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This script visually compares simulations with and without aurora

1 - Define paths

```
workpath = '/Users/akv020/Projects/Dataverse/source/figure5';
%saturationpath = '/Users/akv020/Projects/KHI/source/saturation';
datapath = '/Users/akv020/Projects/Dataverse/data/250m_resolution';
```

2 - Load data

```
cd(datapath)
nev = ncread('5Ne11_L06_V13.nc','ne');
x = ncread('5Ne11_L06_V13.nc','x');
y = ncread('5Ne11_L06_V13.nc','y');
% Needed for plotting horizontally
nev = permute(nev, [2, 1, 3]);
ne_Q00 = nev;

nev = ncread('5Ne11_L06_V13_aurora_Q0.2.nc','ne');
nev = permute(nev, [2, 1, 3]);
ne_Q02 = nev;

nev = ncread('5Ne11_L06_V13_aurora_Q0.5.nc','ne');
nev = permute(nev, [2, 1, 3]);
ne_Q05 = nev;
```

4 - Define interesting time periods

```
time_minutes = [10, 11, 12, 13, 14, 15]; % in minutes
times = (time_minutes * 60) / 10 + 1; % Convert to indices (t = 1:1:181 for
times 0:10:1800 seconds)
```

5 Plot results

```
FIG = figure('units','centimeters','position',[0,0,36.0,39.0]);
sx = 0.045;
sy = 0.065;
```

```

fz = 18;
lw = 3;
colormap(inferno)
cmin = 10.6;
cmax = 11.9;
alf = 'a':'z';

for i = 1:length(times)
    t = times(i);
    time_min = time_minutes(i);

    % No aurora
    subplot_tight(7, 3, (i-1)*3 + 1, [sx, sy])
    imagesc(x, y, log10(squeeze(ne_Q00(:, :, t))))
    shading flat
    title([alf(1 + (i-1)*3), ' ) Q = 0, t = ', num2str(time_min), '
min'], 'fontsize', fz, 'interpreter', 'latex', 'FontWeight', 'normal')
    clim([cmin cmax])
    if i == 1
        ylabel('y [km]', 'fontsize', fz, 'interpreter', 'latex')
        c = colorbar;
        c.Location = 'South';
        c.Ticks = [10.8 11.1 11.4 11.7];
        c.FontSize = fz;
        c.Label.String = 'Denisty [ $m^{-3}$ ]';
