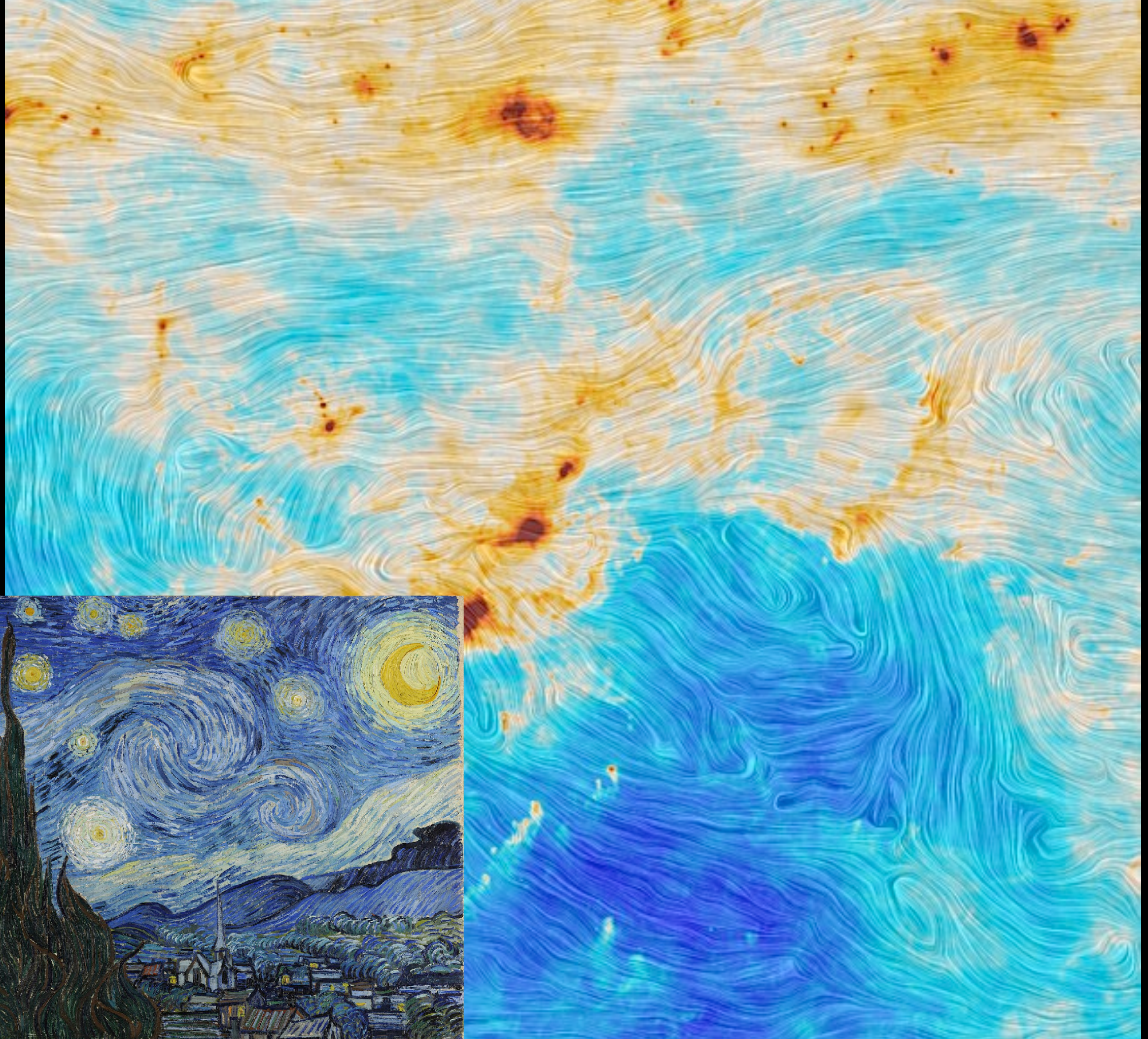


Adjacent Correlation Analysis

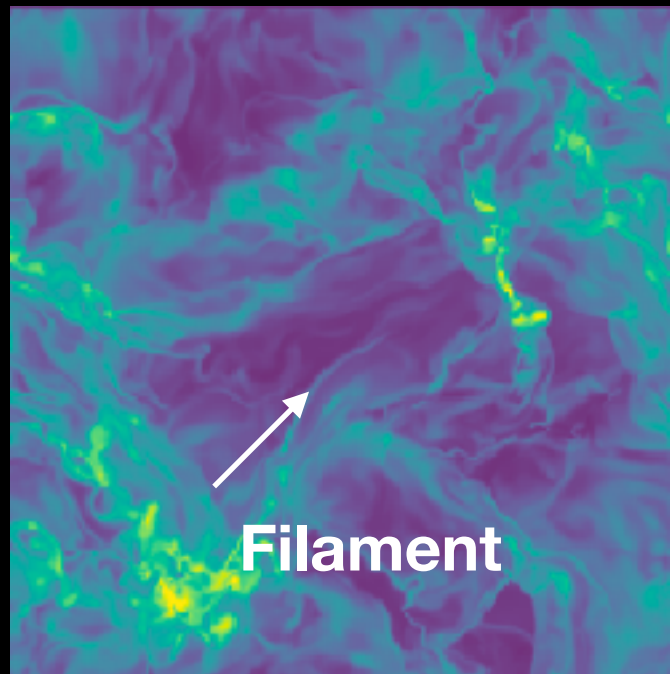
gxli@ynu.edu.cn



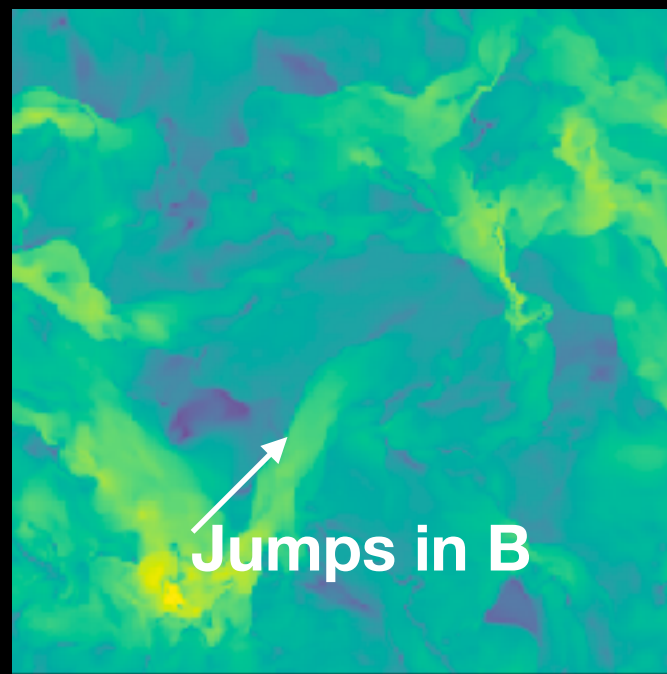


When correlations ponder

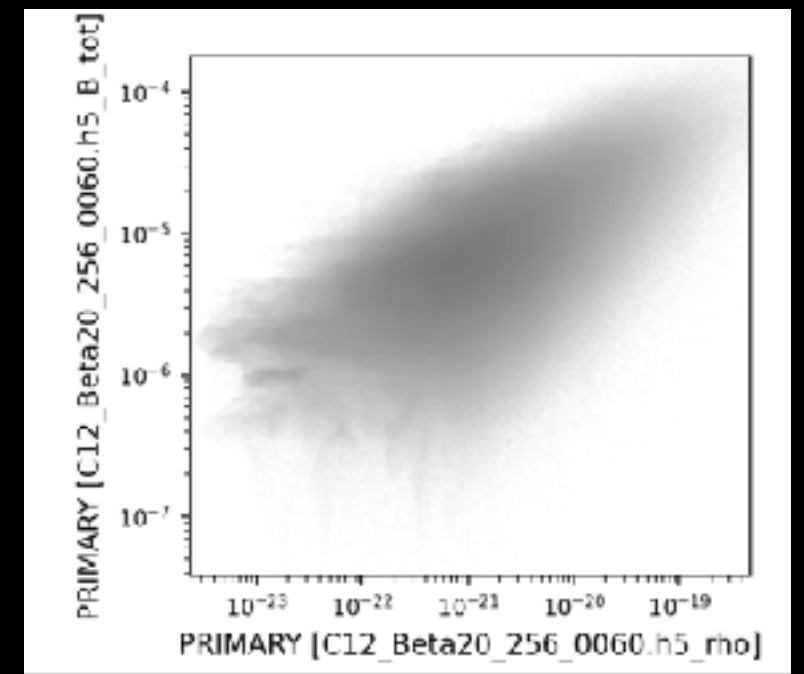
$\log(\rho)$



$\log(B)$



$\log(\rho) - \log(B)$

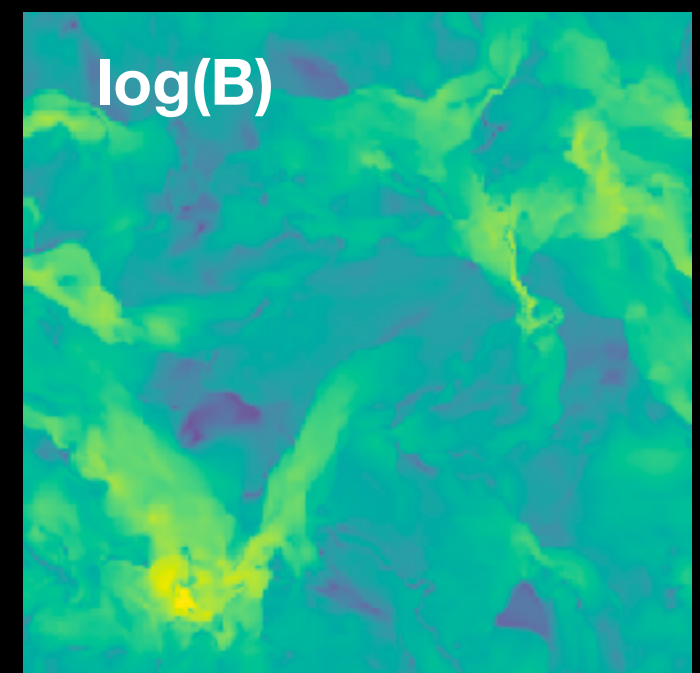
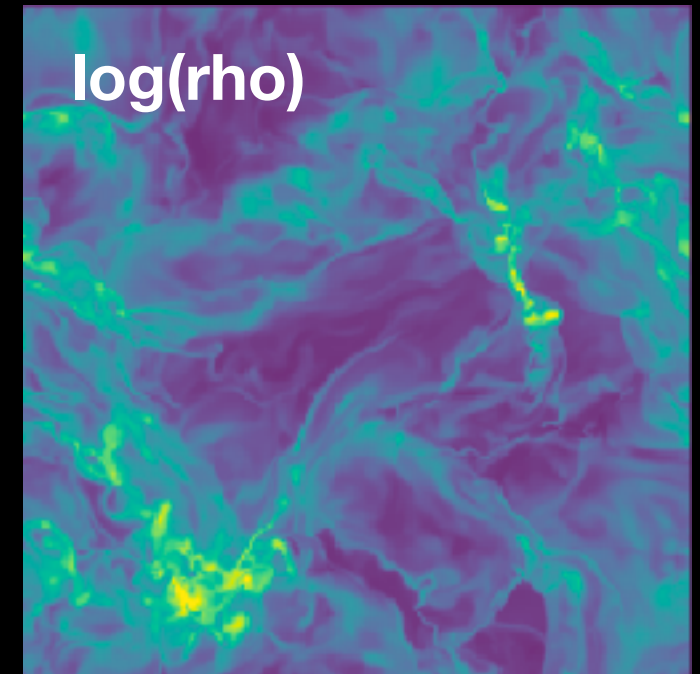
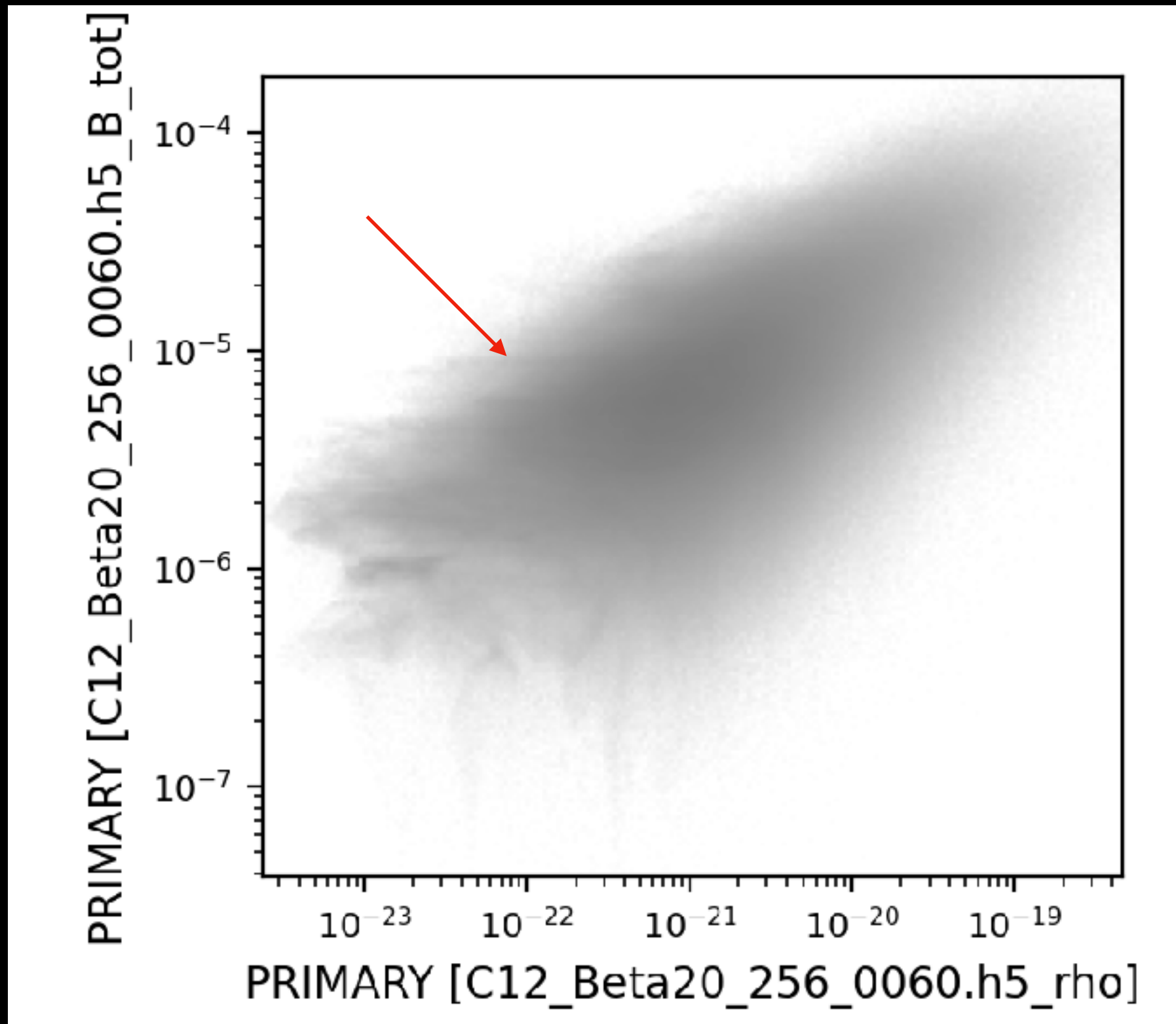


