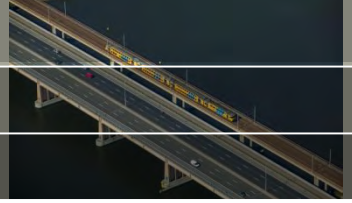
Deltares
Enabling Delta Life

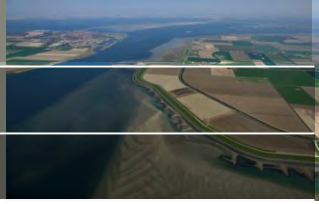
Modelleren van overstromingsschade

Een taak voor kunstmatige intelligentie?

Dennis Wagenaar

Mijn achtergrond





- Msc Civiele Techniek – TU Delft
- Deltares
  - Ontwikkeling SSM schade/slachtoffer model Nederland
  - Deltaprogramma – normering primaire keringen
  - Wereldwijde overstromingsschade modellen
  - Europees onderzoek gevolgen rampen met machine learning
- Part-time VU Amsterdam
  - PhD onderzoek: Data-Driven disaster damage modelling

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Toepassingen gevolgen modelleren

- Normeren dijken
- Kosten-batenanalyses
- Verzekeringen

Noodmaatregelen op gang brengen

Herstel financieren

Noodhulp prioriteren

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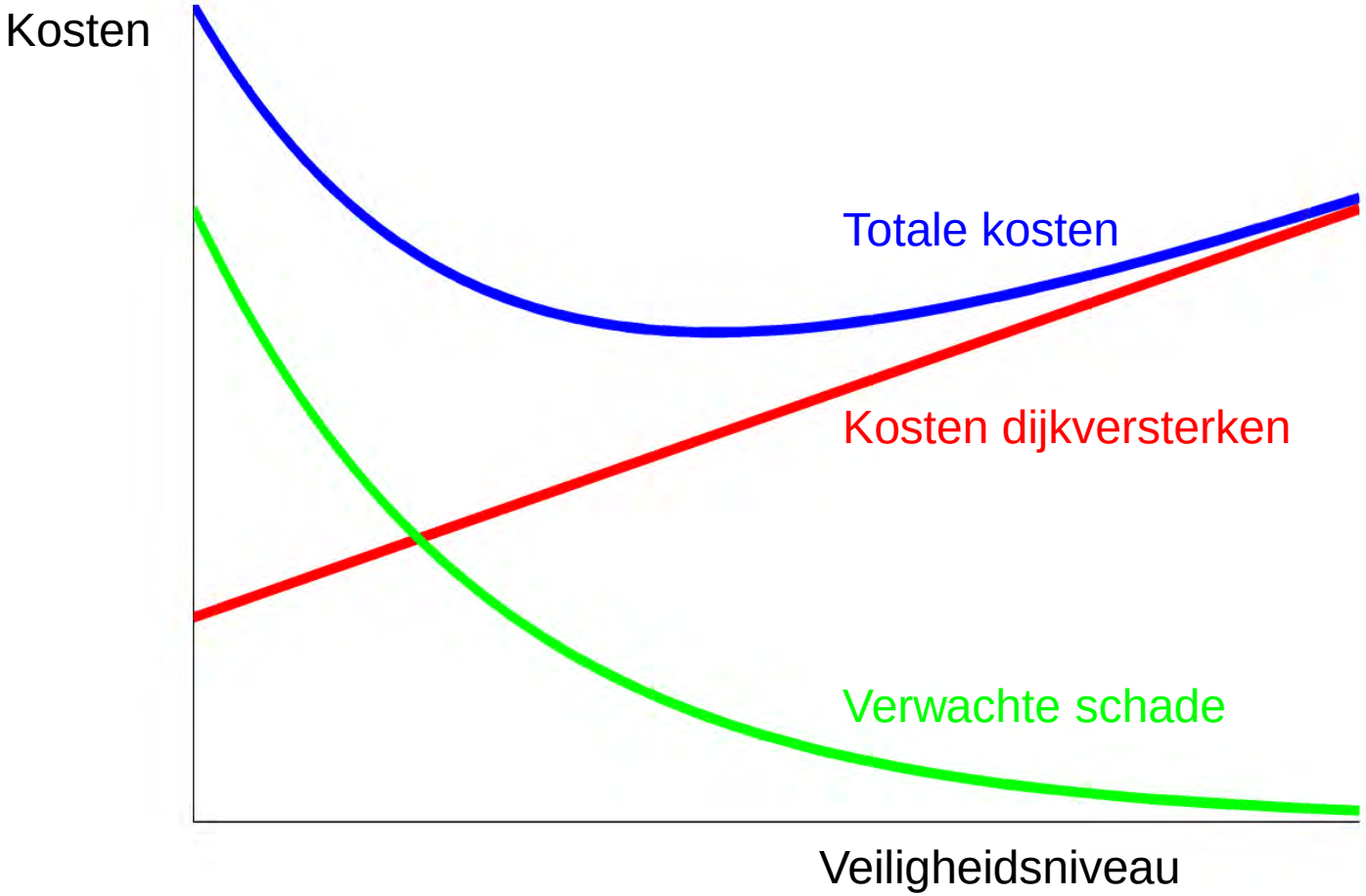
Normeren dijken



