



NextData WP2.5

Archivio digitale di dati numerici e previsionali



Proiezioni climatiche future in regioni montane

CMCC, ENEA, ISAC-CNR

- Costruire un archivio dei risultati di simulazioni climatiche globali, regionali e locali, sia già esistenti sia effettuate durante il progetto.
- Produrre proiezioni di cambiamento climatico ad alta e altissima risoluzione con diverse tecniche di downscaling (dinamico, statistico, stocastico).
- Rendere disponibili i dati climatici mediante un sistema di archivi e portali tematici collegati al Portale Generale.

WP2.5 sub-project



RECCO: REgional Climate in Complex Orography



Development of ensembles of regional climate change scenarios, with focus on variability, extremes and uncertainties in areas of complex orography

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Unit2 (ICTP): Laura Mariotti, Filippo Giorgi

Unit3 (Cineca): Giovanni Erbacci

Unit4 (IMAA-CNR) Fabio Madonna

Aim: improving the physical understanding of the changes in climatological regimes in the NextData regions, with the support of their meteorological characterization

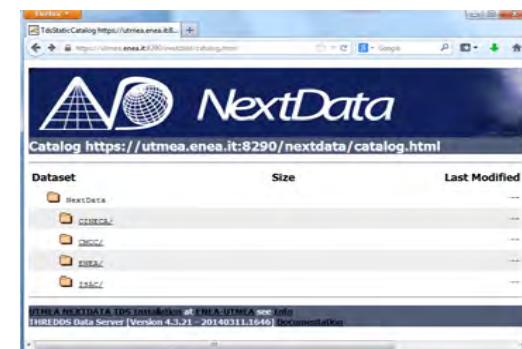
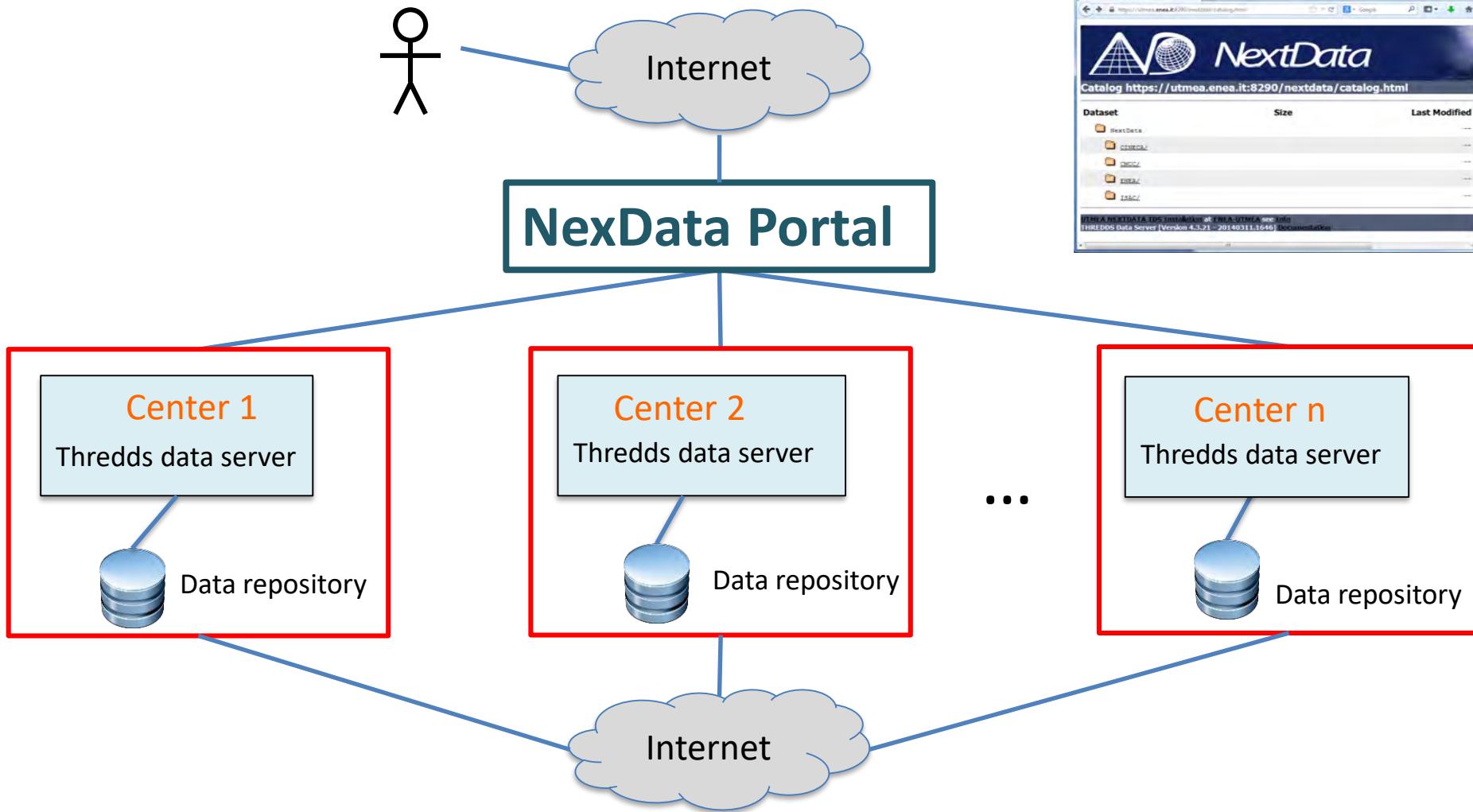
Rationale: the variability and uncertainties of climate and meteorology in the areas of interest (Alpine regions) will be studied with a suite of regional models integrated with mesoscale meteorological models. Each modelling system will be used at different spatial scales, from regional to local, yielding a unique multi-scale framework

Da dove (ri)partiamo:

- Censimento delle simulazioni numeriche globali e regionali da includere negli archivi (D2.5.1).
- Definizione dei protocolli di archiviazione dei dati numerici, della rete di sottoarchivi e delle modalità di accesso ai dati e alle procedure di trasferimento di dati di grandi dimensioni.
- Definizione e preparazione di specifici esperimenti numerici da eseguire nell'ambito del progetto: *Scientific Questions* (D2.5.2).
- Produzione di simulazioni numeriche globali e regionali mirate alle aree d'interesse del progetto.
- Costruzione archivio di dati numerici, globali e regionali con particolare attenzione per l'area Mediterranea, la regione Alpina e la regione HKKH. (D2.5.3)
- Implementazione modelli numerici a scala locale, non idrostatici, per la simulazione della dinamica climatica e ambientale in zone montane con orografia complessa.
- Downscaling statistico/stocastico e la produzione di scenari futuri ad alta risoluzione nelle aree di interesse.

