

Assessing surface solar radiation variability and trends in the SWIO from BSRN-like measurements over Reunion island: proposal for a new site

Béatrice MOREL, Patrick JEANTY, Mathieu DELSAUT, Miloud BESSAFI, Christian BROUAT, Yannis HOARAU, Ludovic ODDOZ

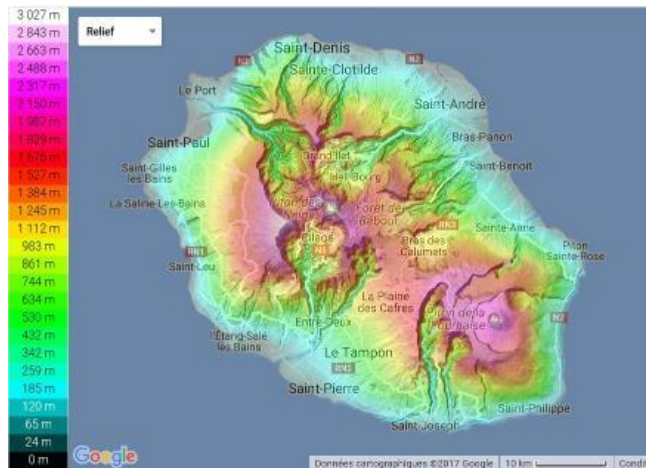
15th BSRN Workshop, Boulder, July 16-20, 2018

