```r
library(plyr)
library(dplyr)
```

```
##
## Attaching package:  'dplyr'
## The following objects are masked from 'package:plyr':
##
##    arrange, count, desc, failwith, id, mutate, rename, summarise,
##    summarize
## The following objects are masked from 'package:stats':
##
##    filter, lag
## The following objects are masked from 'package:base':
##
##    intersect, setdiff, setequal, union
```

```r
library(tidyr)
library(lubridate)
```

```
##
## Attaching package:  'lubridate'
## The following object is masked from 'package:plyr':
##
##    here
## The following object is masked from 'package:base':
##
##    date
```

```r
library(ggplot2)
library(grid)

library(MMWRweek)
library(cdcfluview)

get_legend_grob <- function(x) {
  data <- ggplot2:::ggplot_build(x)

  plot <- data$plot
  panel <- data$panel
  data <- data$data
  theme <- ggplot2:::plot_theme(plot)
  position <- theme$legend.position
  if (length(position) == 2) {
    position <- "manual"
  }

  legend_box <- if (position != "none") {
    ggplot2:::build_guides(plot$scales, plot$layers, plot$mapping,
      position, theme, plot$guides, plot$labels)
```

```
  } else {
    ggplot2:::zeroGrob()
  }
  if (ggplot2:::is.zero(legend_box)) {
    position <- "none"
  }
  else {
    legend_width <- gtable:::gtable_width(legend_box) + theme$legend.margin
    legend_height <- gtable:::gtable_height(legend_box) + theme$legend.margin
    just <- valid.just(theme$legend.justification)
    xjust <- just[1]
    yjust <- just[2]
    if (position == "manual") {
      xpos <- theme$legend.position[1]
      ypos <- theme$legend.position[2]
      legend_box <- editGrob(legend_box, vp = viewport(x = xpos,
        y = ypos, just = c(xjust, yjust), height = legend_height,
        width = legend_width))
    }
    else {
      legend_box <- editGrob(legend_box, vp = viewport(x = xjust,
        y = yjust, just = c(xjust, yjust)))
    }
  }
  return(legend_box)
}
```

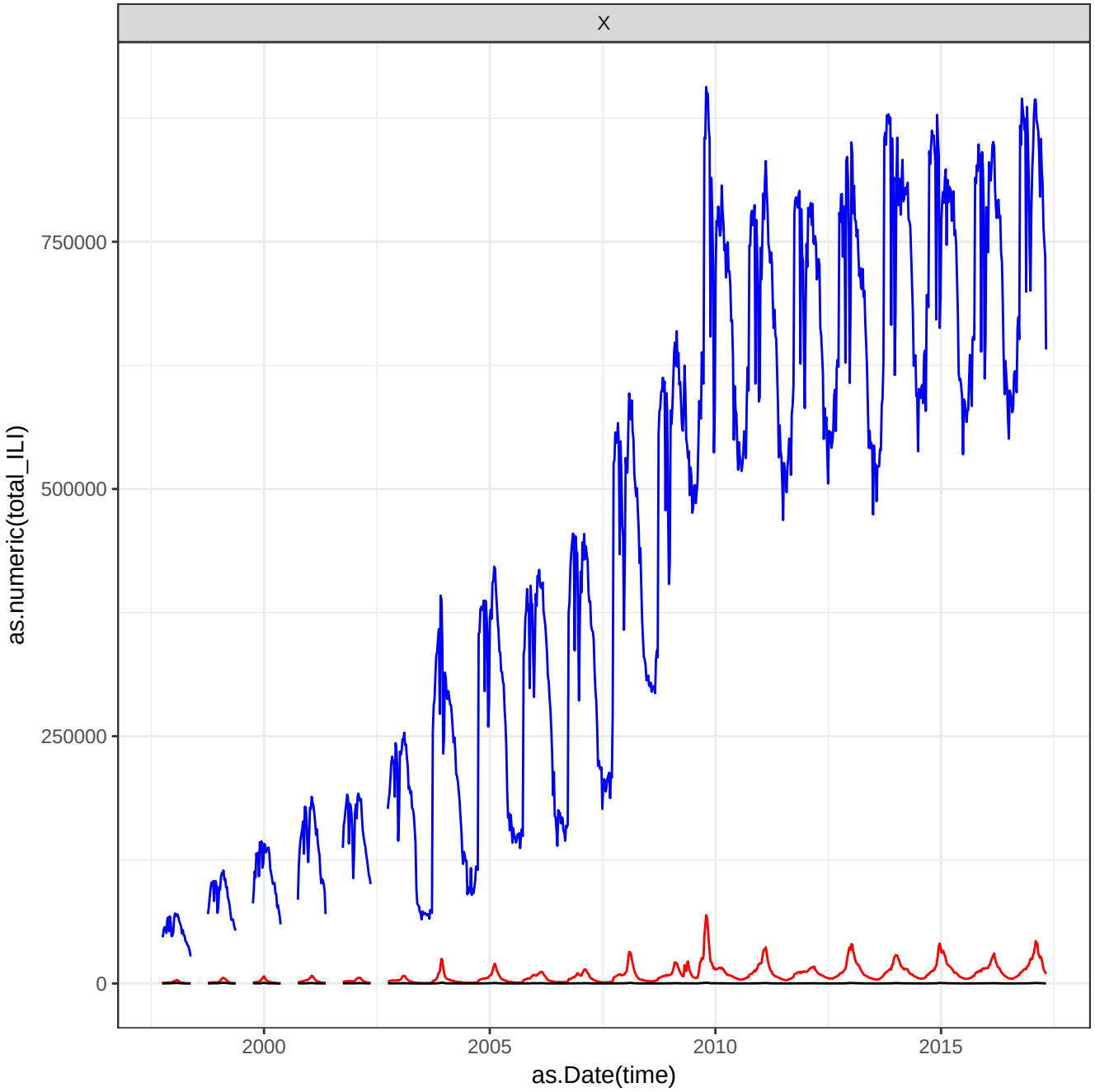
```
regionflu <- get_flu_data("hhs",
  sub_region = 1:10,
  data_source = "ilinet",
  years=1997:2017)
usflu <- get_flu_data("national",
  sub_region = NA,
  data_source = "ilinet",
  years=1997:2017)

flu_merged <- rbind.fill(usflu, regionflu) %>%
  transmute(
    region_type = `REGION TYPE`,
    region = REGION,
    year = YEAR,
    week = WEEK,
    wILI = as.numeric(`% WEIGHTED ILI`),
    ILI = as.numeric(`%UNWEIGHTED ILI`),
    total_ILI = as.numeric(ILITOTAL),
    total_patients = as.numeric(`TOTAL PATIENTS`)
  ) %>%
```

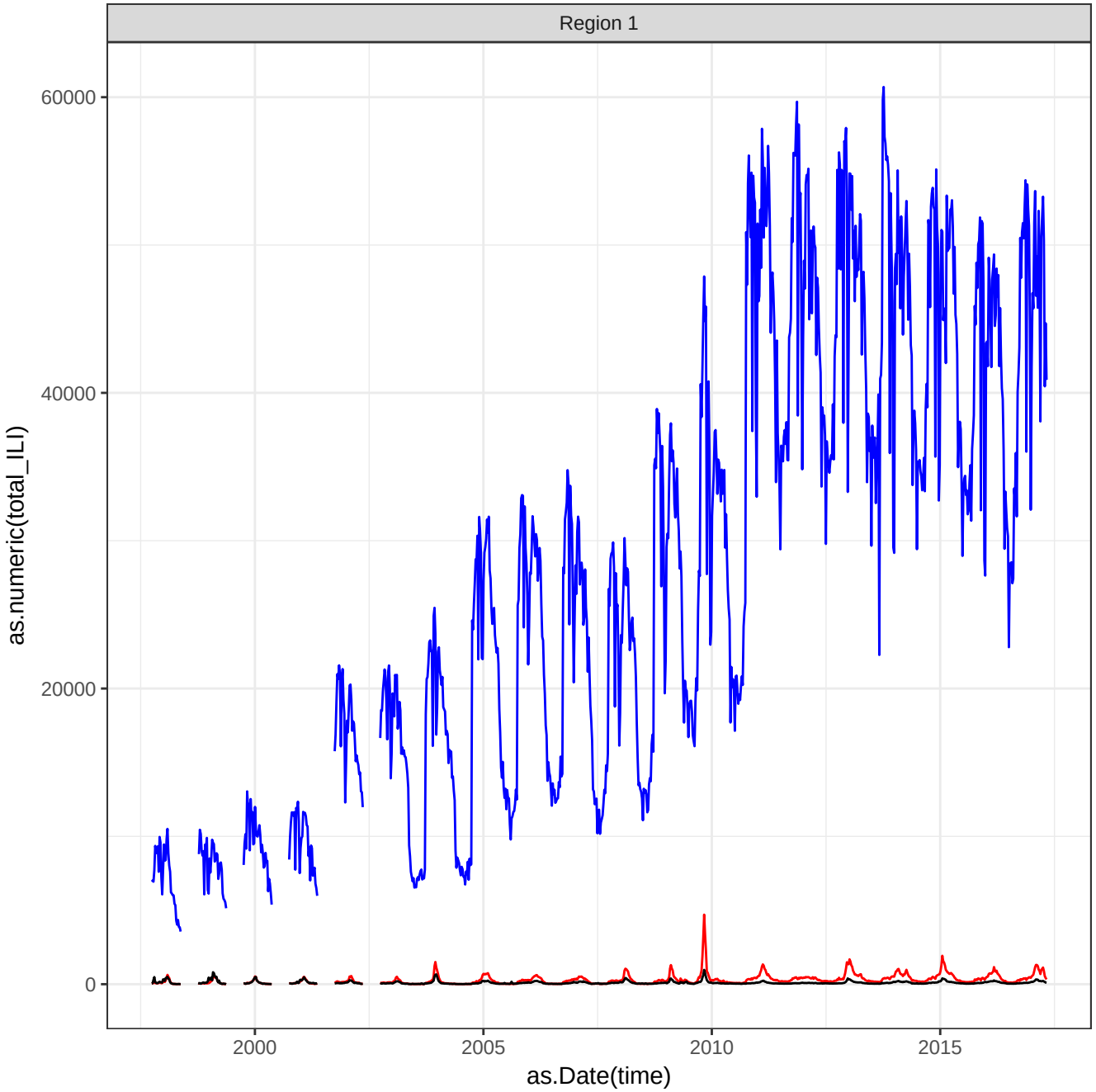
```
  mutate(
    time = MMWRweek2Date(year, week)
  )
```

