Varna, Bulgaria,17 and 18 August 2026

WG4 Meeting Deliverable Writing

Attendance Type: Hybrid
Venue: Conference room, Hotel Modus, Varna
City: Varna
Country: Bulgaria

Start: 17/08/2026, 09:00
End: 18/08/2026, 17:30

Meeting agenda

Day	Time	Topic	Participants

17.08.2026	9:00 – 10:30	TWSI and uncertainty propagation	Laura Mihai Mike Werfeli Andy Hueni Offer Rozenstein Dessislava Ganeva Martin Schlerf
	10:30 – 11:00	Coffee break	
	11:00 – 12:30	TWSI and uncertainty propagation	Laura Mihai Mike Werfeli Andy Hueni Offer Rozenstein Dessislava Ganeva Martin Schlerf
	12:30 – 14:00	Lunch	
	14:00 – 15:30	Paper on best practices	Laura Mihai Mike Werfeli Andy Hueni Offer Rozenstein Dessislava Ganeva
	15:30 – 16:00	Coffee break	
	16:00 – 17:30	Paper on best practices	Laura Mihai Mike Werfeli Andy Hueni Offer Rozenstein Dessislava Ganeva
18.08.2026	9:00 – 10:30	Article from hackathon	Laura Mihai Mike Werfeli Andy Hueni Offer Rozenstein Dessislava Ganeva Michal Antala
	10:30 – 11:00	Coffee break	
	11:00 – 12:30	Article from hackathon	Laura Mihai Mike Werfeli Andy Hueni Offer Rozenstein Dessislava Ganeva Michal Antala
	12:30 – 14:00	Lunch	
	14:00 – 15:30	Preparation for the last year of PANGEOS	Laura Mihai Mike Werfeli Andy Hueni Offer Rozenstein Dessislava Ganeva

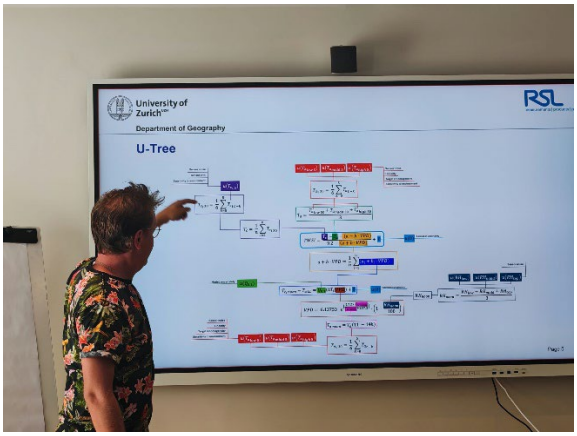
			Esra Tunc Luke Brown All WG leaders*
	15:30 – 16:00	Coffee break	
	16:00 – 17:30	Preparation for the last year of PANGEOS	Laura Mihai Mike Werfeli Andy Hueni Offer Rozenstein Dessislava Ganeva Esra Tunc Luke Brown All WG leaders

Session activities

TWSI and uncertainty propagation

Actual Participants: Laura Mihai, Mike Werfeli, Andy Hueni, Offer Rozenstein, Dessislava Ganeva, Martin Schlerf, Kadmiel Maseyk, Shawn Kefauver

- Mike Werfeli and Dessislava Ganeva presented the advancement in the TWSI project started after the Nitra training course as an example of WG4 and WG3 collaboration, Figure 2.



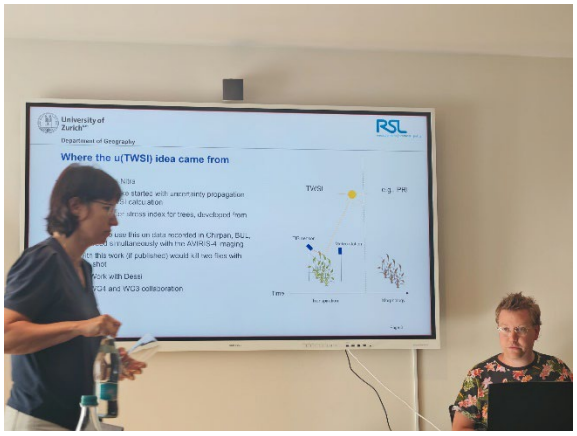


Figure 1. Presentation of the uncertainty analysis for TWSI

- Mike presented the work done for Bambësch with the data and information provided by Martin Schlerf.
- Dessislava presented the data acquired during the field campaign in Chirpan in June 2026, potentially for CWSI.
- The participants discussed the potential article and its goals
- Alternative datasets were considered. For example, from Shawn: crop and forest. From Offer for orchards or vegetables

Results and conclusions:

1. We will continue to work only with Bambësch dataset for forests
2. In addition to the point thermal data from Apogee, Martin will provide thermal data from a drone
3. The article will focus on the uncertainty estimation of TWSI from point data to drone data, with notes and discussion for future thermal satellites with high spatial resolution

Actions:

1. Mike and Dessi will prepare a proposal and time frame for the work by the Core meeting in September 2026

Lunch

Figure 2. Well-deserved lunch at the beach that is a 10-minute walk from the conference room

Paper on best practices

Actual Participants: Laura Mihai, Mike Werfeli, Andy Hueni, Offer Rozenstein, Dessislava Ganeva, Shawn Kefauver

- Mike presented the idea and the possible datasets for the paper
- Andy presented the impact of even remote clouds on the recorded spectra
- The team worked together on the methodology Figure 4.

Results, conclusions and actions:

We decided to have the following article structure for the sensitivity tests for:

1. Temperature experiment lab

Dataset	What	Who
Temperature experiment on ASD at CETAL Romania (Laser4EU project)	1. Convert all from DN to Radiance with calibration from CETAL 2. Plot on the y-axis the correction coefficient c (x) = T(x)/T(Tref=temperature of the calibration) and on the x-axis the temperatures from the experiment (15, 20, 25, 30, 35). Find the fitting function in order to have a correction coefficient for each temperature 3. In parallel, verify for which temperature there is almost no jump between the detectors. Use this temperature as Tref	Dessi, Laura

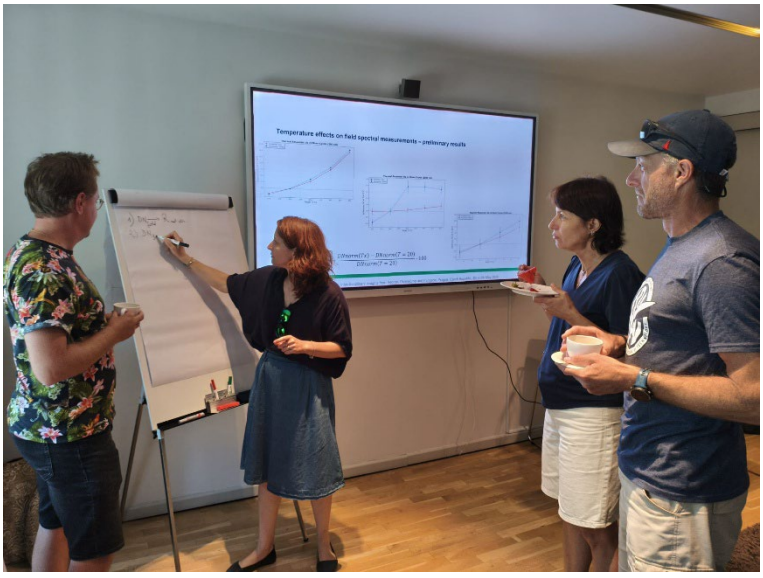


Figure 3. The work continues during the coffee break

2. Temperature influence in the field

Dataset	What	Who
Field Measurement with ASD during 2026 in Chirpan. If necessary, we can add field measurements from 2021, 2022, and 2023 from Chirpan	1. DN -> L -> R with calibration from CETAL. Case 1, not corrected 2. DN -> L -> c(calculated from T lab experiment) * L =L_{Tcorr} -> R_{Tcorr} 3. DN -> $L_{JumpCorr}$ -> $R_{JumpCorr}$ 4. Calculate ΔR_{12} , ΔR_{23} , ΔR_{13} and plot	Dessi

3. Influence of the tilt of the reference panel, lab experiment

Dataset	What	Who
Lab measurement with a goniometer at CETAL Romania (Laser4EU project). Remark: the spectral data is <1000nm	1. To do the same as presented at the Prague conference, but instead of DN -> L	Dessi, Laura

4. Influence of the tilt of the pistol grip, lab experiment

Dataset	What	Who
Lab measurement with a goniometer at CETAL Romania (Laser4EU project). Remark: the spectral data is <1000nm	To do the same as presented at the Prague conference, but instead of DN -> L	Dessi, Laura

5. Pre- and post-panel, field experiment

Dataset	What	Who
Norway dataset	1. How important is it to make Reference-Target-Reference instead of just Reference-Target	Mike

6. Differences between dirty/clean reference panel, field experiment

Dataset	What	Who
1. Chirpan field campaign 2026 with ASD and big (clean)/small (dirty) panel 2. Cost Optimise dataset	1. Find the difference between the R with clean and dirty reference panels for each dataset 2. Compare the results from the 2 datasets	Dessi Mike Laura

7. Reference panel position

Dataset	What	Who
New experiment	Influence of surroundings on spectral measurement, for example, a tree that is close or far from the measurements	Mike

