

Course Overview + IRIS

Dr. Michel Tsamados

m.tsamados@ucl.ac.uk

Overview

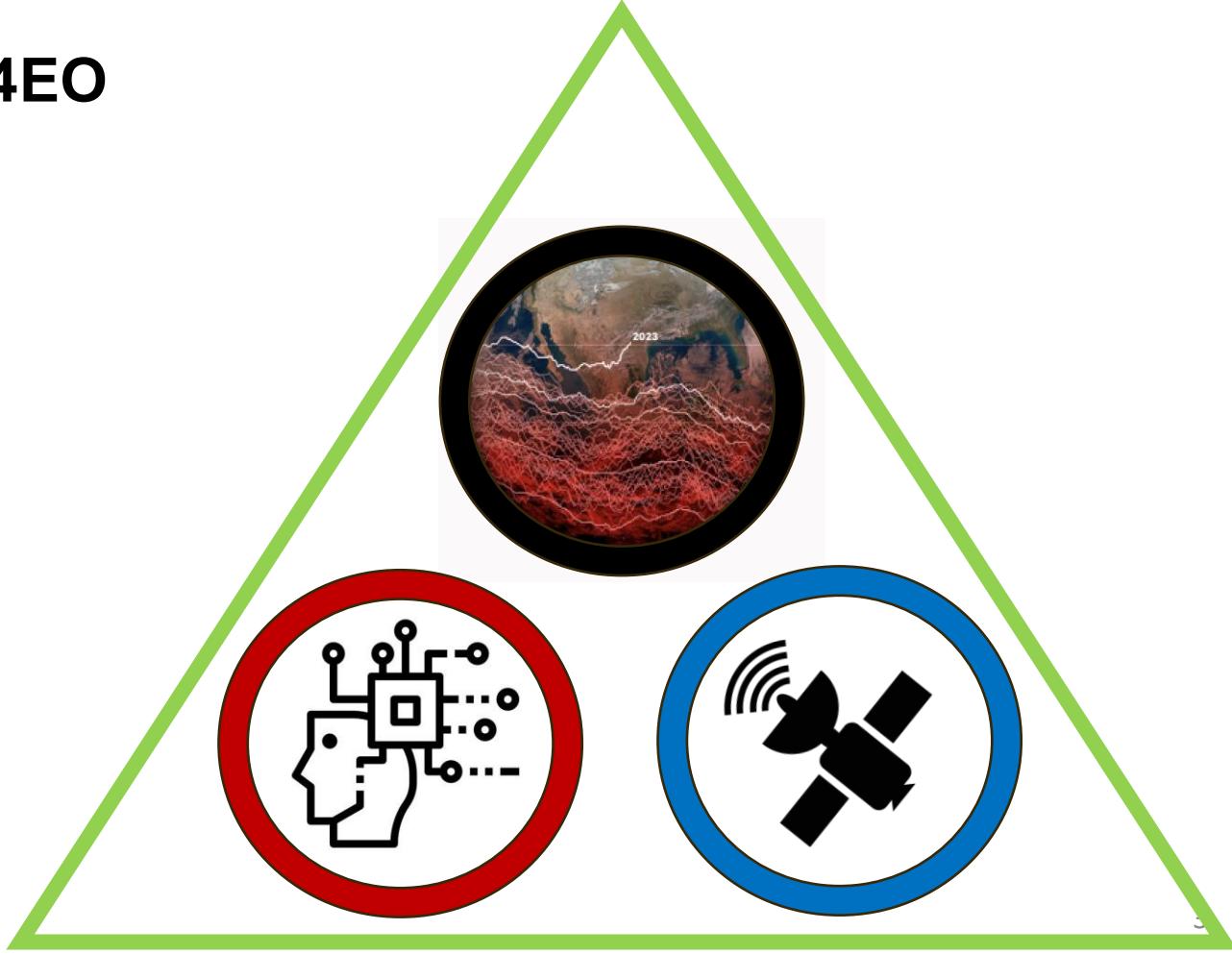
Part 1 - Overview of course

- Who we are, what are we doing here
- Course logistics
- What to expect and assessment
- Summary of course content

Part 2 – Intro to week 1

- Looking at our planet from space
- Google Colab
- IRIS

GEOL0069 – AI4EO



GEOL0069 – AI4EO

The course aims :