Features overlap (highly-organized, plenty of information)

Weak correlations (bad way to represent information)

When correlations ponder

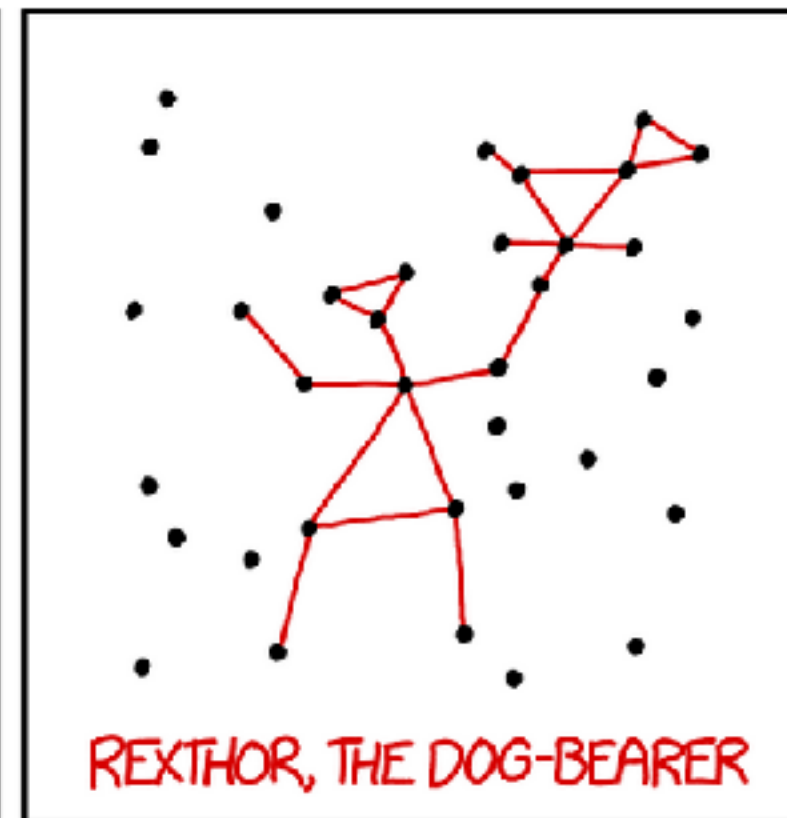
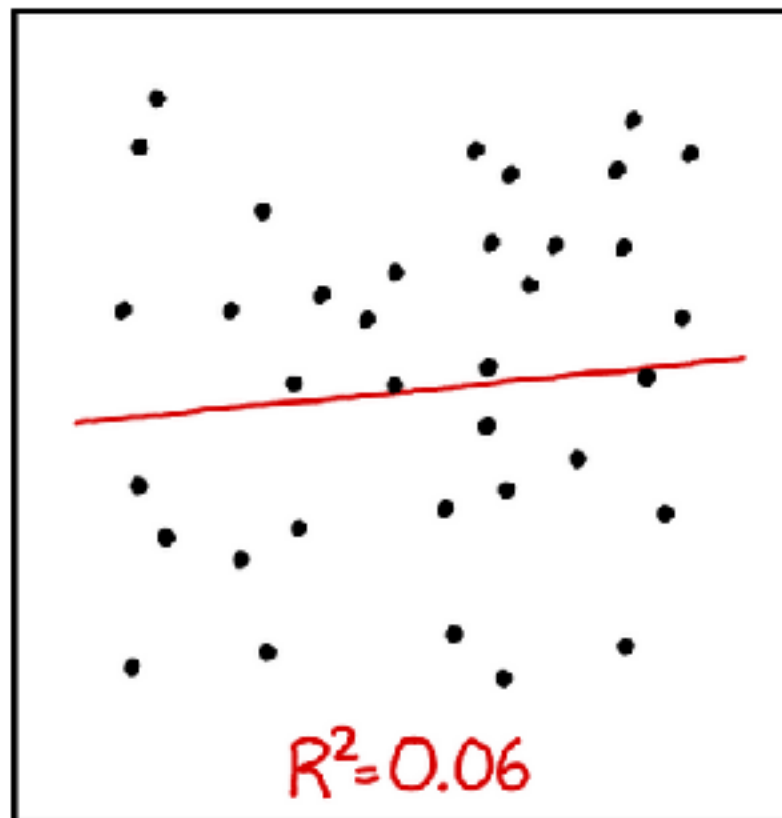
$\log(\rho) - \log(B)$



You job

LINEAR REGRESSION

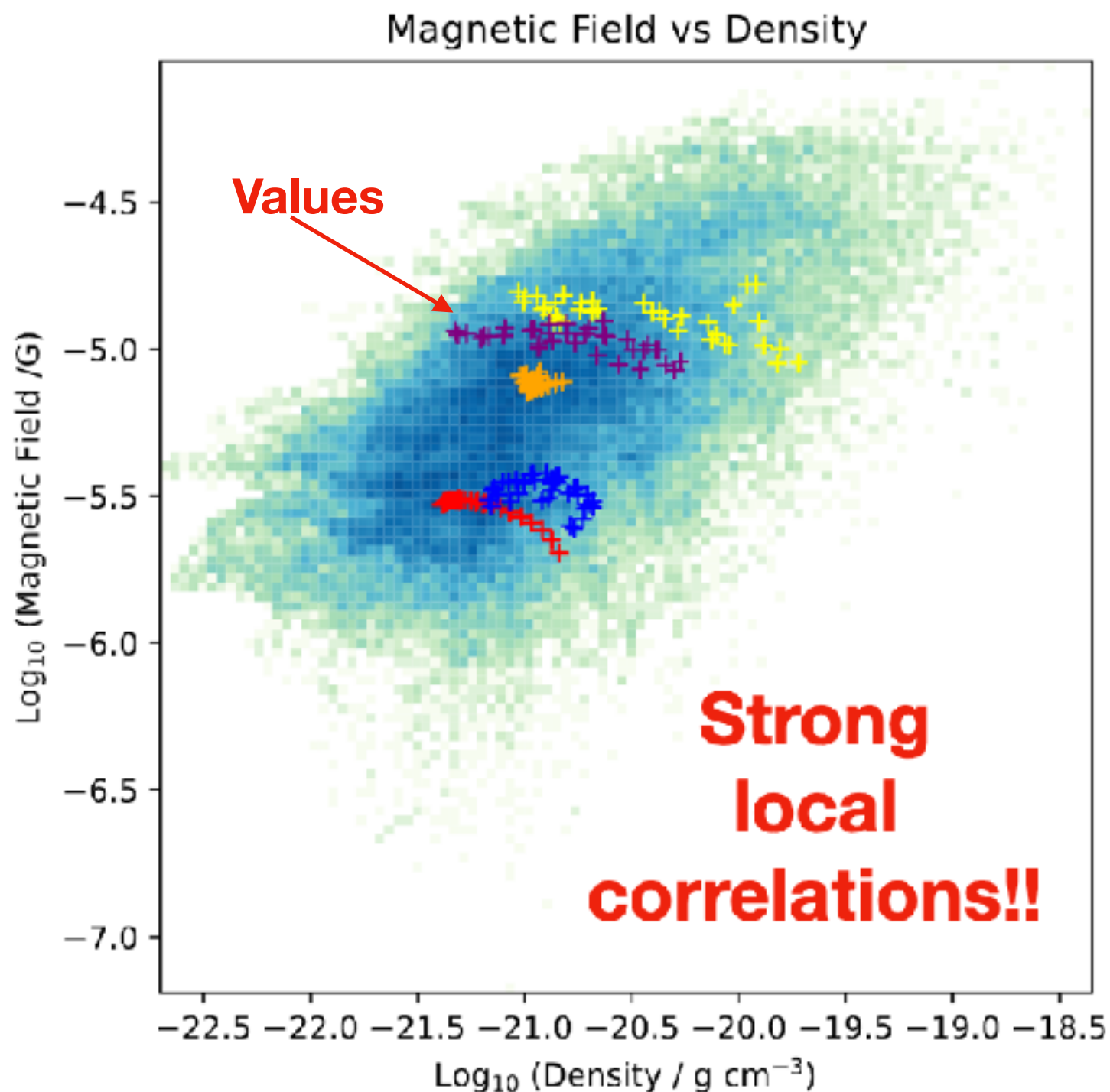
|< < PREV RANDOM NEXT > >|



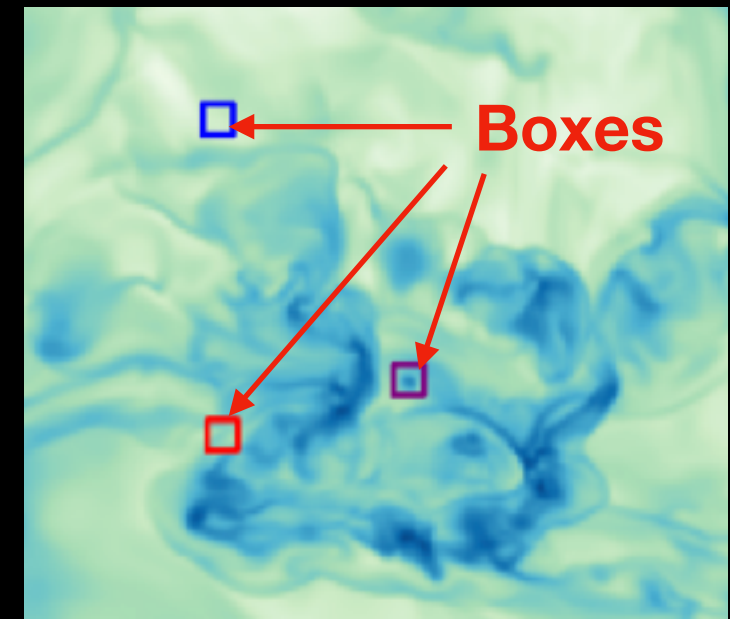
I DON'T TRUST LINEAR REGRESSIONS WHEN IT'S HARDER
TO GUESS THE DIRECTION OF THE CORRELATION FROM THE
SCATTER PLOT THAN TO FIND NEW CONSTELLATIONS ON IT.

