



*Spyglass, QLD, Australia, credits Michael Schaefer CSIRO*

# GEOGLAM RAPP (Rangeland & Pasture Productivity): Context, updates & next steps

Alex Held, Flora Kerblat, Juan Guerschman (CSIRO)

RAPP workshop – ESRIN Frascati (16 & 17 May 2017)

LAND AND WATER  
[www.csiro.au](http://www.csiro.au)



Dr. Juan Pablo Guerschman  
RAPP Component Lead – GEOGLAM  
CSIRO



# Frascati Workshop Objectives

- Provide an annual update from RAPP and partners
- Update on the Global Monitoring system (RAPP Map),
- Showcase the opportunities for routine use of EU Sentinels and eg new EO technologies (eg hyperspectral sensing ) by GEOGLAM RAPP partners
- Discuss R&D progress on production of new products (eg. biomass, grassland types and grassland quality)
- Enhance collaborative work in RAPP by researchers from Europe
- Gain better understanding on information end-user needs and interests, visualizer functionalities, and opportunities
- Review the strategic vision for the future (including funding synergies) and linkages to the UN Sustainable Development Goals

# RAPP Workshop in Frascati at a glance

Hosted at ESA-ESRIN (many thanks!), Magellan room

## Tuesday 16, Day 1

- 8.10: Shuttle departure from Frascati
- 8.30 - 9.00: Registration & opening
- 10.30: Coffee break and group photo
- 12.00-13.00: Lunch
- 15.00: Coffee break
- 18.00: Welcome Cocktail at ESRIN
- ~19.00: Shuttle departure from ESRIN to Frascati centre

## Wednesday 17, Day 2

- 8.15: Shuttle departure from Frascati
- 8.45: Start with day 1 summary
- 11.00: Coffee break
- 13.00-14.00: Lunch
- 15.15: Coffee break
- ~16.45: Shuttle departure from ESRIN to Frascati centre

# RAPP Workshop in Frascati at a glance

## More information

- List of participants (~25-30 people) & agenda distributed
- Internet access at ESRIN
- Remote connection available (Webex)
- Lunch available at the cafeteria (ESRIN)  
⚠ *pay cash at the counter*
- Taxi request at the reception (in advance)



Contacts for logistics: Benjamin Koetz and Lea Civetta (ESA), Flora Kerblat (CSIRO)

# GEOGLAM and RAPP



## GEOGLAM

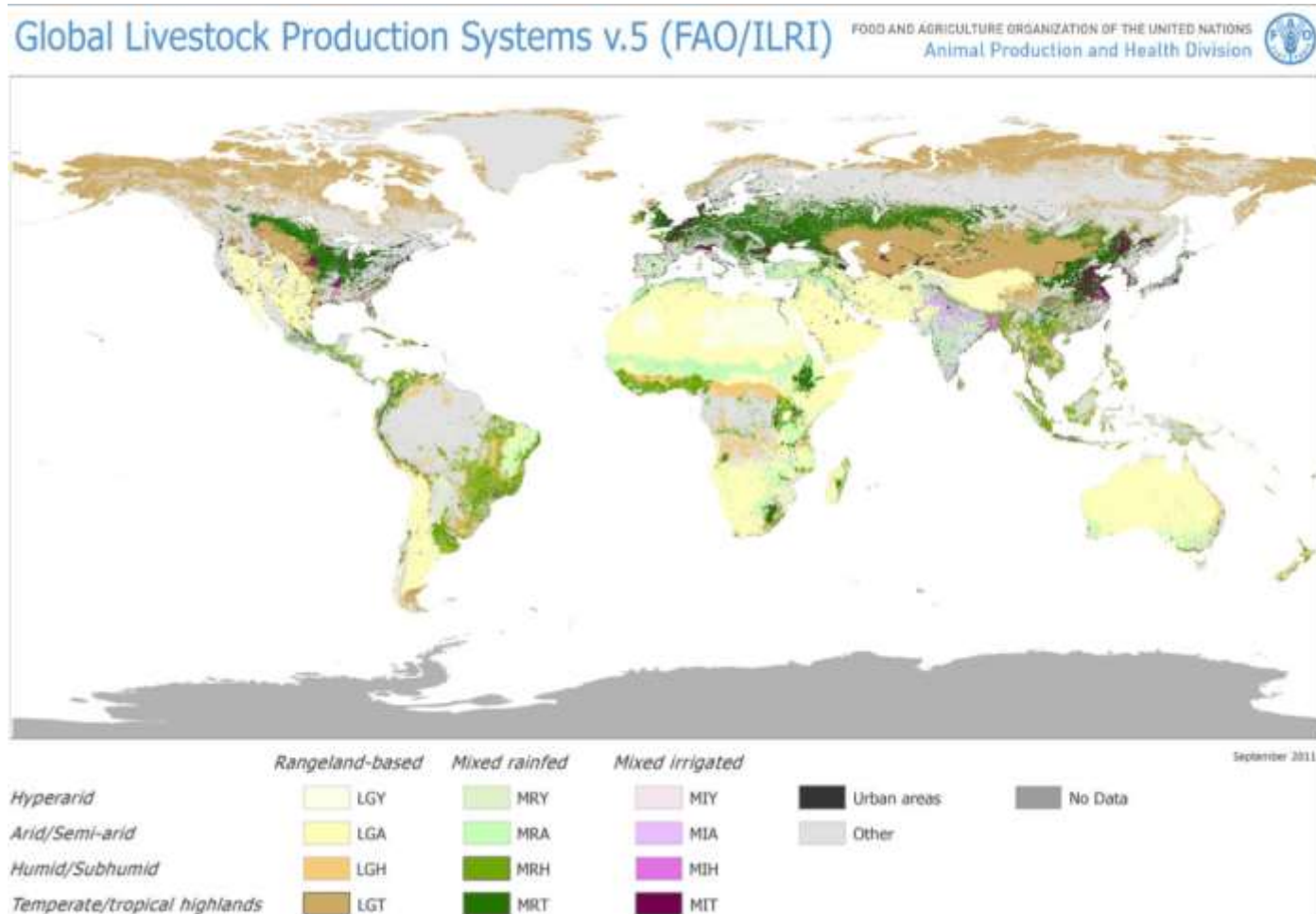
Strengthen the international community's capacity to **produce & disseminate** relevant, timely and accurate **information and forecasts** on **agricultural production** at national, regional and global scales, through reinforced use of **Earth Observations**

