What is a CRS really?

A geodetic view of the ISO/OGC geospatial data model: Broken, but not beyond repair

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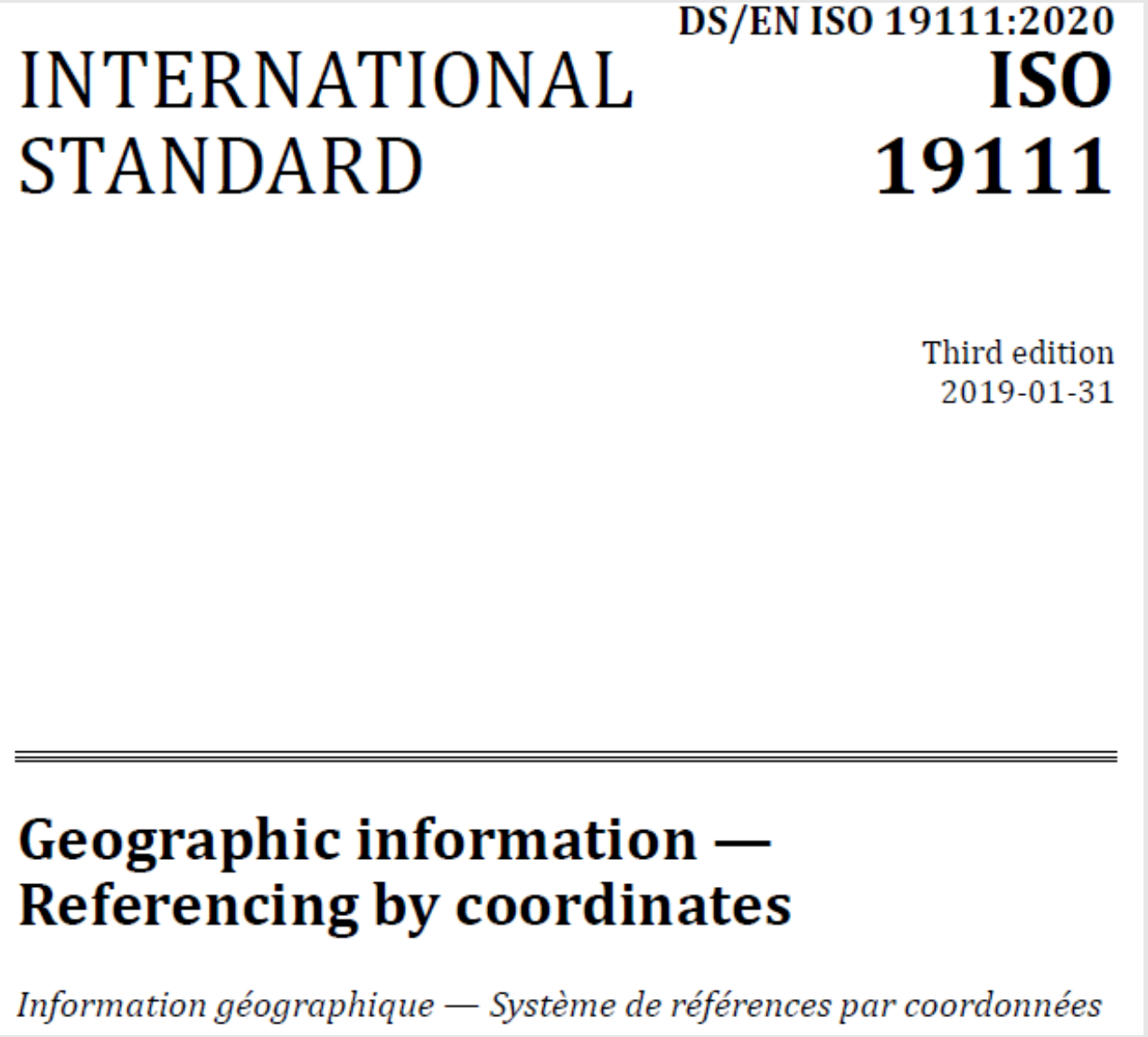

