Climate Services for the Hydropower Sector

Turning climate science into solutions for hydropower production

www.secli-firm.eu

SECLI-FIRM: An EU H2020 project

@SECLI_Firm

Grant Agreement n. 776868

Climate Services for the Hydropower Sector

AGENDA

Introduction
Alberto Troccoli (UEA/WEMC)
5 min

Runoff seasonal forecast in alpine catchments: a SECLI-FIRM case study
Mattia Callegari (EURAC)
12 min

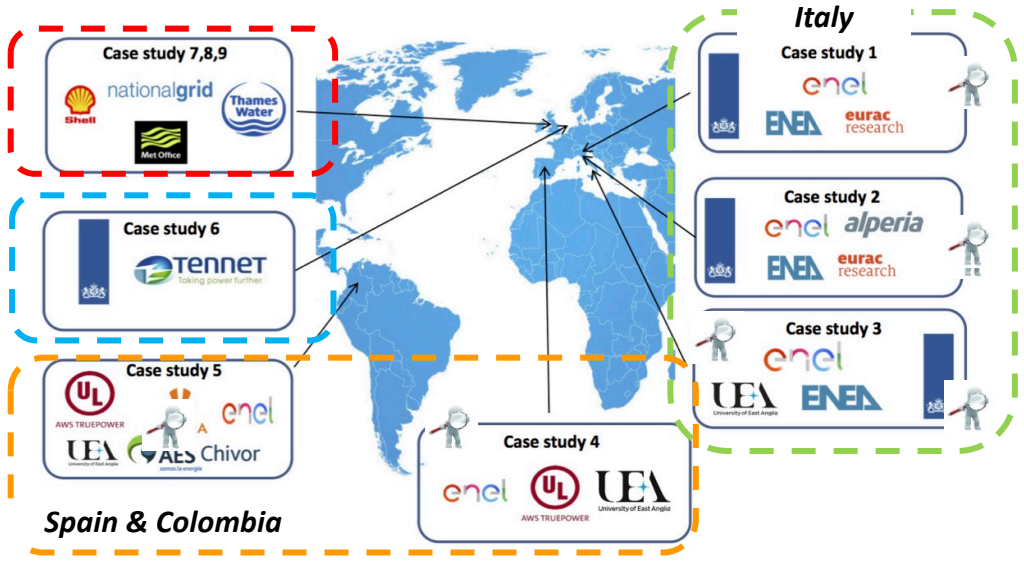
Seasonal forecast of hydro resources in Colombia during strong El Niño events: a SECLI-FIRM case study
Kristian Nielsen (UL)
12 min

Smart Climate Hydropower Tool: An AI-based service for hydropower production seasonal forecast
Paolo Mazzoli (GECOsistema)
12 min

Q&A + Poll – 15 min

Case Studies

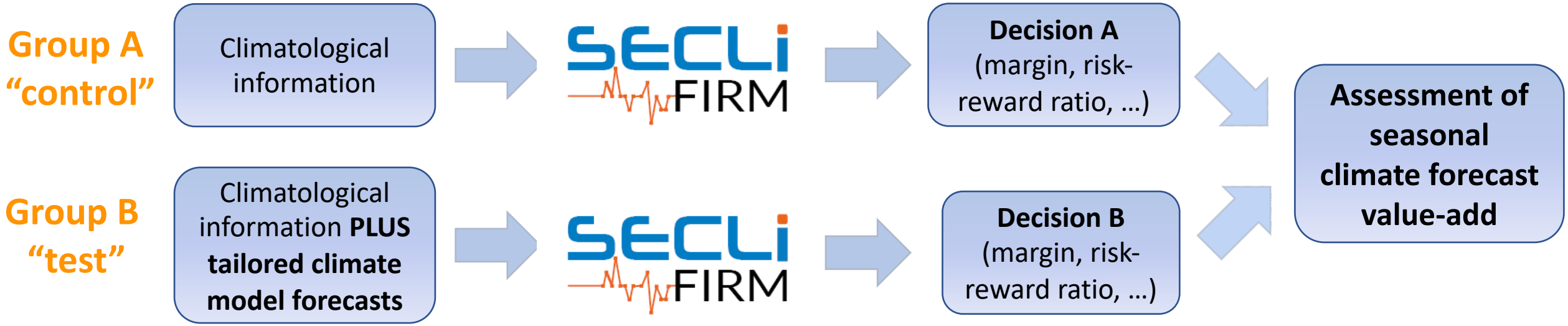
	Case Study	Climate events	Geography	Sectoral impact	Co-designers
Italy	CS1	Heat Wave 2015, and other similar extremes	Southern Europe	Energy –Thermal electricity plant cooling, demand model uncertainty	**ENEL**, ENEA, EURAC, KNMI
Italy	CS2	Dry Winter 2015-16 and other similar extremes	Northern Italy	Energy –Hydroelectric power production	**ENEL**, KNMI, ENEA, EURAC, Alperia
Italy	CS3	Strong Winds March 2016 and other similar extreme	Southern Italy	Energy – Wind power production	**ENEL**, ENEA, KNMI, UEA
Spain & Colombia	CS4	Extreme Winds 2014-15 and other similar extremes	Spain	Energy – Wind power production and balancing	**AWS**, MO, ENEL
Spain & Colombia	CS5	Strong El Niños	South America	Energy – Hydroelectric power production and other RE	**AWS**, UEA, AES Chivor, Celsia, ENEL
	CS6	Low Winds	North Sea	Energy – Offshore operations and maintenance planning	**TenneT**, KNMI



