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Commissariat Général au Développement Durable

Supporting AI for the environmental transition while measuring and reducing the environmental impact of AI

The strategy of the French Ministry of Ecological Transition

ISO/IEC Workshops

June 4th 2024

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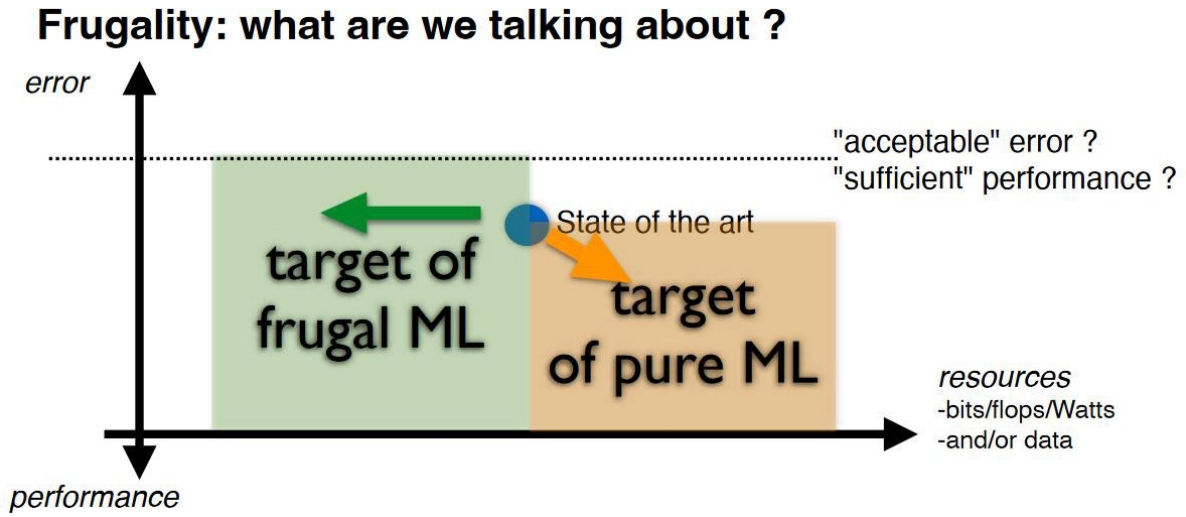
Contents

- French ecosystem on sustainable AI: research institutes, companies, public sector
- AI & Ecological Transition Roadmap for the French Government
- Feedback from a national work group on environmental impact of AI

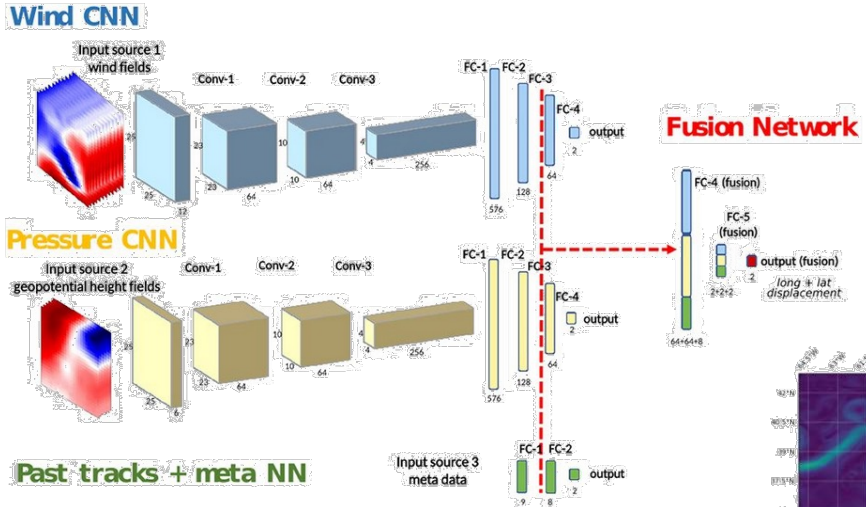
Research – Environmental impact of AI

- EcoInfo: grouping of units of research in CNRS, especially on environmental impact of digital sector
- Research program on Frugal AI:
  - SHARP : frugal models with same performance
  - HOLIGRAIL : energy efficiency of AI algorithms when running inference and training algorithms on specialized hardware.