Introduction

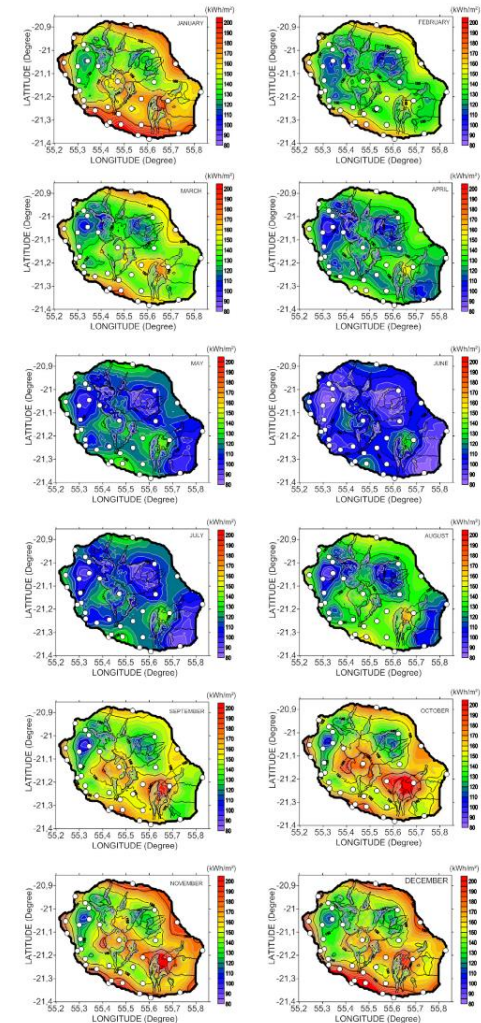


Données cartographiques ©2018 Google 500 mi

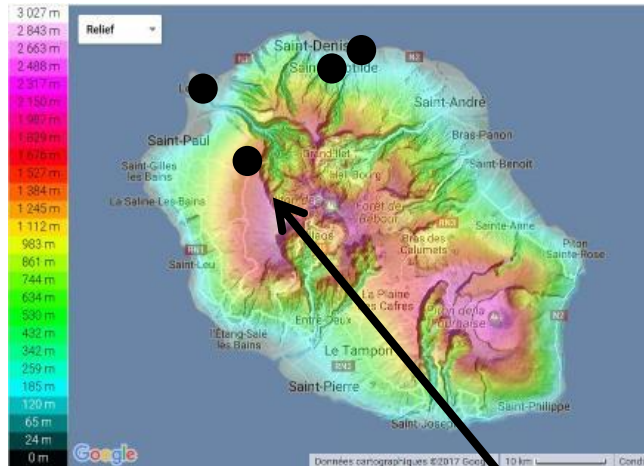
Introduction



Bessafi et al. 2018



Introduction



OPAR
Observatoire de Physique
de l'Atmosphère de la Réunion



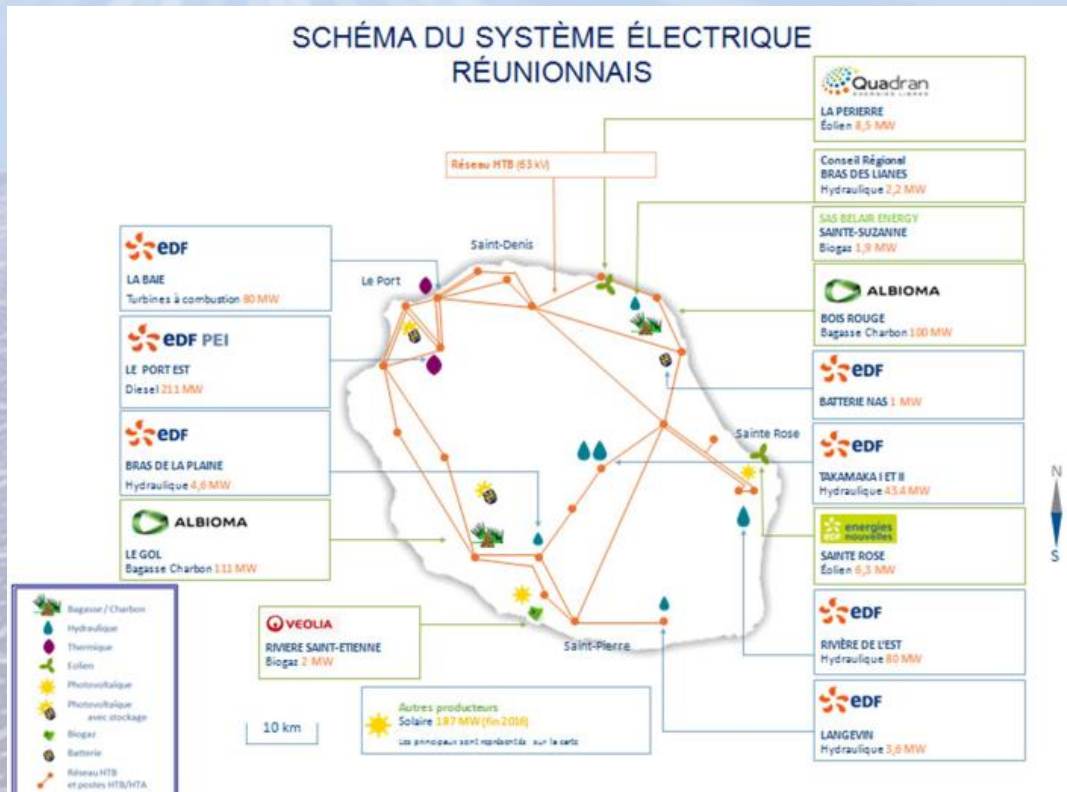
Maïdo Observatory



Introduction

Reunion island: energy context

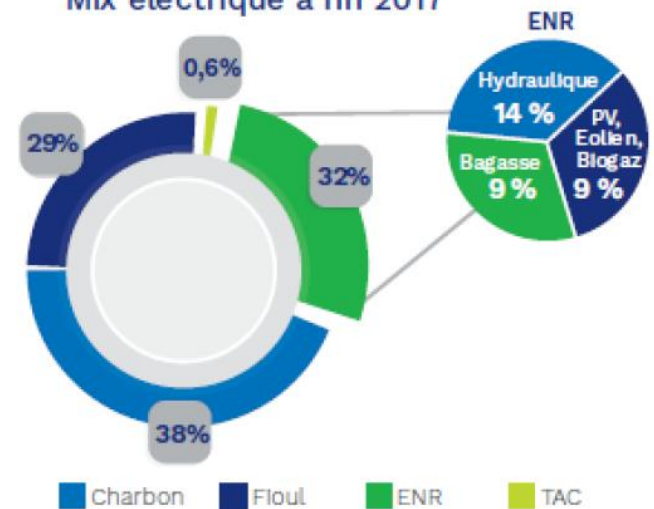
A non-interconnected area



32%
of RE



Mix électrique à fin 2017



Introduction

Reunion island: energy context

Energy Transition Law for Green Growth



Regional objectives

2020



2030



Development of RE

Introduction

LE²P: Smart management of solar energy

Topic 1 – Solar resource variability

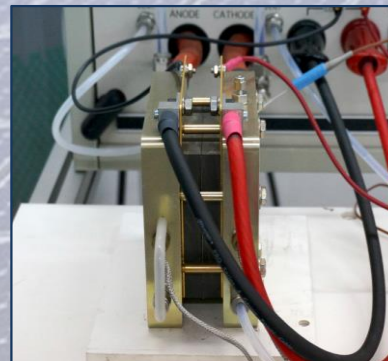
Topic 2 – Energy conversion and storage

Topic 3 – Energy optimization

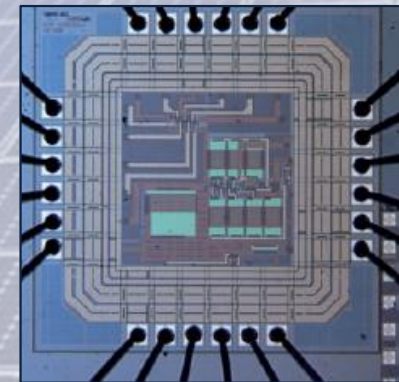
radiative assessment



fuel cell hybrid system



WSN²



Introduction

LE²P: Smart management of solar energy

Topic 1 – Solar resource variability

Pyranometers



Climate variability and changes in solar energy over Reunion Island and in the SWIO