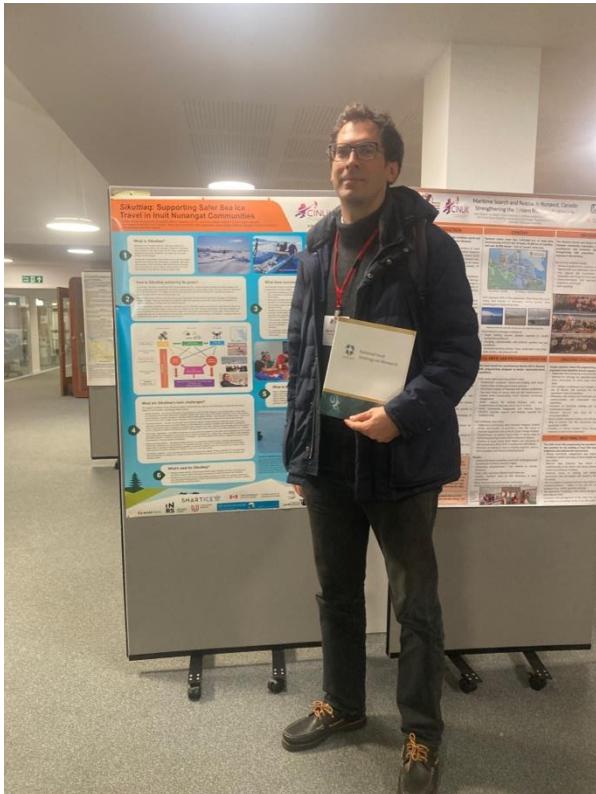
- To define the objectives of Earth Observations and the scientific underpinning for many of the societal challenges that EO can help address.
- To provide a basic introduction into the physics of some geophysical retrieval techniques.
- To provide a hands-on introduction to some of the latest AI tools at our disposal (Deep Learning, Gaussian processes, Feature tracking etc....).
- To provide an introduction to python for geospatial analysis and to cloud computing platforms (i.e. Google Engine).

GEOL0069 – AI4EO

Intended learning outcomes:

- An intro to a range of remote sensing datasets and how they are processed
- A critical view of these datasets and of their spatio-temporal resolution
- A familiarity with the domain of applicability of these datasets to a wide range of societal problems
- Confidence in using python-based algorithms to process parts of these datasets to tackle a variety of problems
- A beginner's understanding of the wide range of AI based techniques
- The capacity to develop a well document code and report on specific case studies

Michel Tsamados



Weibin Chen



Shambhu Bhandari Sharma



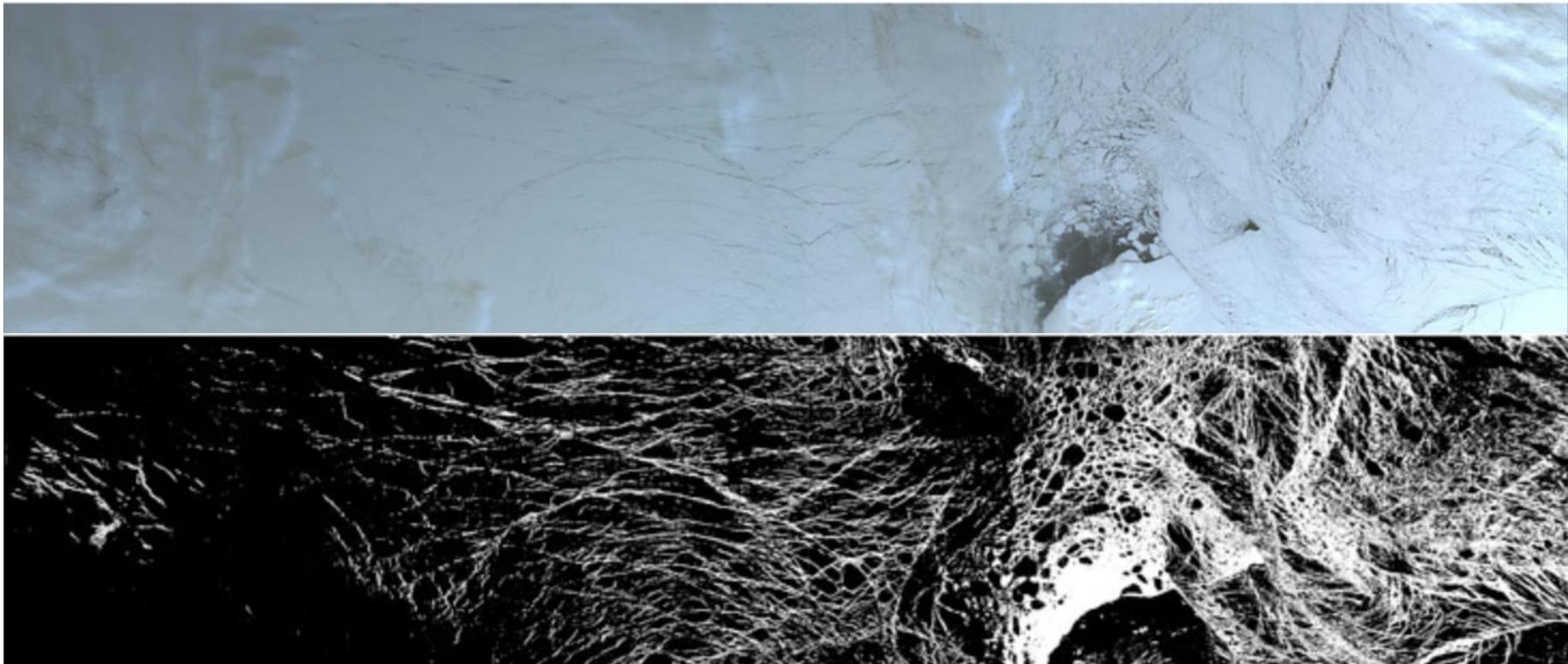
UCL team in a nutshell

Michel Tsamados (Assoc. Prof, satellite and model)
Rosie Willatt (Assist. Prof, polar climate)
Alan Muir (software and IT and much much more)
Thomas Newman (PDRA, radar, drone, sea ice, snow)
Ado Farsi (PDRA, FDEM, AI)
Webin Chen (PhD, AI, Transformers)
Thomas Johnson (PhD, SVR, sea ice roughness)
Connor Nelson (PhD, Passive microwave, altimeter)
Alistair Duffey (PhD, CMIP6, geoengineering)
Ben Mellor (PhD, Met Office, DA, AI)
Sabbie Binti (PhD, ESA, Antarctic, radar)
Carmen Nab (PDRA, Radar)
Ronald Maceachern (RA, AI)
Robbie Mallett (PhD, snow)
William Gregory (PhD, AI, Altimetry)
So Takao (PDRA, general AI expertise)
+ many more (including master students, visitors, etc...)