DS/EN ISO 19111:2020

INTERNATIONAL STANDARD

ISO 19111

Third edition
2019-01-31

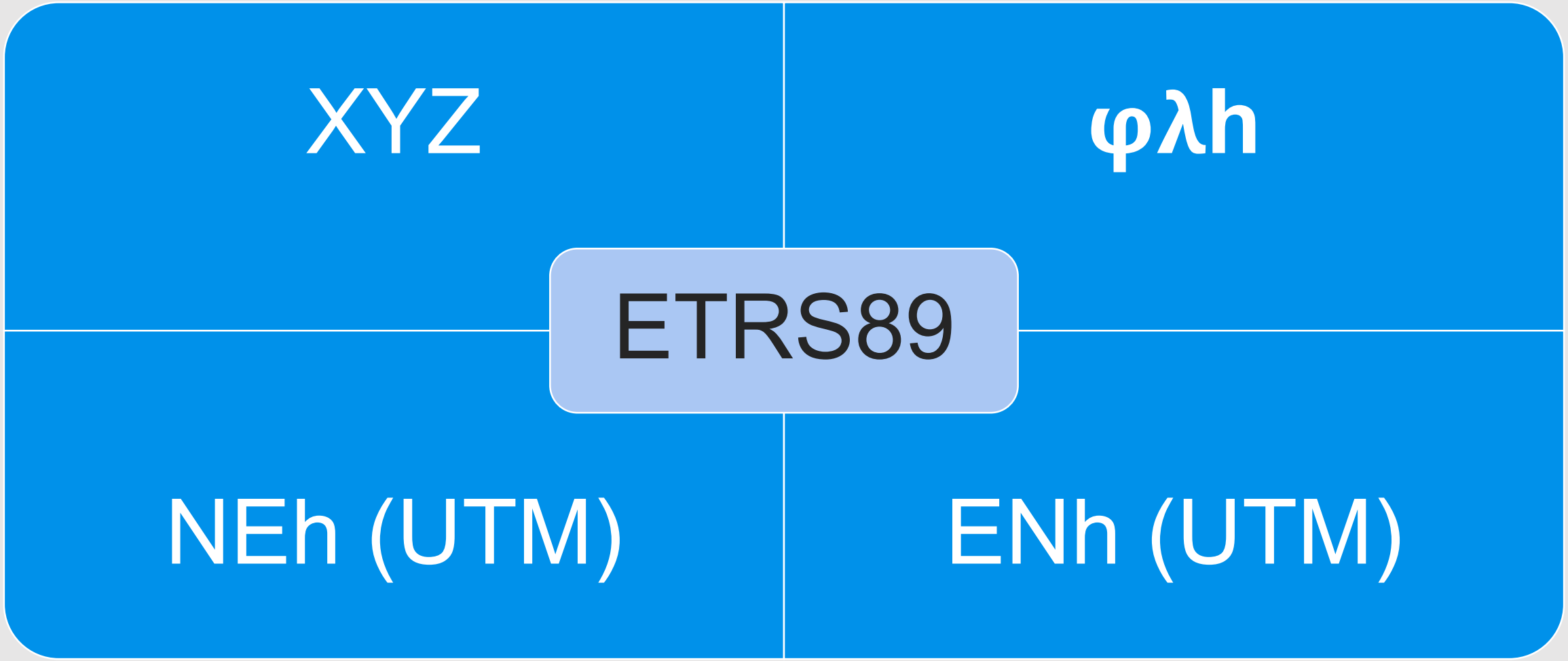
Geographic information — Referencing by coordinates

