Summer School on the Use of AI for the Analysis of Extreme Events

Ethics in AI for Climate Science

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Session Overview

SECTION 1	Why Ethics in Climate AI? — The Stakes
SECTION 2	EU Regulatory Ecosystem — Deep Dive
SECTION 3	International Frameworks & Research Integrity
SECTION 4	Ethics in Practice: Data, XAI & Case Studies
SECTION 5	Discussion, Takeaways & Resources

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Why Ethics in AI for Climate Science? — The Stakes

The stakes are high, and the EU regulatory framework reflects this urgency

The AI Opportunity — and the Responsibility

AI-based models are transforming climate science: from disaster early warning systems to seasonal forecasting and impact assessment.

But with great power comes great responsibility.

Natural disasters disproportionately affect the most vulnerable populations, least developed countries, women, and children. Poor AI design or biased data amplifies these inequalities.

Less than 5% of Earth Observations currently feed AI models, yet these models inform decisions affecting millions of lives.

< 5% of Earth Observations used in AI models

EUR 15B+ annual EU investment in climate research requiring ethical AI governance

2024 Year EU AI Act entered into force — climate AI is now regulated

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Core Ethical Tensions — Four Challenges EU Regulation Addresses

Understanding why the EU built these safeguards

⚡ Speed vs. Rigor

Climate urgency pressures rapid deployment; EU AI Act's risk management requirements (Art. 9) enforce careful validation before real-world use of high-risk systems.

🌍 Global Reach vs. Local Equity

Models trained on European data applied globally. EU AI Act's non-discrimination requirements and GDPR's international transfer rules address this directly.

🔍 Performance vs. Explainability

EU Ethics Guidelines require transparency. The ALTAI checklist operationalises this — opaque models may fail EU trustworthiness requirements.

📊 Open Science vs. Data Protection

GDPR's purpose limitation and data minimisation constrain open sharing of training data. Tension built into Horizon Europe's open science mandate.

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The EU AI Regulatory Ecosystem — Five Interlocking Instruments

These instruments interact and reinforce each other — compliance with all five is required for EU-funded climate AI research.

GDPR (Reg. 2016/679)

Personal data in AI training, data subject rights, DPIAs. Applies to ALL projects handling personal data.

LEGAL BASIS

EU AI Act (Reg. 2024/1689)

Risk classification, obligations for high-risk AI, prohibitions, GPAI rules. Fully applies Aug 2026.

BINDING

Horizon Europe (Reg. 2021/695)

Art. 18–19: mandatory ethics obligations, ALLEA compliance, ethics self-assessment for all funded projects.

FUNDER REQ.

Ethics Guidelines & ALTAI (2019–2020)

7 requirements for Trustworthy AI + self-assessment checklist. Voluntary but referenced in AI Act.

GUIDANCE

INSPIRE Directive (2007/2/EC)

Geospatial data standards, metadata, interoperability — mandatory for EU climate and EO data.

GEODATA

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GDPR (Reg. 2016/679) — Core Principles for Climate AI

Applies to ANY processing of personal data — including data used to train AI models

⚠ GDPR applies to personal data. In climate AI this includes: household energy data, location traces, vulnerability surveys, crowdsourced annotations, and sensor data linked to individuals.

1 Lawfulness, Fairness & Transparency

Must have legal basis. Art. 6(1)(e) public interest or 6(1)(f) legitimate interest for research. Must inform participants about AI use.

2 Purpose Limitation

Data for one purpose cannot be reused for AI training without compatibility assessment. 'Climate monitoring' consent ≠ AI training consent.

3 Data Minimisation

Collect only what is strictly necessary. "Just in case" data collection is not a valid legal justification under GDPR.

4 Accuracy

Personal data must be accurate and kept up to date. Regular review of training datasets for outdated or incorrect records is required.

5 Storage Limitation

Cannot retain personal data indefinitely. Establish documented data retention policies before data collection begins — not after publication.