|< < PREV RANDOM NEXT > >|

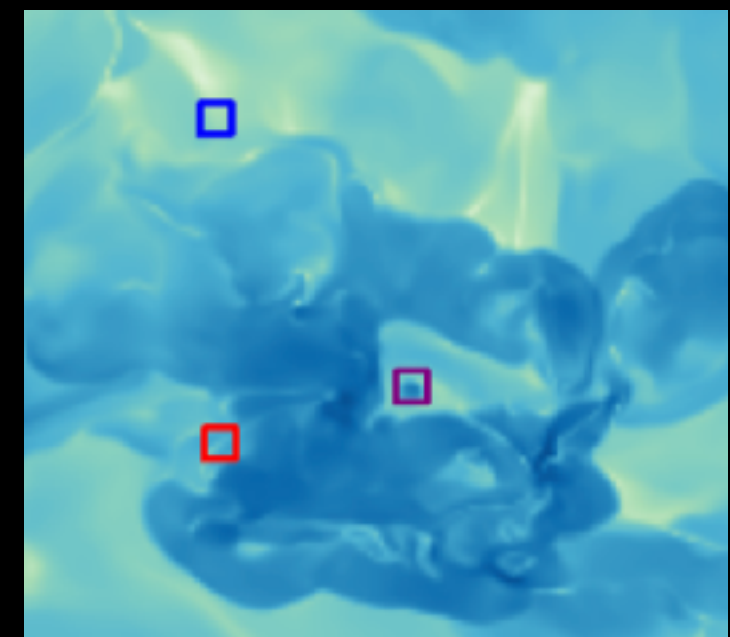
Local correlations are stronger



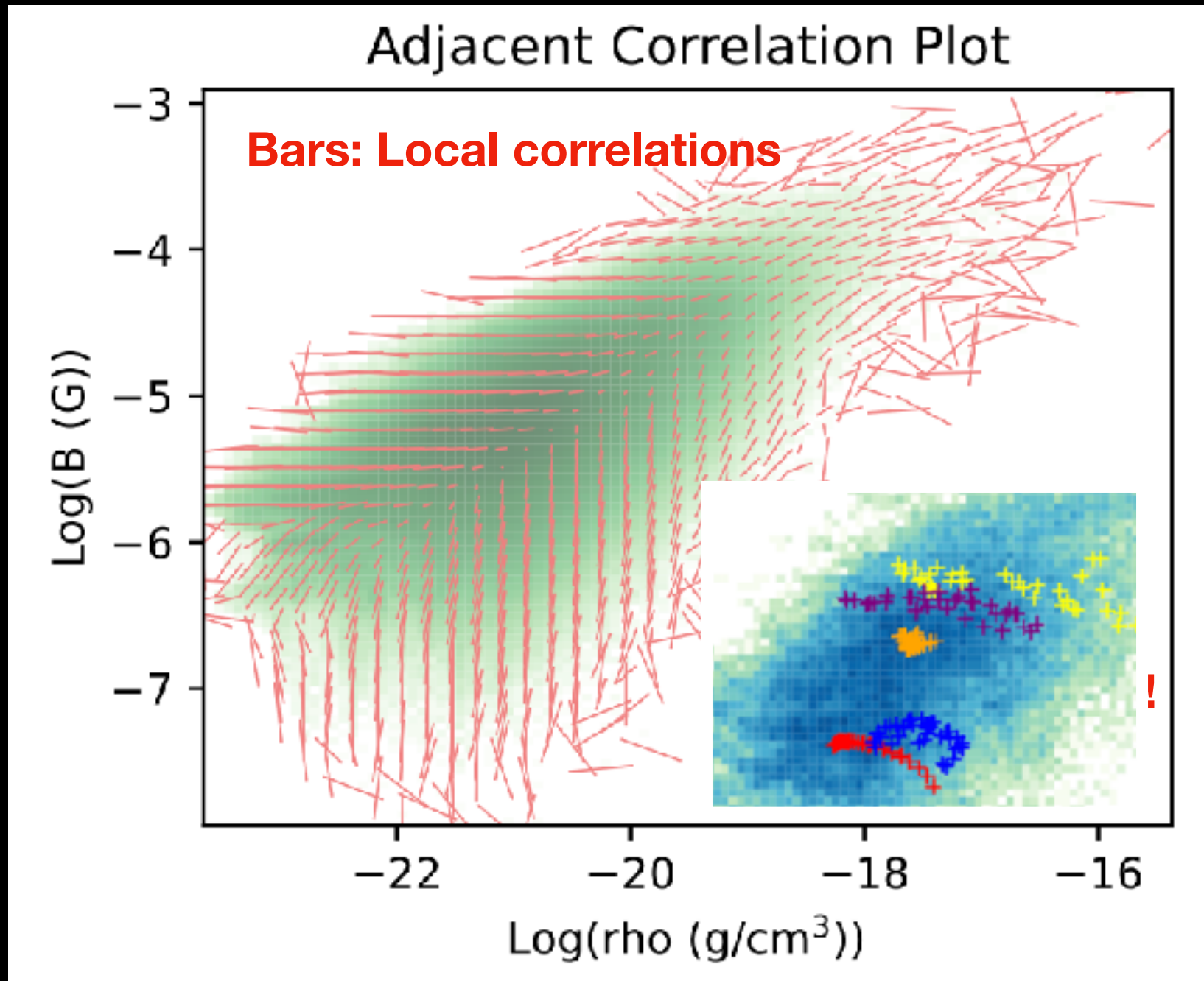
Density



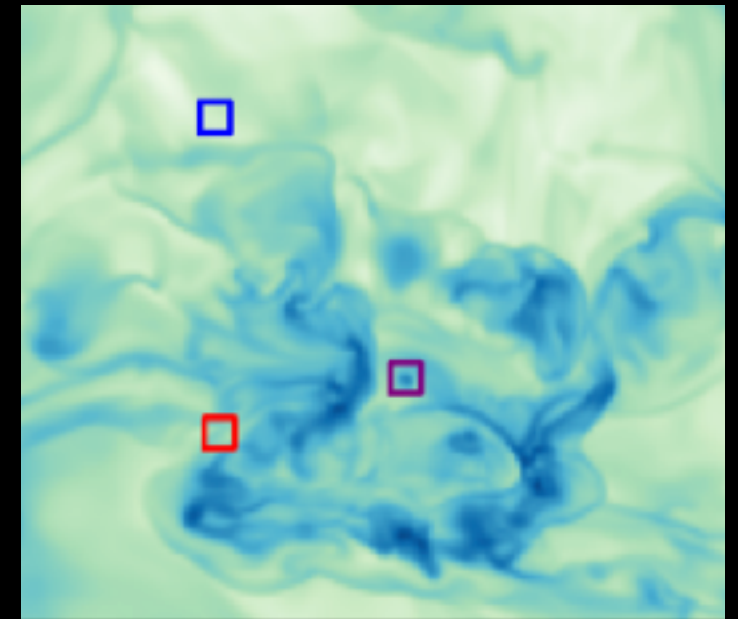
Magnetic field



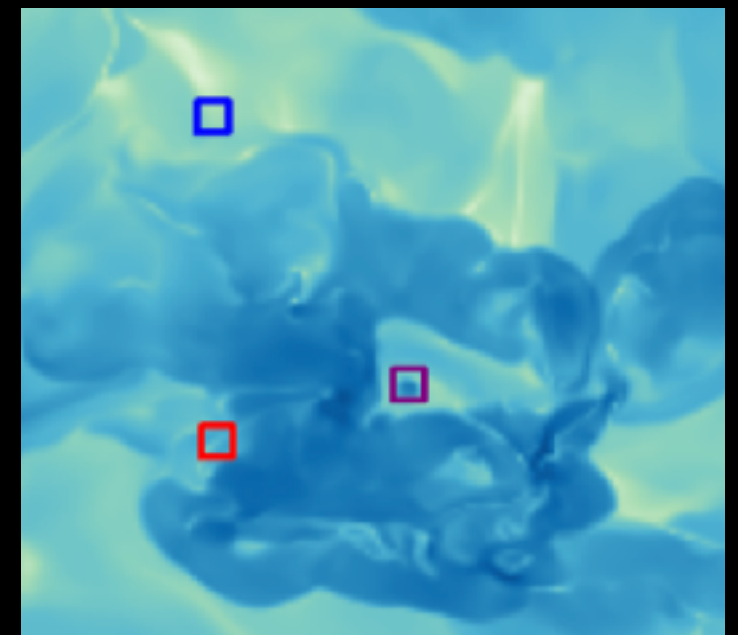
Local correlations are stronger



Density

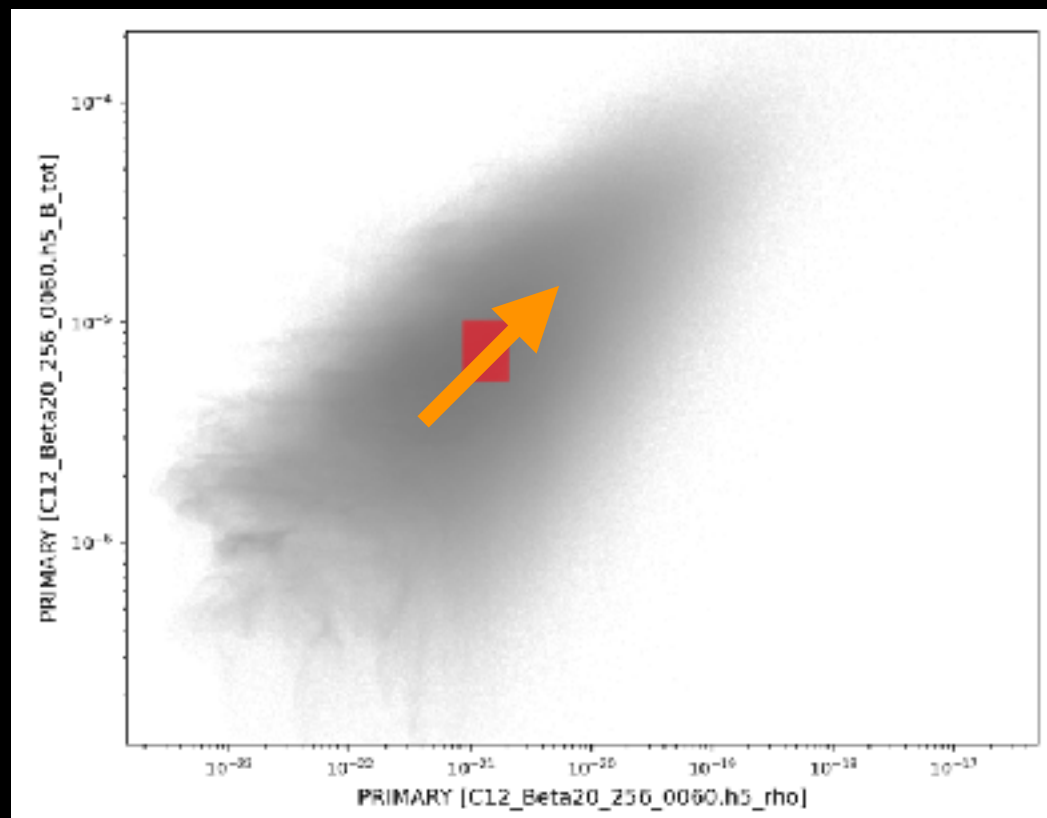


Magnetic field

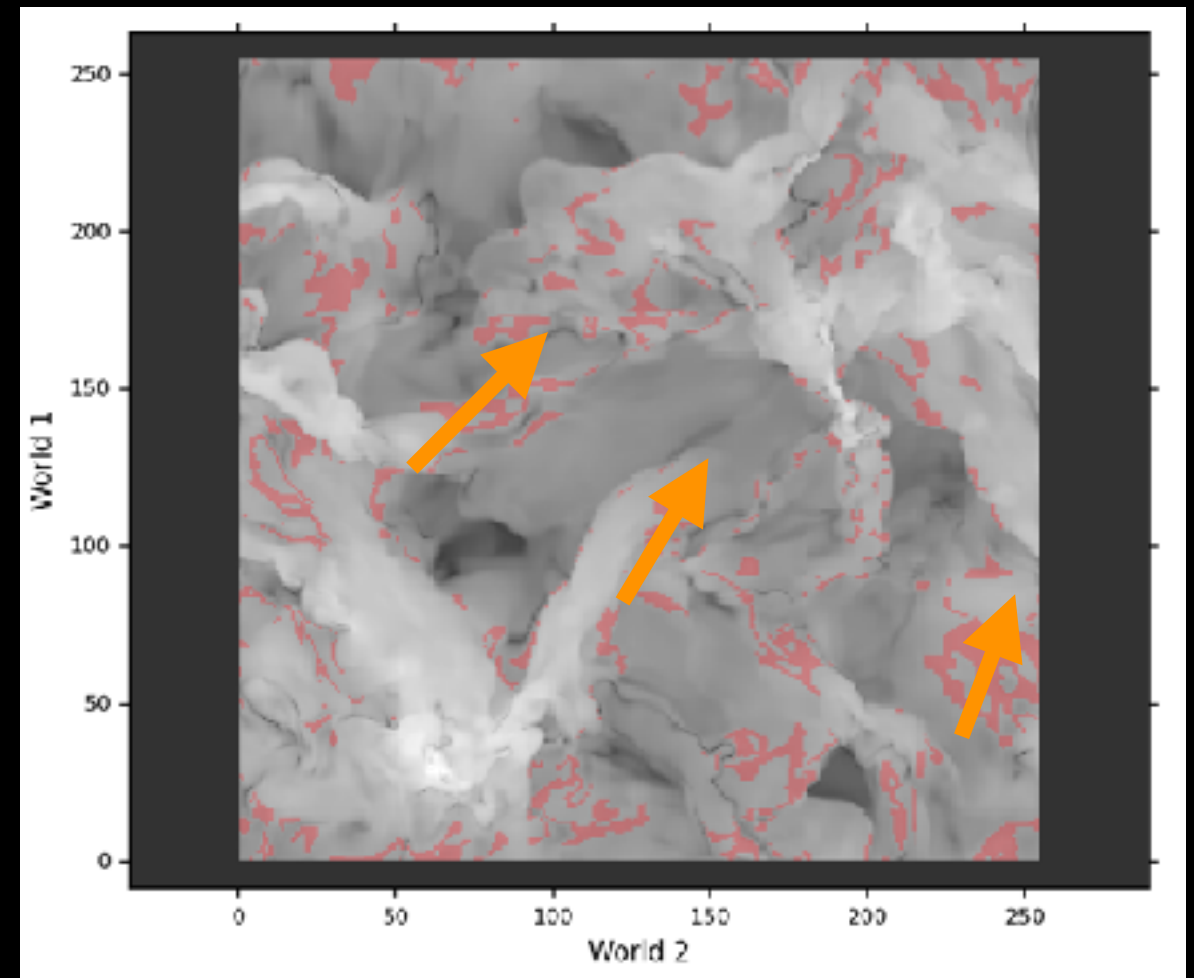


Correlation algebra

Phase space



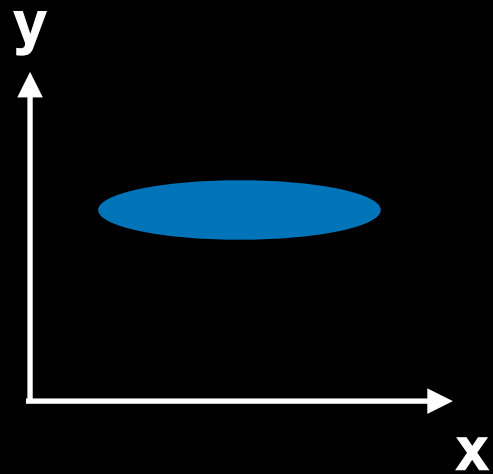
Real space



 ? $=$  $+$  $+$ 

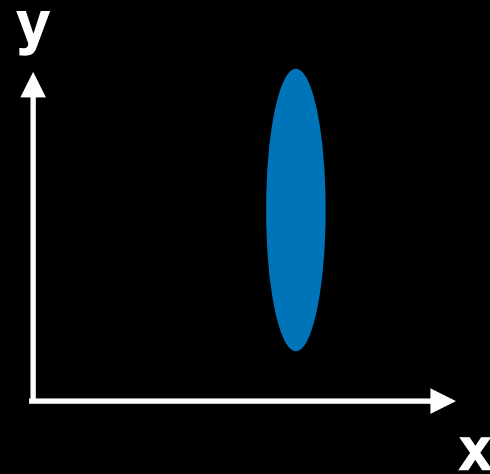
Correlation algebra: Expected behavior

Measurement 1



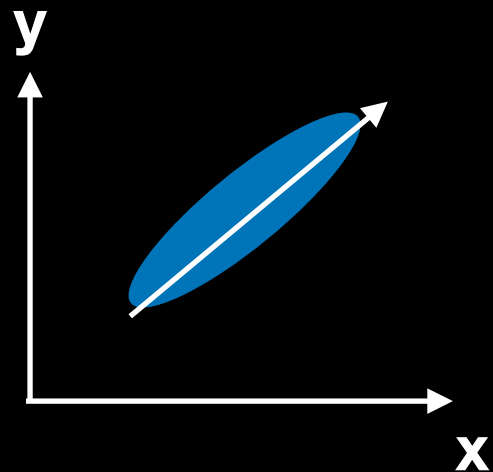
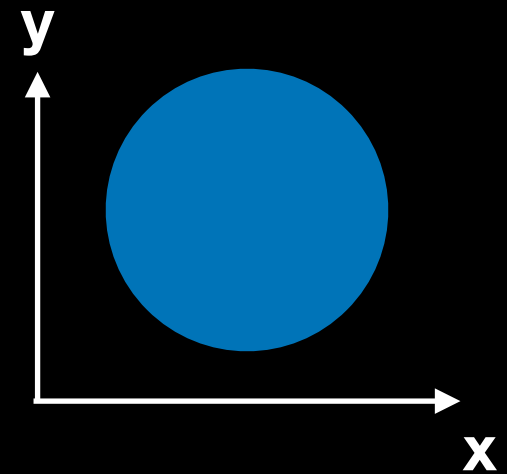
+

