

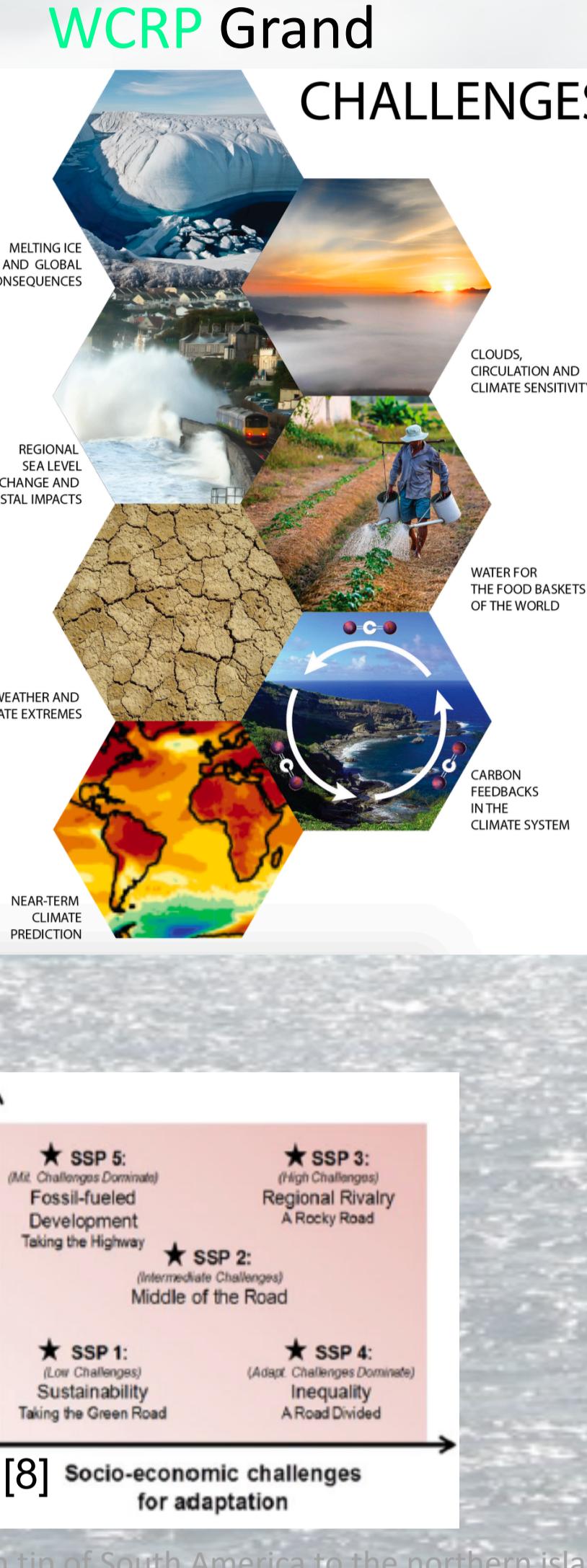
ECAS – Enes Climate Analytics Service

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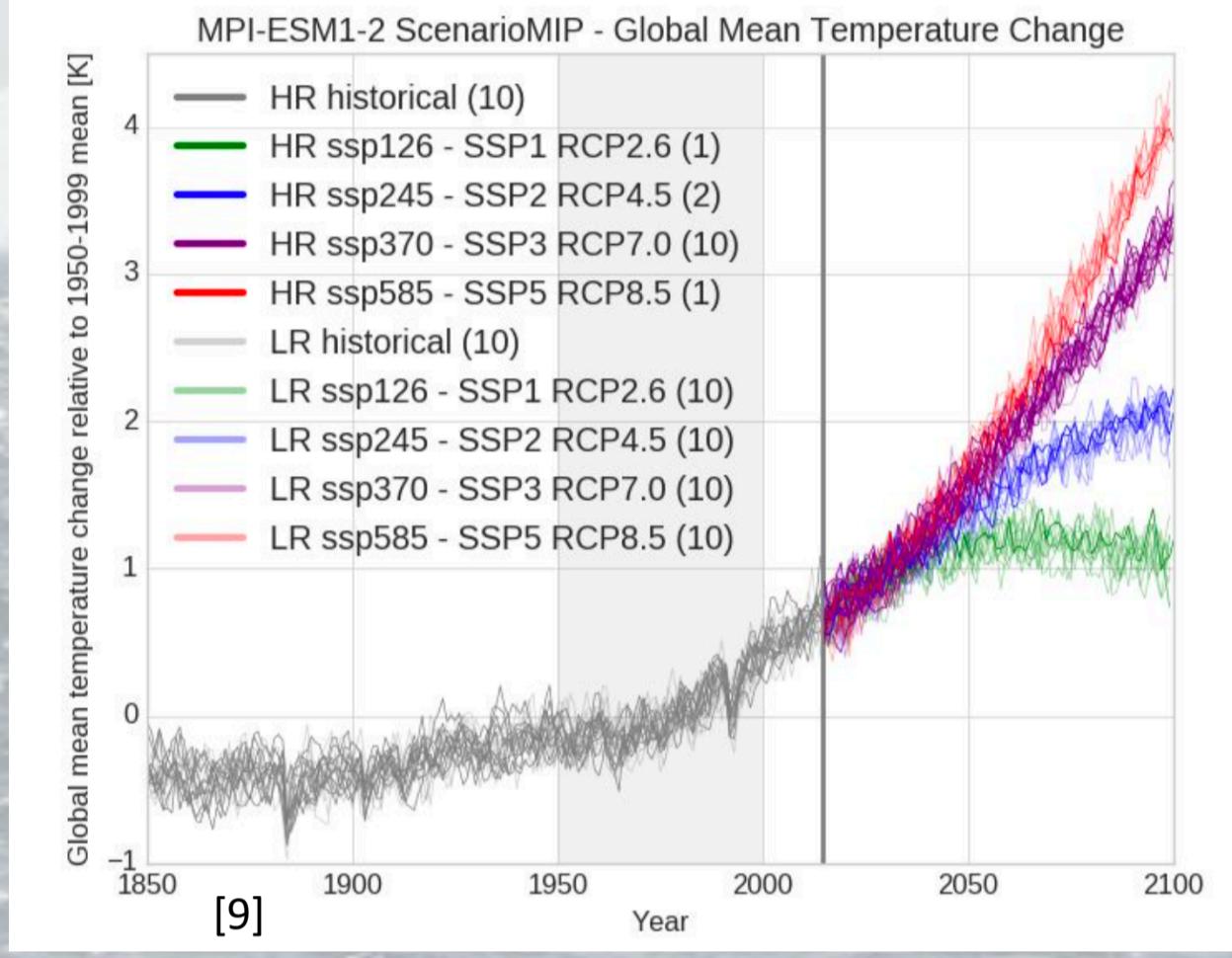


How can we address the Grand Challenges of today's world?

- Global warming, but what are they exactly mean?
- 1. "Melting and global consequences."
- 2. "Regional sea level change and coastal impacts."
- 3. "Weather and climate extremes."
- 4. "Near-term and climate prediction."
- 5. "Clouds, circulation and climate sensitivity."
- 6. "Water for the food baskets of the world."
- 7. "Carbon feedbacks in the climate system."