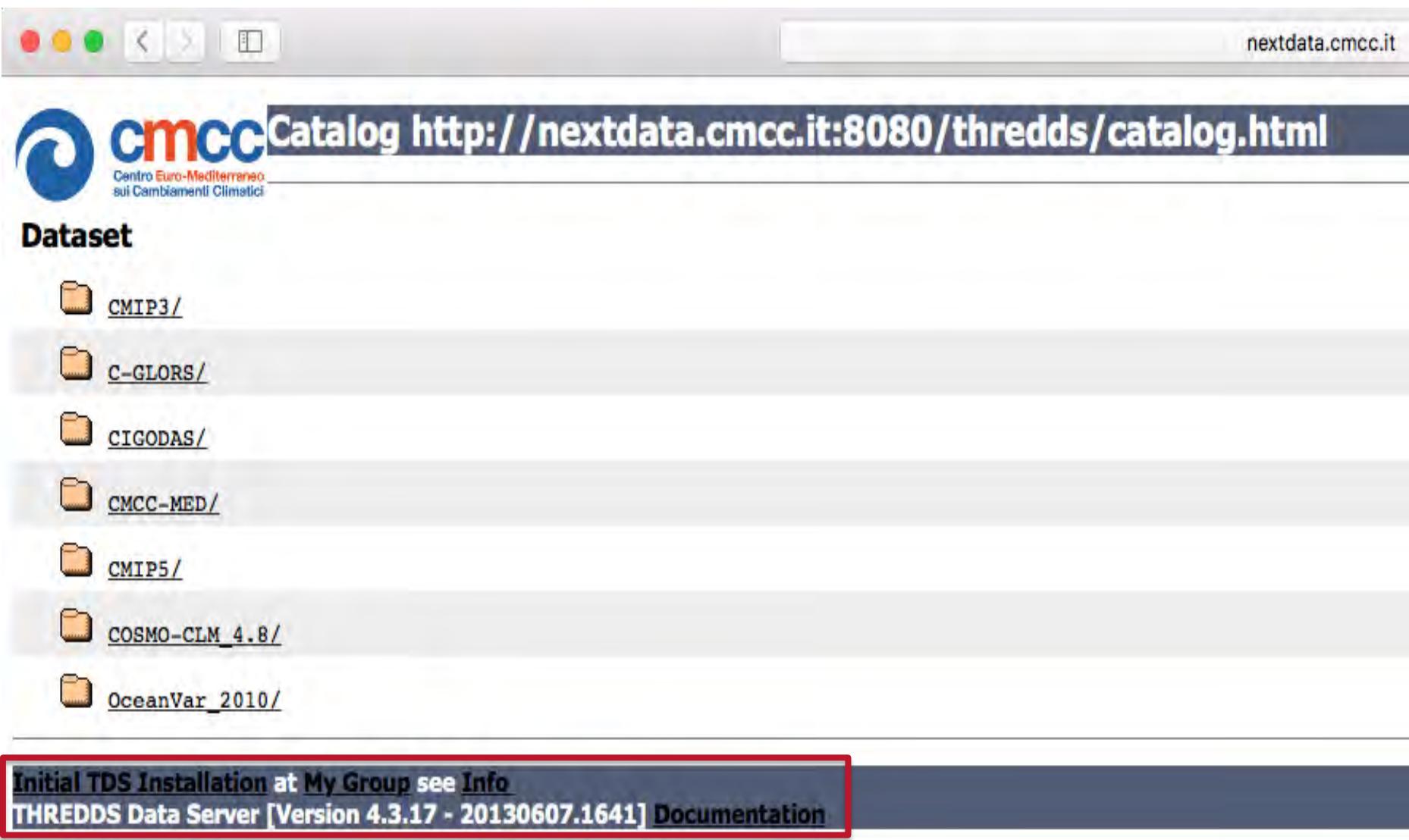
Archivi e accesso ai dati dalle simulazioni

Rendere disponibili i dati prodotti da modelli numerici (sia già esistenti sia prodotti durante il Progetto) mediante un sistema di archivi e portali tematici collegati al Portale Generale.



CMCC Thredds server

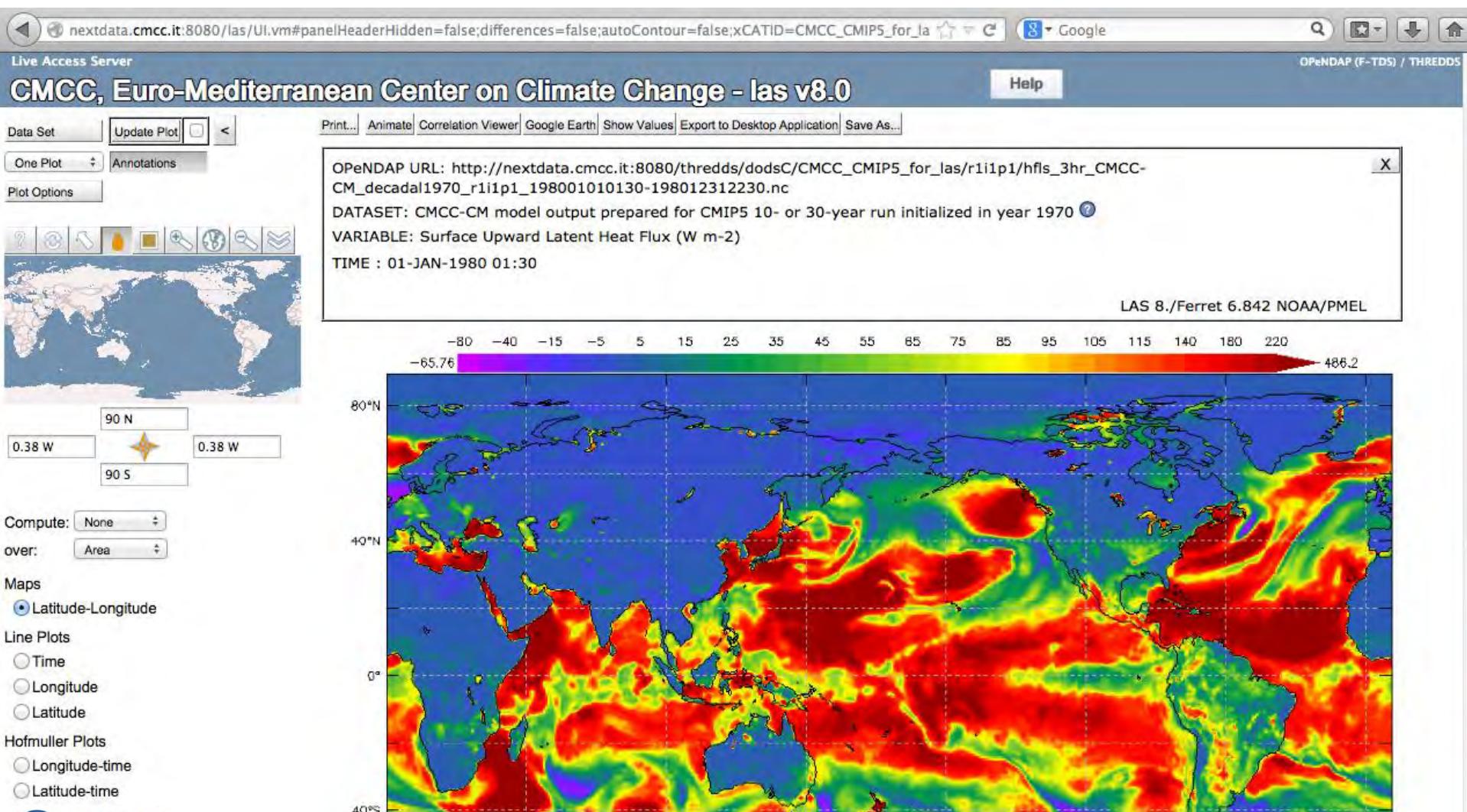
Osvaldo Marra @ CMCC Lecce



The screenshot shows a web browser window with the following details:

- Address Bar:** nextdata.cmcc.it
- Title Bar:** cmcc Catalog http://nextdata.cmcc.it:8080/thredds/catalog.html
- Logo:** cmcc Centro Euro-Mediterraneo sui Cambiamenti Climatici
- Section:** Dataset
- List of Datasets:**
 - [CMIP3/](#)
 - [C-GLORS/](#)
 - [CIGODAS/](#)
 - [CMCC-MED/](#)
 - [CMIP5/](#)
 - [COSMO-CLM_4.8/](#)
 - [OceanVar_2010/](#)
- Footer:**
 - [Initial TDS Installation at My Group see Info](#)
 - [THREDDS Data Server \[Version 4.3.17 - 20130607.1641\] Documentation](#)

CMCC LAS server: overview



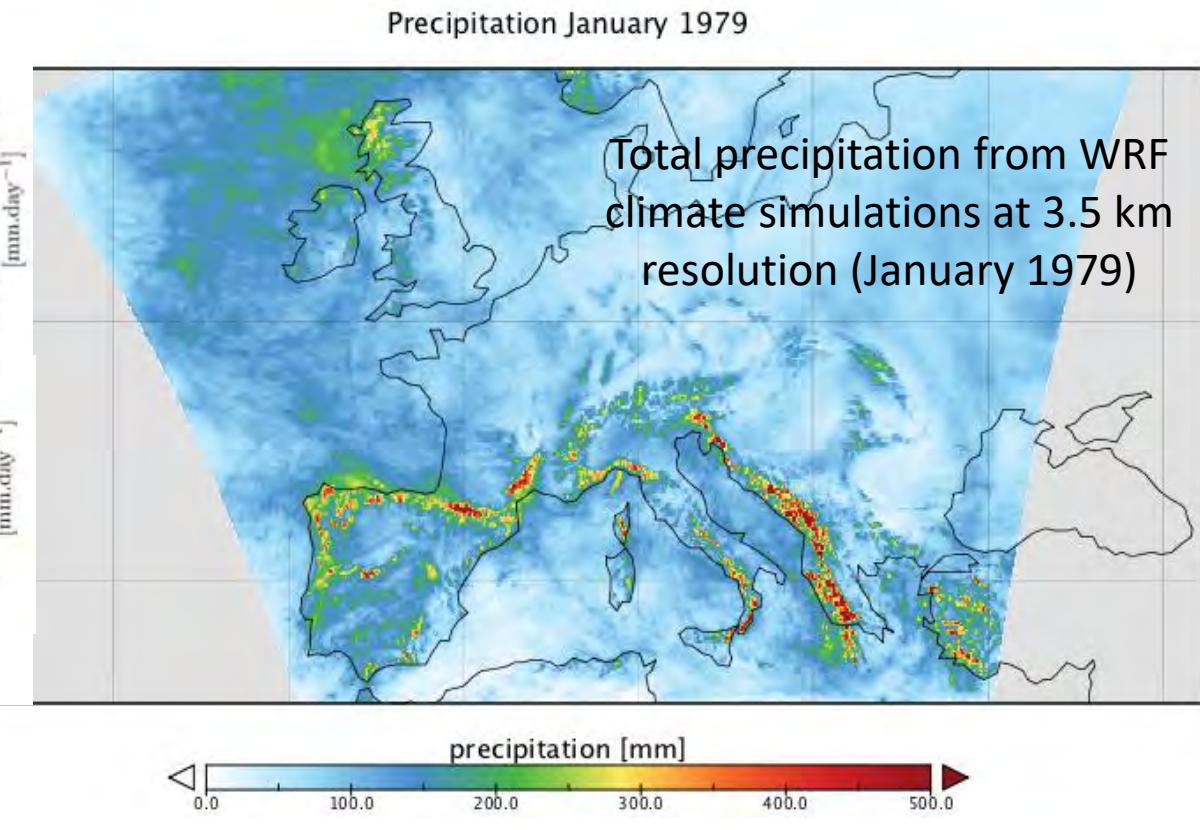
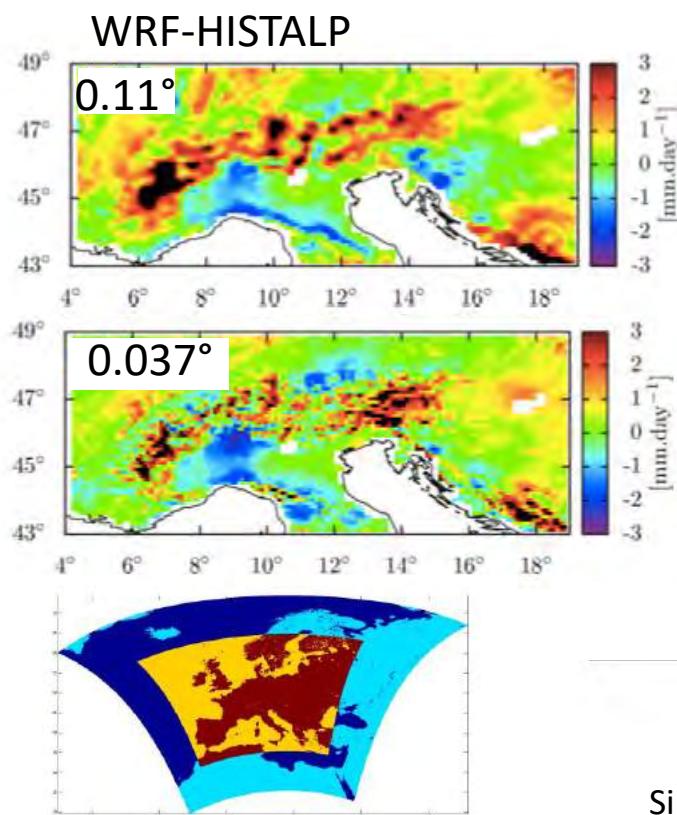
High-resolution dynamical downscaling of global scenarios over Europe

- Climate simulations with the WRF non-hydrostatic regional model for the European domain.
- Resolutions 0.11° and 0.04° .
- 30-yr present (1979-2008), large scale driver ERA-Interim at 0.04° resolution, done.
- Simulations with large scale driver EC-Earth, present-day and future RCP4.5 and RCP8.5 scenarios, at 0.11° , in progress, to be finished by the end of the year.

