Visualization Updates in Maple 2023

Building explorations with the Plot Builder

- The PlotBuilder now supports plotting expressions with extra parameters, constructing an interactive plot with slider controls that change the extra parameter values.
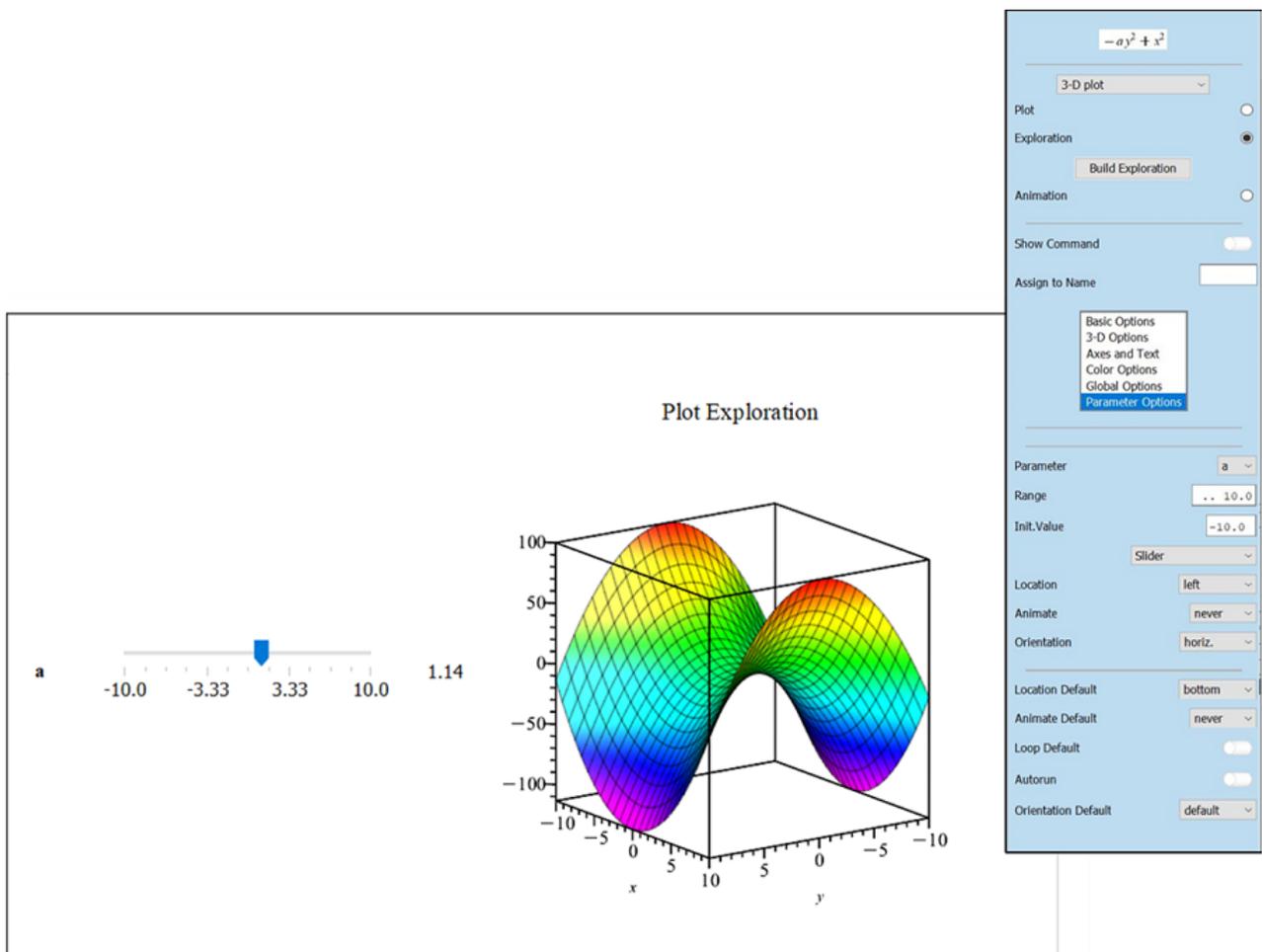
- The choice of which independent names are plotting variables and which are interactive parameters can be changed.

- This functionality supports 2-D and 3-D plots. Multiple expressions can be plotted separately or interpreted together as an appropriate parametric calling sequence.