6 Integrity & Confidentiality

Pseudonymisation is GDPR-recommended for research — but pseudonymised data is STILL personal data under GDPR.

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GDPR — Part 2: DPIAs & Data Subject Rights in Practice

Article 35: Data Protection Impact Assessments are mandatory for high-risk processing

When is a DPIA Mandatory? (Art. 35)

- Systematic profiling with significant effects on individuals
- Large-scale processing of special category data (health, location)
- Systematic monitoring of publicly accessible areas
- Novel technologies — including AI — that may involve high risk
- Automated decisions about individuals

DPIA Process Steps

1 Describe the processing operation
2 Assess necessity & proportionality
3 Identify & assess risks to individuals
4 Identify risk mitigation measures
5 Consult DPO; submit to DPA if residual risk remains high

Data Subject Rights — Climate AI Implications

- **Right to Access:**
  Participants can request ALL their data used in your training set — can you retrieve it?
- **Right to Erasure:**
  'Right to be forgotten' — if someone withdraws, can you remove their data from a trained model? (machine unlearning challenge)
- **Right to Portability:**
  Data must be exportable in machine-readable format — affects how you store training data.
- **Right to Object to Automated Decisions:**
  Art. 22: individuals can object to automated decisions significantly affecting them.
- **Right to Explanation:**
  Art. 22 + Recital 71: 'meaningful information about the logic involved' — legal basis for XAI requirements.

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EU Ethics Guidelines: 7 Requirements for Trustworthy AI

EC High-Level Expert Group on AI (2019) — foundational to the EU AI Act

Trustworthy AI must be: (1) Lawful · (2) Ethical · (3) Robust

1 Human Agency & Oversight

Human-in-the-loop; protect fundamental rights; ensure human review of AI-driven decisions

2 Technical Robustness & Safety

Resilient, secure, accurate, reproducible; fallback plans for system failures

3 Privacy & Data Governance

Full GDPR compliance; data quality and integrity; legitimate access mechanisms

4 Transparency

Traceable data, models and decisions; explanations adapted to stakeholders; AI literacy

5 Diversity, Non-discrimination & Fairness

Avoid bias; accessible to all; involve diverse stakeholders throughout AI lifecycle

6 Societal & Environmental Well-being

Benefit all including future generations; sustainable, energy-efficient AI systems

7 Accountability

Auditability of algorithms, data & design; accessible redress mechanisms

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ALTAI: Assessment List for Trustworthy AI — Your Practical Checklist

EC AI HLEG (July 2020) — free, web-based, ~2–4 hours to complete

ALTAI translates the 7 requirements into concrete yes/no/partial questions. Web-based tool. Free. Increasingly required in Horizon Europe ethics deliverables. · digital-strategy.ec.europa.eu/altai

Human Agency

Is there a process for human oversight of AI decisions?

→ *Climate EWS: does a meteorologist review AI flood alerts before public issuing?*

Robustness

Have you tested performance under edge cases and distribution shifts?

→ *Has your wildfire AI been tested on years with unprecedented fire behaviour?*

Privacy

Have you completed a DPIA? Is training data documented with provenance?

→ *Household vulnerability data used in flood risk AI — DPIA needed before processing.*

Transparency

Can you explain the AI's decision in plain language to affected communities?

→ *Can you explain to a village leader why your model flagged their area as 'high risk'?*

Fairness

Have you tested for performance disparities across regions/income groups?

→ *Does your climate model perform equally in EU countries and partner developing nations?*

Environment

Have you estimated energy consumption and CO_2 of model training?

→ *Large models: document training compute in FLOPs and estimated kWh (mlco2.github.io).*

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EU AI Act (Reg. 2024/1689) — Risk Architecture & Prohibited AI (Art. 5)

Published OJ 12 July 2024 · In force 1 August 2024 · World's first comprehensive AI regulation

UNACCEPTABLE RISK — Prohibited under Art. 5

HIGH RISK — Regulated: Annex III use cases

LIMITED RISK — Transparency obligations (Art. 50)

MINIMAL RISK — Freely allowed (spam filters etc.)

