INNOVA **Ezine**

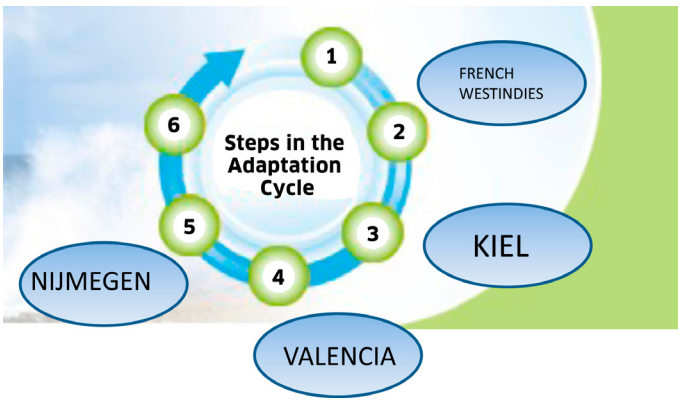
Urban Climate Adaptation

Guadeloupe & Martinique | Kiel Bay | Nijmegen | Valencia

The fourth INNOVA e-zine presents the activities and background of Guadeloupe and Martinique as part of the INNOVA project. These French West-Indies islands (FWI) are investigating solutions to reduce their vulnerability to global climate change. During the last decades, the FWI were subject to many and intense climate impacts on agricultural production. This e-zine continues the INNOVA project narrative describing the four projects 'hubs'. The previous e-zines focused on the Mirror Waal project in the Nijmegen area (the Netherlands); the water management issues in the Valencia metropolitan area (Spain), and the beach resources and environmental problems of the Kiel Bay (Germany).

This e-zine highlights the environmental and climatic challenges related to the agro-ecological transition of predominantly banana and sugar cane production, to more sustainable and locally important crops for Guadeloupe and Martinique. Even so, both these crops are important contributors to the gross domestic product (GDP) of the FWI.

The INNOVA hub of the FWI is designing an intelligent data harvesting framework and a knowledge repository used for the development of climate services. These products will allow users to store, search data and visualize information from a diverse range of sources. Access to appropriate data and information is important to the FWI which is at the beginning of the climate change adaptation cycle. At this stage of the adaptation process, data and information are important elements for the process to develop effective adaptation measures.



Adaptation Support Tool on the European Climate Adaptation Platform

EXPERIMENTING TO REDUCING THE ISLANDS' VULNERABILITY TO GLOBAL CHANGE

Left: Saint Pierre, Martinique (copyright: INRA Antilles Guyane). Right: Fields and forests in Guadeloupe (copyright: Didier-Laurent Aubert – DAAF Guadeloupe)

Guadeloupe and Martinique are considered to be the 5th worldwide hot spot of biodiversity and also vulnerable to global change. Similar to other islands in the Caribbean Community, **agriculture** is an important sector that must contribute to mitigating the effects of climate change. This sector also needs to adapt to the changing climate. Both these can be achieved by building **resilience to natural disasters**, and by committing to the **agro-ecological transition** from mainly large commercial-scale monoculture to a better balance with more diverse and sustainable farming for local use.

The French West Indies (*or Antilles Françaises*) consists of the archipelago of Guadeloupe, and the island of Martinique. Both are volcanic islands of the Caribbean Sea in the West, and the Atlantic Ocean in the East. The archipelago of Guadeloupe consists of two connected island masses: Basse-Terre and Grande-Terre, and several smaller islands: Marie-Galante; Les Saintes and Desirade. The island of Martinique has alsmost fifty islands spread around its coasts.

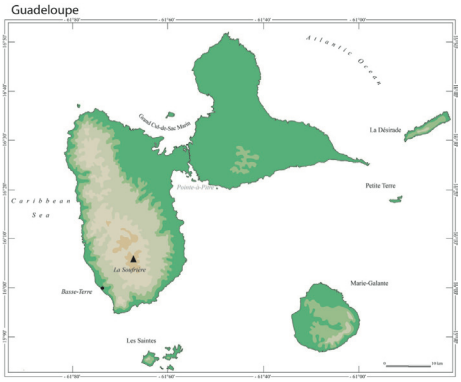
The surface area of Guadeloupe archipelago and Martinique island is 1628 km² and 1128 km² respectively. In 2018 Guadeloupe and Martinique had a population of 390,704 and 376,847 respectively. The population density of the islands is 240 people per km2 for Guadeloupe and 334 people per km2 for Martinique.

