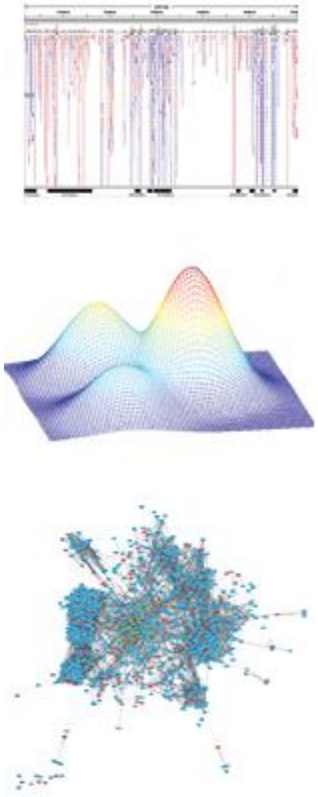
De l'expression des gènes aux réseaux



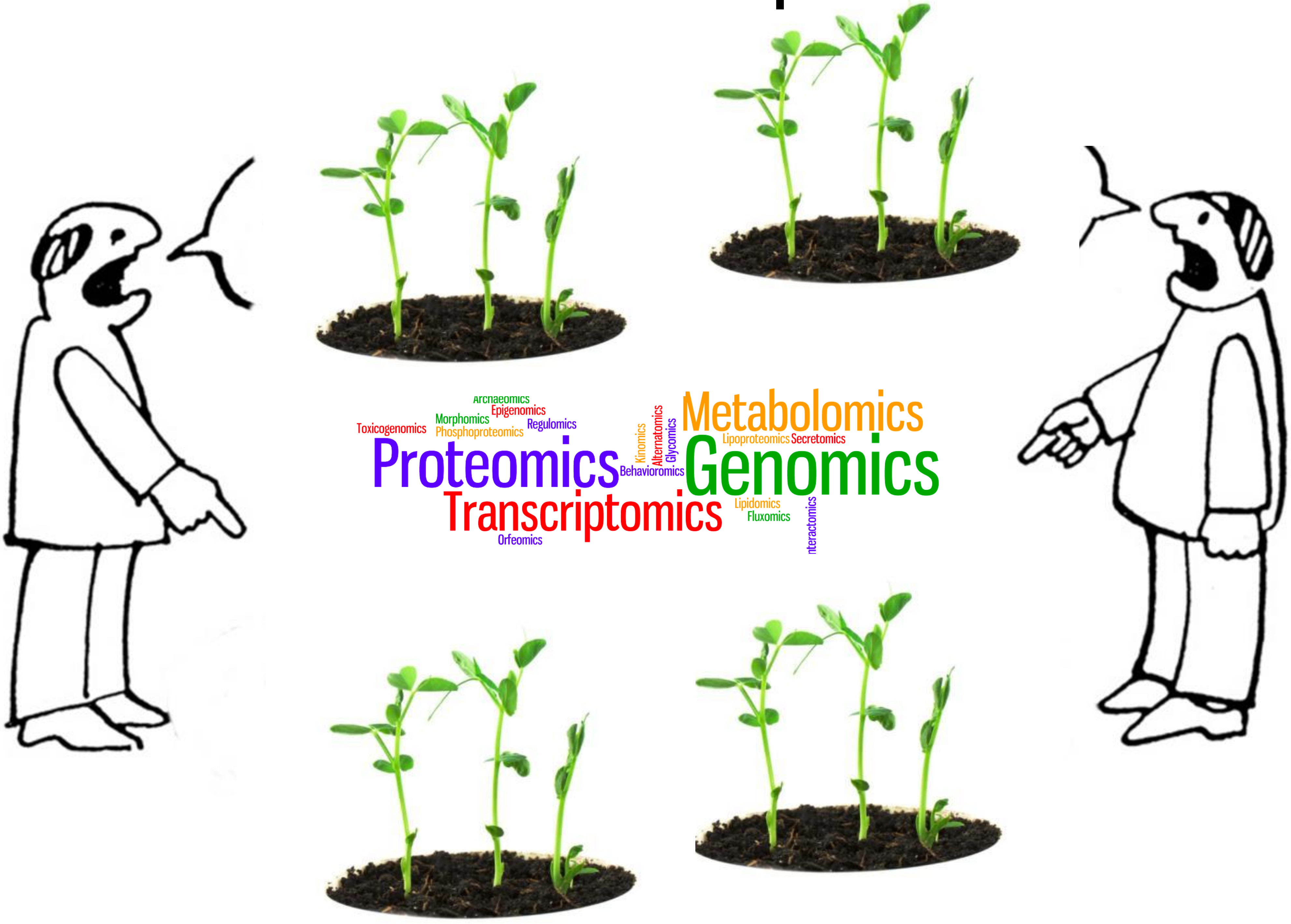
Ecole-chercheur de mai à décembre 2017

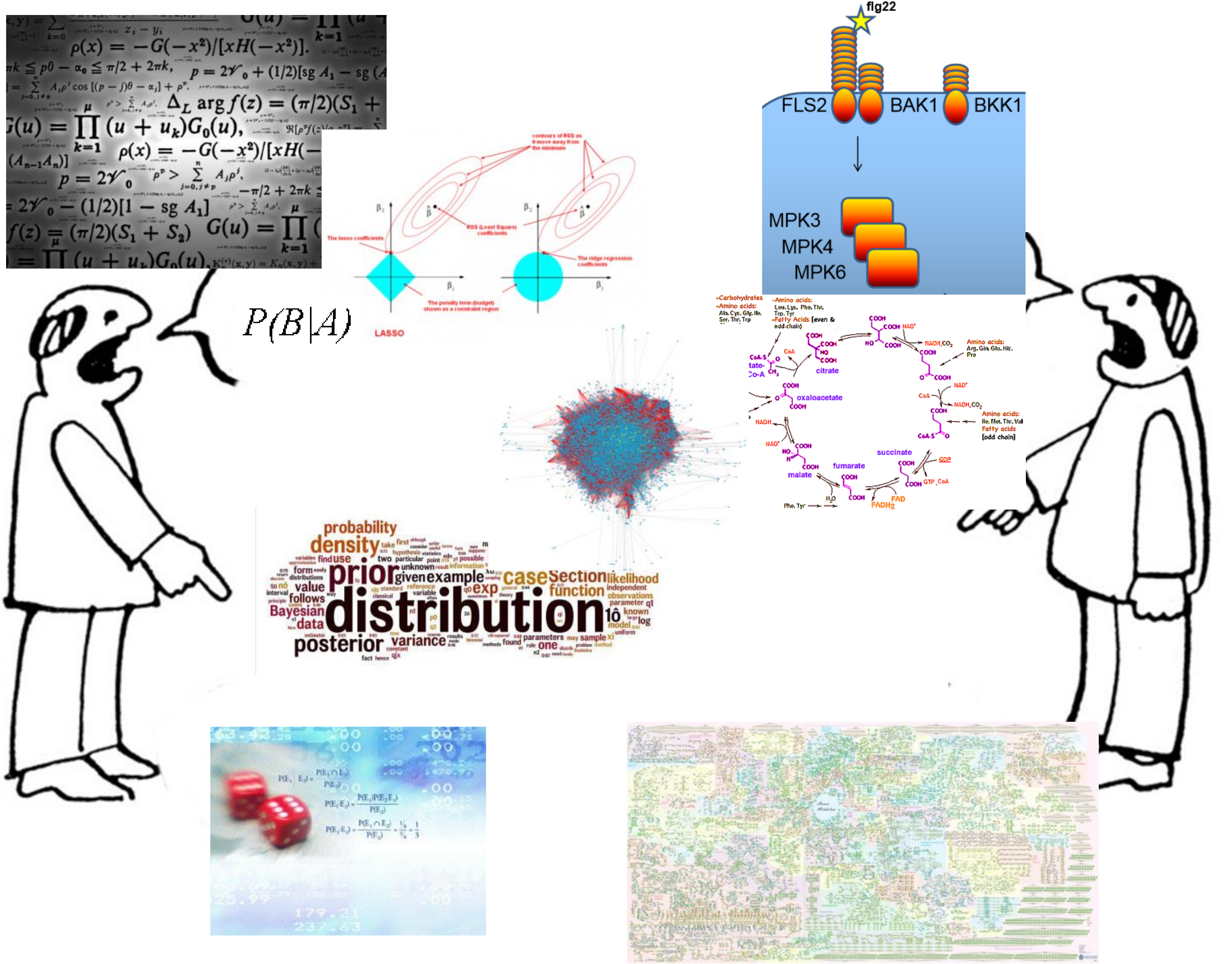
Le projet
Formation

Paris-Saclay
Computational Biology

Réseaux NETBIO
du département MIA

Premières impressions




$P(B|A)$
LASSO
The lasso coefficients
contours of RSS as it move away from the minimum
RSS (Least Square) coefficients
The ridge regression coefficients
The penalty term (budget) shown as a constraint region
flg22
FLS2
BAK1
BKK1
MPK3
MPK4
MPK6
citrate
oxaloacetate
malate
fumarate
succinate
probability
density
prior
distribution
posterior
Bayesian
data
variance
likelihood
function
case
Section
example

