Introduction to Practical MOOC Development: Crop Calendar Case

Anna Boqué-Ciurana
Enric Aguilar
Jon Xavier Olano Pozo

Jon Xavier Olano Pozo
jonxavier.olano@urv.cat
@jonolanopozo

Bs. Sociology (2011)

MsC. Territorial Planning (2014)

PhD. Tourism (2019)

Climate Services for Tourism (2020)

Climate Services and Capacity Building (2022)

Dinning room Manager (2009)

PreDoc Researcher (2016)

Post-Doc Researcher (2019)

Lecturer (2020)

Project Manager and Researcher (2020)

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- Is the public University of Southern Catalonia
- Decentralized Campus on Tarragona, Reus, Tortosa, Vila-Seca, El Vendrell and Vilafranca del Penedès.
- University comprises 24 Research Departments that annually welcome 12.000 undergraduate students, 2.000 master's students and 1.200 PhDs. URV has developed a
- Placed on the first five spanish universities in terms or research outputs (first in Chemistry)
- 112 in Young World University Times Higher Education
- Member of Aurora Network

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RESEARCH ON SUSTAINABILITY, CLIMATE CHANGE AND ENERGY

KNOWLEDGE TRANSFERENCE TO PRIVATE AND PUBLIC ACTORS

CAPACITY BUILDING ON HIGH EDUCATION, SCHOOLS, PROFESIONAL ORGANIZATIONS AND GENERAL PUBLIC.

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2. The Research Institute on Sustainability, Climate Change and Energy Transition.

- Basic Climate Change Science
- Climate Economics and Territorial Analysis
- Climate Justice and Governance, Environmental law
- Climate and contamination impacts on human (health and behaviour) and ecosystems
- Technological solutions
- Climate and Enviromental education

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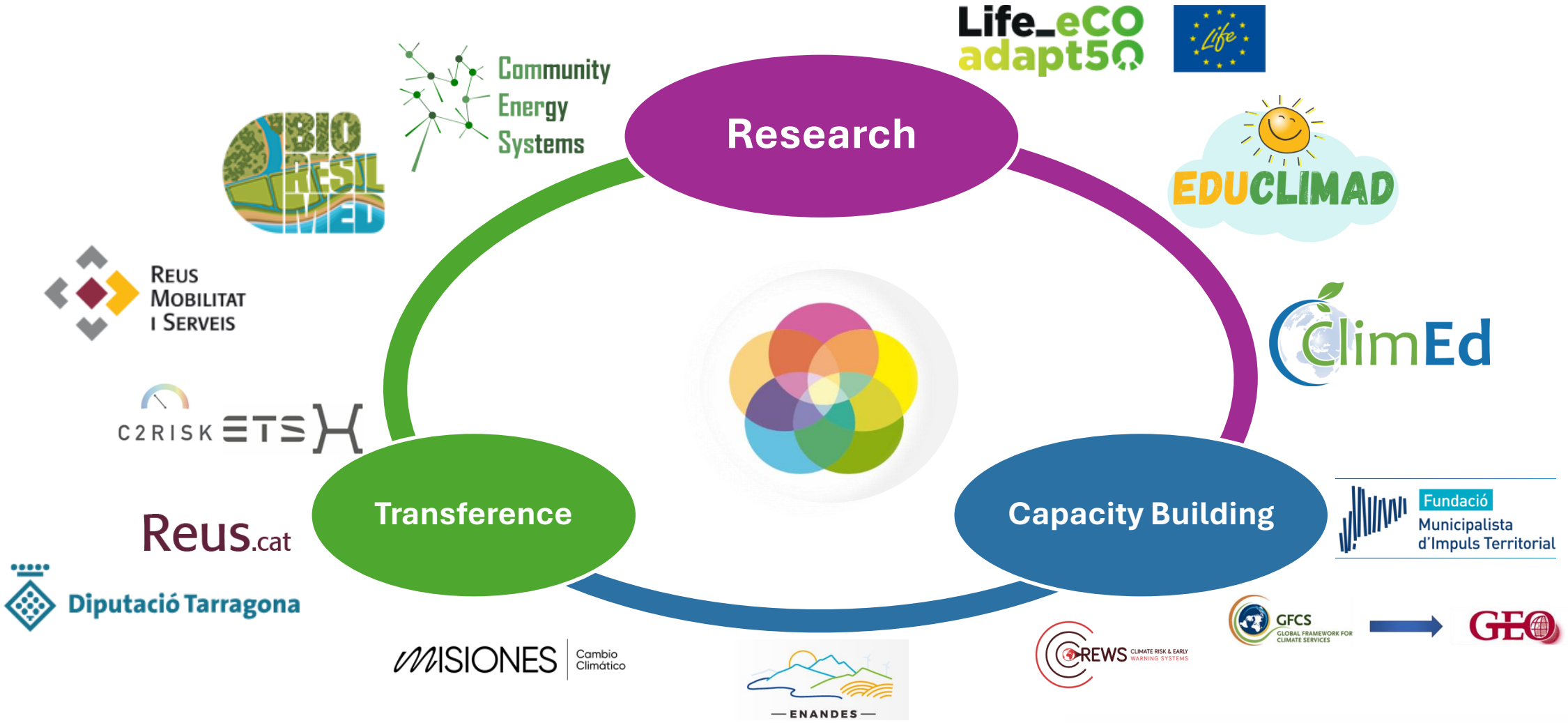
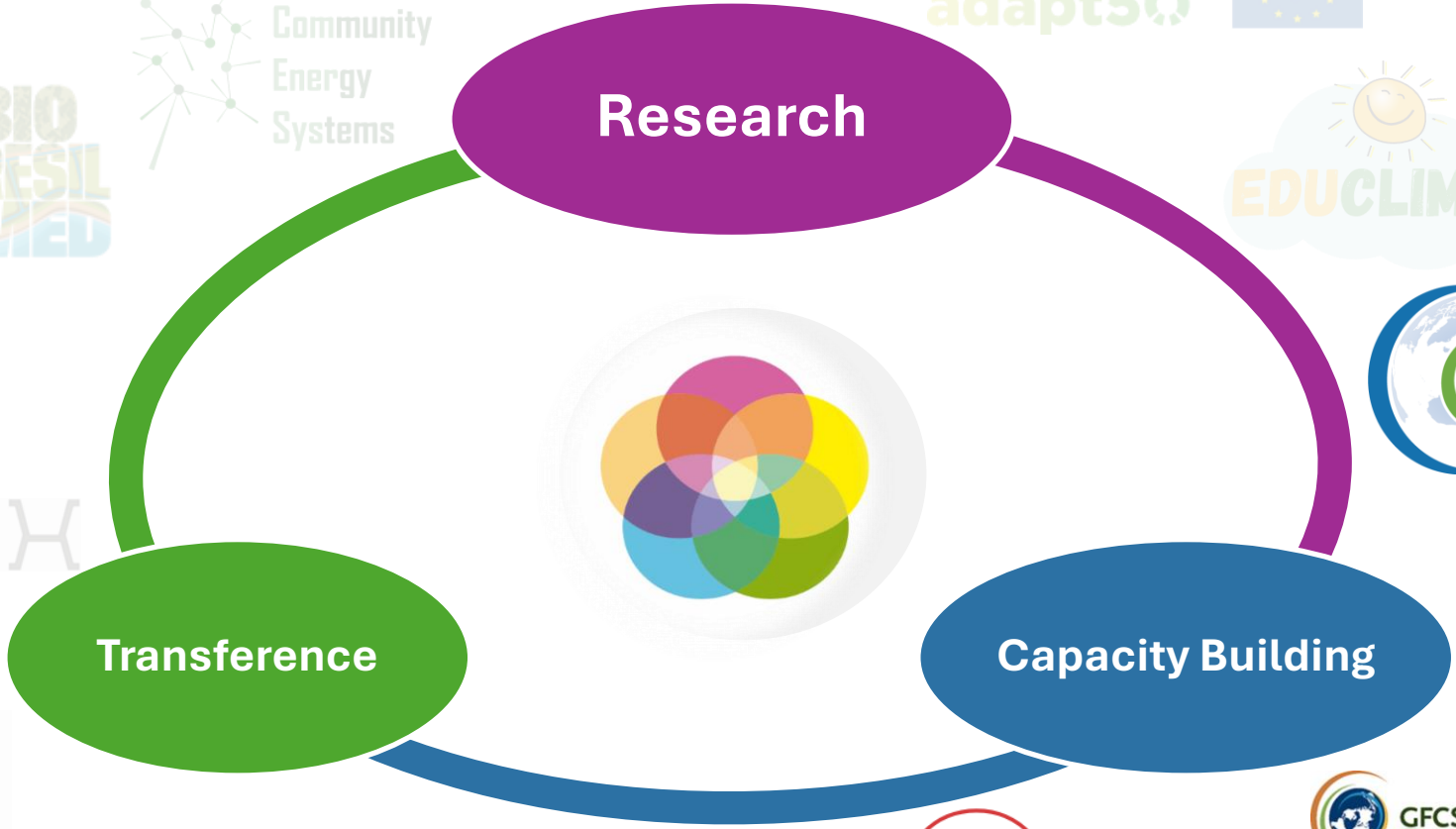
Ongoing Projects



Ongoing Projects



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But, today....

