On the interpretation of oceanic variations in terms of ocean bottom pressure

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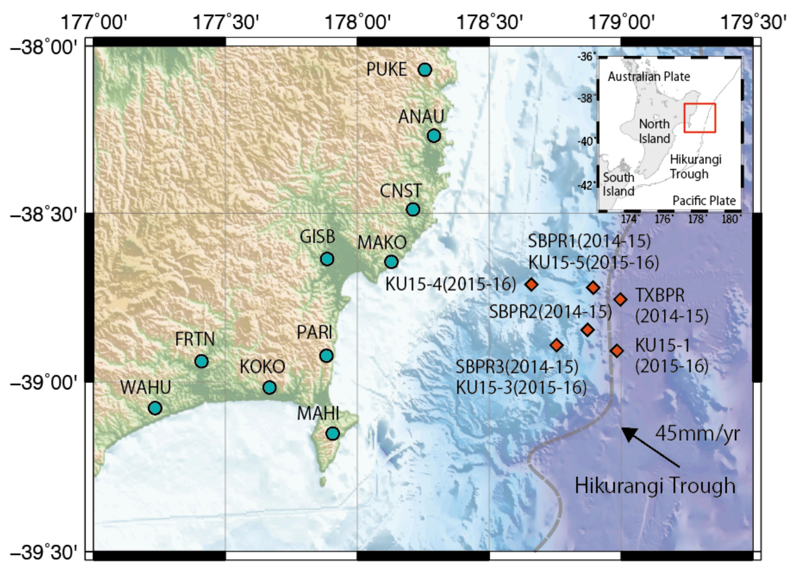
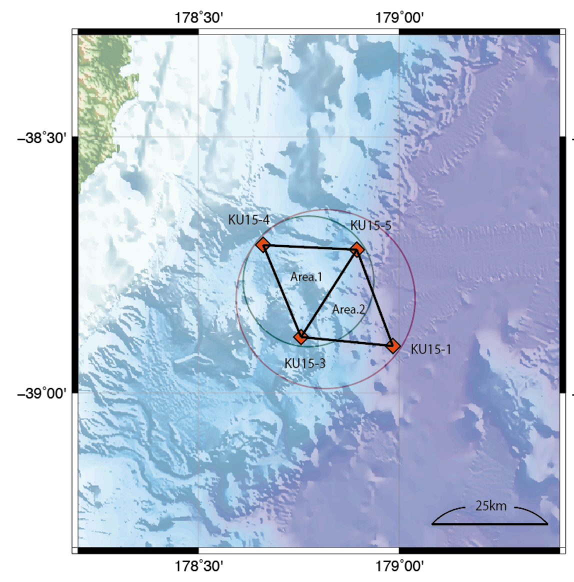
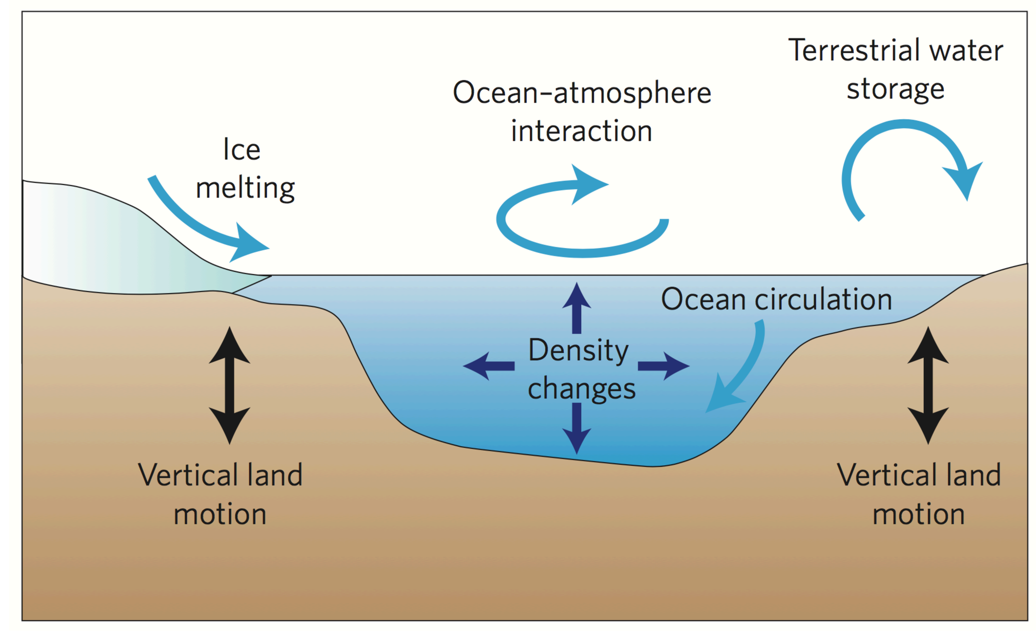
Introduction



