



University of
Zurich^{UZH}

Department of Geography



Fernerkundung von Inlandgewässern Ein Einblick von oben

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Infotag 2016: Seenforschung – aktuelle Einblicke in ein bedeutendes Ökosystem
6. September 2016; 15.15 – 15.35



Inhalt

1) Wie viele Seen gibt es weltweit?

Wo sind sie gelegen?

Wie gross sind diese Seen?

Wie häufig kommen sie vor?

2) Globale Limnologie

Können die Funktionen, Strukturen sowie Stoff- und Energiehaushalte von Seen global gemessen werden?



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Wie viele Seen gibt es weltweit?



Essential Climate Variable: Lakes



NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



Formerly the National Climatic Data Center (NCDC)... [more about NCEI](#) »

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GOSIC

[About the GOSIC](#)

[The Global Climate Observing System \(GCOS\)](#)

[The Global Ocean Observing System \(GOOS\)](#)

[The Global Terrestrial Observing System \(GTOS\)](#)

[GCOS Essential Climate Variables \(ECV\) Data Access Matrix](#)

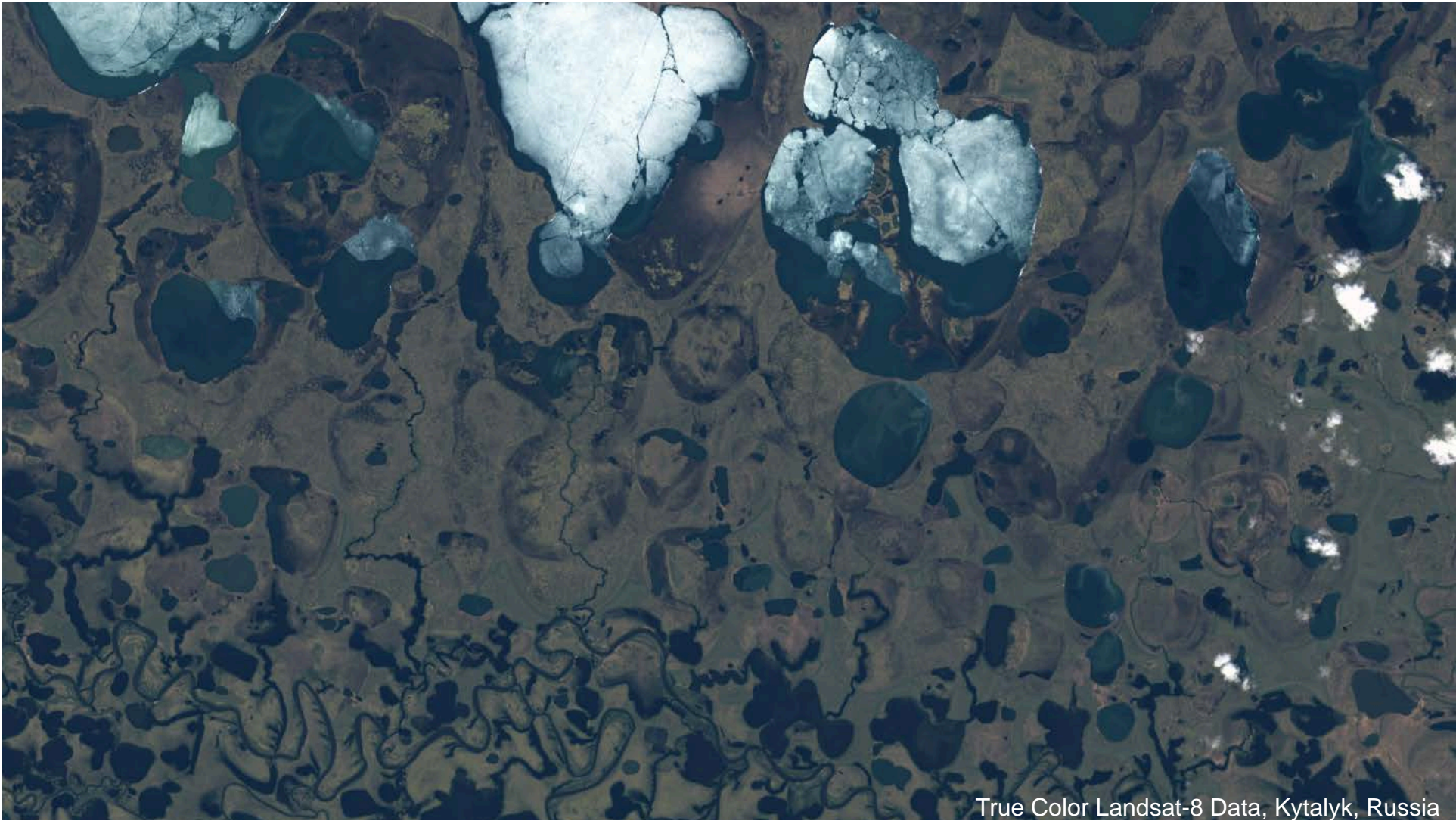
GCOS Terrestrial ECV - Lakes

Surface water storage occurs in lakes, reservoirs (and also wetland areas) for water in its liquid phase. The volume of water in a surface storage unit at any one time is an integrator variable, reflecting both atmospheric (precipitation, evaporation-energy) and hydrologic (surface water recharge, discharge and ground water tables) conditions. Depending on the storage capacity of a reservoir, it may primarily reflect human control. However, if lakes and wetland areas are not being affected by excessive withdrawal, they are strongly driven by extant climate conditions and are important for assessing net climate effects over time. If climate change is leading to a hotter and drier mode, then lakes and wetlands should reflect this promptly. Internally draining lakes such as Aral or Tchad Lake or the Okavango basin are especially important.