Explore sin(x) and sin(x)/y

2-D plot

Build Exploration

Show Command

Assign to Name

Basic Options
2-D Options
Axes and Text
Color Options
Global Options
Parameter Options

| Parameter | y |
Range	1 .. 20.
Init.Value	1
	Slider
Location	bottom
Animate	never
Orientation	horiz.
Location Default	bottom
Animate Default	never
Loop Default	
Autorun	

y   1   20   2
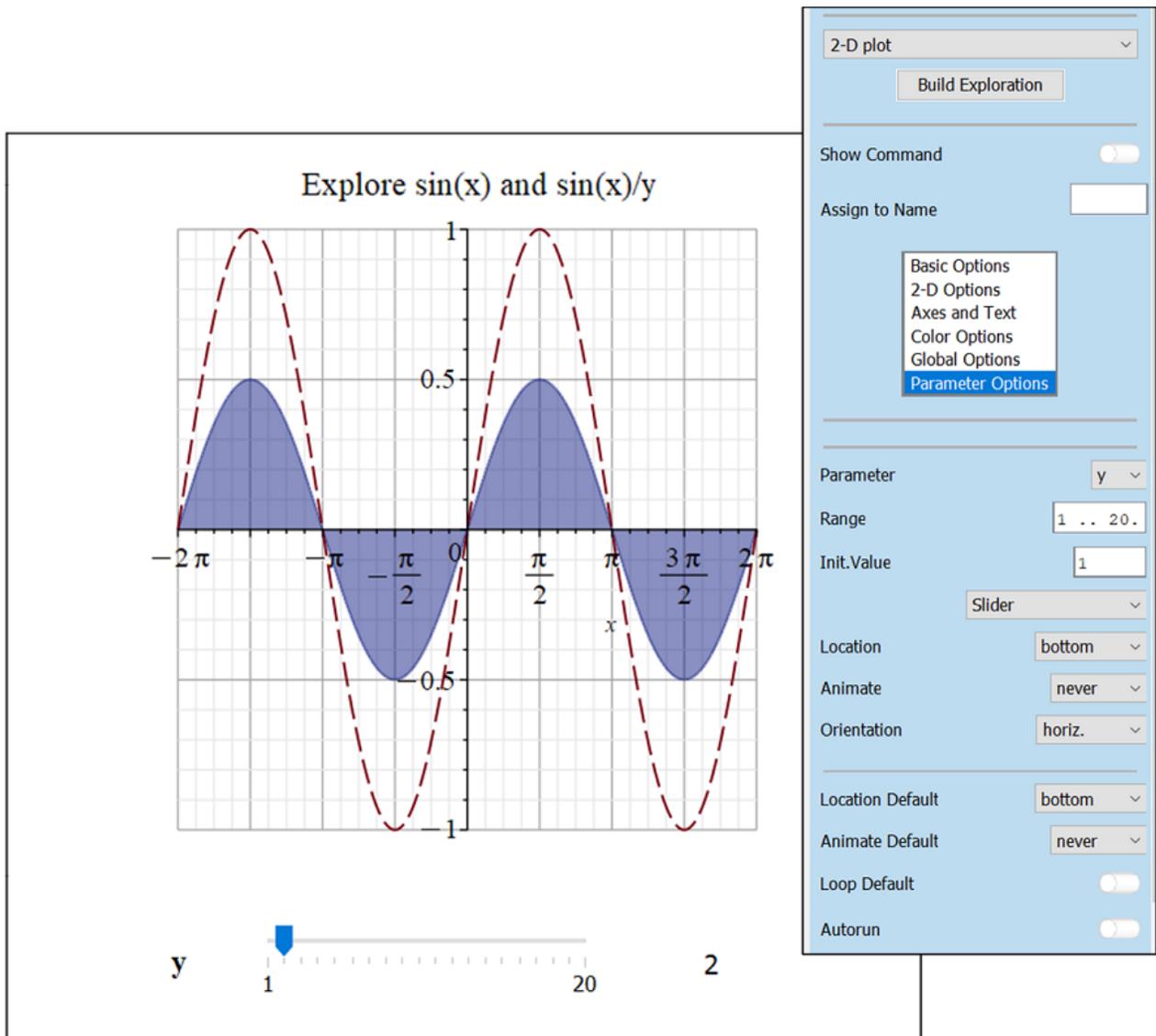
- The choice of plot type and its qualities can be changed by re-entering the **PlotBuilder** in the right-side panel. In the case of a constructed interactive plot an Edit button allows the side panel to reopen with the corresponding saved plotting options.

