Data Cal Project
(Statistical Meter Validation)

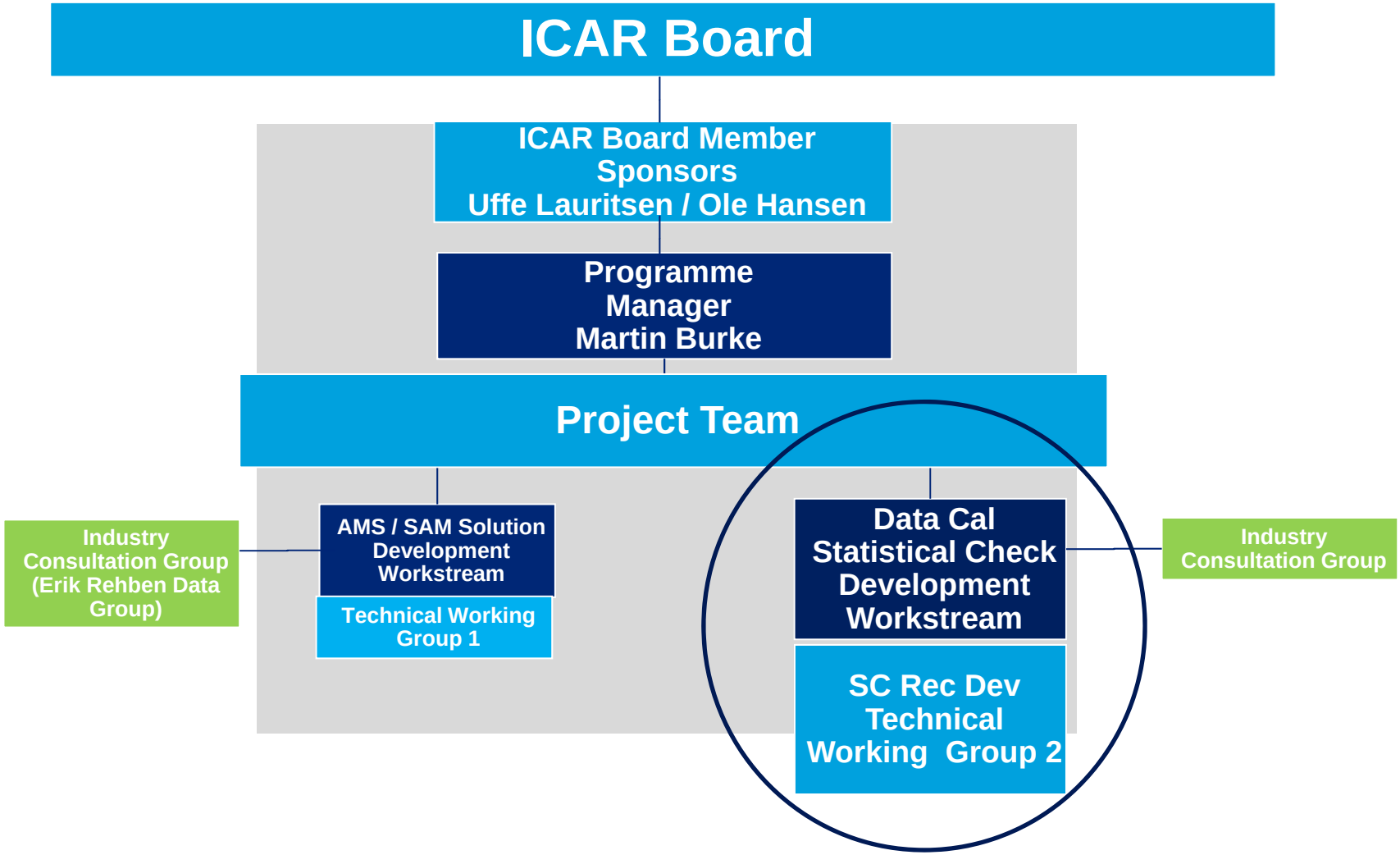
Progress Update August 2011

Martin Burke /Clement Allain & Marlene Trinderup (AgroTech Denmark)
ICAR SC Recording Devices,
EAAP August 2011.