## GEOGLAM RAPP

Provide the global community the means to regularly **monitor** the condition of the world's **rangelands and pasture** lands on a routine basis, and assess their **capacity to sustainably produce animal protein** in real-time, at **global, regional and national** levels

# Global Rangelands – A Source of Food

- Rangelands:
  - ~70% of Earth's Surface
  - Grasslands
  - Savannas
  - Shrubland
  - Wetlands
  - Deserts



# Global Food Security

- Rangelands:  
~70% of Earth's Surface
- ~1.3 billion (18% of global population) depend on livestock
- ~40% of global agriculture's GDP

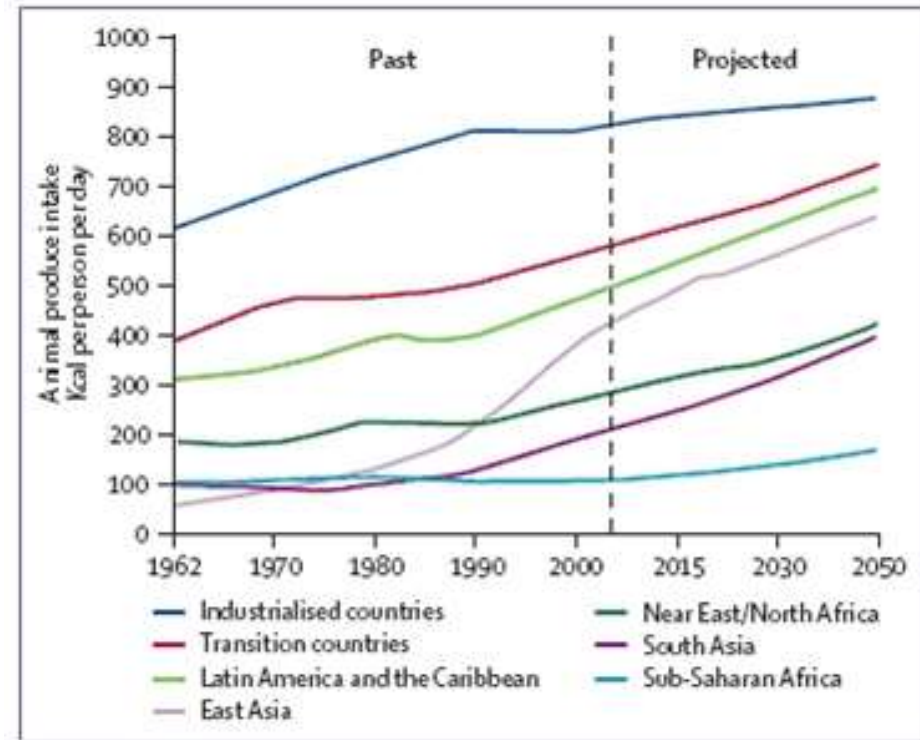


Source: Livestock Global Alliance

# Food Security

- Rangelands:
  - ~70% of Earth's Surface
- ~1.3 billion (18% of global population) depend on livestock
- ~40% of global agriculture's GDP
- World's meat consumption will continue to increase

*But are we sustaining the resource ?*



# Why monitoring rangelands ?

- Land degradation
- Soil erosion
- Forage estimation and prediction
- Drought assessment and monitoring
- Food security, countries at risk
- Livestock markets



# Rangeland monitoring – For who?

## MAIN USERS

- **International:** Global food security, sustainability and global assessments (e.g. AMIS, FAO, Aid Agencies, NGOs)
- **Governments:** National statistics, carrying capacity; economic development, trade and market development, food security, environmental protection
- **Regional:** Sustainable rangeland/pasture & herd management
- **Local:** Farmers, ranchers

# GEOGLAM RAPP Components



## 1. Coordination team

- Global coordination & Communication
- Workshops organization

## 2. Global Information System

- Rangeland Condition & Anomalies
- Rangeland Biomass and Productivity

## 3. National Pilot Sites

- Representative rangelands and producer countries – for product validation, comparison and model parameterization

## 4. Community of Practice & Outreach

- R&D and technical experts, livestock producers, national & international governmental officials

