In [ ]:
```
1
```

Effect of moisture forcing strength (RH100 tscale)

In [2]:
```
# Load modules
using Plots
using NCDatasets
using Statistics: mean
using DelimitedFiles
using PrettyTables
using PaddedViews
using Dates
using Printf

```

In [37]:
```

# Useful functions
function get_var(file_name, var_name, t_spinup, nan_fill_value);
    ds = NCDataset(file_name, "r");
    var = ds[var_name][:];
    data=var[:, :, :, t_spinup:end]; # cut out the spinup;
    replace!(data, NaN=>nan_fill_value)
    return data
    none
end

function get_zonal_mean(file_name, var_name, nan_fill_value);
    ds = NCDataset(file_name, "r");
    var = ds[var_name][:];
    data_mean = mean( var[:,:,:,:], dims=1); # lon, lat,lev, time
    replace!(data_mean, NaN=>nan_fill_value)
    return data_mean[1,:,:,:]
    none
end

function get_slice(
                   file_name, var_name, nan_fill_value,
                   lon_i1, lon_12, lat_i1, lat_i2, lev_i1, lev_i2, t_i1, t_i2

    ds = NCDataset(file_name, "r");
    var = ds[var_name][:];
    data = (var[lon_i1:lon_12, lat_i1:lat_i2, lev_i1:lev_i2, t_i1:t_i2]); # c
    replace!(data, NaN=>nan_fill_value)
    return data
    none
end

function get_coords(file_name)
    ds = NCDataset(file_name, "r");
    lon = ds["long"][:];
    lat = ds["lat"][:];
    lev = ds["level"][:] / 1e3; # height in kilometers
    time = ds["time"][:];  # time
    close(ds)
    return lon, lat, lev, time
    none
end

function get_min_max(var);
    vmax = maximum(filter(!isnan,var))
    vmin = minimum(filter(!isnan,var))
    return vmin,vmax
    none
end

```

```
51 function get_short_expname(fname, var_code_1)
52     driver = fname
53     exp_name =  split(split(driver,var_code_1)[2],"_")[1]
54     return exp_name
55 end
56
```

Out[37]:
```
get_short_expname (generic function with 1 method)
```

In [ ]:
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```

In [33]:
```
# Specify needed directories and filenames: these will be replaced automatica
CLIMA_ANALYSIS = "/central/scratch/elencz/output/hier_RH100_q_active_np128_re
CLIMA_NETCDF = "/central/scratch/elencz/output/SA_crash_data/100RHforcing"
CLIMA_LOGFILE = "/central/scratch/elencz/output/hier_RH100_q_active_np128_rel

# Get the current and previous  GCM netcdf file names in the CLIMA_NETCDF dir
fnames = filter(x -> occursin(".nc", x), readdir( CLIMA_NETCDF ) );


# set file name
filename = "$CLIMA_NETCDF/"fnames[1]

# print data info:
ds = NCDataset(filename, "r")

```

Out[33]:
```
NCDataset: /central/scratch/elencz/output/SA_crash_data/100RHforcing/ctrl_hier_R
H100_q_active_np128_relax60_diffn_none_remove_q_none_AtmosGCMDefault_2020-08-24T
15.19.01.998.nc
Group: /

Dimensions
   long = 361
   lat = 181
   level = 31
   time = 18

Variables
  long   (361)
    Datatype:    Float64
    Dimensions:  long
    Attributes:
     units                = degrees_east
     long_name            = longitude

  lat    (181)
```

In [88]:
```
# get coordinates
lon, lat, lev, time = get_coords(filename);

nan_fill_value = -9999
nexp = size(fnames);

```

```
BoundsError: attempt to access 0-element Array{Any,1} at index [1]

Stacktrace:
 [1] setindex!(::Array{Any,1}, ::Any, ::Int64) at ./essentials.jl:454
 [2] top-level scope at ./In[88]:12
```

