Breakout session: Active Remote Sensing for Ocean Colour

Jamet, C.
Laboratoire d'Océanologie et de Géosciences, Wimereux, France
Churnside, J.
NOAA, Boulder, USA
Hostetler, C.
NASA, Langley, USA

Passive Observation of ocean color (1/2)

- Since CZCS → **Revolutionize our vision** of the marine biomass + understanding of global plankton ecosystems

- **Many advantages:**
  - Multi-spectral retrievals
  - Good spatial resolution (300-1000 meters)
  - High repetitive cycles ($\sim$ 3-4 days)
  - Continuous time series since 1997

Passive Observation of ocean color (2/2)

- **BUT:**
  - Signal limited to near surface layer
  - No information on plankton vertical structure
  - Limited in polar regions
  - Cloud cover
  - Absorbing aerosols
  - Only daytime

→ **Active observations could be very useful and complementary**

Purpose of the breakout session (1/2)

- To present the basics of active remote sensing with the main topic being on LIDAR

- To provide examples from airborne and satellite sensors

- To discuss potential avenues for further advances and potential new sensors

Purpose of the breakout session (2/2)

- **Four key questions:**
  1. How to get a 3D observation of ocean colour?
  2. What is the technology currently available?
  3. How can active measurements be used to validate and improve passive ocean colour retrieval algorithms?
  4. How to link active measurements to ocean colour parameters?

Schedule of the session

14:00-14:20: Introduction to the session and presentation of SAR technique (Cédric Jamet)

14:20-14:40: Airborne ocean profiling lidar (James Churnside)

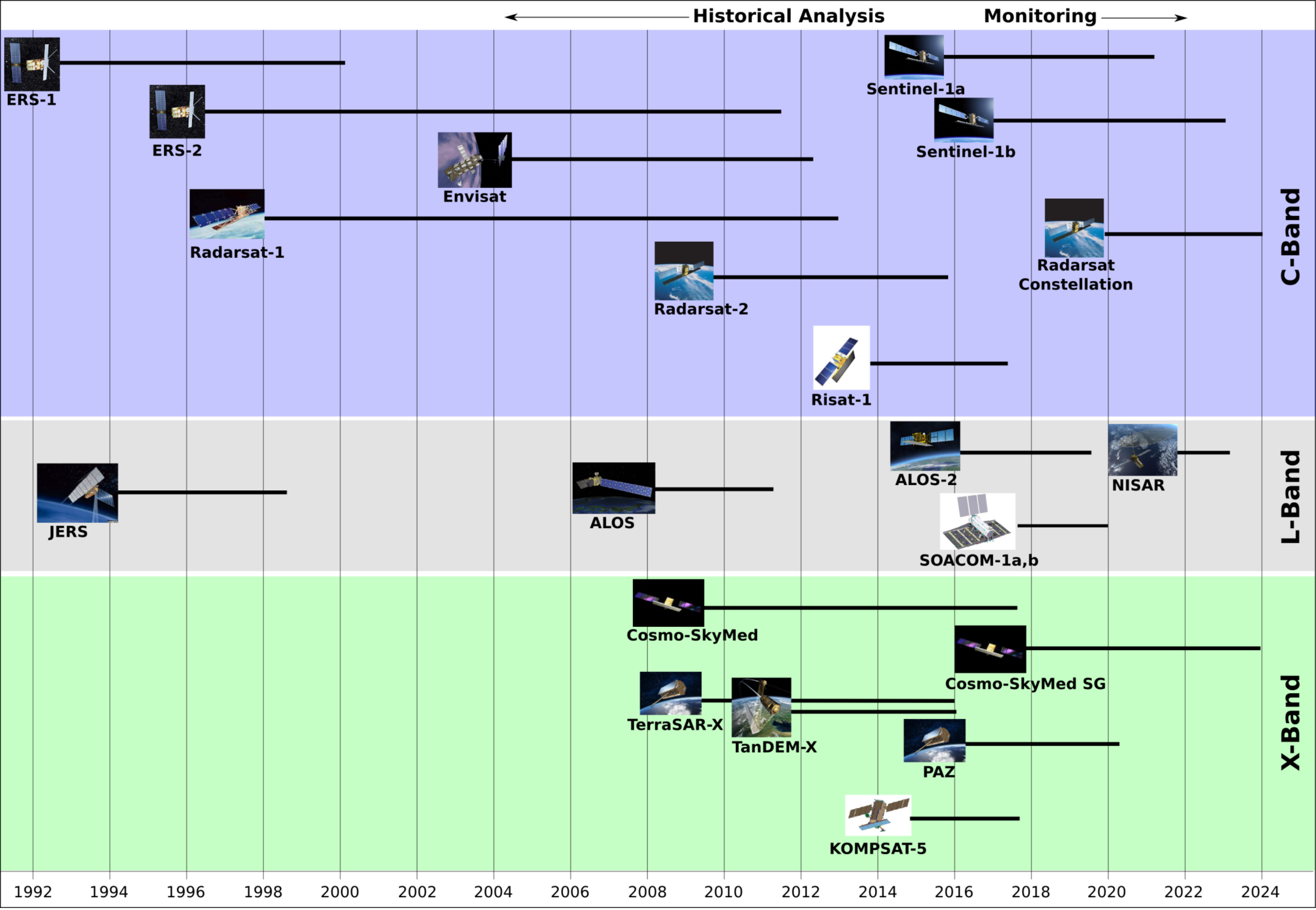
14:40-15:00: Space-borne ocean lidar (Chris Hostetler)