Objectifs de l'école chercheurs

- Comprendre les spécificités des données omiques, en particulier de transcriptomique
- Comprendre les objectifs des analyses bio-informatiques et statistiques
- Connaître les méthodes proposées
- Savoir interpréter a minima les résultats

- Se familiariser avec les concepts et partager un vocabulaire technique commun
- Etre capable d'interagir avec les plateformes de omiques et les modélisateurs
- Savoir faire des choix méthodologiques avisés

6 modules de formation indépendants

Matin > Cours en amphithéâtre

2 fois 90 minutes avec une pause de 15 minutes

Après-midi > 2 TP de 90 minutes pour un groupe de 20 personnes

6 modules de formation indépendants

Organisés selon les différentes étapes de l'analyse

Les technologies de séquençage actuelles et futures et leurs protocoles associés (30 mai)

La bioinformatique du RNAseq **(29 juin)**

Normalisation et analyse différentielle des données RNAseq **(28 septembre)**

Analyse de la coexpression de données RNAseq **(12 octobre)**

Les réseaux de régulation **(30 novembre)**

Les intégrations de données omiques **(14 décembre)**

Gene co-expression analysis

MORNING TALKS

- Co-expression analysis: what for? Examples of co-expression studies
- Co-expression analysis: How?

AFTERNOON PRACTICAL SESSIONS

- coseq R package for RNA-seq co-expression analysis
- Using the Gem2Net database

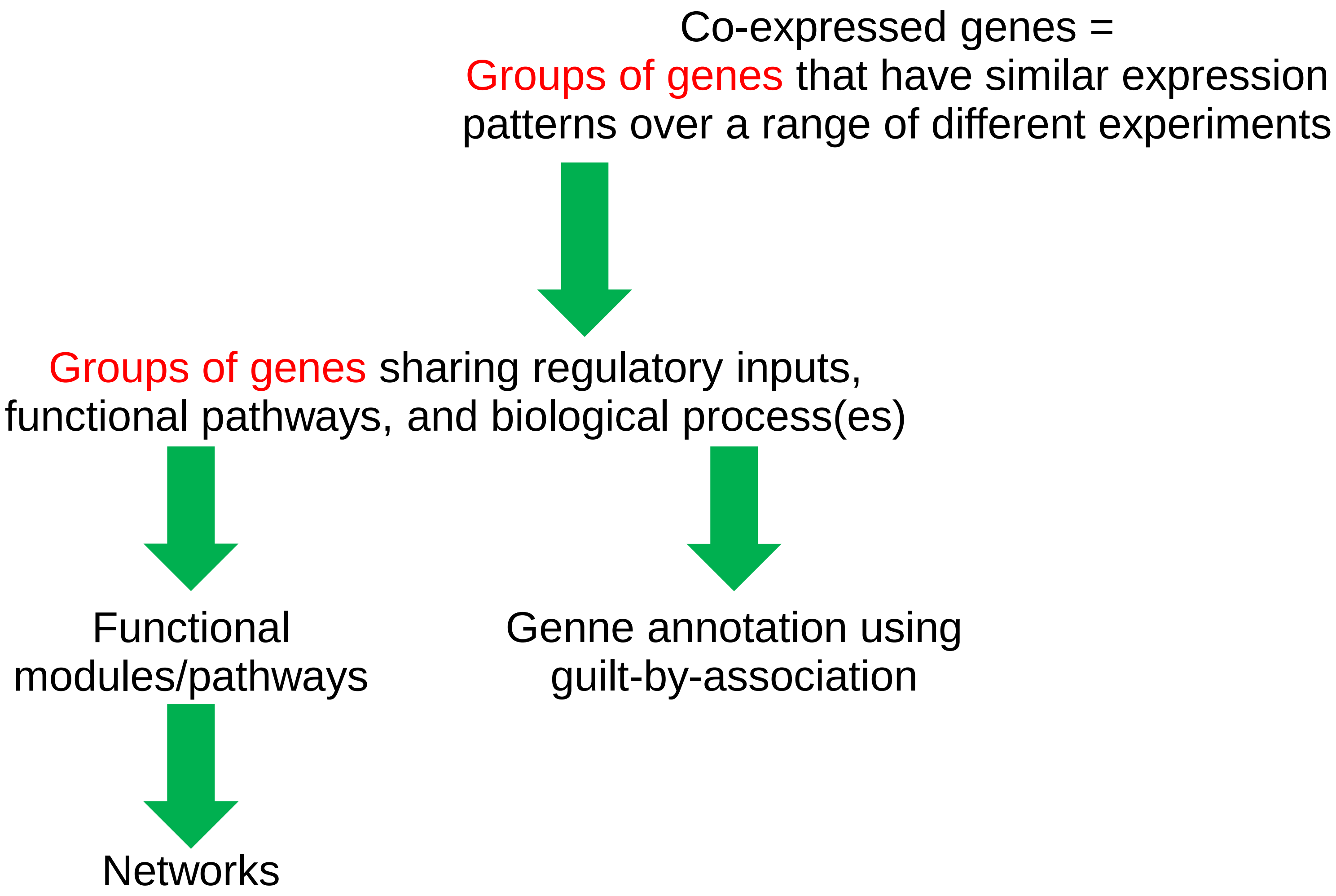
Co-expression analysis: what for?

Examples of co-expression studies

Co-expressed genes =
Groups of genes that have similar expression
patterns over a range of different experiments

Co-expression analysis: what for?

Examples of co-expression studies



Co-expressed genes =
Groups of genes that have similar expression patterns over a range of different experiments

Groups of genes sharing regulatory inputs, functional pathways, and biological process(es)

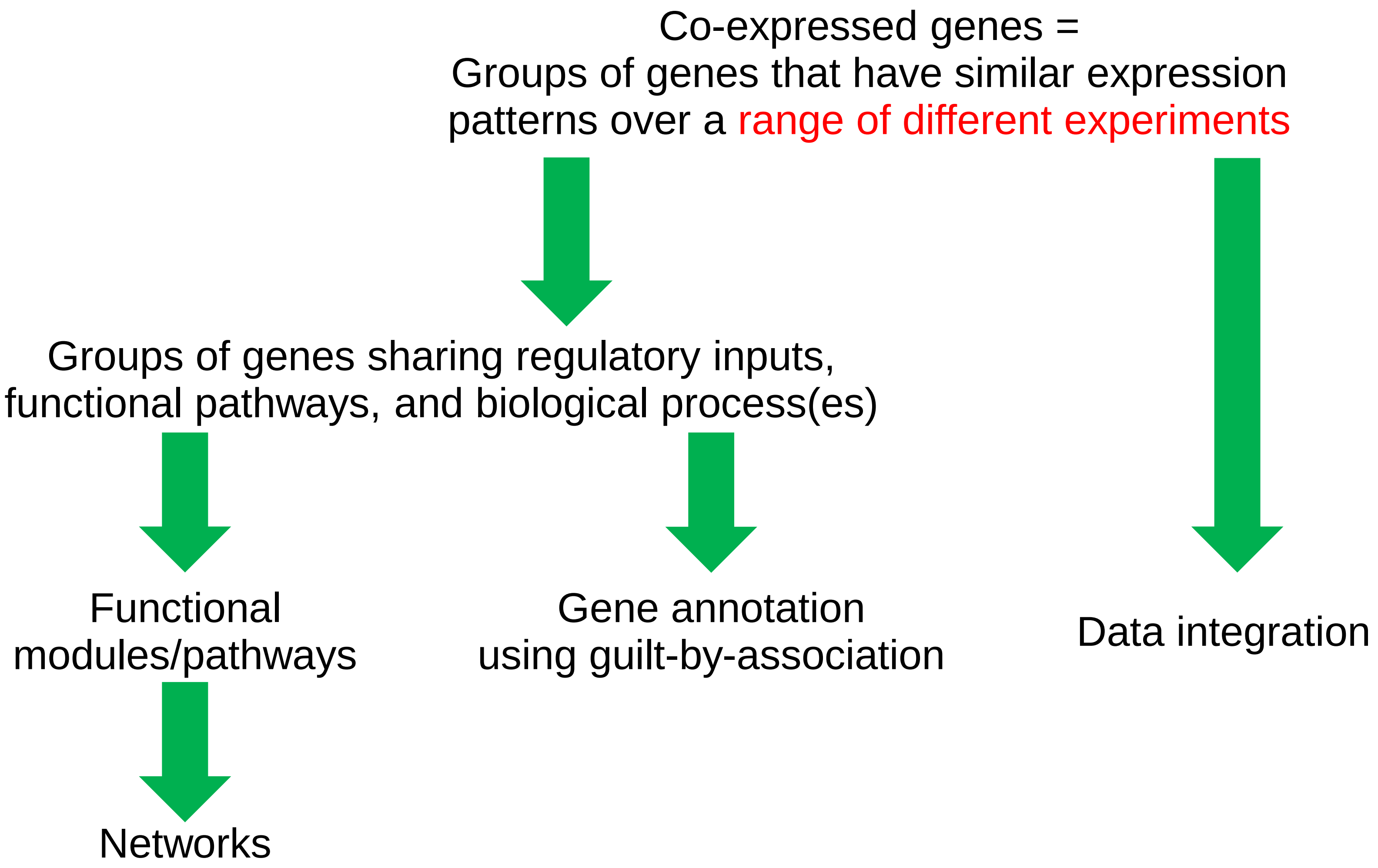
Functional modules/pathways

Networks

Genne annotation using guilt-by-association

Co-expression analysis: what for?