Also, professor on Open University of Catalonia

UOC

- **Established:** 1995, headquartered in Barcelona
- **Pioneer in Online Education**
  - One of Europe's first fully online universities
  - Recognized for innovative e-learning methodologies
- **Global Reach**
  - Over 70,000 students from more than 100 countries
  - Offers bachelor's, master's, and doctoral programs
- **Teaching Model**
  - Flexible and asynchronous online learning
  - Emphasis on continuous assessment and collaborative projects
- **Research & Innovation**
  - Focus on educational technology, digital transformation, and lifelong learning

My today show

MOOC on Climatological Crop Calendars for a climatic zones with a double rainy sessions

H5P tool to develop MOOC contents

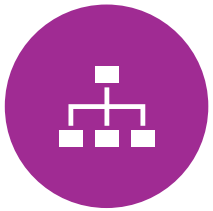
Canva as LMS. Pros and Contras.

Agenda. Sesion 1

WHAT IS A MOOC?

WHY DEVELOP A MOOC ON CROP CALENDARS?

STEPS IN MOOC DESIGN AND DEVELOPMENT



CONTENT STRUCTURE, ASSESSMENT, AND ENGAGEMENT

TESTING MOOC

Q&A

Setting the Context: Why MOOCs?

Setting the Context Why MOOCs?

- Global Shift in Education:
  - Increasing demand for flexible, online education
  - Digital transformation affecting traditional learning models

Setting the Context: Why MOOCs?

- **Equitable Access**
  - Reaches remote or underserved communities
  - Reduces cost barriers compared to in-person courses

Setting the Context: Why MOOCs?

- **Scalability**
  - Potential to enroll thousands of learners simultaneously
  - Broad dissemination of specialized knowledge

Setting the Context: Why MOOCs?

- **Lifelong Learning Trend**
  - Suits professionals and students continuously updating skills
  - Encourages self-directed learning culture

Definition of a MOOC

Massive

Large-scale enrollment (often thousands of participants)

Open

Generally free or low-cost, with minimal prerequisites

Accessible to a global audience

Online

Delivered entirely over the internet

Self-paced or scheduled sessions

Course

Structured curriculum with learning objectives

Often includes multimedia lectures, assessments, and forums

Importance and Growth of Online Learning

- **Market Trends**
  - Steady global increase in online course enrollments
  - Growth fueled by technology adoption and internet penetration

Importance and Growth of Online Learning

- **Flexibility & Convenience**
  - Self-paced study accommodates varied schedules
  - Encourages work-life-learning balance

Importance and Growth of Online Learning

- **Rapid Skill Development**
  - Quick creation and updating of online courses to meet emerging needs
  - Allows immediate implementation of newly acquired skills

The Climatological Crop Calendar Case.

1. Background

A crop calendar

A CROP CALENDAR IS A COMPREHENSIVE SCHEDULE OF THE CRITICAL STAGES IN A CROP'S GROWTH CYCLE, INDICATING OPTIMAL TIMINGS FOR PLANTING, FERTILIZING, IRRIGATING, PEST CONTROL, AND HARVESTING.

OFTEN DISPLAYED AS A TIMELINE OR MONTHLY CHART.

HELPS FARMERS AND EXTENSION WORKERS PLAN ACTIVITIES ACCORDING TO LOCAL CLIMATE, RAINFALL PATTERNS, AND RESOURCE AVAILABILITY.

Why is important?

- Planning & Efficiency
  - Ensures timely field operations (planting, weeding, harvesting).
  - Reduces wastage of resources (e.g., water, fertilizer).

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Why is important?

- Resource Allocation
  - Helps forecast labour needs and input requirements.
  - Improves budgeting by anticipating costs over the season.
- Yield Optimization
  - Aligns crop interventions with critical growth phases.
  - Minimizes crop stress from late planting or missed fertilization windows.

Why Focus on a Crop Calendar MOOC?

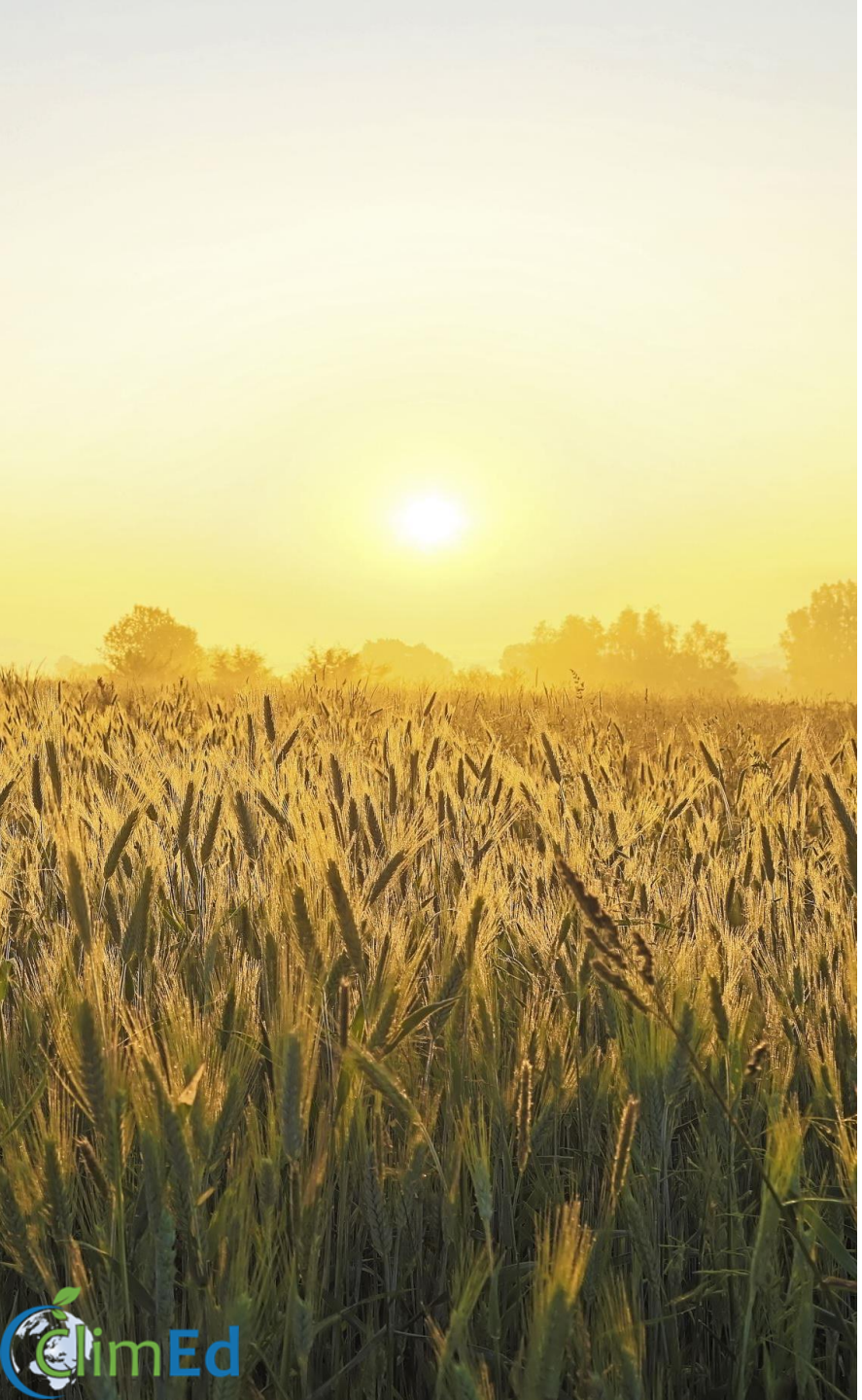
- **Filling Knowledge Gaps**
  - Many farmers rely on tradition rather than updated data or research.
  - Many existing Crop Calendars are done with a bis scale or national climate data → Crop calendar with specific station data.
  - A MOOC democratizes access to best practices and scientific insights.

Why Focus on a Crop Calendar MOOC?

- **Reaching Diverse Farming Communities**
  - Online courses can be accessed by learners in remote areas.
  - Multi-language or region-specific versions expand impact.

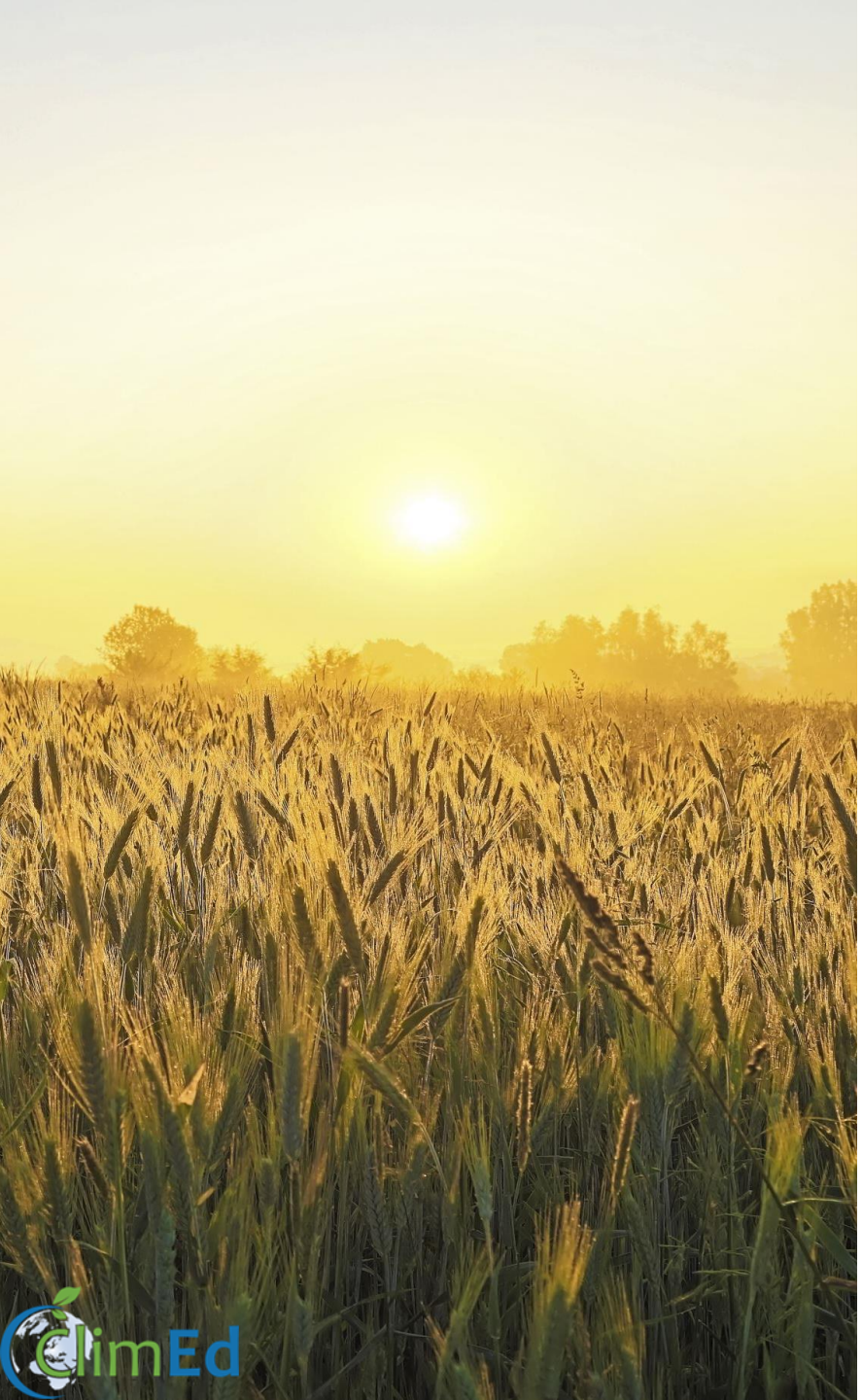
Why Focus on a Crop Calendar MOOC?

- **Scalability of Training**
  - (At the best option). Thousands can enrol simultaneously, from students to extension workers.
  - Consistent learning materials ensure uniform knowledge transfer.
  - Materials for URV staff to develop same trainings in differen countries and regions



Why climatological crop calendars?

- The UN 2030 Sustainable Development Agenda included achieving Zero Hunger as one of its goals, an effort that relies highly on the resilience and sustainability of agriculture,
- This is threathed by cliamte variability and climate change.
- According to the Food and Agriculture Organization for the United Nations (FAO), this objective is far from being achieved, as over 735 million people faced hunger in 2022 (FAO, 2023).
- The geographical distribution of food insecurity is not even across the globe, with greatest impact in less developed countries where subsistence agriculture is a main land use and economic livelihood.
- The agricultural production cycle is driven by climate and seasonal patterns, particularly the start, duration and end of the wet season, in areas of the globe with defined wet and dry seasons



Why climatological crop calendars?

Aspect	Climatological Crop Calendars	Traditional/Static Crop Calendars
Data Source	Uses real-time and historical climate data, satellite info, and localized weather patterns	Relies on long-standing, often generic, seasonal averages or locally passed-down knowledge
Adaptability	Dynamic, can be updated frequently based on changing weather or climate anomalies	Generally fixed, updated occasionally, slower to respond to sudden climate shifts
Accuracy	Higher precision for planting and harvesting dates, factoring in rainfall, temperature, etc.	May lead to suboptimal timing if weather deviates from historical norms
Complexity & Cost	Requires ongoing data collection, processing, and technical expertise	Simpler to develop and maintain but less responsive to variable conditions
Use Cases	Ideal for regions facing high climate variability or unpredictable weather patterns	Common where climate is relatively stable or resources for data collection are limited

Case Study – Crop Calendars in Africa

- **Scalability of Training**
  - (At the best option). Thousands can enrol simultaneously, from students to extension workers.
  - Consistent learning materials ensure uniform knowledge transfer.

Learning Objectives of the Crop Calendar MOOC

MASTER CLIMATE DATA MANAGEMENT

PERFORM QUALITY CONTROL (QC) AND HOMOGENIZATION ASSESSMENTS

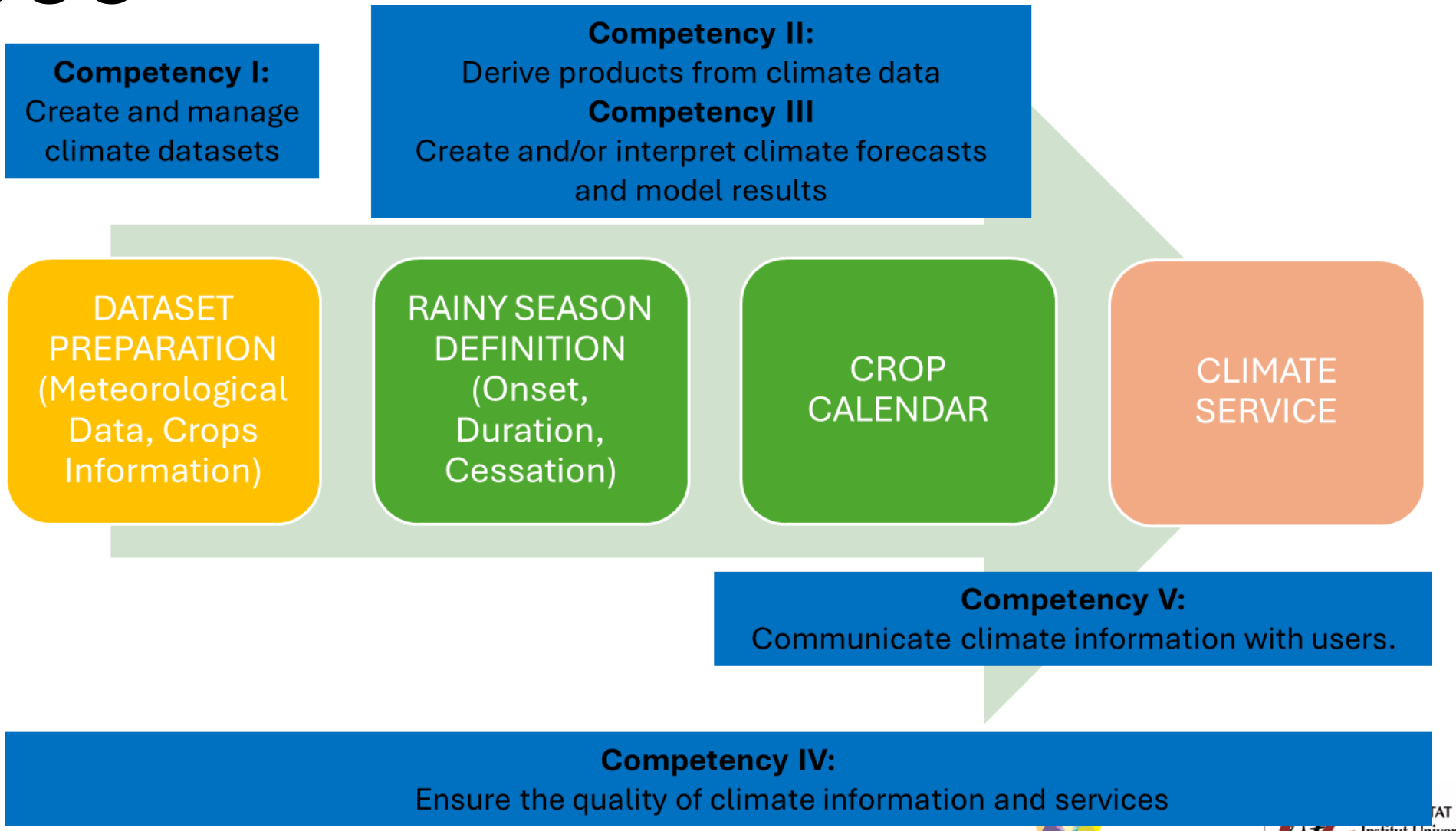
UNDERSTANT AND COMPUTE THE BASIC PARAMETRIZABLE VARIABLES TO KNOW THE KOPPEN CLIMATIC ZONE

COMPUTE AND INTERPRET BASIC CLIMATIC VARIABLES FOR KÖPPEN CLASSIFICATION

PARAMETRIZE RAINY SEASON ONSET AND CESSATION (THRESHOLD-BASED APPROACH)

GENERATE HIGH-QUALITY CLIMATOLOGICAL CROP CALENDARS

Learning Objectives of the Crop Calendar MOOC



Key Considerations. Target Audience

NMHSs workers:

- Professionals who disseminate climatological knowledge and products to local communities.
- Require practical, field-oriented tips and real-life case studies.
- Benefit from community engagement features to share experiences.

Farmers

- May vary in literacy and technological access.
- Require clear, concise explanations and visual aids (infographics, videos).
- Emphasis on **applicability**: step-by-step guidelines they can implement on their farms.

Key Considerations. Target Audience

Agronomists and Experienced Practitioners

- Already have a strong theoretical and practical background.
- Expect more advanced content (data analysis, research updates).
- Value peer collaboration, in-depth discussions, and professional networking opportunities.

Students and New Graduates

- Individuals studying agriculture, environmental science, or related fields.
- Seek foundational knowledge to complement their formal education.
- Need structured, interactive content and clear learning objectives.

Duration & Time Commitment

Short Modules (Micro-learning)

- **Each module could last 10–20 minutes of video plus short quizzes/activities.**
- **Suitable for busy professionals or quick skill refreshers.Students and New Graduates**

Self-Paced

- Learners progress at their convenience, flexibility in scheduling.
- Requires clear navigation and automated feedback systems

Assignments & Assessments

- Plan the intensity of assignments based on target audience time constraints.

MOOC Sumary

Overall Goal

- **Train participants in managing and analysing climate data (quality control, homogenization, and rainy season parameters) and in applying these methods to develop climatological crop calendars.**

Course Structure

- **Theoretical Modules:**
  - Fundamentals of meteorology and climatology for agriculture.
  - Introduction to quality control (QC) and data homogenization methods.
  - Parameters of the rainy season (onset, duration, and cessation) and their agronomic relevance.

Technical Considerations

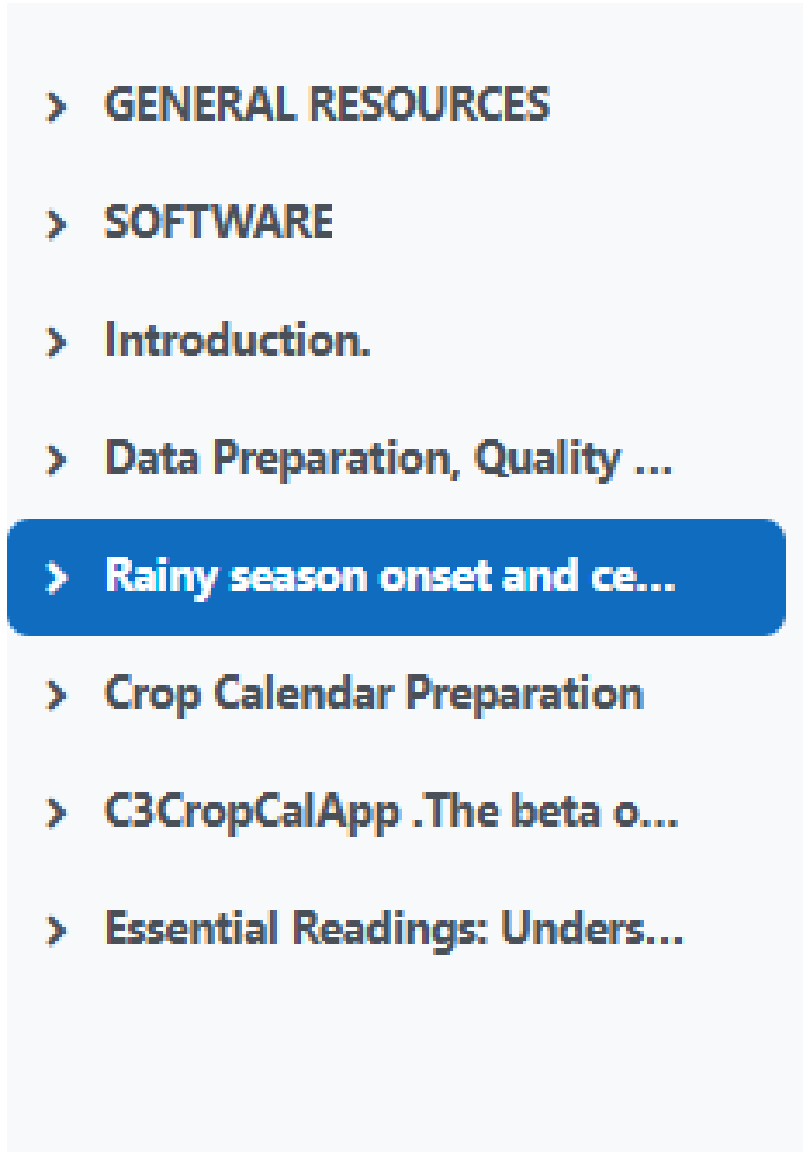
- **Low Data Consumption:**
  - Content primarily in PDF, infographics, and low-resolution videos.
- **Accessible Language:**
  - Clear explanations, avoiding excessive technical jargon.
  - Advanced options available for those with more technical expertise.

MOOC Sumary

- This MOOC is designed to:
  - **Be accessible** in contexts with limited connectivity (light materials, minimal downloads).
  - **Maintain sufficient scientific depth** for training in QC and climate data analysis methods.
  - **Provide practical tools** (scripts and templates) so users without specialized climate or coding backgrounds can manage data effectively.
  - **Offer clear outputs** (tables, charts, calendars) that anyone, whether an expert or not, can interpret and use for agricultural planning.

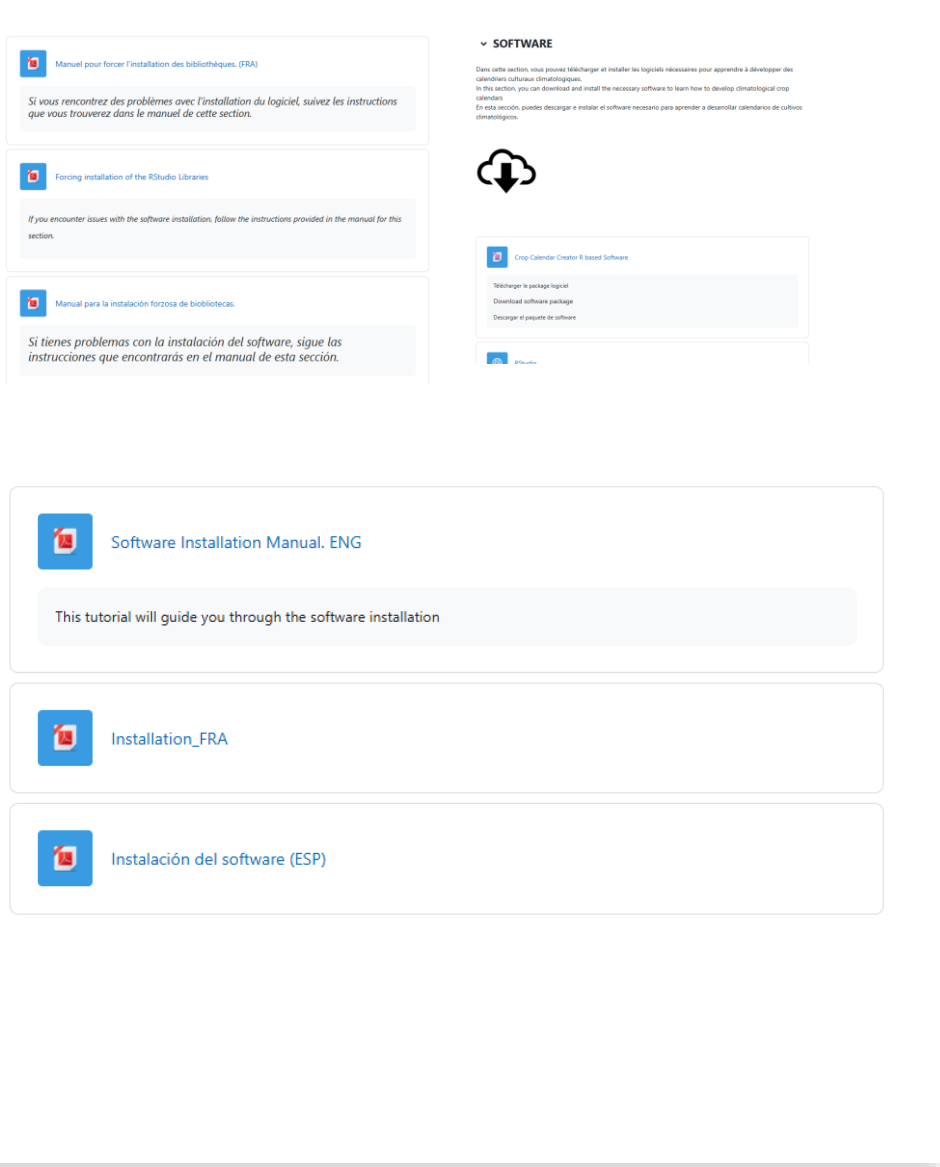
Content Development

General Strcuture



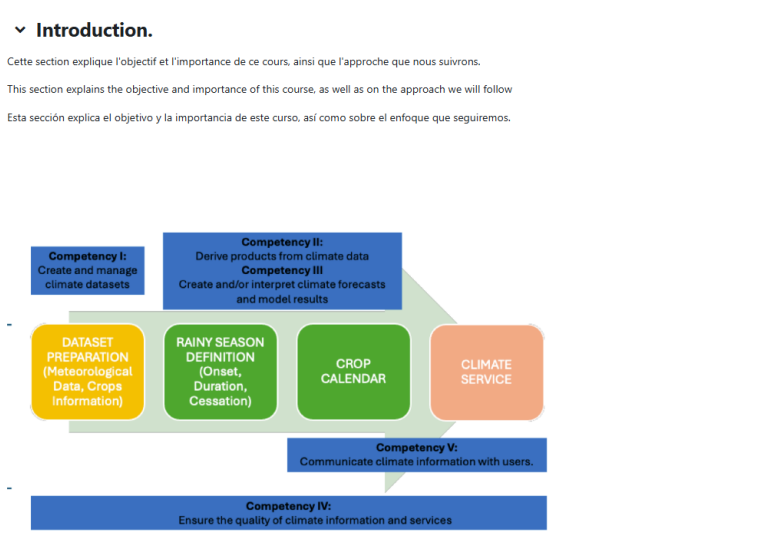
1. General Resources

- Software
  - Crop Calendar Creator
  - Rstudio
  - Manual to install Rstudio and Specific software
  - Manual to force the instalation



1. Why Calendar Crops

- Presentation
- Quizz to evaluate
- Video example, but not video in the course

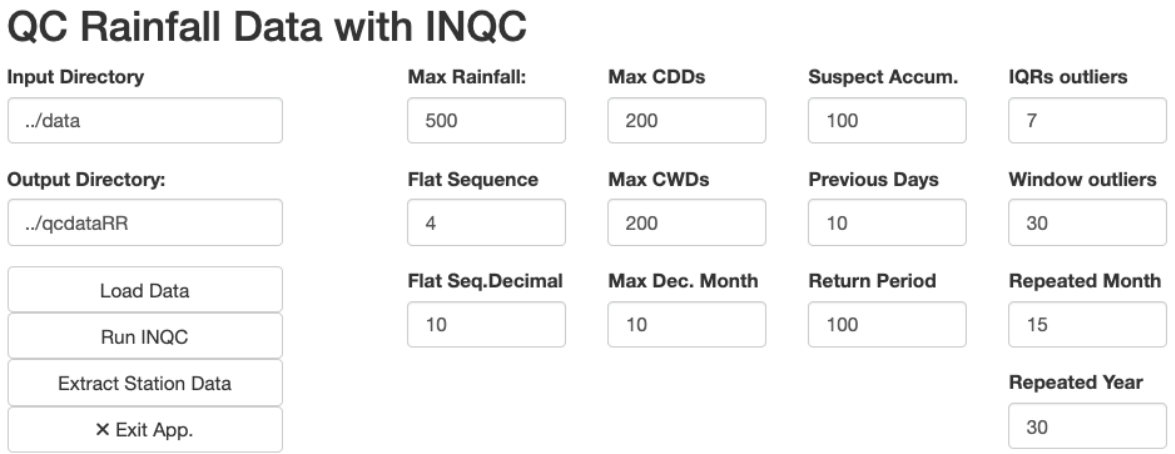


1. Data Management

- Presentation for Data Preparation, QC, and homogenization assessment
- Practice Quality Control Assignement
- Quizzes to evaluate
- Video example, but not video in the course

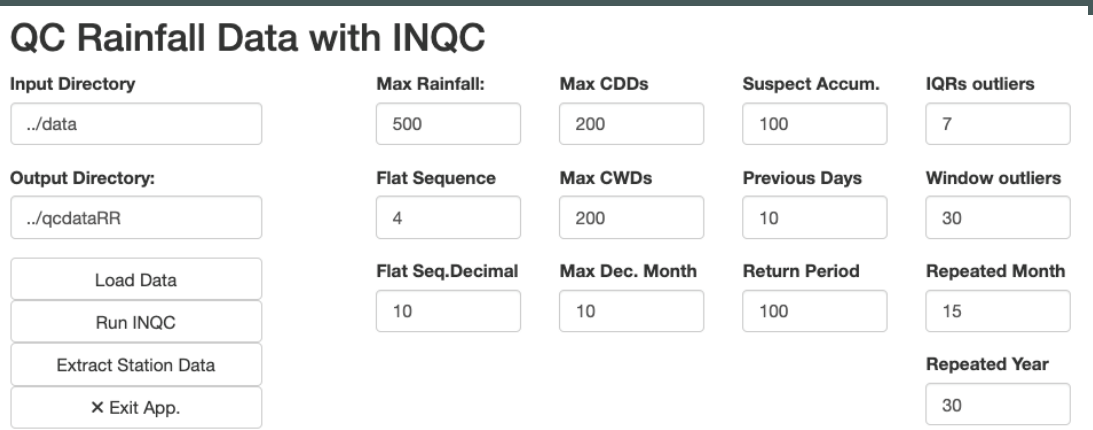
QC tests for precipitacion data (I)

Label	Parameter (default)	Meaning (Category)
large	Max Rainfall (500)	If a precipitation value exceeds the specified value, it is labeled as wrong (1)
small	Non-parameterizable(0)	If a precipitation value does not reach this value, it is labeled as wrong (1)
dryseq	Max CDDs (200)	Maximum number of dry days allowed. If a sequence exceeds it, all values involved are labeled(4)
wetseq	Max CWDs (200)	Same for wet days(4)
susacum	Suspect Accum (100) + Previous Days (10)	If we find a precipitation value equal to or greater than the first preceded parameter of a number of days equal to or greater than the second parameter, it is considered as potential accumulation over different days (2)
iqrout	IQR Outliers (7) + Window outliers (30)	Outliers determined as exceedance of P75/P25 +/- the number of IQRs determined by the first parameter, using a window of days around the day evaluated dimension determined by the second parameter(3)

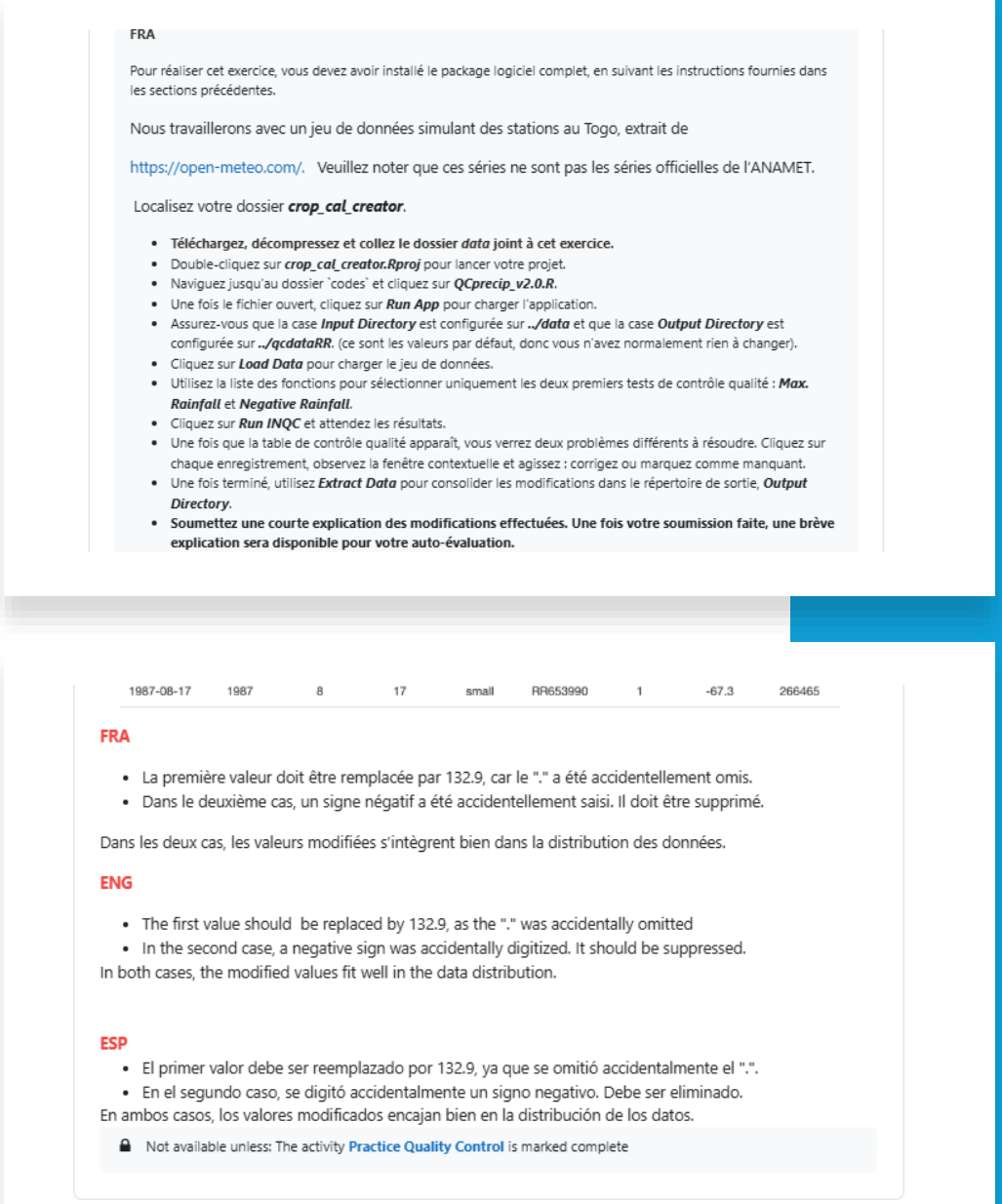


QC tests for precipitacion data (II)

Label	Parameters (default)	Meaning (Category)
flat	Flat Sequence (4)	If a number of consecutive days is located with identical precipitation value (excluding 0.0) greater than that determined by the parameter, the entire sequence is labeled(4)
flatfloat	Flat Seq. Decimal (10)	Same as above, but only for the decimal part: 5.4 and 4.4 share sequence(4)
toomonth	Repeated Month (15)	If a value repeated the times indicated by the parameter is detected, excluding 0.0, the sequence is labeled(4)
tooyear	Repeated Year (30)	Same, for a whole year (4)
pareto	Return Period (100)	Outliers to a fitted Pareto distribution (3)
roundprec	Non-parameterizable(10)	If 10 values are found in a row with the same decimal, the sequence is labeled(4)



1. Data Management. Assignement



FRA

Pour réaliser cet exercice, vous devez avoir installé le package logiciel complet, en suivant les instructions fournies dans les sections précédentes.

Nous travaillerons avec un jeu de données simulant des stations au Togo, extrait de

https://open-meteo.com/. Veuillez noter que ces séries ne sont pas les séries officielles de l'ANAMET.

Localisez votre dossier ***crop_cal_creator***.

- **Téléchargez, décompressez et collez le dossier *data* joint à cet exercice.**
- Double-cliquez sur ***crop_cal_creator.Rproj*** pour lancer votre projet.
- Naviguez jusqu'au dossier `codes` et cliquez sur ***QCprecip_v2.0.R***.
- Une fois le fichier ouvert, cliquez sur ***Run App*** pour charger l'application.
- Assurez-vous que la case ***Input Directory*** est configurée sur ***../data*** et que la case ***Output Directory*** est configurée sur ***../qcdataRR***. (ce sont les valeurs par défaut, donc vous n'avez normalement rien à changer).
- Cliquez sur ***Load Data*** pour charger le jeu de données.
- Utilisez la liste des fonctions pour sélectionner uniquement les deux premiers tests de contrôle qualité : ***Max. Rainfall*** et ***Negative Rainfall***.
- Cliquez sur ***Run INQC*** et attendez les résultats.
- Une fois que la table de contrôle qualité apparaît, vous verrez deux problèmes différents à résoudre. Cliquez sur chaque enregistrement, observez la fenêtre contextuelle et agissez : corrigez ou marquez comme manquant.
- Une fois terminé, utilisez ***Extract Data*** pour consolider les modifications dans le répertoire de sortie, ***Output Directory***.
- **Soumettez une courte explication des modifications effectuées. Une fois votre soumission faite, une brève explication sera disponible pour votre auto-évaluation.**

1987-08-17	1987	8	17	small	RR653990	1	-67.3	266465

FRA

- La première valeur doit être remplacée par 132.9, car le "." a été accidentellement omis.
- Dans le deuxième cas, un signe négatif a été accidentellement saisi. Il doit être supprimé.

