

In-water Algorithm (Neural Network)

Motoaki Kishino
(*RIKEN*)



PI and Co-i

👉 **Motoaki Kishino**

👉 **Tomohiko Oishi**

👉 **Hiroh Satoh**

👉 **Kouji Suzuki**

👉 **Tooru Hirawake**

👉 **Roland Doerffer**

👉 **Helmut Schiller**

👉 **Heinz van de Piepen**

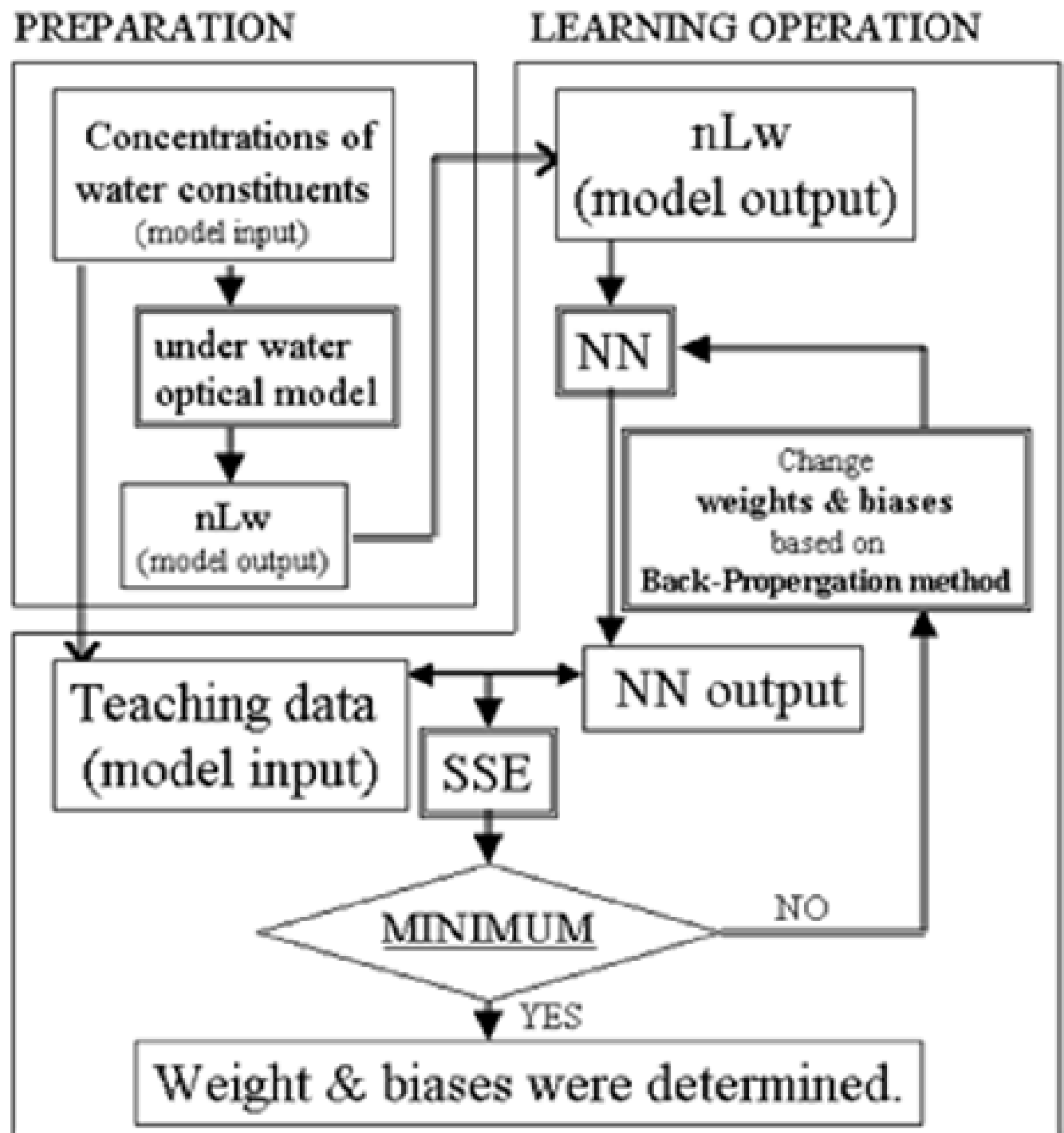
👉 **Carsten Brockmann**

👉 **J. H. M. Hakvoort**

👉 **Herbert Siegel**



NN-Training



Radiative Transfer Model

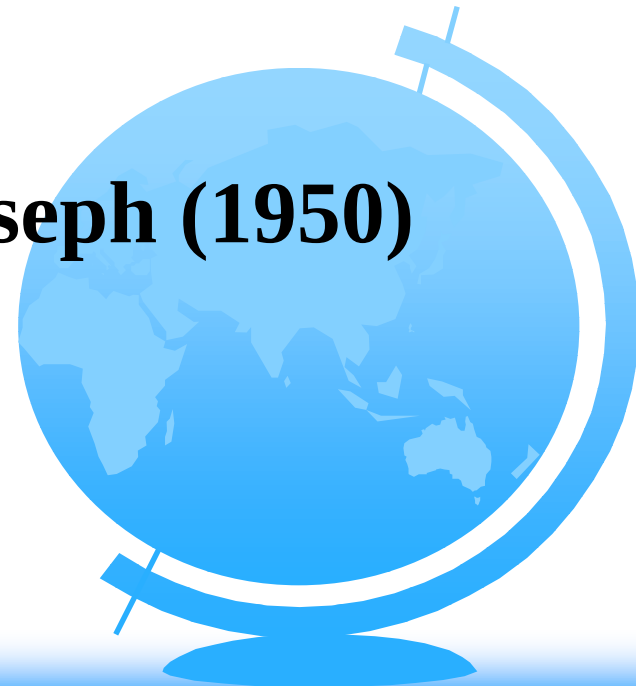
$${}_n L_w = E_s \times R_{rs}$$

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

$$R = \frac{k - a_t}{k + a_t}$$

$$k = \sqrt{a_t (a_t + 2b_{bt})}$$

Joseph (1950)



Model of Optical Properties

Absorption Coefficient

$$a_t = a_w + a_c + a_y$$

a_w : Pope and Fry (1997)

$$a_c = a_c^* \times C$$

a_c^* : average values of the sea truth
