

衛星フェノロジー

地球観測衛星は繰り返し、反復して地球表層の観測を行っている

その中に、フラックスに関する情報はないだろうか？

モデルに物理量を与えるのが衛星RSの役割か？

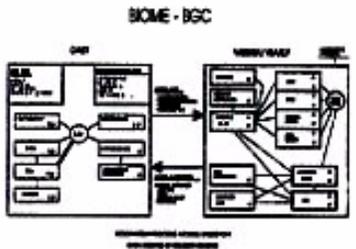
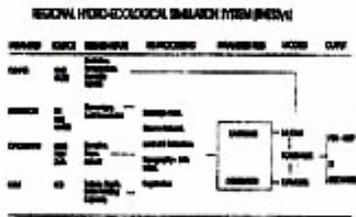
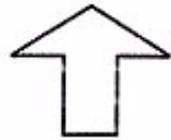
Step 1 経験的な関係の発見

Step 2 物理性の解明

Step 3 モデル化

Model Logic

$$NPP = \epsilon_{BGC} \int NDVI$$



Spatial Scale

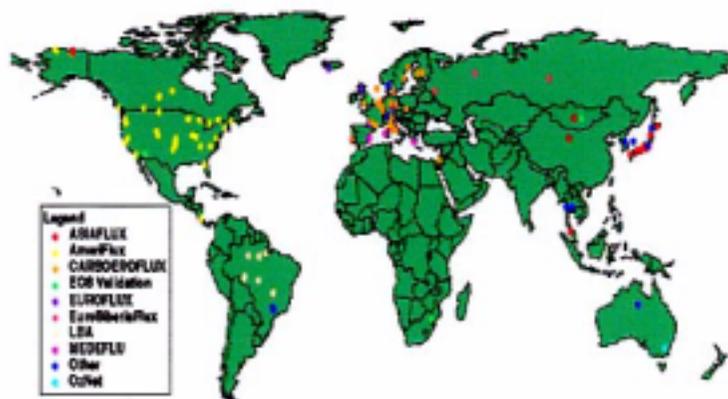


大陸スケールの
単純なモデル

流域スケール
の中間度に複
雑なモデル

プロットスケール
の複雑なモデル

Waring & Running(1998)



FluxNet

AsiaFlux WebPage

Back

Observation Sites of AsiaFlux (Japan)

last updated on July 05, 2000

FLUXNET

Integrating Worldwide CO₂ Flux Measurements

Long-term measurements of carbon dioxide, water vapor, and energy exchange from a variety of worldwide ecosystems integrated into consistent, quality assured, documented datasets.

Announcements **New**

[A New Way to Visualize Tower Sites](#)

[Background Information](#) (including searchable bibliographic database)

[Regional Networks](#)

[Site Characteristics](#)

[Ecoregions Map](#)

[Data](#)

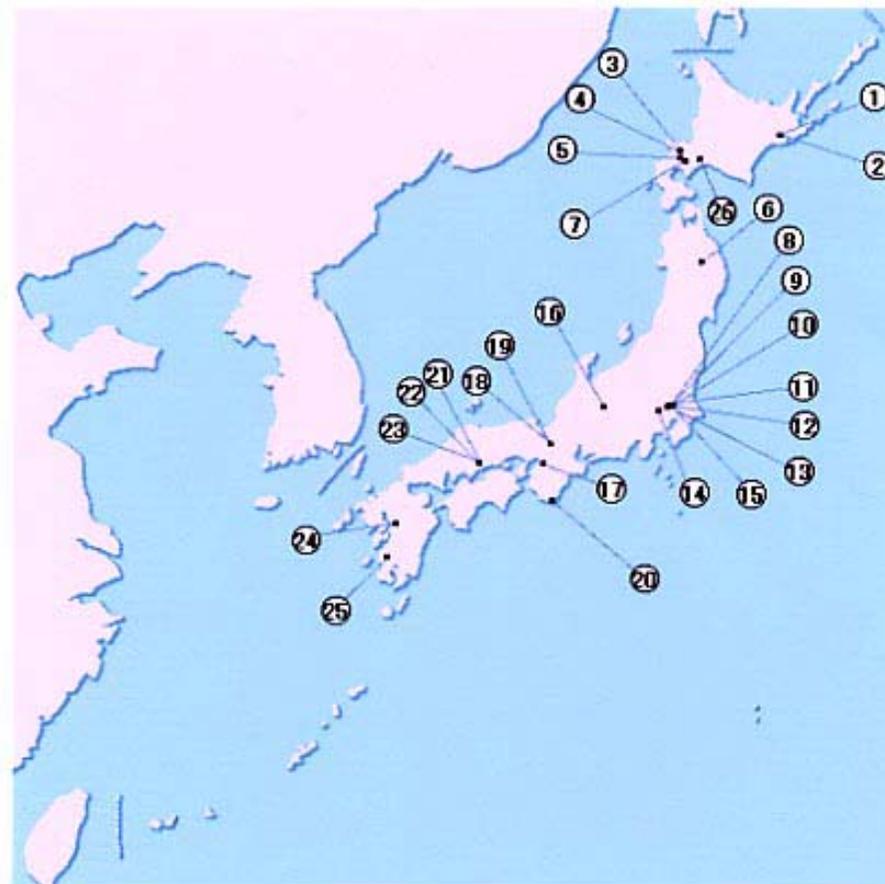
[FLUXNET Server Participant List](#)

[News/Meetings](#)

[Links](#)

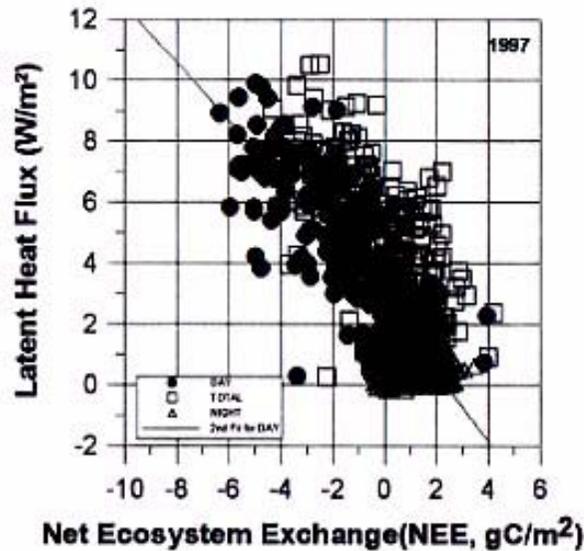
[Contact](#)

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865-574-7819
rjo@ornl.gov

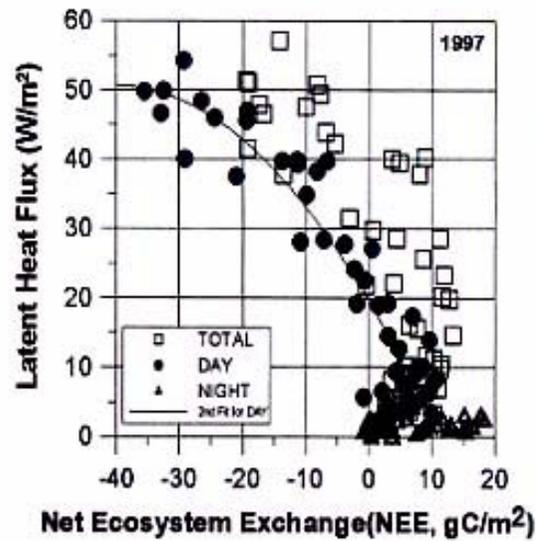


FLUXNET Prototype Gap-filled Flux Data Little Washita Watershed

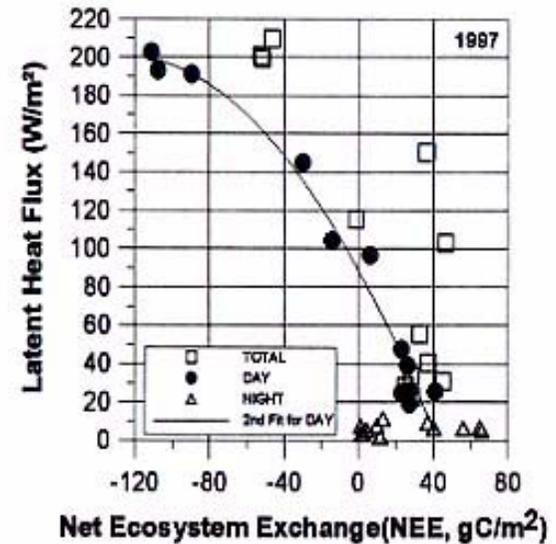
<http://www-eosdis.ornl.gov/FLUXNET/wwwtext.htm>



