



Copernicus Symposium on Climate Services for the Energy Sector

22-23 February 2017
Espai Endesa, Barcelona (Spain)

Summary Report

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C3S Symposium on Climate Services for the Energy Sector

1. Introduction

This Symposium was jointly organised by Copernicus C3S projects European Climatic Energy Mixes (ECEM) and CLIM4ENERGY (C4E). Held at the prestigious Espai, Endesa headquarters in Barcelona 22-23 February 2017, the Symposium welcomed European delegates from a range of organisations including energy companies, TSOs, national and regional organisations and climate and energy providers. A total of 84 people attended, 11 of which were invited speakers.

The structure of the two-day Symposium was such that it addressed the needs of delegates relatively new to the projects as well as those who had attended previous workshops. The first day welcomed external speakers, addressing the subject of 'Climate and energy challenges', followed by a plenary session and testimonials on the subject of 'Why climate matters to energy', with a chance for delegates to 'test drive' the demonstrators in the afternoon and concluding with networking during an evening poster session. Day two commenced with members of both C3S teams addressing through presentations and plenary discussions the subject of 'Improving C3S products' with ideas further developed and cultivated during the subsequent thematic working groups. Delegates were then provided with an appreciation of two other C3S projects, SWICCA and EDgE, with their presentations focussed on hydropower, given the overlap with the ECEM and C4E SISs. A user feedback session linking back to the thematic working groups facilitated the recording of participant feedback and the sharing of ideas and the day was wrapped up by project leaders later in the afternoon.



Figure 1 – Networking during coffee break



2. Symposium objectives

The overarching objective of this stakeholder engagement workshop (or Symposium) was to engage with strategic level policy makers and technical level users. The former to create awareness and understanding of the project for energy security and the energy sector and the latter to elicit priorities and more technical requirements for the ECEM Demonstrator. For this particular ECEM-C4E joint Symposium the following objectives were agreed with ECMWF:

- To showcase results of C3S Energy SISs, also by demonstrating complementarity of effort between the two C3S energy and links with Water SISs – MoS (measure of success): number of attendees; comments on feedback forms
- To seek feedback on C3S Energy demonstrators – MoS: number of interaction and suggestions during the interactive sessions
- To raise awareness about use of climate data for energy and strengthen link between climate and energy communities also in preparation to follow up C3S activities – MoS: number of new people who would like to remain in the loop

Additional specific objectives were agreed by the two project leaders:

- To present and discuss climate data calibrations and their conversion for energy applications, including representation of uncertainty as developed by ECEM and C4E:
 - Uncertainty is quantified via comparisons with observations for the historical period and also using ensemble of simulations for seasonal forecasts or climate projections;
 - Ensembles of forecasts or projections provide potential scenarios, as “weather generators” for current to future climate;
- ECEM and C4E are developing a prototype service – this is an appropriate time to share with stakeholders what we have been doing and receive feedback on features that can be improved
- To canvass new ideas for future research and service developments

3. Symposium content

The Symposium comprised a combination of presentations, plenaries, a demonstrator hands-on session, thematic group work and subsequent feedback sessions, providing delegates with an appreciation of sector challenges, testimonials, a chance to test drive the demonstrators, and also to become au fait with C3S products and other C3S projects. Using both the main conference room and breakout rooms, the Symposium offered delegates an informative couple of days whilst furnishing the projects with useful sector feedback on their respective demonstrators.

All presentations are available at:

<https://climate.copernicus.eu/synthesis-copernicus-symposium-climate-services-energy-sector-22-23-february-2017>



3.1 Day one – Plenary: Energy and climate change

Chaired by Laurent Dubus (EDF), the ‘Energy and climate change’ plenary got underway with a joint presentation by the respective project leaders, Alberto Troccoli and Robert Vautard, who outlined the Symposium context and goals. Carlo Buontempo, SIS Manager (ECMWF) followed with a brief introduction to C3S. Presentations by invited speakers below addressed challenges of climate and energy:

Presentation title	Speaker
Co-production of demand-led and curiosity-driven climate science for a society in energy transitions	Wilfran Moufouma-Okia, Climate Scientist (IPCC/WG1 TSU)
Some issues around weather forecasts for a transmission system operator	Vincent-Lefieux, Head of the RTE Data Science Team
Energy challenges in Catalonia from a policy perspective	Marc Rotllan & David Villar, Energy Planning (GENCAT)

