MODIS Flood Mapping and LIS-HYMAP coupled Flood Modeling in the Greater Horn of Africa

Hahn Chul Jung[1,2,*], Fritz Policelli [1], Augusto Getirana [1,3], Dan Slayback [1,2]

[1]NASA Goddard Space Flight Center
[2]Science Systems and Applications, Inc.
[3] University of Maryland

July 28-29, 2015, Addis Ababa, Ethiopia

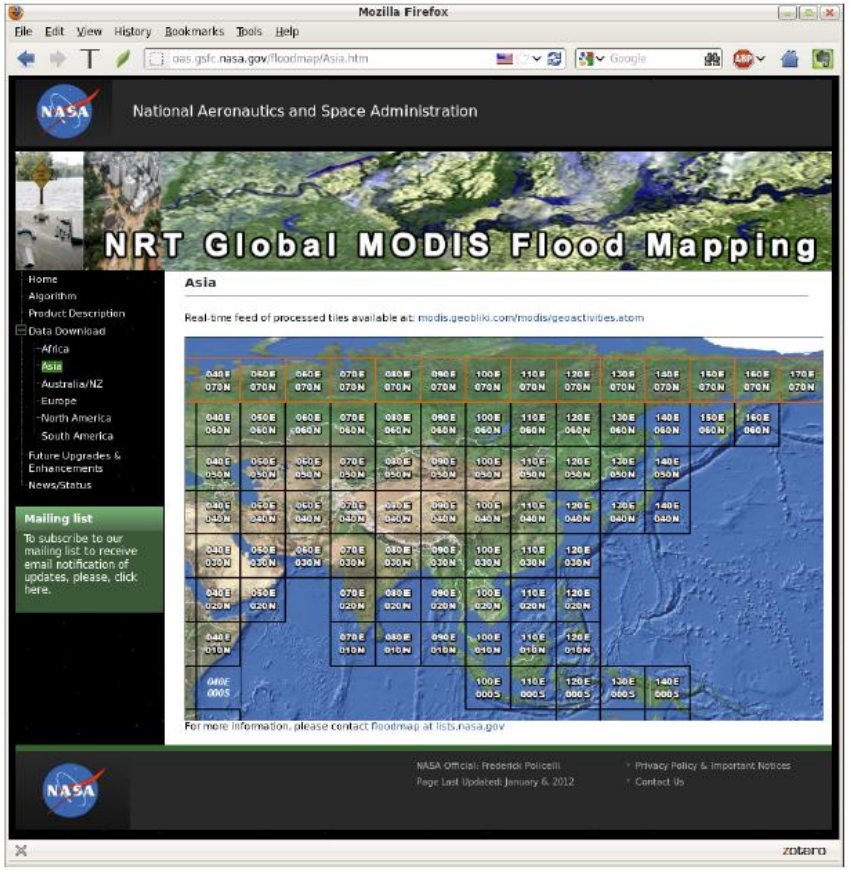
Contents

- MODIS Flood Mapping
  - Intro.
  - Results, Limitation
- LIS-HYMAP Coupled Modeling
  - Intro.
  - Input & Output, Results
- Comparison b/w MODIS and LIS-HYMAP Flood Fractional Maps in Year 2014
- Planned Activities
  - Improvements
  - Seasonal Forecast