Examples of co-expression studies



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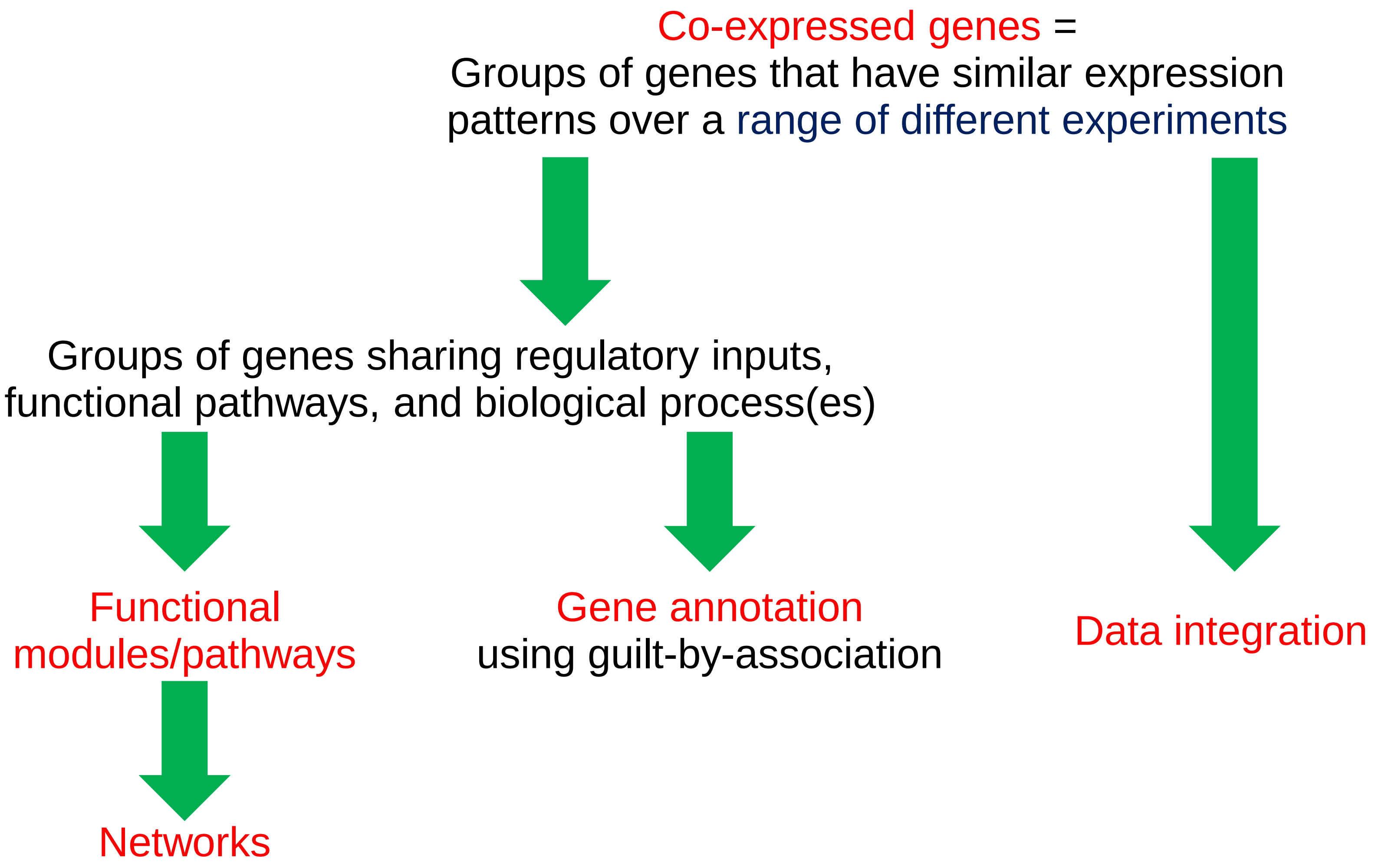

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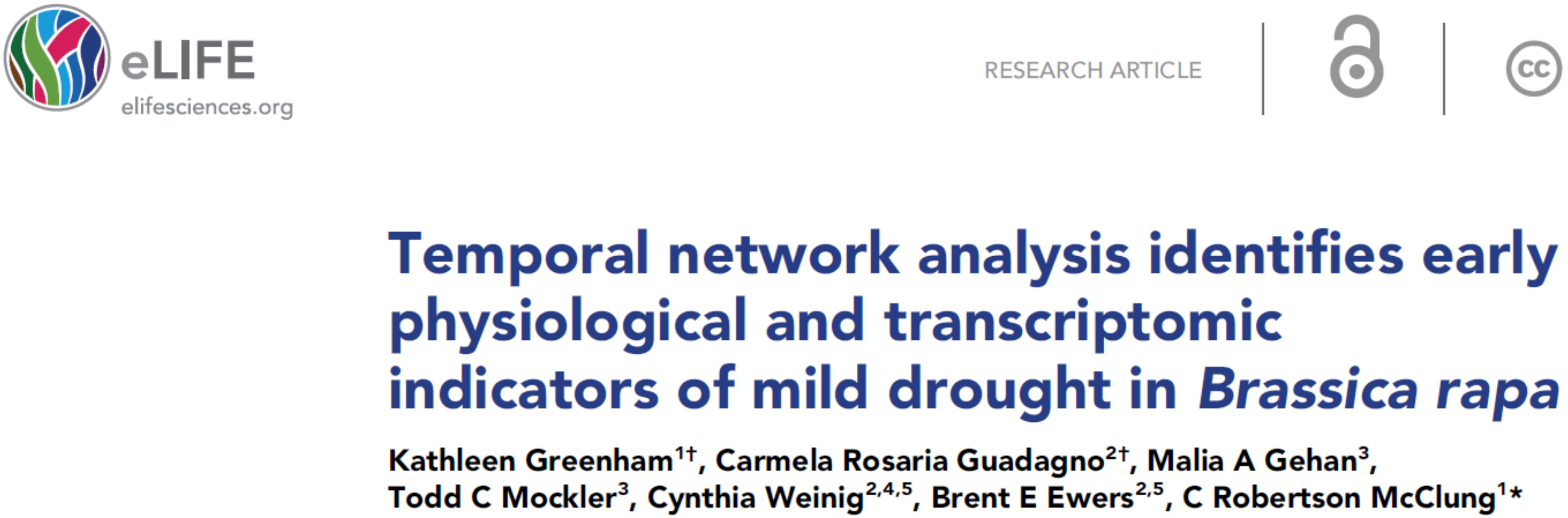


eLIFE
elifesciences.org

RESEARCH ARTICLE

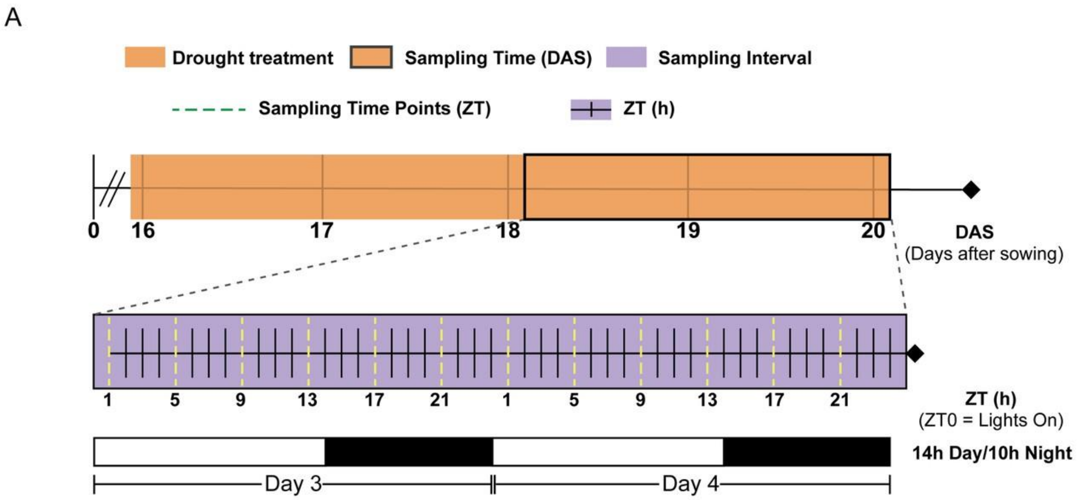
Temporal network analysis identifies early physiological and transcriptomic indicators of mild drought in *Brassica rapa*

