ISBA-A-gs and data assimilation

Jean-Christophe Calvet (VEGEO)

ECMWF-CNRM meeting – Toulouse – 19 January 2018

Heritage

- **End of 1990's**
  - Calvet, Noilhan, et al. AFM 1998: first version of ISBA-A-gs
  - Field campaign: MUREX (1995-1997)
- **2000-2004**
  - Drought avoidance vs. tolerance (AST option in SURFEX)
  - Nitrogen dilution and interactive LAI (NIT option in SURFEX)
  - FP5 ELDAS project led by KNMI (MF and ECMWF involved)
    - A LDAS for hydrology (Meteosat –Ts –, SMOS)
  - Field campaign: SMOSREX (2001-2012)
- **2004-2010**
  - Carbon storage (NCB option in SURFEX)
  - FP6 GEOLAND and FP7 GEOLAND2 (MF and ECMWF involved)
    - Transfer of AST and NIT to ECMWF (CTESSEL)
    - First version of LDAS-France (using NIT option in SURFEX)
  - Field campaigns: SMOSREX (2001-2012), SMOSMANIA (2007-present)
- **2011-2017**
  - New RT model in ISBA-A-gs (Carrer et al. 2013) and explicit FAPAR
  - FP7 IMAGINES and eartH2Observe (MF and ECMWF involved)
    - LDAS-Monde for reanalyses and cross-cutting evaluation of satellite-derived products (Albergel et al. 2017)
  - Field campaigns: METEOPOLE-FLUX (2012-present), SMOSMANIA (2007-present)

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Heritage

- Presentation of GEOLAND objectives at ECMWF-ELDAS workshop (11/2003)

geoland

ONC – Observatory of Natural Carbon fluxes

❑ **Existing Models**
- TESSEL: operational at ECMWF, no photosynthesis, no biomass, no soil carbon, no wood
- ISBA-A-gs: research at Météo-France, photosynthesis, biomass, no soil carbon, no wood
- ORCHIDEE: research at LSCE, photosynthesis, biomass, soil carbon, wood

❑ **Modelling objective**
- ISBA-A-gs: research at Météo-France, photosynthesis, biomass, soil carbon, wood
- C-TESSEL: operational at ECMWF, photosynthesis, biomass, soil carbon, wood
- Method:

Photosynthesis, biomass	ISBA-A-gs	-> C-TESSEL
Soil carbon, wood	ORCHIDEE	-> ISBA-A-gs
Photosynthesis, biomass, soil carbon, wood	ISBA-A-gs	-> C-TESSEL

