Workshop BRUIT-FM
4 March 2025, IPGP
Minutes

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Participants

On site:

Stephan Ker, Richard Dréo, Wayne Crawford, Laurent Duval, Véronique Farra, Mohammed Amin Aminian, Eléonore Stutzmann, Zongbo Xu, Deva Priyan

Online:

Guilhem Barruol, Sara Bazin, Fabrice Ardhuin, Flore Samaran, J-Y Royer.

Presentations and Videos

Are available at the RESANA BRUIT-FM workspace, under Meetings/2025.YearThree/Presentations/ and Meetings/2025.YearThree/Videos/

Administrative information

- Actions
  - Year 3 report written, available on website
  - Consortium reorganized
    - Money from Exail now at IPGP
    - Consortium agreement not yet signed: no reimbursement for Ifremer
  - 1 article published and 3 submitted in last year (see yearly report)
  - Various presentations at conferences (see yearly report), including "advertisements" for the Bruit-FM challenge
- Budget
  - Y3 spent: 15k€ missions, 0k€ external contracts, 82k€ personnel (IE and postdoc salaries)
  - Y4 remaining: 16k€ missions, 65 k€ external contracts, 4 k€ equipement, 54k€ personnel (90k€ - Dreo+Xu commited up to Oct 2025). Priorities are :
    - **Missions** : M Schimmel visits, signal processing conference for BRUIT-FM challenge, EGU for BRUIT-FM challenge
    - **Equipment**: For Dreo and Xu
    - **Personnel**: Internships, extension of Dreo and Xu contracts
    - **External contracts**: rotational seismology study, BRUIT-FM noise challenge meeting, publications.
  - EStutzmann: Not sure that Zongbo can be extended because of 5-yr limit. Also request funding for IASPEI meeting for myself and ZXu.
  - IFREMER: 171k€ starting budget, 85k€ reimbursable to date.
    - Not sure they can recover remaining postdoc money.
- Wayne will request a 1-year no-cost extension to allow rotational seismology, BRUIT-FM Noise Challenge and noise level work to finish
- Get rid of project management spaces for WP2-5, as well as links to them on website
- MAAGM (F Guattari) requested a letter of interest: Wayne will write it.

WP Overviews

Discussion of state of Tasks and Deliverables for each WP, see slideshow for details

WP1

- T1.1 (Management and coordination):
  - With eXail no longer in the project, Frederic Guattari is no longer in the administration.
- T1.2 (Financial management)
  - See budget discussion below and in the Year 3 report (BRUIT-FM workspace, Reports/ directory)
- T1.3 (Promotion of internal communication)
  - Updates to the website:
    - Articles, Presentations and Reports section
    - Deliverables status updated
    - Noise Reduction Challenge page: ARC-EN-SUB data and processing are described, AGU poster linked.
- T1.4 Need to write M30 version of Open Source Guidelines, removing rotational OBS dataset (and adding BRUIT-FM challengs?).
- T1.5 (Dissemination):
  - Add presence on social media (L Duval)?
  - Need to put SEIS-ADELICE dataset online
  - BRUIT-FM Challenge
    - Add Data paper ((synthetic + ARC-EN-SUB data), and Eos article?
    - Only group currently working on challenge is Helen Janeszewski's (ATACR + musical percussion/background separation) group, specifically Charles Hoots.
    - Should also implement BRUIT-FM toolbox and Compy approaches.
  - Make a direct link to map of deployments on the home page, with a snapshot of the map.

WP2

- T2.1: Done and online
- T2.2: Pressure noise bounds underway with Richard and Wayne (presentation in today's Projects section)
- T2.3: Noise source catalogs. Not yet worked on, :remove ?

WP3

- T3.1: Zongbo's work
- T3.2: Probably will not be done (body waves). Want to go back to this topic, but probably not possible in this project
- T3.3: Don't know what this means.
- Other information:
  - Zongbo will work on Antarctic data and some Mediterranean:
  - Wayne is working on DAS data off Monterey for IG waves and Farallon islands for IG-related signal.
    - Nishida et al. (2019) indicate that islands can have "compliance" signal which is just deformation of islands by IG waves.

WP4

- T4.1: Rotational seismometer -> T4.5 : specifying a new OBS rotational seismometer

- T4.2: Articles and websites by Rebeyrol, Crawford and Aminian
- T4.3: No work yet
- T4.4: NEW noise reduction challenge (add to website)
- T4.5: NEW OBS rotational seismometer specification (add to website)
- D4.1: Repackage Scientific Report submitted for Exail's exit, adding all figures and calculations made
- D4.2: Rebeyrol, Aminian and Crawford web pages.

