MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

A PROPOSAL FOR SPATIOTEMPORAL DATA RETRIEVING IN R

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CAP 378 - TÓPICOS EM OBSERVAÇÃO DA TERRA

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AGENDA

- ▸ Introduction

- ▸ R Environment for Spatial, Temporal and SpatioTemporal Data

- ▸ Observation Based Model

- ▸ R Packages for SpatioTemporal Data

- ▸ Software Architecture

- ▸ Proposed R Package Internal Architecture

- ▸ Case Study

- ▸ Further Developments

SPATIOTEMPORAL DATA IS EVERYWHERE

HOW TO EASILY REPRESENT?

HOW TO EASILY ANALYSE?

R LANGUAGE

▸ Free and Open Source;

▸ Strong Package Ecosystem;

▸ Many Tools and Methods for Analysing data;

▸ Good Charts and Graphics Capabilities;

▸ Quick and Fast for Prototyping.

R ENVIRONMENT FOR REPRESENTING DATA

SPATIAL ⟶ RASTER ⟶ RASTER

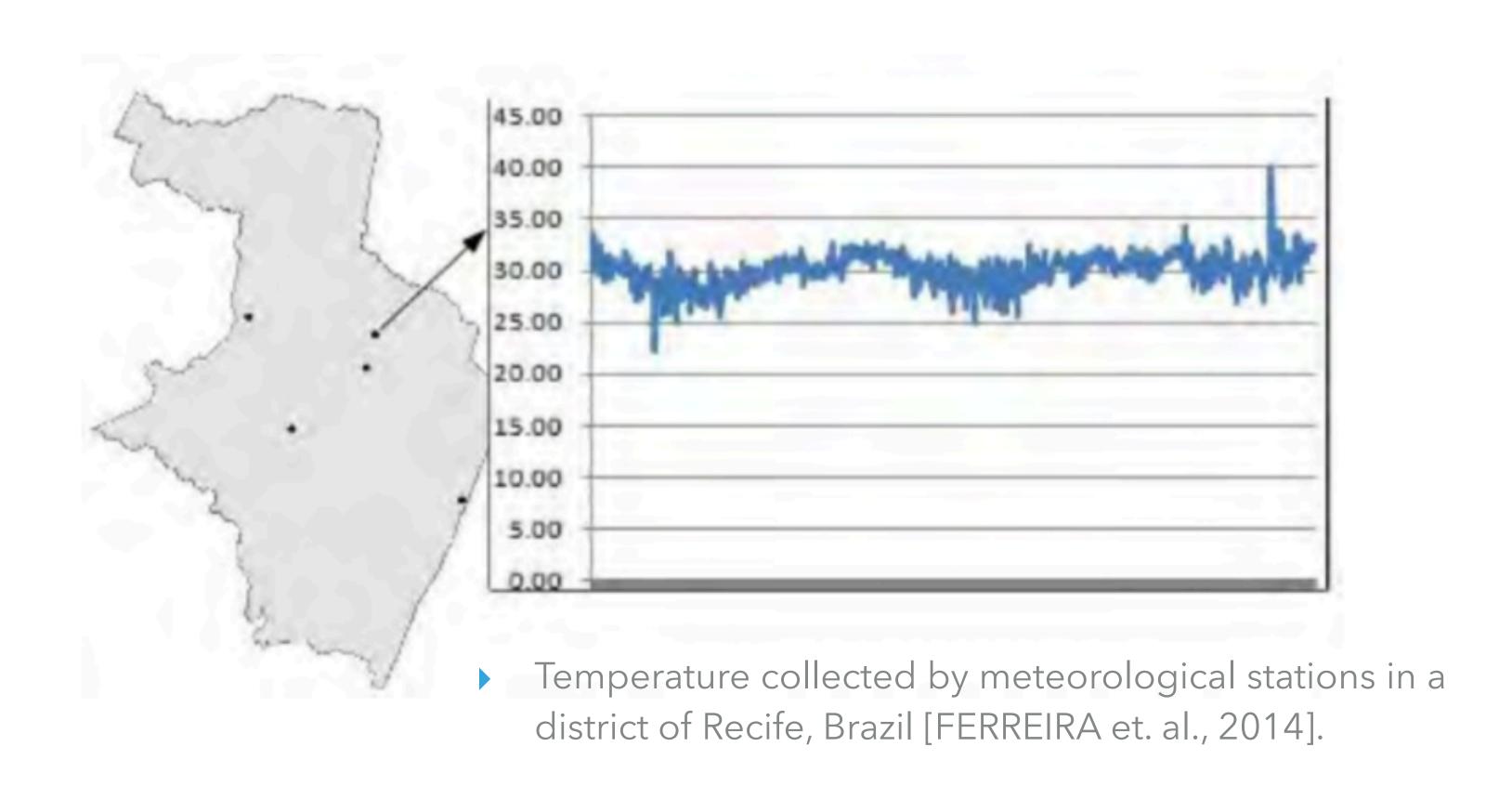VECTOR ⟶ SP / SF

TEMPORAL ⟶ XTS

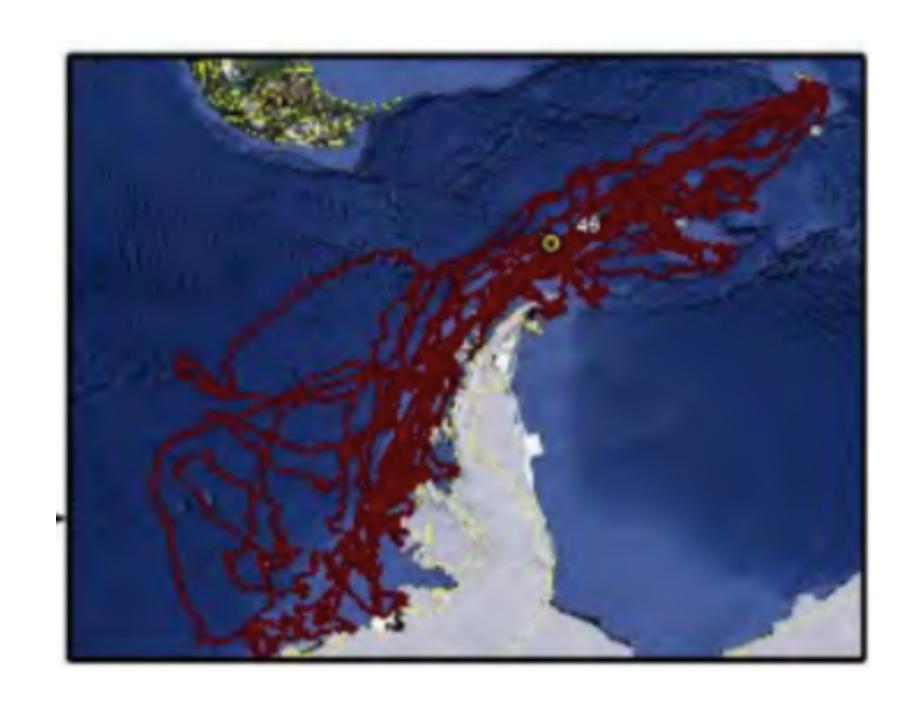SPATIOTEMPORAL ⟶ RASTER ⟶ STARS

VECTOR ⟶ ??????

▸The proposed model starts with observations, which are our means to assess spatiotemporal phenomena in the real world. The model defines three data types as abstractions built on observations.

OBSERVATION BASED MODEL

▸ Temperature collected by meteorological stations in a district of Recife, Brazil [FERREIRA et. al., 2014].

