

# 2016 Spring Phytoplankton Bloom in the Delta Explained with Dissolved Oxygen Data

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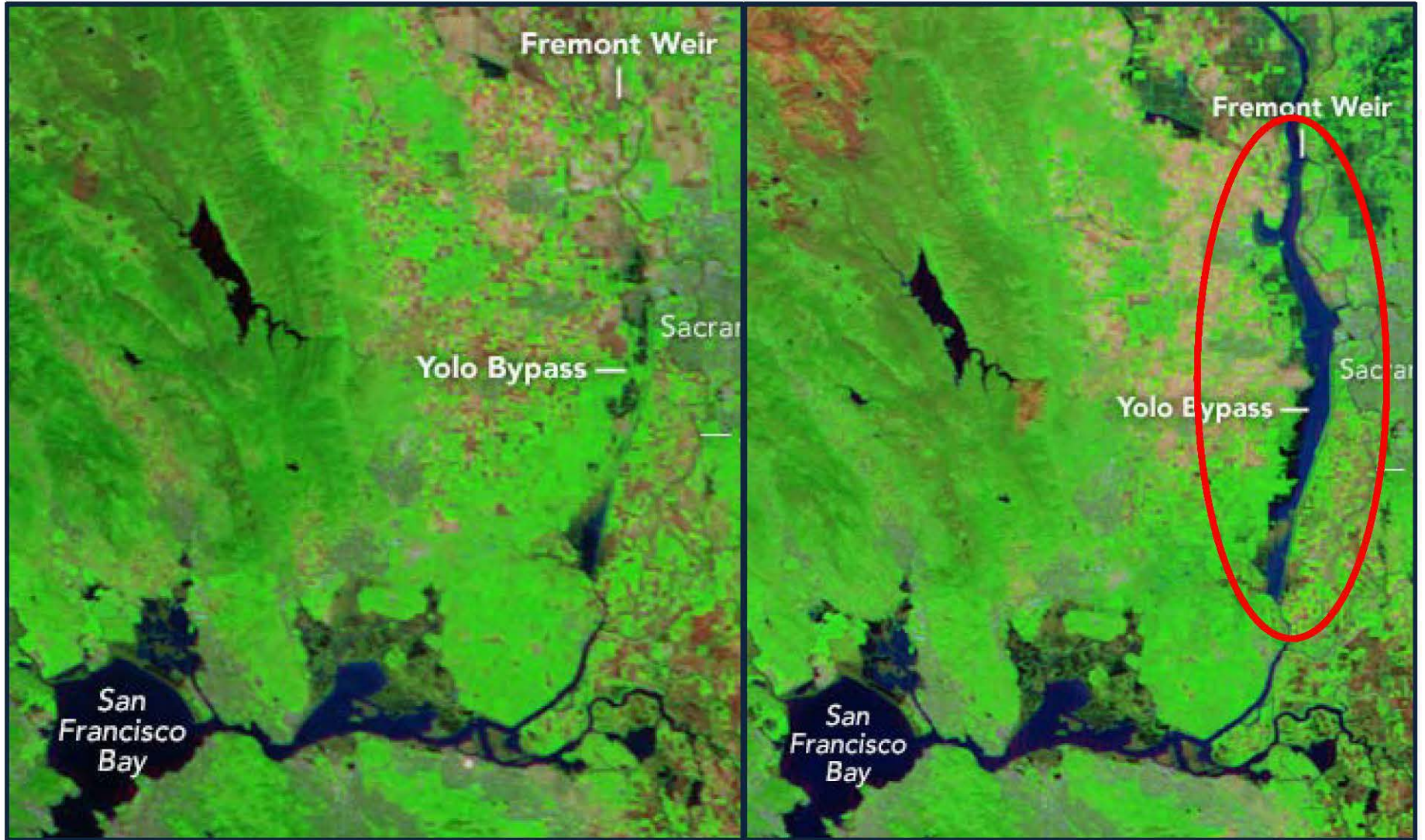