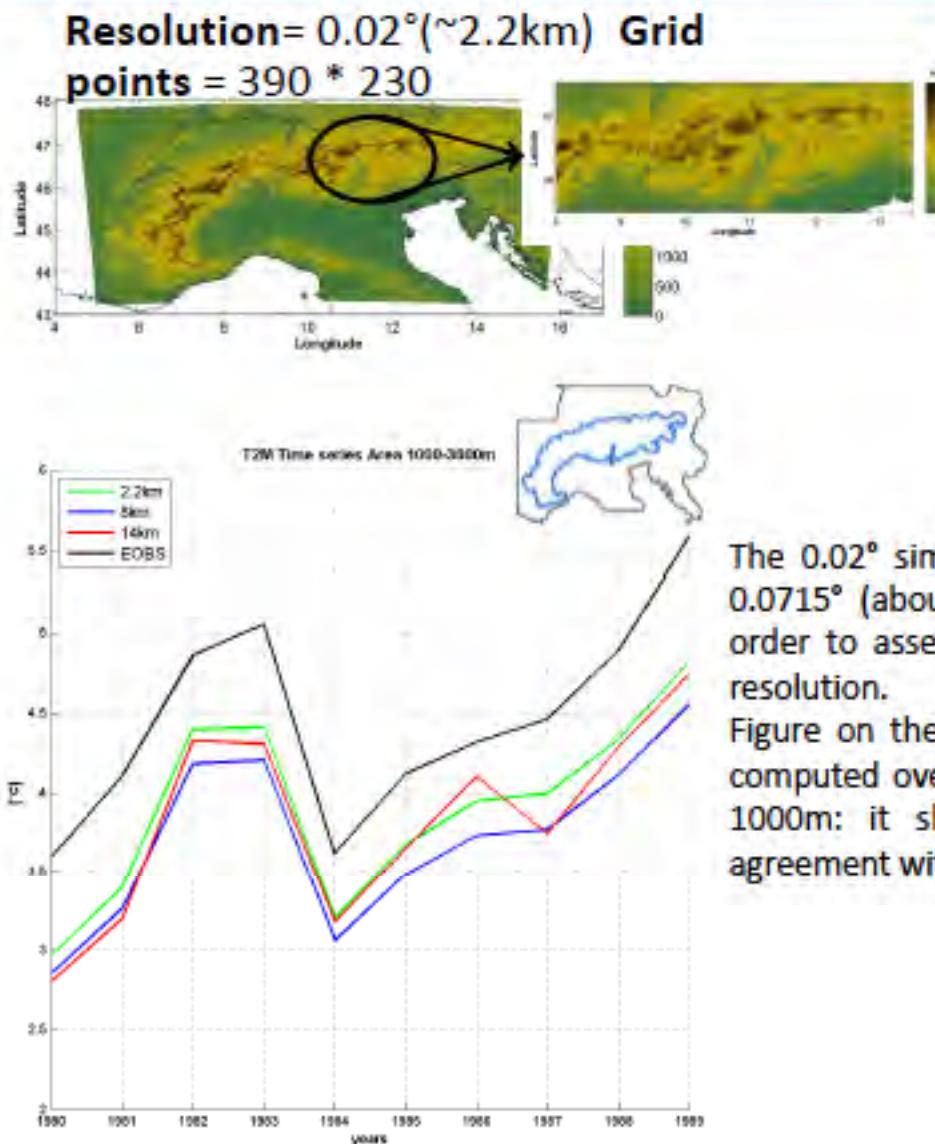


High-resolution (3.5 km) dynamical downscaling of global scenarios over Europe

- 30-yr present (1979-2008). Large scale drivers EC-Earth and ERA-Interim
- 30-yr projection (2021-2050 RCP 4.5) large scale driver EC-Earth.



Very high resolution simulation over Alpine region



A preliminary simulation at very high horizontal resolution of 0.02° (about 2.2km) has been performed over the Alpine region for the period 1979-1990 with the regional climate model COSMO-CLM.

Different observational datasets have been used for the bias assessment: E-OBS for 2-meter temperature, whereas for precipitation EURO4M-APGD and high resolution observed data provided by ARPAs of Veneto and Emilia-Romagna region.

The 0.02° simulation has been compared to previous ones at 0.0715° (about 8km) and 0.125° (about 14km) respectively, in order to assess the added value of using a so high horizontal resolution.

Figure on the left shows the 2-meter temperature time series computed over an area characterized by orography higher than 1000m: it shows that the 0.02° simulation has the best agreement with the observations.

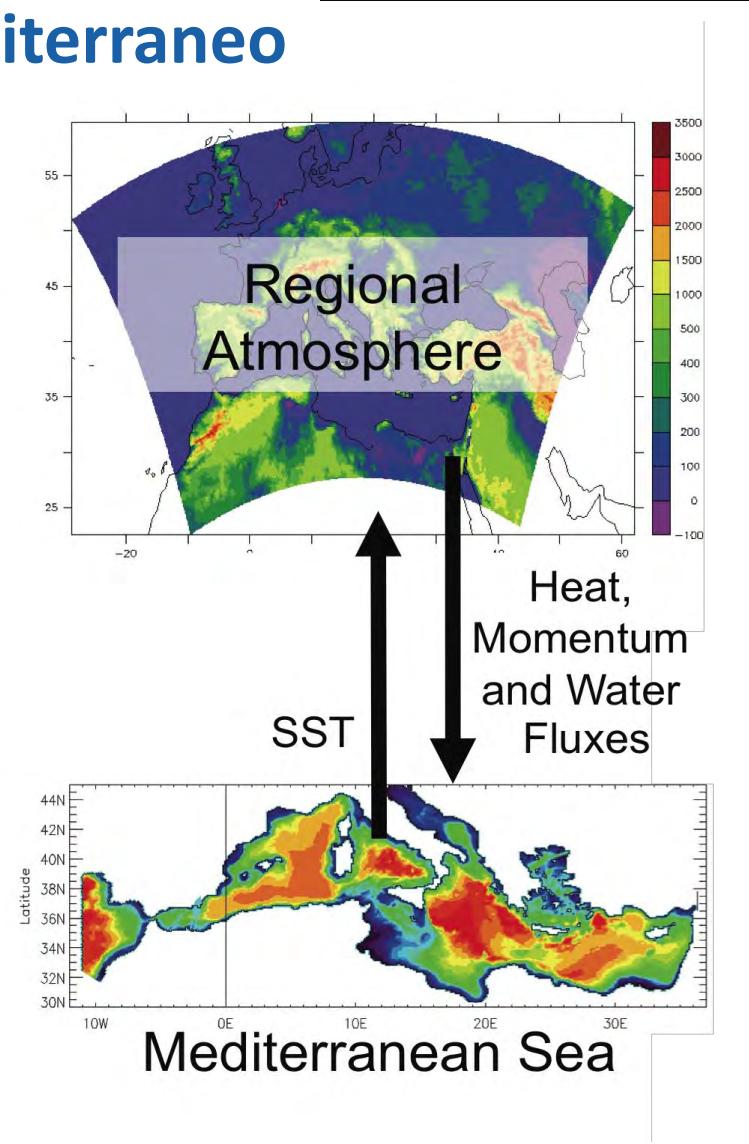
Modellistica accoppiata del Mediterraneo

