

Preliminary study of H_0 anisotropy with ZTF-DR2 data simulation



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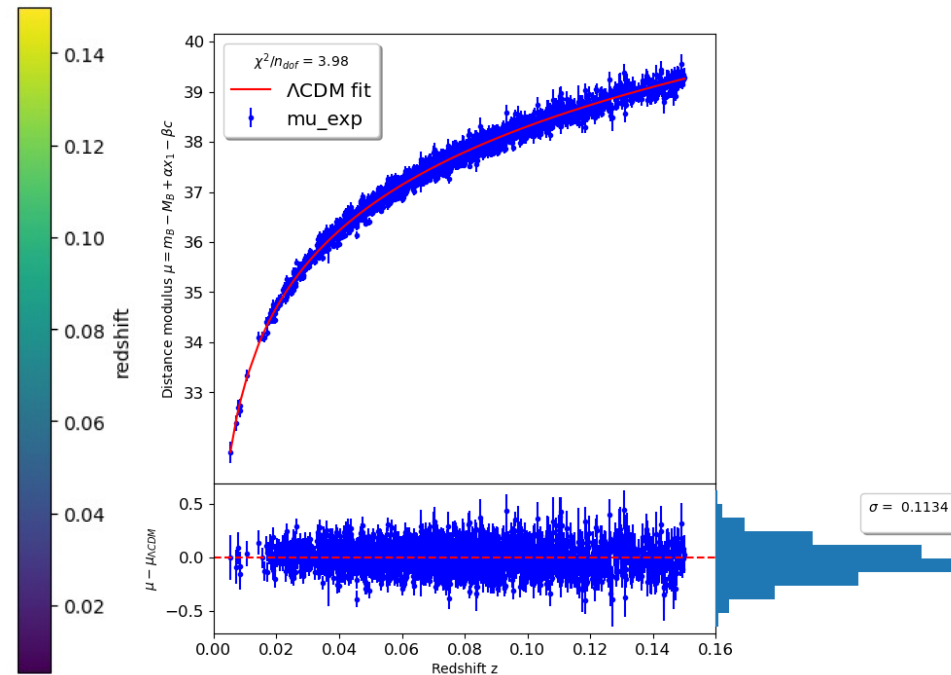
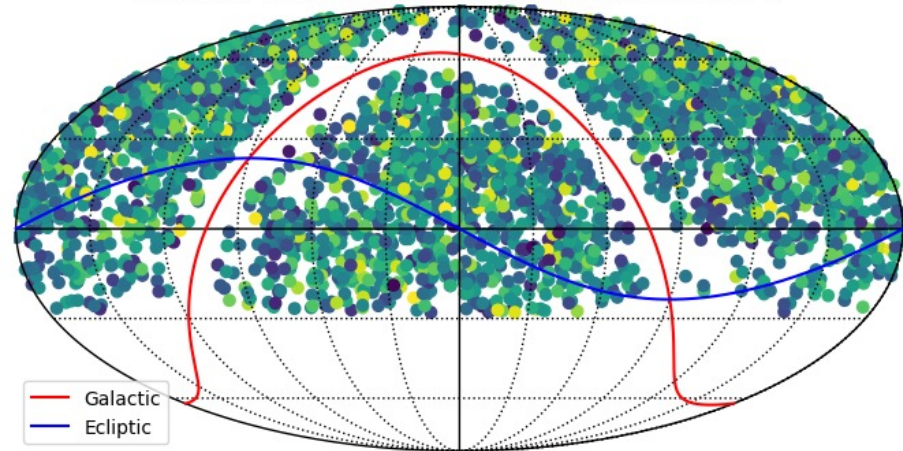


I-SITE Clermont
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ZTF-DR2 realistic simulation

- Simsurvey with ZTF-1-log and BTS spectroscopic selection function
- About 2500 SNe Ia after DR2 selection cuts
- Global Hubble diagram fit with $H_0 = 70 \text{ km s}^{-1} \text{ Mpc}^{-1}$ and $\Omega_m = 0.3$ and $(M_B, \alpha, \beta) = \text{free}$