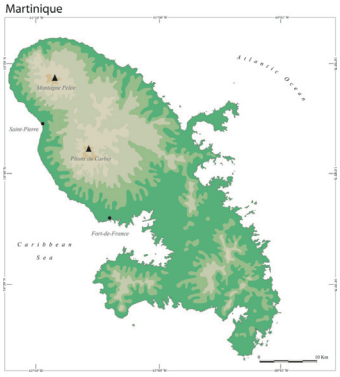
On both islands, tourism is an important sector for the local economy, and well-serviced by international flight routes and by cruise-ships. In Guadeloupe, tourism is concentrated in the south of Basse Terre and in Les Saintes island. In Martinique tourism is concentrated in the south of the island. An increase in tourist visitors (13% in Guadeloupe and 19% in Martinique) was observed in 2017 by comparison with 2016, mainly due to the growing cruise industry. More than 80% of tourists landing on the islands originates from mainland France, and two thirds stay on the islands for leisure activities. Tourists from Europe and North America arrives mainly during the winter months, while in summer they originate mostly from the Caribbean area. The changing climate creates new challenges for the tourism sector, tourism professionals and local authorities alike. Climate change, such as more frequent and intense hurricanes, presents a barrier for tourism development. These extreme events reduce or damage infrastructure and natural resources upon which the tourism sector relies. Climate change may affect public health and safety (increased dengue fever or chikingunya disease), and increase natural risks, such as floods and extreme events like hurricanes. All of these impacts have a negative impact on the perception of potential tourists to the FWI.

The main economic sector of both islands are firstly business services, followed by agriculture. Moreover, farming remains historically, socially and culturally important to the identity of the islands. In 2018, agricultural used about 30% of all land available on both islands. Farm sizes range from less than one hectare to more than 100 hectares.

Agriculture production in the FWI is dominated by **sugar cane** and **bananas**. The prominence of these crops is a legacy of the colonial era. Most of the sugar cane products (60%) and bananas as fruit (95%) are exported to France. The agro-export status quo is based on the concentration of production in the hands of land oligarchies. These benefit from agreements that

protect their interests through quotas or rights of access to the French market, which is now weakened by globalization. This economic model, maintained by agricultural rent (European and national financial support), also results in a low diversification of production and a high degree of extroversion. **Vegetables, fruits, tubers and flowers** produced on the FWI only contributes 25% of what is needed for local consumption. However, recent national policy (Loi d'Avenir on Agriculture and Food, 2014) is supporting diversification towards multifunctional agriculture. This could open up new and more fair opportunities for agriculture in the FWI. Smallholders and family farming will benefit from the new agricultural policies.





Mosaic of vegetable crops (copyright: INRA Antilles Guyane)

Typical landscape with hills, central plains and coasts (copyright: INRA Antilles Guyane)

CHANGING SEASONAL CLIMATE IS AFFECTING THE CULTIVATION PROCESS

During the last decade, the FWI islands have had to deal with many weather events of various intensity, all of which had a considerable negative affect on the agriculture sector.

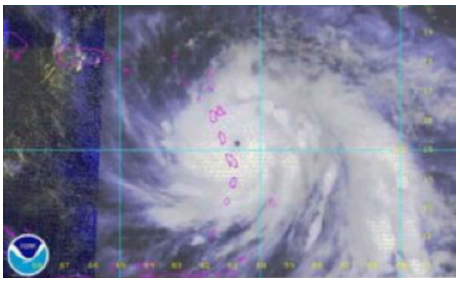
The climate of the FWI is tropical. There are two seasons locally called "*hivernage*" and "*carême*" in Guadeloupe and Martinique. During the *hivernage* (May to November), the weather is generally warm, humid and rainy. During the *carême*, from December to April, the weather usually dry, in comparison. The mean annual temperature generally exceeds 18ºC. The "hurricane season" extends from June to November. Farming is seasonally organized. The growing season for sugarcane is during *hivernage* when there is an abundance of rain, heat and humidity. Harvesting takes places during *carême* when the sugar content of the cane rises due to the comparatively dry conditions. Drought and cold nights promote the sucrose formation.

Climate observations are indicating a change or a shift in the seasons. The timing and volume of rainfall are becoming difficult to anticipate. Testimonies of sugarcane and banana farmers and producers are indicating that the two seasons are no longer as clearly separated. Banana plants and sugar cane are sensitive to climatic conditions. As a result, planning sugarcane cutting, managing banana treatment or cultivating yams is becoming more challenging.

