

Freshwater resources management in coastal zones in different climates

Salinisation Symposium Wageningen University



Contents – key words

1) Fresh and Salt Water

2) Comparison NL with Mallorca

- Problem framing ‘salinisation’
- Use of scientific knowledge
- Evaluation of solutions for ‘salinisation’

3) Netherlands – Schieland case

- Use of scientific knowledge/ JFF
- External salinisation & climate change
- Regional Water management
- Water Framework Directive / Ecology
- Chloride standards

Science

Negotiated
Knowledge

Stakes

Fresh and salt water

Indicators: (mg/l , ppm , %, etc)

- Chlorinity ($[Cl^-]$),
- Natrium ($[Na^+]$),
- Conductivity (Ms/cm)
- Salinity



Uncertainty in research:

- Scientific disciplines use different indicators
- System looked at? (ground/surface/soil moisture)

Uncertainty in policy:

- Stakes &
- Sound thresholds for salt damage risks

Classification systems fresh and salt water

- Stuyfzand (1993): ground water /drinkwater sector
- Wamelink and Runhaar (2000): Ecohydrology
- Venice System (1959): marine ecology

Venice System (1959):

Legend	salinity (g/l)
Fresh	<0.5
Oligohaline	0.5-5 (Brak)
Mesohaline	5-18
Polyhaline	18-30
Mixohaline	0.5-30
Euhaline	30-40

Klassen	Stuyfzand (1993) mg NaCl/l	Wamelink & Runhaar (2000) mg NaCl/l
Zeer zoet (oligosalien)	0 - 5	0 - 150
Zeer zoet - Zoet	5 - 30	-
Zoet	30 - 150	150 - 300
Zoet - Brak	150 - 300	300 - 1000
Brak	300 - 1000	1000 - 5000
Brak - Zout	1000 - 10000	5000 - 10000
Zout	10000 - 20000	>10000
Hypersalien	> 20000	

Indicative CL- values in NL: framing the issue

	CL- (mg l ⁻¹)	Source
North Sea:	16000-18000	Cult. Tech. Vadaceum (1988)
Lake VZM (currently)	200 - 1000	Plan-MER (2010)
Current management objective Lake VZM	450	Peilbesluit (1996)
Lake VZM (future)	8000-10000	Plan-MER (2010)
Drink water threshold (law)	150	RIVM/WHO
<i>Landbouwkundig zoet</i>	1000	Province Zeeland (2006)
Greenhouse horticulture	50-200	Rijkswaterstaat
Arable farming	1000	Rijkswaterstaat

