



Sensing and Spatial Modeling for Earth Observation

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Welcome to the SSMEO course!

You will learn foundations in:

Sensing “metricity”

- How to convert camera-data into a mapping product of a certain quality?

Geo-information extraction

- How to extract information from a geo-rectified image & 3D digital model?

Geostatistical phenomena analysis & modelling

- How to analyze and model geographically related variables in space and time?

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This translates into three rough big chapters

1. 3D reconstruction from images

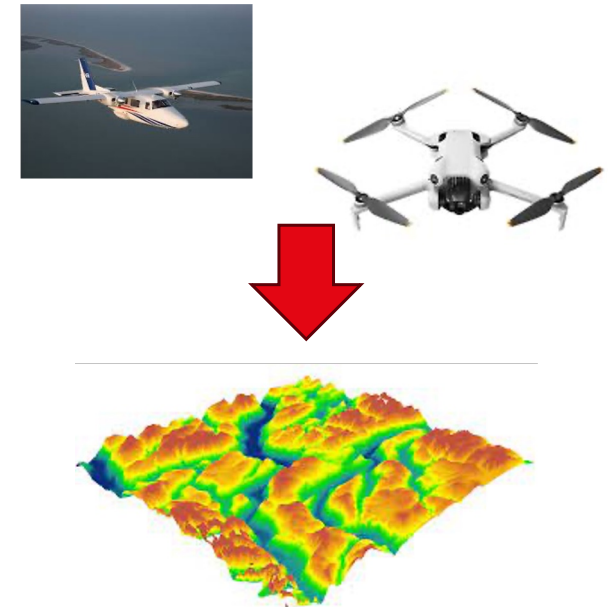
- How to match images acquired by drones / planes
- How to create a 3D model

2. Feature extraction and learning

- How to extract variables of interest from 3D information
- How to build machine learning models to predict environmental targets

3. Geostatistics

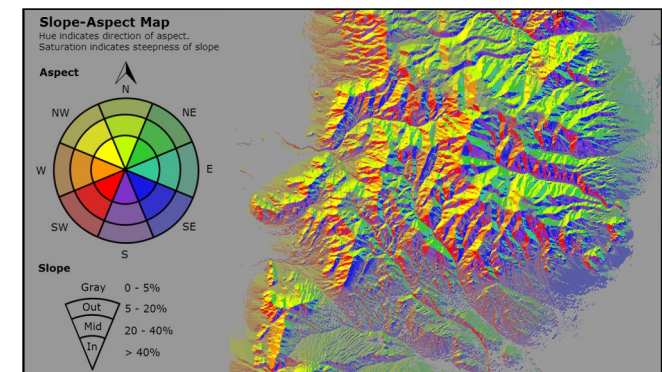
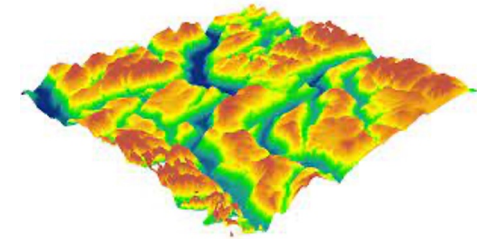
- How to model spatially correlated processes
- How to interpolated spatialised measurements



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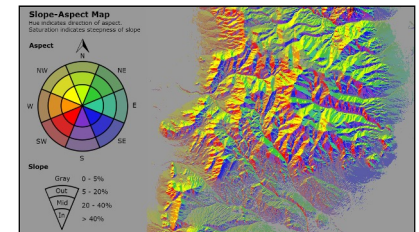
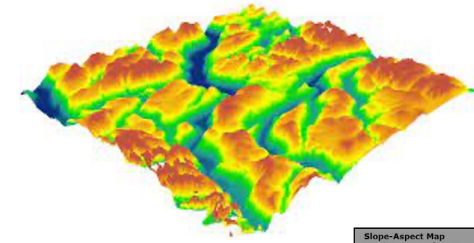
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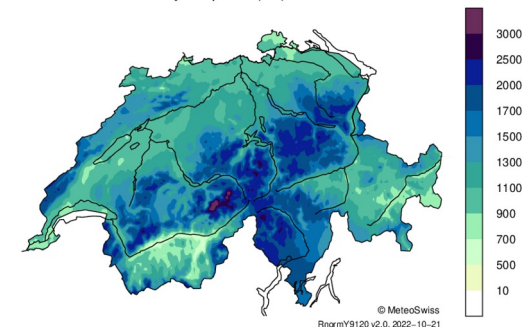
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Mean Yearly Precipitation (mm) 1991-2020



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The three parts are tightly related, we walk you through the entire processing chain

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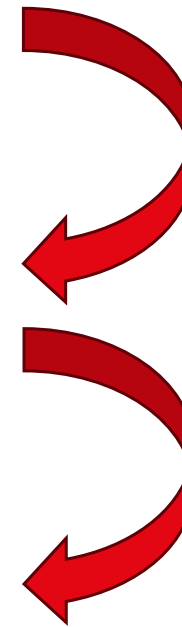
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You need the 3D model to move to this step

You will extend the AI models with geographical explicit approaches

Some admin about ENV-408

Core course

5 credits ECTS

5h / week,

~40% lectures: Thursday afternoon 14h-16h

~60% exercises (mostly Python-based, a bit of R): Friday morning 9h-12h

Rooms:

- INF 119 (here): lectures
- GR B0 01: computer exercises

About the exercises

Key for understanding the content of the lectures!

They follow each other, and often you need the result of one as the input to the next!

Come prepared and be regular

Do it yourself & right

They count for 20% of your final grade!

About the exercises (2)

Tools

- **Python** programming, Jupiter Notebooks (parts 1 and 2)
- **R** for geostat exercises (part 3)
- Professional photogrammetry/CV software (part 1)

The TA-s are there to help and we will provide solutions (in data and/or code) before the following week's one.

Evaluation

Graded exercises: 20%:

- Evaluate understanding of exercises

Final exam: 80%

- Theoretical exam covering all content

Graded exercises 20%

Exercise 4 ("Stereo-orientation")

- Handout Friday Week 4 (13.3.2025)
- Deadline Friday Week 6 (27.3.2025)

Exercise 7 ("Regression")

- Handout Friday Week (10.4.2025)
- Deadline Friday Week (01.5.2025)

Schedule

Week	lecture	Block	Exact topic	Teacher	(Thursday)	(Friday)
1	20.02.2025	Images to Ortho-DEM	Intro	devis	1	
			Image creation	devis (ex by jan team)	1	3
2	27.02.2025		Keypoint generation & matching	devis	2	3
3	06.03.2025		Orientation - absolute	jan	2	3
4	13.03.2025		Orientation - relative	jan	2	3
5	20.03.2025		Orthophoto and DEM creation	jan	2	3
6	27.03.2025	Machine learning	Features from a DEM	devis		Self-study: Catchup 2 with exercises
7	03.04.2025		intro ML	devis	2	3
8	10.04.2025		Regression with linear models, random forest	devis	2	3
9	17.04.2025	Geostat	General intro - Structural analysis 1	alexis	2	no ex (vacances)
	24.04.2025		EASTER HOLIDAYS			
10	01.05.2025		Structural analysis 2	alexis	2	3
11	08.05.2025		Kriging - 1	alexis	2	3
12	15.05.2025		Kriging - 2	alexis	2	3
13	22.05.2025		Kriging - 3	alexis	2	3
14	29.05.2025			alexis	no course (Ascension)	