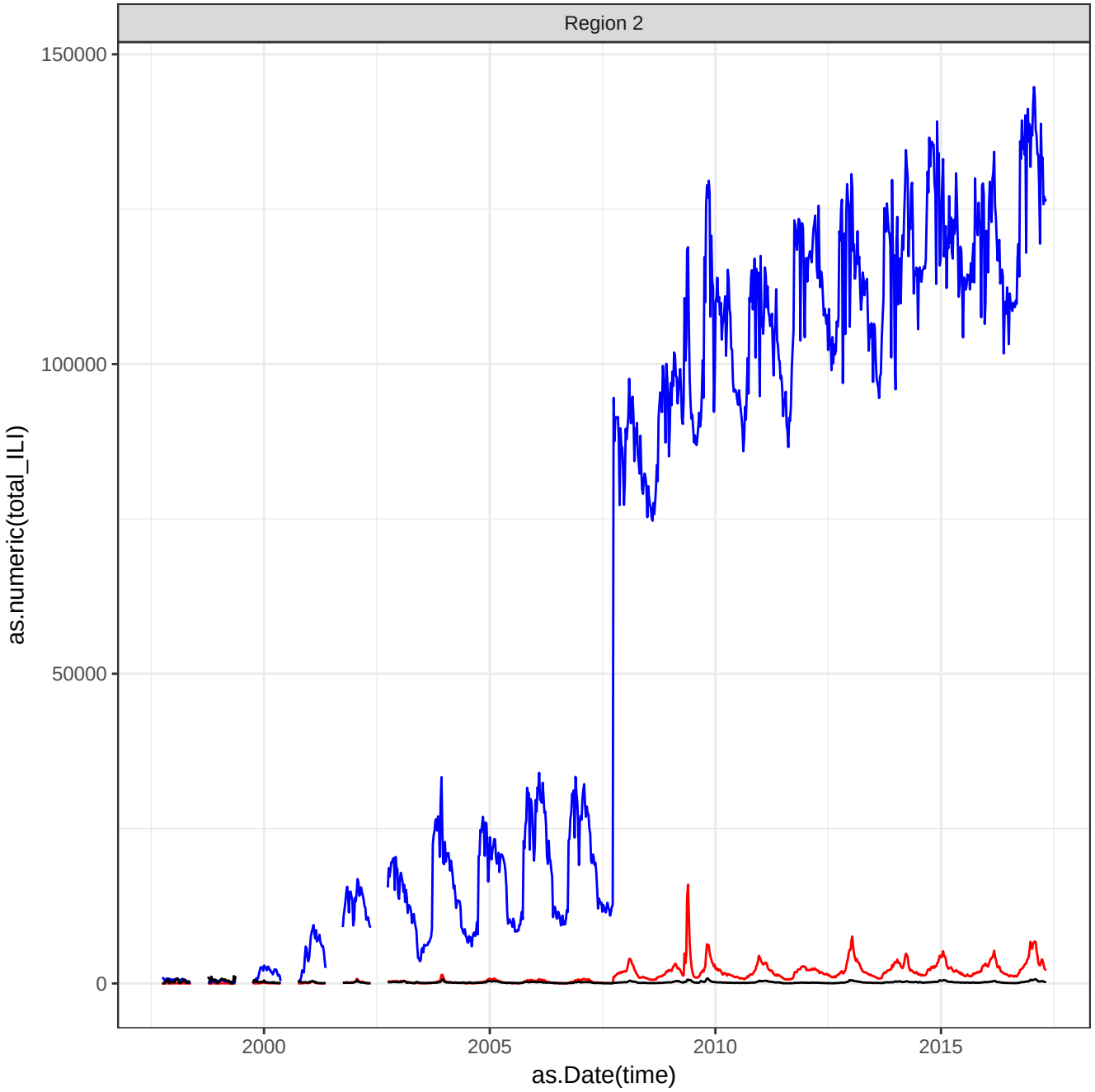
```
## Warning in evalq(as.numeric(c("1.10148", "1.20007", "1.37876", "1.1992", :  NAs introduced by coercion
## Warning in evalq(as.numeric(c("1.21686", "1.28064", "1.23906", "1.14473", :  NAs introduced by coercion
## Warning in evalq(as.numeric(c("570", "615", "681", "653", "700", "655", :  NAs introduced by coercion
## Warning in evalq(as.numeric(c("46842", "48023", "54961", "57044", "55506", :  NAs introduced by coercion
```

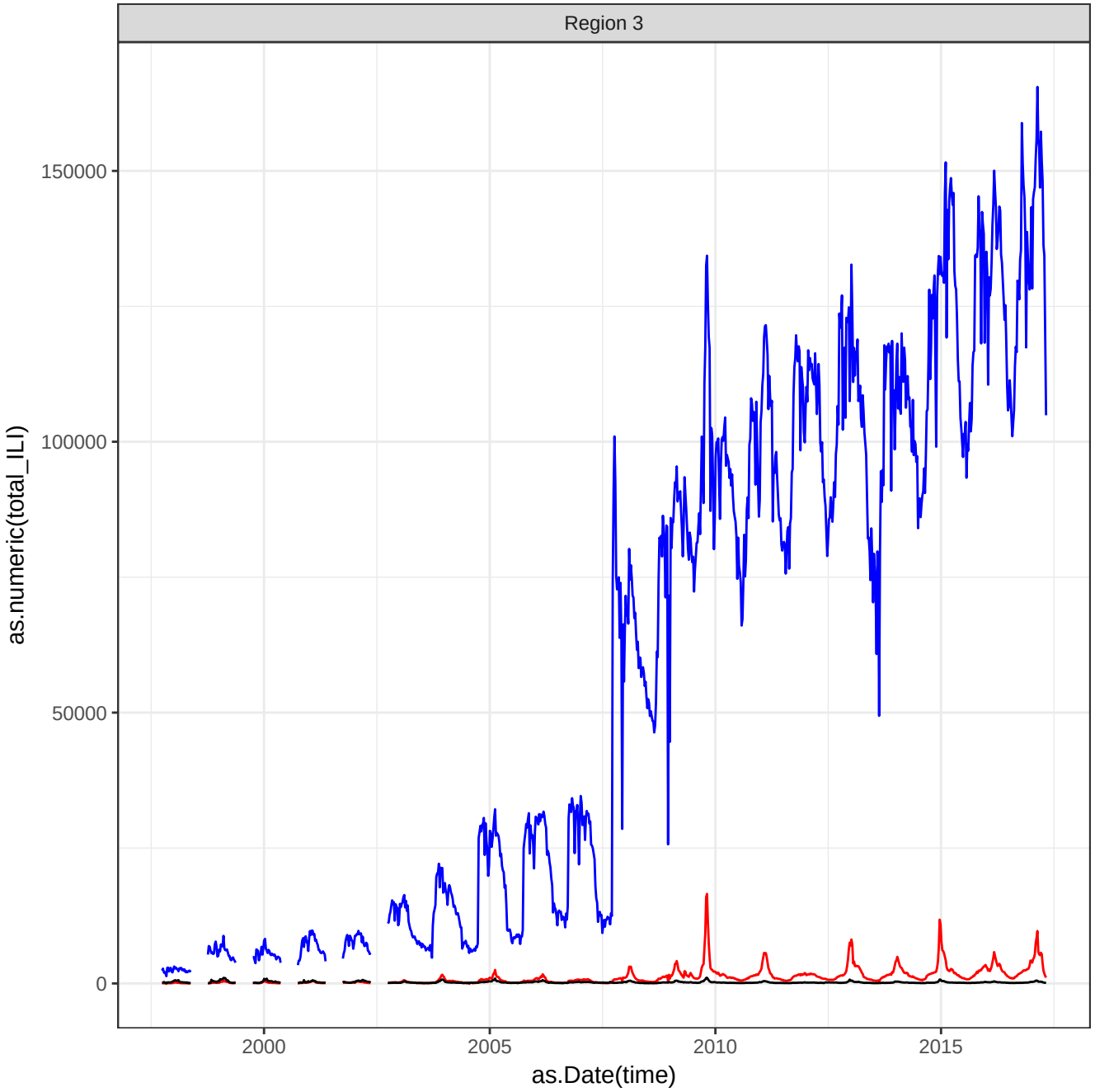
```
flu_merged$season <- ifelse(
    flu_merged$week <= 30,
    paste0(flu_merged$year - 1, "/", flu_merged$year),
    paste0(flu_merged$year, "/", flu_merged$year + 1)
  )

  ## Season week column: week number within season
  ## weeks after week 30 get season_week = week - 30
  ## weeks before week 30 get season_week = week + (number of weeks in previous year) - 30
  ## This computation relies on the start_date function in package MMWRweek,
  ## which is not exported from that package's namespace!!!
  flu_merged$season_week <- ifelse(
    flu_merged$week <= 30,
    flu_merged$week + MMWRweek(MMWRweek:::start_date(flu_merged$year) - 1)$MMWRweek - 30,
    flu_merged$week - 30
  )
```

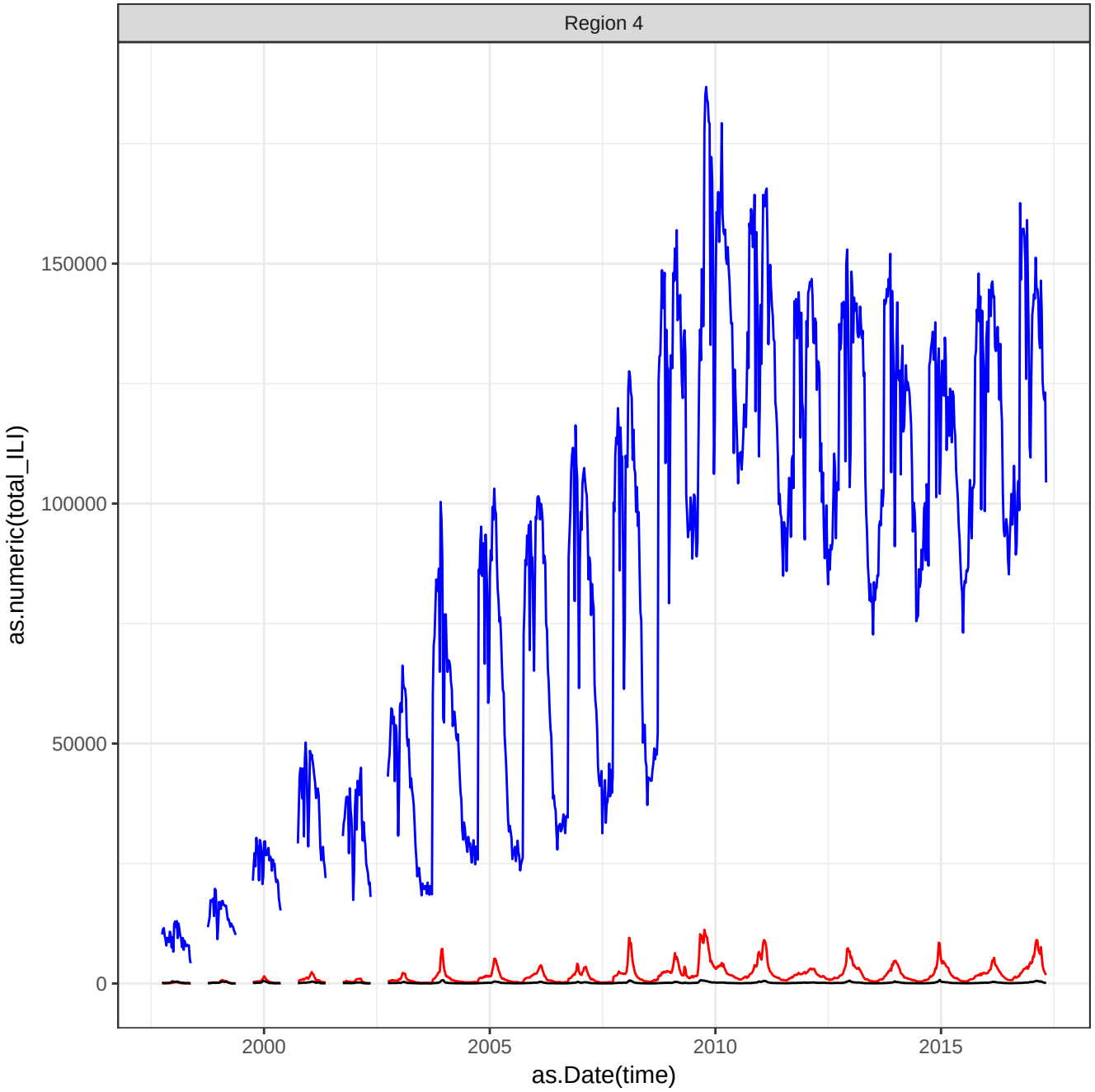
```
palette <- c("#000000", "#E69F00", "#56B4E9", "#009E73", "#F0E442", "#0072B2", "#D55E00", "#CC79A7", rainbow(3))
for(region_val in unique(flu_merged$region)) {
  p <- ggplot() +
    geom_line(aes(x = as.Date(time), y = as.numeric(total_ILI)),
      colour = "red",
      data = flu_merged %>% filter(region == region_val)) +
    geom_line(aes(x = as.Date(time), y = as.numeric(total_patients)),
      colour = "blue",
      data = flu_merged %>% filter(region == region_val)) +
    geom_line(aes(x = as.Date(time), y = 100 * as.numeric(wILI)),
      colour = "black",
      data = flu_merged %>% filter(region == region_val)) +
    facet_wrap(~ region) +
    theme_bw()
  print(p)
}
```

