

# **Climatological influence of Land and Atmospheric Initial conditions on North America and Eurasia surface temperature and circulation in the Past 57 Years (1958–2014) reforecasts**

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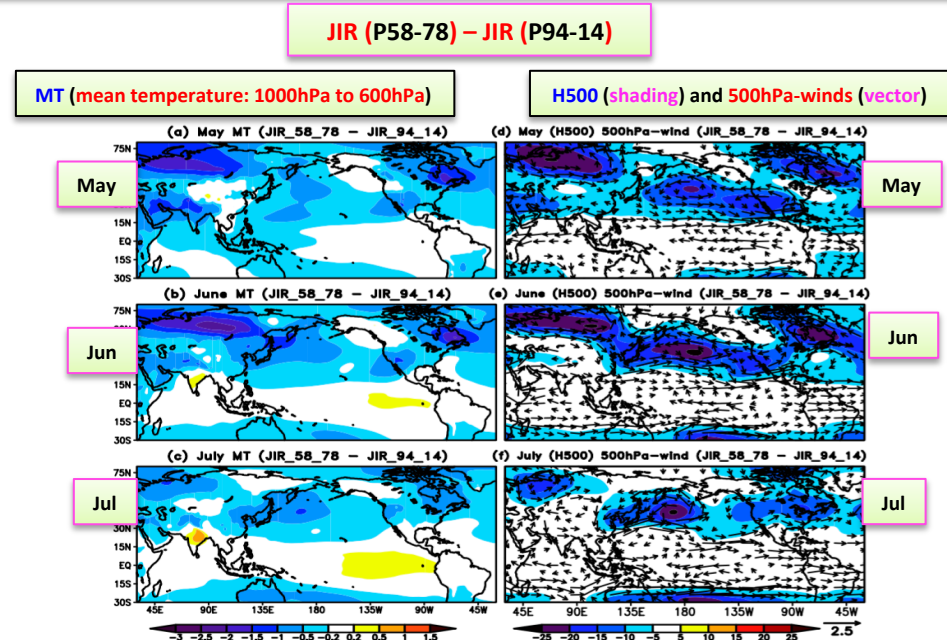
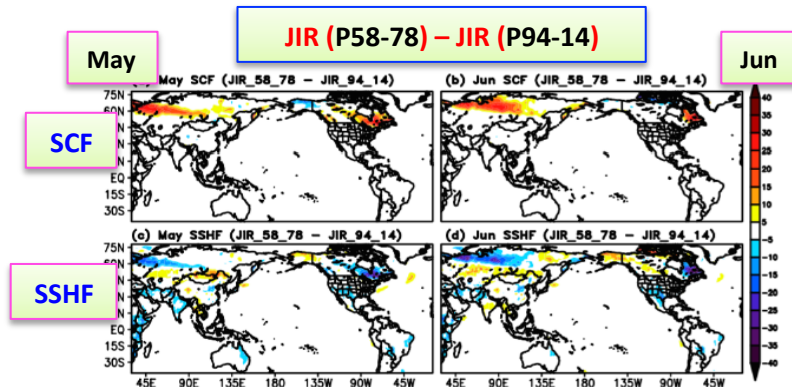
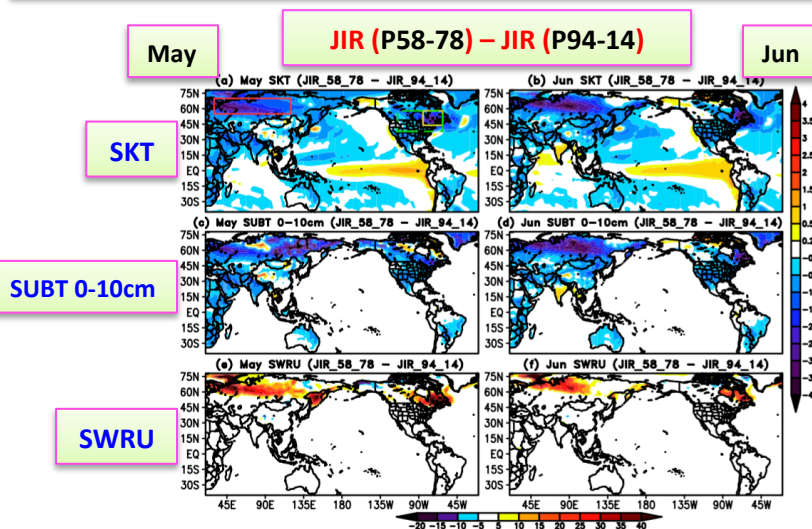
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## Model and Experimental Design:

- **Model:** National Centers for Environmental Prediction (NCEP) Coupled Forecast System version-2 (CFSv2)
- **January initialized reforecasts (JIR) and April initialized reforecasts (AprIR)** for period **1958-2014**
- **Ocean initial conditions (OICs):** European Centre for Medium Range Weather Forecasts (ECMWF) Ocean Reanalysis System 4 (ORAS4) for **1958-2014**
- **The land, atmosphere, and sea ice ICs:** Climate Forecast System Reanalysis for **1979-2014** & For **1958-1978:** Atmospheric ICs (ERA-40 reanalysis) and land ICs (Global Land Data Assimilation System, version 2.0 analysis)
- **Earlier period (1958–1978; P58-78)** and **later period (1994–2014; P94-14)**
- **SKT = Surface Temperature; SUBT=Sub-surface temperature; SCF=snow cover fraction; SWRU= Upward short wave radiation; SSHF= Surface sensible heat flux**



