S2S4E
Climate Services for Clean Energy

Energy forecasts that take climate variability into account: the S2S4E Decision Support Tool

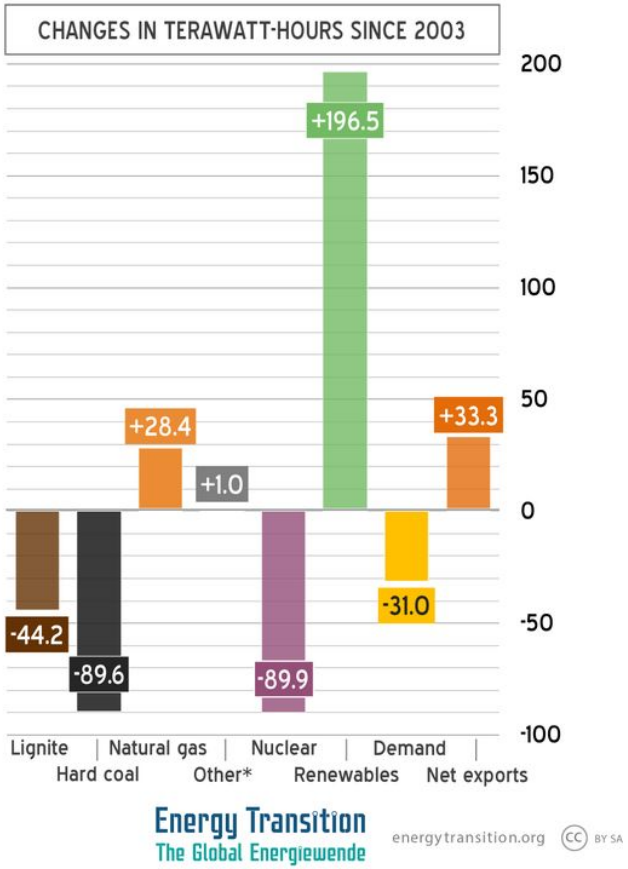
Llorenç Lledó (llledo@bsc.es)

Barcelona Supercomputing Center (BSC), Barcelona, Spain

This project has received funding from the Horizon 2020 programme under grant agreement n°776787.

Energy transition

Germany



- Renewables substitute coal & nuclear
- Highly variable resource

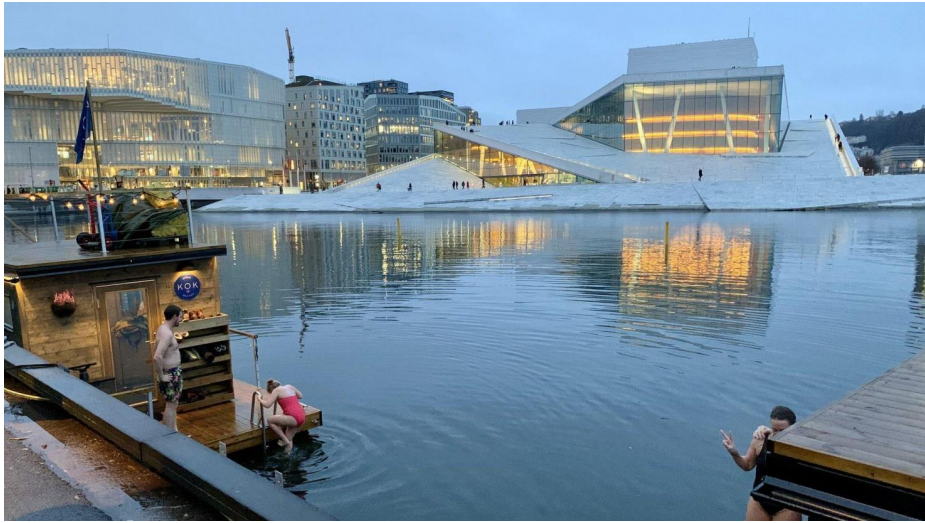
S2S4E
Climate Services for Clean Energy

Atmospheric circulation impacts Energy production & demand

Barcelona Supercomputing Center
Centro Nacional de Supercomputación
Capgemini
CICERO
Center for International Climate Research
EDF renewables
edp
powered by nature
EnBW
Energie braucht Impulse
ENEA
Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile
LGI
sustainable innovation
Nnergix
Energy Forecasting Services
SMHI
the climate data factory
University of Reading

...but the weather is going crazy???