Data Cal Project – Objective;

Update the ICAR guidelines to provide standardised statistical models for validating accuracy of electronic meters (using continuous data from those meters)

Overview Structure



Project Team – DataCal / Meter Working Group 2

The Project Team to agree and define the standardised protocol for validating e-meters through statistical data analysis;

- Martin Burke, Ireland, ICAR Milk Rec. SC (Chair)
- Clement Allain, France, Institut de l‘Elevage
- Emilie Rouzaut, France Institut de l’Elevage
- Kees De Koning, Netherlands ICAR Test Centre
- Erik Schuiling, Wageningen Research, Netherlands
- Marlene Trinderup, Stats Consultant ,Agrotech Denmark
- Steven Sievert, DHIA/QSC, USA
- Mark Adam, NorthStar Coop, USA

Kicked Off Feb 2011

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- Project Definition ,Objectives, Scope

- **What?**

  Establish guidelines & parameters for the use of continuous data from electronic meters to validate the meters' accuracy

- **Why?**

  So Manufacturers, Farmers and/or ICAR members' technicians can take data from electronic milk meters over a long period and apply compliant statistical software models to determine the accuracy levels of the meters involved.

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- Benefits of statistical validation ?
  - ✓Supplements (replace?) the expensive water test
  - ✓Water Test is a once/year view – DataCal is continuous
  - ✓Can be done remotely pre-visit = plan better farm visit
  - ✓Whole lactation data very useful.

Project Team – DataCal / Meter Working Group 2

- **Project Milestones ;**

1. Review existing models.
2. Data analysis on « golden data »
3. Refine Data Model/Parameters
4. Validation on « real data »
5. Prototype Release to members
6. Submit to ICAR Board

Project Team – DataCal / Meter Working Group 2

1. Review existing models

- 6 different models under review:
  - Lefcourt, 1999, USA
  - De Mol & André, 2009, NL – multi stand
  - Trinderup, 2009, DK
  - Olsson, 2011, SW
  - De Mol & André, 2009, NL – one stand
  - Model used in the USA (Sievert)

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1. Review existing models

Parameters	Type of MP	Cow ID	Milking stand ID	Milk yield per cow and per milking	Data quantity needs	Date and milking time	Incomplete milking (yes/no)	Parity	Days in milk	Calving date	Tank collectd on volume	Collectd on date and time	Milk destina -tion	No. Parameters
Lefcourt, 1999 – USA	Multi Stand	X	X	X	min 3 days and *# of cows per stand * # of days* > 100	X	(X)							4
De Mol and André, 2009 – Netherlands (a)	Multi Stand	(X)	X	X	1 milking session (probably more, at least 1 week)	X								3
Sievert, 2010 – USA	Multi Stand	X	X	X	last 10 milkings	X	(X)							4
Trinderup, 2009 – Denmark	Multi Stand	X	X	X	TBD	X	(X)	X	X	X				7
Olsson, 2011 (DeLaval)	Multi Stand	X	X	X	last 14 days	X	(X)							4
De Mol and André, 2009 Netherlands (b)	1 box AMS	(X)		X	data between 2 milk collections	X					X	X	X	5

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2. Data analysis « golden data » to test models;

Agrotech/SAC Farm Denmark (Trinderup model)

- Milking parlor – SAC 26 stands
- Period: Nov. 2010 – Feb. 2011
- 3 times milkings per day

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Institute for AgroTechnology and Food Innovation

Monitoring of electronic milk meters

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Example of validation/modeling data in 2 steps:

Data Used from SAC Farm : Cow-ID, Calving date, Date and time of milking, Yield: kg milk

1. Modeling effect of cow – lactation curve:

$$y_i = a_1(Date_i) + a_2(Milking\_AM/PM_i) + \beta_1 * DIM_i + \beta_2 * DIM^2{}_i + \beta_3 * DIM^3{}_i + \beta_4 * 1/DIM_i + \beta_5(Milking\_AM/PM_i) * DIM_i + \beta_6(Milking\_AM/PM_i) * DIM^2{}_i + \beta_7(Milking\_AM/PM_i) * DIM^3{}_i \beta_8(Milking\_AM/PM_i) * 1/DIM_i + + a(Cow_i) + \varepsilon_i$$

2. Applying state space model to the residuals ε_i :

(a) Observation process:	$y_t = \theta_t + v_t$,	$v_t \sim N(0, V)$
(b) Latent process:	$\theta_t = \theta_{t-1} + w_t$,	$w_t \sim N(0, W)$
(c) Initialising:		$\theta_0 \sim N(m_0, C_0)$