- You can access the Plot Builder using the PlotBuilder command or via the Context Panel for an expression.

Color bars for contour and density plots

- Plots produced by the plots:-densityplot and plots:-contourplot commands now appear with a color bar by default. You can control whether a color bar is displayed by using the **colorbar** (or **colourbar**) option, which is **true** by default.

```
> plots:-densityplot( tan( x^2 - y^2 ), x = -2*Pi .. 2*Pi, y = -2*Pi
    .. 2*Pi, 'colormap' = "Magma" );
```
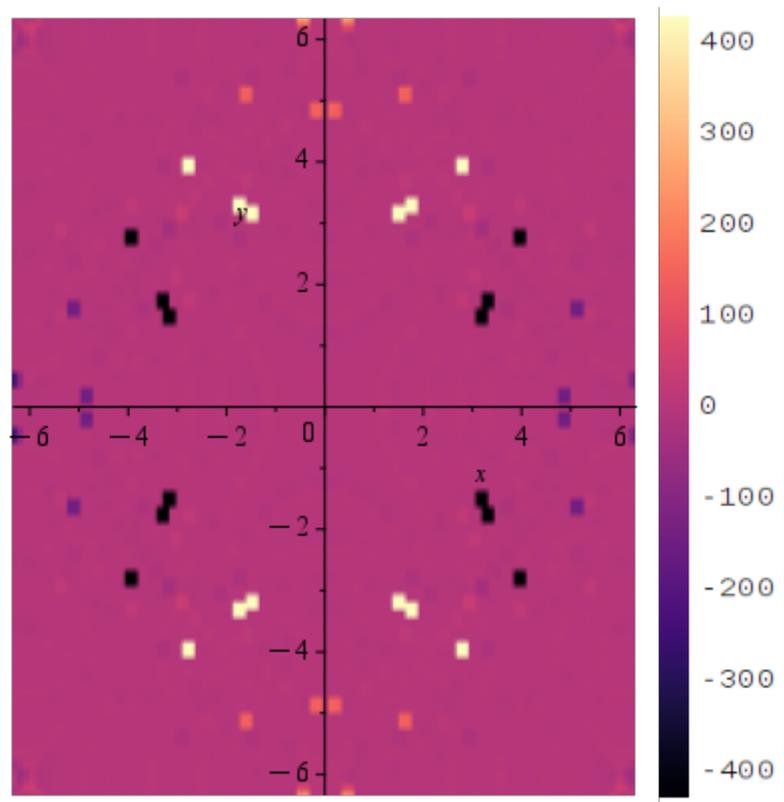
```
> plots:-contourplot( exp( x ) * cos( y ), x = -1 .. 2*Pi, y = 0 ..
  Pi, 'coords' = 'spherical', 'filledregions' = true, 'grid' = [100,
  100]);
```
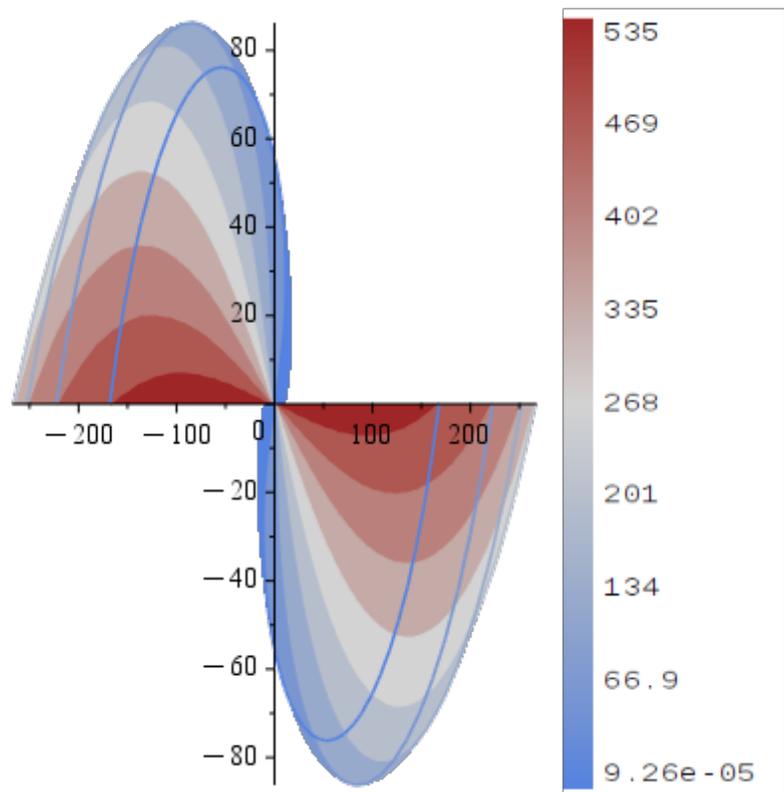
```
> plots:-contourplot( x/(x^2 + y^2 + 1), x = -3 .. 3, y = -3 .. 3,
    'filledregions' = true, 'colormap' = "Executive" );
```
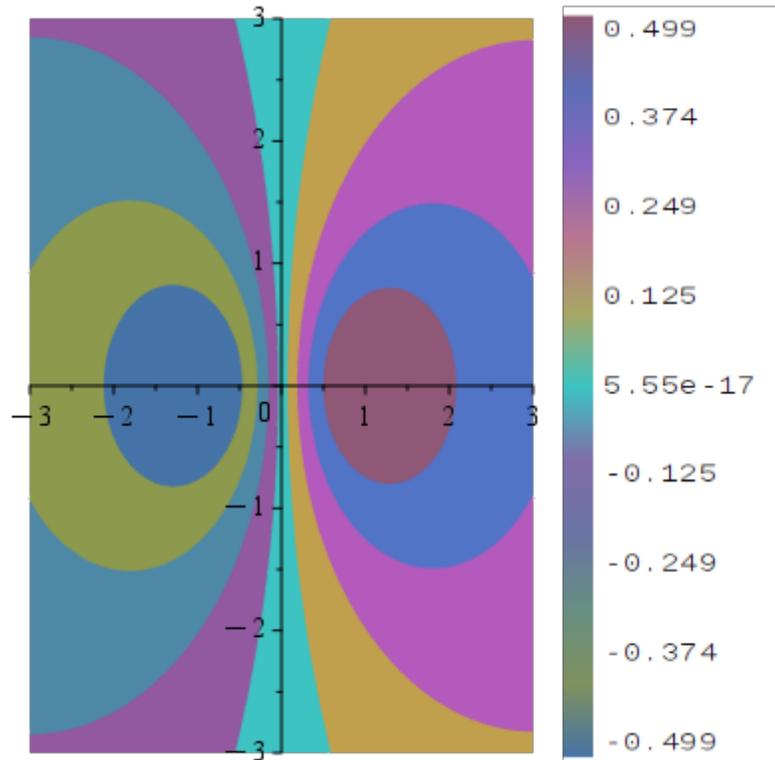

