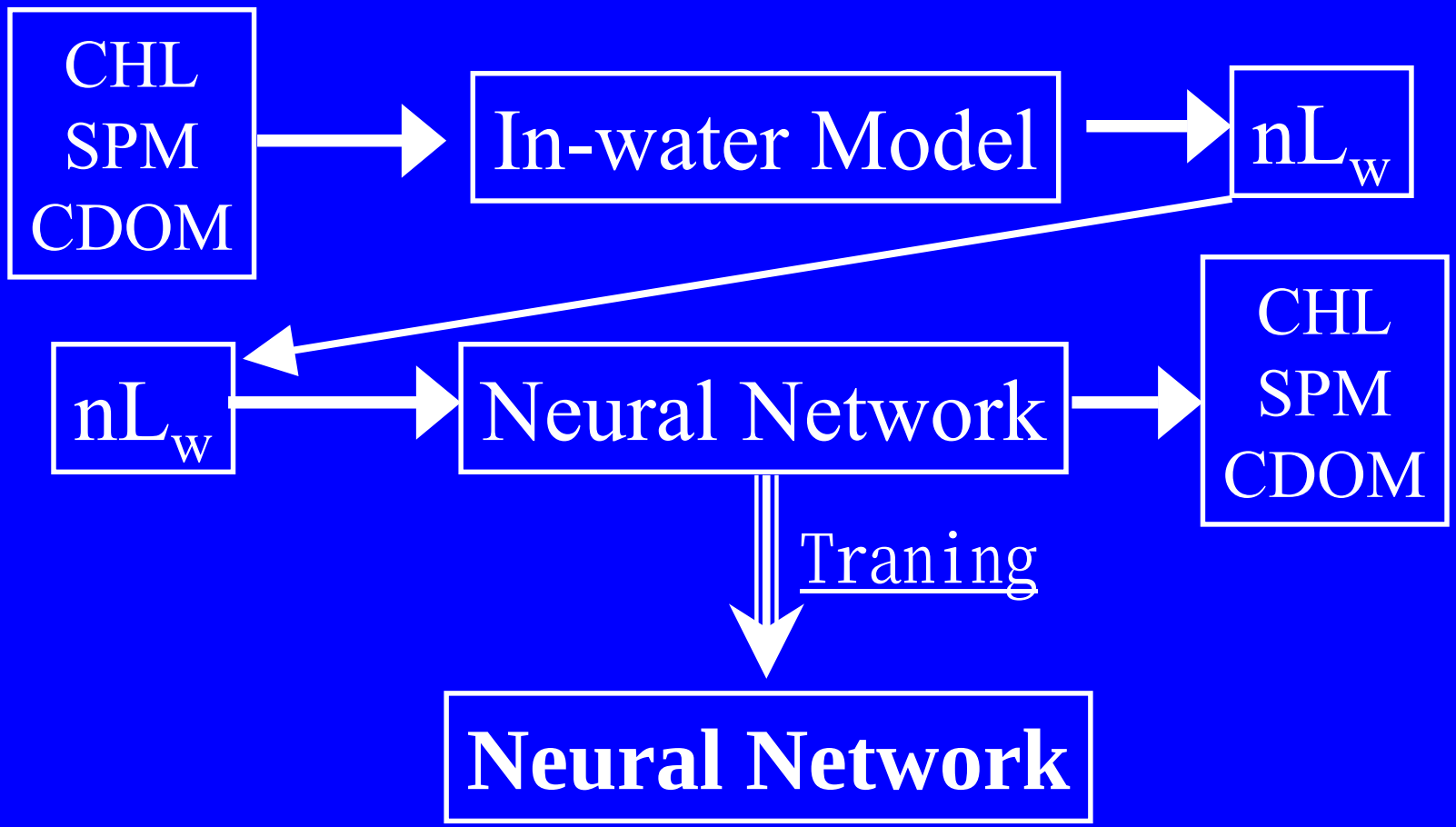
In-water Algorithm Using Neural Network



In-water Optical Model

$$_{n}L_{w} = E_{s} \times R_{rs}$$

$$R_{rs} = 0.533 \times \frac{R}{Q}$$

$$R = \frac{1}{3}\left(\frac{b_b}{a + b_b}\right)$$

Model of Optical Properties Absorption Coefficient

$$a = a_w + C \times a_c^* + a_y(440) \times a_y^*$$

a_w : Pope and Fry (1997)

a_c^* : Tokyo Bay (Kishino *et al.*, 2000)

a_y^* : $e^{-0.014(\lambda - 440)}$ (Roesler *et al.*,1989)