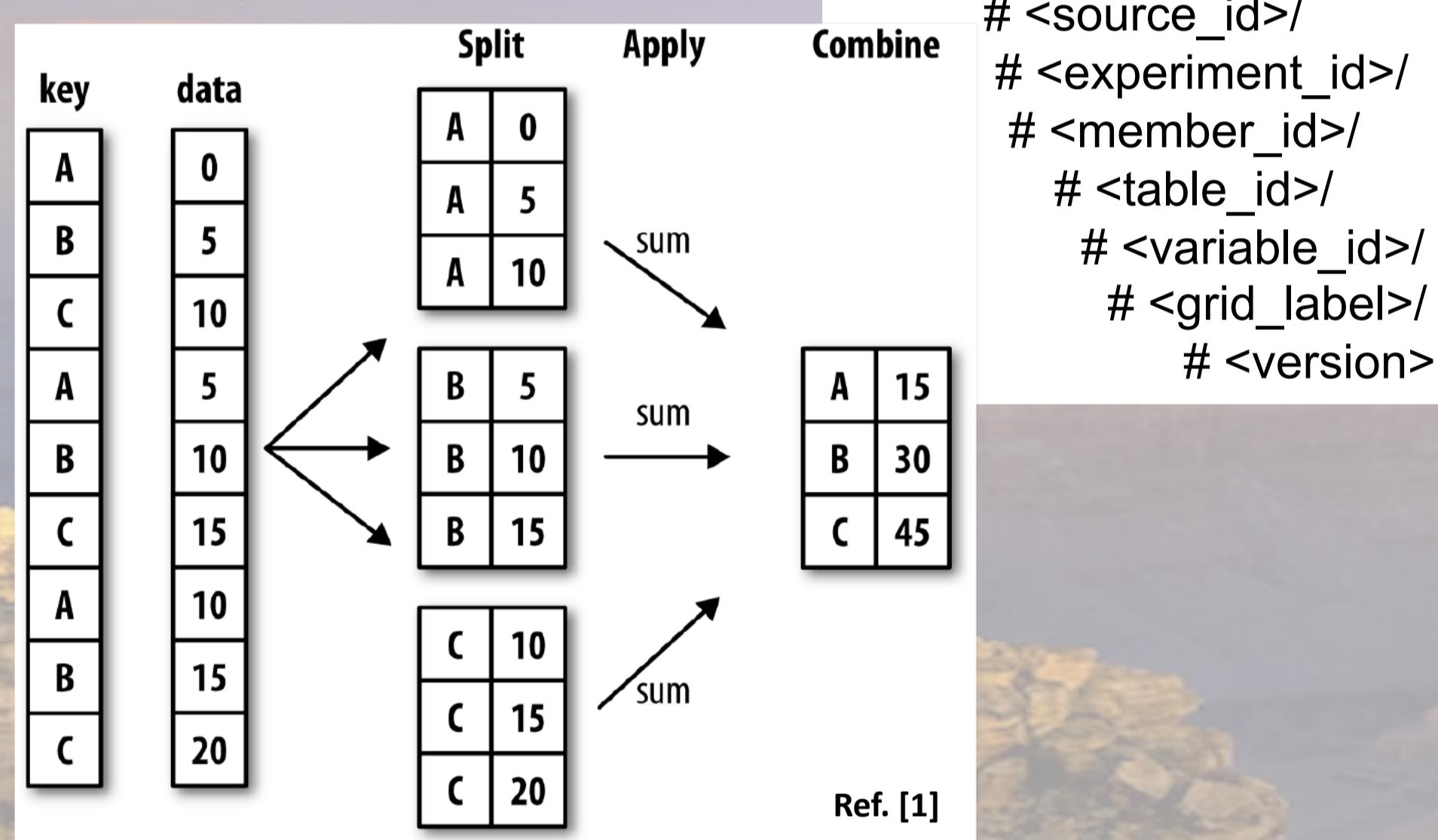


They define the frame in which we do our research!



Drake Passage, Antarctica
This iceberg was found in the Drake Passage, Antarctica, in December 2007. The Drake Passage is the body of water stretching from the southern tip of South America to the northern islands of Antarctica.

GroupBy mechanism



an example from [2]:

activity_id	institution_id	source_id	experiment_id	member_id	table_id	variable_id	grid_label	zstore	dcpp_init_year	path
0	AerChemMIP	BCC	BCC-ESM1	ssp370	r1i1p1f1	Amon	pr	gn	gs://cmip6/AerChemMIP/BCC/BCC-ESM1/ssp370/r1i1...	NaN

an example from mistral:

activity_id	institution_id	source_id	experiment_id	member_id	table_id	variable_id	grid_label	dcpp_init_year	version	time_range	path
0	AerChemMIP	HAMMOZ-Consortium	MPI-ESM-1-2-HAM	ssp370-lowNCF	r1i1p1f1	Lmon	npp	gn	NaN	v20190627	/mnt/lustre02/work/k1017/CMIP6/data/CMIP6/Aer...

Introduction : Key features of xarray

- is an open source software, freely available to everyone,
- good for multi-dimensional handling of data and
- builds on top of pandas, a data processing python library.

Basic operations: opening, inspecting, selecting data.

- **opening:** work locally with example files (proof-of-principle) or use intake or (for massive data analysis) or do both!
- **inspecting:** explore your data! How can I access the variables? What do I need to plot? How to make a plot that a colleague can understand?
- **selecting:** How can I efficiently handle my data, ie. how do I use the concepts of concatenation, the groupby-mechanism and data aggregation?