Oslo, December 2019 ---->

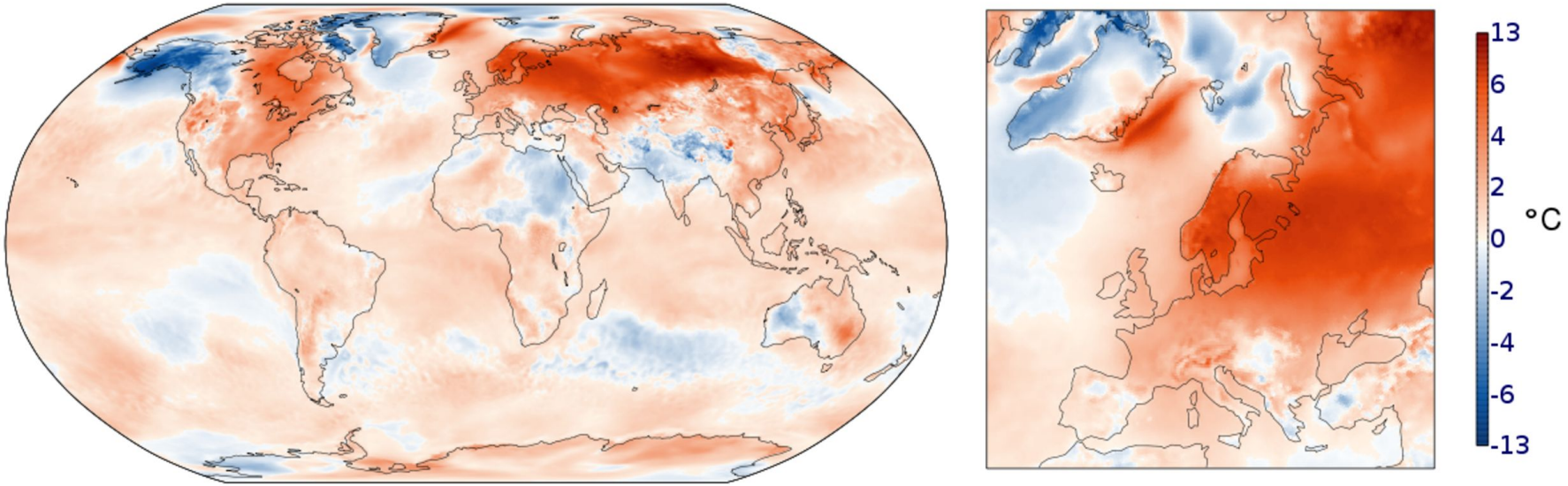


<---- Girona, January 2020
Gloria storm, ~400mm in 4 days

S2S4E
Climate Services for Clean Energy

Hottest January ever in Europe

Surface air temperature anomaly for January 2020 relative to 1981-2010



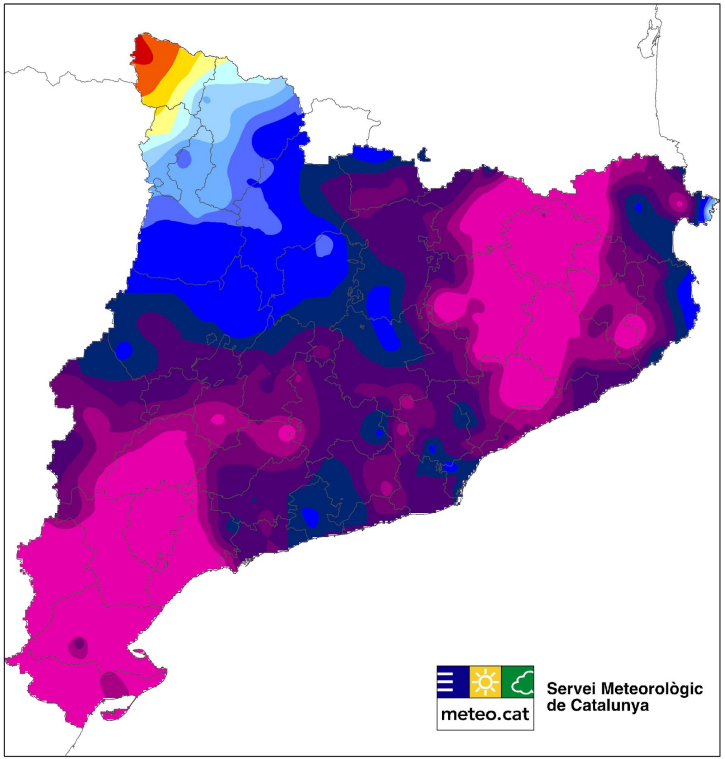
European Commission

Copernicus
Europe's eyes on Earth

Climate Change Service
climate.copernicus.eu

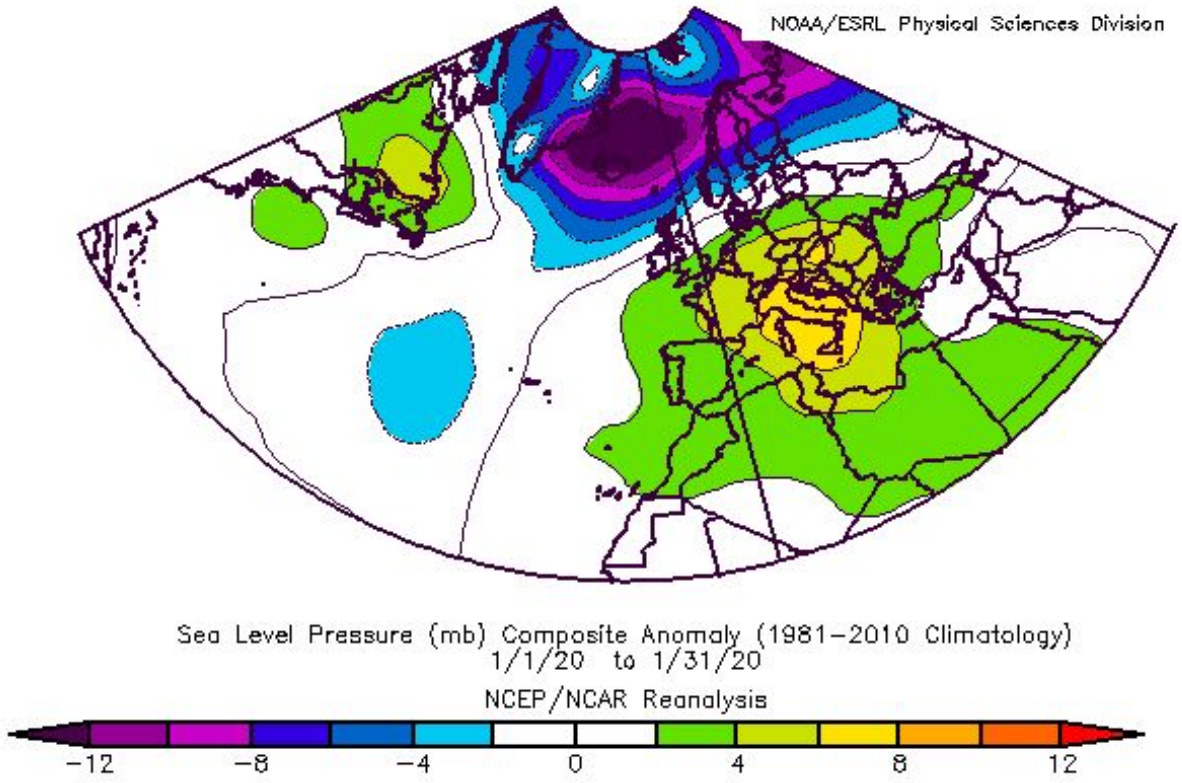
IMPLEMENTED BY ECMWF

Rainiest January ever in Catalunya