Climate AI Relevance:

Flood management AI, drought early warning systems, and emergency resource allocation AI may fall under HIGH RISK (Annex III item 2 — critical infrastructure). Climate vulnerability maps that score households may approach social scoring prohibition if used for service allocation decisions.

Art. 5 — Prohibited AI Systems (selected)

- Subliminal/deceptive techniques causing significant harm
- Exploitation of vulnerabilities (age, disability, socioeconomic)
- Biometric categorisation inferring sensitive attributes (race, religion, sexual orientation)
- Social scoring by public or private entities
- Assessing crime risk based solely on profiling
- Compiling facial recognition databases by untargeted scraping
- Inferring emotions in workplaces or educational institutions
- Real-time remote biometric ID in public spaces (law enforcement exceptions)

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EU AI Act — High-Risk AI: Annex III Use Cases & Provider Obligations

Art. 6 & Art. 8–17: if your system is high-risk, substantial compliance obligations apply

Annex III High-Risk Use Cases (climate AI relevant)

Critical Infrastructure (item 2):

Safety components in management of water, gas, heating, electricity — flood/drought management AI likely qualifies.

Emergency Management (item 2):

Systems used to manage or coordinate emergency responses — climate early warning AI for public authorities.

Essential Services (item 5):

Systems affecting access to essential public services — climate resource allocation with individual-level decisions.

Important note:

A system that 'performs a narrow procedural task' or 'improves a previously completed human activity' may be exempt. Your system design choices matter.

Provider Obligations for High-Risk AI (Art. 8–17)

✓ **Risk Management System (Art. 9)**	Continuous lifecycle risk management
✓ **Data Governance (Art. 10)**	Training data: relevant, representative, error-free
✓ **Technical Documentation (Art. 11)**	Full documentation for regulatory inspection
✓ **Record-Keeping (Art. 12)**	Automatic logging of system events
✓ **Transparency (Art. 13)**	Instructions enabling human oversight
✓ **Human Oversight (Art. 14)**	Design must enable oversight measures
✓ **Accuracy, Robustness & Cybersecurity (Art. 15)**	Appropriate performance throughout lifecycle
✓ **Quality Management (Art. 17)**	Documented quality management system
✓ **Conformity Assessment (Art. 43)**	Before market placement: internal or 3rd-party

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EU AI Act — Implementation Timeline & General Purpose AI (GPAI)

Know what applies when — and whether you are using a GPAI model

Implementation Timeline

Aug 2024 → AI Act enters into force

Feb 2025 → Prohibitions (Art. 5) apply; AI Literacy

Aug 2025 → GPAI rules apply; governance

NOW Jun 2026 → Guidelines on high-risk classification

Aug 2026 → FULL application: high-risk AI

Aug 2027 → Existing high-risk AI must comply

GPAI Models (Chapter V)

All GPAI providers (ChatGPT, Gemini, Claude): technical documentation, instructions for use, Copyright Directive compliance, training data summary.

GPAI with systemic risk (≥10^{25} FLOPs): adversarial testing, incident reporting, cybersecurity measures.

What This Means for Your Research

PROVIDER (you deploy an AI system): check Annex III classification immediately.

USER/DEPLOYER (you use GPAI via API in a climate application): you have obligations too — especially if you configure, fine-tune, or deploy for safety-critical use cases.

Using pre-trained foundation models in climate AI creates shared responsibility.

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Horizon Europe (Reg. 2021/695) — Ethics Obligations for EU-Funded Research

Articles 18 & 19: mandatory for ALL Horizon Europe projects, including climate & earth science

If your research is funded by Horizon Europe — including this summer school project — Articles 18–19 are legally binding. Non-compliance can lead to financial penalties, suspension, or termination of the grant.

Article 19 — Guiding Principles

"Actions shall comply with ethical principles and relevant Union, national and international legislation, including the Charter of Fundamental Rights of the EU."