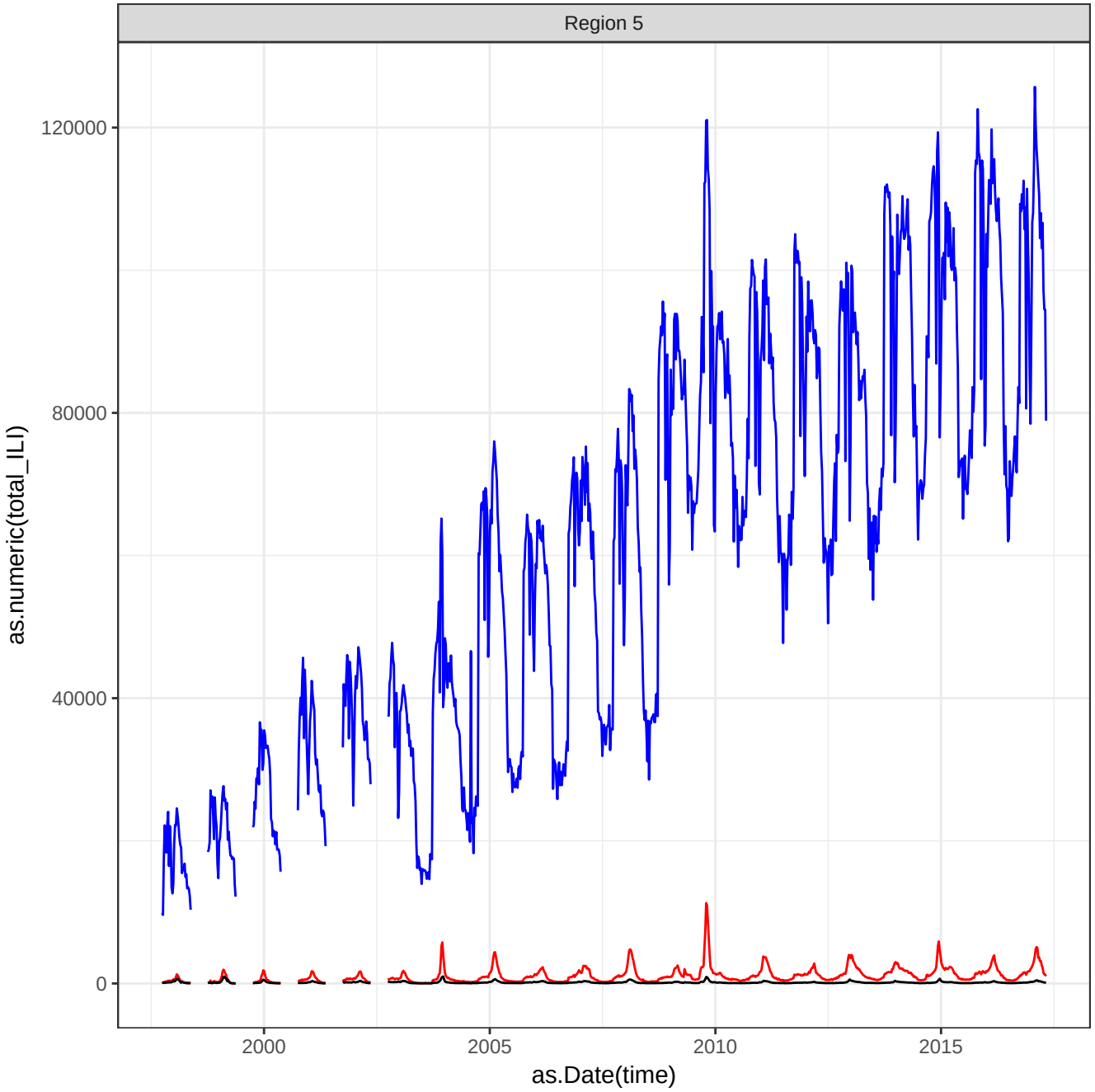

X
750000
500000
250000
0
as.numeric(total_ILI)
2000
2005
2010
2015
as.Date(time)

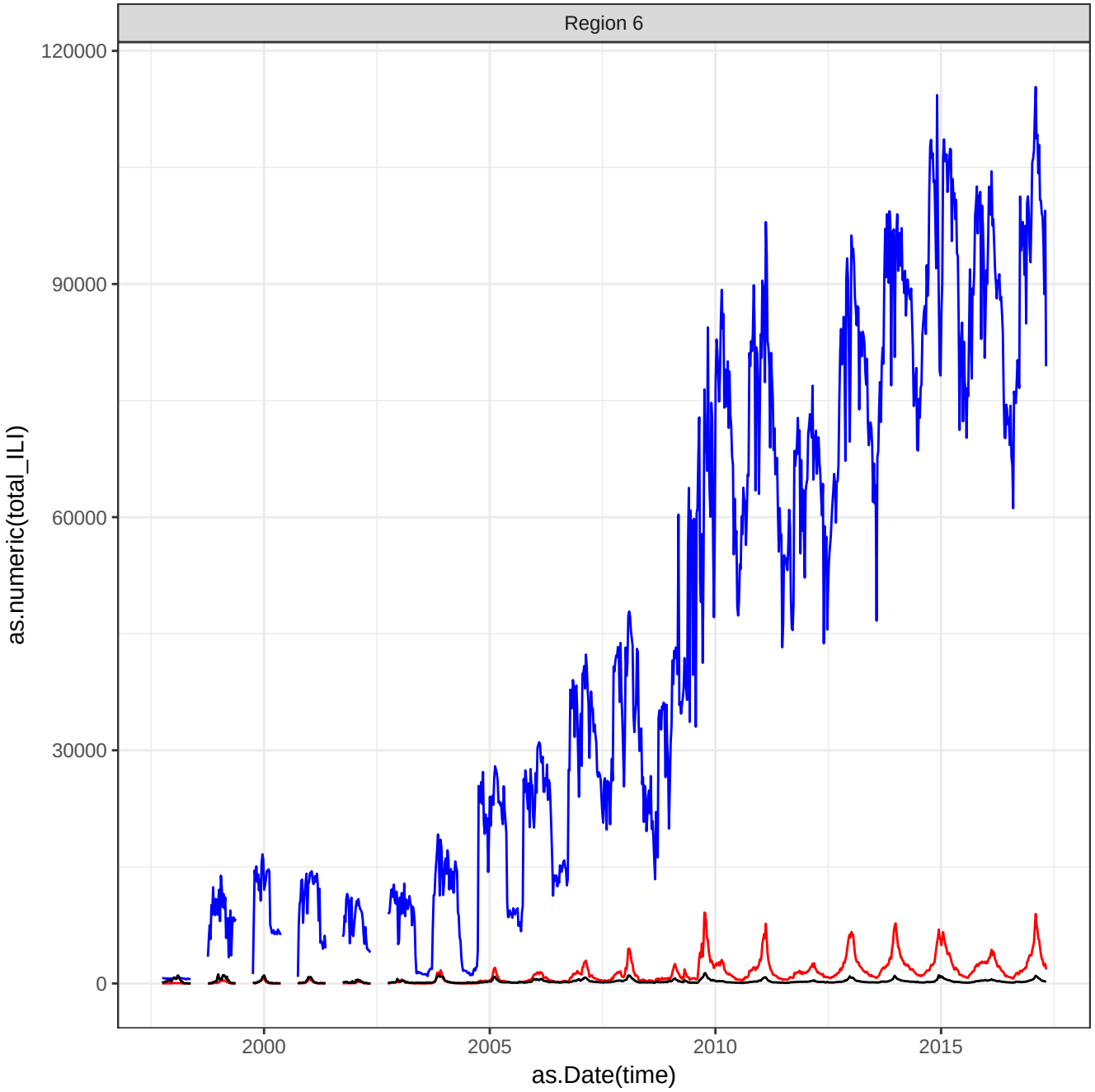

Region 1
60000
40000
20000
0
as.numeric(total_ILI)
2000
2005
2010
2015
as.Date(time)

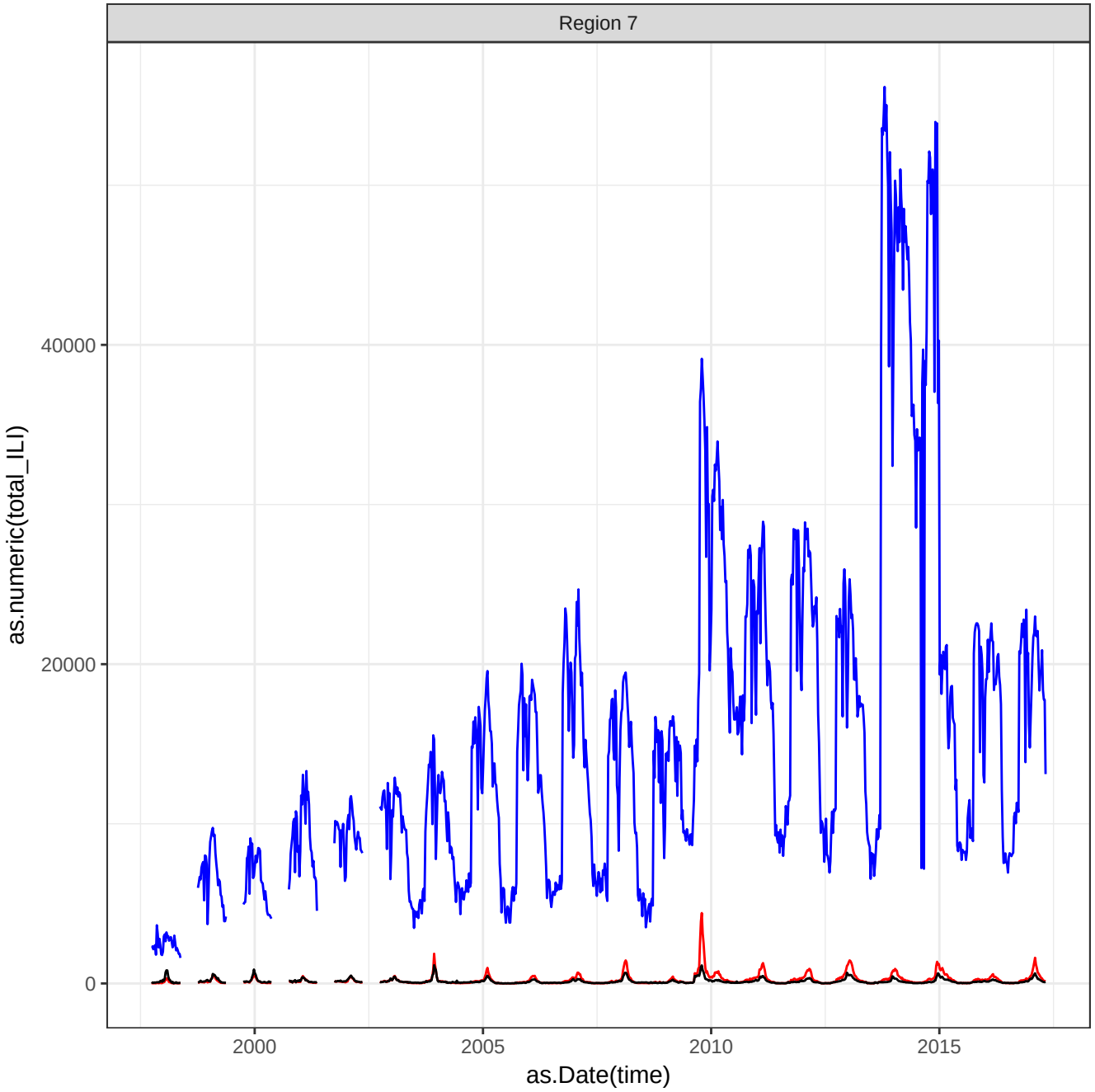

Region 2
150000
100000
50000
0
as.numeric(total_ILI)
2000
2005
2010
2015
as.Date(time)

