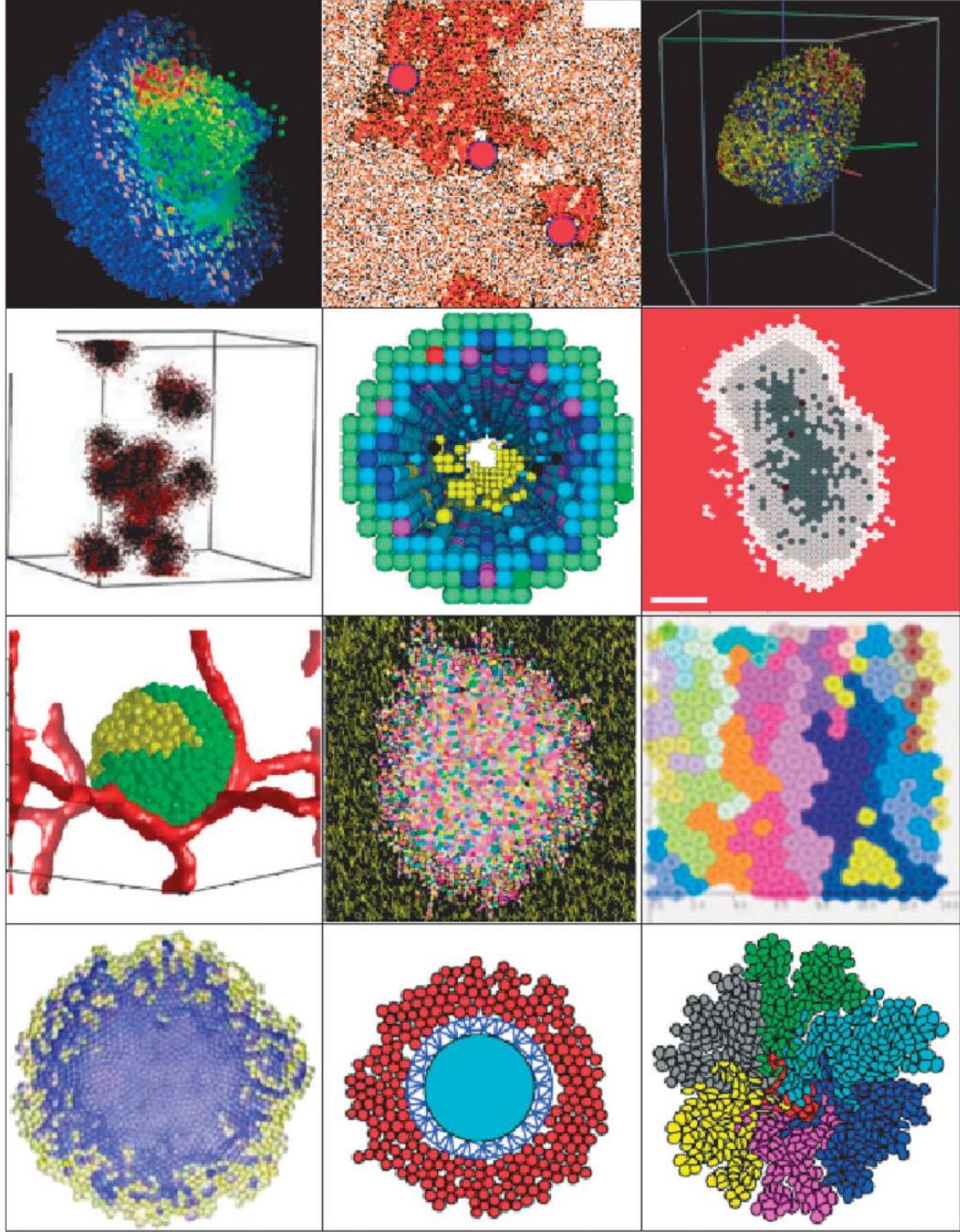
Hybrid Modeling Framework

What is Hybrid Modeling?
Agents (cells) + PDEs (chemicals)

- Modeling agents as cells is useful because cells are discrete entities with complex behaviors and internal dynamics
- PDEs allow realistic flow simulation of drugs/endogenous chemicals
- Hybrid models allow chemicals to affect cells and vice versa
- The Framework is designed to help facilitate hybrid modeling



From Rejniak and Anderson 2010

Example 1:

Division Death Mutation

Legend:

Cells colored by number of mutations

Example 2:

Stem Cell Model

Legend:

Stem cells are Red

Differentiated Cells are Blue

Example 3:
Contact Inhibition

Legend:
Pink cells divide rapidly but are sensitive to contact inhibition

Purple cells divide slowly but ignore contact inhibition

Example 4:

PDE example

Legend:

Source exists in the middle

Sinks are teal

Background colored by Diffusible concentration

Example 5:

Spreading And Metastasis

Legend:

Vessels are Red

Tumor Cells colored by local oxygen concentration

Example 6:

Competitive Release

Legend:

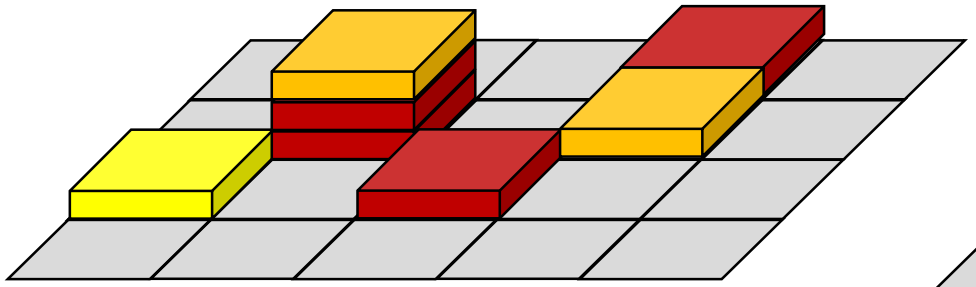
Drug sensitive cells are Blue

Drug resistant cells are Green

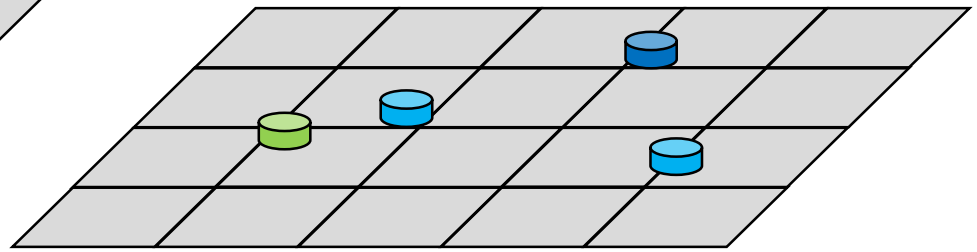
Background colored by Drug concentration