S2S4E
Climate Services for Clean Energy

January 2020: strong NAO+ pattern

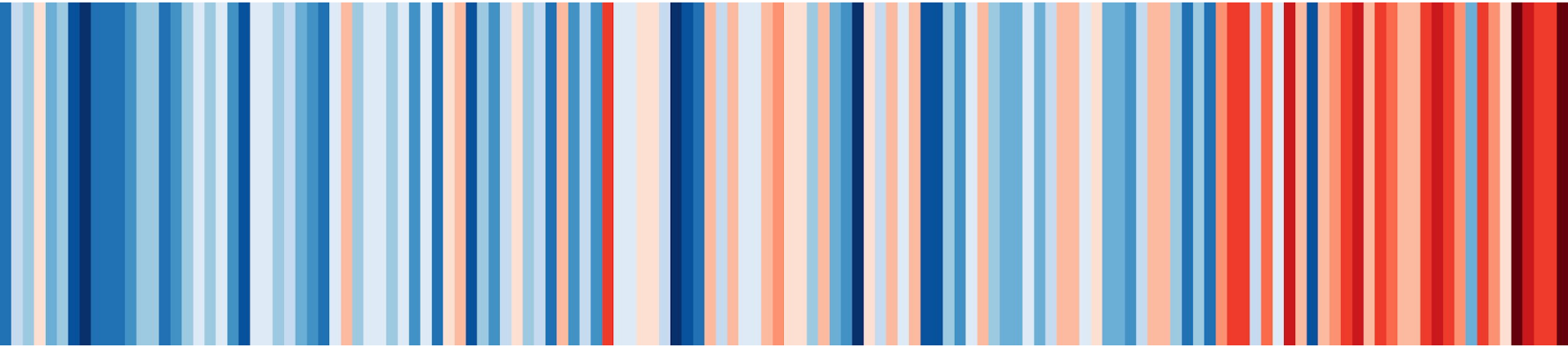


S2S4E
Climate Services for Clean Energy

Climate Stripes for Germany

Evident trend ---------->

Climate change



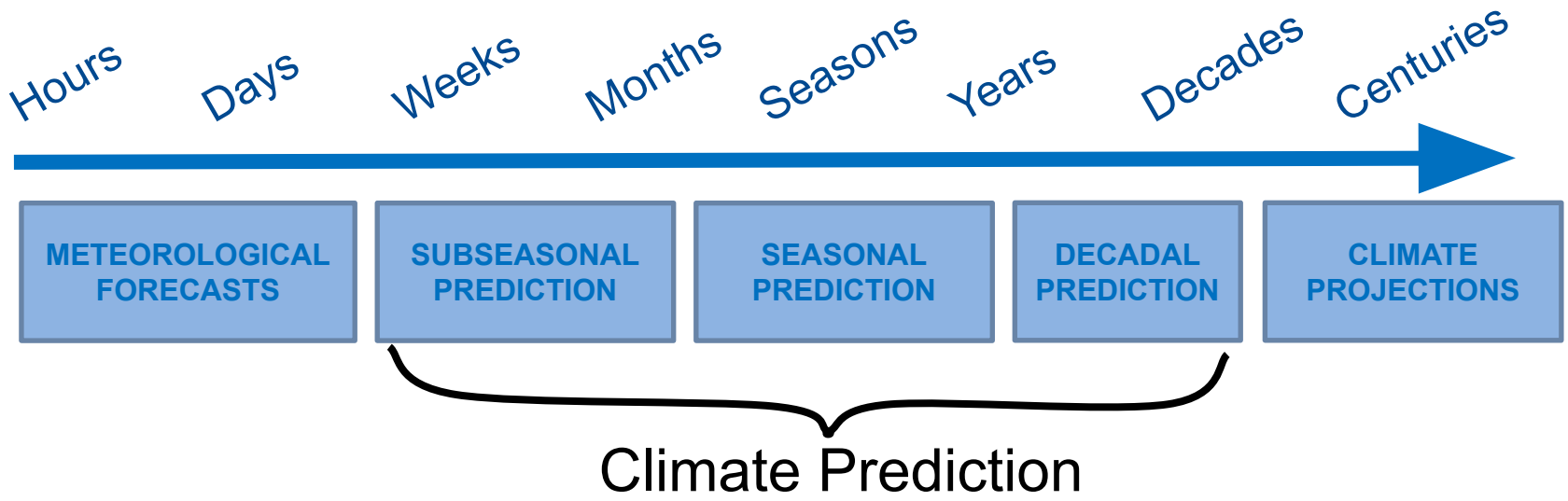
Substantial variations from one year to the next one

Interannual variability

Climate stripes from Ed. Hawkins

S2S4E Climate Services for Clean Energy

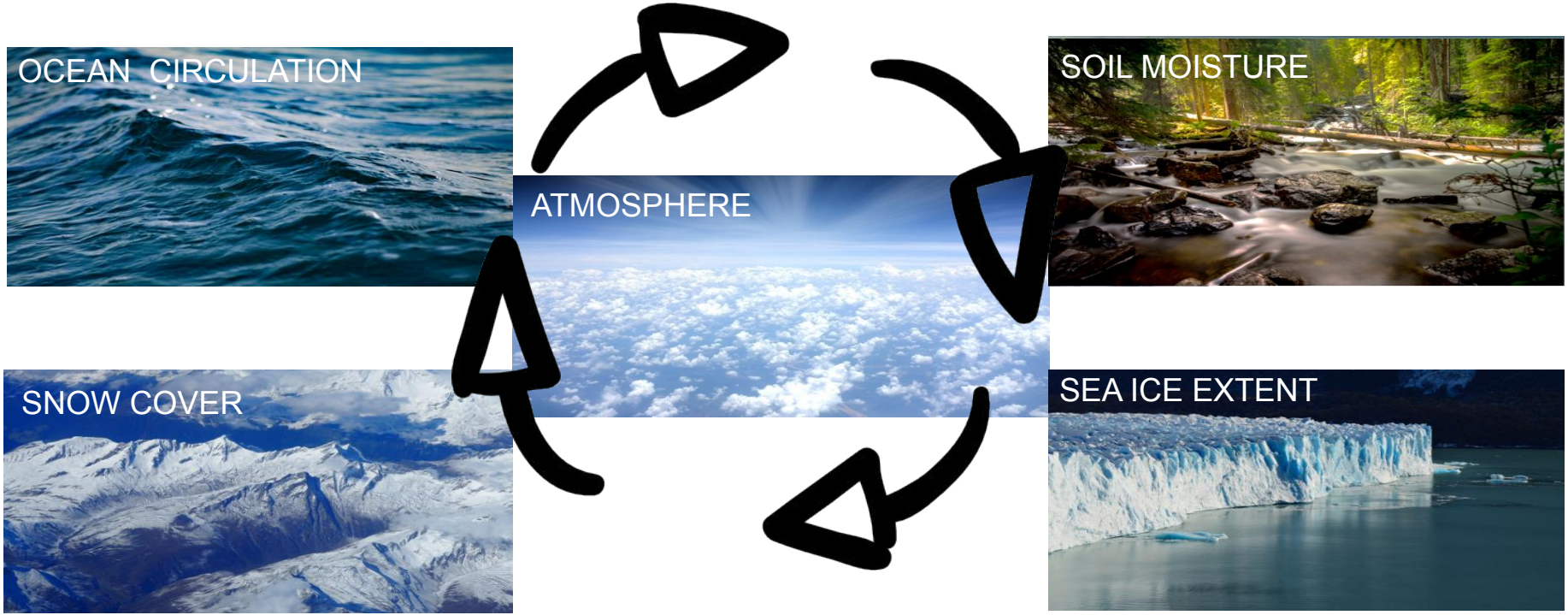
Can we anticipate unseasonal weather months ahead?