Freshwater dependent nature

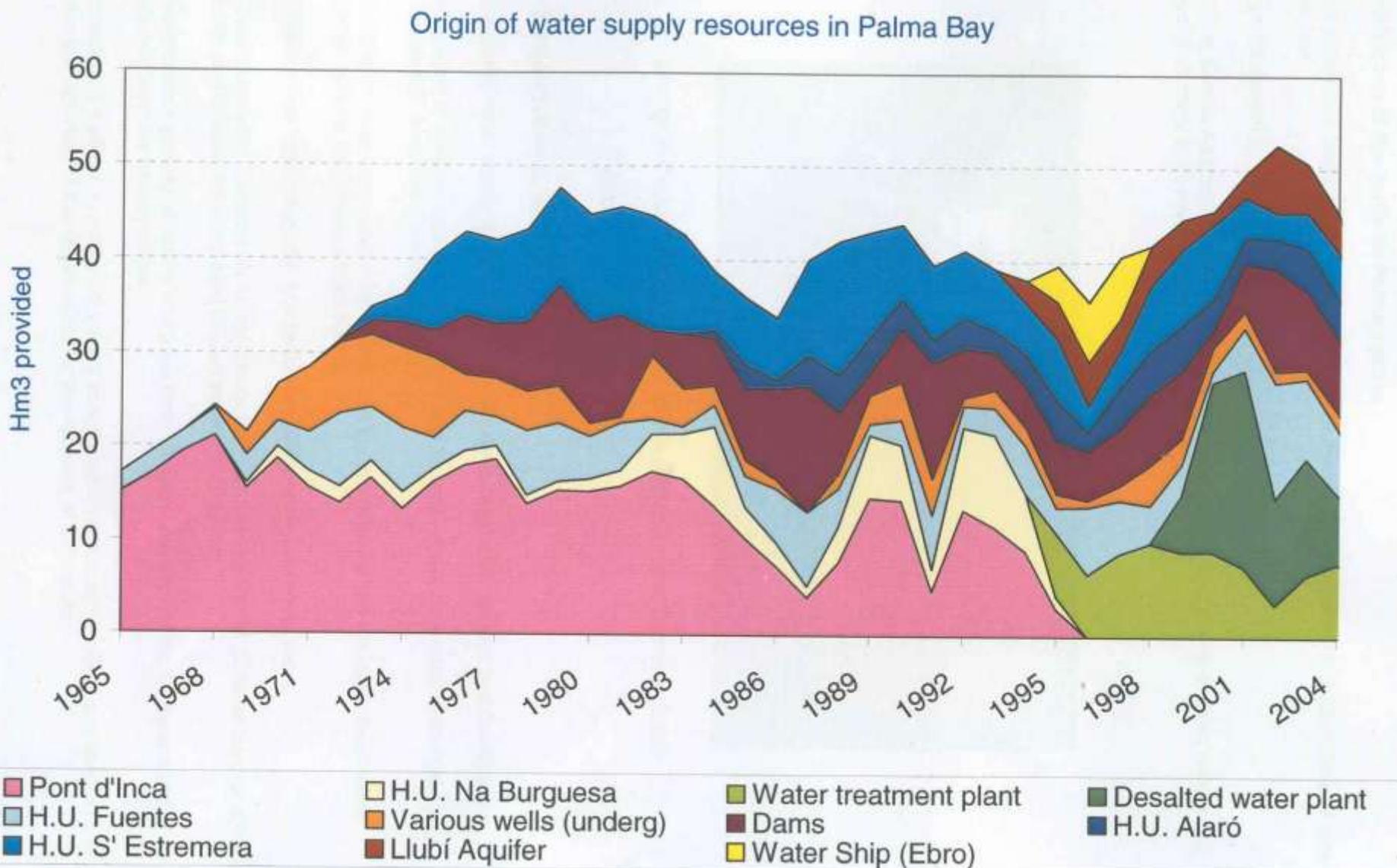
300-1000

Rijkswaterstaat

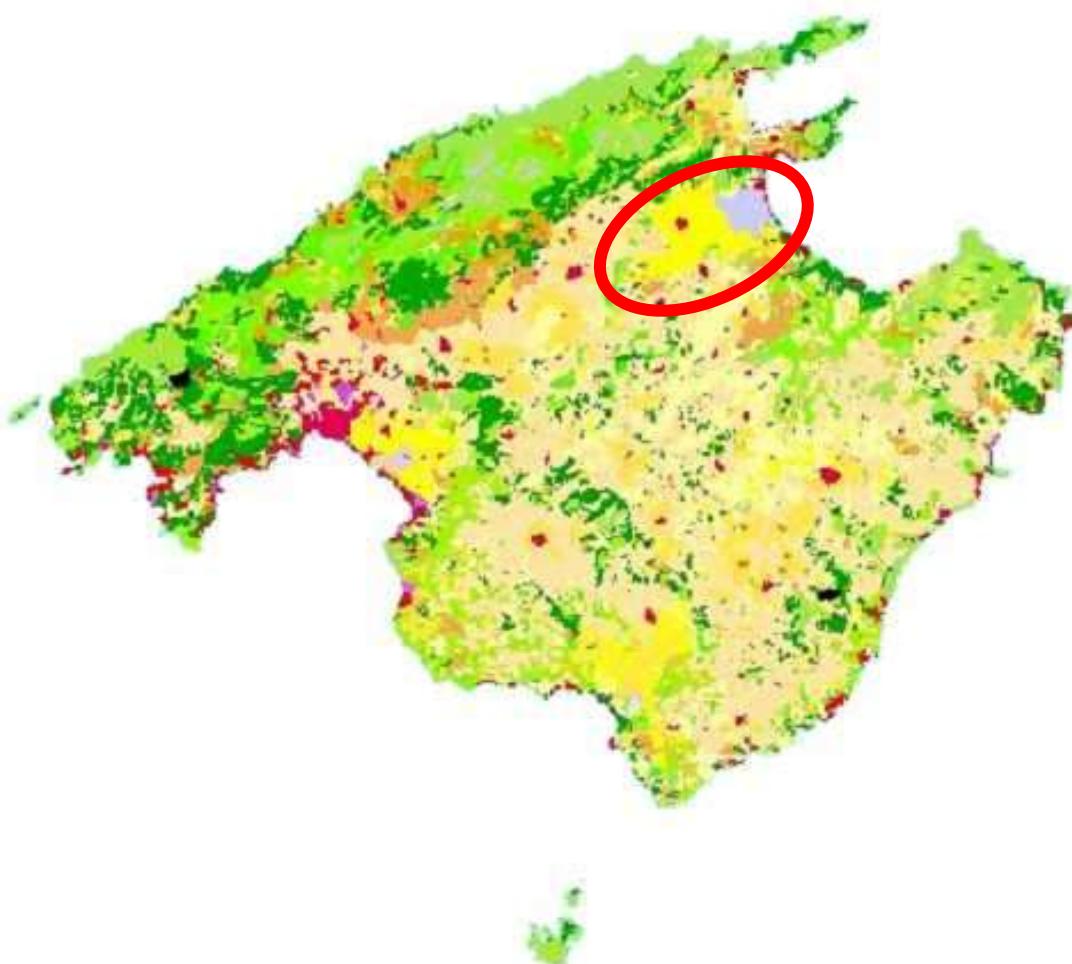
Netherlands – Mallorca: compared beforehand

	SW- Netherlands/ Schieland	Mallorca
Problem framing Salinisation/water scarcity	Distribution issue	Depletion and pollution of ground water resources
Solutions	Water supply management	Alternative resources (desalination, waste water)
Climate CC & Water resources	Moderate climate CC on political agenda	Mediterranean climate CC Not on political agenda
Water supply	Rivers, precipitation, ground water	Precipitation, ground water
Water demand	Increasing	Booming! (Tourism)
Science – Policy interactions	High	Low
Chloride standards	Issue of scientific and societal debate [CL-]	Non existent, monitoring include salinity & EGV.
Regional Water Management	Water boards	Ministerio de Medi Ambiente

