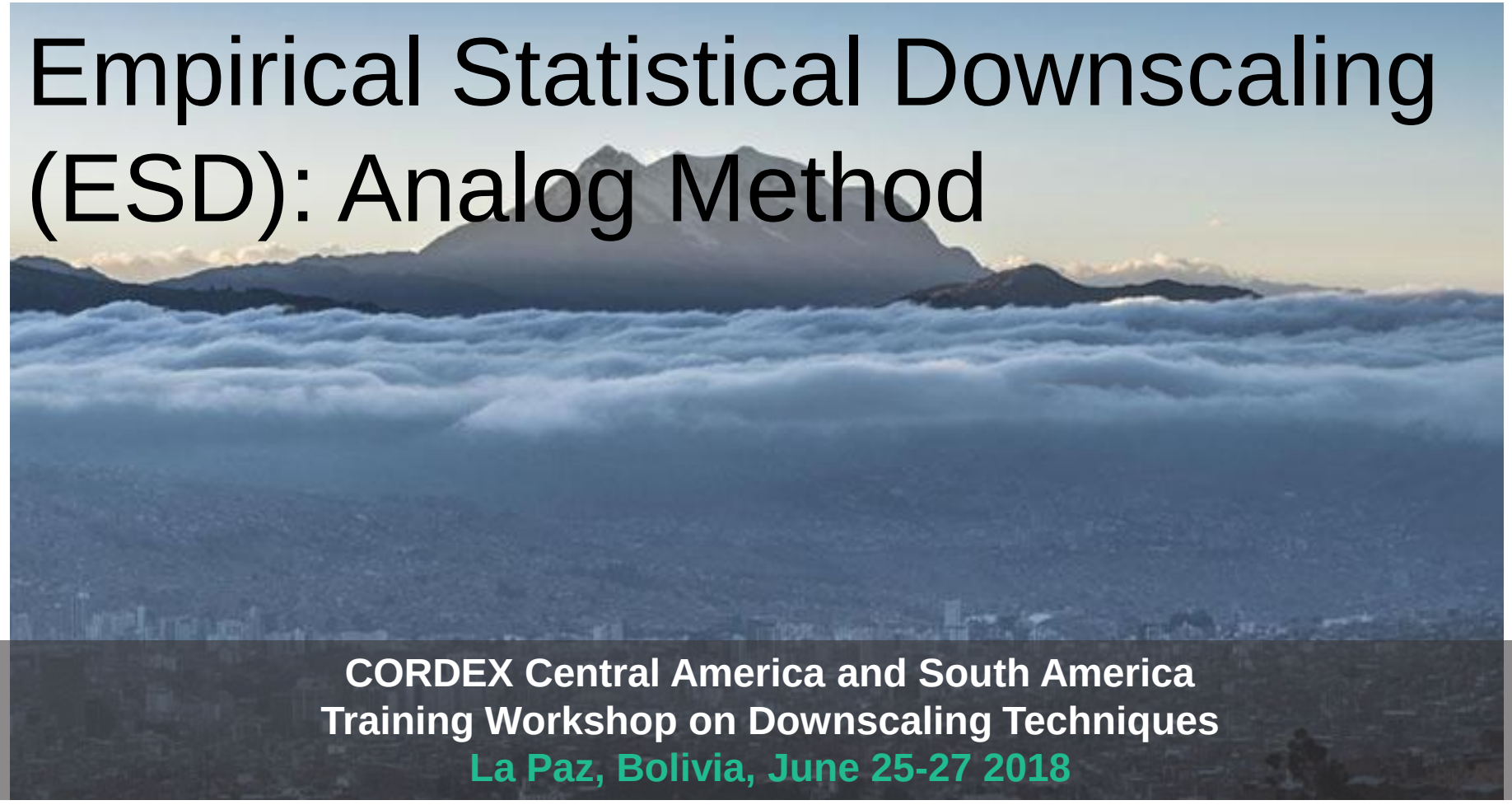
Empirical Statistical Downscaling (ESD): Analog Method



CORDEX Central America and South America
Training Workshop on Downscaling Techniques
La Paz, Bolivia, June 25-27 2018

