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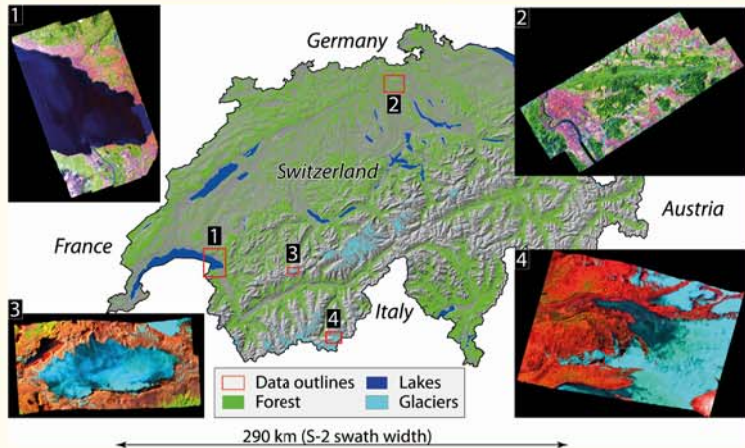
RSL — measurements | products | policy

Simulated Sentinel-2 Products: Quantification of Essential Climate Variables and associated parameters

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Motivation & Objectives

Motivation: The forthcoming **Sentinel-2** satellites will provide the underlying data for advanced remote sensing **products & services** tracking human-induced and climate related surface changes.

Objectives: In this study, we use simulated Sentinel-2 data based on airborne imaging spectroscopy acquisitions (APEX sensor) to characterize surface processes and states in the **cryosphere**, **hydrosphere** and **biosphere**. Based on established algorithms, we infer **Essential Climate Variables** and related variables for each sphere represented by *Lake Geneva* (1), *Lägeren* mountain forest (2), *Plaine Morte* (3) and *Findelen* Glacier (4).

Results & Outlook
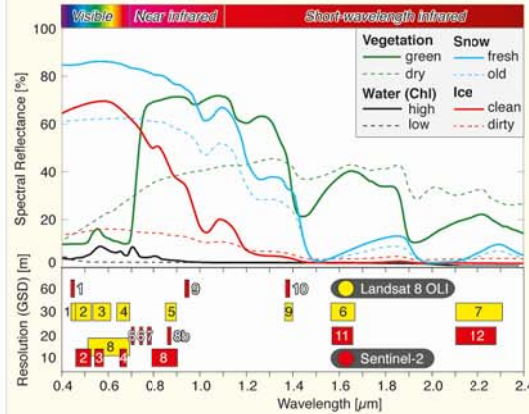
Results: The selected examples of derived ECVs and associated remote sensing products across different spheres underline the **unique potential of Sentinel-2** to deliver diverse remote sensing products on local to global scales in a high temporal resolution. The imagery further highlights the **advanced spatial and spectral resolution** of Sentinel-2 compared to Landsat-8, facilitating **novel monitoring products and services** with an increased accuracy.

Outlook: High-resolution multispectral sensors like Sentinel-2 and Landsat enable frequent and global monitoring of our environment and the generation of high-level operational products. These information will benefit **services in land management, agriculture, forestry, and hydrology** as well as disaster control and humanitarian relief operations. Furthermore, these products will help to develop effective adaptation strategies and counter measures for ongoing climate change and increasing pressure on biodiversity and ecosystem services. Data from Sentinel-2 will provide scientists, companies and decision makers with accurate, up-to-date and reliable information on the **state and change of our environment**.

Cryosphere
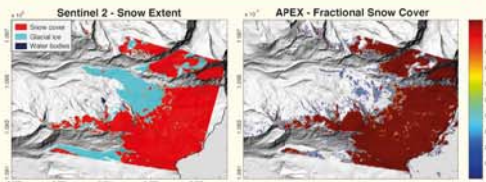
Snow extent: We determine snow cover based on the NDSI=(B3-B11)/(B3+B11) [*Dozier and Marks*, 1987] using a threshold of NDSI > 0.4. Distinction between snow, ice, water and shadows is based on the NDWI and segmentation of the bimodal reflectance distribution in VNIR range.
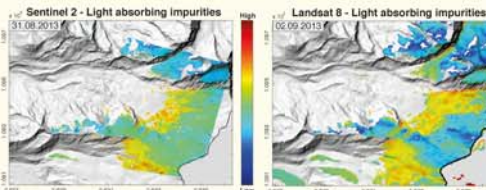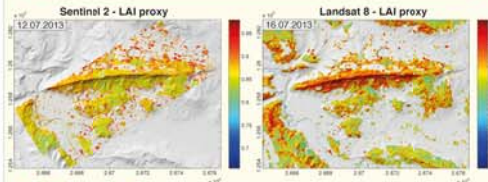