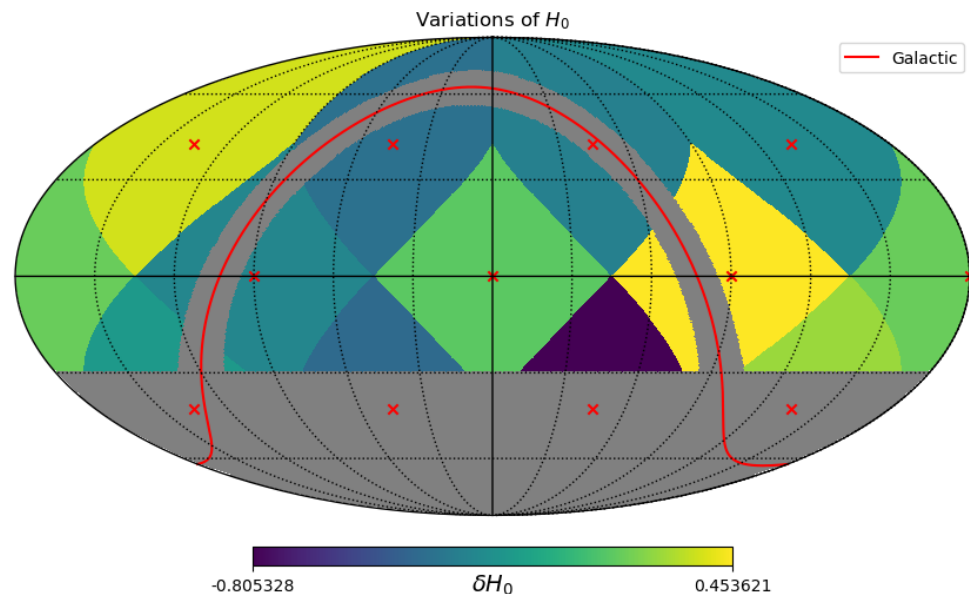
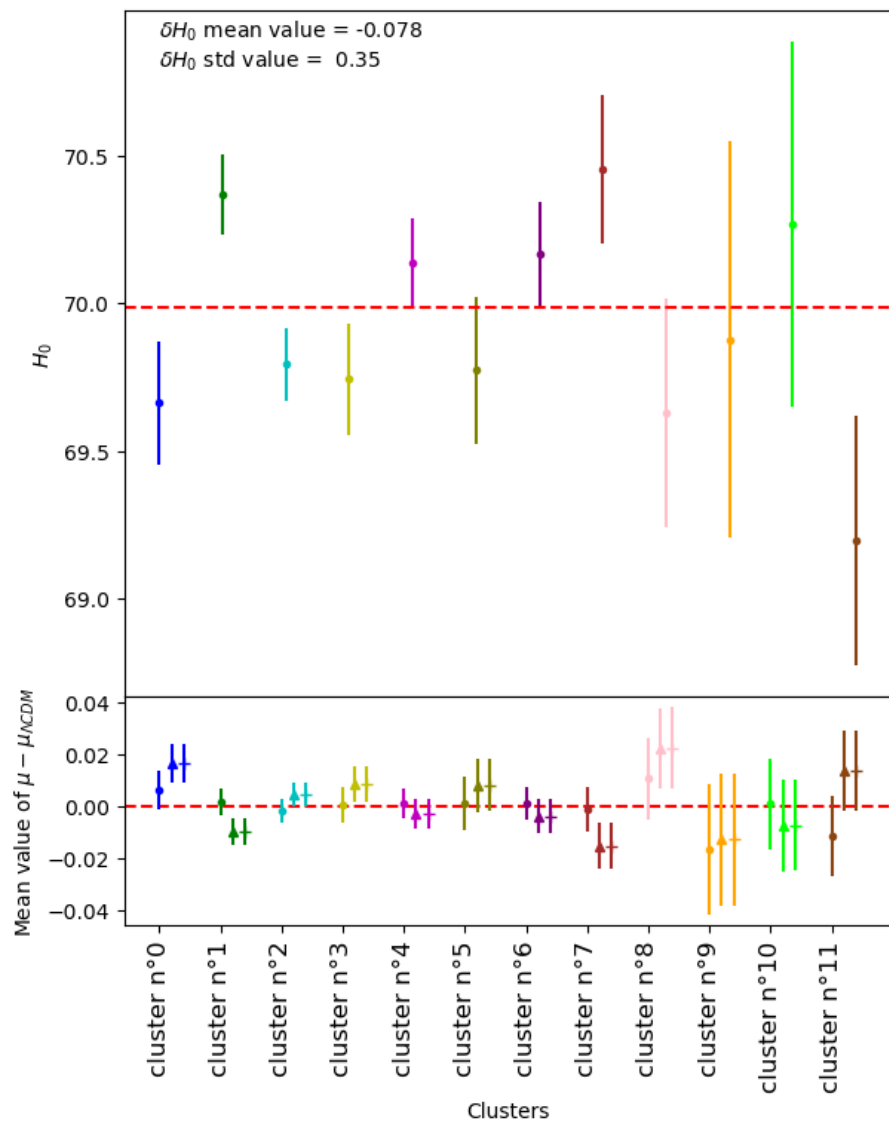
Equatorial coordinates representation of simulated SN Ia