Particular attention to:

- Principle of proportionality
- Right to privacy & protection of personal data
- Right to physical and mental integrity
- Right to non-discrimination
- Need to ensure protection of the environment ← unique in EU research law
- Need to ensure high levels of human health protection

Mandatory Ethics Process

Proposal	Complete Ethics Issues Table (Section 4, Part A). YES to any question → complete Ethics Self-Assessment.
Grant Signature	Ethics conditions added to Grant Agreement. Project must fulfil them before starting affected activities.
GAP Invitation	'Grant Agreement Preparation' may include Ethics Review — independent expert panel. Can take 3–6 months.
Project Execution	Before ANY ethics-flagged task: obtain required approvals (DPA, DPIA, ethics committee). Document everything.
Final Report	Report on how ethics issues were addressed. No ethics violations = criterion for final payment.

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INSPIRE Directive, EU Open Science & GDPR for Geospatial Data

EU obligations specifically relevant to climate and Earth observation data

INSPIRE Directive (2007/2/EC)

- EU spatial data infrastructure directive — mandatory for EU public bodies
- 34 spatial data themes including meteorology, natural risk zones, energy resources
- Requires metadata (ISO 19115/19139), interoperability, data sharing
- Climate EO data for public bodies: must be INSPIRE-compliant
- Ethics link: INSPIRE transparency requirements align with ALTAI Req. 4

EU Open Science & Data Mandate

- Horizon Europe: Open Access to publications (immediate) and open research data
- 'As open as possible, as closed as necessary' — GDPR provides legitimate reason to restrict
- Data Management Plan (DMP) mandatory — FAIR principles, sharing timeline, GDPR constraints
- Recommended repositories: PANGAEA (ocean/climate), Zenodo (general), institutional
- Open model weights ≠ open training data: check GDPR before publishing datasets

Where GDPR Meets Geospatial Data

- GPS traces, mobile sensor data, drone imagery of individuals = personal data
- Aggregated, truly anonymised spatial statistics = not personal data (high bar)
- Special sensitivities: imagery of refugee camps, informal settlements, conflict zones
- Satellite imagery can re-identify individuals at high resolution (<0.5m/px)
- Dual-use risk: vulnerability maps can enable surveillance or targeting of communities

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International Frameworks — UNESCO · OECD · ALLEA · Helsinki

UNESCO (2021) · OECD (2019) · WMA Helsinki (2024) · ALLEA (2023)

UNESCO Recommendation on AI Ethics (2021)

- First globally adopted AI ethics instrument — 193 member states
- Explicitly includes environmental & ecosystem protection — unique
- Key for EU researchers working with Global South partners
- Environmental protection as an AI ethics principle

OECD AI Principles (2019)

- Adopted by 42+ countries including all EU member states
- Inclusive growth, human-centred values, transparency, robustness, accountability
- Common language for international research partnerships
- OECD AI Policy Observatory tracks national implementation

ALLEA Code of Conduct (2023)

- Reliability, Honesty, Respect, Accountability — four pillars
- MANDATORY for all Horizon Europe projects (Article 18 Reg. 2021/695)
- Covers: reproducibility, data provenance, AI-specific reporting
- Applies to ALL EU-funded researchers regardless of field

WMA Helsinki Declaration (2024)

- Applies when climate AI uses identifiable human data
- Relevant for: vulnerability surveys, crowdsourced annotations
- Informed consent, ethics committee approval required
- 2024 revision strengthened protections for vulnerable populations

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Data Ethics & Bias in Earth Observations

Biased data → biased models → unjust outcomes — and EU law requires you to address this

Types of Bias in Climate AI

- **Spatial Bias:**

186 avalanche stations in Swiss Alps vs. 26 in Himalayas. Models trained on Swiss data underperform in Asia — communities lose warning quality. (Kuglitsch et al., 2023)

- **Temporal Bias:**

Short EO records for slow-onset hazards (earthquakes recur 100–1000 yr); rare extreme events are underrepresented in AI training sets.

