AMIES II –Final Meeting

28th- 29th September 2017

Project-unit C

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Modelling biomass of mountainous grassland by including a species composition map

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1. Introduction: aims
2. Method: Modelling species composition with remote sensing
3. Results: Modelling of grassland properties

   Reflectance signatures of shrub encroachment
4. Discussion and Conclusion
5. Outlook

The floristic diversity of grassland in the Kazbegi valley is closely related to land-use practices.

Assessment of grassland **species composition, biomass, and functional groups** supports sustainable land management

and can be used to develop normative land-use scenarios.

Broader scope:

EU Biodiversity Strategy:
→ Action 5: **Map** and assess **the state** and economic value **of ecosystems** and their services in the entire EU territory; promote the recognition of their economic worth into accounting and reporting systems across Europe.

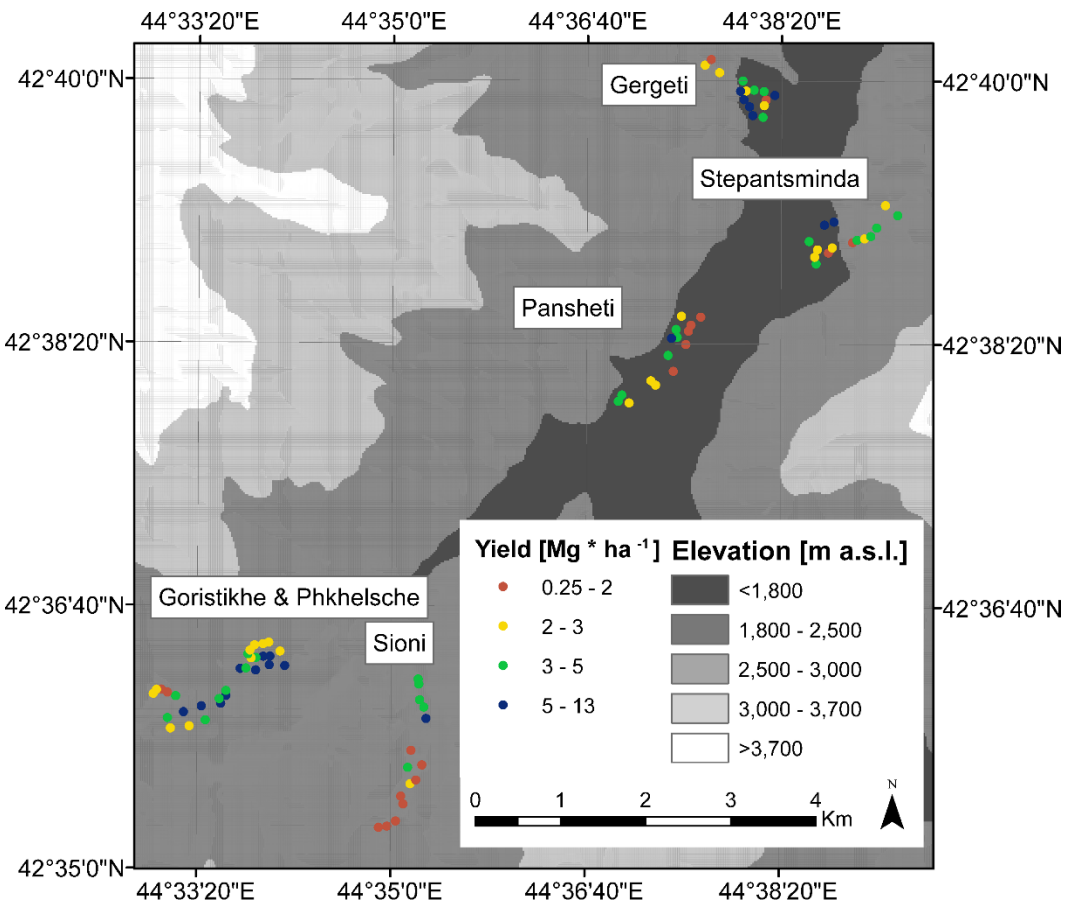
UN-Sustainable development goals:
→ **Goal 15 Life on Land:** By 2020, **integrate ecosystem and biodiversity values into national and local planning, development processes**, poverty reduction strategies and accounts.