Model of Optical Properties Backscattering Coefficient

$$b_b = b_{bw} + b_{bc} + b_{bs}$$

$$b_{bw} = 0.00144\left(\frac{\lambda}{500}\right)^{-4.32} \quad \text{(Morel, 1974)}$$

$$b_{bc} = 0.00235 \times C^{0.698}\left(\frac{\lambda}{550}\right)^{0.2933}$$

(Kishino *et al.*,2000 : Takahashi *et al.*2001)

$$b_{bs} = 0.00499 \times S \times \left(\frac{\lambda}{550}\right)^{-0.812} \quad \text{(Kronfeld, 1988)}$$

Parameters and their range for the neural network training

Parameter	Range	Unit
Chlorophyll *a*	0.01 - 50	mg m^{-3}
Inorganic Suspension	0.01 - 10	g m^{-3}
CDOM	0.001 – 5	m^{-1}

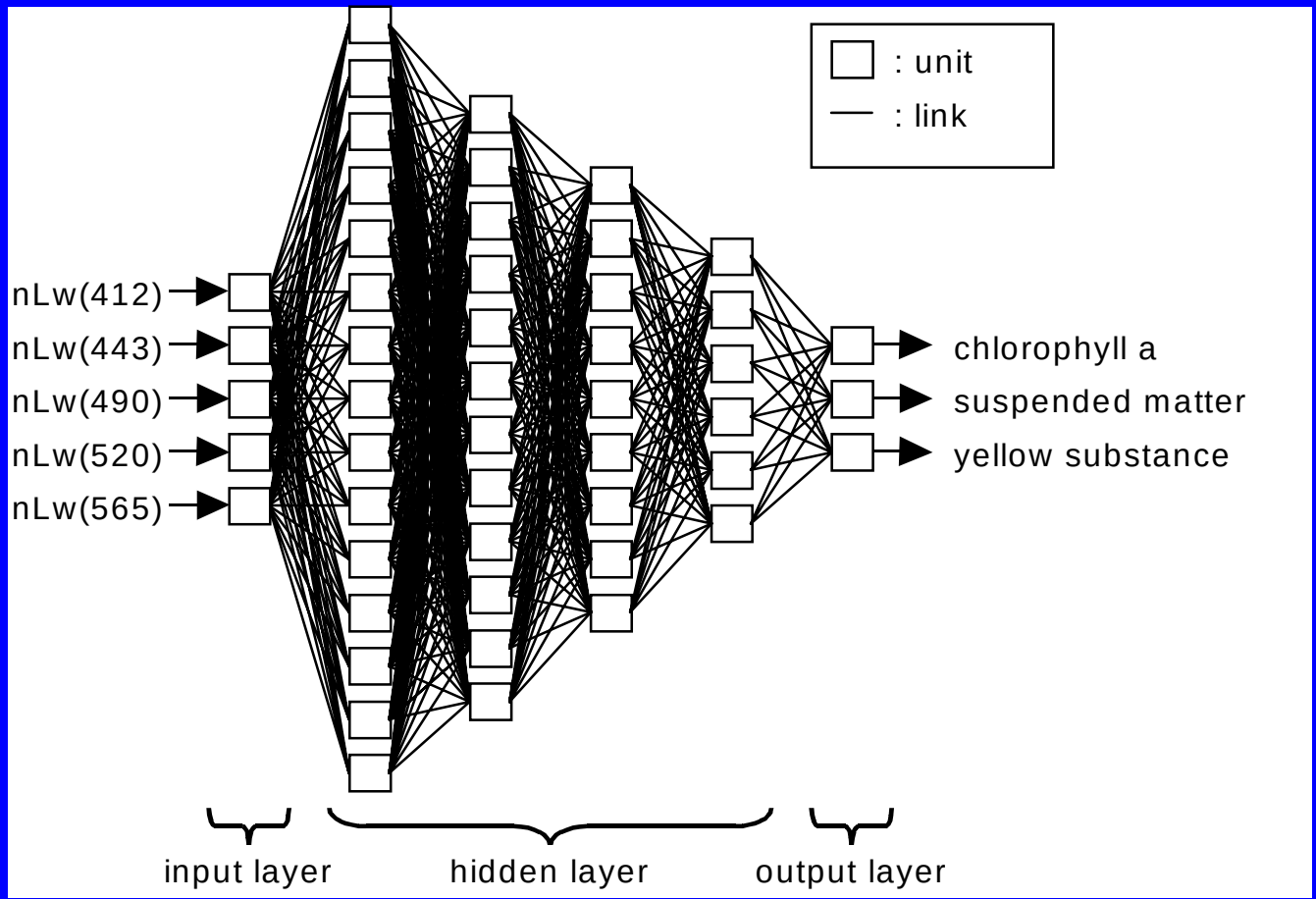
Data Set for neural network training

60,000

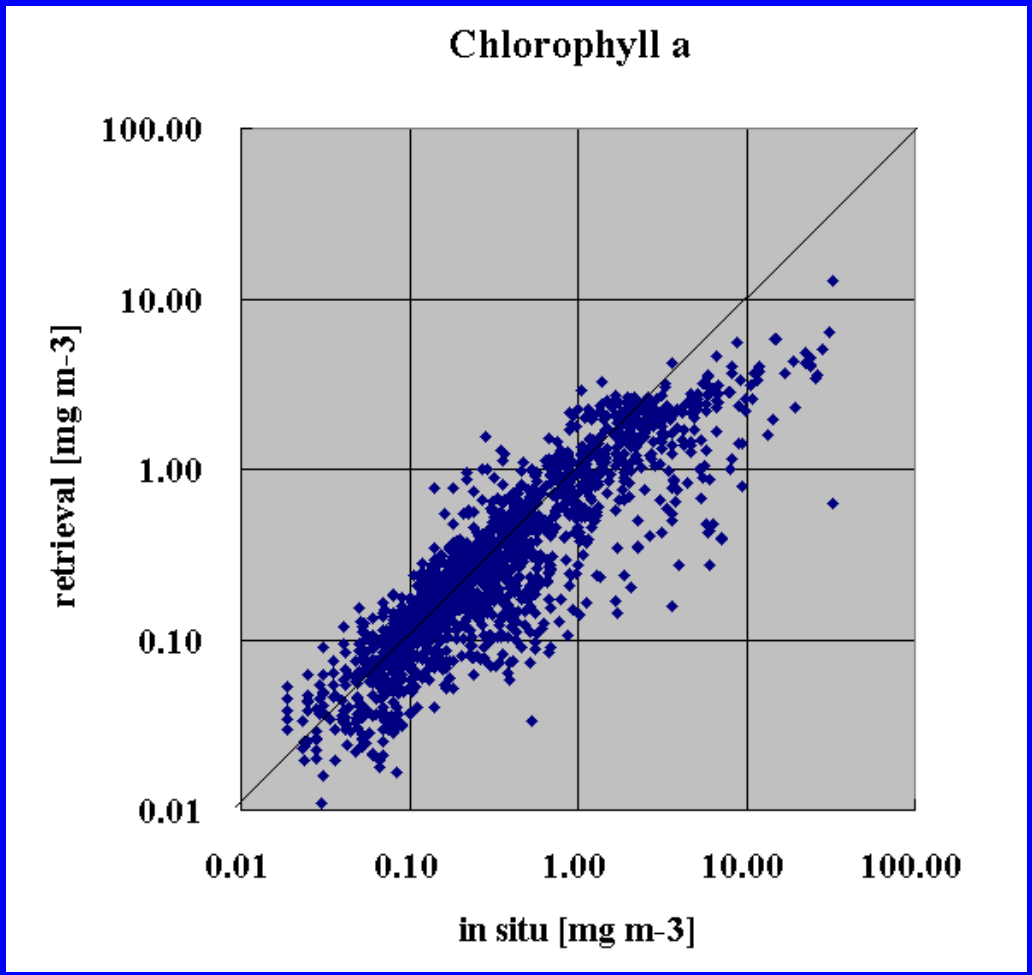
Data set for validation

40,000

Result of Neural Network



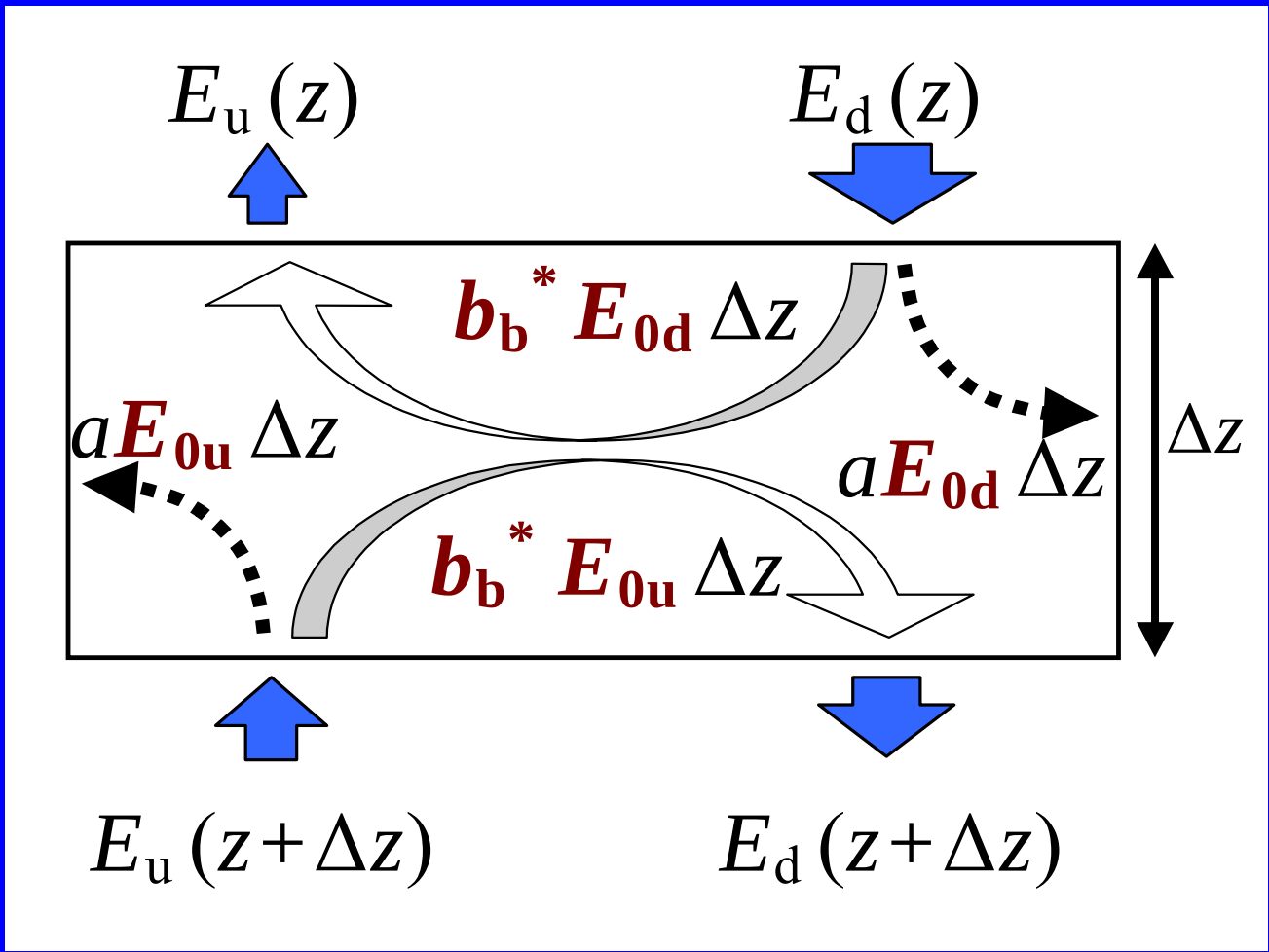
Compare with in-situ data



In-water Model Problems

- **Radiative Transfer Model**
  - **Shape factor**
  - **Average cosine**
- **Optical Properties Model (absorption and Backscattering Coefficient)**
  - **Phytolankton (Chlorophyll *a*)**
  - **Organic and Inorganic Suspension (SS)**
  - **CDOM**

TWO-STREAM EQUATION
Aas (1987)



To advance in-water model...

- **IOPS from same sample**

  Concentrations, absorption and backscattering coefficient

- **At same station**

  E_d, E_u, L_u, E_{0d}, E_{0u}, a, b_b ,c