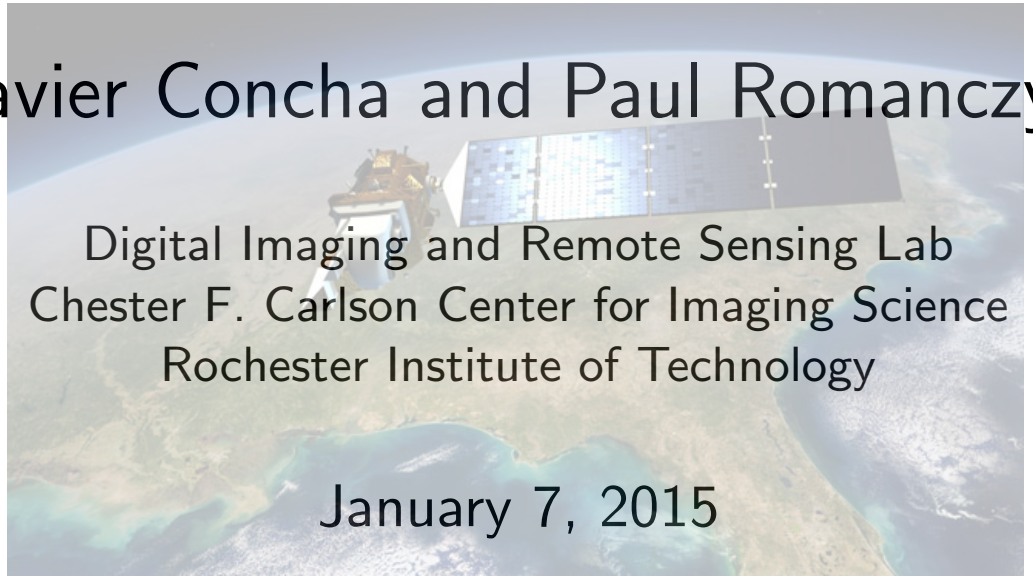
Intro to Instrumentation and Field Measurements in Remote Sensing



Javier Concha and Paul Romanczyk

Digital Imaging and Remote Sensing Lab
Chester F. Carlson Center for Imaging Science
Rochester Institute of Technology

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Presented for 2015 Intersession Term

Outline

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Course Goals

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- Learn the importance of field measurements
- Learn how to take field measurements
- Learn about DIRS instruments

Course Description

- Friday: Introduction
- Monday: Introduction (con't) and DIRS instruments exhibition
- Tuesday: Lab: Reflectance measurements
- Wednesday: Lab: LIDAR measurements

Definitions

Field Measurements or Groundtruth:

"Observations or measurements made at or near the surface of the earth in support of remote sensing."

Remote Sensing:

"Remote sensing is the science of obtaining information about objects or areas from a distance, typically from aircraft or satellites."

Motivation

Why is it important?