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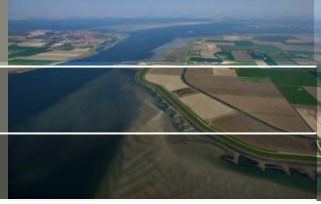
Mogelijke aanpak



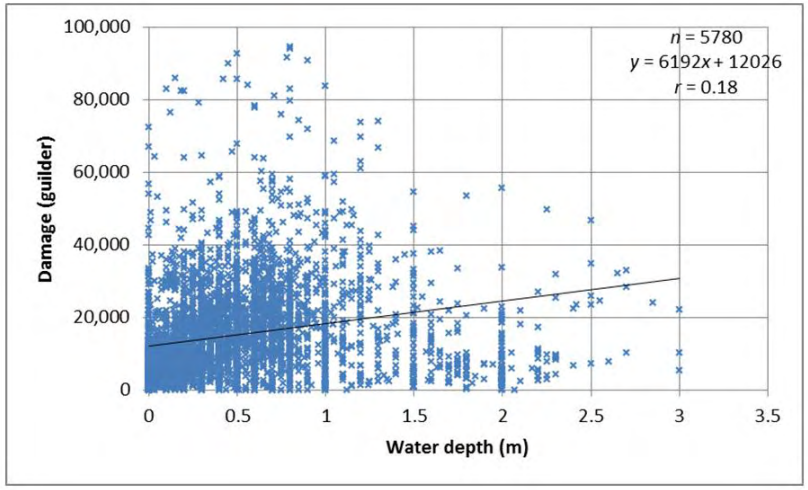
Traditioneel

- Schatting relatie waterdiepte en schade
- Gebaseerd op ervaring experts
- Alleen water diepte meegenomen

