GNSS-A

Revolutionary seafloor geodetic monitoring

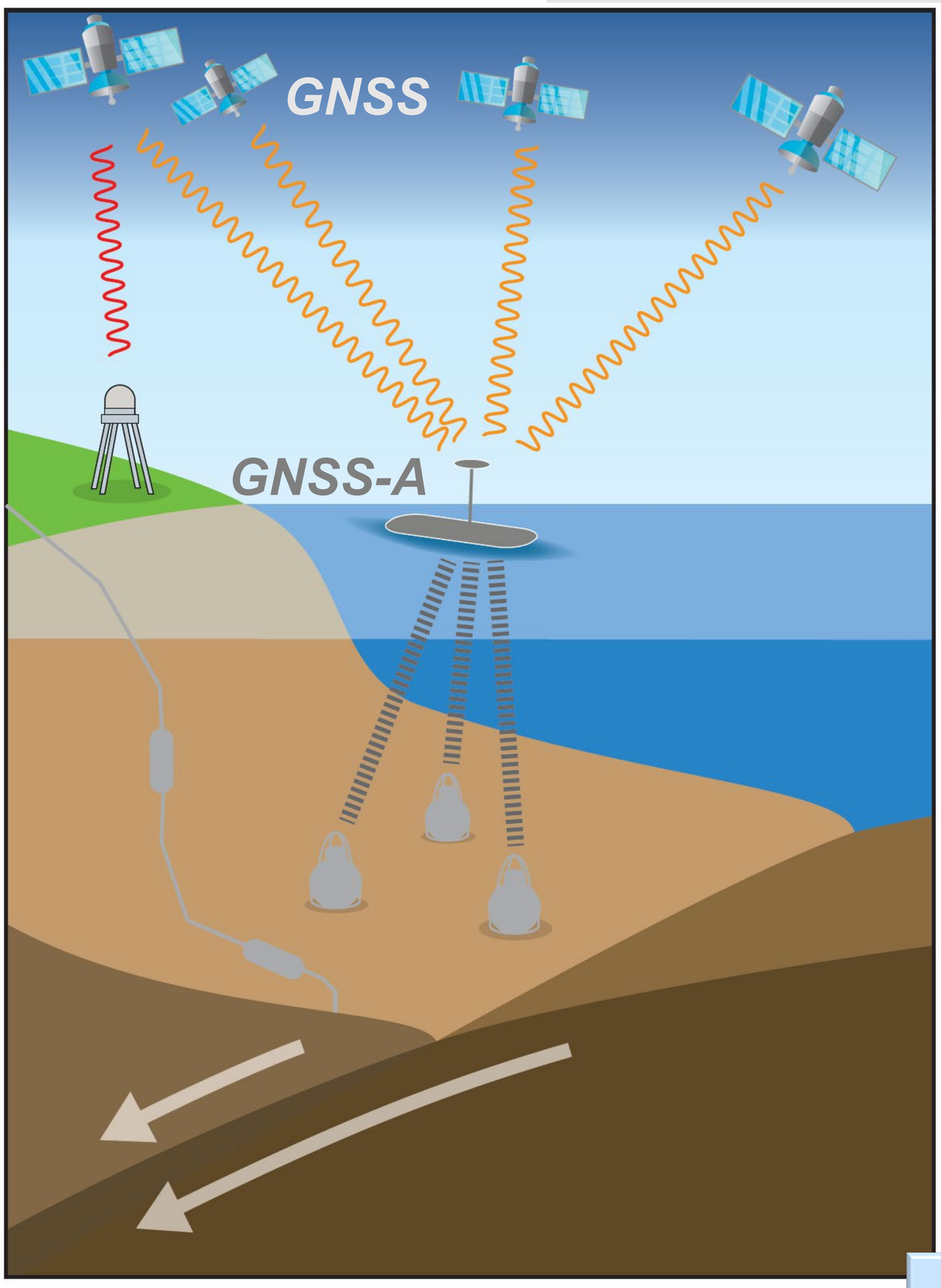
Since the 1980s, with the advent of GNSS, the location of land has been precisely determined, but there has been no technique for determining the location of the seabed.
In recent years, GNSS-A has made it possible to measure the movement of the seabed precisely. This information is extremely important in seismology and earthquake disaster prevention engineering, and enhances the existence value.

