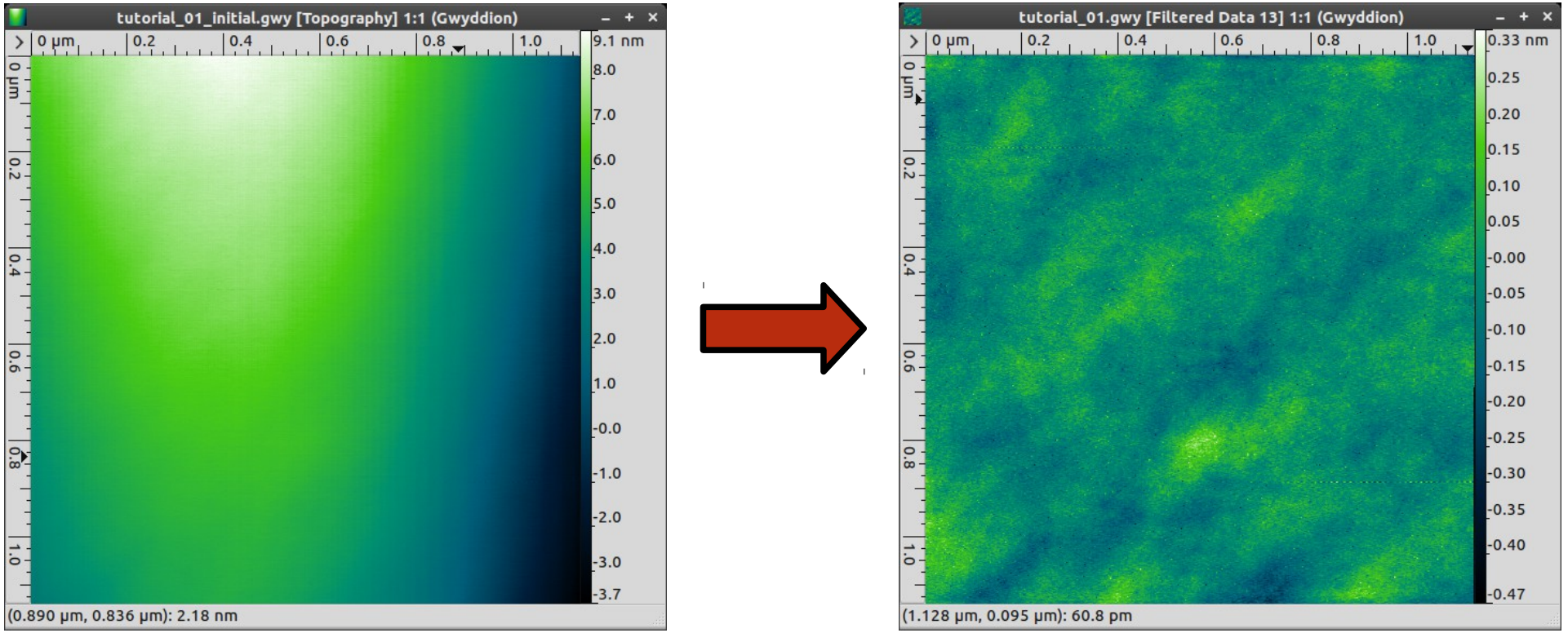
Gwyddion

Tutorial #1



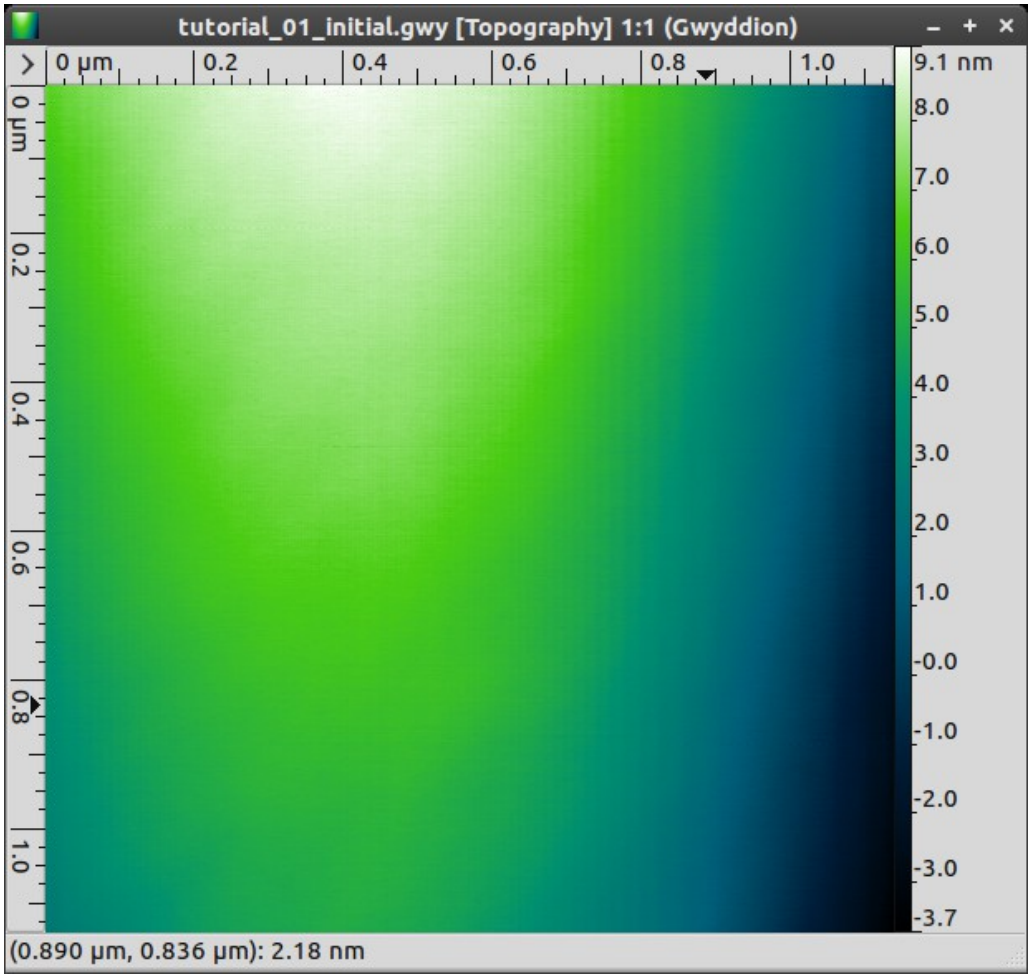
Basic data correction

Introduction

- In this tutorial we will see basic tools to correct the most obvious defects in your images:
  - Tilt / curvature
  - Height steps
  - Scars