Kathleen Greenham[1†], Carmela Rosaria Guadagno[2†], Malia A Gehan[3], Todd C Mockler[3], Cynthia Weinig[2,4,5], Brent E Ewers[2,5], C Robertson McClung[1*]

October, 4th 2017

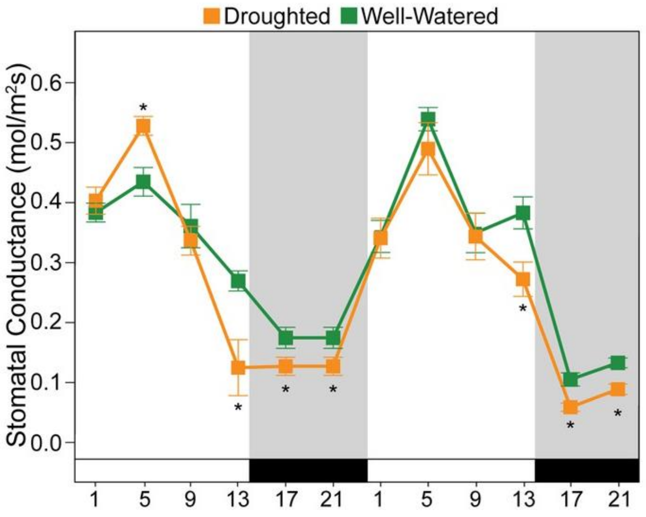
Co-expression analysis: what for?

Examples of co-expression studies



Mild drought, sampling every 4h for 48h

Physiological measures



Fv’/Fm’, gs and NSC are impacted by drought

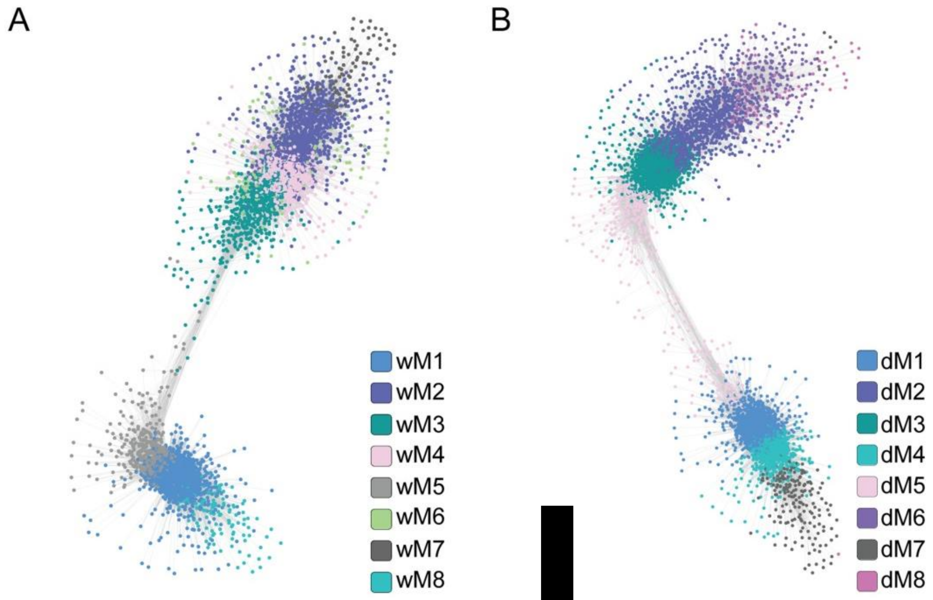
Co-expression analysis: what for?

Examples of co-expression studies

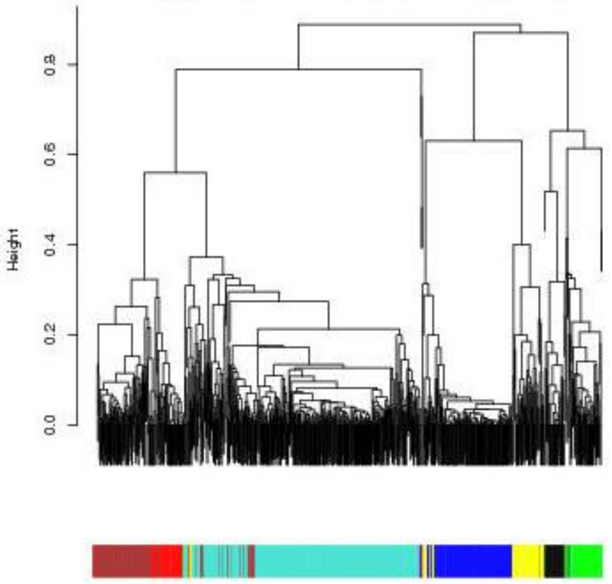
RNA-seq

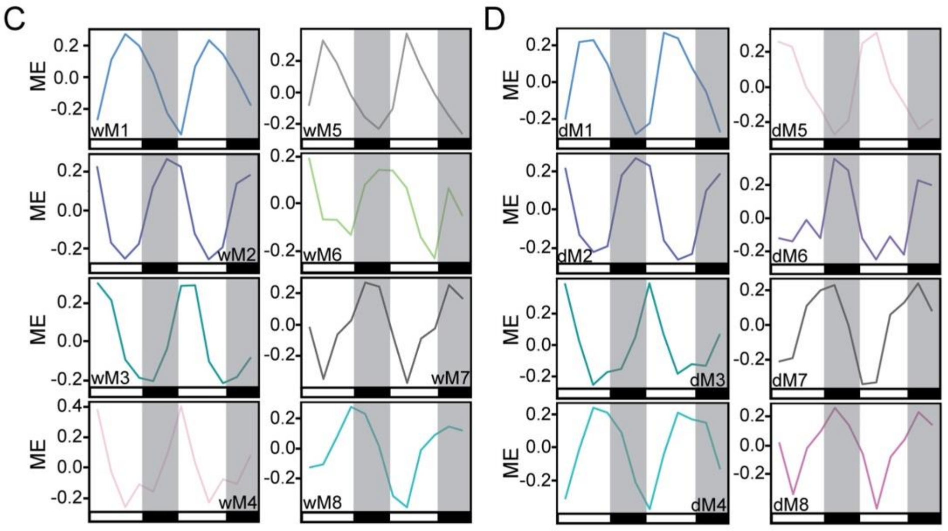
FPKM normalization

Pearson correlations
and soft thresholding
(WGCNA)



«Distances» between genes in the network





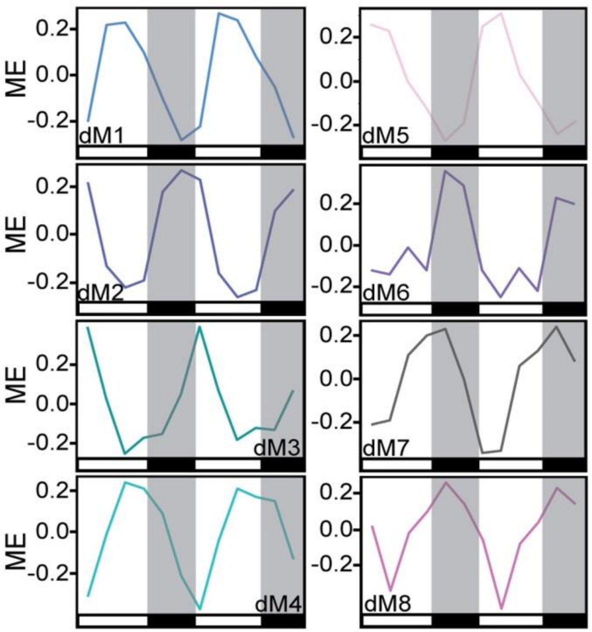
Gene clusters

Co-expression analysis: what for?

Examples of co-expression studies

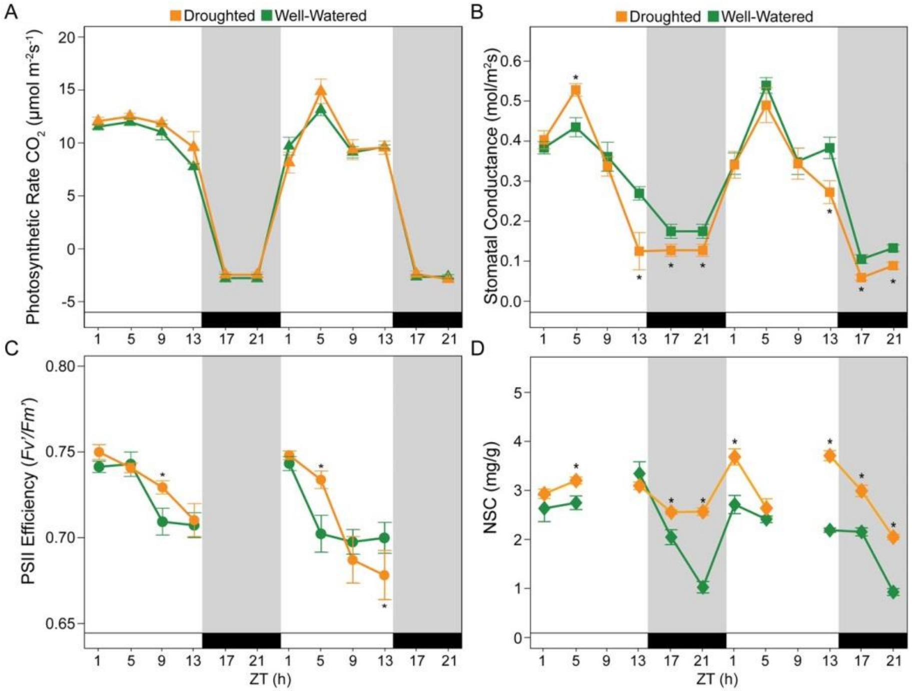
Selection of the clusters of interest

clusters



Pearson
correlation

physiology



+
changes in expression rythm between drought and control

Co-expression analysis: what for?

