

Monitoring Water Pollution in the River Ganga: Preliminary findings from imaging spectroscopy

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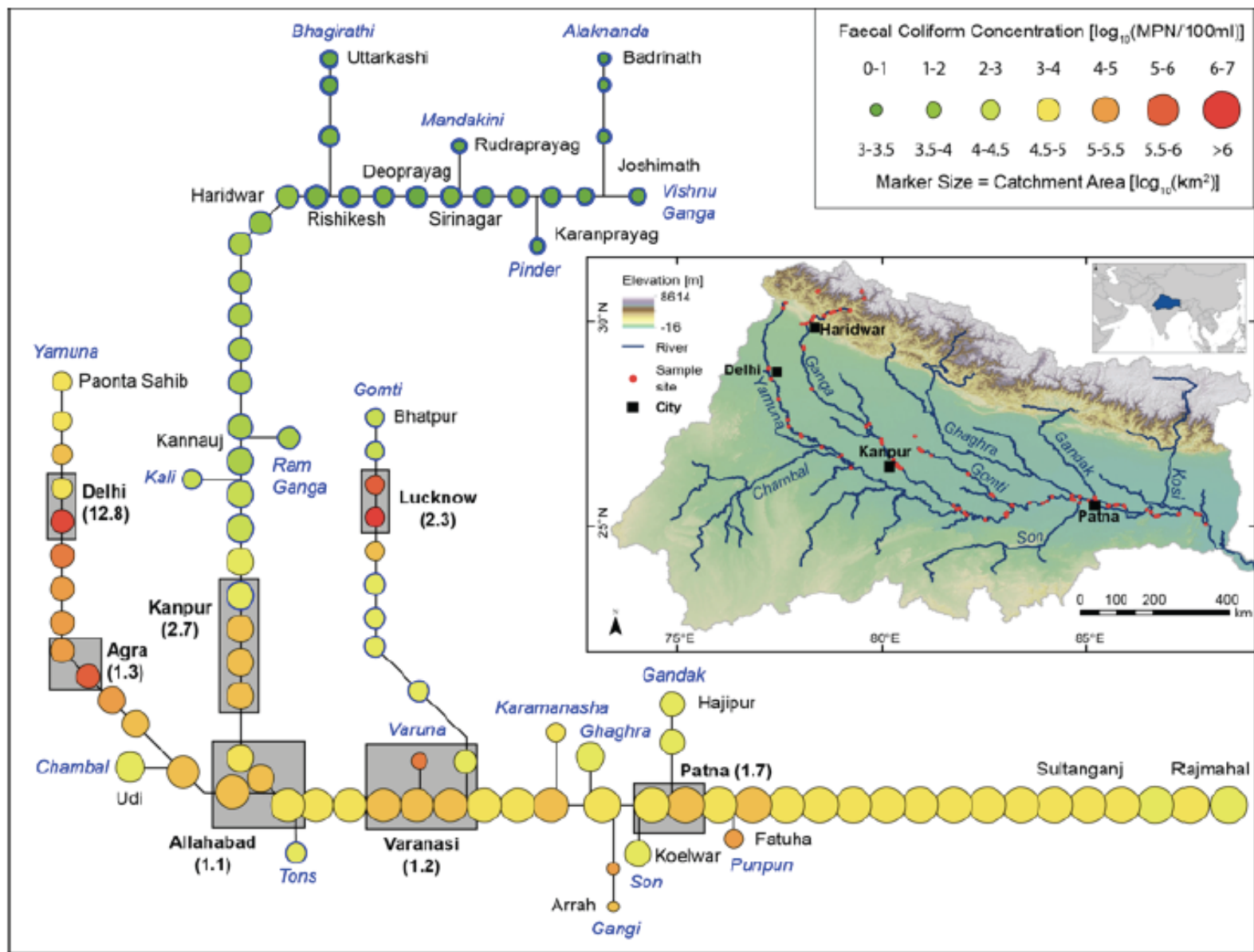
Outline

- Estimated status of WQ in the Ganga basin
- First principles and detection potential of chromium
- Trial with EO-1 Hyperion data
- Future challenges