In [64]:
```
1 hs_c
```

Out[64]:

```
361×181×1×1 Array{Float64,4}:
[:, :, 1, 1] =
 0.0257339  0.195857  0.376395  0.563586  …  0.373674  0.193105  0.0229673
 0.0253596  0.149126  0.329301  0.516114     0.326636  0.146421  0.022593
 0.0249775  0.149588  0.329983  0.517172     0.327326  0.146888  0.0222117
 0.0245878  0.150056  0.330671  0.518244     0.328021  0.147361  0.0218238
 0.0241907  0.15053   0.331363  0.519328     0.328723  0.147841  0.0214291
 0.0237861  0.151008  0.332059  0.520424  …  0.329429  0.148327  0.021028
 0.0233744  0.151492  0.332759  0.521531     0.33014   0.148818  0.0206204
 0.0229555  0.15198   0.333463  0.522647     0.330855  0.149316  0.0202065
 0.0225296  0.152473  0.334169  0.523771     0.331574  0.149818  0.0197865
 0.0220968  0.152971  0.334878  0.524902     0.332296  0.150326  0.0193605
 0.0216573  0.153473  0.335589  0.526038  …  0.33302   0.150839  0.0189286
 0.0212112  0.153979  0.336301  0.527179     0.333747  0.151357  0.0184909
 0.0207587  0.154488  0.337015  0.528321     0.334475  0.151879  0.0180476
 ⋮                                       ⋱                    ⋮
 0.029311   0.190609  0.371584  0.560039     0.368918  0.187903  0.0265998
 0.0290287  0.19111   0.372006  0.560239  …  0.369332  0.188396  0.0263082
 0.0287374  0.191607  0.372431  0.560464     0.369749  0.188885  0.0260086
 0.0284374  0.192099  0.372859  0.560712     0.370171  0.189371  0.025701
 0.0281288  0.192587  0.373292  0.560985     0.370597  0.189853  0.0253857
 0.0278116  0.19307   0.373727  0.561283     0.371027  0.190331  0.0250626
```

```
1 # Vertical Slices
```

In [86]:

```
#Slices
t_slice = 18
z_slice = 5
var_name = "v"

# vertical
lon_i1, lon_12, lat_i1, lat_i2, lev_i1, lev_i2, t_i1, t_i2 = [1, length(lon),

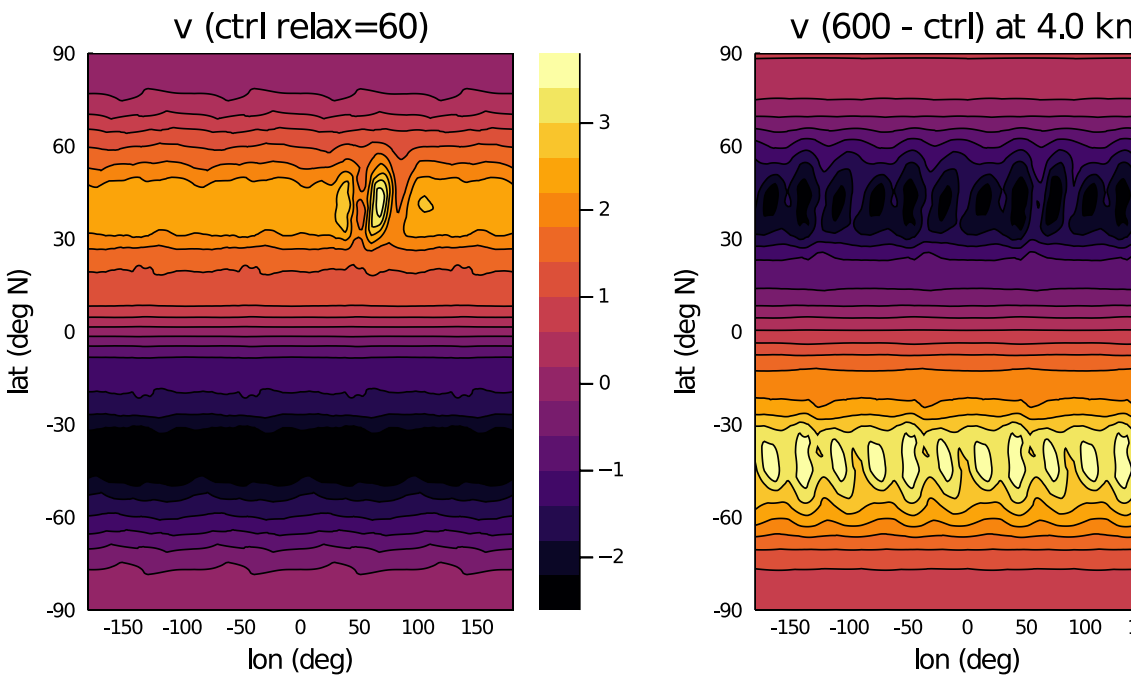
# control
hs_c = get_slice( filename, var_name, nan_fill_value, lon_i1, lon_12, lat_i1,
p_ctrl = contourf( lon, lat, (hs_c[:,:,1,1])', title="$var_name (ctrl relax=6
#
# Make anomaly plots and save them in an array
plot_array = Any[p_ctrl]; # can type this more strictly
for i in 2:nexp[1]
  hs = get_slice( "$CLIMA_NETCDF/"fnames[i], var_name, nan_fill_value, lon_i1
  exp_name = get_short_expname(fnames[i], "relax")
  z_in_km = lev[z_slice]
  one_plot = contourf( lon, lat, ( (hs[:,:,1,1]-hs_c[:,:,1,1])*1.0 )', title=
  push!(plot_array,one_plot); # make a plot and add it to the plot_array
end

fig=plot(plot_array... , layout=(1, 2), size=(800, 400) )
#savefig(fig, string("$CLIMA_ANALYSIS/plot_$var_name","_hovmoller_sens.pdf"))



display(fig)

