Assignment

Electrical Methods of Prospecting

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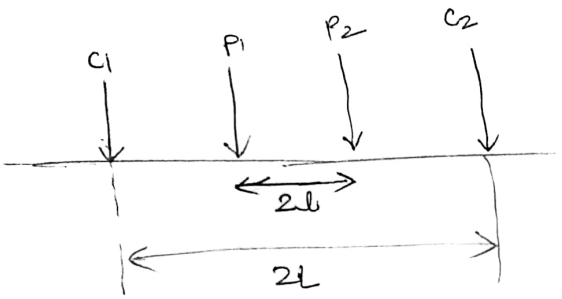
Schlumberger Array



Potential at P_1 due to C_1 and C_2 will be

$$V_{P_1} = \frac{\rho I}{2\pi} \cdot \frac{1}{(L-l)} - \frac{\rho I}{2\pi}\left(\frac{1}{L+l}\right)$$

Potential at P_2 due to C_1 and C_2 will be

$$V_{P_2} = \frac{\rho I}{2\pi} \cdot \frac{1}{(L+l)} - \frac{\rho I}{2\pi} \cdot \frac{1}{(L-l)}$$

Potential difference at $V_{P_1} - V_{P_2} = \Delta V$

$$= \frac{\rho I}{2\pi}\left\{\frac{1}{L-l} - \frac{1}{L+l} - \frac{1}{L+l} + \frac{1}{L-l}\right\}$$

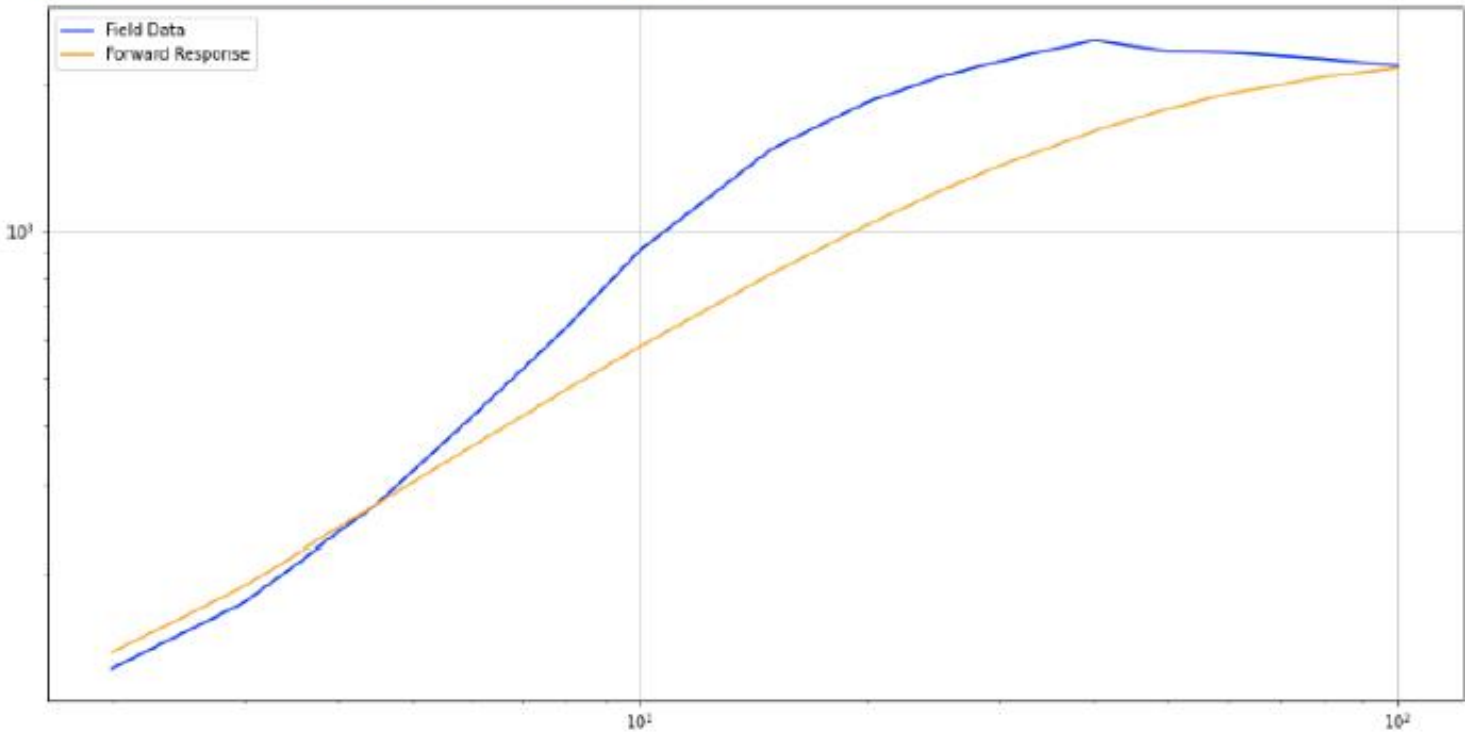
$$f = f_a = \left\{\frac{\pi(L^2-l^2)}{2l}\right\}\frac{\Delta V}{I}$$