Essential Biodiversity variables:
Remotely sensed **Essential Biodiversity Variables**
→ key variables on a regular and global basis, to monitor changes in the Earth's biodiversity.

Research aims:

- to analyse the **species composition** and main **environmental gradients** of the subalpine grassland,
- to test the predictability of **species composition, aboveground biomass and plant functional groups**, as cover fractions of grass, herb, and legume by remotely sensed data and subsequently map them, and
- to test the possibility of **identifying encroaching shrub species** in remotely sensed data, with respect to sensor characteristics and acquisition time.



Vegetation relevés

Biomass clippings

Predictors

Topographic parameters

Satellite imagery

Vegetation indices

Target variable

Isomap axes
Yield
Plant functional groups

Random Forest Model

Methode nach: Feilhauer, H.; Faude, U.; Schmidtlein, S., 2011: Combining Isomap ordination and imaging spectroscopy to map continuous floristic gradients in a heterogeneous landscape. - *Remote Sensing of Environment* 115 (10): 2513-2524.

Predictors for vegetation modelling:

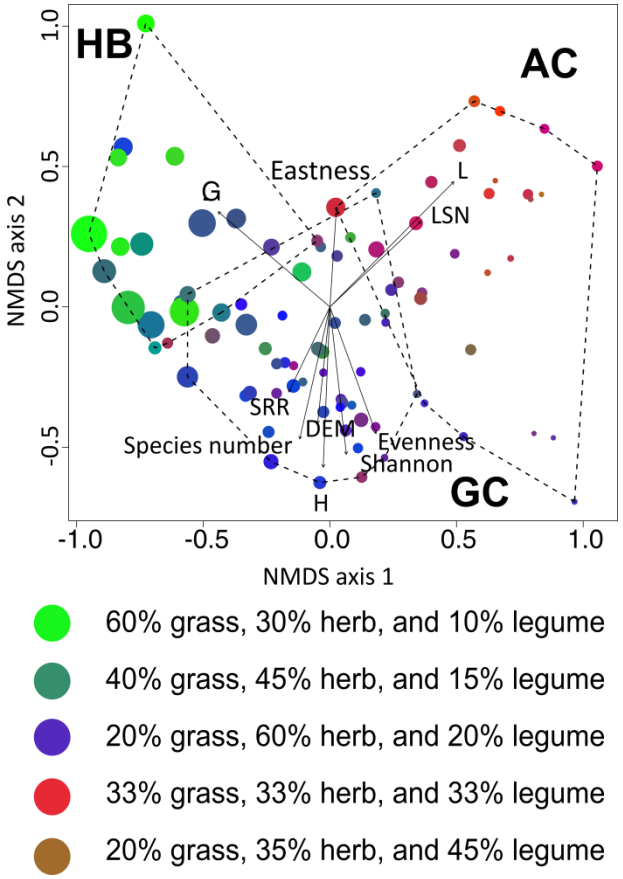
Topographic Parameters

Inclination [°]
Eastness
Northness
Elevation [m a.s.l.]
Profile curvature
Planform curvature
Mean curvature
Topographic Ruggedness Index
Heat Load Index
Compound Topographic Index
Surface Relief Ratio
Solar radiation [Wh/m²]

Vegetationindices

Satellitenbänder (blau, grün, rot, red-edge, NIR)
Red edge / red
NIR / red edge
Red edge / NIR
NIR / red
NIR /green
Normalized Difference Vegetation Index
Normalized Difference Red edge Index
Enhanced Vegetation Index
Atmospherically Resistant Vegetation Index 2
Blue-Wide Dynamic Range Vegetation Index
Wide Dynamic Range Vegetation Index
Soil Adjusted Vegetation Index (SAVI 05)
Modified Soil Adjusted Vegetation Index

Ordination of subalpine grassland vegetation



→Vegetation composition can be explained by topography

→Grassland types are characterized by gradual transitions

***HB**: Hordeum brevisubulatum* meadow
***GC:** Gentianella cauacasea* grassland
***AC:** Astragalus captiosus* grassland

Magiera, A., Feilhauer, H., Waldhardt, R., Wiesmair, M., Otte, A.: Mapping plant functional groups in subalpine grassland of the Greater Caucasus. - Mountain Research and Development (submitted on 27.07.2017).