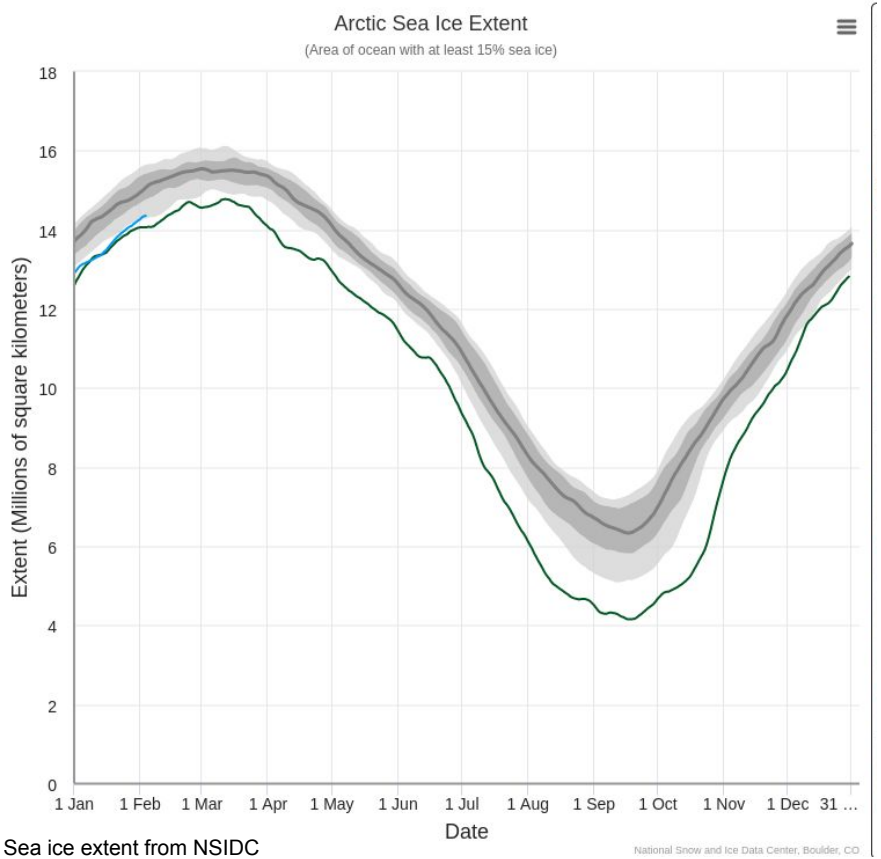
S2S4E
Climate Services for Clean Energy

Earth System predictability

- How can we predict conditions for the coming season if we cannot predict the weather next week? Slow components of the Earth System force the atmosphere.



Climate forcings



Arctic Sea ice extent from NSIDC

- Low arctic sea ice
- Solar radiation is not reflected
- Ocean temperature rises
- Atmospheric circulation changes
- Energy demand & generation is affected

This is happening now, not in 50 or 100 years!!!

S2S4E Climate Services for Clean Energy

Decision Support Tool (DST)

[s2s4e-dst.bsc.es](s2s4e-dst.bsc.es)

S2S4E Climate Services for Clean Energy

January 2020 forecasts

S2S4E
Climate Services
for Clean Energy

S2S4E Decision Support Tool
Climate Services for Clean Energy

s2s4e-dst.bsc.es

Llorenç

Search location

Check previous forecast
2019 Dec 18

Forecast window
1 2 3 4 1 2 3
Next 4 weeks | Next 3 months

Forecast launched on 2019 Dec 01
Next forecast update on 2020 Feb 13

BETA v1.3.2

VARIABLES

Select category
Essential climate variables

Select variable
Sea level pressure

FILTERS

Skill level

0%
View all
0 100

Probability threshold

50 × %

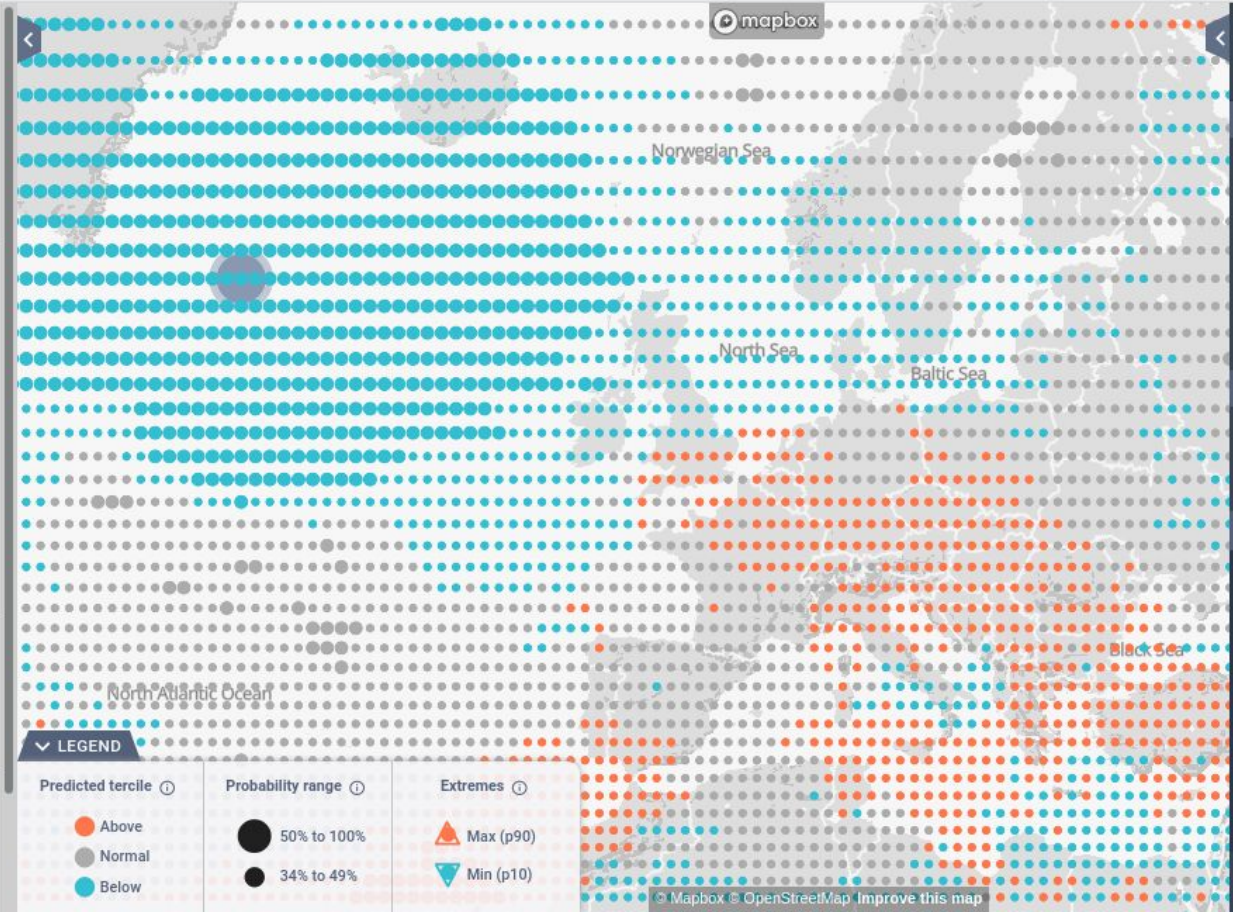
Show extremes

CUSTOMISE DISPLAY

Dark map
Installed power

HELP

Guided tour
Advanced information



January
(1 - 31 January 2020)
Sea level pressure

SUMMARY

FORECAST	SKILL
4% ABOVE	13%
18% NORMAL	(Fair)
78% BELOW	

EXTREMES (p10-p90)

FORECAST		SKILL	
MIN	MAX	MIN	MAX
49%	0%	< 0%	26%

FORECAST DISTRIBUTION

1004.07 hPa
998.74 hPa
993.77 hPa
988.75 hPa

DOWNLOAD REPORT

S2S4E Decision Support Tool — Climate Services for Clean Energy

s2s4e-dst.bsc.es

Llorenç

Search location

Check previous forecast: 2019 Dec 18

Forecast window: 1 2 3 4 1 2 3 (Next 4 weeks / Next 3 months)

Forecast launched on 2019 Dec 01
Next forecast update on **2020 Feb 13**

BETA v1.3.2

VARIABLES

Select category: Essential climate variables

Select variable: Sea level pressure

FILTERS

Skill level

View all — 0% (0 – 100)