ESD Techniques

ESD methods can be classified according the type of the Statistical Technique

Transfer Functions
Based on linear or nonlinear regression models

Analogs and Weather Typing

Weather Generators

Wilby et al., 2004; Wilby & Fowler, 2010

ESD Techniques

ESD methods can be classified according the type of the Statistical Technique

Transfer Functions
Based on linear or nonlinear regression models

Analogs and Weather Typing

Weather Generators

ESD Techniques

ESD methods can be classified according the type of the Statistical Technique

Analogs and Weather Typing

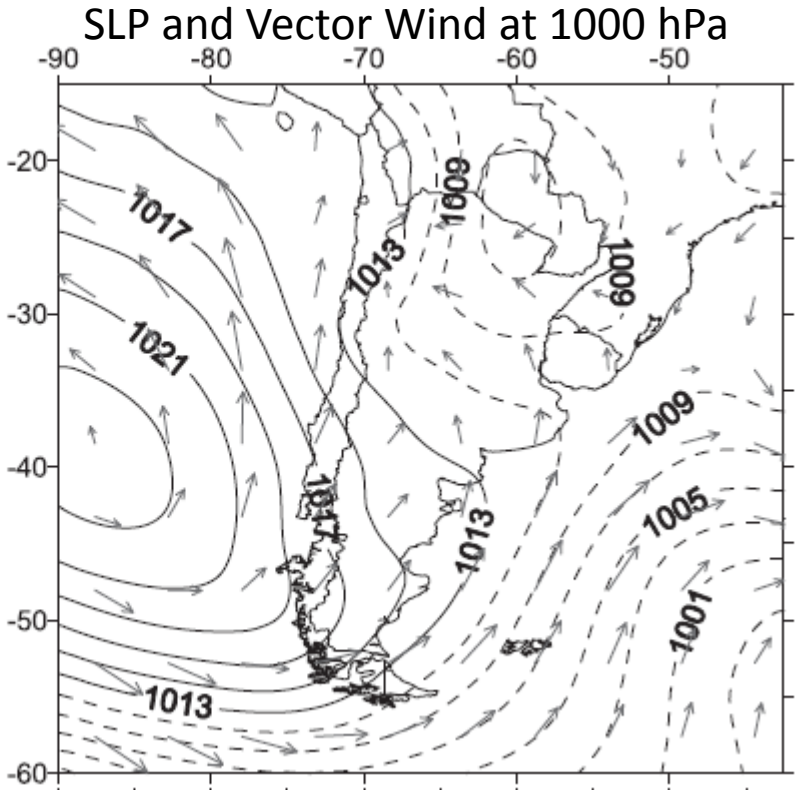
The downscaling methods relate weather classes to local and regional weather conditions.

For instance

Analogs and Weather Typing

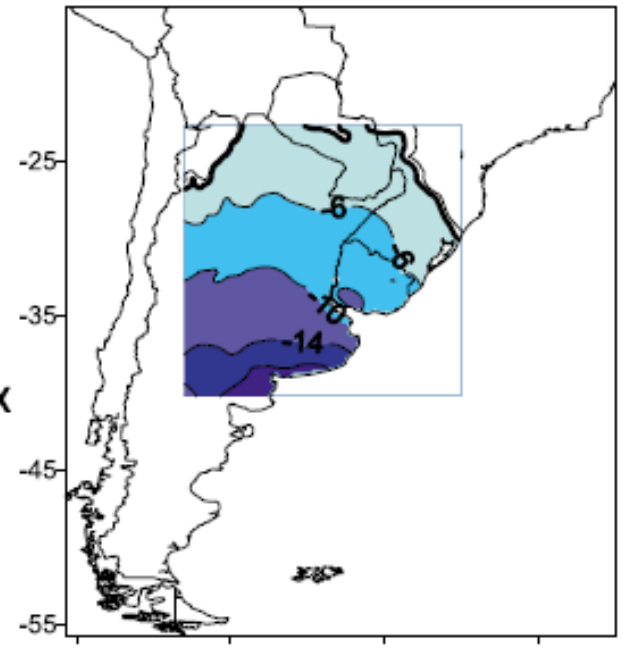
The downscaling methods relate weather classes to local and regional weather conditions.

CT1s



CT1s

T_{MAX}



Analog Method

In the analogue method, historical large-scale weather situations similar (according to a selected metric) to the large-scale weather situation on a given target day are identified.

Analog Method

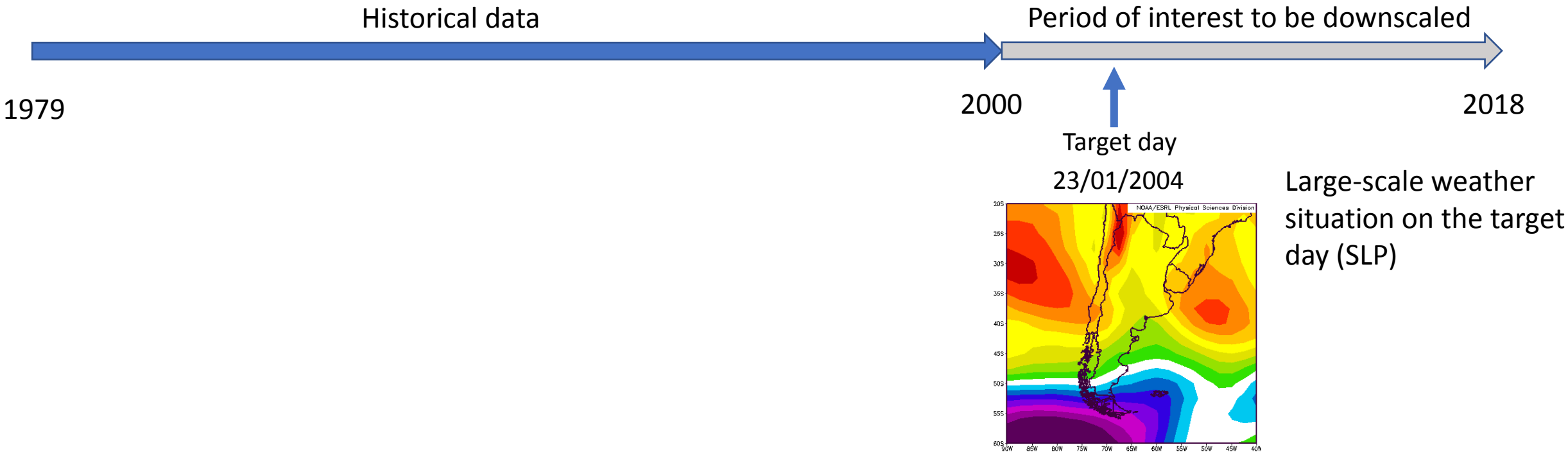
In the analogue method, historical large-scale weather situations similar (according to a selected metric) to the large-scale weather situation on a given target day are identified.