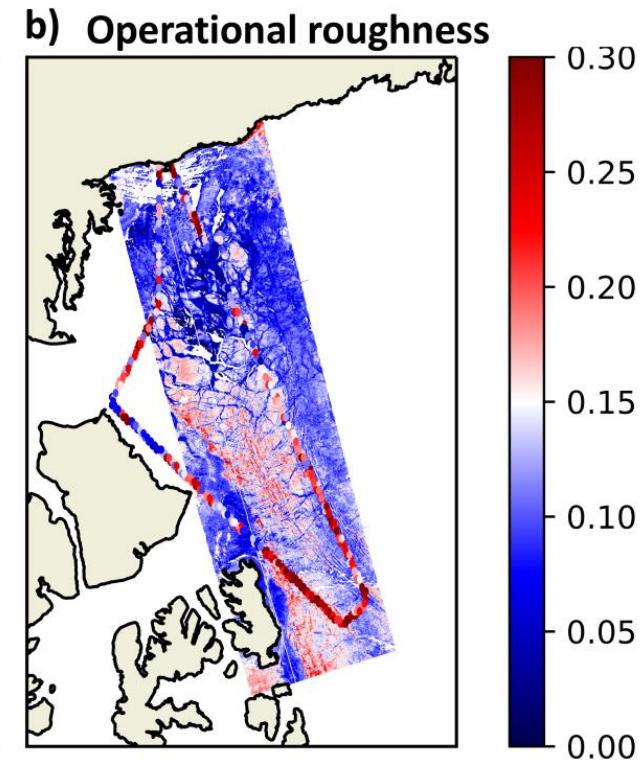
Part 1: Image classification using deep learning and other machine learning tools (Week1 to Week 2)

Chen et al. (2024)



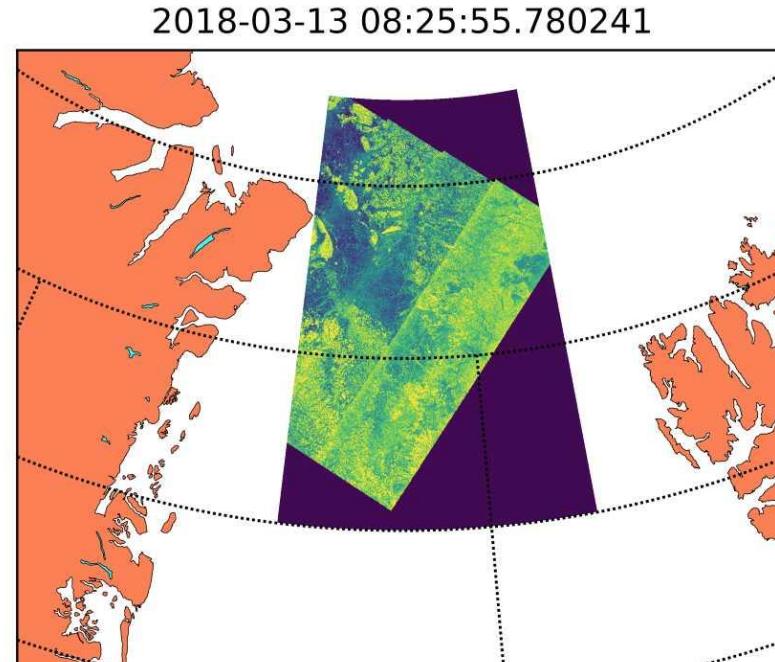
Part 2: Regression using deep learning and other machine learning tools (Week3 + Week 5)

Johnson et al. (2022)



Part 3: Image preprocessing: e.g. collocation and alignment using pattern matching and image tracking algorithms (Week 4 + Week 6)

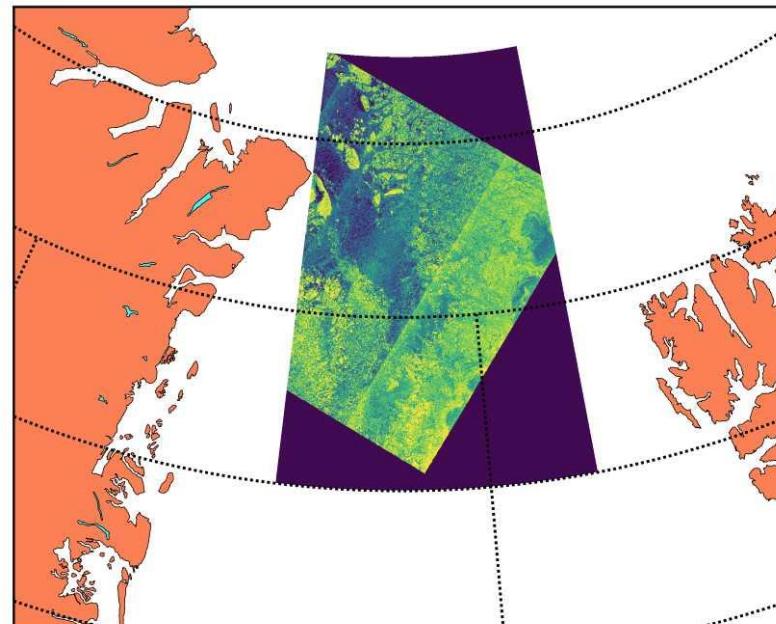
Sea ice velocities
from Sentinel1 pair
of images (Fram)