Probability threshold

50 × %

Show extremes

CUSTOMISE DISPLAY

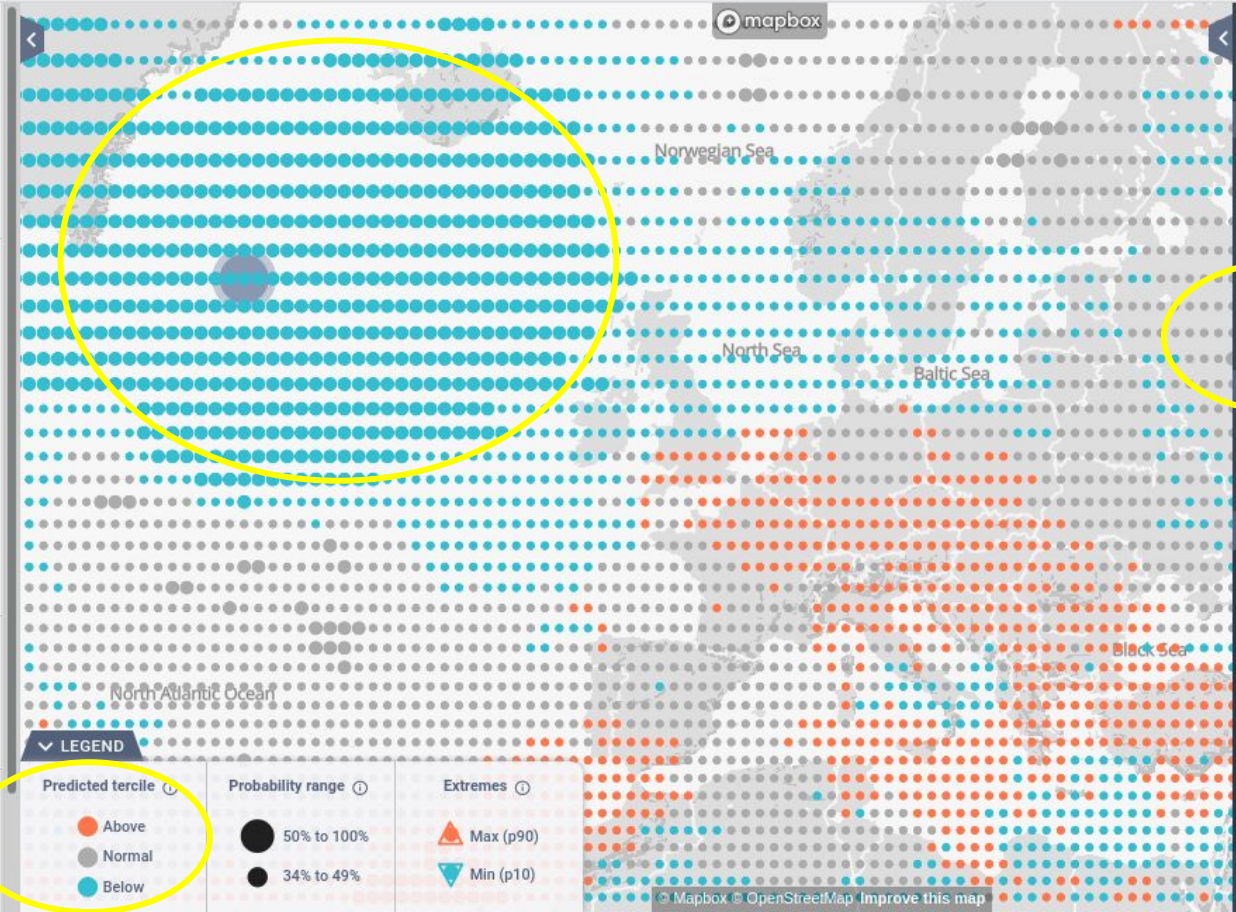
Dark map

Installed power

HELP

Guided tour

Advanced information



January

(1 - 31 January 2020)

Sea level pressure

SUMMARY

FORECAST	SKILL
4% ABOVE	13% (Fair)
18% NORMAL	
78% BELOW	

EXTREMES (p10-p90)

FORECAST		SKILL	
MIN	MAX	MIN	MAX
49%	0%	< 0%	26%

FORECAST DISTRIBUTION

DOWNLOAD REPORT

Energy indicators

Converting forecasts of atmospheric variables into forecasts of energy variables:

- Solar and wind capacity factors
- Energy demand at country level
- River basin streamflows

Temperature and energy demand anomalies (January 2020)

