

# Prototyping MuSLI [Multi-Source Land Imaging](#) Canopy Chlorophyll Content for Assessment of Vegetation Function and Productivity

New NASA project 17-LCLUC17-0013 (2018-2020)

**Jana Albrechtova**, Petya Campbell,

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Charles University, Faculty of Science  
UMBC – NASA GSFC, USA

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## Prototyping MuSLI [Multi-Source Land Imaging](#) Canopy Chlorophyll Content for Assessment of Vegetation Function and Productivity

### Research Team:

PI: Dr. Petya Campbell, UMBC, NASA GSFC

### Co-Is:

CU: Jana Albrechtova,

UMBC: Karl Huemmrich,

NASA GSFC: Elizabeth Middleton, Christopher Neigh



### Collaborators:

#### U.S.:

1) **USDA, MD:** Dr. C. Daughtry and Dr. R. Hunt; and

2) **University of Nebraska, Mead, NE:** Drs. T. Arkebauer, J. Gamon, A. Gitelson, E. Walter-Shea.

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3) **Czech team:** Charles University, Global Change Research Institute (CzechGlobe)-  
Coordinated by J. Albrechtova

4) **Cyprus University of Technology:** Prof. Diofantos Hadjimitsis,  
Dr. Kyriacos Themistocleous and Dr. Athos Agapiou

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#### Overall Project Goal:

To use homogenized L-8 and S-2 (HLS) high-frequency time series to develop a new canopy Chlorophyll content product, and to assess the seasonal changes in land cover chlorophyll content and associated productivity for key agricultural crops, grasslands and forested ecosystems.

**To produce consistent medium resolution (30m) Chl product prototypes and robust algorithms that can reliably be scaled to regional and continental scales.**

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### Project Workflow:

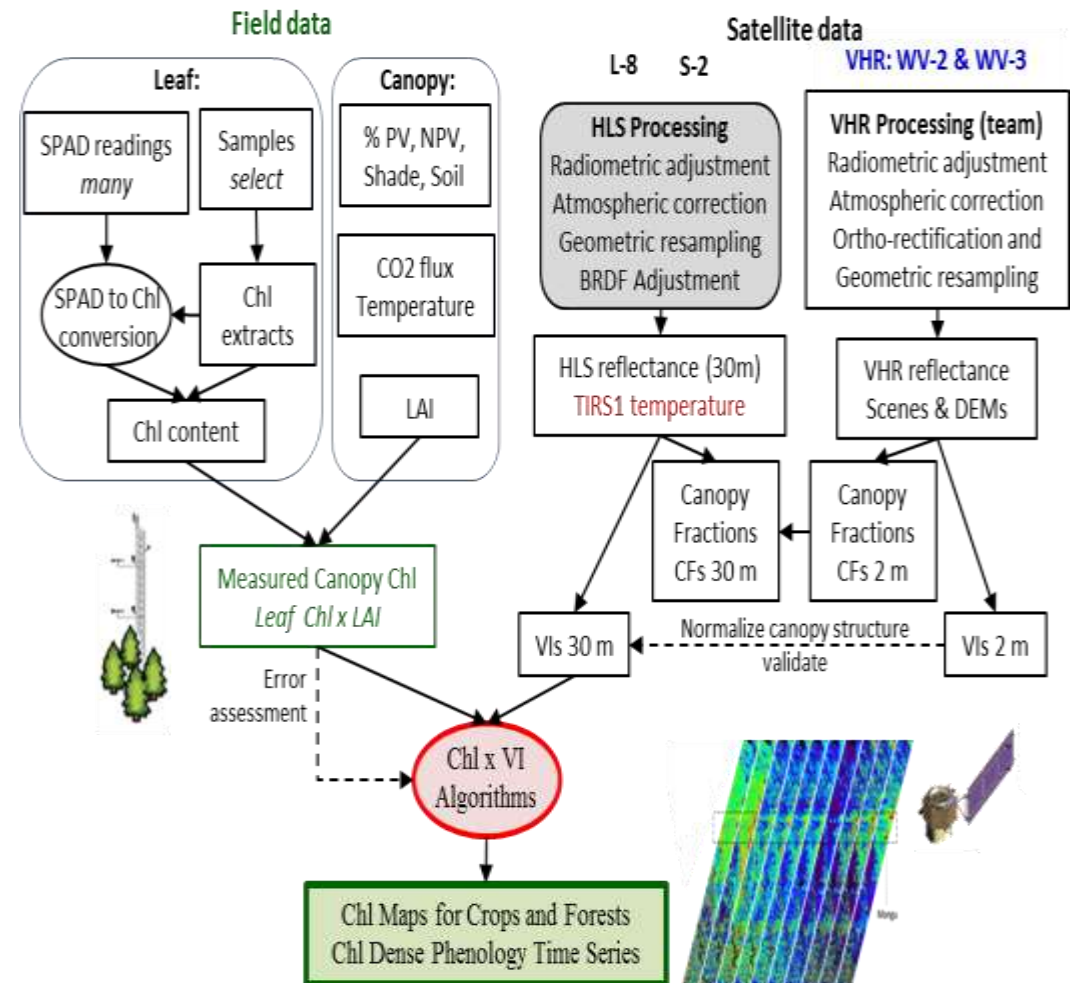


Figure 2: Technical approach and project workflow.

### Study areas – sites and network association:

**Table 2:** Study areas (sites) and network association.

	Study area	Vegetation cover type(s)	Network
1	USDA, MD, USA - OPE3 & Choptank, GB	Maize and Soybean	2 flux towers, LTAR <sup>2</sup>
2	SERC, MD, USA	Mixed hardwood forest	Smithsonian, NEON <sup>3</sup>
3	Mead, NE, USA: Ne2 and Ne3	Maize-soybean rotation	Fluxnet <sup>1</sup> , SpecNet <sup>4</sup>
4	Duke Forest NC, USA	Mixed hardwood forest	Fluxnet, SpecNet
5	Spruce forest (10 sites, Tab. 3), including acid rain decline	Norway spruce forest (evergreen conifers)	Forest study sites – survey BK - Fluxnet, CzechCOS/ICOS <sup>5</sup>

<sup>1</sup> Fluxnet, [http://fluxnet.ornl.gov/site\\_list](http://fluxnet.ornl.gov/site_list); <sup>2</sup> Long Term Agricultural Research (LTAR); <sup>3</sup> National Ecological Observatory Network (NEON); <sup>4</sup> SpecNet, <http://specnet.info>; <sup>5</sup> CzechGlobe, <http://www.czechglobe.cz/en/home>

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*GACR project: New spectral insight into biogeochemistry of small forested watersheds (2017-2019)*

### Main project objective:

To apply modern remote and proximal sensing techniques (satellite and airborne imaging spectroscopy, airborne laser scanning and laboratory spectroscopy) for spatio-temporal analysis of air pollution and biogeochemical cycles in small forested watersheds across the Czech Republic

### network of small forested watersheds GEOMON

Czech geo. survey:  
since 1994 precipitation,  
throughfall and hydrology  
monitoring (monthly)

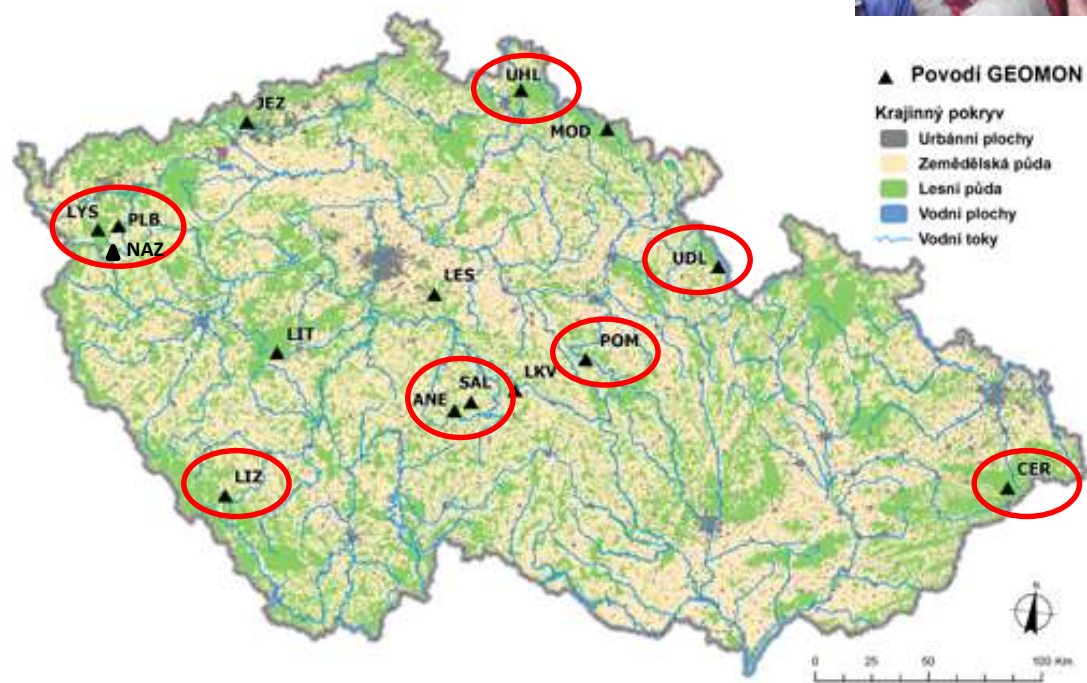
GA CR project (17-05743S 2017-2019)