Water supply to Palma



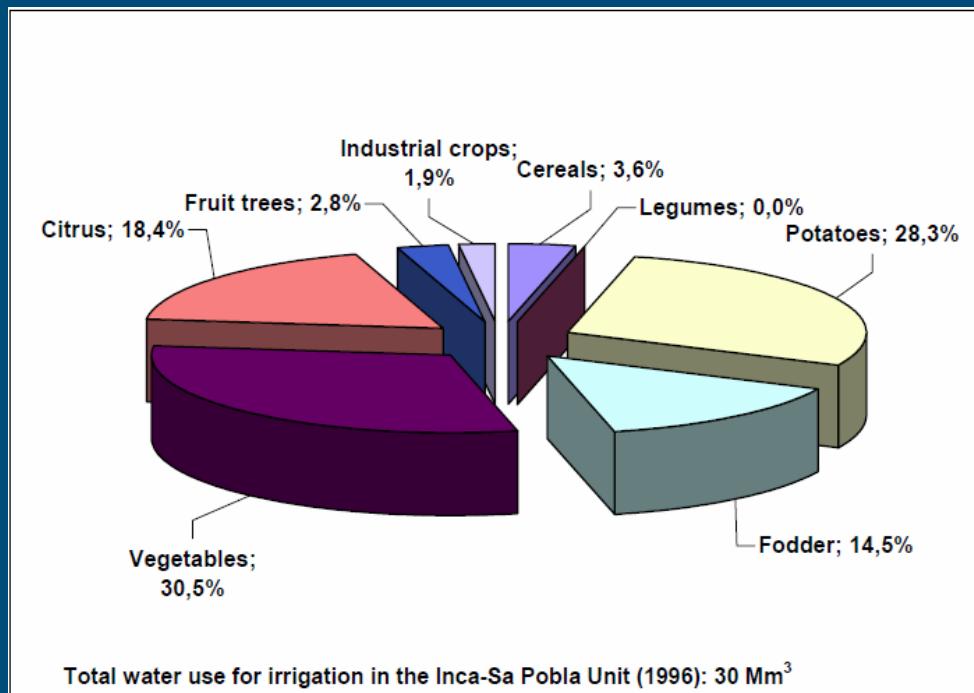
Case study Mallorca: s'Albufera



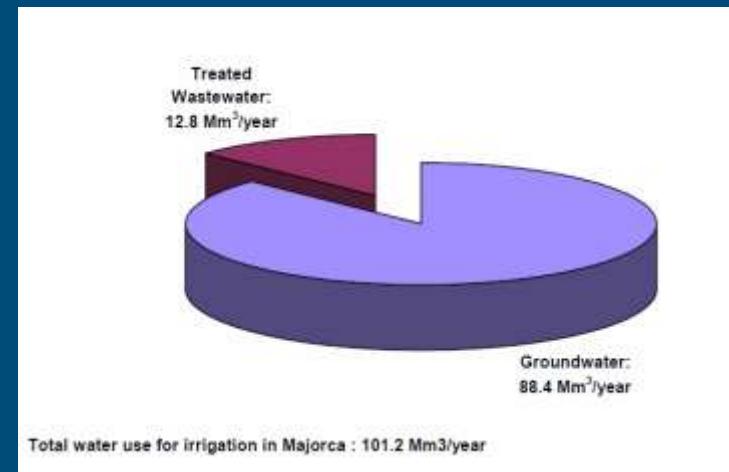
Land use

- Yellow: Intensive agriculture (irrigated)
- Light yellow: Almonds, Olives, fruit, etc
- Green: Forest
- Red: Urban
- Purple: Wetland

Irrigation in Inca-Sa Pobla Unit



**Total water use for irrigation
in Mallorca: 101,2 Mm³/year (1996)**



Water use per crop (%) of total water use in irrigated agriculture for the Inca Sa-Pobla Hydrogeological Unit (after Plan Hidrológico de las Islas Baleares, 1999).