Monitoring of electronic milk meters

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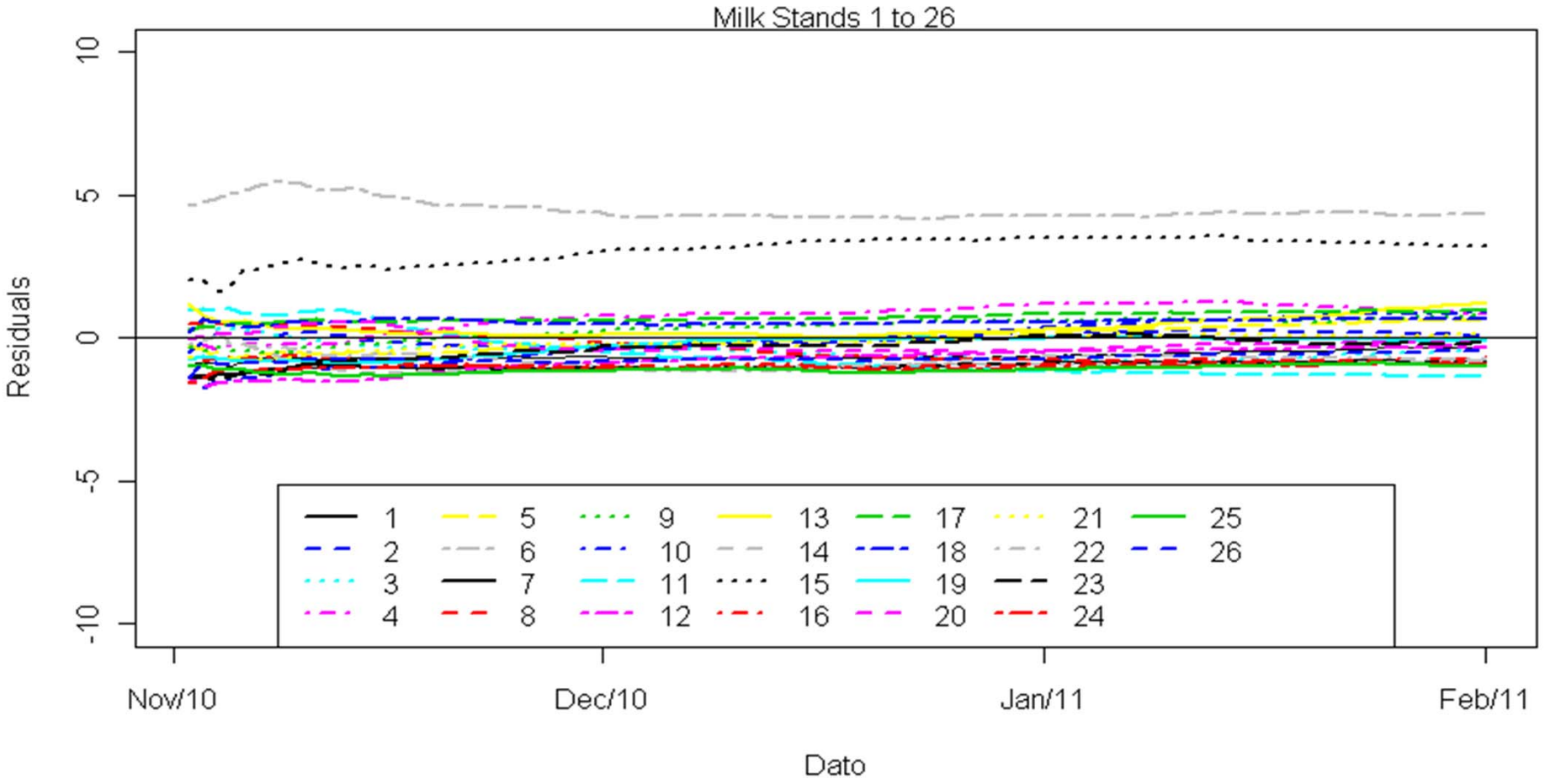