2D

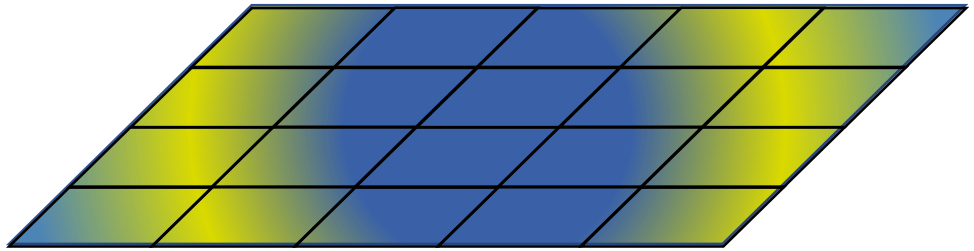
On Lattice Agents



Off Lattice Agents

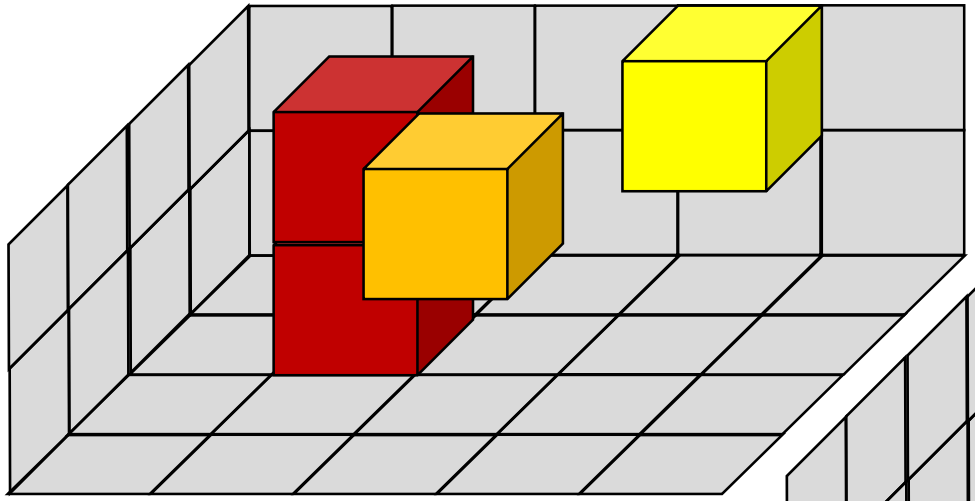


Diffusible PDEs

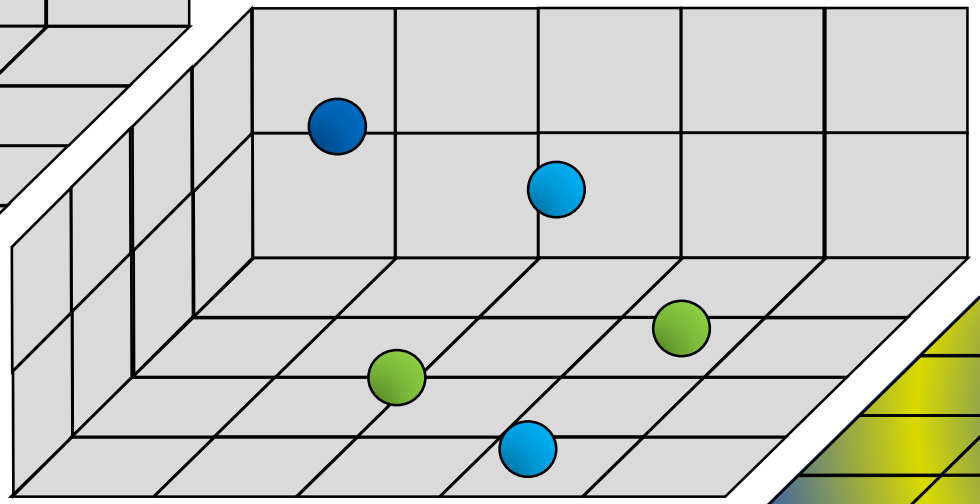


3D

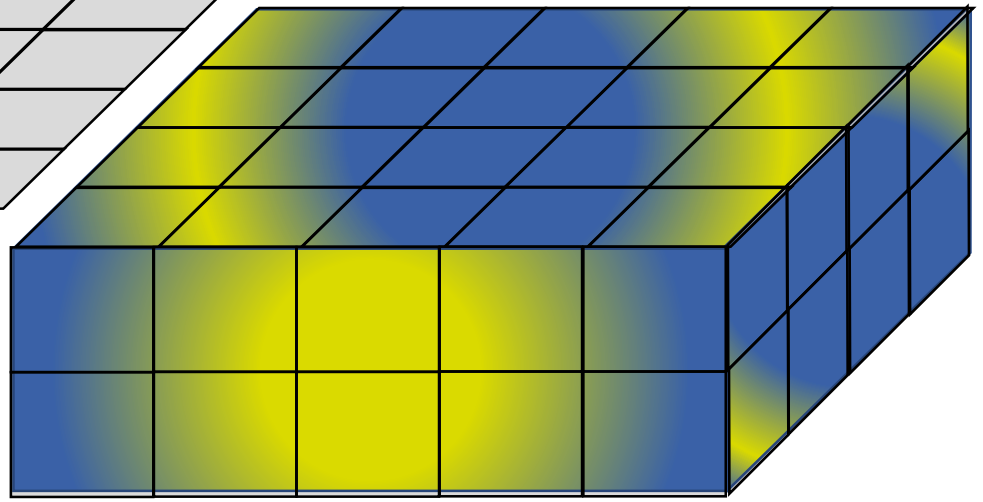
On Lattice Agents



Off Lattice Agents



Diffusible PDEs

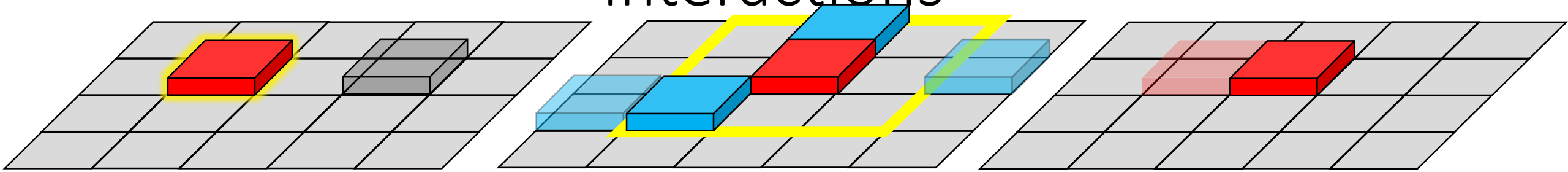