France: +3ºC ----> -6GW

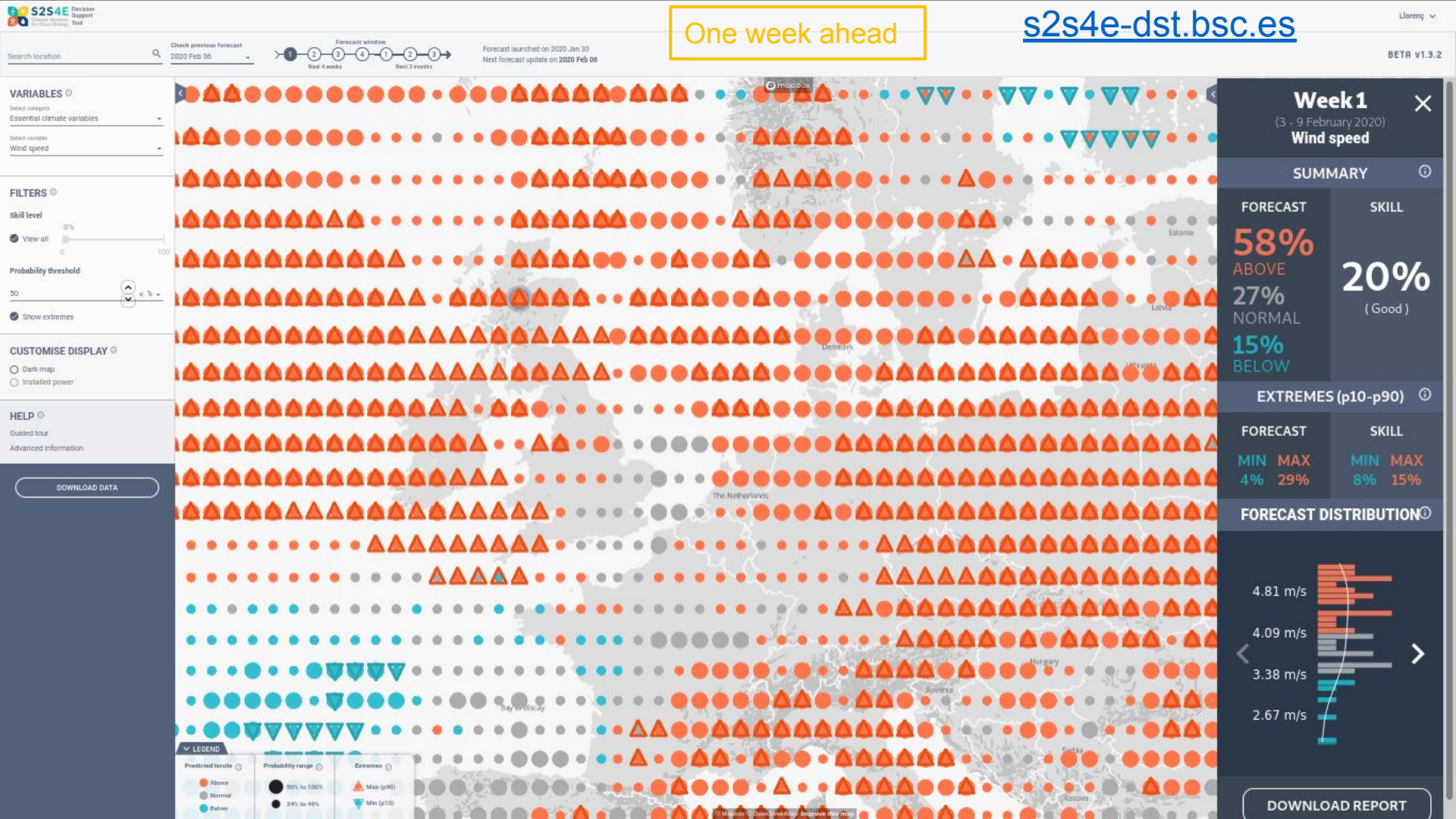
Sweden: +5ºC ----> -2GW

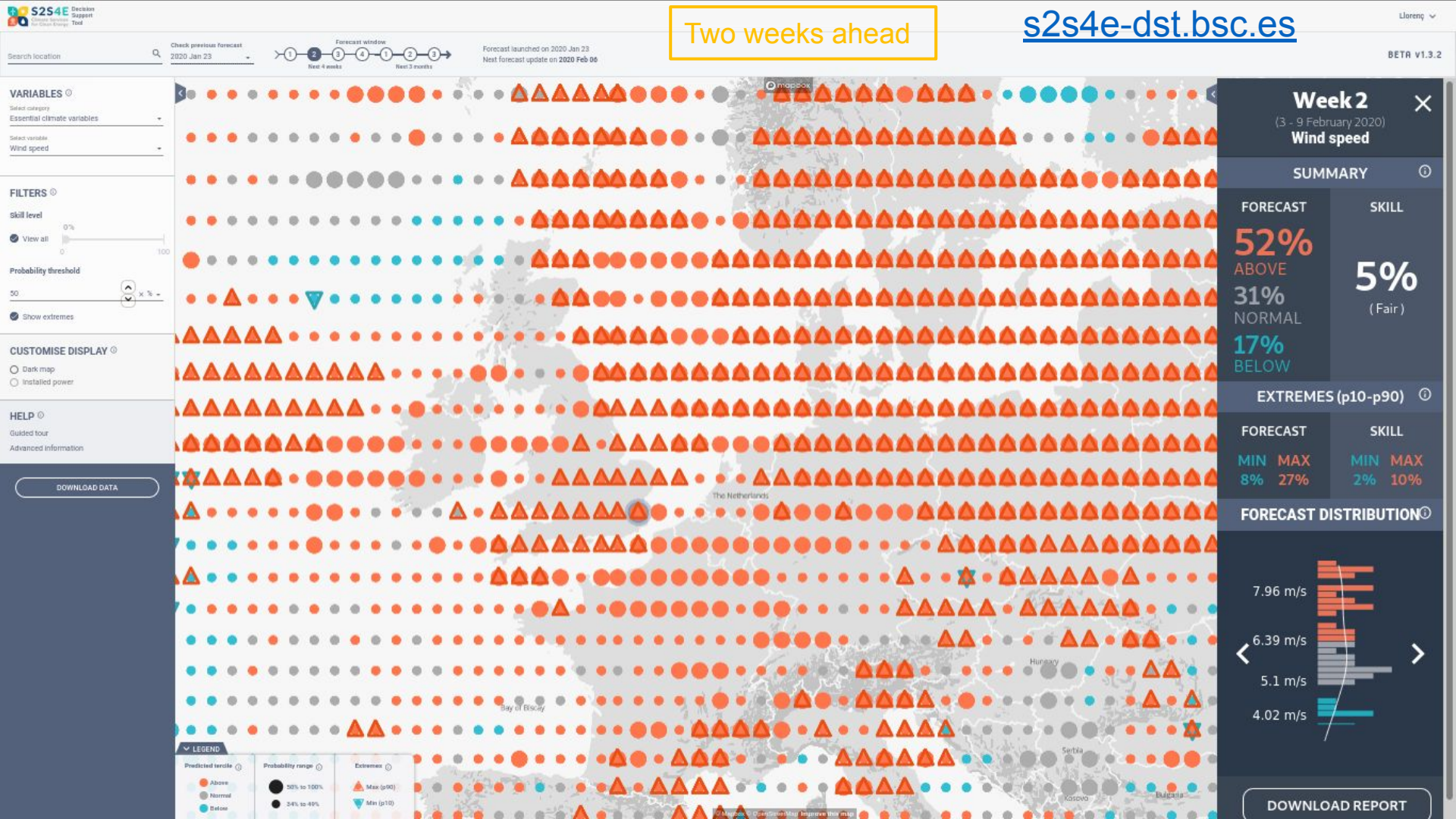
Source: S2S4E demand model, Hannah Bloomfield, UREAD