8. Influence from clouds

Dataset	What	Who
Svartberg dataset. Cloud event at 11h30	1. Cloud effect on different bands 2. Compute pseudo PRI	Andy Mike

Additional Actions:

1. Laura to confirm what the temperature is during the calibration of the ASD
2. Agree on a timeframe for the completion of the work

Dinner at the pirate ship

Article from the hackathon

Actual Participants: Laura Mihai, Mike Werfeli, Andy Hueni, Offer Rozenstein, Dessislava Ganeva, Shawn Kefauver, Michal Antala Figure 6

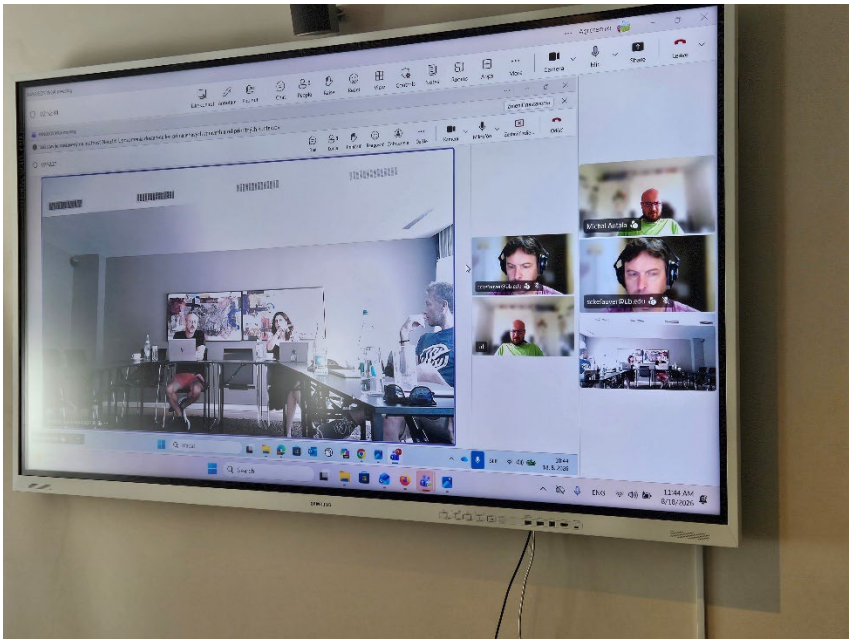


Figure 4. Hybrid meeting for the hackathon paper

Results and conclusions:

We decided to follow these tasks:

1. Baseline model – CGM with no uncertainty, no RS, no measured LAI, CHL – WG4 has nothing to do
2. CGM + PF + measured LAI + measured CHL
    a. Michal's PF code in R to be transformed into Python
    b. We work with 1 value that comprises the 2 measurements/plot for 3 plots with the same treatment (irrigation + N)
    c. Variability = SD(6 measurements) - u_{random} , Variability is NOT uncertainty
    d. For LAI: 2.1. Run Michal PF code (Python) with random uncertainty (5%), where $u_{random} = \frac{\overline{LAI}}{\sqrt{3}} \cdot 5\%$ (in ABSOLUTE)
    e. For LAI: 2.2. Run Michal PF code (Python) with systematic uncertainty (10%), where $u_{systematic} = \frac{\overline{LAI}}{\sqrt{3}} \cdot 10\%$ (in ABSOLUTE)
    f. $u_{total} = \sqrt{u_{random}^2 + u_{systematic}^2}$
    g. For LAI, propagate the random uncertainty for $\mu = \frac{LAI_1+LAI_2+LAI_3}{3}$, where LAI_x is the LAI measurement from the same condition (irrigation and N)
    h. For LAI, propagate the systematic uncertainty for $\mu = \frac{LAI_1+LAI_2+LAI_3}{3}$, where LAI_x is the LAI measurement from the same treatment (irrigation and N)

i. For LAI, propagate the random uncertainty for $\sigma = \sqrt{SD(LAI_1)^2 + SD(LAI_2)^2 + SD(LAI_3)^2} - u_{random}$; u_{random} is a constant
j. For LAI, propagate the systematic uncertainty for $\sigma = \sqrt{SD(LAI_1)^2 + SD(LAI_2)^2 + SD(LAI_3)^2} - u_{random}$; u_{random} is a constant
k. To do a similar uncertainty analysis and propagation for CHL as for LAI
l. Remark: for 1 realisation of MC, there are 1000 PFs