```



Zonal means

In [77]:

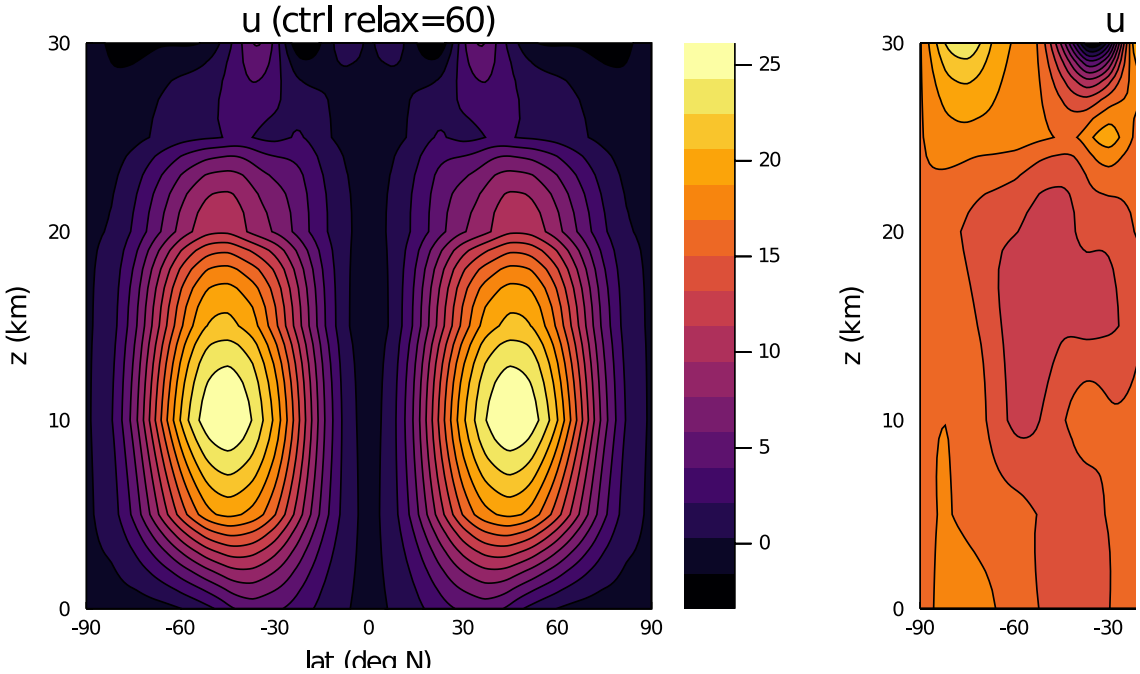
```
# get_zonal_means
t_slice = 18
var_name = "u"

zm_c = get_zonal_mean(filename, var_name, nan_fill_value)
p_ctrl = contourf( lat, lev, (zm_c[:,:,t_slice])' , title="$var_name (ctrl re

# Make anomaly plots and save them in an array
plot_array = Any[p_ctrl]; # can type this more strictly
for i in 2:nexp[1]
```

```
  zm = get_zonal_mean( "$CLIMA_NETCDF/"fnames[i], var_name, nan_fill_value);
  exp_name = get_short_expname(fnames[i], "relax")
  one_plot = contourf( lat, lev, (zm[:,:,t_slice]-zm_c[:,:,t_slice])', title=
  push!(plot_array,one_plot); # make a plot and add it to the plot_array
end

fig=plot(plot_array... , layout=(1, 2), size=(1000, 400) )
#savefig(fig, string("$CLIMA_ANALYSIS/plot_$var_name","_hovmoller_sens.pdf"))
display(fig)
```