- To suppress the display of a color bar, set the **colorbar = false** option.

```
> plots:-densityplot( sin( x/y ), x = -Pi .. Pi, y = -Pi .. Pi,
    'colormap' = "DivergeRainbow", 'colorbar' = false );
```
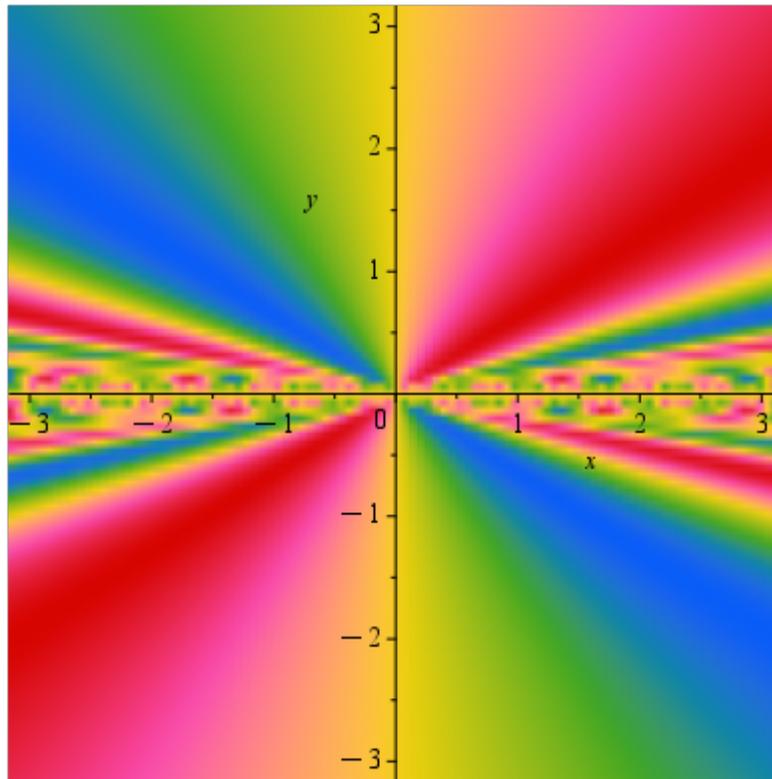
More new colormaps for gradient color schemes

