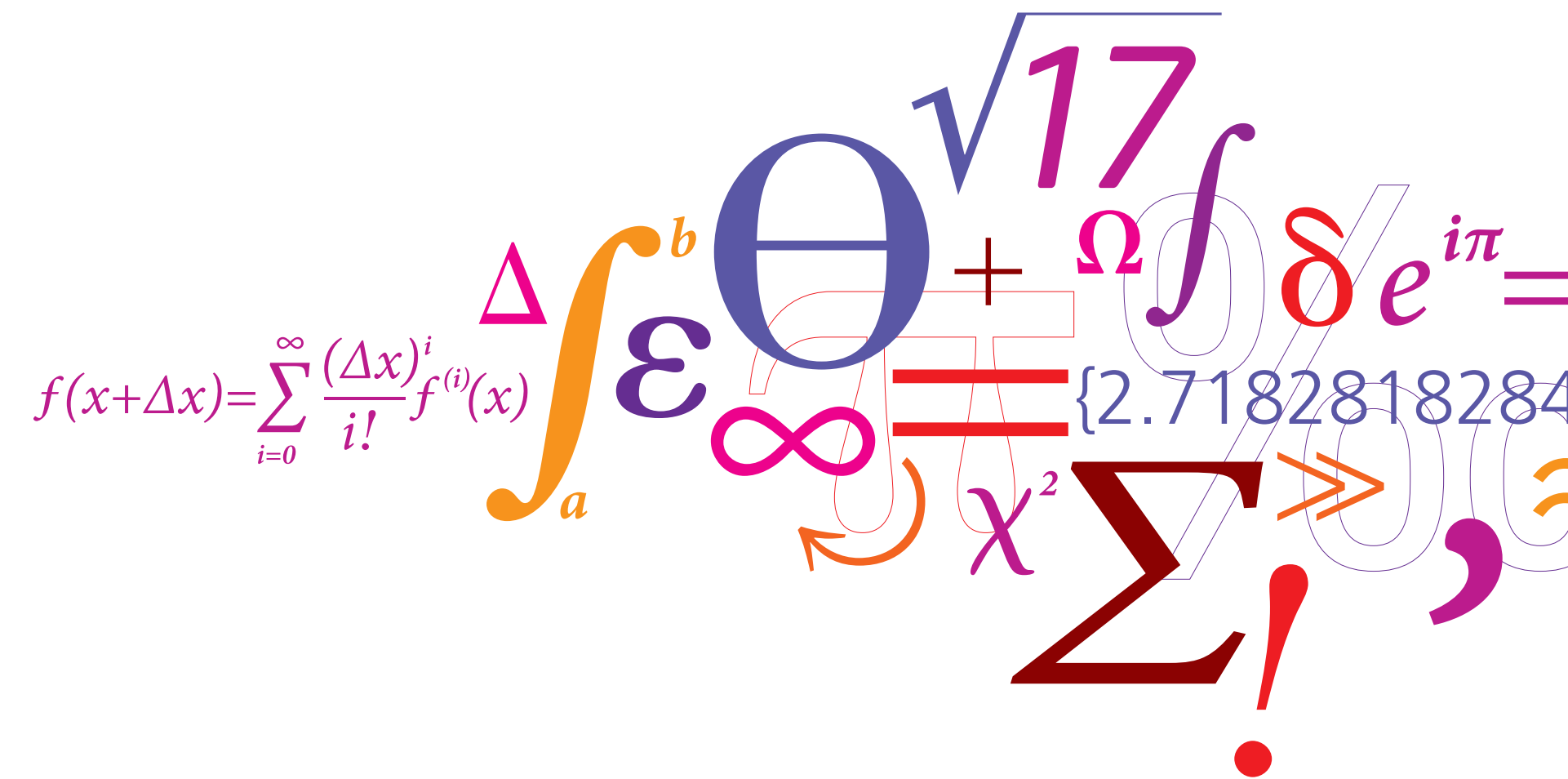


Analyse af globale GRACE data

01666 Fagprojekt - Frederik & Andreas



DTU Compute

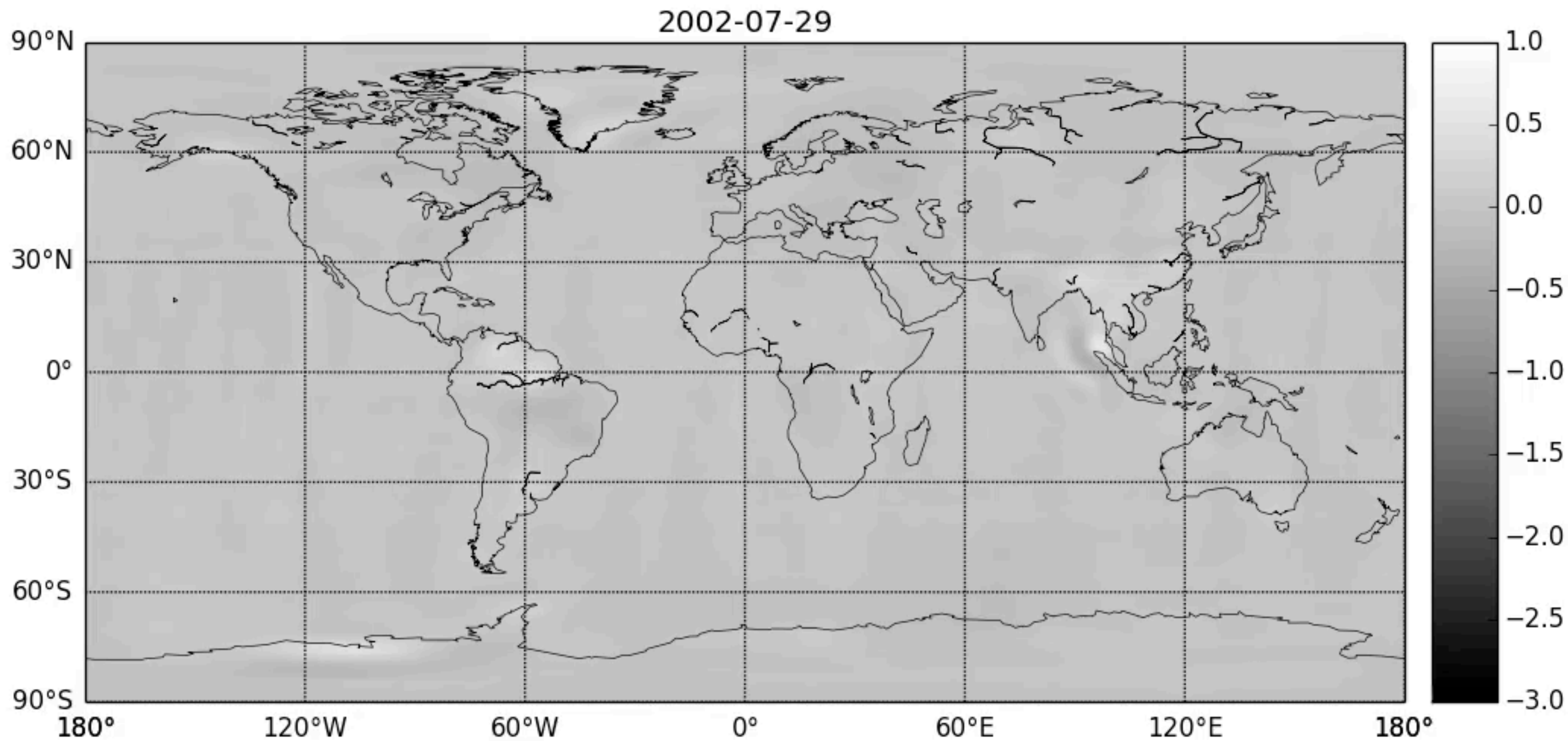
Department of Applied Mathematics and Computer Science