$$G = \left\{\frac{\pi(L^2-l^2)}{2l}\right\}$$

Sounding Layer Interpretation

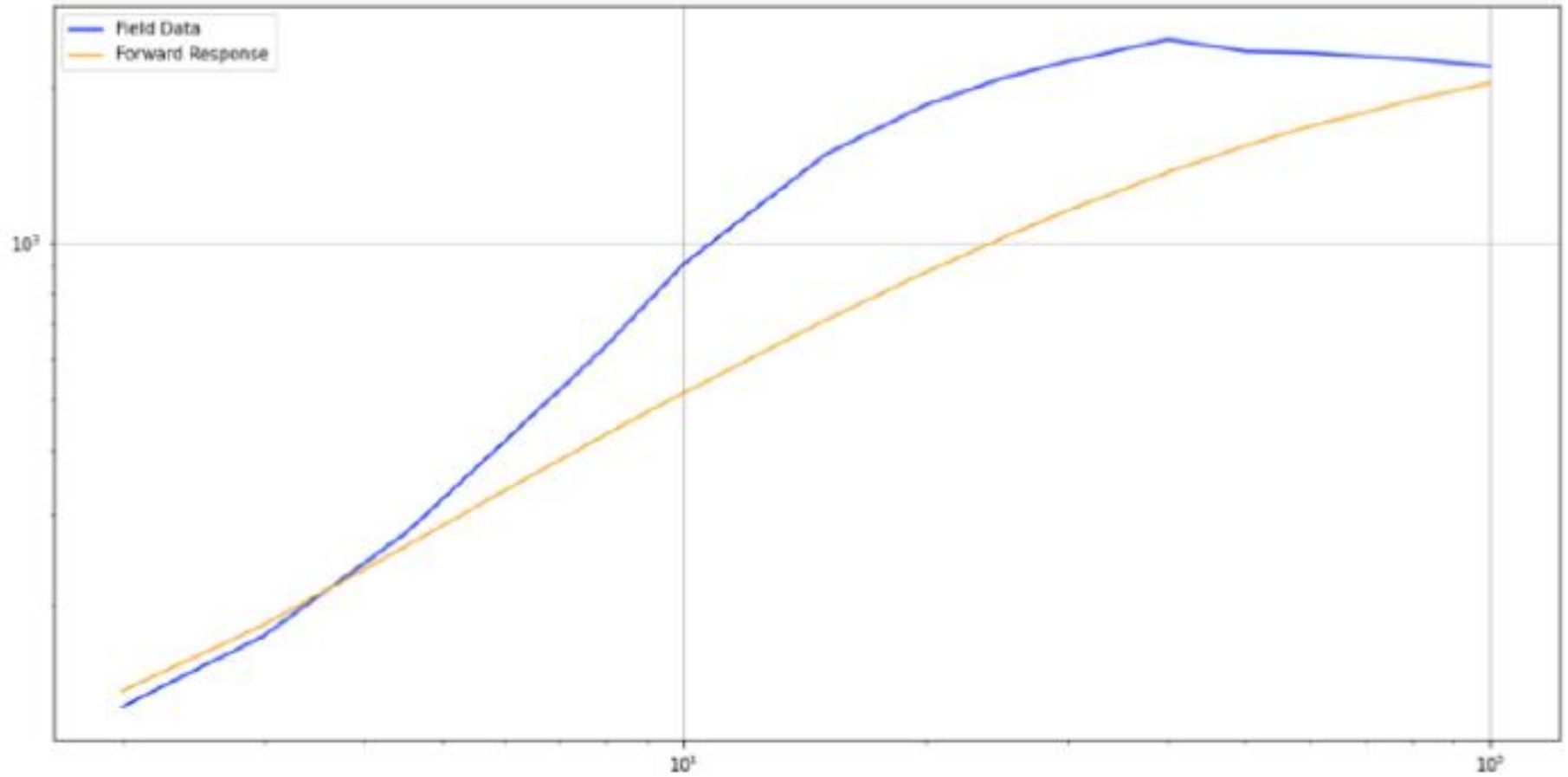
Fig 1. 4 Layer interpretation

Apparent resistivity vs AB/2 plot



For a 4 Layered Model, type of Master Curve obtained is AK Type [$\rho 1 < \rho 2 < \rho 3 > \rho 4$] , where, $\rho 1 = 100$ ohm-m , $\rho 2 = 1000$ ohm-m , $\rho 3 = 2600$ ohm-m , $\rho 4 = 2300$ ohm-m. The Values of Thicknesses are found to be, $\boldsymbol{h1} = 1.6\ m$, $\boldsymbol{h2} = 2\ m$, $\boldsymbol{h3} = 8\ m$.

