



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

Purpose of the breakout session

- 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

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)

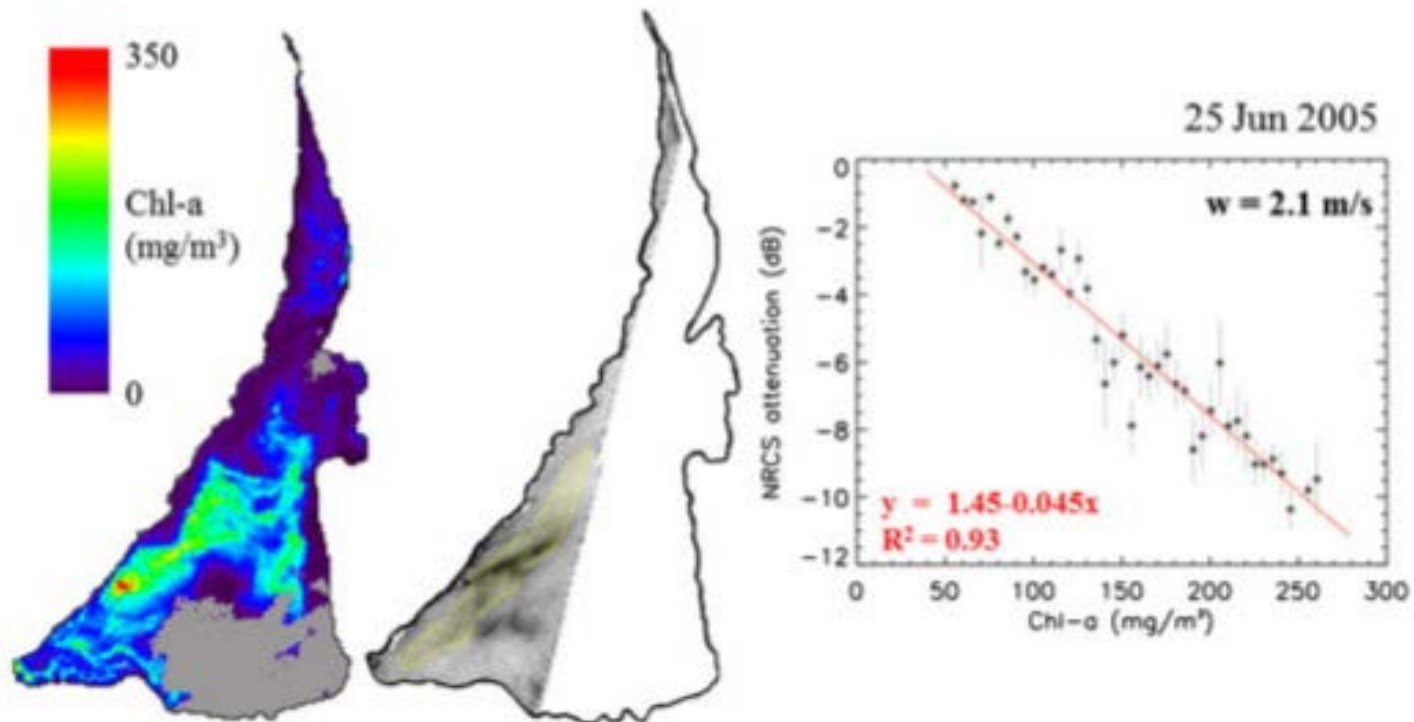
15:00-16:00: Discussion

16:00-16:45: Write-up of the

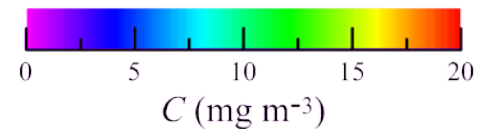
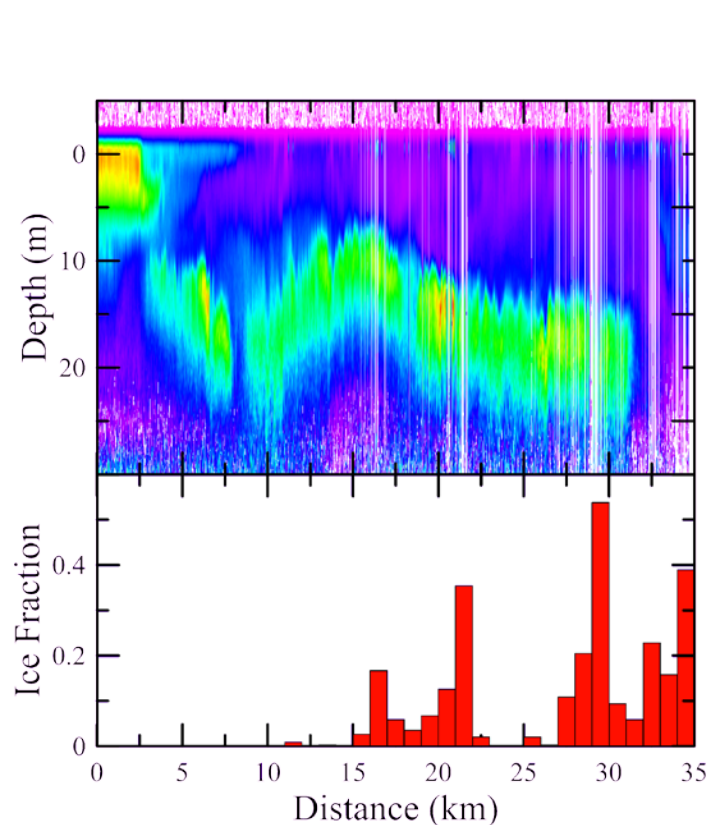
Synergistic use of MERIS and ASAR images to detect cyanobacteria and scum formation