(off Sanriku, Japan, Kishino)

$$a_y = CDOM \times e^{-0.014(\lambda - 440)} \quad \text{Roesler et al. (1989)}$$



Model of Optical Properties

Backscattering Coefficient

$$b_{b_t} = b_{b_w} + b_{b_c} + b_{b_s}$$

$$b_{b_w} = 0.00144 * \left(\frac{\lambda}{500} \right)^{-4.32}$$

Morel (1974)

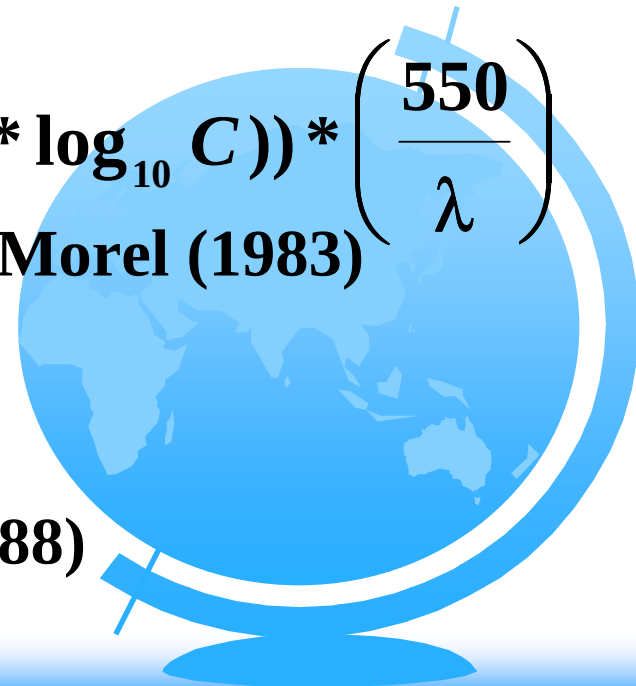
$$b_{b_c} = 0.30 * C^{0.62} * (0.002 + 0.02 * (0.5 - 0.25 * \log_{10} C)) * \left(\frac{550}{\lambda} \right)$$

Gordon and Morel (1983)

$$b_{b_s} = 0.001848 * S * \left(\frac{\lambda}{550} \right)^{-0.812}$$

Morel (1988)

Kronfeld (1988)



Parameters and their range for the Neural Network training

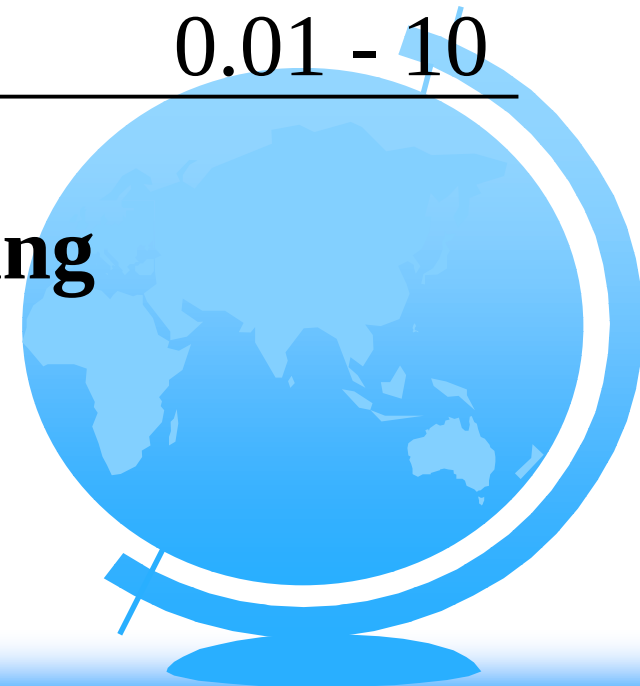
Parameter	Unit	Range
Chlorophyll a	mg m ⁻³	0.1 - 50
Inorganic Suspension	g m ⁻³	0.1 - 50
CDOM	m ⁻¹	0.01 - 10