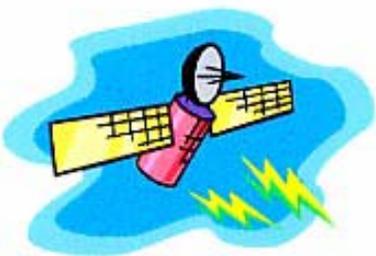
DAILY



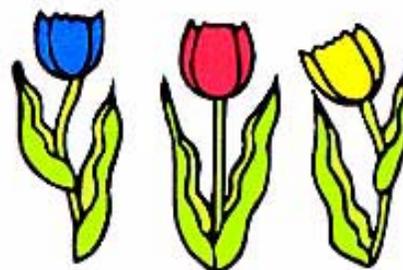
WEEKLY



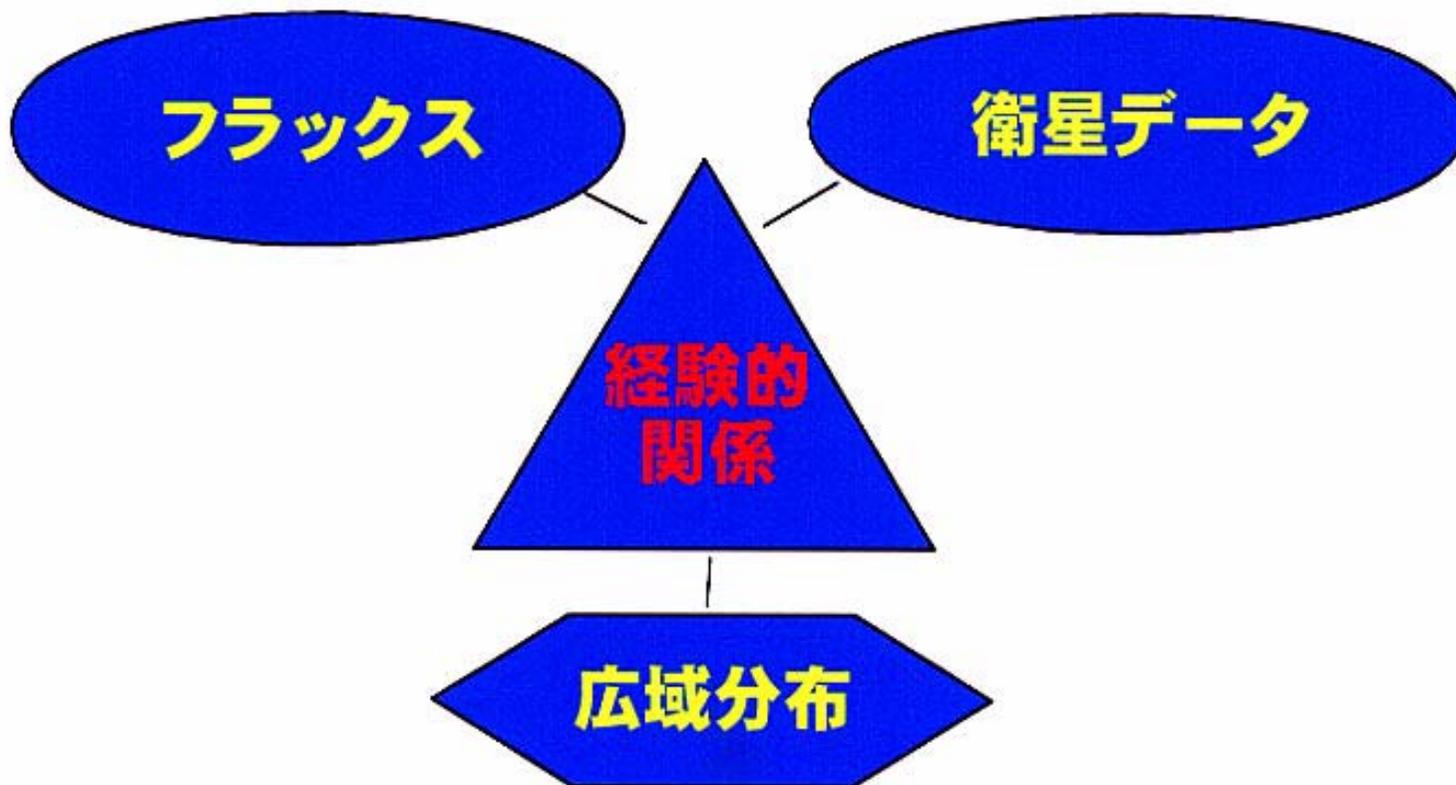
MONTHLY



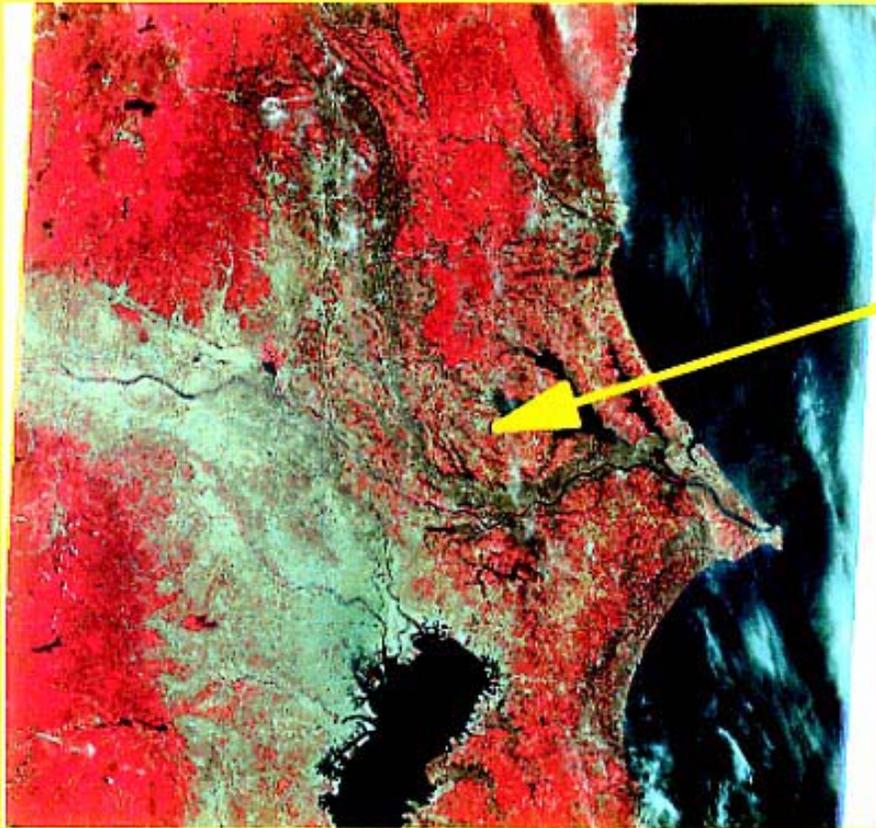
目的



フラックスの広域分布を衛星計測で求めること



Satellite Phenology and Flux



LANDSAT-5

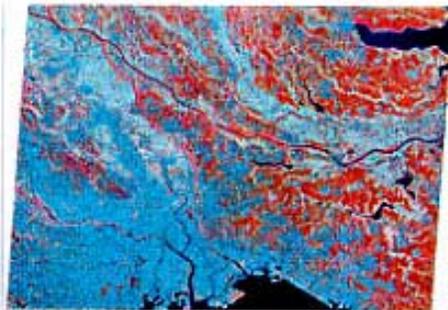
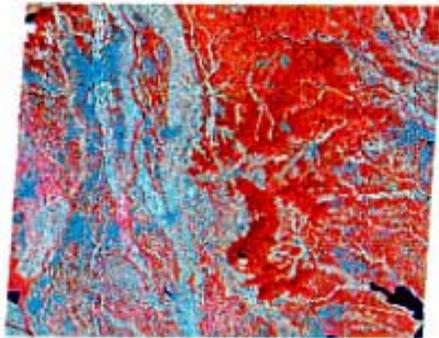
- Launched in 1984
- 80 cloud free scenes



Flux observation



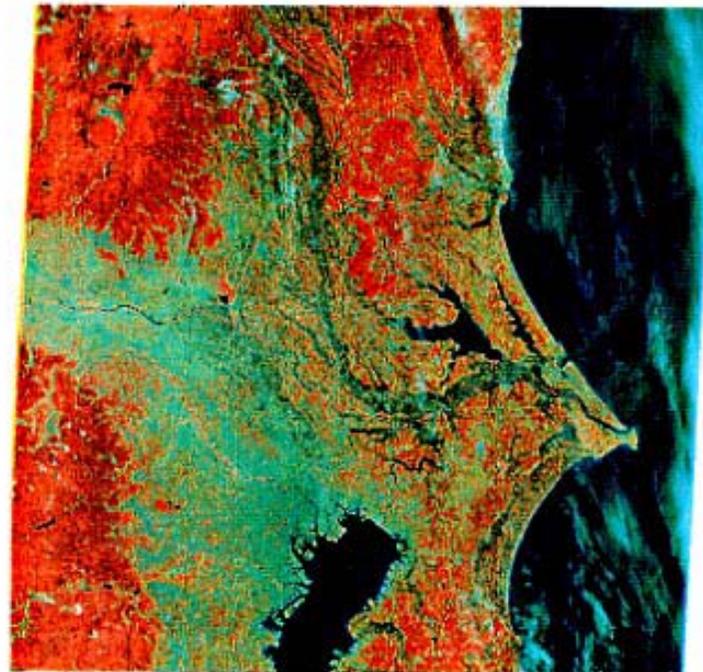
SATELLITE DATA



SPOT/XS

1997, 1998

Band 1 Green 0.50–0.59 μm
Band 2 Red 0.61–0.68
Band 3 NIR 0.79–0.89



LANDSAT/TM

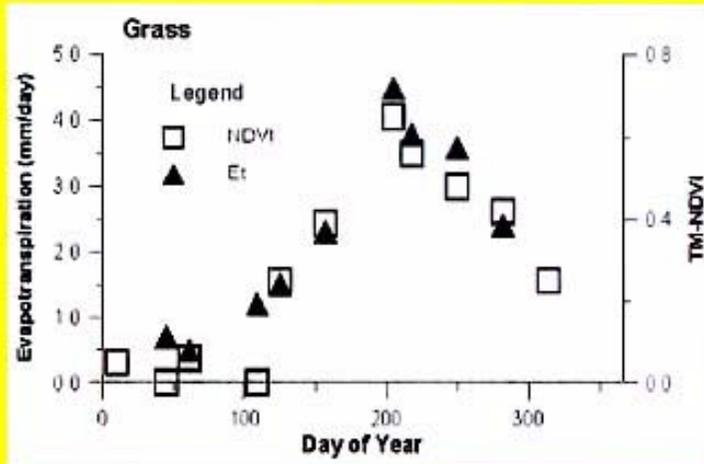
1984 – 1998

Band 1 Blue 0.45–0.52 μm
Band 2 Green 0.52–0.60
Band 3 Red 0.63–0.69
Band 4 NIR 0.76–0.92
Band 5 SWIR 1.55–1.75
Band 6 TIR 10.4–12.5
Band 7 SWIR 2.08–2.35