3.2 Day one – Plenary: Why climate matters to energy

After the break, Elisabeth Viktor (GERICS/HZG) chaired four testimonial presentations by the following external speakers:

Presentation title	Speaker
Climate change adaptation in the electricity sector. ENDESA experience.	Alejandro Rodriguez Palao, Environment Expert (Endesa)
December 15 vs. December 16 and how the energy market behaved	Matthias Piot, Meteorologist/Gas Analyst (EnBW)
Why is climate change important for the hydropower industry?	Mikael Sundby, Senior Hydrologist (Vattenfall)
How marine climate & ocean data services are essential to support the energy sector	Stephen Hall, Vice Chair IOC-UNESCO (Met Office)

3.3 Day one – Plenary: Hands-on demonstrator session

Before lunch Clare Goodess (UEA) and Robert Vautard (CNRS/IPSL) presented the ECEM and C4E demonstrators respectively, as introduction to hands-on demonstrator sessions after lunch where delegates could ‘test drive’ each product.

The ECEM hands on session took place in ‘Alttillo’ breakout room where ECEM Demonstrator developer Barbara Percy (University of Reading) provided an overview to delegates on its menu structure and functionalities. Delegates used their own laptops or tablets to access the ECEM demonstrator. The ECEM team were on hand to help delegates and to answer questions about the Demonstrator itself and the data currently incorporated. Feedback was collected using a number of different mechanisms: a feedback form; post-it notes; and comments written on large-size printed



screen shots of various parts of the Demonstrator. Following the Symposium, this material will be reviewed and used to guide further developments of the Demonstrator. As well as indicating a number of ways in which the Demonstrator can be improved (including some issues already identified by the ECEM team), the feedback comments indicate the generally positive response to the Demonstrator, for example:

- *“What is good? The tool is friendly, easy-to-use”*
- *“The tool is easy to use and gives you an idea of the trends for large areas/countries.”*
- *“Is useful and looking forward to having the rest of options enabled to use them.”*
- *“As a whole sounds very promising”*
- *“What is good? What I like is the easy way of exploring data available through graphs and maps. Download is a good functionality too. Legend configuration is good functionality. Choice of time periods and variables is good.”*

The CLIM4ENERGY products visualization was organized from the web site from a demonstration tool showing examples of indicators and products (see Figure 4). Six demonstrations took place, and were organized in the main room from 3 tables, each having a large monitor for display. Delegates could also follow demonstrations using their laptop and further explore the demonstration tool and possibilities. Each table hosted two subgroups and interaction took place between delegates, the product developers and their industry co-designers. A number of remarks was drawn from this session, which will help the development of the C4E demonstrator, due to be completed by Q4 2017.

Delegates and users provided a number of useful comments, and insisted on a few major issues:

- Measuring and demonstrating skill is key to using climate data
- Consistency across products and climate variables is key, as energy users need an overall view of drivers of e.g. energy prices
- Seasonal forecasts are extremely interesting for the energy sector but their currently estimated modest skill is a limiting factor for possible uptake; a thorough uncertainty estimation would therefore be very useful
- The use of climate projections to investigate not only future but current risks is to be investigated, including the development of “return periods” indicators

It was clear from the discussions that there will be a wide variety of users and product requests, ranging from energy users with expertise in climate data, essentially requiring high quality climate data and methods, to service companies building tailored products for their customers, and to end users requiring well-documented tailored products.