Information géographique — Système de références par coordonnées

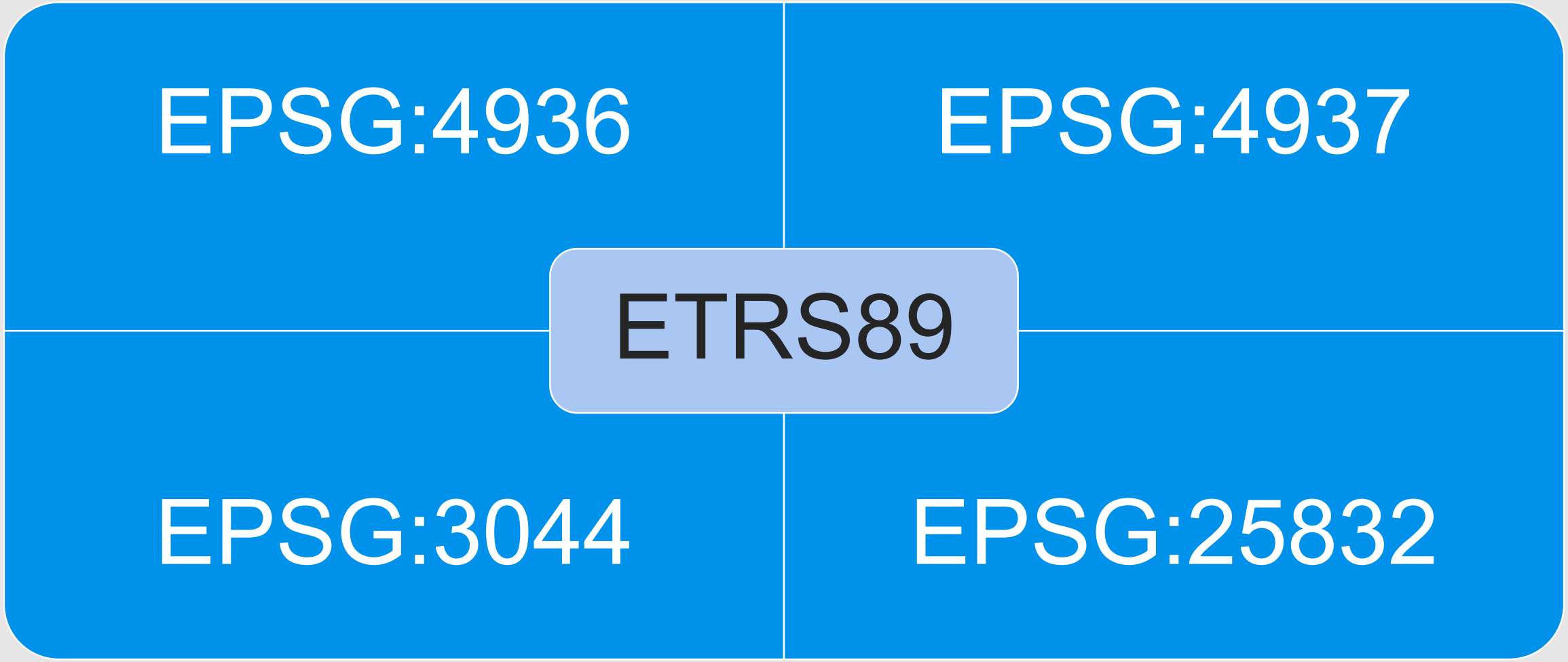
CRS

- Coordinate Reference System
- A concept from geoinformatics
- Not really any 1:1 geodetic term
- But the end-users of georeferencing use geoinformatics tools (GIS, Navigation) based on ISO-19100 concepts
- So we better understand the discrepancies, in order to understand our users

The geodesist's view: "**It's just ETRS89**"



The geoinformaticist's view: "**No, it's not**"



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GEOMATIC SOLUTIONS

EPSG Geodetic Parameter Dataset

About the EPSG Dataset

The IOGP's EPSG Geodetic Parameter Dataset is a collection of definitions of coordinate reference systems and coordinate transformations which may be global, regional, national or local in application.The EPSG Geodetic Parameter Dataset is maintained by the Geodesy Subcommittee of the IOGP Geomatics Committee.

Recent changes to the EPSG Dataset can be viewed in Release Information History Table.

About registration

To gain access to the EPSG data through these web pages, you must agree to the Terms of Use by registering on this site. Once logged in, you will have access to additional functionality and may also manage your account including your subscription to EPSG updates.

To register, you must enter your email address (visible to IOGP) and password (not visible). This information is not used outside this site, nor is it passed on to any third party.