Part 3: Image preprocessing: e.g. collocation and alignment using pattern matching and image tracking algorithms (Week 4 + Week 6)

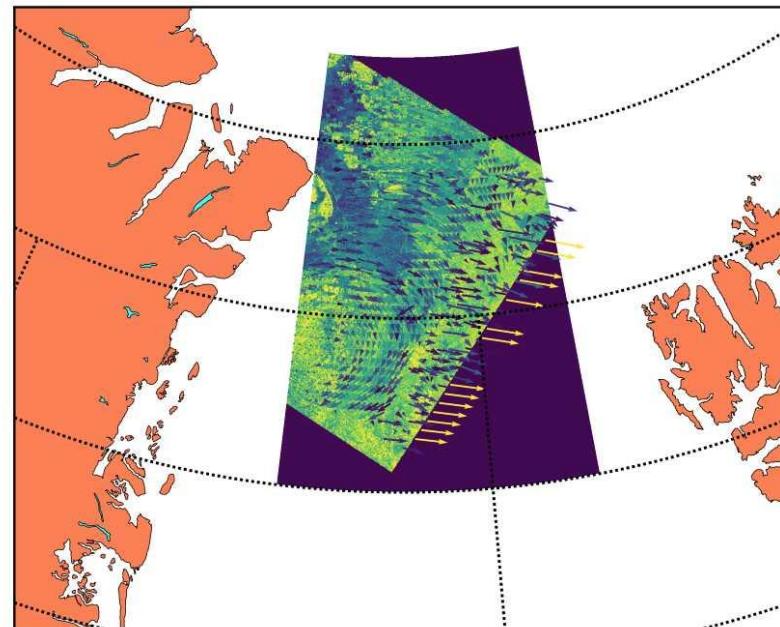
Sea ice velocities
from Sentinel1 pair
of images (Fram)

2018-03-14 08:17:05.081099



Part 3: Image preprocessing: e.g. collocation and alignment using pattern matching and image tracking algorithms (Week 4 + Week 6)

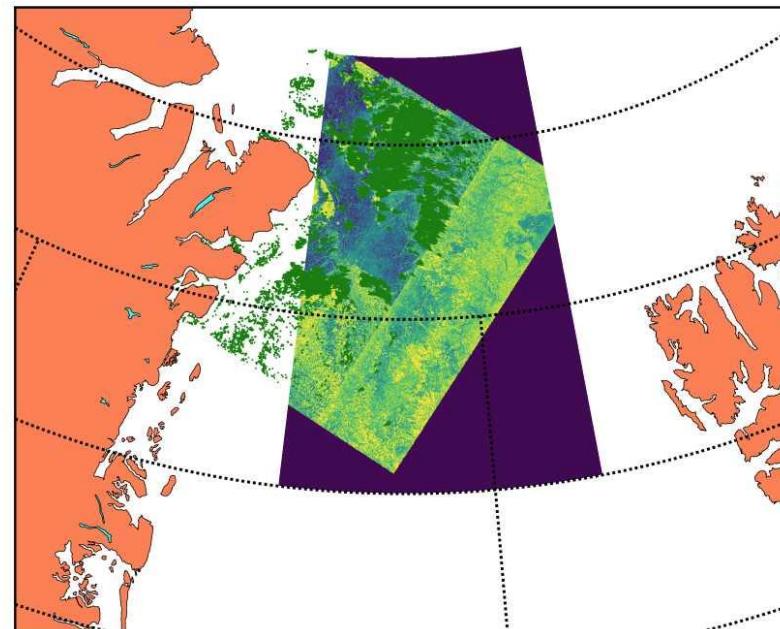
Sea ice velocities
from Sentinel1 pair
of images (Fram)
-> Pattern Matching



