

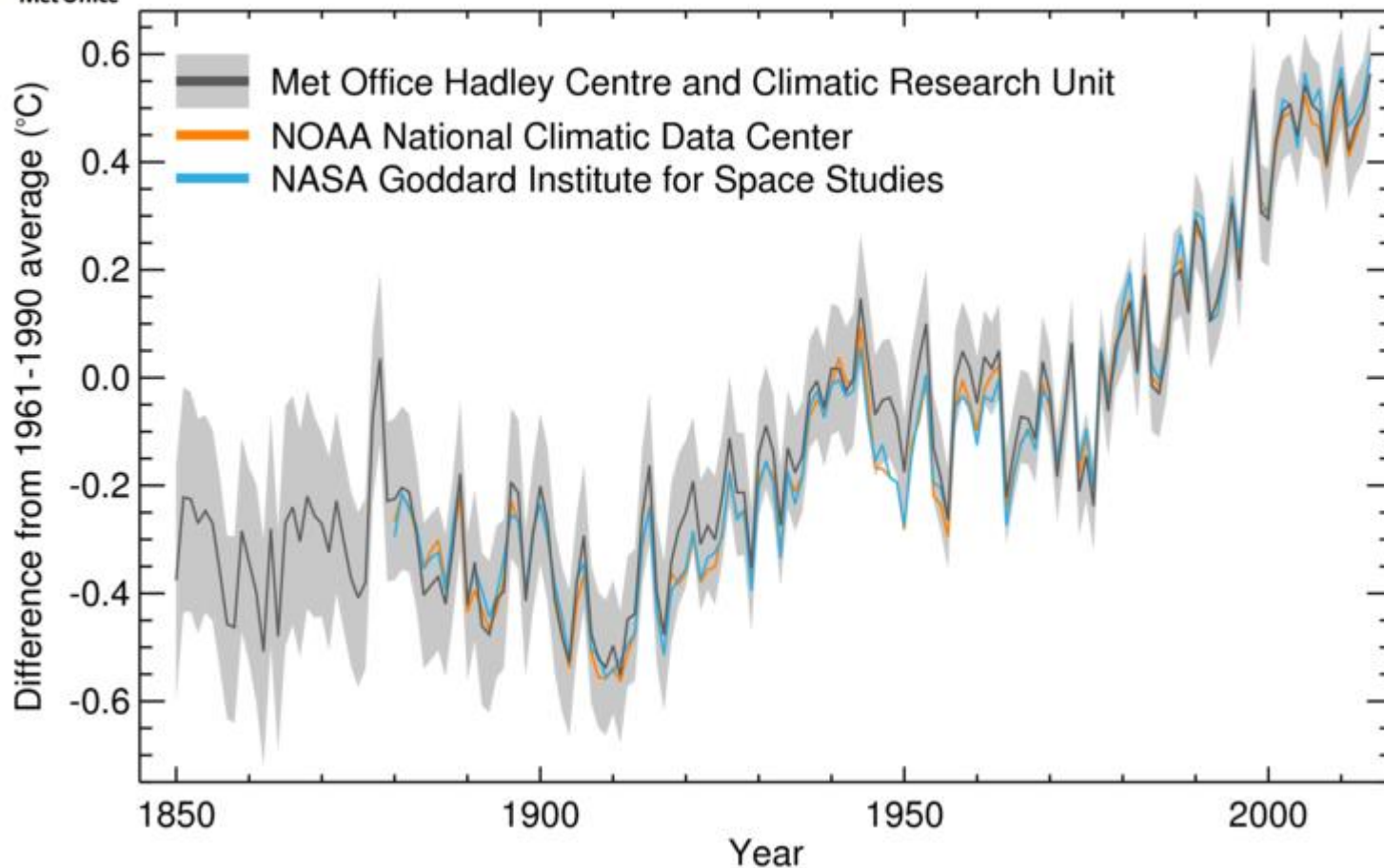
Elin Sjökvist och Gustav Strandberg

Att beräkna framtidens klimat

Temperaturökningen fram till idag



Global average temperature anomaly (1850-2014)



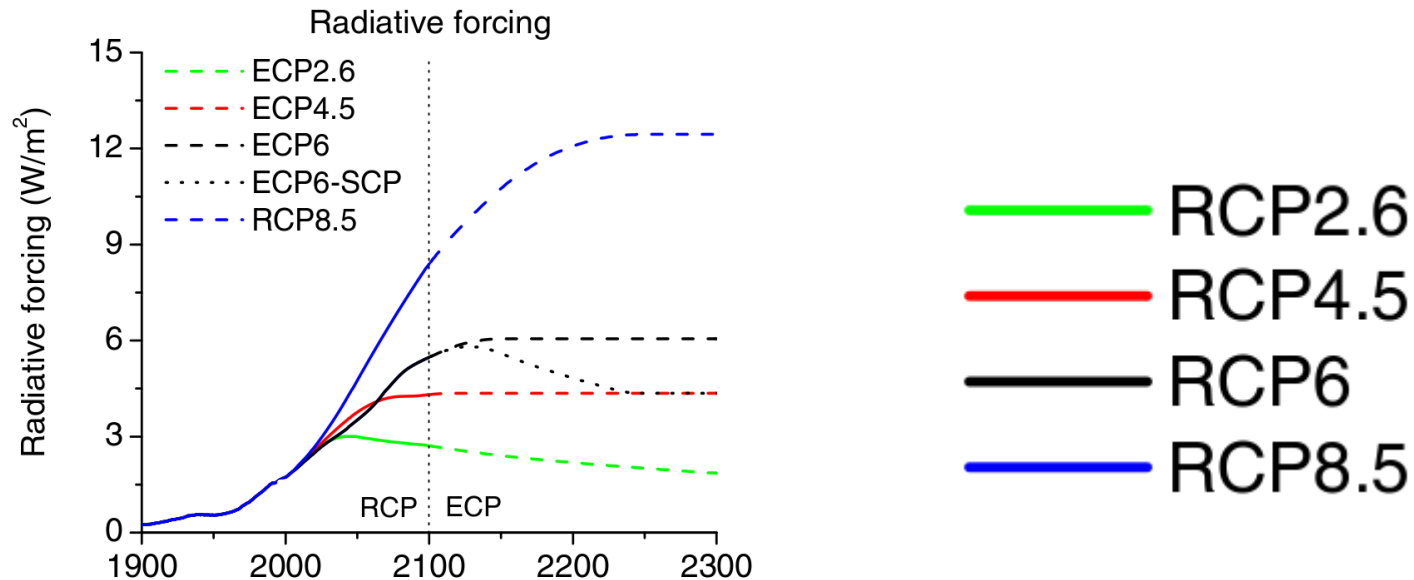
Vad är ett klimatscenario?

Koncentrationsscenario + global klimatmodell + (regional klimatmodell) + tidsperiod = klimatscenario

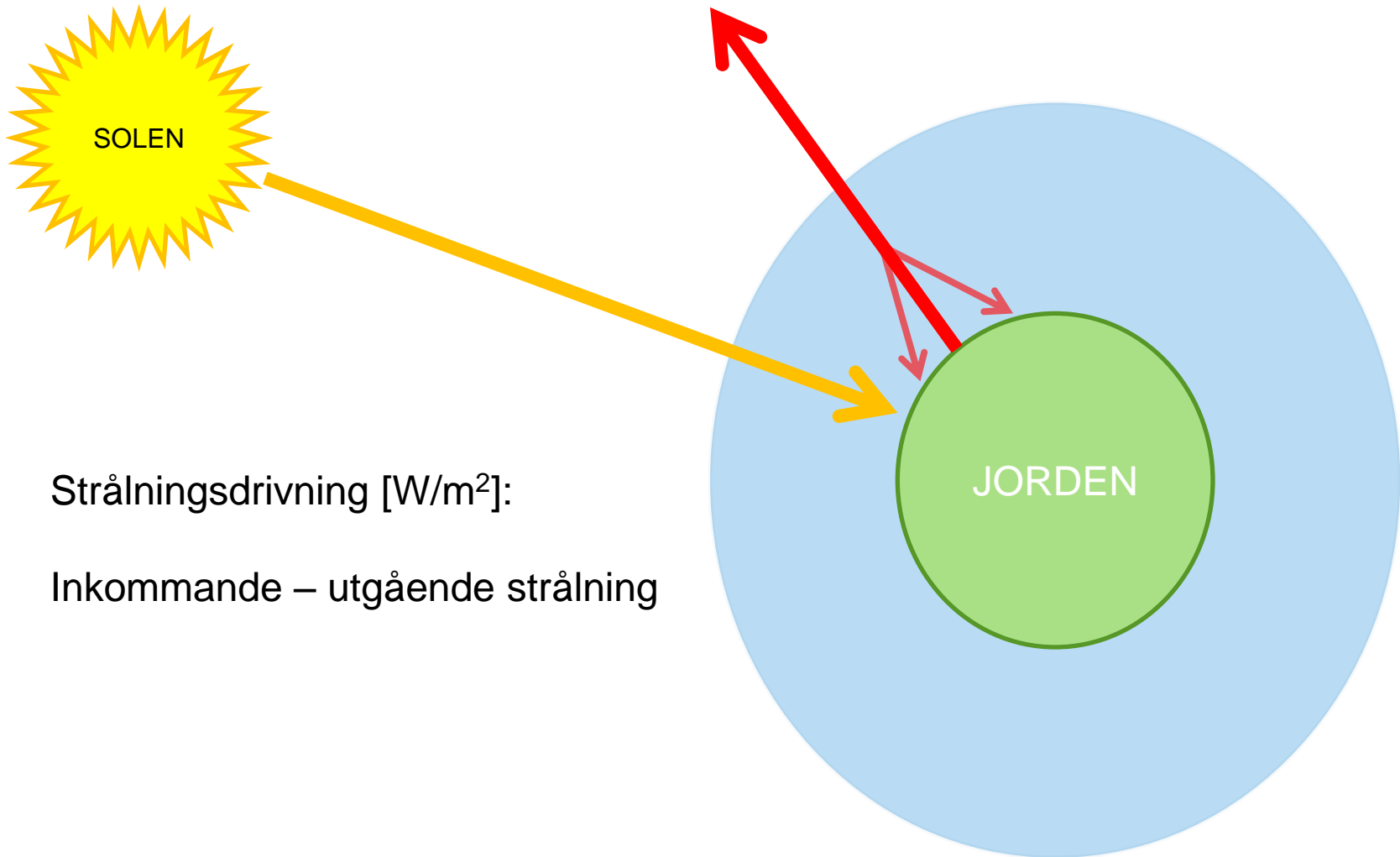
Klimatscenario är en kombination av flera antaganden

Vad är ett strålnings-/koncentrations scenario?

BLI EXPERT
PÅ 10 MINUTER

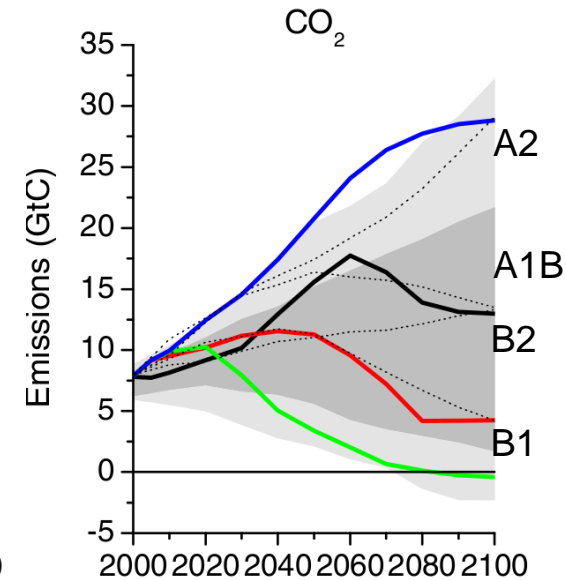
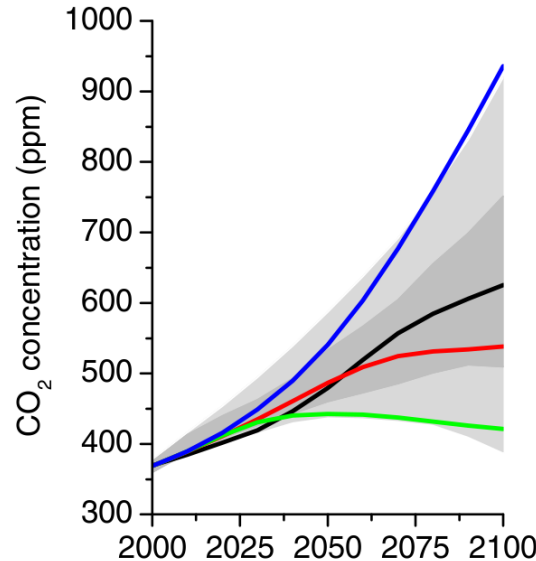
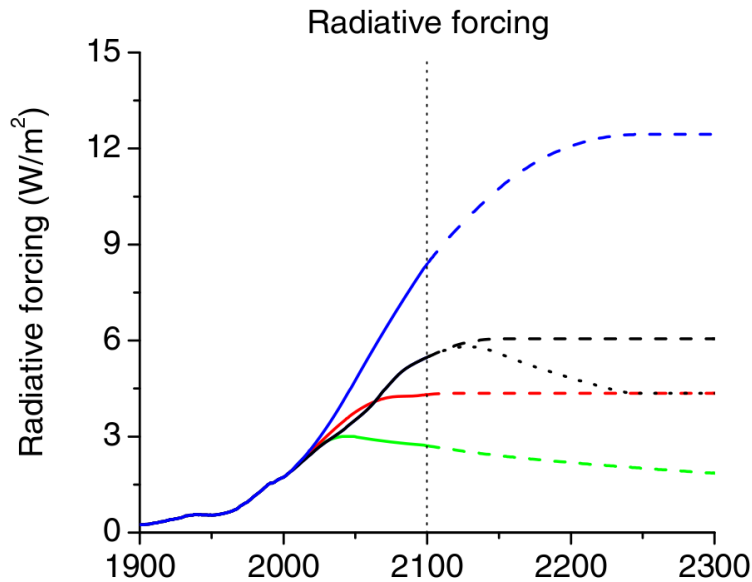


Strålningsdrivning



Vad är ett strålnings-/koncentrations scenario?