# RAPP Map [map.geo-rapp.org](http://map.geo-rapp.org)

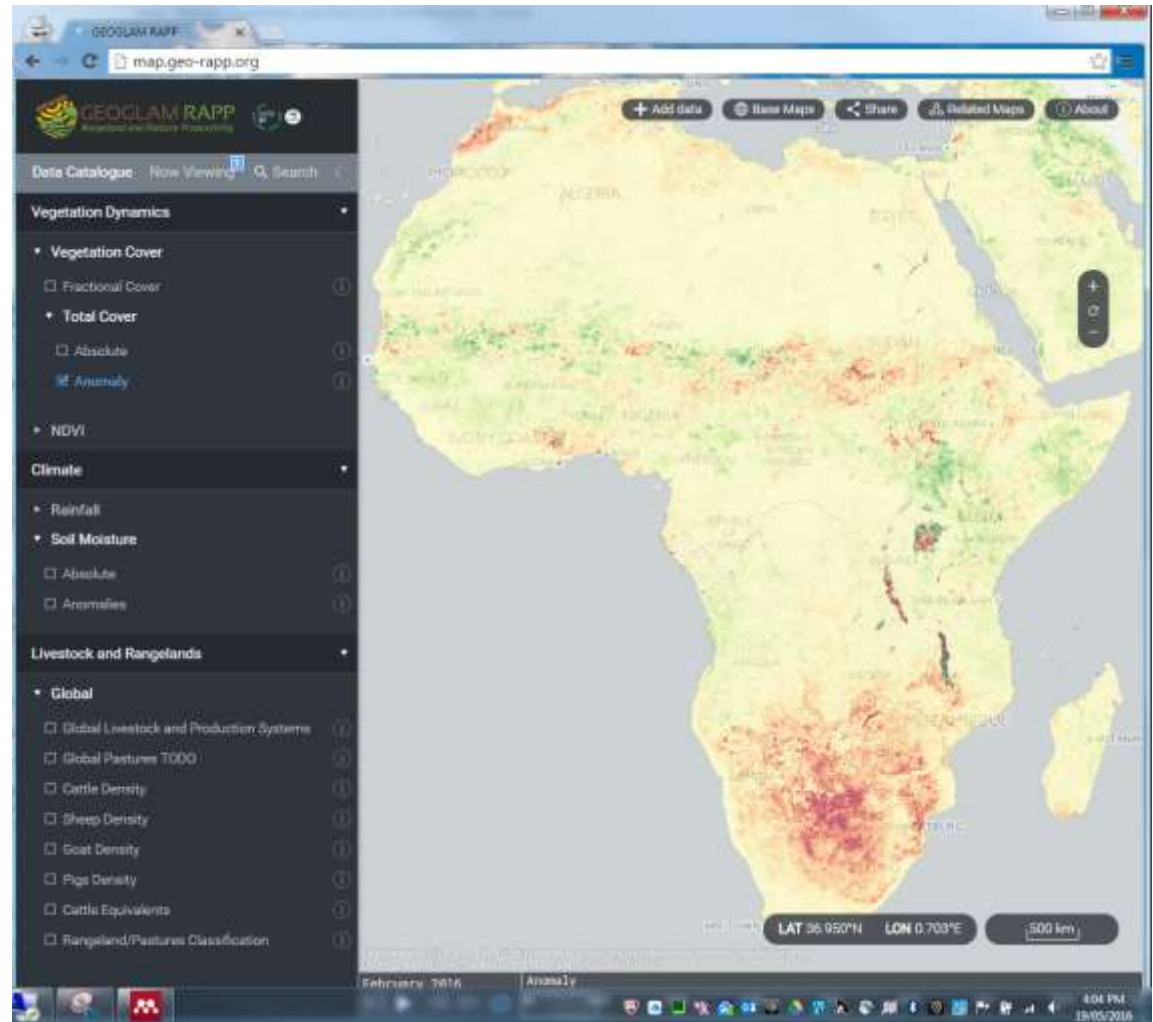
*More later with J. Guerschman*

Web-based tool to visualise and query information on rangeland condition

“Open Beta” release:

- Spatio-temporal data on **vegetation cover, NDVI, rainfall and soil moisture**
- Ancillary layers on **land use/ land cover, rangeland types and livestock densities** from various sources

