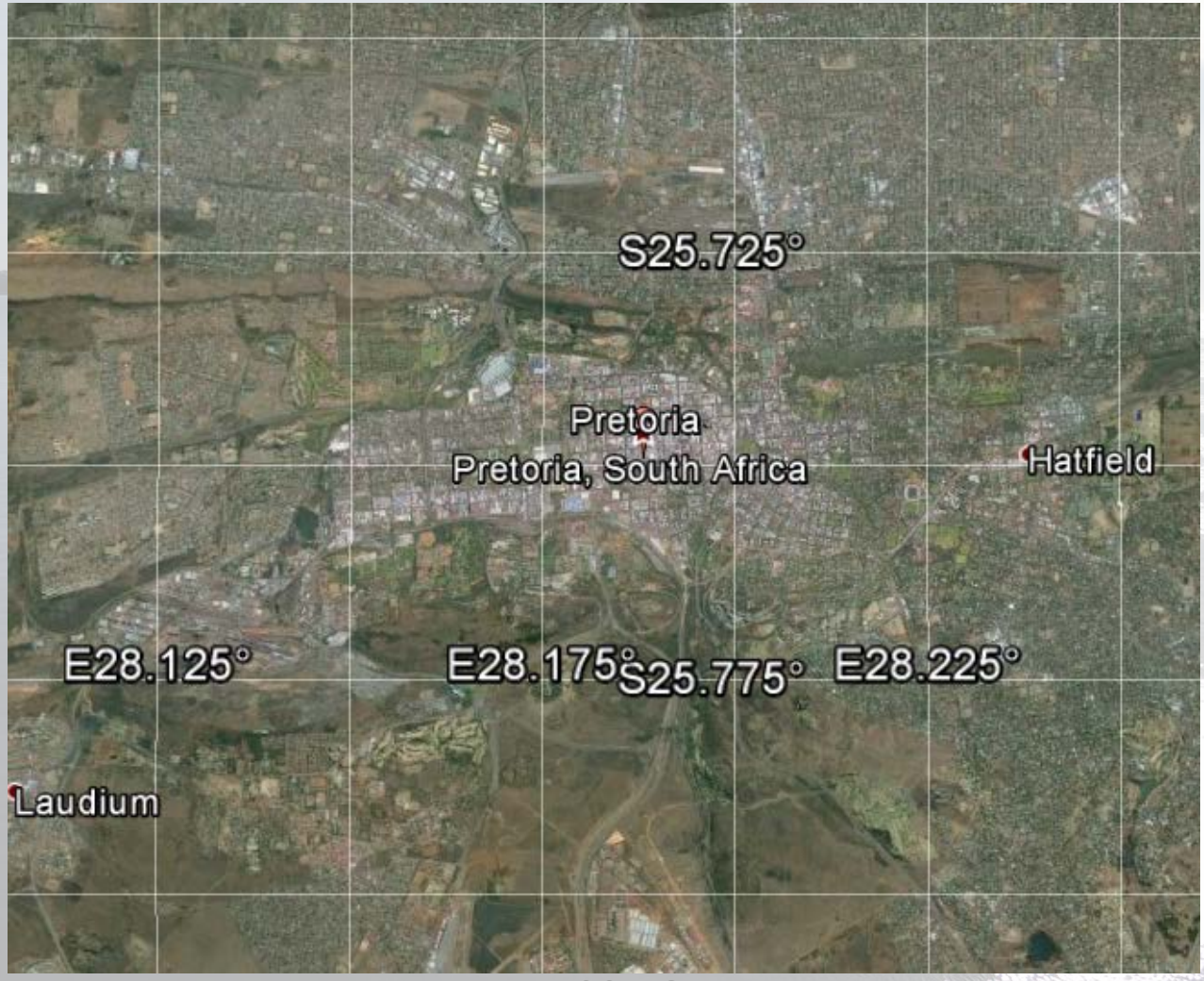
Time to Strom Sewer Overflow:

$$T_s^0 = -\ (1 / b)\ \mathbf{ln\{}1 - b\ X_s^0\ /\ [(1/3.6)\ U_0\ f_A\ A]\mathbf{\}}$$

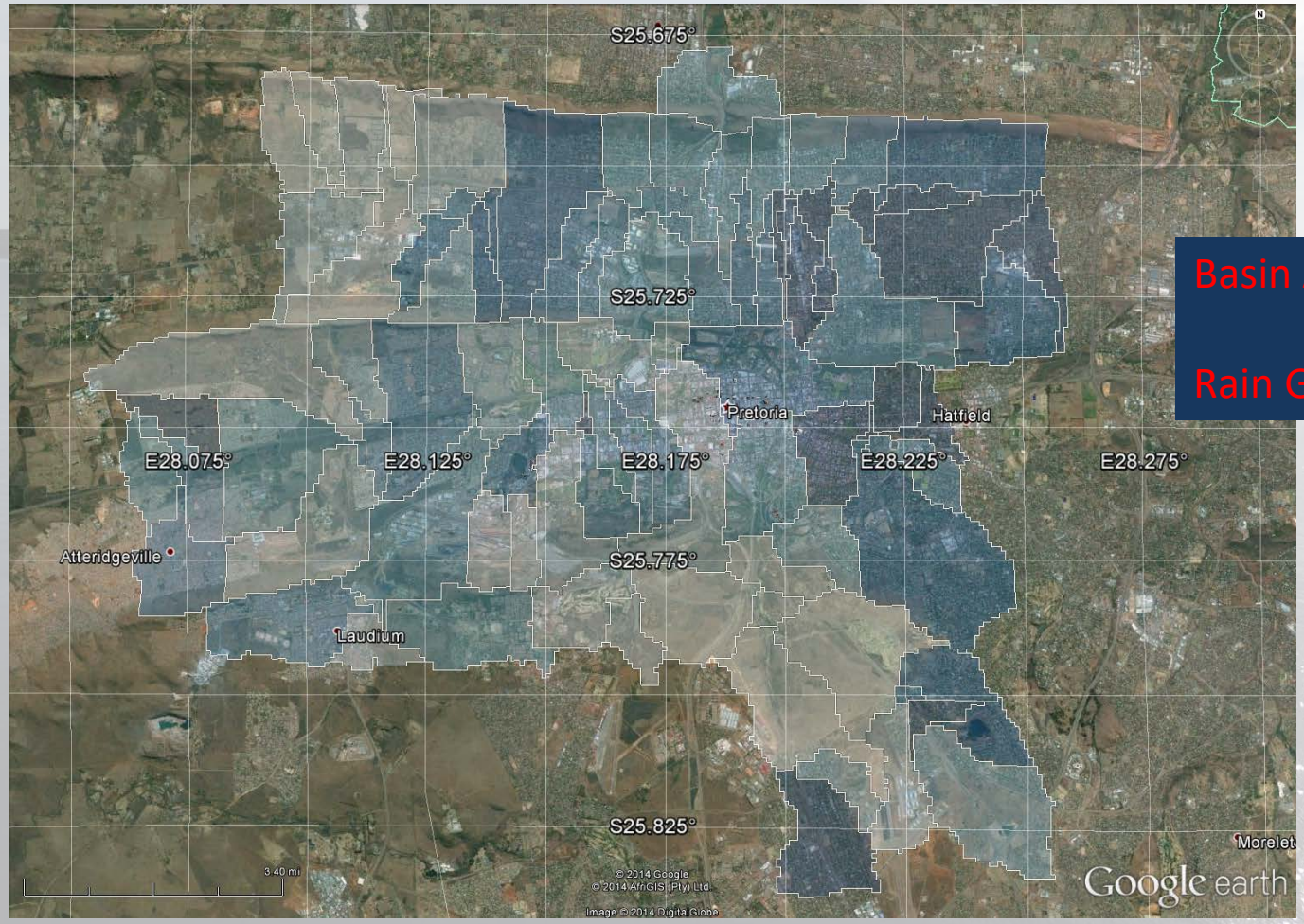
Scaling of Bankfull Q and Bankfull v:

$Q_{BNKF} = \alpha\ A^{\beta}$

Demonstration of feasibility (city of Pretoria)