BLI EXPERT
PÅ 10 MINUTER

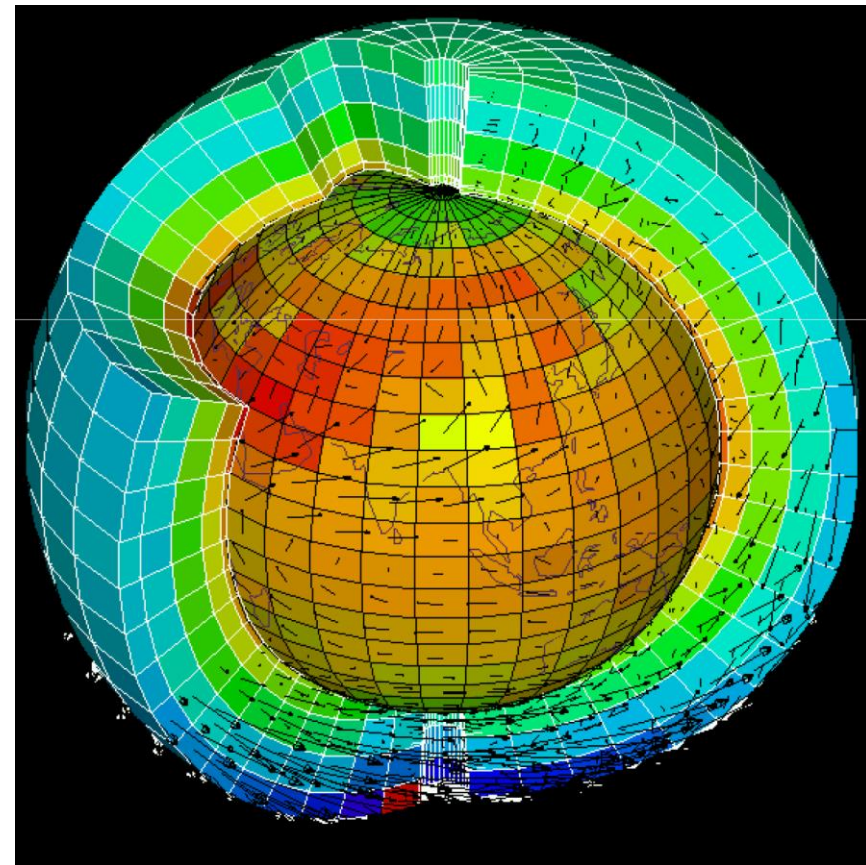
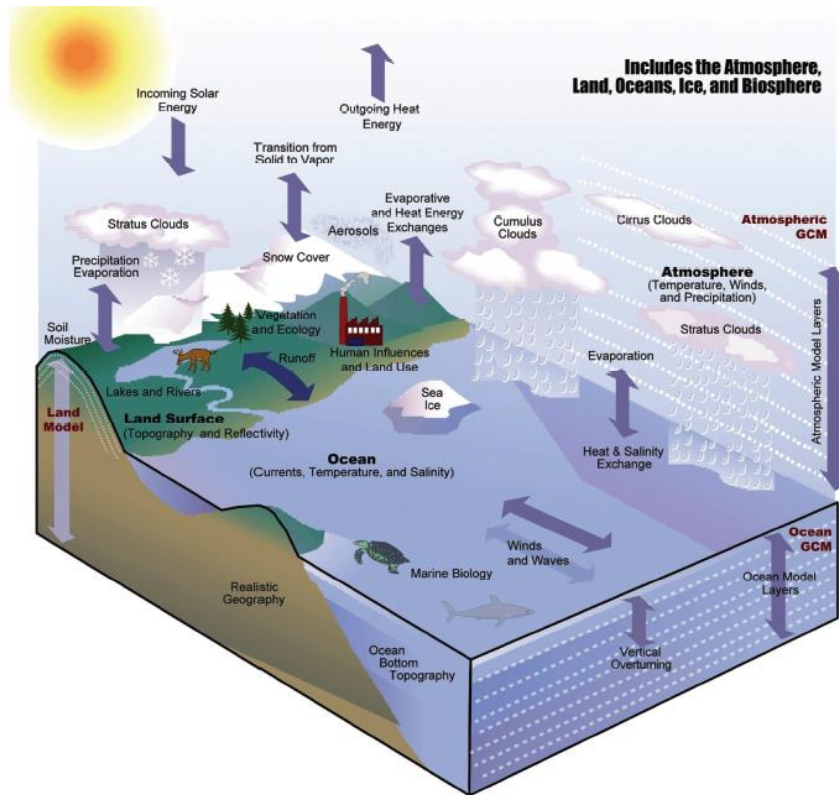


- RCP2.6
- RCP4.5
- RCP6
- RCP8.5

BLI EXPERT
PÅ 10 MINUTER

Hur fungerar en klimatmodell?

Klimatmodellen - en tredimensionell representation av atmosfären kopplad med markytan och havet.



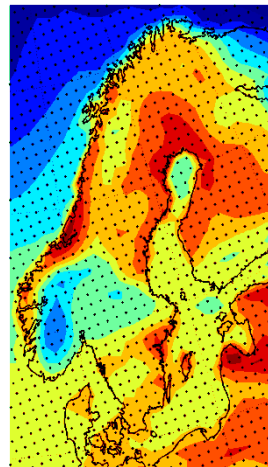
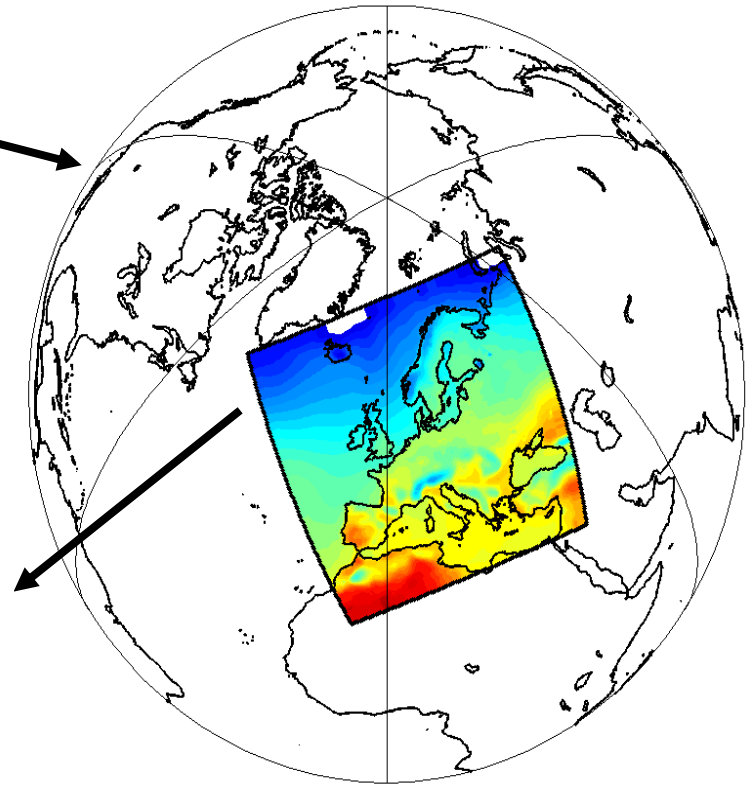
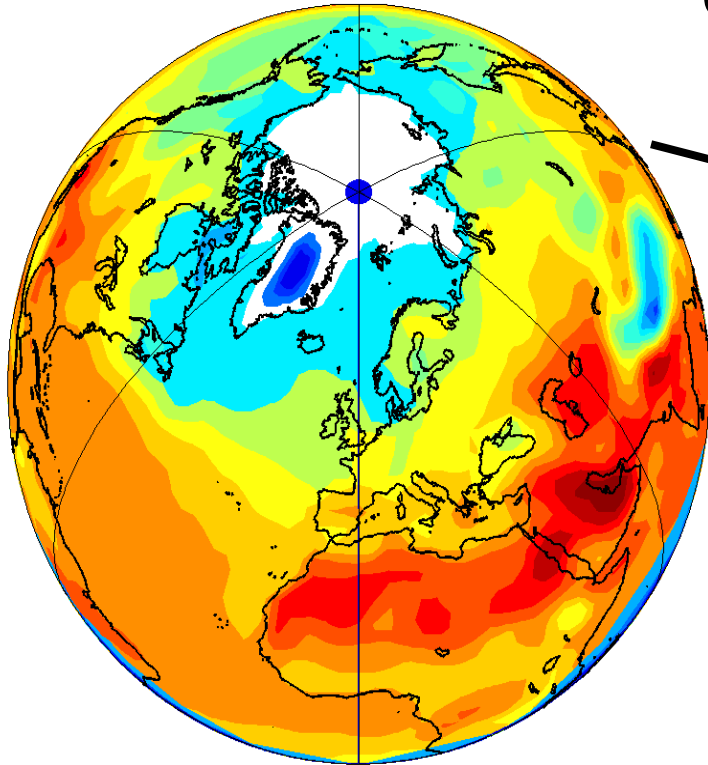
Upplösning i en regional klimatmodell (50x50 km)



Modellkedja

Global modell

Regional modell

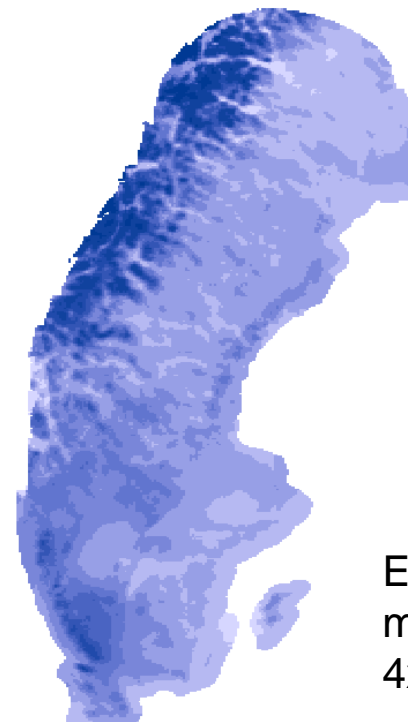
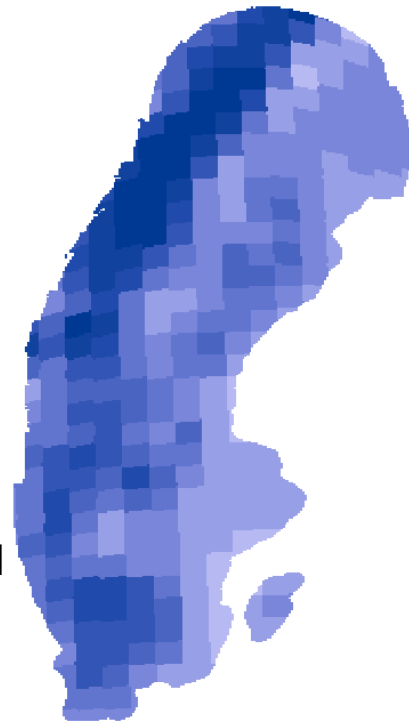


Lokal-regionala
effektstudier

Nedskalning...










- Jämföra en kontrollperiod med observationer (4x4 km)
- Minimera systematiska fel
- Användning i effektstudier, tex hydrologiska modeller

Utdata från
regional klimatmodell
50x50 km
(dygnsnederbörd)



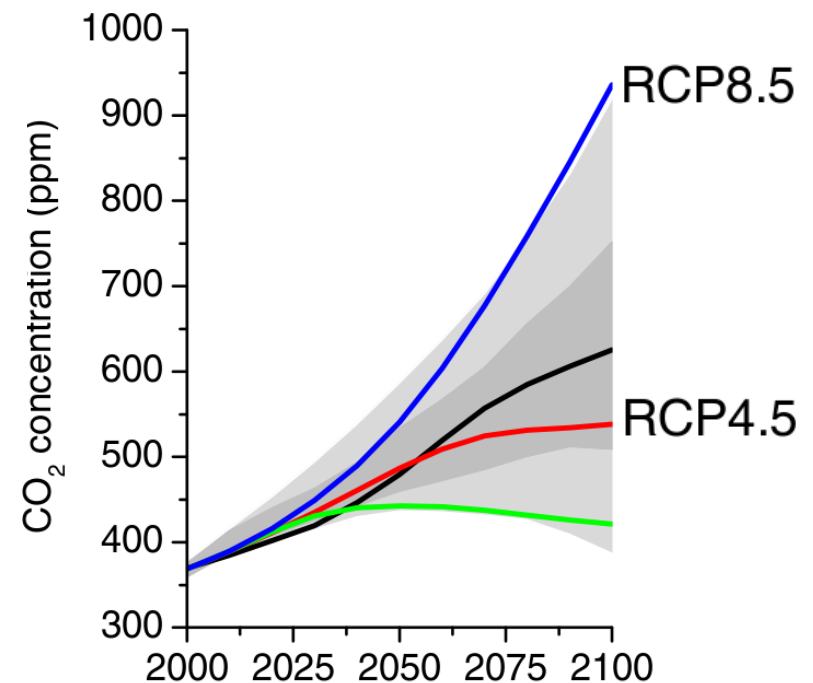
Efter nedskalning
med DBS
4x4 km

Nedskalning...