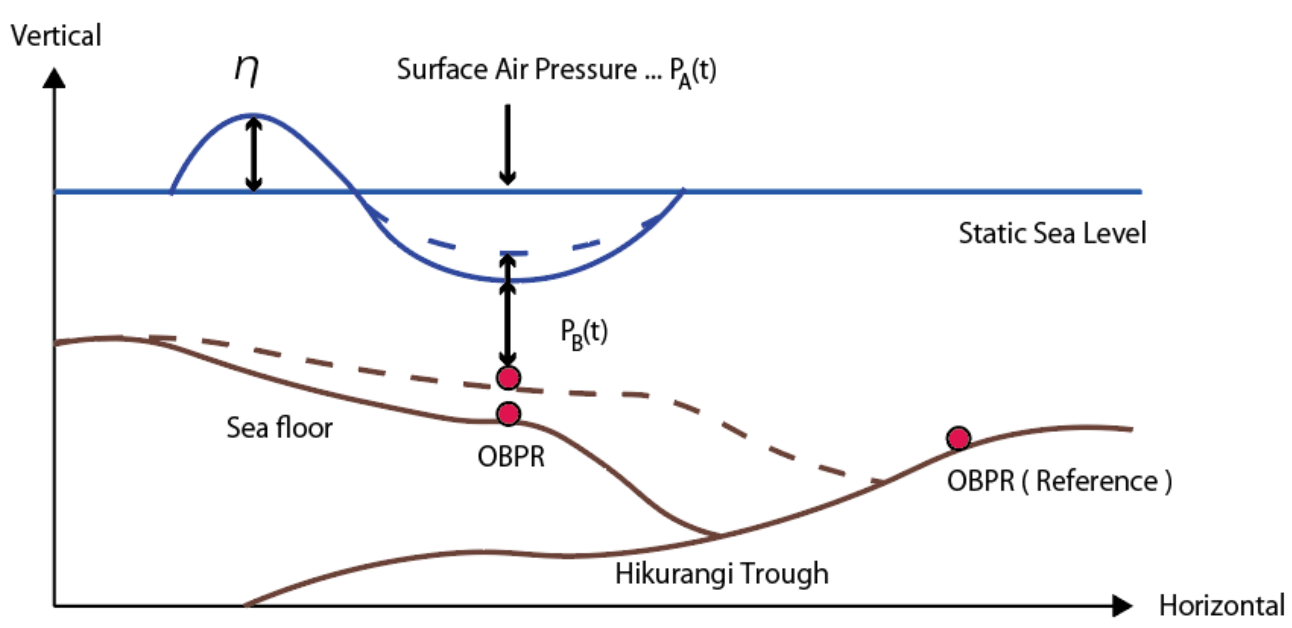


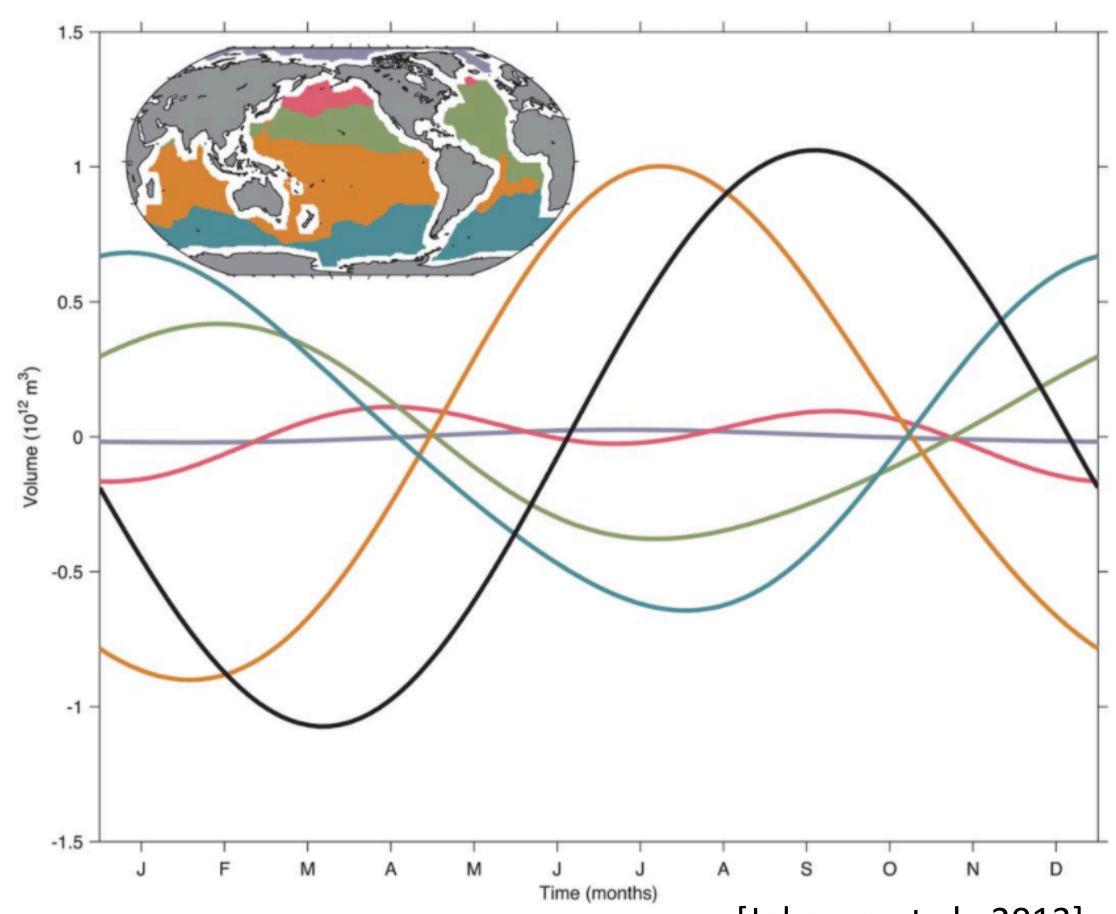


[Milne et al., 2009]

$$\Delta V_{sea-water}(t) = \Delta V_{ice\ on\ land}(t) + \Delta V_{capacity}(t)$$