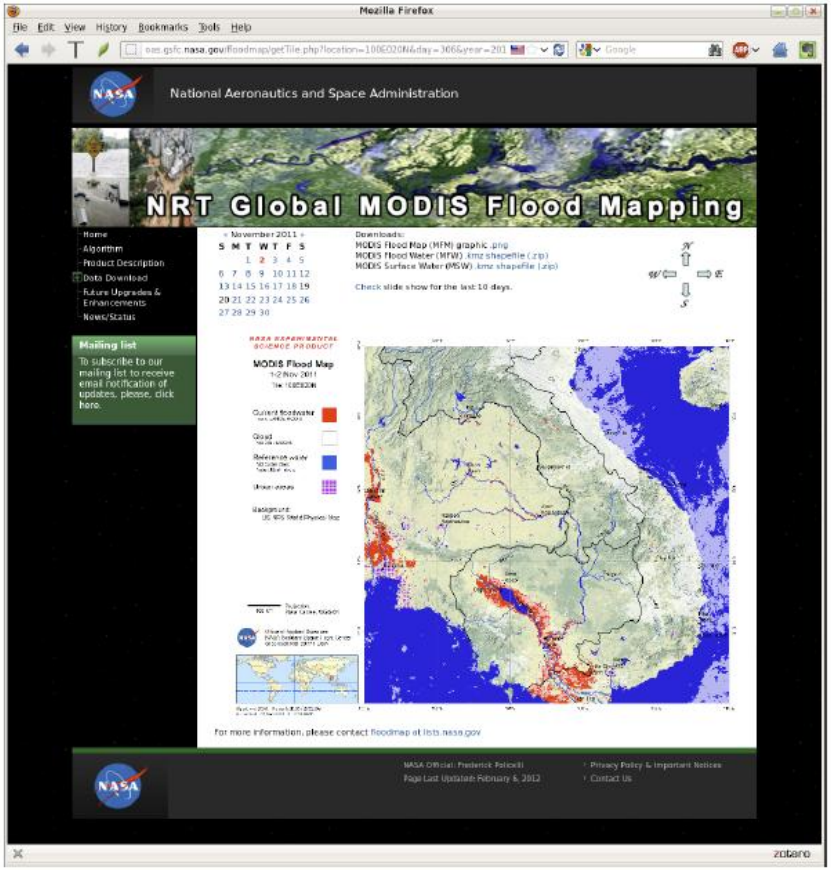
Global NRT MODIS Flood Mapping

Distribution: OAS website

http://oas.gsfc.nasa.gov/floodmap



Continental tile overview



Specific tile:

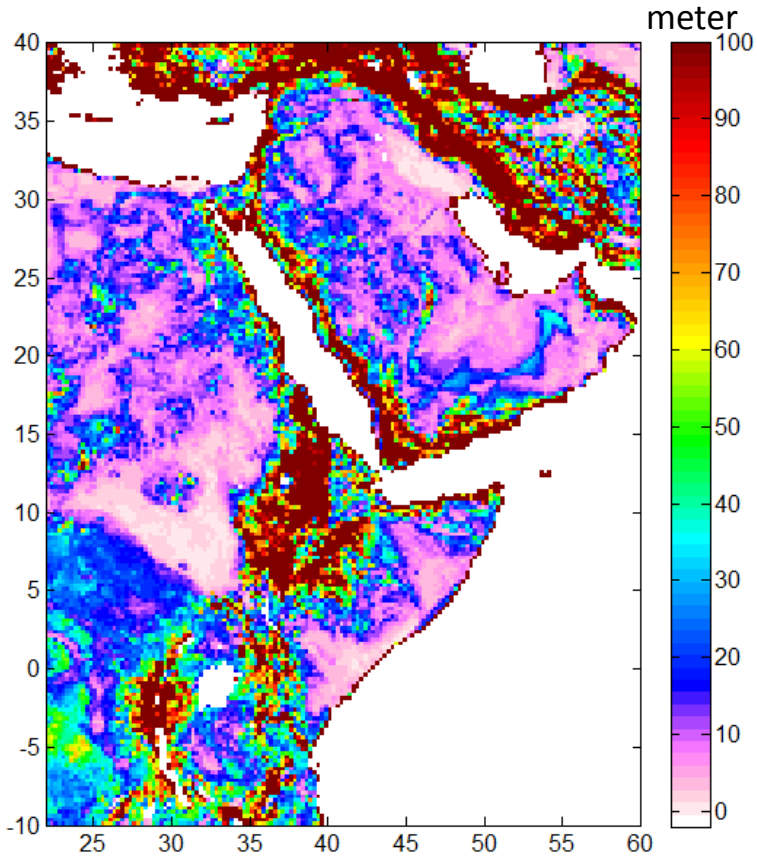
- date selection
- adjacent tile navigator

Key Features

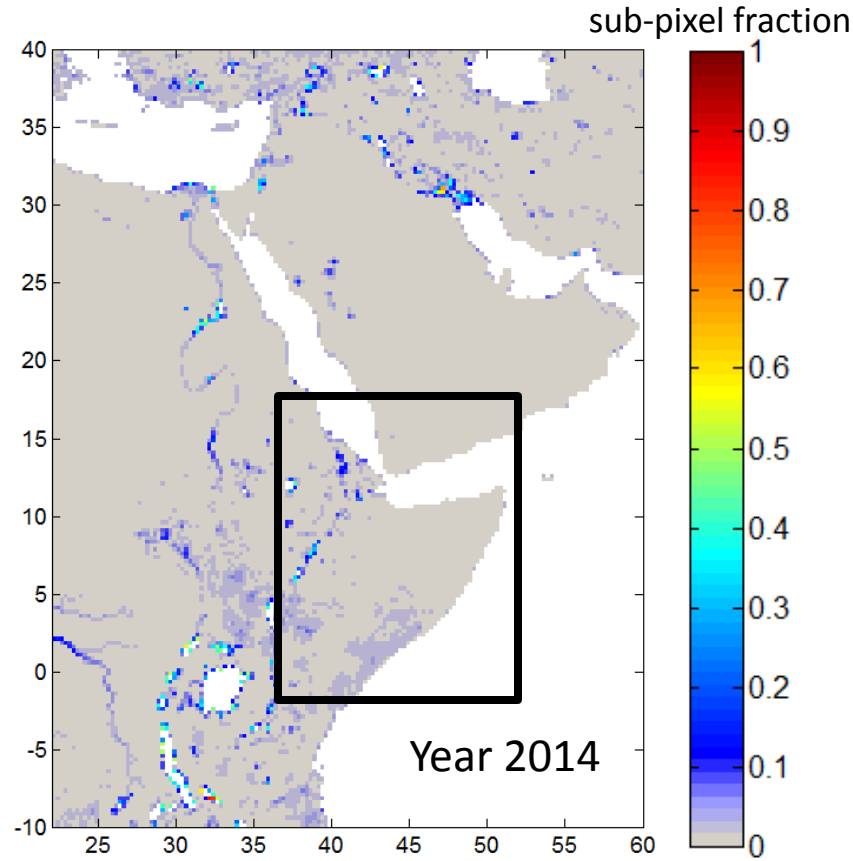
- Partnership with Prof. Bob Brakenridge (Dartmouth Flood Observatory at U. Colorado)
- Fully automated systems runs 24/7, ingesting new MODIS imagery as available from LANCE
- Empirically derived band ratio threshold to detect surface water: (Band1+A)/(Band2+B)
- Known issues: incomplete coverage (cloud shadow, swath coverage gaps), terrain shadow, dense canopy
- Landsat flood mapping system in development
- Investigating VIIRS and Sentinel-1 flood mapping systems