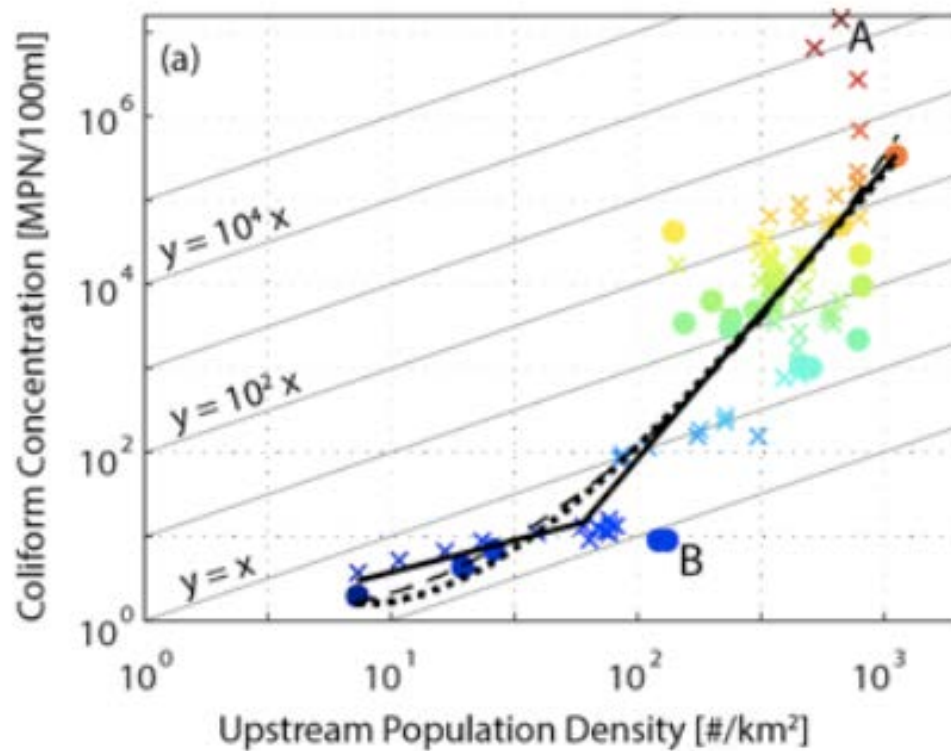
Basin Scale Water Quality

Data

- Database maintained at IIT-K of WQ data for the Ganga basin
- 102 locations across the basin, some since 1993
- Mainly the Ganga main stem, but confluences sampled, some other rivers as well (Yamuna, Gomti)
- FC, BOD, COD, pH, temp
- India Census data
- SRTM watershed