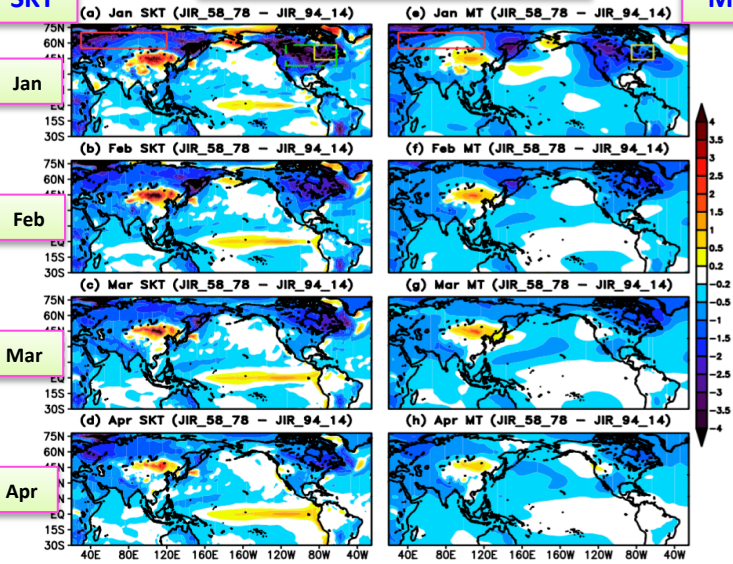
The climatological differences between **earlier period (1958–78)** and **later period (1994–2014)** of JIR over northern latitudes from May to June are similar to differences between reforecasts initialized in winter (e.g. February) and spring (e.g. May) during period 1979-2008 as reported by some recent studies (Shukla *et al.* 2019; Shukla and Huang 2020).



### JIR (P58-78) – JIR (P94-14)

SKT

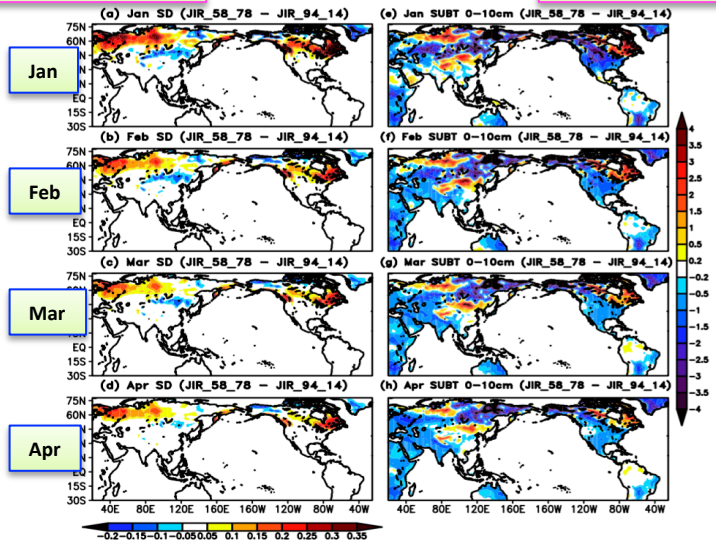
MT



### JIR (P58-78) – JIR (P94-14)

Snow Depth (SD)

SUBT 0-10cm



### AprIR (P58-78) – AprIR (P94-14)

Jan

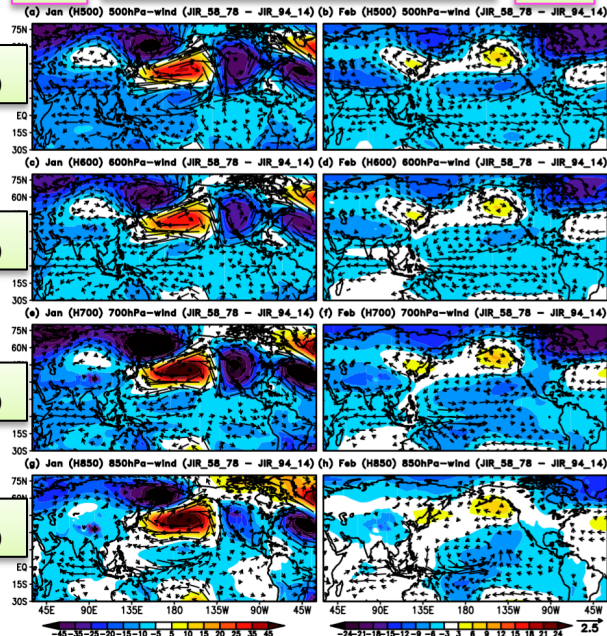
JIR (P58-78) – JIR (P94-14)

