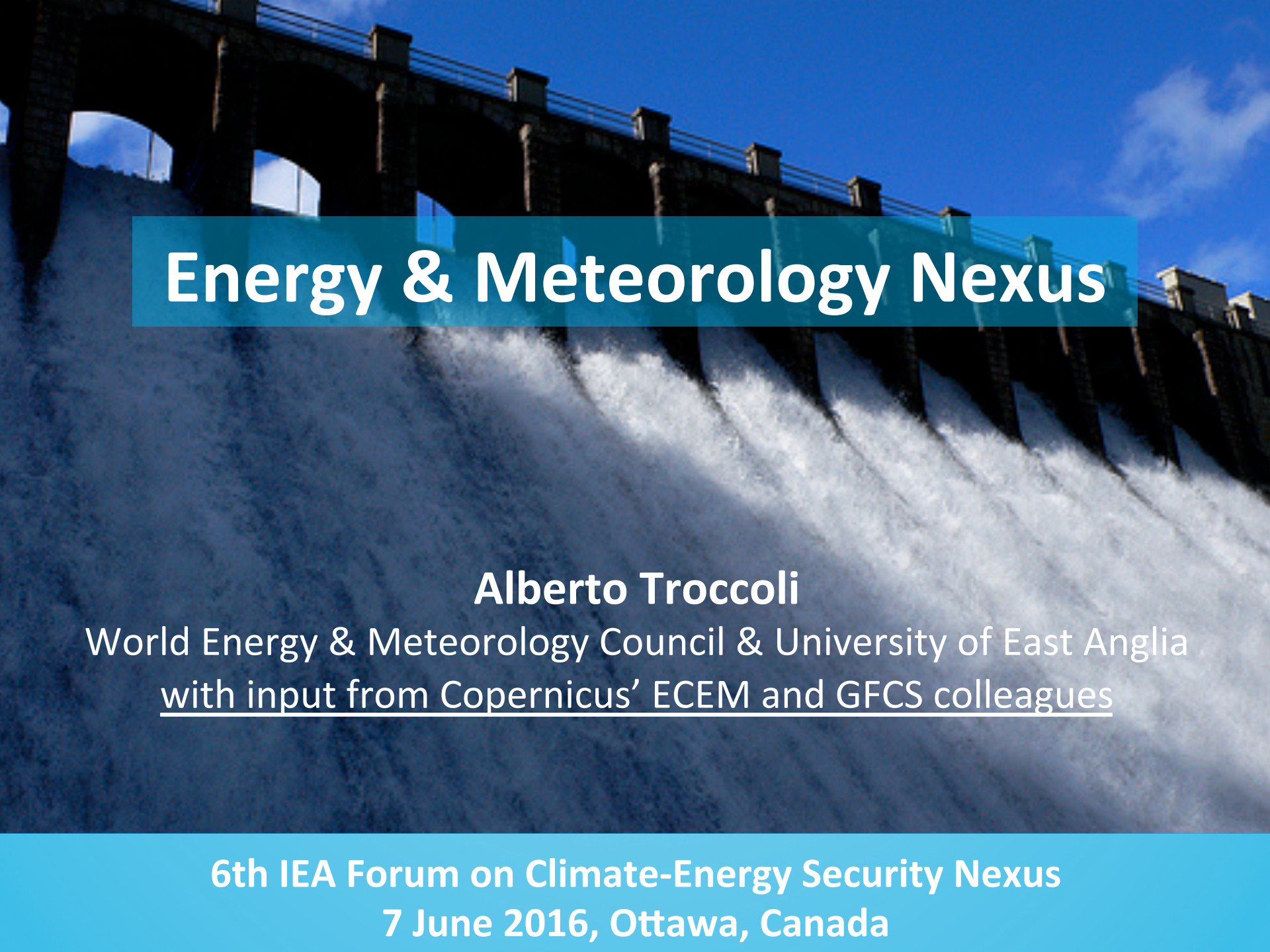
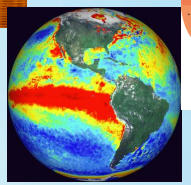


