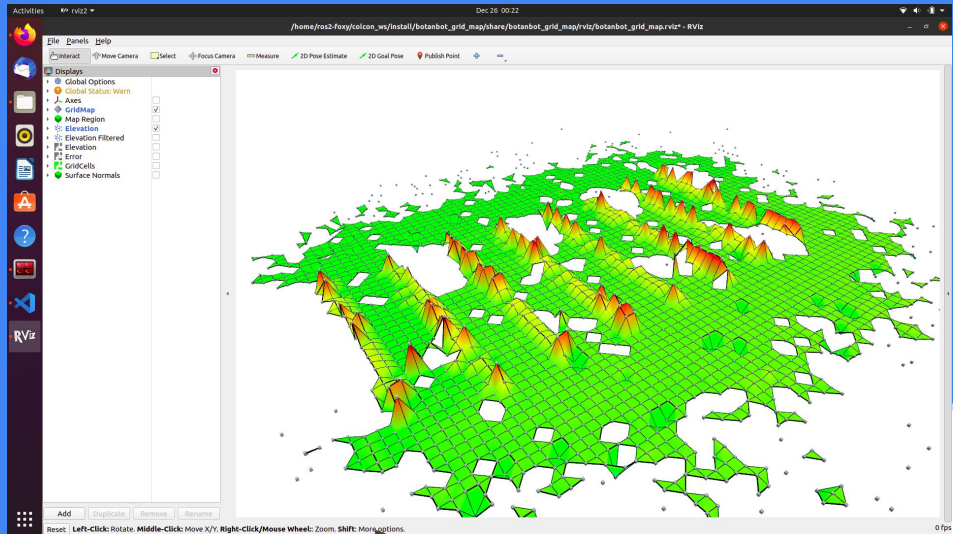
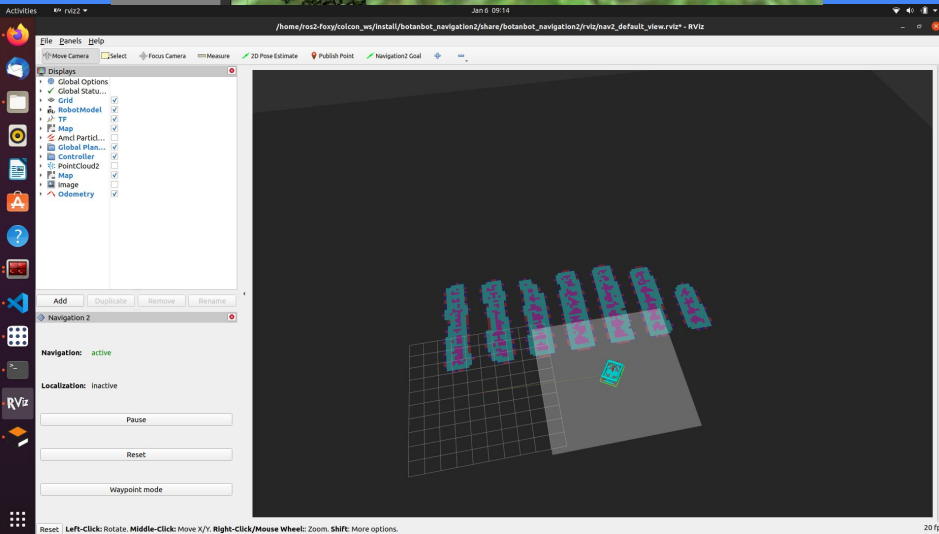