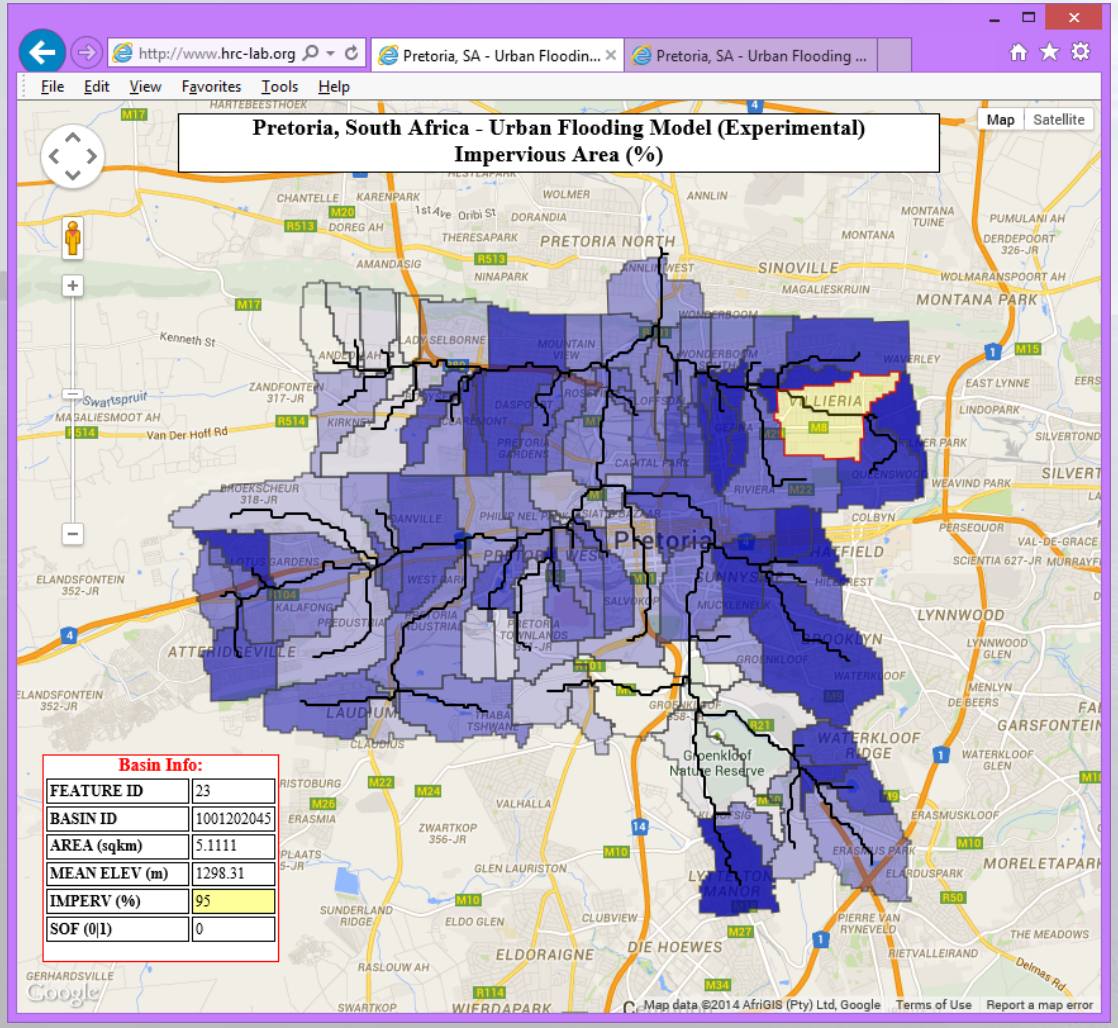
Demonstration of feasibility (city of Pretoria)



Basin Areas: 1-5 km²

Rain Grid Area: 16 km²

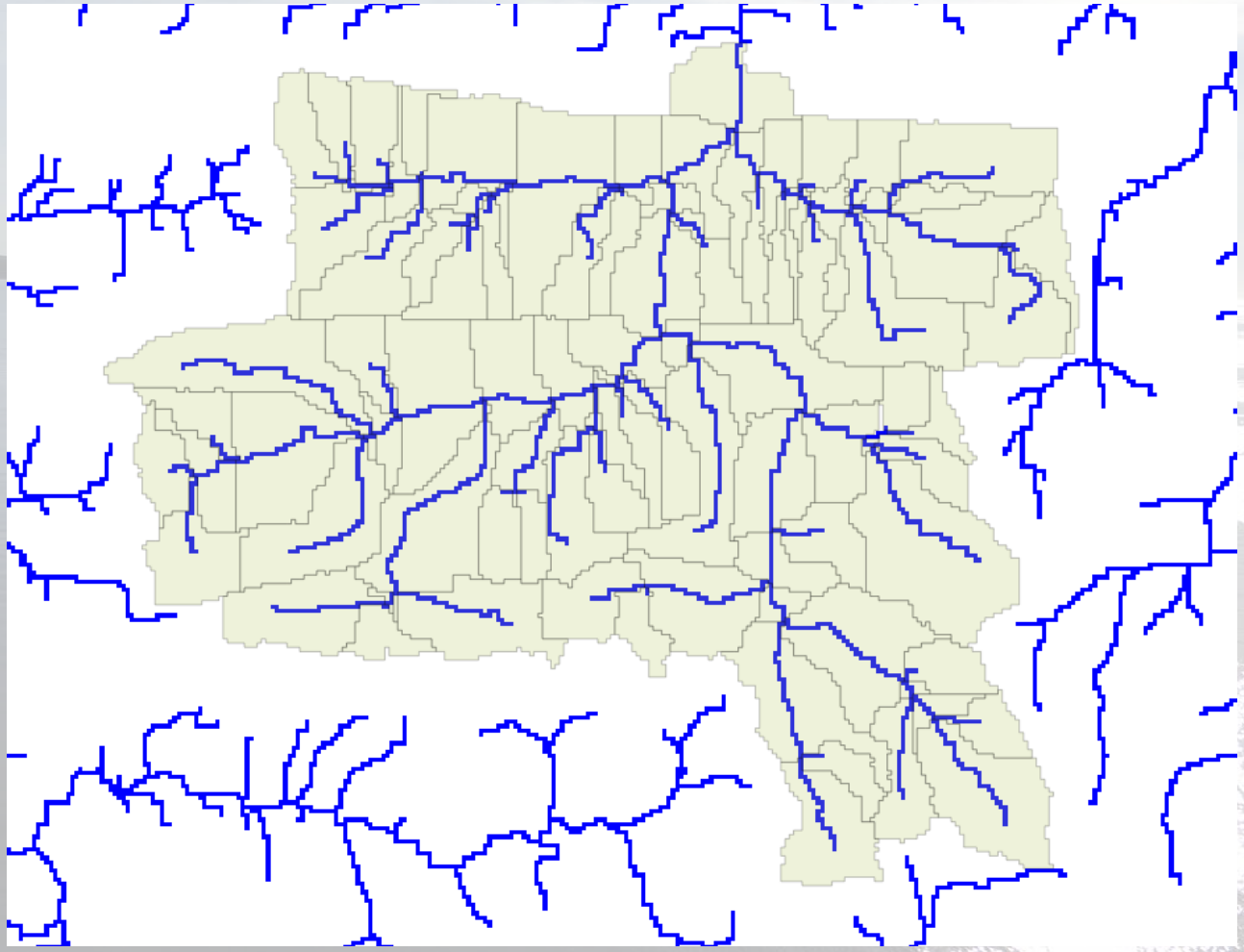
Demonstration of feasibility (city of Pretoria)