- **Class Imbalance:**

Extreme events are rare by definition; AI models see mostly 'normal' conditions. Use oversampling, synthetic data, or cost-sensitive learning.

- **Label/Annotation Bias:**

Crowdsourced labels reflect annotator demographics and knowledge. Quality control and diverse annotator pools are essential.

EU Legal Hooks on Data Quality

EU AI Act Art. 10	High-risk AI training data must be 'relevant, sufficiently representative, and to the best extent possible, free of errors and complete'
GDPR Art. 5(1)(d)	Accuracy principle: personal data must be accurate; if inaccurate, erased or rectified without delay
ALTAI Checklist	Asks: have you tested for biases? Have you considered geographic/demographic distribution of training data?
EU AI Ethics Req. 5	Diversity and non-discrimination: AI must avoid unfair bias causing negative impacts, including marginalisation
Horiz. Europe Grant	Art. 14 Annex 5: activities must comply with EU values and not discriminate — extends to AI training data choices

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Explainability & Transparency — A Legal AND Scientific Obligation

From EU AI Act Art. 13–14 to GDPR Art. 22 — plus a cautionary tale from the field

"XAI methods can build trust in AI model results and encourage greater adoption of AI methods in geoscience."

Dramsch, Kuglitsch et al. Nat.Geosci. 2025

EU Legal Requirements

- GDPR Art. 22: right to 'meaningful information about the logic involved' in automated decisions
- EU AI Act Art. 13: high-risk AI must provide interpretable output
- EU AI Act Art. 14: human oversight requires understandable AI
- ALTAI Req. 4: explanations adapted to each stakeholder
- Only 6.1% of geoscience AI papers reference XAI (Dramsch et al. 2025)

XAI Methods

- SHAP: feature importance, model-agnostic
- GradCAM / saliency maps: satellite / spatial data
- Concept relevance propagation: abstract human-readable explanations
- White box first: causal trees, interpretable regression
- Local: why this prediction? Global: why does system repeatedly fail?

Practical Guidance

- Choose XAI method BEFORE model architecture
- Validate XAI outputs against domain physics
- Document XAI choices in technical documentation (Art. 11)
- Funders, reviewers and deployers should explicitly demand XAI
- Integrate XAI from the start — not as afterthought

Contrasting Cases

✗ Black box failure

Google Android Earthquake Alert — Kahramanmaraş 2023: alerts patchy despite all favourable conditions. Lack of transparency made failure impossible to diagnose.
(Kuglitsch et al., Eos 2024)

✓ Transparent system

USGS ShakeAlert: named seismometer network, published algorithm, publicly accountable institution. Users and researchers can independently audit it.

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AI Across the Four Phases of Disaster Management

AI can contribute at every phase — but each phase has specific transparency requirements and failure risks. · Kuglitsch et al., Eos (2024)

🛡 MITIGATION

Actions taken well in advance of disaster

Key AI examples:

- One Concern: AI + digital twins Japan
- DestinE: Earth system digital twins + ML
- Gazzea et al. (2023): traffic sensor optimisation
- AI landslide susceptibility maps

🔍 Transparency need:

Document training geography & limitations; disclose how maps drive decisions.

📡 PREPAREDNESS

Forecasting & monitoring as disaster becomes imminent

Key AI examples:

- ECMWF AIFS, GraphCast, FourCastNet, Pangu-Weather
- AltaML: wildfire prediction
- ALERTCalifornia: 77 fires before 911 calls
- Pano AI: camera + satellite + sensor fusion

🔍 Transparency need:

Communicate forecast uncertainty. Document thresholds. Report known failure modes (Pangu-Weather: smooth forecasts, cyclone intensity issues — Ben Bouallègue et al. 2024).