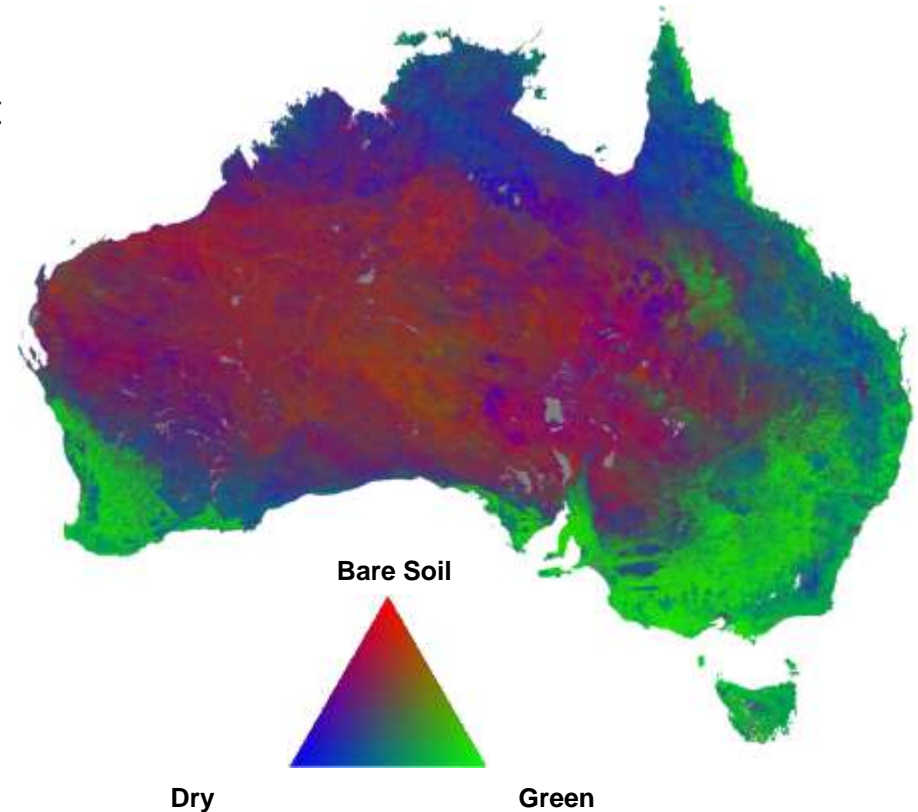
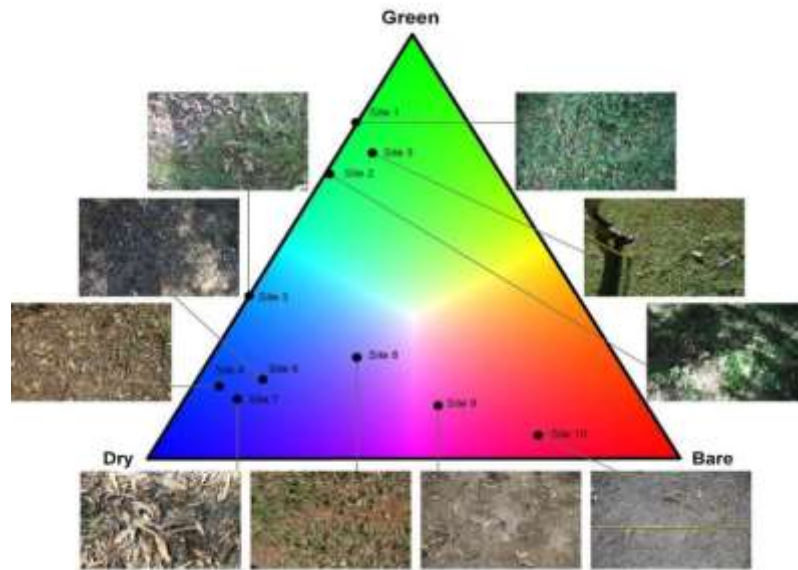
Easily add new user-provided layers.



# Rangeland Condition Monitoring Product

“Fractional Cover” (from MODIS, Landsat, soon Sentinel-2)

- Vegetation indices based unmixing of **photosynthetic vegetation**, **non-photosynthetic vegetation** and **bare soil**
- Based on MODIS or Landsat reflectance
- Australia, 8-day, 500 meter, 2000-present
- operational, updated weekly



From: Guerschman, et. all; Remote Sensing of Environment. 2015; 161(1 1):12-26.

# Dynamic Land-use Change Tracking



■ green

■ dry

■ soil

1998

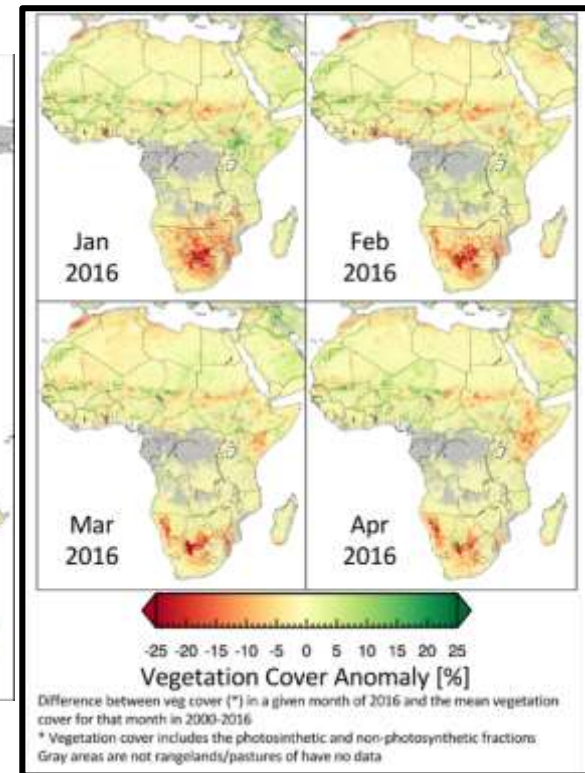
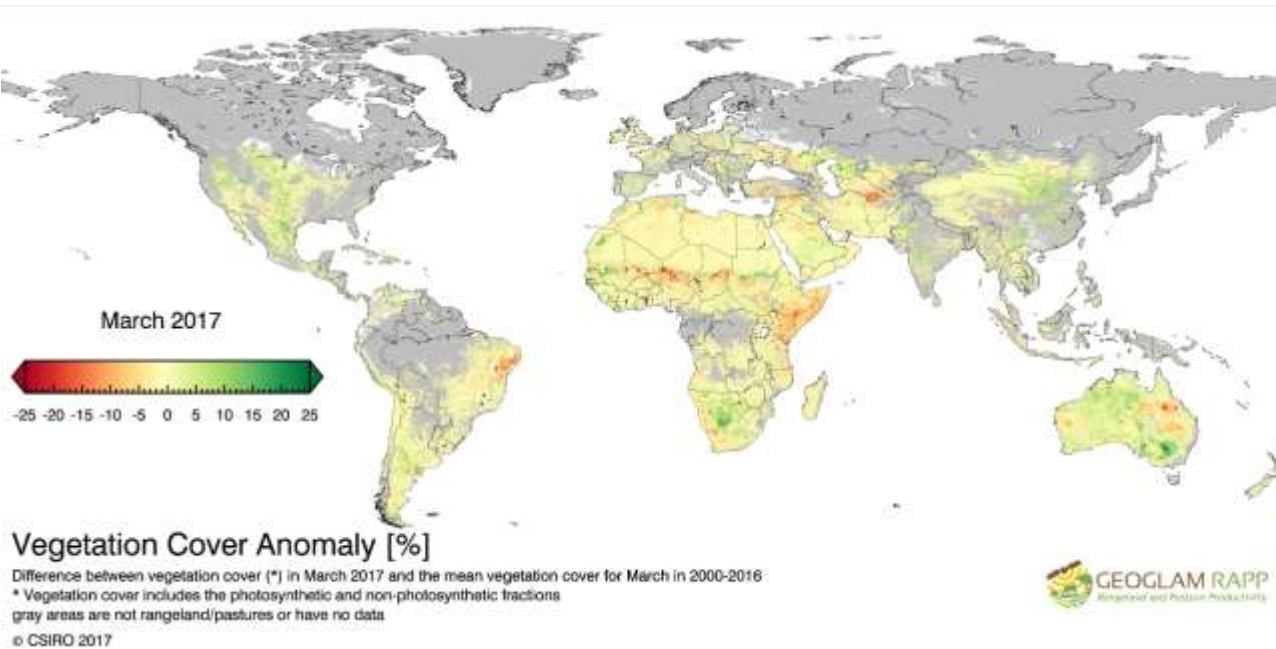
2000