Adding another dimension to robot's world

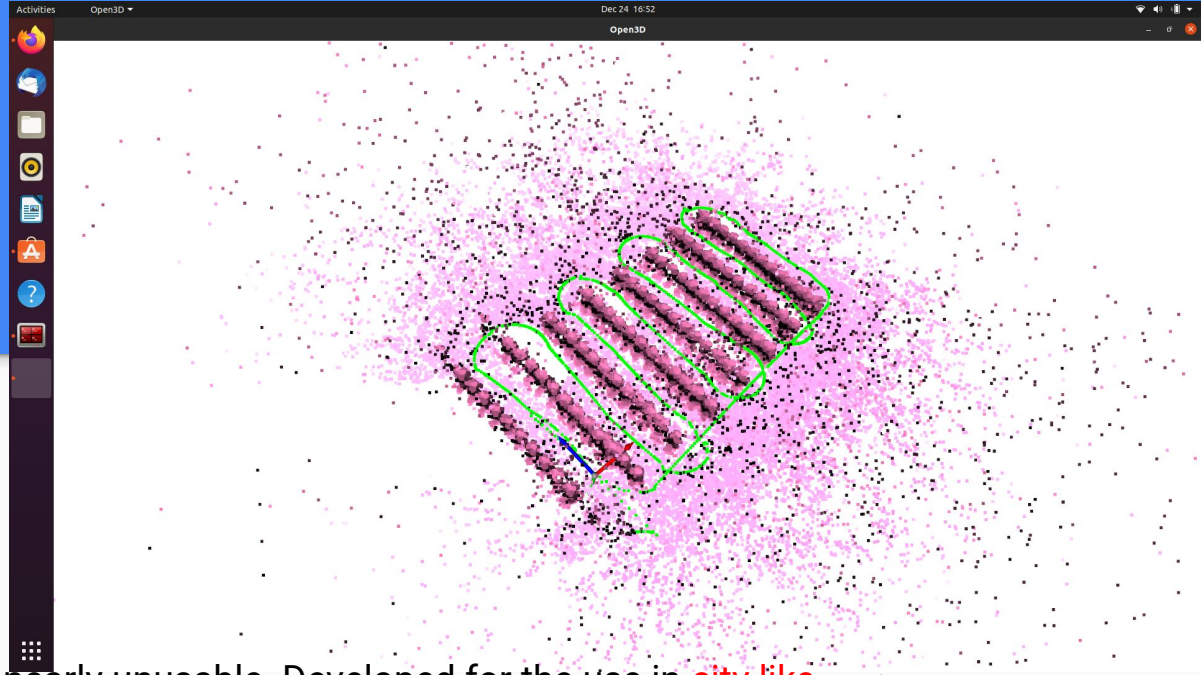


Problem Definition

Elevation and **unevenness** is in the nature of outdoor world. Make robot to be aware of them while the robot is doing its navigation tasks.