DELTA STEWARDSHIP COUNCIL





<http://mavensphotoblog.com/2015/08/20/wet-and-dry-times-at-the-fremont-weir/>



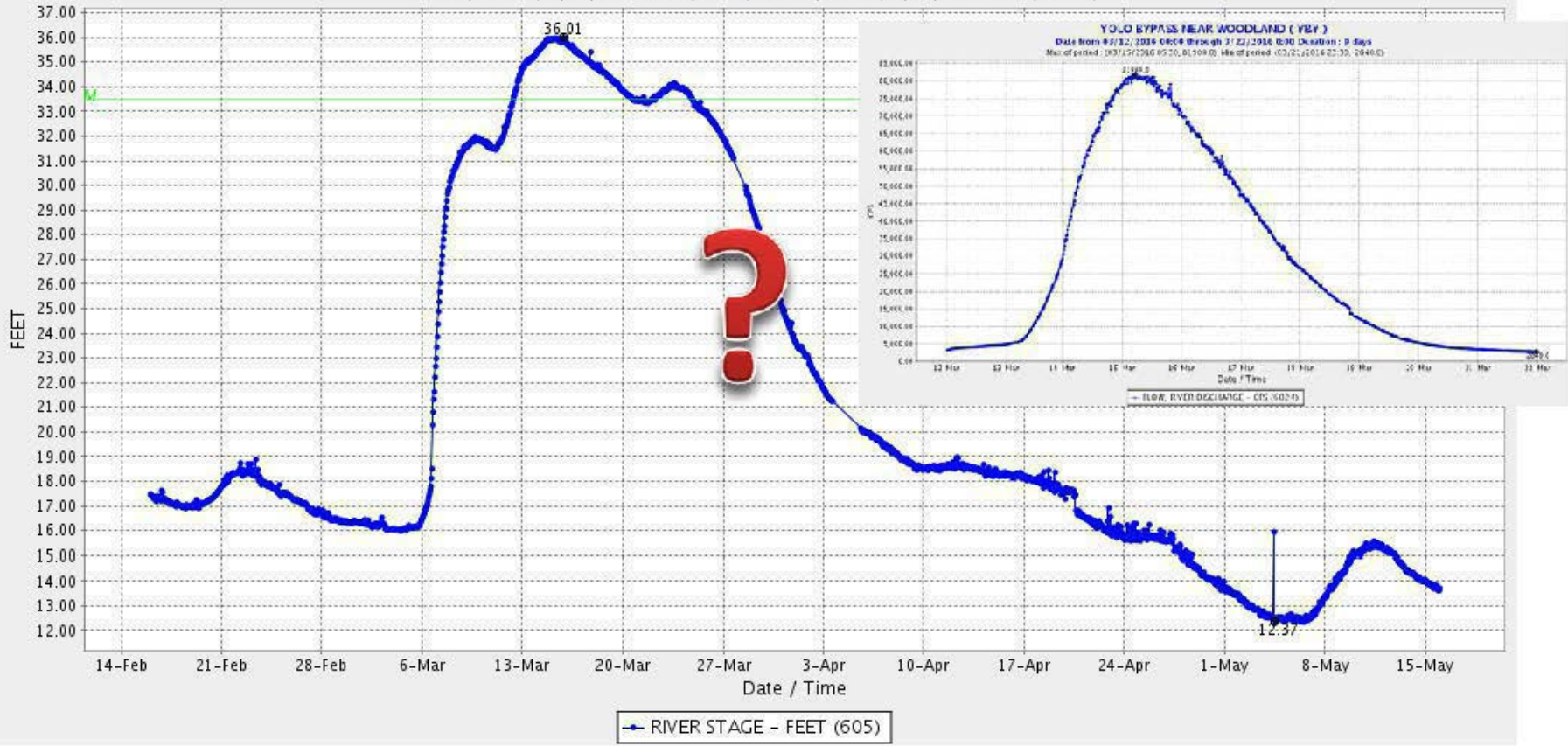
<http://earthobservatory.nasa.gov/IOTD/view.php?id=87719>

# Sacramento River at Fremont Weir

SACRAMENTO R @ FREMONT WEIR(CREST 32.0') ( FRE )

Date from 02/16/2016 00:00 through 5/16/2016 0:00 Duration : 89 days

Max of period : (03/15/2016 23:00, 36.01) Min of period : (05/04/2016 12:00, 12.37)