Veraart, 2008



Veraart, 2008



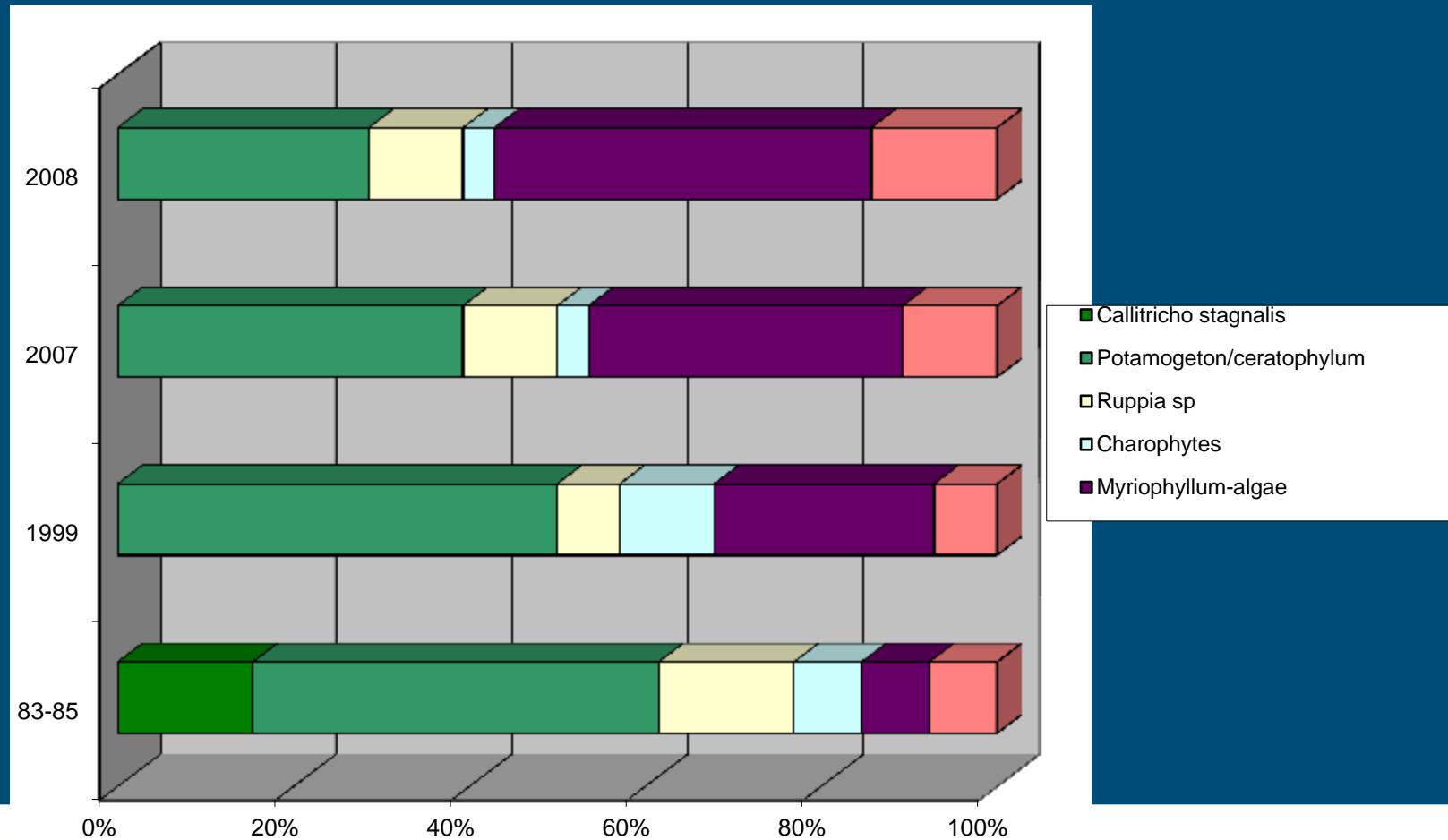
**Salinity surface water at this picture
(2008): 2.5-3 g/l (\approx 750 -1000 mg/l**

Chloride) the Mallorcan water manager calls
this water fresh, while Dutch water managers
call this water brackish.



Long-term ecological monitoring

Aquatic Macrophyte Communities in canal system Albufera (n=14)