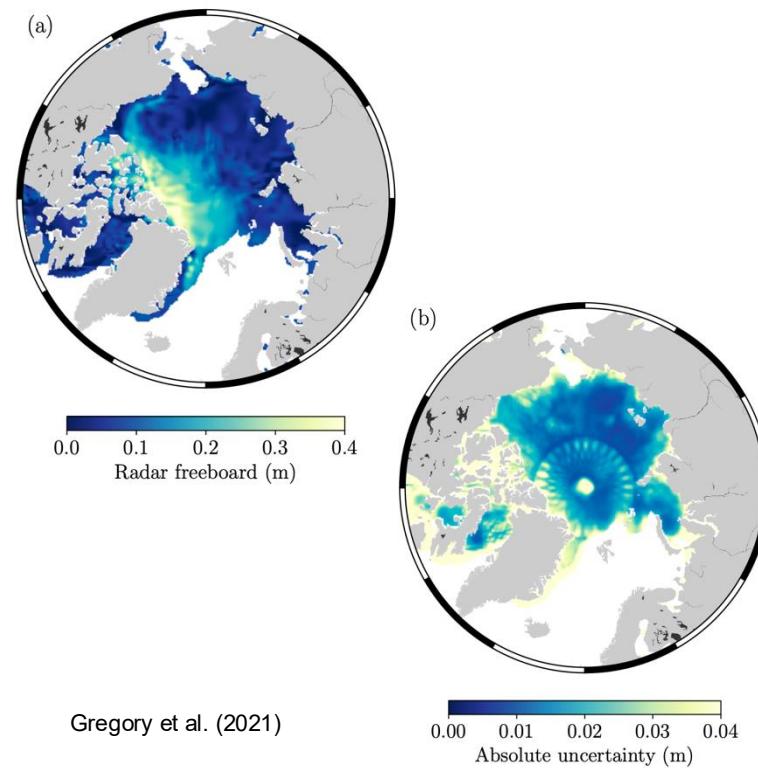
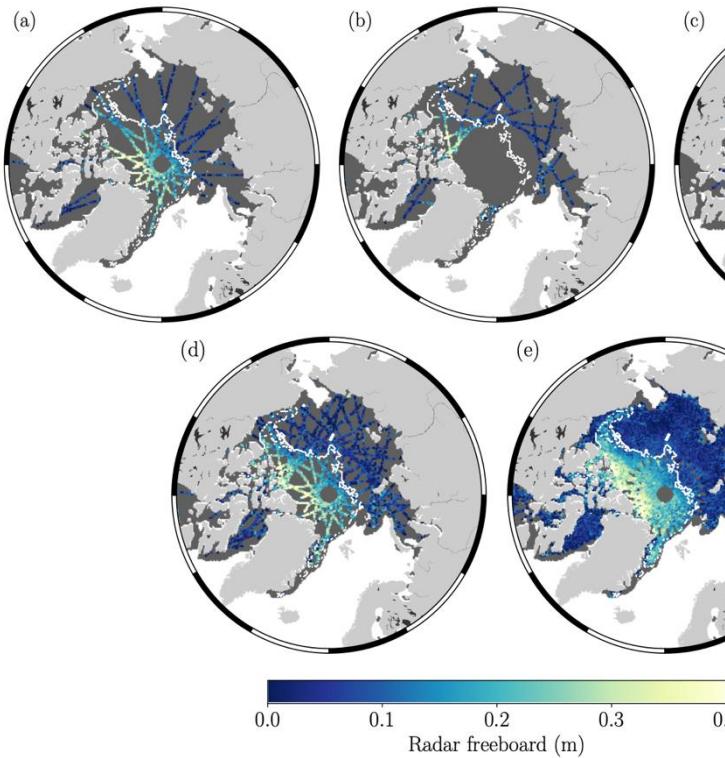
Part 3: Image preprocessing: e.g. collocation and alignment using pattern matching and image tracking algorithms (Week 4 + Week 6)

Sea ice velocities
from Sentinel1 pair
of images (Fram)