        c.Label.Position = [11.25, -2.672727368094684, 0];
        c.Label.Interpreter = 'latex';
        set(c, 'TickLabelInterpreter', 'latex')
        yaxisproperties= get(gca, 'YAxis');
        yaxisproperties.TickLabelInterpreter = 'latex'; % tex for y-axis
    end
    ylabel('y [km]', 'fontsize', fz, 'interpreter', 'latex')
    yaxisproperties= get(gca, 'YAxis');
    yaxisproperties.TickLabelInterpreter = 'latex'; % tex for y-axis
    if i > 5
        xlabel('x [km]', 'interpreter', 'latex');
        xaxisproperties= get(gca, 'XAxis');
        xaxisproperties.TickLabelInterpreter = 'latex'; % latex for x-axis
    else
        set(gca, 'XTick', [])
    end

    % Low flux aurora
    subplot_tight(7, 3, (i-1)*3 + 2, [sx, sy])
    imagesc(x, y, log10(squeeze(ne_Q02(:, :, t))))
    shading flat
    title([alf(2 + (i-1)*3), ' ) Q = 0.2 mWm $^{-2}$  $, t = ',
num2str(time_min), '
min'], 'fontsize', fz, 'interpreter', 'latex', 'FontWeight', 'normal')
    clim([cmin cmax])
    if i > 5
        xlabel('x [km]', 'interpreter', 'latex');
        xaxisproperties= get(gca, 'XAxis');
        xaxisproperties.TickLabelInterpreter = 'latex'; % latex for x-axis

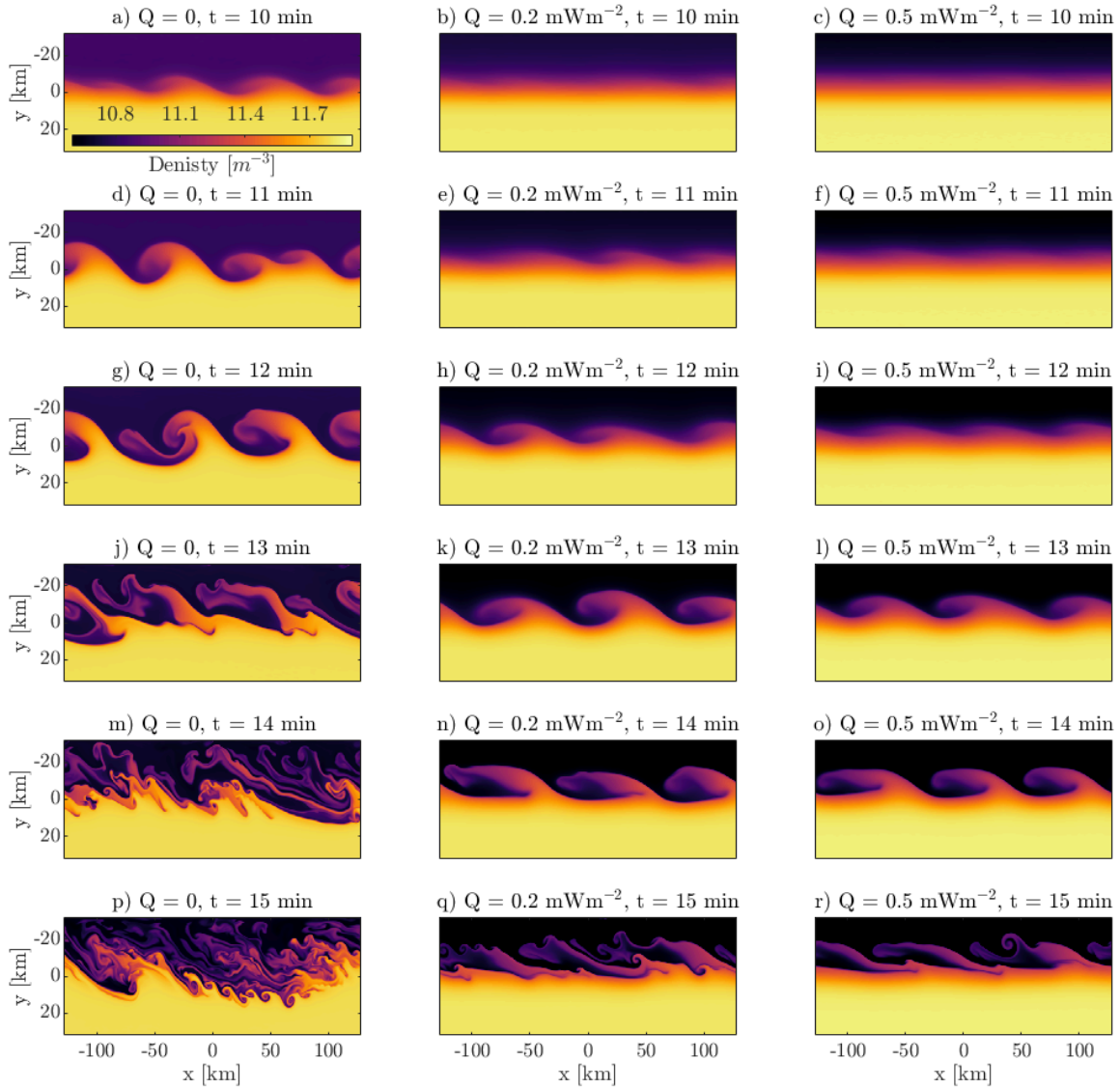
```

```

else
    set(gca, 'XTick', [])
end
set(gca, 'YTick', [])

% High flux aurora
subplot_tight(7, 3, (i-1)*3 + 3, [sx, sy])
imagesc(x, y, log10(squeeze(ne_Q05(:, :, t))))
shading flat
title([alf(3 + (i-1)*3), ' ) Q = 0.5 mWm$^{-2}$, t = ',
num2str(time_min), '
min'], 'fontsize', fz, 'interpreter', 'latex', 'FontWeight', 'normal')
clim([cmin cmax])
if i > 5
    xlabel('x [km]', 'interpreter', 'latex');
    xaxisproperties = get(gca, 'XAxis');
    xaxisproperties.TickLabelInterpreter = 'latex'; % latex for x-axis
else
    set(gca, 'XTick', [])
end
set(gca, 'YTick', [])
end
end