In [52]:

```
# get_zonal_mean: T
t_slice = 18
var_name = "temp"

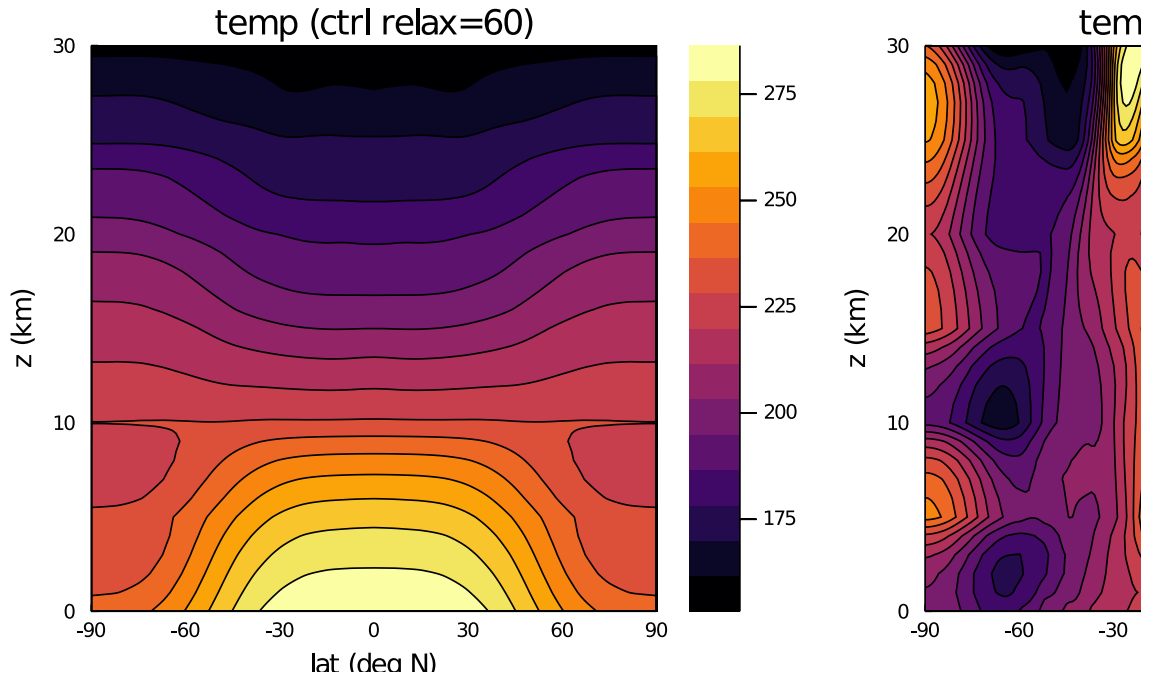
zm_c = get_zonal_mean(filename, var_name, nan_fill_value)
p_ctrl = contourf( lat, lev, (zm_c[:,:,t_slice])' , title="$var_name (ctrl re

# Make anomaly plots and save them in an array
plot_array = Any[p_ctrl]; # can type this more strictly
for i in 2:nexp[1]
  zm = get_zonal_mean( "$CLIMA_NETCDF/"fnames[i], var_name, nan_fill_value);
  exp_name = get_short_expname(fnames[i], "relax")
  one_plot = contourf( lat, lev, (zm[:,:,t_slice]-zm_c[:,:,t_slice])', title=
  push!(plot_array,one_plot); # make a plot and add it to the plot_array
end

fig=plot(plot_array... , layout=(1, 2), size=(1000, 400) )
#savefig(fig, string("$CLIMA_ANALYSIS/plot_$var_name","_hovmoller_sens.pdf"))
display(fig)

fig=plot(plot_array... , layout=(1, 2), size=(1000, 400) )
#savefig(fig, string("$CLIMA_ANALYSIS/plot_$var_name","_hovmoller_sens.pdf"))
display(fig)
```