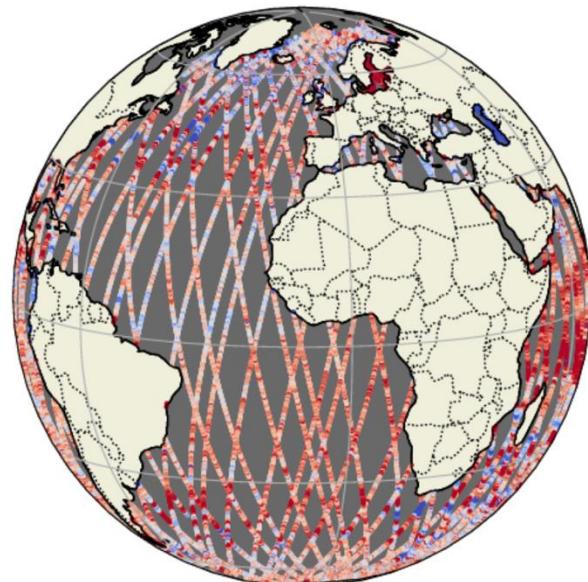
-> Feature tracking



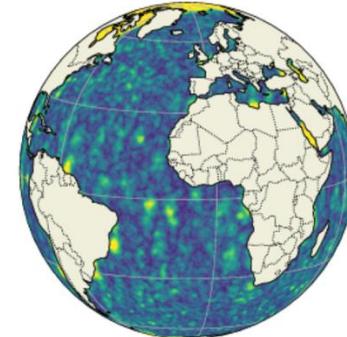
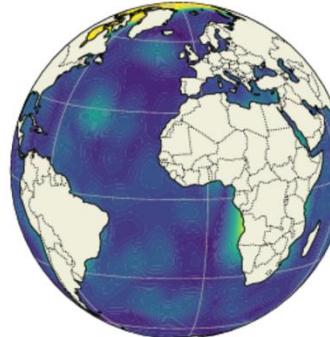
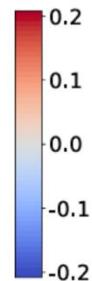
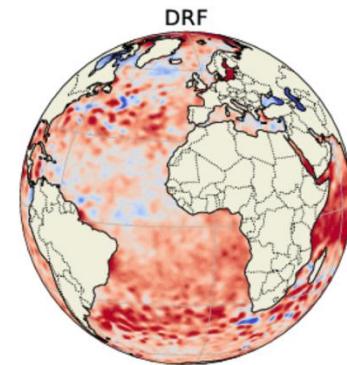
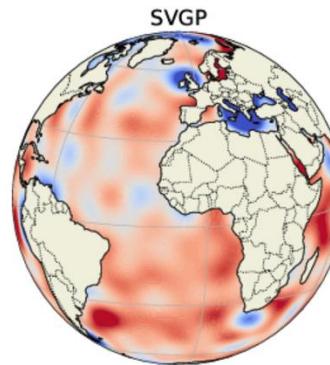
Part 4: Optimal interpolation using Gaussian Processes (Week 7 + Week 8)



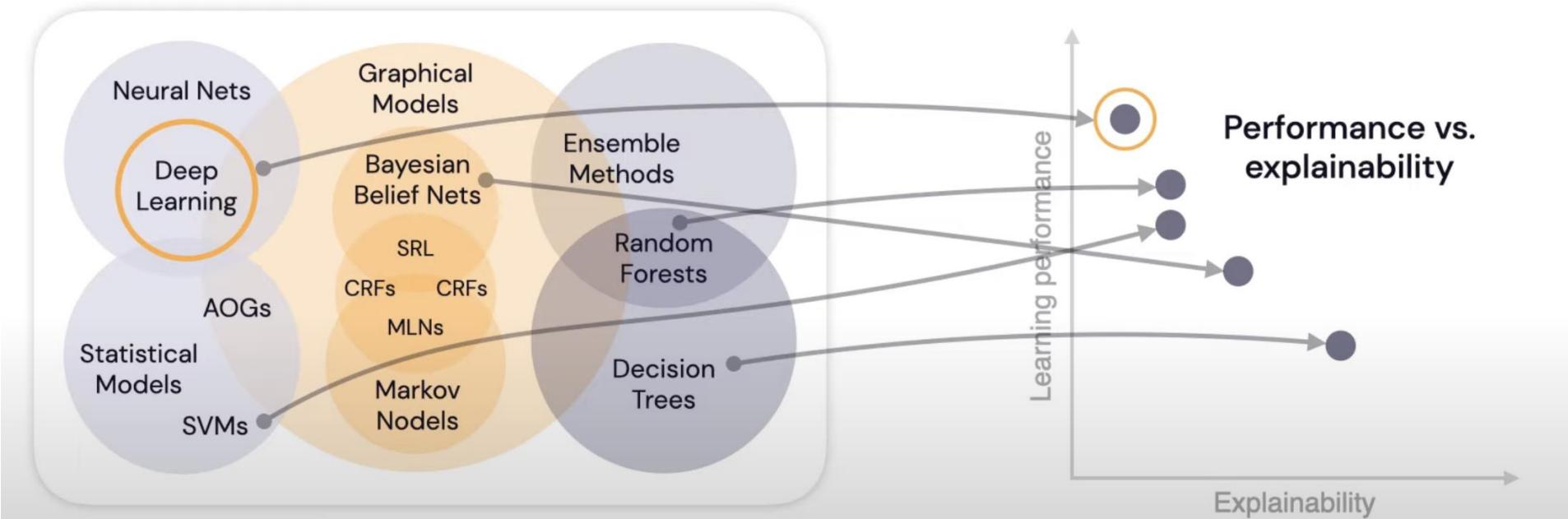
Part 4: Optimal interpolation using Gaussian Processes (Week 7 + Week 8)



Chen et al. (2025)



Part 5: Explainable AI (Week 9 + Week 10)



Weekly Timetable

Tuesdays, 9AM-11AM – **Lecture/Practical**

Location: G01 - Gower Street (66-72)

Fridays, 4PM-6PM – **Lecture/Practical**

Location: Anatomy G04 Gavin de Beer LT

Office hours @ Kathleen Lonsdale Building 301 B/C

- You don't have access so email in advance

Moodle

All course material will be available on the course moodle page, organized by week

- Lecture slides
- Readings
- Assessments

The screenshot shows a Moodle course page with the following structure:

- General:** This tab is selected and highlighted in dark blue.
- Class resources:** A link to class resources.
- Week 1: January 7-11**
- Week 2: January 14 - 18**
- Week 3: January 21 - 25**
- Week 4: January 28 to February 1**
- Week 5: February 4 - 8**
- Week 6: February 18 - 22**
- Week 7: Feb 25-March 1**
- Week 8: March 4-8**
- Week 9: March 12-16**
- Week 10: March 18-22**

Course Information:

- from space to core earthsciences UCL**: The course logo, featuring a stylized Earth and the text "from space to core earthsciences" above the letters "UCL".
- GEOLOGY0013 Principles of Climate**: The course title.
- Contact Details:** Dr. Peter Irvine and Dr Michel Tsamados.

