VQ2. Ecosystem Function, Physiology, and Seasonal Activity

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VQ2 Overarching Question:

What are the seasonal expressions and cycles for terrestrial and aquatic ecosystems, functional groups, and diagnostic species?

How are these being altered by changes in climate, land use, and disturbance?

Decadal Survey: Strategic Role of Ecosystem Observations: Observing Conditions and Trends
Predicting Trajectories
Managing Events
VQ2 Thematic Subquestions

**VQ2a:** How are ecosystems being altered by changes in climate, land use, and disturbance?

**VQ2b:** How are seasonal patterns of ecosystem function being affected by climate change?

**VQ2c:** How do changes in phenology affect productivity, carbon sequestration, and hydrological processes across ecosystems and agriculture?

**VQ2d:** How do environmental stresses affect the seasonality of the physiological function of water and carbon exchanges within ecosystems?

**VQ2e:** What is the seasonality and environmental impact of algal blooms in shallow water environments?
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Submerged aquatic vegetation (HyMap data – June)

- Herbicide application areas
- SAV classification

Area covered = 134.9 ha

Bar graph showing areas:
- 2003: 200 ha
- 2004: 400 ha
- 2005: 600 ha
- 2006: 200 ha
- 2007: 400 ha

Use of Hyperspectral Remote Sensing to Evaluate Efficacy of Aquatic Plant Management

Maria J. Santos, Shuni Khatn, Erin L. Heir, Margaret E. Andrew, Sopika S. Rajapakse, Jonathan A. Greenberg, Lan W. J. Anderson, and Susan L. Usdin*
Seasonal Changes in Submerged aquatic vegetation in the Sacramento-San Joaquin Delta

June 2005

October 2005

Water surface

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Max root lenth

Mar shoot biomass

Flowering

Elongation

Branching
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Seasonal Vegetation Dynamics at Jasper Ridge Biological Field Station, California

Field Based Map

Evergreen Forest
Chaparral

Water
Deciduous Forest
Grassland

AVIRIS SMA Fraction Images

June
July
September
October

Red > NPV Green > GV Blue > Soil

Green Veg Residue
Soil

Ustin et al. 1999. in Remote Sensing Change Detection: Environmental Monitoring Applications and Methods, Pp. 163-180
Monthly MODIS CWC for Continental U.S. in 2005

- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December

□ no data

CWC (mm)
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NDVI image March/April 2007

Donatella Zona et al. In prep.

NDVI and Corresponding monthly flux tower data

NDVI isn’t predictive of the net CO₂ flux
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Scaling Fluxes to Region: Land Cover Classification

March-April

SAM classification AVIRIS trained of 5 eddy flux tower footprint classes

% of Class in Image
Scaling Fluxes to Region: Land Cover Classification

August

- Tonzi
- Vaira
- Jasper Ridge
- Sherman Island
- Blodgett Forest
- Unclassified

% of Class in Image
Mapping Invasive Species: Co-occurrence of multiple phenologic stages

August: Water hyacinth with vertical leaves

June: Water hyacinth with short rounded leaves

October: Senescent foliage

February: Water hyacinth residue

Summer: Water hyacinth: flowering
Floating Species

**Challenges:**

Water hyacinth is spectrally similar:
- co-occurring floating & emergent species
- sunlit portions of tree crowns
- multiple phenological stages at any acquisition time
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ET estimated using MASTER data and SEBS

Agriculture and Water Demand

Almond Orchard (10m)

Low ET
Max. Irrigation
High ET

Nandita Gaur, SARP student 2009

Pistachios

Almonds
Biological soil crust under simulated climate change

Summer irrigation, nitrogen, and disturbance treatments simulate predicted climate and environmental change conditions.
Lichen cover vs global change treatment

Ustin et al., RSE 2009
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Interannual Spread of SAV

Maria Joao Santos et al., in prep.