Global modellering	Global modell	Regional modell
	CCCma-CanESM2	RCA4
	CNRM-CERFACS-CNRM-CM5	RCA4
	ICHEC-EC-EARTH	RCA4
	IPSL-IPSL-CM5A-MR	RCA4
	MIROC-MIROC5	RCA4
	MPI-M-MPI-ESM-LR	RCA4
	NCC-NorESM1-M	RCA4
	NOAA-GFDL-GFDL-ESM2M	RCA4
	MOHC-HadGEM2-ES	RCA4

9 dataset från globala modeller

2 strålningsdrivningsscenarier
= 18 klimatscenarier

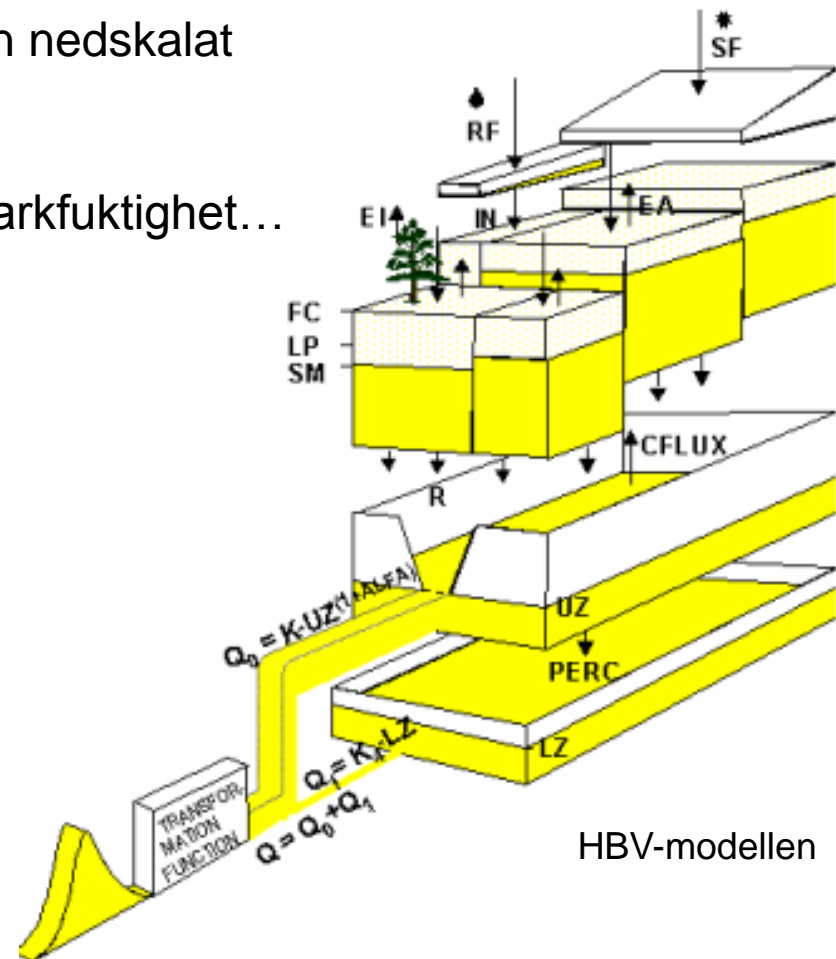


Hydrologisk modellering

Indata: Nederbörd + temperatur från nedskalat klimatscenario (4x4 km)

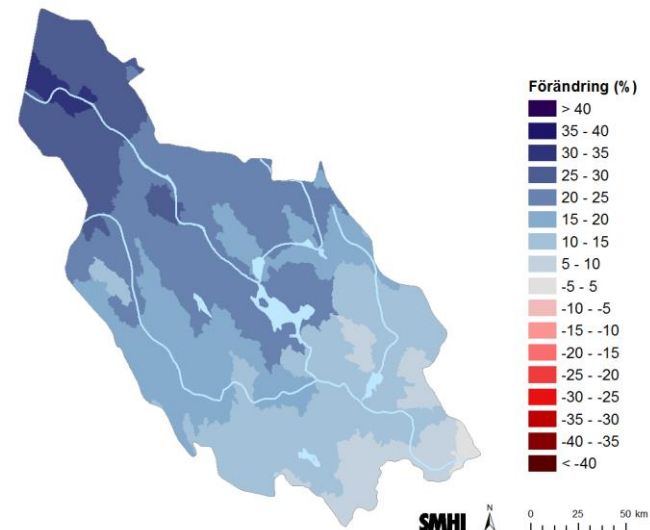
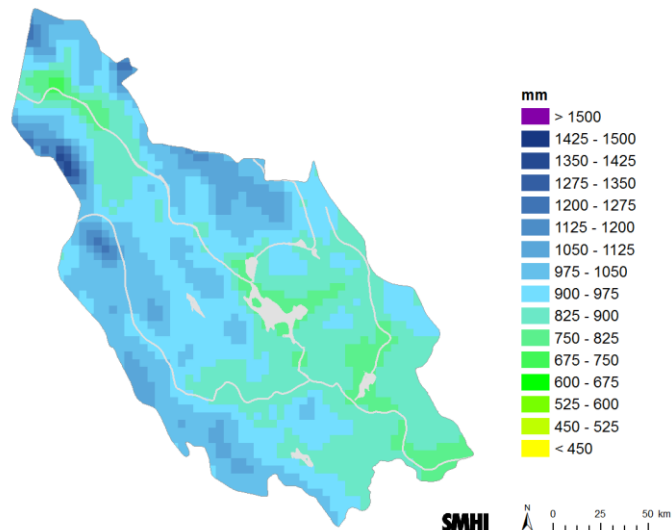
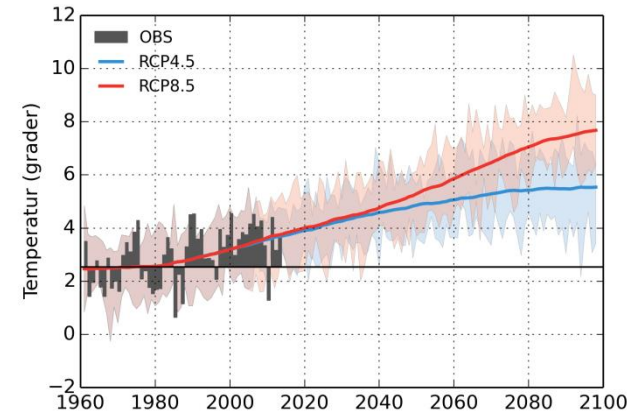
Utdata: Flöden, snö, avdunstning, markfuktighet...

=> Framtida översvämningar?



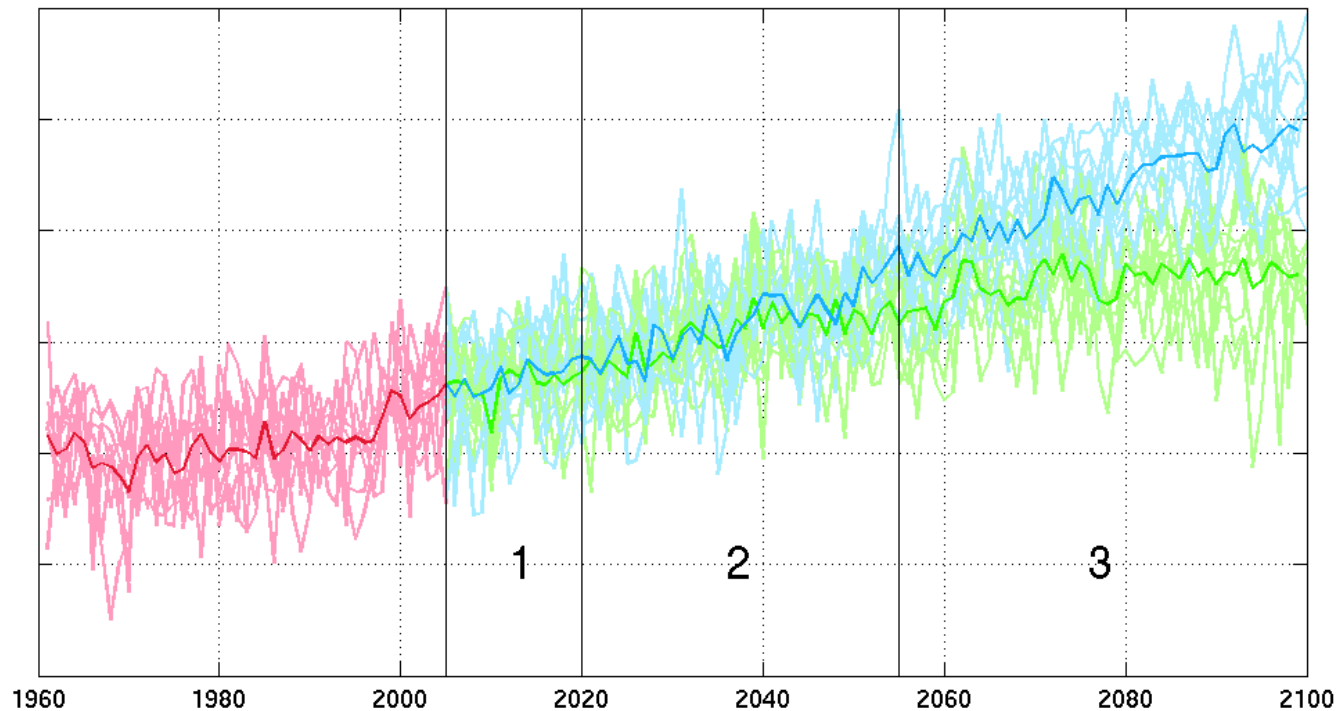
21 länsrapporter

- Tidigare länsanalyser baserades på äldre scenarier, individuella beställningar: olika innehåll
- Nya analyser (RCP-scenarier) publiceras **2 november** på smhi.se

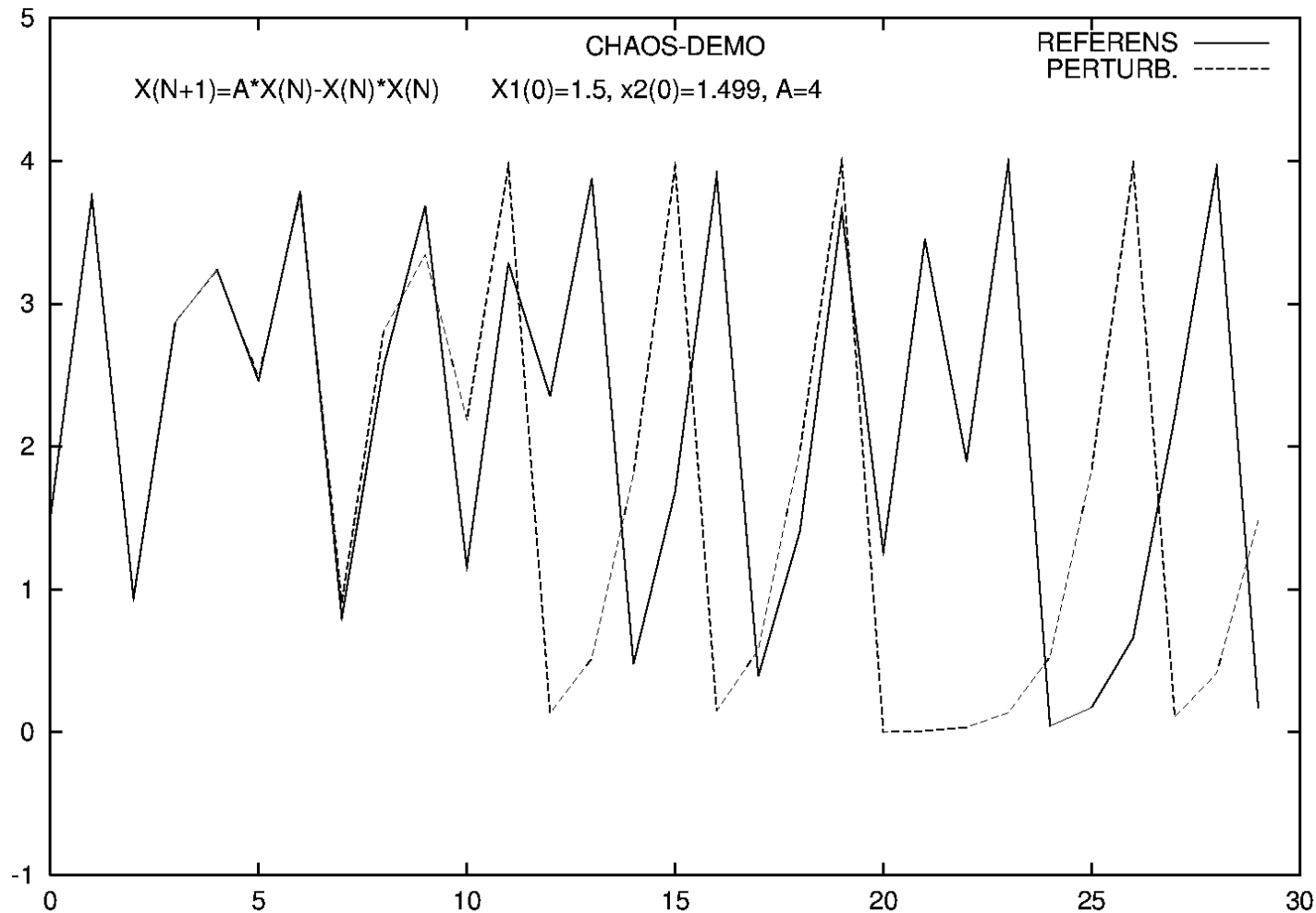


Osäkerheter i scenariot

- Naturlig variabilitet. En klimatmodell kan inte exakt återge klimatet för en specifik tidpunkt.
- Det vi inte kan beskriva. Olika modeller representerar klimatet olika och med olika kvalitet
- Det vi inte vet. Framtida koncentrationer av växthusgaser



Hur kan vi säga något om klimatet om hundra år när prognosen blir fel efter en vecka?