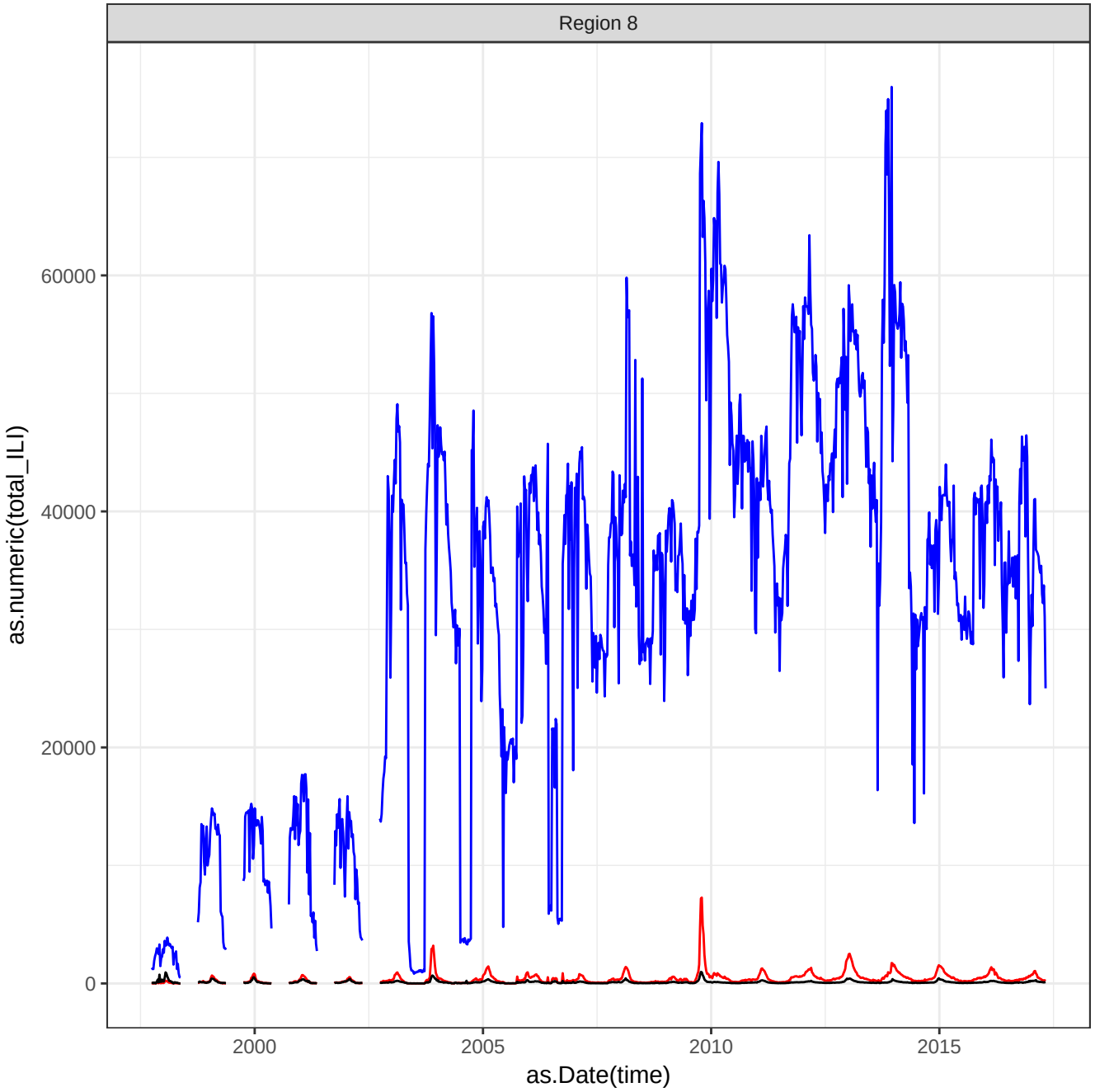

Region 3
150000
100000
50000
0
as.numeric(total_ILI)
2000
2005
2010
2015
as.Date(time)

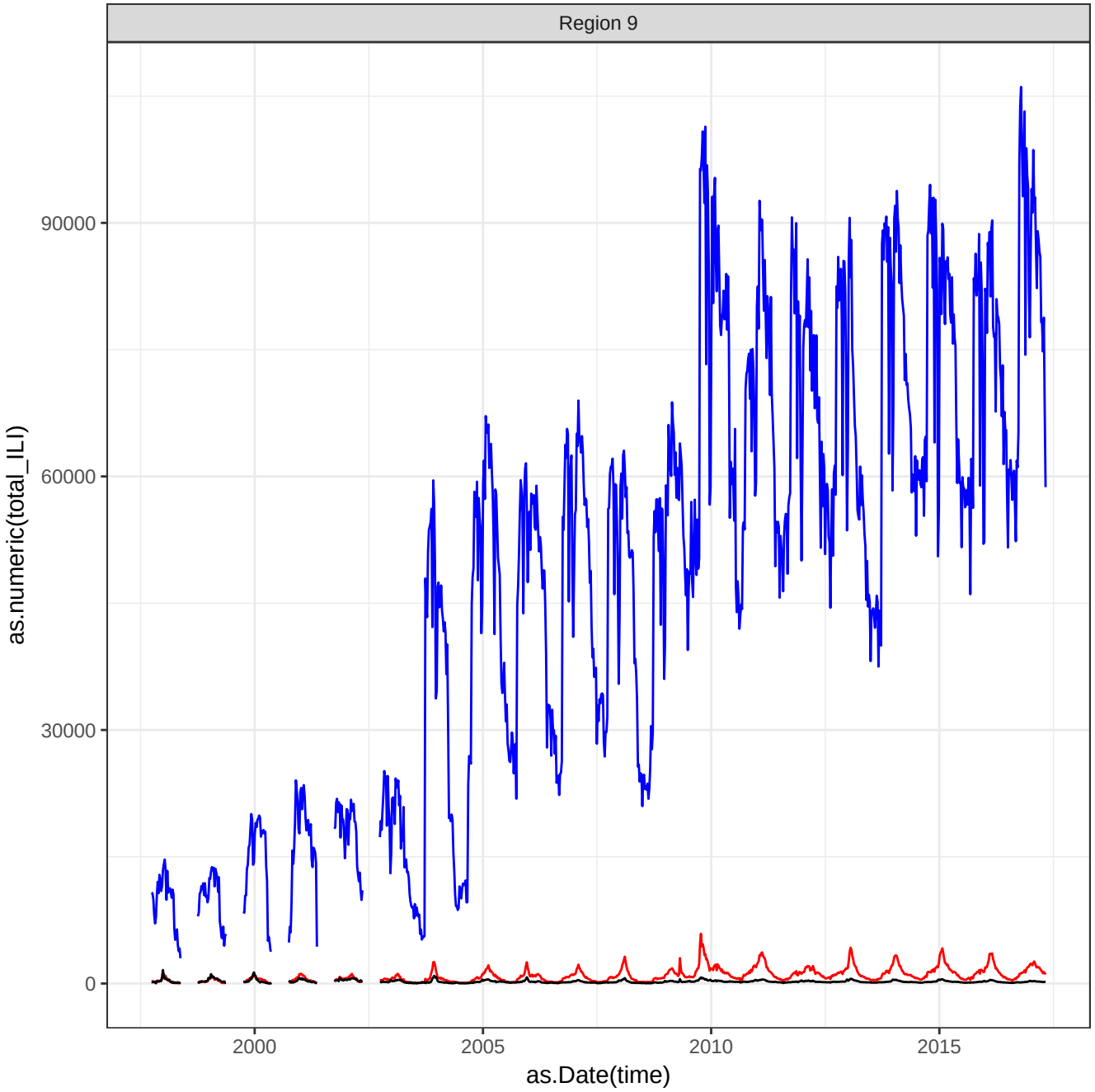

Region 4
150000
100000
50000
0
as.numeric(total_ILI)
2000
2005
2010
2015
as.Date(time)

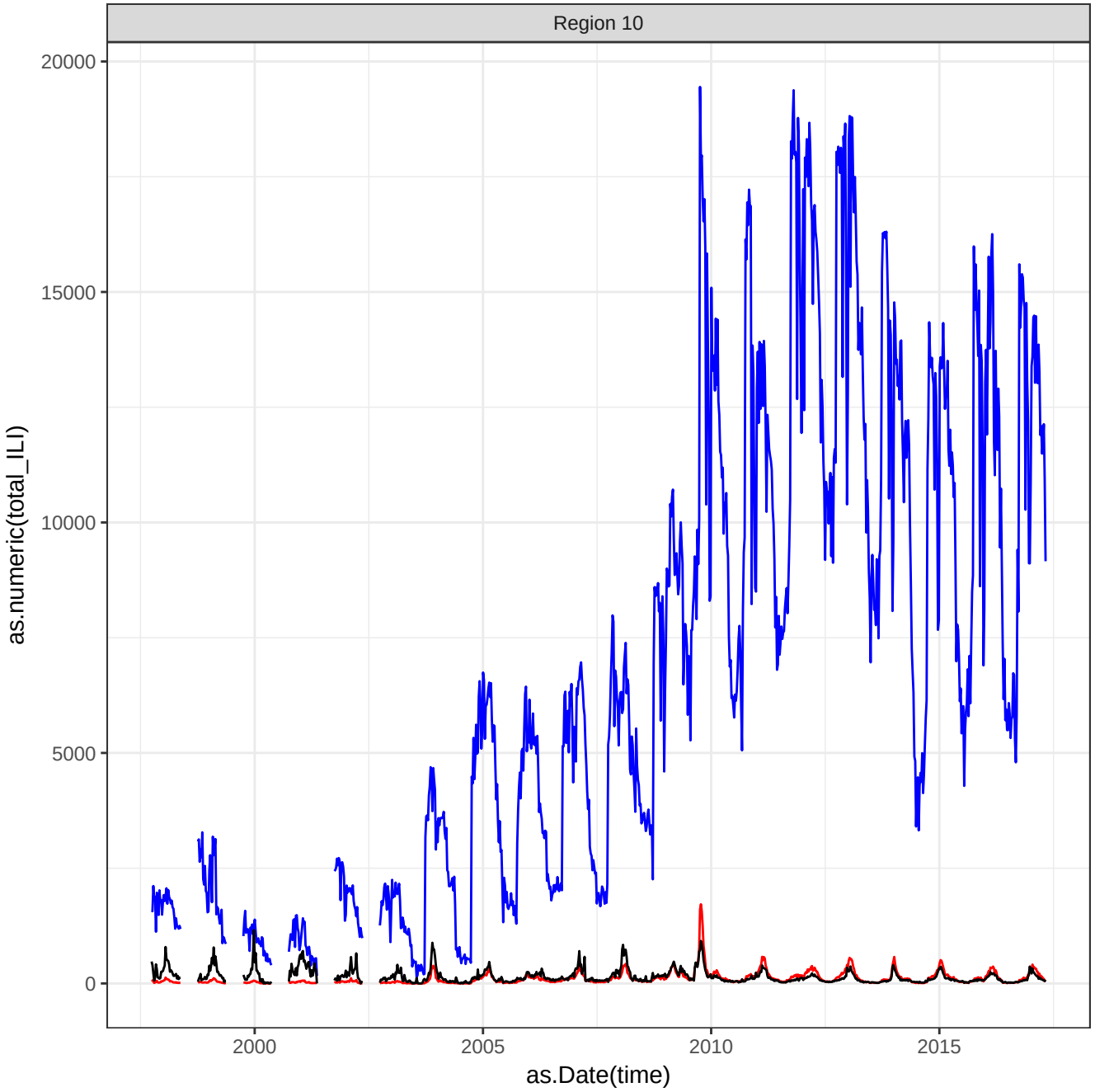

Region 5
120000
80000
40000
0
as.numeric(total_ILI)
2000
2005
2010
2015
as.Date(time)


Region 6
120000
90000
60000
30000
0
as.numeric(total_ILI)
2000
2005
2010
2015
as.Date(time)


Region 7
40000
20000
0
as.numeric(total_ILI)
2000
2005
2010
2015
as.Date(time)


Region 8
as.numeric(total_ILI)
60000
40000
20000
0
2000
2005
2010
2015
as.Date(time)

