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Fig. SI1. Example of data selecting for the optimal interpolation analysis. \Box is the grid, whereas \bullet mean the analyzed value. As for one grid, the analyzed value within arbitrary setted radius (R km) is used to the optimal interpolation analysis.



Fig. SI2. Distribution of mixed layer depths in the North Pacific Ocean provided by NCEP Global Ocean Data Assimilation System (GODAS). (a) April 2011, (b) May 2011. The monthly average value was used to estimate the inventory.



Fig. SI3. Vertical distributions of (a) ¹³⁴Cs and (b) ¹³⁷Cs activities in the North Pacific Ocean. The measurements were conducted in 10 times within 6 months after the FDNPP accident. The locations of sampling is as follows: 29 April 2011, 142.83°E, 38.40°N; 5 July, 2011, 141.09°E, 36.92°N; 5 July 2011, 141.35°E, 36.92°N; 7 July, 2011, 141.43°E, 36.92°N; 29 Aug., 2011, 142.84°E, 38.41°N; 24 Sep., 2011, 184.99°E, 36.00°N; 25 Sep., 2011, 180.00, 36.00°N; 27 Sep., 2011,175.00°E, 36.00°N; 28 Sep., 2011,170.00°E, 36.00°N; 29 Sep., 2011, 165.00°E, 35.01°N.



Fig. SI4. Overview of datasets for the OI analysis. The data was composited with observed data during several days (3, 5, 7, 15, 21, 31, 45, 61 day). The reference day±(span-1)/2 days was regarded as one data.



Fig. SI5. Selection of optimal parameters of R in D01. Box plots of correlation coefficients for OICs134 and AKCs134 at each R for each data set in D01. (a) 3 days, (b) 5 days, (c) 7 days, (d) 15 days, (e) 21 days, (f) 31 days, (g) 45 days, and (h) 61 days dataset. The lower boundary of the box indicates the 25th percentile, the line within the box marks the median, the dotted line within the box marks the average, and the upper boundary of the box indicates the 75th percentile. Whiskers above and below the box indicate the 10th and 90th percentiles. The 5th and 95th percentiles are



Fig. SI6. Statistical results for selecting optimal value of parameters for D01. Average values of correlation coefficients between observed activities and OICs134 activities as a function of R for each dataset.





Fig. SI7. Selection of optimal parameters of R in D01. Box plots of correlation coefficients for OICs137 and AKCs137 at each R for each data set in D01. (a) 3 days, (b) 5 days, (c) 7 days, (d) 15 days, (e) 21days, (f) 30 days, (g) 45 days, and (h) 60 days dataset. The lower boundary of the box indicates the 25th percentile, the line within the box marks the median, the dotted line within the box marks the average, and the upper boundary of the box indicates the 75th percentile. Whiskers above and below the box indicate the 10th and 90th percentiles. The 5th and 95th percentiles are denoted by closed circles.



Fig. SI8. Selection of optimal parameters of σ_0 and R in D01. (a) Box plots of correlation coefficients for OICs137 and AKCs137 at each ram for the all data set. (b) Box plots of grid number for available OI grid value against R for all dataset. The horizontal line at 476 corresponds to half of all 952 grid cells. The lower boundary of the box indicates the 25th percentile, the line within the box marks the median, the dotted line within the box marks the 75th percentile. Whiskers above and below the box indicate the 10th and 90th percentiles. The 5th and 95th percentiles are denoted by closed circles.







Fig. SI9. Statistical results for selecting optimal value for the parameters for D02. (a) Box plots of correlation coefficients between observed ¹³⁷Cs activities and OICs137 activities as a function of xref for all datasets. (b) Box plots of correlation coefficients between ¹³⁷Cs activities and OICs137 activities as a function of σ_0 for data at the optimal xref of 35 km). (c) Box plots of correlation coefficients between observed ¹³⁷Cs activities and OICs137 activities and OICs137 activities as a function coefficients between observed ¹³⁷Cs activities and OICs137 activities as a function of σ_0 for data at the optimal xref of 35 km). (c) Box plots of correlation coefficients between observed ¹³⁷Cs activities and OICs137 activities as a function of yref for data corresponding to xref = 35 km and σ_0 = 30. The lower boundary of the box indicates the 25th percentile, the line within the box marks the median, the dotted line within the box marks the average, and the upper boundary of the box indicates the 75th percentile. Whiskers above and below the box indicate the 10th and 90th percentiles. The 5th and 95th percentiles are denoted by closed circles.



OiCs137_20110406'c_'15'd_R'800'_ram'100

OiCs137_20110411'c_'15'd_R'800'_ram'100



Fig. SI10. Distribution of OICs137 in D01. (a) 1 April 2011, (b) 6 April 2011, (c) 11 April 2011, (d) 21 April 2011, (e) 1 May 2011, and (f) 11 May 2011. The circles are observed activities. The black region is the area where OI analysis were not conducted. The color scale indicates the OICs137 and observed ¹³⁷Cs activities in units of Bq m⁻³.



Fig. SI11. Distribution of OICs137 in D02. (a) 1 April 2011, (b) 6 April 2011, (c) 11 April 2011, (d) 21 April 2011, (e) 1 May 2011, and (f) 11 May 2011. Circles indicate measurement data. Triangles indicate the location of the FNPP1. The black region is the area where OI analyses were not conducted.



Fig. SI12. Time variations of data number and grid number of OI analysis in case of the optimal values of parameters. (a) D01,OICs134, (b) D01, OICs137, (c) D02, OICs134, (d) D02, OICs134.



Fig. SI13. Sensitivity check for the inventory against R. (a) D01. R was in ranged from 200 to 2000 km. (b) D02. yref was in ranged from 25 to 205 km.



Fig. SI14. Sensitivity check for the normalized inventory against R. (a) D01. Normalization was calculated against 800km of R. (b) D02. Normalization was calculated against 65 km of yref.



Fig. SI15. Daily OICs137 inventories during the period from 21 March 2011 to 31 May 2011 in the North Pacific Ocean.