

MODELS AND TECHNOLOGIES FOR RISKS REDUCTION

The Division develops models and delivers measurements for the assessment of policies, plans and strategies for the adaptation and mitigation of risks deriving from natural causes, especially seismic, with particular focus on climate change, extreme events and air quality.

Activities are carried out in three labs: “climate modelling and impacts”, “atmospheric pollution”, “technologies for structure dynamics and seismic and hydrogeological risk prevention”

Strategic areas:

- Development of models and systems for the analysis of scenarios for the assessment of anthropogenic impacts and the reduction of natural hazards at local and national scales.
- Development of numerical models for describing interactions between greenhouse gas emissions, air pollution, climate change, energy and technology scenarios to assess relevant economic and social impact, and propose strategies for the adaptation and mitigation of risks.
- Development, design and validation of innovative anti-seismic systems and technologies, with built resilience analysis and application of geomatic techniques to the protection of land, landscape and architectural heritage.
- Research and development on seismic input characterisation and seismic microzonation, with investigations for the definition and control of geomorphological and hydrogeological risk and surface erosion. Research on the preservation of water resources.

Facilities and platforms:

- Instrumentation for the chemical-physical characterisation of Atmospheric Particulate Matter for the identification of different sources. Transportable laboratory equipped for sampling with offline determination methods of the main air quality parameters and online monitors for high temporal resolution.
- MINNI Integrated Assessment Modelling System of Atmospheric Pollution on national scale, consisting of two main components:
- The Atmospheric Modelling System producing hourly three-dimensional fields of meteorological variables and concentrations of major pollutants in forecast and hindcast mode at the following link: <http://airqualitymodels.enea.it/>.
- The GAINS-Italy System, which develops emission scenarios at national and regional levels for analysing impacts on air quality and costs of abatement/mitigation measures.
- Modelling system of daily climate/marine projections viewable at the following link: <https://giotto.casaccia.enea.it/forecasts/>
- Seismic Hall at C. R. Enea Casaccia with vibration table with passive 3D motion capturesystem dedicated to seismic tests. There are also two electrodynamic shakers and a contrast wall with two actuators for dynamic or pseudo-static tests.
- Non-destructive diagnostic equipment for assessing the state of damage to structures.
- Scanning Electron Microscope (SEM) for morphological analysis of electron microscopy and semi-quantitative microanalysis.
- Remote Sensing and Image Processing.



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MODELS AND TECHNOLOGIES FOR RISKS REDUCTION



DEPARTMENT FOR SUSTAINABILITY

- Efficient use of resources and closure of cycles
- Sustainable Materials
- **Models and technologies for risks reduction**
- Protection and enhancement of the territory and natural capital
- Biotechnology and agroindustry
- Technologies and methodologies for health protection

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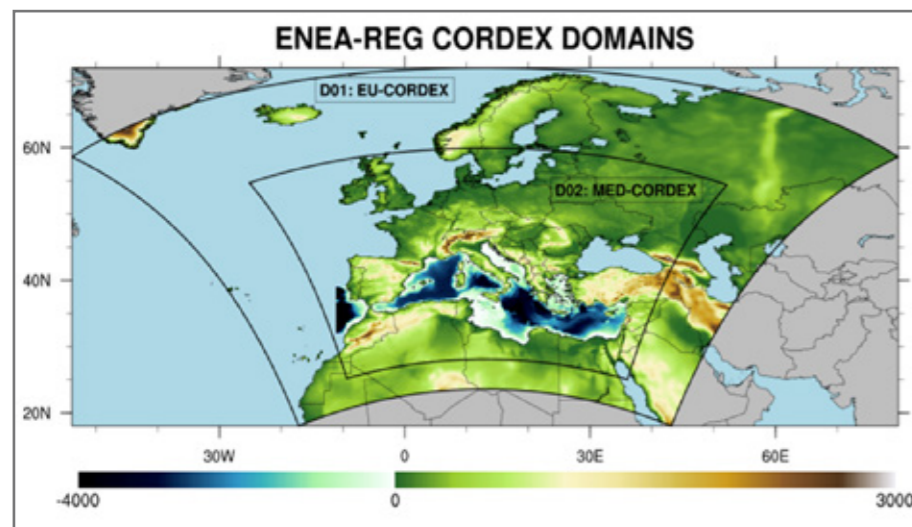
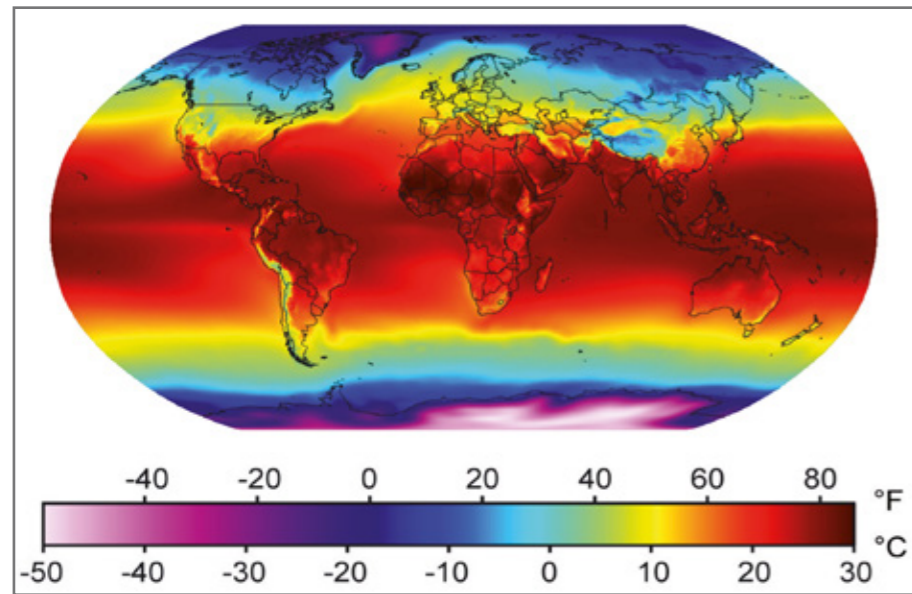
DEPARTMENT FOR SUSTAINABILITY



