STARGATE

Resilient farming by adaptive microclimate management

Analysis of climatic trends in selected regions

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Prague INSPIRE Hackathon 2020
(ČZU - Česká zemědělská univerzita v Praze
PRAHA, 27.01.2020)

www.STARGATE.eu

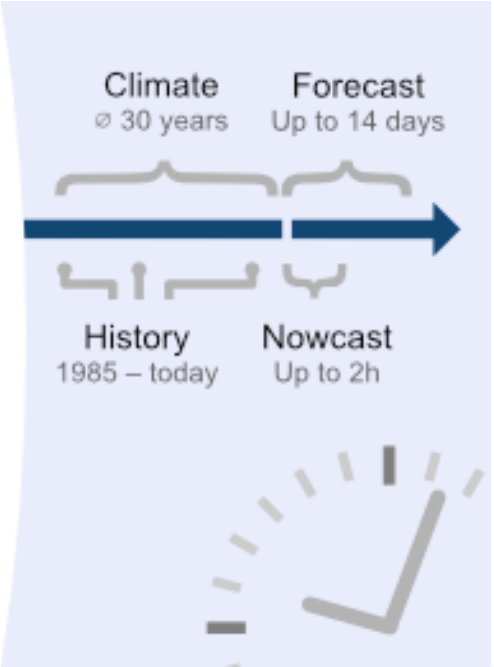
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 818187

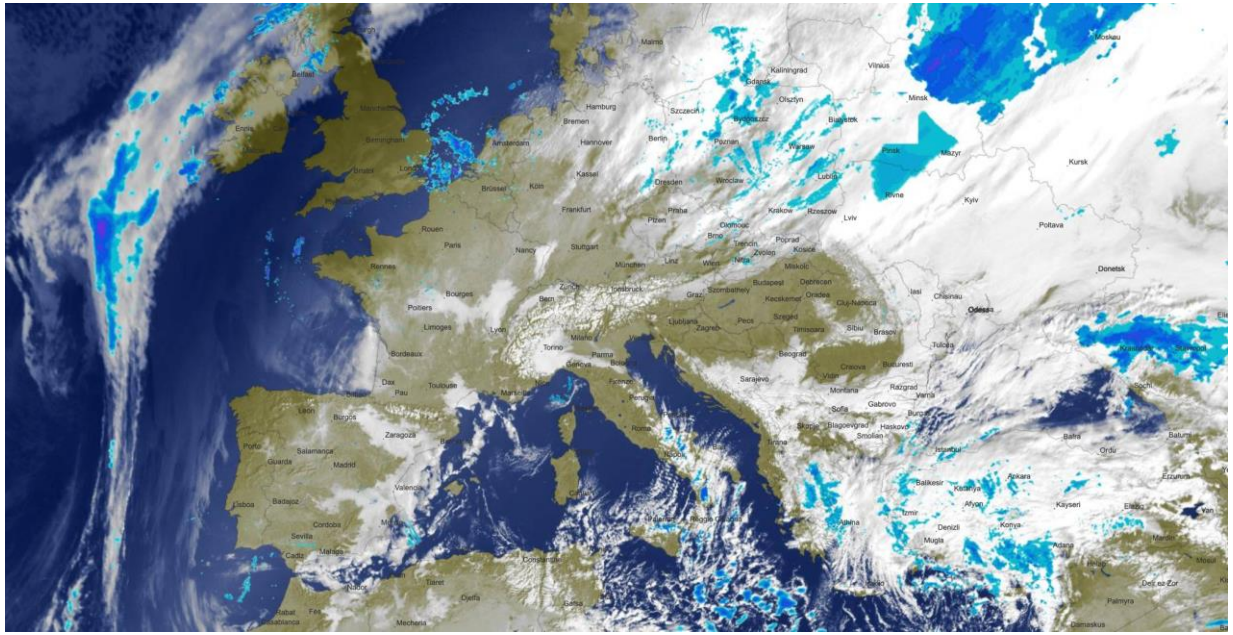
Agenda

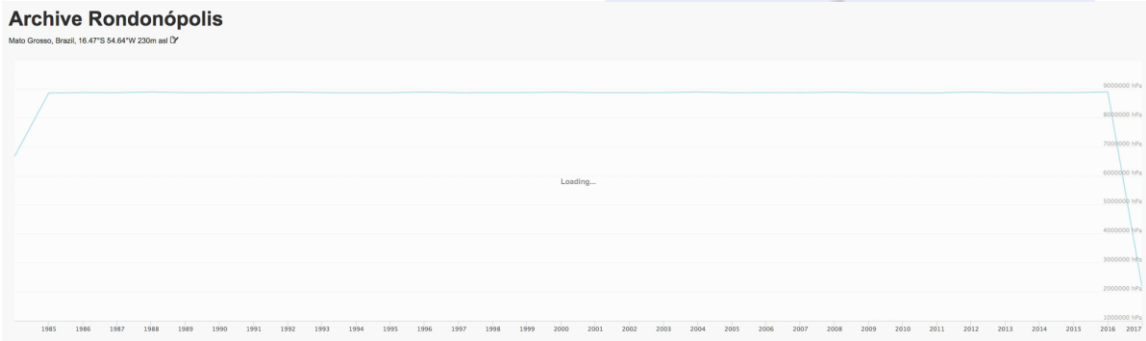
1. State of the art: climatic trends analysis
   - Climate data provider: meteoblue
   - Example pilots
   - Climate trends
   - Risk assessment
2. What’s next

Climate data provider: meteoblue

- Provider of precision weather information for every place in the world
- Founded in 2006, as spin-off from University of Basel in Switzerland
- Delivers automated precision weather info
- Member nº 10 of STARGATE project







Climate data provider: meteoblue

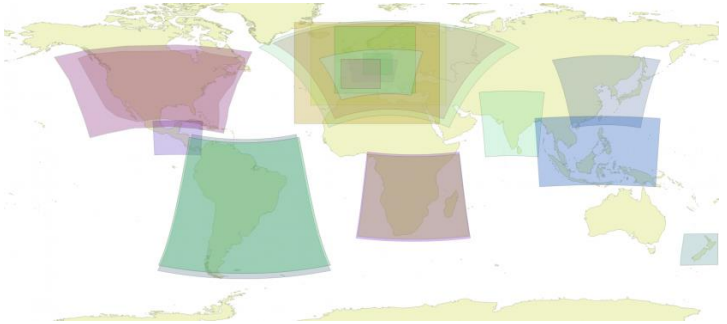
1. Weather available **everywhere:**
   worldwide - any point on land or sea

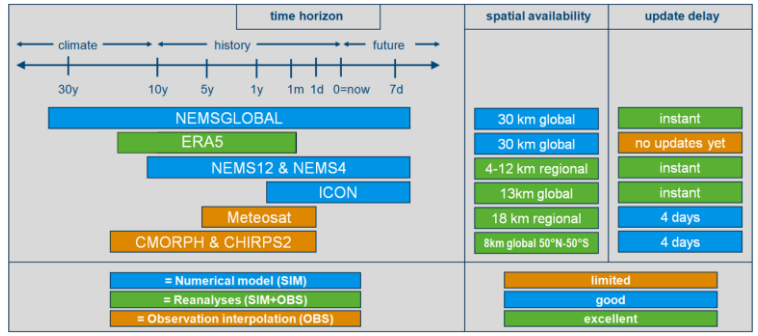
2. Weather for **every time:**
   forecast and history, hourly since 1984

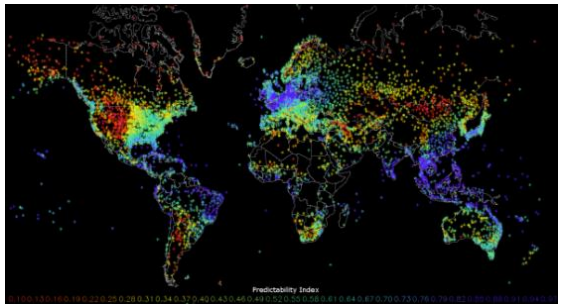
2. Documented **high precision** level

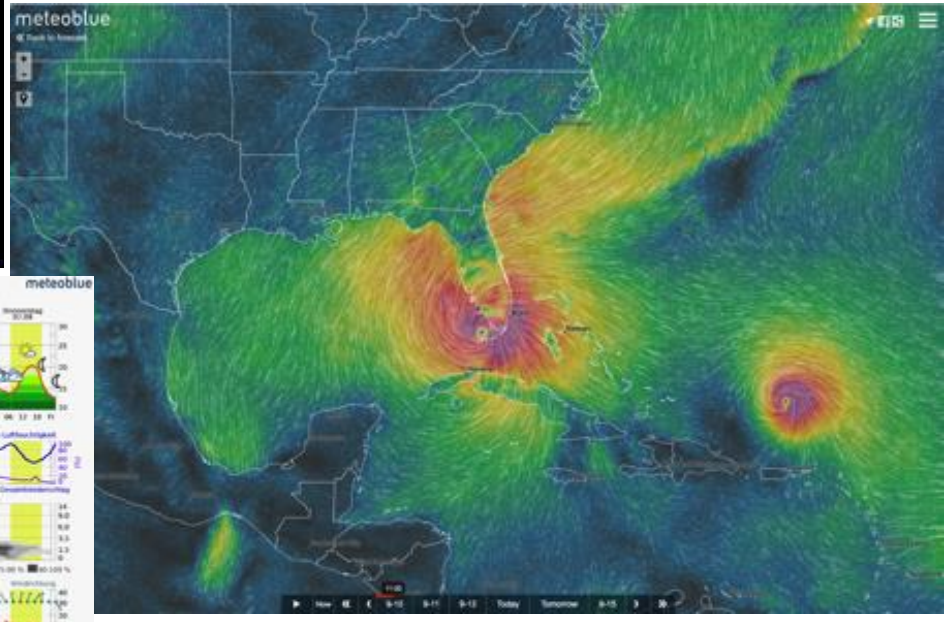
3. M**ultiple output**: data, images

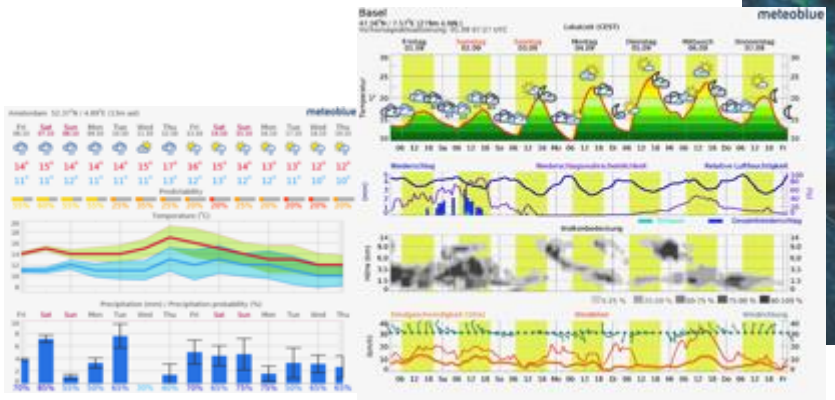
4. **High-speed delivery**:
   website, App, API, email, FTP