Examples of co-expression studies

Correlated to

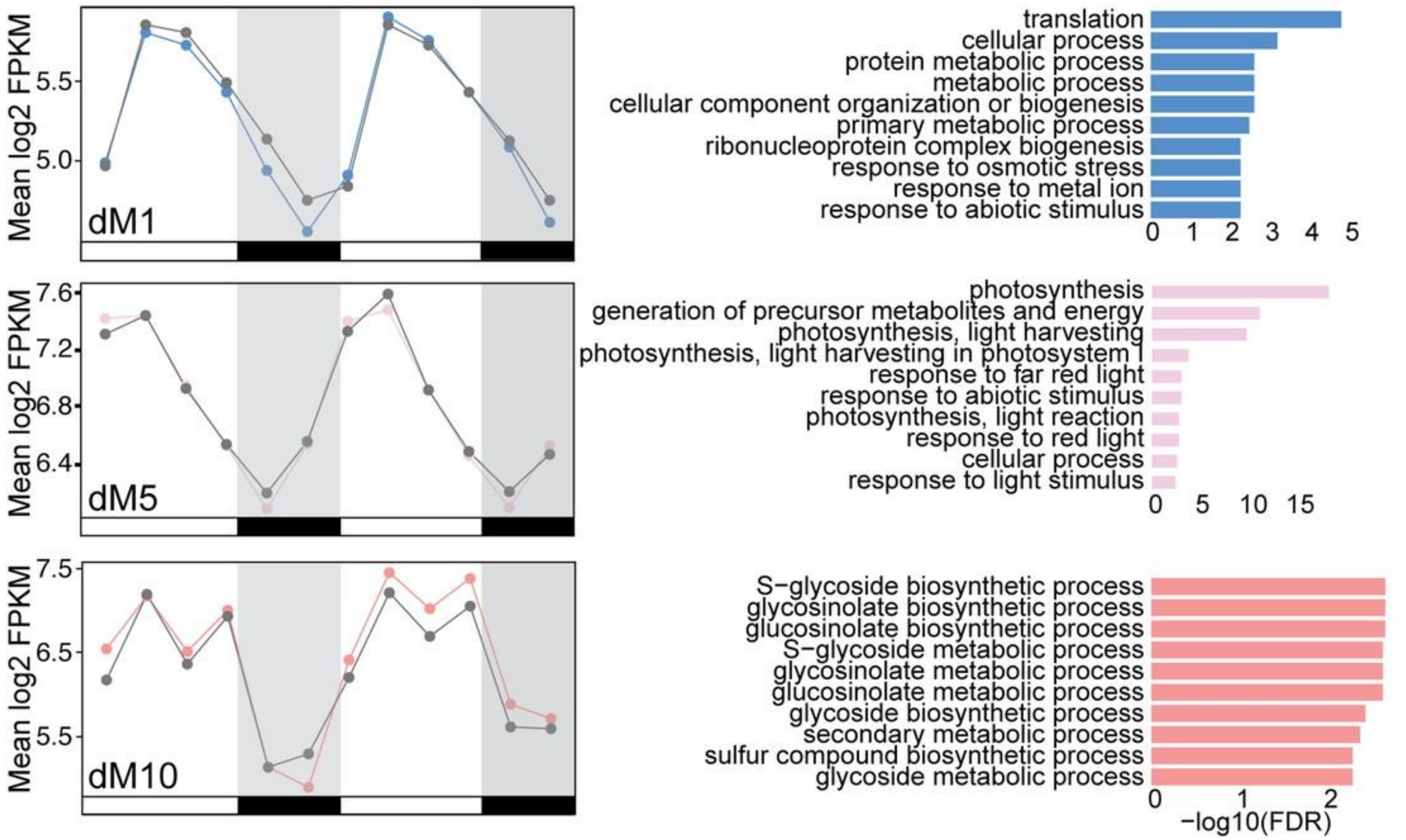
Cluster expression profile

GO enrichments

gs

gs

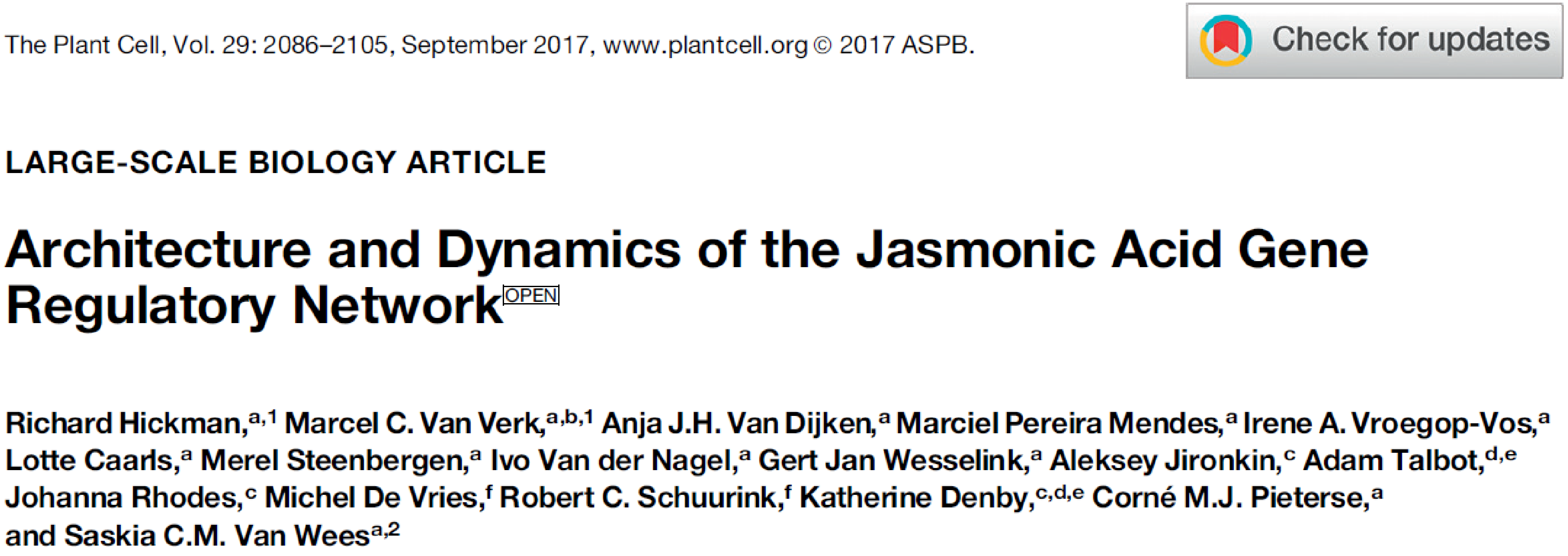
Fv'/Fm'



Identification of functional modules (pathways) associated with the early onset of drought

Co-expression analysis: what for?

Examples of co-expression studies



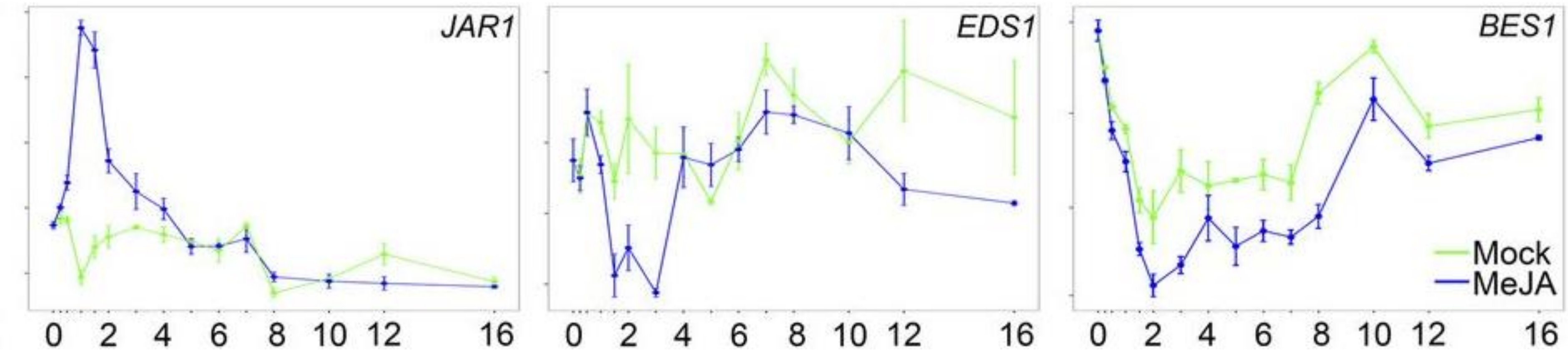
The Plant Cell, Vol. 29: 2086–2105, September 2017, www.plantcell.org © 2017 ASPB.