Cosmo-CLM 4.8
 horizontal resolution \sim 44 km
 $\Delta t=240''$
 $nlevs=40$

MEDCORDEX domain+atlantic box

Oasis 3 CMCC parallel version
 coupling frequency 4800''

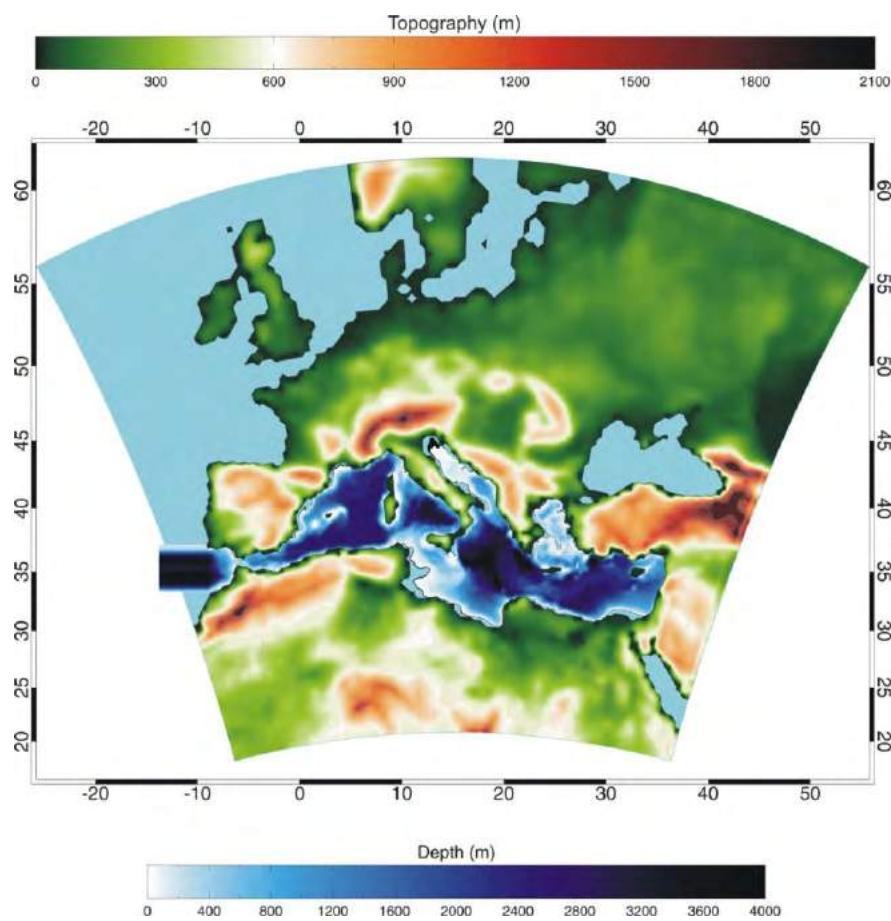
Nemo 3.4 (MFS)
 horizontal resolution 1/16
 $\Delta t=600''$





Modellistica accoppiata del Mediterraneo

ENEA-PROTHEUS 1.0



Model components

RegCM3

18 sigma vertical levels
30 Km horizontal resolution

BATS + IRIS

BATS: Biosph.-Atmosph. Transfer Scheme
IRIS: interactive Rivers Scheme

OASIS 3
Freq. 6h



HF-WF-Wind

MedMIT

42 zeta vertical levels (partial cell)
1/8° x 1/8° horizontal resolution



Work plan 2017-2018

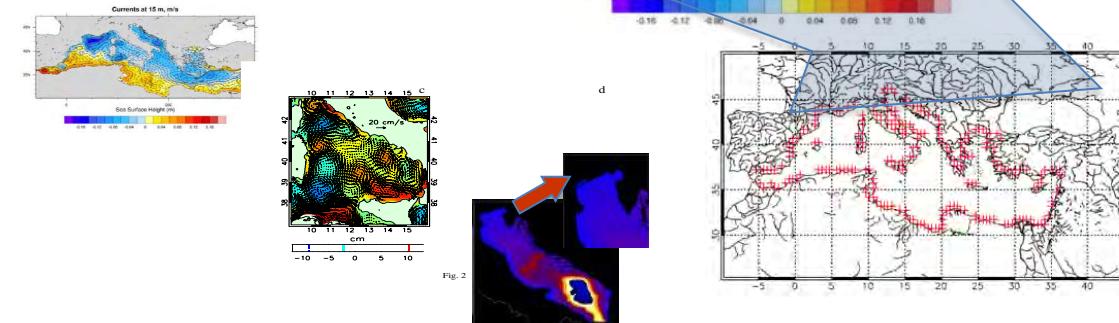
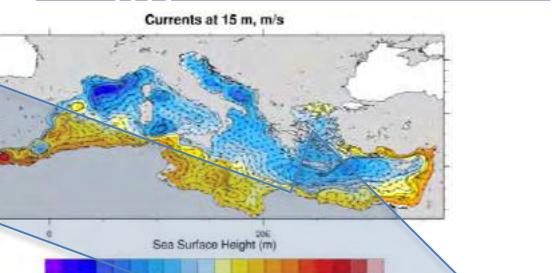
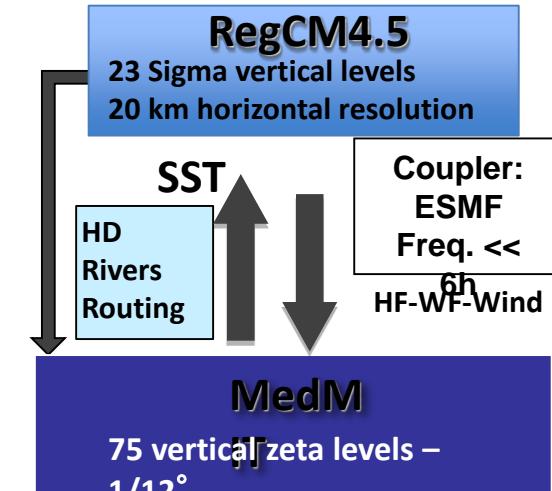
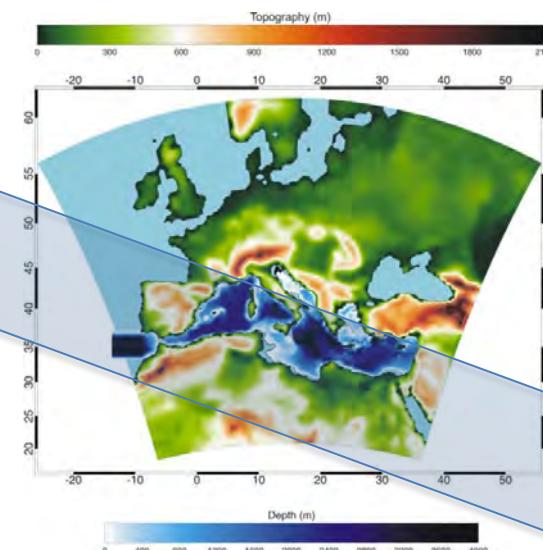
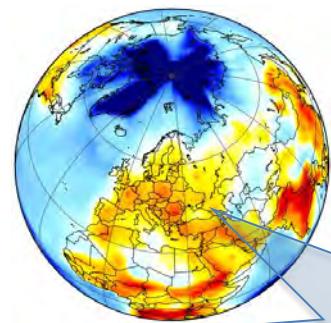
- Costruire un archivio dei risultati di simulazioni climatiche globali, regionali e locali, sia già esistenti sia effettuate durante il progetto.
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- Rendere disponibili i dati climatici mediante un sistema di archivi e portali tematici collegati al Portale Generale.