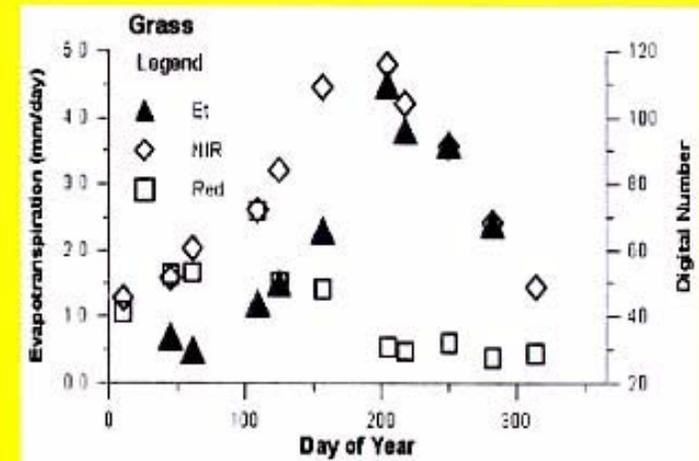
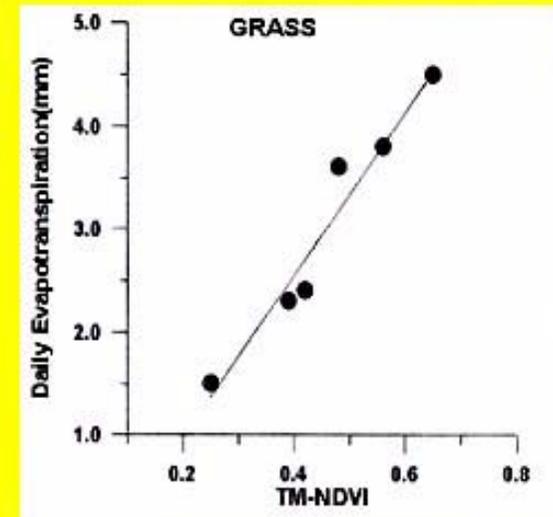
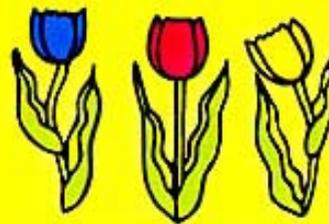


Satellite Phenology and Flux

Kondoh(1998)

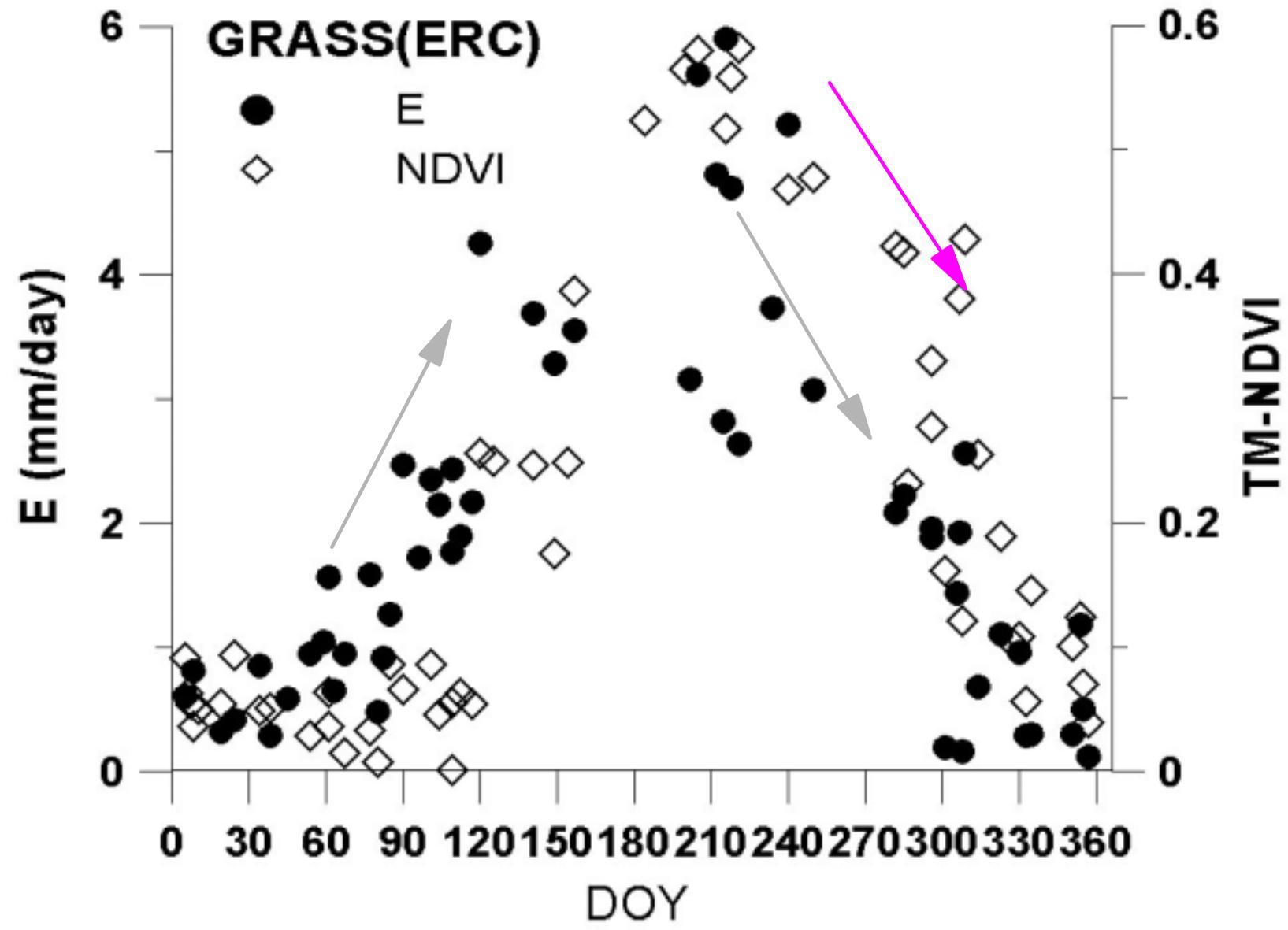


Correlation between NDVI and Et is quite high.