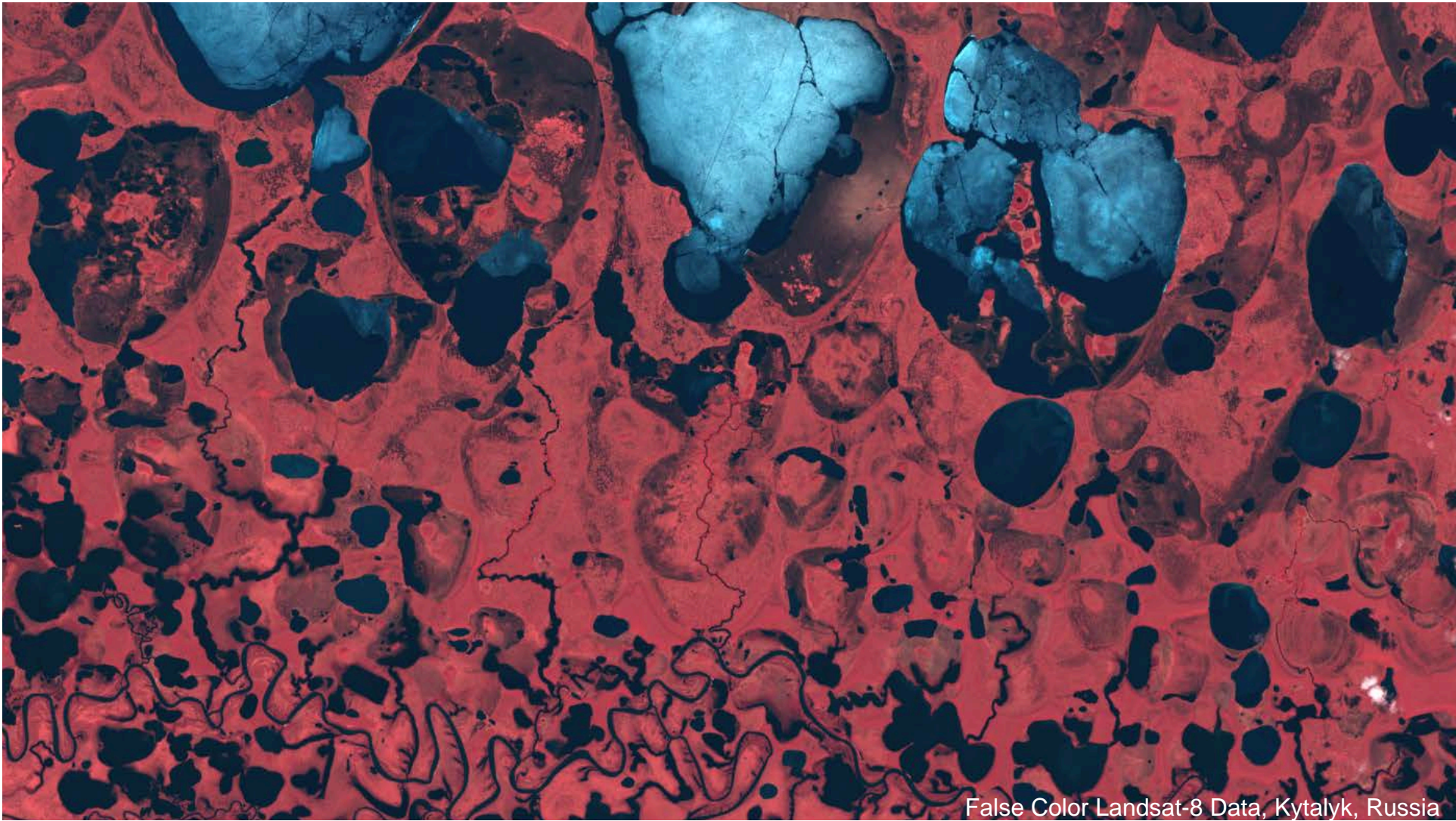


Kytalyk Naturresevat (Yakutia, Russland)





True Color Landsat-8 Data, Kytalyk, Russia



False Color Landsat-8 Data, Kytalyk, Russia



SenseFly eBee Data, Kytalyk, Russia; G. Schaepman



Juzsak, I., Iturrate-Garcia, M., Gastellu-Etchegorry, J., Schaepman, M.E., Maximov, T.C., & Schaepman-Strub, G. (2016 (accepted)). Drivers of shortwave radiation fluxes in Arctic tundra across scales. *Remote*

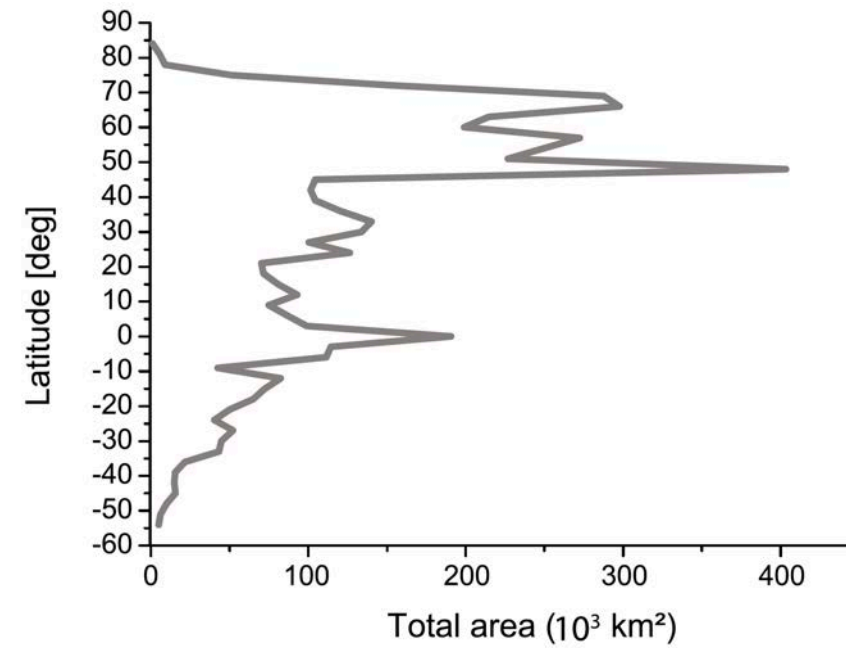
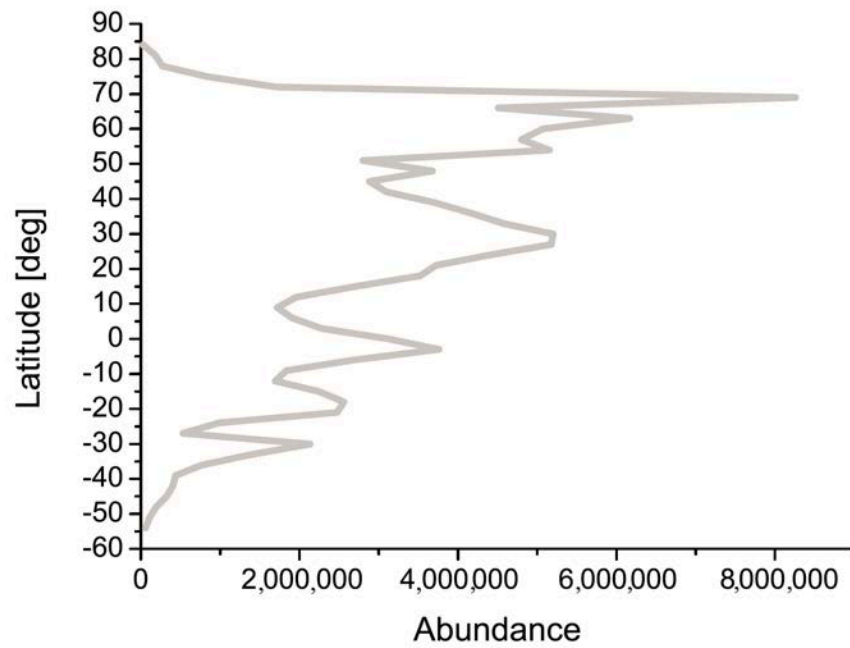
SenseFly eBee Data, Kytalyk, Russia; G. Schaepman