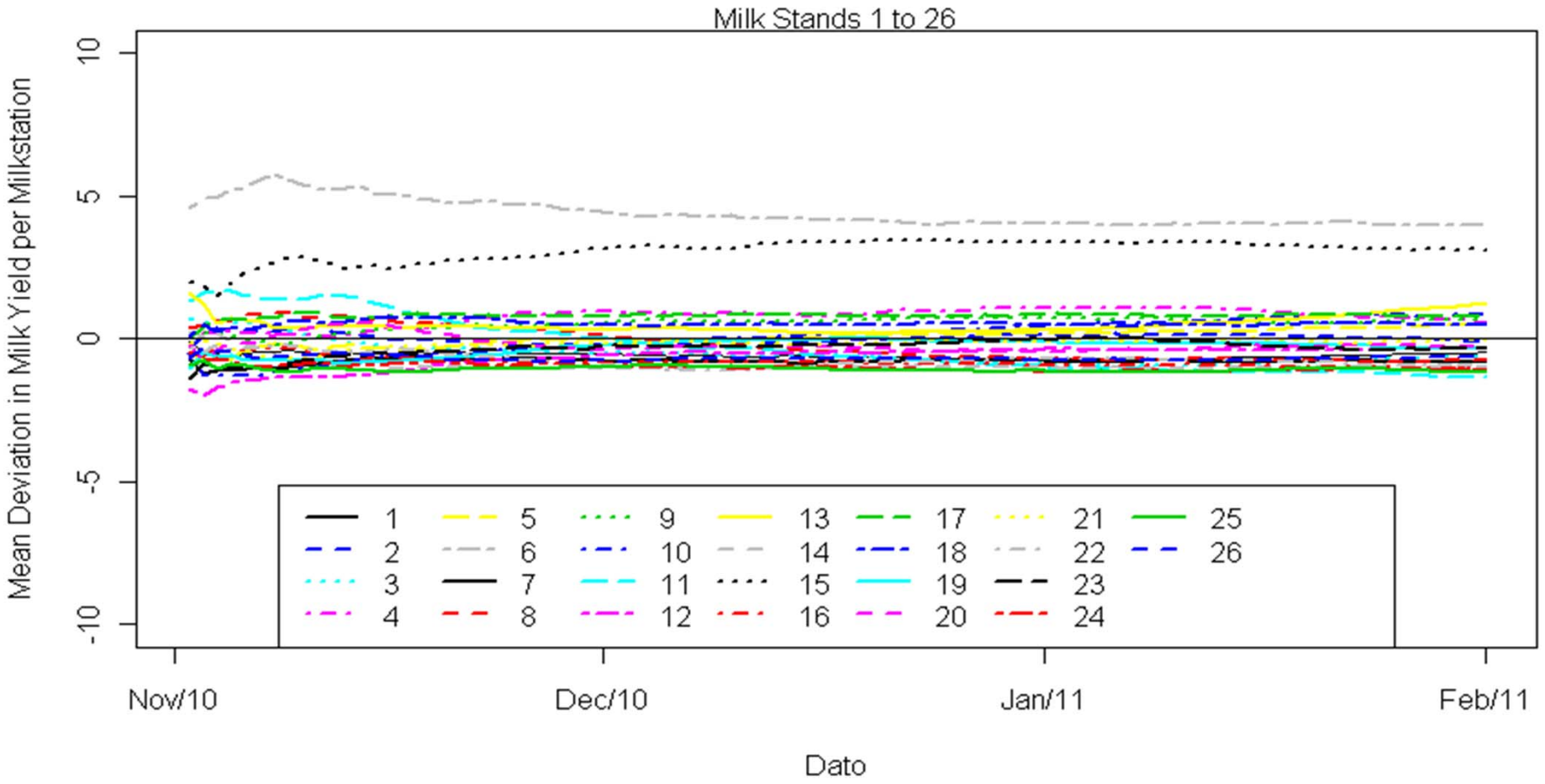
Results from the state space model – Residuals in the two step model