Analog Method

In the analogue method, historical large-scale weather situations similar (according to a selected metric) to the large-scale weather situation on a given target day are identified.

Analog Method

In the analogue method, historical large-scale weather situations similar (according to a selected metric) to the large-scale weather situation on a given target day are identified.



Analog Method

In the analogue method, historical large-scale weather situations similar (according to a selected metric) to the large-scale weather situation on a given target day are identified.

Historical data

Period of interest to be downscaled

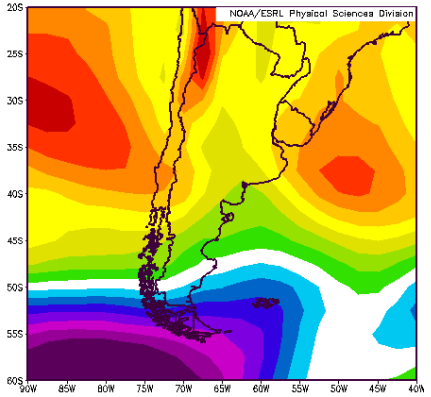
1979

2000

2018

Target day

23/01/2004



Large-scale weather situation on the target day (SLP)

Local climate associated to this situation: ???

Analog Method

In the analogue method, historical large-scale weather situations similar (according to a selected metric) to the large-scale weather situation on a given target day are identified.

Historical data

Period of interest to be downscaled

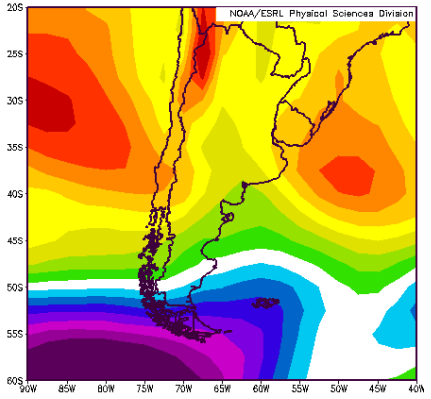
1979

2000

2018

Target day

23/01/2004



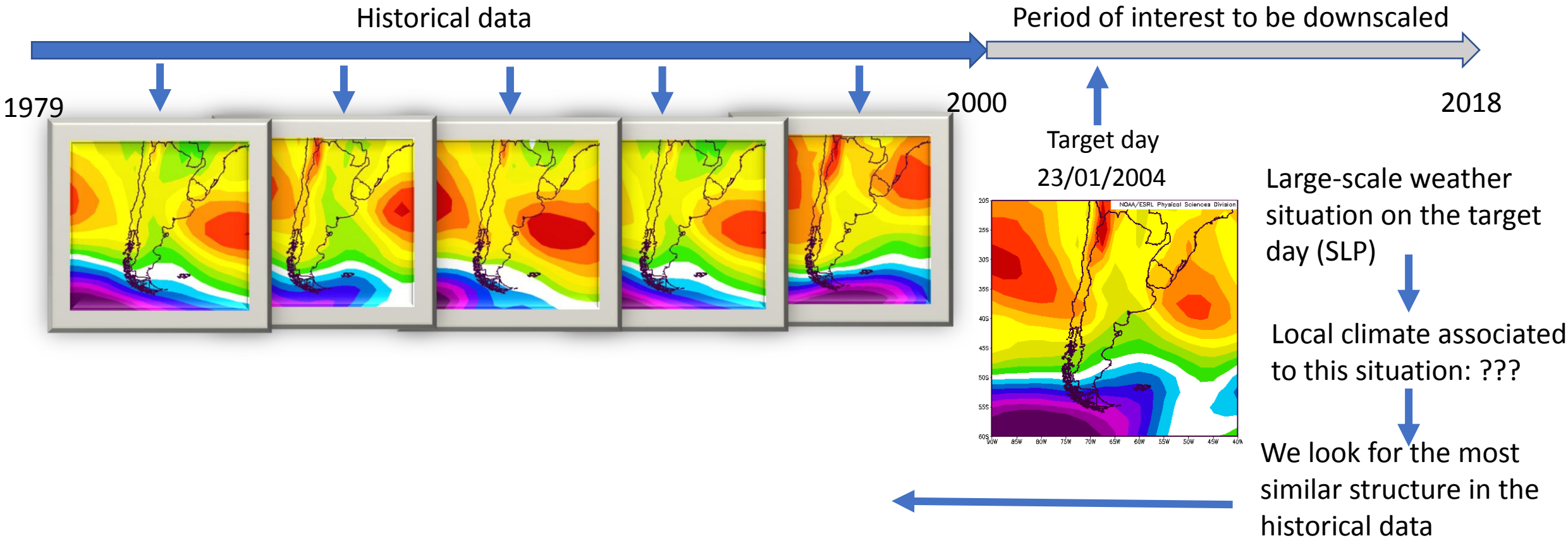
Large-scale weather situation on the target day (SLP)

Local climate associated to this situation: ???