H_0 anisotropy analysis

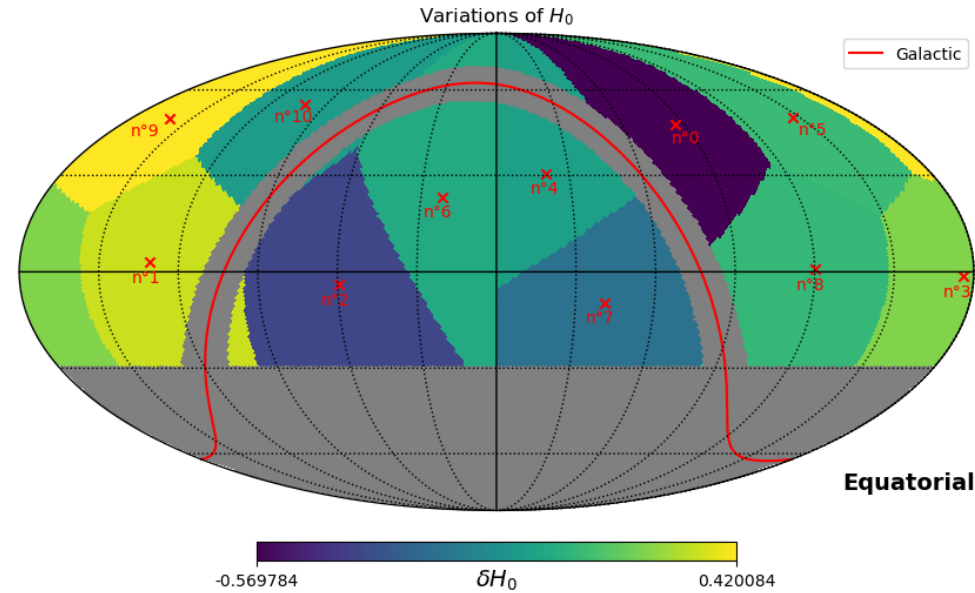
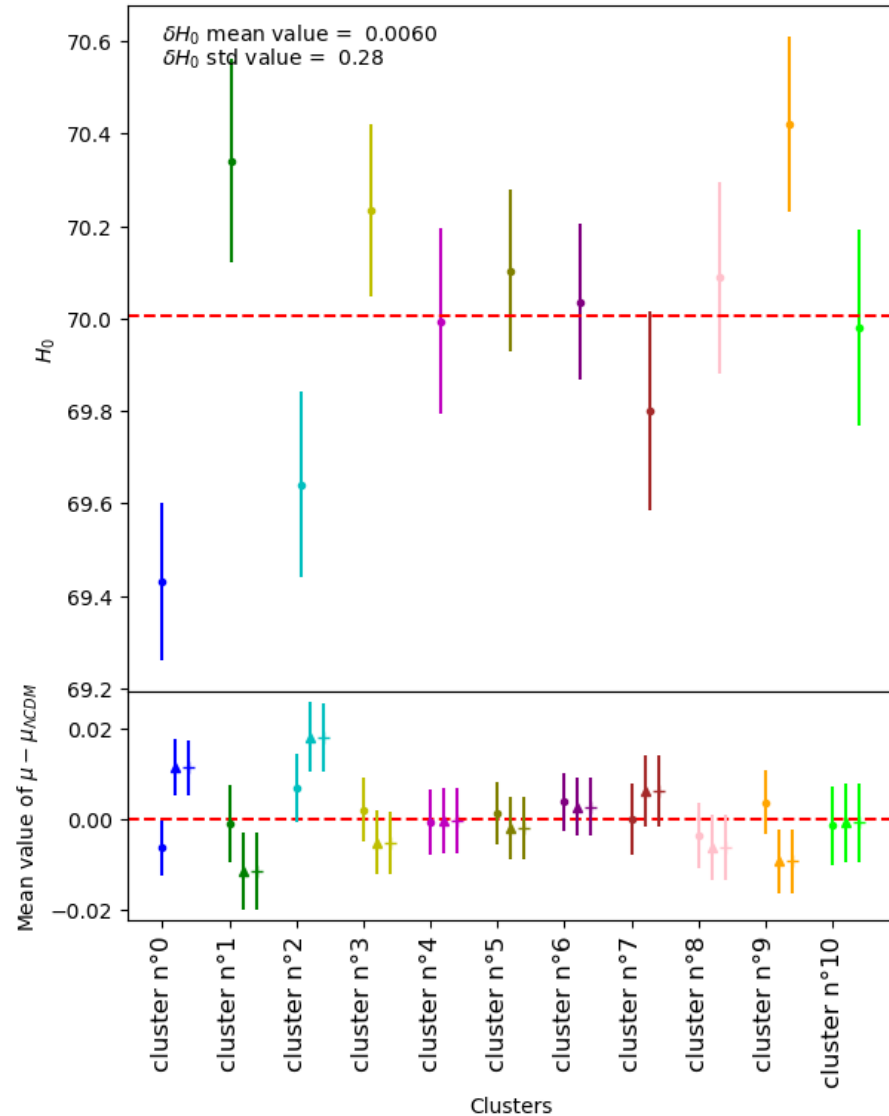
- one H_0 free parameter per sky-direction patch
- M_B fixed to global fit result
- $(\alpha, \beta) = \text{free}$ but common to all patches

H_0 fit on fixed cluster grid



- Healpy used to patch the sky
- Advantage: fixed patches
- Disadvantage: non equal statistic per patch
- Sensitivity: $\sigma_{\delta H_0} \approx 0.4$