Case Study	Climate events	Geography	Sectoral impact	Co-designers
CS7	Severe climate events in 'shoulder' months	North Sea	Energy – Offshore operations and maintenance planning	**Shell**, MO
CS8	Anomalous winter conditions	UK	Energy – Winter electricity demand	**National Grid**, MO
CS9	Dry Spring and Summers	UK	Water – Water use restrictions	**Thames Water**, MO

Grant Agreement n. 776868

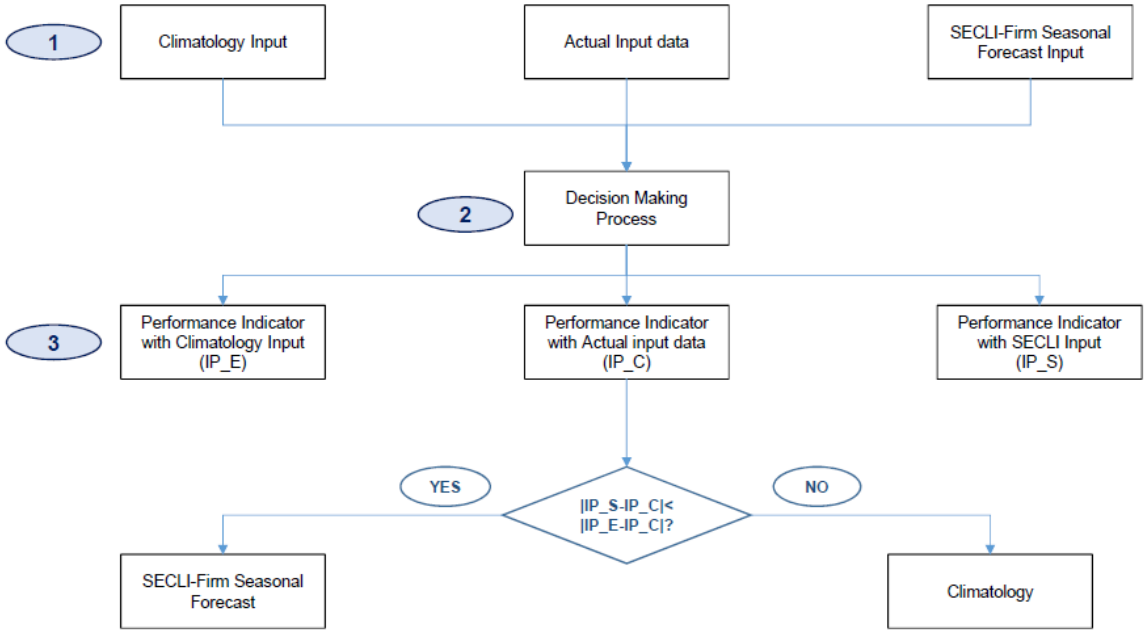
Value assessment of seasonal forecasts

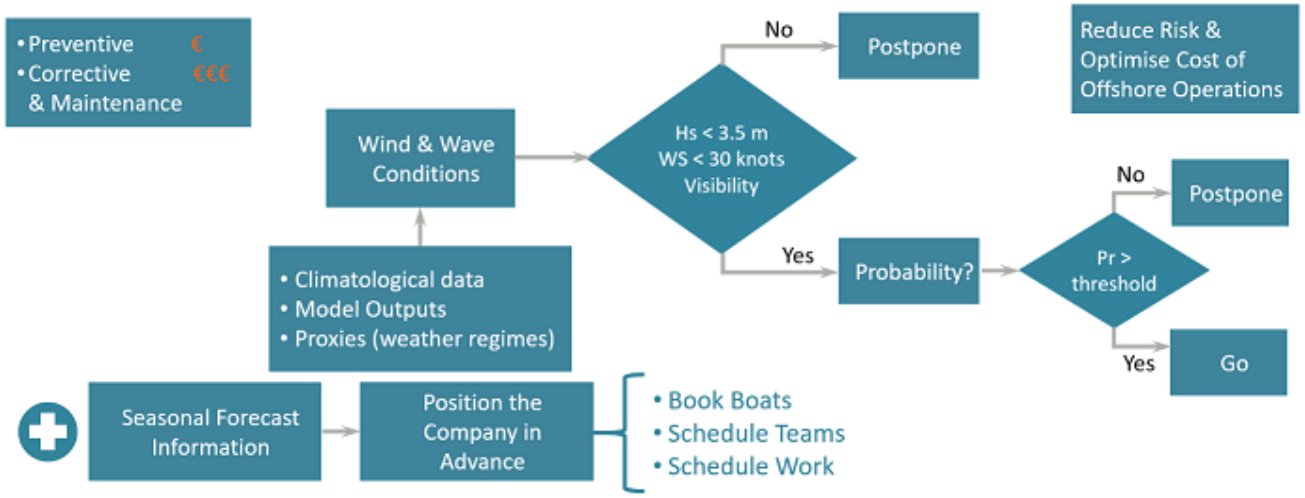


A control case only utilises climatological conditions based on historical averages, while a test case also considers individually optimised and tailored state-of-the-art probabilistic seasonal forecasts