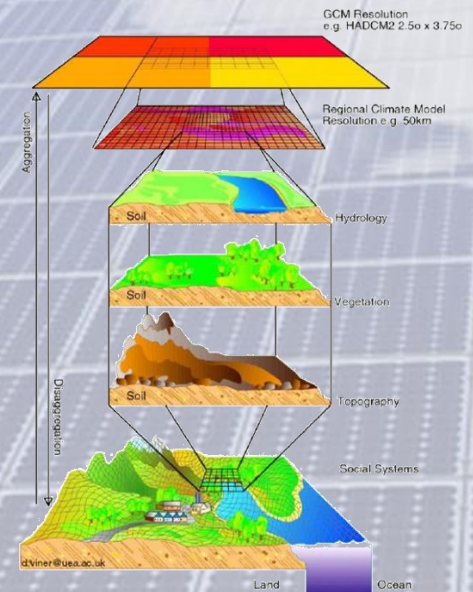
Observations

Regional Climate Modelling



Satellite

RCM



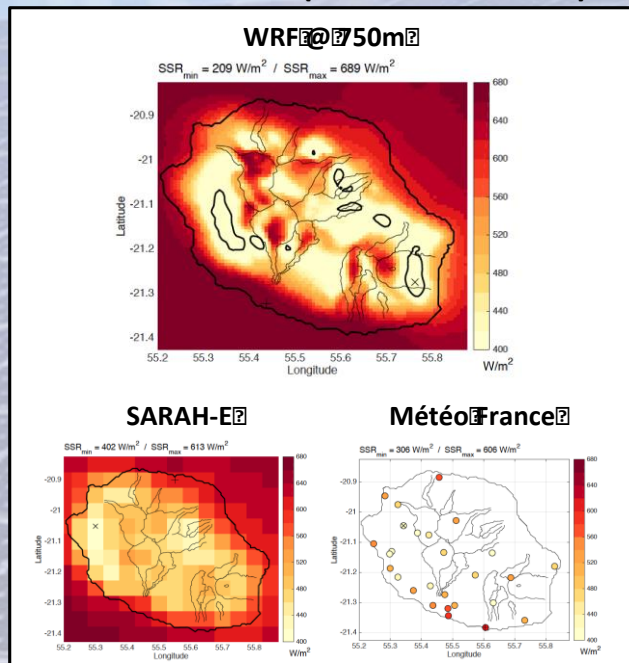
Introduction

LE²P: Smart management of solar energy

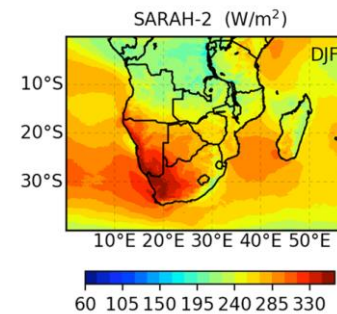
Topic 1 – Solar resource variability

Tang et al. 2018

Seasonal mean (NDJFMA 2000-01)

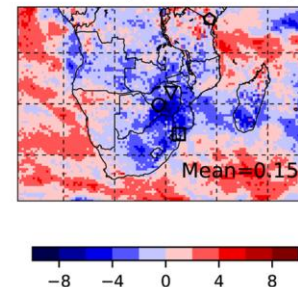


Seasonal means (1990-2005)



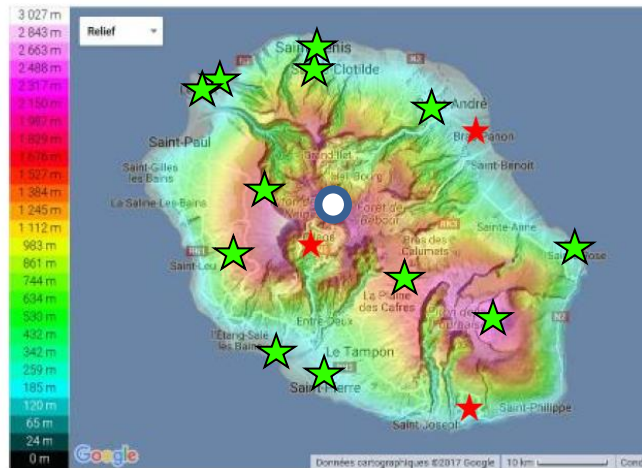
Trends (1990-2005)

SARAH-2 (W/m² per decade)