15:00-16:00: Discussion

16:00-16:45: Write-up of the discussion and recommendations

SAR for ocean features

- SAR: Synthetic Aperture Radar
- **Microwaves (including polarization)**
- **High spatial resolution** (meters-tens of meters)
- **Low repetitivity** (12-35 days)
- Interactions microwaves/ocean dependent of roughness of ocean
- Analysis of the backscatter signal (Bragg scattering)
- Microwave response of water surfaces strongly influenced by wind affecting its surface roughness



http://www.unavco.org/instrumentation/geophysical/imaging/sar-satellites/sar-satellites.html

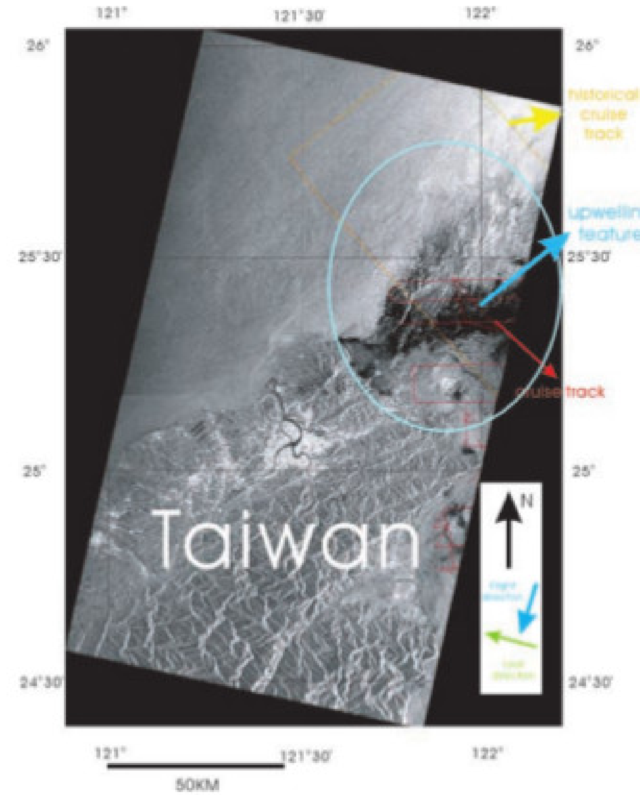
SAR for ocean features

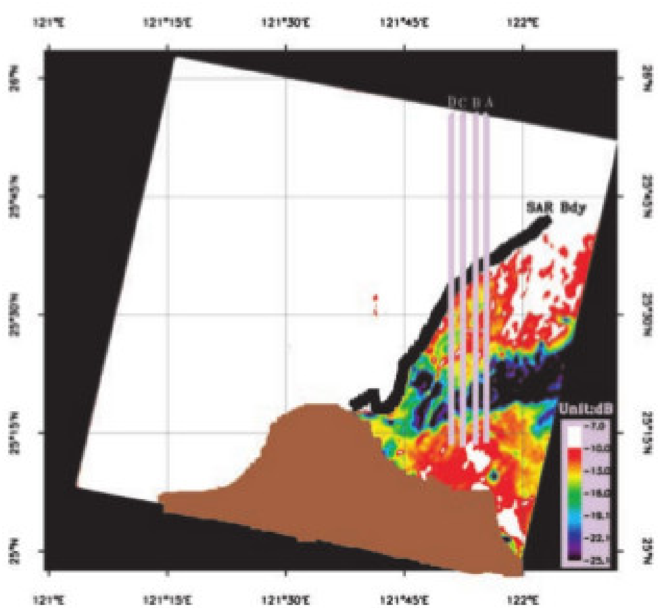
- **Applications:**
  - Oil spills
  - Bathymetric features in shallow water
  - Ships
  - Phytoplankton
  - Coastal winds
  - Ocean waves
  - Surface currents, fronts and eddies
  - Natural films on surface