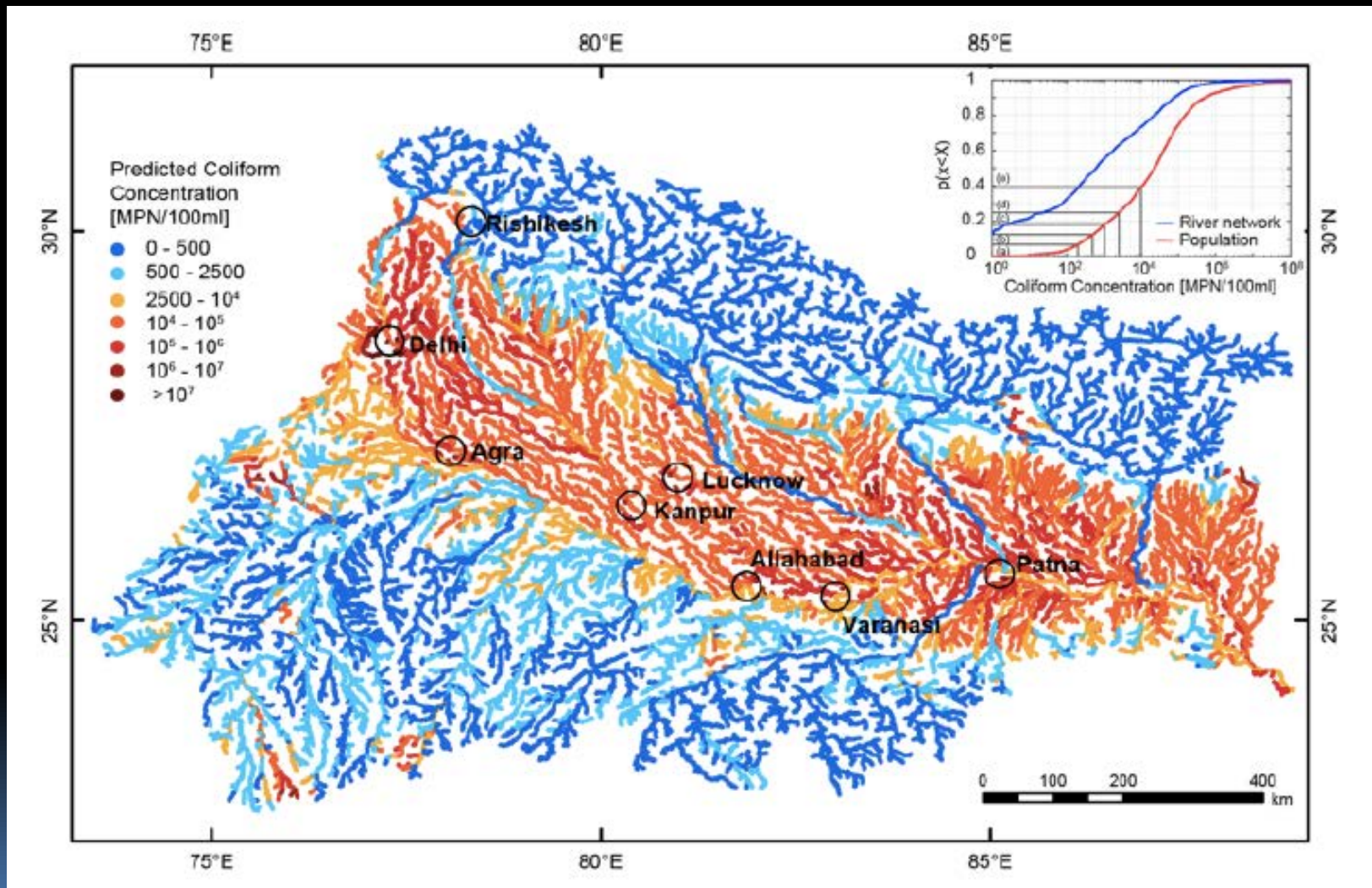


Population Density and Water Quality



- Log linear relationship between FC and population density

Modelled estimate of WQ for the Ganga basin



Potential of EO

Pros:

- Synoptic
- Managed at national/ international levels
- Affordable/Free

Cons

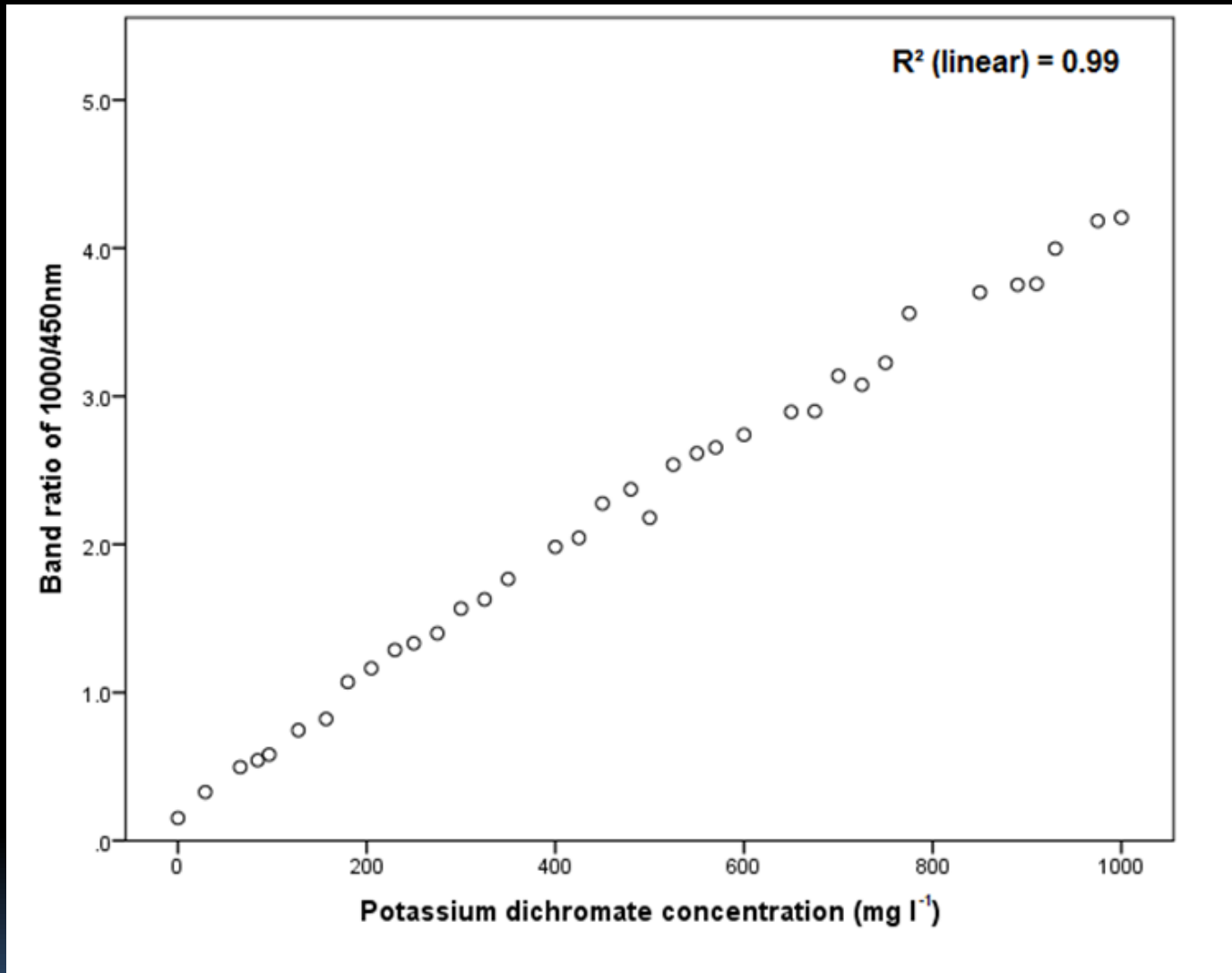
- Requires ground data
- Good progress for turbidity, less so for other WQ parameters
- WQ degradation involves toxins/pathogens in relatively low concentrations. Detectable?