- We will use a single image presenting all of these defects, and apply the tools offered by Gwyddion

Initial data

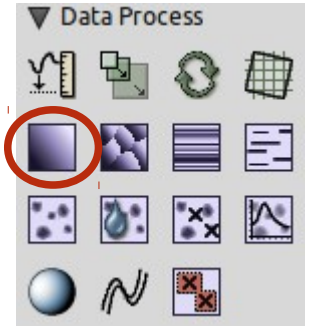
- Let's start with the raw image: an AFM scan of a silicon sample

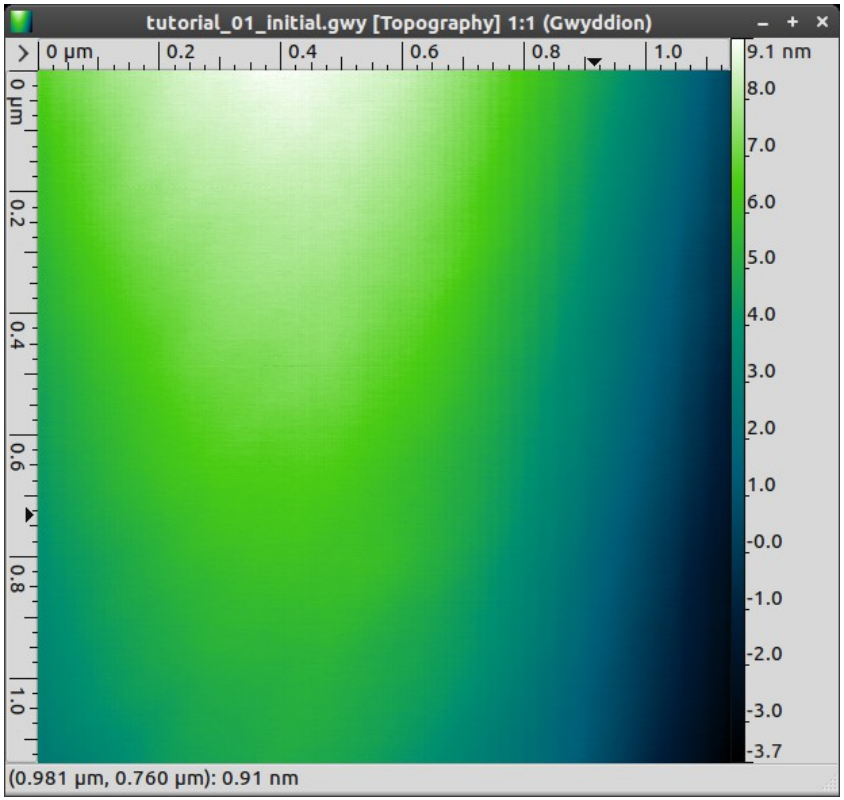


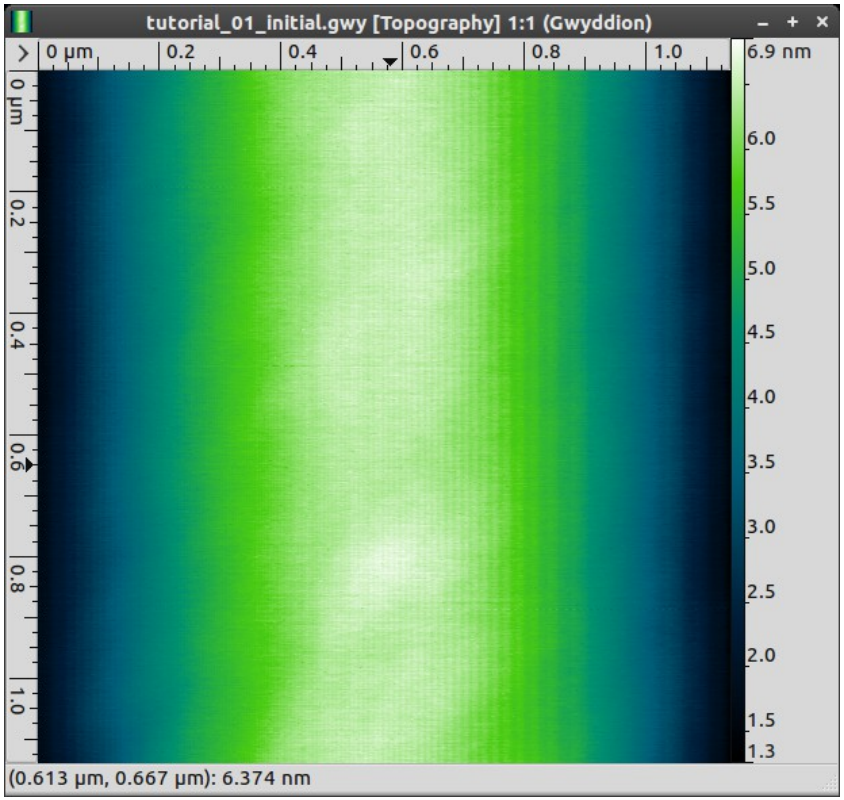
- There is obviously some tilt and curvature...