→ SAR data used to flag areas affected by scums

→ SAR: additional tool to increase temporal coverage of OC sensors



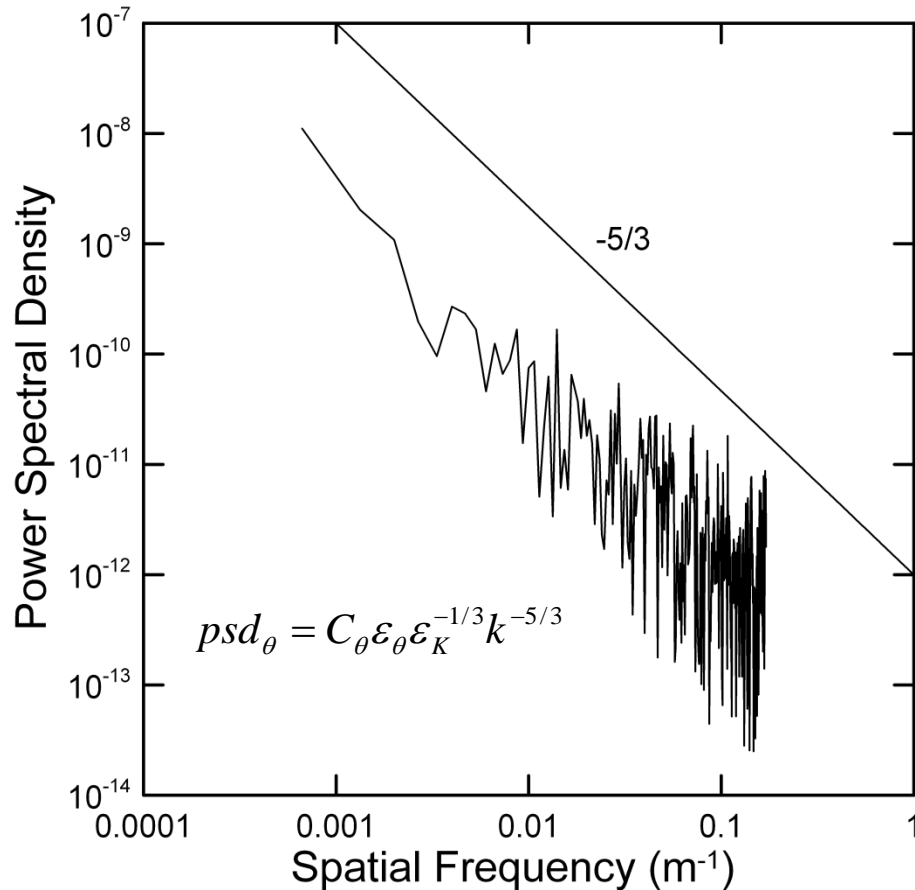
Example of airborne lidar: Plankton Layer in the Arctic



Chlorophyll concentration, C , is estimated from lidar using attenuation and backscatter in a bio-optical model.

Ice fraction from lidar is fraction of lidar shots with ice in 1 km segment of flight track.

