Phenological data set of five taxonomic groups and agrarian activities in temperate climate: trends (and influencing factors*), Latvian case study

* Delay due to Sars cov 2

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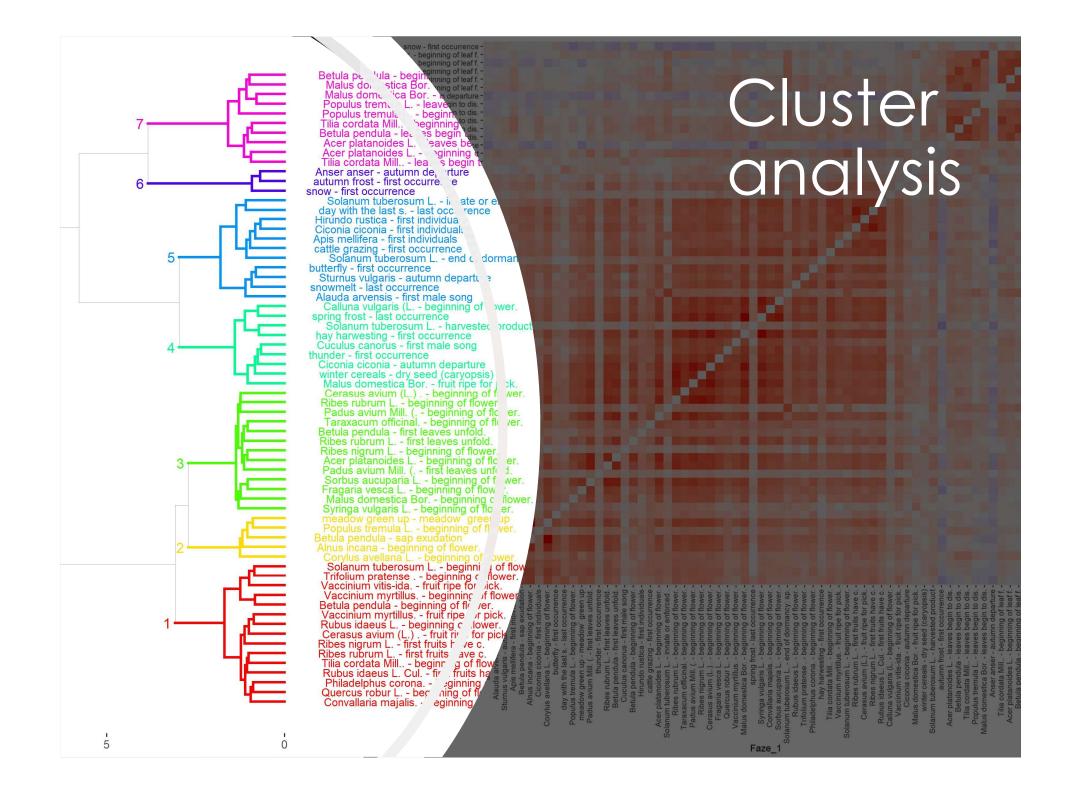## Phenological data digitization