▸A time series represents the variation of a property over time
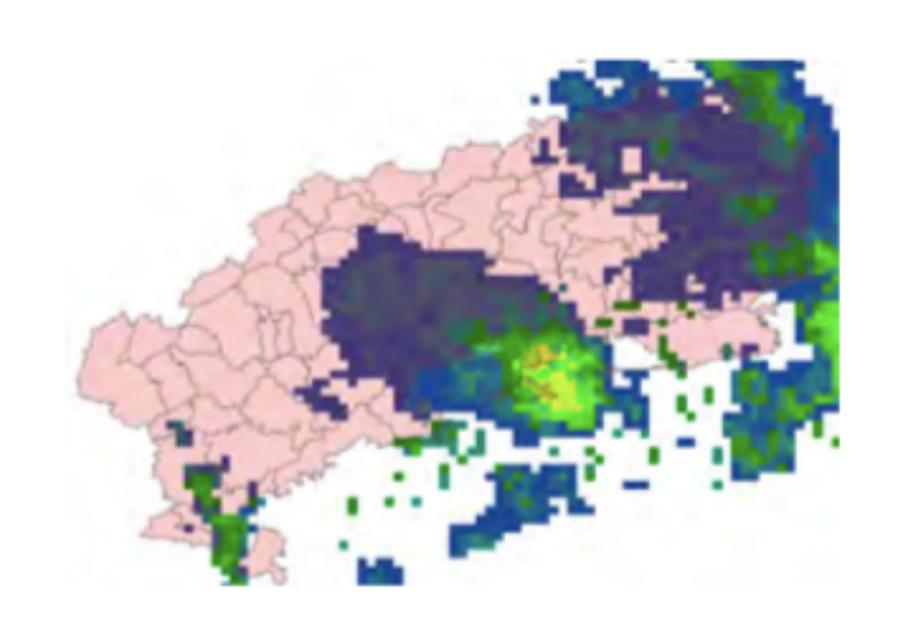
▸ Trajectories of ten sea elephants in Antarctica (red lines) [FERREIRA et. al., 2014].

▸ A trajectory represents how locations or boundaries of an object change over time.
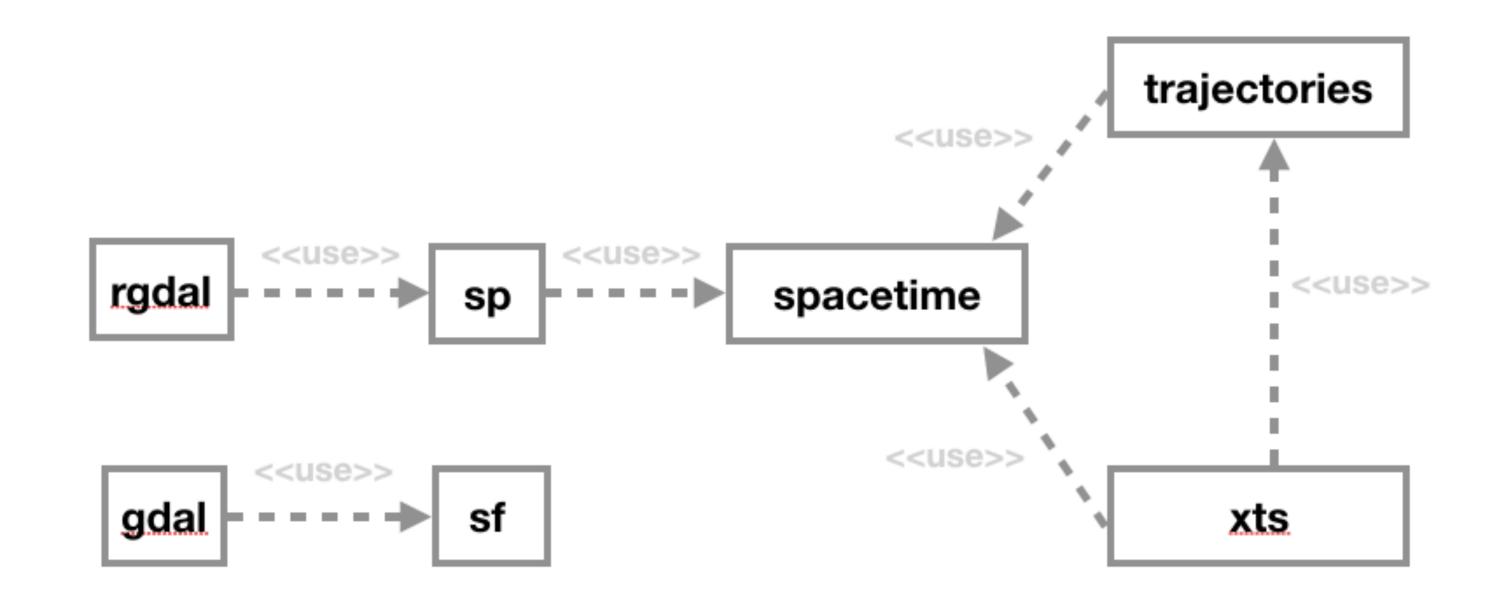
▸ Rain in the state of Rio de Janeiro, Brazil, in 11 January 2011 [FERREIRA et. al., 2014].