Measurement 2

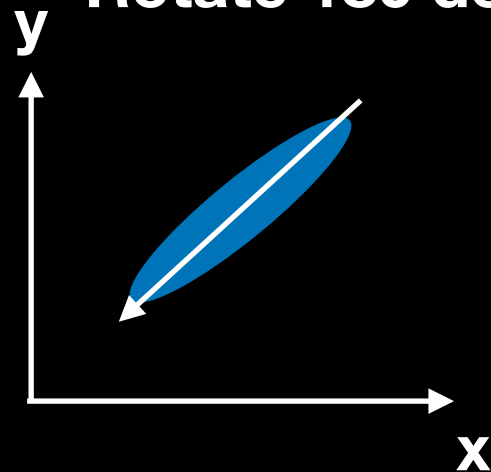


=

No correlation

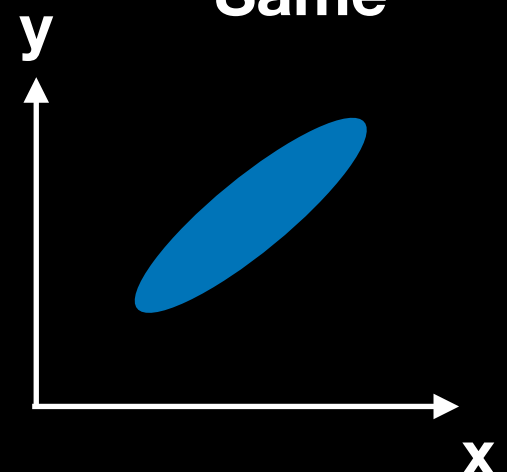


Rotate 180 deg



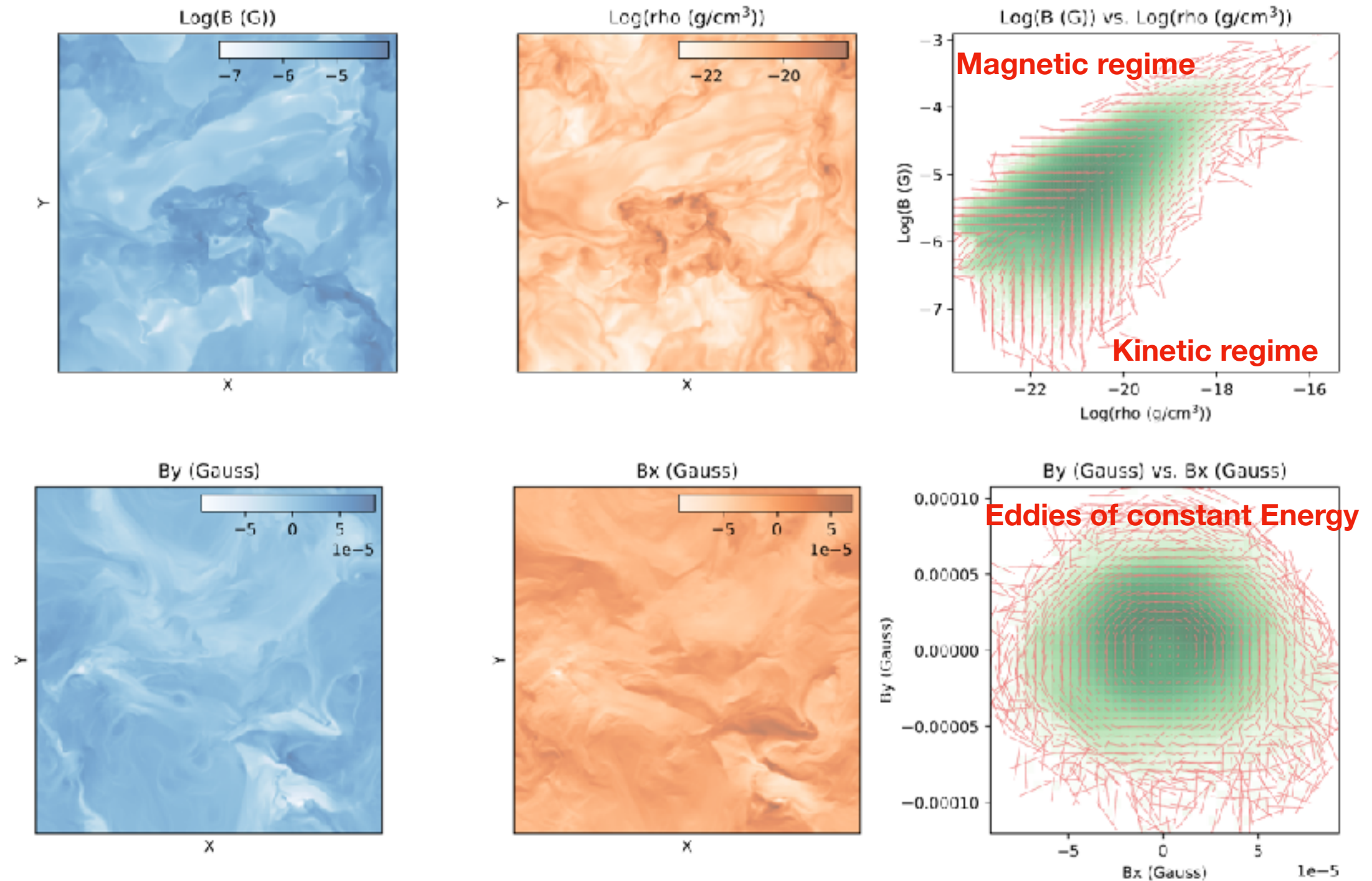
=

Same



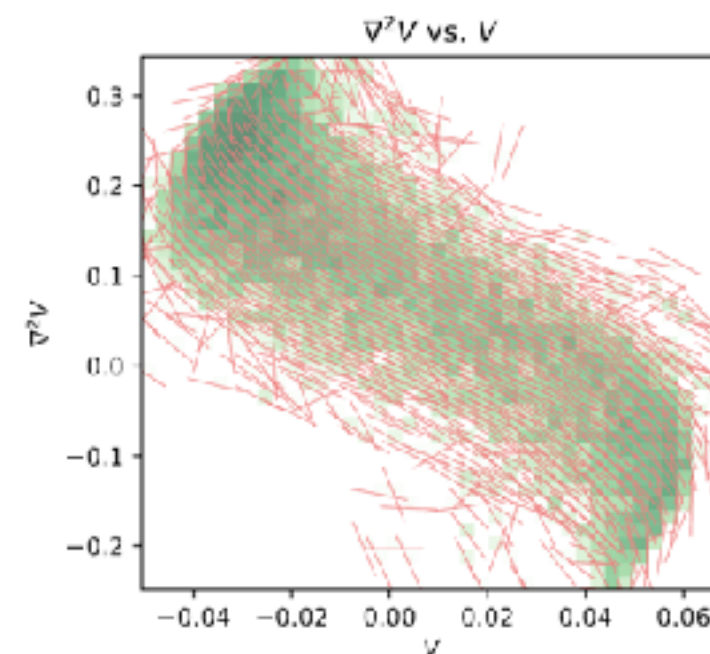
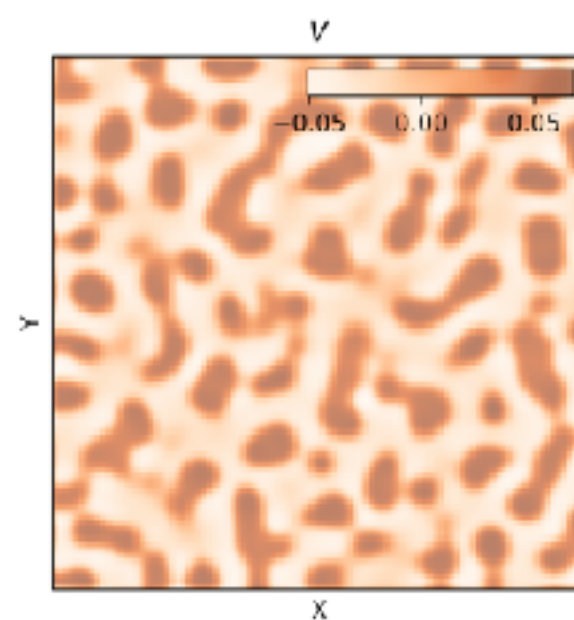
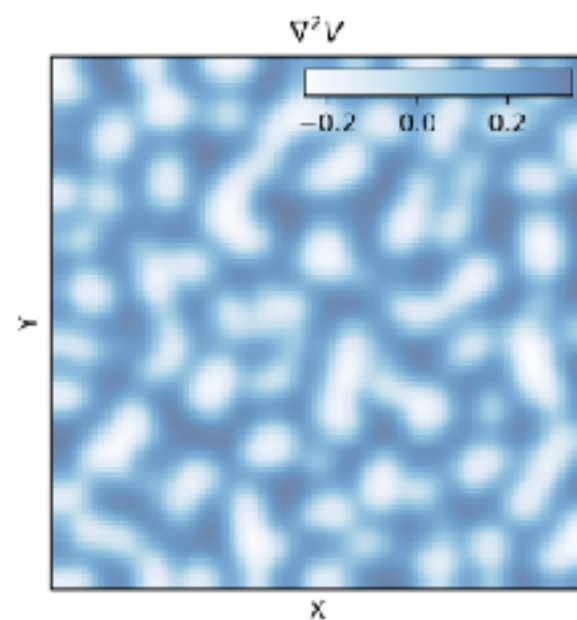
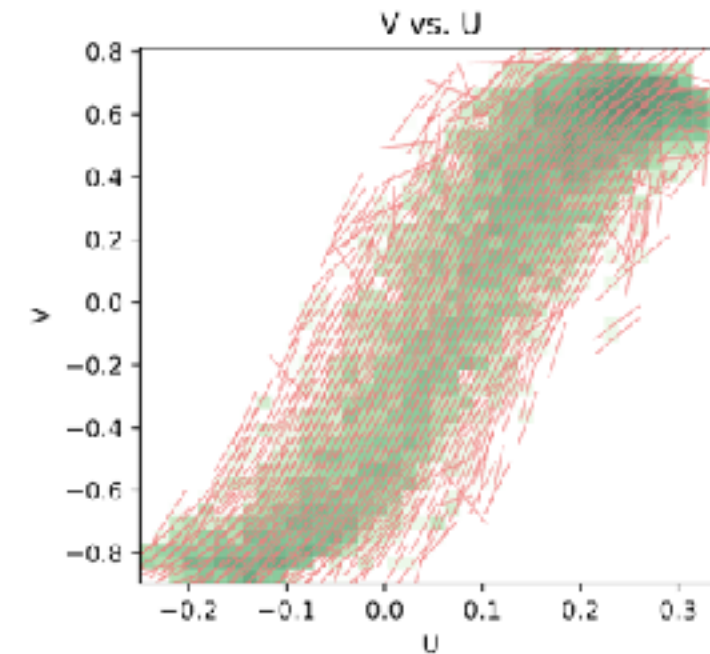
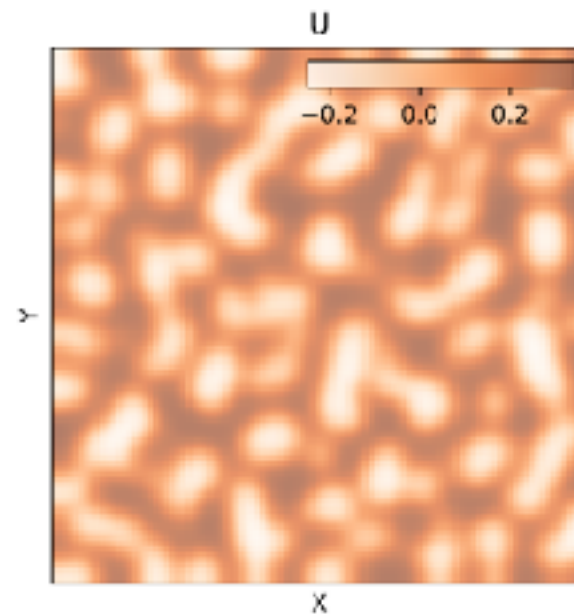
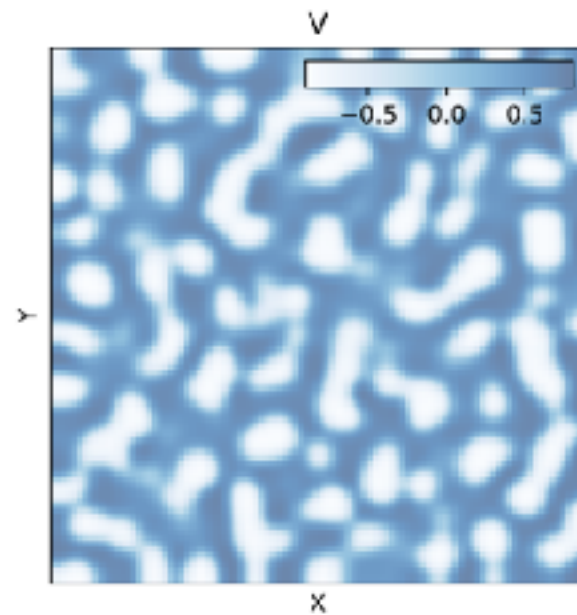
Applications

MHD simulations



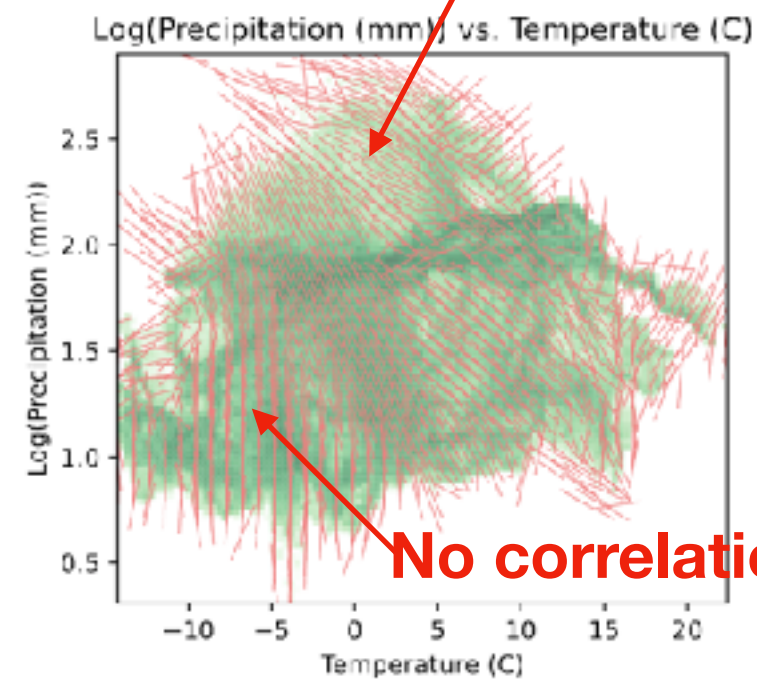
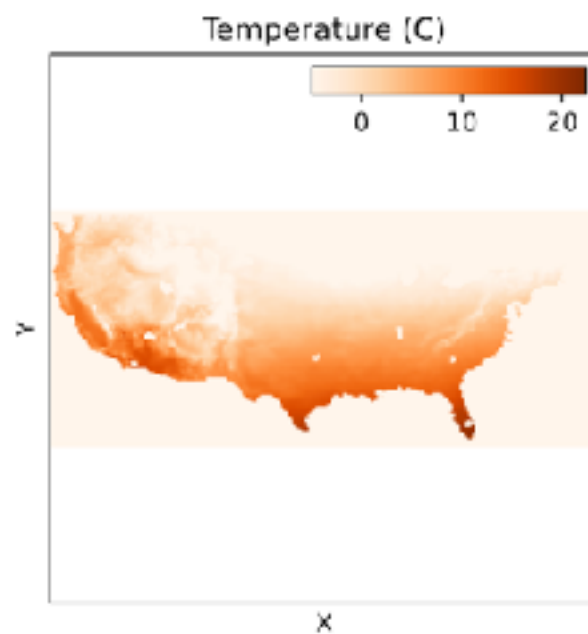
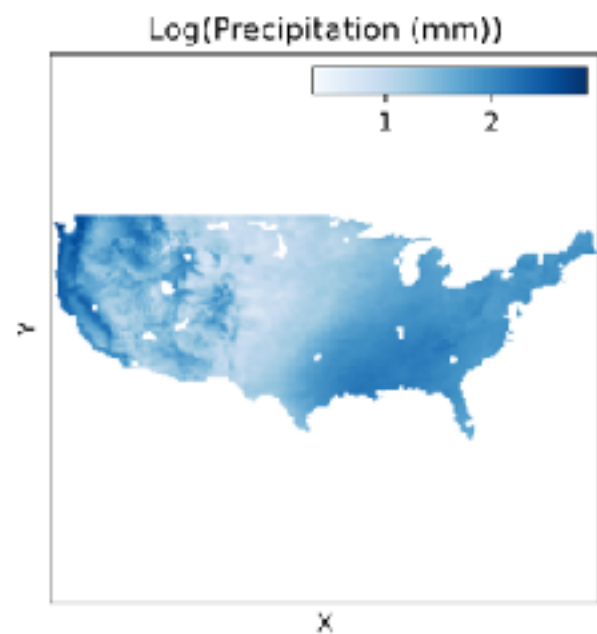
Turing pattern