- Validation
- Calibration
- Correction

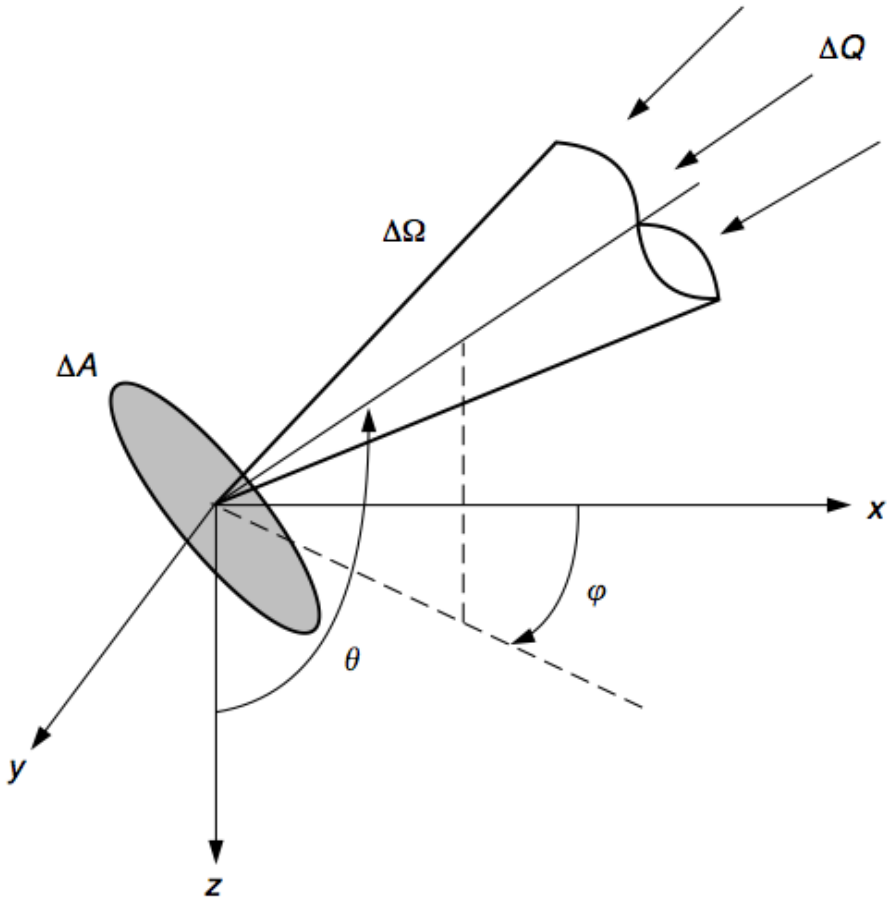
Motivation
Examples

Include:
Javier's example (over water mea.)
Paul's example (LIDAR and trees?)

Kind of Measurements

- reflectance
- concentration
- location

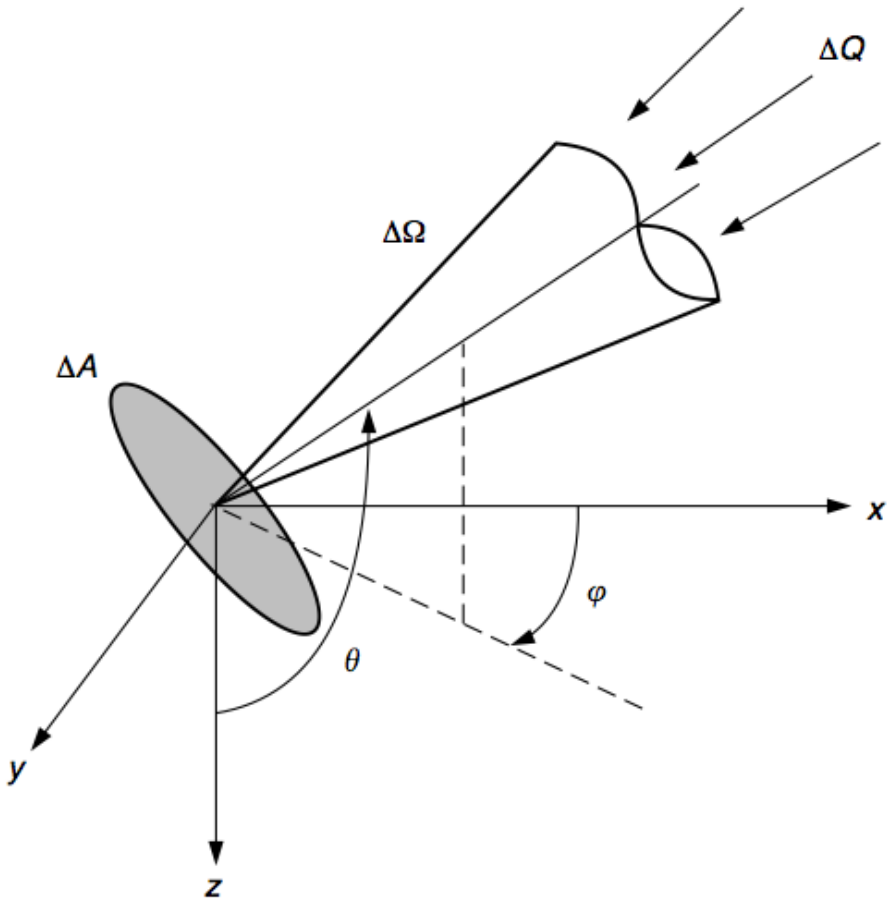
Radiometric Quantities



ΔQ: radian energy incident
Δt: time interval
ΔA: surface area at location (x,y,z)
$\Delta\Omega$: solid angle in direction (θ,φ)
$\Delta\lambda$: photons wavelength interval