Turbulence Measurements

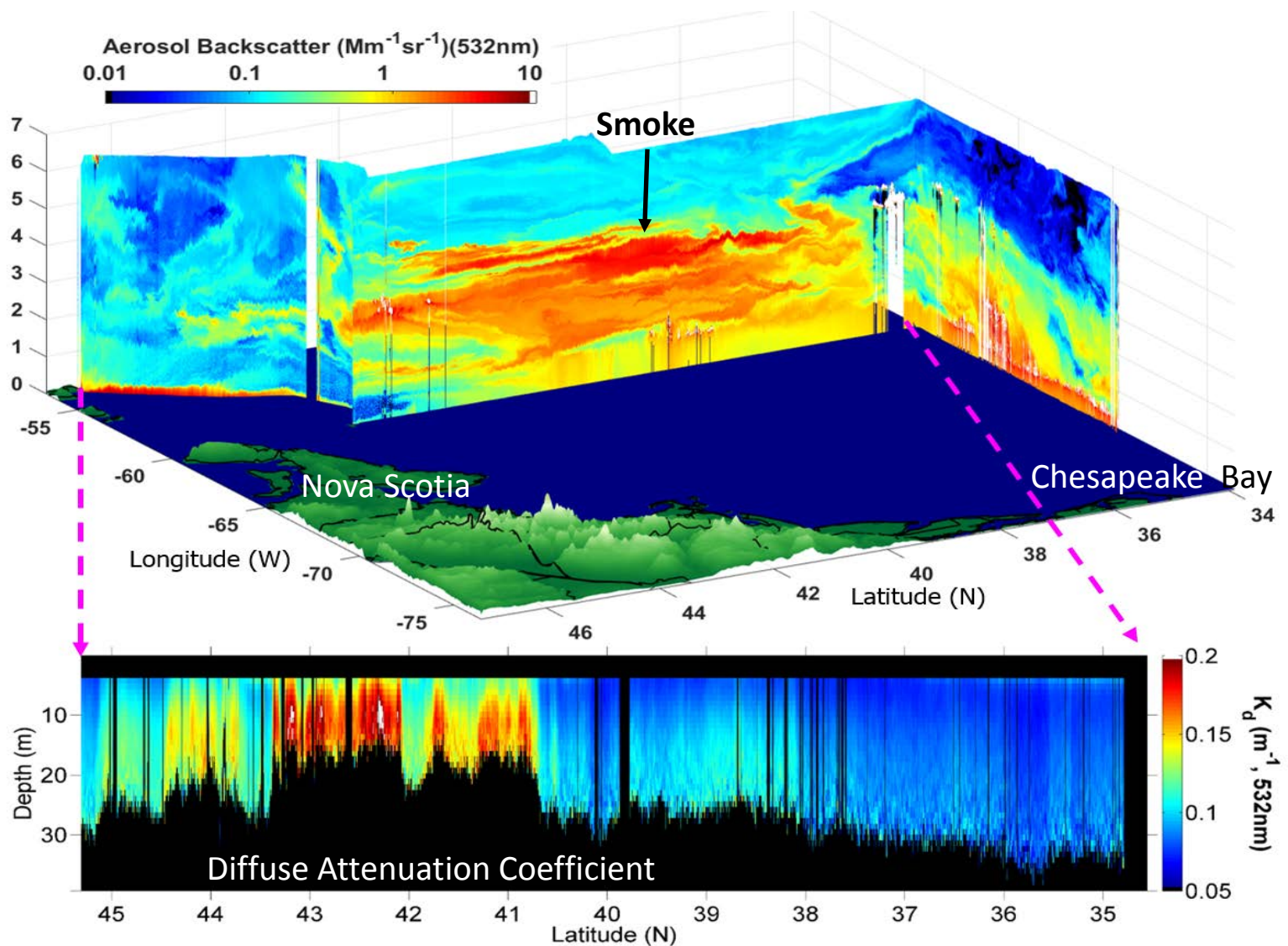


Stratified Turbulence

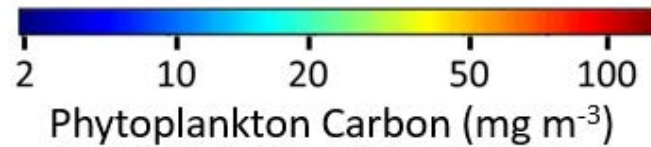
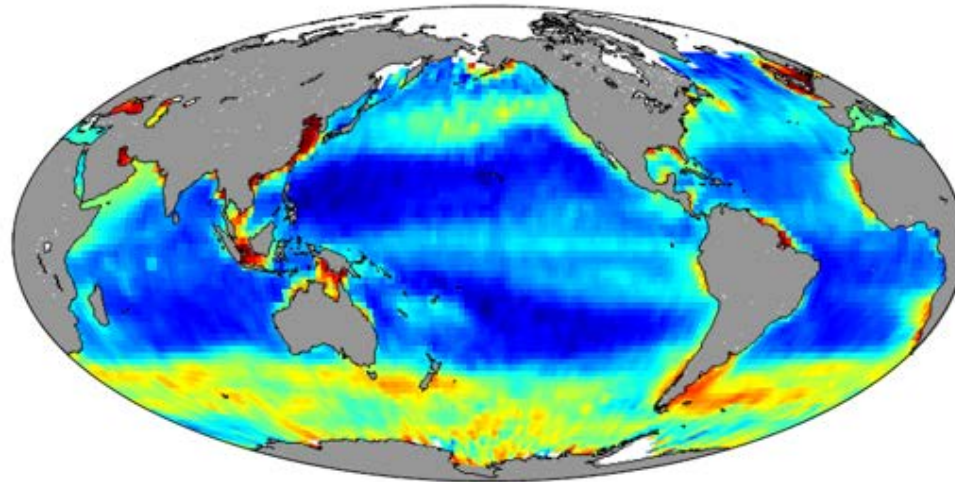
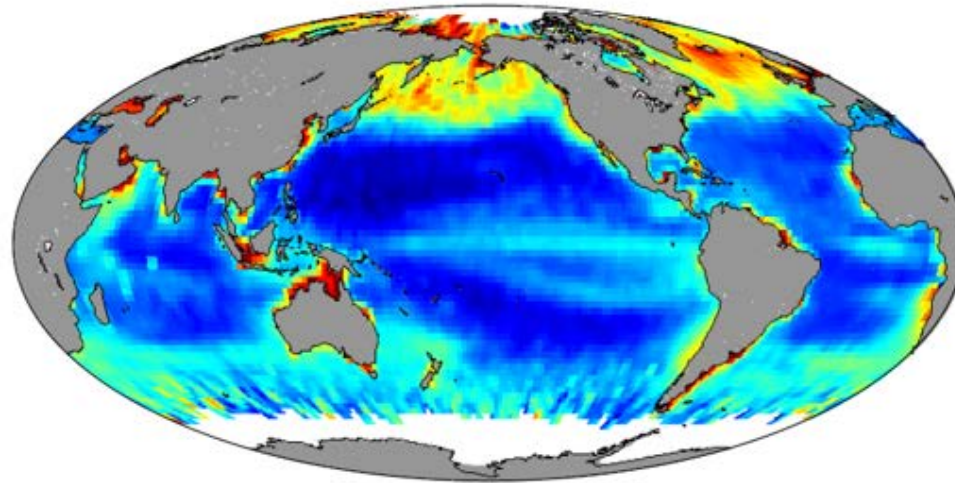
Horizontal power spectrum of optical-scattering fluctuations at center of