Sites and instrumentation

LE²P station map



REUNION :

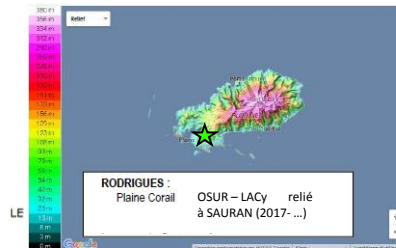
Moufia	site de référence (2008 - ...)
Bois de Nêfles	RCI_GS site EDF (2012 - ...)
Port-Est	RCI_GS site EDF (2012 - ...)
mairie du Port	GEO_SUN relié à SAURAN (2015 - ...)
St-André	RCI_GS site EDF (2012 - ...)
Bras-Panon	RCI_GS (2010 - 2014)
Maïdo	OPAR ULB – BIRA (2012 - ...)
Piton des Neiges	SWIO-Energy site d'altitude (2019 ?)
Cilaos	projet Enertime (2013 – 2016)
St-Leu	RCI_GS site EDF (2012 - ...)
Pl. des Cafres	OSUR - OVPF (2016 - ...)
Cratère Bory	OSUR – OVPF (2016 - ...)
Riv. -St-Louis	(2017 - ...)
St-Pierre	RCI_GS site EDF (2012 - ...)
St-Joseph	(2014 – 2015)

(de haut en bas, de gauche à droite)

MAURICE :

Bras d'Eau	AAP Région relié à SAURAN (2016 - ...)
RoseHill	US-net (2019 ?)
Trou aux Cerfs	SWIO-Energy site d'altitude (2019 ?)

(de haut en bas, de gauche à droite)



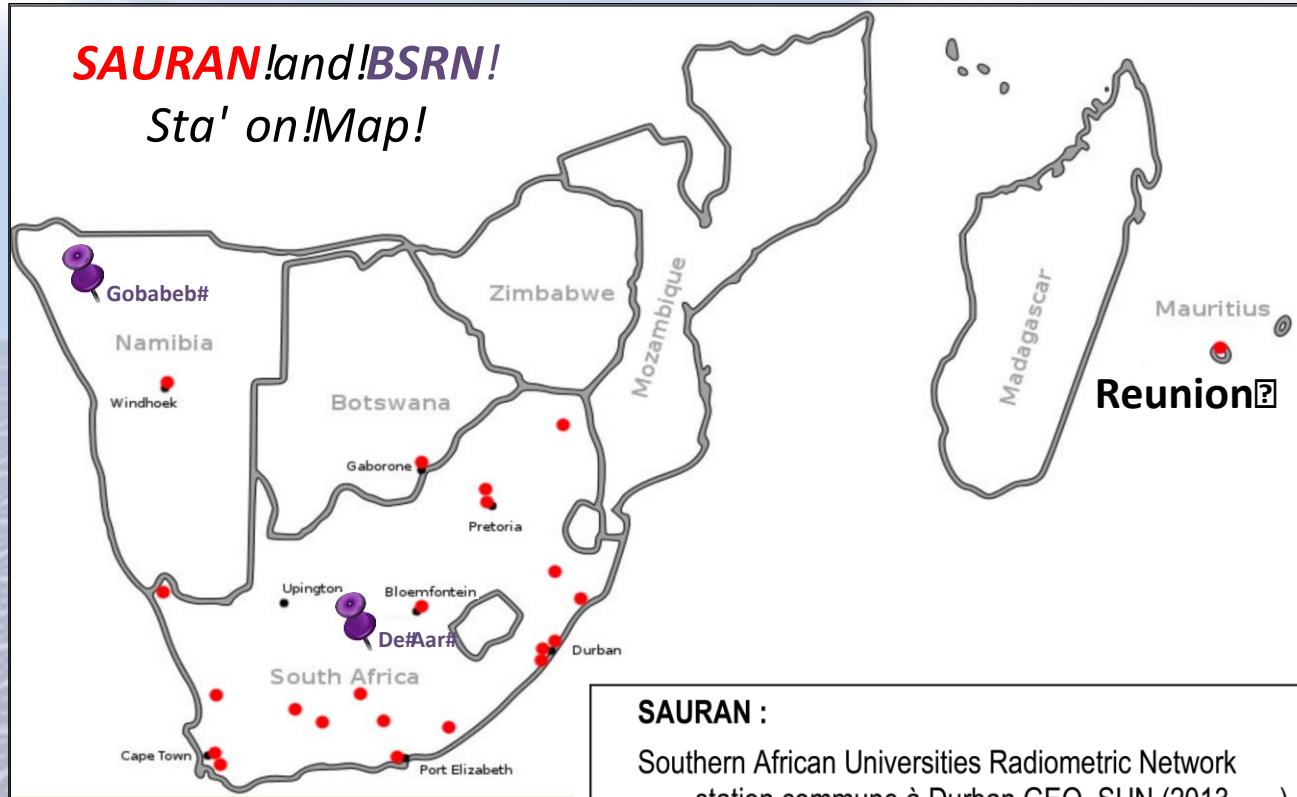
- ★ running
- ★ closed
- future



AFRIQUE DU SUD :

Durban	GEO_SUN relié à SAURAN (2013- ...)
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Sites and instrumentation



SAURAN :
 Southern African Universities Radiometric Network
 station commune à Durban GEO_SUN (2013 - ...)