Hordeum brevisubulatum-meadows:

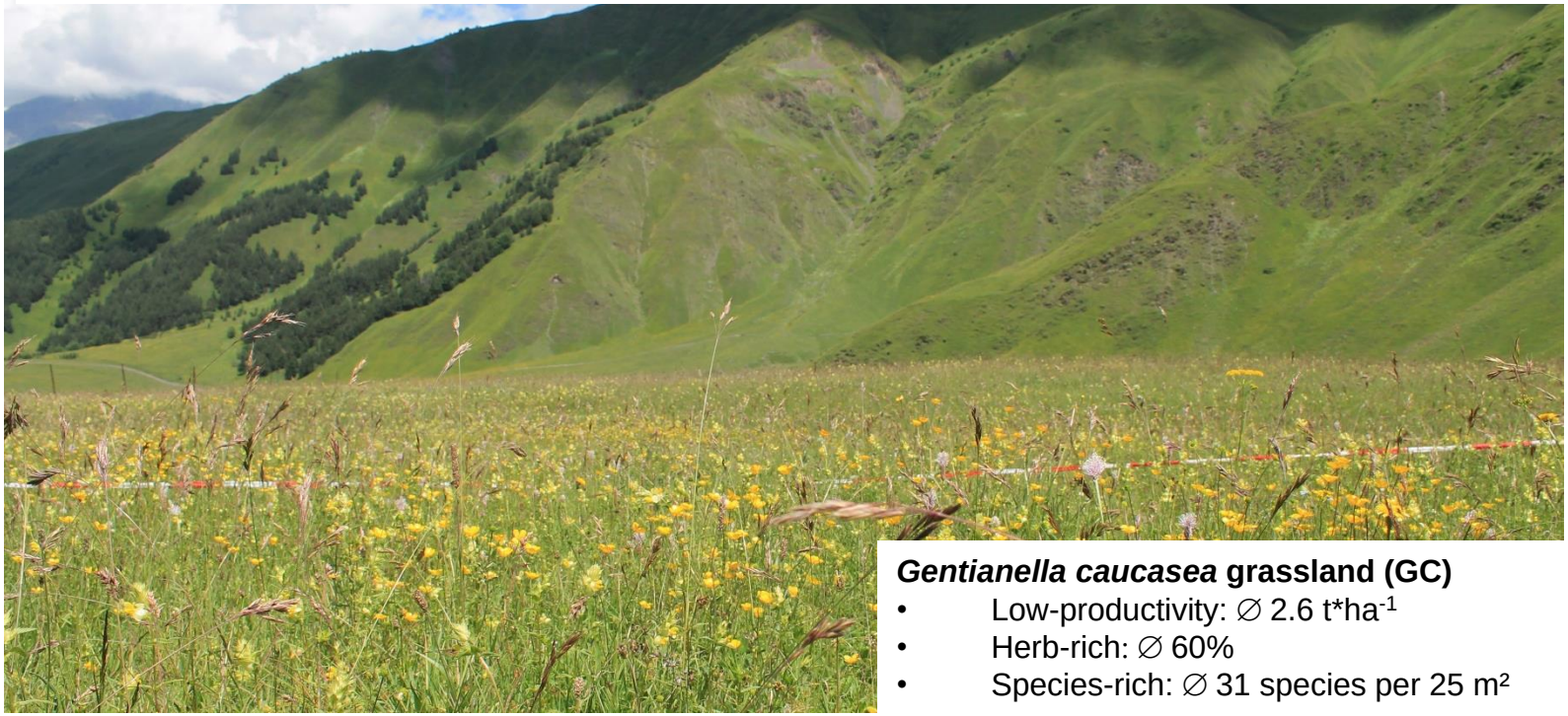
Hordeum brevisubulatum, Phleum pratense, Silene vulgaris, Rumex acetosa, Carum carvi, Festuca pratensis, Bunias orientalis, Poa trivialis, Vicia tenuifolia ssp. variabilis, Poa pratensis, Rumex obtusifolius