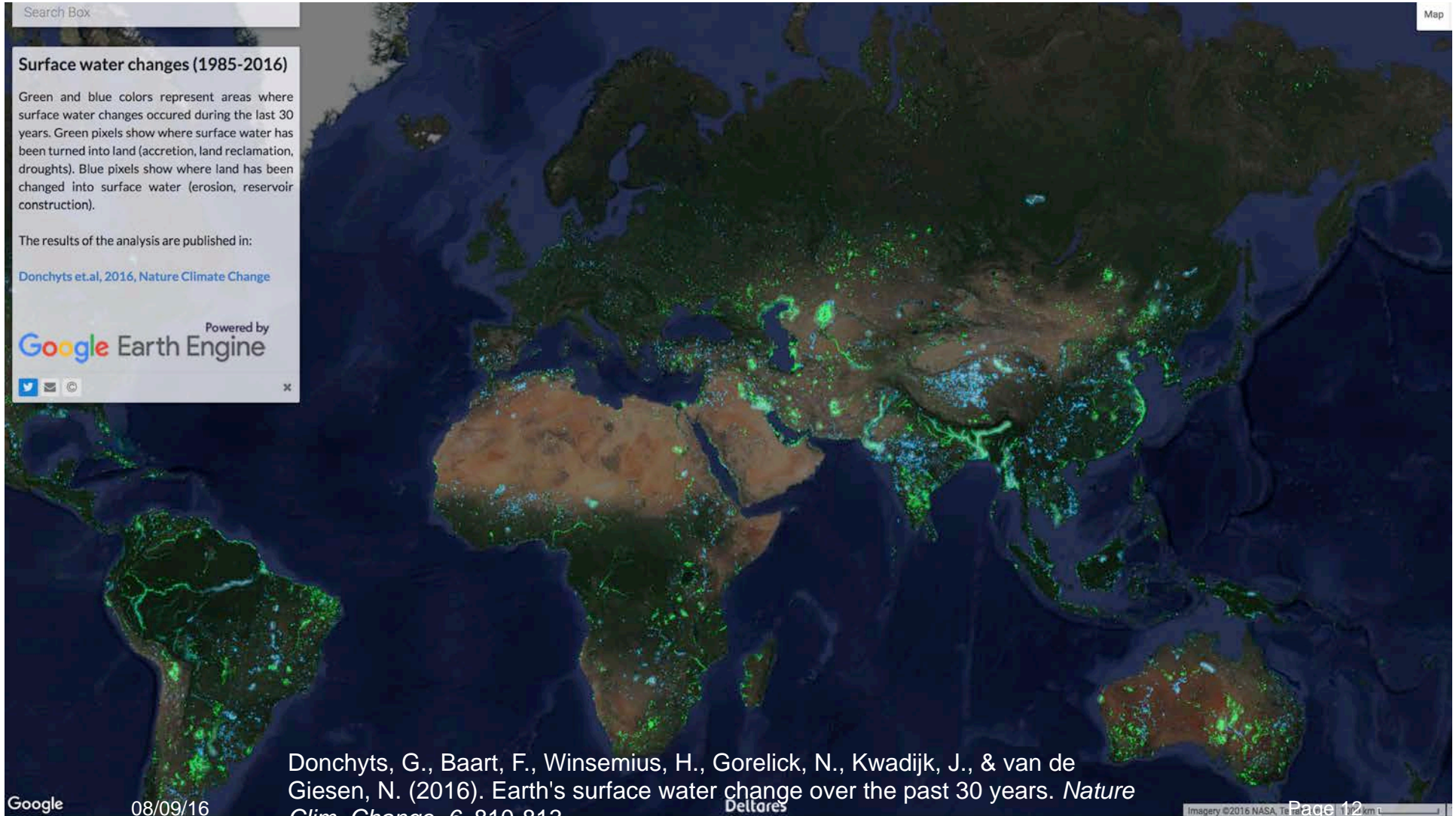


Kytalyk / Yakutia / Russia, Photo: M. Schaepman



Globale Inventur von Seen anhand von Satellitendaten







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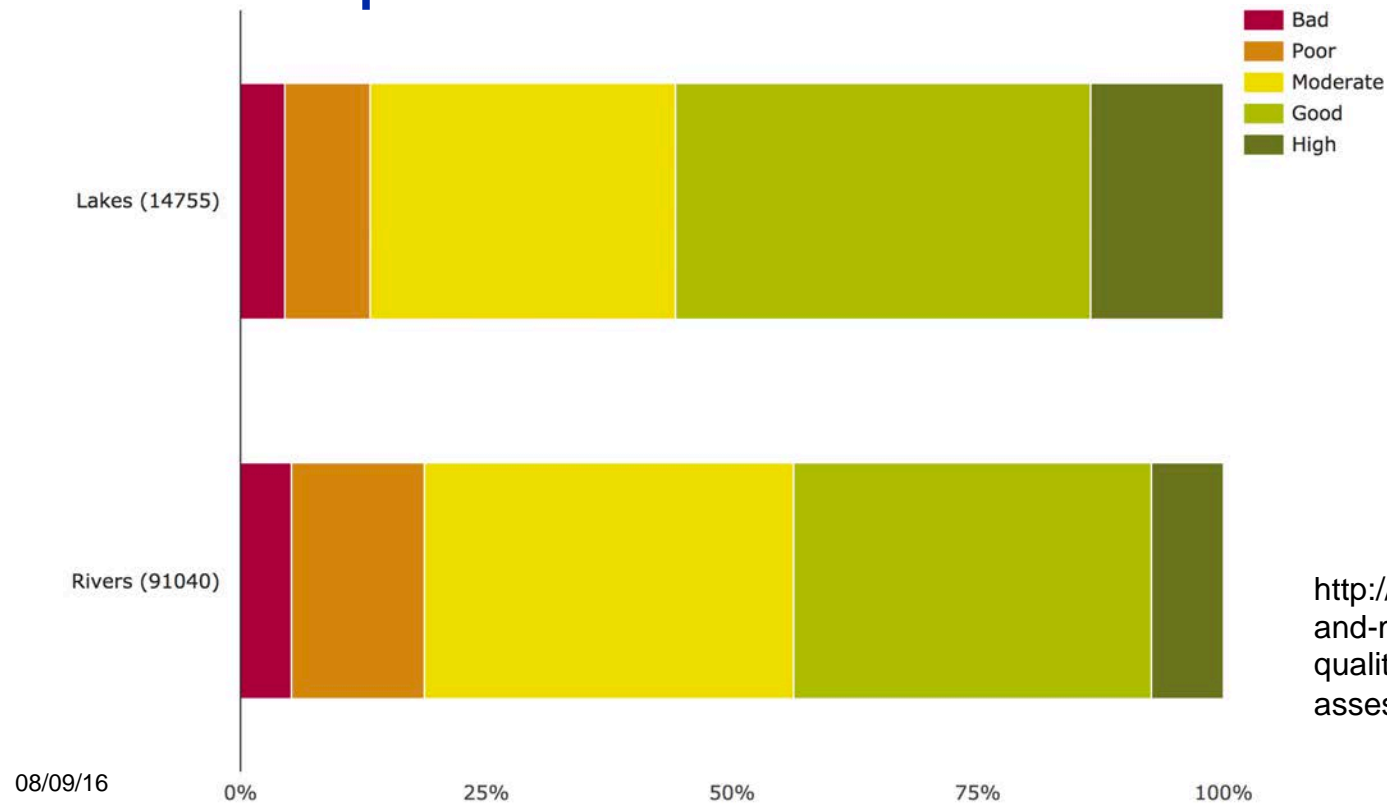
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2) Globale Limnologie