▸ A coverage represents the variation of a property in a spatial extent at a time.
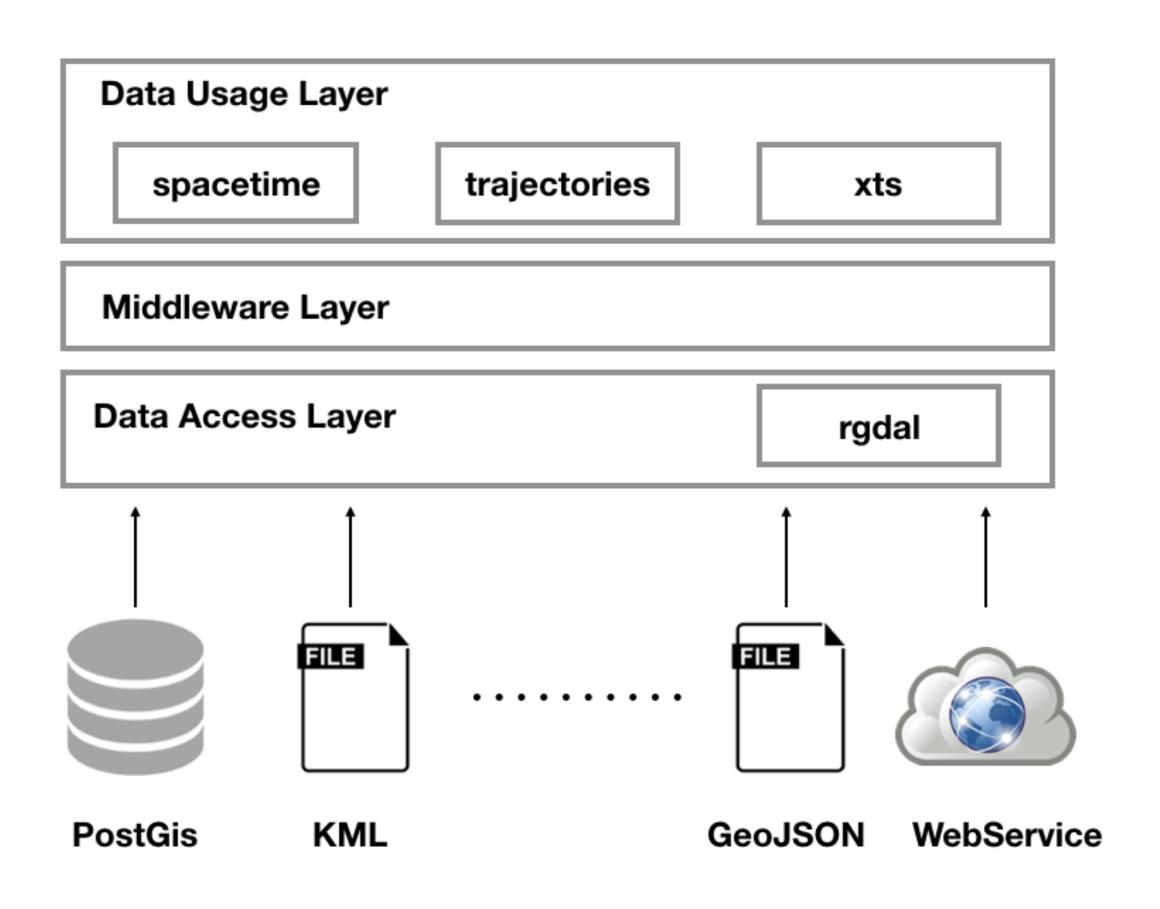
R PACKAGES FOR SPATIOTEMPORAL DATA

▸ Package sp: Obsolete by sf.