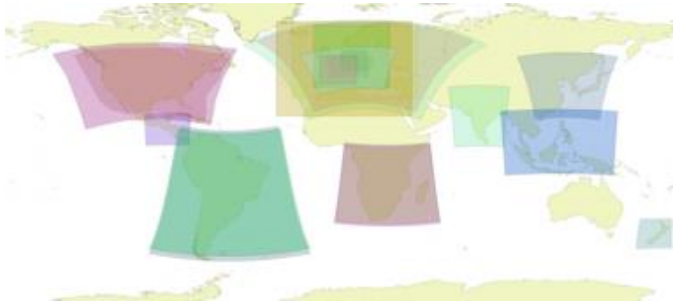




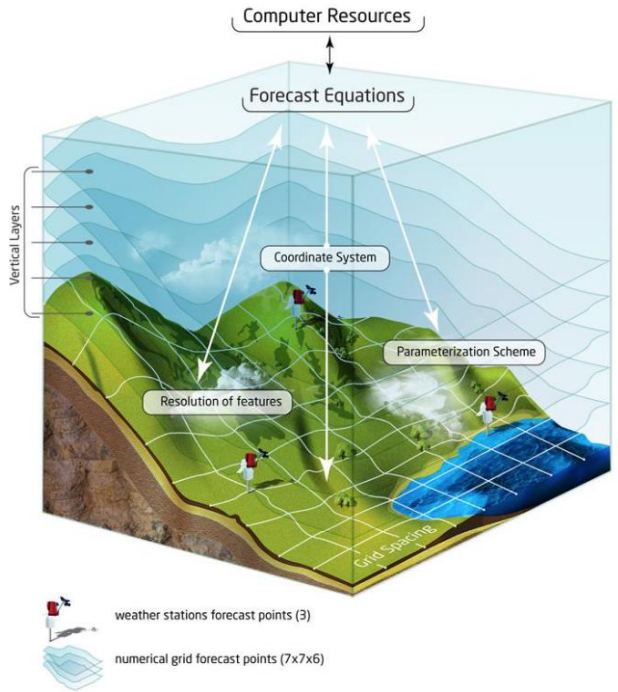
Climate data provider: meteoblue

Numerical weather modelling

- Full spatial and temporal coverage (4D)
- Past 30 years without gaps, 14 days in the future
- Post processing with measurements from >70’000 weather stations



- Land and sea
- City and mountain
- Ground and air
- The best of 8 global and 18 regional models



NEMS model family: Improved NMM successors, operational since 2013. NEMS is a multi-scale model (used from global down to local domains) and significantly improves cloud-development and precipitation forecast.

Model	Region	Resolution		Source
NEMS4	Central Europe	4 km	72 h	meteoblue
NEMS12	Europe	12 km	180 h	meteoblue
NEMS2-12	Europe	12 km	168 h	meteoblue
NEMS-8	Central America	12 km	180 h	meteoblue
NEMS12	India	12 km	180 h	meteoblue
NEMS10	South America	10 km	180 h	meteoblue
NEMS10	South Africa	10 km	180 h	meteoblue
NEMS8	New Zealand	8 km	180 h	meteoblue
NEMS8	Japan / East Asia	8 km	180 h	meteoblue
NEMS30	Global	30 km	180 h	meteoblue
NEMS2-30	Global	30 km	168 h	meteoblue

NMM model family: The first weather model from meteoblue, operational since 2007. NMM is a regional weather model and highly optimised for complex terrain.

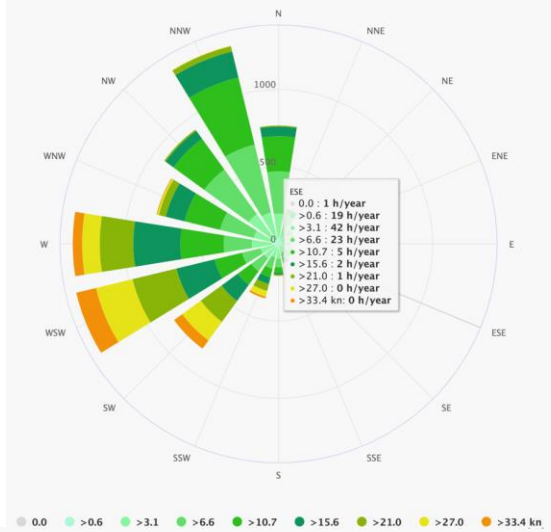
Model	Region	Resolution		Source
NMM4	Central Europe	4 km	72 h	meteoblue
NMM12	Europe	12 km	180 h	meteoblue
NMM18	South America	18 km	180 h	meteoblue
NMM18	South Africa	18 km	180 h	meteoblue
NMM18	Southeast Asia	18 km	180 h	meteoblue

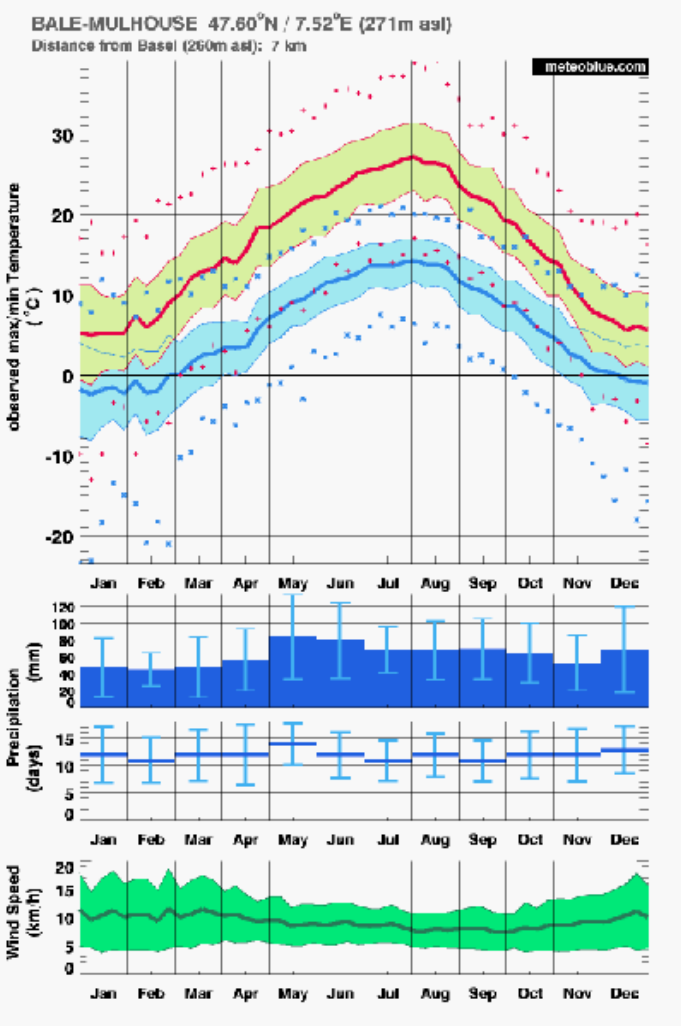
Third-party domains:

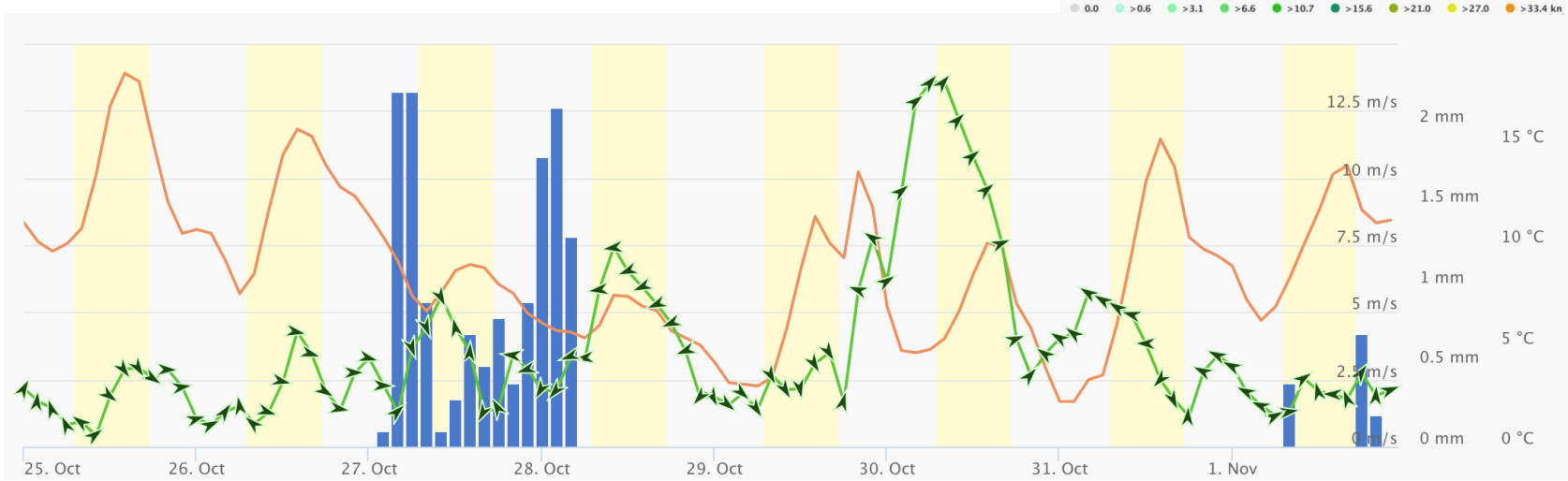
Model	Region	Resolution		Source
GFS22	Global	22 km	180 h (@ 3 h)	NOAA NCEP
GFS40	Global	40 km	180 h (@ 3 h)	NOAA NCEP
GFSENS05	Global	40 km	384 h (@ 6 h)	NOAA NCEP
NAM5	North America	5 km	48 h	NOAA NCEP
NAM12	North America	12 km	84 h (@ 3 h)	NOAA NCEP
ICON7	Europe	7 km	120 h (@ 3 h)	Deutscher Wetterdienst
ICON13	Global	13 km	180 h	Deutscher Wetterdienst
COSMO2	Germany	2.5 km	27 h	Deutscher Wetterdienst
GEM15	Global	15 km	168 h (@ 3 h)	Environment Canada
AROME2	France	2 km	36 h	METEO FRANCE
ARPEGE11	Europe	11 km	96 h	METEO FRANCE
ARPEGE40	Global	40 km	96 h (@ 3 h)	METEO FRANCE
HIRLAM11	Europe	11 km	48 h	KNMI