Click here to register.

About this site

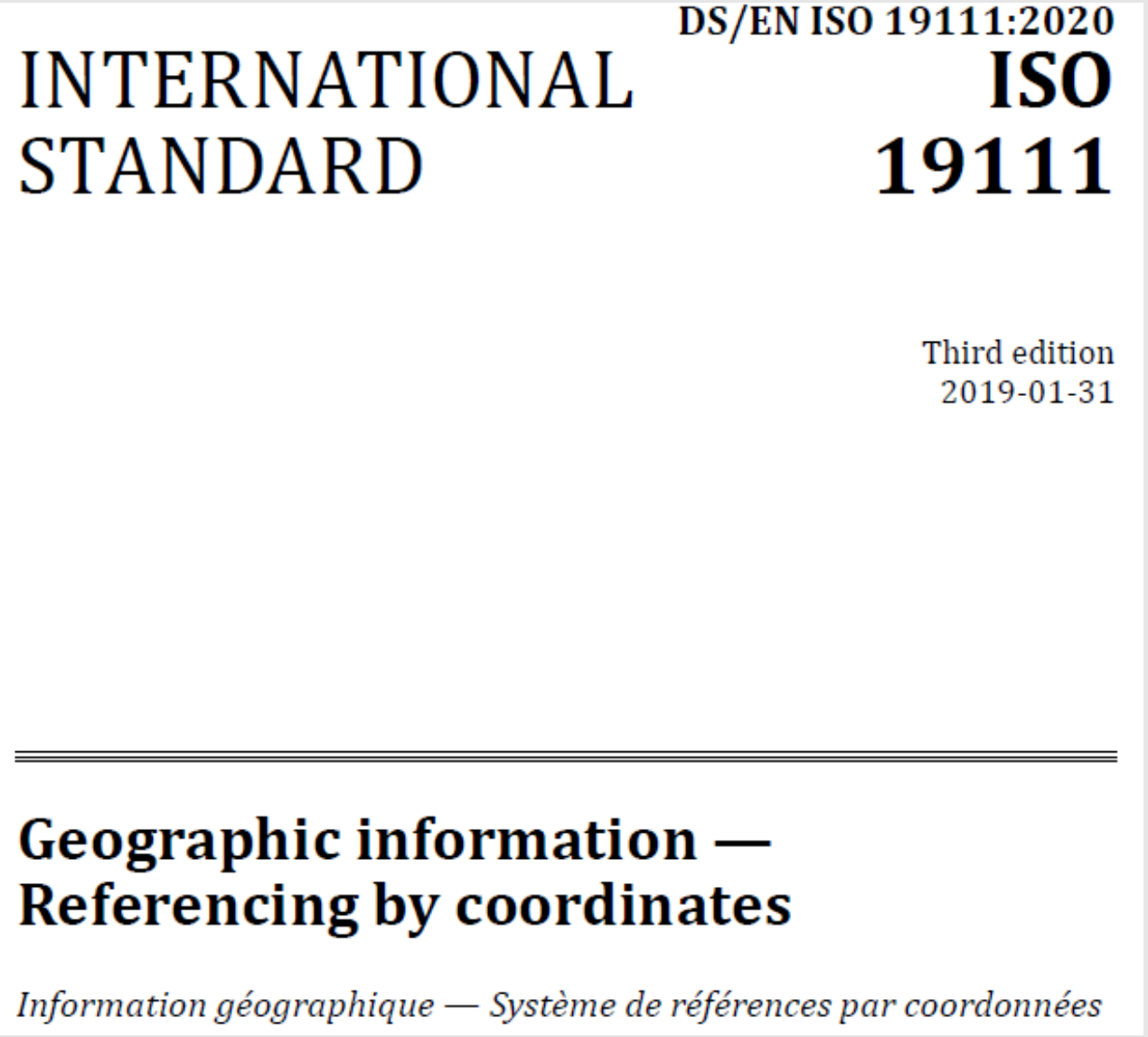
This site contains the master EPSG Dataset. Its data model follows the ISO 19111:2019 international standard for referencing by coordinates, including its provision for dynamic datums, geoid-based vertical datums, datum ensembles and derived projected coordinate reference systems. EPSG Dataset versions 10.0 and later follow this data model. It is generally backward compatible with the previous 19111:2007 model data model but has some modifications and additional elements. For an overview of the model changes see here.