Dans les deux cas, les valeurs modifiées s'intègrent bien dans la distribution des données.

ENG

- The first value should be replaced by 132.9, as the "." was accidentally omitted
- In the second case, a negative sign was accidentally digitized. It should be suppressed.

In both cases, the modified values fit well in the data distribution.

ESP

- El primer valor debe ser reemplazado por 132.9, ya que se omitió accidentalmente el ".".
- En el segundo caso, se digitó accidentalmente un signo negativo. Debe ser eliminado.

En ambos casos, los valores modificados encajan bien en la distribución de los datos.

Not available unless: The activity **Practice Quality Control** is marked complete

2. Rainy Session

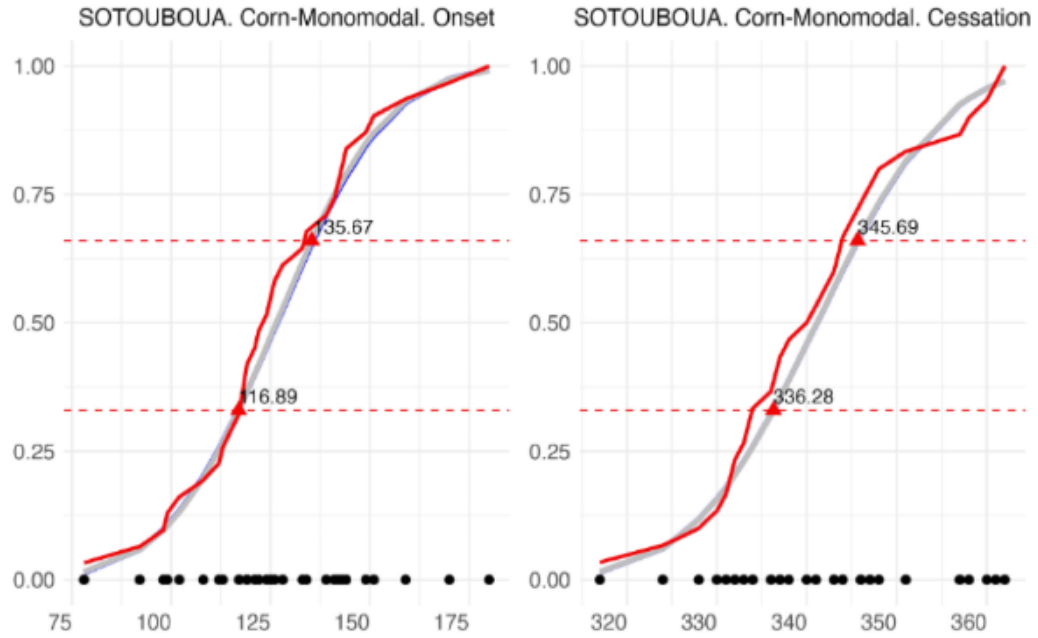
- Tools to define the different rainfall regimes and, subsequently, to parameterize and detect the start and end of the rainy season.
- Practice Quality Control Assignement
- Quizzes to evaluate
- Video example, but not video in the course

Rainy season onset and cessation detection

Dans cette section, nous proposons des outils pour définir les différents régimes pluviométriques et, par la suite, paramétrer et détecter le début et la fin de la saison des pluies.

In this section, we provide tools to define the different rainfall regimes and, subsequently, to parameterize and detect the start and end of the rainy season.

En esta sección, ofrecemos herramientas para definir los distintos regímenes pluviométricos y, a posteriori, parametrizar y detectar el inicio y final de la estación de lluvias



Paramerization of the Threshold Based (Agronomic) method. Onset.

- Threshold based methods involve the definition of different parameters influencing the effective onset of reliable rains from an agricultural point of view.
- The correct detection of the onset is critical, as it is assimilated to the start of the sowing period.
- These parameters include the first day to start looking for possible onsets; an accumulation of rain in a given number of consecutive days; the absence of a given sequence of dry days after the accumulation
- The selection of the parameters is local or, at least, by agroecological zone and must take into account the characteristics of the different crops
- The adjacent table, shows the definitions adopted for corn in Togo and for two different rainfall regimes: Monomodal (North of the Country) Bi-Modal (South of the Country).

Season	Onset
Monomodal	First day after March, 15th accumulating 20 mm in 3 days and with less than 10 consecutive dry days in the following 30 days
Bimodal (long rains)	Same as for monomodal, but after 1st February.
Bimodal (short rains)	Same as for monomodal, but after August, 15th

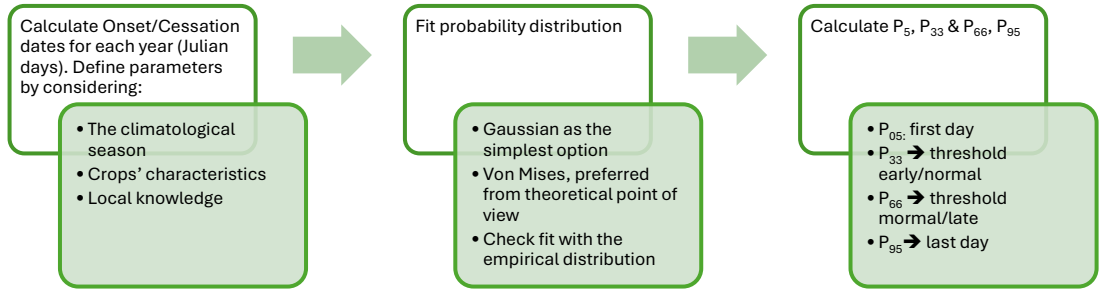
Paramerization of the Threshold Based (Agronomic) method. Cessation

- Threshold based methods involve the definition of different parameters influencing the effective cessation of reliable rains from an agricultural point of view.
- The correct detection of the cessation is critical to understand whether the crops will be harvested with or without water availability
- The parametrization looks at identifying the first sequence of a given number of days accumulating less than a prefixed amount of rain
- The adjacent table, shows the definitions adopted for corn in Togo and for two different rainfall regimes: Monomodal (North of the Country) Bi-Modal (South of the Country).

Season	Cessation
Monomodal	First day after October, 1st accumulating less than 15 mm. in 17 days
Bimodal (long rains)	Same as for monomodal, but after 1st July.
Bimodal (short rains)	Same as for monomodal, but after October, 15th

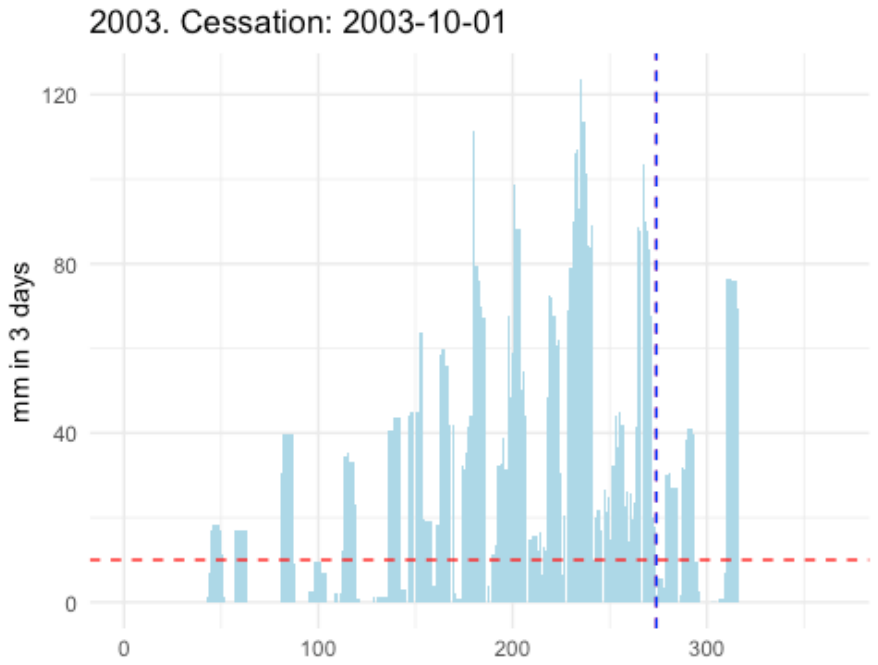
Fitting parametrical distributions to the empirical season for the determination early, normal and late onsets and cessations