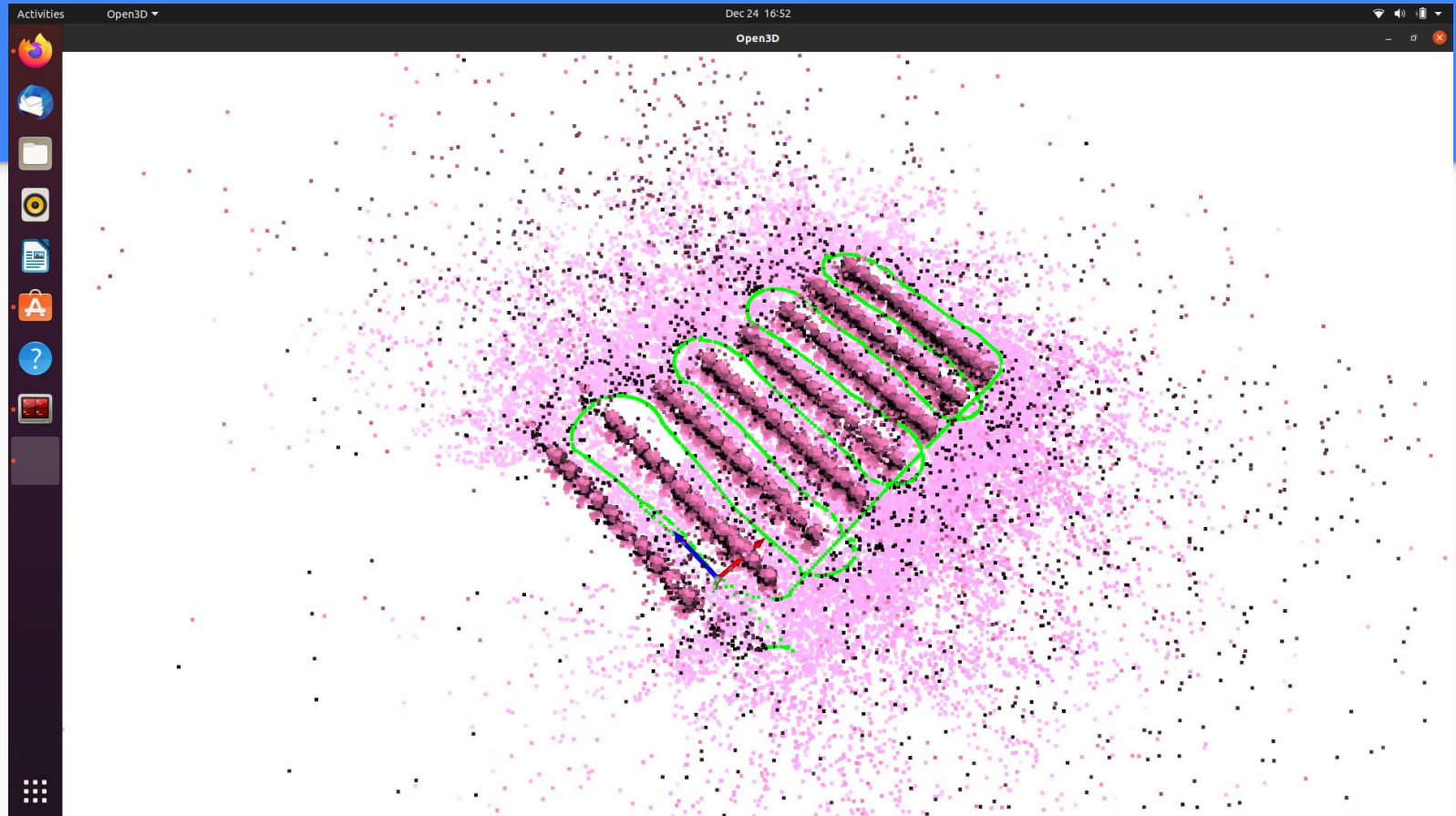
- Think of a way that is not limited to 2D Occupancy grid for navigation.