LARGE-SCALE BIOLOGY ARTICLE

Architecture and Dynamics of the Jasmonic Acid Gene Regulatory Network OPEN

Richard Hickman,[a,1] Marcel C. Van Verk,[a,b,1] Anja J.H. Van Dijken,[a] Marciel Pereira Mendes,[a] Irene A. Vroegop-Vos,[a] Lotte Caarls,[a] Merel Steenbergen,[a] Ivo Van der Nagel,[a] Gert Jan Wesselink,[a] Aleksey Jironkin,[c] Adam Talbot,[d,e] Johanna Rhodes,[c] Michel De Vries,[f] Robert C. Schuurink,[f] Katherine Denby,[c,d,e] Corné M.J. Pieterse,[a] and Saskia C.M. Van Wees[a,2]

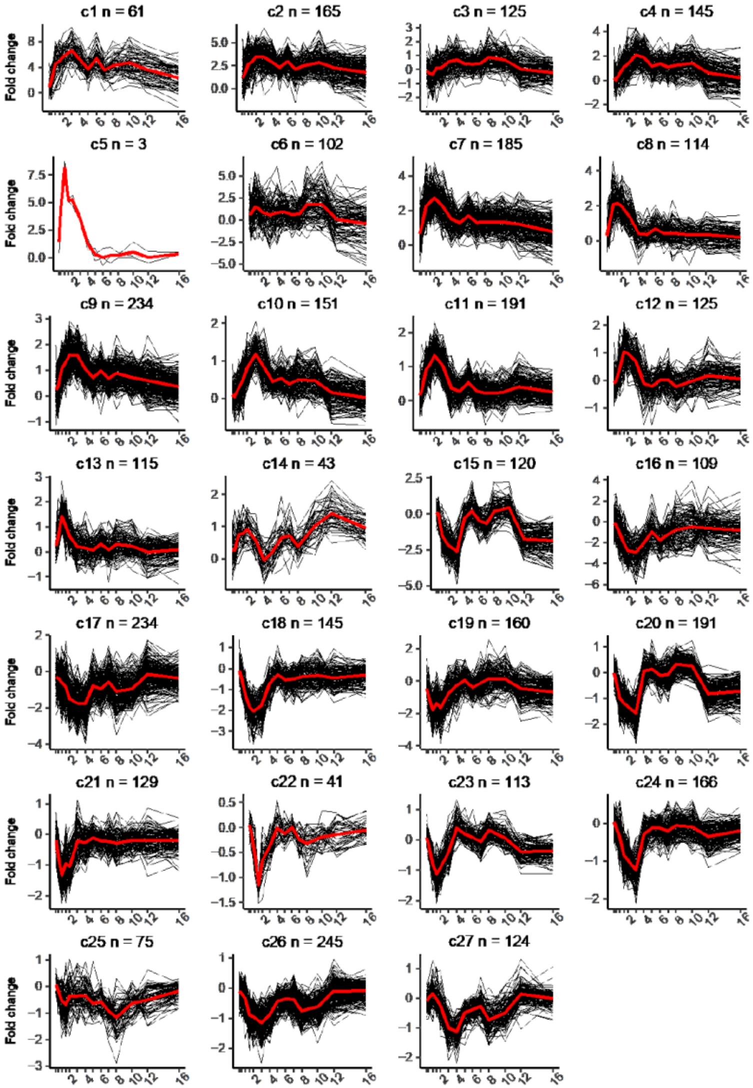
MeJA treatment of *Arabidopsis thaliana* leaf 6 (+mock).
Kinetic over 16h with 15 time points followed by RNA-seq analysis

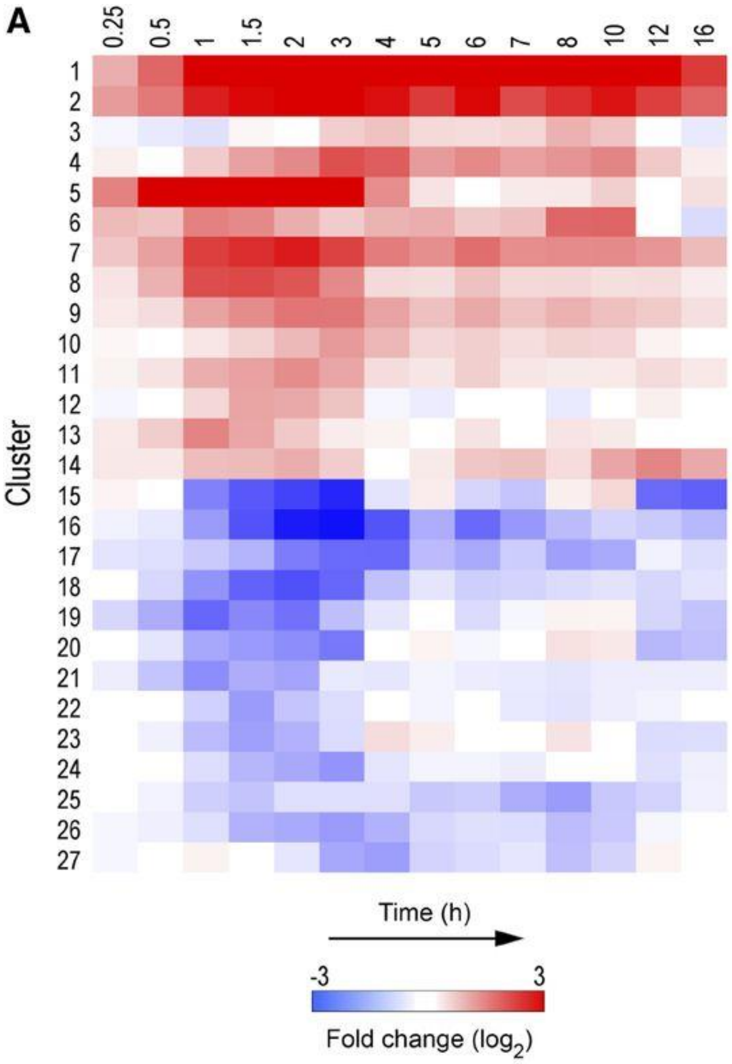


Co-expression analysis: what for?

Examples of co-expression studies

RNA-seq → GLM filtering → 3611 DE genes → model-based clustering (SplineCluster) → 27 clusters