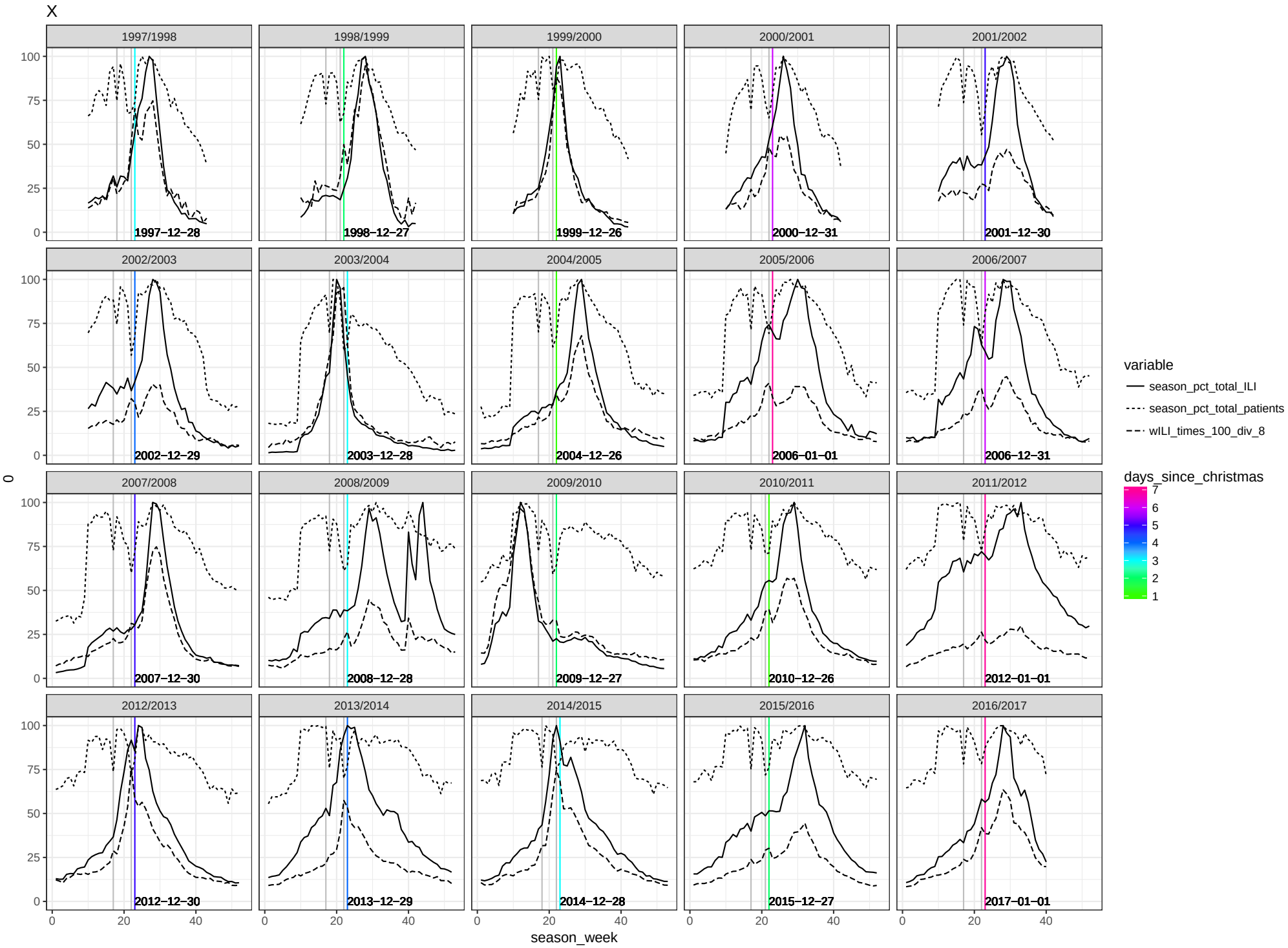

Region 9
90000
60000
30000
0
as.numeric(total_ILI)
2000
2005
2010
2015
as.Date(time)

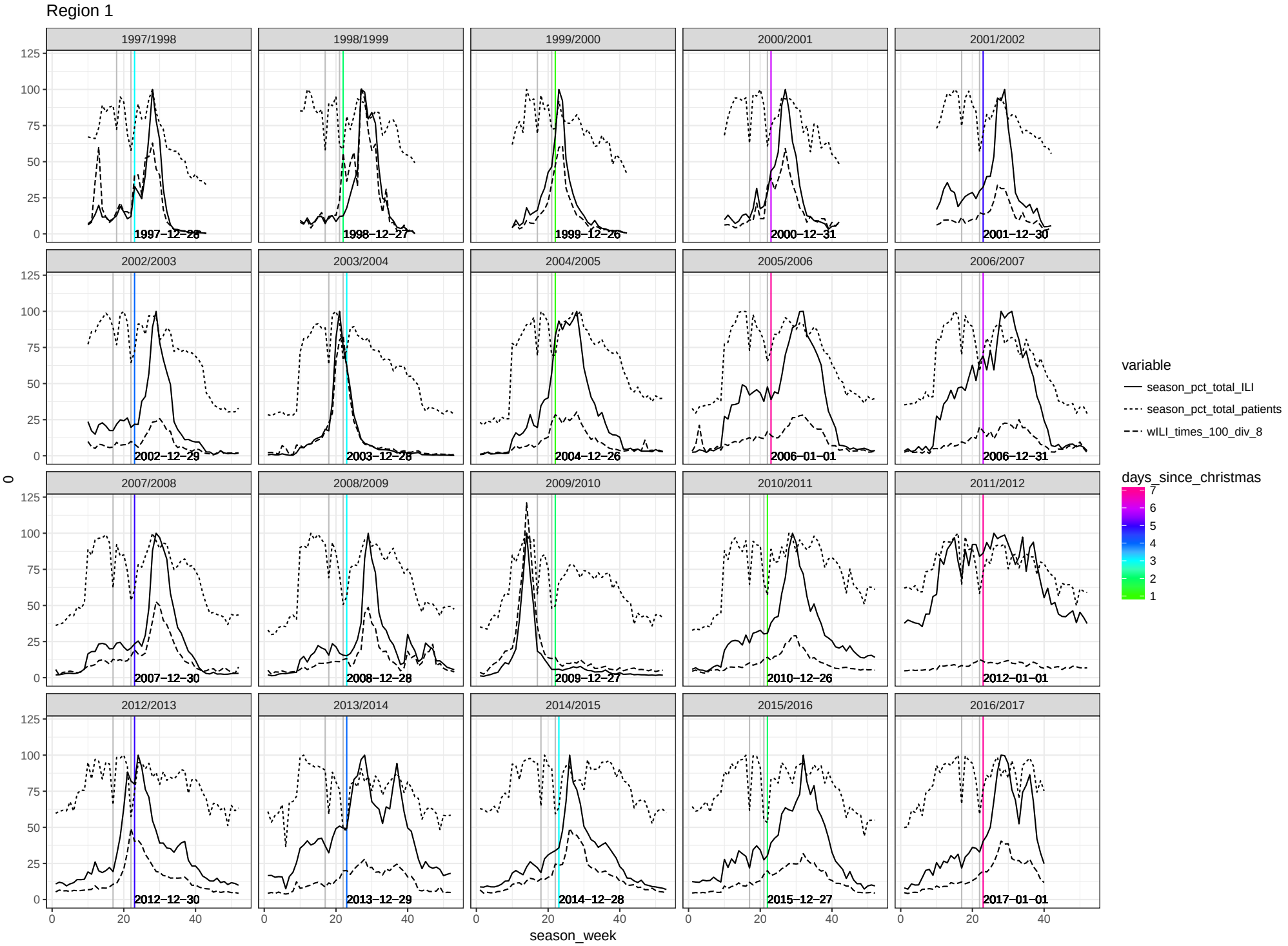


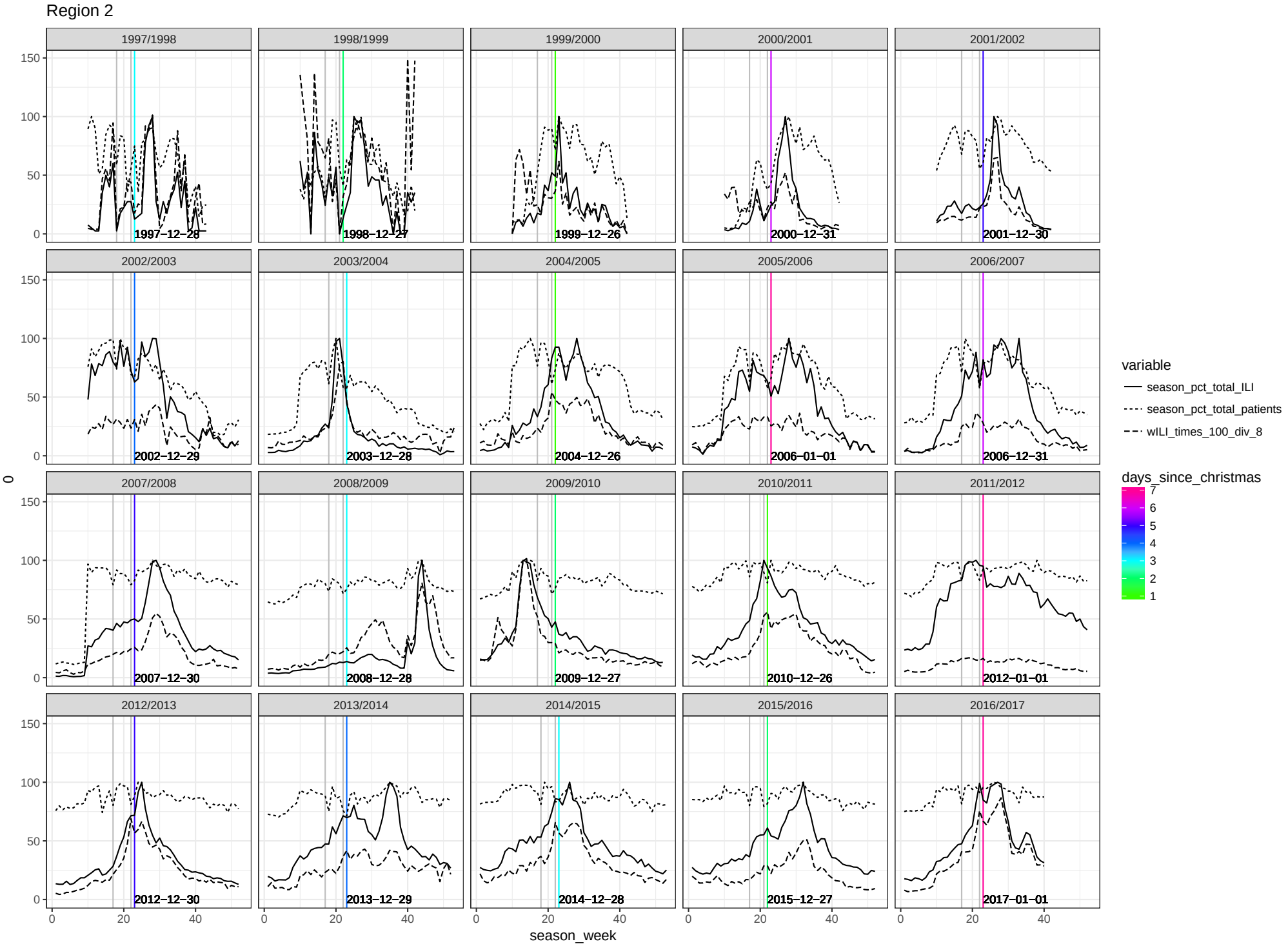

```
flu_merged <- flu_merged %>%
  group_by(region, season) %>%
  mutate(
    season_max_total_ILI = max(total_ILI, na.rm = TRUE),
    season_max_total_patients = max(total_patients, na.rm = TRUE),
```