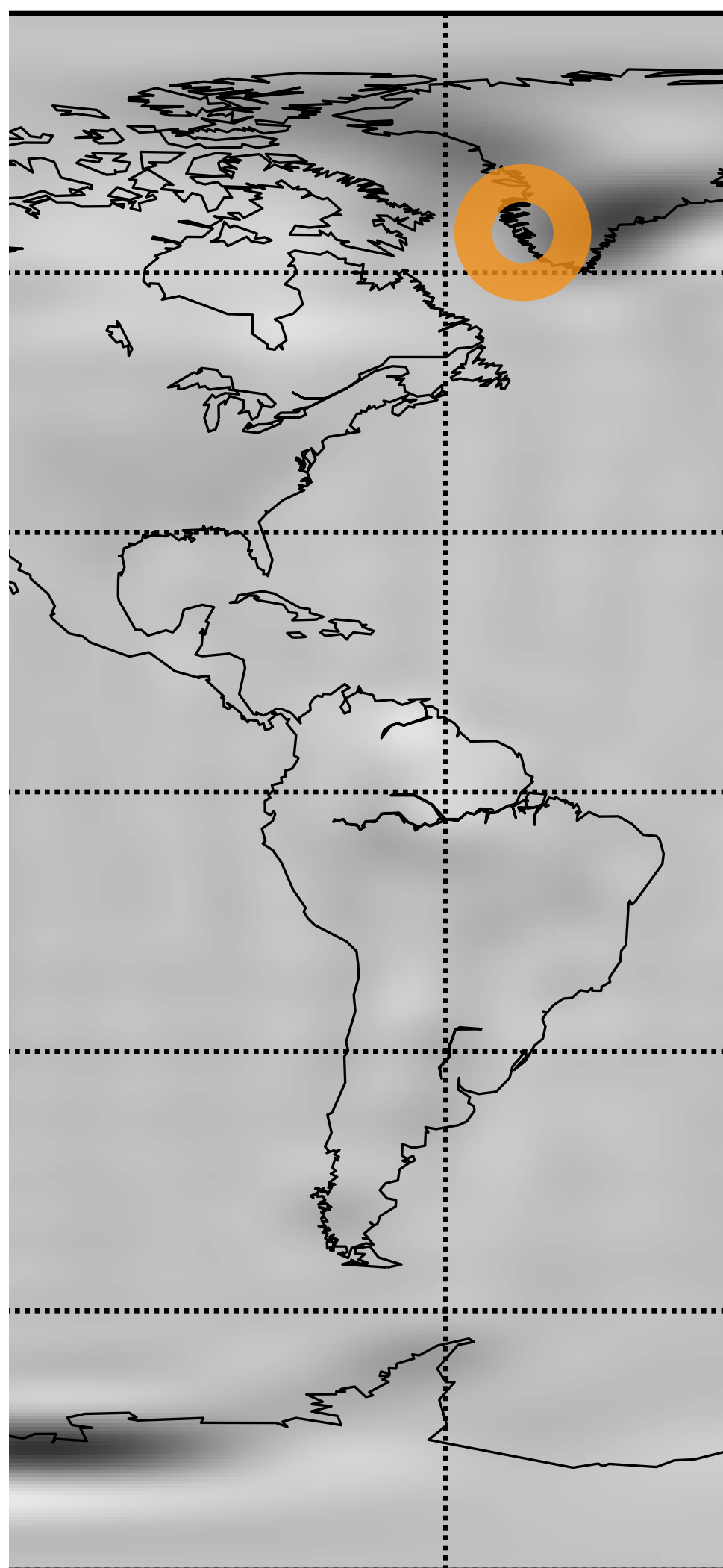
Analyse af globale GRACE data

- GRACE
- OLS Regression
- PCA Diagnostic
- Andre Analyser

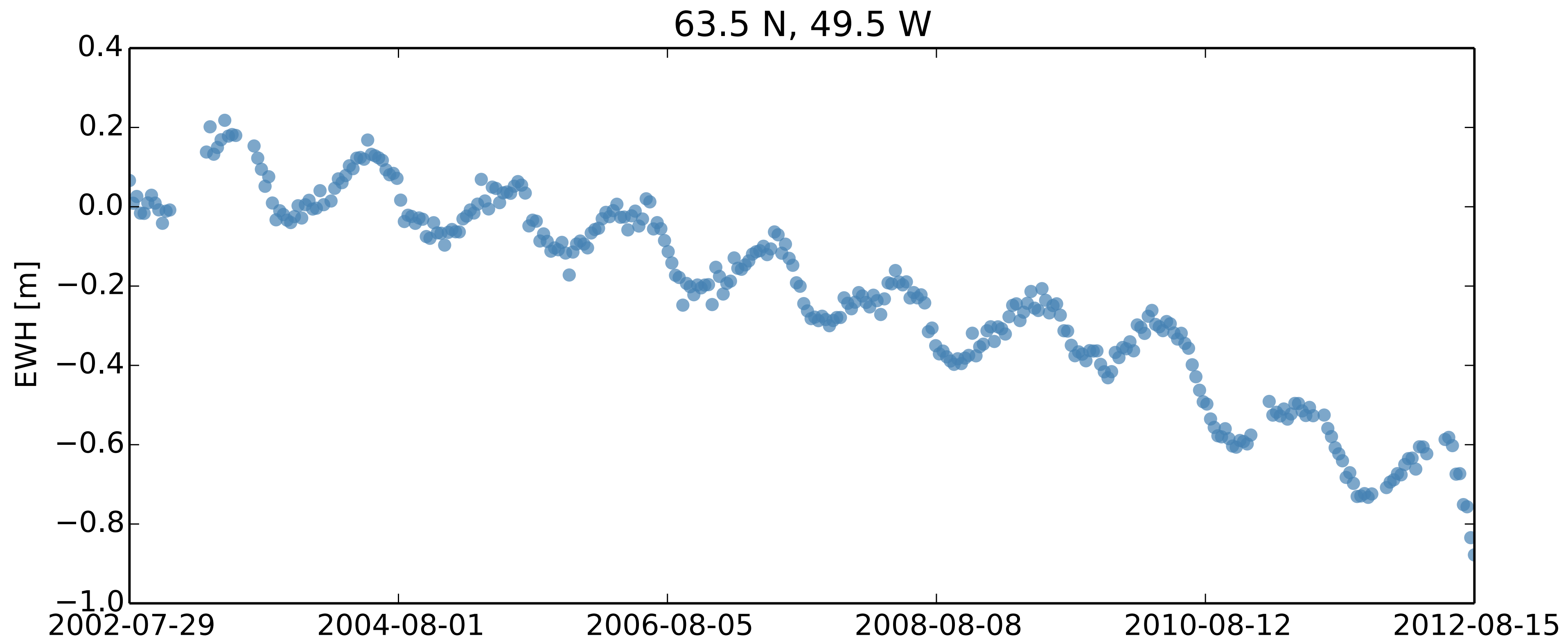
GRACE

Gravity Recovery and Climate Experiment



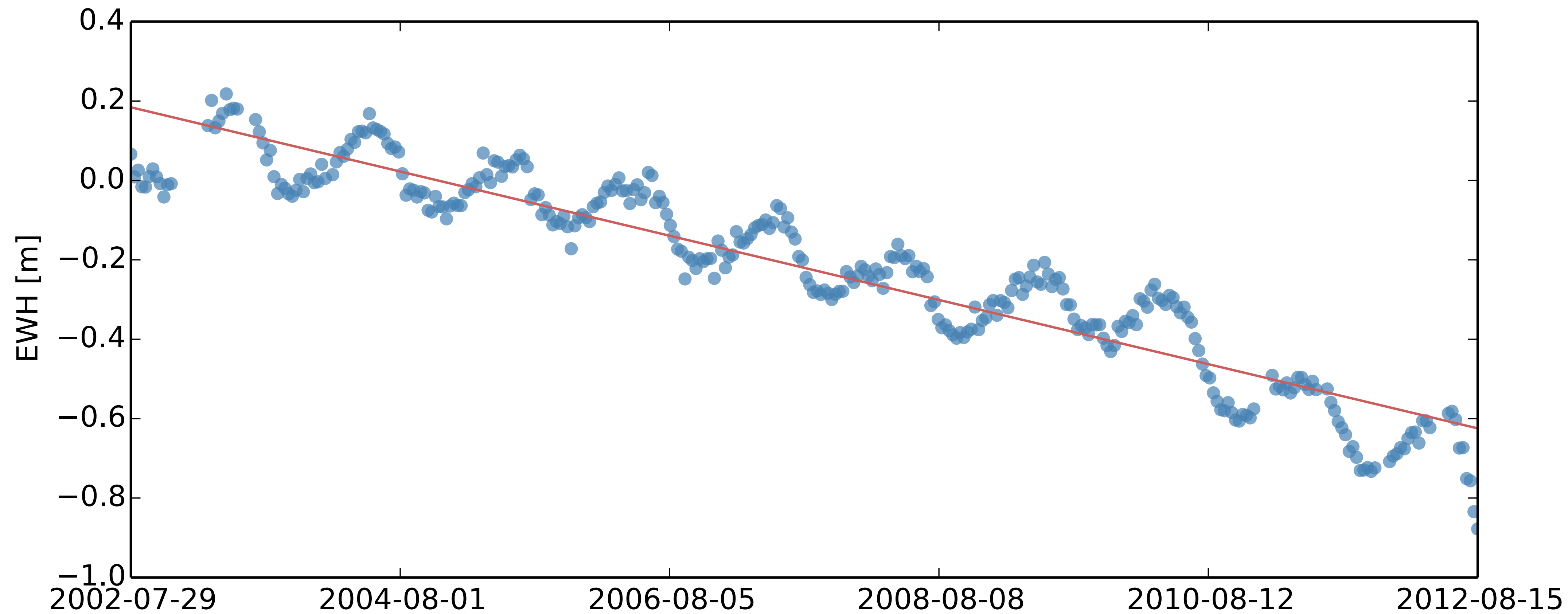


60°W

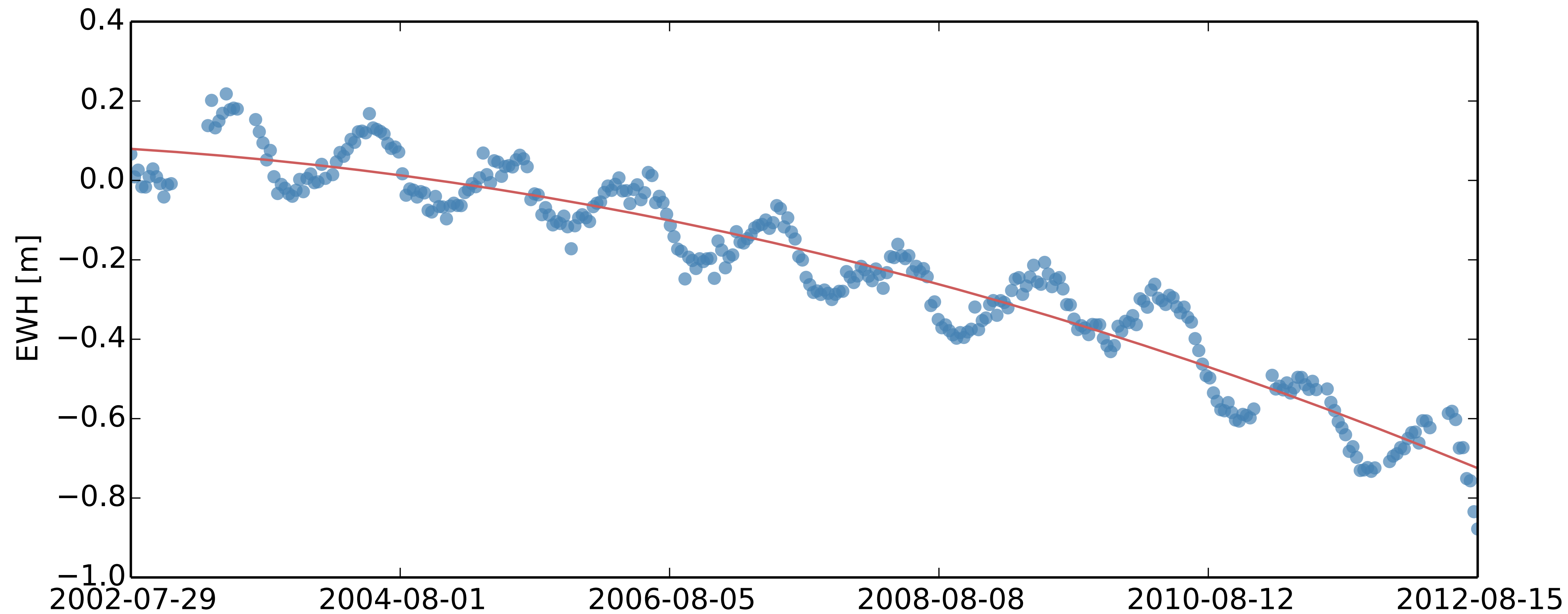


OLS Regression

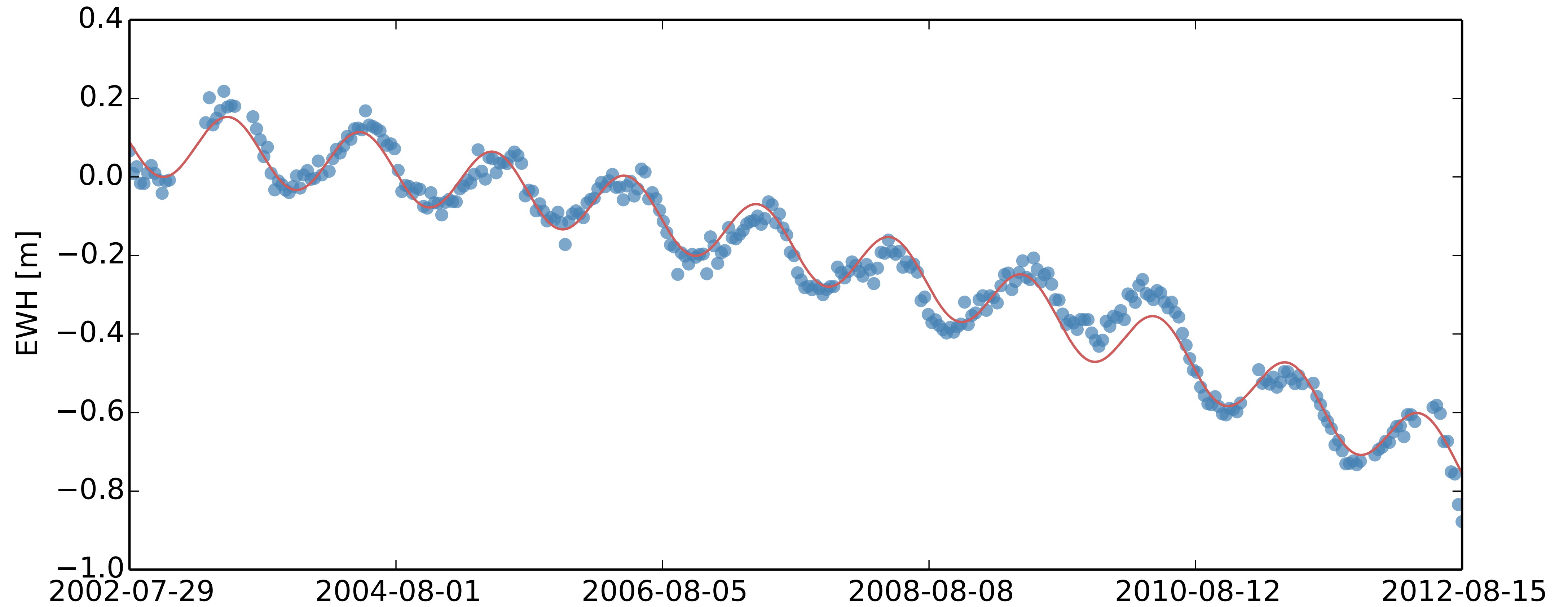
Ordinary Least Square Regression



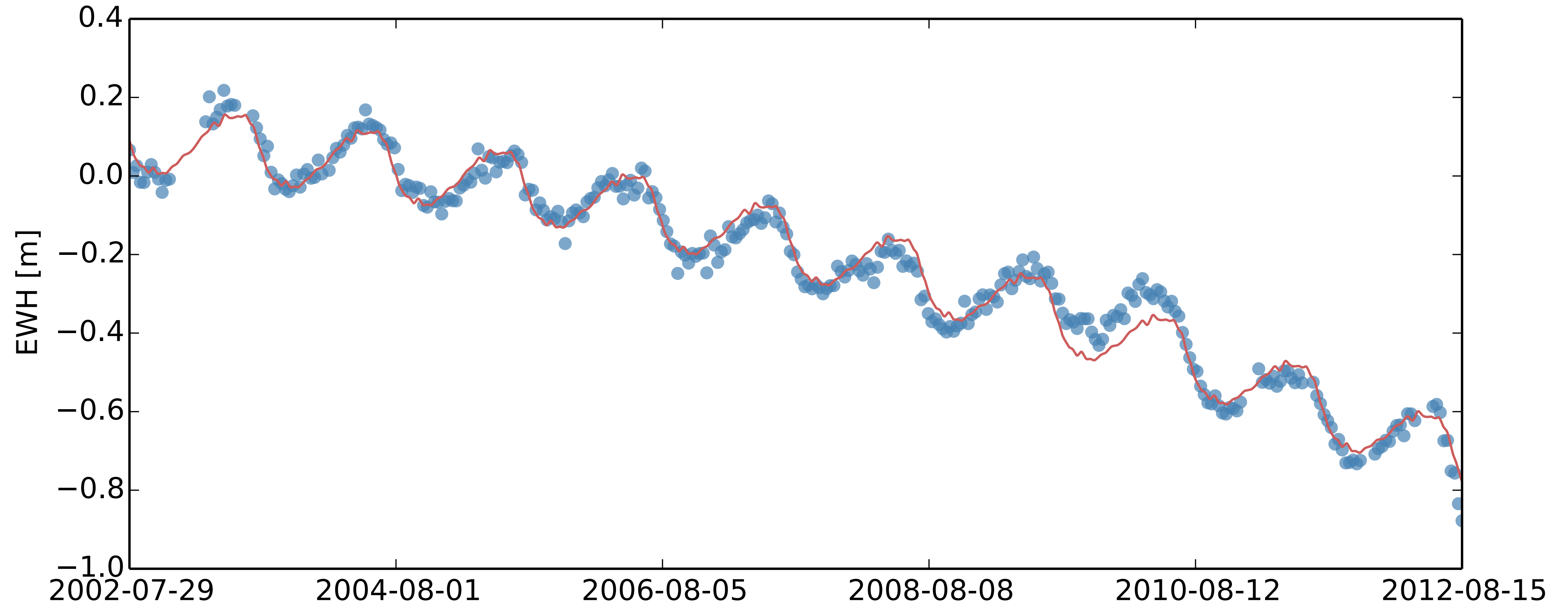
$$\hat{y} = \beta_1 + \beta_2 t$$



$$\hat{y} = \beta_1 + \beta_2 t + \beta_3 \frac{1}{2} t^2$$



$$\hat{y} = \beta_1 + \beta_2 t + \beta_3 \frac{1}{2} t^2 + \beta_4 \cos \left(\frac{2\pi}{\frac{365.242}{1}} t \right) + \beta_5 \sin \left(\frac{2\pi}{\frac{365.242}{1}} t \right)$$



$$\hat{y} = \beta_1 + \beta_2 t + \beta_3 \frac{1}{2} t^2 + \beta_4 \cos \left(\frac{2\pi}{\frac{365.242}{1}} t \right) + \beta_5 \sin \left(\frac{2\pi}{\frac{365.242}{1}} t \right) + \cdots + \beta_{38} \cos \left(\frac{2\pi}{\frac{365.242}{18}} t \right) + \beta_{39} \sin \left(\frac{2\pi}{\frac{365.242}{18}} t \right)$$