SLAM's role

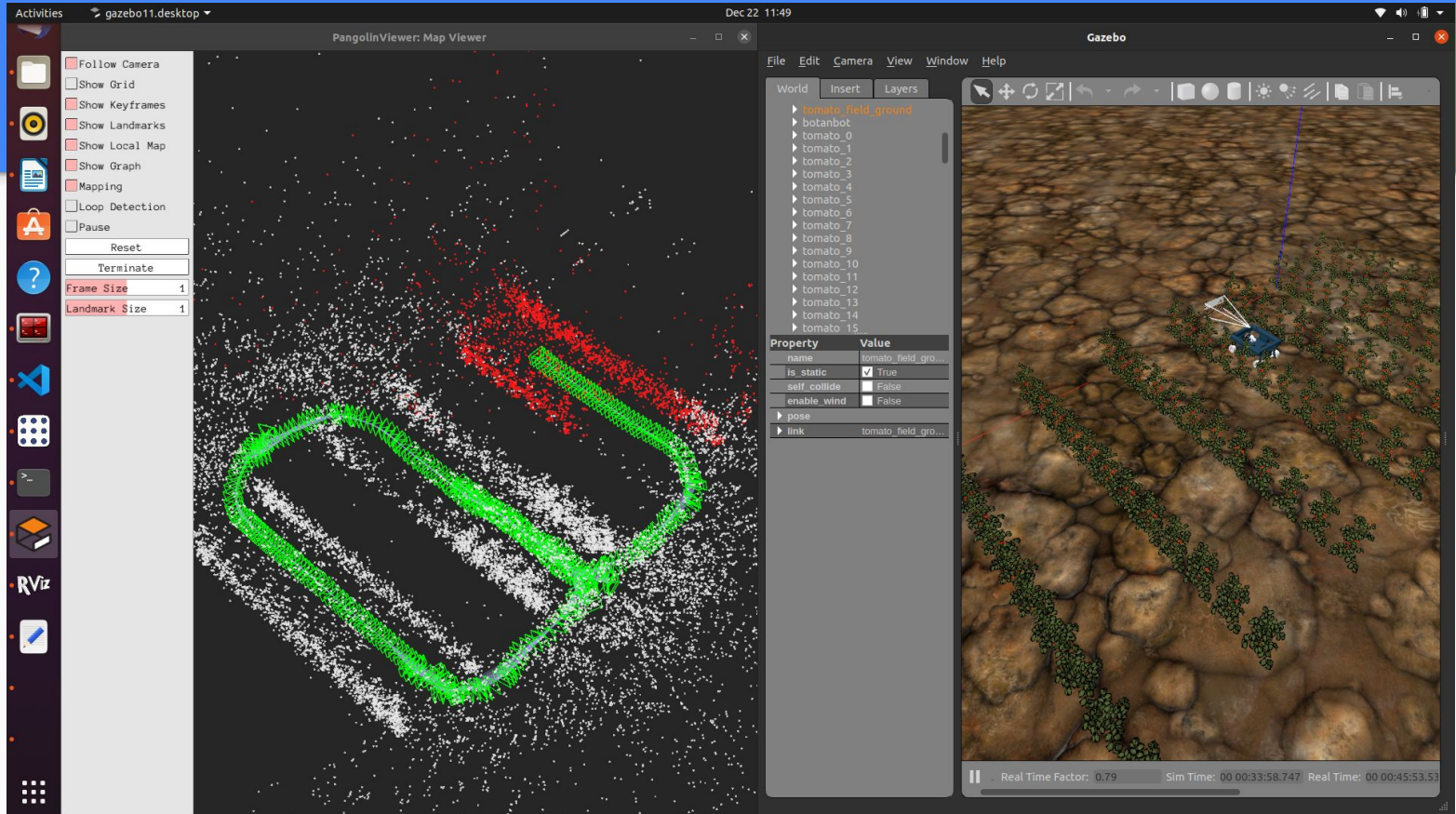


- LIDAR based 3D SLAM in the field is nearly unusable. Developed for the use in **city like** environments.
- Lack of solid shapes, **repetitive occuring** patterns confuses the algorithms.
- Visual SLAM performs better in the field. With an RGBD camera a **correctly scaled map** of agricultural field can be obtained.
- [Botanbot openvslam](#), is a client package to [openvslam](#), a visual slam based o ORB-SLAM2 Both **mapping** and **localization** nodes are available

