%%%%%%%%%%%% aniso model%%%%%%%

clear

clc

tic

%Unit side length

DX=[2000 2000 2000 2000 2000 1000 1000 1000 500 250 250 ...

250 250 500 500 500 500 500 500 500 500 500 500 250 250 ...

250 250 500 1000 1000 1000 2000 2000 2000 2000 2000];

DY=[2000 2000 2000 2000 2000 1000 1000 1000 500 250 250 ...

250 250 500 500 500 500 500 500 500 500 500 500 250 250 ...

250 250 500 1000 1000 1000 2000 2000 2000 2000 2000];

DZ1=[4000 2000 2000 1000 500 200 200 100];

DZ2=[100 200 200 500 500 500 500 500 ...

500 500 500 500 500 500 ....

500 500 1000 1000 1000 2000 3000 3000 3000 3000 3000 3000];

DZ=[DZ1 DZ2];

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%Air layer, vertical direction 1-8

%Abnormal body, x horizontal 12-25, y horizontal 12-25, vertical 17-22

%%%Parameters

Nair=size(DZ1,2);

NX=size(DX,2);

NY=size(DY,2);

NZ=size(DZ,2);

X=[0 cumsum(DX)]-sum(DX)/2;

Y=[0 cumsum(DY)]-sum(DY)/2;

Z=-[0 cumsum(DZ(Nair+1:end))];

%%%%%%%%%

%%%anomaly%%%%%

xa1=12;xa2=25;

ya1=12;ya2=25;

za1=9;za2=14;

%%%%%%%%

xx=[X(xa1) X(xa2+1) X(xa2+1) X(xa1) X(xa1)];

yy=[Y(ya1) Y(ya1) Y(ya2+1) Y(ya2+1) Y(ya1)];

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%aniso conductivity

pxyz=[1 5 9];

Pair=1e12;

%%%%anomaly aniso%%%%%%%%%%%%%

% rhoax=10;rhoay=15;rhoaz=20;

% srhoa1=[1/rhoax 0 0;0 1/rhoay 0;0 0 1/rhoaz];

% thetaS=10/180\*pi;

% thetaD=20/180\*pi;

% thetaL=30/180\*pi;

rhoax=10.0;rhoay=10;rhoaz=10;

srhoa1=[1/rhoax 0 0;0 1/rhoay 0;0 0 1/rhoaz];

thetaS=0/180\*pi;

thetaD=0/180\*pi;

thetaL=0/180\*pi;

RzS1=[cos(-thetaS) sin(-thetaS) 0;-sin(-thetaS) cos(-thetaS) 0;0 0 1];

RxD1=[1 0 0;0 cos(-thetaD) sin(-thetaD);0 -sin(-thetaD) cos(-thetaD)];

RzL1=[cos(-thetaL) sin(-thetaL) 0;-sin(-thetaL) cos(-thetaL) 0;0 0 1];

RzS2=[cos(thetaS) sin(thetaS) 0;-sin(thetaS) cos(thetaS) 0;0 0 1];

RxD2=[1 0 0;0 cos(thetaD) sin(thetaD);0 -sin(thetaD) cos(thetaD)];

RzL2=[cos(thetaL) sin(thetaL) 0;-sin(thetaL) cos(thetaL) 0;0 0 1];

sigani=RzS1\*RxD1\*RzL1\*srhoa1\*RzL2\*RxD2\*RzS2;

%%%%surrounding rock aniso%%%%%%%%%%

% rhoax=80;rhoay=120;rhoaz=100;

% srhoa2=[1/rhoax 0 0;0 1/rhoay 0;0 0 1/rhoaz];

% thetaS=20/180\*pi;

% thetaD=45/180\*pi;

% thetaL=30/180\*pi;

rhoax=100;rhoay=100;rhoaz=100;

srhoa2=[1/rhoax 0 0;0 1/rhoay 0;0 0 1/rhoaz];

thetaS=0/180\*pi;

thetaD=0/180\*pi;

thetaL=0/180\*pi;

RzS1=[cos(-thetaS) sin(-thetaS) 0;-sin(-thetaS) cos(-thetaS) 0;0 0 1];

RxD1=[1 0 0;0 cos(-thetaD) sin(-thetaD);0 -sin(-thetaD) cos(-thetaD)];

RzL1=[cos(-thetaL) sin(-thetaL) 0;-sin(-thetaL) cos(-thetaL) 0;0 0 1];

RzS2=[cos(thetaS) sin(thetaS) 0;-sin(thetaS) cos(thetaS) 0;0 0 1];