Description:

This module aims to describe and explain the basics of climate science, which will equip you with an understanding of how and why the climate is changing. The module will also provide you with a basic understanding of the options available to tackle climate change and the impacts that climate change will have on society and ecosystems. The module's practical work will include the analysis of climate data and mock climate negotiation. Students will produce a summary of the previous week's content using the digital technology of their choice. Follow live discussion on the course content on @twitter with hashtag #GEOL0013

Accessibility

If you have any accessibility issues, please let us know!

- m.tsamados@ucl.ac.uk

Lectures/Practicals

Bring your laptop!



Course Assessment

30% - Continuous assessment (Throughout module)

A continuous assessment component where each student will upload regular content following the hands-on coding practicals.

20% - In class coding assessment (During Term 2)

Two practical sessions will serve as graded assessments. During these 2-hour sessions, you will be required to complete specific coding tasks to demonstrate your practical skills.

50% - Coding assignment (Due in Term 3)

A coding assignment to cover a broader AI4EO problem (doesn't have to be on sea ice). This will build on some of the tools we have covered during the class. Your result should include the following elements

- A description of the problem to be tackled
- A figure illustrating the remote sensing technique
- A diagram of the AI algorithm and its implementation
- A well-documented GitHub repository with your well documented python code

Coding assignments

The screenshot shows a GitHub repository page for 'ICESat-2-sea-ice-thickness'. The repository is public and has 4 commits, 12 forks, and 15 stars. It was last updated 4 years ago. The repository description is 'Generating sea ice thickness estimates from NASA's ICESat-2 freeboard data'. There are two releases, with the latest being 'Version 1' from Dec 22, 2022.

akpetty / ICESat-2-sea-ice-thickness

Type ⌘ to search

Code Issues Pull requests Actions Projects Security Insights

ICESat-2-sea-ice-thickness (Public)

Watch 4 Fork 12 Star 15

master 2 Branches 3 Tags

Go to file t + <> Code

about

Generating sea ice thickness estimates from NASA's ICESat-2 freeboard data

Readme

Activity

15 stars

4 watching

12 forks

Report repository

Releases 2

Version 1 Latest on Dec 22, 2022

File	Description	Time Ago
a5da149 · 4 years ago	remove personal information, update readme	20 Commits
AncData	added new plotting scripts	4 years ago
Code	remove personal information, update readme	4 years ago
Figures	added new plotting scripts	4 years ago
.DS_Store	clean up code	4 years ago
.gitignore	added new plotting scripts	4 years ago
IS2flowchart.png	readme updates	4 years ago
README.md	remove personal information, update readme	4 years ago

Your Feedback to us

Informal feedback during course

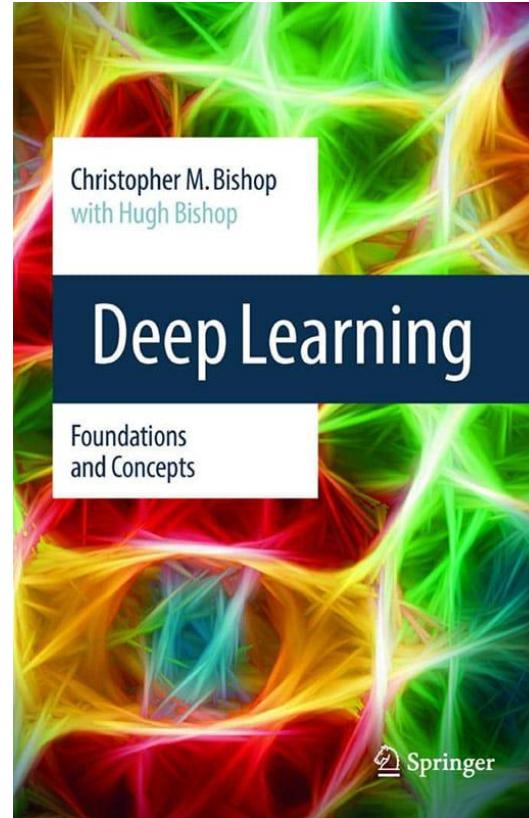
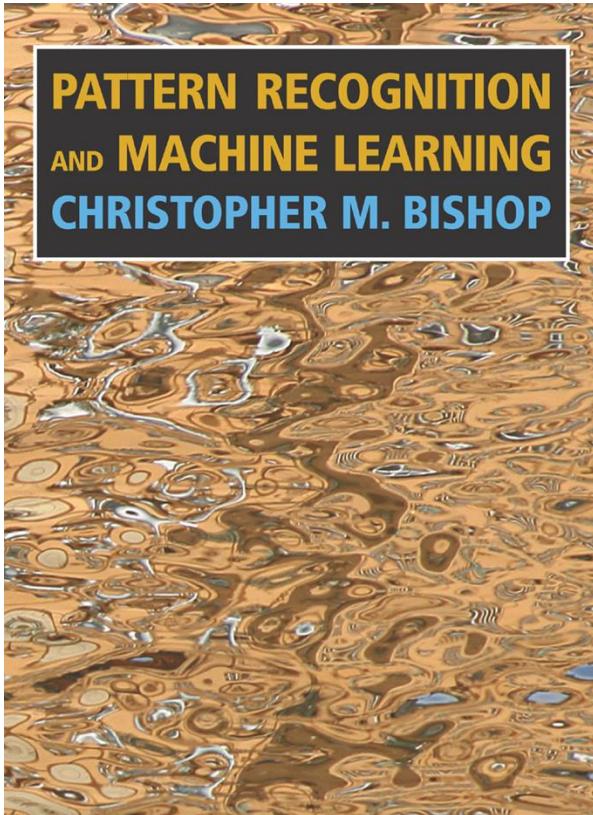
- Let us know any questions you have on moodle
- Give us anonymous feedback (NOT on moodle), details TBD

LinkedIn / BlueSky discussion: #GEOL0069

- Share questions, articles, etc.

