The evolution of the smartphone as a general computing platform combined with the rich sensing functionalities that it has acquired in recent years, have led to a new collective data gathering paradigm called participatory sensing. Participatory sensing is the driving technology behind so-called citizen observatories; i.e. a set of cloud-based software tools that are used to gather, analyse and visualise data by a group of citizens that share some collective concern. Participatory sensing is often used in so-called campaigns. A campaign is a collective data gathering effort that is delimited in space and/or time.

Today citizen observatories have to be developed from scratch for each application domain, meaning that deploying a new citizen observatory is nothing less than a complex cloud-driven software engineering project that is extremely labour-intensive precisely because of its technical complexity. Despite an overwhelming demand for such platforms, they are thus beyond the reach of most societal stakeholder groups.

What is needed is a generic approach towards reusable and reconfigurable citizen observatories, i.e. a citizen observatory meta-platform that can be used by stakeholders to create new and adapt existing citizen observatories. Thus, apart from the technical design challenges, a key requirement of such a meta-platform is that it is easily accessible by societal stakeholders and communities. Deploying a new citizen observatory and setting up campaigns through the meta-platform should therefore be possible without or with only very limited programming skills.

In this dissertation, we present DISCOPAR (Distributed Components for Participatory Campaigning), a novel visual flow-based domain-specific programming language created specifically to hide the non-essential complexity of citizen observatories from the end-user, and to present only concepts that are truly relevant to their domain. DISCOPAR is used throughout the meta-platform to enable end-users to construct every part of a citizen observatory: the mobile data gathering app, server-side data processing, and web-based visualisations can all be set up using a single visual language, thereby greatly increasing the accessibility by end-users.

We validate our citizen observatory meta-platform and the DISCOPAR language - in terms of expressiveness, suitability and usability - through experiments both in laboratory as well as in real-world conditions. We demonstrate expressiveness by creating three radically different citizen observatories and test the suitability and usability during real-world experiments performed by different groups of people without any programming knowledge.