RxD2=[1 0 0;0 cos(thetaD) sin(thetaD);0 -sin(thetaD) cos(thetaD)];

RzL2=[cos(thetaL) sin(thetaL) 0;-sin(thetaL) cos(thetaL) 0;0 0 1];

siganiD=RzS1\*RxD1\*RzL1\*srhoa2\*RzL2\*RxD2\*RzS2;

%%%%%%%%%%%%%

sig1d=zeros(2,9);

sig1d(1,pxyz)=1/Pair;

sig1d(2,:)=[siganiD(1,:),siganiD(2,:),siganiD(3,:)];

sig3d=[sigani(1,:),sigani(2,:),sigani(3,:)];

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

srho=zeros(9,NX\*NY\*NZ);

sigmani1d=zeros(NZ,9);

%%%%%%%%air%%%%%

for z=1:Nair

for y=1:NY

for x=1:NX

index=(z-1)\*NX\*NY+(y-1)\*NX+x;

srho(:,index)=sig1d(1,:);

sigmani1d(z,:)=sig1d(1,:);

end

end

end

%%%%%%%surrounding%%%%%%

for z=Nair+1:NZ

for y=1:NY

for x=1:NX

index=(z-1)\*NX\*NY+(y-1)\*NX+x;

srho(:,index)=sig1d(2,:);

sigmani1d(z,:)=sig1d(2,:);

end

end

end

%%%%%%%%anomaly%%%%%%%%

for z=za1+Nair:za2+Nair

for y=ya1:ya2

for x=xa1:xa2

index=(z-1)\*NX\*NY+(y-1)\*NX+x;

srho(:,index)=sig3d(1,:);

end

end

end

%%%%%%%%%%%calculate boundarry%%%%%%%%

fre=0.1;

%%%%%%%%%%%%%%%%%

eTop1=[1,0];

eTop2=[0,1];

zNode=[1,cumsum(DZ)];

%%%%%%%%%%%1D analytical%%%%%%%%%%

for fm=1:size(fre,2)

[Ex1t,Ey1t,Ez1t,Hx1t,Hy1t,Ex2t,Ey2t,Ez2t,Hx2t,Hy2t]=mt1DAniAnalyticxyEH(fre(fm),sigmani1d,zNode,eTop1,eTop2);

Ex1tf(fm,:)=Ex1t(1,:);

Ey1tf(fm,:)=Ey1t(1,:);

Ez1tf(fm,:)=Ez1t(1,:);

Ex2tf(fm,:)=Ex2t(1,:);

Ey2tf(fm,:)=Ey2t(1,:);

Ez2tf(fm,:)=Ez2t(1,:);

end

[Ex1,Ey1,Ez1,Hx1,Hy1,Hz1,Ex2,Ey2,Ez2,Hx2,Hy2,Hz2]=MT3DvectanisoforT(srho,sig1d,fre,Nair,NX,NY,NZ,DX,DY,DZ,Ex1tf,Ey1tf,Ez1tf,Ex2tf,Ey2tf,Ez2tf);

toc

%%%cal Z%%

Temp=Hx1.\*Hy2-Hx2.\*Hy1;

Zxx=(Ex1.\*Hy2-Ex2.\*Hy1)./Temp;

Zxy=(Ex2.\*Hx1-Ex1.\*Hx2)./Temp;

Zyx=(Ey1.\*Hy2-Ey2.\*Hy1)./Temp;

Zyy=(Ey2.\*Hx1-Ey1.\*Hx2)./Temp;

%计cal apprarent resistivity

mu0=4\*pi\*1e-7;

for ff=1:size(fre,2)

rhoxxT(:,:,ff)=abs((Zxx(:,:,ff)).^2\*sqrt(-1)/(2\*pi\*fre(ff)\*mu0));

rhoxyT(:,:,ff)=abs((Zxy(:,:,ff)).^2\*sqrt(-1)/(2\*pi\*fre(ff)\*mu0));

rhoyxT(:,:,ff)=abs((Zyx(:,:,ff)).^2\*sqrt(-1)/(2\*pi\*fre(ff)\*mu0));

rhoyyT(:,:,ff)=abs((Zyy(:,:,ff)).^2\*sqrt(-1)/(2\*pi\*fre(ff)\*mu0));

phxxT(:,:,ff)=-atan(imag(Zxx(:,:,ff))./real(Zxy(:,:,ff))).\*180/pi;

phxyT(:,:,ff)=-atan(imag(Zxy(:,:,ff))./real(Zxy(:,:,ff))).\*180/pi;

phyxT(:,:,ff)=-atan(imag(Zyx(:,:,ff))./real(Zyx(:,:,ff))).\*180/pi;

phyyT(:,:,ff)=-atan(imag(Zyy(:,:,ff))./real(Zxy(:,:,ff))).\*180/pi;

end

save MT3DanisoDT

toc

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%%%%%%%%surveying points%%%%%%%%%