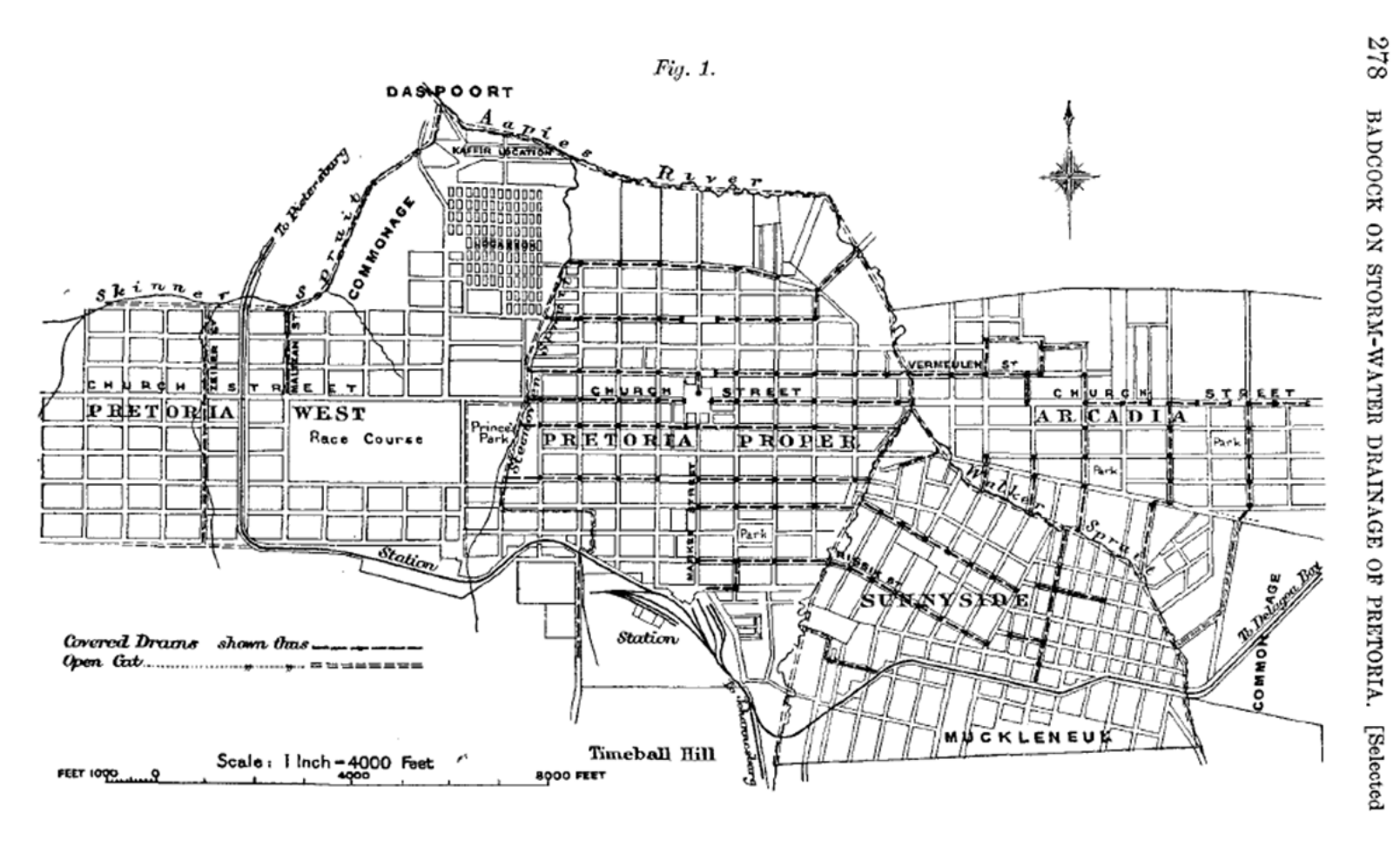
Av. Basin Area: 1-5 km^2

Rain Grid Area: 16 km^2

Demonstration of feasibility (city of Pretoria)



Demonstration of feasibility (city of Pretoria)



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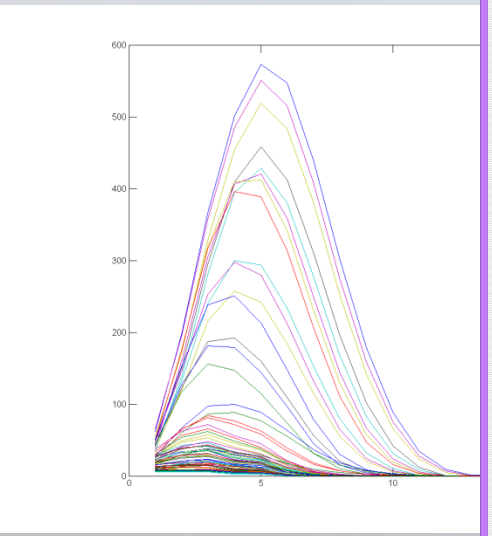
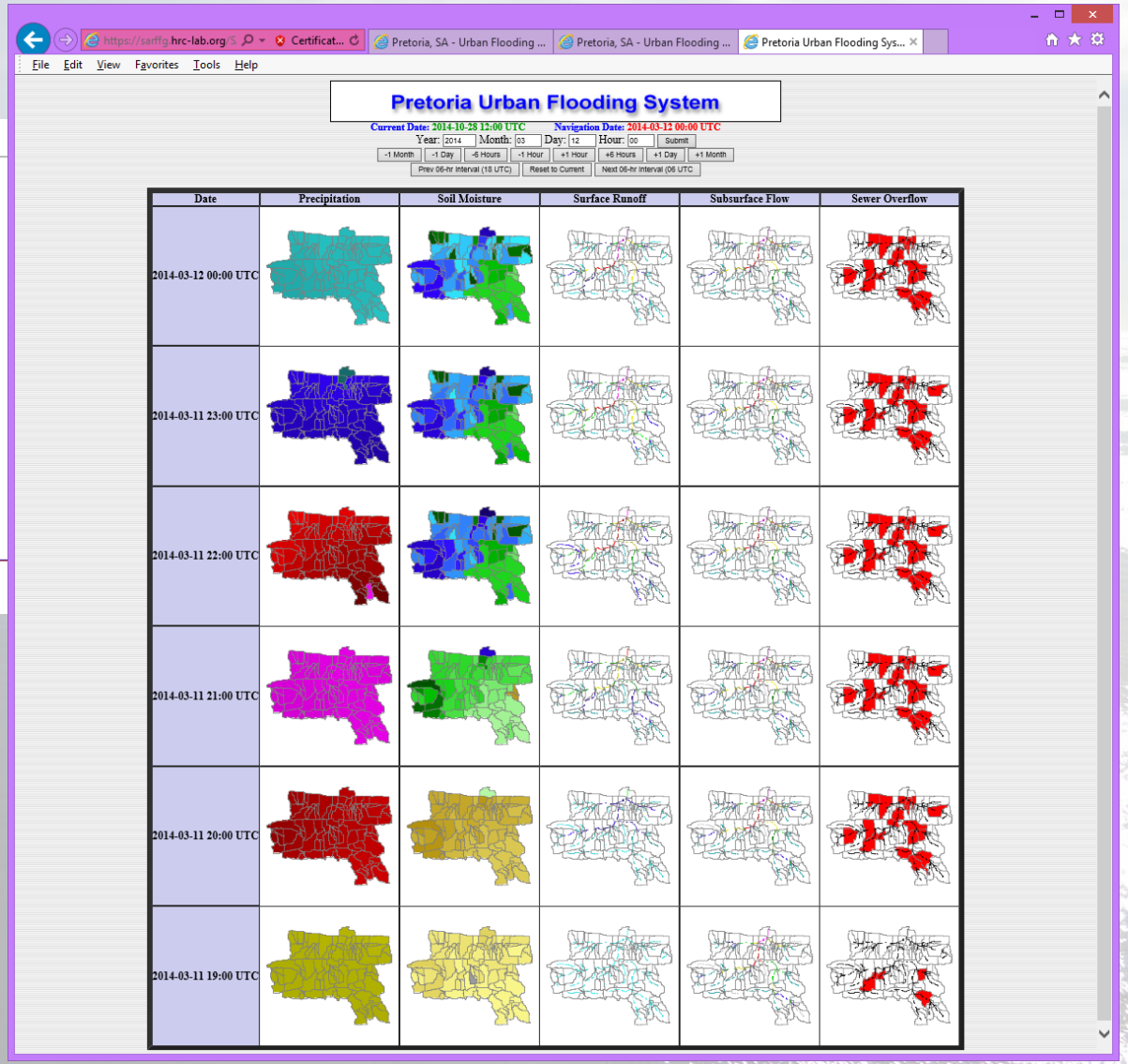
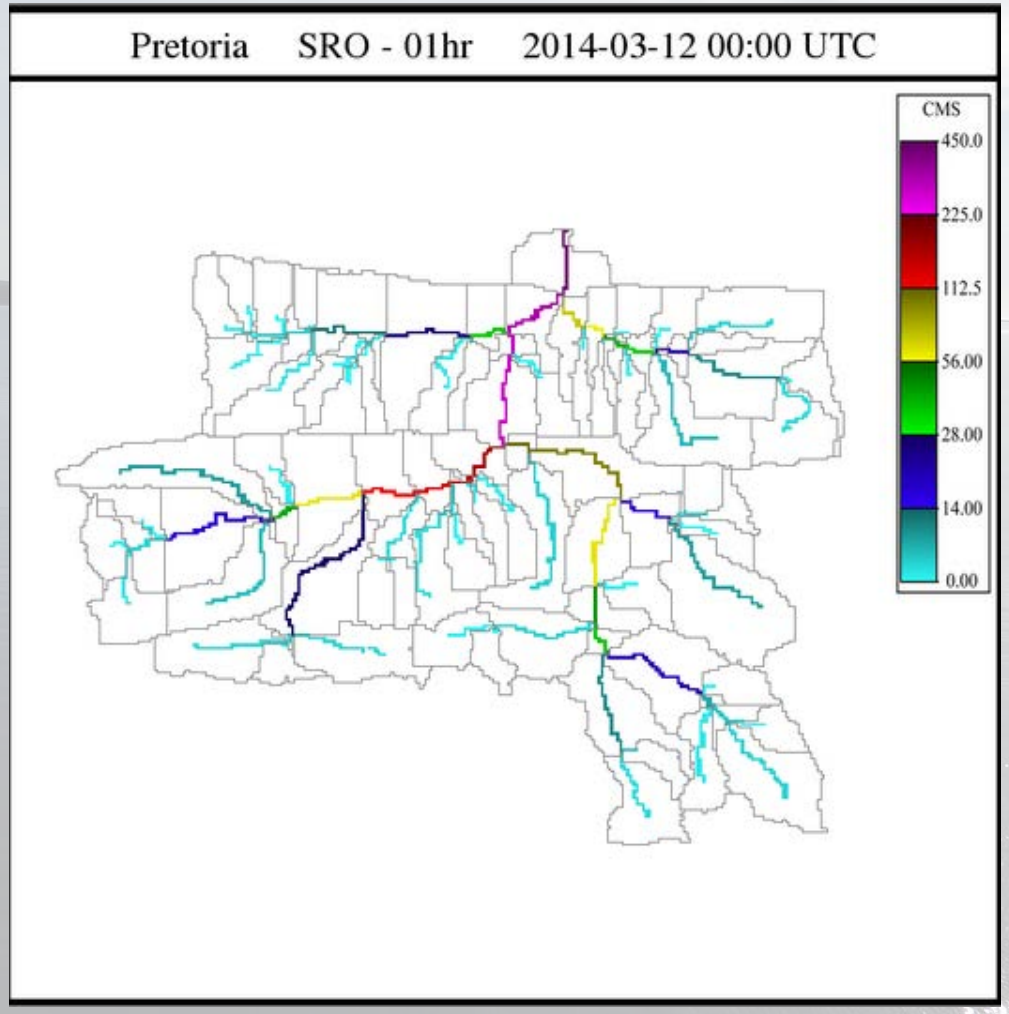