CLIMATE MODELLING

The activities of the Climate Modelling and Impacts Laboratory (CLIM) are:

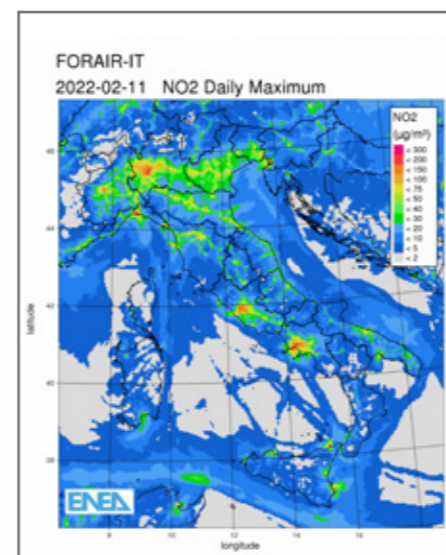
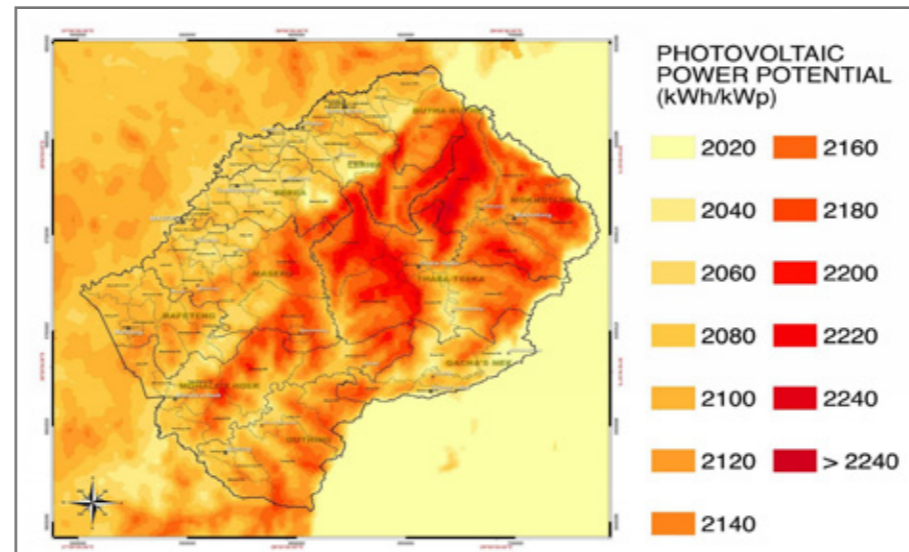
- Development of the European Earth System Model (ESM) in the EC-Earth consortium. With the global ESM, a contribution was made to the CMIP6 climate projections used for IPCC's Sixth Assessment Report on Climate Change. EC-Earth is also used for forecasting on seasonal to decadal scales and for studying the interactions between climate and land surfaces.
- In the CORDEX project, development of high spatial resolution simulations in the Euro-Mediterranean area for the present and future climate. A regional model was developed to simulate the dynamics of the atmosphere, ocean and biogeochemical processes at the surface, such as the carbon and hydrological cycle. Assessment of the impact of sea level rise on the coastal areas of the Mediterranean.
- Support for the design, installation and operation of power plants that convert energy from wave and tidal currents. A wave energy forecasting system is operational over the entire Mediterranean basin and one that provides five-day hourly forecasts of currents, temperature, salinity and sea level. The charts are available online: <https://giotto.casaccia.enea.it/mito/>
- Development of Climate Services at national and international levels for the sectors of energy, water management and coastal regions, food security, tourism and agriculture. Innovative multi-model methodologies are developed to maximise the performance of seasonal forecasts.