EPSG Dataset versions v10.003 in the 2019 model and v9.9.1 in the 2007 data model released in September 2020 contain the same data. Both are available from the Dataset Archives. Subsequent data releases including the current one have been made only in the new data model.

The software for this site is subject to continuous improvement and from time to time small changes in functionality may be made.

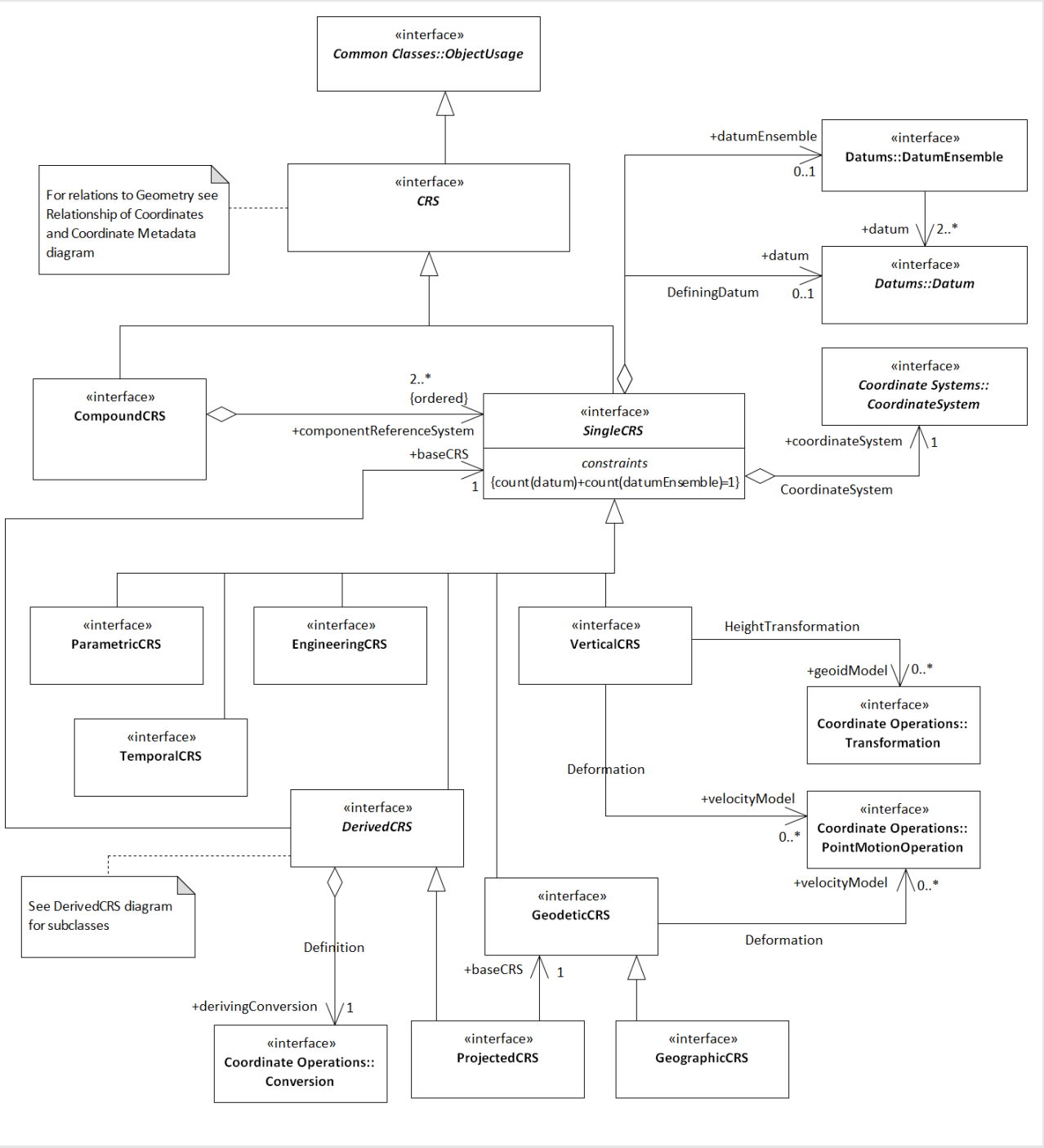
GeoRepository API

Software developers can find the RESTful GeoRepository API here (swagger)