Tilt correction

- We can first remove the tilt with a simple click

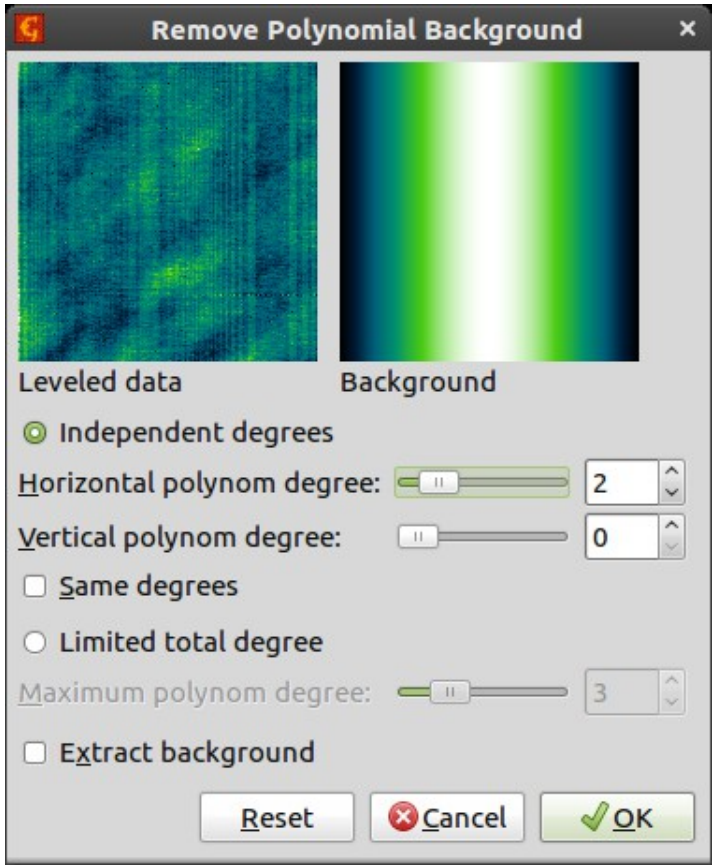


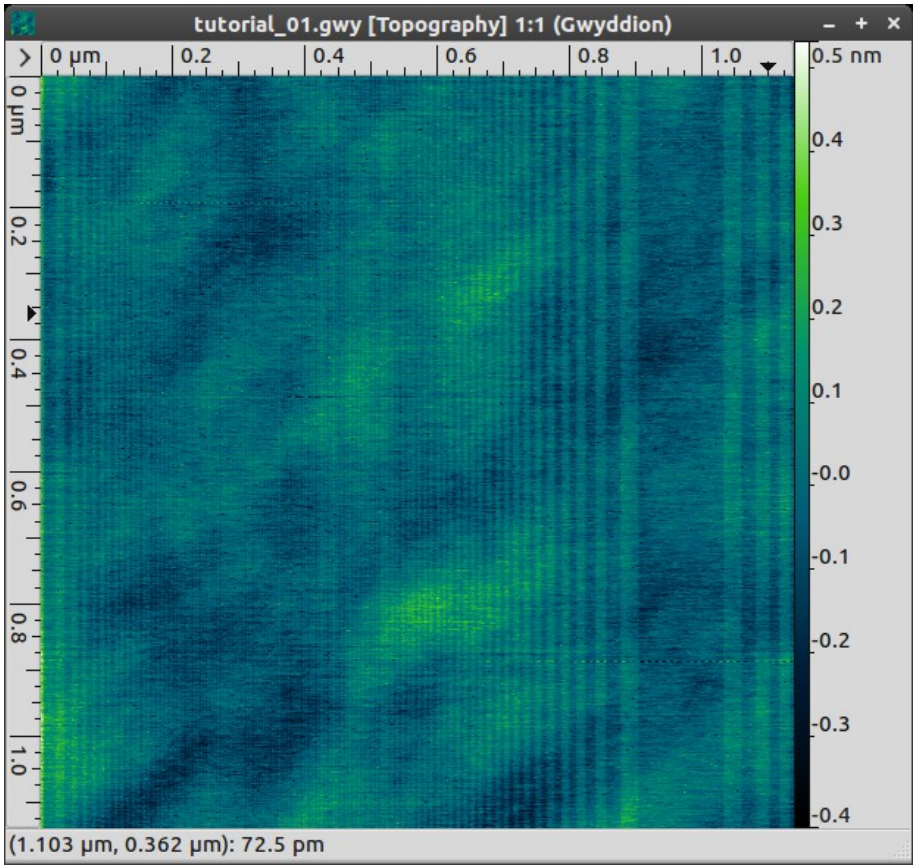




Curvature correction

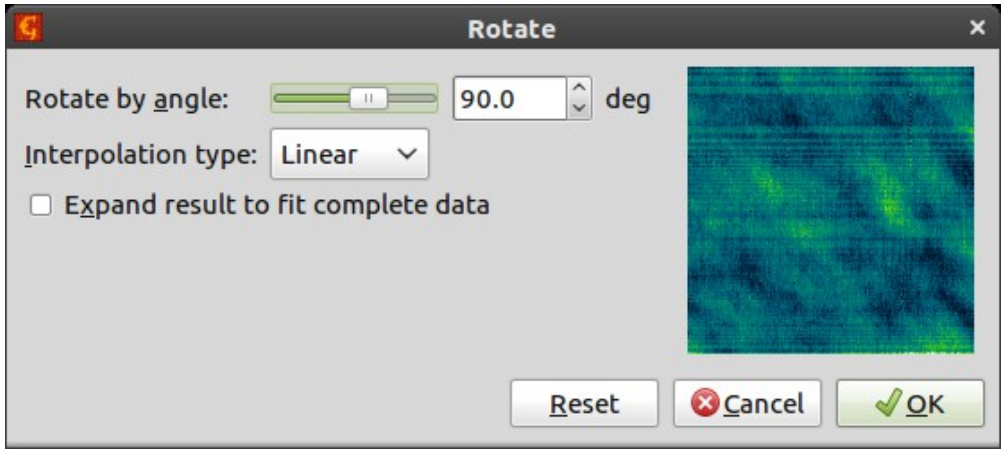
- The polynomial background correction will easily remove the curvature
  - Use the smallest polynomial degree to avoid removing actual surface waviness

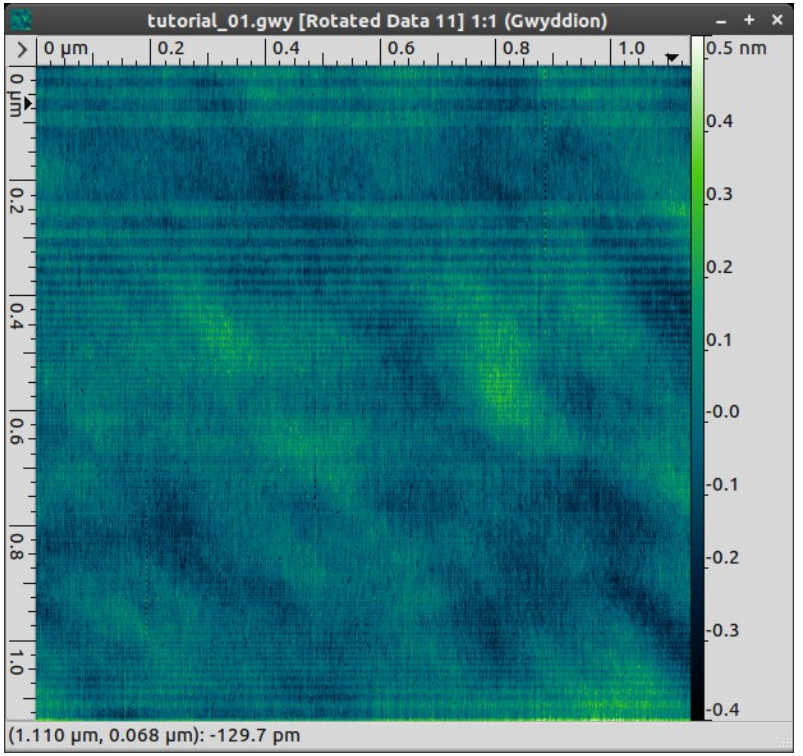




Height steps correction

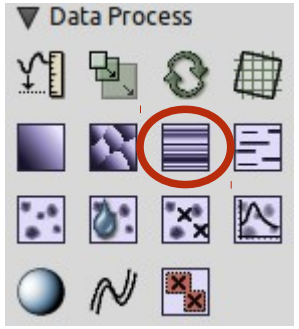
- Once the background removed, we can notice vertical « fringes »
- Median height line correction is able to remove this on horizontal lines, so we must first rotate de image