Structure Items	Percent of Total	New Item Value ($)	Repair or Replace Cost ($)	Flood Level (feet) Relative to First Floor: -1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
Repair or Replacement Damage Value ($)																							
Heat and Cool Units/Ducts	4.4%	4,100	4,564	857	1,571	1,571	1,628	1,864	1,864	2,421	2,914	3,200	3,200	3,200	3,200	3,200	4,243	4,564	4,564	4,564	4,564	4,564	4,564
Floor Insulation	1.6%	1,460	1,511	617	810	1,511	1,511	1,511	1,511	1,511	1,511	1,511	1,511	1,511	1,511	1,511	1,511	1,511	1,511	1,511	1,511	1,511	1,511
Wood Subfloor	3.1%	2,913	3,141	0	0	2,470	3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141
Bottom Cabinets	1.9%	1,749	1,835	0	0	413	1,266	1,835	1,835	1,835	1,835	1,835	1,835	1,835	1,835	1,835	1,835	1,835	1,835	1,835	1,835	1,835	1,835
Plumbing Fixtures	3.6%	3,314	2,157	0	0	129	429	814	1,200	1,286	1,471	2,071	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157
Tile	0.8%	731	774	0	0	400	774	774	774	774	774	774	774	774	774	774	774	774	774	774	774	774	774
Paint/Wallpaper (Interior)	4.4%	4,093	4,093	0	0	643	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093
Doors/Trim	3.5%	3,286	3,414	0	0	514	3,129	3,129	3,129	3,129	3,129	3,414	3,414	3,414	3,414	3,414	3,414	3,414	3,414	3,414	3,414	3,414	3,414
Sheetrock/(Walls)	5.0%	4,614	4,917	0	0	321	2,498	2,641	2,641	2,801	2,801	4,917	4,917	4,917	4,917	4,917	4,917	4,917	4,917	4,917	4,917	4,917	4,917
Wall Insulation	1.6%	1,657	1,726	0	0	129	796	868	868	921	921	1,726	1,726	1,726	1,726	1,726	1,726	1,726	1,726	1,726	1,726	1,726	1,726
Base Molding	1.1%	1,027	1,091	0	0	349	1,091	1,091	1,091	1,091	1,091	1,091	1,091	1,091	1,091	1,091	1,091	1,091	1,091	1,091	1,091	1,091	1,091
Built-in Appliances	1.5%	1,389	1,467	0	0	293	453	1,149	1,363	1,363	1,467	1,467	1,467	1,467	1,467	1,467	1,467	1,467	1,467	1,467	1,467	1,467	1,467
Electrical and Lighting/Panel	5.6%	5,143	5,307	0	0	71	543	543	1,709	1,709	2,021	2,979	3,393	4,293	4,600	5,071	5,307	5,307	5,307	5,307	5,307	5,307	5,307
Counter Tops	0.9%	814	864	0	0	107	214	214	214	214	864	864	864	864	864	864	864	864	864	864	864	864	864
Wall Cabinets	1.3%	1,181	1,256	0	0	161	321	321	321	321	482	482	1,256	1,256	1,256	1,256	1,256	1,256	1,256	1,256	1,256	1,256	1,256
Windows/Trim	4.1%	3,821	3,229	0	0	0	0	0	161	718	1,484	1,400	3,229	3,229	3,229	3,229	3,229	3,229	3,229	3,229	3,229	3,229	3,229
Ceiling Insulation/Trim	3.1%	2,914	3,029	0	0	0	143	143	143	143	143	286	286	286	286	3,029	3,029	3,029	3,029	3,029	3,029	3,029	3,029
Roof	2.1%	1,928	1,774	0	0	0	0	0	0	0	0	0	0	0	0	492	1,253	1,324	1,513	1,513	1,703	1,703	1,774
Exterior Wall/Siding	12.6%	11,650	8,293	0	0	0	1,100	3,918	4,098	4,773	4,879	5,126	6,809	7,197	7,303	7,409	7,514	7,783	7,888	7,993	8,081	8,187	8,293
Piers/Foundation	5.5%	5,069	810	107	107	375	810	810	810	810	810	810	810	810	810	810	810	810	810	810	810	810	810
Structural Frame	17.6%	16,321	2,729	0	0	0	1,229	2,729	2,729	2,729	2,729	2,729	2,729	2,729	2,729	2,729	2,729	2,729	2,729	2,729	2,729	2,729	2,729
Wood Floor	14.5%	13,479	13,861	0	0	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861
Total Value	100.0%	92,654	71,543	1,581	2,488	23,230	39,038	49,452	47,547	49,639	52,344	57,768	62,560	63,652	64,285	66,977	70,222	70,883	71,159	71,363	71,559	71,665	71,843
Associated Repair and Clean-up Costs																							
Permits			716	16	25	133	343	448	471	492	517	564	610	634	638	668	698	706	709	710	713	714	716
Dehumidifiers			2,500	0	0	0	0	1,000	1,000	1,000	1,000	1,500	1,500	1,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Emergency Service			4,500	0	0	2,250	2,250	2,250	2,250	2,250	2,250	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Industrial Hygienist			500	0	0	0	0	0	0	0	500	500	500	500	500	500	500	500	500	500	500	500	500
Sanitize/Mold Remediation			3,000	0	0	0	0	1,000	1,000	1,000	1,000	2,000	2,000	2,000	2,000	2,000	2,000	3,000	3,000	3,000	3,000	3,000	3,000
Total Damages			83,059	1,597	2,513	25,616	43,631	56,150	52,266	54,380	59,111	66,852	71,670	73,986	74,403	78,245	81,420	82,089	82,367	82,474	82,772	82,879	83,059
Damage/New Value			89.6	1.7	2.7	27.6	47.1	54.1	56.4	58.7	63.8	72.2	77.4	79.9	80.3	84.4	87.9	88.6	88.9	89.0	89.3	89.4	89.6
			Minimum	0.0	0.9	3.5	16.0	45.1	47.8	48.4	53.3	61.8	64.3	66.7	69.2	72.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2
			Most Likely	1.7	2.7	27.6	47.1	54.1	56.4	58.7	63.8	72.2	77.4	79.9	80.3	84.4	87.9	88.6	88.9	89.0	89.3	89.4	89.6
			Maximum	3.6	4.6	41.9	50.4	64.5	65.2	66.3	73.2	78.0	82.5	85.2	86.2	102.3	107.9	107.9	108.2	108.2	109.2	109.2	109.2