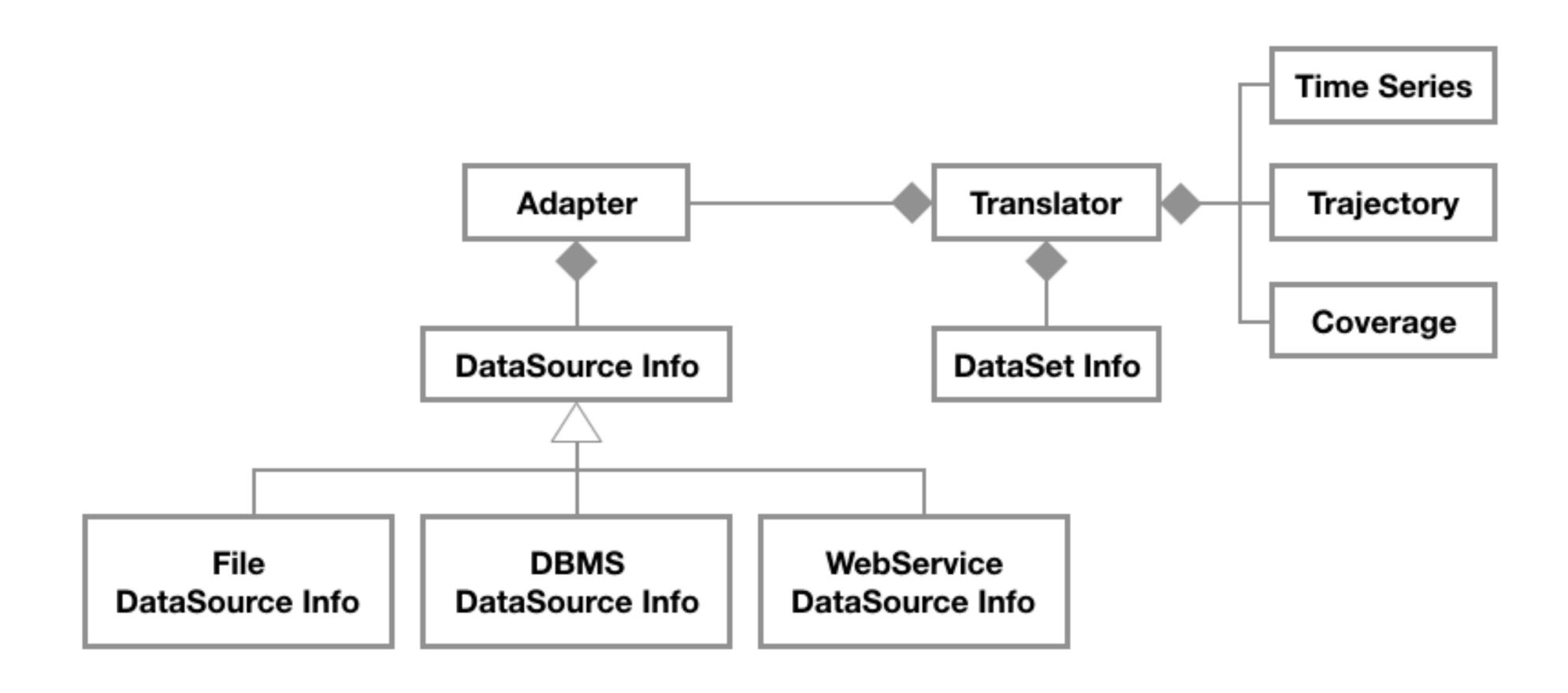▸ Package sf: spacetime and trajectories not compatible.

SOFTWARE ARCHITECTURE

▸ Data Usage Layer: provide high level classes for developer usage;

▸ Middleware Layer: code that translate data to high level classes;

▸ Data Access Layer: deal with different data sources, access the raw data, and provide this data to developers.

▸ 1. Raw data stored as a geometry table on a PostGIS Database.

```
dataSourceInfo <- DBMSDataSourceInfo(
    type = "postgis",
    host="192.168.1.103",
    port="5432",
    dbname="argo",
    username="postgres",
    password="mypass"
)
```

▸ 1. Raw data stored as a geometry table on a PostGIS Database.

▸ 2. Developer provide a Data Source Info object.

```
dataSetInfo <- DataSetInfo (
    spatialColumn = "obs_loc",
    temporalColumn = "obs_date",
    dataColumn = "temper",
    objectIdColumn = "argos_id"
)
```

▸ 1. Raw data stored as a geometry table on a PostGIS Database.

▸ 2. Developer provide a Data Source Info object.