🚨 RESPONSE

Actions taken during a disaster

Key AI examples:

- Social media clustering (Powers et al. 2023)
- AIDERS project: RPAS drone sensor data
- AI chatbots: guidance & decision support
- ⚠ RISK: chatbot hallucination can be lethal

🔍 Transparency need:

Human-in-the-loop verification critical. Clearly label AI-generated vs. human-verified information.

🔄 RECOVERY

Actions after most damage has occurred

Key AI examples:

- Pre/post satellite imagery diff (Kaur et al. 2023)
- AI-assisted debris removal optimisation
- Infrastructure damage classification

🔍 Transparency need:

Document model performance on specific disaster type. Uncertainty bounds must accompany all damage estimates.

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Cultivating Trust: Steps Toward Transparency in AI for DRR

From documentation to auditing to collaboration — Kuglitsch et al., Eos (2024)

1 FAIR Documentation

Open-access metadata, data sheets & model cards. Disclose: origins, processing, quality issues, biases, privacy considerations, and whether data is equitably shared.

EU law *EU AI Act Art. 11; GDPR Art. 30*

2 Model Cards

Short document documenting modeling methods, decisions, limitations, and ethical considerations. Published on GitHub/GitLab. Mitchell et al. (2019) is the reference.

EU law *EU AI Act Art. 11 & 13; ALTAI Req. 4*

3 White Box or Explained Black Box

Prefer interpretable algorithms. When complexity is needed, combine black-box models with XAI. Local: why this prediction? Global: why does system repeatedly fail?

EU law *GDPR Art. 22; EU AI Act Art. 13–14*

4 Communicate Uncertainty & Thresholds

When operationally deployed: what uncertainty is tolerable? What threshold triggers a flash flood alert? What technical requirements must be met? Silence = hidden risk.

EU law *EU AI Act Art. 13; ALTAI Req. 2*

5 Regular Independent Audits

Periodic audits using relevant performance metrics and fairness benchmarks. Public reporting of findings. Proactive — not just reactive incident reporting.

EU law *EU AI Act Art. 61–62; Art. 72 (incident reporting)*

6 Stakeholder & End-User Integration

Multi-party interdisciplinary collaboration. Harmonised terminology (FG-AI4NDM → UN Global Initiative). EU AI Act + Executive Orders provide policy framework.

EU law *EU AI Act Art. 4 (AI literacy); HEU Art. 14*

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Case Study: UNICORN — EU Ethics Compliance in Practice

UNICORN (Copernicus Emergency Applications for Resilience, HE-101180172): D1.4 GDPR, Gender Balance & Ethical Issues Management Plan (March 2025) — every element maps to a specific legal or contractual obligation.

Horizon Europe — **Ethics Manager**

Appointed from project start. Responsible for ethical conduct within consortium AND stakeholder/citizen engagement.

GDPR Art. 56 — **GDPR Lead Authority**

German Federal Commissioner (BfDI) identified as lead supervisory authority. Project registered in Germany. Data processing inventory (Art. 30) completed.

HEU Eligibility Criterion — **Gender Equality Plan**

43% women / 57% men; 60% of Work Packages led by women; Project Coordinator is a woman. Gender-neutral language in all communications.

ALTAI & HEU Ethics — **Dual Use Assessment**

Copernicus emergency data assessed for dual-use risk. Conclusion: low direct risk, but satellite surveillance potential noted and documented.

Art. 18 Reg. 2021/695 — **Ethics Self-Assessment**

Completed at proposal stage. Systematic screening for privacy, dual use, vulnerable populations, environmental ethics. Required before grant agreement.

GDPR Art. 30 — **Data Processing Inventory**

Catalogue of all personal data types processed, legal basis for each, and assigned data controllers — mandatory for all processing activities in the project.