Hordeum brevisubulatum meadow (HB)

- Productive: ∅ 6t*ha^{-1}
- Grass-rich: ∅ 40%

Gentianella caucasea-grassland

Alchemilla sericata, *Gentianella caucasea*,
Primula algida, Seseli alpinum



***Gentianella caucasea* grassland (GC)**

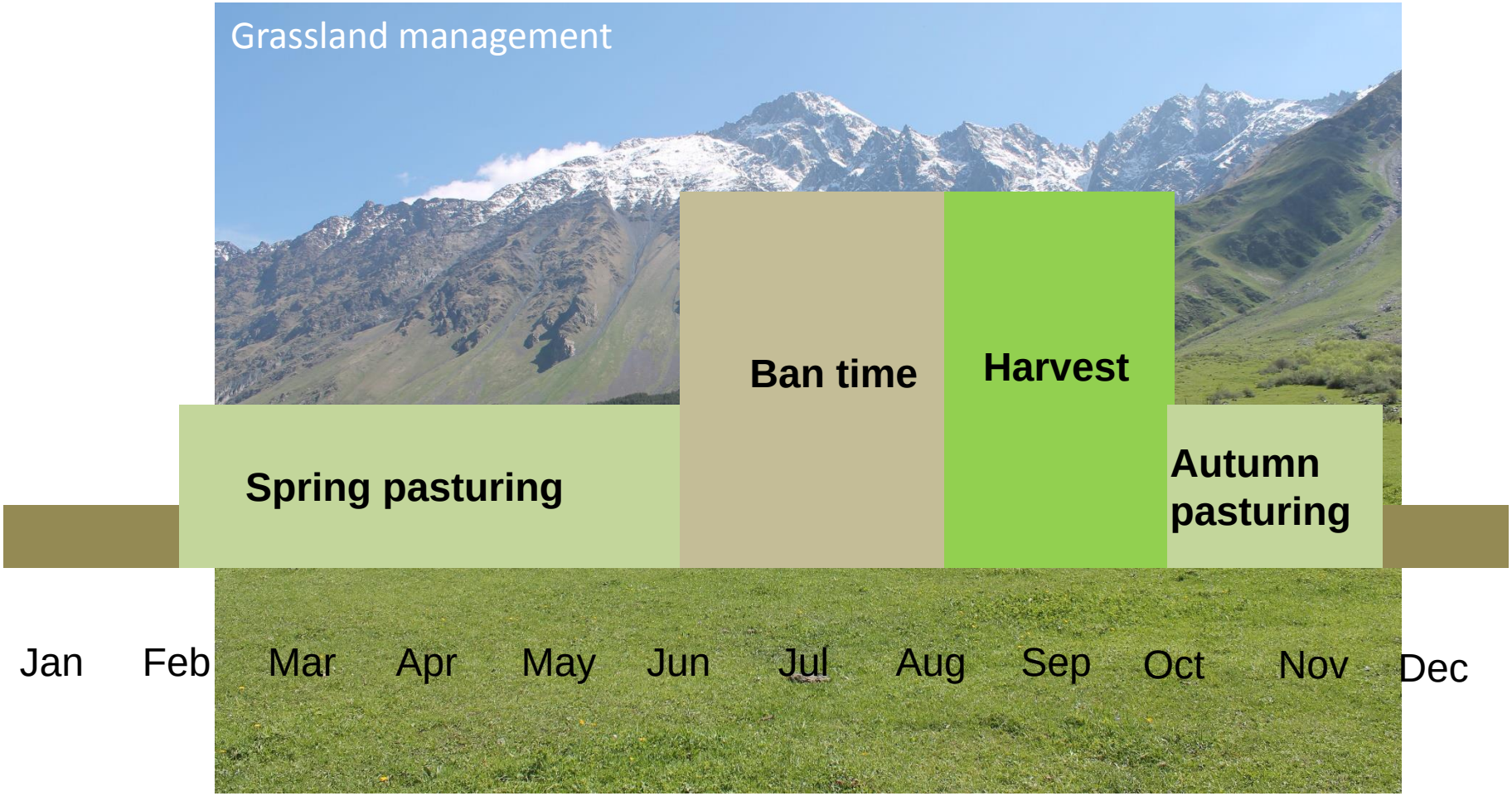
- Low-productivity: ∅ 2.6 t*ha^{-1}
- Herb-rich: ∅ 60%
- Species-rich: ∅ 31 species per 25 m²