We look for the most similar structure in the historical data

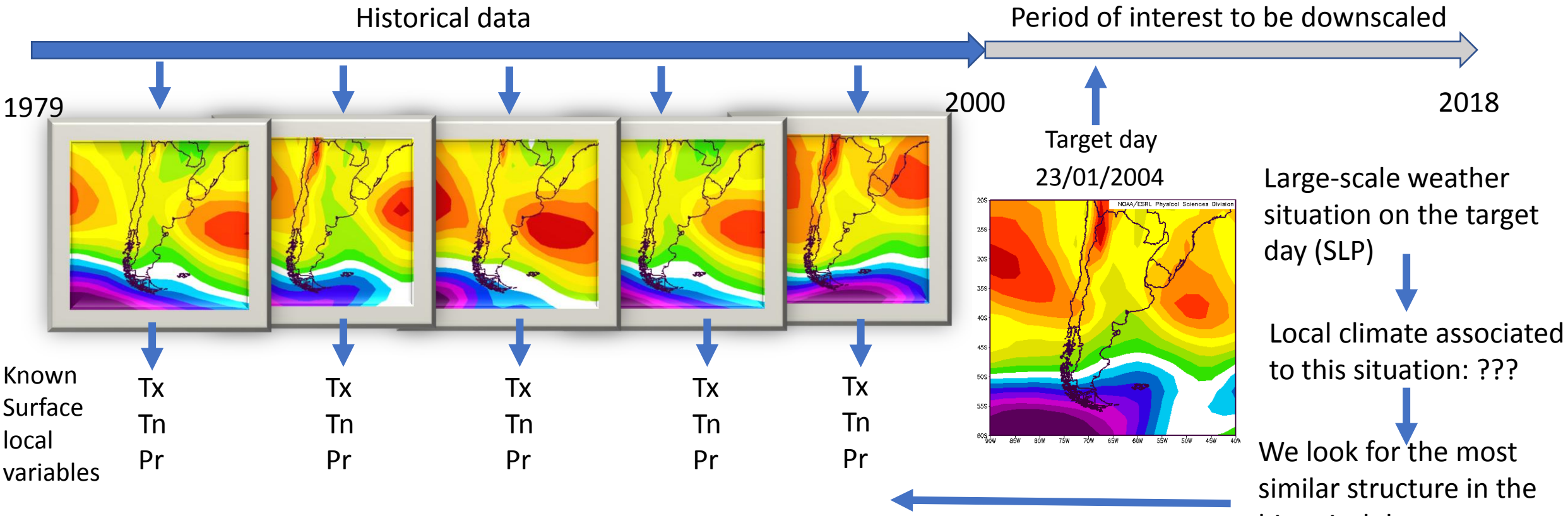
Analog Method

In the analogue method, historical large-scale weather situations similar (**according to a selected metric**) to the large-scale weather situation on a given target day are identified.



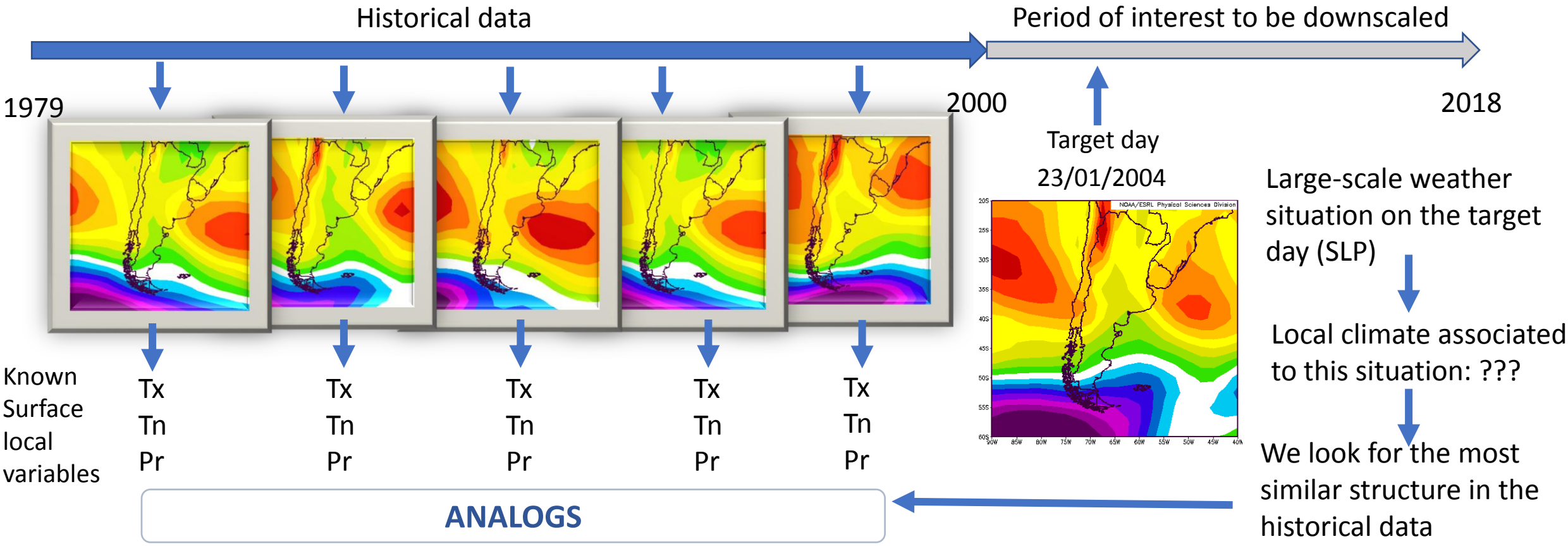
Analog Method

In the analogue method, historical large-scale weather situations similar (according to a selected metric) to the large-scale weather situation on a given target day are identified.