Atmosfären är som en icke-linjär ekvation: $X=A*X - X^2$

Scenarier är inte prognoser

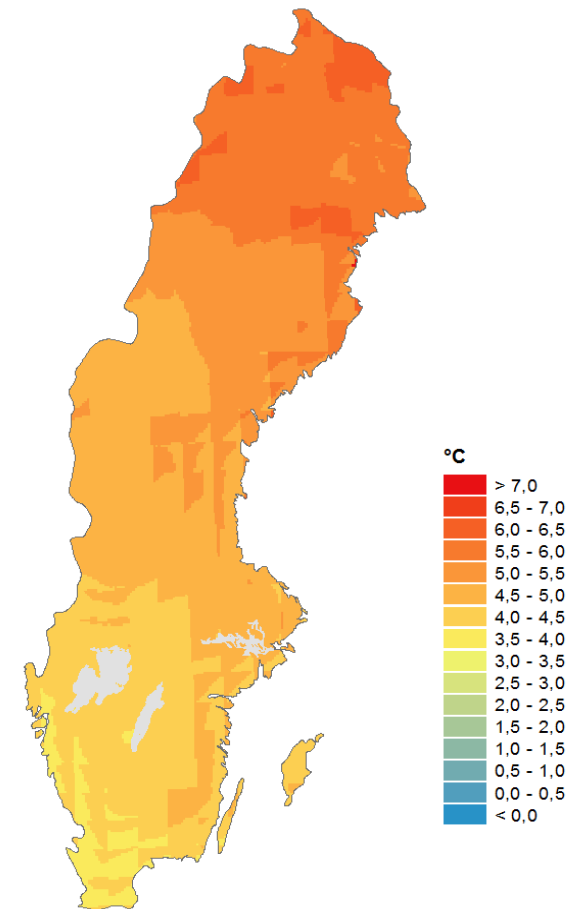
Klimatmodeller kan inte återskapa det faktiska vädret på en särskild plats vid en viss tidpunkt. En klimatmodell av god kvalitet ger ett troligt väderläge med realistiska statistiska egenskaper.

Exempel:

Vi kan inte säga något om huruvida julafton 2089 kommer att vara vit, men vi kan säga något om vintrarna i slutet av seklet.

Osäkerheter i nedskalning

- Nedskalning: anpassa data på högre upplösning
-> förändrar datat
- Diff-värden (förändring mellan två tidsperioder)
kan se konstiga ut.
- DBS ska inte ändra på klimatförändringen.
- Lösning: ta hänsyn till omgivande gridrutor



Förändring i årsmedeltemperatur mot slutet av seklet (RCP8.5), jämfört med 1961-1990

Sammanfattning

- Klimatmodeller kan återskapa klimatet på ett trovärdigt sätt
- Framtidens klimat beror till störst del av framtida utsläpp av växthusgaser
- Det finns osäkerheter, men de går att hantera
- Modellresultat kan inte alltid jämföras direkt med observationer
- För effektstudier (tex hydrologisk modellering) behövs efterbearbetning/nedskalning

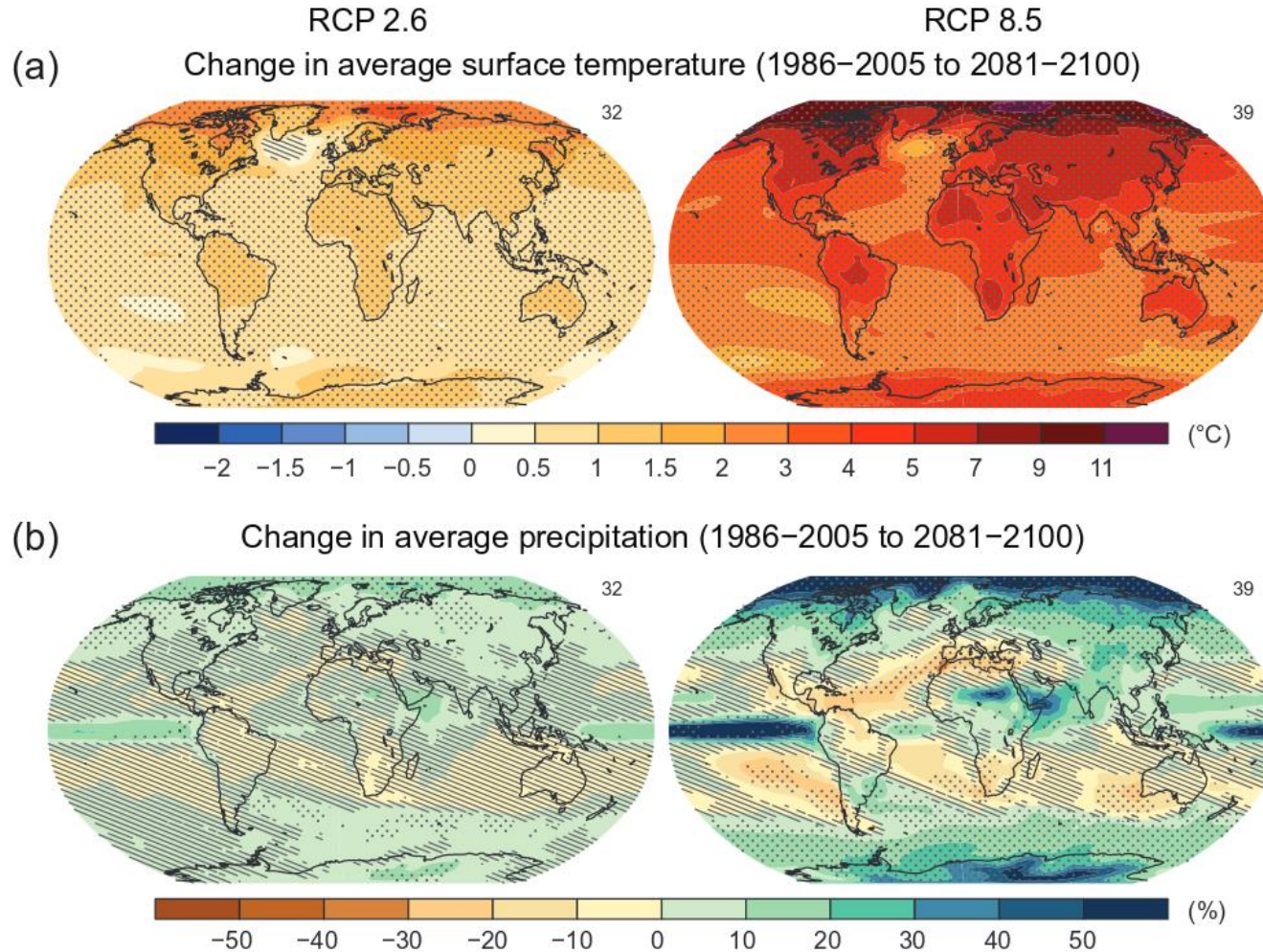
Vill du dra dina egna slutsatser? Titta på:

www.smhi.se/klimatdata/framtidens-klimat/klimatscenarier/

Elin Sjökvist och Gustav Strandberg

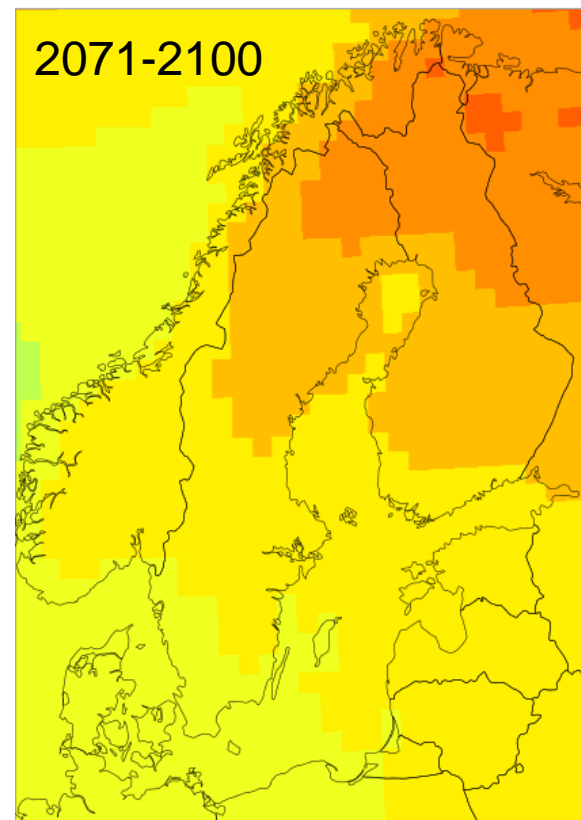
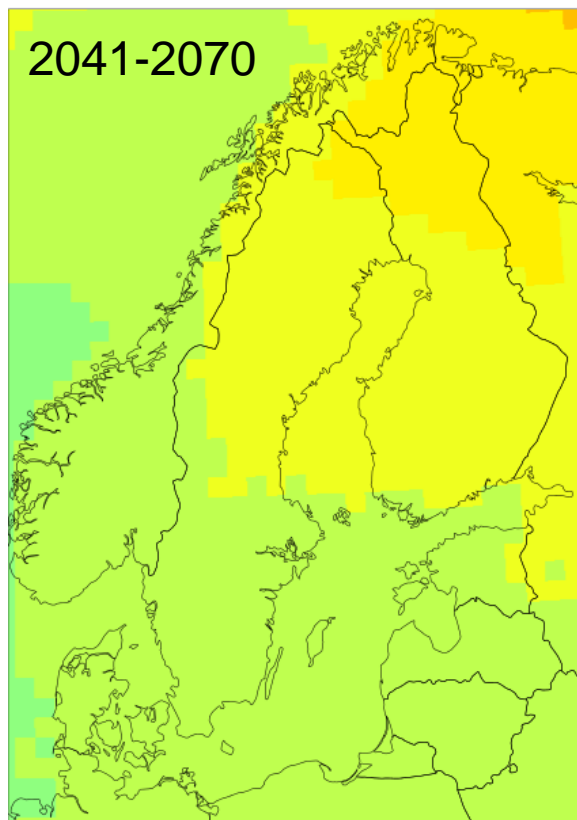
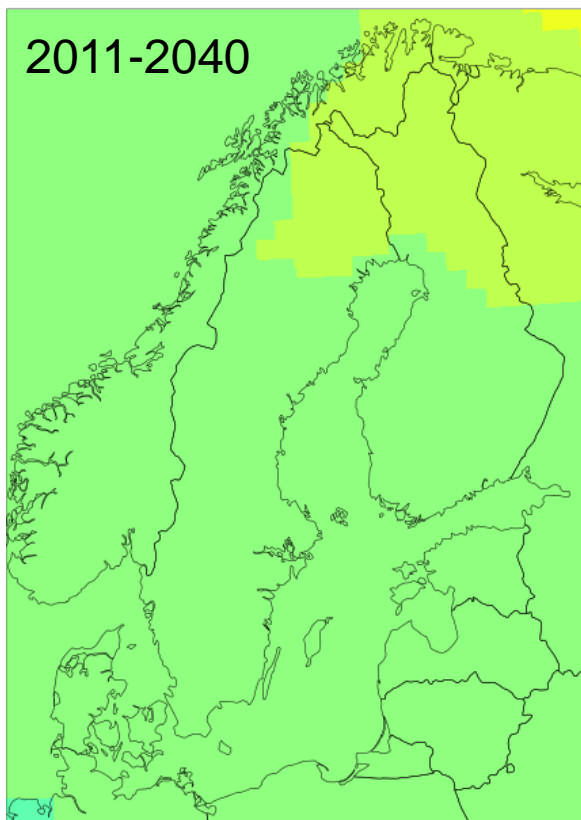
Kunskapsläget om klimatets utveckling i Sverige

Vad säger scenarierna om framtiden?



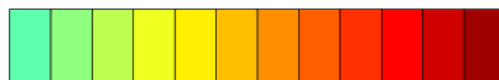
Det blir varmare

Förändring i årsmedeltemperatur (°C) enligt RCP 8,5



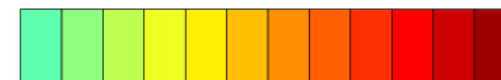
1 2 3 4 5 6 7 8 9 10 11

tas (°C)



1 2 3 4 5 6 7 8 9 10 11

tas (°C)

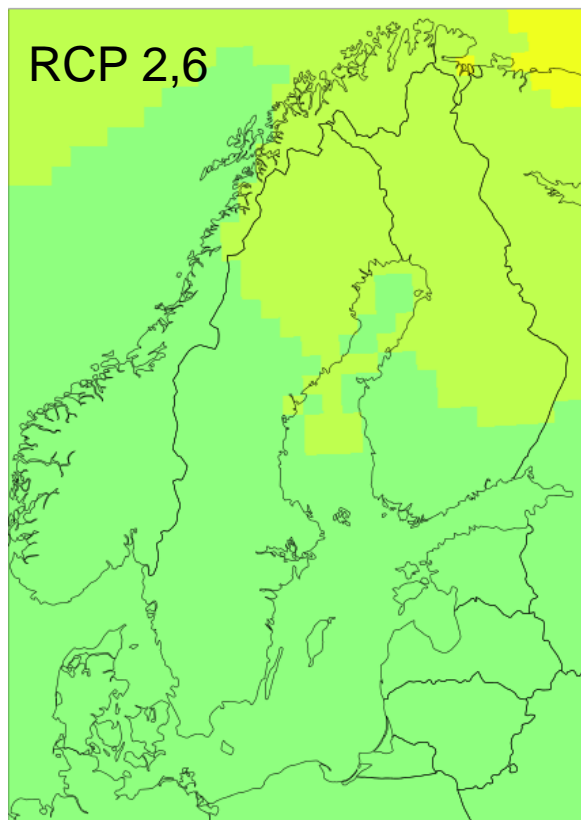


1 2 3 4 5 6 7 8 9 10 11

tas (°C)