▸ 3. Developer provide a Data Set Info object.

```
> track <- getTrajectory(
    translator,
    layer = "argo_profiles_geom",
    objectId = 46027
)

> class(track)
[1] "Track"
attr(,"package")
[1] "trajectories"
>
```

▸ 1. Raw data stored as a geometry table on a PostGIS Database.

▸ 2. Developer provide a Data Source Info object.

▸ 3. Developer provide a Data Set Info object.

▸ 4. Developer retrieves a trajectory, as a high level class.

```
> track
An object of class "Track"
Slot "connections":
    distance duration        speed direction
1 0.3141481    863207 3.639313e-07 249.89224
2 0.3304905    863226 3.828552e-07 254.19749
3 0.3788892    861852 4.396221e-07 283.11930
4 0.2104661    870342 2.418201e-07 266.18593
5 0.1255388    858348 1.462563e-07 149.34933
6 0.2539705    868012 2.925887e-07 101.35418
7 0.3836040    863234 4.443800e-07  50.50041

Slot "sp":
SpatialPoints:
      coords.x1 coords.x2
[1,]    -22.344    14.202
[2,]    -22.639    14.094
[3,]    -22.957    14.004
[4,]    -23.326    14.090
[5,]    -23.536    14.076
[6,]    -23.472    13.968
[7,]    -23.223    13.918
[8,]    -22.927    14.162
Coordinate Reference System (CRS) arguments: NA
```

```
Slot "data":
      values      ID
1     21.042   ID 1
41    22.311  ID 41
75    13.652  ID 75
97    22.788  ID 97
169   23.528 ID 169
231   24.008 ID 231
298       NA ID 298
336   24.486 ID 336

Slot "time":
                       [,1]
2017-03-12 03:40:25       1
2017-03-22 03:27:12      41
2017-04-01 03:14:18      75
2017-04-11 02:38:30      97
2017-04-21 04:24:12     169
2017-05-01 02:50:00     231
2017-05-11 03:56:52     298
2017-05-21 03:44:06     336
```

▸ 1. Raw data stored as a geometry table on a PostGIS Database.

▸ 2. Developer provide a Data Source Info object.

▸ 3. Developer provide a Data Set Info object.

▸ 4. Developer retrieves a trajectory, as a high level class.
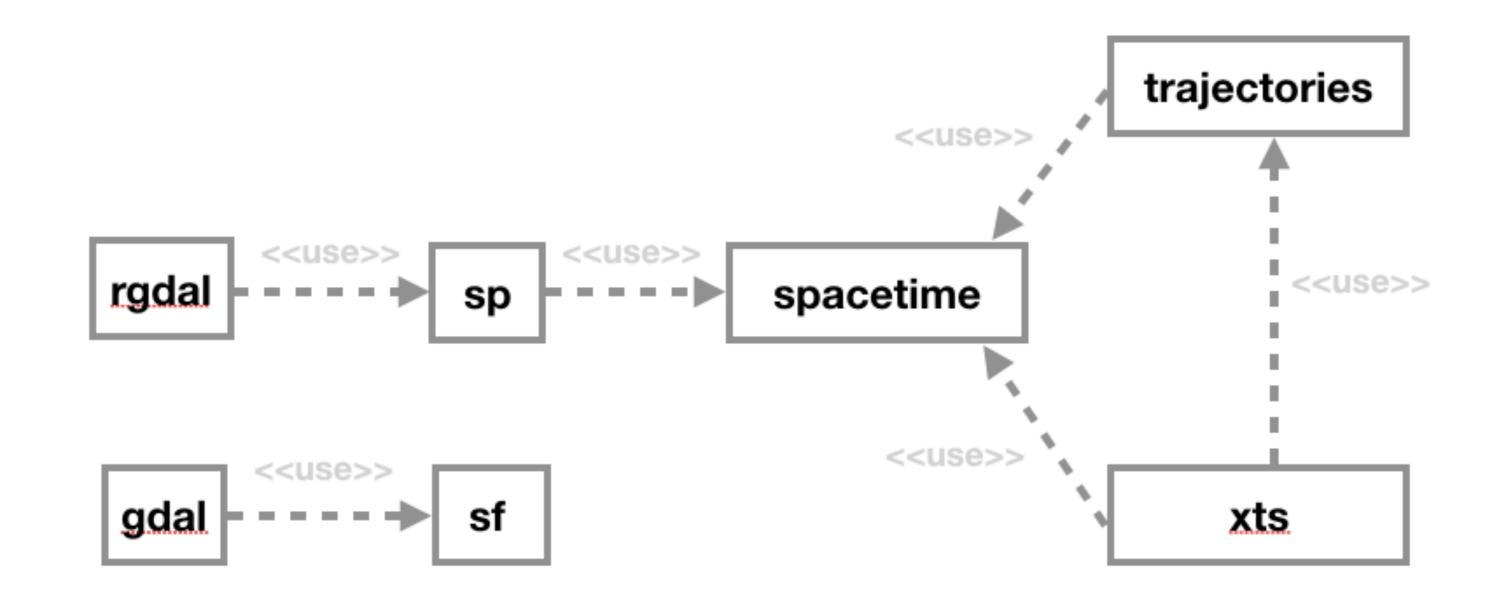
▸ **Improve Translator class capabilities:** There are many date/time formats and no standardisation, an important modification on this class should be the use of regular expressions on date/time pattern recognition;

