Enhancements for FFGS improved operations

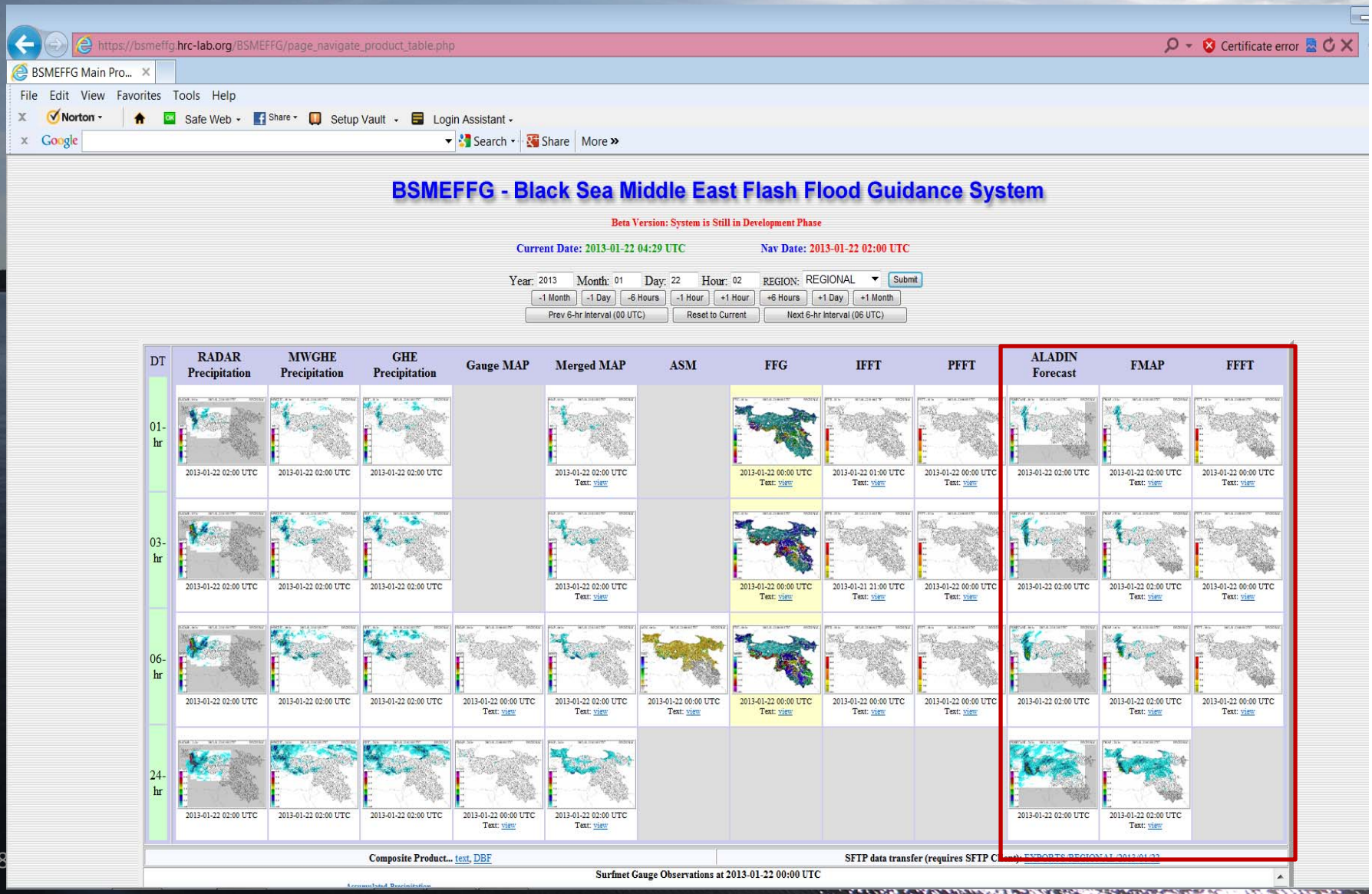
Hydrologic Research Center

28 April 2016

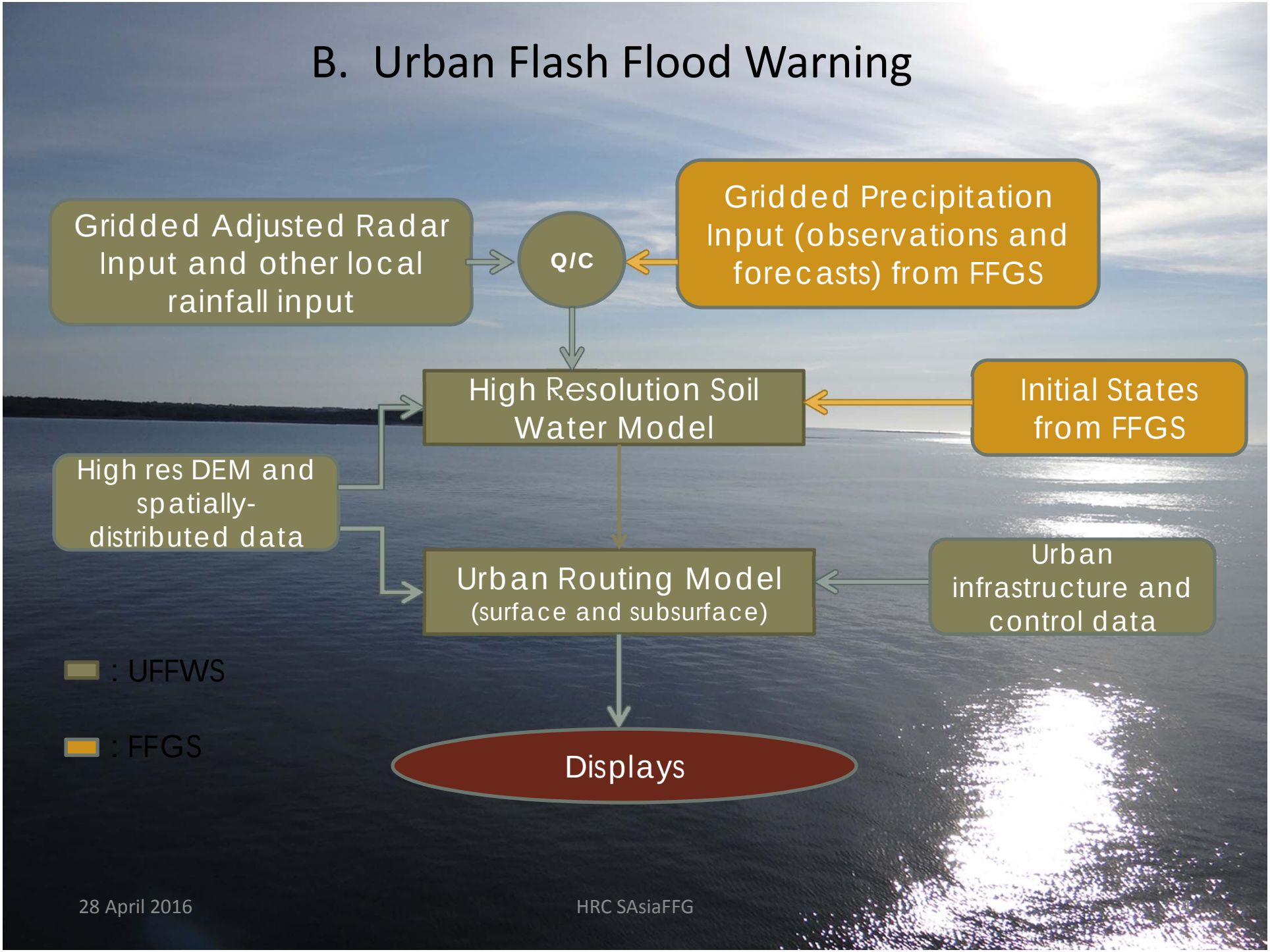
Enhancements to be discussed

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

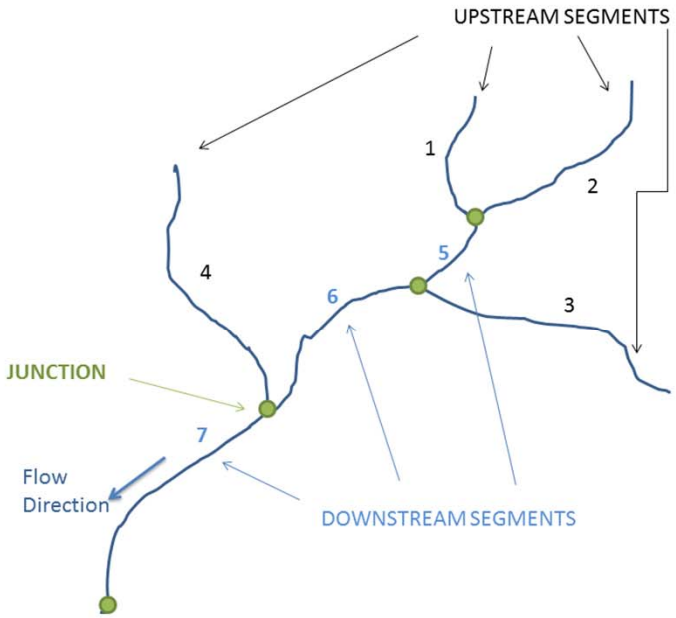
A. Multiple Mesoscale Model Input

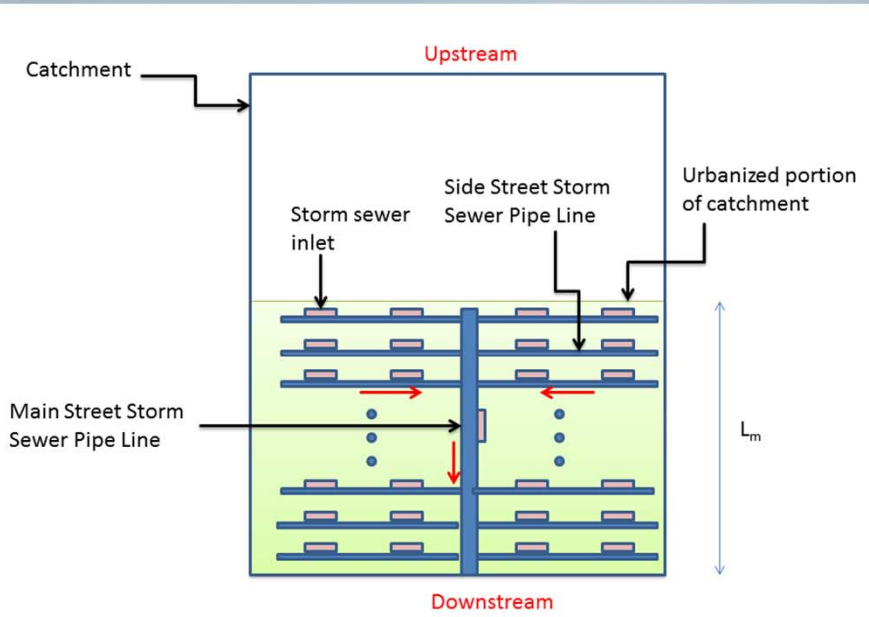


B. Urban Flash Flood Warning



Basic technical elements UFFWS