Data Set for neural network training

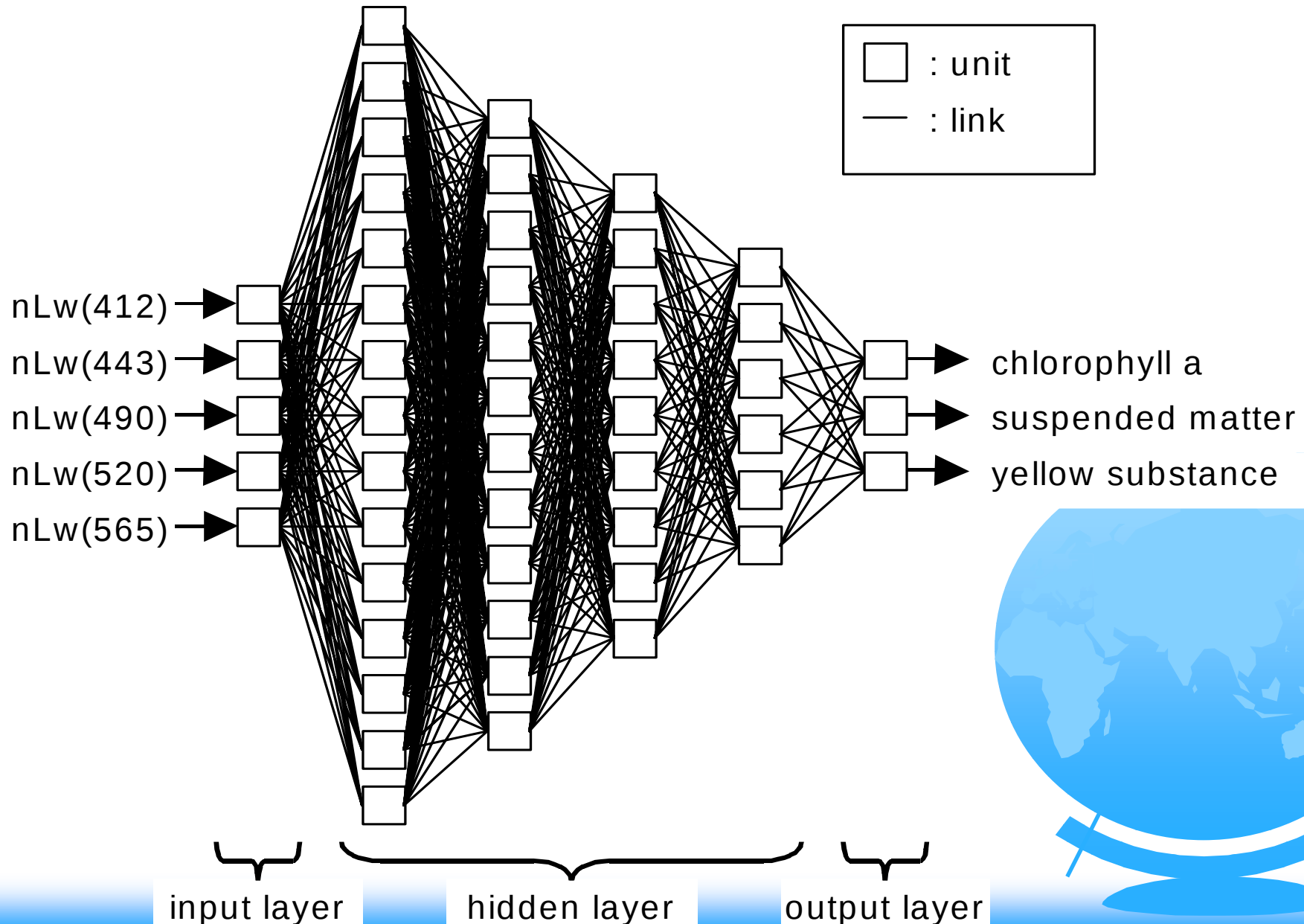
100,000

Data set for validation

50,000

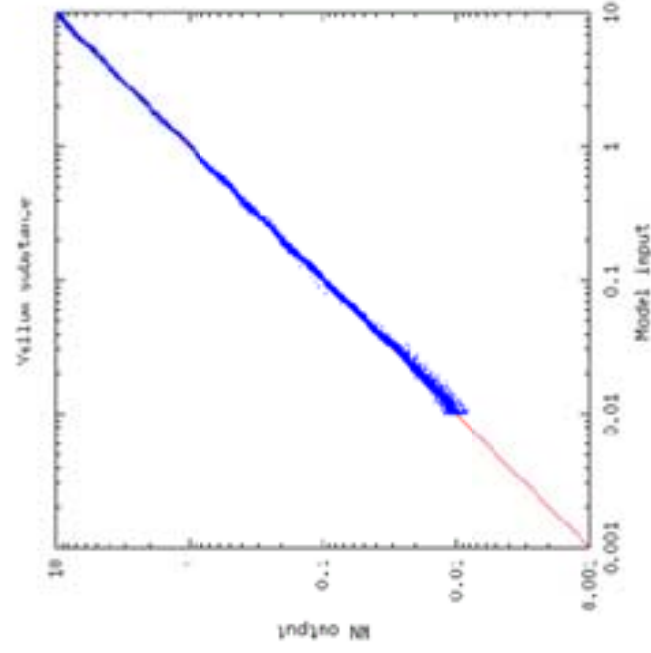
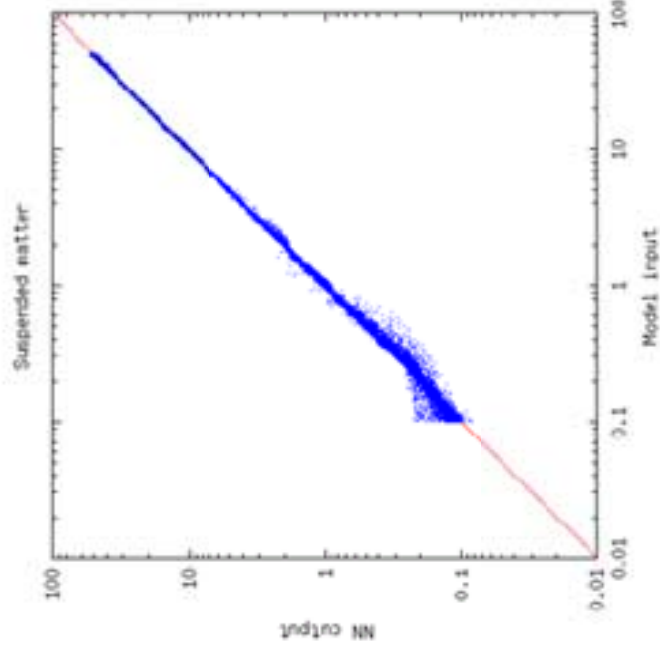
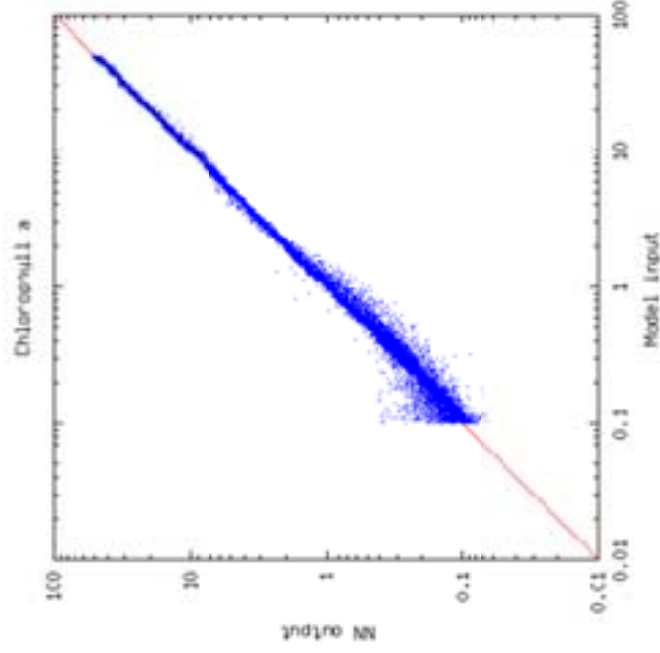


Neural Network example for OCTS data



All Bands 11 Bands

380, 400, 412, 443, 465, 490, 520, 545, 565, 625, 666 nm



RMS:

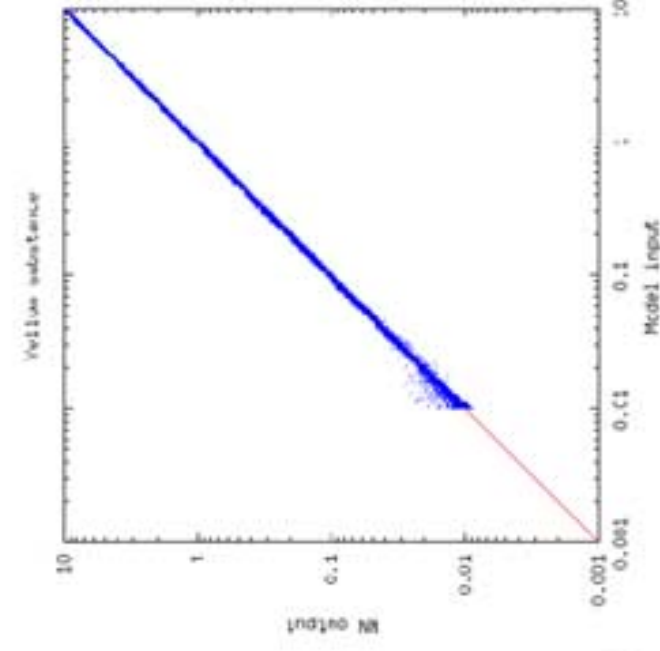
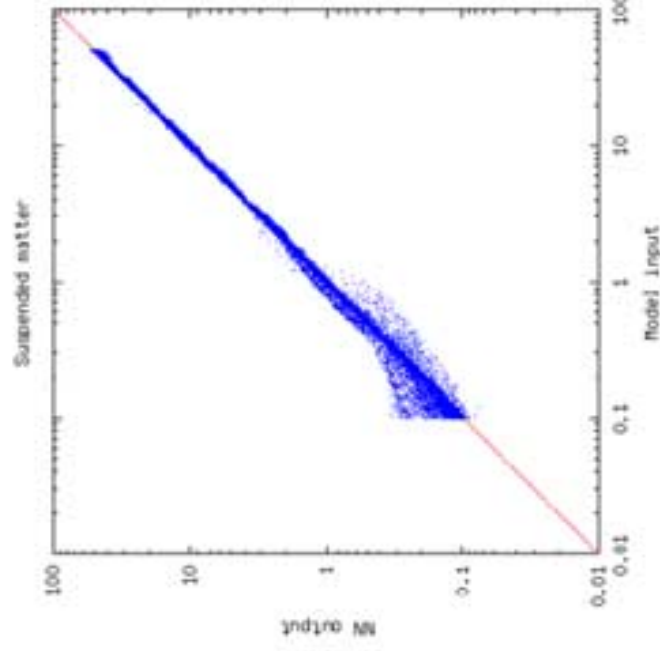
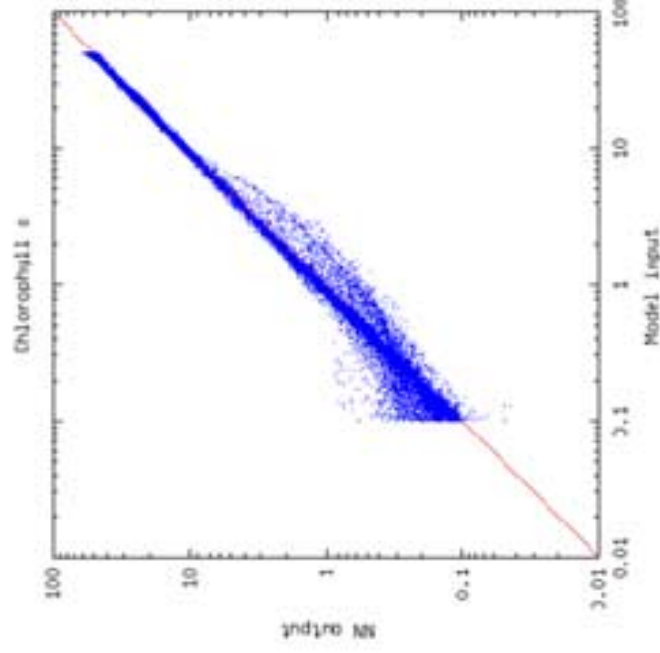
0.00178

0.00189

0.000168

Except Saturation Bands 9 Bands

380, 400, 412, 443, 465, 520, 545, 625, 666 nm



RMS:

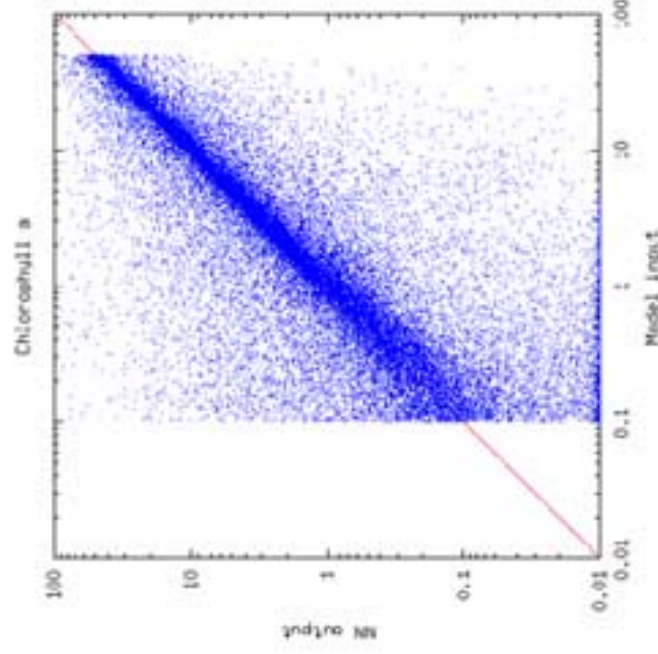
0.00473

0.00221

0.000212

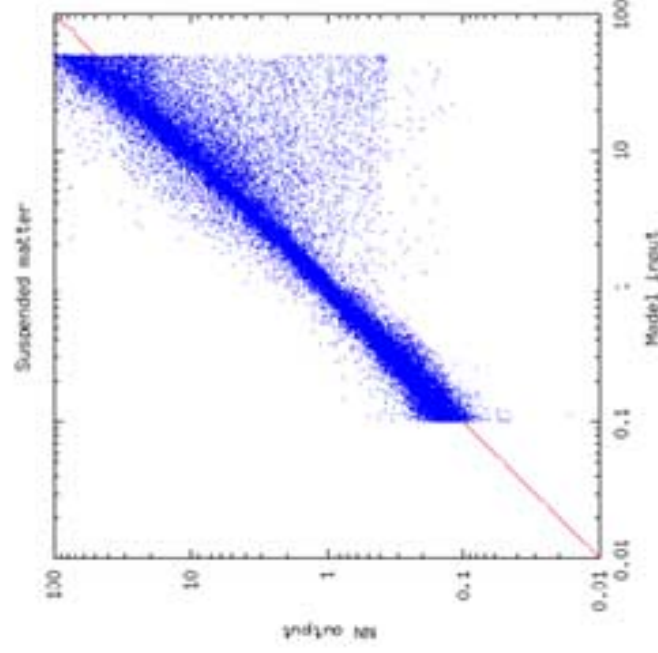
All Bands with 10% Noise 11 Bands

380, 400, 412, 443, 465, 490, 520, 545, 565, 625, 666 nm

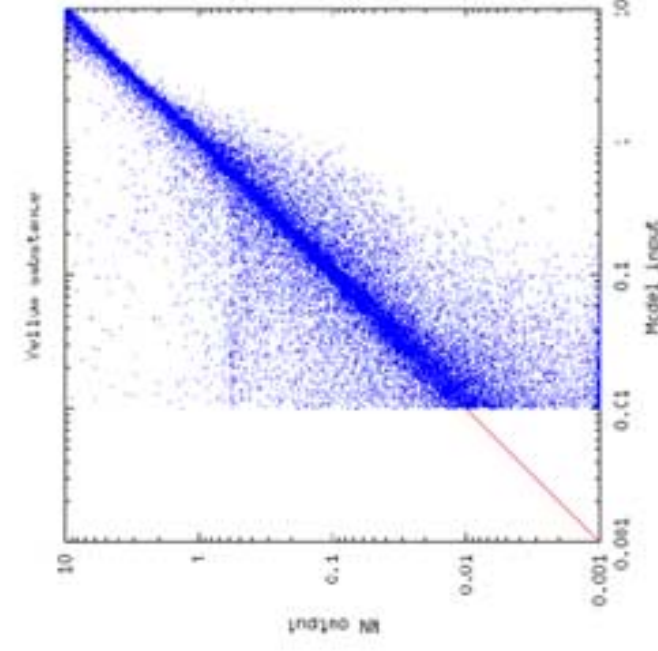


RMS:

0.0302



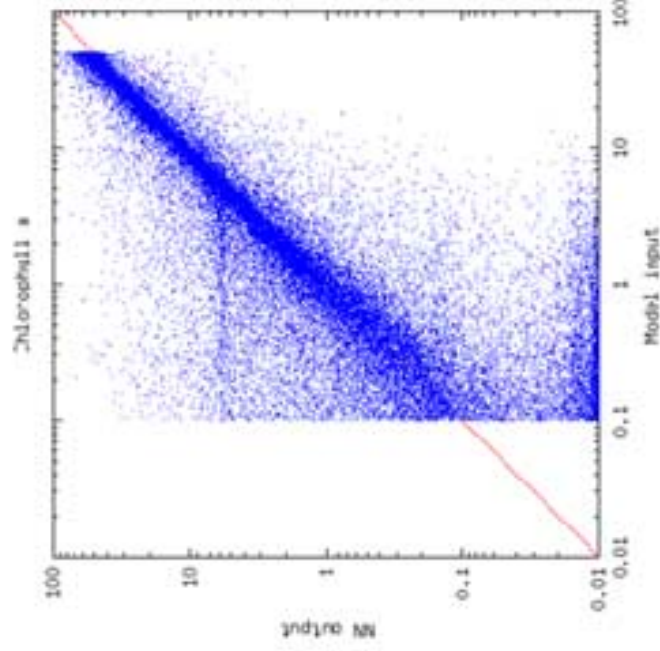
0.0569



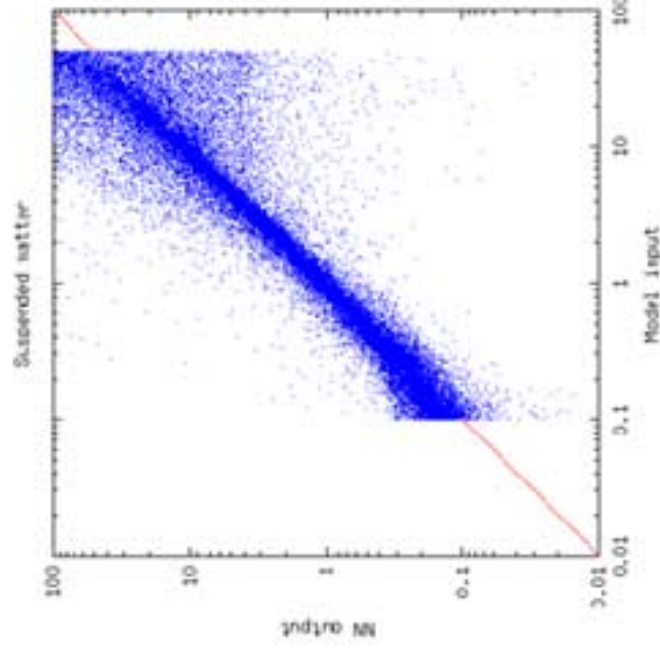
0.00312

Except Saturation Bands with 10% Noise 9 Bands

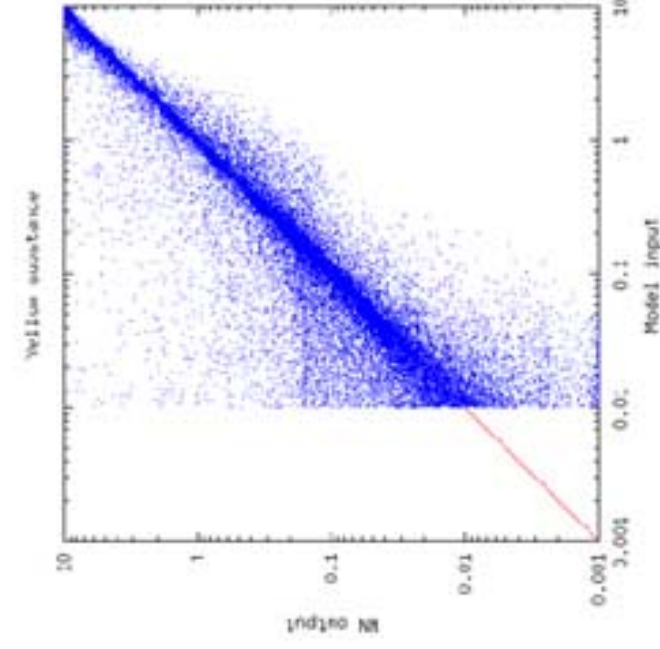
380, 400, 412, 443, 465, 520, 545, 625, 666 nm