$$\Delta V_{capacity}(t) \fallingdotseq 0 \quad (t << \text{To some extent})$$





[Johnson et al., 2013]

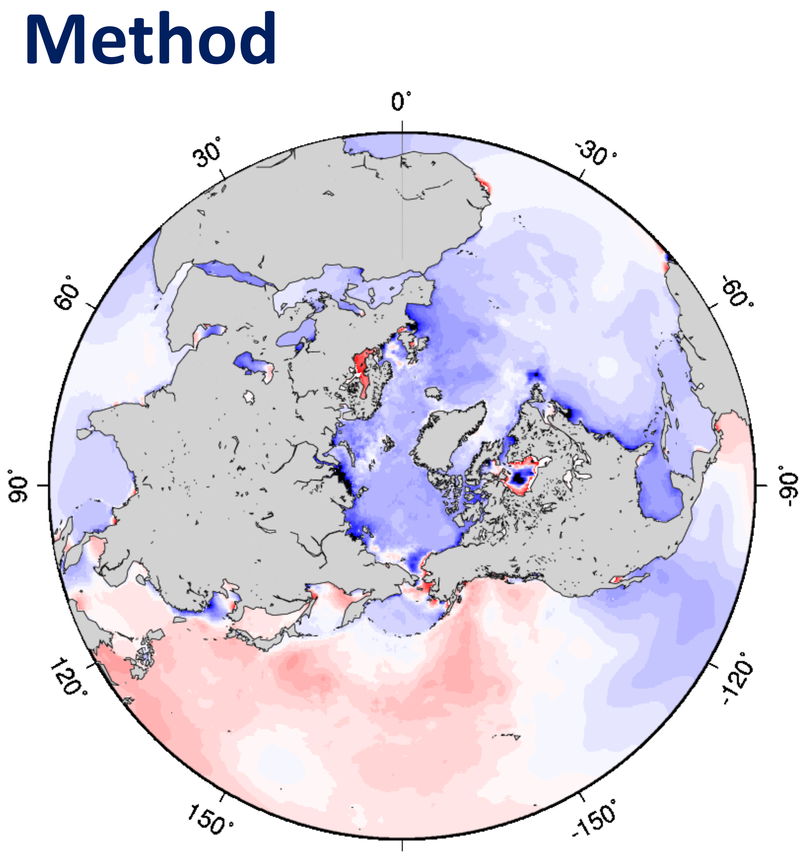
$$P_B(t) = P_c(t) + P_t(t) + P_o + P_s(t) + P_d(t) + P_A(t) + \epsilon(t)$$