2006

2014

# Vegetation Cover product

**Vegetation Cover Anomaly in Rangelands** (map produced every month and published on [RAPP website](#) and twitter account)

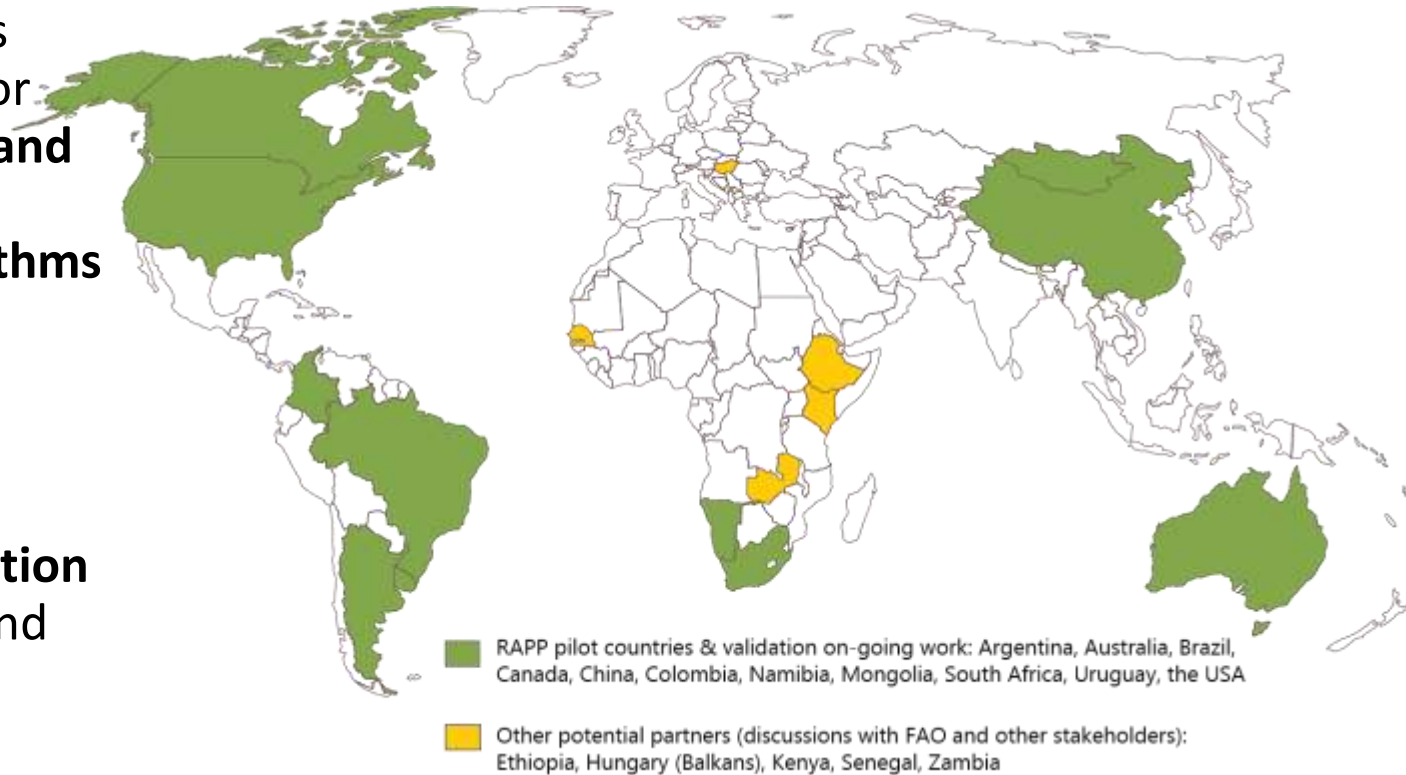


# RAPP Pilot Countries

## RAPP Pilot & Validation Sites



- Inspired by JECAM
- A network of sites and institutions for **exchanging field and satellite data, comparing algorithms and jointly developing monitoring and reporting tools**
- **Facilitate distribution of satellite data and inform CEOs of requirements for rangelands and pastures**



# Field validation work

*More later with J. Guerschman*

## Harmonising Field Methodologies and validation within RAPP

- Joint validation of vegetation cover products
- Field measurements of similar variables and protocols
- Australia, Namibia, Argentina, Mongolia
- Links to UN SDG 15.3.1 ?