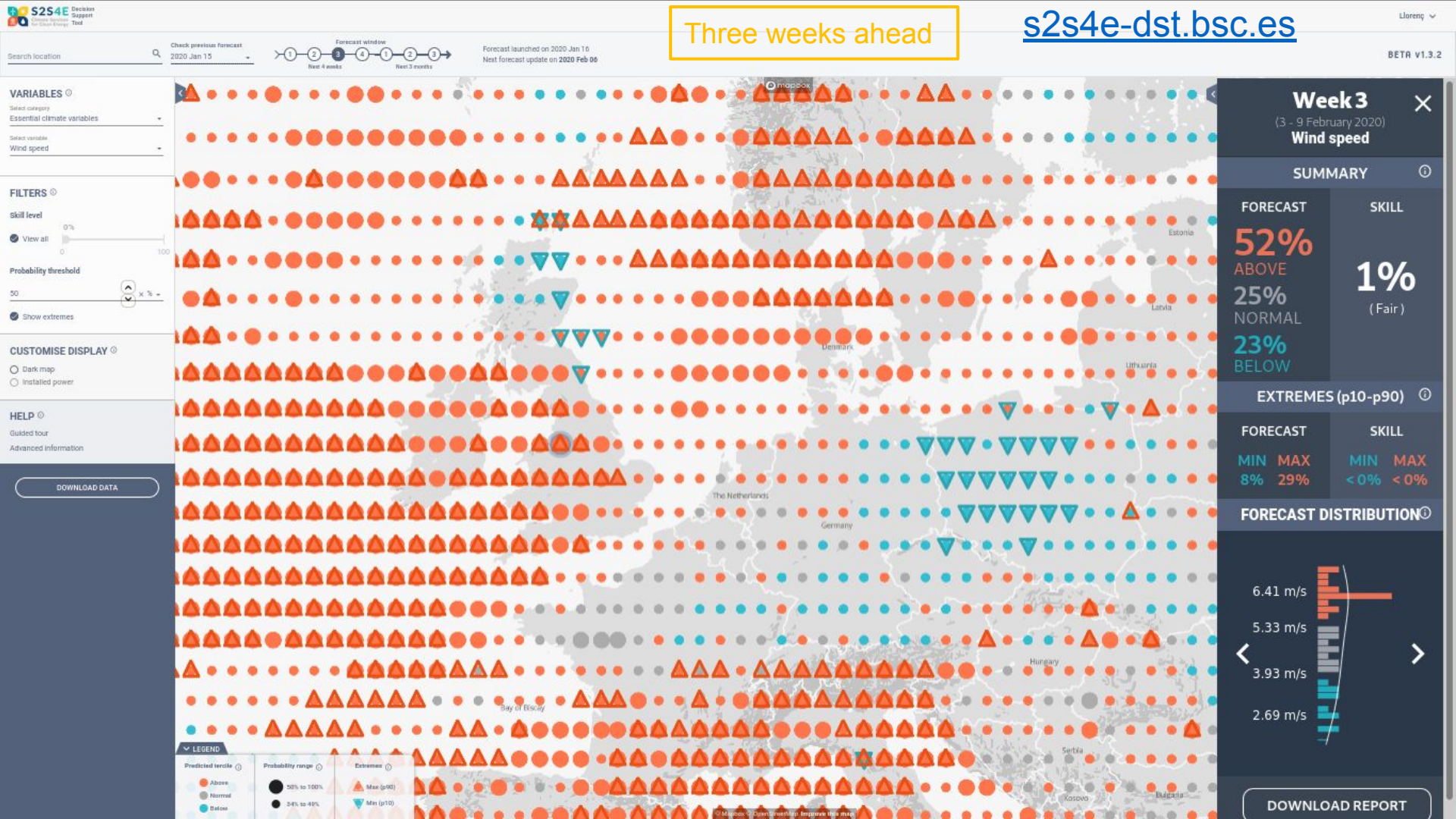
S2S4E Climate Services for Clean Energy

Ciara storm Feb 2020

S2S4E
Climate Services
for Clean Energy


S2S4E
Search location
Check previous forecast
2020 Feb 06
Forecast window
Next 4 weeks
Next 3 months
Forecast launched on 2020 Jan 30
Next forecast update on 2020 Feb 06
Llorenç
BETA v1.3.2
One week ahead
s2s4e-dst.bsc.es
VARIABLES
Select category
Essential climate variables
Select variable
Wind speed
FILTERS
Skill level
View all
Probability threshold
50
Show extremes
CUSTOMISE DISPLAY
Dark map
Installed power
HELP
Guided tour
Advanced information
DOWNLOAD DATA
LEGEND
Predicted tercile
Above
Normal
Below
Probability range
50% to 100%
34% to 49%
Extremes
Max (p90)
Min (p10)
Week 1
(3 - 9 February 2020)
Wind speed
SUMMARY
FORECAST
58%
ABOVE
27%
NORMAL
15%
BELOW
SKILL
20%
(Good)
EXTREMES (p10-p90)
FORECAST
MIN MAX
4% 29%
SKILL
MIN MAX
8% 15%
FORECAST DISTRIBUTION
4.81 m/s
4.09 m/s
3.38 m/s
2.67 m/s
DOWNLOAD REPORT
Estonia
Latvia
Denmark
The Netherlands
Hungary
Slovenia
Serbia
Kosovo


S2S4E
Decision Support Tool
Search location
Check previous forecast
2020 Jan 23
Forecast window
Next 4 weeks
Next 3 months
Forecast launched on 2020 Jan 23
Next forecast update on 2020 Feb 06
Llorenç
BETA v1.3.2
VARIABLES
Select category
Essential climate variables
Select variable
Wind speed
FILTERS
Skill level
View all
Probability threshold
Show extremes
CUSTOMISE DISPLAY
Dark map
Installed power
HELP
Guided tour
Advanced information
DOWNLOAD DATA
Two weeks ahead
s2s4e-dst.bsc.es
Week 2
(3 - 9 February 2020)
Wind speed
SUMMARY
FORECAST
52%
ABOVE
31%
NORMAL
17%
BELOW
SKILL
5%
(Fair)
EXTREMES (p10-p90)
FORECAST
MIN MAX
8% 27%
SKILL
MIN MAX
2% 10%
FORECAST DISTRIBUTION
7.96 m/s
6.39 m/s
5.1 m/s
4.02 m/s
DOWNLOAD REPORT
LEGEND
Predicted tercile
Above
Normal
Below
Probability range
50% to 100%
34% to 49%
Extremes
Max (p90)
Min (p10)
The Netherlands
Hungary
Bay of Biscay
Serbia
Kosovo
Bulgaria


S2S4E Decision Support Tool
Search location
Check previous forecast
2020 Jan 15
Forecast window
Next 4 weeks
Next 3 months
Forecast launched on 2020 Jan 16
Next forecast update on 2020 Feb 06
Llorenç
BETA v1.3.2
Three weeks ahead
s2s4e-dst.bsc.es
VARIABLES
Select category
Essential climate variables
Select variable
Wind speed
FILTERS
Skill level
View all
Probability threshold
50
Show extremes
CUSTOMISE DISPLAY
Dark map
Installed power
HELP
Guided tour
Advanced information
DOWNLOAD DATA
Week 3
(3 - 9 February 2020)
Wind speed
SUMMARY
FORECAST
52%
ABOVE
25%
NORMAL
23%
BELOW
SKILL
1%
(Fair)
EXTREMES (p10-p90)
FORECAST
MIN 8%
MAX 29%
SKILL
MIN < 0%
MAX < 0%
FORECAST DISTRIBUTION
6.41 m/s
5.33 m/s
3.93 m/s
2.69 m/s
DOWNLOAD REPORT
LEGEND
Predicted tercile
Above
Normal
Below
Probability range
50% to 100%
34% to 49%
Extremes
Max (p90)
Min (p10)
Estonia
Latvia
Denmark
Lithuania
The Netherlands
Germany
Hungary
Bay of Biscay
Serbia
Kosovo
Bulgaria

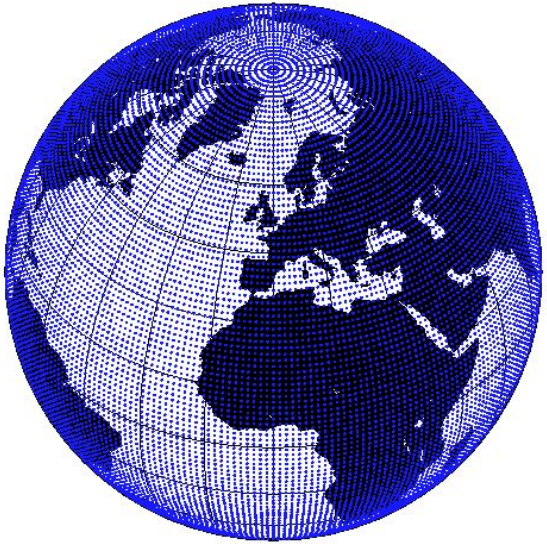
Winter is over?