U, V: different chemicals in the reaction-diffusion equations

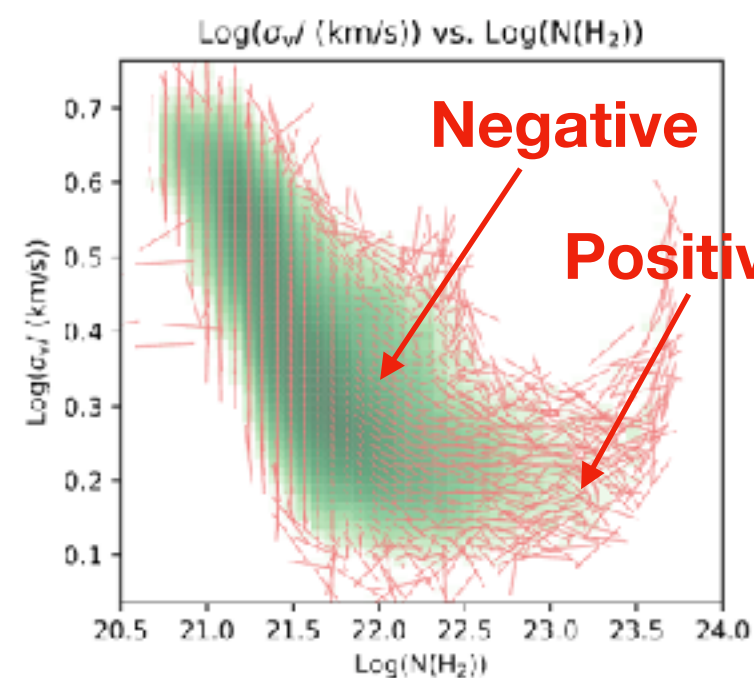
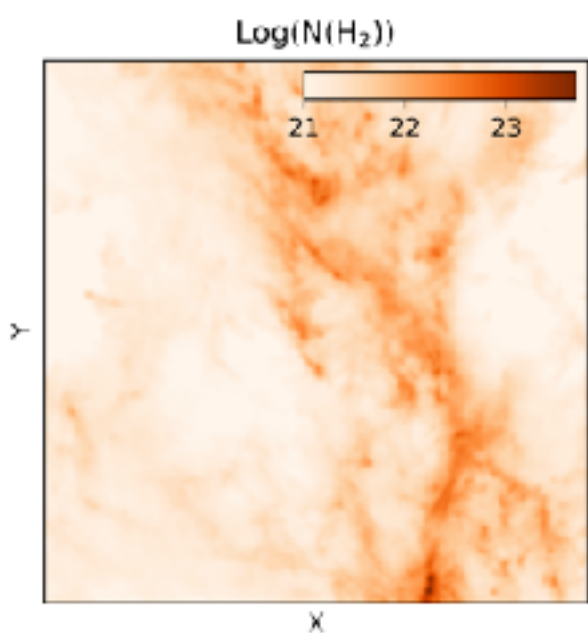
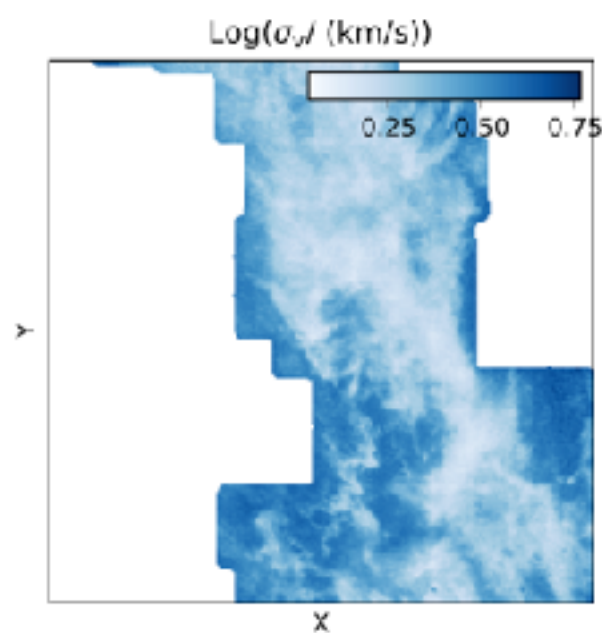