Problems with milk stand 6 and 15

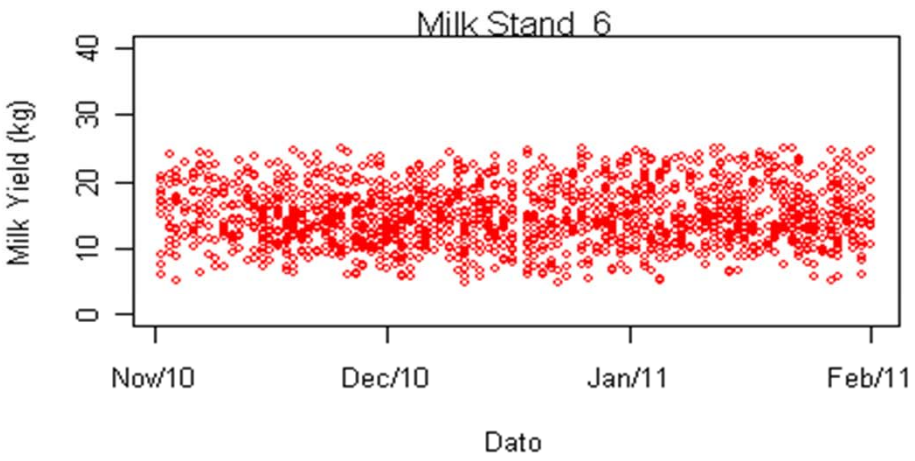
Results from the state space model

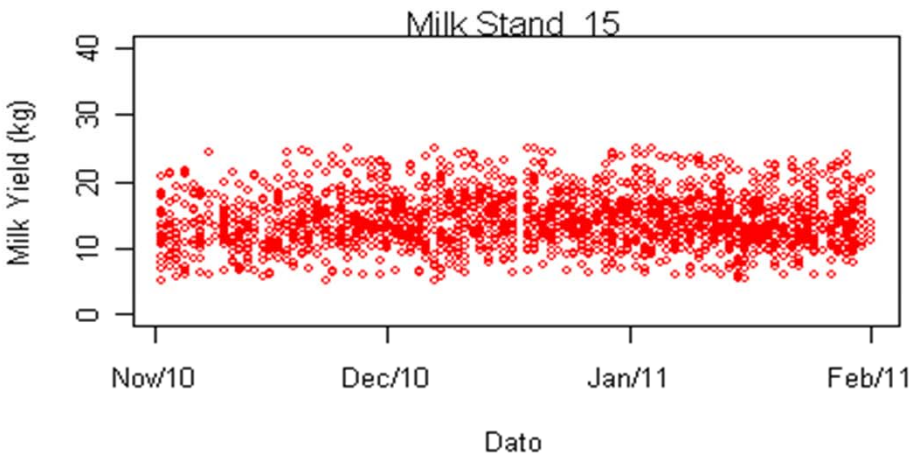
– Input data are deviations between daily avg per milk stand and overall daily avg

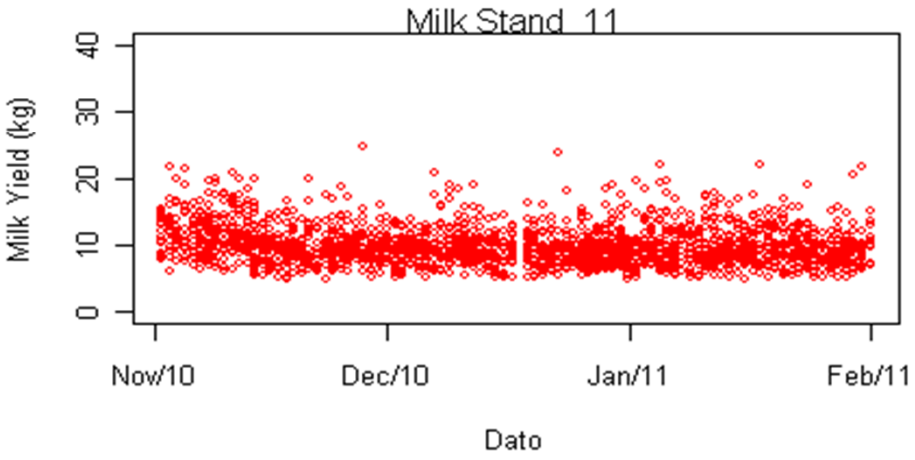


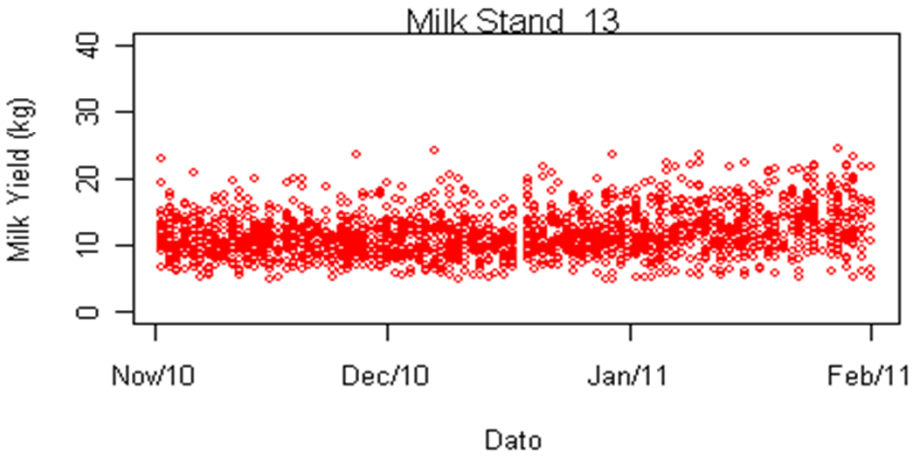
Again shows Problems with milk stand 6 and 15

