Airborne Imaging Spectroscopy Workshop

Roundtable

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Content

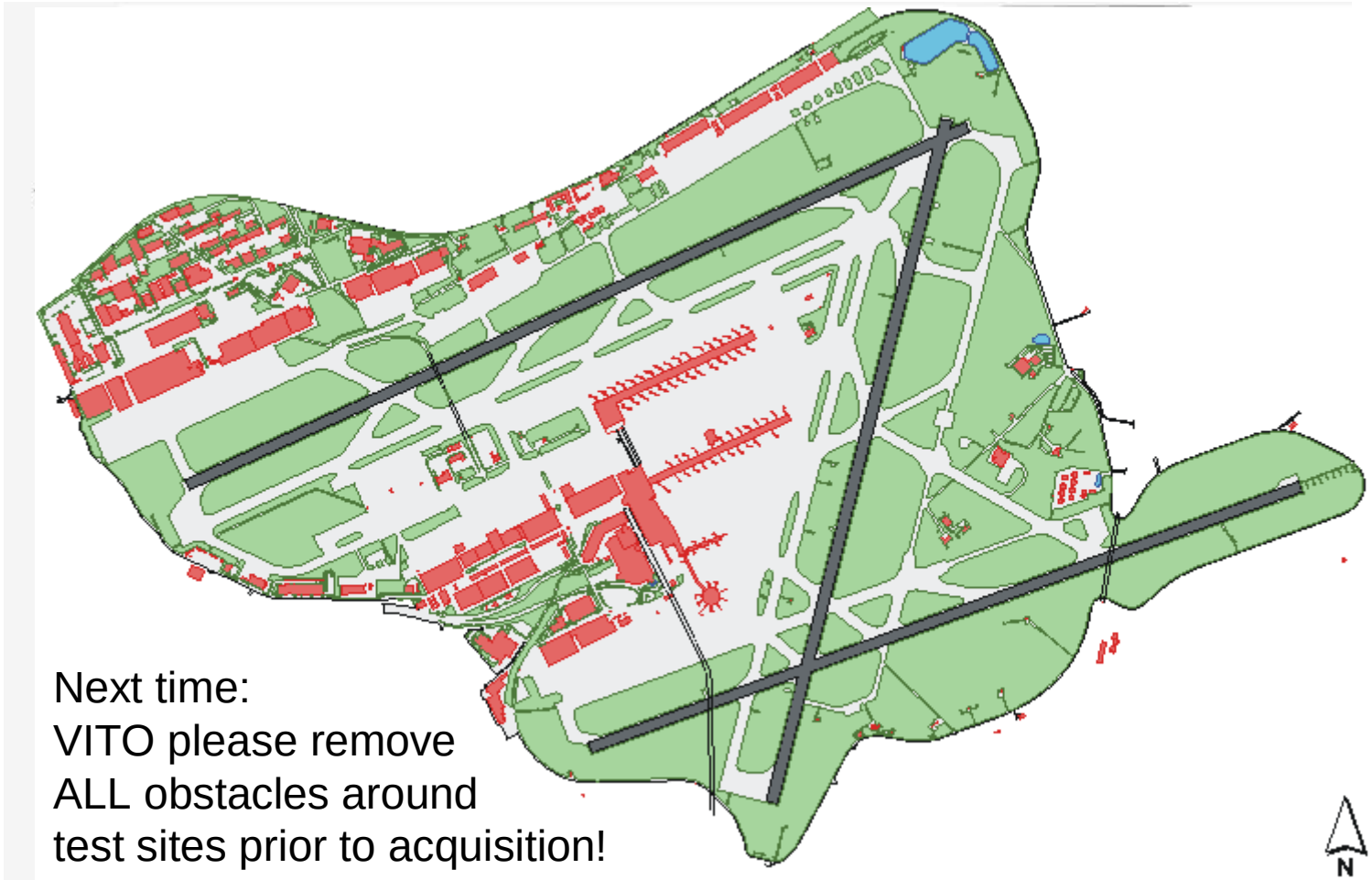
- The Questionnaire
- Data Collection Planning
- Imaging Spectroscopy in the Defence Area
- Imaging Spectroscopy in Earth System Sciences
- Future Activities and Plans
- Conclusions