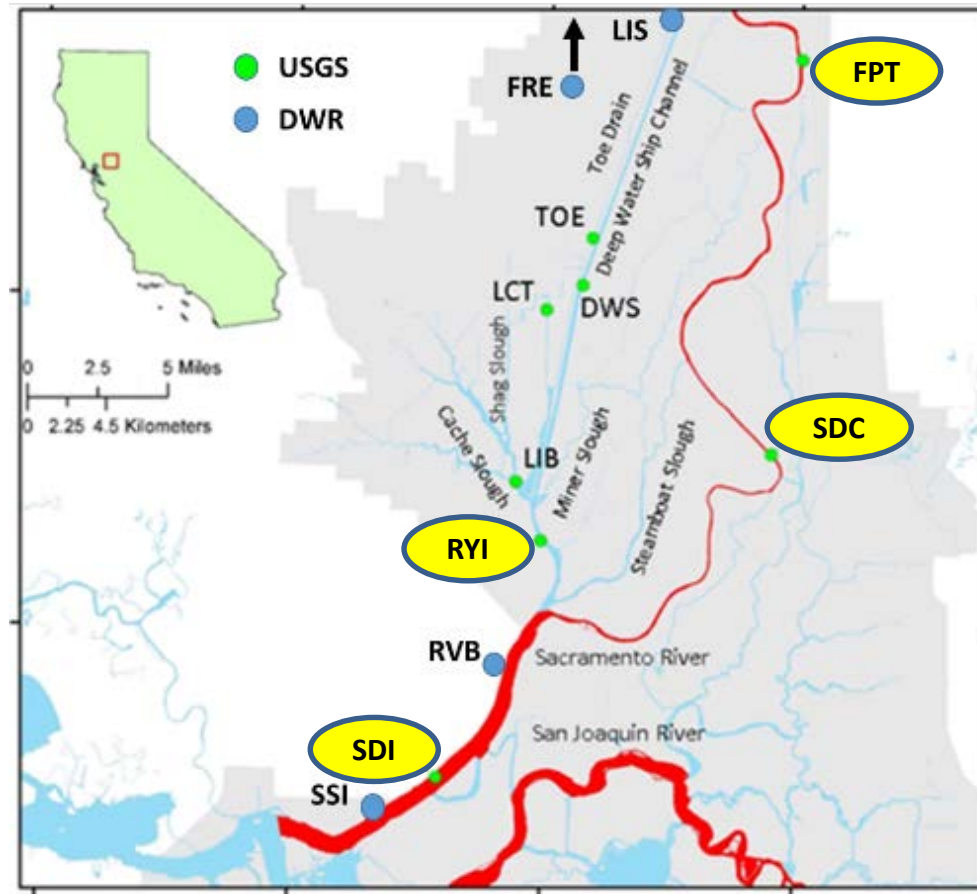
# Objectives



- Use the water quality data to monitor the phytoplankton growth
  - USGS gaging station data
- Track the progression of phytoplankton “bloom” in the Delta
  - March 2016 storm
  - Yolo Bypass flooding
- Preliminary estimation of community metabolism
  - Gross primary production
  - Community respiration
- Future directions

# Study Locations

Map provided by Anke Mueller-Solger, USGS



FPT: Sacramento River at Freeport ([11447650](#))

SDC (WGA): Sacramento River above Delta Cross Channel ([11447890](#))

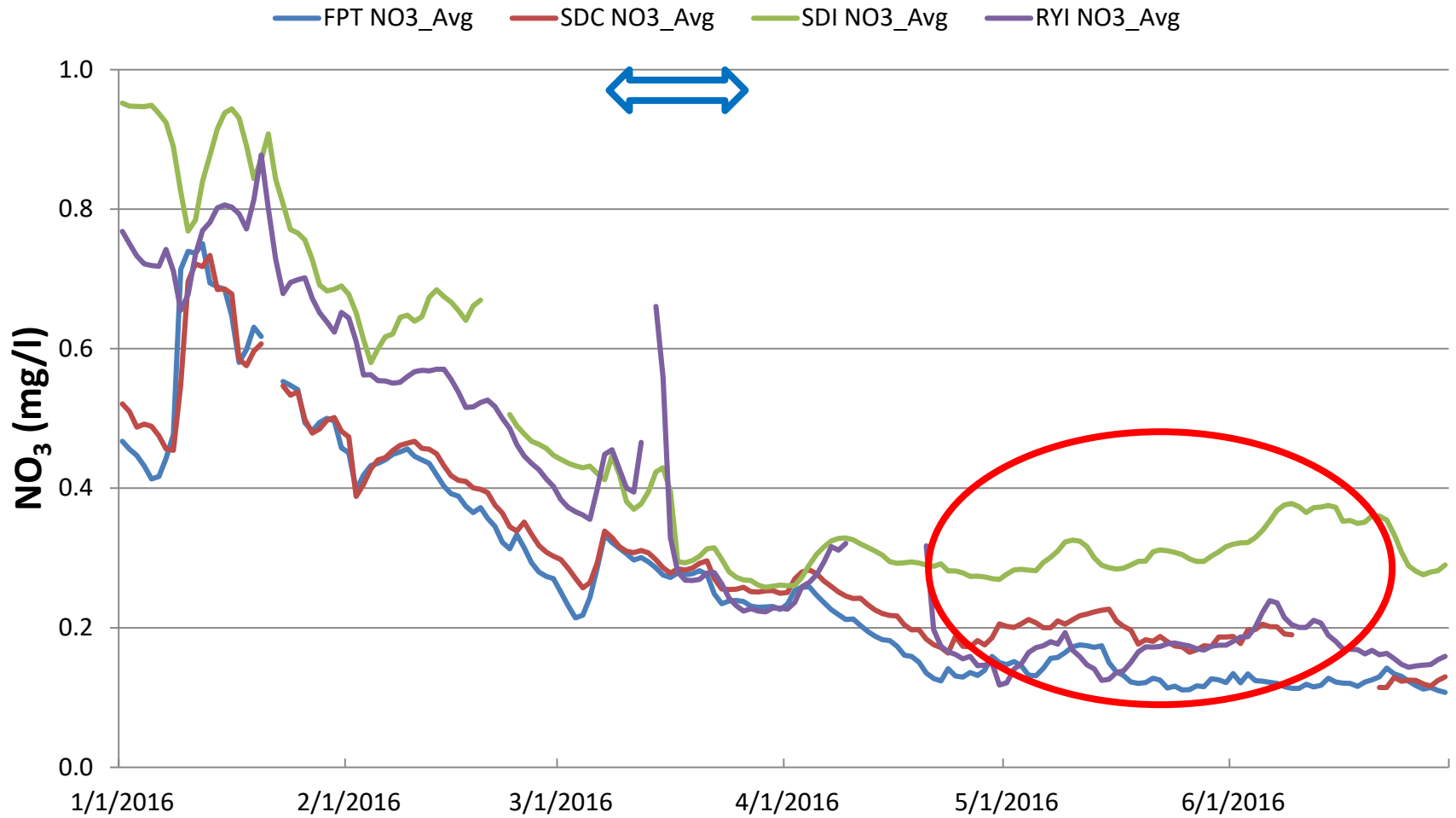
SDI (DEC): Sacramento River at Decker Island ([11455478](#))