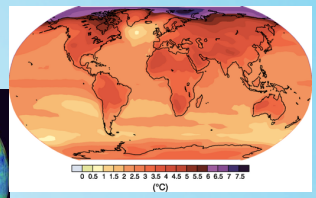
Energy & Meteorology Nexus

Alberto Troccoli
World Energy & Meteorology Council & University of East Anglia
with input from Copernicus' ECEM and GFCS colleagues

6th IEA Forum on Climate-Energy Security Nexus
7 June 2016, Ottawa, Canada

Energy & Meteorology go hand in hand





Lightning	Passing clouds	Thunder -storms	Hurricane	Drought	Heat wave	El-Niño	Long term changes
Flickering	Drop in solar power	Disruptions to energy transport	Disruptions to oil rig operations	Reduced hydro power	Changes in Demand	Mainte nance	Resource Assessment

Seconds Minutes Days Months Seasons Years Decades

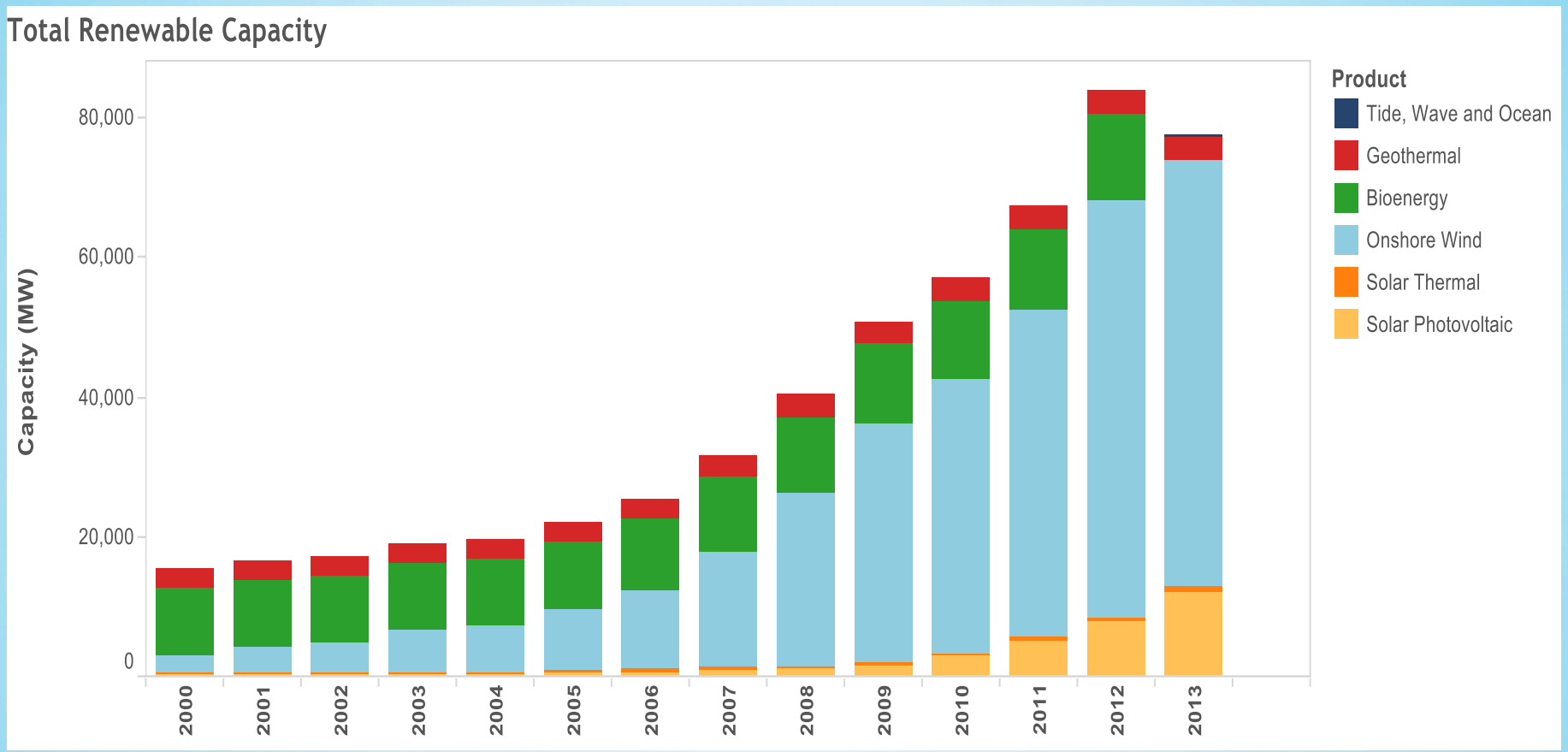
World Energy & Meteorology Council

The Energy industry has a multi-decadal experience in dealing with meteorological variables, so what's the big deal?

