# SysSon: A Systematic Design for the Sonification of Radio Occultation Data

H. H. Rutz, V. Goudarzi, K. Vogt, A. K. Steiner, M. Jury

## Overview

**Sonification:**

- use of non-speech audio to convey information extracted from data
- interdisciplinary technique at the border of science and arts

**SysSon:**

- develop an auditory interface to compliment standard visualisation tools that climate scientists use
- challenging task due to high dimensionality of data
- design of a novel tool, incorporating domain specific user experience gathered through interviews and experiments

**Methodology:**

(1) Contextual Inquiry: Interviews with eighteen climate scientists assessing their needs, analysing their tasks and workflow, reviewing their existing tools.

(2) Focus group interviews: Observe communication between experts within three distinct groups.

(3) Analysis of metaphors in the use of language of climate scientists.

(4) Building a sound space and relating sounds to climate metaphors for the auditory display.

(5) Iterative approach to establish patterns in the data analysis using sonification. At various stages of the project, the domain scientists are participating in the evaluation of the aesthetic qualities and usability of the framework.

(6) Observation and formalisation of the design process, e.g. by registering its evolution with the help of a versioning system.

## References


[1] K. Vogt, V. Goudarzi and R. Parncutt, "Empirical Aesthetic Evaluation of Sonifications," *Proceedings of the 19th International Conference on Auditory Display (ICAD)*, 2013.

[2] K. Vogt and R. Höldrich, "A metaphoric sonification method - towards the acoustic standard model of particle physic," *Proceedings of the 16th International Conference on Auditory Display (ICAD)*, 2010.

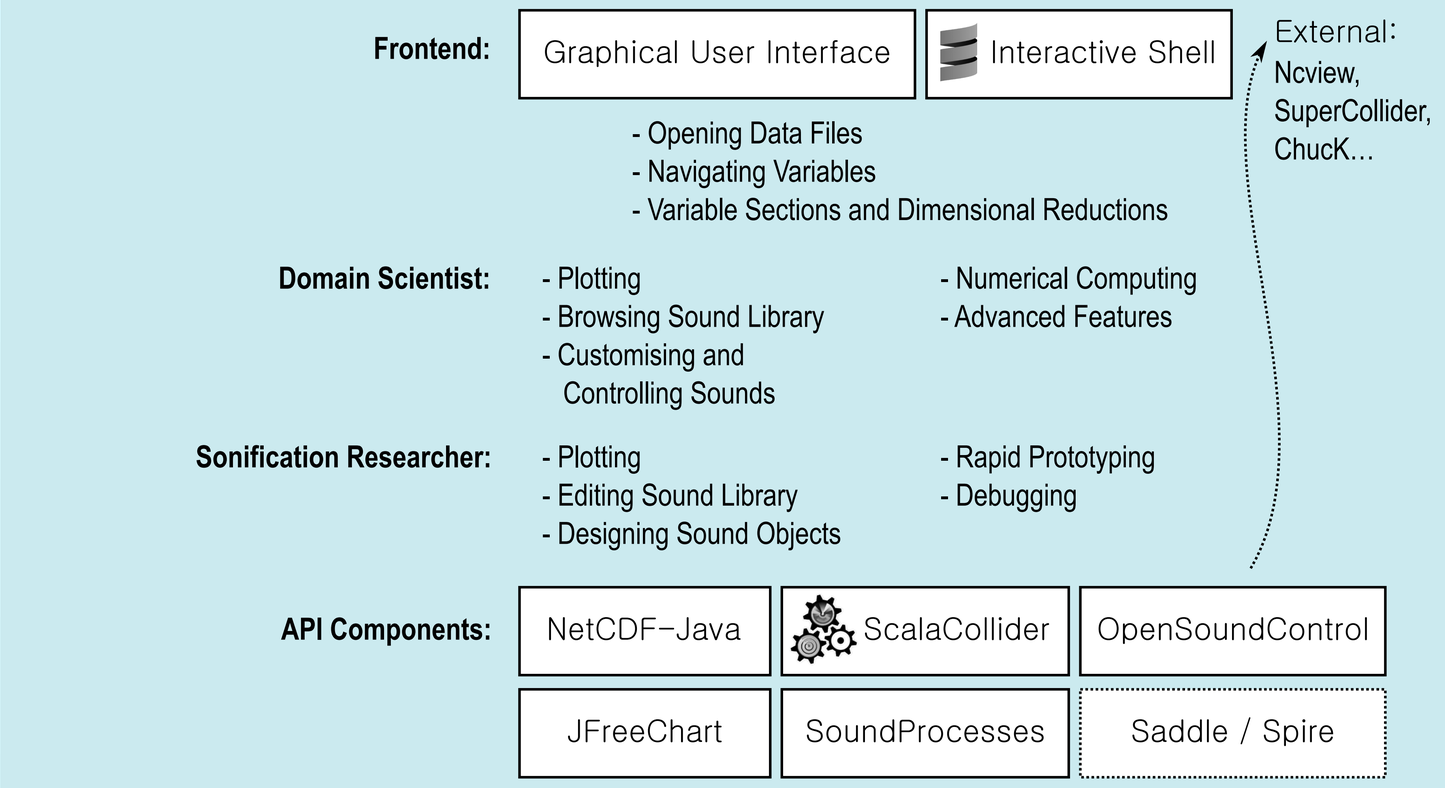
[3] H. H. Rutz, "A Reactive, Confluently Persistent Framework for the Design of Computer Music Systems," *Proceedings of the 9th Sound and Music Computing Conference (SMC)*, pp. 121–129, 2012.