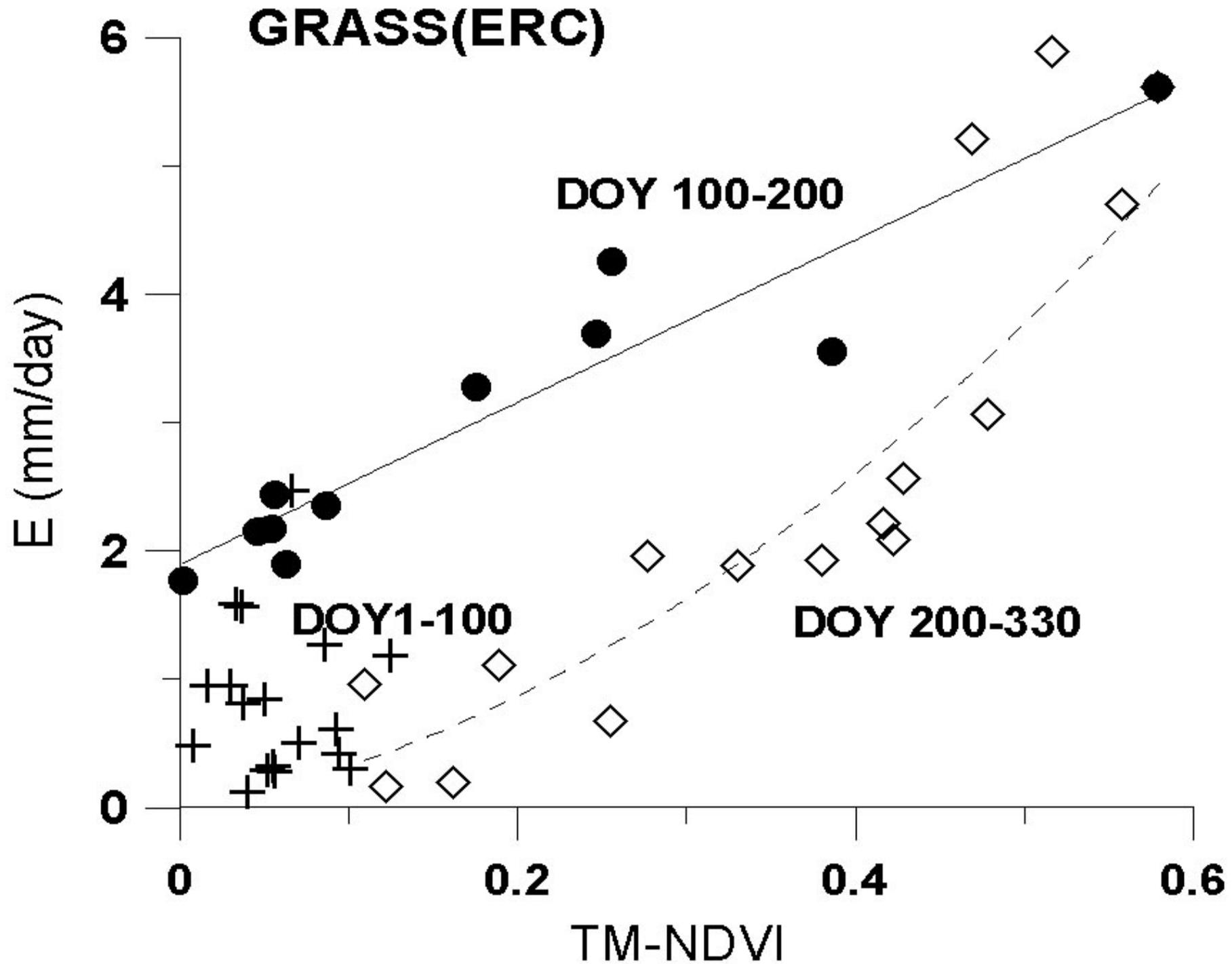


TM : GRASSLAND

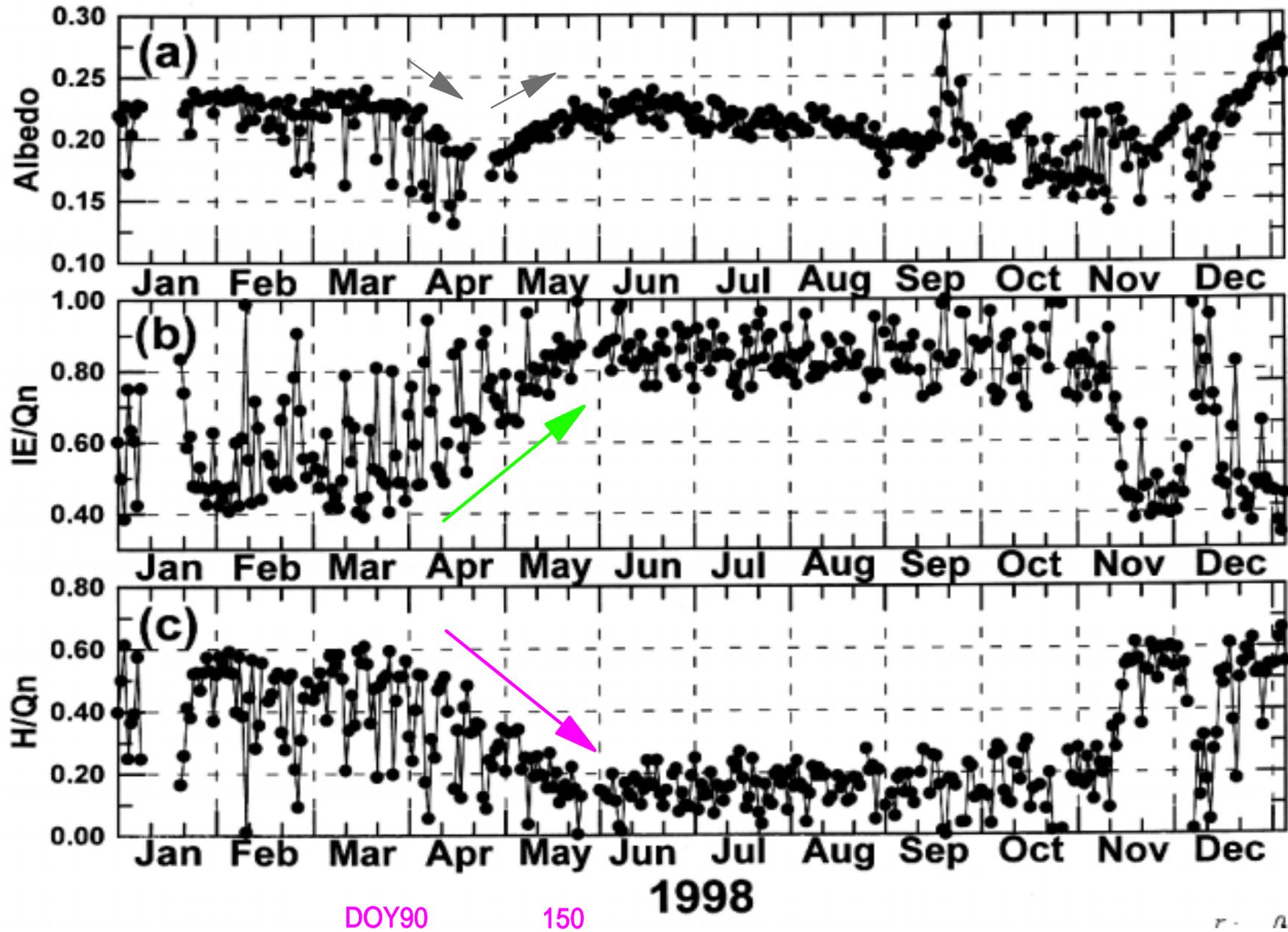
Daily Evapotranspiration(mm) and TM-NDVI



TM : GRASSLAND



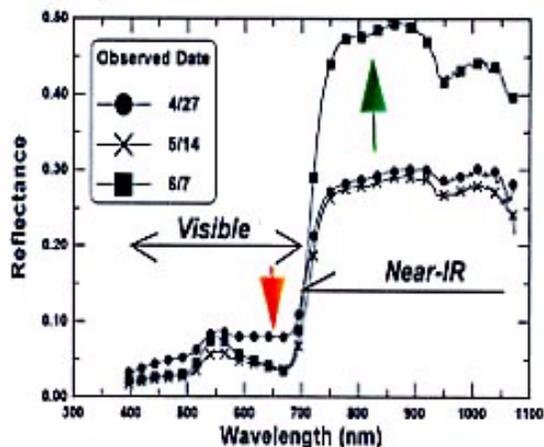
Seasonal Changes in Albedo, IE/Qn and H/Qn Grassland 1998



TM : GRASSLAND

Red and Infrared Brightness

Hyper-Spectral Reflectance at Grassland Observed from 30 m Tower

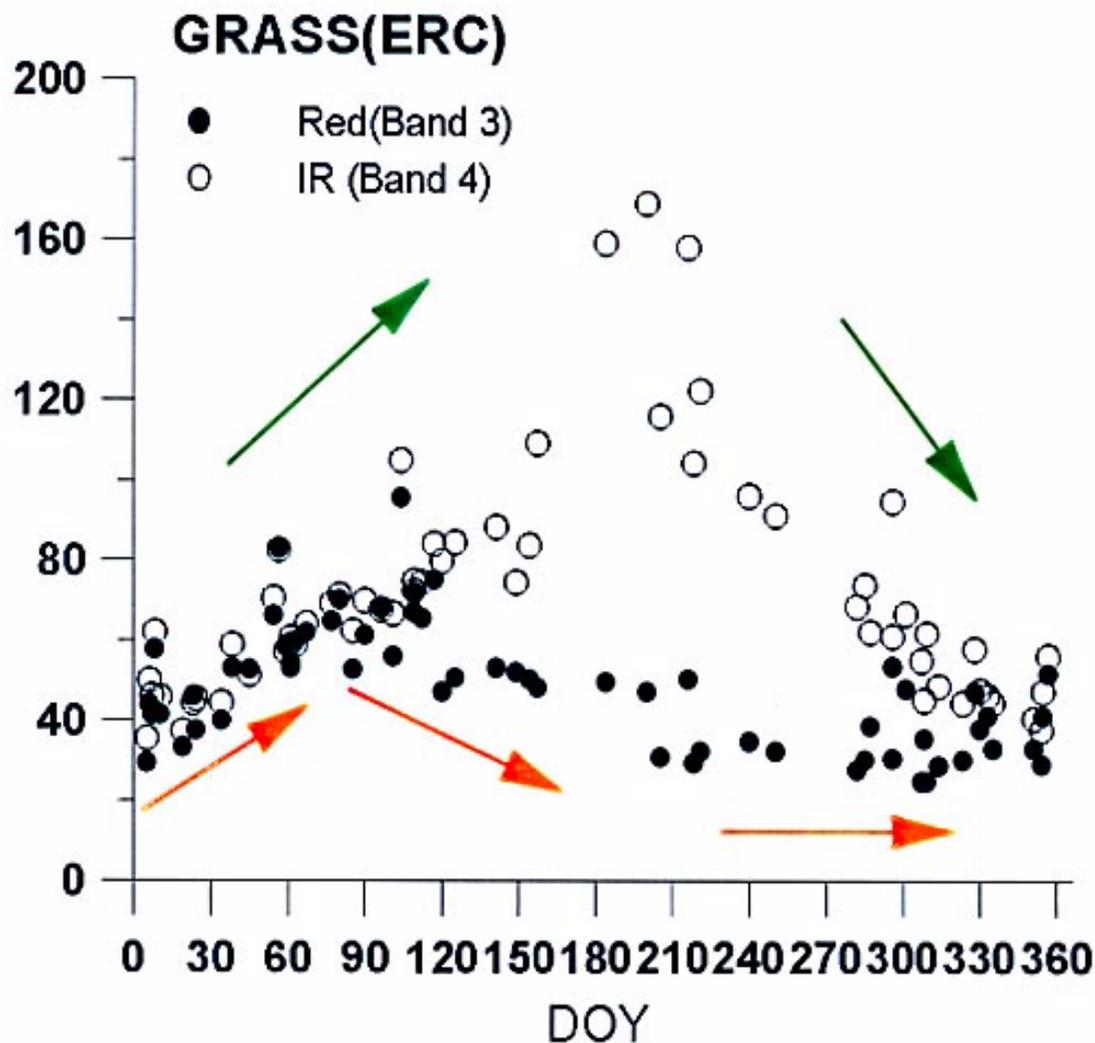


(Courtesy Nishida, 1999)