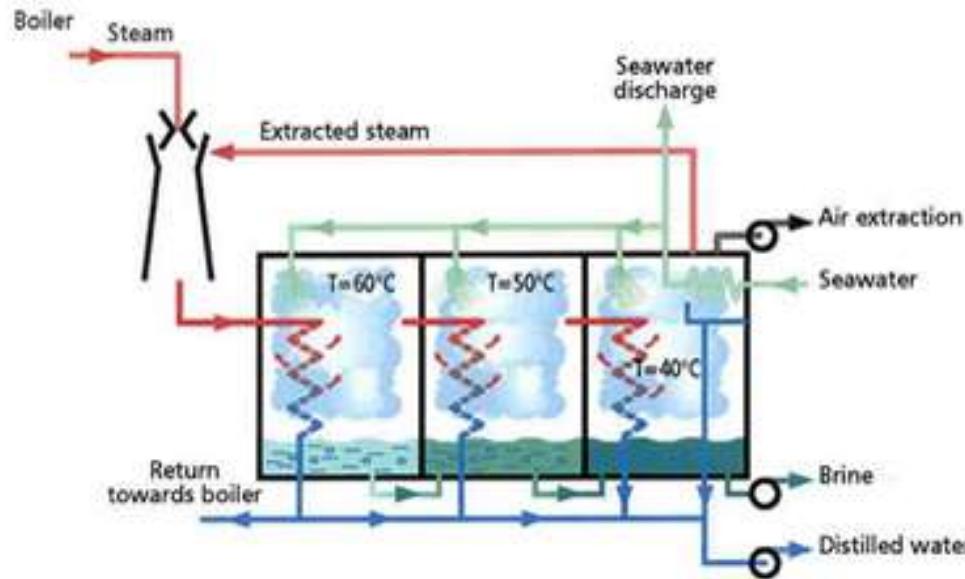


L'aigua de la zona humida és cada vegada més salabrosa

- Canvi d'espècies cap a tolerants de variacions en salinitat. Pèrdua d'espècies i comunitats d'aigües dolces.
- Comparació dades conductivitat/salinitat:
 - Entre 83/84 i 94/98 hi ha un **increment** del 10-40%
 - De 26 punts de control (Veraart) hi ha increment significatiu de salinitat en 6 punts (entre 94/98 i 04/08) i **3 minven**.
- Hi ha variabilitat espacial i temporal, però la tendència de les espècies és cap a una major resistència a una salinitat incrementada i variable.
- Al 1988 l'aqüífer Inca-Sa Pobla es considera excedentari i no afectat per intrussió marina. Al 1999 la isolínea de 500ppm de clorurs es situa a l'oest de l'Albufera (Galimont et al 2003).
- Entre 2003 i 2005 la salinitat ha minvat una mica (Conselleria/IGME).