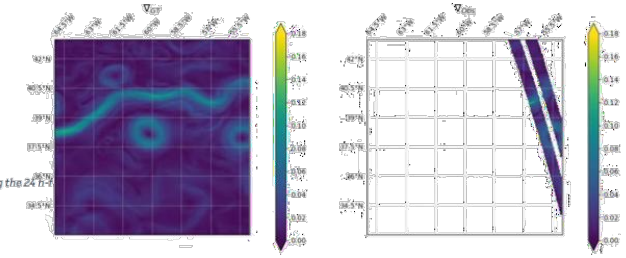


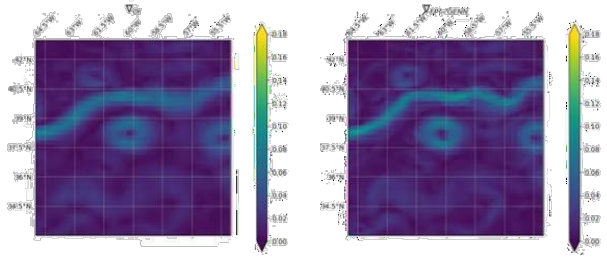
Research – AI for ecological transition

- Arches : AI research for climate change and environmental sustainabily (research team in INRIA)
- OceaniX : Physics-Informed AI for Observation-driven Ocean AnalytiX



General architecture: the three types of data feed three neural networks trained separately. The final fused network is re-trained before predicting the 24 h-displacement. CNN = Convolution Neural Network. (Giffard-Roisin et al., 2020).





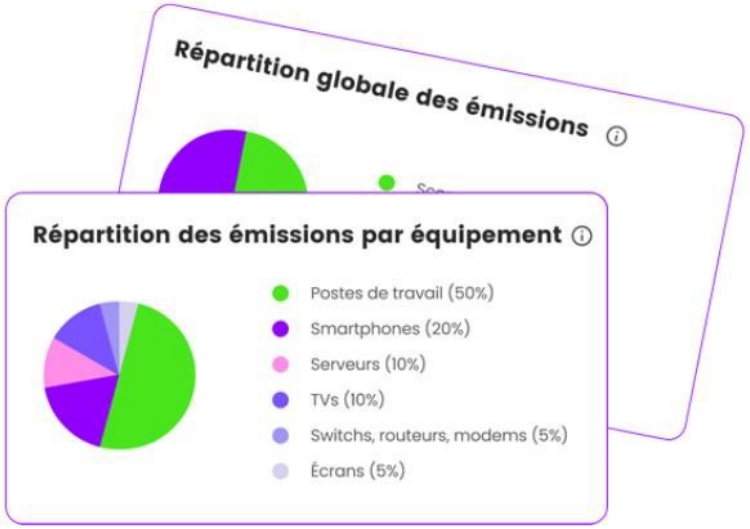
Velocities of the altimetric fields issued from satellite data using 4DVarNN framework

Companies – Environmental impact of AI

Efforts towards smaller language models with competing performances

Market segment on measure of environmental impact of digital services -> shift towards AI

CroissantLLM: A Truly Bilingual French-English Language Model



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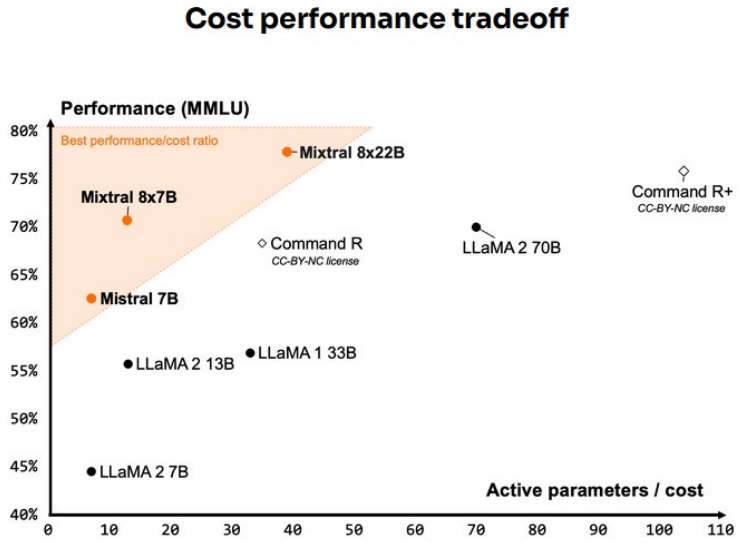

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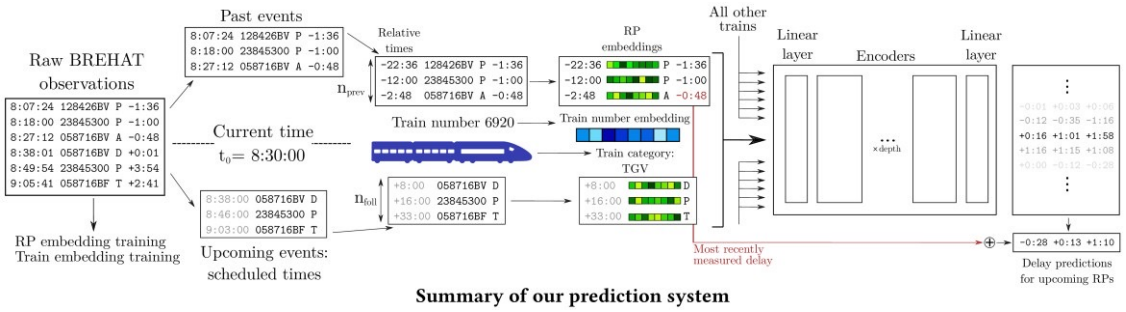
Companies – AI for ecological transition