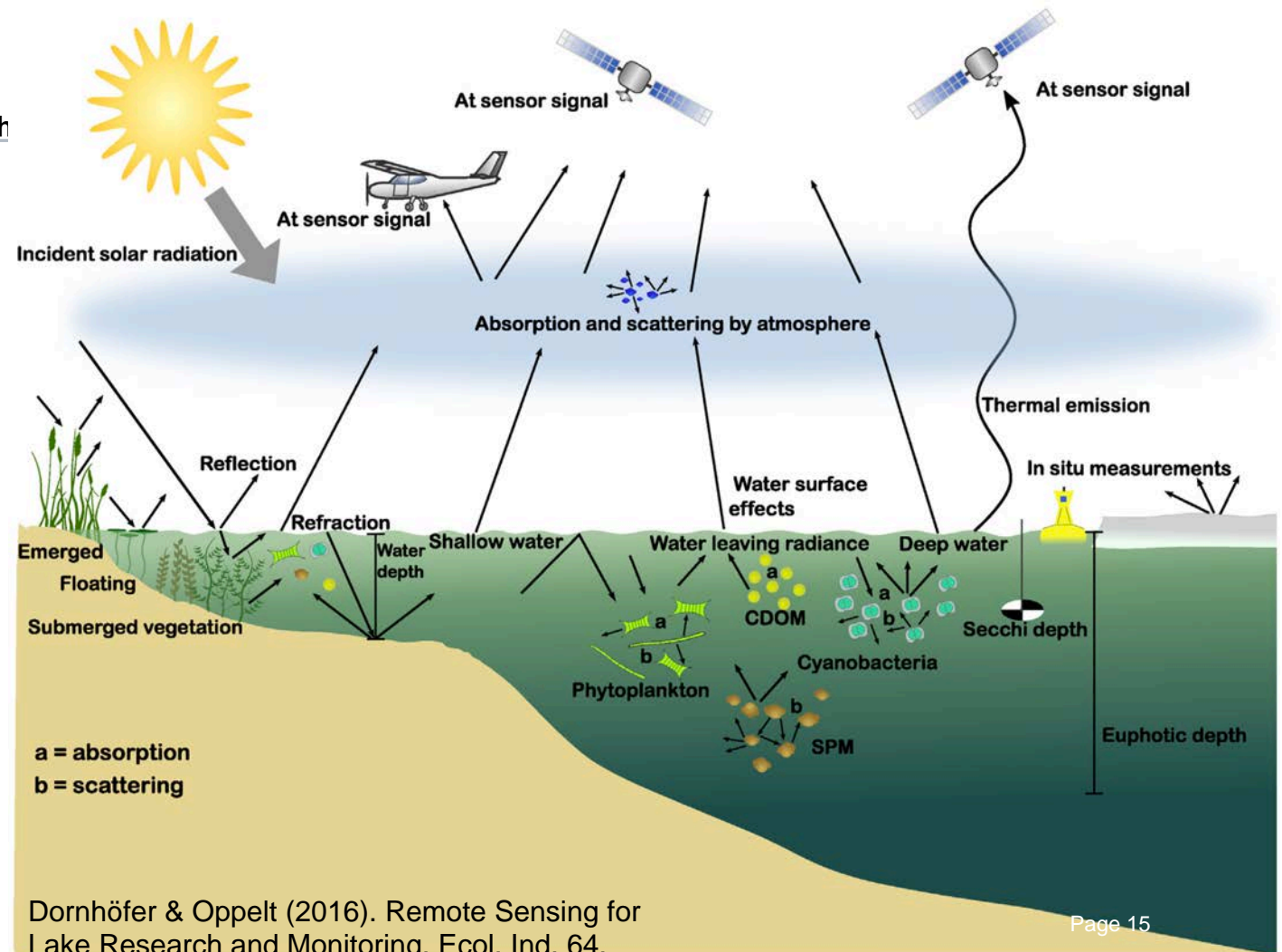
Zustand Europäischer Gewässer



<http://www.eea.europa.eu/data-and-maps/indicators/freshwater-quality/freshwater-quality-assessment-published-may-2>



Wechselwirkung von Licht mit Wasser





Abbildende Spektroskopie mittels APEX



Quantitative Messung
von > 20 biochemischen
physikalischen und
strukturellen Eigenschaf
der Erdoberfläche und
der Atmosphäre.

1'000 Pixel/Zeile
>500 Spektralkanäle/Pix
2 m räumliche Auflösung
max. 2'000 km²/Tag

(Beispiele: Fluoreszenz,
Chlorophyll a&b, weitere
Pigmente, Albedo, TSM,
DOM, NO_x, Wassergehalt
Aerosole, etc.)

Schaepman, M.E., Jehle, M., Hueni, A., D'Odorico, P., Damm, A., Weyermann, J., Schneider, F.D., Laurent, V., Popp, C., Seidel, F.C., Lenhard, K., Gege, P., Küchler, C., Brazile, J., Kohler, P., De Vos, L., Meuleman, K., Meynart, R., Schläpfer, D., Kneubühler, M., & Itten, K.I. (2015). Advanced radiometry measurements and Earth science applications with the Airborne



Optische Eigenschaften von Wasser aus fernerkundlicher Sicht



08/09/16



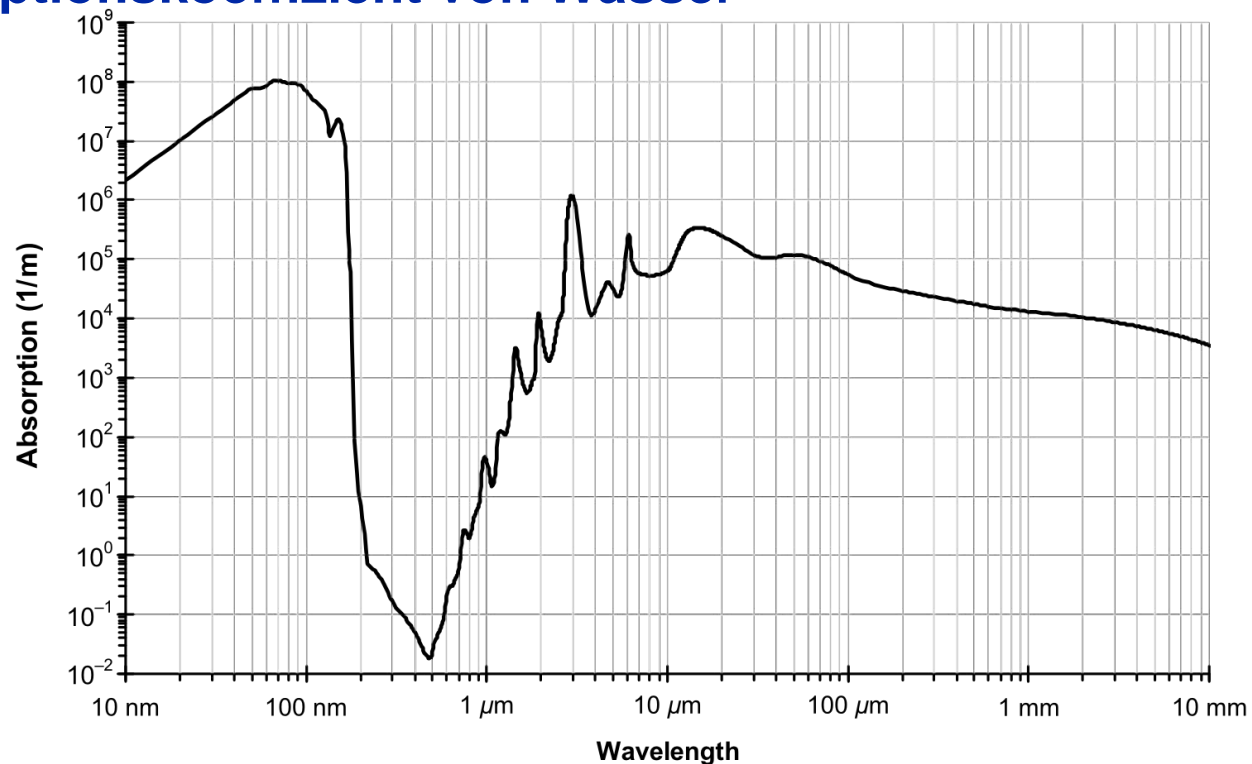
APEX & <http://earthobservatory.nasa.gov/IOTD/view.php?id=84333>



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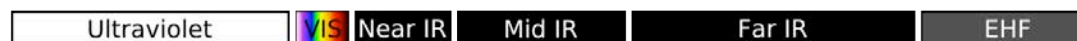