+	Réunion	mairie du Port
	Maurice	Bras D'Eau
	Rodrigues	Plaine Corail

Sites and instrumentation

Instrument	Measurement	Product Manufacturer	Calibration
Sunshine Pyranometer	SW GHI and DHI ($W.m^{-2}$)	SPN1 Delta-T Devices	June 26 th , 2018 (Reunion, Moufia)
Multi-Weather Sensor	T ($^{\circ}C$), RH (%), p (hPa), Wnd spd ($m.s^{-1}$) and direction ($^{\circ}$), TPR (mm)	WXT520 Vaisala	/
Measurement and Control Datalogger		CR1000 Campbell Scientific	Yes (factory)

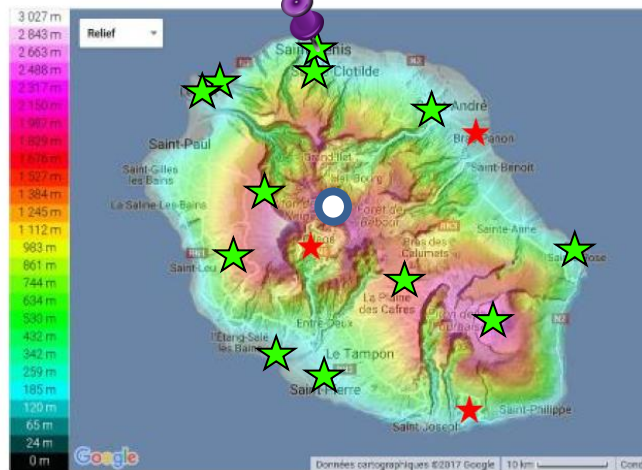


Sites and instrumentation

Instrument	Measurement	Product Manufacturer	Calibration
Sun tracker	/	Solys GD Kipp & Zonen	/
Pyranometer	SW GHI and DHI ($W.m^{-2}$)	CMP22 Kipp & Zonen	July 03 rd , 2017 (Davos)
Pyrheliometer	SW DNI ($W.m^{-2}$)	CH1 Kipp & Zonen	May 16 th , 2017 (Davos)
Pyrgeometer	LW downward irradiance ($W.m^{-2}$)	CGR4 Kipp & Zonen	June 21 st , 2017 (Davos)
UV Radiometer	SW UV-A and erythema horizontal irradiance ($W.m^{-2}$)	UVS-AE-T Kipp & Zonen	Aug. 08 th , 2017 (Davos)

Sites and instrumentation

LE²P station map



REUNION :

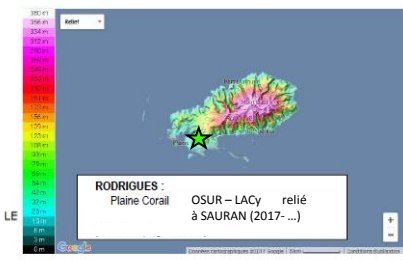
Moufia	site de référence (2008 - ...), station BSRN
Bois de Nêfles	RCI_GS site EDF (2012 - ...)
Port-Est	RCI_GS site EDF (2012 - ...)
mairie du Port	GEO_SUN relié à SAURAN (2015 - ...)
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Riv.-St-Louis	(2017 - ...)
St-Pierre	RCI_GS site EDF (2012 - ...)
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(de haut en bas, de gauche à droite)

MAURICE :

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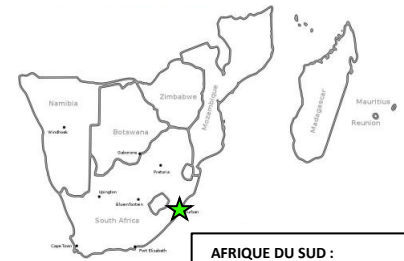
(de haut en bas, de gauche à droite)



RODRIGUES :

Plaine Corail	OSUR – LACY relié à SAURAN (2017- ...)
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- ★ running
- ★ closed
- future



AFRIQUE DU SUD :

Durban	GEO_SUN relié à SAURAN (2013- ...)
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Sites and instrumentation