A major climate-related issue for sugarcane farming is the increasingly inconsistent yield and sugar concentrations. In Guadeloupe, sugarcane crop yields and sugar levels were very low during the 2008 harvest, and the 2009 harvest was marked by abundant rainfalls that led to a reduction of sugar level. The increase in fungal diseases such as Black Sigatoka on banana trees, or vector-borne (insect) citrus greening on lemon trees are other climate-related challenges for farmers. Black Sigatoka (*Mycosphaerella fijiensis*) on banana leaves is a fungal disease which development is favoured by high humidity, and that reduces fruit production. Infected plants also needs to be destroyed, further reducing and interrupting production of bananas.

Hurricanes also have a negative effect on crop production. Banana stands are particularly affected by strong wind which break the tall and fragile plants. When banana plants are pushed over by the extreme wind associated with hurricanes two farming strategies may be followed depending on the degree of destruction. If the plants are partially damaged, they are cut in a particular way called *cyclonage*. This allows the plants to continue growing during the year. However, if the plants are completely destroyed, the fields are left fallow before replanting during the following season. In such a case a new harvest is not possible for several years.

Faced with the challenge of adapting to climate change, the agro-ecological transition from the export crops banana and sugar cane to food production for local markets, offers a basis for designing innovative climate services. The agro-ecological transition for the islands of the FWI is strategically importance for economic, social and environmental stability in a changing climate.



Hurricane Maria in 2017

Flooded sugar cane field during harvest in Guadeloupe

Banana plants damaged after a hurricane in Guadeloupe (copyright: Didier Laurent Aubert – DAAF Guadeloupe)

Banana fields after Maria Hurricane in 2017 (copyright: Didier-Laurent Aubert – DAAF Guadeloupe)

CLIMATE AND AGRICULTURAL CHALLENGES

The sanitary scandal of Chlordecone (1) in 2009, was a first trigger for start of the **agro-ecological transition of agriculture in Guadeloupe and Martinique**. This was supported by a new legislative framework, both national and regional (Economic Development Scheme of Regional Communities) and ambitions for a green economy, which proposes another vision for the development of the agricultural sector.

The climate and agricultural challenges of the FWI are associated with adaptation and mitigation, i.e. a reduction of food imports and the resulting carbon footprint. Currently, the two islands are more than 80% dependent on food imports. The replacement of imported synthetic fertiliser and pesticides with locally produced biofertilizers and biopesticides, coupled with climate anticipation and adaptation, can increase the resilience of the current farming systems. The co-identification, with policy-makers and stakeholders, of pathways for better-decision-making is an important part of the transition. The agro-ecological transition can be facilitated through several actions such as:

* **Teaching and advising farmers** to adhere to and pursue the new agricultural policies – for instance agriculture business chambers can provide ongoing training.
* **Setting up networks** of farmers to enable them to share their experiences – for instance since 2015 economic interest groups have been supporting farmers to get involved in sustainable agriculture. There are seven such groups in Guadeloupe and five in Martinique.
* Reducing the use of pesticides and fertilizers – for instance sanitizing plants havebeen used in banana fields for five years and banana trees are also used as a sanitizing plants for;
* Developing **permaculture, organic agriculture and agroforestry**.

(1) Chloredecone is a very toxic and persistent pesticide used on banana fields for 20 years from 1972. It is a organochlorine compound and a colourless solid. Chlordecone is an obsolete insecticide related to Mirex and DDT. Its use was forbidden in France but allowed in the French West Indies. Thousands of hectares have been contaminated through the long-term use of Chloredecone. A report published in 2009 proposed to compensate the victims in Guadeloupe and Martinique.

Diversified agriculture: fields with pineapples, yams and bananas (copyright: INRA Antilles Guyane)

Plantain bananas, peas and tomatoes (copyright : INRA Antilles Guyane)

Plantain bananas, peas and tomatoes (copyright : INRA Antilles Guyane)

Field of local roots « Madere » in Guadeloupe (copyright : INRA Antilles Guyane)

VIDEO

https://youtu.be/dqAvCR231os

CLIMATE CHANGE AND CARBON CONSTRAINTS

JEAN-MARIE FLOWER

Below is a conversation between the INNOVA team in FWI and Jean-Marie Flower, a consultant (tropical expert) on aspects related to ecology, the environment and the energy transition. This meeting took place at an informal meeting at INRA Antilles Guyane in December 2018. The INNOVA team questioned him about his perspectives on the critically needed agro-ecological transition that is facing the FWI.