- Greentech Innovation Initiative: label from the Ministry to a number of startups and SMEs to encourage public buyers
- Big players in transportation (SNCF, RATP), energy (EDF, RTE) and water management (Suez) for predictive management of infrastructures and optimization of resources



Architecture Transformer © SNCF

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Public sector – AI for ecological transition

- National strategy for AI: AI & ecological transition, one of our 4 priorities (with Edge AI, Trustworthy AI and Generative AI)
- Monitoring of land artificialization, weather predictions, conversational agents related to ecological transition knowledge, planification of energy renovations
- Cost-benefit analysis
- Development in-house (state-level) or with private providers (local level)
- Specific AI & environmental transition roadmap

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AI & Ecological Transition Roadmap

Axis 1: Make high-quality data accessible on the topics of ecological transition

Axis 2: Accelerate the ecological transition through the use of AI by local authorities

Axis 3: Support innovative AI & environment ecosystems in the private sector

Axis 4: Support the development of AI services to answer the need of public authorities working in environment

Axis 5: Support the evaluation of projects with regard to their ethical and environmental aspects

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Public sector – Environmental impact of AI

- Environmental impact of the digital sector in France (2022-2023), Ademe-Arcep
- Cost-benefit analysis in funding programs, mandatory to use Green Algorithms
- AI consumes energy, water and resources, and emits greenhouse gases, but little reliable data and no shared methodologies
- Uncomparable answers -> we need a shared methodology

Goals of a shared methodology

- Give a framework to economic players (actionable, concrete framework), especially in the context of funding programs
- Propose a first level of consensus on frugal AI for the public and private sector
- Ensure the development of AI systems respect a cost-benefit analysis in terms of environmental impact

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Work group on sustainable AI

- Start: January 15th
- End: May 21st
- 4 plenaries
- 1 meeting each week or every two weeks in subgroups
- 3 subgroups: terminology & communication, indicators and calculation methods, good practices

Content

Environmental assessment methodology

- Direct impacts due to the life cycle of equipment (first order)
  - Functional unit
  - Perimeter and boundaries of the system
  - Allocation rules
  - Collection of inventory data
  - Choice of environmental impact calculation methodologies
  - Environmental indicators
  - Tools and databases that can be used
- Indirect impacts linked to the use of the service (second order and higher orders)
- Limitations of the proposed methodology

Best practices

Methodological approach

Description of good practices

Summary of good practices

Top best practices

Progress of a frugal AI project

To go further

Communication

Quantitative assessment of environmental indicators over the life cycle

Frugal AI service

Frugal AI service with positive impact

Debates

- Definition of frugal AI
  - Difference between efficiency and frugality
- Main indicators for environmental impact of AI
  - Include water?
- Identification of the very best practices
  - Impossible to measure
- Communication expectations
  - Frugal AI: not only an evaluation of indicators

Conclusion

- Frugal or sustainable AI : a differentiating factor for companies
- Need for a framework to measure and communicate on sustainable AI
- CEN/CENELEC JTC21: maybe a future standard on environmental impact of AI

AI Act

- Article 40 : The standardisation request shall also ask for deliverables on **reporting and documentation processes** to improve AI systems' resource performance, such as **reducing the high-risk AI system's consumption of energy and of other resources during its lifecycle**, and on the energy-efficient development of general-purpose AI models.
- Article 95 : The AI Office and the Member States shall facilitate the drawing up of codes of conduct concerning the voluntary application, including by deployers, of specific requirements to all AI systems, on the basis of clear objectives and key performance indicators to measure the achievement of those objectives, including elements such as, but not limited to: […] (b) **assessing and minimising the impact of AI systems on environmental sustainability, including as regards energy-efficient programming and techniques for the efficient design, training and use of AI**

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Preliminary Work Item – CEN/CENELEC JTC 21 WG 4

- Define guidelines around calculation methods and good practices to address and reduce the environmental impact of artificial intelligence.
- Provide easy-to-use tools for businesses and organizations to understand and lead actions around their development and use of artificial intelligence systems.
- Address the gap in the normative literature in terms of shared calculation methods, with the same perimeters (training, inferences) and consensual good practices for developers and clients of AI.