November 2004 - geoland/ONC   © geoland Consortium   18

LDAS-Monde

- LDAS-Monde: poweful tool to integrate geographical information into the model (Summer 2015)
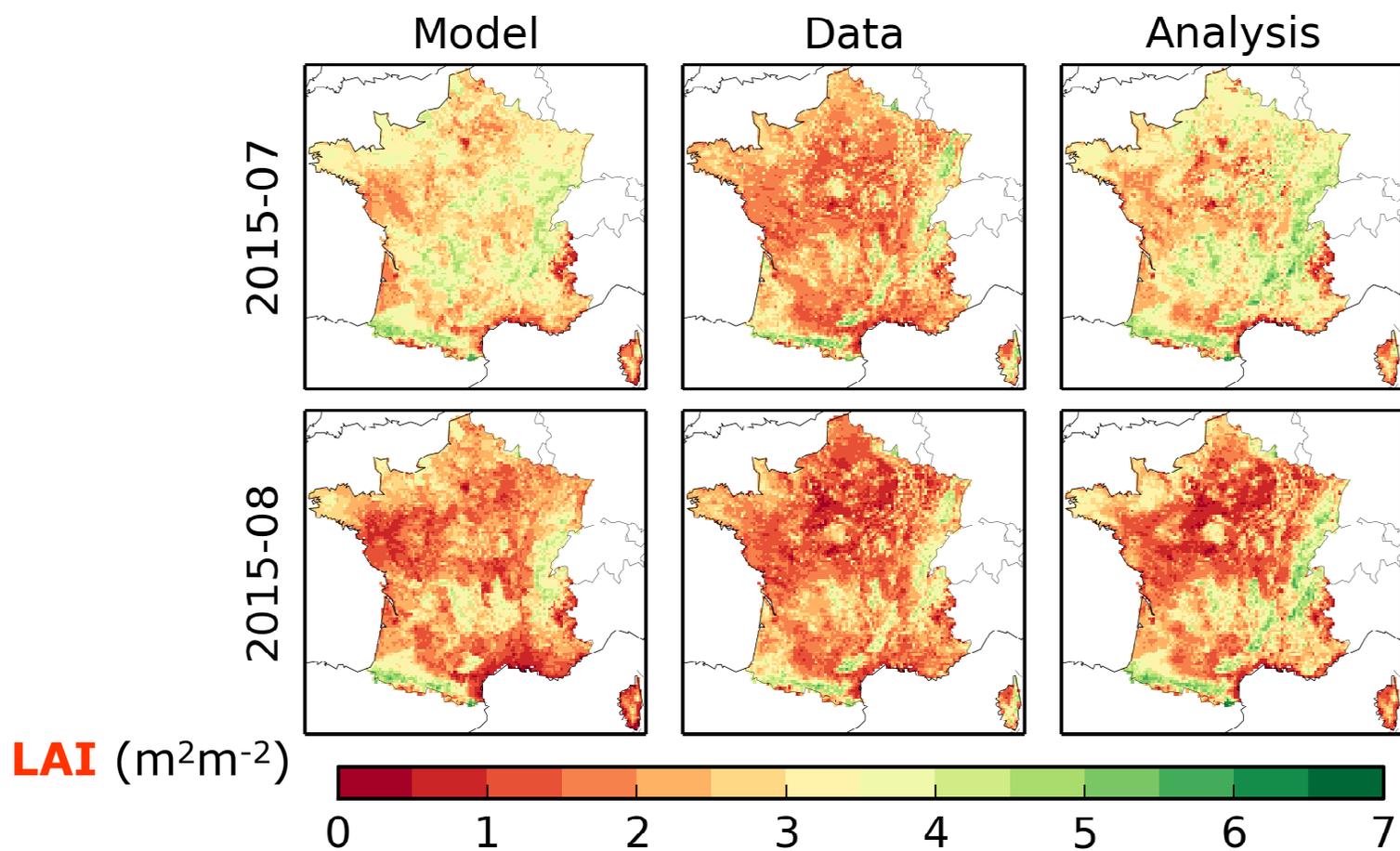
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LDAS-Monde

- LDAS-Monde: poweful tool to assess consistency between LAI and SSM

  - **Example: LAI and soil moisture over France during late Summer of 2016**

    - Extreme drought event !