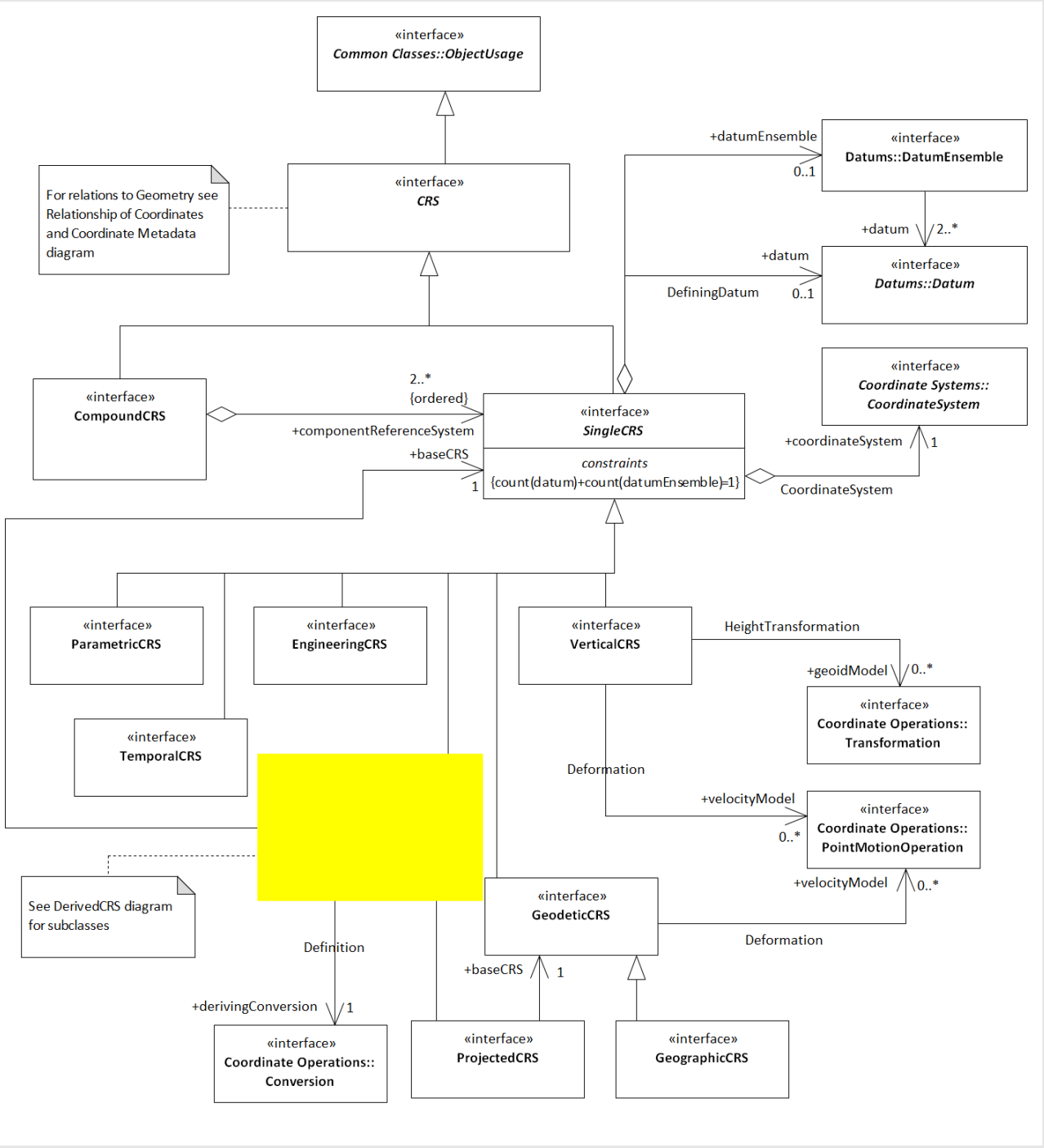
Let's return to the CRS

- Coordinate Reference System
- Not really any 1:1 geodetic term
- But kind-of-a-datum-plus-a-coordinate-system-stereotype
- **But with enough internal state