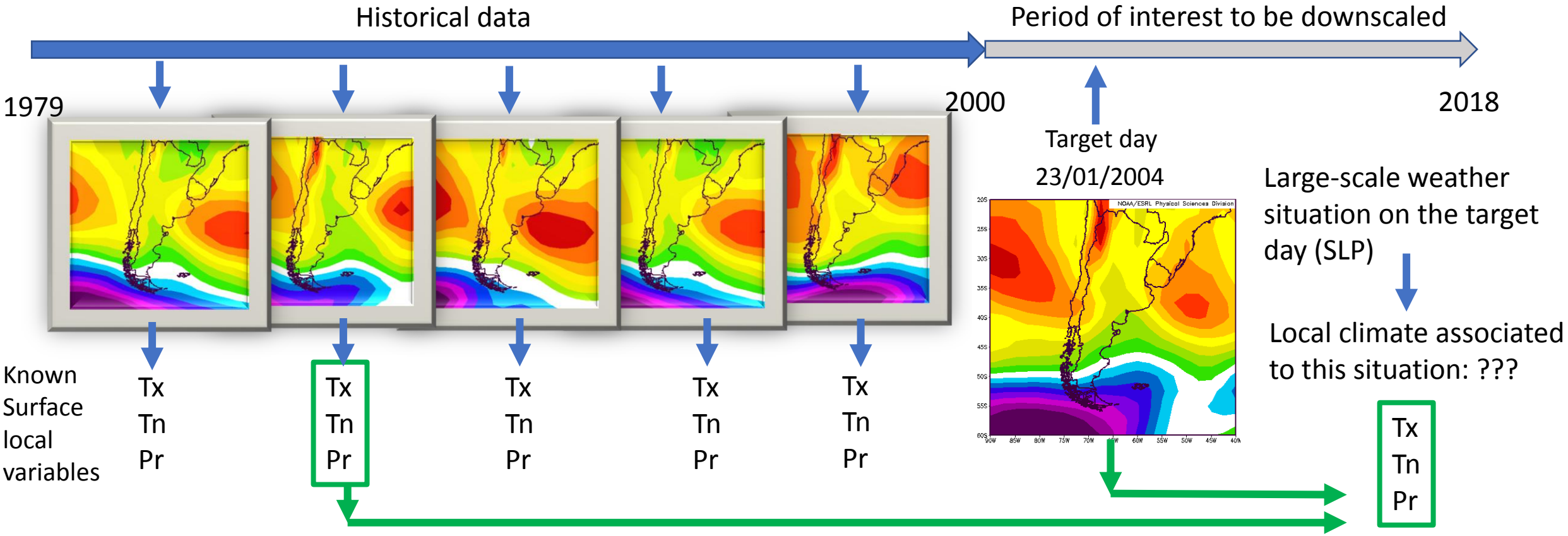
Analog Method

Then, the corresponding historical local weather conditions are used to estimate local weather conditions on the target day.



Analog Method

Then, the corresponding historical local weather conditions are used to estimate local weather conditions on the target day.



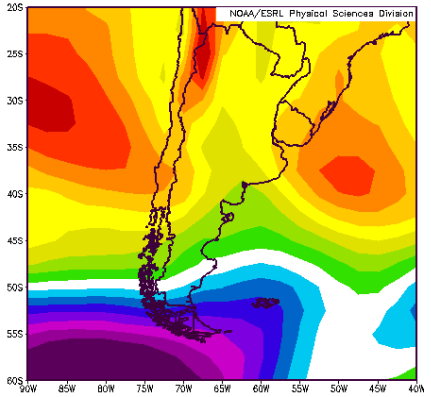
Analog Method

In the whole process several decisions have to be made ….

Analog Method

In the whole process several decisions have to be made ….

- What large scale variables should be considered to define de large scale weather situation?
- Which is the best domain size for those variables?
- How do we get the information about those variables? Raw data? EOF?



Large-scale weather situation on the target day (SLP)

Analog Method

In the whole process several decisions have to be made ….