$$L(x,y,z,t,\theta,\varphi,\lambda) \equiv \frac{\Delta Q}{\Delta t \Delta A \Delta\Omega \Delta\lambda} \quad \left[Js^{-1}m^{-2}sr^{-1}nm^{-1}\right] \qquad (1)$$

Radiometric Quantities



ΔQ: radian energy incident
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$$L(x,y,z,t,\theta,\varphi,\lambda) \equiv \frac{\partial^4 Q}{\partial t \partial A \partial \Omega \partial \lambda} \quad \left[Js^{-1}m^{-2}sr^{-1}nm^{-1}\right] \qquad (1)$$

Radiometric Quantities

Spectral downwelling scalar irradiance at depth z:

$$E_{od}(z,\lambda) = \int_{2\pi_d} L(z,\theta,\varphi,\lambda)d\Omega \quad \left[Wm^{-2}nm^{-1}\right] \tag{2}$$

Spectral upwelling scalar irradiance at depth z:

$$E_{ou}(z,\lambda) = \int_{2\pi_u} L(z,\theta,\varphi,\lambda)d\Omega \quad \left[Wm^{-2}nm^{-1}\right] \tag{3}$$

Spectral scalar irradiance at depth z:

$$E_o(z,\lambda) \equiv E_{od}(z,\lambda) + E_{ou}(z,\lambda) \tag{4}$$

$$= \int_{4\pi} L(z,\theta,\varphi,\lambda)d\Omega \tag{5}$$

Radiometric Quantities

Spectral downwelling plane irradiance at depth z:

$$E_d(z,\lambda) = \int_{2\pi_d} L(z,\theta,\varphi,\lambda)|cos\theta|d\Omega \quad \left[Wm^{-2}nm^{-1}\right] \qquad (6)$$

Photosynthetic available radiation, **PAR**:

$$PAR(z) \equiv \int_{350nm}^{700nm} \frac{\lambda}{hc} E_o(z,\lambda)d\lambda \quad \left[photons\ s^{-1}m^{-2}\right] \qquad (7)$$

Apparent Optical Properties

AOPs: depend both on the medium and on the directional structure of the ambient light field

Irradiance reflectance:

$$R(z,\lambda) \equiv \frac{E_u(z,\lambda)}{E_d(z,\lambda)} \tag{8}$$

Remote sensing reflectance:

$$R_{rs}(\theta,\varphi,\lambda) \equiv \frac{L_w(\theta,\varphi,\lambda)}{E_d(\lambda)} \quad \left[sr^{-1}\right] \tag{9}$$

where L_w is the **water-leaving radiance**

Objectives

- Develop over-water atmospheric correction
- Design water constituent retrieval algorithm
- Apply glint correction
- Validate results
- Demo process to a different study site