to derive transformations between two different CRS!**



”Enough internal state”

- A quite complex data model is required…



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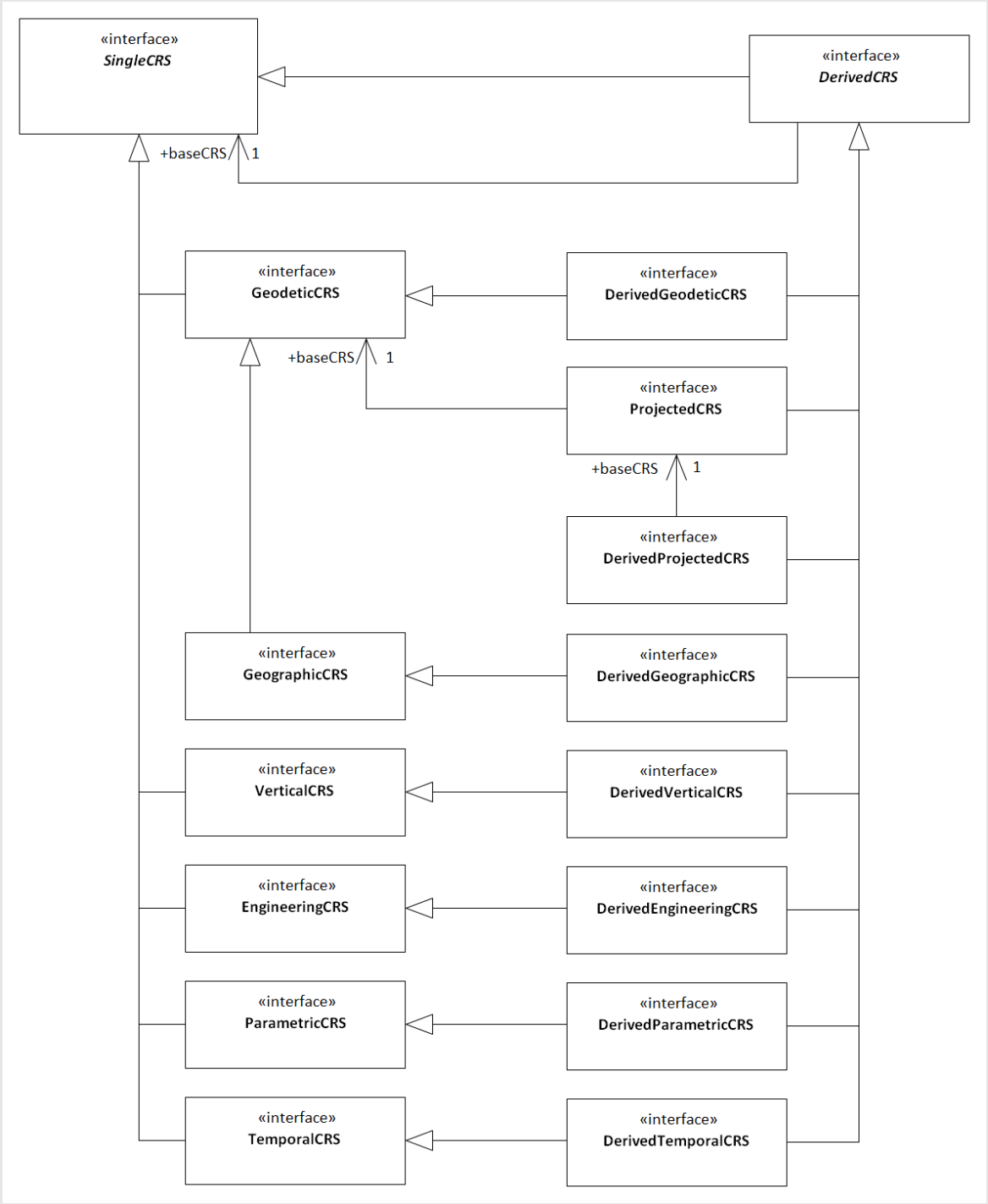

