INTERNATIONAL ATOMIC ENERGY AGENCY
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
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SMR.780 - 33

FOURTH AUTUMN COURSE ON MATHEMATICAL ECOLOGY

(24 October - 11 November 1994)

"Measles Lecture Handout"

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These are preliminary lecture notes, intended only for distribution to participants.

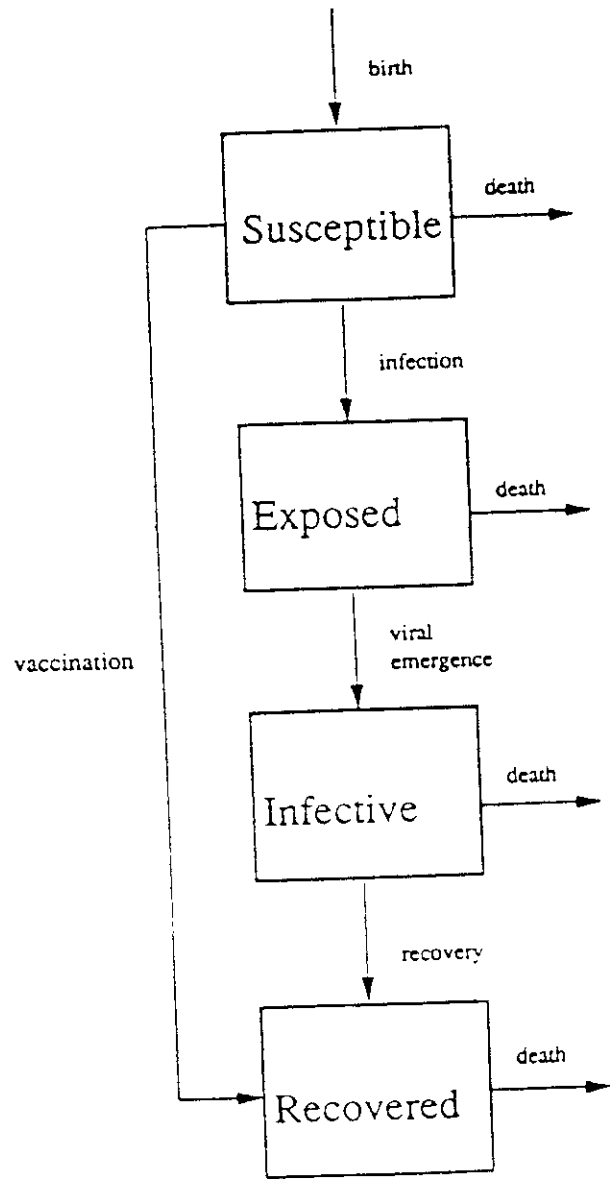
EPIDEMIOLOGY

- Cycles (linear)
- Persistence
- Stochasticity
- Age structure
- Spatial structure

- VACCINATION
  cycles
  eradication threshold

NONLINEAR DYNAMICS

- Cycles (nonlinear)
- Stochasticity
- Nonlinear predictability


birth
Susceptible
death
infection
Exposed
death
viral
emergence
vaccination
Infective
death
recovery
Recovered
death

The SEIR model for measles

(Susceptible, Exposed, Infectious, Recovered)