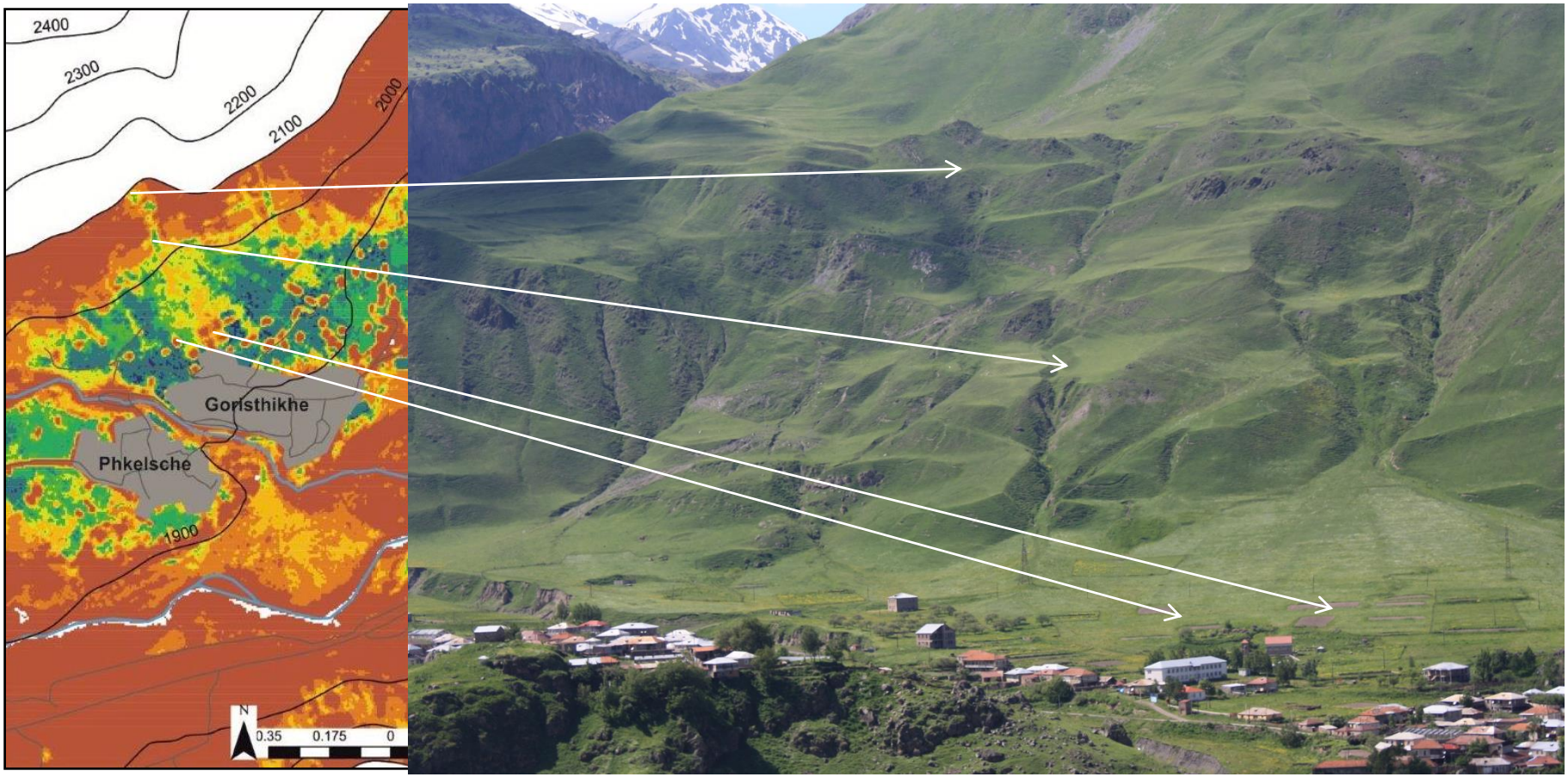
***Astraglus captiosus*-Weiden:**

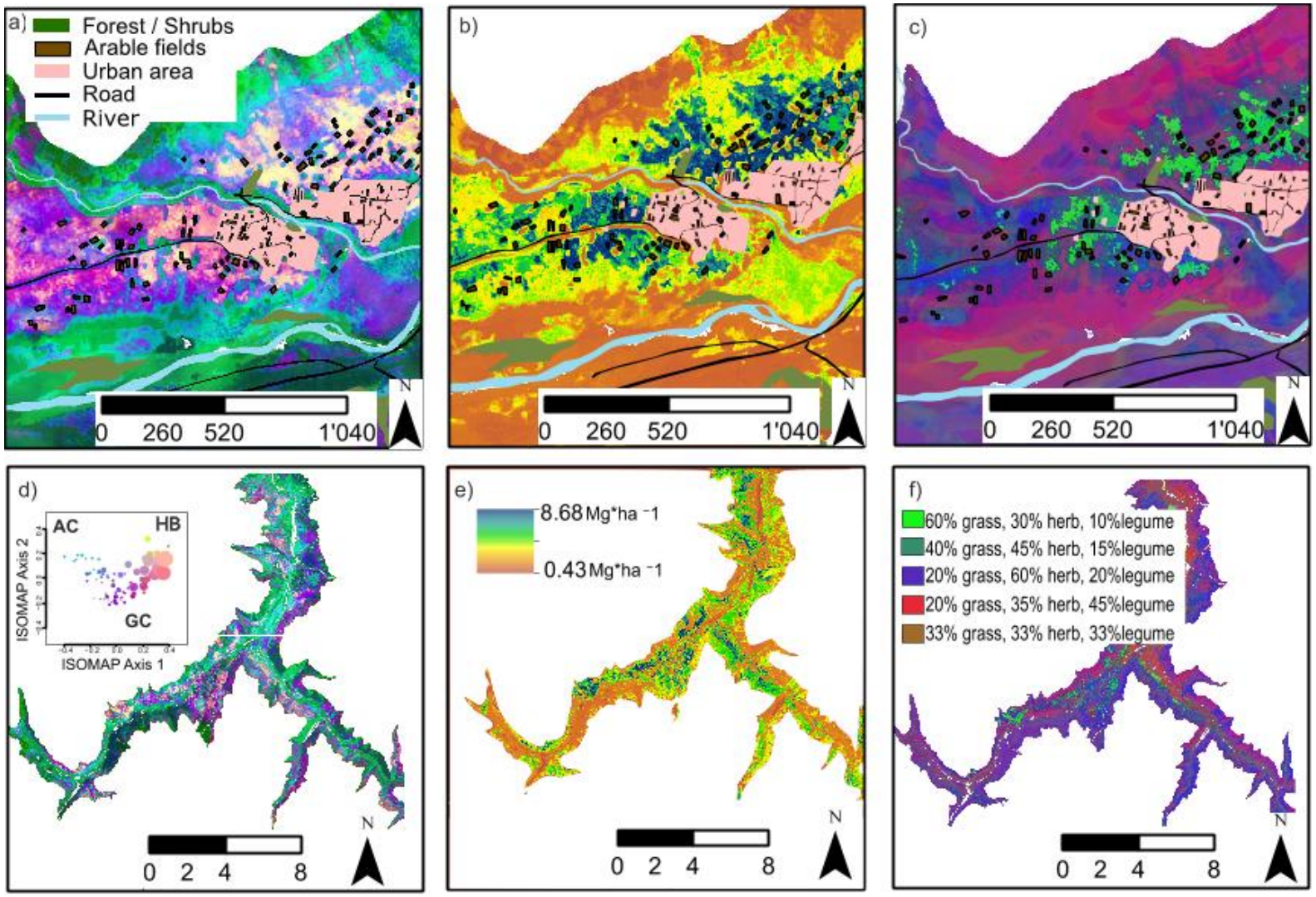
Astragalus captiosus, *Potentilla crantzii,*
Silene linearifolia, Campanula sibirica ssp. *hohenackeri*

