C3S SIS Energy

Overlook on the C3S SIS Energy service with a focus on seasonal forecast

Raphaël Legrand, Météo-France

1 C3S-SIS-Energy: presentation of the project

2 Focus on seasonal forecast dataset
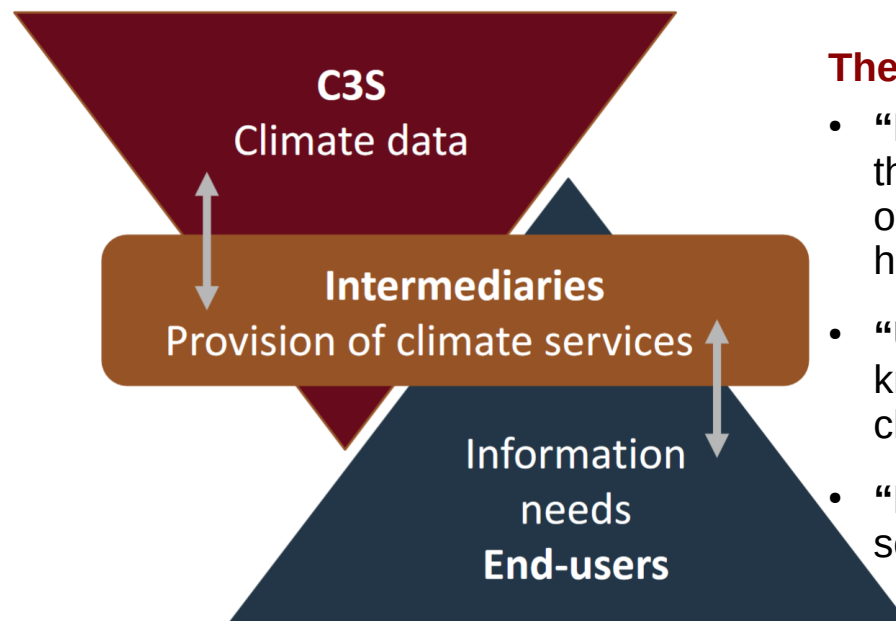
3 Historical and Climate projection dataset

4 Conclusions and perspectives

Climate
Change

Copernicus Climate Change Service (C3S)

C3S
Climate data

Intermediaries
Provision of climate services

Information needs
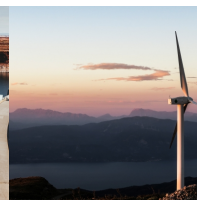**End-users**

The role of climate services:

- **"Non linearity"**: Facilitate the access to huge amount of climate dataset (e.g. homogeneity and SI infra.)

- **"Usability"**: Apply user's knowledge and expertise on climate data.

- **"R&D"**: Enhance applied science and services

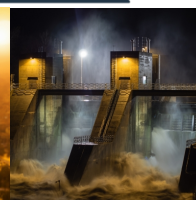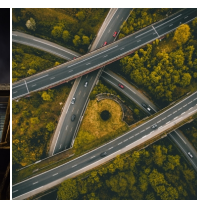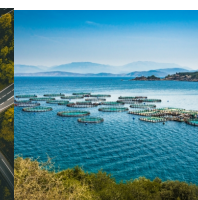Agriculture   Water Management   Energie   Transport   Tourism   Health   Insurance   Infrastructure   Costal area

Climate Change

Consortium

WEMC World Energy & Meteorology Council
Alberto Troccoli (lead)
Luke Sanger
Janice Ogonji
Lin Ho
Clare Goodess

eDF
Laurent Dubus
Yohan Moreau

cea DE LA RECHERCHE À L'INDUSTRIE
Robert Vautard
Flavio Pons
S. Firion
Guillaume Levavasseur
Bianca Bartok

METEO FRANCE
Raphaël Legrand
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Lucas Grigis
Christian Viel
Ludovic Bouilloud

Met Office
Caroline Acton
Joana Mendes

ARMINES
Yves-Marie St Drenan
Thierry Ranchin

Energy

We support the energy sector, which is increasingly relying on renewable energy production, by providing climate-related information, such as forecasts of air-temperature, atmospheric transparency, wind strength, and projections of wave size and frequency.