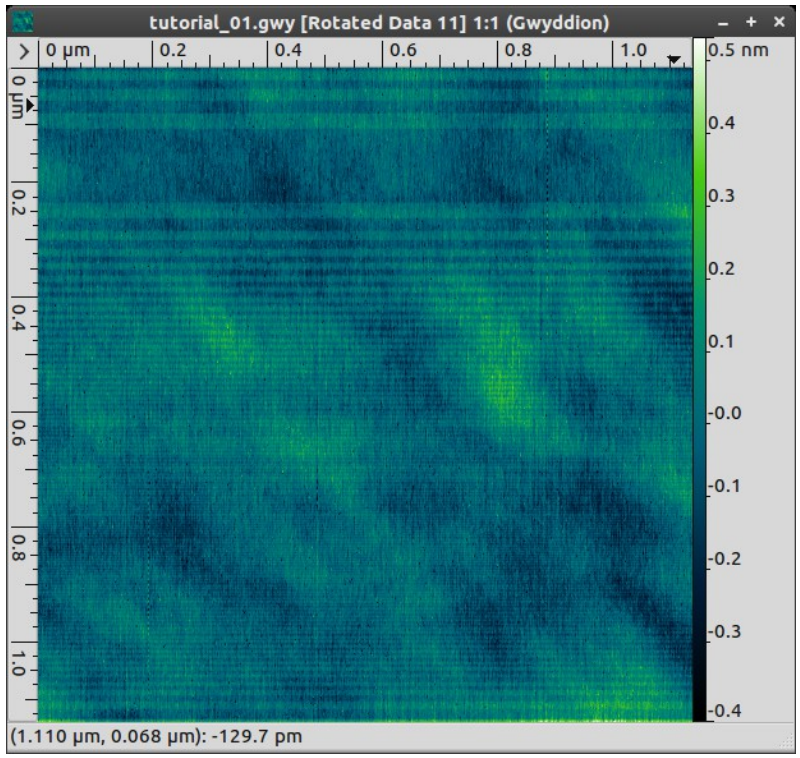


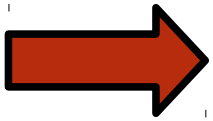


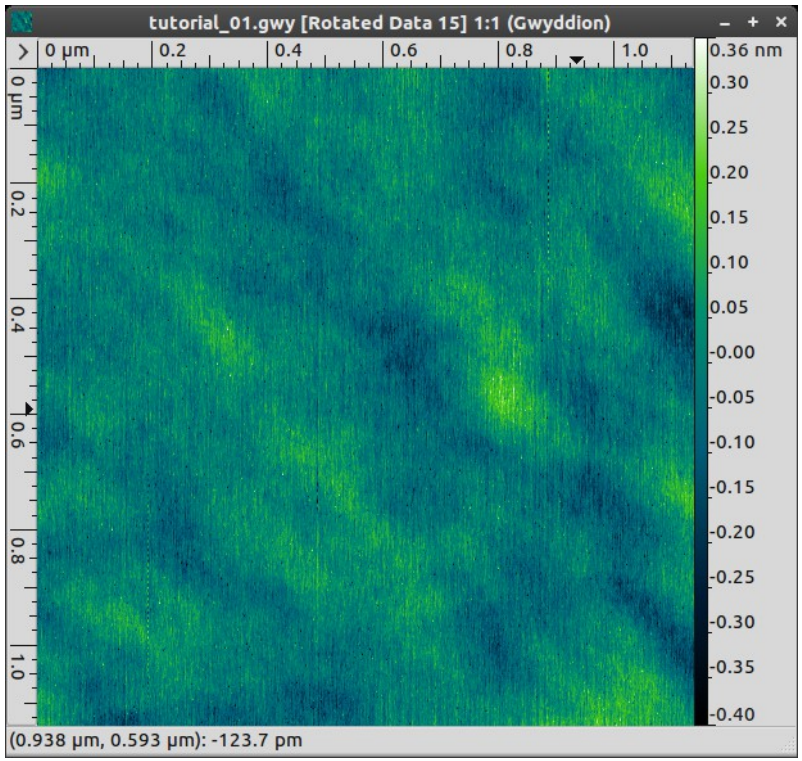
Height steps correction

- A simple click removes the steps
- We will need to rotate back the image for the next step