WP5

- T5.1: Dreo work on whales in the Mozambique channel (OFB contract and JASA 2025 paper). FSamaran will try to make a catalog of whale calls (w/J-Y Royer, 2 interns in July)
- T5.2: Main contact (B Kinda) has moved on to another structure, probably no longer working on anthropogenic noise.
    - Ker/Duval could put their research on wind turbines noise in this task. Williams et al. 2019 Nature Commun paper looks at EQs with this DAS : is hindered by presence of wind turbines.
    - RDreo is also supposed to submit report on the effect of seismic shots on whales in the Mozambique channel, using SBazin data.
- T5.3: Trabattoni 2023 JASA paper is related. RDreo work on whale-ship collision ("ship strikes" could also enter in this task (report to French biodiversity agency).
- T5.4: SEIS-ADELICE database (2 years OBS) in prep. Ecole Navale Internship 2023. Le Bris 2025 JGR paper.
- D5.1 : no catalog, remove this deliverable ?
- D5.2: 2 scientific articles (Le Bris et al, under review ; Dreo et al., accepted)

Discussion

- S Bazin asks for support to attend the 2025 UACE conference.
- WCrawford reiterates desire to pay for internships.
- Extension ZXu and RDreo desirable.
- Guilhem would like for ZXu or RDreo to work on SEIS-ADELICE data using BRUIT-FM salary, or obtain an additional salary for someone else.
- Signal processing conferences: GRETSI (Strasbourg August 2025, deadline 28 March), ICASSP 2026 (Barcelona April 2026)

Projects

Rotational OBS

Need to make tender/offer for a company to specify what is needed in space an energy to make a seafloor rotational, 3-axis, seismometer with 10x better resolution than the blueSeis 1C. No mechanical engineer at OBS lab as of April, so will need to do completely outside work. Nobody in the group has strong experience with tenders, Wayne will contact the IPGP contracts office to see what needs to be done and how it should be done. Felix Bernauer could provide very useful input.

Felix Bernaueur hired Andreas Broetzer as postdoc, will visit MAAGM 17-21 March about development.

BRUIT-FM challenge

- Presented (poster) at 2024 AGU, will present (oral) at 2025 EGU, would also like to have presented at a signal processing conference. A data paper and Eos article are planned. Currently the only response is from the Janezewski group (ATACR + percussion/background separation). Charles Hoots from her group suggested putting the data on Kaggle.com
- Need to establish a deadline (one year?). GRETSI conference has an abstract deadline in 2 weekss, requires 4-page abstract.
- Eleonore: should write a generic email that can be sent by members to mailing lists (such as SPIN).

Pressure Noise levels

- Create high and low noise level models, useful for evaluating station quality, identifying signals, verifying instrument response, evaluating instrument data quality.
- Wayne wrote to EnvSeis ESR04 leaders to make sure that they are not studying the same thing, did not hear back. EStutzmann is in the ITN but does not know the name of the student. She will be in a meeting with them in two weeks, will ask. Thinks it is HF noise.
- Zongbo could calculate the pressure at the seafloor in order to help validate the instruments and give a background on the noise levels.
- RDreo has been trying to calculate PSDs of sensor data, comparing to the results of Ruan et al (2014, JGR:SE) for the ratio between pressure and vertical displacement.
- RDreo Has problem with coherence level (doesn't go to zero between IG waves and microseisms) Also problem with transfer function, which he gets sloped rather than flat at low (compliance) frequencies.

Discussion:

- EStutzmann wonders if the units (m/Pa) given by Ruan et al are false, could it be velocity/Pa? Also, Mohammad-Amin's code does this without problem.
- WCrawford finds it surprising to find any compliance that is flat, although thick sediments could create a nearly constant value at highest frequencies for dimensions of 1/Pa.
- Zongbo's model is based on ocean state and sediments (1D model).
- Should try MAAminian's Compy code to calculate this ratio.

- WCrawford asked about other standard values that can be used
    - Local EQ high frequency Z/P ratio
    - Rayleigh wave Z/P ratio at frequencies less sensitive to
    - Whale and boat source signals?
    - Sea levels measured at nearby buoys
    - Values measured at nearby stations (assuming there is not a systematic problem)
    - *A priori* pressure level limits (to get rid of ridiculous values)
    - ICMWF wind model (Richard has worked with Ifremer on this, some R?HI?M-RUM work on this).
- Wayne and Richard have a document suggesting the methods to use. Should put it on a work site (RESANA?) as a shared document.