C3S SIS ENERGY

HISTORICAL

1979

2018

Operational service

SEASONAL

Real time → +7months

2100

PROJECTIONS

Whole dataset available on the Climate Data Store (CDS)
https://cds.climate.copernicus.eu/

METEO FRANCE · ECMWF · Copernicus Europe's eyes on Earth · European Commission

C3S-SIS-Energy: available dataset

Climate Change

Variable	Timescale	Source	Highest Temporal Resolution	Highest Spatial Resolution	Spatial Aggregation
Climate indicators					
Temperature	Historical	ERA5	1 hour	0.25 deg	C&C
	Seasonal	EC, MF, MO	1 day	1.00 deg	Country
	Projection	E-Cordex (BA)	3 hours	0.25 deg	C&C
Precipitation	Historical	ERA5	1 hour	0.25 deg	C&C
	Seasonal	EC, MF, MO	1 day	1.00 deg	Country
	Projection	E-Cordex (BA)	1 day	0.25 deg	C&C
Wind (10 m and 100 m)	Historical	ERA5	1 hour	0.25 deg	C&C
	Seasonal	EC, MF, MO	6 hours	1.00 deg	Country
	Projection	E-Cordex (BA)	3 hours	0.25 deg	C&C
Solar Radiation at surface	Historical	ERA5 (BA)	1 hour	0.25 deg	C&C
	Seasonal	EC, MF, MO	1 day	1.00 deg	Country
	Projection	E-Cordex (BA)	3 hours	0.25 deg	C&C
Mean Sea Level Pressure	Historical	ERA5	1 hour	0.25 deg	Country
	Projection	Euro-Cordex	1 day	0.25 deg	Country
Energy indicators					
Electricity Demand	Historical	B.o. ERA5	1 day	Country	Country
	Seasonal	B.o. EC, MF, MO	1 day	Country	Country
	Projection	B.o. E-Cordex	1 day	Country	Country
Wind Power (onshore and offshore)	Historical	B.o. ERA5	1 hour	0.25 deg	C&C
	Seasonal	B.o. EC, MF, MO	6 hours	1.00 deg	Country
	Projection	B.o. E-Cordex	3 hours	0.25 deg	C&C
Solar Power (PV)	Historical	B.o. ERA5	1 hour	0.25 deg	C&C
	Seasonal	B.o. EC, MF, MO	1 day	1.00 deg	Country
	Projection	B.o. E-Cordex	3 hours	0.25 deg	C&C
Hydro Power (Run-of-River and Reservoir)	Historical	B.o. ERA5	1 day	Country	Country
	Seasonal	B.o. EC, MF, MO	1 day	Country	Country
	Projection	B.o. E-Cordex	1 day	Country	Country

Data available online:
https://cds.climate.copernicus.eu/
open data policy

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Search results

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Sort by
Relevancy
Title

Product type
- Climate projections (5)
- Reanalysis (12)
- Satellite observations (12)
- Seasonal forecasts (6)
- Sectoral climate indices (2)

Spatial coverage
- Global (6)

Temporal coverage
- Future (6)
- Past (6)

Showing 1-6 of 6 results for Seasonal forecasts ×

Seasonal forecast anomalies on single levels from 2017 to present
This entry covers single-level data post-processed for bias adjustment on a monthly time resolution. Seasonal forecasts provide a long-range

Seasonal forecast monthly statistics on single levels from 2017 to present
This entry covers single-level data aggregated on a monthly time resolution. Seasonal forecasts provide a long-range outlook of changes in

Seasonal forecast monthly statistics on pressure levels from 2017 to present
This entry covers pressure-level data aggregated on a monthly time resolution. Seasonal forecasts provide a long-range outlook of changes

Seasonal forecast daily data on single levels from 2017 to present
This entry covers single-level data at the original time resolution (once a day, or once every 6 hours, depending on the variable). Seasonal f

Seasonal forecast daily data on pressure levels from 2017 to present
This entry covers pressure-level data at the original time resolution (once every 12 hours). Seasonal forecasts provide a long-range outlook

Seasonal forecast anomalies on pressure levels from 2017 to present
This entry covers pressure-level data post-processed for bias adjustment on a monthly time resolution. Seasonal forecasts provide a long-r