▸ **Improve DataSetInfo and DataSourceInfo:** This classes could also be improved using RDF to describe the data, instead of source codes;

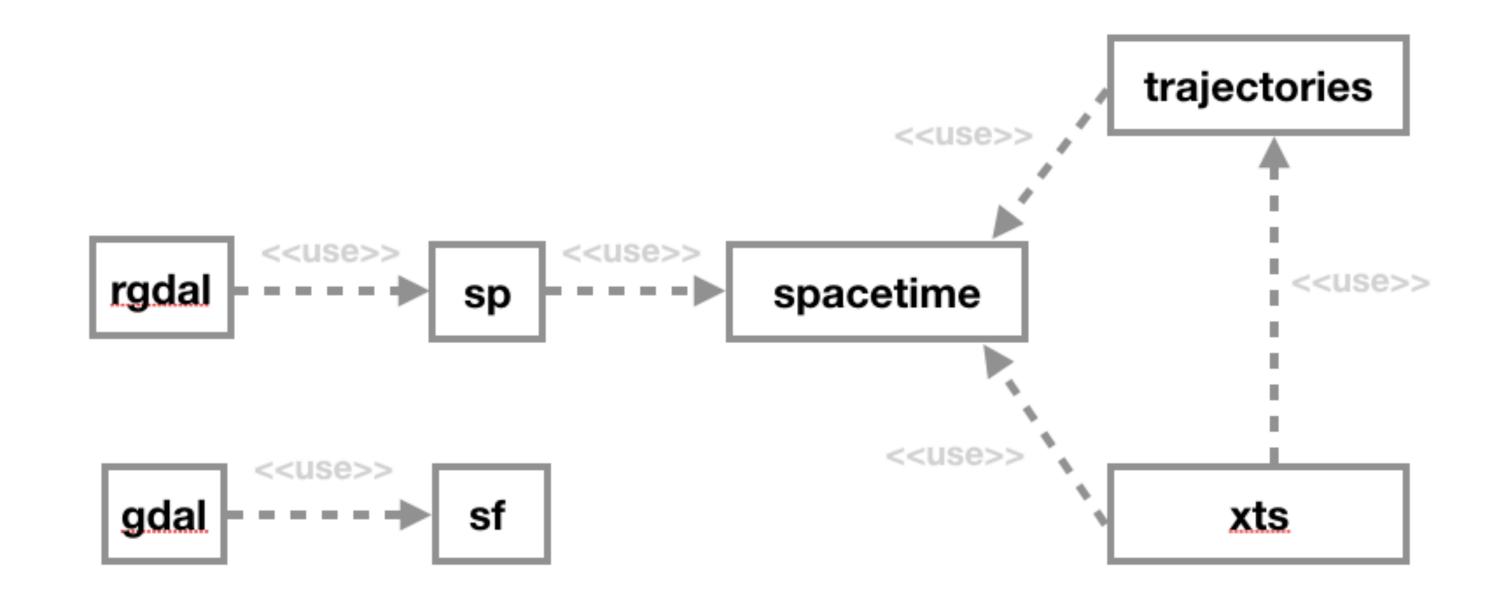▸ **Event retrieving functionality:** If the user adds some restriction (eg. a time slice, an object id or a bounding box), the package should be able to return an event, included on that