OLS Regression

1. Opskriv ligning

$$\hat{y} = \beta_1 + \beta_2 t + \beta_3 \frac{1}{2} t^2 + \beta_4 \cos \left(\frac{2\pi}{\frac{365.242}{1}} t \right) + \beta_5 \sin \left(\frac{2\pi}{\frac{365.242}{1}} t \right) + \dots$$

2. Udtrykt på matrix form

$$\underline{\hat{y}} = \underline{\beta} \cdot \underline{X} \quad \text{hvor} \quad \underline{X} = \begin{bmatrix} 1 & t & \frac{1}{2} t^2 & \cos \left(\frac{2\pi}{\frac{365.242}{1}} t \right) & \sin \left(\frac{2\pi}{\frac{365.242}{1}} t \right) & \dots \end{bmatrix}$$

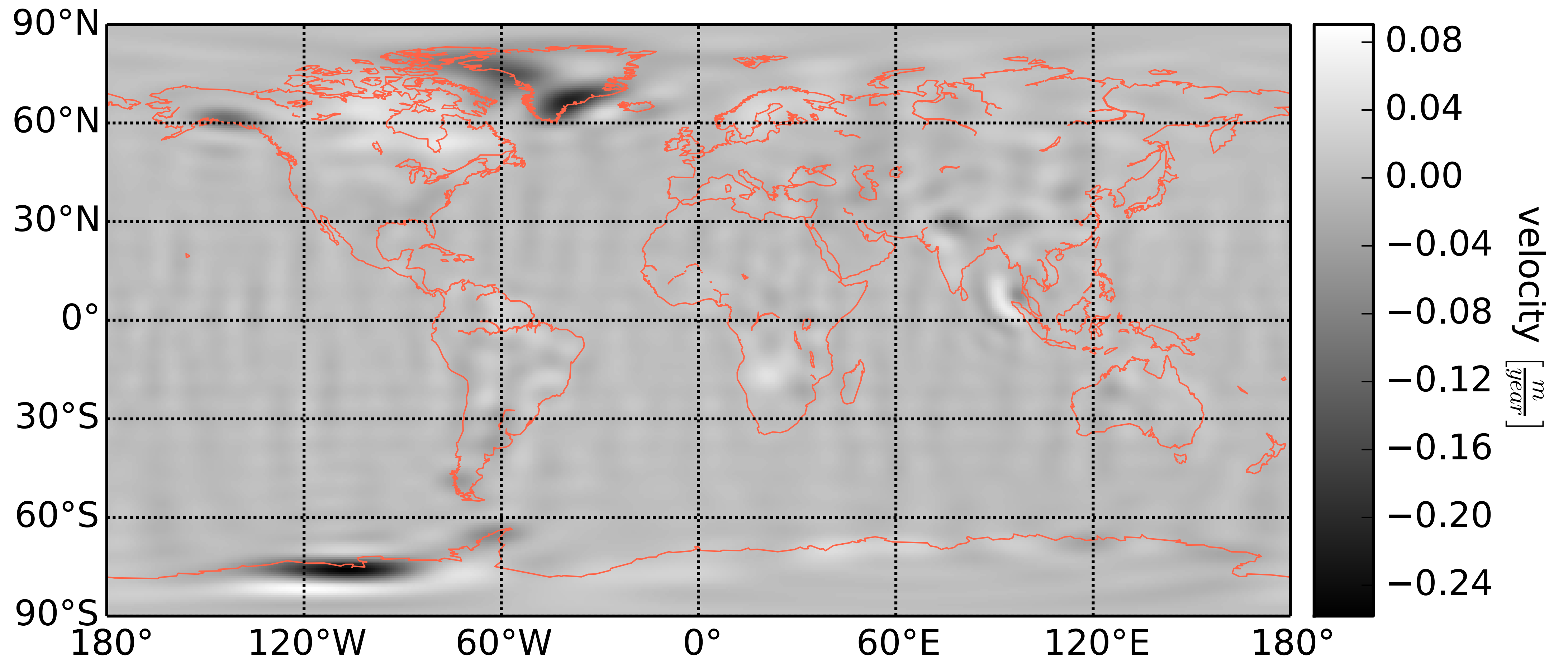
3. Minimer de kvadreret residualer

$$\frac{\partial}{\partial \beta} (\underline{y} - \underline{\beta} \cdot \underline{X})^T (\underline{y} - \underline{\beta} \cdot \underline{X}) = 0 \Rightarrow \underline{\hat{\beta}} = (\underline{X}^T \underline{X})^{-1} \underline{X}^T \underline{y}$$