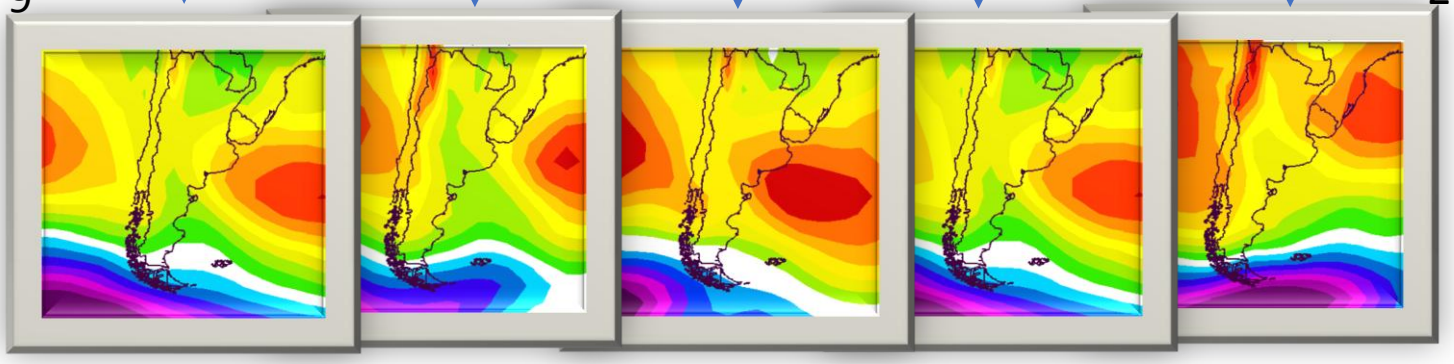
Historical data

Period of interest to be downscaled

1979

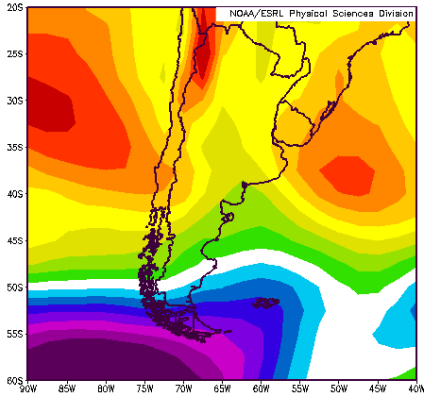
2000

2018



Target day

23/01/2004



Large-scale weather situation on the target day (SLP)

Local climate associated to this situation: ???

We look for the most similar structure in the historical data

How do we look for the most similar large scale weather situation?
Which is the best period of historical data to be considered?
Which is the best metric? (Euclidean Distance is the most common)

Analog Method

In the whole process several decisions have to be made ….

How do we estimate local weather conditions using the analogs?

Historical data

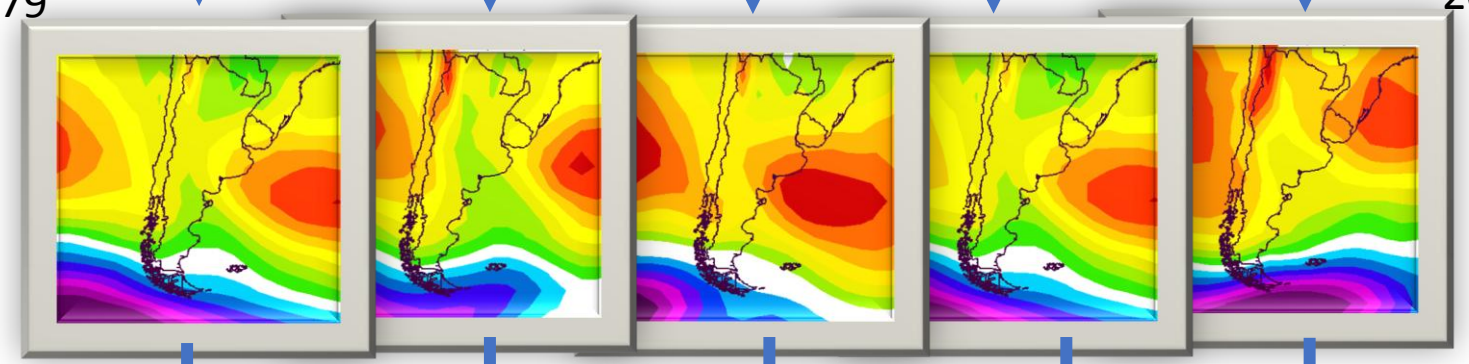
Period of interest to be downscaled

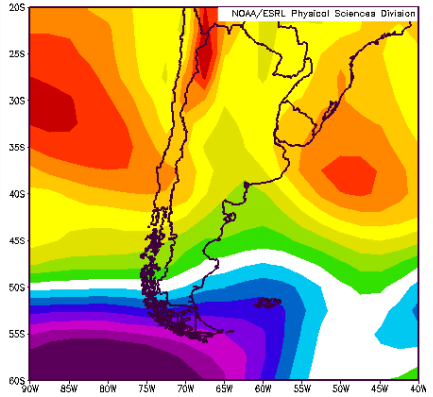
1979

2000

2018

Target day
23/01/2004





Known Surface local variables

Tx Tn Pr | Tx Tn Pr | Tx Tn Pr | Tx Tn Pr | Tx Tn Pr

Large-scale weather situation on the target day (SLP)