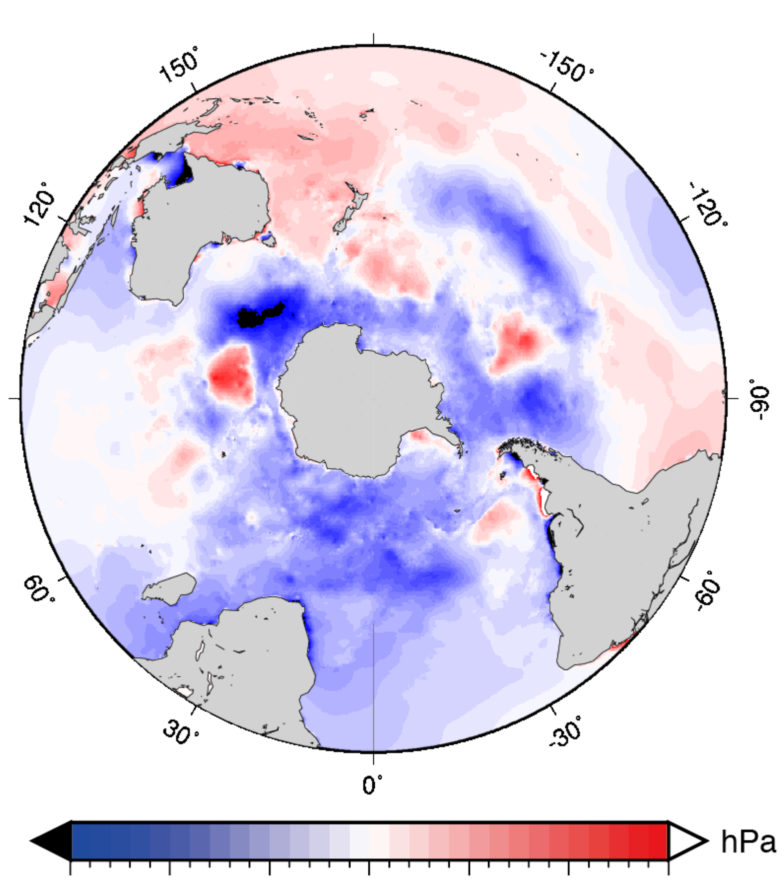
- $P_B(t)$ ...Raw data (Pressure deviation)
- $P_c(t)$ ... Sea floor vertical displacements
- $P_t(t)$ ... Tides (Ocean tide and Earth tide) ... ~ 100cm, ~1day-cycle
- $P_o(t)$ ... Nontidal oceanic variations ... ~5hPa
- $P_s(t)$ ... **Seasonal Fluctuation** ... ~1.5hPa, ~365day−cycle
- $P_d(t)$ ... Instrumental drifts
- $P_A(t)$ ... Surface air pressure ... ~1030hPa
- $\epsilon(t)$ ... Residuals

$$\psi_{Assumed\ trend}(t) = \sum_{1}^{n}\left(b_n \sin\left(\frac{2^n \pi t}{T}\right) + c_n \cos\left(\frac{2^n \pi t}{T}\right)\right)$$

In this study, we consider about the factor of sea floor pressure change, especially temporal variation of several months to annual cycle from observed data. In this study, we use observed pressure records which spanned from June 2015 to June 2016 at off the coast of north island in New Zealand using independent type Ocean Bottom Pressure Recorders. By using Baytap-G, we calculated the tidal component and subtracted it from the raw data. Then, we calculated sea-level anomaly (non-tidal oceanic variation) driven by air pressure and wind using barotropic ocean model. Comparing with Ocean Bottom Pressure Record after removing tidal component and calculated sea-level anomaly using ocean model, we found that there is a long-term component included in the Ocean Bottom Pressure Record that cannot be expressed by calculating ocean model. This long-term component's amplitude is about 1.0hPa and has about a 180-day cycle. In evaluating the pressure change derived from crustal deformation due to SSE, the amplitude of this component we detected in this study cannot be ignored. In this study, we consider the origin of this tong-term component from sea-level record etc. As a result, we found that This is a "fluctuation" which can be approximated as summation of harmonic mode.