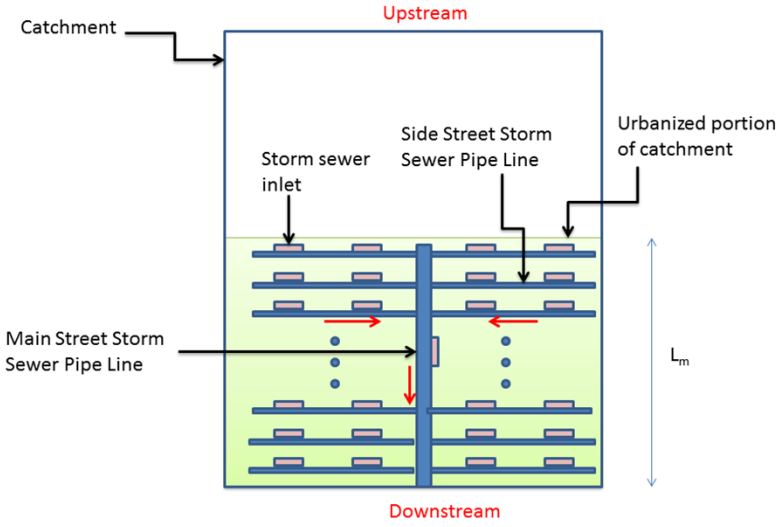


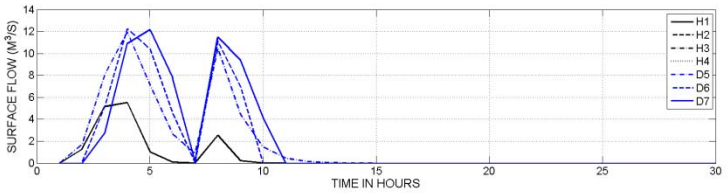


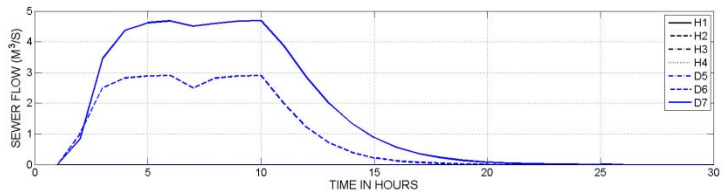
$$\partial y/\partial t + \partial(vy)/\partial x = 2q_L/B - f$$

$$S_f = S_0 - \partial y/\partial x$$

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:

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

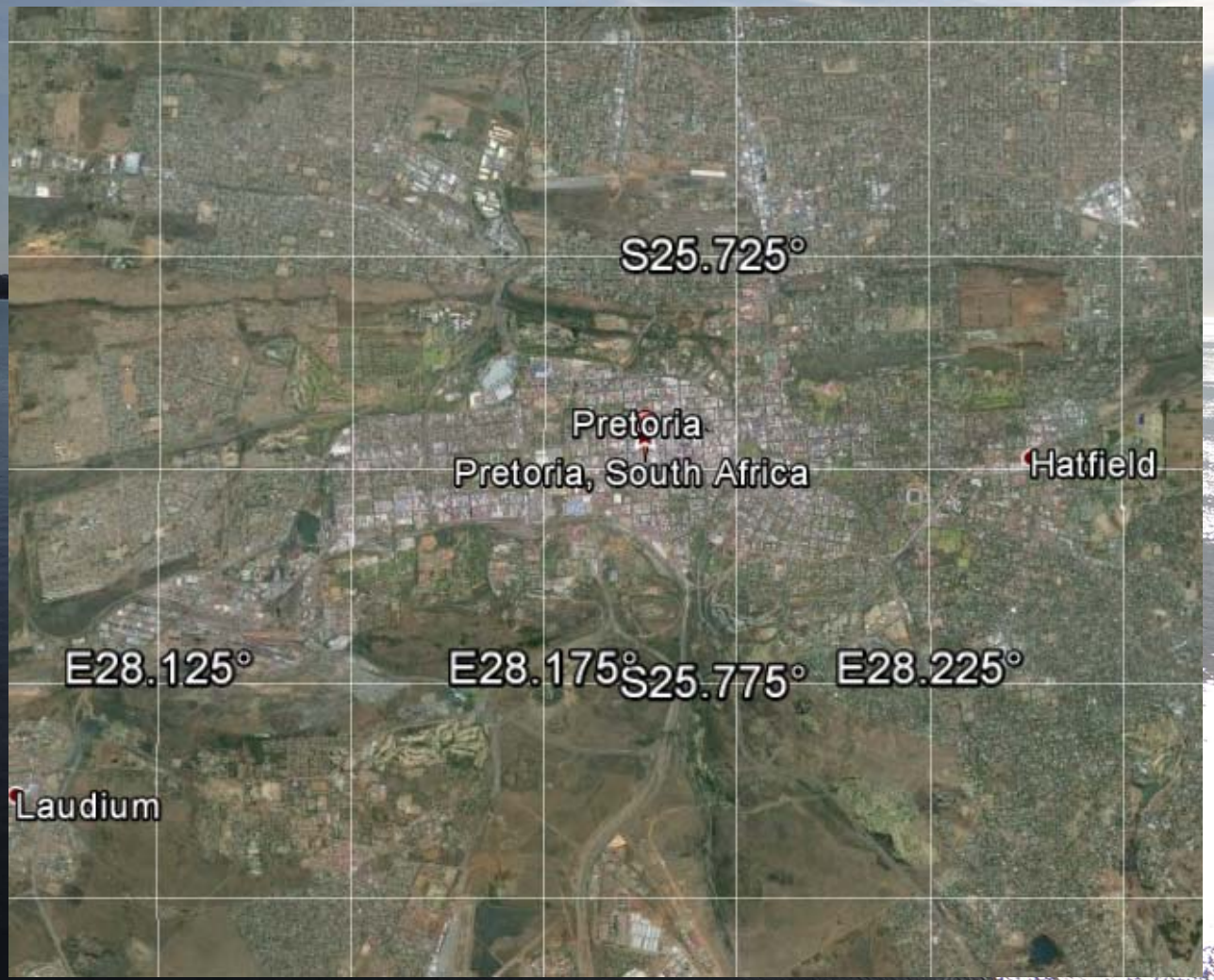
Time to Strom Sewer Overflow:

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

Scaling of Bankfull Q and Bankfull v:

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

Demonstration of feasibility (city of Pretoria)



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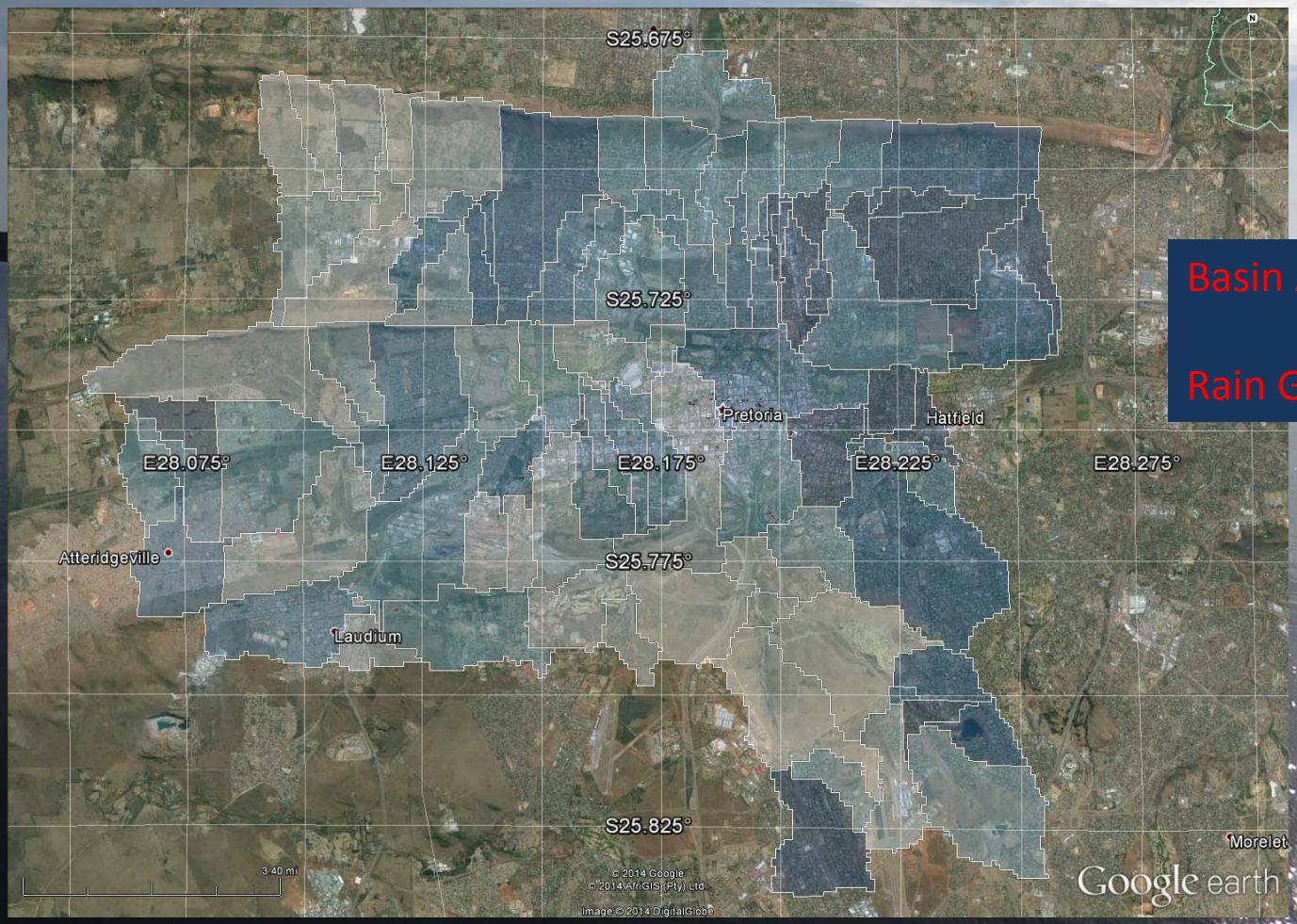
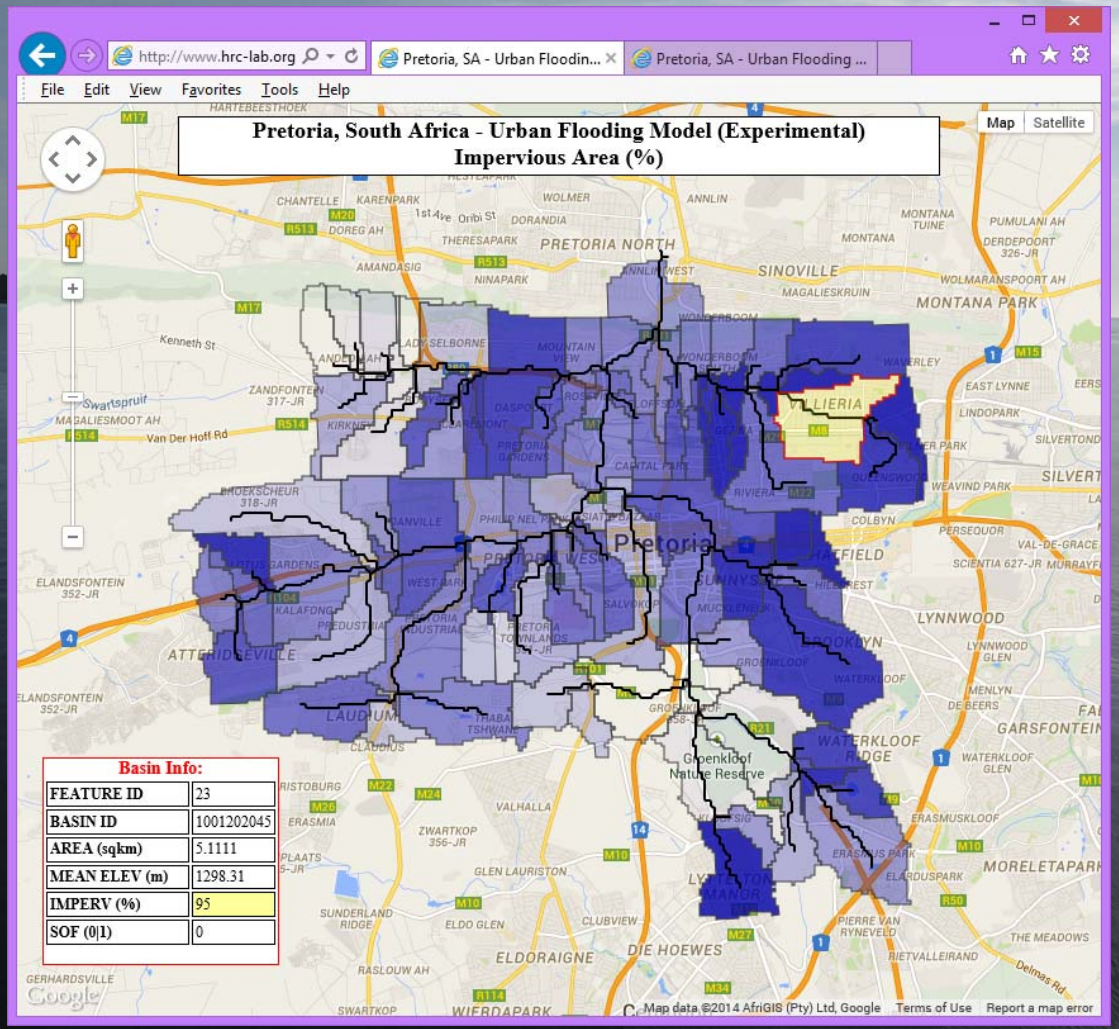


