EDO & GDO Latest Developments

- Extended LISFLOOD Window (Carolina)
- New Global Soil Moisture Product (Carmelo)
- Database of Drought Events (Marco & Dario & Jonathan)
- Drought Events in GDACS+ (Alfred/Diego)
- Forecasting Drought & Temperature Extremes (Christophe)

Implementation of the LISFLOOD Extended Window

Carolina ARIAS MUÑOZ
LISFLOOD distributed rainfall-runoff-routing model

- JRC in-house development since 1997
- **Original aim (1997):** simulation of impact of measures on floods at large river basin scale
- **Aims added later:**
  - Flood forecasting
  - Simulations at continental scale
  - Effects of climate change
  - **Droughts (soil moisture and low-flows)**
  - Flash floods

**LISFLOOD user manual**

Spatially distributed hydrological model with routines for:

- Snowmelt
- Interception
- Evapotranspiration
- Infiltration
- Overland flow
- **Soil moisture re-distribution**
- Groundwater flow
- Preferential flow
- **River discharge**
- Lakes
- Reservoirs
- Retention polders
- Water abstraction & consumption
Changes in LISFLOOD:

- **Water abstraction and consumption included** (irrigation, manufacturing industry, water use for energy production, water use by livestock, public water abstraction & use)

- **Sub-grid variability included** for landuse & elevation, based on 100x100 m land use (CORINE) and elevation (SRTM) data, for every grid:
  - Fraction of forested areas (increased evapotranspiration, infiltration)

Soil water redistribution between 2 soil layers:

- Soil moisture upper layer, forest fraction.
- Soil moisture lower layer, forest fraction.
- Soil moisture upper, other fraction.
- Soil moisture lower layer, other fraction.
Other technical changes of LISFLOOD outputs:

- Bigger spatial domain: inclusion of more reservoirs (countries as Turkey, Armenia, Syria, part of Iraq and a small portion in the north of Africa).
- Different data files format (from PCRaster to NetCDF).
- Spatial Reference system changed (from GISCO to EPSG 3857).

Implications of the Changes:

- Verification of inconsistencies and agreements between previous and current LISFLOOD model versions.
- Adaption the storage and publication procedures of:
  - Soil Moisture Anomalies Indicator.
  - Low-Flow Index.
- Recalculation the historical data.
- Change the software from Commercial (Arc info) to Open Source (Python and related Geo Libraries).
Comparing Soil Moisture Anomalies between previous and current versions of LISFLOOD hydrological model

Soil Moisture Anomalies (SMA) from EDO to GDO

Carmelo CAMMALLERI
OVER EUROPE

- "limited area"
- well characterized hydrologically
- reliable meteorological forcing

http://edo.jrc.ec.europa.eu

GLOBALLY

- remote areas included
- heterogeneous hydrological and meteorological conditions

http://edo.jrc.ec.europa.eu/gdo/

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Rationale

- A single model/dataset is not capable to reliably capture soil moisture anomalies at global scale.
- Ensemble products have provided added value in monitoring drought events in case of uncertain accuracy.

Research Goals

- Evaluation of the similarities among three datasets to be used as proxy of soil moisture anomalies for drought monitoring.
- Application of the Triple Collocation (TC) procedure to evaluate the errors associated to each dataset in comparison with the "true" status.
- Development of an ensemble product to be used within the Global Drought Observatory (GDO).

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Proxy of SM anomalies

**LISFLOOD** de Roo et al. (2000) [Hydrol. Process. 14]
- precipitation-Runoff model.
- 0.1 degree spatial resolution.

The three datasets are:
- averaged on a 30-day moving window updated every **dekad**.
- Spatially aggregated at **0.1 degree** resolution.
- **Masked** over the areas with low quality or snow coverage.
- Converted into **anomalies** by using the same 2001-2015 baseline.

- 5-km spatial resolution.
- 8-day aggregated
- Covered period: 2001-2015

**CCI** Dorigo et al. (2016) [Bull. Amer. Meteorol. Soc. 97]
- merged passive/active microwave
- 25-km spatial resolution.
- Covered period: 1979-2015

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Triple Collocation (TC) method

**Hypothesis**
- Linearity between the true signal of soil moisture anomalies and the 3 datasets.
- Signal and error stationarity.
- Independency between the errors and the signal (error orthogonality).
- Independency between the errors in the 3 datasets (zero error cross-correlation).