    - LAI and root-zone soil moisture increments: LAI assimilation
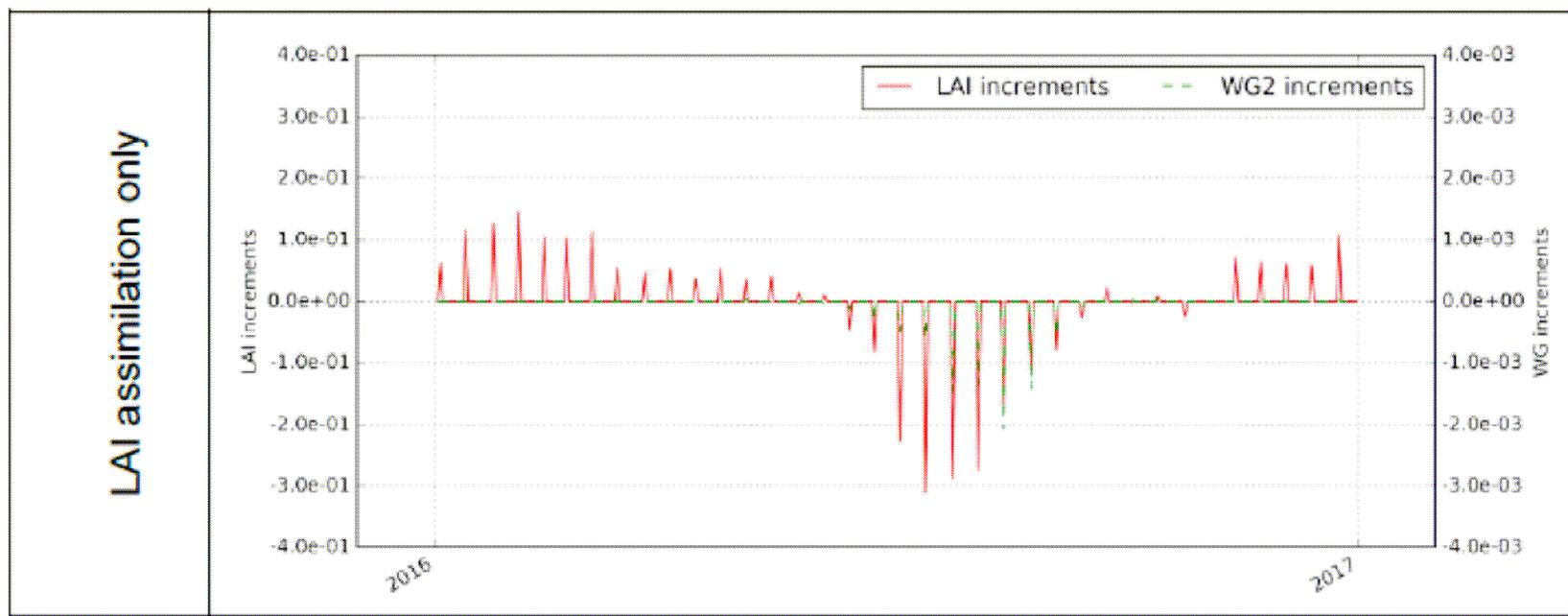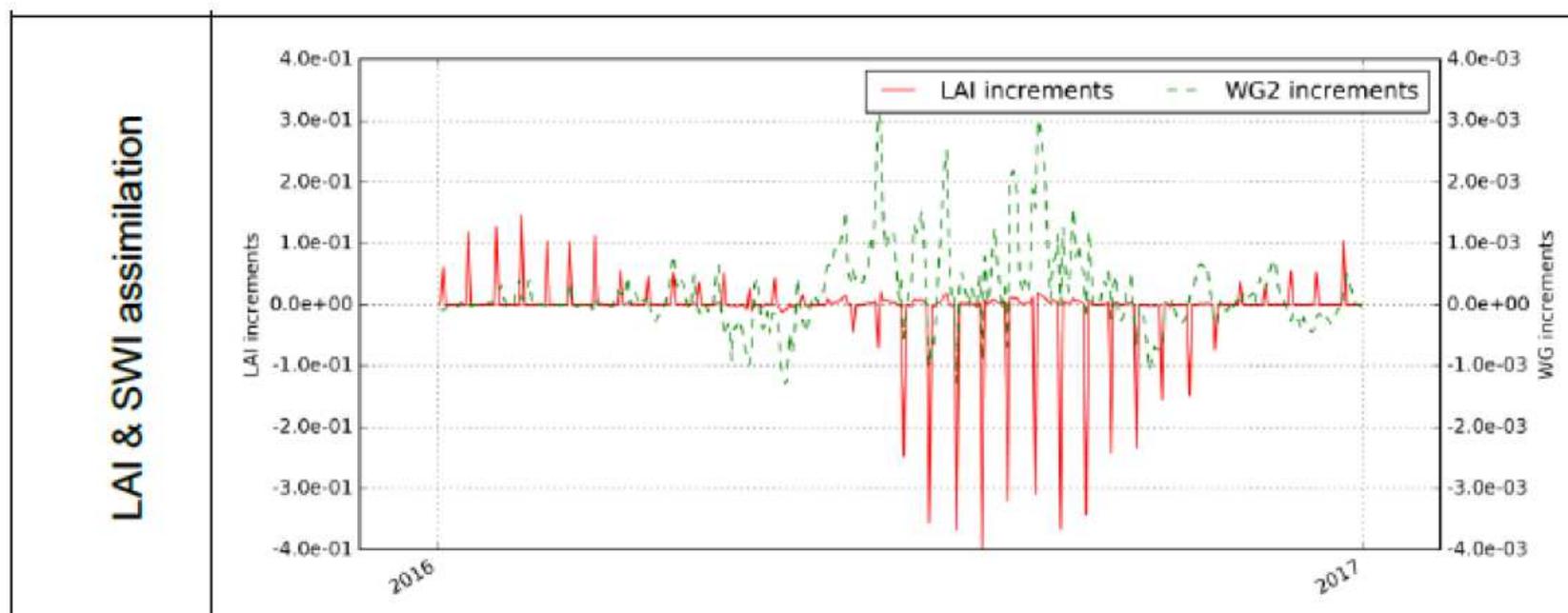

