Climate Change Impact Adaptation Measurement Indicators
### Main Catalan Actions

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>1st report on Climate Change in Catalonia</td>
</tr>
<tr>
<td>2006</td>
<td>Catalan Office for Climate Change</td>
</tr>
</tbody>
</table>
| 2008 | Climate Change Convention: 1,000 proposals; 800 participants  
KP Mitigation Framework Plan 2008-2012 (voluntarily commitment)  
| 2009 | Carbon Expo / BCN talks (UNFCCC) |
| 2010 | 2nd report on Climate Change in Catalonia  
Voluntary Agreement Program (150 Organizations joined) |
| 2011 | Carbon Expo  
Kick off Climate Change Observatory of Pyrenees |
### Main Catalan Actions

<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
</tr>
</thead>
</table>
| 2012 | Energy & Climate Plan 2020  
Catalan Strategy for adapting to climate change 2013-2020 |
| 2013 | Carbon Expo  
Climate Change Act: Kick off  
Life project on Adaptation LIFE MEDACC: forest, agriculture and water (5 y) |
| 2015 | Climate Change Act: proposal approved by Government  
“INDC” (2030 targets) COP21 Paris  
Adaptation indicators  
Launch: CO2eq Offsetting program  
Life project on Adaptation LIFE ADMICLIM: tourism, agriculture, water, fisheries (4 y) |
| 2016 | Climate Change Act: discussion in the Parliament  
ForEsmap: Evaluation and mapping of ecosystem services of forests in Catalonia  
Evaluation & Monitoring Catalan Strategy for adapting to climate change  
Life project on Adaptation LIFE CLINOMICS: tourism, agriculture, forest (5 y)  
Study of vulnerability and building capacity for local Adaptation Plans  
3rd report on Climate Change in Catalonia |
Objective of adaptation climate change law

- Reduce the vulnerability of the population and socio-economic sectors ecosystems adverse impacts of climate change, as well as the creation and reinforcement national capacities to respond to these impacts.

- The economic sectors adaptation and the incorporation of the analysis of the resilience climate change in the planning of infrastructure and buildings.

Parliament Catalonia plenary session 19/04/2016
Catalan Strategy for Adapting to Climate Change (2013-2020)

To become less vulnerable to climate change impacts

**Strategic goal**

- **Transversal goal**
  - Generating knowledge and transferring Information
  - Building capacity

- **Operational goal**
  - RDI
  - POLICY PLANNING
  - OPORTUNITIES

**Specific measures** for:

- Natural systems:
  - Agriculture and livestock
  - Biodiversity
  - Water management
  - Forest Management

- Socioeconomic sectors:
  - Energy sector
  - Fisheries
  - Health
  - Industry, Services and Trade
  - Mobility and transport infrastructure
  - Tourism
  - Town Planning and Housing

**Generic measures** cross-cutting natural systems and socioeconomic sectors
**Catalan Strategy for Adapting to Climate Change (2013-2020)**

**SUMMARY OF IMPACTS**

- **Observed**: 24
- **Potential**: 19
- **Global change**: 8

- **63 impacts analyzed**
- **32 impacts observed**

**SUMMARY OF MEASURES**

- **30 GENERIC (cross-cutting) proposed**
- **152 SPECIFIC (sectors/systems) proposed**
- **182 TOTAL**
Conclusions ESCACC most vulnerable Catalonia areas: Pyrenees (mountain region) and Ebro’s Delta (litoral)
Conclusions ESCACC main climatic impact:
Temperatures increase and heat waves. Most irregular precipitations.

Conclusions ESCACC most vulnerable system:
Water

Public / Private sector:
Private sector awareness and action are generally low.
Public sector is crucial to guarantee policy coherence across many sectorial policies (mainstreaming) helping to ensure its effectiveness and efficiency.
2016 Evaluation & Monitoring Catalan Strategy for adapting to climate change

ESCACC generic measures (cross-cutting): 83% started in progress

ESCACC specific measures (sectors/systems): 72% started in progress

- Generating knowledge and transferring Information
- Forest Management
- Health
- Town Planning and Housing
- Industry, Services and Trade
- Tourism
- Water management
- Agriculture and livestock
- Biodiversity
- Energy sector
- Mobility and transport infrastructure
- Fisheries
**Project**

MEDACC is a 5-year LIFE+ project where some innovative solutions will be tried to adapt the agroforest and urban systems to the climate change impacts through demostrative actions in three basins of Catalonia.
LIFE+ MEDACC Project medacc-life.eu

La Muga
- Area: 758 km²
- A watershed mainly influenced by Mediterranean conditions.
- 71% Forests
- 24% Crops
- 11,225 ha irrigated surface
- Agricole use ... 75% w.d.
- Urban use ...... 20% w.d.
- High stationary pressure
- Water abstractions
- Hydrologic drought periods

El Ter
- Area: 2,955 km²
- It contributes to Barcelona water supply.
- 19% Crops
- 75% Forests
- 32,390 ha irrigated surface
- >50% water to Barcelona
- Urban use ...... 76% w.d.
- Ecological flow

El Segre
- Area: 13,000 km²
- It is the largest river of Catalonia and tributary to Ebro river.
- 34% Crops
- 63% Forests
- 140,000 ha irrigated surface
- Agricole use ... 95% w.d.
- Ground water quality
- Ecological flow
A Global Indicator of climate change adaptation in Catalonia

Basic requirements of indicators:
- Accessibility of information
- Historical data
- Easy to interpret
- Specific data to the Catalan country