SLAM's role

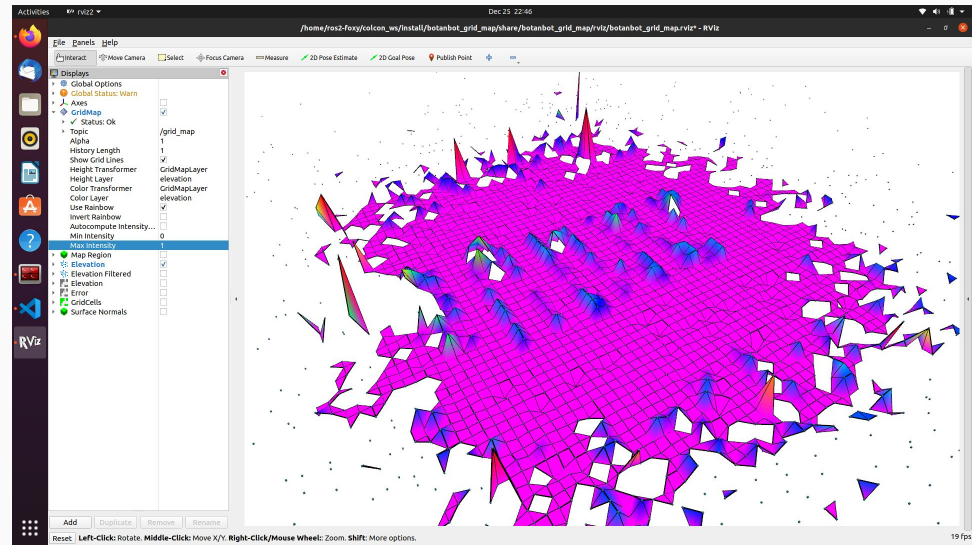


SLAM's role

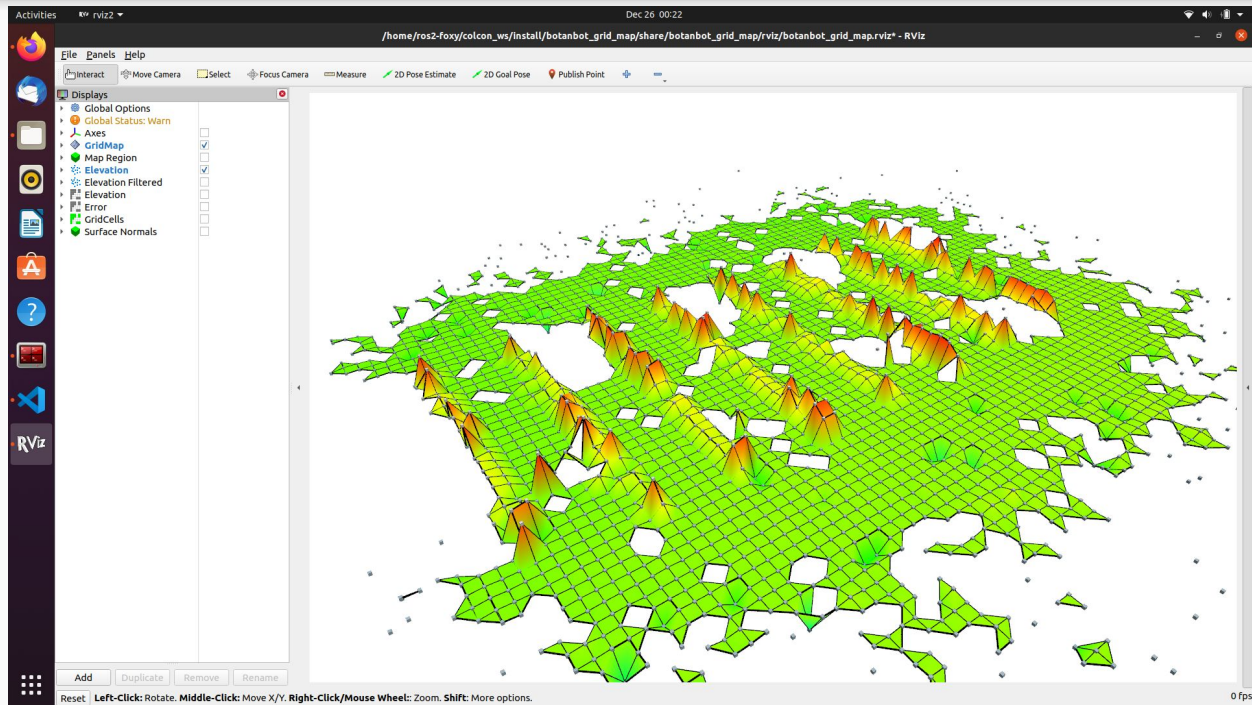


Getting the map into grid_map

- [Botanbot_grid_map](#) is a client package for grid_map, with provided ROS node and config files, a map(.pcd file) created by visual SLAM is retrieved as grid_map and published.



Getting the map into grid_map



How to do navigation based on this grid_map?

- The map does not seem perfect, there are things/parameters that certainly could be improved.
- But this map should be OK to move forward with.
- Planning, **planning** is the next step for creating feasible motion plans within this map.