Surface Drainage Flow



C. Inundation Mapping for SM Estimation

MRC FLASH FLOOD GUIDANCE SYSTEM - MRCFFG

In Operation Since 2009

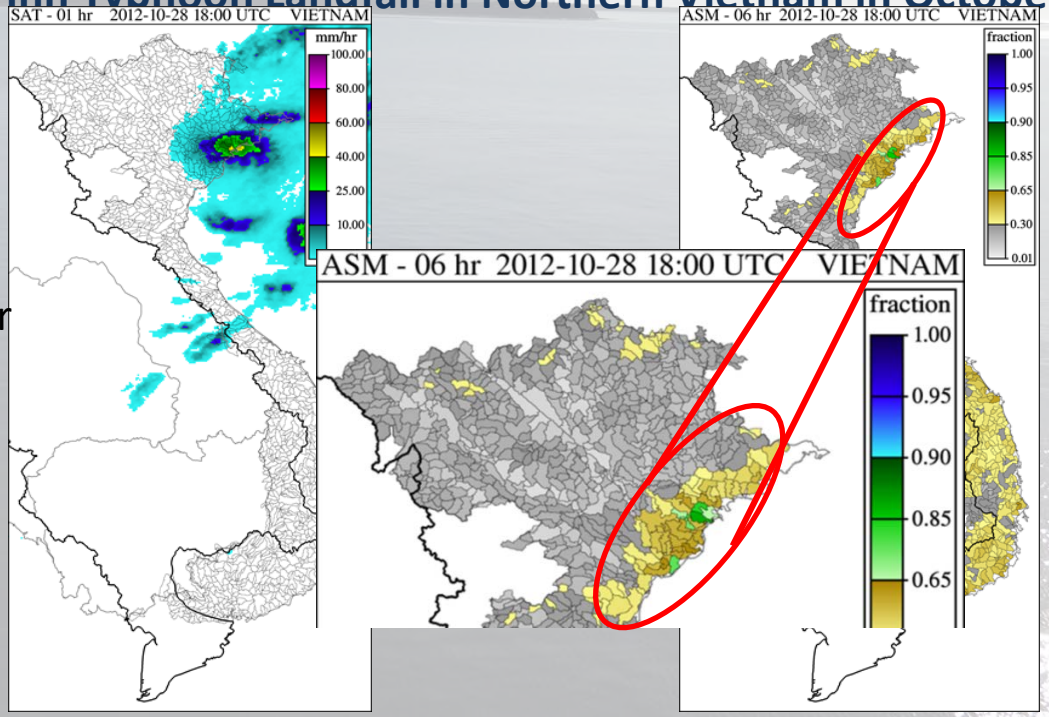
Development/Implementation/Training: Hydrologic Research Center

Purpose: Provide Regional Products with High Resolution to Forecasters in Thailand, Lao PDR, Cambodia and Vietnam to Provide Real-Time Warnings for Flash Floods

Sample Products for Flash Flood Prone Basins Delineated in Vietnam

(Son Tinh Typhoon Landfall in Northern Vietnam in October 2012)

Precipitation at Landfall from NESDIS HydroEstimator



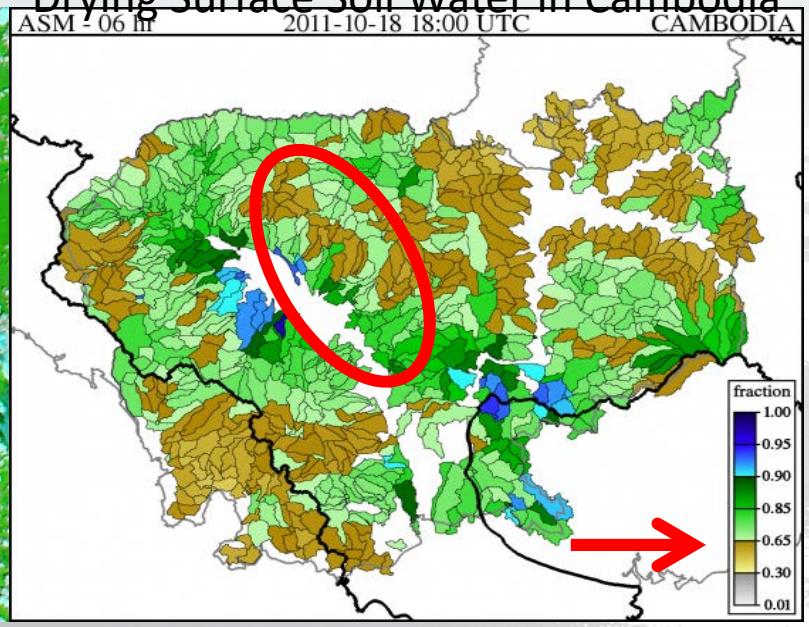
Upper-Soil Water Saturation Fraction at Landfall from operational MRCFFG (uses bias-adjusted HE pixel values)

C. Inundation Mapping for SM Estimation

STANDING WATER CORRECTIONS TO MODEL SOIL WATER FROM NASA PRODUCTS

MODIS-Based Observed Inundation Area in Cambodia

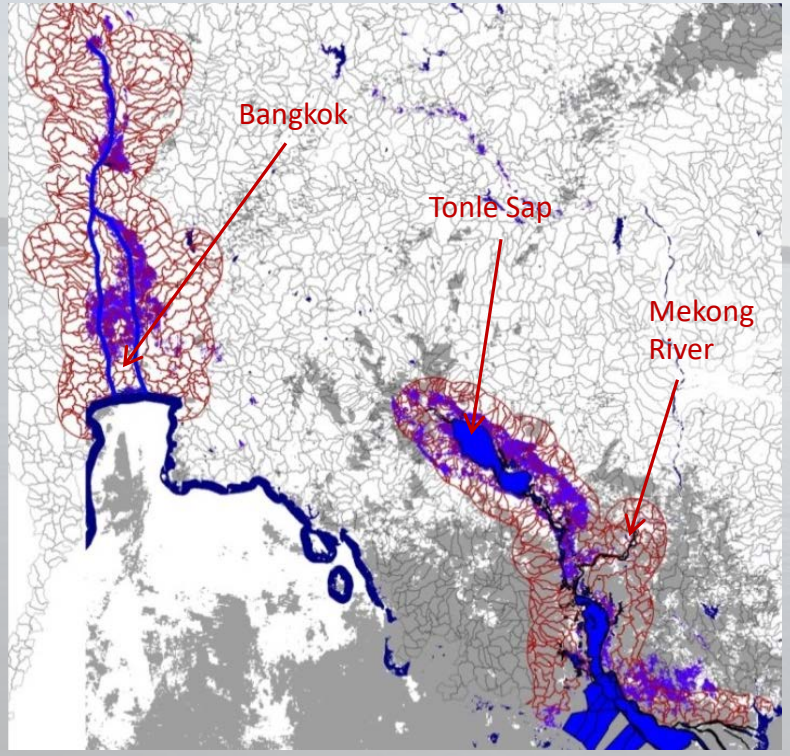
MRCFFG Modeled Drying Surface Soil Water in Cambodia

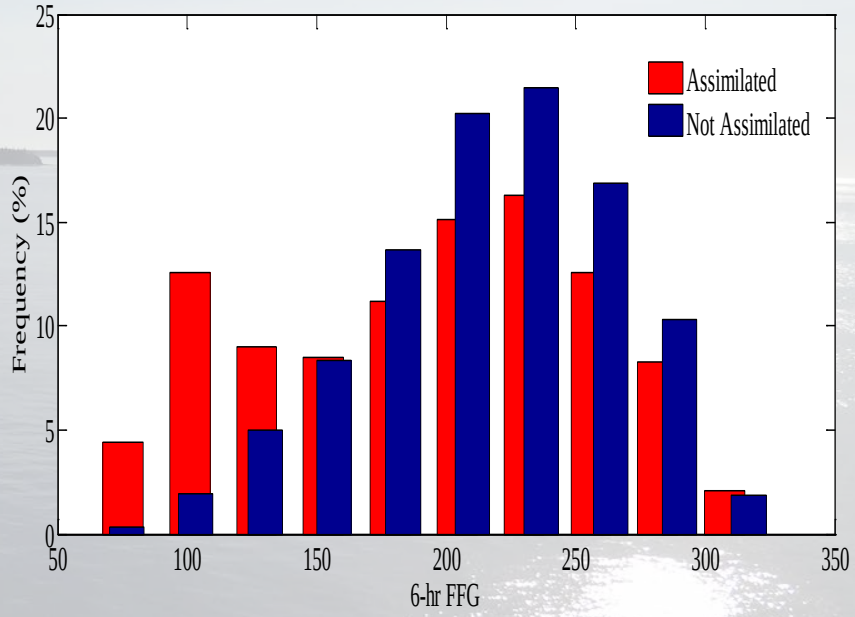


HRC Current Work: *Feasibility and Effectiveness of Correcting Operational Model Soil Water with MODIS Inundation Information in Real Time*