Grant Agreement n. 776868

Close interaction with users to build decision trees



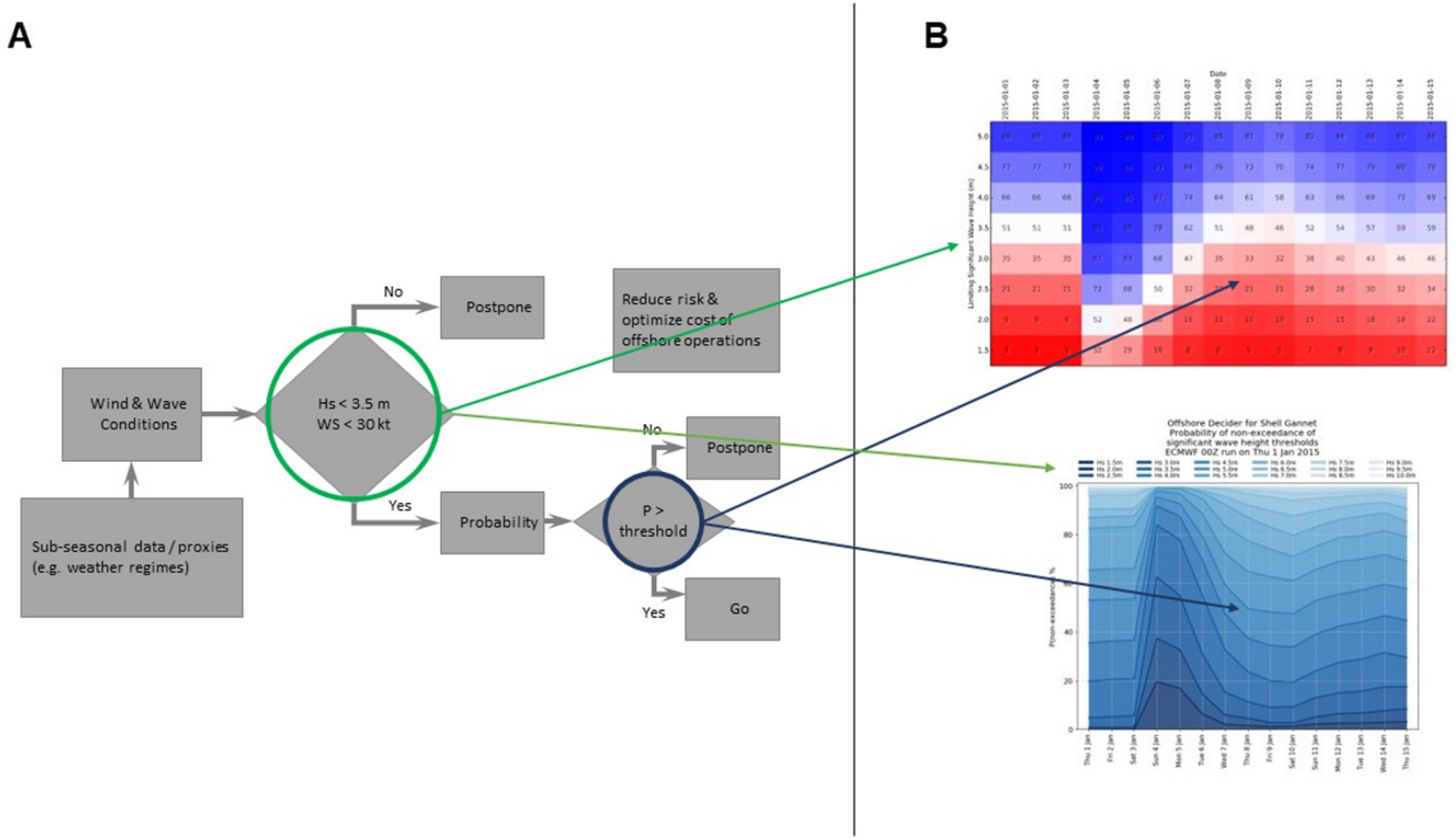


Grant Agreement n. 776868

Wind and wave height prediction for offshore operations & management

Decision making

- This climate service supports the decisions defined in a typical offshore industry decision tree
- The visualisation is kept simple to allow flexibility in adapting the service and its delivery