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LDAS-Monde

- LDAS-Monde: poweful tool to assess consistency between LAI and SSM

  - **Example: LAI and soil moisture over France during late Summer of 2016**

    - Extreme drought event !

    - LAI and root-zone soil moisture increments: LAI **and SWI** assimilation

Work in progress at VEGEO

- Towards explicit surface albedo
    - C. Planque PhD thesis, Leroux et al. in prep. 2018

- LDAS-Monde (Albergel et al. GMD 2017)
    - A European « Global LDAS » … and more !
        - Coupled to hydrology (CTRIP)
        - Sequential assimilation of LAI and SSM (unique !)
        - LAI at 1km disaggregated by vegetation type (Munier et al. 2018)
        - LAI_{min} map
        - Evaluation (SIF, CO_2 fluxes, evapotranspiration, crop yields, river discharge …)
    - Parameter calibration using assimilation of LAI (H. Dewaele PhD thesis)
    - Observation operator for ASCAT sigma-0 (D. Shamambo PhD thesis)

- Forests (NCB option): MaxAWC from observed forest biomass
- Effect of soil-cooling rains (Zhang and Calvet in prep. 2018)
- Soil thermal conductivity: pedotransfer function for quartz (Calvet et al. SOIL 2016)

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Observation operators

- Can satellite-derived variables be simulated by ISBA ?

  - SSM: seasonal matching is needed
  - LAI: yes (could be improved)
  - FAPAR: yes (could be improved)
  - Surface albedo: crude proxy (must be improved)
  - Surface temperature: crude proxy (must be improved)
    - MEB ; directional effects ; sunlit – shaded leaves

- ASCAT sigma-0

  - Permits using signal information on vegetation
  - Better representation of SSM

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Prospects for LDAS-Monde

- Consolidate EnKF option in LDAS-Monde

- Improve spatial resolution (0.25 degree global ?, 300 m France ?)

- Use new observations (e.g. microwave VOD)
    - Forests: towards plant hydraulics ?

- Use MEB option and assess its impact on analyses

- Use ECOCLIMAP-SG and assess its impact on analyses
    - Validation using HR maps (summer crops in particular)

- Consolidate the irrigation module from Calvet et al. (2008)

- Towards applications (Euro-Mediterranean area)
    - Drought monitoring in NRT
    - Evaluation of ECVs (reanalyses)
    - Produce NPP estimates: use NCB option

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Conclusions

- ISBA-A-gs and LDAS tools where built jointly

  - Flexible LAI (no GDD-based phenology) allows sequential assimilation of observations of vegetation variables

  - Unique capability !

  - MEB / NCB options will trigger new developments

- Code transfer work is complex

  - A project or project-like framework is needed

  - Staff exchange (e.g. L. Jarlan and S. Lafont in GEOLAND)

- Updating transferred code is not easy

  - Cannot rely only on short-lived research projects

  - Long-term collaboration is needed

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VEGEO (Végétation, Eau, et Géophysique)

Thank you for your attention !

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