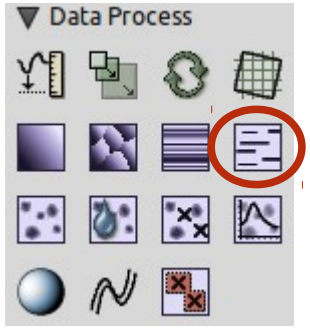


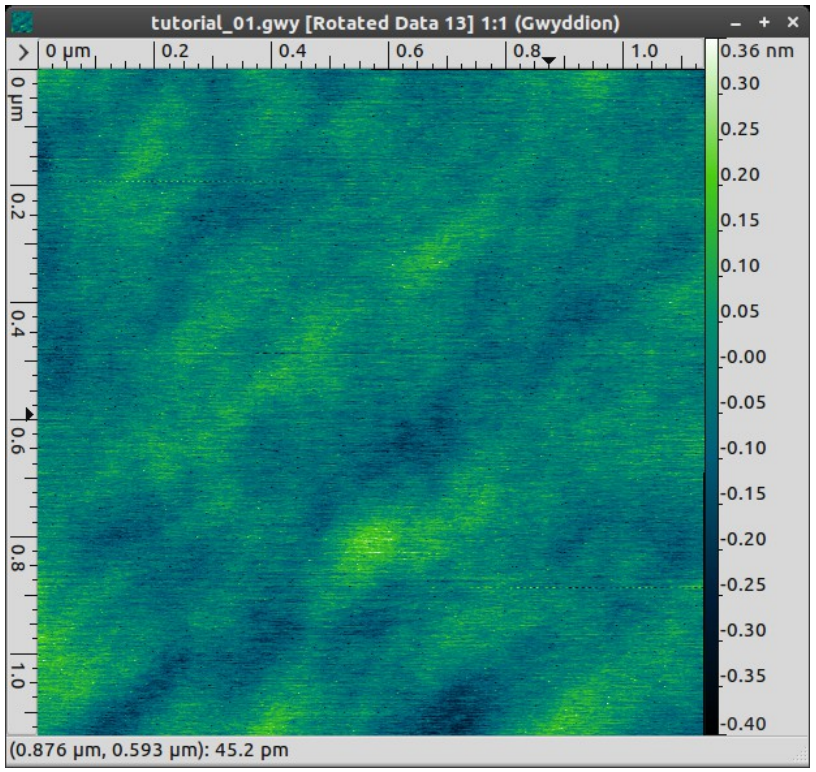


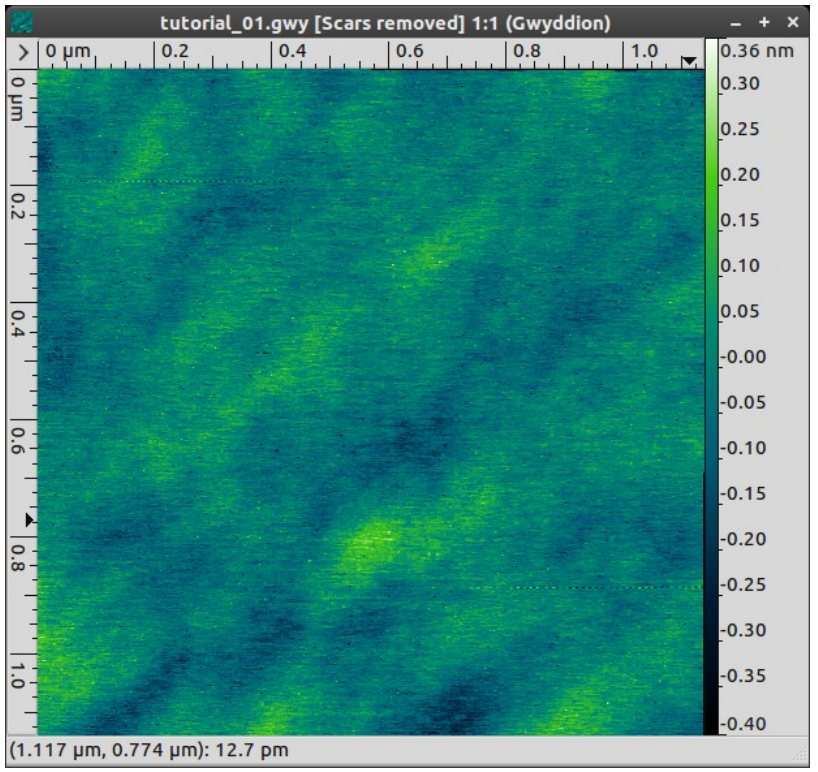


Scars removal

- Thin linear artifacts (« scars ») can be removed with the scars removal tool
  - Depending on the scars aspect, the correction can be more or less obvious...