Scientific talks:

See the slides for the actual information given, here are noted the major points and, especially, any discussion.

Singing around the volcano: detecting baleen whales in the Mozambique Channel based on their song rhythms, from seismic and hydroacoustic data (R Dréo)

Paper (JASA) almost accepted. Use a technique using observed/expected song rhythms/intervals, which allows an automatic and rapid scan of big datasets. Using four types of whales: Antarctic blue whale, SWIO pygmy blue whale Antarctic Minke whale and Fin whale. Some false detections during seismic experiments with a shot interval close to the whale call interval. Seismometer channel results are very similar to hydrophone channel results (cor = 0.95 for vertical seismometer). See consistent yearly patterns for each whale species: pygmy blue whales are bi-annual, should run tracking to see if they are going north in one and south in the other. Fin whales the most variable annually.

Study of interactions between whales and ships: risk of collision (R Dréo)

Report for the Mayotte marine refuge, but study on a global scale. Trying to understand ship strikes of whales. There is a map of ship strikes per FAO area, most reported strkies are off the East Coast of the US and in the Mediterannean Sea (although ground truthing is difficult). Shows variability of farthest distances at which whales will hear nearby boats, which depends on the water velocity profile. In areas with strong negative surface velocity gradients (such as the Mediterranean in summer), waves dive quickly and boats are heard only very far away and then again very close. Richard made a map of the time between hearing a ship and the ship arriving at 25 kts in the Mediterranean (standard speed for ferries): under 40s in several areas in June-July-August.

Q: can we relate whale “spyhopping” or other out-of-surface behaviors to seasons with bad near-range propagation?

SEIS-ADELICE 2020-2025: Cryosismicité du glacier de l’Astrolabe (G Barruol)

Small glacier with a floating part on the ocean. 1m/day velocity, floating tongue 4x10 km, about 700 m thickness at grounding point. Deployed stations on glacier, on stable ice, and at the seafloor close to the floating tongue. Also some nodes and DAS expts. 2 years of OBS deployments, can see icequake activity, particularly at high tides. Also some longer-period glacier quakes. 100m water depth.

Discussion

- WCrawford: We need to get the StationXMLs made and the data online.
- GBarruol: We have decided to make these data open.
- WCrawford: We need to confirm the clock drift. Masters student working on clock correction with same instruments for Stromboli. Liqun Cheng is working on clock correction for an ambient noise study using Chinese OBSs. Should work together on confirming Guralp BREVE instrument response.

Follow-up questions and notes:

- The SWOBS PSDs appear to be offset on two different OBSs? Suggests a gain problem!

Ocean-bottom microseism observation and modelling (Z Xu)

2024 work. How to improve modeling of secondary microseisms, article in review (JGR Solid Earth). Does so by adding 1D sediments from CRUST 1.0 beneath the source and receiver sites to the classic (Longuet-Higgins Secondary Microseism (LH-SM)) modeling, which only takes into account the water depth. Create a source site coefficient and a receiver site coefficient. Using AlpArray INSU OBSs to ground-truth models

Discussion

- Q: Is there any effect of land sediments at the receiver?
- A: Can be incorporated, but we have only studied permanent stations, which are almost never on sediments.
- Q: Have you thought of using AlpArray DEPAS OBSs to ground-truth?
- A: Not yet
- WCrawford: You saw some weekly noise variability in both the AlpArray and RHUM-RUM datasets: looking at the DEPAS data could help to see if this is real or an instrumentation effect.
- Q: Which is most important, the receiver site or the source site coefficient?
- A: That depends on the site, not whether it's a receiver or a source
- Q: What range of sources do you use?
- A: Whole earth oceans, so at this Mediterraean site (see slide) you can see some storms from Mediterranean and some others from the Atlantic.
- Q: There are some peaks that look better in the LH-SM model, can you comment?
- A: Future work could also be to look at DAS cables and see if you can use calculated versus observed levels to evaluate cable coupling.

Follow-up questions from Wayne:

- Would it make sense to plot the difference between the data and the models, to get a better sense of when the LH-SM model works better and when the Xu model works better?

Sea-ice time lapse monitoring using microseism(Z Xu)

2025 work. Try to answer questions using secondary microseisms:

- How thick are sea ices around Antartica?
- How does the sea-ice thickness vary in a year?