MODIS Flood Fraction Map in the GHA

- NASA Global Flood Mapping products in the Greater Horn of Africa and the Middle East Asia for year 2014
- Step 1: Generate HAND (Height Above the Nearest Drainage) map from SRTM and HYDROSHED data in order to minimize false water detections under terrain shadow
- Step 2: Find flooded pixels (250 m) detected more than two observations per month and less than 15 m in HAND
- Step 3: Set flooded pixel one and nonflooded pixel zero
- Step 4: Spatially upscale it into 0.25 degree equivalent to spatial resolution of our LIS-HYMAP model
- This product will be investigated for calibration and validation of LIS/HYMAP hydrological modeling



<HAND Filter Map>



<Yearly Averaged Flood Fraction Map >

LIS-HYMAP Coupled Model

- Land Information System (LIS) is a comprehensive system that integrates the use of various land surface models, assimilation algorithms, observational sources for users at NASA, AFWA, NOAA, USDA and other agency investigators (Kumar et al., EMS, 2006).

- Hydrological Modeling and Analysis Platform (HYMAP) is a global flow routing scheme specifically designed to better capture floodplain dynamics (Getirana et al., J. Hydrometeorol., 2012).

LIS-HYMAP Coupled Model Inputs in the GHA

1. SURFACEMODEL: land surface model (Noah.3.3), met forcing source (Global LDAS ¼ deg.),

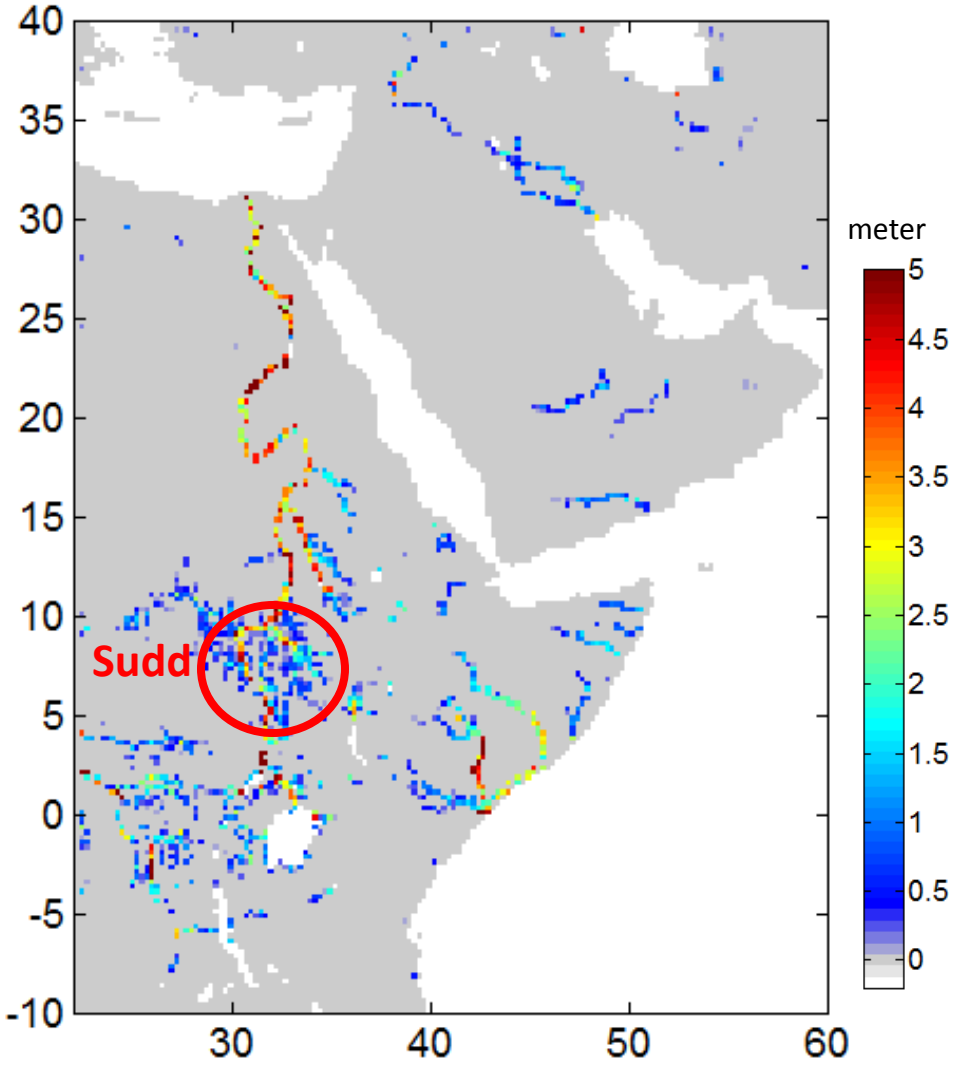
2. ROUTING: river (width, height, roughness, length), floodplain (roughness, height), flow direction, grid elevation & distance, runoff time delay, reference discharge map