# Data requirements & products for RAPP

*More later with B. Killough (CEOS)*

## Remote sensing

- Global Rangeland vegetation fractional cover time-series (2-weekly composites) – MODIS/S-3/VIIRS/GCOM-C
- Aboveground biomass (Seasonal/Annual) :  
SAR-derived biomass – Sentinel-1, Radarsat Constellation (& other wide-area SAR) - for Model-Data Assimilation Approach

*Phase-1: Selected pilot sites; Phase-2: Global rangelands*

- Soil Moisture & climatic data – SMOS/SMAP & ECVs - global
- Grassland Types & Nutritional Quality : eg multi-sensor & hyperspectral

*Phase-1: Selected pilot sites; Phase-2: Global rangelands*

**In-situ data** for model validation and parameterization

# Satellite Data requirements

- GEOGLAM RAPP informing CEOS on EO requirements for rangeland monitoring
- Similar requirements for crop monitoring (biomass, cover, phenology)
- Crop type / rangeland type
- Crop yield / rangeland cover and biomass

## Main differences:

- vegetation structure (rangelands often more complex in shrub, tree cover)
- species composition and nutritional quality more critical for rangelands

Req#	What?		How?		When?	Where?	Rangelands and Pastures (RP) Requirements Types						
	Spatial Resolution	Spectral Range	Primary Missions (future in RED)	Contributing Missions (future in RED)	Effective observation frequency (cloud free)	Sample Type	RP Mask	RP Calendar	Vegetation Cover	Vegetation Variables (e.g. NDVI, LAI)	Feed Quantity and Growth Rates	Quality and Digestibility	Environment Variables (e.g. Soil moisture)
							A	B	C	D	E	F	G
<b>Coarse Resolution (&gt;100m)</b>													
1	500-2000m	VIS, NIR, SWIR, TIR	MODIS (1000m)	Suomi-NPP (750m) Proba-V (1000m)	Daily	Full Country			X		X	X	
2	100-500m	VIS, NIR, SWIR, TIR	MODIS (250/500m) Sentinel-3A (500m)	Suomi-NPP (75m) Proba-V (100/300m)	2 to 5 per week	Rangelands Extent	X	X	X		X	X	
3	5-50km	Microwave	Aqua GCOM-W1/W2	SMOS SMAP	Daily	Rangelands Extent							X
<b>Moderate Resolution (10 to 100m)</b>													
4	10-70m	VIS, NIR, SWIR, TIR	Landsat-7 (30m) Sentinel-2A/B (10-20m)	ResourceSat-2 (56m) CBERS-4 (20-40m)	Monthly (min 22 out of 3 seasons in season) Required every 1-3 years.	Rangelands Extent	X	X					
5	10-70m	VIS, NIR, SWIR, TIR	Landsat-7 (30m) Sentinel-2A/B (10-20m)	ResourceSat-2 (56m) CBERS-4 (20-40m)	~Weekly (8 days min) per 60 days	Sample	X	X	X	X	X	X	X
6	10-100m	Radar Dual Polarization	Sentinel-1A/B (C-band)	Radarsat-2 (C-band) RCM (C-band) ALOS-2 (L-band)	~Weekly (8 days min) per 60 days	Rangelands Extent Sample	X	X	X		X	X	X
<b>Fine Resolution (5 to 10m)</b>													
7	5-10m	VIS, NIR, SWIR	RapidEye	SPOT-6, SPOT-7 CBERS-4	TBD	Rangelands Extent							
8	5-10m	VIS, NIR, SWIR	RapidEye	SPOT-6, SPOT-7 CBERS-4	~Weekly (8 days min) per 60 days	Sample			X	X	X	X	X
9	5-10m	Radar Dual Polarization	Sentinel-1A/B (C-band)	Radarsat-2 (C-band) RCM (C-band) ALOS-2 (L-band)	Monthly	Sample			X		X	X	
<b>Very Fine Resolution (&lt;5m)</b>													
10	<5m	VIS, NIR	Pleiades	SPOT-6, SPOT-7	TBD	Rangelands Extent							
11	<5m	VIS, NIR	Pleiades	SPOT-6, SPOT-7	Monthly	Sample			X		X	X	

Table produced by CEOS SEO and RAPP teams, August 2016 (inputs and discussions from RAPP workshop in South Africa)

# GEOGLAM RAPP Communication & Outreach

- Global coordination, communication & outreach
- Brochures updated for RAPP events
- Website regular updates:

[www.geo-rapp.org](http://www.geo-rapp.org)

- News/events, Products (vegetation cover anomaly)
- Pilot sites updates
- Interactions with GEOGLAM team (website, CEOS Ad-hoc team, GEO)
- Quarterly newsletter: new format distributed via Mailchimp and available on RAPP website
- Regular mailing with pilot sites PoC
- Twitter account [@geoglamRAPP](https://twitter.com/geoglamRAPP)