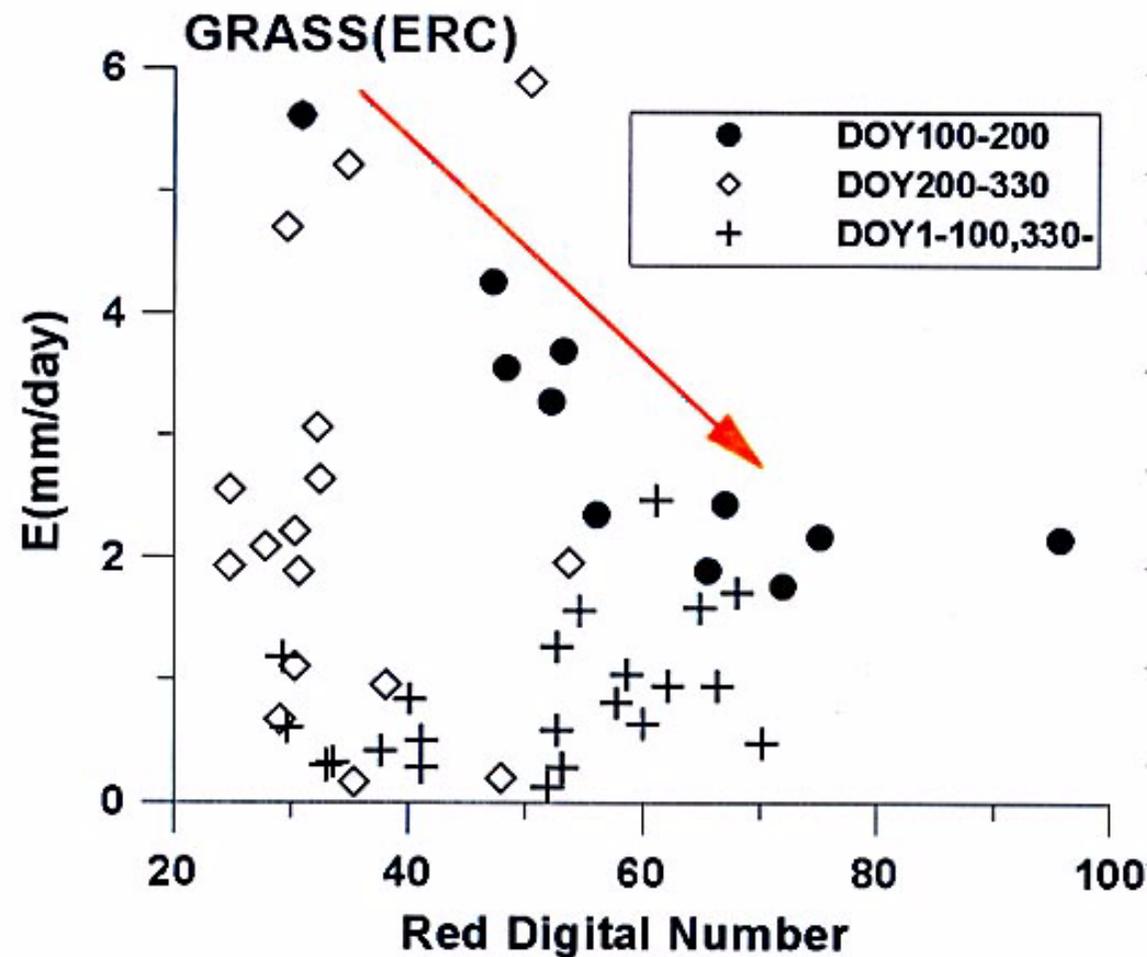
- Red region has high action spectrum, and the reflectance had decreased during growing season.

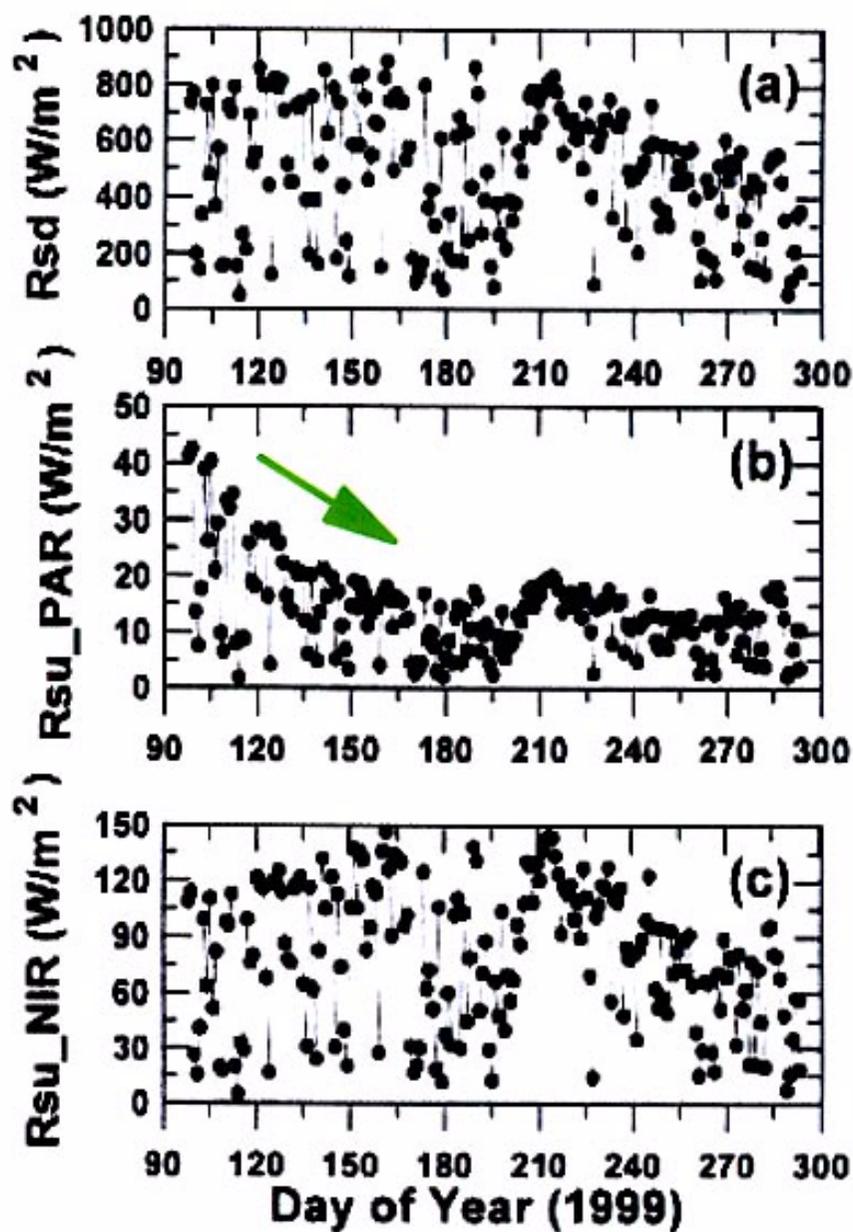
- NIR reflectance had increased in the growing season.