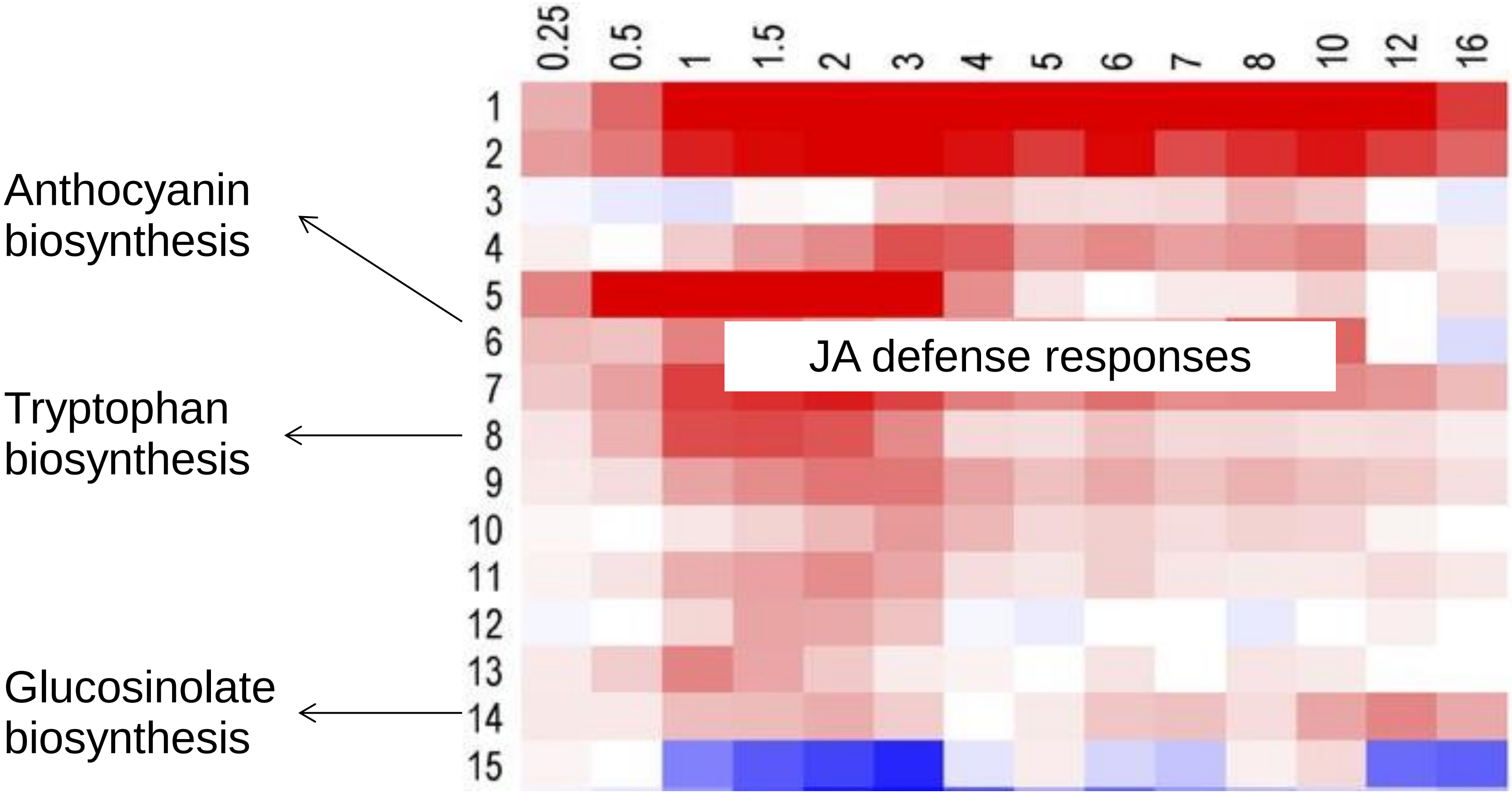




Co-expression analysis: what for?

Examples of co-expression studies

Functional modules: GO enrichments



JA defense responses

Anthocyanin biosynthesis

Tryptophan biosynthesis

Glucosinolate biosynthesis

Identification of discrete sectors of the JA-controlled gene network

Co-expression analysis: what for?

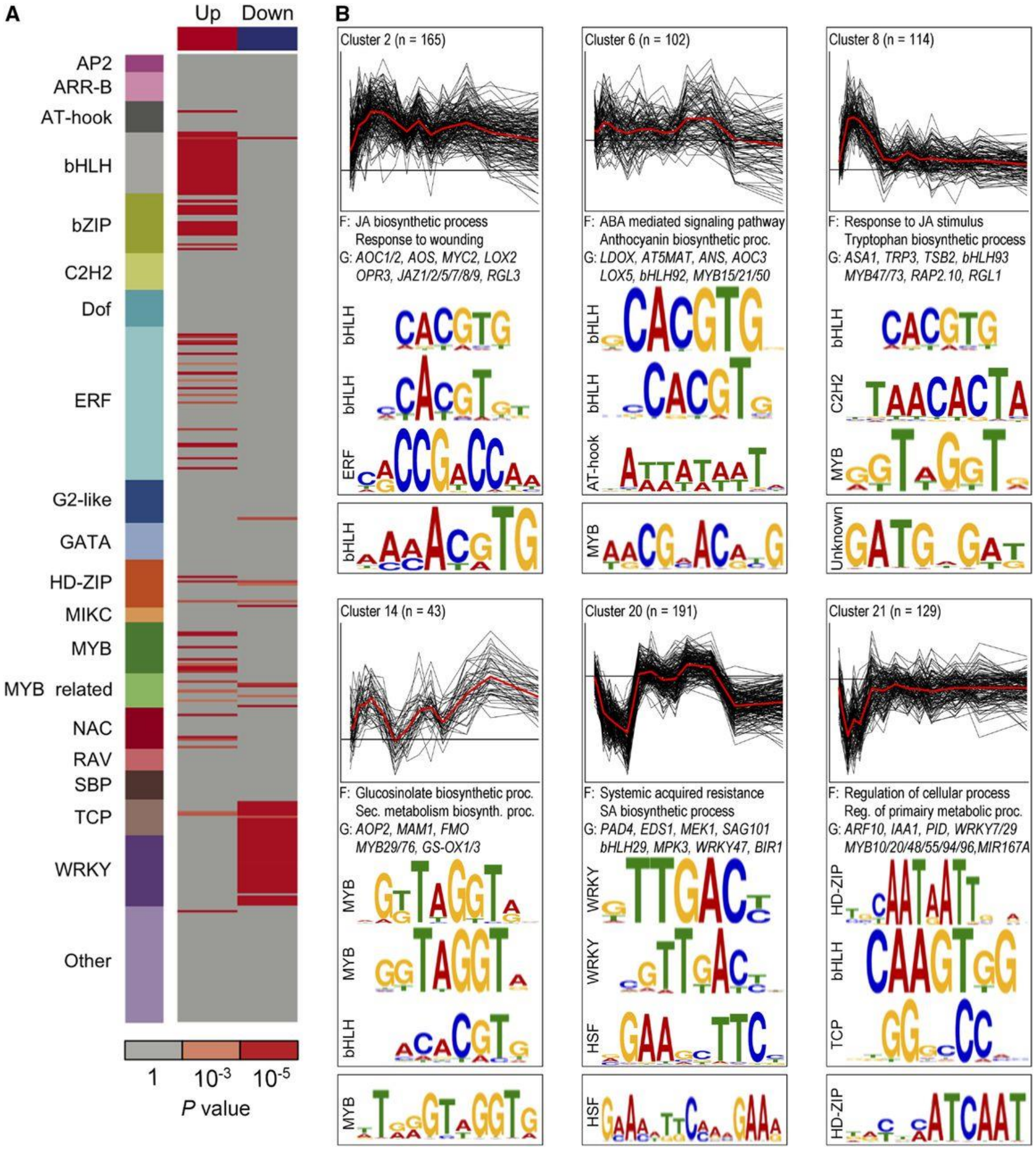
Examples of co-expression studies

Gene regulation:

DNA binding motif analysis

bHLH binding motifs enriched in most up-regulated clusters

bHLH TFs are essential components of MeJA induction

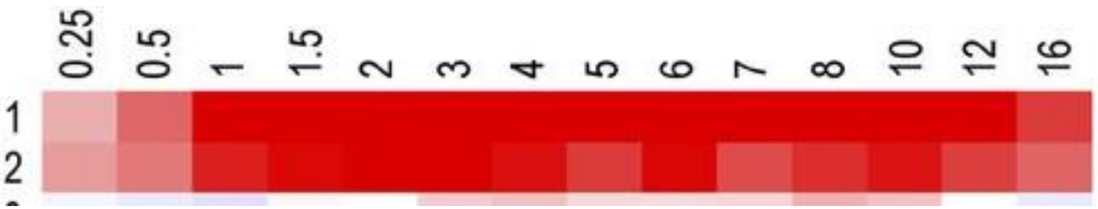


Co-expression analysis: what for?

Examples of co-expression studies

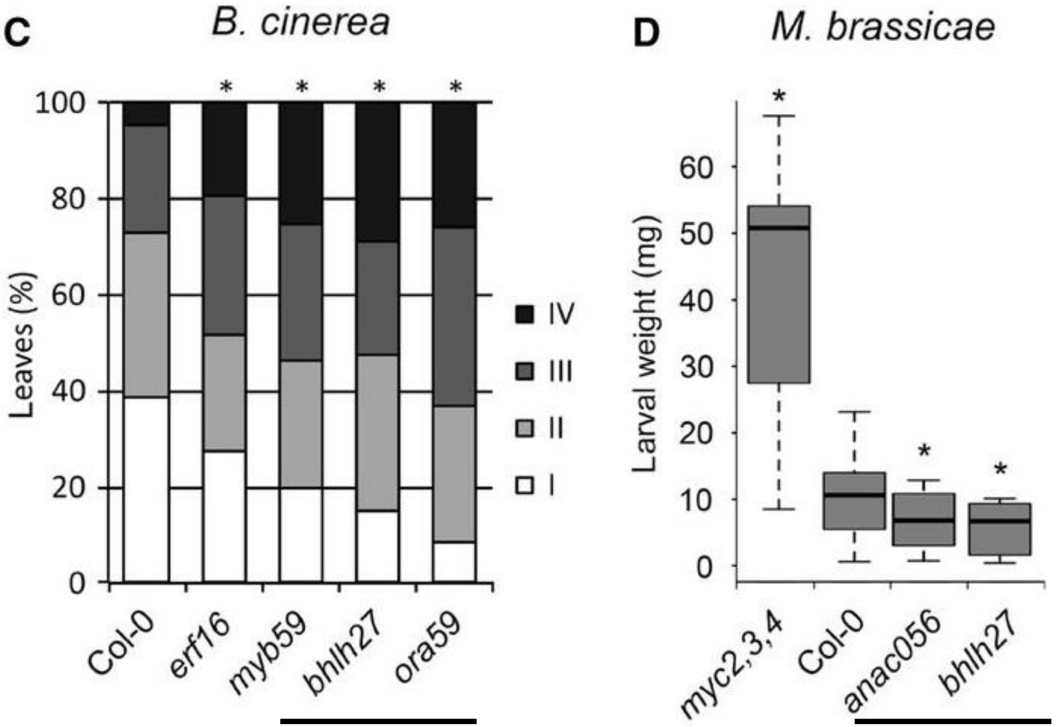
Gene annotation: New regulators of JA defense responses

