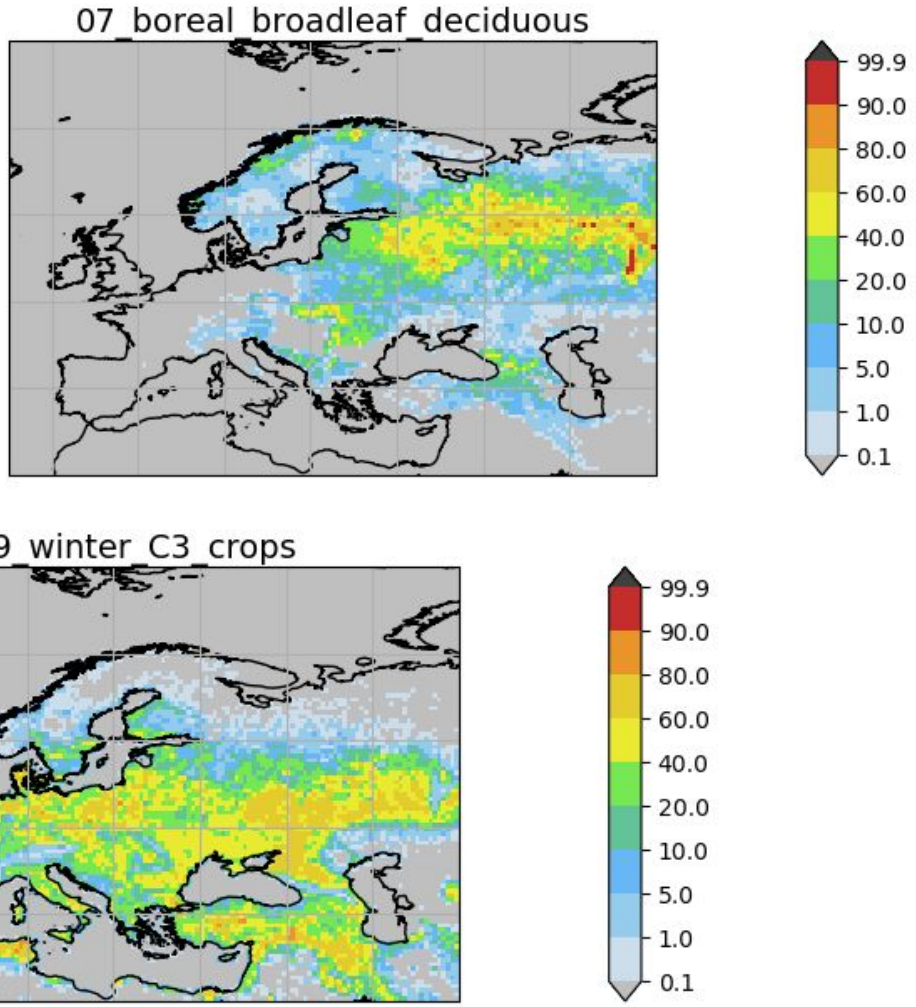
Land-cover: Intro & EMEP experiences

(Or, be careful what you wish for…..!)

David Simpson
Met Norway

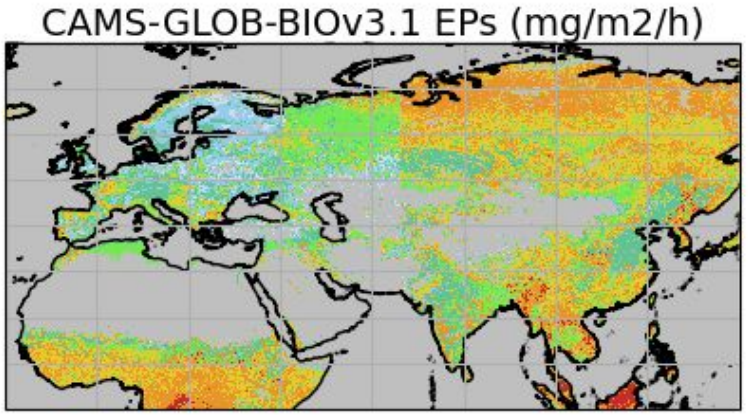


Figs. from ECO-SG dataset

Land-cover, Intro & EMEP experiences

Current EMEP LC:

- EMEP **European** LC from harmonised CCE/SEI-Y database
  - 1km
  - Has ca. 16 categories, incl. tundra, moorland, med. scrub, etc.
  - European BVOC emission factors from EMEP + JRC maps (> 130 tree species!) - assigned to PFTs
- EMEP **RoW LC** is hybrid, from GLC2000, CLM (MEGAN classes), Olson (for deserts)
- LAI/Phenology from tables and LPJ-GUESS
- Issues:
  - Messy
  - Discontinuous at old and new EMEP domain boundaries.
  - Phenology for crops in RoW not known.



Land-cover, Intro & EMEP experiences

- Currently trying to update land-cover (LC) for EMEP as part of **CAMS2-61** for soil NO and **CAMAERA** for BVOC.
- For example:
  - For soil-NO would like to distinguish shrubs (A_{wet}=0.01) from grass/savannah (A_{wet}=0.84), etc.
  - BVOC would like different forest species, at least on general level
  - Wildfires also allocates emission factors to different LC
  - In future probably want better soil characteristics also.
- Also need phenology/LAI etc.
- Nothing off-the-shelf!
- Can of worms!!

Which land-cover to use?

Investigated:

- ESA PFT
- ECOCLIMAP-SG
- IFS/ECLand
- MODIS for SNOx
- Other

Supplemented by:

Olson, MEGAN, CORINE, SEI/CCE harmonised, Koeppen-Gieger

- needed to get e.g. deserts, savannahs, tundra, moorlands

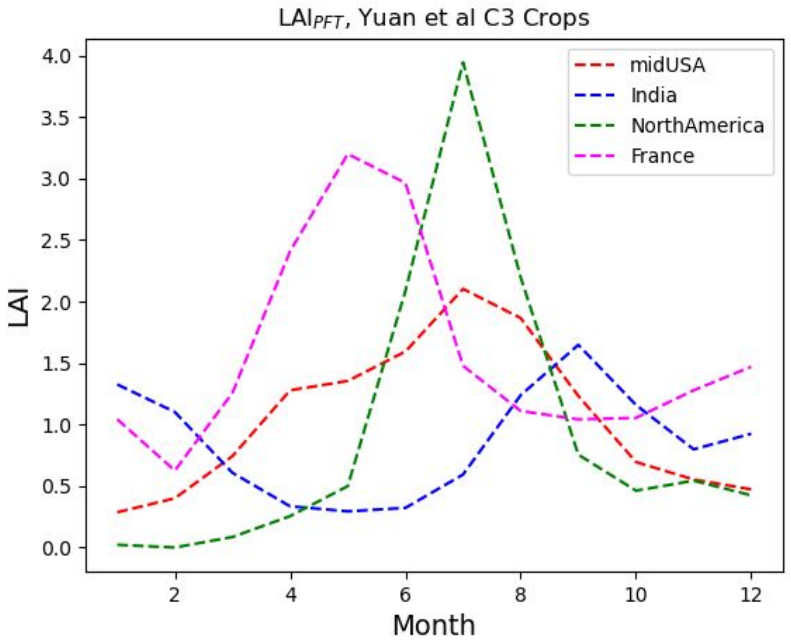
For LAI/Phenology:

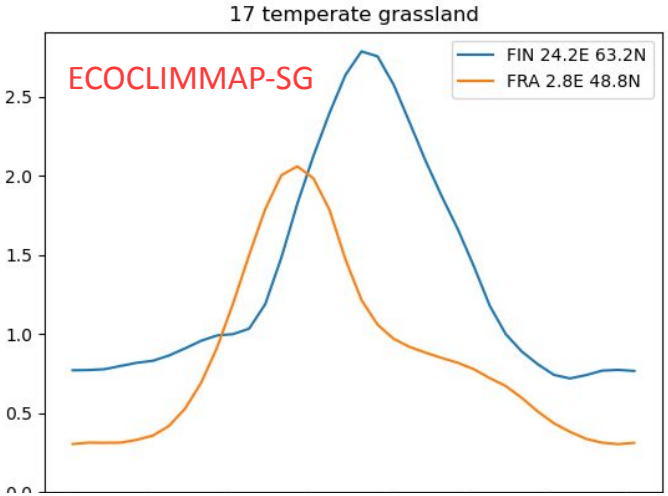
- Yuan et al. (PFT-based, provided by Hua Yuan, 2025)
- ECOCLIMMAP-SG (PFT-based)
- GEOV2
- SEEDS/SURFEX (For Europe, P. Hammer, pers. comm.)

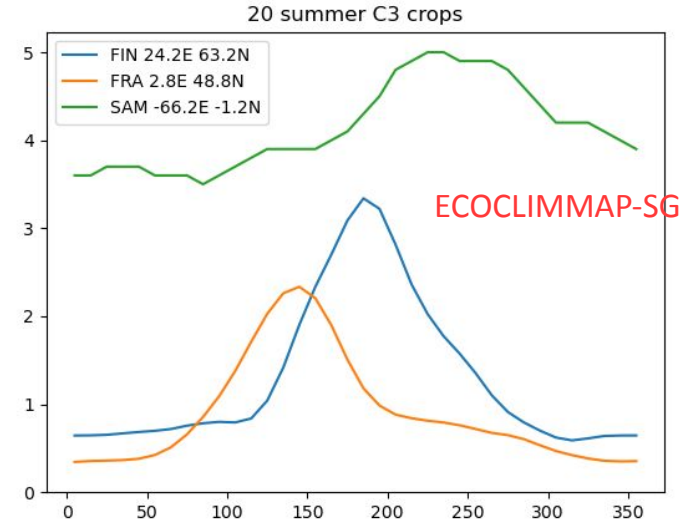
ESA CCI	**Pro:** Global 300m data-set. Used by IFS. Continuous update. **Con:** Requires cross-walk table. Misses wetlands, tundra, etc. No desert category. Issues with European Med. vegetation.
ESA PFT	**Pro:** Global 300m data-set. Continuous update. PFTs are represent "pure" land-cover types - no cross-walk table required. This simplifies usage in CTMs. **Con:** Few categories of low vegetation (and shrubs defined as >3m). Misses wetlands, tundra, etc. No distinction of boreal, etc.
IFS ECLand	**Pro:** Link to IFS model. Has bogs & marshes **Con:** Crops seem to be "Tall Grass". Unclear sources.
ECOCLIMAP-SG	**Pro:** Global 300m data-set, derived from ESA CCI. Distinction of boreal, etc. Distinction of C3 and C4 crops, also summer and winter crops. Has associated height and LAI of vegetation. **Con:** Issues with European Med. vegetation. Misses wetlands, tundra, etc.
CLM	**Pro:** Land-cover used by MEGAN BVOC system. **Con:** MEGAN version fixed. Only categories for vegetation (ie no urban, lakes, deserts , etc.)
Olson	**Pro:** Many LC categories. **Con:** Not updated.
SEI/CCE	**Pro:** Harmonised European land-cover map, combining CORINE with JRC-Forest data. Distinguishes several types of low vegetation: grass, moorland, tundra, Mediterranean scrub. Designed with EMEP CTM in mind. **Con:** Lack of global coverage. Discontinued (available through EMEP system).
MODIS	**Pro:** Associated with several biogenic inventory systems, e.g. Guenther et al. (2012) for BVOC and Hudman et al. (2012) for soil NOx. **Con:** Categories include "mixed forest". Definition of savannahs places them further north (e.g. Norway) than in other land cover classifications. Does not distinguish fresh from sea water.
CCE	**Pro:** Global update of CCE, link to critical loads **Con:** categories difficult to interpret for CTM usage. Unclear updates.