Globally, see microseism variation that is assumed to be caused by changes in sea ice around Antarctica (Stutzmann et al., 2009). Ice could affect reflection of ocean waves at shoreline. Tune R-squared reflection parameter from 0 to 10%. In Austral summer, best-fitting R^2 is 5.5% and 7% for two different years, whereas, in Austral winter, best-fitting is 0% in both years..

Now usingSEIS-ADELIE SWOBS data to see how sea ice affects receiver site coefficient. Can see that the receiver site coefficient is strongly frequency dependent and changes greatly between no-ice and 200-m sea ice. Two different modes for sea ice, one of which could generate local stress and fracturing w/in the sea ice.

Plan is to

1) Compare the field observations (OBS, DRV) with theoretical predictions
2) Infer monthly variation of R-squared and Cr
3) Finish one research paper.

Discussion

- Q: 200-m is way too thick, more like 1-3m. And water thickness = 100m and almost no sediments.
- Q: Shouldn't R-squared be larger for icebergs than for land?
- A: This is sea ice, not icebergs. Also the R-squared values for icebergs are unknown, wave models set a parameter for small icebergs but it hasn't been validated yet.
- Q: See energy down to 100s, do you think it's real since the SWOBS is only supposed to be sensitive down to 10s. Is the pressure sensor more sensitive to low frequencies than the seismometer?
- A (Wayne): I don't think the hydrophone is more sensitive to low frequencies than the seismometer, because it was created for active seismics. Also seeing the 100s signal in summer but not in winter suggests that it is real.

Hydro-acoustic surveillance of volcanic eruptions (S Bazin)

1:40:10-2:16:18 – 2:25:15

International terrestrial network does not see low-magnitude (ML<3.5) seismicity on mid-ocean ridges, hydrophones in the oceanic acoustic waveguide can see small events from far away, allowing broad coverage with a limited number of stations. Also see ships, whales, icebergs, sea state and weather noise.

OHA-GEODAMS hydrophone network: Seismicity (and more) recorded in the Indian Ocean, covering the Southwest, Southeast and Central Indian Ridges, including several swarms. Started with manual picks, now doing machine learning picking.

MAHY network, covering the Mayotte eruption area, including impulsive events from lava flow quenching.

OHA-GEODAMS seafloor observatory: Geodesy and seismology on a very active segment of the SE Indian Ridge on the Amsterdam plateau. Eruption during the geodetic network.

Discussion

- FArdhuin: Low noise observed on spectrograms could be a good case for applying Zongbo's new tools using our ocean wave models.
- ZXu: Can you use T-phase to compute the corner frequency of some events?
- SBazin: LF limit is 2 Hz, probably not low enough to find EQ corner frequencies.
- WCrawford: There are versions of the sensor that go out to 20-30 seconds.
- SBazin: JYRoyer had a broaderband hydrophone for one deployment.
- RDreo: In your last slide, did you check on the OBSs to see if you have similar LF noise?
- WCrawford: Can OBS data see landslides as well.
- SBazin: Yes, but we didn't closely compare OBS and hydrophone data quality.
- ZXu: Is it possible to see effects of ocean currents?

- SBazin: Yes, I was wondering if the currents could make the mooring resonate? Oceanographers on site measure strong deep currents in the area, which could have an effect.
- GBarruol: During the RHUM-RUM project, we had some X-Hz signals that were likely related to ocean tides, and internships of K Sigloch showed that one could almost map current levels, particularly on stations with buoys overhead (S Stahler, 2018, SRL).
- WCrawford: Stahler showed a certain resonant frequency based on the length, linear density and tension of the wire, imagine that this frequency would be lower for your moorings.

Wind-generated waves in the Earth system: observations and modelling updates (F Ardhuin)

02:25:42-02:39:26 – 2:44:40

Overview of primary and secondary microseisms and infragravity waves, based on articles from 2010-2018. Working in last 3-4 years on the shape of the 1-4 second spectra. Wave spectrum is very broad at high frequencies. Only 3 years ago found way to reproduce this in a model. Regenerated 100 years of microseisms using this new parameterization, correlates better with data. Romero (2019) and Alday & Ardhuin (2023) are relevant references. Work on intermediate waves still in progress.

SWOT satellite allows much better measurements of long waves, down to 3 cm waveheights. First time we can record reflected waves. Get 10% reflection coefficient off Australia.