The landscape, in both climate and energy spaces, is changing rapidly

World Energy & Meteorology Council

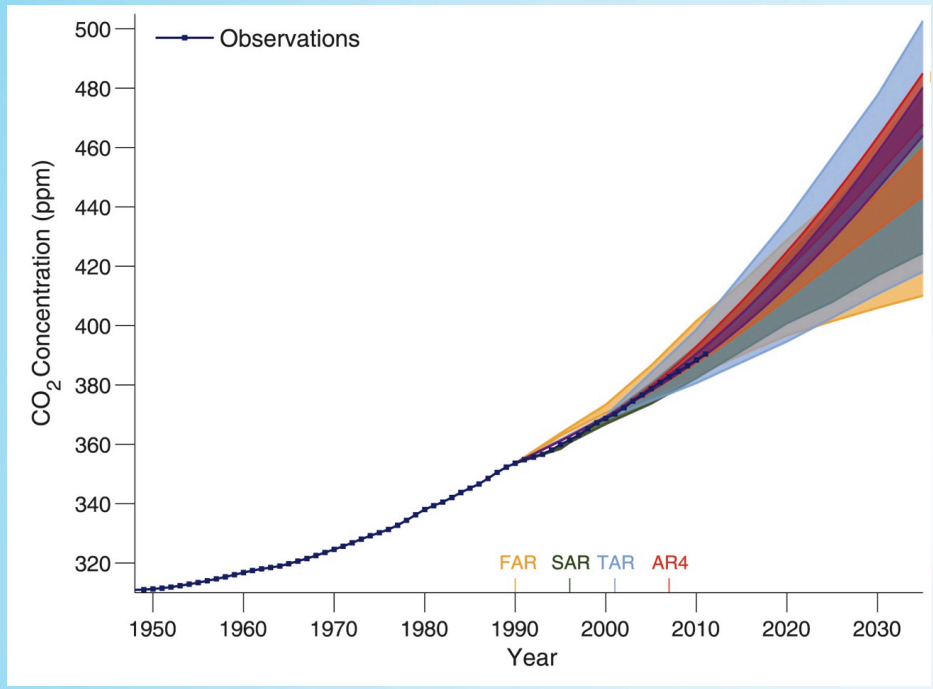
Strong growth in renewables

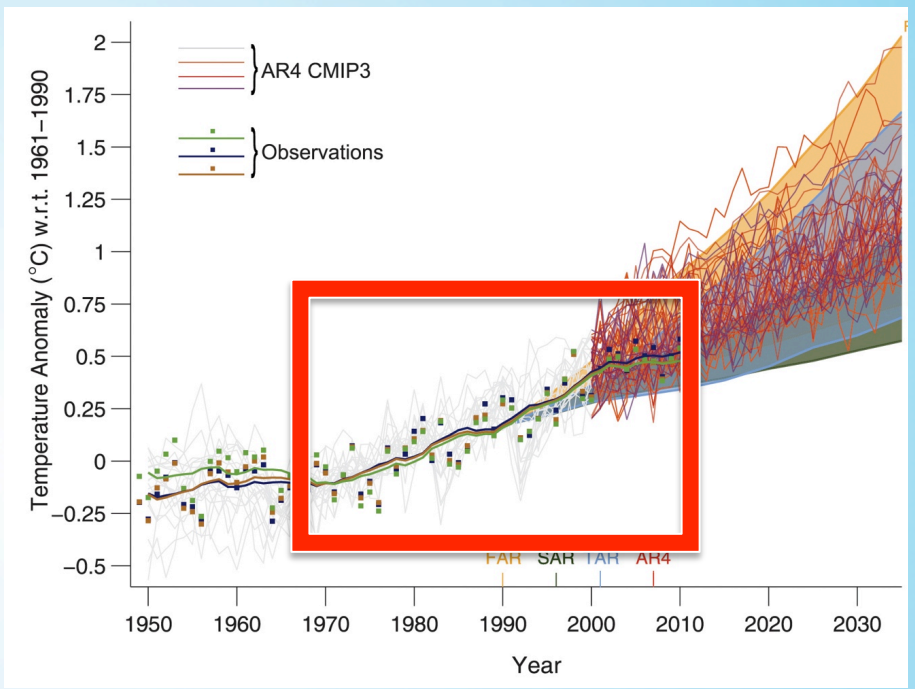


IRENA (2014)