Feb

SKT

MT

H500 (shading) and 500hPa-winds (vector)

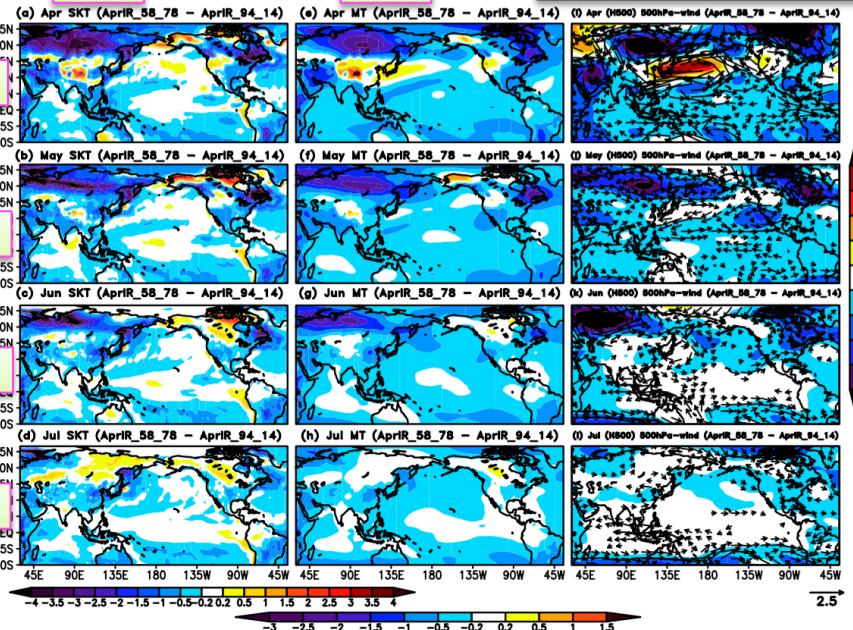


Apr

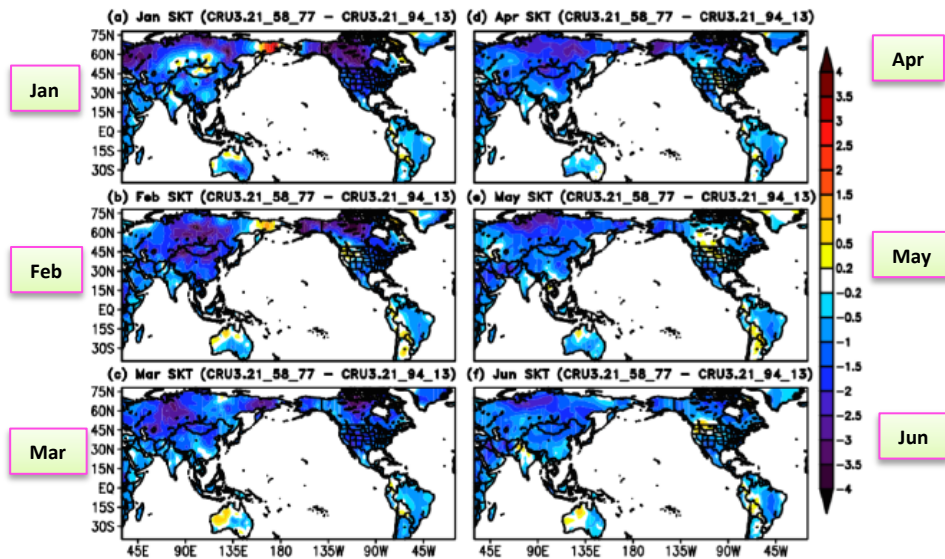
May

Jun

Jul



## CRU3.21 SKT (P58-78) – CRU3.21 SKT (P94-14)



The nature of **wintertime land conditions** (e.g. **land surface temperature**) in observations (e.g. CRU 3.21) was **different before and after 1979**.

## Conclusion:

- The climatological difference between JIR P58-78 and P94-14 depicts enhanced cold SKT and sub-surface temperature at 0-10cm over northern Eurasia and northeast region of North America from May to June.
- Model overestimates snow cover fraction from May to June in JIR P58-78 than JIR P94-14, which leads to excessive upwards-shortwave radiation in the northern latitudes.
- Due to cold temperature from the surface to mid-troposphere, model depicts lower geopotential heights in mid-troposphere, which leads to increase westerly winds at mid-troposphere over northern latitudes from May to June.
- The climatological differences between earlier and later periods of JIR from May to June are similar to differences between reforecasts initialized in winter and spring as reported by some recent studies (Shukla et al. 2019 and Shukla and Huang 2020).
- The climatological difference between JIR P58-78 and P94-14 depicts enhanced cooling from surface to 600hPa over northern latitudes in January. As lead months increase, the magnitude of cold temperature decreases gradually from February to March.
- Most prominent centers of geopotential height from surface to mid-troposphere over northern latitude in climatological differences between earlier and later periods of JIR in January vanish in February.
- The possible causes for the large differences in variables between earlier and later periods of JIR are mainly due to the different sources of land and atmospheric ICs before and after 1979 and different nature of land conditions before and after 1979.