ATMOSPHERIC POLLUTION

The activities of the Atmospheric Pollution Laboratory (INAT) are:

- Meteorological and air quality simulations on European, national, local domains and validation with measured data (air quality monitoring networks – Italian Legislative Decree 155/2010).
- FORAIR-IT, operational air quality forecasting system on national scale using supercomputing resources.
- Source apportionment techniques on modelled and measured data (receptor models).
- Emission and air quality scenarios. Scenario projections for analysing the impact of climate change on air quality.
- Evaluation of the cost-effectiveness of emission reduction strategies to support air quality policies.



- Health impact assessments and risk analysis.
- Support to air quality policies in developing countries as part of actions financed by World Bank, EU and MAECI.
- Impact of climate and meteorology on solar and wind power generation.
- Simulations for assessing the environmental sustainability of industries.
- Development of innovative sampling methods for air pollutants: monitors for hourly measurements of water-soluble inorganic fraction in PM_{2.5}, carbonaceous fraction (EC, OC and TC) in PM₁ and PM_{2.5}, non-refractory organics and secondary ions in PM₁.
- Qualitative and quantitative determinations of sodium and uranium in PM₁₀ by EDXRF energy-dispersive X-ray fluorescence spectrometer.



TECHNOLOGIES FOR THE DYNAMICS OF STRUCTURES AND THE PREVENTION OF SEISMIC AND HYDROGEOLOGICAL RISK

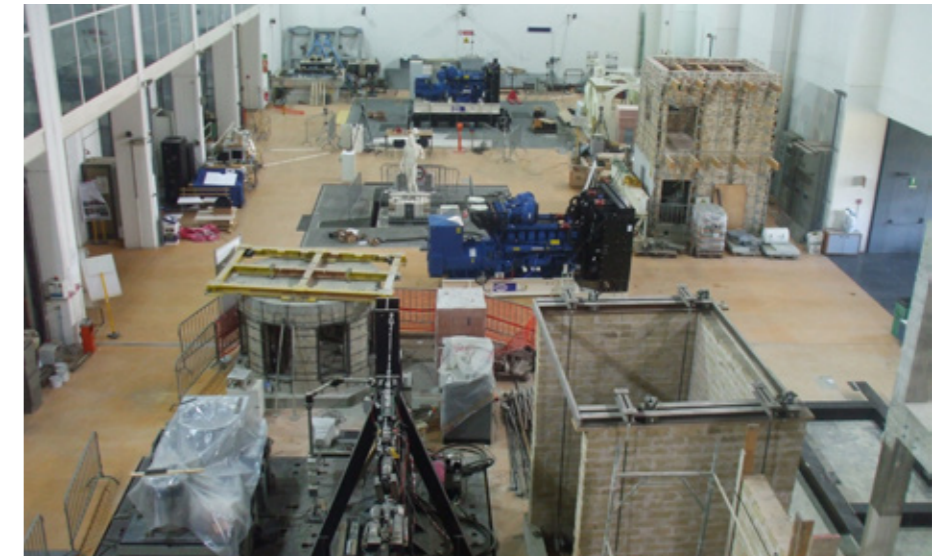
The activities of the laboratory Technologies for Structural Dynamics and the Prevention of Seismic and Hydrogeological Risk (DISPREV) are:

- Assessment of structural health and seismic vulnerability of industrial, civil and historic structures, including in situ testing and seismic monitoring.
- Development and support for design and validation of innovative seismic devices, systems and technologies
- Development of strategies for protection of buildings against man-made risks and seismic risks.
- Analysis of the resilience of the built environment, including in situ experimental campaigns with the digital support of building inventories, geo-referenced databases.

- In situ and laboratory diagnostic analyses of urban habitat materials.
- Research on surface erosion and protection of water resources.
- Geomorphological and hydrological risk analysis: historical analysis of events, study of the causes of landslides and of their evolutionary trends.
- Systems for monitoring and controlling the evolutionary dynamics of slope processes, measures for sustainable mitigation of geomorphological risk.
- Characterisation of seismic input, seismic microzonation, local seismic response, seismic-induced landslides, including in-situ measurements.
- Geomatics applied to the preservation of the environment and territory and the protection of the landscape and architectural heritage.



Villa of the Mysteries - Pompeii. Diagnostic campaign



Technology hall vibrating tables