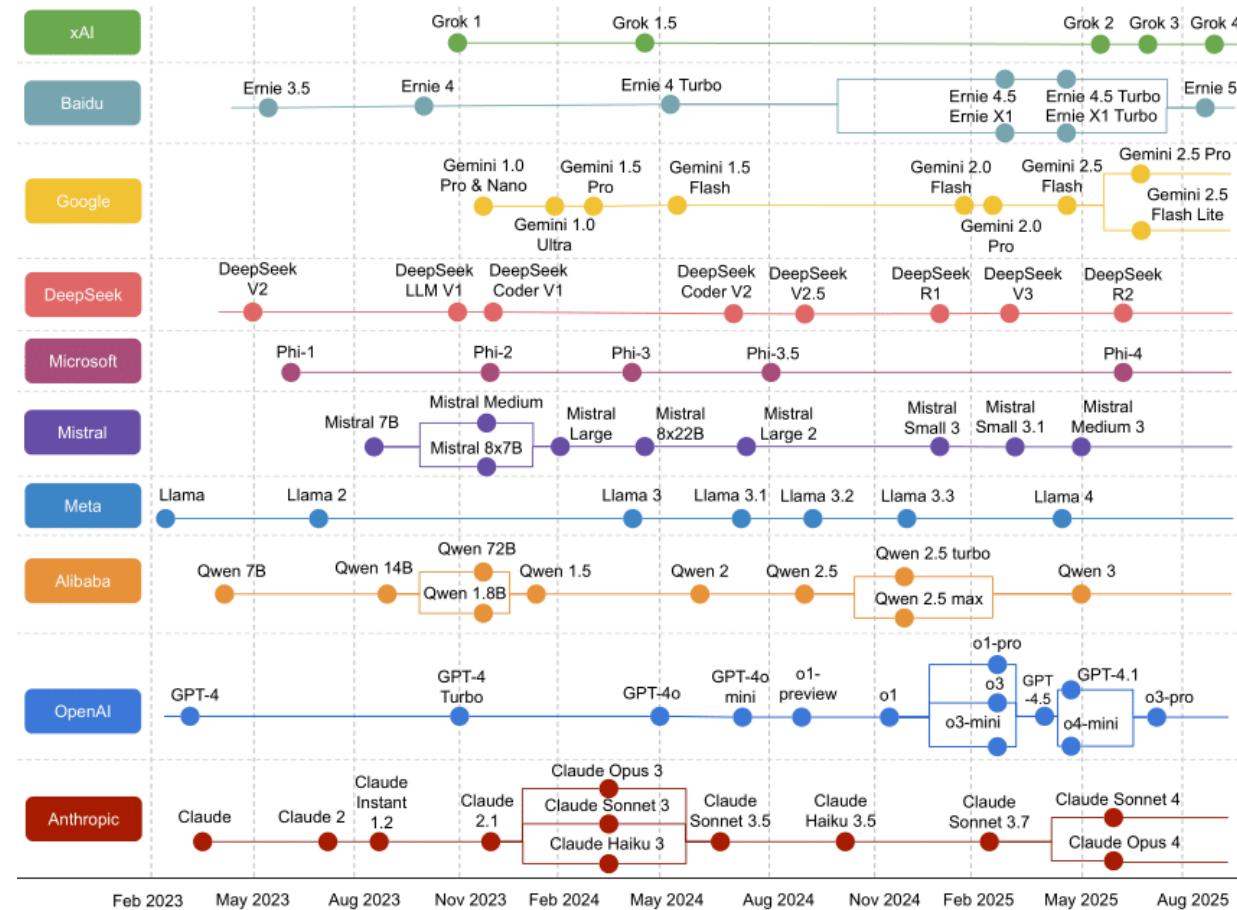
Formal feedback after course – Please complete!

Some useful references and blogs



A screenshot of the 'satellite-image-deep-learning' blog homepage. At the top, there is a navigation bar with links to Home, Podcast, YouTube, Github, LinkedIn, X/Twitter, Discord, and Consulting. Below the navigation bar, there is a banner featuring a portrait of Yosef Akhtman and the text 'Super-Resolution at gamma.earth'. The main content area displays several news articles with titles like 'New discoveries #22', 'New discoveries #21', and 'New discoveries #20'. Each article includes a thumbnail image, the author's name, and the publication date. The bottom of the page features a banner for 'Deep Learning in Google Earth Engine' with a portrait of Jake Wilkins.

Use of LLM



Is AI the doom of ecology (optional but important)

“Fields Medal-winning mathematician Cédric Villani and polar climate expert Michel Tsamados (University College London) come together in Chania for a rare and thought-provoking public discussion as part of Festum π.”



Attendance

Mentimeter -> student number