Introduction to Climate
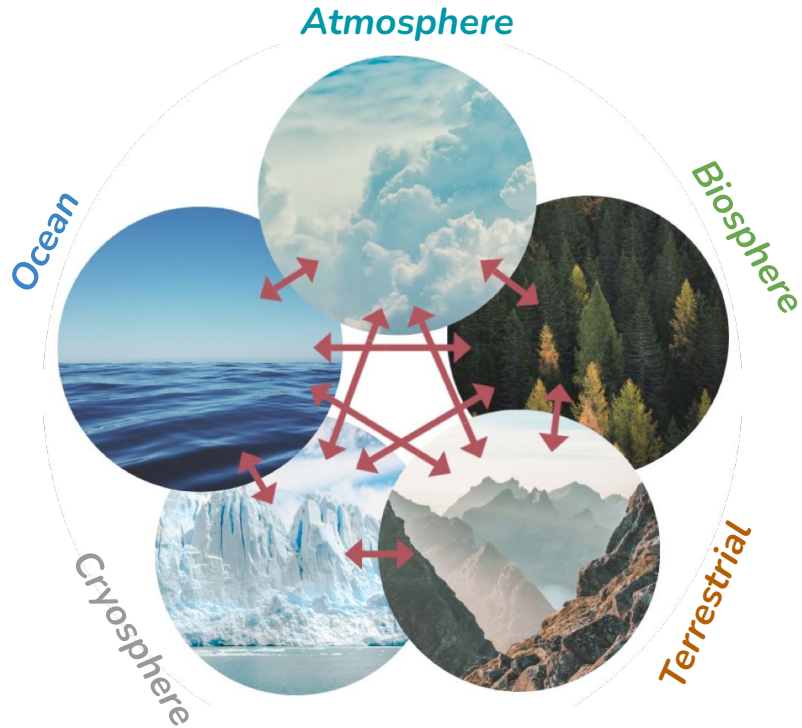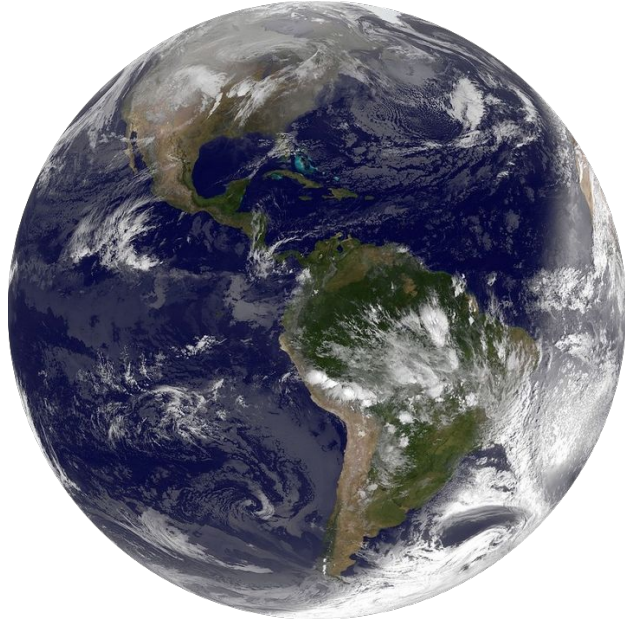
Sloane Garelick

What is climate?

Atmosphere

Ocean

Biosphere

Cryosphere

Terrestrial

(NASA, CC BY 2.0; Femkemilene, CC BY-SA 4.0)