Real data

Negative

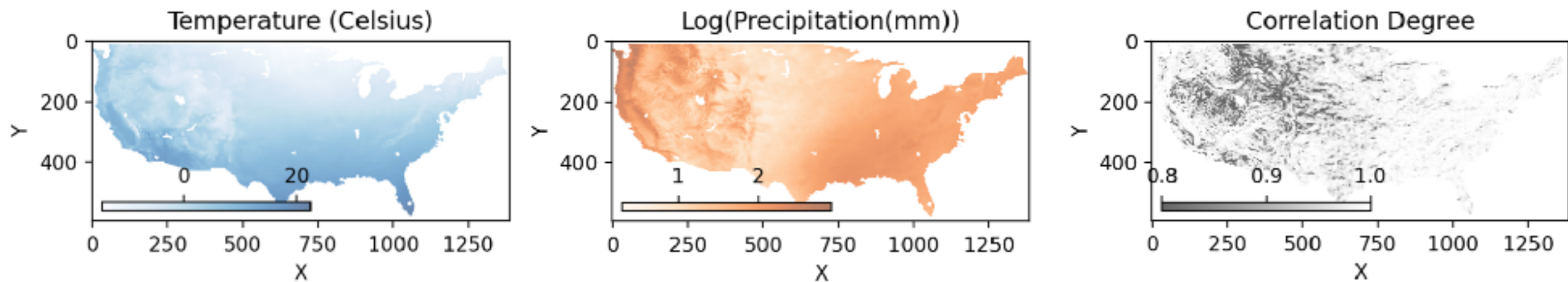


No correlation

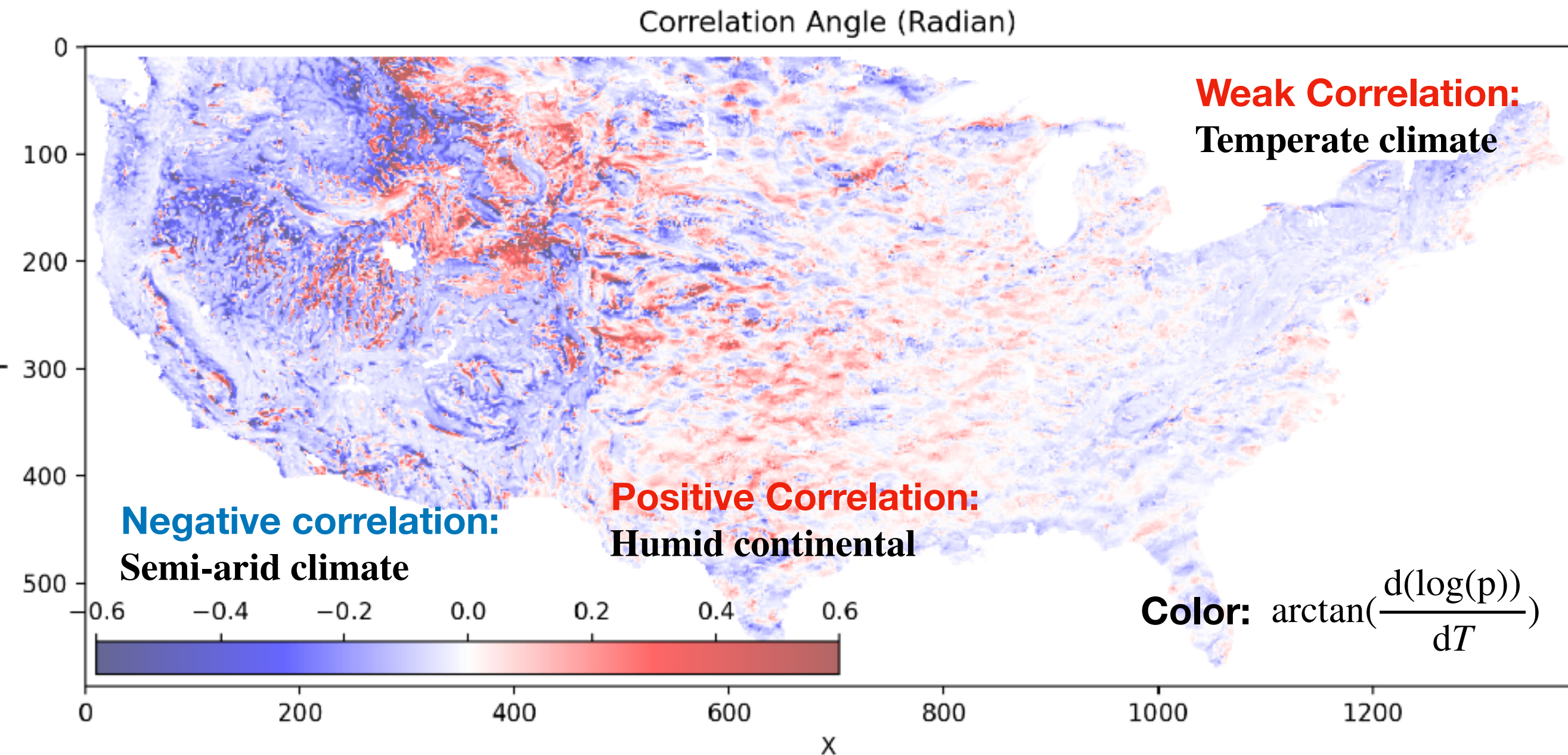


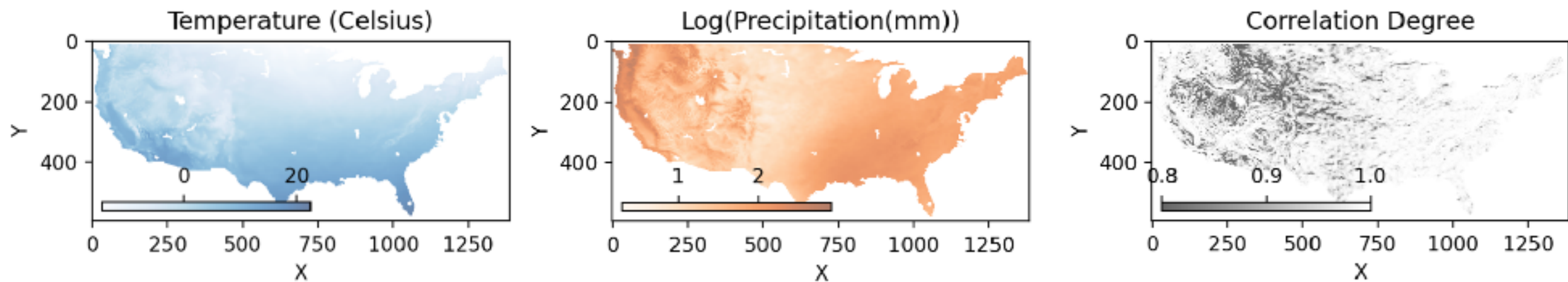
Negative

Mapping spatial correlations

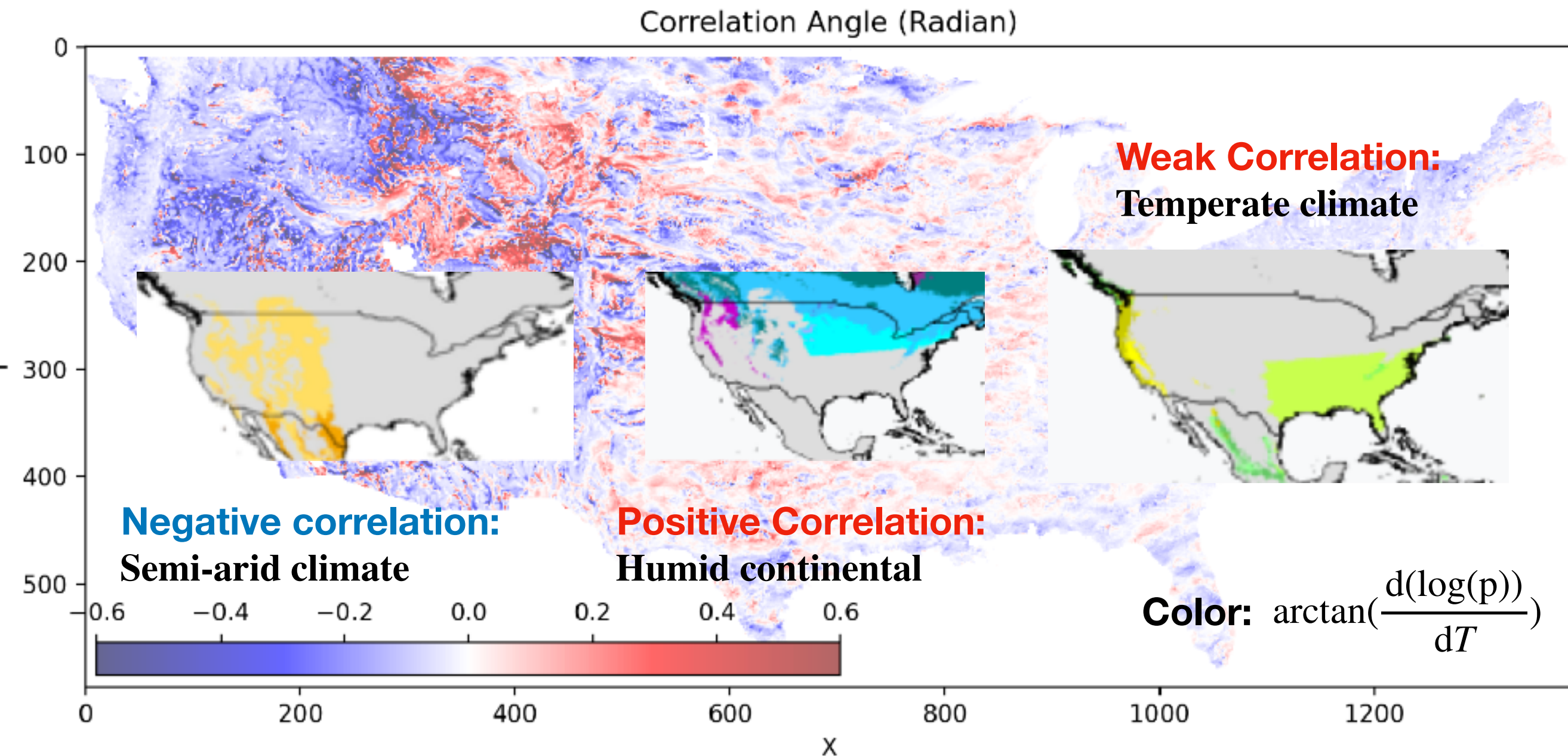


Correlations with full spatial information



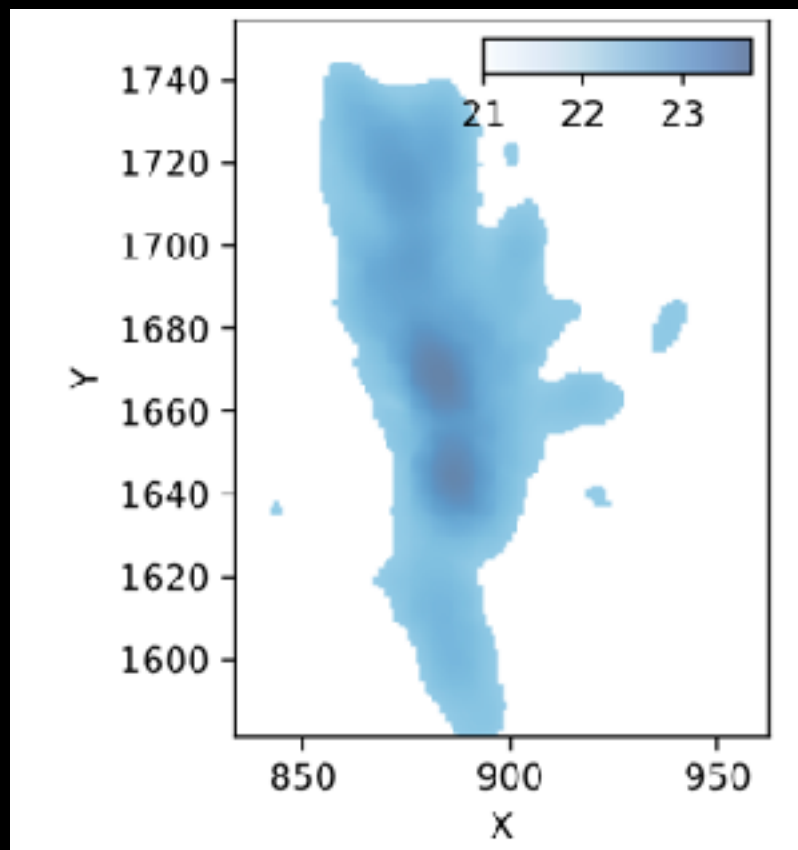