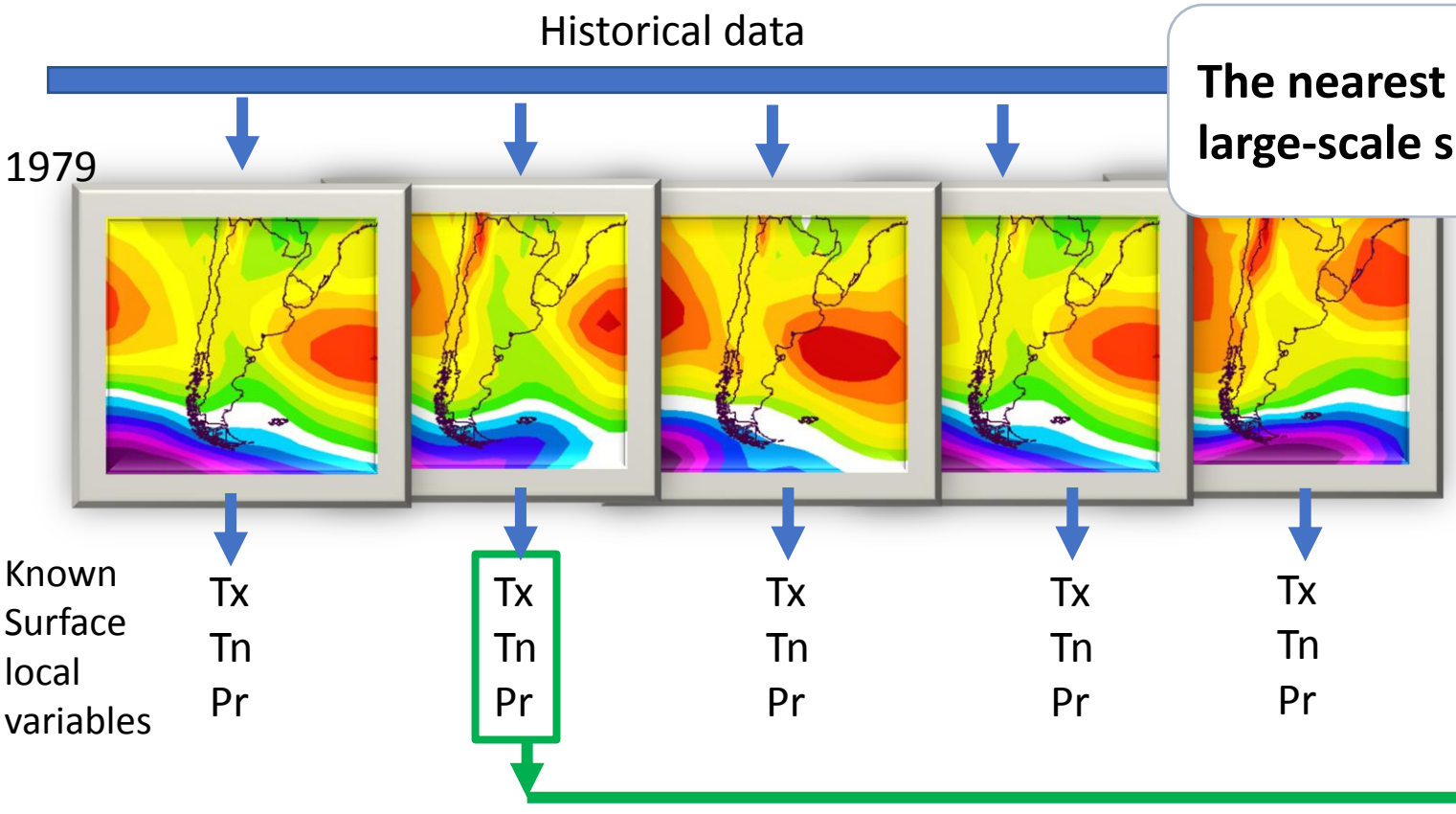
Local climate associated to this situation: ???

We look for the most similar structure in the historical data

Analog Method

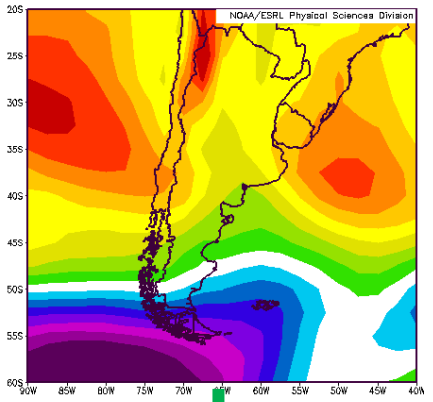
In the whole process several decisions have to be made ….

How do we estimate local weather conditions using the analogs?



The nearest neighbor: we consider the most similar large-scale situation (lowest distance), just one analog.

target day
23/01/2004



Large-scale weather situation on the target day (SLP)

Local climate associated to this situation: ???

Tx
Tn
Pr

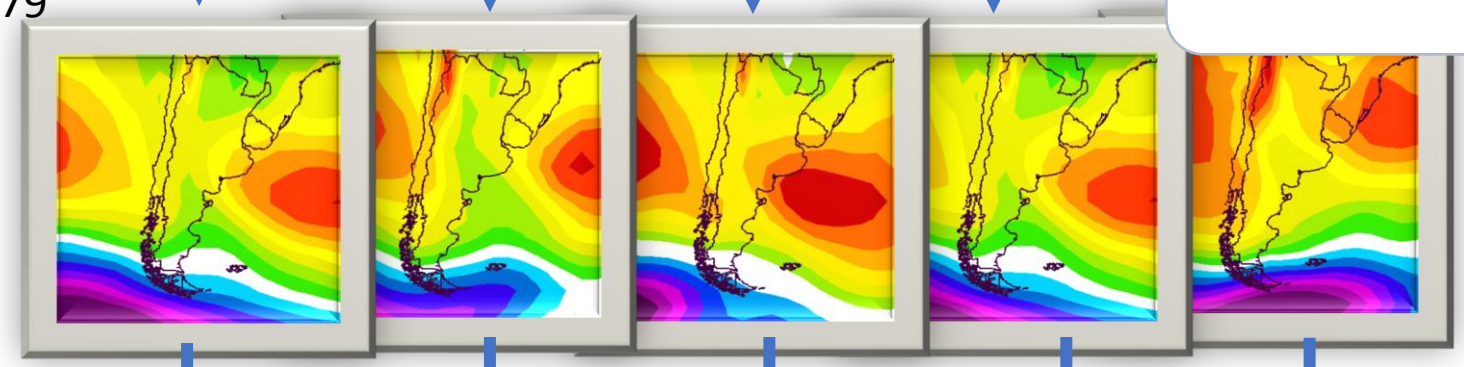
Analog Method

In the whole process several decisions have to be made ….