Climate data provider: meteoblue

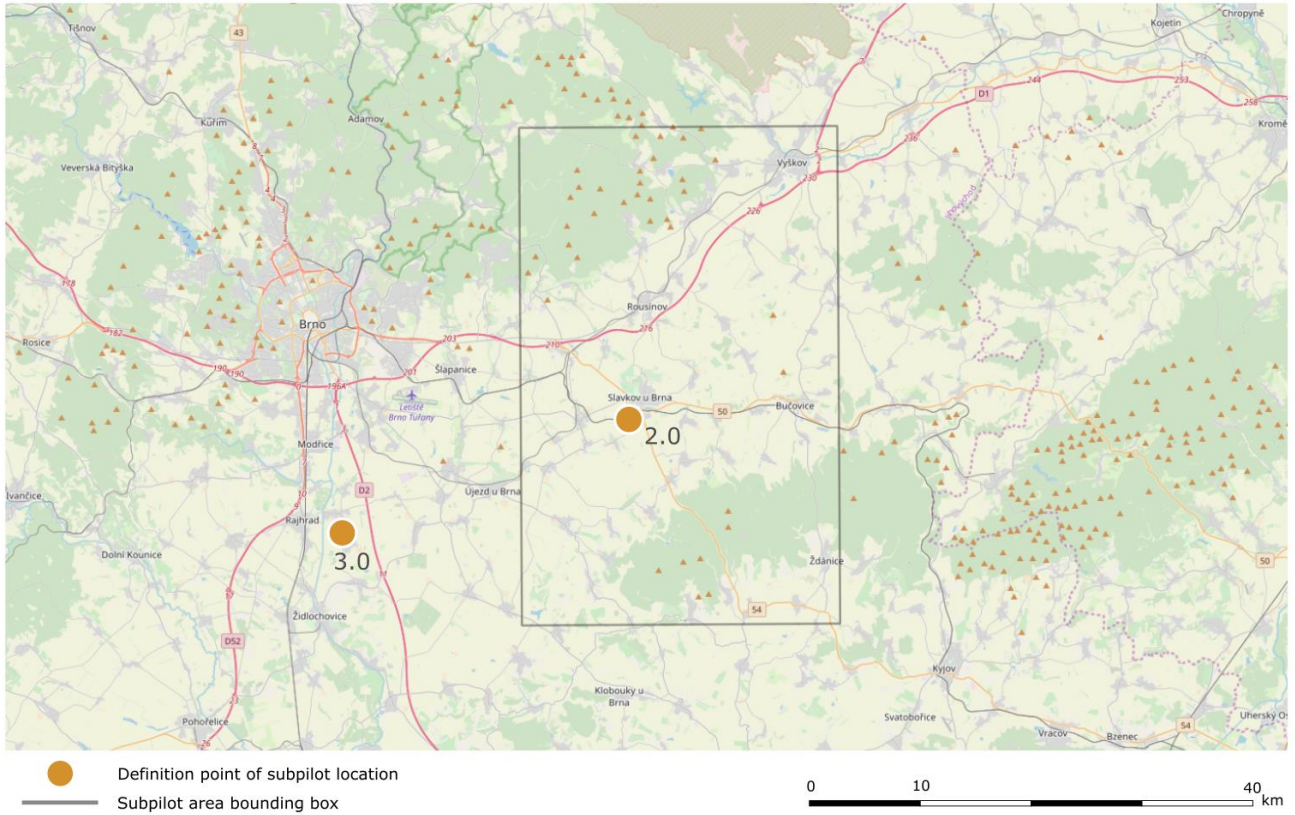
- Hourly data since 1984 – worldwide, no gaps
- Extreme years analysis (P10, P90)
- Climate patterns and expected conditions
- Risk assessment, year comparison, wind rose, histograms
- High speed access





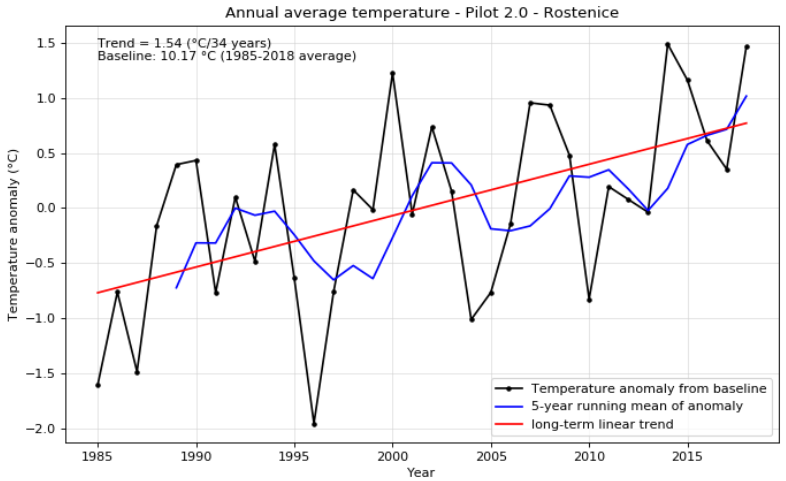


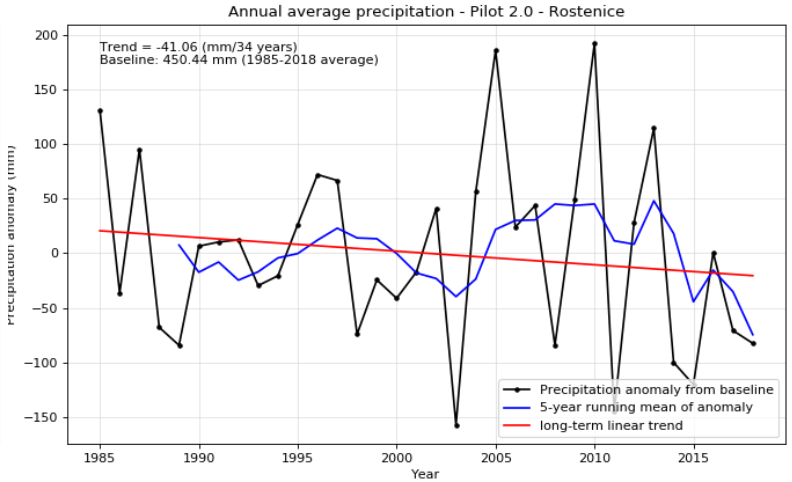
Example: Pilot 2 - Czech Republic (CZ), Rostenice



Climate trends at Rostenice (CZ)

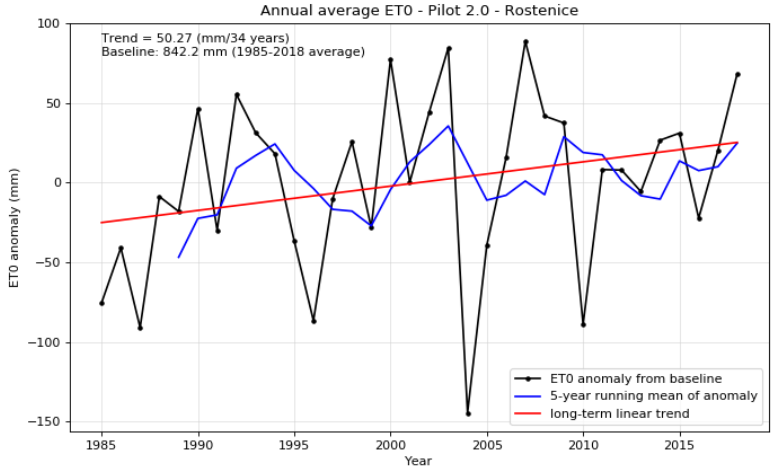
Temperature

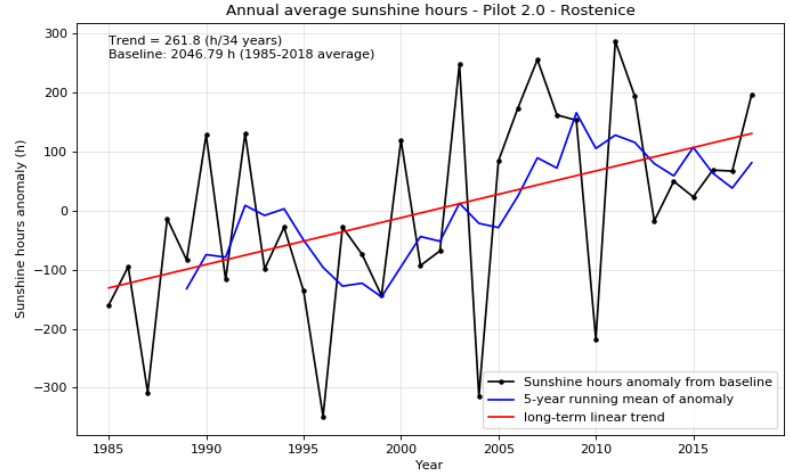




Precipitation

Reference evapotranspiration (FAO)





Sunshine hours

Anomaly from baseline (1985-2018 average)