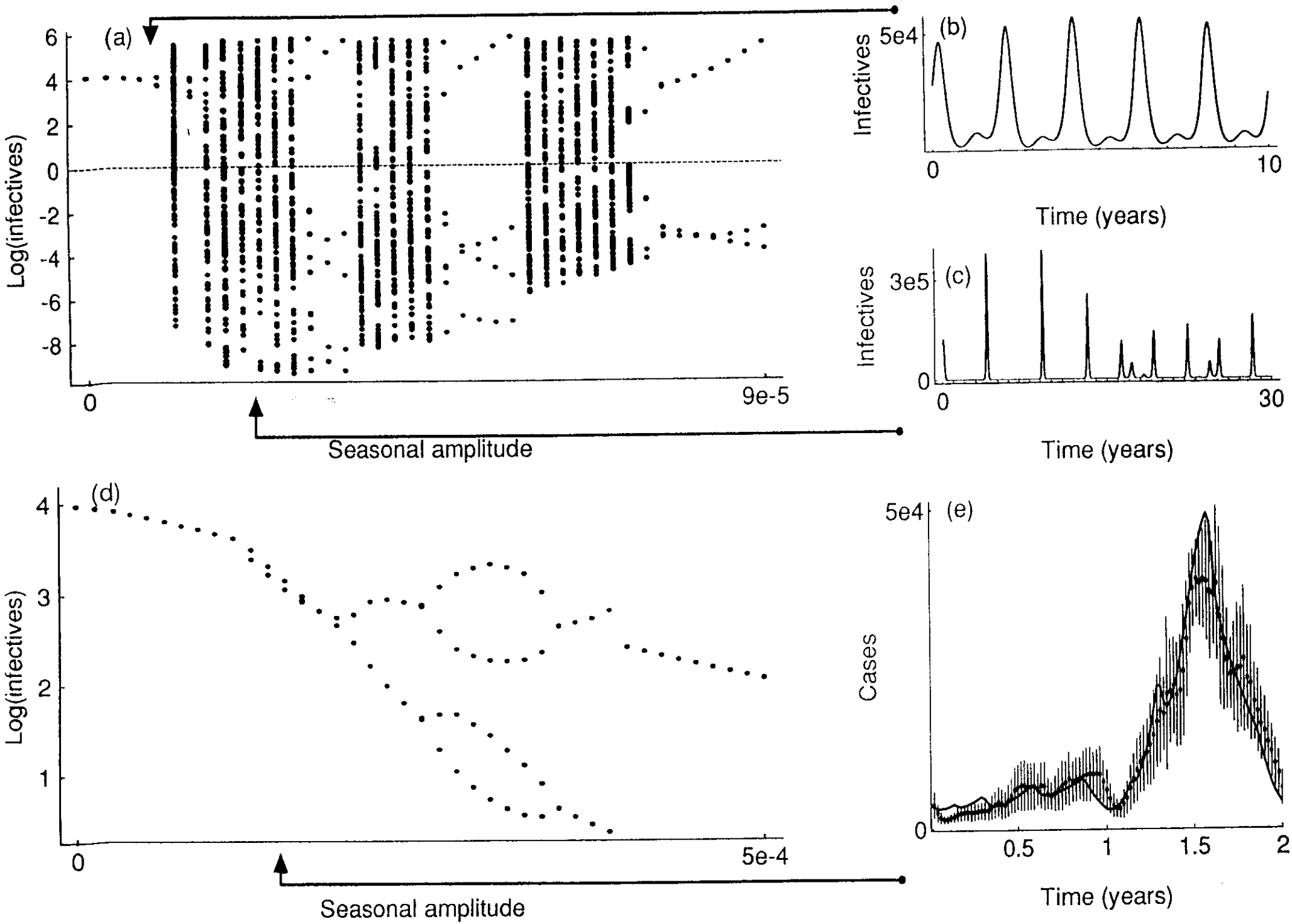
$$\frac{dS}{dt} = \mu N - - (\mu + \beta I)S$$

$$\frac{dE}{dt} = \beta IS - (\mu + \sigma)E$$

$$\frac{dI}{dt} = \sigma E - (\mu + \gamma)I$$

Seasonal forcing in the infection rate

$$\beta(t) = b_0(1 + b_1 \cos(2\pi t))$$


(a)
6
4
2
0
-2
-4
-6
-8
Log(infectives)
0
9e-5
Seasonal amplitude
(b)
5e4
Infectives
0
10
Time (years)
(c)
3e5
Infectives
0
0
30
Time (years)
(d)
4
3
2
1
Log(infectives)
0
5e-4
Seasonal amplitude
(e)
5e4
Cases
0
0.5
1
1.5
2
Time (years)