RYI (CCH): Cache Slough at Ryder Island ([11455350](#))

# Water Quality Data Analysis

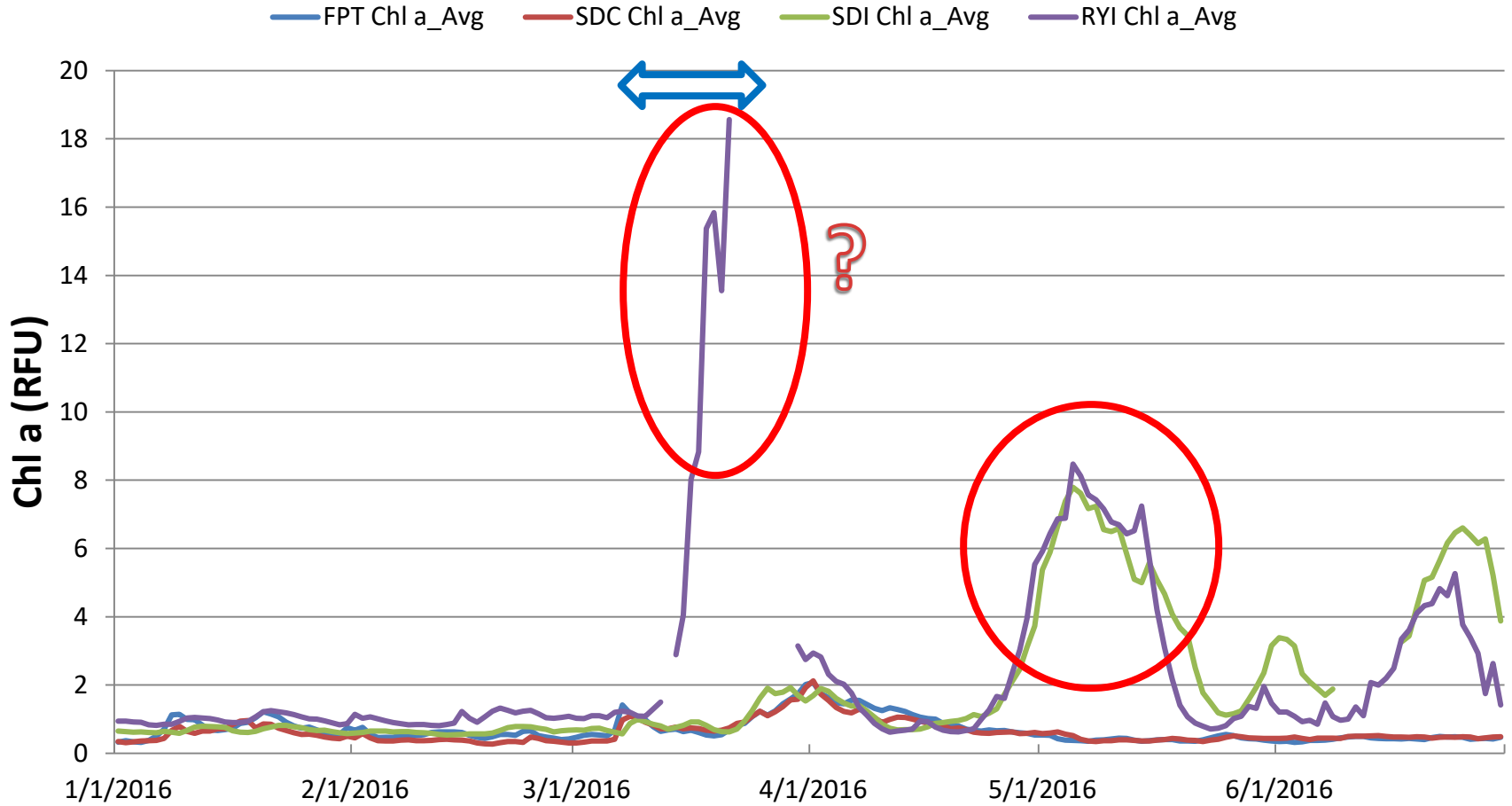
- USGS gaging station data
- Parameters
  - Water temperature
  - Dissolved oxygen concentration (**mg/l** and **% saturation**)
  - Chlorophyll *a* (RFU)
  - Nitrate (mg/l)
  - Daily average and amplitude (max-min)
- Ecosystem metabolism calculation
  - Dissolved oxygen data
  - Single-station, open-system method