- Fourteen new colormaps are now available in Maple as ColorTools palettes that can easily be used with the **colorscheme** option for plot commands that accept it.

- There is one new linear colormap Cividis which is a more colorblind friendly version of previously added linear color map Viridis.

```
> ColorTools:-Swatches("Cividis", 'mode'=gradient, 'title'=
  "Cividis");
```


Cividis
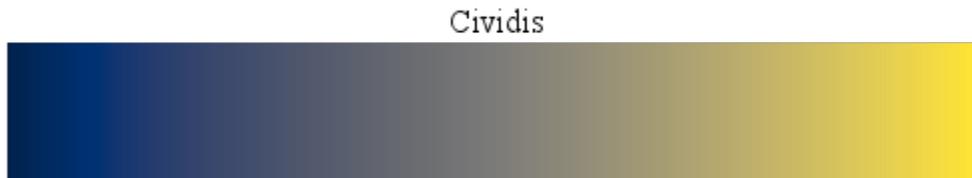
- There are three cyclic colormaps Colorwheel, Isocircle, and Twilight useful for data that cycles.

```
> plots:-display( Array([ seq(ColorTools:-Swatches(m, 'mode'=
  'wheel', 'title'=m), m in ["Colorwheel", "Isocircle", "Twilight"])]
  ) );
```

Colorwheel · Isocircle · Twilight
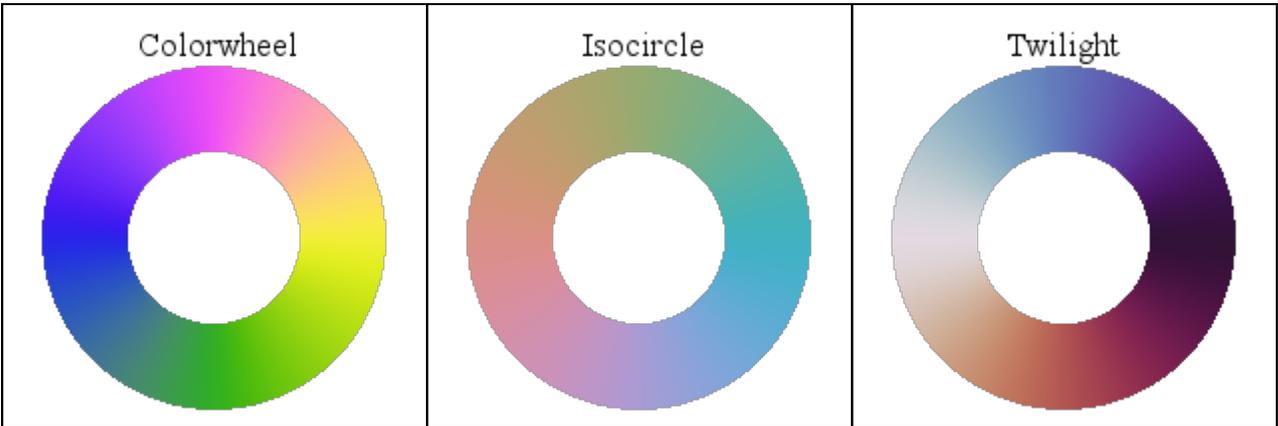
- There are seven divergent colormaps which emphasize the central values and change differently above and below. Those colormaps are Coolwarm, DivergeBJY, DivergeBKR, DivergeBKY, DivergeBWY, DivergeGWV, and DivergeRainbow.

```
> ColorTools:-Swatches("DivergeRainbow", 'mode'='gradient');
```



```
> plots:-display(Matrix(2,3,[seq(ColorTools:-Swatches(m, 'mode'=
  'gradient', 'title' = m), m in ["Coolwarm", "DivergeBWY",
  "DivergeBJY", "DivergeBKR", "DivergeBKY", "DivergeGWV"])]));
```