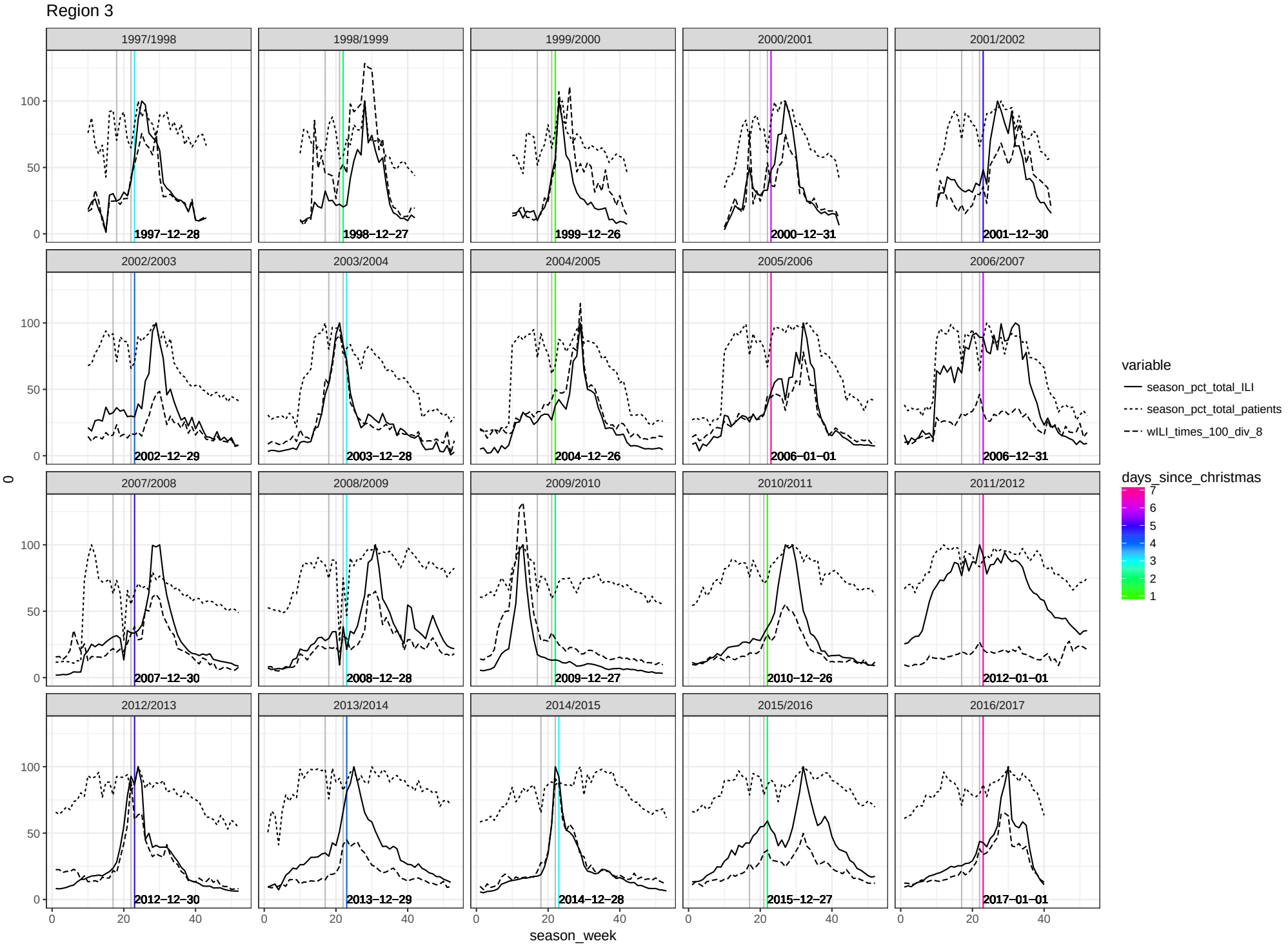
```
    season_pct_total_ILI = total_ILI / season_max_total_ILI * 100,
    season_pct_total_patients = total_patients / season_max_total_patients * 100,
    wILI_times_100_div_8 = wILI * 100 / 8,
    leq_christmas_week = (month(time) == 12 & day(time) <= 25),
    csum_leq_christmas_week = cumsum(month(time) == 12 & day(time) <= 25) + leq_christmas_week,
    christmas_week = (csum_leq_christmas_week == max(csum_leq_christmas_week)),
    prev_week_incl_nov_thursday = ((month(time) == 11) & (mday(time) >= 3)),
    csum_prev_week_incl_nov_thursday = cumsum(prev_week_incl_nov_thursday) +
      prev_week_incl_nov_thursday -
      !prev_week_incl_nov_thursday,
    thanksgiving_week = (csum_prev_week_incl_nov_thursday == 4)
  ) %>%
  select(-leq_christmas_week,
    -csum_leq_christmas_week,
    -prev_week_incl_nov_thursday,
    -csum_prev_week_incl_nov_thursday)

christmas_week_times <- unique(flu_merged$time[flu_merged$christmas_week])
flu_merged$christmas_week_plus_1 <- FALSE
flu_merged$christmas_week_plus_1[
  flu_merged$time %in% (christmas_week_times + 7)] <- TRUE

christmas_week_plus_1_inds <- which(flu_merged$christmas_week_plus_1)
flu_merged$christmas_week_time <-
  ymd(
    paste(
      year(flu_merged$time - 7),
      "12",
      "25",
      sep = "-"
    )
  )

flu_merged$days_since_christmas <- NA
flu_merged$days_since_christmas[christmas_week_plus_1_inds] <-
  (as.Date(flu_merged$time[christmas_week_plus_1_inds]) -
    flu_merged$christmas_week_time[christmas_week_plus_1_inds])
flu_merged$days_since_christmas <- as.numeric(flu_merged$days_since_christmas)

flu_gathered_pcts <- flu_merged %>%
  select(region,
    season,
    season_week,
    christmas_week,
    christmas_week_plus_1,
    days_since_christmas,
    thanksgiving_week,
```

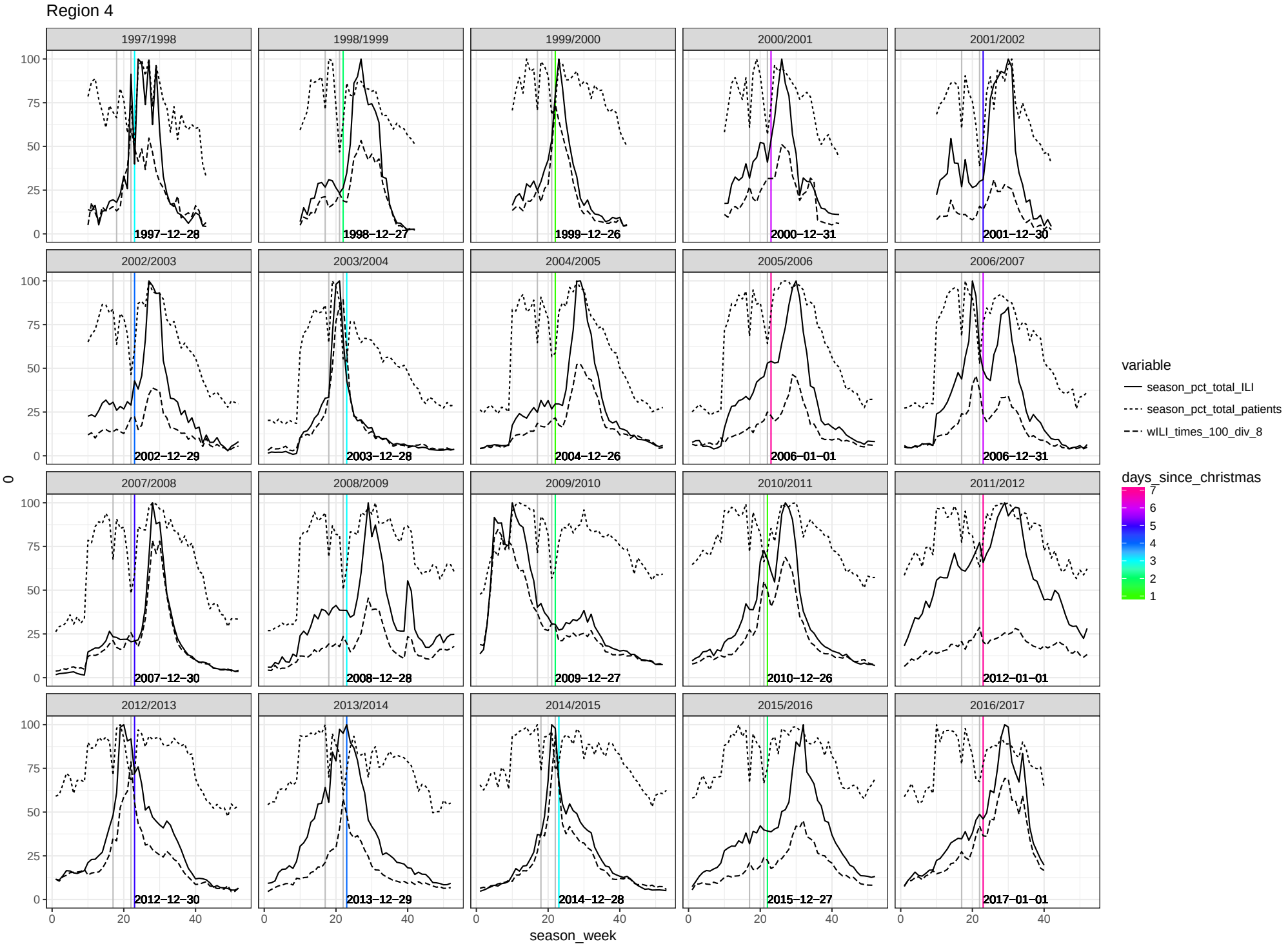
```
    season_pct_total_ILI,
    season_pct_total_patients,
    wILI_times_100_div_8) %>%
  gather_("variable", "value",
    c("season_pct_total_ILI",
      "season_pct_total_patients",
      "wILI_times_100_div_8"))

palette <- c("#000000", "#E69F00", "#56B4E9", "#009E73", "#F0E442", "#0072B2", "#D55E00", "#CC79A7", rainbow(3))
for(region_val in unique(flu_merged$region)) {
  p <- ggplot() +
    geom_vline(aes(xintercept = season_week),
      colour = "grey",
      data = flu_merged %>% filter(christmas_week)) +
    geom_vline(aes(xintercept = season_week, colour = days_since_christmas),
      data = flu_merged %>% filter(christmas_week_plus_1)) +
    geom_vline(aes(xintercept = season_week),
      colour = "grey",
      data = flu_merged %>% filter(thanksgiving_week)) +
    geom_text(aes(x = season_week, y = 0, label = as.Date(time)),
      hjust = 0,
      size = 3,
      data = flu_merged %>% filter(christmas_week_plus_1)) +
    geom_line(aes(x = season_week, y = value,
      linetype = variable),
      data = flu_gathered_pcts %>% filter(region == region_val)) +
    scale_colour_gradientn(colours = rainbow(10)[4:10]) +
    ggtitle(region_val) +
    facet_wrap(~ season) +
    theme_bw()
  print(p)
}
```