DIGITAL NUMBER



Relationship between Red band brightness and daily evapotranspiration





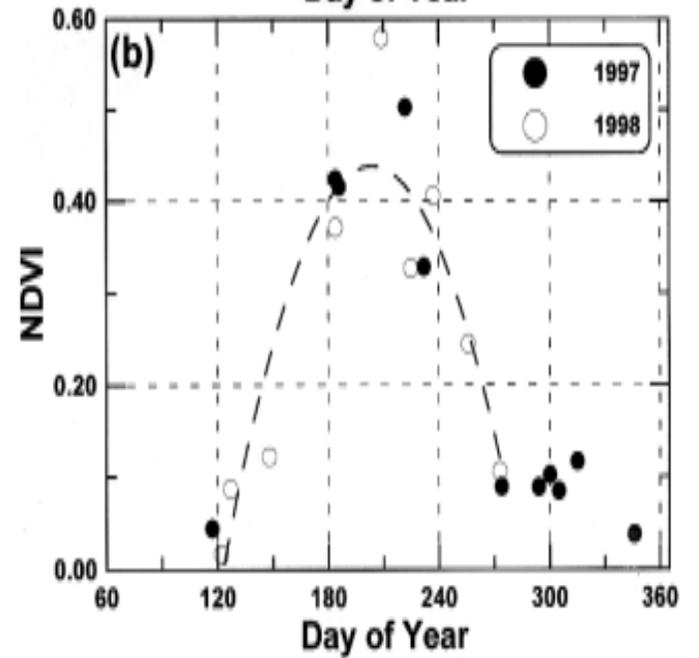
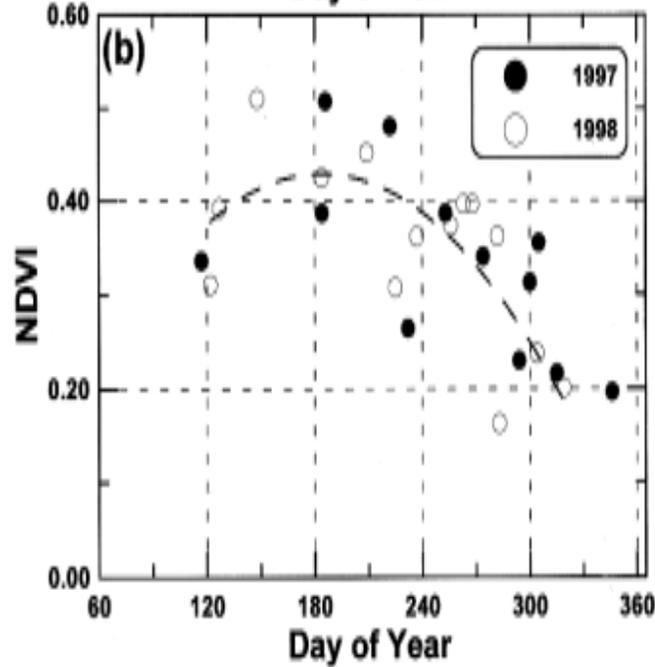
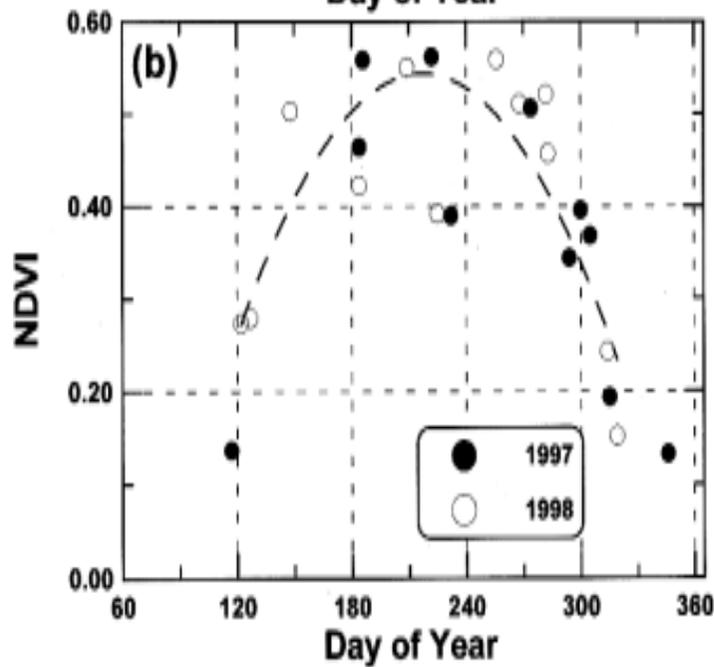
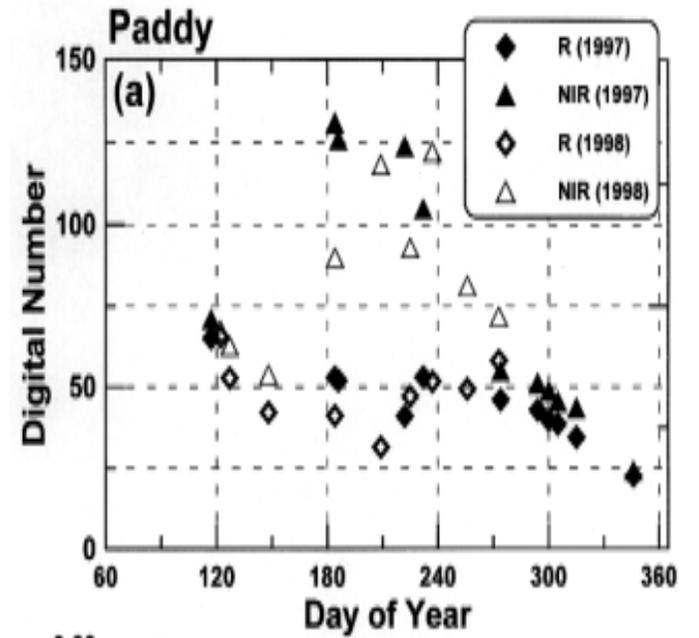
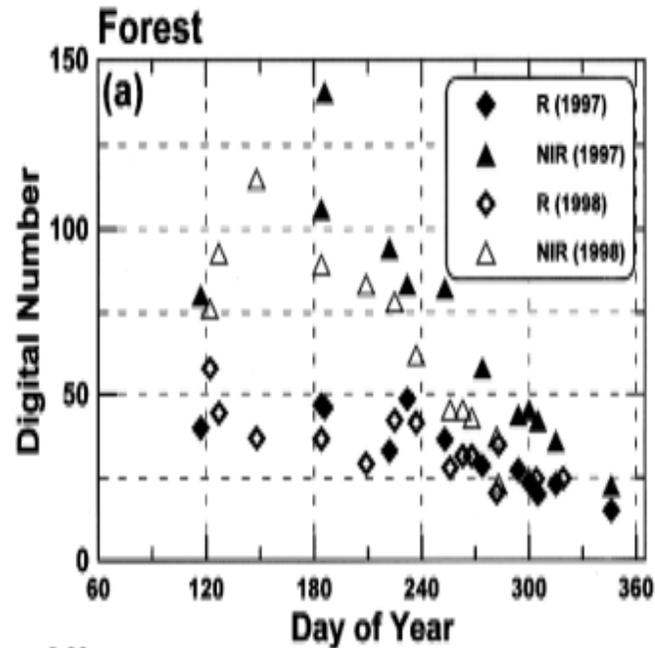
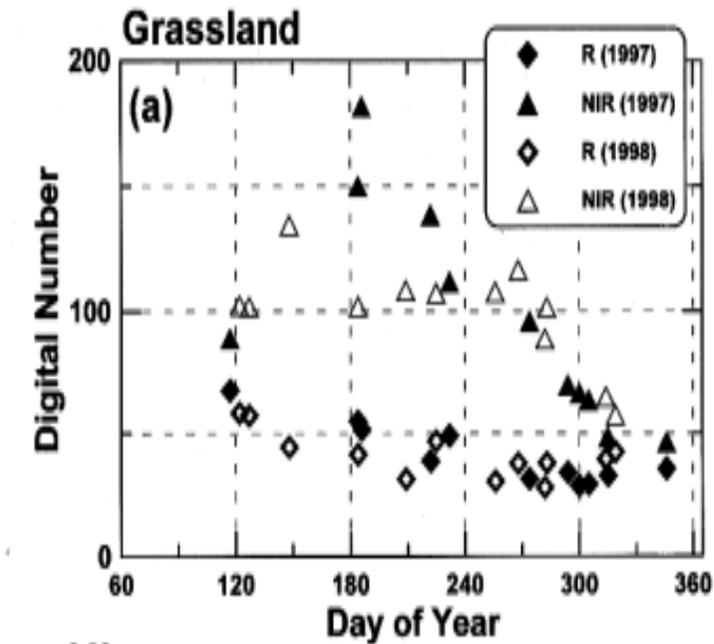
光量子計による観測において草の生長初期に上向きPAR成分の低下が認められる (中段の図)



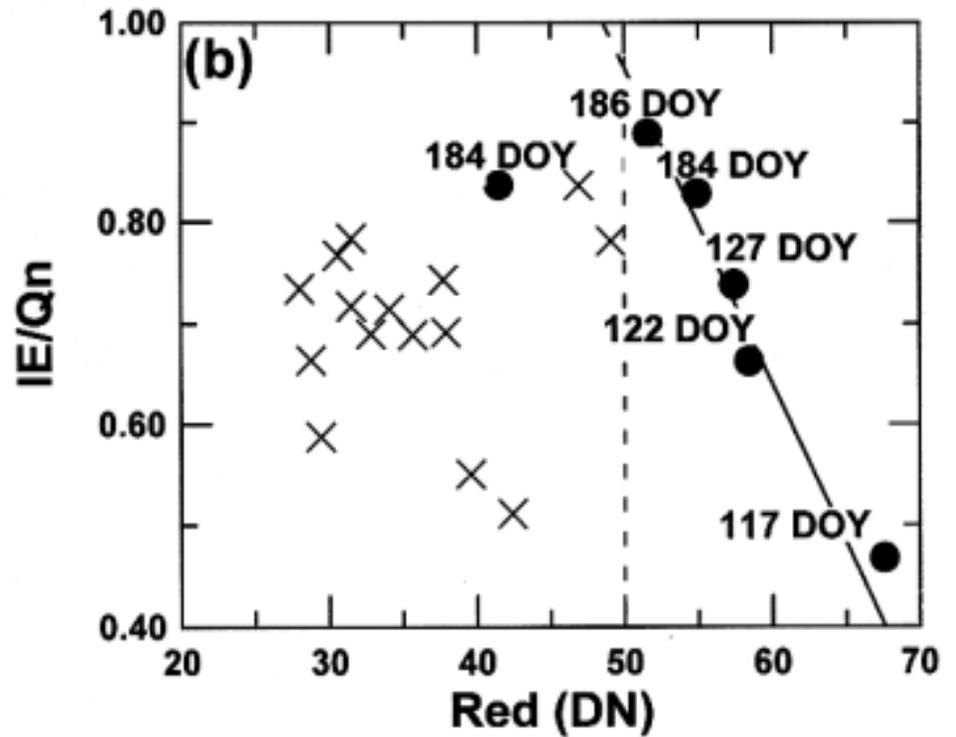
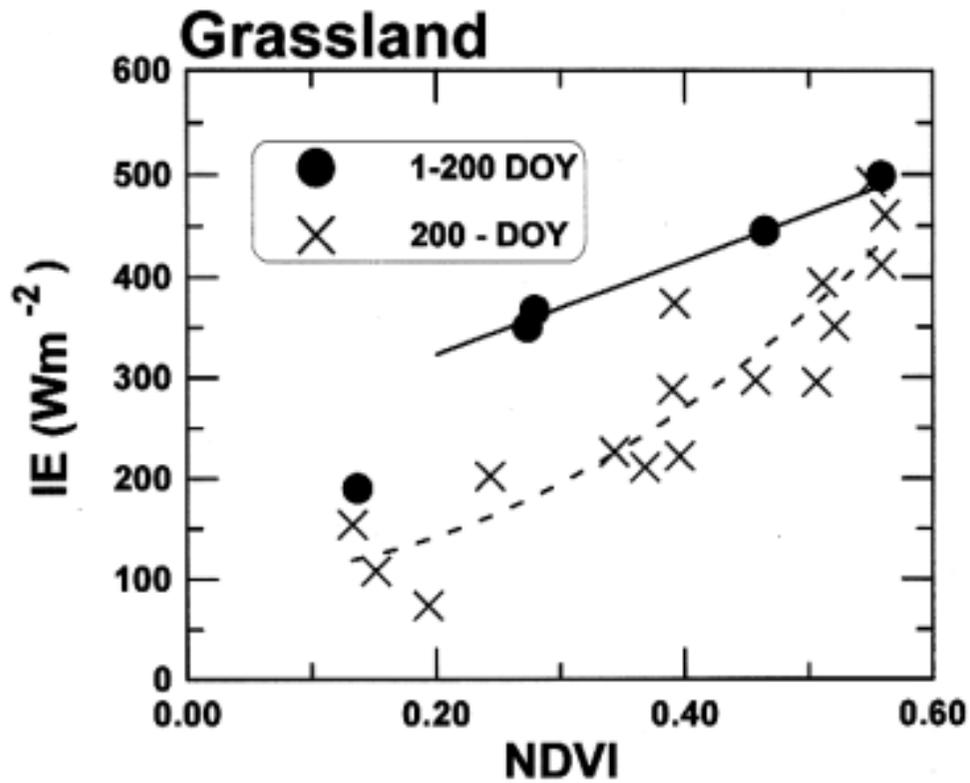
TMデータの解析からわかったこと

- NDVI と E_t の相関は極めて高いが、生育ステージによって異なること
- 赤の波長域の輝度が成長期に減少すること
- その減少の開始が潜熱フラックスの増加開始と一致すること
- 成長期には赤の波長域の輝度と、 E_t の相関が極めて高いこと