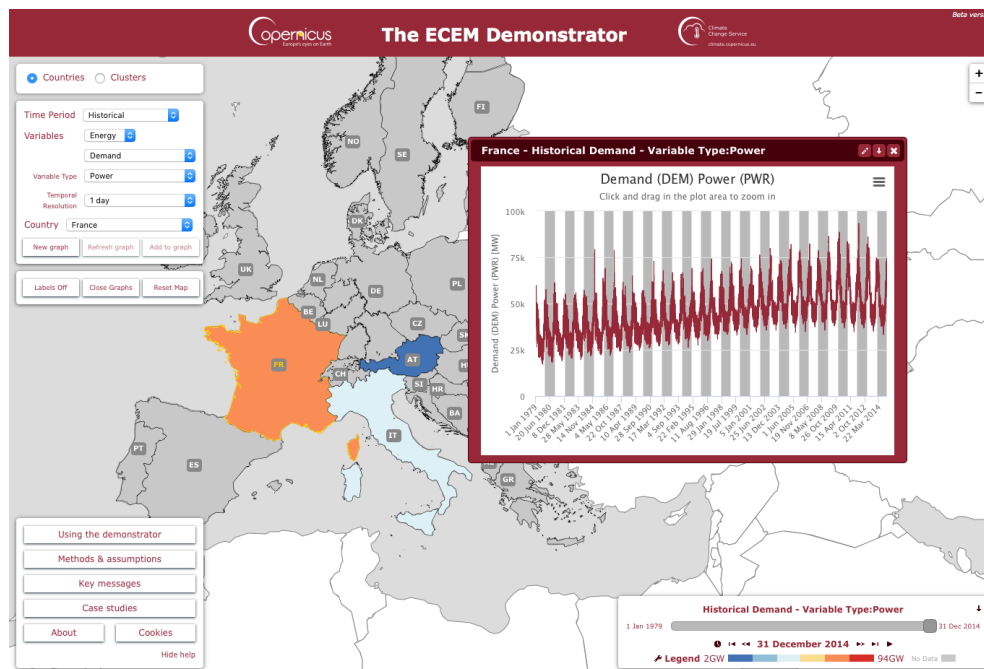


Figure 2– A view of the ECEM demonstrator



Figure 3– Hands-on the ECEM demonstrator!

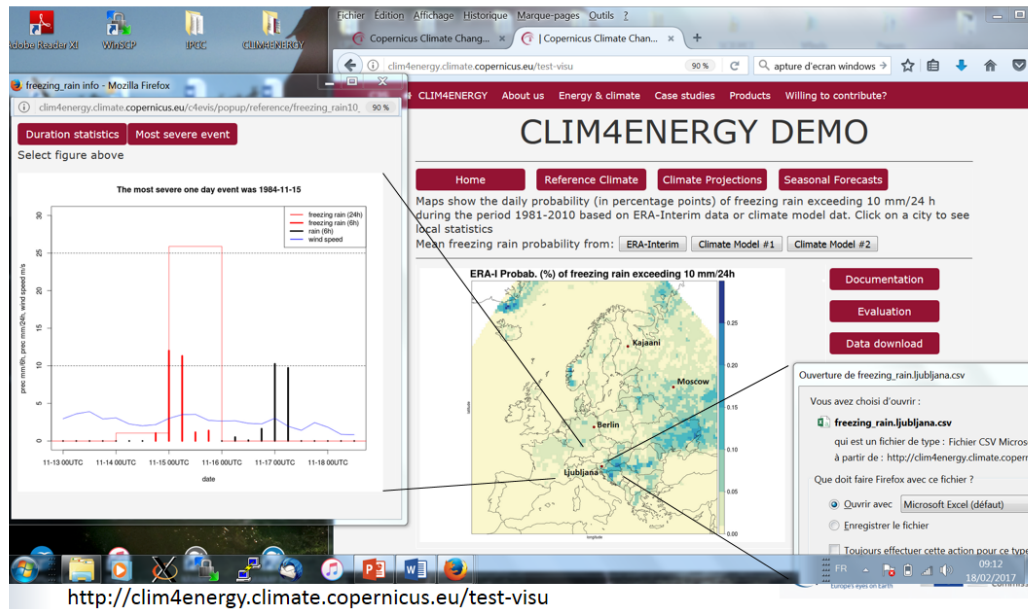


Figure 4 – A view of the CLIM4ENERGY preliminary demonstration tool



Figure 5 – CLIM4ENERGY use case demonstrations



3.4 Day one – Plenary: General Discussion

Caroline Acton, Business Manager Energy Consultant (Met Office), chaired a general discussion focussing on the two questions posed to participants in the registration questionnaire:

- What do you consider to be the major barrier(s) to the uptake by the energy sector of climate information provided through climate services such as C3S?
- How can the value of climate services be demonstrated in the energy sector to encourage greater use?