C. Inundation Mapping for SM Estimation

Posner et al. Remote Sens. **2014**, *6*, 10835-10859 – Open Access



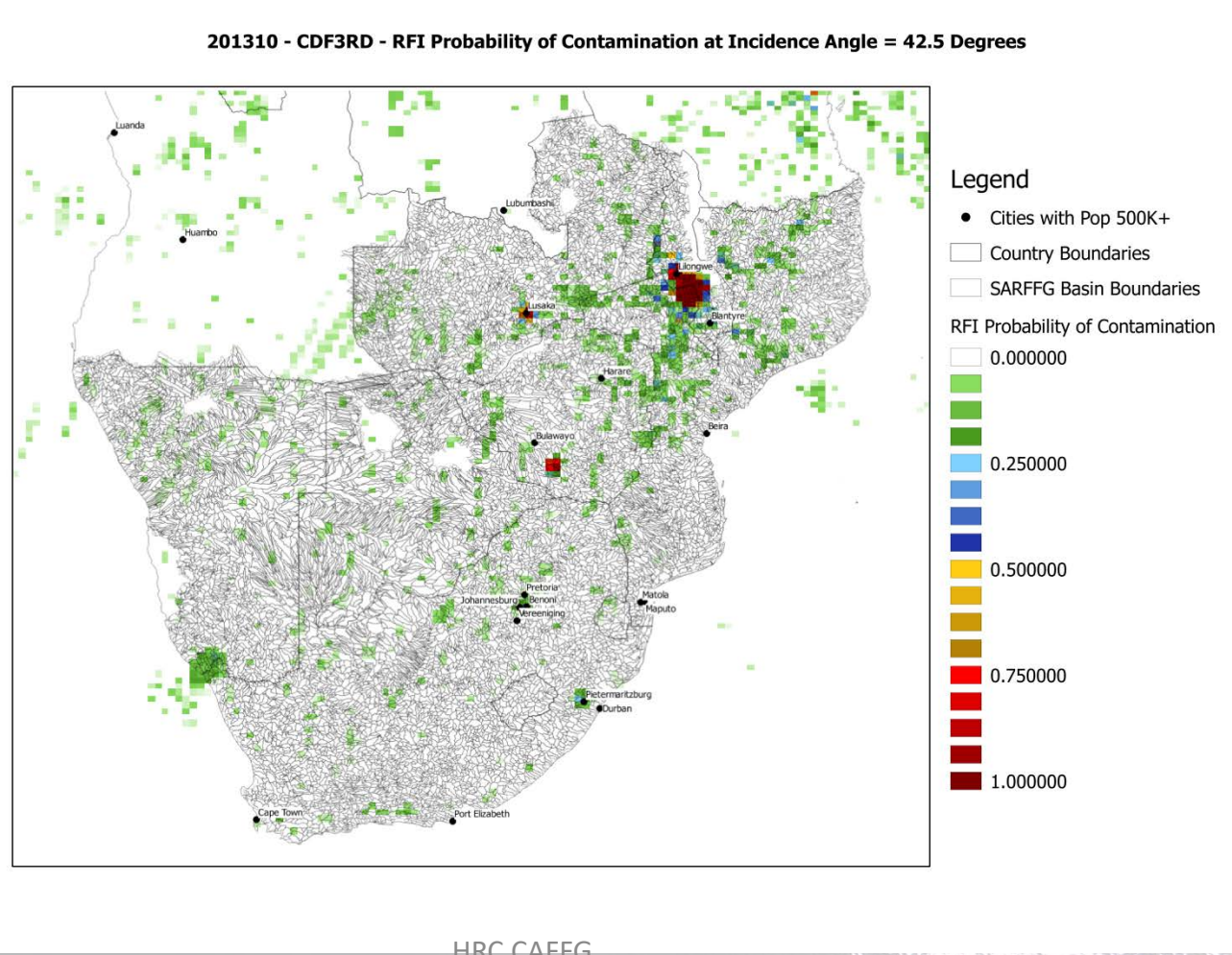


Method: Assimilation of saturation of upper soil in catchments with inundation greater than 85% and use of soil model to adjust lower soil water.

C. SMOS Data

Working with WMO(Bijinski), ESA(Drusch), CESBIO(Kerr) and UGent(Verhoest) to develop a project for HRC to examine the utility of incorporating SMOS in FFG systems

Radio Frequency Interference -RFI



D. Landslide prediction using FFGS output

- D.1 Susceptibility map development in a region with an adequate database (El Salvador, Central America) (completed)
- D.2 Real Time landslide prediction using FFGS rainfall and soil water thresholds in El Salvador (completed)
- D.3 Generalization for Central America and implementation/demonstration in CAFFG (on going)

D.1 Susceptibility Mapping

Parameter

(e.g. Slope)

Classes

Low

Medium

High

Landslide Class Density

$$\frac{N_{pixels}(with\ Landslides\ in\ Parameter\ Class)}{N_{pixels}(in\ Parameter\ Class)}$$