Jean-Marie Flower was born in Guadeloupe and he completed a PhD in Ecology from the University of the French West Indies in 2004. His thesis focussed on addressing issues related to the destruction of mangrove vegetation in the Lesser Islands. He currently shares his time between the botanic conservatory in Basse-Terre, Guadeloupe, and his own consulting service - *Fleur de carbone* (*Flè Kawbon*) – that provides strategies to reduce the ecological footprint of agricultural in Guadeloupe. Jean-Marie has been an ecologist since 2005, and has since then worked on the ecological transition of the islands of Guadeloupe and Martinique. He was motivated to do this after he calculated his own ecological footprint. His perspective was particularly valuable due to his deep knowledge of ecology and biodiversity of the FWI.

Innova team: **What are the most notable effects of climate change in the French West Indies?**

Jean-Marie Flower: I would rather refer to **climate disruption** and even **climate shift**. In 2000, when I was studying the destruction of mangrove vegetation, I evaluated rainfall variability of the last 50 years. What I found was that between 1950 and 2001, rainfall decreased by 30%. It also seems like since 1970, the climate of our islands is increasingly unpredictable. Dry periods and rainy periods are continuously alternating, rains are becoming more intense, droughts are becoming severe and longer. Up until the 70s, the climate was stable for 5000 years. Now the two seasons of *hivernage* and *carême* are less distinct. Hurricanes can be formed at any time of the year, sea water temperature is increasing, and two thirds of the coast is eroding. This is a major concern for our islands that have agricultural land, cities and roads at sea level. I have learned that as ecosystems and sustainable agro-systems age, they become more resilient to climate variability. Creole gardens, for instance, adapt to soil and climate conditions during the years are as a result very resilient to change. Conversely, commercial and intensive mono-culture crop production dependent on fertilisers and pesticides for its quality and quantity are directly affected by climate variation and change.

Innova team: **Do you think the Caribbean islands are more exposed to the impacts of climate change?**

Jean-Marie Flower: They are just scale models of the planet. We should take inspiration from the first people that settled in the Caribbean area. For instance, the Kalinagos were living in balance with their environment. They intuitively reduced their footprint on lands. They spent half their time on the sea and they shared the resources with all the Caribbean islands from Granada to Antigua. That is why they were able to resist colonization for 150 years.

> ‘If the nature has enough time and space like one thousand years, eco-systems will naturally become forests with trees of diverse species and sizes, vines and tall herbs in the margin’

Communication between islands was easier and direct than it is currently. In general, we should use these historical examples to shape our behaviour as we attempt to transition to sustainability. For instance, we should think of the tragic period called *Sorin time* (1) during which Guadeloupe and Martinique were under the so-called blockade. At that time, there was a strong solidarity between cities and countryside, between poor and wealthier people, and recycling was common. For example, rum was used as fuel, tires were used for shoe soles and soaps were made with local resources. According to the GIEC (*Groupe d’experts intergouvernemental sur l’évolution du climat*), we have as little as two years to change our practices.

Therefore, and rather to evoke fears of climate change, I prefer to talk about carbon constraint, which includes the concept of climate change, but also the idea that we have to be more efficient with the same or less resources. The alternative is for the human species to become extinct. In my opinion, the ecologic transition is inescapable and will become obvious in the short- and medium-term.

Innova team: **Given that such an agri-ecological transition is imminent, what are the requirements for the French West Indies?**

Jean-Marie Flower: Agricultural systems must start resembling natural forests in order to become more resilient. The ecosystems of the lesser islands are still predominantly forest. If the nature has enough time and space like one thousand years, eco-systems will naturally become forests with trees of diverse species and sizes, vines and tall herbs in the margin. The forest is the best compromise for soils, climate, rainfall and solar energy in our islands. Forests have existed for thousands of years and have proved their sustainability.

Innova team: **Is agro-forestry a solution to preserve forest development and also to promote self-sufficiency in the islands?**

Jean-Marie Flower: Yes, agro-forestry enables medium densities of populations. Agriculture has to evolve in a way that supports trees because they naturally capture and store carbon and enhance water percolation. The agro-ecological transition in Guadeloupe and Martinique will also need to rely on labour because of the concomitant need to reduce the use of fossil fuel. It is of great importance and urgency to improve the perception of agricultural as a source of employment in the island society.