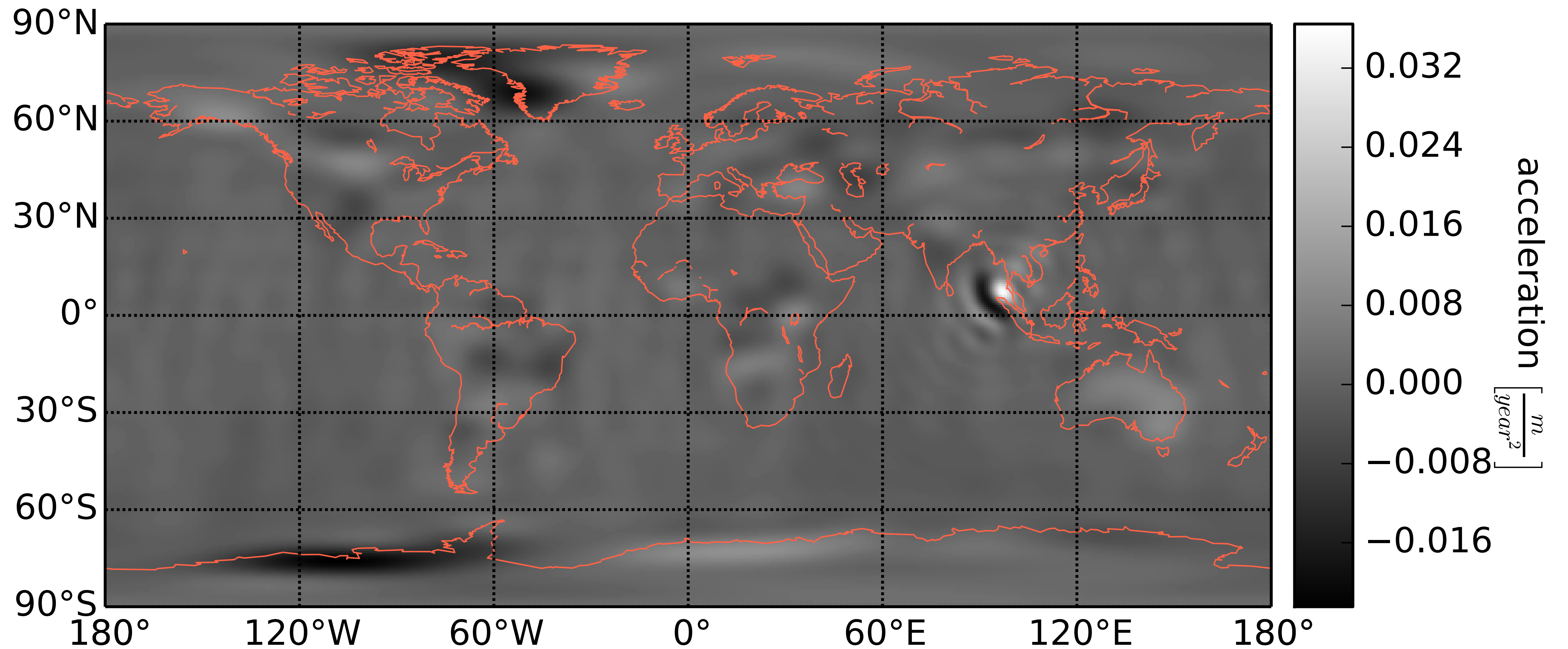
4. Udregn for alle positioner

$$\underline{\hat{\beta}} = (\underline{X}^T \underline{X})^{-1} \underline{X}^T \underline{y}$$

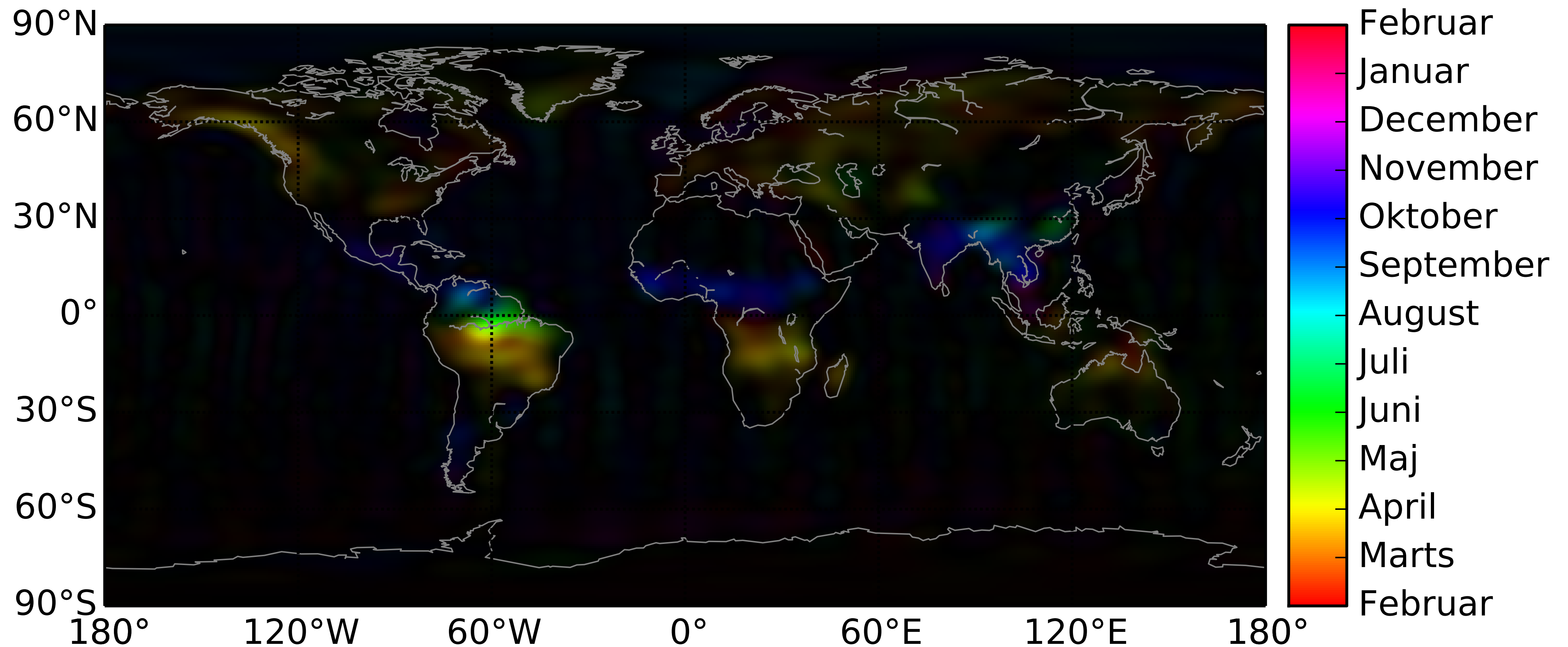
Hastighed



Acceleration



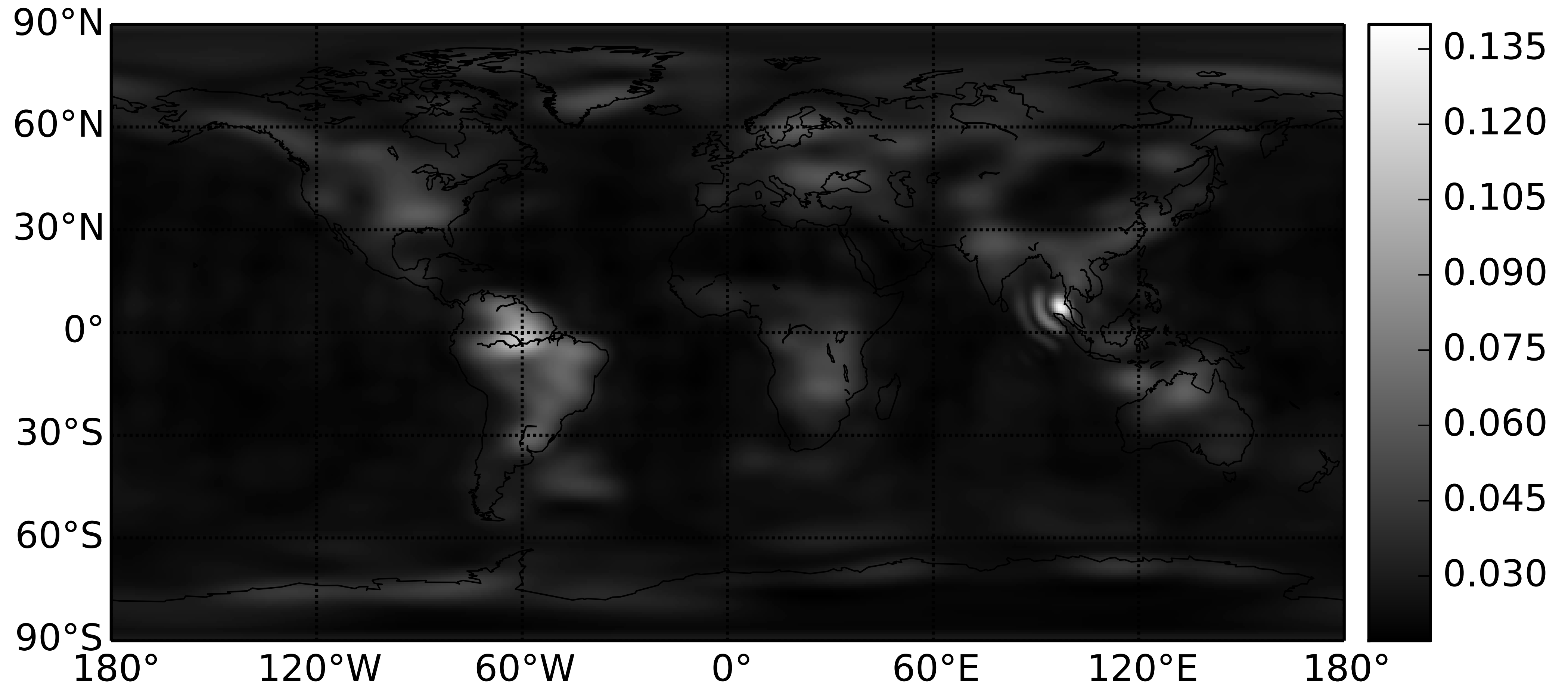
Årssvingning



Root Mean Squared Error

$$RMSE = \sqrt{\frac{(\underline{y} - \underline{\beta} \cdot \underline{\underline{X}})^T (\underline{y} - \underline{\beta} \cdot \underline{\underline{X}})}{n - p}}$$

Root Mean Squared Error



PCA Diagnostic

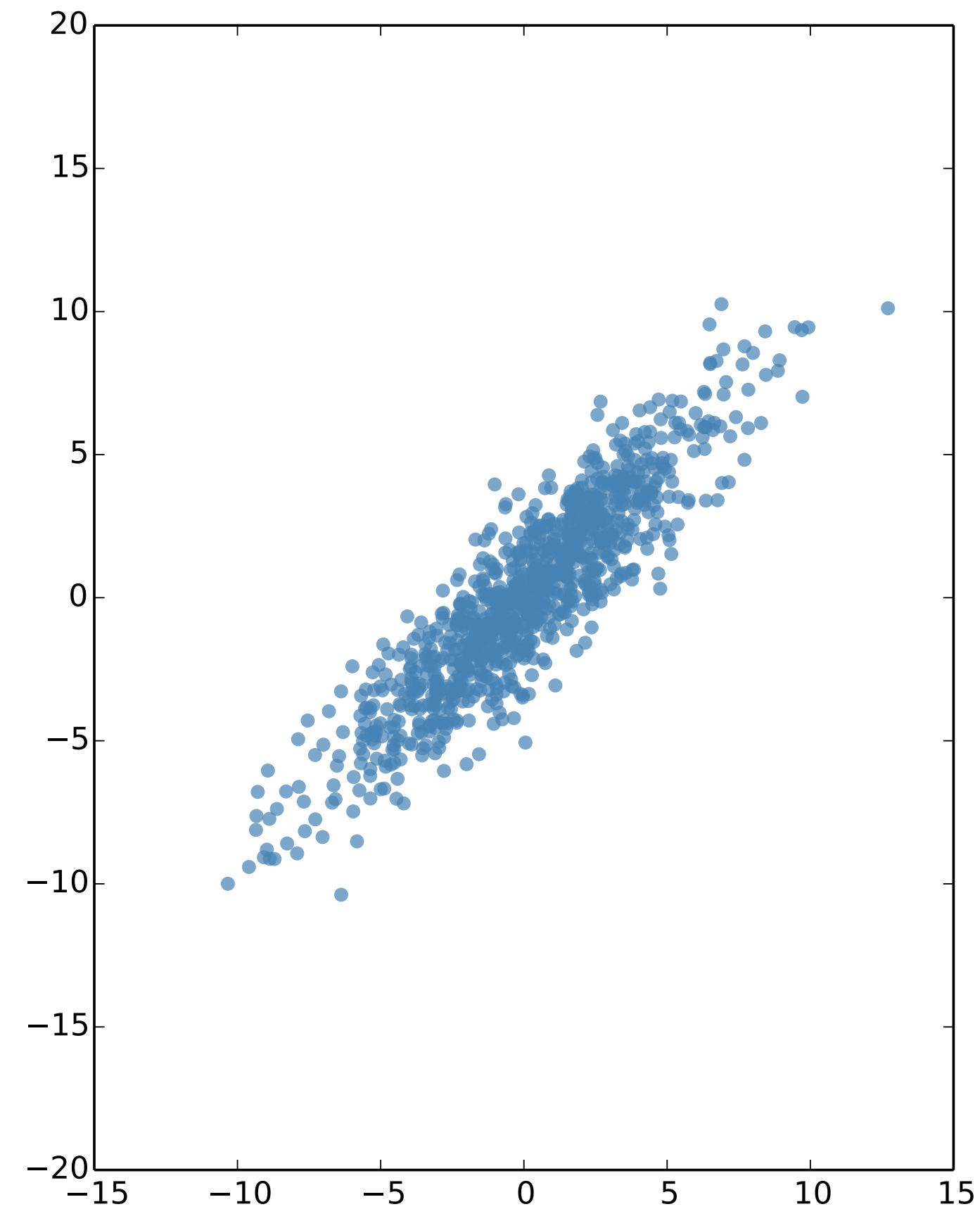
Principal Component Analysis Diagnostic

PCA

- Finder ortogonal projektion der gør data ukorrelerede

$$U = \underline{\underline{X}} \underline{\underline{V}} \underline{\underline{\Sigma}}^{-1}$$