Correlations with full spatial information

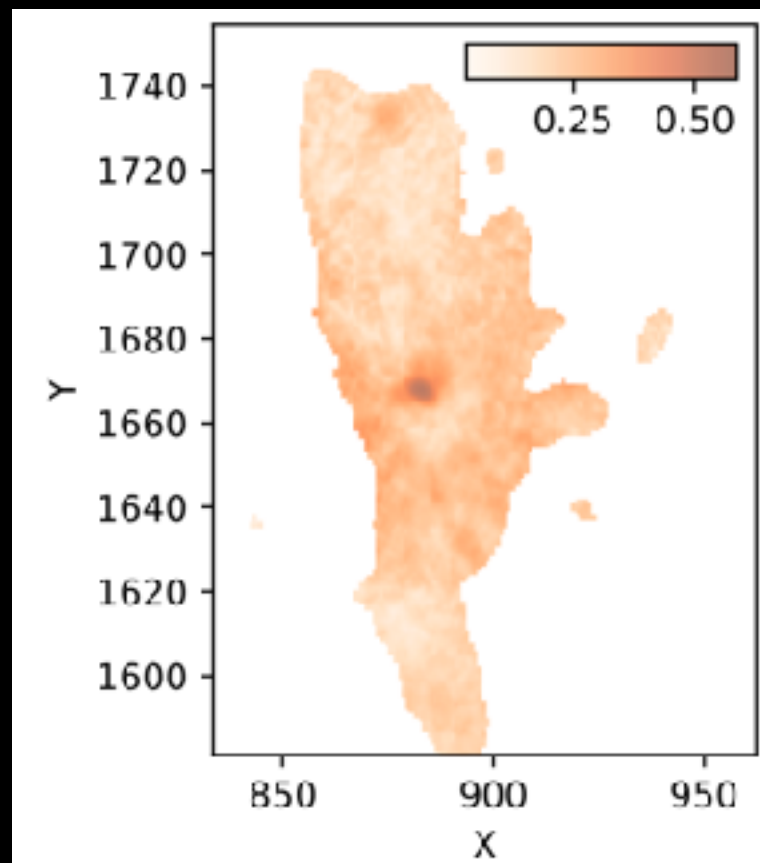


Mapping correlations: Gravitational collapse in Orion A

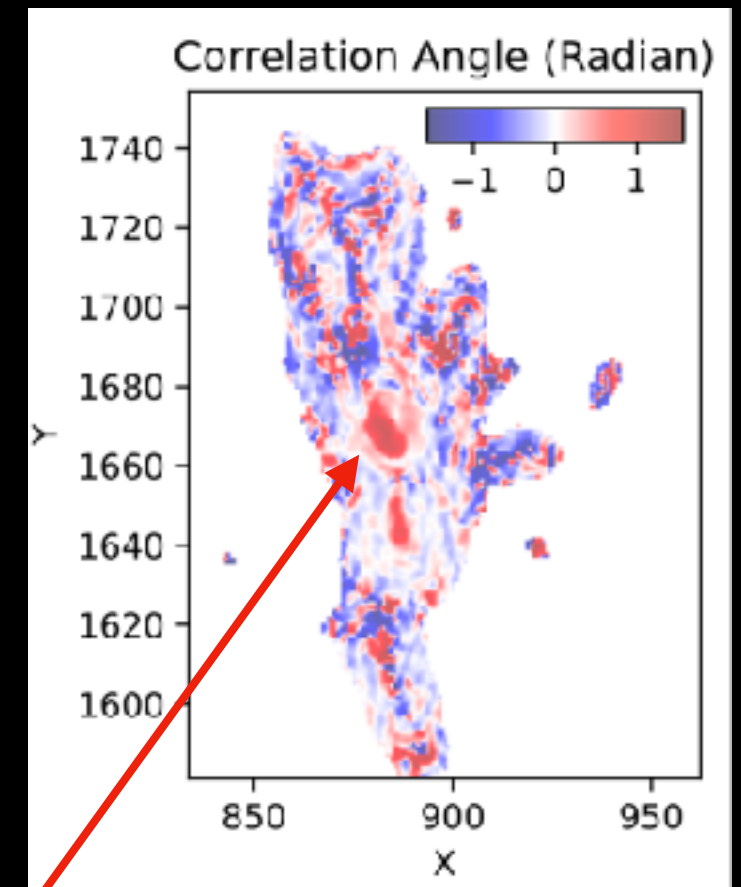
Surface density (Σ)



Velocity dispersion (σ_v)



Correlation plot

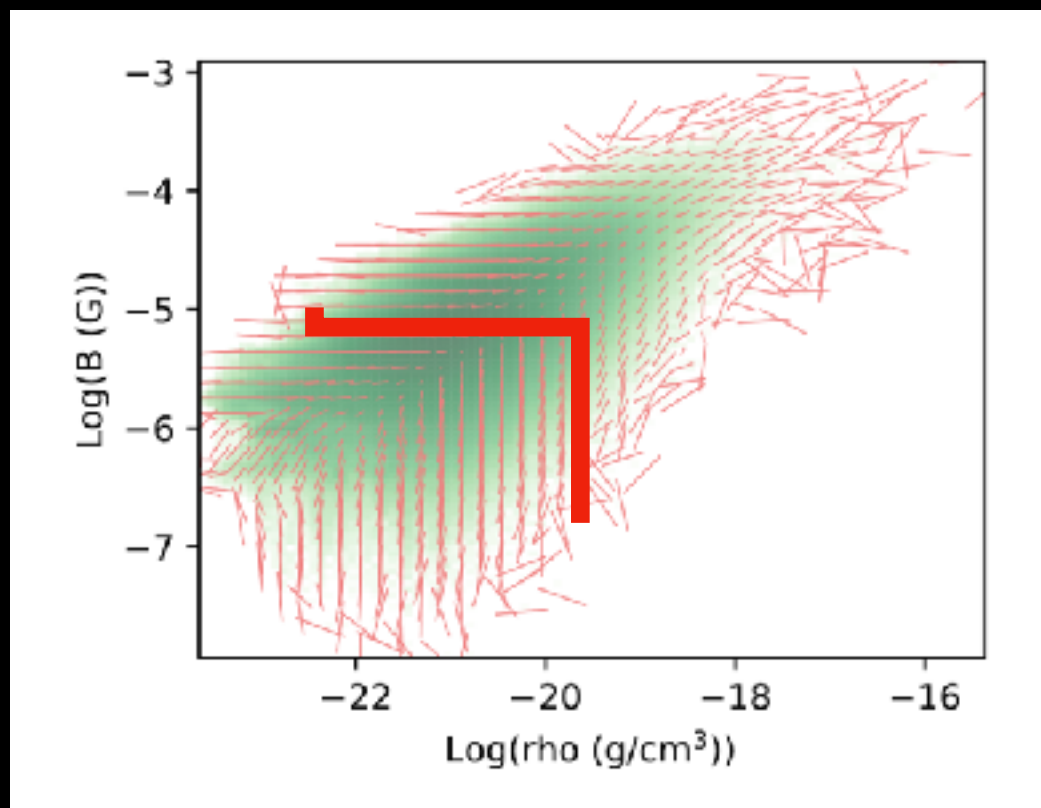
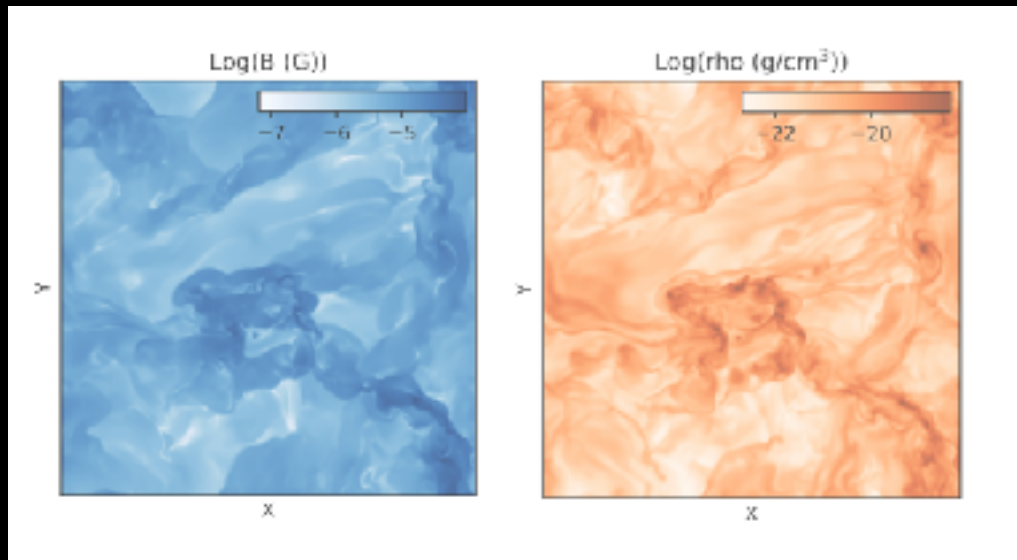