Method

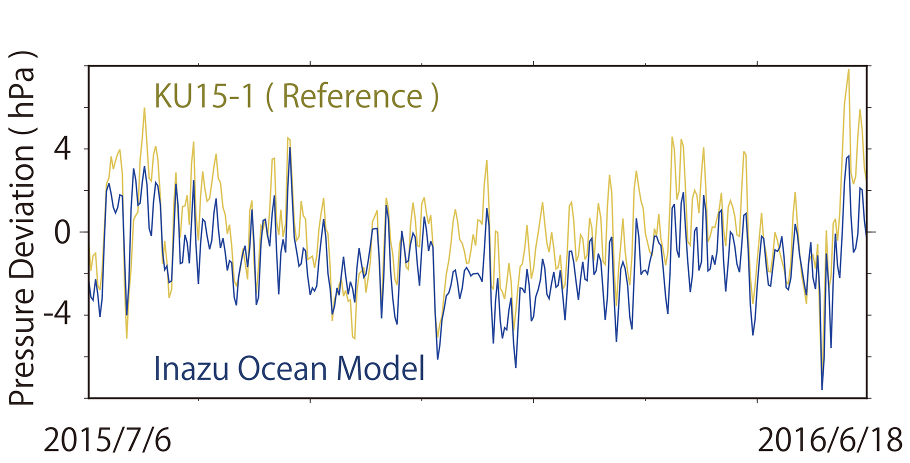




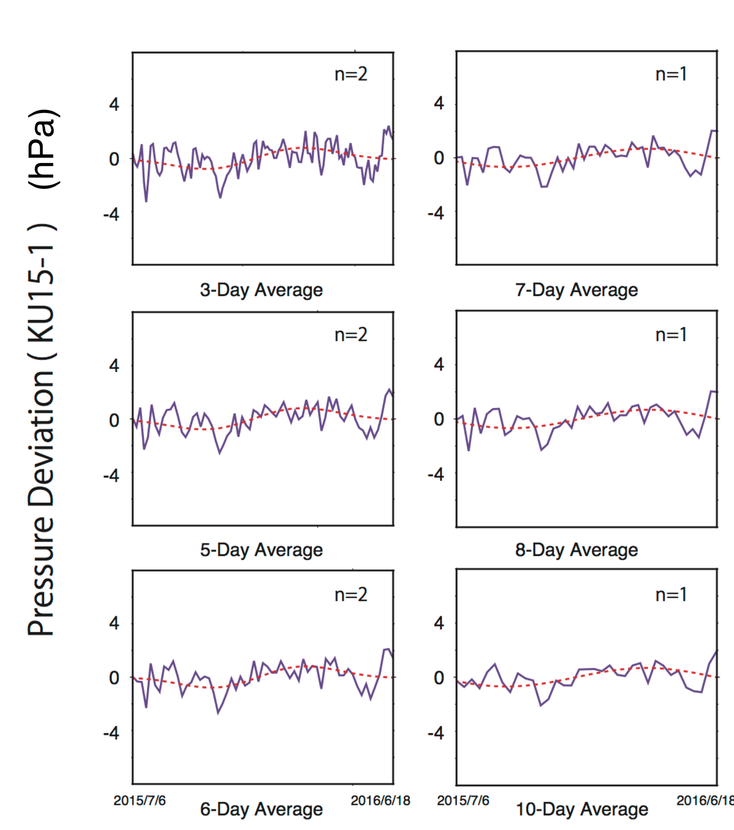
$$\frac{\partial \mathbf{v}}{\partial t} + (\mathbf{v}\cdot\nabla)\mathbf{v} + \mathbf{f}\times\mathbf{v} = \nabla\left(-g\eta - \frac{P}{\rho}\right) + \frac{\tau}{\rho H} - \gamma_b\frac{\mathbf{v}|\mathbf{v}|}{H} + A_H\nabla^2\mathbf{v}$$