Absorptionskoeffizient von Wasser

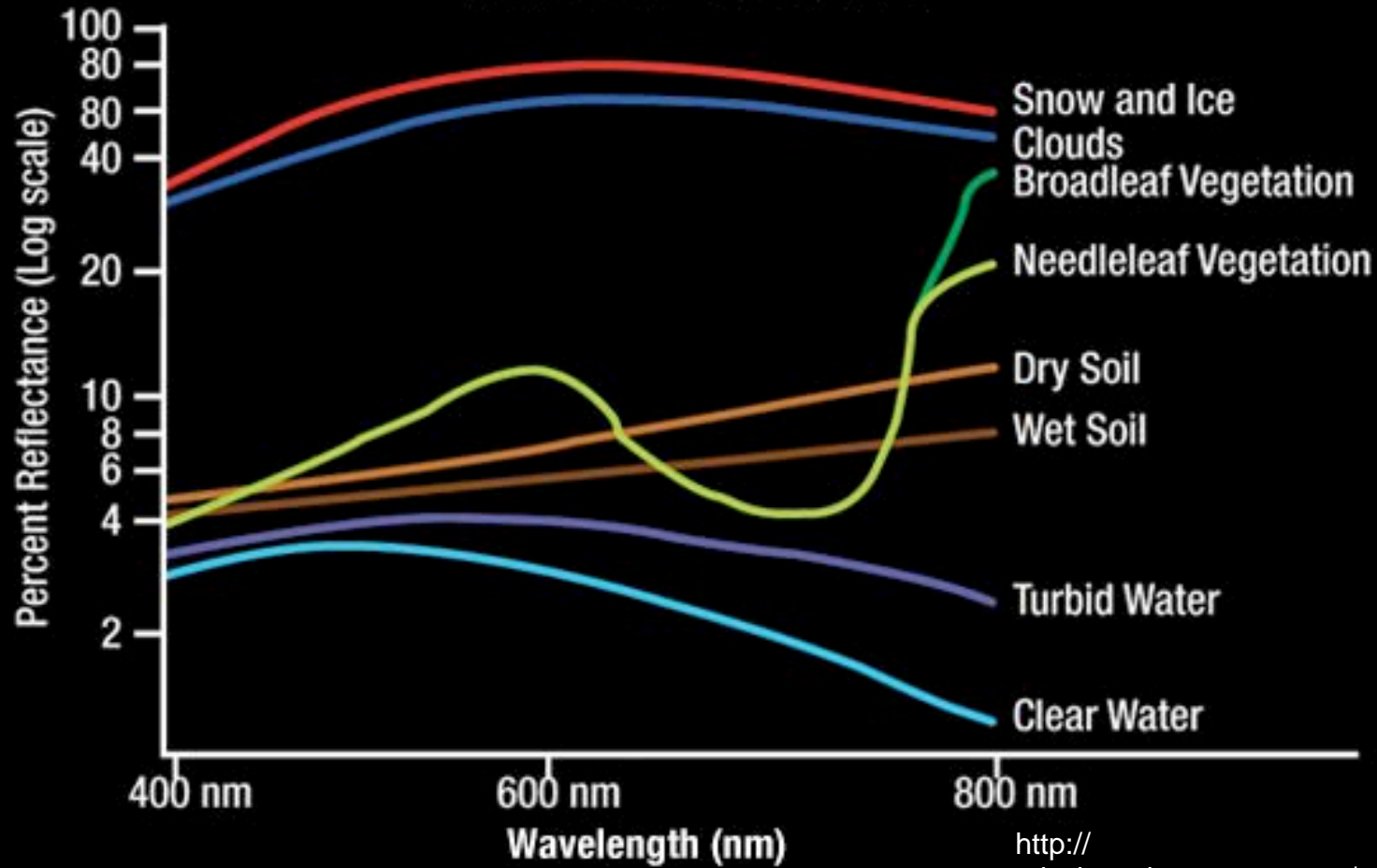


https://upload.wikimedia.org/wikipedia/commons/1/18/Absorption_spectrum_of_liquid_water.png

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SPECTRAL SIGNATURES OF EARTH FEATURES