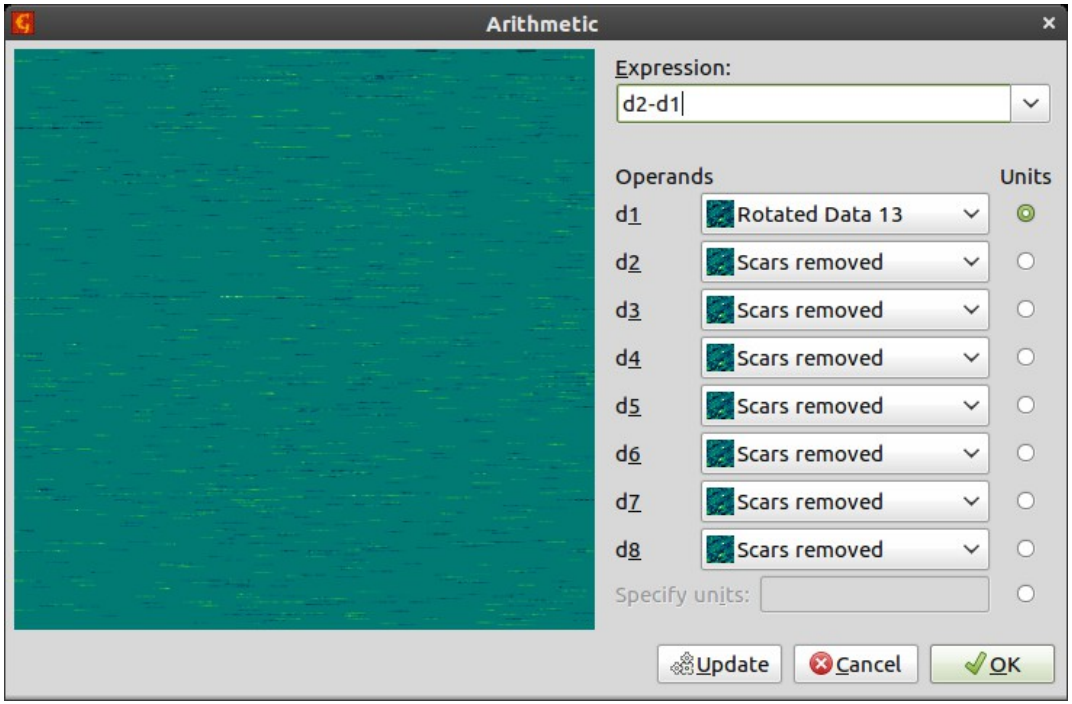


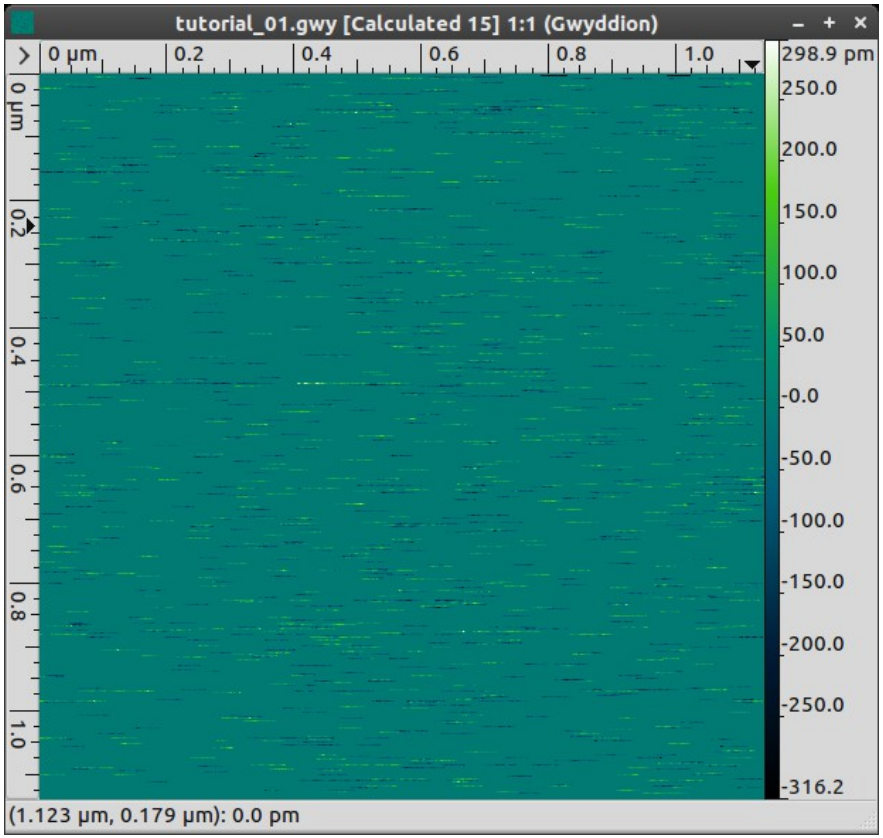




Scars removal

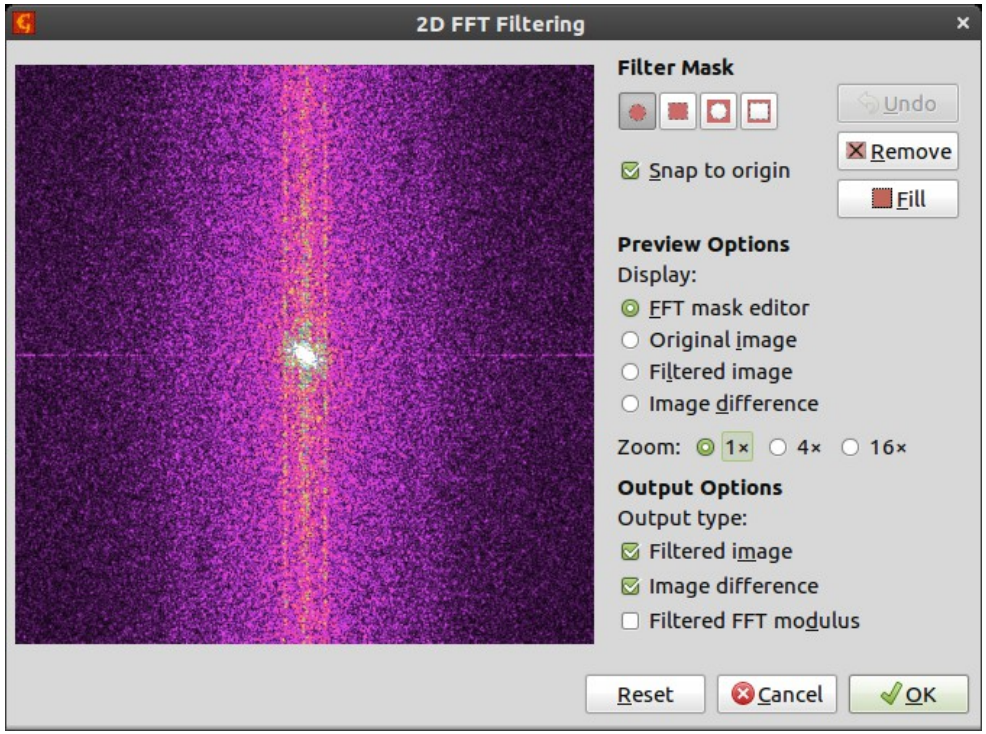
- If you are not convinced, make an image difference !
  - Data Process → Multidata → Arithmetic





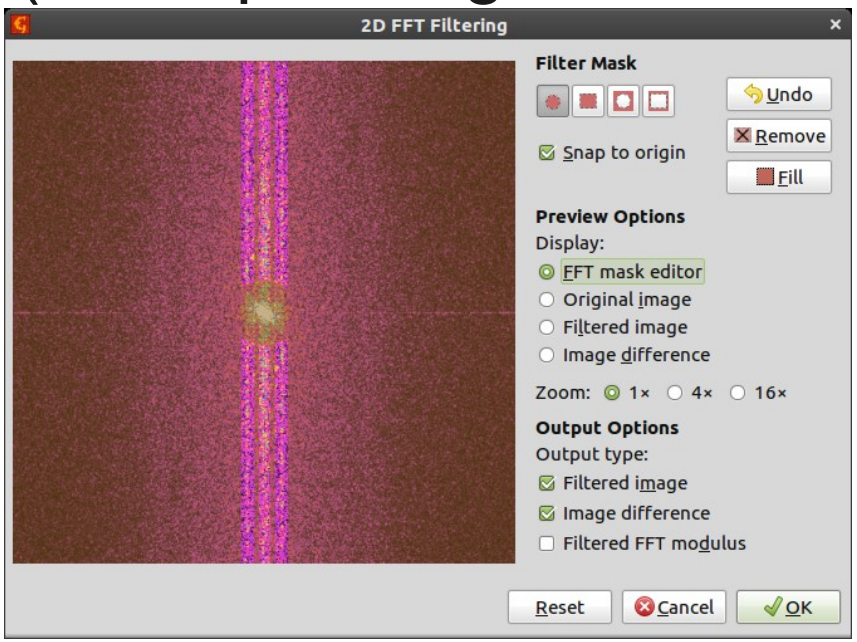
Fourier filtering

- Another method to remove the residual artifacts is to filter them in the Fourier space
- **Warning**: this can remove actual surface features, and create filtering artifacts !
  - Data Process → Correct Data → 2D FFT filtering