Error: 19.29%



For a 5 Layered Model, type of Master Curve obtained is AAK Type [$\rho 1 < \rho 2 < \rho 3 < \rho 4 > \rho 5$],where,$\rho 1$=100 ohm-m,$\rho 2$=800 ohm-m,$\rho 3$=1800 ohm-m,$\rho 4$=3000 ohm-m and $\rho 5$ = 2600. The Values of Thicknesses are found to be, $\boldsymbol{h1}$ = 1.5 m, $\boldsymbol{h2}$ = 0.2 m, $\boldsymbol{h3}$=2.5m, $\boldsymbol{h}$4=2

Misfit Error: 13.61 %

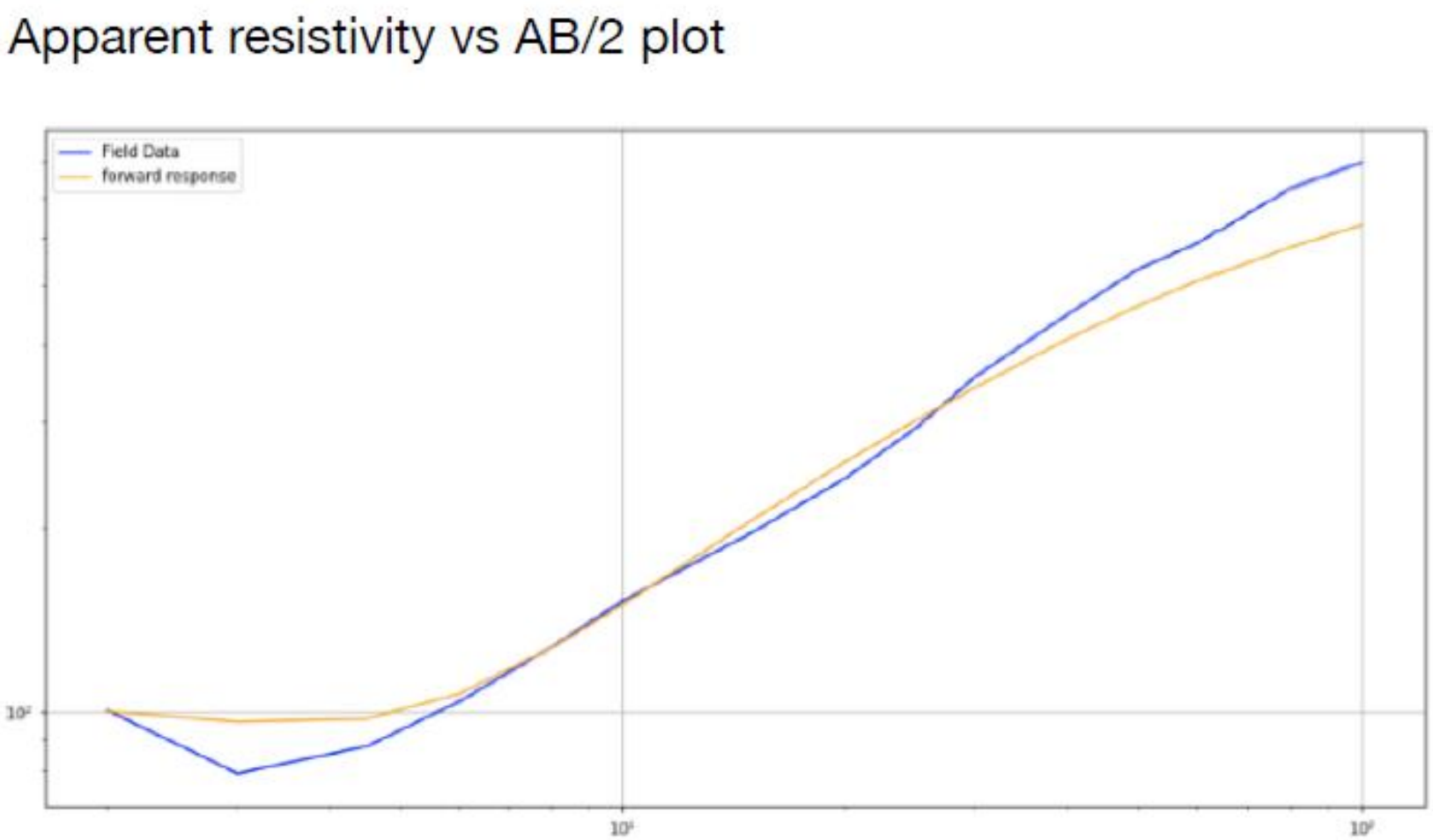
The Concept of Equivalence: Dierent layers of dierent resistivities can produce the same or similar sounding curve which creates ambiguity in interpretation. This can be due to the presence of a conductive layer between two resistive layers or vice-versa.