Basin Areas: 1-5 km^2

Rain Grid Area: 16 km^2

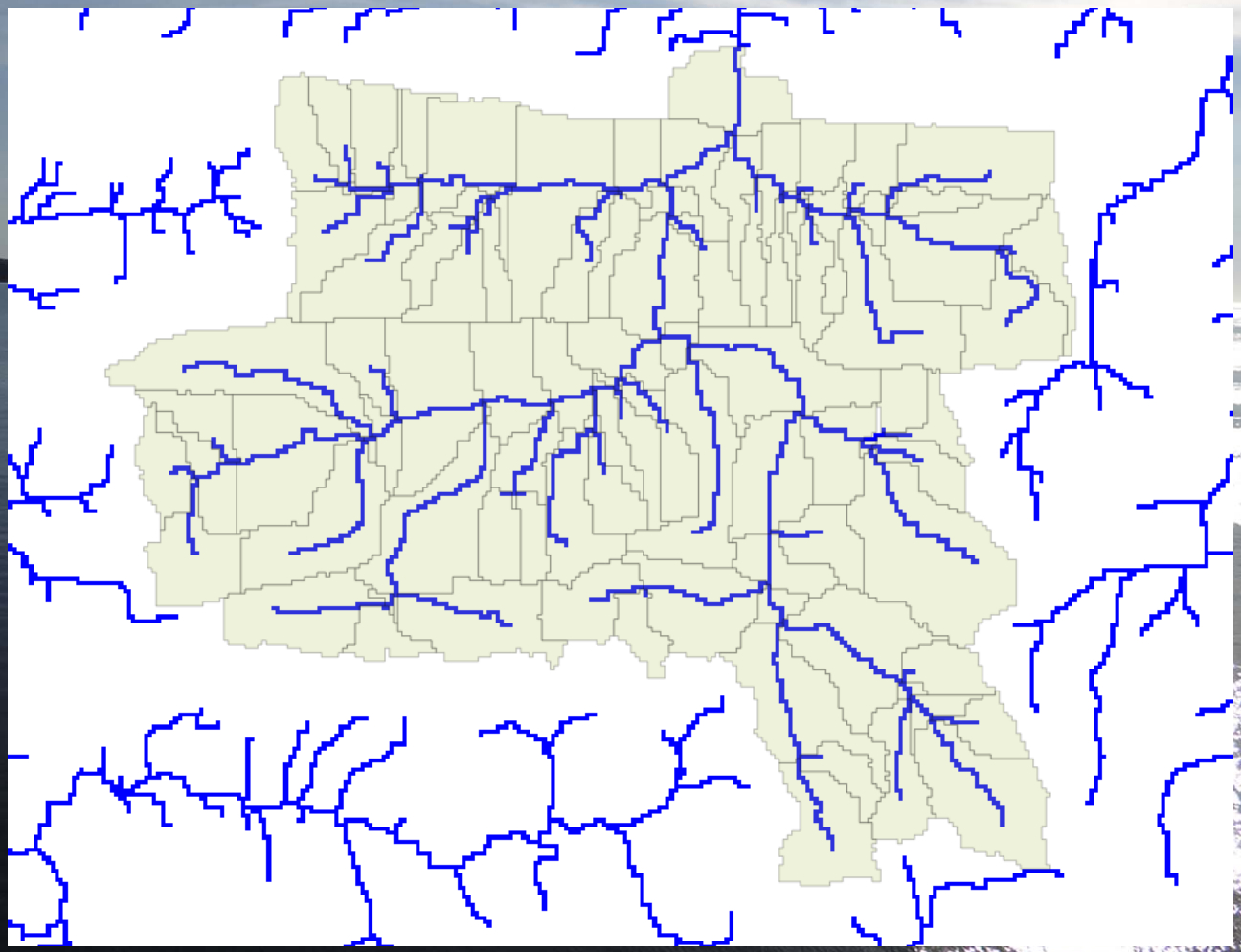
Demonstration of feasibility (city of Pretoria)



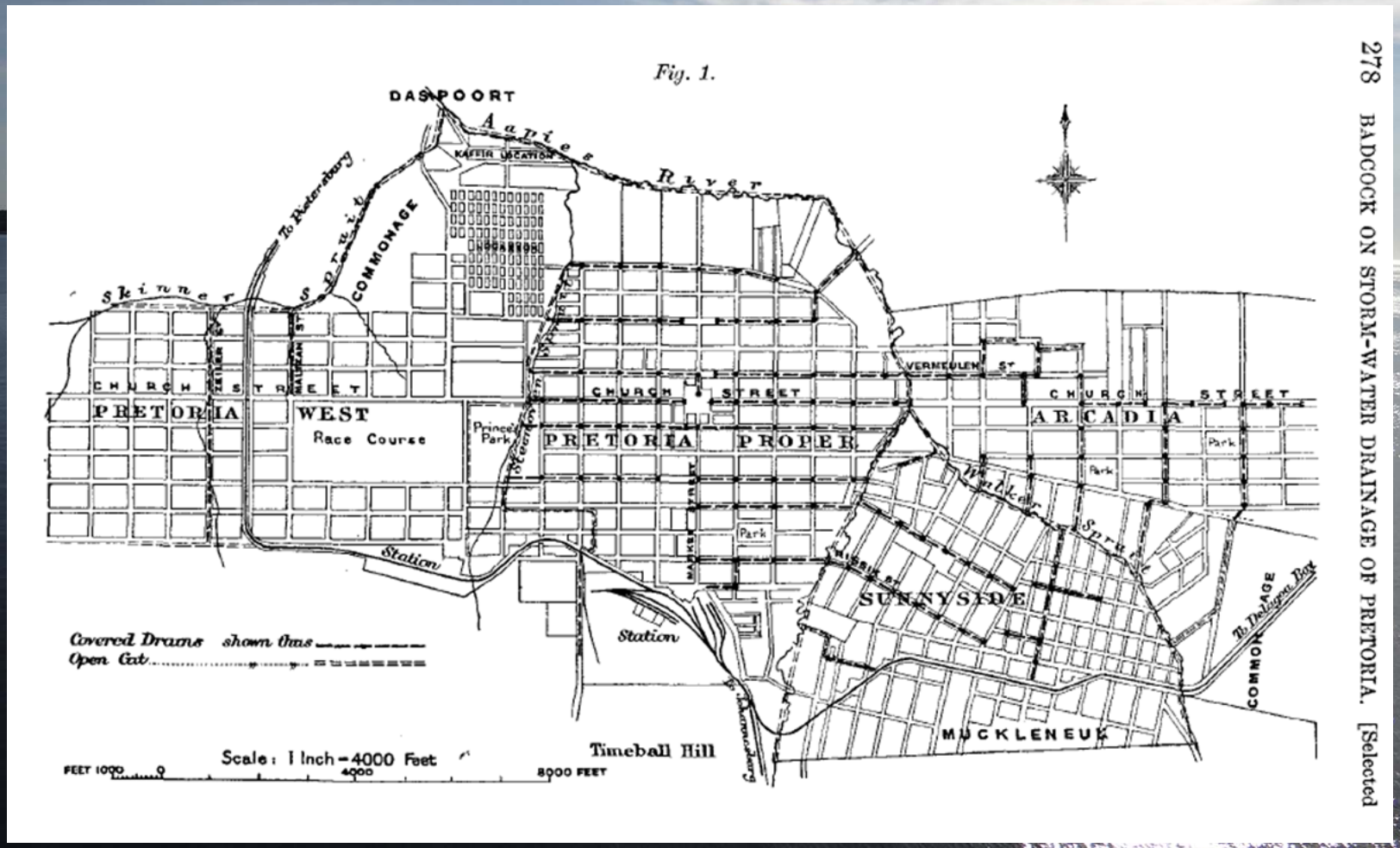
Av. Basin Area: 1-5 km^2

Rain Grid Area: 16 km^2

Demonstration of feasibility (city of Pretoria)