### Project partners:

Czech Globe – PI L. Homolová

Charles University- Co-I **Z. Lhotakova**

Czech Geological Survey – Co-I V. Kopačková



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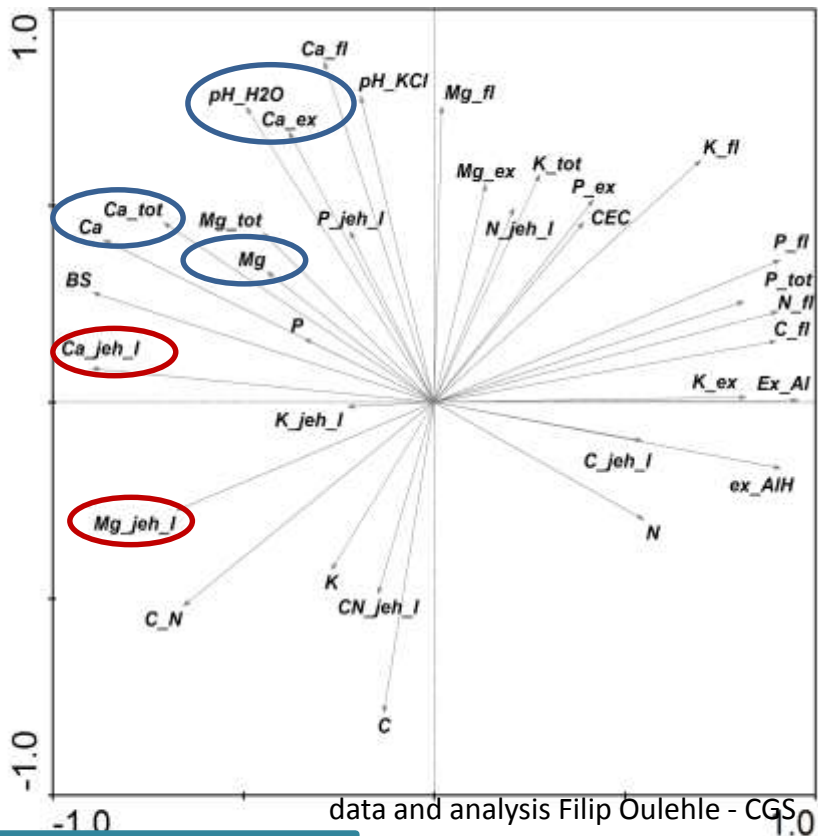
PCA: current year needle chemistry and soil chemistry (previous needle and soil chemistry data)

Correlation:  
Ca and Mg concentration in FH soil horizon and Ca and Mg needle content

Search for suitable indicators of soil chemistry in needle spectra



Mg – chlorophyll content  
Ca – cell wall components (cellulose) content?  
 $\Delta$  Mg (chlorophyll) in C and C+1 needles – indicator of Mg reutilization