First Principles

Lab experiment:

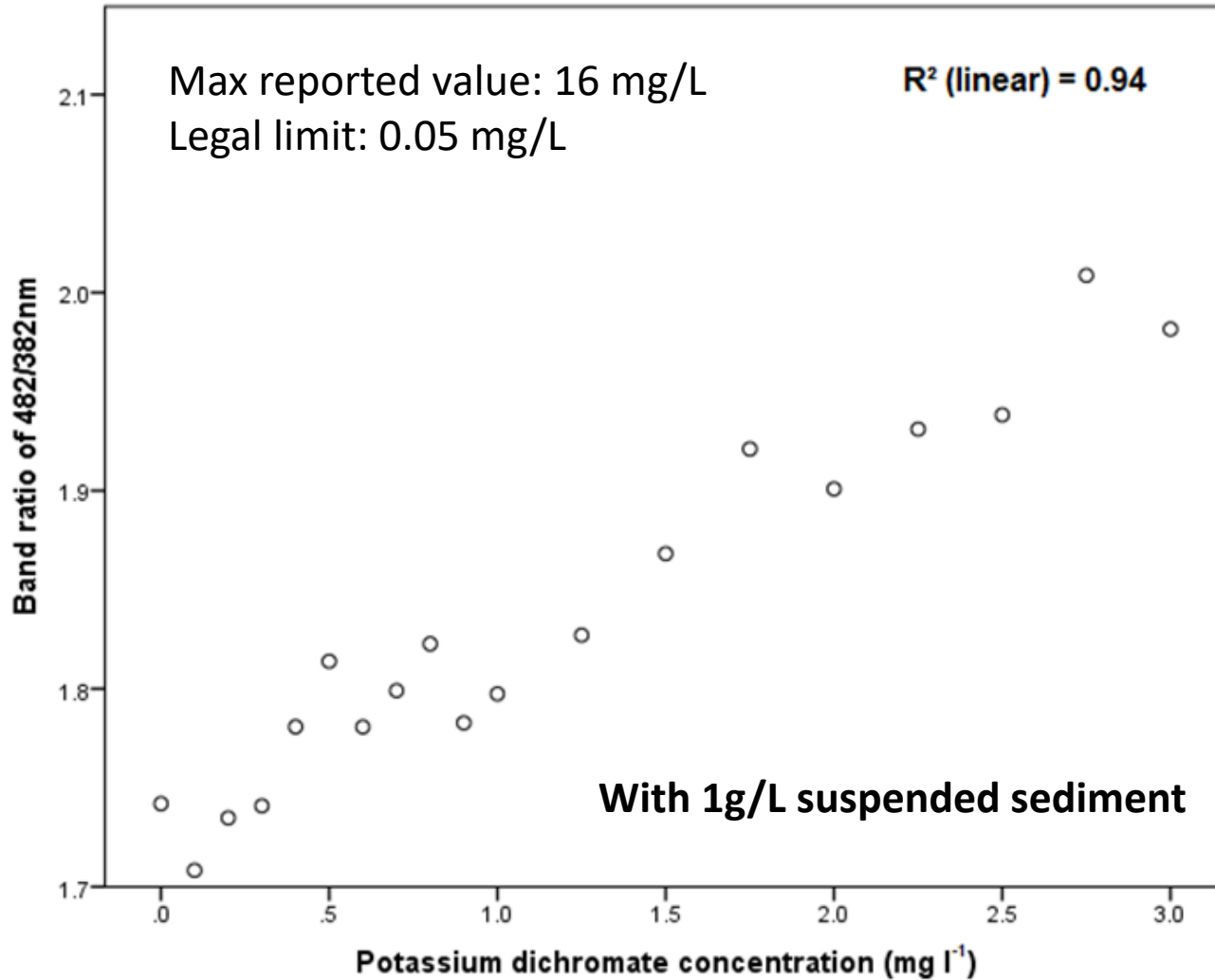
- Controlled quantities of Cr(VI) in aqueous solution and fine silt
- Sample with and ASD Spectrometer (300-1200nm in 2nm intervals)
- Explore band ratios for correlations, especially at low concentrations.