West/+3.3°

N-W/-0.5°

North/-0.5°

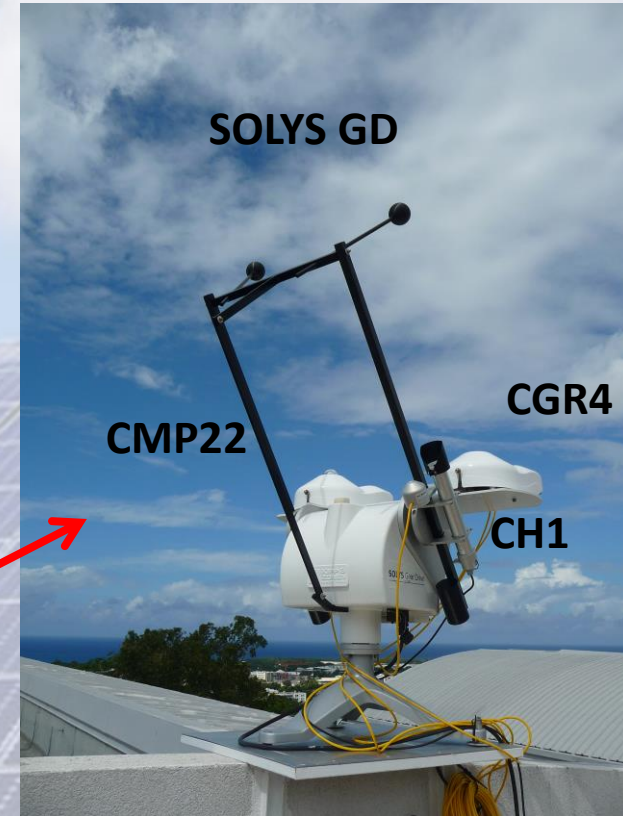
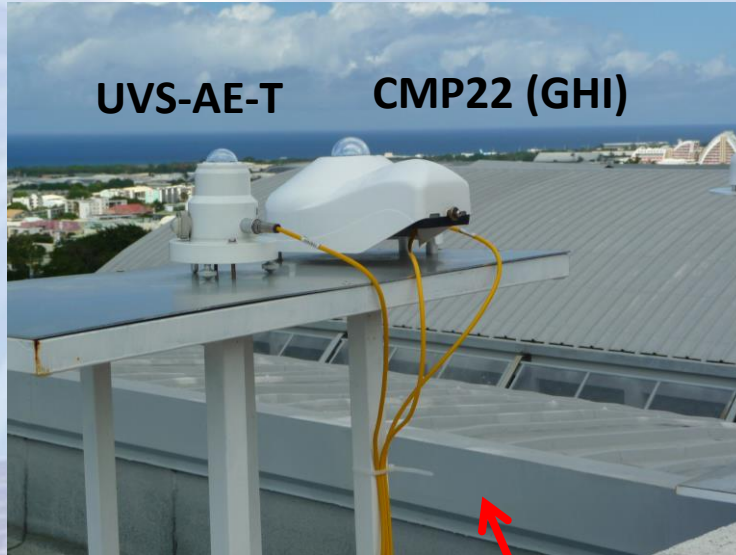
N-E/-0.5°