Hur mycket varmare beror på scenariot

Förändring i årsmedeltemperatur (°C) vid 2071-2100

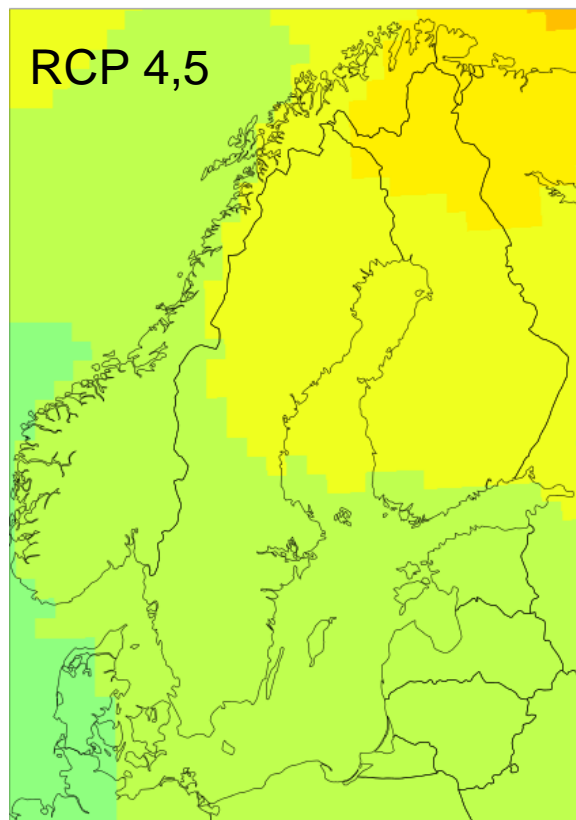


RCP 2,6



1 2 3 4 5 6 7 8 9 10 11

tas (°C)

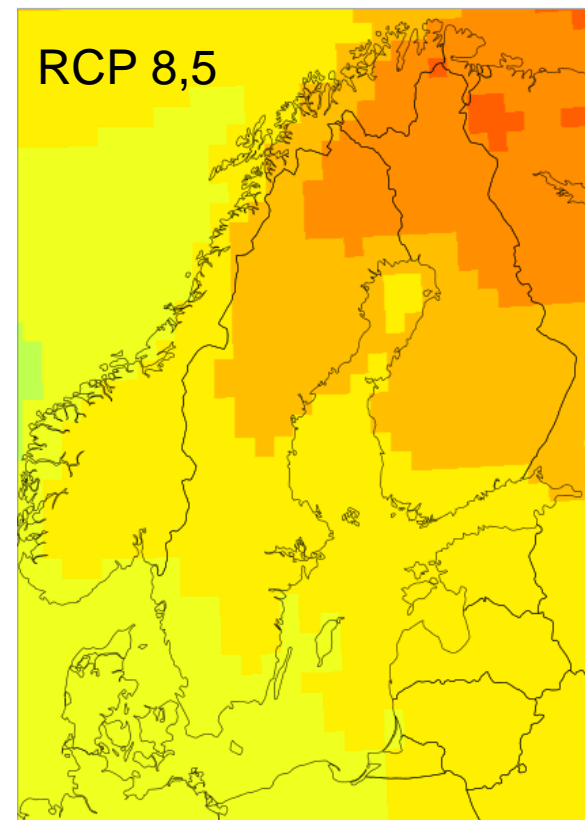


RCP 4,5

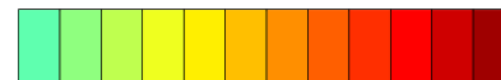


1 2 3 4 5 6 7 8 9 10 11

tas (°C)



RCP 8,5

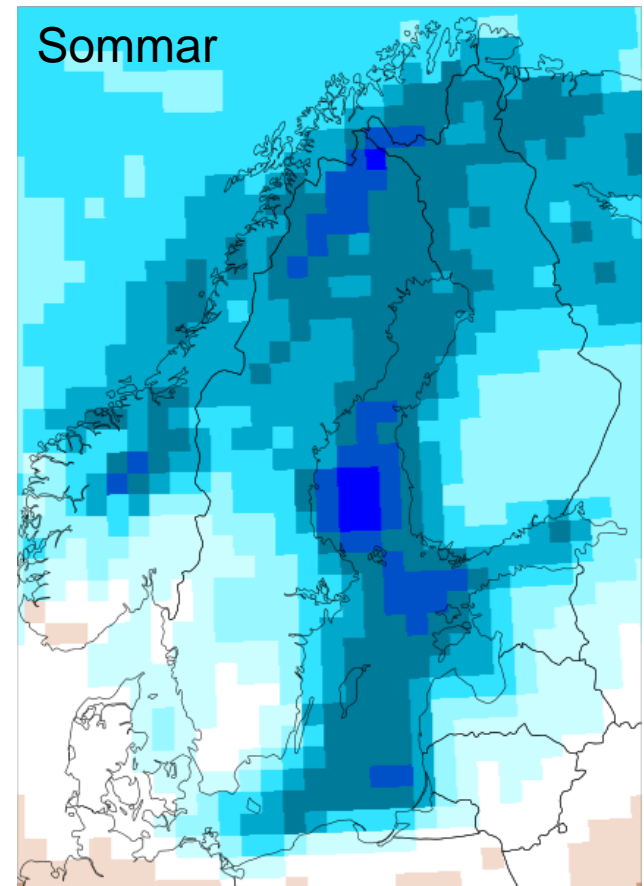
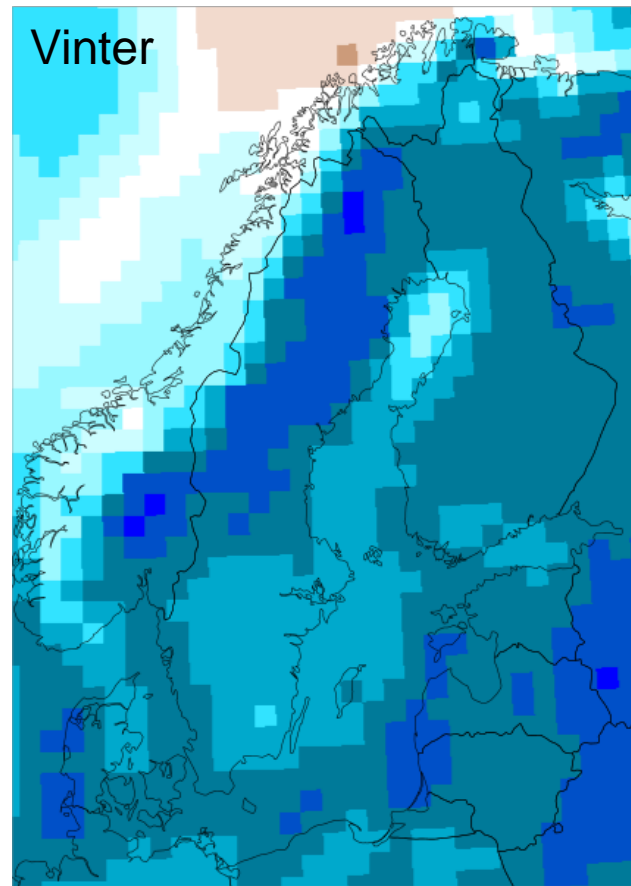


1 2 3 4 5 6 7 8 9 10 11

tas (°C)

Det blir blötare

Nederbörds-
förändring (%) till
2071-2100,
RCP 8,5



-10 -5 0 5 10 15 20 25 30 35 40

pr (%)

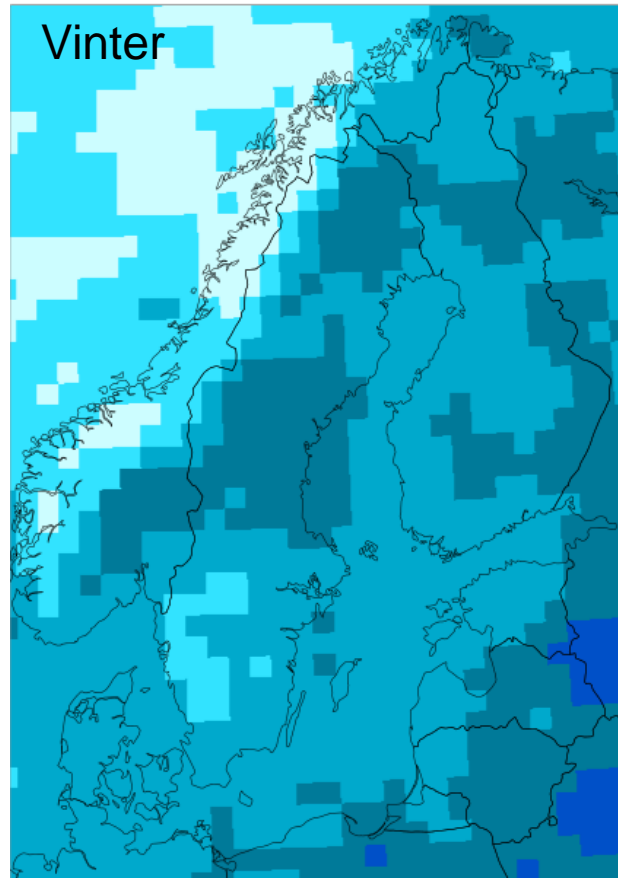


-10 -5 0 5 10 15 20 25 30 35 40

pr (%)

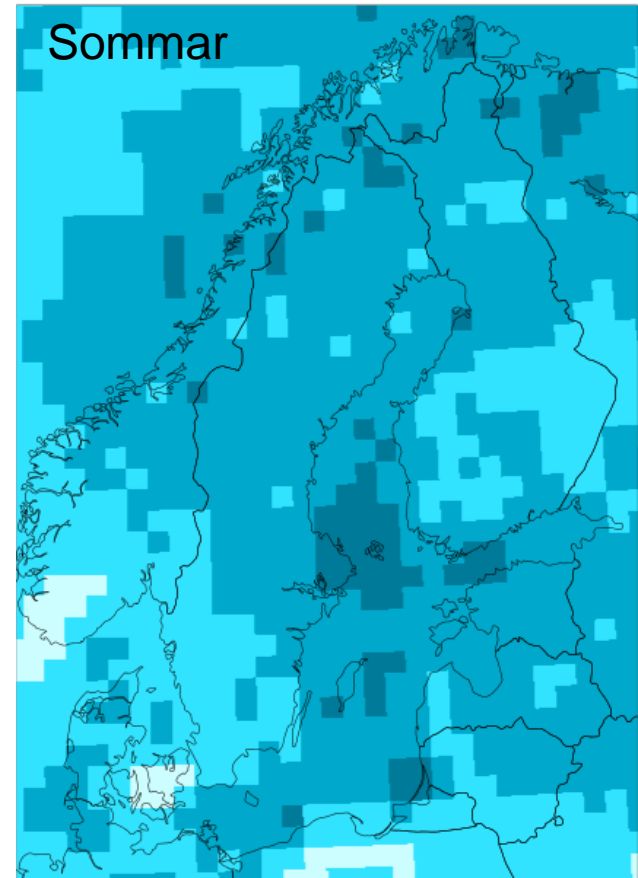
Nederbörden blir kraftigare

Förändring av största dygnsnederbörden(%) till 2071-2100, RCP 8,5



-30 -20 -10 0 10 20 30 40 50 60

Precipmax (%)



-30 -20 -10 0 10 20 30 40 50 60

Precipmax (%)

Förändring i extrem korttidsnederbörd

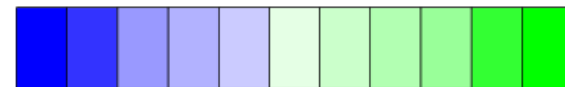
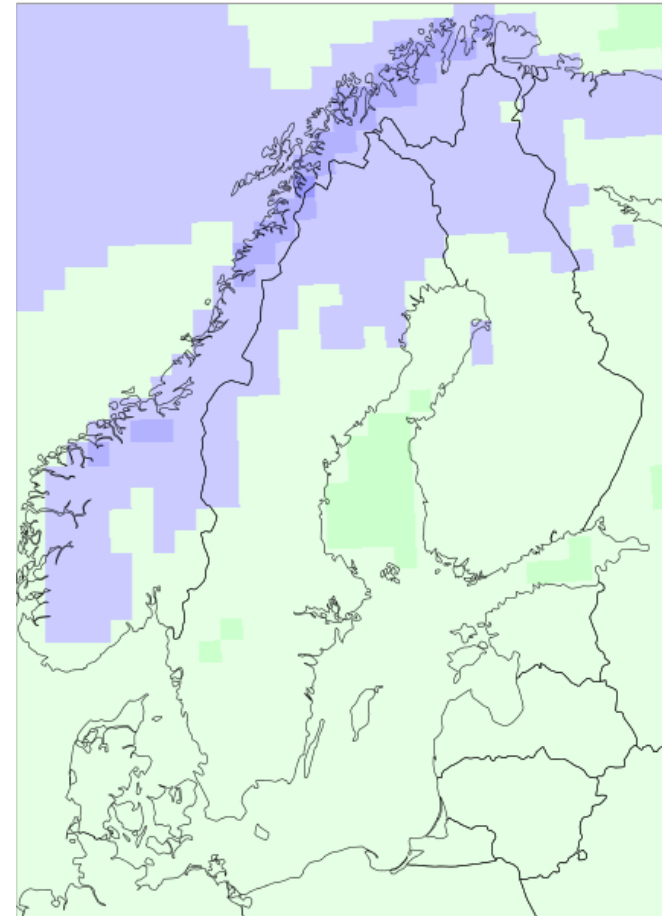
	2021-2050		2069-2098	
Varaktighet	RCP 4,5	RCP 8,5	RCP 4,5	RCP 8,5
20 min	19	23	30	51
1 timme	14	16	20	34
3 timmar	13	13	17	29
12 timmar	12	14	18	29

Procentuell ökning av korttidsnederbörd med 10 års återkomsttid från 1961-1900 till de båda perioderna 2021-2050 och 2069-2098. Beräkningen är gjord för olika varaktigheter på regnet och för scenarierna RCP4.5 och RCP8.5. Medelvärde för hela Sverige.

