ARNAUD CERBELAUD

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Career Summary

I am a graduate engineer from both the French **Ecole Polytechnique** and **ENSAE ParisTech** from France. Between 2015 and 2019, I worked for the French National Institute of Statistics and Economics Studies in Paris, France. Embracing a new career path, I underwent a second **MS degree in Meteorology, Oceanography and Remote Sensing** at **Sorbonne Université Paris VI** in 2020. My research interests now focus on the **use of earth observation instruments in freshwater-related research**. I particularly seek to participate in highly motivated research activities on the application of **satellite remote sensing to study Earth surface water stores and fluxes**, including physics-based modeling.

Current Position: **Postdoctoral Fellow @ NASA's JPL - Caltech** (Pasadena, CA)

Education

- **2020 - 2023** ▪ **ISAE-Supaéro & Université Toulouse III - Paul Sabatier**
  PhD Fellow in Earth & Space Sciences at Onera, The French Aerospace Lab & CNES, the French National Space Agency ▪ Toulouse, France
  Pluvial flood detection using optical & SAR satellite remote sensing and machine learning techniques for the evaluation of surface runoff susceptibility mapping models.
  PhD director: X. Briottet (Onera).   Supervisors: L. Roupioz (Onera), G. Blanchet (CNES), P. Breil (INRAE).

- **2019-2020** ▪ **Sorbonne Université Paris VI, Pierre-et-Marie-Curie**
  MS in Meteorology, Oceanography, Climate and Remote Sensing ▪ Paris, France
  Honored as Valedictorian ▪ Master Thesis: Contribution of the WRF-Hydro hydro-meteorological model to understanding the hydrological cycle in New Caledonia ▪ **Institute of Research and Development (IRD) Nouméa**, New Caledonia (6 months).
  Thesis director: C. Menkes.   Advisors: J. Lefèvre, P. Genthon.

- **2013-2015** ▪ **École Polytechnique & ENSAE ParisTech**
  MS in Data Sciences and Econometrics ▪ Paris, France
  Master Thesis: How to motivate biased agents to acquire and transmit information under uncertainty? ▪ **Columbia University in the city of New York**, USA (6 months). Thesis director: Pr. Charles Angelucci.

- **2009-2013** ▪ **Collège Stanislas & École Polytechnique**
  BS in Engineering ▪ Paris and Palaiseau, France
  Highly advanced multidisciplinary studies in mathematics, mechanics, physics, chemistry ▪ Ranked among the top 1% students sitting for the Top French Scientific *Grandes Ecoles* annual entrance exams (2011) ▪ Military service in the Air Force Paratroopers (2012).

Work Experience

- **2016-2019** ▪ **French National Institute of Statistics (INSEE) - Budget & Treasury Directorate General**
  Deputy Head of Office in charge of Public Finance Forecasts ▪ Paris, France
  Working alongside the Cabinet of the French Minister of Economics and Finance on the evolution and sustainability of the French Public Debt and Deficit. Head of office: M. Laurent Pichard - M. Harry Partouche.

- **2015-2016** ▪ **O.E.C.D, Economics Department, Structural Surveillance Division**
  Research Assistant in Macroeconometrics ▪ Paris, France
  Impact of structural reforms on sub-components of GDP in OECD countries. Advisor: Dr. Balazs Egert.

Awards and Honors

- **French Air Force National Defense Medal**, Bronze Level (2013).
- ***"My PhD from Space" award*** for the 9th annual thematic meeting of the French National Remote Sensing Program (PNTS/CNRS) for best 3-minute PhD presentation (2022). Awarded resource: 2.000€.

Teaching Experience

- **2016-2019** ▪ **French Ministry of Economics and Finance - *École Nationale d'Administration* (ENA)**
  Various teaching experiences as Deputy head of Public Finance Forecasts office (~ 20h yearly).

- o **2022-2023** ▪ <u>Université Toulouse III - Paul Sabatier</u>
  Master's level courses in: Image processing (6h) ▪ Classification & Machine Learning (16h) (coming)

Research Overview

- o <u>**2020-2023**</u> ▪ <u>Pluvial flood detection using high resolution multitemporal optical and SAR satellite imagery and machine learning. Assessment of overland flow hydrological models (PhD thesis)</u>:
  Pluvial floods (PFs) caused by extreme overland flow of rainwater account for half of all flood damage claims each year, equally with fluvial floods (FFs). Several types of hydrological approaches have been elaborated to map susceptibility towards the occurrence of intense surface runoff. Comprehensive evaluation of these models requires that they be confronted with proxy data of runoff-related damages and rainfall radar measurements from past events. For this, I am developing transposable tools involving image processing and machine/deep learning techniques (GPC, Random Forest, U-net CNN) based on satellite remote sensing (*Sentinel*-1 and 2, *Pléiades*). Using the resulting high-performing damage proxy maps of PFs and the measured radar rainfall intensities on multiple extreme weather events, the French IRIP© geomatics model was found highly relevant to implement better prevention strategies against PF-related hazards. Improvements to IRIP's core framework were also suggested. Because pluvial floods are directly related to local rainfall, radar precipitation downscaling will also be achieved by informing rainfall stochastic simulators on the spatial distribution of pluvial floods according to runoff susceptibility.