World Energy & Meteorology Council

CO2 emissions and temperature

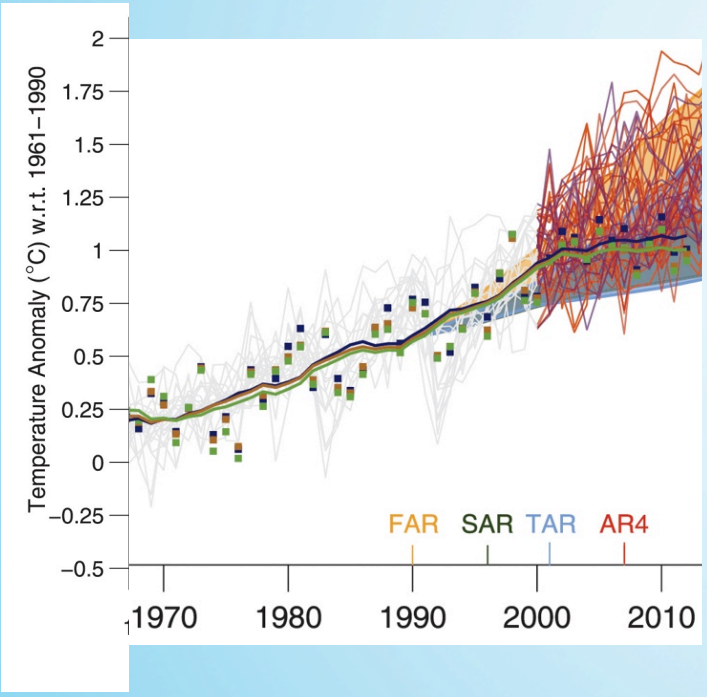


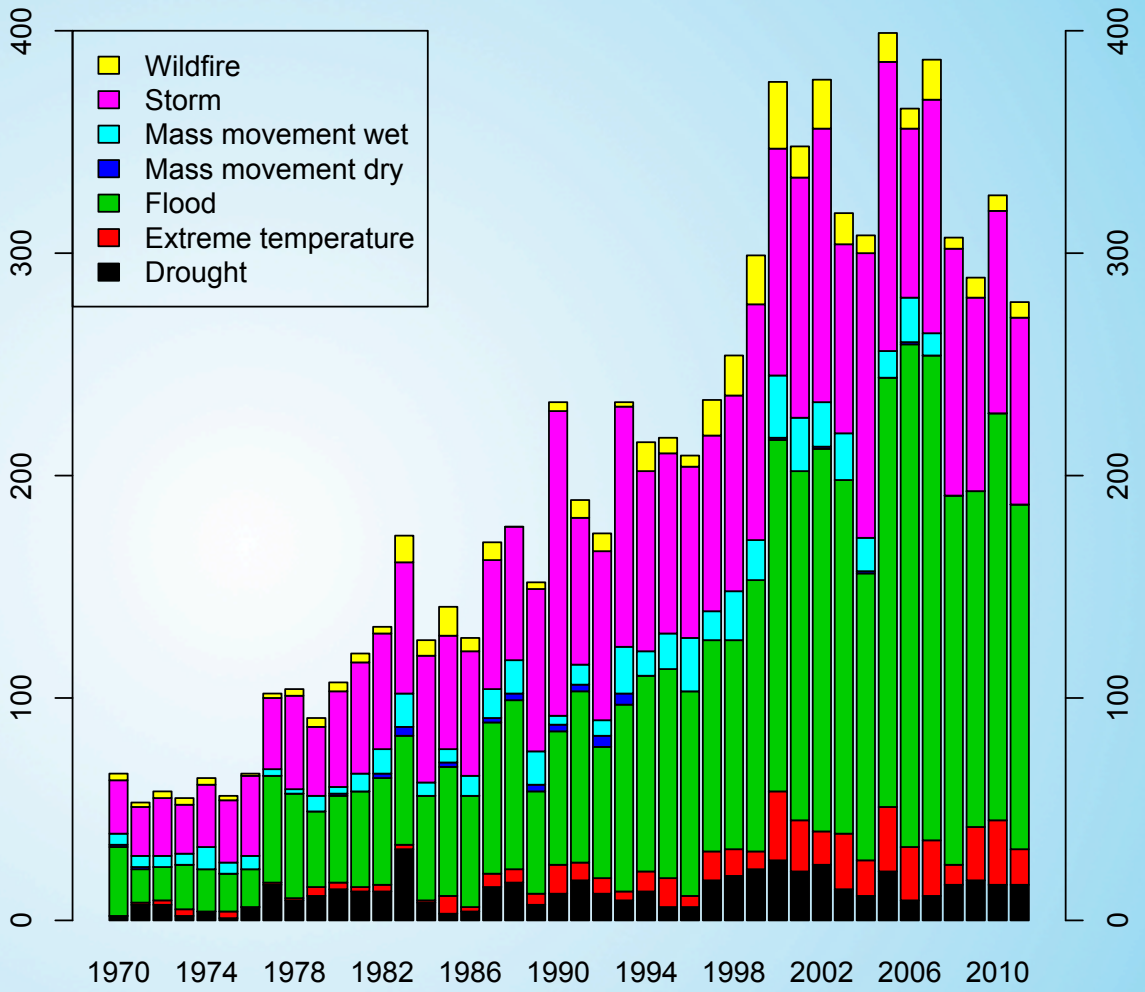