***Astragalus captiosus* grassland (AC)**

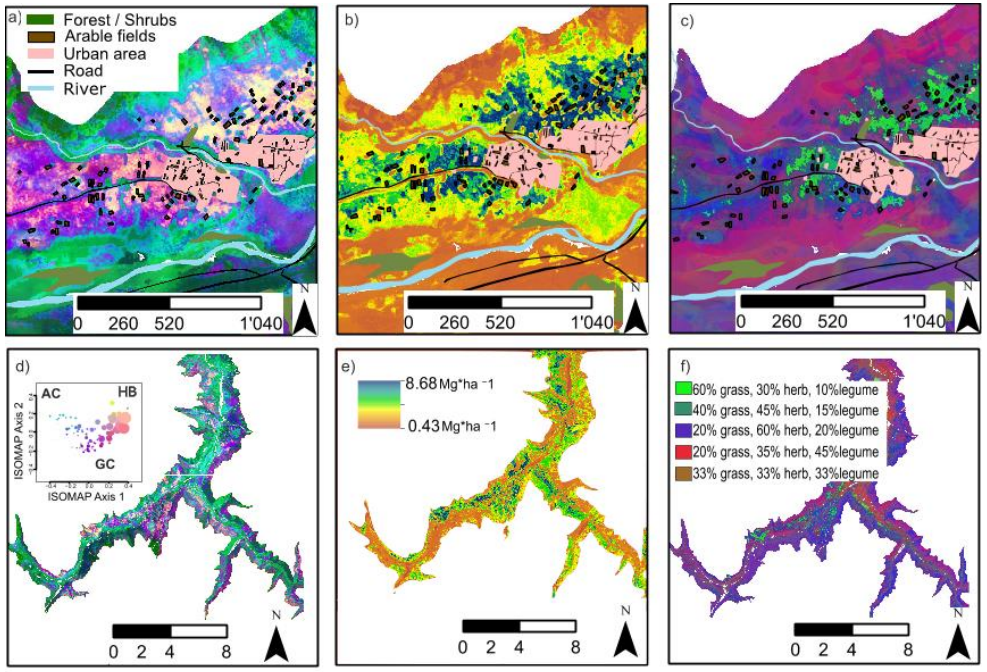
- Low-productivity: ∅ 2.6t*ha^{-1}
- Legume-rich: ∅ 35 %


Grassland management
Ban time
Harvest
Spring pasturing
Autumn pasturing
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


2400
2300
2200
2100
2000
Goristhikhe
Phkelsche
1900
N
0.35
0.175
0



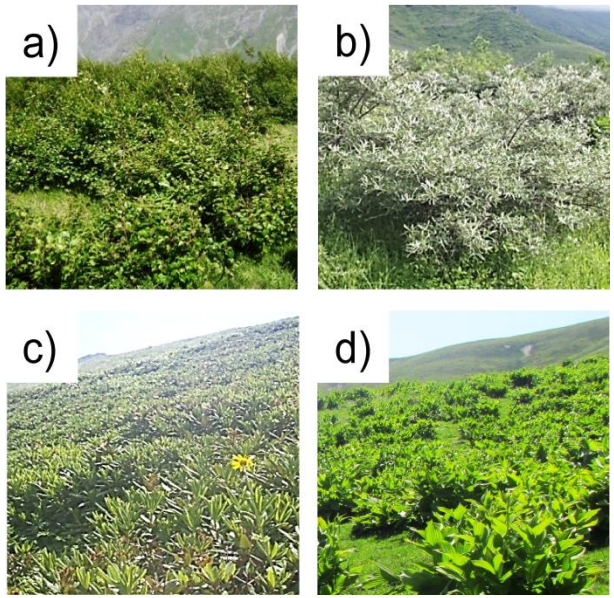
Magiera, A., Feilhauer H., Waldhardt, R., Wiesmair, M., Otte, A. 2017: Modelling biomass of mountainous grasslands by including a species composition map. - Ecological Indicators 78: 8-18.