Deliverables

- **D2.5.A (giugno 2017)**: Versione preliminare dell'archivio e portali di accesso alle simulazioni globali e regionali effettuate in ambito NextData, con risoluzione spaziale rispettivamente da circa 70 a 120 km per le simulazioni globali e da circa 4 a circa 50 km per le simulazioni regionali, per i periodi di riferimento 1950-2005 (storico) e 2006-2050 per gli scenari futuri RCP4.5 e RCP8.5.
- **D2.5.B (giugno 2018)**: Archivio e portale di accesso al software e ai campi di temperatura e precipitazione disaggregati con tecniche di downscaling statistico e stocastico, con risoluzione spaziale fino a 1 km e temporale fino a 6 ore sulle aree montane italiane nel periodo storico (1950-2005) e negli scenari futuri.
- **D2.5.C (dicembre 2018)**: Versione completa dell'archivio e portali di accesso alle simulazioni globali e regionali effettuate in ambito NextData.



Model Suite @ ENEA



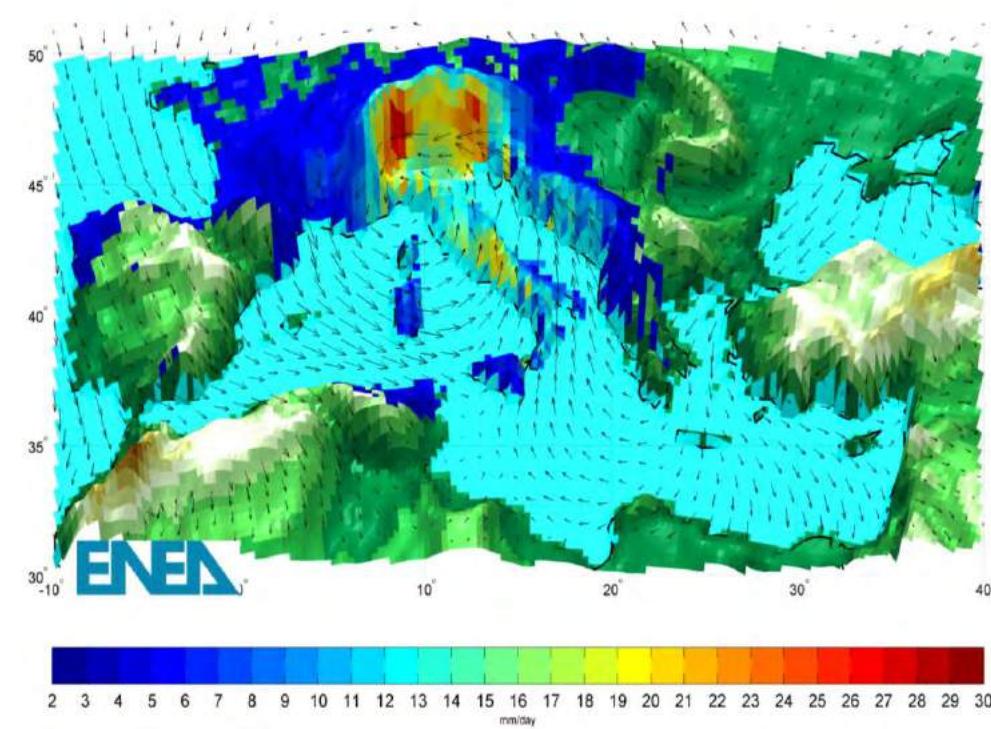
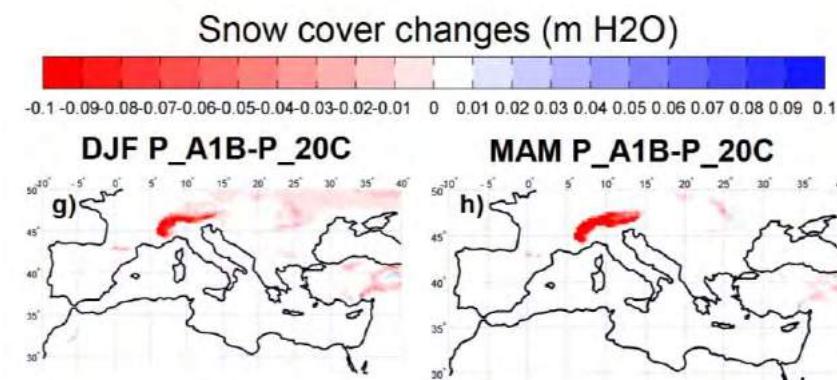
Simulazioni attese

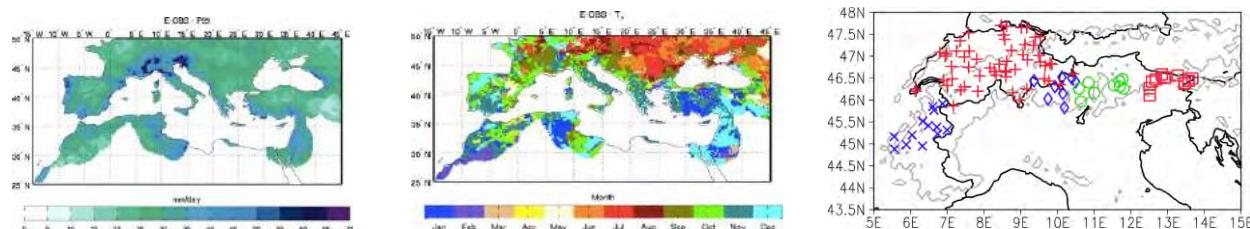
- ERA-INTERIM 1979-2012
- Historical 1960-2005
- RCP 8.5 /RCP 2.6