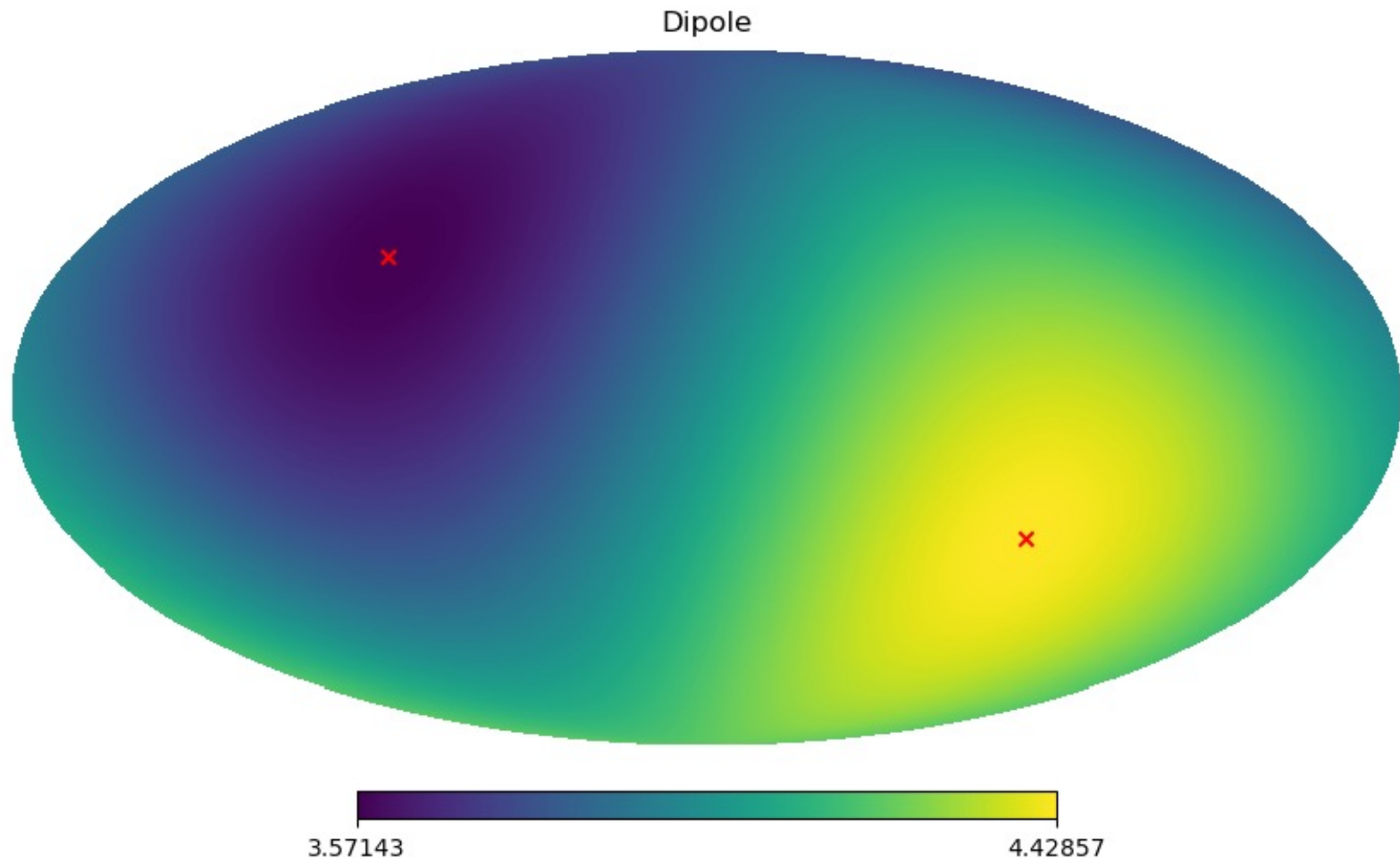
H₀ fit on adapted clustering



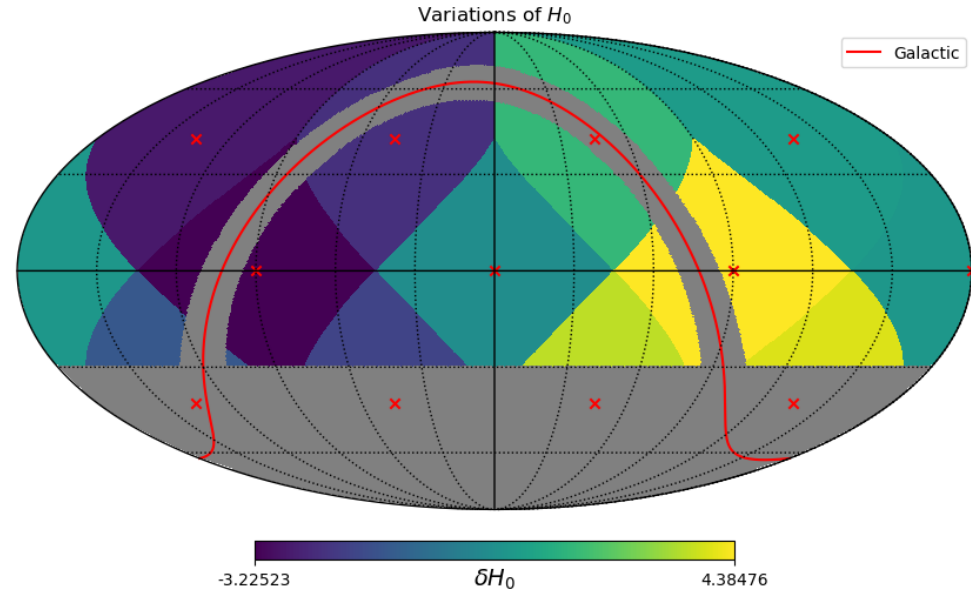
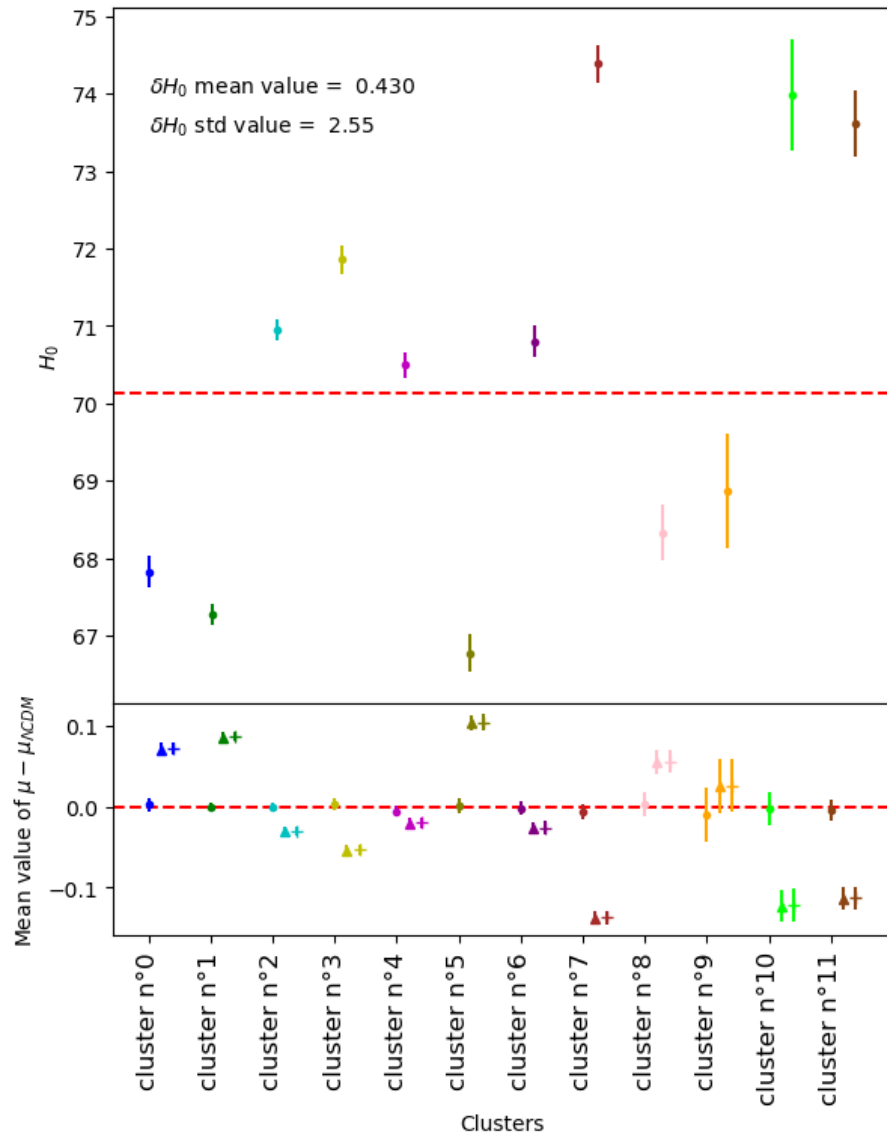
- `sklearn.cluster.Kmeans`
- Advantage: equal statistic per patch
- Disadvantage: patches definition depend on initial parameters for clustering
- Sensitivity: $\sigma_{\delta H_0} \approx 0.3$