Coolwarm · DivergeBWY · DivergeBJY · DivergeBKR · DivergeBKY · DivergeGWV
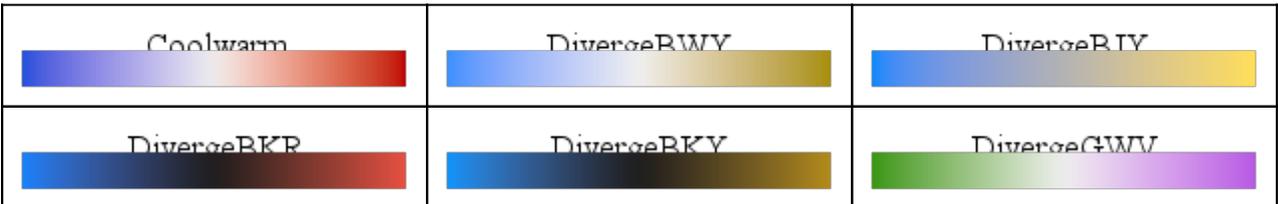
- Twilight is also a good divergent colormap.

```
> plot([abs(x)*sin(x), abs(x)*cos(x), x = -3*Pi .. 3*Pi],
  colorscheme = "DivergeRainbow", thickness = 5, title = "Twilight",
  scaling = constrained);
```

Twilight
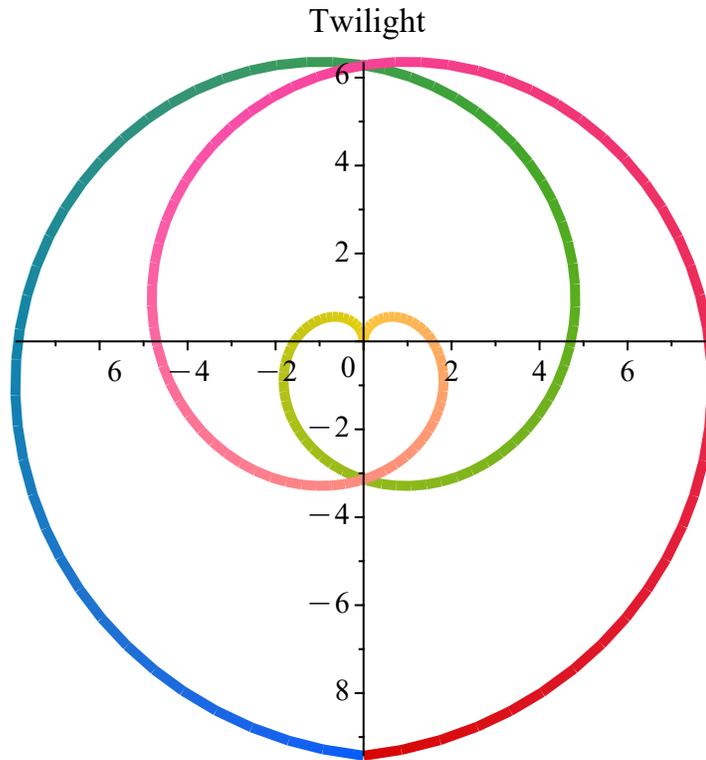
- There are three new rainbow colormaps, Isoluminant, Rainbow, and Turbo all aiming to be visually appealing without the drawbacks of using a HSV color hue spread colormap.

```
> plots:-display( Array([ seq(ColorTools:-Swatches(m, 'mode'=
  'gradient', 'title'=m), m in ["Isoluminant", "Rainbow", "Turbo"])])
  );
```