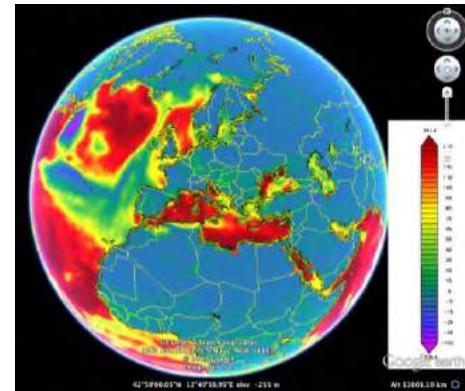
Obiettivi scientifici

- Analisi eventi estremi ad alto impatto legati ad interazioni area-mare (ciclogenesi; precipitazioni intense sulle Alpi)
- Analisi copertura nevosa nella'ottica di un cambiamento complessivo ciclogenesi del Mediterraneo





- An ensemble of high resolution simulations (from 100 km to 25 km) performed with the (global) CMCC climate model (HighResMIP).
- Enlarge the climate change projection ensemble over the Mediterranean region produced with the coupled regional climate model: RCP4.5 and RCP2.6.
- Analysis of the 2.2 km simulation over Alpine area over a reference period (1979-1990)
 - evaluation of the performances for sub daily precipitation and related specific features (e.g. duration, inter time events).
- Assessment of the sub daily precipitation variation over the period 2021-2050, using IPCC scenario RCP4.5, with respect to a reference period.
 - future scenarios of sub daily precipitation will be produced with stochastic disaggregation (Ciervo et al., 2016) of the regional climate simulations at 8 km over the Alpine region. This method will be based on the statistical parameters obtained using sub daily precipitation available over the reference period from the 2.2 km configuration.

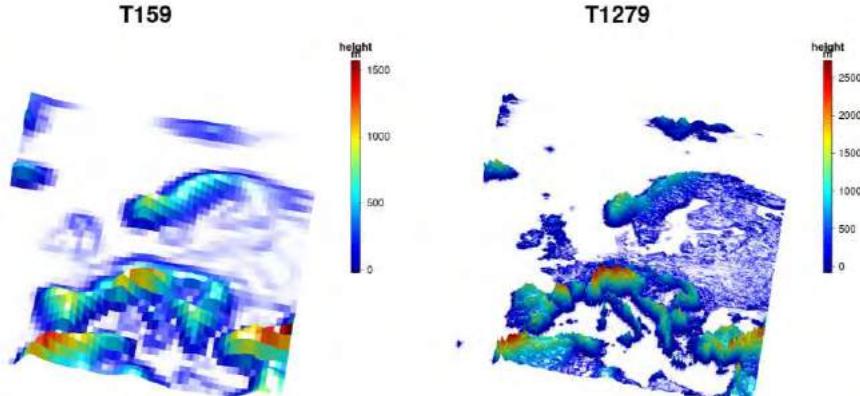




High-resolution climate projections

Inclusion in the archive of projections from the global climate model **EC-Earth 3**:

- a large ensemble (up to 10 members per resolution) of very high resolution AMIP simulations (from 125km to 16km) performed in the PRACE EU projects (2015-2017) **Climate SPHINX** and **Climate SPHINX reloaded**
- High-resolution projections performed using **stochastic physics**
- High-resolution coupled simulations (up to 40km) following **HighResMIP** specifications



In collaboration with the
EUDAT pilot Data-SPHINX led
by ISAC-CNR



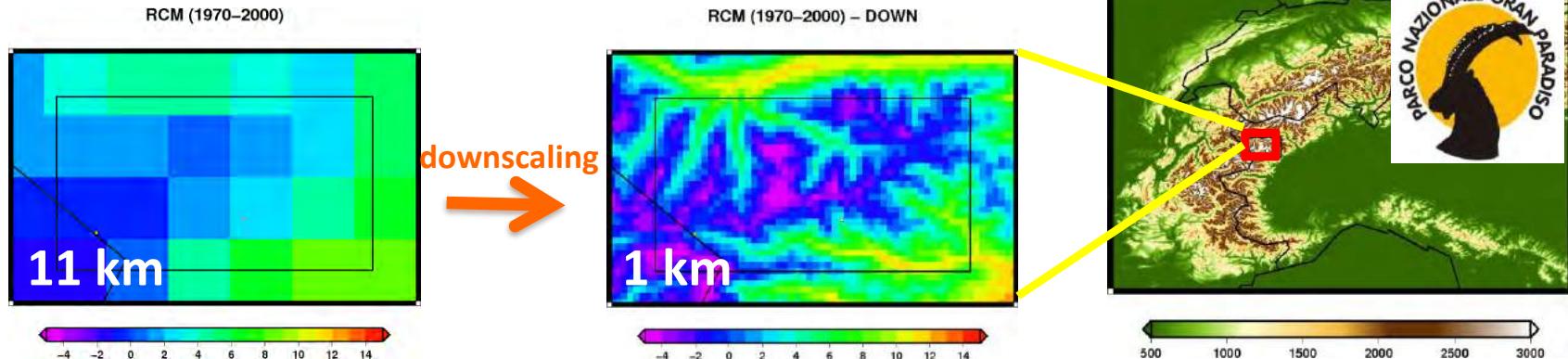


Orographic downscaling of temperature

Method: large scale temperature fields are downscaled by applying a simple orographic correction based on a annual or monthly adiabatic lapse rate (known from the literature or previous studies, e.g. [Rolland 2003](#)).

Case study: downscaling of EOBS gridded observations and EURO-CORDEX regional climate models (0.11° resolution) to 1 km over the area of Gran Paradiso National Park, Italy.

Software: open-source command line tools developed by ISAC-CNR, made available on [GitHUB](#).

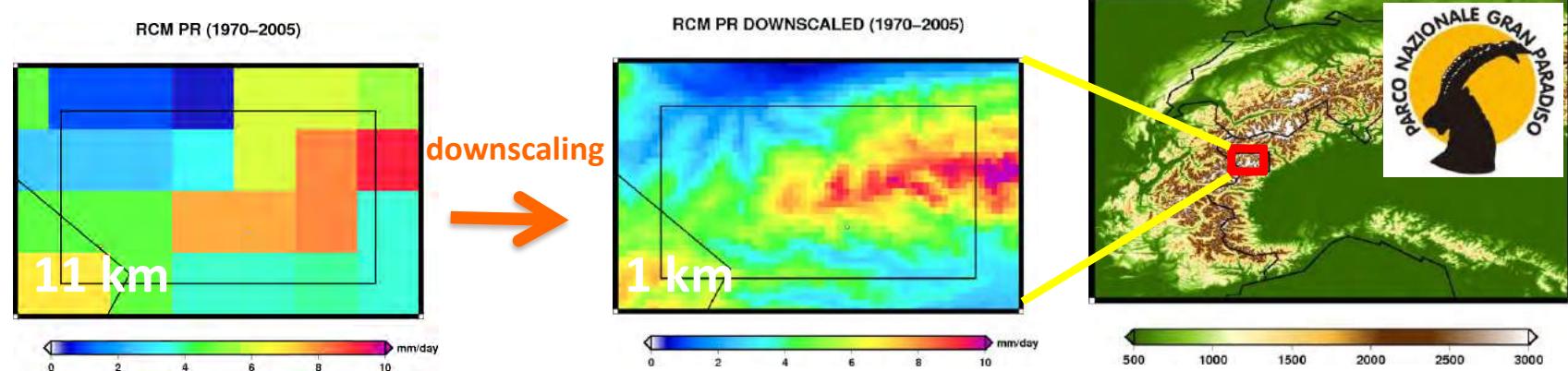




Orographic downscaling of precipitation

Method: a reference fine-scale climatology from gridded observations or high resolution simulations is used to derive corrective weights which are applied to realisations of stochastic fields generated with the RainFARM stochastic downscaling technique (*Rebora et al., 2006; D'Onofrio et al., 2014*)