```



6 - Calculate pertubation growth

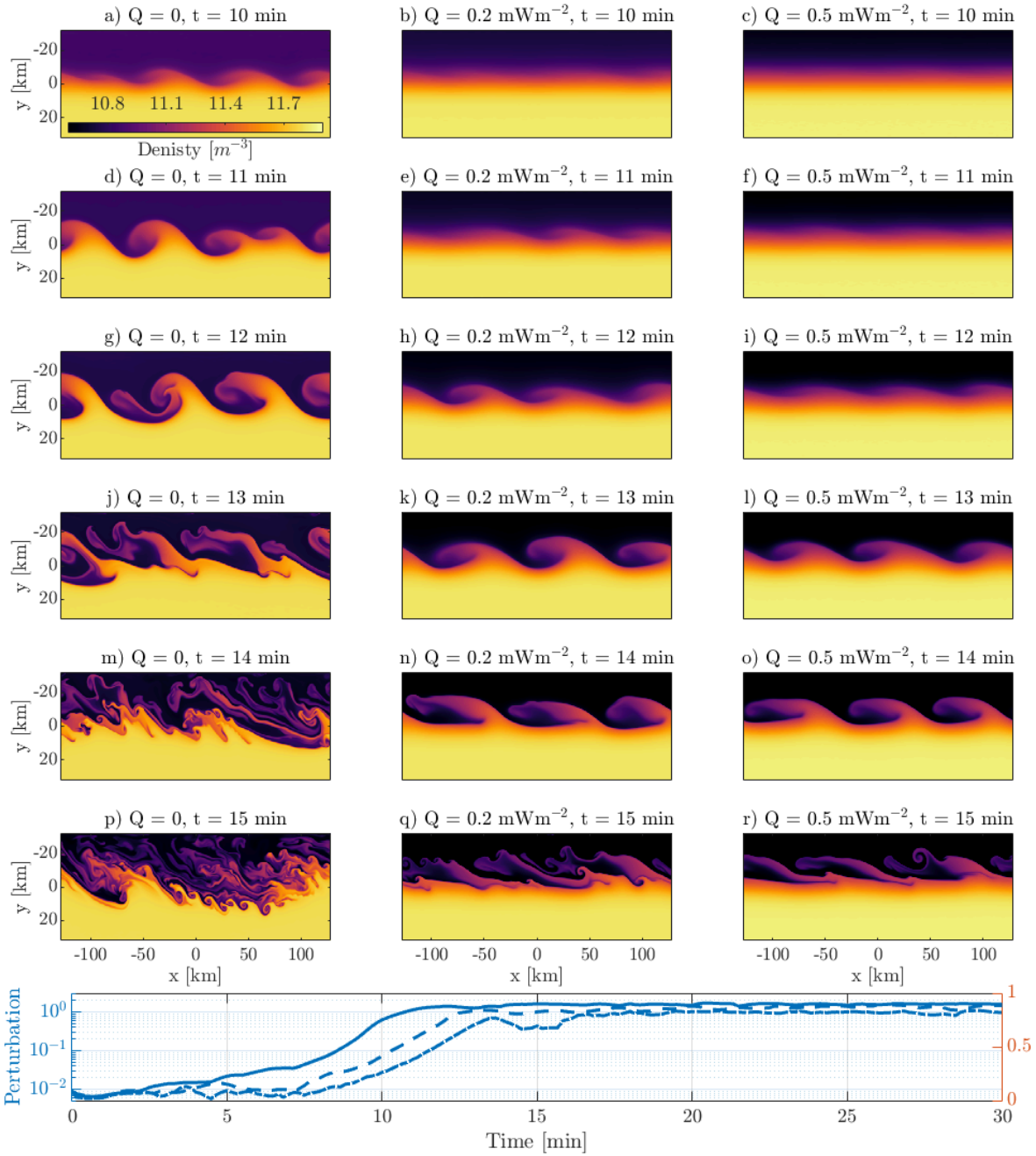
```
cd(workpath)
colors = {[0.6350, 0.0780, 0.1840],[0.4660, 0.6740, 0.1880],[0, 0.4470,
0.7410]};
% Use Equation 5 in article
growth_Q00 = pertubation_signal(ne_Q00);
growth_Q02 = pertubation_signal(ne_Q02);
growth_Q05 = pertubation_signal(ne_Q05);
subplot_tight(7,3,[19 20 21],[sx+0.0, sy+0.01])
```

```

yyaxis left
plot(linspace(0,30,181),growth_Q00,'Color',colors{3},'LineWidth',lw,'LineStyle','--')
hold on
plot(linspace(0,30,181),growth_Q02,'Color',colors{3},'LineWidth',lw,'LineStyle','--')
plot(linspace(0,30,181),growth_Q05,'Color',colors{3},'LineWidth',lw,'LineStyle','-.')
ylabel('Perturbation','fontSize',fz,'interpreter','latex')
xlabel('Time [min]','fontSize',fz,'interpreter','latex')
axisproperties= get(gca, 'XAxis');
axisproperties.TickLabelInterpreter = 'latex'; % latex for x-axis
yaxisproperties= get(gca, 'YAxis');
yaxisproperties(1).TickLabelInterpreter = 'latex'; % tex for y-axis
grid on
set(gca,'ycolor',colors{3})

set(gca,'Ytick',[0.01 0.1 1])
set(gca,'YScale','log')
axisproperties= get(gca, 'XAxis');
axisproperties.TickLabelInterpreter = 'latex'; % latex for x-axis
yaxisproperties= get(gca, 'YAxis');
yaxisproperties(2).TickLabelInterpreter = 'latex'; % tex for y-axis
set(gca,'fontSize',fz)
xlim([0 30])
ylim([5e-3 3e0])