- $\underline{\underline{V}}$ er en rotationsmatrix
- $\underline{\underline{\Sigma}}^{-1}$ er en diagonalmatrix

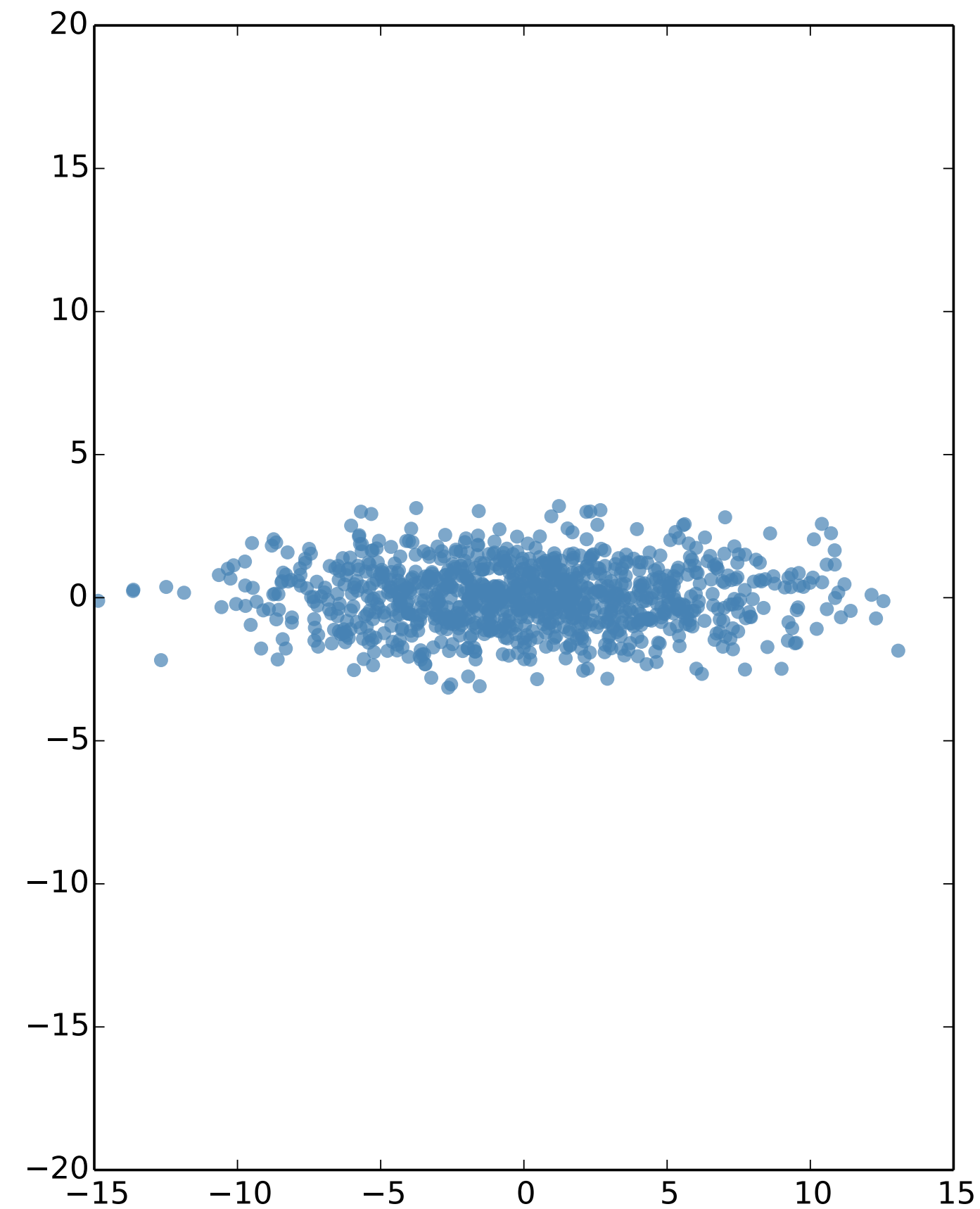


PCA

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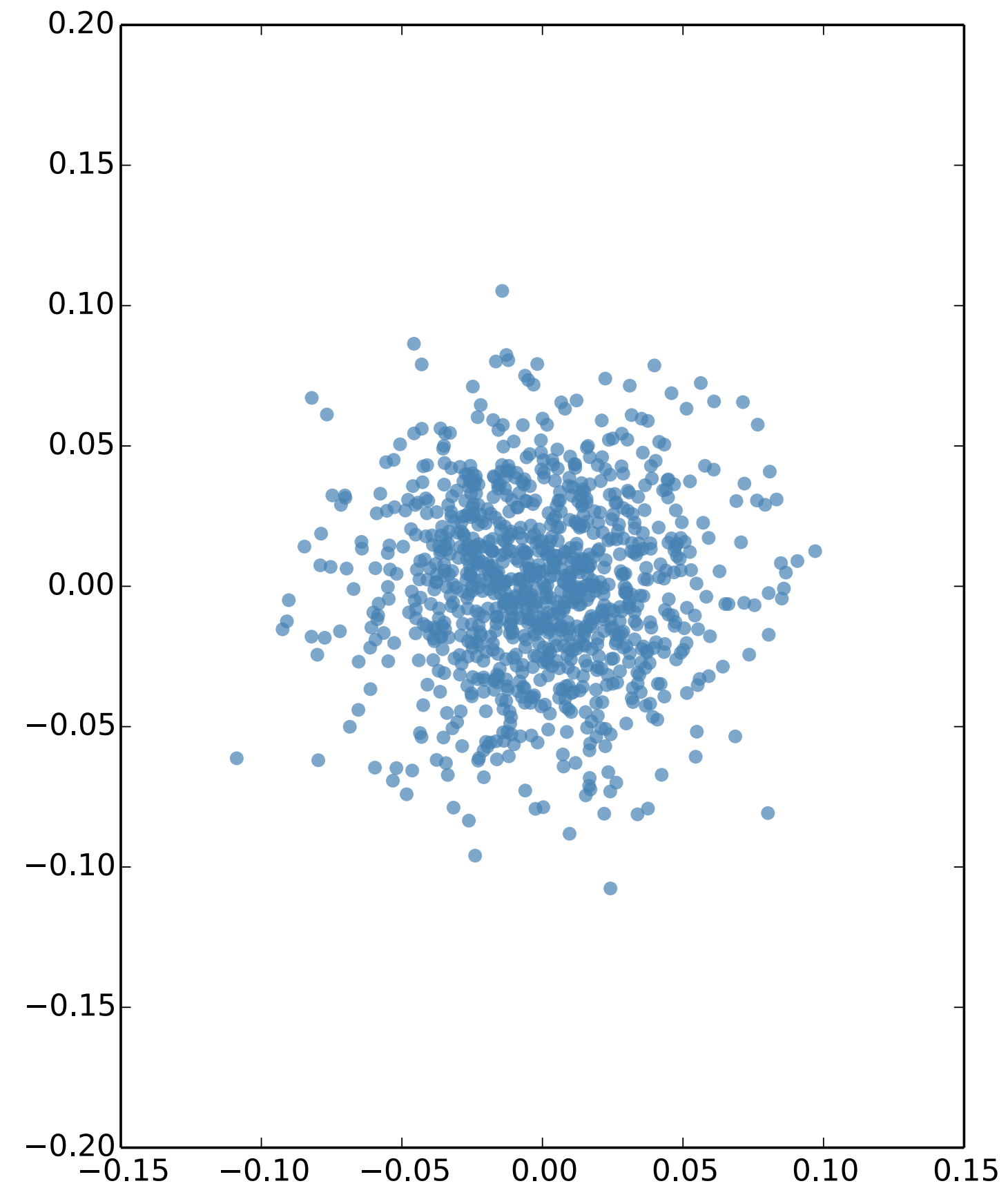


PCA

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$$U = \underline{\underline{X}} \underline{\underline{V}} \underline{\underline{\Sigma}}^{-1}$$