How do we estimate local weather conditions using the analogs?

Historical data

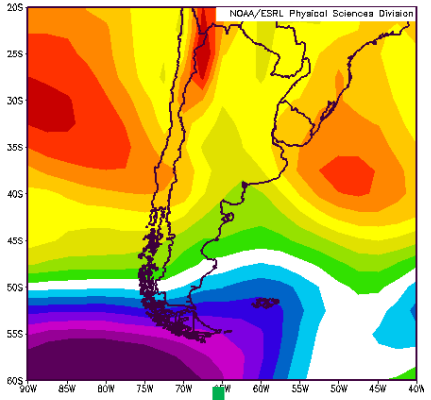
1979



We can also consider the average of several analogs (n).

target day

23/01/2004



Large-scale weather situation on the target day (SLP)

Local climate associated to this situation: ???

Known Surface local variables

Tx	Tx	Tx	Tx	Tx
Tn	Tn	Tn	Tn	Tn
Pr	Pr	Pr	Pr	Pr

Tx
Tn
Pr

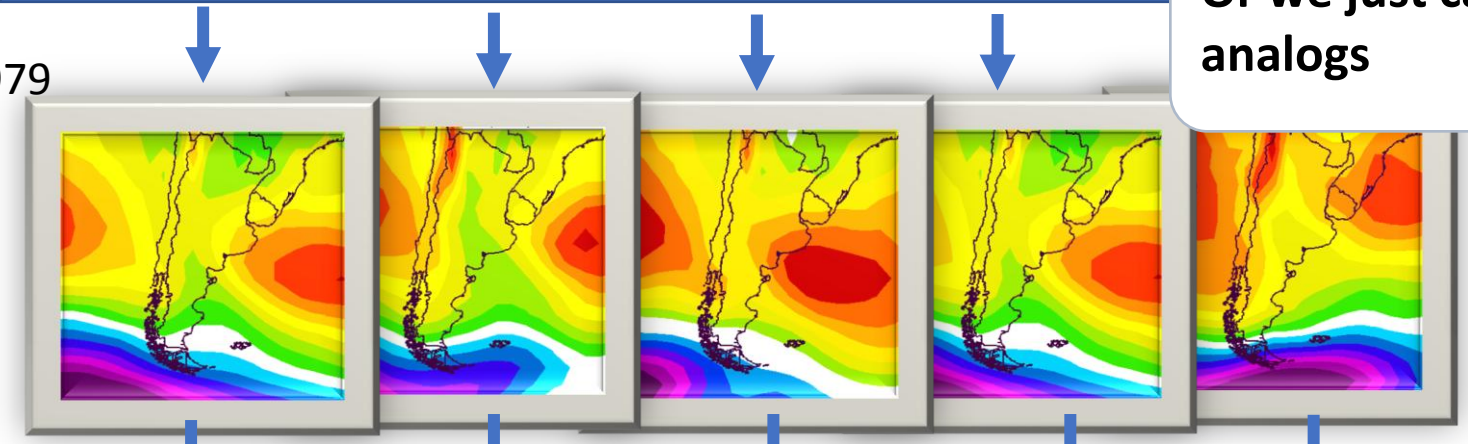
Analog Method

In the whole process several decisions have to be made ….

How do we estimate local weather conditions using the analogs?

Historical data

1979



Known Surface local variables

Tx
Tn
Pr

Tx
Tn
Pr

Tx
Tn
Pr

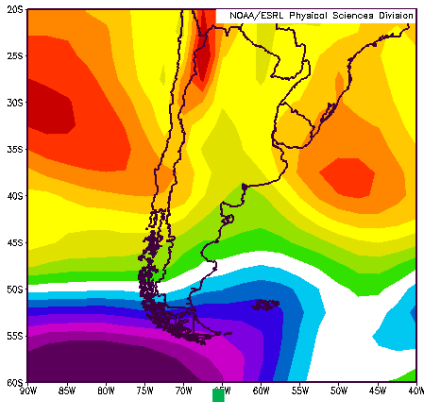
Tx
Tn
Pr

Tx
Tn
Pr

Or we just can pick a random analog among the n analogs

target day

23/01/2004



Large-scale weather situation on the target day (SLP)

Local climate associated to this situation: ???

Tx
Tn
Pr

Analog Method

With a relatively simple design, the analog method has shown to perform as well as more complicated methods.

It is able to be applied to both normally and non-normally variables such as local temperatures and precipitation.

However, it is incapable of predicting new values that are outside the range of the historical data.

Our training is on Analogs ….

Analog Method

We will use the Climate4R tool developed by the Santander Meteorology Group
https://www.meteo.unican.es/en/climate4R