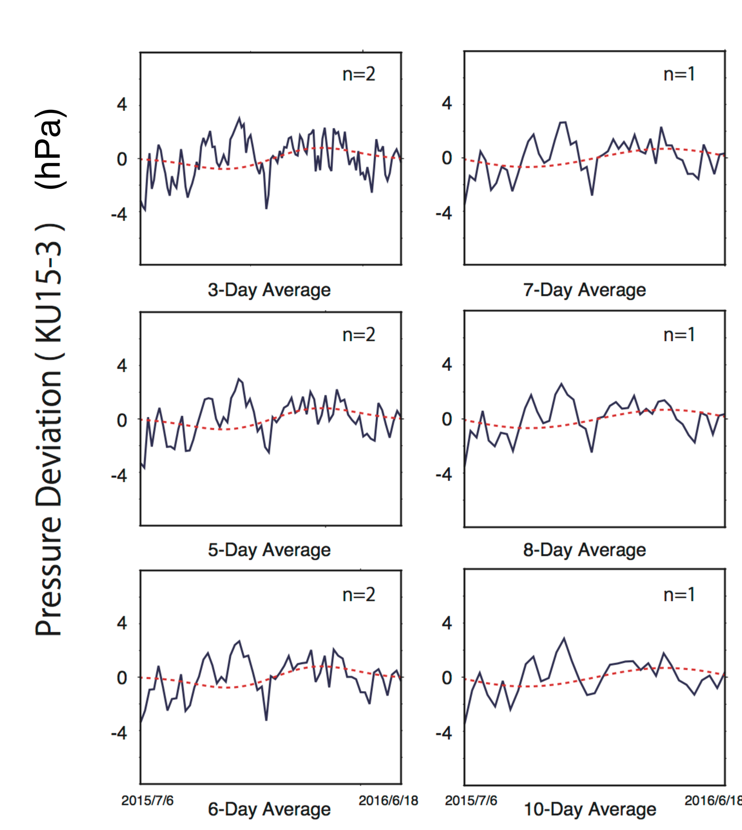
$$\frac{\partial \eta}{\partial t} + \nabla\cdot(\mathbf{v}H) = 0 \qquad \tau = \rho_a C_d \mathbf{W}|\mathbf{W}|$$

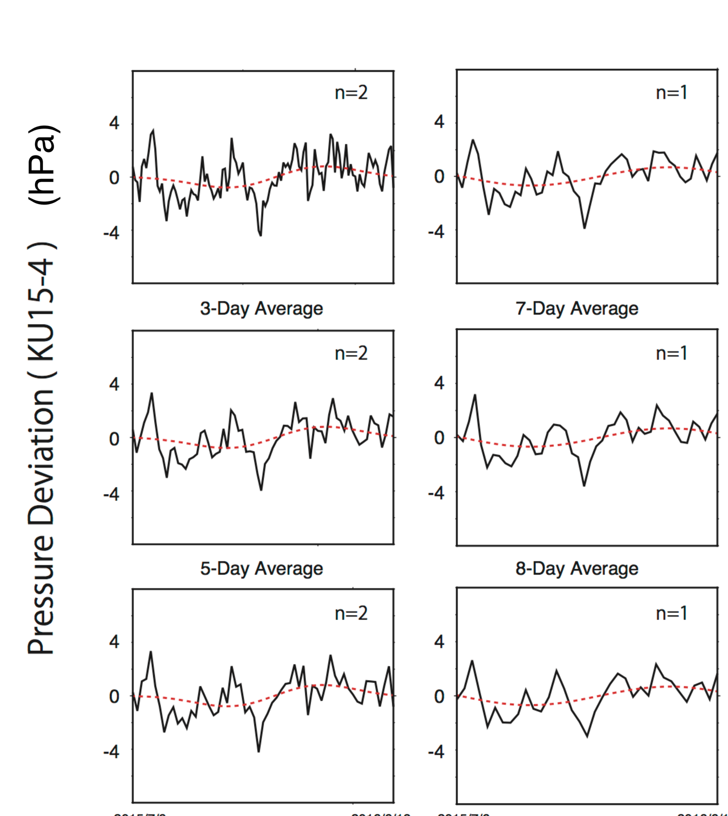
$$\Delta P_B(t) = \rho g \eta(t) + P_A(t)$$