IPCC AR5 (2013)

World Energy & Meteorology Council

Disasters due to natural events





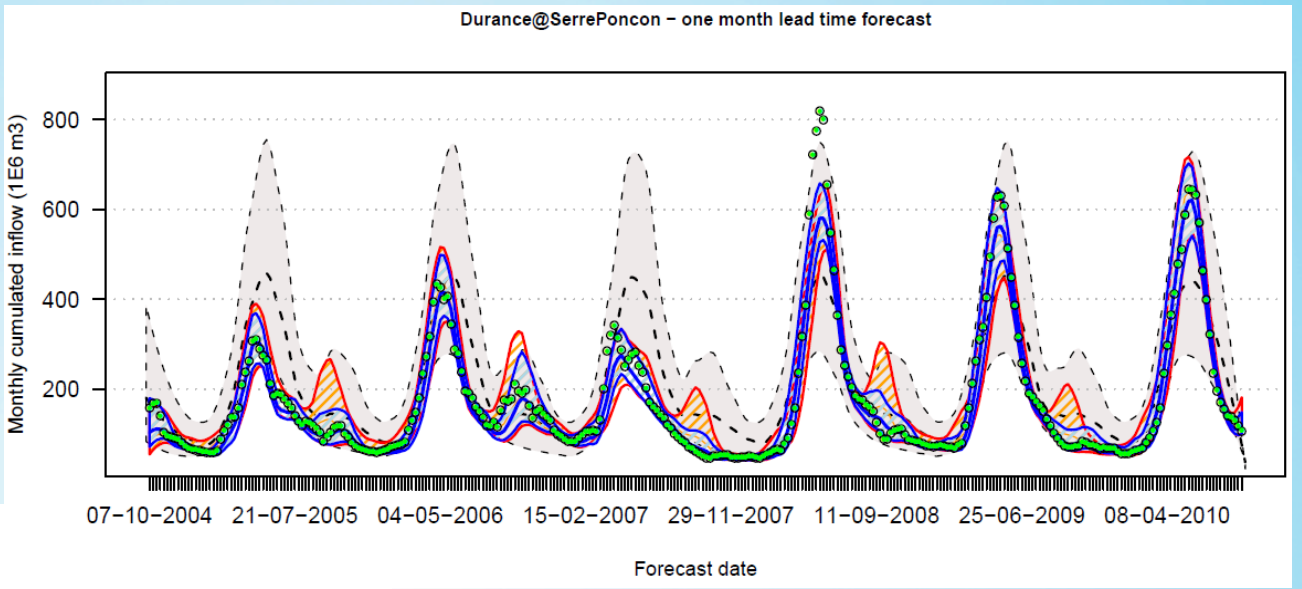
EM-DAT (2012)