SPOT/XS : Seasonal Variation of Spectral Brightness(Red and NIR) and NDVI

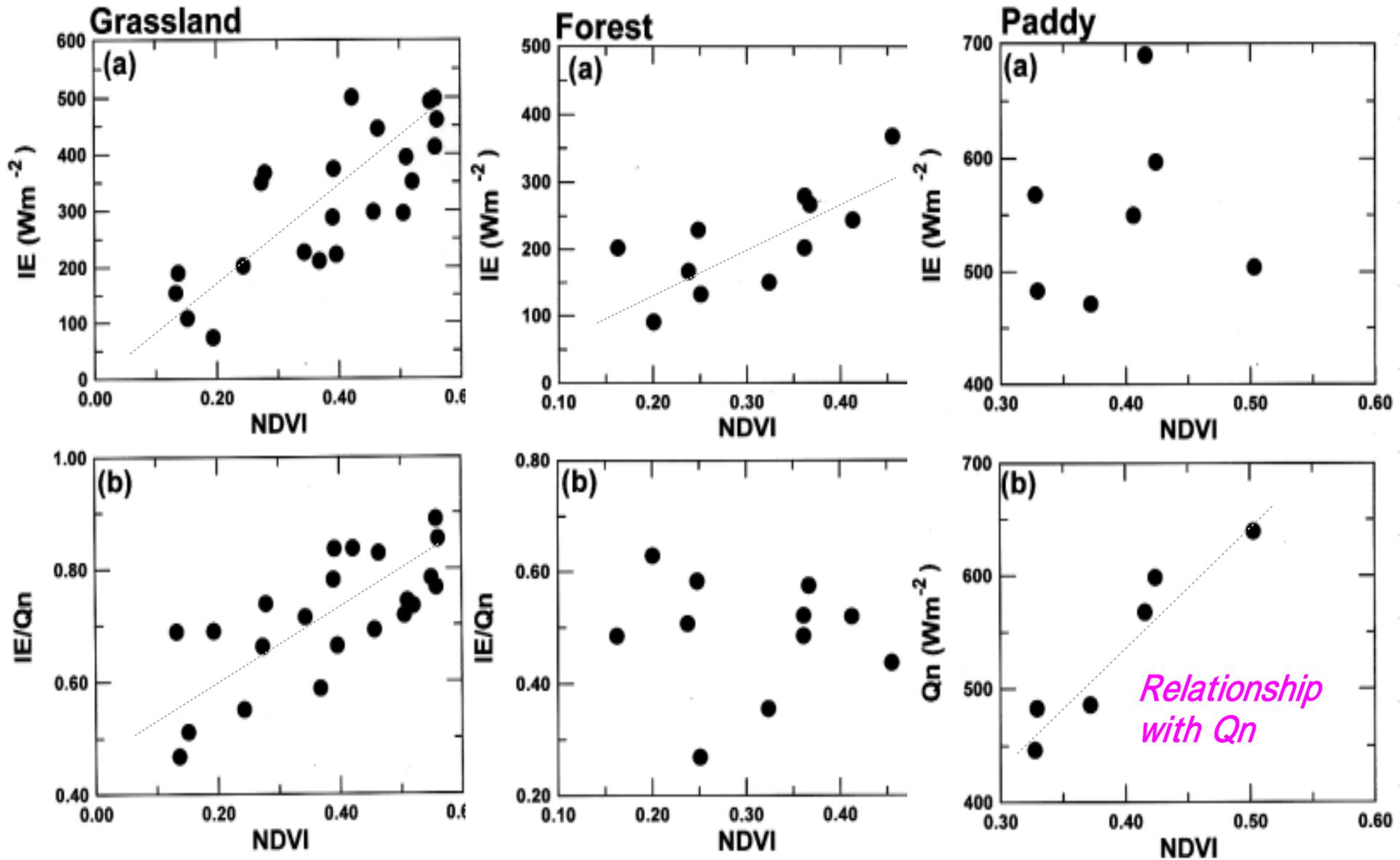


SPOT/XS : Relationship of IE with NDVI and Red Band Brightness



- Fine correlation between NDVI and IE in growing season
- The mature season has another correlation
- Inverse correlation between Red band brightness and IE/Qn

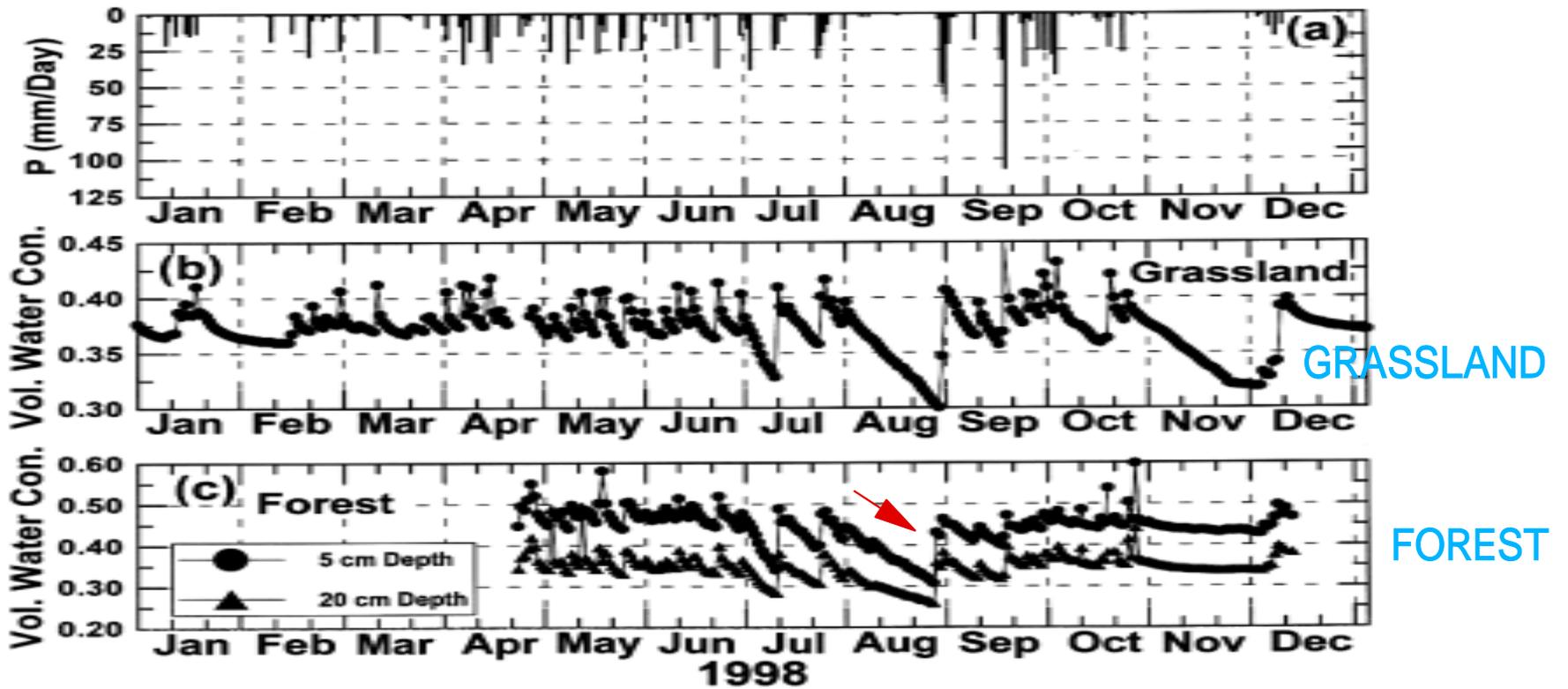
SPOT: Relationship of NDVI with IE and IE/Qn



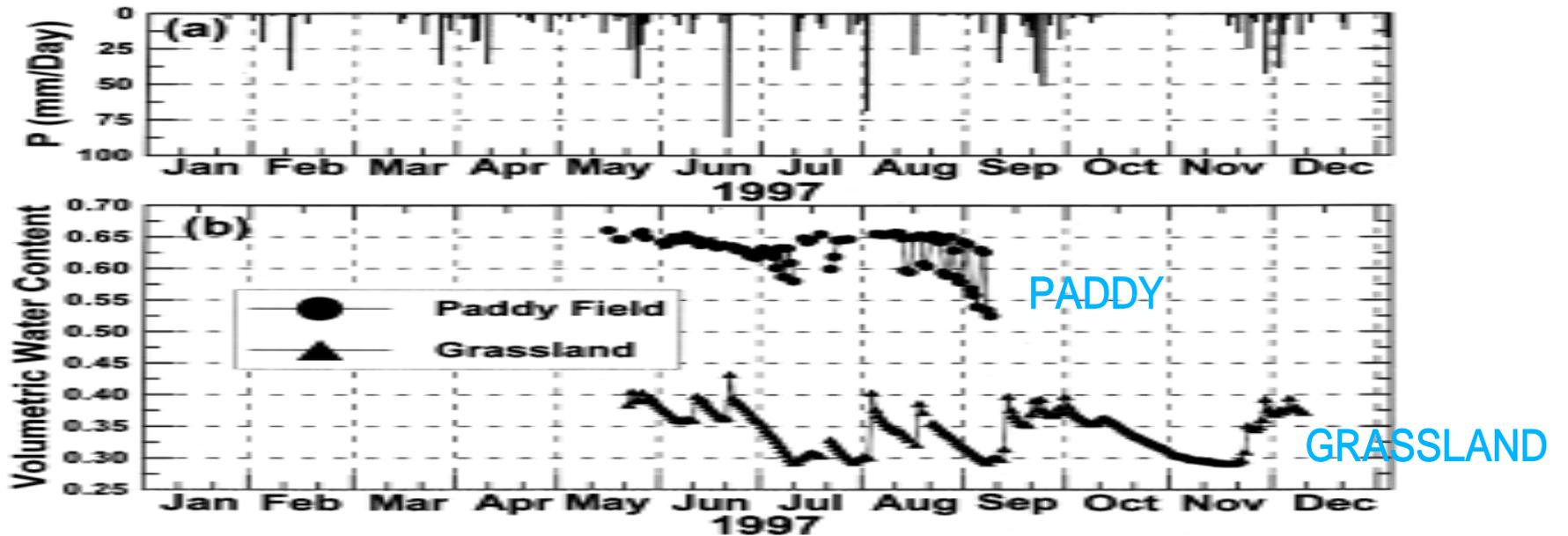
Decrease in heat storage with increase in NDVI