# Nitrate concentration





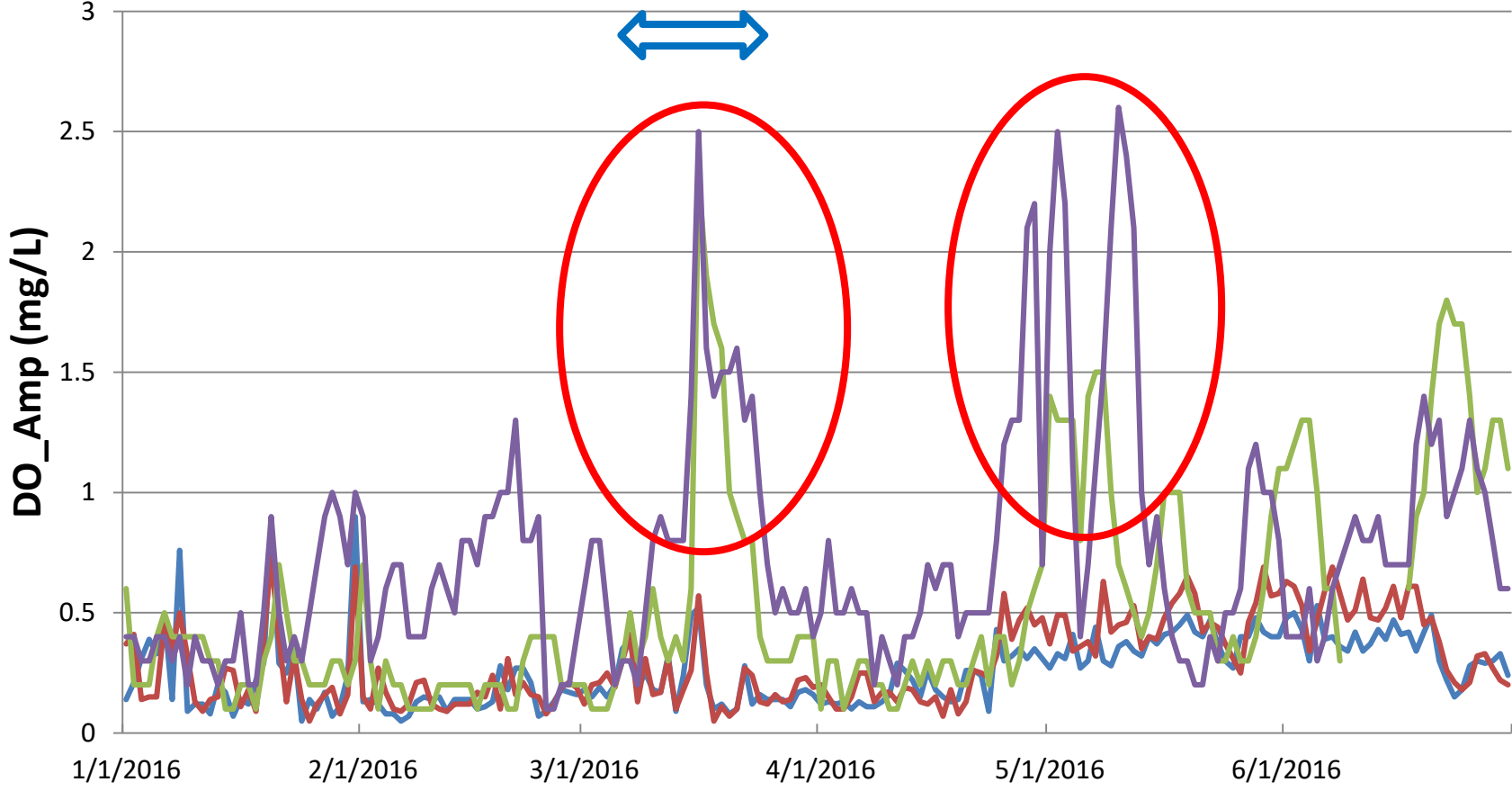
# Average Phytoplankton