Lab Results I

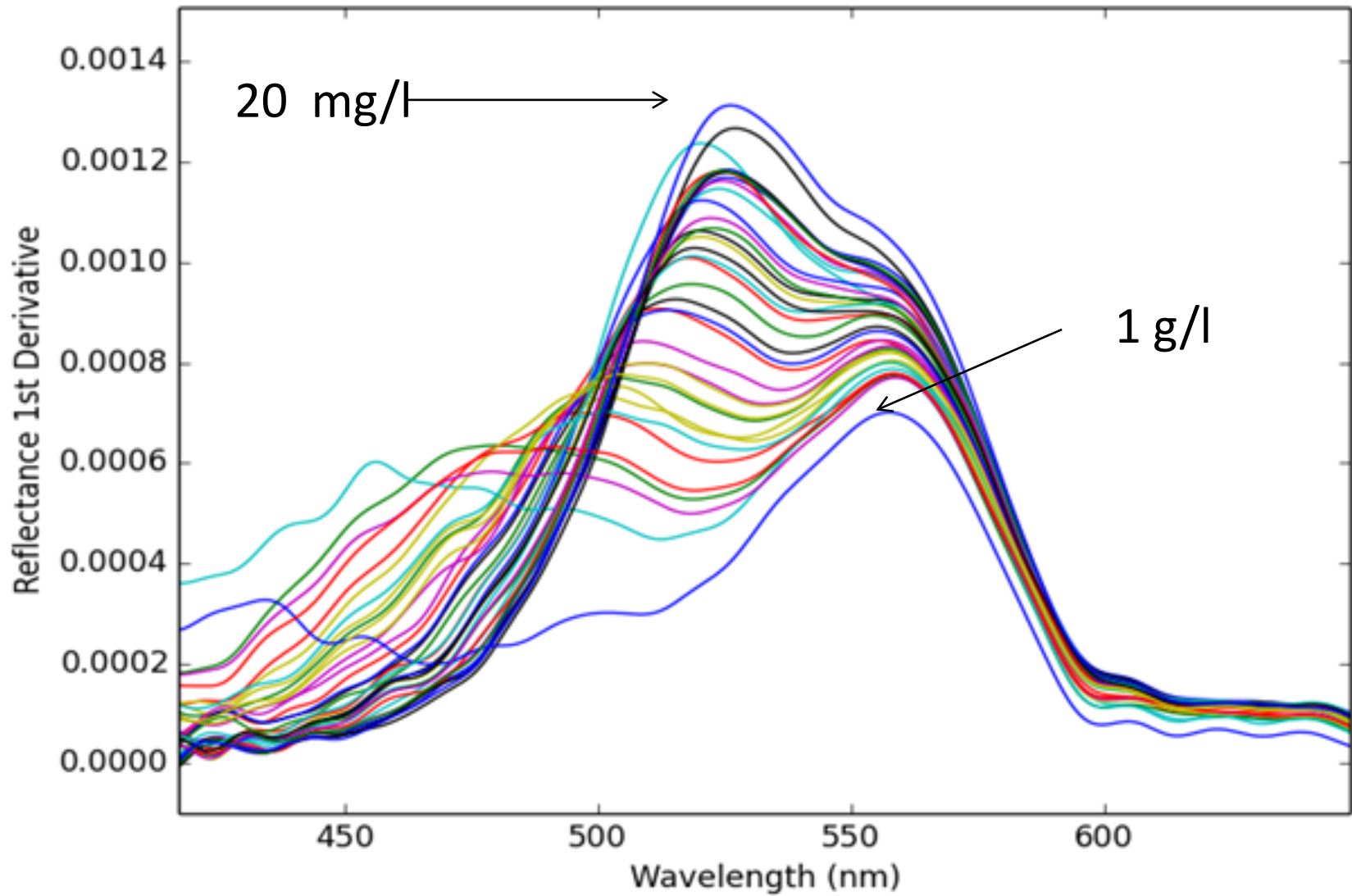


Project work of Avinoam Baruch and Stuart Scott

Lab Results II



Lab Results III



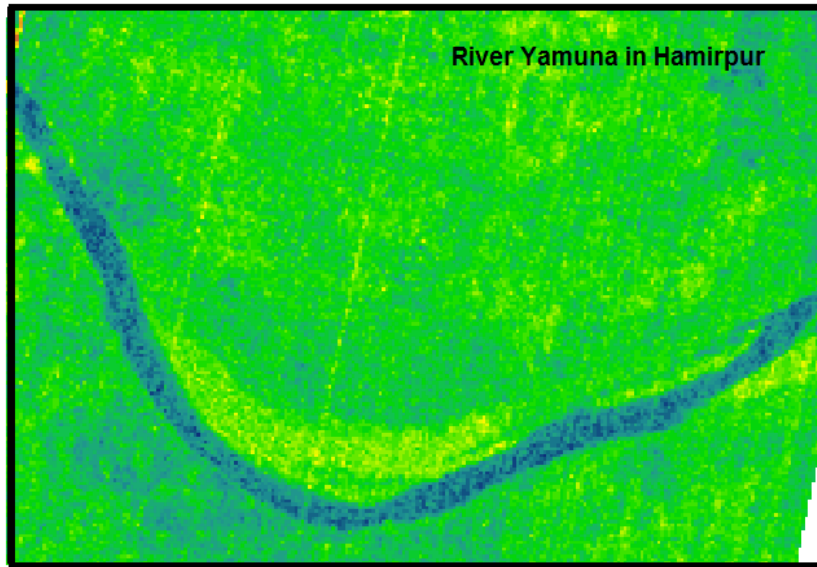
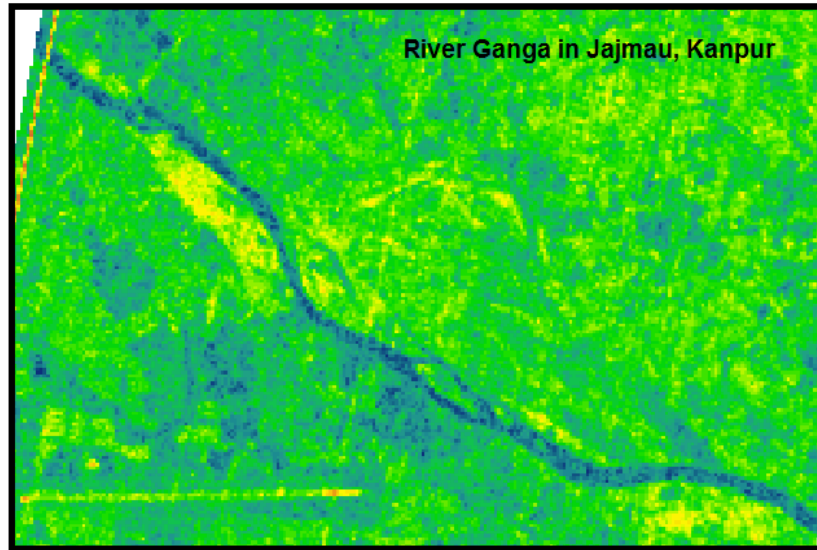
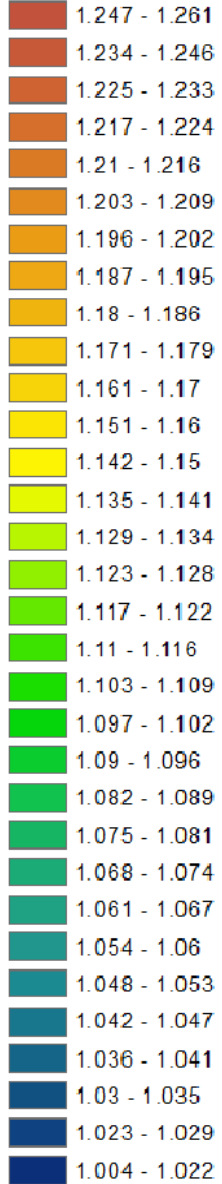
Lab Summary Findings