Desalination Plant Alcudia



Sewage treatment water coastal zone



© 2011 Tele Atlas
Image © 2011 DigitalGlobe
Image © 2011 GeoEye

39°46'46.11" N 3°06'59.09" E elev 0 m

©2009 Google™

Eye alt 583 m



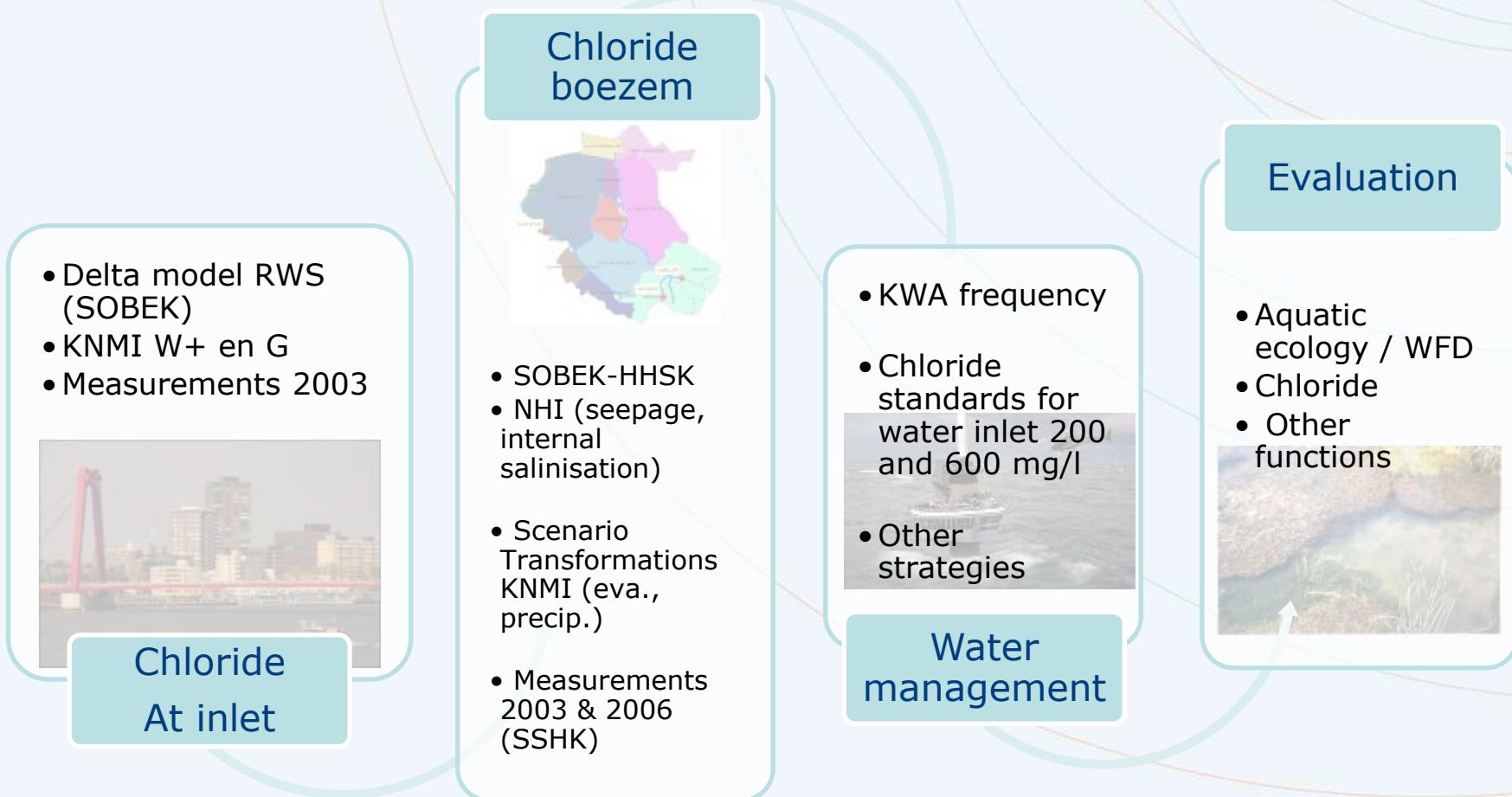
Water management in Schieland

Risk perception: Increased probability that the flushing of polders has to be done with slightly brackish water (400-1000 mg/l) due to climate change.

Research questions:

- What is the increase of external salinisation?
- What are the impacts for the regional water system?
- What are possible adaptation options in relation to water management and land use?
- What are the impacts of the alternative strategies for the objectives for the Water Framework directive?

Research approach



Joined Fact finding and Schieland

Lessons learned



- Shared insights in con's, pro's and synergies between different models (NHI, SOBEK) and monitoring
- A chloride standard for water inlet of 600 mg/l is 'no regret' from a Ecological/WFD perspective under G and W+ scenario
- The KWA procedure will be less frequently used with 600 mg/l

Uncertainties:

- Conversion factor EGV/Chloride (UNESCO, 1973)
- Toxicological information about salt tolerance of species

Societal disputes

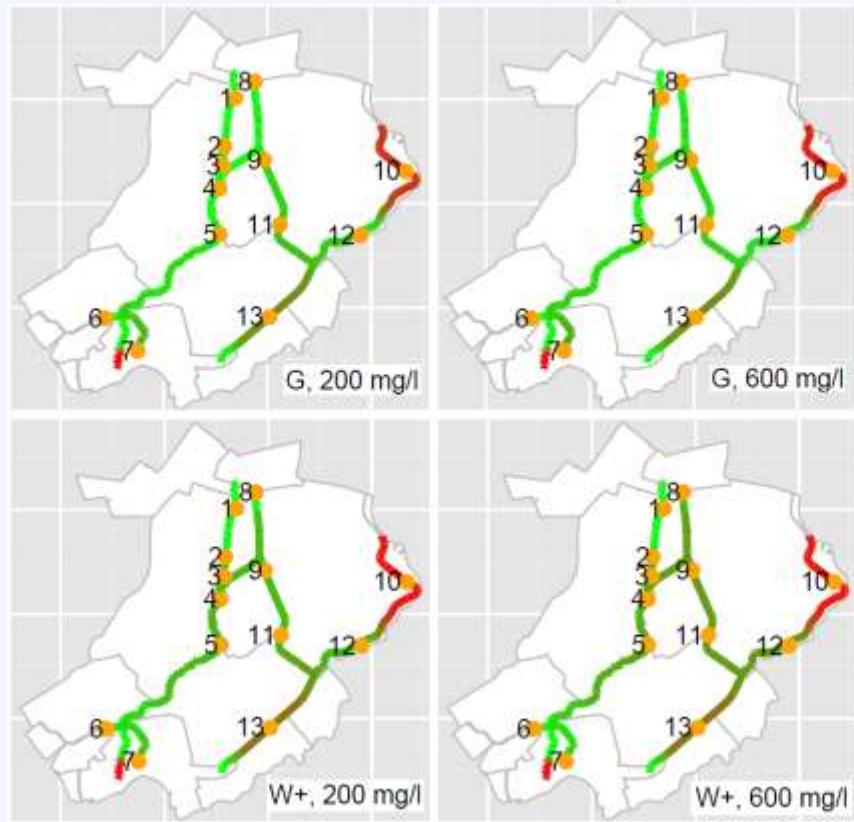
- The need for flushing: agriculture – nature