Biomass



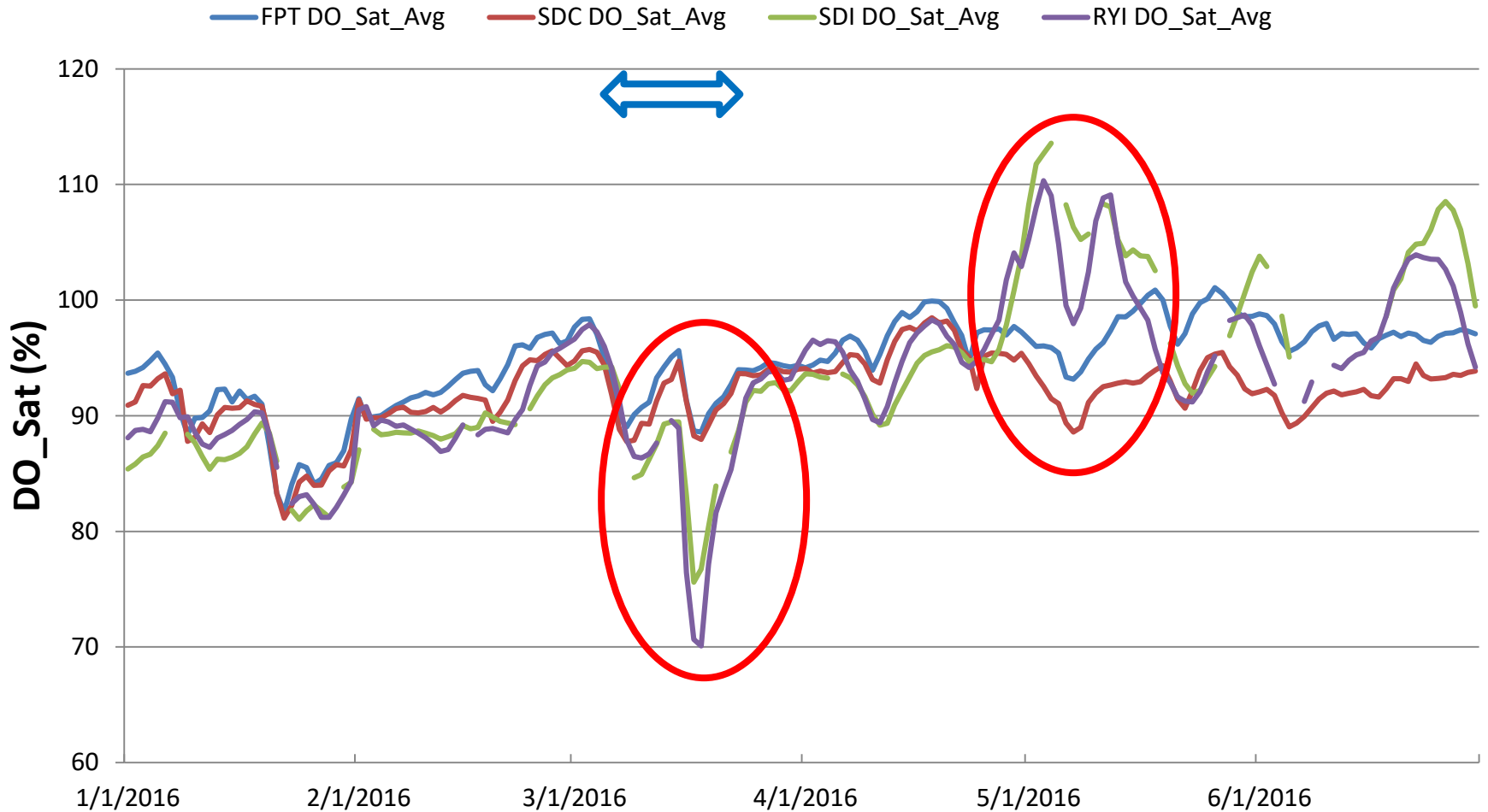
# Daily DO Change

(daily max-min)