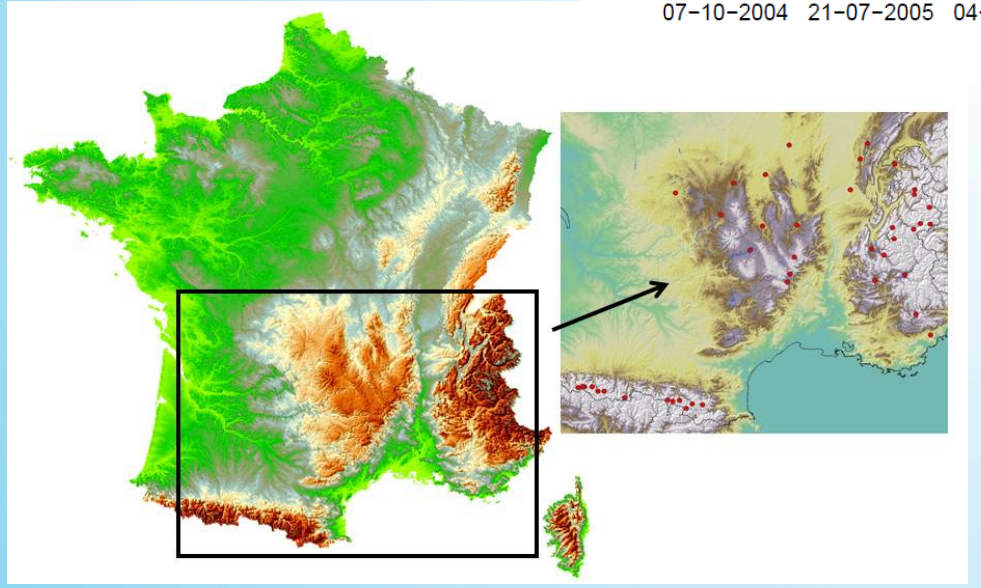
World Energy & Meteorology Council

Addressing the ever variable nature of climate

World Energy &
Meteorology Council

Monthly forecasts for hydro power in France





Hydropower represents 20.6% of EDF's installed capacity in France and provides very attractive flexibility during peaks in demand. Forecasts of river flow and water stocks are therefore crucial for the managers of the system.

World Energy & Meteorology Council

Dubus (2014)

European Climatic Energy Mixes (ECEM)

Copernicus
Europe's eyes on Earth

Climate Change Service
climate.copernicus.eu

Calibrated Climate Variables

- Temperature
- Rainfall
- River Discharge
- Wind Speed
- Cloud Cover
- Solar Radiation
- Others ?

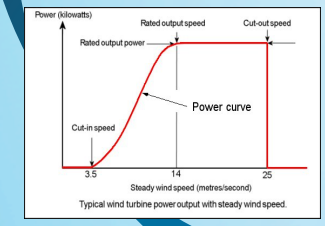
+Ancillary

- Skill & Reliability
- Assessment of Seasonal Forecasts of Energy Variables

+ Extreme Events Case Studies

Impacts of Climate Variability & Change on Energy Variables

Define models & transfer functions
Select / Gather relevant datasets

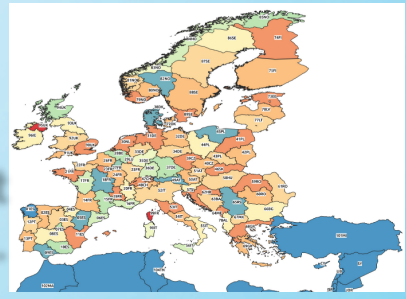


Typical wind turbine power output with steady wind speed.

Energy Variables

- Demand
- Hydro Power
- Wind Power
- Solar Power
- Thermal Power

- Sub-Country Scale
- Historical Period
- Seas. Fcst
- Clim. Proj.



