A BIOMETEOROLOGICAL POPULATION DYNAMIC MODEL FOR *Aedes albopictus* (Skuse) ADAPTED TO URBAN ITALIAN (EMILIA-ROMAGNA REGION) CONTEXT

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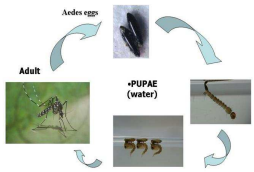
Increasing health risk connected to *Aedes albopictus* even Mediterranean area, contributed to form in 2007 a multidisciplinary working group directed by the Public Health Department of Emilia-Romagna Region in order to study and improve the knowledge about the mechanisms of adaptation and colonization of *Aedes albopictus*, characteristics of breeding sites and vector control strategies. A biometeorological population dynamic model developed by Otero et al. (2006) from the University of Buenos Aires has been investigated, adapted and modified to Italian urban context. The model run operatively every week on 10 Emilia Romagna provinces for a 2 weeks mosquito infestation forecasting.

Core model: dynamic of 5 life stages (eggs, larvae, pupae, female adults not having laid eggs and female adults having laid eggs) originating from a finite number of breeding sites with equal physical characteristics and driven by daily mean air temperature. The 5 age classes are described with deterministic equations, each modelled by a stochastic Poisson process. Developmental, mortality, emergence and oviposition rates are the same of CiMSIM (Focks et al., 1993).



Adapted model - BiTE (Biometeorological Tiger mosquitoes Estimator): is a fully meteorological input driven model, with environmental parameter adapted to italian urban context and with the introduction of diapause mechanism. Also interventions can be modelled, hence their effectiveness can be tested. BiTE can be used either for diagnostic or for short, medium and long term prognostic application.

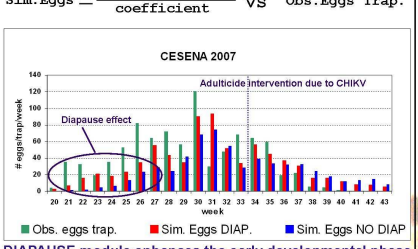
DIAPAUSE MODULE - preliminary results

Diapause is the main change in *Aedes albopictus* biology as an adaptation strategy to temperate climate countries: winter temperature and photoperiod are the key variables for diapause mechanism (Haley et al., 1988; Hanson, 1995, Carrieri et al., 2010 sub.paper)

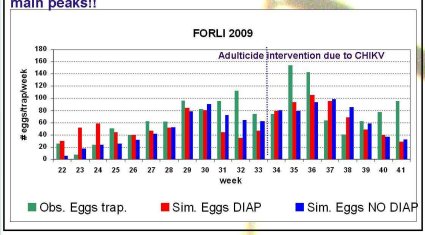
Observations VS BiTE Simulations

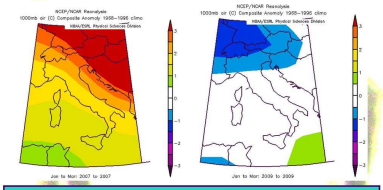
$$\frac{\text{estimated adult females in 1ha with pupal/demographic survey}}{\text{eggs sampled in ovitraps 1 week later}} = \text{Coefficient (Carrieri et al., 2009, 2010 submitted paper}$$

$$\text{Sim.Eggs} = \frac{\text{Sim.females(i-1)}}{\text{coefficient}} \text{ VS Obs.Eggs Trap.}$$



DIAPAUSE module enhances the early developmental phase and seasonal variability with a better reproduction of the main peaks!!



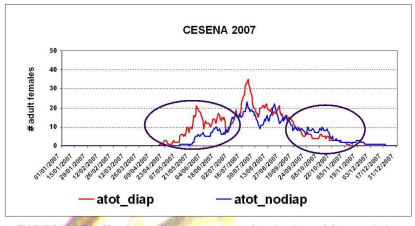


DIAPAUSE plays a fundamental role in the survival of winter eggs.
The results confirm that the DIAPAUSE mechanism is more evident after a warm winter season like 2007 !

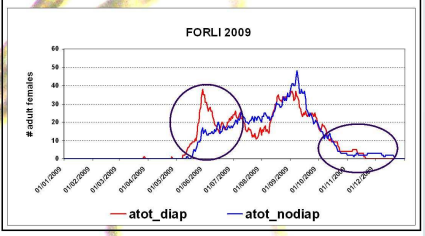
DISCUSSION:

- Mosquito densities are highly dependant on number of BS per hectar: our settings follow the pupal/demographic survey in 2008, hence BS is always a big assumption !
- No eggs observations are available for most of spring and autumn season:further investigations will be carried out for a better evaluation of diapause impacts !
- DIAPAUSE mechanism can be further enhanced through the use of rain as the triggering effect for activation of winter eggs !

Simulated females: diapause VS no diapause



DIAPAUSE effects: advance on early start and lower late phase !

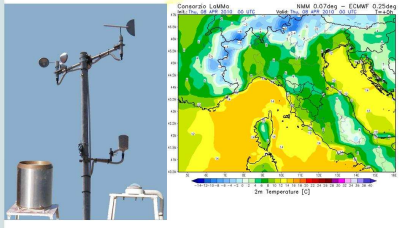


OTHER MODEL CHANGES

WEATHER INPUT:

Observed meteorological data, weather forecasting or climatological numerical model. WRF-NMM weather model output were calibrated on each of the 10 urban weather station of Emilia Romagna through a statistical algorithm based on linear regression.

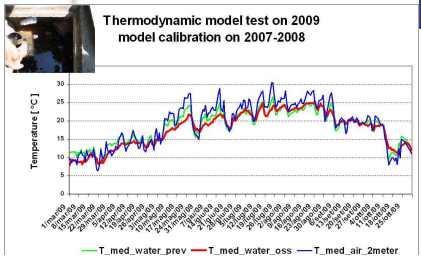
Tmed, Tmax, Tmin, RH



Catch basin thermodynamic model

Linear regression model for a better representation of water temperature of a standard urban catch basin as a function of air temperature and relative humidity.
Model calibration on 2007-2008 and tested on 2009.

TEST: $R^2 = 0,92$ MSE = 2,08°C



Dynamic setting of breeding site: quantity and capacity

pupal/demographic-survey (2008) in 4 Emilia Romagna provinces (Carrieri et al., 2010, submitted paper)

BS settings BITE 2009	RIMINI BS	RIMINI CAP. (L.)	RAVENNA BS	RAVENNA CAP. (L.)	CESENA BS	CESENA CAP. (L.)	FORLI BS	FORLI CAP. P.	GENERIC BS	GENERIC CAP. (L.)
< JUNE	52	23	76	18	60	12	102	11	81	12
JUNE	3	40	3	15	4	16	12	18	8	17
JULY	4	37	3	15	6	15	4	23	5	19
AUG - OCT	2	34	4	15	3	16	6	15	5	16
NOVEMBER	52	23	76	18	60	12	102	11	81	12

Intervention period

Catch basin is the main responsible for urban infestation