The Concept of Suppression: According to the principle of suppression, a skinny layer with resistivity values that lies between the overlying and underlying resistivity values might produce no eect at the resistivity curves; thereby such skinny layers would be neglected at some point of resistivity sounding information interpretation. This can be seen in figure 1 and figure 2 shown above.

• **Problem of Equivalence in S1 sounding:** For the above AK-type curve, for any values of h3 *and* $\rho 3$ will satisfy as long as h3 * $\rho 3$ is steady.

• **Problem of Suppression in S1 sounding:** When the number of layers was increased to 5 such that value of $\rho 3$ is close to $(\rho 2 + \rho 4)/2$. The misfit error was about 13.61%. Therefore, we can face the problem of suppression in this sounding data.

Figure 2: 5 Layer interpretation:



For a 4 Layered Model, type of Master Curve obtained is HA Type [$\rho 1 > \rho 2 < \rho 3 < \rho 4$], where,$\rho 1$=105 ohm-m,$\rho 2$=60 ohm-m,$\rho 3$=450 ohm-m,$\rho 4$=850 ohm-m.The Values of Thicknesses are found to be, $\boldsymbol{h1} = 1.7\ m$, $\boldsymbol{h2} = 2.25\ m$, $\boldsymbol{h3} = 2.75\ m$.

