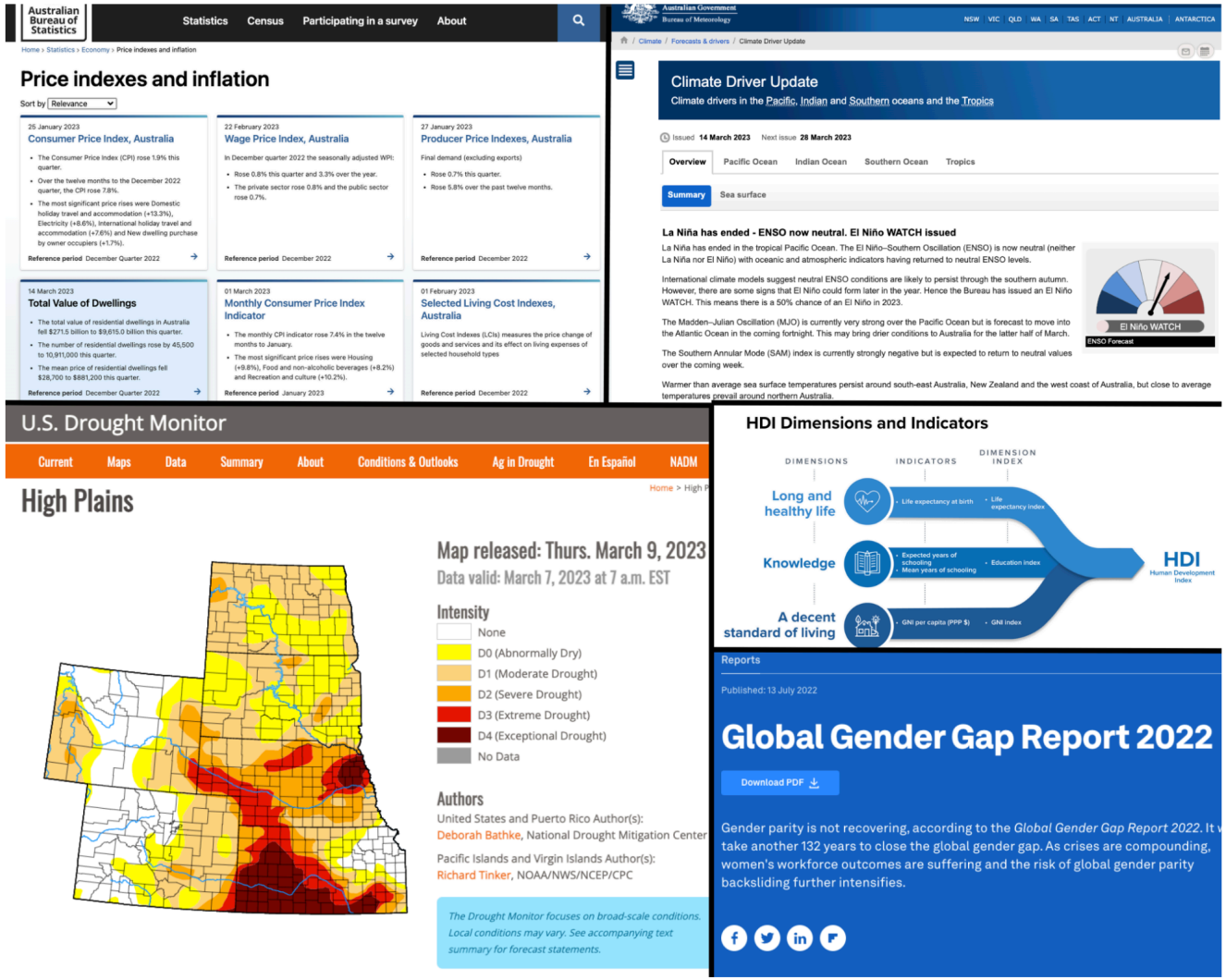
Indexes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NADM
High Plains
Map released: Thurs. March 9, 2023
Data valid: March 7, 2023 at 7 a.m. EST
Intensity
None
D0 (Abnormally Dry)
D1 (Moderate Drought)
D2 (Severe Drought)
D3 (Extreme Drought)
D4 (Exceptional Drought)
No Data
Authors
United States and Puerto Rico Author(s):
Deborah Bathke, National Drought Mitigation Center
Pacific Islands and Virgin Islands Author(s):
Richard Tinker, NOAA/NWS/NCEP/CPC
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
HDI Dimensions and Indicators
DIMENSIONS
INDICATORS
DIMENSION INDEX
Long and healthy life
Knowledge
A decent standard of living
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Reports
Published: 13 July 2022
Global Gender Gap Report 2022
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Gender parity is not recovering, according to the Global Gender Gap Report 2022.

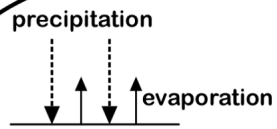
A class of drought indexes

Standardised Precipitation Index (SPI)

monthly precipitation series
1. aggregate across time
2. distribution fit to the agg series
3. convert to normal Z-score

what about evaporation?