# GEOGLAM Community of Practice



## RAPP international workshops & meetings



*Group photo, RAPP workshop, Brazil (Campinas) – July 2015*



*Field trip USDA workshop, Iowa – by Peter Scarth*



*Group photo, RAPP workshop, South Africa (Pretoria) – June 2016*

# Future activities

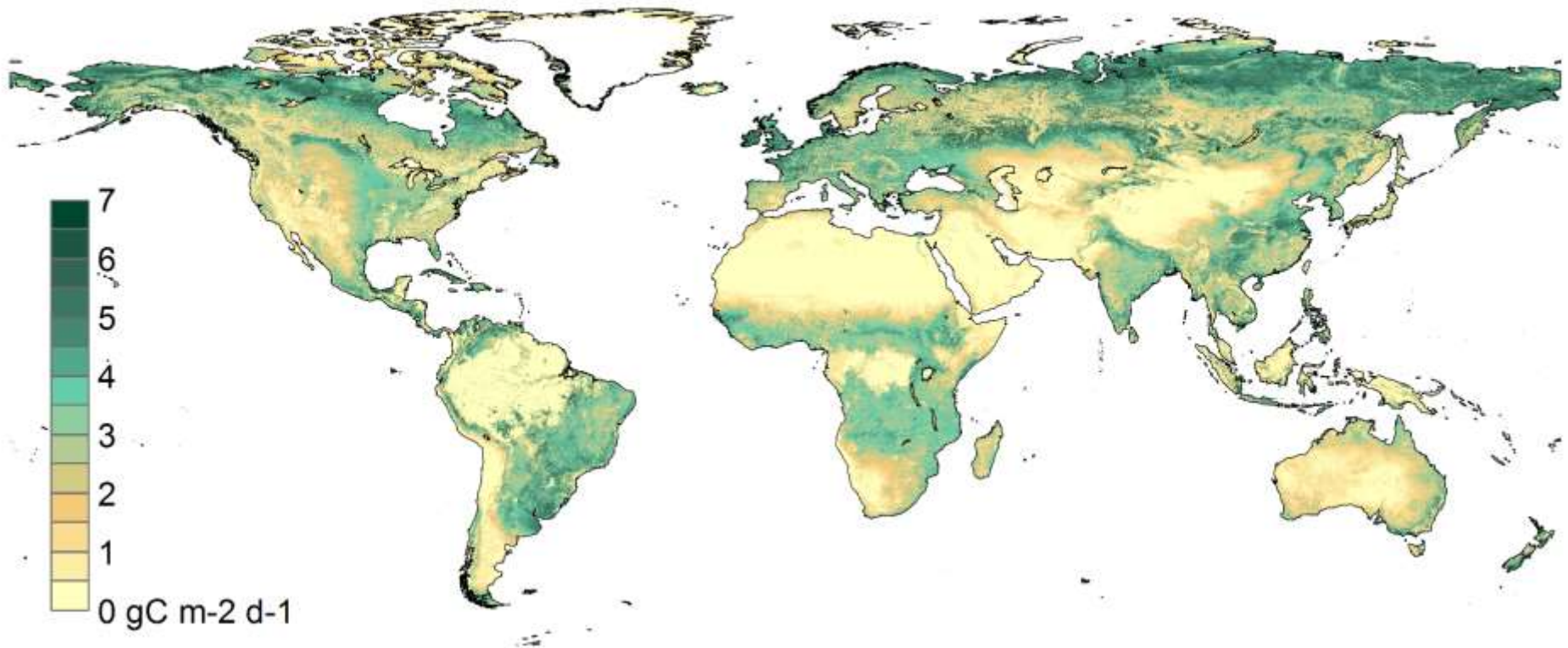
*For last discussion session (Day 2)*



## Work Plan/Road Map for 2018 and beyond including:

- Improvement & development of the **RAPP Map**
- Continuation & expansion of **field validation** campaigns: global methods? Other countries to be included?
- **Early Warning System for Rangelands?**
- R&D activities: **Modelling** (linkages with climate, CO2 emissions, animal health), **Radar** & hyperspectral technologies
- **UNSDGs: how to support the process?**
- **Commercial sector's involvement** (agribusinesses, insurance?)
- Keep collaborating with GEO/GEOGLAM/JECAM/CEOS at various scales:
  - Participation to meetings (ex GEOGLAM IT in June) & teleconferences
  - Reinforce national connections in country members (research centres, universities, space agencies)
- **Global coordination** & Outreach: call for additional **co-leads** in Americas and Europe?