Software: open-source command line tools developed by ISAC-CNR, made available on GitHub

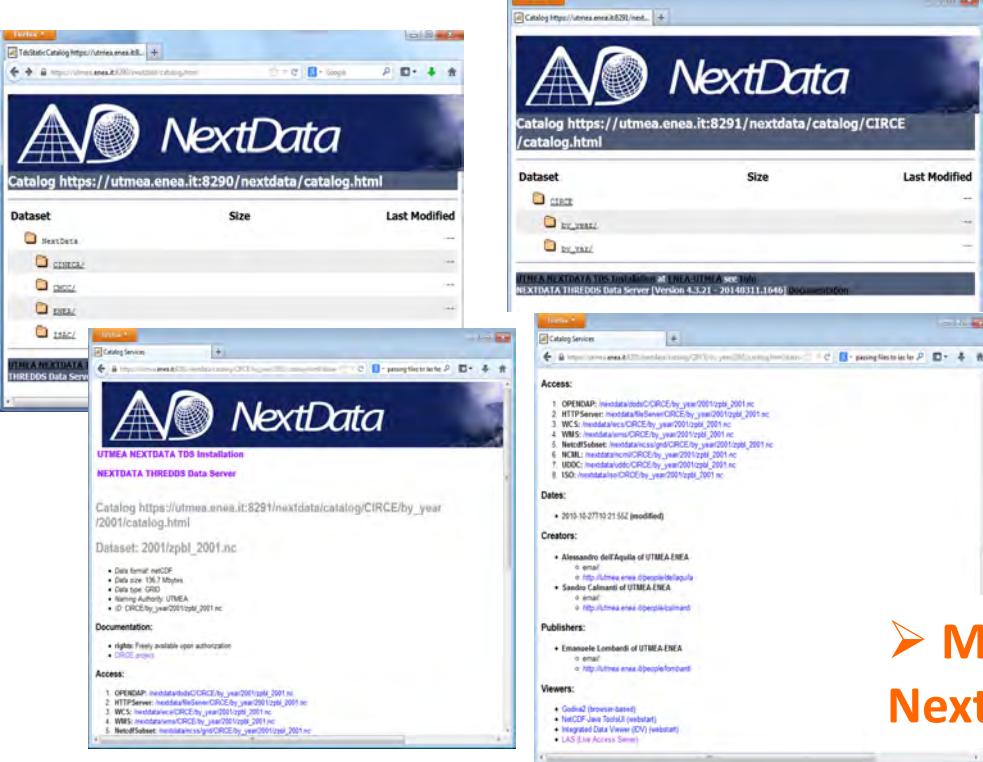


Rebora, N., L. Ferraris, J. von Hardenberg, and A. Provenzale, 2006: RainFARM: Rainfall downscaling by a filtered autoregressive model. J. Hydrometeor., 7, 724–738, doi:10.1175/JHM517.1

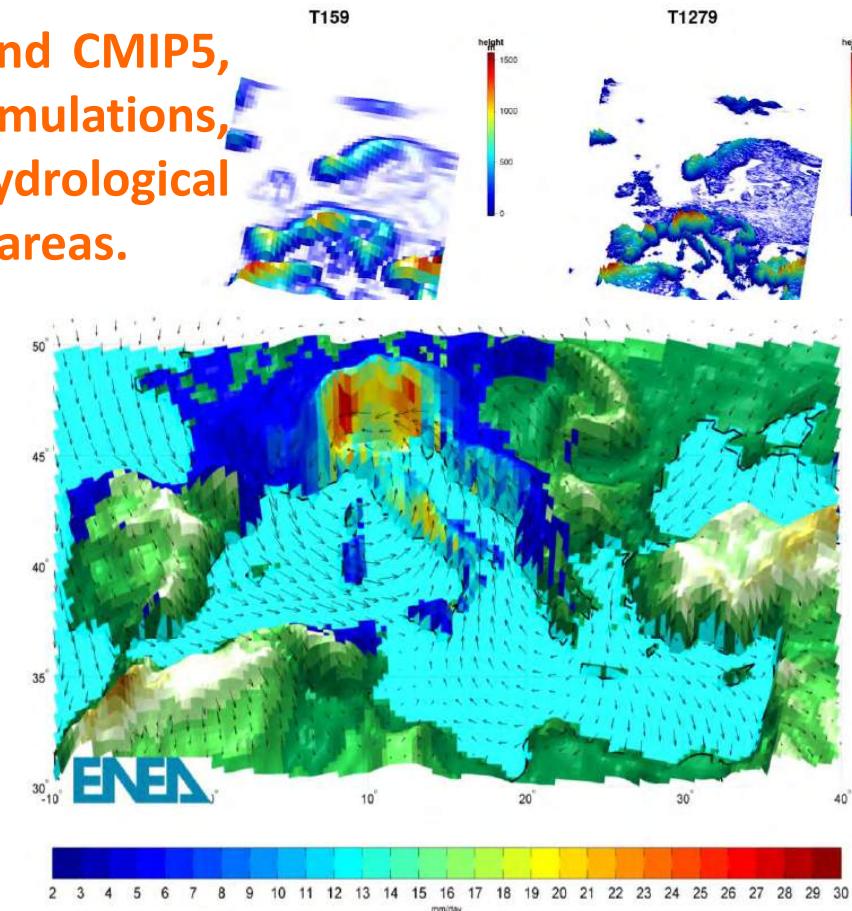
D. D'Onofrio, E. Palazzi, J. von Hardenberg, A. Provenzale, and S. Calmant, 2014: Stochastic Rainfall Downscaling of Climate Models. J. Hydrometeor., 15, 830–843, doi: 10.1175/JHM-D-13-096.1.

Summary

➤ Significant extension of the archive, beyond CMIP5, with state-of-the-art, very high-resolution simulations, useful for modelling and studying the hydrological cycle, resources and ecosystems in mountain areas.



The screenshot shows the NextData catalog interface. It displays a list of datasets under the 'Dataset' section, including CIRCE, ICED, RCM, and T259. Each dataset entry includes a 'Size' and 'Last Modified' column. Below this, there are two smaller windows: one for 'Catalog Services' and another for 'Thredds Data Server', both showing similar NextData branding and navigation.



➤ Maintenance and up-grade of the NextData thredds server

Grazie!