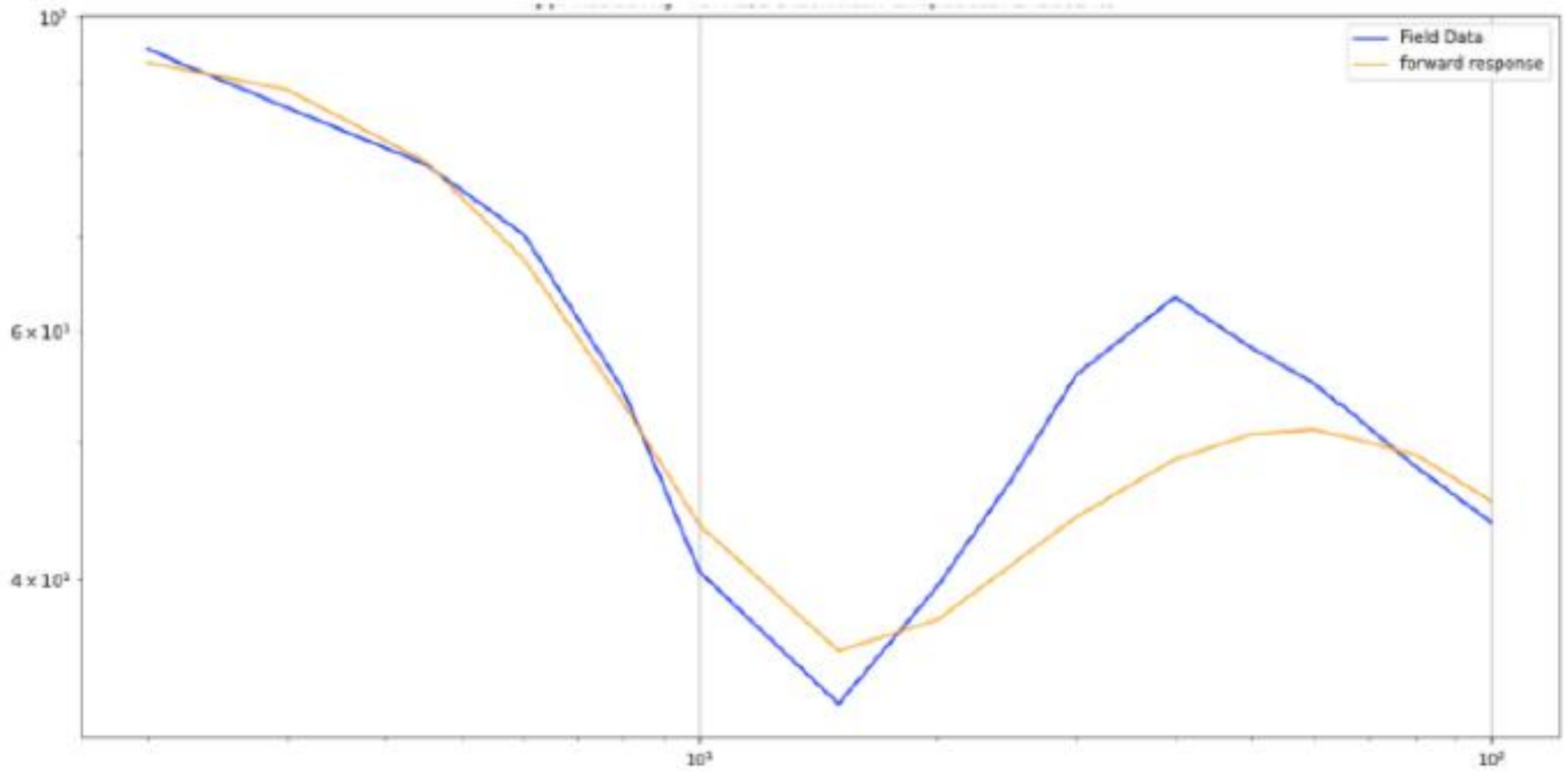
Misfit Error: 8.42%

• **Problem of Equivalence in S2 sounding:** For the HA-type sounding curve obtained above, any values of h2 *and* $\rho 2$ would satisfy as long as the h2/$\rho 2$ is constant. Any variation in the values of h2 and $\rho 2$ by its mean value leads to a very negligible change in the error.

• **Problem of Suppression in S2 sounding:** When the number of layers become accelerated to 5 such that fee of $\rho 4$ is close to ($\rho 3 + \rho 5$)/2. The misfit error was about 9.23%. Therefore, we can face the problem of suppression in this sounding data.

Sounding 3:

Apparent resistivity vs AB/2 plot



For a 4 Layered Model, type of Master Curve obtained is HK-Type [$\rho 1 > \rho 2 < \rho 3 > \rho 4$], where, $\rho 1$= 95ohm-m, $\rho 2$=13 ohm-m, $\rho 3$=80 ohm-m, $\rho 4$=25 ohm-m. The Values of Thicknesses are found to be, $\boldsymbol{h1} = 3.8\ m$, $\boldsymbol{h2} = 4\ m$, $\boldsymbol{h3} = 23\ m$.