Hierarchical indexing

- is an important feature of pandas which allows you to work on higher dimensional data in a lower dimensional form.

```
# plot
# choose one of the ds
lon = da_sep['lon']
lat = da_sep['lat'] #x

fig = plt.figure(figsize=(10, 4))
ax = plt.axes(projection=ccrs.PlateCarree())
ax.coastlines()

# so mittelt man ueber die ersten 10 Jahre
ds10 = da_sep['pr'].isel(time=slice(0,10)).mean('time')

# so berechnet man den MW der 10 Jahre ruckwaerts von 240 Zeitschritten
pr10end=da_sep['pr'].isel(time=slice(240-10*12,240)).mean('time')

# difference
prdiff = pr10end - pr10end

# arguments: coordinates, y, x, z, dims, p = plt.contourf(lon, lat, prdiff, 20,
#                 transform=ccrs.PlateCarree(), cmap='RdBu')

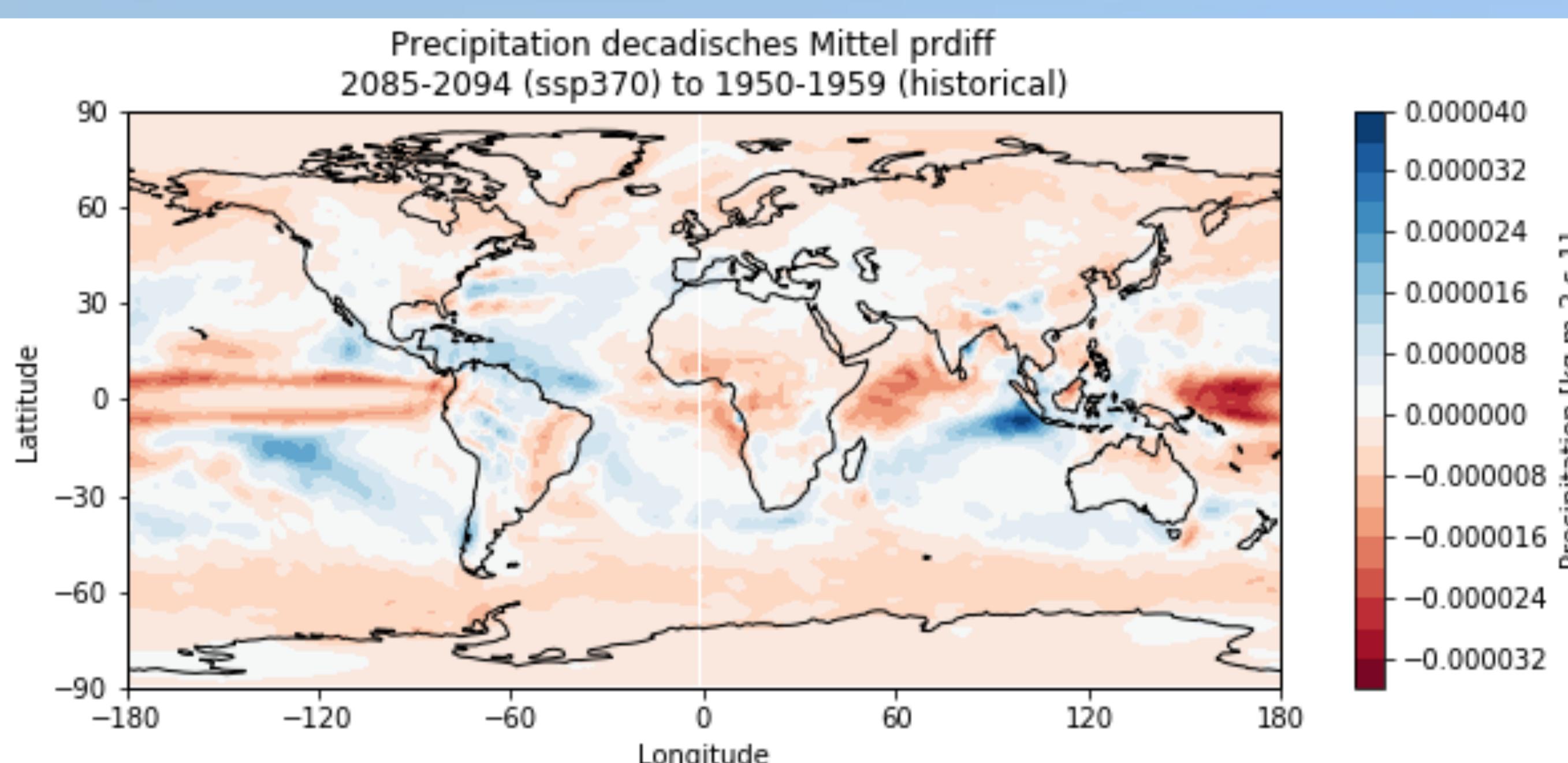
# -- label
ax.set_xlabel('Longitude')
ax.set_ylabel('Latitude')

# -- per Hand
ax.set_xticks([-180,-120,-60,0,60,120,180])
ax.set_yticks([-90,-60,-30,0,30,60,90])
```

The tutorial can be found at https://github.com/regkwee/dm/blob/master/xarray_local.ipynb

References:

- [1] Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython 2nd Edition, 2018
- [2] last visited 02.May 2020, <https://intake-esm.readthedocs.io>
- [3] xarray.pydata.org: visited on 02.May 2020 <http://xarray.pydata.org/en/stable/>
- [4] egu2017 xarray tutorial, last visited on 02.May 2020: <http://pure.iiasa.ac.at/id/eprint/14952/1/xarray-tutorial-egu2017-answers.pdf>
- [5] dask.org
- [6] LunchBytes on 26.3.2020 by Aaron Spring, Max-Planck-Institute for Meteorology
- [7] Climate Data Meetup, 20.Feb. 2020, DKRZ
- [8] Riahi et al., The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview, *Global Environmental Change* 42 (2017) 153–168, <http://dx.doi.org/10.1016/j.gloenvcha.2016.05.009>
- [9] Martin Schupfner, private communication, Dec. 2019



Outlook and conclusions

- include Dask [5] for more and faster computing!
- stay tuned for more pythonic fun!