East/-0.4°

S-E/+6.3°



Sites and instrumentation



Quality management

Calibration



9060/9846/9847/17025



Indoor calibration



Outdoor calibration

Quality management

QC *based on BSRN range tests*

Calibration



9060/9846/9847/17025



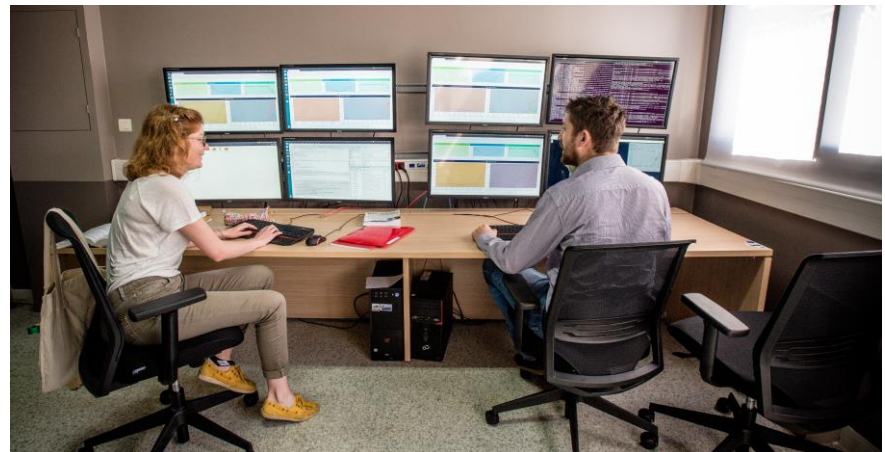
Indoor calibration



Outdoor calibration



+ visual inspection



Quality management

QC

Calibration



9060/9846/9847/17025

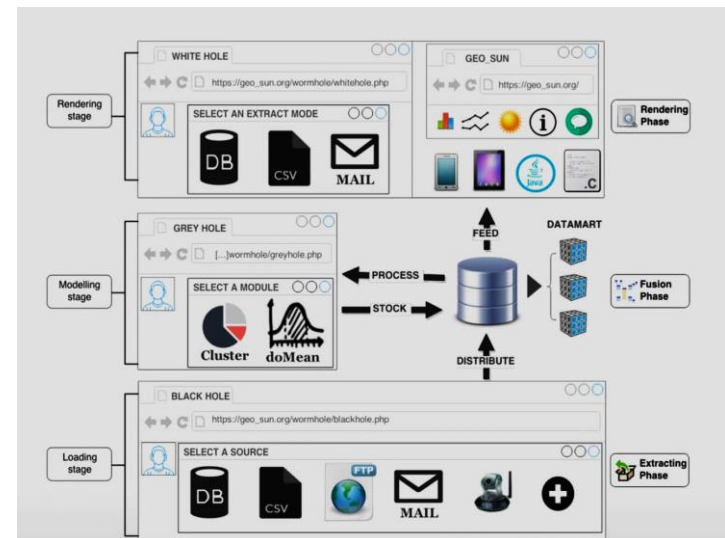


Indoor calibration

Outdoor calibration



DWH



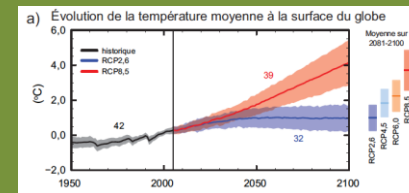
Perspectives

Start the **SWIO-Energy*** project

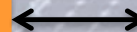
* Solar and Wind Energy in the Indian Ocean



Climate variability and changes in local climate of Reunion and Mauritius islands and impacts on solar and wind energy