In [53]:
```
1
```


temp (ctrl relax=60)
tem
z (km)
lat (deg N)
30
20
10
0
-90
-60
-30
0
30
60
90
275
250
225
200
175

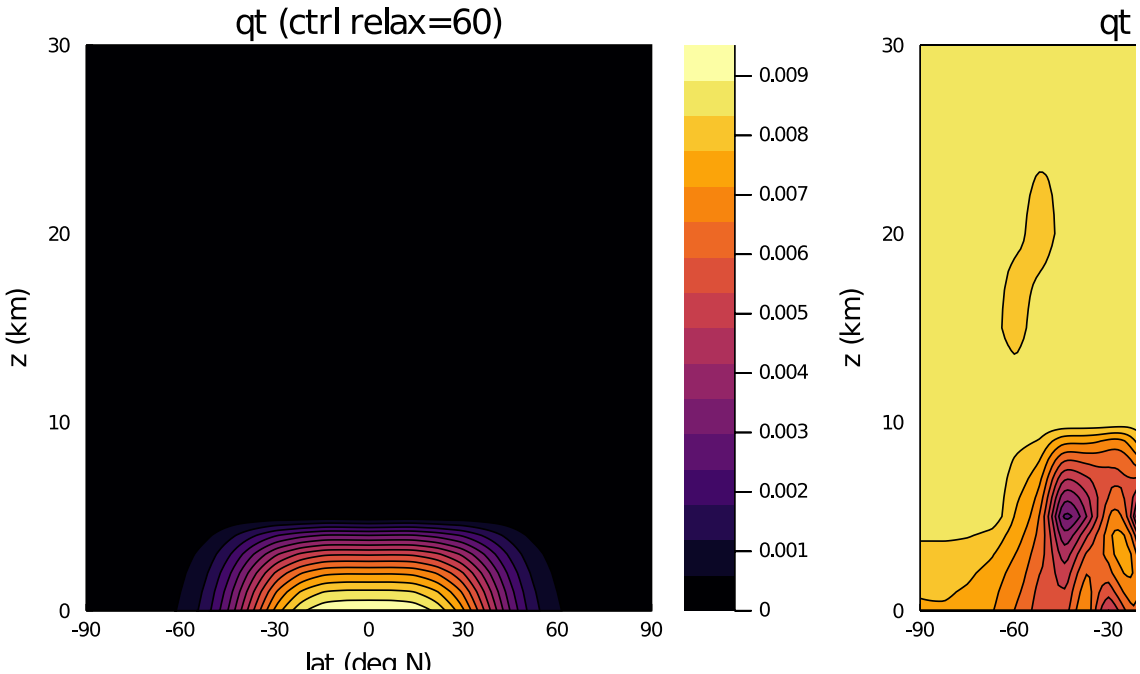
In [54]:

```
# get_zonal_mean: qt
t_slice = 18
var_name = "qt"

zm_c = get_zonal_mean(filename, var_name, nan_fill_value)
p_ctrl = contourf( lat, lev, (zm_c[:,:,t_slice])' , title="$var_name (ctrl re

# Make anomaly plots and save them in an array
plot_array = Any[p_ctrl]; # can type this more strictly
for i in 2:nexp[1]
  zm = get_zonal_mean( "$CLIMA_NETCDF/"fnames[i], var_name, nan_fill_value);
  exp_name = get_short_expname(fnames[i], "relax")
  one_plot = contourf( lat, lev, (zm[:,:,t_slice]-zm_c[:,:,t_slice])', title=
  push!(plot_array,one_plot); # make a plot and add it to the plot_array
end

fig=plot(plot_array... , layout=(1, 2), size=(1000, 400) )
#savefig(fig, string("$CLIMA_ANALYSIS/plot_$var_name","_hovmoller_sens.pdf"))
display(fig)
```