Criteria for selection:
- Quantify the outcome of adaptation actions
- Qualitative indicators (planning)
- Measure of sensitivity or degree of exposure

Requirements for final treatment:
- Historical data based on at least 10 consecutive years
- Qualitative indicators (planning)
- Unavailability annual data
- Not enough observations

<table>
<thead>
<tr>
<th>Category</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture &amp; livestock</td>
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<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Biodiversity</td>
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<td>2</td>
<td>0</td>
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<tr>
<td>Water management</td>
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<td>2</td>
<td>2</td>
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<tr>
<td>Forest management</td>
<td>12</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Industry, services &amp; trade</td>
<td>6</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Mobility &amp; Transport infrastructure</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Fishing &amp; marine ecosyst.</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Health</td>
<td>13</td>
<td>8</td>
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</tr>
<tr>
<td>Energy</td>
<td>10</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Tourism</td>
<td>13</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Urban planning &amp; housing</td>
<td>9</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>3</td>
<td>1</td>
<td>1</td>
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</tbody>
</table>

Total: 83 50 29
A Global Indicator of climate change adaptation in Catalonia

ESCACC adaptation measures
- 83 indicators (12 sectors/systems)
- 50 indicators (11 sectors/systems)
- **29 indicators** (10 sectors/systems)

Phase 1: preparatory work
Phase 2: later selection
Phase 3: final treatment

**PRINCIPAL COMPONENT ANALYSIS (PCA)**

**Weight percentages of the indicators by sector**
- urban planning and housing: 6%
- agriculture and livestock: 10%
- tourism: 6%
- energy: 8%
- health: 10%
- RDI: 3%
- mobility and transport infrastructure: 6%
- industry, services and trade: 6%
- forest management: 10%
- water management: 35%

**FACTOR 1**
- 61% variability
  - Use of resources (primarily water and energy)

**FACTOR 2**
- 39% variability
  - Environment quality (primarily atmospheric emissions)

<table>
<thead>
<tr>
<th>Use of resources</th>
<th>Environmental quality</th>
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</thead>
<tbody>
<tr>
<td>5.06</td>
<td>5.13</td>
</tr>
<tr>
<td>4.97</td>
<td>5.06</td>
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</tbody>
</table>

2006 vs 2011
The study ForEsmap: Evaluation and mapping of ecosystem services of forests in Catalonia prepared by the CREAF and promoted by the Catalan Office for Climate Change. It has assessed and mapped 10 ecosystem services from the catalan forests at county scale using 15 biophysical indicators based on previous research. The study shows the spatial relationship between them and with some socio-economic and climatic variables (temperature and precipitation).
Forests: Ecosystem Services

REGULATION SERVICES

Quantitative

Qualitative

Mean Regulation Value
Mean Value of Regulation ES (std. 0 to 1)
- 0.00 - 0.48
- 0.48 - 0.57
- 0.57 - 0.65
- 0.65 - 0.72
- 0.72 - 0.92
- Municipalities with <3 forest plots
- Counties’ limits

Mean Regulation Value
Mean Value of Regulation ES (std. 0 to 1)
- 0.00 - 0.43
- 0.43 - 0.52
- 0.52 - 0.59
- 0.59 - 0.66
- 0.66 - 0.80
- Municipalities with <3 forest plots
- Counties’ limits
Forests: Ecosystem Services

Quantitative

Qualitative
The objective of project LIFE CLINOMICS is to increase the resilience of local Mediterranean from intervention in three areas: the Montseny Natural Park, the Alt Penedès and Terres de l'Ebre; and about three significant economic activities: tourism, agriculture and forestry.

With the project will be implemented participatory bodies, territorial and socio-economic studies and documents (such as action plans and strategies for adaptation); it will be designed tools for local authorities and socioeconomic agents (such methodologies and pilot tests), and generate knowledge, training and information and awareness agents and other factors which should facilitate action in favor of adaptation.
Building capacity for local Adaptation Plans

Vulnerability to water demand increase for urban users

[Map showing vulnerability levels for different areas in green and yellow shades, indicating varying degrees of vulnerability.]
The project LIFE EBRO-ADMICLIM (ENV/ES/001182) puts forwards pilot actions for adaptation to and mitigation of climate change in the Ebro Delta (Catalonia, Spain), an area vulnerable to sea level rise and subsidence.

We propose an integrated approach for managing water, sediment and habitats (rice fields and wetlands), with the multiple aim of optimizing ground elevation (through inputs of inorganic sediment and organic matter), reducing coastal erosion, increasing the accumulation (sequestration) of carbon in the soil, reducing emissions of greenhouse gases (GHG), and improving water quality.

This type of approach has not been applied so far in the European Union, and it is clearly innovative internationally.
Adaptation measure water management: Thresholds drought plan with new desalination and reuse infrastructure ITAM Llobregat and ETAP Sant Joan Despí
Conclusions

✓ First synthetic indicator of climate change adaptation in Catalonia based on principal component analysis.
✓ The synthetic indicator of adaptation is determined by two factors that explain 100% of the variability of the information contained in 29 indicators.
✓ The result of both factors shows a medium level of adaptive capacity to the impacts of climate change in Catalonia.
✓ These results indicate that it is necessary to invest in adaptation.
✓ Indicators need to be reviewed every 5-10 years.
✓ Biodiversity requires a more qualitative assessment.
✓ The fisheries sector requires more knowledge-based of impacts.

Some guiding questions
• how could we integrate qualitative indicators?
• it's a useful indicator for policy-making purposes?
• an indication of progress rather than an evaluation of effectiveness?