As noted by Alberto Troccoli and Robert Vautard in their opening remarks in the morning, the majority of responses fell into the following three major categories:

- Data access
- Reliability of products
- Consistency of climate/user data

Key things for encouraging greater uptake are:

- Case studies
- Demonstration of (economic) added value

Responses that appeared in answer to both questions were:

- Communication
- Dialogue
- Co-design/co-production

The resulting plenary discussion focused on the following related questions:

- To what extent are the two projects addressing the barriers to uptake and demonstrating the value of climate services for the energy sector?
- What else do they need to do?
- To identify any issues/questions which require further discussions on Day 2.

The first point raised was that of **evaluation, quality control and quality assurance**. The evaluation of models data (reanalyses and particularly forecasts) is critical because of a variety of decision-making situations, as in the case of trading when a large investment can be made based on a particular weather situation. Some of the activities of C3S include a provision of quality assurance processes namely:

- Evaluation of seasonal predictions
- Standardised quality assurance procedures
- All data will undergo rigorous quality checking

Also, evaluation must take into account the fact that the quality can vary significantly depending on which time period is used to assess the data, and also on what specific data stakeholders are interested in. Hence quality assurance procedures need to be flexible and adaptable. Further, a key



step is to remove barriers to data access so that the datasets themselves can be critically assessed by a wider group and improved further.

The discussion then went on necessary steps to improve use and user engagement. As there will be more and more new products and indicators, it will also be essential that stakeholders clearly understand the **gain and added value** in using them. This needs more and more demonstrative cases.

A key point also discussed was how to improve the models and resulting datasets through using industry data. An important question is to ask industry partners permission to share their observations (weather and energy variables). There are examples where sharing data leads to an improvement of models data. However at a broad scale there is a need for an analysis of what datasets can be shared that would be of higher benefit. The question was raised as to whether the C3S could help in addressing this issue. TSOs usually share their data. A group called the Marine Industry Liaison group (MILG) are also happy to share ~30 years of met ocean data from offshore platforms with scientists. However a key problem is the metadata. There is a need of harmonization of standards. A way to progress this is also with (re-)insurance companies which usually require such standards. The C3S Climate Data Store (CDS) provides an opportunity to explore data standards with users. There will be a unique access point for climate data and a metadata structure in place – the question is whether we can harmonize these standards with those in use by the energy industry and this is to be investigated.

3.5 Poster session and networking

The early evening poster and networking session allowed some delegates to present details about their work in poster format and all delegates and speakers to network and share industry and climate sector learning and ideas.

3.6 Day two – Plenary: Improving C3S products

This first session chaired by Thierry Ranchin (ARMINES/MINES ParisTech) comprised six talks on climate and energy products, combining material from team members of both projects.

The presentations were thought provoking, cited examples and identified areas where further improvement is needed.

Presentation title	Speaker
Improving the quality and reliability of historical climate data for energy applications	Phil Jones (UEA)
Improving seasonal forecast products for the energy sector	Christian Viel (Meteo-France) and Philip Bett (Met Office)
Climate Projections: Do they provide relevant and reliable information for the energy sector?	Isabelle Tobin (CNRS)
Meeting the challenges in providing useful and usable energy variables and data sets	Laurent Dubus (EDF)
Understanding variability and risk in the energy sector	Emma Suckling (University of Reading)
Effective communication of climate information	Elisabeth Viktor (GERICS/HZG) and Alberto Troccoli/Clare Goodess (UEA)

3.7 Day two – Improving C3S products - Thematic working groups

Following the plenary presentations above and after a short break, delegates were organised into five thematic working groups each with a moderator and rapporteur at a group station. After about 45 minutes delegates were encouraged to move onto a second station to discuss another of the five themes below:

Theme	Moderator and Rapporteur
Improving the quality and reliability of historical climate data for energy applications	Phil Jones (ECM) and Llorenç Lledó (C4E)
Seasonal forecasts: do they provide relevant and usable information for the European energy sector?	Christian Viel (C4E) and Philip Bett (ECM)
Climate projections: do they provide relevant and reliable information for long-term planning in the energy sector?	Isabelle Tobin (C4E) and Emma Suckling (ECM)
Meeting the challenges in providing useful and usable energy variables and data sets	Laurent Dubus (ECM) and Sophie Martinoni-Lapierre (C4E)
Integration, delivery and communication of data and information with the spotlight on the user	Elisabeth Viktor (C4E) and Steve Dorling (ECM)

Each group discussed issues and questions specific to each topic listed on the final slide of each related presentation, as well as two generic questions:

- What is good, useful and/or usable from what is currently available?
- What is missing or lacking?