World Energy & Meteorology Council

UEA University of East Anglia

EDF

University of Reading

Met Office

MINES ParisTech ARMINES

ENEA

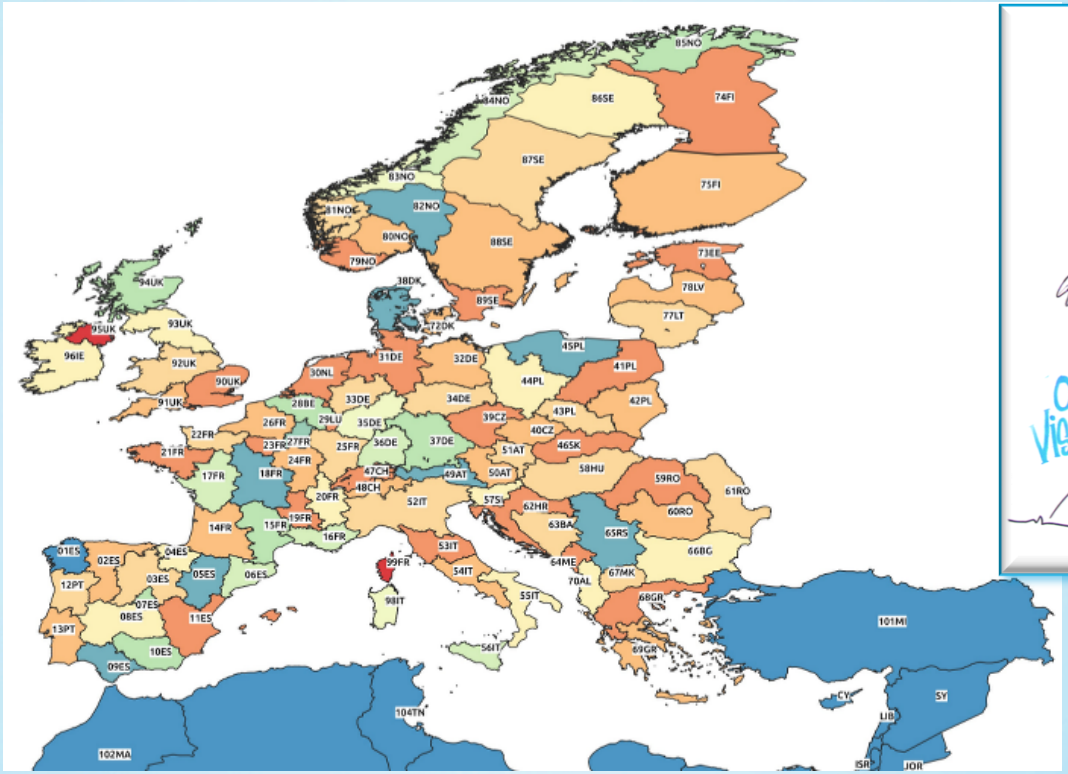
ECEM Demonstrator Mock up

Copernicus
Europe's eyes on Earth

Climate Change Service
climate.copernicus.eu

Climate variables | Energy variables

- Historic
- Seasonal Forecasts
- Decadal Projections



Using the demonstrator | Methods & assumptions | Key messages & pre-prepared graphics | Case studies

World Energy & Meteorology Council

UEA University of East Anglia

EDF

University of Reading

Met Office

MINES ParisTech ARMINES

ENEA

Harmonising meteorological information to effectively tackle energy resilience

World Energy &
Meteorology Council

A lot of expert knowledge around …

- IEA Wind and Solar Heating & Cooling Tasks
- WMO Commission for Climatology
- IRENA
- World Bank
- EU-Copernicus
- American/European Meteorological Society
- ESIP-FED
- …

World Energy & Meteorology Council

… but how can one

① Navigate the system?

② Be re-assured the information available can be trusted?

③ Obtain better access to data?

World Energy & Meteorology Council

GFCS is a UN-led initiative which provides a worldwide mechanism for coordinated actions to enhance the quality, quantity and application of climate services.