Position correlations between Σ and σ_v

→ Gravitational collapse

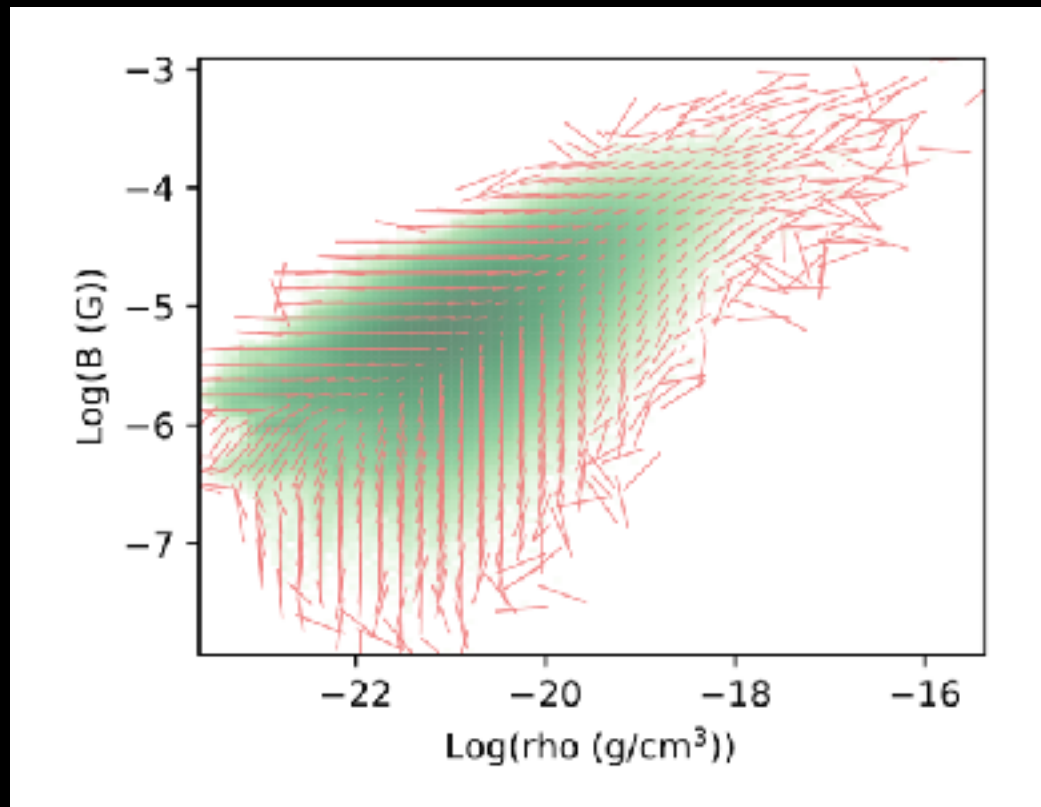
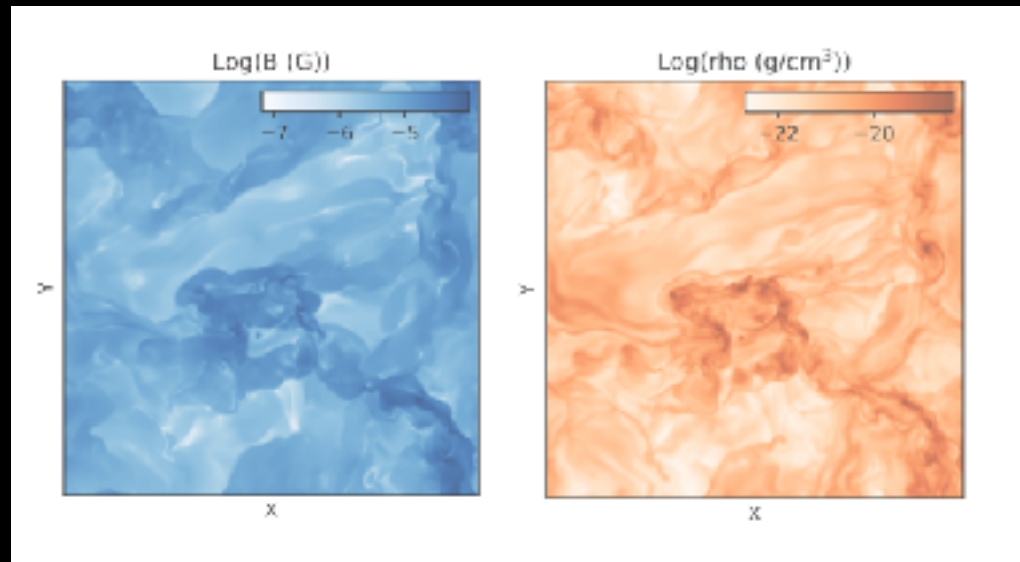
Summary: Adjacent correlation analysis

Patterns as dynamical systems

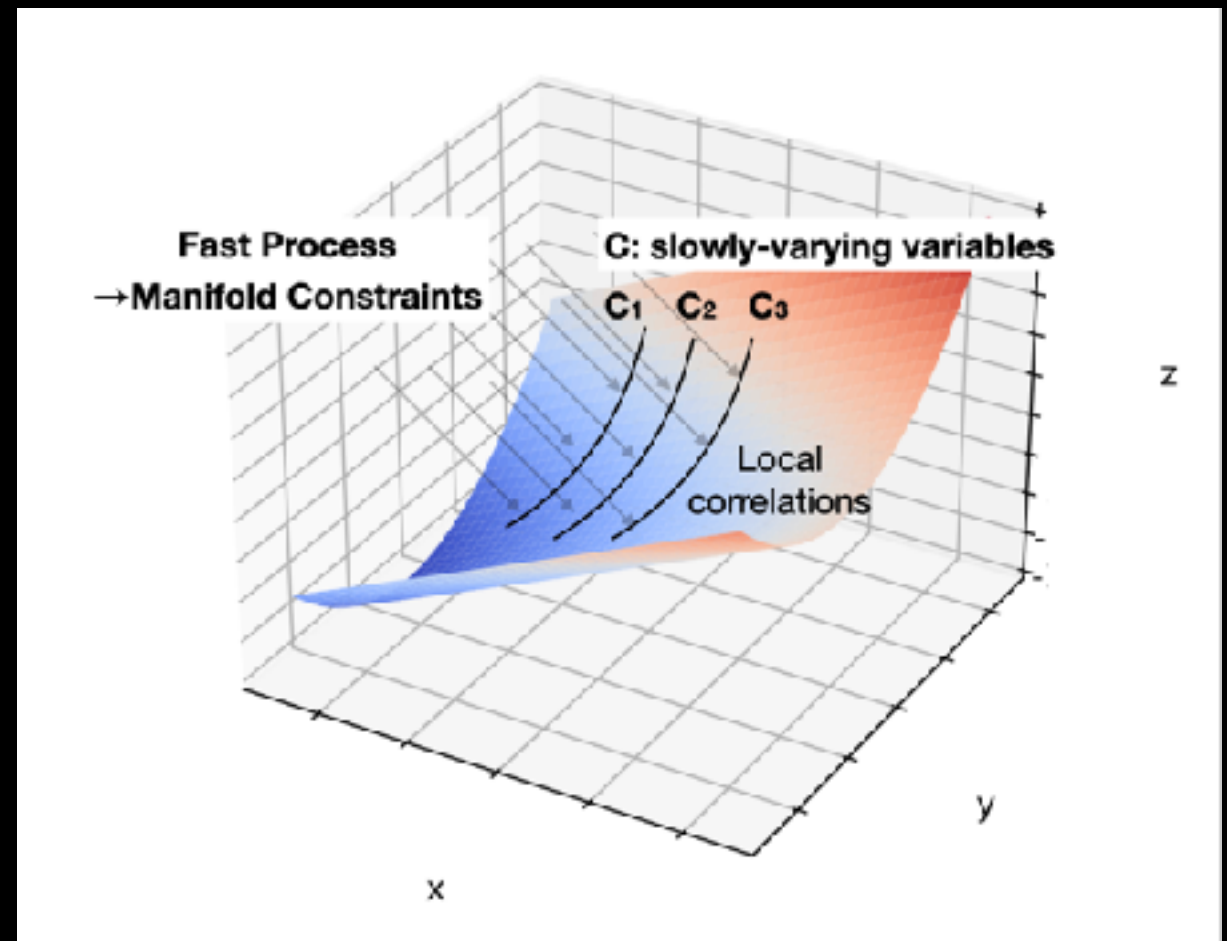


Summary: Adjacent correlation analysis

Patterns as dynamical systems



Manifold interpretation



Applications

Image 2

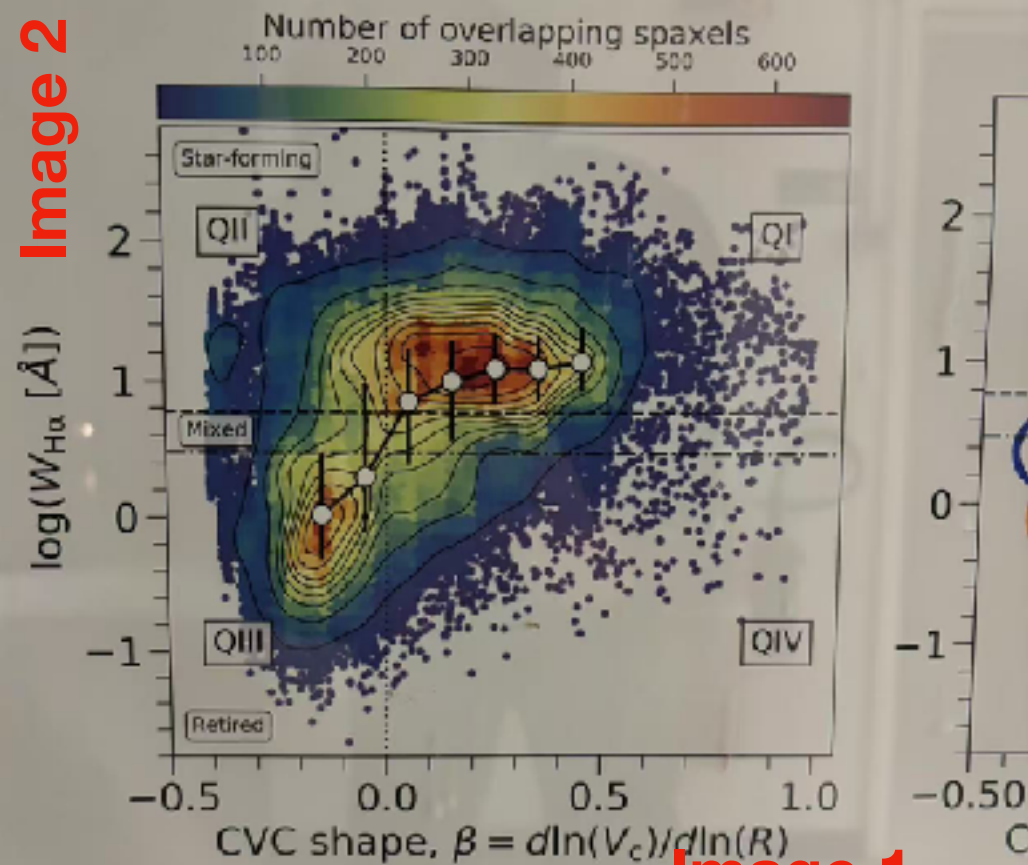
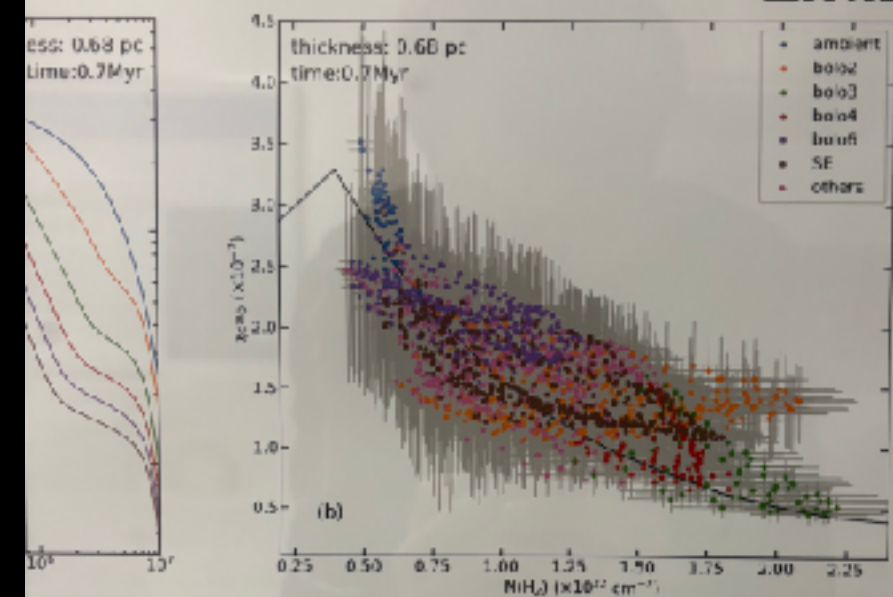


Fig. 3: Quenching versus shape of the circular velocity curve (V_c) measured through $\beta = d \ln V_c / d \ln R$ from CALIFA stellar dynamics with regions of rising V_c ($\beta > 0$), flat V_c ($\beta \sim 0$) and declining V_c ($\beta < 0$) (Kalinova et. al, 2022, A&A, submitted).

Active Galactic Nuclei (AGN) quenching

Primary track—Fast formation



Chemical age of < 2Myr

Chemical abundances as a function of time, (Du 2021). (b) Observed $C^{18}O$ as a function of H_2 column density. The track is indicated by the black line. the QR code.