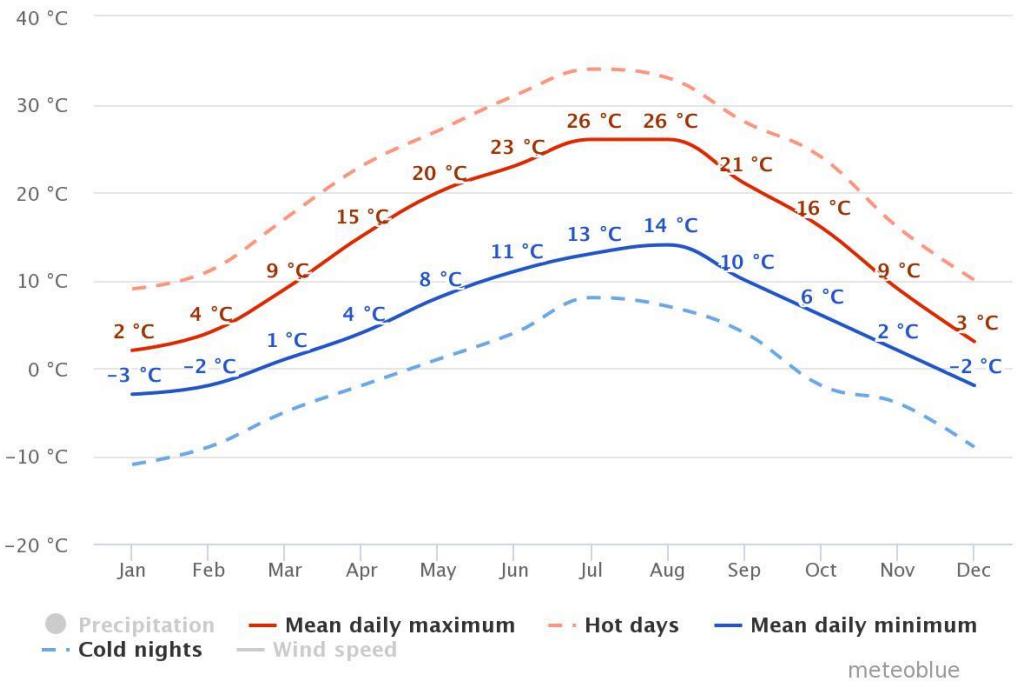
5-year running mean of anomaly

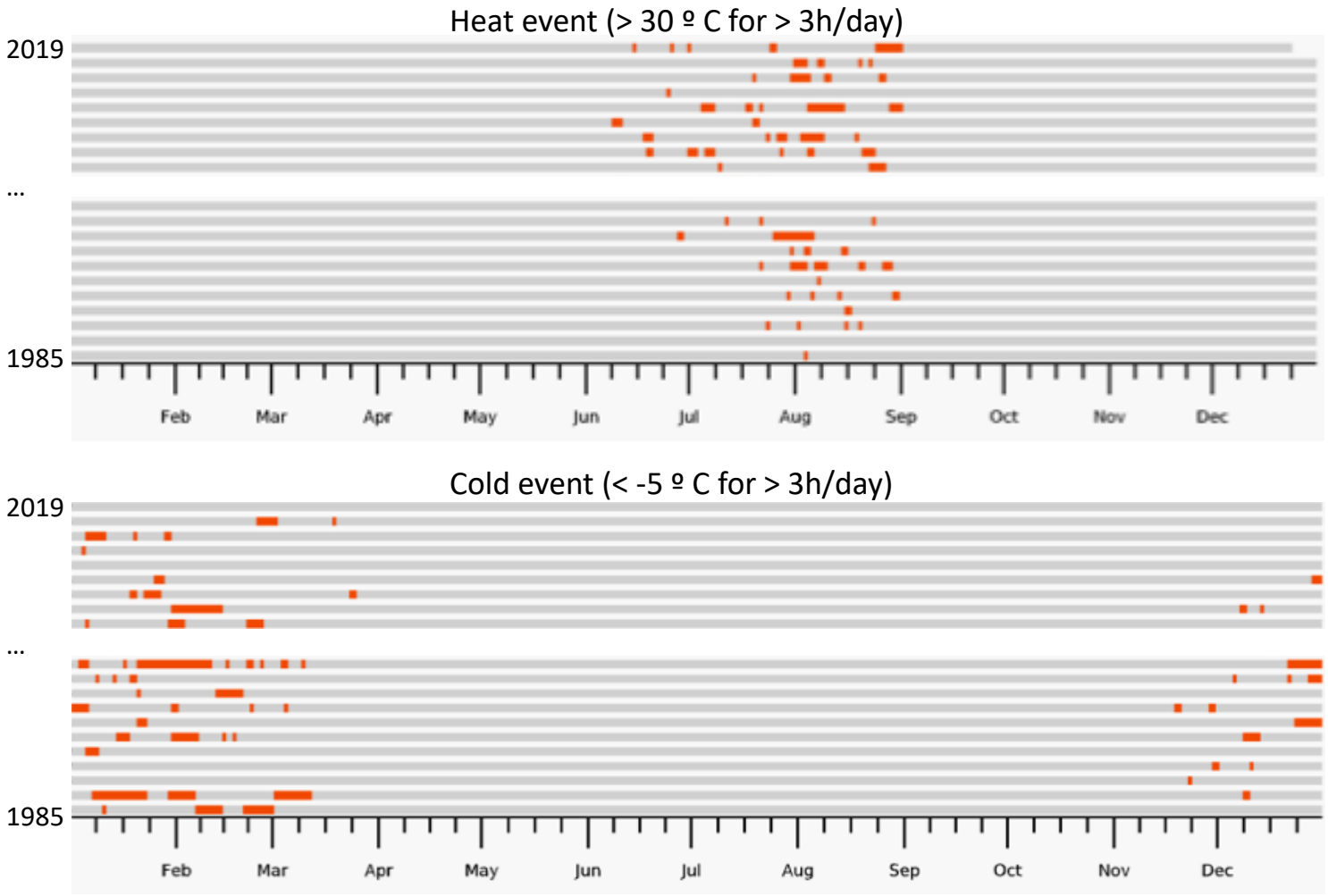
Long-term linear trend

Risk assessment

Heat and cold events at Rostenice (CZ):