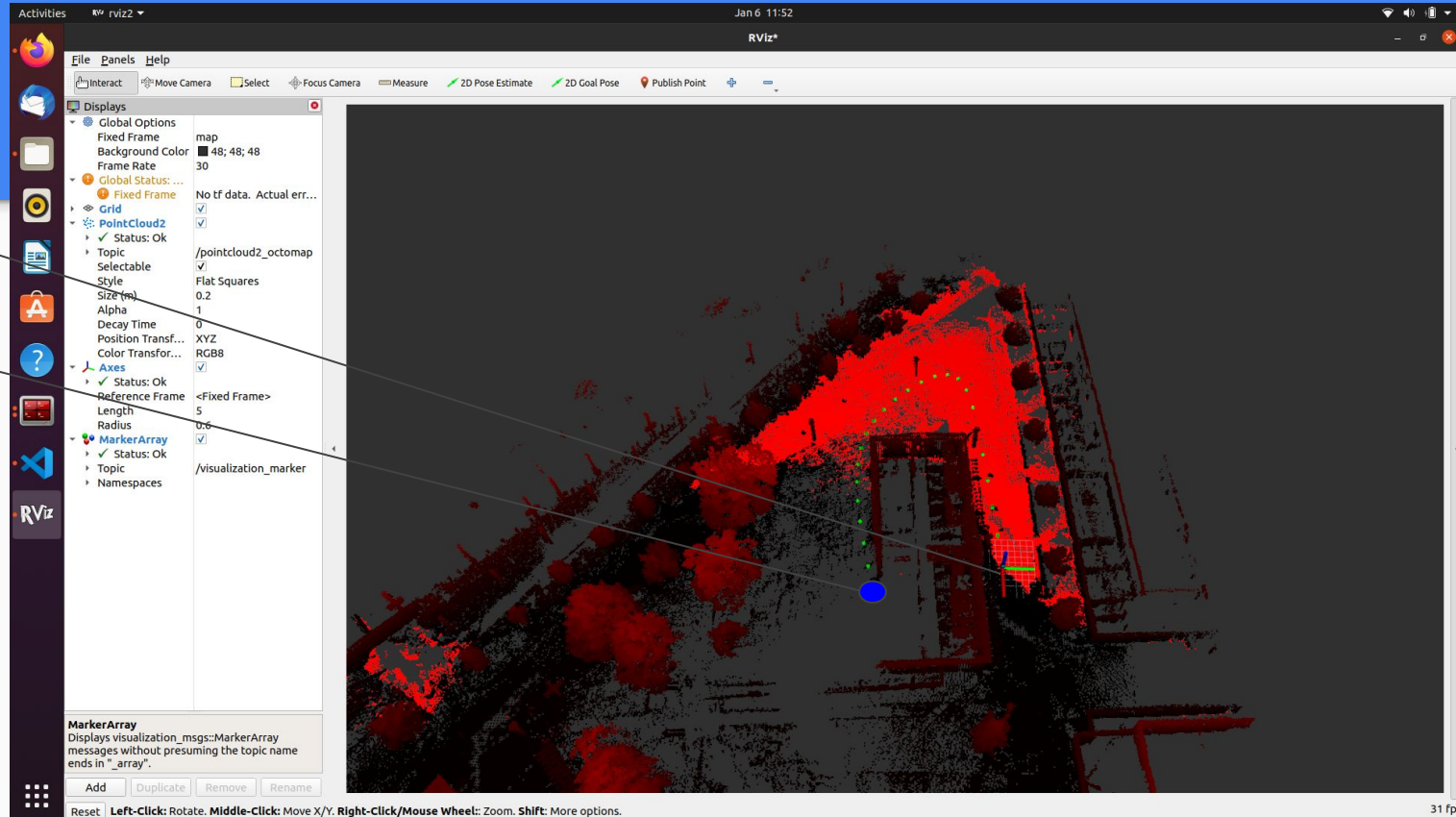
How to do navigation based on this grid_map?

- [Botanbot_ompl_experimental](#) is a client package to [OMPL](#), OMPL is an very powerful motion planning library. The whole ROS stacks(moveit, navigation) depend on OMPL.
- The planners here are **probabilistic**!, So far I have not been able to create optimal plans ackerman robot.
- Current efforts will be focused getting collision free kinematically possible paths.
- With [FCL](#), collision checking between robot's skeleton and map is performed. The map is Represented as octree and robot boy as 3D bounding box.