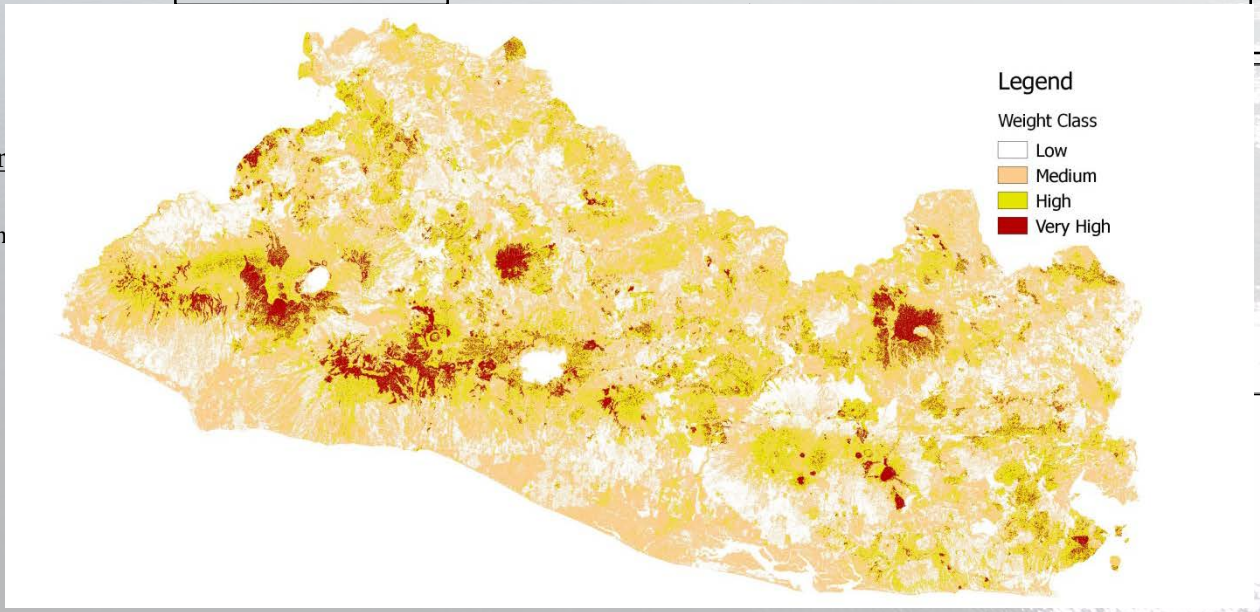
Landslide Map Density

$$\frac{Total\ N_{pixels}(with\ Landslide)}{Total\ N_{pixels}(in\ region)}$$

Landslide Inventory Map

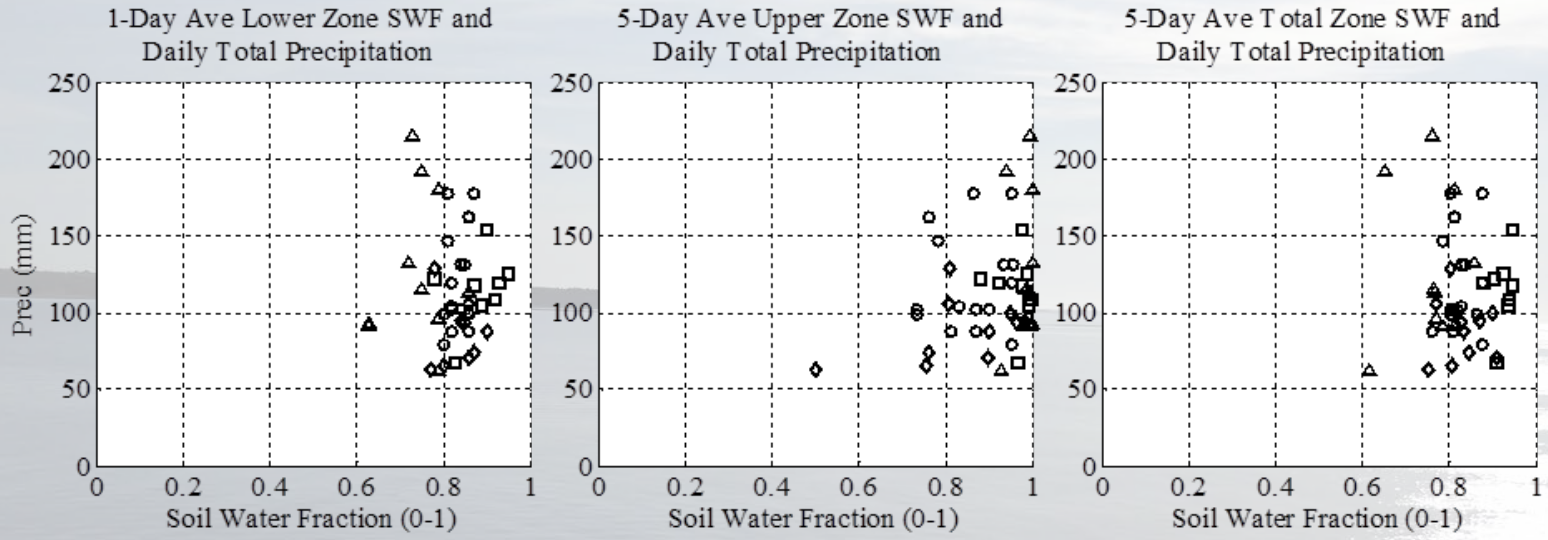
Factor

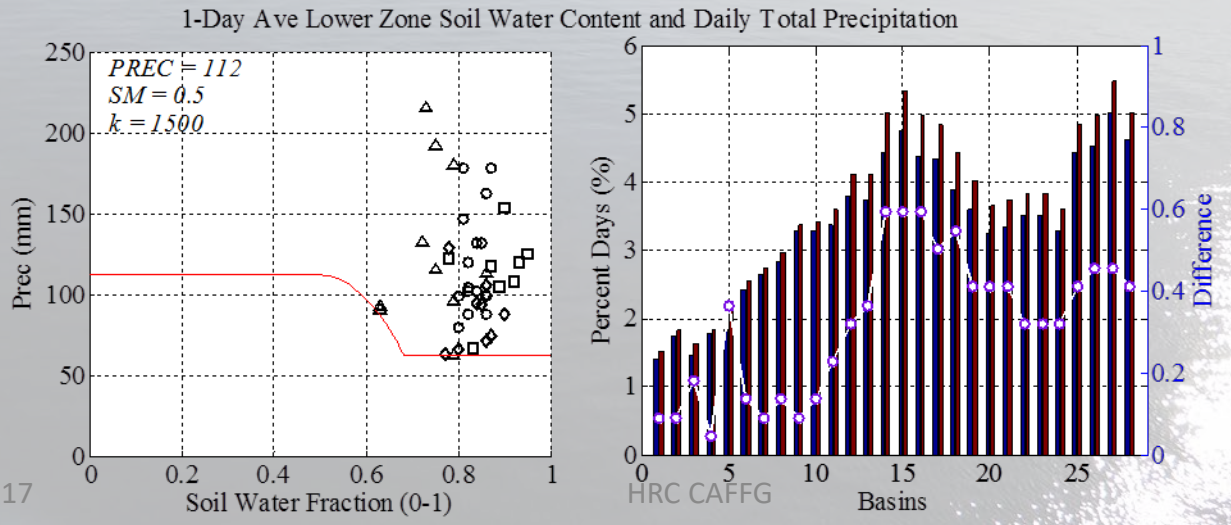
$W_i = \ln$



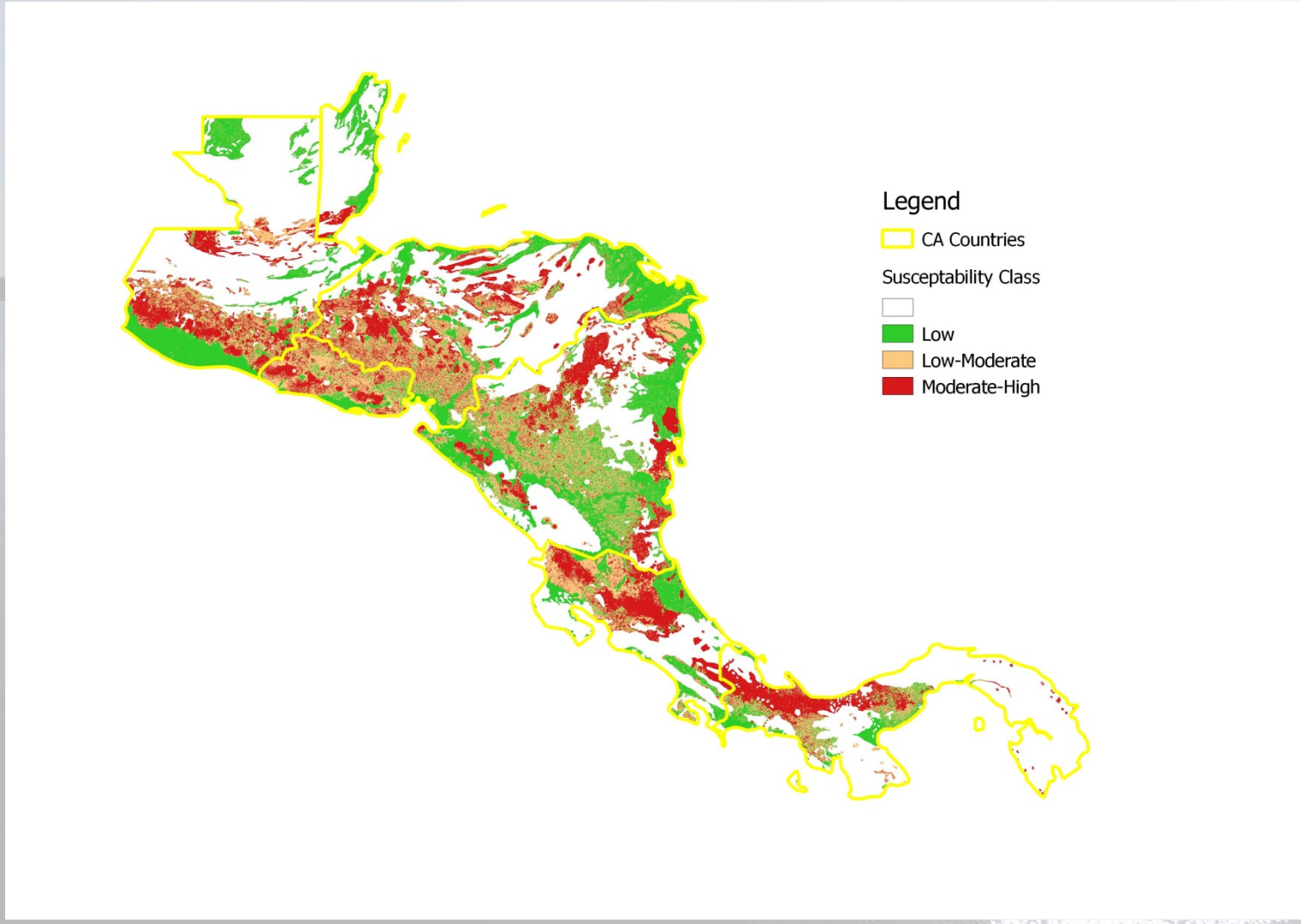
Continuous Susceptibility Weight Values to Discrete Classes

D.2 Real-time Occurrence Prediction based on FFGS Rainfall and SM





D.3 Generalization for Central America



Channel Routing for FFGS

Goal:

To provide capability to forecast flow discharge at pre-specified locations along the channel network of selected river basins and to train forecasters and others on the use of information

Prerequisites:

1. Mesoscale numerical weather prediction forecasts (single or ensemble forecasts) for FFGS ingest (*countries and the RC*)

2. Selection of a specific river basin and forecast points within the river basin (*countries and the RC*)

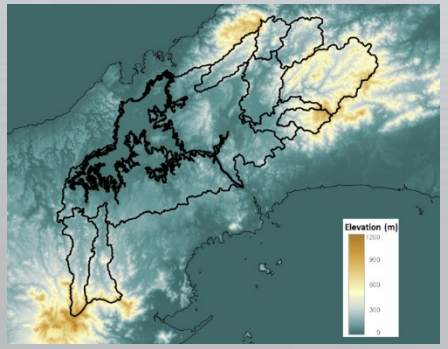
3. Information at sites of the river channel and reservoir information for those reservoirs included (*countries*)