Det blir inte blåsigare

Förändring av maximal byvind
(m/s) till 2071-2100,
RCP 8,5

Medelvärde 9 modeller, rcp85
2071-2100 - 1971-2000 ANN



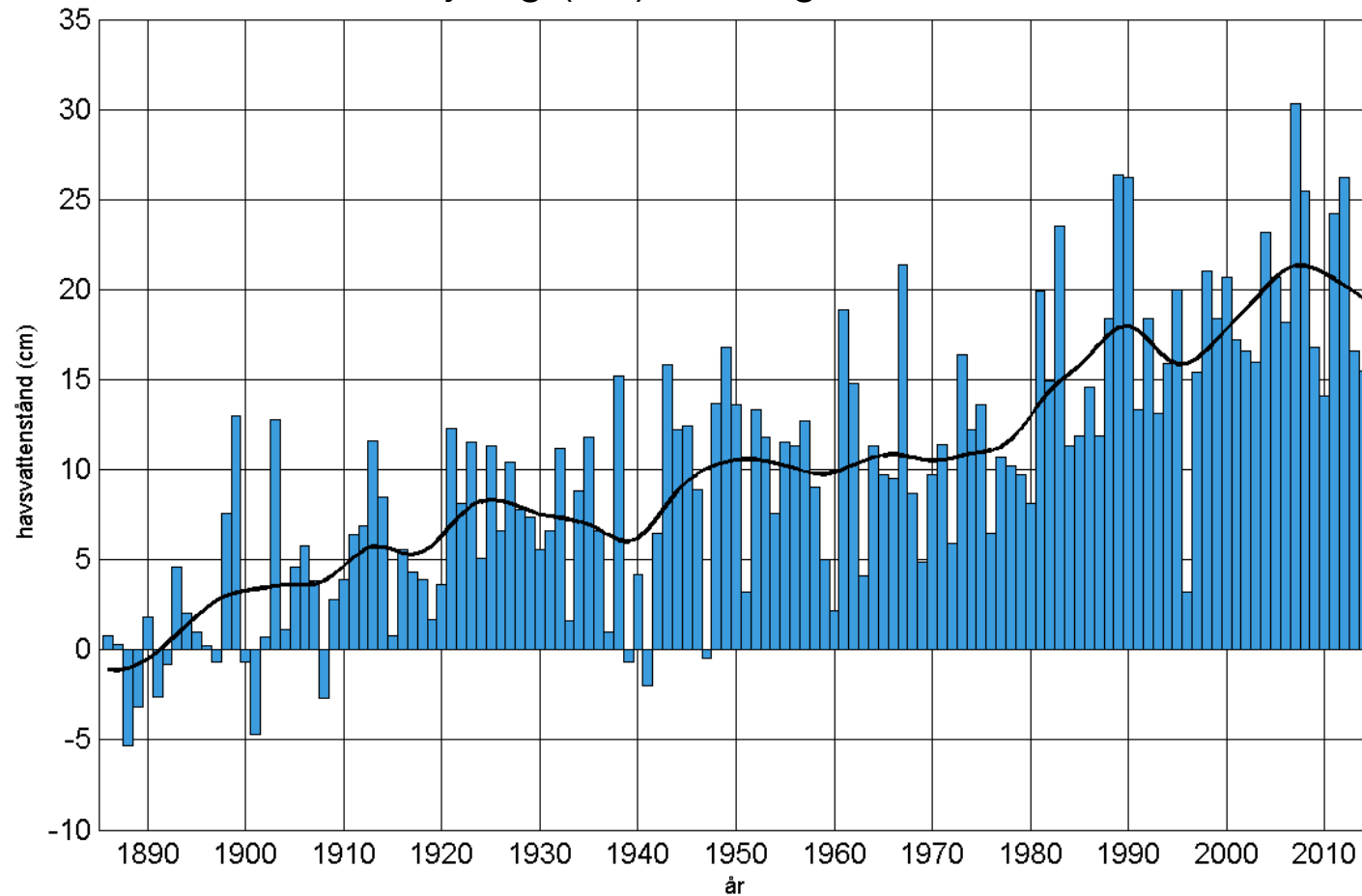
-4 -3 -2 -1 0 1 2 3 4 5

Gustwindmax (m/s)

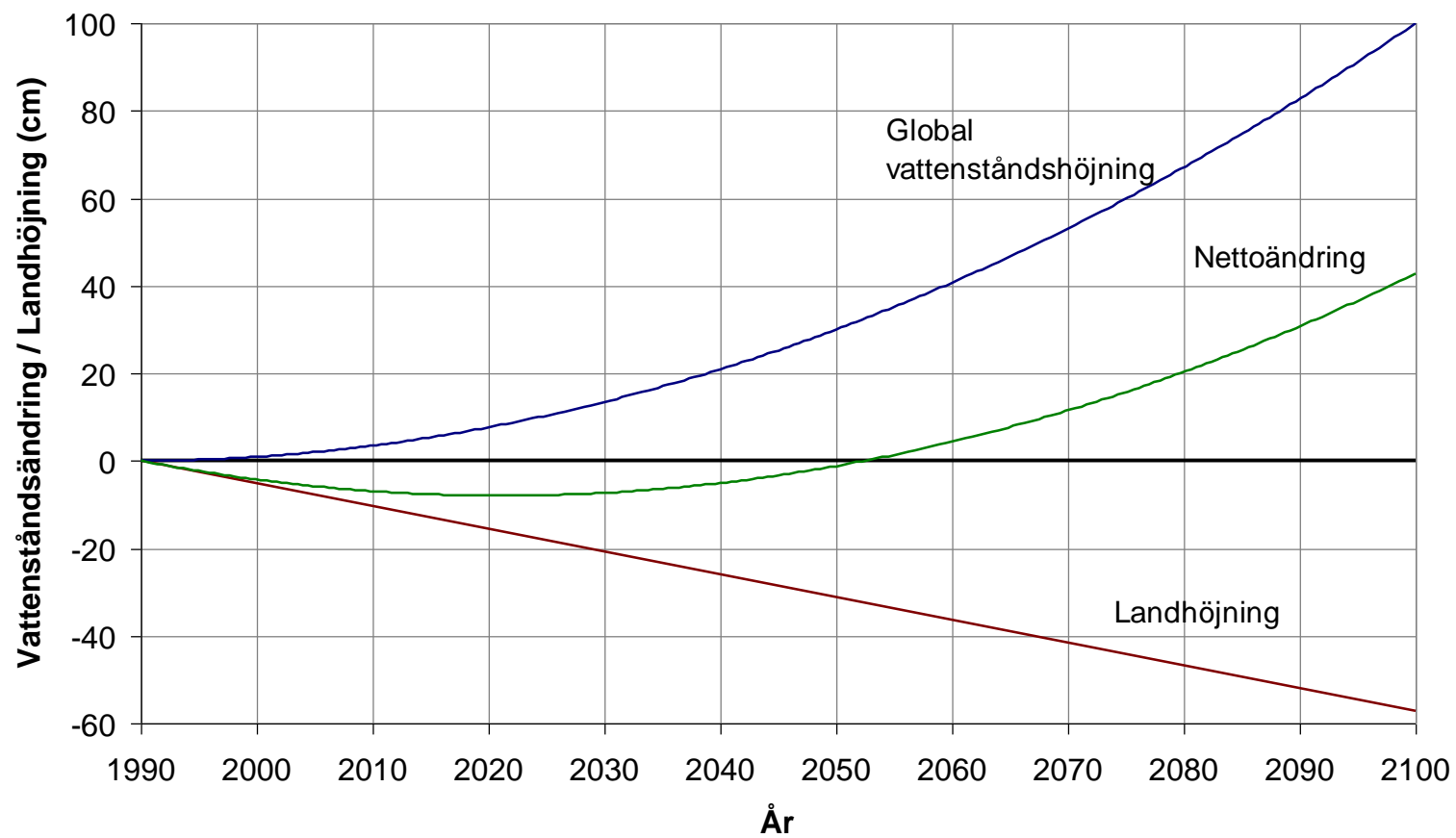
Havsnivån fortsätter att stiga

SMHI

Havsnivåhöjning (cm) i Sverige, 1886-2014



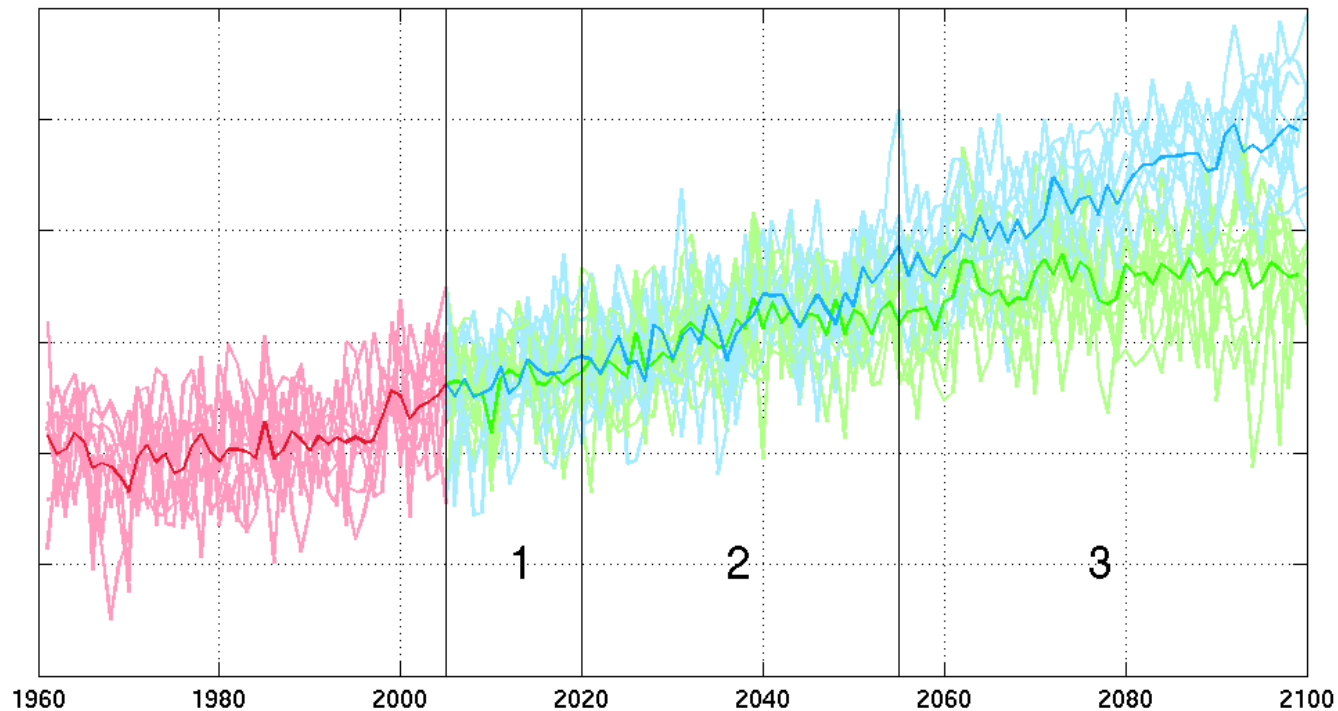
Stockholm



Resultaten är robusta

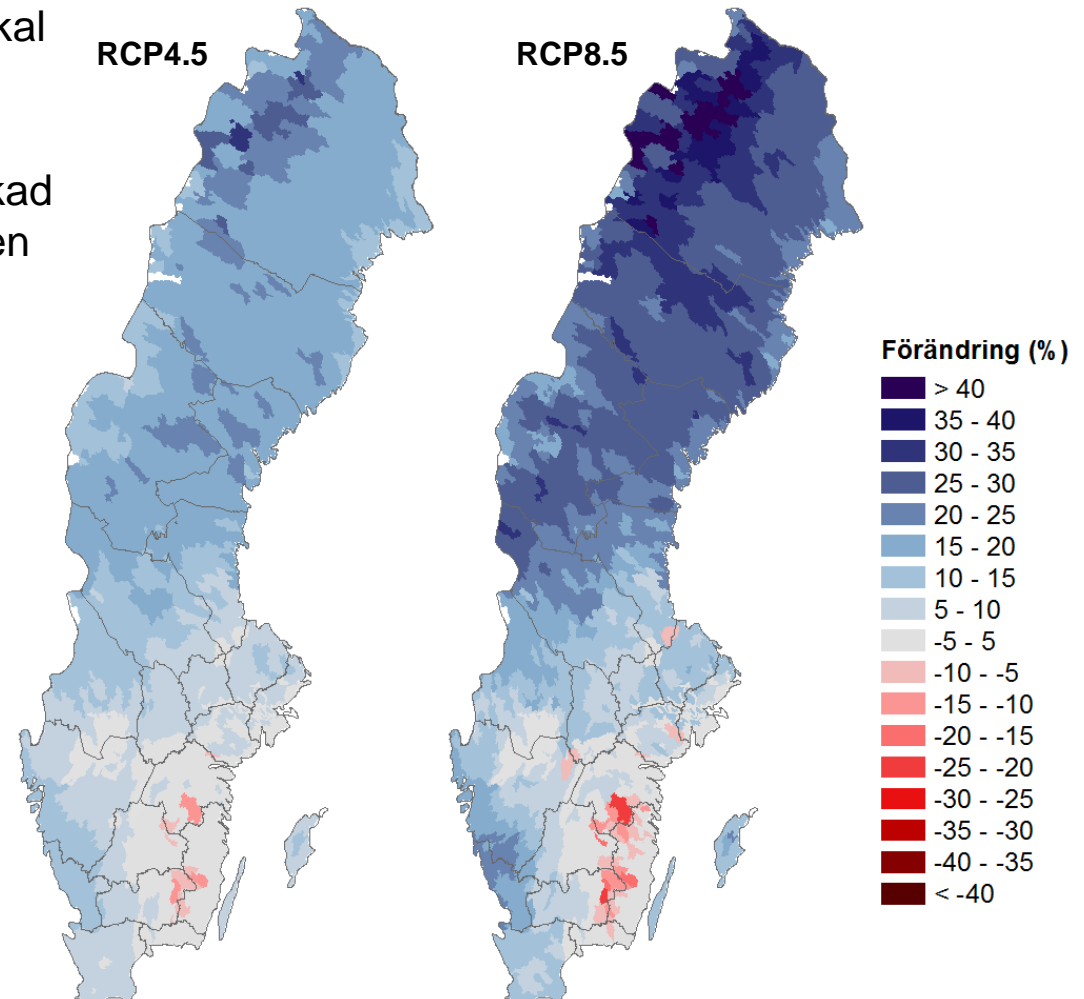
Alla klimatmodeller ger liknande uppskattningar av framtidens klimat även om skillnader finns.