GNSS application

$$\rho = \sqrt{(x^s - x_r)^2 + (y^s - y_r)^2 + (z^s - z_r)^2} - \Delta\rho$$

$$\boldsymbol{x} = (\boldsymbol{r}_r^T, \boldsymbol{v}_r^T, Z_r, G_{N,r}, G_{E,r}, Z_b, G_{N,b}, G_{E,b}, \boldsymbol{I}^T, \boldsymbol{B}_1^T, \boldsymbol{B}_2^T, \boldsymbol{B}_5^T)^T$$

GNSS positioning formulation



Onshore GNSS

Non-linear inverse problem

$$y = Ax + e$$

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ \vdots \end{pmatrix} = \begin{pmatrix} A_1 & 0 & 0 & \cdots \\ A_2 & A_2 & 0 & \cdots \\ A_3 & 0 & A_3 & \cdots \\ \vdots & \vdots & \vdots & \ddots \end{pmatrix} \begin{pmatrix} X_1 \\ D_2 \\ D_3 \\ \vdots \end{pmatrix} + e$$

Non-linear inverse problem

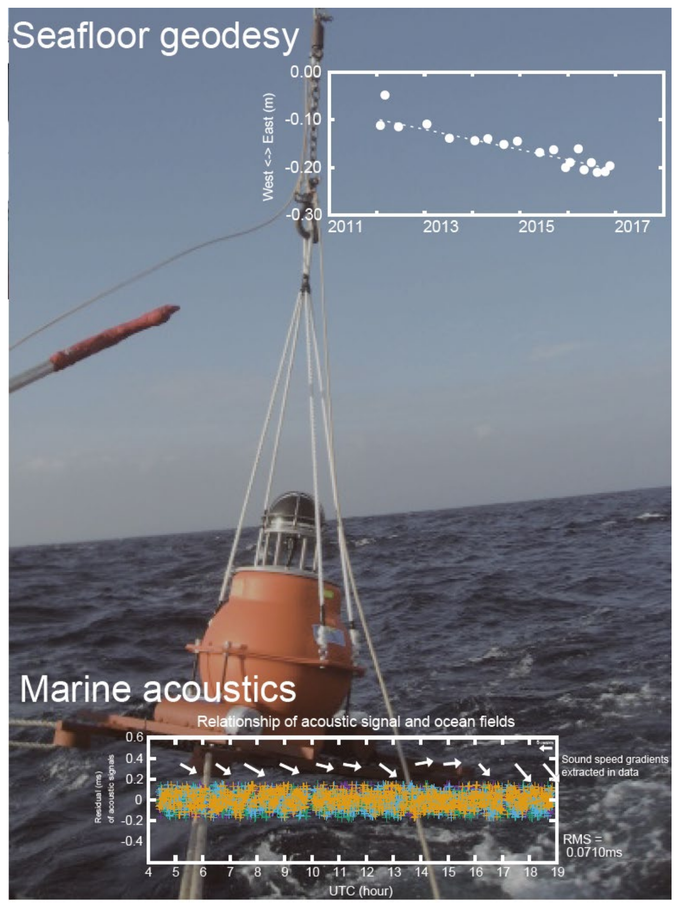


Plate coupling

$$e_{ij} = \frac{1}{2}\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right)$$

$$\sigma_{ij} = \lambda e_{kk}\delta_{ij} + 2\mu e_{ij}$$

Internal strain & stress

km-scale ocean field

$$\Delta V_1(t) = \sum_i V_i(t)x(t)\cos(\theta_i(t) - \theta_a(t))$$

$$\Delta V_{2j}(t) = \sum_i V_{2i}(t)x_j(t)\cos(\theta_{2i}(t) - \theta_j(t))$$

Extractions of ocean field