- increased number of hot days
- decreased number of cold days

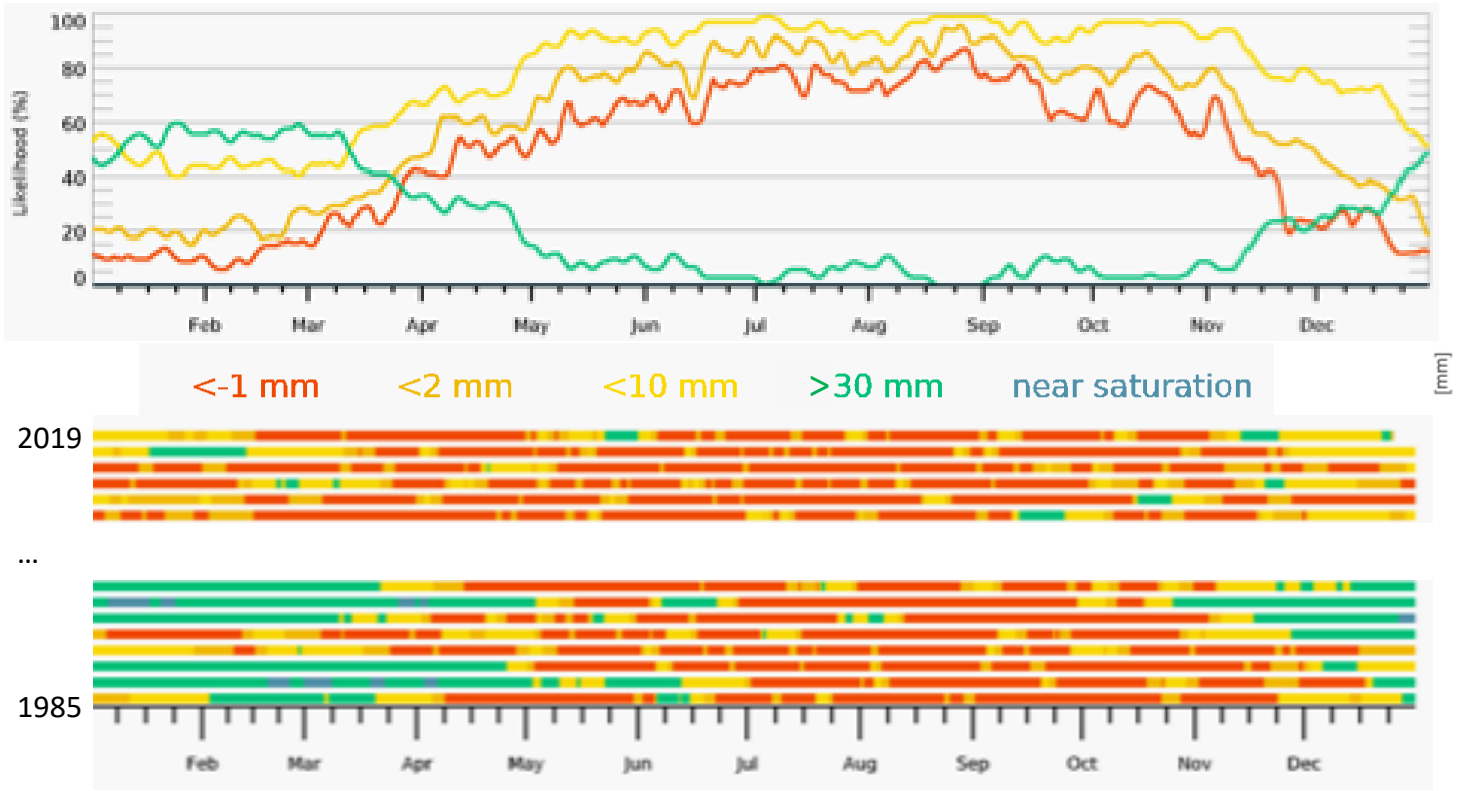


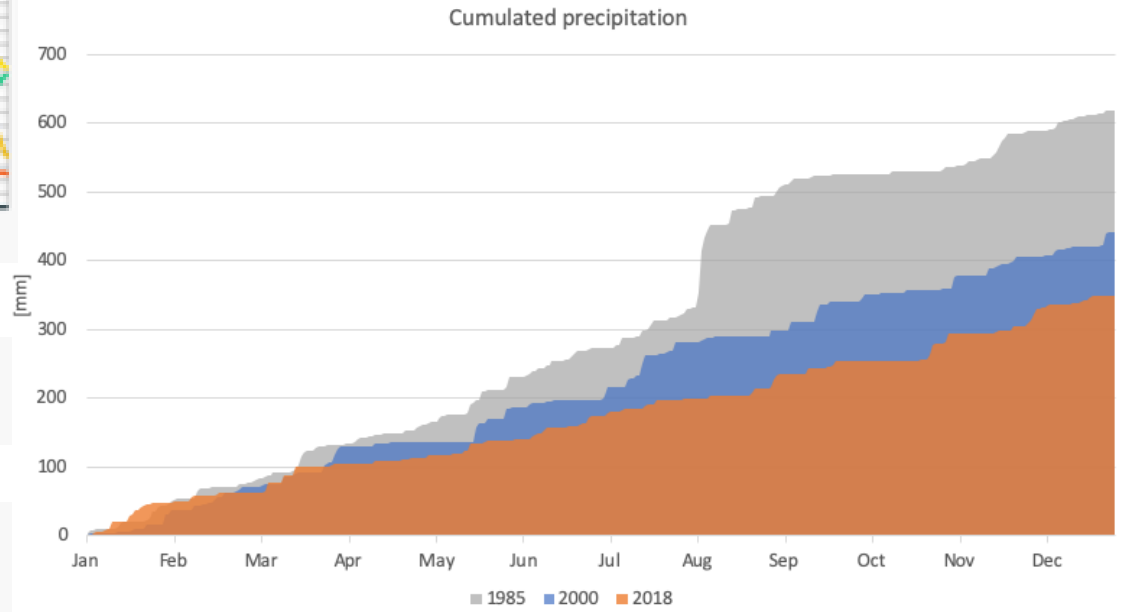


Risk assessment

Droughts at Rostenice (CZ): increased duration and frequency

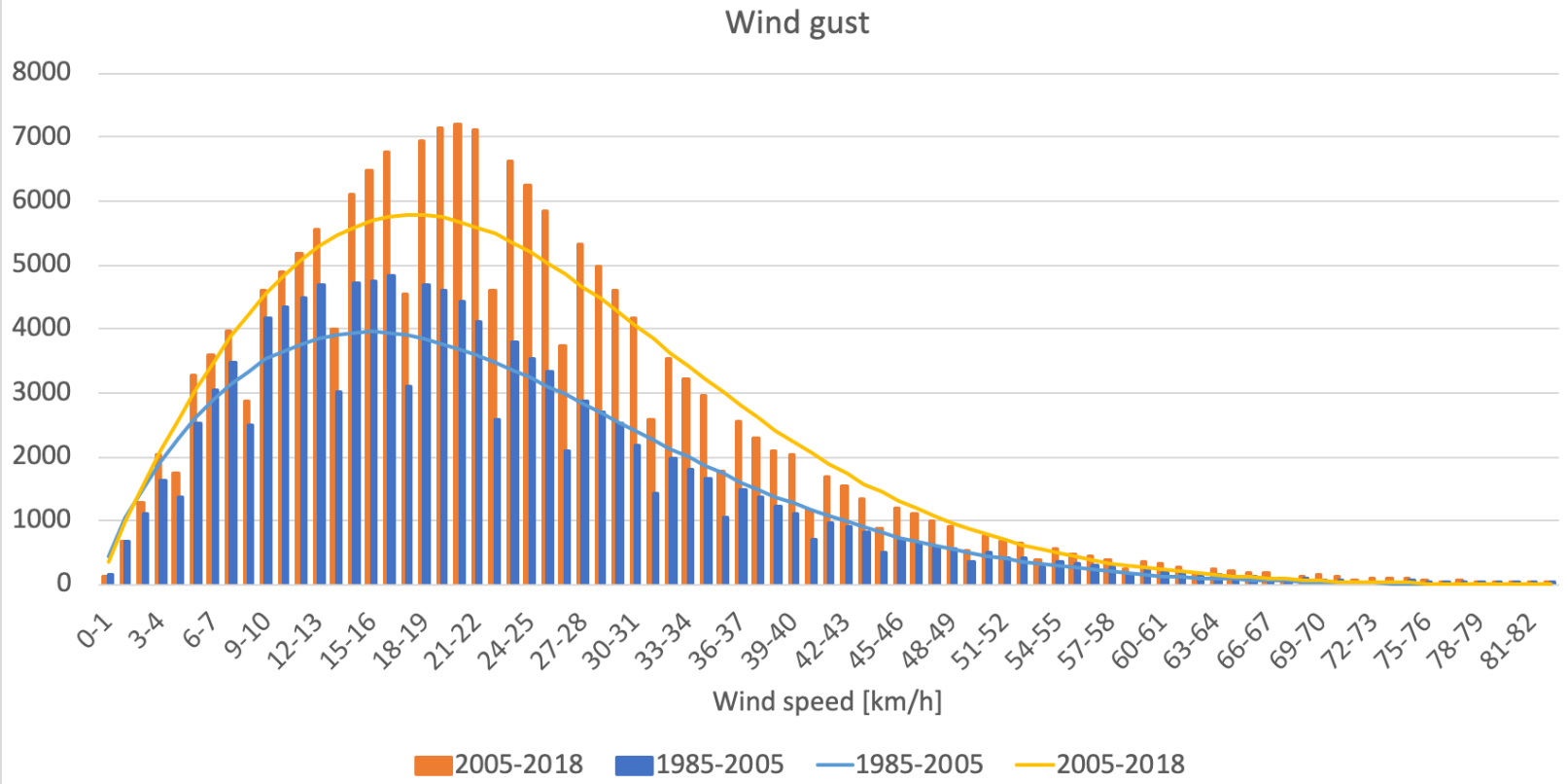
Available Soil Water (max: 100mm)

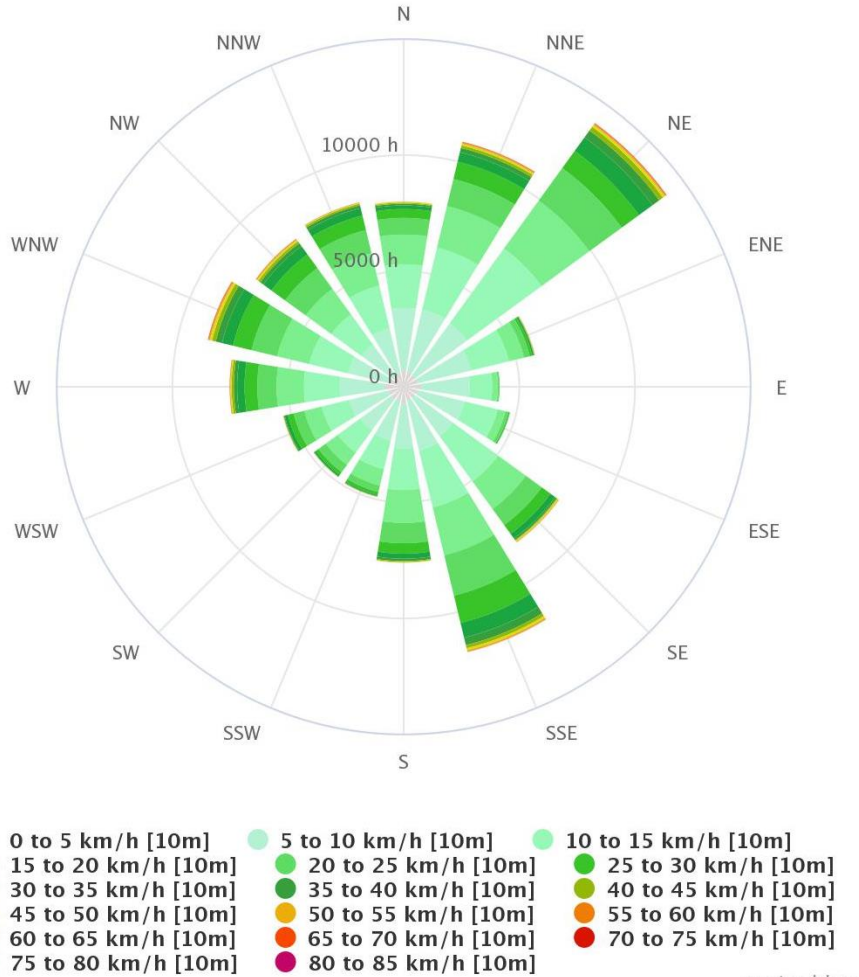




Risk assessment

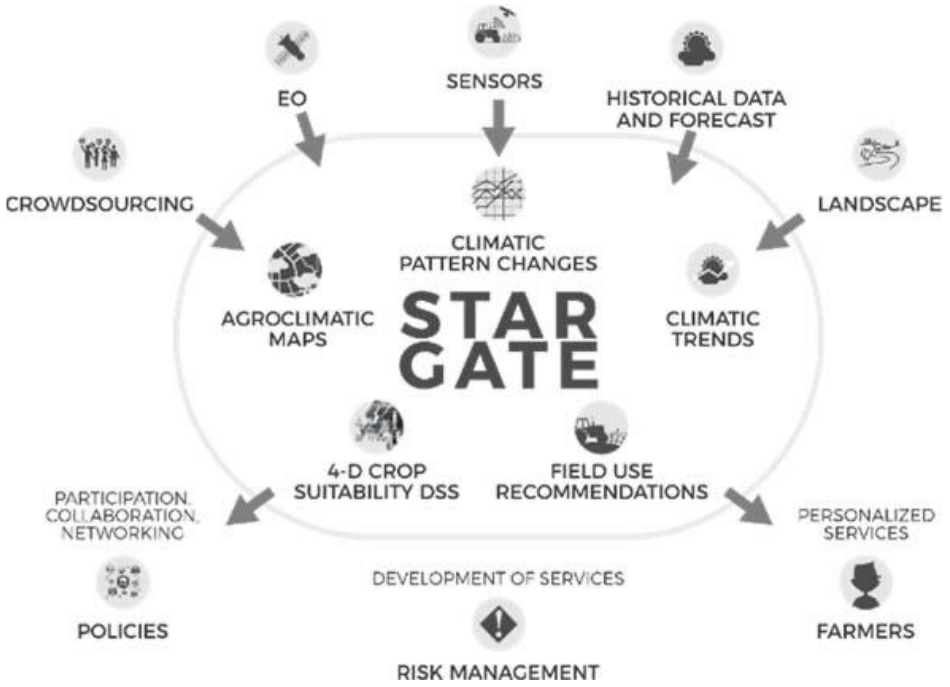
Wind gusts at Rostenice (CZ): increased frequency and intensity





Agenda

1. State of the art: climatic trends analysis
2. What's next
   - Enable Climate Smart Agricolture
   - Improved decision making
   - Examples



Climate Smart Agriculture

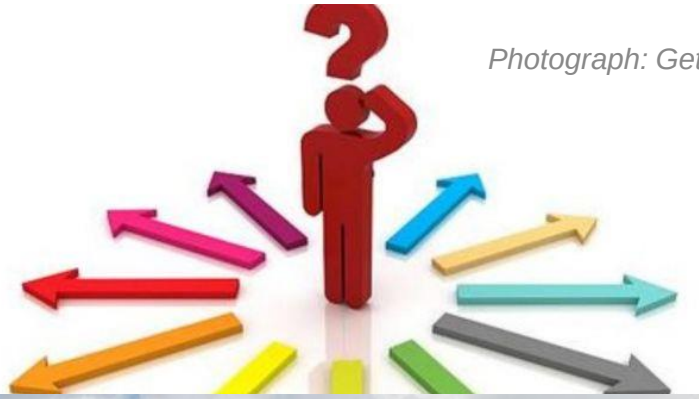
- Agri-environment-climate technical solutions:
  - Climate and microclimate change scenarios
  - Crop specific analysis
  - High resolution weather forecast
  - Yield potential
  - Dynamic agro-climatic maps
- Sustainable agriculture development at landscape level
- Farm management modernization:
  - Crop selection and rotation models
  - Transfer technology
  - Irrigation and fertilization recommendations
  - Crop protection recommendations
  - Soil trafficability
  - Harvesting time

https://cloudblogs.microsoft.com/uploads/prod/2018/11/SustainableFarming_blog1_SN.pn

https://www.fbk.eu/wp-content/uploads/2019/07/AI-AGRICOLTURA_MICROSOFT-fbk-1600x600.jpg

Improved decision making

- Get to know ecological factors that shape the farming landscape
- STARGATE climatic platform:
  - Effective geospatial visualization of big data
  - Advanced, dynamic charting
  - Extra quality assurance
  - Easy and affordable tool
- Decision support tools for farmers and policy makers



Photograph: Getty Images

https://d6prv7be4nrvy.cloudfront.net/wp-content/uploads/shutterstock_718214302.jp

Example: Climate Smart Agriculture in practice

- To get reliable results on climate resilient technologies:

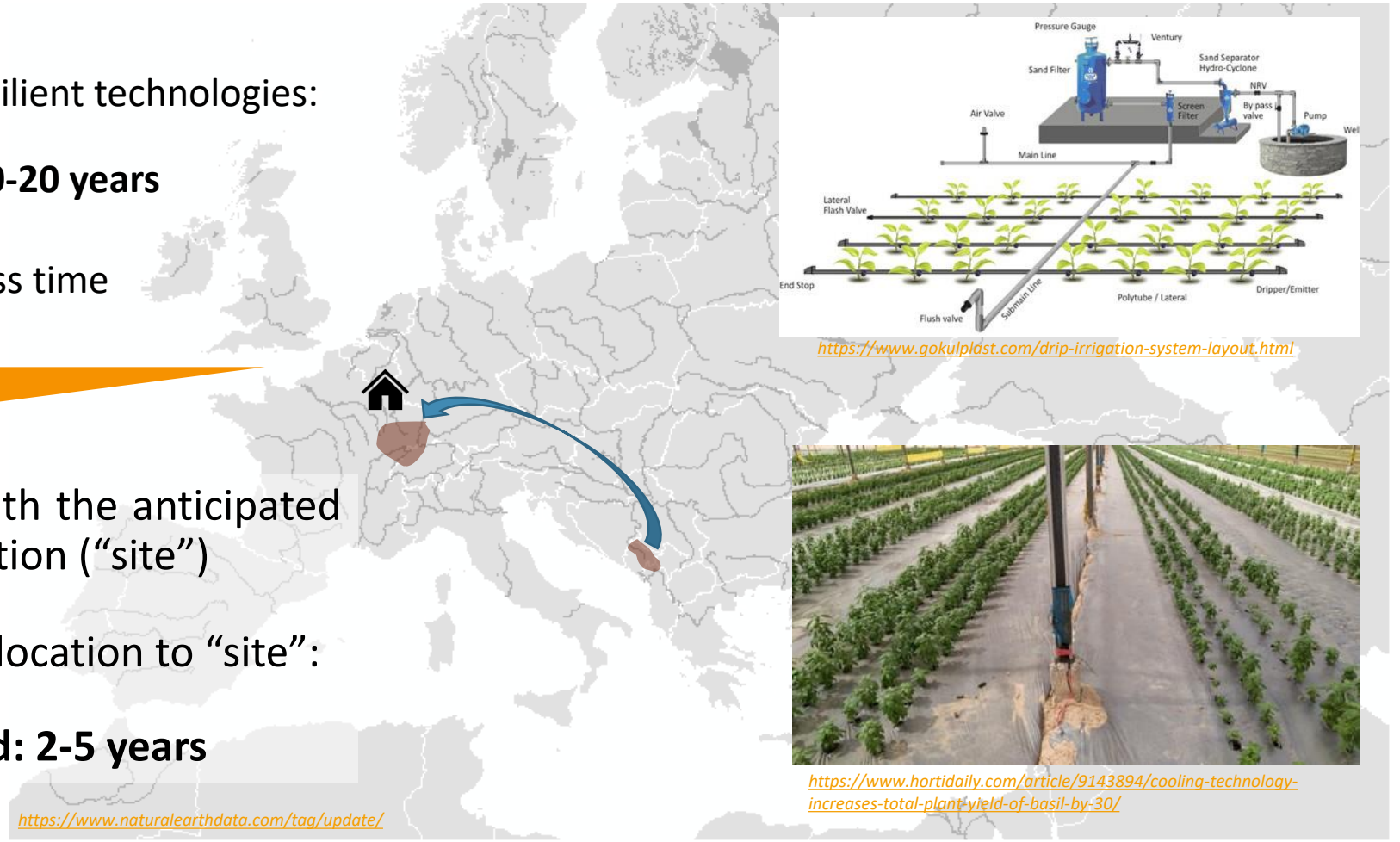
  → **development time needed: 10-20 years**