Current results of planning in 3D

Start(0.0, 0.0, 1.0)

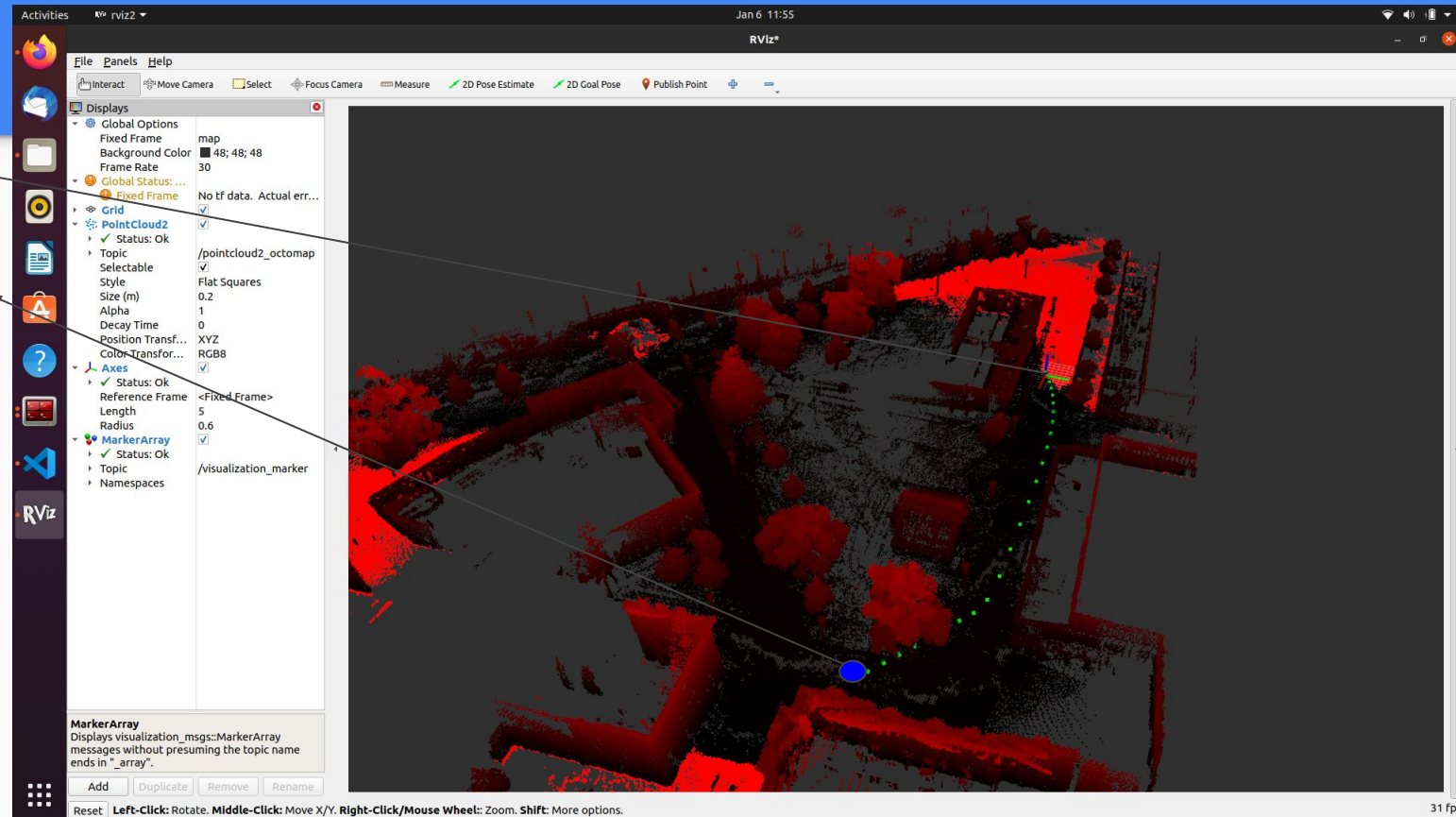
Goal(5.0, -25.0, 1.0)



Current results of planning in 3D

Start(0.0, 0.0, 1.0)

Goal(80.0, -5.0, 1.0)



NEXT STEPS

- Still not sure if we can get away just using OMPL
- Will put on efforts onto getting reliable/deployable plans from OMPL for Ackermann type car.
- Investigate this work from ETH people; [mav_voxblox_planning](#)

Thanks!