**Error estimation**
Gruber et al. (2016) [Int. J. Appl. Earth. Obs. Geoinf. 45: 200-211]

Model data variance
Model error variance
Sensitivity of the model to variation in the true status

$\sigma_1^2 = \sigma_2^2 = \sigma_3^2$
$\alpha_1 = \alpha_2 = \alpha_3$
$\alpha_1, \alpha_2, \alpha_3$

$\bar{\sigma}_1^2$ = Lisflood (LIS)
$\bar{\sigma}_2^2$ = MODIS LST (LST)
$\bar{\sigma}_3^2$ = ESA microwave (CCI)

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Results of the TC analysis

Spatial distribution of the weighting factors for each product (inverse of the model error variance).

- LIS is more reliable over the northern latitudes.
- LST is more reliable over some dry areas.
- CCI is more reliable over the southern hemisphere.

Results – Implementation in GDO
Global Database of Drought Events

Diego MAGNI, Marco MAZZESCHI, Jonathan SPINONI

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Database of Drought Events

A web tool (dashboard-like) to interactively examine a global database of meteorological drought events

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Jonathan SPINONI

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Dario MASANTE,
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Alfred DE JAGER,
Marco MAZZESCHI

Injection of Information on Drought Events into GDACS+

Diego MAGNI, Marco MAZZESCHI

Considered Natural Disasters:
- Earthquakes
- Tsunamis
- Volcanoes
- Tropical Cyclones
- Storm Surges
- Floods
Drought events in GDACS+

GOAL:
Display drought events on GDACS+ (the development version of GDACS)

1) Drought Events Automatic Detection
Dedicated algorithm for:
• computing statistics of RDrI-Agri*
• defining drought events based on RDrI-Agri values
• saving events’ temporal evolution
Constraints:
• event duration ≥ 1 month
• at least 3 cells** of Medium class or at least 1 cell of High class must be found into the event
* RDrI-Agri = Risk of Drought Impact for Agriculture
** Cells have a dimension of 1 decimal degree

STEPS:
1) Automatic detection of agricultural (and other type in perspective) drought events
2) Evaluation and classification of detected drought events
3) Publication in GeoJSON format of confirmed and classified events and display on GDACS+
Drought events in GDACS+

Each event has the following attributes:

With values set by the algorithm
- ID (unique, primary key)
- Geometry (multi-polygon)
- Name (affected country by default)
- Alert level / alert value (RDrI-Agri)
- Begin date → reference (last) date
- Affected countries and administrative reporting units

With values set during evaluation / classification
- Name (changing the automatic one)
- Alert level (changing the automatic one)
- Status (confirmed, discarded, deferred to next period)
- URL of Analytical Report (if available)
- Event summary and impact type texts
- Event membership to aggregate different events in a unique one
- GDACS Score : quarters of unit from 0 to 3

2) Drought Events Evaluation and Classification

3) Drought Events Publishing → GDACS+

http://www.gdacs.org/default_plus.aspx

Forecasting Droughts and Temperature Extremes

Christophe LAVAYSSE

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Monitoring of the HW/CWs:

- Operational daily product derived from gridded observations (2-d lag)

**Adaptation of the HW/CW detection**
Lavaysse et al. 2017

Forecasting of the HW/CWs:

**Predictability the HW in France in 2003:**
- Slightly underestimation of the intensities
- Good forecast 7 days before with the correct duration

**Using 20 years of reforecasts, predictability of:**
- HW/CW presence: 2-w lead time
- HW/CW onset: 1-w lead time
- Intensities: slightly underestimation

Lavaysse et al. 2018
EDO – GDO
Forecasting ext. SPI

Early warning of extreme wet/dry conditions:

- Operational monthly product derived from the seasonal S5 products (ECMWF)
- Worldwide, from 1-m to 6-m cum. periods (i.e. SPI1, SPI3 and SPI6)
- Computation of the EFI of SPI when extreme precip. detected (Lavaysse et al. 2016)
- Providing comprehensible index of warning (3 levels for dry and for wet conditions) based on hindcast (1981-2010)
- Forecasts available from January 2017

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Forecasting ext. SPI

Validation

- Understanding the index w.r.t. uncer. / int. in the hindcasts.
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Forecasting ext. SPI

Validation

- Complete validation of the hindcasts (1981-2010) w.r.t. GPCC depending
  - Durations
  - Wet/Dry
  - Seasons
  - Intensities
- Validation of the forecasts (on going)