layer follows a $-5/3$ power law, even though turbulence is not isotropic. (Lindborg)

Level of spectrum depends on horizontal dissipation rate since plankton are passive additives. Only solved for

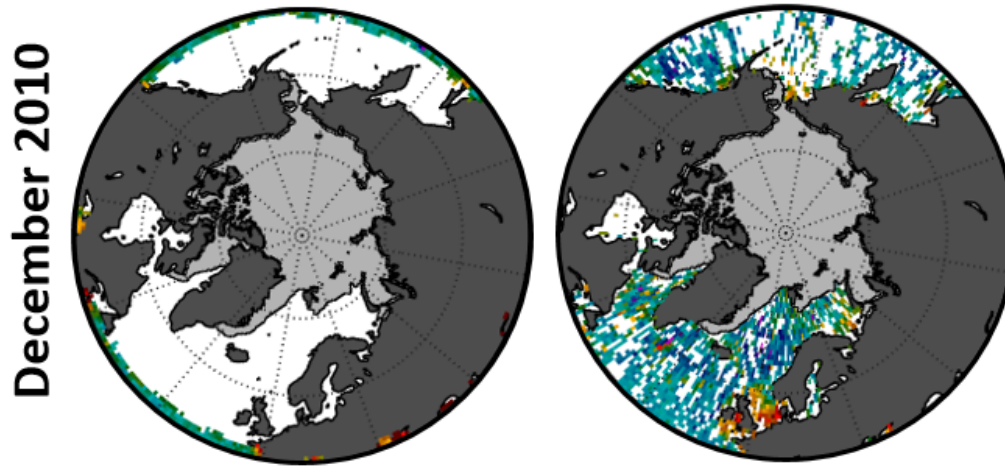
Improved retrievals with advanced technology