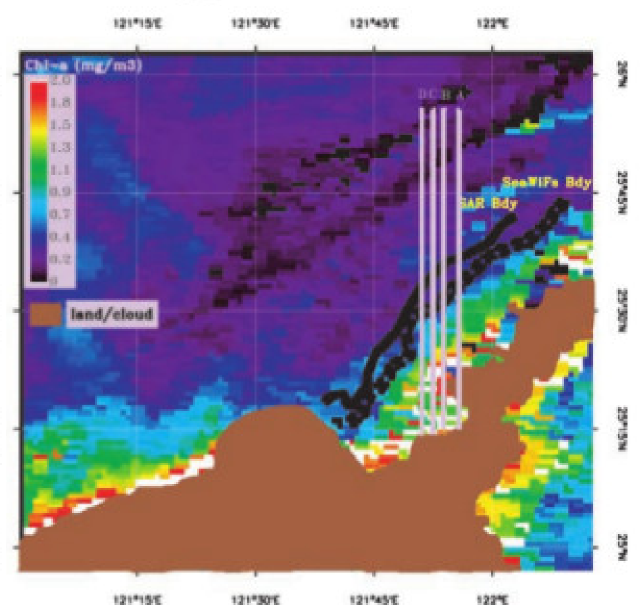
SAR for ocean features

- **Applications:**
  - Oil spills
  - Bathymetric features in shallow water
  - Ships
  - **Phytoplankton**
  - Coastal winds
  - Ocean waves
  - Surface currents, fronts and eddies
  - Natural films on surface

- Use of ERS-2 SAR and SeaWiFS images
- Northeastern Taïwan
- 19 August 2000
- AVHRR SST data
- Simultaneous in-situ measurements (SST, SSS, Chl-a)







Lin et al., 2002

- Correction of SST and wind effects on the normalized radar cross-section parameter (NRCS)
- **Higher Chl-a concentrations == higher attenuation of NRCS**
- Derived NRCS versus Chl-a relationship consistent with in-situ data in a limited range of parameters
- Detection of upwelling features: low NRCS, high Chl-a

→ Direct evidence relationship between SAR NRCS and Chl-a
→ Association between presence of ocean surface slicks and biological activity