- Onsets and cessations can be determined using rainfall data for each year
- Using a long enough rainfall series (see Step 1 presentations), we generate an empirical time series of onsets and cessations, expressed in Julian days (1 to 366)
- We can compute percentiles over the empirical distribution to divide each series (onsets and cessations) in early (p5-p33), normal (p33-p66) and late (p66-p95) periods using percentiles
- In order to improve our estimates done over a limited number of observations (years) we can fit a parametrical probability distribution. Even though the Gaussian distribution has been traditionally the preferred one, given the cicular nature of the data (i.e., day 1 is closer to day 365 than to day 4), we suggest the usage of the Von Misses distribution

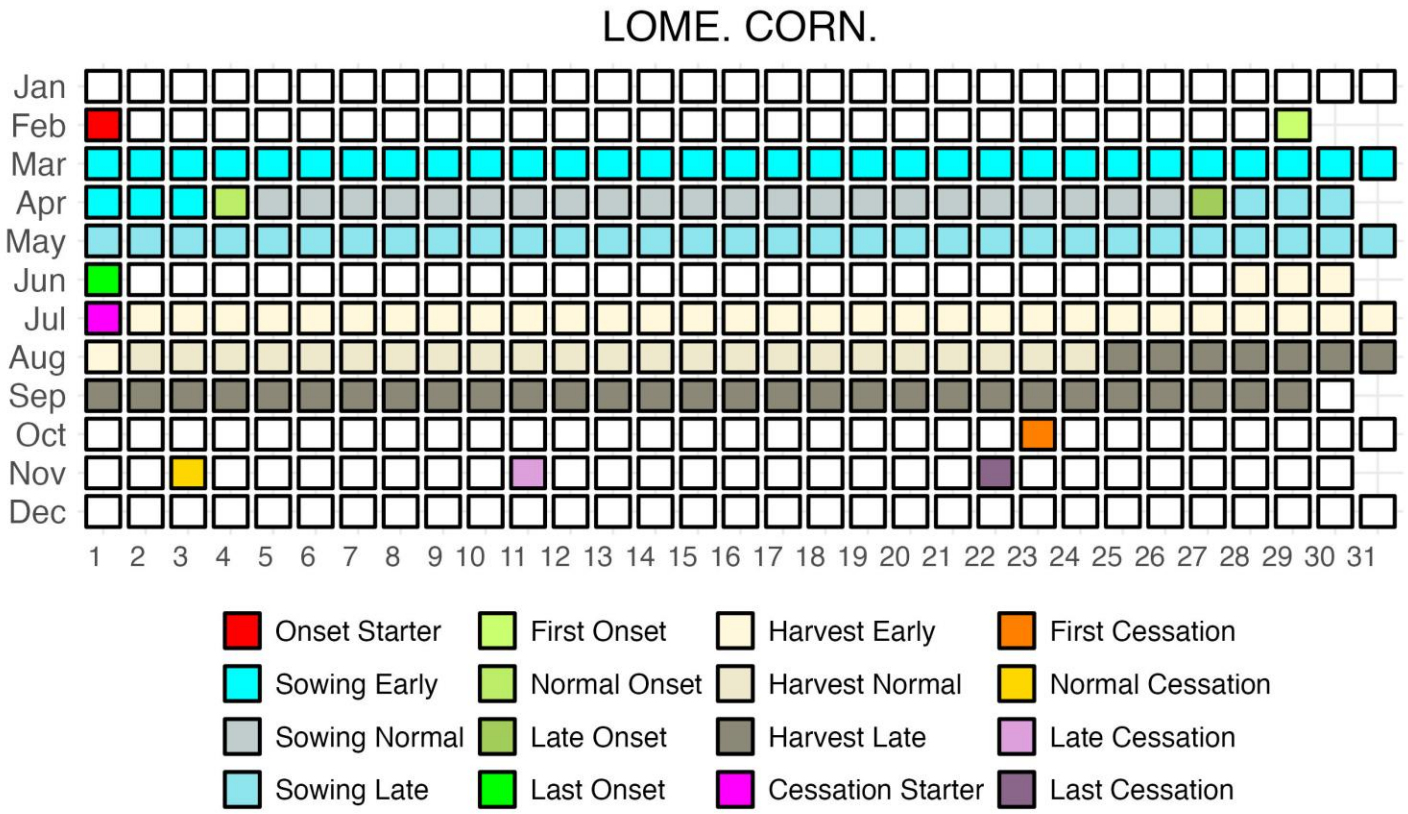


Example. Sotouboua, Togo. Cessation determination for 2003

- Blue bars: 17-days accumulated rainfall in mm
- Red dashed line: 15 mm. threshold
- Blue dashed line: cessation day



1. Crop Calendar Preparation



1. Crop Calendar Preparation

Rainy Season and Crop Calendars

In Section 3, we have introduced the identification of the rainy season onset and cessation

In the case of the crop calendar, the timing of farm operations like land tilling and harvesting can be identified in relation to early, normal or late planting, allowing better planning for farm operations and other planning related to food security. The understanding of crop production practices by farmers is crucial here, for example, how soon before the rains do farmers normally till the land.

In the case of the climatological length of growing season, decisions can be made on which crops (e.g., maize or millet) and varieties (i.e. short or long cycle) can be planted in a given location, considering factors like the risk of a certain crop or variety not reaching maturity before the end of the rainy season if planted during a certain time, which can also be changed into advice for farmers.

Onset Starter	First day for the algorithm to start searching for the RSO
Onset Early / Sowing Early	Period between the 5th and the 33rd percentile of the probability distribution fitted to the RSO time series
Onset Normal /Sowing Normal	Period between the 33rd and the 66th percentile of the probability distribution fitted to the RSO time series
Onset Late /Sowing Late	Period between the 66th and the 95th percentile of the probability distribution fitted to the RSO time series
Harvest Early	First day in the Sowing Early period + length of the crop cycle
Harvest Normal	First day in the Sowing Normal period + length of the crop cycle
Harvest Late	First day in the Sowing Late period + length of the crop cycle
Cessation Starter	First day for the algorithm to start searching for the RSC
Cessation Early	Period between the 5th and the 33rd percentile of the probability distribution fitted to the RSC time series
Cessation Normal	Period between the 33rd and the 66th percentile of the probability distribution fitted to the RSC time series
Cessation Late	Period between the 66th and the 95th percentile of the probability distribution fitted to the RSC time series

Assignement

Run the Crop Calendar Generator

FRA

Pour réaliser cet exercice, vous devez avoir installé le package logiciel complet, en suivant les instructions fournies dans les sections précédentes.

Nous travaillerons avec un jeu de données simulant des stations au Togo, extrait de

https://open-meteo.com/. Veuillez noter que ces séries ne sont pas les séries officielles de l'ANAMET.

- Localisez votre dossier ***crop_cal_creator***.
- Téléchargez, décompressez et collez le dossier ***assessed*** joint à cet exercice.
- Double-cliquez sur ***crop_cal_creator.Rproj*** pour lancer votre projet.
- Naviguez jusqu'au dossier ***codes*** et cliquez sur ***calendarAPP_v2.0.R***.
- Une fois le fichier ouvert, cliquez sur ***Run App*** pour charger l'application.
- Exécutez l'application en mode station unique. Choisissez la station et les paramètres de votre choix.
- Exécutez l'application en mode batch à l'aide du fichier batch fourni.
- Sélectionnez une station et commentez le calendrier (consultez les présentations et le manuel pour l'interprétation). **Créez un document de travail avec des graphiques et des commentaires, puis postez-le dans cet espace.**

ENG

To run this exercise, you should have installed the complete software package, following the instructions provided in previous sections.

We will work with a dataset simulating stations in Togo, extracted from

https://open-meteo.com/ . Please, notice that these series are not the official series from ANAMET.

- Locate your ***crop cal_creator folder***
- **Download, uncompress and paste the *assessed* folder attached to this exercise**
- Double click on ***crop cal_creator.Rproj*** to start your project

Practical Session