Figure 6– Fruitful group discussions in beautiful Espai Endesa venue



Each group presented a single summary slide in the following plenary session. The content of these slides is presented below:

Group 1 – Improving the quality and reliability of historical climate data for energy applications

Summary of findings

- Bias adjustment code and methods available for future usage
- Bias adjusted data from ECEM may have limitations (undercatchment problems for precipitation, station representativeness)
- Better discussion of bias-adjustment approaches
- Double bias-adjustment (once for each ECV, and second for energy indicator)
- Issue of trends in the mean of some Reanalysis ECVs
- Usage of ensemble members for uncertainty assessment (to fully use this there is a need to run all members, but this is a lot of data)
- Running programs directly on the CDS to avoid large data downloads

Group 2 – Seasonal forecasts: do they provide relevant and usable information for the European energy sector?

Summary of findings

Including skill in the Demonstrators is important

- How much better are the forecast systems compared to climatology?
- Does climate change affect your climatology? (depends!) What is your “normal” ? Compare to recent years, as well as past 30
- Use measures of skill relevant to the users... Could simplify (e.g. poor, moderate, good), but different users will have different definitions of “good”...
- Learn from progress across our Demonstrators in how to display signal+uncertainty+skill (e.g. Project Clim4Energy as follow-up of UKKO)
- Important to be able to access skill information directly from the forecasts - not separately

Comparing models is also important

- Including comparison with models outside C3S!
- Which model is better (for this variable/season/country)? Can this be robustly determined?
- Which systems correctly model processes of interest in my case, e.g. stratospheric warmings, NAO, temperature trends? → include in Factsheets
- Including “net” energy metrics (as skill + forecast), e.g. wind+solar+hydro [- demand] as well as separately
- Seasons of interest, and lead time:
 - DJF is not tradable; but Q1 (JFM) is, so more useful → include
 - e.g. could e.g. forecast next 2 quarters in each month's forecasts, as well as standard rolling seasons
 - Interannual/decadal forecasts are not in C3S, but there's interest in using recent developments for lead times of 6-12m
- Case study of how to use the seasonal info provided:



- Can show how to assess “value” of forecasts to a user – would you have benefitted?
- Real use of forecasts might involve statistical downscaling to the users' assets;
- How will C3S SIS Demonstrators be able to link to such procedures/tools e.g. through Copernicus Climate Data Store toolbox? → Useful to demonstrate how C3S Demonstrators can be “plugged in” to other existing tools

Group 3 – Climate projections: do they provide relevant and reliable information for long-term planning in the energy sector?

Summary of findings

- Relevance of climate projections for users?

Mid to long term climate change information needed (planning for policy makers; asset investment for business users) and CP have already been used in some cases to support decision

- Obstacles

Wide spread of future changes, unavailability of key variables (100m wind speed, turbulence and stability parameters), coarse resolution vs confidence in data

- What is lacking?

Reliability, user guidance on how to use CP, synthesis on ensemble sub-sampling methods

- How to improve?

Sharing energy data from industry with research (wind mast data) (pricing, regulation, benefits)
Downscaling and tailoring by consultants

Group 4 – Meeting the challenges in providing useful and usable energy variables and data sets

Summary of findings

- Good / Useful / Usable: Everything? ++ Homogeneous datasets for all variables of interest
- Missing / Lacking: some variables (E-P), higher temporal resolution
- Transfer functions / Wind / Solar: intercomparison with JRC / NINJA / real ENTSO-E data
- Spatial & temporal resolution (consistency ERAi/CP), high Temporal res (sub-hourly)
- Expectations different for different variables / users: Climate only or Energy (demand, wind, hydro)
- Seasonal Forecast potentially very useful if skilful: better interact with users to maximise usefulness
- Validation criteria are user dependant: improvement over current practice / on some specific cases
- Documentation and guidance: assumptions, methods, models to be documented
- Possible Feedback mechanism when data are available (even after projects 'end)

Strong expectations for post-C3S-Energy: ERA4, CMIP6 ... Follow-up (operational) activities?

Group 5 – Integration, delivery and communication of data and information with the spotlight on the user

Summary of findings

- How to sustain co-production and collaboration
- Integrating user data?