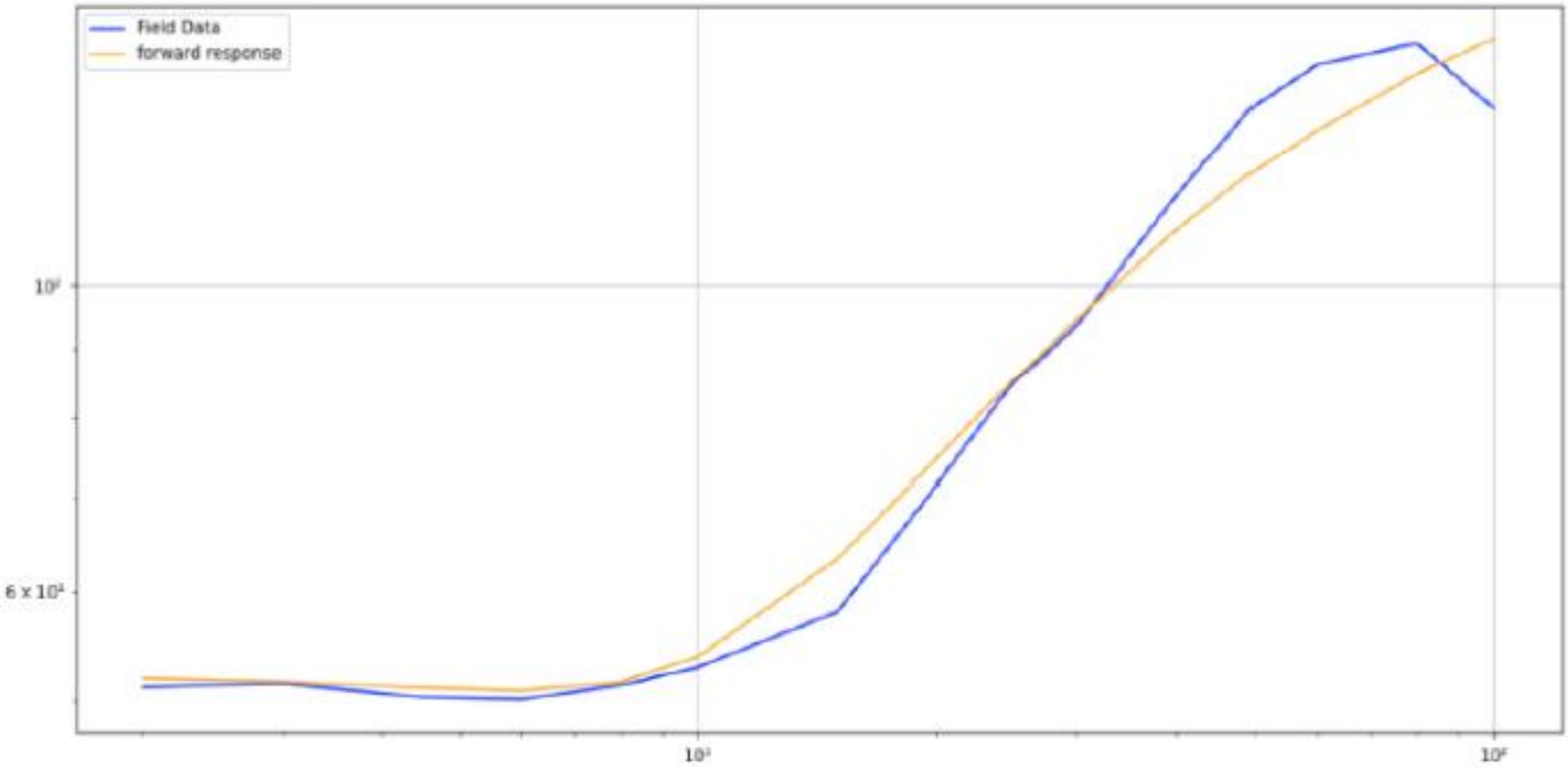
Misfit Error: 8.29%

• **Problem of Equivalence in S3 sounding:** For the HK-type curve, any values of h2, h3, $\rho 2$, *and* $\rho 3$ would validate as long as the h2/$\rho 2$ *and* h3 * $\rho 3$ is constant. The curve will fit exactly the same. Any variation in the values of h1, $\rho 1$, h2 and $\rho 2$ by its mean value leads to a very negligible change in the error.

• **Problem of Suppression in S3 sounding:** When the number of layers was increased to 5 such that value of $\rho 4$ is close to ($\rho 3$ + $\rho 5$)/2. The misfit error was about 8.90%. Therefore, we can face the problem of suppression in this sounding data.

Sounding 4

Apparent resistivity vs AB/2 plot



For a 4 Layered Model, type of Master Curve obtained is HK-Type [$\rho 1 > \rho 2 < \rho 3 > \rho 4$], where, $\rho 1$=52 ohm-m, $\rho 2$=34 ohm-m, $\rho 3$=450ohm-m, $\rho 4$=180 ohm-m. The Values of Thicknesses are found to be, $\boldsymbol{h1} = 4\ m$, $\boldsymbol{h2} = 4\ m$, $\boldsymbol{h3} = 1\ m$.