Leaf Area Index (LAI, here PLAI) - some examples:

- MEGAN uses grid.avg LAI
- Prefer to derive PFT-specific LAI
- Several sources
- BUT …. another can of worms!



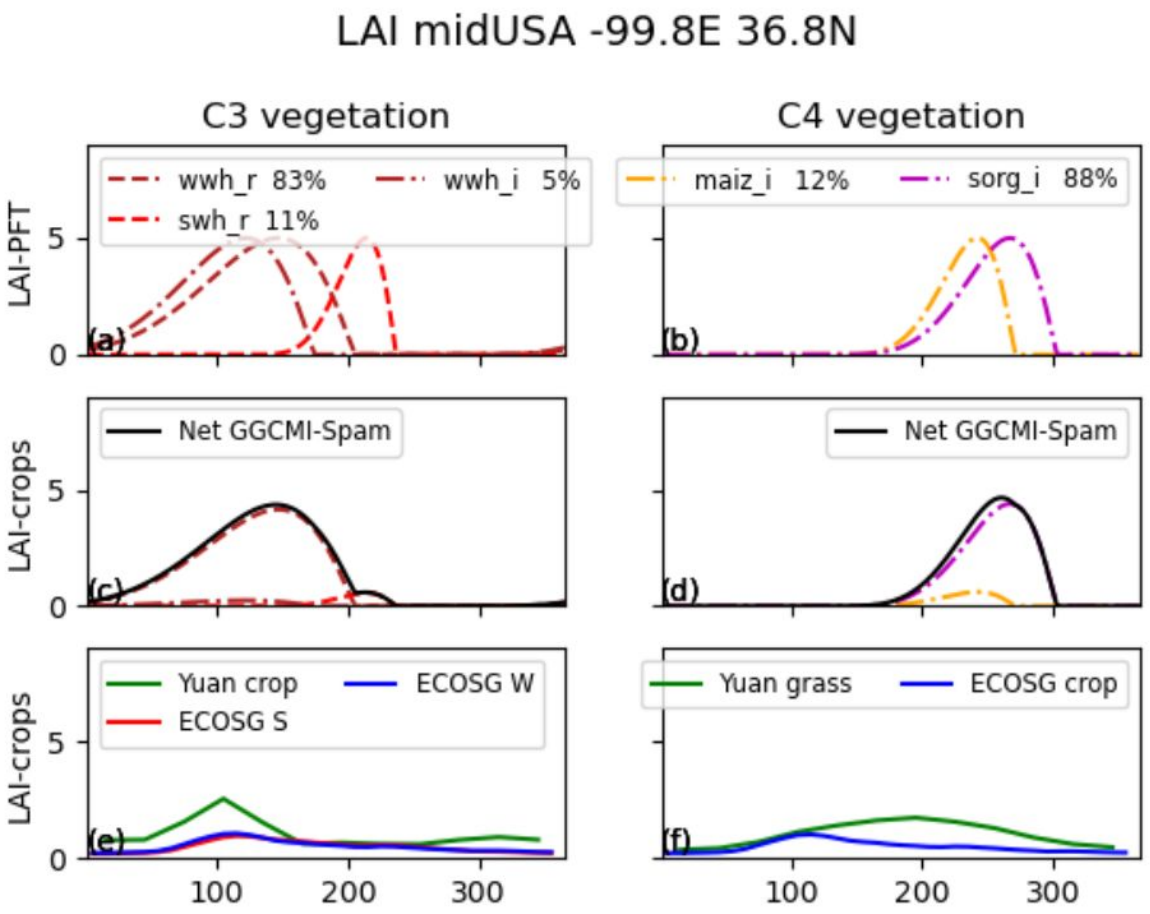




WP7 Crops, cont.