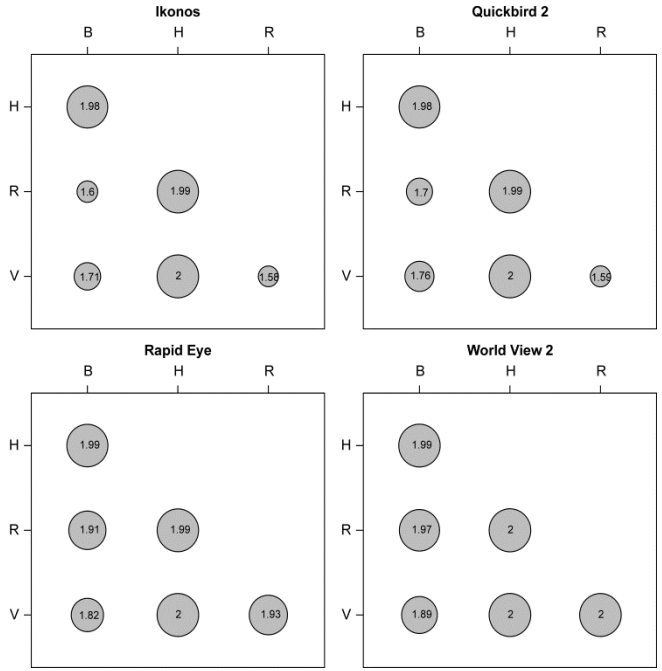


Variance explained:
Axis one = 64 %
Axis two = 33 %
Axis three = 46 %

Variance explained:
Grass cov. = 32 %
Herb cov. = 25 %
Legume cov. = 37 %

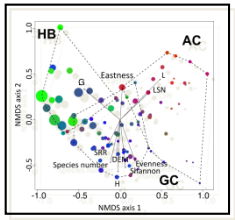
Variance explained:
Yield = 62 %



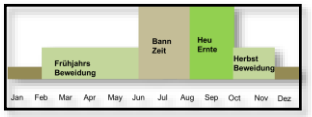


- ***B****etula litwinowii* (a) and ***H****ippophae rhamnoides* (b), show a good seperability.
- ***R****hododendron caucasicum* (c), as well as ***V****eratrum lobelianum* (d) are difficult to seperate from *Betula litwinowii.*

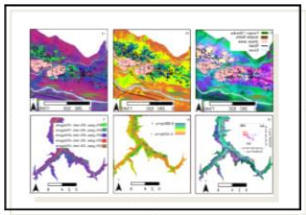
Magiera, A., Feilhauer, H., Tephnadze, N., Waldhardt, R., Otte, A. 2016: Separating reflectance signatures of shrub species – A case study in the Central Greater Caucasus. - Applied Vegetation Science 19: 304–315.



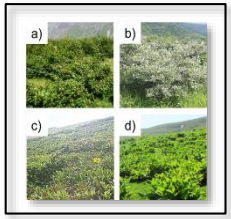
→ Grasslandvegetation is related to topograhic conditions (elevation, aspect).



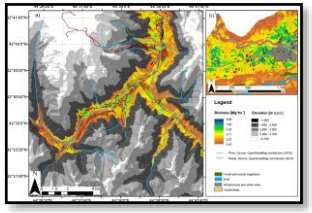
→ Broad transitions between grassland types.



→ Species composition and biomass can be modelled by satellite imagery, vegetation indices, and topographic parameters.



→ Monitoring of shrub encroachment on species level is possible.



→ Multi-scale maps of grassland properties are important tools for determination of the carrying capacity of a remote high-mountain region.


Thank you