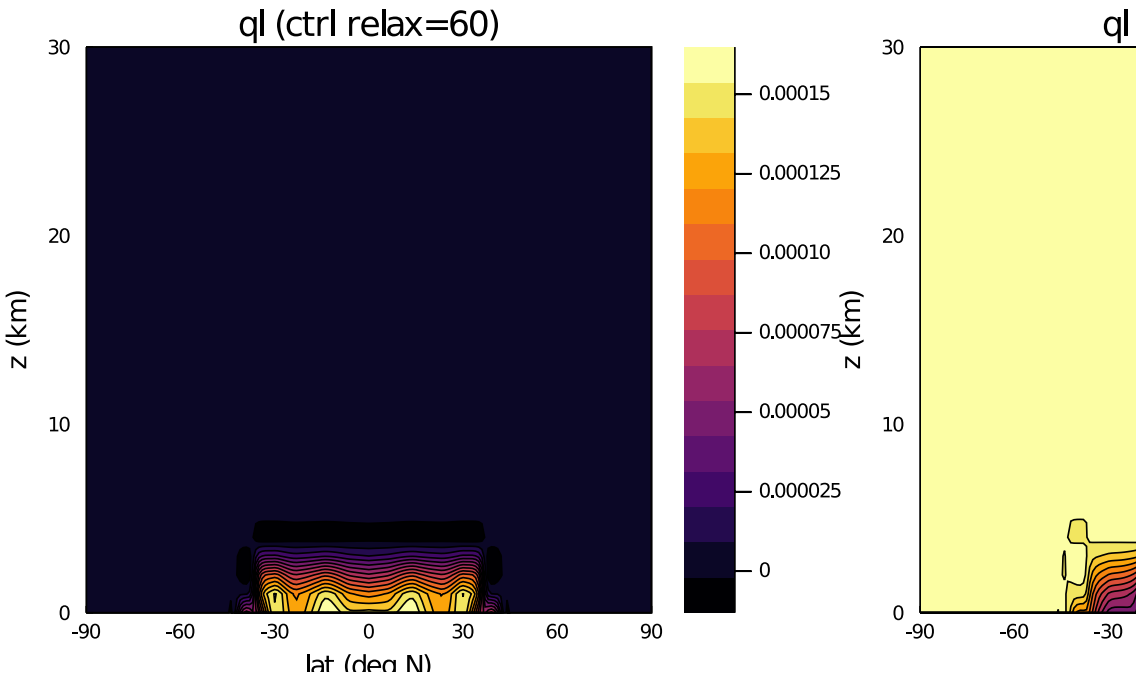
In [55]:

```
# get_zonal_mean: ql
t_slice = 18
var_name = "ql"

zm_c = get_zonal_mean(filename, var_name, nan_fill_value)
p_ctrl = contourf( lat, lev, (zm_c[:,:,t_slice])' , title="$var_name (ctrl re

# Make anomaly plots and save them in an array
plot_array = Any[p_ctrl]; # can type this more strictly
for i in 2:nexp[1]
  zm = get_zonal_mean( "$CLIMA_NETCDF/"fnames[i], var_name, nan_fill_value);
  exp_name = get_short_expname(fnames[i], "relax")
  one_plot = contourf( lat, lev, (zm[:,:,t_slice]-zm_c[:,:,t_slice])', title=
  push!(plot_array,one_plot); # make a plot and add it to the plot_array
end

fig=plot(plot_array... , layout=(1, 2), size=(1000, 400) )
#savefig(fig, string("$CLIMA_ANALYSIS/plot_$var_name","_hovmoller_sens.pdf"))
display(fig)
```