Volumetric Water Content of Surface Soil Layer

1997



1998



SPOTの解析からわかったこと

Empirical Relationships

Grass

- Good correlation between IE, IE/Qn and NDVI

Forest

- Good correlation between IE and NDVI

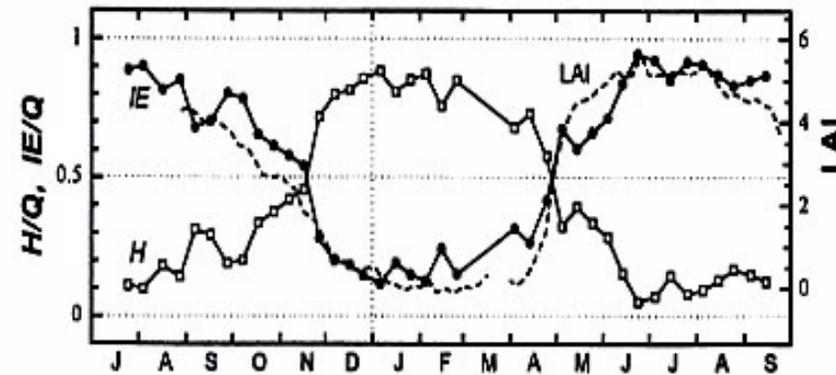
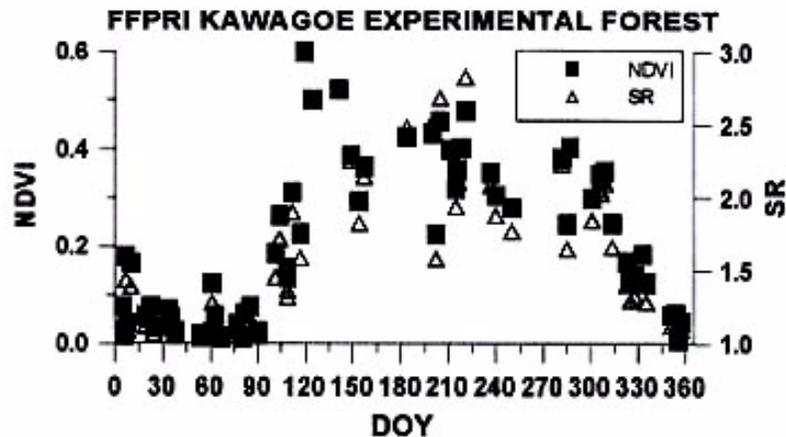
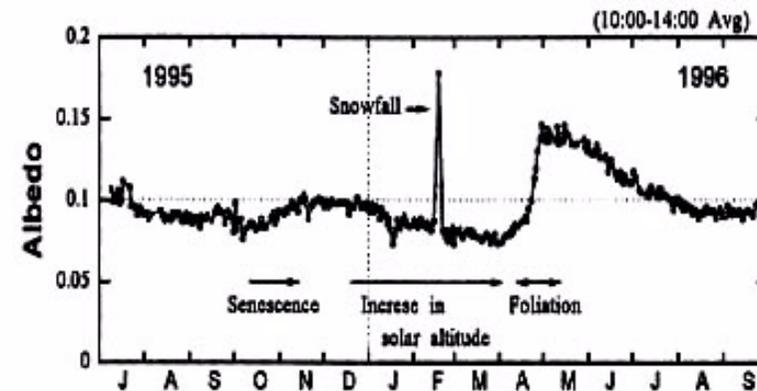
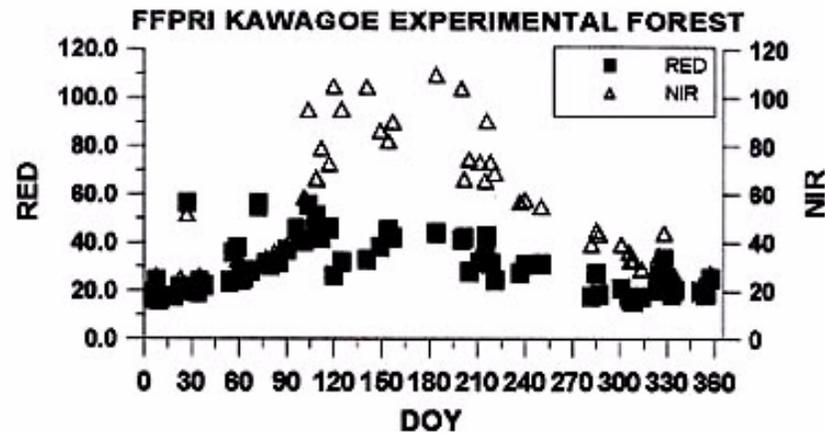
Paddy

- Good correlation between Qn and NDVI

赤の波長帯の輝度が夏の乾期に増加した。これはストレスを表しているのか？

FFPRI KAWAGOE EXPERIMENTAL FOREST

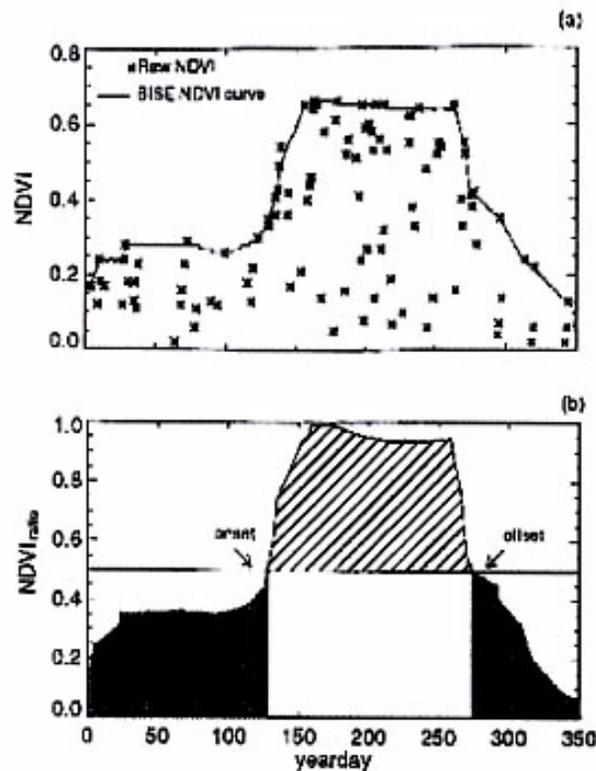
Watanabe *et al.*(1996)



LANDSAT TM 1984-1998

Measured albedo, LAI, H/Q, and IE/Q
1995-1996

Importance of Satellite Phenology



Satellite Phenology
White et al.(1997)

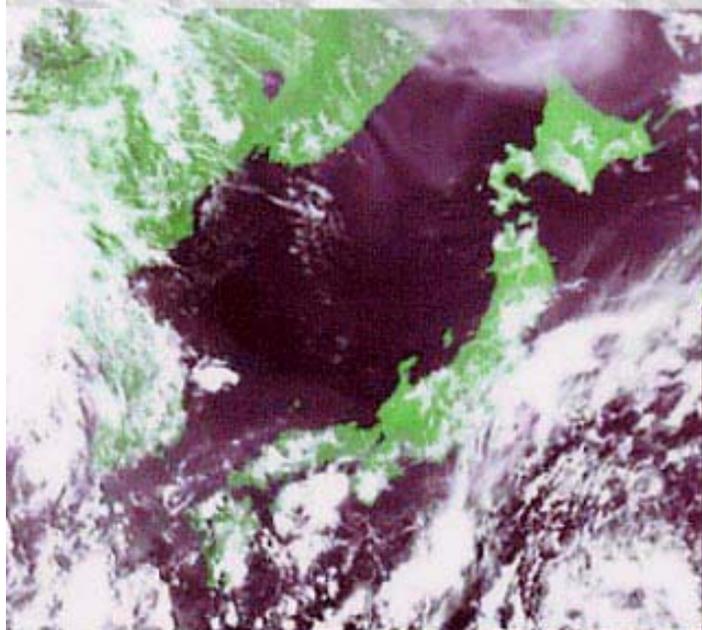
Phenological parameters

- Onset and offset date
- Annual integrated NDVI
- Duration of growing season
- etc.

Example

- $NPP = \epsilon_{BGC} \int NDVI$ (Waring & Running, 1998)
- $Flux = f(veg) \int NDVI$

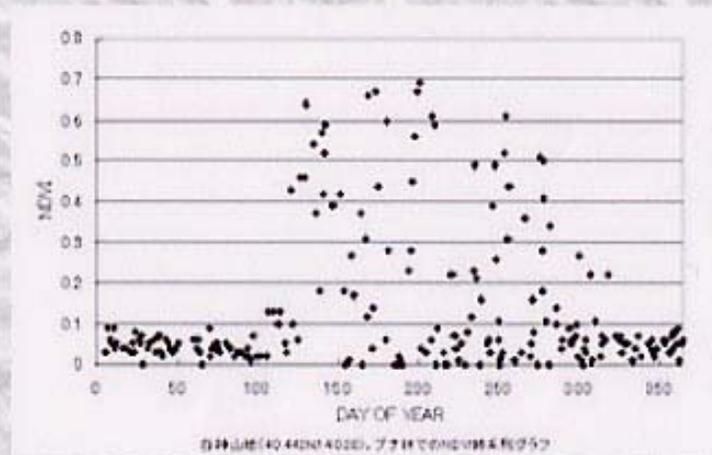
衛星リモートセンシングによる フェノロジー(植物季節)モニタリング



NOAA衛星による
日本列島の
モニタリング



照葉樹林(左)
とブナ林の植
生指標(NDVI)
の季節変化



- 年間のNDVIの積算値、生育期間の長さ、等の変数とフラックスの関係は？
- これらのパラメーターは年々の気象状況の変化にどのように応答するか？