Base Behaviors

Birth/Death

Neighborhood Interactions

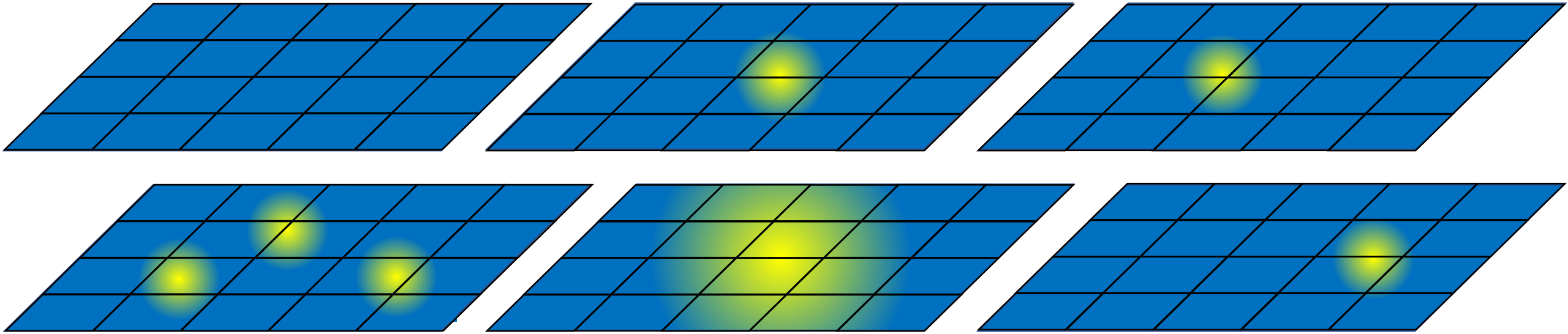
Movement



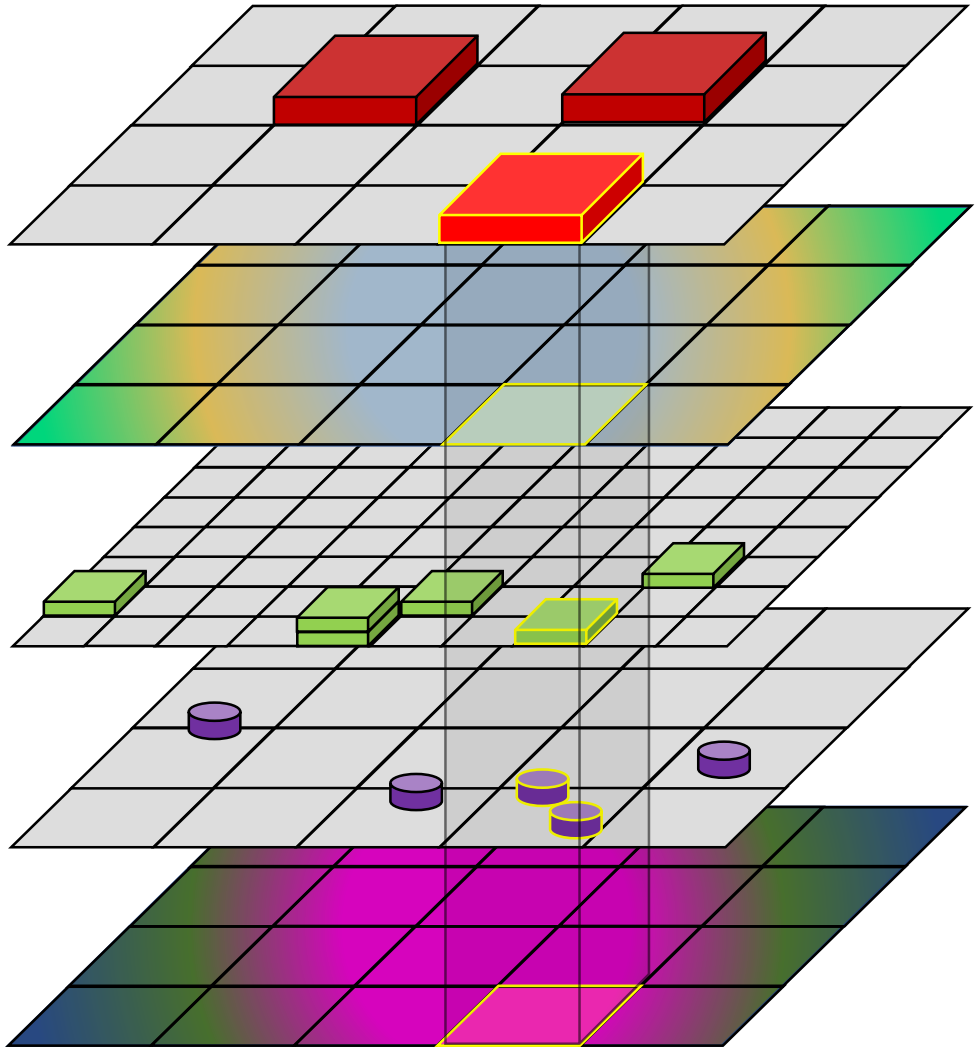
Reaction

Diffusion

Advection



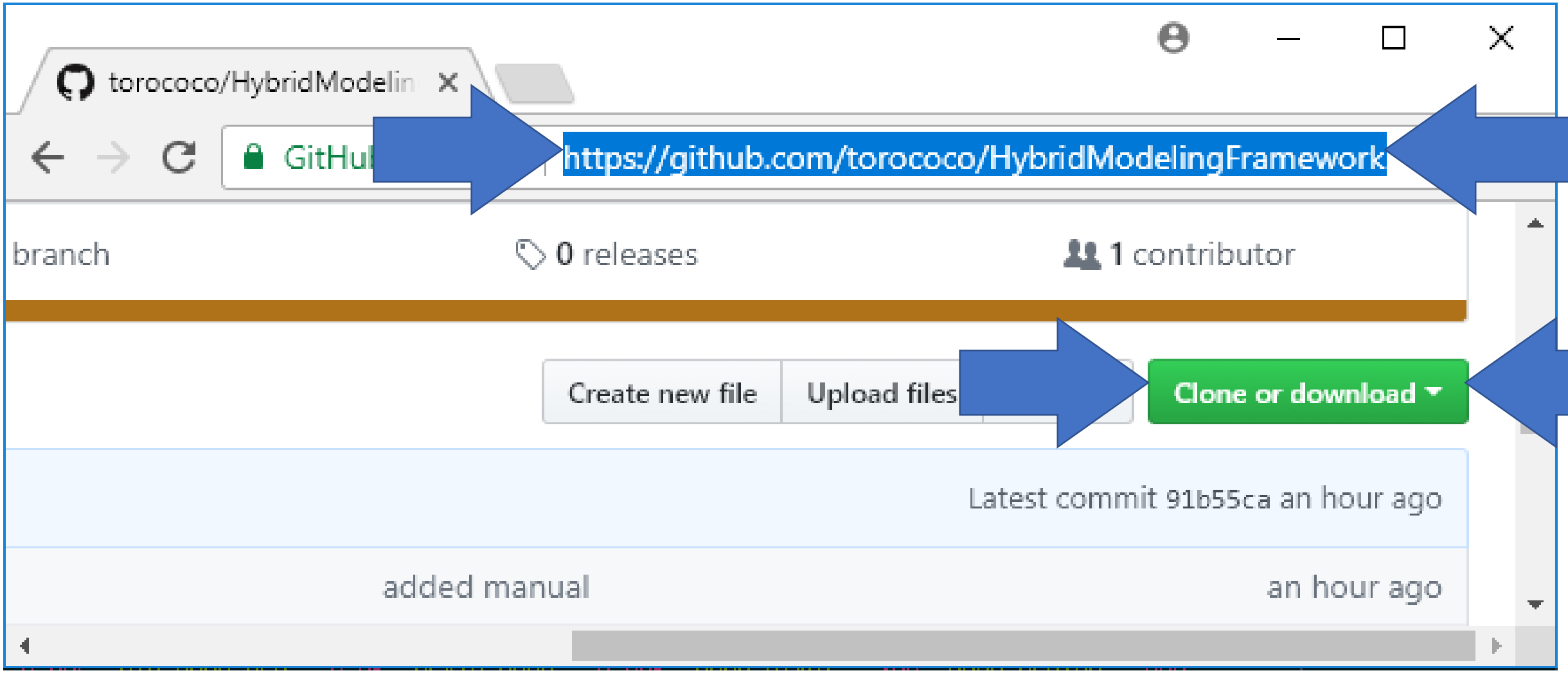
Facilitate Interactions using Spatial Queries



Framework Features

- Generic flexible components
- Simple, consistent function interface
- Fast to write and debug (each example is under 200 lines of code)
- Fast Performance
- Easy to use Gui System
- Can be easily combined with external libraries and tools

How to get it?



- Comes with a manual to help get setup and programming
- Questions: rafaelrbravo@gmail.com, or find me