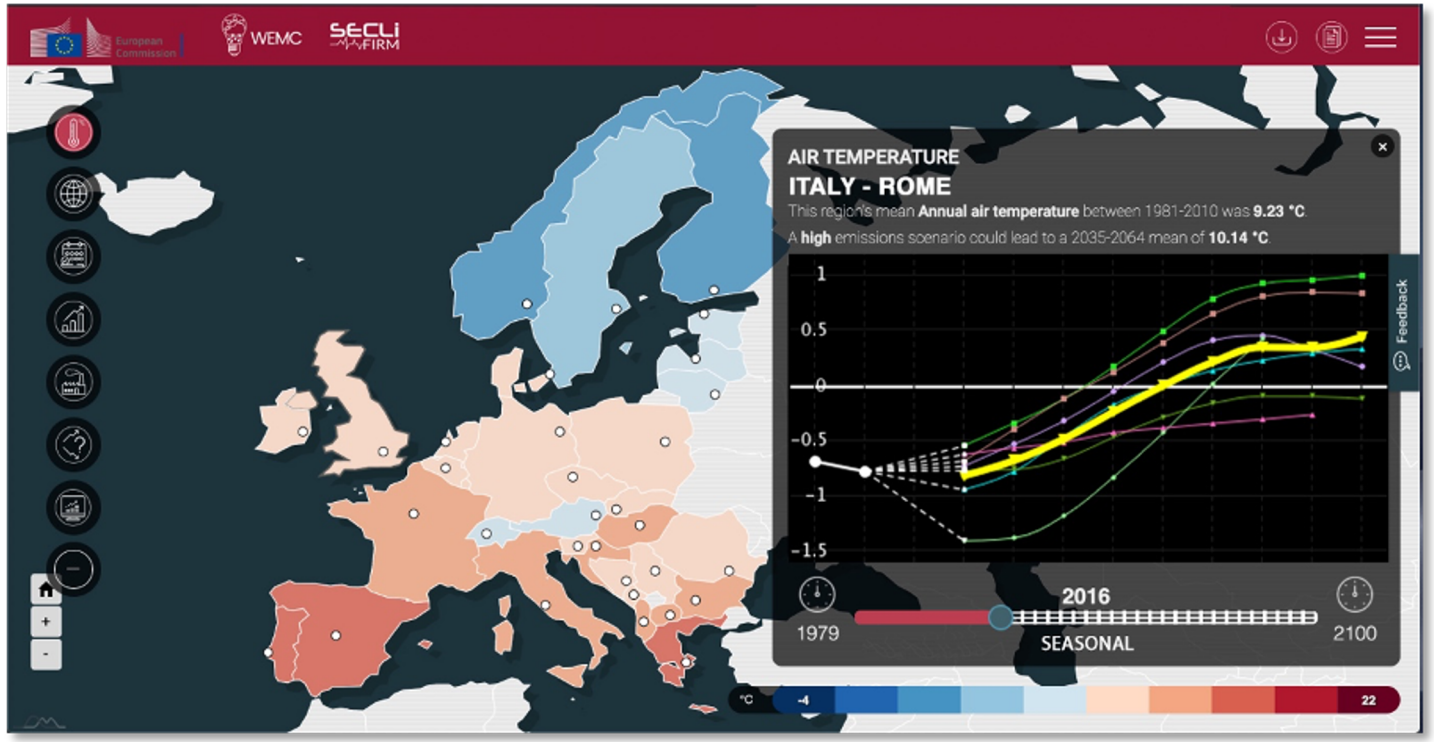


Grant Agreement n. 776868

Climate visualisation tool for energy trading

Map and graph view

- Displays historical to modelled seasonal forecast data on a world map at country level
- Ability for different spatial resolution views on pre-determined areas of interest (cities and market zones)
- Functionality for session recall as saveable ‘presets’
- It will also display different seasonal forecast models



Mobile version

- Identical to desktop tool but with adapted functionalities

Grant Agreement n. 776868

Case Study Flyers

Case study 1
Heat waves in southern Europe and energy generation

Focus: Heat waves in southern Europe for energy generation and demand

Boosting decision making

- The main objective of this case study is to illustrate the benefits c products for the identification of extreme summer heat waves power system.
- How can ENEL effectively manage the risks associated with extr

The seasonal forecasting context

- This case study focuses on seasonal forecasts of surface tempe extreme summer weather such as occurred in Italy in July 2015.

Sectoral challenges and opportunities

- Electricity price dynamics associated with air conditioning demar production).
- Power price management and hedging of generation portfolio – v
- How are market and asset portfolio decisions affected by the (un)a plant cooling?
- Accommodating enhanced demand model uncertainty due to ext

SECLi FIRM Grant Agreement n. 776868

Case study 2
Dry winters in northern Italy and energy generation

Focus: A mild, dry winter 2015/16 due pressure system over the Mediterranea France - the impacts on energy genera