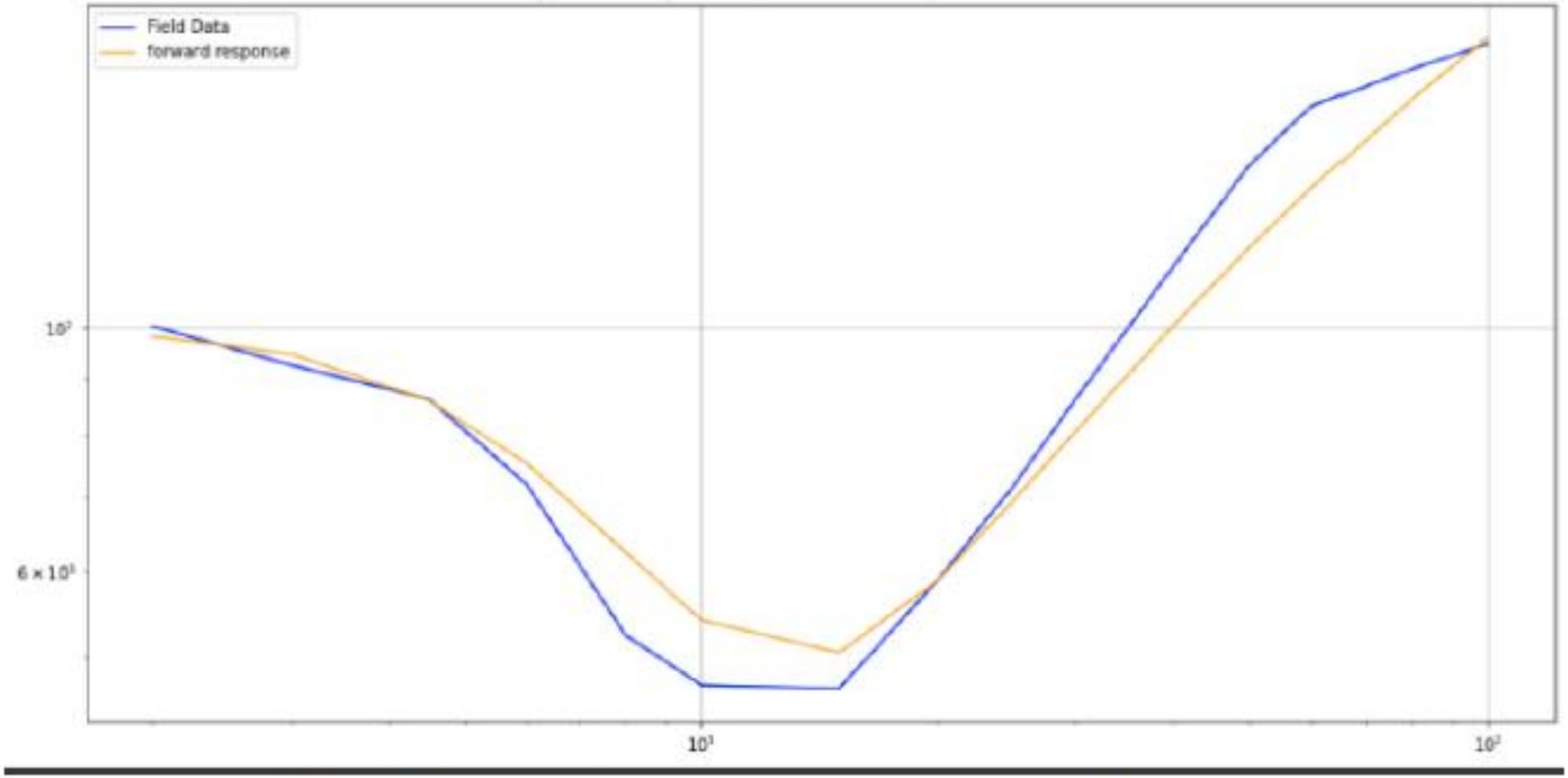
Misfit Error: 5.94%

• **Problem of Equivalence in S4 sounding:** For the HK-type curve, any values of h2, h3, $\rho 2$, *and* $\rho 3$ would validate as long as the h2/$\rho 2$ *and* h3 * $\rho 3$ is constant. The curve will fit exactly the same. Any variation in the values of h1, $\rho 1$, h2 and $\rho 2$ by its mean value leads to a very negligible change in the error.

• **Problem of Suppression in S4 sounding:** When the number of layers was increased to 5 such that value of $\rho 4$ is close to ($\rho 3$ + $\rho 5$)/2. The misfit error was about 8.90%. Therefore, we can face the problem of suppression in this sounding data.

Sounding 5

Apparent resistivity vs AB/2 plot



For a 4 Layered Model, type of Master Curve obtained is HA-Type [$\rho 1 > \rho 2 < \rho 3 < \rho 4$], where, $\rho 1$= 100ohm-m, $\rho 2$=14 ohm-m, $\rho 3$=50 ohm-m, $\rho 4$=350 ohm-m.The Values of Thicknesses are found to be, $\boldsymbol{h1} = 4\ m$, $\boldsymbol{h2} = 3.5\ m$, $\boldsymbol{h3} = 0.5\ m$.