- Copernicus users will be diverse - NMSs (esp E.Europe), Intermediaries (DG-Grow), Industry, Policy
- 'First Impressions' engagement is important for uptake
- But ... being glossy and attractive can also be dangerous (e.g. skill claims)
- Data traceability/provenance should be a Copernicus trait
- Explaining when European level support is appropriate? 'Common Language'.
- Copernicus Outreach and Dissemination in infancy at the moment – will pick up - Wikipedia ??
- Copernicus has a Level 1 Help Desk. Level 2 support also needed.
- FAQs

More detailed reports from each group, together with the discussion questions/issues and a record of the resulting plenary discussion are being compiled into an internal report.

3.8 Day two – Plenary: Other C3S projects: SWICCA and EDGE

After lunch delegates were given the opportunity to enhance their knowledge of the two water C3S projects with their hydropower-focussed presentations and a discussion chaired by Isabelle Tobin (CNRS):

Presentation title	Speaker
Case Study - Hydropower	Linnea Gimbergson, Consultant Production Hydrology (SMHI)
Climate services for the hydropower sector	Hege Hisdal, Senior Climate Change Advisor (NVE)

3.9 Day two – Plenary: Users feedback - Synthesis of key developments for the future

This final session was chaired by Alberto Troccoli and Robert Vautard, the two project leaders, with the objective of synthesising future developments for ECEM, C4E, and more broadly C3S and the energy sector. The discussion focused on a few perspectives from the previous days: Thematic topics, energy sector perspective, and how the two projects propose to modify their activities in response to feedback. The two projects are working together for a better integration, harmonization and complementarity of the climate service products for the energy sector. One of the key objectives of this co-ordination between ECEM and C4E is to provide energy sector users (and possibly related stakeholders) with more robust products, while avoiding ambiguities.

4. Summary

As a stakeholder engagement activity, this Symposium effectively achieved the objectives. The quality and detail of user engagement feedback captured particularly during the hands-on sessions and thematic working groups, provided both projects with an insight into the priorities, the more technical requirements for their respective demonstrator products, also how industry ready they were and the likely take up of the demonstrators. With regard to raising the profile of the projects, the overall communication before, during and after the workshop proved successful in attracting potential users from relevant industry sectors and eliciting offers from industry experts regarding future involvement in subsequent stakeholder engagement for both projects.



5. Appendix 1 Symposium agenda



Copernicus Symposium on Climate Services for the Energy Sector Programme | 22 -23 February 2017

Day 1

9:00	Welcome and Introduction	I Buesa (Endesa)
9:10	Plenary: Energy and Climate Change	
	Context and goals of the Symposium	A Troccoli (UEA/WEMC) & R Vautard (CNRS)
	C3S presentation	C Buontempo (ECMWF)
	3 Keynote presentations on climate & energy issues	
	Challenges of climate & energy	W Moufouma-Okia (IPCC/WG1 TSU)
	Energy challenges in the energy industry variability and change	V Lefieux (RTE)
	Energy challenges in Catalonia from a policy perspective	M Rotllan & D Villar (GENCAT)
11:00	Break	
11:30	Plenary: Why climate matters to energy Four testimonies	A Rodriguez Palao (Endesa) M Piot (EnBW), M Sundby (Vattenfall) S Hall (Met Office)
12:30	Presentation of CLIM4ENERGY & ECEM demonstrators	R Vautard (CNRS) & C Goodess (UEA)
13:00	Lunch	
14:30	Hands-on demonstrator sessions	Break-out groups
16:30	Break	
17:00	General discussion	
18:00	Poster session and reception	

Day 2

8:30	Plenary: Improving C3S products Six talks on climate and energy products	P Jones (UEA) I Tobin (CNRS) L Dubus (EDF) E Suckling (U Reading) E Viktor (GERICS/HZG) C Viel (Meteo France)
10:30	Break	
11:00	Improving C3S products	Thematic working groups
12:30	Lunch	
14:00	Other C3S projects: SWICCA and EDGE energy cases	L Gimbergson (SMHI) H Hisdal (NVE)
15:00	Users feedback, synthesis of key developments for the future	
16:00	Wrap-up	





6. Appendix 2 Attendee List



Copernicus Symposium on Climate Services for the Energy Sector Attendee list | 22 -23 February 2017