Enhanced observational means

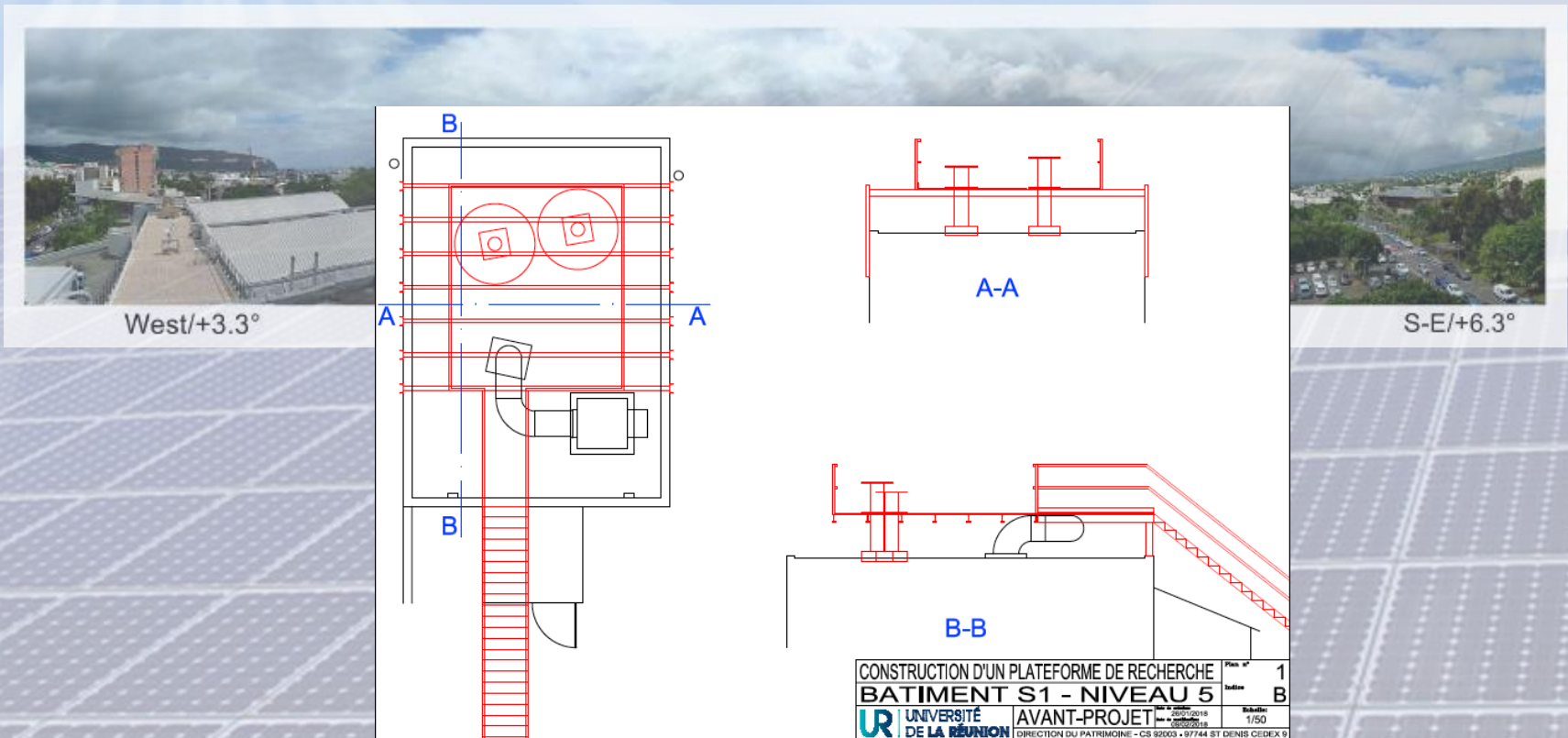


Simulations of present-day and future climate at local scales (~1km)

Perspectives

Start the **SWIO-Energy** project

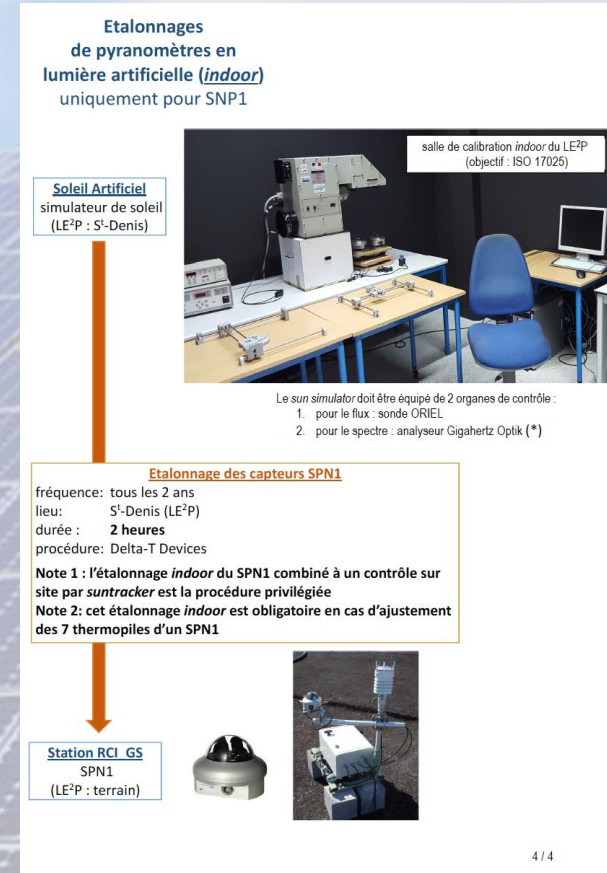
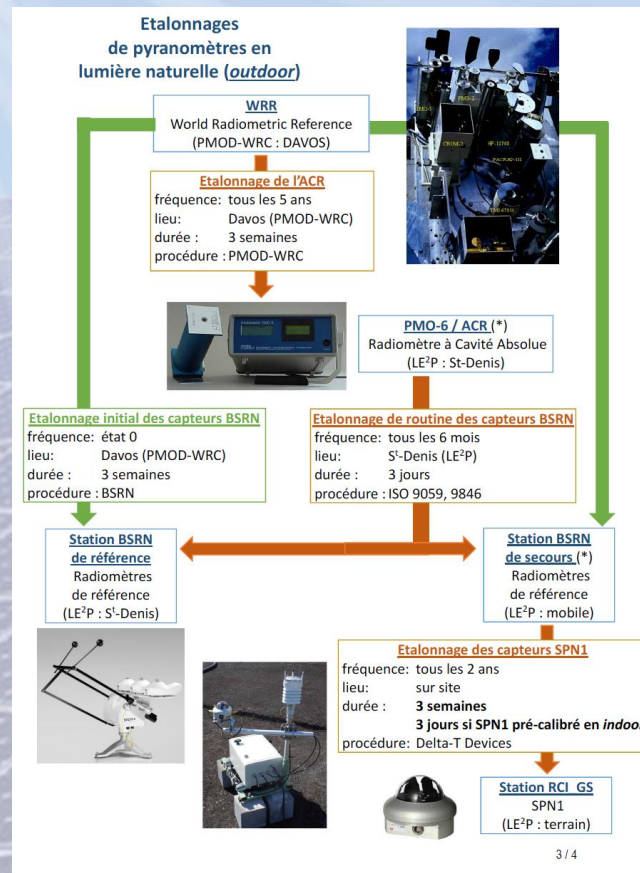
Platform



Perspectives

Start the SWIO-Energy project

Calibration





Thank you