- Project and climate change allow less time

Identifying regions of similarity with the anticipated future climate at the selected location (“site”)

Transferring technology from that location to “site”:

→ **development time reduced: 2-5 years**



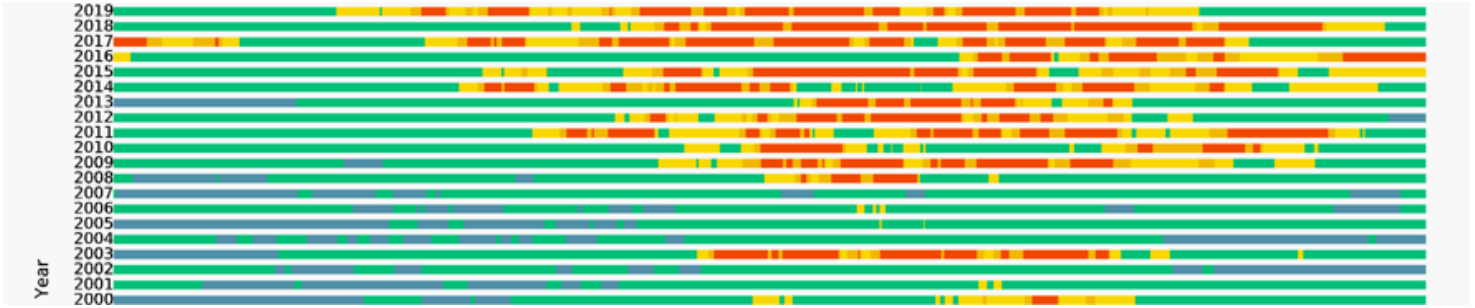
https://www.gokulplast.com/drip-irrigation-system-layout.html

https://www.hortidaily.com/article/9143894/cooling-technology-increases-total-plant-yield-of-basil-by-30/

https://www.naturalearthdata.com/tag/update/

Example: climate change characterization

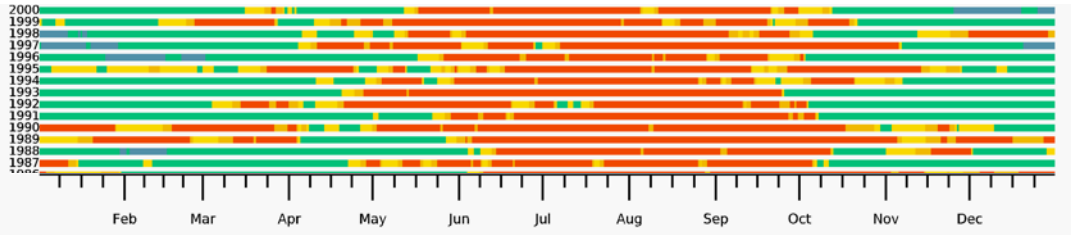
Periods of drought in Basel (CH), soil with 200 mm water holding capacity, 2000-2019



Real data

Lyon (FR) 1985-2000

Milano (IT) 1985-2000



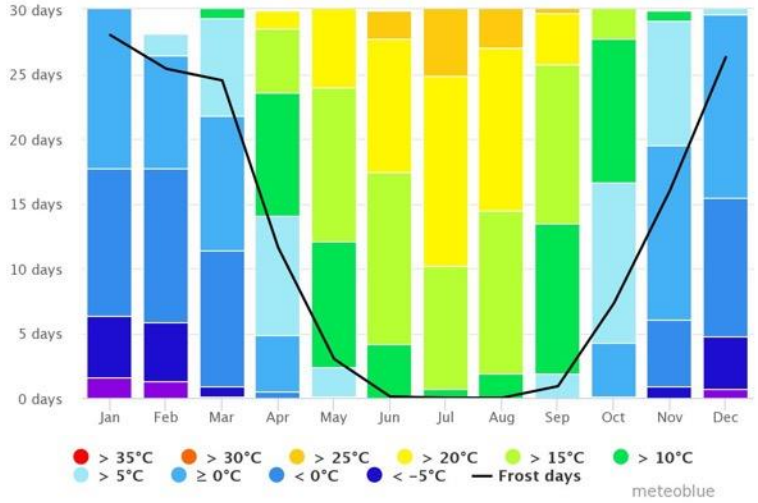
Which profile is more similar to Basel – Lyon or Milano?

→ this could be the place with the best adaptation technology offer…

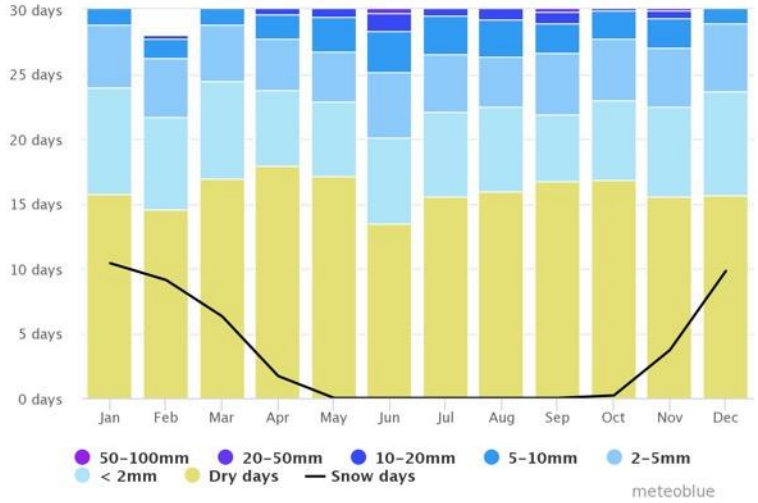
Example: climate change characterization

1985-2005

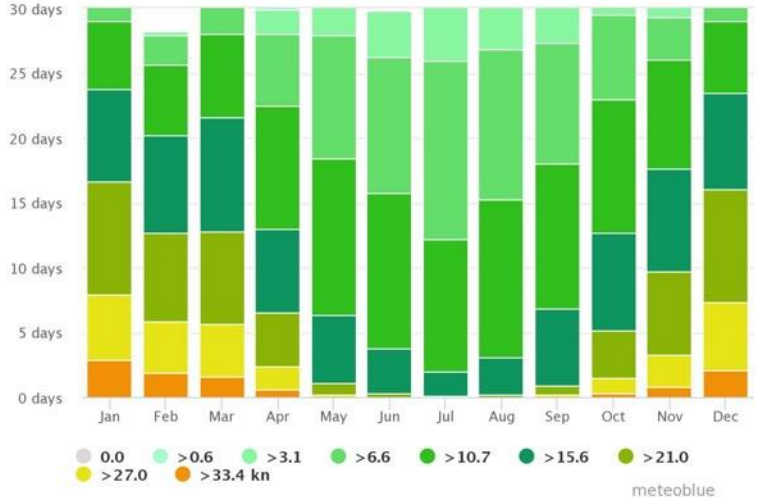
Temperature



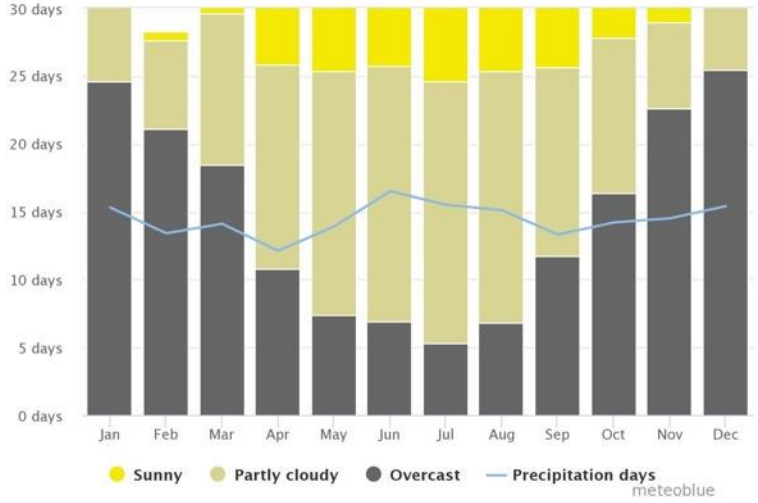
Precipitation



Wind



Sunshine hours

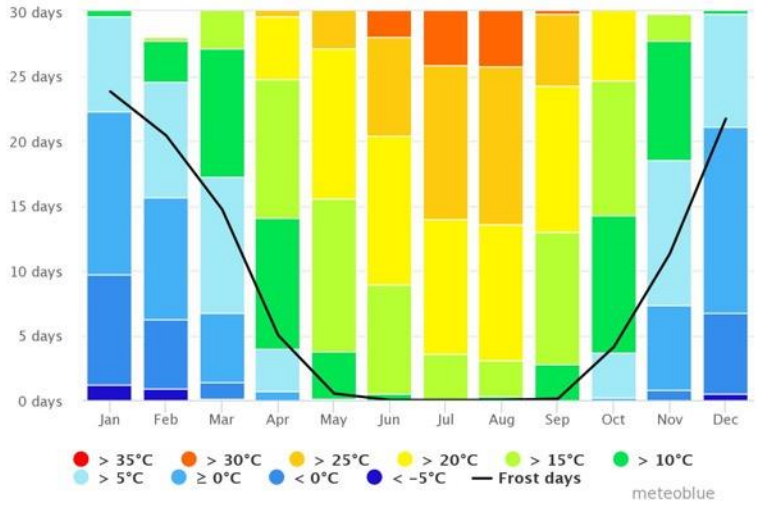


Sample data for visualization example only

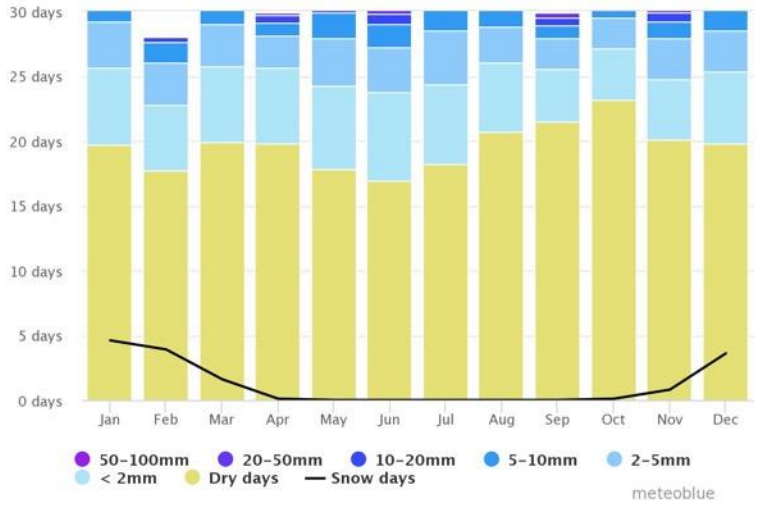
Example: climate change characterization