Preliminary Findings:

- Low concentrations detectable in lab settings
- Also detectable in the presence of sediment
- Derivatives $dR/d\lambda$ also sensitive and make a case for hyperspectral data.

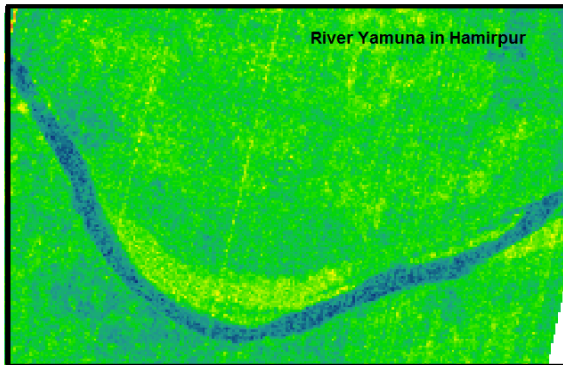
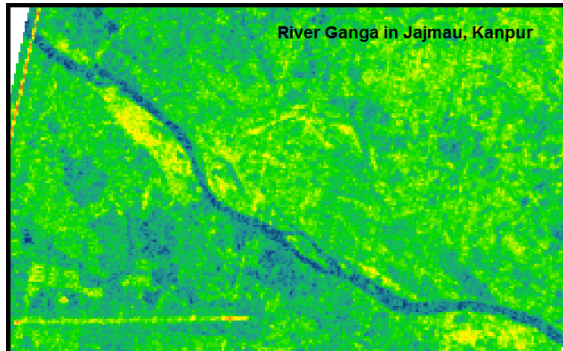
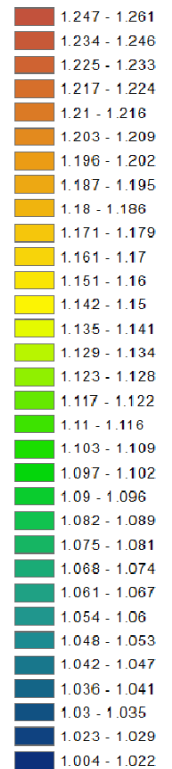
Trial with EO-1 Hyperion

Ratio of bands 13/8



Trial with EO-1 Hyperion

Ratio of bands 13/8



0 0.5 1 1.5 2 4 Kilometers

Pifalls:

- Lack of concurrent ground truth
- Complex water chemistry
- Complex atmospherics (Visual SixS not performing well)

Reducing Atmospheric effect with sUAS and airborne platforms



Additional Challenges

- Governance and haathi in the room: we do not need new research to establish that there is a WQ problem in the Ganga basin.
- Ethics and the social context: The Ganga is not a normal river.
- Information dissemination regarding transboundary water.
- Consistent ground validation
- Sensors, multi and hyperspectral of adequate resolution.