FPT DO\_Amp    SDC DO\_Amp    SDI DO\_Amp    RYI DO\_Amp



# Daily Average DO\_Sat (%)



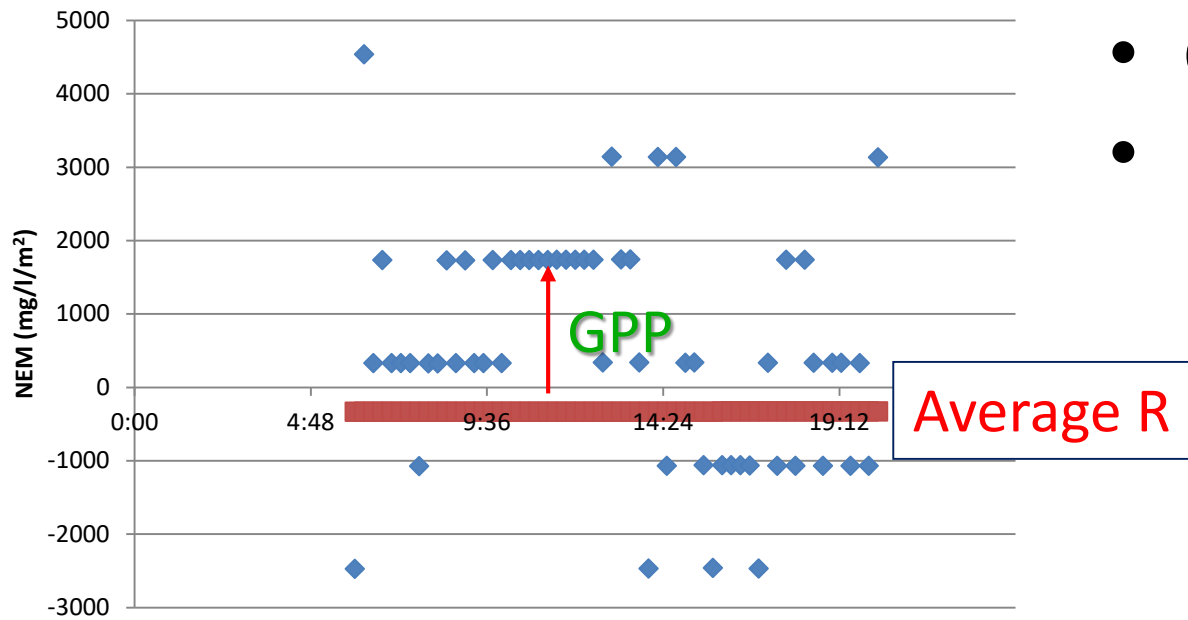
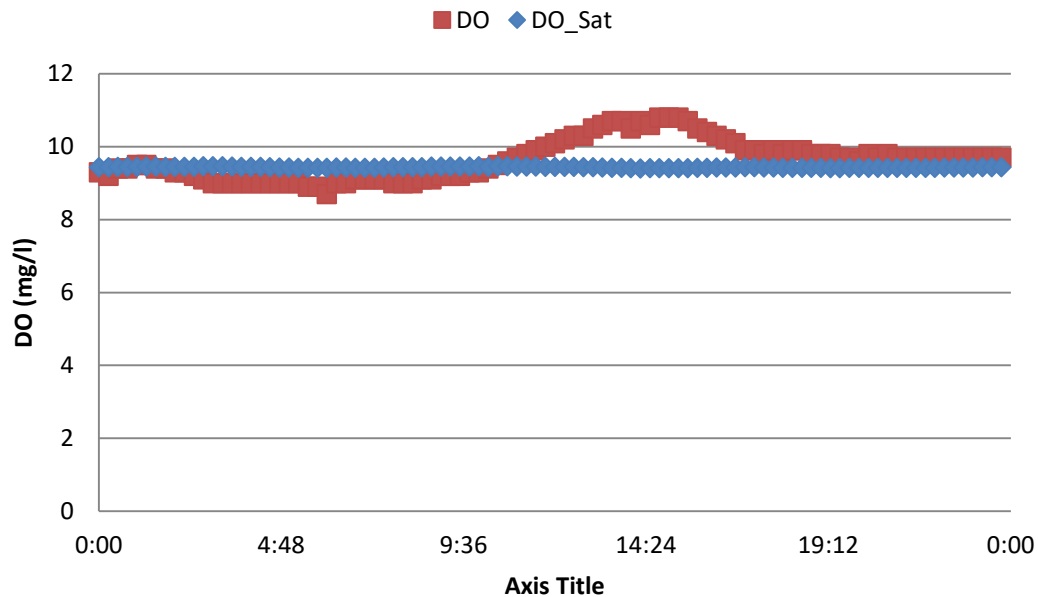
# Ecosystem Metabolism

- Single-station method
  - H. T. Odum (1956)
  - $\Delta\text{DO} = P - R \pm E$ 
    - Gross primary production (GPP)
    - Community respiration (CR)
    - $E = \text{O}_2$  exchange between water and atmosphere ( $K$ )
- Reaeration rate ( $K_a$  at 20 °C per day)
  - $K_a = 4.7531 \left( \frac{U}{H^{1.5}} \right) 1.0241^{T-20}$ 
    - $U$  = velocity (m/s)
    - $H$  = depth (m); NOAA Chart 18661 and 18662
    - Isaacs and Gaudy (1968) cited by Cox (2003) and Dodds et al. (2013)

# Ecosystem Metabolism

- DO change during day: GPP and CR
- DO change during dark: CR
- $\text{NDM} = \text{GPP} - \text{CR}_{24}$
- $\text{g O}_2/\text{m}^2/\text{day}$
- Factors to consider,
  - Reaeration coefficient (K)
  - Dark or light respiration
  - Anaerobic respiration
  - Hydrologic effects (e.g., groundwater, tidal flux)