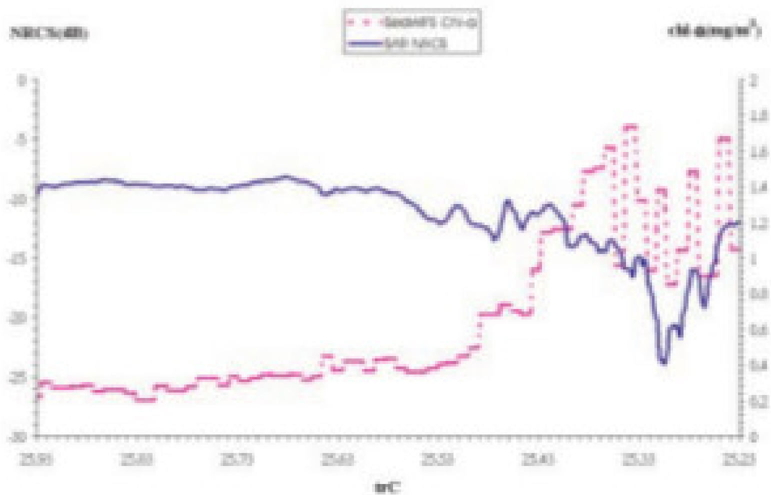


Figure 4. Clear negative correlation is found between SAR NRCS and SeaWiFS Chl-a concentration along the pink transect C.

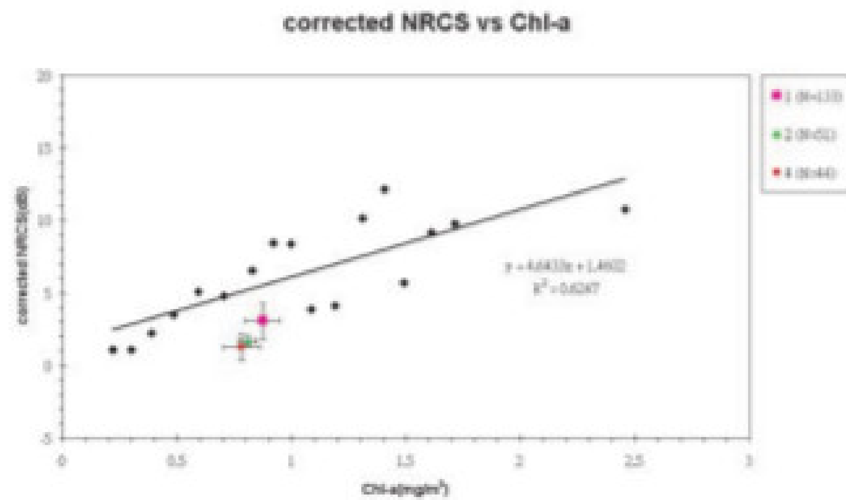


Figure 6. Relationship between the SST corrected ERS-2 SAR NRCS attenuation (with respect to ambient NRCS) and SeaWiFS Chl-a concentration. The three sea truth Chl-a measurements are