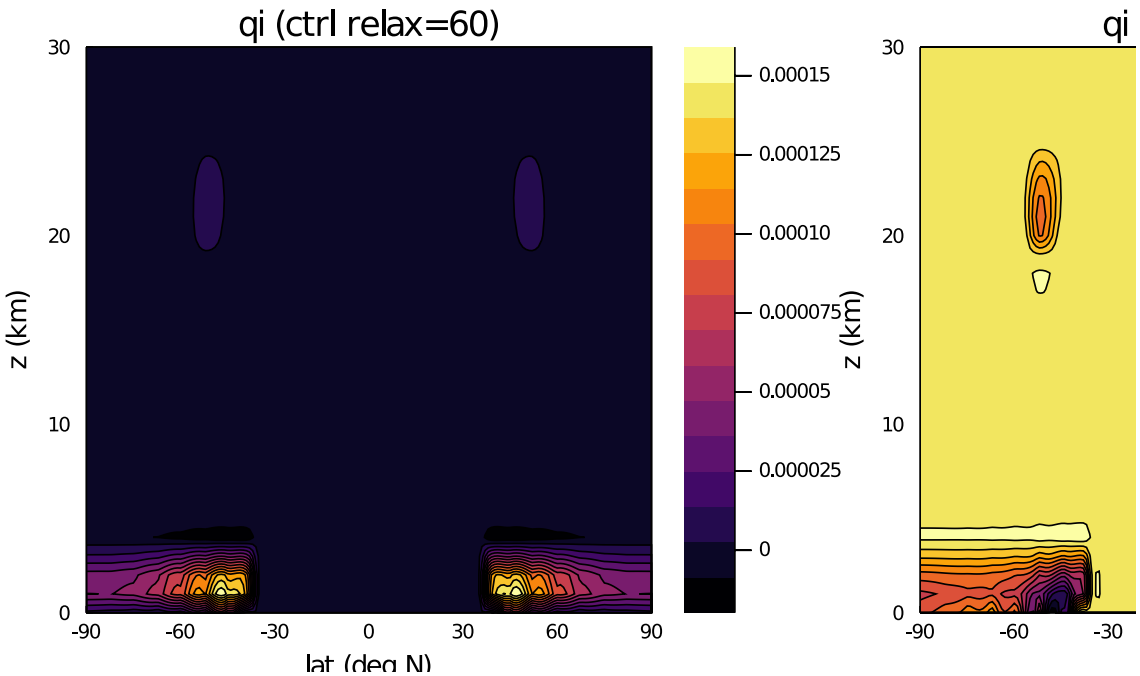
In [56]:

```
# get_zonal_mean: qi
t_slice = 18
var_name = "qi"

zm_c = get_zonal_mean(filename, var_name, nan_fill_value)
p_ctrl = contourf( lat, lev, (zm_c[:,:,t_slice])' , title="$var_name (ctrl re

# Make anomaly plots and save them in an array
plot_array = Any[p_ctrl]; # can type this more strictly
for i in 2:nexp[1]
  zm = get_zonal_mean( "$CLIMA_NETCDF/"fnames[i], var_name, nan_fill_value);
  exp_name = get_short_expname(fnames[i], "relax")
  one_plot = contourf( lat, lev, (zm[:,:,t_slice]-zm_c[:,:,t_slice])', title=
  push!(plot_array,one_plot); # make a plot and add it to the plot_array
end

fig=plot(plot_array... , layout=(1, 2), size=(1000, 400) )
#savefig(fig, string("$CLIMA_ANALYSIS/plot_$var_name","_hovmoller_sens.pdf"))
display(fig)
```



In [ ]:

```
1
```