Diversity II Products examples - Inland waters

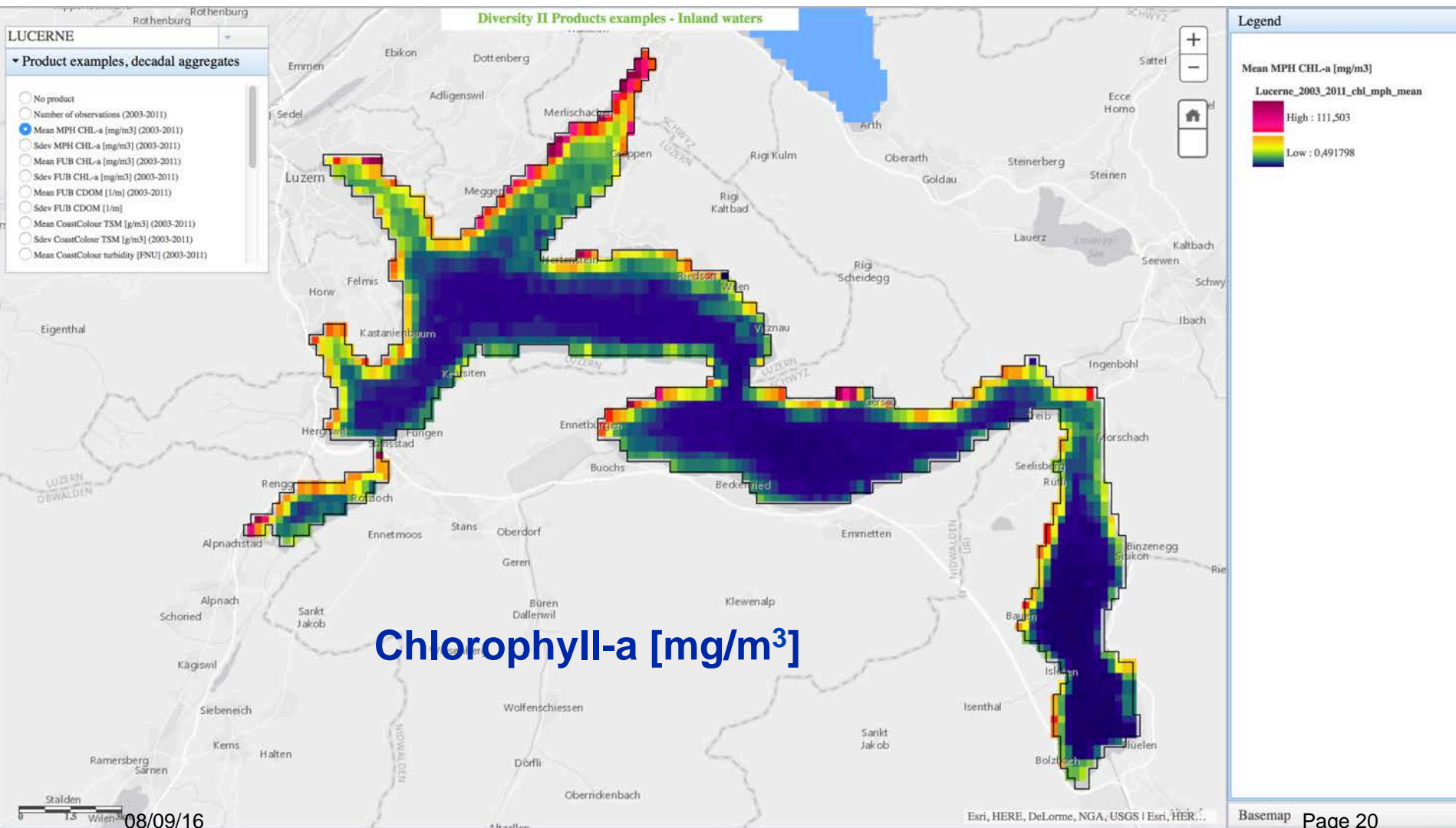
Legend

Mean MPH CHL-a [mg/m3]

Lucerne_2003_2011_chl_mph_mean

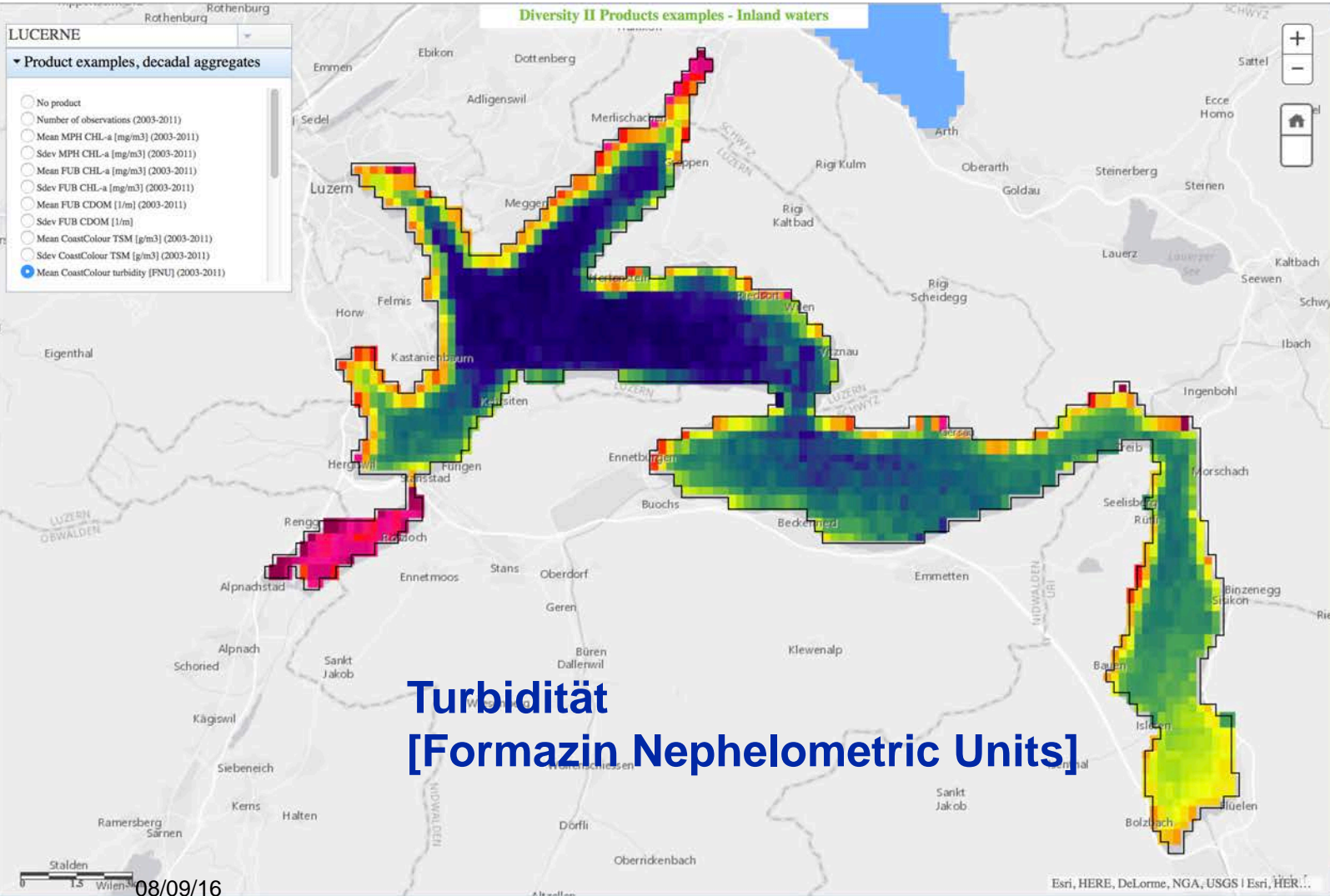
High : 111,503

Low : 0,491798



Diversity II Products examples - Inland waters

- LUCERNE
- ▼ Product examples, decadal aggregates
- No product
 - Number of observations (2003-2011)
 - Mean MPH CHL-a [mg/m3] (2003-2011)
 - Sdev MPH CHL-a [mg/m3] (2003-2011)
 - Mean FUB CHL-a [mg/m3] (2003-2011)
 - Sdev FUB CHL-a [mg/m3] (2003-2011)
 - Mean FUB CDOM [1/m] (2003-2011)
 - Sdev FUB CDOM [1/m]
 - Mean CoastColour TSM [g/m3] (2003-2011)
 - Sdev CoastColour TSM [g/m3] (2003-2011)
 - Mean CoastColour turbidity [FNU] (2003-2011)