More plot types are responsive to global color settings

- The default colors for plots can be set with the plots:-setcolors command those colors are now used as the default colors for densityplot, contourplot, and DEtools:-DEplot.
- These are the new default colors for these plots:

```
> plots:-display( <
  DEtools:-DEplot(diff(y(t), t) = 2.0 - 0.1*y(t), y(t), t = 0 .. 20,
  [y(0) = 10, y(0) = 30, y(0) = 50]) ,
  plots:-contourplot( -5*x/(x^2 + y^2 + 1), x=-3..3, y=-3..3,
  colorbar=false) ;
  plots:-contourplot( -5*x/(x^2 + y^2 + 1), x=-3..3, y=-3..3,
  colorbar=false, filled) ,
```

```
plots:-densityplot( -5*x/(x^2 + y^2 + 1), x=-3..3, y=-3..3,
colorbar=false)
> );
```
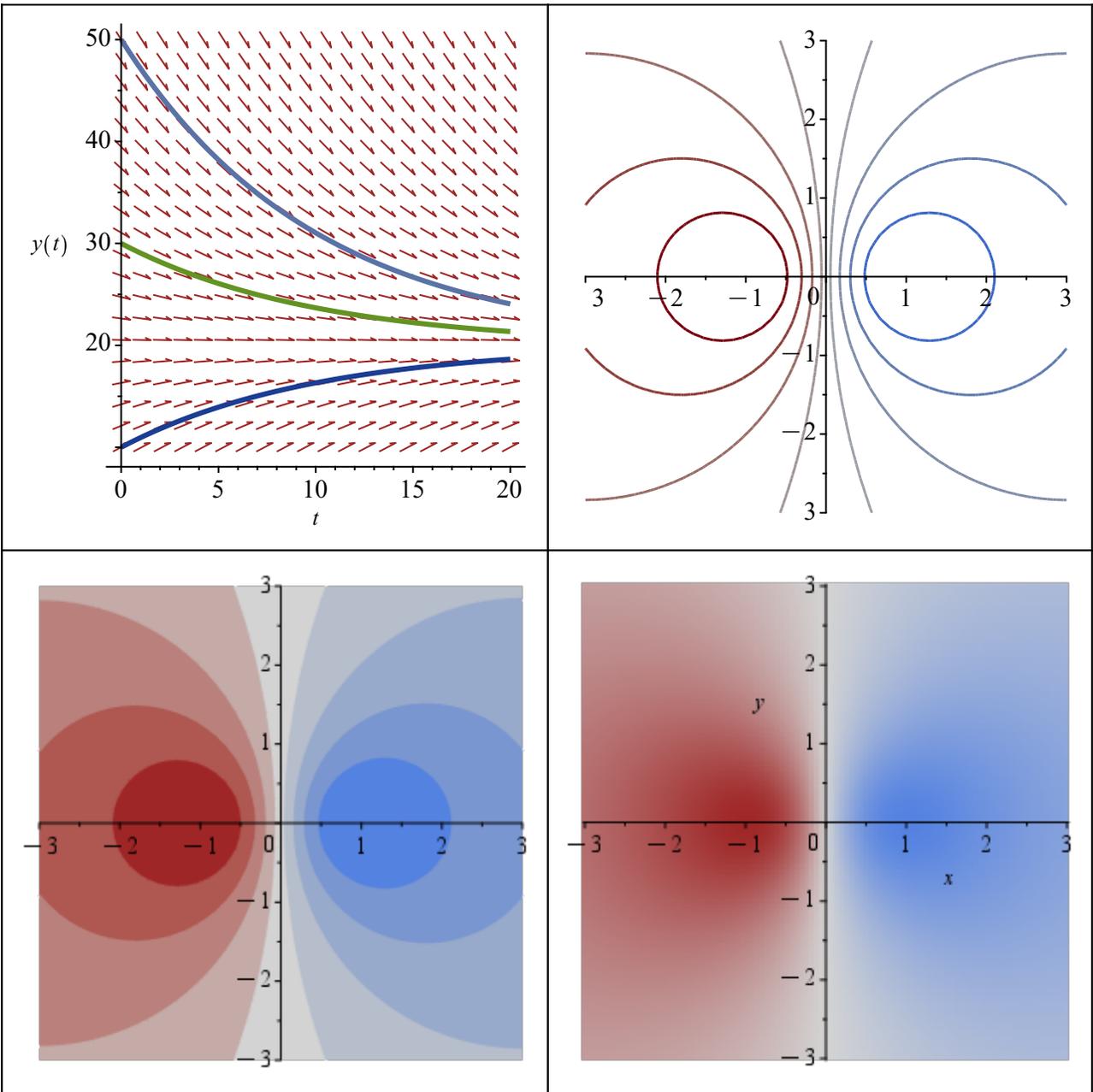