X1=(X(2:end)-DX/2);

Y1=(Y(2:end)-DY/2);

%%%%%%%plot%%%%%%%%%%

%%%%%%%rangge-10km to 10km%%%%%%%%%%%

xt=4:NX-3;%

yt=4:NY-3;

rhoxxDT=rhoxxT(yt,xt,1);

rhoxyDT=rhoxyT(yt,xt,1);

rhoyxDT=rhoyxT(yt,xt,1);

rhoyyDT=rhoyyT(yt,xt,1);

save rhoxxDT rhoxxDT

save rhoxyDT rhoxyDT

save rhoyxDT rhoyxDT

save rhoyyDT rhoyyDT

X2=X1(xt)./1000;

Y2=Y1(yt)./1000;

%% plot

figure(1)

subplot(2,3,1)

pcolor(X2,Y2,rhoxyDT);

shading interp

ylabel('Y(km)')

xlabel('X(km)')

title('\lambda=1')

h1=colorbar('vert');

colormap('Jet')

set(h1,'Position',[0.94 0.62 0.015 0.24])

h2=get(h1,'title');

set(h2,'string','\rho\_x\_y(\Omegam)','fontsize',10);

rhoscalexy=[50 120];

caxis(rhoscalexy)

hold on;

plot(yy/1000,xx/1000,'w--','linewidth',1.5)

subplot(2,3,4)

pcolor(X2,Y2,rhoyxDT);

shading interp

ylabel('Y(km)')

xlabel('X(km)')

h1=colorbar('vert');

colormap('Jet')

set(h1,'Position',[0.94 0.12 0.015 0.24])

h2=get(h1,'title');

set(h2,'string','\rho\_y\_x(\Omegam)','fontsize',10);

rhoscaleyx=[50 120];

caxis(rhoscaleyx)

hold on;

plot(yy/1000,xx/1000,'w--','linewidth',1.5)

%

subplot(2,3,2)

pcolor(X2,Y2,rhoxyDT2);

shading interp

title('\lambda=2')

ylabel('Y(km)')

xlabel('X(km)')

h1=colorbar('vert');

colormap('Jet')

set(h1,'Position',[0.94 0.62 0.015 0.24])

h2=get(h1,'title');

set(h2,'string','\rho\_x\_y(\Omegam)','fontsize',10);

rhoscalexx=[50 120];

caxis(rhoscalexx)

hold on;

plot(yy/1000,xx/1000,'w--','linewidth',1.5)

%

subplot(2,3,5)

pcolor(X2,Y2,rhoyxDT2);

shading interp

xlabel('X(km)')

ylabel('Y(km)')

h1=colorbar('vert');

colormap('Jet')

set(h1,'Position',[0.94 0.12 0.015 0.24])

h2=get(h1,'title');

set(h2,'string','\rho\_y\_x(\Omegam)','fontsize',10);

rhoscaleyy=[50 120];

caxis(rhoscaleyy)

hold on;

plot(yy/1000,xx/1000,'w--','linewidth',1.5)

subplot(2,3,3)

pcolor(X2,Y2,rhoxyDT4);

shading interp

title('\lambda=4')

ylabel('Y(km)')

xlabel('X(km)')

h1=colorbar('vert');

colormap('Jet')

set(h1,'Position',[0.94 0.62 0.015 0.24])

h2=get(h1,'title');

set(h2,'string','\rho\_x\_y(\Omegam)','fontsize',10);

rhoscalexx=[50 120];

caxis(rhoscalexx)

hold on;

plot(yy/1000,xx/1000,'w--','linewidth',1.5)

%

%

subplot(2,3,6)

pcolor(X2,Y2,rhoyxDT4);

shading interp

xlabel('X(km)')

ylabel('Y(km)')

h1=colorbar('vert');

colormap('Jet')

set(h1,'Position',[0.94 0.12 0.015 0.24])

h2=get(h1,'title');

set(h2,'string','\rho\_y\_x(\Omegam)','fontsize',10);

rhoscaleyy=[50 120];

caxis(rhoscaleyy)

hold on;

plot(yy/1000,xx/1000,'w--','linewidth',1.5)

The results are shown in the following figure:

