modextreme

agriculture facing extreme climatic events

Workshop

Analyzing simulation results with IMMA

(*Integrated Multi-metrics Model Analyzer*)

The Team of Work Package 2






What does IMMA do?

- IMMA implements a state-of-the-art wide choice of model evaluation procedures
- It allows a simple and quick evaluation processing
  - 1) load data 2) associate them 3) call the procedure
- It is extensible and customizable, and it can run additional procedures obtained from third parties, or you can develop yours and give it to others
- It is capable of doing a global judgment about model quality





Working with IMMA

- A typical work session with IMMA follows three main steps:
  - Load the two series of data to be compared
  - Associate the two series with some coupling criteria
  - Execute the desired statistical method



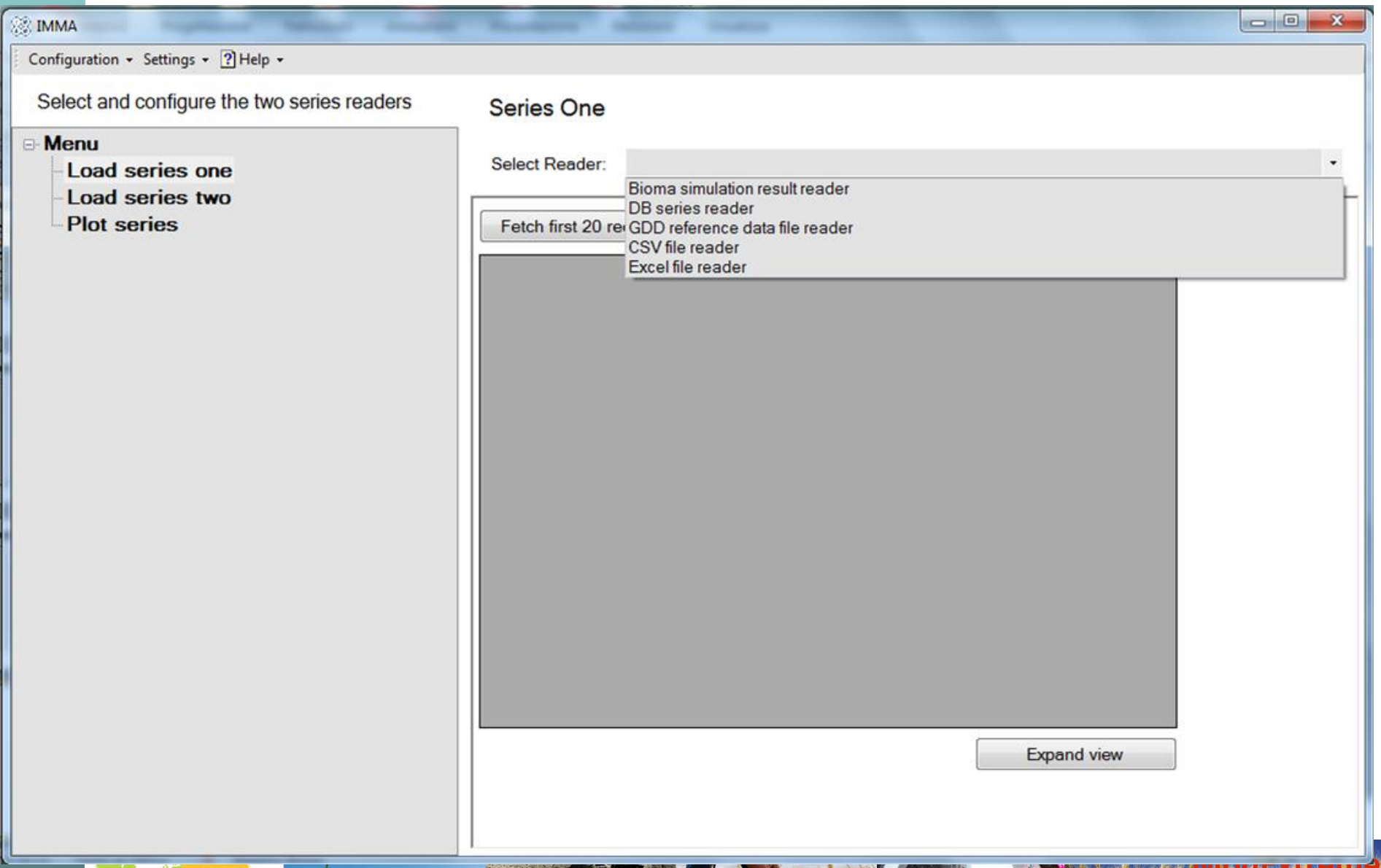



Step 1: Load data

- The typical situation encountered by most modelling researchers is to compare an estimated data series (E – “estimates”) against some experimental results/observations (M - “measures”)
- You can load data from various sources (Excel, CSV files, Bioma output, Databases).
- (If necessary) filter the two series to create a subset of data, according to a given criterion, which is specified with logical operators.
- Once the dataset has been specified, it can be saved in a configuration file, to be retrieved later without repeating the previous operations.

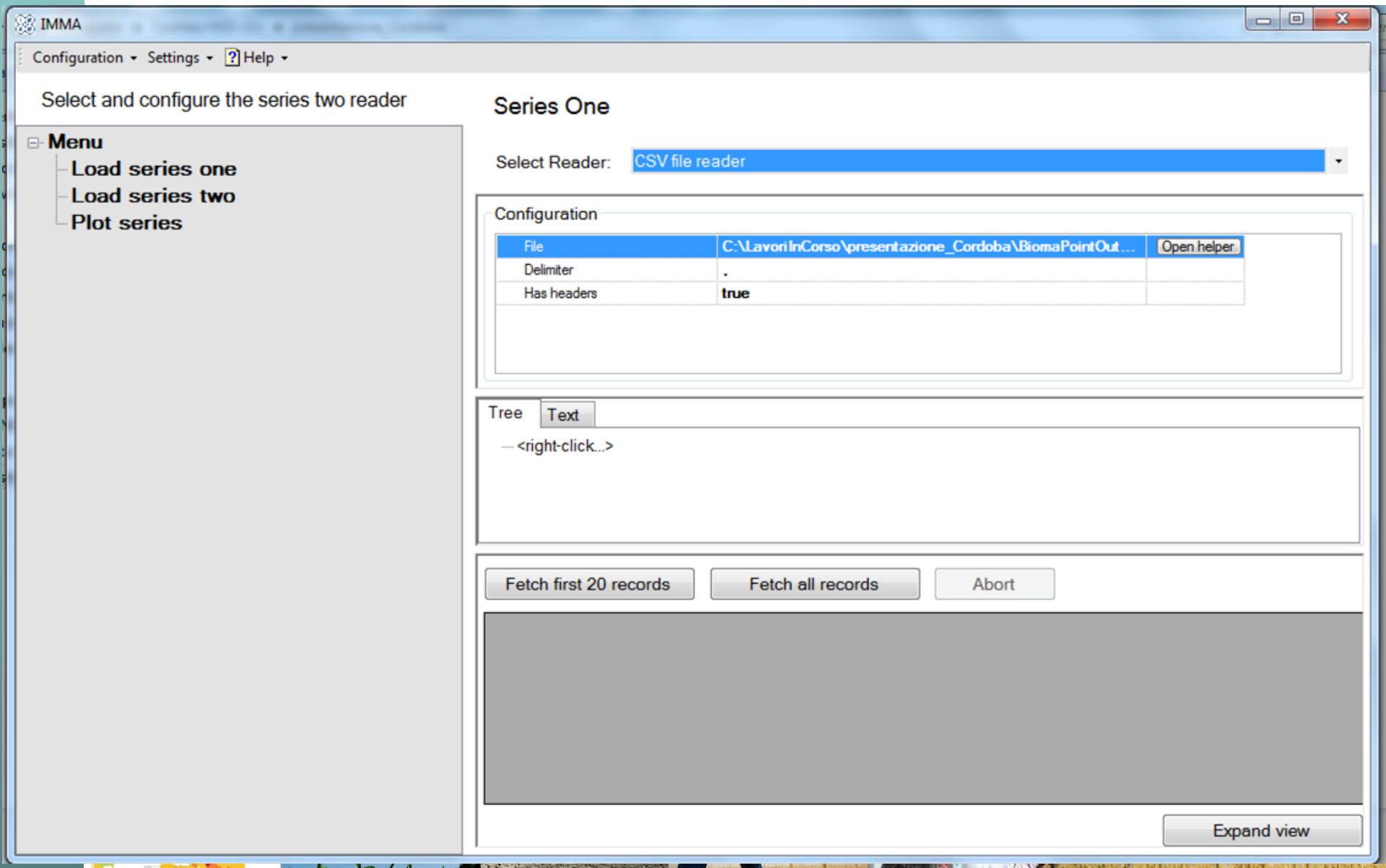





IMMA
Configuration
Settings
Help
Select and configure the two series readers
Menu
Load series one
Load series two
Plot series
Series One
Select Reader:
Bioma simulation result reader
DB series reader
GDD reference data file reader
CSV file reader
Excel file reader
Fetch first 20 re
Expand view