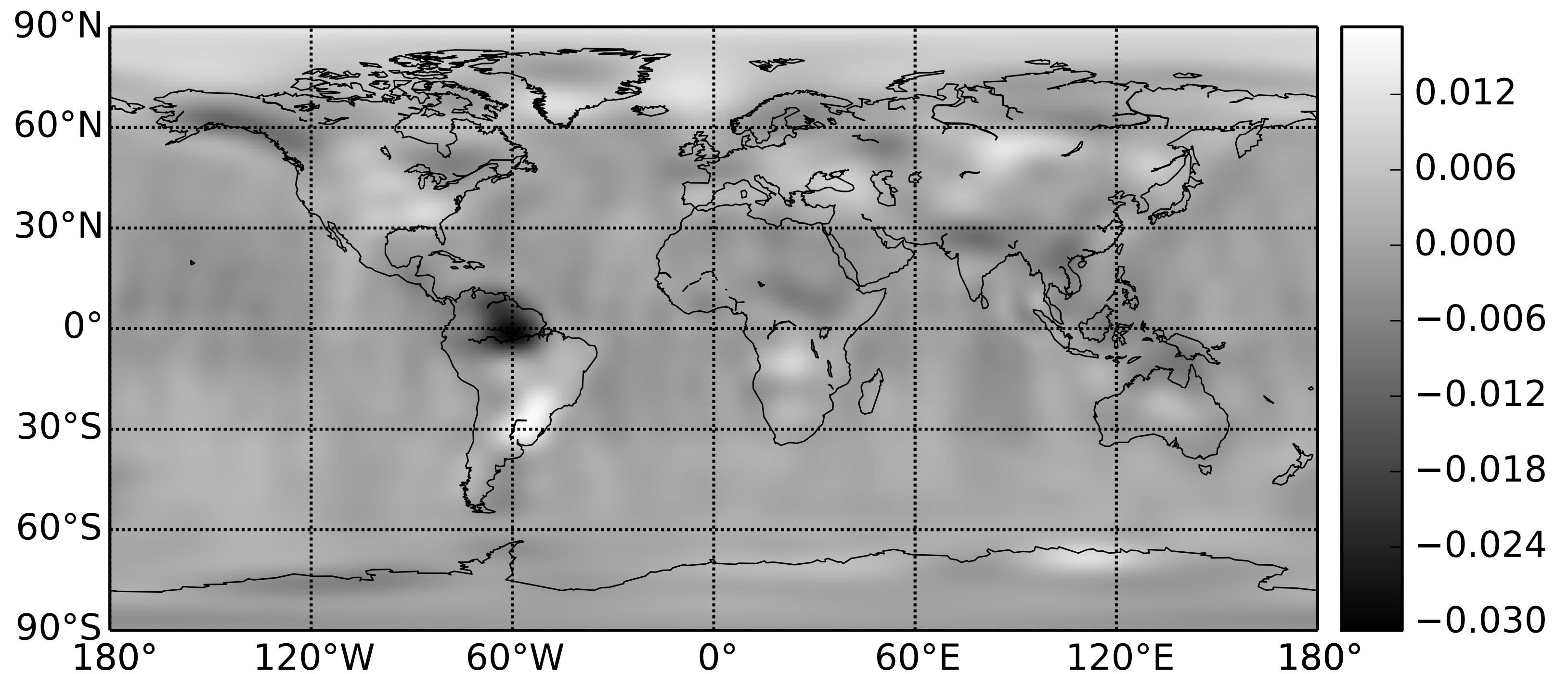
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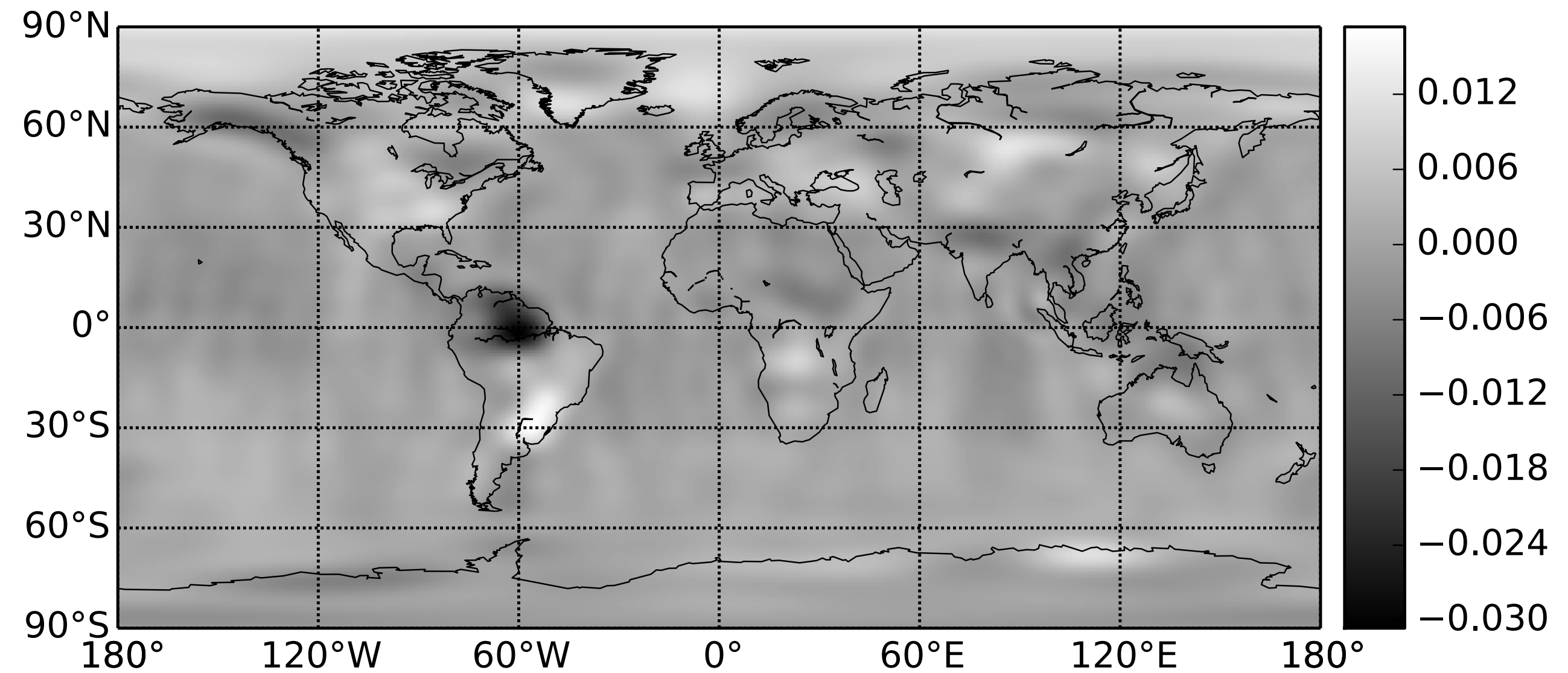
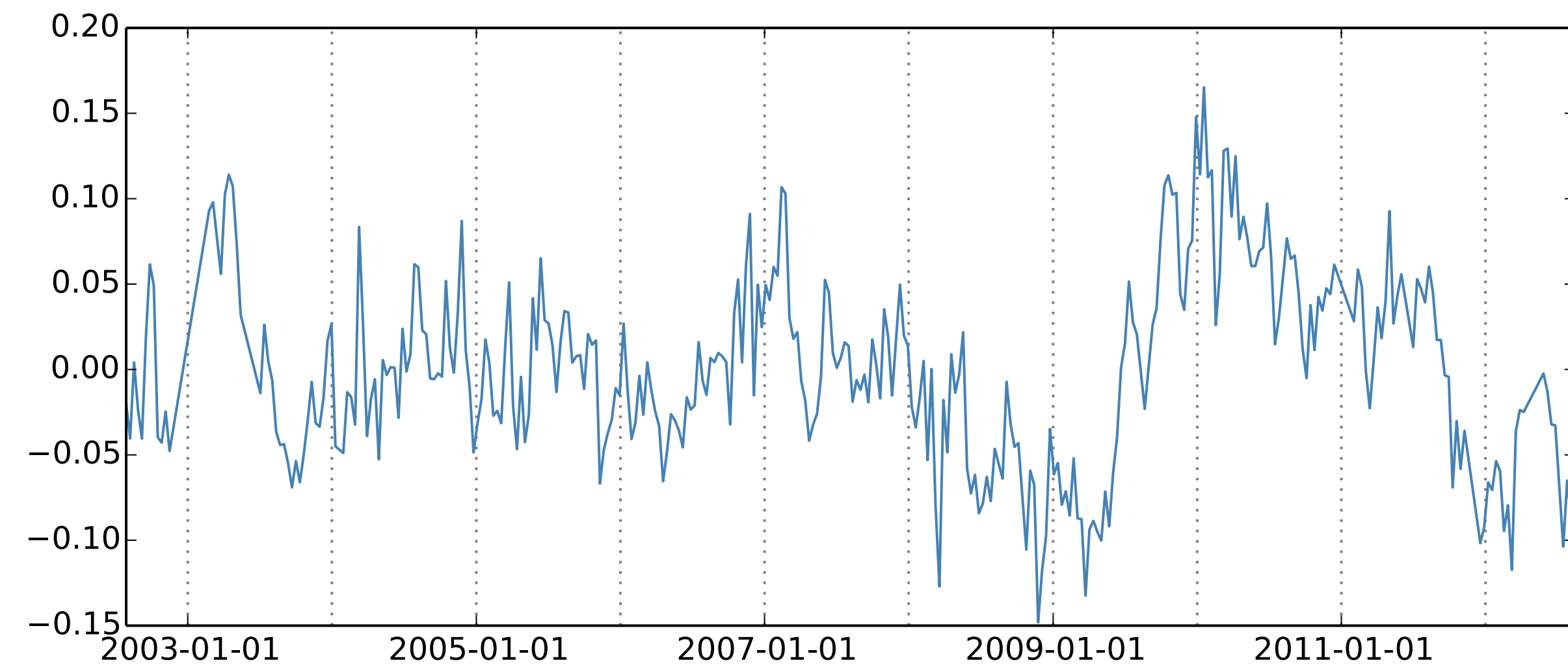
PCA Diagnostic

PCA på OLS residualerne kan
vise mønstre.