Historical

Seasonal

Projection

Python code will also be an open source

Climate
Change

1 C3S-SIS-Energy: presentation of the project

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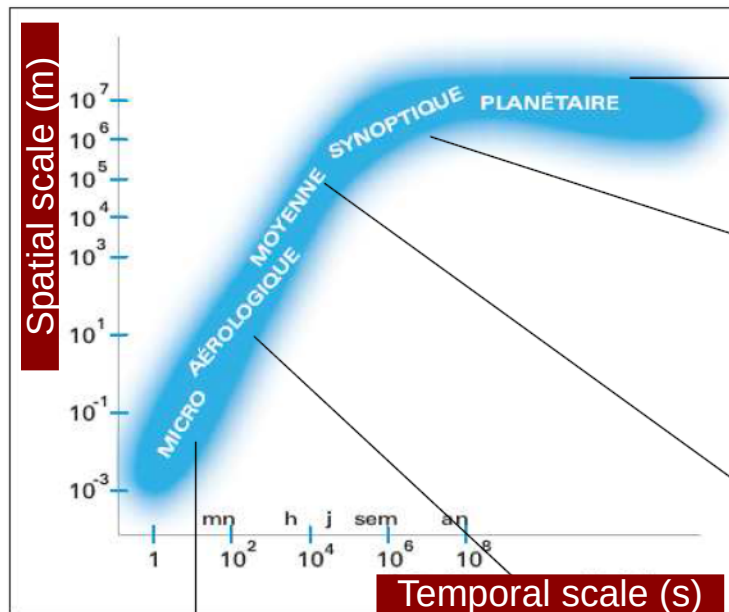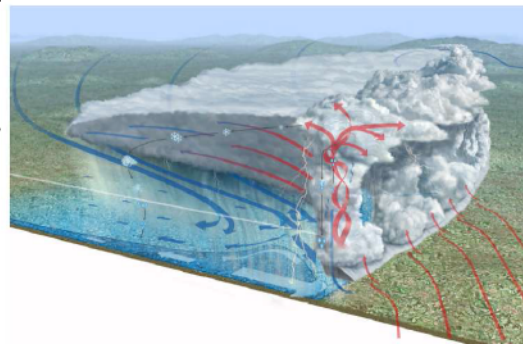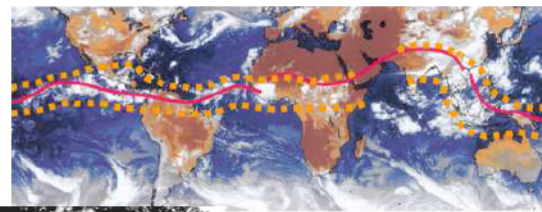**3** Historical and Climate projection dataset

4 Conclusions and perspectives

Seasonal forecasts are climate data

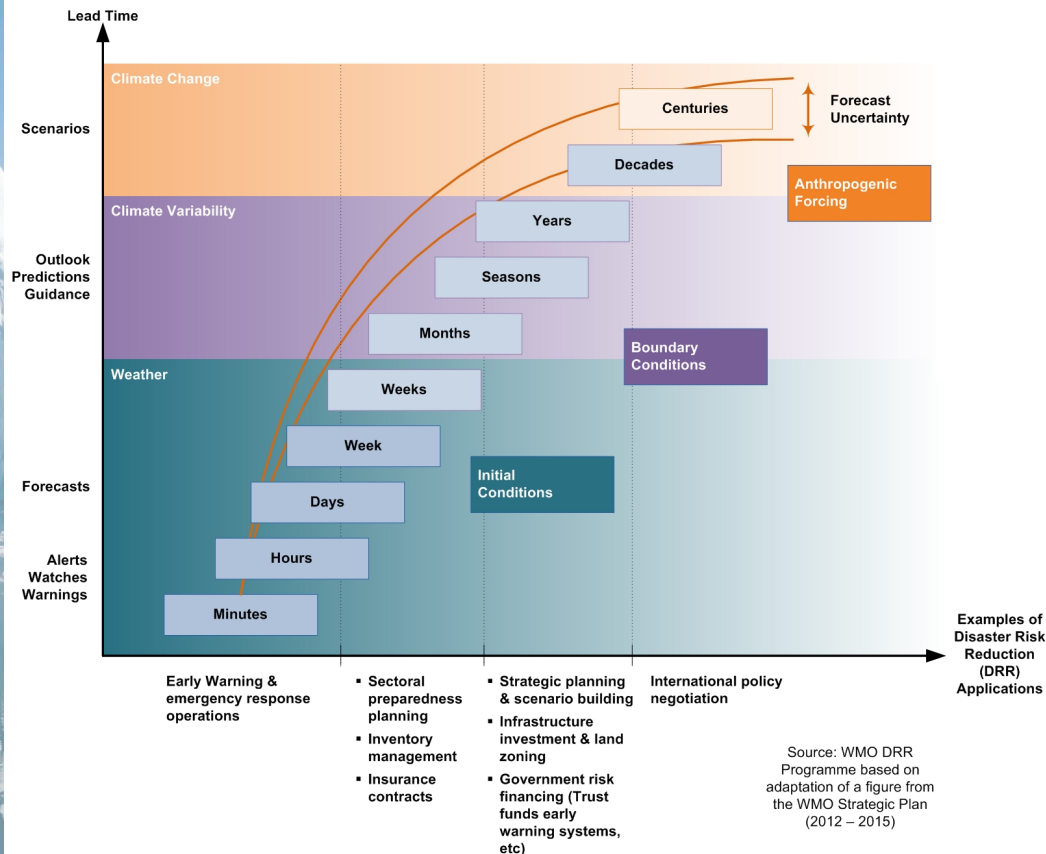D'après : Malardel
Fondamentaux de météorologie