RMS: 0.0218



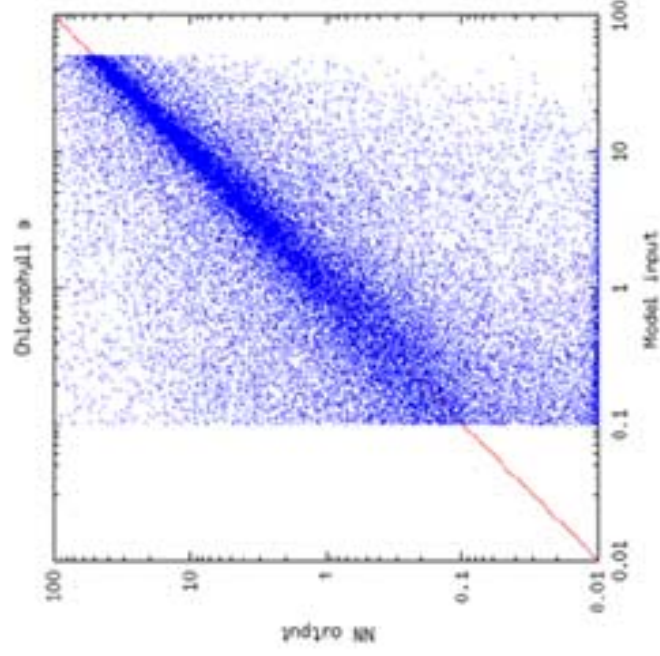
0.135



0.00828

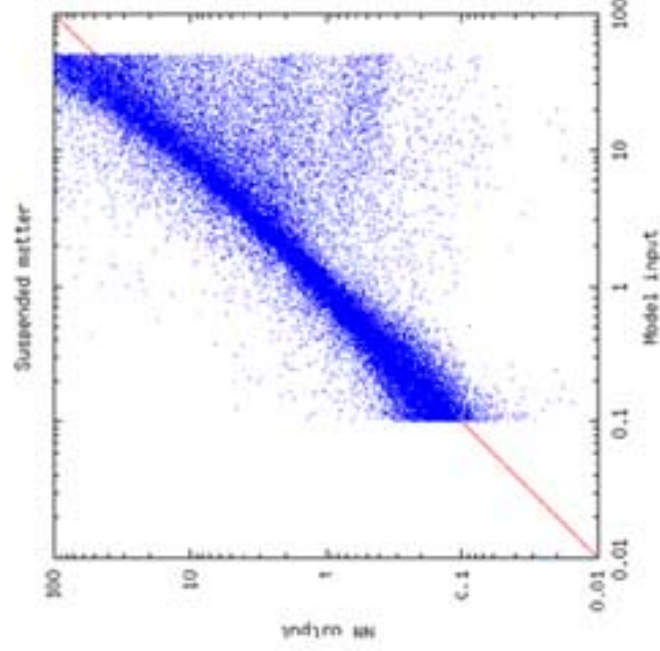
All Bands with 20% Noise 11 Bands

380, 400, 412, 443, 465, 490, 520, 545, 565, 625, 666 nm

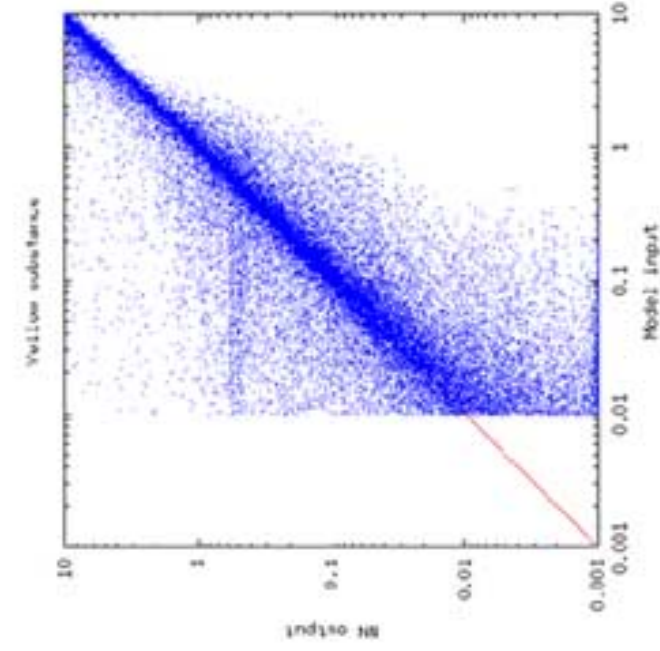


RMS:

0.0520



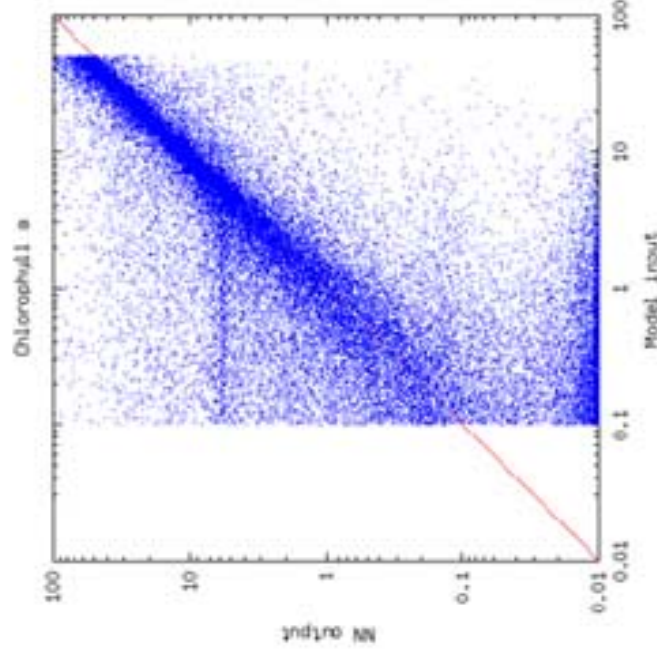
0.141



0.00601

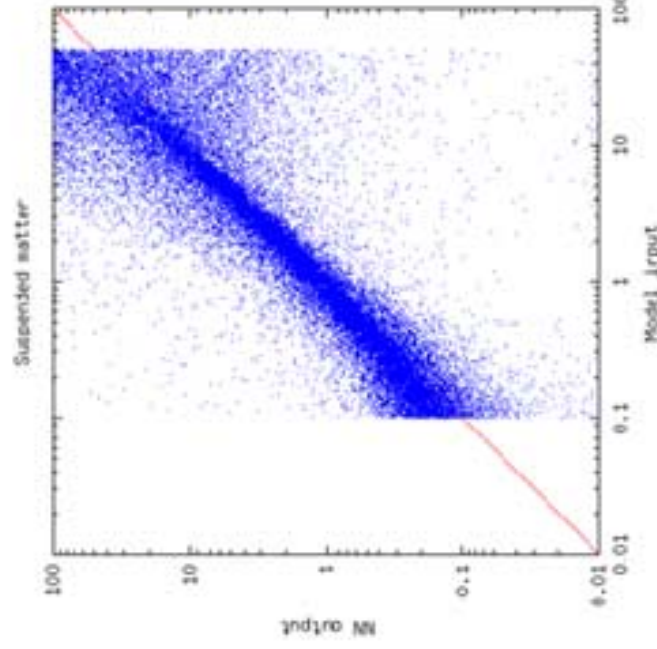
Except Saturation Bands with 20% Noise 9 Bands

380, 400, 412, 443, 465, 520, 545, 625, 666 nm

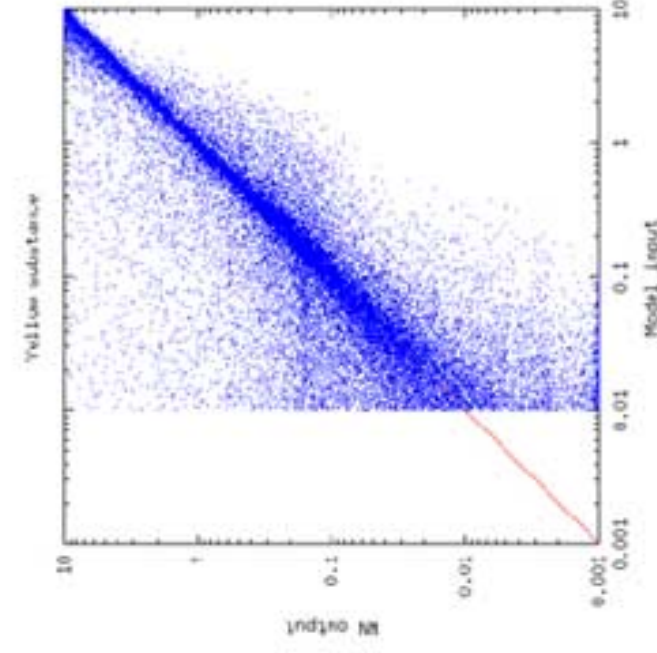


RMS:

0.0577



0.201



0.0207

R M S

All Bands 11 Bands

	Chl <i>a</i>	IOS	CDOM
0%:	0.00178	0.00189	0.000168
10%:	0.0302	0.0569	0.00312
20%:	0.0520	0.141	0.00601

Except Saturation Bands 9 Bands

	Chl <i>a</i>	IOS	CDOM
0%:	0.00473	0.00221	0.000212
10%:	0.0218	0.135	0.00828
20%:	0.0577	0.201	0.0207