Global retrievals demonstrated with CAL

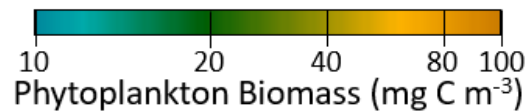
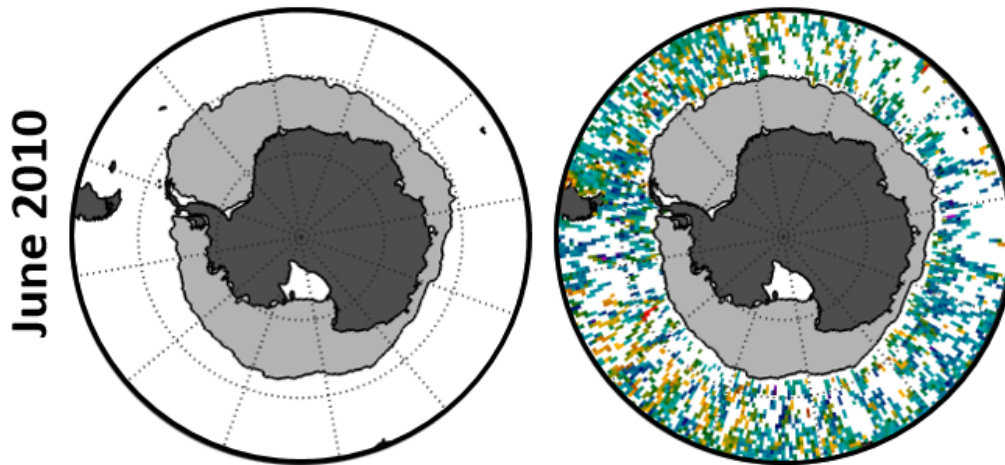


Lidar particularly critical in polar



MODIS biomass

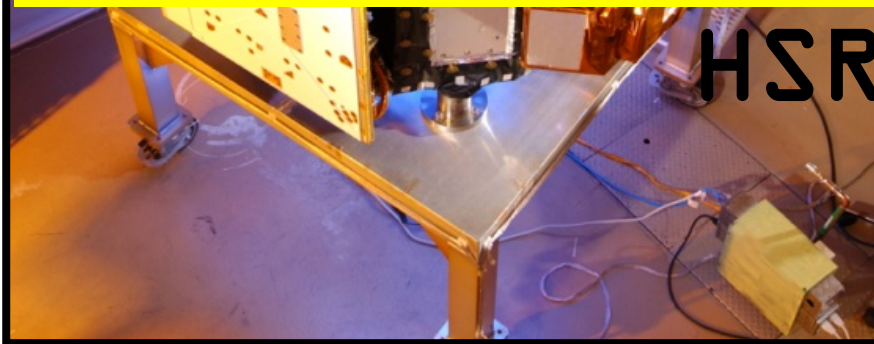
CALIOP biomass



'Proof-of-Concept'



We can do much more for
minor change to mission
cost (profiling, spectral



HSRL)