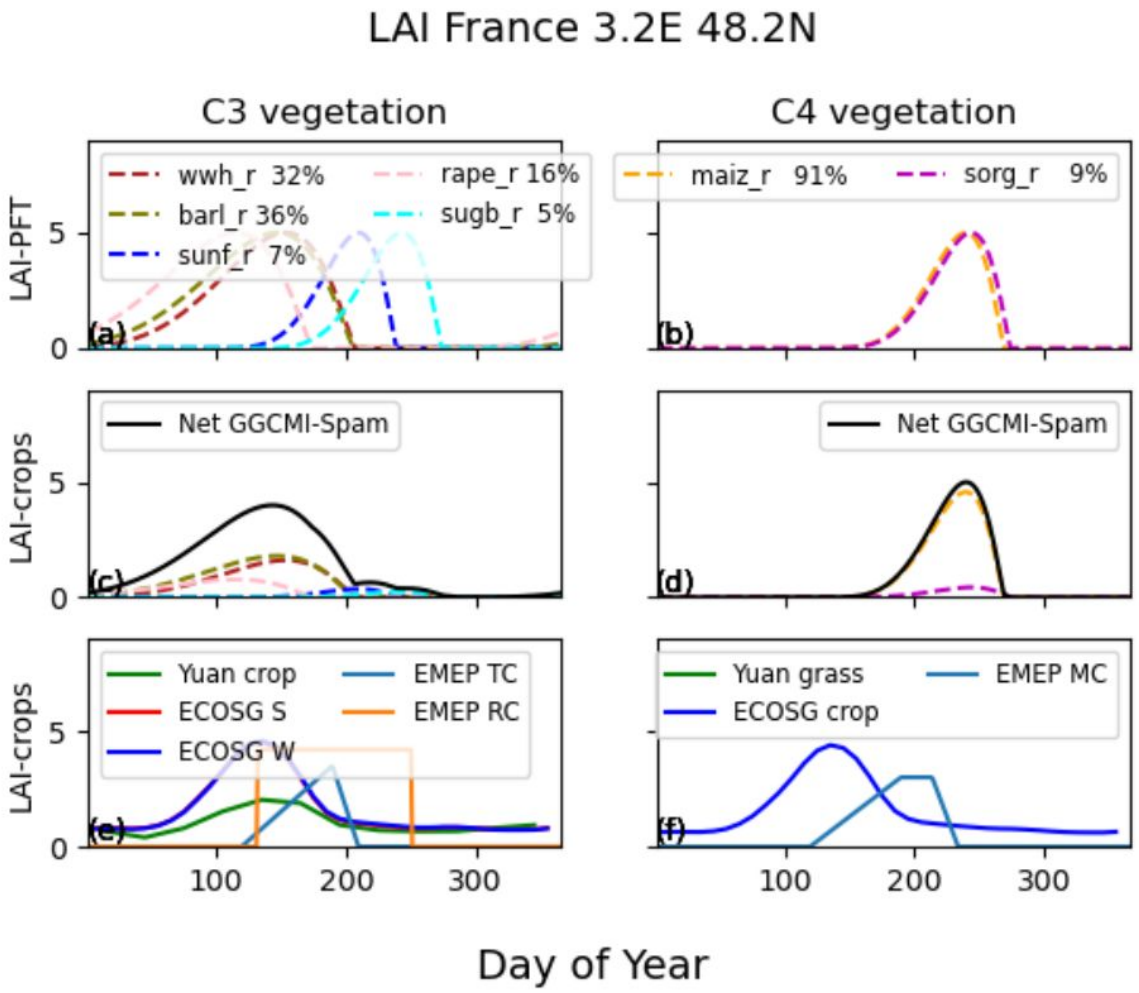
Crops …. large contributor to LAI (+ soil NOx!) but little isoprene or terpene. Important to get growing-season about right.

- Testing GS from:
  - crop-calendars
  - ECOCLIMMAP
  - Yuan et al.
- Some clear issues; probably not possible to solve in next months
- Conclusion: use ECOCLIMAP or Yuan (ie satellite-based).



Thanks to Hua Yuan for crop-specific LAI

WP7 Crops, cont.