2005-2015

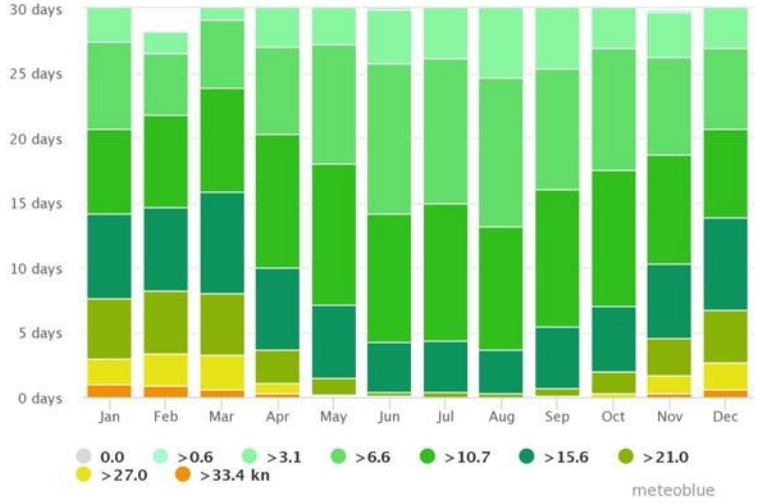
Temperature



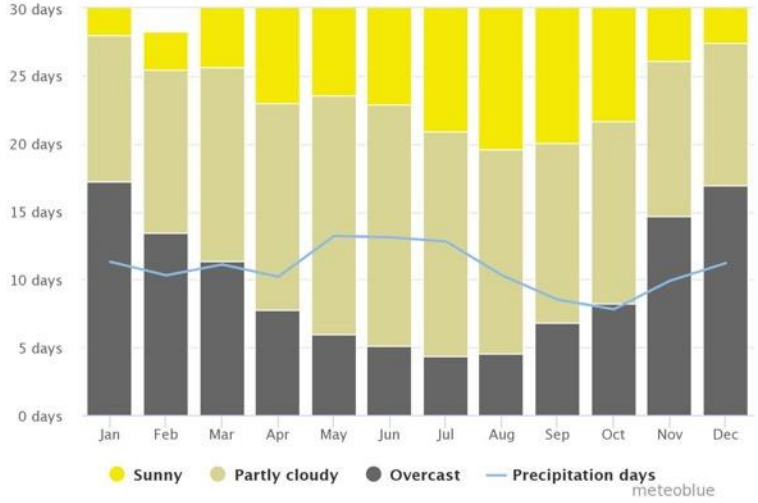
Precipitation



Wind



Sunshine hours

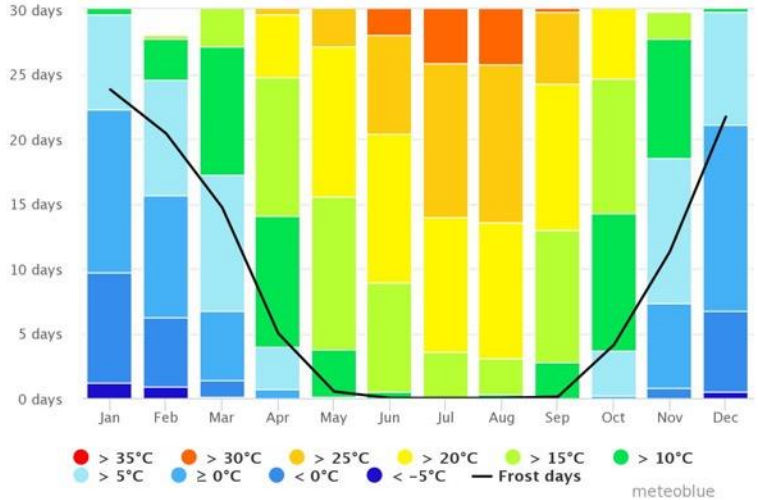


Sample data for visualization example only

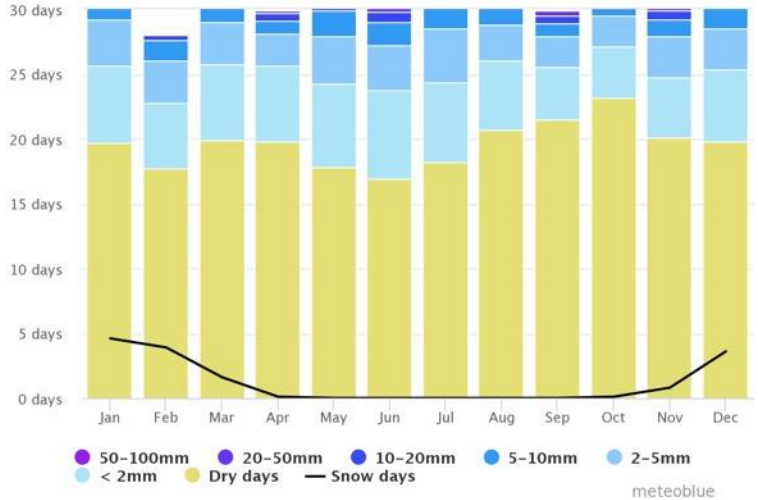
Example: climate change characterization

2005-2015

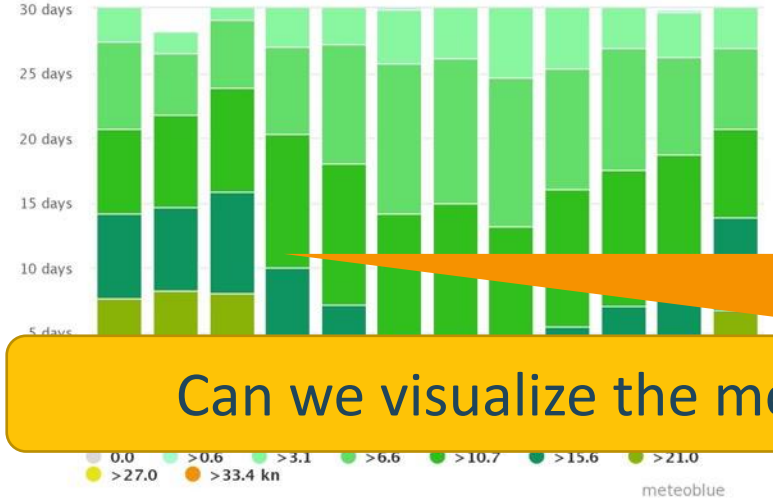
Temperature



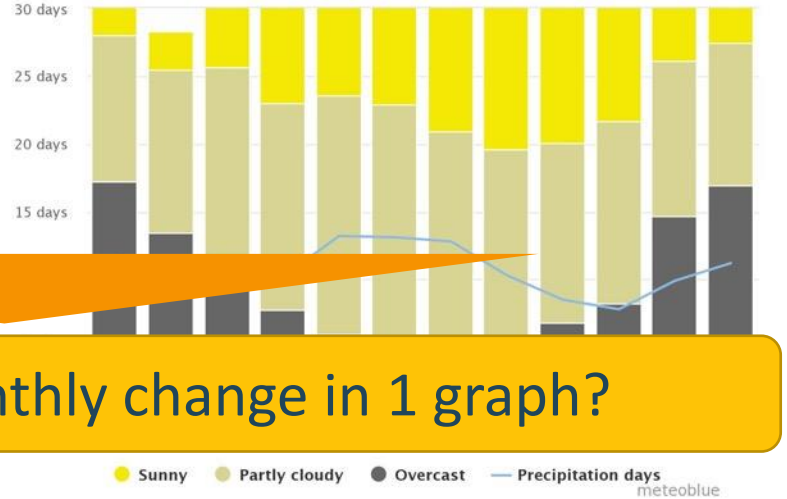
Precipitation



Wind



Sunshine hours



Can we visualize the monthly change in 1 graph?