[4] A. K. Steiner et al., "Quantification of structural uncertainty in climate data records from GPS radio occultation," *Atmo. Chem. Phys.*, vol. 13, pp. 1469–1484, 2013.

[5] Th. Hermann et al. (eds), "The Sonification Handbook," Berlin: Logos Publishing House, 2011.


SysSon
A SYSTEMATIC PROCEDURE TO DEVELOP SONIFICATIONS
http://sysson.kug.ac.at

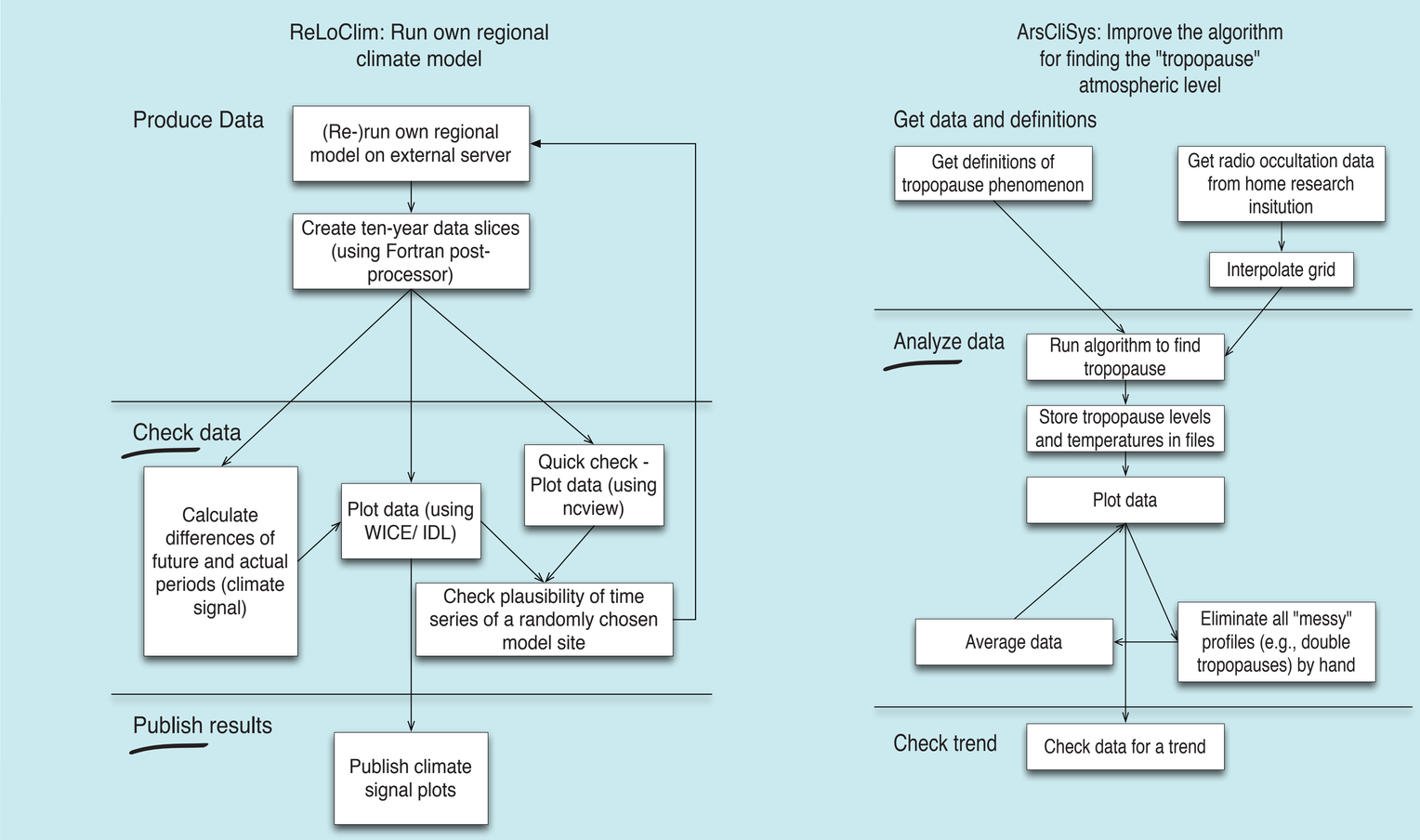
## A Framework for Systematic Sonification Design




The framework we are developing provides a rich application programming interface (API) which interlinks data I/O, visual and auditory display. A **standalone application** provides both a graphical user interface and a text based shell for the Scala language. Third party numerical computing libraries such as Saddle can be easily integrated, but also communication with external clients such as Ncview—a commonly used plotter—is possible through the OSC protocol.

The framework dual functions as **analysis tool** for the climate scientists and **development environment** for the sonification design. It will be subject to **user-based testing** and will drive a sound installation. Real-time sound synthesis is provided through the ScalaCollider library, and we are evaluating the use of the SoundProcesses framework which allows us to record a historical **trace of the sound design process** in order to better understand and to formalise it.

## Workflow and Visualisation in Climate Science




Workflows of the probands were analysed, two examples are depicted above. Climate scientists depend heavily on the visual display of their data. Verifying the data involves comparisons between different data sets. The average number of data sets to compare with each other was as high as 47, with single tasks demanding up to 400 sets. Analysis tasks involve preprocessing of data, such as taking slices or averaging across dimensions.

## Auditory Display in Climate Science

The learning experience of the auditory display for the climate scientists must be **seamlessly integrated** with their accustomed workflows, but also expand it with **new display and analysis tools**. The spatial dimension and colour overlays in visual displays must be translated to the temporal unfolding in hearing, the capabilities of simultaneous information processing through spatialisation and auditory scene analysis.

**Navigation** in the data is a major concern due to the amount and high dimensionality of the climate data, but also because scientists are not used to extracting information with their ears. The auditory display must **align with visual cues**, allow precise reproduction and might benefit from **aural analogues** of visual features such as coordinate axes, focus and zoom.