• Using setcolors to choose a new ColorCollection changes the defaults for all four plots to use the new palette:

```
> plots:-setcolors("Dalton"):
```

```
> plots:-display( <
  DEtools:-DEplot(diff(y(t), t) = 2.0 - 0.1*y(t), y(t), t = 0 .. 20,
  [y(0) = 10, y(0) = 30, y(0) = 50]) ,
  plots:-contourplot( -5*x/(x^2 + y^2 + 1), x=-3..3, y=-3..3,
  colorbar=false) ;
  plots:-contourplot( -5*x/(x^2 + y^2 + 1), x=-3..3, y=-3..3,
  colorbar=false, filled) ,
  plots:-densityplot( -5*x/(x^2 + y^2 + 1), x=-3..3, y=-3..3,
  colorbar=false)
> );
```
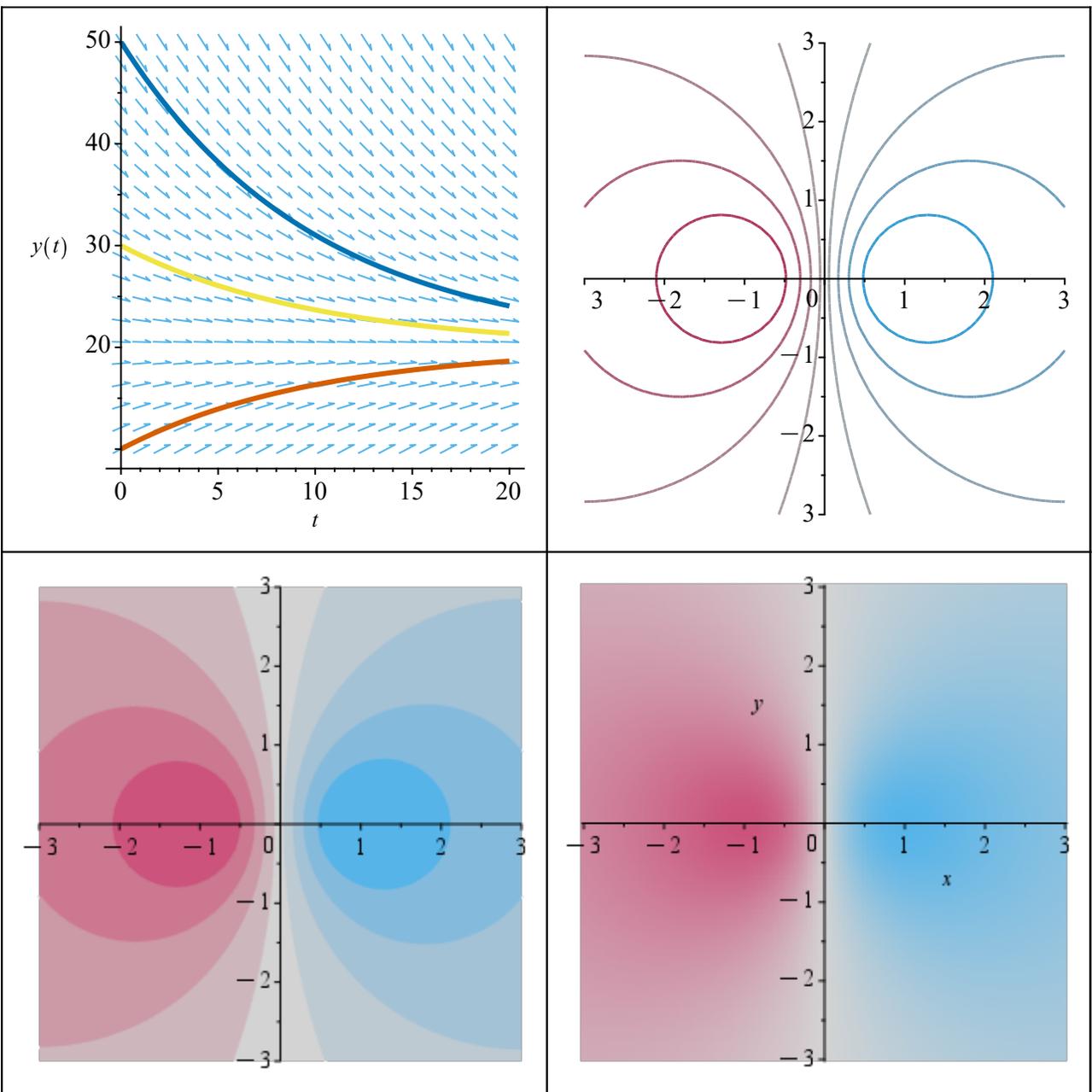
Plotting is faster and uses less memory

- Plotting in Maple uses a smart, adaptive plotting engine. In Maple 2023, we focused on improving the speed and memory usage of the adaptive plotting engine. See [Performance Improvements for Plots](#) for details.