LIS-HYMAP Coupled Model Outputs in the GHA

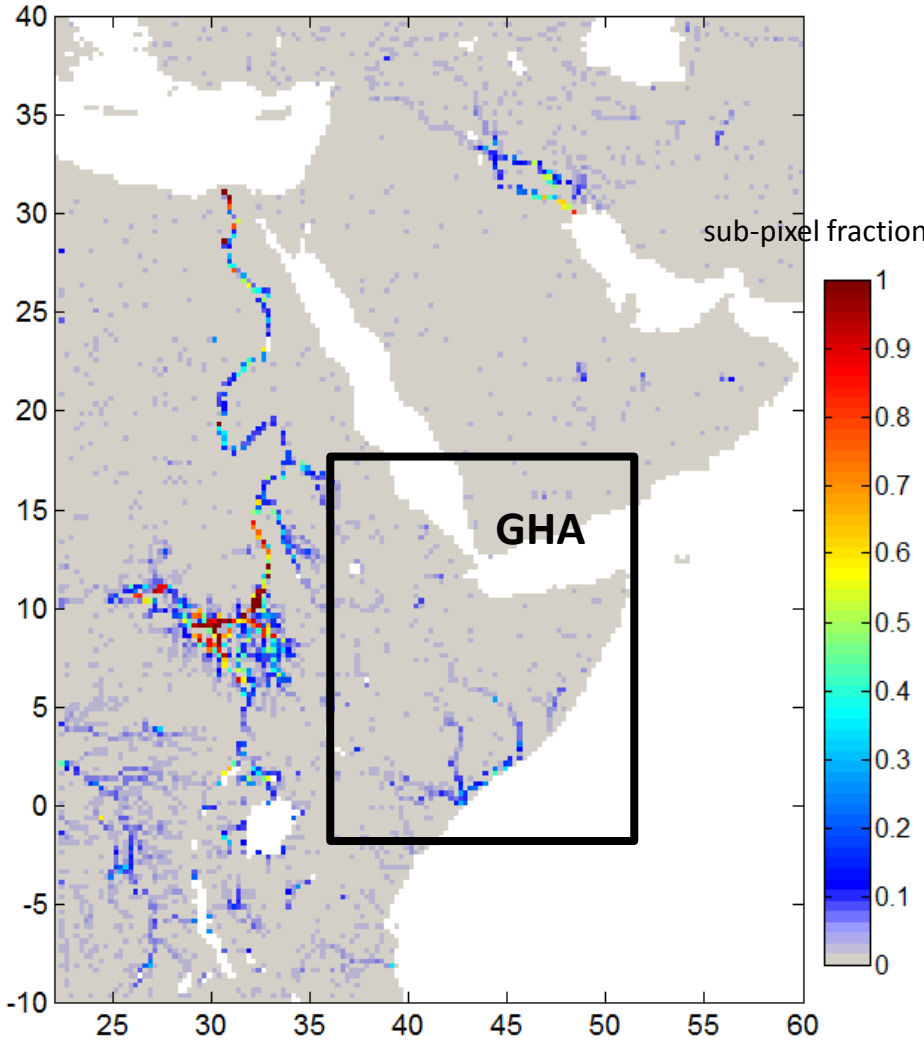
1. SURFACEMODEL: energy & water balanced components, surface & subsurface state variables, evaporation components

2. ROUTING: Streamflow, RiverStor, RiverDepth, RiverVelocity, FloodQ, FloodEvap, FloodStor, FloodDepth, FloodVelocity, FloodedFrac, FloodedArea, SurfElev, RunoffStor, BaseflowStor

LIS-HYMAP Flood Fraction Maps in the GHA

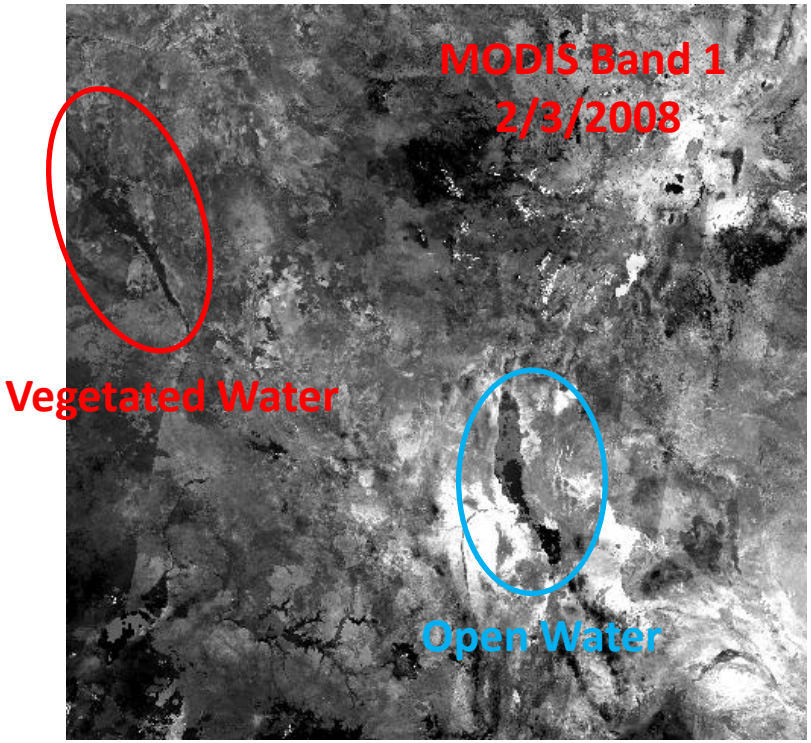


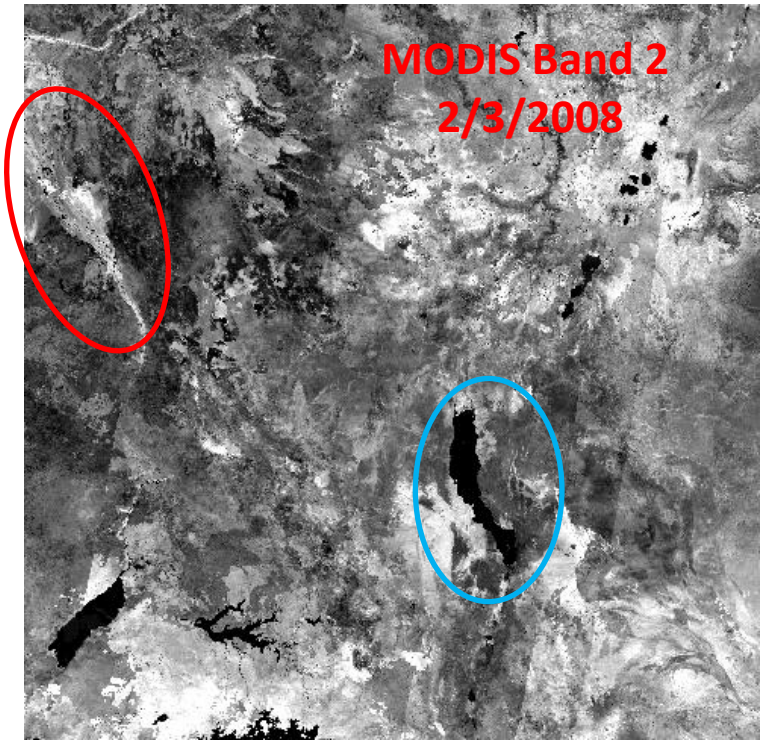
<Daily Flood Depth Map on 6/6/2014 >

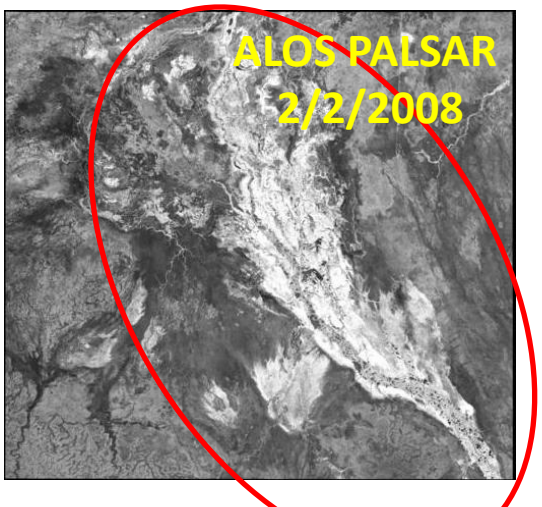