Comparison Mallorca – Netherlands

- Differences in definition salt – fresh
- 'Controversial' solutions already in place at Mallorca

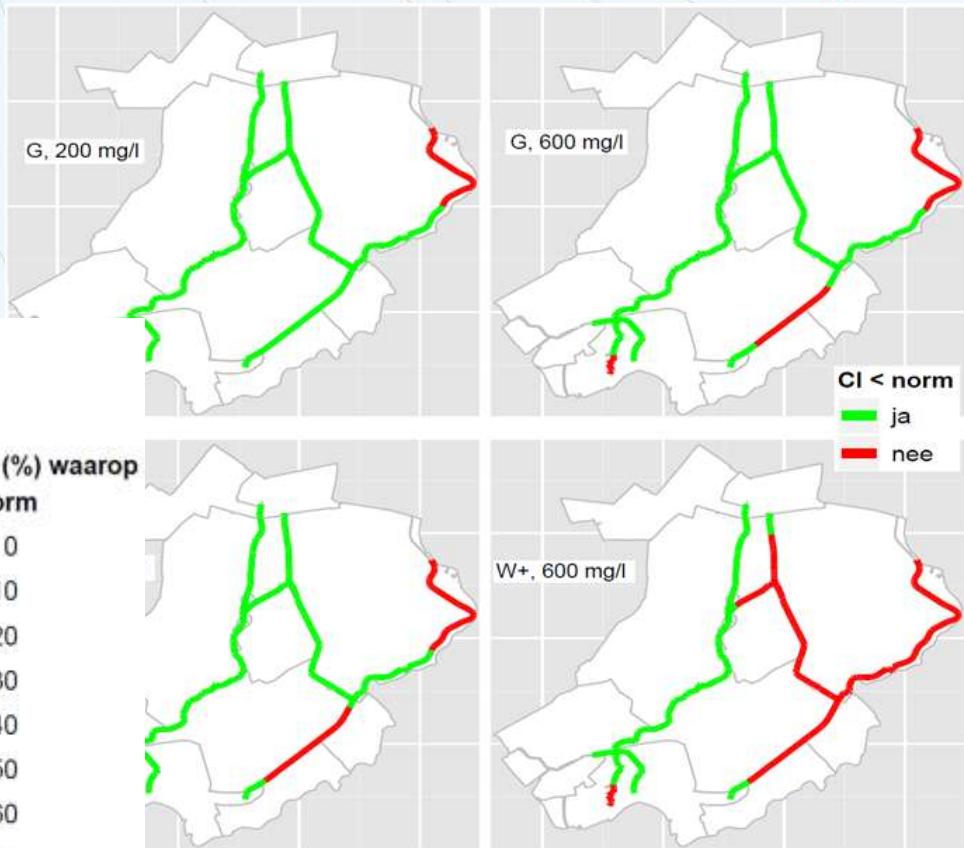
2050: G/W+ and 200-600

Visualisation of uncertainties



dagen (%) waarop
Cl > norm

- 0
- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100



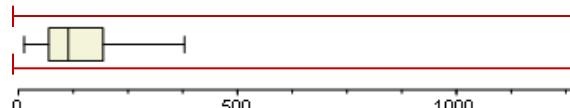


Limnodatabase (STOWA)

Uncertainties

(1)

Cl (mg/l)



Box-Whisker plot *Ceratophyllum demersum* voor chloride obv database STOWA,
(indicatief de marges op Mallorca en Finland)

(2) Calculation factor from salinity to chloride (UNESCO, 1973); holds only true for <20 promille salinity

(3) Salt is more than chloride;
Krabbenscheer.

(4) Autonomous Adaptation within the ecosystem (dispersion, seeds, propagules, recolonisation)



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Thank you