Spatial scale (m)

Temporal scale (s)

INP TOULOUSE ENM METEO FRANCE

European Commission

Seasonal forecasts are climate data

Source: WMO DRR Programme based on adaptation of a figure from the WMO Strategic Plan (2012 – 2015)

Some important specificities of Long Range Forecast :

- forecasting of Climate Variability, not weather
➔ time-integration/statistics of climate variables, probability of scenarios

- predictability comes from the slow components of the Climate System (oceans, ground, sea ice...) through boundary conditions
➔ concept of "forcing"

From http://www.wmo.int/pages/prog/drr/

Climate Change

Stratosphere

Cryosphere

SST*

ENSO (El Niño – La Niña)

Forcings: components of the climate system that evolve slowly and could influence atmospheric conditions

Main forcings on Atlantic and Europe at seasonal scale

The **predicability in Europe** :

✔ Is still **modest** (little added value vs climatology), mainly available on **large scale output and after time-integration/statistics**

✔ **Can be very different from one place to another, from one year to another** (depending on the strengh of the forcings and on the type of climate)

The European climate is partly influenced by these forcings, but mainly chaotic.

(*SST: "Sea Surface Temperature")

METEO FRANCE   ECMWF   Copernicus Europe's eyes on Earth   European Commission

Climate Change

A robust and well-organised operational production

WMO Global Producing Centres for Long-Range Forecasts

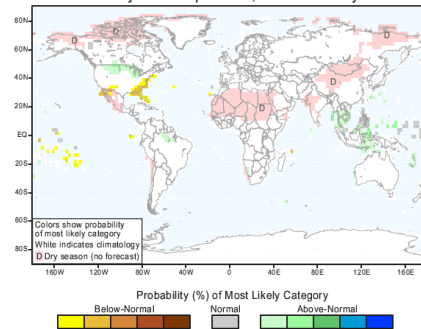http://www.wmo.int/pages/prog/wcp/wcasp/gpc/gpc.php

EUROSIP multi-model seasonal forecast
Prob(most likely category of 2m temperature)
Forecast start reference is 01/11/16
Unweighted mean
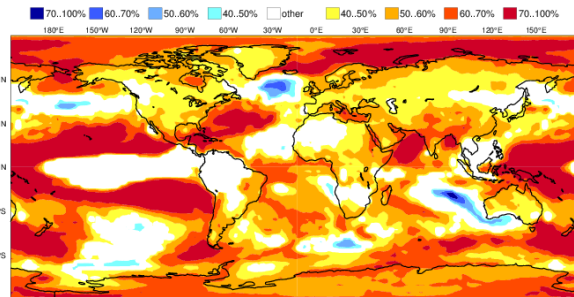
ECMWF/Met Office/Meteo-France/NCEP
JFM 2017

http://www.ecmwf.int/en/forecasts/charts/seasonal/

IRI Multi-Model Probability Forecast for Precipitation
for February-March-April 2017, Issued January 2017

http://iri.columbia.edu

… supported by active research projects

ENSEMBLES

SPECS

Seasonal-to-decadal climate Prediction for the
improvement of European Climate Services