Energy has been recently adopted as a priority area

See draft of Energy exemplar at:
http://gfcs.wmo.int/sites/default/files/2015.10.27 IBCS MC-3-d05-2-REV1-Energy Exemplar-Approved_en.docx

World Energy & Meteorology Council

http://gfcs.wmo.int/

GFCS–Energy Implementation

- Final endorsement of the exemplar by IBCS MG
- Stakeholders interface platform
  - Coordination and implementation support
  - Partnership with Energy organizations such as IEA, IRENA and WEC and boundary institutions such as WBCSD and WEMC
- Compilation of tools and methods, fill gaps
- Applied work and demonstrations in specific regional and market contexts
  - E.g. proposal preparation for GCF

World Energy & Meteorology Council

Areas of Focus for Energy

1. Identification & Resource Assessment
2. Impact assessments (incl. infrastructure and environment)
3. Site Selection & Financing
4. Operations & Maintenance
5. Energy Integration
    - ✓ Market trading (incl. supply and demand forecasts) & Insurance
    - ✓ Energy efficiency

World Energy & Meteorology Council

Requirements – Building Blocks

	User Interface Platform	Climate Services Information System	Observations and Monitoring	Research Modelling and Prediction
Identification & Resource Assessment	• Provide information about appropriate repositories of data and products for resource and climate risk estimation	• Historical datasets of relevant meteorological data (in situ, satellite-derived and model-based) and related metadata	• In situ, and satellite-derived meteorological data for assessment of resources and risks	• Improvement of observation instrumentation • Improvement of satellite retrieval and conversion algorithms
Impact assessments	• Identify relevant meteorological and climate phenomena for specific infrastructure	• Historical datasets and climate analyses of extreme events	• High-grade in situ data • Air quality and gas emission database	• Characterization of extreme events and probabilities, return periods, probabilities of occurrence, exceedance

← CAPACITY DEVELOPMENT AND SUPPORT →

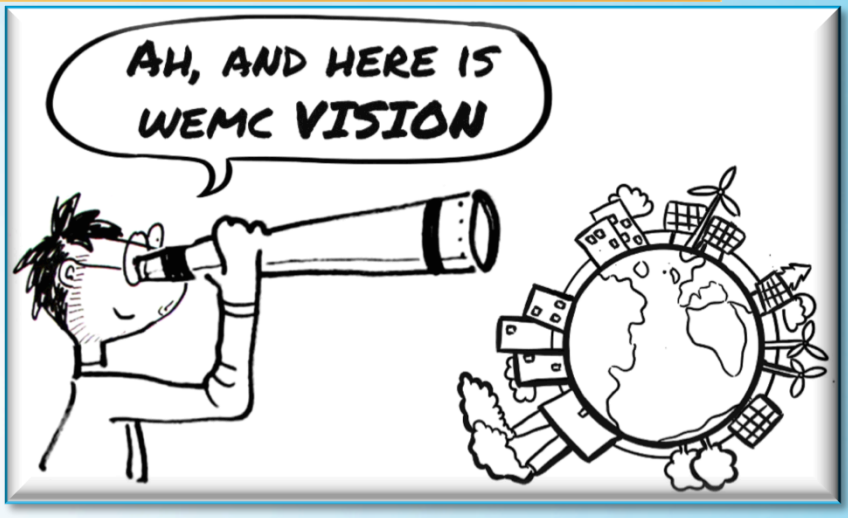
World Energy & Meteorology Council

- WEMC's primary goal is to enable improved sustainability, resilience and efficiency of energy systems under ever changing weather and climate
- WEMC is based at the University of East Anglia (UEA) in the UK

World Energy & Meteorology Council

http://www.wemcouncil.org/

World Energy & Meteorology Council



- To **enhance productivity and policy formulation** for the energy industry through a close collaboration
- To achieve **improved adoption** of weather, climate and other environmental information by the energy industry towards more efficient and sustainable risk management practices
- To **maximize the exchange of** weather, climate and other environmental **information between developed and developing countries**

Take away messages

- Energy and Meteorology are closely **connected**
- Energy systems are already experiencing **sizeable impacts**, which are likely to become more severe
- There is a strong need:
  - to **improve knowledge** of meteorological data and processes
  - to **provide trusted information** to the energy industry through coordination efforts
  - to **improve access** to meteorological, and possibly energy, data

World Energy & Meteorology Council


Thank you