- \> 47 000 observations;
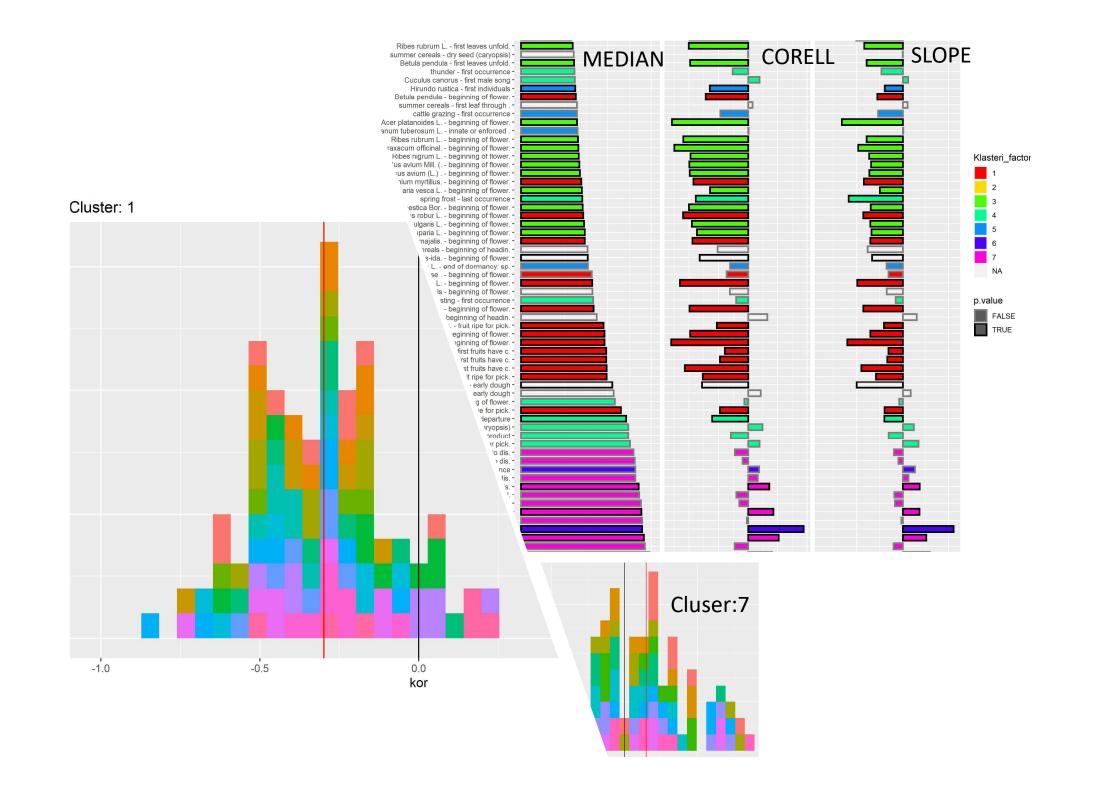- 148 phenological phases;
- period: 1970-2018

Data quality control

- Outliers identification;
- Phase order control

Multivariate analysis

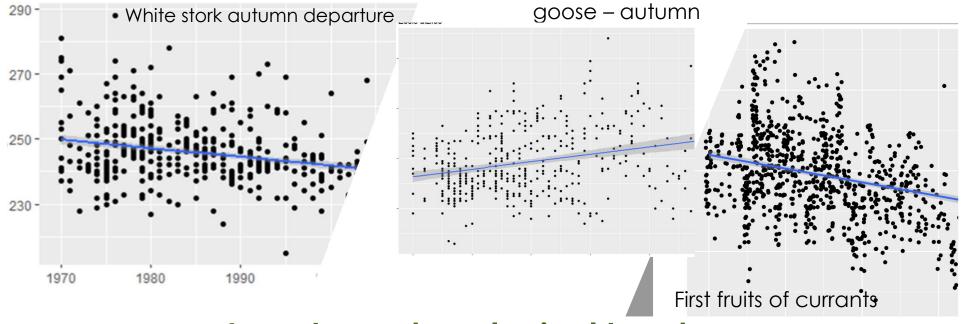- Cluster analysis ⟶ 7 clusters
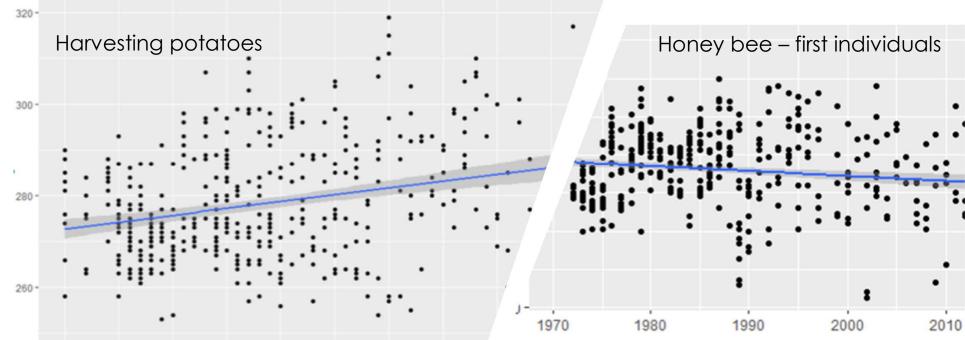- PCA (principal component analysis)