METEO FRANCE   ECMWF   Copernicus   European Commission

Seasonal dataset

Variable	Timescale	Source	Highest Temporal Resolution	Highest Spatial Resolution	Spatial Aggregation
Climate Indicators					
Temperature «TA-»	Seasonal	EC, MF, **MO**	1 day	1 deg	Country
Precipitation «TP-»	Seasonal	EC, MF, **MO**	1 day	1 deg	Country
Wind (10 and 100m) **«WS-»**	Seasonal	EC, MF, **MO**	6 hours	1 deg	Country
Solar Radiation at surface «GHI»	Seasonal	EC, MF, **MO**	1 day	1 deg	Country
Energy Indicators					
Electricity Demand « EDM »	**Seasonal**	**EC, MF, MO**	**1 day**	**/**	**Country**
Wind Power «WON» and «WOF»	Seasonal	EC, MF, **MO**	6 hours	1 deg	Country
Solar Power «SPV»	Seasonal	EC, MF, **MO**	1 day	1 deg	Country
Hydro Power «HRE»	**Seasonal**	**EC, MF, MO**	**1 day**	**/**	**Country**

Tasks planned for "Fall 2019"

ECMWF system 5 - T2M - Bias (dg C)
Init. : 10 (OCT) - Lead Time : 1 (NDJ)
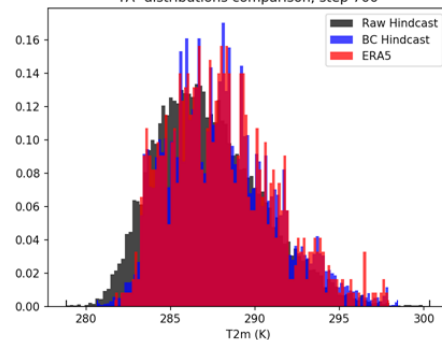reference ERAI 1993-2016

TA- distributions comparison, step 700
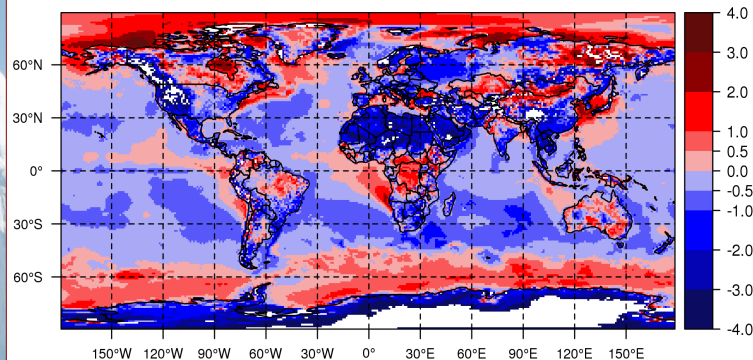
Why bias adjustment of Seasonal Forecast ?

- All global model exhibit significant mean errors compared with observations
- It is common to found bias values exceeding
  - ✗ Several degrees for temperature
  - ✗ More than 100mm/year for precipitation

Method used for bias adjustment:

- Quantile matching (e.g. Déqué et al., 2007)
- Reference: ERA5 on 1993-2016 period
- Special treatment for extreme values
- Moving +/-15days windows
- Bias adjustment of climate indicators (only)

Seasonal dataset

From the ensemble of forecast (ECMWF, Météo-France or UKMO) what is actually provided on the CDS?
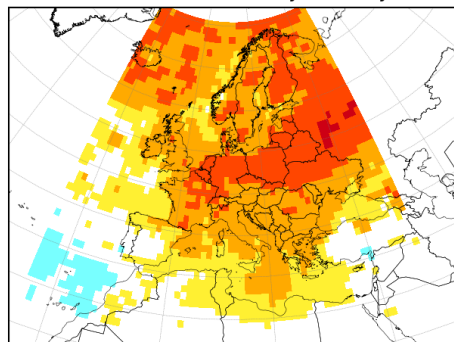
Probabilistic values for each indicator:
- Mean anomaly
- Low/middle/high terciles probabilities