```



7 - Calculate spatial growth

Use Equation 6 in article

```
[spatial_Q00] = y_distance(ne_Q00,y,0.1);
[spatial_Q02] = y_distance(ne_Q02,y,0.1);
[spatial_Q05] = y_distance(ne_Q05,y,0.1);

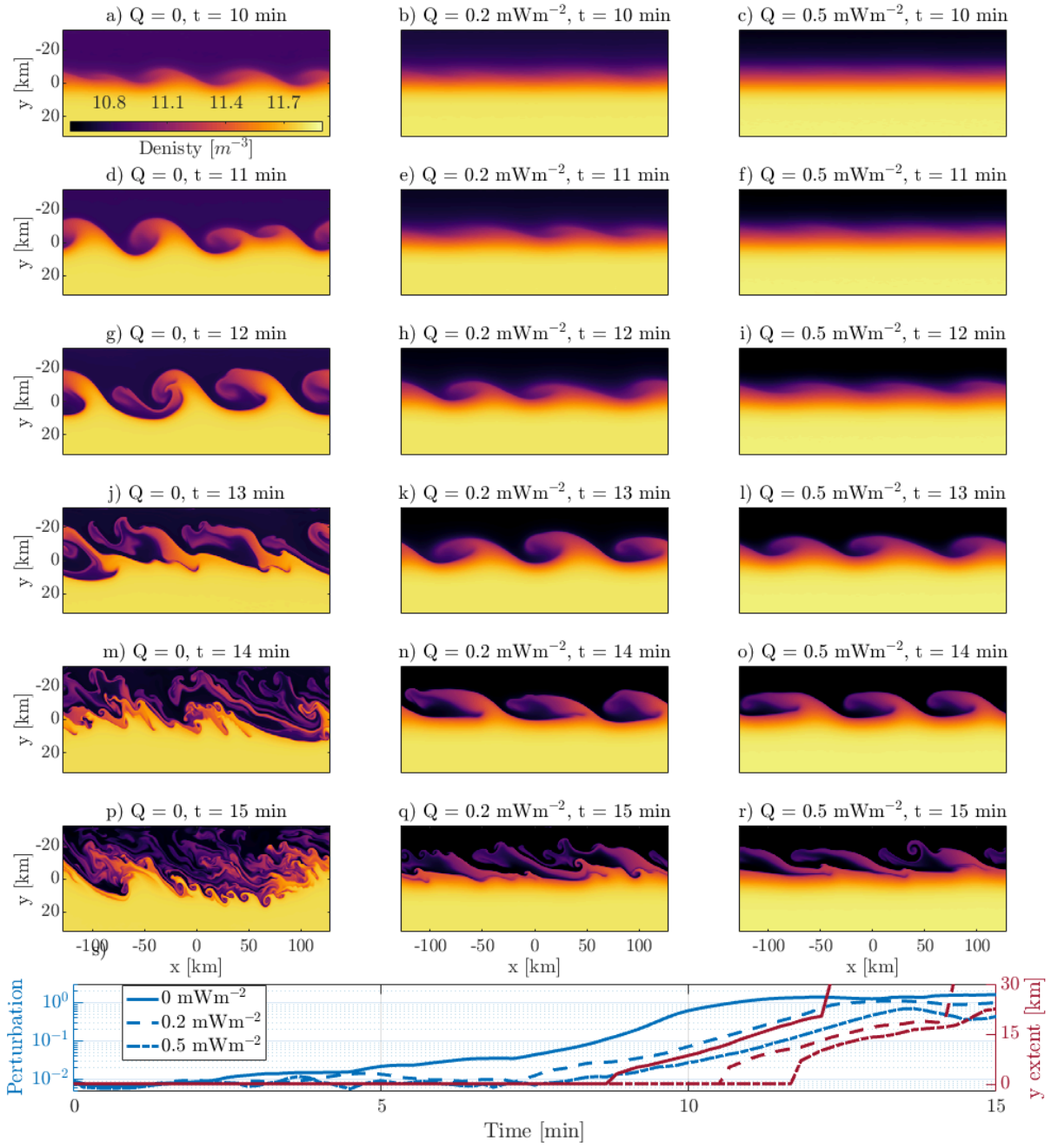
yyaxis right
plot(linspace(0,30,181),spatial_Q00,'Color',colors{1},'LineWidth',lw,'LineStyle','-')
```

```

hold on
plot(linspace(0,30,181),spatial_Q02,'Color',colors{1},'LineWidth',lw,'LineStyle','--')
plot(linspace(0,30,181),spatial_Q05,'Color',colors{1},'LineWidth',lw,'LineStyle','-.')
xlim([0 15])
ylim([-2 30])

ylabel('y extent [km]','fontsize',fz,'interpreter','latex')
xlabel('Time [min]','fontsize',fz,'interpreter','latex')
set(gca,'ycolor',colors{1})
grid on
set(gca,'Ytick',[0 15 30])
xaxisproperties= get(gca, 'XAxis');
xaxisproperties.TickLabelInterpreter = 'latex'; % latex for x-axis
yaxisproperties= get(gca, 'YAxis');
yaxisproperties(2).TickLabelInterpreter = 'latex'; % tex for y-axis
txt = 's';
text(0.3,40,txt,'FontSize',fz,'interpreter','latex');
legend('0 mWm$^{-2}$','0.2 mWm$^{-2}$','0.5 mWm$^{-2}$','Position',[0.12
    0.0719    0.1328    0.0631],'fontsize',fz,'interpreter','latex')
set(gca,'fontsize',fz)

```



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