Climate System Forcings and Variables

Climate Forcings

Natural Forcings

- Solar radiation
- Orbital cycles
- Carbon cycle

- Anthropogenic

Climate Variables

- Temperature
- Precipitation
- Atmospheric composition
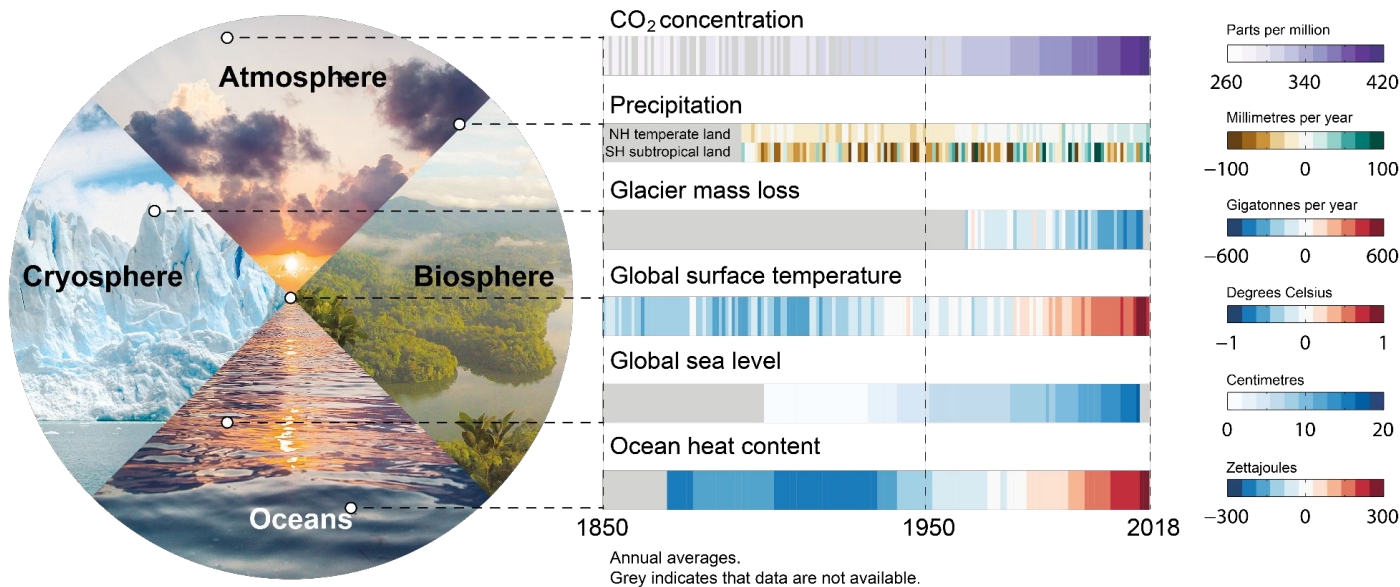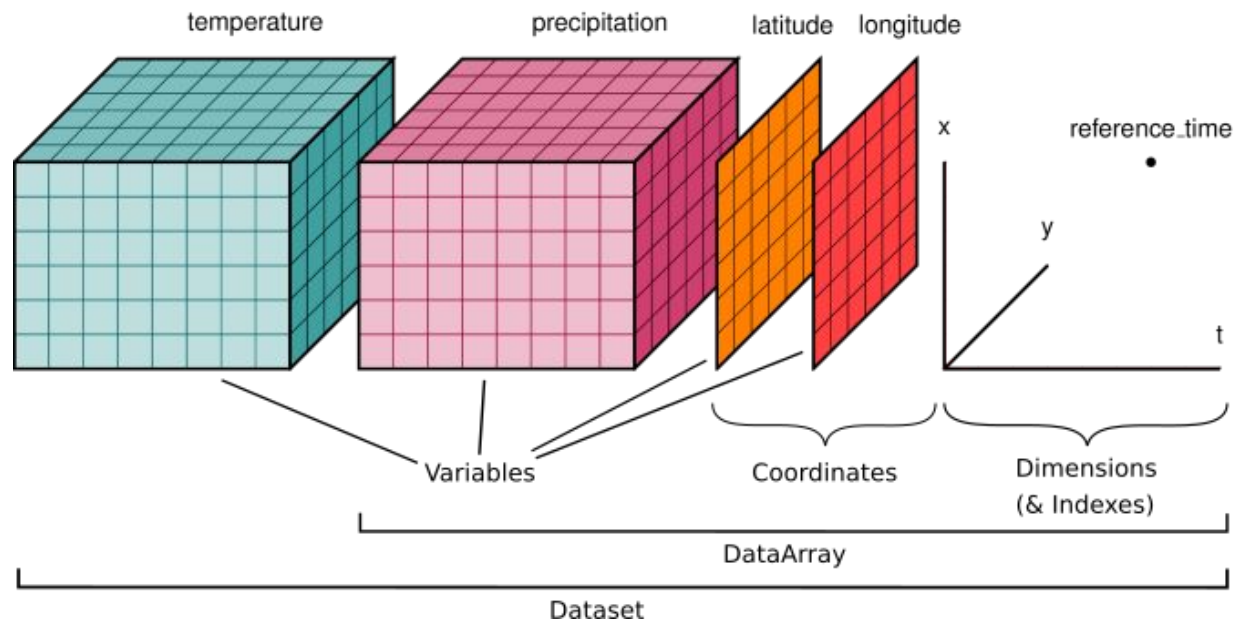- Vegetation

Variations in Earth's Climate System

Figure 1.4 | Changes are occurring throughout the climate system. Left: Main realms of the climate system: atmosphere, biosphere, cryosphere and ocean. Right: Six key indicators of ongoing changes since 1850, or the start of the observational or assessed record, through 2018. Each stripe indicates the global (except for precipitation which shows two latitude band means), annual mean anomaly for a single year, relative to a multi-year baseline (except for CO2 concentration and glacier mass loss, which are absolute values). Grey indicates that data are not available. Datasets and baselines used are: (i) CO2: Antarctic ice cores (Lüthi et al., 2008; Bereiter et al., 2015) and direct air measurements (Tans and Keeling, 2020) (see Figure 1.5 for details); (ii) precipitation: Global Precipitation Climatology Centre (GPCC) V8 (updated from Beckeret al., 2013), baseline 1961–1990 using land areas only with latitude bands 33°N–66°N and 15°S–30°S; (iii) glacier mass loss: Zemp et al. (2019); (iv) global surface air temperature (GMST): HadCRUT5 (Morice et al., 2021), baseline 1961–1990; (v) sea level change: (Dangendorf et al., 2019), baseline 1900–1929; (vi) ocean heat content (model–observation hybrid): Zanna et al. (2019), baseline 1961–1990. Further details on data sources and processing are available in the chapter data table (Table 1.SM.1).

Figure 1.4 in IPCC, 2021: Chapter 1. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Chen, D. et al.)

Tutorial 1: Creating DataArrays and Datasets in Xarray

temperature precipitation latitude longitude

Variables

Coordinates

Dimensions (& Indexes)

DataArray

Dataset

reference_time

x

y

t

(Project Pythia)

- Assessing changes in global climate systems and their forcings, involves large, global datasets with multiple dimensions and variables

- In this tutorial, we'll use the DataArray and Dataset objects to, organize and interpret these large datasets