Discussion

- ZXu: Have you measured R^2 in polar regions?
- FArdhuin: Not yet, but it is planned for coasts. Interesting question for the ice.
- WCrawford: Can we predict seafloor pressure level based on winds?
- FArdhuin: I think so because waves are highly correlated with winds, but will depend on sediment effects.
- WCrawford: How about frequencies about 10 Hz?
- FArdhuin: I think this noise is dominated by breaking and bubbles, not so easy to model
- GBarruol: Cases of sea ice breaking in winter time, related to storms. Have you observed this kind of phenomena?
- FArdhuin: We see effect of sea ice, trying to model using ice thickness (not known very well). I could send you some things that we've done.

Discussion

State of WPs and tasks

WP1

- Improving presence on social networks: L Duval is the only one who has any experience
- Personnel money (42 k€): +3 months Zongbo? 3+ months Richard ? Travail sur SeisAdelice ? Nous avons assez pour ~9 mois de postdoc, ou 15 mois IE mi-temps
- Webpage : Homepage line and image for stations map
- Mission money:
    - Meetings
    - Martin Schimmel (combine de semaines ?) prevu 4x2 semaines mais pas encore payé sur BRUIT-FM)

WP4

- Eos paper and data paper, conferences (discuss with LDuval)
- BRUIT-FM workshop and Noise Reduction Meeting (March-July 2026?)

Should we remove the source catalog deliverables from each WP ?

- All agree (mention in the Y3 report)

WP5

- Add Stephan's wind turbines task

Year 4 Plans

- Wayne
    - No-cost extension request
    - Repartition budget (w/administrator GM)
    - MAAGM letter of interest
    - Open Source guidelines M30
    - Tender for seafloor rotational seismometer (w/Felix Bernaueur)
    - D4.1: report on rotational seismometer integration
    - Website:
        - Remove WP 2-5 project management spaces
        - Add direct link with image for the dataset map.
        - Add synthetic dataset links and description to BRUIT-FM challenge page
        - Add T4.4 (Noise reduction challenge) and T4.5 (rotational seismometer specification) to website
        - Remove noise catalog deliverables
        - Add Wind turbines task to WP5.
- Pressure noise levels study
    - Calibration/validation (add Eleonore, Veronique and Zongbo to discussions)
        - Admittance (noise et teleseisms: test Compy code
        - Prediction admittance/signal Zongbo
        - Pression/motion ratio at high frequencies (local EQs)
        - Comparison between stations
    - Evaluation
    - Put working document on shared site (RESANA?)
- BRUIT-FM challenge (papers, conferences, organize meeting)

    - Write data paper
    - Write EOS article
    - Write generic email announcement.
    - Apply BRUIT-FM toolbox and Compy to the BRUIT-FM Challenge data.
- Sara/Fabrice low frequency noise levels.
- SEIS-Adelice
    - Clock corrections
    - Put data and metadata online (preferably Epos-France)

Meetings to participate in

- EGU 2025 (Wayne)
- IASPEI 2025 (Zongbo et Eleonore)
- UACE (Sara)
- Signal processing (Laurent): Gretsi 2025 (France August), ICASSP 2026 (April)

Budget

- External contracts (rotseis, bruit-fm challenge, publications)
- Missions (Conferences, Schimmel, BRUIT-FM workshop)
- Personnel (CDDs et stages)

Administrative meeting

Approved Y4 Expenditures

- **External contracts (64 899€):**
  - Rotational seismology tender: ~45k€
  - Bruit-FM challenge workshop + conference: ~8k€
  - Dreo et al. JASA publication : ~3k€
  - **9 000€ remaining** : Y4&5 publications ?
- **Missions (16 251€):**
  - EGU 2025 Crawford (~2 500€)
  - IASPEI 2025 Stutzmann (~2 500€)
  - IASPEI 2025 Xu (~2 500€)
  - UACE 2025 Bazin (~2 500€)
  - Gretzi 2025 Duval (~1 500€)
  - These Jury RDreo (~1 000€)
  - 2 weeks mission Martin Schimmel (~3 500€)
  - 2026 Bruit-FM meeting (~2000€)
  - **-1 750€ Remaining** : Y5 ICASSP 2026, 2 more weeks M Schimmel, 2027 BRUIT-FM meeting, Bruit-FM challenge invitations? Get from another budget?
- **Personnel (90 831 €)**
  - Already commited contracts Xu and Dreo to Oct 1 2024: 47 901€
  - 3 additional months Xu (Oct-Dec 2025): ~13 500€
  - 5 additional months Dreo (Oct 2025 – Feb 2026): ~12 000€
  - **17 200€ Remaining**: Internships, Y5 Dreo extension? Transfer some to missions?
- **Expendables (60€)**
- **Equipment (4 329€)**
  - Computer equipment for Xu and Dreo