Machinaal leren

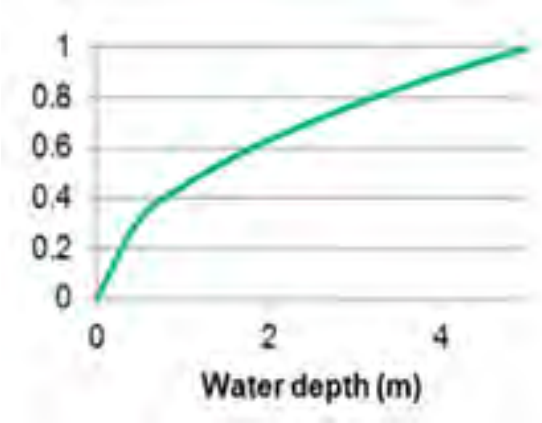
- Relaties uit historische data halen
- Data niet altijd beschikbaar



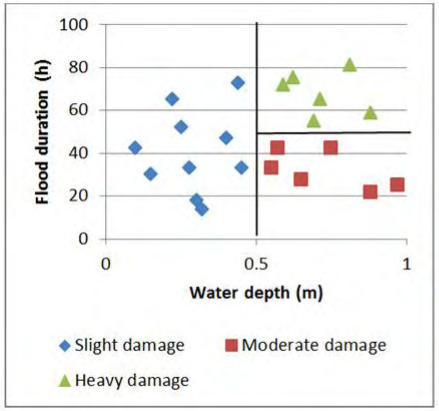
Multi variable schademodel

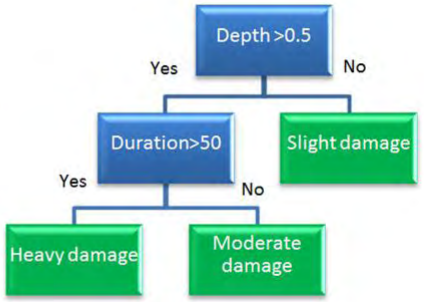
Traditioneel: Schadefractie = f(waterdiepte)
Nieuw: Schadefractie = f(waterdiepte, duur, golven, materialen,…)

DF = f(waterdiepte)



DF = f(waterdiepte, materialen, golfhoogte, …..)





Machinaal leren voor multi-variabele modellen, veel te complex voor experts.