3. CGM + PF + retrieved with ML LAI + retrieved with ML CHL + Reflectance
   a. Analyse and propagate the uncertainty of the Reflectance to obtain $u_{reflectance_{total}}$
   b. To propagate the $u_{reflectance_{total}}$ through the ML model and application. To do that, we need a meeting with the ML person
   c. We work with 3 values that comprise the 2 measurements/plot for each plot individually
   d. For LAI: 3.1. Run Michal PF code (Python) with random uncertainty (5%), where $u_{random} = \overline{LAI_i} \cdot 5\ \%$ (in ABSOLUTE), where i is the number of each plot
   e. For LAI: 3.2. Run Michal PF code (Python) with systematic uncertainty (10%), where $u_{systematic} = \overline{LAI_i} \cdot 10\%$ (in ABSOLUTE), where i is the number of each plot
   f. To do a similar uncertainty analysis and propagation for CHL as for LAI
   g. The result should look like, Figure 8.

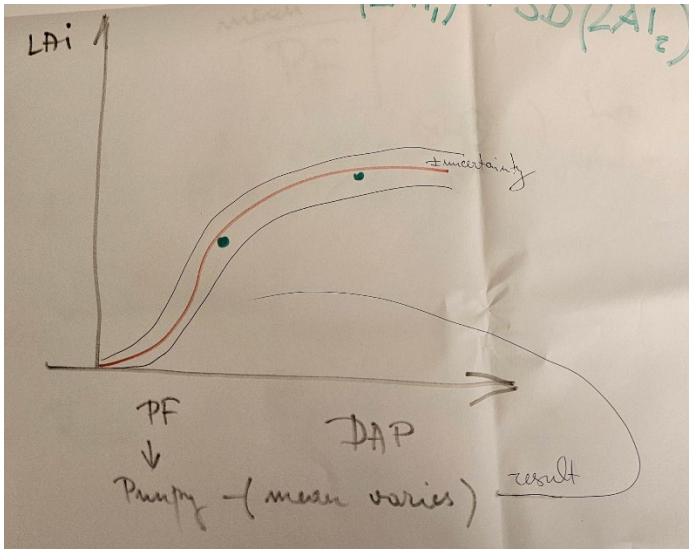


Figure 5. Result for 1 PF with uncertainty buffer, with the mean of the value (LAI or CHL) that varies

Actions:

Case	What	Who

Cases 2&3	Michal PF code in R to be transformed into Python	Dessi
Cases 2&3	To get the data from Egor for the CHL measured calibration	Michal
Cases 2&3	To determine the uncertainties for CHL measured	Mike
Cases 2	Uncertainty analysis and propagation for LAI measured through PF	Dessi
Cases 2	Uncertainty analysis and propagation for CHL measured through PF	Mike
Cases 3	Meeting with the ML person	Michal
Cases 3	Obtain $u_{reflectance_{total}}$	Mike
Cases 3	Propagate $u_{reflectance_{total}}$, $u_{LAI_{total}}$, $u_{CHL_{total}}$ through the ML model and application	Mike & Dessi
Cases 3	Propagate $u_{LAI_{retrieved}}$, $u_{CHL_{retrived}}$, through the PF	Mike & Dessi

Preparation for the last year of PANGEOS

Actual Participants: Laura Mihai, Mike Werfeli, Andy Hueni, Offer Rozenstein, Dessislava Ganeva, Shawn Kefauver, Esra Tunc, Luke Brown, Jose Gomez-Dans, Lea Hallik, Miriam Machwitz, Kadmiel Maseyk

- Laura went through the MOU to point out which parts of it were covered and which still needed work. The participants discussed different possibilities, and the results and conclusions are listed below

Results and conclusions:

To strengthen our position with potential stakeholders:

- Shawn proposed to create documents that can serve in our communication with stakeholders: graphical abstracts, common graphical components and multi-language posters
- Dessi proposed to use the webinar series to create short videos that explain PANGEOS scientific concepts to a larger audience.

General:

- To organise the final conference in early summer 2027

How WG4 could complete the proposed tasks and deliverables in the MOU:

- Meeting in Zurich in spring 2027 targeted toward how the PANGEOS members, the community, and stakeholders in general use/apply the uncertainty analysis and propagation in their work. Think about which stakeholders could be

involved/invited; for example, space agencies – Mike will present a plan during the Core meeting in September 2026

- Student from the University of Zurich to work on code that uses SPECCHIO to automatically propagate uncertainty associated with measurements
- Connection between WG1&WG4 – already covered with multiple activities
- Connection between WG2&WG4
    - Miriam, Offer, and Jose will discuss the review article being written as part of WG2 deliverables and get back to the WG4 team if additional activities are needed
    - The hackathon article in preparation is part of this connection
- Connection between WG3&WG4
    - The TWSI article in preparation is part of this connection
    - Kadmiel and Shawn proposed an activity for mission validation, for example, Flex. Will have a proposal by the Core meeting in September 2026