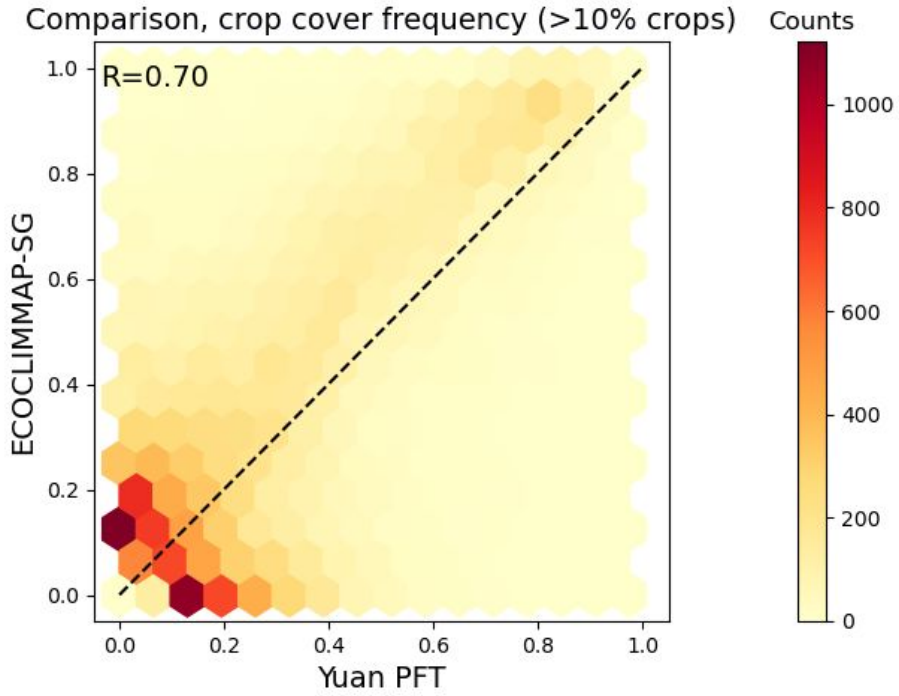
What to do?

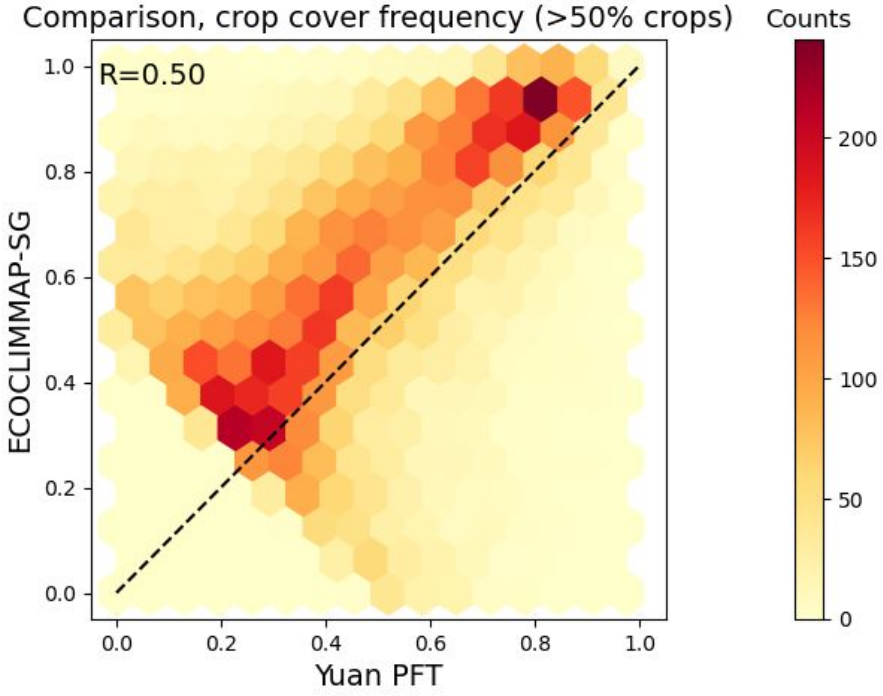
For crops, EMEP will use satellite LAI and accept that artefacts are present.

Note also - LAI is thus grid average (or average over several crops), and not for “real” vegetation.