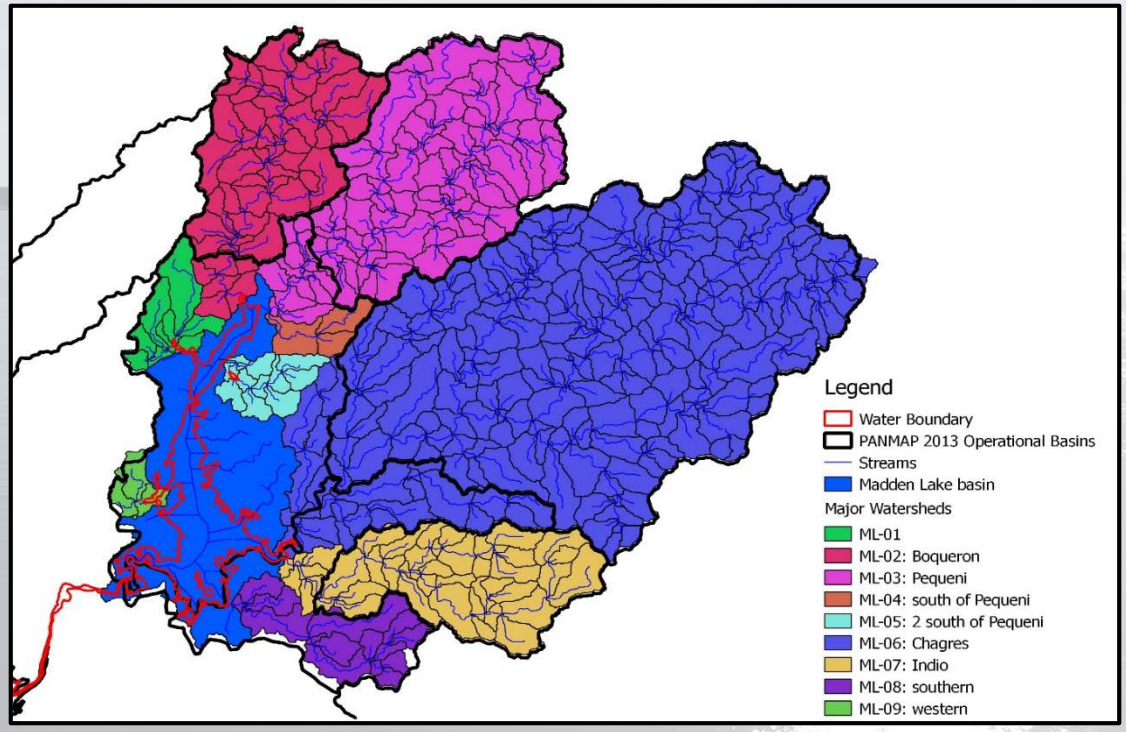
Geospatial Analysis for Routing

Subbasin Av. Resolution: 2 km^2

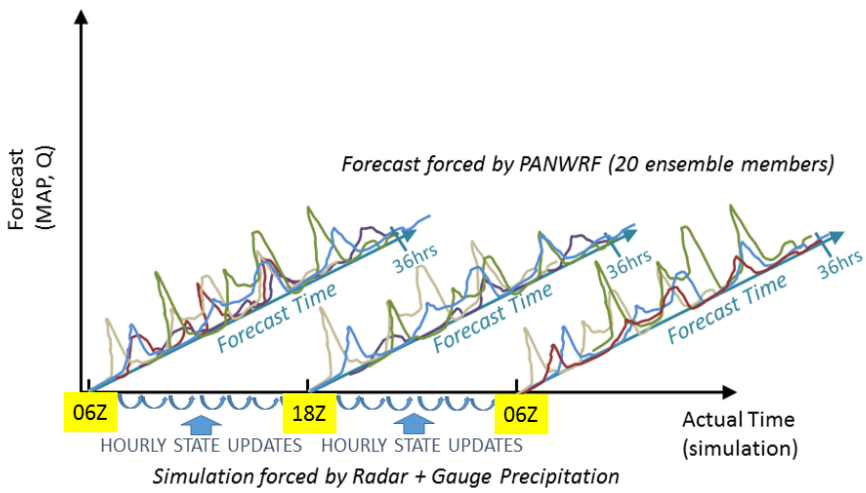
SRTM 30m

Madden Lake boundary
(SRTM water boundary &
Google Earth Adjustments)