Raw data – Problems with 6 and 15, apparently no problems with 11 and 13









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2. Data analysis « golden data » to test models;

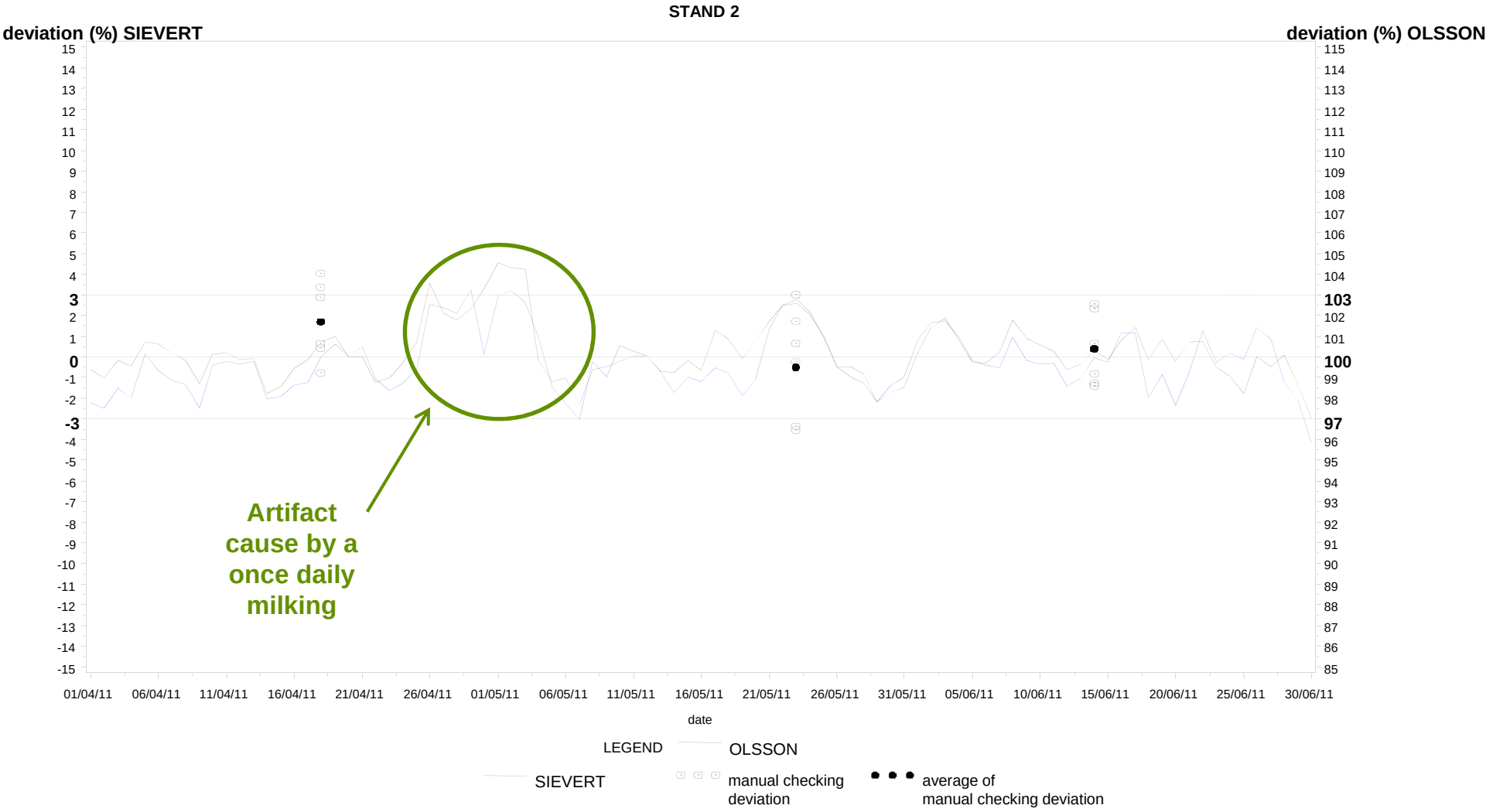
Institut de l'Elevage / INRA Farm France