Trend analysis

- Long time series

Cluster analysis

7

6

5

4

3

2

1

5   0

snow - first occurrence -
- beginning of leaf f. -
- beginning of leaf f. -
Betula pendula - beginning of leaf f. -
Malus domestica Bor. - ng of leaf f. -
Malus domestica Bor. - n departure
Populus tremula L. - leaves begin to dis.
Populus tremula - beginning to dis.
Tilia cordata Mill.. - beginning to dis.
Betula pendula - leaves begin dis.
Acer platanoides L. - leaves begin
Acer platanoides L. - beginning t
Tilia cordata Mill.. - leaves begin t
Anser anser - autumn departure
autumn frost - first occurrence
snow - first occurrence
Solanum tuberosum L. - innate or e
day with the last s. - last occurrence
Hirundo rustica - first individual
Ciconia ciconia - first individuals
Apis mellifera - first individuals
cattle grazing - first occurrence
Solanum tuberosum L. - end of dorman
butterfly - first occurrence
Sturnus vulgaris - autumn departure
snowmelt - last occurrence
Alauda arvensis - first male song
Calluna vulgaris (L. - beginning of flower.
spring frost - last occurrence
Solanum tuberosum L. - harvested product
hay harvesting - first occurrence
Cuculus canorus - first male song
thunder - first occurrence
Ciconia ciconia - autumn departure
winter cereals - dry seed (caryopsis)
Malus domestica Bor. - fruit ripe for pick.
Cerasus avium (L.) . - beginning of flower.
Ribes rubrum L. - beginning of flower
Padus avium Mill. (. - beginning of flower.
Taraxacum officinal. - beginning of flower.
Betula pendula - first leaves unfold
Ribes rubrum L. - first leaves unfold.
Ribes nigrum L. - beginning of flower.
Acer platanoides L. - beginning of flower.
Padus avium Mill. (. - first leaves unfold.
Sorbus aucuparia L. - beginning of flower.
Fragaria vesca L. - beginning of flower.
Malus domestica Bor. - beginning of flower.
Syringa vulgaris L. - beginning of flower.
meadow green up - meadow green up
Populus tremula L. - beginning of flower.
Betula pendula - sap exudation
Alnus incana - beginning of flower.
Corylus avellana L. - beginning of flower.
Solanum tuberosum L. - beginning of flow
Trifolium pratense . - beginning of flower.
Vaccinium vitis-ida. - fruit ripe for pick.
Vaccinium myrtillus. - beginning of flower
Betula pendula - beginning of flower.
Vaccinium myrtillus. - fruit ripe for pick.
Rubus idaeus L. - beginning of flower.
Cerasus avium (L.) . - fruit ripe for pick
Ribes nigrum L. - first fruits have c.
Ribes rubrum L. - first fruits have c.
Tilia cordata Mill.. - beginning of flow
Rubus idaeus L. Cul. - first fruits ha
Philadelphus corona. - beginning
Quercus robur L. - beginning of fl
Convallaria majalis. - beginning

Faze_1

Cluster #	Trends	
1. Late spring and summer bloom and ripening	Earlier..... later ⬅	Advanced; Ripening phases less pronounced trend;
2. Early spring (hazel, alder, aspen BBCH61)	⬅ ⬅	Large year-to year variability; Highest slope values; Strong advanced;
3. Spring bloom (BBCH61)	⬅ ⬅	Flowering of wild and garden berries, shrubs and trees during May; Strong advanced;
4. Mix	⬅ ➡	Variable;
5. "Birdy"	⬅	Birds arrival earlier; Insects – negative tendency; Field works – variable.
6. Deep autumn	➡	First frost, birds migration, first snow. Positive trends.
7. Leaves senescence	⬅ ➡	Species-species variability (maple and aspen – advanced, other – delay); Regional differencies.

Long term phenological trends

White stork autumn departure

goose – autumn

First fruits of currants

Harvesting potatoes

Honey bee – first individuals

1. **Data base:** > 47 000 records: 5 taxsonomic groups, agrarian activities, abiotical observations (first and last frost, first snow, snow melting);
65 % > 11 years data series; long term data (1970-2018)

2. **Seven clusters:** 3 blooming clusters (early flowering, second blooming (maple tree) and late spring; distincts 2 autumn clusters (leaves senescence and birds migration);

3. spring **trends** - negative; autumn – variable.

4. influecing factors – coming soon...

Conclusion remarks

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