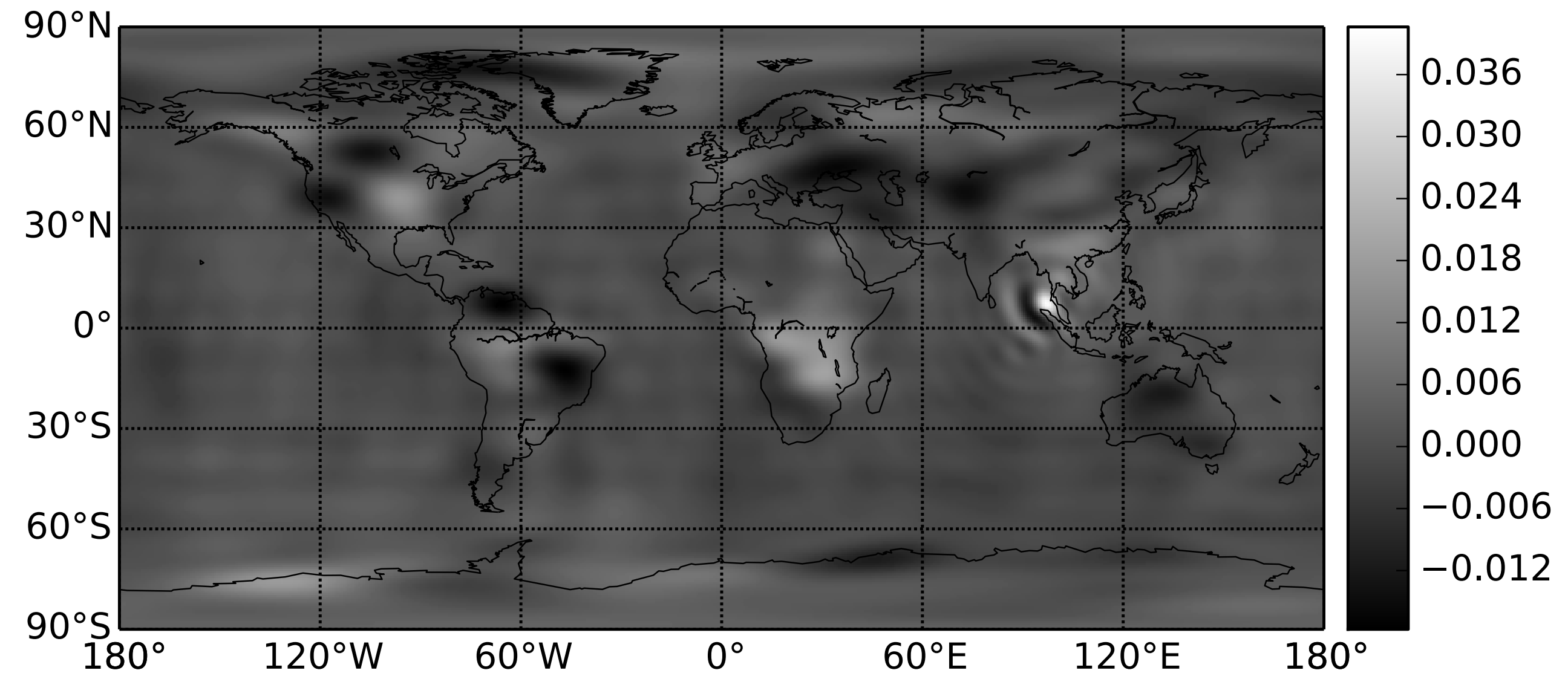
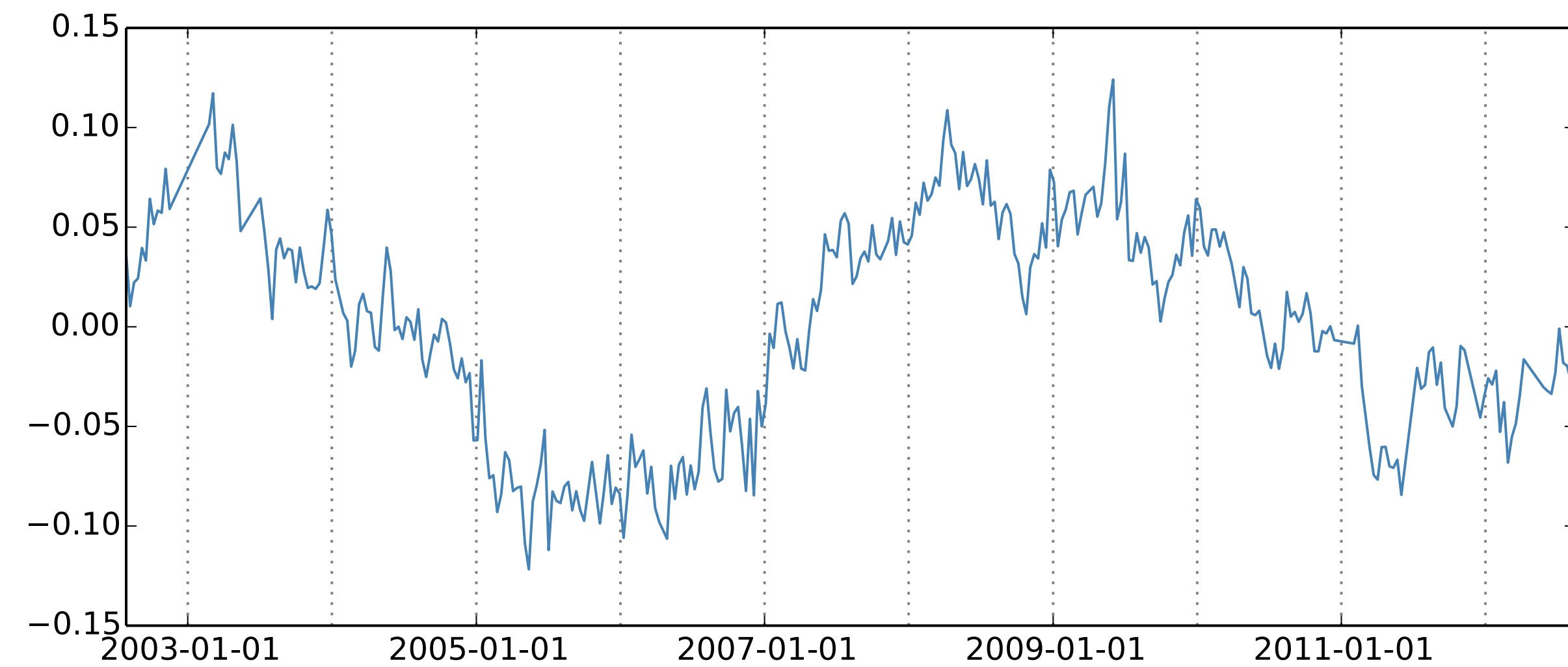
Mønstre vil optræde der hvor
modellen ikke er ideel.



PCA Diagnostic

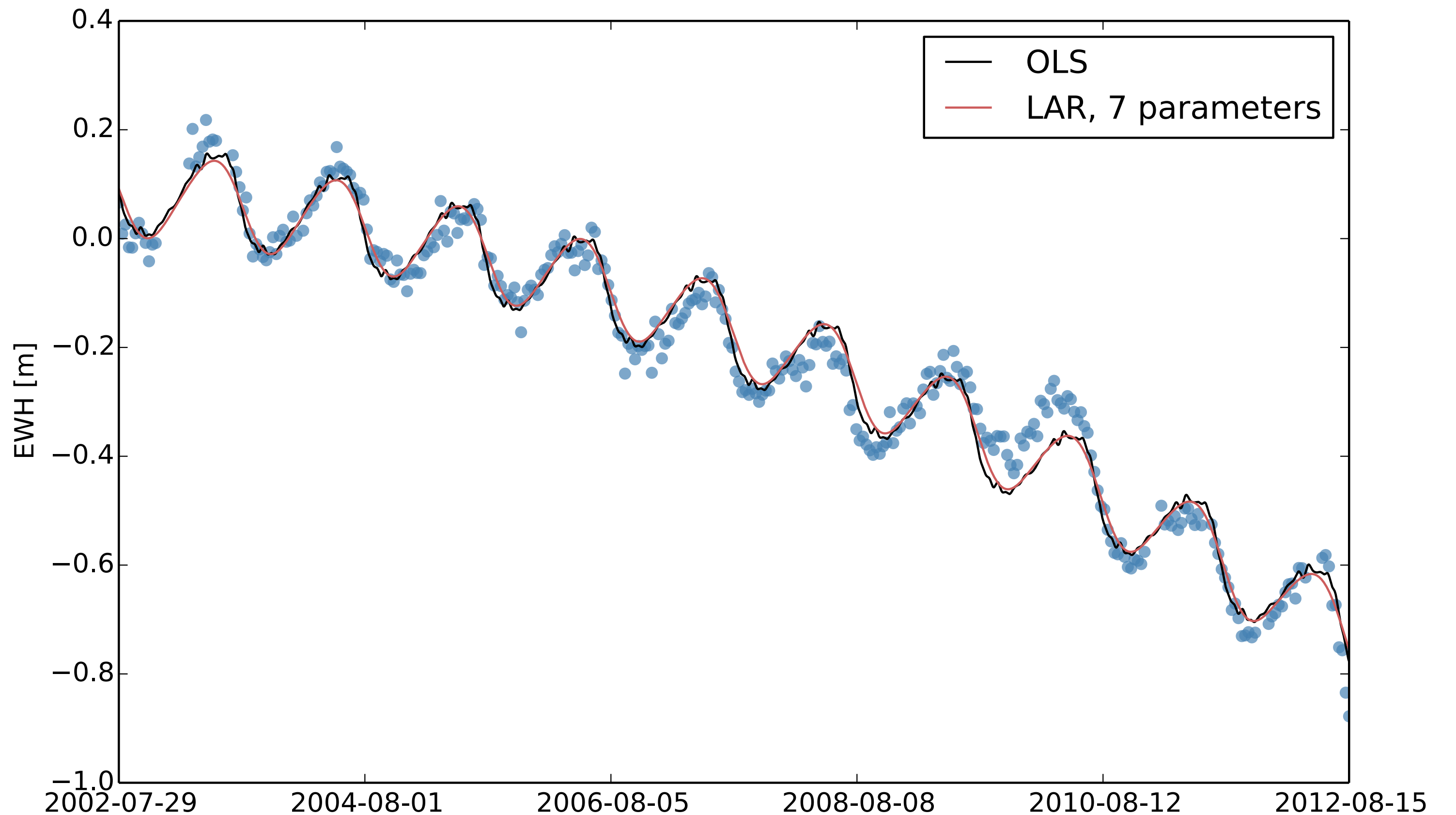


PCA Diagnostic



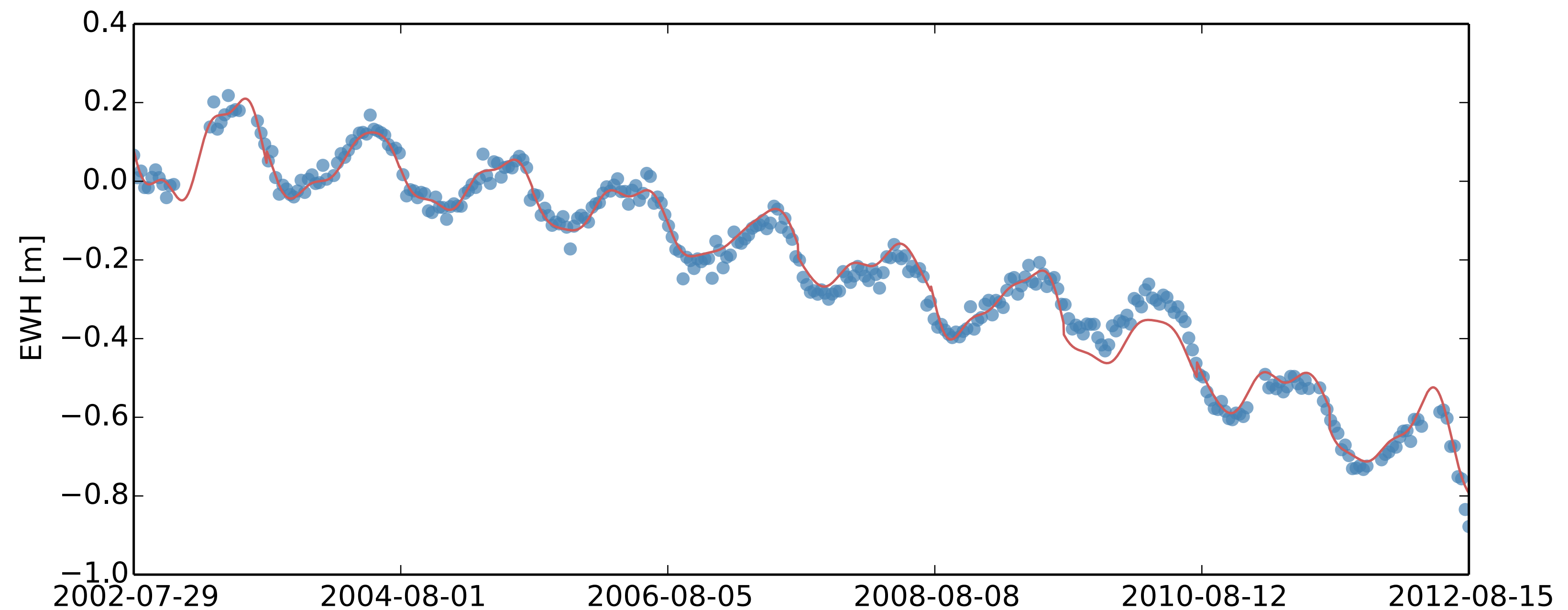
Andre analyser

- Least Angular Regression
(Hvor mange frekvenser)
- OLS med splines
(forskellige års svingninger)
- K-means
(Simpel gruppering af steder)
- GMM og Kernel PCA
(Avanceret gruppering af steder)