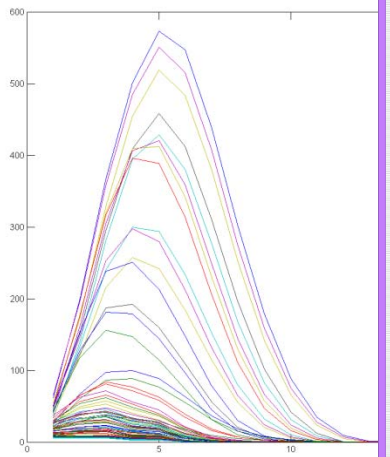


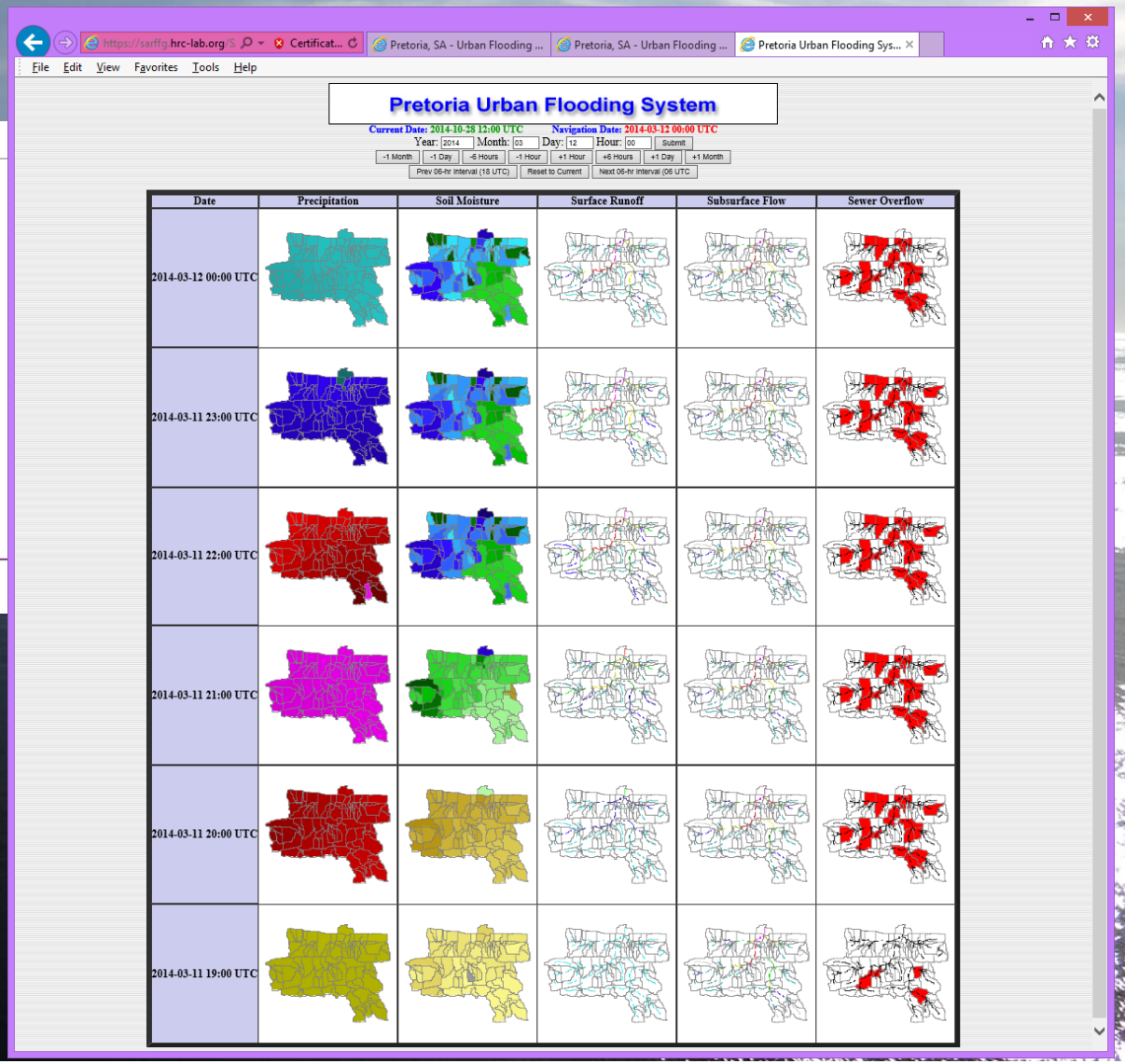
Demonstration of feasibility (city of Pretoria)



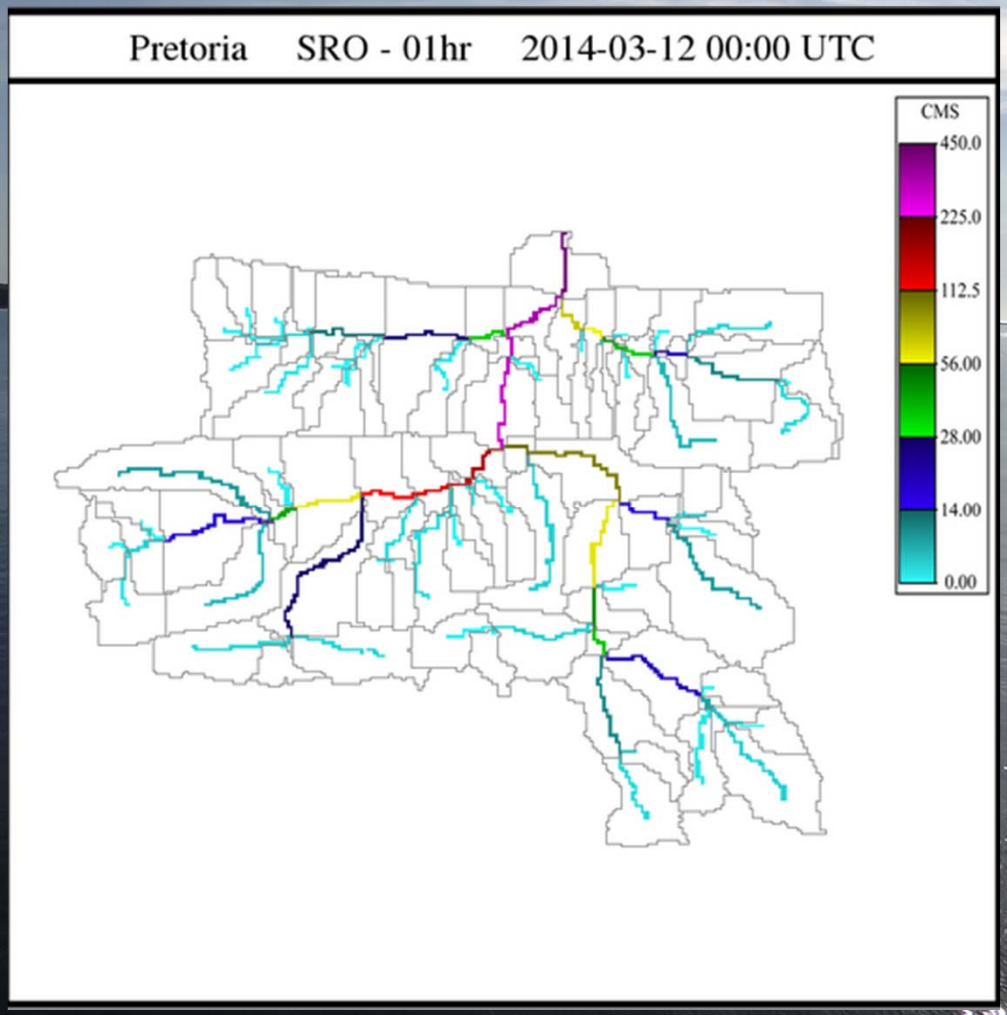
278 BADCOCK ON STORM-WATER DRAINAGE OF PRETORIA. [Selected