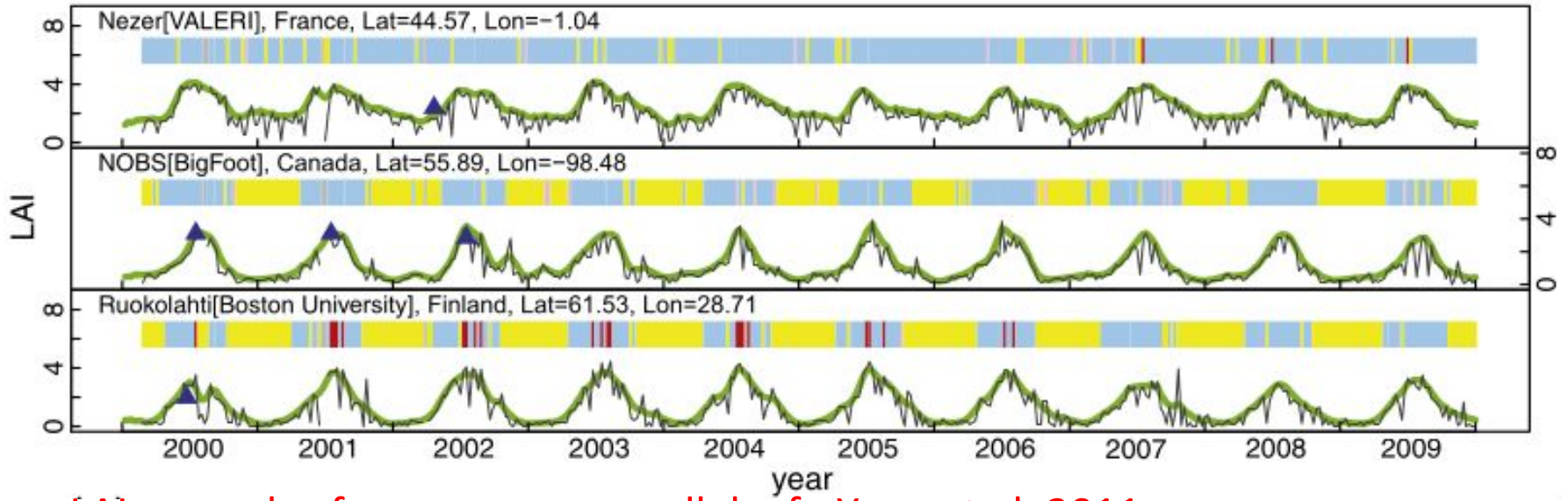
Crops - most difficult!

Different land-cover data-sets show different locations for crops!





LAI for needleaf - tends to be zero in all retrievals!



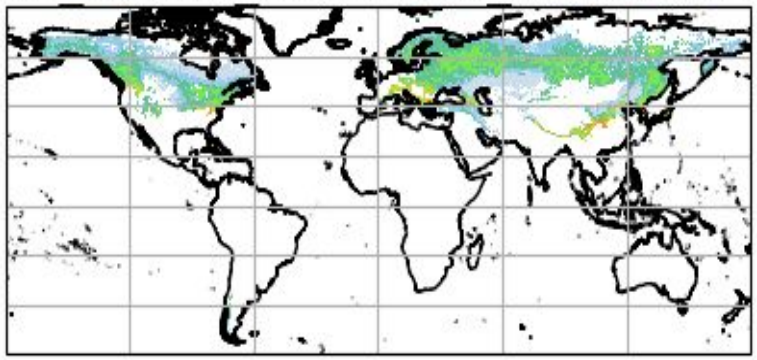
LAI examples for evergreen needleleaf - Yuan et al. 2011.

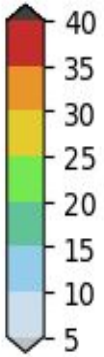
- Difficult to understand values sometimes, e.g. shouldn't evergreen needleleaf have little LAI variation over year?
- Similar issues seen in GEOV2, MODIS
- Risk of artefacts - difficult to spot in global data.
- **For EMEP: evergreen will stay evergreen! (ie constant LAI!)**

Finally, heights?