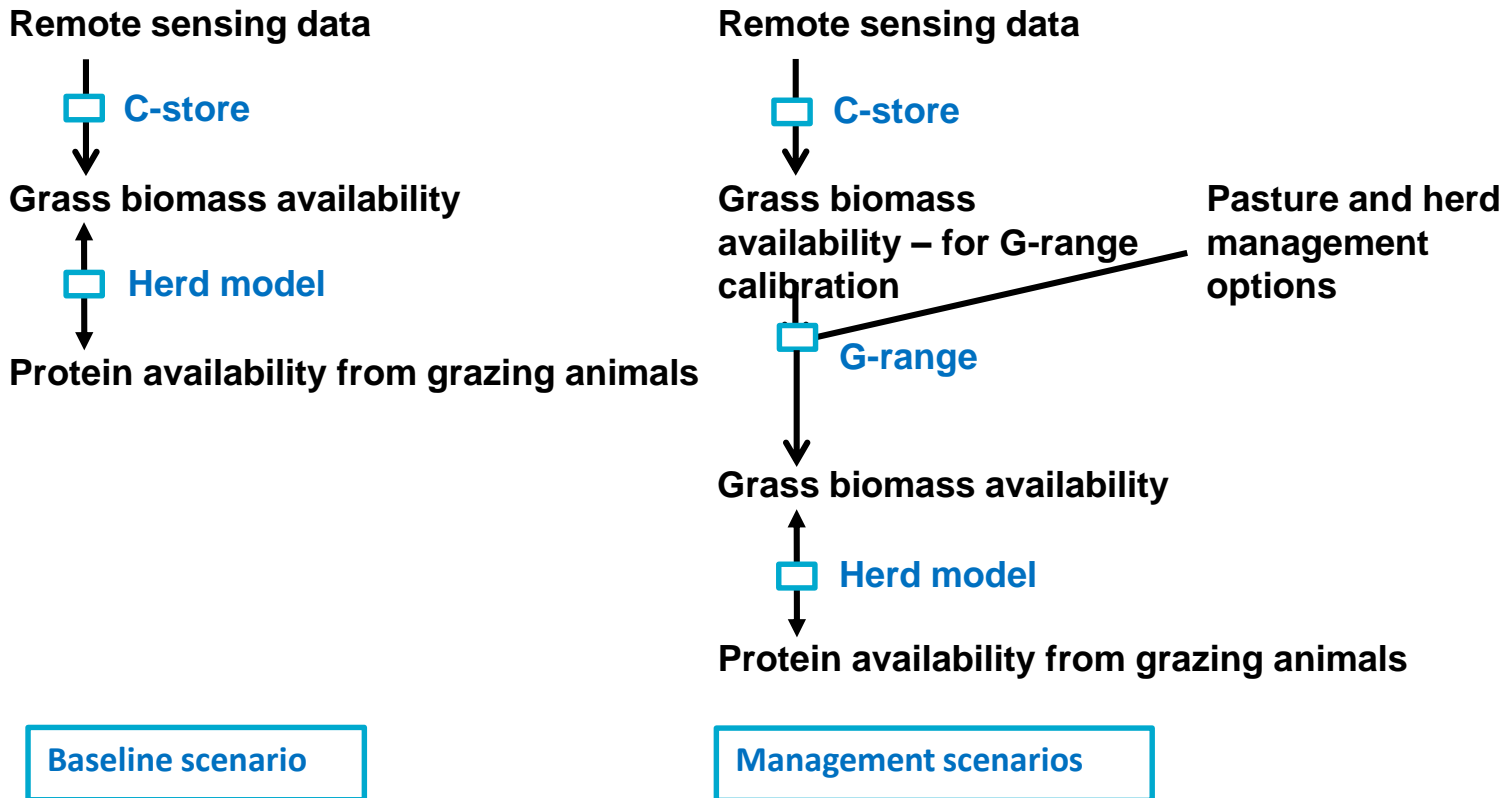
# Next Steps: Global Grassland Growth, Standing Biomass & Livestock Productivity



Preliminary “C-Store” Model Output- Annual grass GPP from 2001-2016  
(Source: R. Donohue, CSIRO - 2017, pers. communication)

# Modelling opportunities for RAPP

## Current forage-livestock modelling activities



*Mario Herrero's team, CSIRO Agriculture (Brisbane), 2016*

# Modelling opportunities for RAPP

## Next steps in modelling for RAPP

- **Refine relationship between biomass and animal performance**
  - include forage quality impacts, e.g. forage types, digestibility, N content
  - explore link between LAI and relative intake
- **Refine full herd model**
  - Link mortality and calving rates to forage availability/quality and live weight gain
- **Include additional production systems, species, environmental impacts**
  - Dairy, Small ruminant, GHGs
- **Scale up from case study sites to region and globe**

# RAPP in support of the UNSDGs *More on SDG session (Day 2)*

## (Sustainable Development Goals)

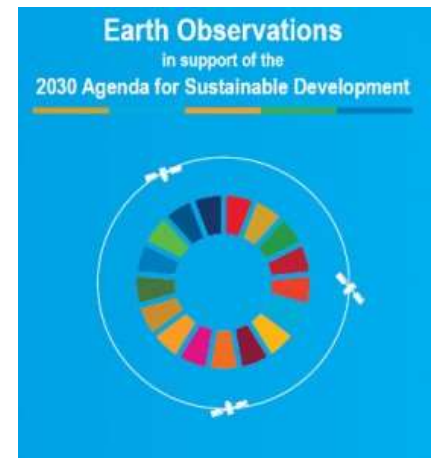
### Various GOALS, TARGETS and INDICATORS:

- Goal 2: Food Security
- Goal 6: Water issues (drought )
- Goal 13: Climate action (carbon emissions)
- Goal 15: Life on Land (land degradation with the indicator 15.3.1)



### Existing work (international working groups):

- GEO: EO4SDGs initiative – collect information within GEO and work with the UN entities:
  - => GEO/CEOS *Report incl. case studies and how EO data can help monitoring the UNSDGs*
- CEOS: new ad hoc team on SDGs to support GEO and promote spatial activities around SDGs
- CSIRO: commissioned to produce a guidance method document on 15.3.1 (Land degradation) for UNCCD
- ABS/CSIRO (Australia) collaboration to use EO data





*Agricultural Research Service (ARS) Fort Keogh Livestock and Range Research Station in southeastern Montana*

*USDA photo by Jack Dykinga*

# Thank you !

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Websites: [www.geo-rapp.org](http://www.geo-rapp.org); [www.csiro.au](http://www.csiro.au)  
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