First Name	Surname	Company
Caroline	Acton	Met Office
Armand	Albergel	ARIA Technologies
John	Bazire	CEA
Joaquín	Bedia	Predictia Intelligent Data Solutions
Christina	Beisland	NVE
Hingray	Benoit	CNRS
Philip	Bett	Met office
Dragana	Bojovic	Barcelona Supercomputing Center
Roberta	Boscolo	WMO
Carlo	Buontempo	ECMWF
Daniel	Cabazon	EDPR
Nada	Caud	CEA - LSCE
Gaelle	Collin	METEO FRANCE
Lucy	Cradden	University College Dublin
ARACELI	DE CARLOS	IBERDROLA, S.A.
Matteo	De Felice	ENEA
Arona	DIEDHIOU	IRD
Laurent	DUBUS	EDF R&D
Stephen	Dorling	UEA
Christoph	Elsässer	EnBW Energie Baden-Württemberg AG
Manuel	Fernandez Gonzalez	PhD
Sonia	Firion	CEA
Maxime	Fortin	RTE
Victor Fierro	Gama	RWE Innogy UK Ltd
Agnes	Gerse	MAVIR ZRT.
Linnéa	Gimbergson	SMHI
Iratxe	Gonzalez-Aparicio	European Commission DG-Joint Research Centre
Clare	Goodess	UEA
Benjamin	GRAFF	Compagnie Nationale du Rhône
Claudia	Gutierrez Escribano	UCLM
Stephen	Hall	National Oceanography Centre
Jarmo	Hämäläinen	Metsäteho Oy
Hege	Hisdal	Norwegian Water Resources and Energy Directorate
Otto	Hyvärinen	Finnish Meteorological Institute
Barbro	Johansson	Swedish Meteorological and Hydrological Institute
Philip	Jones	UEA
Garcia-Moya	Jose A.	Agencia Estatal de Meteorología
Justin	Krijnen	Met Office





First Name	Surname	Company
Oriol	Lacave	Vortex Factoria de Càlculs
Ignacio	Lainez	EDPR
Vincent	Lefieux	RTE/Innovation and Data
Ulrich	Leopold	Luxembourg Institute of Science and Technology
Llorenç	Lledó	Barcelona Supercomputing Center
Prohom	Marc	Meteorological Service of Catalonia
Joan Miquel	Marin	Nnergix
Sophie	Martinoni-Lapierre	Météo-France
Giacomo	Masato	Marex Spectron
Wilfran	Moufouma-Okia	IPCC/WGI/TSU
Pekka	Niemi	Fingrid Plc
James	Norman	University of Leeds
Sylvie	Parey	EDF
Barbara	Percy	The Institute For Enviornmental Analytics
Matthias	Piot	EnBW AG
Thierry	Ranchin	ARMINES / MINES ParisTech
Thomas	Remke	Climate Service Center Germany (GERICS)
Anna	Riverola	AWS Truepower
Alejandro	Rodríguez Palao	Endesa
Marc	Rotllan Puig	ICAEN (Generalitat de Catalunya)
Yves-Marie	Saint-Drenan	ARMINES / MINES ParisTech
Enrique	Sanchez	UCLM
Rafael	Sanchez Duran	Endesa
Carine	Saut	Capgemini
Georgi	Slavov	Marex Spectron
Albert	Soret	Barcelona Supercomputing Center
Petr	Stepanek	Global Change Research Institute, Czech Academy of Sciences
Mikko	Strahlendorff	Finnish Meteorological Institute
Juliana	Subtil	Barcelona Supercomputing Center
Emma	Suckling	U Reading
Mikael	Sundby	Vattenfall AB
Hazel	Thornton	Met Office
Isabelle	Tobin	LSCE-IPSL-CNRS
Alberto	Troccoli	UEA
Mérodie	Trolliet	ARMINES / MINES ParisTech
Robert	Vautard	CEA & IPSL
Fanny	Velay-Lasry	ARIA Technologies
Vidyunmala	Veldore	DNV-GL AS
Jose	Vidal	AWS Truepower SLU
Christian	Viel	Météo-France
Elisabeth	Viktor	HZG - GERICS
David	Villar Hernández	ICAEN (Generalitat de Catalunya)
Chabot	Vincent	Météo-France
Lucien	Wald	ARMINES



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