Boosting decision making

- The main objective of this case study is to illustrate the benefits products to identify winter conditions in the Alps and Apennines
- How can ENEL and Alperia effectively manage the risks associa

The seasonal forecasting context

- This case study focuses on seasonal forecasts of precipitation a forecasts of precipitation and snow pack will be used to forecast of potential energy stored by snow and ice.

Sectoral challenges and opportunities

- Power price management and hedging of generation portfolio –
- Prediction of gas price movements in a context of low hydroelec demand net of total renewables.
- Optimising efficiency in hydropower production management (Al

SECLi FIRM Grant Agreement n. 776868

Case study 3
Wind strength variability in Italy and energy generation

Focus: During the first days of March 201 variability in the wind regime over Italy synoptic systems over the Mediterran implications for supply-demand balance

Boosting decision making

- The main objective of this case study is to illustrate the benefits of products to identify variability in the wind regime that impacts on th
- How can ENEL effectively manage the risks associated with extrem

The seasonal forecasting context

- This case study focuses on seasonal forecasts of strong wind event A challenge is the time sampling of such events that is usually short for temporal downscaling of seasonal forecasts will be investigated

Sectoral challenges and opportunities

- Power price management and hedging of generation portfolio – wh
- Managing variable wind power production in a multi-asset system h