”Enough internal state”

- A quite complex data model is required…

The geoinformatics world view in summary:

- A coordinate reference system (CRS) is a **real, tangible object** with internal state, reflecting its “definition”
  - Based on which axiomatic basis?
- For a set of 2 CRS, we can infer a transformation between them, from their “definitions”

ED50 to ETRS89 (1)	1588	transformation	Norway - offshore north of 65°…
ED50 to ETRS89 (10)	1650	transformation	France
ED50 to ETRS89 (12)	15932	transformation	Spain - mainland and Balearic…
ED50 to ETRS89 (13)	5040	transformation	Portugal - mainland - onshore
ED50 to ETRS89 (14)	5661	transformation	Spain - Catalonia onshore
ED50 to ETRS89 (15)	9224	transformation	Europe - offshore North Sea -…
ED50 to ETRS89 (16)	9408	transformation	Spain - mainland onshore and C…
ED50 to ETRS89 (17)	9409	transformation	Spain - Balearic Islands
ED50 to ETRS89 (3)	1589	transformation	Norway - offshore 62°N to 65°N…
ED50 to ETRS89 (4)	1626	transformation	Denmark - onshore
ED50 to ETRS89 (5)	1628	transformation	Gibraltar
ED50 to ETRS89 (6)	1630	transformation	Spain - Balearic Islands
ED50 to ETRS89 (7)	1632	transformation	Spain - mainland except northw…
ED50 to ETRS89 (8)	1634	transformation	Spain - mainland northwest
ED50 to ETRS89 (9)	1783	transformation	Turkey

Despite the complexity, it doesn't work very well:

- Transformations are seldom unique
- You'll need geodetic context to select the right one
- And that context is not sufficiently represented in the CRS data model

The geoinformatics world view in summary:

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The geodetic world view in summary:

- A coordinate reference system (CRS) **just a label**
- There is no axiomatic foundation on which to build “definitions” of CRS
  - Since reference frames are empirical, not mathematical, obejcts
- **Transformations are the “real objects”,** but they are fundamentally of empirical nature
  - (Some) constants are derived, not defined

The problem in summary:

- **Geodetic terminology** is sloppy, and hardly useful for implementation of generic software
- **Geoinformatics terminology** is strict, consistent, highly useful for implementation of generic software - and often not at all in accordance with geodetic practice
- Hence, there's a discrepancy between geodetic practice and end user software
- So end users cannot follow geodetic advice: Transformations are hidden, CRS are instantiations of overengineered, imaginary contraptions

Fortunately

- The *strict ISO-19111 term* **transformation** means essentially the same as the identically spelled *geodetic sloppy term*.
- And ISO-19111 is **up for revision** in a few years' time…

Call-to-action!

- Let's provide proper geodetic input to the revision process:
  - Better focus on transformations
  - Intensive pruning of the overengineered CRS concept
- And in a decade or so, geodetic end users (= everyone) may be able to handle their data in a geodetically meaningful way
- In the meantime: Work towards a **less sloppy geodetic terminology**, in better support of end users' understanding and application

Conclfusion

- Tell the world that
  - **CRS are labels**
  - **Transformations are real**
    - **(unless declared integer ☺)**
- Don’t let your friendly geoinformaticist colleague tell you otherwise


Stop asking what a CRS is. Ask how it relates to other CRS!


But we came to hear you tell
“what *is* a CRS really?”


A CRS is a label!