tree / forest physiological status spectral indicators

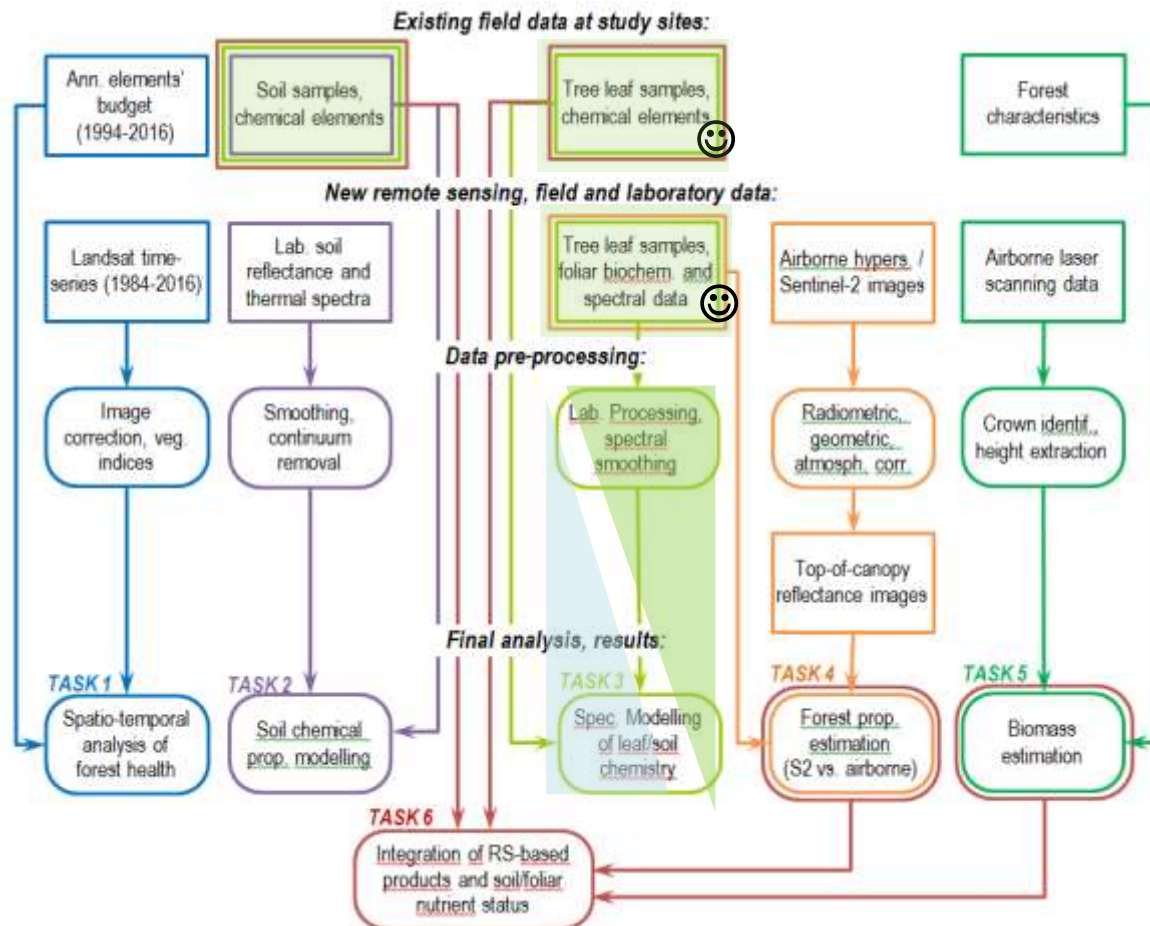


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### Project Data and Methodology Flowchart



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### TUNDRA Research 2018

#### 1 Czech site: Tundra in KRNAP

-southernmost relict area of the arctic-alpine tundra in Europe

Team:

Kupková, Potůčková, Červená - KAGIK

Albrechtová, Lhotáková - KEBR

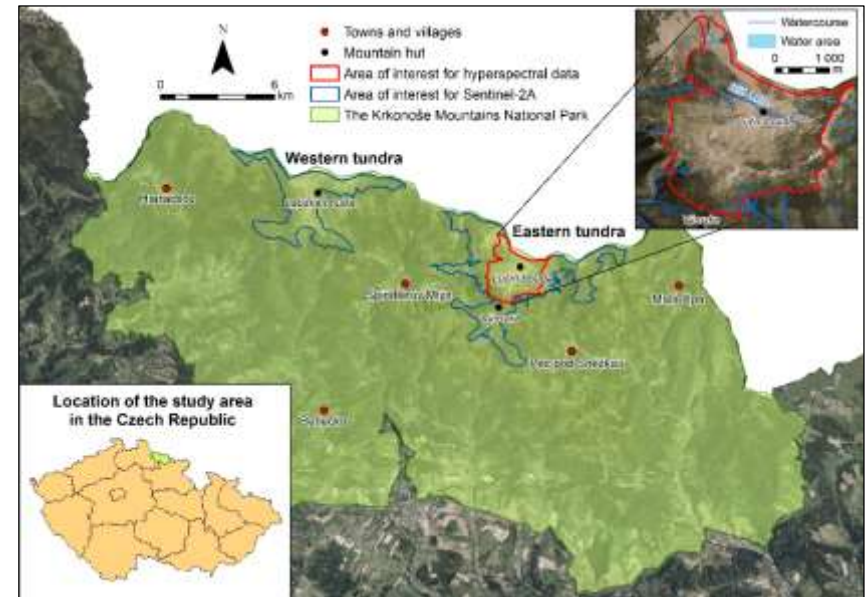
Field campaigns 2018: June, July, August – annual phenological changes

