

## Supplementary Material for

### The Coupling Cloud: A community database of megathrust kinematic coupling models

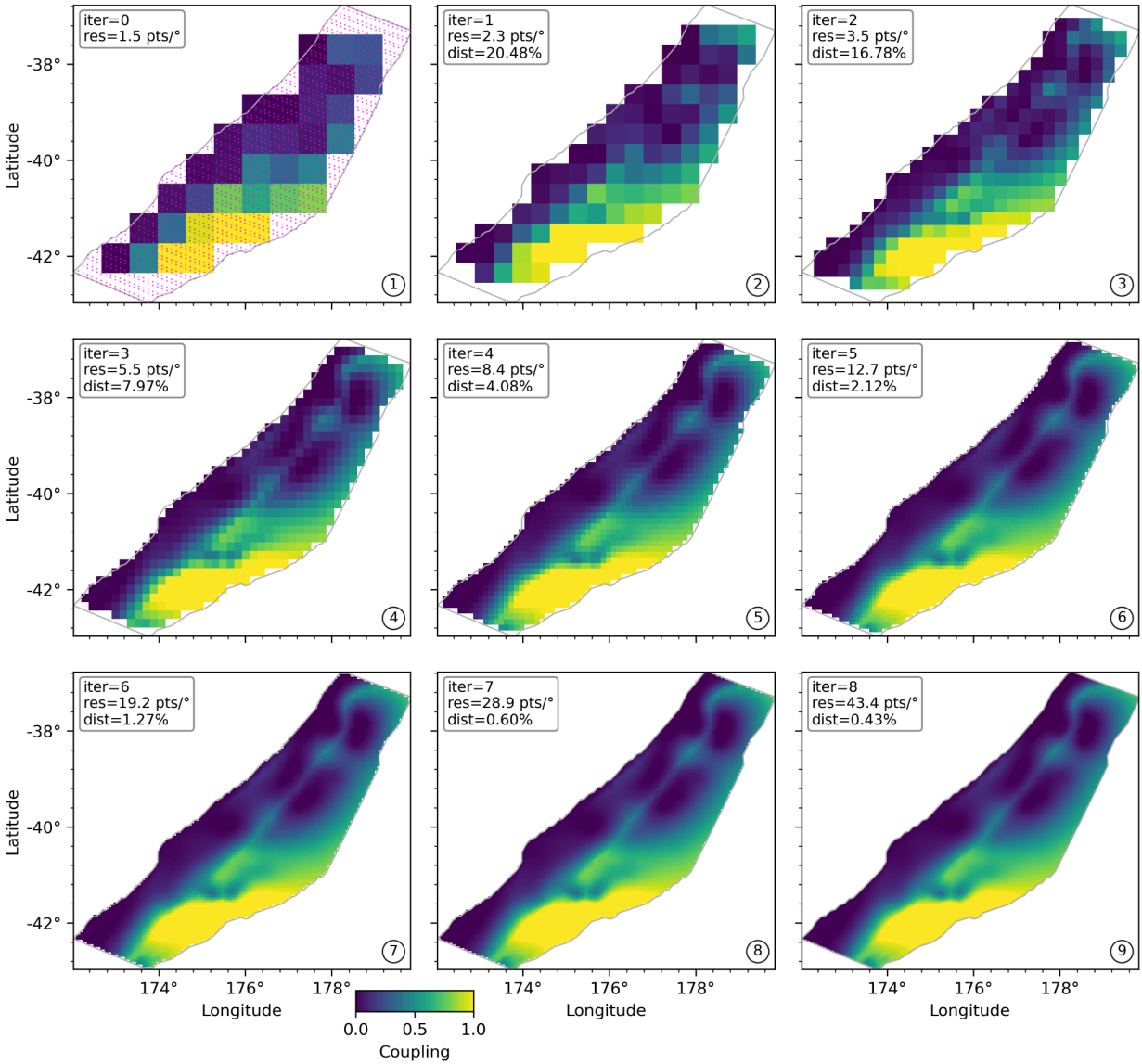
#### Text S1 - Interpolation to a uniform latitude-longitude grid

In cases where gridded outputs are not available in the original publication and only scattered data points defining coupling values are available, the coupling field is interpolated from these scattered geographic coordinates (latitude-longitude) onto a regular grid. The grid domain is defined by the minimum and maximum latitude and longitude coordinates of the available data points. To prevent extrapolation beyond the modeled region, interpolation is restricted to grid points located within an  $\alpha$ -shape boundary (Edelsbrunner & Mücke, 1994) constructed from the original data points. The  $\alpha$  parameter is chosen such that the boundary encloses all points while defining the smallest enclosing area (Fig. S1). Coupling values are then interpolated using linear interpolation, which was selected to minimize the introduction of artificial spatial structures that may arise from higher-order interpolation schemes.

The grid resolution is chosen to preserve the aspect ratio of the longitude-to-latitude extent of the data. The resolution is then determined adaptively by progressively refining the grid until the relative difference between two successive interpolated fields satisfies the following criterion:

$$\epsilon = \frac{\|C_{n+1} - C_n\|_2}{\|C_{n+1}\|_2} < 0.5\% \quad (1),$$

where  $C_n$  and  $C_{n+1}$  denote the interpolated coupling fields obtained at two successive grid resolutions,  $\| \cdot \|_2$  denotes the L<sub>2</sub> norm over all grid points, and  $\epsilon$  is set to  $\epsilon = 0.5\%$ . This ensures that the gridded representation has numerically converged while avoiding unnecessary oversampling (Fig. S1). In cases where coupling models are provided on triangular meshes, coupling values are instead interpolated onto grid points using triangular interpolation within the original mesh elements. In our tests, this procedure introduces differences of approximately ~1% in coupling (RMSE) between the gridded representation and the original mesh values.



**Figure S1** - Illustration of the adaptive grid-resolution procedure used to determine the spatial resolution of the interpolated coupling field in Hikurangi (Maubant et al., 2022). Each panel shows the interpolated coupling field for a given iteration together with the corresponding grid resolution (*grid\_res*) and the relative difference between two successive interpolated fields (*dist*). The grey line surrounding the interpolated data points represents the  $\alpha$ -shape boundary computed from the original data, which are shown as red points in panel 1.

## References

- Edelsbrunner, H., & Mücke, E. P. (1994). Three-dimensional alpha shapes. *ACM Trans. Graph.*, *13*(1), 43–72. <https://doi.org/10.1145/174462.156635>
- Maubant, L., Radiguet, M., Pathier, E., Doin, M.-P., Cotte, N., Kazachkina, E., & Kostoglodov, V. (2022). Interseismic coupling along the Mexican subduction zone seen by InSAR and GNSS. *Earth and Planetary Science Letters*, *586*, 117534. <https://doi.org/10.1016/j.epsl.2022.117534>