Chemical Symphony is my contribution to the exhibition in ZKM of Karlsruhe (Germany), after the impetus of the famous sociologist Bruno Latour. A collaborative project led by architects Soheil Hajmirbaba, Alexandra Arènes (SOC - Société d'Objets Cartographiques / atelier shaā) and biologist Paul Floury (IPGP, ExtraLab).

Critical Zone is a notion invented by Earth scientists to bring together many different disciplines that have not collaborated sufficiently in the past. Whether you study water, soil, plants, rocks, weather, or animal life, all of those phenomena are confined to a very thin domain when compared to the whole of planet Earth, as viewed from outer space. The Critical Zone is just a few kilometers thick. It is the only region of the Earth that has been transformed by life over many eons. It is also the only part of the world that you have any chance to experience directly with your senses. Although human activity is barely visible at the planetary scale – not to mention the scale of the universe – it is hugely disruptive at the scale of this thin, fragile, and highly complex Critical Zone. This is why we need to learn how it behaves just as much as we need to know how our body functions. And yet, although we have a vast number of tools and instruments to monitor our bodily health, we don't have many to monitor the health of the Critical Zone in which we humans live – as well as all of the life forms on which we depend. This domain is called "critical" because this tiny part of the Earth on which we are totally dependent has entered into a sort of intensive care. All efforts should be made to sustain its well-being.

This exhibition aims to work on common representations across disciplines. Soheil and Alexandra have developped an installation where the visitor explores the critical zone of a certain catchment area of a river located in Alsace (France). This description is only made by scientific measurement tools, such as the RiverLab (Paul was part of its development team), a set of *in-situ* tools that measure the physico-chemical fluctuations of the river.

I made a sonification of these data sets through an musical algorithm built around artistic decisions, *informed* but scientific knowledge. This mapping algorithm *is* the composition itself : it's a latent musical field, an ensemble of figures, lines, masses set in polyphonic relationship ; this field activates by the data going through, whose behavior is known.

Different set durations (from 10 days to 1 year) allow to comprehend the interactions between parameters at different scales : climatic conditions, physical, chemical, biological phenomena. The scrolling speed of the data rendering across time is indexed on the River Flow : this allows to dramatize a highly destablizing event such as a flood.

The variations of sunshine are also put in different time scales. One day, the life of a dragonfly, is represented by a massive orchestral *crescendo/descrescendo*, more or less bright (or even brassy, when it's hot). From a tree's life perspective, a day will be only a flash and this chord a single *staccato* note. This rhythm remains a perceptive anchor in the polyphony of data. It comes in co-variance with the dissolved oxygen in water and Nitrate, whose behavior witnesses the biological activity of the river : they are heard through wind instruments frames, with distinct harmonic textures. The variation of sulfites

and magnesium (that folllow the same type of variation than water temperature, linked to sunshine, but phase-shifted) are represented by harps. When a flood occurs, the harp figures have more animation. Potassium data has a intempestive behavior and given to 2 oboes' figures ; chemical activity linked to precipitations (sodium and chlorine) is represented by flute frames ; amount of precipitations is correlated to the complexity of the percussion activity.

The installation is shown in a small cabin. A pre-coronavirus version was with headphones, but they were replaced by small Genelec loudspeakers for health-related reasons. The sunshine data is linked to a sonic event (an orchestral chord, as I said before) but also to a LED projector controlled by DMX through Max via ENTTEC device.

I used Max through the whole process, in three steps.

Data sets where given to me by Paul under the form of a huge CSV file. As a first step, I transcribed the data into a multichannel soundfile where data were resampled (1 audio sample = 10 minutes of river data) normalized. It was less cumbersome to use for me than Mubu Library.

Then, the sonification process in itself was done by reading and remapping the soundfile's data thanks to the accuracy of gen~. I then developed several sampler modules playing microtonally folders of hand-picked orchestral samples. The main difficulty was to control the harmony and to build figures, such as for the oboe (repeated notes or legato) or harps.

Last step, the patch that actually runs in the ZKM installation shows the data under the forum of png files whose display is scripted, and the activity of the sonic layers is linked to the alpha parameter of the corresponding parameter (for example : the potassium curve opacity is linked to the amplitude of the oboe line). This could have been made under the form of a video, but I had to also control simultaneously the DMX. So the installation patch reads three multichannel audiofiles one after the other. The first 8 channels are for the different audio layers (thanks to mc.xxx objects!) and the last 2 channels read a value between 0 and 1 for DMX luminosity, and a value for the cursor (that doesn't scroll regularly).

This installation was launched on May 22, 2020 and exists online (1st sequence only) and also on-site in ZKM.

https://zkm.de/en/exhibition/2020/05/critical-zones
Online exhibition : https://critical-zones.zkm.de/#!/