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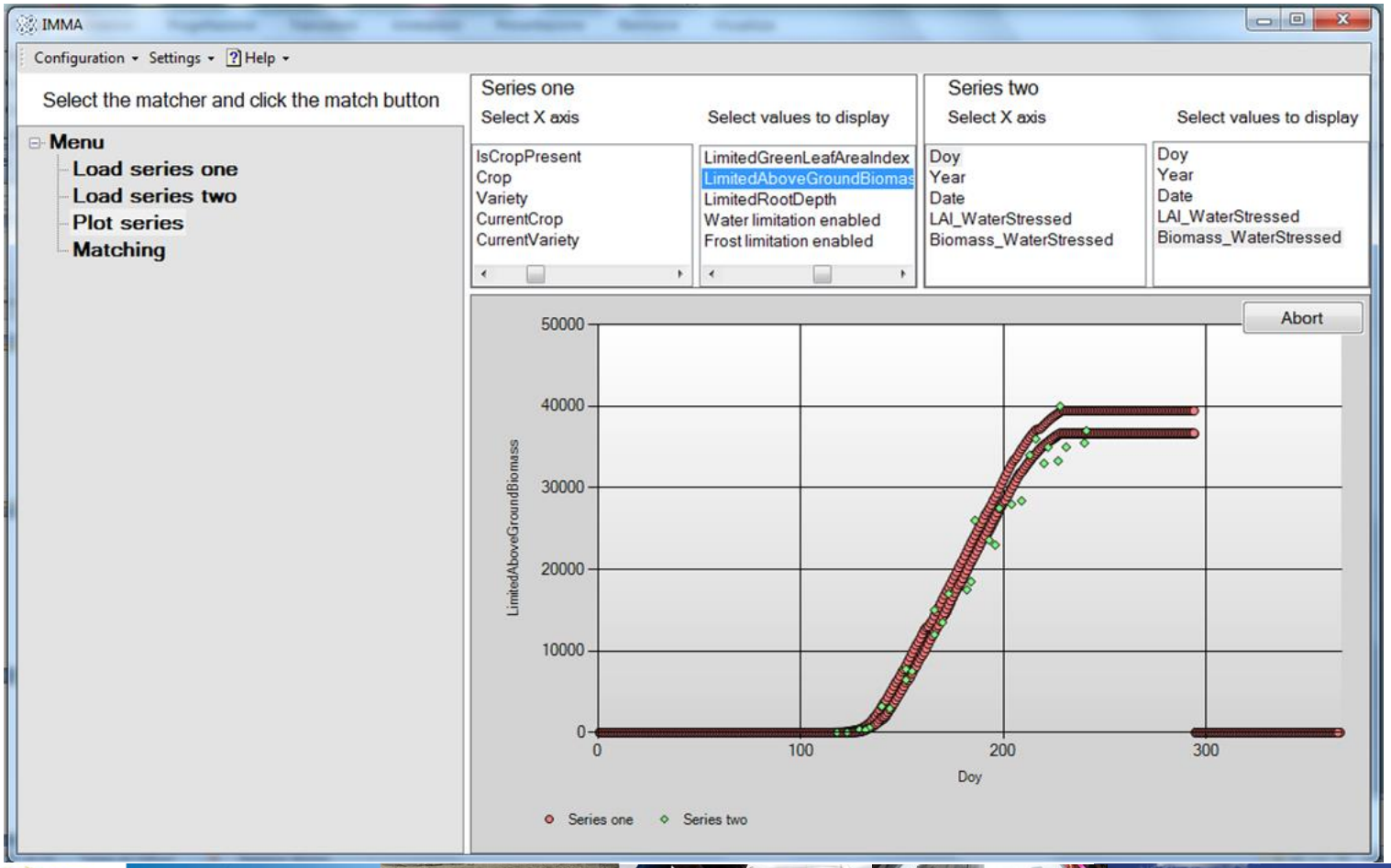
Step 2: Match data

- In order to process data, IMMA needs to know how to couple the two series, to identify the correct pairs.
- In the most typical situation, a continuous daily estimates series is compared to a sparse observation series (simulation outputs are produced for each simulation time-step, while field observations are carried out at intervals).
- In cases like this, you generally extract simulation estimates corresponding to the available observation dates, and generate an equal number of pairs.






	A	B	C	D	E	F	G
1	Date	LimitedAboveGroundBiomass			Date	LimitedAboveGroundBiomass	
2	03/05/1999	0.06			03/05/1999	0.11	
3	04/05/1999	0.07			14/05/1999	0.93	
4	05/05/1999	0.1			01/06/1999	4.8	
5	06/05/1999	0.12			15/06/1999	5.6	
6	07/05/1999	0.16			01/07/1999	5.99	
7	08/05/1999	0.2			12/07/1999	6.3	
8	09/05/1999	0.27			23/07/1999	4.9	
9	10/05/1999	0.38			01/08/1999	2.7	
10	11/05/1999	0.5			10/08/1999	1.5	
11	12/05/1999	0.66			19/08/1999	0.9	
12	13/05/1999	0.87			28/08/1999	0.7	
13	14/05/1999	1.08			29/08/1999	0.55	
14	15/05/1999	1.18			27/04/2000	0.05	
15	16/05/1999	1.49			08/05/2000	0.9	
16	17/05/1999	1.63			19/05/2000	3.3	
17	18/05/1999	1.85			31/05/2000	4.6	
18	19/05/1999	2.04			14/06/2000	5.9	
19	20/05/1999	2.2			21/06/2000	5.9	
20	21/05/1999	2.34			04/07/2000	6.5	
21	22/05/1999	2.58			16/07/2000	5.95	
22	23/05/1999	2.9			03/08/2000	2.5	
23	24/05/1999	3.19			15/08/2000	1.5	
24	25/05/1999	3.41			12/05/2001	0.7	
25	26/05/1999	3.64			24/05/2001	3.5	
26	27/05/1999	3.86			04/06/2001	5.2	
27	28/05/1999	4.03			19/06/2001	5.3	
28	29/05/1999	4.2			03/07/2001	5.2	
29	30/05/1999	4.35			15/07/2001	5.4	
30	31/05/1999	4.47			28/07/2001	2.5	
31	01/06/1999	4.6			08/08/2001	0.7	
32	02/06/1999	4.71			15/08/2001	0.2	



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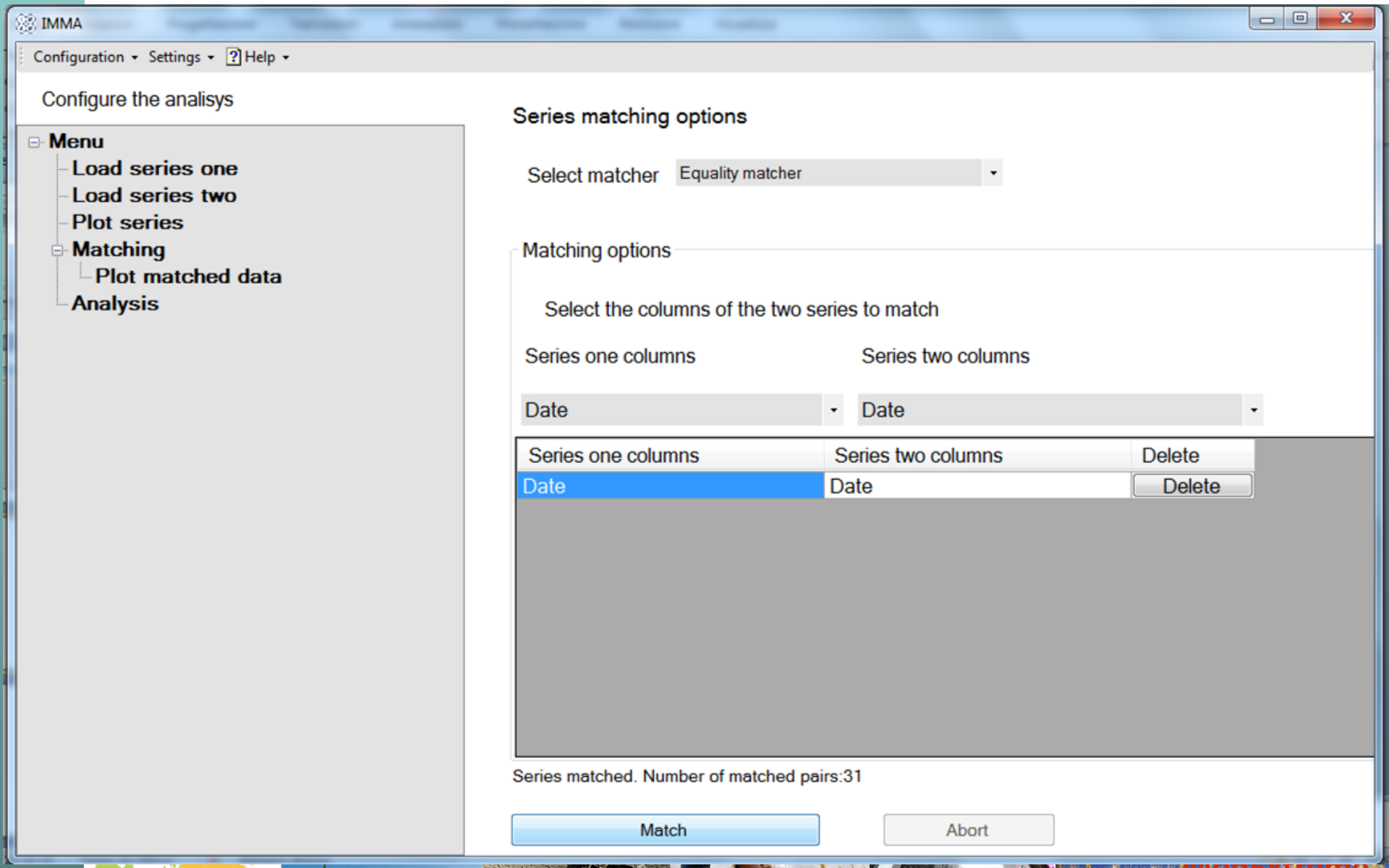
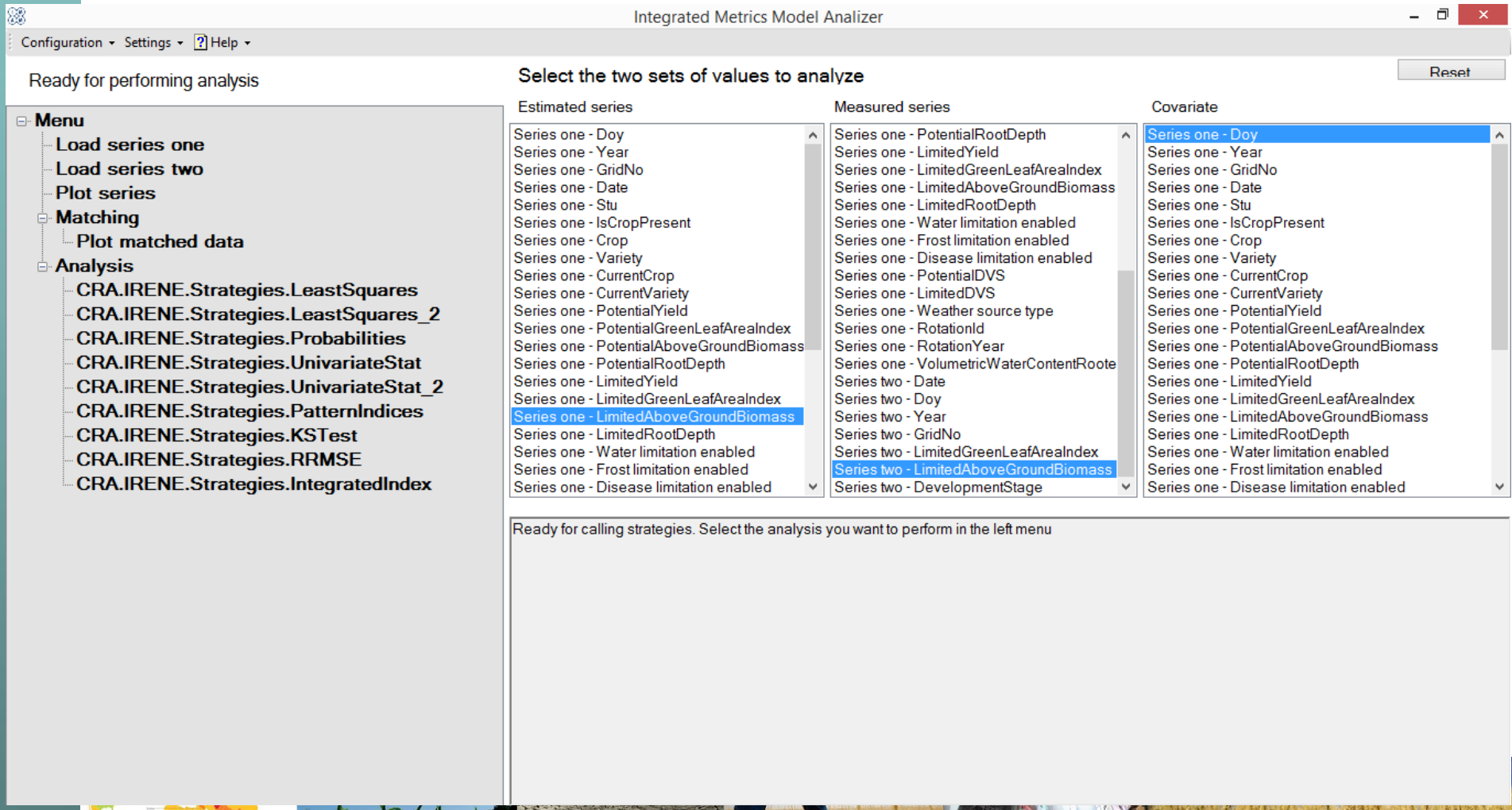