SECLi FIRM Grant Agreement n. 776868

Case study 4
High/low winds in Spain and energy generation

Focus: Sustained high and low wind s energy generation in high penetration m

Boosting decision making

- The main objective of this case study is to illustrate the benefits of products to predict energy production in markets with high penetra

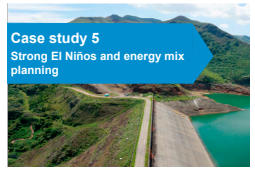
The seasonal forecasting context

- This case study focuses on demonstrating the impact of using winc for a big utility with multiple generation assets of different technolo such forecasts, the case study will explore the value of this inform

Sectoral challenges and opportunities

- To know in advance the expected energy production from renewat the generation with conventional plants.
- When will I need higher generation from nuclear or gas plants? Ho complement the wind energy? Can I reduce my fossil fuel costs by optimize the operation of my energy assets to increase my revenu

SECLi FIRM Grant Agreement n. 776868



Case study 5
Strong El Niños and energy mix planning

Focus: Strong El Niños in a South Ameri mix planning

Boosting decision making

- The main objective of this case study is to illustrate the benefits o products to predict the expected amount of flow of the hydro reso
- As a complementary study, the case study will estimate how an o technologies can be achieved in Colombia. This could help to ov such as strong El Niños when relying on a single energy source.

The seasonal forecasting context

- This case study focuses on demonstrating the impact of using sea big utilities with a large proportion of hydro power in their portfolio

Sectoral challenges and opportunities

- To plan the future hydro resources during El Niño-La Niña events
- To buy fossil fuels options in advance at lower prices to compens
- To design a future energy mix adapted to the local climate variabi

SECLi FIRM Grant Agreement n. 776868 www.secli-firm.eu

Case study 6
North Sea wind and wave impact on maintenance planning and logistics

Focus: North Sea wind and wav for maintenance

Boosting decision making

- The main objective of this case study is to illustrate the applica the use of vessels for offshore maintenance or supply operat

The inter-seasonal to seasonal forecastin

- For offshore maintenance planning meteorological parameter height and mean wave period are important. This case stu forecasts of wind (at 10m up to 100m height), and wave (m conditions in the North Sea, from a climatological and foreca
- This case study will assess the skill and value of forecasts of possible (i.e. at long-lead times beyond 15 days ahead).

Sectoral challenges and opportunities

- Optimising the scheduling of vessel hire and personnel mana operations and maintenance planning.
- When should the vessel hire take place, and for what period, specific offshore operation that is scheduled within the summ

SECLi FIRM Grant Agreement n. 776868 www.secli-firm.eu

Case study 7
Energy logistics: wind and wave conditions

Focus: Wind and wave conditions during s months in the North Sea and energy logisti

Boosting decision making

- The main objective of this case study is to illustrate the application of ic than that typically used by the offshore oil and gas industry) to identify and spring months, facilitating earlier decision-making and reduced energy sector.

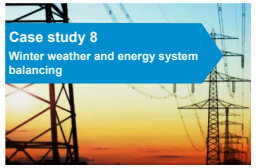
The seasonal forecasting context

- Seasonal forecast evaluation will consider the skill of predicting calm w (September to November) and spring (March to May) months in the No 2018.
- This will be illustrated from the point of view of the Asset Manager or M operations such as those involving drilling, large infrastructure installati

Sectoral challenges and opportunities

- The expense of working in the offshore environment places special em reduce supply chain costs, such as those related to vessel charter and efficient operational planning.
- At present, the application of the latest weather science developments industry is traditionally very conservative, with limited use of fortnig outputs, or even climate projections and teleconnections.

SECLi FIRM Grant Agreement n. 776868 www.secli-firm.eu



Case study 8
Winter weather and energy system balancing

Focus: The use of seasonal forecasts Grid Operator

Boosting decision making

- The main objective of this case study is to illustrate the benefits of better predict the UK winter mean electricity demand and wind po

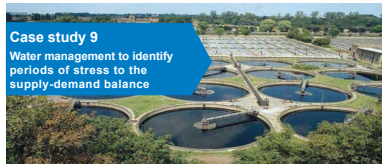
The seasonal forecasting context

- This case study focuses on demonstrating the impact of using seasor circulation forecast information for the United Kingdom (UK) Natior
- The climate forecasts will be translated into energy information, to demand and wind power.