Data Collection Planning

Imaging Spectroscopy in the Defence Area

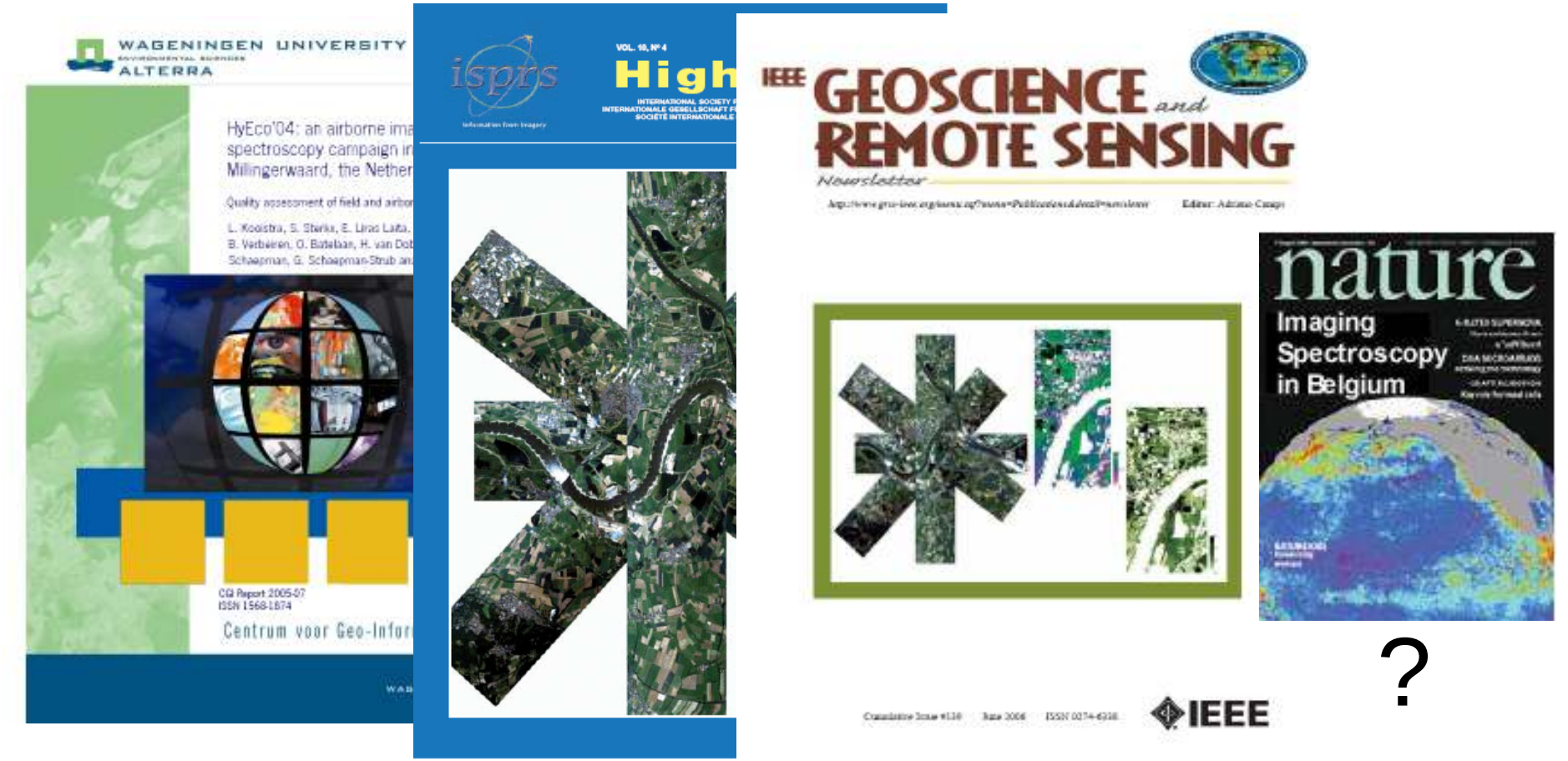
Imaging Spectroscopy in Earth System Sciences

Flight Planning



Next time:
VITO please remove
ALL obstacles around
test sites prior to acquisition!

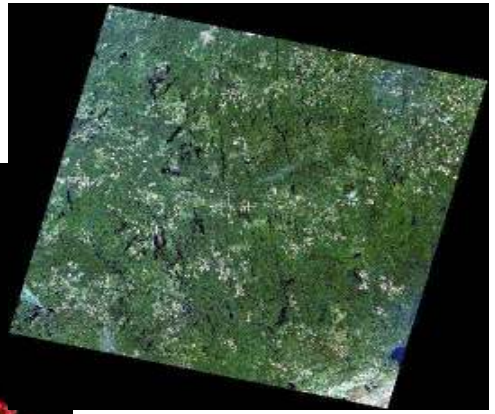
Evolution of Campaign Activities



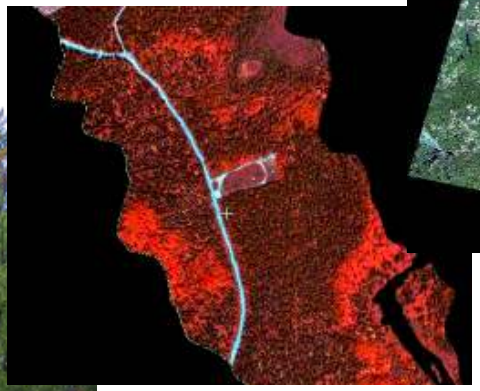
Linking Scales

Scaling - up

Satellite



Airborne



Spatial scale, adjacency effects

Crown/canopy

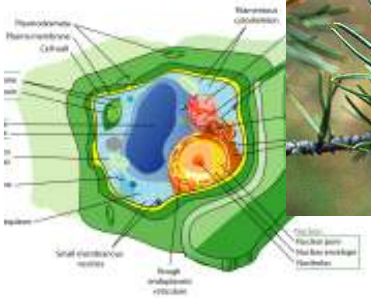
Canopy RT model: link BRF to LAI, fCover, structure, background

Leaf/needle

Leaf RT model:

link leaf (r, t) to pigments, water, etc

Molecule



Atmosphere RT model: link spectral radiance to scattering & absorption effects of variable aerosol & H_2O

Linked- RT models

Modified after
Miller, J. et al. IGARSS, 2006
Ustin, S. et al. IGARSS, 2006

Toward an IS satellite mission?