Standardised Precipitation-Evapotranspiration Index (SPEI)

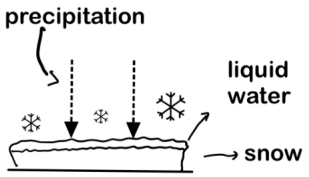


monthly precipitation & temperature series
- transform temperature into pet
- calculate the difference p-pet

1. aggregate the difference series across time

what about snow?

Standardised Snowmelt and Rain Index (SMRI)



daily precipitation & temperature series
- aggregate snow melt from precipitation and temperature

1. aggregate the daily snow melt and rain series

what about streamflow?

Standardised Streamflow Index (SSI)

monthly streamflow series

Pipeline envisaged

Standardised Precipitation Index (SPI)

```
data - precipitation %>%
temporal aggregation %>%
distribution fit %>%
augment
```

Standardised Precipitation-Evapotranspiration Index (SPEI)

```
data - precipitation
data - temperature   %>%
variable transformation %>%
dimension reduction %>%
temporal aggregation %>%
distribution fit %>%
augment
```

Standardised Snowmelt and Rain Index (SMRI)

```
data - precipitation
data - temperature   %>%
temporal aggregation %>%
temporal aggregation %>%
distribution fit %>%
augment
```

Standardised Streamflow Index (SSI)

```
data - streamflow %>%
temporal aggregation %>%
distribution fit %>%
augment
```

The pipeline design (9 modules)

data with spatial ($\mathbf{s}$) and temporal ($\mathbf{t}$) dimensions:

$$x(\mathbf{s}; \mathbf{t})$$

- **Temporal processing**: $f_\psi(x(\mathbf{s}; \mathbf{t}))$
- **Spatial processing**: $g_\theta(x(\mathbf{s}; \mathbf{t}))$

- **Variable transformation**: $h_\tau(x(\mathbf{s}; \mathbf{t}))$
- **Scaling**: $[x(\mathbf{s}; \mathbf{t}) - \alpha]/\gamma$
- **Normalising**: $\Phi^{-1}[x(\mathbf{s}; \mathbf{t})]$

- **Distribution fit**: $F_\eta(x(\mathbf{s}; \mathbf{t}))$
- **Benchmarking**: $u[x(\mathbf{s}; \mathbf{t})]$
- **Dimension reduction**

$$x_{p^*}(\mathbf{s}; \mathbf{t}) \rightarrow x_p(\mathbf{s}; \mathbf{t})$$

- **Simplification**

$$\begin{cases} C_0 & c_1 \leq x(\mathbf{s}; \mathbf{t}) < c_0 \\ C_1 & c_2 \leq x(\mathbf{s}; \mathbf{t}) < c_1 \\ \cdots & \\ C_z & c_z \leq x(\mathbf{s}; \mathbf{t}) \end{cases}$$

Pipeline for two drought indexes - SPI

```r
idx_spi <- function(.scale, .dist, ...){
  ...
  data %>%                              # data contain `prcp`
    aggregate(.var = prcp,              # step 1: temporal aggregation
              .scale = .scale)%>%       #         aggregate `prcp` with time scale
                                        #         `.scale` to create `.agg`, by default
    dist_fit(.dist = .dist,             # step 2: distribution fit
             .method = "lmoms",         #         using L-moment to fit `.dist`
             .var = .agg) %>%           #         distribution on `.agg`
    augment(.var = .agg)                # step 3: normalising
                                        #         find the normal density for `.agg`
}
```