Outline

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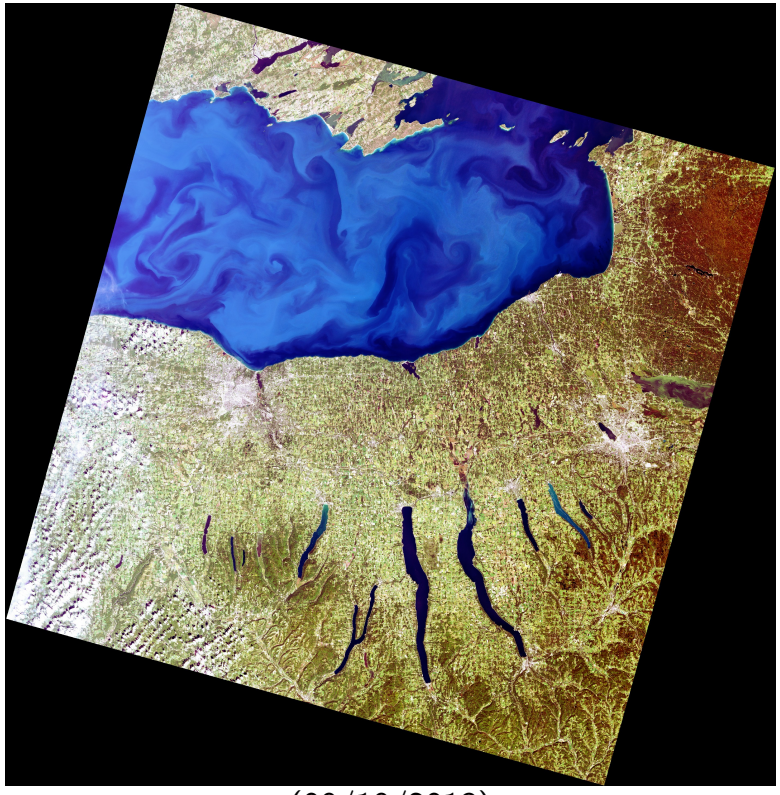
Conclusions

- Current retrieval algorithm depends on IOPs from the field. Not always available!
- LUT from Hydrolight: Highly dependent in phase function
- Obtain field data for Landsat-8 is difficult, mainly for weather conditions

Thanks for your attention!

QUESTIONS?

Javier A. Concha
jxc4005@rit.edu



(09/19/2013)

Thanks for your attention!

QUESTIONS?

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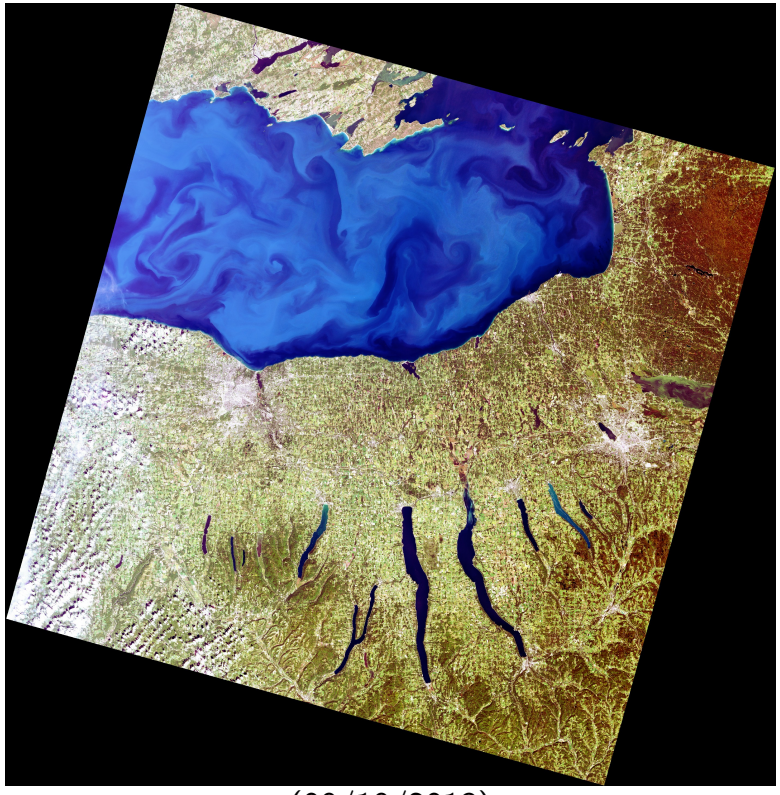
jxc4005@rit.edu



References

[[Muller-Karger et al., 2013]]Muller-Karger, F., Roffer, M., Walker, N., Oliver, M., Schofield, O., Abbott, M., Graber, H., Leben, R., and Goni, G. (2013).
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Geoscience and Remote Sensing Magazine, IEEE, 1(4):8–18.