Demonstration of feasibility (city of Pretoria)





Surface Drainage Flow



C. Inundation Mapping for SM Estimation

MRC FLASH FLOOD GUIDANCE SYSTEM - MRCFFG

In Operation Since 2009

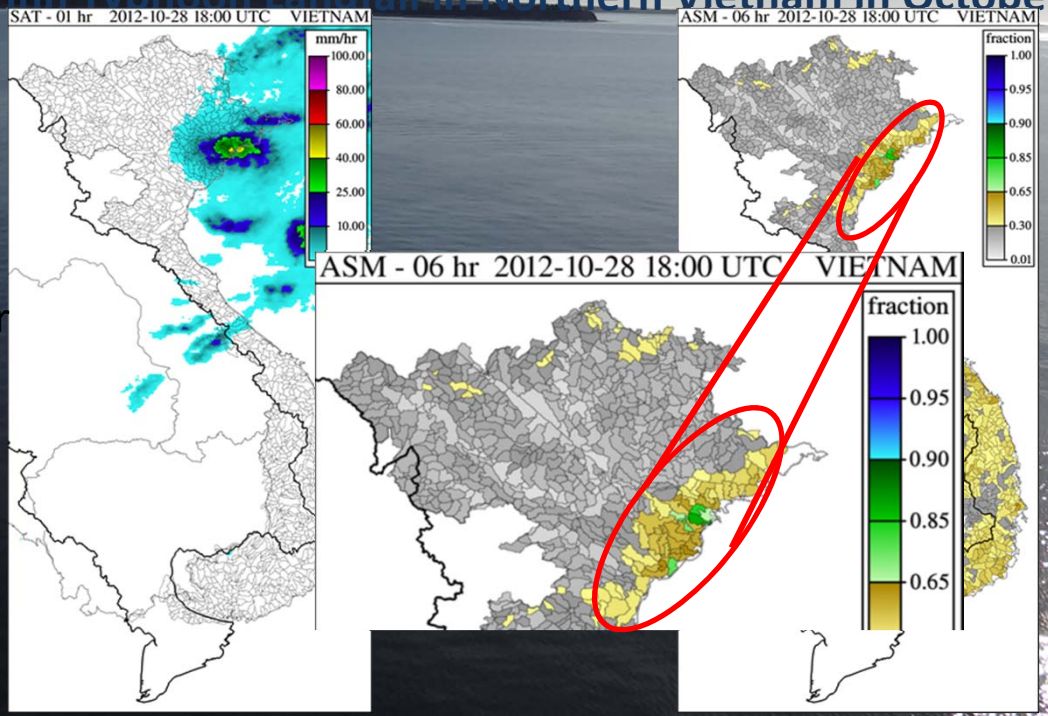
Development/Implementation/Training: Hydrologic Research Center

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



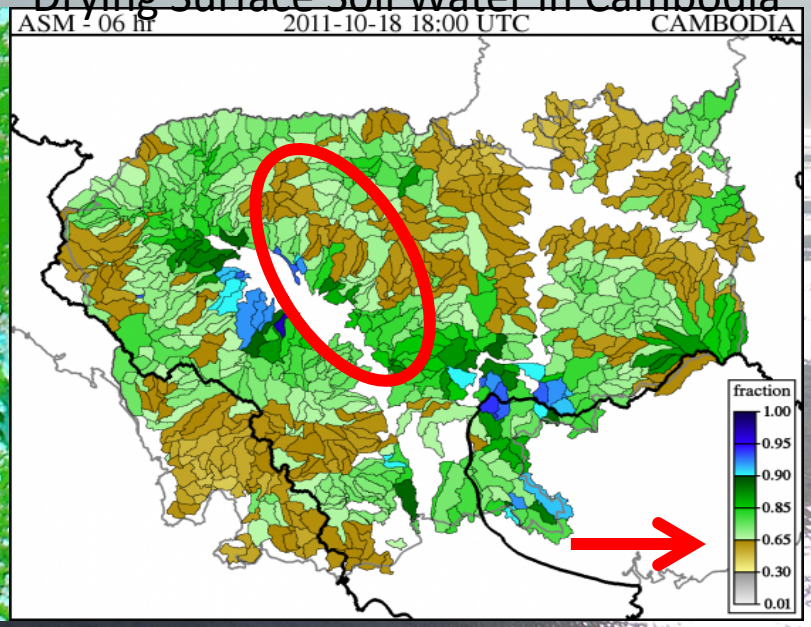
Upper-Soil Water Saturation Fraction at Landfall from operational MRCFFG (uses bias-adjusted HE pixel values)

C. Inundation Mapping for SM Estimation

STANDING WATER CORRECTIONS TO MODEL SOIL WATER FROM NASA PRODUCTS

MODIS-Based Observed Inundation Area in Cambodia

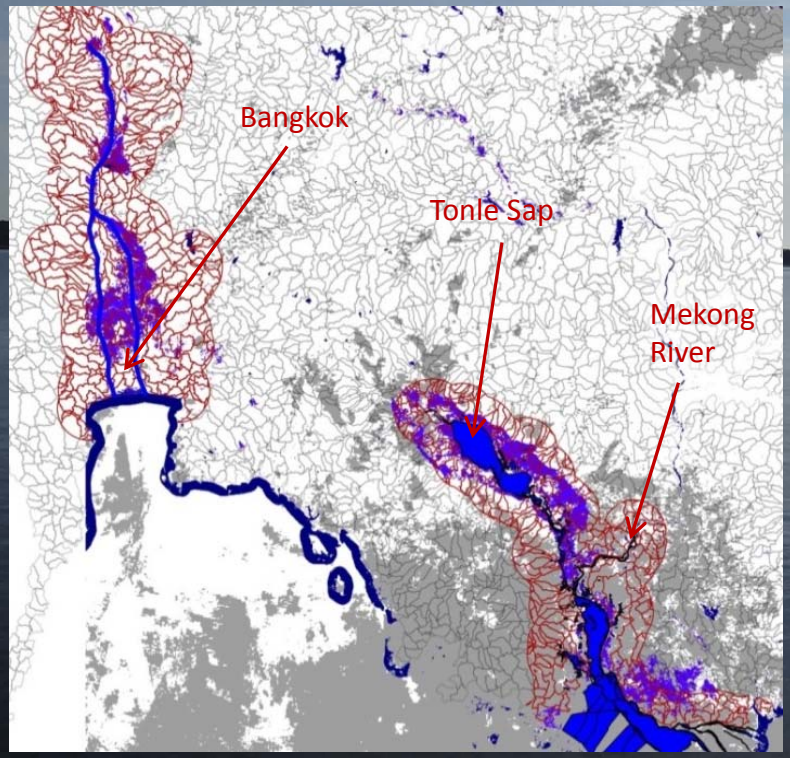
MRCFFG Modeled Drying Surface Soil Water in Cambodia

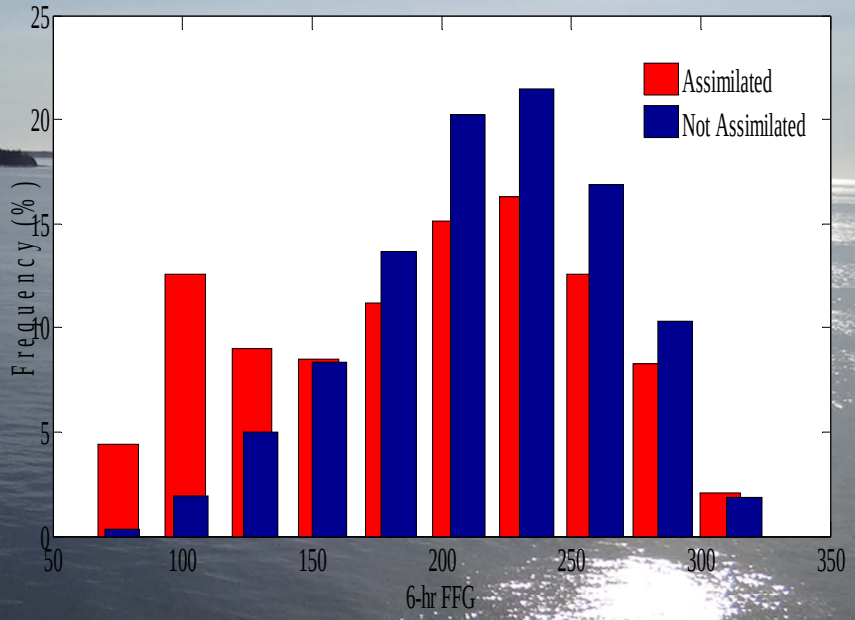


HRC Current Work: *Feasibility and Effectiveness of Correcting Operational Model Soil Water with MODIS Inundation Information in Real Time*