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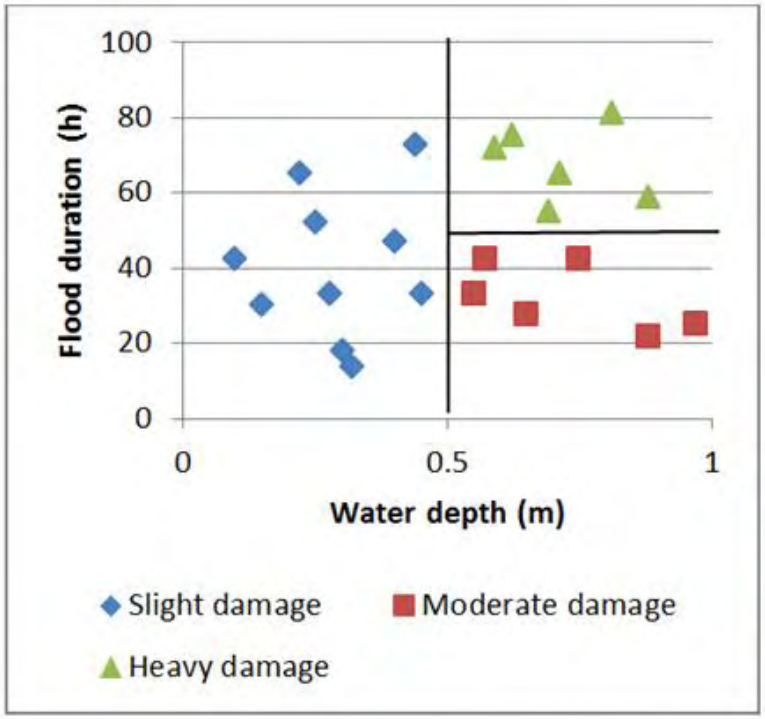
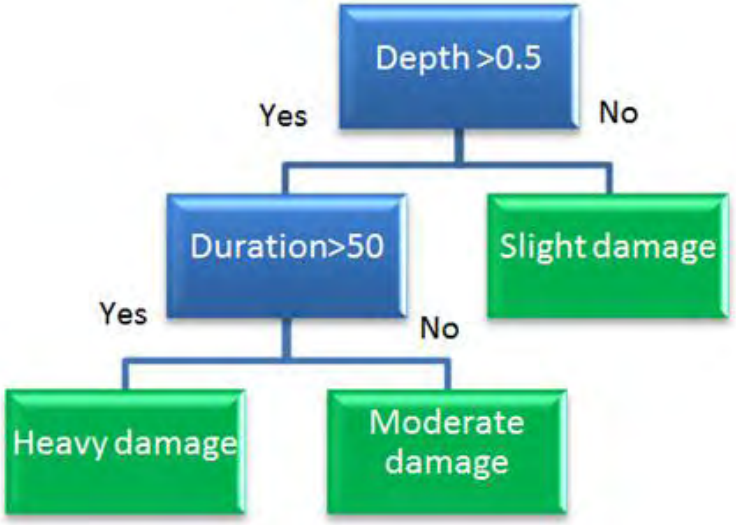
Machinaal leren: hoe het werkt

Voorbeeld: Regressie bomen





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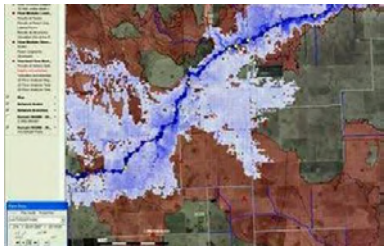
Fysiek modelleren vs kunstmatige intelligentie

Niet alle problemen zijn geschikt voor kunstmatige intelligentie

Gebruik formules gebaseerd van de fysieke processen



Exacte bekende relaties

Complexe processen met veel variabelen

Overweeg kunstmatige intelligentie

Overstromingsschade modelleren ➡ taak kunstmatige intelligentie

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Slimmer of dommer

- Kunstmatige intelligentie zorgt voor
  - .. **slimmere** beslissingen
  - .. **dommere** experts

Slimmer:

- Nauwkeurige dus slimmere beslissingen.
- Nieuwe kennis over relaties variabelen en schade

Dommer (luie expert):

- Expert vertrouwd op computer.

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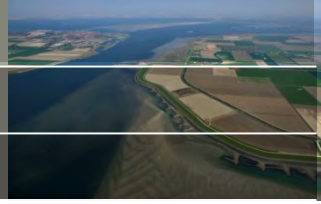
Kunstmatige Intelligentie bij Deltares



Andere kunstmatige intelligentie toepassingen binnen Deltares:

- Water conflicten voorspellen
- Ondergrond dijken vaststellen
- Globaal monitoren van water lichamen
- Landslides voorspellen

Open voor samenwerking!

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