Pipeline for two drought indexes - SPEI

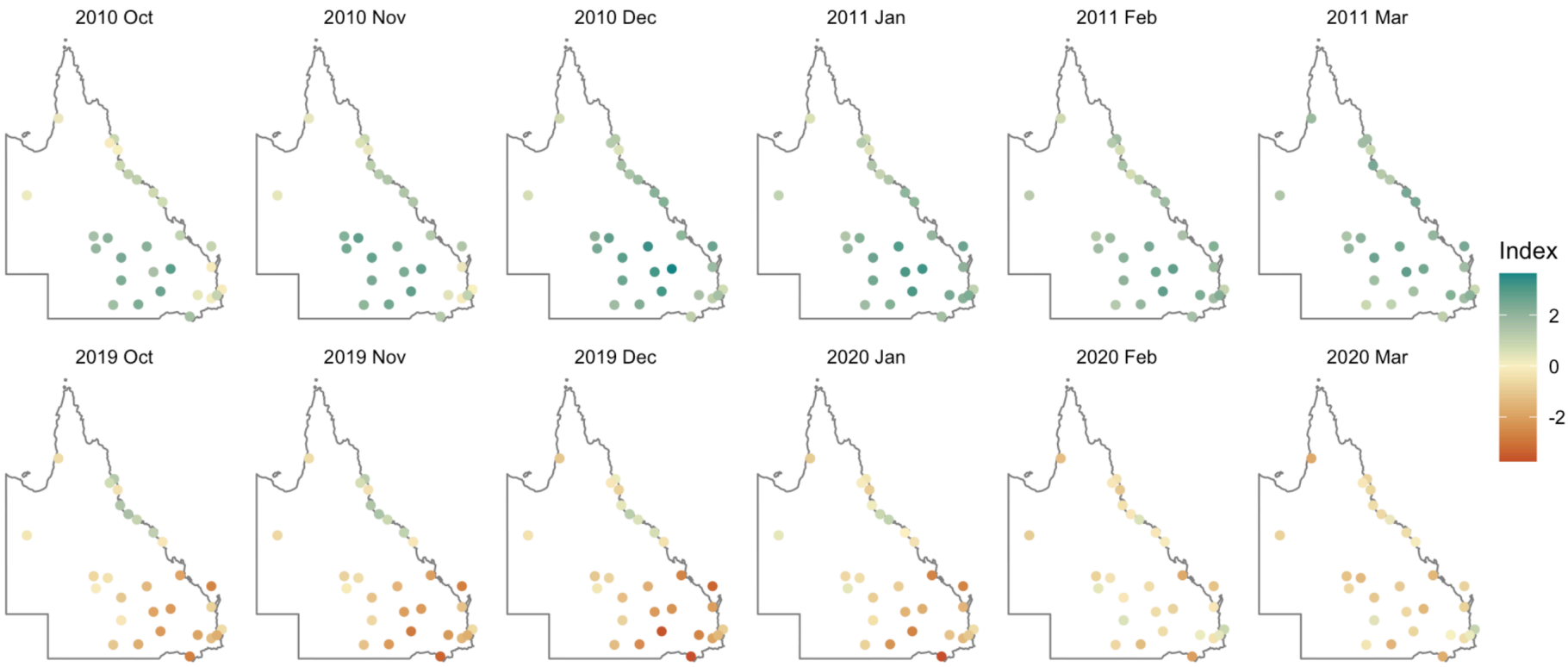
```r
idx_spei <- function(.scale, .dist, ...){
  ...
  data %>%                                    # data contain `tavg` and `prcp`
    var_trans(                                # step 1: variable transformation
      .method = "thornthwaite",               #         using the thornthwaite function
      .vars = tavg, .new_name = "pet") %>%    #         on `tavg` to create `pet`
    dim_red(diff = prcp - pet) %>%            # step 2: dimension reduction
    aggregate(                                # step 3: temporal aggregation
      .var = diff,                            #         aggregate `diff` with time scale
      .scale = .scale) %>%                    #         `.scale` to create `.agg`
    dist_fit(                                 # step 4: distribution fit
      .dist = .dist, .method = "lmoms",       #         using L-moment to fit `.dist`
      .var = .agg) %>%                        #         distribution on `.agg`
    augment(.var = .agg)                      # step 5: normalising
                                              #         find the normal density for `.agg`
}
```

Example

```r
.scale <- c(6, 12, 24, 36)
(idx <- queensland %>%
  init(id = id, time = ym) %>%
  compute_indexes(
    spei = idx_spei(
      .pet_method = "thornthwaite", .tavg = tavg, .lat = lat,
      .scale = .scale, .dist = c(gev(), loglogistic())),
    spi = idx_spi(.scale = .scale)
  ))
```

```
# A tibble: 128,586 × 19
   .idx  .period id           ym  prcp  tmax  tmin  tavg  long   lat name    pet
   <chr>   <dbl> <chr>     <mth> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <chr> <dbl>
 1 spei        6 ASN00… 1990 Jun   170  29.7  16.2  23.0  142. -15.5 KOWA…  86.3
 2 spei        6 ASN00… 1990 Jun   170  29.7  16.2  23.0  142. -15.5 KOWA…  86.3
 3 spei        6 ASN00… 1990 Jun     0  23.0  11.8  17.4  139. -20.7 MOUN…  47.6
 4 spei        6 ASN00… 1990 Jun     0  23.0  11.8  17.4  139. -20.7 MOUN…  47.6
 5 spei        6 ASN00… 1990 Jun   794  25.8  18.1  21.9  146. -16.9 CAIR…  80.3
 6 spei        6 ASN00… 1990 Jun   794  25.8  18.1  21.9  146. -16.9 CAIR…  80.3
 7 spei        6 ASN00… 1990 Jun   504  23.0  13.8  18.4  145. -17.1 WALK…  48.2
 8 spei        6 ASN00… 1990 Jun   504  23.0  13.8  18.4  145. -17.1 WALK…  48.2
 9 spei        6 ASN00… 1990 Jun  1970  23.9  16.4  20.2  146. -17.6 SOUT…  70.3
10 spei        6 ASN00… 1990 Jun  1970  23.9  16.4  20.2  146. -17.6 SOUT…  70.3
# … with 128,576 more rows, and 7 more variables: diff <dbl>, .scale <dbl>,
#   .agg <dbl>, .method <chr>, .fitted <dbl>, .dist <chr>, .index <dbl>
```

2010 Queensland flood & 2019-20 Australia drought



All time scales agree on an extreme drought in 2019-20 bushfire season