Innova team: **What climate service can benefit the imminent agro-ecological transition of the islands?**

Jean-Marie Flower: The agro-ecological transition is happening at a fast pace and climate services must be designed to anticipate climate impacts and unexpected events. It must proceed with great simplicity, sobriety or even austerity, not unlike a wartime economy. In my opinion, there are three urgent measures to take: 1) **to regulate the carbon cycle** and 2) **the water cycle in urban areas** and, finally, 3) to create **ecological corridors**.

(1) Constant Sorin, Governor of Guadeloupe, 1940-1943

TIMELINE

SEE NEXT PAGE

Timeline: the French Lesser Islands

5000 BC

The first indigenous people in the Caribbean islands are the Arawaks and the Caribs (or Kalinagos), as well as Ameridians from Venezuela. They subsist on fishing and hunting and produce crops. They grow mainly cassava but also cotton, vegetables, fruits and medicinal herbs.

15th – 16th century

In 1493, **Christopher Columbus** reaches the island he names Guadeloupe and in 1502 the island of Martinique. He wrote about the Arawaks that they brought them parrots, bundles of cotton, javelins, and that they did not carry weapons. In 1503, the Arawaks are almost totally annihilated by the Spanish, and by diseases introduced by Europeans. Despite the treaty, the French and the English organize expeditions to the Lesser islands. Discoverers, traders and seafarers are fascinated by the native ecology.

17th – 18th century

In 1635, the **Company "des îles d'Amérique"** is created by Cardinal Richelieu to settle a French colony in Guadeloupe and in Martinique. This company relies initially on tobacco crop and trade. First colonists are poor people recruited in France and given small farms on which they cultivated a mixed of crops including tobacco and indigo for export, and cassava and food crops for their own use. Sugar quickly becomes a valuable commodity and intensive production begins in 1642. Both islands are organized into large sugar farms called *habitations* with an economy built on slavery. These farms also produce coffee, cacao and cotton. It also marks the beginning of the slave trade. The islands are subject to major meteorological and seismic risks. The first cyclones are reported in the period 1656-1680 and they are described as especially active, devastating crops, milds, habitations and ships.

19th century

After 200 years slavery is abolished in 1848 and the organisation of labour is transformed. Numerous indebted *Habitations* are gradually sold, expropriated or reorganized. Some of them convert to rum manufacturing, and others are merged to form large central sugar cooperatives and factories. In 1852, the economy still relies on sugarcane production with more than 45000 indentured labourers from India to compensate for the lack of local farm workers. Agriculture remains the main activity on both islands, alongside with coffee, cacao, cassava, vanilla. Two major earthquakes mark the century and in 1839, the city of Fort de France in Martinique is completely destroyed with hundreds of casualties. In 1843, a strong earthquake in the Lesser islands destroys the city of Pointe à Pitre and 3000 people lose their lives.

20th century

Sugarcane continues to dominate the economy until the mid-20th century despite the crisis of sugar that caused bankruptcy of numerous enterprises ruined by big variations in the price of sugar. Banana and rum manufacturing competes with sugar for export income on both islands. In 1902, the eruption of the volcano *Montagne Pelée* destroys the city of Saint Pierre in minutes and kills 30 000 people. In 1946, Guadeloupe and Martinique become French departments and their citizens qualify for French nationality. The new status of the islands results in major changes in the economy and in society. In 1976, the *Soufrière*, the volcano in Guadeloupe wakes up with a phreatic eruption, and 25000 people are evacuated. And in 1989, the category 5 hurricane Hugo devastates the Guadeloupe and other Caribbean islands in one night and 60% of the sugarcane harvest and banana plantations are complete destroyed.

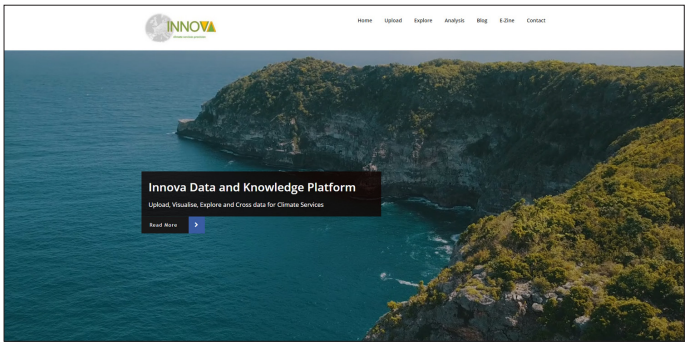
Current

Guadeloupe and Martinique is faced with economic challenges due to their geographic insularity and limited local market. The economy remains dependent on mainland France. Agriculture sector is a paradox. The agricultural sector is an important contributor to employment even though it only contributes 6% of the Gross Domestic Product. Banana and sugarcane crops continues to dominate the export market. Since the *loi d'avenir* in 2014, Guadeloupe and Martinique are involved in diversification of farming. With climate change, the islands are even more subject to natural hazards. 2017 is among the top ten active cyclone seasons: in one month the Lesser islands are affected by two Category 5 hurricanes Irma and Maria.