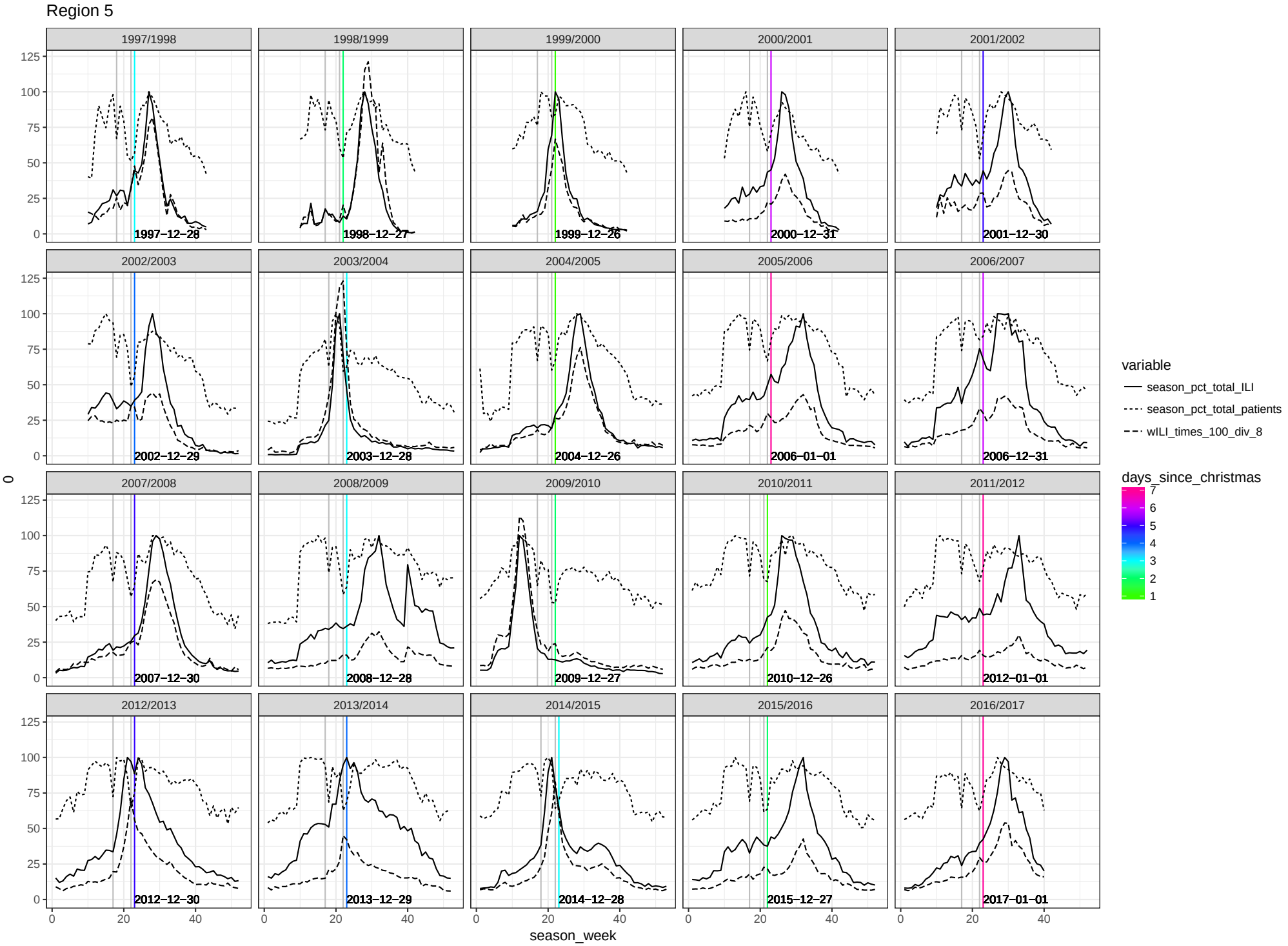

X
1997/1998
1998/1999
1999/2000
2000/2001
2001/2002
2002/2003
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
2015/2016
2016/2017
1997−12−28
1998−12−27
1999−12−26
2000−12−31
2001−12−30
2002−12−29
2003−12−28
2004−12−26
2006−01−01
2006−12−31
2007−12−30
2008−12−28
2009−12−27
2010−12−26
2012−01−01
2012−12−30
2013−12−29
2014−12−28
2015−12−27
2017−01−01
0
25
50
75
100
0
20
40
season_week
variable
season_pct_total_ILI
season_pct_total_patients
wILI_times_100_div_8
days_since_christmas
7
6
5
4
3
2
1


Region 1
1997/1998
1998/1999
1999/2000
2000/2001
2001/2002
2002/2003
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
2015/2016
2016/2017
1997−12−28
1998−12−27
1999−12−26
2000−12−31
2001−12−30
2002−12−29
2003−12−28
2004−12−26
2006−01−01
2006−12−31
2007−12−30
2008−12−28
2009−12−27
2010−12−26
2012−01−01
2012−12−30
2013−12−29
2014−12−28
2015−12−27
2017−01−01
0
25
50
75
100
125
0
20
40
season_week
variable
season_pct_total_ILI
season_pct_total_patients
wILI_times_100_div_8
days_since_christmas
7
6
5
4
3
2
1


Region 2
1997/1998
1998/1999
1999/2000
2000/2001
2001/2002
2002/2003
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
2015/2016
2016/2017
1997−12−28
1998−12−27
1999−12−26
2000−12−31
2001−12−30
2002−12−29
2003−12−28
2004−12−26
2006−01−01
2006−12−31
2007−12−30
2008−12−28
2009−12−27
2010−12−26
2012−01−01
2012−12−30
2013−12−29
2014−12−28
2015−12−27
2017−01−01
0
50
100
150
0
20
40
season_week
variable
season_pct_total_ILI
season_pct_total_patients
wILI_times_100_div_8
days_since_christmas
7
6
5
4
3
2
1


Region 3
1997/1998
1998/1999
1999/2000
2000/2001
2001/2002
2002/2003
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
2015/2016
2016/2017
1997−12−28
1998−12−27
1999−12−26
2000−12−31
2001−12−30
2002−12−29
2003−12−28
2004−12−26
2006−01−01
2006−12−31
2007−12−30
2008−12−28
2009−12−27
2010−12−26
2012−01−01
2012−12−30
2013−12−29
2014−12−28
2015−12−27
2017−01−01
0
50
100
0
20
40
season_week
variable
season_pct_total_ILI
season_pct_total_patients
wILI_times_100_div_8
days_since_christmas
7
6
5
4
3
2
1


Region 4
1997/1998
1998/1999
1999/2000
2000/2001
2001/2002
2002/2003
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
2015/2016
2016/2017
1997−12−28
1998−12−27
1999−12−26
2000−12−31
2001−12−30
2002−12−29
2003−12−28
2004−12−26
2006−01−01
2006−12−31
2007−12−30
2008−12−28
2009−12−27
2010−12−26
2012−01−01
2012−12−30
2013−12−29
2014−12−28
2015−12−27
2017−01−01
0
25
50
75
100
0
20
40
season_week
variable
season_pct_total_ILI
season_pct_total_patients
wILI_times_100_div_8
days_since_christmas
7
6
5
4
3
2
1