Sample data for visualization example only

Example: climate change characterization

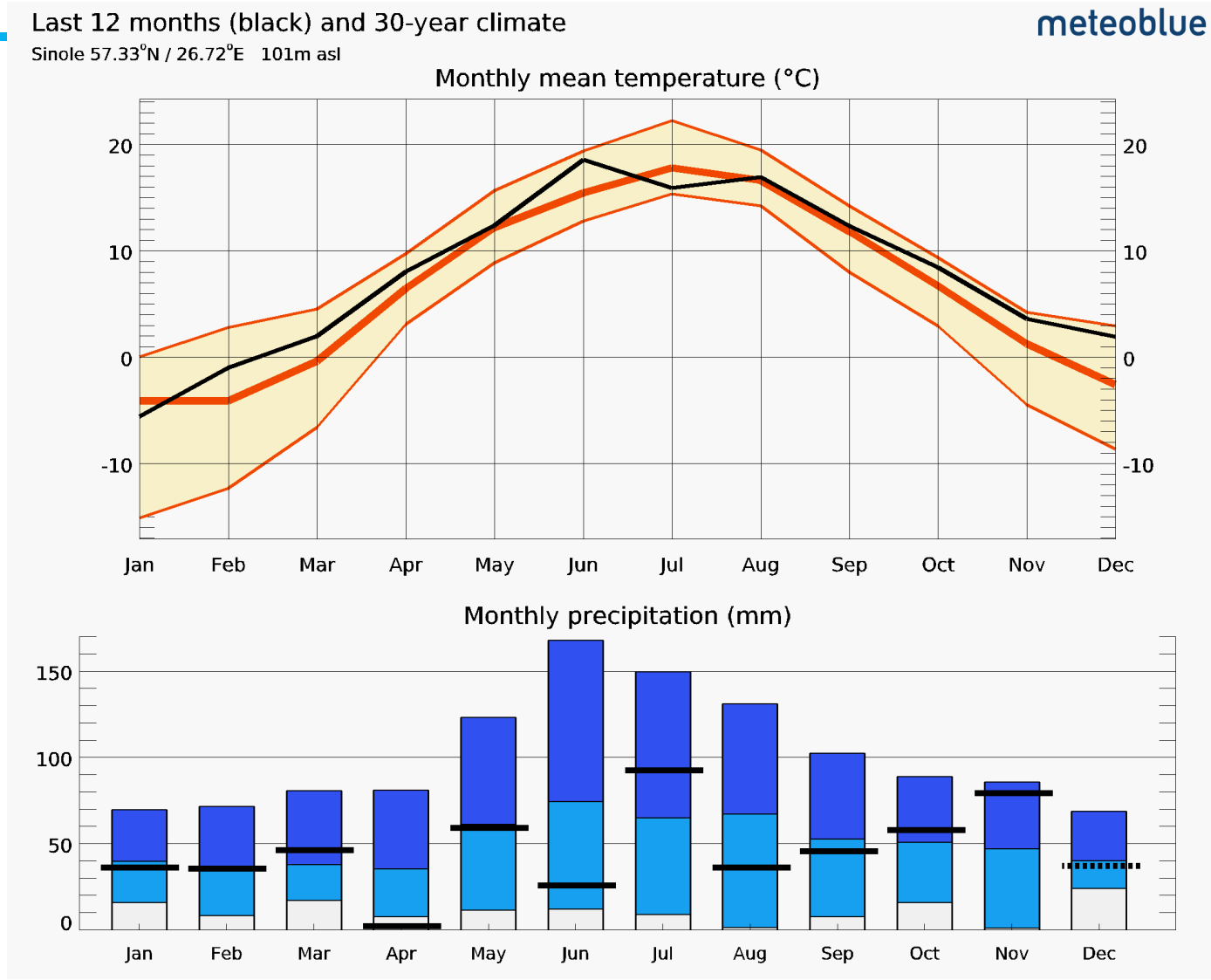
Current year

Mean of last 30 years
Max and Min of last 30 years

Current year

Max of last 30 years
Min of last 30 years
Boundary: Mean of last 30 years

Sample data for visualization example only

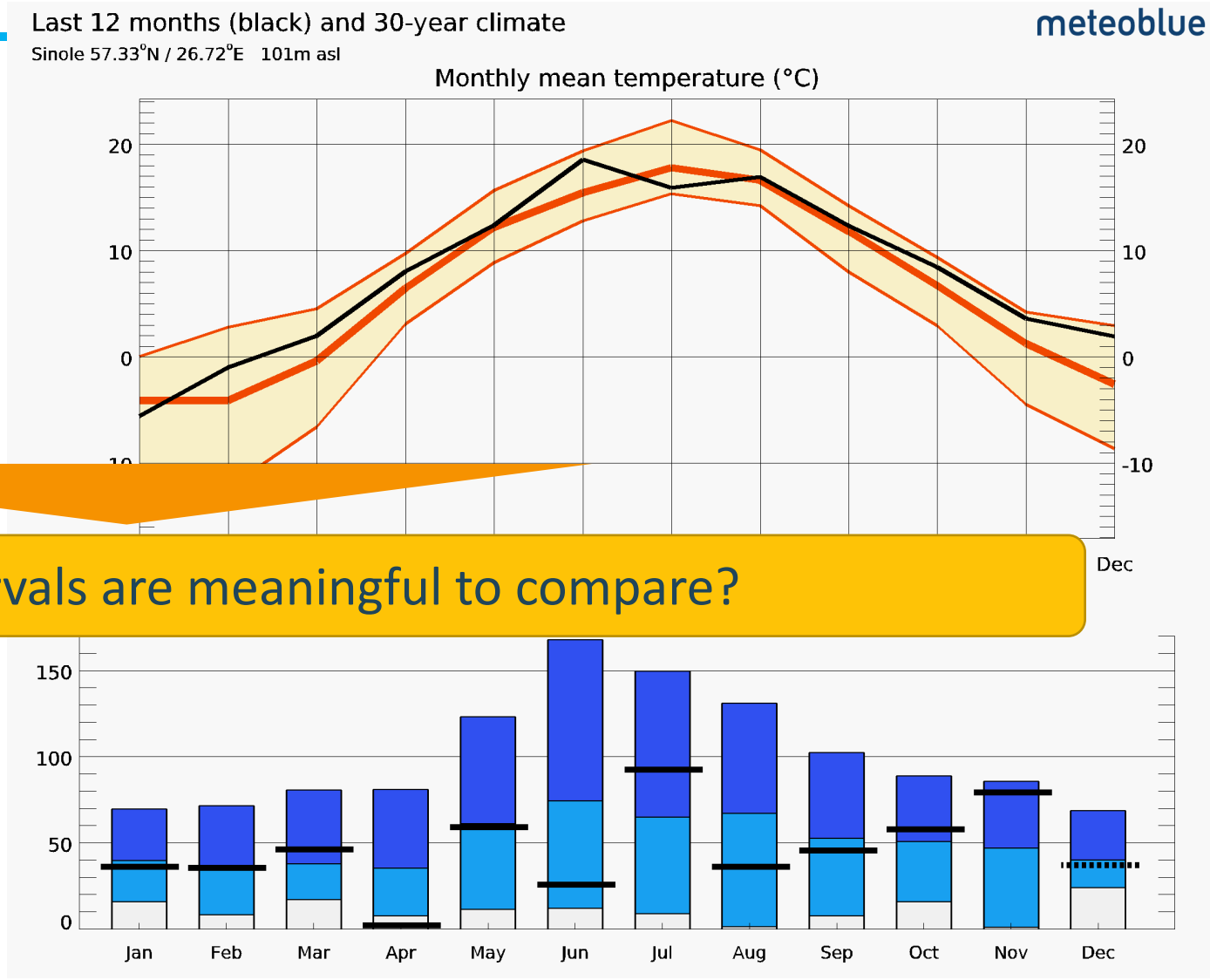


Example: climate change characterization

Current year

Mean of last 30 years

Max and Min of last 30 years



What other time intervals are meaningful to compare?

Max of last 30 years

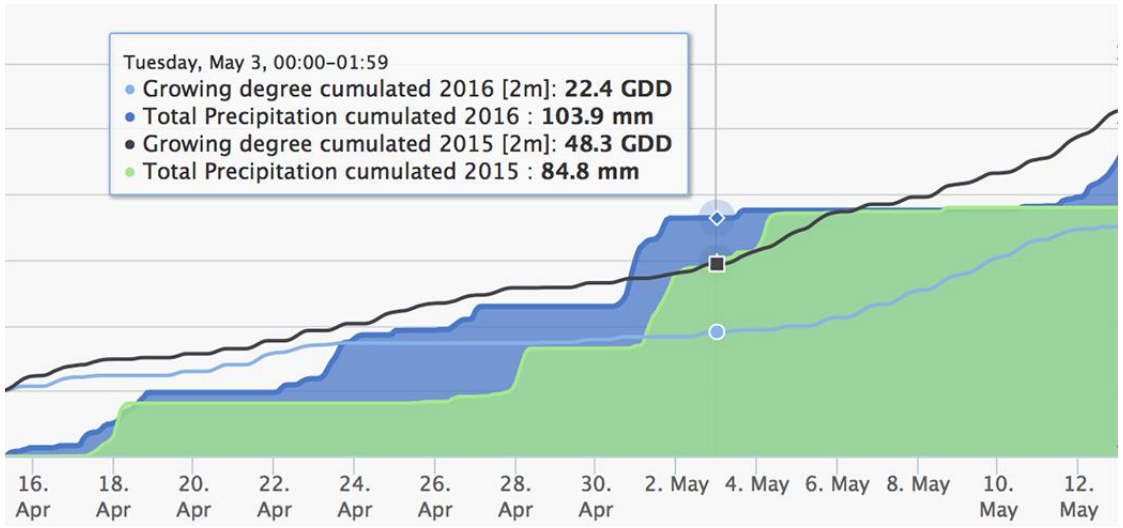
Min of last 30 years

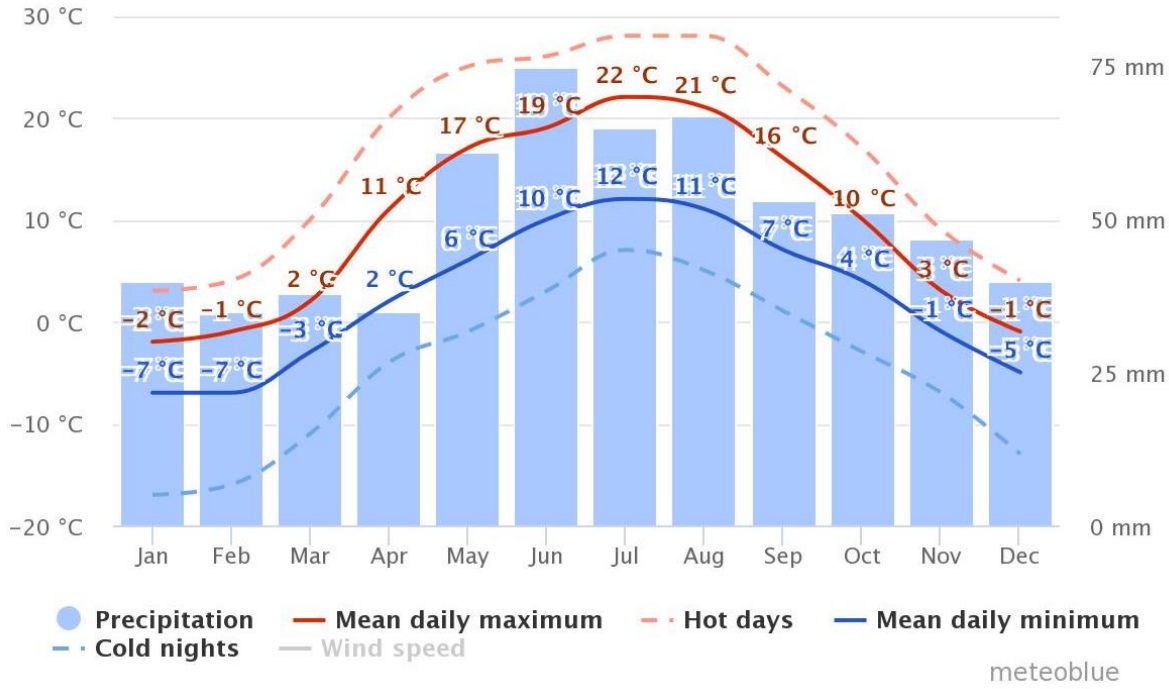
Boundary: Mean of last 30 years

Sample data for visualization example only

Example: climate change characterization

- For each crop-specific growing season (e.g. Oct - May, Feb - Aug, Apr - Oct)
- Growing season length and shift
- Weather variables analysis
- Frequency of drought, frost, heat, tropical nights





Sample data for visualization example only

Conclusions

1. Base-line information is available
2. Existing graphics and data packages allow site - specific conclusions
3. Technology transfer strategy based on climate similarities seems possible
4. Development of tools / analytics needed to support decisions

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Thank you for your attention

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