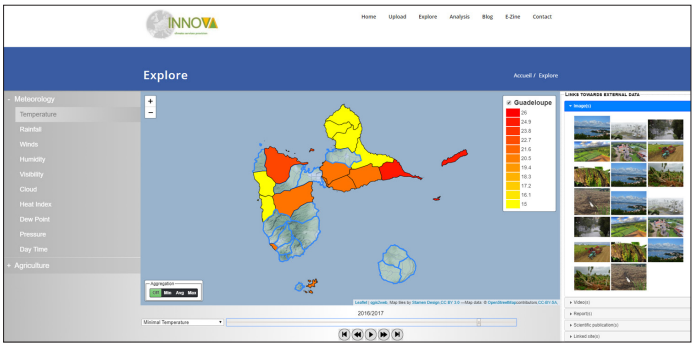
CLIMATE SERVICES: BUILDING A FRAMEWORK AND KNOWLEDGE REPOSITORY

In the INNOVA **FWI hub** we are designing **an intelligent information framework and a knowledge repository** that has to be scalable, ergonomic and informative. This framework should allow users to store, search and visualize various pieces of information and knowledge about the impact of climate change on agriculture processes in the islands. **Data analytics are also conducted on key indicators** that are defined and extracted from agricultural and climatic data in order to better characterize season disturbance and changes into plant life cycles in correlation with temperatures, rains and droughts variability.

The framework is called a **Data and Knowledge Web Platform (DKP)** and is intended to be used either by project members and stakeholders but also by people who need information about climate change. Use cases of the DKP are various: it will be used to store data from other INNOVA hubs, to connect to web platforms on climate and climate change, to search for information on climate change, to get a list of available information on a climate change subject, and to show raw data in various kinds of charts and in a geographic information system. The data that will be stored on the DKP may be structured data (e.g. climate change projections and indices) but also semi-structured and unstructured data such as narratives, images, and raster maps. The DKP is intended to support climate-based decision making and is presented as a technological climate service.



FWI Hub Data and Knowledge platform



FWI Hub Data and Knowledge platform

The Urban Climate Adaptation Ezine is a newsletter of the INNOVA project. It is the fourth e-zine out of ten. INNOVA is an EU research project aiming to develop innovative services for local challenges relating to climate change. A “climate service”, in simple terms, is a process or (set of) tools that brings climate change data and information to decision- or policy-makers. The climate information is presented in a way that makes sense to these users, is specific for their unique problem, and is easy to incorporate into their own work processes. Climate projections, which are simulations of possible future climate based on the scenarios of greenhouse gases, is normally the key element of climate services.

INNOVA aims to show how climate services can support the adaptation efforts of three European cities, and two small island states. These are: **Kiel Bay** in Germany, **Nijmegen** in The Netherlands, **Valencia** in Spain, and finally, the French West-Indies Islands of **Guadeloupe & Martinique**.

These locations are so called “innovation hubs” and are the testing ground for the development of climate services for specific and local issues related to climate change impacts. These four hubs are also generally representative of many other local areas and issues around the globe.

They connect adaptation to climate change with local economic development, urban and rural planning and many other real-world issues. INNOVA values social alongside that of scientific innovation and the needs and ultimate benefit of the stakeholders are at the heart of the project.

INNOVA is funded by the EU Programme entitled ERA4CS.

This ezine has been produced for INNOVA

by
Wim Timmermans & Fokke de Jong (Wageningen Environmental Research)
with Martine Collard and Erick Stattner (Universite des Antilles, France), Harry Ozier-Lafontaine (Inra French Antilles and Guyana)
and Louis Celliers (Helmholtz Center Geesthacht, Centre for Materials and Coastal Research, Germany)
and Daphne de Bruijn & Harry Harsema (Blauwdruk Publishers)
April 2019