CZCS

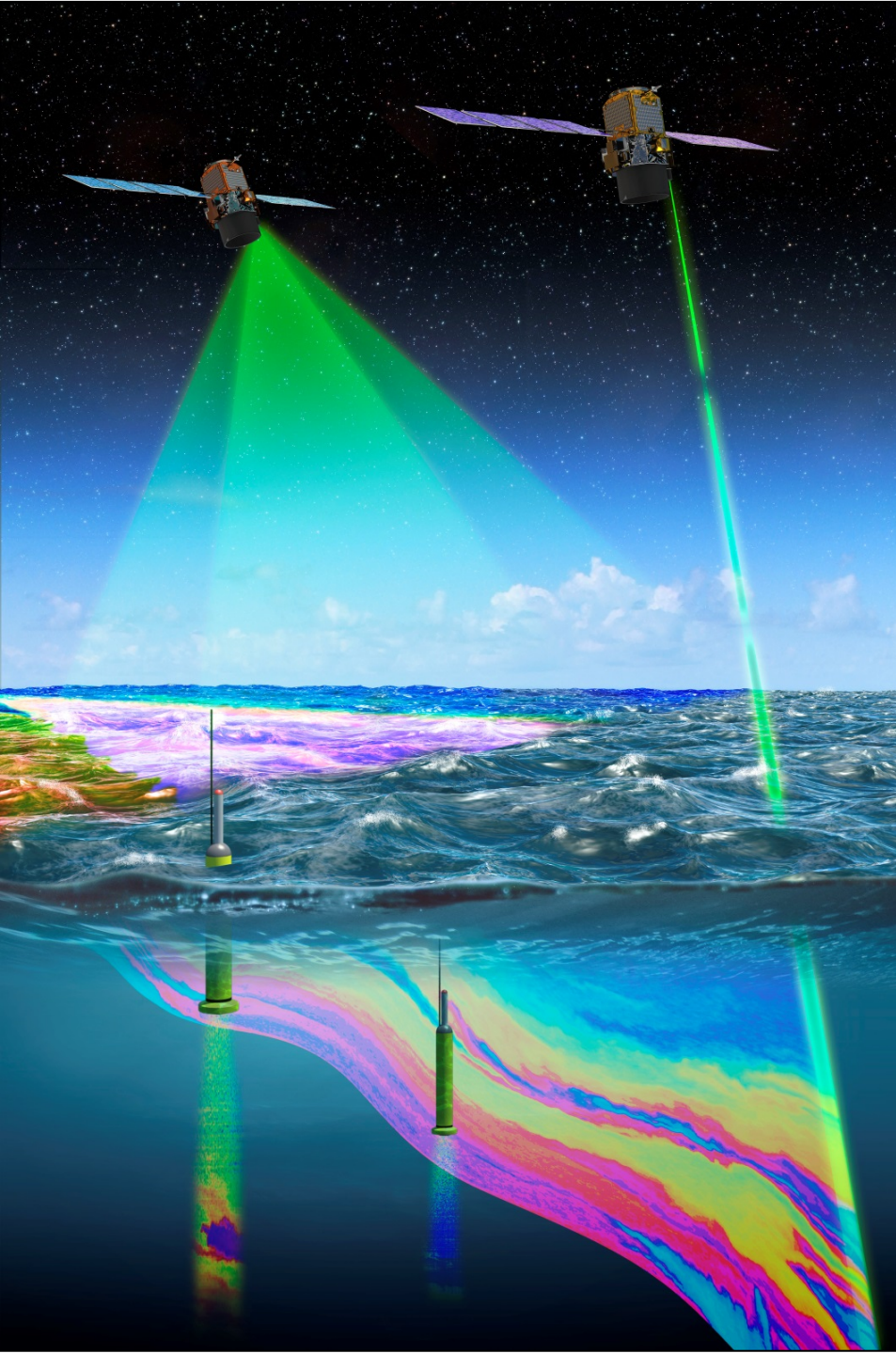
Discussions/Recommendation

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- 35 participants
- Strong support of the community for oceanic profiling lidar
- Recognition diverse benefits of oceanic profiling lidar → new era
- **Tools developments:**
 - Simulation of passive/active data (modelling statistical analysis, ..)
 - Data distribution/users friendly format
 - Develop user community
- **Needed investments:**
 - Near-future lidar mission, e.g. MESCAL
 - Airborne prototype instruments
 - Next-generation satellite technology, e.g. Blue lasers
- **Investigations:**
 - beam C retrieval
 - Separation of CDOM from pigment absorption
 - Particle size distribution
 - Others

Recommendations

- Future space-borne lidar MESCAL (NASA/CNES):
 - Enthusiasm for the mission
 - HRSL very valuable
 - “Enhanced” scenario most interesting for new science
 - YES for a lidar at 355 and 532 nm → much new science
 - 3-m vertical resolution will be great



Enabling a 3-dimensional reconstruction of global ocean ecosystems by combining strengths of different approaches

- Optimized ocean-atmosphere lidar
- Advanced ocean color sensor
- Scanning Polarimeter
- Bio-Geo-Argo global array

Achievable in near future (PACE)