Imaging Spectrometer data: full spectrum, multi-view, multi-temporal

calibration,
atmospheric correction,
spectral polishing,
etc.
-> TOC BRF

Environment & Resource Management "Products" of Interest

Agriculture:

e.g. Yield forecast map
Crop spatial/temporal growth variability maps
Crop stress map (nitrogen deficiency, insect, disease, dehydration, senescence)

Forestry:

e.g. Forest inventory map (e.g., forest area, forest type, fragmentation, stem volume
Productivity map
Forest carbon map (reforestation, afforestation, deforestation)
Forest condition map (e.g., health, water stress, fuel type)

the current & most important challenge

Analysis Paradigms: Combinations of

- Canopy/leaf reflectance models
- Feature fitting based on physical/empirical models
- Optimized vegetation indices & RT models
- Linear/Non-linear SMA
- Spectral matching
- Artificial Neural networks trained with model runs
- Vegetation growth models

Biophysical Variables:

- LAI, Leaf Chlorophyll content
- Leaf or Canopy water content
- Bio-indicators: canopy chemistry, pigment ratios
- Fractional cover, APAR, biomass
- Spectral albedo
- Clumping index

increased accuracy through remote sensing science innovations

Modified after Miller, J. et al. IGARSS, 2006

Planned Instruments

- Space Activities
  - HERO - Hyperspectral Environment and Resource Observer, Natural Resources Canada, Canadian Space Agency
  - EnMAP - Environmental Mapping and Analysis Program (GFZ, Germany)
  - Flora - NASA ESSP proposal
  - FLEX - ESA Earth Explorer proposal
  - SpectraSat - Full Spectral Landsat proposal
  - ZASat - South African proposal (University of Stellenbosch)
  - HIS - Chinese Space Agency
  - COIS - Coastal Optical Imaging Spectrometer (on NPOESS?)
- Airborne Activities
  - ARES (DLR, Germany)
  - APEX (RSL, VITO (CH, B))
  - HICO (NRL, USA)
  - SAMSON (NRL, NOAA, USA)
  - Continuation, upgrades from existing instruments (AVIRIS, CASI, AISA, Daedalus, etc.)

Schaepman, M.E., Green, R.O., Ungar, S., Boardman, J., Plaza, A.J., Gao, B.-C., Ustin, S., Miller, J., Jacquemoud, S., Ben-Dor, E., Clark, R., Davis, C., Dozier, J., Goodenough, D., Roberts, D., & Goetz, A.F.H. (2006 (accepted)) The Future of Imaging Spectroscopy – Prospective Technologies and Applications. In IGARSS, pp. 5. IEEE, Denver (USA).

Ongoing/Future Activities

- Hyressa (EU FP6, Specific Support Action) – Hyperspectral remote sensing research infrastructure
- Hyper-I-Net (EU FP6, Marie Curie RTN) – High-level training in hyperspectral imaging
- DeSurvey (EU FP6, Integrated Project) – Surveillance system for assessing and monitoring of desertification
- Ecochange (EU FP6, Integrated Project) - Assess and forecast changes in terrestrial biodiversity using advanced remote sensing methods
- … and many more …

Conclusions

- Imaging spectroscopy enables biophysical and biochemical variables of the Earth's surface and atmospheric composition to be mapped with unprecedented accuracy.
- Imaging spectroscopy has significantly contributed to an improved physical understanding of interactions of photons with the atmosphere, cryosphere, land and water
- Imaging spectroscopy offers to bridge scaling gaps from previously non-accessible scale ranges (from molecules to ecosystems)

Conclusions II

- To achieve new success, improved data quality and wider availability of consistent imaging spectrometer observations to the user community are required
- Combined instrumented approaches are not only with complementing measurement techniques (LIDAR, SAR, fluorescence, etc.), but also with multispectral sensors that have wider swaths and more frequent sampling intervals
- Broader availability of high-performance computing resources is needed to run quantitative, physically based models
- The imaging spectroscopy community has to increase its efforts to convince relevant stakeholders of the urgency to acquire for the Earth, continuous highest quality imaging spectrometer data for extended periods of time
- The observed trends indicate that this need is becoming better understood and seen as essential for the sustainable development of our resources and the protection of our environment.

Conclusions III

- The panel recommends therefore to adopt the following statements:
  - The participants to the Belgian funded flight campaigns 2005 express their gratitude to the Belgian Space Office and thank Belspo for all the efforts taken to successfully implement these campaigns.
  - The participants particularly encourage Belspo to continue these activities wherever possible.
  - The participants conclude that a continuation and further fostering of spectroscopy related research at all relevant levels should take place (e.g., national, ESA, EU (GMES), GEO/GEOSS, international)