Legend

Mean CoastColour turbidity [FNU]

Lucerne_2003_2011_turb_cc_mean

High : 5,63462

Low : 0,839371

Turbidität
[Formazin Nephelometric Units]

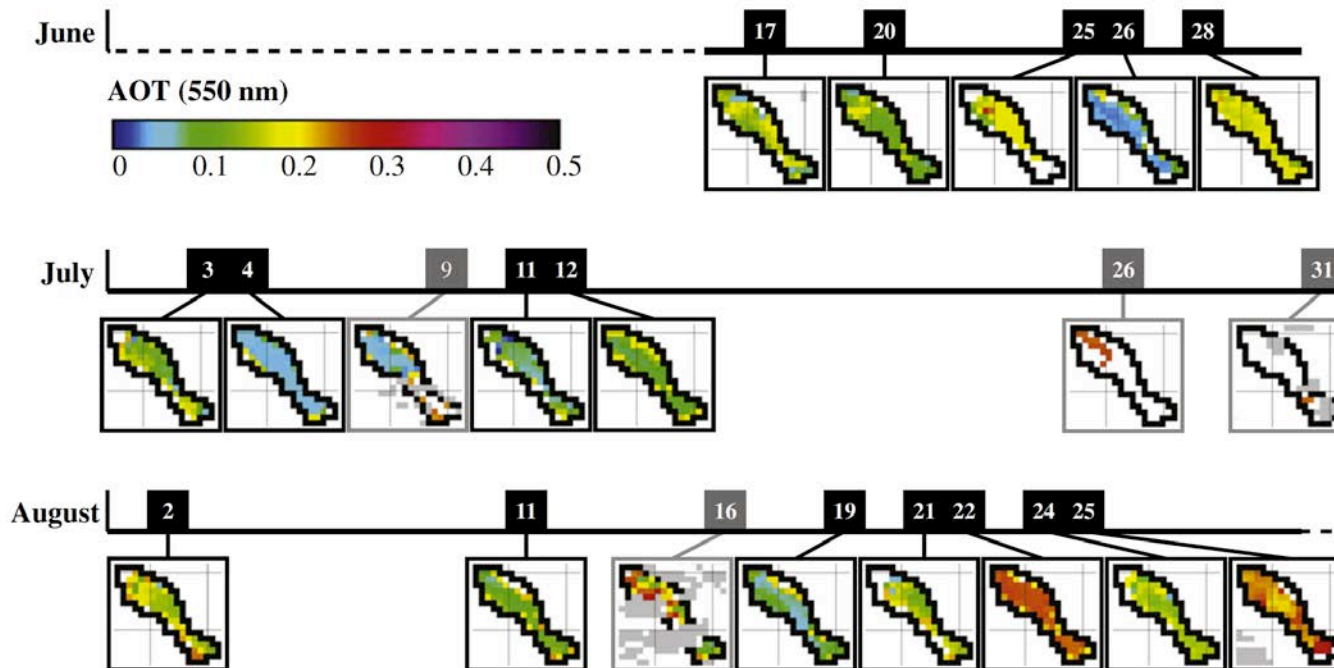


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Esri, HERE, DeLorme, NGA, USGS | Esri, HER...



Aerosol Optische Dichte von 20 Satellitenaufnahmen





Zusammenfassung

Globale Erfassung sowie Monitoring von Seen gelingt mit hochauflösenden Satelliten sowie mittels langer Zeitreihen.

Erste Datenbanken versprechen ein zeitlich dynamisches Inventar – dennoch sind v.a. Seen $>55^{\circ}\text{N}$ und $<55^{\circ}\text{S}$ noch schlecht dokumentiert.

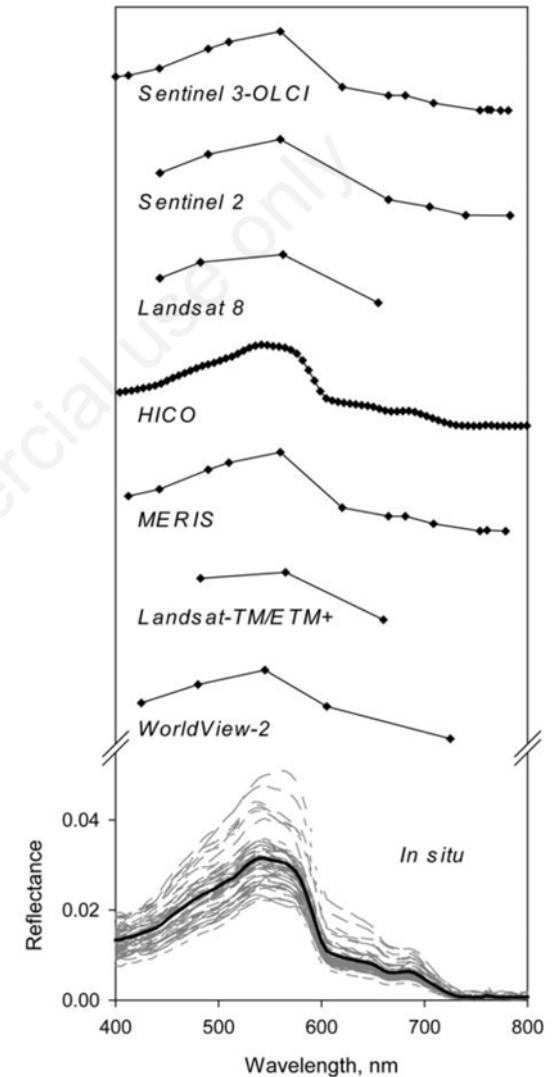
Ausgewählte (v.a. grosse Seen) werden zunehmend mittels einer globalen Limnologie erfasst.

Vergleich von Funktionen und Stoffhaushalten sind – über Landesgrenzen hinaus – möglich.

Der Beitrag der Fernerkundung zur globalen Erfassung von Flüssen steht noch offen (Turbidität, geringe optische Säule, etc.).

08/09/16

Giardino et al., Optical Remote Sensing of Lakes: an overview of Lago Maggiore. J. Limnol., 2014; 73(s1): 221-231





Besten Dank für Ihre Aufmerksamkeit!