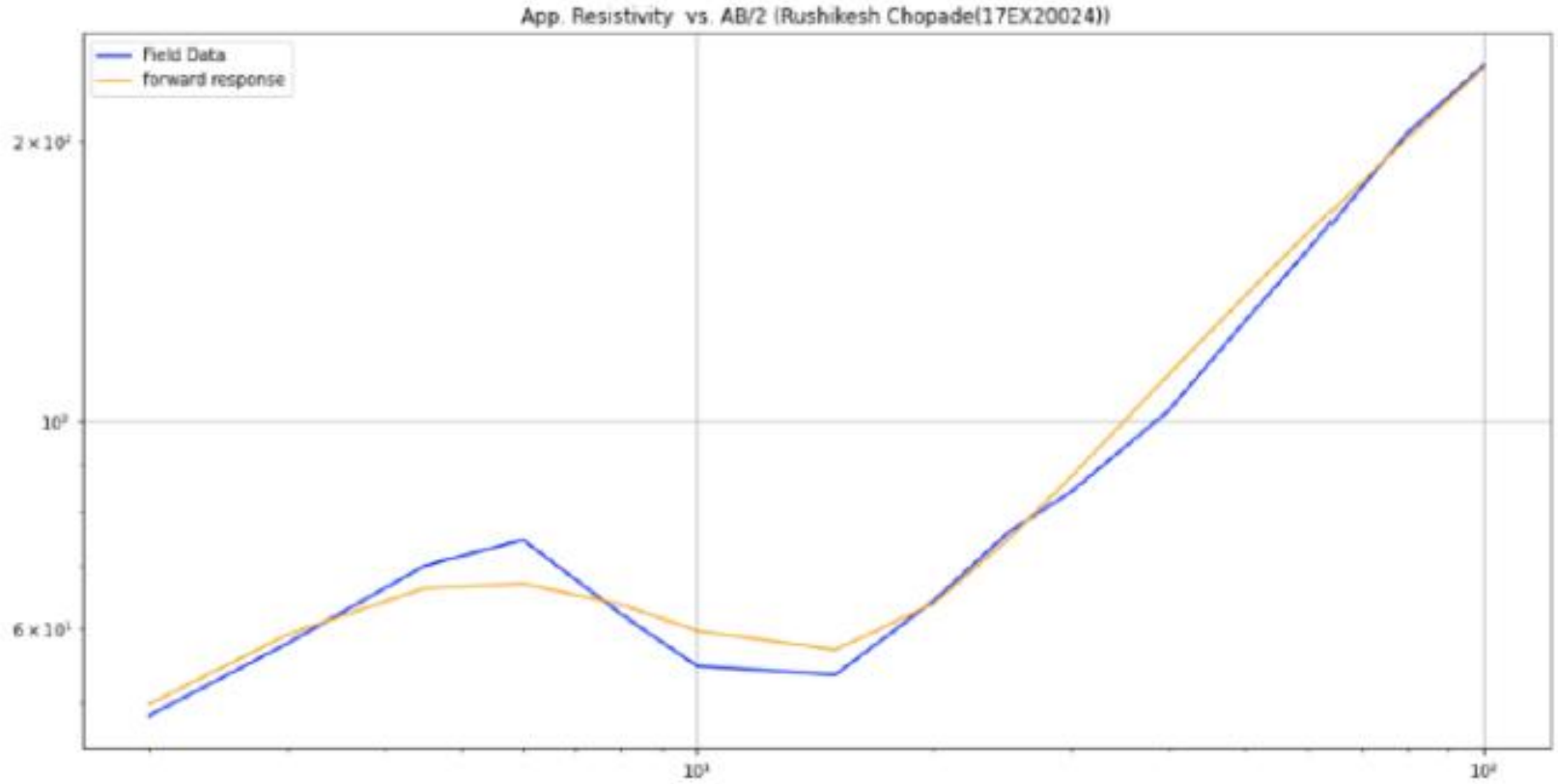
Misfit Error: 8.65%

• **Problem of Equivalence in S5 sounding:** For the HA-type sounding curve obtained above, any values of h2 *and* $\rho 2$ would satisfy as long as the h2/$\rho 2$ is constant. Any variation in the values of h2 and $\rho 2$ by its mean value leads to a very negligible change in the error.

• **Problem of Suppression in S5 sounding:** If the number of layers become accelerated to 5 such that fee of $\rho 3$ is close to ($\rho 2$ + $\rho 4$)/2. The misfit error was about 7.83%. Therefore, we can face the problem of suppression in this sounding data.

Sounding 6

Apparent resistivity vs AB/2 plot



For a 4 Layered Model, type of Master Curve obtained is KH-Type [$\rho 1 < \rho 2 > \rho 3 < \rho 4$],where, $\rho 1$=38ohm-m, $\rho 2$=180 ohm-m, $\rho 3$=22 ohm-m, $\rho 4$=850 ohm-m.The Values of Thicknesses are found to be, $\boldsymbol{h1} = 1.25\ m$, $\boldsymbol{h2} = 1.5\ m$, $\boldsymbol{h3} = 6\ m$.

Misfit Error: 5.35%

• **Problem of Equivalence in S6 sounding**: For the KH-type curve, any values of h2, h3, $\rho 2$, *and* $\rho 3$ would validate as long as the h3/$\rho 3$ *and* h2 * $\rho 2$ is constant. The curve will fit exactly the same. Any variation in the values of h1, $\rho 1$, h2 and $\rho 2$ by its mean value leads to a very negligible change in the error.

• **Problem of Suppression in S6 sounding:** If the number of layers was increased to 5 such that value of $\rho 4$ is close to ($\rho 3$ + $\rho 5$)/2. The misfit error was about 6.21%. Therefore, we can face the problem of suppression in this sounding data.

Sounding (4 Layer Model)	ρ1 ohm-m	ρ2 ohm-m	ρ3 ohm-m	ρ4 ohm-m	H1 (m)	H2 (m)	H3 (m)	Misfit Error
S1	100	1000	2600	2300	1.6	2	8	19.29%
S2	105	60	450	850	1.7	2.25	2.75	8.42%
S3	95	13	80	25	3.8	4	23	8.29%
S4	52	34	450	180	4	4	1	5.94%
S5	100	14	50	350	4	3.5	0.5	8.65%
S6	38	180	22	850	1.25	1.5	6	5.35%

Geoelectrical section