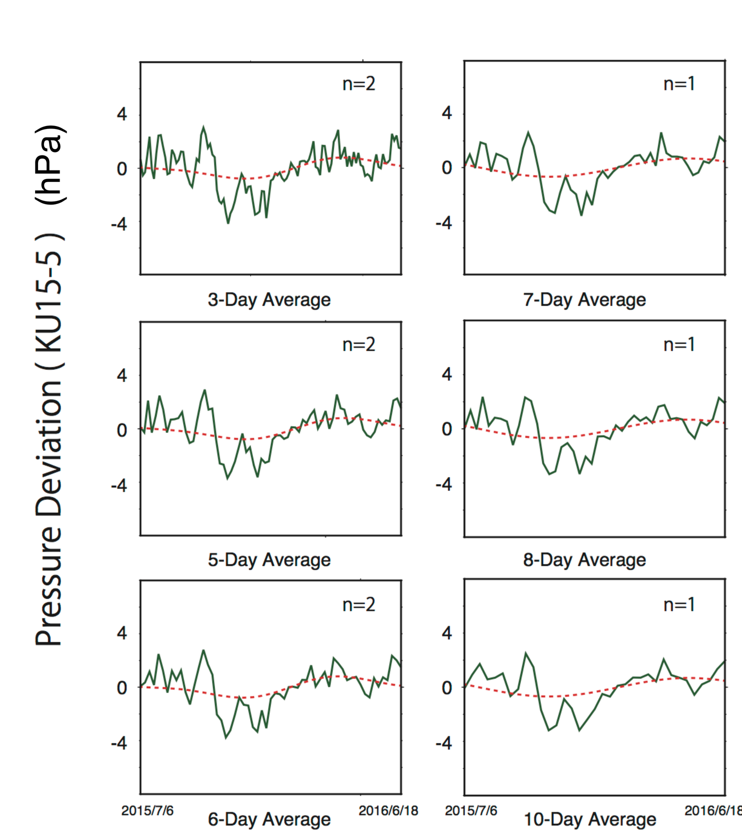


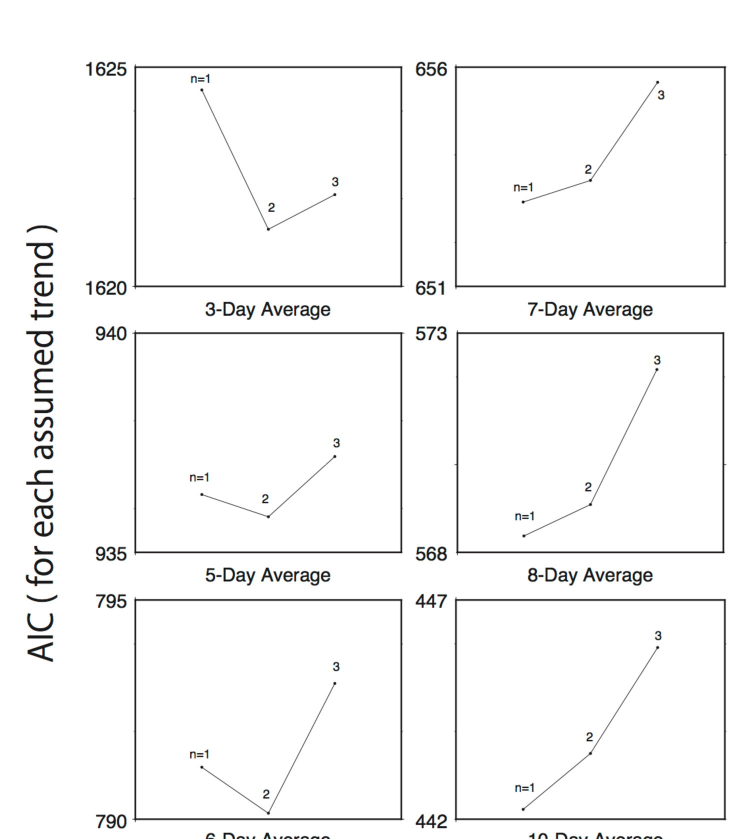
Result and Discussion

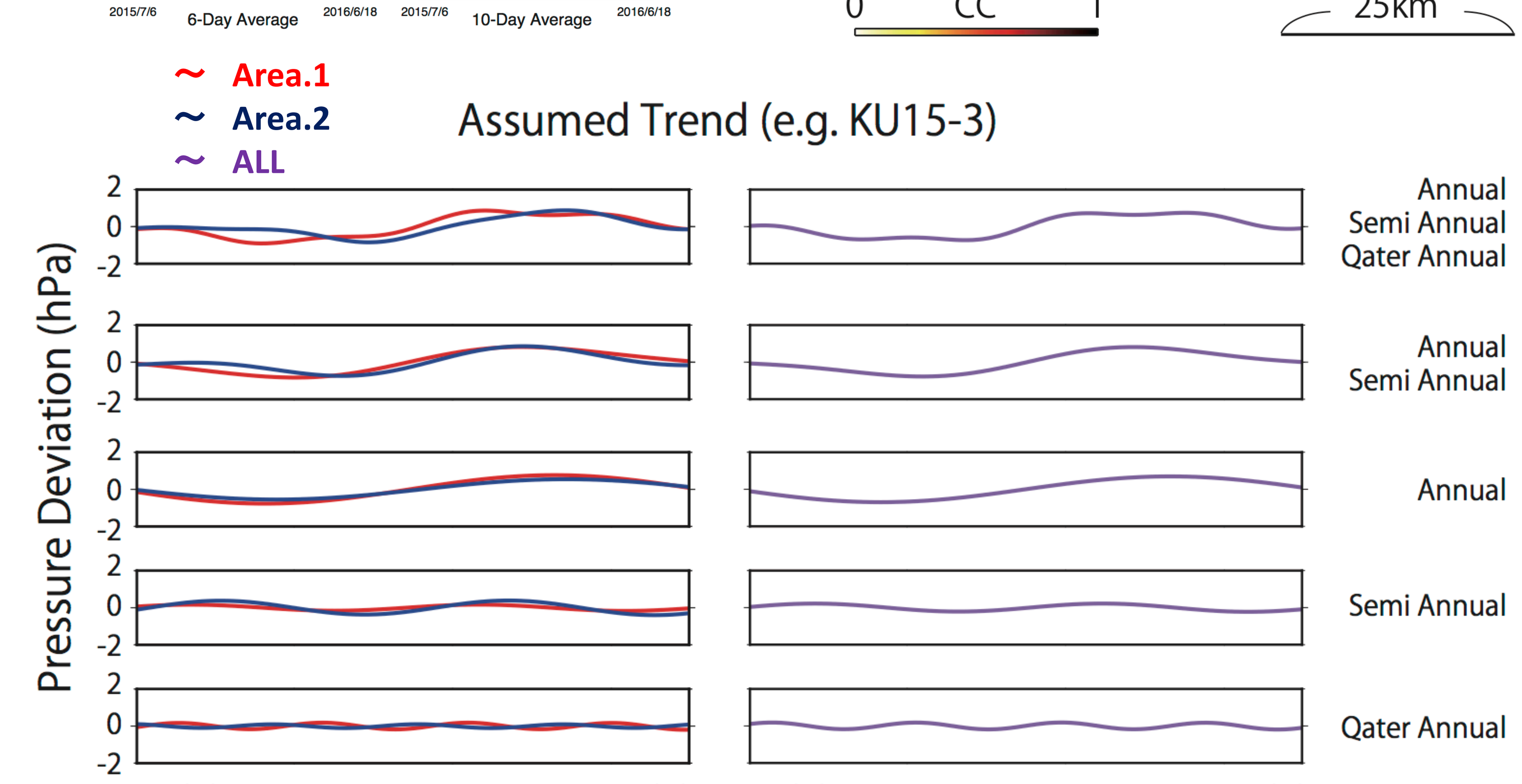












Conclusion

We evaluated long-term component from ocean bottom pressure record. To evaluate long-term component accurately, We calculated Non-tidal anomaly.
This result is consistent with [Nagura and McPhaden., 2016] and[Johnson and Chambers., 2013]. The infragravity wave (IG wave) creates periodic, horizontally propagating pressure fields at the deep seafloor. Maybe, the result of this study shows the effect of such a wave.