Lin et al., 2002

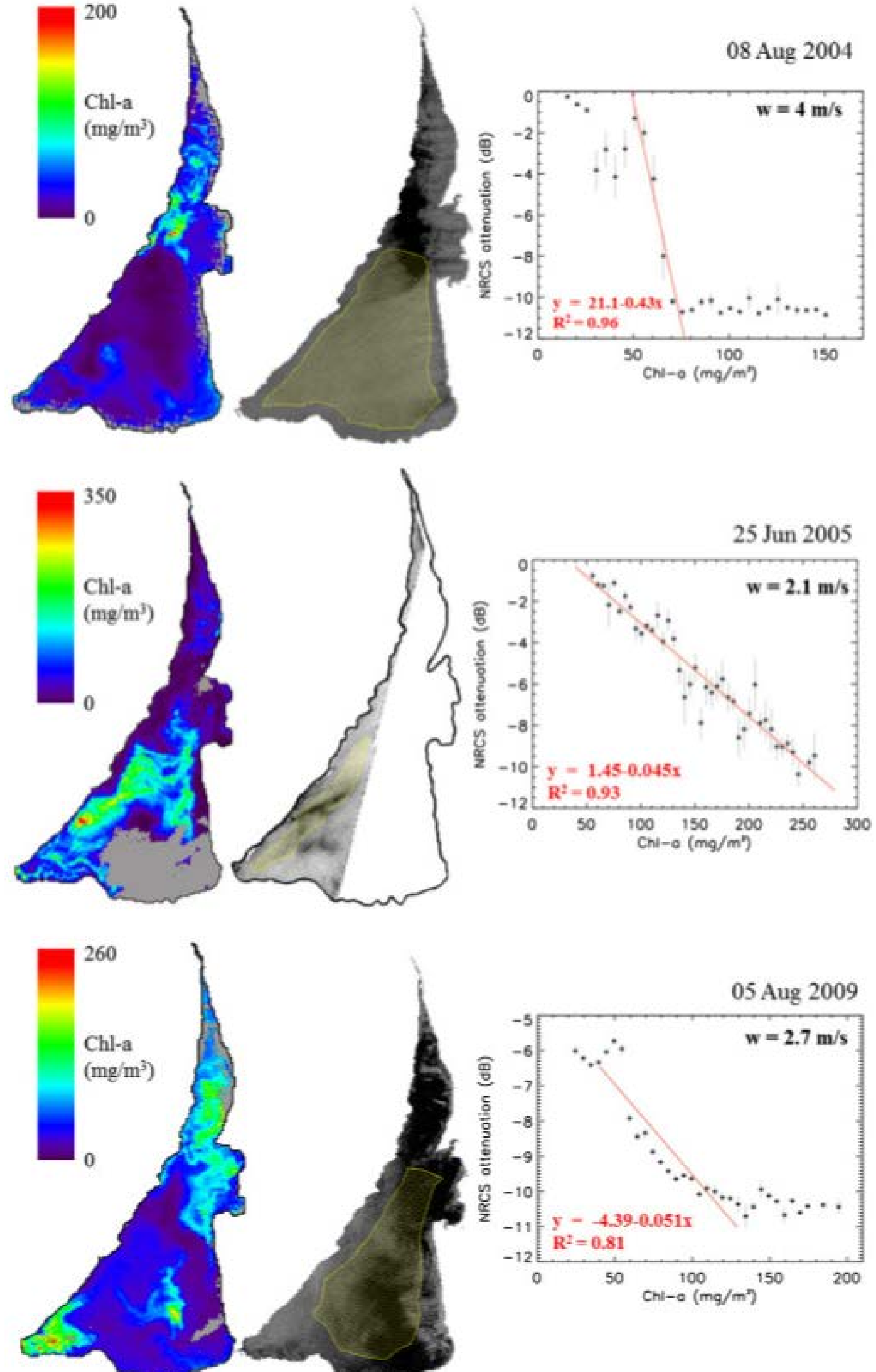
Synergistic use of MERIS and ASAR images to detect cyanobacteria and scum formation

→Step-wise decrease in the NRCS for chl-a>50 mg.m^{-3} and wind speeds [2-6] m.s^{-1}

→ Feasibility of correlating normalized radar cross-section parameter corrected for wind speed with Chl-a concentrations

→ SAR data can be used to flag areas affected by scums

→Use of microwave RS as additional tool to increase temporal coverage of OC sensors



Bresciani et al., 2014

Slides for discussion part

Purpose of the breakout session (1/2)

- To present the basics of active remote sensing with the main being on LIDAR
- To provide examples from airborne and satellite sensors
- To discuss potential avenues for further advances and potential new sensors

Purpose of the breakout session (2/2)

- **Four key questions:**
  1. How to get a 3D observation of ocean colour?
  2. What is the technology currently available?
  3. How can active measurements be used to validate and improve passive ocean colour retrieval algorithms?
  4. How to link active measurements to ocean colour parameters?

Use of lidar for ocean color

- What is the instrumentation currently available?
  - Is there an interest to develop in-situ lidar?
- What prevent us to use lidar for OC?
  - Is one wavelength enough for science?
- How different are the physics and algorithms?
  - What is the effort to make to use lidar?
  - How easy is to use/process lidar?
- What budget for using/shifting to OC?
- What kind of help we need from space agencies?

MESCAL CNES/NASA space mission

- Is there interest for:
  - 355 nm?
  - High vertical resolution (less, 2, 5, 10 meters)
  - Fluorescence à 685 nm
  - Kd, bbp
  - Other parameters