C. Inundation Mapping for SM Estimation

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



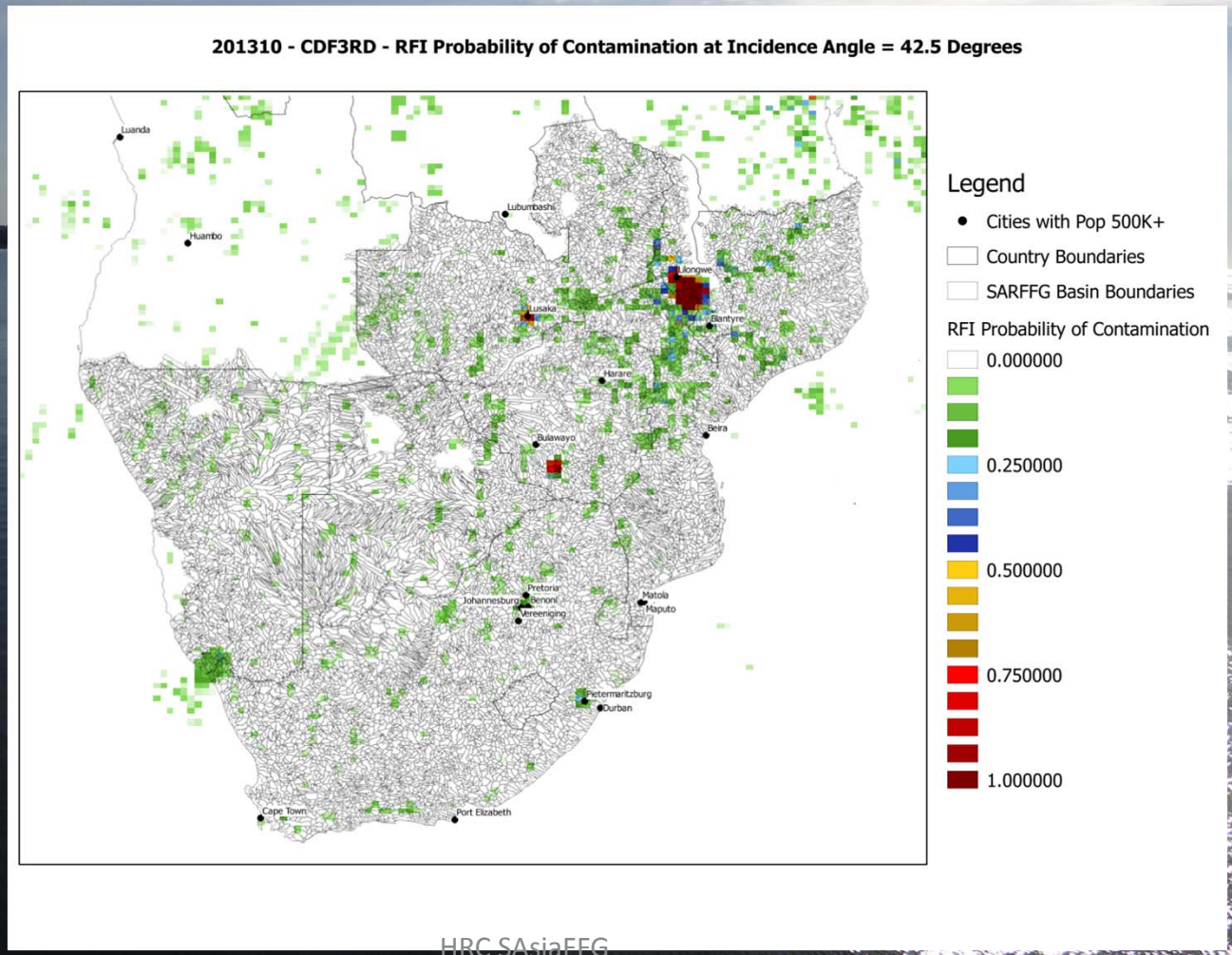


Method: Assimilation of saturation of upper soil in catchments with inundation greater than 85% and use of soil model to adjust lower soil water.