<Yearly Averaged Flood Fraction Map in Year 2014 >

Sudd, South Sudan

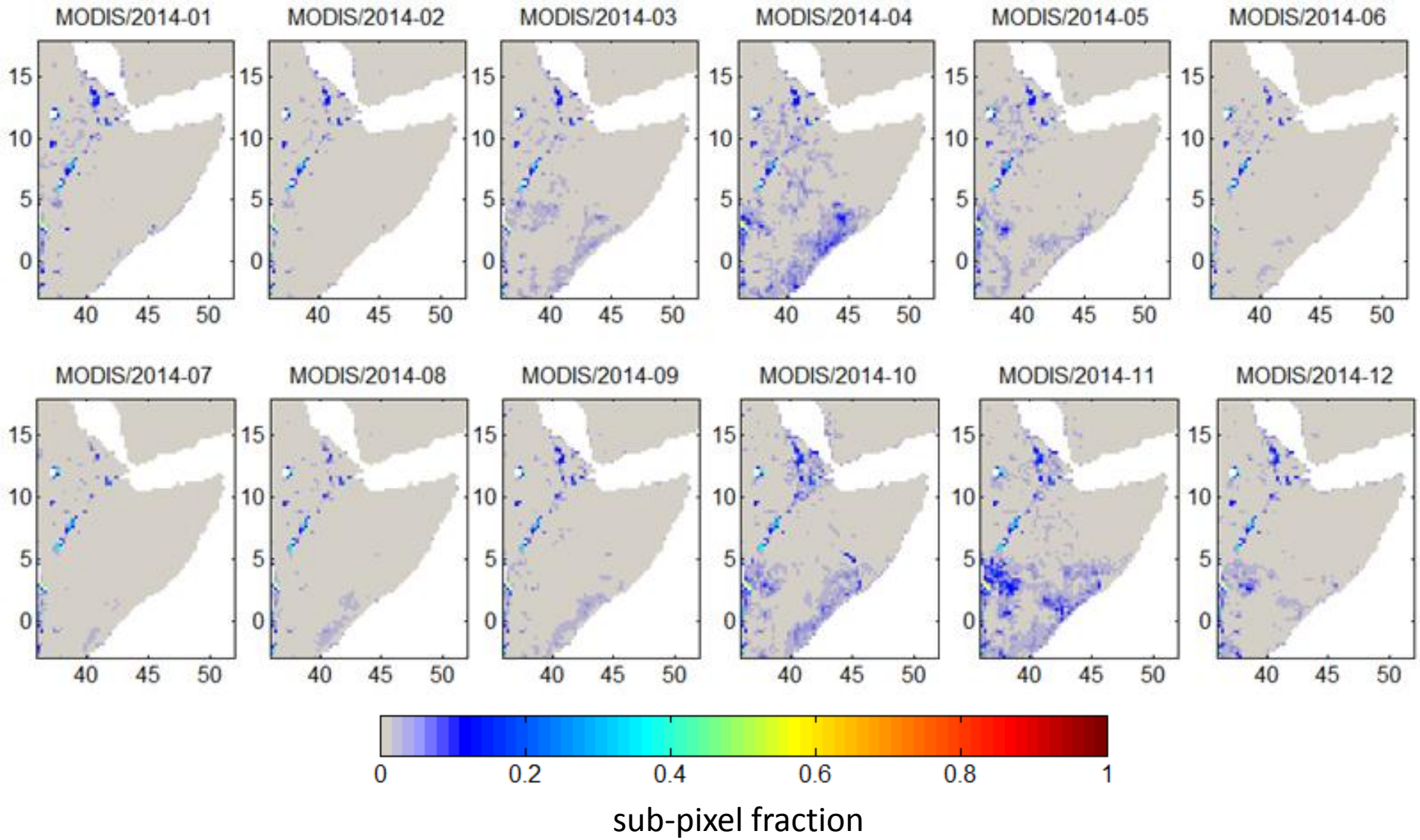




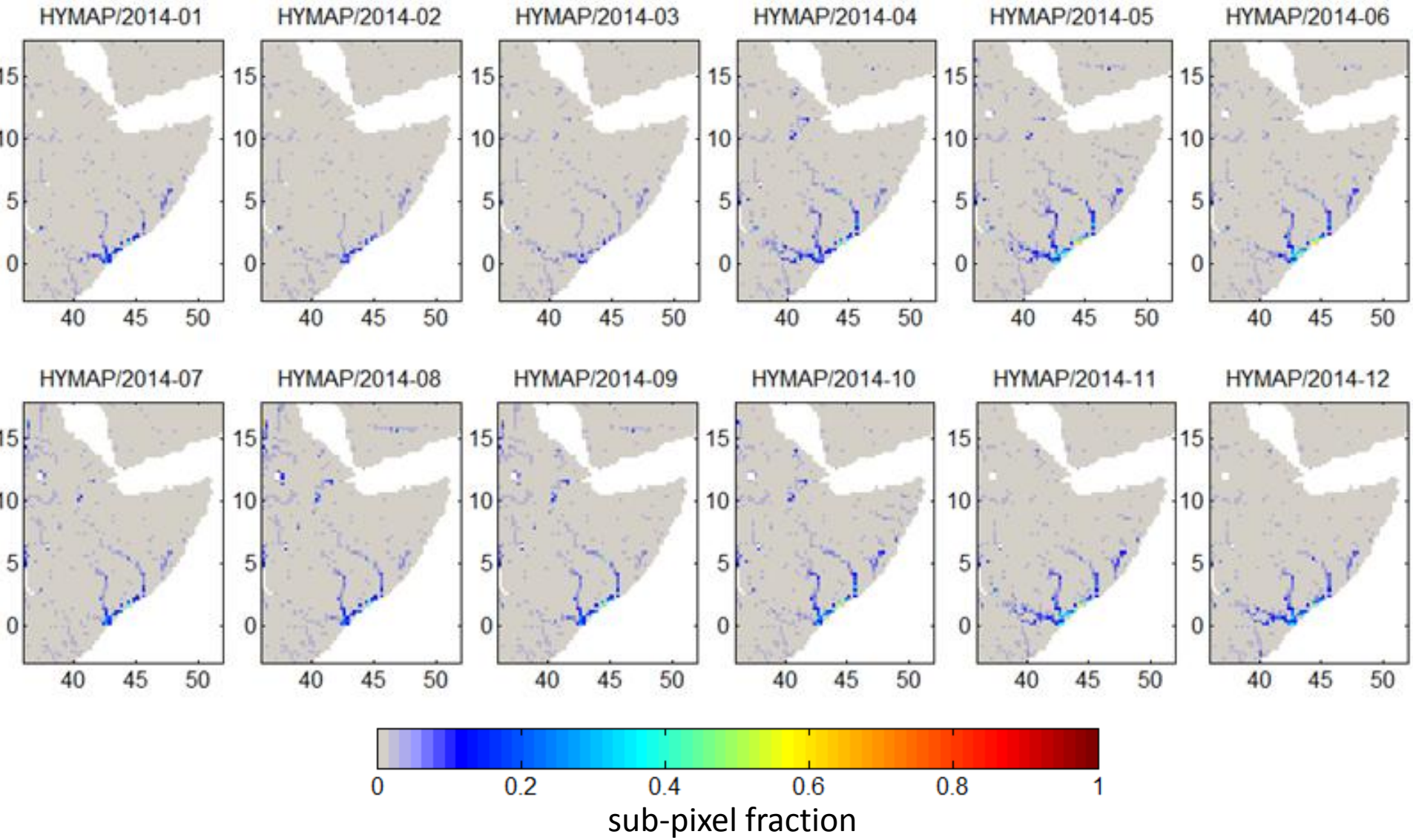


- flooded area under vegetation
- optically different features as compared to open water
- not detected by MODIS, but by HYMAP
- brighter in the amplitude of ALOS PALSAR due to double bounce effect

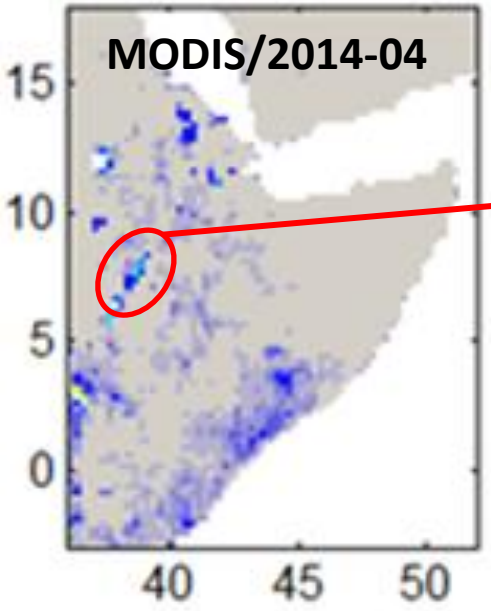
MODIS: Monthly Flood Fraction Map (0.25 deg, Year 2014)