Simulation of anisotropy: dipole effect

- SN redshift: $z = H_0 d \rightarrow z' = H'_0 d = (H_0 + \delta H_0) d$
- Dipole effect: $\delta H_0 \equiv \delta H_0 \cos \Delta\theta$ where $\Delta\theta = (\widehat{\text{dip}}, \widehat{\text{SN}})$
- Cross (x) defined dipole direction with an amplitude $\delta H_0 = 5 \text{ km s}^{-1} \text{ Mpc}^{-1}$

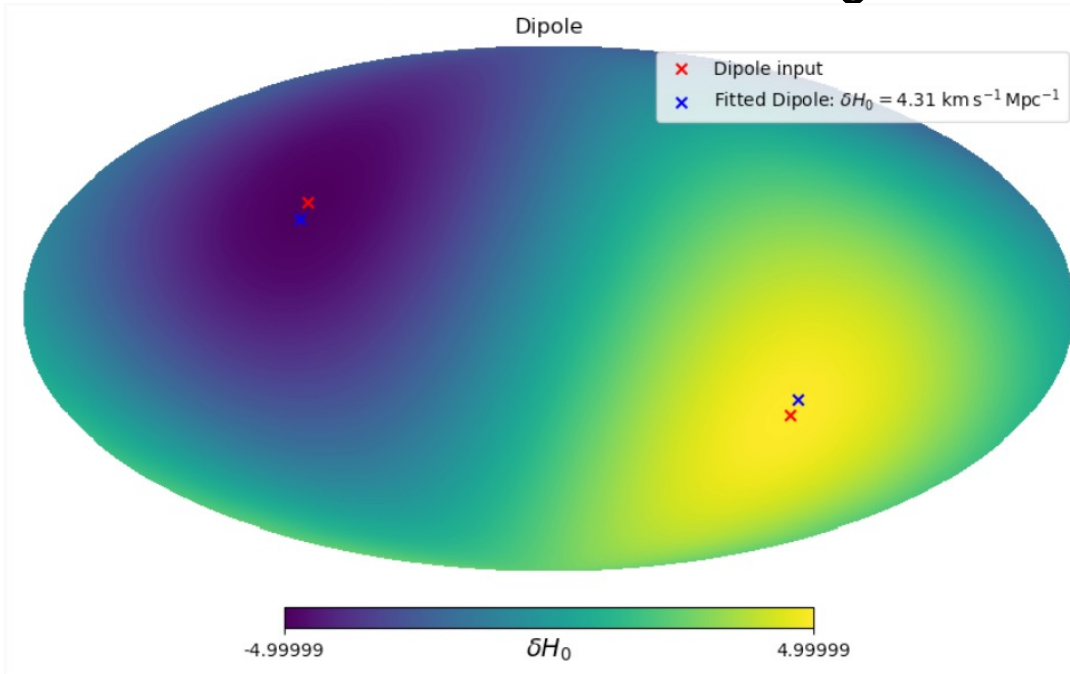


H₀ fit on dipole anisotropy effect

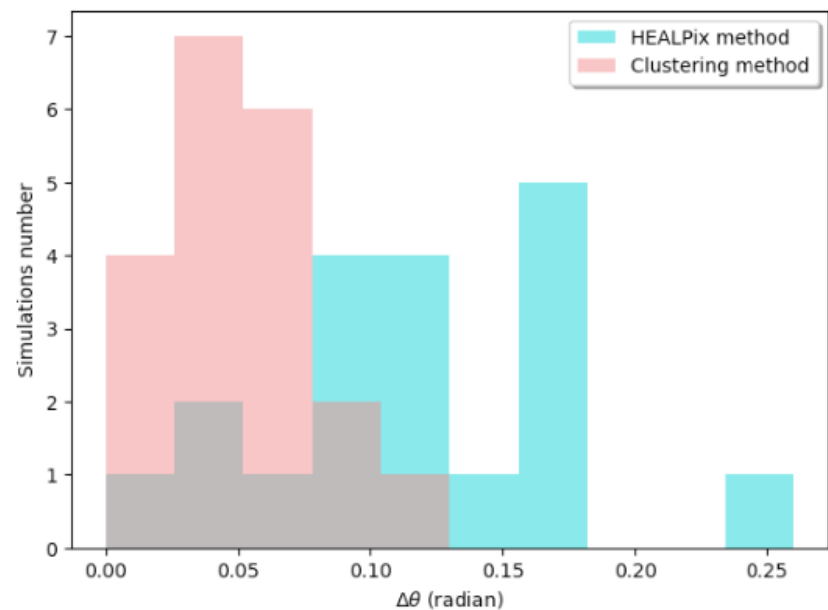
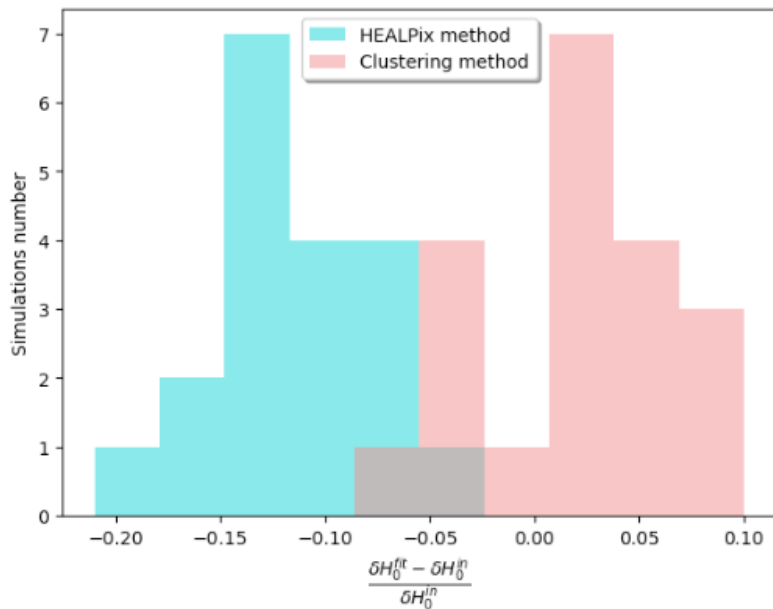


- Fixed patches case
- Initial H_0 anisotropy map retrieved by the fit

Dipole fit of H_0 anisotropy map



$$\chi^2 = \sum_i^{N_{\text{cluster}}} \left(\frac{H_0^i - H'_0(\Delta\theta_i)}{\sigma_{H_0^i}} \right)^2$$



Conclusion and perspectives

Conclusions

- DR2 sample can allow to detect H_0 anisotropies with a sensitivity
$$\sigma_{\delta H_0} \approx 0.3 \text{ km/s/Mpc}$$
- Dipole anisotropy of amplitude $\delta H_0 = 5 \text{ km/s/Mpc}$ can be reconstructed with
 - an amplitude resolution of $\sim 5\%$
 - a direction resolution of $\sim 3^\circ$

Next steps : **Chloé Barjou-Delaire Thesis (starting October, 1st)**

- Introduction of Cosmic web into simulations
- Work on fitting procedure and sky-patches granulometry
- Forecast sensitivity with different H_0 anisotropy scenario (quadrupole...) over a large dynamic amplitude in all sky directions
- ... DR2 data analysis

Hubble diagram in different patches