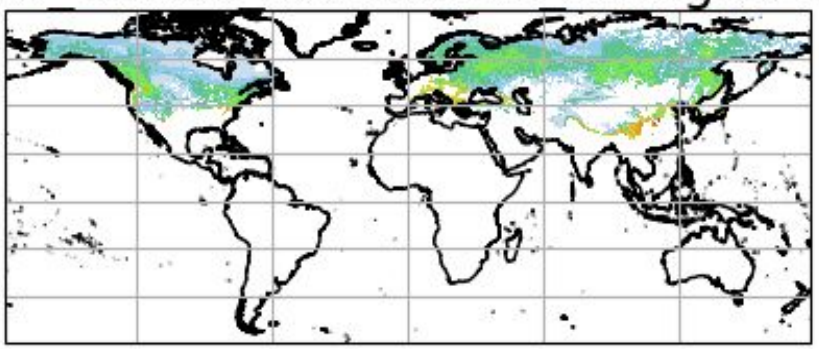
ECOCLIMAP-SG: has heights per PFT

07_boreal_broadleaf_deciduous

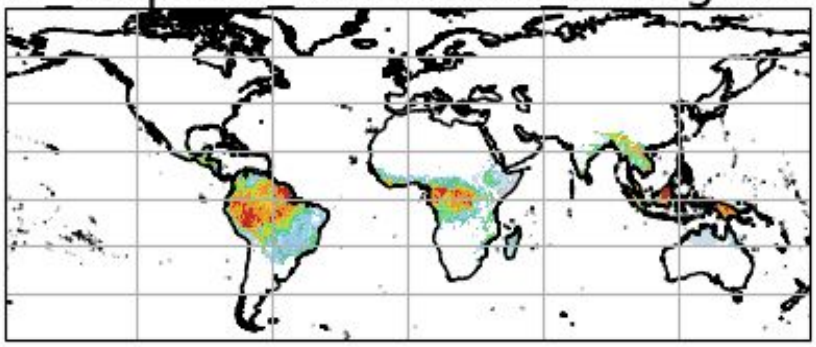




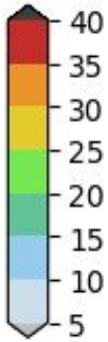
12_boreal_needleleaf_evergreen

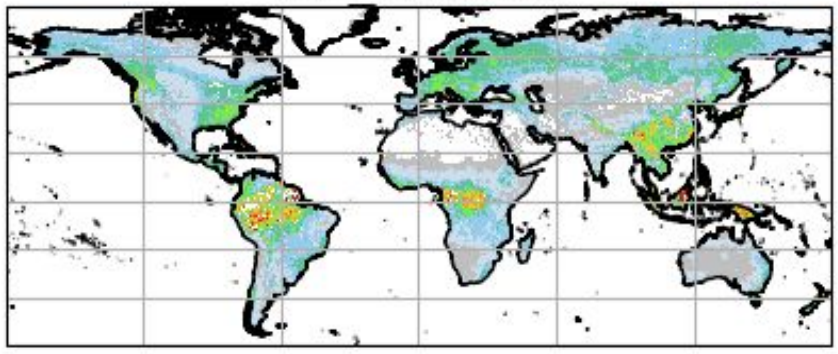


11_tropical_broadleaf_evergreen



15_shrubs





conclusions: trees ok, shrubs not!

Land-cover, conclusions

- No current LC database seems to satisfy all BVOC/SNOx/wildfire needs.
- Major issues with landcover definitions, LAI and phenology between products.
- Landcover datasets are **extremely difficult** – typically requires large group of diverse experts to improve.
- Still, for CAMAERA/EMEP we now have all mentioned databases in common format and projections.
- Hierarchy system built (prelim) for CTM (yesterday's talk).
- For LAI, use constant for evergreens, & from ECOCLIMAP and/or Yuan for other PFTs.

Acknowledgments:

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