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

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

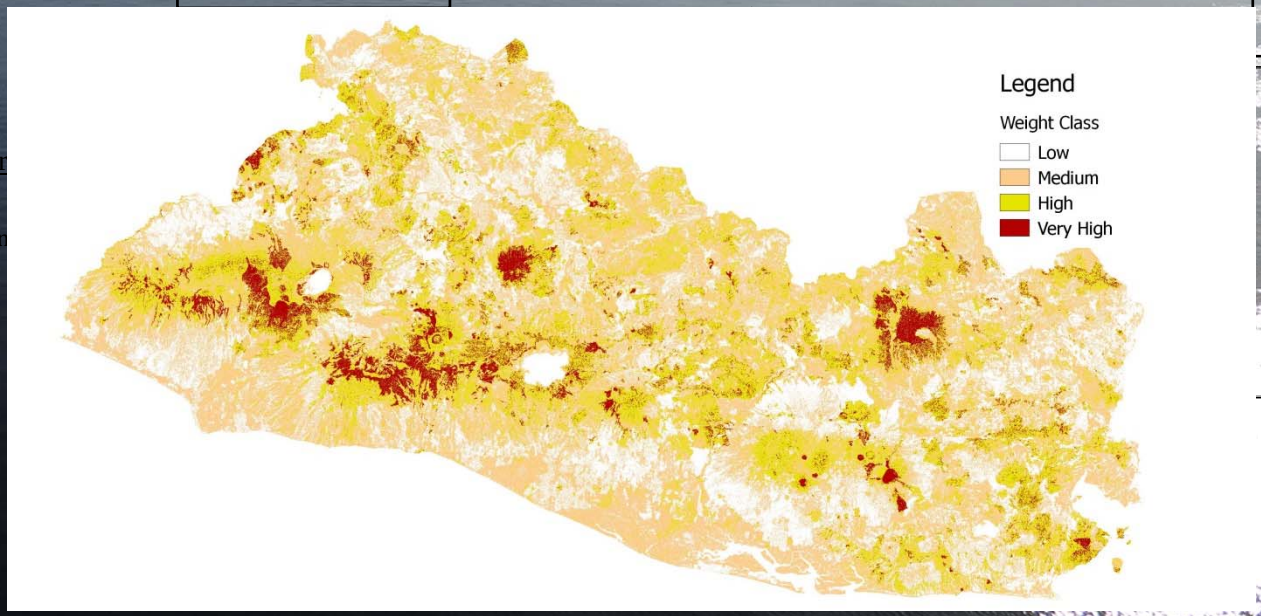
Landslide Map Density

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

Landslide Inventory Map

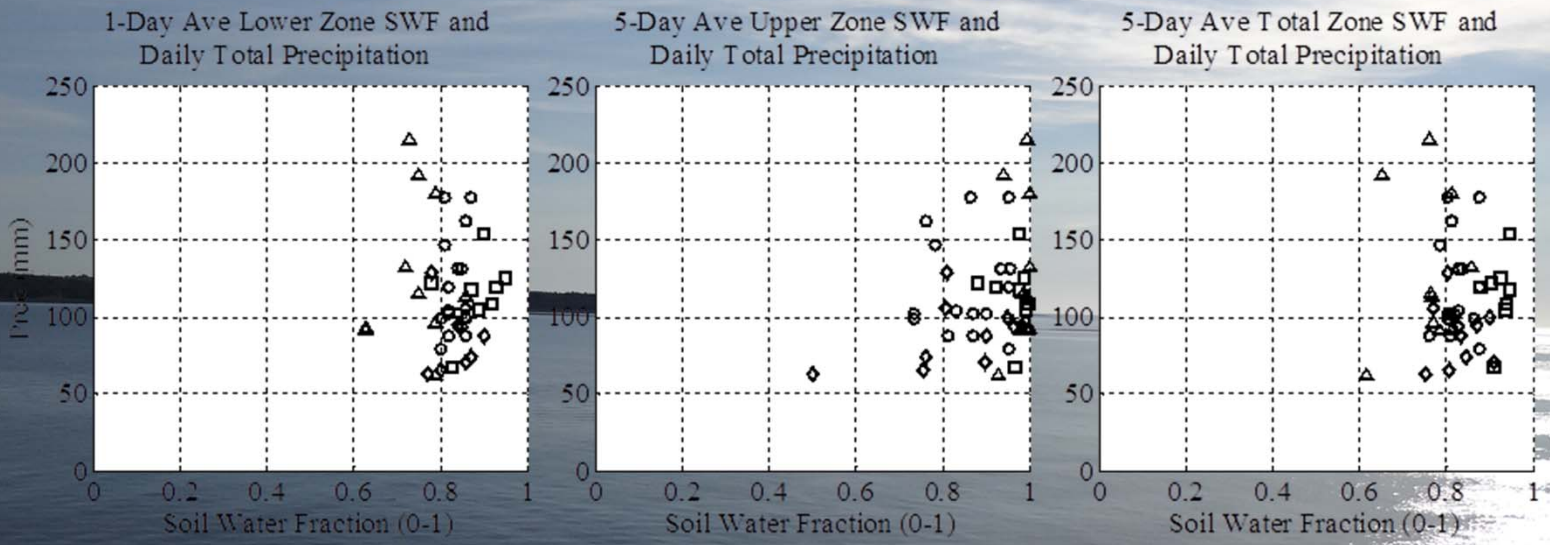
Factor

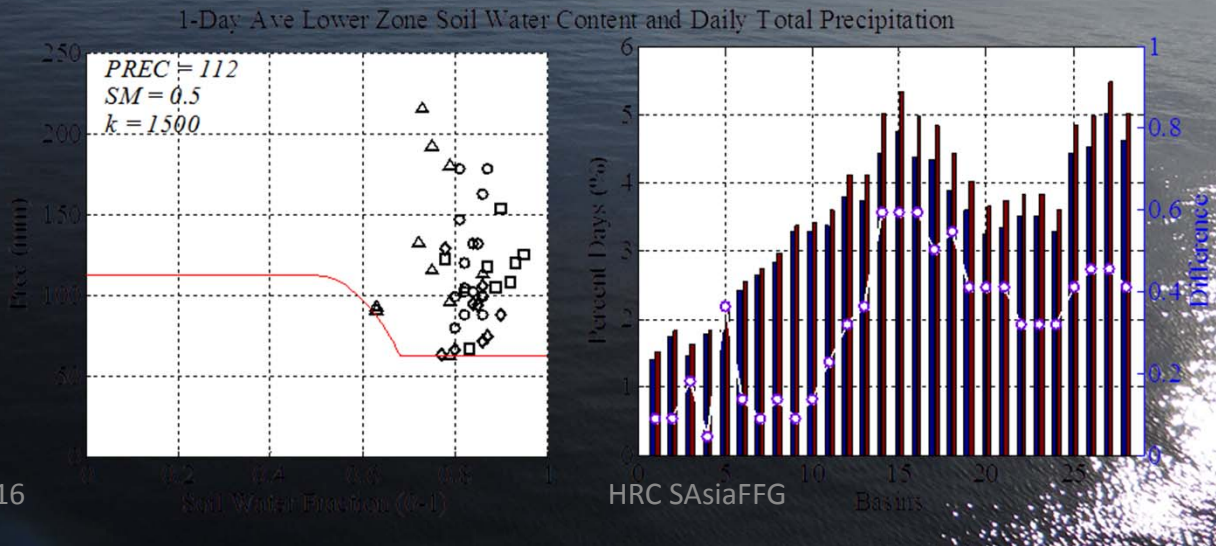
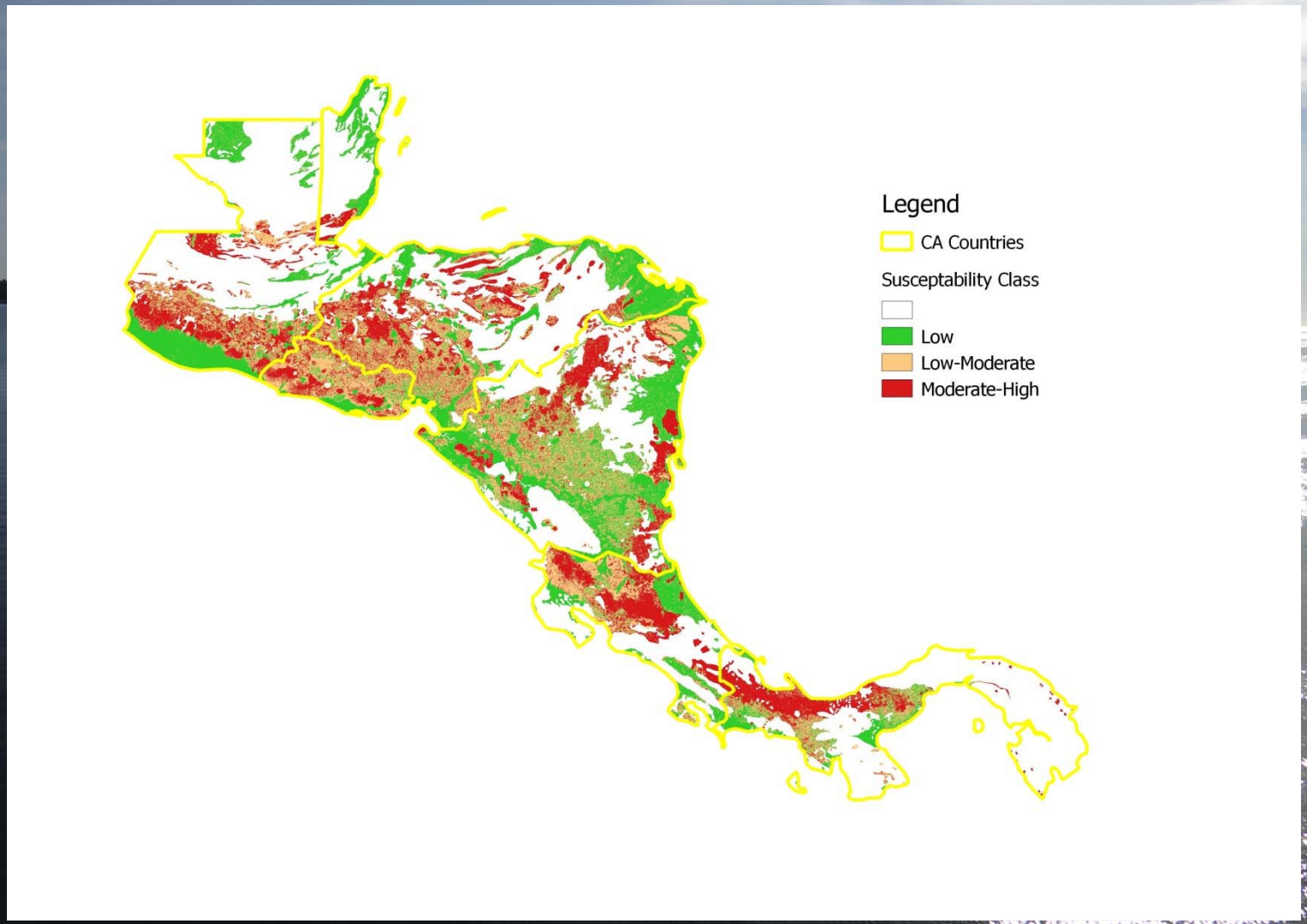
$W_i = \ln$



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