- o <u>**2020**</u> ▪ <u>Contribution of the WRF-Hydro hydro-meteorological model to understanding the hydrologi-cal cycle in New Caledonia (Master thesis)</u>:
  In the context of a projected reduction of extreme precipitation events by ~ 20% by 2100 combined to large land cover variability, I implemented, calibrated and assessed the WRF-Hydro physics-based distributed hydro-meteorological model over the French tropical island of New Caledonia. The model showed very consistent water budget components for simulated flash-floods (90%) and adjusted physical parameters matched known watershed morphological and hydrological features. Spatial patterns of soil moisture and flood hydrograph decomposition led to improved understanding of watershed behavior and even to a revision of infiltration properties for one of them, which will contribute to better model the water cycle under climate change and land cover transformations in New Caledonia.

Skills and Qualifications

- o <u>**Hard skills**</u>
  <u>IT:</u> Python, R, Visual Basic 6+ yrs ▪ SAS/SQL, Stata 3+ yrs. ▪ Fortran, Matlab, Eviews, Javascript, CSS, HTML 2+ yrs. ▪ LATEX, Microsoft Office 8+ yrs.
  <u>Geospatial statistical analysis:</u> SciPy, Statsmodel, Scikit-Learn, Keras, TensorFlow   4+ yrs.
  <u>Geographical Information System and hydrological modeling</u>: QGIS, GRASS, SAGA   4+ yrs.
  <u>Multispectral and multi-sensor image processing:</u> Coregistration, spectral, gdal, skimage   3+ yrs.
  <u>English C2</u> (proficient) and <u>Spanish B1</u> (intermediate)

- o <u>**Soft skills:**</u> Meticulous, disciplined and demanding ▪ Highly adaptable, rigorous and autonomous in problem-solving, analysis and scientific writing on various research topics ▪ Trustworthy, benevolent and warm in the workplace ▪ Well-appreciated by colleagues.

Selected peer-reviewed publications

- o **(2023) Cerbelaud, A.**, et al. Mapping pluvial flood-Induced damages with multi-sensor optical remote sensing: A transferable approach. *Remote Sens.* 15 (9), 2361. https://doi.org/10.3390/rs15092361.
- o **(2022) Cerbelaud, A.** et al. Assessment of the WRF-Hydro uncoupled hydro-meteorological model on flashy watersheds of the Grande Terre tropical island of New Caledonia (South-West Pacific). *J. Hydrol. Reg. Stud.* 40, 101003. DOI: 10.1016/j.ejrh.2022.101003.
- o **(2022) Cerbelaud, A.** et al. Proxy data of surface water floods in rural areas: application to the evaluation of the IRIP intense runoff mapping method based on satellite remote sensing and rainfall radar. *Water* 14 (3), 393. DOI: 10.3390/w14030393.
- o **(2021) Cerbelaud, A.** et al. A repeatable change detection approach to map extreme storm-related damages caused by intense surface runoff based on optical and SAR remote sensing: evidence from three case studies in the South of France. *ISPRS J. Photogramm. Remote Sens.* 182, 153-175. DOI: 10.1016/j.isprsjprs.2021.10.013.

Communications

- o **(2023)** EGU General Assembly 2023, Vienna, Austria. 24–28 Apr 2023, EGU23-12249, https://doi.org/10.5194/egusphere-egu23-12249.
- o **(2022)** 17th Plinius EGU Conference on Mediterranean Risks, 18–21 Oct 2022, Frascati, Italy. DOI:10.5194/egusphere-plinius17-68.
- o **(2022)** Paper and oral presentation at the 22nd Onera/DLR Symposium (ODAS), 1-3 June 2022, Hamburg, Germany.
- o **(2022)** Poster at the Living Planet Symposium LPS22, 23-27 May 2022, Bonn, Germany.
- o **(2022)** 9th annual thematic meeting of the French National Remote Sensing Program, 1 April 2022, Virtual.
- o **(2021)** EGU General Assembly 2021, online, 19-30 Apr 2021, EGU21-344. DOI: 10.5194/egusphere-egu21-344.
- o **(2021)** ISPRS Conference 2021, online, 5-9 Jul 2021. Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci. XLIII-B3-2021, 693–700. DOI: 10.5194/isprs-archives-XLIII-B3-2021-693-2021.