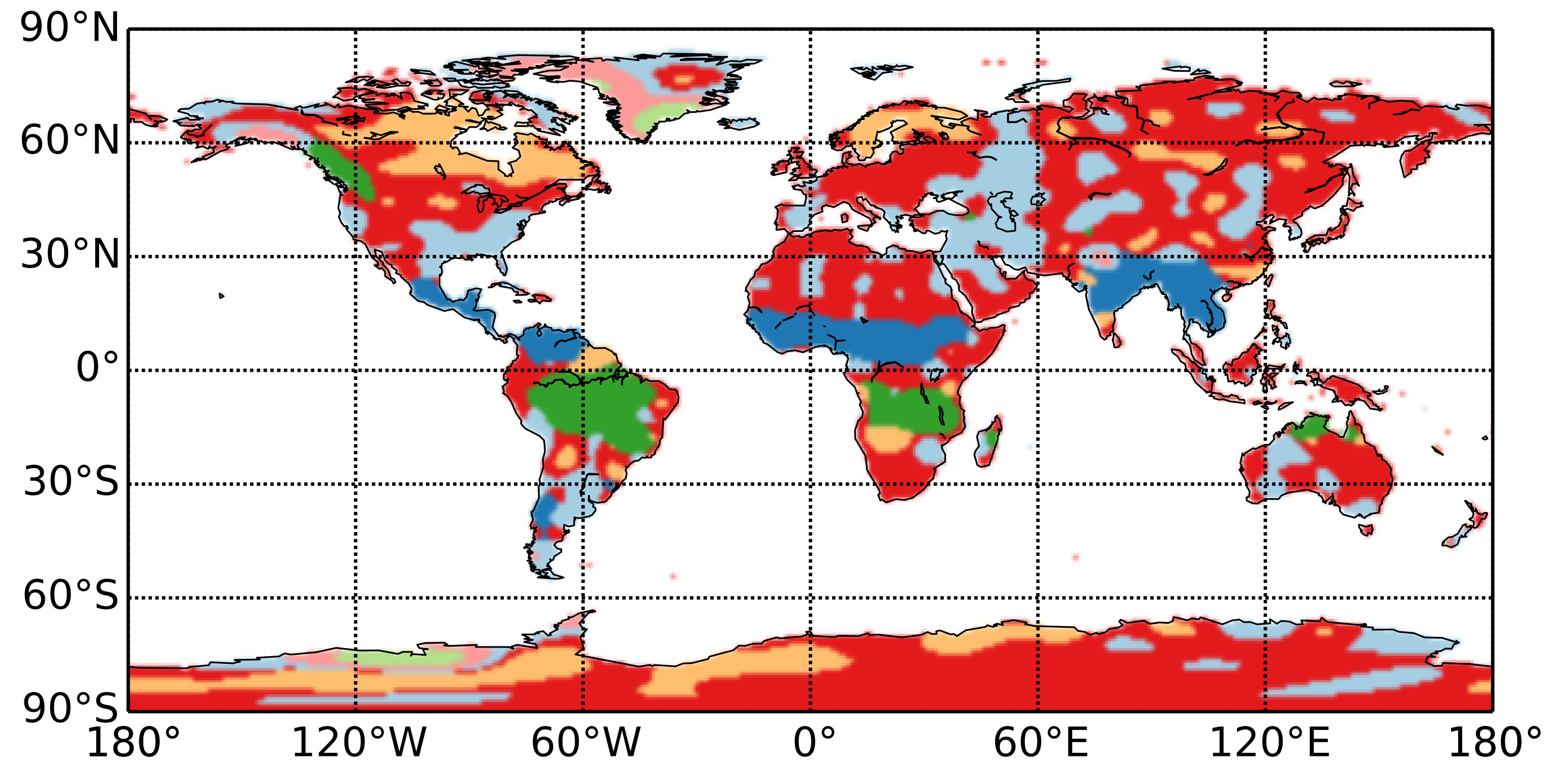
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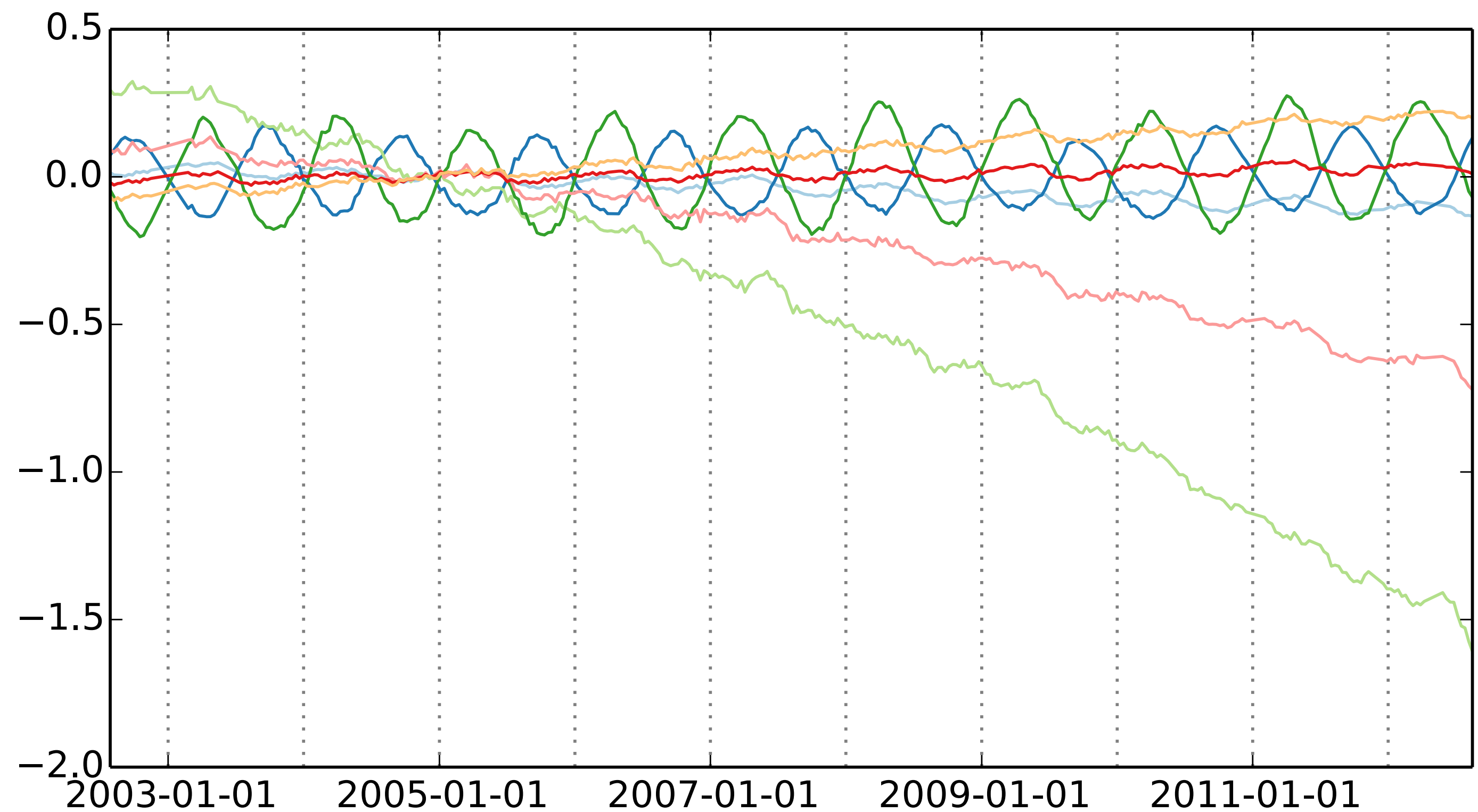
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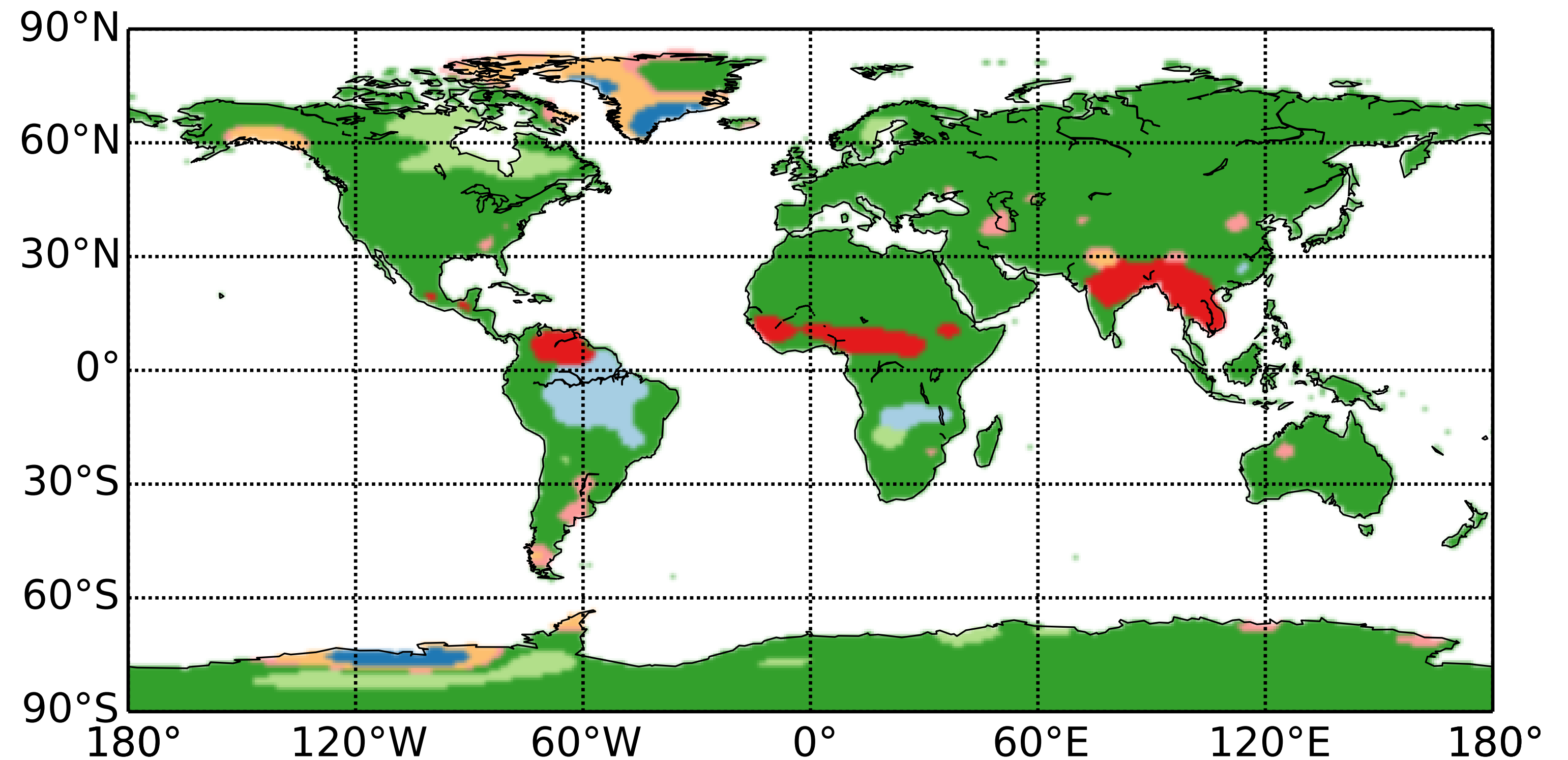
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