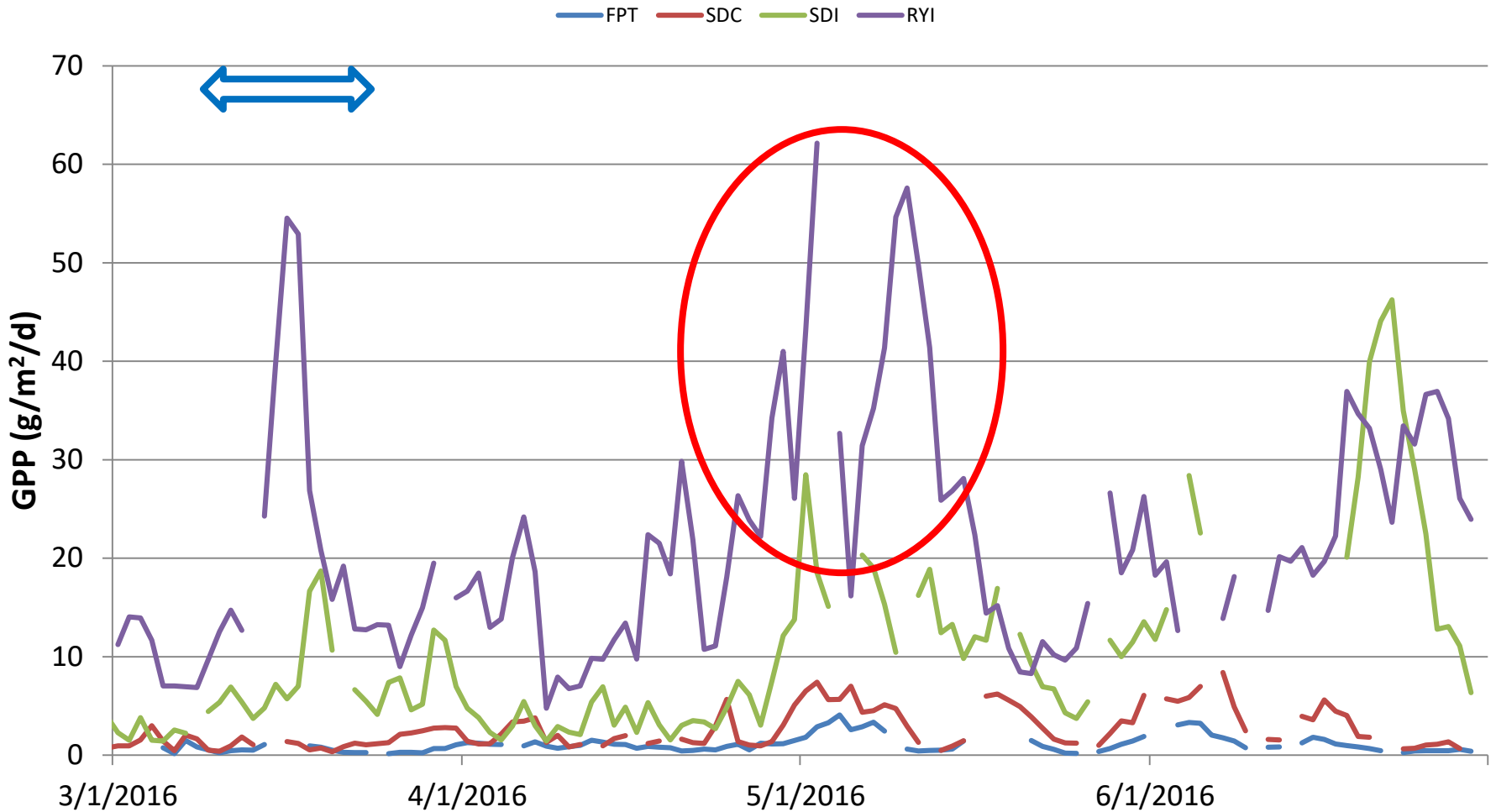




## R<sub>YI</sub>

- 5/9/2016
- Depth = 14 m
- GPP = 54.6 g/m<sup>2</sup>
- CR = 31.7 g/m<sup>2</sup>
- Net autotrophic...
  - At least for this day

# GPP (preliminary)





# Summary

- Nitrate decreased after the March storm at all sites.
  - Remained highest at SDI during May.
- Phytoplankton biomass (chl  $a$ ) highest in early May
  - Higher at RYI and SDI
  - High chl  $a$  at RYI in March (?)
- Daily DO amp and % saturation highest in early May
  - High primary productivity
  - Higher at RYI and SDI
  - Higher DO amp during March is questionable.
- Metabolism estimates
  - High GPP at RYI and SDI
  - More information is needed.
- Missing Data...

# Science for Solutions:

## *Linking* DATA *and* DECISIONS

9th Biennial Bay-Delta Science Conference • November 15-17, 2016 • Sacramento Convention Center

- System maintenance and data processing and sharing
- Floating, mobile sensor systems (?)
- DO corrections for tidal flows (mixing)
  - Systematic understanding of the physics (hydrodynamics)
  - Continuous monitoring and high-speed real-time measurements
- Reaeration coefficients
  - Tidal and river flows
  - Wind effects
  - Depth-integrated profiles (DO, temperature)
- Other primary producer groups
  - Planktonic or attached (benthic or periphytic) production