Enriched in known JA-related genes including regulators



Testing of 12 uncharacterised TF from these clusters

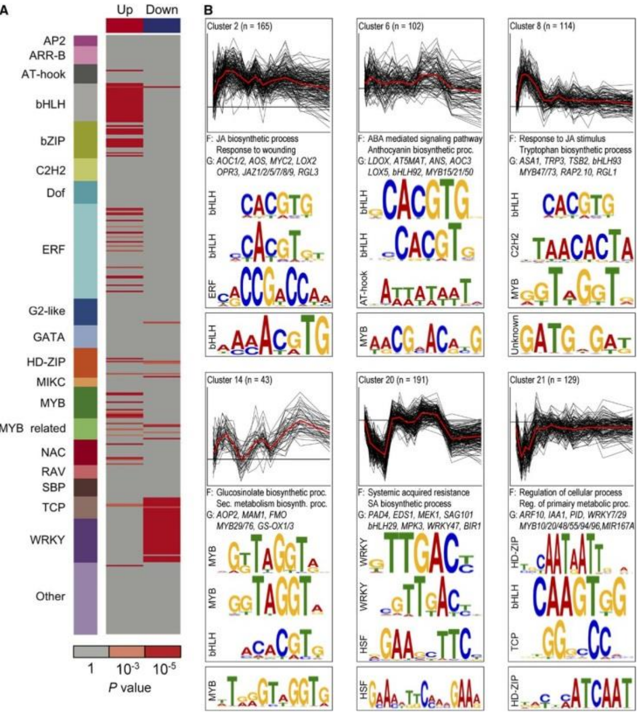
4/12 tested TF are involved in JA defense responses



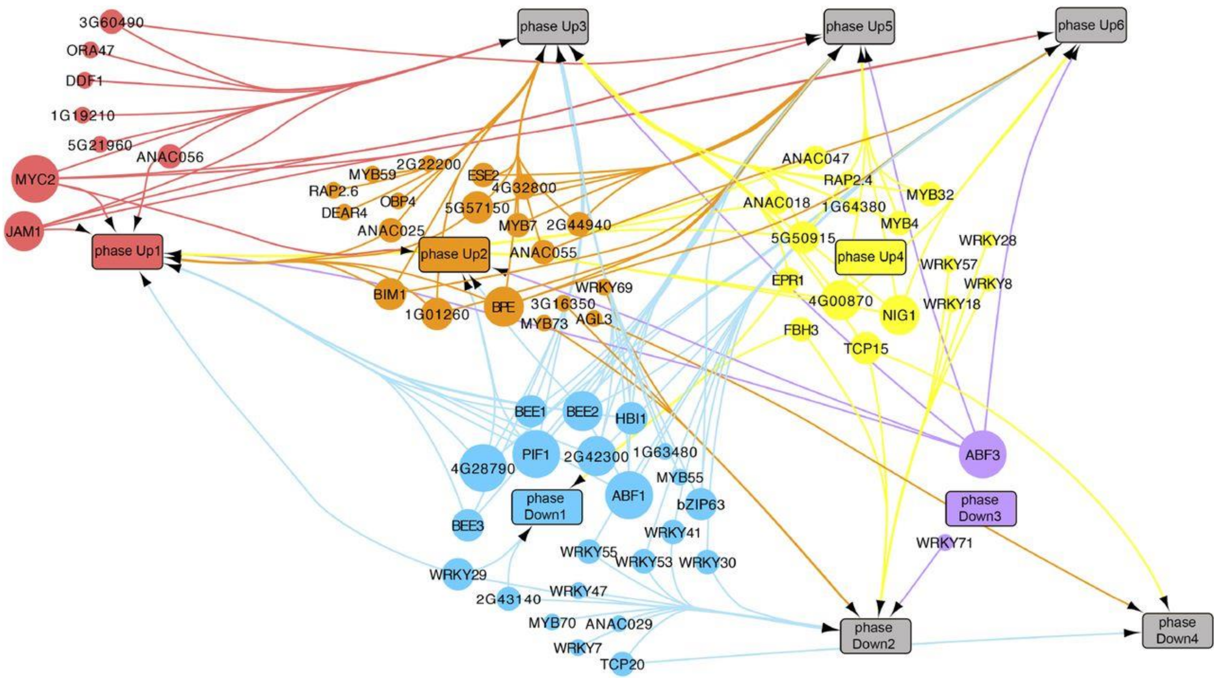
Co-expression analysis: what for?

Examples of co-expression studies

Data integration and gene clustering for network inference



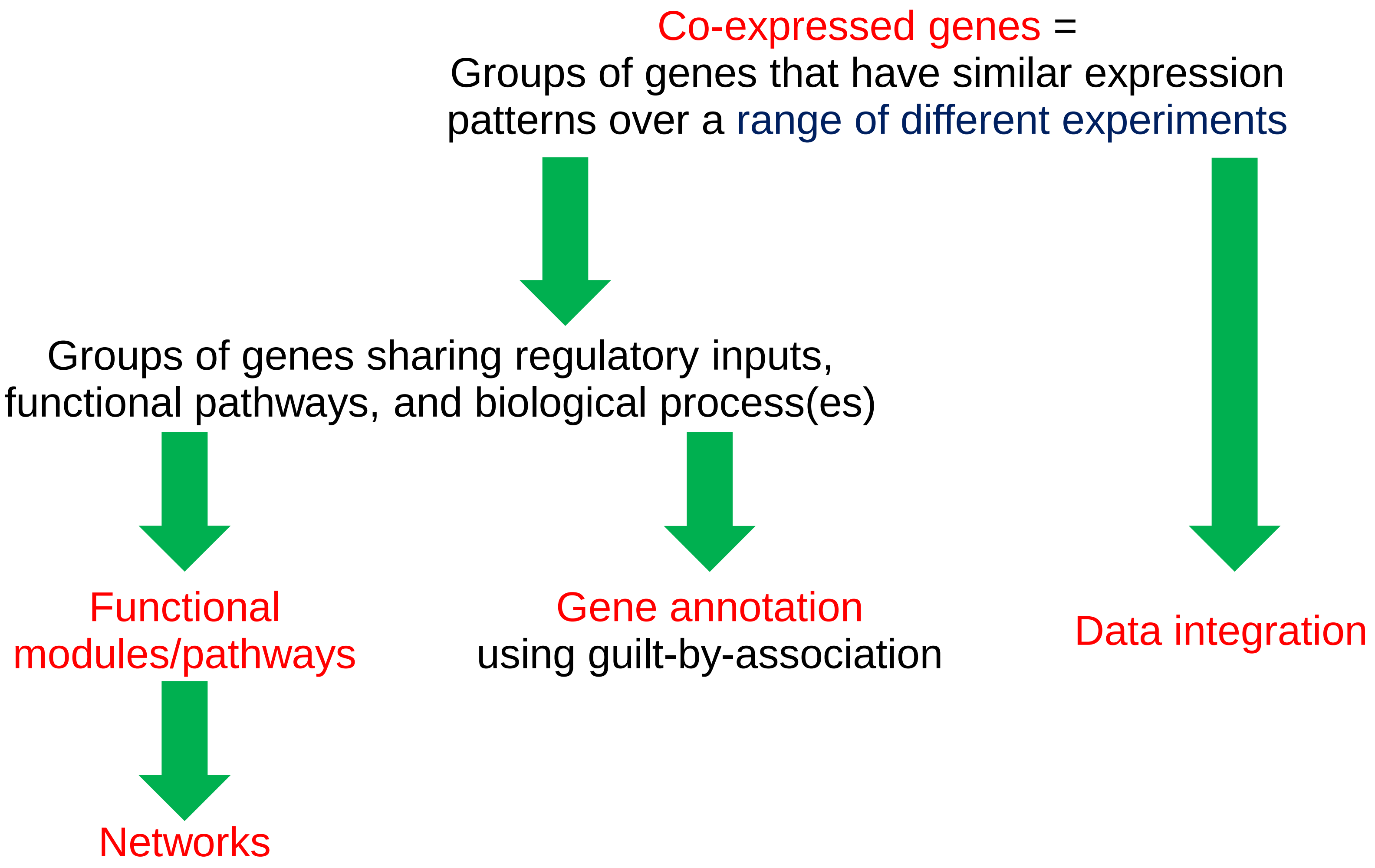
Gene clusters, gene annotation and promoter analysis



JA gene regulatory network

Co-expression analysis: what for?

Examples of co-expression studies



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