Collaboration with:

**Petya Campbell, UMBC, NASA GSFC, USA**

**Howard Epstein, University of Virginia, USA**

**John Gamon, University of Nebraska., USA**



Kupková, L., Červená, L., Suchá, R., Jakešová, L., Zagajewski, B., Březina, S. and Albrechtová, J., 2017. Classification of Tundra Vegetation in the Krkonoše Mts. National Park Using APEX, AISA Dual and Sentinel-2A Data. *European Journal of Remote Sensing*, 50(1), pp.29-46.

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Work in relict arctic tundra of the Krkonoše Mts.

- **Spectral characterization of invasive species** (*Molinia caerulea* and *Calamagrostis villosa*) and their differentiation from *Nardus stricta* using field spectra and imagery with high spatial resolution (orthophotos, data from UAV)
- **Monitoring of community composition dynamics:**
  - expansion of prostrate dwarf pine (*Pinus mugo*) on areas formerly covered by *Nardus stricta*
  - shifts in distribution of herb species and expansion of Norway spruce
  - grass species and vegetation communities distribution along environmental gradients
- New instruments will be used for the monitoring
  - UAV – DJI M600  
<https://www.dji.com/matrice600-pro?site=brandsite&from=nav>
  - Hyperspectral camera Headwall NANO Hyperspec  
<http://www.headwallphotonics.com/spectral-imaging/hyperspectral/nano-hyperspec>

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### TUNDRA Research

**Lucie Červená,**  
Ph.d. student



SCERIN initiated student stay

pre-arranged **stay in September 2018** in the Lab of prof. Epstein to learn the know-how of the use of the hyperspectral data acquisition by UAV.

**Prof. Howard Epstein,**  
University of Virginia, USA



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#### *New Project Proposal*

#### **The call of the Ministry of Education, Youth and Sports of the Czech Republic:**

Programme INTER-EXCELLENCE, Sub-Programme INTER\_ACTION LTUSA18

Deadline: 30<sup>th</sup> April 2018

#### **Project Proposal Title:**

**Assessment of ecosystem function based on Earth observation of vegetation quantitative parameters retrieved from data with high spatial, spectral and temporal resolution**

#### **Project aim:**

A complex evaluation of a seasonal dynamics of physiological status, function and productivity of vegetation in different ecosystems using phenological course of quantitative parameters of vegetation derived from various sources of EO data with different spatial and spectral resolution (novel HLS dataset, satellite data WorldView-2/RapidEye and very high spatial resolution airborne / drone-based hyperspectral images) and trained and validated based on field and laboratory in-situ (biochemical and biophysical parameters - Cab, water content, LAI).

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### *New Project Proposal*

**Czech PI: Prof. RNDr. JANA ALBRECHTOVÁ, Ph.D.**

**Czech Co-I: Ing. Petr Lukeš, Ph.D.**, CzechGlobe- Global Change Research Institute, Czech Academy of Sciences, Department of Remote Sensing, Brno, Czech Republic

**Project Duration:** 1.1. 2019 – 31.12. 2022

### **U.S. Partners in the project:**

**Dr. Petya Campbell:** University of Maryland Baltimore County (UMBC) Joint Center for Earth Systems Technology (JCET), NASA/Goddard Space Flight Center  
Greenbelt, MD 20771 USA

**Prof. Howard E. Epstein**

University of Virginia, Department of Environmental Sciences,  
Charlottesville, VA 22904-4123





**Thank you for  
your attention**  
😊

Photo Z. Kubínová, Z. Lhotáková