Fourier filtering

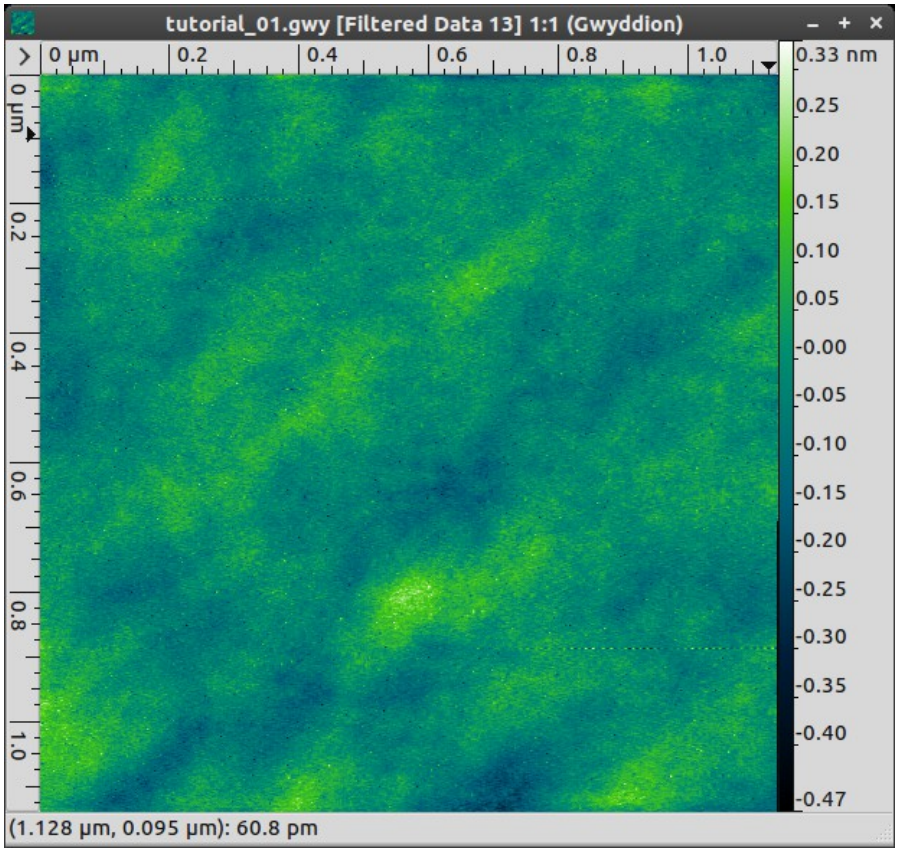
- One can notice 3 vertical lines in the Fourier space representation, these correspond to the scars spatial frequencies
  - Fill the entire space, and isolate the lines with rectangles (uncheck « Snap to origin »)
  - Re-fill the center space to not remove surface features (« Snap to origin » can be useful here)



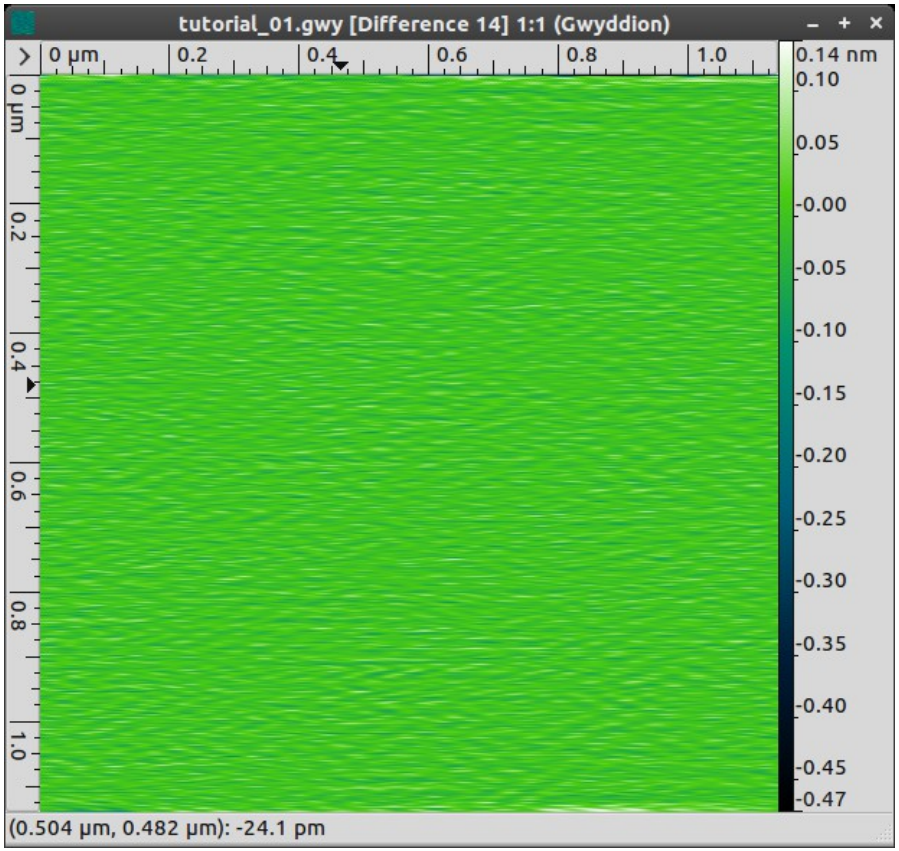
Fourier filtering

- Scars have been sucessfully removed, however some waves have been created

Result



Difference (= removed features)



Conclusion

- We have seen common tools that you may use on most of your data:
  - Tilt correction
  - Polynomial background subtraction
  - Median line correction
  - Scars removal

- Fourier filtering can also be a powerful tool, but it should be used very carefully