För vissa parametrar är signalen säkrare än för andra



Förändring lokal tillrinning (år)

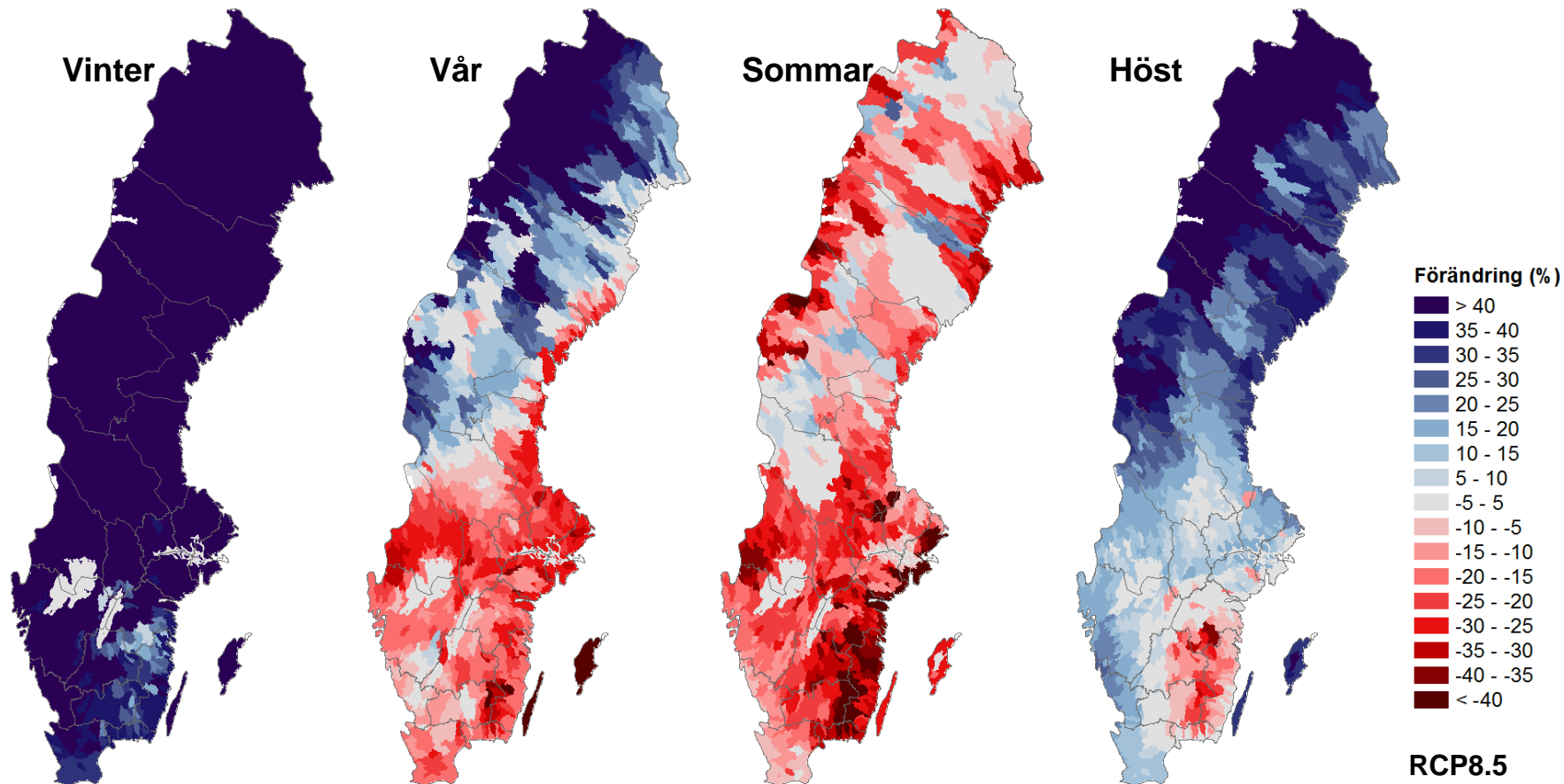
- Ökad nederbörd ger ökad lokal tillrinning i norra och västra Sverige.
- I sydost en tendens till minskad lokal tillrinning (avdunstningen ökar mer än nederbörden)



2069-2098 vs. 1961-1990

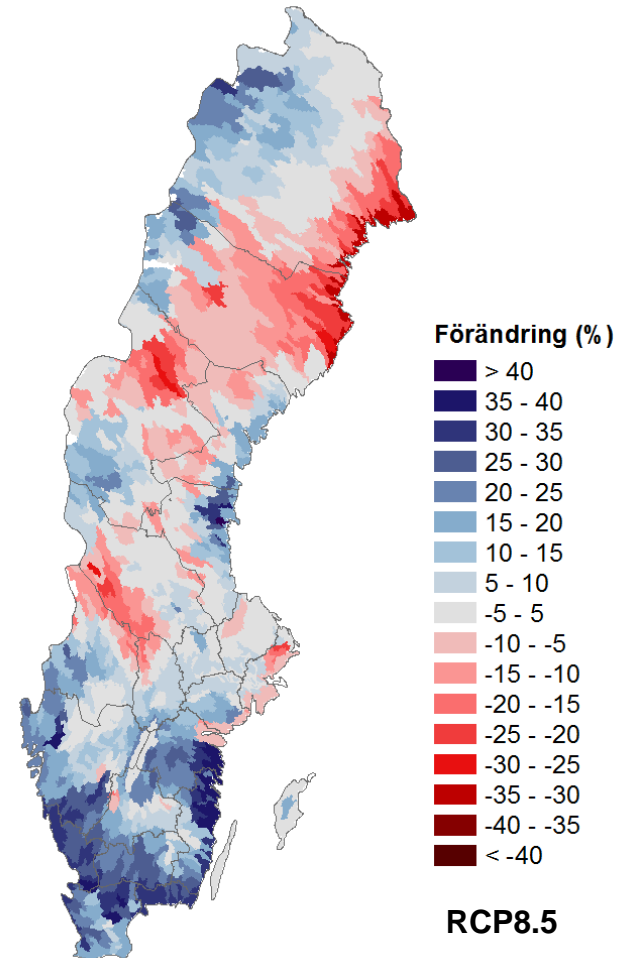
Förändring lokal tillrinning (säsong)

Störst nederbördsökning vintertid, mest avdunstning sommartid



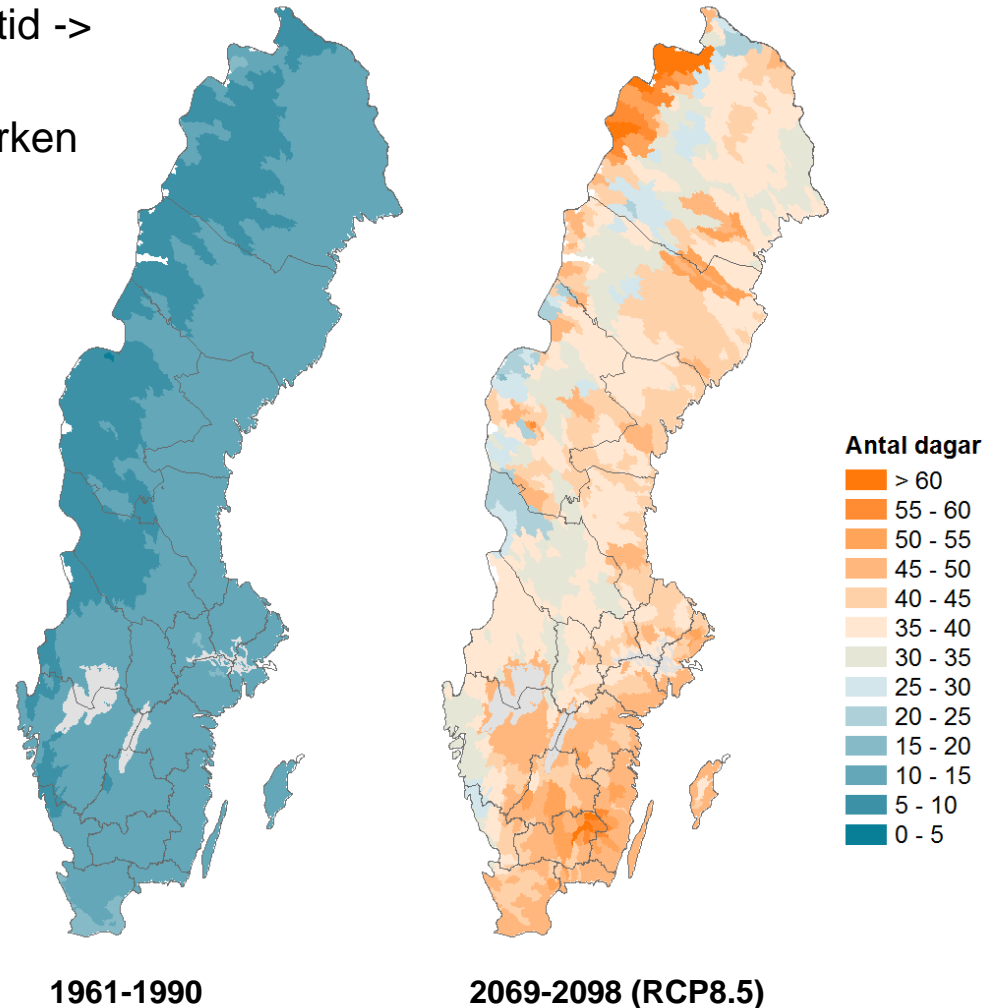
Förändring 100-årsflöde

- Orsakas av kraftig nederbörd/
snösmältning
- Minskat snötäcke -> minskad vårflood
- Ökad kraftig nederbörd -> ökade 100-
årsflöden i södra Sverige

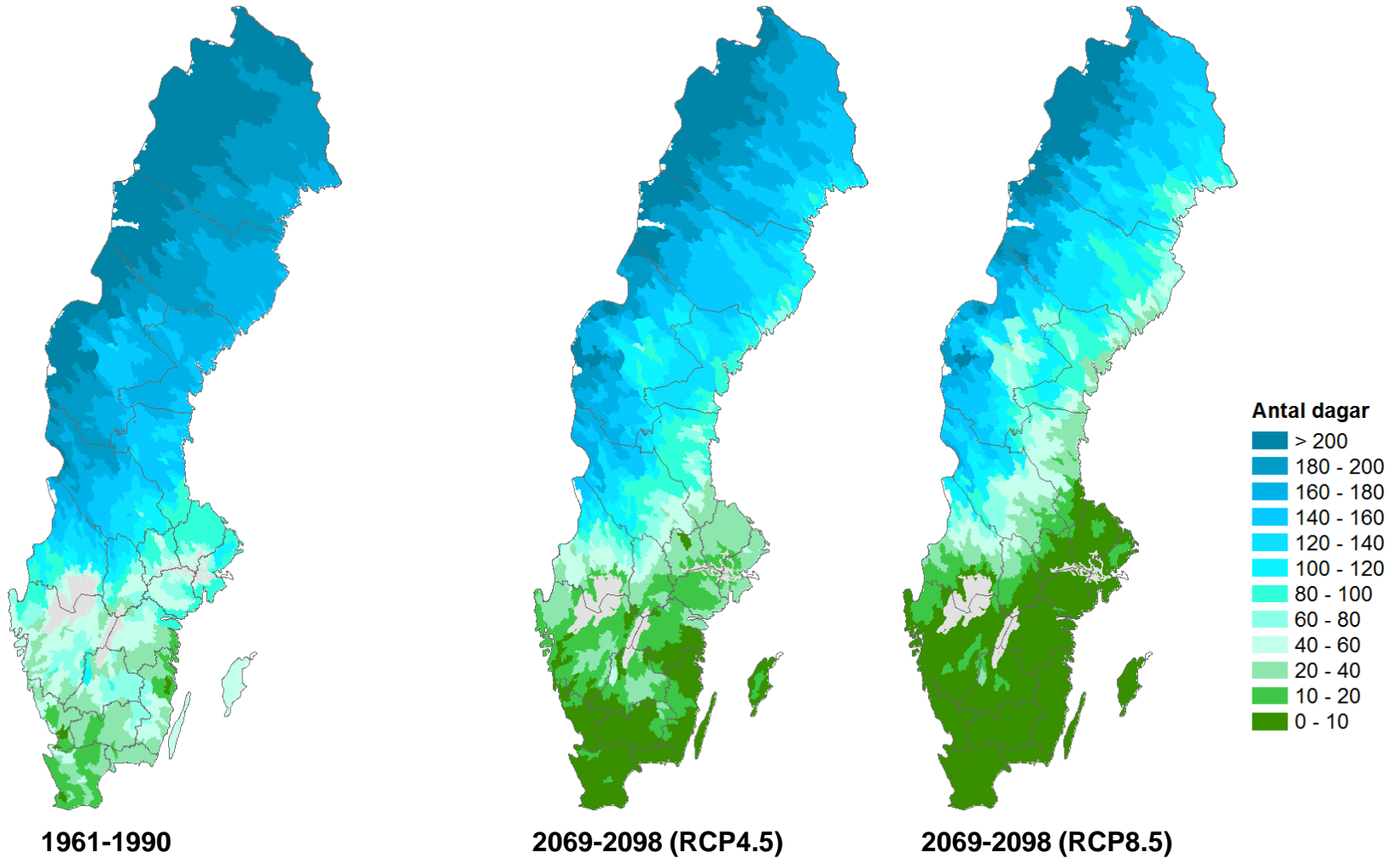


Dagar med låg markfuktighet

- Hög avdunstning främst sommartid -> ökad avdunstning
- Minskade flöden -> torrare i marken