Light absorbing impurities in snow are identified using the contamination index [*Dozier* 1989] CI = (B2-B3) / (B2+B3).
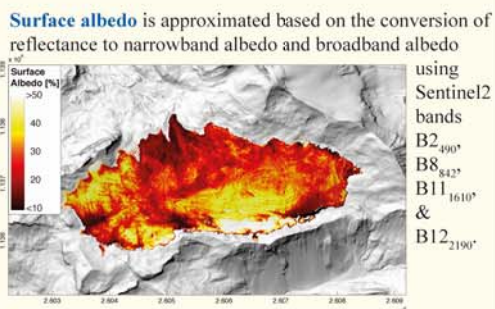
Surface albedo is approximated based on the conversion of reflectance to narrowband albedo and broadband albedo using Sentinel2 bands $B2_{490}$, $B8_{842}$, $B11_{1610}$ & $B12_{2190}$.
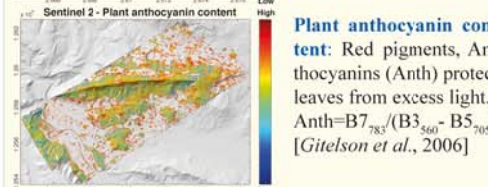

Biosphere

Leaf area index: The modified chlorophyll absorption ratio index (MCARI2) is less sensitive to chlorophyll content variations and linearly related to green LAI, which is used to estimate foliage cover and forecast crop growth and yield (*Haboudane et al.* 2004).
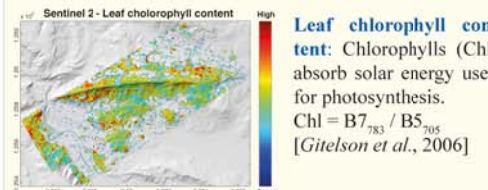
Leaf chlorophyll content: Chlorophylls (Chl) absorb solar energy used for photosynthesis.
$Chl = B7_{783} / B5_{705}$
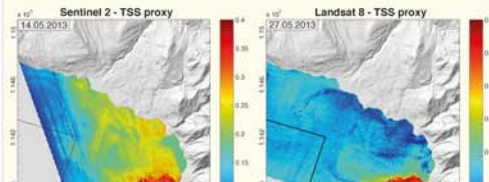[*Gitelson et al.*, 2006]
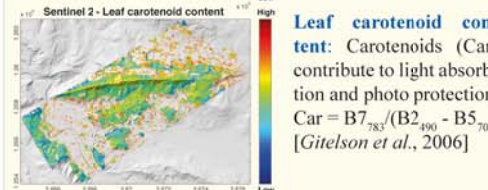
Leaf carotenoid content: Carotenoids (Car) contribute to light absorption and photo protection.
$Car = B7_{783}/(B2_{490} - B5_{705})$
[*Gitelson et al.*, 2006]

Plant anthocyanin content: Red pigments, Anthocyanins (Anth) protect leaves from excess light.
$Anth = B7_{783}/(B3_{560} - B5_{705})$
[*Gitelson et al.*, 2006]

Hydrosphere

Total suspended solids characterize the total mass of suspended particles per water volume, including organic and inorganic suspended matter. This parameter characterizes water quality and is related to primary production and sediment transport [*Matthews* 2011].
$TSS = (B3_{560} - B2_{490}) / (B3_{560} - B2_{490})$
[*Gittelson et al.*, 1993]
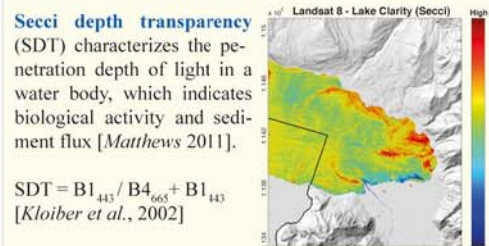
Secci depth transparency (SDT) characterizes the penetration depth of light in a water body, which indicates biological activity and sediment flux [*Matthews* 2011].
$SDT = B1_{443} / B4_{665} + B1_{443}$
[*Kloiber et al.*, 2002]

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