(Ollson, USA (so called Sievert Models)

- Milking parlor – DeLaval rotary, 28 stands
- Period: Sept 2010 – Jun 2011
- 2 times milkings per day

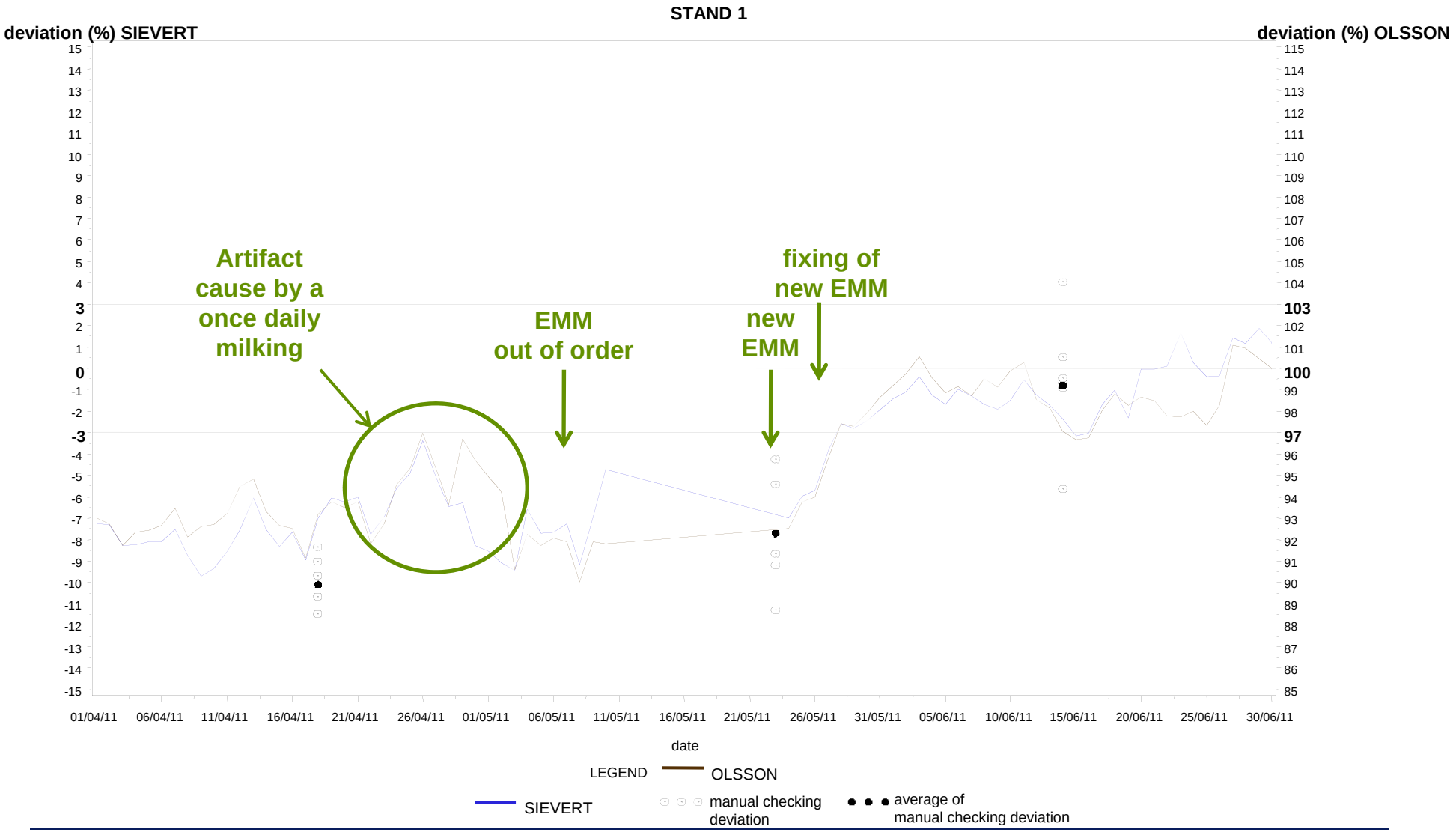
Sievert / Ollson

example correct EMM



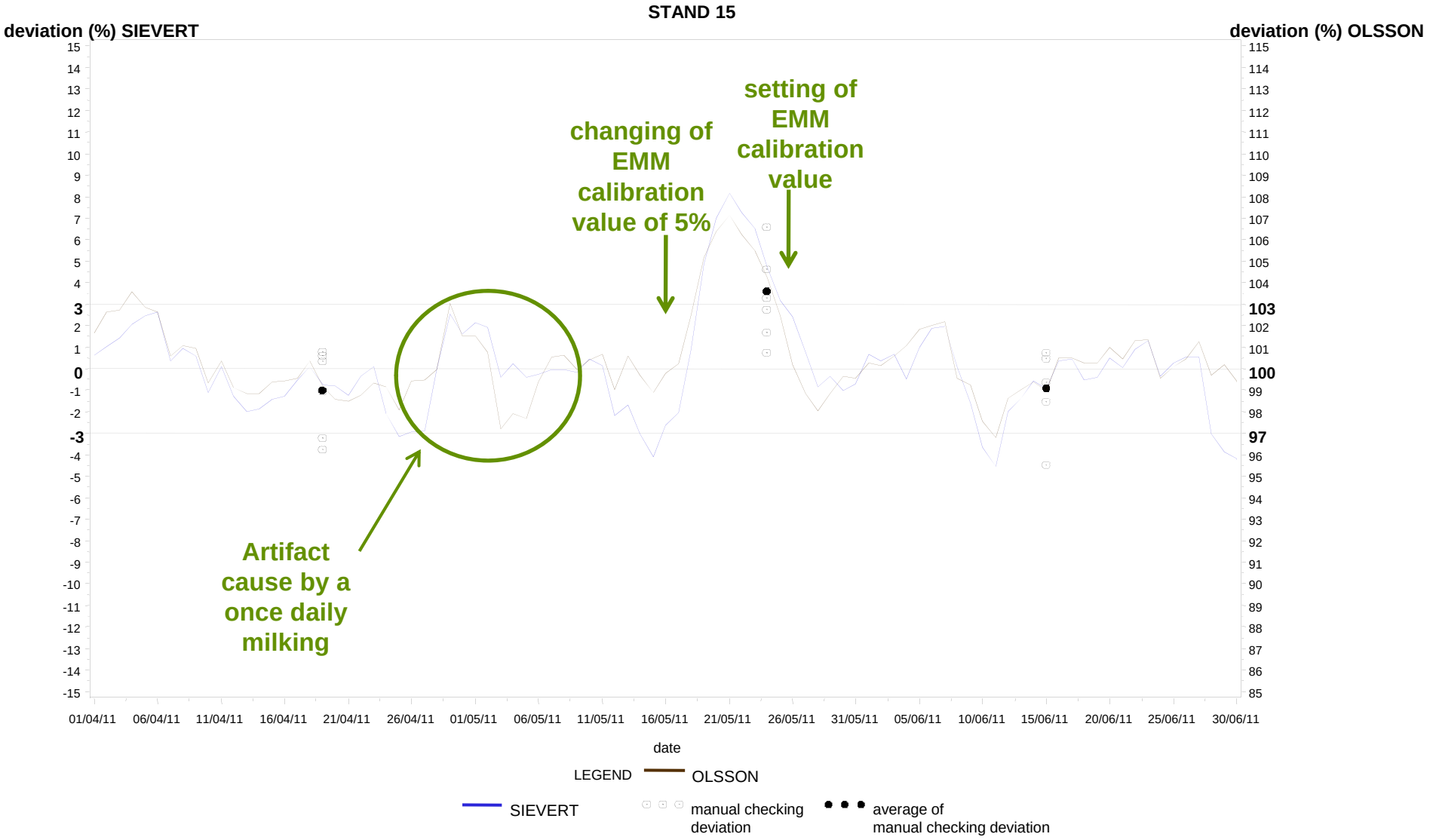
Sievert / Ollson

example faulty EMM



Sievert / Ollson

example voluntarily faulty EMM



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- **Project Milestones ;**

1. Review existing models.	*Complete Q2 / 11*
2. Data analysis on « golden data »	*Complete Q2 / 11*
3. Refine Model/Parameters	*In Progress Q3/11*
4. Validation on « real data »	*Planned Q4/11*
5. Prototype Release to members	*December 2011*
6. ICAR Board Cork	*Ratify May 2012 Cork*

ICAR 2012
CONFERENCE

CORK
IRELAND

Mon 28th May
- Fri 1st June 2012

www.icar2012.ie