Region 5
1997/1998
1998/1999
1999/2000
2000/2001
2001/2002
2002/2003
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
2015/2016
2016/2017
1997−12−28
1998−12−27
1999−12−26
2000−12−31
2001−12−30
2002−12−29
2003−12−28
2004−12−26
2006−01−01
2006−12−31
2007−12−30
2008−12−28
2009−12−27
2010−12−26
2012−01−01
2012−12−30
2013−12−29
2014−12−28
2015−12−27
2017−01−01
0
25
50
75
100
125
0
20
40
season_week
variable
season_pct_total_ILI
season_pct_total_patients
wILI_times_100_div_8
days_since_christmas
1
2
3
4
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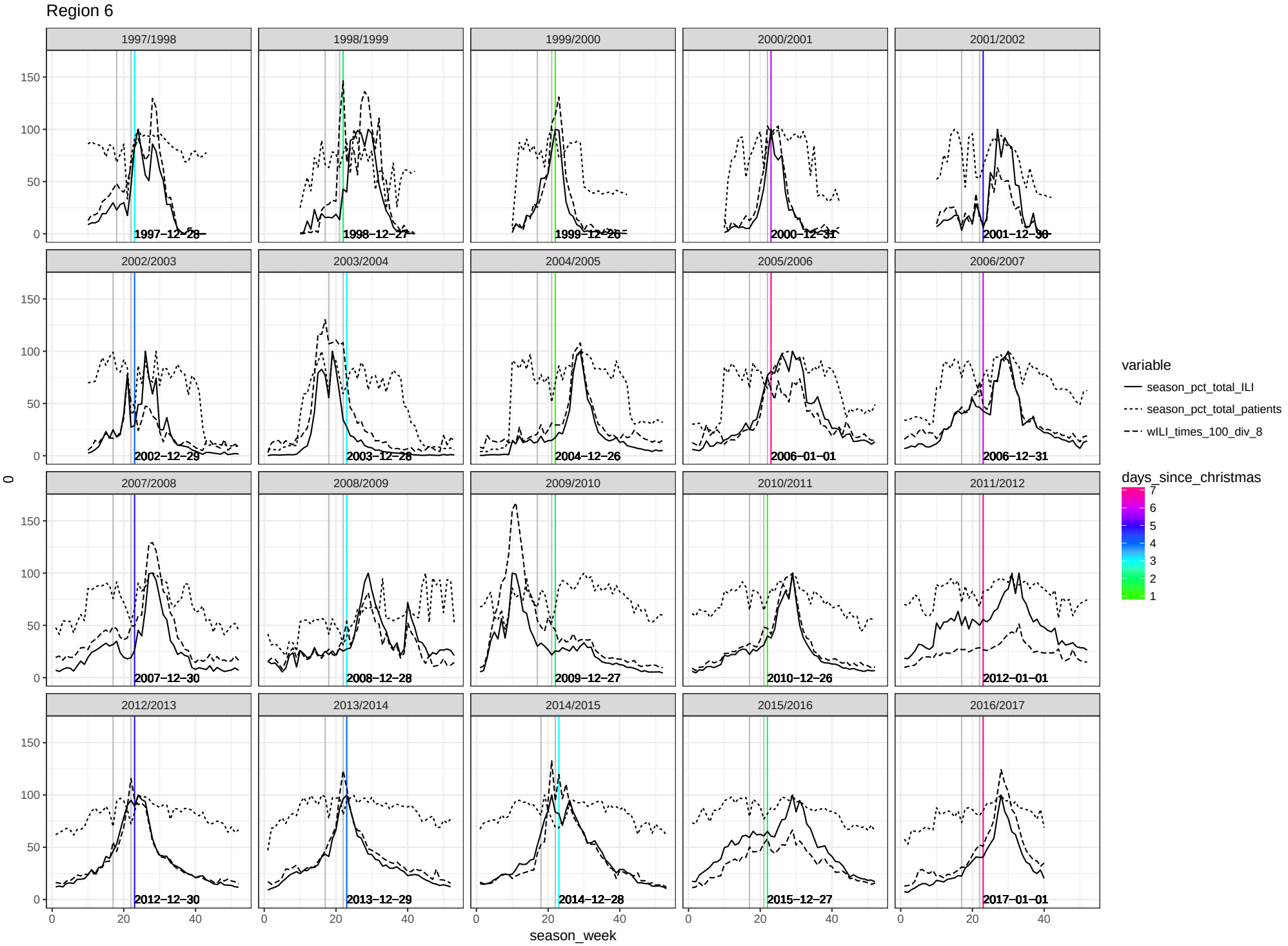
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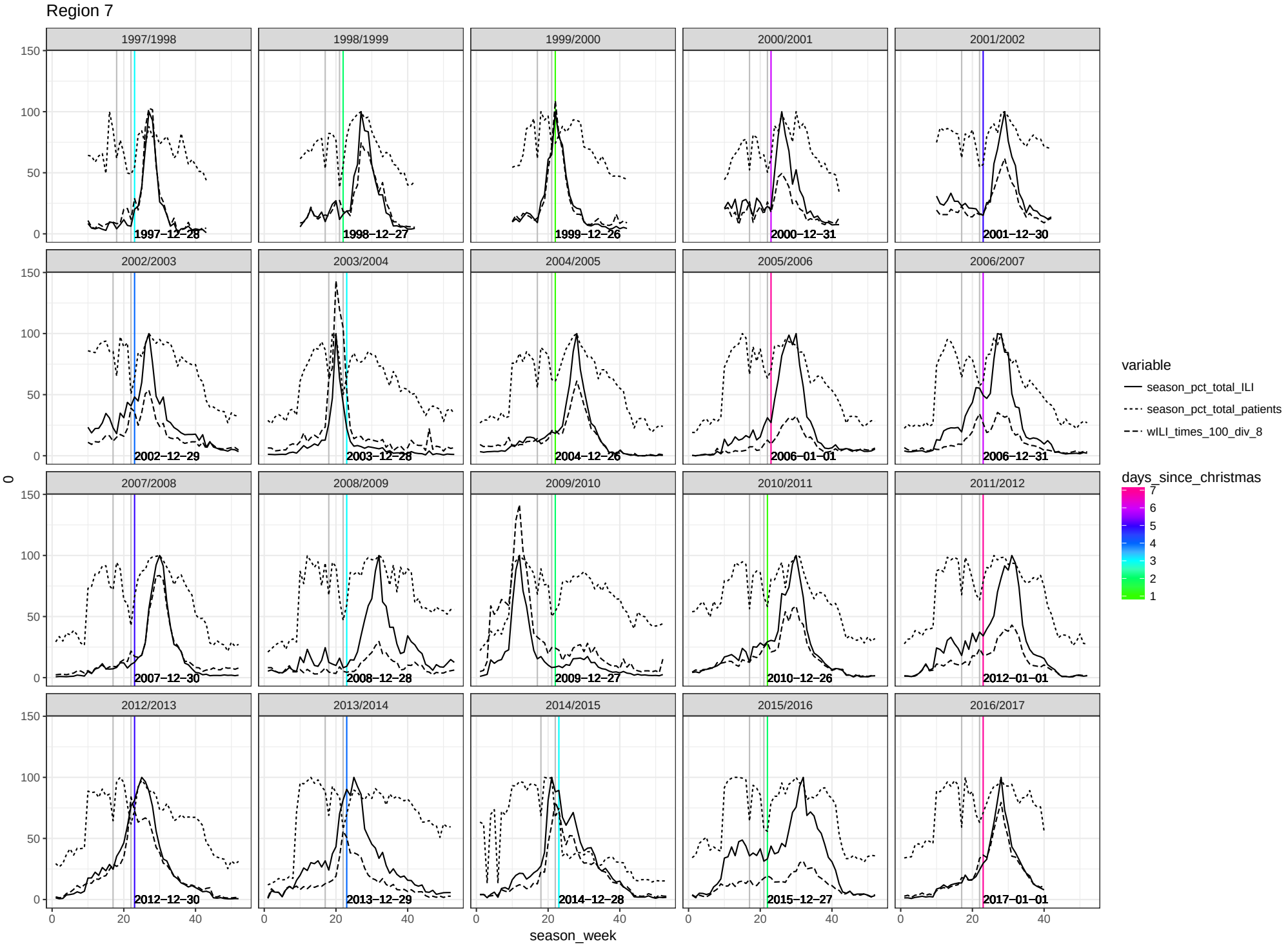
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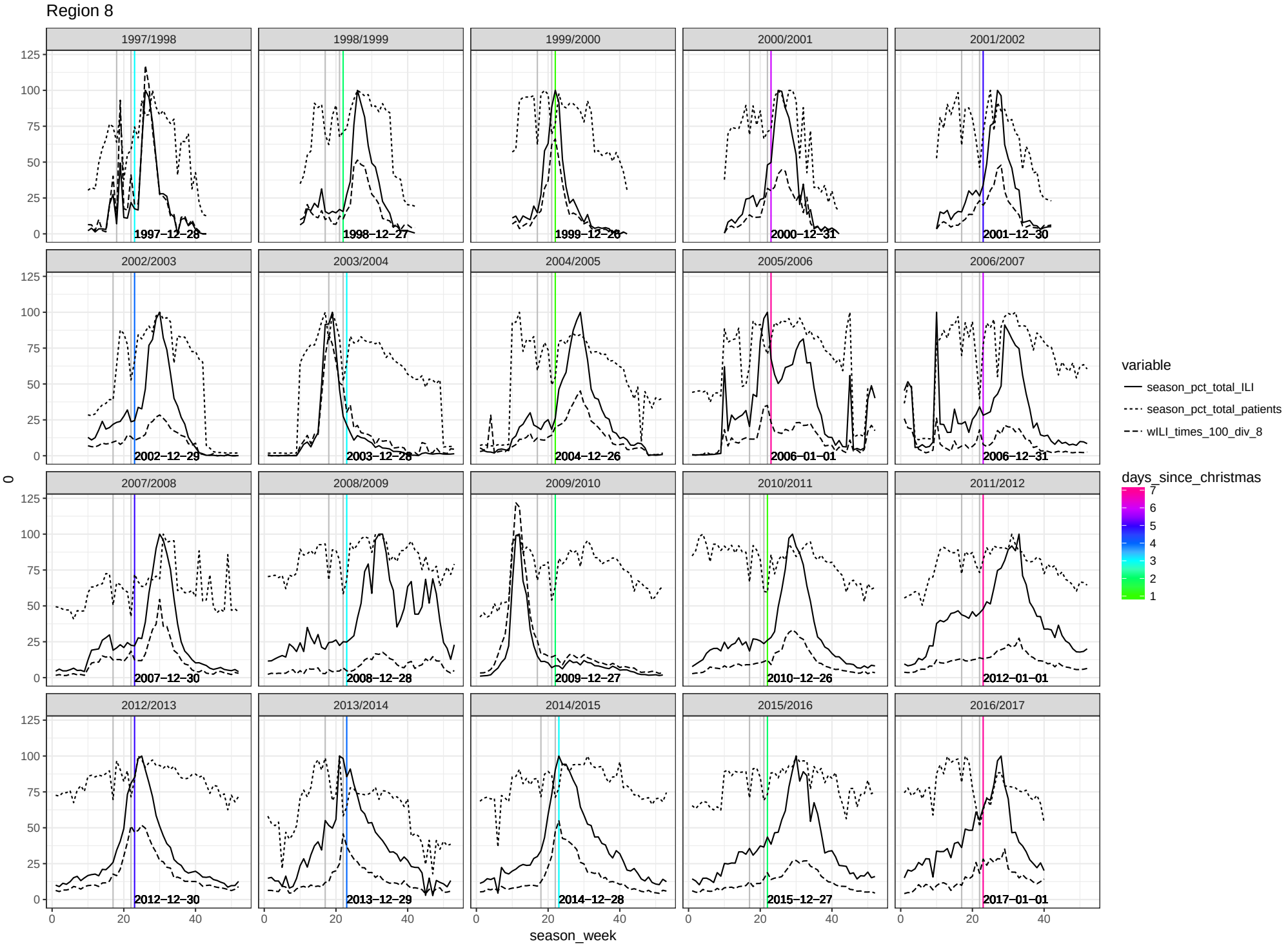
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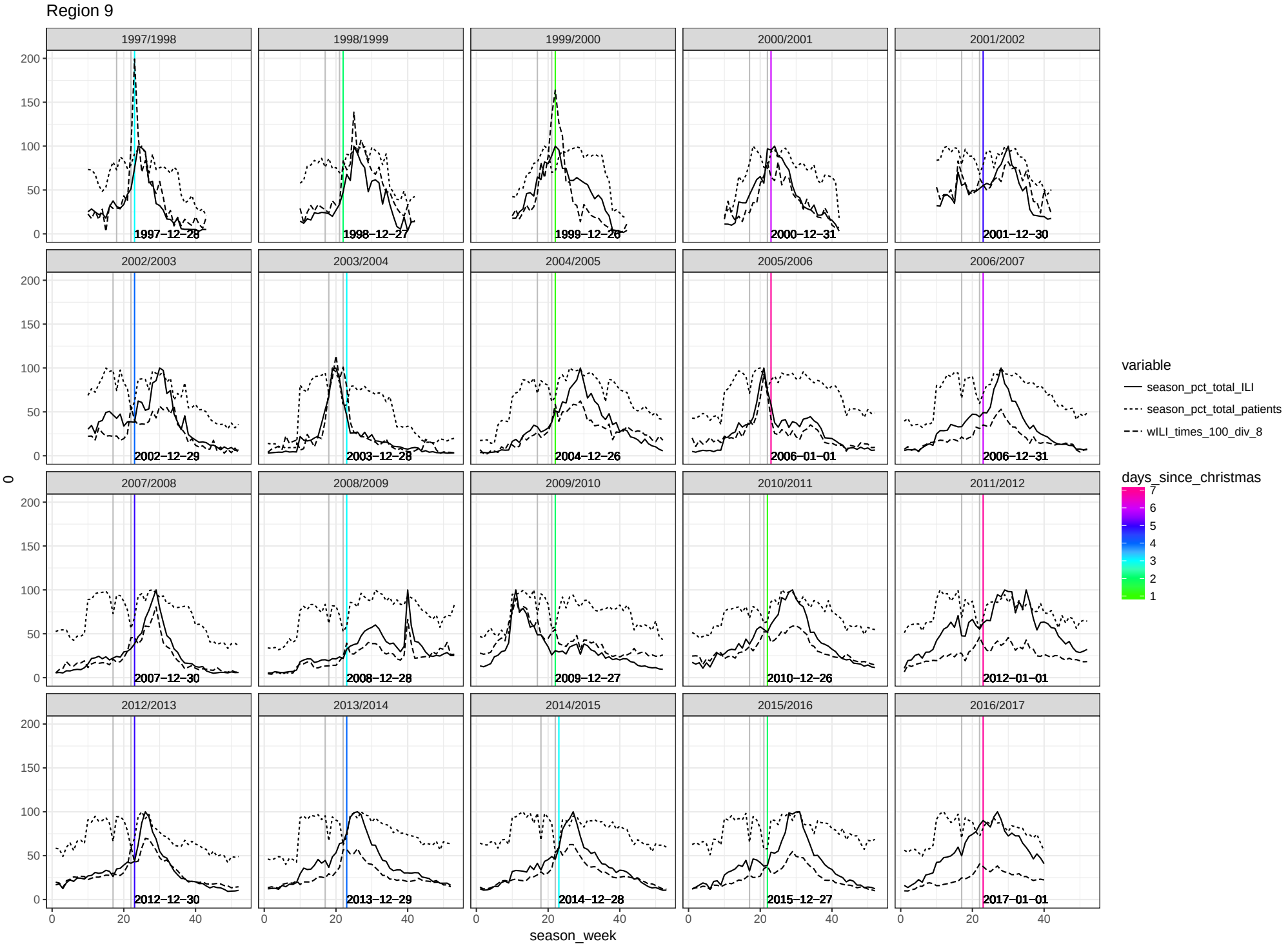
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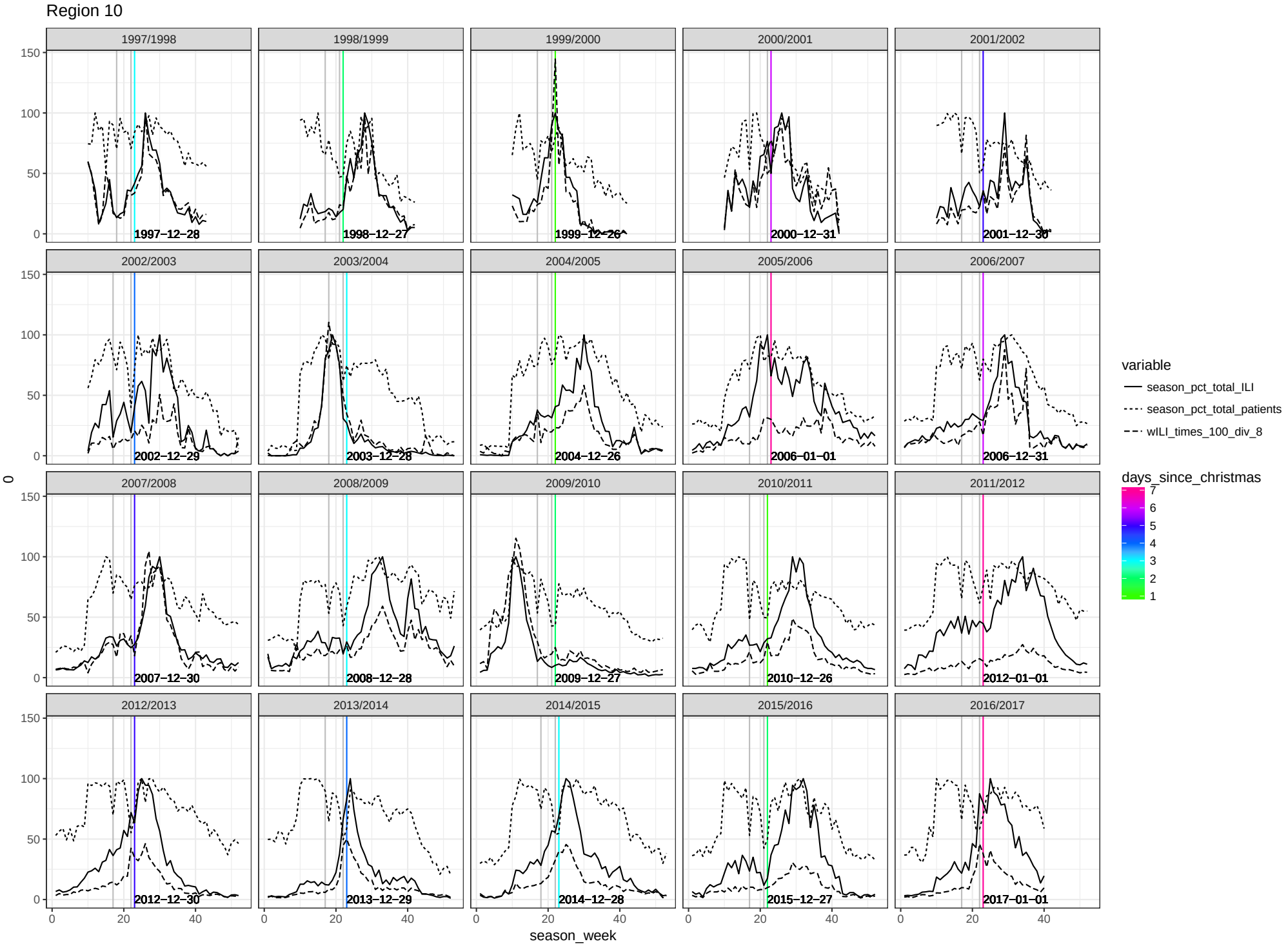
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