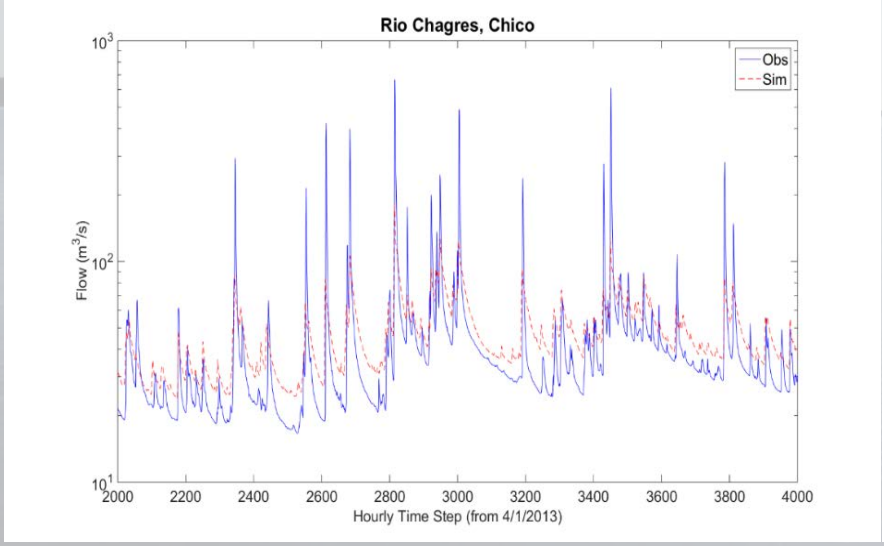


Simulations and Forecasts

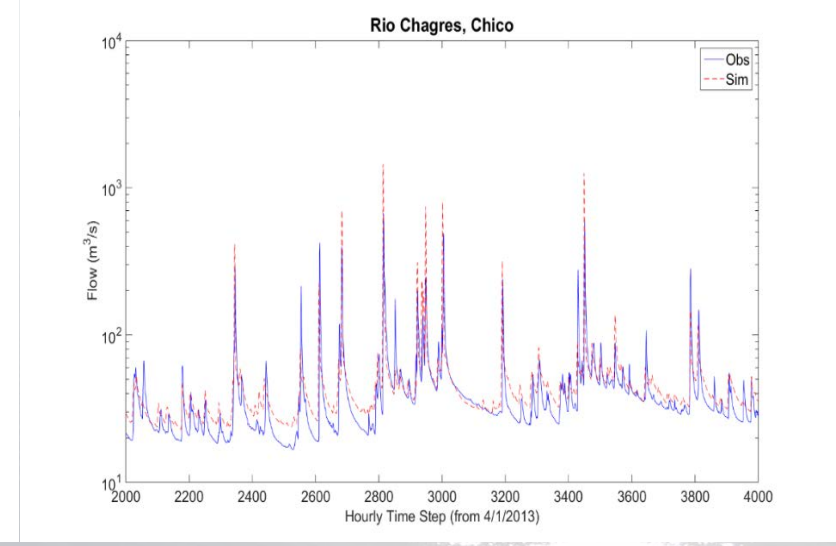


Initial Adjustment of Parameters from Operational Model Values

BEFORE



AFTER



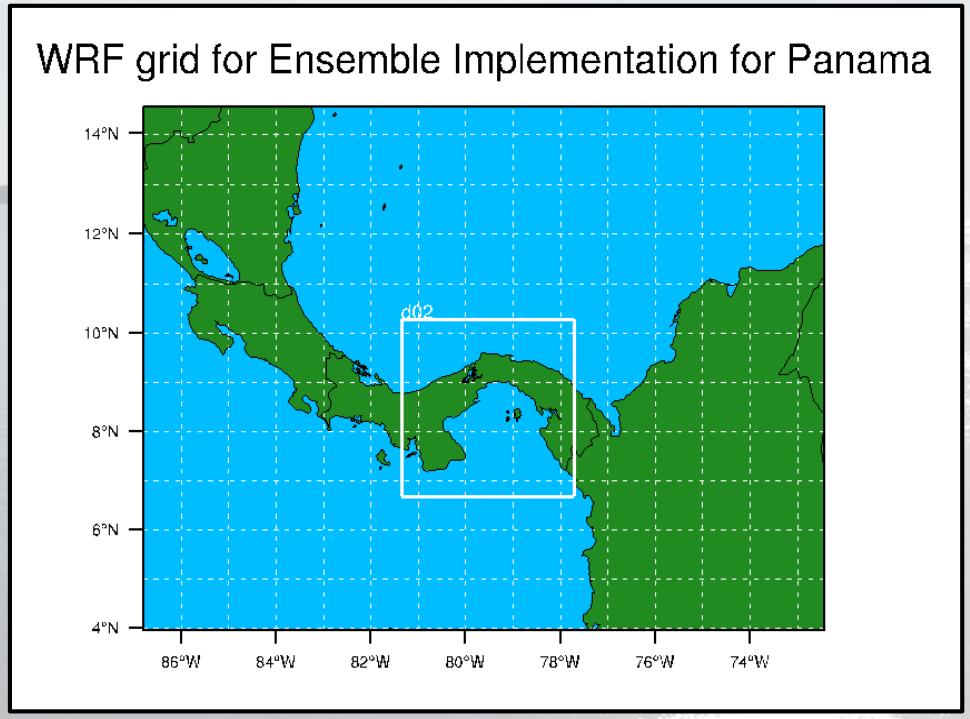
PANWRF Ensemble Run Configuration

20-Member Ensembles

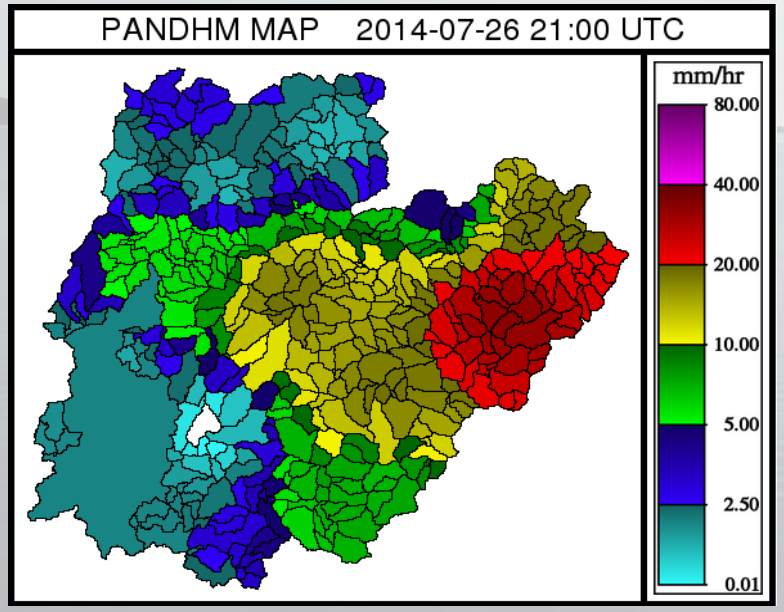
4-km resolution

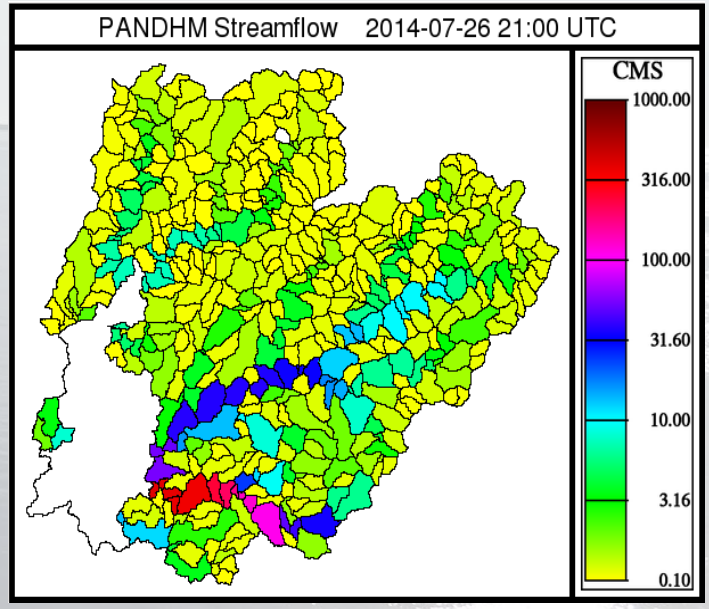
00 UTC and 12 UTC starts

NCEP GEFS forcing

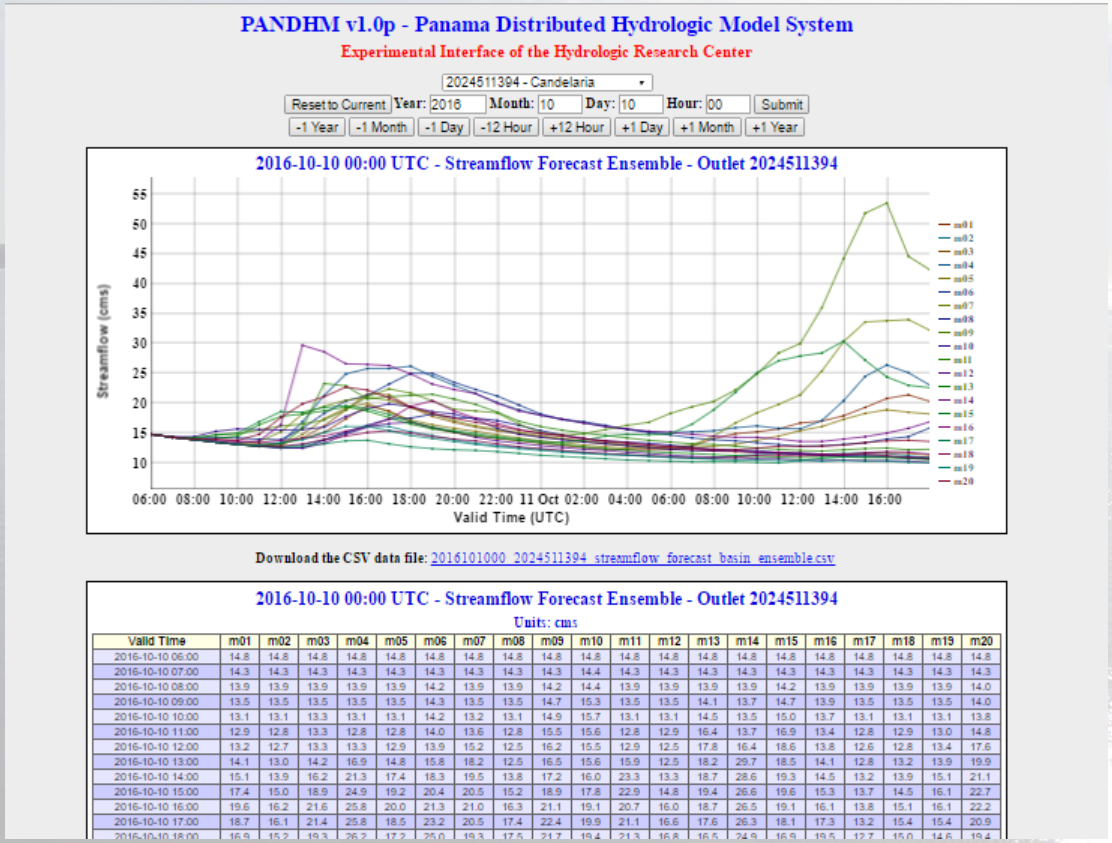


Example Routing Simulation Products





Type of Interface: Ensemble Traces and Table



Valid Time	m01	m02	m03	m04	m05	m06	m07	m08	m09	m10	m11	m12	m13	m14	m15	m16	m17	m18	m19	m20
2016-10-10 06:00	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
2016-10-10 07:00	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.4	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3
2016-10-10 08:00	13.9	13.9	13.9	13.9	13.9	14.2	13.9	13.9	14.2	14.4	13.9	13.9	13.9	13.9	14.2	13.9	13.9	13.9	13.9	14.0
2016-10-10 09:00	13.5	13.5	13.5	13.5	13.5	14.3	13.5	13.5	14.7	15.3	13.5	13.5	14.1	13.7	14.7	13.9	13.5	13.5	13.5	14.0
2016-10-10 10:00	13.1	13.1	13.3	13.1	13.1	14.2	13.2	13.1	14.9	15.7	13.1	13.1	14.5	13.5	15.0	13.7	13.1	13.1	13.1	13.8
2016-10-10 11:00	12.9	12.8	13.3	12.8	12.8	14.0	13.6	12.8	15.5	15.6	12.8	12.9	16.4	13.7	16.9	13.4	12.8	12.9	13.0	14.8
2016-10-10 12:00	13.2	12.7	13.3	13.3	12.9	13.9	15.2	12.5	16.2	15.5	12.9	12.5	17.8	16.4	18.6	13.8	12.6	12.8	13.4	17.6
2016-10-10 13:00	14.1	13.0	14.2	16.9	14.8	15.8	18.2	12.5	16.5	15.6	15.9	12.5	18.2	29.7	18.5	14.1	12.8	13.2	13.9	19.9
2016-10-10 14:00	15.1	13.9	16.2	21.3	17.4	18.3	19.5	13.8	17.2	16.0	23.3	13.3	18.7	28.6	19.3	14.5	13.2	13.9	15.1	21.1
2016-10-10 15:00	17.4	15.0	18.9	24.9	19.2	20.4	20.5	15.2	18.9	17.8	22.9	14.8	19.4	26.6	19.6	15.3	13.7	14.5	16.1	22.7
2016-10-10 16:00	19.6	16.2	21.6	25.8	20.0	21.3	21.0	16.3	21.1	19.1	20.7	16.0	18.7	26.5	19.1	16.1	13.8	15.1	16.1	22.2
2016-10-10 17:00	18.7	16.1	21.4	25.8	18.5	23.2	20.5	17.4	22.4	19.9	21.1	16.6	17.6	26.3	18.1	17.3	13.2	15.4	15.4	20.9
2016-10-10 18:00	16.9	15.2	19.3	26.2	17.2	25.0	19.3	17.5	21.7	19.4	21.3	16.8	16.5	24.9	16.9	19.5	12.7	15.0	14.6	19.4