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Case Studies: AI for DRR — EU Regulatory Dimensions

Real examples from the field with EU regulatory implications (Kuglitsch et al., 2022, 2023)

Hazard	AI Achievement	Ethical Concern	EU Regulatory Hook
Tsunamis	GNSS + AI predicts amplitude without magnitude saturation	Data not shared by some countries — people at risk lose warning time.	EU AI Act Art. 14: human oversight. GDPR: GNSS data transfers. WMO Unified Data Policy.
Volcanoes	ML detects seismic events for early warning (VULCAN.ears)	Data monopolies hurt forecasts — Goma eruption: European data access issues delayed warnings.	EU AI Act Annex III: safety-critical. INSPIRE: shared geophysical data standards.
Avalanches	AI + infrasound sensors: real-time detection (Swiss Alps)	186 stations Swiss Alps vs. 26 Himalayas — models don't transfer; communities underserved.	EU AI Act Art. 10: representative training data. ALTAI Req. 5: non-discrimination.
Floods	FloodSENS: automated ML flood mapping from satellite	Tested only Mozambique/Hungary — unknown performance elsewhere; premature deployment risk.	EU AI Act Art. 9: out-of-distribution risk management. GDPR: settlement data.
Infrastructure	Satellite AI detects road closures post-hurricane (Gazzea et al. 2023)	Training on Florida data only; other regions may receive unreliable guidance.	EU AI Act Art. 10: geographic representativeness. ALTAI Req. 2: robustness.

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Gender Balance, Diversity & EU Equality Obligations

UNICORN (2025): 43% women / 57% men — 60% of Work Packages led by women — Project Coordinator is a woman | GEP mandatory for Horizon Europe applicants from public organisations

EU Legal Basis

- Horizon Europe: Gender Equality Plan (GEP) mandatory eligibility criterion for public bodies and research organisations
- EU Charter Art. 21: non-discrimination on grounds of sex
- EU AI Act / ALTAI Req. 5: AI systems must be accessible to all, avoid discriminatory bias
- Horizon Europe Art. 14 Grant Agreement: research must comply with EU values including gender equality

Why Diversity Improves Climate AI

- Diverse teams detect algorithmic biases that homogeneous teams miss
- Disasters disproportionately affect women & children (Sendai Framework) — AI must capture this
- AI trained without gender-disaggregated data misses differential vulnerability
- Climate risk maps must reflect gendered dimensions of exposure and adaptive capacity

What You Must Do

- Use gender-inclusive language in publications, datasets, and communications
- Include gender dimension in research content — not just team composition
- Publish open access: remove barriers for Global South researchers
- Credit all contributors: data collectors, annotators, local experts
- Apply GEP to your team: equal opportunities in hiring, supervision, speaking roles

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Your EU Compliance Toolkit — Concrete Actions for Climate AI Researchers

Six mandatory or strongly recommended instruments with direct links

Mandatory **ALTAI Self-Assessment**

Map your AI to the 7 requirements. Web-based, 2–4 hours. Increasingly required in Horizon Europe deliverables. digital-strategy.ec.europa.eu/altai

Mandatory if high risk **Data Protection Impact Assessment (DPIA)**

GDPR Art. 35: conduct BEFORE data collection. Use EDPS or DPA templates. Consult your institution's DPO. edps.europa.eu/dpia

Mandatory **Horizon Europe Ethics Self-Assessment**

Answer the ethics questions table at submission. If any YES: complete ethics self-assessment in Part B. Do not leave this to the last minute.

Mandatory **Data Management Plan (DMP)**

Required by Horizon Europe. Cover FAIR principles, data sharing, GDPR constraints, retention policy. Use the DMP template from the Funding & Tenders portal.

Best Practice **Model Card**

Document your AI model: training data, evaluation, performance gaps, known limitations, ethical considerations. Increasingly required by top ML venues. Mitchell et al. (2019).

Mandatory if High Risk **Technical Documentation (Art. 11)**

For high-risk AI: full technical documentation required before market placement. Covers: purpose, performance, training data, architecture, risk management. Start from Day 1.

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Group Discussion: EU Regulatory Dilemmas in Climate AI

Discuss in pairs — 3 minutes · then share with the group

Scenario A: The High-Risk Ambiguity

Your AI system predicts which households are most vulnerable to flooding and informs the allocation of municipal emergency resources. Is this HIGH RISK under EU AI Act Annex III? If yes, what documentation do you need before deploying?