Sectoral challenges and opportunities

- The grid network has a central role to play in the future energy mix. National Grid is working to meet ambitious low carbon energy targ the people who use them, and find innovative ways to enable the c
- Ahead of each winter, the UK grid operator must estimate the dem particular focus on peak electricity demand. This is to ensure there to meet this demand.
- By identifying potential risks to the system ahead of the winter, we reduce balancing costs over the winter period.

SECLi FIRM Grant Agreement n. 776868 www.secli-firm.eu



Case study 9
Water management to identify periods of stress to the supply-demand balance

Focus: The use of seasonal forecasts for water management to identify periods of stress to the supply-demand balance

Boosting decision making

- The water industry case studies will explore the application of seasonal forecasting to identify periods of stress to the UK supply-demand balance. These seasonal signatures may highlight chronic or acute periods of stress many weeks out, which will affect the operational management of the water system and the experience of the consumer through supply restrictions.

The seasonal forecasting context

- This case study will explore the ability to identify periods of chronic stress (prolonged excessively high demand driven by either leakage or consumption). Climatologically, these will include conditions indicative of dry and hot summers, or drought conditions, or peaks in demand due to long periods of below average winter temperatures. If such conditions were predictable at seasonal timescale, it would help to flag high demand and support preparedness in terms of capacity and demand management.
- This case study will also explore the ability to identify acute stress (highly variable demand) including heat waves or extremely cold and/or freeze-thaw conditions. If such conditions were predictable at medium/seasonal timescale, it would help flag high variability in demand and support preparedness in terms of resilience.

Sectoral challenges and opportunities

- The United Kingdom (UK) water supply market operates within the private sector comprising of a number of autonomous water companies. The sector is overseen by the Office of Water Regulation (OFWAT), which focuses on consumer regulation. The Environment Agency focuses on environmental regulation. The water businesses constantly balance supply of raw water with demand. Both supply and demand have a significant dependency on the weather.
- By timely identification of potential risks, we will explore whether it is possible to secure customer supply and optimise operational costs.

SECLi FIRM Grant Agreement n. 776868 www.secli-firm.eu

http://www.secli-firm.eu/case-studies/

University of East Anglia · enel · ENEA · METEO FRANCE · Met Office · UL · WEMC World Energy & Meteorology Council · eurac research · alperia

Grant Agreement n. 776868

Climate Services for the Hydropower Sector

AGENDA

Introduction
Alberto Troccoli (UEA/WEMC)
5 min

Runoff seasonal forecast in alpine catchments: a SECLI-FIRM case study
Mattia Callegari (EURAC)
12 min

Seasonal forecast of hydro resources in Colombia during strong El Niño events: a SECLI-FIRM case study
Kristian Nielsen (UL)
12 min

Smart Climate Hydropower Tool: An AI-based service for hydropower production seasonal forecast
Paolo Mazzoli (GECOsistema)
12 min

Q&A + Poll – 15 min

Climate Services for the Hydropower Sector

Q&A

1. Q for Mattia: you compared with benchmark climatology runoff. How would your methodology compare with runoff predicted directly by MME seasonal climate prediction systems collected in SECLI-FIRM?
2. Q for Mattia: Hi, I am Ignacio, Thanks for your presentation, Did you show results for just one alpine basin? did you tested this methodology in other alpine basins? Is there any relation between skill of SF and mean elevation of the catchment? Thanks.
3. Q for Kristian: results are very good. However when considering SST only (as you noted) the prediction from the MME appears to be overconfident (so not all the variability captured); so one direction for improvement appears how to better sample the uncertainty of the prediction. How do you plan to proceed in this respect?
4. Q for Paolo: Could you elaborate on the ML learning methods used? Perhaps LSTMs?
5. Q for all three presenters: It seems to me that the forecast of "extreme" low and high runoff has the most value rather than the overall fit of the true runoff curve. I would imagine a value added product when focussing more attention on trying to catch the extreme low and extreme high and rare events

Climate Services for the Hydropower Sector

Thank you for attending

For more information visit our website:

www.secli-firm.eu

Or find us on social media:

@SECLI_Firm

SECLI-FIRM: An EU H2020 project

Grant Agreement n. 776868