S2S4E
Climate Services for Clean Energy

Who would you ask?

Punxsutawney Phil

or



S2S4E DST

s2s4e-dst.bsc.es

S2S4E Climate Services for Clean Energy

S2S4E
Climate Services for Clean Energy

Discover our forecasting tool for renewable energy

Llorenç Lledó
Barcelona Supercomputing Center

Karla Hernández
Nnergix

Joan Miquel Anglès
Nnergix

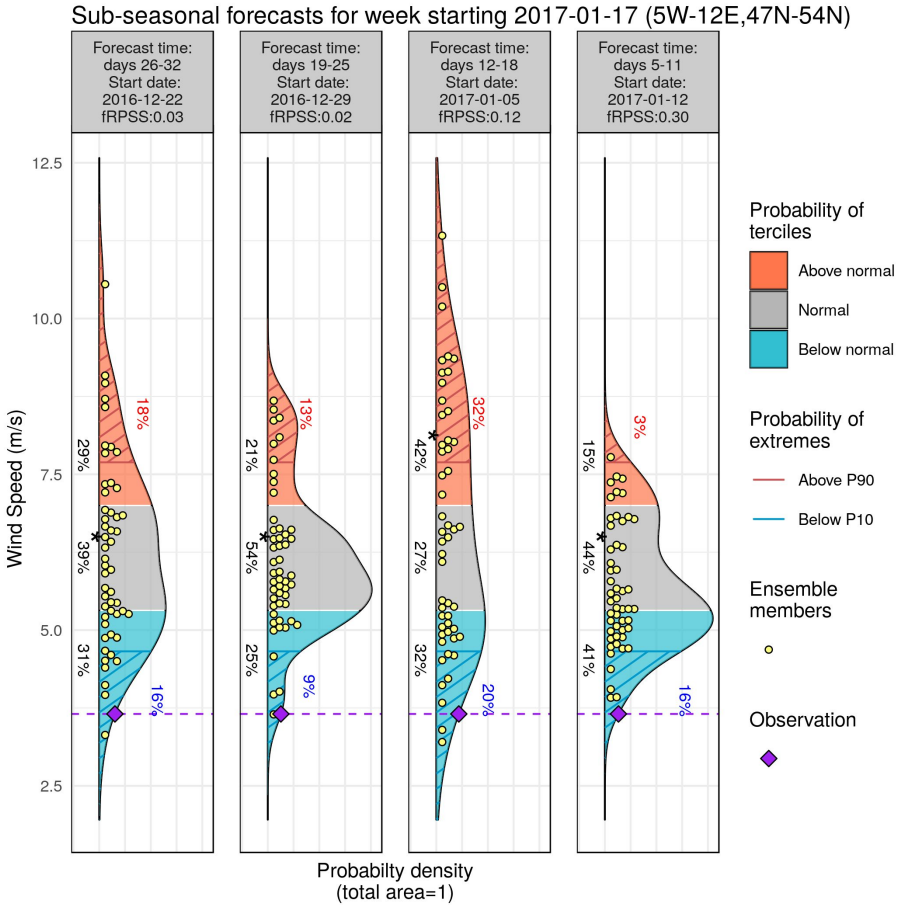
Find us at the MONTEL stand!

Meet us at E-world energy & water

11.-13.2.2020
ESSEN/GERMANY
www.e-world-essen.com

MONTEL

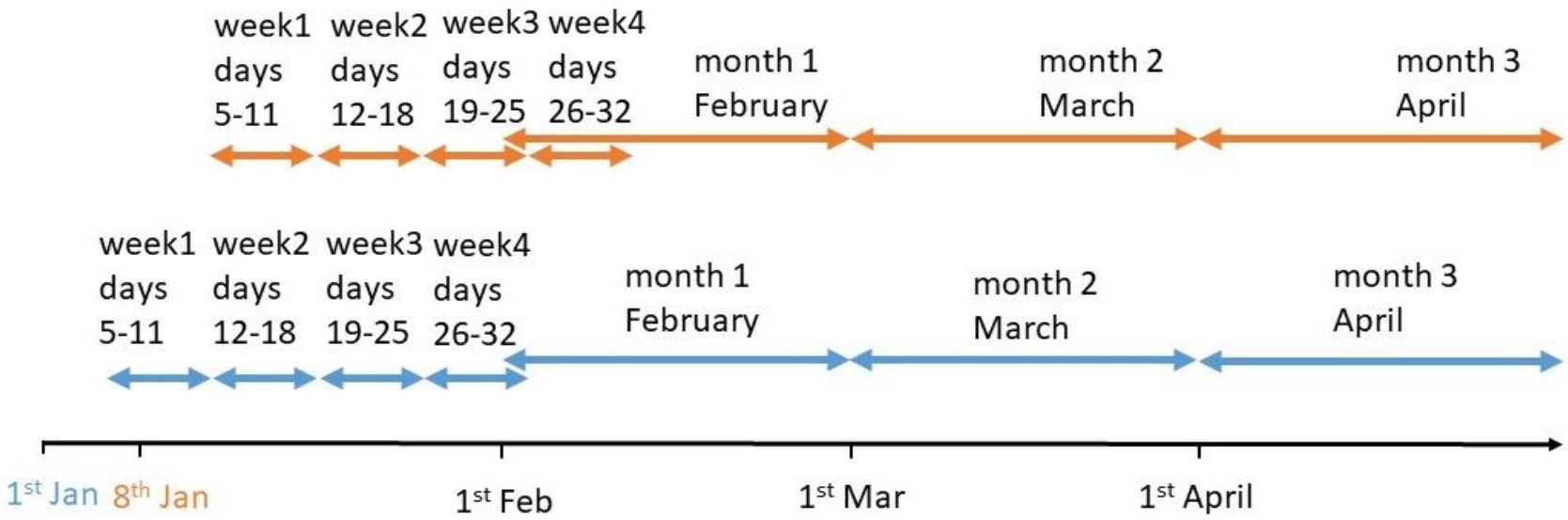
Wind speed forecasts



System: ECMWF monthly prediction system
Reanalysis: ERA-Interim
Bias adjustment: calibration
Hindcast: 1996-2015
Area: 5W-12E/47N-54N

S2S4E Climate Services for Clean Energy

Lead times



S2S4E
Climate Services for Clean Energy

Wind drought in UK

Like 15M

ADVERTISEMENT

Britain's turbines are producing 40% less energy as wind 'disappears' for six weeks across the UK causing record low electricity production

- Britain got 15 per cent of its power from wind last year — twice as much as coal
- Since the start of June, wind farms have been producing almost no electricity
- The 'wind drought' has seen July 2018 be 40% less productive than July 2017
- In the still weather, solar energy has increased by 10% to help cover the drop-off

By JOE PINKSTONE FOR MAILONLINE

PUBLISHED: 15:48 BST, 18 July 2018 | **UPDATED:** 17:29 BST, 18 July 2018

S2S4E Climate Services for Clean Energy