Assessment:
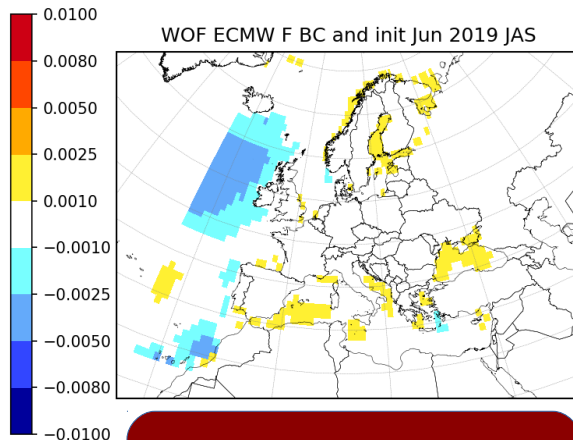- Anomaly coefficient correlations
- ROC score

Example of Energy Indicators

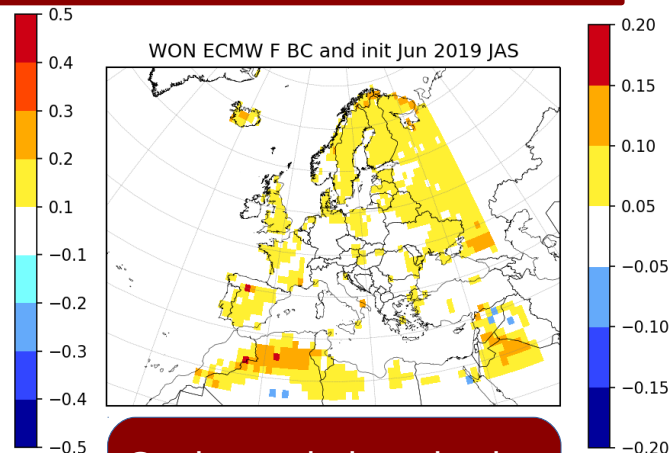Photovoltaic production
mean anomaly
[init June, J.A.S. 2019]

Offshore wind production
mean anomaly
[init June, J.A.S. 2019]

Onshore wind production
mean anomaly
[init June, J.A.S. 2019]

Climate Change

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Climate Change

- C3S-SIS-Energy provide an operational service of production of climate and energy indicator. Meteorology reference taken: ERA5.

- Energy indicators addressing the demand and supply balance:

SF:

Electricity demand	Wind power production	photovoltaic production	Hydro production
Daily, NUTS0	*6h, 1° & NUTS0*	*6h, 1° & NUTS0*	*Daily, NUTS0*

- 3 time periods:

Past	Real time	Future
Historical *(1973-2016)*	Seasonal forecasts *(→ 7months, each month)*	Climate projection *(up to 2100)*

Whole dataset available on the Climate Data Store (CDS)
https://cds.climate.copernicus.eu/

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Climate
Change
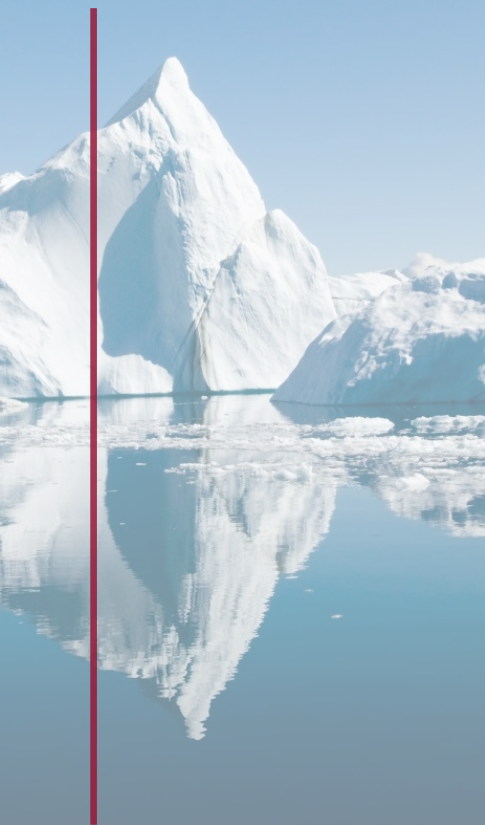
C3S-SIS-Energy contract ends in April 2020 so what could be done next?

a) Keep operational all the real-time running code
b) Extend to other model as the Italian and german ones for seasonal.
c) Extend to larger domain over the whole globe
d) Address other needs for the demand and supply balance as gaz consumption, maximum ampacity, other solar productions.
e) Test other statistical models to make the bias adjustment
f) Other use cases to get better information on user's needs
g) Others… ?

END

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