Scenario B: The GDPR Purpose Clash

You trained a wildfire risk model on household income census data collected under GDPR's 'public interest' legal basis. A partner institution wants to use your model and training data. What GDPR issues arise?

Scenario C: The Horizon Europe Ethics Gap

Your project is 18 months in. You realise your AI drought prediction model uses GPS traces of farmers who consented to 'agricultural monitoring' — not AI training. What are your obligations under Reg. 2021/695 and GDPR?

Scenario D: The ALTAI Failure

Your flood early warning AI scores 88% in France and Germany but 59% in Romania. ALTAI Req. 5 flags non-discrimination concerns. You are 3 months from project end and the Commission expects a deployment demo. What do you do?

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Key Takeaways — What Every EU-Funded Climate AI Researcher Must Know

1 You are regulated.

GDPR, EU AI Act, and Horizon Europe Regulation 2021/695 all apply to your research. Learn which obligations are mandatory BEFORE starting.

2 Ethics starts early.

DPIAs, ethics self-assessments, and data governance must be planned at proposal stage, not retrofitted at project end.

3 Your data has legal constraints.

Purpose limitation, data minimisation, and accuracy principles mean your training datasets need documented provenance and consent chains.

4 XAI is a legal requirement.

GDPR Art. 22 and AI Act Art. 13–14 create genuine explainability obligations for AI affecting individuals — not just best practice.

5 Bias is a compliance issue.

EU AI Act Art. 10 requires high-risk training data to be representative. Spatial bias in EO data = potential non-compliance.

6 Document everything.

Technical documentation, model cards, DPIA records, ethics committee approvals — these are not bureaucratic burdens, they are your legal shield.

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Key References & Resources

EU Regulation & Governance

- EU AI Act (Reg. 2024/1689) — artificialintelligenceact.eu
- EU HLEG Ethics Guidelines for Trustworthy AI (2019) — digital-strategy.ec.europa.eu
- ALTAI Self-Assessment Checklist (2020) — digital-strategy.ec.europa.eu/altai
- GDPR (Reg. 2016/679) & DPIA guide — edps.europa.eu
- Horizon Europe Reg. (EU) 2021/695 Articles 18–19
- INSPIRE Directive (2007/2/EC) — inspire.ec.europa.eu

International Frameworks

- UNESCO Recommendation on AI Ethics (2021) — unesdoc.unesco.org
- OECD AI Principles (2019) — oecd.org/going-digital/ai/principles
- ALLEA Code of Conduct for Research Integrity (2023) — allea.org
- WMA Declaration of Helsinki (2024, 75th Assembly) — wma.net

Scientific Papers

- **Kuglitsch et al. (2024) EOS 105 — Cultivating Trust in AI for DRR ← KEY**
- Dramsch et al. (2025) Nat. Geosci. 18, 112–114 — XAI in geoscience
- Kuglitsch et al. (2023) Environ. Res. Lett. 18, 093004 — EO in AI for DRR
- Kuglitsch et al. (2022) Nat. Commun. 13, 1579 — Collaboration in AI/DRR
- Ben Bouallègue et al. (2024) BAMS 105(6) — AI weather forecasting limitations
- Mitchell et al. (2019) ACM FAT* — Model Cards

Projects & Practical Tools

- UNICORN D1.4: GDPR, Gender & Ethics Plan (2025, HE-101180172)
- ML CO2 Calculator — mlco2.github.io
- GO FAIR Principles — go-fair.org
- ITU/WMO FG-AI4NDM / UN Global Initiative — itu.int/ai4ndm
- EU Funding & Tenders ethics guide — ec.europa.eu
- CONVERGENCE/FERMI materials — convergence.gr

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STRENGTHENING THE RESEARCH CAPACITIES
FOR EXTREME WEATHER EVENTS IN ROMANIA

Thank you very much!

Elena Xoplaki

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