Snötäcke (5 mm)



Framtidens klimat

Klimatscenarioer

[Ladda ner scenariodata](#)[Arkiv - Klimatscenarioer](#)[Vägledning klimatscenarioer](#)

Meteorologi

[Temperatur](#)[Nederbörd](#)[Moln](#)[Vind](#)[Strålning](#)[Snö](#)[Lufttryck](#)[Åska](#)[Ozon i stratosfären](#)[UV-strålning](#)

Hydrologi

[Vattenföring](#)[Vattenstånd](#)[Is](#)[Avdunstning](#)[Sjöar och vattendrag](#)

Oceanografi

[Havsvattenstånd](#)[Havsströmmar](#)[Havsvågor](#)[Havstemperatur](#)[Havsis](#)[Algarkivet](#)[Havsmiljödata](#)

Miljö

[Lufthalt och deposition](#)[Marknära ozon](#)

Klimatscenarioer

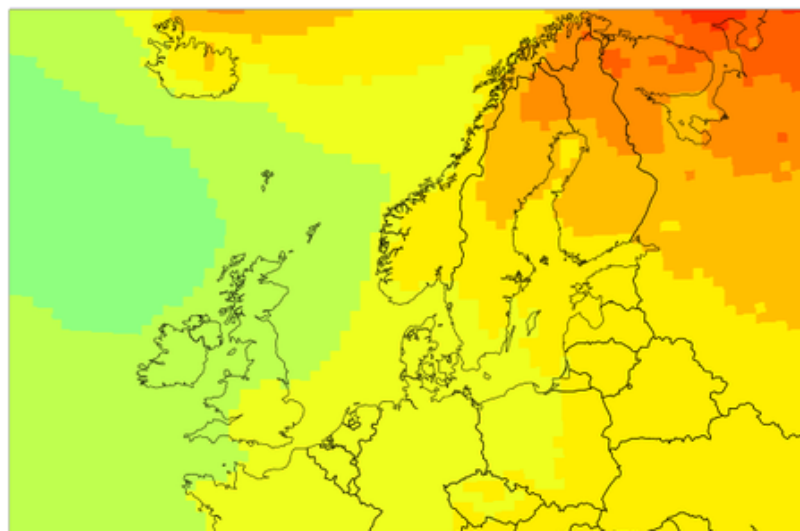
[English](#)

Här hittar du resultat från SMHI:s klimatforskning vid Rossby Centre. Klimatscenarioerna presenteras på kartor, i diagram och som nedladdningsbara data. Här finns också förklarande [information om resultaten](#) och hur de arbetats fram. En introduktion till klimatscenarioer finns på sidan [Om klimatscenarioer](#). Det finns även en [vägledning](#) som ger stöd för att tolka och använda klimatscenarioer.

Genom att klicka i den blå rutan nedan väljer du geografiskt område, scenario, årstid och det klimatindex du är intresserad av.

Område	Scenario i	Årstid i	Klimatindex i
<input type="radio"/> Världen	<input type="radio"/> RCP 2.6 (låg)	<input type="radio"/> Vinter	Temperatur
<input type="radio"/> Afrika	<input type="radio"/> RCP 4.5 (mellan)	<input type="radio"/> Vår	Läs mer om temperatur
<input checked="" type="radio"/> Europa	<input checked="" type="radio"/> RCP 8.5 (hög)	<input type="radio"/> Sommar	
<input type="radio"/> Sverige	<input type="radio"/> SRES A1B (mellan, äldre)	<input type="radio"/> Höst	
<input type="radio"/> Län		<input checked="" type="radio"/> År	
<input type="radio"/> Distrikt			
<input type="radio"/> Avrinningsområde			

Förändring av årsmedeltemperaturen i Europa, scenario RCP 8.5



[English](#)

Framtidens klimat

[Klimatscenarioer](#)

[Ladda ner scenariodata](#)

[Arkiv - Klimatscenarioer](#)

[Vägledning klimatscenarioer](#)

Meteorologi

[Temperatur](#)

[Nederbörd](#)

[Moln](#)

[Vind](#)

[Strålning](#)

[Snö](#)

[Lufttryck](#)

[Åska](#)

[Ozon i stratosfären](#)

[UV-strålning](#)

Hydrologi

[Vattenföring](#)

[Vattenstånd](#)

[Is](#)

[Avdunstning](#)

[Sjöar och vattendrag](#)

Oceanografi

[Havsvattenstånd](#)

[Havsströmmar](#)

[Havsvågor](#)

[Havstemperatur](#)

[Havsis](#)

[Algarkivet](#)

[Havsmiljödata](#)

Miljö

[Lufthalt och deposition](#)

[Marknära ozon](#)

Ladda ner scenariodata

Här kan du ladda ner resultat från SMHI:s klimatforskning vid Rosaby Centre. Klimatberäkningarna omfattar olika geografiska områden, scenarier, tidsperioder och klimatindex.

Klimatmodeller på global och regional skala har använts inom två stora, internationella samarbetsprojekt: [CMIP5](#) (Coupled Model Intercomparison Project Phase 5) och [CORDEX](#) (Coordinated Regional climate Downscaling Experiment). Inom CMIP5 har ett antal globala klimatmodeller använts och resultaten jämförts. Dessa resultat har sedan använts inom CORDEX för att driva olika regionala klimatmodeller.

Modelldata

Modelldata från bland annat SMHI går i Federation).

Regionala data

Via formuläret nedan kan bearbetade, observationer gjorda sedan 1961. Se [här](#).

Ladda ned beräknad förändring av år:

[Historiska data sedan 1961](#)

[Scenariodata 1961-2100](#)

Data för effektstudier

Inom SMHI-projektet Nedskalning av RCP-scenarier har det skapats en databas som innehåller meteorologisk och hydrologisk statistik för nutida och framtida klimat. Databasen baseras på de regionala klimatscenerierna ovan, men resultaten har förädlats för att möjliggöra till exempel hydrologiska effektstudier.

[SCID-databasen, information och nedladdning.](#)

SCID databas
- Climate index database for Sweden

Databas
Sjätte utgåva, SCIP 11 och SCIP 12
Egenhet: global klimatdata, SAM, CMIP5, CORDEX, ECHAM5, ECHAM6, IPSL-CM5, INMCM3, MIROC5, MIROC6, MRI-CGCM2, RCM3, RCM3G2, RCM3G3, RCM3G4, RCM3G5, RCM3G6, RCM3G7, RCM3G8, RCM3G9, RCM3G10, RCM3G11, RCM3G12, RCM3G13, RCM3G14, RCM3G15, RCM3G16, RCM3G17, RCM3G18, RCM3G19, RCM3G20, RCM3G21, RCM3G22, RCM3G23, RCM3G24, RCM3G25, RCM3G26, RCM3G27, RCM3G28, RCM3G29, RCM3G30, RCM3G31, RCM3G32, RCM3G33, RCM3G34, RCM3G35, RCM3G36, RCM3G37, RCM3G38, RCM3G39, RCM3G40, RCM3G41, RCM3G42, RCM3G43, RCM3G44, RCM3G45, RCM3G46, RCM3G47, RCM3G48, RCM3G49, RCM3G50, RCM3G51, RCM3G52, RCM3G53, RCM3G54, RCM3G55, RCM3G56, RCM3G57, RCM3G58, RCM3G59, RCM3G60, RCM3G61, RCM3G62, RCM3G63, RCM3G64, RCM3G65, RCM3G66, RCM3G67, RCM3G68, RCM3G69, RCM3G70, RCM3G71, RCM3G72, RCM3G73, RCM3G74, RCM3G75, RCM3G76, RCM3G77, RCM3G78, RCM3G79, RCM3G80, RCM3G81, RCM3G82, RCM3G83, RCM3G84, RCM3G85, RCM3G86, RCM3G87, RCM3G88, RCM3G89, RCM3G90, RCM3G91, RCM3G92, RCM3G93, RCM3G94, RCM3G95, RCM3G96, RCM3G97, RCM3G98, RCM3G99, RCM3G100, RCM3G101, RCM3G102, RCM3G103, RCM3G104, RCM3G105, RCM3G106, RCM3G107, RCM3G108, RCM3G109, RCM3G110, RCM3G111, RCM3G112, RCM3G113, RCM3G114, RCM3G115, RCM3G116, RCM3G117, RCM3G118, RCM3G119, RCM3G120, RCM3G121, RCM3G122, RCM3G123, RCM3G124, RCM3G125, RCM3G126, RCM3G127, RCM3G128, RCM3G129, RCM3G130, RCM3G131, RCM3G132, RCM3G133, RCM3G134, RCM3G135, RCM3G136, RCM3G137, RCM3G138, RCM3G139, RCM3G140, RCM3G141, RCM3G142, RCM3G143, RCM3G144, RCM3G145, RCM3G146, RCM3G147, RCM3G148, RCM3G149, RCM3G150, RCM3G151, RCM3G152, RCM3G153, RCM3G154, RCM3G155, RCM3G156, RCM3G157, RCM3G158, RCM3G159, RCM3G160, RCM3G161, RCM3G162, RCM3G163, RCM3G164, RCM3G165, RCM3G166, RCM3G167, RCM3G168, RCM3G169, RCM3G170, RCM3G171, RCM3G172, RCM3G173, RCM3G174, RCM3G175, RCM3G176, RCM3G177, RCM3G178, RCM3G179, RCM3G180, RCM3G181, RCM3G182, RCM3G183, RCM3G184, RCM3G185, RCM3G186, RCM3G187, RCM3G188, RCM3G189, RCM3G190, RCM3G191, RCM3G192, RCM3G193, RCM3G194, RCM3G195, RCM3G196, RCM3G197, RCM3G198, RCM3G199, RCM3G200, RCM3G201, RCM3G202, RCM3G203, RCM3G204, RCM3G205, RCM3G206, RCM3G207, RCM3G208, RCM3G209, RCM3G210, RCM3G211, RCM3G212, RCM3G213, RCM3G214, RCM3G215, RCM3G216, RCM3G217, RCM3G218, RCM3G219, RCM3G220, RCM3G221, RCM3G222, RCM3G223, RCM3G224, RCM3G225, RCM3G226, RCM3G227, RCM3G228, RCM3G229, RCM3G230, RCM3G231, RCM3G232, RCM3G233, RCM3G234, RCM3G235, RCM3G236, RCM3G237, RCM3G238, RCM3G239, RCM3G240, RCM3G241, RCM3G242, RCM3G243, RCM3G244, RCM3G245, RCM3G246, RCM3G247, RCM3G248, RCM3G249, RCM3G250, RCM3G251, RCM3G252, RCM3G253, RCM3G254, RCM3G255, RCM3G256, RCM3G257, RCM3G258, RCM3G259, RCM3G260, RCM3G261, RCM3G262, RCM3G263, RCM3G264, RCM3G265, RCM3G266, RCM3G267, RCM3G268, RCM3G269, RCM3G270, RCM3G271, RCM3G272, RCM3G273, RCM3G274, RCM3G275, RCM3G276, RCM3G277, RCM3G278, RCM3G279, RCM3G280, RCM3G281, RCM3G282, RCM3G283, RCM3G284, RCM3G285, RCM3G286, RCM3G287, RCM3G288, RCM3G289, RCM3G290, RCM3G291, RCM3G292, RCM3G293, RCM3G294, RCM3G295, RCM3G296, RCM3G297, RCM3G298, RCM3G299, RCM3G300, 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RCM3G1092, RCM3G1093, RCM3G1094, RCM3G1095, RCM3G1096, RCM3G1097, RCM3G1098, RCM3G1099, RCM3G1100, RCM3G1101, RCM3G1102, RCM3G1103, RCM3G1104, RCM3G1105, RCM3G1106, RCM3G1107, RCM3G1108, RCM3G1109, RCM3G1110, RCM3G1111, RCM3G1112, RCM3G1113, RCM3G1114, RCM3G1115, RCM3G1116, RCM3G1117, RCM3G1118, RCM3G1119, RCM3G1120, RCM3G1121, RCM3G1122, RCM3G1123, RCM3G1124, RCM3G1125, RCM3G1126, RCM3G1127, RCM3G1128, RCM3G1129, RCM3G1130, RCM3G1131, RCM3G1132, RCM3G1133, RCM3G1134, RCM3G1135, RCM3G1136, RCM3G1137, RCM3G1138, RCM3G1139, RCM3G1140, RCM3G1141, RCM3G1142, RCM3G1143, RCM3G1144, RCM3G1145, RCM3G1146, RCM3G1147, RCM3G1148, RCM3G1149, RCM3G1150, RCM3G1151, RCM3G1152, RCM3G1153, RCM3G1154, RCM3G1155, RCM3G1156, RCM3G1157, RCM3G1158, RCM3G1159, RCM3G1160, RCM3G1161, RCM3G1162, RCM3G1163, RCM3G1164, RCM3G1165, RCM3G1166, RCM3G1167, RCM3G1168, RCM3G1169, RCM3G1170, RCM3G1171, RCM3G1172, RCM3G1173, RCM3G1174, RCM3G1175, RCM3G1176, RCM3G1177, RCM3G1178, RCM3G1179, RCM3G1180, RCM3G1181, RCM3G1182, 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Sammanfattning

- Norra Sverige och vintern visar störst temperaturökning
 - Varmare atmosfär -> mer nederbörd
 - Kraftigare skyfall
 - Stigande havsnivå, landhöjdning i norra Sverige
 - Det blir inte blåsigare
-
- Flödena ökar vintertid men minskar sommartid
 - 100-årsflödet minskar i norra Sverige (minskad vårflood) men ökar i södra Sverige (kraftig nederbörd)
 - Dagar med låg markfuktighet ökar
 - Snötäcket minskar
-
- Olika klimatmodeller ger lite olika resultat men trenderna är lika