restriction. In the above example, an event could be: two touching floats, or a float registering a high temperature increasing in a small amount of time
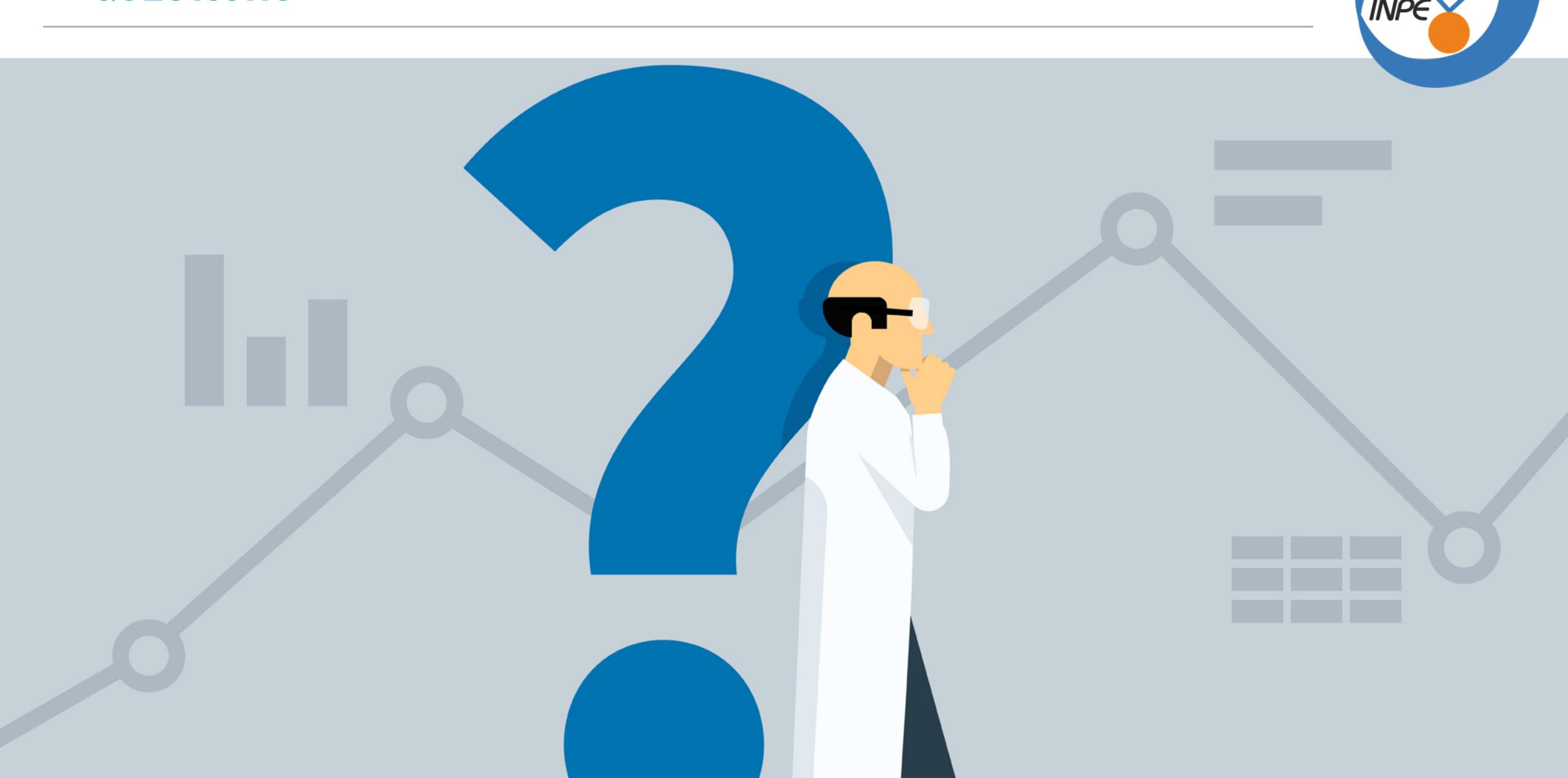
▸ Package sp: Obsolete by sf.

▸ Package sf: spacetime and trajectories not compatible.

TEMPORAL SIMPLE FEATURE

THANKS!

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