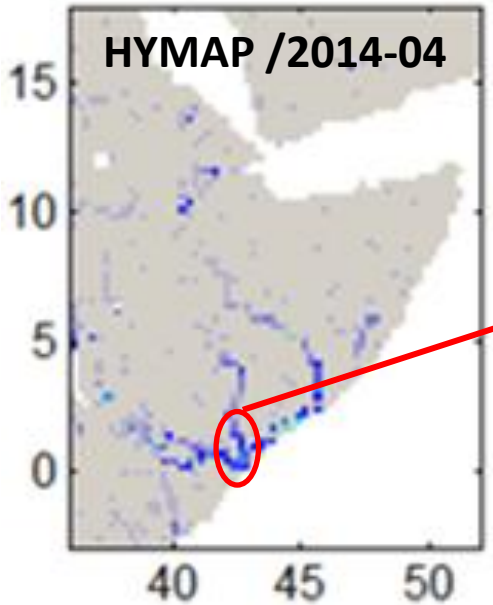


LIS-HYMAP: Monthly Flood Fraction Map (0.25 deg, Year 2014)

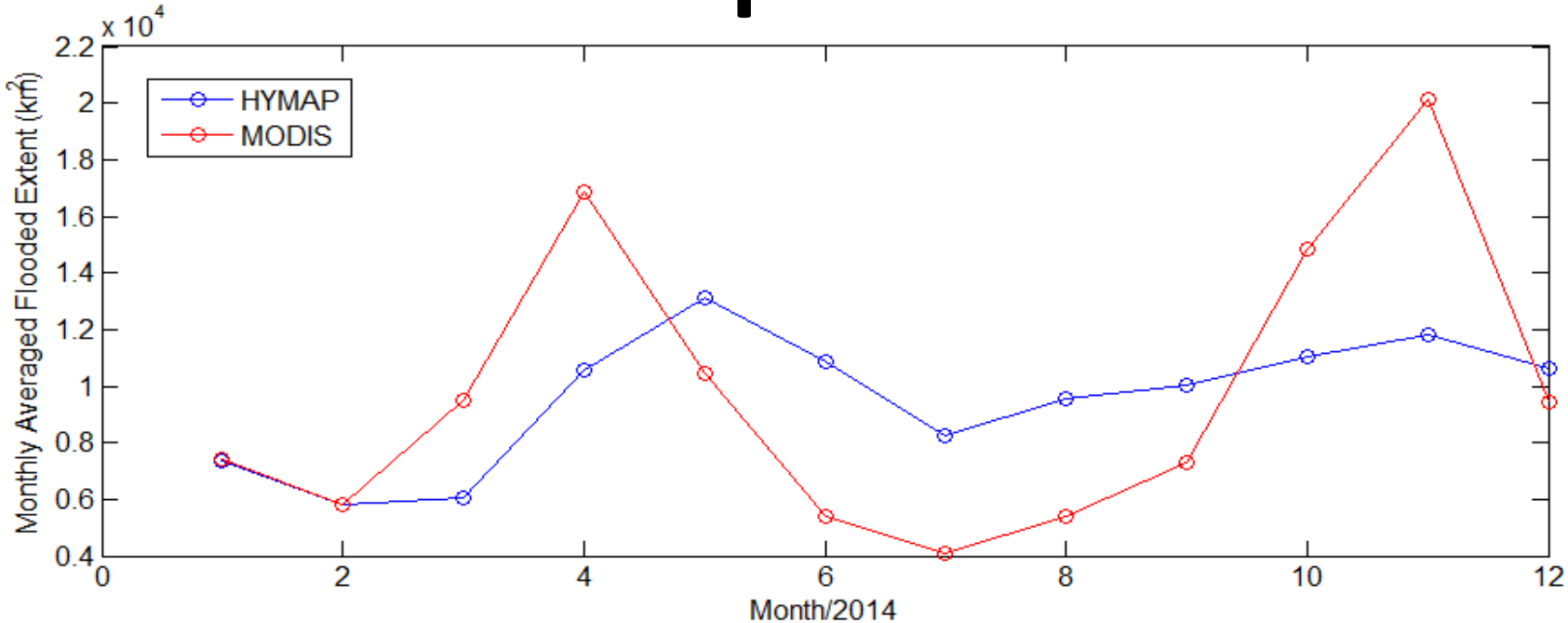


Detailed Comparison in 2014-04





Comparison



- **MODIS**:

(+) high resolution (250m), daily global observation

(-) not easy for flood detection under thick canopy and cloud contamination

(-) very sensitive to the amount of water in plants and soils

- **HYMAP**:

(+) good to classify flooding along the river streams

(+) able to link meteorological forcing data in LIS modeling for seasonal prediction of hydro-climate extremes

(-) coarser resolution (10 or 25 km)

(-) not able to capture water on rift valley, dam, reservoir, etc.

Planned Activities

- Update site-specific MODIS flood algorithm
- Integration of radar, Landsat, and potentially other sources of water extent
- Investigate MODIS water extent maps for calibration and validation of LIS-HYMAP coupled hydrological model.
- Force LIS-HYMAP coupled modeling with GEOS5 seasonal forecast data
- Assess Seasonal Flood Forecasts

Thanks you for your attention.

Hahn Chul Jung
hahnchul.jung@nasa.gov