IMMA
Configuration
Settings
Help
Configure the analisys
Menu
Load series one
Load series two
Plot series
Matching
Plot matched data
Analysis
Series matching options
Select matcher
Equality matcher
Matching options
Select the columns of the two series to match
Series one columns
Series two columns
Date
Date
Series one columns
Series two columns
Delete
Date
Date
Delete
Series matched. Number of matched pairs:31
Match
Abort

Step 3 – Analysis

- As soon as data are correctly matched, the available statistical methods are displayed, ready to be used.
- A set of CRA.IRENE methods are currently implemented
- Wrapping R methods is ongoing
- To activate methods, an “estimated”, “measured” and “covariate” series must be individuated.







Integrated Metrics Model Analizer
Configuration
Settings
Help
Ready for performing analysis
Menu
Load series one
Load series two
Plot series
Matching
Plot matched data
Analysis
CRA.IRENE.Strategies.LeastSquares
CRA.IRENE.Strategies.LeastSquares_2
CRA.IRENE.Strategies.Probabilities
CRA.IRENE.Strategies.UnivariateStat
CRA.IRENE.Strategies.UnivariateStat_2
CRA.IRENE.Strategies.PatternIndices
CRA.IRENE.Strategies.KSTest
CRA.IRENE.Strategies.RRMSE
CRA.IRENE.Strategies.IntegratedIndex
Select the two sets of values to analyze
Reset
Estimated series
Series one - Doy
Series one - Year
Series one - GridNo
Series one - Date
Series one - Stu
Series one - IsCropPresent
Series one - Crop
Series one - Variety
Series one - CurrentCrop
Series one - CurrentVariety
Series one - PotentialYield
Series one - PotentialGreenLeafAreaIndex
Series one - PotentialAboveGroundBiomass
Series one - PotentialRootDepth
Series one - LimitedYield
Series one - LimitedGreenLeafAreaIndex
Series one - LimitedAboveGroundBiomass
Series one - LimitedRootDepth
Series one - Water limitation enabled
Series one - Frost limitation enabled
Series one - Disease limitation enabled
Measured series
Series one - PotentialRootDepth
Series one - LimitedYield
Series one - LimitedGreenLeafAreaIndex
Series one - LimitedAboveGroundBiomass
Series one - LimitedRootDepth
Series one - Water limitation enabled
Series one - Frost limitation enabled
Series one - Disease limitation enabled
Series one - PotentialDVS
Series one - LimitedDVS
Series one - Weather source type
Series one - RotationId
Series one - RotationYear
Series one - VolumetricWaterContentRoote
Series two - Date
Series two - Doy
Series two - Year
Series two - GridNo
Series two - LimitedGreenLeafAreaIndex
Series two - LimitedAboveGroundBiomass
Series two - DevelopmentStage
Covariate
Series one - Doy
Series one - Year
Series one - GridNo
Series one - Date
Series one - Stu
Series one - IsCropPresent
Series one - Crop
Series one - Variety
Series one - CurrentCrop
Series one - CurrentVariety
Series one - PotentialYield
Series one - PotentialGreenLeafAreaIndex
Series one - PotentialAboveGroundBiomass
Series one - PotentialRootDepth
Series one - LimitedYield
Series one - LimitedGreenLeafAreaIndex
Series one - LimitedAboveGroundBiomass
Series one - LimitedRootDepth
Series one - Water limitation enabled
Series one - Frost limitation enabled
Series one - Disease limitation enabled
Ready for calling strategies. Select the analysis you want to perform in the left menu

Strategy LeastSquares

- Fit a linear regression model between two series
- Calculate the residuals
- Plot the results






Strategy Probabilities

- Display probability density functions
- Allows a visual direct assessment of difference between the two series






Strategy UnivariateStat

- Display basic descriptive statistics






Strategy PatternIndices

- Detect presence of patterns in the residuals respect to an independent covariate






Strategy KSTest

- Kolmogorov-Smirnov test






Strategy Integrated Index

- Using fuzzy-logic rules, calculate indicator based on custom-designed aggregated statistics
- Allow to build evaluation criteria around specific needs



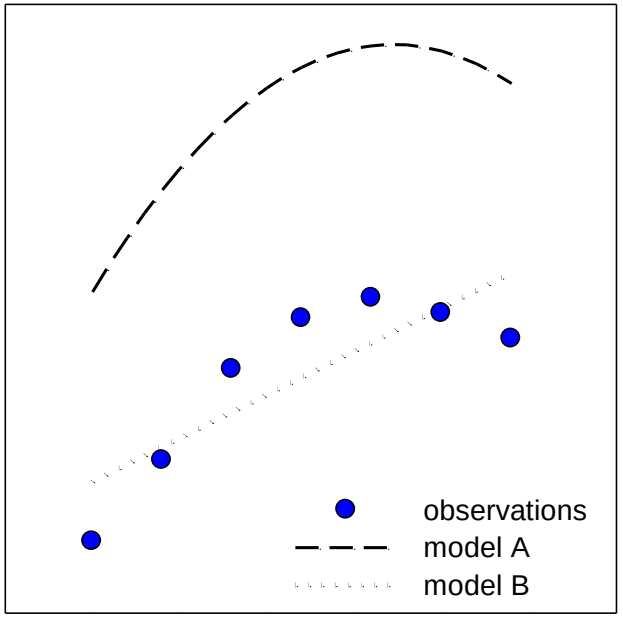



Why Integrated Indices are useful

Which is the best model?

Model A: good reproduction of model behaviour (reliable model), but not very useful

Model B: good accuracy (useful model), but scarce capacity to capture model behaviour (not reliable)








How to build an Integrated Index

- An Integrated Index is a model evaluation metric whose output depends on the values taken by an array of indices.
- The indices composing the Integrated Index are chosen according to specific evaluation needs.






How to build an Integrated Index

- In IMMA Integrated Indices are based on fuzzy-logic rules:
- They can take values between 0 (= good model performance) and 1 (= bad model performance)





How to build an Integrated Index

- To build an Integrated Index:
  - Choose the basic indices to aggregate
  - For each basic index, it must be specified:
  - The Weight
    - The relative importance assigned to the index withing the integrated index
  - The Favourable Limit
    - The index value, beyond which the user is absolutely sure that the value can be considered «good».
  - The Unfavourable Limit
    - The index value, beyond which the user is absolutely sure that the value can be considered «bad».






How to build an Integrated Index

- Some examples:
  - RRMSE (%) (the smallest, the better)
    - F-Limit = 20
    - U-Limit = 90
  - r Pearson (the highest, the better)
    - F-Limit = 0.90
    - U-Limit = 0.50






Let’s start the lab!